The Voice Imperative

Providing Real-Time Person-to-Person Communication Services in an LTE-Environment

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Executive Summary

The market for mobile voice services is slowly reaching a point of saturation and the share in the revenue-mix of voice service provision is gradually decreasing. By providing open Internet access the mobile operators gave direct-to-consumer service providers the ability to make unpaid use of the operators' resources, which they can employ to provide their own mobile services to the mobile subscribers. Amongst these parties are providers of Internet telephony services, offering a substitute to the operators' voices services. At the moment however, these service providers are not able to deliver voice services with a quality comparable to that of the voice services of the operators due to the latency within the current network technologies.
The introduction of the LTE network technology is about to change this however. The increased network capacity and fully IP-based network architecture will provide Internet telephony service providers with an infrastructure to deliver their services to mobile subscribers with comparable quality as the current PSTN communication services. In order to minimize the disruptive impact of these emerging communication services, mobile operators will have to look at ways to adapt their communication service provision in such a way that they keep their current customer ownership and remain their subscribers' preferred communication service provider in the upcoming fully IP-based environment. The objective of this research project was to give an advice to TMNL about how it should develop its communication service provision for this upcoming fully IP-based telecom environment. This lead to the following research question:

> *How should TMNL provide real-time person-to-person communication services in order to achieve a sustained competitive advantage in the fully IP-based telecom environment that is expected to emerge in 2015?*

In its approach to answering this question, this research project has focused on the organizational aspects of the provision of mobile communication services. By looking at these services from a value network perspective, insight could be gained into the strategic consequences of different possible configurations for mobile communication service provision as different value network models entail different power structures between the actors in the value creating process as well as differences in their innovative abilities. By defining four distinctive model configurations and analyzing their strategic consequences this project was able to provided an advice on how TMNL should develop its service provision and fortify its strategic position. In formulating its recommendations, the project has taken the operator's sources of sustained competitive advantage vis-à-vis the emerging competitors from the Internet domain as a point of departure. Following the resource-based view of the firm as postulated by Barney (1991) and his definition of sustained competitive advantages this concept was defined as 'a value creating strategy that is not simultaneously being implemented by these emerging competitors and of which these other firms are unable to duplicate the benefits'.

In order to be able evaluate the different value network models, a framework was constructed on the basis of scientific theory that assesses the viability of a model by looking at the governance structure of the value network as well as the performance of the value network as a whole:

- The amount of control an actor has in a value network was determined by its resource dependency relationships with actors in the value network it operates in and its disposition over certain bottleneck resources, giving it a strategic advantage over other actors and the ability to influence certain aspects of the value creating process more than the rest.
- The performance of a value network was determined by the level of vertical integration of actors within the value creating process and the openness of the network. The vertical integration of the platform provider determines the amount of room there is for an ecosystem of complementary product to come into existence and the openness of the network determines the innovative ability of this ecosystem.

The next phase of the research project constituted an extensive study of the telecom domain. By taking a number of generic roles in the field of mobile voice service provision as a point of departure a high-level representation of the value network for TMNL's current voice communication service provision was constructed. This model gave insight into the actors involved in the current configuration of service provisioning, the relations between them and the roles they fulfill.
Subsequently an analysis was made of relevant developments in the environment of the value network. Following the STOF approach by Bouwman et al. (2008), these developments were summarized into technological developments, market developments and regulation. The insight into these developments enabled the analysis of their impact on the value network and the accompanying consequences for the roles, the actors and the relationships. The results of these analyses were used as design variables for the construction of the generic value network models.
The study of the telecom domain also yielded an overview of the possible technological solutions that are available to TMNL for the provision of real-time person-to-person communication services in an all-IP environment. Different solutions were taken into account. First two interim solutions were put forth that leverage the current network architecture and cater for a fast deployment of voice services over LTE. Secondly two IMS-based solutions were presented that enable enriched IP-based communication services and finally two fully IP-based and carrier-independent solutions were elaborated on. As well as contributing to the construction of the models, these solutions were employed in the final phase of the project to translate the findings of the empiric phase into a more concrete advise in terms of the actual technological interpretation of the proposed communication service provision.

In order to take a wide scope of possible value network models into account and make them generic rather then specific, the models were designed by laying the nexus of service provisioning with different actors in the value creating process. Subsequently the models were related to the developments in the mobile domain that contributed to their materialization. The following generic value network models were discerned:

- An **operator centric model** laying the nexus of the communication service provisioning with the mobile telecom operator. The service provisioning in this model is tightly coupled with the operator's network resources and the service platform enabling the enriched communication services resides in the control layer of the operator's network architecture in combination with a software client on the subscriber's handset. As this platform enables fixed mobile convergent services the operator's service portfolio can be accessed over different access networks.
- A **device centric model** where mobile handset functions as the first point of reference to the subscriber for his voice service provision, giving the device manufacturer the most potential influence on the subscriber's service usage. This configuration places the central platform of the communication service provision with the mobile handset that supports both the fully integrated front-to-end operator's mobile voice service provision and the decentralized end-to-end Internet-based service provision.
- A **service centric model** where mobile service and mobile access provision are offered by different actors and an Internet-based communication service provider plays a central role and is responsible for most of the roles regarding voice service provisioning. The communication service is carrier-independent and can be offered on a mobile handset over WLAN as well as the operator's mobile broadband network. The mobile operating system also plays an important role in this configuration since it serves as a software platform enabling the Internet telephony client software to be installed and used on the mobile handset.
- An **aggregator centric model** making a third-party service aggregator determinant for the service provision. The aggregator functions as a portal and combines and integrates the services of multiple Internet-based communication service providers into a single unified user interface. It offers a single starting point towards mobile communication services, but the subscriber still needs separate user profiles with each of the service providers to access their contacts.

The four generic value network models were evaluated by looking at the resource dependencies and division of gatekeeper roles determining the balance of control in the value network and the vertical integration and openness inherent to in the model that influence its performance. By conducting semi-structured interviews with experts in the field of mobile communication, both from within and external to TMNL, insight was gained into a number of stakeholder perceptions about how the models relate to the elements of the framework defined earlier in this research project. Furthermore the respondents were inquired after their perceptions regarding the likelihood and desirability of the different models as well as the operator's sources of competitive advantage.

Overall, the operator centric model was considered to remain dominant for the following years, however not sustainable in the light of the developments in the mobile domain. Most respondents perceived the decoupling between service and access provision present in the service centric model as very likely to manifest itself in the mobile domain. However not within the timeframe considered in this research project; the operator centric model and the service centric model will remain to coexist in parallel for years to come.

After evaluating the different models on basis of aggregated empirical data gathered during these interviews, it was concluded that none of the value network models satisfies both conditions for a viable value network model. In those models where the governance structure was favorable for the mobile operator, the overall value network performance was assessed to be quite low. Similarly the models that were likely to produce a high level of network performance, showed a very decentralized power structure and a very limited ability for the mobile operator to influence the value creation process. In comparison to TMNL's current voice service provision, the models displayed a gradual shift and decrease of the operator's control over the value network due to the decentralized organizational structure and increasingly loose couplings between the different actors. This was reflected in its disposition over bottleneck resources as well as its relationships of dependency with the other actors. The emerging decoupling of service and access provision gives the Internet-based service provider a large amount of autonomy and flexibility in its service development, which enhances the overall innovativeness of mobile communication service provision.
As the different models are expected to coexist it is clear that the mobile operator will loose a fair amount of control over the value creating process. Its position as the mobile network operator will still make it indispensible, but it depends on how he leverages this whether this will provide it with a source of control and a way to provide added value. The increased decentralization of service provision drives the mobile domain towards a more open market model.

In order to forty its position in this changing environment, TMNL must leverage its sources of sustained competitive advantage and create a situation where its own resource position directly or indirectly makes it more difficult for others to catch up. It must base its strategy on its strengths and develop its future strengths from its current strengths. This entails that it should not only focus its strategic analysis on the mobile industry but also on the company itself. The analysis of TMNL's sources of sustained competitive advantage have yielded the following results:

- TMNL should not leave the front-to-end service model and refrain from developing carrier-independent services
- TMNL should leverage the abilities of its physical resources, not only with regard to its own service provisioning but also towards third-party service providers
- TMNL should leverage the long-lasting service relation it has with its subscribers

These elements were used as the basis for the advice to TMNL on how it should develop its real-time person-to-person communication service provision in the fully IP-based telecom environment that is expected to emerge in 2015.

In order to TMNL to implement a service configuration that does satisfy both conditions for a viable value network model, it must look for a model that incorporates aspects of both the operator centric and the service centric model. This thesis proposes a twofold strategy for achieving this situation that consists of *deploying fixed-mobile convergent communication services that maintain a tight coupling with the underlying infrastructure while nurturing an ecosystem of complementary third-party service providers through the provision of an open interface towards its network resources.*

In developing its service portfolio, TMNL should focus on those services that require a dedicated connection such as voice & video calling and in-call file sharing. By taking its mobile voice service provisioning, for which TMNL has a long lasting-lasting service relation with its subscribers, as a point of departure and by developing its IP-based service provision from there, TMNL will keep a close relation with its subscribers in this new environment.
It must acknowledge however that it does not have the organizational abilities to compete on equal terms with Internet-based service providers and thus not venture into the realm of Internet-based and carrier-independent services. Rather it should incorporate the merits of service centric model by leveraging its network infrastructure as a service platform towards third-party service providers. By putting forth its network as a platform, TMNL can draw a development community to its own network resources and partially shift the ownership of the service creation environment away from the mobile operating system and back to its own network. This will provide it with the ability to create added value in a service centric environment towards Internet-based service providers and thereby indirectly to its own subscribers by providing services such as carrier billing support and contextual information about the subscriber. It will open up new sources of revenue and stimulate third-party service innovation while endowing the operator with a certain amount of control over the outcome of the value creating process. This way TMNL can also differentiate in which types of services it will grant access to its resources and for instance deny these services towards Internet-based substitutes to its communication services provision while allowing it to services in the periphery of communication such as social media, presence and instant messaging.

These conclusions lead to the following recommendations

- **Focus on Front-to-End Service Provisioning and Implement VoLGA**
  TMNL should stick to those services that can be tightly coupled to its network infrastructure and implement VoLGA for the provision of voice services over LTE. It should not venture into the realm of Internet-based and carrier-independent services, since it does not have the organizational abilities to compete on equal terms with Internet-based service providers.
- **Offer both Fixed and Mobile Connectivity and Implement IMS**
  TMNL should extend its network services towards the provision of both fixed and mobile connectivity. This way it will strengthen the relationship with its subscribers and increase its customer ownership. By implementing IMS in the control layer of its network architecture, TMNL will be able to extend its portfolio towards the provision of fixed-mobile convergent services.
- **Provide Voice Services over Alternative Access Networks**
  Through enabling its subscribers to connect to its core network and its services with a softphone over an IP-based access network, TMNL can take a first step towards the provision of fixed-mobile convergent services and has the ability to counter one of the USPs of Internet telephony services providers: cheap calls from abroad.
- **Leverage Network Resources as a Service Platform and Develop Network APIs**
  By putting forth its network as a service platform and developing Application Programming Interfaces to interact with it, TMNL will have the ability to leverage its network infrastructure as a service creation environment and to create added value towards Internet-based service providers. This way TMNL can open up new sources of revenue and draw a development community to its own network resources, thereby partially shifting the ownership of the service creation environment back from the mobile operating system.

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2G	Second Generation
3G	Third Generation
3GPP	3rd Generation Partnership Project
3GPP2	3G Partnership Project 2
4G	Fourth Generation
API	Application Programming Interface
BSC	Base Station Controller
BTS	Base Transceiver Station
CAPEX	Capital Expenditures
CDMA	Code Division Multiple Access
CS	Circuit-Switched
D2C	Direct to Consumer
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
FMC	Fixed-Mobile Convergence
FNO	Fixed Network Operator
GAN	General Access Network
GHz	Gigahertz
GPRS	General Packet Radio Service
GSM	Global System for Mobile communications
GSMA	GSM Association
HLR	Home Location Register
HSDPA	High Speed Downlink Packet Access
HSPA	High Speed Packet Access (also HSxPA)
HSUPA	High Speed Uplink Packet Access
IM	Instant Messaging
IMS	IP Multimedia Subsystem
IMSI	International Mobile Subscriber Identity
IN	Intelligent Network
IP	Internet Protocol
IPv6	IP version 6
ISDN	Integrated Services Digital Network
ITU	International Telecommunications Union
ITU-T	International Telecommunications Union – Telecommunication standardization section
LAN	Local Area Network
LTE	Long Term Evolution
Mbps	Megabit per second
MGW	Media Gateway
MMS	Multimedia Messaging Services
MMTel	Multimedia Telephony
MNO	Mobile Network Operator
MSC	Mobile Switching Centre
MSISDN	Mobile Subscriber ISDN Number
MSS	Mobile Switching Center Server
MVNO	Mobile Virtual Network Operator
NGMN	Next Generation Mobile Networks
NGN	Next Generation Network
NVS	Nokia Voice-over-IP application Server
OPEX	Operational Expenditures

OSI	Open System Interconnection
P2P	Peer-to-Peer
PC	Personal Computer
PS	Packet-Switched
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RAN	Radio Access Network
RCS	Rich Communications Suite
RNC	Radio Network Controller
SAC	Subscriber Acquisition Costs
SAE	System Architecture Evolution
SBC	Session Border Controller
SDK	Service Development Kit
SIP	Session Initiation Protocol
SMS	Short Messaging Service
SRC	Subscriber Retention Costs
STP	Signaling Transfer Point
TCP	Transmission Control Protocol
TMNL	T-Mobile Netherlands
TMO	T-Mobile International
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
USP	Unique Selling Point
VANC	VoLGA Access Network Controller
VAS	Value Added Service
VLR	Visitor Locator Register
VoIP	Voice over IP
VoLGA	Voice over LTE Generic Access
WiFi	Wireless Fidelity
WiMAX	Worldwide Interoperability for Microwave Access
WLAN	Wireless Local Area Network

1 Introduction

1.1 Problem Specification

In august 2005 T-Mobile Netherlands (TMNL) was the first Dutch mobile operator to introduce open Internet access without a data limit and offer their customers unlimited access to all Internet sites for a flat fee price plan (T-Mobile website, 2008). With this proposition TMNL was the first Dutch operator to leave the 'walled garden' business model; a 'closed' model where only content from a selected group of providers was made available through a controlled mobile web-portal. This way the operators used to have control over what online services their subscribers were using and positioned themselves in such a way that content creators were kept well away from the end-users (Peppard & Rylander, 2006). The other Dutch operators soon followed and by opening up the Internet business model, the mobile service domain changed dramatically. Numerous actors entered their environment from the content domain and were given the ability to bypass the mobile operators and make unpaid use of the operators' network resources to provide their own mobile Internet services directly to the mobile subscribers. These parties are referred to as 'over-the-top' or 'direct-to-consumer' (D2C) service providers. These service providers are not limited to the 'traditional' content providers such as media and publishing companies. As D2C mobile content revenues grew exponentially over the last couple of years, Internet giants such as Google, Amazon and eBay as well as hardware manufacturers such as Nokia and Apple started to offer mobile content services as well (Netsize, 2008). Furthermore, a number of these players have their own mobile operating systems allowing them to change the face of mobile service provision even further. These systems are catering for fast and flexible development of mobile services, enabling developers to create, publish and distribute an application within a matter of days.

Amongst these newly developed mobile services, Internet telephony clients are also gradually finding their way toward the mobile handset. These software clients enable subscribers to use Voice over Internet Protocol (VoIP), which can be defined as the transmission of digitized voice in packages over an IP-based connection (Goode, 2002). They offer a substitute to the mobile operator's voice service provision at a far lower price and pose a threat to the already decreasing voice service revenues that account for the largest part of the operator's income by far. At the moment however, Internet telephony services are not able to deliver voice services with a quality comparable to that of the voice services of the operators. Due to fluctuations of the latency in the current mobile network technologies, the quality of service (QoS) of Internet telephony services on mobile handsets is much lower than the 'traditional' mobile voice services offered by the mobile operators. The introduction of the Long Term Evolution (LTE) mobile network technology is about to change this however.

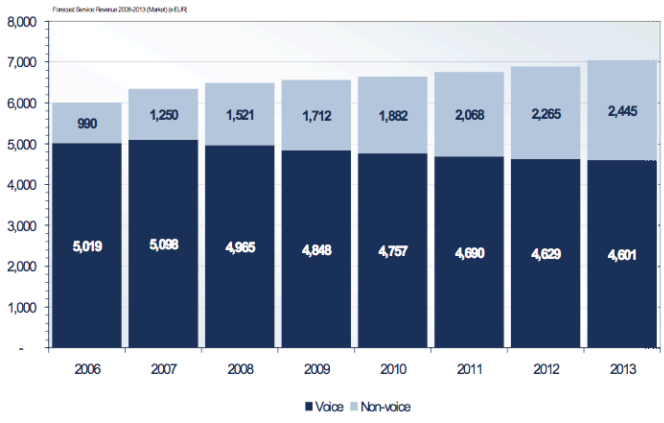


Figure 1: Non-voice service revenue market share (Telecompaper, 2009a)

By implementing LTE, the next generation in telecom network infrastructure, the operators will roll out a mobile broadband network that is fully IP-based and offers high throughput with little latency. This development will take away one of the last remaining barriers for Internet-based communication service providers to become fully-fledged competitors to the mobile operators. Mobile subscribers will have an always-on connection to the Internet which will enable them to always be reached over these

Internet telephony services on a network that enables these service to be provided with a QoS comparable to GSM or UMTS voice services.

The deployment of the LTE network will greatly enhance the mobile operators' network capacity and enable them to provide much more elaborate mobile services. However, at this moment there still is no real consensus within the mobile industry on how to implement voice service in this new environment (TMO, 2008). As the competitive field of the mobile telecom domain changes and the provision of mobile connectivity will no longer be a precondition for the provision of mobile communication services, mobile operators will have to look at ways to adapt their communication service provision in such a way that the disruptive impact of these emerging communication services is minimized. This way the operators remain their subscribers' preferred communication service provider in the upcoming fully IP-based environment instead of gradually losing their leverage and turning into a mobile bit-pipe where all services are provided by third parties.

1.1.1 Research Focus

- **Value Network Models**
  This research project will focus on the organizational aspects of the provision of mobile communication services. By looking at these services from a value network perspective, insight will be gained into the strategic consequences of different possible configurations for mobile communication service provision as different value network models entail different power structures between the actors in the value creating process. By defining different model configurations, analyzing their strategic consequences and linking these models to technology and market drivers in the mobile telecom industry, this project will provide an advice on how TMNL should develop its service provision and fortify its strategic position.
- **Real-Time Person-to-Person Communication Services**
  In order to take note of the possibilities that the IP-based telecom environment will offer to communication services, this research project will not limit itself to voice service provision. To take a wider range of advanced mobile communication services into account, e.g. services that include communication technologies such as instant messaging and/or video conferencing, this project will look at real-time person-to-person communication services.
- **Sustained Competitive Advantage**
  This research project will look for sources of sustained competitive advantage for the mobile operator vis-à-vis the emerging competitors from the Internet domain. Following the resource-based view of the firm as postulated by Barney (1991) and his definition of sustained competitive advantages this concept will be defined as 'a value creating strategy that is not simultaneously being implemented by the emerging competitors and of which these other firms are unable to duplicate the benefits'.
- **Long Term Evolution**
  Furthermore, this research project will mainly focus on the LTE access network technology. It will not go into detail into other access network technologies such as HSPA+ and WiMAX; these will only be taken into account circumstantially. In the case of the former because it's very much regarded as an intermediary technology and its impact on mobile communication service provision will be relatively limited. Concerning the latter, because there still are a lot of uncertainties with regard to the scale that this technology will be rolled out. Furthermore its impact on the mobile domain is likely to limit itself to the provision of a mobile broadband connectivity to laptops within the timeframe considered in this research project.

Timeframe

The scope of this research project has been set around 2015. This timeframe has been chosen because it incorporates both the effects of the current developments that shape the mobile domain and the first consequences of the deployment and introduction of LTE networks in the Netherlands. The first LTE infrastructures are expected to emerge in 2012, however there is a chance that this will be delayed due to the current situation on the financial market.

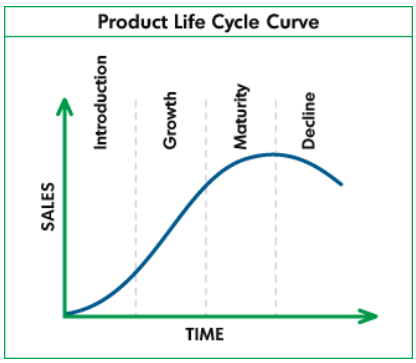


Figure 2: Product life cycle curve (Anderson & Zeithaml, 1984)

Initially the network will be used to provide mobile broadband Internet connectivity to laptops and personal computers with the use of USB-dongles. The first LTE-enabled handsets are expected to reach the Dutch market around 2013 and will be commercially available through operators' sales channels around 2014 (Schöneboom, 2009). Since LTE will be deployed by mobile operators around the world, with operators like NTT DoCoMo planning to launch its first commercial LTE services in the second half of 2010 (Telecompaper, 2009d), LTE-enabled devices are likely to have reached the growth phase of their life cycle curve by the time they are introduced to the Dutch market. This entails that the first available devices will not be limited to high-end devices alone; mid-tier devices will be available from the start as well, which will have a positive effect on the market penetration rate of LTE-enabled devices due to their reasonable affordability.

Due to the relatively mature phase the LTE-enabled handsets are expected to be in by the time they are introduced to the Dutch market and the necessity for the Dutch mobile operators to provide advanced mobile communication services this research project will take 2015 as its focal point. By this time the operators will need to have their answer ready and take their service provision into the next phase.

1.1.2 Perspective

This research project was commissioned by T-Mobile Netherlands and will therefore be conducted from its perspective. With a customer base of 6.1 million subscribers (including MVNOs), TMNL is the second largest mobile operator in the Netherlands (Telecompaper, 2009a). TMNL is a 100% subsidiary of T-Mobile International (TMO), the mobile branch of German telecom incumbent Deutsche Telekom and one of the largest mobile communications operators worldwide. TMO is currently present in eleven European countries as well as in the United States.

The mission of TMO is to be the most highly regarded service company. This mission statement implies that serving the customer lies at the core of all T-Mobile's operations; it wants to stand out in the perception of its customers and become well known for its service provision. Within this statement, the term service provision does not comprise the customer experience of the contact with customers through the call centers and shops alone; it embodies the aggregation of the experience of all services that T-Mobile promises to offer to its customers (T-Mobile Group Intranet, 2008). TMNL has translated this mission statement into a more concrete goal:

> *The mission of TMNL is to be number one in customer appreciation as well as the fastest growing operator in 2010.*

This mission statement is focused on a relatively short term however, while the developments taken into account in this research project are set in a somewhat larger time frame. Therefore the mission of TMO will be chosen to determine the most favorable situation for TMNL; to be the most highly regarded service company. As depicted in Figure 3 the strategy to achieve this consists of the provision

unique services and superior products, supported by a superior network. This strategy is very much focused on the interaction of T-Mobile with its subscribers and emphasizes the importance of its relationship with the customer.

Figure 3: TMO's strategy (T-Mobile Group Intranet, 2008)

Requirements

The following two requirements for the outcome of this research project follow from the perspective of TMNL:

- As TMNL is a subsidiary of a multinational company that is quoted on the stock exchange, an important requirement is that the actions proposed in this project's recommendations have a positive impact on the company's EBITDA (Earnings Before Interest, Taxes, Depreciation and Amortization), a measure for a company's net earnings.
- Due to the mission and accompanying strategy of T-Mobile the preferable outcome, as mentioned in the research focus, consists of a situation where TMNL is its customer's main mobile communication service provider.

On the basis of these requirements, this research project considers a role division model to be viable from TMNL's perspective when it:

- endows the operator a central role in the value creating process of communication service provision,
- enables the operator to influence the outcome of this process and
- ensures it to remain the mobile subscriber's main service provider.

Mobile operators are becoming increasingly dependent on other actors in their domain. Where they used to be part of a relatively simple value chain consisting of network operators and hardware manufacturers, they now find themselves in a value network where value is co-created by a group of actors that work together to co-produce value (Peppard & Rylander, 2006; Reuver & Bouwman, 2008). This entails that the focus should not lie on the company or the industry, but on the value creating process itself (Normann & Ramirez, 1993). The first two aspects are closely related and maximize the operator's ability to monetize the value creating process. This meets the first requirement derived from TMNL's perspective because it contributes to a positive impact a certain role division model has on the development of the company's EBITDA.
The third aspect stated above is directly derived from the second requirement from TMNL's perspective. With the emergence of Internet-based communication service providers in the mobile domain, mobile operators will have to look at ways to adapt their communication service provision in such a way that it leverages its resources and minimizes the disruptive impact of these emerging communication services.

1.2 Research Objective

On the basis of the problem specified above, the objective of this research project is formulated as followed:

To gain insight into the different possible value network models for the provision of advanced mobile communication services and provide an advice to T-Mobile Netherlands on how it should develop its real-time person-to-person communication service provision in order to achieve a sustained competitive advantage in the upcoming fully IP-based telecom environment.

This objective leads to the following research question:

How should TMNL provide real-time person-to-person communication services in order to achieve a sustained competitive advantage in the fully IP-based telecom environment that is expected to emerge in 2015?

1.3 Research Approach

The approach of this research project is based on the designing cycle by Verschuren and Hartog (2005) and the interpretation by Koppenjan and Groenewegen (2005) of the Metamodel by Herder and Stikkelman (2004).

Designing Cycle

In order to introduce a design-oriented research methodology to the social sciences domain, Verschuren and Hartog developed a research and evaluation methodology that functions as systematic input for the process of designing. They formulated a designing cycle with six stages, which may be used in order to attain 'considerable improvement of the process and product of designing' (Verschuren & Hartog, 2005). Due to the scope of this research project and the long-term timeframe of the actual implementation of its outcome, it will therefore limit itself the first three steps of the cycle (Verschuren & Hartog, 2005):

1. **First Hunch**
   This is the first stage of a designing process where a hunch or an initiative for the design is given. The main result of this stage is a set of goals that is to be realized with the design.

2. **Requirements and Assumptions**
   In this stage both the requirements that are to be fulfilled within the frame that is defined by the goals and the assumptions underlying the design are specified.
   A number of different requirements can be distinguished: functional requirements indicating the functions that the design should fulfill, user requirements that are to be fulfilled on behalf of the future users of the design and contextual requirements containing prerequisites set by the political, economical, legal and or social environment. Similarly there are different types of assumptions: about the future users of the design, its context and the functions that are to be fulfilled.

3. **Structural Specifications**
   In this stage of the design cycle the structure of the design is derived from the requirements and assumptions. These specifications contain the characteristics, aspects and parts that the design must have in order to satisfy the whole set of requirements and assumptions stated during the previous stage.

Metamodel

In the view of Herder and Stikkelman (2004), the process of designing is 'selecting an instance in the design space that meets the objectives and constraints'. Based on a wide range of theories for the design and design process of physical systems they have constructed a framework for design processes. This framework is based on a number of concepts that together roughly outline the substance each stage in a design process and depicted in the figure below.

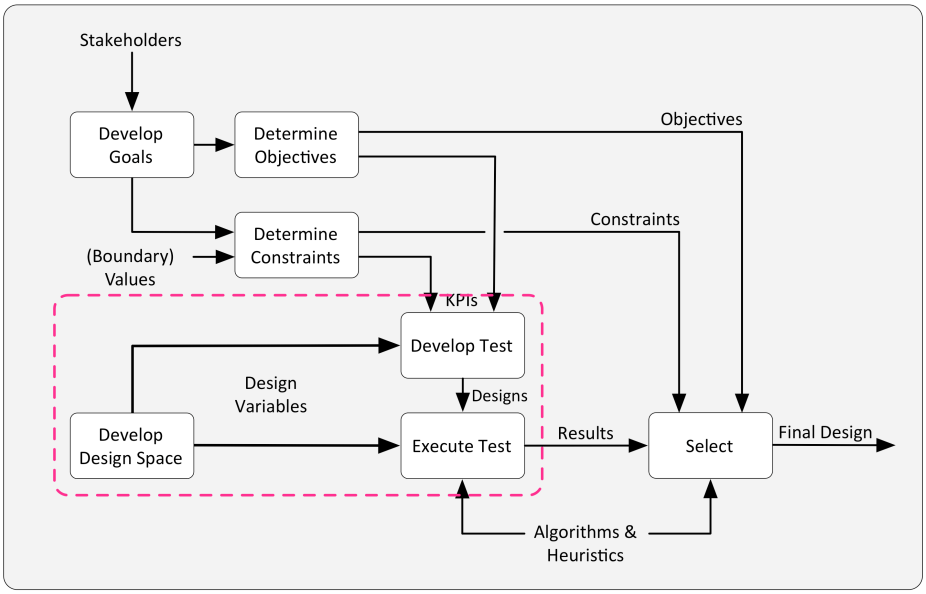


Figure 4: Metamodel (Herder & Stikkelman, 2004)

However, instead of viewing this framework as a number of connected building blocks it is also possible to interpret it as describing a design process by two different sequences of activities (Koppenjan & Groenewegen, 2005).
The first sequence is about:

- defining a list of functional requirements derived from the objectives of stakeholders and the constraints placed upon the design,
- operationalizing that program by formulating performance indicators,
- developing a test that can measure whether the design can achieve the performance indicators and
- implementing the test, adapting designs and selecting designs that pass the test.

The second sequence is indicated with the dotted line in the figure above and is about the actual design activities:

- developing the design space by making choices about the demarcation of the design and by determining the design variables
- combining design variables into a design.

The process of first specifying the design space by determining the different design variables and subsequently combining different combinations of these variables into designs that are to be evaluated as contained in the last of the two sequences is a very structured approach to making a design. This sequence of activities will be implemented in order to design the different value network configurations.

Project Phases

Based on the two design approaches described above, this research project will be conducted in the following phases:

Phase 1: This phase comprises the first and second stage of the designing cycle by Verschuren & Hartog. A specification of the problem will be given, resulting in a first hunch of the intended design of this research project and a small set of goals that it will have to realize. Furthermore a number of requirements are derived from these goals and an outline will be made of the context the design will be implanted in, leading to a number of assumptions about its future environment.

Phase2: This phase is based on the second sequence of the interpretation of Koppenjan and Groenewegen of the Metamodel. It will determine the design variables of the design and present a number of technological solutions to providing voice services over LTE. Subsequently it will combine the variables into a number of generic value network models that will function as input for the evaluation phase.

Phase3: Along with phase four, this phase is based on the third stage in the designing cycle. In the third phase of this research project, the value network models will be evaluated on the basis of qualitative research and the requirements specified in the first phase. Furthermore insight will be gained into the operator's strengths and limitations in service development. This will lead to a set of structural specifications for the eventual design for advanced communication service provision.

Phase4: In this fourth phase the structural specifications for the value network models for providing real-time person-to-person communication services will be compared to the different solutions for communication service provision in an LTE environment. This will enable the formulation of an advice on how TMNL should provide advanced mobile communication services in the fully IP-based telecom environment that is expected to emerge in 2015.

1.3.1 Sub Questions

After specifying the four design phases that need to be followed in order to answer the main research question of this research project, it is possible to derive the sub-questions that have to be answered in order to complete each phase in the design process. In this section the different sub-questions per design phase are stated. In the next sections these sub-questions will be specified further in terms of methodology and deliverables.

Phase1:

Q1: Which concepts and what scientific theory provide basic foundation and framework for constructing viable value network models for providing real-time person-to-person communication services?

Phase 2:

Q2: How is the current voice communication service provision configured and what is the impact of future developments in its domain?

Q3: What are the possible technological solutions available to TMNL for the provision of real-time person-to-person communication services in an LTE-environment?

Q4: What generic value network models can be discerned for the provision of real-time person-to-person communication services?

Phase 3:

Q5: What is the evaluation of the different value network models in terms of the framework for constructing viable value network models for providing real-time person-to-person communication services (i.e. network governance and network performance)?

Q6: What should be the operator's basis for the development of its real-time person-to-person communication service provision for the upcoming fully IP-based telecom environment?

Phase 4:

This phase will provide answer to this project's main research question:

How should TMNL provide real-time person-to-person communication services in order to achieve a sustained competitive advantage in the fully IP-based telecom environment that is expected to emerge in 2015?

1.3.2 Methodology

The methodology used to answer the different sub-questions is depicted below.

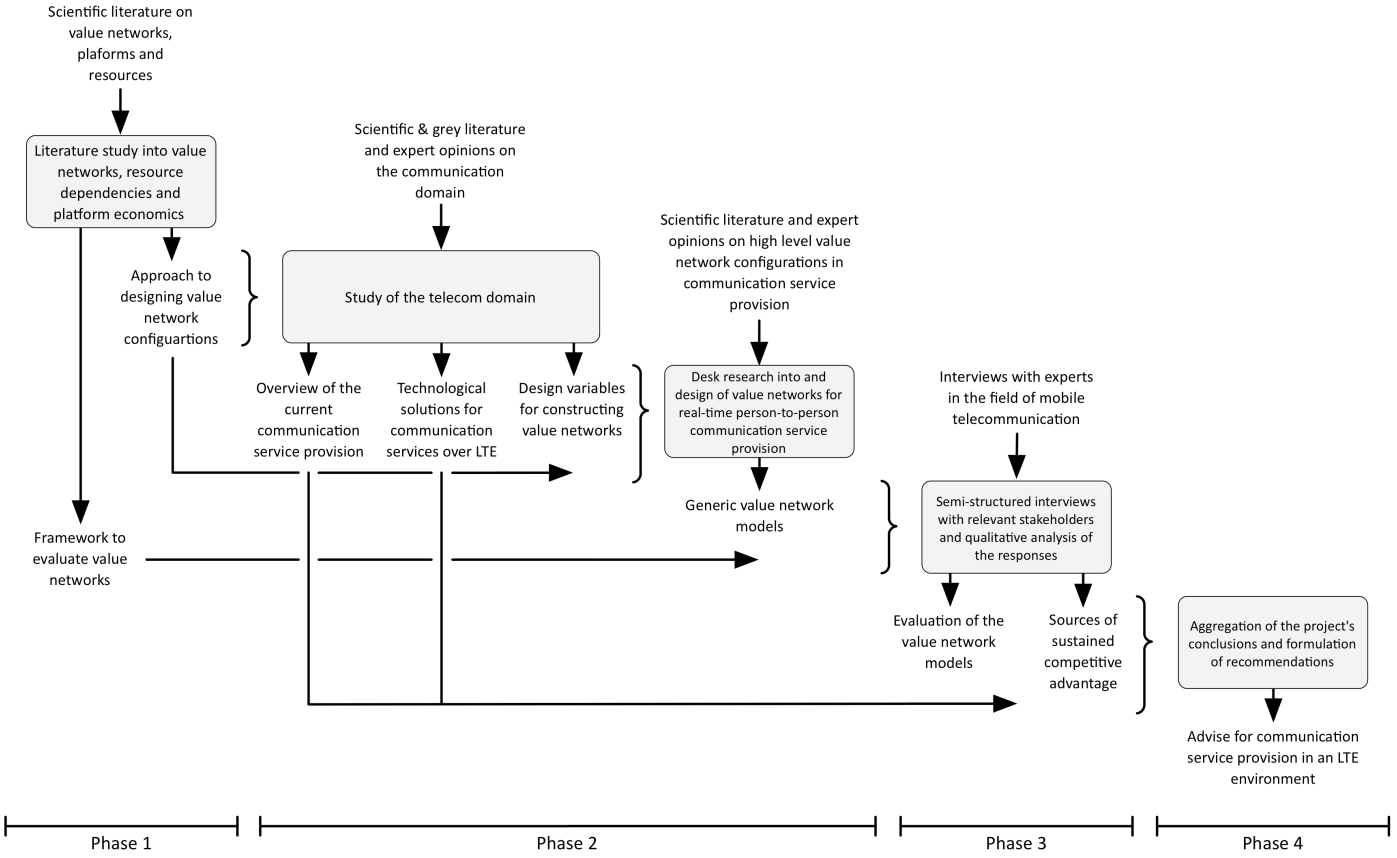


Figure 5: Research methodology flow diagram

Research Phases

Most of the different phases of the project will be conducted with different research methods.

- The first phase will comprise of a literature study into value networks, resource dependencies, gatekeeper roles and platform economics. These topics will form the basis for a framework for assessing the viability of value networks from a theoretical point of view (input for phase 3) and approach to designing value network models (input for phase 2)

- The second phase clearly is the most extensive one of this research project. It comprises three sub questions and consists of two different blocks of research methods. First scientific and grey literature about the mobile telecom domain will be employed to get insight into the current voice communication service provision and future developments in the mobile telecom domain. This analysis will be structured according to the STOF approach. It will result in an overview of the current voice communication domain and a set of design variables for the construction of the value networks. Subsequently the different technological solutions available to TMNL for its communication service provision over LTE will be analyzed.
  The second block of methodology consists of desk research and design. A number of value network models for the provision of advanced communication services will be designed and elaborated. The design process will be supported by a small number of interviews with experts from within TMNL in order to validate the models. Each configuration will also be illustrated by a short case study to provide some context. The value networks and their accompanying use cases, along with the framework for assessing the viability of these models will be used as input for the third phase of the project.
- The third phase of this research project will provide and answer to the fifth and sixth sub-questions. On the basis of interviews with experts in the field of mobile communication, the value network models will be evaluated with the framework constructed in the first phase. Furthermore insight will be gained into the operator's sources of sustained competitive advantage. The results of this phase will be used as input for the fourth phase along with the overview of the current voice communication service provision and the solutions for communication services over LTE that were put forth in phase two.
- In the fourth and final phase of this research project the evaluation of different value network models will be used to determine in which direction TMNL should develop its communication service provision.

Different Research Methods

This section will elaborate on the different research methods in more detail.

Scientific Literature and Grey Literature Studies

Both in specifying the problem and in elaborating on the concepts that provide a basic foundation for constructing value networks for providing real-time person-to-person communication services, scientific literature and grey literature will be consulted. This will include literature on resource dependencies, gatekeeper functions within a value network, platform-based competition and open versus closed models. These methods will be used in the first and second phase of the research project.

External Forces of the STOF Approach

The STOF approach for analyzing and designing viable business models by Bouwman et al. (2008) will be implemented as a structured approach to gaining an overview of TMNL's current role division model and the future developments influencing it. The STOF framework provides a holistic view on business models by analyzing them from four interrelated aspects (Faber et al., 2003):

- Service aspect; defining the value proposition of the service and identifying the market segment where the service will be offered
- Technology aspect; defining the functional requirements and technical functionalities needed to realize a service offering
- Organization aspect; defining the structure of the value network required to create and distribute the service offering
- Financial aspect: estimating the cost structure and profit potential of producing the service offering

Following Morris et al. (2005) the STOF approach also postulates that it is important to maintain a fit with external factors to keep a business model sustainable over time. According to Hill and Jones (1995) there are two types of environments that can influence the performance of firms: the industry or competitive environment and the macro-environment. At the industry level, Porter's (1985) model of competitive and industry analysis can be a powerful tool. At the macro-environmental level however, factors identified in the PESTEL framework become relevant, i.e. political, economic, social, technological, environmental, and legal factors (Johnson & Scholes, 2002). In the STOF model, these competitive and macro-environments are summarized into market drivers (i.e. influence of suppliers, customers and competitors), technology drivers (i.e. influence of changing technology and innovations) and regulation drivers (i.e. changes in legislation). A diagram showing how these different aspects of the STOF model and the external forces interact is depicted in the figure below.

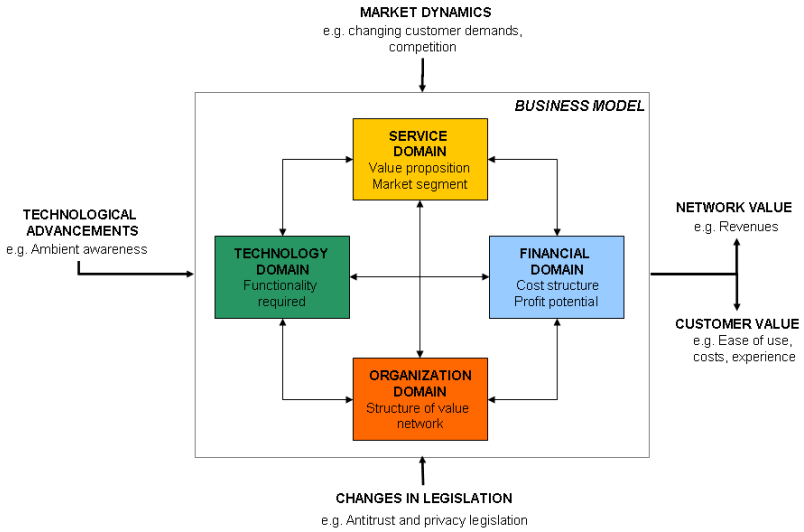


Figure 6: STOF-framework (Faber et al, 2003)

Semi-Structured Interviews

The basis of conducting interviews is talking to selected respondents about a specific topic in order to find answers to research questions. The results of interviews offer a way to analyze the similarities and differences between the answers of the different respondents and to relate the individual responses to the big picture set by the research question (Hart, 2005). The purpose of this research project is to gain insight into the perceptions of different stakeholders about a number of value network models for real-time person-to-person communication service provision. Therefore conducting structured interviews, which make the results comparable, is a well-suited method for validating the configurations. Because of the explorative nature of this project it is also relevant to gain a broad view of the different perspectives of stakeholders. From this point of view, conducting interviews is well suited as well because it is an excellent method to get in-depth qualitative information from a small number of respondents (Hart, 2005). For this reason, the interviews will be semi-structured. This allows a researcher to follow his own line of inquiry, but also allows new questions to be brought up during the interview in response to the interviewees' answers (Yin, 2003). This provides a possibility to get more insight into underlying motivations for certain perceptions a respondent has. The respondents for the interviews will be selected on the basis of a profile or a particular field of expertise. The interviews will be conducted in the third phase of this research project.

Qualitative Analysis

In order to evaluate and gain insight into the perception about the different value network models, the choice was made to base the empirical aspects of this research project on qualitative research rather then quantitative research. The rationale behind this decision is based on a number of factors (Miles & Huberman, 1994):

First of all the actualization of the context that the design is to be implemented in, is situated around 2015 and thereby rather distant. There is only a limited amount of information present at this moment that can form a profound basis for assumptions about this complex socio-technical environment; all relevant variables within the environment of the design can not jet be determined and delineated nor can their (inter-) relationships be measured.

Secondly, the information that is to be gathered to discover these perception is very subjective and from an insider's point of view. Interviews will be held with experts both internal and external to T-Mobile Netherlands and it is their subjectivity that will be of most value to this research project because that will offer the possibility to gain insight into the similarities, but also the differences between the different perspectives.

Thirdly, because the environment that the design is to be implemented in lies in the distant future, the conversion of data (the different perceptions) to numerical indices has little meaning at this point. It is far more valuable to gain a holistic understanding of the perspective of the different actors, both within and outside T-Mobile.

The qualitative analysis of the results of the interviews will be conducted with the support of ATLAS.ti. This is a software package for qualitative research that helps researchers uncover and systematically analyze complex phenomena hidden in text or data. It provides tools that let the user locate, code, and annotate findings in primary data material, to weigh and evaluate their importance, and to visualize complex relations between them (ATLAS.ti website, 2009). This method will be used in order to in the third phase of the research project.

1.4 Thesis Outline

This thesis is structured as follows. The first two chapters will constitute the first phase of the research project. Chapter 1 will provide some background information on the topic of this research project and specify the research objective and approach. Chapter 2 will present a basic introduction into value networks and construct a framework for assessing the viability of value network models. This framework will be applied to a number of generic value network models in the third phase of the project.
The second phase of this research project starts off with an oversight of the value network model of TMNL's current mobile voice service provision and insight into the impact of (future) developments within its domain. This will lead to a set of design variables that will form the basis of a number of value network models that will be constructed in chapter 5. However, before going into these models, chapter 4 will present an overview of the different solutions that are available to TMNL for providing communication services in an LTE network environment. These solutions will enable this research project to come to a more concrete and complete advice in chapter 7.
In chapter 6 the models constructed in chapter 5 will be evaluated with the framework specified in the second chapter on the basis of expert opinions, both from within TMNL and from external experts. This will provide insight into the similarities and differences in perspectives of the different respondents and seek to validate the different configurations. Furthermore, the operator's sources of sustained competitive advantage will be identified on the basis of these interviews as well. Chapter 6 will represent the third phase of the research project.
Finally in chapter 7, the findings of the previous chapters will be aggregated into an advice for the implementation of advanced communication services. Furthermore it will present a reflection on the research project and the methodology as well as make recommendations for further research. This last represents the fourth phase of the project.

The relationship between the chapters is depicted in the figure below.

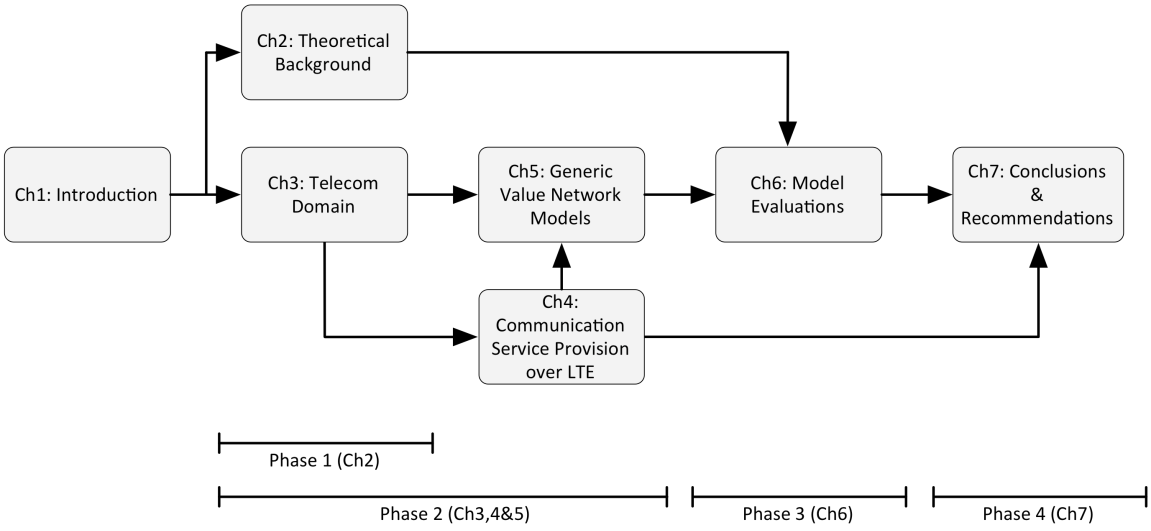


Figure 7: Thesis outline

2 Theoretical Background

2.1 Introduction

This chapter will provide an answer to the fist sub-question. The goal of this chapter is to construct a framework that can be applied to evaluate the viability of value network models for the provision of real-time person-to-person mobile communication services. It will be founded on a study of scientific literature into different concepts that are determinant for the viability of a value network model. This framework will be used in the third chapter to analyze the current mobile telecom domain and will be applied as a frame of reference to put the developments in its environment into perspective. Subsequently the framework will be used to evaluate the different value network models that will be designed in the fourth chapter.
As stated in the introductory chapter, this research project considers a value network model to be viable from TMNL's perspective when it:

- endows the operator a central role in the value creating process of communication service provision,
- enables the operator to influence on the outcome of this process and
- ensures it to remain the mobile subscriber's main service provider.

These requirements for the value network model contain both internal and external aspects. They focus on the position of TMNL in its value network and the accompanying strategic consequences as well as on the performance of its value network vis-à-vis the value networks of competing services. Both aspects will have to be taken into account in the framework that will be constructed in this chapter.

In order to put this framework in perspective the first section of this chapter will elaborate on the concept of a value network and the properties of value network models (section 2.2). Furthermore, the concept of sustained competitive advantages introduced in the previous chapter will be elaborated on (section 2.3). Subsequently, it will focus on the internal aspects of these models that determine its governance structure (section 2.4). First it will look at the resource-based view of the firm and the resource dependency theory (section 2.4.1). Then, a number of bottleneck resources and accompanying gatekeeper roles will be identified whose allocation has a substantive impact on the distribution of power within the value network of service provision in an IP-based environment (section 2.3.2). This will provide insight into the way the distribution of certain resources and capabilities influences the control actors have in a value network and thereby the way that the network is governed. Another consequence of the shift towards the IP-based paradigm is the dramatic change of a mobile operator's competition field. Where an operator initially only had other operators and MVNOs to worry about, he will encounter new competitors from the Internet domain such as Google, Microsoft and eBay that are developing possibly substitutive service platforms. The next step towards constructing the framework will be to look at the external aspects of the value network model and gain insight into the properties of the service provided by the value network and its value creating process that will provide an advantage in the competition against these other service platforms (section 2.5). First a basic understanding of service platforms and multi-sided markets will be provided (section 2.5.1). Subsequently it will discuss the competition between service platforms and introduces a number of levers for attaining platform leadership (section 2.5.2). Finally it will elaborate on these levers with the concept of open and closed models and the open innovation paradigm (section 2.5.3).
The theories and concepts described in these sections will provide a scientific basis for determining an operator's strategy within the value network it operates in but also towards the value networks it competes with. They will be combined into a single framework for evaluating the viability of value network models for the provision of real-time person-to-person mobile communication services (section 2.6).

2.2 Value Networks

Introduced by Porter in 1985, the concept of a value chain has been determinant in the analysis of industries over the past two decades. This method for modeling an industry can be implemented to demonstrate how value is added to a certain product or service through the sequential activities in the process of producing it. All the companies involved in the production process occupy a certain position in this chain and the different stages in this process follow each other in a linear sequence (Porter, 1985).

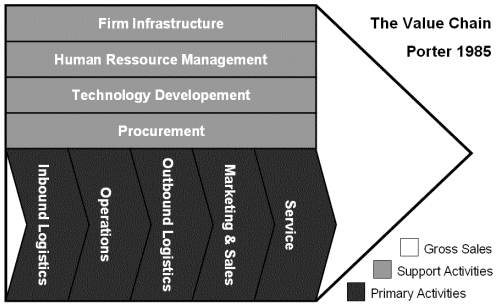


Figure 8: Porter's value chain model

The value chain ontology is very much founded on industrial production logic and does not always hold in the complex reality of current network economy. Some of the first authors to criticize the value chain approach were Normann & Ramirez (1993). They disagreed with the linearity that the approach implied, which may hold for the fabrication of products but certainly not for the provision of services, and introduced the term 'value constellation'. They argued that successful companies increasingly don't just add value, but reinvent it; the key strategic task of companies is to reconfigure roles and relationships among a constellation of actors (suppliers, business partners, customers) in order to mobilize the creation of value in new forms and by new players. In other words, value is co-created by an often-shifting constellation of actors in a network. Such a group of actors that pursue a shared set of objectives and form a network of complementary nodes and links where the service is delivered through the cooperation between these network elements is typically referred to as a value network (Demkes, 1999; Peppard & Rylander, 2006).

Each actor in the network controls certain resources and capabilities and together they perform value activities and create value for the end-users while realizing their individual strategies and goals (Faber et al., 2003). These specific resources and capabilities give each actor certain roles in the value creating process. The concept of roles was first discussed by Barley (1990), who writes about the importance of role-based approaches in analyzing organizations at an individual level. Kambil and Short (1994) extended this concept to the organizational level, defining roles as technologically separable value-adding activities in a business network. They argue in favor of analyzing business networks on the basis of the roles and relationships between the players involved. Roles can be played by different actors and individual actors can play various roles. The resources that a player has at its disposition have an effect on the roles that that player can fulfill in the value network. The division of the roles among the various players within a value network can be a source of conflict. For example, both third-party service providers and operators will be interested in owning the relationship with the customer; billing customers provides additional revenues as well as more in-depth information on customer transactions and behavior (Weill & Vitale, 2001).

As Barney (1991) asserts, there exists heterogeneity with respect to the strategic resources that companies control and a certain amount of immobility within these resources that increases the longevity of this heterogeneity. This entails that no single company possesses all the resources for a typical mobile service offering. Pfeffer and Salancik's resource dependency theory (1978) predicts that this heterogeneity of resources among organizations will make them interdependent, requiring them to work together. This will be elaborated in section 2.4.1. Because of these interdependencies, actors within a value network also have certain relationships amongst each other.

Representation of a Value Network

It can be derived from the previous section that value networks can be described in terms of actors, roles and relationships. These concepts will be defined as followed (Kambil and Short, 1994; Ballon, 2009):

- An **actor** is a commercial entity in the marketplace, fulfilling one or more roles in the value network
- A **role** is a specific value adding activity in the value network
- A **relationship** is the expression of an interaction between roles or actors in the value network.

A value network can be represented as a graph, where the different actors are represented by nodes and their relations by edges. The roles each actor fulfills are stated within each node. This representation is depicted in the figure below.

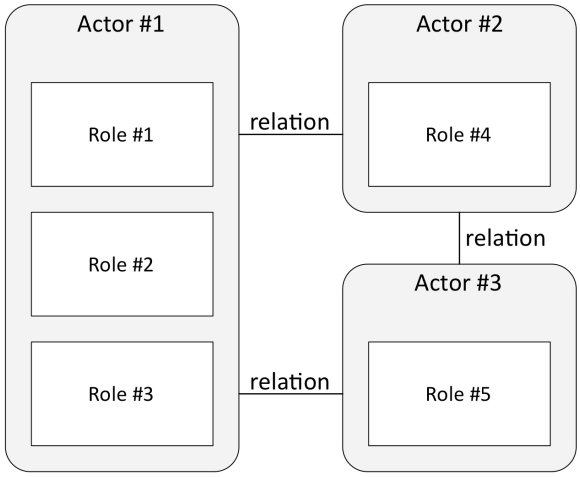


Figure 9: Representation of a value network

By looking at the value creation process as a division of value creating roles/activities amongst multiple actors, an overview can be gained on the way these roles are divided for different configurations of service provision. By subsequently analyzing the strategic consequences of these role divisions, insight can be gained on its impact on a company's position in its industry. The value network ontology will be implemented in chapter three for describing the role division in the current voice communication service provision. Furthermore it will be used in chapter five to construct the archetypical value network models for mobile communication service provision that will form the basis for the empirical phase of this research project.

2.3 Sustained Competitive Advantages

Since the 1960's, the framework depicted in the figure below has been used to structure most of the research in the field of strategic management in order to comprehend sources of competitive advantage. This framework suggests that companies are able to gain competitive advantages by implementing strategies that exploit their internal strengths and avoids internal weaknesses, while responding to environmental opportunities and neutralizing external threats (Barney, 1991). While this framework comprises both the internal and external analysis of a firm, up until 1984 most literature tended to focus primarily on the analysis of a firm's opportunities and threats in its competitive environment (Lamb, 1984, u.q. Barney, 1991). One of the most influential pieces on this subject is that of M. Porter. He noted that 'the essence of formulating competitive strategy is relating a company to its environment' and proposed three generic strategies for achieving and maintaining competitive advantage (Porter, 1980):

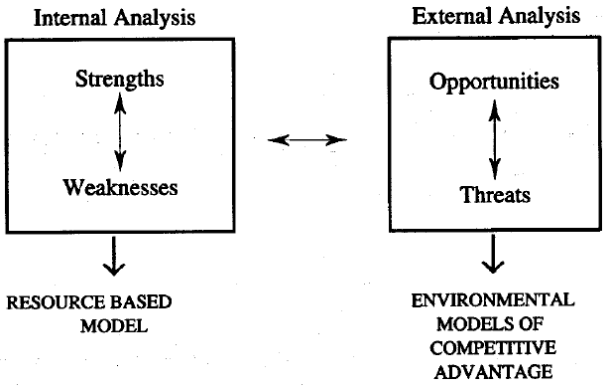


Figure 10: Models related to internal and external analysis of the firm (Barney, 1991)

- **overall cost leadership**, caused by economies of scale and experience curve effects.
- **product differentiation**, the production of a product of service that is being recognized industry-wide as being unique.
- **market segmentation**, focusing on a narrow market segment or a niche market in order to seek **cost focus** or **differentiation focus**

According to Barney (1991), this (positioning-based) view of a firm assumes implicitly that all companies in a certain industry are identical in terms of the resources they control and the strategies they deploy. These assumptions cannot hold however when taking into account resources such as a firm's geographic location, its access to raw materials, human capital and informal relationships with its environment. By contrast the resource-based view of the firm was proposed (Rumelt, 1984; Wernfelt, 1984; Barney, 1991; Amit & Schoemaker, 1993; Medcof, 2001), which stated that competitive advantages arise by having resources at ones disposition that are a source of value and are unique. These two aspects (value and uniqueness) determine a resource's strategic importance. Following the definition of Wernfelt (1984), this research project will define resources as tangible and intangible assets which are tied semi-permanently to the firm and can be thought of as its strengths or weaknesses. In order to further specify these tangible and intangible resources, the classification by Collis & Montgomery (1998) will be used, that goes one step further and makes a subdivision in the intangible resources. They distinguish the following types of resources:

- **Tangible resources:** basically the only resources that appear on a firm's balance sheet including resources such as real estate, production facilities and raw materials.
- **Intangible resources:** such things as company reputation, brand names, cultures, technological knowledge, patents and trademarks, and accumulated learning and experience.
- **Organizational capabilities:** complex combinations of assets, people and processes that organizations use to transform inputs into outputs. The list of organizational capabilities includes a set of abilities describing efficiency and effectiveness: low cost structure, "lean" manufacturing, high quality production and fast product development.

Barney (1991) elaborated on the concept of uniqueness mentioned on the previous page and stated that this was related to the heterogeneity of the strategic resources that companies control and a certain amount of immobility within these resources that increases the longevity of this heterogeneity. This immobility arises from a number of reasons (Teece et al., 1997). First, due to the complexity of the process of business development, many companies lack the organizational capacity to quickly develop new competences. Secondly, some assets, like tacit knowledge and reputation, just aren't readily tradable and can therefore not be leveled out through market processes. Finally, even when an asset can be purchased, not all companies will be able to fully exploit its potential.

The resource-based view offered a whole new approach to gaining sustained competitive advantages and defined this concept as 'a value creating strategy not simultaneously being implemented by any current or potential competitors and when these other firms are unable to duplicate the benefits of this strategy' (Barney, 1991). The fact that such an advantage is called sustained doesn't mean that it's everlasting however; it implies that the advantage will not be diminished by duplication efforts of competitors. However, events that have a structural impact on an industry as a whole may change the playing field and render a former source of sustained competitive advantage irrelevant within the new environment. Likewise a resource that used to be of little relevancy may suddenly become a source of sustained competitive advantage (Barney, 1991). As stated by Wernerfelt (1984), what a company wants to do is to create a situation where its own resource position directly or indirectly makes it more difficult for others to catch up. In order to gain a sustained competitive advantage companies:

- must **base their strategy on their strengths**, because that (along with its weaknesses) it what makes it distinctive and
- can only **develop their future strengths from today's strengths**, shifting the focus of strategic analysis from the industry to the company itself.

As described above, these strengths come from a company's resources that create value in a certain industry and are unique.

2.4 Network Governance

This section will focus on the properties of a value network that determine its governance structure and the amount of control an actor has over the value creating process.

2.4.1 Resource Dependencies

Following Barneys contribution to the resource-based view of the firm that assumes heterogeneity between companies, all resources necessary to develop, implement and market a product or service are not necessarily available within a single company. Furthermore these resources may not be perfectly mobile, as a result of which a company may not be able to acquire them over time as well. This entails that companies become dependent of each other in order to offer their products or services (Reuver & Bouwman, 2008). This dependency forms the foundation of the resource dependency theory whose fundamentals were formulated by Pfeffer and Salancik (1978). This theory states that the power an organization has, depends on the resource dependency relationships it has with other organizations within the value network it operates in. So if an organization is highly dependent on another organization for a vital resource, that other organization will have power over the former one (Pfeffer & Moore, 1980; Harpaz & Meshoulam, 1997; Cool & Henderson, 1998; Medcof, 2001).
More specifically the resource dependency theory postulates that three factors are critical in determining the dependence of one organization on another and thereby the distribution of power among them (Medcof, 2001):

1. **Resource importance**: the more vital a certain resource controlled by an organization is, the more other organizations in need of that resource will be dependent upon the former.
2. **Alternatives**: the fewer the alternatives sources for a resource there are, the more other organizations will be dependent on it.
3. **Discretion**: the greater the degree of discretion an organization has in deploying a resource, the greater the dependence of others on it.

The resource dependency theory is useful to explain how actors in a value network interact and organize their collective action; the power an actor has is directly proportional to the strategic importance of the resources they have control of (Reuver & Bouwman, 2008; Medcof, 2001). Therefore organizations will attempt to reduce their dependence relationships, for strategic purposes, by minimizing their own dependence or by increasing the dependence of other organizations on themselves (Ulrich & Barney, 1984).

2.4.2 Bottleneck Resources & Gatekeeper Roles

Beside differences in the amount of power certain actors have in a value network due to individual endowments of heterogenic and immobile resources, actors can also derive power from the positions in the value network they take up. Some positions, as well as functions in the functional architecture, carry more weight then others. Such positions are referred to as ‘gatekeeper roles’. The distribution of these roles within a value network is a consequence of the distribution of bottleneck resources; certain resources that are either scarce or critical to the value creating process. Actors that have these roles have a strategic advantage over other actors and are able to influence certain aspects of the value creating process more than the rest. Because of this, these roles are both a source of power and a position from where one can add value to the service provision. Access to information about customers, products, markets and costs has a great influence on the business model viability. Due to the specific information these gatekeepers have at their disposal intrinsic to their position, they have the possibility to filter and select the information they distribute as well as qualitatively alter its content through active accumulation, processing and packaging (Weill & Vitale, 2001; Farrell & Weisener, 2003; Ballon, 2009).

A number of generic gatekeeper roles can be identified that are related to the distribution of access to certain information as a source of power. Weil and Vitale (2001) have defined the concept of customer ownership as such a source of power and identified three different aspects of this concept: ownership of the customer relationship, ownership of the customer data and ownership of the customer transaction. The table below contains an operationalization of each of these three concepts.

Aspects of ownership	Operationalization
Customer relationship	The customer repeatedly purchases from the actor.
	The actor has a set of historical data to profile the customer.
	The customer trusts the firm and has brand recognition regarding it.
	The actor has more potential influence over the customer then others in the value network.
	The actor has enough influence and the potential to earn a fee from third parties whose services are used by its customers.
Customer data	The actor electronically captures the customer data and can analyse it at customer or segment level.
	The actor has more insight about the customer than other actors in the value network.
Customer transaction	The actor receives revenue from the transaction.
	The actor owns the customer transaction data.
	The actor has exclusive responsibility for completion of the transaction in the mind of the customer.

Table 1: Operationalization of customer ownership (Weil & Vitale, 2001)

Control of each of these aspects of customer ownership entails a strategic advantage over other actors in the value network and introduces different types of leverage (Weill & Vitale, 2001):

- Ownership of the **customer relationship** gives an actor the leverage of influence on the customer of the service. The latter looks to the relationship holder for trust, recommendations and tailored advice.
- Ownership of the **customer data** brings an actor the leverage of customer insight. Access to customer data is a precondition for business intelligence, giving the actor detailed information about a customer's history, needs and desires. The actor owning the customer data is able to get the most complete picture of the customer, while providing the other actors with the absolute minimum amount information needed for them to do their part in the process of value creation.
- Ownership of the **customer transaction** gives an actor the leverage of revenue for the service provision; they will receive a fee or profit margins for any service provided and are at the front end of the revenue stream in the value network.

Similarly, Ballon & Walraven (2008) have identified four different crucial roles in the provision of mobile services. These roles are:

- **Service Provisioning/Service Brokerage**: An actor with this role functions as the reference point for the customer to use, retrieve and subscribe to services and/or service components.
- **Profile/Identity Management**: An actor that fulfills this role manages general user data and user preferences.
- **Charging & Billing**: An actor with this role performs the charging and billing within a value network.
- **Service Creation Environment**: An actor controlling the service creation environment offers a set of development and hosting tools for third-party service developers.

The first three of these last four roles correspond to the three roles related to customer ownership as identified by Weil & Vitale (2001). Similar to the actor that has ownership of the customer relationship, the actor that is responsible for service provisioning and/or service brokerage has the ability to influence the customer. Similar to the one that has ownership of the customer data, the actor that takes care of profile and identity management has the leverage of customer insight, as the access to this data is a precondition for business intelligence. Finally, the actor that does the charging and billing within the value network has the same leverage within the network as the actor that has ownership of the customer transaction; he forms the front end of the revenue stream within the network.
The fourth role sets the categorization of roles by Ballon & Walraven apart from the one by Weil & Vitale. It is in line with Farrell & Weisener (2003), who identify the control over a service platform as a potential bottleneck to service innovation and a source of power of other companies in a particular industry. This is closely related to the concept of resource dependency discussed in the previous section and a very interesting approach to the mobile communication industry from the perspective of the objective of this research project. Therefore it will be taken into account as well. To follow the line of the other three gatekeeper roles, this research project has chosen to rename it into 'ownership of the service creation environment'.

This leads to the following categorization of bottleneck resources:

- **Ownership of the Customer Relationship**
  An actor that owns the customer relationship functions as the point of reference of the customer for his service usage. This gives the actor more potential influence on the customer than others in the value network.
- **Ownership of the Customer Data**
  An actor that owns the customer data has the most insights about the customer within the value network. He has the most complete picture of the customer, while providing the other actors with the absolute minimum amount information needed for them to do their part in the process of value creation. Furthermore this actor enables service personalization towards the customers.
- **Ownership of the Customer Transaction**
  An actor that owns the customer transaction handles the financial transactions with the customers. Because of this position, this actor has a direct financial benefit from customers' service usage and functions as the front end of the revenue stream in the value network. Furthermore this gives him the ability to determine the pricing of the service and thereby the positioning of the service within the market.
- **Ownership of the Service Creation Environment**
  An actor that owns the service creation environment has control over the variants of the mobile service platform. In other words over the interfaces between the platform on the one side and applications and/or complementary services on the other side. This gives the actor a certain amount of influence on properties of the other actors that join the value network.

2.4.3 Towards a Framework

This section presented a study of scientific literature to gain insight into those aspects of a value network model that determine the governance structure among the different actors involved and contribute to an actor's control over the value network he takes part of. It discussed the resource-based view of the firm that postulated that resources that create value and are unique, can function as a source of sustained competitive advantage. Subsequently it elaborated on this concept by introducing the resource dependency theory that states that the power an organization has depends on the resource dependency relationships it has with other organizations within the value network it operates in. Finally it introduces a number of bottleneck resources and accompanying gatekeeper roles. Control over these specific resources that are either scarce or critical to the value creating process provide certain actors with strategic advantages over other actors and the ability to influence certain aspects of the process more than the rest.

These analyses have enabled the first step towards construction a framework for evaluating the viability of value network models for the provision of real-time person-to-person mobile communication services. A preliminary design of the framework is depicted in figure 11 below. It identifies the distribution of roles and the accompanying resources as a source of value network control due to its impact on the resource dependencies and the division of gatekeeper roles in a value network.

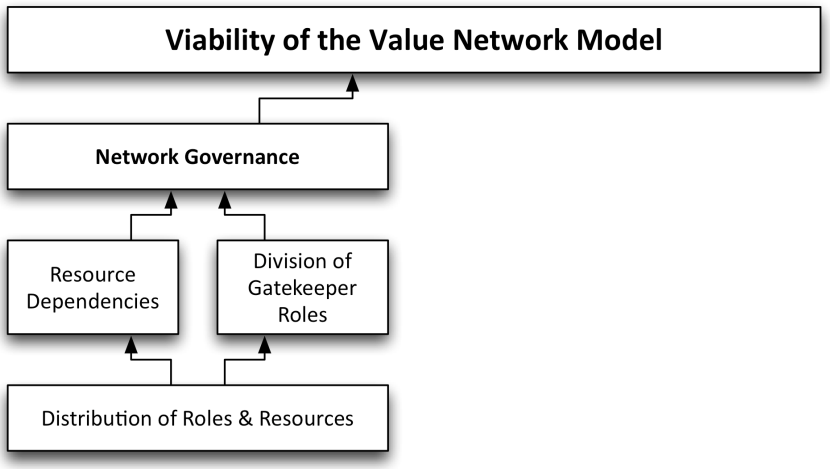


Figure 11: First step in constructing the framework: network governance

2.5 Platform Competition

This section will focus on the competition between service platforms. It will analyze the properties of the service provided by the value network and its value creating process that will provide an advantage in the competition against other service platforms.

2.5.1 Service Platforms and Multi-sided Markets

First an understanding of service platforms and the functioning of multi-sided markets will be provided. The basis for these two concepts lies in the existence of network externalities. These are of particular interest with regard to mobile communication services because the latter are an outstanding example of networked services. Network externalities arise when a consumer's value for a certain good increases when another consumer has a compatible good and/or is connected to the same network (Farrell & Saloner, 1985; Katz & Shapiro, 1985). These network externalities are caused by network effects. Similarly to the externalities, network effects exists if the value of joining a network by buying compatible products increases through the number of other adopters who join the network by purchasing compatible products (Church & Grandal, 2004). Two different types of network effects can be discerned (Katz & Shapiro, 1994; Church & Grandal, 2004):

- **Direct network effects** are based on horizontal compatibility between users. A user's link to a network has no value by itself, except to facilitate interaction with other users. A clear example of direct network effects can be found in communication services; when the service has n subscribers, each subscriber can call n-1 others. The larger the number of subscribers is, the more attractive the service will be.
- **Indirect network effects** are based on vertical compatibility. Indirect networks consist of a primary and a secondary (or complementary) market. Typical examples of such a network are systems that consist of a piece of hardware and a piece of software. It's in the interaction of the two components that the added value is created; either one of the components has little to no stand-alone value. Indirect network effects arise when the added value of a piece of hardware doesn't directly depend on the number of users who have compatible pieces of hardware. Rather, the number of users is interesting because it increases the incentive for the production of software that is complementary to that piece of hardware. Therefore users benefit indirectly from the adoption of that hardware by other users because this will eventually allow them to use a wider variety of complementary software.

Service Platforms

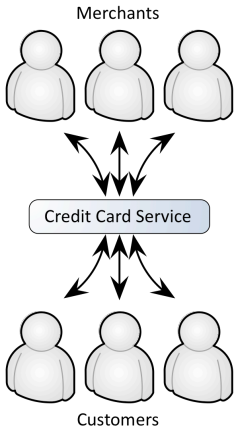
The notion of a hardware product supporting multiple pieces of software is very similar to the concept of a platform. A platform can be described as the set of common elements, interfaces and processes in a product family and the individual product instances derived from this platform can be described as its variants (Meyer & Lehnerd, 1997). In the same terminology as above, the hardware would be the platform and the software the variants. But it may just as well be an operating system that forms the platform and compatible software clients that are its variants. The existence of a platform as an intermediary creates added value when three conditions have been met (Evans, 2003):

- First of all there should be a two or more distinct groups of customers. These groups can be different altogether such as merchants and customers for a credit card payment platform or men and women for a dating platform. But they can also differ only for the transaction at hand. Examples are users on a peer-to-peer network that sometimes transmit or sometimes receive data or subscribers on a telecom network who are sometimes callers, sometimes receivers.
- Second of all, a member of a group must have a certain benefit from having its demands coordinated with one or more members of another group at the opposite side of the platform. By coordination the interaction between both groups, the platform enables the internalization and transformation of the network effects created by one group into benefits for the members of the other group (Ballon & Walraven, 2008).

- Third of all, the platform should be able to coordinate or facilitate the transaction more efficiently than a direct bi-lateral relationship between the members of the different groups.

A platform that meets the conditions described above is called a multi-sided platform (Evans et al., 2005). Platforms reside in two different areas of telecommunication service provision. There are platform operators that facilitate the transmission of voice and data between the customers and the mobile network operators (Kuo & Yu, 2006). These platforms reside within the radio access network infrastructure. Furthermore there are platforms that allow customers to access and use mobile services on their handsets and likewise enable mobile service providers to offer their services to the customer (Reuver et al, 2008). The latter are software platforms and will form the foundation of IP-based communication service provision. Li & Whally (2002) have identified two different types of mobile software platform operators. First there are the companies that have extended their business from the mobile handset market to the software market because they seek to enhance the functionality of mobile phones and perceive it be complementary to their current line of business. These new functionalities may open up new commercial opportunities and/or drive the sales of their handsets. Good examples being Nokia with their Symbian operating system and Apple with their mobile OX. Secondly there are companies who extend their software operations to a new market. By doing this the open up the possibility to offer applications compatible to their former software platform over a new medium. Examples of such companies are Google with their Android operating system and Microsoft with Windows Mobile.

Multi-Sided Markets

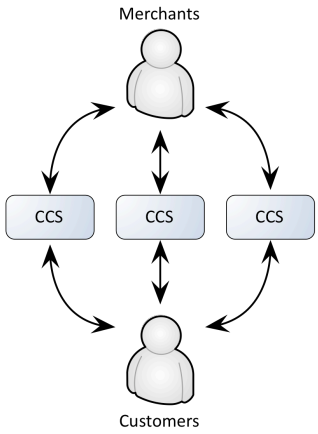


Markets that are coordinated by a multi-sided platform, facilitating the transactions between two or more distinct types of customers that are dependent on each other and whose joint participation creates the added value of the platform for each, are labeled two- or multi-sided markets (Rochet & Tirole, 2002; Evans et al., 2005; Ronson, 2005). The classic example of a two-sided market is a credit card service where the service functions as the platform between consumers and merchants. One of the main drivers for a consumer to decide if he will subscribe to a particular credit card service is the number of merchants that accept the card, whereas merchants make a choice for a certain credit card service based on the number of consumers that whish to use it. The perceived value of joining a credit card service (or platform) thus depends on expectations of the size of the group on the opposite side of the platform (Ronson, 2005).

From the platform point of view, by taking these internalized network externalities into account vendors of multi-sided platforms must not only choose the price levels for their service but also a price structure. The vendors have to 'get both sides of the market on board' while earning revenue as well. This may result in a platform vendor setting different price structures for different sides of the platform (Rochet & Tirole, 2002; Ballon & Walravens, 2008). Actually, most platform vendors seem to earn most of their profits from only one side of the platform (Evans et al., 2005; Ronson, 2005). A good example is the business model implemented by a number of videogame platforms such as Sony, Sega and Nintendo. These companies make money on game developers through per-unit royalties on games and fixed fees for software development kits and lose money on the gamers' side (Rochet & Tirole, 2002). By selling their game-consoles with loss to the end-users they increase the number of gamers and thereby the market for the game developers. Another interesting example is Apple, which releases free Software Development Kits (SDKs) for iPhone applications. Apple's primary interest is to make money by selling iPhones. However by enabling cost free third-party application development it has stimulated the availability of a wide variety of iPhone applications, which increases the attractiveness of their device. Subsequently Apple provides another platform, the Apple App store, where they sell these applications and receive 30% of the revenues.

As indicated in the section on network effects, indirect network effects are dependent on the variety of complementary products and services to a certain platform. This entails that an increase in the variety of complementary products will increase the appeal of and thus the demand for the core product or platform through the presence of network externalities. Therefore a successful business model for a mobile (communication) service platform is not so much a case of cost oriented pricing but rather of pricing policies that maximize both the quality and quantity of applications, content providers and end users (Ballon & Walravens, 2008). If necessary, this can be achieved through cross-subsidization between the different sides of the platform

2.5.2 Platform Leadership



Actors on either side of a two- or multi-sided market may also use multiple platforms to coordinate their transactions so their interaction can go through different channels. This phenomenon is called multihoming (Rochet & Tirole, 2002; Evans, 2003; Ronson, 2005) and is depicted in the adjacent figure. Following the example of the credit card platform on the previous page, the merchant is multihoming when he enables his customers to pay with different credit cards and similarly the customer is multihoming when he has multiple credit cards to pay with. In such a situation the different platforms will try to influence the multihoming on either side of the market. This introduces a level of complexity in the functioning of multi-sided markets, because it incites strategic behavior by the different platforms and influences the degree of competition between these platforms (Rochet & Tirole, 2002; Evans, 2003; Ronson, 2005). As indicated in the previous section, an increase in the variety of complementary products will increase the appeal of and thus the demand for the core product or platform. Taking into account that usually multiple platforms are competing in a given market and customers display multi-homing behavior, a company wants its platform to become the basis on which the majority of companies that manufacture complementary products in that industry focus. This concept is referred to as platform leadership (Gawer, 2000; Gawer & Cusumano, 2002).

Scientific theory on platform leadership deals with the formulation and implementation of strategies aimed at fostering network effects while exercising a form of control over complementary products and services (Ballon, 2009). Gawer defines platform leadership as “a firm’s ability to influence the development of a large number of complementary products by almost all other firms in their industry” (Gawer, 2000 p.24) and she states that “one can determine whether a given firm is a platform leader by observing whether other firms invest specific assets to preserve compatibility with the firm’s product, even as that product evolves” (Gawer, 2000 p.24).
The concept of platform leadership is very similar to what has been described by Padgett (1981) as ecological control, where influence is not directly or self-consciously exerted but indirectly through the underlying premises of decision-making. By spinning a large web of complementary products and services around one’s platform, the market is continuously but subconsciously being steered towards that platform. This gives the platform a very firm position within the market it operates in. Furthermore, achieving a level of platform leadership could function as a powerful way to raise entry barriers for potential competitors that may want to introduce a competing (and incompatible) platform in the same industry. These competitors would not only have to produce a product or service with a better price/performance ratio, they would also have to rally all the companies producing the complementary products to adapt their designs for this new platform (Gawer, 2000).

As stated by Gawer & Cusumano (2002) the strategy for platform leadership is two-fold; on the one hand a company has to continually innovate its own core products or services that shape its platform while on the other hand it should encourage companies that make products or services that are complementary to its platform to keep producing these products and services and to keep innovating on them. They have identified four levers that are critical for achieving and sustaining platform leadership. These levers are distinct but still closely related. Platform leaders or companies that want to become one have to align their choices on these dimensions (Gawer, 2000; Gawer & Cusumano, 2002; Ballon, 2009):

1. **Scope of the Firm**
   This lever deals with the decision about what products complementary to a company's platform it should develop in-house, and which ones it should leave to third-parties. The decision a company makes in this tradeoff should be heavily dependent on the resources and capabilities it has. Defining the scope of one's company determines the chance of an ecosystem of complementary services to develop; the more limited the scope, the more room there is for an ecosystem to come into existence. However in doing so a company is giving up some of its bargaining power with its complementors.
2. **Product Technology**
   This lever deals with the degree of modularity of the system, the degree of openness of the platform interfaces and to what extent the information about and technical specifications of the platform and its interfaces should be available for third parties. The modularity of the platform will make it more transparent and will provide complementors with more areas to innovate in. Openness about the specifications of the platform and its interfaces stimulates the development of complementary products and services; it greatly lowers the costs to innovate for the complementors.
3. **Relationships with External Complementors**
   This lever determines how collaborative or competitive the relationship between the platform leader and its complementors should be. As stated above, a platform leader should encourage complementors to continue their production and to keep innovating. In order to achieve this, the leader has to both achieve a certain level of consensus about the interfaces between the platform and the complementary products and services within the industry it operates in, as well as maintain some control over the directions the interfaces are developing in, thus influencing a lot of design decisions by third parties. The control should be exerted in the form of ecological control as described above, since attempts to directly control one's complementors while trying to get them to collaborate at the same time can be quite a challenge. By defining the underlying premises and parameters of choices in the decision process, the need to force complementors into a certain direction can be averted. There is a relation of mutual dependency between the platform owner and its complementors; they are all dependent on how well the other operates. For this reason the platform leaders should develop a long-term relationship of trust with its complementors, but they should also communicate that they are willing to enter a complementary market when it is not performing well enough in order to stimulate innovation.
4. **Internal Organization**
   This lever enables platform leaders to use their internal organizational structure to manage conflicts of interest. The balancing act between competition and collaboration as described above could be achieved with a division of labor within the firm where different groups may have objectives that are sometimes conflicting; while some units are cooperating with third parties, other units within the company may be competing with them. By establishing processes that allow these conflicting objectives and dissentient units to come together, profound decisions can be taken about what to do in each complementary submarket.

2.5.3 Open vs. Closed Models

The previous section introduced four levers for achieving and sustaining platform leadership. These levers were focused on the coming into existence of a thriving business ecosystem on the one hand and innovation on the other hand. Especially in the first two levers, the level of openness of the value network model plays an important part. This section will elaborate on the concept of open models and introduce the open innovation paradigm. These will be used to accentuate the levers presented in the previous section.

Feijóo et al. (2006) have identified a continuum between the situation where the platform provider has full control over the services its user can access and the situation where these third-party complementary service providers have full access to the platform provider's customers without intervention of the latter. These two situations are called the walled garden and the open model respectively. Both extremes have their advantages and disadvantages (Reuver et al., 2008a; Feijóo et al., 2006; Forrester, 2006):

- A walled garden model enables a platform provider to offer a consistent customer experience to its users because it determines the availability of services that are offered over its platform. This model also ensures the platform provider a large share of the revenues generated through the platform. The downside of this model however, is that it limits the customer's choice as well as restricts the access of service developers to the end-users. This introduces the risk for the latter that their services may not reach the intended market segment because it's not allowed on the portal, lowering their incentive to develop services that are complementary to that platform and thereby limiting service innovation.
- An open model on the other hand does not constrain service developers and gives them direct access to the end-user. This encourages complementary service innovation and thereby gives the end-user access to more diverse content. There are a number of disadvantages related to this model as well however. Customers may be faced with a certain amount of complexity in their service usage due to the disintegration of service provision. This causes issues such as a lack of centralized billing and customer support and separate login procedures for different services. Furthermore the platform provider has fewer incentives to invest in its network resources and middleware to support third-party service provision on their platform because they are uncertain that they will get a share of the generated revenues.

Open vs. Closed Innovation

Besides the level of access that complementary service providers have to a certain platform's customers, another factor that can be determinant for the development of a healthy ecosystem of complementary services is its innovation process. Chesbrough (2003) has identified two different innovation paradigms; closed innovation and open innovation. Closed innovation takes the assumption that successful innovation requires control as a starting point. In a closed innovation process, companies generate and develop their own ideas and then finance, build, market and distribute them on their own. A process of open innovation on the other hand has as the basic assumption that companies should use both internally and externally generated ideas as a source of innovation and utilize both internal and external paths to the market. This implies that a company should both develop services in house, but also benefit from the wealth of activities outside of the firm and leverage the discoveries of others. By incorporating start-ups for instance, a company can acquire the ownership of potentially successful services they didn't develop themselves. This increases the number of possible sources of innovation, offers flexibility and speed in service development and enables an organization to adapt to changes in its environment and react to strategic opportunities. A company could even help fund a start-up in order to explore an area of potential future interest. Furthermore, by allowing other parties to incorporate a company's innovative service into their own service provision multiple paths are created for that service to reach the market which may result in a more wide spread adoption of it (Chesbrough, 2004, Chesbrough et al., 2006; Dittrich & Duysters, 2007).

2.5.4 Towards a Framework

This section presented a study of scientific literature to gain insight into those aspects of a value network model and its value creating process that will provide an advantage in the competition between service platforms. In this competition it is key to attain a position of platform leadership. The levers for achieving this position are focused on continually innovating one's platform and stimulating companies to make complementary products while exercising a form of control over these companies as well. The first lever is concerned with the amount of room a platform provider gives to complementary service provider to offer their services to the end user. This is closely related to tradeoff between open and closed models described in section 2.5.3. The second lever is concerned with the transparency of the platform and the ability of third parties to innovate using its technology. This lever was extended with the concept of open innovation.

Both of these levers are determined by the division of roles and resources in the value creation process and therefore fall within the focus of this research project. The former has been labeled 'degree of vertical integration' and the latter 'degree of openness'. They are depicted in an adaptation of the framework below.

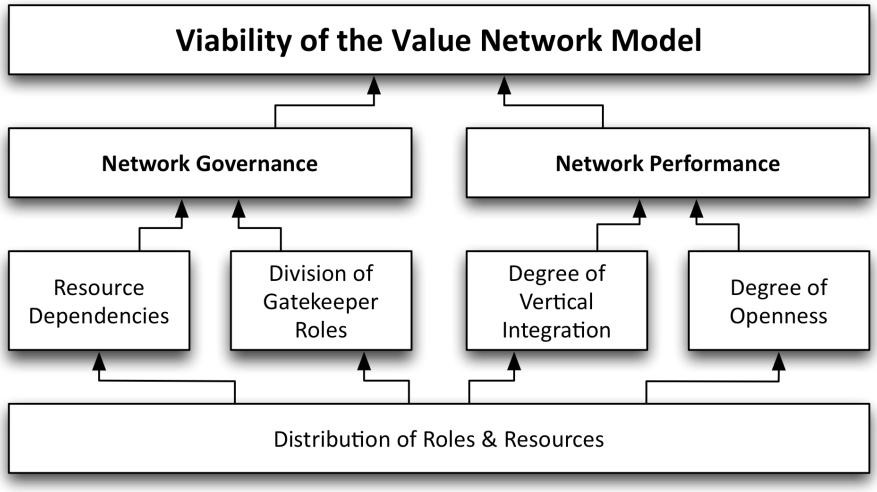


Figure 12: Second step in constructing the framework: network performance

Besides stimulating innovation and the production of complementary services, the position of platform leader must also have a certain amount of control over these third parties in order to be able to steer the value creation process towards a favorable direction. The second and third levers are concerned with this aspect and they introduce a tradeoff between the amount of openness in a value network and the amount of control a platform providers has.

2.6 Conclusions

In this chapter a framework was created for evaluating the viability of value network models for the provision of real-time person-to-person mobile communication services. This framework takes into account the position of an actor in its value network and the accompanying strategic consequences as well as the performance of its value network vis-à-vis the value networks of competing service platforms. It assesses the viability of a value network model by the amount of control an actor has over the value network he participates in as well as the performance of the value network as a whole. Only those aspects have been taken into account that were directly related to the distribution of roles and resources in the network.

Network Governance

The network governance structure is be determined by the resource dependency within the value network and the distribution of gatekeeper roles.

The resource dependency theory states that the power an organization has, depends on the resource dependency relationships it has with other organizations within the value network it operates in. This dependence of one organization on another and the accompanying distribution of power among them is determined by the importance of the resources, the availability of alternatives and the discretion an actor has in implementing those resources. The resource dependency theory is useful to explain how actors in a value network interact and organize their collective action; the power an actor has is directly proportional to the strategic importance of the resources it has control over.

Actors can also derive power from the positions in this value network they fulfill. Some positions, as well as functions in the functional architecture, carry more weight then others. Such positions are referred to as 'gatekeeper roles'. The distribution of these roles within a value network is a consequence of the distribution of bottleneck resources; certain resources that are either scarce or critical to the value creating process. Actors that have these roles have a strategic advantage over other actors and are able to influence certain aspects of the value creating process more than the rest.

Network Performance

The performance of a value network will be determined by the degree of vertical integration of actors within the value creating process and the degree of openness of the network.

These two aspects both contribute to attaining a position of platform leadership where the majority of companies that manufacture complementary products in a given industry focus on. The levers for achieving this position are focused on continually innovating one's platform and stimulating companies to make complementary products while exercising a form of control over these companies as well. The vertical integration of the platform provider determines the amount of room there is for an ecosystem of complementary product to come into existence and the openness of the network determines the innovative ability of this ecosystem.

Tradeoff

However, the platform leader must also have a certain amount of control over these third parties in order to be able to steer the value creation process towards a favorable direction. This links the two aspects of the framework together and introduces tradeoffs that have to be made.

1. The amount of discretion an actor has and keeps in implementing certain resources may increase the amount of power he has over the value creating process and enhance an actor's sustained competitive advantage but it may also decrease the innovativeness of the value network.
2. Similarly, by controlling all gatekeeper roles within a value network an actor may have control over all different stages in the value creation process, however this leaves little room for the coming into existence of a ecosystem of complementary service providers.

These two tradeoffs are graphically depicted in the two figures on the next page.

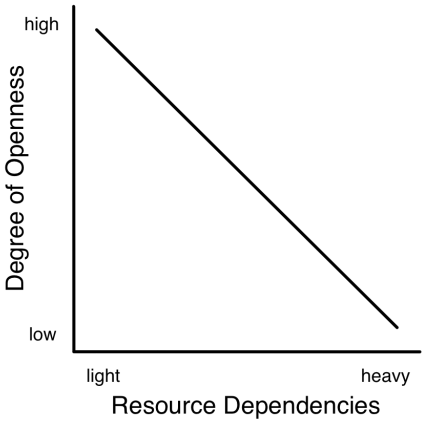


Figure 13: First tradeoff in the framework

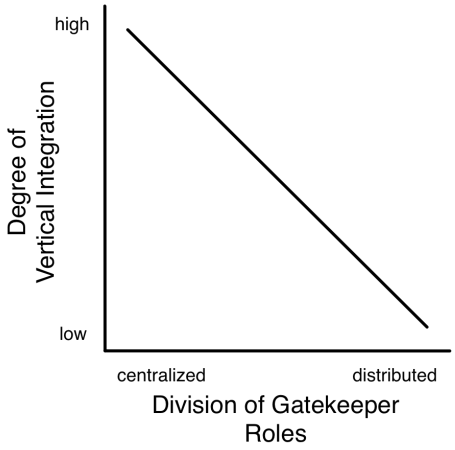


Figure 14: Second tradeoff in the framework

The Framework

Due to the existence of these tradeoffs the two different aspects of the framework are interrelated. To make this explicit in the framework, they are connected with a double-headed arrow. The definitive framework now looks as depicted in the figure below. This framework will be used to evaluate the different value network models that will be designed in the fifth chapter.

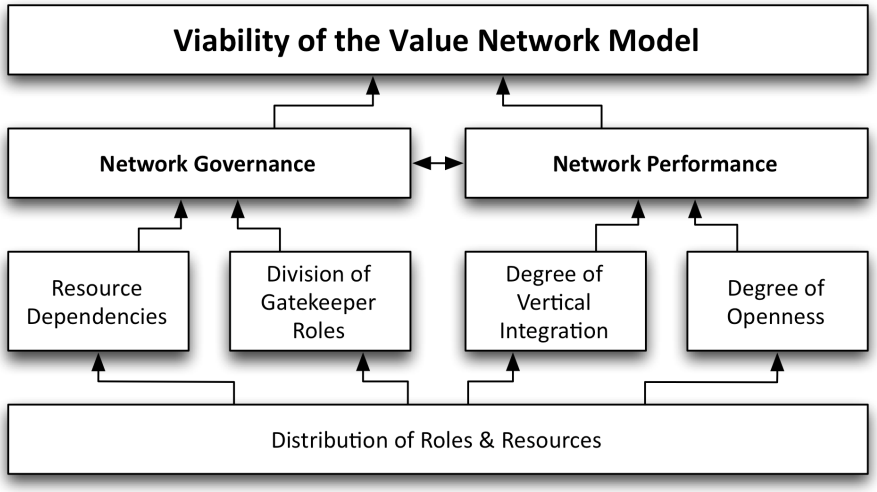


Figure 15: Final framework for assessing the viability of a value network model

3 Telecom Domain

3.1 Introduction

This chapter will provide an answer to the second sub-question. The goal of this chapter is to present an oversight of the value network model of TMNL's current mobile voice service provision and gain insight into the impact of (future) developments within its domain; how they will influence the nature of the different roles, the division of these roles among the actors involved and the relations between the actors.
The first part of this chapter (section 3.2) will provide an overview of the current mobile voice service provision by TMNL. This will provide a frame of reference for the developments elaborated on later on in this chapter and allows for their impact on TMNL's service provision to be put into perspective. The service provision will be set forth by implementing certain aspects the STOF approach, a holistic view on business models. The next stage will be to analysis of relevant developments in the environment of the value network. Also following the STOF approach, these developments are summarized into technological developments (section 3.3), market developments (section 3.4) and regulation (section 3.5). The overview of these developments will enable an analysis of their impact on the value network (section 3.5). It will elaborate on the consequences they will have for the roles, the actors and the relationships in the network. These will function as the different design variables for the construction of the value network models in chapter five.

3.2 Analysis of TMNL's Mobile Communication Service Provision

This section will provide an overview of the current mobile communication service provision by TMNL. As stated in the introductory chapter this research project focuses on the value network models for mobile communication service provision and the evolution from mobile voice service provision to the provision of advanced mobile communication services. To put this evolution into perspective, this section will briefly summarize TMNL's current voice communication service provision. It will do so by following the STOF approach, a holistic view on business models that analyzing them from four interrelated perspectives: the service perspective (section 3.2.1), the technology perspective (section 3.2.2), the organization perspective (section 3.2.3) and the financial perspective (section 3.2.4).

3.2.1 Mobile Communication Services

The current voice communication service provision by TMNL is mobile only. It owns, operates and maintains a mobile network infrastructure roughly providing 99% 2G-coverage and 86% 3G-coverage in the Netherlands (Hooijkaas, 2009). It provides its subscribers with the ability to make calls to and receive calls from other TMNL subscribers. It also provides interoperability with other network operators (both fixed and mobile, both national and international), which allows its subscribers to make calls to and receive calls from subscribers of other operators worldwide. TMNL has roaming agreements with operators in foreign countries to enable their subscribers to make use of that other operator's network and services when visiting that particular country. The subscriber is then billed for his network and service usage through his TMNL subscription.
TMNL offers mobile subscriptions with postpaid or prepaid price plans. Under the former construction a subscriber gets billed afterwards for his service usage each month, under the latter a subscriber buys a certain amount of credit with the operator within which he is able to use the operator's services.
Since this research only focuses on real-time communication services alone, TMNL's voicemail services will not be taken into account.

3.2.2 Technological Architecture

TMNL's mobile service provision is supported by a network infrastructure covering practically the whole of the Netherlands. The network architecture of TMNL is depicted in the diagram below.

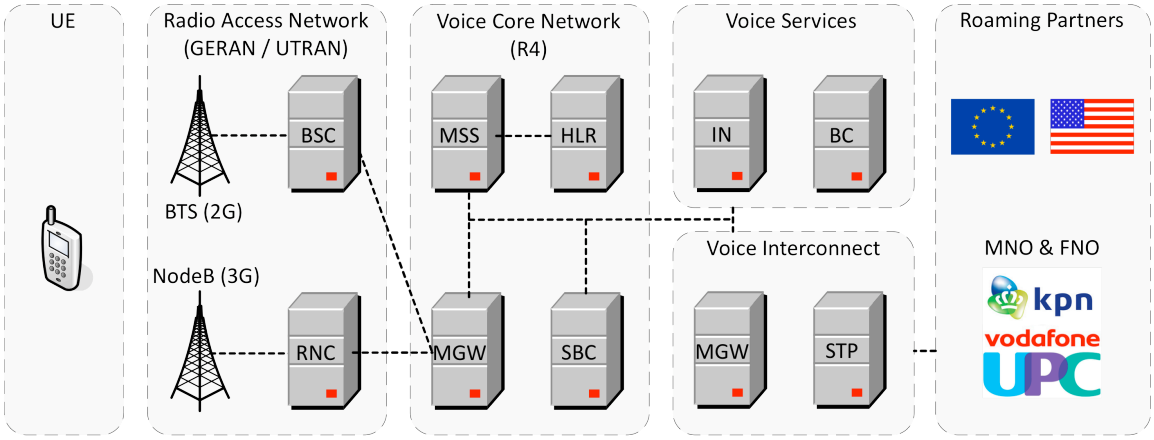


Figure 16: Technological architecture of TMNL's current voice service provision

On the left side of the diagram the mobile user equipment is depicted which is connected to the network either through a Base Transceiver Station (BTS) in case of a GSM connection or through a NodeB in case of a UMTS connection. These antennas form the different network cells and multiple antennas are connected to a Base Station Controller (BSC) or a Radio Network Controller (RNC) respectively. These controllers handle the allocation of radio channels and the seamless handover of calls between different network cells connected to it. Furthermore they bundle the network traffic towards the core of the network. The controllers are connected to Media Gateways (MGW). The latter ensure the compatibility of different radio access network technologies with the core network. Because the core network is IP-based, while GSM and UMTS are circuit-switched, it has to convert the signals to or from a certain encoding. The media gateways are connected to Mobile Switching Center Servers (MSS). These servers are the replacements of the former Mobile Switching Centers (MSC) within the new IP-based network core and are responsible for mobility and voice-call management. This entails that they support the handover between different controllers during a call and take care of the set-up and termination of a connection. TMNL has four MSSs in the Netherlands, each one of them dealing with the mobile traffic in another part of the country. Each MSS contains a Visitor Location Register (VLR), which keeps track of the exact location of each mobile user within the sector of that MSS. This information is necessary to be able to route all incoming communication traffic to the right BSC or RNC and from then on towards the correct mobile handset. In order to determine what services a subscriber may access, the MSSs are connected to a Home Location Register (HLR). These registers use the International Mobile Subscriber Identity (IMSI) on a subscriber's SIM card to access his record containing his accessible services, current location and call forwarding settings. In order to take price-plan differentiations into account, the MSS is connected to the IN platform (Intelligent Network). The IN handles the real-time billing for prepaid customers and keeps track of the remaining credits of a pre-paid subscriber.
Interconnection between TMNL and other operators is being signaled through a dedicated Media Gateway in combination with the Signaling Transfer Point (STP). Together they form a single point of interconnection access towards other operators and international roaming partners. Furthermore the core network enables interconnectivity to other IP transport networks through the Session Border Controller (SBC) platform, for example IP trunking to an office PBAX (an IP-based office switchboard).

This section was based on multiple conversations with technological experts within TMNL.

3.2.3 The Mobile Value Network

The organizational aspect of the service describes the way the value network is structured and the different actors interact. As discussed in the previous chapter, value networks are constructed of actors (commercial entities in the marketplace, fulfilling one or more roles in the value network), roles (specific value adding activities in the value network) and relationships (expressions of interactions between roles or actors in the value network).
TMNL's current voice service provision still has many properties of a value chain, where the value creating process basically consists of network operators and equipment manufacturers (Reuver & Bouwman, 2008). However to be able to compare the current voice service provision to possible future configurations for communication service provision, this research project has chosen to approach the current service provision as a value network as well.
In constructing the value network of TMNL's current mobile voice service provision, this research project will take generic roles in mobile voice service provision as a point of departure. In order to reduce the complexity of the value network, these roles will be demarcated and aggregated to a limited set of roles that can be used to provide a high level representation of the current mobile voice service domain. The roles that are taken into account are focused on the actual communication service provision. More infrastructure-related roles such as the network infrastructure manufacturer and the long distance carrier are not taken into account.
By plotting these roles within the current mobile communication domain, an overview will be gained of the actors that fulfill these roles and the way these actors relate.

Generic Roles in Telecom Service Provision

This section will list the generic roles in mobile voice communication service provision. Each role encompasses a set of functions in a value network; the provision of these functions may be dependent on the disposition over certain resources (Apfelbeck, 1998). The descriptions of these roles are based on comparing and combining different categorizations of roles in telecommunication service provision and mobile commerce found in a survey of scientific literature. An oversight of the different role definitions and the way they are combined is given in appendix A1. Because the scope of this research project is limited to a high-level representation of the value network, some roles have been omitted. Therefore the list below does not provide a complete list of all roles in telecom service provision. It is sufficient however within the scope of the project. Where necessary, some roles are described in more detail then others. The following roles have been discerned (Apfelbeck, 1998; Li & Whally, 2002; Kuo & Yu, 2006; Reuver & Bouwman, 2008; Ballon & Walraven, 2008):

- **Customer**
  The customer is the end user of the communication service.

- **Service Provider**
  The service provider offers communication services to the customer.

- **Network Operator**
  An actor that has the role of network operator provides the connectivity to the user's handset end thereby to the customer. The operator owns a communication network infrastructure, holds the licenses to deploy and exploit it and is responsible for the network performance.

- **Platform Operator**
  A platform operator coordinates or facilitates the interaction between service providers and end-users.

- **Data Collector**
  The role of data collector combines different data related roles. First of all it contains the management of the identification and authentication process, which enables the provision of a personalized service portfolio to a specific customer by giving him access to the services linked to his profile. Furthermore it enables the data collector to keep track of a customer's service usage. This information can be used as input for billing where it is compared to a customer's subscription to determine his (monthly) fee. Second of all, this role is endowed to an actor that has a database with customer demographics contains the information about each individual customer

- **Transaction Manager**
  The actor with the role of transaction manager takes care of the subscriber charging, billing and accounting for the service provision. This may be done either through pre- or postpaid billing arrangements. He may function as a mediator between the customer and other actors that indirectly contribute to the service provision by functioning as the starting point of the revenue stream in the value network. Furthermore, the transaction manager also arranges for the actual collection of payments from customers.

- **Handset Manufacturer**
  A handset manufacturer designs and produces mobile phones or other devices that support mobile communication network technologies as well as mobile communication services.

Value Network

The diagram depicted below shows a high-level representation of TMNL's current mobile voice service provision. Three actors fulfill the roles identified in the previous section: the mobile telecom operator, the device manufacturer and the mobile subscriber.

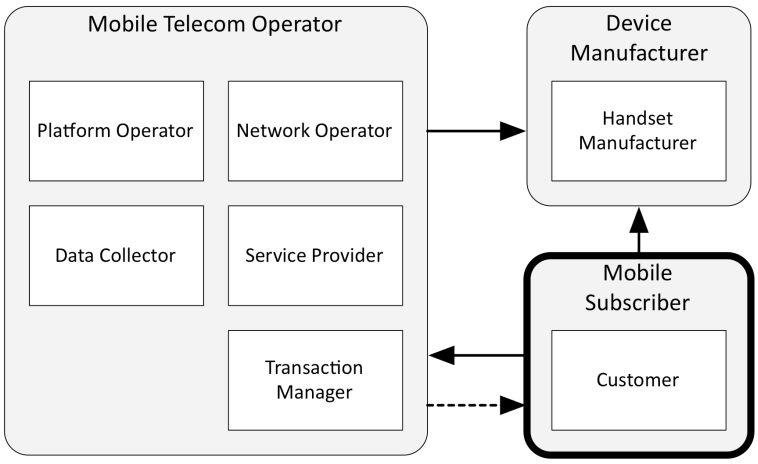


Figure 17: Value network of TMNL's current voice service provision

The Mobile Telecom Operator

The vast majority of the service provision is performed by the mobile telecom operator. As the network operator it provides mobile connectivity to the subscriber's handset and supports handset mobility within his access network. It is responsible for the performance of the network and does most of the maintenance. By ensuring its network is interoperable with other network operators it also provides interconnectivity with subscribers from other operators. Through operating the network the mobile telecom operator also functions as a platform operator, coordinating and facilitating the

interaction between customers and communication service providers. This may seem obvious in the model depicted in figure 17, but that is modeled after TMNL's current situation where it fulfills both the role of a network operator and a communication service provider. These two can be decoupled as well however as is the case in an MVNO configuration. It is for this reason that the role is explicitly attributed to the mobile telecom operator.
As mentioned above, the mobile telecom operator provides voice communication service to its customers over its network and functions as a point of contact for the customer in case problems occur regarding this service provision. Furthermore, it has a wide variety of databases to support its service provision. The HLR, described in the technical architecture, manages the identification and authentication of the subscribers and provides the operator with information about his context. Within a mobile telecom network this is done via a subscriber's SIM card, which has a specific International Mobile Subscriber Identity (IMSI) to identify him in the operator's HLR. The operator also keeps a record of a customer's service usage and has a database with subscriber demographics that contains information about each individual customer such as his age, gender and marital status. This information is usually required when acquiring a postpaid mobile voice subscription. Finally, an actor with this role may also have the ability to keeping track of the context of a customer's service usage enabling the provision of context-aware services. Finally, TMNL takes care of the customer billing and the collection of the invoices (Corver, 2009).

The Device Manufacturer
The device manufacturer designs and produces mobile phones or other devices that support the operator's network technologies and communication services.

The Mobile Subscriber
The mobile subscriber owns a handset provided by the handset manufacturer and a mobile subscription provided by the mobile network operator.

Relationships

The relations in the diagram are represented either by a straight arrow or by a dotted one. A straight arrow represents a relationship of a financial nature and a dotted arrow the course of the voice service provision. All actors in the value network are related to each other. The mobile telecom operator purchases handset from the device manufacturers on a wholesale level and offers these handsets to the mobile subscriber in combination with a mobile subscription. Due to the scale of these transactions, this relation provides the operator with a fair amount of buyer power that enables him to make demands about certain handset properties such as its preinstalled software applications. Furthermore the operator provides voice services to the mobile subscriber, for which the latter pays the operator either on a postpaid or a prepaid basis. Apart from the mobile telecom operator, the mobile subscriber may also have a direct relationship with the device manufacturer since he can acquire a handset directly from the manufacturer through its own sales channels as well.

3.2.4 Financial aspects

This section will provide some insight into the costs and revenue sources of TMNL's mobile communication service provision. It will focus on TMNL's service revenues, determining its EBITDA, and its operational expenditures (OPEX). Capital expenditures (CAPEX) such as network upgrades will not be taken into account in this section because of TMNL's subsidiary status. The latter expenditures are highly dependent on the budget of T-Mobile International, which will not be elaborated on due to confidentiality considerations. The two pie charts in figure 18 are based on internal figures provided by TMNL in the first half of 2009. The top figure roughly depicts the distribution of revenues between customer segments, the bottom one the distribution between different types of services:

- Service Revenue Mobile Operated Voice (SR MO Voice): revenues generated by voice service usage of TMNL's own subscribers
- Service Revenue Mobile Terminated Voice (SR MT Voice): interconnection fees paid by other operators whose subscribers have called TMNL subscribers
- SMS traffic
- Data usage, both Internet access to mobile phones (confined connectivity) and to laptop computers over a USB modem (full connectivity)
- Roaming by visiting subscribers from operators from abroad who make use of TMNL's network resources

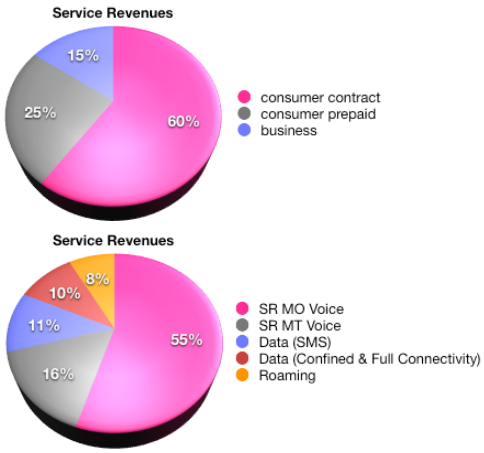


Figure 18: Distribution of TMNL's service revenues between different segment and services

When looking at TMNL's revenues, it is apparent that the vast majority comes from consumer voice services; the revenues generated by voice communication by and with their own subscribers. Mobile data service provision still contributes to a relatively small percentage of the total revenues but it is increasing steadily at the expense of voice service revenues; the Dutch mobile market has seen an increase in non-voice service revenues (SMS & Data) from 22.3 to 25.6 percent between Q1 2008 and Q1 2009 (Telecompaper, 2009a). This development was also visible in figure 1. Besides the service revenues, TMNL also generates revenues through wholesale deals (e.g. with MVNOs) where it enables other parties to make use of some of its network infrastructure as well as through interconnection fees it receives for terminating call from subscribers of other Dutch operators.

TMNL's operational expenditures (OPEX) can be categorized into three different components: sales costs, cluster costs and interconnection fees.

- Sales costs consist of Subscriber Acquisition Costs (SAC) and Subscriber Retention Costs (SRC) (discounts on handsets available in TMNL's own sales channels and on TMNL's subscriptions), costs of marketing campaigns and dealer commissions.
- Cluster costs contain items such as the costs of employees, network maintenance and lease of network sites, customer service channels and sales channels.
- Interconnection fees are the costs incurred by voice calls that were terminated by other Dutch operators.

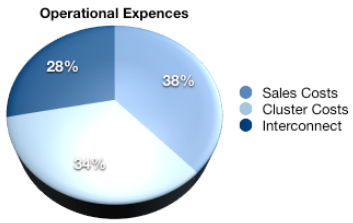


Figure 19: Distribution of TMNL's OPEX

From all three debit entries, the sales costs can be influenced on the short term. Cluster costs and interconnection fees are deeply embedded into the company and the market it operates in and will therefore be more difficult to influence.

3.3 Technological Developments

This section will discuss the technological developments that influence the value network.

3.3.1 Next Generation Networking

In order to address the increasing demands for new mobile multimedia services as well as enhanced mobility and thereby facilitate the convergence of networks and the convergence of services the International Telecommunication Union – Telecommunication Standardization Sector (ITU-T), the standardization body of a specialized agency of the United Nations in the field of telecommunications (ITU), started in 2003 with the development of a number of recommendations, standards and implementation guidelines for the realization of Next Generation Networks (ITU-T, 2004; ITU website, 2008). They have defined a Next Generation Network as *'a packet-based network able to provide telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. It enables unfettered access for users to networks and to competing service providers and/or services of their choice. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users'* (ITU-T, 2004). This definition contains a number of important issues related to Next Generation Networks. The network will be fully IP-based but different than the current Internet access, which restricts service delivery to best effort, NGNs will be able to guarantee Quality of Service. By implementing network control functions the network operators will have the possibility to manage the QoS of communication and multi-media service provision, which improves user experience. Secondly it indicates a decoupling between service provision and transport. This entails a shift from vertically integrated service-specific networks towards a unified network architecture capable of carrying any type of service. Thirdly it states that users should be free to select a provider for any given service, which also implies that service providers should have access to the subscribers of any given access network. Finally a NGN must support generalized mobility. This means that an end-user must have the ability to communicate and/or access servicers independent of his location or technological environment. In other words it must support fixed-mobile convergence. (ITU-T, 2004; Knightson et al., 2005; Lee & Knight, 2005). A list of characteristics, issued by ITU-T, that further specifies a NGN can be found in appendix B.

Next Generation Mobile Network Alliance

Since the work by the ITU-T only provided a set of recommendations and guidelines in order to assist the realization of NGN, it was up to the mobile industry to decide at their own discretion whether and how to actually implement it. In 2006, a number of leading mobile operators founded the Next Generation Mobile Network (NGMN) Alliance. The purpose of this initiative was to come to a coherent vision for the technological evolution beyond 3G of mobile networks that complemented the work of ITU-T (MGMN Alliance, 2009 p.18). Over 50 key players in the telecommunication industry currently support this initiative.

The NGMN Alliance has formulated a list of operationalized criteria for an NGN radio access network (NGMN website, 2008)

- Peak data rates in the downlink beyond 100 Mbps (> 40 Mbps cell average);
- Peak data rates in the uplink beyond 50 Mbps;
- Spectrum efficiency and cell throughput (capacity) 3 – 5 times better than 3G/HSPA and CDMA-2000/EVDO;
- Low latencies (round-trip times) of 20 – 30 ms end-to-end;
- Flat All-IP network architecture, with open interfaces, legacy interworking, optimized routing and always-on support;
- Seamless mobility in indoor, pico/micro-cellular, metropolitan and wide-area deployment scenarios;

- Easy and cost-efficient network deployment leveraging advanced self-organization, self-configuration and self-optimization techniques;
- Flexible allocation of radio channel bandwidths in the range between 1.25 MHz and 20 MHz, utilizing FDD and/or TDD duplex modes;
- Operation in a wide range of frequency bands between 400 MHz and 5 GHz taking into account the ITU spectrum identified for IMT-2000 and IMT-Advanced systems;
- High-performance, attractive and affordable end-user devices.

The NGMN Alliance announced in June 2008 that 3GPP LTE/SAE was the first network technology that met the criteria stated above. Since then the majority of its members, have publicly endorsed this network technology as the next generation of their communication networks. These members include its founding members T-Mobile, NTT DoCoMo, China Mobile, Vodafone, Orange and KPN (NGMN website, 2009).

3.3.2 Long Term Evolution

A new generation in mobile communication technology has recently reached its final stage of development: the Long Term Evolution (LTE) networking technology. To ensure the competitiveness of 3GPP radio access technologies beyond 3G, the 3GPP initiated the development of LTE in 2004 (Fuhrt & Ahson, 2009). The technology was specified as part of the 3GPP Release 8 that was frozen in December 2008 (3GPP website, 2009). As an evolution of UMTS, LTE is labeled as the 3.9G communication technology. Compared to its predecessors, LTE can offer much higher throughput with far lower latency. The targets for downlink and uplink peak data rate requirements were set on 100Mbps and 50Mbps respectively but recent tests have already shown downlink rates of up to 170Mbps (NGMN website, 2008). Network latency is expected to be less than 10ms under normal everyday network conditions (Dahlmann et al., 2007). What really sets it apart from these other network technologies however, is the fact that LTE is fully IP-based and provides always-on mobile broadband connectivity. This significantly reduces both operational expenditures (OPEX) and capital expenditure (CAPEX) for the mobile operator (Beming et al., 2007). It will enable operators to provide advanced mobile communication services and a real mobile broadband Internet experience to their subscribers on LTE handsets and LTE-enabled USB-dongles.

LTE will be accompanied by the System Architecture Evolution (SAE) network core architecture, embodying utilities such as charging, user identification and authentication, service setup and interconnection to external networks. Furthermore it will offer seamless mobility over different network technologies. These network technologies do not only comprise earlier 3GPP standards such as GSM or UMTS but also the 3GPP2 standards (the CDMA family) and even fixed-access networks (Dahlmann et al., 2007; Ericsson, 2007) Due to its broad base of support and backwards compatibility, LTE will be deployed on a worldwide scale. Some of the world's leading mobile operators such as T-Mobile, China mobile, NTT Docomo, Verizon Wireless and Vodafone have publicly endorsed the network technology and are currently running the first trials. Some of these operators have even recently confirmed that they are planning to offer their first commercial LTE-based services by late 2010 (Deutsche Telecom website, 2009; Verizon Wireless website, 2009; NTT Docomo website, 2008; Vodafone website, 2009).

With regard to the Dutch market, all three major Dutch telecom operators have publicly committed themselves to this technology (Engadget, 2008) and first LTE rollouts were expected in the beginning of 2012. However they may be delayed due to the current situation on the financial market.

3.3.3 The IP-paradigm

End-to-End Service Provisioning

With the implementation of LTE, TMNL will migrate towards an all-IP network infrastructure where both its radio access network and its core network are fully IP-based. The IP-paradigm approaches the

transmission of data in a number of layers that operate independently of each other (Stallings, 2000). As depicted in the adjacent figure, this separation of network functions entails a separation between applications and the underlying network infrastructure. This gave rise to the concept of end-to-end service provision, placing all network intelligence and functionalities at the applications standing at the endpoints of the communication system (Salzer et al., 1984). This enables direct contact amongst users and between users and service providers over the Internet, while minimizing the intervention and impact of 'intermediaries' such as the mobile network operator (Braet & Ballon, 2007). This contrasts sharply with the traditional telecommunication service provisioning where all functionalities are integrated into the network architecture and the mobile access provider is the mobile service provider by default. So in terms of the mobile industry, a migration towards an all-IP network infrastructure will separate the function of access provider from the function of service provider. This will increase the ability of over-the-top service providers to bypass the mobile operators and make use of the operators' network resources to provide their own mobile Internet services directly to the mobile subscribers. The subscriber pays for his network usage; therefore using the network infrastructure doesn't entail any costs for these service providers.

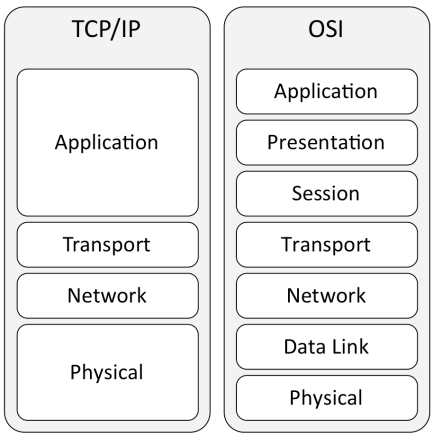


Figure 20: Separation of network functions

The main advantage of the end-to-end paradigm is that in increases the efficiency of service development. The IP protocol provides a network-agnostic transport mechanism, which implies that any type of service can be deployed over any IP-based access network, both fixed and mobile (Dahlman et al., 2008). This enables service providers to design services independent of the medium it will be delivered over, increases the amount of users the services can reach and reduces the time-to-market of these services. It poses a number of drawbacks as well however. Originally the IP-protocol restricts service delivery to best effort and does not use any of the properties of the underlying network infrastructures. There are some workarounds that are able to guarantee some QoS, but these are lightweight solutions that are not always successful (Braet & Ballon, 2007). Especially in a mobile network infrastructure were handover between network cells and network congestion are very common, this may pose a serious threat to the perceived quality of the service provision.

IPv6

For more than a decade researchers have been working on a new protocol in an effort to improve the scalability of the Internet called IPv6. This greatly enhanced the number of available IP-addresses. Furthermore each mobile node will always be identified by the same IP-address that will remain unchanged regardless of its current point of attachment to the Internet (Perkins & Johnson, 1996; Chao et al., 2004). The introduction of IPv6 will enable mobile devices to roam seamlessly between different IP-based network technologies while maintaining the same IP address, making them access network independent (Choi et al, 2006). IPv6 has encountered implementation problems however due to legacy applications supporting IPv4, its currently dominant predecessor. The volume of these legacy applications as well as their life span and the magnitude of realizing IPv4/IPv6 compatibility for all these applications is such a costly and time consuming endeavor that the implementation process of IPv6 is a gradual process taking many years (Chao et al., 2004). However, the worldwide transition from IPv4 to IPv6 has begun and as things stand, the IPv6 Forum, a worldwide consortium of Internet vendors, projects its worldwide Internet penetration to reach 25% by 2010, 35% by 2015 and 50% by 2020 (IPv6 Forum website, 2009). The introduction of IPv6 will enhance the carrier-independency of smartphones. Because a handset will keep the same IP-address while roaming different network technologies, communication sessions can be handed over seamlessly between them.

3.3.4 Fixed-Mobile Convergent Service Provisioning

IP Multimedia Subsystem (IMS)

In order to add network control functions to an IP-based network architecture such as LTE, its network core can be complemented with an IP Multimedia Subsystem (IMS). This platform gives the network operators the possibility to manage the QoS of communication and multi-media service provision and is considered to be the 3GPP standard for multimedia service deployment over IP technology (Trouwborst, 2009). It enables the convergence of voice, video and data over an IP-based network and addresses many of the NGN characteristics listed in Appendix B.
IMS uses the Session Initiation Protocol (SIP) as its core protocol; a generic session protocol for different kinds of media streams with IP-based voice telephony as one of its main applications. Many Internet applications, such as HTTP and FTP, use a protocol model in which every transaction requires a separate TCP connection. When clients issue multiple requests to the same server, this model is quite inefficient. Session control protocols, such as SIP, solve this problem and allow a client and a server to have multiple connections over a single TCP connection. A number of critical elements were missing in the SIP specifications however, such as sufficient scalability, sufficient security and the ability to give right of passage to specific data packets in congested network cells (Sauter, 2009). The 3GPP has specified the IMS protocol in order to address these missing elements and make it applicable to mobile telecom network.

In contrast to Internet model, where the network is transparent and all services are provided by the end points, IMS places the network operator in the centre; third parties will have the ability to use IMS as a platform to build services on, while the operator keeps the central role in the business value chain (Knightson et al., 2005; Cuevas et al., 2006). Amongst other things, IMS will be likely to offer the following functionalities in the short to mid term (Castelli & Leung, 2008; Sauter, 2009):

- Communication session control
- Data package differentiation (enabling QoS guarantees for voice services)
- In call handover between different network technologies
- Session handover from one device to another
- Centralized billing for multiple access networks
- Presence and instant messaging
- Voice and video conferencing with three or more partners

IMS & Fixed Mobile Convergence (FMC)

Because its functionalities enable service interoperability across different network technologies, IMS is considered to be the key platform required for the migration towards the convergence of fixed and mobile service provision. This will provide network operators with the ability to offer fixed-mobile convergent services; services that are usable from different devices over multiple access technologies with a single network core providing the control functionalities for both access networks. Not only does it enable the handover of IP-based services between different network technologies in the network infrastructure of a single operator, but because of its centralized billing and security abilities, it also enables service interoperability between the networks of different operators (Rokkas et al., 2009).
Through enabling true FMC, the implementation of IMS fulfills one of the characteristics for Next Generation Networks: generalized mobility.

3.4 Market Developments

This section will discuss the market developments that influence the value network.

3.4.1 Emergence of the Smartphone and the Mobile Operating System

The term smartphone was introduced when a new class of cell phones entered the mobile market that could facilitate data access and processing with significant computing power. They could be viewed as a merger between PDA's and mobile phones. These smartphones have evolved to powerful mobile computing devices often supporting a wide range of access technologies such as GSM, UMTS, GPRS, HSPA, WiFi & Bluetooth. With the emergence of smartphones the first real mobile software platforms appeared in the form of mobile operating systems. They functioned as middleware between the hardware of the handset and the applications, determining the level of access to the device properties and network resources as well as the look and feel of user interface (Sauter, 2009). These operating systems provide a platform for software developers to design applications for mobile handsets. The world's most prevalent mobile operating system is Symbian, but other platforms are rapidly gaining market share. A good example of such a platform is Google's Android, a free, open source and fully customizable mobile operating system containing a large set of application programming interfaces (APIs). These interfaces allow the development of applications by third-party developers that make full use of the possibilities and resources of Android and the handset it is installed on (Android website, 2009). Similarly, Apple has launched a content portal called the iPhone App store with an accompanying iPhone DevCenter. The latter is a platform that supports the development of applications for the iPhone by offering tutorials, sample codes, coding how-to's etc. (Apple DevCenter website, 2009). Within a year after it was launched in June 2008, the portal offers over 65.000 applications, has over 100.000 associated developers and over 1.5 billion applications have been downloaded by iPhone users (Telecompaper, 2009c). Nokia has also launched a platform for its mobile Internet services called Ovi (meaning door in Finnish) and has recently issues the Ovi API and Ovi SDK (Nokia website, 2009). These systems are catering for fast and flexible development of mobile services; developers are able to create an application within a matter of days and offer it through the channels affiliated to these platforms such as the Ovi Store, the Android Market or Apple's App Store.

This has contributed to the availability of a wide range of mobile services available on the smartphone today. The increase in processing power and this spur in mobile software development has put the voice communication service in a spot where it becomes one of the many functionalities of the mobile handset. Furthermore, it enables software developers to design applications that make full use of the capacities of a handset and the network resources it has access to.

3.4.2 Emergence of Mobile Internet Telephony

Amongst these newly developed mobile services, Internet telephony client software is also gradually finding its way toward the mobile handset. These software clients enable subscribers to use Voice over Internet Protocol (VoIP), which can be defined as the transmission of digitized voice in packages over an IP-based connection (Goode, 2002). In order to avoid ambiguity, two different types of VoIP service provision are discerned: telephony over the Internet and Internet telephony. The former indicates a telephony service offered by network operators that use the TCP/IP protocol to transport and route calls. A good example is a cable company that offers telephony services over a broadband connection. Internet telephony on the other hand indicates Internet-based communication services such as Skype, Google Chat and Truphone which enable contacts to communicate when they are both online and running the software client. This research project will focus on the latter. As mentioned before these

Internet telephony services are gradually getting a stronger foothold in the mobile domain. A good example is the recent announcement by Skype and Nokia that a Skype client will be pre-installed in all new Nokia N-series handsets (Skype website, 2009).
Most of the Internet telephony service providers wield an indirect revenue model, allowing them to offer their service for free. Contrary to the direct revenue model, where the service is paid for by its subscribers, in the indirect revenue model the service is paid for by advertisement-generated income and/or payments for referrals (Weill & Vitale, 2001; Bouwman et al., 2008; Ballon, 2009). This entails that these service providers must maximize their user base in order to increase revenues.

As a communication service, Internet telephony is highly dependent on direct network effects and becomes increasingly attractive as more people are using it and/or can be interconnected with it. A good illustration is the way Skype has attained both. On the one hand the software can be downloaded for free and is spreading virally, leading to 405mnl users in Q4 2008 (eBay, 2009). On the other hand it facilitates free Skype-to-Skype calls and two premium services that offer the possibility to interconnect with PSTN subscribers: Skype-in and Skype-out. The former allows a Skype user to buy a personal number that subscribers of PSTN networks can call, the latter enables a Skype user to call persons on fixed or mobile phones with their Skype client. For this last service, Skype strikes wholesale deals with local PSTN operators. There the transmission is made from a package-switched signal to a circuit-switched signal and the interconnection with fixed and mobile phones is realized. For this to work Skype only needs an affiliation with a single operator per country, the rest of the network traffic is dealt with a normal interconnection between the local operators (Baalen & van den Berg, 2009).
This entails that these Internet telephony services are able to provide international calls at lower rates than PSTN operators because it is routed to its destination via the Internet and then terminated locally. Furthermore, this means that when two mobile subscribers have an Internet telephony client running on their mobile handset and are connected to the Internet, they will be able to communicate without having to pay for that service. Their only costs will be their Internet access subscription, which is increasingly being offered under flat rate price plans. The first condition, the presence of an Internet telephony client, already is becoming visible since Nokia, the world leader in smartphones sales, will fully integrate an always-on Skype client into the address book of all its upcoming N-series handsets as mentioned above. The latter might also not take too long. The recently launched Google G1 phone already has an always-on Internet connection (TMNL website, 2009) as does the new iPhone OS 3.0 that enables push notifications (Apple website, 2009).

Lagging Quality of Service in Mobile Service Delivery

At the moment however, Internet telephony services are not able to deliver voice services with a quality comparable to that of the voice services of the operators. This is due to the relatively large amount of latency in the GPRS, UMTS and HSPA network technologies. Latency (also known as round-trip time or RTT) can be described as the amount of time it takes for a data package to travel through the network from source to destination, in the case of voice service provision from mouth-to-ear (SANS Institute, 2004). As depicted in figure 21, the recommenced maximum amount of latency by ITU-T for voice communications is about 150 milliseconds; above that amount the perceived quality quickly diminishes to a level where it becomes dissatisfactory in comparison to the traditional mobile voice services.

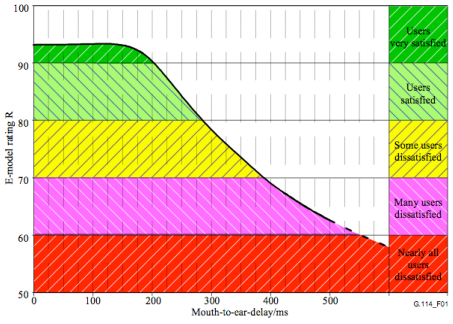


Figure 21: Determination of the effects of absolute delay (ITU-T, 2003)

Figure 22 shows the minimum RTT of the current network technologies. At first sight the most recent network technologies seem to be able to offer IP-based voice services at satisfactory quality. However, the actual latency in the network is highly dependent of the network configuration and conditions.

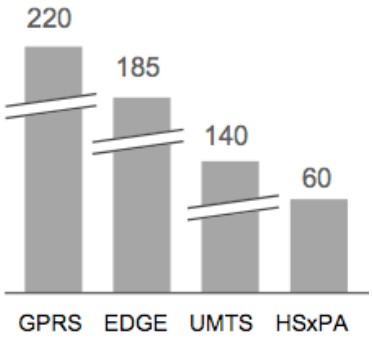


Figure 22: RTT of network technologies (NGMN Alliance, 2008)

Network operators have tailored their network configurations in a cell-by-cell manner according to the particular site's local demographics, the estimated network traffic and target coverage area of the cell (Tan, 2008). Therefore the cell capacity can vary quite a lot between different operators in a particular area but also between the different sites of a single operator. Furthermore, empirical research has shown that even under lightly loaded network conditions, substantial additional latencies for data services (more than 100ms at a minimum) are imposed on a 3G network due to the processing and queuing of the data. Under fully loaded network conditions, the average latency for 3G data services even increased to beyond 1 second. Similar as the minimum latency, the network latency due to processing and queuing is roughly 50% lower in a HSDPA network than in a UMTS network (Tan, 2008). Due to fluctuations of the actual latency in the current mobile network technologies, the quality of service (QoS) of Internet telephony services on mobile handsets is much lower than the 'traditional' mobile voice services offered by the mobile telecom operators. The introduction of the Long Term Evolution technology is about to change this however. It will take away one of the last remaining barriers for Internet-based communication service providers to become fully-fledged competitors to the mobile telecom operators. Mobile subscribers will have an always-on connection to the Internet which will enable them to always be reached over these Internet telephony services on a network that enables these service to be provided with a QoS comparable to GSM or UMTS voice services.

Internet Telephony Aggregators

Next to Internet telephony service providers, another type of service provider has entered the mobile domain: the Internet telephony aggregator. Typically, third-party service providers do not interconnect their services, that is, a subscriber from one service provider cannot call to subscribers from another. Therefore, there is an opportunity for a service aggregator to offer a portal: a single application that enables users to communicate over different Internet telephony services. The user still has to have a separate account for each of these services but the application provides a unified buddy list, functioning as a single starting point for these Internet-based communication services. A good example it the Dutch company Nimbuzz. They offer a free application that lets users connect and interact with their buddies across popular communities, including Skype, Windows Live Messenger, Yahoo! Messenger, ICQ, Google Talk (Orkut), AIM, and social networks including Facebook and MySpace (Nimbuzz website, 2009).

An important note to make here is that these aggregating clients do not provide interconnection between the different Internet-based communication services. A number of the most popular Internet telephony service providers can be characterized as walled gardens with strong customer lock-in and are based on proprietary software instead of open standards (Braet & Ballon, 2007). These services do not provide interoperability because most of their revenue models are not subscription- but advertisement-based. This entails that they benefit from attaining a user base that is as large as possible. Providing interconnectivity with other Internet telephony services would reduce user lock-in and lower the incentives to join a certain service because there are other means to communicate with its user base.

3.4.3 Financial Crisis

During the course of this research project the effects of the financial crisis on the Dutch telecom sector slowly started to manifest themselves. The expectation among many industry analysts is that the full impact of the crisis on mobile telephony has not yet materialized and for this reason these development cannot be taken fully into account. However based on a report on the impact of the financial crisis on the ICT industry issued by the ITU (2009) in cooperation with authors from leading research institutions in the ICT sector a number of assumptions will be made about how the crisis will effect the mobile industry. These assumptions are complemented with recent researches and news reports. Due to the current financial crisis patterns of spending are changing and consumption is decreasing (CBS, 2009). Mobile subscribers will try to restrain their spending, resulting in reduced service usage. A recent nationwide survey by T for Telecom showed that almost 20% of Dutch people over eighteen calls less than before the crisis. This effort to restrain spending may also cause a reduction in subscriber loyalty and increased churn as they will be searching for bargains. Furthermore it is also likely that they will look for ways to enhance their control over their mobile expenditures, resulting migration from postpaid to prepaid subscriptions and a rising market demand for flat-rate propositions (ITU, 2009).

These changes in subscriber behavior are likely to have a negative impact on the operator's EBITDA as was already visible in TMNL's quarterly figures of Q2 2009 where it showed a decrease in EBITDA of almost 10% compared to Q2 2008 (TMO, 2009). Due to this decrease in EBITDA, the operator's free cash flow will decrease as well, which is likely to result in a reduction of CAPEX. This entails that fewer investments will be made into radio access network upgrades and planned rollout scenarios may be delayed. Therefore the planned rollout of LTE by the Dutch mobile operators in 2012 could be delayed till later that year or to 2013. Besides less CAPEX, TMNL is likely to want to reduce OPEX as well. As elaborated on in section 3.2.4 TMNL's operational expenditures consist of sales costs, cluster costs and interconnection fees. Since its subscribers generate the interconnection fees, TMNL has little instruments to lower these costs. That leaves cluster costs and sales costs to bring about OPEX reductions. The former are induced to support service provision and are deeply embedded into the companies organizational structure, therefore it is not desirable to reduce them. This entails that budget cuts are likely to be made in sales costs, resulting in less handset subsidization. Less handset subsidization will make the operator's sales channels less important for the device manufacturer and will thereby weaken the dependency relationship between the two parties. Another consequence of the subscriber's effort to reduce their spending and increase their control over their expenditure is likely to be a growing preference for contracts with lower tariffs and a shorter lifespan above those that offer handset upgrades (ITU, 2009). This may have a negative effect on the increase in smartphone penetration and thus slow down its adoption rate.

3.5 Regulation

This section will discuss regulation that will influence the value network.

3.5.1 Blocking of Internet Telephony Services

In a reaction to a number of question in the European Parliament related to recent reports about the blocking of the Skype application by T-Mobile over its broadband networks in Germany, Vivian Reding, member of the European Commission responsible for Information, Society and Media, stated that the European Commission views Internet telephony as a *'technological innovation with the potential to radically change the existing structure on the telecom markets, to enhance competition and to make telephony more cost-efficient, more flexible and more consumer friendly*'. She also stated that '*On 11 February 2005, the Commission and the national telecom regulators of the Member States expressed their support for a pro-competitive approach to Internet telephony in the EU. As a matter of principle, discrimination of Voice-over-IP services by operators with significant market power must not be tolerated by national regulatory authorities and should be addressed with the tools available already today under the regulatory framework for electronic communications networks and services*' (Reding, 2009).

These tools constitute of Articles 81 and 82 of the EC Treaty, dealing with the Community antitrust rules and the Roaming Regulation that entered into force on 1 July 2009. The two Articles of the EC treaty set out the European Community's competition rules by which anti-competitive behavior may be addressed by the Commission itself but also by the national competition authorities (Kroes, 2009):

- **Article 81** prohibits all agreements and concerted practices among undertakings that restrict competition and may affect trade between the member states.
- **Article 82** prohibits all abusive unilateral conduct of undertakings in a dominant position that may affect trade between the Member States. Including a ban of market foreclosure, leveraging and other exclusionary conduct that harms competition.

Furthermore, the Roaming Regulation stresses that (Reding, 2009):

- There should be no obstacles to the emergence of applications or technologies, which can be a substitute for, or alternative to, roaming services such as WiFi, VoIP and Instant Messaging.

Due to these European laws, it is not possible for a mobile operator to restrain their subscribers from using Internet telephony services by blocking the usage of these services on its network.

3.5.2 Network Neutrality

Besides the blocking of applications another important regulatory issue is the operator's ability to differentiate between data traffic on its network. This is referred to as the net neutrality issue. As stated by Google (2009), one of its prominent advocates; *"Network neutrality is the principle that Internet users should be in control of what content they view and what applications they use on the Internet"* and *"broadband carriers should not be permitted to use their market power to discriminate against competing applications or content".* Or as Vivian Reding said in her speech about Net Neutrality and Open Networks on a conference on Network Neutrality in 2008: '*Net Neutrality is seen as the Guardian Knight that will allow the proverbial "2 guys in a garage" to be able to amaze the world with the next big thing'* (Reding, 2008).

The discussion about net neutrality pitches up network providers and Internet-based service providers against each other. The former oppose it and see it as a big threat to their ability to capitalize on their network investments because it would basically entail that operators would have to share their own network capacity on an equal basis with over-the-top service providers when the operators migrate their own service provision towards the IP-paradigm. The Internet-based service providers on the other hand view it as a precondition to keep the Internet open and enhance the innovativeness of the Internet services.

The European Commission allows form traffic prioritization within its view of an open and competitive digital market. This entails that operators will have the ability to manage their networks efficiently and guarantee reliable QoS-enabled connections. However, when this prioritization leads to anti-competitive behavior, both the European Commission and the National Regulatory Authorities will have the ability to interfere (Reding, 2008). Under Article 22(3) of the Universal Service Directive, national regulators will have the ability to intervene by setting minimum QoS requirements for network transmission services when competitive forces are insufficient to safeguard the openness of the Internet (Reding, 2009).

Therefore it follows that Net Neutrality itself is not directly an issue and TMNL will have the ability to prioritize its own services over those of third-party Internet-based service providers. It may not however deliberately limit the Quality of Service of these Internet-based services up to level where their service provision deteriorates.

3.5.3 2.6GHz Auction

In the first quarter of 2010, the Dutch ministry of Economic Affairs has planned to auction the 2.6GHz spectrum. In contrast to earlier auctioned spectra, this radio spectrum will be technology neutral. The parties that obtain a license will be free to choose the communication technology they are going to deploy over the frequency making all parties far more flexible and able to cater to consumer needs, which eventually should promote innovation (Min EZ, 2008). Due to its technology neutral nature, the spectrum will be able to support different network technologies such as LTE and WiMAX, a wireless broadband technology that provides high data throughput with low latency (WiMAX Forum, 2006). WiMAX already is a quite mature wireless broadband technology that has already been deployed on a small scale. A good example of this is the WiMAX network of Worldmax that was introduced in Amsterdam in June 2008. The 2.6GHz spectrum will enable WiMAX operators to offer their services on a much larger scale because it increases network capacity and enables mobile access provision in a much larger area (a couple of square kilometers per beacon) (Worldmax website, 2008).
The provisions of the auction have also posed a cap on the amount of network spectrum that TMNL, KPN and Vodafone are allowed to acquire. Due to this cap of 20, 20 and 30MHz respectively, there will be room for three new entrants on the mobile market (Min EZ, 2009a). Furthermore, there are also certain obligations attached to acquiring a slot in the spectrum regarding the introduction of the service. All parties are obliged to offer a public commercial service, which uses the particular spectrum in an area of at least twenty square kilometers within two years and at least two hundred square kilometers within five years (Min EZ, 2009b).
As a result of the auction of the 2.6GHz spectrum band, it is very likely that new players will enter the Dutch mobile access market. It is still somewhat uncertain which players this will be and what network technology they will employ, but the assumption can be made that it will contribute to emergence of WiMAX as an access technology in urban areas. Because their technology already is quite mature, they will also be able to roll out a network on this spectrum in a relatively short amount of time. Due to the rollout obligation attached to the auction, these networks will encompass at least twenty square kilometers by 2012 and two hundred kilometers by 2015. This widespread alternative to LTE may enhance the carrier-independency of mobile handsets in large urban areas because they will be able to support their functionalities over multiple access technologies.

3.6 Impact on the Value Network

In the beginning of this chapter (section 3.2.3) a high-level representation of the value network of TMNL's current mobile voice service provision was constructed. This representation is depicted in the adjacent figure. The following three sections elaborated on developments in the environment of the network that influenced it. A distinction was made between technological advances (section 3.3), market developments (section 3.4) and regulation (section 3.5). In this section the impact of these developments will be translated into terms of the network itself. It will elaborate on the consequences for the roles, the actors and the relations in the network.

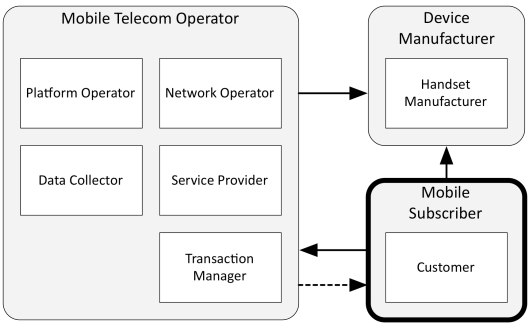


Figure 23: Value network of TMNL's current voice service provision

3.6.1 Roles

The most important driver for the emergence of new roles in the service provision is the emergence of Internet telephony service providers. This development in the mobile industry is brought about by the emergence of smartphones that provide a platform for IP-based services as well as by advances in mobile network technologies, more specifically the implementation of LTE, that enable these services to be provided at a high QoS-level. Due to European regulation, mobile operators will not be allowed to block these services on their network, nor impede their service provision. Since most of the Internet telephony service providers wield an indirect revenue model, they are able to offer a large share of their service provision for free. This ability will be one of their key USPs vis-à-vis the mobile operator's mobile voice service provision. With the emergence of Internet telephony service providers, service aggregators have also entered the mobile domain, offering a single application that enables users to communicate over different Internet telephony services. For these communication applications to find their way to the mobile subscriber, distribution channels, such as the Apple App store, have become relevant in the mobile domain.
Different categorizations of roles in mobile commerce have been compared in order to define the roles. An oversight of the different role definitions is given in appendix A2. Where necessary, some roles are described in more detail then others. The following roles will be added to the value network (Li & Whally, 2002; Kuo & Yu, 2006; Reuver & Bouwman, 2008; Ballon & Walraven, 2008):

- **Application Developer**
  Actors with this role develop Internet-based applications and, when necessary, convert them into an appropriate format for the wireless environment. These applications will provide mobile communication services and will typically be developed by the Internet-based service providers.

- **Advertiser**
  As Internet-based communication services are partially based on an indirect revenue model, the role of advertiser becomes important in the value creating process. An actor with this role provides sponsored content to the application developer or service provider. This content is to be included in their service, for which the advertiser pays a fee.

- **Service Aggregator**
  The service aggregator offers a portfolio of services. He aggregates, integrates, and re-packages or distributes services provided by other Internet-based service providers.

- **Portal Provider**
  An actor with the role of portal provider functions as a gate towards and a first starting point for Internet-based services.

- **Mobile Access Subscriber & Mobiles Service Subscriber**
  With the separation of mobile access provision and mobile service provision due to the emergence of the IP-paradigm in the mobile domain, the role of customer has to be redefined. To make a clear distinction between these different aspects it will be substituted by the roles of mobile access subscriber and mobile service subscriber.

3.6.2 Actors

As new roles emerge in the value network, new actors will emerge as well to fulfill these roles. Some are directly related to the roles described above, others are related to existing roles that can be fulfilled by multiple parties due to the impact of the described developments on the mobile domain.

- **Internet-Based Communication Service Provider**
  Due to the developments in mobile data connectivity and the emergence of the IP-paradigm and the accompanying end-to-end service provisioning in the mobile domain, the provision of mobile connectivity will no longer be a precondition for the provision of mobile communication services. IP-based communication service providers become credible substitutes to the mobile telecom operator and will enter the value network. They will fulfill the role of service provider, but contrary to the mobile telecom operator this is not intrinsic to the role of network operator. Their service provision is carrier-independent which entails that it functions independently of the underlying infrastructure and is available over both cellular and WiFi networks. Due to the IP-paradigm, the role of Internet-based communication service provider now goes hand in hand with that of the application developer described above. This actor will therefore fulfill both of these roles. Furthermore, the mobile subscriber will have a user profile for the applications, allowing the Internet-based communication service provider to gather user data as well.

- **Mobile Network Operator**
  With the emergence of carrier-independent service providers as described above, the function of the mobile operator changes as well. In such an environment the operator will be the provider of mobile broadband connectivity rather than an integrated access and service provider; Internet-based communication service providers will take up this latter role. To make a clear distinction between these the different function of the mobile operator in this situation it will therefore be referred to as mobile network operator. It will still have a relationship with the mobile subscriber but rather a mobile access related one than a service related one. Therefore there will still be a financial relation between these actors and the mobile network operator will still be able to collect customer data.

- **Financial Intermediary**
  Some of the Internet-based communication service providers also have a direct revenue model and charge their users for particular services, good examples being SkypeIn and SkypeOut. Although Skype does take care of the charging for these services, it does not go as far as to collect the actual payments. For this activity it uses financial intermediaries such as credit card companies or e-wallet services such as PayPal as financial intermediaries that subscribers can use to top up their credit.

- **Service Aggregator**
  Along with the IP-based communication service provider another actor may also enter the value network, this actor fulfills the role of service aggregator. He operates an independent service platform that aggregates multiple communication services and functions as a starting point for mobile IP-based communication services.

- **Advertiser**
  Similarly an actor will enter the network that fulfills the role of advertiser, a provider of sponsored content that enables indirect revenue models.

- **Fixed Network Operator**
  With end-to-end service provisioning and IPv6 gradually manifesting themselves in the mobile domain over the following years, mobile communication services will become more and more carrier-independent. Mobile devices will be able to connect to WiFi networks while regaining their communication functionalities. Therefore fixed network operators, providing the Internet connectivity for these WiFi networks will also become a relevant actor.

3.6.3 Relationships

Besides a change in the roles and actors involved in the service provision, the relationships between the actors in TMNL's current value network will also be influenced by the described developments in its environment. As there were three actors in the value network, this section will elaborate on all three relationships between them.

- **Relationship Between the Mobile Telecom Operator and the Device Manufacturer**
  There is a long lasting relationship between mobile telecom operators and device manufacturers in the mobile domain. The operators purchase handset from the device manufacturers on a wholesale level and offer these handsets to their subscribers in combination with mobile subscriptions. The handsets used to have a bit of subordinate role concerning mobile communication service provision, their main role being the support of the mobile services offered by the mobile telecom operators. However with the emergence of smartphones and the mobile operating system as a service platform, the position of the handsets has shifted and taken up a more central role in the value creating process. Voice has become one-of-many functionalities supported by the handset and due to technological advances such as end-to-end service provisioning and IPv6 they are becoming increasingly carrier-independent as well. This entails that the handsets' functionalities are less tightly coupled with the mobile operator's network infrastructure. Furthermore, as new wireless operators may be entering the Dutch market as a result of the spectrum auctions planned in 2010, other sales channels may become of interest to the device manufacturer as well. Especially because operators are looking into lowering handset subsidies in an attempt to reduce OPEX, the operator's channels may become less attractive for mobile subscribers and thus less relevant for the device manufacturers.

- **Relationship Between the Mobile Subscriber and the Mobile Telecom Operator**
  Very much in line with the previous bullet, the relationship between the mobile subscriber and the mobile telecom operator will become less strong as well. With the increasing ability for subscribers to use communication services over different access networks, their dependency on their mobile operator's network infrastructure will diminish. Due to the financial crisis they are also likely to have a growing preference for contracts with lower tariffs and a shorter lifespan. Their effort to restrain spending may cause a reduction in subscriber loyalty and increased churn as they will be searching for bargains.

With the emergence of IP-based mobile communication service providers, the mobile telecom operators will not be the subscriber's sole provider of communication services anymore. This will reduce their relationship with the customer as well.

- **Relationship Between Mobile Subscriber and Handset Manufacturers**
  At the expense of the relationship between the operator and the subscriber, the relationship between the subscriber and the handset manufacturers is becoming much stronger. As stated above, handsets are taking up a more central role in the value creating process. Due to the gradual shift towards the IP-paradigm, more network functions are placed at its end-nodes: the mobile handsets. With the increasing amount of functionalities it supports and its central position in service creation, the impact of the mobile operating system on service usage is increasing. Furthermore, handset manufacturers are creating their own service platforms and use these to build relationships with subscribers on other territories different from the operator's communication services.

3.7 Conclusions

The purpose of this chapter was to describe the way TMNL's current voice communication service provision is configured and to gain insight into the impact of developments in its domain. This was to lead to a set of design variables that will be used as input for the construction of the different value network models. It described the current service provision as well as relevant developments in the environment of the service provision were elaborated on as well as their impact on the value network.

3.7.1 TMNL's Voice Communication Service Provision

The current voice communication service provision by TMLN is mobile only. It owns, operates and maintains a mobile network that allows it to provide its customers the ability to make calls to and receive calls to and from other TMNL subscribers as well as subscribers of other operators, both national and international. The mobile service provision is supported by a network infrastructure covering practically the whole of the Netherlands. This network infrastructure consists of a Radio Access Network, providing connectivity to subscriber handsets and a Core Network, performing functions such as setting-up and tearing down voice connections, subscriber identification, authentication and localization, routing of incoming calls and interconnection to other operators. The technological architecture shows a tight coupling between the operators network infrastructure and its service provision.

To be able to construct a high-level representation of a value network for TMNL's current voice communication service provision, this research project has taken a number of generic roles in mobile voice service provision as a point of departure. When plotting these roles on TMNL's current voice service provision, three different actors fulfill them: the mobile telecom operator, the mobile subscriber and the device manufacturer.

The adjacent diagram provides a high level representation of the value network. In this diagram, the different relationships between the actors are represented either by a straight arrow or by a dotted one. A straight arrow represents a relationship of a financial nature and a dotted arrow the course of the voice service provision. All actors in the value network are related to each other. The mobile operator purchases handsets from the device manufacturers on a wholesale level and offers these handsets to the mobile subscriber in combination with a mobile subscription. Due to the scale of these transactions, this relation provides the operator with a fair amount of buyer power, enabling him to make demands about certain handset properties such as its preinstalled software applications. Furthermore the operator provides voice services to the mobile subscriber, for which the latter pays the operator either on a postpaid or a prepaid basis. Apart from the mobile telecom operator, the mobile subscriber may also have a direct relationship with the device manufacturer since he can acquire a handset directly from the manufacturer as well.

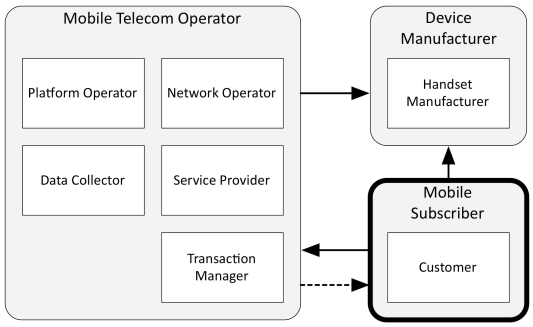


Figure 24: Value network of TMNL's current voice service provision

3.7.2 Roles, Actors and Relationships

This chapter has identified a number of roles and actors that fulfill these roles within the realm of mobile voice service provision. Following the metamodel design approach by Herder & Stikkelman (2004) these will constitute the design variables for the different value network models that will be designed in chapter five. The following two tables give a short recap of these roles and accompanying actors. The order of the roles and actors has been changed in order to group several service-related roles and voice service-oriented actors.

Roles	Description
Service Provider	The communication service provider offers (voice) communication services to the customer and provides customer services.
Data Collector	This actor performs one or more of the following functions: he takes care of the identification & authentication of the customer, has a record of a customer's demographics, his context (location, device, connection) and service usage.
Transaction Manager	An actor with this role is involved in the billing process. He bills the customer for his service usage and/or facilitates the payment collection.
Platform Operator	A platform operator coordinates or facilitates the interaction between service providers and end-users.
Application Developer	Actors with this role develop web-based applications and, when necessary, convert them into an appropriate format for the wireless environment.
Service Aggregator	The service aggregator offers a portfolio of services. He aggregates, integrates, and re-packages or distributes services provided by others.
Portal Provider	An actor with the role of portal provider functions as a gate towards and a first starting point for Internet services.
Network operator	The network operator is the actor that provides the connectivity to the end-user's handset.
Mobile Service Subscriber	A mobile service subscriber is the end-user of mobile communication services.
Mobile Access Subscriber	A mobile access subscriber is a customer of network access providers that provide mobile connectivity to its handset.
Handset Manufacturer	A handset manufacturer designs and produces mobile phones or other devices that support mobile communication network technologies.
Advertiser	An actor with this role provides sponsored content to the application developer or service provider. This content is to be included in their service, for which the advertiser pays a fee.

Table 2: Possible roles in the generic value network models

Actors	**Description**
Mobile Telecom Operator	The mobile operator provides mobile connectivity and services to the subscriber's handset.
Mobile Network Operator	Mobile network operators provide mobile broadband connectivity to the subscriber' handset.
Communication Service Provider	These actors provide Internet-based communication services.
Device Manufacturer	The device manufacturer designs and produces mobile phones or other devices that support mobile communication services.
Service Aggregator	Service aggregators operate an independent service platform that aggregates multiple communication services and functions as a starting point for mobile IP-based communication services.

Table 3: Possible actors in the generic value network models

Actors	Description
Mobile Subscriber	The mobile subscriber is the end-user of the mobile communication service provision.
Advertiser	Advertisers provide sponsored content.
Financial Intermediary	These actors arrange the collection of subscriber payments for Internet-based communication service providers.
Fixed Network Operator	Fixed network operators provide landline Internet connectivity, providing Internet access to local wireless networks.

Table 3 (cont.): Possible actors in the generic value network models

Besides a change in the roles and actors involved in the service provision, the relationships between the actors TMNL's current value will also be influenced by the described developments in its environment.

- **Relationship Between the Mobile Telecom Operator and the Device Manufacturer**
  The emergence of the mobile operating systems has shifted the service platform towards the mobile handset. Communication services have become one-of-many functionalities on handset that are becoming increasingly able to support these functionalities over multiple access technologies. Due to these developments, the device manufacturers are less dependent on the operator's resources.

- **Relationship Between the Mobile Subscriber and the Mobile Telecom Operator**
  With the surfacing of IP-based mobile communication service providers, the mobile operators will not be the subscriber's sole provider of communication services anymore. Furthermore, the financial crisis is likely to cause a reduction in subscriber loyalty and increased churn as they will try to restrain their spending. This will loosen the relationship between customer and service provider.

- **Relationship Between the Mobile Subscriber and Handset Manufacturers**
  Due to the handset's increasing functionalities and growing importance of the position of the mobile operating system in mobile service provision, handset manufacturers are gaining a much more central position in the value network. They are expanding their own relationship with the mobile subscriber at the expense of the mobile operator's customer relationship.

4 Communication Service Provision over LTE

4.1 Introduction

This chapter will provide an answer to the third sub question and will analyze the possible technological solutions that are available to TMNL for the provision of real-time person-to-person communication services in an LTE-environment. On the basis of an elaborate desk study and consultation with a number of experts from TMNL it will present different types of technological solutions that TMNL can implement. It will first discuss a do nothing scenario where TMNL will not provide voice services over LTE (section 4.2). Then it will set forth two interim solutions that enable leveraging the current 2G/3G network architecture for a fast deployment of communication services over LTE (section 4.3). Subsequently it will introduce two IMS-based solutions to providing communication services (sections 4.4) and finally it will put forth two Internet-based solutions (section 4.5) and give a short summary of this chapter's findings (section 4.6).

4.2 Do Nothing

This first technological solution constitutes the 'do nothing option' for TMNL where it does not offer any communication services over its upcoming LTE network infrastructure within the timeframe considered in this research project. As schematically depicted in figure 25 below, TMNL will remain to offer its communication services over its 2G/3G network infrastructure and use its LTE network to provide mobile broadband connectivity to laptops and Internet tablets. This entails that TMNL will not offer LTE-enabled handsets through its sales channels and that its mobile communication service portfolio will confine itself to its current circuit-switched environment and not migrate towards a fully-IP-based network environment in the upcoming 5 years.
An important note to be made here is that the deployment of LTE is taken as a given in this analysis since TMNL has publicly endorsed the network technology. Therefore the do nothing scenario does not take into account a situation where LTE is not deployed at all.

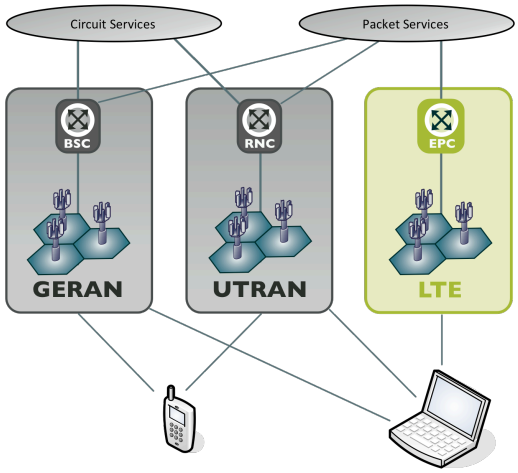


Figure 25: Service architecture of 'do nothing' option

4.3 Interim Solutions

4.3.1 Voice over LTE Generic Access (VoLGA)

With the deployment of the LTE network architecture mobile operators acknowledge consumer demand for mobile broadband connectivity, but in doing so they also enable the provision of voice services by over-the-top service providers. In order to be able to quickly introduce a voice service over the LTE network architecture and counter the over-the-top service providers, T-Mobile International and a number of network infrastructure and device vendors have initiated the VoLGA forum. The goal of the VoLGA forum is to specify and promote an approach for extending traditional GSM and UMTS circuit-switched services over LTE access networks (VoLGA forum website, 2009). It reuses as much of the current network architecture as possible, and thereby provides a cost- and time-efficient approach to offering voice and SMS service over this new network technology.

Based on the 3GPP General Access Network (GAN) standard, the concept of VoLGA is to extend the operators existing circuit-switched core network to act as an IP-based service delivered over the LTE network. The handsets will be equipped with a 2G/3G radio module as well as with a LTE module. This allows subscribers to seamlessly roam between the circuit-switched GSM/UMTS network architectures and the packet-switched LTE network. When connected to a GSM or UMTS a VoLGA-enabled handset will use circuit and packet-based services in a similar manner as the current handsets. However when the handset detects an LTE network, it uses it to establish a secure IP-connection to a VoLGA Access Network Controller (VANC) in the operator's core network. This VANC appears to the rest of the core network as a standard cellular base station, allowing the handset to access the circuit-switched services over an IP-based network connection (Kineto, 2009).

By leveraging the circuit switched core, the interoperability with the other operators is safeguarded as well because their interfaces will remain the same.

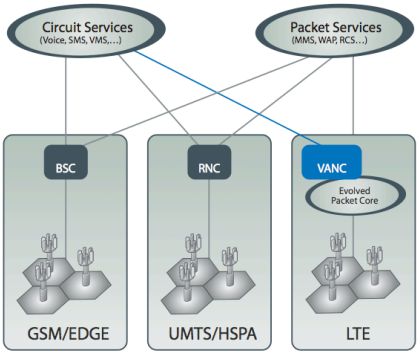


Figure 26: VoLGA service architecture (VoLGA forum, 2009)

VoLGA & IMS

Besides being a quick and low-cost technological solution to providing voice over LTE, VoLGA also provides an interim solution for those operators that want to migrate all their services to IMS, the 3GPP standard for multimedia service deployment over IP technology. This takes away the need to replicate all these functionalities as depicted in figure 27 (Kineto, 2009). Rather, operators will be able to gradually deploy IMS-based non-telephony services while leveraging their existing 2G/3G architecture for voice services over LTE as depicted in figure 28.

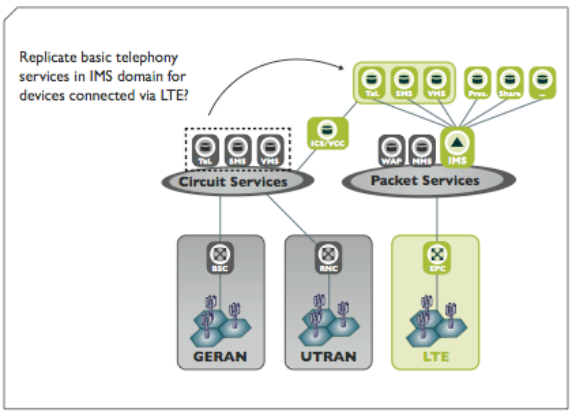


Figure 27: IMS without VoLGA (Kineto, 2009)

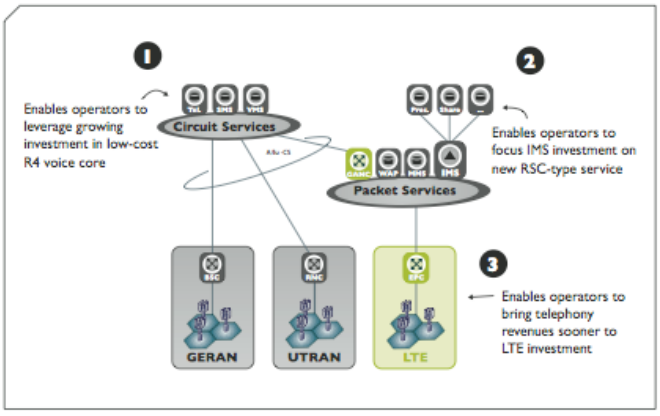


Figure 28: IMS with VoLGA (Kineto, 2009)

4.3.2 Circuit-Switched Fall Back

Similar to VoLGA, Circuit-Switched (CS) fall back is an interim solution to offering voice services in an LTE network environment that leverages the legacy 2G/3G network infrastructure. However in this setup all of the voice service is provided over the circuit-switched legacy networks.
LTE-enabled handsets will be attached to the LTE network as their preferred network, which they will use to access (IP-based) services. However when a subscriber makes or answers a call, his handset disconnects from the LTE network and falls back to a 2G/3G network. When the session is finished, he switches back to the LTE network. If the legacy network supports concurrent circuit and packet-switched services, the subscriber's packet session can also be handed over and run simultaneously to the call; if not, the session is suspended until the subscriber returns to the LTE network (Motorola, 2008). The latter will be the case for TMNL's 2G network infrastructure. This will have as a consequence this network technology will not be possible to provide a migration path towards combinational voice and data services such as those offered by the IMS-based Rich Communication Suite described later on in the next section.

The picture below provides a clear overview of CS fall back in comparison to VoLGA.

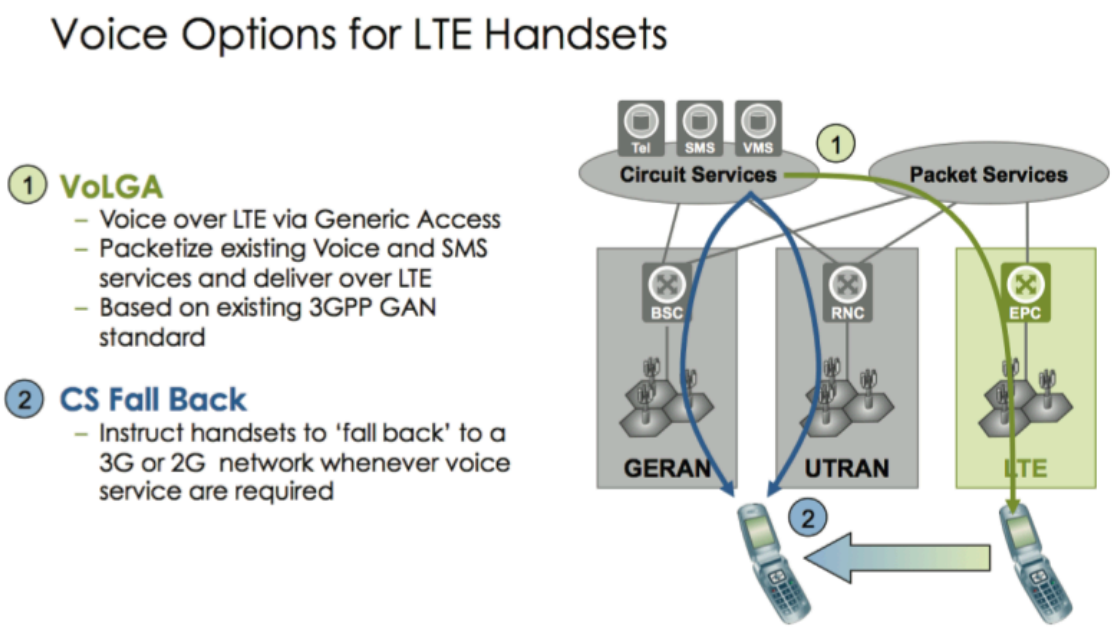


Figure 29: VoLGA compared to CS Fall Back (Kineto, 2009)

This technological solution may seem fairly similar to the 'do nothing' option described in section 4.2, however it differs in the fact that TMNL will provide LTE-enabled handsets in the case of CS Fall Back, whereas it does not in the do nothing scenario.

4.4 IMS-Based Solutions

4.4.1 Rich Communication Suite (RCS)

The Rich Communication Suite (RCS) embodies a number of communication services, including voice and video calling, instant messaging, in-call file sharing and a presence enhanced phonebook. The suite is carrier-independent and its services can therefore be launched from a contact list on a mobile handset as well as from a client software program installed on a PC.

Founded in 2007, a consortium of telecom operators, handset manufacturers and networking equipment vendors called the RCS Initiative started the development of an integrated suite of communication services that make use of the capabilities of IMS. In September 2008 the GSMA, the global trade group for the mobile industry, adopted RCS to its work program in a collaborative effort to realize the *'rapid adoption of applications and services providing an interoperable, convergent, rich communication experience both in mobile and fixed environments'* (GSMA, 2008). Simultaneously and maybe even more important, the program functioned as a *'collaborative effort to speed up and facilitate the introduction of commercial IP Multimedia Subsystem (IMS) based rich communication services over mobile networks (…) and later extending to fixed networks'* (GSMA, 2008). By focusing on interconnection and interoperability requirements related to a core feature set of rich communication capabilities, the program will enable the telecom industry to focus on a delimited set of functionalities in their implementation of IMS. Because of the wide range of possibilities of IMS, its not yet fully standardized implementations and proprietary value-adding extras from different vendors, the danger arose that many incompatible IMS architectures would arise within the telecom industry (Lucas, 2008). The alignment in implementation will enable RCS to be introduced on an industry wide level, which would increase its perceived network externalities and drive mainstream adoption. Furthermore it will increase the speed of the introduction of an answer by the mobile industry to the emergence of Internet-based communication platforms, such as Skype or Truphone, in the mobile domain (GSMA, 2008; RCS Initiative, 2008).

The core feature set of the RCS consists out of the following functionalities:

- **Enriched Call**
  RCS offers subscribers the possibility to communicate with both voice and video calls. Furthermore it supports the sharing of multimedia content, such as images, video and files, during a call. Here it will show only those forms of multi-media sharing to the call participants that are supported by both sides in order to avoid the annoyance of incompatibility errors.

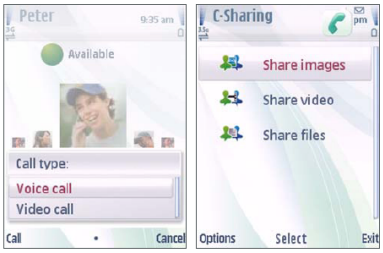


Figure 30: In-call file sharing

- **Enhanced Messaging**
  RCS also supports a 'conversational messaging experience' where it is possible to view all messaging services (SMS, MMS and IM) in a conversational view as depicted on the right-hand side of the adjacent figure. This enables an integrated interface for different messaging services and the ability to look at a coherent history of both sent and received messages.

Figure 31: Conversational messaging

- **Enhanced Phonebook**
  The phonebook of the RCS is enhanced with presence and depicts all available communication capabilities with the other RCS contacts. The presence information of a certain contact indicates his or her ability and willingness to communicate. The list of communication capabilities allows a mobile subscriber to choose from an extensive set of services in order to take into account the contents of the message, the context and the recipient's presence status.

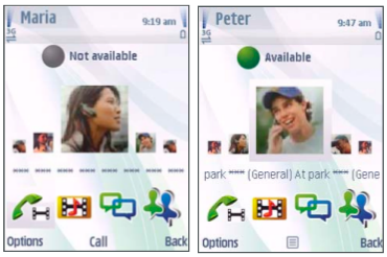


Figure 32: Presence enhancement

In order to provide these functionalities, an IMS client will have to be installed on subscriber handsets and the IMS platform implemented in the operator's network. Eventually both CS voice and PS voice service provision will be supported (GSMA, 2009). However, voice services will initially be provided over the legacy circuit-switched technologies while the other functionalities such as IM, presence and file sharing will be packet-switched and provided through the IMS (Norp, 2009).
This is the reason why VoLGA provides a migration path towards the IMS-based Rich Communication Suite in an LTE-environment, while CS fall back does not. Because VoLGA-enabled handsets stay on the LTE network while their calls are routed to the legacy network core, they preserve a packet-switched connection to the network. This entails that RCS functionalities will still be available during a voice call with the high throughput of the LTE network. With CS fall back however, the handset switches over to a 2G or 3G network and sets up a circuit-switched connection. The latter would imply that all packet-switched RCS services will either witness a big step down in network throughput when handsets fall back to a 3G network or will not be available at all when falling back to 2G.

4.4.2 Multimedia Telephony (MMTel)

While the RCS is focused on a unified and timely implementation of IMS that takes legacy network infrastructures into account, the 3GPP Multimedia Telephony (MMTel) standard is presented as the evolution of legacy fixed and mobile telephony services with the intent to eventually phase out circuit-switched service provisioning and replace it with an IMS-based solution. The standard is fully IP-based and offers converged, fixed and mobile real-time multimedia services. It has the same functionalities as the RCS (IM, video chat, file sharing, presence etc.) but does not incorporate the ability to make voice calls over legacy circuit-switched network technologies. Instead it is focused on offering true carrier-independency and the provision of exactly the same services (multimedia and supplementary services) to fixed as well as mobile clients (Ericsson, 2008).

Basically, RCS and MMTel provide the same IMS-based services. The difference however, is that RCS-clients have the ability to make voice calls using legacy circuit-switched network technologies as well, while MMTel clients only support packet-switched technologies. Therefore they should not be seen as two separate and independent standards. Rather the RCS is as an intermediary stage in the evolution towards MMTel.

4.5 Internet-Based Solutions

4.5.1 Mobile Internet Telephony

Mobile Internet telephony can best be described as a carrier-independent voice service built on existing data communication services (Hassan et al., 2000). Two different kinds of Internet telephony can be discerned: client-to-client Internet telephony and 'Off-net' Internet telephony. The former takes place between two mobile devices with a VoIP (SIP) client installed on them over a packet-switched network connection. This is depicted in the figure below with a blue line. The latter describes the situation where a call from an Internet telephony client is routed over the Internet to a VoIP/PSTN gateway and terminated on a mobile or fixed network (Goode, 2002). This is depicted with the magenta line in the figure below.

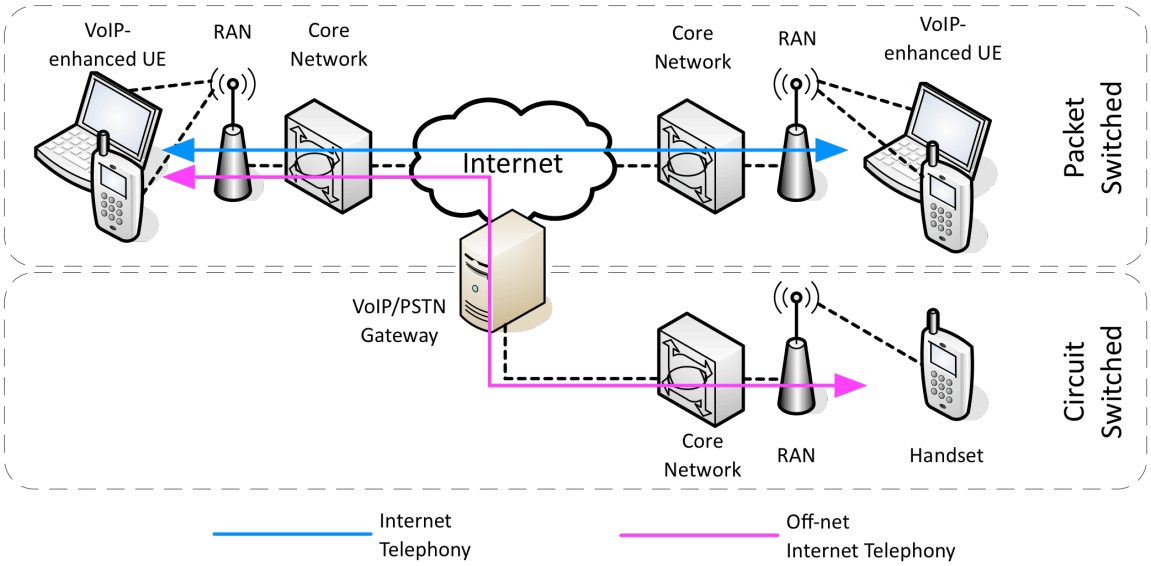


Figure 33: Basic architecture of Internet telephony service provision

Good examples of Internet telephony service providers are Skype, and Truphone and Google Talk. These applications offer free client-to-client communication service to their subscribers over a data network provided by an access provider. Of course the users will have to pay for their data connection, but to the access providing party not to Skype who provides the communication service. The service offers a presence enhanced 'buddy list' that shows a subscriber's contact that are currently reachable with the communication service along with their current status (e.g. available or busy). Some of these service providers, such as Skype and Truphone, also offer off-net Internet telephony services that enable users to make calls to and be called by PSTN phone numbers. These off-net services are billed for and function as one of the main sources of income for these service providers (Telecompaper, 2009c).

4.5.2 Voice over Alternative Access

Next to these carrier-independent Internet telephony service providers, TMNL has the ability to offer these off-net Internet telephony services as well.

As the first Dutch and probably even European mobile operator TMNL has successfully implemented the 3GPP R4 core network architecture. Part of the R4 network architecture is the Session Border Controller (SBC); a network element that enables setting up, conducting and tearing down multimedia session over an Internet connection. Furthermore it has recently installed a Nokia Voice-over-IP application Server (NVS) in its core network that enables the interaction between Internet telephony services and circuit-switched telephony services within TMNL's core network. Together these network elements function as the VoIP/PSTN gateway mentioned in the previous section and enable connecting with TMNL's core network and its services with a softphone over an IP-based access network. A softphone is a software client for making IP-based telephone calls on a PC, such as the Skype client, but could also be installed on a smartphone.
This service, named Voice over Alternate Access, provides network-agnostic access to TMNL's communication services, which implies that these services can be access over multiple IP-based access network technologies. This also implies that the service provision becomes device independent because it can be accessed from a laptop or desktop pc, as well as from a mobile handset. These devices will have to have a SIP client installed on them in order to be able to set up a dedicated connection to the NVS. A schematic overview of the system architecture is depicted in the figure below.

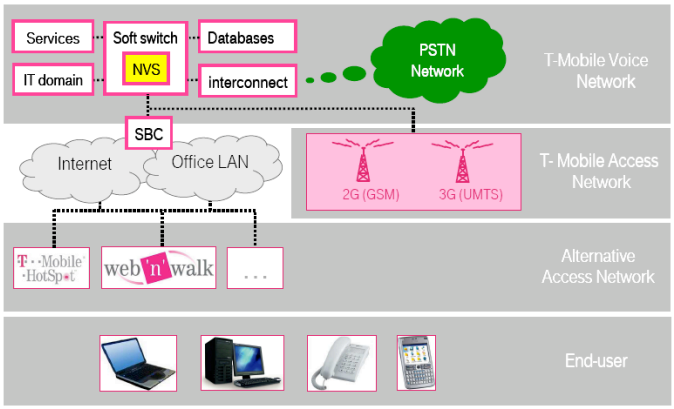


Figure 34: Voice over Alternative Access service architecture (Trouwborst, 2009)

On a national level, the added value of this service lies in ability to communicate on multiple devices with the same MSISDN (phone number). So for instance when a subscriber is on the move and his phone battery runs dead, he can connect his laptop to the Internet with a USB-dongle and can still be reached by phone as well as make calls. Because all of his communication still is routed through TMNL's core network and terminated in a regular way, the subscriber will be billed under the same tariff rates as he would have been had he called over GSM/UMTS.
On an international level, Voice over Alternate Access does provide financial advantage. It enables the lowering of the tariffs for calls made abroad by TMNL subscribers because it induces no financial obligations to roaming partners since the calls are being routed through the Internet instead of other operators. Because of this, TMNL can charge their subscribers far less for these calls while receiving the same profit margin itself.

4.6 Conclusions

The goal of this chapter was to give an overview of the possible technological solutions for TMNL to provide real-time person-to-person communication services in an LTE-environment. It has elaborated on a wide range of technological solutions, differing from interim solutions that leverage the current network architecture to fully IP-based and carrier-independent solutions. The different technological solutions are summarized in the table below.

Category	Option	Description
Do Nothing	**Data Only**	TMNL does not migrate its voice service provision toward LTE. It sticks to 2G/3G network technology for communication service provision and uses the LTE network to offer mobile broadband connectivity.
Interim Solutions	**Voice over LTE Generic Access (VoLGA)**	Voice calls are routed over the LTE network towards the same network core used for 2G/3G voice service provision.
	Circuit-Switched Fall Back (CS Fall Back)	The LTE network is used for mobile broadband access, but the handset switches back to 2G/3G to make ordinary voice calls.
IMS-Based Solutions	**Rich Communication Suite (RCS)**	An extensive communication suite including enriched calling, file sharing and enhanced address books. The suite uses a packet-switched connection for advanced services, while both the 2G/3G networks as well as LTE can be used for voice calls.
	Multimedia Telephony (MMTel)	A fully IP-based and network-agnostic suite of advanced communication services.
Internet-Based Solutions	**Internet Telephony**	An Internet-based communication service that operates independently from the underlying infrastructure.
	Voice over Alternative Access	A service that enables accessing the TMNL core network and its services over any IP-based access network.

Table 4: Technological solutions for the provision of communication services over LTE

These technological solutions for the provision of communication services will be used in the construction of a number of generic value network models in the next chapter. Furthermore, they will be employed in chapter 7 to be able to translate the findings of the empiric phase into a more concrete advise in terms of the actual technological interpretation of the proposed communication service provision.
Though all solutions other then the 'do nothing' option are able to provide communication services in an LTE-environment, there are substantial differences in the way their approach. The table below summarizes the technological consequences of the different solutions. As will be explained below, some of the variables will have consequences in the organizational domain.

Category	Option	Communication Service Provision	Circuit / Package switched	Access Network	Handover to Legacy	Software Client on Handset	Coupling with Network Architecture	Requires Alignment With Other Operators
Do Nothing	**Data Only**	No	-	-	-	-	-	-
Interim Solutions	**Voice over LTE Generic Access (VoLGA)**	Yes	PS	LTE	Yes	Yes	Tight	No

	Circuit-Switched Fall Back (CS Fall Back)	Yes	CS	2G/ 3G	Yes	Yes	Tight	No
IMS-Based Solutions	**Rich Communication Suite (RCS)**	Yes	PS	3G+/ LTE/ DSL/ Cable	Yes	Yes	Tight	Yes
	Multimedia Telephony (MMTel)	Yes	PS	3G+/ LTE/ DSL/ Cable	No	Yes	Tight	Yes
Internet-Based Solutions	**Internet Telephony**	Yes	PS	3G+/ LTE/ DSL/ Cable	No	Yes	Loose	No
	Voice over Alternative Access	Yes	PS	3G+/ LTE/ DSL/ Cable	No	Yes	Loose/ Tight	No

Table 5: Technological consequences of the different solutions

- **Communication Service Provision**
  All solutions but the 'do nothing' option will be able to provide real-time person-to-person communication services in an LTE-environment. These will be referred to below as the feasible options.
- **Circuit / Packages Switched**
  All feasible options but CS Fall Back use an IP-based connection to the network architecture when making or receiving voice calls. This entails that all other options will be able maintain a high-speed data connection while supporting real-time communication services, while CSFB will fall back to the legacy 2G/3G network infrastructure.
- **Access Network**
  Both interim solutions are mobile only, while the other feasible solutions enable fixed-mobile convergent service provision.
- **Handover to Legacy**
  Only the two interim solutions and RCS have the ability to hand over a communication session to the legacy circuit-switched network architecture in areas where the LTE network infrastructure is not available. The other three solutions are focused on IP-based service provision alone.
- **Requires Software Client on Handset**
  All feasible solutions require a software client to be installed on the subscriber handset en therefore create a certain dependency on the cooperation of the handset manufacturers.
- **Coupling with Network Architecture**
  Both the interim solutions and the IMS-based solutions are tightly coupled with the underlying network architecture, while the two Internet-based solutions are not. This has consequences for the operator's ability to control the quality of the service provision. The Voice over Alternative Access option can be labeled as both loose and tight because this because it can be accessed over different network infrastructures but still is coupled to TMNL's core network.
- **Requires Alignment with other Operators**
  The two IMS-based solutions require an alignment in the implementation of IMS in the control layer of the other operators' network architecture to safeguard the interoperability of the services. This creates a relationship of dependency with the other operators and may slow down service implementations. The two interim solutions as well as Voice over Alternative Access use the existing network core, which already is interoperable between the operators. Internet telephony is an over-the-top service and has no relation to the operator's network core.

5 Generic Value Network Models

5.1 Introduction

This chapter will provide an answer to the fourth sub-question. Its goal is to design and specify a number of generic business model configurations for the provision of real-time person-to-person communication services. In constructing the value network model, the notion of design as put forth in the Metamodel of Herder & Stikkelman (2004) will be implemented. They postulated a design methodology that first specifies the design space by determining the different design variables and subsequently arranges different combination of these variables into designs that are to be evaluated. The roles and actors that fulfill these roles within the realm of mobile communication service provision, identified in chapter three, will constitute the design variables for the different value network models that will be created in this chapter.
Four generic value network models will be designed on the basis of these variables. In order to take a wide scope of possible value networks into account and make them generic rather then specific, the value networks will not be tailored to different technological solutions to communication service provision. Instead, they are designed by laying the nexus of service provisioning with different actors in the value creating process. This way the models can be analyzed in a more objective way and contribute to providing a broad context for the eventual result of this research project. The following generic models will be discerned:

- The **operator centric model** (section 5.2), where the mobile telecom operator is the main communication service provider.
- The **device centric model** (section 5.3), where the handset manufacturer is determinant for the subscriber's service usage.
- The **service centric model** (section 5.4), where a third-party communication service provider plays a central role and is responsible for most of the roles regarding voice service provisioning.
- The **aggregator centric model** (section 5.5), where a third-party service aggregator will be determinant for the service provision.

The dominant actor in each of these value network models was determined by gradually increasing the distance between the mobile operator and the actor responsible for the communication service provision. The distinction between the different models is depicted in the figure below.

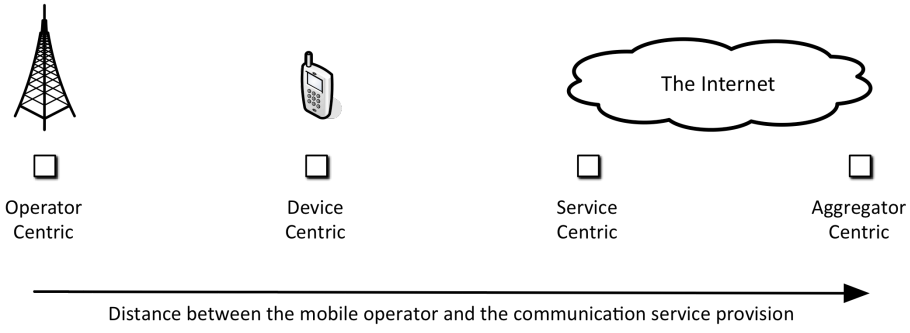


Figure 35: Nexus of the different value network models

Each section will first list the drivers for the model in question by referring to developments in the mobile domain that were put forth in chapter three. Subsequently a short case study of an example of the model will be conducted to put the model into perspective. Then it will be further specified with an analysis of the division of roles among the different actors involved and the construction of the value network. The value network models will be used as input for the qualitative phase of this research project where they will be evaluated in semi-structured interviews.

5.2 Operator Centric Model

The first generic value network model lays the nexus of the communication service provisioning with the mobile telecom operator. It takes the value network model of TMNL's current voice service provision that was constructed in section 3.2.3 as a starting point, but also takes into account the possible technological solutions for the operator to evolve its service provisioning that were presented in the previous chapter. This model is related to the following drivers in the telecom domain:

- The emergence of the smartphone and the mobile operating system
- The decreasing latency of mobile broadband connectivity
- The forthcoming implementation of the fully IP-based LTE network infrastructure
- The need to migrate the operators' communication service provision towards an all-IP environment
- The emergence of fixed-mobile convergent service provision

The operator centric model will be illustrated by the Rich Communication Suite, described in section 4.4.1. This technological solution was selected over the other ones because it constitutes an IP-based service environment that is tightly coupled with the operators network resources and enables fixed-mobile convergent service provision. Because of these properties it can be seen as a fully-fledged migration of the operator's service provision into this new environment.

5.2.1 Case: Rich Communication Suite

The Rich Communication Suite is an IMS-based solution to providing communication services. As put forth in section 3.3.4, IMS is a platform-based on the SIP protocol that enables the convergence of voice, video and data over an IP-based network infrastructure. IMS gives the operators the possibility to manage the QoS of communication and multi-media service provision and is considered to be the 3GPP standard for multimedia service deployment over IP. While migrating the service provisioning towards in IP-based environment, all functionalities remain tightly coupled with the operator's network resources. The core feature set of the RCS consists out of the following functionalities (GSMA, 2008; RCS Initiative, 2008):

- **Enriched Call**
  RCS offers subscribers the possibility to communicate with both voice and video calls. Furthermore it supports the sharing of multimedia content, such as images, video and files, during a call.
- **Enhanced Messaging**
  RCS also supports a 'conversational messaging experience' where it is possible to view all messaging services (SMS, MMS and IM) in a conversational view.
- **Enhanced Phonebook**
  The phonebook of the RCS is enhanced with presence and depicts all available communication capabilities with the other RCS contacts.

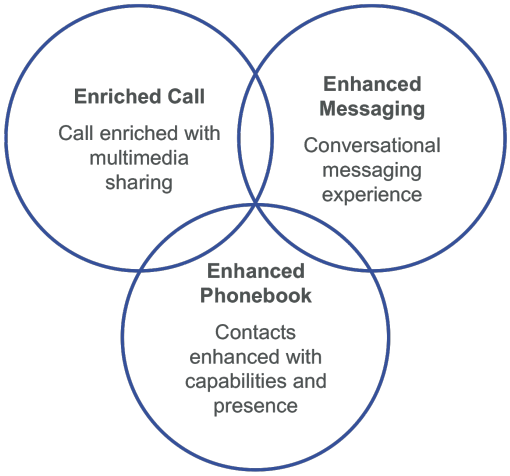


Figure 36: Three aspects of the Rich Communication Suite (RCS Initiative, 2008)

In order to provide these functionalities, an IMS client will have to be installed on subscriber handsets and the IMS platform implemented in the operator's network. It can also be extended with an IMS-based RCS client on Macs and PCs, enabling operator centric fixed-mobile convergent service provisioning (Norp, 2009).

5.2.2 Specification of the Operator Centric Model

Similar to the current value network model of TMNL's voice service provisioning, the mobile telecom operator takes up the central position in this generic model. It is the sole provider of communication services and has the ability to collect data on the customer's service usage. Though some of the service provisioning is IP-based, it will still be tightly coupled with the operator's network resources. The platform facilitating the interaction between the communication services and the service subscribers resides in the control layer of the operator's network architecture in combination with a software client on the subscriber's handset. Both the mobile telecom operator and the device manufacturer therefore fulfill the role of platform operator. In the case of the latter, it also fulfills this role with the control over the mobile operating system.

As mentioned in the short case study in the previous section, the platform in the operator's control layer enables fixed mobile convergent services allowing the operator's service portfolio to be accessed over different access networks. Therefore a fixed network operator will be able to provide the connectivity as well and both the mobile telecom operator and the fixed network operator can fulfill the role of network operator. This entails that both of these actors will have a financial relationship with the subscriber and thus also fulfill the role of transaction manager. Different from the mobile operator however, the fixed network operator is not seen as a data collector because it doesn't really provide connectivity to individuals but rather to households or offices. The user data it generates is of a much more generic nature and therefore does not fall within the scope of the role of data collector as specified in the third chapter.

Due to this network heterogeneous nature of the service provision, the mobile subscriber has both mobile access and service providers. Its role of 'customer' as defined in the value network model of TMNL's current voice service provision will therefore be replaced with that of service and access subscriber. The role division of the operator centric model is depicted in the table below.

Actors \ Roles	**Service Provider**	**Data Collector**	**Transaction Manager**	**Platform Operator**	**Network Operator**	**Service & Access Subscriber**	**Handset Manufacturer**	Application Developer	Service Aggregator	Portal Provider	Advertiser
Mobile Telecom Operator								-	-	-	-
Device Manufacturer								-	-	-	-
Mobile Subscriber								-	-	-	-
Fixed Network Operator								-	-	-	-
Mobile Network Operator	-	-	-	-	-	-	-	-	-	-	-
Communication Service Provider	-	-	-	-	-	-	-	-	-	-	-
Service Aggregator	-	-	-	-	-	-	-	-	-	-	-
Advertiser	-	-	-	-	-	-	-	-	-	-	-
Financial Intermediary	-	-	-	-	-	-	-	-	-	-	-

Table 6: Distribution of roles over actors in the operator centric model

By taking into account the relationships between the different actors involved, the value network can be drawn up. The value network model of the operator centric model is depicted in figure 37 on the next page. Contrary to the value network model of TMNL's current voice service provisioning presented in section 3.2.3 this diagram discerns three different types of relationships. Besides the straight and dotted arrows representing a relationship of a financial nature and the course of the voice service provisioning respectively, a straight line without arrowheads is added to the diagram. This line represents a relationship of dependency other than a financial one. The nature of this dependency will be elaborated on in the accompanying text.

Both the roles fulfilled by the telecom operator and the relations it has with other actors in the network are more or less similar to the value network of TMNL's current voice service provisioning. The relationship between the operator and the device manufacturer changed however to one of mutual dependencies. The operator still has a fair amount of buyer power due to scale of its wholesale purchases, but as was put forth in section 3.6.3 this dependency has become less strong due to the emergence of the mobile operating system and shift of the operator's communication services from one of the handset's main functionality to 'one-of-many functionalities'. This latter development makes the operator dependent on the device manufacturer as well; if the operator wants to offer a service such as the Rich Communication Suite, the device manufacturers will have to embed an IMS client in their handsets.
The mobile subscriber has a relation with both the mobile telecom operator and the fixed network operator for the provision of mobile connectivity. He has a service relation with the mobile telecom operator, for which he pays the operator either on a postpaid or a prepaid basis. Furthermore the mobile subscriber may also have a direct relationship with the device manufacturer since he can acquire a handset directly from the manufacturer through its own sales channels as well.

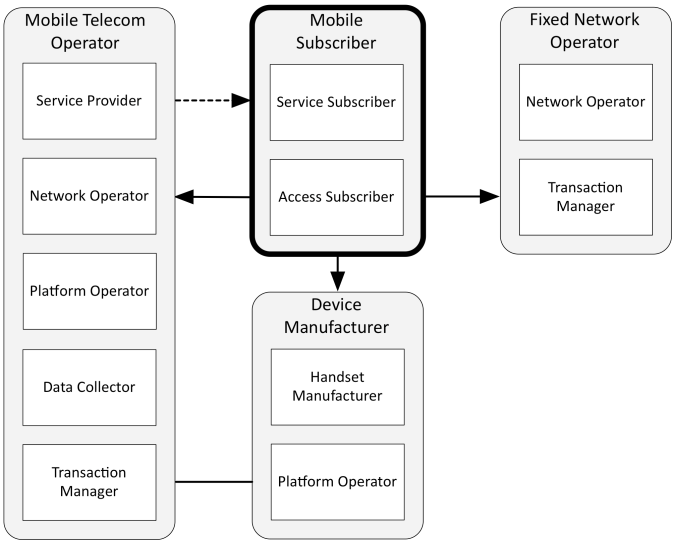


Figure 37: Value network of the operator centric model

5.3 Device Centric Model

This second value network model lays the nexus of the mobile communication service provisioning with the mobile handset. In incorporates both the operator's communication service provision and that of Internet-based service providers. The following drivers can be related to the emergence of this device centric model for mobile voice communication:

- The emergence of mobile end-to-end service provisioning
- The emergence of the smartphone and the mobile operating system
- The reduction of voice services as one of many functionalities of the mobile handset
- The increase in carrier-independent handset functionalities
- The emergence of mobile Internet telephony
- The decreasing importance of the operator's sales channels for mobile handsets

5.3.1 Case: Nokia N97

This case study is based on the integration of Skype's Internet telephony services the Symbian (S60) operating system. In February 2009 Nokia and Skype announced a strategic partnership as a result of which a Skype client will be pre-installed and integrated into the operating systems of all new N-series handsets, starting with the Nokia N97 device launched in Q3 2009. This provides the mobile end-users with a Skype client embedded in the address book of their Nokia device, enabling presence as well as instant messaging. Furthermore it enables subscribers to make and receive Skype-to-Skype calls over a HSPA or WLAN Internet connection as well as low-cost Skype calls to landlines and mobile devices (Nokia, 2009). What really sets this setup apart from a regular mobile Skype client running on a handset, as shown in the service centric model in section 5.4, is the tight coupling between the software and the operating system. In order to use Skype's service the subscriber does not have to launch the application on his devices first, instead he can see which of his Skype buddies are online directly from his address book.

5.3.2 Specification of the Device Centric Model

This configuration places the central platform of the communication service provision with the mobile handset; it plays a central role and is very determining for the subscriber's communication service usage. A platform for and a portal towards multiple communication services is embedded in the handset and functions as the main starting point for all communications sessions. Whenever a user decides to make a call, the handset-based portal offers the choice to make calls using the fully integrated operator voice service provision or the carrier-independent third-party communication service. In this way, the mobile operating system (and its address book in specific) functions as a portal towards the communication services of both providers, as well as aggregate them into a single user interface; the address book. Due to the central position of the mobile operating system in communication service usage, the handset manufacturer also has the ability to gather user data.

As the mobile subscriber has the ability to use either the mobile operator's voice service provision or the Internet-based communication service, these actors have all the same functions as endowed on them in the operator centric model and the service centric model (presented in the next section) respectively. Since the Internet-based service is carrier-independent, a fixed network operator can also fulfil the role of network operator and will therefore have a financial relationship with the subscriber and thus also fulfill the role of transaction manager. Finally, the communication service provider has the ability to implement a direct and/or an indirect revenue model. As the Internet-based communication service provider may also wield an indirect revenue model, an advertiser is added to this model as well.

The table below depicts the division of the different roles over the actors involved. Both the mobile operator and the communication service provider fulfill service related roles while the handset developer has a much more supporting but nonetheless influential position. The value network model of the device centric model is depicted in figure 38 on the next page.

Actors \ Roles	Service Provider	Data Collector	Transaction Manager	Platform Operator	Application Developer	Service Aggregator	Portal Provider	Network Operator	Service & Access Subscriber	Handset Manufacturer	Advertiser
Mobile Telecom Operator											
Communication Service Provider											
Device Manufacturer											
Mobile Subscriber											
Advertiser											
Financial Intermediary											
Fixed Network Operator											
Mobile Network Operator	-	-	-	-	-	-	-	-	-	-	-
Service Aggregator	-	-	-	-	-	-	-	-	-	-	-

Table 7: Distribution of roles over actors in the device centric model

Similar to the operator centric model described in the previous section, the configuration for the device centric model contains the same thee different types of relationships, indicated by the same shapes of lines. The value network model of the device centric model is depicted in the diagram on the next page.

In this configuration, the subscriber has a relationship with all actors but the advertiser. Both the mobile telecom operator and the fixed network operator have a financial relationship with the subscriber as providers of broadband connectivity. In addition to that, the mobile telecom operator fulfills the role of service provider as well.

To stress the central function of the device, the dotted line indicating the course of the voice service provision first goes towards the device manufacturer and from there on towards the mobile subscriber. Since the mobile operator's voice service provisioning still is one of the main handset functionalities, the mobile operator will still offer them through his own sales channels in order to differentiate himself from his competitors. This entails that the mobile telecom operator will have wholesale deals with the device manufacturer and the relationship between the two actors will be of a financial nature.

Next to the mobile operator, the subscriber will also be able to use voice services provided by the Internet-based communication service provider. As is the case with the mobile operator, the actual voice service is again routed through the device manufacturer because of the portal function of the mobile handset. Furthermore, the communication service provider may wield both a direct and an indirect revenue model, thus also has a financial relationship with an advertiser as a source of sponsored content.

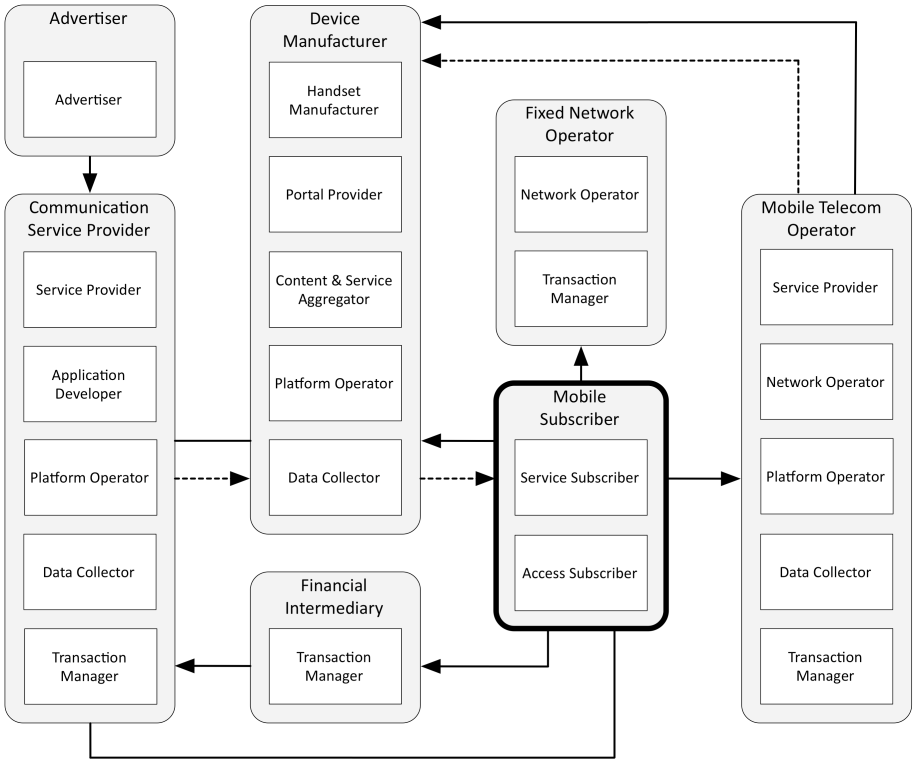


Figure 38: Value network of the device centric model

5.4 Service Centric model

This third value network model lays the nexus of the mobile voice communication service provision with the Internet-based communication service provider. The emergence of this model is related to the following drivers described in chapter three:

- The emergence of mobile end-to-end service provisioning
- The emergence of the smartphone and the mobile operating system
- The increase in carrier-independent handset functionalities
- The emergence of mobile Internet telephony
- The decreasing latency of mobile broadband connectivity
- The prohibition for mobile operator to restrain their subscriber's Internet telephony service usage
- The prohibition for mobile operator to deliberately limit the QoS of Internet telephony services over their network

5.4.1 Case: Skype Mobile

Traditionally Skype is a peer-to-peer (P2P) Internet telephony service. Its software clients function as nodes in a network and join together dynamically to participate in traffic routing and processing as well as in bandwidth intensive tasks that would otherwise be handled by central servers. In this way, each new software client (or node) added to the network adds potential processing power and bandwidth to the network (Skype website, 2009).

Besides its VoIP and instant messaging (IM) services, Skype has launched a mobile version of its software client as well. This application enables free Skype-to-Skype calls and IM sessions for WiFi/data enabled handsets, as well as to Skype clients on desktop computers. To be able to use the Skype service, the client will first have to be installed on the user's handset. Skype currently has a client for most mobile operating systems (Symbian, Android, IPhone OS, Windows Mobile and Linux). Subsequently the handset needs Internet connectivity to be able to use the Skype Internet telephony service. As stated above, this means that the handset will have to be data and/or WiFi enabled. This will allow the Skype client to communicate with other Skype clients over the Internet over a HSPA connection provided by a mobile subscriber or a local WiFi network connected to a landline Internet connection.

Its users can buy Skype Credit, using a financial intermediary such as PayPal, iDEAL or a credit card company. This credit allows the users to use Skype's premium services such as voice mail, text messaging and making calls to landlines and cell phones across the world. Furthermore Skype also offers actual subscriptions, allowing its users to make unlimited calls to landlines for a fixed amount per month (Skype website, 2009; Telecompaper, 2009b).

5.4.2 Specification of the Service Centric Model

In this model the core of the service provision lies with the Internet-based communication service provider who provides an IP-based and carrier-independent voice service to the mobile subscriber. Due to these two properties, both the mobile network operator and the fixed network operator can fulfill the role of network operator. This entails that both of these actors will have a financial relationship with the subscriber and thus also fulfill the role of transaction manager. In addition to that, as a provider of mobile connectivity the mobile operator will also gather a great deal of user data concerning the subscriber's demographics, behavior and context.

The communication service provider fulfills practically all roles related to the communication service provision. It provides the communication service and houses the service development. The application or software client functions as a platform, facilitating the interaction between the customers on the one hand and communication services on the other hand; a single client may provide and integrate

different means of communication, such as voice and video calling, instant messaging and an e-mail service. Furthermore the software client may also functions as a platform between the customers and advertisers or other sources of sponsored content. Though not applicable to the Skype case, some Internet telephony service providers also wield an indirect revenue model and generate revenues by integrating sponsored content into their application. Furthermore it is also possible that they implement a direct revenue model, such as Skype, where a fee is asked for using their premium services. Most Internet-based communication service providers do keep track of theirs subscriber's service usage and take care of the billing, but they do not have the actual infrastructure to collect the bills from their customers. For this they call upon the services of a financial intermediary such as a credit card company or an e-wallet service provider.
The mobile operating system also plays an important role in this configuration. It serves as a software platform enabling the Internet telephony client software to be installed and used on the mobile handset.

The table below depicts the division of the different roles over the actors involved. It clearly shows that the communication service provider fulfills most of the roles related to the actual voice service provisioning, while the mobile operator has a more subordinate function as mobile access provider. It is for this reason that the mobile operator is labeled as a mobile network operator instead of a mobile telecom operator.

Actors \ Roles	**Service Provider**	**Data Collector**	**Transaction Manager**	**Platform Operator**	**Application Developer**	**Network Operator**	**Service & Access Provider**	**Handset Manufacturer**	**Advertiser**	Service Aggregator	Portal Provider
Mobile Network Operator										-	-
Communication Service Provider										-	-
Device Manufacturer										-	-
Mobile Subscriber										-	-
Advertiser										-	-
Financial Intermediary										-	-
Fixed Network Operator										-	-
Mobile Telecom Operator	-	-	-	-	-	-	-	-	-	-	-
Service Aggregator	-	-	-	-	-	-	-	-	-	-	-

Table 8: Distribution of roles over actors in the service centric model

The diagram on the next page depicts the value network model of the service centric model for mobile voice service provisioning. Similar to the previous models, this model contains the same thee different types of relationships, indicated by the same shapes of lines.
In this configuration the mobile subscriber again has a relationship with practically all actors in the service provisioning. He is a customer of both the mobile and the fixed network operator and pays these actors for mobile Internet connectivity. Furthermore, the customer has a mobile handset, which he could have bought directly from one of the device manufacturer's sales channels but also from an indirect sales channel. It is very likely that the mobile operator will no longer subsidize handsets in a situation where he is a mere access provider and for as far as that is concerned it is not clear whether the communication service provider will take over this function. For this reason the relationship between the mobile operator and the device manufacturer has not been defined as a financial one. There is however a certain amount of dependency between these actors since their infrastructure and devices have to be compatible in order to be able to provide mobile connectivity. The subscriber's voice services are provided by the communication service provider with whom the subscriber will have

a user account. This account will also enable him to use premium services for which he will be billed. In that case a financial intermediary will take care of the actual transaction.
The communication provider may implement both a direct and an indirect revenue model, which entails that he will have a financial relationship with the customer (through the financial intermediary) as well as with an advertising actor providing sponsored content. Furthermore his software client will have to be compatible with the operating system on the subscriber's handset. In order to achieve this, the communication service provider will need the ability to develop software for the device manufacturer's software platform. This may be in the form of a license he has to pay or certain restrictions he has to abide by (as is the case for iPhone developers). This also creates a relationship of dependency between these two parties.

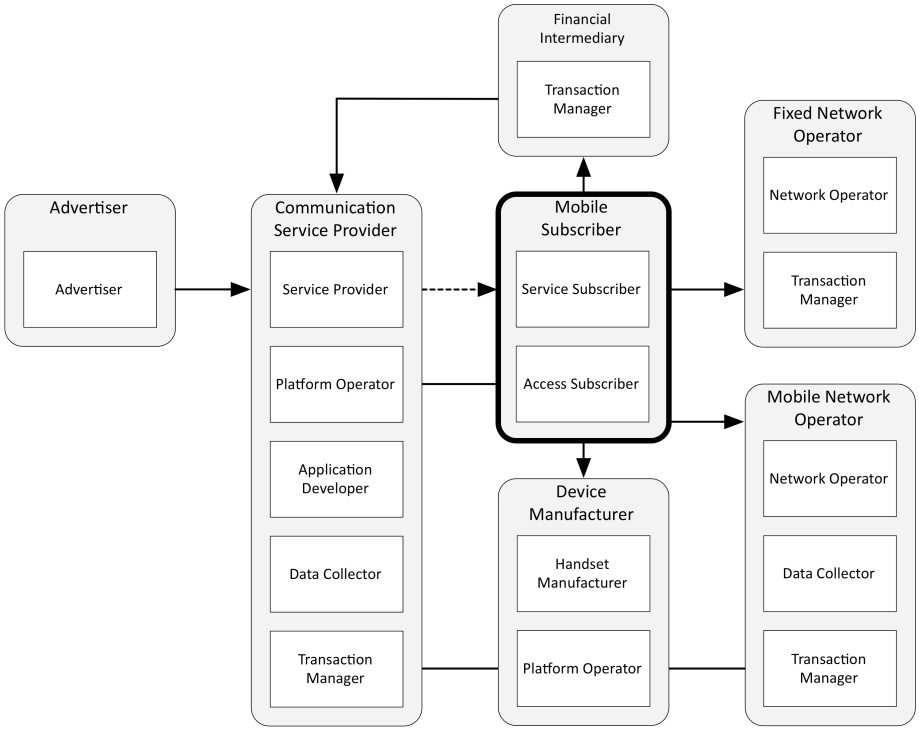


Figure 39: Value network of the service centric model

5.5 Aggregator Centric Model

In the fourth value network model, an actor with an aggregating function plays the central role in the service provisioning. This model is closely related to the service centric model and shares the same drivers. In order to avoid too much repetition, the list below does not go into as much detail as the previous ones. The following drivers can be related to the emergence of aggregator centric model for mobile voice communication,

- The emergence of mobile end-to-end service provisioning
- The emergence of the smartphone and the mobile operating system
- The emergence of mobile Internet telephony
- The emergence of Internet telephony aggregators

5.5.1 Case: Nimbuzz

Founded in 2006, the Netherlands-based company Nimbuzz launched its first service in 2008. It offers a software client that functions as a single point of access towards multiple social media communities, enabling its users to communicate over different Internet-based communication services. As depicted in the adjacent picture, the subscriber will still need a separate account for each of the services but the aggregator's application provides a unified buddy list integrating the different services in a single user interface. In this list, the users can see which of his buddies are 'online' and available over which communication medium. Furthermore, the service also provides a way to let contacts that are offline know that someone is trying to contact them by sending them a 'Buzz'. Besides prompting them, the mobile Nimbuzz software client can also even be activated by the 'buzz-call server', which makes a regular phone call to the handset in question but only lets it ring for an instant. The client is set to start when it receives such a call. The client operates on multiple software platforms, allowing its users to communicate with friends between practically any Internet enabled device; mobile to mobile, mobile to PC/Mac and vice versa (Nimbuzz website, 2009).

Figure 40: Nimbuzz user interface

As its service architecture shows, Nimbuzz functions as a platform between different communication services and user devices. As a result of this diversity, Nimbuzz combines different revenue models. Similar to Skype it offers a number of premium services for which it charges its subscribers. But it also gets revenue shares of some of the communication services it provides an interface for, supports mobile advertising and product licensing to the corporate market. Nimbuzz has thus implemented both a direct and an indirect revenue model (NASPERS, 2008).

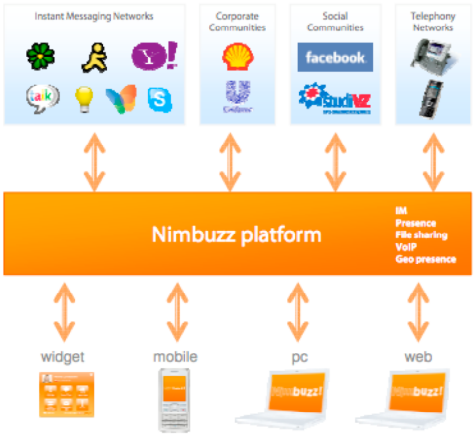


Figure 41: Nimbuzz service architecture (NASPERS, 2009)

5.5.2 Specification of the Aggregator Centric Model

This configuration is similar in a way to the device centric model; there is a central portal providing access to different communication services. However in this model, a third-party service aggregator provides the function of portal provider. Another difference is the fact that this portal does not incorporate the mobile operator's voice services, only Internet telephony services.
The actors providing these services fulfill the same roles as they would in the service centric model. As these services typically aren't interoperable, the subscriber will have separate accounts with each of the different service providers. And thus each of the service providers has the ability to generate user data and charge users for premium service usage. Also similar to the service centric model, both the mobile and the fixed operator have supportive functions as access providers. Because the aggregating software client and the IP-based communication services it provides a portal for are carrier-independent, the subscriber can access them over the mobile broadband network provided by his mobile network operator as well as over a wireless LAN connected to a landline provided by fixed network operator. The mobile operator therefore has all the roles related to his mobile broadband network and relationship with its customers as access-provider. Finally, the mobile operating system plays an import role in this configuration as well since it serves as a software platform enabling the aggregator client software to be installed and used on the mobile handset.

The table below depicts the division of the different roles over the actors involved.

Actors \ Roles	Service Provider	Data Collector	Transaction Manager	Platform Operator	Application Developer	Service Aggregator	Portal Provider	Network Operator	Service & Access Subscriber	Handset Manufacturer	Advertiser
Mobile Network Operator		■	■					■			
Communication Service Provider	■	■	■	■	■						
Device Manufacturer				■						■	
Service Aggregator		■	■	■	■	■	■				
Mobile Subscriber									■		
Advertiser											■
Financial Intermediary			■								
Fixed Network Operator			■					■			
Mobile Telecom Operator	-	-	-	-	-	-	-	-	-	-	-

Table 9: Distribution of roles over actors in the aggregator centric model

The diagram on the next page shows the value network model of the aggregator centric model, including the same types of relations as the previous models.
The subscriber has a relationship with both the mobile and the fixed network operator to provide him with broadband connectivity. He pays a subscription fee for these services and thus has a financial relationship with both actors. The mobile operator also has a relationship with the device manufacturer, but similar to the service centric model this is mainly due to standardization purposes to safeguard the interoperability of the network infrastructure and mobile devices. Since the mobile operator is not likely to subsidize handsets in this configuration, the mobile subscriber will purchase it through a direct or indirect sales channel of the device manufacturer. Furthermore he will have relationships with multiple communication service providers, with which he interacts through the service aggregator's user interface. Because of this, the service provisioning is depicted as passing through the aggregator towards the subscriber. With different sources of income, as described in the Nimbuzz case, the service aggregator has multiple financial relations. He may receive fees from the

subscriber for premium service usage, include sponsored content in its software client and receives revenue shares from communication service providers.
In this model there is no direct relationship of dependency between the communication service providers and the device manufacturer because the service aggregator acts as an intermediate platform.

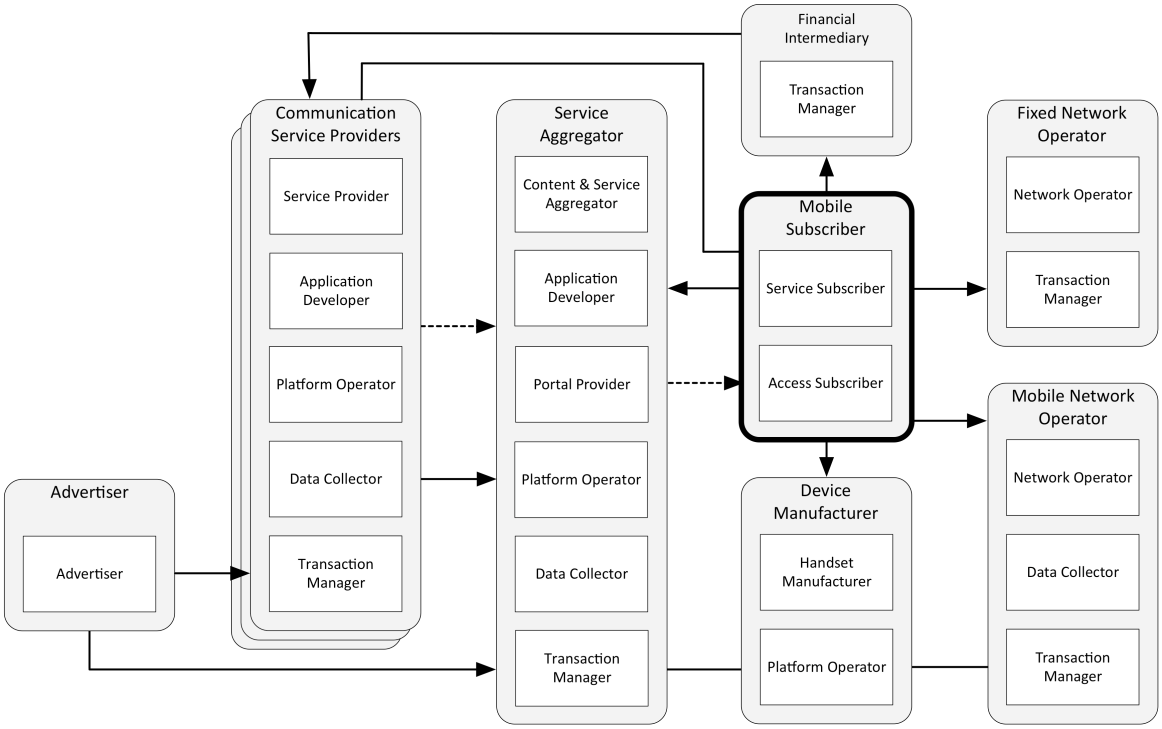


Figure 42: Value network of the device centric model

5.6 Conclusions

This chapter has provided an answer to the third sub-question. Its goal was to design and specify a number of generic business model configurations for the provision of real-time person-to-person communication services. These configurations were based on a number of design variables that were identified in chapter three, consisting of roles and actors. By laying the nexus of service provisioning with different actors in the value creating process four generic models have been identified. These four different models were:

- An **operator centric model** where the mobile telecom operator is the sole actor providing the communication services.
- A **device centric model** where both the operator and the Internet-based service provider offer communication services to the subscriber. In this model the handset takes up a central position by integrating the two services and has a large influence on the subscriber's service usage.
- A **service centric model** where service and access provision have been separated and a third-party communication service provider fulfills most of the roles regarding voice service provisioning.
- An **aggregator centric model** where the communication services of multiple Internet-based service providers are combined and integrated into a software client providing a unified user interface and a single starting point towards these different services.

These four models will be used as input for the qualitative phase of this research project where they will be evaluated in semi-structured interviews and analyzed with the framework that was constructed in chapter two.

6 Model Evaluations

6.1 Introduction

This chapter will answer the fifth and sixth sub-questions. First it will evaluate the different value network models with the framework for determining the viability of value network models for the provision of real-time person-to-person communication services. It will do so by systematically determining the governance structure and performance of the different value network models constructed in the previous chapter. Subsequently it will determine what the operator's base should be for developing its communication service provision for the upcoming IP-based network environment.

The chapter will begin with elaborating on the interviews that were conducted for this research project and go into detail about how the interview protocol was constructed, on what basis and which respondents were selected and how the interviews were conducted and analyzed (section 6.2). Subsequently the different models that were specified in the previous chapter will be evaluated with the framework; the resource dependencies and division of gatekeeper roles determining the balance of control in the value network and the vertical integration and openness inherent to in the model that influence its performance (section 6.3). Then an overview will be gained into those resources that can function as a source of sustained competitive advantage, both from the operator's perspective (section 6.4.1) and from the Internet-based service provider's perspective (section 6.4.2). Insight into these sources is critical in order to be able to give a profound advice about how it should develop its service provision. Finally conclusions will be drawn about the viability of each of the models (section 6.5)

6.2 Interview Method

6.2.1 Formulation of the Interview Protocol

A week before the interview, an interview protocol was sent to the respondents with the request if they could go through it in order to prepare themselves. This would enhance the quality of the discussions during the interviews because the respondents had already given the subject some thought and less time would be needed to run through the models before coming to the actual questions. Before sending the protocol to respondents external to TMNL, it was run through the legal department in order to check whether it didn't contain any confidential information. The interview protocol is included in appendix C.
The document starts with some background information on developments in the mobile domain that form the context of this research project and the accompanying research question. Subsequently it lists the questions that are to be discussed during the interview. These questions have been grouped into three categories: introductory, model specific and generic.

- The first three introductory questions (1-3) are meant as a warm up and an opportunity for the respondent and the interviewer to get acquainted with each other. Furthermore it allows the respondents to ask some questions about the context of the research project and the contents of the interview protocol.

- The next three questions (4-6) specifically cover the four value network models. The first of these questions (4) is meant as a validation of the value network models, to see whether they present a complete picture of the possible configurations for future mobile voice service provision and whether they portray a correct distribution of high-level roles among the actors in each diagram. As the division of roles is determinant for the distribution of gatekeeper roles among the actors, this information is needed to assess the amount of value network control an actor has in the network. Question 5 then seeks the respondent's perspective on which of the configurations is the most likely to become the de facto future standard and which is the most desirable from their perspective. By aggregating these answers, insight can be gained about what the general opinion is on how mobile voice service provision will develop over the years to come. Furthermore, it attempts to analyze whether a discrepancy exists between the expected and the desired situation from the perspective of T-Mobile Netherlands as a whole and that of the respondents external to the company. Furthermore it attempts to analyze whether large differences can be discerned between the different departments within TMNL. Subsequently, in question 6 the respondent is asked to elaborate on the most important sources of relationships of (inter-) dependencies within the value network model they selected as the most likely one in the previous question. This will help determine the other factors that are determinant for the amount value network control as indicated in the theoretical framework. The reason why this question is only limited to a single value network model is the limited amount of time that was available for each interview session. As the appointments were typically scheduled to take one hour, the interview protocol had to be constructed in such a way that it was possible to discuss all of the questions within that time span. As a consequence, the scope of this question had to be narrowed.

- The final four questions (7-10) were of a more generic nature. The first of them (7), seeks to validate the identified market and regulatory developments put forth in the third chapter. This will help assess whether all of the important drivers are accounted for. Subsequently question 8 asks the respondents for resources inherent to the mobile operator that will offer him an advantage in the competition with Internet-based service providers and vice versa. This question is related to determining sources of sustained competitive advantage. Questions 9 and 10 continue on this topic by putting forward two propositions; one regarding the effects op opening

up one's resources to third-party service developers and the other regarding the importance of a service ecosystem. They are directly related to the two factors related to value network performance in the theoretical framework.

The relationship between the theoretical framework and the questions in the protocol for the semi-structured interviews is depicted in figure 43 below. As it shows, the division of gatekeeper roles has not been included in the interview protocol. Because the identification of these roles has been done on the basis of a scientific literature study in the second chapter and they relate directly to the distribution of roles among the actors in the value network, a validation of the value network models, as performed in question 4, will be sufficient to determine their division.

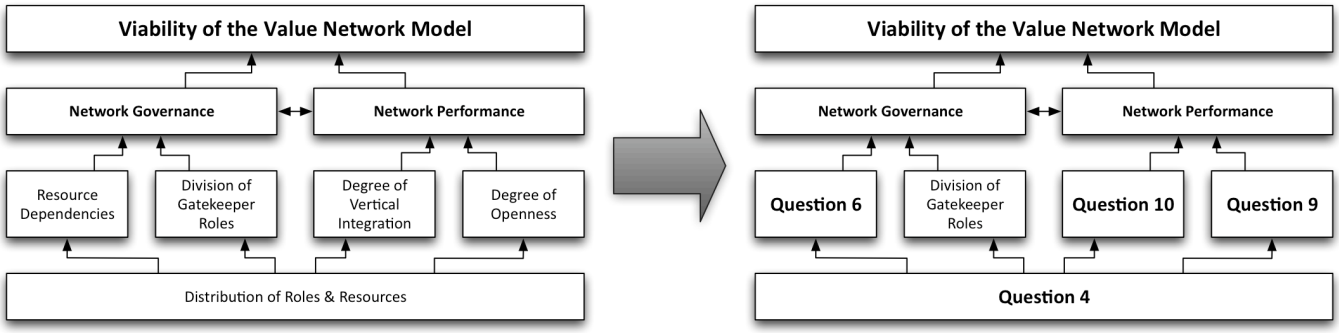


Figure 43: Relation between the framework and the interview protocol

The last three pages of the interview protocol are focused on the value network models. First an introduction is given, explaining how the diagrams representing the configurations are set up and presenting an overview and a description of the different roles in the networks. Subsequently, four different configurations are presented: the operator centric model, the service centric model, the device centric model and the aggregator centric model**.** Each of the models is accompanied with a short description, putting it into perspective.
Because their goal was to convey the different models and their nexus of service provisioning as clear as possible the models differ somewhat from the ones presented in the previous chapter. In order to focus on the position of the mobile operator and keep the diagram surveyable, the roles of the fixed network operator have been limited to that of network operator. Furthermore, to stress shift in the main actor responsible for the service provisioning and the central position of the platform functionality of the mobile operating system, the role of platform operator is limited in each model as well.

6.2.2 Selection of Respondents

The respondents were selected on the basis of a their particular field of expertise. Besides getting a broad view on the developments and possible value network models from different actors in the value network, another important function of the empirical phase is to analyze whether large differences can be discerned between the views of different departments of T-Mobile Netherlands. In order to get a broad view of the perceptions within TMNL, respondents were selected from both market-oriented departments (strategy and marketing services) and technology-oriented departments (technology and products & services). Table 10 shows the division of respondents among companies and the departments in question. These departments are responsible for the direction, development and positioning of service provisioning and therefore of most interest to this research project.
With regard to the respondents external to TMNL, the choice was limited. Due to confidentiality conditions, the choice was made not to include direct or possible future competitors to T-Mobile's service provisioning. In order to still be able to get a broad range of perspectives, respondents were selected with an advisory, regulatory or content background.

Company	Department	Respondents	Referral
TMNL	Strategy	4	TMNL Strat.1-4
TMNL	Technology	4	TMNL TSI.1-4
TMNL	Products & Services (Marketing)	2	TMNL M4.1-2
TMNL	Marketing Services (Marketing)	5	TMNL M7.1-5
CM Corporate Mobile Messaging	CEO	1	CM
TNO	Business Consultant at TNO Information and Communication Technology	1	TNO ICT
OPTA	Economic Officer, Roaming Department	1	OPTA
Philips / iPhone developer	Former Director of Philips' NatLab, certified iPhone application developer	1	iDev
Sanoma	Strategy & Acquisitions	1	Sanoma Strat.

Table 10: Interview respondents

6.2.3 Conducting and Analysis of the Interviews

With the permission of the respondents an audio recording was made of all the interviews and subsequently transcripts were made of each of them. These transcripts were then imported into computer aided qualitative data analysis software called ATLAS.ti, which is devoted to the goal of theory building (Weizman & Miles, 1995; Strübing, 1995). This software allows one to connect 'codes', which can be seen as variables, to segments of text in all of the important documents. This way all segments across the different interviews related to a certain topic can easily be grouped together. Furthermore the software enables a visualization of the codes in a 'network view'. This functionality provides a tool to create a visual representation the way the different codes are related to each other, which is very useful in structuring the data.

6.3 The Models Evaluated with the Framework

This section will present the analyses of the value network models, based on the interviews conducted for this research project. The four configurations will be discussed separately. First it will be analyzed in terms of the framework. This section will focus on the outcomes, but a full account of these analyses is included in appendix D. The two aspects of the models determining the value network control, the resource dependencies and the division of gatekeeper roles, will be represented in a table. In order to make a distinction between the different levels of dependency between the actors they have been color-coded according to the division presented in the figure below. The categorization of the relationships of dependency is directly derived from the elaborate analyses of the models in appendix D2.

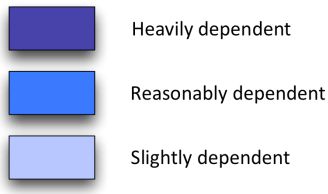


Figure 44: Differentiation in levels of dependency

6.3.1 Operator Centric Model

This section will present the analysis of the operator centric model depicted below. As stated in appendix D1, this model was considered by to remain dominant within the timeframe considered in this research project. The majority of respondents, both internal and external to TMNL, were of the opinion however that it was not sustainable over time and that a decoupling of service and access provision will take place in the mobile domain. With regard to the desirability of the different models, the vast majority of respondents internal to TMNL referred to the operator centric as the most desirable one. This contrasts sharply with the answers of the respondents external to TMNL, of which none referred to this model as the most desirable one.

This section will present the evaluation of the operator centric model with the framework constructed earlier in the research project. It is based on a more elaborate analysis of the model that can be found in appendix D2.

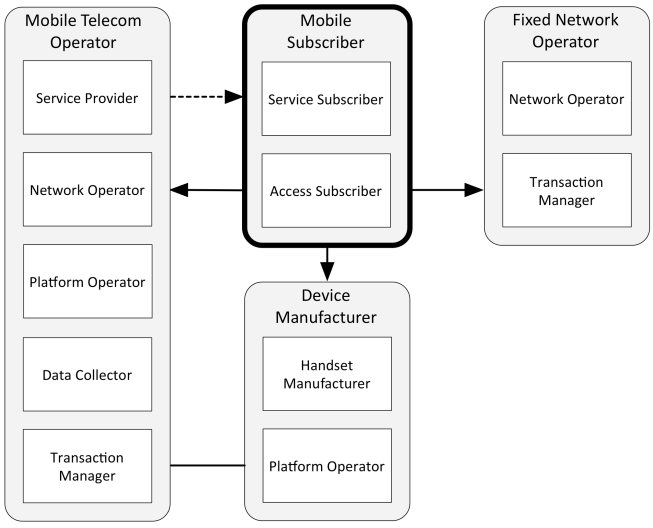


Figure 45: Value network of the operator centric model

Network Governance

The mobile telecom operator plays a central part in the value creating process within the operator centric model. It fulfills all roles related to the service provision and controls the majority of resources necessary for the service provisioning. As a result of the shift towards fixed-mobile convergent service provision, the operator's service portfolio can be accessed over different access networks. This entails that a fixed network operator will also be able to provide the end-user connectivity and thereby take part in the value creating process. This doesn't create a relationship of dependency between the mobile telecom operator and the fixed network operator but it does introduce a new dependency relationship for the mobile subscriber; he will now be dependent on two actors for his connectivity. His dependency on the mobile telecom operator will remain a lot stronger however.

With the emergence of the mobile operating system and the shift of the operator's communication services from the main functionality of the handset to 'one-of-many functionalities', the relationship between the mobile telecom operator and the device manufacturer has become one of mutual interdependency. One the one hand the operator still has a fair amount of buying power due to the scale of its wholesale purchases. However on the other hand, the operator will be dependent on the device manufacturer for support of its communication service client.

When looking at the distribution of the bottleneck resources that are related to gatekeeper roles within the value network (see table 11 below), the mobile telecom operator has control over each of them though not exclusively. By being both the communication service provider and customer service provider, the operator functions as the point of reference for the customer's service usage and therefore has ownership of the customer relation. By having exclusive access an extensive amount of information about the customer, the operator has ownership of the customer data. Furthermore, the operator has the ability to determine the pricing of the service and thereby the positioning of the service within the market and does both the billing and the collection of payments in house. This endows it with ownership of the customer transaction as well. Finally, the platform facilitating the interaction between the communication services and the service subscribers resides in the control layer of the operator's network architecture in combination with a software client on the subscriber's handset. Both the mobile telecom operator and the device manufacturer therefore fulfill the role of platform operator and therefore determine the available service functionalities. This entails that both actors have partial control of the service creation environment.

	Resource Dependencies										**Gatekeeper Roles**			
Dependent on: / **Actors**	**Mobile Telecom Operator**	**Device Manufacturer**	**Mobile Subscriber**	**Fixed Network Operator**	Mobile Network Operator	Communication Service Provider	Service Aggregator	Advertiser	Financial Intermediary		**Ownership of the customer relation**	**Ownership of the customer data**	**Ownership of the customer transaction**	**Ownership of the service creation environment**
Mobile Telecom Operator	x				-	-	-	-	-					
Device Manufacturer		x			-	-	-	-	-					
Mobile Subscriber			x		-	-	-	-	-					
Fixed Network Operator				x	-	-	-	-	-					
Mobile Network Operator	-	-	-	-	x	-	-	-	-		-	-	-	-
Communication Service Provider	-	-	-	-	-	x	-	-	-		-	-	-	-
Service Aggregator	-	-	-	-	-	-	x	-	-		-	-	-	-
Advertiser	-	-	-	-	-	-	-	x	-		-	-	-	-
Financial Intermediary	-	-	-	-	-	-	-	-	x		-	-	-	-

Table 11: Resource dependencies and division of gatekeeper roles in the operator centric model

The analysis of the amount of value network control bestowed to the mobile operator in the operator centric model concludes that the mobile operator takes up a central position in the value creating process and has control of the most important resources. With the extension of the service platform from the operator's network core towards the mobile handset, the device manufacturer takes up an important role in the value creating process as well. This is both visible in the dependency of the operator on this actor as well as the distribution of the gatekeeper roles.

Network Performance

The operator centric model displays a high degree of vertical integration of mobile telecom operator into the value creating process. Though parts of the service creation environment also reside in the mobile handset, there is a tight coupling between the platform on the handsets and the platform in the mobile telecom operator's network architecture. Therefore this second service platform does not signify a separation between network and service functionalities. This tight integration slows down service evolution: changing the functionality of a service also requires making changes to the network, a costly and time-consuming endeavor (Sauter, 2009). This makes it less flexible and able to respond quickly to market developments.

Accompanying the high degree of vertical integration on behalf of the mobile telecom operator into the value creating process, is a low degree of network openness. Since the service functionalities are embedded into the operator's network architecture, the system is not modular or transparent. Therefore there is little to no room for an ecosystem of complementary products to come into existence and the value network performance would not seem to lead to a high level of innovation within the industry.

6.3.2 Device Centric Model

This section presents the analysis of the device centric model, depicted in the figure below. Tough many of the respondents, both internal and external to TMNL, expected the operator centric and the service centric model to coexist in parallel, some differences of opinion existed on whether this would be in the form of the device centric model with a central and determining position for the device manufacturer. As put forth in appendix D1, the main argument for the latter was the emergence of Android, Google's open source mobile operating system. This is seen as disruptive to the device centric model because it takes away the device manufacturer's control over the applications running on his handset. It will give the handset a much more supporting position as it will mainly function as a more enabling platform like it does in the service and the aggregator centric model. In general this model was not perceived as very likely or sustainable.

It was referred to as the second most desirable one by a number of respondents internal to TMNL, when taking into account that the operator centric model will not be sustainable over time. They referred to the device centric model because this configuration would still place service related roles with the operator.

This section will present the evaluation of the device centric model with the framework constructed earlier in the research project. It is based on a more elaborate analysis of the model that can be found in appendix D2.

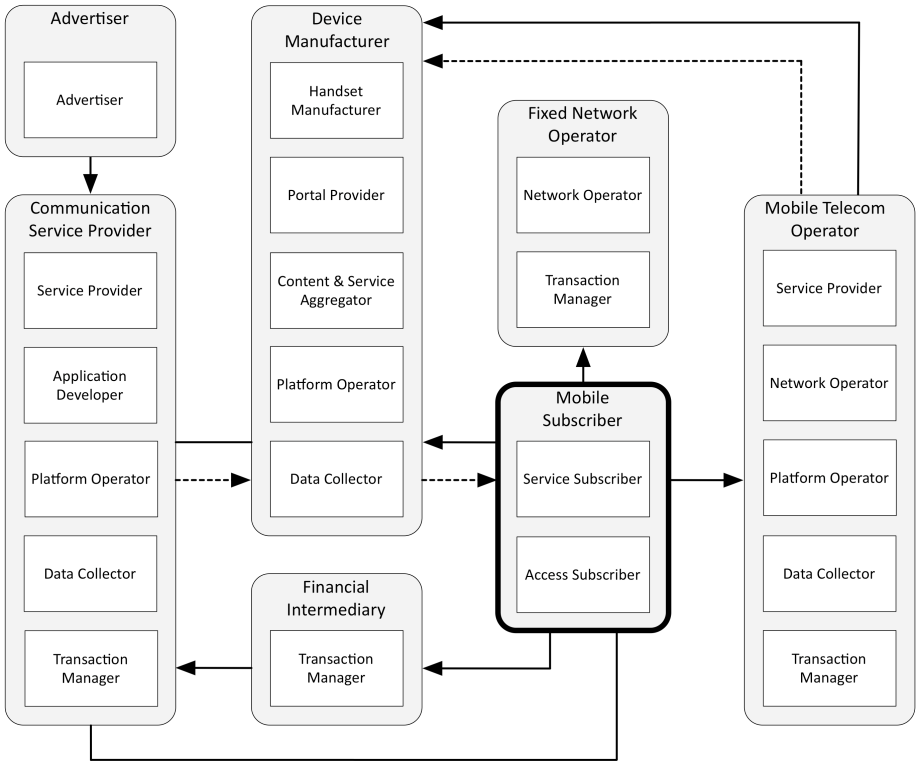


Figure 46: Value network of the device centric model

Network Governance

Because the mobile subscriber has two communication service providers in this model, he is less dependent on them in comparison to the operator and the service centric model. Both the mobile telecom operator and the Internet-based service provider control resources that are critical to the subscriber, however they are direct substitutes of each other which entails that alternatives are present in the model for both services. Both of these actors also have a relation of mutual dependency with the device manufacturer. Similar to the operator centric model the mobile operator is dependent

on the device manufacturer for the support of its communication software client when migrating its service provision towards an IP-based environment. On the other hand the operator will still be a wholesale customer of the device manufacturer, endowing it with a fair amount of buyer power.

The Internet-based communication service provider and the device manufacturer are dependent on each other as well, but less in balance as the relationship described above. This is also visible in table 12. The device manufacturer is only slightly dependent on the communication service provider's application for its functioning as a communication device because it still supports the operator's services. Furthermore it may also be somewhat reluctant in integrating applications into its handsets handset's operating system because of pressure by the mobile operator. This increases the amount of discretion the device manufacturer has towards the Internet-based parties regarding the availability of its resources. These latter parties on the other hand are highly dependent on the device manufacturer for access towards the device's functionalities and a platform to access their end-users.

In this value network model both the mobile operator and the device manufacturer have ownership of certain aspects of the customer data as well as ownership of a service creation environment. Because both the operator's voice service provision and Internet-based communication service provision are integrated into this configuration, services can be developed in the operator's network core as well as on the mobile operating system. The device manufacturer functions as the starting point for the subscriber's service provision. This gives it the ownership of the customer relation and more potential influence in the value network. However in this model, the mobile operator is an important wholesale customer of the device manufacturer. This gives the operator buyer power and thereby leverage over the device manufacturer that mitigates the ownership of the customer relation as a source of value network control.

The control ownership of the customer relation as well as of the service creation environment does give the device manufacturer some power over Internet-based communication service providers since they are highly dependent on its resources. The latter are also disadvantaged in their relation to the customer in comparison to the mobile operator because the operator has a double function in this model as a fully integrated service provider and as the provider of wireless broadband connectivity.

	Resource Dependencies										Gatekeeper Roles			
Dependent on: / Actors	Mobile Telecom Operator	Communication Service Provider	Device Manufacturer	Mobile Subscriber	Advertiser	Financial Intermediary	Fixed Network Operator	Mobile Network Operator	Service Aggregator		Ownership of the customer relation	Ownership of the customer data	Ownership of the customer transaction	Ownership of the service creation environment
Mobile Telecom Operator	x							-	-					
Communication Service Provider		x						-	-					
Device Manufacturer			x					-	-					
Mobile Subscriber				x				-	-					
Advertiser					x			-	-					
Financial Intermediary						x		-	-					
Fixed Network Operator							x	-	-					
Mobile Network Operator	-	-	-	-	-	-	-	x	-		-	-	-	-
Service Aggregator	-	-	-	-	-	-	-	-	x		-	-	-	-

Table 12: Resource dependencies and division of gatekeeper roles in the device centric model

Network Performance

In this model, the mobile operating system functions as a central service platform. Because it supports the fully integrated front-to-end operator's mobile voice service provision as well as the decentralized end-to-end Internet-based service provision, there is only room for an ecosystem of complementary products in the latter part of it. However, due to the dependency relationship between the mobile operator and the device manufacturer, the ability of third-party service developers to integrate their services into the handset may be interfered with and limited by the mobile operator.

The actual integration of these third-party services into the handset's functionalities also makes the service creation environment less transparent compared to the service centric model. There are no publicly available SDKs, instead the development and integration has to be done in cooperation or alliance with the device manufacturer. This lack of autonomy of the third-party service developer hampers the innovative ability of the ecosystem and thereby the performance of the value network.

6.3.2 Service Centric Model

This section presents the analysis of the service centric model, depicted in the figure below. As stated in appendix D1, most respondents perceived the decoupling between service and access provision that is present in this model as very likely to manifest itself in the mobile domain. But also that the service centric model will coexist in parallel with the operator centric model for the years to come and will not become the de facto standard within the timeframe considered in this research project. It was considered to be the most desirable value network model by the respondents external to TMNL, while being viewed as disruptive and undesirable by most of the respondents internal to TMNL.
The rest of this section will present the evaluation of the service centric model with the framework constructed earlier in the research project. It is based on a more elaborate analysis of the model that can be found in appendix D2.

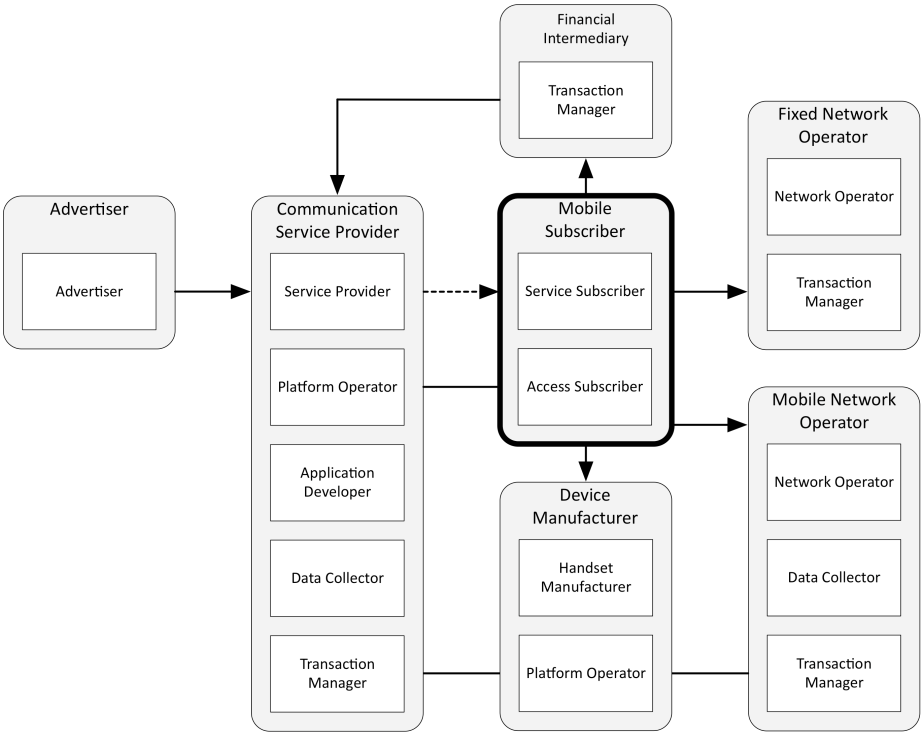


Figure 47: Value network of the service centric model

Network Governance

Table 13 shows both the relationships of resource dependencies and the division of the gatekeeper roles in the service centric model. Due to the carrier-independent properties of the Internet-based service provider, the subscriber is dependent on both network operators for the provision of connectivity. Its dependence on the mobile network operator is stronger than on the fixed network operator however, because the former has nation-wide coverage.

As a platform the device manufacturer is dependent on the applications it supports for its attractiveness towards the subscribers. On the other hand, the communication service provider is dependent on the device manufacturer for the support of his application by the mobile operating system, the platform. The sustainability of this latter source of dependency is questionable however because the interaction between the subscriber and the third-party service provider is expected to eventually be facilitated by the Internet browser of the mobile device rather then the mobile operating system.

Due to the separation of the role of access provider and service provider, the dependency relation between the mobile network operator and the device manufacturer will be less strong compared to the operator centric model. First of all, the operator's network won't be the only one supported by the device anymore. Second of all, the operator is very likely to drop or lower handset subsidies in this model, making its sales channels less important for the device manufacturer. Device manufacturers will look for alternative sources of subsidy to be able to realize lower market prices of their handsets such as alliances with application developers to pre-install their client on the handset.

Looking at the division of gatekeeper roles, it clearly shows that the communication service provider fulfills most of them. Its options to actually leverage this influence as a source of control over other actors are limited however. As the sole provider of communication services in this model, it has exclusive ownership of the customer relationship and the ability to influence its service usage. It shares the ownership of the customer data with the mobile network operator as both actors have a large amount but also different information about the subscriber. The subscriber has multiple financial relationships with actors that all have a direct financial benefit from his service usage. Because the Internet-based service provider is the only actor with the ability to determine the pricing of the communication service provision it has the ownership of the customer transaction. The ability to leverage this bottleneck resource as a source of control is very limited however, because it has no influence on the pricing of the other actors in the value network. Furthermore, the ownership of the service creation environment is only endowed the device manufacturer. With its control over the mobile operating system it is determinant for the software clients that are able to run on the handset and has a certain amount of influence on the abilities for third-party service provision. Again, the ownership of this bottleneck resource is not considered to be sustainable over time.

Due to the decentralized organizational structure with loose couplings between the different actors, there is no single actor that has substantial and/or sustainable control over the value network as a whole. Though the Internet-based communication provider has control over the majority of bottleneck resources, it has little ability to leverage it as a source of control in the value network.

	Resource Dependencies										Gatekeeper Roles			
Dependent on: / **Actors**	**Mobile Telecom Operator**	**Communication Service Provider**	**Device Manufacturer**	**Mobile Subscriber**	**Advertiser**	**Financial Intermediary**	**Fixed Network Operator**	Mobile Telecom Operator	Service Aggregator		**Ownership of the customer relation**	**Ownership of the customer data**	**Ownership of the customer transaction**	**Ownership of the service creation environment**
Mobile Network Operator	x							-	-					
Communication Service Provider		x						-	-					
Device Manufacturer			x					-	-					
Mobile Subscriber				x				-	-					
Advertiser					x			-	-					
Financial Intermediary						x		-	-					
Fixed Network Operator							x	-	-					
Mobile Telecom Operator	-	-	-	-	-	-	-	x	-		-	-	-	-
Service Aggregator	-	-	-	-	-	-	-	-	x		-	-	-	-

Table 13: Resource dependencies and division of gatekeeper roles in the service centric model

Network Performance

Due to the decentralized distribution of roles in the service centric model and its consequence that the ownership of the customer relation and the ownership of the service creation environment reside with different actors there is no single central service platform in the model. Rather it lies in the combination of the mobile operating system and the communication software client. Therefore it is difficult to make claims about the competitiveness of the platform.

However it is possible to assess the overall performance of the value network as a whole. Since no actor shows a large amount of vertical integration into all aspects of the value creating process and service developers have a large amount of flexibility the model enables short design-cycles and the ability to respond quickly to customer demands. The software platform that functions as the service creation environment, the mobile operating system, is quite transparent for third-party service developers and provides them with the ability to innovate using its technology by offering SDKs. However limitations are set on the actual availability of these services to the end-user because the most of the device manufacturers control the distribution channels of these applications as well. Therefore this model produces a high degree of innovativeness, but with some constraints.

6.3.4 Aggregator Centric Model

This section presents the analysis of the aggregator centric model, depicted in the figure below. Only one respondent expected the aggregator centric model to become dominant and saw it as the most desirable one (see appendix D1). His rational behind this was the importance of a single and central user interface for multiple services, not only for communication services but for web services as well. In general however, this model was very much seen as an intermediary solution to unify the access to Internet-based communication services as long as they aren't interoperable. Both by the respondents internal and external to TMNL. Some respondents expected this interoperability to eventually be arranged on an architectural level anyway, thus taking away the necessity of an aggregating client. Furthermore, the service aggregator was not expected to become the dominant party due to the little added value it offers over the communication services it combines and its limited customer lock-in
This section will present the evaluation of the service centric model with the framework constructed earlier in the research project. It is based on a more elaborate analysis of the model that can be found in appendix D2.

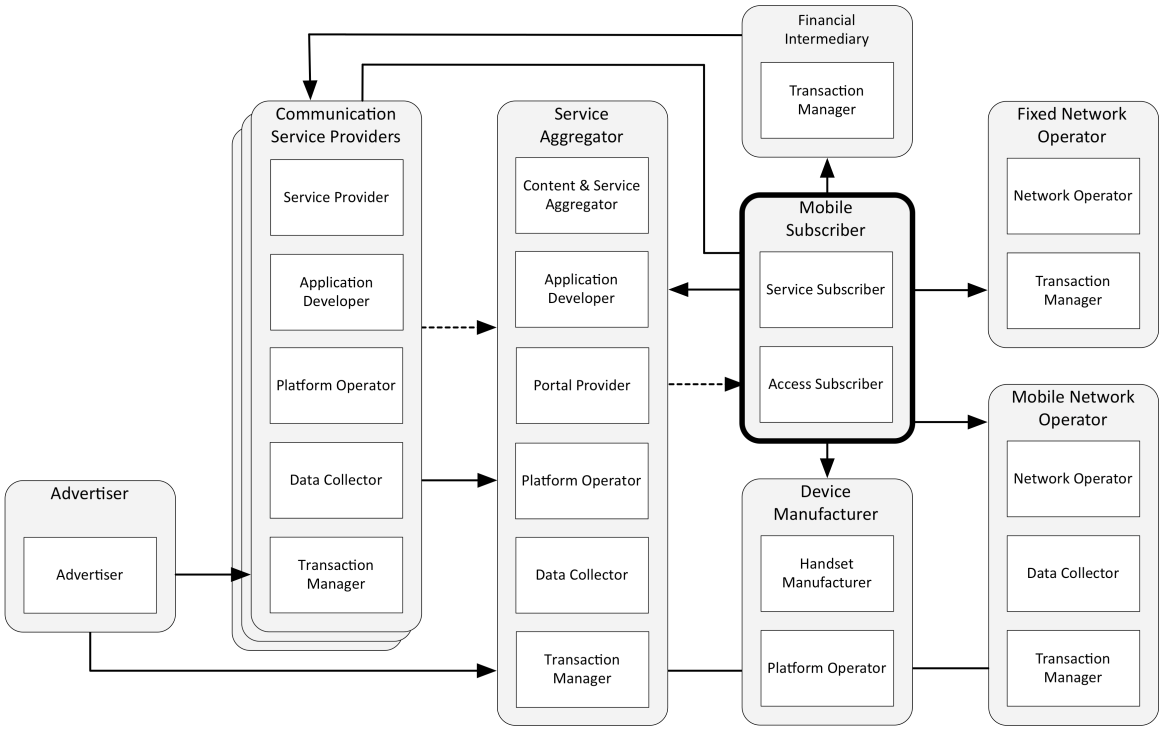


Figure 48: Value network of the aggregator centric model

Network Governance

The aggregator centric model displays an even more decentralized distribution of roles among the actors then the service centric model. As a consequence it involves the largest number of actors and contains the largest amount of dependency relationships compared to the other value network models.

The aggregator centric model integrates multiple Internet-based communication services in a single user interface. Through the parallel usage of multiple services, the subscriber is dependent on each of the communication service providers for a certain part of his communication service usage because his contacts are distributed over them. This entails that the subscriber is strongly dependent on the communication service providers as a group, however less dependent on each of them individually. This relation is therefore less strong compared to the service centric model. Because the service aggregator's added value is combining different Internet-based communication services, he is

dependent on these services for the actual communication service provision. This relationship of dependency is not mutual however, because the communication providers may just as well offer their services directly to the subscriber with their own software client on a handset. This lack of a lock-in mechanism is also visible in its relationship with the mobile subscriber. The aggregator provides some added value by providing a unified interface to the different communication services, but the subscriber still has separate user profiles with each of the service providers. There is no lock-in with the aggregating service and therefore it is easily swapped for another service aggregator. This entails that the subscriber's relationship with the communication service provider will remain stronger than its relationship with the intermediating aggregator.

Similarly the gatekeeper roles are distributed over multiple actors. The communication service providers have ownership of the customer relation, but their individual influence on the subscriber is limited because they have to share the customer relationship amongst each other since the subscriber uses different services in parallel. Both the service aggregator and the mobile operator have insight into certain aspects of customer data and therefore own the customer data. With regard to the ownership of the customer transaction, the Internet-based service providers have the ability to independently determine the pricing of the communication service provision. However, just like in the service centric model, the ability to leverage this bottleneck resource as a source of control is very limited, because it has no influence on the pricing of the other actors in the value network. Again, the device manufacturer has the ownership of the service creation environment, giving it a certain amount of control over the services on its platform. However, as mentioned before, the sustainability of this latter source of dependency is questionable.

Due to the decentralized distribution of roles among the actors in the aggregator centric model there is no single actor that has substantial and/or sustainable control over the value network as a whole.

	Resource Dependencies										Gatekeeper Roles			
Dependent on: / Actors	Mobile Telecom Operator	Communication Service Provider	Device Manufacturer	Service Aggregator	Mobile Subscriber	Advertiser	Financial Intermediary	Fixed Network Operator	Mobile Telecom Operator		Ownership of the customer relation	Ownership of the customer data	Ownership of the customer transaction	Ownership of the service creation environment
Mobile Network Operator	x								-					
Communication Service Provider		x							-					
Device Manufacturer			x						-					
Service Aggregator				x					-					
Mobile Subscriber					x				-					
Advertiser						x			-					
Financial Intermediary							x		-					
Fixed Network Operator								x	-					
Mobile Telecom Operator	-	-	-	-	-	-	-	-	x		-	-	-	-

Table 14: Resource dependencies and division of gatekeeper roles in the aggregator centric model

Network Performance

Similar to the service centric model, the ownership of the customer relation and the ownership of the service creation environment reside with different actors. Therefore there is no central service platform in this model as well and claims can only be made about the overall performance of the value network as a whole.

There is no direct relation between the communication service provider and the device manufacturer due to the intermediary position of the aggregator's client. Furthermore the aggregator is more dependent on the communication service provider then the other way around. This gives the latter more autonomy and enhances its innovative ability.

The opposite is true for the service aggregator however. In providing its services the aggregator is highly dependent on two different software platforms that are both not fully transparent; the Internet-based communication service provider and the device manufacture. This hampers its ability to innovate on the basis of these platforms. So while the value network as a whole promotes service development, the central actor is limited in its abilities to offer them to their full extent to the customer.

6.4 Re: Sources of Sustained Competitive Advantage

This section will provide an answer to the sixth sub-question of this research project and analyze what the operator's basis should be for the development of its real-time person-to-person communication service provision for the upcoming fully IP-based telecom environment. Before being able to give an advice to TMNL about how it should develop its voice service provision, an overview must be gained of the strengths of its current service provision. Following Barney's resource-based view of the firm as elaborated on in section 2.3, in order to gain competitive advantage a company

- must **base its strategy on its strengths**, because that (along with its weaknesses) it what makes it distinctive and
- can only **develop its future strengths from today's strengths**, shifting the focus of strategic analysis from the industry to the company itself.

During the interviews, the respondents were asked to identify those resources that gave the mobile operator an advantage in competing with Internet-based service providers. The same question was asked for the situation the other way around. The following two sections give an overview of the answers of the respondents, first from the operator's perspective and then from the Internet-based service provider's perspective. The interview results are discussed in further detail in appendix E.

6.4.1 Operator Specific Resources

The table below shows an overview of the resources that were identified during the interviews as sources of competitive advantage for the mobile operator vis-à-vis Internet-based communication service providers. This table discerns between those respondents that were internal and external to TMNL in order to make the results more transparent and expose any subjectivity that may be present in the answers.
In appendix E1, a number of visual representations of the respondents' answers are presented. Drawn up by ATLAS.ti, these figures discern between the answers of the two different groups of respondents. Furthermore they state the frequency with which the respondents mentioned each of the resources and are accompanied with a table that provides a short description of each of the resources in the figures. Because of the qualitative approach that was chosen for the empirical research, these numbers cannot be applied as weights for the different resources. They do however give insight into the more obvious ones. Furthermore there is some overlap between the resources mentioned by the respondents. Therefore some resources have been aggregated according to the table presented in appendix E1. Those resources that were mentioned more frequently were leading in the process of aggregation.
Following the categorization by Collis & Montgomery (1998) presented in section 2.3, the following resources were put forward by the respondents during the interviews:

	Tangible Resources	Intangible Resources	Organizational Capabilities
Respondents internal to TMNL	- Network infrastructure - Billing infrastructure - Customer service channels	- Long-lasting service relation - Customer relation - Customer data - Customer billing relation	- Front-to-end service provision - Interoperability
Respondents external to TMNL	- Network infrastructure - Billing infrastructure - Customer service channels	- Long-lasting service relation - Customer data - Customer billing relation	- Front-to-end service provision

Table 15: Categorization of operator specific resources

When comparing the answers of the different groups of respondents, it shows that the majority of resources were mentioned by the respondents internal as well as external to TMNL. All resources except for 'customer relation' and 'interoperability' can therefore be seen as not being subjective from the point of view of TMNL employees and be taken into account. The interoperability between the operators' network resources and services had surfaced earlier in this research project during the analysis of the telecom domain. It is viewed by this research project as a discerning factor between the operator and the Internet-based service providers and will therefore be taken into account as well. The customer relation however is very much dependent on the configuration of service provision and not exclusively endowed to the mobile operator, as was clearly visible in the analyses of the different models in section 6.3. This research project therefore agrees with the respondents external to TMNL to omit this resource. Taking these considerations into account, the following operator specific resources are eligible as sources of sustained competitive advantage for the mobile operator:

Tangible Resources	Intangible Resources	Organizational Capabilities
- Network infrastructure - Billing infrastructure - Customer service channels	- Long-lasting service relation - Customer data - Customer billing relation	- Front-to-end service provision - Interoperability

Table 16: Operator specific resources aggregated

6.4.2 Internet Specific Resources

In chapter two, the concept of a sustained competitive advantages was defined as 'a value creating strategy not simultaneously being implemented by any current or potential competitors and when these other firms are unable to duplicate the benefits of this strategy' (Barney, 1991). To get an overview of those strengths of the mobile operator that may form the basis of a sustained competitive advantage in an IP-based service environment, insight must be gained of the strengths of its competitors within that environment as well. Table 17 below shows the strengths of Internet-based service providers that were mentioned by the respondents. They are described in further detail in appendix E2.
Similar to the operator specific resources some of them have been aggregated. A table showing these choices is also presented in appendix E2. Following the same categorization as the operator specific resources, the Internet specific resources can be grouped into the following segments:

	Tangible Resources	Intangible Resources	Organizational Capabilities
Respondents internal to TMNL	-	- Image - Customer relation - Customer data - User communities	- Clout in service development - Cost-efficiency - Flexibility - Worldwide presence - Non-commitment
Respondents external to TMNL	-	- Image - Customer data	- Clout in service development - Flexibility - Worldwide presence

Table 17: Categorization of Internet specific resources

The overview in table 17 has two interesting properties. First of all, both the respondents internal as well external to TMNL mentioned no tangible resources that could form a source of competitive advantage. Secondly, all resources mentioned by the latter group of respondents were mentioned by the former group as well. With respect to the first point, this research project recognizes that the answers may have been biased towards the Internet-based activities of these service providers and do not take into account the physical resources needed for the service provision such as service platforms and data centers. However these resources cannot be viewed as possible sources of competitive

advantage because they can easily be acquired and implemented by other actors as well. Furthermore they are also present in the operator's network architecture and would therefore not constitute a competitive advantage vis-à-vis this actor.
Then there are the differences in the answers between the different respondents. Similar to the operator specific resources, respondents internal to TMNL mentioned the customer relation as a source of competitive advantage. Due to its non-exclusive nature however, this resource cannot constitute a sources of sustained competitive advantage and will therefore not be taken into account. In the view of this research project, the other differences do not exhibit a subjective or negatively biased view of the Internet-based service provider by the respondents internal to TMNL and will therefore be taken into account. This leads to the following list of Internet specific resources that are eligible as sources of sustained competitive advantage for the Internet-based service provider:

Tangible Resources	Intangible Resources	Organizational Capabilities
-	- Image - Customer data - User communities	- Clout in service development - Cost-efficiency - Flexibility - Worldwide presence - Non-commitment

Table 18: Internet specific resources aggregated

6.4.3 Comparison Between the Two Types of Actors

The table below summarizes the previous findings and presents them in a way that they can be compared.

Type of Actor:	Tangible Resources	Intangible Resources	Organizational Capabilities
Mobile Operator	- Network infrastructure - Billing infrastructure - Customer service channels	- Long-lasting service relation - Customer data - Customer billing relation	- Front-to-end service provision - Interoperability
Internet-based Service Provider		- Image - Customer data - User communities	- Clout in service development - Cost-efficiency - Flexibility - Worldwide presence - Non-commitment

Table 19: Operator and Internet specific resources

The most striking difference between the two types of actors is the fact that Internet-based service providers have no tangible resources that can be leveraged as a source of competitive advantage. The disposition over a network infrastructure and the accompanying frequency spectrum licenses has already been identified as a resource that other actors in a value network constellation are dependent on. A network infrastructure with nation-wide coverage is a unique asset of mobile operators and not easily duplicated by other actors. These aspects make the operator's network infrastructure a source of sustained competitive advantage. Furthermore, the operator has its own billing infrastructure and customer service channels. Though these resources can easily be duplicated on a small scale, TMNL has multiple large call centers, 83 shops across the Netherlands and a billing infrastructure that handles a customer base of about 5.4mln subscribers. Because of the large scale of TMNL's billing infrastructure and customer service channels, these two resources can be seen as sources of sustained competitive advantage as well.
Concerning the intangible resources, there is some overlap between the mobile operator and the Internet-based service provider; they both have insight into a large amount of customer data. This was

also visible in the division of gatekeeper roles of the different models discussed in section 6.3. What does set the mobile operators apart is that due to the longevity of their relation with the subscriber. Mobile subscribers are very familiar with mobile communication services from the mobile telecom, and have been using them for years now. It will therefore be likely that they will initially look towards the mobile operator for the provision of communication services in the future as well. Similarly, the operator has a long lasting billing relationship with its subscribers. These intangible resources make the operator's services very intuitive to its end-users, which it not easily duplicated by Internet-based service providers. They can therefore be seen as sources of sustained competitive advantage.

Internet-based services providers on the other hand, have a more appealing and engaging image and the appearance of providing services for free or at least as cheap as possible. Furthermore their users are more organized in communities that organize their own customer support channels. These intangible resources are distinctive for Internet-based service providers hard to duplicate as well. Therefore they are source of competitive advantage on their behalf.

A strong organizational capability of the mobile operator is its ability to provide front-to-end service provisioning. Because it controls both the service platform of its own services (the network core) and the access network used to provide them to its subscribers it has control over all service related aspects. This provides it with a fair amount of control over the quality of its service provision and enables it to offer the full service package to its subscribers; with a single subscription they have everything necessary for mobile communication. Furthermore, due to the industry wide standardization in the telecom sector the network technologies and services of the mobile operators are interoperable. This greatly enhances the direct network effects of the operator's services. Because of the large amount of proprietary software and tendency of Internet-based communication service providers not to interconnect amongst each other, this organizational capability of the operator can be seen as a source of sustained competitive advantage as well.

Many of the organizational capabilities of the Internet-based service providers are derived from being in the exact opposite situation as the mobile operator. Because of their carrier-independent nature and lack of interconnection among each other they are far more flexible and autonomous in service development. These abilities enable them to quickly respond to market needs and give it far more clout in service development compared to the mobile operator. Due to the constant need of the operators to safeguard interoperability and reach industry wide consensus, this clout is a strong source of sustained competitive advantage of the Internet-based service providers. Their ability to develop and provide services independent of the underlying infrastructure makes this process a lot more cost-efficient and enables a single service provider to provide its services on a worldwide scale. These competitive advantages are sustained as well. Finally, their services have a certain degree of non-commitment to them that lowers the barriers to try them out. Using an Internet-based service usually requires the creation of a user profile rather then becoming a subscriber. This cannot be regarded as a source of competitive advantage however because a comparable configuration is possible with a mobile operator in the form of a prepaid subscription. The sources of sustained competitive advantage of the two different actors that were identified in this section are summarized in table 20 below.

Type of Actor:	Tangible Resources	Intangible Resources	Organizational Capabilities
Mobile Operator	- Network infrastructure - Billing infrastructure - Customer service channels	- Long-lasting service relation - Customer billing relation	- Front-to-end service provision - Interoperability
Internet-based Service Provider		- Image - User communities	- Clout in service development - Cost-efficiency - Flexibility - Worldwide presence

Table 20: Sources of sustained competitive advantage

6.5 Conclusions

This chapter has provided the answers to the fifth and sixth sub-questions. It evaluated the four value network models with the framework for determining the viability of value network models for the provision of real-time person-to-person communication services and determined what the basis should be for a mobile operator in the development of its real-time person-to-person communication service provision for the upcoming fully IP-based telecom environment. This section will present a short recap of the chapter's findings.

6.5.1 Viability of the Value Network Models

After evaluating the different value network models with the framework it can be concluded that none of the models satisfies both conditions for a viable value network model. In those models where the governance structure was favorable for the mobile operator, the overall value network performance was assessed to be quite low. On the other hand, the models that did portray a high level of network performance, showed a very decentralized power structure and a very limited ability for the mobile operator to influence the value creation process. A short summary of each model's evaluation is presented in the table below.

	Network Governance	**Network Performance**
Operator Centric	**++** The mobile operator has full control over most of the bottleneck resources and takes up a central position in the value creating process. However its dependency on the service platform on the mobile handset makes it dependent on the device manufacture and limits its hegemony.	**- -** The tight integration between network and service provision in this model slows down service evolution. It makes the network less flexible and able to respond quickly to market developments and leaves little to no room for an ecosystem of complementary products to come into existence.
Device Centric	**+** The device manufacturer takes up a central position but shares most of its ability to exert control in the model with the mobile telecom operator. The device manufacturer functions as the starting point for the subscriber's service provision, giving it the ownership of the customer relation and more potential influence in the value network.	**-** Because this model supports both the fully integrated front-to-end operator's mobile voice service provision and the decentralized end-to-end Internet-based service provision, there is only room for an ecosystem of complementary services in latter part of it. However, due to the dependency relationship between the mobile operator and the device manufacturer, the ability of third-party service developers to integrate their services into the handset may be interfered with and limited by the mobile operator. Furthermore their service has to be fully integrated into the mobile operating system. This causes a decrease of autonomy of the third-party service developer hampers the innovative ability of the ecosystem.
Service Centric	**-** Due to the decentralized organizational structure with loose couplings between the different actors, there is no single	**+ +** The software platform that functions as the service creation environment, the mobile operating system, is quite

	actor that has substantial and/or sustainable control over the value network as a whole. Though the Internet-based communication services provider has control over the majority of bottleneck resources, it has little ability to leverage it as a source of control in the value network.	transparent for third-party service developers and provides them with the ability to innovate using its technology due to the availability of SDKs. However limitations are set on the actual availability of these services to the end-user because the most of the device manufacturers control the distribution channels of these applications as well. Therefore this model produces a high degree of innovativeness, but with some constraints.
Aggregator Centric	**-** The aggregator centric model displays an even more decentralized distribution of roles among the actors then the service centric model. As a consequence it involves the largest number of actors and contains the largest amount of dependency relationships compared to the other value network models. Due to the decentralized distribution of roles among the actors in the aggregator centric model there is no single actor that has substantial and/or sustainable control over the value network as a whole.	**+** In providing its services the aggregator is highly dependent on two different software platforms that are both not fully transparent; the Internet-based communication service provider and the device manufacture. This hampers its ability to innovate on the basis of these platforms. So while the value network as a whole promotes service development, the central actor is limited in its abilities to provide them to the customer.

Table 21: Evaluation Summary

Network Governance

The analyses of the network governance structures of the four value network models and the amount control the different actors have in them showed that the more decentralized the division of roles amongst actors is, the less control a single actor has over the other actors in the network and the value creating process. None of the models contains a single actor that controls all of the bottleneck resources; rather they are divided among different actors in the network and become non-exclusive. In comparison to TMNL's current voice service provision, the models portray a gradual shift and decrease of the operator's control over the value network, both in its disposition over bottleneck resources and its relationships of dependency with the other actors.

All four models for the provision of communication services in an IP-based environment show a clear position of the mobile handset as the service creation environment. Even in the operator centric model, the mobile telecom operator shares the role of platform operator and thereby the control over the service creation environment with the device manufacturer. While the latter actor gains an increased ability to determine service functionalities, it's becoming less dependent on the mobile operator. On the other hand, Internet-based communication service providers are dependent on the device manufacturer for the support of his application by the mobile operating system. With its control over the mobile operating system it is determinant for the software clients that are able to run on the handset and has a certain amount of influence on the abilities for third-party service provision. The sustainability of this latter source of dependency is questionable however because the interaction between the subscriber and the third-party service provider is expected to eventually be facilitated by the Internet browser of the mobile device rather then the mobile operating system.

The emergence of a number of actors in the mobile domain and the division of these gatekeeper roles create a complex set of (inter-) dependency relationships between the actors in the value networks, limiting the ability to actually leverage these roles. Due to the increasingly decentralized organizational structure with loose couplings between the different actors, there is no single actor that has

substantial and/or sustainable control over the value network as a whole. As the different models are expected to coexist it is clear that the mobile operator will loose a fair amount of control over the value creating process. Its position as the mobile network operator will still make it indispensible, but it depends on how he leverages this whether this will provide it with a source of control and a way to provide added value.

Network Performance

The increased decentralization of service provision drives the mobile domain towards a more open market model. The emerging decoupling of service and access provision gives the Internet-based service provider a large amount of autonomy and flexibility in its service development, which enhances the overall innovativeness of mobile communication service provision and provides room for an ecosystem of complementary products to come into existence. This decentralization and the separation of service and access provision may have a downside as well however, because of the discrepancy that arises between service revenues and infrastructural investments. A situation where the mobile operator only is a provider of mobile access may turn it into a mobile bit-pipe. This will eventually lead to the marginalization of operator profits, limiting their free cash flow and possibly resulting in less network upgrading.

With the shifting of the service platform and service creation environment from the operator's network core towards the mobile operating system new walled gardens are raised; by influencing the distribution of applications that are able to run on their operating systems, device manufacturers put some restriction on the access that third-party service developers have towards their end-users. This makes these third party service developers dependent on the device manufacturer's resources and, similar to the classic walled garden model, it limits the incentive for service development and diminishes the innovative ability of the market model. The sustainability of these walled gardens are questionable however due to the emergence of open sourced mobile operating systems such as Google's Android, that shift the support of Internet-based applications from the mobile operating system towards the mobile browser.

On the service development side a number of large players are present. Their communication software clients are typically based on proprietary software and therefore not on open source coding. This entails that they provide neither openness nor transparent interfaces towards their services. Due to their market model they do not interconnect and all strive to gain as much users as possible. This lack or interconnectivity also makes the perceived direct network effects of a communication services very important, making it difficult for new players to enter the market.

Tradeoffs Between Control and Performance

The tradeoffs that were presented in section 2.6 are also visible in the analyses of the different models. First there was the tradeoff between discretion and transparency; the greater the degree of discretion an actor has in deploying a resource, the greater the dependence of others on it. But on the other hand, openness and transparency stimulate the development of complementary services and the overall innovativeness of the value network. In the operator centric model, the focus lies on control. Due to its fully integrated service architecture, it provides little transparency and modularity. However also in the more decentralized configurations such as the service centric and the aggregator centric model, actors put some restraints on the openness of their platform. This is clearly visible in the way that the device manufacturer provides an open programming interface to its operating system by issuing SDKs, while controlling the eventual distribution of the applications. This way it stimulates the overall value network performance while preserving a certain amount of value network control.

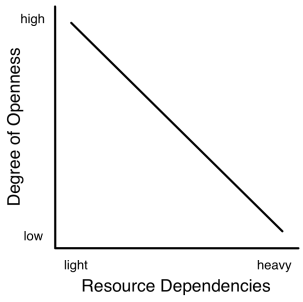


Figure 49: First tradeoff in the framework

Secondly there was the tradeoff between controlling and leveraging bottleneck resources and stimulating the coming into existence of a healthy service ecosystem. There is a difference between the ways different actors dealt with this tradeoff. While the device manufacturer doesn't fully exploit its ownership of the service creation environment and still provides an open interface to stimulate the development of complementary services, the mobile network operator and communication service provider are more focused on leveraging their gatekeeper roles than creating an ecosystem. They benefit more from control; either to be able to guarantee the QoS of its service provision, in case of the operator, or to be able to increase the direct network effects, customer base and indirect revenues in case of the latter.

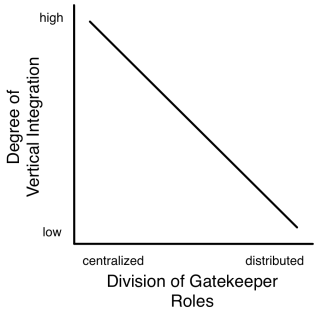


Figure 50: Second tradeoff in the framework

Likelihood & Desirability

Overall, the operator centric model was considered to be dominant in the following years, however not sustainable in the light of the developments in the mobile domain. Most respondents perceived the decoupling between service and access provision present in the service centric model as very likely to manifest itself in the mobile domain. However not within the timeframe considered in this research project; the operator centric model and the service centric model will remain to coexist in parallel for years to come. Interestingly enough, there was some discrepancy in the answers given by the different departments within TMNL. Although there was consensus about the emergence of Internet-based communication service providers as serious players in the mobile domain, there was a difference in how these players were viewed. The majority of respondents from the marketing and strategy departments were very much thinking in terms of the operator centric model and the (negative) impact of developments in the mobile domain as well as the emergence of alternative value networks on the position of the mobile operator and on its business model. Respondents from the technology department as well as the product & services department on the other hand had the tendency to view these Internet-based service providers not so much as a threat, but also as an opportunity. It were the latter respondents that most frequently mentioned the hybrid model discussed below.

Most respondents from TMNL referred to the operator centric model as the most desirable. When taking into account that this model will not be sustainable over time, they then chose for the device centric model because this configuration would still place service related roles with the operator. The respondents external to TMNL generally referred to the service centric model as the most desirable one.

Hybrid Value Network Model

Several respondents also put forward a value network model that was not among the generic models defined in this research project. In this model, the mobile operator takes up a more enabling role towards Internet-based service providers and provides added value by enabling these parties to make optimal use of its network resources. This 'hybrid model' will enable the mobile operator to leverage its network infrastructure as a service creation environment towards third-party service providers, providing it with an ability to create added value towards Internet-based service providers and thereby indirectly to its subscribers in a service centric environment. In a way this model resembles the service centric model, however it places the central service platform in the operator's network architecture. This will stimulate third-party service innovation while endowing the operator with a certain amount of control over the outcome of the value creating process. This way the emergence of these third-party (communication) service providers may prove to be an interesting source of revenue as well and not only a cause for decreasing service revenues. A possible configuration of this hybrid model is presented in the figure on the next page.

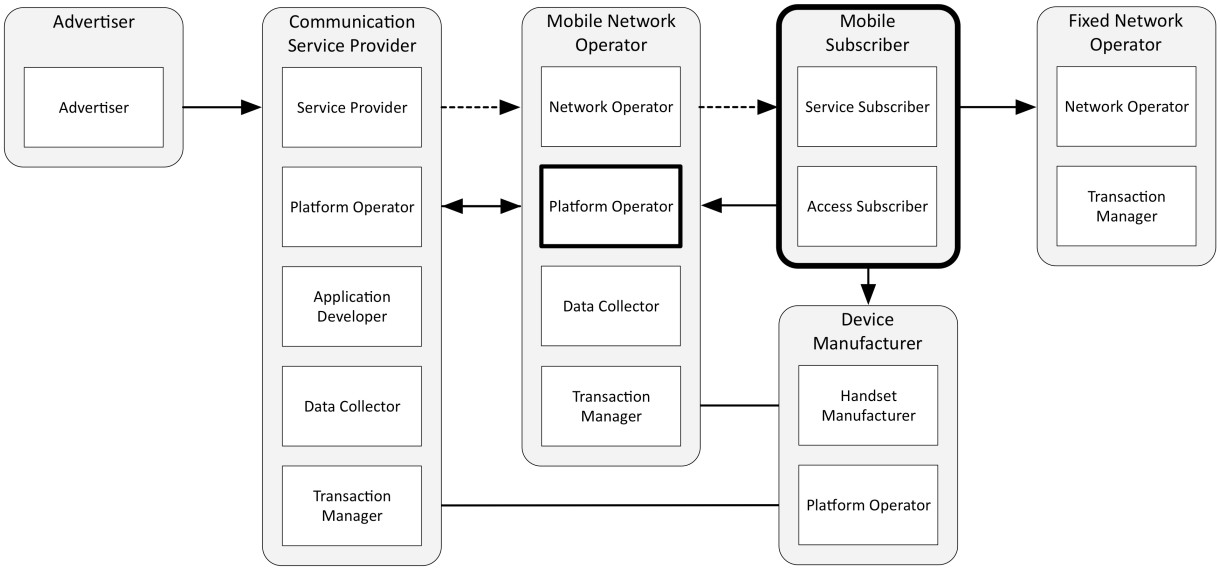


Figure 51: Possible configuration of a hybrid value network model

6.5.3 Sustained Competitive Advantages

The concept of a sustained competitive advantage was defined as 'a value creating strategy not simultaneously being implemented by any current or potential competitors and when these other firms are unable to duplicate the benefits of this strategy' (Barney, 1991). To get an overview of those strengths of the mobile operator that may form the basis of a sustained competitive advantage in an IP-based service environment, insight must be gained into the strengths of the mobile operator as well as its competitors within that environment.

The sources of sustained competitive advantage of the two different actors that were identified in this section are summarized in the table below. The table below clearly shows that as a mobile operator, TMNL should base it's strategy and develop it's future strengths on its physical resources, the amount familiarity with the operator's service provision and its ability to provide mobile connectivity with worldwide interconnectivity and a guaranteed quality of service.

Furthermore, it shows that when it comes to service development and innovative abilities, the Internet-based service provider has a clear advantage in terms of efficiency and effectiveness. It is therefore not advisable for a mobile operator to compete directly with these actors on a service level.

Type of Actor:	Tangible Resources	Intangible Resources	Organizational Capabilities
Mobile Operator	- Network infrastructure - Billing infrastructure - Customer service channels	- Long-lasting service relation - Customer billing relation	- Front-to-end service provision - Interoperability
Internet-based Service Provider		- Image - User communities	- Clout in service development - Cost-efficiency - Flexibility - Worldwide presence

Table 22: Sources of sustained competitive advantage

7 Conclusions & Recommendations

7.1 Conclusions

The market for mobile voice services is slowly reaching a point of saturation and the share in the revenue-mix of voice service provision is gradually decreasing. By providing open Internet access the mobile operators gave direct-to-consumer service providers the ability to make unpaid use of the operators' resources, which they can employ to provide their own mobile Internet services to the mobile subscribers. Amongst these third parties are VoIP providers, who may provide a substitute for the operators' voices services. At the moment, Internet telephony services are not able to deliver voice services with a quality comparable to that of the voice services of the operators due to the latency in the current network technologies. The introduction of the Long Term Evolution technology is about to change this however. The increased network capacity and fully IP-based network architecture will provide Internet telephony services with an infrastructure to deliver their services to mobile subscribers with comparable quality as the current PSTN communication services. In order to minimize the disruptive impact of these emerging communication services, mobile operators will have to look at ways to adapt their communication service provision in such a way that they keep their current customer ownership and remain their subscribers' preferred communication service provider in the upcoming fully IP-based environment. Instead of gradually losing their leverage and turning into a mere access provider while third parties provide all services: the bit-pipe scenario.
The objective of this research project was to give an advice to TMNL about how it should adapt its business model for the provision of voice services within this upcoming fully IP-based environment. This lead to the following research question:

How should TMNL provide real-time person-to-person communication services in order to achieve a sustained competitive advantage in the fully IP-based telecom environment that is expected to emerge in 2015?

This research project postulates that the operator centric model of communication service provision will not be sustainable in the light of the developments in the mobile domain. Though it will remain dominant for the following years, service and access provision will eventually become decoupled and there will be a shift in the mobile domain; a migration from an operator centric to a service centric paradigm. This will not take place within the timeframe considered in this research project however; the operator centric model and the service centric model will remain to coexist in parallel for years to come.
Mobile operators will have more competition due to the emergence of substitutive communication service providers and mobile access technologies. Their environment will become more complex due to an increase in (inter-) dependencies; where they used to be part of a relatively simple value chain consisting of network operators and hardware manufactures they now find themselves in a complex network of actors where value is co-created in the process of communication service provision. The mobile subscriber will have multiple customer relationships and look towards multiple parties as a point of reference for his service uptake.

In order to forty its position in this changing environment, TMNL must leverage its sources of sustained competitive advantage. It must base its strategy on its strengths and develop its future strengths from its current strengths. This entails that it should not only focus its strategic analysis on the mobile industry but also on the company itself. From this line of reasoning, TMNL should not limit itself by focusing on the negative impact of developments in its environment on the current model for voice service provisioning and approaching it from a Porterian point of view. Rather it should seek those

resources that are unique to its position as a mobile operator and use these as the starting point for the migration of their communication service provisioning towards an all-IP network environment.
The analysis of TMNL's sources of sustained competitive advantage have yielded the following results:

- TMNL should not leave the front-to-end service model and refrain from developing carrier-independent services
- TMNL should leverage the abilities of its physical resources, not only with regard to its own service provisioning but also towards third-party service providers
- TMNL should leverage the long-lasting service relation it has with its subscribers

This should be the basis for the provision of advanced mobile communication services in the fully IP-based telecom environment that is expected to emerge in 2015.
These elements satisfy the requirements that were derived from TMNL's mission and strategy in section 1.1.2. The first element gives the operator full control over the provision of its mobile communication services and therefore gives it the full ability to influence the value creating process. By opening up its network resources as a service to third-party service providers, it leverages its network as a central platform facilitating third-party (communication) service provision as well. This endows the operator a central role in the value creating process. Finally, by taking those services for which TMNL has a long lasting-lasting service relation with its subscribers as a point of departure and developing its IP-based service provision from there, it will keep a close relation with its subscribers and remain their main service provider.

In order to TMNL to implement a service configuration that does satisfy both conditions for a viable value network model, it must look for a model that incorporates aspects of both the operator centric and the service centric model. This thesis proposes a twofold strategy for achieving this situation that consists of *deploying fixed-mobile convergent communication services that maintain a tight coupling with the underlying infrastructure while nurturing an ecosystem of complementary third-party service providers through the provision of an open interface towards its network resources.*

In developing its service portfolio, TMNL should focus on those services that require a dedicated connection such as voice & video calling and in-call file sharing. By taking its mobile voice service provisioning, for which TMNL has a long lasting-lasting service relation with its subscribers, as a point of departure and by developing its IP-based service provision from there, TMNL will keep a close relation with its subscribers in this new environment.
It must acknowledge however that it does not have the organizational abilities to compete on equal terms with Internet-based service providers and thus not venture into the realm of Internet-based and carrier-independent services. Rather it should incorporate the merits of service centric model by leveraging its network infrastructure as a service platform towards third-party service providers. By putting forth its network as a platform, TMNL can draw a development community to its own network resources and partially shift the ownership of the service creation environment away from the mobile operating system and back to its own network. This will provide it with the ability to create added value in a service centric environment towards Internet-based service providers and thereby indirectly to its own subscribers by providing services such as carrier billing support and contextual information about the subscriber. It will open up new sources of revenue and stimulate third-party service innovation while endowing the operator with a certain amount of control over the outcome of the value creating process. This way TMNL can also differentiate in which types of services it will grant access to its resources and for instance deny these services towards Internet-based substitutes to its communication services provision while allowing it to services in the periphery of communication such as social media, presence and instant messaging.

7.2 Recommendations

The following sections will further elaborate the advice into specific recommendations on how TMNL should provide advanced mobile communication services in the fully IP-based telecom environment that is expected to emerge in 2015. They will be set forth according to the STOF approach in order to provide an holistic advice that takes into account the four interrelated aspects of service provisioning: services, technology, organization and finance. A roadmap for the recommended directives is added in appendix F.

7.2.1 Services

Focus on Front-to-end Service Provisioning

With the operator's inability to restrain their subscribers from using Internet telephony services by blocking these services on its network and to deliberately limit the QoS of these Internet-based services due to European legislation, TMNL will have to evolve its communication service provisioning and exploit the possibilities of an packet-switched service environment in order to provide more advanced services and keep on par with these emerging substitutes. However, in developing its service portfolio, TMNL should stick to those services that can be tightly coupled to its network infrastructure. It should not venture into the realm of Internet-based and carrier-independent services, since it does not have the organizational abilities to compete on equal terms with Internet-based service providers. With the shift towards IP-based service provision, service development will take place in much shorter design cycles. Due to their flexibility, cost-efficiency and clout in service development these latter actors have a sustained competitive advantages vis-à-vis the mobile operators with regard developing these services. For this reason there must a strong emphasis on the technological aspects of the different solutions for voice service provision TMNL can implement over LTE. Only those solutions should be considered that are tightly coupled to the network infrastructure. This will enable TMNL to leverage one of its most powerful network resources: its ability to seamlessly handover communication sessions between different mobile access networks, more specifically between packet-switched network infrastructures and the circuit-switched legacy network infrastructures.

With regard to the possible technological solutions for the provision of real-time person-to-person communication services that were presented in chapter 4, this section has stressed the need to migrate TMNL's service provision towards the upcoming IP-based environment while keeping the services tightly coupled to the network resources. This entails that both 'do nothing' option and the provision of Internet telephony services are discarded.

Offer both Fixed and Mobile Connectivity

As mobile communication service provisioning is gradually migrating towards the service centric model, it is becoming increasingly carrier-independent. This entails the emergence of services that are decoupled from the underlying infrastructure and both the mobile network operator and the fixed network operator can fulfill the role of network access provider. Because of this development, the complexity of the value network increases as well as the amount of customer relationships the mobile subscriber has. TMNL has the ability to reduce this complexity and increase the surveyability of the subscribers' service usage by providing both fixed and mobile connectivity. This will strengthen the relationship between TMNL and the subscriber and thereby increase its amount of customer ownership compared to other actors in the network. This will also provide TMNL with the ability to offer fixed-mobile convergent services: services that are usable from different devices over multiple access technologies with a single network core providing the control functionalities for both access networks. These services are expected to retain customer loyalty, reduce churn and generate new sources of revenue.

Provide Voice Services over Alternative Access Networks

TMNL is one of the first European mobile operators to have deployed an R4 core network, which enables the connection to its core network and its services with a softphone over an IP-based access network. First of all this will function as a first step towards the provision of fixed-mobile convergent services as described above. TMNL subscribers will be able to communicate on multiple devices with the same phone number while all of their sessions are still routed through TMNL's core network and terminated (and billed) in a regular way. This is what separates it from Internet-based services; while they can be accessed over different network infrastructures, this service still is coupled to TMNL's core network. Therefore there is no danger of the service cannibalizing on TMNL's voice revenues, it merely adds extra functionalities to TMNL's voice service provision. Furthermore, it provides TMNL with the ability to counter one of the USPs of Internet telephony services providers: cheap calls from abroad. It enables the lowering of the tariffs for calls made abroad by TMNL subscribers to other Dutch subscribers because it induces no financial obligations to roaming partners. Since he calls are being routed through the Internet instead of other operators, TMNL can charge their subscribers far less for these calls while receiving the same profit margin itself.

This research project therefore recommends the implementation of the 'Voice over Alternative Access' option for the provision

Leverage Network Resources as a Service Platform

By putting forth its network as a service platform, TMNL will have the ability to leverage its network infrastructure as a service creation environment. This will provide it with the ability to create added value towards Internet-based service providers. The major weakness of these service providers is that they cannot guarantee the quality of their service provision in a same way a mobile operator can. Similar to the hybrid model that was mentioned during the empiric phase of this project, it enables an arrangement between an operator and a service provider similar to an MVNO construction; the operator takes care of the connection with the end-users and the QoS of the service delivery while the third-party service provider performs other service related functions such as user identification, profile management and service distribution. Furthermore it would enable services such as carrier billing, allowing subscribers to charge certain online purchases back to their phone bill, and the enhancement of services with detailed contextual information about the end-user. This way the mobile subscriber will also benefit through improved Internet-based service delivery on TMNL's network, increasing the attractiveness of TMNL as a network operator. From this perspective the emergence of these third-party communication service providers may prove to be an interesting source of revenue as well and not only a cause for decreasing service revenues.

By providing third-party service providers with the ability to integrate certain capabilities of the network infrastructure into their own IP-based services, TMNL can draw a development community towards its own network resources. Currently, mobile operating systems are the dominant service platforms with large communities of application developers that base their services on the handset functionalities, rather then the network capabilities. Through positioning its network as a platform, TMNL can draw a development community to its own network resources and partially shift the ownership of the service creation environment back from the mobile operating system. It will be able to differentiate in what type of services it gives access to its resources and for instance denying these services towards Internet-based substitutes to its communication services provision while allowing it to services in the periphery of communication such as social media. This way TMNL can develop an ecosystem of services that are complementary rather then disruptive to its own service provision and thereby enhance the service experience of its subscribers.

7.2.2 Technology

Implement VoLGA as an Interim Solution to Providing Voice Services over LTE

As stated in section 1.1.1, the first LTE-enabled handsets are expected to be available through the Dutch operators' sales channels by 2014, these handsets will be equipped with a 2G/3G radio module as well as with a LTE module. The increased network capacity and fully IP-based network architecture of LTE will enable Internet telephony service providers to deliver their services to mobile subscribers with comparable quality as the current PSTN communication services. In order to be able to quickly introduce a voice service that allows the subscriber to exploit all capabilities of the LTE network architecture and counter the over-the-top service providers, this research project recommends the implementation of VoLGA as an intermediary solution to providing voice services over LTE. It offers an approach that is both timely and pragmatic, because it reuses as much of the current network architecture as possible and safeguards service interoperability with the other operators. By using the LTE-network to connect to the CS network core, the subscriber maintains his mobile broadband connection during calls allowing him to simultaneously connect to IP-based non-telephony services and use its LTE connection to the full extent. This is what sets it apart from CS fall back, the other possible interim solution because the latter abandons the LTE network when calls are made. This research project therefore recommends VoLGA as the interim solution to providing voice services in the upcoming LTE environment.

Due to the interconnection and interoperability requirements, this research project assumes it to be unlikely that the RCS nor MMTel can be implemented within the timeframe considered in this research project, i.e. before 2015. As it still is uncertain whether the other operators will implement IMS and which functionalities they will focus on, such a decision can only be made after alignment of the operator interests.

Implement IMS

In order to add the network control functions needed to support some aspects of the service provision put forth in section 7.2.1, as well as to safeguard the compatibility of its next generation communication services with other mobile operators, this research project recommends TMNL to implement IMS.

- Based on the Session Initiation Protocol, IMS enables a mobile operator to manage the QoS of communication and multi-media service provision in an IP-based network environment and thereby allows it to provide advanced communication services while sticking to the front-to-end service model.
- IMS is considered to be the key platform required for the migration towards the convergence of fixed and mobile service provision because its functionalities enable service interoperability across different network technologies. It enables an integrated service portfolio over different IP-based network technologies and thereby enables network-agnostic service provisioning while still maintaining a tight coupling with the underlying infrastructure.
- IMS enables TMNL to develop itself as a service intermediary and leverage its network resources to offer added value towards third-party service providers. It will provide TMNL with the ability to apply data package differentiation to provide Internet-based services with a QoS guarantee as well as with a platform that enables single sign-on and unified billing. Third parties will have the ability to develop services based on this platform, while the operator maintains the central role in the value creating process.

The implementation of IMS can be realized incrementally and in parallel to VoLGA. Because the latter maintains an LTE connection while using the existing 2G/3G core network for voice services, non-voice IP-based services such as presence and file sharing can be gradually added to the service portfolio. Furthermore it is the underlying framework that enables interconnectivity of the Rich Communication Suite across different network operators.

Rollout Voice over Alternative Access
This service is currently technologically possible, has already been prototyped and tested with success at TMNL.

Develop Application Programming Interfaces (APIs)
In addition to leveraging its network resources in order to create added value towards third-party service providers, TMNL should also provide an interface for these parties that allows them to make optimal use of the resources. By designing Application Programming Interfaces (APIs) TMNL can expose its network functionalities to a selected third-party service provider in a secure and unified way, allowing the latter to develop and implement advanced services in a more flexible and rapid fashion. It will enable the service providers to utilize the operator's billing system and use it to charge users for or it could enhance their service with contextual information about the end-users such as the quality of its current network connection, its location, its device, its demographics and/or its preferences. The implementation of IMS as described above, would further extend the possible enabling services with QoS guarantee as well as single sign-on, session handover and unified billing over different network technologies.

7.2.3 Organization

Keep a Strong Relationship with the Handset Manufacturers
To realize a successful introduction of VoLGA, mobile operators will need a close relationship with the handset manufacturers. This solution to bringing communication services to the LTE environment requires a software client to be installed on the mobile handset. In order to increase the potential of its large-scale adoption, the client needs to be installed by default on the handset and not only on those handsets that are sold through the operators' sales channels. However with the emergence of smartphones and the mobile operating system as a service platform, the position of the handsets has shifted and taken up a more central role in the value creating process. Voice has become one-of-many functionalities that are supported by the handset and the handsets' functionalities are less tightly coupled with the mobile operator's network infrastructure. With the entrance of new players on the Dutch mobile market, other sales channels may become of interest to the device manufacturer as well. These developments have made the handset manufacturers less dependent on the operators' resources. To realize a successful introduction of VoLGA the mobile operators must preserve the relevance of their sales channels to the handset manufactures and safeguard a relationship of dependency with these actors.

Incorporate Online
To extend its access service provisioning towards fixed access connectivity, this research project recommends TMNL to incorporating its ADSL subsidiary Online, which was de-merged from Orange after the acquisition by T-Mobile. Online is a mature Internet service provider with over 0.3mnl subscribers whose ADSL services are available in 98% of the Netherlands (Online website, 2009). Therefore it provides a turnkey solution to TMNL in extending its access service portfolio.

Create a Relationship with Internet-Based Service Providers; A New Customer Segment
Developing oneself as a service platform means creating a relationship with the Internet-based service providers. As stated in section 2.5.2, in order to become the leading service platform in a given industry a company should continually innovate the resources that shape its platform while encouraging the provision and innovation of complementary services. This entails that TMNL enters into relationships of mutual dependency with these service providers because both are dependent on the others' performance. For this ecosystem to perform well, a level of consensus has to be reached about the interfaces between TMNL's network resources and these third-party services: the network APIs. As users of the operator's service platform, these actors will constitute a new segment of

customers of TMNL service provision. The operator should expand its customer segments from business and consumer customers to these third parties as well. This way it can develop its network APIs in such a way that it meets their demands and increases the uptake of the service platform.
More specifically in terms of TMNL's organizational structure, this implies that its Customer Services department (M7) and its Customer Insights team in particular should expand its field of activities towards gaining insights in third-party service providers as well. This will enable this team to support the wholesale team of the Products & Services department (M4) with the successful implementation of the network as a service platform and thereby instigate a more market driven approach in developing and reconfiguring TMNL's advanced communication service provision for the upcoming fully IP-based telecom environment. Furthermore, it may help align the line of thinking between the more market oriented and more technology oriented departments and smooth out the discrepancy that was indentified in the empiric phase of this research project.

Gain Consensus with Other Operators on the Implementation of VoLGA and IMS
In order to safeguard service interoperability in the emerging all-IP network environment TMNL will need consensus with the other Dutch operators about the implementation of VoLGA and the IMS architecture. Especially concerning the latter, there is the possibility that incompatible architectures may be implemented due to its wide range of possibilities, its not yet fully standardized implementations and proprietary value-adding extras from different vendors. TMNL should create a forum with KPN and Vodafone NL to align their service and network architecture developments.

7.2.4 Financial

Keep Subsidizing Handsets and Be Cautious with Exclusivity Deals
As stated in the previous section, the mobile operators must preserve the relevance of their sales channels to the handset manufactures in order to enhance the successful introduction of VoLGA. In an effort to reduce OPEX to compensate the decrease in service income, budget cuts are likely to be made in sales costs, possible resulting in less handset subsidization. This will make the operator's sales channels less important for the device manufacturer. When the financial advantage of acquiring a handset in combination with a subscription diminishes, customers will increasingly look at other sales channels for their handsets. A reduction in handset sales will endow the operator with less buyer power as a wholesale customer and therefore with less leverage over the handset manufacturers. This research project therefore urges TMNL to take these long-term strategic consequences into account in the decision-making about lowering their handset subsidies.
Similarly, the long-term consequences of exclusivity deals regarding handsets should be taken into consideration as well. By asking exclusivity from a device manufacturer, TMNL will put this actor in a position where it can make demands and thereby decreases its own ability to leverage its sales channels in the dependency relationship with the manufacturer. Though such deals may result in an increase of subscribers in the short term, it will help the manufacturers in strengthening the position of the mobile operating system as the central service platform and force the mobile operator in a subordinate position in the value creating process. In the long run it will therefore contribute to the emergence of the situation where TMNL is a mere access provider while third parties provide all services: the bit-pipe scenario

Open Up New Revenue Sources
By offering its network resources as a service to third-party service providers as described in the section about the APIs above, TMNL will be able to open up new revenue sources to compensate the decrease of their voice service revenues. By closing revenue sharing deals with the partnering service providers or charging them a fixed monthly fee for the access to its network resources, TMNL has the ability to generate revenues with the added value it provides to them.

7.3 Discussion & Reflection

7.3.1 Research Focus

Real-Time Person-to-Person Communication Services
The focus of this research project lay on the provision of real-time person-to-person communication services. This enabled the project to take a wide range of advanced mobile communication services into account but in doing so, it also excluded the provision of mobile (non-communication) web services. The value network models therefore presented a demarcated view of mobile service provision focussing on communication rather than the whole range of services. Though this was in line this project's research focus and contributed to achieving its research goal, it does not do full justice to all developments in the mobile domain. Especially with the identified shift from communication services from a mobile handset's main functionality to 'one-of-many' functionalities. This poses certain limitation in applicability of the project's recommendations in determining the development of an operator's entire service portfolio. For this, it is recommended to take into account a study of the strategic consequences of different configurations for mobile web service provision as well.

Long Term Evolution
Most technological developments taken into account in the domain description are focussed on the implementation of the LTE access network technology. Due to present uncertainties with regard to the scale that competing mobile access technologies such as WiMAX will be rolled out as well as uncertainties regarding their actual impact on mobile communication service provision, they were not fully taken into account. If the scope and impact indeed remain limited the recommendations of this research project remain valid. However when the fixed network operators aggressively enter the mobile service and access markets on a nation wide scale a re-assessment will have to be made of this projects findings and the will have to be adapted to this new environment.

Competitive Field
In determining the development of service provision, the project focused on the competition between the mobile operator and emerging Internet-based mobile communication service providers. With the introduction of the mobile telecom operator and the mobile network operator as generic actors in the mobile domain, the different mobile operators in the Netherlands were treated as equal and like-minded companies. In reality they are companies with different backgrounds, distinctive network architectures and diverging strategic interests. As they need consensus in order to be able to provide interoperable mobile services in an all-IP environment, insight into the points of view of the different operators is needed as well to be able to assess the applicability of the different solutions for the provision of communication services in an IP-based network environment.

Geographical Scope
This research project was focused on the Dutch mobile market. Though many of the developments in the telecom domain that were taken into account take place on a worldwide scale, some differences will exist between different continents and countries. Already in Belgium there are different regulations concerning the coupling of handsets with mobile subscriptions, which is seen as conditional sale and therefore not allowed. Similarly there are different roadmaps for the rollout of the LTE network infrastructure between operators in different countries. This will have a large influence on the development and maturation of mobile IP-based communication service provision within the timeframe considered in this research project. As the recommendations made in this research project are specifically tailored to the Dutch market, they may not be directly applicable to actors in other countries. The generic framework, overview of relevant developments in the mobile domain as well as their impact on the operators' service provision may however provide valuable insights to actors active in the mobile telecom domain.

7.3.2 Perspective

As this research project was commissioned by TMNL, it was conducted from the company's perspective. This entailed that the requirements for this project's outcome were derived from the mission statement of its mother company TMO. As presented in section 1.1.2 and depicted on the left side of figure 52 below, the mission of TMO is to be the most highly regarded service company. Its strategy to achieve this consists of the provision unique services and superior products, supported by a superior network. This strategy is very much focused on T-Mobile as the main service provider and its relationship with the subscriber. However when taking into account the developments in the mobile domain and the recommended reconfiguration of its service provisioning, TMNL will not be the only service provider on its network any more.

When revising T-Mobile's strategy with respect to the conclusions and recommendations, this research project proposes an adaptation of the overall strategy: the provision of superior products to the subscriber should include stimulation of high quality third-party service delivery over its network as well. This research project proposes a redefinition of one of the strategy pillars from 'providing customer centric proposition' to 'enabling high quality service delivery'. This recommendation is visually represented in the figure below.

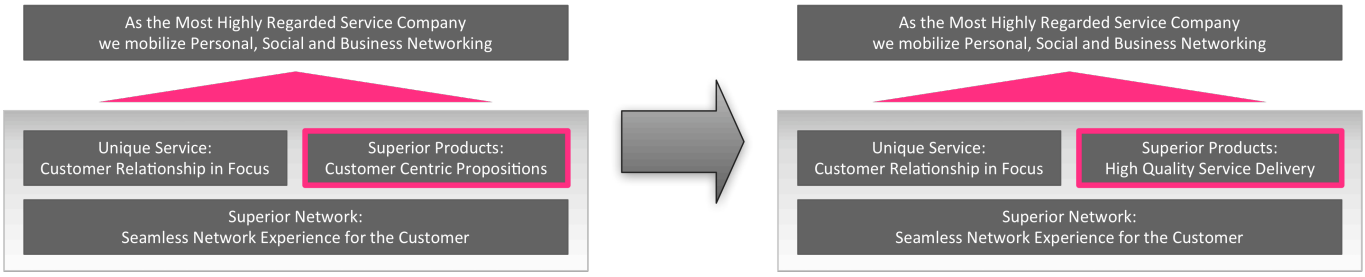


Figure 52: Adaptation of T-Mobile's strategy

7.3.3 Research Method

Research Approach

The research approach of this project was based on the designing cycle by Verschuren and Hartog (2005) as well as on the Metamodel by Herder and Stikkelman (2004). However instead of using the view of the latter two who postulated that a process of designing is 'selecting an instance in the design space that meets the objectives and constraints' (Herder & Stikkelman, 2004), this research project implemented the interpretation of this model by Koppenjan and Groenewegen (2005) and combined it with the designing cycle by Verschuren and Hartog. Following this re-interpretation, elaborated on in section 1.3, this research project proposes an adaptation of the Metamodel. This adaptation connects the two sequences of activities in the model and aligns them by providing a single point of departure. Furthermore it explicitly inserts the activity of actually making the designs into the model. The proposed adaptation is depicted in the two diagrams below. The one on the left is the original diagram of the Metamodel and the one on the right is its adaptation.

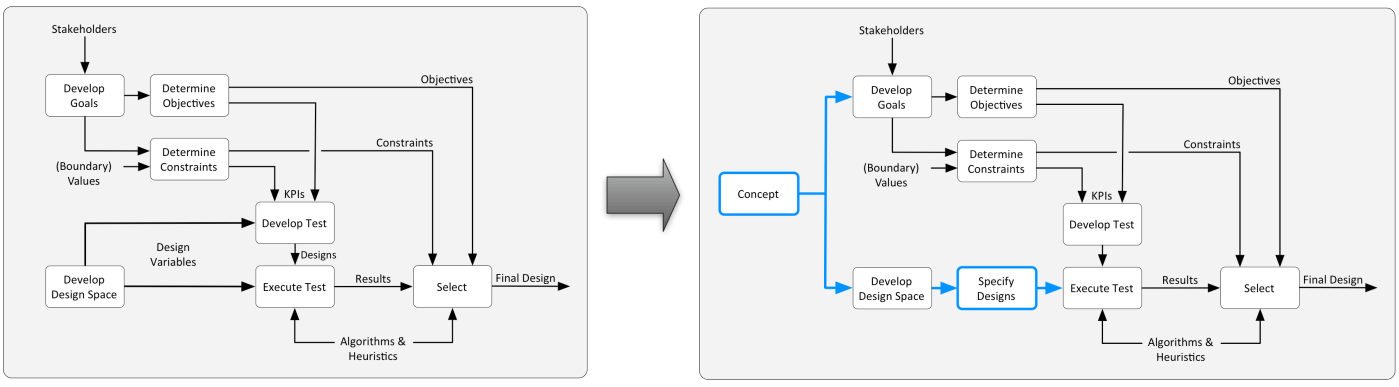


Figure 53: Adaptation of the Metamodel

Similar the first stage of the designing cycle, the adapted design approach starts off with the creation of a preliminary concept or idea of a design based on the initial problem specification and the conceptualization of a possible solutions. Following Koppenjan and Groenewegen (2005), this concept functions as the starting point for two different sequences of activities. The first sequence is about developing a test that can measure whether a design achieves certain requirements, implementing that test and selecting designs that pass it. The second sequence is about specifying a design space by determining the different design variables and subsequently combining different combinations of these variables into designs that are to be evaluated. It is this second sequence of activities that is represented quite implicit and ambiguous in the original diagram of the model. This research project therefore proposes to explicitly add the activity of specifying the designs to the model as depicted in the diagram on the right of figure 52.
This adapted framework for structuring a design process was implemented in constructing the research methodology flow diagram and the outline of this thesis.

Semi-Structured Interviews
Qualitative data about the different value network models was gathered by conducting semi-structured interviews. This interview approach left a lot of room for going into detail about certain subjects and entering into a discussion about certain aspects of or mechanisms in the telecom industry. Though this has greatly enhanced the researcher's insight into the domain and its many facets, a lot of the information was not directly applicable for the purpose of this research project. Furthermore the open nature of the interviews yielded some ambiguous answers that could not be interpreted clear enough to be used in analyzing the results. This is visible in the answers concerning the desirability of the different models where the answers of some respondents are missing because could not be used due to their ambiguity. Though the semi-structured approach definitely added value tot the results of the interviews, it is recommended to add a short questionnaire at the end of an interview protocol that quickly runs through all the questions again and lets the respondent summarize his or her answer in a number of keywords.

Choice of respondents
The choice of respondents posed some limitations on the overall objectiveness of the qualitative data. In consultation with the commissioner of the research project, the choice was made not to include any direct or possible future competitors to TMNL. This limited the pool of external respondents and brought some imbalance in the proportion between respondents internal and external to TMNL.
Though a large effort has been made in analyzing and aggregating the results in a balanced and unbiased way, the position and the interests of the mobile operator still were more strongly represented. This poses some restrictions on the generic applicability of the conclusions and recommendations of this research project, as they may be inclined towards the point of view of the mobile operator.

Qualitative Data Analysis
The interview results were analyzed in ATLAS.ti, a software package for systematically analyzing qualitative data. It proved to be a very practical tool for grouping together quotes about a particular subject over the different interviews and has been a great aid by providing a structured approach to analyzing and comparing a large amount data. However there were some limitations to the extent of insights that could be gained out of the data. The tool did not provide a query tool that could provide a clear oversight of which labels correlated and with how often that happened. Though this did not prove to be a great impeding for the course this research project, there is definitely room for improvement in the query tool. Furthermore it is recommended to make the suite available for Mac users as well as there are no real substitutive software tools available for this operating system.

7.3.4 Theoretical Framework

The conceptual framework that was designed and implemented during the course of this research project was created in a process of many iterations and delineations. Initially the framework by Bouwman et al. (2008) was taken as a point of departure, consisting of Critical Success Factors for designing a viable business model and a set of Critical Design Issues that need to be addressed in order influence these factors. Some of these design issues were then accentuated by some design parameters taken from a framework for constructing, categorizing and analyzing a feasible business model by Ballon (2009) that was based on the same ontology. As a result, an extensive framework was drawn up for determining the viability of a business model by looking at its internal aspects. However in order to be able to reach this research project's objective, external aspects of the business model had to be taken into account as well and insight had to be gained in the competitive ability of the model vis-à-vis models of competing or substitutive services. The framework was therefore extended with a number of levers for achieving platform leadership. This yielded a very elaborate and complex framework, depicted in the adjacent figure, that far exceeded the scope of its purpose. In order to demarcate the theoretical framework to a point where it was much more concise and effective, the choice was made to limit it to the organisational aspects of a business model and focus on those issues that related to the value network.

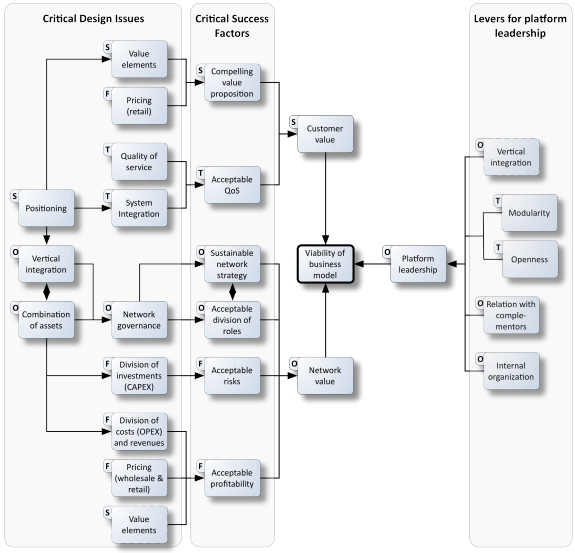


Figure 54: Initial theoretical framework

The framework that was eventually constructed and implemented focused on the governance and the performance of a value network, taking both its internal and external aspects into account. The analyses of the governance structure by looking at the resources dependencies between the different actors and their control over certain bottleneck resources proved to be an adequate approach to determining the division of power and control. The four bottleneck resources and their accompanying gatekeeper roles gave a good overview of the distribution network control in mobile service provision, though they did not do justice to the importance of mobile connectivity and the added value that can be created by leveraging one's network resources. In order to incorporate this explicitly into further value network analyses of mobile (communication) service provision, this research project proposes a fifth gatekeeper role:

- **Ownership of the access network**
  The actor that controls the access network takes care of end-user connectivity and has the ability to enhance the quality and functionalities of third-party service providers.

With regard to the analyses of value network performance, the indicators that were selected to assess the value network models turned out to be somewhat positively biased towards configurations where value is co-created by a network of actors. They did not take into account the complex reality of service and network innovation in an infrastructure-based service domain. Furthermore, the quality of the services produced by the value network was not taken into account as well.
This research project therefore recommends further research into the factors that better capture the innovative ability of infrastructural industries and a revision of the network performance aspects of the framework.

7.3.5 Design Process

During the design process a number of choices were made to limit the complexity of the value network models. Though most of them have been accounted for in their respective sections, there is one in particular that will have to be brought under attention when reflection on the design process.
The mobile operating system was presented as an integrated part of the handset and therefore under the control of the device manufacturer. This meant that the impact of the emergence of vendor-independent operating systems such as Google's Android was not taken into account in the construction of the value network models. This will play an important role in the shift of mobile service platform from the operating system towards a 'cloud'-based platform. Though this configuration of mobile service provision still is in its infancy and it is uncertain whether it will reach a stage of maturity during the timeframe taken into consideration in this research project, it is recommended to take these actors and service platforms into account in further research into the organizational aspect of future mobile communication service provision.

7.3.6 Results

The Interview Protocol
During the interviews, the respondents were presented with the value network models as they are show in appendix C. These differed somewhat from the value network models that were eventually presented in chapter 5 of this thesis. Most of them were only slightly modified during the course of the project, but the operator centric model did get a large makeover. After a round of feedback from the research committee, the decision was made to base this model on the advanced solutions for providing communication services in an IP-based environment presented in chapter 4 rather then the model of TMNL's current voice service provision as was the case in the interview protocol. This may have caused a negative bias towards the operator centric model and the likelihood of it becoming the de facto standard. However when revising the interview transcripts of respondents that showed a preference for the service centric model, the choice for this model as the most likely one was often accompanied with a belief in the separation of access and service provision. Therefore the assumption is made that the influence of this on the empiric results will only have been marginal.

Hybrid Value Network Model
In the interviews, several respondents put forward an additional value network model; a hybrid model that was based on the service centric model but with an extra relationship between the mobile network operator and the third-party communication service provider. In this model, the mobile operator takes up a more enabling role towards Internet-based service providers and provides added value by enabling these parties to make optimal use of its network resources.
Unfortunately, the conduction of interviews had advanced to such an extent that this hybrid model could not be incorporated in the interview protocol without compromising the answers of the respondents that had already been interviewed. The line of thinking that was embedded in this model proved to be very insightful however and contributed a great deal in coming to an answer to this project's research question. It is therefore highly recommended that this model is elaborated on in further research to gain insight into the full extent of its potential.

Final results
After evaluating the four value network models, it showed that none of the models satisfied both conditions for a viable value network model for providing real-time person-to-person communication services in an all-IP environment. In those models where the governance structure was favorable for the mobile operator, the overall value network performance was assessed to be quite low. On the other hand, the models that did portray a high level of network performance, showed a very

decentralized power structure and a very limited ability for the mobile operator to influence the value creation process. Part of this result can be contributed to the positive bias in the analysis of value network performance towards value networks where value is co-created by a network of actors that was indicated in section 7.3.4. However it is in line with the tradeoffs that were identified between the factors that determine the two conditions for a viable value network model.

7.4 Contribution to Science & Recommendations for Further Research

The LTE networking technology is only recently taking up concrete forms and its influence on the mobile domain is gradually becoming clear. This research project has described this upcoming environment and offers insight into its impact on mobile service provisioning and mobile communication service provision in particular. It has mapped the different value network models for the provision of person-to-person real-time mobile communication services and presented an oversight of the possible solutions for the provision of these services in a fully IP-based network environment. It has offered insight into the areas of tension between the actors involved and the way they are influenced by present and future developments in the telecom domain. By laying the emphasis on the position of the mobile telecom operators it acknowledges that that the implementation of this network technology will not be a greenfield project and a lot is at stake for these actors. Rather then focusing on what is technologically possible from a utopian line of thinking, it provides a realistic and pragmatic approach to analyzing the domain and the consequences of developments in its environment.
The project has made a first attempt at the construction of a unified framework for the evaluation of value network models that makes explicit the tradeoffs between network governance and network performance. By taking both the 'internal' and 'external' aspects of the value network into account, it provides a tool to support decision-making with regard to service evolution and innovation in infrastructure-based industries.

Recommendations for Further Research

Based on the discussions and reflection in the previous sections, this research project recommends the following topics to be subjected to further research:

Regarding the theoretic framework:

- Service evolution and innovation in infrastructure-based industries.
- Generic applicability of the framework constructed in this research project by applying it to other domains.

Regarding the mobile domain:

- The validation of this project's findings.
- Business models for the hybrid value network model where operators open up their network resources as a service platform towards third-party service providers.
- A financial feasibility study of the different value network models.
- The impact of fixed-mobile convergent service provision on the mobile industry.
- The emergence of cloud computing in the mobile service domain.
- Gaining an all-encompassing view of the mobile domain by combining this project's findings with earlier analyses of the strategic consequences of different value network models for mobile web service provision.
- The impact of the extension of the service portfolios of fixed-network operators towards the provision of mobile access.
- The individual positions of the different mobile network operators with regard to service provision in an all-IP network environment.

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APPENDICES

Appendix A: Roles

A1: Roles in the Current Circuit-Switched Communication Service Provision

Customer		
Author	**Concept**	**Description**
Apfelbeck, 1998	Subscriber	Mediates between the billing partner and the user
	End-user	End-user of the service
Li & Whally, 2002	End-customer	Consumes the services
Kuo & Yu, 2006	Customer	End-users and companies

Communication Service Providers		
Author	**Concept**	**Description**
Apfelbeck, 1998	Service provider	Offers composed services that offer value to the end-user
Kuo & Yu, 2006	Service provider	Provides mobile application services to consumers
Ballon & Walraven, 2008	Mobile service provider	Produces and operates applications and services for the end-users

Customer Service		
Author	**Concept**	**Description**
Reuver & Bouwman, 2008	Customer support	Point of reference for end-users with questions regarding service provision

Network Operator		
Author	**Concept**	**Description**
Apfelbeck, 1998	Mobile access provider	Supports terminal mobility within the access network
	Network operator	Connects various access networks and long distance lines
Li & Whally, 2002	Infrastructure company	Provides a physical connection between senders and receivers of information
Kuo & Yu, 2006	Mobile network operator	Provides mobile communication networks
Reuver & Bouwman, 2008	Network operator	Operates the cellular or short-range network and providers connectivity to the end-users
Ballon & Walrvaren, 2008	Network operator	Provides network connectivity to the mobile devices

Platform Operator		
Author	**Concept**	**Description**
Li & Whally, 2002	Software intermediary	Enhances functionality of mobile phones (2 kinds: equipment>software & software>new market)
Kuo & Yu, 2006	Technology platform vendor	1) Operates and does maintenance of backbone network, base stations, and the infrastructure 2) Provides mobile operating systems 3) Provides mobile Internet browsers
Reuver & Bouwman, 2008	Platform provider	Allows consumers to access web services on their mobile devices and web service

		providers to reach mobile subscribers
Ballon & Walraven, 2008	Platform operator	Provides and operates a service platform

Identification & Authentication Manager		
Author	**Concept**	**Description**
Reuver & Bouwman, 2008	Identification & authentication manager	Identifies and authenticates the end-user in order to give him access to his services

Demographics (& Lifestyle) Database Operator		
Author	**Concept**	**Description**
Reuver & Bouwman, 2008	Demographics database operator	Manages the demographic information about the specific end-users

Context Database Operator		
Author	**Concept**	**Description**
Reuver & Bouwman, 2008	Context database operator	Manages information about the context of the user (e.g. his location)
	Peripheral database operator	Manages info about the handset, browser and applications on the handset

Billing		
Author	**Concept**	**Description**
Reuver & Bouwman, 2008	Billing	Issues bills and accounts and divides the revenues among the actors involved in the particular service provision

Payment Collector		
Author	**Concept**	**Description**
Reuver & Bouwman, 2008	Billing	Arranges for collection of payments for customers

Handset manufacturer		
Author	**Concept**	**Description**
Kuo & Yu, 2006	Infrastructure and mobile equipment vendor	Designs and manufactures network infrastructure equipment and/or mobile handsets
Reuver & Bouwman, 2008	Handset provider	Provides mobile devices end-users require to receive service
Ballon & Walraven, 2008	Device manufacturer	Develops and builds mobile devices

Retailer		
Author	**Concept**	**Description**
Kuo & Yu, 2006	Mobile equipment retailer	Distributor of handsets and subscriptions

Network Equipment Manufacturer		
Author	**Concept**	**Description**
Li & Whally, 2002	Equipment company	Provides the network elements, switches and transmission systems
Kuo & Yu, 2006	Infrastructure and mobile equipment vendor	Design and manufacture network infrastructure equipment and/or mobile handsets
Reuver & Bouwman, 2008	Network Manufacturer	Provides antennas, base stations and the core network

Long Distance Carrier		
Author	**Concept**	**Description**
Apfelbeck, 1998	Long distance carrier	Provides transparent data lines between two or more distant points

Aggregation of Roles

In order to make the value network models more surveyable and improve their communicative ability, a number of closely related roles have been aggregated into a single role. The table below shows these aggregated roles.

Aggregated roles	Roles derived from scientific literature
Service Provider	Communication service provider
	Customer service / care
Data Collector	Identification & authentication manager
	Demographics (& lifestyle) database operator
	Context database operator
Transaction Manager	Billing
	Payment collector

Demarcation of Roles

The following roles will not be included in the high-level value network representation:

- Retailer
- Network Equipment Vendor
- Long Distance Carrier

The rationale behind this decision is that this research project assumes the distribution of these roles to remain stable over the period that falls within the timeframe considered in this research project and that the extent to which the actors that fulfill these roles will be effected by the external factors identified in this project will be limited.

A2: Additional Roles for Package-Switched Communication Service Provision

Application Developer		
Author	**Concept**	**Description**
Li & Whally, 2002	Content provider	Develops services and applications
Kuo & Yu, 2006	Application developer	Develops mobile applications

Advertiser		
Author	**Concept**	**Description**
Reuver & Bouwman, 2008	Sponsored content provider	Provides sponsored content to content providers, aggregators and service providers, to be included in their content services, for which the advertiser pays a fee

Content & Service Aggregator		
Author	**Concept**	**Description**
Li & Whally, 2002	Portal	Integrates services provided by others, and therefore bases its success on its ability to identify, and then obtain, the services sought by customers
Kuo & Yu, 2006	Content aggregator	Aggregates, integrates, and re-packages or distributes products or services related to consumers
Reuver & Bouwman, 2008	Content aggregator	Bundles content and possibly filters, edits and customizes it
Ballon & Walraven, 2008	Service aggregator	Offers a portfolio of services and bundles

Portal Provider		
Author	**Concept**	**Description**
Kuo & Yu, 2006	Mobile portal providers	Offers a gate to the internet and is the first point of browsing, also provides indexes, search tools, and related services to assist users in searching for desired information

Appendix B: NGN Characteristics

ITU-T has defined Next Generation Networks further by the following characteristics (ITU-T, 2004 p.3):

- Packet-based transfer;
- Separation of control functions among bearer capabilities, call/session, and application/service;
- Decoupling of service provision from transport, and provision of open interfaces;
- Support for a wide range of services, applications and mechanisms based on service building blocks (including real time/ streaming / non-real time and multimedia services);
- Broadband capabilities with end-to-end QoS (Quality of Service);
- Interworking with legacy networks via open interfaces;
- Generalized mobility;
- Unrestricted access by users to different service providers;
- A variety of identification schemes;
- Unified service characteristics for the same service as perceived by the user;
- Converged services between fixed/mobile;
- Independence of service-related functions from underlying transport technologies;
- Support of multiple last mile technologies;
- Compliant with all regulatory requirements, for example concerning emergency communications, security, privacy, lawful interception, etc.

Appendix C: The Interview Protocol

The following questionnaire was used as the basis for conducting semi-structured interviews.

Achtergrond

Het continu verbeteren van hun netwerk infrastructuur en het verlaten van de 'walled garden' aanpak voor mobiele Internet diensten hebben de operators in staat gesteld een steeds betere Internet beleving aan hun klanten te bieden. Hiermee hebben ze echter ook het mobile domein opengesteld voor dienstverleners die zonder tussenkomst van de operators hun content of diensten direct aan de consument kunnen leveren. Onder deze dienstverleners bevinden zich ook partijen die Internet telefonie (VoIP) bieden zoals Skype en Truphone. Tot op heden hebben deze diensten echter nog weinig afname gevonden onder de mobiele consument, mede door gebrekkige QoS en het achterblijven van netwerk effecten.
Met het uitrollen van LTE, de volgende generatie netwerk infrastructuur, bieden de operators een mobiel breedband netwerk dat volledig gebaseerd is op IP. Deze ontwikkeling neemt een deel van de laatste barrières weg voor Internet telefonie diensten om volwaardig te concurreren met de mobiele operators. Klanten zullen altijd een Internetverbinding open hebben staan en daardoor ook altijd bereikbaar kunnen zijn op Internet telefonie diensten op een netwerk waarop deze diensten met een vergelijkbare QoS geleverd kunnen worden als de huidige GSM/UMTS voice dienstverlening.

Doelstelling

Voor mijn MSc onderzoek aan de TU Delft ben ik opzoek naar business modellen voor T-Mobile Nederland om haar voice dienstverlening, haar grootste bron van inkomsten, succesvol aan te passen in het licht van deze ontwikkelingen. Mijn centrale onderzoeksvraag luidt:

> *How should TMNL provide real-time person-to-person communication services in order to achieve a sustained competitive advantage in the fully IP-based telecom environment that is expected to emerge in 2015?*

Dit document bevat een aantal open vragen die mij helpen een antwoord hierop te vinden. De eerste drie vragen dienen ter introductie en om eventuele onduidelijkheden weg te nemen, vragen 4 t/m 6 gaan over de configuraties op pagina 3-5 en de overige vragen zijn generiek van aard.
Ik ben erg benieuwd naar uw visie op deze ontwikkelingen en mening over de verschillende modellen van dienstverlening. Indien gewenst zal ik uw antwoorden in anonimiteit behandelen.

Introductie **ca. 10min**

1) Voorstel rondje

2) Heeft u vragen naar aanleiding van de geschetste achtergrond of de doelstelling van mijn onderzoek?

3) Heeft u vragen of zijn er onduidelijkheden over deze vragenlijst of de waarde netwerk configuraties?

Model specifieke vragen: **ca.25min**

4) Dekken de waarde netwerk configuraties de mogelijke manieren om mobiele voice diensten te leveren en zijn ze volledig?

5) Welk van de configuraties is het meest waarschijnlijk om de toekomstige standaard te worden? Welk van de configuraties is het meest wenselijk vanuit uw perspectief?

6) Wat zijn de belangrijkste bronnen van (wederzijdse) afhankelijkheid tussen de verschillende actoren binnen deze meest waarschijnlijke configuratie?

Generieke vragen: **ca.25min**

7) Welke ontwikkelingen binnen de Telecom markt en op het gebied van regulering verwacht u op de lange termijn een grote impact te hebben op de voice dienstverlening en waarom?

8) Welke resources (zowel tastbare als ontastbaar) zijn specifiek voor een mobiele operator en zullen hem een voordeel bieden in de concurrentie met Internet spelers? En andersom?

9) Wat is uw reactie op de volgende stelling:
Om het meeste uit de operator specifieke resources te halen, moet de operator het merendeel hiervan openstellen voor 3^{e} partijen.

10) Wat is uw reactie op de volgende stelling:
Binnen IP-based communicatie dienstverlening (zoals VoIP) hangt het succes van een dienst af van het ecosysteem van complementerende diensten, bijvoorbeeld web services waarin de dienst geïntegreerd is.

Waarde Netwerk Configuraties

In de volgende paar pagina's worden een aantal archetypes van waarde netwerk configuraties voor mobiele voice dienstverlening beschreven. Deze modellen zullen dienen als input voor de vragen 4t/m6.

De verschillende configuraties bestaan uit een aantal actoren die een of meerdere rollen vervullen. Tevens hebben de verschillende actoren relaties met elkaar. Deze relaties zijn weergegeven d.m.v. pijltjes en lijnen: de volle pijlen geven financiële stromen weer binnen het model, de gestippelde pijlen het verloop van de voice dienstverlening en lijnen zonder pijlpunt een veronderstelde afhankelijkheidsrelatie die niet gebaseerd is op de geldstroom of directe dienstverlening.

Elke configuratie is voorzien van een korte beschrijving.

In de diagrammen zijn een aantal rollen is met een kleur weergegeven, de reden hiervoor is dat de verschuiving van deze rollen het meest tekenend zijn voor de verschillen tussen de configuraties.

De verschillende rollen die de actoren in kunnen nemen worden in de onderstaande tabel toegelicht. Deze tabel is in het Engels omdat een aantal concepten zich bondiger er duidelijker laten omschrijven in deze taal.

Rollen	Omschrijving
Customer	The customer is the end user of the service, he is the one that owns the mobile device, has a subscription with the mobile operator or communication service provider.
Service Provider	The communication service provider offers (voice) communication services to the customer and provides customer services.
Network operator	The mobile operator is the actor that provides the connectivity to the user's handset end thereby to the customer.
Data collector	This actor performs one or more of the following functions: He takes care of the identification & authentication of the customer, has a record of a customer's demographics, his context (location, device, connection) and service usage.
Transaction manager	An actor with this role is involved in the billing process. He bills the customer for his service usage and/or facilitates the payment collection.
Handset Manufacturer	A handset manufacturer designs and produces mobile phones or other devices that support mobile communication network technologies.
Platform Operator	A platform operator coordinates or facilitates the interaction between service providers and customers.
Application Developer	Actors in the group develop and provide web applications.
Content Developer	Content developers provide contents that are accessible via mobile (web) services. This content also comprises advertisements.
Content & Service Aggregator	These actors aggregate, integrate, re-package or distribute content and or services.
Portal Provider	A portal provider functions as a gate and a first starting point for Internet-based services

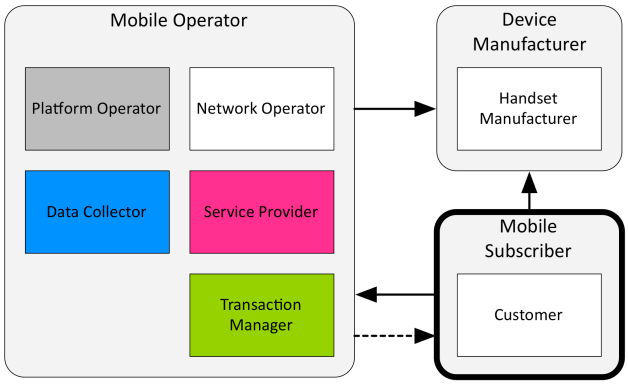
Om de communiceerbaarheid te bevorderen zijn de volgende rollen weggelaten in de configuraties:

- retail kanalen
- long distance carriers
- terminating operators
- MVNOs

De reden hiervoor is dat ze een stabiele rol vervullen in de verschillende configuraties en daardoor minder interessant zijn binnen de onderzoeksvraag.

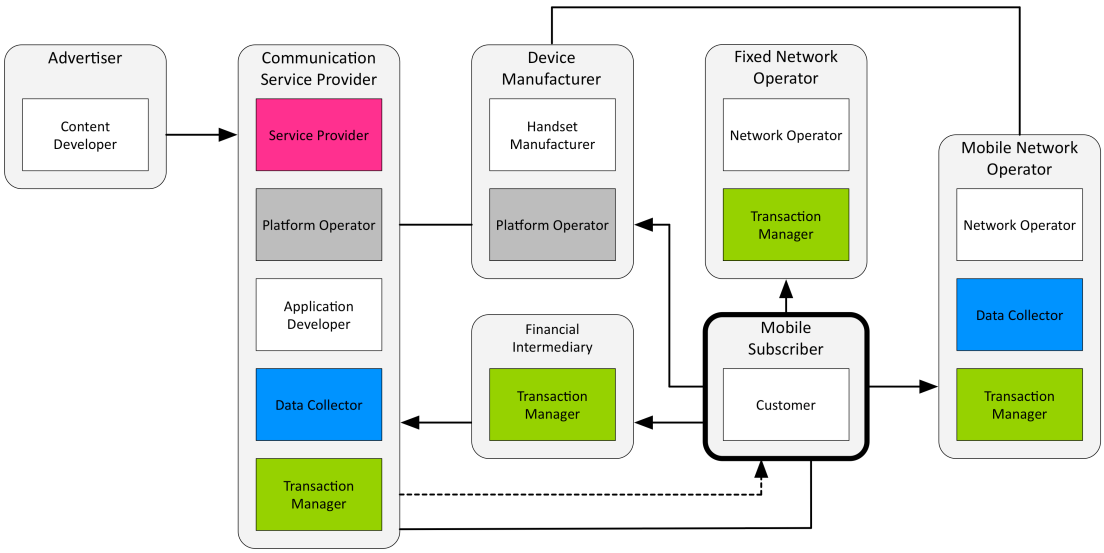
Operator Centric Model

Dit model komt overeen met de huidige standaard voor voice dienstverlening, die volledig geleverd wordt door de mobiele operators. De consument neemt al zijn mobiele voice diensten af van zijn operator, op een handset die hij ofwel in combinatie met een abonnement door zijn operator gesubsidieerd krijgt ofwel via een direct verkoop kanaal van de handset fabrikant aanschaft.



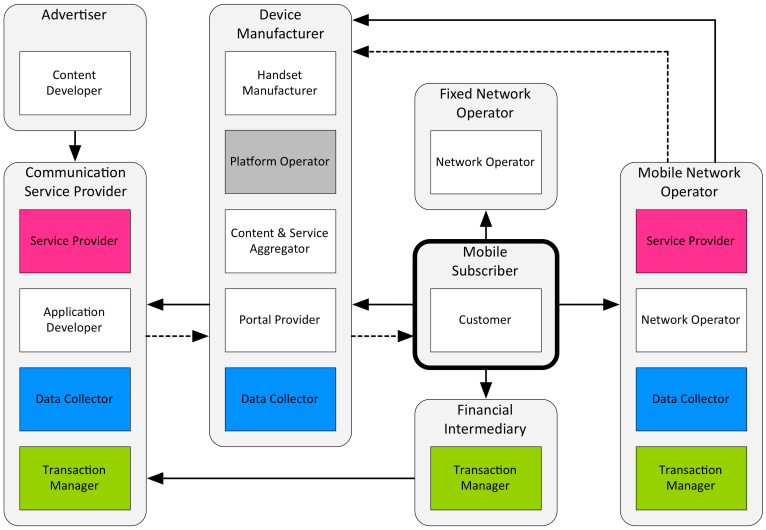
Service Centric Model

In deze configuratie ligt het zwaartepunt bij de dienst zelf en heeft een ontkoppeling plaatsgevonden tussen de voice dienstverlening en het leveren van connectiviteit. De dienst is netwerk onafhankelijk en daardoor zowel beschikbaar over een mobiel breedband netwerk als bijvoorbeeld over een wireless LAN. Een goed voorbeeld hiervan is het bellen via een VoIP dienst op een mobile telefoon.
De communicatie dienstverlener factureert ofwel direct aan de klant of via een financiële bemiddelaar (bijv. een creditcard bedrijf of PayPal). Daarnaast kan de dienstverlener ook nog inkomsten genereren d.m.v. reclame op zijn platform.



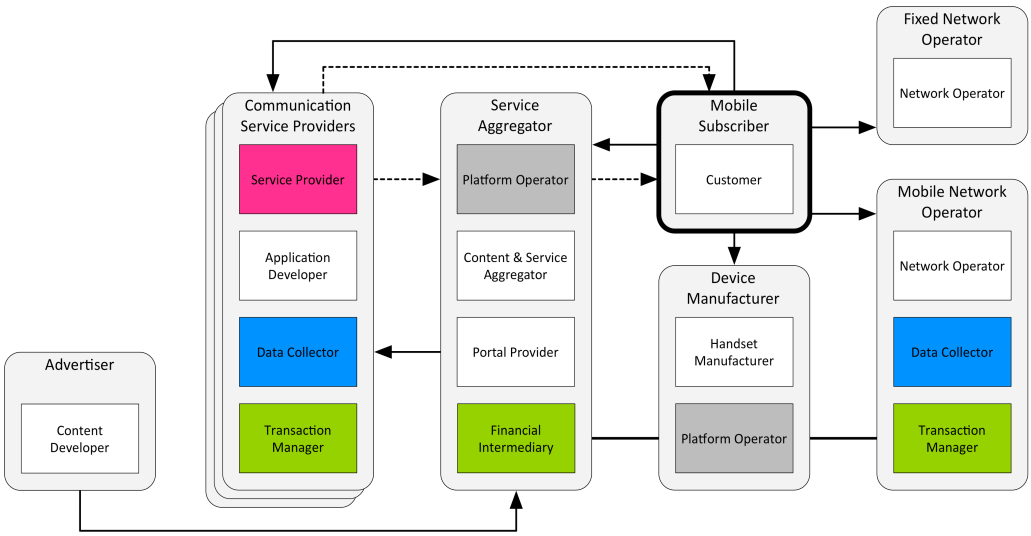
Device Centric Model

In deze configuratie staat de handset centraal en fungeert als portal tot de dienstverlening. De handset ondersteunt zowel de dienstverlening van de operator als die van bepaalde Internet partijen die geïntegreerd zijn met de functionaliteiten van het toestel.
De dienstverlening is niet geheel netwerk onafhankelijk want de voice dienst van de operator is alleen toegankelijk over diens netwerk. De dienstverlening van de Internet partijen is echter wel netwerk onafhankelijk en dus zowel beschikbaar over een mobiel breedband netwerk als over een wireless LAN.
Een praktijk voorbeeld van een dergelijke configuratie is de nieuwe Nokia N97 die de gebruiker de mogelijkheid biedt vanuit zijn adressenboek zijn contacten ofwel via zijn operator ofwel via een geïntegreerde Skype client te bellen.



Aggregator Centric Model

In deze configuratie ligt de portal functie bij een 3e partij. Deze partij (de service aggregator) functioneert als een portal voor de consument die toegang biedt tot meerdere Internet telefonie diensten. De diensten zijn netwerk onafhankelijk, dus kunnen zowel over een mobiele breedband netwerk als over bijvoorbeeld een wireless LAN geleverd worden.
Een goed voorbeeld van een dergelijke dienstverlener is Fring, deze dienst biedt een mobiele software client die de gebruiker in staat stelt te communiceren met meerdere diensten zoals Skype, MSN, Google Talk en ICQ.



Appendix D: Value Network Analyses

The representation of the value network model of TMNL's current voice service provision was used as the operator centric model during the empiric phase of this research project. Therefore all observations considering the operator centric model in this appendix will concern this model rather then the generic operator centric model presented in section 5.2. Another important aspect to keep in mind is that the models were discussed with regard to the provision of communication service provision and not of (mobile) web services. This will have to be taken into account when aggregating the findings of this appendix.

D1: Likelihood and Desirability

Likelihood of the Different Models

The majority of both the respondents internal and external to TMNL were of the opinion that the service centric model will eventually become the de facto standard. Many of them did stress that the operator would remain dominant within the timeframe considered in this research project, however they recognized that the latter was not sustainable in the light of the current an upcoming developments in the mobile domain. It was clear that the service centric model will definitely manifest itself in the mobile domain and a decoupling of access and service provision will take place, also concerning the operator's mobile service provision. However for years to come the operator centric model and the service centric model will coexist in parallel and the latter will not become the de facto standard within the timeframe considered in this research project; before 2015. Especially now regulation is driving down termination fees and roaming prices are being lowered, the price advantage offered by VoIP services becomes less of a unique selling point. An overview of the answers is given in the two figures below.

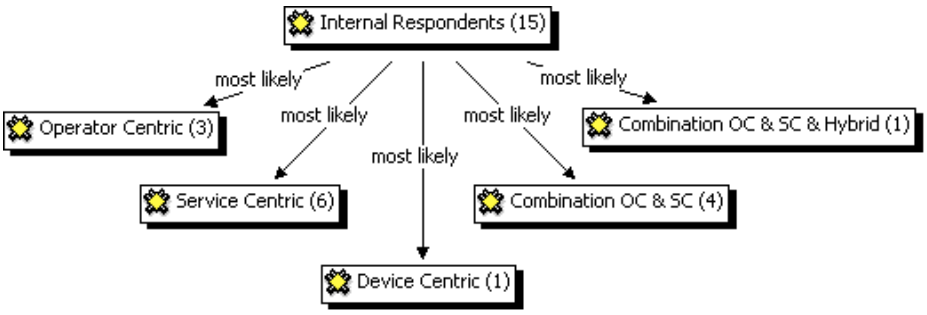


Figure A 1: Likely models according to respondents internal to TMNL

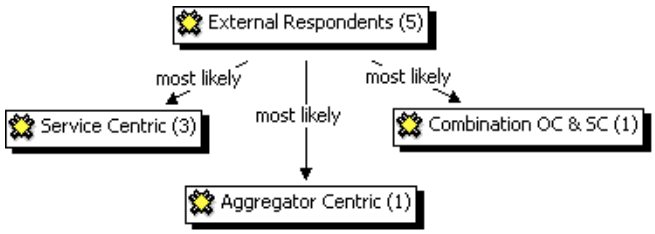


Figure A 2: Likely model according to respondents external to TMNL

Some differences of opinion existed on whether the parallel existence of the two models would be in the form of the device centric model, with a central and determining position for the mobile handset, or whether the handset would have a somewhat more subordinate position in the process of service provisioning and support both service providers. The main argument for the latter was the emergence of Android, Google's open sources mobile operating system, which is seen as disruptive to the device centric model as it takes away the device manufacturer's control over the applications running on his handset. This will give the handset a much more supporting position since it will mainly function as a more enabling platform like it does in the service and the aggregator centric model.
A number of respondents also expected that the market would not tip towards a certain model of service provision; that multiple models would remain to coexist in parallel rather then one of them becoming the de facto standard.

Only one respondent expected the aggregator centric model to become dominant. His rational behind this was the importance of a single and central user interface for multiple services, not only for communication services but for web services as well. In general however, this model was very much seen as an intermediary solution to unify the access to Internet-based communication services as long as they aren't interoperable. This interoperability is expected to eventually be arranged on an architectural level, taking away the necessity of an aggregating client. Furthermore, the service aggregator is not expected to become the dominant party due to the little added value it offers over the communication services it combines and its limited customer lock-in.

Desirability of the Different Models

With regard to the desirability of the different configuration, most respondents from TMNL chose the operator centric model when reasoning from the operator's perspective. When taking into account that this model will not be sustainable over time, they then referred to the device centric model because this configuration would still place service related roles with the operator. A single respondent from TMNL referred to the service centric model as the most desirable one due to its network-agnostic properties. Furthermore another model was put forward by two respondents from the company, that was not present in the generic models defined in this research project: a hybrid model where the mobile operator takes up a more enabling role towards Internet-based service providers and provides added value by enabling these parties to make optimal use of its network resources (TMNL Strat.2, TSI.1, TSI.2, TSI.4, M4.1, M4.2; TNO ICT).
The respondents external to TMNL generally found the service centric model to be the most desirable one. The respondents that referred to the aggregator centric model as the most desirable on explicitly added that that he did so in the context of it being an optimal extension of the service centric model.

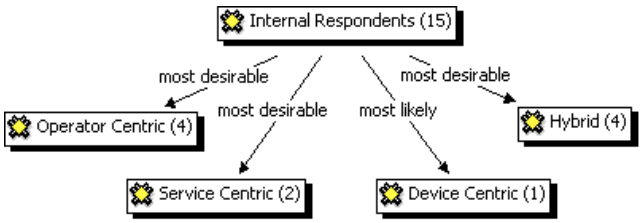


Figure A 3: Desirable models according to respondents internal to TMNL

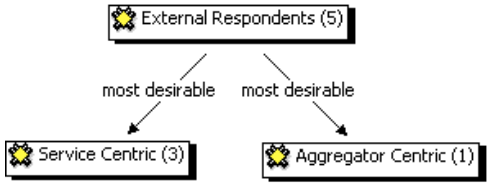


Figure A 4: Desirable models according to respondents external to TMNL

Internal Discrepancies

There was some discrepancy in the answers given by the different departments within TMNL. The distribution of the answers over the different departments from which the respondents came, is presented in four figures below. Although there was consensus about the emergence of Internet-based communication service providers as serious players in the mobile domain, there was a difference in how these players were viewed. The majority of respondents from the marketing and strategy departments were very much thinking in terms of the operator centric model and the (negative) impact of developments in the mobile domain as well as the emergence of alternative value networks on the position of the mobile operator and on its business model. Respondents from the technology department as well as the product & services department on the other hand had the tendency to view these Internet-based service providers not so much as a threat, but also as an opportunity. It were the latter respondents that most frequently mentioned the hybrid model discussed in the previous section.

This indicates that the market oriented departments reason in terms of the operator centric model, the incumbent circuit-switched paradigm so to say, while the technology oriented departments tend to think more in terms of the packet-switched paradigm and the value of the operator's resources in a service centric environment where service provision and access provision have been decoupled.

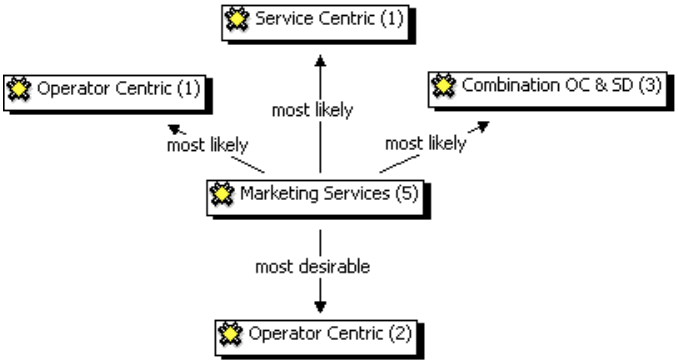


Figure A 5: Answers by respondents from TMNL's Marketing Services department

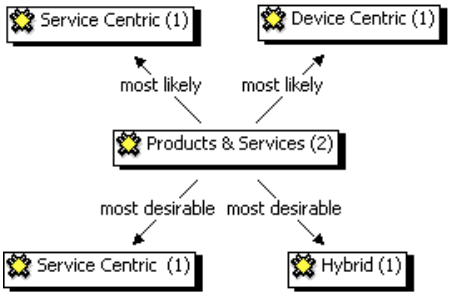


Figure A 6: Answers by respondents from TMNL's Products & Services department

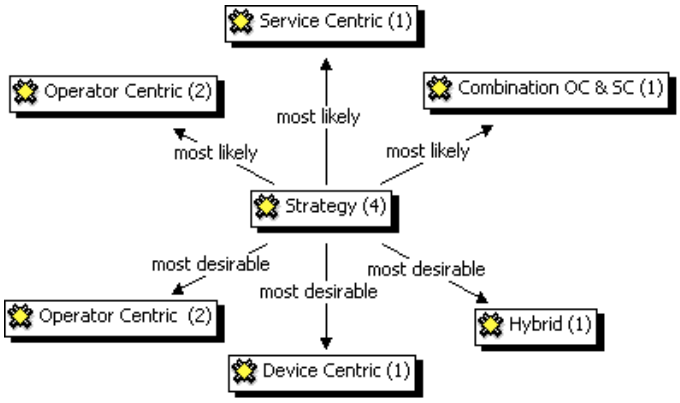


Figure A 7: Answers by respondents from TMNL's Strategy department

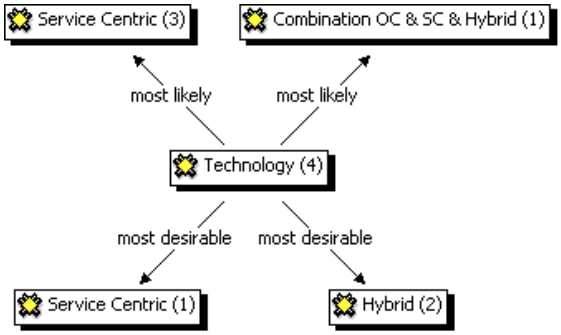


Figure A 8: Answers by respondents from TMNL's Technology department

D2: Models Evaluated with the Framework

Evaluation of the Operator Centric Model

Relationships of Dependency

Needless to say the operator plays a central part in the value creating process within the operator centric model. It fulfills all roles related to service provision and controls the majority of resources necessary for the service provisioning (TMNL Strat.1, Strat.3, OPTA, Sanoma). The operator has frequency spectrum licenses and operates the radio access network infrastructure forming the basis for the mobile services, controls the network core that enables the provision these services and controls the hardware that provides the services (TMNL Strat.1, Strat.3, TSI.2, TSI.4, M4.1, M4.2). As a result of the shift towards fixed-mobile convergent service provision, the operator's service portfolio can be accessed over different access networks. This entails that a fixed network operator will also be able to provide the end-user connectivity and thereby takes part in the value creating process. Though this makes the latter responsible for the actual delivery of the mobile operator's service provision, it does not create a relationship of dependency between the two actors; the fixed network operator has no discretion in deploying its resource since it does not pose limitations on different types of their subscriber's data traffic and will treat it like any other application. When looking from the subscriber's point of view however, this actor will be dependent on both the mobile and the fixed operator, though his dependency on the former will be a lot stronger.

There is a relationship of mutual dependency between the mobile telecom operator and the device manufacturer. The operator still has a fair amount of buyer power due to the scale of its wholesale purchases, but this dependency has become less strong due to the emergence of the mobile operating system and shift of the operator's communication services from the main functionality of the handset to 'one-of-many functionalities'. This latter development makes the operator quite dependent on the device manufacturer as well; if the operator wants to offer a service such as the Rich Communication Suite, the device manufacturers will have to embed an IMS client in their handsets.

Division of Gatekeeper Roles

When looking at the distribution of the bottleneck resources that are related to gatekeeper roles within the value network, the mobile telecom operator has control over each of them though not exclusively. Due to its role of communication service provider, the operator functions as the point of reference for the customer's service usage and therefore has ownership of the customer relation.

By having exclusive access to an extensive amount of information about the customer, the operator has ownership of the customer data. Furthermore, the operator has the ability to determine the pricing of the service and thereby the positioning of the service within the market and does both the billing and the collection of payments in house. This endows it with ownership of the customer transaction as well. Finally, the platform facilitating the interaction between the communication services and the service subscribers resides in the control layer of the operator's network architecture in combination with a software client on the subscriber's handset (TMNL Strat.1, Strat.2, Strat.3, TSI.2, M7.4, M7.5, M4.1, M4.2). Both the mobile telecom operator and the device manufacturer therefore fulfill the role of platform operator and determine the available service functionalities. This entails that these actors have partial control of the service creation environment.

The distribution of the gatekeeper roles is depicted in figure A9 on the next page.

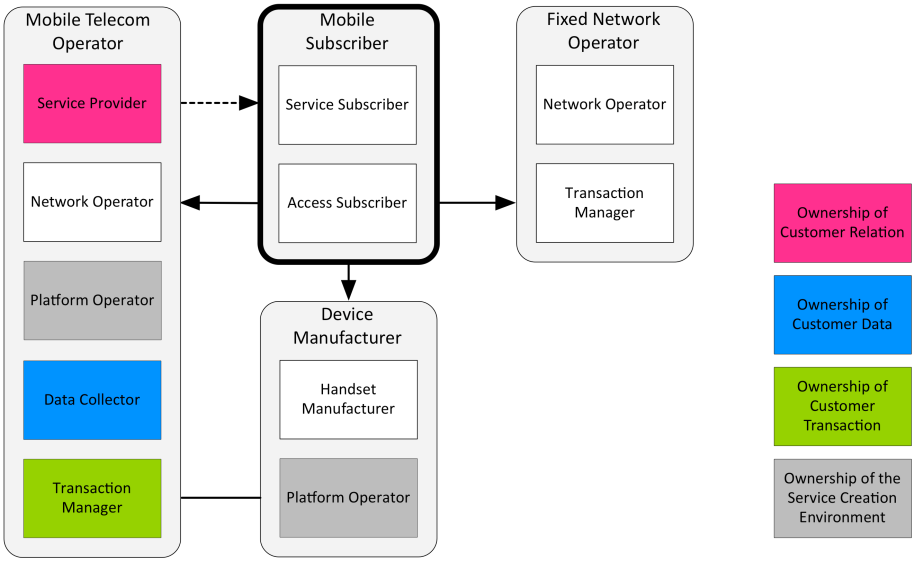


Figure A 9: Division of gatekeeper roles in the operator centric model

Degree of Vertical Integration

The diagram above clearly shows that there is a high degree of vertical integration of mobile telecom operator into the value creating process. It is responsible for the communication service provision, partially controls the service creation environment and is the subscriber's main provider of mobile connectivity. Though parts of the service creation environment also reside in the mobile handset, there is a tight coupling between the platform on the handsets and the platform in the mobile telecom operator's network architecture. Therefore this second service platform does not signify a separation between network and service functionalities. A fixed network operator may also offer some of the access provision, but this will only account for a small share of the overall service provision.

Degree of Openness

Accompanying the high degree of vertical integration on behalf of the mobile telecom operator into the value creating process is a low degree of network openness. Since the service functionalities are embedded into the operator's network architecture, the system is neither modular nor transparent. This leaves no room for third-party developers of complementing services to innovate using the service platform's abilities (TMNL Strat.1, TSI.1, TSI.2, M4.1, M7.4; OPTA; TNO ICT).

Evaluation of the Device Centric Model

Relationships of Dependency

Because the mobile subscriber has two communication service providers in this model, he is less dependent on them in comparison to the operator and the service centric model. Both the mobile telecom operator and the Internet-based service provider control resources that are critical to the subscriber for his mobile communication, however they are direct substitutes of each other which entails that alternatives are present in the model for both services. Besides a fully integrated voice service provider, the mobile operator also functions as a provider of mobile broadband connectivity to support Internet-based communication service provision. The mobile operator shares this role with the fixed operator, but even though they can both be seen as vital to the subscriber's Internet-based communication they are not full substitutes of each other. The fixed network operator only provides connectivity in certain areas such as the subscriber's home, while the mobile operator has nationwide coverage. Therefore the subscriber's dependency on the mobile operator's resources is stronger than his dependency on the fixed operator's resources.

The subscriber is dependent on the device manufacturer for the support of a certain Internet-based communication service. By deciding which communication services will be integrated into the device, the device manufacturer decides which service the subscriber can and cannot use and thereby has the ability to limit the subscriber's choice (TMNL Strat.1, M4.2). Alternatives are available however due to the diversity of mobile operating systems and handset manufacturers. There is a certain amount of lock-in due to the high prices for smartphones and/or the duration of the mobile subscriptions they are coupled with. During that period the subscriber is quite dependent on the device manufacturer for the functionalities of the handset, but in the long run this relationship is easily replaceable and therefore not sustainable (TMNL Strat.1).

Contrary to the service centric model, the mobile operator still functions as a service provider in the device centric model and therefore will still be likely to provide handsets in combination with its subscriptions. This also entails that it buys handsets from the device manufacturer on wholesale basis and in some cases even subsidizes them to lower their retail price. This accounts for a large share of the device manufacturer's sales, which makes it dependent on the operator's sales channels. This relationship of dependency enables the mobile operator to make demands about what software clients are pre-installed on the handsets and more important which ones are not (TMNL Strat.1, TSI.4, M4.1, M7.1, M7.4; OPTA). Similar to the operator centric model, this relationship of dependency is mutual, since the operator is dependent on the manufacturer for the support of its service functionalities on the handset.

The relationship of dependence between the communication service provider and the device manufacturer is of a different kind. The latter is not fully dependent on the communication service provider's application for its functionality as a communication device because it still supports the operator's services as well. While the device manufacturer is less dependent on the communication service provider, the opposite is true for this relation the other way around. Due to potential pressure from the mobile operator the manufacturer may be more reluctant in integrating applications into its handsets handset's operating system. This increases the amount of discretion the device manufacturer has regarding the availability of its resources. However, the sustainability of this latter source of dependency is questionable due to the expected shift in the support of Internet-based applications from the mobile operating system towards the mobile browser (TNO ICT; CM).

Furthermore, the Internet-based communication service provider is dependent on advertisers since it typically wields an indirect revenue model as well as on a financial intermediary since it typically does not have its own billing infrastructure in place. These relationships of dependency are not strong however due to the large amount of alternatives that are available among both types of actors.

Division of Gatekeeper Roles

The mobile telecom operator and the Internet-based communication service provider both offer voice services in this model. However, due to its role as portal provider, the device manufacturer functions as the first point of reference to the subscriber for his voice service provision and therefore has the most potential influence on the subscriber's service usage. This entails that the device manufacturer has the ownership of the customer relation.

Due to the distribution of data among multiple actors in this model, no single actor has a complete picture of the customer and his service usage. Both the mobile telecom operator and the Internet-based communication service provider generate a large amount of user data through their role as service providers, but for each actor this means they only have insight into part of the subscriber's service usage. The mobile telecom operator has additional information about the customer however, due to his role as access provider and therefore more insight into the customer. Furthermore, the device manufacturer has the ability to gain insight into the subscriber's preferences and frequency of the usage of the different services, but has less in-detail view of the actual usage. Due to this fragmentation of customer data, the ownership of this data cannot be attributed to a single actor. Rather the ownership is divided between the device manufacturer and the mobile telecom operator.

The subscriber has multiple financial relationships with transaction managers. There is the financial relationship with the two service providers (with the intervention of a financial intermediary in the case of the communication service provider) and then the subscriber also has two access providers. Here a distinction is made between the mobile operator as a service provider and as an access provider, because it functions both as a fully integrated voice service provider and as a provider of mobile broadband connectivity that supports Internet-based communication service provision. Only the mobile telecom provider and the Internet-based service provider however have the ability to determine the pricing of both options for communication service provision. The ownership of the customer transaction is therefore attributed to both actors.

The service creation environment is also divided among multiple actors. First there is the mobile operator whose network core functions as platform for its own service implementation. Secondly the mobile operating system functions as a software platform, facilitating the interaction between the subscribers and the communication service providers and determining which software clients are able to run on the handset. Therefore this last gatekeeper role is distributed between these two actors.

The distribution of the gatekeeper roles is depicted in figure A10 on the next page.

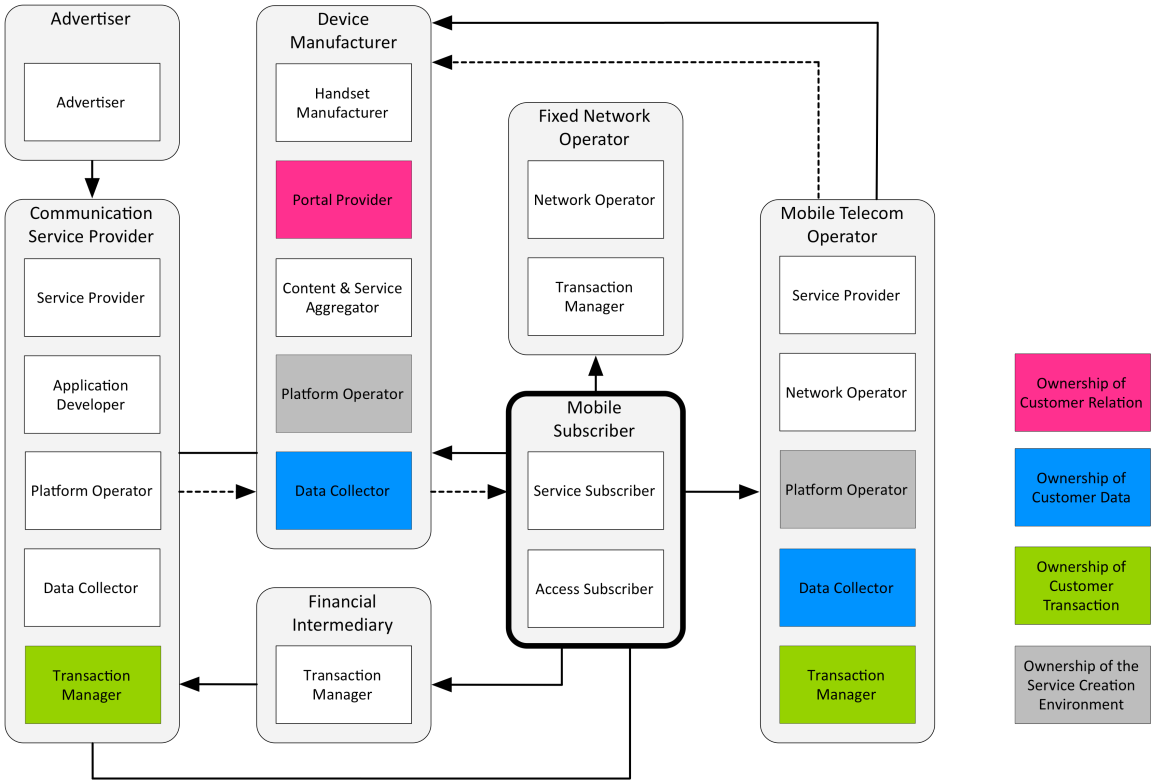


Figure A 10: Division of gatekeeper roles in the device centric model

Degree of Vertical Integration

The device centric model includes the fully integrated front-to-end operator's mobile voice service provision as well as the decentralized end-to-end Internet-based service provision. Due to the integration of the Internet-based communication service in the handsets operating system as well as the tight coupling between the operator's network architecture and its service provision, the device centric model displays a high degree of vertical integration.

Degree of Openness

The portal function of the handset raises a walled garden in the device centric model because the handset manufacturer will control the integration of communication applications into the handset's operating system. This will enable it to determine which Internet communication service providers will be integrated into the device and therefore to limit the subscriber's choice; the device manufacturer decides which service the subscriber can and cannot use, not the subscriber himself. Therefore this model does not have a high level of modularity nor transparency towards third-party service providers.

Evaluation of the Service Centric Model

Relationships of Dependency

In this model, the mobile subscriber is fully dependent on the communication service provider's application to communication with others. This application sets up the communication sessions and contains the subscribers address book (or 'buddy list'). To use this service, the subscriber needs mobile broadband connectivity. For this, he is dependent on the network operators (both mobile and fixed) because they control the infrastructures provide him with connectivity as well the customer service channels that help him solve connection related problems (TMNL M7.1, M7.4). The relationships with the two access providers are not of equal importance to the service provision however. They only provide a substitute for each other under certain conditions, i.e. when the subscriber is at home and his device has access to his home WLAN network or in area's were public WiFi is available. In most parts of the Netherlands, the mobile operator is the only provider of mobile broadband connectivity available to the subscriber and therefore the relationship of dependency between the two is stronger then the one between the fixed operator and the subscriber (TMNL M4.1).

With its platform functionality, the device is providing added value towards the subscriber since it is determinant for the applications that the subscriber can use and the quality with which these applications are supported by the device (TMNL Strat.1, M4.2). However as was put forward in the evaluation of the device centric model, the sustainability of this relation of dependency is limited. Therefore this relationship is perceived as one of limited dependency. This platform functionality also carries a mutual relationship of dependency between the communication service provider and the device manufacturer (TMNL M4.2, M7.2, M7.4). As a platform the device manufacturer is dependent on the applications it supports for its attractiveness towards the subscribers. On the other hand, the communication service provider is dependent on the device manufacturer for the support of his application by the mobile operating system, the platform. The sustainability of this latter source of dependency is questionable however because the interaction between the subscriber and the third-party service provider is expected to eventually be facilitated by the Internet browser of the mobile device rather then the mobile operating system (TNO ICT). Furthermore it is less strong then the relation between the two actors in the device centric model where the service has to be integrated into the handsets operating system rather then supported by it.

Due to the separation of the role of access provider and service provider, the dependency relation between the mobile network operator and the device manufacturer will be less strong compared to the operator centric model (TMNL M7.3, M7.4). Of course, there will remain a fair amount of interdependency because their infrastructure and devices have to be compatible, but the operator's network won't be the only one supported by the device anymore. The device runs carrier-independent service applications that function over WLAN as well as the operator's mobile broadband network. Furthermore, the mobile operator may still offer handsets through its own sales channels, but will not be likely to subsidize them anymore since they don't support the operator's communication service provision. Less handset subsidization will make the operator's sales channels less important for the device manufacturer and thereby weaken the dependency relationship between the two parties. Device manufacturers will look for alternative sources of subsidy to be able to realize lower market prices of their handsets such as alliances with application developers to pre-install their client on the handset. This will also entail that the operator will not advertize the handsets anymore, and the device manufacturers will have to do more of their own marketing. The configuration of their handsets will be more subscriber-driven instead of catering to the needs of the mobile operator as a wholesale customer.

Finally, the relationships between the Internet-based communication service provider and the advertisers as well as between the former and the financial intermediary do not contain a large amount of (inter-) dependency due to large amount of alternatives available to these parties.

Division of Gatekeeper Roles

When looking at the distribution of bottleneck resources and the accompanying division of gatekeeper roles in the service centric model, the diagram in figure A11 again shows a distributed allocation of the roles. In this model the communication service provider offers a carrier independent voice service to the subscriber and functions as the point of reference of the customer for his actual service usage. Therefore this actor has the ownership of the customer relationship and the ability to influence its service usage.

Both the communication service provider and the mobile network operator share the ownership of the customer data in the service centric model. As the service provider, the communication service fulfills certain data related roles such as the user identification and has insight in the customer's service usage and social communities. As the access provider the mobile operator also has a large amount of customer data; he identifies and authenticates the subscriber when connecting him to the network. Furthermore, the mobile operator has insight into the subscriber's demographics and his context such as location, device and connection speed.

As the diagram clearly displays, there are multiple transaction managers in this model. The subscriber has a financial relationship with both access providers and can also get billed by the Internet-based communication service provider for premium service usage. The former two actors take care of both the service billing and payment collection, while the latter outsources the collection to a financial intermediary. However the only actor that has the ability to determine the pricing of the communication service provision is the Internet-based service provider. This actor therefore has the ownership of the customer transaction.

Though there are two platform operators in this model, ownership of the service creation environment is only endowed to one of them: the device manufacturer. It has control over the mobile operating system installed on the handset and thereby controls the platform that facilitates the interaction between the subscribers and the communication service providers and is determinant for the software clients that are able to run on the handset. This gives him a certain amount of influence on the functionalities of third-party services. Though the software client of the communication service provider can also be seen as a platform because it can support different communication services and facilitate the interaction between the subscriber and the sponsored content, it is the inability to actually influence others that sets it apart from the mobile operating system. Therefore this latter platform is not seen as a source of ownership of the service creation environment.

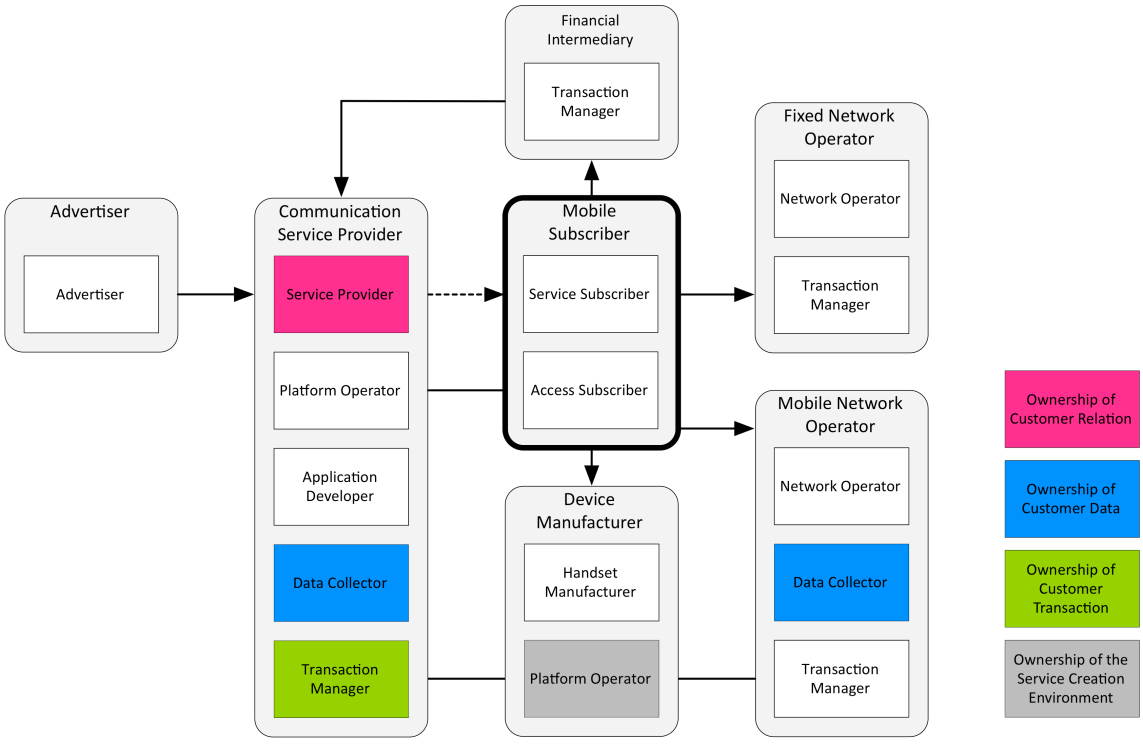


Figure A 11: Division of gatekeeper roles in the service centric model

Vertical Integration

As the diagram of the service centric model shows, the service related roles are separated from the access related roles and supported by the handset as a software platform. This clearly shows a decentralization of the communication service provision and no actor shows a high degree of vertical integration into all aspects of the value creating process. In comparison to the operator centric model where the service platform, service and access provision are situated with the same actor, the service centric model provides more flexibility and room for service innovation.

Openness

Due to the decentralized distribution of roles in the service centric model and its consequence that the ownership of the customer relation and the ownership of the service creation environment reside with different actors there is no single central service platform in the model. Rather it lies in the combination of the mobile operating system and the communication software client.

The openness of the former differs between vendors. As elaborated on in section 3.4.1, most of them provide some transparency and the ability to innovate to third-party application developers using its platform by issuing service development kids (SDKs). However the distribution and availability of these applications is subject to a fair amount of control by cannels such as Apples App Store or Nokia's Ovi Store. Google is different that way because it does provide a channel for these applications but doesn't impose restrictions or certain obligations on them as a condition for their availability. So in conclusion, the mobile operating system is quite transparent as a service platform but poses limitations to the ability of third parties to innovate using its technology. Regarding the communication software clients, these usually cannot be labeled as open service platforms. They are very much based on proprietary software and provide little to no interconnection with other communication services because of their indirect revenue model and the accompanying 'winner takes is all' approach.

Evaluation of the Aggregator Centric Model

Relationships of Dependency

In the aggregator centric model, multiple Internet-based communication services coexist in a single user interface. Through the parallel usage of multiple services, the subscriber is dependent on each of the communication service providers for a certain part of his communication because his contacts are distributed over them. Therefore the subscriber is strongly dependent on the communication service providers as a group, however less dependent on each of them individually (CM). This relation is therefore less strong compared to the service centric model.

Because the service aggregator's added value is combining different Internet-based communication services, he is dependent on these services for the actual communication service provision. He needs to be able to embed the communication service into his own portal and therefore dependent on the service providers for a standardized interface that enables him to do so. This relationship of dependency is not mutual however, because the communication providers may just as well offer their services directly to the subscriber with their own software client on a handset. Furthermore, the service aggregator is dependent on the device manufacturer for the support of his software client on the mobile handset (TMNL M4.2, M7.2, M7.4). This latter relation is of a similar relation as the one between the device manufacturer and the Internet-based service provider in the service centric model evaluated in the previous section.

Though using the service aggregator as a portal towards communication services, the subscriber is not heavily dependent on this actor. The aggregator provides some added value by providing a unified interface to the different communication services, but the subscriber still has separate user profiles with each of the service providers. There is no lock-in with the aggregating service and therefore it is easily swapped for another service aggregator (TMNL Strat.1, TSI.4; TNO ICT; CM).

The rest of the dependency relationships are similar to the service centric model.

The mobile subscriber is dependent on the device manufacturer for the support of the aggregation client by the mobile operating system on the handset. This dependency is limited by the diversity and available choice of mobile operating systems and handset manufacturers.

The two network operators provide connectivity, however the subscriber is not equally dependent on them. Due to the difference in the coverage of access service provision they offer to a single customer (as mentioned in the previous two models as well), the subscriber's dependency on the mobile operator's resources is stronger than his dependency on the fixed operator's resources.

There is a relation of interdependency between the device manufacturer and the mobile operator because they support each other's functionalities. Furthermore there may still be handset sales through the operator's sales channels, but similar to the service centric model not likely in combination with handset subsidization. The mobile operator will still have some buyer power over the device manufacturer as wholesale customer, but less compared to the operator centric model.

Finally, the advertiser's relationships with the communication service providers and the service aggregators do not contain large interdependencies due to the alternatives available to these parties. The same goes for the relationship between the financial intermediary and the communication service providers.

Division of Gatekeeper Roles

Though the service aggregator functions as a portal towards the services of different Internet-based communication service providers, this cannot be viewed as a source of customer ownership as was the case for device manufacturer in the previous model. It does function as the first point of references for the subscriber, however the latter still needs separate user profile with all communication services that are aggregated by the portal. The customer's relation with the communication service providers is stronger due to customer lock-in; they each have separate address books (or buddy lists) and certain contacts that are available through that particular service. This strong relationship reduces the amount

of potential influence the service aggregator has over the subscriber. Therefore, the ownership of the customer relation is attributed to the communication service providers in the model.
Different actors in the model have the ability to collect data. The communication service providers and the service aggregator both have insight into the subscriber's service usage. However because the service aggregator's software client facilitates the interaction between the subscriber and the services it has insight into service usage over different Internet-based communication services, while the communication service providers only have insight into the usage of their own service. For this reason the service aggregator has the ownership over the service related customer data. Besides the aggregator, the mobile operator has a large amount of user data as well due to its role as mobile access provider. This provides with insights into the subscriber's demographics, context and, to a certain extent, service usage. This gives the mobile operator ownership over a certain amount of customer data as well.
The subscriber has multiple financial relationships with transaction managers. He has a subscription with a fixed and a mobile network operator to provide him with mobile connectivity and a user account with both the service aggregator and with communication service providers who bill him for premium services. However just like in the service centric model there is but one actor with the ability to determine the pricing of the communication service provision: the Internet-based service provider. This actor therefore has the ownership of the customer transaction.
Also Similar to the service centric model, there are multiple platform operators in this model, while the ownership of the service creation environment is only endowed to one of them: the device manufacturer. With its control over the mobile operating system, it is determinant for the software clients that are able to run on the handset. This gives it influence on the service aggregator and, indirectly, on the communication service providers.

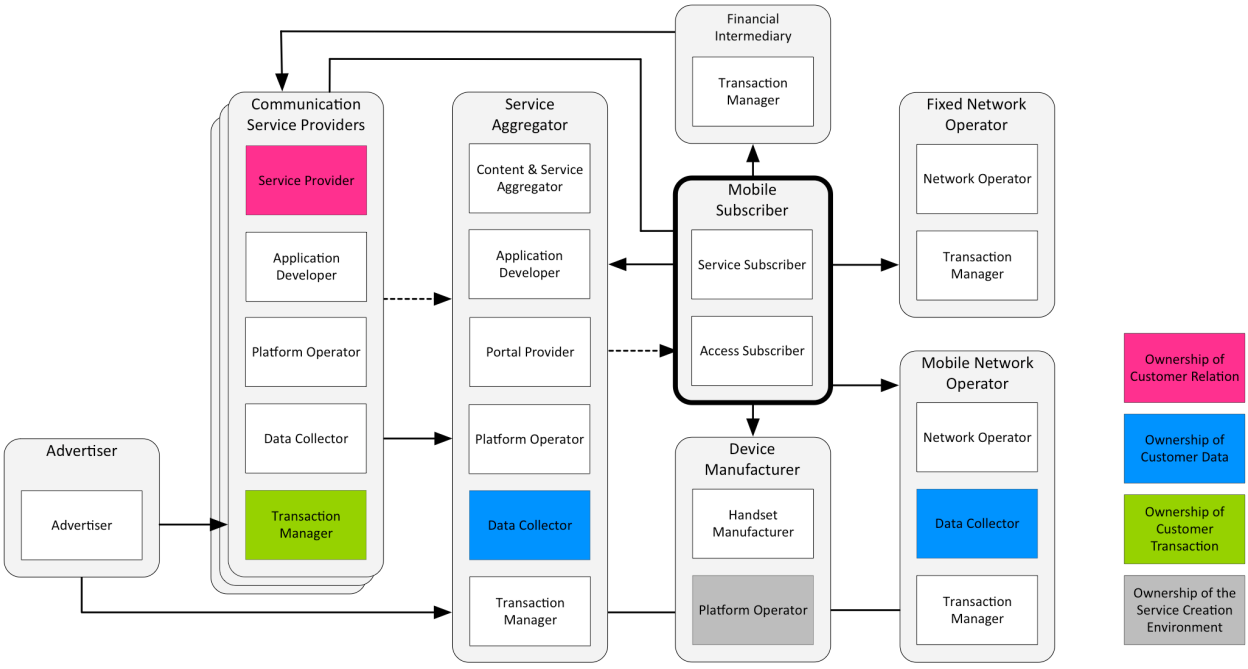


Figure A 12: Division of gatekeeper roles in the aggregator centric model

Vertical Integration

In this value network model, access and service provision are separated and divided over different actors in the network. No single actor is fully integrated into all aspects of the value creating process.
By providing SDKs to its platform, the device manufacturer stimulates the development of services complementary to its operating system such as the service aggregator's software client. Due to the intermediary position of the aggregator's client, there is no direct support needed in the mobile operating system for the communication service. This makes the communication service provider even more autonomous in developing its services because it shares no interface and therefore has no direct relationship with the mobile operating system.

Openness

Though the aggregator's client functions as the portal towards third-party Internet-based communication services, it does not raise a walled garden like the device manufacturer does in device centric model. It still remains an application that the subscriber chose to install on the handset and therefore it doesn't really limit his choice; if he wants to use a certain communication service, he can download an aggregating client that does support it or just install the software client of that particular Internet-based communication service separately. This limited ability to influence the subscriber's service usage is related to the lack of customer lock-in as mentioned earlier in this evaluation.
In providing its services the aggregator is dependent on two different software platforms that are both not fully transparent. The mobile operating system is reasonably transparent but poses limitations on the ability of third parties to innovate using its technology. The communication service providers on the other hand are very much based on proprietary software and have little incentive to provide a transparent interface towards an aggregating party because of their indirect revenue model and the accompanying 'winner takes is all' approach.

Appendix E: Actor Specific Resources

E1: Operator Specific Resources

The two figures below give an overview of answers of the different groups of respondents regarding the resources that will give the mobile operator an advantage in competing with Internet-based service providers. A short description of each of the resources is presented in the table on the next page.

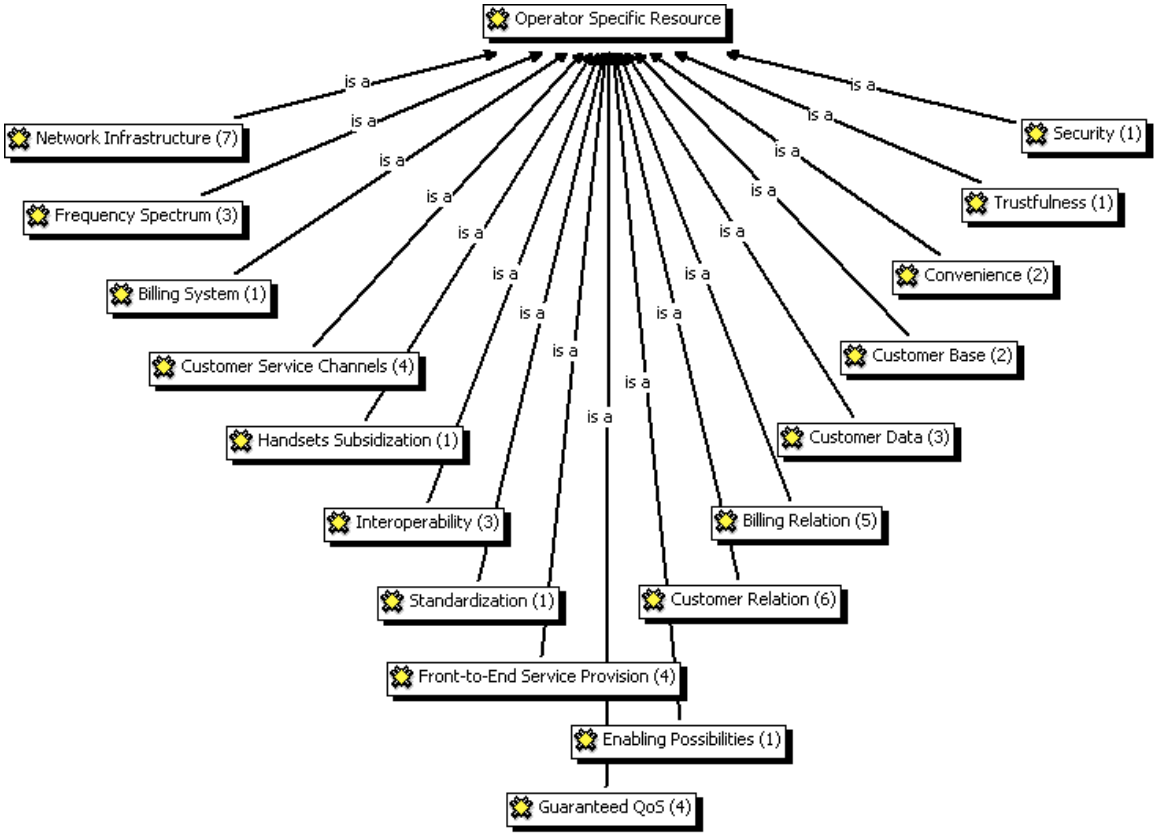


Figure A 13: Operator specific resources mentioned by respondents internal to TMNL

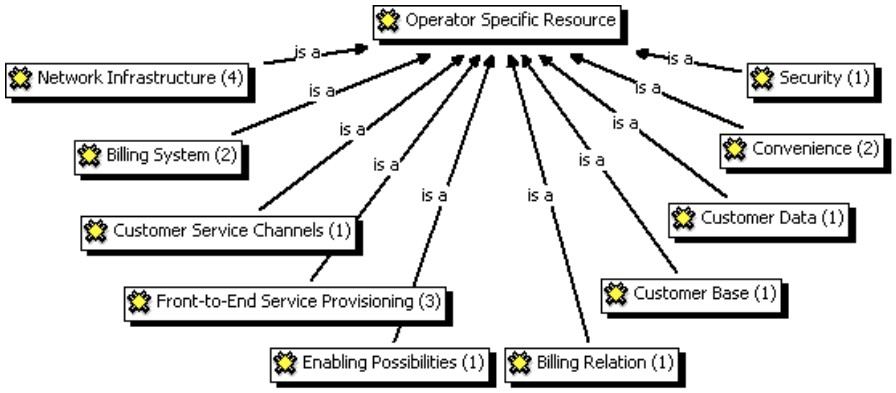


Figure A 14: Operator specific resources mentioned by respondents external to TMNL

Resources	Description
Network Infrastructure	A Core Network and a Radio Access Network
Frequency Spectrum	License to use certain frequencies for wireless communication
Billing System	A system that bills customer's service usage according to their subscription and collects the payments
Customer Service Channels	Call centers and shops
Handset Subsidization	Giving an advance and subsidy to subscribers for their handsets
Interoperability	The interoperability of network infrastructures, enabling interconnection of services between operators
Standardization	Industry wide standardization enabling harmonious implementation of technologies and services
Front-to-End Service Provisioning	A fully integrated service architecture, enabling control over all service related aspects
Guaranteed QoS	Independence of other parties for the quality of service delivery
Enabling Possibilities	Resources that can offer added value to third-party service providers
Customer Relation	A close relationship with the customer as his service provider
Billing Relation	A customer's trust and benevolence to pay invoices
Customer Base	A large base of customers
Customer Insights	Detailed information about the customers (demographics, context, service usage)
Convenience	The position of the obvious provider of communication services in the eyes of the customer
Trustfulness	The image of a trustful communication service provider
Security	A secure and authenticated network connection to mobile services

In order to remove some overlap between the different resources and make them more concise, they will be aggregated according to the table below.

Aggregated Resources	Resources
Network Infrastructure	Network Infrastructure
	Frequency Spectrum
	Enabling Possibilities
Billing Infrastructure	Billing System
Customer Service Channels	Customer Service Channels
	Handset Subsidization
Long-Lasting Service Relation	Convenience
	Trustfulness
Customer Relation	Customer Relation
	Customer Base
Customer Data	Customer Insights
Billing Relation	Billing Relation
Front-to-End Service Provisioning	Front-to-End Service Provisioning
	Guaranteed QoS
	Security
Interoperability	Interoperability
	Standardization

E2: Internet Specific Resources

The two figures below give an overview of answers of the different groups of respondents regarding the resources that will give the Internet-based service provider an advantage in competing with mobile operators. A short description of each of the resources is presented in the table on the next page.

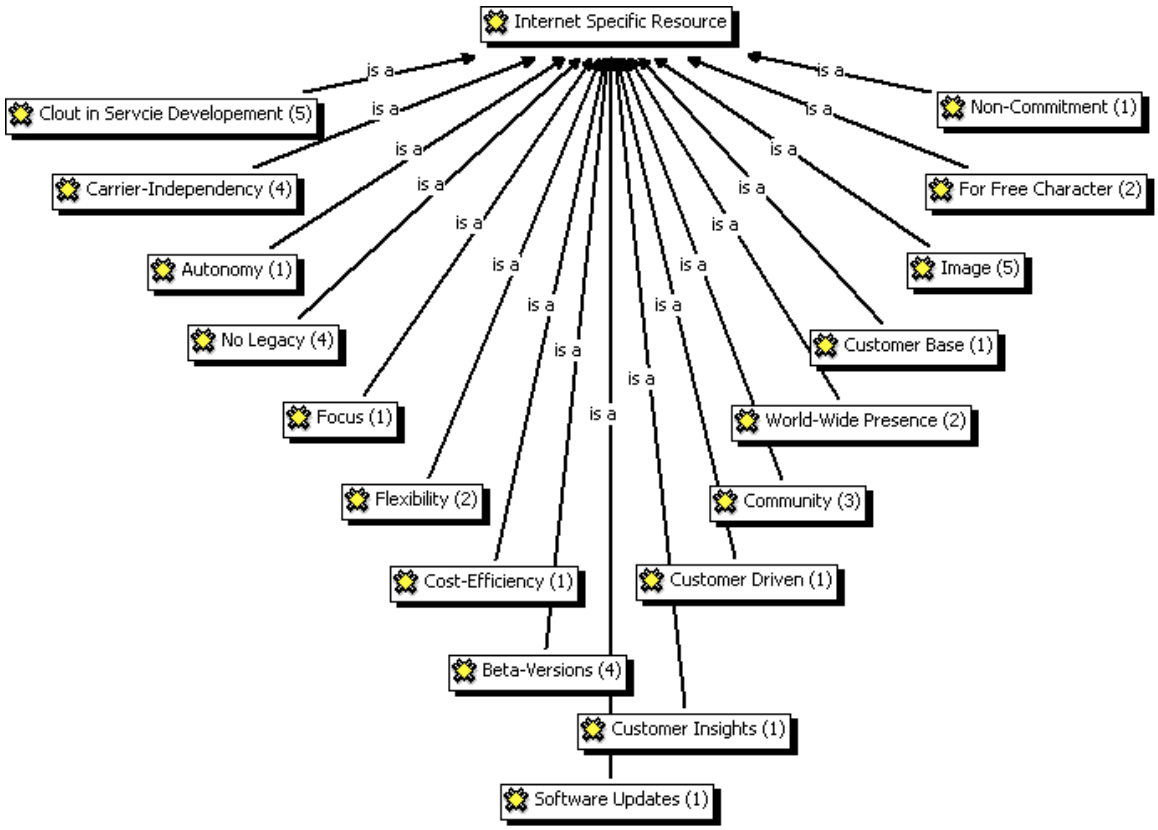


Figure A 15: Internet specific resources mentioned by respondents internal to TMNL

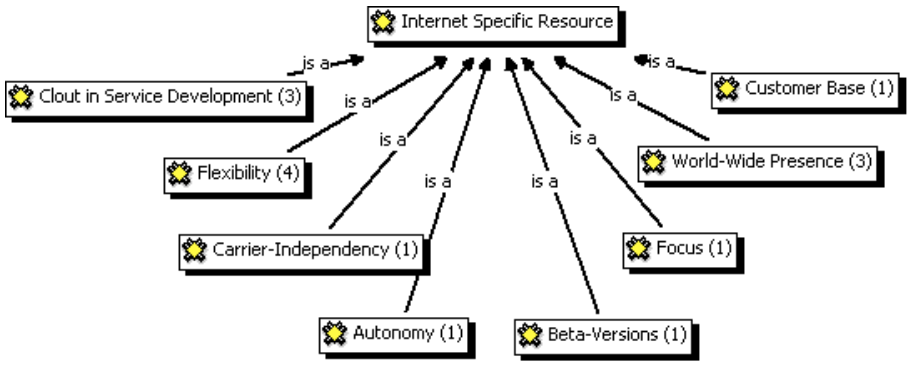


Figure A 16: Internet specific resources mentioned by respondents external to TMNL

Resources	Description
Clout in Service Development	Quick and efficient development of services
Carrier-Independency	The independence of a service and its functionalities on the underlying infrastructure
Autonomy	The ability to develop services independently and without the need for approval of other actors
No Legacy	No need for integration and backwards compatibility with legacy infrastructures
Focus	A limited and specialized service portfolio
Flexibility	Flexibility in service design and portfolio management
Cost-Efficiency	Cost-efficient service development
Beta-Versions	The ability to launch services that aren't fully finished yet
Software Updates	The ease in updating service functionalities and software clients
Customer Insights	Detailed information about the customers
Customer Driven	The ability to quickly and directly respond to customer needs
Community	Customers of a certain service form a community and give each other service support
Worldwide Presence	The services are available all over the world
Customer Base	A large and world-wide customer base
Image	An appealing and engaging brand
For Free Character	An image of providing services for free or as cheap as possible
Non-Commitment	A user account is far less binding than a subscription

In order to remove some overlap between the different resources and make them more concise, they will be aggregated according to the table below.

Aggregated Resources	Resources
Image	Image
	For-Free Character
	Customer-Driven
Customer Relation	Customer Base
Customer Data	Customer Insights
User Communities	Community
Clout in Service Development	Clout in Service Development
	Autonomy
	Focus
	Beta-Versions
Cost-Efficiency	Cost-Efficiency
	Software Updates
Flexibility	Flexibility
	Carrier-Independency
	No Legacy
Worldwide Presence	Worldwide Presence
Non-Commitment	Non-Commitment

Appendix F: Roadmap for Recommendations

The table below plots the different recommended actions into a timeline and illustrates their urgency.

What?	When?	Urgency
Provide Application Programming Interfaces	2010	High
Endorse VoLGA	2010	High
Commercially offer Voice over Alternative Access	2010	Med
Incorporate Online	2010	Med
Handset subsidization	2010	Med
Start IMS implementation	2011	High
Commercially offer fixed mobile convergent communication services	2013	Med
Implement VoLGA	2014	High