THE TRANSPORTATION OBJECT PLATFORM

TOP

Background and visions

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THE PRESENTATION:

1. Introduction
2. The EU-project BRIDGES
3. The Copenhagen-Ringsted Models
4. Background for the TOP-project
5. The TOP-solution
6. Introduction to main topological objects in TOP
7. Benefits of TOP
8. Why ScanRail launched the TOP-project

MODELS WITH INCREASING TOPOLOGIC COMPLEXITY OVER TIME:

- Early road based models with simple link-node topology
- Intersection delay models
- Public transport specific planning models
- Multi-modal models
- Rail specific simulation models

PURPOSES OF BRIDGES:

- To ‘bridge’ traffic models and GIS
- To develop a Generalized Transport Format (GTF) for the exchange of traffic modeling data
- This should reflect different topologic models in the most commonly used software packages
- To develop a specific format – ‘GIS-GTF’ – for exchange of data with GIS
- To develop ‘workarounds’ for maintaining the most common topologic traffic modeling objects in GIS

ORGANISATION:

- Funded by EU for 1997-1999 (1 mill. Euro)
- International consortium with European Universities and Private Companies
- DTU and ScanRail Consult was responsible for GIS-GTF and for ARC/INFO Workarounds
- The conceptual discussions are continued in a more ‘exclusive’ consortia in the EU-funded SPOTLIGHT-project

2. The EU-project BRIDGES

Topologic relationships transit networks:

ROUTE-SEGMENTS

ID	CHANGE-TO	SEGMENT-LIST	ROUTE
RS1	C6,C1,C7	L3	R4
RS2		L4	R4
RS3		L3	R1
RS4		L2,T10,L5	R3
RS5	C2,C3,C8	L5,T9,L2,T7,L1	R4
RS6		L2,T10,L5	R2
RS7	C10	L1	R2
RS8	C4,C5,C9	L4	R2

CHANGES

ID	FROM-SEGMENT	TO-SEGMENT	AT-TERMINAL
C1	RS1	RS3	TE2
C2	RS5	RS2	TE2
C3	RS5	RS7	TE2
C4	RS8	RS3	TE2
C5	RS8	RS2	TE2
C6	RS1	RS7	TE2
C7	RS1	RS2	TE2
C8	RS5	RS3	TE2
C9	RS8	RS7	TE2
C10	RS7	RS6	TE1
C11	RS7	RS4	TE1

ROUTES

ID	SEGMENTS
R1	RS5,RS3
R2	RS8,RS7,RS6
R3	RS4
R4	RS1,RS2

LINKS

ID	TURNS-TO-FORWARD	TURNS-TO-BACKWARD
L1	T2,T4	T8
L2	T10	T7
L3		T3,T5
L4	T6,T1	
L5	T9	

TERMINALS

ID	AT-NODE	CHANGES
TE1	N1	C10,C11
TE2	N2	C1,C2,C3,C4,C5, C6,C7,C8,C9

TURNS

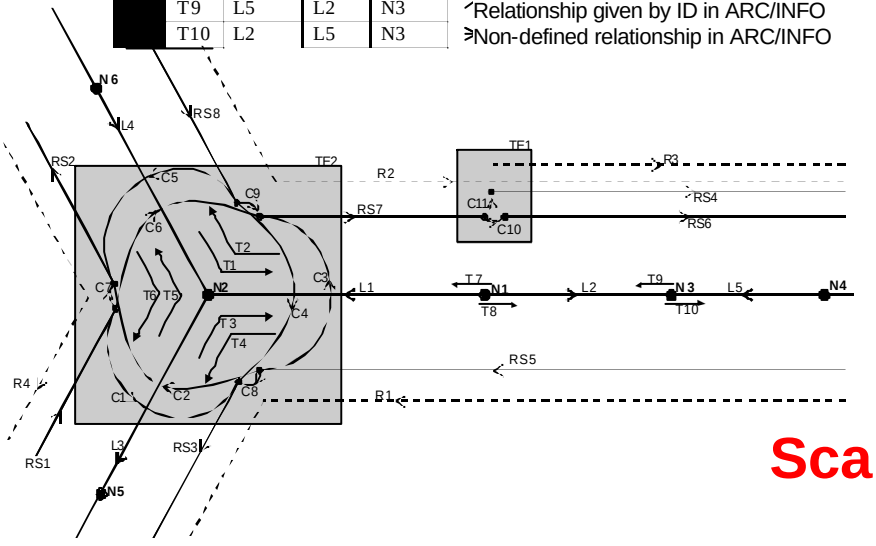
ID	FROM-LINK	TO-LINK	AT-NODE
T1	L4	L1	N2
T2	L1	L4	N2
T3	L3	L1	N2
T4	L1	L3	N2
T5	L3	L4	N2
T6	L4	L3	N2
T7	L2	L1	N1
T8	L1	L2	N1
T9	L5	L2	N3
T10	L2	L5	N3

NODES

ID	TURNS
N1	T7,T8
N2	T1,T2,T3, T4,T5,T6
N3	T9,T10
N4	
N5	
N6	

Relationship given by ID in ARC/INFO

Non-defined relationship in ARC/INFO



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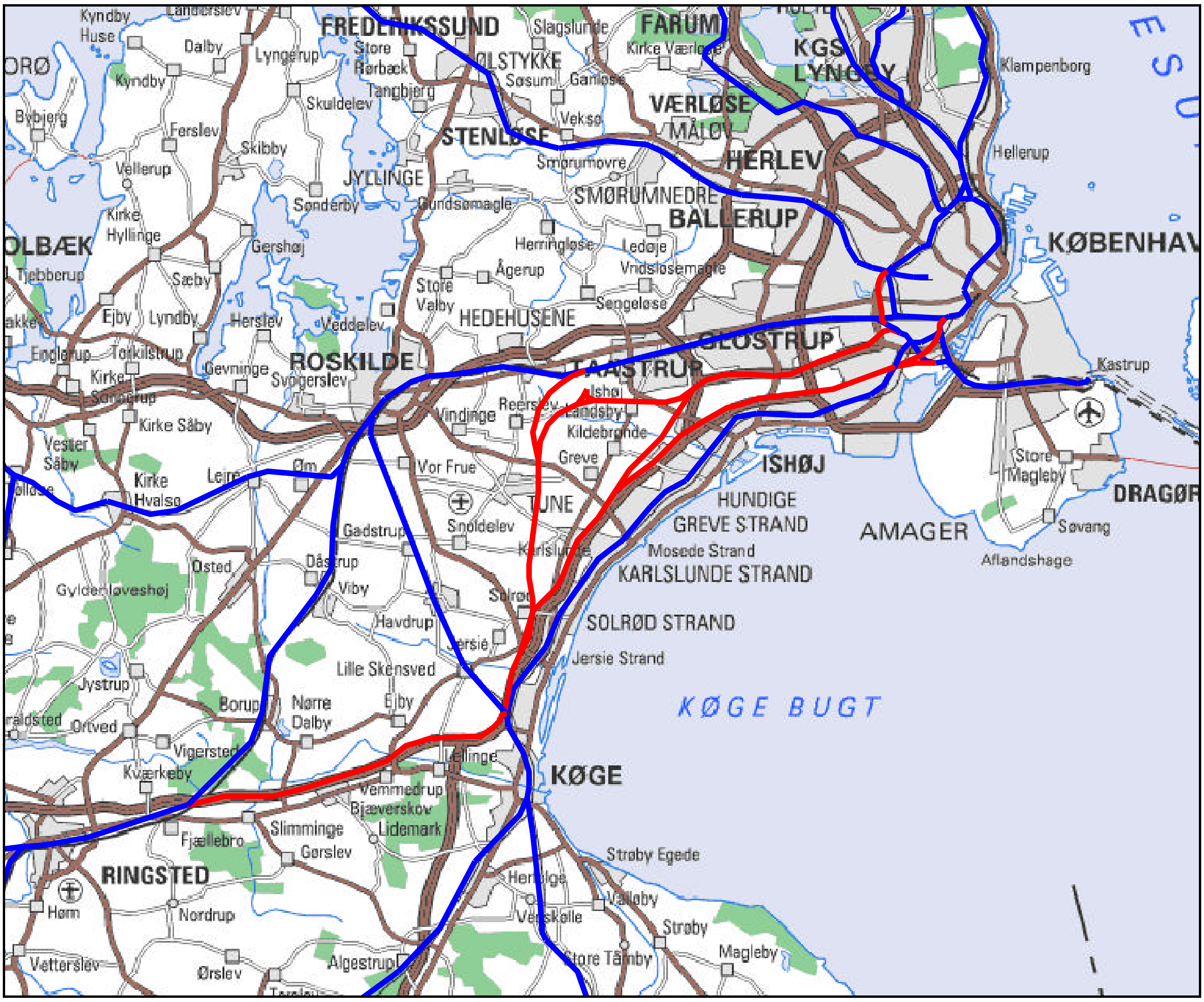
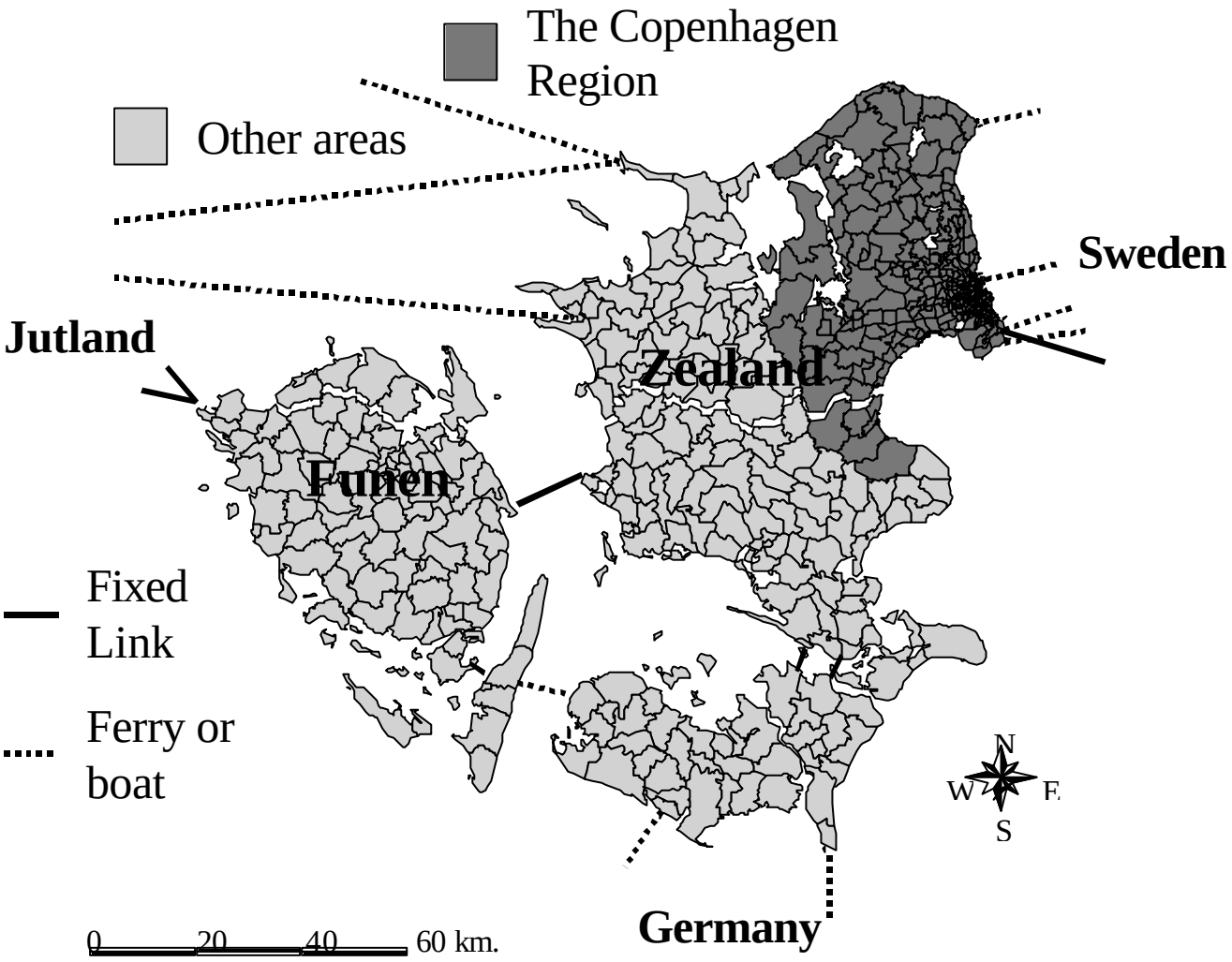
LESSONS LEARNED:

- Extremely difficult to maintain multi-modal traffic modeling data in GIS
- Very difficult to formulate simple topo-logic models with a sufficient degree of generalization
- Standard traffic modeling packages contain redundant data in many cases
- Or they contain data that is under-defined in a geographical sense
- Paradoxically, it was extremely difficult to make some traffic modelers think geo-graphically

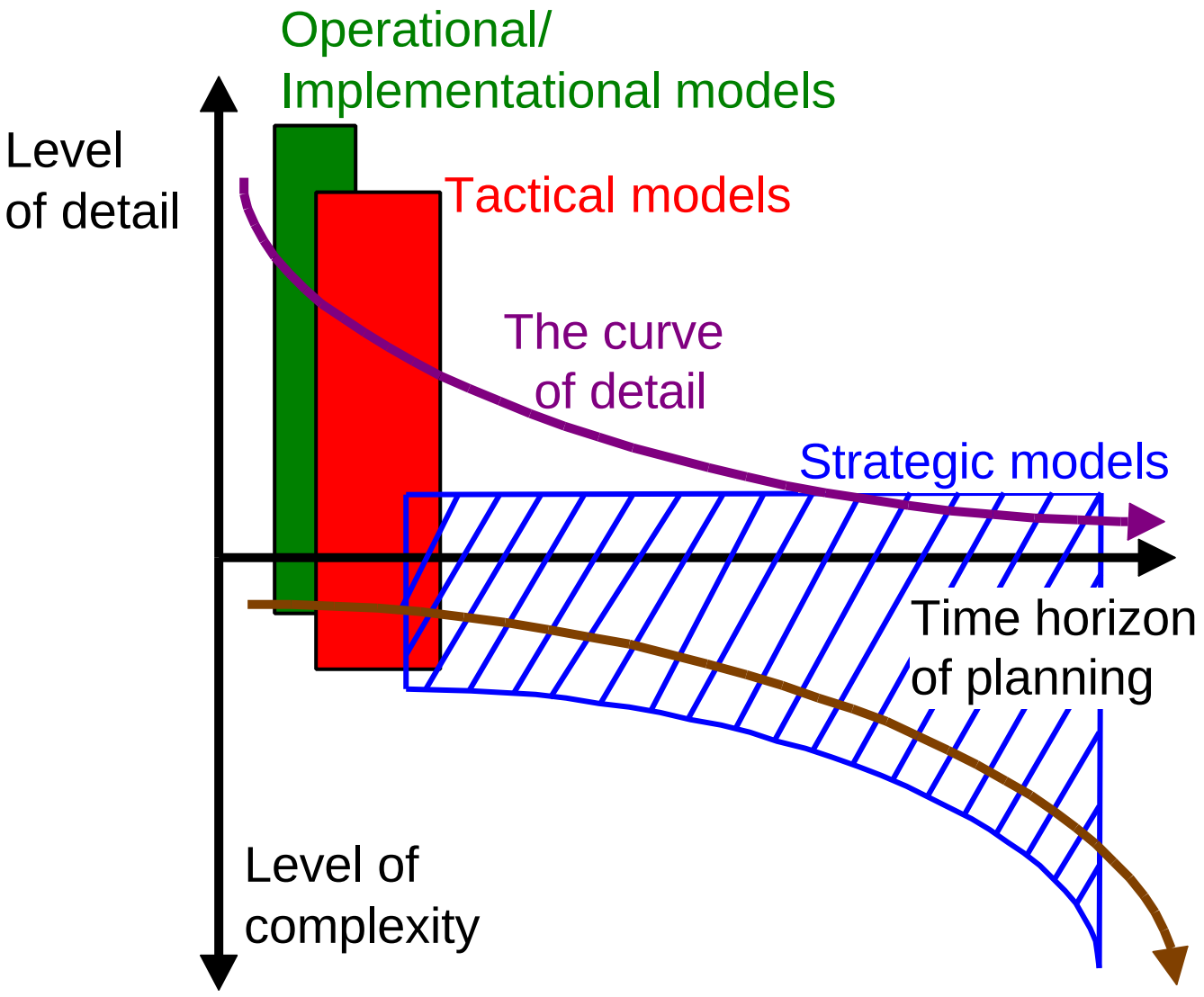
THE COPENHAGEN-RINGSTED RAILWAY PROJECT (1-1½ billion US$):



GEOGRAPHY:

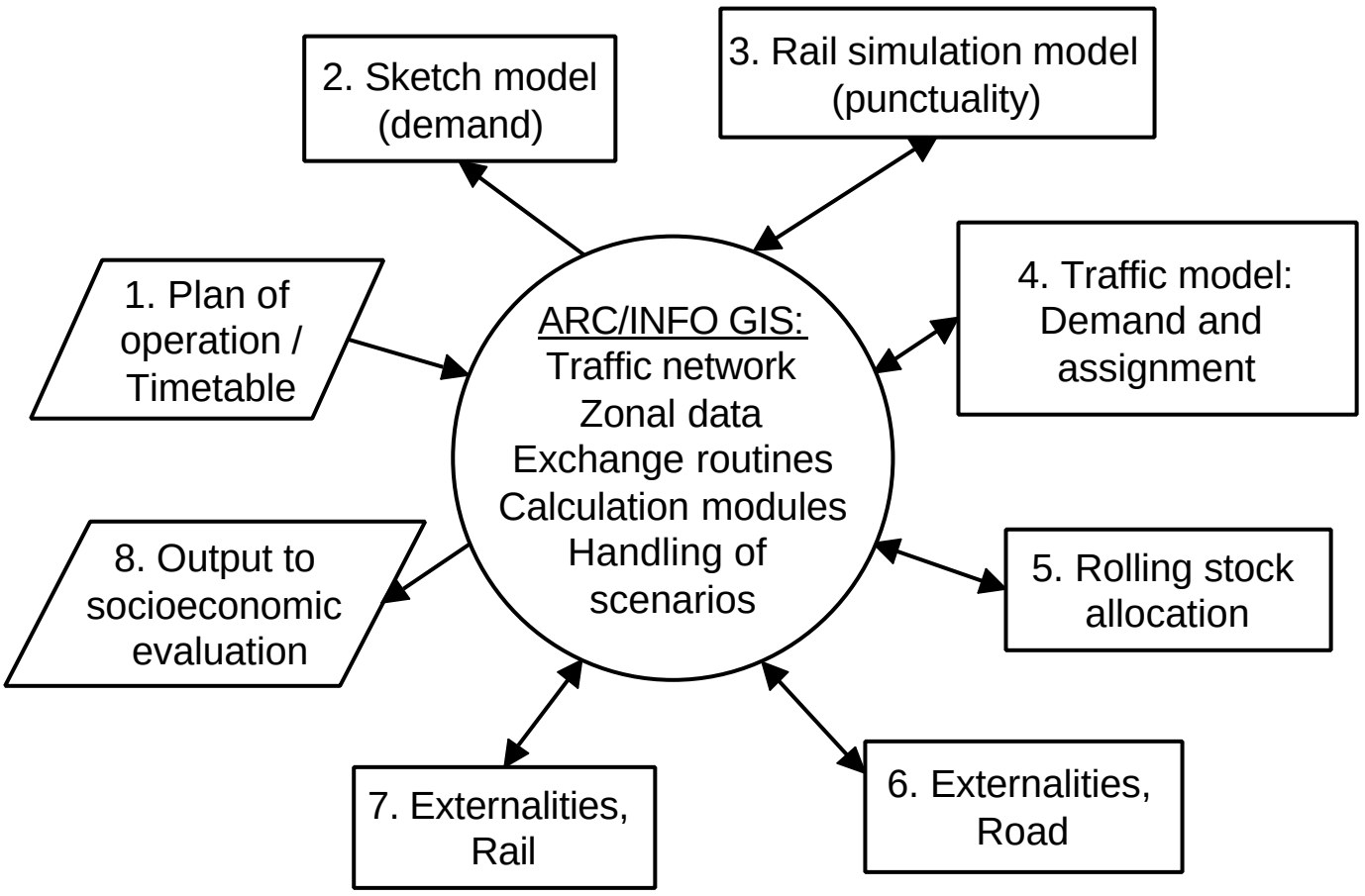

The Copenhagen Region
Other areas
Sweden
Jutland
Zealand
Funen
Fixed Link
Ferry or boat
N
W
E
S
0
20
40
60 km.
Germany

SUMMARY OF THE REQUESTS TO THE MODEL-ABILITIES:



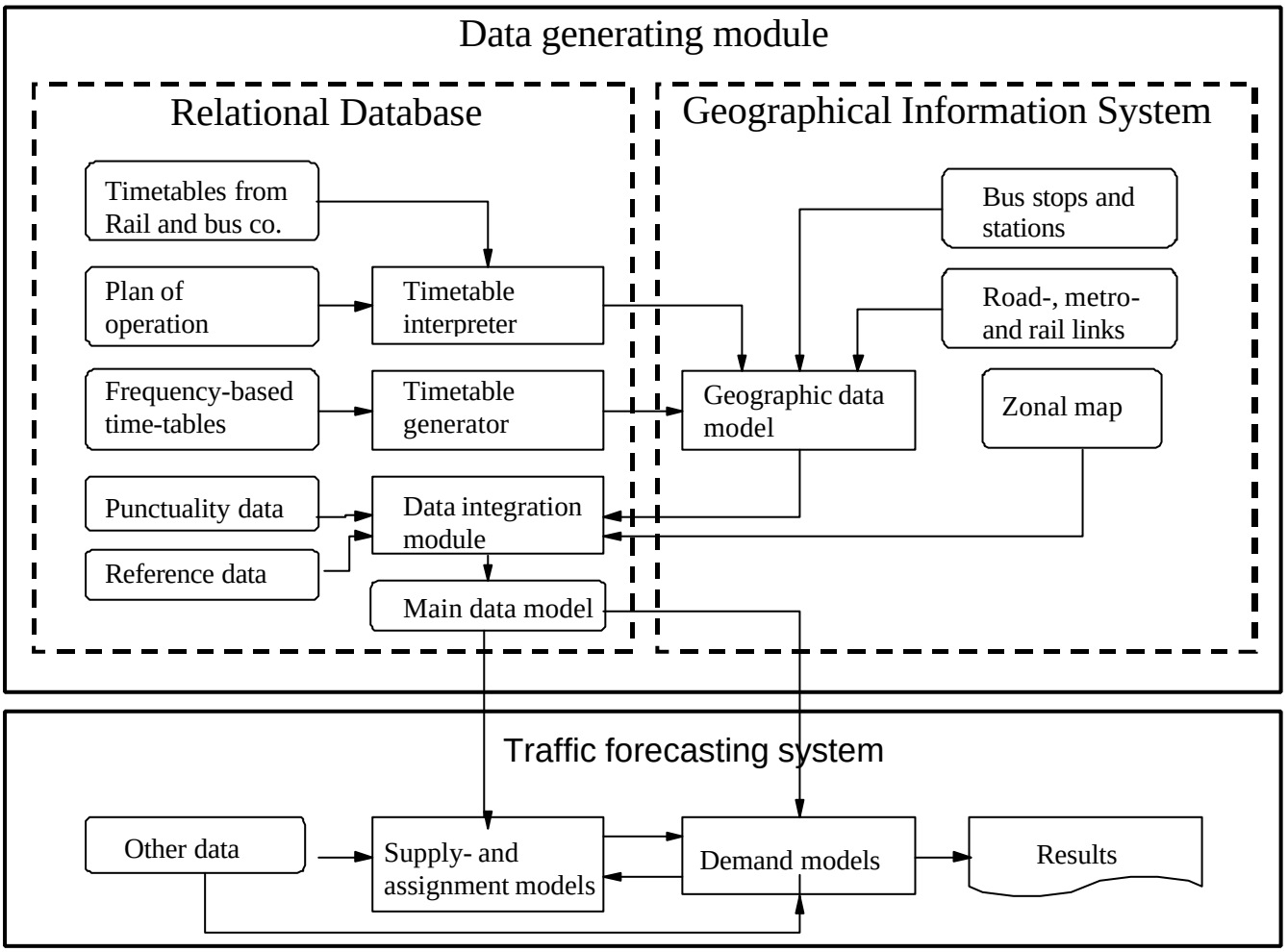
OVERVIEW OF THE MODELLING COMPLEX:

Main models:



3. The Copenhagen-Ringsted Models

DATA FLOW CONCERNING THE PUBLIC TRANSPORT NETWORK:



THE DATA FOUNDATION:

The *zone structure* includes 610 zones, resulting in matrices for:

- *Freight traffic:* Vans and trucks
- *Passenger traffic:* Bicycle, walk, public transport, and car
- *Trip purposes:* Commuters, business trips, education trips, and 'private' trips (leisure, shopping etc.).
- *Time of day:* 1 am -7 am; 7 am-9 am; 9 am-3 pm; 3 pm - 5 pm; 5 pm - 1 am

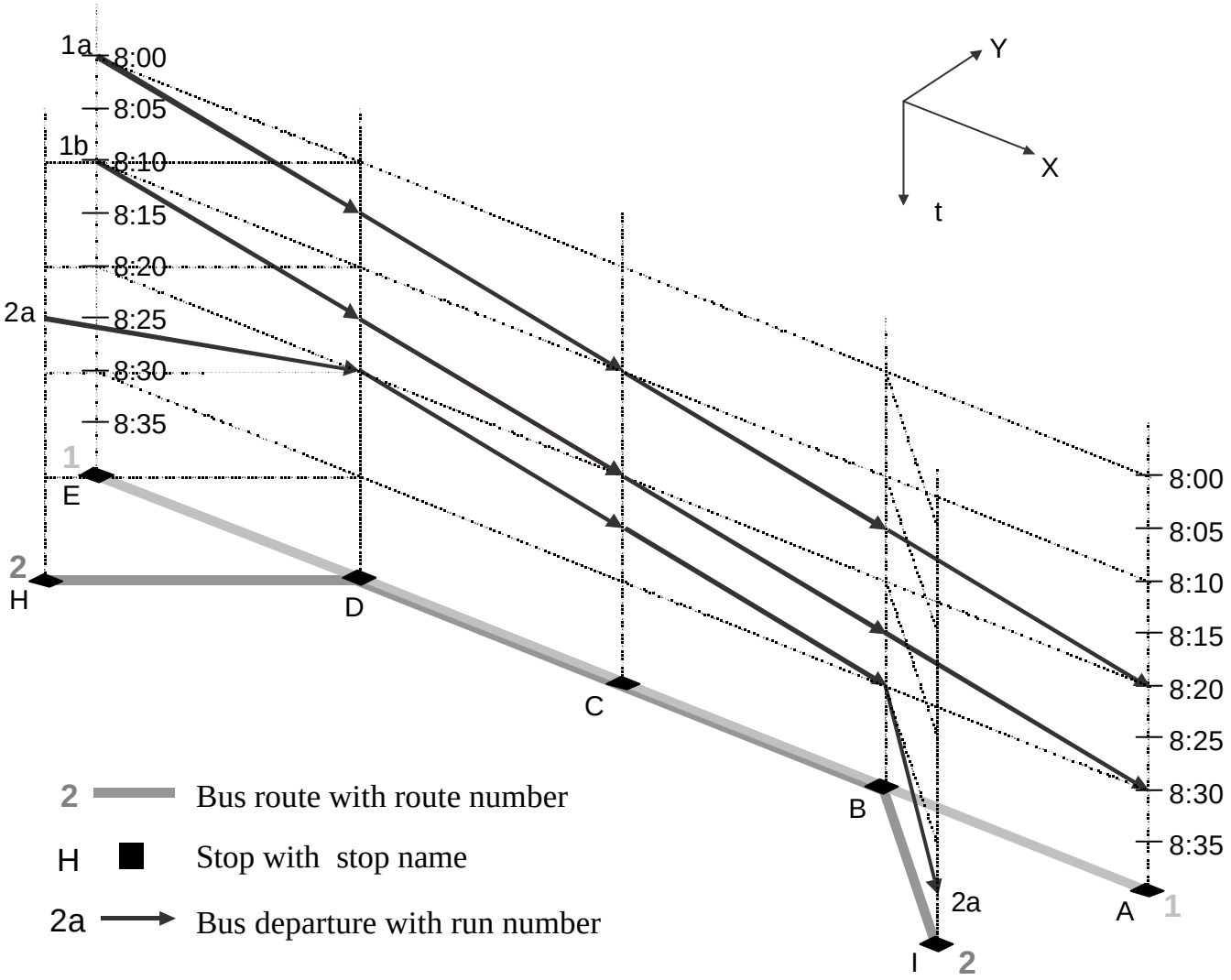
ROAD NETWORK:

- 2,369 intersections with 19,111 turns
- 24,677 links, hereof;
- 747 zone-connectors, 12,006 bus-roads, 3,000 in Copenhagen. and 9,000 in the rest of the modeling area

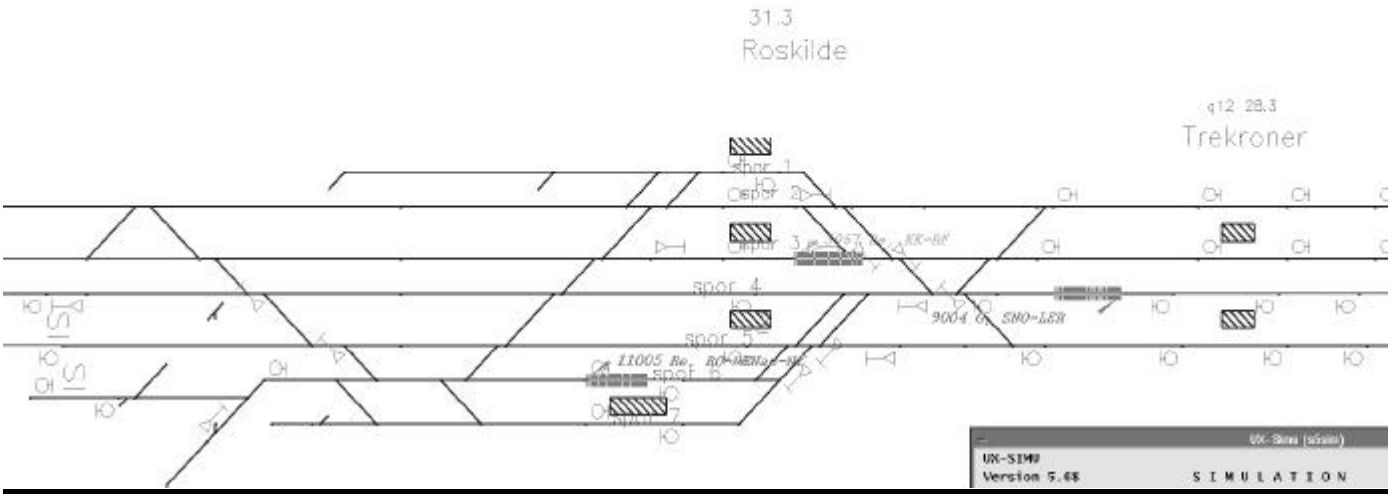
PUBLIC TRANSPORT NETWORK:

- All lines and departures for rail and buses in the model area
- Walk-links and zone-connectors
- The resulting graph has about 0,5 mill. nodes and 3 mill. links

TIMETABLE INFORMATION:

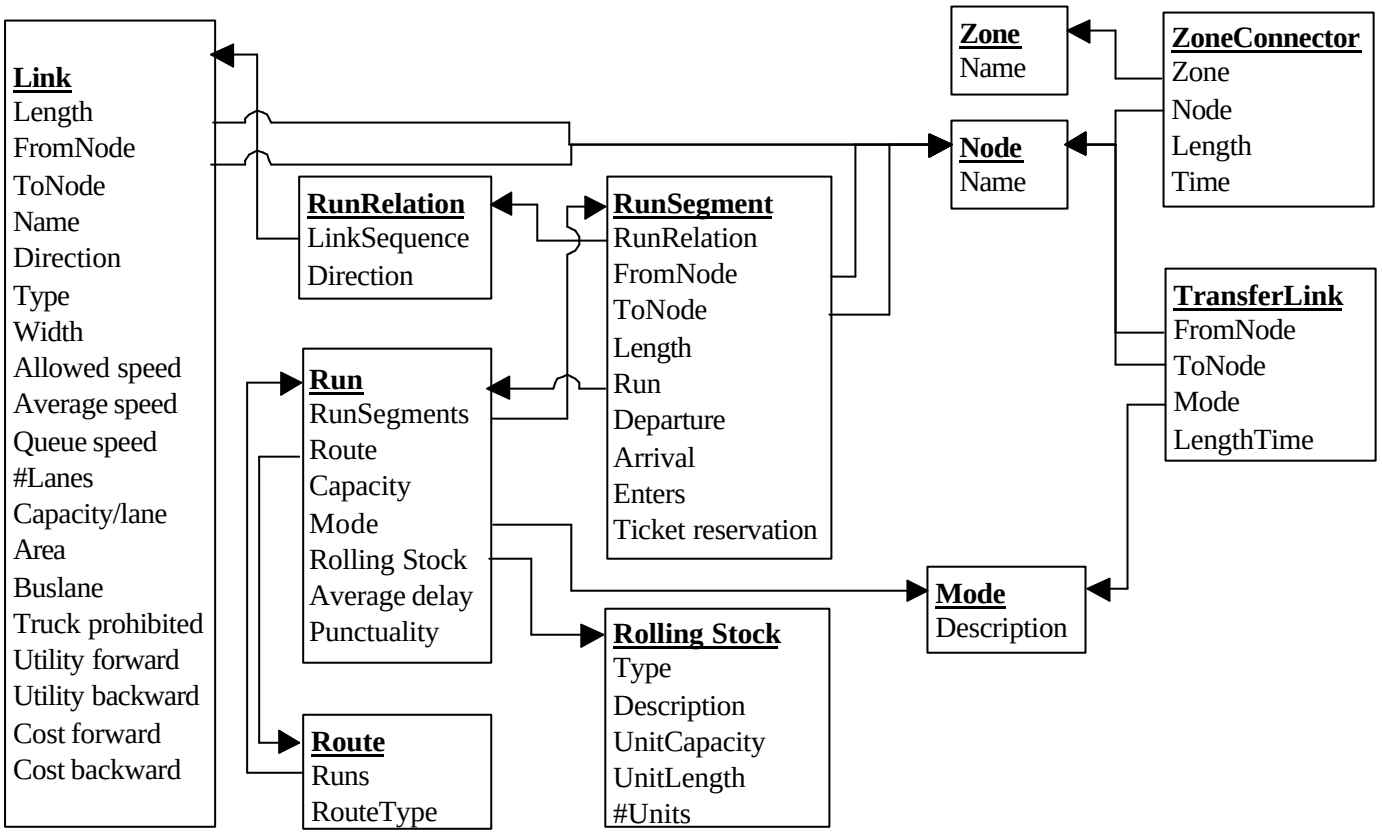


THE DATA FOUNDATION FOR THE REGULARITY MODEL:



- Main rail network in the whole area
- Calibrated from automatic registrations of delays
- Secondary lines, urban rail and buses described by statistical distributions

MAIN TOPOLOGICAL DATA MODEL FOR PUBLIC TRANSPORT



BACKGROUND FOR THE TOP PROJECT:

Problems with conventional models:

- Separate Departments are responsible for infrastructure-, timetable- and rolling stock data
- Data is often placed on different soft-ware platforms
- Some data are even stored in closed proprietary formats

Complex features - e.g. interchanges at terminals - are not treated explicitly as unique topological objects

THE RESULTING PROBLEMS:

4. Background for the TOP-project

- Models do not fully utilize the available data
- Inconsistencies between ‘sub-solutions’ in data platforms
- Sub-models do not prevent inconsistent data
- Lack of proper visualization and editing tools contribute to data inconsistency
- Lack of tools for scenario management
- Different formats from different vendors lead to numerous one-time translation and aggregation tasks

TOP-VISIONS:

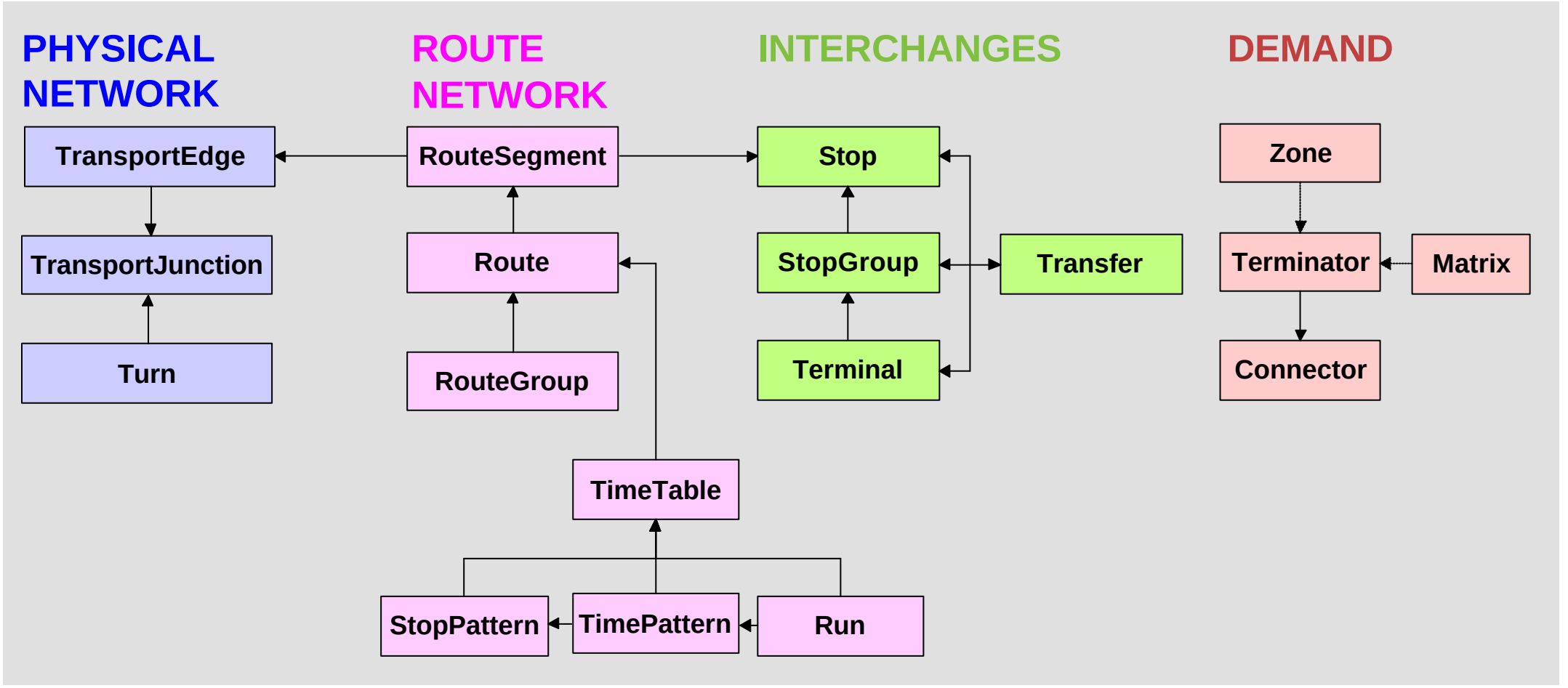
- An open and extensible object model based on the ArcInfo 8 Geodatabase
- COM components of *TOP* are custom behavior classes in the Geodatabase
- Forced intelligent relations between objects in *TOP*
- This applies to all client-applications

Special tools supplement ArcMap for analysis, modeling and presentation purposes:

- Visualization and editing complex multi-modal network data
- Managing demand data; e.g. trip-matrices and freight delivery tables
- Datamodel-foundation for complex modeling applications
- Display results from applications; e.g. transfer patterns in a terminal
- Methods for managing hierarchical scenario-structures

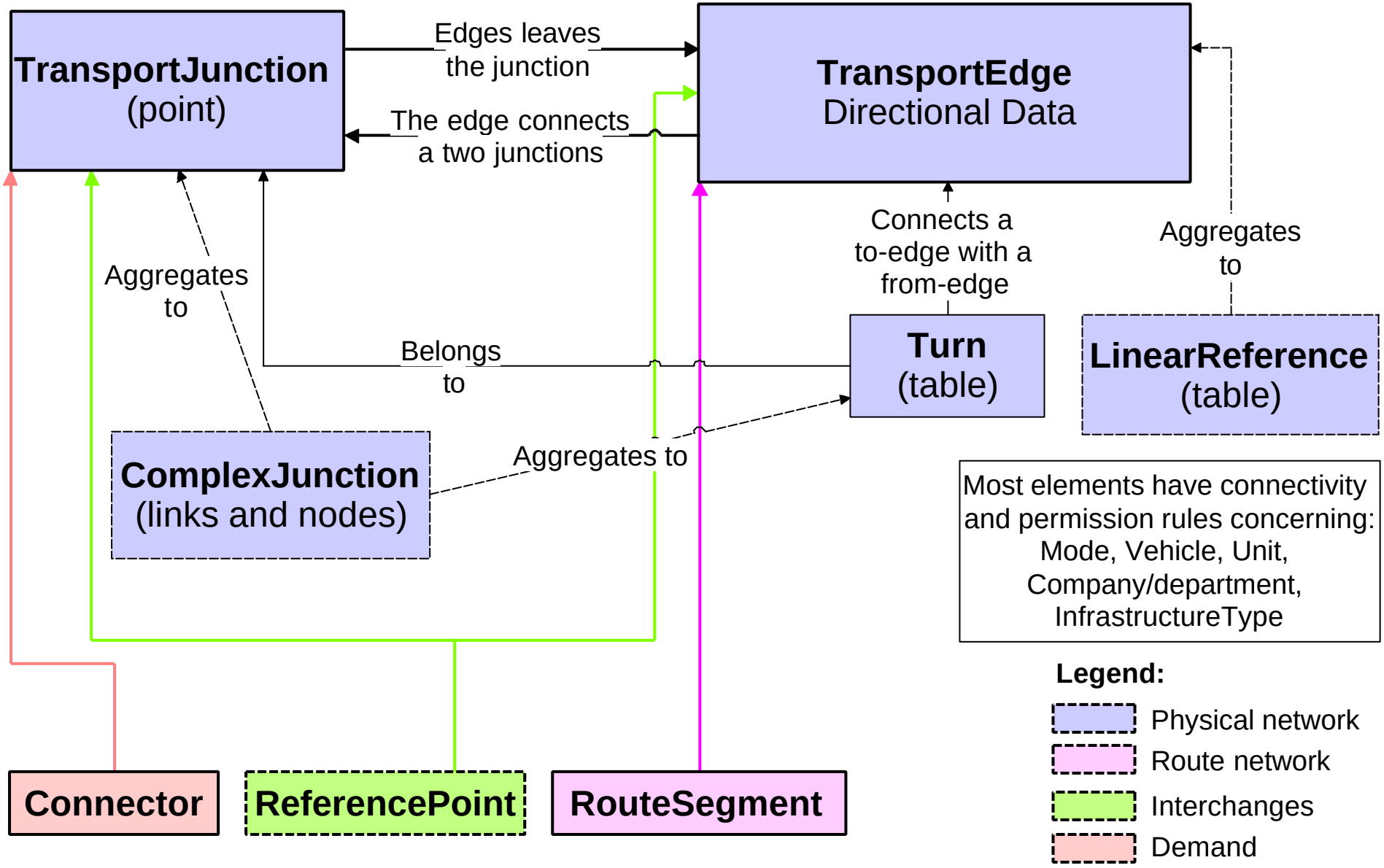
6. Introduction to topological objects in TOP

TOP Conceptual Overview



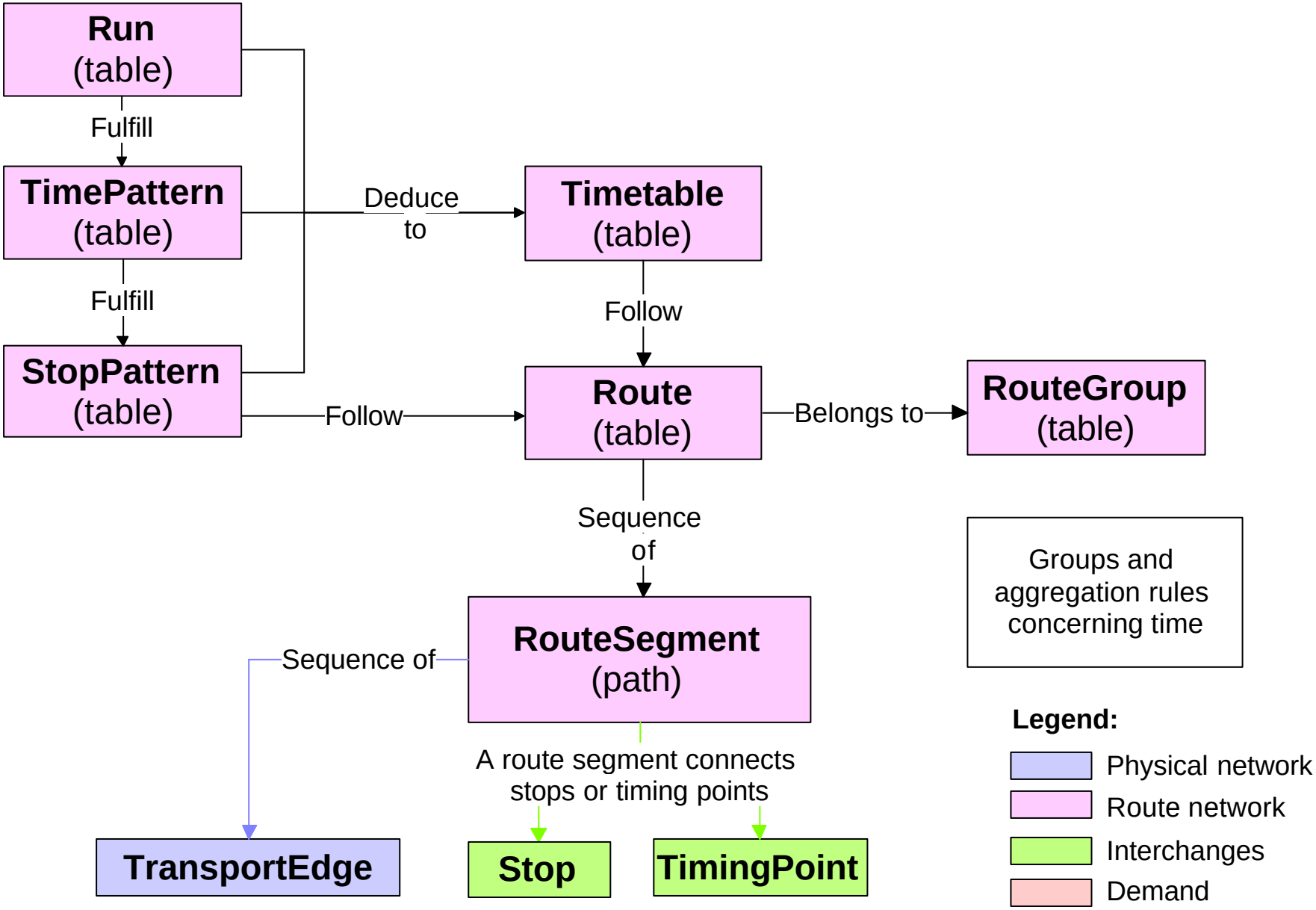
6. Introduction to topological objects in TOP

PHYSICAL NETWORK



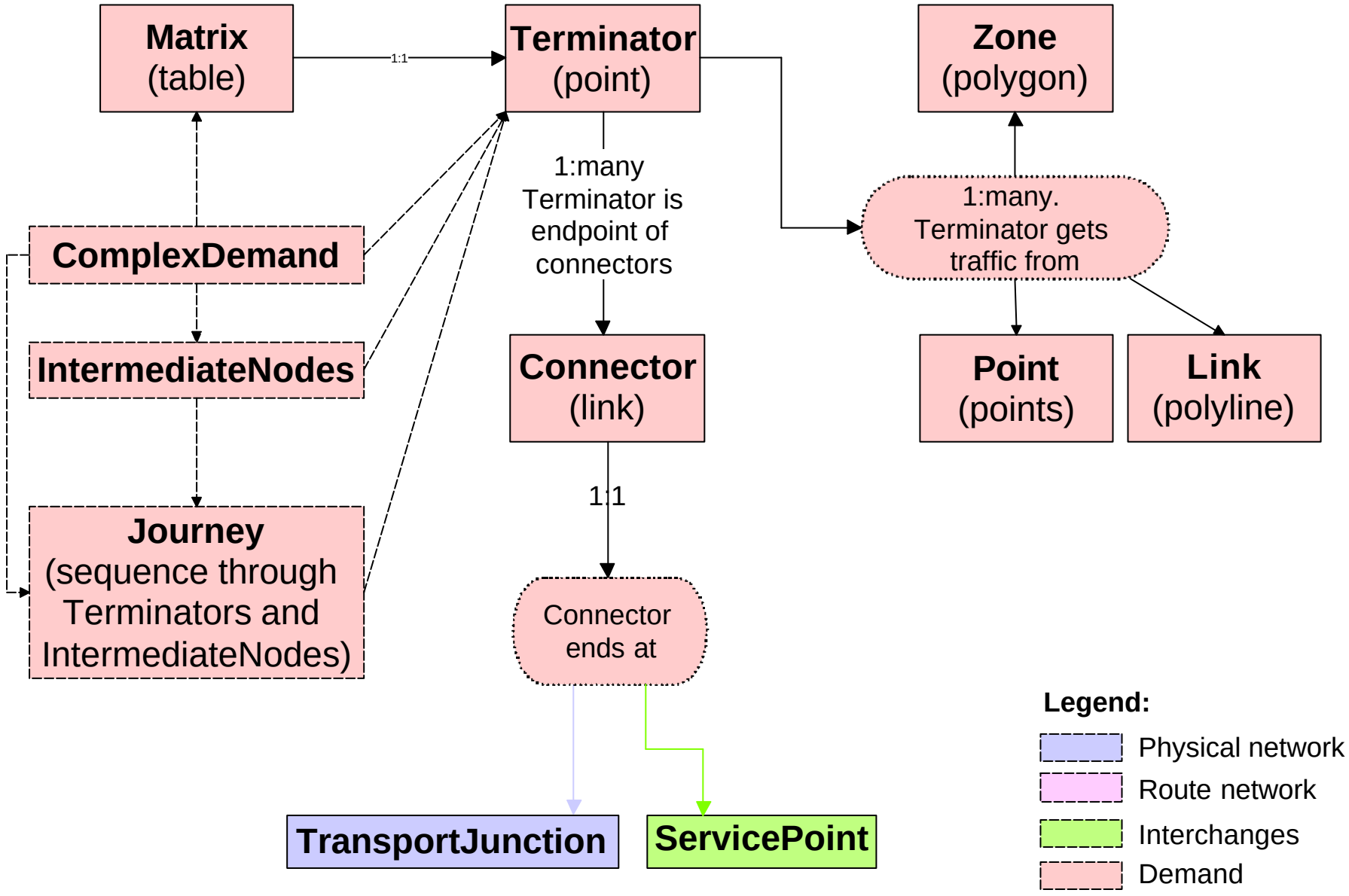
6. Introduction to topological objects in TOP

ROUTE NETWORK



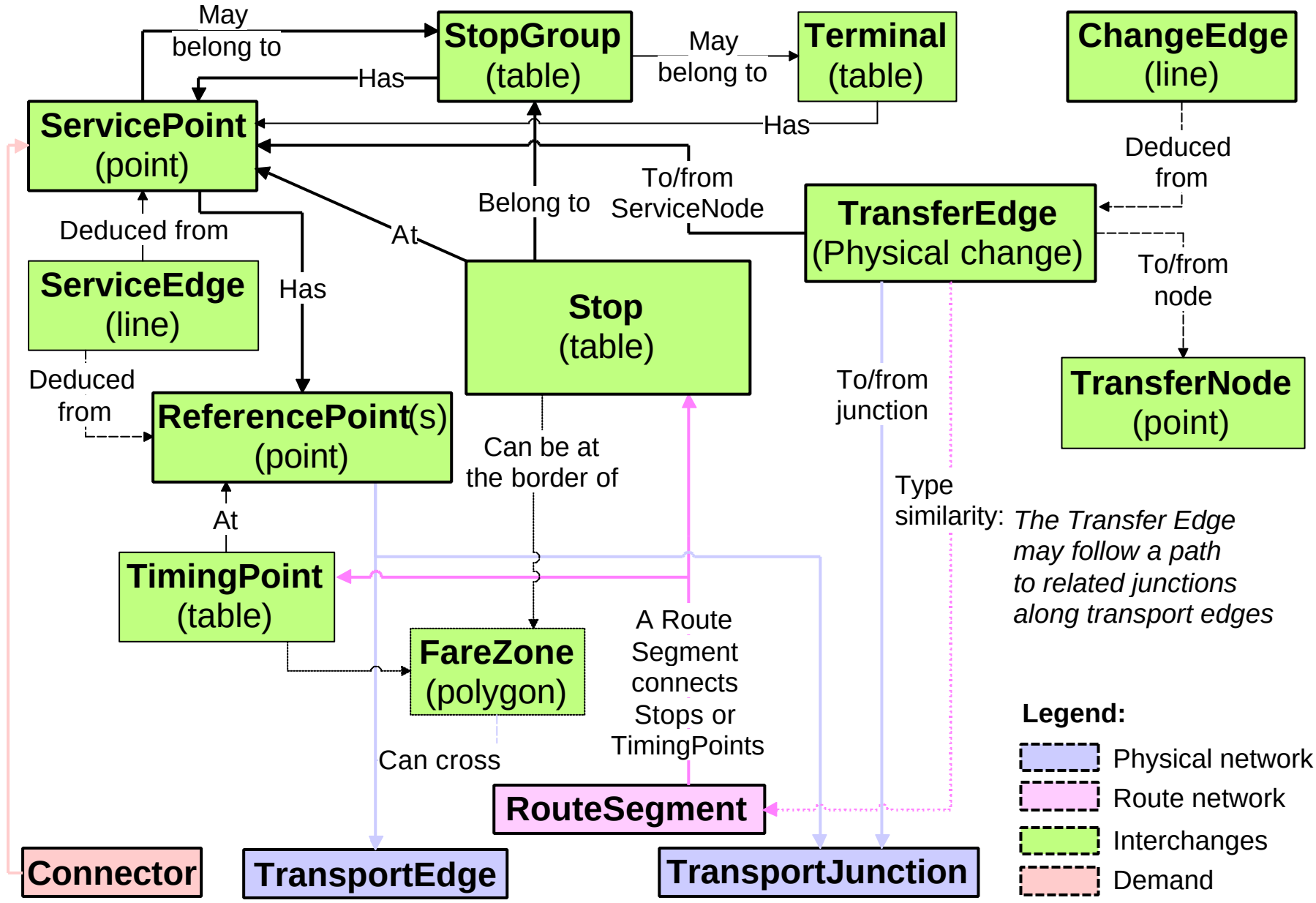
6. Introduction to topological objects in TOP

DEMAND



6. Introduction to topological objects in TOP

INTERCHANGES



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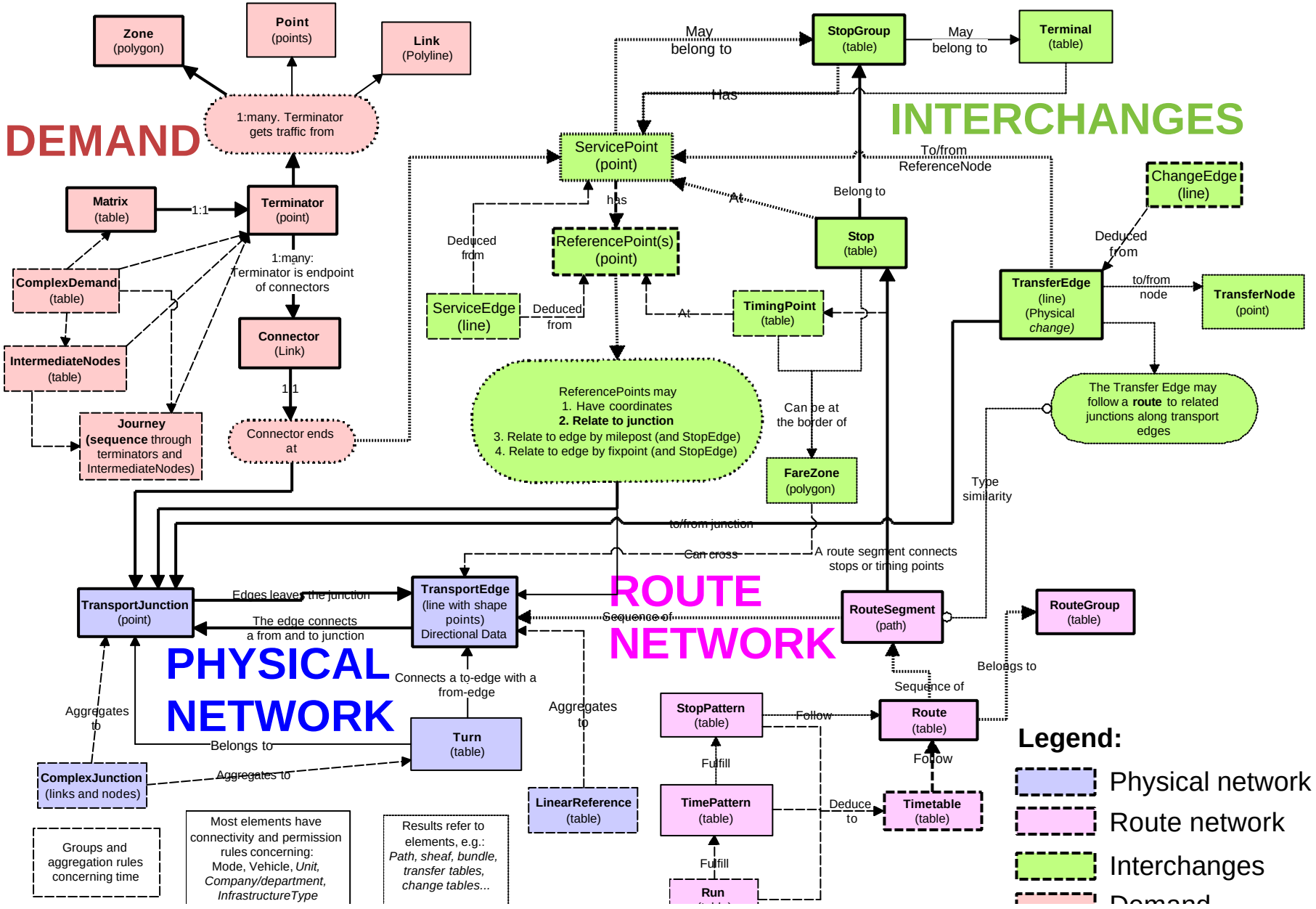


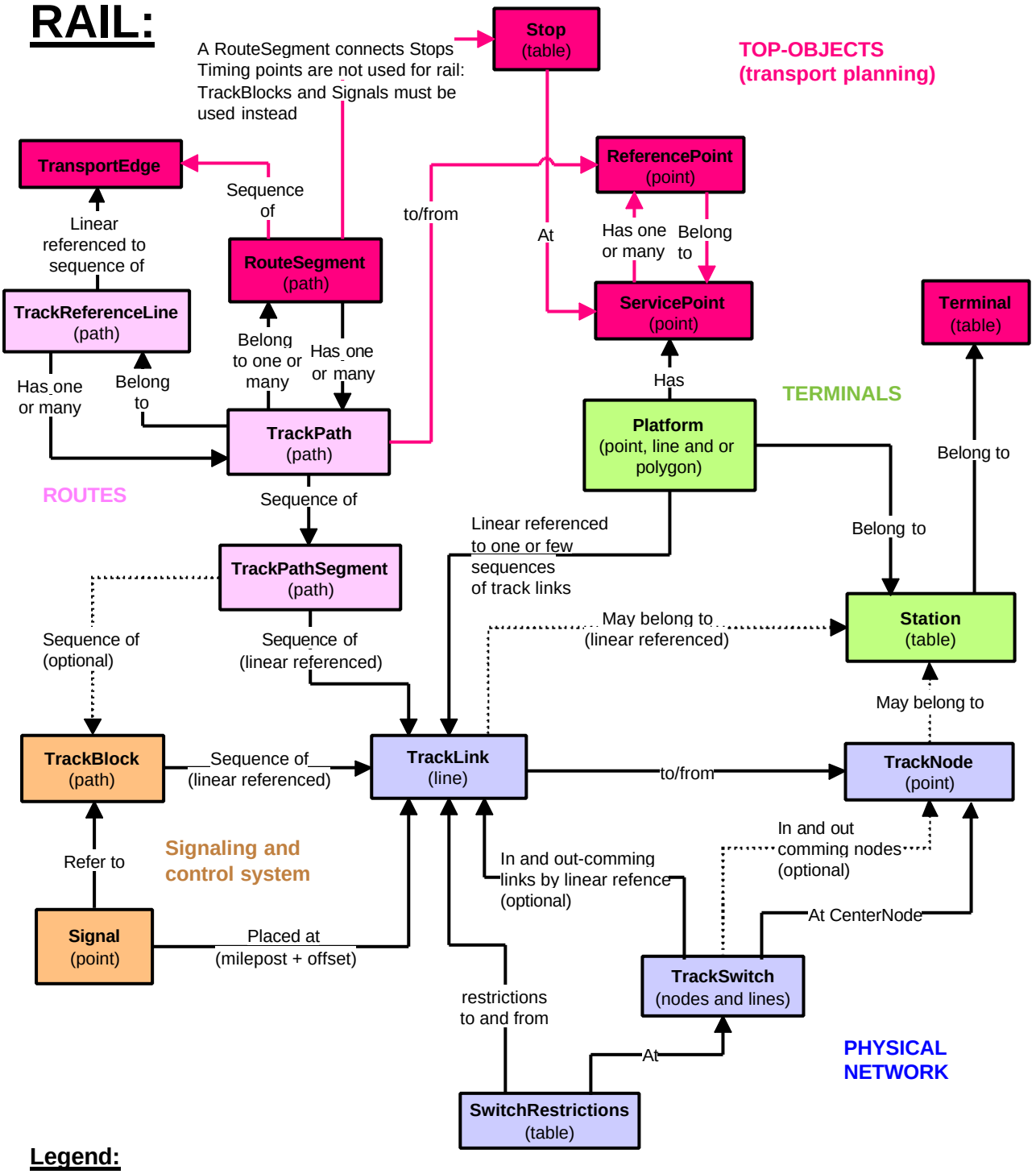
TOPOLOGIC ELEMENTS FOR RAIL:

- A more detailed level of aggregation than TOP
- Some elements are linked to TOP
- This makes it possible to aggregate and disaggregate data
- But this needs intelligent behavior and in most cases tailored applications

MAIN GROUPS OF ELEMENTS:

- Physical network
- Train paths
- Objects related to terminals
- Signaling systems
- Links to TOP

6. Introduction to topological objects in TOP



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MAIN BENEFITS OF TOP:

- Maintains complex topological models
- Eliminates multiple proprietary solutions for data management
- Prevents inconsistent data
- Eases editing, visualization and analyses of transport data
- Provides a basis for applications and more efficient solution algorithms

WHY SCANRAIL HAS LAUNCHED THE TOP-PROJECT:

- Efficient basis for data management in the National Railway Administration
- Facilitates implementation of new more efficient solution algorithms and applications
- This eases modeling in the Railway Administration and gives ScanRail a competitive edge in the consulting market
- Sale of TOP
- Happy employees