interconnectivity, passenger transport integration

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TYPES OF SOLUTIONS IMPROVING PASSENGER TRANSPORT INTERCONNECTIVITY

Summary. The objective of the paper is to present different types of solutions which could improve interconnectivity of passenger transport especially within interconnections between long and short transport distance. The topic has particular relevance at the European level because the European transport networks' role as integrated international networks is compromised by poor interconnectivity and because the next generation of European transport policies will have to be sensitive to the differences between short, medium and long-term transport markets and the market advantages of each transport mode. In this context, a realistic assessment of intermodal opportunities is a key ingredient to future policy development.

Effective interconnection requires the provision of integrated networks and services which are attractive to potential users and this is likely to require co-operation between a range of authorities and providers in the public and private sectors and may necessitate a wider vision than might otherwise prevail.

The paper is based on the results of the project realised by the team of the University of Gdansk in the EU funded 7 Framework Programme - INTERCONNECT (Interconnection between short- and long-distance transport networks) with partners in the UK, Germany, Denmark, Poland, Spain and Italy. Different types of solutions will be summarized in the paper including e.g. local link infrastructure solutions, improved local public transport services, improvements at the interchange, solutions involving improved procedures for check-in or luggage transfer & documentation, pricing and ticketing solutions, solutions involving marketing, information and sales.

TYPY ROZWIĄZAŃ POPRAWIAJĄCE INTEGRACJĘ TRANSPORTU PASAŻERSKIEGO

Streszczenie. Celem artykułu jest zaprezentowanie różnych rodzajów rozwiązań, które mogą poprawić integrację w transporcie pasażerskim, szczególnie w aspekcie powiązań między transportem długiego i krótkiego zasięgu. Zagadnienie to ma szczególne znaczenie na poziomie europejskim, ponieważ rozwój europejskich sieci transportowych może być blokowany przez złe powiązania, a również dlatego, że w przyszłości cele europejskiej polityki transportowej będą musiały być w coraz większym stopniu wrażliwe na zróżnicowanie rynków transportowych różnego zasięgu oraz na korzyści uzyskiwane z funkcjonowania gałęzi transportu. W tym kontekście realistyczne podejście dla potencjalnych możliwości powiązań międzygałęziowych wydaje się być istotnym elementem przyszłego rozwoju polityki transportowej UE.

Efektywne połączenia międzygałęziowe wymagają odpowiedniej sieci transportowej i usług, które są atrakcyjne dla potencjalnych użytkowników, czego z kolei nie można zapewnić bez współpracy między władzami a operatorami na rynku transportowym zarówno w sektorze prywatnym, jak i publicznym.

Artykuł powstał na bazie wyników projektu INTERCONNECT (Interconnection between short- and long-distance transport networks), w którego realizację włączeni byli autorzy. W projekcie partnerami były instytucje z 6 krajów europejskich. W artykule dokonano zestawienia najważniejszych rozwiązań usprawniających powiązania międzygałęziowe w transporcie pasażerskim, począwszy od rozwiązań w zakresie lokalnych połączeń infrastrukturalnych, poprzez poprawę lokalnych usług transportu publicznego, usprawnienia w węzłach przesiadkowych, ułatwienia w zakresie procedur odprawy i transferu bagażu oraz dokumentacji, rozwiązania w zakresie integracji biletowej i cenowej, marketingowe, aż do tzw. rozwiązań usprawniających.

1. INTRODUCTION

Effective integration of passenger transport systems requires good interconnection which cannot be guaranteed without the provision of integrated networks and services which are attractive to potential users. This is likely to require co-operation between a range of authorities and providers in the public and private sectors and may necessitate a wider vision than might otherwise prevail. Moreover, the creation of effective interconnection may sometimes conflict with the priorities of authorities and providers who have hitherto be concerned solely with serving a local constituency.

The paper is based on the results of the project realised by the team of the University of Gdansk in the EU funded 7 Framework Programme - INTERCONNECT (Interconnection between short- and long-distance transport networks) together with partners from five EU countries [1].

One of the key result of the project is the toolkit referring to 94 potential solutions to the problems of poor interconnectivity experienced by long distance travellers whose journeys require them to use short distance "local" mode(s) to commence and/or complete their journeys.

The toolkit comprises:

– a list of 94 potential solutions,
– a brief description of the problems of interconnectivity,
– a discussion of the criteria by which to judge the usefulness of different solutions,
– text descriptions of each of seven categories of solution,
– matrices summarising the usefulness of the 94 identified solutions,
– text descriptions of each of the 94 identified solutions, including examples of their application,
– references and links to more detailed case studies and sources of information.

In the paper short introduction to the toolkit is presented. Solutions are grouped in different thematic areas as it is described in the next sections of the paper.

2. LOCAL LINK INFRASTRUCTURE SOLUTIONS

The local link infrastructure category includes those solutions which seeks to address the problem of inadequate infrastructure for the link between an interchange (such as an airport) and the centre of the city which it serves.

This category of solutions will deal with the question whether, and, if yes, to which extent and under which circumstances, interconnectivity can be improved by either adding new links or enhancing existing links between transport nodes for either the same mode or to better connect different modes. In this group 18 solutions are indentified and enumerated below:

– ferry link,
– Maglev link,

– link into general HRS system,
– dedicated hsr link,
– link into heavy rail system,
– metro / s-bahn link,
– tram link,
– monorail / people mover,
– motorway link,
– park and ride facilities,
– tramtrain or traintram link,
– guided bus link,
– segregated bus lanes,
– in-road bus lanes,
– HOV lanes,
– cycle path link,
– improved maintenance and earlier replacement of public transport infrastructure,
– vehicle or service upgrade for increased comfort and convenience.

The problems which can be solved in this case refers firstly to lack (or inadequate capacity) of connecting links (rail, road, LRT, etc) or to absence /inadequacy of local/regional connection service. The main limitations which can be recognise concerning this kind of solutions can be costs of building and maintaining infrastructure and ooperation costs of services. As example Maglev link to connect major interchanges to city centres can be mentioned. Maglev is faster, quieter and smoother than wheeled trains, but the cost of building a Maglev system is also extremely high. The Shanghai system cost about € 1 billion for 30 km, i.e. € 33 million per km. The last estimate for the planned system for Munich, that was eventually abandoned, was € 90 million per km [2]. Another important issues is that a Maglev system is very unlikely to be profitable. The Shanghai system carries 7,000 passengers per day at a fare of around € 5, but it is not even expected to recoup the building costs during its lifetime, not to talk about the operating costs [3].

In the cases where a bus or coach service between city centre and interchange is, or would be, hampered by congestion, construction of a tram link (light rail running on the road, either mixed in with normal traffic or on segregated tracks) from major interchange to city centre is suggested. The cost Tram projects are also expensive. The Edinburgh tram system that is currently under construction was originally expected to cost in total, for all elements of the project, in the region of € 30 million per km while latest figures indicate that the costs soared to more than € 45 million per km [4]. That solution is used in many European cities and, in almost every case, the trams connect to the main rail station. Many cities have tram networks which serve their airports. Examples include: Bremen [5], Erfurt [6] and Newcastle. Similar links are planned, or under construction, in Edinburgh, Alicante (downtown to HSR station and to Alicante airport) [7] and in Tenerife (the L1 extension).

The same kind of thinking is used in the case of a combination of heavy rail track and urban tram track to allow trams to link major interchanges to city centres. TramTrain operation involves both track-sharing light rail/heavy rail and dual- or multi-mode operation (Heavy rail voltage / Light rail voltage). The track-sharing sections may also include main line heavy rail infrastructure. Usually infrastructure (tracks and stations) is owned by the railway infrastructure owners (DB Netz, RFF, Prorail, Network Rail etc.) and track access and station use charges apply for the light rail operator. TrainTram-operation is reversing the tram-train idea; direct access from the region to city centres is not achieved by bringing the tramway out onto the railway, but by bringing heavy rail vehicles onto the urban tramway or onto a tramway-like alignment. The heavy rail vehicles being used under urban conditions follow tramway regulations [8]. The first and still best known system exists in Karlsruhe, but this and many variants of the original system have been introduced for instance in Saarbrücken, Heilbronn, Kassel, Chemnitz and Geneva and a host of further systems are under consideration or already under construction.

3. IMPROVED LOCAL PUBLIC TRANSPORT SERVICES

This group of solutions concerns improvements to the organisation of local transport services which could be achieved without major investment in new infrastructure. Following solutions can be identified in that area:

- introduction of robust schedules,
- integrated timetabling,
- regular interval timetabling,
- creating hub-and-spoke schedules by adding short 'spokes',
- increased service frequency or capacity,
- service re-routing,
- direct (shuttle or express) services by rail or bus,
- addition of intermediate stops,
- demand-responsive bus service,
- provision of dedicated shared-ride taxi services,
- link into general bus lines,
- shuttle bus links between different interchange points,
- provision of short feeder flights.

Many of the solutions in this section presuppose a substantial degree of local co-ordination and might require 'enabling' measures. Some of these solutions seem to have particularly high potential to improve interconnectivity. Especially integrated timetabling could be mentioned which is a system-wide solution based on clear and consistent rules, such as Taktfahrplan implemented on Swiss Railways since 1982. This solution is applicable when it is deemed important to provide a network of interconnecting transport services (not so relevant where the focus is exclusively on point-to-point journeys. Also increased service frequency or capacity has a great importance since that means increasing the frequency or capacity of any bus, tram, train, ferry or air service which provides the "local" connection in a long distance journey. The solution is applicable when waiting times are long and expected passenger numbers justify the increased level of service. Additionally direct (shuttle or express) services by rail or bus (provision of direct bus or train services between the port or airport and major destinations – typically the downtown) are likely to yield the highest benefit/cost ratios.

4. IMPROVEMENTS AT THE INTERCHANGE

Solutions designed to improve interchanges at choke points are designed to facilitate seamless travel on connection of different modes (at rail stations, airports, ports). Solutions identified as practical tools for improvement of interchanges are as follows:

- additional, conveniently located, car parks,
- convenient positioning of local transport services,
- convenient positioning of taxi services,
- moving walkways,
- elevators and escalators,
- level access to trains and buses,
- visibility axis between modes,
- direct, un-interrupted, logical paths,
- provision of assistance for travelers with reduced mobility,
- tactile guidance systems for disabled
- improved lighting
- increased space and comfort at waiting areas,
- provision of services for travelers,
- train information / tickets at baggage claim area of airports,
- multilingual or pictogram information,
- increased provision of staff,

- provision of monitoring cameras,
- cycle facilities at modal interchanges,
- use of charges and subsidies to reduce congestion at the interchange,
- multi-modal information and ticketing booths.

Generally speaking those tools serve main purpose of making the interchange as little a nuisance to the travelers as possible.Broadly solutions at interchange point could be divided into those which improve infrastructure, those that are aimed at better services and those whose goal is more easily accessible and complete information. The first group aim is to ensure more comfort for travellers and more direct walking paths to reach modes to which traveller switches at the interchange. Second group constitutes actions necessary to make continuation of a journey less troublesome. It includes more ticket stands, ticket machines/booths more easily accessible, visible departure points and actions oriented at making wait time more comfortable (like additional services, shops, food stops etc.). Third group is oriented at making change to other mode easy by providing full information necessary to continue trip (departure times and point, visualisation of paths etc.). Currently a large scale integrated portal to serve this purpose is under development [9].

5. SOLUTIONS INVOLVING IMPROVED PROCEDURES FOR CHECK-IN OR LUGGAGE TRANSFER & DOCUMENTATION

One of the major obstacles to quick change of modes is baggage reclaim procedure and check-in procedures. It is most commonly encountered in interconnections between air mode and other modes providing access to/from airport. Solutions aimed at improving procedures in those two areas could be recognized as:

- at-station passenger check-in for flights,
- in-train passenger check-in for flights,
- full check-in and luggage drop point at airport stations,
- door-to-door luggage transport,
- flight luggage check-in at train stations,
- early issue of luggage labels,
- post-flight luggage collection from local train station,
- RFID tagging for luggage,
- self-service luggage check-in and drop-off.

The above solutions are primarily procedural, but aside for necessary organizational changes they will require some investment in infrastructure and information technology. Both rail station or train check-in (passenger and luggage) for air flight are designed to reduce wait time at the airport. Huge advantage of this solution is also that it necessitates cooperation agreement between airline and train operator which should include provision for late arrival of the train. Thus no-show for flight penalty could be avoided. This solution is however hard to pursue due to security needs. Working examples are exclusive AIRail agreements between Lufthansa and Deutsche Bahn [10]. If departure station or in-train check-in is not possible dedicated check-in could be located directly at the train arrival point within the airport. Another solution is to completely relieve passengers from care of luggage. Airport service could pick up a traveler's luggage at home (or designated station), day before the traveler leaves, and delivers it to the trip destination before the traveler arrives. Working example of this solution could be found in Switzerland [11].

Different solution regarding direct luggage delivery could be used upon arrival. Air passengers' luggage could be routed straight to the destination rail station without it having been "reclaimed" by the passenger at the airport. Speeding up of luggage operations (and thus reducing luggage reclaim waiting times) could be achieved by the use of radio-frequency identification (RFID) chips embedded into luggage tags The use of RFID chips allows also for easy check-in at the departure point – the passenger could check-in his own luggage and drop it off without recourse to assistance from staff.

Those most technically advanced solutions although so far rare nevertheless are used by some carriers – e.g. Quantas Airlines [12].

6. PRICING AND TICKETING SOLUTIONS

Pricing and ticketing solutions are aimed at improving ticket availability and reducing time and effort necessary to obtain tickets for second stage of journey. Actions facilitating ticket purchases could be enumerated:

- pre-paid tickets or cards allowing unlimited local travel,
- simple tariff structure for local transport services,
- provision of integrated tickets for local journeys,
- competitive pricing of integrated tickets,
- integrated ticketing for air and rail as well as within mode,
- pre-booked ticket for parking and public transport,
- integrated ticketing for long-distance rail and local public transport,
- inclusion of local taxi journeys in rail or air tickets,
- smart cards,
- payment via mobile telephone text messages,
- virtual tickets on smart phones.

Some of the solutions oriented on ticketing are technical in nature other demand systemic change as perceived in EU policy documents [13]. For instance possibility to pre-pay tickets or cards should be available through internet services because this is needed for travelers arriving at destination from long distance and willing to use public transport at destination. Alternative possibility to by integrated (for all local public transport) ticket possibly for couple of days should be available at ticket offices at arrival points. Integrated ticket could be in form of traditional ticket or electronic smart card – the latest facilitates multiple use as ticket could be checked in various vehicles by contactless reading of the card [14].

Integrated ticket for local public transport should be also competitive against sum of single tickets – price has to be lower than price of separate tickets for consecutive stages of journey in order to attract users. Another problem is need to differentiate ticket based on zones/distance travelled – more zones mean more complicated tariff and reduces usability of integrated ticketing. Apart from integrated ticketing on local (short distance) transport a solution really improving interconnectivity is ticket covering both long and short distance legs of journey. Common ticket for rail-public transport or air-public transport is always welcome by users. It is however hard to achieve due to the problem of revenue distribution between different transport companies. Similar solution is inclusion of taxi fare in long distance ticket price – this is achieved by cooperation between airlines and taxi companies and could be found in some cities (e.g. Vienna). Nowadays improvements in mobile phone design and capabilities enable another solution - introduction of electronic ticket purchased via text messages or virtual tickets on smart phones.

7. SOLUTIONS INVOLVING MARKETING, INFORMATION AND SALES

Travellers make decisions on the basis of their perception of the travel options available to them. However, their awareness of multi-modal opportunities tends to be poorer than that of mono-modal opportunities because, for institutional reasons, the relevant information is usually provided mode-by-mode or service-by-service. It is not sufficient simply to provide factual information about interconnections (though this is better than not doing so). The information has to be accessible and to command attention.

In the absence of accessible information about multi-modal, or multi-operator, opportunities, travellers have to make extra effort to plan journeys using such services and, quite naturally, they tend to choose options which are more widely publicised. Effective interconnectivity is thus stifled when

information about interconnecting services is poor and when publicity focuses on individual modes and services.

This group of solutions concern the marketing of the components of long distance journeys. It includes branding, the provision of information and new sales channels. The idea being that this will make a multi-leg journey easier to plan and execute and will help users identify and access the most appropriate options for their journey. Following solutions can be identified in that area:

- common information design guidelines across operators,
- uniform branding and marketing across operators,
- pre-trip marketing of connecting services,
- en-route marketing of connecting services,
- pre-journey information about interchanges,
- 'one stop shop' multi-modal journey planner – national,
- 'one stop shop' multi-modal journey planner – international,
- local transport ticket sales via internet,
- smart cards,
- payment via mobile telephone text messages ,
- virtual tickets on smart phones.

Some of solutions will be presented more detailed below. For instance common information design guidelines across operators is to facilitate the access to information for passengers. Inconsistent approaches to information provided by different operators making it difficult for travellers to understand the information being provided and to recognise opportunities for multi-modal trips. This is associated with the fragmented nature of the operating environments within which long distance intermodal journeys take place. Development of best practice and standard design/content guidelines will ensure consistency of information between multiple operators. This measure is focussed on ensuring a certain degree of uniformity in information/marketing design and content but does not require individual operators to give up or diminish their own brand. As a good example such guidelines is "Good Practice Guide for providing information to passengers" prepared by the UK Association of Train Operating Companies (ATOC), in partnership with the infrastructure manager (Network Rail) and passenger representatives (Passenger Focus), first published in 2007 and subsequently reviewed at yearly intervals [15]. This document sets out mandatory and advisory guidelines covering information off station (pre-trip), on station (wayside) and on train (on-board), which train operating companies are now expected to follow.

Another tool is solution based ob the uniform branding and marketing across operators. This solution can be applicable when incorporation of the services are provided by distinct yet complementary operators under the umbrella of a single brand, marketing strategy and information channel. Although individual operators may retain their individual brand and most of their marketing functions, it is envisaged that the collective brand is given more prominence. To give some examples the following could be enumerated:

- Multimodal travel planning websites (e.g. SBB, Transport direct)
- Multimodal operator's websites (e.g. National Express)
- High profile marketing of linking service (e.g. Heathrow Link, Gatwick Shuttle) with targeted advertising at airports, in in-flight magazines, via air line booking websites etc.

To reduce the difficulties and inconvenience involved in purchasing local transport tickets four solutions are proposed - local transport ticket sales via internet, smart cards, payment via mobile telephone text messages and virtual tickets on smart phones. An electronic ticket in the form of smart card equipped with a memory chip to enable use of a range of different transport services (and other services). Card can be re-loaded with credit or a new, pre-loaded, card can be purchased. Price of travel is deducted by swiping the card – or contactlessly reading it. The introduction of smart cards provides highly accurate passenger-trip information which can be used for patronage monitoring, marketing and network planning. As examples of such solution can be mentioned OV-chipkaart in the

Netherlands, the Oyster card in United Kingdom, YTV Greater Helsinki card or Opencard in Prague - Prague Public Transport Season Ticket and Payment for Parking in Prague.

8. ENABLING SOLUTIONS

The interventions discussed in this group do not provide a complete solution to problems affecting end users. Rather, they seek to facilitate the implementation of solutions by reforming aspects of the operating environment. Many of the impacts of these solutions would come about indirectly – because some other development is facilitated. In this category we will have such solutions as:

- introduction of a single strategic authority,
- voluntary partnerships,
- intermodal agreements,
- relaxation of antitrust laws,
- increase competition where little or none exists,
- strengthened independent regulation,
- tendering/franchising/concessioning,
- serial motorway concessions en route to major ports/airports,
- joint management of car parks and serial transport services,
- price regulation for serial rail concessions,
- coordination between local public transport operators and long distance rail providers,
- coordinated policy for management of an interchange's access modes,
- System for fair distribution of ticket revenue.

The aims of these kind interventions are to bring together the various governmental decision-making bodies into a single strategic authority, such as in London, Paris and several German regions (e.g. Frankfurt). Voluntary arrangements amongst authorities and other stakeholders belong to this group. The main purpose is to come together in an effort to promote a strategy and to combine resources. Many examples of partnerships to enhance provision of public transport exist in Europe. For example, in Finland, government fosters voluntary co-operation (e.g. by co-funding projects to promote co-operation on ticketing systems), and in the UK, several Rural Transport Partnerships exist, with the aim of improving access to public transport in rural areas.

For this category of solutions to a large group practices related to market regulation, particularly agreements that may be made between the various stakeholders in this market. Often too restrictive legislation to prevent cooperation and that is to the detriment of passengers. Therefore, intermodal agreements and the relaxation of antitrust laws, as well as new forms of cooperation are mentioned as useful tools.

Another kind of solutions are connected with coordination between local public transport operators and long distance service providers. Un-coordinated provision of services and of prices leading to higher prices and less attractive services for journeys involving local public transport and long distance one. The general idea is that coordination would allow prices to be set, and services scheduled, so as to encourage travelers to use a combination of the long distance rail and local public transport services.

9. CONCLUSIONS

Suggested solutions can impact interconnectivity in a different way. Therefore it is interesting to assess the influence in a coherent method. Within the INTERCONNECT project the solutions have been assessed against a number of criteria [16]:

- indicative cost of implementing the solution

– technical feasibility
– financial feasibility
– organisational/legal feasibility
– acceptance by users
– other aspects of political acceptability (in addition to expected acceptance by users)
– impact on users' door to door travel time
– impact on users' door to door travel cost
– initial impact on comfort or convenience of the users' journey
– any detectable increase in users' safety
– any detectable increase in users' personal security
– any detectable increased access for people with reduced mobility (including those with
– physical disabilities or infirmities, those carrying heavy luggage and those accompanied by young children).

Detailed analysis of the impact is presented in the matrices in one of the major deliverables of the project [16].

The local link infrastructure category includes solutions addressing the problem of inadequate infrastructure for the link between an interchange (such as an airport) and the centre of the city which it serves. The question of financial feasibility is very important for many of these solutions. The initial investment by government (local, regional, national or supranational, a special purpose authority, or the private sector, will generally be recouped by usage charges which are met, directly or otherwise, by end users. The assessment of overall financial feasibility is based on a judgement as to whether the initial and ongoing costs could be recouped in this way.

The local transport services category includes those solutions which concern improvements to the organisation of local transport services which could be achieved without major investment in new infrastructure.

The category labelled improvements at the interchange point includes those solutions which address problems experienced at the modal interchange point (e.g. within airports or at major rail stations or ports). It includes improvements to infrastructure which will facilitate movement within the interchange facility, design details which should make movement easier and quicker, and other interventions designed to make the time spent within the interchange more pleasant or productive. Some of these solutions, e.g. car parks and traveller facilities, may generate revenues, but most do not – except indirectly in so far as they might contribute to the attractiveness of the interchange. Their financial feasibility may thus be an issue.

A special category is included for solutions which concern check-in and luggage transfer. Although primarily procedural, all will require some investment in infrastructure and information technology. Even where they do not directly generate additional revenue, the financial case for them may be based on the fact that they may attract additional passengers.

Ticketing and pricing solutions concern the provision of integrated pricing and/or ticketing for the individual components of long distance journeys. The idea being that this will make a multi-leg journey easier to understand, plan and execute. The general justification for providing "seamless" journeys is that it would reduce the effort involved in making such journeys.

A distinct group of solutions involving marketing, information and sales was identified and includes branding, the provision of information and new sales channels. The idea being that this will make a multi-leg journey easier to plan and execute and will help users identify and access the most appropriate options for their journey.

A final, rather different, category of interventions was identified comprising enabling solutions which, while not providing a complete solution to problems affecting end users, seek to facilitate the implementation of more specific solutions by reforming aspects of the operating environment. Many of the impacts of these solutions would come about only indirectly – because some other development is facilitated. These enabling solutions generally involved regulatory or organisational changes.

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