

The Seventh International Conference on City Logistics

## Improving urban freight transport sustainability by carriers – Best practices from The Netherlands and the EU project CityLog

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### Abstract

Carriers face serious challenges in making their urban freight transport efficient and sustainable. Local authorities claim that many carriers are not innovative and do not cooperate in improving their city logistics operations. There are three solution directions to make urban freight transport more efficient and more sustainable: policy, technology and logistics. Carriers can use logistical and technical solutions. In this paper several best practices and carrier-initiatives are presented that are actually brought in practice (in the Netherlands) to improve city logistics. It depends on the type of carrier, either a regional or functional specialist or a generalist, which solution can be effectively used in the urban freight transport operations.

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*Keywords:* City logistics; best practices; carriers; urban freight transport

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### 1. Introduction: The role of carriers in making urban freight transport more sustainable

Efficient and sustainable distribution in urban areas is a challenge for carriers. Next to infrastructural limitations in cities (e.g. narrow streets, street furniture, etc.), the truck drivers in cities are confronted with vulnerable road users, such as pedestrians and cyclists, that share the urban infrastructure with the supplying freight transport. Besides, carriers face governmental restrictions, such as environmental zones

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and time-windows in many cities. However, not only carriers face difficulties in urban freight transport. Next to the carriers, who are responsible for the actual urban freight transport, the local authorities are the most important actors, since they determine the conditions in which urban freight transport can take place. The local authorities are especially interested in a livable city with good air quality and as limited nuisance (e.g. noise, traffic safety) from supplying traffic as possible. Therefore, local authorities use regulations, such as emission zones and time-windows. However, these regulations make it very difficult for carriers to be efficient in their urban freight transport operations (see [1]).

Over the last decade there have been several initiatives to make urban freight transport more sustainable [1]. And, in the Netherlands at least, what strikes most is that the majority of these initiatives come from actors other than carriers. Initiatives have been initiated by local authorities, new organizations (e.g. Binnenstadservice, see [2]), consultants or researchers in often subsidized projects. The result is that local authorities (in the Netherlands) often blame carriers for being not innovative in their urban freight transport operations and for being not cooperative in making urban freight transport more sustainable. On the other hand, carriers reproach especially these local authorities to make it impossible to organize their urban freight transport in an efficient way. A suchlike argument of local authorities fits in the way these authorities look at city logistics issues; they limit their scope to the city only, whereas carriers operate more regionally or nationally. Carriers claim that they are working on all kinds of initiatives to actually make urban freight transport more sustainable (in real, in contrast to the pilot studies and initiatives by other stakeholders). However, due to the different scope of local authorities and carriers this does not attract the attention. Next, carriers and local authorities usually hardly communicate, and even if it happens, it turns out they do not understand each other. Their worlds are too different (see [1]). So, many of the solutions carriers use to make urban freight transport more sustainable and more efficient are not noticed nor recognized by local authorities.

In this contribution several of the solutions that carriers can use to make urban freight transport more sustainable and on the other side contribute to the carriers' profitability (or at least do not result in financial losses for the carriers) are discussed. First the different solution directions to improve urban freight transport sustainability in general are presented. Then, a distinction is made between three carrier types. The last part of the paper discusses best practices and possibilities the different carrier-types have to organize their urban freight transport activities in a more sustainable way.

## **2. Solution directions to improve urban freight transport sustainability**

To organize urban freight transport more sustainable, we basically distinguish three solution directions: logistical innovations, policy measures and technical improvements. To truly improve urban freight transport, the solution directions should not be considered separately, but be combined in a good mix of solutions from all three directions. This implies action from public and private actors that are coherent and complementary: an overall urban freight transport strategy that considers the variety of objectives of the different stakeholders. In this contribution we present these solutions that carriers can initiate (even without public cooperation) themselves to make their urban freight transport operations more sustainable. These carriers' solutions could fit in an overall strategy, but form only a part of this strategy. This paper's objective is to present innovative carriers' initiatives that actually contribute to making urban freight transport more sustainable and do not (necessarily) require governmental support (financial or in regulations). These initiatives are in that sense financial viable in practice in the long run (in contrast to some other city logistics pilots from the past). One example in which all solution directions are combined is discussed in the section 'Solutions to reduce noise nuisance'.

Carriers are usually unable to directly influence the (local) authorities' policy in various urban areas. Carriers' interest groups lobby to do so, but this is not direct influence. So, if carriers want to improve the

sustainability of their urban freight transport operations, they can only do so by innovations in their logistics organization or by technical improvements (in their vehicles or information and communication systems). In this contribution we discuss a selection of best practices from industry on logistical solutions and technological solutions that are brought in practice in the Netherlands or that are developed in the CityLog project for the different carrier types. The CityLog European project, started on January 2010, is a focused research collaborative project co-funded by the European Commission under the Seventh Framework Programme, Theme 7, Sustainable Surface Transport (see for recent project information [3]). CityLog is supported by EUCAR, the European Council for Automotive R&D. Obviously, the logistical improvements and the technical innovations presented in this contribution do not form a complete overview of the possibilities carriers have to improve their operations, nor does it present a full coverage of all best practices currently brought in practice by carriers anywhere in the world. In this contribution, we discuss best practices that are currently experimented with in the Netherlands and that are developed in the CityLog project. It is not the aim to be complete in the overview of solutions, but especially to present and show what carriers are already doing or are able to undertake to improve their urban freight transport operations in order to become more sustainable.

### **3. Different types of carriers**

Urban freight transport operations are carried out by different types of carriers. Some practices fit one carrier-type better than other solutions or some solutions (e.g. policy restrictions) affect one carrier-type more than another type (see for example [4]). Therefore, we make a distinction between carrier-types. Roughly, we distinguish three types of carriers, based on the different company-strategies formulated by [5]:

- The regional specialist (RS). The RS usually has a high drop density in a limited region and is able to deliver (all kinds of cargo) at low costs. In order to make sure the RS has enough volume to deliver and collect in its region, many regional specialists cooperate with other RSs in a network. Notice that large carriers, who have their own network, in the Netherlands companies like DHL or TNT, can be considered as a collection of regional specialists, or a regional specialist that is specialized in several regions. The RS competes on costs.
- The functional specialist (FS). The FS adds extra value for a specific market or for a specific type of goods. This carrier is usually active in a larger region than the RS, but transports only these goods that it is specialized in. Examples are carriers that transport fashion (hanging garments), furniture, and so on. The FS competes on service; this implies that it is more expensive than the RS, but the shippers are willing to pay more for the extra service the FS can offer.
- The generalist (G). The G takes care of all distribution transport for its clients. The G is competing on costs with the RS and on service / differentiation with the FS. G runs the risk to be stuck in the middle; i.e. being more expensive than the RS and not able to offer similar services as the FS. Basically, the generalist can be characterized as a carrier that does not make strategic choices. It tries to offer all services the shipper might ask for (or in the words of a carrier: ‘solve all problems a shipper might face’). So G does not limit its services to a region or a specific market or function. Where, as the next section shows, both the regional and the functional specialists have several logistical and technical opportunities to improve urban freight transport, the generalists are especially confronted with threads concerning the urban freight transport operations (either due to policy regulations or due to competition with the specialists).

Obviously, there are all types of hybrid forms possible between these three carrier-types.

## 4. Best practices

Many carriers are quite active in organizing their urban freight transport operations in an efficient and sustainable way. However, for several reasons a lot of these efforts and innovations are hardly noticed by other urban freight transport actors, such as local authorities and residents. First of all, due to the non-urban, but more regional focus of many carriers, the efficiency gains in the distribution, that also result in fewer kilometers as well as fewer CO<sub>2</sub> emissions, are not noticed in cities by actors whose focus is mainly (or even only) at the city, e.g. the local authorities and residents. Next, carriers are used to solve problems. Basically, solving problems for shippers is what many logistics service providers see as their main competitive capabilities. Due to the habit of solving problems (and increasing efficiency), many carriers consider it quite normal what they do. And as a result, they do not communicate their efforts and efficiency gains to the outside world. This habit (partly) causes that some of the carriers' solutions are not recognized by the public as innovative or as solution. To sum up, carriers' logistical solutions for more sustainable urban freight transport are often not communicated as a solution for city logistics problems. The result is that these solutions are not recognized in cities by for example authorities, residents, receivers, or the shopping public. This is, to a lesser degree, also true for technical innovations. Since technical innovations often concentrate on reducing urban freight transport's nuisance, these effects are noticed better in cities.

### 4.1. Logistics solutions

Carriers in the Netherlands bring several logistical solutions into practice to organize their urban freight transport more sustainable and more efficient. In this contribution we discuss the advantages and lessons from companies that are experimenting with these solutions (based on interviews and public information; this contribution is partly based on a Dutch report, see [6]). We discuss several logistical best practices. From the following logistical solutions examples are provided and details are discussed: network collaboration of carriers, carriers decoupling vehicles at the border of the city centers, and possibilities for carriers (and shippers) to bundle at the source.

#### 4.1.1. Network collaboration

In network collaboration carriers try to organize their (urban) transport operations as efficient as possible, resulting in a high drop density and load factor in a relative small delivery area (i.e. a city or a region). Usually, this is done by bundling shipments of different clients (i.e. shippers), due to exchanging the shipments in a network (with network partners that cover other regions) and subsequently deliver (and collect) the shipments in a minimal number of routes for one city or region. We distinguish several types of networks:

- A carrier can have its own network. A few big carriers, for example DHL Exel Supply Chain with over 30 locations in the Netherlands, are able to create an own network that covers the entire country from where distribution activities are carried out. Sufficient number of shipments for all regions is the main requirement for having (or setting up) an own network.
- Collaboration between several carriers in a network with (at least one) central hub(s).
- Collaboration between several carriers in a network without a hub. This implies that shipments are directly exchanged between the partners in the network.

A combination of the last two types is also possible. Network collaboration is especially interesting for regional specialists. By finding good network partners, a RS can increase the drop density in its region and as a result decrease its costs per drop. Another advantage is that the RS is able, due to the cooperation

with other RSs, to present itself as a generalist to shippers, since the network partners take care of the deliveries (and pickups) outside the RS's region.

For those carriers that do not fulfill the requirement for an own network, i.e. sufficient pickups and deliveries for all regions, cooperation with others is the form to create a fully covering network. In the Netherlands we distinguish several of these collaborative networks; with at least one central hub (e.g. TransMission, Network Benelux) and direct exchanges between partners (e.g. TeamTrans, DHB, and Distri-XL). In this contribution the case of TransMission is discussed and the main results, according to the carriers in the other cooperations, of the other collaborative networks are presented. TransMission (see [7] and [8]) is the largest cooperation of independent transport and distribution companies in the Netherlands and Belgium. In total 16 transport and distribution companies cooperate under one name, but the companies remain independent (often family) firms. The TransMission partners have divided The Netherlands and Belgium in regions, so that every company operates in its own regions (as a RS). This regional subdivision applies to all LTL (less-than-truckload) deliveries and pickups (i.e. packages and pallets) of the partners in the collaborative network. The TransMission collaboration contains 13 locations in the 13 regions in which The Netherlands is divided by the partners, of which one is used as central depot. All central affairs are arranged by a separate organization with a central management. This cooperation is based on uniform agreements between all partners (see also [9]). The cooperation is organized as follows: all goods that are suited for the collaborative network, i.e. LTL deliveries and pickups, are transported from the partner's region to a central hub in Utrecht. All partners carry the cargo that has to be delivered in their own region back from this central hub. During the night all deliveries are cross-docked between the partners in this central hub. All partners use the same software and barcodes for tracking and tracing. Fig. 1 shows an example of how the TransMission's network collaboration between different RSs results in more sustainable and efficient urban freight transport operations. TransMission's partner responsible for Amsterdam receives 87% of all drops it makes in Amsterdam from the partners. Without the collaboration in the TransMission network, these deliveries in Amsterdam would require four times more trucks than in the current collaborative situation. Overall, this network collaboration has other advantages as well: long distance transport (from and to the hub) is done in down-peak periods (i.e. nights) and therefore, in the morning all cargo is already in the region of destination.



Fig. 1. TransMission's drops in Amsterdam centre (white x dots are Amsterdam RS's own drops, dark dots are drops from network partners)



Other network collaborations between RSs also present positive results, concerning the sustainability as well as the efficiency of the urban freight transport operations [10]. Distri-XL, a collaborative network with five carriers and only direct exchange, presents a kilometer reduction of 11% and an increase in volume for all partners of 25%. Other collaborations show similar results, see for example Netwerk Benelux and TeamTrans.

The results that were presented for the collaborative networks are mainly fewer kilometers driven and as a result fewer CO<sub>2</sub> emissions [10]. The importance for cities of the bundling activities in these collaborative networks (by regional specialists) is that fewer vehicles enter the cities, the vehicles are loaded fuller, the carriers have a better drop density and perhaps due to overlap even fewer stops. Positive results for cities are therefore: fewer local emissions (thus better air quality), less noise nuisance, and better traffic safety. Local regulations, especially time-windows, have pros and cons for RSs in a collaborative network. On the one, the RS has an advantage compared to the non-regional carriers, that have to travel from further to enter the city and that are confronted with multiple cities and overlapping time-windows. So, RSs argue that the narrower or stricter local authorities' regulations become, the likelier it becomes that private- and non-regional carriers will outsource city distribution activities to a regional specialist. For an RS it is easier to use the entire time-window including the early hours in the time-window, because the RS starts its roundtrips nearby the city (in the region) and is not confronted with congestion in its trip towards the city. On the other hand, due to the bundling and the resulting high number of drops (up to 50); it is sometimes not possible for the RS to make all deliveries within the narrow governmental time-windows. The RS usually uses the afternoon to make pick-ups at clients in the region, so in this way the vehicle utilization over the day is still high (even though many of the deliveries have to be made during the morning).

#### *4.1.2. Decoupling at the border of the city centre*

Quite often, large or heavy trucks are not allowed to enter cities (or city centers). Especially those movements where a considerable number of kilometers is necessary to reach the city (or the go back to the carrier's depot), e.g. this typically can be the case for a functional specialist, or when it concerns big volumes (for example supermarkets), can profit considerable in case decoupling takes place at the border of the city. A huge disadvantage of using small trucks in cities and large trucks for transport outside the cities is the handling necessary to transfer goods from one truck to another (and the resulting issues on liabilities and the extra costs). These handling activities are necessary in city distribution centers (see for example [1] and [2]). However, in this contribution we do not discuss decoupling at a city distribution centre (or a similar type of facility). Here, in this logistical solution for carriers, a decouple location is not similar to a city distribution centre, where goods are actually transferred from one truck to another. The idea of the decouple location is that carriers (more specifically the truck drivers) can decouple the trucks themselves. Extra handling is hardly necessary at these locations. We discuss two practices that are currently used by carriers in the Netherlands: the Ecocombi (a special form of a LHV, a longer and / or heavier vehicle, see [11]) and the use of swap bodies. The idea of decoupling at the border of a city (centre) is that longer distance transport outside the city can be done efficiently by big trucks, whereas the final distribution in the city (centre) is carried out by smaller trucks.

The use of Ecocombis is relatively new. In the Netherlands there have been experiments with LHVs (Longer and / or Heavier Vehicle) since 2001. Nowadays, carriers are allowed to use these Ecocombis under some restrictions and on a restricted network (see [11]). Since 2009, the use of LHVs in the Netherlands increased dramatically. This is (partly) due to the introduction of the LHV combination in which two so-called city trailers with a length of 10.6 meter can be used for distribution activities of especially supermarkets (see Fig. 2). These Ecocombis are only allowed at highways and approved secondary ways. The distribution idea is that the LHV is used on the route from a distribution centre to

the border of a city. In the city, the supermarkets are supplied with a single trailer. The handling activities necessary for decoupling this LHV configuration are limited. After decoupling, the truck can carry one city trailer to a store, return to the decoupling location and then make another delivery with the remaining city trailer. It is also possible to pick up the remaining city trailer by another truck. Cornelissen (a Dutch carrier from Nijmegen, see also Fig. 2) for example, uses a CNG (compressed natural gas) truck to carry the remaining city trailer into the city (CNG trucks' advantages and disadvantages are discussed under technology solutions).



Fig. 2. Example of innovative LHV-city trailer combination used for distribution

We present the case of the largest supermarket chain in the Netherlands, i.e. Albert Heijn (AH) to illustrate the use of LHVs for distribution and how it contributes to more sustainable and efficient urban freight transport (this case is based on an interview with Peter Leegstraten [12] transport manager at Albert Heijn). AH decided to use LHVs after the double city trailer configuration (Fig. 2) became available. The advantage of this configuration is that it is not necessary to buy new trailers, since the single city-trailer (in combination with a truck) was already used for distribution activities. So, these trailers can be used in a LHV combination as well as with a truck only. The concept that AH tries to realise (in cooperation with its carriers) is the following: for longer trips (i.e. distance of 1 hour and 15 minutes) between the distribution centre and a city AH plans to use the Ecocombi. These combinations are uncoupled at the city border, and taken to the stores one by one. The idea is to minimize the total empty LHV-runs, by collecting return loads to the AH retail distribution centre from suppliers in the region, or to use the Ecocombi for transport between AH distribution centers. The main reasons for AH (and its carriers) to start using LHVs are increased efficiency, fuel savings, and a reduction in CO<sub>2</sub> emissions (which fits in AH's policy on corporate social responsibility). Besides, AH expects that it will be difficult to find truck drivers in the coming years and that the fuel prices increase further. Next, by using Ecocombis traffic jams can be avoided; this can be done by driving to a city with a quiet (see PIEK in technology solutions) LHV early in the morning (before the rush hour), uncouple and take care of distribution activities with one city trailer. When it is empty, the other trailer can be taken for a second distribution run. The return trip happens after rush hour. In this case, distribution takes place outside the regular workday. AH expects a 35% cost reduction by using LHVs (for these areas located further than 75 minutes away from a distribution centre). Kilometer and CO<sub>2</sub> reductions are also considerable.

A similar way of decoupling can also be found with regular combinations. An example of a carrier using a regular truck combination is the functional specialist Martin Slangen [10]. Martin Slangen transports furniture to many locations including destinations in city centers. The truck driver decouples the trailer at the border of the city and then delivers goods at the locations in the city. The truck is refilled from the parked trailer and other deliveries can be made in cities. Slangen estimates that this system results in about 15% reduction in kilometers (but not in cities), due to fewer kilometers in transport between the depot and the cities. Another form of decoupling at the border of the city (centre) will be experimented with in the CityLog project. In the CityLog concept a large freight bus will carry three

standard boxes that are off loaded at the border of the city (centre). Delivery vans, that can carry one box, will be responsible for the final deliveries in the city (centre).

The advantages of decoupling at the border of the city are not (always) visible in cities for local authorities and residents. In spite of the savings in CO<sub>2</sub> emissions and the reduced congestion pressure of distribution trucks, the local environment (e.g. air quality and noise nuisance) in cities does not improve.

#### 4.1.3. Decoupling at the border of the city centre

Another option to increase the drop density is bundling at the source. Many functional specialists already do so, think about retail distribution centers. An example from the Netherlands is Centraal Boekhuis that bundles the majority of all book deliveries in a central warehouse [13].

In the CityLog project another example of bundling at the source is developed, i.e. the so-called BentoBox. This is solution especially for parcel deliveries to private homes. One of the big problems of parcel services is the high non-response rate, because of addressees that are not at home. In the CityLog project a mobile box will be developed, that can be used to pick-up parcels by residents. The BentoBox is a type of container that can be used after being “parked” as a mobile pack station. This container could be used for advanced home deliveries or for giving a sender the possibility to send a parcel. An advantage of the container is that it makes silent night freight deliveries possible; its benefit is represented by the possibility to de-couple the interaction between the operator and the customer. The carrier is free to move the freight during the night to the city centre. The final user can take and/or send the parcels when he/she prefers, without waiting to meet the carrier. The BentoBox will be placed in a docking station that provides energy (see Fig. 3 for an illustration). The BentoBox can be used for both the collection and for the delivery of parcels. It is also possible to refill the BentoBox at the docking station location. In that case it functions as a pack station. In the Modular BentoBox case the Docking Station has a chassis that can accommodate several modules (or trolleys) [14]. The receivers should be contacted (e.g. e-mail or SMS) with details how to retrieve their parcels from the box. This solution, as long as it is not a shared facility, is only relevant for carriers with a high drop density (RS), otherwise the BentoBox will not be filled or the receivers have to travel long distances to the box (the density of boxes in a city will be too low then). If it is a shared facility it can also be relevant for an FS, this will not be experimented with in the CityLog project.

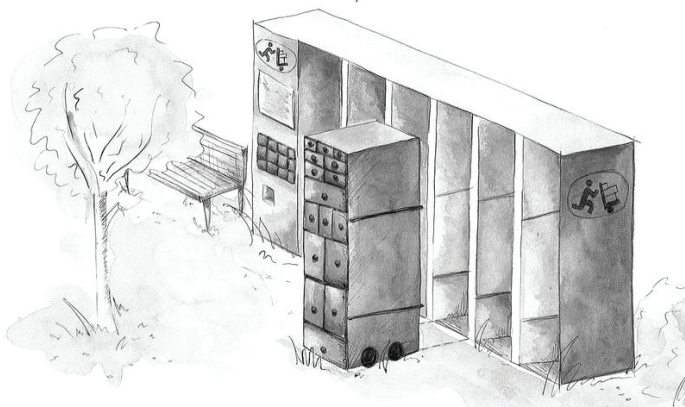


Fig. 3. Suggestion for a Modular BentoBox System (CityLog)



## 4.2. Technology solutions

Next, carriers also have technological solutions to improve the sustainability and efficiency of their urban freight transport operations. Usually, vehicle technological solutions do not change the number of truck kilometres in the city, but the negative impacts caused by these travelled kilometres decrease. Technological ICT solutions can reduce the number of kilometres driven in urban areas. We discuss several technical solutions that carriers have in order to improve their urban freight transport operations in a more sustainable way; from the following technical innovations examples are provided and details are discussed:

- Vehicle innovations, i.e. engine solutions.
- Vehicle and equipment solutions to make low-noise deliveries possible.
- ICT and ITS solutions that improve efficiency of carriers' operations.

### 4.2.1. Engine solutions

Many industry innovations to make urban freight transport more sustainable are related to engine solutions. Obviously, the use of Euro 5 engines (pushed by European regulations and the establishment of low emission zones or environmental zones in cities by local authorities) already results in fewer local emissions due to city logistics activities and as a result in better air quality in urban areas. These newer Euro-norms do not result in fewer CO<sub>2</sub> emissions (on the contrary). Many carriers are actively reducing their CO<sub>2</sub> footprint and are to a lesser extent interested in decreasing their local emissions (see for Dutch examples [15]).

Therefore, other engine solutions are promising from carriers' point of view, i.e. the use of CNG (compressed natural gas) and biogas engines. The NO<sub>x</sub> as well as the CO<sub>2</sub> emissions of CNG engines are lower than for diesel and PM<sub>10</sub> is hardly emitted. The vast majority of trucks used for urban freight transport use currently diesel-engines. There are some disadvantages of using CNG engines for urban distribution; the radius of action is more limited than that of diesel-engines. However, for urban distribution this should not be a problem, because of the relative small distances travelled in cities. Next, the number of filling stations is limited (in the Netherlands) at the moment. And finally, purchasing a CNG truck is about 5 – 10 % more expensive than a comparable diesel-truck. An example of the use of CNG trucks was already discussed in the case of Albert Heijn (see section 'Decoupling at the border of the city centre'). The carriers use the CNG to carry the city trailer that was delivered in the Ecocombi to the city border. Besides, some of Albert Heijn's carriers experiment for small distance-transport with the 'Economic CNG' (see Fig. 4) with low entrance so that drivers can easier notice vulnerable road users in cities. Next to this example from regional specialists, a functional specialist (i.e. Paul Klarenbeek, fashion transport) uses CNG trucks for its urban fashion deliveries, resulting in less noise nuisance and fewer local emissions.



Fig. 4. CNG truck used to supply supermarkets

The use of CNG trucks can be the first step in the transition towards the even more environmental-friendly gasses biogas and hydrogen. Biogas from (for example) dumping sites or the breakdown of organic matter (e.g. organic waste and compost) has similar composition as CNG and can be mixed with natural gas or used directly by CNG trucks. This transition can make the transport more sustainable in the area of CO<sub>2</sub> emissions (as well as for local emissions). In the distant future a transition to hydrogen could be possible; the necessary infrastructure corresponds to that of natural and biogas.

Another technology solution in the engine types that is often mentioned in relation with urban freight transport is the use of electric vehicles. These vehicles do not emit local pollution and there are no CO<sub>2</sub> emissions (due to driving). The total amount of emitted CO<sub>2</sub> depends on the way the electricity is generated. Several experiments with city logistics using electric vans can be mentioned in the Netherlands (see for example Cornelissen in Nijmegen or 020stadsdistributie in Amsterdam), that have in common that the purchase of these vans is subsidized. The biggest disadvantages of electric transport are the limited battery capacity (resulting in a limited radius of action), the high costs for batteries, and the long battery charging times. The limited radius of action makes electric transport especially suitable for regional specialists (in combination with network collaboration). Electric vehicles make no noise, so the noise nuisance disappears (except for unloading), however this can cause problems for vulnerable road users. Currently, the costs for electric vehicles are high, so often subsidies are necessary for carriers to purchase these vehicles. One best practice from the Netherlands in electric vehicles is the so-called Cargohopper. This electric road train is used by a regional specialist in Utrecht (i.e. the TransMission member Hoek Transport) to perform city distribution in the city centre of Utrecht (see Fig. 5). This RS combines a logistics solution (i.e. network collaboration) with a technical innovation, the Cargohopper. This is an electric vehicle on solar power with a length of 16 meter that makes deliveries on a clean and noiseless way. This combination of solutions was part of the City Distribution award winning initiative in the Netherlands in 2009 [16 ; 17]. This solution shows how a regional specialist (and its logistical solution, i.e. network collaboration, to improve urban freight transport sustainability and efficiency) can be visible for local authorities and residents, i.e. in Cargohopper the RS's logistical solution of network collaboration (which is not visible) is combined with a very visible technical solution. The logistical concept is a necessary condition for the technical solution to be successful! (The network collaboration provides sufficient volume to make cost-effective roundtrips in the city). This applies to (almost) all forms of electric transport in urban areas.



Fig. 5. The Cargohopper in Utrecht

#### 4.2.2. *Solutions to reduce noise nuisance*

Technical innovations made it possible to reduce noise emissions (during loading and unloading activities). In the last decade several vehicles and equipment received a PIEK certificate, which implies that (un)loading activities are carried out under the 60db(A) [18]. This noise level is suitable for night time deliveries, without resulting in noise nuisance for residents. Obviously, a technical innovation has to be used in practice to solve a problem. Especially Dutch supermarkets switched to PIEK certified vehicles and equipment, in order to deliver their stores in off-peak hours (e.g. the early morning). So the technical innovation is combined with a change in the logistical organization. The idea is that supermarkets, many times FTL (full-truckloads) deliveries, are supplied by their FS. This functional specialist collects goods at a supermarket chain's distribution centre and drives during the early morning to the store. An advantage of this moment of the day is that the vehicle is not hindered by congestion. After delivering (outside the store-opening hours) the vehicle can return to the DC before the morning peak. Due to the quiet material, these deliveries can be made in the late night. The effects of the implementation of evening and night-time distribution are calculated in two case studies [19]; they show that the savings in costs, kilometres and emissions are substantial. However, for carriers it only makes sense to invest in PIEK certified vehicles and equipment (i.e. quiet material) if, and only if, they are allowed to make these quieter deliveries outside the time-window periods. So next to the already discussed logistical changes (other delivery times and another way of organizing the goods receipt at the stores), changes in local authorities' regulations are required in order to make this carriers' solution for a more efficient and sustainable urban freight transport working in practice (see also [20 ; 4]). This takes quite a lot of time and energy, and - at this moment - supermarkets (or carriers) have to discuss these privileges with different local authorities separately [21]. Not all local authorities are willing to cooperate and make off-peak deliveries in the early morning possible.

#### 4.2.3. *ICT and ITS solutions*

In CityLog telematics solutions will be developed and tested. The telematics solutions, i.e. the logistics planner, is composed of the pre-trip planner, the dynamic navigator, the last mile tracking device and static and dynamic map attributes. The CityLog logistic planner will be an "intelligent management system" that supports carriers in defining optimized routes for their vehicles during specific time window periods. The assignment of time windows will be fully flexible; so that it can easily be adopted to different local authorities' regulations as well as in respect to the different vehicle typologies (e.g. silent vehicles will have also the availability of night time windows). The first device in the CityLog logistics planner is the pre-trip planner. This planner allows the carrier to organize the missions not only to find the optimal route but also to take into account real-time traffic data and traffic restricting policies or events (e.g. road constructions and urban freight transport restrictions). The second device is the dynamic navigator, which manages dynamically the traffic information and exploits ad hoc map attributes for commercial vehicles. The navigation support for drivers is important to make urban freight transport activities more sustainable. The navigation services must comply with all the rules and restrictions for urban freight transport. Next, the navigator will be based on the most advanced map technologies (see later in this section) and will be able to take all dynamically appearing changes into account. The third device is the last mile tracking device, which matches the vehicle position information and the dispatched notes in order to inform the final addressees about the expected delivery time. Planned pick-up and delivery tours (trips) can be monitored in order to compare the actual status with the plan and to become able to react on deviations and to adjust the ETAs (estimated time of arrival) of the next stops. Customers can be informed about their ETAs and severe deviations can initiate further messages informing about the new ETA. The locations of the delivery vehicles are determined on-board by GPS/Galileo and then transferred to the carriers' monitoring application. On-board clients providing position information and

fleet monitoring applications are already widely in use. The work in CityLog will focus on the integration of available components and on the development of the customer delivery warning (ETA) linked to the management system of the carrier. The main advantage should be that the number of unsuccessful (parcel / home) deliveries decreases, and with that the number of kilometres travelled in the cities. Finally, the last device contains the static and dynamic map attributes for urban freight transport. Commercial vehicles-targeted enhanced maps will include specific map attributes related to all relevant features for urban freight deliveries. Maps attributes will relate both to physical constraints and to traffic restrictions defined by the public authorities, therefore they will also be dynamic. Pre-trip planning and navigation/guidance of delivery vehicles are based on maps where new application functions often need to be reflected by new map attributes. The task here is to extend the map regarding urban freight transport in general (e.g. include freight routes) and especially regarding the new CityLog applications. Environmental restricted zones, access restrictions, delivery time windows are taken into account [6]. Fig. 6 shows this CityLog telematics solution [22]. These telematics solutions are especially interested for functional specialists and generalists. As a general rule, regional specialists have in depth knowledge on issues in their region (e.g. traffic, roads, and regulations); this local knowledge provides the RS a competitive advantage in comparison to carriers that are less familiar with the circumstances and make less efficient trips. These telematics solutions provide a possibility for non-local carriers (FSs and Gs) to get detailed local information as well.

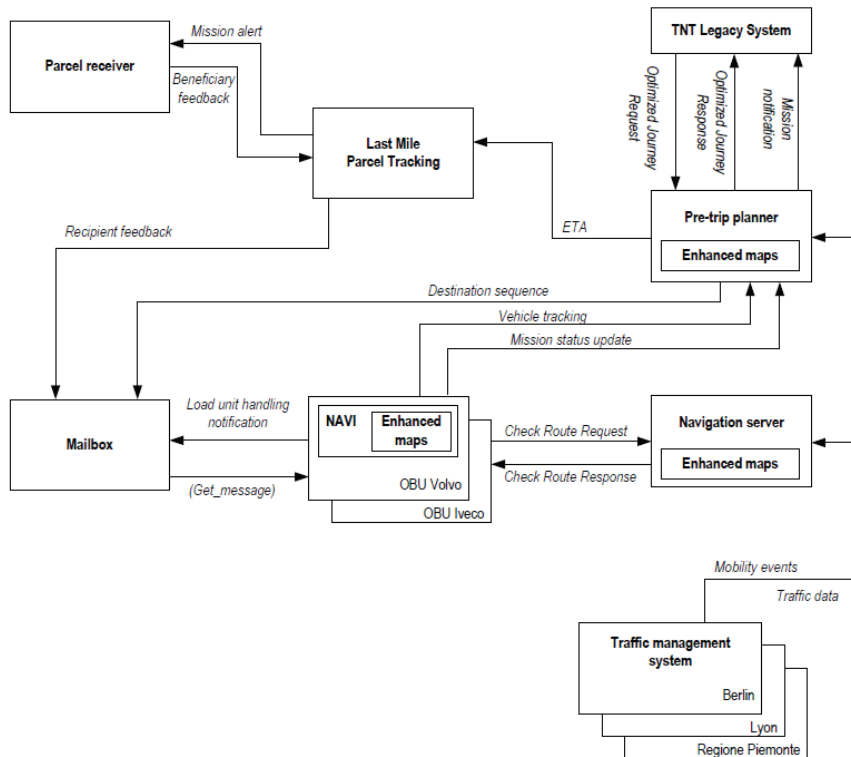


Fig. 6. CityLog overall architecture. The four ICT tools proposed for the logistic-oriented redesign are connected to ensure wider benefits [22].

## **5. Conclusions**

Carriers are very active in solving all kinds of urban freight transport related issues. On the one hand, carriers do this by ‘just doing their jobs’ (being as efficient and cost-effective as possible), but on the other hand carriers bring plenty of innovations (both logistics and technical) in practice to make their urban freight transport activities more sustainable. The main problem (for the carriers) is that their solutions are quite often not recognized (and therefore not acknowledged) by other stakeholders in the city (i.e. local authorities and residents). This is partly due to the larger regional focus (than a city) of carriers’ solutions than the often limited scope of local authorities and residents, who focus mainly only on the city (centre). The main challenge for carriers seems therefore not so much to find (innovative) solutions to improve their urban freight transport operations, but rather to make these solutions visible and recognizable for all relevant city logistics stakeholders.

Next to that, it can be a challenge for a carrier to find the solution that fits its operations. The right solution for a carrier to improve its urban freight transport operations depends (partly) on the carrier-type. In this contribution, three carrier types are distinguished that all make urban deliveries (and / or pickups): the regional specialist, the functional specialist and the generalist. Urban freight transport offers plenty of opportunities for regional specialists, because these carriers bundle regionally and usually carry fully loaded trucks into cities. However, these bundling activities are usually not visible for local authorities. The example of the Cargohopper in Utrecht showed that a technical solutions can make the regional specialist visible (and with that appreciated) in the city.

A regional specialist can use several logistical and technical solutions to improve the sustainability and efficiency of its urban freight operations: cooperation in a network (with other regional specialists), bundle outside the city (i.e. be a city carrier for other carriers), use electric vehicles for final distribution, and other technical innovations, such as CNG trucks and improved diesel performance can be used by RSs. A functional specialist also has several options to increase the sustainability and efficiency of its urban distribution activities: decoupling at the city border (for example using boxes or an EcoCombi) with minimum handling activity, bundling at the source, off-peak deliveries, telematics solutions, and the use of CNG vehicles and improved diesel performance of the engines. Finally, the generalist finds itself in a difficult situation concerning urban freight transport; i.e. the generalist should be able to offer the same services as a (functional and regional) specialist to be competitive in the urban environment. This implies that the generalist should have low prices (to compete against the regional specialist) and specific services (to compete against the functional specialist). The generalist runs the risk to get stuck in the middle concerning its urban freight transport operations in the longer run, i.e. too expensive and not being able to offer distinguishing services. The presented opportunities in this contribution to improve urban freight transport operations are mostly applicable to functional and regional specialists, and may make it even more difficult for generalists to compete with the specialists in city logistics activities.

## **Acknowledgements**

The author likes to thank Babiche van de Loo (TLN) for her useful comments and ideas on the Dutch version of this contribution, Tariq van Rooijen (TNO) for his inputs on especially the technical solutions discussed in this contribution, and the CityLog partners for their efforts.



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