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# Toward a Shared Urban Transport System Ensuring Passengers & Goods Cohabitation

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## ABSTRACT

Nowadays, cities are looking for instruments and policies to ensure an efficient and effective urban mobility for both passengers and goods, from a sustainable development point of view.

The optimization of the flow of passengers and goods in the urban area, with the aim of reducing the direct and external costs related to the increasing mobility, is assuming growing importance.

Goods transport, long excluded from the city's problems, seems now to attract renewed interest both from the traditional players such as institutional or professionals of road transport, but also from the new players such as operators of public transport.

Urban communities of all sizes, in Europe, are wondering how to enter further into this issue: to design and manage of combined urban transport solutions, could be a real opportunity to extend urban transport services, allowing a smooth sharing of passengers and goods.

Examples of urban communities' involvement in urban logistics are increasing but we do not dispose of much knowledge on how these innovative solutions can be deeply integrated into a global urban mobility strategy. The aim of this paper is to explore this issue.

It presents radical new urban transportation system concepts, potentially allowing changing the economic and environmental costs of passenger and freight transportation.

It focuses on the concept of sharing, which means to make a joint use of transport resources, between passengers and goods flows. At first, the concept of shared passenger & good urban transport is defined and existing solutions are described, carried out on an international survey. From a field observation of several existing solutions, an inductive reasoning enables us to move from a set of specific facts to establish an archetype for a radical new urban transportation system. Once the archetype defined, it is translated in real life through the example of the On Route proposal for London. The named proposal was submitted to Transport for London (TfL)'s 'A New Bus for London' competition, launched in 2008. The New Bus for London is a planned 21st Century replacement of the iconic Routemaster as a bus built specifically for use in London. A prototype is expected to be on the road by late 2011, with the first buses due to enter service in early 2012, in time for the 2012 Summer Olympics to be held in London.

The research frame of this paper is the French C-Goods project (City Goods Operation Optimization using Decision support System), financed by the French research agency.

Started in February 2009 the project involves four partners, the multi-disciplinary French engineer school EIGSI (Ecole d'Ingénieurs en Génie des Systèmes Industriels), the French university ENMP (Ecole Nationale Supérieure des Mines de Paris), the Poitiers Urban Community (CAP), and the consulting service Interface Transport, specialized in transport economy. The project will end on 2012.

## Problem Statement

Both people and goods move in the urban environment, the ones transported by their individual vehicles and collective transports, the others by freight carriers, shippers, craftsmen, people

An efficient and effective transport for passengers and goods is an essential element for cities life and development. As passengers need to resort to efficient transport solutions, allowing reaching their destinations at scheduled time, similarly, goods must be handled quickly to avoid creating excessive stocks and to minimize

warehouses size and related operating costs. As urban space is a limited resource, it is commonly argued that the movement of passengers and goods inter-act each other strongly. Consequently, the global level of urban accessibility decreases for both: according to this trend, congestion problems result and the travel time increases for all. One of the key factors to reverse this trend could consist, for cities, to adopt a different way to manage the transport network, ensuring a smooth sharing of passengers and freights.

"Urban freight distribution could be better integrated within local policy-making and institutional settings. Public passenger transport

is usually supervised by the competent administrative body while freight transport distribution is normally a task for the private sector. Local authorities need to consider all urban logistics related to passenger and freight transport together as a single logistics system". (European Commission 2007).

To be coherent with this European recommendation, cities could lean three axes of development:

1. Improve the sharing of road space between private&public motorised road transport passengers flows and private motorised road transport goods flows;
2. Shift passengers and goods flows from private motorised road transport to others urban transport modes – i.e. public transport like buses, tramways, subways, car&bike sharing systems – . An increased use of public means could release cities from congestion while increasing revenues to public transport, making it less subsidy dependent.
3. Introduce distribution facilities – like consolidated centres, urban delivery stations and storage equipments - in urban areas already devoted to passengers hanging on – i.e. car park areas, public transport stations, etc.–.This could be useful to avoid empty runs or unnecessary driving and parking.

Actually, these axes of development are not really explored, because of several reasons (cultural, historical, and economical). Sustainable urban mobility plans still adopt approaches taking into account passengers and goods flows separately, even if encouraging measures for both sides; this situation leads sometimes to antagonist solutions and introduces perverse effects which limit the efficiency of global mobility in the city.

### Existing shared solutions

Nevertheless, for each of the three identified axes, several experiments have been implemented in cities leading to a large range of results, showing in many cases the difficulty to set up solutions or compromises which can be accepted by both stakeholders. The detected solutions are detailed in the next part, and summarized in the Table 1.

Axe 1: To improve the sharing of road space

Multiuse lanes: this solution aims to use lanes as priority bus lanes, during the peak hours and to convert on-street parking spaces into unloading spaces during the prescribed hours. Web-based information services give bus priority regulations, through variable message signs. Multi-use lanes have been implemented in Barcelona, as an implementation of the CIVITAS I MIRACLES project (202-206) ([www.civitas.eu](http://www.civitas.eu)).

Night deliveries: this solution aims to manage vehicle traffic in high density central business districts of urban areas, delivering to retailers and shops in the inner city area during the night hours

when the city is usually quiet and inactive. Typical times are between 10.00 p.m. and 7.00 a.m. In several cities such as Barcelona or Dublin, successful experiences with trials on night delivery are made replacing a higher number of vehicles operating during day time by a fewer number of vehicles operating during night time ([www.bestufs.net](http://www.bestufs.net)).

Shared Bus&lorry lanes: this solution aims at recognising lorries, along with buses, as essential components of urban traffic, assuring a prioritise treatment where possible (e.g. shared lorry and bus lanes).

At present, in Europe, there is only limited experience from this type of prioritisation initiative. The introduction of shared bus&lorry lanes has taken place in London and Newcastle-upon-Tyne (Browne, 1997). Recently, the Smartfreight project ([www.smartfreight.info](http://www.smartfreight.info)) aims to specify, implement and evaluate Information and Communication Technology (ICT) solutions that integrate urban traffic management systems with the management of freight and logistics in urban areas.

Axe 2: To shift passengers and goods flows from private motorised road transport to others urban transport modes.

Shared buses: this solution aims to combine a door-to-door service for passengers and a transport service of goods (parcels and small packets), in order to develop a public transport service oriented to users needs in time of little demand. This solution has been implemented in Germany, in the framework of MULI project (1996 - 1999).

The project had the aim to propose buses able to carry not only passengers, but also small goods. The project takes place in three German municipalities, Gangelt, Selfkant and Waldfeucht (district of Heinsberg) located at the border to the Netherlands, about 20 kilometres north to Aachen. The region is characterized by disperse settlements.

Usually, the transport of small goods was carried out in an uncoordinated way by different service providers. Multibus aimed at bundling up these transportation trips (Shaefer, 2003).

Shared subway: within urban areas there are only limited opportunities to enhance physical capacity of road infrastructure at surface level.

This solution aims to reserve access to underground infrastructures, during specific periods, for goods vehicles. Some Japanese, American and Dutch cities have considered such option. (Van Binsbergen and Visser 1999), (Chiron-Augereau 2009).

Shared tramway network: In Zurich, Cargo tram and E Tram assure free services to collect large and heavy rubbish and electrical items, such as hairdryers, keyboards, etc.. This offer is reserved for pedestrians, cyclists and passengers using public transport, at stated times and stops on the line. In Dresden, supplies to the Volkswagen factory are delivered by tram. In Vienna, there are plans to introduce a freight tram service.

Various Dutch cities are planning freight tram services. Of these, the plans of Amsterdam are most advanced (Chiron-Augereau 2009).

Car sharing: this solution aims to enlarge the urban use of the sharing vehicles systems, to the good distribution, to answer a demand for goods transportation by craftsmen, shopkeepers and even citizens. In Osaka, a new co-operative system of electric vehicles started, in 1999. In Genoa, a car-sharing service dedicated to goods transport (Van-Sharing service), has been introduced in the framework of the Civitas Caravel ([www.civitas.eu](http://www.civitas.eu)) project, (2005 - 2009), to rationalize the vehicles use, by the traders who transport goods to the shops with their own cars. In La Rochelle, a van sharing service has been introduced too, since 2008, in the framework of the Civitas Success ([www.civitas.eu](http://www.civitas.eu)) project (2005 - 2009).

Axe 3: To introduce distribution facilities in urban areas

Shared delivery bays: this solution aims to increase of parking areas in cities, allowing all vehicles parking in loading/unloading bays, during the night and the bank holiday. They should only be restricted to goods vehicles if absolutely necessary. A recent implementation of this solution has been done in Paris, often characterized by a lack of parking areas (Maire de Paris 2009).

Automatic goods lockers in car parks : this solution aims to offer to the small shops and the costumer service professionals to receive during night- time on its dedicated urban logistic automats their spare-parts delivered by the freight company of their choice.

One of the advantages of the system is to reduce the traffic by avoiding workers from the small shops and technicians make daily return trips to their providers located in the suburbs. An implementation of this solution has been done in Paris, where the Consignity Company settled up the first Parisian network of eight logistic relays located in car parks of the city (Atlassy 2006).

Lockers in underground stations: this solution aims to settle up lockers to be used to facilitate consumer deliveries, i.e. those times when it is more convenient to collect a parcel from a locker in a chosen location than wait somewhere for it to be delivered – This service is becoming increasingly popular in Europe. In Paris, Coliposte, the parcel division of LaPoste, launched a postal lockers service, Cityssimo, during 2006 (Chiron-Augereau 2009).

Urban delivery stations in car parks: this solution aims to settle up services and infrastructures to urban distribution in urban areas, already devote to the passengers hanging up.

Experimentation has been done by Chronopost International, in Paris. The company started a program to gain ISO 14001 certification at its sites. For this reason, an Urban Delivery Station has been placed, in the underground park of La Concorde, to deliver the Champs Elysées quarter.

This experimentation, managed in cooperation with the city of Paris, has seen interesting results, achieving reductions in greenhouse gas emissions. (Chiron-Augereau 2009).

### Toward a shared urban transport system

After a field observation of several real cases of implemented solutions, an inductive reasoning enables us to move from a set of specific facts to establish some concepts and principles in order to ensure a smooth movement of passengers and goods in urban transport network.

We firstly characterise urban mobility as a complex system.

A systemic approach allows us to decompose urban mobility into different components strongly linked and in interaction. These components refer to passengers and goods' flows. From the statement that the local improvement of one component of urban mobility does not ensure the improvement of the global system, the necessity to plan and to control their coexistence comes.

Once urban mobility characterised, we introduce a whole concept for city transport system, in order to ensure a smooth cohabitation of passengers and goods in urban transport.

Two principles define the concept:

- The first principle prefigures that urban transports are shared between passengers and goods, through the access for both to the largest modes available in the network (i.e: bus, tramway, subway, car sharing, bike sharing).
- The second principle prefigures that cities are equipped of shared gates ensuring a smooth trans-shipment for passengers and goods, arriving from various sources, and having various destinations.

Through the coupling of those principles, we propose an archetype for a radical new urban transportation system.

The Urban mobility as a system: characterisation

"The essential characteristic of a system is the interaction of its parts. Consequently the individual improvement in the performance of its parts taken separately, although necessary, does not assure the overall improvement of its performance. A determinant factor of this performance is how well the different parts of the system fit together." (Macario 2005). Urban mobility, designed as a system, can be decomposed as follows: a piloted system and a control system which heads the piloted system (Doumeingts and Vallespir, 1994). The control system can be decomposed into two subsystems: the information system and decision system. The piloted system can be decomposed into two subsystems, as well:

- The system of passengers urban transport;
- The system of goods urban transport.

Elements characterizing the urban mobility piloted system are:

- Physical flows, including passengers and goods.
- Urban transport operators, companies that provide public transport, operating a fleet of vehicles. They may or may not be regulated or subsidized by authorities. The infrastructure used may be exclusive, or shared with private vehicles.

- Equipments, including drivers, vectors and maintenance workers, assuring passengers and goods movement.
- Transport infrastructures, including the circulation network, parking areas, delivery bays and waiting zones – bus shelters, railway stations, underground stations, etc.
- Information flow, it groups initiatives in the field of traffic telematics, to help keep up-to-date on traffic conditions along routes. They warn drivers of specific traffic incidents, including accidents and construction, to adjust route and avoid getting stuck in jams.

Sketching an archetype for a radical new urban transportation system

In a sustainable urban development point of view, it should be necessary to plan a transport network ensuring:

- The circulation of both passengers and goods, through the largest number of transport modes that cities can offer. Transport planners have to design urban transport systems equipped to satisfy not only the movement of people's flow, but also goods flow.
- The modal change for both passengers and goods. Efficient interfaces between long-haul transport and short distance distribution to the final destination, should be settled. An integrated network of urban gates able to shift passengers and goods urban commutes to cleaner and environmentally friendly modes. The urban replenishment should be ensured through smaller, efficient and clean vehicles, replacing the conventional commercial vehicles trips and ensuring a capillary distribution of goods. This alternative scheme could reduce not only the total number of city kilometres, but also the CO2 emissions per city kilometre.

Coupling the previous requirements, it is possible to outline the archetype of a whole shared urban transport system. The sketch of this archetype is drafted in the scheme below.

### From archetype to real life: the On Route proposal for London<sup>1</sup>

A multi-disciplined design specialist has come up with a radical urban transport proposal, called On-Route, which he believes tackles the two biggest problems caused by city-centre transport today; congestion and pollution. Frost's proposal was submitted to Transport for London (TfL)'s 'A New Bus for London' competition, which Mayor of London Boris Johnson launched from July to September 2008.

A real 'step change' in city transportation logistics, On Route proposal marks the integration of passenger and freight transportation, providing increased passenger and freight capacity,

improved convenience and service, whilst reducing congestion, pollution and real costs. It covers with:

1. A new iconic design of double-decker bus, Freight\*BUS™, that combines a passenger-carrying bus with that of freight haulage with the minimum of disruption to either service. It can be reconfigured in seconds by the conductor or driver to carry freight and passengers. Furthermore, passenger space & freight space can be easily adjusted to match demand. The new city bus is a full car length shorter than the "bendy bus". In maximum seated mode it will seat a whopping 43 more passengers than the bendy bus. At night time when not carrying passengers it can deliver up to 34 pallets when fully loaded.
2. Consolidation centres and cross-docks for freight movement and hubs for passenger and freight delivery and collection.
3. Hubs located at major bus stops, and concentrations of retail, commercial & light industrial units.

It is evident that this avant-garde concept requires a whole new way of thinking about urban transportation systems and it will have a profound impact on city infrastructure. But then, it is possible to observe that many of these elements already exist and can be linked into existing infrastructure such as bus/rail stations & depots; haulage/sorting depots etc.

To bear out this thesis, Frost points to studies which have already been carried out in London showing that the implementation of alternative freight systems, including the use of 'Consolidation Centres' in city areas can give exceptional results. One such study found a 68% reduction in construction vehicles entering the City of London for the project, an average journey time reduction of 2 hours, a circa 75% reduction of CO2 emissions, and a 10% reduction in local distribution journey times. The On-Route Bus supports the existing aims of the London Freight Plan as set out of in the Mayor of London's existing Transport Strategy.

When looking at the idea of consolidation in relation to bus routes and passenger transport, Frost quickly realized that not only were there opportunities to improve bus routing & linking with other transport services and types using consolidation principals, but that there is an even bigger opportunity to use the buses for freight as well as passenger movement that would reduce the numbers of goods vehicles on city roads (especially light goods vans which are responsible for 15% of all UK carbon emissions from all forms of transportation) by as much as 50%.

He remarks: "We looked at passenger & freight systems end to end and concluded that there is sufficient overlap to be able to build on and integrate existing infrastructure of both passenger & freight systems". Taking London as an example, Frost leans on low bus occupancy statistics, and says that "the most optimistic proposals put the average occupancy of its buses at 25%. However, our calculations show that for around four hours a day, their utilisation drops to as low as 20%.

Despite this, city authorities are tasked with increasing the numbers of vehicles, routes and service frequency to supposedly reduce congestion and improve services. My idea is to put our cities' buses to good use by using them to provide an alternative city freight system at times of low passenger capacity utilisation. This could reduce the numbers of freight vehicles on city roads by as much as 30%. By using the buses to carry freight in the evening and overnight, the utilisation of these vehicles would be maximised, offering maximum return on investment (ROI) and substantially increased revenue from the vehicles. However, in order to fulfil this dual role, the entire concept of buses, as we know them today, needs to be re-visualised." The design of Freight\*BUS will readily accommodate battery or fuel cell technology. The 200mm deep space in the main floor of the bus will house batteries or fuel cells and the accompanying hydrogen storage tanks (if required).

Indeed, it is envisaged that when fuel cell technology is affordable, that the fleet could be easily switched to this propulsion system, while keeping the drive motors and control systems in place. Similarly, its re-configurable interior design could even be broadly applied to existing vehicles built with combustion engines. However, it is the designer's view that the latest and emerging advances in battery technology will make the re-fit and the use of hydrogen and fuel cells unnecessary. Freight\*BUS would also feature the very latest in other emission-saving technology, such as distributed wheel motors which can be as much as 50% more efficient than central motors.

## Conclusion

Improving urban mobility: which challenge for urban transformations governance? The ambition of this paper is to provide relevant thinking, ideas and examples in order to improve urban mobility. We conclude addressing some recommendations on the subject of the governance of urban transformations. We are conscious that to shape the competitive city of the future, equipped of a radical new urban transportation system, it is necessary to ensure a thorough governance of urban transformations.

Our statement lies on the assumption that "a key input for the Urban Mobility System is the interaction between policies, namely between land-use, environment and socioeconomic development of the urban area, since these aspects are upstream the generation of mobility requirements (through land-use) and the choices made by the citizens (through the pricing system, regulation on environmental protection, fiscal incentives, etc)" (Macario 2005, pg. 233).

At the same time, we are aware that, while designing the physical system and considering all the options for the optimization of the mobility chains, the really hard task consists in taking into

consideration the concerns about the social, economic and functional impact of each configuration.

Indeed, as Macario stated, "the demands falling over an urban mobility system are very diverse and require the system to continuously adjust to the urban changes. Besides, clients are divided in segments that represent different preferences which are sometimes in conflict.

This means that the activities that add value to a specific segment of clients might well subtract value to other segments (Macario 2005, pg. 231).

From this rationale comes out the evidence that a management model is needed. This management model should serve as a basic framework for the planning and control urban transformations. The starting point of the model building process should be the adoption of a systemic approach toward urban mobility. To manage the whole urban mobility system, the model should distinguish three decisional levels associated to different temporal horizons: the strategic level, the tactical level and the operational level. Each level should ensure the integration of both flows. The definition of a clear and well structured regulatory and organisational framework, assuring an effective interaction between the different parts of the system, will be a determinant factor for a coherent structure of the model.

Finally, we are aware that it necessary to focus on a costs-benefits analysis of the impacts of the proposed archetypes on the different urban mobility stakeholders, increasing political momentum around issues such as resource scarcity, climate change, security and new regulations.

Until now, the most important parameters for supply chain designs have been related to cost efficiency and on-shelf availability. As a result of the growing importance of these emerging issues, new factors are becoming increasingly critical, such as traffic congestion in urban areas, energy consumption, CO2 emissions and the permanent rise in transportation costs.

Further research directions

Starting from these conclusions, this research work will be further developed, with the aim to find useful results leading local transport authorities' managers to improve the integration of freight and passengers transport. The research objective is to pursue the following axes:

- To assess a priori the effects of the adoption of the identified new solutions in French medium size cities like Poitiers and La Rochelle.
- To built a management model adapted to local authorities managers to guide them in the process of optimizing the whole passengers & goods transport activities.
- To propose some scenarios for the Milan's urban mobility system, in order to derive general conclusion on the transferability of the model.

## Notes

- <sup>1</sup> Text extract from the website <http://www.onroutebus.co.uk>.  
<sup>2</sup> [www.tfl.gov.uk/tfl/corporate/projectsandschemes/technologyanandequipment/anebusforlondon](http://www.tfl.gov.uk/tfl/corporate/projectsandschemes/technologyanandequipment/anebusforlondon)

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