

Discussion note by Prof. Joop Evers: Profile of new intercity transport

Joseph J.M. Evers
Transport Policy and Logistics Organization
Technology, Policy and Management
Delft University of Technology
P.O. Box 5015
2600 GA Delft
The Netherlands
tel: +31 15 27 88384
fax: +31 15 27 82719
e-mail: J.J.M.Evers@tudelft.nl

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The massive use of private cars causes serious problems. Despite parking problems and traffic congestions, for many the private car remains favourable. As an alternative, a new type of public intercity transport has been proposed, called Fast Transport on Request (FTR). Specific elements are: dedicated tracks for high speed bus driving between the cities; booking via Internet or intelligent telephone; intelligent logistics control reducing the number of stops and excluding detours; adaptive seats and digital facilities.

Keywords: Public transportation, ITS, automobility, RBT, DTR, transport logistics

1. Public transportation versus the private car

The massive use of private cars causes serious problems. Often industrial areas and vital urban facilities are blocked by traffic congestions. It is clear that an effective alternative in the form of public transportation is badly needed. Yet, despite parking problems and annoyance of traffic congestions, for many the private car remains favourable. The car appeals to feelings of freedom and independence.

In that context a new type of public transportation is sketched, which is focussed on intercity travelling. That is to say, the travelling between urban centres situated at mutual distances from 10 to 50 kilometres, covering an area with a length up to 200 km. In this segment the majority of daily travelling takes place.

The inspiration for this transportation concept is borrowed from three sources: the success of the private car, the new world of Internet and communication and modern real-time logistics. This leads to the concept *Fast Transport on Request*.

2. The meaning of automobility

In his study on *Autonomy and automobility*, the philosopher Lomasky (1995) states that automobility and personal autonomy are complementary and arise from, and give expression to the fundamental human quality of self-determination. To this, the private car adds an extra dimension. The car enables people to choose where to live, to work, to study, to recreate and to separate the related decisions. The private car has created a new experience of space and time (Urry, 2004). The unconditional availability of personal, fast transportation offered by private cars is essential.

Sociologist Sheller (2004) analyses the emotional aspects of car driving. Although most of the car trips are planned in advance, the idea to change the intension always is an option. Waiting in traffic congestions is a waste of time, but also a frustration of freedom. Sheller concludes that for many people, car driving gives a feeling of freedom, power and social participation. Another aspect is the experience of privacy. The car protects its passengers from the outside world and gives a feeling of social security.

Lomaski (1995) observes that often the attitude of societal authorities is *a priori* negative to automobility, neglecting the positive qualities. The background is a hidden conflict between authority and personal autonomy. The idea is that the enlightened administrator does the right things for the citizens. Rejection is taken as out of place. In this way automobility is experienced as a continuing rejection of governmental policy to discourage car driving and to promote public transportation. In contrast to this, railways are valued as the result of successful policy.

3. Virtual mobility and autonomy

With the modern mobile telephone people can communicate instantaneously from any place to any place at any time, without meeting each other. This has led to a communicative life style, where one continuously has virtual contact with family, friends and colleagues. Another development is the rise of Internet which has led the world of cyberspace. Cyberspace accommodates many forms of service providing, taking advantage of the unlimited access to information and of the possibilities of taking virtual decisions and to settle financial commitments. There is no need to work within an organisation to get access to these facilities.

This reality also is visible in modern management. The personal span-of-control has become much larger and, via business-to-business transactions, reaches beyond the boundaries of the organisation. Markets are agile and enterprises must react fast. New organisations operate with autonomous business units, co-ordinating the work with the help of digital performance contracts.

In contrast to this the railways still follow the traditional model. Trains are rigid: they cannot leave the rails; they cannot pass each other; the following times between trains are at least three minutes. Trains must operate in fixed schedules. Operational control is focused on maintaining the schedules. The corresponding organisational form is hierarchical. Local perturbations can propagate fast, which may lead to stagnation of the whole system.

Bus transport operates differently. Each bus functions autonomously and is committed to the running operation plan via a performance contract. Malfunction of a single bus will not lead to failure of the system.

4. The logistical viewpoint

Services can be taken as products with “lifetime zero”. Indeed unused capacity vanishes instantaneously. Clearly, such products cannot be held on stock. A surplus of service capacity is required to satisfy, with a prescribed probability (for instance 95%), current demands. The “lifetime” of a service can be extended artificially by moving up the moment of its “availability” by booking. When reservations of future capacity are transferred to others they can be taken as options on capacity. In fact we then have a virtual ticket market.

In logistics the *ABC-classification* is well known. In this, the assortment is subdivided in highly, moderately and rarely demanded products. Often the so-called 80/20-rule applies, stating that 80% of the demand concerns only 20% of the assortment; this typically represents the *A-segment*. Usually, the *B-segment* represents 15% of the demand on (say) 30% of the assortment. The remaining part falls under the *C-segment*. Often the C-segment is loss making, but can't be missed because of complementary with other segments.

In the transportation market, the A-segment typically consists of trips during rush hours. The B-segment covers daily trips on popular trajectories, whereas the accent of the C-segment typically lies on nightly trips. Normally, the demand follows a weekly and a daily pattern, which can be forecasted with the help of dynamic statistical methods. Also the year calendar with holydays and public events can be taken into account.

Production may be induced by keeping stocks. Stocks may cause stock risks, implying that possibly they can't be sold. For products of the “A-segment”, such risks can be small and therefore acceptable. Since the seventies production on stock is largely replaced by production on demand. Indeed from the viewpoints of quality of service providing and efficiency, the appropriate form is production on demand. Using modern ICT, the demand could be entered via Internet or telephone.

Public transport operating with fixed schedules is a form of “production on stock”. These stocks consist of seats in the acting vehicles. Unsold stocks are visible as empty seats. Dial-a-ride public transport “produces on demand”. In this context, a driving empty taxi can be taken as a “machine” adapting to switch from a completed job to a new job.

5. Transportation concepts

Intercity personal transport mainly goes by train, where the stations are passed in line. On each station travellers may use the local transport system to start or to complete their travel. This can be characterised as a *line-hub-spoke concept*; c.f. figure 1.

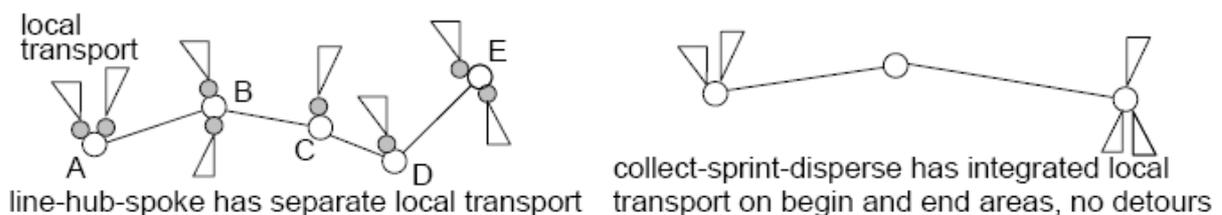


Figure 1. Line-hub-spoke versus collect-sprint-disperse

Busses offer other possibilities. To be specific, a trip along the intercity tracks both may start and end with a local trip, serving a rather small number of popular stopping places. This might be characterised as a *collect-sprint-disperse* concept. The leading idea is to avoid transfer between local transport and intercity transport, and with this shorten travel times. Line-hub-spoke and collect-sprint-disperse might be combined in the sense that a part of the travellers may avoid local related transfers indeed, whereas others use separate local transport.

6. State of art of fast transport by busses

Public transport with busses, driving on dedicated lanes, with separate halting lanes and with right of way on crossings is an interesting option. In USA such Bus Rapid Transit (BRT) systems are widely in operation; c.f. Miller, Yin (2004), Moss, Townsend (2000), US General Accounting office (2001). The largest BRT network has Curitiba (Brasil). On the average this system transports 1.3 million passengers daily. The subways in London and in New York transport the double.

Often the potential of BRT is underestimated; c.f. Samuel (2004). An obstinate prejudice is that BRT fails with respect to capacity; c.f. Federal Transit Administration (1994). Observing that the follow times for busses are four seconds and those for light rail trains three minutes, an elementary calculation shows the opposite. In practice there is the bus lane of the Lincoln Tunnel in NY. On the average, this connection accommodates 750 busses per hour in rush hour, corresponding with 25,000 passengers per hour; c.f. Mosseri, Hall, Rivera (2003). In terms of numbers of passengers this is almost two times the capacity of light rail.

7. Demand Responsive Transport

Demand Responsive Transport (DRT) mainly concerns transport with minibuses to serve scattered demands in rural environments; c.f. Mageean, Nelson (2003, van Nes (2002). The routes and the deployment of vehicles are planned in response on requests entered by telephone.

There are various forms of DRT. *Dial-a-ride* transport is the most flexible. There are forms with main routes and with fixed stops. Responding on demands, busses may deviate from a main route to pick-up or put down passengers and, after this, return to the main route. There are systems for *telematics-based DRT services*, which respond quickly on demands and try to optimise the deployment of the fleet.

8. Suggestions for the design of public intercity transport

Learning from the success of the private car, the world of IC and the success of modern real-time logistics, table 1 shows the resulting indications for the design of future public intercity transport.

Table 1. Heuristics indications for the design of public intercity transport

Private car	Indications for public intercity transport
Reliable, unconditional access to fast mobility	<ul style="list-style-type: none"> • High driving frequencies, or quick service on request • Stops on short distances from desired departure and arrival points • For individual traveller, no detours and no intermediate stops • Travel times all-in shorter than private car, parking included • Certainty about back travel
Comfort, privacy and control over travel environment	<ul style="list-style-type: none"> • Comfortable, automatically adjusting chairs • Environment for digital information providing and amusement • Direct connections without change over
Suitable for family or group travelling	<ul style="list-style-type: none"> • Option to book several neighbouring seats in the same vehicle • Facilities for travelling kids
IC world	
Integrated in communicative life style	<ul style="list-style-type: none"> • Booking via Internet and intelligent mobile telephone • Identification and financial settlements via personal smart cards • Compatible with active metropolitan life style
Response on demand	<ul style="list-style-type: none"> • Anticipating deployment of vehicles, using dynamical statistics • Anticipating response on public happenings
Co-ordinated autonomy of actors	<ul style="list-style-type: none"> • Autonomously operating vehicles, prevents system failures • Overall co-ordination promoting quality of service and efficiency
Modern logistics	
Service dynamics: service on four types of stations	<ul style="list-style-type: none"> • Intercity stations with parking and change over facilities • Stationary local stop places • Demand related varying local stop places
Demand intensities and selection of assortment	<ul style="list-style-type: none"> • Service related to ABC-classification and minimal requirements on service providing • Balance between differentiation of service and demand intensities
Concept	<ul style="list-style-type: none"> • Combination of collect-sprint-disperse and line-hub-spoke
Production on stock or on demand	<ul style="list-style-type: none"> • Serve minimal required service level with fixed schedule • Serve A-segment largely on the basis of demand forecasts • Serve other demand on request
Logistic control	<ul style="list-style-type: none"> • Capacity planning, using aggregated demand forecasts • Real-time operations planning on combined deployment of vehicles and allocation of seats

It is clear that the quality offered by the private car can't be beaten in all respects. However, transport "new style" scores on aspects such as availability, speed, comfort, and social integration. An important point is that changing over must be avoided. It is experienced as an infringement of traveller's privacy and control on his travelling.

The current ICT offers special means to implement an intelligent customer interface with a booking system, a virtual ticket market and with an interactive travelling supporting system. The leading idea is to define a service, which gives unconditional, reliable access to personalised, fast intercity transport. The logistical viewpoint gives indications how to arrange the locations and selection of stops, how to serve strongly varying demands, which transportation concept is to be preferred and how to control the operations.

9. The concept Fast Transport on Request

It is natural to combine the systems of *BRT* and *DR* and add a few elements related to the structuring of the routes, the intercity travelling speed, the availability via an intelligent customer interface and the personalised service.

On the distances between the main urban centres the driving times can be shortened by driving fast on dedicated, specially protected lanes called *sprint tracks* with separate (parallel) halting lanes. With proven technology, busses can be constructed safely driving 180 km per hour. Sprint tracks are reserved for qualified vehicles. Of course, driving at normal speeds, such vehicles also can be used on public roads. To be allowed to drive on a sprint track, a car must be equipped with a system for lateral stabilisation, a system to follow a virtual roadmap and with an intelligent cruise controller. However the driver will stay fully responsible.

Travelling can be shortened by reducing the number of intermediate stops and by avoiding making detours. To issue such special trips, the planning system needs information on the demand. This information can be deduced from real-time forecasts, but above all from requests to be served, entering via Internet and telephone. Clearly a booking system is a natural apparatus to improve the service level and therefore has to be the core of and intelligent customer interface.

Also it is clear that an Internet customer interface with an intelligent booking system will improve the availability of public transport to be offered. With this one may select appropriate departure and destination stops and desired timing. One has the choice to book “on-timing” or “on-last-minute”. The customer interface supports a virtual ticket market. Reservation can be cancelled or transferred to others. One may book a series of trips. In this way, using the year calendar, one may book an optional forensic series. Another service offered by the customer interface is, that on traveller’s request, a connection with local transport system may be arranged.

To offer (at least for the “A-segment”) intercity travelling without need to use local public transport and, at the same time, to avoid intermediate stopping and to exclude making detours, operating according to the *collect-sprint-disperse* concept is appropriate. Supplementary (for the “C-segment”), travelling according the *line-hub-spoke* concept may be acceptable.

Crucial is the role of the logistic control system. It produces real-time updated demand forecasts. It discovers patterns in travelling requests, for instance on forensic and recreational travelling and may propose to open or close stops (temporarily). An important task is to group incoming travel requests, to deploy vehicles assign seats, in such a way that, travelling on the sprint tracks, there never will be more than one intermediate stop, at least for trips in the “A-segment”.

To provide personalised travel services, the traveller must have a unique code to identify himself. This can be arranged with the help of a *personal responsive smart card*. On request the system may guide the traveller during his trips. Another aspect is traveller’s comfort during the trip. The vehicles may be equipped with seats which adjust them self automatically to traveller’s profile. Each seat is equipped with digital facilities for communication, radio and television. Thus we arrive at the characteristics presented in table 2:

Table 2. Characteristics of Fast Transport on Request (FTR)

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- For the transport between the cities, there are dedicated and protected tracks (sprint tracks) for fast driving cars, which are connected with (dedicated) local road networks.
 - Trips have to be booked via Internet or telephone, which can be done “on-timing”, “on last-minute”, or as “option”. The booking system is connected with a virtual ticket market. One may book bundles of trips and “connected tickets”.
 - An operations control system clusters the travel requests, deploys the vehicles and allocates the seats, such that travellers never will make a detour and such that intermediate stops are avoided.
 - The vehicles are equipped with digital facilities and comfortable seats, which adapt themselves automatically to the profile of the traveller.
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Characteristic is the application of advanced technology in vehicles, traffic control and communication. Remarkable is the rigorous integration of the words of public transport, cyberspace and system intelligence, aimed to offer a quality which can compete with the use of the private car.

10. An example

Figure 2 shows an example of a hypothetical FTR-connecting between the Hague, Leiden, Amsterdam, Almere and Lelystad-Airport, with a branch connecting Haarlem with Amsterdam, Almere and Lelystad-Airport.

The halts in Den Haag, Leiden, Haarlem, Hoofddorp, Almere and Lelystad-Airport give integration with one or more local routes. The intelligent trip control system clusters the travel requests, deploys the vehicles and allocates the seats, such that travellers never will make a detour and such that intermediate stops are avoided. For example: a traveller who wants to go from “Den Haag-1” to “Almere-3” will follow the main track without deviation and, normally, making no more than one intermediate stop on this main track.

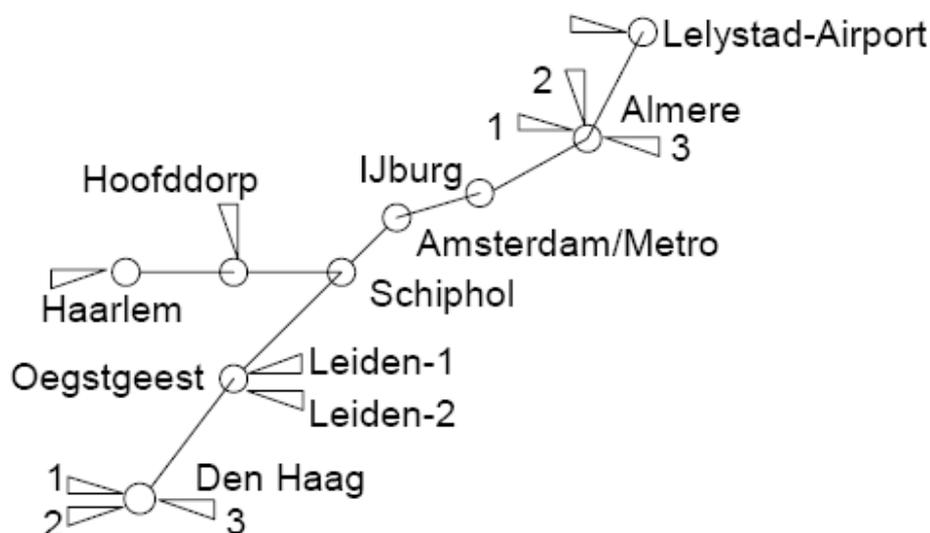


Figure 2. Example of an FTR-connection centred around Amsterdam

11. Feasibility

In a first approach the feasibility has been scanned on the basis of public studies on the construction of a fast connection between Amsterdam Airport and Groningen, in the north-east of the Netherlands, covering a distance of 185 kilometres. This connection counts six intermediate stations.

The governmental Project Organisation ZZL studied the intercity train, the TGV and the magnet hover train (MHT) as design options; see Project Organisation ZZL (2005). On this ZZL we projected FTR, operating according to the collect-sprintdisperse concept, where the busses are supposed to have 50 seats and to drive, on the sprint tracks, 180 kilometres per hour; see Evers (2005), Consortium FTR (2006)

It appears that for at least 80% of the travellers, FTR is faster than MHT and offers average frequencies of 10 to 4 times per hour. The estimates of the investment and exploitation costs are deduced from figures from the report *Cost Indicators of Public Transport* from the Ministry of Transport, Netherlands, c.f. CVOV (2005). The most important results are summarized in table 3.

Table 3. Results of the feasibility scan FTR

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- On the average, high frequencies are possible with high degree of occupation of the sprint cars.
 - The travel times all-in are much shorter than those of the private car.
 - The productivity of the vehicles is extremely high (because of high speed and high occupation).
 - The exploitation costs are lower than the conventional bus transport.
 - The cost of the sprinttracks is much lower than the costs of railways.
 - Since (driving at normal speeds) the sprint cars may use normal roads, the infrastructure can be constructed gradually.
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For a new concept such as FTR extensive R&D is needed to elaborate and to verify the technology, the logistic control system, the safety aspects and the societal acceptance. People are not used to book their daily travelling, but the unique buying reasons are that travelling with FTR is cheap, fast and “tailor made”.

12. Conclusions

The success factors of the private car are its reliable, unconditional access to fast mobility, combined with its comfort, privacy and control on travel environment. From the modern IC-world we see de rise of unprecedented technological possibilities which enables a communicative life style. Logistically, we see that the modern approach is serving on demand, enabled by an Internet customer interface.

These viewpoints suggest that callable, “tailor made”, transport with fast busses is the appropriate form of intercity transport. Thus, it is natural to combine the systems of *BRT* and *DRT* and add a few elements related to the structuring of the routes, the travelling speed, the availability via an intelligent customer interface and the personalising of the service. This leads to the concept *Fast Transport on Request*.

Explorative feasibility studies on a fast connection between Amsterdam Airport and Groningen, in the north-east of the Netherlands show promising results. R&D is needed to elaborate and to verify the technology, the logistic control system, the safety aspects and the

societal acceptance. People are not used to book their daily travelling, but the unique buying reasons are that travelling with FTR is cheap, fast and “tailor made”.

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