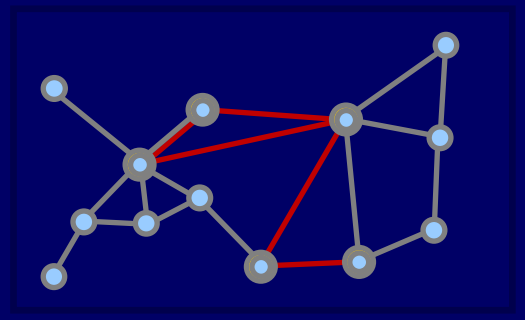
Network connections, multimodality, intermodality



Transport networks 6.
András Gulyás PhD habil
associate professor

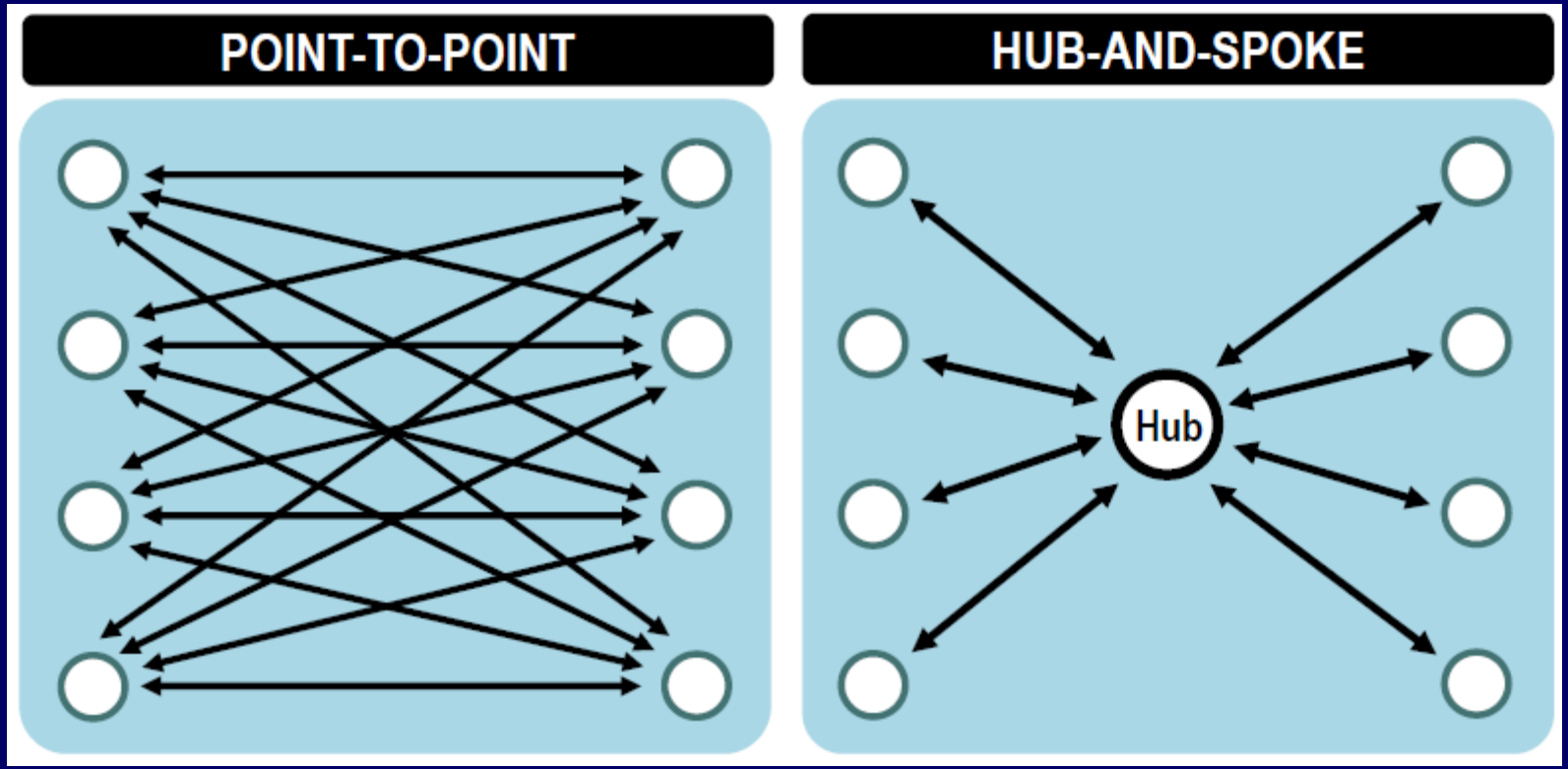
Content

- Importance of network connections
- Multimodality and intermodality
- Design of intermodal interchanges
- Types of intermodal interchanges
- Examples of intermodal interchanges in the world
- Examples of intermodal interchanges in Hungary

Importance of network connections

- **Within transport networks, connections among parts of the network and among various transport modes provide the possibility for a continuous movement, travel and freight.**
- **Connection points are extremely important for smooth traffic operation, providing transfer of passengers and freight.**
- **Network connection points often includes non-transport functions as well, such as trade, services, storage, etc.**
- **Co-ordination in space and time is essential for network connections.**

Importance of network connections

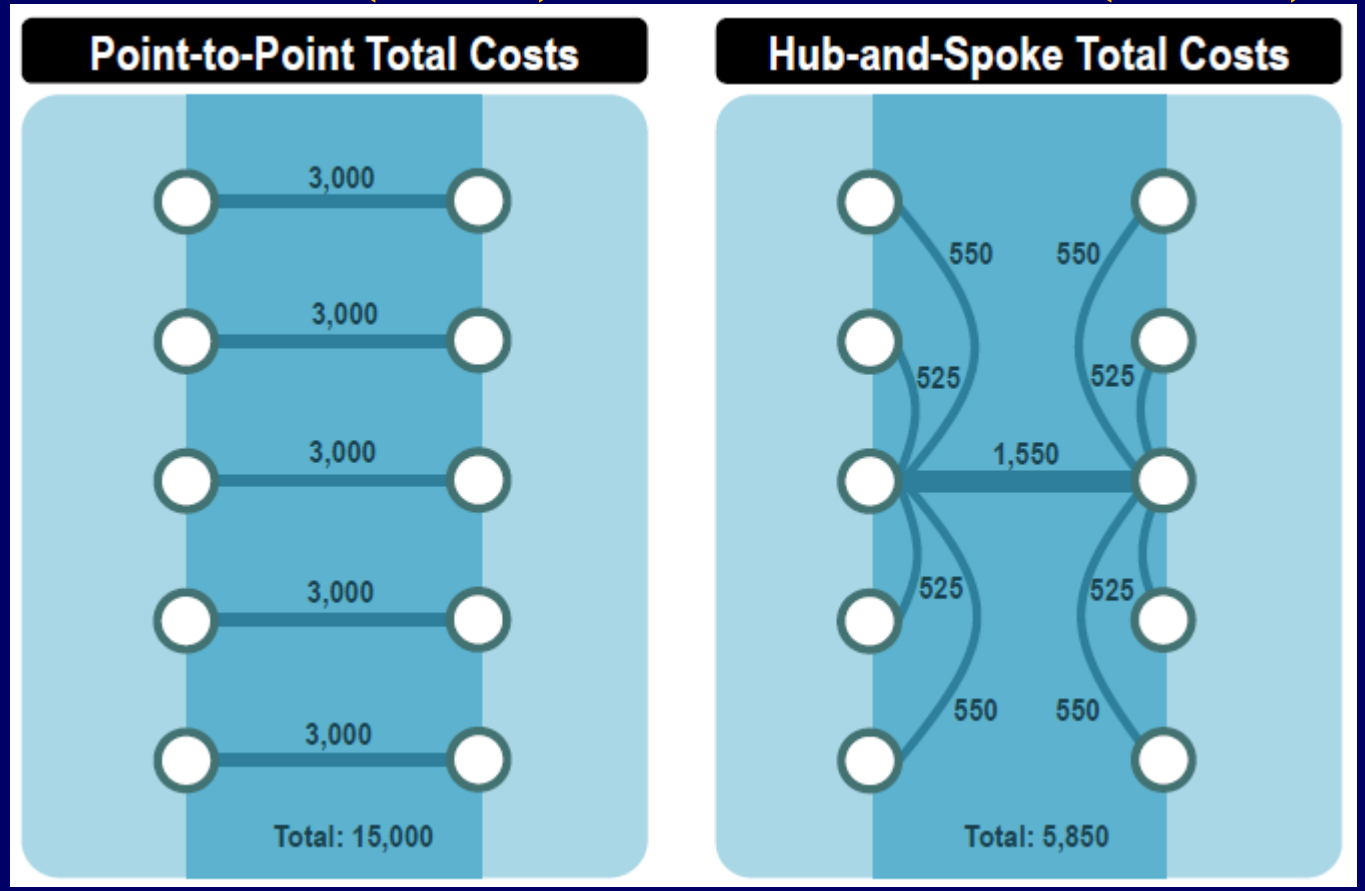


Source: Rodrigue, J-P et al. (2020) The Geography of Transport Systems, Hofstra University, Department of Global Studies & Geography, https://transportgeography.org/

Importance of network connections

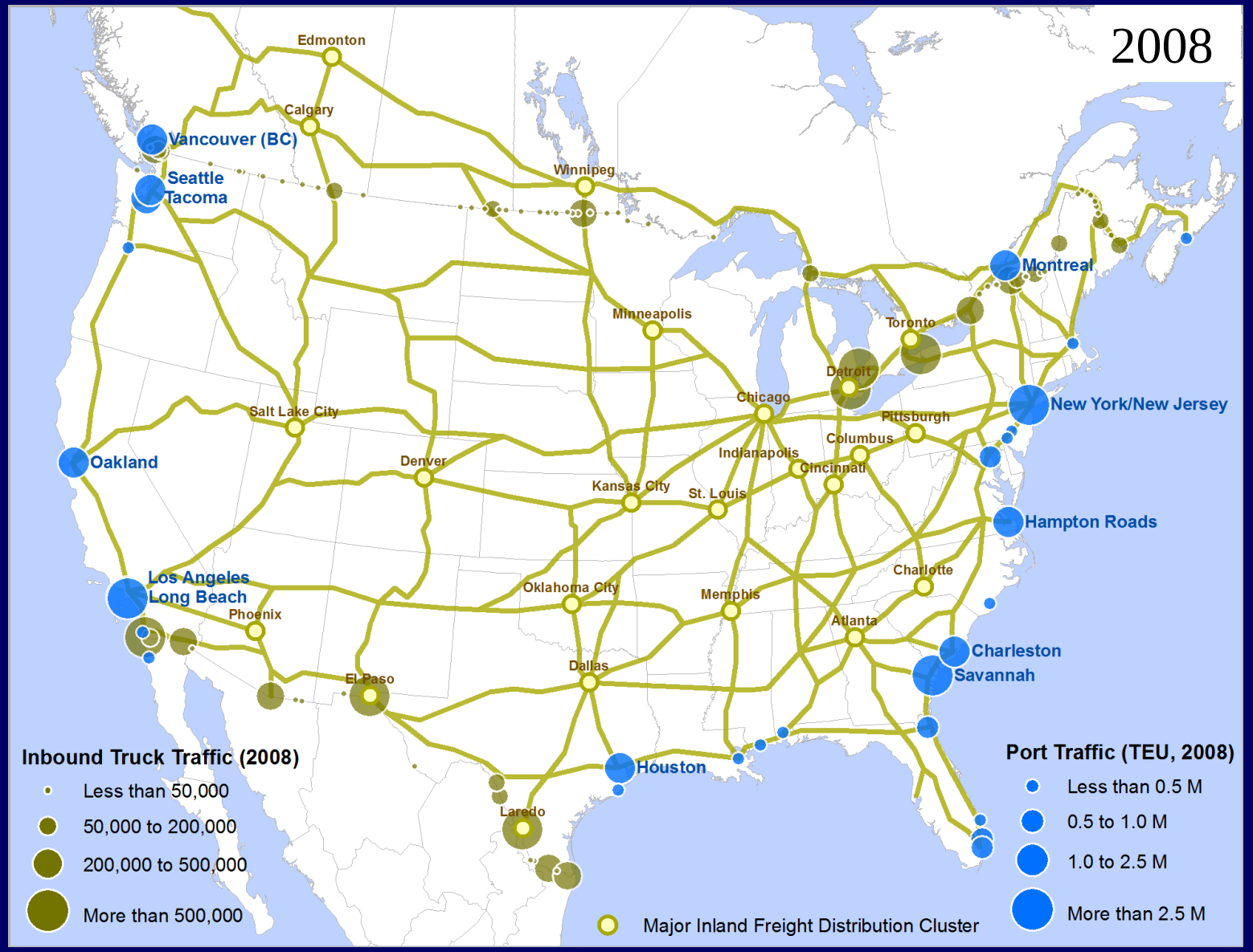
Cost Structure of Point-to-Point and Hub-and-Spoke Networks

15000 (100%) **5850 (32.5%)**



Source: Rodrigue, J-P et al. (2020) The Geography of Transport Systems, Hofstra University, Department of Global Studies & Geography, https://transportgeography.org/

Freight corridors and interchanges in the USA



Multimodality and intermodality

- **In the field of freight, multimodal transport is defined as the use of several modes of transport to convey goods to their final destination.**
- **In the field of passenger transport, multimodality is the use of different modes for different trips (i.e., by bike to work and by taxi ti the theatre).**
- **Multimodal corridors and networks combine various transport modes operated spatially at the same place or connected places.**
- **In a multimodal junction, connections of different transport modes are present together, forming a continuous network.**

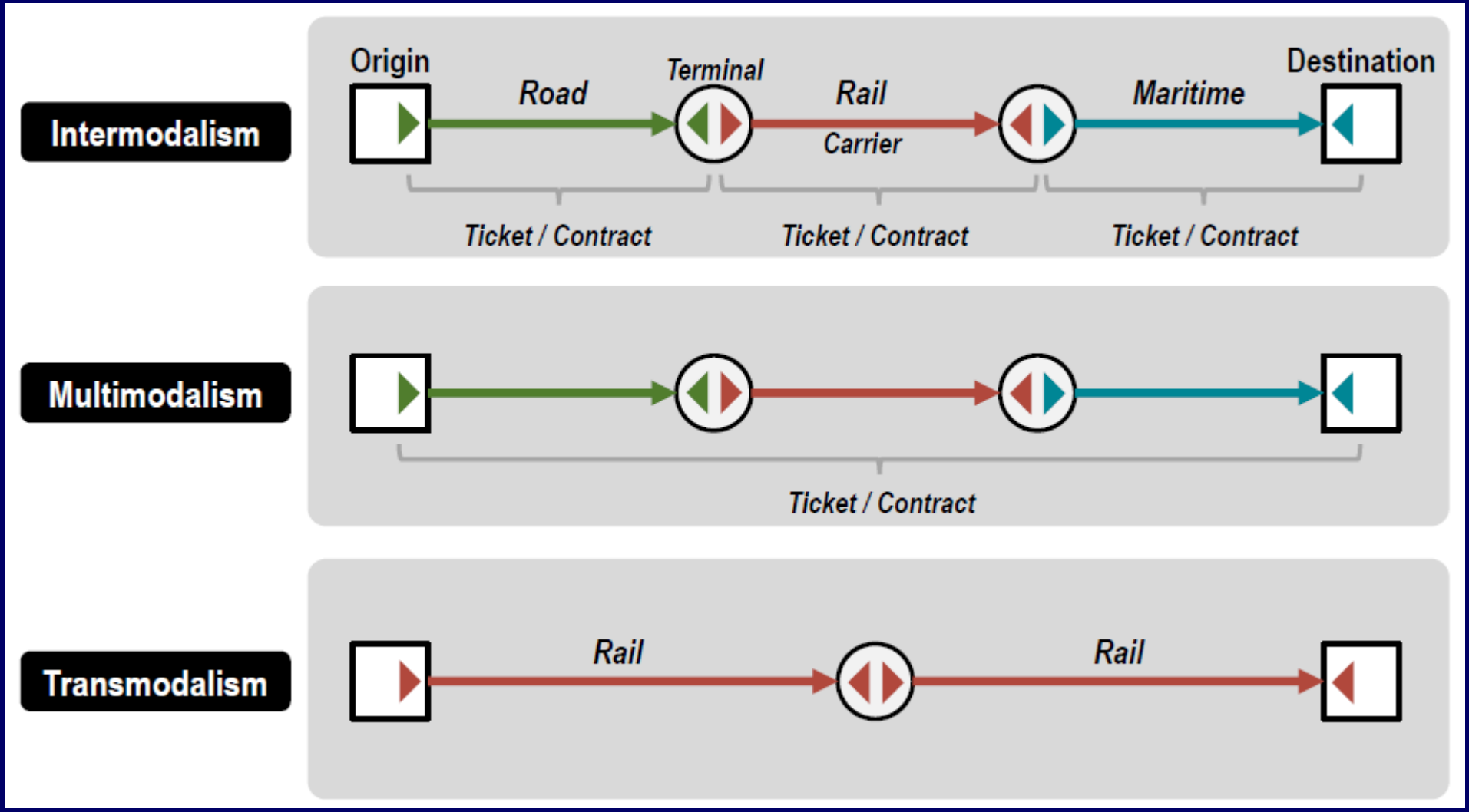
Source: http://www.epomm.eu/newsletter/electronic/0711_EPOMM_enews_HU.php (EPOMM = European Platform on Mobility Management http://www.epomm.eu/index.php)

Multimodality and intermodality

- **Intermodal passenger transport, also called mixed-mode travel, involves using two or more modes of transportation in a trip or trip chain. An example of intermodality is the P+R)parking at the station and using a public transport vehicle).**
- **Intermodal interchanges are places where the modes of transport are changed and combined during one trip (i.e., between city public transport and train at a railway station).**
- **Co-modality has been defined by the European Commission. Co-modality is a notion to achieve an optimum in the transport system by an efficient use of all modes (including intermodality and multimodality)**

Source: http://www.epomm.eu/newsletter/electronic/0711_EPOMM_enews_HU.php (EPOMM = European Platform on Mobility Management http://www.epomm.eu/index.php)

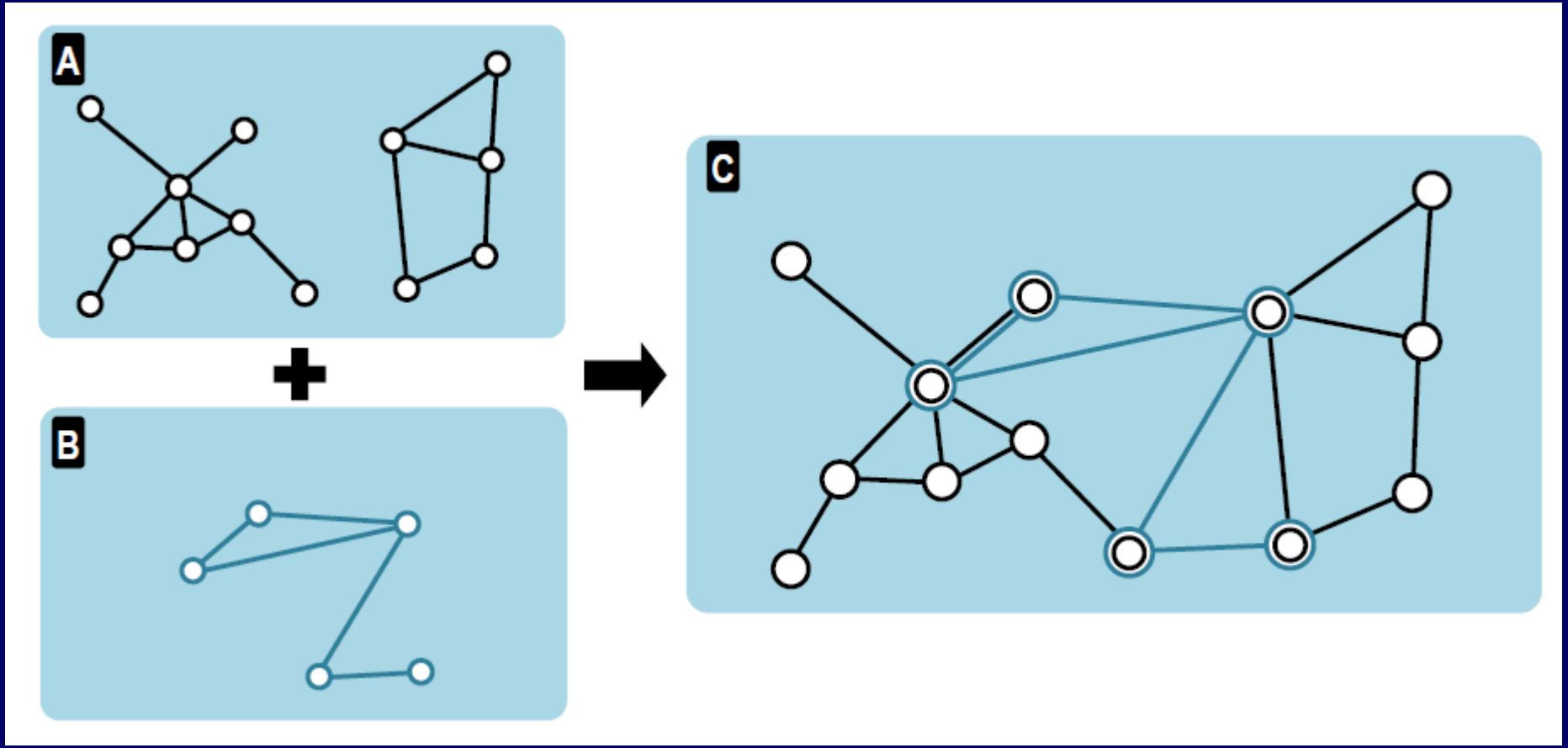
Multimodality and intermodality



Source: Rodrigue, J-P et al. (2020) The Geography of Transport Systems, Hofstra University, Department of Global Studies & Geography, https://transportgeography.org/

Multimodality and intermodality

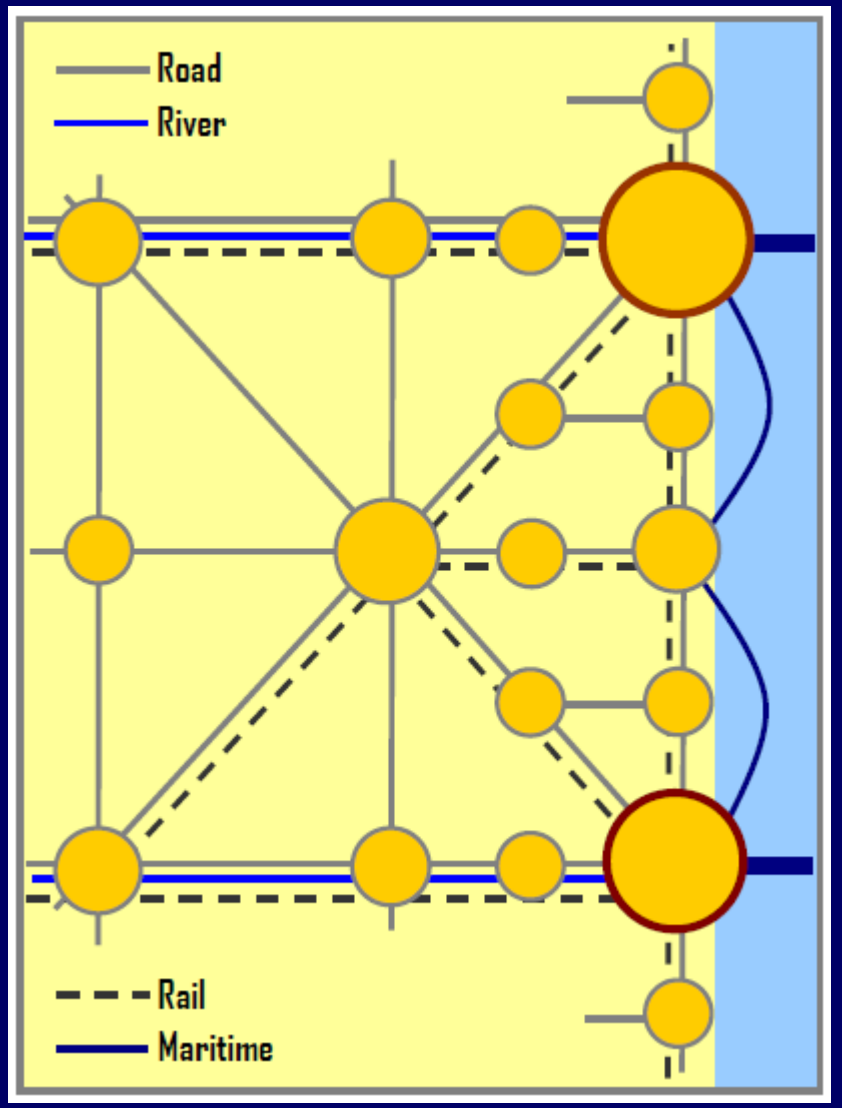
„A” mode + „B” mode = „C” network (spatial continuity)



Source: Rodrigue, J-P et al. (2020) The Geography of Transport Systems, Hofstra University, Department of Global Studies & Geography, https://transportgeography.org/

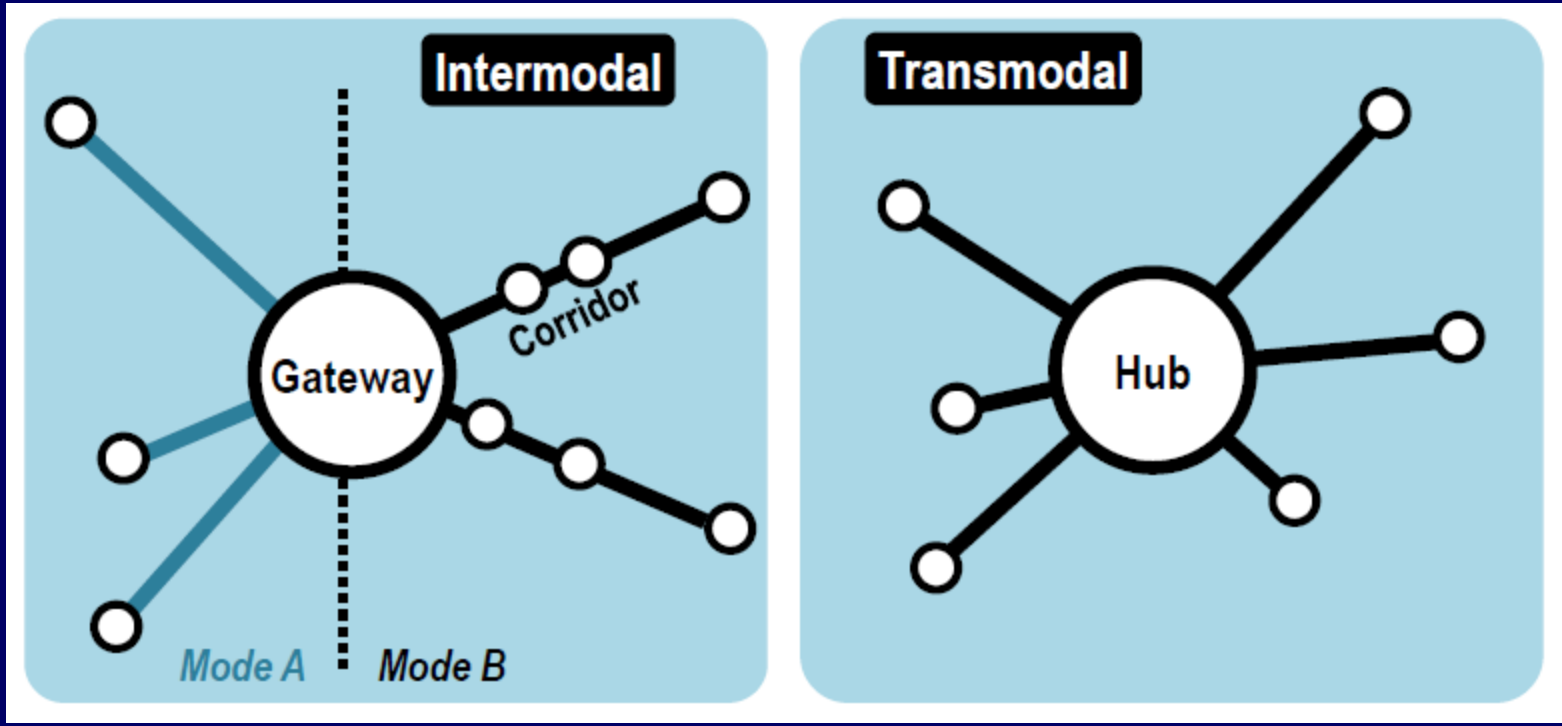
Multimodality and intermodality

Modal Corridors in Mega Regions



Source: Rodrigue, J-P et al. (2020) The Geography of Transport Systems, Hofstra University, Department of Global Studies & Geography, https://transportgeography.org/

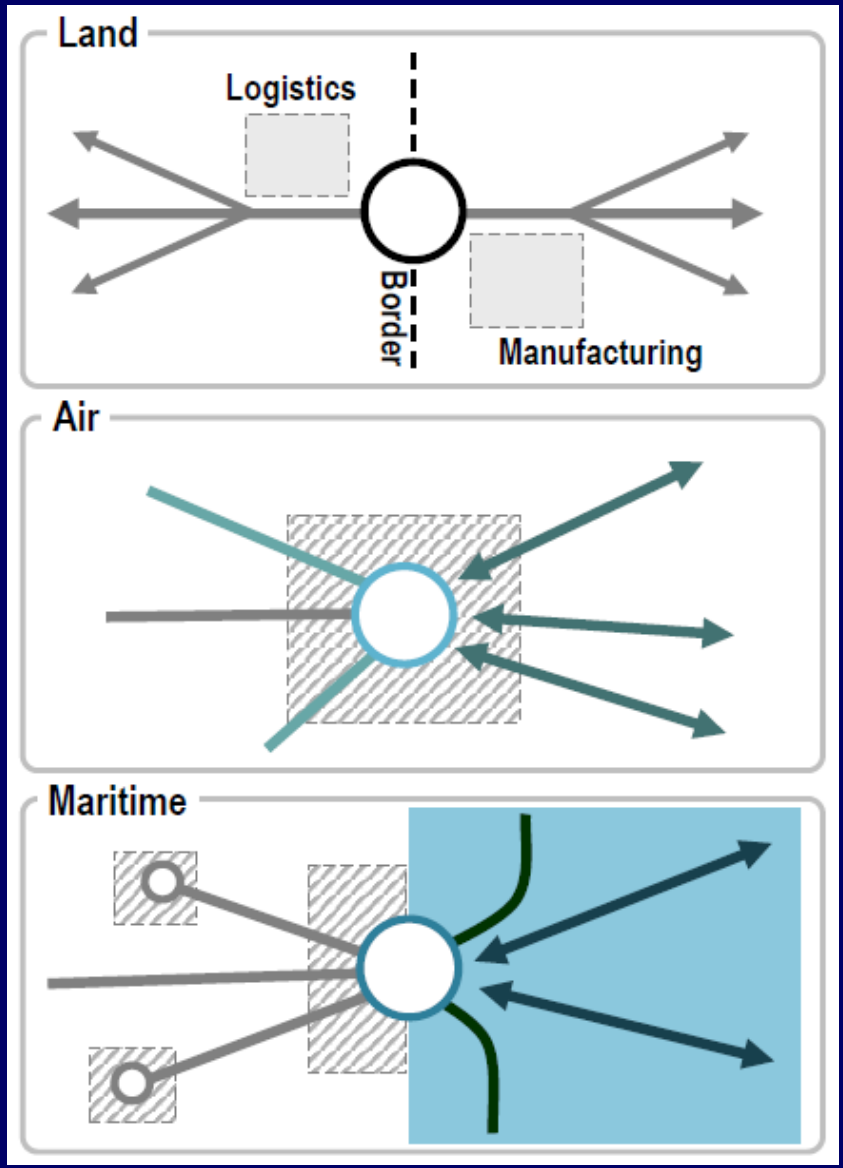
Multimodality and intermodality



Source: Rodrigue, J-P et al. (2020) The Geography of Transport Systems, Hofstra University, Department of Global Studies & Geography, https://transportgeography.org/

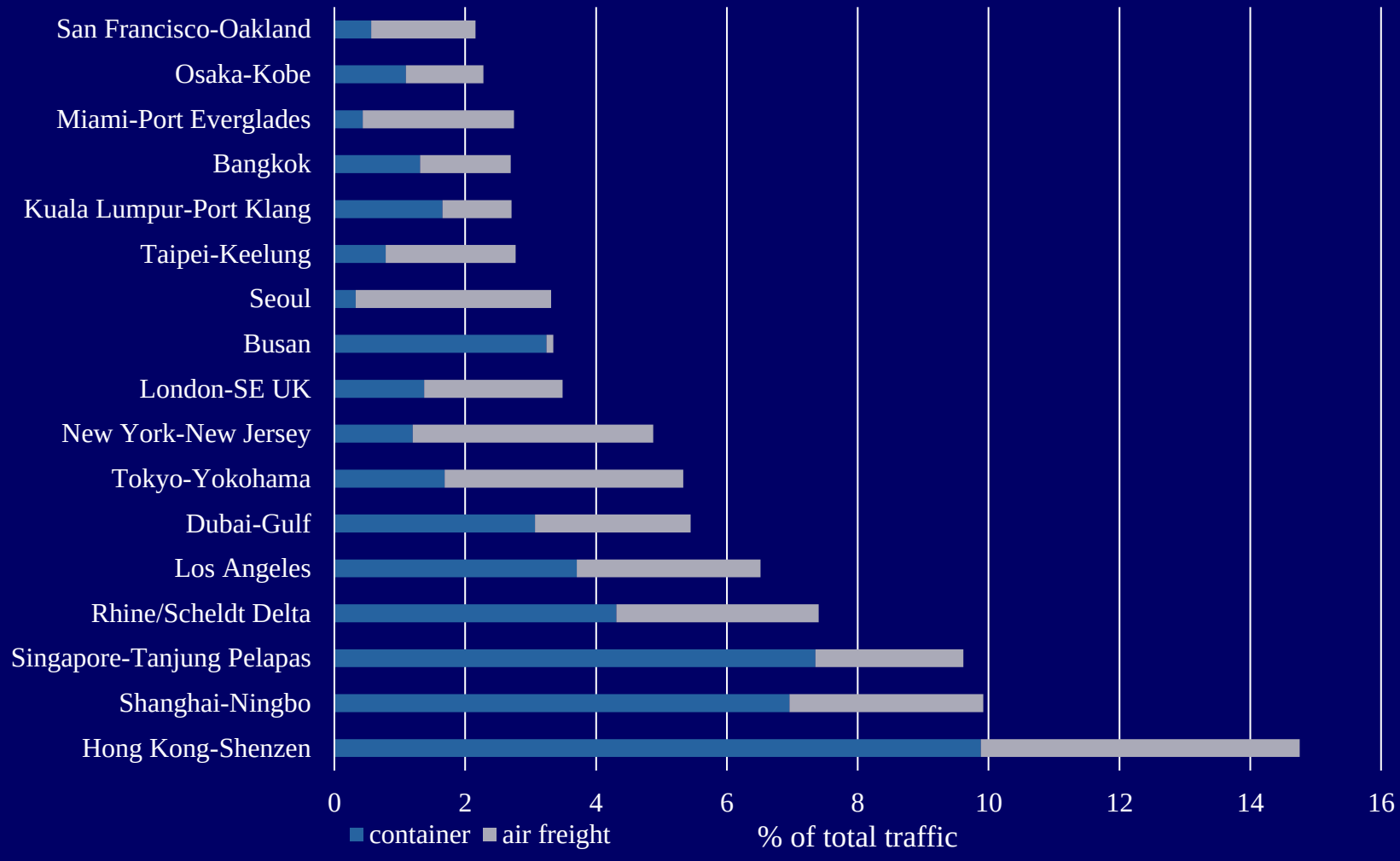
Multimodality and intermodality

Intermodal gateways



Source: Rodrigue, J-P et al. (2020) The Geography of Transport Systems, Hofstra University, Department of Global Studies & Geography, https://transportgeography.org/

Intermodal interchanges in the world 2006



Design of intermodal interchanges

- **Within the spatial structure, the intermodal interchange is essentially a special place for the transition among different connected or overlapped networks. At a modelling level, the intermodal interchange is the connection point of individual networks and service systems.**
- **In respect of functionality, the intermodal interchange provides high-level connections and services for transfer, ensuring the operation of trip chains. The intermodal interchange may exist spontaneously or rather consciously in the interlocking connected space of the settlement network and the multi-layered transport network.**

Source: Babós Gyula: Intermodális csomópontok megvalósításában rejlő közlekedésfejlesztési, valamint terület- és városfejlesztési lehetőségek. Intermodális közösségi közlekedési csomópontok tervezési útmutatójának bemutatása 2012. Nemzeti Fejlesztési Ügynökség http://www.nfu.hu/doc/3591 (in Hungarian)

Design of intermodal interchanges

- There is a professional debate on the role of intermodal interchanges. A major trend is to regard the intermodal interchange as a transport-related problem (branch approach). However, the intermodal interchange can be better regarded as an integrated sub-system of the complex urban spatial and functional system (complex or urban approach).
- The influence of an intermodal interchange on the city is undeniable, considering the possible synergies may help in better understanding of the role of the intermodal interchange within the life of the city.

Source: Babós Gyula: Intermodális csomópontok megvalósításában rejlő közlekedésfejlesztési, valamint terület- és városfejlesztési lehetőségek. Intermodális közösségi közlekedési csomópontok tervezési útmutatójának bemutatása 2012. Nemzeti Fejlesztési Ügynökség http://www.nfu.hu/doc/3591 (in Hungarian)

Design of intermodal interchanges

- **Main coexisting tasks of an intermodal interchange:**
  - **providing optimal transfer among various transport modes and vehicles,**
  - **fitting in the transfer process the daily routine activities of passengers,**
  - **organising the mobility processes of the attracted area and its transport networks,**
  - **structural, functional and architectural enrichment of public places and the city area concerned.**

Source: Babós Gyula: Intermodális csomópontok megvalósításában rejlő közlekedésfejlesztési, valamint terület- és városfejlesztési lehetőségek. Intermodális közösségi közlekedési csomópontok tervezési útmutatójának bemutatása 2012. Nemzeti Fejlesztési Ügynökség http://www.nfu.hu/doc/3591 (in Hungarian)

Design of intermodal interchanges

- **The essence of intermodality is the „seamless” travel, according to various types of connection points.**
- **Transfer is perhaps the most frightening phase of travelling. This disadvantage can be turned into an advantage, if the transfer is reliable and not uncomfortable, if the transfer is time gaining instead of time-losing, since it can be linked to everyday activities of the passenger.**
- **An efficient intermodality requires an effective co-operation among transport branches, operators, space owners and municipalities concerned.**

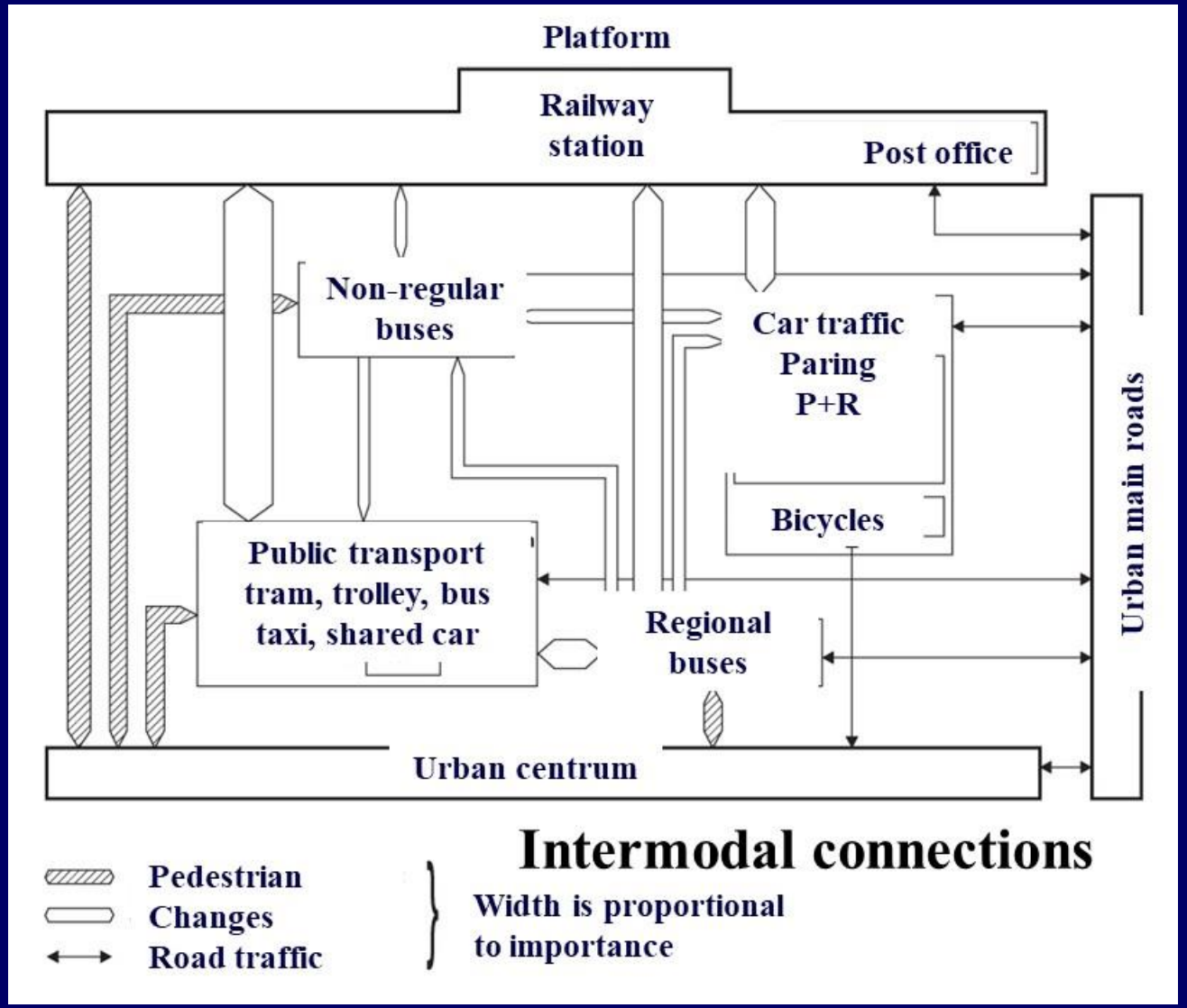
Source: Molnár László: Az intermodalitás – össz-közlekedési szempontrendszerek. Intermodális közösségi közlekedési csomópontok tervezési útmutatójának bemutatása 2012. Nemzeti Fejlesztési Ügynökség http://www.nfu.hu/doc/3591 (in Hungarian)

Design of intermodal interchanges

- **The renaissance of the railways does not mean the gaining back its long-ago dominance, but rather the losing of the car dominance, since in the post-modern era there will be no dominant transport mode.**
- **Besides the renaissance of the railways, nowadays the renaissance of the railway stations is more important, since any railway station is a meeting point in two aspects: on one hand it is an intermodal interchange of various transport facilities, and on the other hand it provides an „interface” between the transport and the urban life.**

Source: Fleischer Tamás: A pályaudvarok szerepe a kibővített Európai Unióban MTA Világgazdasági Kutatóintézet Kihívások, 186. sz., 2005. (in Hungarian)

Design of intermodal interchanges



Source: Hungarian Road Society

Design of intermodal interchanges

- **Spatial location – Interchange Hubs have the best chance to be sustainable at areas where there is a strong connectivity between transport modes and where there are existing opportunities for urban development. In other words, the areas selected should allow connectivity with other territories.**
- **Accessibility – accessibility of the interchanges' operations entail designing it with three different layers: Station, Service, Vehicle. These layers are called the three pillars of accessibility and should pay attention to impaired groups such as users with reduced eyesight or mobility.**

Source: https://smmr.asia/topics/intermodal-mobility-hubs/

Design of intermodal interchanges

- **Connectivity – Intermodal mobility implies using different transport modes during the same trip. It entails transferring from one transport mode to another. Improving the quality of the transfer time through services offer and shortening the waiting time will positively impact the experience of the intermodal mobility by the passengers. Connectivity can also be improved by reducing the distances between the transport services in a city's transport system. Interchanges need to be carefully planned in the context of a wider system, to ensure that connectivity is optimal between transport modes.**

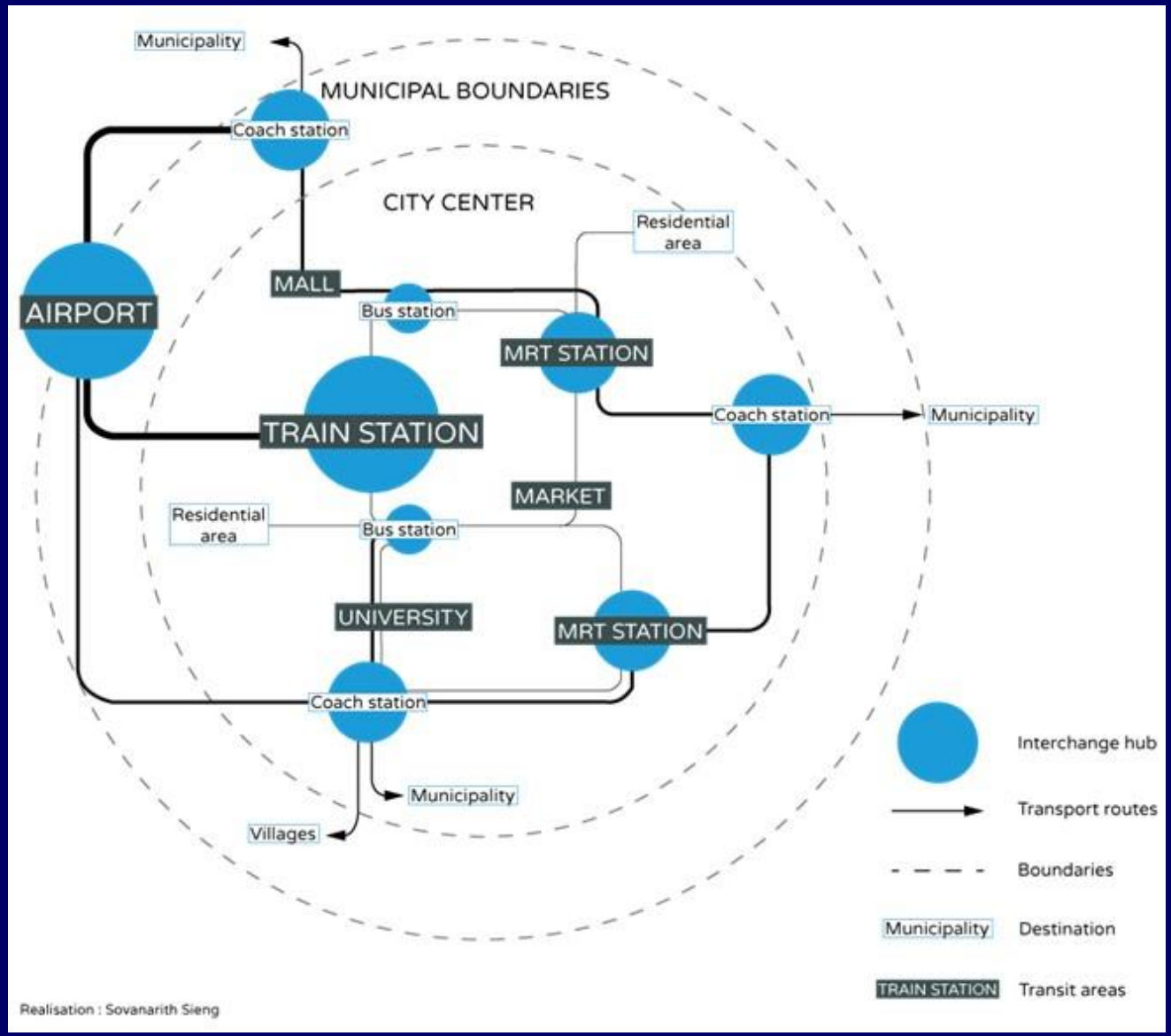
Source: https://smmr.asia/topics/intermodal-mobility-hubs/

Design of intermodal interchanges

- **Functionality and urban integration – a more sustainable mobility implies effectively articulating transport with urban planning, for a better integration of the interchange in the urban fabric. On the contrary, an interchange without proper integration to the local urban opportunities will not succeed at being sustainable. At a strategic level, the local authorities should use interchanges as a tool for urban development. The concept of Transit-Oriented-Development (TOD) is widely known to initiate a sustainable interchange for its users, investors and transport operators.**

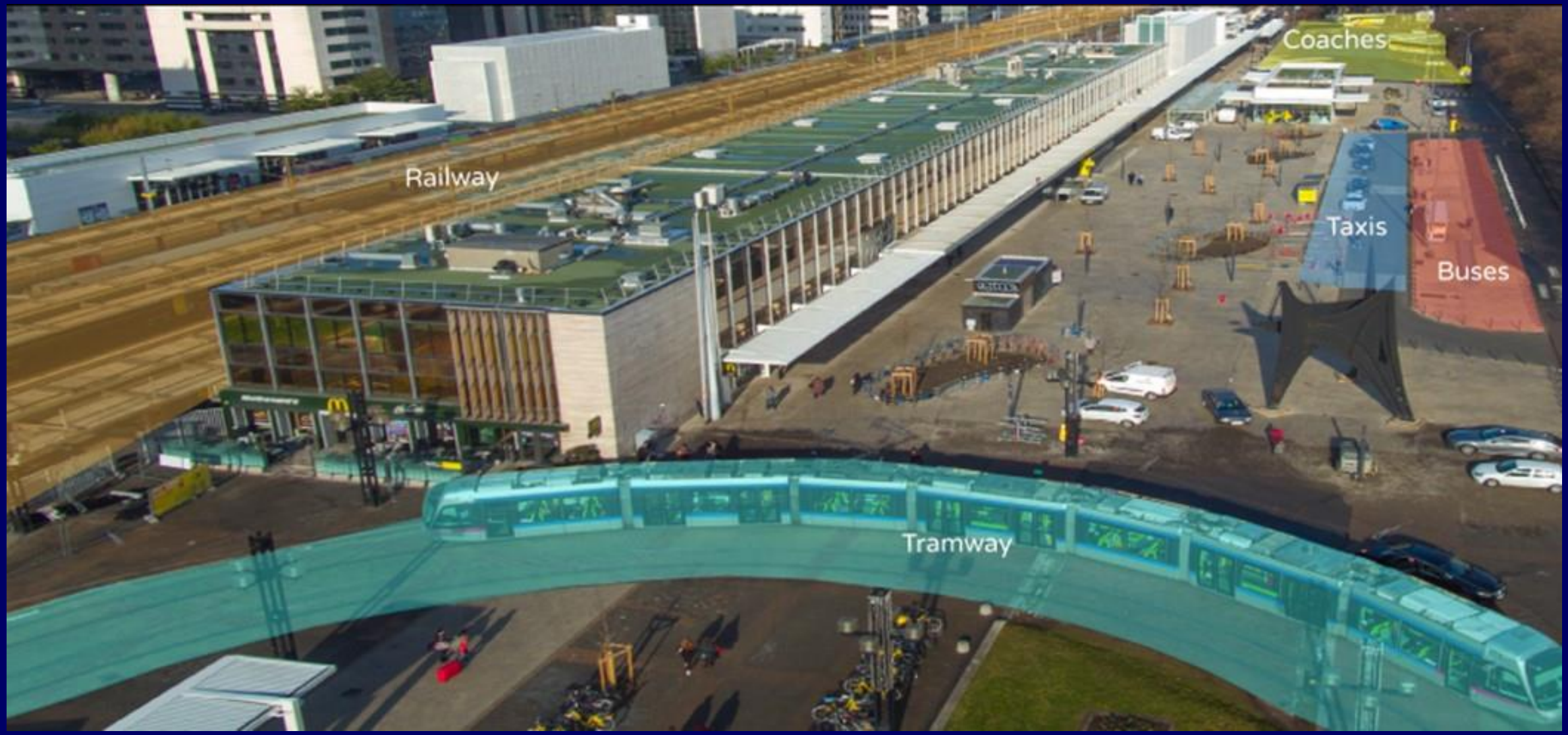
Source: https://smmr.asia/topics/intermodal-mobility-hubs/

Design of intermodal interchanges



Source: https://smmr.asia/topics/intermodal-mobility-hubs/

Design of intermodal interchanges



Source: https://smmr.asia/topics/intermodal-mobility-hubs/

Design of intermodal interchanges

- Main physical requirements of the users of the interchanges
  - Level changes
  - Waiting rooms
  - Long waiting spaces
  - Walkways
  - Interior design
  - Facade materials
  - Automatic doors
  - Hygienic services
  - Illumination
  - Vehicle design
  - Ticket automats
  - Parking areas
  - Taxi ranks

Source: N. Desiderio: Requirements of Users and Operators on the Design and Operation of Intermodal Interchanges Technische Universität Darmstadt

Types of intermodal interchanges

- **Main parameters for classification of intermodal interchanges:**
  - **expected daily passenger traffic**
  - **expected daily citizen use**
  - **number of incoming (connected) transport lines and routes**
  - **position and potential in the spatial structure**
  - **role in the transport system and transport structure**

Source: Molnár László: Az intermodalitás – össz-közlekedési szempontrendszerek. Intermodális közösségi közlekedési csomópontok tervezési útmutatójának bemutatása 2012. Nemzeti Fejlesztési Ügynökség http://www.nfu.hu/doc/3591 (in Hungarian)

Types of intermodal interchanges

- **A. International, inter-regional intermodal interchange**
- **Mainly covering large areas, trans-regional connections, international transport corridors and metropolises, large cities of outstanding importance and attraction**
- **Usually in the vicinity of such intermodal interchanges there takes place conscious, emphasised, state-supported development of complex services and systems**
- **This type of intermodal interchange has got an individual caracter, therefore a general parameter list cannot be established**

Source: Babós Gyula: Intermodális csomópontok megvalósításában rejlő közlekedésfejlesztési, valamint terület- és városfejlesztési lehetőségek. Intermodális közösségi közlekedési csomópontok tervezési útmutatójának bemutatása 2012. Nemzeti Fejlesztési Ügynökség http://www.nfu.hu/doc/3591 (in Hungarian)

Types of intermodal interchanges

- **B. Regional (county, district, agglomeration area) main intermodal interchange**
  - **at least 40 000 inhabitants in the attraction area**
  - **at least 2 guided land transport connections**
  - **at least 6 feeder public transport lines**
  - **central position in the land-use structure**
  - **at least 3 000 m^2 commercial area**
  - **basic services**
  - **at least 1 000 P+R parking**
  - **daily minimal number of transferring passengers: 20 000 people (in two directions)**
  - **daily minimal number of citizen use: 10 000 people**

Source: Babós Gyula: Intermodális csomópontok megvalósításában rejlő közlekedésfejlesztési, valamint terület- és városfejlesztési lehetőségek. Intermodális közösségi közlekedési csomópontok tervezési útmutatójának bemutatása 2012. Nemzeti Fejlesztési Ügynökség http://www.nfu.hu/doc/3591 (in Hungarian)

Types of intermodal interchanges

- C. Intermodal interchange
  - at least 20 000 inhabitants in the attraction area
  - at least 1 guided land transport connection
  - at least 4 feeder public transport lines
  - good position in the land-use structure
  - at least 300 m^2 commercial area
  - basic services
  - at least 300 P+R parking
  - daily minimal number of transferring passengers: 3 000 people
  - daily minimal number of citizen use: 300 people

Source: Babós Gyula: Intermodális csomópontok megvalósításában rejlő közlekedésfejlesztési, valamint terület- és városfejlesztési lehetőségek. Intermodális közösségi közlekedési csomópontok tervezési útmutatójának bemutatása 2012. Nemzeti Fejlesztési Ügynökség http://www.nfu.hu/doc/3591 (in Hungarian)

Types of intermodal interchanges

- **D1. Main transfer point**
  - **at least 10 000 inhabitants in the attraction area**
  - **at least 1 guided land transport connection**
  - **at least 2 feeder public transport lines**
  - **acceptable position in the land-use structure**
  - **travel-related services**
  - **at least 100 P+R parking**
  - **daily minimal number of transferring passengers: 800 people**

Source: Babós Gyula: Intermodális csomópontok megvalósításában rejlő közlekedésfejlesztési, valamint terület- és városfejlesztési lehetőségek. Intermodális közösségi közlekedési csomópontok tervezési útmutatójának bemutatása 2012. Nemzeti Fejlesztési Ügynökség http://www.nfu.hu/doc/3591 (in Hungarian)

Types of intermodal interchanges

- **D2. Transfer point**
  - **at least 5 000 inhabitants in the attraction area**
  - **at least 2 connected public transport lines**
  - **travel-related services**
  - **at least 50 P+R parking**
  - **daily minimal number of transferring passengers: 300 people**
  - **sometimes situated at the border of the settlement**

Source: Babós Gyula: Intermodális csomópontok megvalósításában rejlő közlekedésfejlesztési, valamint terület- és városfejlesztési lehetőségek. Intermodális közösségi közlekedési csomópontok tervezési útmutatójának bemutatása 2012. Nemzeti Fejlesztési Ügynökség http://www.nfu.hu/doc/3591 (in Hungarian)

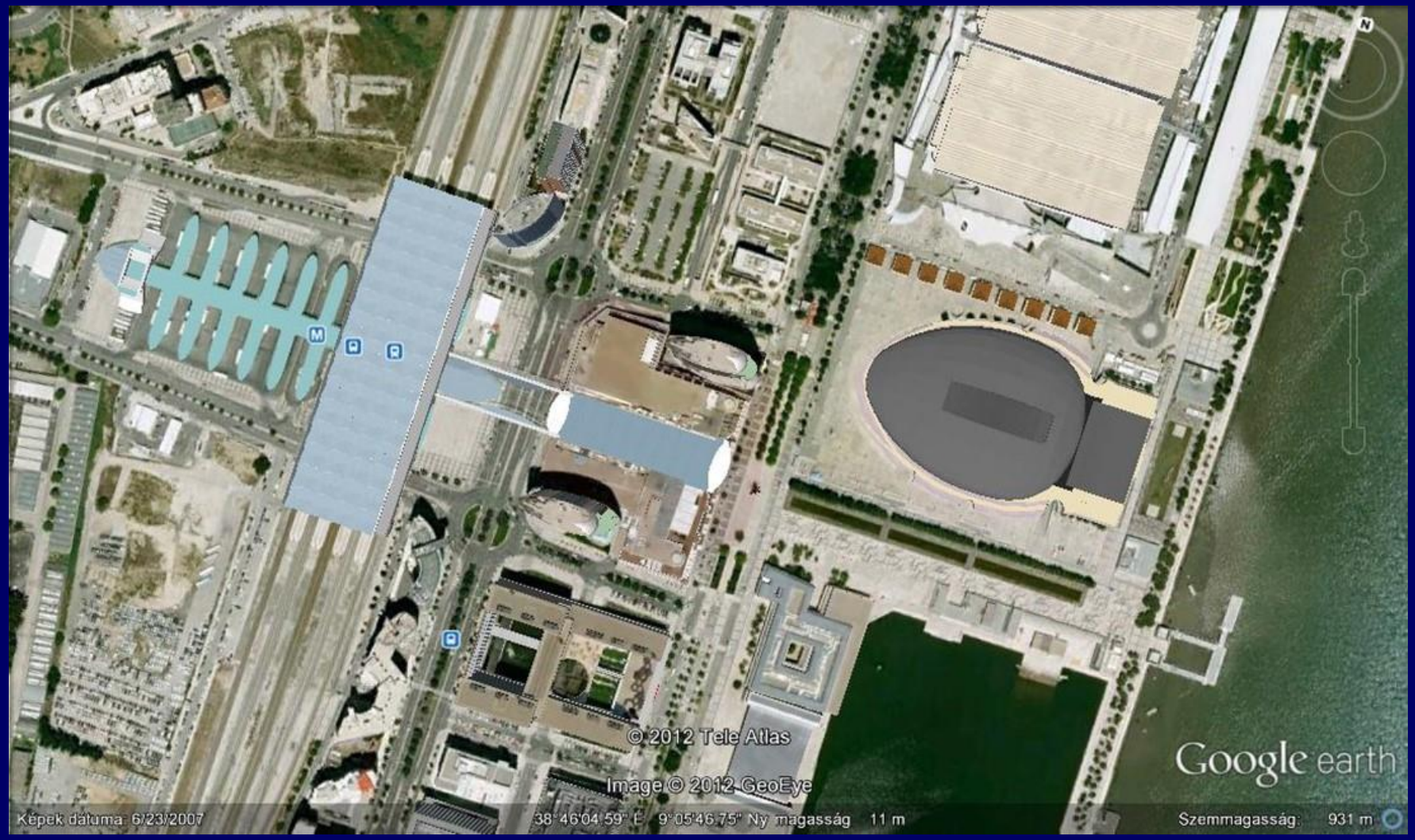
Examples of intermodal interchanges in the world

- Lisbon Oriente railway station
- Rome Tiburtina railway station
- West-Australia Perth railway station
- Berlin central railway station

Lisbon Oriente railway station

- The Lisbon Oriente station is the most important one in Portugal.
- The station was designed by Santiago Calatrava and it opened in 1998 for the World Expo.
- High speed trains (Alfa Pendular), regional and local trains and buses start from here.
- There is a metro station and a bus station nearby as well as a shopping centre.
- The station is highly trafficked serving 75 million passengers per year.

Lisbon Oriente railway station



Lisbon Oriente railway station

- Calatrava won the contest for the new station.
- There was at that time a ruined industrial area where the development provided a new intermodal traffic junction for intercity and other trains, metro and buses.
- In the time of the World Expo as well as since then the station has an important role in the city life.
- The appearance of the building resembles the waves of the ocean.

Lisbon Oriente railway station

Lisbon Oriente railway station

Lisbon Oriente railway station

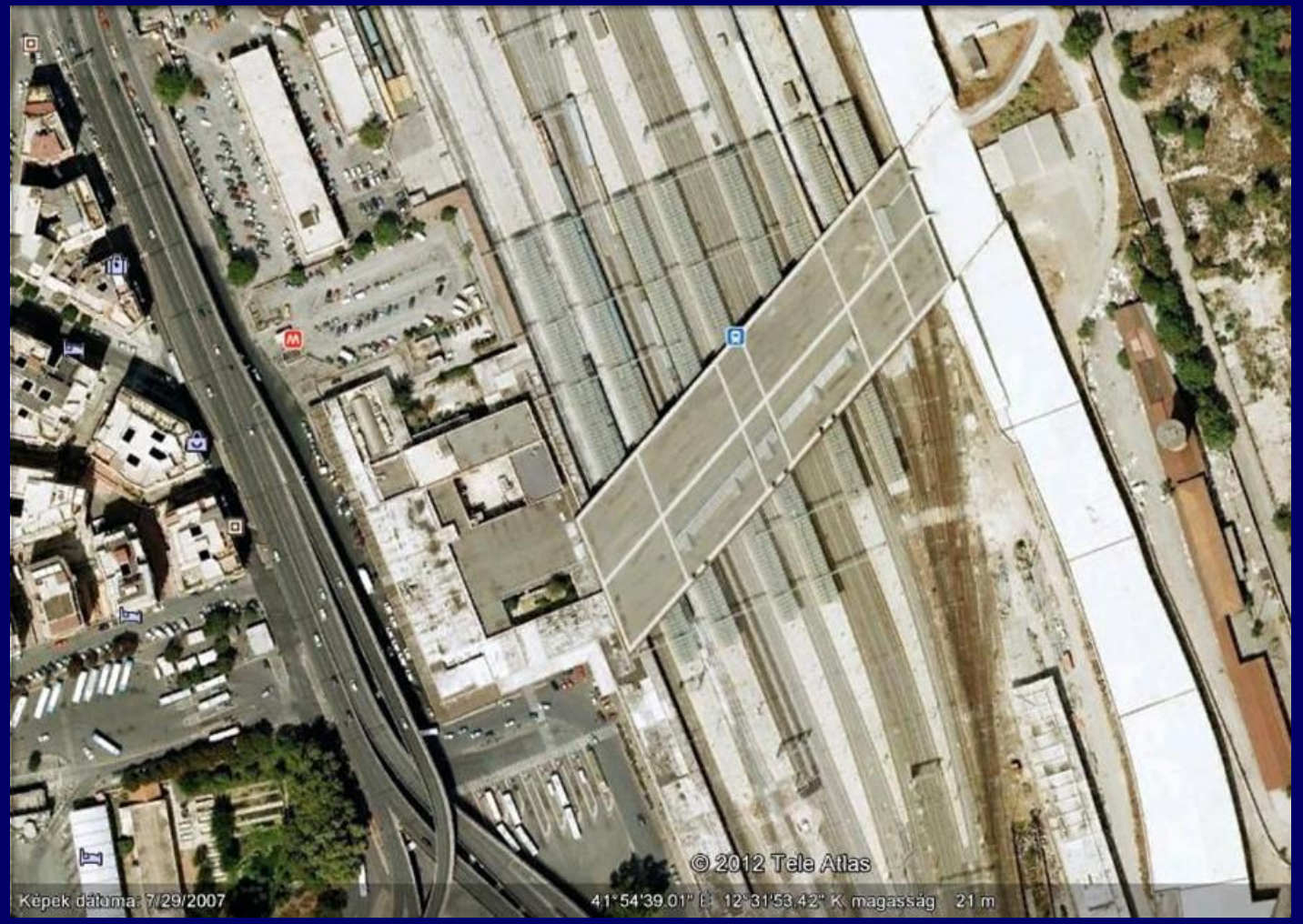
Lisbon Oriente railway station

Rome Tiburtina railway station

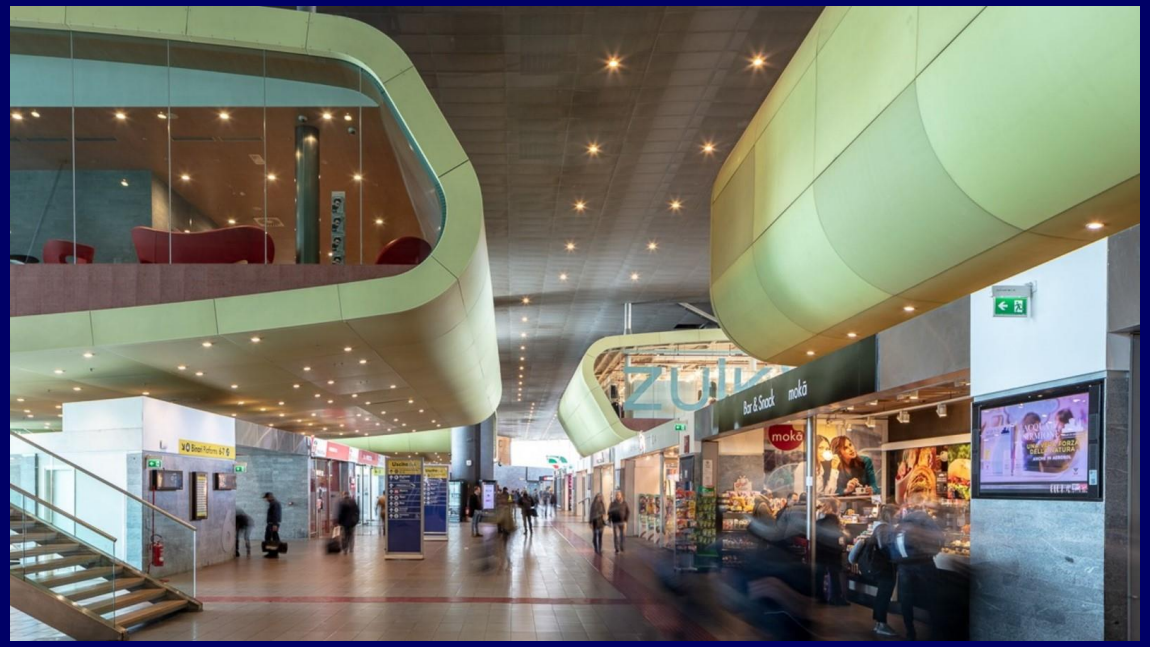
- The Tiburtina station in Rome has been totally reconstructed by 2011.
- The main goal is to provide a station for the high-speed trains in a through traffic mode instead of the previous head station Termini moreover the station has regional tasks as well.
- There are daily 140 high-speed intercity trains and 290 regional trains in the timetable.
- The surprising bridge-like architectural solution is advantageous for passengers and operation.

Rome Tiburtina railway station

Rome Tiburtina railway station



Rome Tiburtina railway station



Perth railway station

Urban buses have a stop on the overpass providing direct access to train platforms

Source: Molnár László: Az intermodalitás – össz-közlekedési szempontrendszerek. Intermodális közösségi közlekedési csomópontok tervezési útmutatójának bemutatása 2012. Nemzeti Fejlesztési Ügynökség http://www.nfu.hu/doc/3591 (in Hungarian)

Berlin central railway station

Source: Molnár László: Az intermodalitás – össz-közlekedési szempontrendszerek. Intermodális közösségi közlekedési csomópontok tervezési útmutatójának bemutatása 2012. Nemzeti Fejlesztési Ügynökség http://www.nfu.hu/doc/3591 (in Hungarian)

Examples of intermodal interchanges in Hungary

- Kecskemét railway station
- Debrecen railway station
- Budapest Etele tér intermodal interchange
- Budapest Kőbánya-Kispest interchange
- Budapest Rákoskert railway stop

Kecskemét railway station

- „Kecskemét intermodal interchange, development of the railway station and the connected public transport system” feasibility study 2011
- Development of the level of service of the public transport, transfer and modal change concerning local and regional public transport and road transport as well as the railway network
- Development of the level of service of the operation on the local bus network
- Environment friendly transport vehicles
- Development of P+R parking
- Development of the passenger information system and the operation management in the public transport

Source: http://kecskemetivarosfejleszto.hu/2012/02/19/reszletes-megvalosithatosagi-tanulmany-osszefoglaloja/ (in Hungarian)

Kecskemét railway station

Source: http://kecskemetivarosfejleszto.hu/2011/12/16/intermodalis-palyaudvar-latvanytervek/ (in Hungarian)

Debrecen railway station

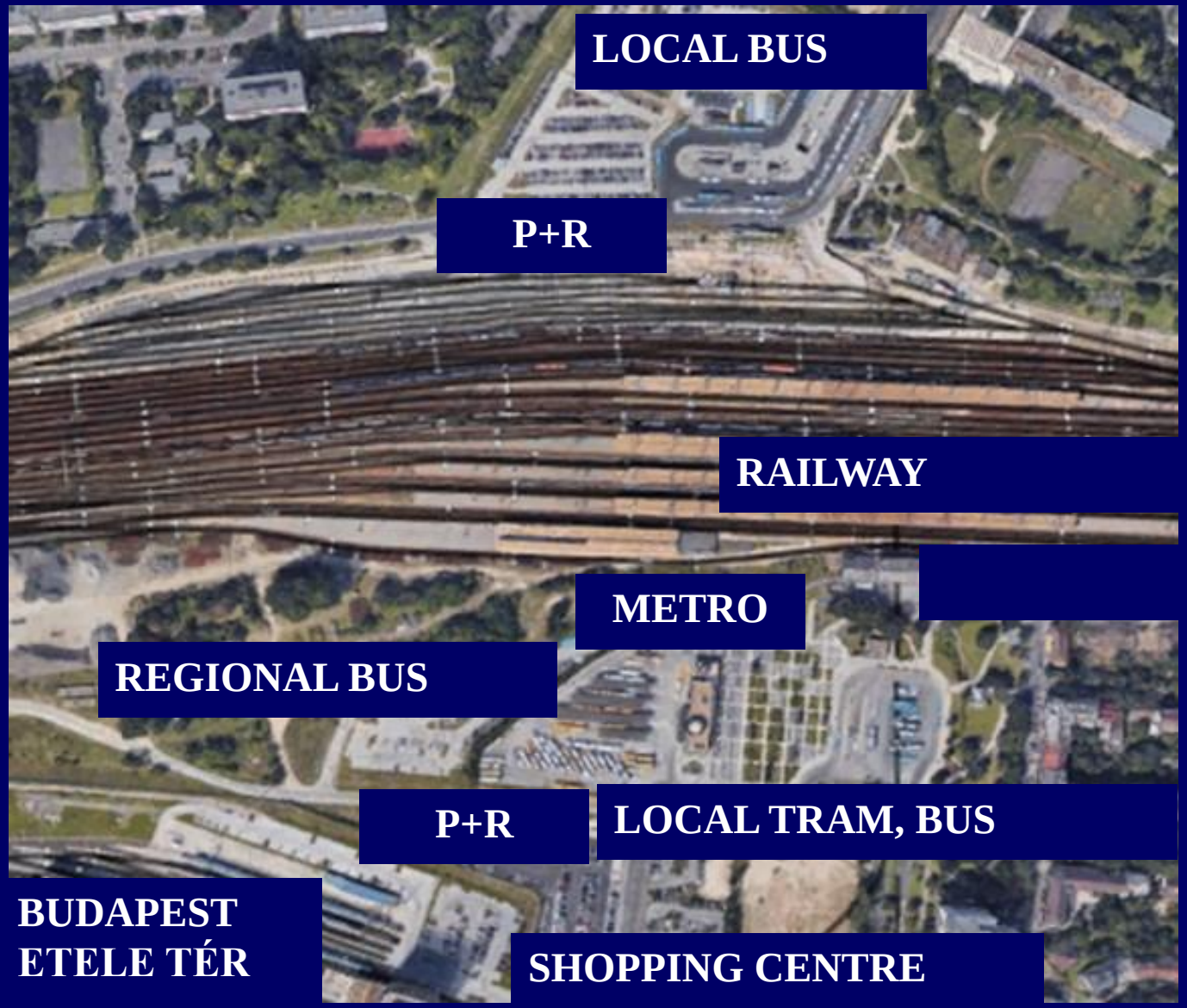
- The feasibility study for the intermodal interchange analysed 3 alternatives, including
  - a brand new railway station building at a new place
  - a railway station above tracks
  - the rehabilitation or replacement of the existing building
- The decision voted to the rehabilitation alternative
- The development includes a regional bus station, a local bus station, passenger services and commercial area as well as a deep garage for 600 cars and an office building of 12 000 m^2

Source: http://www.haon.hu/tervezes-elott-az-intermodalis-kozpont/1985316 (in Hungarian)

Debrecen railway station

Source: http://www.haon.hu/tervezes-elott-az-intermodalis-kozpont/1985316 (in Hungarian)

Budapest Etele tér intermodal interchange



Budapest Kőbánya-Kispest interchange

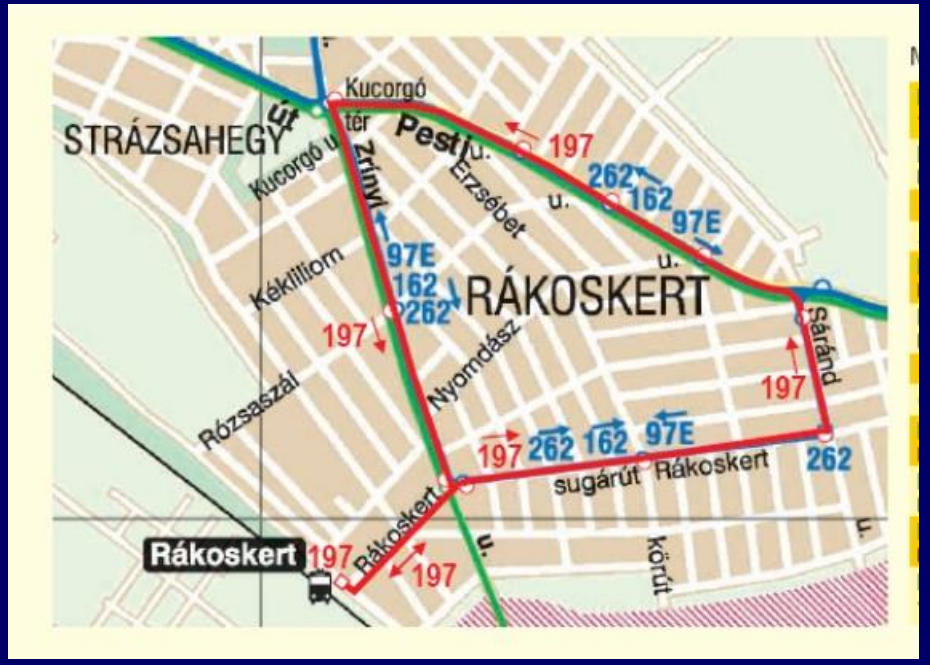
From the arriving bus stop to the metro station there is a need to cross the shopping centre where everything is closed in the morning peak.

Budapest Rákoskert railway stop

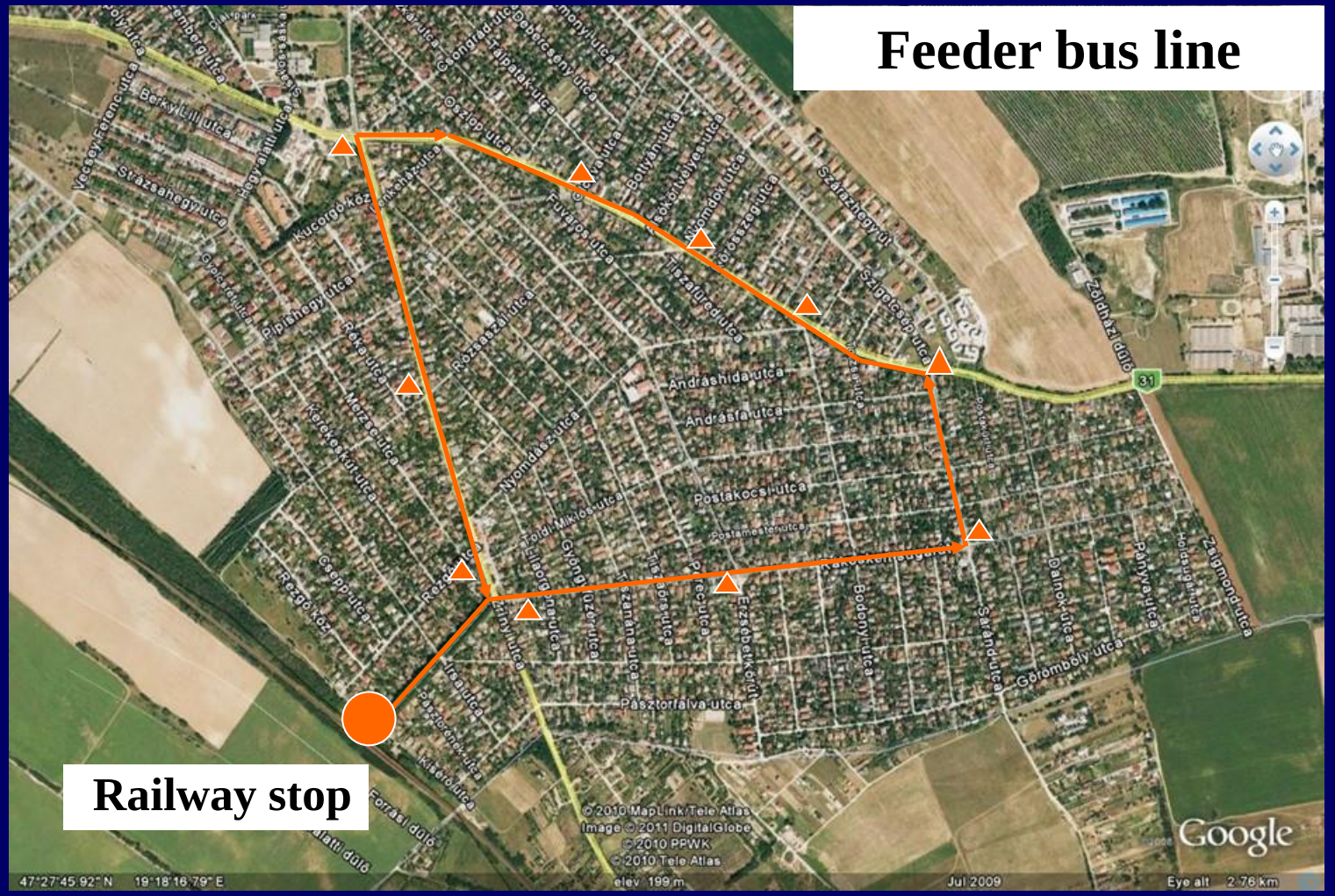
- In 2010 an intermodal connection has been constructed at a suburban railway station: P+R car parking, bike parking and bus terminal.
- The timetable of the new bus line is co-ordinated with the timetable of the railway. In the afternoon period, in case of train delay the bus waits at the terminal for a certain time.
- The intermodal connection considerably decreases travel time between the suburb and the capital centrum.

Budapest Rákoskert railway stop

Budapest - new bus line connected to suburban railway by EU co-financing



Budapest Rákoskert railway stop



Budapest Rákoskert railway stop

Bus terminal

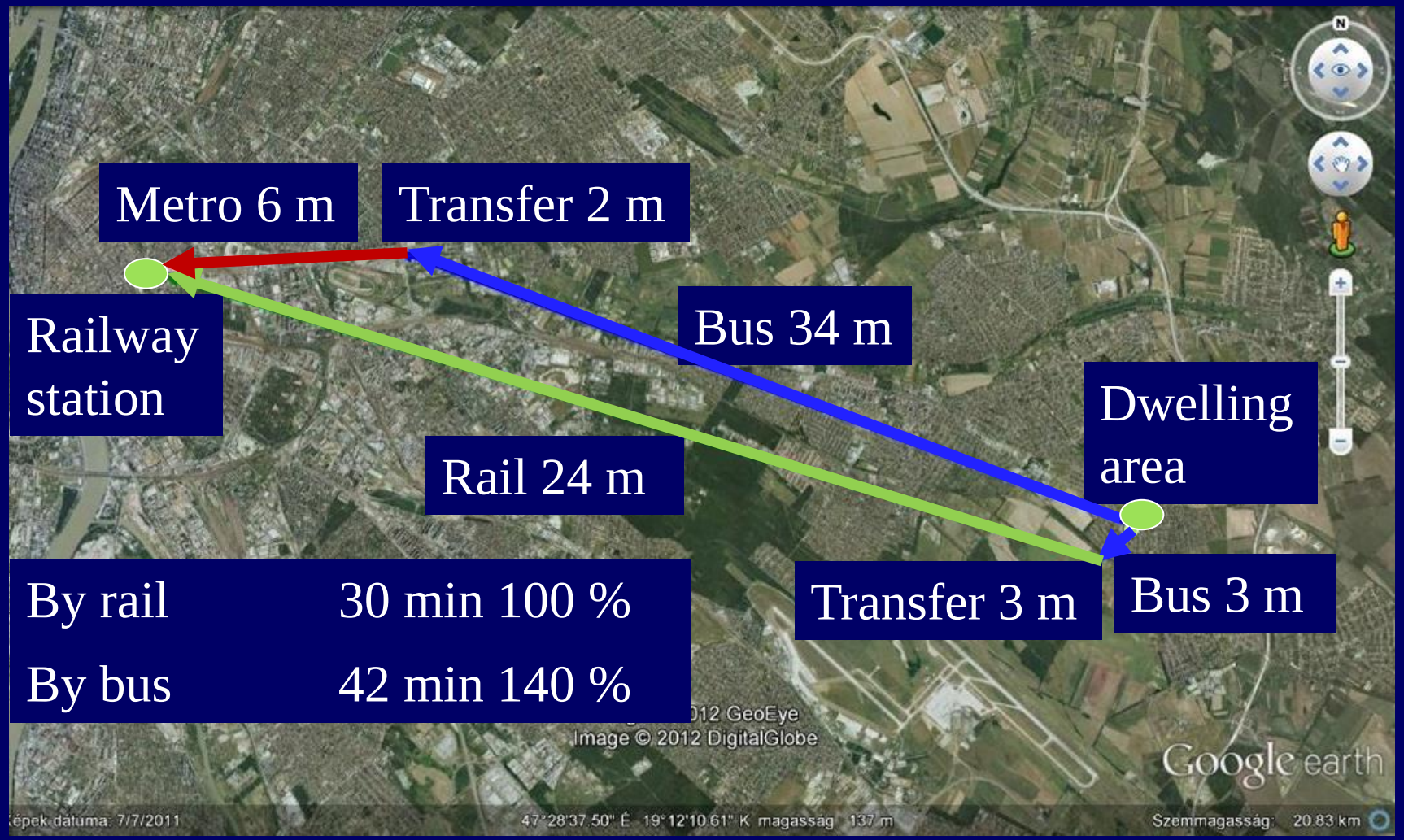
Passenger information, timetable

P+R parking

Bike parking

Budapest Rákoskert railway stop

Accessibility of the city centre (about 20 km)



Summary

- Connections among parts of the network and various transport modes provide the possibility for a continuous movement, travel and freight.
- Multimodal transport is defined as the use of several modes of transport to convey goods to their final destination.
- Main functions of an intermodal interchange connecting various transport modes: providing optimal transfer, fitting in the daily routine activities of passengers, organising the mobility processes of the attracted area as well as structural, functional and architectural enrichment of public places and the city area concerned.

Thank you for your attention!

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