Shift2Rail

IP4

Shift2Rail

CONNECTIVE

Project Information

Updated Dec 2019

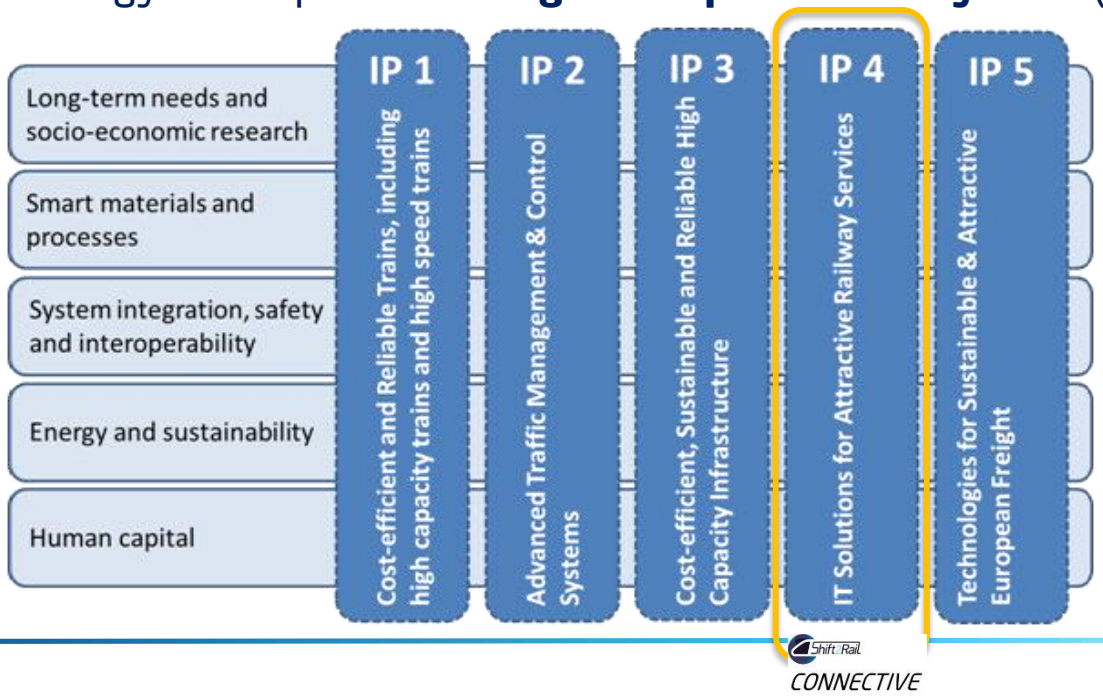
INDEX

1. Shift2Rail and IP4 context

1.1. Shift2Rail initiative

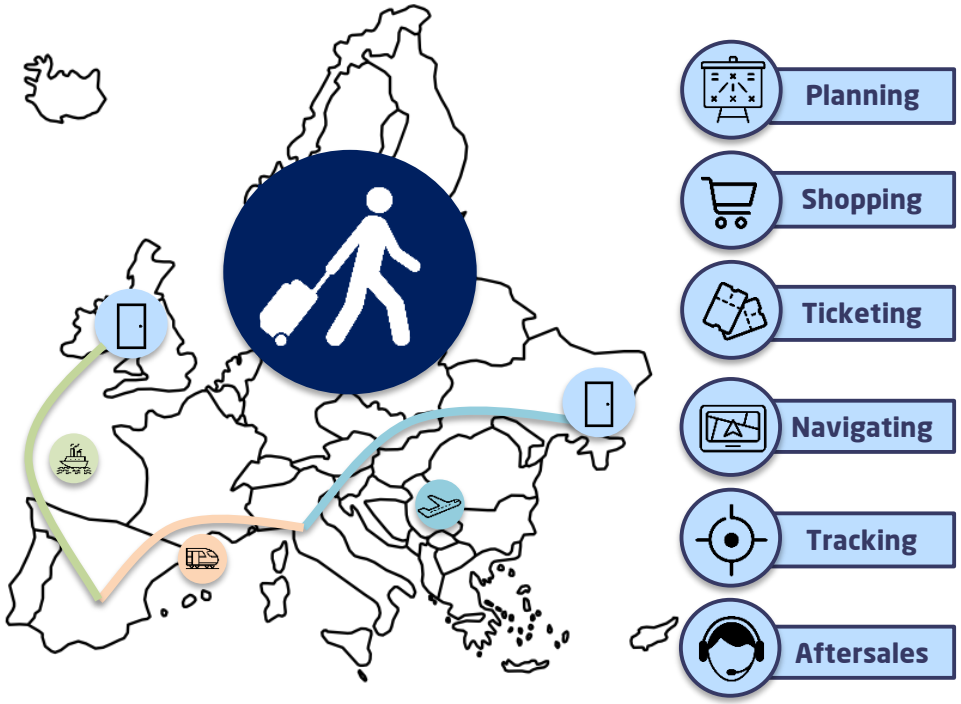
Shift2Rail is the first European rail initiative to seek focused research and innovation (R&I) and market-driven solutions by accelerating the integration of new and advanced technologies into **innovative rail product solutions**.

Shift2Rail promotes the competitiveness of the European rail industry and meets changing EU transport needs. R&I carried out under this Horizon 2020 initiative develops the necessary technology to complete the **Single European Railway Area** (SERA).

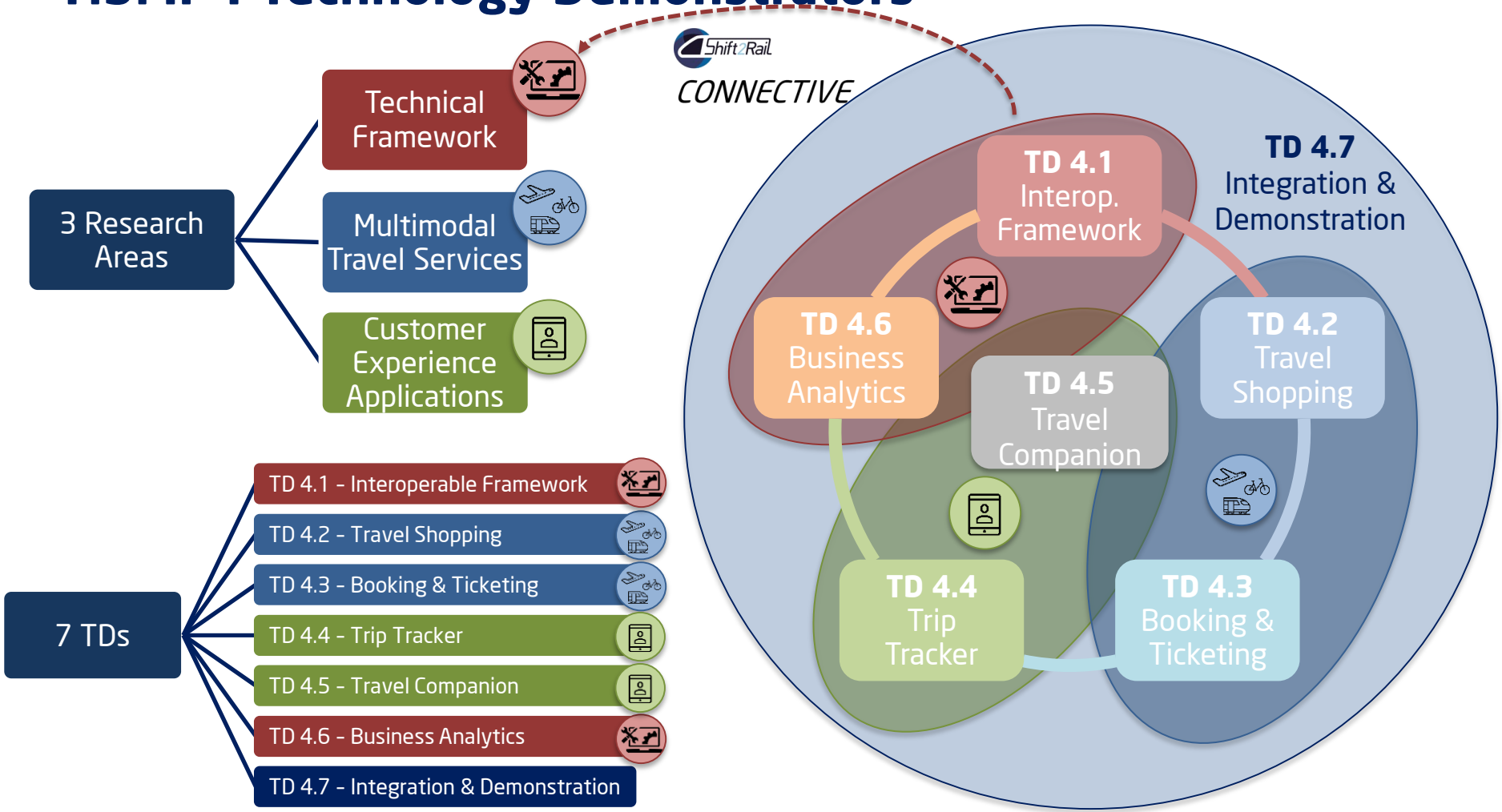


1.2. IP4 overview and objectives

- Put the traveller back at the centre, ease access to rail, increasing its attractiveness
- Complete multimodal travel offer connecting the first and last mile to long distance journeys
- Give access to all multimodal travel services (shopping, ticketing, and tracking) through its travel-companion
- Build an open framework providing full interoperability whilst limiting impacts on existing systems



1.3. IP4 Technology Demonstrators



1.5. IP4 components overview

Travel Companion

- Unique ID
- Tickets stored in Virtual Wallet
- Services tailored to preferences
- Real time notifications
- Location Based Experiences

IP4 ecosystem

Traveller services

Planning | Shopping | Ticketing | Navigating | Tracking | After sales

- Dialogues with each provider
- Integration of data
- Logic for added value services

Logic and orchestration

Transport providers' functionalities

- Clearing & Settlement
- Configuration of multimodal agreements
- Business Analytics

Interoperability framework
to interact with different interfaces and data models

2. Project Overview

PROJECT

CONNECTIVE: Connecting and Analyzing the Digital Transport Ecosystem
01/09/2017-31/06/2022

PARTNERS

indra
(coordinator)

HaCon
Traffic • Software • Service

THALES

NetworkRail

DIGINEXT
be visionary

Ansaldo STS

Complementarity

Added value of Travel Experts and academia

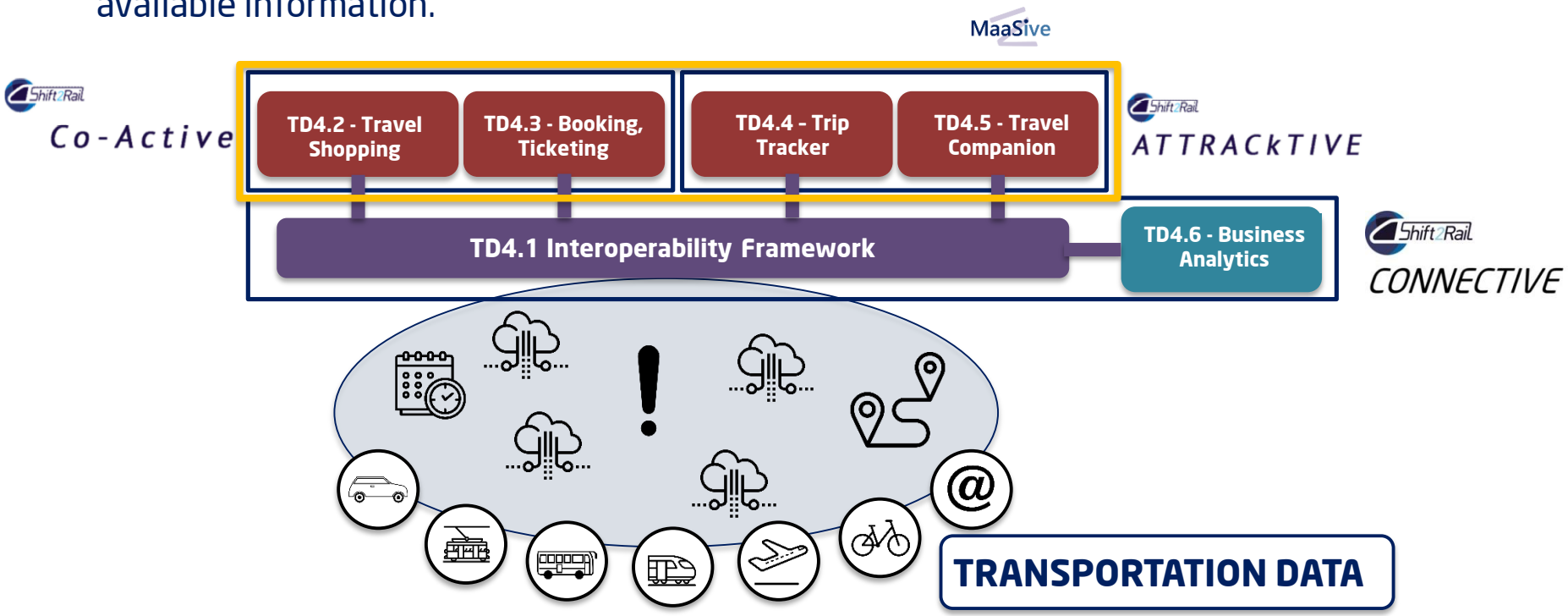
ST4RT
(Completed)

GoF4R
(Completed)

sprint
(started 2019)

CONNECTIVE: Connecting and Analyzing the Digital Transport Ecosystem

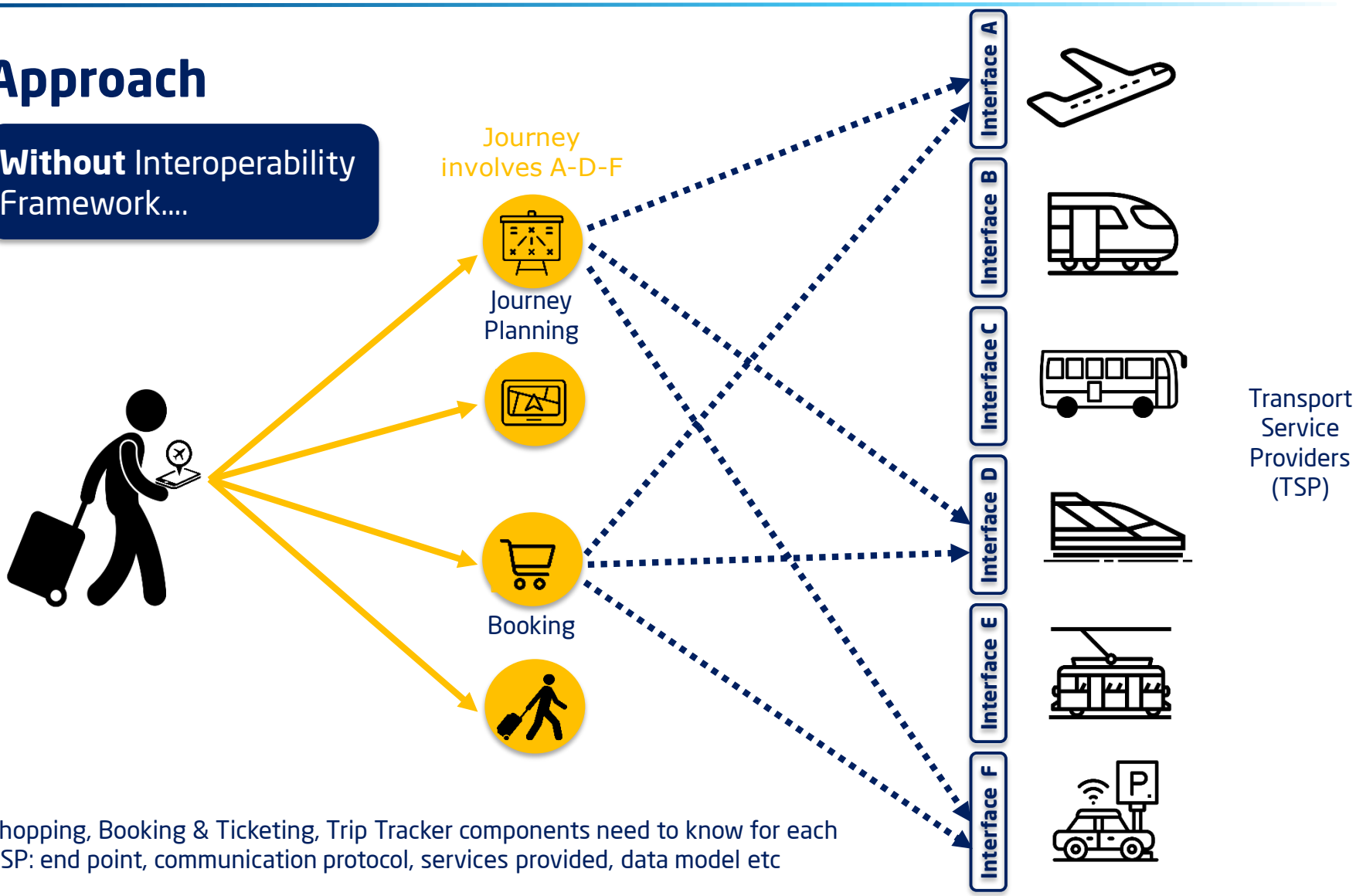
The CONNECTIVE project will work towards the **digital transformation** of rail and all transport services, providing the **framework, tools** and technologies to allow **data exchange** among different actors of the transport ecosystem and facilitating **interoperability** among systems, but also the creation of **added value** services using all available information.



3. Interoperability Framework (IF)

Approach

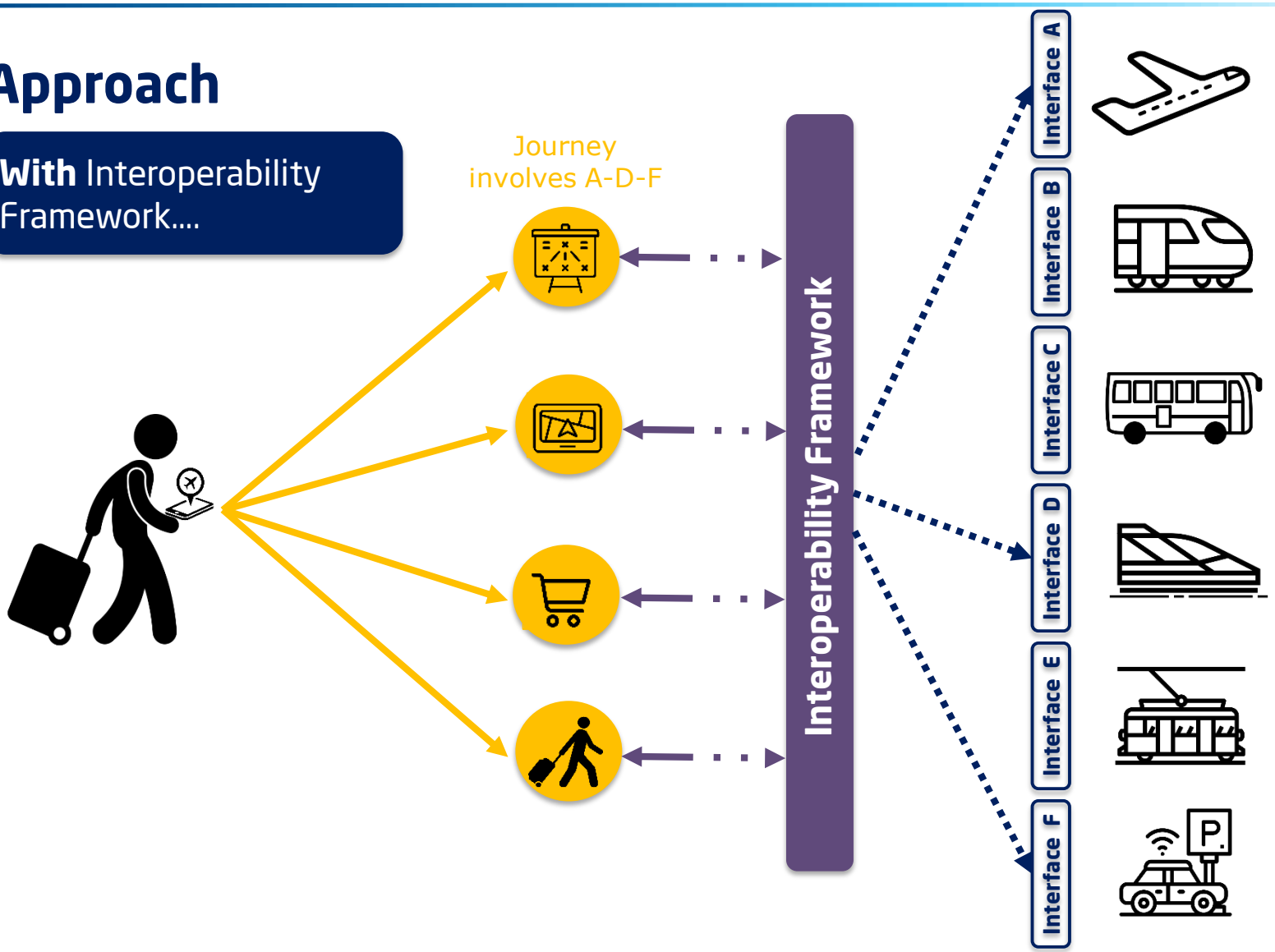
Without Interoperability Framework....



Shopping, Booking & Ticketing, Trip Tracker components need to know for each TSP: end point, communication protocol, services provided, data model etc

Approach

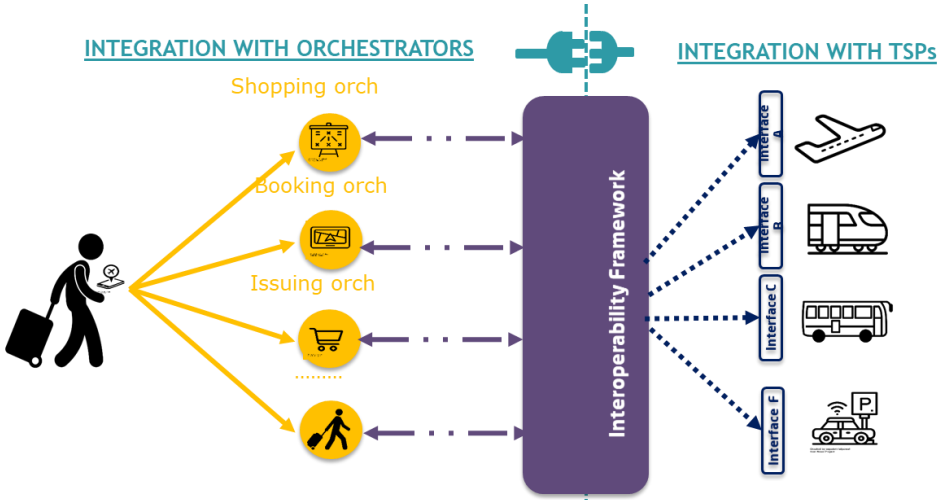
With Interoperability Framework....



Baseline

- CONNECTIVE-IF activities took as starting point the results of IT2Rail project. This included:
  - First approach to the IP4-IF definition and functionalities
  - First S2R-IP4 ontology
  - A set of software components (web services) to allow communication with a number of TSPs

- CONNECTIVE-IF initial activities were focused at covering ATT/COA needs to communicate orchestrators and TSP and provide multimodal services.



Work Streams

- Connect and allow exchanges among heterogeneous systems that use different interfaces:
  - semantic approach based on **ontologies**
  - Need of **conversion** among interfaces
  - Need to manage **communications**: urls, endpoints, certificates ...
- Provide an access point for TSP to **register their services** in the ecosystem, making them available for the IP4 applications.
  - Make the services available for orchestrators
  - Extra functionalities provided through the same portal: creation of business rules, view transactions etc
- Provide generic **components (web services)** to simplify the operation of the applications, allowing them to select the relevant providers and data

Ontologies

Converters

Brokers

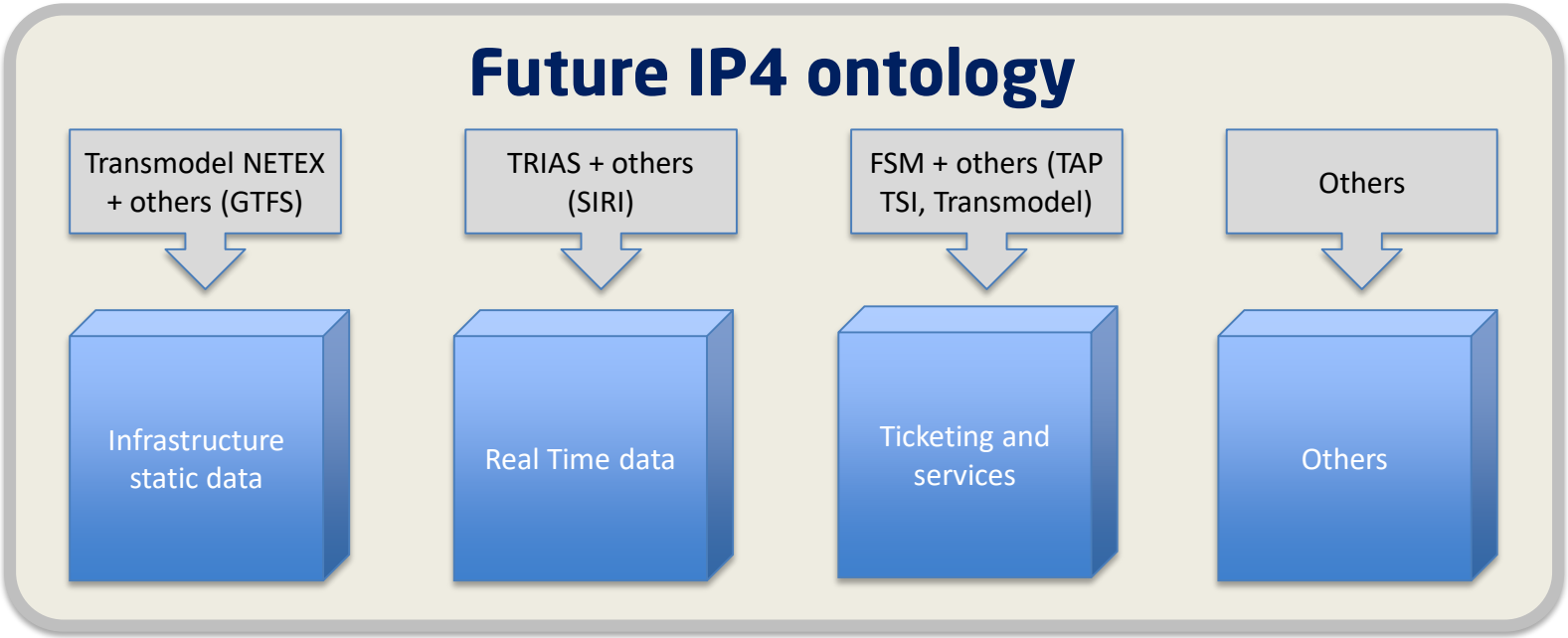
Operator Portal

Resolvers

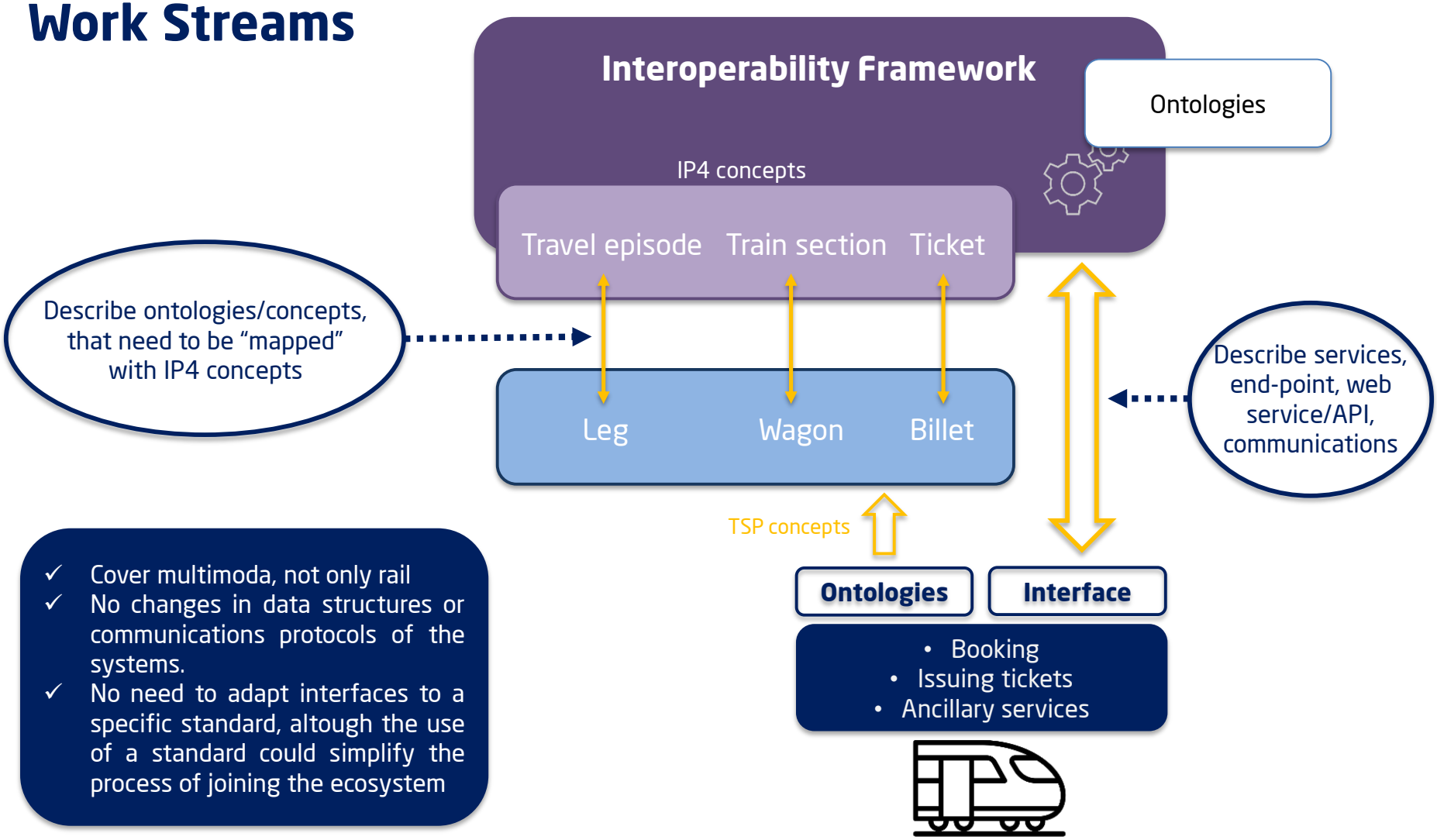
Work Streams

Ontologies

- Evolution of the S2R-IP4 ontology
  - Start with IT2Rail ontology
  - Being reviewed to include concepts from existing standards
  - Separate “monolithic” ontology into modules.

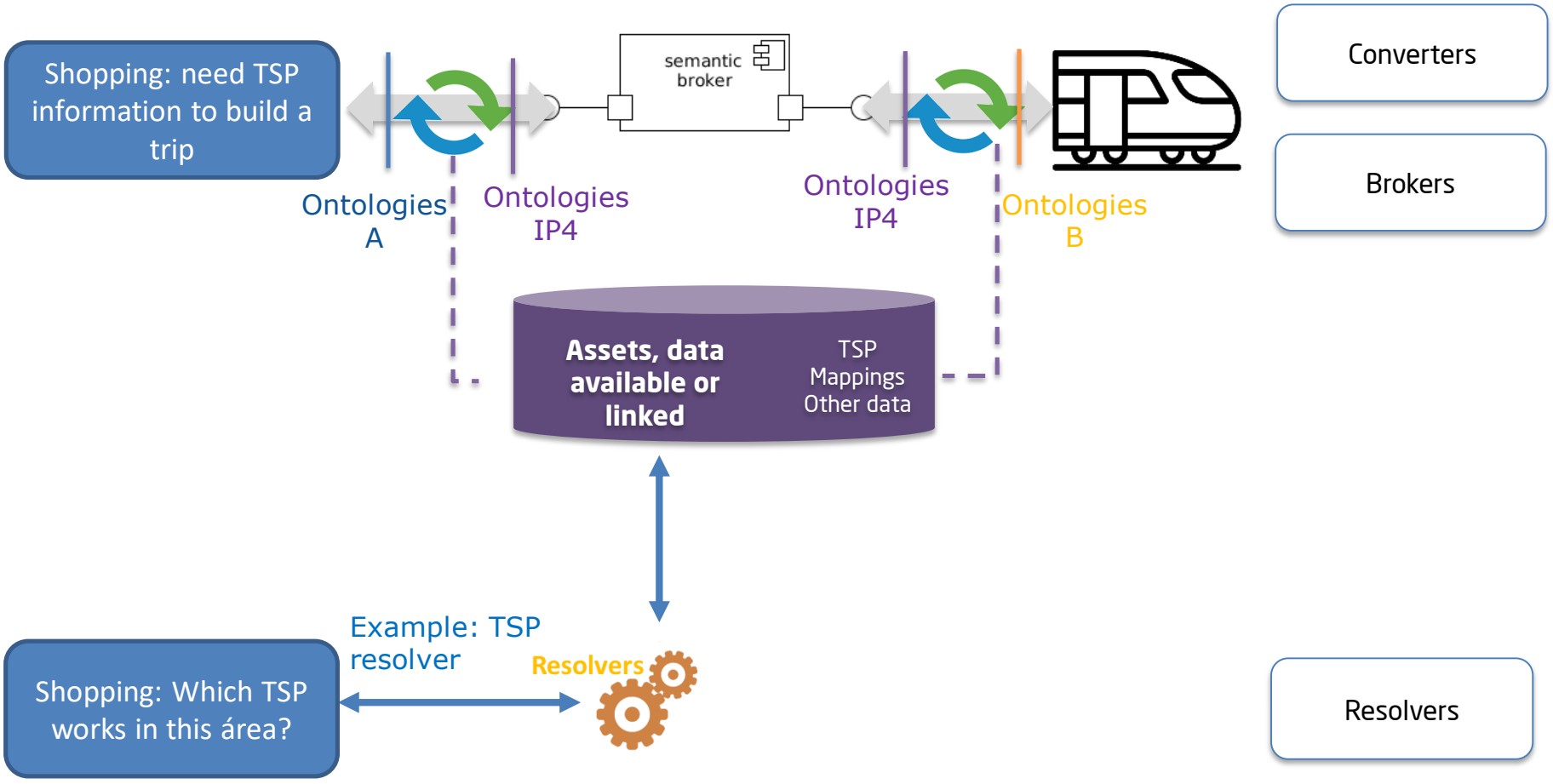


Work Streams



- ✓ Cover multimoda, not only rail
- ✓ No changes in data structures or communications protocols of the systems.
- ✓ No need to adapt interfaces to a specific standard, altough the use of a standard could simplify the process of joining the ecosystem

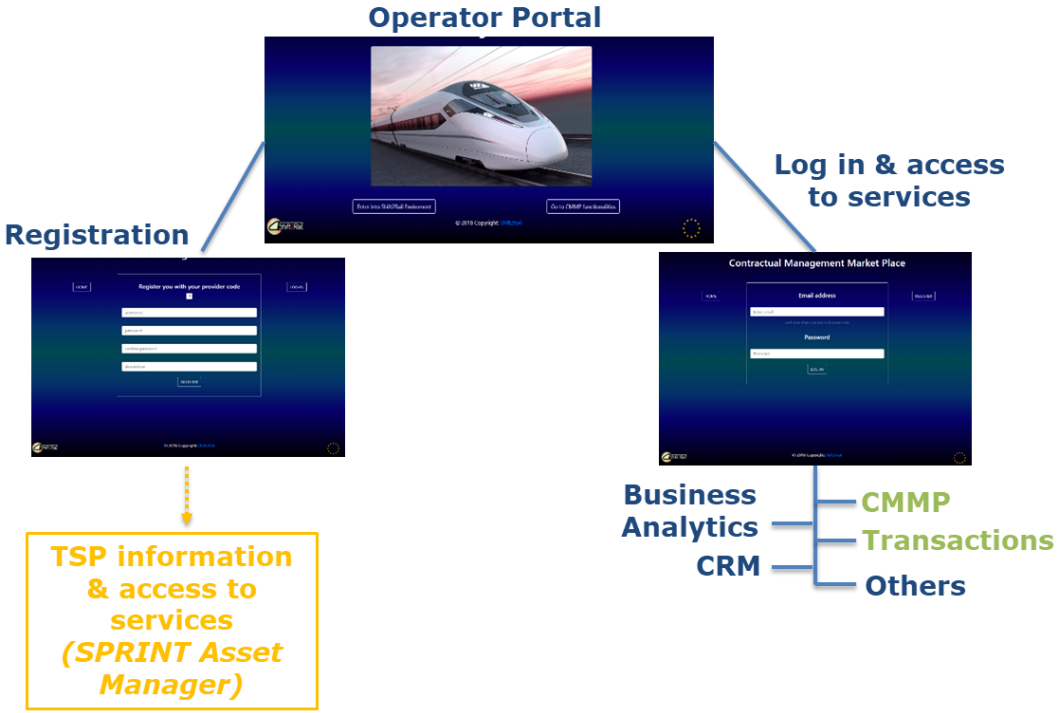
Work Streams



Work Streams

Operator Portal

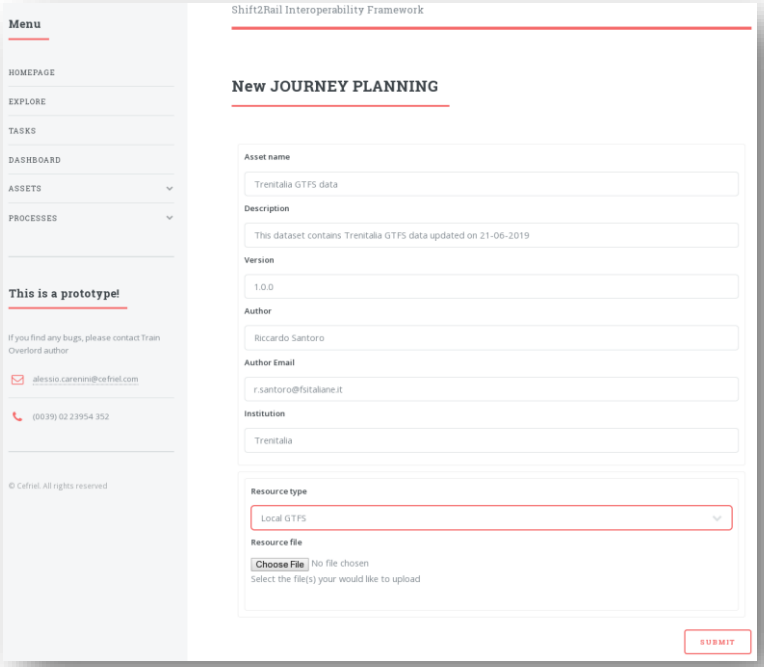
- Provide TSPs with a web portal that they could use to:
  - register and describe their services, to make them available for multimodal shopping/booking/etc applications
  - Access extra functionalities provided by IP4 ecosystem (such as transactions information

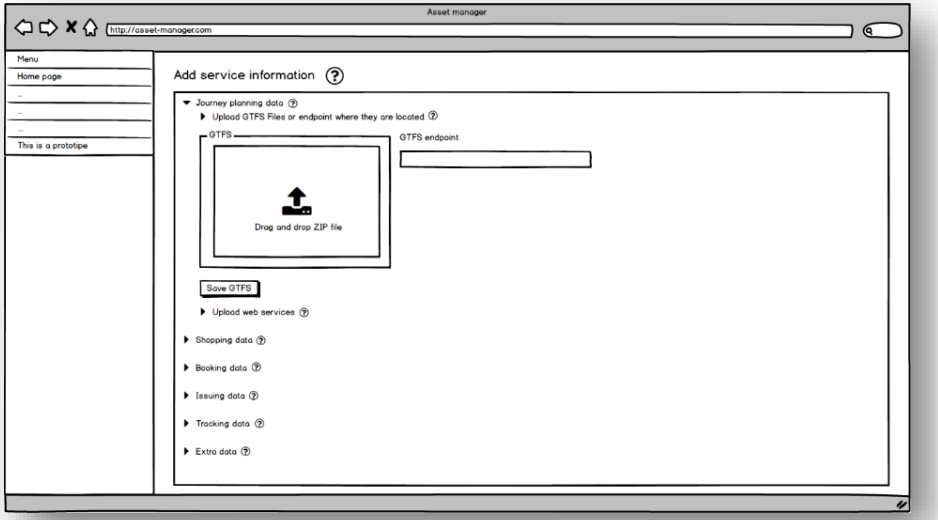


Work Streams

Operator Portal

- Registration of services: includes network data, end points, interfaces information etc needed to interoperate with the service





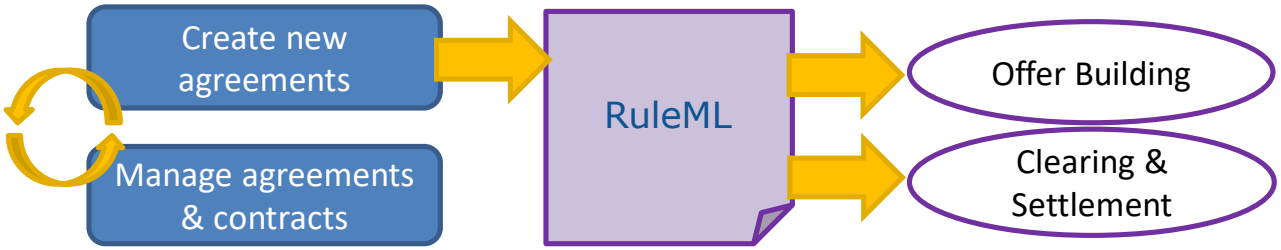
Work Streams

Operator Portal

- Additional functionalities: ***creation of Multimodal agreements***:

- Allow to configure tariffs, specially multimodal agreements, specify the conditions and the benefits for the user and the revenue split among TSPs.

- "translates" to a technical level the rules, and feeds other IP4 components involved in shopping and clearing processes

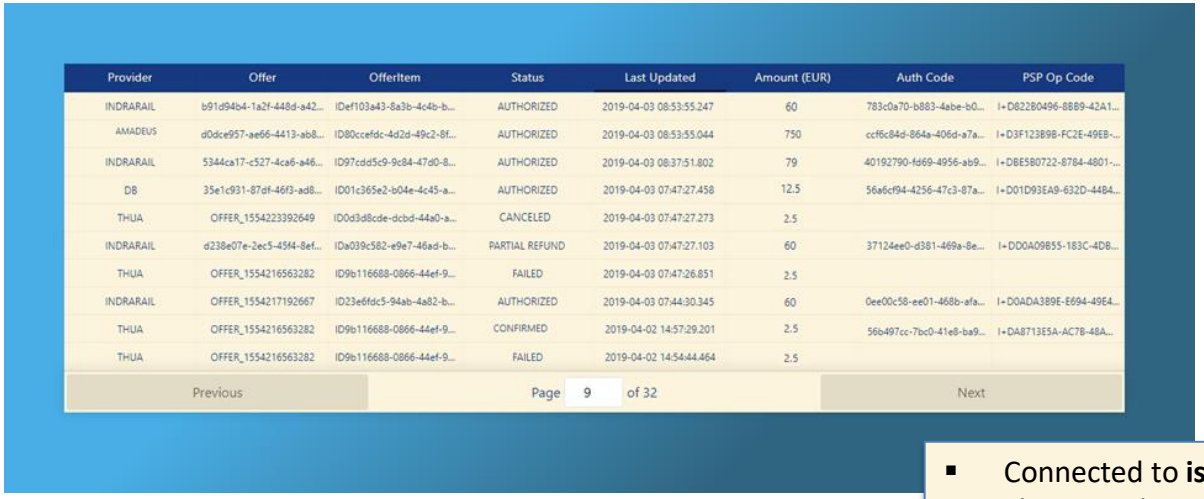


- Will be evolved to create Mobility Packages, including MaaS

Work Streams

Operator Portal

- Additional functionalities: ***visualize status of transactions***



Provider	Offer	OfferItem	Status	Last Updated	Amount (EUR)	Auth Code	PSP Op Code
INDRARAIL	b91d94b4-1a2f-448d-a42...	IDef103a43-8a3b-4c4b-b...	AUTHORIZED	2019-04-03 08:53:55.247	60	783c0a70-b883-4abe-b0...	I+D822B0496-8B89-42A1...
AMADEUS	d0dce957-ae66-4413-ab8...	ID80ccefdc-4d2d-49c2-8f...	AUTHORIZED	2019-04-03 08:53:55.044	750	ccf6c84d-864a-406d-a7a...	I+D3F123B98-FC2E-49EB-...
INDRARAIL	5344ca17-c527-4ca6-a46...	ID97cdd5c9-9c84-47d0-8...	AUTHORIZED	2019-04-03 08:37:51.802	79	40192790-fd69-4956-ab9...	I+DBE5B0722-8784-4801-...
DB	35e1c931-87df-46f3-ad8...	ID01c365e2-b04e-4c45-a...	AUTHORIZED	2019-04-03 07:47:27.458	12.5	56a6cf94-4256-47c3-87a...	I+D01D93EA9-632D-44B4...
THUA	OFFER_1554223392649	ID0d3d8cde-dcbd-44a0-a...	CANCELED	2019-04-03 07:47:27.273	2.5		
INDRARAIL	d238e07e-2ec5-45f4-8ef...	IDa039c582-e9e7-46ad-b...	PARTIAL REFUND	2019-04-03 07:47:27.103	60	37124ee0-d381-469a-8e...	I+DD0A09B55-183C-4DB...
THUA	OFFER_1554216563282	ID9b116688-0866-44ef-9...	FAILED	2019-04-03 07:47:26.851	2.5		
INDRARAIL	OFFER_1554217192667	ID23e6fdc5-94ab-4a82-b...	AUTHORIZED	2019-04-03 07:44:30.345	60	0ee00c58-ee01-468b-afa...	I+D0ADA389E-E694-49E4...
THUA	OFFER_1554216563282	ID9b116688-0866-44ef-9...	CONFIRMED	2019-04-02 14:57:29.201	2.5	56b497cc-7bc0-41e8-ba9...	I+DA8713E5A-AC7B-48A...
THUA	OFFER_1554216563282	ID9b116688-0866-44ef-9...	FAILED	2019-04-02 14:54:44.464	2.5		

Previous Page 9 of 32 Next

- Connected to **issuing and clearing flows**
- Shows each transaction and associated price
- Shows **status** of each transaction: Authorized, Confirmed (paid), Partial/total refund, Failed
- Each Operator logged can consult its own transactions. Admin to consult all
- Configure and download reports

4. Business Analytics (BA)

Overview

Take advantage of the data existing/generated in the ecosystem and provide useful information for travelers and TSP.

- Punctuality
- Service Quality
- Most Used Modes

- Crowed Stations
- Favorite Destinations
- Revenues per mode

Incidents in the line

DATA
- Operational data coming from TSP's systems
- S2R applications data
- Data coming from travelers
- Other external data: open data, social network data ....

MANAGEMENT
- Anonymization techniques to guarantee privacy and confidentiality
- Consideration of GDPR

ANALYTICS
- Develop descriptive, predictive and prescriptive analytics

VISUALIZATION
- Interactive and dynamic visualization capabilities

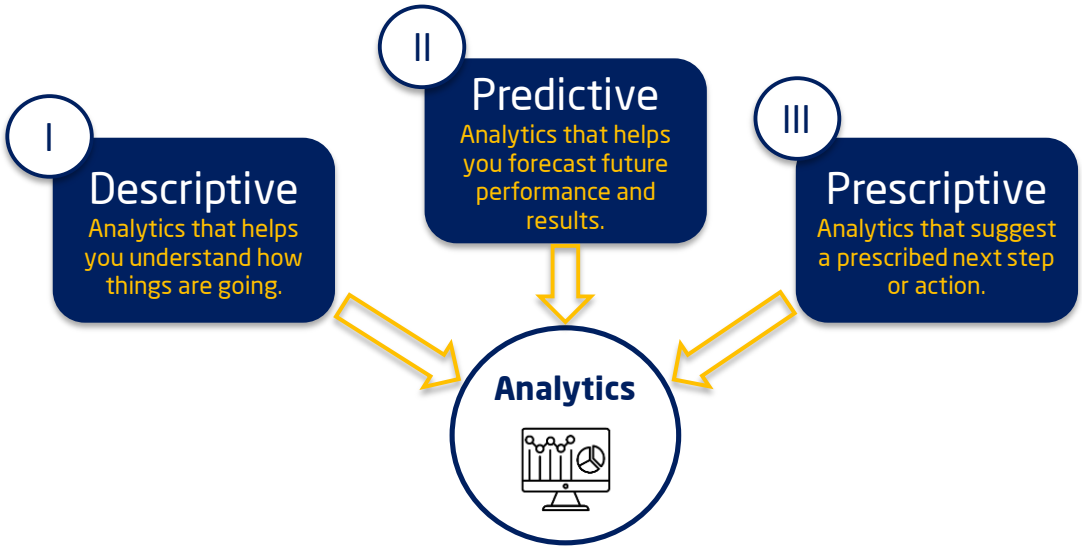
Analysis

I **Descriptive** Analysis
Use data aggregation and data mining to provide insight into the past and answer: **"What has happened?"**

II **Predictive** Analysis
Use statistical models and forecasts techniques to understand the future and answer: **"What could happen?"**

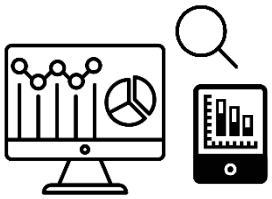
III **Prescriptive** Analysis
Use optimization and simulation algorithms to advice on possible outcomes and answer: **"What should we do?"**

Business Analytics at three levels:



Examples of Analytics

Business Data Analytics



Assets management

- Monitoring stations; optimize maintenance; optimize passenger flow
- Optimize revenue collection
- Fraud control
- Characterize problems/incidences and impact depending on type of day

Demand management

- Mobility patterns, demand prediction, OD Matrix
- Correlate demand and day type, events, weather, etc.
- What-If analysis, support to the deployment of strategies and offer-demand adjustment
- Control passenger entrance at stations

Passenger & Services Management

- Patterns of transport usage depending on sociodemographic profiles
- Business KPI: cost and revenues
- Loyalty programs, ancillary services, preferred bookings, etc.

Multimodal

- Combining data from different TSP, users and IP4 services:
  - Travel patterns: preferred multimodal itineraries, etc.
  - Multimodal KPIs
  - Resource management depending on other modes

Examples of Use Cases: Analytics on Ticketing and service performance

Objectives

- Use available information from ticketing equipment on board and in stations (vending machines, access gates), which could be useful to:
  - Enhance operators performance and maintenance
  - Allow users to know in advance the situation of the equipment in the stations as well as peak times

Data available

Databases of urban operator:

- Operation Assistance Services (OAS) and Automatic Vehicle Location (AVL)
- On board/ on station equipments:
  - Sales
  - Validations
  - Alarms

Analytics

- Total sales, sales per hour, sales per location, average of sales.
- Validation per line, validation per profile, validation per equipment.
- Demand prediction by line, stop, at peak hour
- Total benefits, Payed transactions, number of cards on the black list, Transaction per minutes.
- Delay time for each stop, occupation per service, occupation per service and per stop place.
- Alarms and failures patterns
- Prediction of delays

Examples of Use Cases: Crowd management in stations

Objectives

- Infrastructure design
- Offline analysis: Evaluate and enrich evacuating existing scenarios and train operators
- Online analysis: Forecasting analysis
- Online analysis: What-if analysis

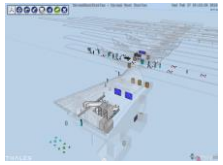
Data available

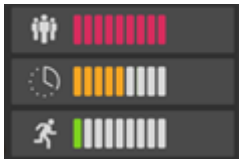
Warsaw West station

- Real situation analyses
- Sensors installation inside the station allowing simulation model recalibration
  - Video Analytics
- Creation of virtual sensor data based on the simulated data

Technical details

- Analytics:
  - Machine Learning (virtual sensors and labelled data)+Transfer learning (real data and unlabelled or partially labelled data)
  - Data imputation algorithms
  - Predictive Analytics: short and medium terms predictions
  - Prescriptive Analytics: What-if analysis
- Visualization:
  - Visualizing simulation, KPIs





Shift2Rail

IP4

Shift2Rail

CONNECTIVE

THANKS FOR YOUR ATTENTION

@ https://shift2rail.org/ip4/connective/

@S2R_CONNECTIVE