Freight transport, logistics
Water and air transport networks

Transport Networks 8.
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Content

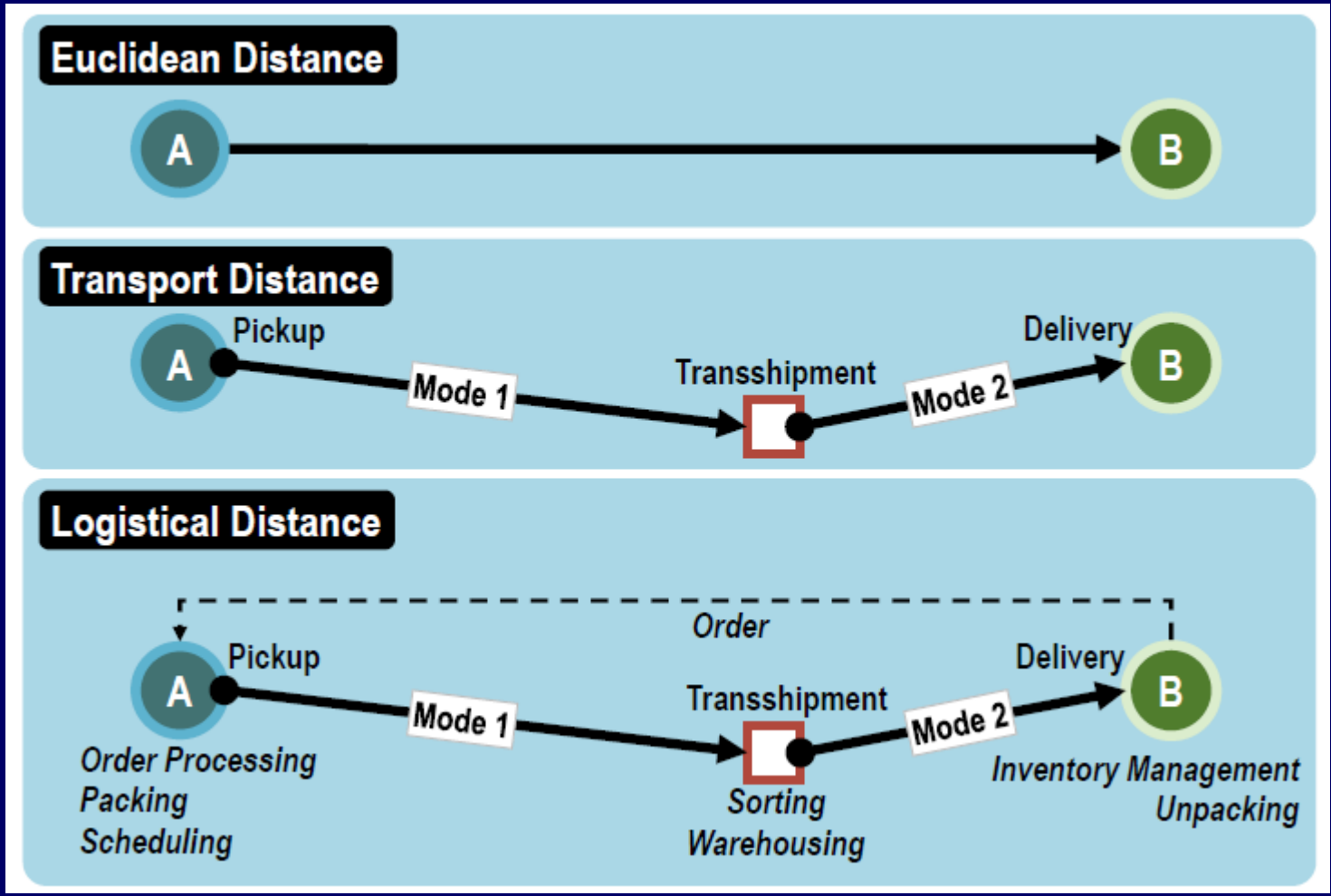
- Characteristics of freight transport
- Freight transport in the EU White Book
- Basics of logistics, logistics centres
- Water transport networks
- Air transport networks

Characteristics of freight transport

- **Movement of freight (goods) requires a significant amount of cost, energy and organisation.**
- **Determination of transport routes and transport modes calls for optimal solutions.**
- **Freight transport is a complex activity, there are a lot of connected elements, including trade and customs issues as well as warehousing.**
- **Freight transport differs from passenger transport, it is less flexible, although the networks are more or less the same.**

Characteristics of freight transport

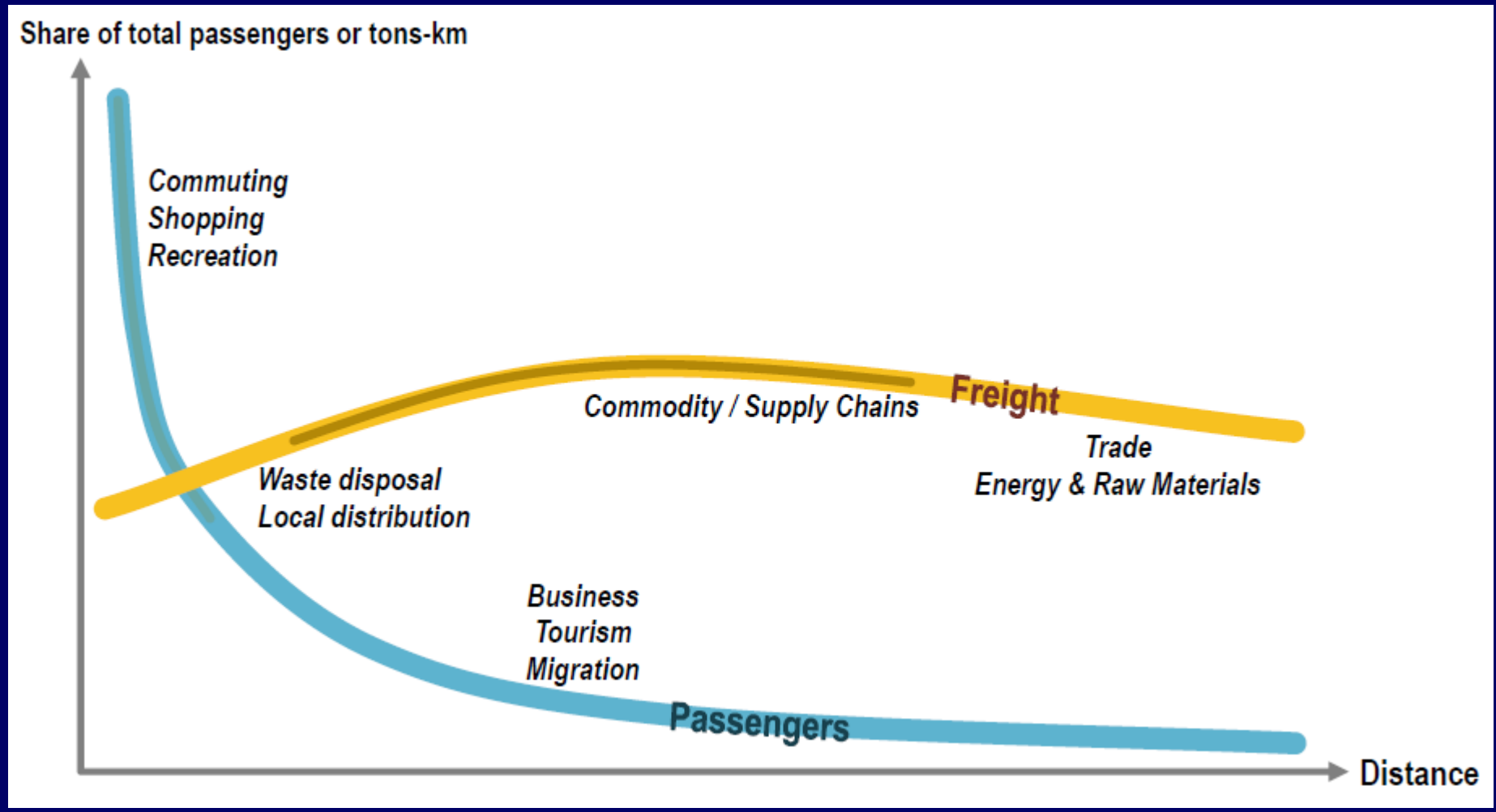
Different representations of distance



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

Characteristics of freight transport

Mobility of passengers and freight



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

Characteristics of freight transport

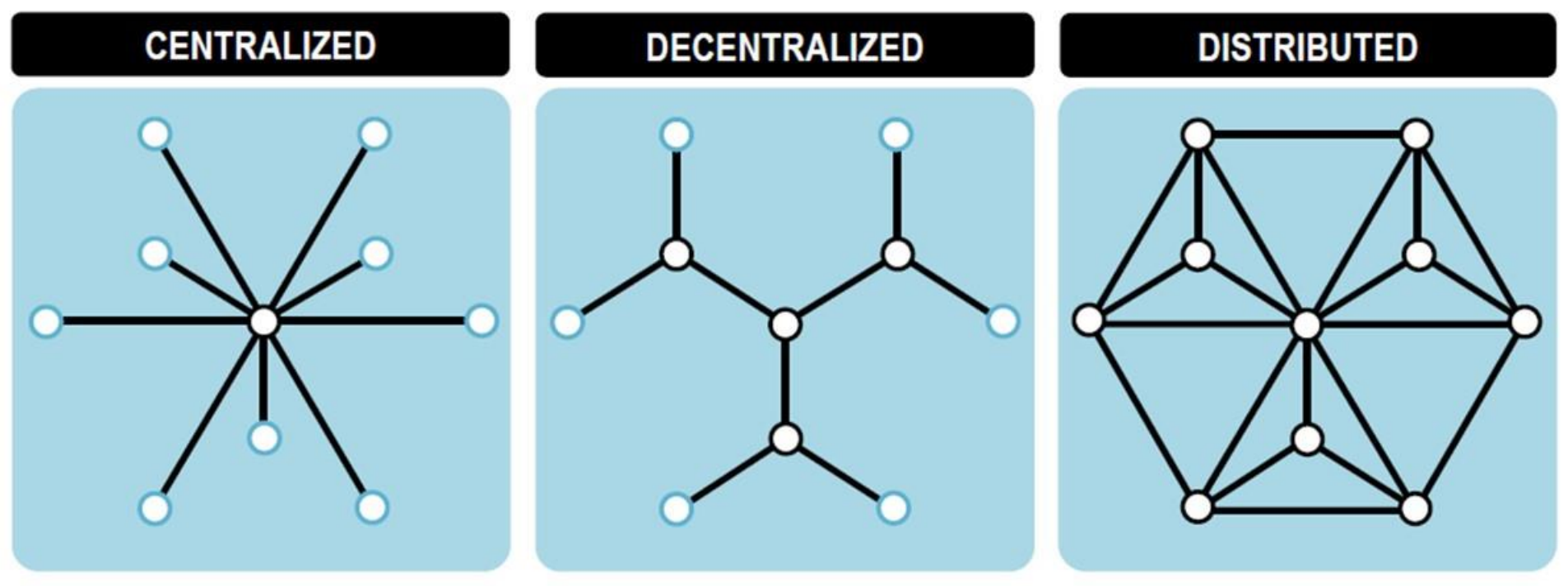
- Board, get off and transfer without assistance.
- Process information and act on it without assistance.
- Make choices between transport modes without assistance but often irrationally.
- Require travel accommodations related to comfort and safety.

- Must be loaded, unloaded and transferred.
- Information must be processed through logistics managers.
- Logistics managers meet choices between transport modes rationally.
- Require accommodations related to storage.

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

Characteristics of freight transport

Network types for distribution of goods



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

Characteristics of freight transport

- **Transport and warehousing makes about 10-15 % of the cost of any product.**
- **In the European Union, within the long-distance hauling, the proportion of road transport is 33 %, while the proportion of railway and water transport remains under 21 %.**
- **This fact also means unfavourable environmental efffects.**
- **The railway and water transport would be more favourable, however, it still cannot gain a suitable proportion at medium and long distances in the freight transport.**

Source: http://ec.europa.eu/transport/strategies/facts-and-figures/index_en.htm

Characteristics of freight transport

- 25 new trucks provide less noise together than one manufactured in the 1980s. There has been a significant achievement in the field of noise reduction in the past decades. Even road pavements can be constructed to reduce noise applying a special wearing course.
- International hauling is not easy because of the lack of interoperability. A truck moving on the EU road network must has got the Eurovignette (road user charge), besides this, 5 different national vignettes and 8 different fee collection devices (on board units), having individual contracts for using all these.

Source: http://ec.europa.eu/transport/strategies/facts-and-figures/index_en.htm

Characteristics of freight transport

Main road freight transport flows in Hungary

Source: Institute for Transport Sciences

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Main railway freight transport flows in Hungary

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Characteristics of freight transport

Main railway freight transport flows in Hungary

Source: Institute for Transport Sciences

Freight transport in the EU White Book

- **In the intermediate distances, new technologies are less mature and modal choices are fewer than in the city. However, this is where EU action can have the most immediate impact (fewer constraints from subsidiarity or international agreements).**
- **More resource-efficient vehicles and cleaner fuels are unlikely to achieve on their own the necessary cuts in emissions and they would not solve the problem of congestion. They need to be accompanied by the consolidation of large volumes for transfers over long distances. This implies greater use of buses and coaches, rail and air transport for passengers and, for freight, multimodal solutions relying on waterborne and rail modes for long-hauls.**

Source: European Commission: COM(2011) 144 White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system

Freight transport in the EU White Book

- **Rail, especially for freight, is sometimes seen as an unattractive mode. But examples in some Member States prove that it can offer quality service.**
- **The challenge is to ensure structural change to enable rail to compete effectively and take a significantly greater proportion of medium and long distance freight (and also passengers).**
- **Considerable investment will be needed to expand or to upgrade the capacity of the rail network. New rolling stock with silent brakes and automatic couplings should gradually be introduced.**

Source: European Commission: COM(2011) 144 White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system

Freight transport in the EU White Book

- **30% of road freight over 300 km should shift to other modes such as rail or waterborne transport by 2030, and more than 50% by 2050, facilitated by efficient and green freight corridors. To meet this goal will also require appropriate infrastructure to be developed.**
- **By 2050, complete a European high-speed rail network. Triple the length of the existing high-speed rail network by 2030 and maintain a dense railway network in all Member States. By 2050 the majority of medium-distance passenger transport should go by rail.**

Source: European Commission: COM(2011) 144 White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system

Freight transport in the EU White Book

- **By 2050, connect all core network airports to the rail network, preferably high-speed; ensure that all core seaports are sufficiently connected to the rail freight and, where possible, inland waterway system.**
- **Airport capacity needs to be optimised and, where necessary, increased to face growing demand for travel to and from third countries and areas of Europe otherwise poorly connected, which could result in a more than doubling of EU air transport activities by 2050. In other cases, (high speed) rail should absorb much medium distance traffic.**

Source: European Commission: COM(2011) 144 White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system

Freight transport in the EU White Book

- **The area where bottlenecks are still most evident is the internal market for rail services, which must be completed as a priority in order to achieve a Single European Railway Area. This includes the abolishment of technical, administrative and legal obstacles which still impede entry to national railway markets.**
- **A further integration of the road freight market will render road transport more efficient and competitive.**
- **For maritime transport, a "Blue Belt" in the seas around Europe shall simplify the formalities for ships travelling between EU ports, and a suitable framework must be established to take care of European tasks for inland waterway transport. Market access to ports needs to be further improved.**

Source: European Commission: COM(2011) 144 White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system

Freight transport in the EU White Book

- **Ensure effective and non-discriminatory access to rail infrastructure, including rail related services, in particular through structural separation between infrastructure management and service provision.**
- **The preferred options for unbundling should ensure the development of competition, continued investment and efficiency in the cost of service provision.**
- **Create in the context of the ‘core network’ multimodal freight corridor structures to synchronise investments and infrastructure works and support efficient, innovative and multimodal transport services, including rail services over medium and long distances.**

Source: European Commission: COM(2011) 144 White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system

Basics of logistics

- Logistics is generally the detailed organization and implementation of a complex operation. In a general business sense, logistics is the management of the flow of things between the point of origin and the point of consumption to meet the requirements of customers or corporations. The resources managed in logistics may include tangible goods such as materials, equipment, and supplies, as well as food and other consumable items.
- Logistics consists of planning, implementation and analysis of activities related to the transport of passengers, goods and processes, including connected activities. One of its applications is the freight transport.

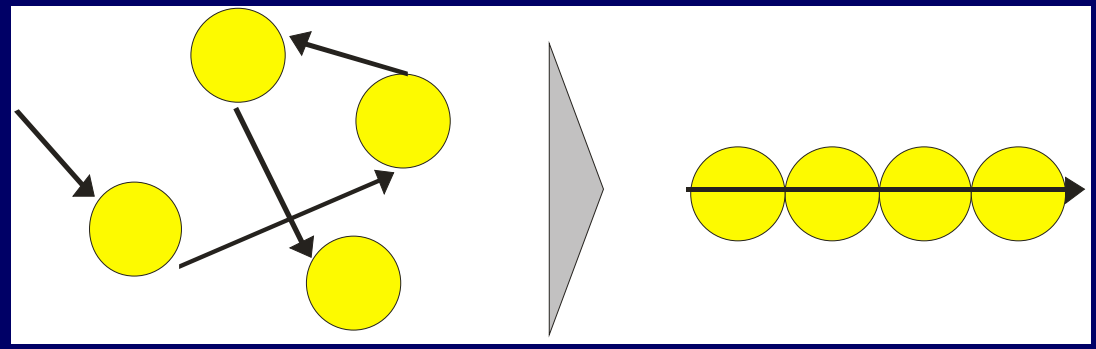
Source: https://en.wikipedia.org/wiki/Logistics

Basics of logistics

- The objective of logistics is the optimal co-ordination of supply, production and distribution processes.
- Main elements of logistical systems are: the transport, the warehousing and the information system.
- Freight transport can be operated by:
  - own vehicles (i.e., Coca-Cola),
  - contracted transport companies,
  - haulage contractors organising services for freight movements as well as connected services.

Basics of logistics

- **Just in Time (JIT) method for supply:**
  - **the proper type of product**
  - **of the expected quality**
  - **at the required time**
  - **in the demanded quantity**
  - **shal be available at the point of usage (consumption)**



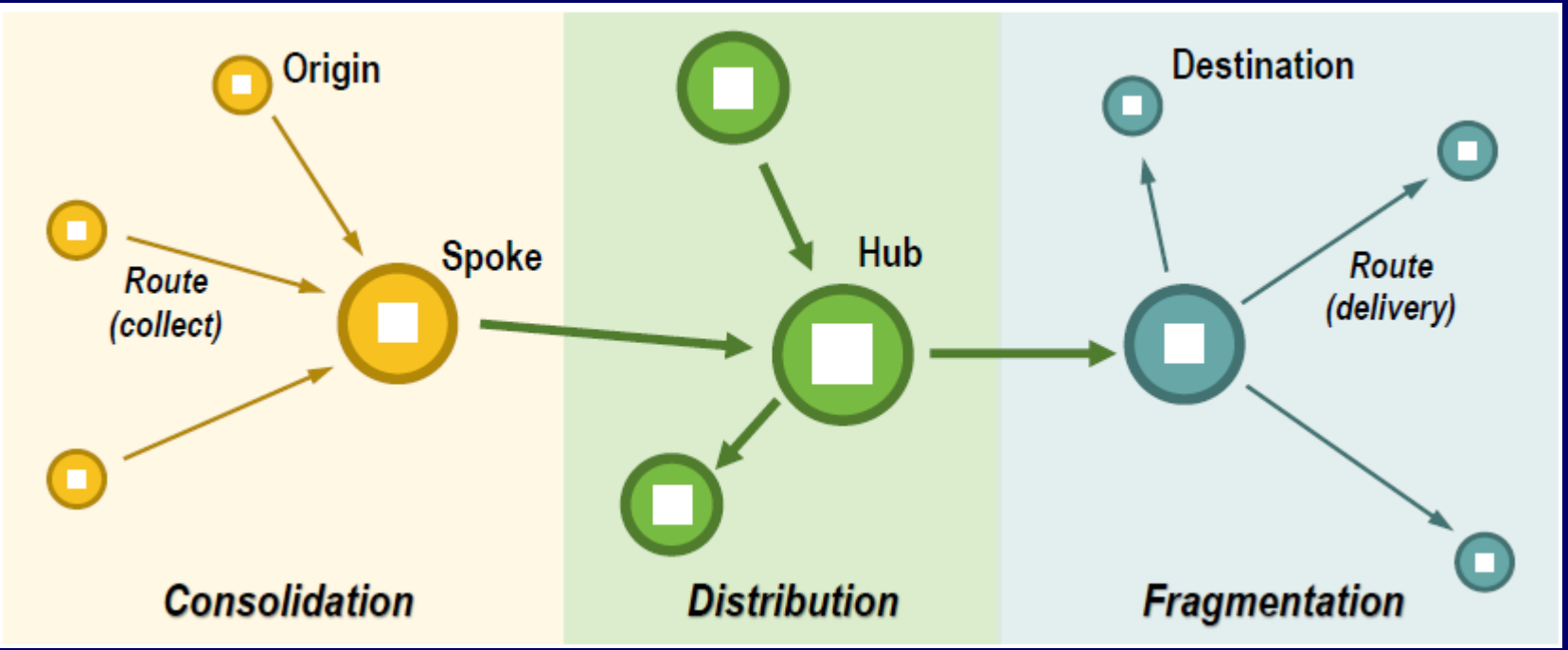
Source: Stasztny Péter: Vevői igények kielégítése a karcsú (Lean) gyártási rendszer kialakításával Győr, 2008 (in Hungarian)

Basics of logistics

- Logistics management is part of supply chain management and supply chain engineering.
- The freight transport mode can be traditional, container based or combined transport (i.e., trucks on a special train or ship).
- The integrated supply chain includes the warehousing and the exchange of information. There are different technologies for the identification of goods, such as barcode or Radio Frequency Identification (RFID)
- In the logistical information systems the Electronic Data Interchange, EDI is widely used.
- An European objective is to promote the reasonable division of labour, taking into account the competitive neutrality.

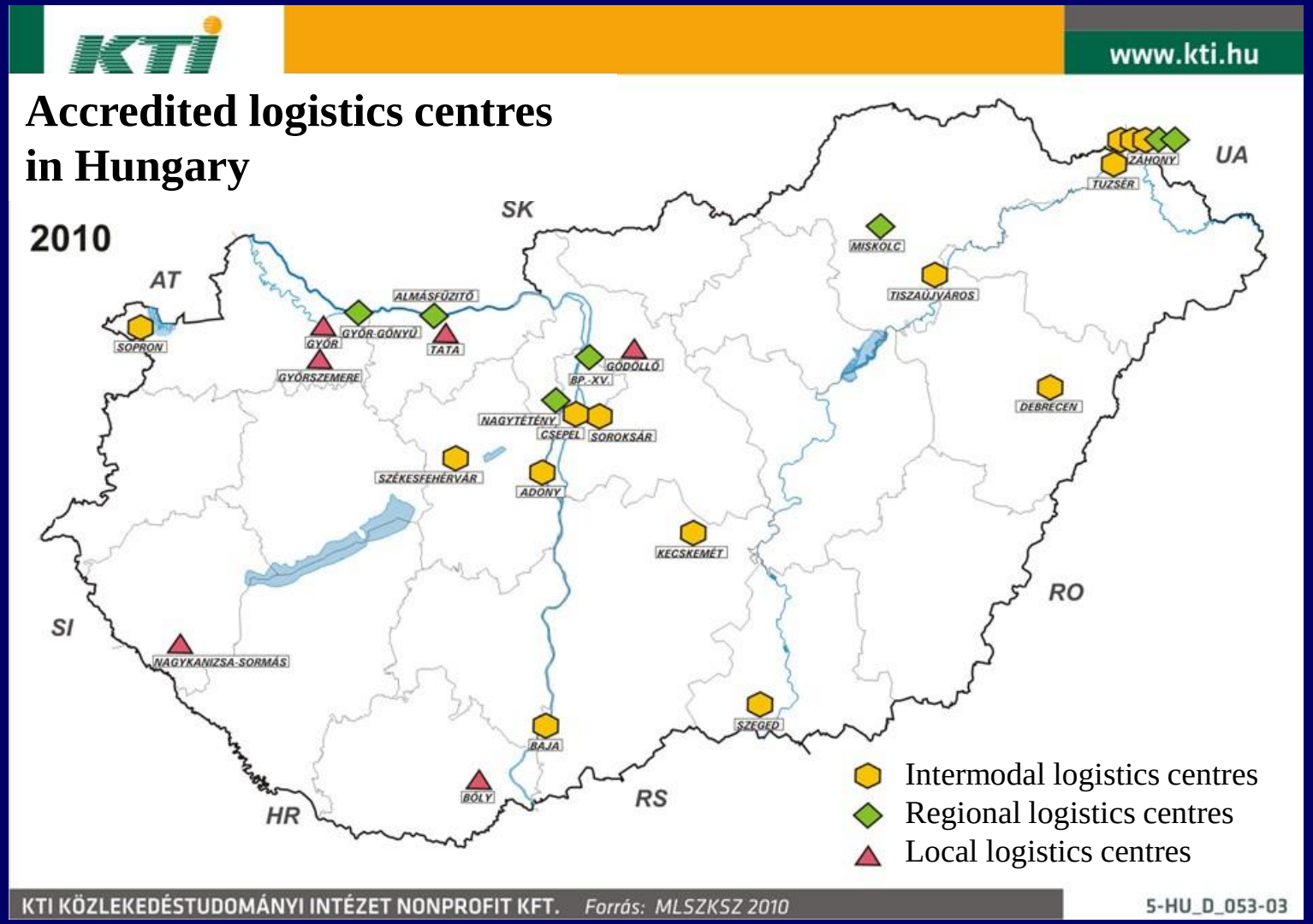
Basics of logistics

The hub-and-spoke structure of parcel carriers



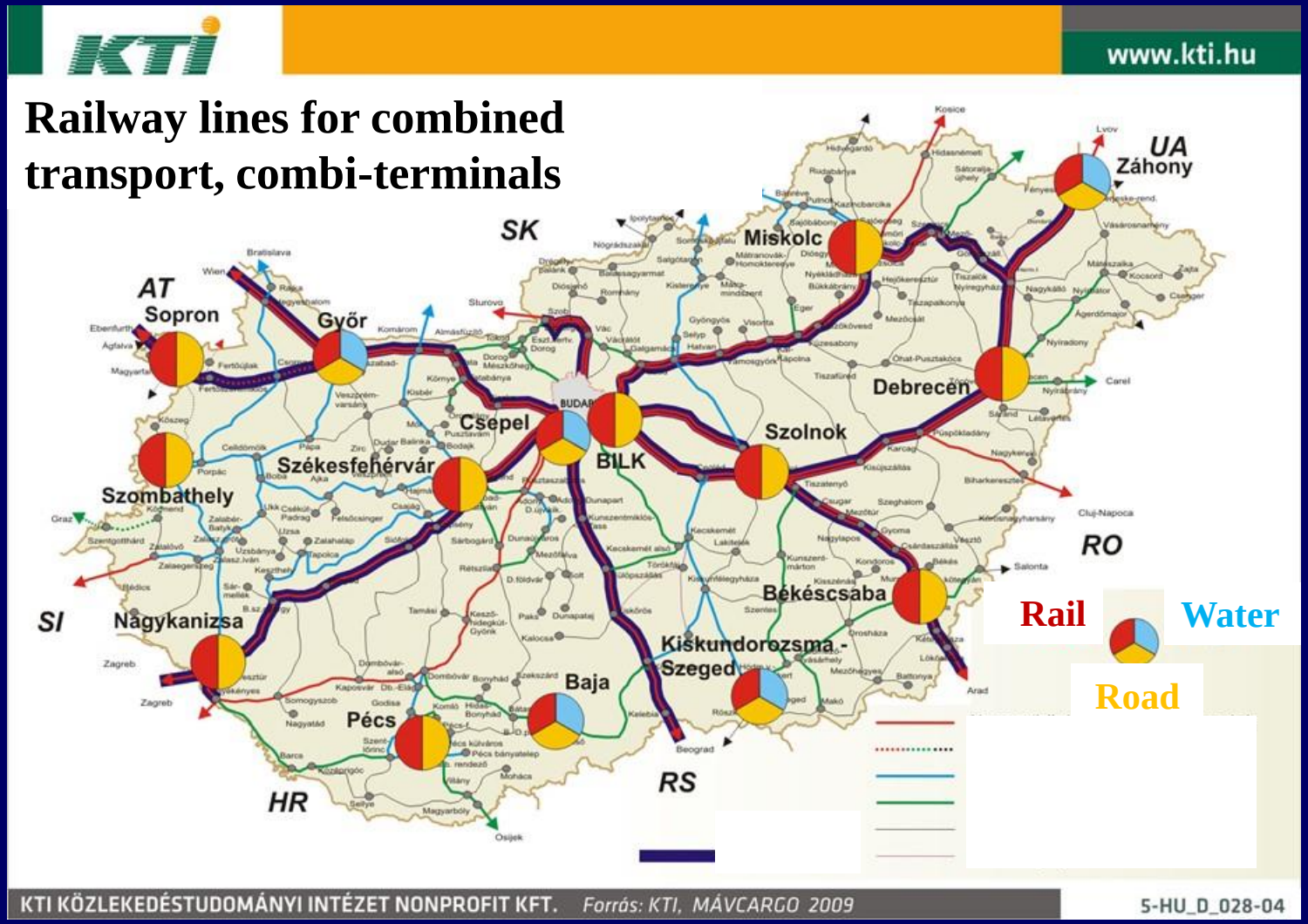
Source: Rodrigue, J-P et al. (2020) The Geography of Transport Systems, Hofstra University, Department of Global Studies & Geography, https://transportgeography.org/

Logistics centres



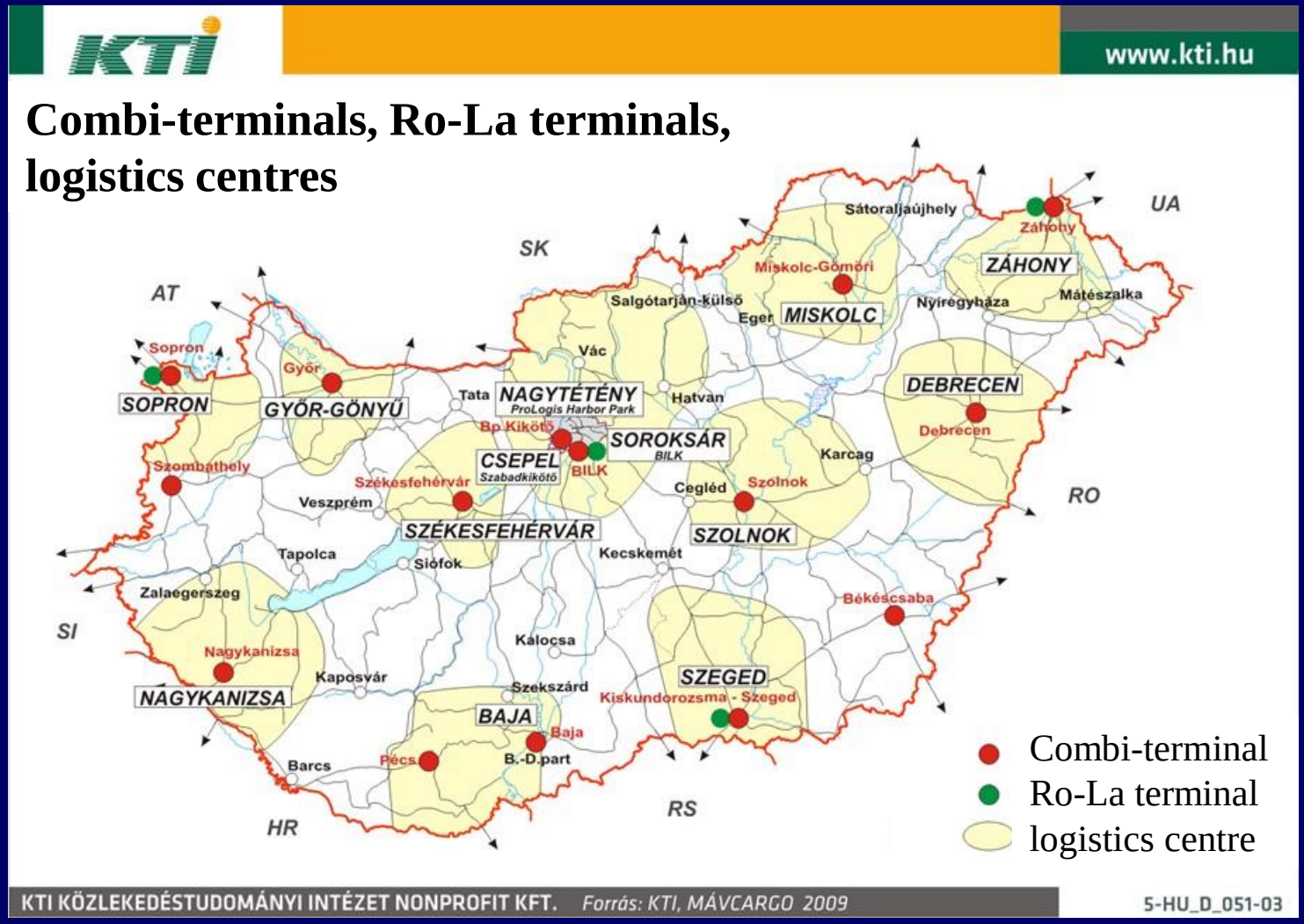
Source: Institute for Transport Sciences

Logistics centres



Source: Institute for Transport Sciences

Logistics centres



Source: Institute for Transport Sciences

Logistics centres

- **Budapest Intermodal Logistics Centre (BILK) – provides complex logistics services:**
  - **Transport preparation**
  - **Freight transport**
  - **Supply, production and distribution functions**
  - **Collection and distribution functions**
  - **City supply logistics functions**
  - **JIT services for high capacity production systems in a 20 - 30 km area**
- **The complex has more than 207,000 m2 of warehouse and office space , including ‘A’ category logistics, cross-dock, refrigerated warehouses and ADR-certified warehouses, as well as office buildings.**

Source: www.bilk.hu

Logistics centres

Budapest Intermodal Logistics Centre (BILK)

Source: www.bilk.hu

Water transport networks

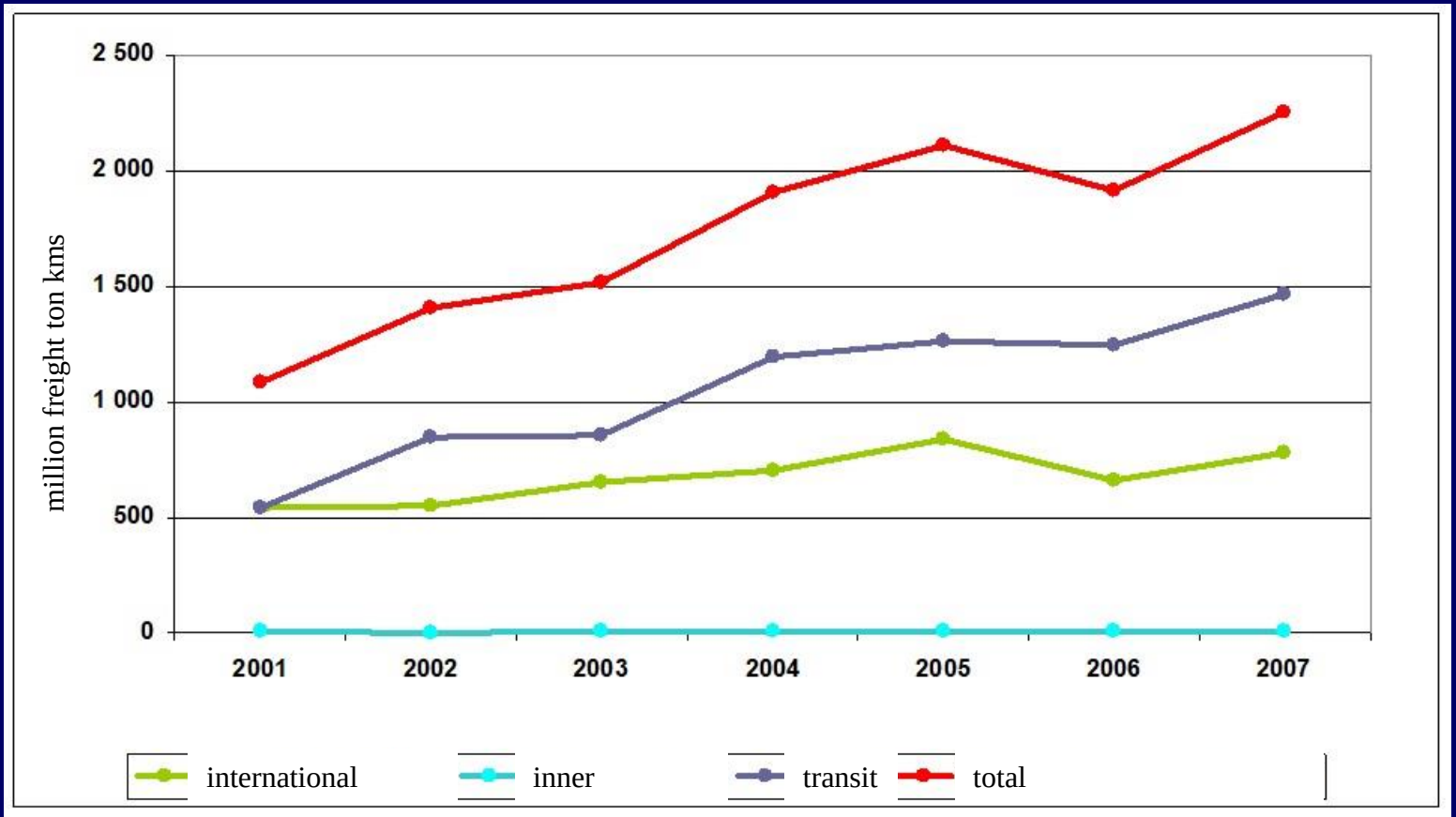
- Water transport can be regarded as a special guided transport, its characteristics are the slow but continuous movement and the ability for transport of large masses.
- Water transport is affected by adverse weather conditions, on rivers navigability problems may occur in dry season, moreover on seas safety and security issues may be present.
- Water transport is environment friendly, therefore it would be worth to increase its proportion.
- Water passenger transport mainly consists of leisure time travelling.

Water transport networks in Hungary

- In Hungary water transport takes about 5-6 % of the total freight transport volume.
- There is a difference between the inner and international transport, the latter being more significant, reaching a 10 % proportion in freight ton kms (export, import and transit together).
- In Hungary in the passenger water transport the tourism is the main activity, although in Budapest recently in a certain period public transport ship lines had been operated as well (between 2012 and 2020).

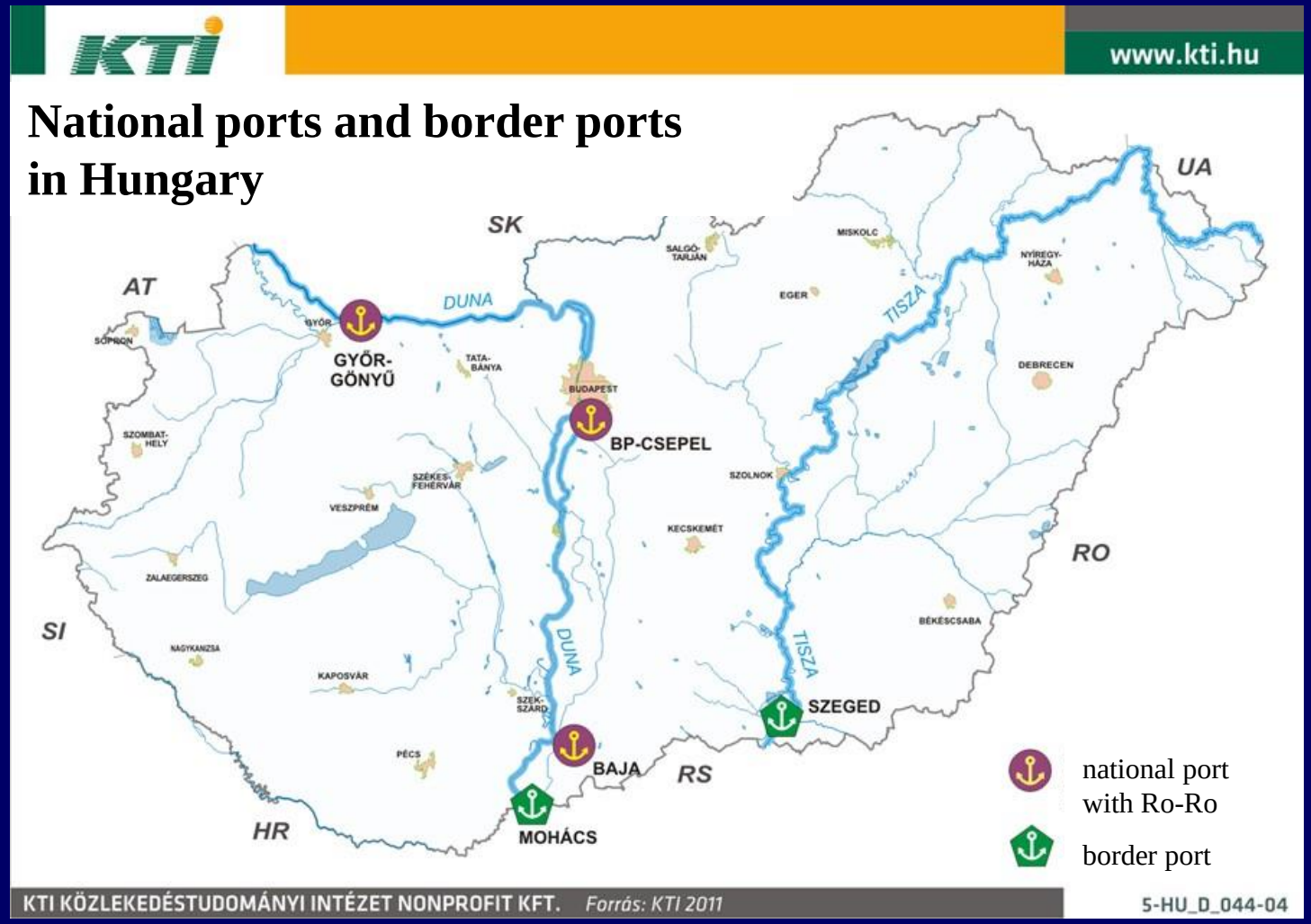
Water transport networks in Hungary

Water transport in Hungary 2001-2007



Source: „Tanulmányok a Duna hajózhatóságának javításáról” program - Környezeti vizsgálat (in Hungarian)

Water transport networks in Hungary



Source: Institute for Transport Sciences

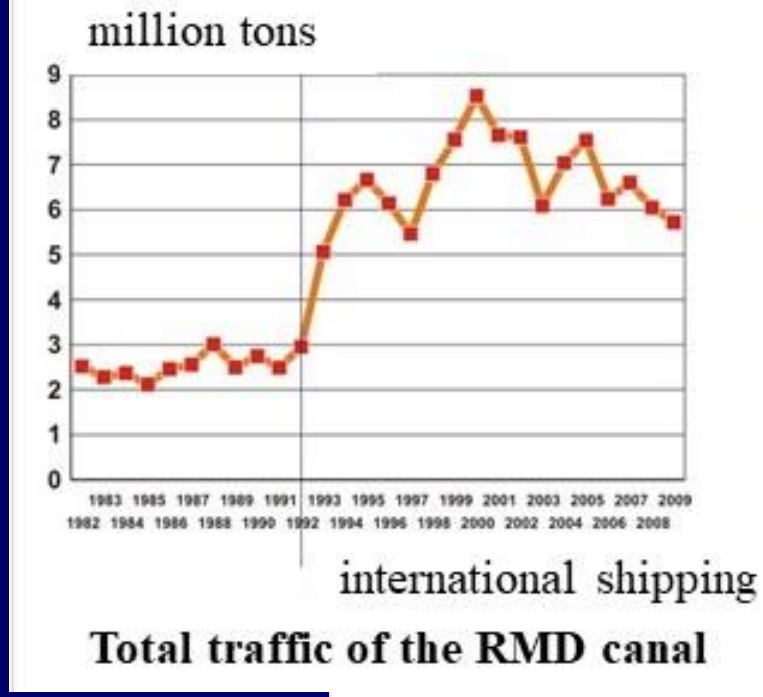
Water transport networks in Europe

- **The Rhine-Main-Danube waterway is the longest inland waterway in the world, its length is 3483 km, connecting about 12 000 km waterways. Its crucial element is the 171 km long Rhine-Main-Danube canal, constructed in 1992.**
- **The water connection between the Danube and the Rhine rivers had been considered by Charles the Great in 793, because of its military and trade potential.**
- **The narrow canal, that existed since the 1840s, has been reconstructed with 16 new locks, managed from four remote control centres.**

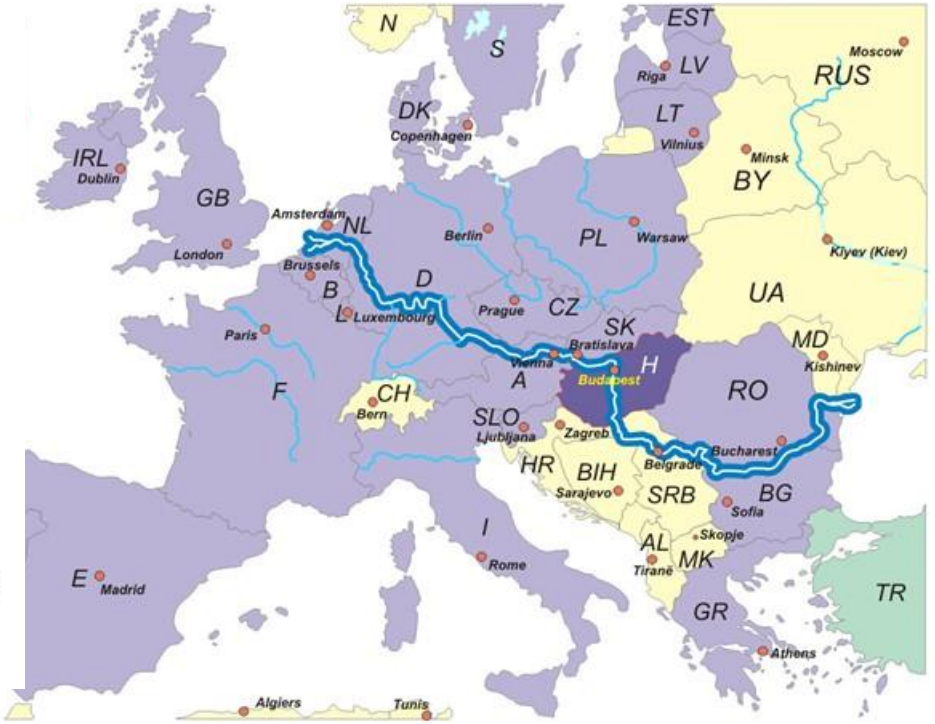
Water transport networks in Europe

KTI www.kti.hu

The Rhine-Main-Danube waterway



Total traffic of the RMD canal



KTI KÖZLEKEDÉSTUDOMÁNYI INTÉZET NONPROFIT KFT. *Forrás: Wasser und Schifffahrtsamt Nürnberg 2010* 1-HU_A_046-07

Source: Institute for Transport Sciences

Water transport networks in Europe

Water transport networks in Europe

- The world’s largest trade ship fleet is in Europe. In the European water transport there are 300 thousand employees, supplemented by about 3 million land employees. Every year more than 80 thousand merchant ships connect European ports.
- However, there is still a lot of administration and paperwork in the water transport. When a ship registered in the EU moves from Rotterdam to Antwerp, the quantity of the paperwork is the same as for a movement to Panama.
- In the Rotterdam port the loading and unloading are performed by automated cranes and vehicles.

Source: http://ec.europa.eu/transport/strategies/facts-and-figures/index_en.htm

Water transport networks in Europe

The Rotterdam port-system

Water transport networks in Europe

- **On the coasts, more and efficient entry points into European markets are needed, avoiding unnecessary traffic crossing Europe. Seaports have a major role as logistics centres and require efficient hinterland connections. Their development is vital to handle increased volumes of freight both by short sea shipping within the EU and with the rest of the world. Inland waterways, where unused potential exists, have to play an increasing role in particular in moving goods to the hinterland and in linking the European seas.**

Source: European Commission: COM(2011) 144 White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system

Water transport networks in Europe

- **The European Maritime Transport Space without Barriers should be further developed into a "Blue Belt" of free maritime movement in and around Europe, and waterborne transport should be used to its full potential.**
- **Establish an appropriate framework to optimise the Internal Market for Inland waterway transport, and to remove barriers that prevent its increased use. Assess and define the necessary tasks and mechanisms for their execution, also with a view to the wider European context.**

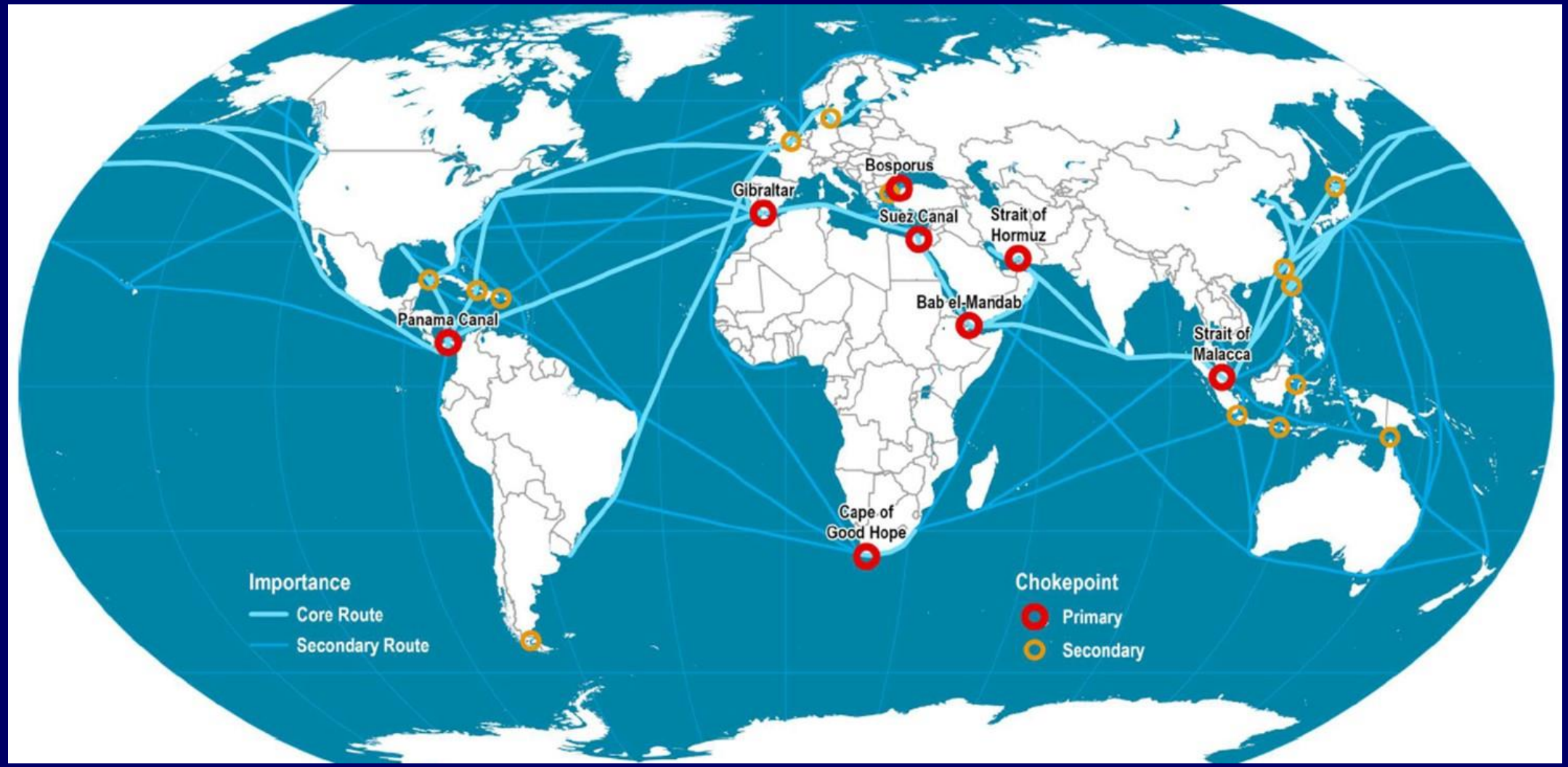
Source: European Commission: COM(2011) 144 White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system

Water transport networks worldwide

Canals in North-East America in the 19th century

Water transport networks worldwide

Main maritime shipping routes and chokepoints



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

Air transport networks

- Air transport – despite of its virtual freedom – is a guided transport mode, because of the pre-defined pathways or airways, called flight paths, three-dimensional highways for aircraft.

- The specific energy requirement and the environmental pollution of the air transport is considerably high.
- Air transport is characterised by quick and significant changes, causing realignment of the network and the market.

Air transport networks

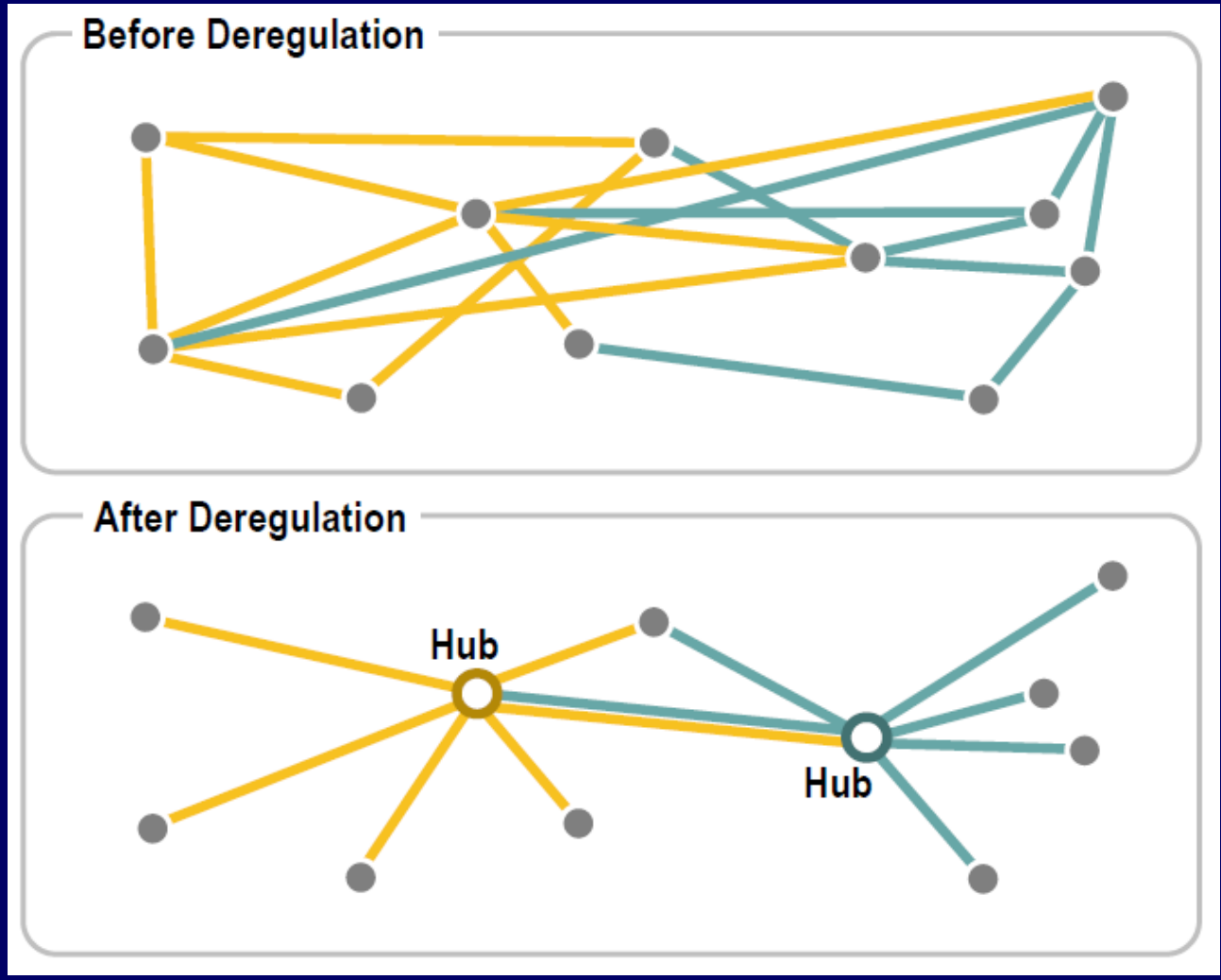
- The typical air transport network system is the hub and spoke system, that is advantageous in case of shorter routes and smaller passenger demand, compared to direct connections.
- From the passengers' point of view, the somewhat lengthened travel time is compensated by the increased accessibility and lower fares.
- The hub and spoke system is mainly used in the USA and Africa.
- In case of a higher passenger demand it is still worth to organise direct routes.

Air transport networks

Airline deregulation and hub-and-spoke networks

Point to point

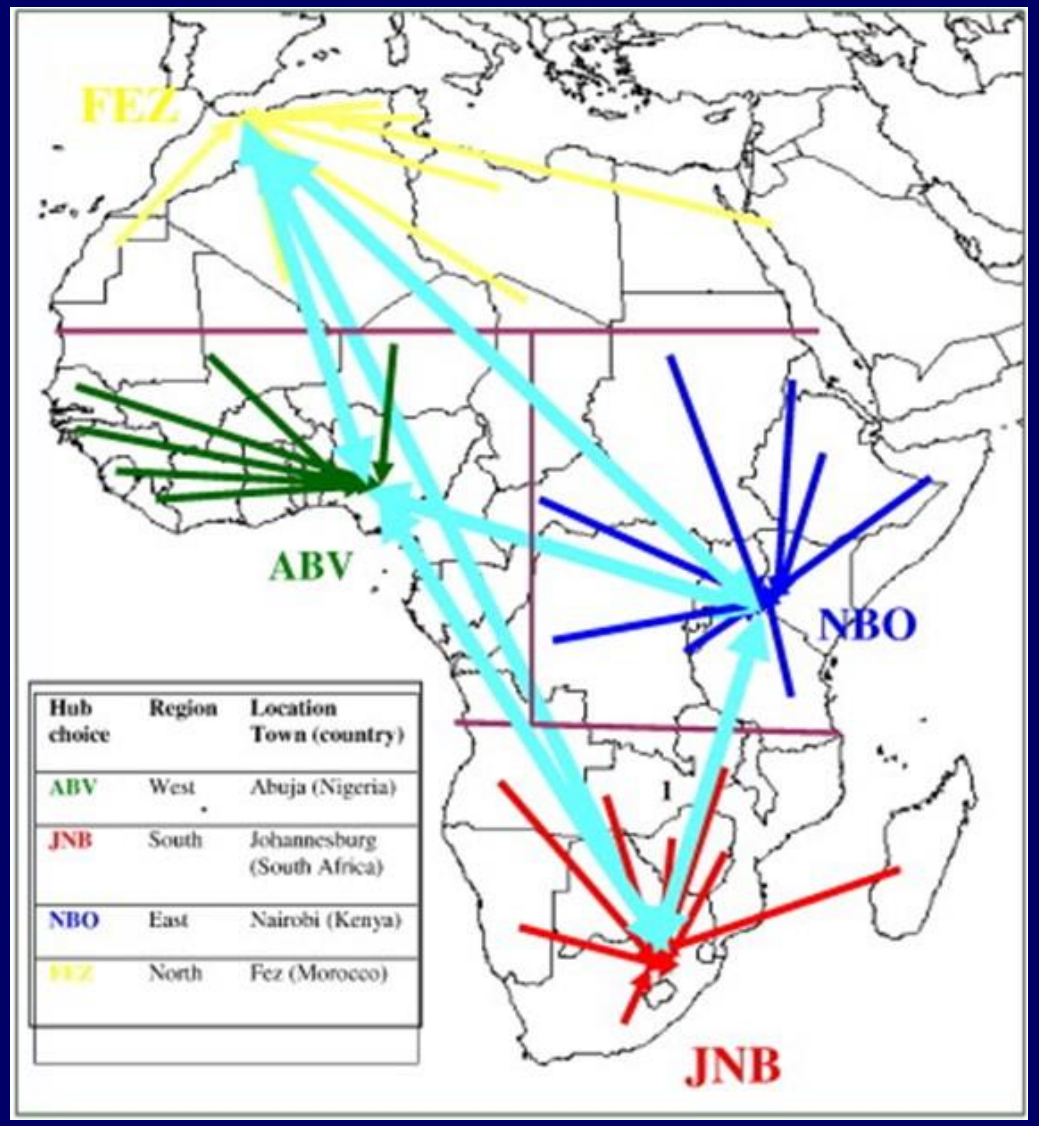
Hub-and-spoke



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

Air transport networks

African example of hub-and-spoke air networks, with direct routes between hubs



Source: Bridget Ssamula: Comparing air transport network operations in sparse networks in Africa. Elsevier Research in Transportation Business & Management Volume 4, October 2012, Pages 22–28.

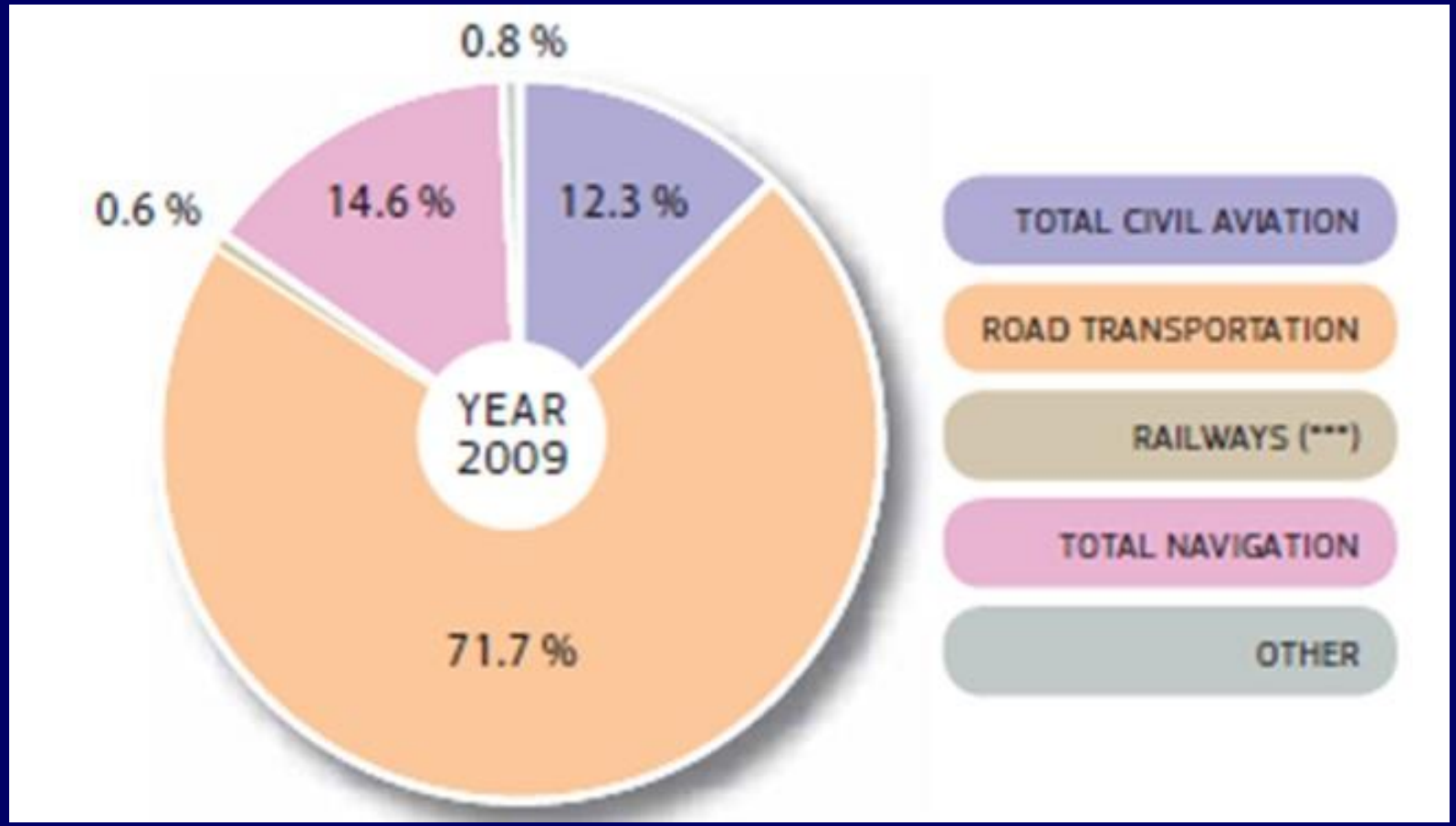
Air transport networks in Europe

- In the European air transport there are 670 thousand employees (together with airports), supplemented by about 3.2 million employees in companies depending on air transport.
- A railway trip between London and Brussels results nine times less harmful emission than a similar air trip.
- The new generation of aircrafts has about 10-15 % less harmful emission. There is an expected 40 % decrease until 2030.
- A current objective is the Single European Sky, including an European air traffic management infrastructure modernisation program.

Source: http://ec.europa.eu/transport/strategies/facts-and-figures/index_en.htm

Air transport networks in Europe

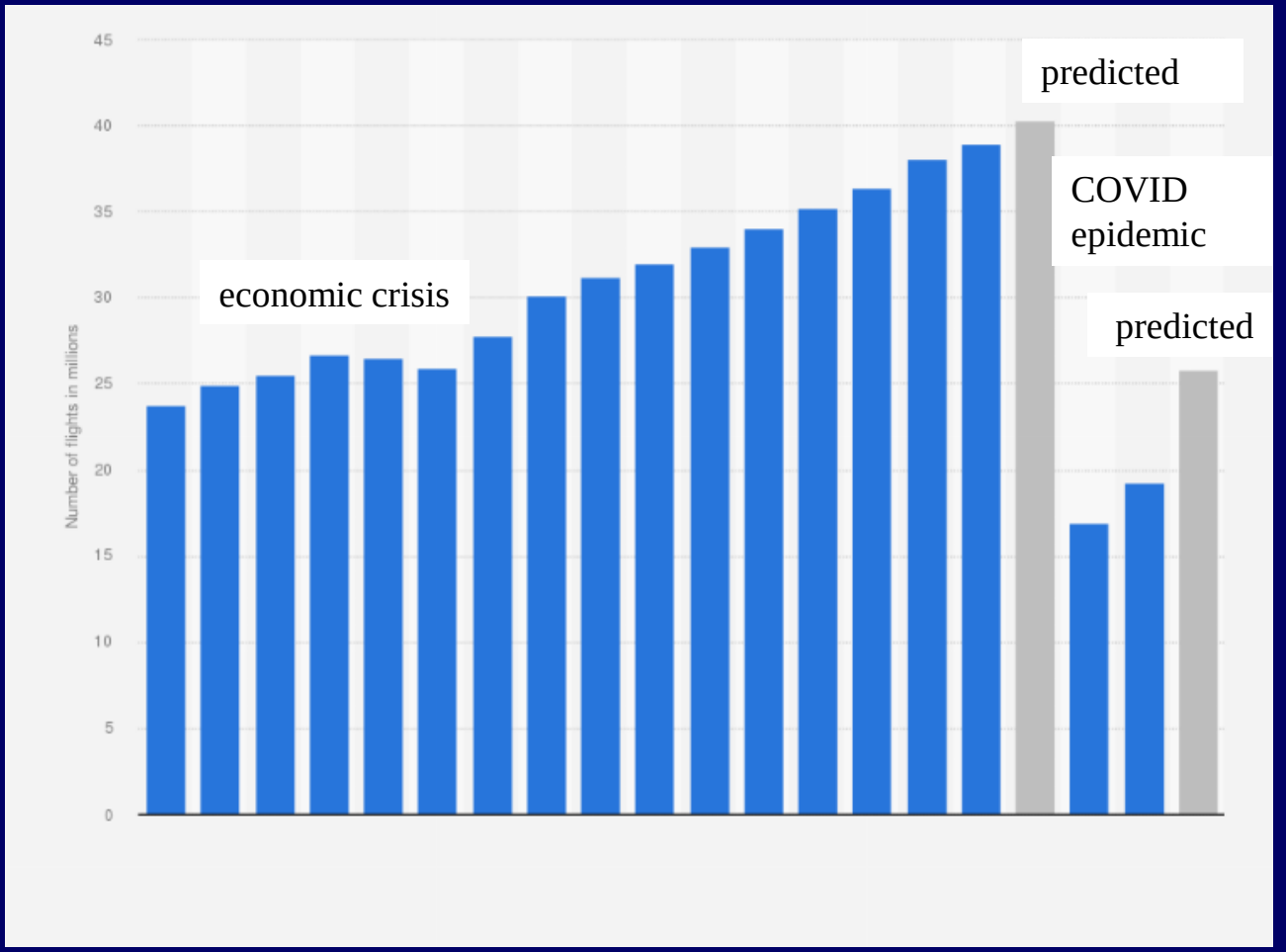
CO_2 emission proportions of transport modes



Source: European Commission: EU transport in figures. Statistical pocketbook 2012. http://ec.europa.eu/transport/facts-fundings/statistics/doc/2012/pocketbook2012.pdf

Air transport networks worldwide

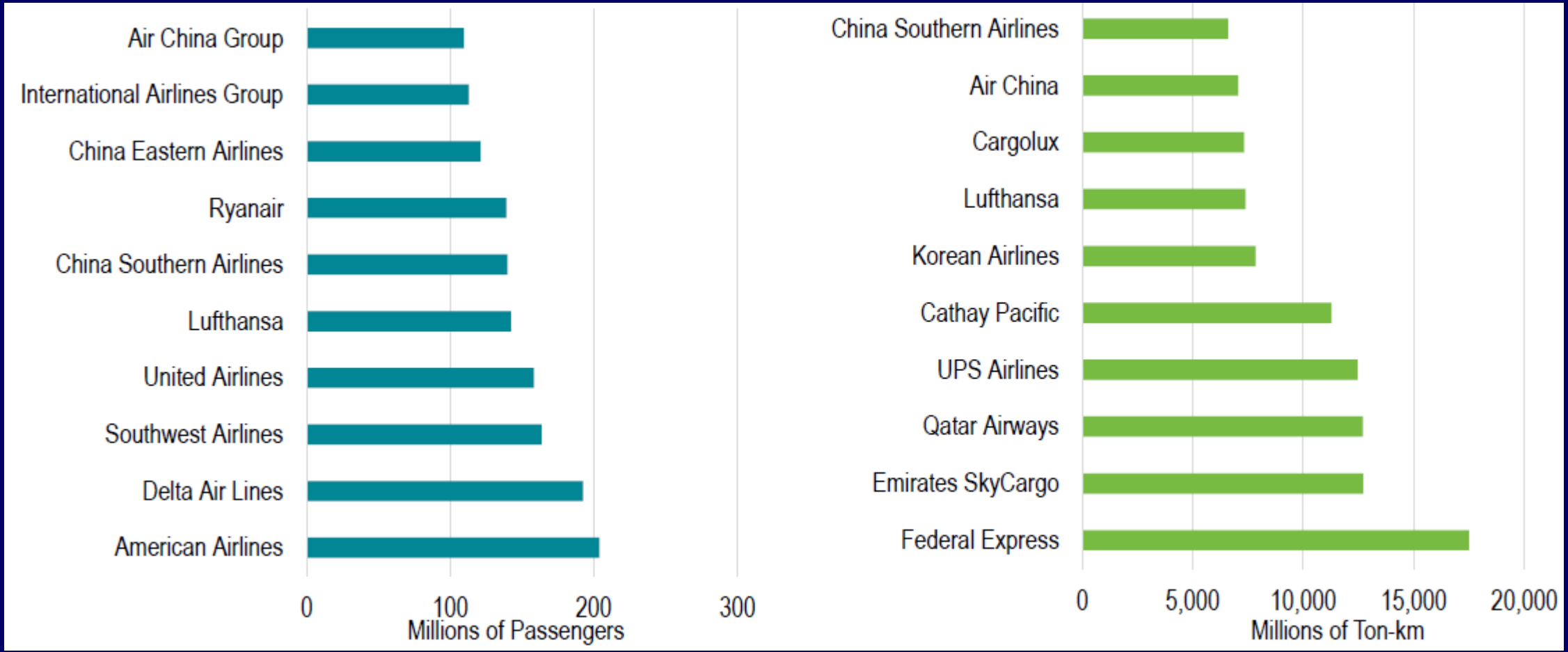
Number of flights performed by the global airline industry from 2004 to 2022 (in millions)



Source: https://cdn.statcdn.com/Statistic/560000/564769-blank-754.png

Air transport networks worldwide

World's 10 largest passengers and freight airlines 2018



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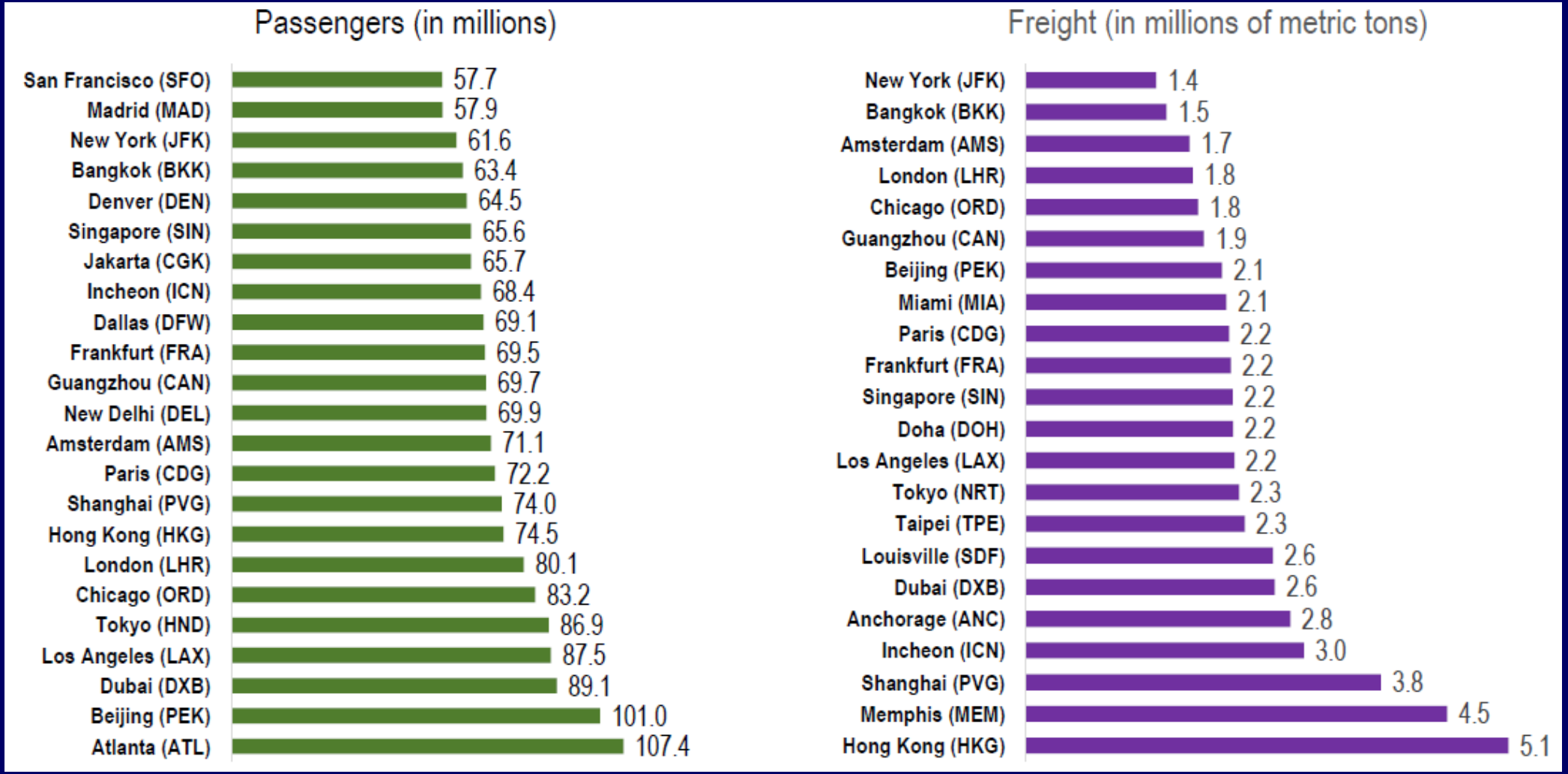
Air transport networks worldwide

World's 10 largest passengers and freight airports 2018



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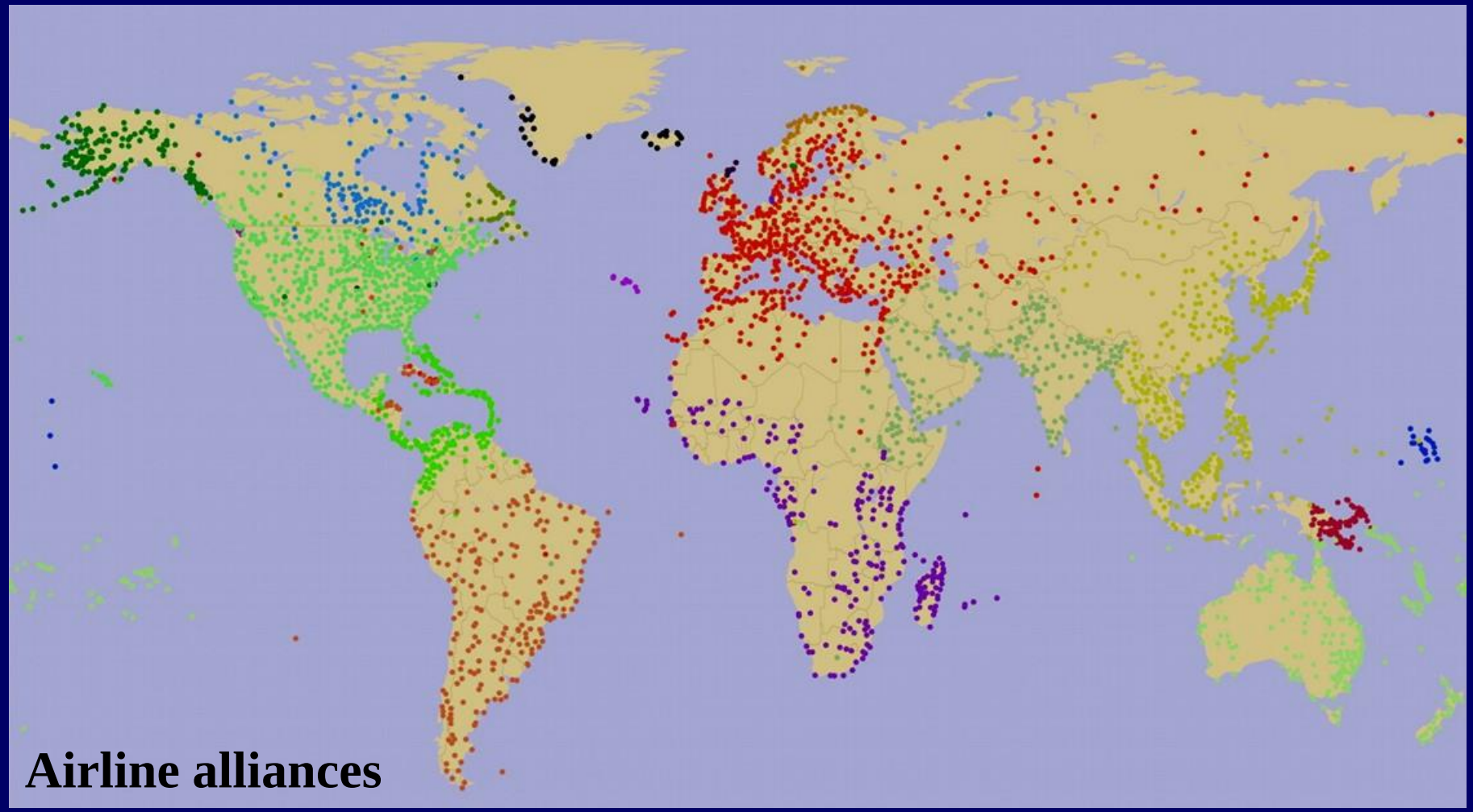
Air transport networks worldwide



Source: R. Guimerà, S. Mossa, A. Turtschi, L.A.N. Amaral: The worldwide air transportation network: Anomalous centrality, community structure, and cities' global roles Proceedings of the National Academy of Sciences of the USA May 31, 2005; 102 (22) http://www.pnas.org/content/102/22/7794.long

Air transport networks worldwide

Cities with most connections

Most central cities

Source: R. Guimerà, S. Mossa, A. Turtschi, L.A.N. Amaral: The worldwide air transportation network: Anomalous centrality, community structure, and cities' global roles Proceedings of the National Academy of Sciences of the USA May 31, 2005; 102 (22) http://www.pnas.org/content/102/22/7794.long

Airport transport connection

- The airports of the large cities with big passenger traffic can be connected directly into the high-speed railway system or at least to the urban or suburban metro or railway network.
- The rail connection provides a quick and convenient access to the city centre.
- A temporary solution is to establish a stop on an existing railway in case of smaller passenger traffic.

Airport transport connection

Brussels – railway access to the airport

Airport transport connection

- At the Budapest Airport there is a railway stop on an existing line near to Terminal 1 with a pedestrian overpass where even intercity trains stop. Unfortunately Terminal 1 has been closed a few years ago. Terminal 2 can be reached only by bus from the railway stop.
- There are recent plans to construct a direct rail connection to Terminal 2.

Summary

- Determination of freight transport routes and freight transport modes calls for optimal solutions.
- Main elements of logistical systems are: the transport, the warehousing and the information system.
- Water transport is characterised by slow but continuous movement and the ability for transport of large masses.
- The typical air transport network system is the hub and spoke system.

Thank you for your attention!

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