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Korte  
inhoud     : Het PTT monopolie op de markt voor randappara-  
              tuur komt per 1-1-1989 te vervallen. Directe  
              afzet van producten wordt hier dan ook mogelijk.  
              Ook wordt op korte termijn ISDN (Integrated  
              Services Digital Network) ingevoerd in Nederland  
              als vervolg op de digitalisering van de  
              infrastructuur.

Het is echter veel toekomstige gebruikers  
onduidelijk wat ISDN precies is, wanneer het  
komt, wat het kost, wat de voordelen voor de  
kantoorcommunicatie zijn en hoe het moet worden  
geïmplementeerd.

Doel van dit afstudeerwerk is het bestuderen van  
het ISDN concept, bepalen of er product-ideeën  
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dat zijn en ten slotte vaststellen of die ideeën  
te realiseren zijn.

TECHNISCHE UNIVERSITEIT DELFT

Faculteit der Elektrotechniek

Vakgroep Telecommunicatie- en Verkeersbegeleidingssystemen  
Laboratorium Automatische Verkeerssystemen

a f s t u d e e r o p d r a c h t

Te verrichten door : M. Willems

De opdracht zal worden uitgevoerd bij het laboratorium voor  
Automatische Verkeerssystemen

Mentoren: Ir. J. Kok (Siemens)  
Ir. H.I.P. van Soest (Siemens)  
Ir. J.R. Westerveld (TU DELFT)

Omschrijving van de opdracht:

Het PTT monopolie op de markt voor randapparatuur komt per 1-1-1989 te vervallen. Directe afzet van producten wordt hier dan mogelijk.

Ook wordt op korte termijn ISDN (Integrated Services Digital Network) ingevoerd in Nederland als vervolg op de digitalisering van de infrastructuur.

Het is echter veel toekomstige gebruikers onduidelijk wat ISDN precies is, wanneer het komt, wat het kost, wat de voordelen voor de kantoorcommunicatie zijn en hoe het moet worden geïmplementeerd.

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Hoogleraar,

(prof. ir. J.L. de Kroes)

**Verslag examenzitting Mark Willems**  
**Donderdag 12 november 1987, Delft**

- Kok: Sluit de normalisatie van het gebruikers-interface (vierdraads S-interface of tweedraads U-interface) aan bij de gebruikerswensen?
- Willems: Dit is sterk afhankelijk van het aantal aderpennen dat een bestaande bedrijfsinfrastructuur kent. Bedrijven met een vier-aderige infrastructuur zijn best tevreden met een S-interface. Globaal blijkt dat de voordelen van een U-interface (twee-aderig, lengte) zwaarder wegen dan de voordelen van een S-interface (tot 8 terminals op een bus). De keuze voor de S-bus door het CCITT lijkt wat minder gelukkig.
- de Kroes: Hoe denkt de PTT en met name dhr. Akerboom over dit onderwerp?
- Willems: Akerboom ondersteunt in principe het U-interface als gebruikers-interface.
- Kok: Bestaat de mogelijkheid om op de S-bus te subadresseren?
- Willems: Dat kan d.m.v. de zogenaamde Terminal Endpoint Identifier (TEI), die een data link connection tussen twee specifieke logische of fysieke terminals identificeert.
- Kok: Kan dit van buitenaf, door de PABX heen, geschieden?
- Willems: Dit gaat d.m.v. de 'TEI assignment procedure', die in de PABX of in de openbare switch draait. Elke willekeurige gebruikersterminal kan deze procedure opstarten. Deze procedure verifieert de TEI-waarde van een geadresseerde logische of fysieke terminal met een vaste TEI (0-63) of kent een eenmalige waarde toe aan de desbetreffende data link connection (64-127).
- Kok: Hoe kan het misverstand dat subadressering niet mogelijk is zo hardnekkig zijn?
- Willems: Dit is een onzinnig misverstand. Het feit, dat communicatie tussen twee terminals op dezelfde S-bus via een PABX mogelijk is, bewijst dat subadressering mogelijk is.
- Kok: Is een chef/secretaresse-installatie een interessante toepassing voor ISDN?
- Willems: Op zich wel, omdat zo'n installatie twee buitenlijnen kent (privé en openbaar), die makkelijk op een enkel koperpaar (S-bus) kan worden aangesloten.
- Kok: Waarom heeft dit idee toch zo laag gescoord in de beoordeling?
- Willems: Dit idee kwam relatief slecht door de groep van gebruikercriteria en is door de zware weegfactor van deze groep weggefilterd.
- Kok: Waarop is de software-opzet gebaseerd?
- Willems: Enerzijds heeft de belangrijke eis van modulariteit geleid tot een opzet met veel kleinere modules. Deze modules vervullen een beperkt aantal functies en roepen dan een volgende module aan. Anderzijds zijn gemeenschappelijke functies samengepakt in modules die door meerdere hogerliggende modules kunnen worden aangeroepen.

van Soest: Gebeurt de introductie van ISDN wel bottom-up, de aanschaf van een PABX is toch een top-down gebeurtenis?

Willems: Eerst wordt een digitale pre-ISDN PABX gekocht. ISDN-faciliteiten worden geïmplementeerd door 2B+D lijnkaarten te installeren en is dus toch weer een bottom-up gebeurtenis.

van Soest: Moet door de S-bus subadressering het nummerplan worden gewijzigd?

Willems: Dit is onnodig. De 'TEI assignment procedure' worden automatisch bij elke 'call setup procedure' geïnitieerd. Verder vindt in laag 5 identificatie van het type sessie plaats, dat ook al aangeeft welke terminal gesubadresseerd wordt.

van Soest: Zijn er 2 Mbit/s toepassingen "achter" de PABX, zodat breedband ISDN voor gebruiker nodig wordt?

Willems: Er zijn wel toepassingen, vnl. video diensten, maar de vraag lijkt weinig structureel, zodat "eiland-oplossingen" i.p.v. een breedband ISDN infrastructuur mogelijk blijven.

van Soest: Leidt "vroege ontplooiing" niet tot problemen vanwege de trage standarisatie?

Willems: Op zich is dat waar, echter twee andere zaken ondersteunen het principe van "vroege ontplooiing". Juist voor een bedrijf als SN is vroegtijdig verlies van markt-aandeel aan de concurrent onwenselijk. Verder is het kweken van een high-tech imago van groot belang bij het verwerven van een aanzienlijk marktaandeel in innovatieve producten.

Westerveld: Hoe komt het dat onderhoud aan digitale systemen gemakkelijker is?

Willems: Het testen en meten aan digitale systemen is eenvoudiger dan aan analoge systemen.

van Soest: Netwerk management kan bij digitale systemen gemakkelijker worden opgezet.

Westerveld: Is het overbodig worden van de 3,1 kHz begrenzers werkelijk een voorbeeld van economischer gebruik van middelen.

Willems: "Middelen" slaat hier op de bekabeling en niet op de begrenzers.

Westerveld: Zijn "jeans" werkelijk een vervangende innovatie?

Willems: Jazeker, want "jeans" maken gebruik van bestaande technologieën en behoeften en zijn op zoek naar nieuwe doelgroepen.

Westerveld: Wat is de validiteit van de metingen?

Willems: Het uitvoeren van een dergelijk onderzoek kan beter gedaan worden door een "technaut" met commercieel inzicht dan door een bedrijfskundige met technische affiniteit, omdat zo de finesses van het concept werkelijk op tafel komen.  
Van de andere kant zijn 15 interviews statistisch gezien te weinig en is het opzetten en stellen van een objectieve vragenlijst een vak apart.

Westerveld: Waarom is er niet zo veel aandacht besteed aan het gebruikers-interface?

Willems: Alleen de consistentie van alle geboden diensten is onder de aandacht geweest. Andere aspecten, b.v. ergonomische, worden niet tot het technische ontwerp gerekend.

**INNOVATIONS IN ISDN PRODUCTS  
FOR OFFICE COMMUNICATION**

**Mark Willems**

Delft University of Technology,  
Faculty of Electrical Engineering,  
Department of Telecommunication and Traffic Systems,

in co-operation with

Siemens Nederland N.V.,

November 1987

## PREFACE

This report has been made within the framework of the final thesis study of Mark Willems, graduate student from the Department of Electrical Engineering, Faculty of Telecommunication and Traffic Systems of the Delft University of Technology. The study on ISDN peripherals has been carried out in close co-operation with Siemens Nederland N.V. in The Hague.

This version of the report does not contain confidential information. Anyone, who is interested in the subject, is welcome to read the report.

Some acquaintance with the technical principles of telecommunications in general, and the ISDN transmission techniques in particular, is assumed.

I wish to thank gentlemen de Kroes, Westerveld, Kok, and van Soest for their support during the study. Moreover all interviewees are thanked for their time and expert output.

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## SUMMARY

The digitization of the Dutch infrastructure towards an Integrated Digital Network (IDN) is currently taking place. Evolving from this IDN, public Integrated Services Digital Network (ISDN) connections are about to be introduced in Holland. ISDN-based PABXs and multifunctional workstations are already available.

Moreover, starting January 1st 1989, the PTT will lose its monopoly on the peripheral market. Especially Siemens Nederland N.V. will be challenged to gain a considerable share of the Dutch ISDN peripheral market.

Unfortunately the ISDN concept has been technology-pushed so far. Users seem very sceptical about the usefulness of ISDN in their offices.

The goal of this survey is to find new, attractive ISDN peripherals for the office communication, which fit the (user) requirements as much as possible. The full stretch, from idea generation, via market research and product selection, up to product design, has been completed.

New products, or innovations, may be categorized into three groups: replacing, improving, and widening innovations. Replacing innovations provide solutions to existing problems with a better price/performance ratio than current solutions. Improving solutions provide solutions to insufficiently solved problems. Widening innovations provide entirely new applications.

ISDN in office communication appears to provide all three types of innovations.

Even after the demonopolization of the Dutch PTT, they continue to influence the development of ISDN peripherals strongly. The PTT determines the introduction scenario for public ISDN connections. Therefore, they decide upon issues as geographical coverage, degree of penetration, time schedule, bearer services, boundary of infrastructure, target group, and tariff structure. The large, professional market is the initial target group. Furthermore medium-bandwidth non-voice communication services appear to be the most attractive applications.

Subsequently the initial, most potential customers of ISDN equipment have been determined. Penetration of various telecommunication devices per branch and company size considerations have been studied. The initial target group are the (very) large companies in the food, paper, basic industries, wholesale, banking/insurance, service providers, and government branches.

The visited companies have been selected from this group as well. Nine companies, within this target group, have been interviewed on subjects, such as: the current company's telecommunication structure, strategy towards introduction of ISDN services, and concrete product suggestions. The main results are listed here.

Users are actually interested in ISDN, but wish to apply it to existing problems (replacing and improving innovations) for the time being. Indeed users are more interested in non-voice communication services on their ISDN-based company network. Current equipment will not be depreciated faster than usual, because of ISDN. Therefore, (some) ISDN products must be able to upgrade existing equipment to ISDN capabilities. ISDN investments must always be re-earned: it must save money, increase a company's market share, or boost productivity.

Finally the requirements, regarding the Siemens Nederland organization, have been listed. Important is the principle of 'early deployment' of ISDN services and products. Siemens should deploy its ISDN range as early as possible. Thus they may proliferate themselves as an ISDN competent, high-tech company, and gain a share of the Dutch ISDN market as fast as possible.

Some product-ideas appeared to fit the requirements very well. Moreover, these very chancefull ideas were realizable with the current components and ISDN knowledge.

## SAMENVATTING

De digitalisering van de Nederlandse infrastructuur tot het 'Integrated Digital Network' (IDN) is in volle gang. De openbare 'Integrated Services Digital Network' (ISDN) aansluitingen, die hieruit voortvloeien, worden spoedig geïntroduceerd. ISDN PABXen en multifunctionele werkstations zijn al beschikbaar.

Bovendien zal op 1 januari 1989 de PTT haar monopolie op de randapparatuur-markt verliezen. Vooral voor Siemens Nederland N.V. betekent dit een uitdaging om een aandeel van de Nederlandse ISDN markt voor zich op te eisen.

Helaas is het ISDN concept sterk 'technology-pushed' gewenst. Gebruikers zijn nog erg sceptisch over het nut van ISDN voor de kantoorcommunicatie.

Het doel van deze studie is nieuwe, kansrijke ISDN randapparatuur te vinden en die grondig te toetsen aan de wensen van de markt. Het totale traject, van het genereren van ideeën, via marktonderzoek en productkeuze, tot product-ontwerp, is doorlopen.

Nieuwe producten, of innovaties, kunnen worden onderverdeeld in drie groepen: vervangende, verbeterende en verbredende innovaties. Vervangende innovaties bieden oplossingen voor bestaande problemen met een betere prijs/prestatie verhouding. Verbeterende innovaties bieden oplossingen voor onvoldoende opgeloste problemen. Verbredende innovaties bieden geheel nieuwe toepassingen. ISDN in de kantoorcommunicatie blijkt alle drie typen innovaties te herbergen.

Zelfs na januari 1989 blijft de PTT de ontwikkeling van ISDN randapparatuur sterk beïnvloeden. The PTT bepaalt namelijk het introductie scenario voor openbare ISDN aansluitingen. Dat betekent dat zij de beslissingen nemen, t.a.v. de geografische dekkingsgraad, penetratie-graad, tijdsschema, 'bearer services', grens van de concessie en de tariefiëring.

De groot, zakelijke markt is aanvankelijk hun doelgroep. Medium-bandbreedte 'non-voice' communicatie diensten komen als meest veelbelovende toepassingen naar voren.

Vervolgens werden de meest kansrijke, "eerste" klanten van ISDN apparatuur bepaald. Hiertoe zijn de penetratiecijfers van verschillende telecommunicatiediensten per branch en de invloed van de bedrijfsgrootte bestudeerd. De doelgroep, geschikt om ISDN op te lanceren, zijn de (zeer) grote bedrijven uit de branches: 'food', papier, basis industrie, groothandel, banken/ verzekeringen, zakelijke dienstverlening en de overheid.

Uit deze groep werden ook de bezochte bedrijven geselecteerd. Negen bedrijven zijn geïnterviewed over onderwerpen als: de huidige bedrijfstelecommunicatie-structuur, strategie t.a.v. de invoering van ISDN in het bedrijf en concrete product-ideeën. De belangrijkste

resultaten zijn hier opgesomd. Gebruikers zijn daadwerkelijk geïnteresseerd in ISDN, maar willen het aanvankelijk toepassen voor al bestaande problemen (vervangende en verbeterende innovaties). Gebruikers zijn inderdaad meer geïnteresseerd in 'non-voice' communicatiediensten op het bedrijfs-ISDN. Bestaande apparatuur zal niet versneld worden afgeschreven, ten gunste van ISDN. (Sommige) ISDN producten zullen dus in staat moeten zijn om huidige apparatuur op te waarden naar ISDN prestaties. ISDN investeringen zullen altijd moeten worden terugverdiend. Of, doordat het geld uitspaart, het marktaandeel kan worden vergroot, of door de productiviteit te verhogen.

Ten slotte worden de eisen van de Siemens Nederland organisatie opgesomd. Belangrijk is de eis van een "vroege ontplooiing" van ISDN services en producten. Siemens zou het concept van "vroege ontplooiing" van ISDN moeten gebruiken om zich te manifesteren als een ISDN-capabel, high-tech bedrijf en een aandeel van de Nederlandse ISDN markt voor zich op te eisen.

Verscheidene product-ideeën bleken zeer goed aan de criteria te voldoen. Bovendien zijn deze kansrijke ideeën te realiseren met de huidige set componenten en ISDN kennis.

## 1. INTRODUCTION

Telecommunication in Holland is headed for a very exciting period, due to two facts.

First of all digitization of switching and transmission techniques have penetrated in public (PTT-managed) and private (company-managed) networks in Holland. From the digitized infrastructure or Integrated Digital Network (IDN) the Integrated Services Digital Network (ISDN) will evolve. A great deal has already been said and written about this subject. Despite widespread sceptism, it is very clear that the introduction of ISDN is inevitable. Commitment of PTT and suppliers is high. The Dutch PTT has a detailed schedule on how to provide the large, professional market with public ISDN connections. Telecommunication suppliers are developing ISDN-based products, like PABXs and multi-functional workstations (MFWS); computer-service companies prepare all sorts of Value Added Network Services (VANS). Yet users seem uninterested, mainly due to the great uncertainty about ISDN's real benefits. The threshold to start implementing ISDN into the office is still high.

Secondly the deregulation of the Dutch PTT is currently taking place. Starting January 1st 1989, the PTT will lose its monopoly on the peripheral market. This means a new challenge to suppliers, to sell (PTT-approved) in-house equipment directly to customers. Interaction between user wishes and product development will grow stronger. Lots of new ideas will have to be generated to complete the private ISDN picture.

The goal of this survey is to find new ISDN or ISDN-based peripherals (all equipment between the NT1 and the end-user), which subscribe as much as possible to user needs. Products, which decrease the threshold of introducing ISDN into one's company and have therefore more chances to be successful.

This means the full stretch, from idea generation, via market research and product selection, up to product design, has to be completed. This external version of the report mainly deals with two items: the description of the ISDN concept and its possibilities, according to the innovation theory and the results of the market study.

Chapter 2 provides more information on the approach to new ISDN peripherals. In chapter 3 ISDN services for office communication are summarized from a new point-of-view. Chapter 4 deals with the PTT introduction scenarios. In chapter 5 the target group is selected and an inventory of user requirements is made. In chapter 6 the Siemens requirements and the product selection procedure are presented. In chapter 7 the conclusions are listed.

## 2. ISDN EVOLUTION

This chapter provides more information on the evolution of the conventional telecommunication networks into ISDN and shows how this leads to new markets for both PTT and suppliers. Then the fundamentals of dealing with innovations in general and developing new ISDN peripherals specifically are discussed. The approach to ISDN innovations is outlined.

### 2.1 Current situation

In the current communication structure there are different types of networks, each optimized for its own specific service.

The circuit-switched telephone network is star-shaped, and uses mainly two-wire copper cable, on the local network level and is mesh-shaped on the higher levels. It uses an in-slot signalling on the local loop, which means a physical connection must be set-up to transport signalling information. The available bandwidth is limited to 3.1 kHz by low-pass filters in the infrastructure. On trunk connections voice channels are multiplexed onto 500 MHz-channels, using Frequency Division Multiplexing (FDM). Except for telephony it's used for data transport up to 9600 bps (through modems) as well.

The packet-switched data network, DN-1 in Holland, has the same structure as the telephone network. It uses the X.25 protocol as user-network interface and transports up to 48 kbps. On trunk connections between the three packet switches data is multiplexed, using statistical multiplexing.

Furthermore a separate telexnet, a radio/tv distribution-net, a mobile network, and an alarm network are recognized. (See figure 2.1 for several penetration figures.)

|                   |                       |
|-------------------|-----------------------|
| Telephony network | 5,000,000 connections |
| Radio/tv network  | 4,000,000 connections |
| Mobile network    | 100,000 connections   |
| Telex network     | 30,000 connections    |
| Data network      | 2,000 connections     |

Figure 2.1. Network penetration figures.

### 2.2 Digitization in telecommunications

The conventional use of the available, physical medium with analogous technology was rather inefficient and would have lead to network overloads within ten or fifteen years. Therefore other possibilities had to be considered.

In computer technology digital techniques had become popular and were introduced into the field of communication. A good example is the development of Local Area Networks for high-capacity, reliable in-house datacommunication. Also the traditional circuit-switched network was affected by digitization.

Because of the use of only two different physical signal levels, digital techniques incorporate several important advantages:

1. Relatively cheap because hardware prices for processing digital information have dropped dramatically;
2. Availability is higher, MTBF for digital systems is higher, because handling digital information is far less critical;
3. Transmission reliability is higher, since a correctly transmitted bit is determined by a correct decision between 0 or 1 at the receiver, and thus allows a worse S/N-ratio;
4. Maintenance may be more accurate, because network management is better organized in digital networks.
5. More economic use of available equipment, through digitization of switching and transmission ordinary copper wiring carries more than 100 kbps along a few kilometers;
6. Integration of different types of information on the same wiring, since eventually all information is transported as 0s or 1s. This is the fundament of mixed-mode communication.

For these reasons the Dutch infrastructure is now in the process of digitization. A digital overlay network, a digital switch per district connected through digital transmission systems, is designed. This will lead to a digital parallel network at the end of 1987. In addition 2 Mbps trunk connections and circuit-switched 64 kbps end-to-end connections are set-up.

This telephony Integrated Digital Network (IDN) is the base for ISDN.

### 2.3 ISDN as a new product

As transmission and switching become digital, a whole set of new standards must be developed to assure an optimal organization of available bandwidth, both in infrastructure and inhouse section. Several national administrations and industrial participants made proposals to the International Telegraph and Telephone Consultative Committee (CCITT) on this subject. A major limitation in defining new communication standards is the local loop, a star network, in which mainly two-wire copper runs from the local switch to every subscriber individually. The investments in this section amount up to 50% of the total telecommunication investments (in Holland) and thus cannot be replaced. The local loop length may run up to 7 km (in Holland), reducing the S/N-ratio severely.

Finally the ISDN concept of two 64 kbps circuit-switched B-channels and one 16 kbps packet-switched D-channel was adopted by the CCITT and further described in the I-series [11].

As mentioned above, the PTTs and hardware and software suppliers were the initiators of the ISDN idea. As the

mature, they recognized new possibilities to make money. The main contributor to the PTT Telecommunicatie's turnover, the telephony market, is saturated. Besides the fact that margins on hardware services are negligible, profits come from value-added services. For the PTT ISDN is the perfect tool to offer a new package of services to the customer.

The same applies to hardware and software suppliers. Through this new concept they can offer a new range of services and products.

#### 2.4 Innovations in peripherals

General ISDN user demand is expected to be boosted by three major aspect [4]:

- Availability of public ISDN connections:  
They must be available at reasonable costs, with a country-wide coverage and a sufficient penetration
- Availability of ISDN PABXs:  
An ISDN PABX forms the backbone of a ISDN-based company-network.
- Availability of a wide range of peripherals:  
This enables the user to actually explore the ISDN advantages for his/her good

Finding the most attractive peripherals is the objective of this study.

First of all innovations in general are examined. Basically innovations are based on three aspects: technology, target group, and user needs (figure 2.2):

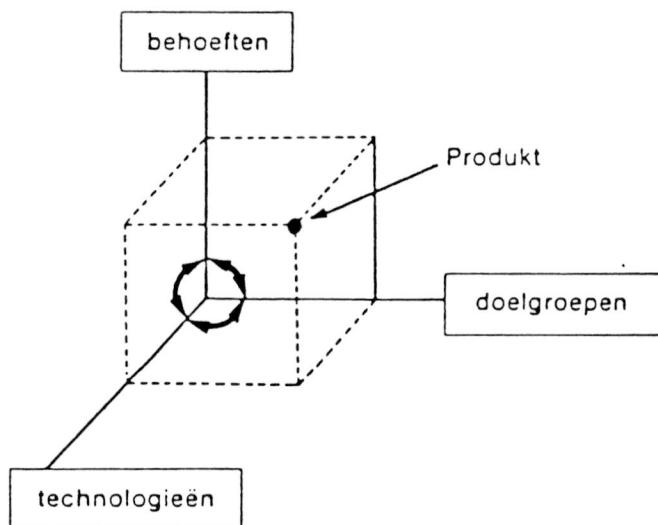


Figure 2.2. Innovation space.

Successful new products must have a sound base in all three of these previously mentioned categories [34]. Usually a new product starts from two dimensions and moves towards

new product starts from two dimensions and moves towards the third one. We distinguish three different types of innovations:

1. Replacing innovations:

These innovations are based on a certain technology and user needs and are looking for a certain target group. A product provides its target group with the same functions as existing products and is therefore judged on its efficiency. Marketeers emphasize on the price/performance-ratio. This type is least risky because of existing needs. An example is the jeans.

2. Improving innovations:

These are based on target group and user needs and require a certain new technology. These products provide solutions to insufficiently solved problems and are judged on their effectivity. Marketeers emphasize on functionality. This type is more risky, because it depends on the user acceptance of the solution. New environmental filters are good examples.

3. Widening innovations:

This type is based on existing technology and a certain target group and tries to create a user need. These products increase the human potential and are judged on their ability to boost productivity. Marketeers underline this productivity increase. This type is very risky because latent markets needs have to be made manifest. An example is the video-recorder.

Innovations are very conjuncture-sensitive. In a weak, economical climate, replacing innovations are most succesful. The stronger the economical environment, the more risky the product may be.

ISDN is a technology-pushed concept. Development is strongly based on the dimension technology. The target group is more or less determinable. A great deal of uncertainty, however, still concerns the user needs.

When approaching to new peripherals, the ISDN concept appears to contain all three types of innovations. The above classification is used in the inventory of ISDN services in chapter 3 and the selection of the target group and overview of user needs in chapter 5.

## 2.5 Involved parties in shaping ISDN peripherals

Managing a product line implies taking all involved parties into consideration and trying to combine all different fields of influence into a good product. Completing the full stretch implicates an inventory of all involved parties and their specific interests has to be made. This list of requirements is used in the selection procedure (chapter 6). In this particular case the following parties are recognized:

1. Available technology, standards, and derived services:

Technology was the traditional trigger in developing ISDN products and services. In chapter 3 we make an

- inventory of currently available services.
2. PTT:  
The PTT remains in charge of the Dutch infrastructure. They hold a strong influence on the development of peripherals through tariffs, offered bearer services, target group, time schedule, etc.. Chapter 4 deals with the PTT scenarios.
  3. Users:  
They make the investments eventually. Opposed to most previous publications, this survey emphasizes on their considerations and requirements to introduce ISDN into their companies. Chapter 5 is dedicated to this study.
  4. Competitors:  
Their activities may influence one's own product strategy. In this study competitor's activities have not been taken into account.
  5. Siemens A.G. and Siemens Nederland N.V.:  
They determine whether a new product(range) fits their corporate and national activities on the field of R&D, manufacturing, marketing and sales. (chapter 6).

### 3 ISDN SERVICES IN OFFICE COMMUNICATION

In this chapter ISDN services for the office communication are summarized. In the framework of this study, office communication is considered to be a wide concept. Communication includes human-to-human communication, machine-to-machine, as well as all sorts of combinations. The list is made, according to the three innovation categories.

For a sound understanding of what ISDN actually is about, the single, most important aspect of the whole ISDN concept is considered: the conversion of an analogous, twisted-pair 3,1 kHz speech channel into two digital, transparent, circuit-switched 64 kbps channels and a separate 16 kbps packet-switched channel on the same wiring. The two most important features of this conversion are:

1. Digital transmission:

Transmission with a relatively high bandwidth of 64 kbps per B-channel. Obviously digital transmission is not restricted to ISDN only, but yet it is an essential part of the concept. It provides all important advantages of digital transmission (see 2.2) to the end-user. The 64 kbps capacity is an enormous step in the right direction, compared to the current digital transmission capacity (up to 9.6 kbps on twisted-pair).

2. Two separate, transparent channels:

These channels allow simultaneous use of different communication services by the same end-user on one twisted-pair. The additional, third D-channel for handling signalling information assures fully transparent, service-independent B-channels.

The services are first categorized by bearer service and secondly by type of innovation. Here the classification of innovations in three groups is recalled: replacing, improving, and widening innovations. We now apply it to the list of ISDN services. Sometimes the boundary between a replacing and an improving services is vague. Both apply to existing problems. Replacing innovations provide more cost-effective solutions to already solved problems. Whereas improving innovations are concerned with inadequately solved problems.

#### 64 kbps circuit-switched, transparent B-channel:

1. Replacing benefits:

- High-quality voice service through the transmission of PCM-coded voice. After datacompression digitized 7,1 kHz voice-channel becomes possible.
- High-speed non-voice services because transmission is upgraded from around 1200 bps (Viditel) or 9600 (file transfer via modem) upto 64 kbps. Facsimile documents are sent within seconds instead of a minute; teletex messages have a reduced transmission time of less than a second (A4). High-speed access to public and private databases will be part of the ISDN. This allows for

instance fast 'glancing' through database-pages.

- High-resolution non-voice services because bandwidth increases dramatically. Videotex databases may contain photographic-quality information; fax documents look 'professional'; teletex may use the extended character set. Even voice mail services with databases, storing 64 kbps, may be handled.
- Medium-bandwidth datacommunication may now be handled on the existing telephony network, both private and public. Except for data sessions with a very short session length (<1 sec.), combined with high-bandwidth traffic (> 64 kbps), the telephony network is now capable of providing data services. The relative high capacity of 64 kbps and the statistical character of many terminal-computer, computer-computer, database-computer sessions ask for multiplexing. This benefit of private ISDN is mainly expressed in cost-savings. Less modem use, lower investments in dedicated data networks, less public connections (both dial-up datalinks and fixed connections) and favourable datacommunication tariffs (as it appears) enable cost-savings. Furthermore a considerable improvement of response times may be achieved.

2. Improving benefits:

- Low-error non-voice communication because of the high reliability and simple fault-recovery-circuits in digital transmission. Bit error rates of  $10^{-7}$  are possible.
- Simple interconnection of digital networks through the use of the ISDN as a digital intermedium. Data from the network is converted onto the S- or U-bus and transparently switched to another network destination.

3. Widening benefits:

- Mixed-document transmission because of the digitization of the medium there is no longer a distinction between voice, data, text or images, since all information is transmitted by means of the same physical signals.
- New services like colour fax, voice mail

16 kbps packet-switched D-channel:

1. Replacing benefits:

- More efficient use of B-channel through outslot signalling. All signalling procedures, i.e. call setup, charging, call information transfer, are handled in the D-channel. Resulting in a fully transparent B-channel, set-up only for user information transfer.
- Fast connection set-up because of the use of fast, packet-switched signalling, thus avoiding waiting-time. Response times are improved, and in specific cases lease lines or DNI-connections may be replaced by ISDN dialup lines.

2. Improving benefits:

- Control-/diagnose possibilities again because of the HDLC-signalling. From a central control node, i.e. a

PABX, all nodes in the network are accessed through the D-channel and status and/or statistical information may be exchanged.

3. Widening benefits:

- Mixed circuit-/packet-switched communication within the private ISDN. A user uses the B- and D-channel for respectively circuit- and packet-switched information.
- Extra features since the D-channel can handle an unprecedented amount of supporting information. An example is 'calling party identification' at the called party's display.

Two 64 kbps B-channels with one number:

1. Widening benefits:

- Mixed communication allowing an end-user to communicate with another end-user using different services simultaneously, i.e. a telephone call accompanied by a fax transfer. Different services may be accessed via the same subscriber number. This might lead to an increase in flexibility and productivity.
- Multiple communication enabling a single end-user to access different sources simultaneously, i.e. a telephone call, supported by a database consult under another subscriber number.

#### 4 ISDN PERIPHERALS AND THE PTT

Although the PTT administration will lose its monopoly on the inhouse market, they remain strongly involved in the development of services and products for the inhouse market. As mentioned in paragraph 2.5, public ISDN connections are essential to a successful launching of ISDN in general. No company is interested in isolated site-networks (ISDN 'islands'). In this chapter we examine the possible fringe benefits the PTT puts onto new products.

##### 4.1 Introduction scenario

###### - Integrated Digital Network:

The first step to ISDN to be taken is the buildup of an IDN. PTTs may choose out of two approaches:

- \* Island scenario, in which closed user groups are provided with a high penetration of connections. Geographical coverage, however, is more or less limited to this 'island'. In this bottom-up approach local switches are replaced by ISDN switchew, one by one. This scenario might be interesting when certain user groups have a high, internal communication potential, e.g. Teleport in Amsterdam.
- \* Overlay scenario, in which users are provided with connections country-wide, but with a relatively low degree of penetration. This top-down approach requires a digital overlay network, from which digital paths are built down to subscribers. When national coverage is demanded and low penetration is allowable for the time being, this approach is preferable.

By implementing at least one digital switch per district, connected by digital transmission systems (2 Mbps links), the Dutch PTT has chosen the last scenario. From this stage circuit-switched end-to-end 64 kbps channels are setup. Obviously companies wish to integrate all their sites into one ISDN and ,therefore, need country-wide coverage. Penetration is a less important demand for the time being. Nevertheless on local scale ISDN islands may be created on specific demand, e.g. the Dutch 'Agglomeratienetten'.

###### - Time schedule:

The preliminary time schedule looks as follows

(the last four data are very rough indications):

- \* Introduction 2 Mbps connections (on local loop) 1985
- \* Common-channel signalling via digital ASL'70 1985
- \* Buildup digital parallel overlay-network 1987
- \* Circuit-switched 64 kbps end-to-end connections 1987
- \* Common-channel signalling via C7 1988
- \* Tariff structure available 1988
- \* First 'primary rate' ISDN connections 1989
- \* Interworking with existing networks 1990
- \* 5%-penetration according to EC 1993
- \* Packet-switched user data in D-channel around 1993
- \* First 'basic access' connections around 1994

- \* Penetration in home market around 1997
- \* Interworking with broadband/TV networks around 2000

Important is the non-availability of basic access connections and D-channel user data transmission on the short term.

- Provided services:  
Initially the 'primary rate' connection (30B+D) is the only 'bearer service', provided by the PTT. In case a 30B+D-channel is too much or not yet available, different sites are linked through switched 64 kbps connections or 2 Mbps lease lines. The first teleservices become available when end-users may access service-specific networks (telex, DN1) via the telephony infrastructure, by means of interworking. Only in the mid nineties 'basic access' connections will become available, due the high price of NT1 devices. When further European-wide standardization of the U-interface allows 'economy-of-scale' production and VLSI prices decline even more, prices may drop to a few hundreds of guilders.
- Boundary of infrastructure:  
In the previous chapter the PTT's definition on the boundary between infrastructure and inhouse section is mentioned. Although there's a lot of objection from the industry, the T-interface is assumed to be the boundary for the time being. This leaves the NT1 within the concession.

#### 4.2 Target group

Obviously the PTT is aiming at the large, professional market (LPM). The medium-size and small, professional market, as well as the home market seem to be a potential market in the future.

For numerous reasons the PTT has chosen the LPM:

- Most sophisticated communication users:  
The more advanced one's communication needs are, the more benevolent one is to give new, sophisticated techniques a try.
- (Pre-)ISDN PABX as the basis for a private ISDN:  
These PABXs are a necessary condition for the buildup of an internal ISDN and are only present at large companies. Besides large PABXs already use multiple connections to the infrastructure (e.g. 30 analogous channels) which may be easily upgraded to 'primary rate' ISDN connections.
- Ability to fill the 2 Mbps capacity:  
'Basic access' connections are not available yet, due the lack of reasonably priced NT1s. The 30B+D links may be installed without specific network termination devices.

The five percent penetration will therefore be entirely achieved in the LPM. This results in 270.000 connections in 1993, according to European Commission recommendations.

### 4.3 Tariff structure

A favourable tariff structure may be a strong promotor for ISDN investments. Unfortunately a great deal of uncertainty still surrounds this essential subject. Nevertheless, both the CCITT and the national administrations are making progress on the subject.

The Study Group III of the CCITT made four statements:

1. Tariffs should be cost-based.
2. Tariffs should generally be independent of the type and volume of carried data. They should be channel-capacity-oriented.
3. Tariffs must take into account the interworking of ISDN services with services on other networks.
4. Permanent bearer services should be offered on a 'flat rate' charging basis.

A current proposal, circulating within the Dutch PTT as a possible solution, is partially based on these considerations. It leaves the variable costs unchanged: the costs of using 64 kbps connections are identical to the existing analogue carriers. The monthly fixed costs, however, might be increased. In this way the PTT wants to regain the extra investments they have to make in the infrastructure (interworking facilities, A/D-conversion at conventional switches).

Traffic, which is redirected within the infrastructure to other networks, will be additionally charged. The total charges, however, will not exceed the costs for a separate network connection.

There will probably be no volume- or type-dependent charges.

All this indicates a favourable environment for datacommunication. Especially the lack of increased time-dependent, volume- or type-dependent charges might make ISDN a cost-effective solution for datacommunication problems.

Taking other European countries into consideration, we see a similar structure. British Telecom is the first carrier currently offering ISDN on a commercial basis. Variable ISDN charges are similar to current ones and rental (fixed) charges have increased. An identical situation is found in Germany and France, where variable costs remain unchanged and fixed costs are between present telephone and 64 kbps data line charges. Again there are different charges for different services, but no indication on volume tariffs.

Obviously all preliminary tariffs favour datacommunication (may include also image and text files), especially datacommunications with a bandwidth close the maximum line capacity.

#### 4.4 PTT Criteria

The consequences of continuing PTT involvement for the choice of new peripheral products are summarized.

- Products which are situated at the boundary between the inhouse section and the infrastructure (the T-interface for the time being) should handle 30B+D connections. Only in roughly 3-5 years products should handle public 2B+D- connections.
- Products are more chanceful when projected at the (very) large, professional market. Eventually products should be aimed at the medium-size and small, professional market as well.
- Products integrating datacommunication onto the company's ISDN are chanceful. Especially those which enable optimum use of the available bandwidth.
- Products should be situated at the left side of the NT1 in the CCITT 'reference configuration'.

## 5. ISDN PERIPHERALS AND USERS

Perhaps the most important chapter in this report deals with the user's view on ISDN and its position within office communication. First the most appropriate target group for launching new ISDN products on the short term is decided upon. Besides ISDN target group, it is been used to select companies for the interview sessions. Subsequently the results of these user interviews are presented. Finally all user criteria, indicating how to position ISDN from a user's point-of-view, are listed once more.

### 5.1 ISDN target group

A first categorization divides the professional from the private market. Generally the private market (households) is not expected to be potential ISDN user within ten years. Furthermore the private market is a very bad partner for evaluating user needs, because of its extent and incompetence on the subject. It will not be considered in this survey.

Within the professional market a further categorization upon branch and size is made.

#### 5.1.1 Branch selection

Decision criteria:

In order to select the most potential, initial ISDN customers (and candidates for being interviewed) from the list of 20 branches in Holland, relevant decision criteria are necessary. Again the three different types of innovations (and benefits) are recalled: replacing, improving, and widening. In chapter 3 is shown, that ISDN for office communication covers all three types of innovations. The estimated need per branch and per type of innovation is used as the ultimate decision criteria. Our goal, therefore, is to estimate for each branch the:

1. Replacing potential (RP)
2. Improving potential (IP)
3. Widening potential (WP)

First-degree indicators:

To estimate the potential in every area, indicators are necessary. The chosen (first-degree) indicators are shown below. Between parentheses the used abbreviation for the indicator and the area of potential demand (RP, IP, WP), for which it is an indicator, are given. The indicators are the estimated amount of:

1. Internal communication, in general (CI; RP,IP,WP);
2. External communication, in general (CE; RP,IP,WP);
3. Voice communication (V; WP);
4. Data communication, by means of PC (DP; RP,IP,WP);
5. Data communication, by means of other EDP tools (DR; RP,IP,WP);
6. Text communication (T; RP,WP);

7. Image communication (I; RP,WP),  
and the:
8. Expected, general attitude towards automation (AM; WP).

Second-degree indicators:

However, to estimate the first-degree indicators we need branch-related figures on the penetration of various communication devices, investments in automation employees and equipment, etc.. Information is gathered from the Siemens Nederland Marketing Department [21] and the Dutch Statistics Office, Centraal Bureau voor de Statistiek (CBS) [3]. The second-degree indicators are shown below. Between parentheses the used abbreviation and the first degree indicators, for which it is an second degree indicator are found:

1. Number of establishments per branch (POP);
2. Number of extensions (EXT; V,CI);
3. Number of incoming telephone lines (ITL; V,CE);
4. Number of outgoing telephone lines (OTL; V,CE);
5. Penetration of facsimiles (FIB; I,CE);
6. Penetration of telex equipment (T,CE);
7. Penetration of PCs (PC; DP,CI,CE);
8. Penetration of communication terminals (CT; CE,CI,DR);
9. Penetration of wordprocessing monitors (WM; T);
10. Number of people working in automation (AP; AM);
11. Investments in automation projects (AC; AM);
12. Degree of automation (AD; AM);

The exact figures are not shown here; they may be found in Appendix 2. The results of the estimation procedure are shown in figure 5.1.

|                        | CI | CE | V | DP | DR | T | I | AM | RP | IP | WP |
|------------------------|----|----|---|----|----|---|---|----|----|----|----|
| 1. Food/drink/tobacco  |    |    |   |    |    |   |   |    | +  | +  | +  |
| 2. Textiles/clothing   |    |    |   |    |    |   |   |    | +  | +  | -  |
| 3. Paper/wood          |    |    |   |    |    |   |   |    | +  | +  | +  |
| 4. Graphical ind.      |    |    |   |    |    |   |   |    | -  | +  | -  |
| 5. Chemical ind.       |    |    |   |    |    |   |   |    | +  | +  | +  |
| 6. Metal engineering   |    |    |   |    |    |   |   |    | +  | +  | +  |
| 7. Basic products      |    |    |   |    |    |   |   |    | +  | +  | +  |
| 8. Other ind.          |    |    |   |    |    |   |   |    | +  | +  | +  |
| 9. Construction ind.   |    |    |   |    |    |   |   |    | -  | -  | -  |
| 10. Construction serv. |    |    |   |    |    |   |   |    | -  | -  | -  |
| 11. Wholesale          |    |    |   |    |    |   |   |    | +  | +  | +  |
| 12. Retail             |    |    |   |    |    |   |   |    | -  | -  | -  |
| 13. Catering           |    |    |   |    |    |   |   |    | +  | +  | -  |
| 14. Transport          |    |    |   |    |    |   |   |    | +  | +  | +  |
| 15. Banking/insurance  |    |    |   |    |    |   |   |    | +  | +  | +  |
| 16. Business services  |    |    |   |    |    |   |   |    | +  | +  | +  |
| 17. Government         |    |    |   |    |    |   |   |    | +  | +  | +  |
| 18. Education          |    |    |   |    |    |   |   |    | -  | -  | -  |
| 19. Health/medical     |    |    |   |    |    |   |   |    | -  | -  | -  |
| 20. Social services    |    |    |   |    |    |   |   |    | -  | -  | -  |

Figure 5.1. Estimation of indicators and decision criteria.

We see strong, potential users in the food and paper branches, the basic industries, wholesale, banking/insurance, service providers, and government. Even more interesting are chains of potential branches. Branches, which are dependent upon each other via supply of raw materials or subassemblies, exchange large amounts of information and influence each other mutually on the choice of networking facilities. Sometimes common projects are initiated to co-ordinate the communication planning, i.e. TRANSCOM for the wholesale/retail/supply branches.

### 5.1.2 Size selection

The size of a company is defined here as the number of employees. Figure 5.2 shows the buildup of the Dutch market.

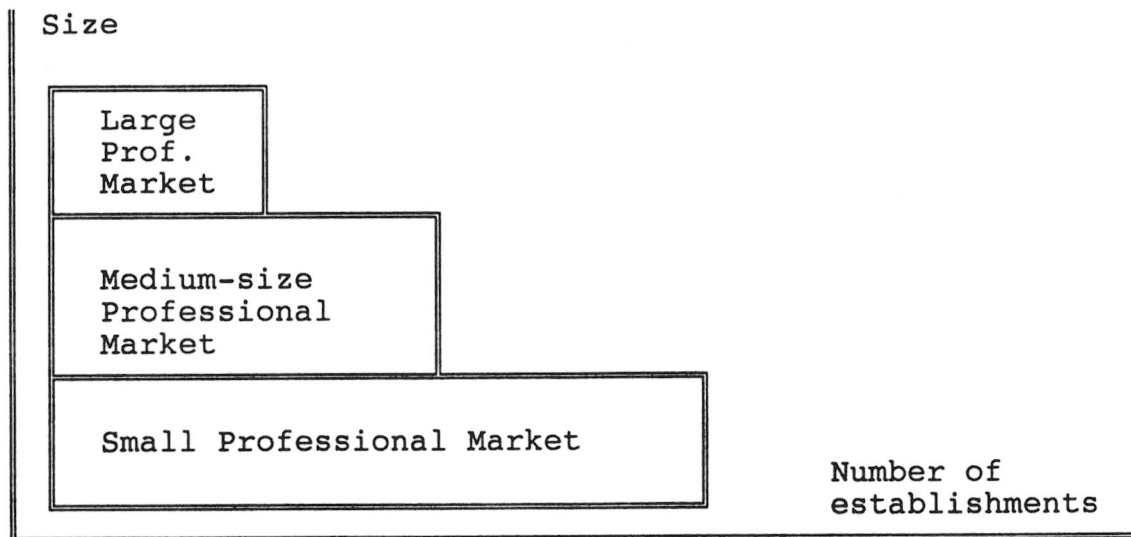


Figure 5.2. Buildup of the Dutch market

The large, professional users are widely accepted as the initial target group. Several large-company features justify this assumption:

1. Positive attitude towards automation:  
They are more willing to consider introduction;
2. Available automation budgets:  
Their budgets are relatively high and leave space for new applications;
3. Presence of sophisticated PABXs:  
These (pre-ISDN) PABXs are the basis for private ISDN facilities. Moreover, they are expected to boost ISDN peripheral demand as well [4];
4. Supply of public ISDN connections:  
The PTT will provide them with primary rate connections within the next years and thus create the ability to communicate with the outside world via ISDN standards. These connections might trigger peripherals demand as well;

#### 5. Large 'trade chain':

This trade chain is a star-shaped 'network' between central headquarters and distributed sales offices, retail firms, dealers or customers. This 'network' carries fast-changing, continuously needed, high-volume information flows. The bigger a company, the larger the trade chain. These type of flows trigger ISDN demand.

#### 6. Mature counter-partner in evaluating user requirements:

Large companies have specialized automation divisions, which develop corporate communication strategies. They employ office communication experts, who develop a complete set of requirements. Mature user requirements result in mature product specifications.

The small, professional market, on the other hand, causes a dilemma. Although they are very attractive, because of their size (they contribute up to 90% of the total number of establishments in Holland), they form a very difficult group. Their interest and expertise in ISDN is low, for the time being. Moreover they are hard to approach. Because they lack every above-mentioned feature, the small and medium-size markets are uninteresting on the short term. Therefore, short term ISDN peripherals will not be aimed at this segment.

Small and medium-size users will become interested in the spin-off from the large, professional users.

Hence (very) large companies in food, paper, basic industries, wholesale, banking/insurance, service providers, and government will be the target group, for launching ISDN innovations for the office communication.

## 5.2 User requirements

### 5.2.1 Interviews

From the selected target group several companies have been approached and questioned about their ISDN strategies. They were spread throughout the selected branches, had different sizes (all LPU) and more or less geographically distributed. A list is found in Appendix 3.

During the interviews, their existing communication structure were discussed first. Often this gives a first indication on possible ISDN applications. Then, if they were thinking about introducing ISDN, we would analyze why and how they were planning ISDN. This gives an idea to suppliers and PTT on how to position ISDN in general and results in the most important list of requirements which short-term ISDN innovations have to meet. Finally we went into further detail, by examining required bearer and tele-services and evaluating the list of generated ideas. A complete questionnaire is found in Appendix 4.

## 5.2.2 Results

### 1. Type of application:

It appeared to be impossible to point-out a single area of application. Almost everybody mentioned ISDN applications referring to all types of innovations: replacing, improving, and widening. However, there appeared to be a time schedule in introducing the different types of applications. This is confirmed by recent publications from IDC [4] and Communication Week [15]. Two schedules may be recognized:

- \* ISDN is initially applied to existing problems (replacing and improving) and then eventually upgraded to new ISDN applications (widening);
- \* ISDN is first implemented because of its real added-value, integration of services (widening), and then existing applications are handled by this ISDN as well.

Telecommunication managers strongly favour the first schedule. They see a growthpath from ISDN at existing problems to ISDN at new applications. Telecom managers are pragmatic, concerned with short-term problems, emphasize on network performance, are always interested in cost-savings and disapprove any form of uncertainty. ISDN's end-to-end digital transmission via transparent 64 kbps channels is attractive in replacing or improving existing solutions. For example, large facsimile documents will be transmitted virtually real-time, allowing on-line information handling (i.e. credit authorization). Or unstructured, time-variant, high-volume data traffic between remote sites (LAN, cluster of stand-alone PCs or terminals) and a centralized EDP environment (mainframe/database) is multiplexed and transmitted along (relatively little) fast ISDN dial-up lines. A company may set-up a videotex service with photographic quality on the telephony network. Emphasis is first on cost-savings and secondly on network performance.

After having experimented with the new technology and products, entirely new applications, which introduce uncertainty and extra investments, will be introduced. For example, desktop integrated communication facilities. Offering this real ISDN added-value is essential, because otherwise users will stop investing, when their networks are digitized. Emphasis is here on end-user productivity.

Only few companies think in the reverse order. They are satisfied with their current networking solutions and will only introduce ISDN for its new applications.

One telecom manager underlined the importance of both a 'high profile' and 'low profile' product line for a telecom supplier. A high profile line contains large, expensive product, with 'widening features', like an ISDN-PABX or multi-functional workstation. This line

forces the supplier to make large investments, but enables him to proliferate itself as a reliable, high-tech company.

The low profile line covers all relatively simple, cheap, replacing- and improving-oriented devices, like multiplexers, adaptors, slotted-in boards, printers, etc.. This line attracts a large target group and accounts for the actual profit-making.

2. Data vs. voice emphasis:

Nearly everybody emphasizes on data communication. ISDN is expected to result in more reliable and cheaper data communication. High-quality speech is uninteresting.

3. Non-voice/non-voice vs. non-voice/voice integration:

The majority favours integration of text and image and to a lesser extent data services. This, however, is handled by dedicated software packages (i.e. desktop publishing), and has little to do with ISDN. ISDN's role is limited to fast transmission of mixed documents. Considering item 2 as well, we may conclude users emphasize on non-voice (data, image, and text) communication facilities.

Voice/non-voice integration requires real ISDN facilities, since two B-channels are necessary.

4. Use of equipment:

To introduce ISDN facilities, equipment (medium, hardware, software) has to be installed. We recognize two ways:

- \* Upgrading existing equipment to ISDN use, by adding the appropriate interfaces, multiplexers, etc.. This requires no accelerated depreciation of office equipment.

- \* Investments in new ISDN-specific equipment

Users strongly favour the upgrading scenario. They dislike desinvestments and try to reduce uncertainty as much as possible. This suggests a range of interfaces to integrate the ISDN concept onto existing wiring, hardware, and software.

Either when new equipment is unavoidable, or devices are entirely written-off, new investments are justified.

5. Costs:

Essential is the awareness that every investment must be regained, one way or the other. From the user's point-of-view this aspect is very clear. They are multiple ways to re-earn the investment.

The investment saves money somewhere else. For instance a multiplexer, which reduces the number of outgoing lines.

Other investments result in an increased market share, turnover, and profit (in the ideal case). An example is a photographic videotex service, which informs customers far better than current videotex databanks.

Investments, concerning new applications, are justified

by an increased end-user productivity.

When dealing with an improving innovation: an alternative solution to an inadequately solved problem, it may cost a little money, depending on the urge of the problem. For instance extra network control modules (D-channel utilization) may be necessary.

6. Partial vs. total solution:

Everybody agrees on the fact that ISDN is a partial solution for the office communication problem. Service-specific networks, i.e. an IBM-based network for corporate administration, will always remain. This requires communication with non-ISDN environments. Nevertheless, ISDN is not considered stand-alone but is part of an overall office automation strategy.

7. Bottom-up vs. top-down implementation:

Managers choose a bottom-up approach unanimously. ISDN services, like every other new OA tool, are introduced step-by-step and layer-by-layer into an organization. This cautious approach has important benefits: OA investments are spread, no unnecessary desinvestments, higher user acceptance, and better user training possibilities. ISDN innovations must meet this important requirement.

### 5.3 User criteria

Briefly all relevant user requirements are summarized. Products should:

1. Aim at the selected target group: (very) large companies within the selected branches. Products, which fit several branches simultaneously, or which eventually might appeal to the small, professional market, are welcome;
2. Fit within the most likely application scenario: introduce ISDN on existing problems and eventually expand to new applications;
3. Provide non-voice communication (data, image, text) services;
4. Support upgrading of existing equipment to ISDN facilities and avoid accelerated depreciation;
5. Allow cost-savings, either directly or indirectly;
6. Allow communication with non-ISDN environments;
7. Allow bottom-up implementation;
8. Be supported by a manifest market demand.

## 6 ISDN PERIPHERALS AND SIEMENS NEDERLAND

This chapter deals with Siemens Nederland (SN) requirements in the first paragraph and the final selection procedure of the appropriate product(s) in the second paragraph.

### 6.1 Siemens Nederland criteria

The following requirements are not suited to judge an arbitrary ISDN idea on its viability. They are only relevant, when it actually comes to developing, producing, and selling of one of the ideas in the Siemens Nederland organization. Products should:

1. Fit the development capacity of the OPW department:  
An indication of their developing capacity is roughly one 'Eurocard' of hardware and up to 30 kbytes of software (C-language programming with 3 statements/hour during 18 manmonths);
2. Assure ISDN-userboard involvement:  
If possible the prototype should be tested on the ISDN userboard;
3. Fit the production capacity of the Woerden production plant:  
This plant is specialized in complicated print boards, which require a high added-value from the machinery;
4. Fit the current SN sales activities:  
The new products should match with the current SN product range of OA equipment and aim at market segments, in which SN has already a considerable share and expertise;
5. Match with the SN time schedule:  
The time schedule, concerning the launching of ISDN services and products, is a strategic decision. Basically there are two possibilities:
  - \* Deferred deployment of private ISDN:  
Wait for a certain period (about five years) until users have become enthusiastic about the concept and have precise opinions on product specifications. This assumes users are currently uninterested in ISDN facilities and adhere to conventional networking methods for the time being. In the meantime standards may be completed and suppliers may sort out current uncertainties and develop mature products. Major risk of this strategy is loss of market share to competitors;
  - \* Early deployment:  
Launch ISDN (or pre-ISDN) products as soon as public ISDN connections are being provided. This strategy is a bet on rapid buildup of user demand for ISDN peripherals and assumes users are willing to do business with innovative suppliers. As demand has

grown and changed, following the already-mentioned growthpath, so does the supplier's product line. Considering the fact, that users are actually moving towards private ISDN on the short term (replacing and improving innovations), early deployment is highly preferable. This offers Siemens Nederland the possibility to proliferate itself as a problem-solving, innovative, ISDN-specialized and yet realistic and pragmatic company. Moreover the perspective of gaining a considerable market share of the Dutch, demonopolized inhouse ISDN market looks very attractive;

6. Fit the Siemens A.G. fields of expertise:  
If new products fit the Siemens A.G. expertise the mother-company might back-up during development, production, and marketing of the products;
7. Fit the Siemens A.G. development activities:  
A product, to be developed by SN, should not already be handled by Siemens Germany. Obviously this would be a waste of effort;
8. Must be supported by the Siemens ISDN chipset as much as possible;

## 6.2 Final selection

During the entire study, product ideas have been generated. At one side, ideas are derived from articles and discussions with users, PTT, and Siemens employees. At the other side some ideas were 'invented'. Unfortunately some of these original ideas appeared to exist already. In the first subparagraph the ideas are described briefly. In the second subparagraph the list of criteria is summarized. Finally in the last subparagraph the product selection is made.

### 6.2.1 Overview of ISDN-based product-ideas

Switching functions:

1. Departmental ISDN switch for use behind a central PABX. It provides internal 2B+D-switching and additional 'supplementary services'. Thus it offloads the central PABX resulting in increased reliability and less remote telephone lines. Such a product may also be used to gain experience on ISDN in a pilot department;
2. ISDN resource switch as a tool to share expensive peripherals or databases within (a section of) a private ISDN. Thanks to the high available bandwidth on the company network this device is a cost-effective alternative to LANs;

3. Departmental ISDN LAN, for instance on a single S-bus. It provides both real-time telephony and datacommunication on twisted-pair wiring. This requires a NT with additional intelligence to handle the internal switching and interface chips for every attached device;
4. Packet-switching server on the PABX to automatically direct X.25-packets to a DNI connection, instead of transmitting packets via a public ISDN connection to DNI;
5. Extra control- and diagnose-facilities from a central network management center (e.g. PABX) via HDLC signalling in the D-channel. This requires additional control modules throughout the network (possibly integrated into existng devices).

Multiplexing functions:

6. Multi-service, flexible multiplexer for 2Mbps links to optimize the utilization of public links between different locations. Voice, data, image, and text information with totally different traffic characteristics are adaptively multiplexed on intra-site links in order to save on number of public connections;
7. Static primary rate multiplexer to assign fixed data sources to fixed timeslots in the 2Mbps stream for relatively little money;
8. Statistical multiplexer for one or more basic access channels to provide a cost-effective use of transmission capacity for smaller users;
9. B-channel multiplexer (statistical or static) to enable several non-voice devices with different traffic characteristics to access the network via a single line. One B-channel is switched transparently towards one destination, in practice, however, this is hardly objective;
10. D-channel X.25-multiplexer to provide single line access for several packet-switching end-user terminals.

Interfacing functions:

11. Terminal adaptors avoid desinvestments and smoothly integrate existing equipment into ISDN. Interfacing may be done on different levels of the OSI-models. For example, medium level (e.g. coaxial cable/twisted pair/optical fiber interface), layer 1 (V.24/X.21/a/b/combined a/b and X.25bis to S-bus/U-channel interface) or layer 2/3 (BSC/SDLC/asynchronous/X.25) to S/U interface. An

interesting example is a PC-adaptor, providing full connectivity between PCs and a host, via an ISDN-based company network;

12. Local Area Network adaptor to provide PABX-LAN communication and interconnection of different digital networks via the existing wiring. LANs are based on different internal protocols (IEEE 802.3/4/5);
13. Printer adaptor allowing high-bandwidth documents to access high-quality printer via telephone links;
14. CAD-workstation adaptor; single CAD-workstations roughly require 50-100 kbps transmission capacity and may therefore be networked on the existing company telephony network;
15. Wordprocessing station adaptor; many companies use dedicated wordprocessing workstations, which may communicate via a S/U-bus;
16. Multivendor PABX interface is not a specific ISDN product, but might nevertheless be useful for better network planning and management;
17. Telex switch adaptor might be very useful for efficient communication between telex and PC/terminal-networks via the PABX.

End-user functions:

18. Desktop integration module to integrate existing desktop communication devices (such as telephone, PC, printer, fax, etc.) and interface them to a single basic access connection on existing wiring (S or U). Different versions are thinkable: from a stand-alone device with all possible interfaces to a PC slot-in card with a limited number of interfaces;
19. Chief/secretary terminal on a single, existing telephony connection with all familiar functions: private channel, public channel for both chief and secretary, direct chief/secretary communication and additional features;
20. Facsimile group 4 equipment for high-resolution, high-speed 64 kbps image communication;
21. Integrated teletex/high-quality printer terminal to fully utilize text communication via high-bandwidth channels;
22. Fotographic videotex terminals for communication with fotographic videotex databases along existing wiring;

23. Slow-scan television requires a rather sophisticated set of equipment, consisting of camera's, terminals, data compression modules, etc.. Applications are, among others, distribution of slow-scan images, security systems;
24. Conference television on the existing telephony network by means of appropriate desktop equipment;
25. Text/image/data software packages, although they are hardly related to ISDN, the B-channel may be used for fast, reliable transmission;

### 6.2.2 Overview of relevant criteria

Chancefull products should:

Technology (not mentioned before, but obvious):

- A. Be based on available techniques;
- B. Be based on mature standards;
- C. Fit within one of the mentioned types of innovations;

PTT:

- D. Handle 30B+D-channels, in case the product is located at the T-interface; in the middle-long term 2B+D-products must be available;
- E. Aim at the (very) large, professional market;
- F. Handle datacommunication, particularly optimization of bandwidth utilization is interesting;
- G. Be situated at the left side of the NT;

End-users:

- H. Aim at the (very) large companies within the selected branches;
- I. Fit within the most likely application scenario: introduce ISDN on existing problems and eventually expand to new applications;
- J. Provide non-voice communication (data, image, text) services;
- K. Support upgrading of existing equipment to ISDN facilities and avoid accelerated depreciation;
- L. Allow cost-savings, either directly in case of a replacing innovation, or indirectly in case of a widening innovation;
- M. Allow communication with non-ISDN environments;
- N. Allow bottom-up implementation;
- N\*. Be supported by a manifest market demand;

Siemens Nederland:

- O. Fit the SN development capacity;
- P. Be testable on the ISDN userboard;
- Q. Fit the SN production capacity;

- R. Match the SN sales activities;
- S. Fit the early deployment strategy;
- T. Fit the Siemens A.G. expertise on technology;
- U. Fit the Siemens A.G. development activities;
- V. Be based on Siemens ISDN chipset.

### 6.2.3 Selection procedure

The dimensions of the selection matrix are formed by the product ideas and criteria.

All criteria have a so-called 'priority figure' (PF), which indicates the importance for a certain product to fit this criterium. At the entries of the matrix we find the so-called 'fitting figure' (FF), indicating the degree to which the product fits the requirement. Unevitably all inputted figures are somewhat subjective, but nevertheless derived from thorough discussions with telecommunications users, PTT, and Siemens Nederland experts.

Then PF and FF are multiplied and vertically averaged per category of criteria. Subsequently each category is weighted again, in order to emphasize on more important categories, like the user criteria. All four weighted subtotals are then averaged again and result in the final result.

The selection matrix showed to be very stable. The output sensitivity for fluctuations in PF and FF has been measured.

Unfortunately the selection results are confidential, at least for the time being, and are therefore excluded from this report.

## 7 CONCLUSIONS

- ISDN is a technology-pushed, but yet very powerful innovation. The concept contains replacing, improving, as well as widening services.
- Since the PTT remains in charge of the infrastructure, they will determine the scenario for the introduction of public ISDN connections. Therefore, they will strongly influence the growth of private ISDN demand.
- The initial target group for launching the ISDN peripheral innovations are the very large companies from the food, paper, basic industry, wholesale, banking/insurance, service provider, and government branches. Chains of potential companies are even more interesting.  
The availability of a (pre-)ISDN PABX and a public ISDN connection are important promoters of ISDN peripheral use.
- Currently ISDN contains too many uncertainties, to be really attractive. The user is kept uncertain about tariffs, availability of peripherals, product prices (Return-on-Investment), time scenario's, and degree of penetration.
- In the short term users strongly emphasize on introducing ISDN to existing problems in their communication architecture (both replacing and improving innovations). Subsequently users might implement ISDN's widening services, the integration of communication services, as well. User interest in ISDN indicates a growthpath for ISDN from existing to new applications.
- Datacommunication will initially trigger ISDN demand, both for public connections and private ISDN equipment. The transparent, 64 kbps B-channels will probably be available for datacommunication favourable tariffs. They allow fast, simple, reliable, medium bandwidth datacommunication, at reasonable costs.  
Besides datacommunication, image and text communication are attractive applications for an ISDN.
- Users are not prepared to depreciate existing equipment in a accelerated way, in favour of ISDN. Moreover, ISDN will be, equal to all office innovations, implemented bottom-up. This leads to a more or less 'low profile' product line, which decreases uncertainty, avoids huge, initial investments, increases user acceptance, and possibly upgrades existing equipment to ISDN capabilities.

- Early deployment of the ISDN concept is possible, because there is a user demand for ISDN products. Despite all sceptism, users are interested in certain ISDN possibilities, but in a different way than predicted.
- The ISDN concept is now positioned at widening innovations too one-sidedly by telecom suppliers. Most suppliers lack an attractive 'low-profile' ISDN product line, containing replacing and improving innovations. The ISDN concept should, therefore, be repositioned at more replacing and improving innovations.
- Many products fit the requirements, resulting from this study.
- The selected product-ideas are realizable. The CCITT I-series, the OSI seven-layer model, and especially the Siemens ISDN chipset appear to be effective tools to design the products.

## APPENDIX 1

### List of used abbreviations:

AC :Automation Costs  
AD :Automation Degree  
A/D :Analogue/Digital  
ADC :Administration/Diagnose/Control  
ALE :Address Latch Enable  
AM :Automation-Minded  
AMI :Alternating Mark Inversion  
AP :Automation Personnel  
ARCOFI :Audio Ringing Codec Filter  
ASCII :American Standard Code for Information Interchange  
ASL'70 :Analogue Subscriber Line 1970  
BAT :Batch file  
B-CPU :Board CPU  
BMUX :B-channel (de)multiplexer  
CBB :Central Board Bus  
CBS :Central Bureau for Statistics  
CCITT :International Telegraph and Telephone Consultative  
Committee  
CE :Communication, Externally  
CEI :Connection Endpoint Identifier  
CEPT :Conference Européenne des Administrations des  
Postes et des Telecommunications  
CES :Connection Endpoint Suffix  
CI :Communication, Internally  
CPU :Central Processor Unit  
C/R :Command/Response  
CRC :Cyclic Redundancy Check  
CS :Chip Select  
CSMA :Carrier Sense Multiple Access  
CT :Communication Terminals  
C7 :Common-channel signalling no.7  
DAT :Data file  
DLCI :Data Link Connection Identifier  
DN-1 :Datanet-1  
DP :Data services, via PC  
(DP)RAM :(Dual Port) Random Access Memory  
DR :Data services, rest  
EA :Adress Extension  
EC :European Committee  
EDP :Electronic Data Processing  
E-mail :Electronic Mail  
ET :Exchange Terminal  
EXE :Executable file  
EXT :Extensions  
FCS :Frame Check Sequence (equals CRC)  
FDM :Frequency Division Multiplex  
FF :Fitting Figure  
FIB :Facsimiles In Business  
FIFO :First-In First-Out  
HDLC :High-level Data Link Control  
HSCC :High-level Serial Communication Controller  
I :Image services

IBM :International Business Machines (Corp.)  
 ICC :ISDN Communication Controller  
 IDC :International Data Corporation  
 IDN :Integrated Digital Network  
 IOM :ISDN-Oriented Modular  
 IP :Improving Potential  
 ISAC-S :ISDN Subscriber Access Controller/S-bus  
 ISDN :Integrated Services Digital Network  
 ITL :Incoming Telephone Lines  
 LAN :Local Area Network  
 LAPD :Link Access Protocol D-channel  
 LIB :Library file  
 LPM :Large, Professional Market  
 LPU :Large, Professional Users  
 LT :Line Termination  
 MFWS :Multi-Functional Workstation  
 $\mu$ P :Micro-Processor  
 MPU :Medium-size, Professional Users  
 MTBF :Mean Time Between Failures  
 NRZ :Non-Return-to-Zero  
 NT :Network Termination  
 OA :Office Automation  
 OPW :Ontwikkeling Productie Woerden  
 OSI :Open Systems Interconnection  
 OTL :Outgoing Telephone Lines  
 PABX :Private Automatic Branch Exchange  
 PC :Personal Computer  
 PCM :Pulse Code Modulation  
 PF :Priority Figure  
 POP :Population  
 PRI :Priority  
 PROM :Programmable Read Only Memory  
 R&D :Research & Development  
 RD/WR :Read/Write  
 RM :Result after Multiplication  
 RP :Replacing Potential  
 RS :Resource Switch  
 SAP :Service Access Point  
 SAPI :Service Access Point Identifier  
 SBC :S-Bus Controller  
 SLD :Subscriber Line Data  
 SN :Siemens Nederland N.V.  
 SPU :Small, Professional Users  
 SSI :Serial, Synchronous Interface  
 T :Text services  
 TA :Terminal Adaptor  
 TDM :Time Division Multiplex  
 TE :Terminal Equipment  
 TEI :Terminal Endpoint Identifier  
 TIB :Telexes In Business  
 TIC :Telecommunications IC  
 Tlf :Telephone  
 Tlx :Telex  
 U(S)ART :Universal (Synchronous) Asynchronous Receiver  
           Transmitter  
 V :Voice Services

VANS :Value Added Network Services  
WAN :Wide Area Network  
WM :Wordprocessing Monitors  
WP :Widening Potential

APPENDIX 2

Penetration figures of telecommunication devices:

| Indicator for:         | POP | EXT<br>v,ci | ITL<br>v,ce | OTL<br>v,ce | FIB<br>i,ce | TIB<br>t,ce | PC<br>dp,ci<br>ii |
|------------------------|-----|-------------|-------------|-------------|-------------|-------------|-------------------|
| 1. Food/drink/tobacco  | 1   | 8.4         | 3.2         | 6.0         | 1           | 2.6         | 27                |
| 2. Textiles/clothing   | 1   | 6.8         | 4.5         | 5.6         | 0           | 1.7         |                   |
| 3. Paper/wood          | 1   | 5.7         | 2.4         | 3.0         | 1           | 1.7         |                   |
| 4. Graphical ind.      | 3   | 2.9         | 2.3         | 2.8         | 5           | 2.1         |                   |
| 5. Chemical ind.       | 1   | 14.7        | 5.9         | 7.4         | 2           | 3.2         |                   |
| 6. Metal engineering   | 2   | 6.3         | 3.8         | 3.6         | 6           | 10.7        |                   |
| 7. Basic products      | 0   | 14.0        | 7.3         | 7.4         | 3           |             |                   |
| 8. Other ind.          | 1   | 4.5         | 1.3         | 1.3         | 1           |             |                   |
| 9. Construction ind.   | 5   | 1.4         | 0.5         | 1.2         | 1           | 4.0         | 5                 |
| 10. Construction serv. | 2   | 1.6         | 0.6         | 1.5         | 0           |             |                   |
| 11. Wholesale          | 10  | 4.1         | 1.8         | 3.5         | 20          | 30.6        | 19                |
| 12. Retail             | 29  | 0.8         | 0.2         | 0.8         | 2           | 4.4         |                   |
| 13. Catering           | 6   | 3.0         | 1.6         | 1.9         | 0           | 1.3         |                   |
| 14. Transport          | 3   | 2.9         | 1.6         | 2.2         | 9           | 13.0        |                   |
| 15. Banking/insurance  | 2   | 10.8        | 4.8         | 7.1         | 4           | 11.2        | 37                |
| 16. Business services  | 13  | 3.4         | 2.7         | 2.9         | 32          | 7.3         |                   |
| 17. Government         | 2   | 24.2        | 10.4        | 11.2        | 5           | 2.2         |                   |
| 18. Education          | 6   | 4.3         | 1.2         | 1.9         | 2           | 0.2         | 12                |
| 19. Health/medical     | 7   | 3.7         | 1.9         | 1.9         | 0           | 0.2         |                   |
| 20. Social services    | 5   | 5.1         | 4.2         | 4.6         | 4           | 1.6         |                   |

| Indicator for:         | CT<br>ce,ci<br>dp | WM<br>t | AP<br>am | AC<br>am |
|------------------------|-------------------|---------|----------|----------|
| 1. Food/drink/tobacco  | 6                 | 8       | 22       | 3        |
| 2. Textiles/clothing   | 1                 | 0       | 4        | 1        |
| 3. Paper/wood          | 4                 | 11      | 16       | 2        |
| 4. Graphical ind.      |                   |         |          |          |
| 5. Chemical ind.       | 14                | 17      | 28       | 6        |
| 6. Metal engineering   | 29                | 34      | 75       | 15       |
| 7. Basic products      | 10                | 14      | 33       | 4        |
| 8. Other ind.          |                   |         |          |          |
| 9. Construction ind.   | 1                 | 5       | 15       | 1        |
| 10. Construction serv. | 1                 | 2       | 10       | 1        |
| 11. Wholesale          | 26                | 36      | 110      | 11       |
| 12. Retail             | 9                 | 8       | 33       | 5        |
| 13. Catering           |                   |         |          |          |
| 14. Transport          | 15                | 8       | 30       | 4        |
| 15. Banking/insurance  | 33                | 42      | 114      | 16       |
| 16. Business services  | 33                | 71      | 224      | 25       |
| 17. Government         | -                 | -       | -        | -        |
| 18. Education          | 5                 | 4       | 9        | 1        |
| 19. Health/medical     | 5                 | 8       | 13       | 1        |
| 20. Social services    |                   |         |          |          |

### APPENDIX 3

#### Overview of visited companies/institutions:

- Ahold N.V.
- Bank, Mees & Hope N.V.
- BSO/Automation Technology N.V.
- CMG Bedrijfsinformatiesystemen B.V.
- Delft University of Technology, Faculty of Telecommunications and Traffic Systems
- Holland International B.V.
- Lease Plan Holding N.V.
- PTT Telecommunicatie
- Nederlandse Middenstands Bank (indirectly)
- Raad voor de Informatie Technologie, 'Aandachts Cluster' ISDN
- Siemens Nederland N.V.
- Unilever Research Laboratories

#### Overview of functions of interviewees:

- Data manager
- Deputy Director Executive Affairs
- Director
- Director Automation
- Director Business Information Systems
- Director Computer Centre
- Director User Services
- Manager Information Centre
- National Account Manager
- National Co-ordinator ISDN Infrastructure
- Professor on Industrial Aspects Telecommunications

## APPENDIX 4

### Questionnaire:

#### Huidige communicatiestructuur:

- Hoe ziet uw huide communicatiearchitectuur eruit?
  - \* Externe aansluitingen op telefoon-, telex-, datanet, vaste verbindingen?
  - \* Welke interne netten heeft u gerealiseerd (PABX, berichten- schakelaar, LAN, intelligente bus)?
  - \* Welke eindapparatuur (typen en aantallen) is hierop aangesloten?
  - \* Welke interne en externe communicatiediensten zijn op deze structuur gerealiseerd voor spraak, data (type, omvang, frequentie), beeld en tekst?

#### Diensten:

- Doet u dat vrnl. om bestaande problemen op te lossen (grotere betrouwbaarheid, makkelijkere interconnectie van verschillende digitale netwerken, meer netwerk controle, voldoende bandbreedte beschikbaar voor datacommunicatie)?
- Of bijvoorbeeld om bestaande diensten beter en sneller uit te voeren, zoals fax group 4, teletex, (fotographic) videotex?
- Bent u ook duidelijk geïnteresseerd in nieuwe ISDN diensten
  - \* Legt u de nadruk op de vele extra features voor de voice diensten, zoals 'call diversion', calling party identification', etc. (supplementary services)?
  - \* Of gaat het u juist om de integratie van diensten? Welke typen diensten wilt u integreren?
- Hoe belangrijk is de kostenbesparing per bovengenoemde categorie? (Vrnl. door economischer gebruik van de transmissie capaciteit, enkelvoudige openbare aansluiting en minder modemgebruik). Denkt u b.v. aan datacommunicatie over de bestaande koperdraden?
- Is ISDN voor u een oplossing voor deelproblemen dan wel een totaaloplossing binnen de kantoorautomatisering?
- Is het beleid rondom ISDN een onderdeel van het gehele KA-beleid?

#### Middelen:

- Wilt u in eerste instantie met behulp van bestaande middelen, zoals telefoons, PC's, bekabeling, e.d., ISDN faciliteiten aanbieden aan de gebruiker?
- Of gaat u meteen over tot de aanschaf van nieuwe middelen, zoals multifunctioneel werkstation, digitale telefoon?

#### Toekomstige communicatiestructuur:

- Wilt u naast openbare 'primary rate' ook openbare 'basic access' aansluitingen hebben?
- Welke ISDN faciliteiten heeft uw huiscentrale?
- Wilt u schakelfuncties decentraliseren door uw bedrijf, zoals b.v. een departementale ISDN schakelaar?
- Denkt u één randapparaat op één kanaal aan te sluiten, of

- wilt meerdere apparaten op een kanaal zetten?
- Bent u ook geïnteresseerd in packet-switching communicatie op uw ISDN?
  - Wilt u uw eindgebruikers daadwerkelijk een 2B+D-verbinding aanbieden?

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