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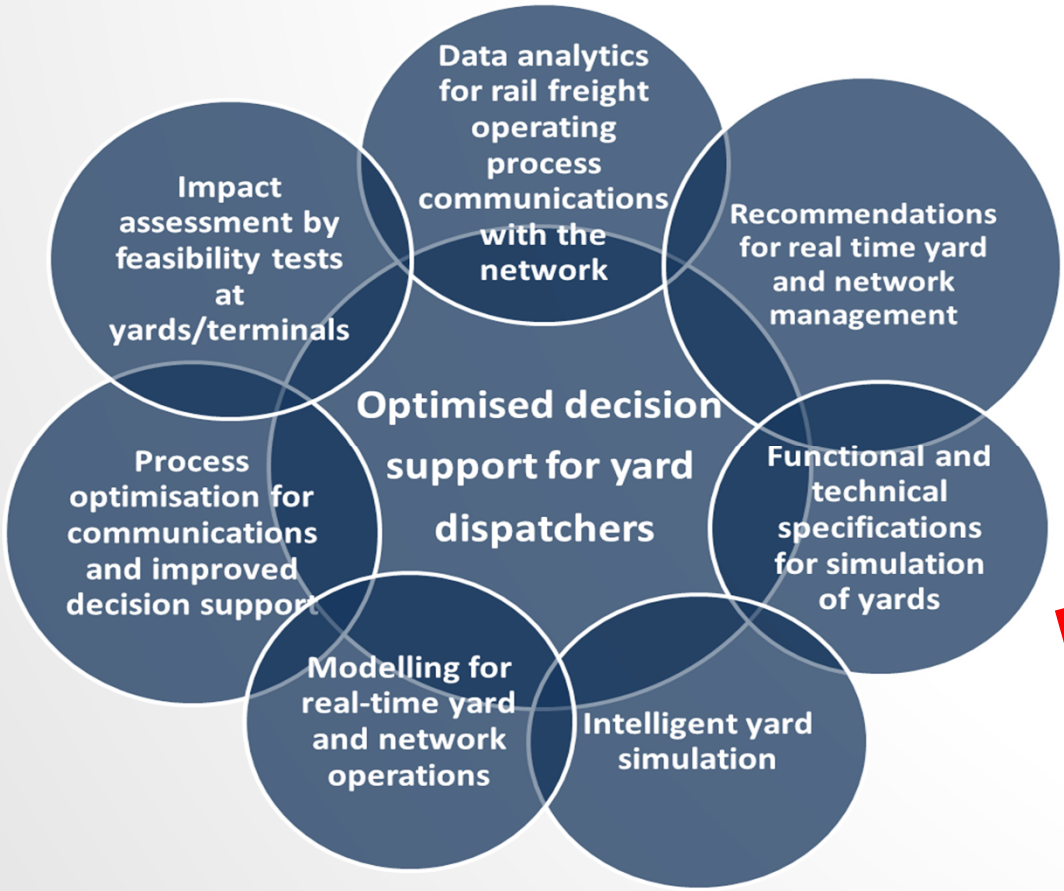
WP 3 – SPECIFICATIONS

Developing the Functional and Technical Specifications for an Integrated and Real-Time System of Yard and Network Management

OptiYard Mid-Term Conference, Paris, 5th October 2018

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OPTIYARD INNOVATION ACTIVITIES



This talk

KEY CHALLENGES

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- Successful real-time yard management lies in understanding, designing, implementing and managing the real-time information exchange between the yard and the relevant eco-system, and managing the interactions between yard management and network management
- WP3 aims to specify the simulation of yard operations and the co-ordination of this simulation with the relevant network eco-system
- This is tackled in stages through four Tasks.

TASKS TO MEET THE OBJECTIVES

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3.1 **Requirements for the general applicability of the simulation environment**

- To specify the OptiYard eco-system, to aid our understanding of how to design a suitable simulation environment to assess the OptiYard developments

3.2 **The Functional Specification**

- To specify the functions required to present the key elements of the eco-system, their roles and actions in the eco-system, the processes involved in real-time yard operations and the interactions between yard operations and real-time network management

3.3 **The Technical Specification**

- To set out the technical specifications to ensure flexibility and computational efficiency

3.4 **Specification for data management interface**

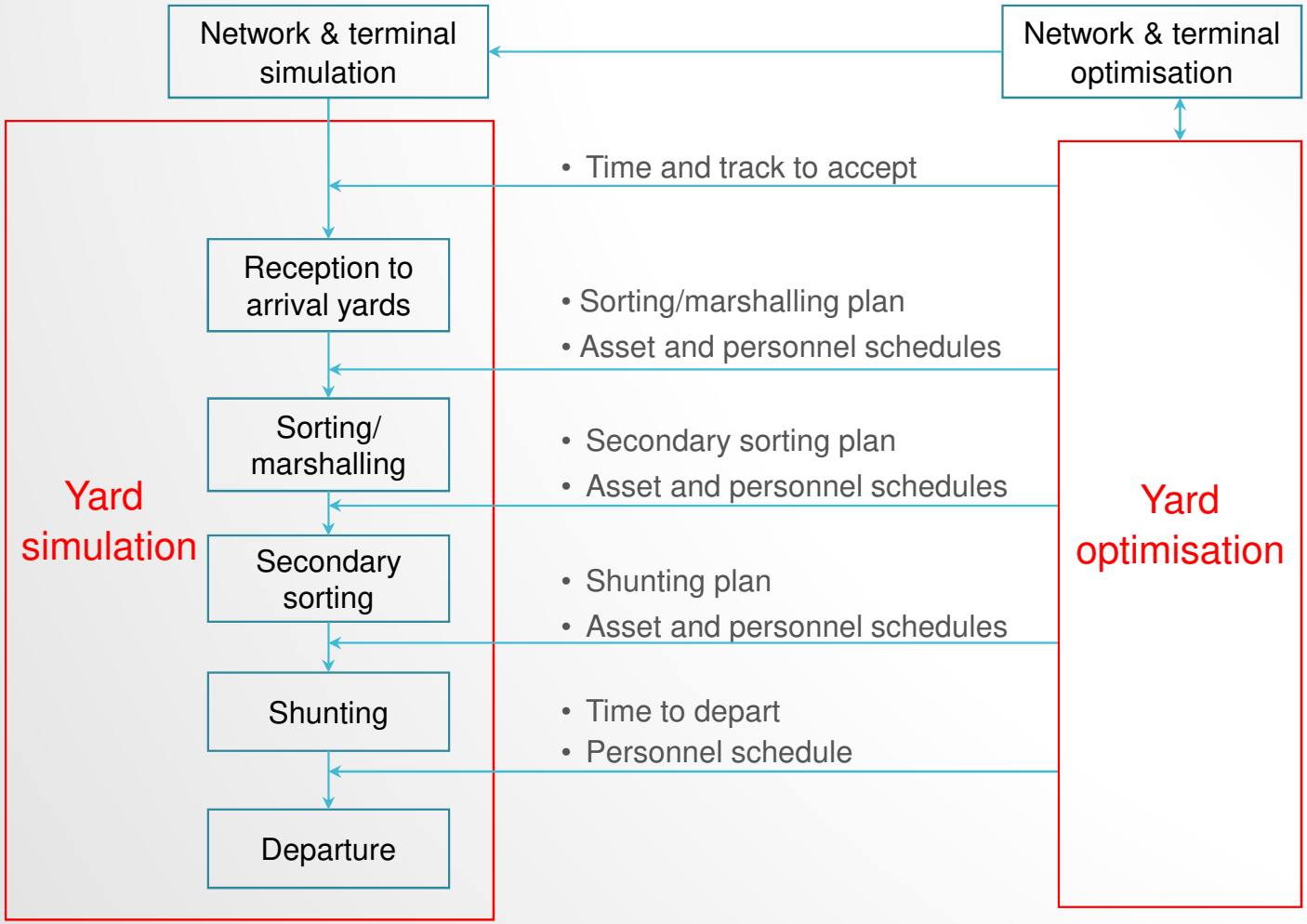
- To provide the specifications for real-time data management and information exchange within the OptiYard eco-system, and between the OptiYard eco-system and the wider railway network.

TASK 3.2 THE FUNCTIONAL SPECIFICATION

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- To describe all the business processes involved in yard operation and network management and to specify the functions that simulation must perform
- To build a full listing and understanding of the sequence of events relevant to yard operations
- To develop a high-level design incorporating all functions and modules within an overall view of they interact and fit together

YARD AND NETWORK PROCESS



FUNCTIONAL SPECIFICATION: INFRASTRUCTURE

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- **Yard facilities**
  - Type of the yard: hump yard, flat yard, gravity yard
  - Infrastructure layout (receiving yard, classification bowl, departure yard, hump, maintenance track, repair track, sorting bowl, etc.)
  - Track characteristics (running direction, speed limit, gradient, curvature, signal, electrification, etc.)
  - Asset (shunting and line locomotives)
  - Personnel
- **Intermodal terminal facilities**
  - Infrastructure layout, track characteristics, equipment (type, capacity, etc.), cost for loading/unloading
- **Surrounding network**
  - Infrastructure layout, signalling system, track characteristics

FUNCTIONAL SPECIFICATION: VEHICLES

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- **Wagon**
  - ID, owner, length, weight, number of axles, maximum speed, braking characteristic, net weight of cargo
  - Trip plan
  - Preferred arrival time at the destination terminal and the penalty for late arrival
- **Common data for freight and passenger trains**
  - ID, Type and priority
  - Maximum speed, characteristics of traction, braking and running resistance
  - Train control system on board: fixed-block, ETCS (and level), etc.
  - Train route and schedule
- **Extra data for freight trains**
  - Composition: block train or single wagon load (for SWL trains, Wagon ID and ordering)
  - Wagon content
  - Status: incoming, waiting to be decoupled, waiting to be coupled, ready-to-depart
  - ETA time at the yard or ETD time from the yard

FUNCTIONAL SPECIFICATION: NETWORK SIMULATION AND OPTIMISATION

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- The **network simulation** model should
  - Simulate the movement of passenger and freight trains in the network, according to the schedule
  - Plan the speed profile for each train according to the schedule
  - Estimate the Time of Arrival at yards
  - Provide the train location, speed and ETA to yards on request
  - Simulate the random delays occurring when trains are running on the line and/or dwelling at stations
- The **network management and optimisation** model should
  - Decide the train priority when two or more trains request to access the same resource at the same time
  - Conduct ad-hoc rescheduling and rerouting
  - Determine the path for a waiting-to-depart freight train and the associated schedule

TASK 3.3 THE TECHNICAL SPECIFICATION

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THE YARD MODEL; TECHNICAL SPECIFICATION

- The Villon rail simulation tool has been selected as the basis for the yard simulation model
- This is a well-established and tested tool which provides the functionality we need, operates at an appropriate level of detail, and has manageable data requirements
- The tool, its application to the project, its technical specifications and data needs and hardware requirements are set out in the relevant OPTIYARD deliverables

THE NETWORK MODEL; TECHNICAL SPECIFICATION

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- A development of **TrackULA** (Track Unified simuLation Algorithms)
- A ***Network*** simulation tool:
- ***Microscopic***: the rail infrastructure is modelled, and individual train & train driver behaviour can be modelled
- ***Dynamic*** and ***stochastic***:
  - Simulating explicitly the trains' space-time movements
  - Modelling variations in train/driver behaviour
  - Modelling variations in line/network conditions
- ***Flexibility***: new rules can be readily incorporated and tested
- Embedding the function of ***speed profile optimisation***

TASK 3.4
DATA MANAGEMENT REQUIREMENTS

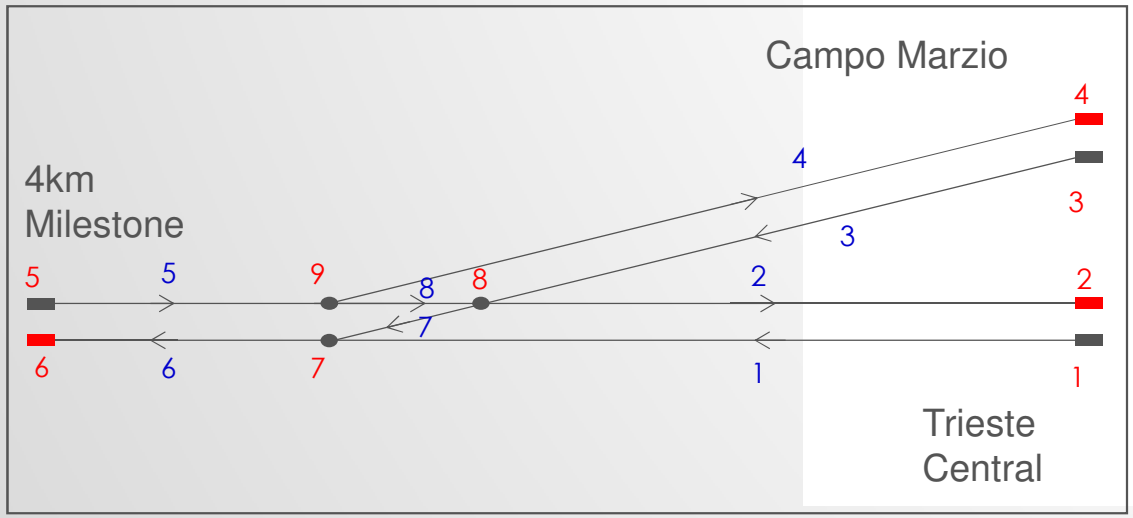
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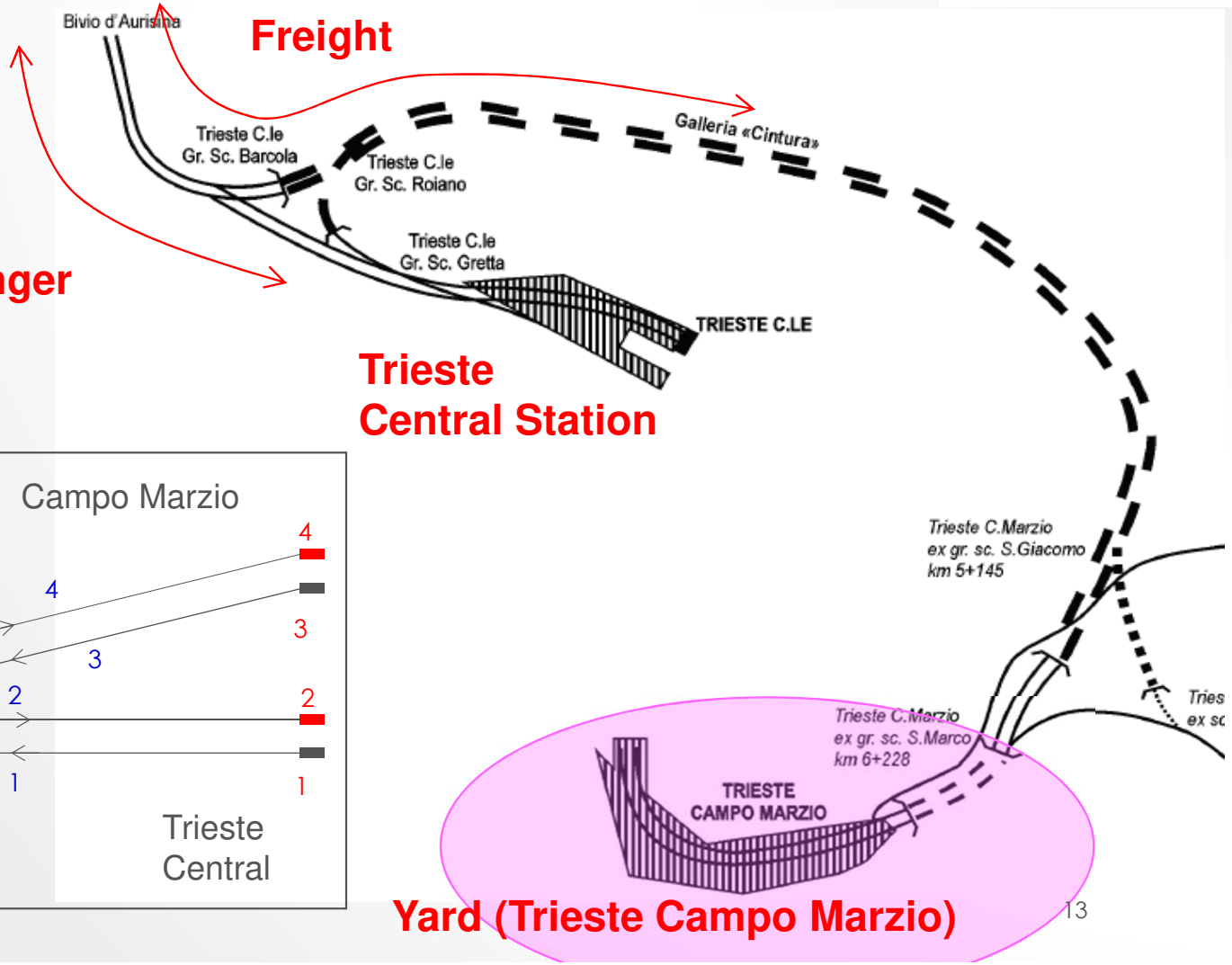
- Need to manage and process data in a way to provide rapid response to yard and traffic control personnel
- Speed, accuracy and flexibility to produce reports in formats suitable for user needs, e.g. Graphing
- Ability to produce output data to calculate relevant KPIs
- High IT security to ISO standards
- Access and administrative rights need to be agreed
- Documentation needs to be produced and maintained
- Suitable common data structures for efficient data exchange between different applications
- Compatibility with emerging rail industry data formats eg RailML

EXAMPLE ILLUSTRATION: NETWORK SIMULATION

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- Trieste, Italy



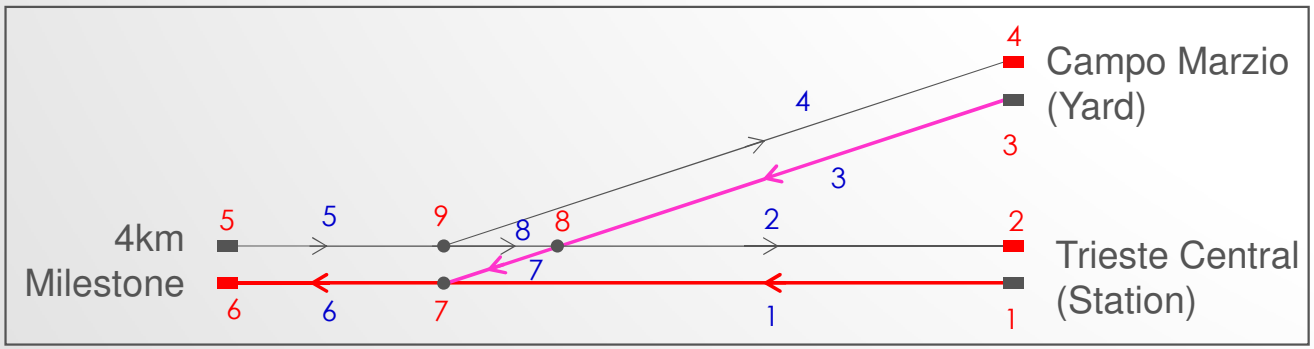


SIMULATION EXAMPLE

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- Train schedules: a typical working Wednesday in 2018

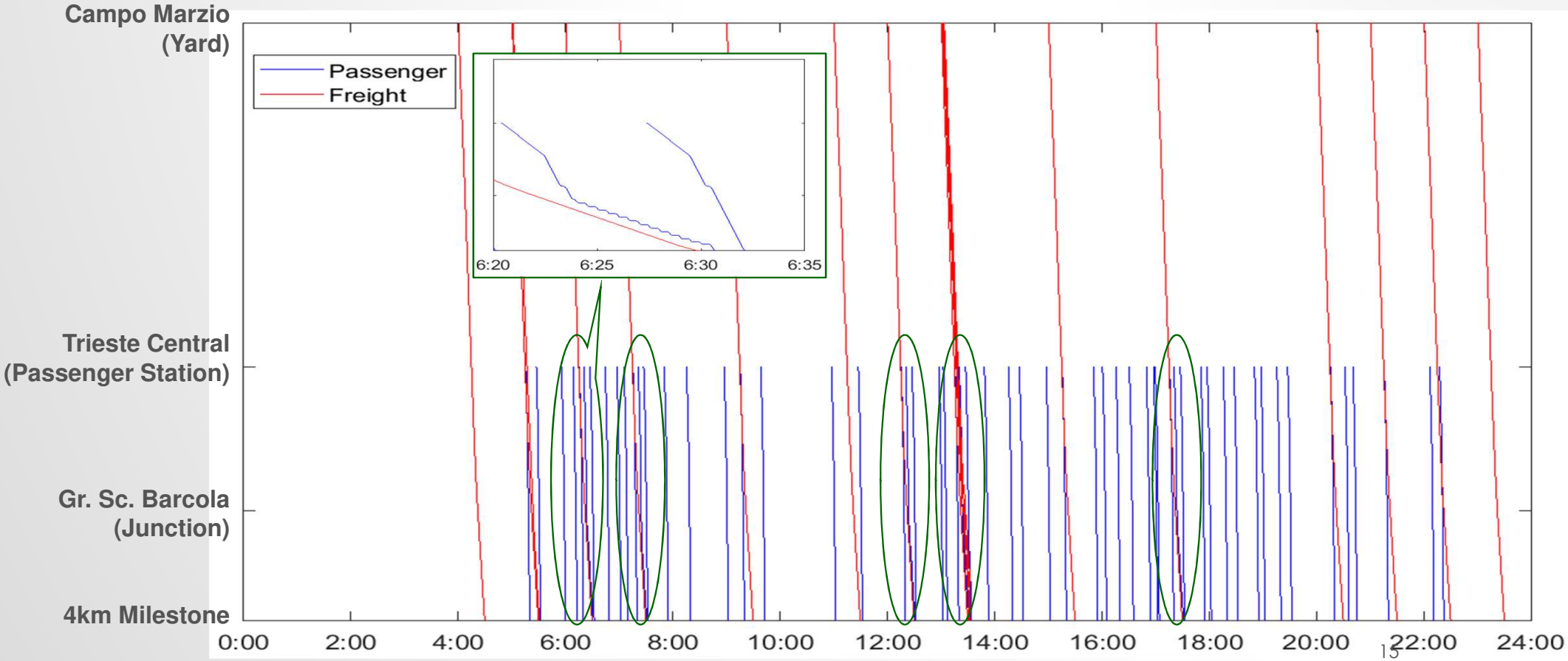
	Passenger		Freight	
	Inbound	Outbound	Inbound	Outbound
Number of trains	57	57	13	18
Scheduled running time per train (min)	16.2	3.6	30.0	30.0
Delay per train (min)	2.0	2.0	0.4	0.4



CAUSE OF DELAY

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Trajectories for outbound trains



SUMMARY

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- OptiYard is aimed at designing a simulation and optimisation tool for better real-time operation and management of railway yards and networks
- The functional specification identifies:
  - All necessary information and characteristics of yards, terminals, surrounding networks, wagons and trains for simulation
  - activities and behaviours in yards, terminals and surrounding networks that need to be simulated
- The technical specifications are based on existing systems but these are being adapted to the precise needs. They also need to be interfaced together and their compatibility with developing rail information systems needs to be ensured
- The network simulation model is developed and shows the occurrence and causes of delays
- Better real-time network management can help to reduce the delay

Thank you!

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