



GENERAL OVERVIEW

STEFANOS GOGOS (UNIFE) – PROJECT COORDINATOR

InnoTrans Presentation - 20/09/2018



IN2DREAMS Facts & Figures

INtelligent solutions 2ward the Dvelopment of Railway Energy and Asset Mangement Systems in Europe



Total Budget
2.2M€



Partners
14



Duration
24 Months



Start date
01 09 2017

IN2DREAMS Project Partners

PROJECT COORDINATOR



TECHNICAL LEADERS



UNIVERSITÀ DEGLI STUDI
DI GENOVA

BENEFICIARIES



IN2DREAMS Challenge & Scope

- Predicted growth of transport, especially in European railway infrastructures, is expected to introduce a dramatic increase in freight and passenger services by the end of 2050.
- To support sustainable development of these infrastructures, novel data-driven ICT solutions are required.
- These will enable monitoring, analysis and exploitation of energy and asset information for the entire railway system including power grid, stations, rolling stock and infrastructure.
- IN2DREAMS will address these challenges through two distinct work streams: Work Stream 1 (WS1), focusing on the management of energy-related data and Work Stream 2 (WS2), focusing on the management of asset-related data

IN2DREAMS High-level Objectives

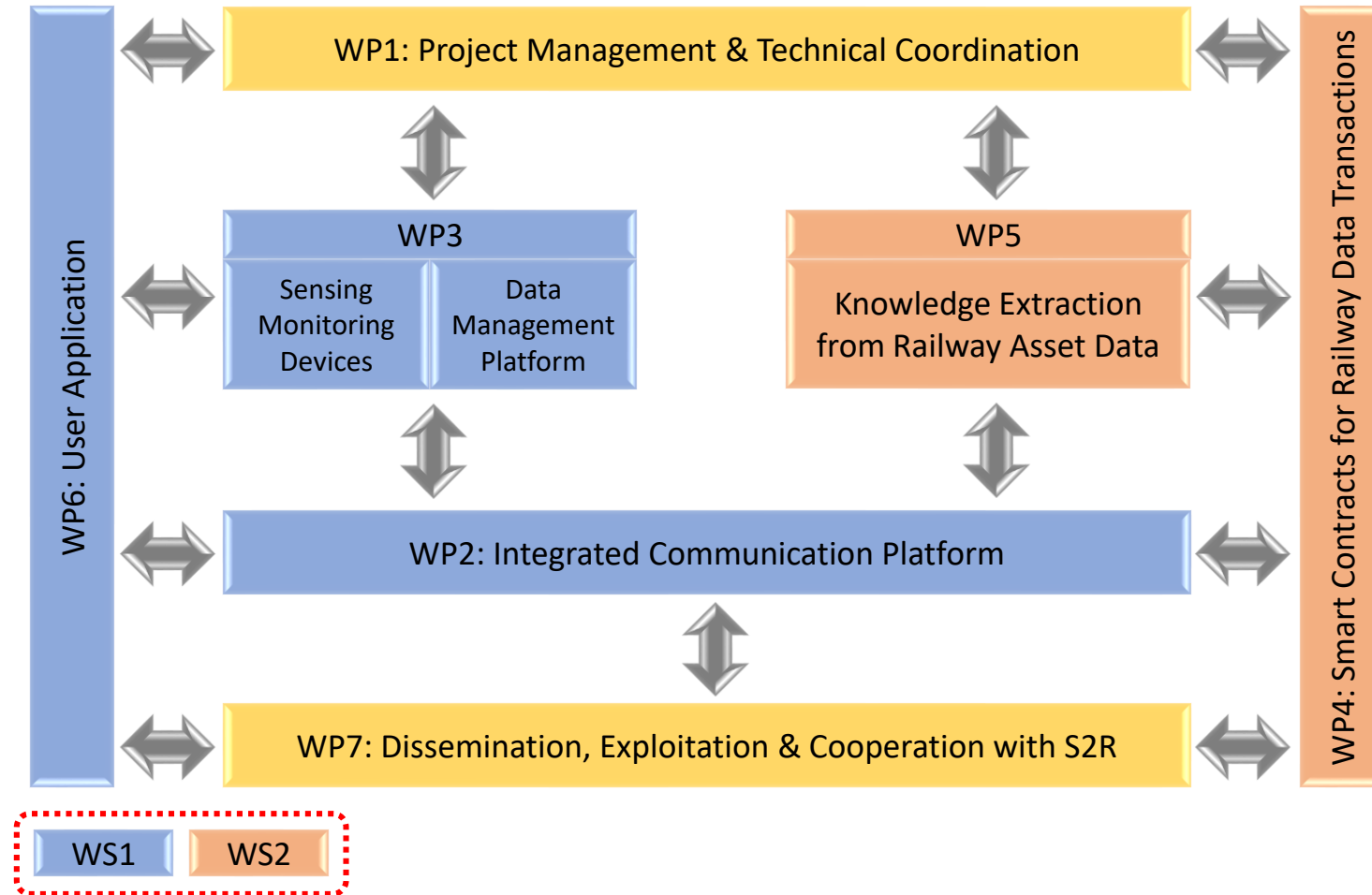
Work Stream 1 – Management of Energy-related Data

WS1 aims to remove the current and anticipated limitations of REMS, by making these capable of supporting a much wider array of requirements than it is currently the case.

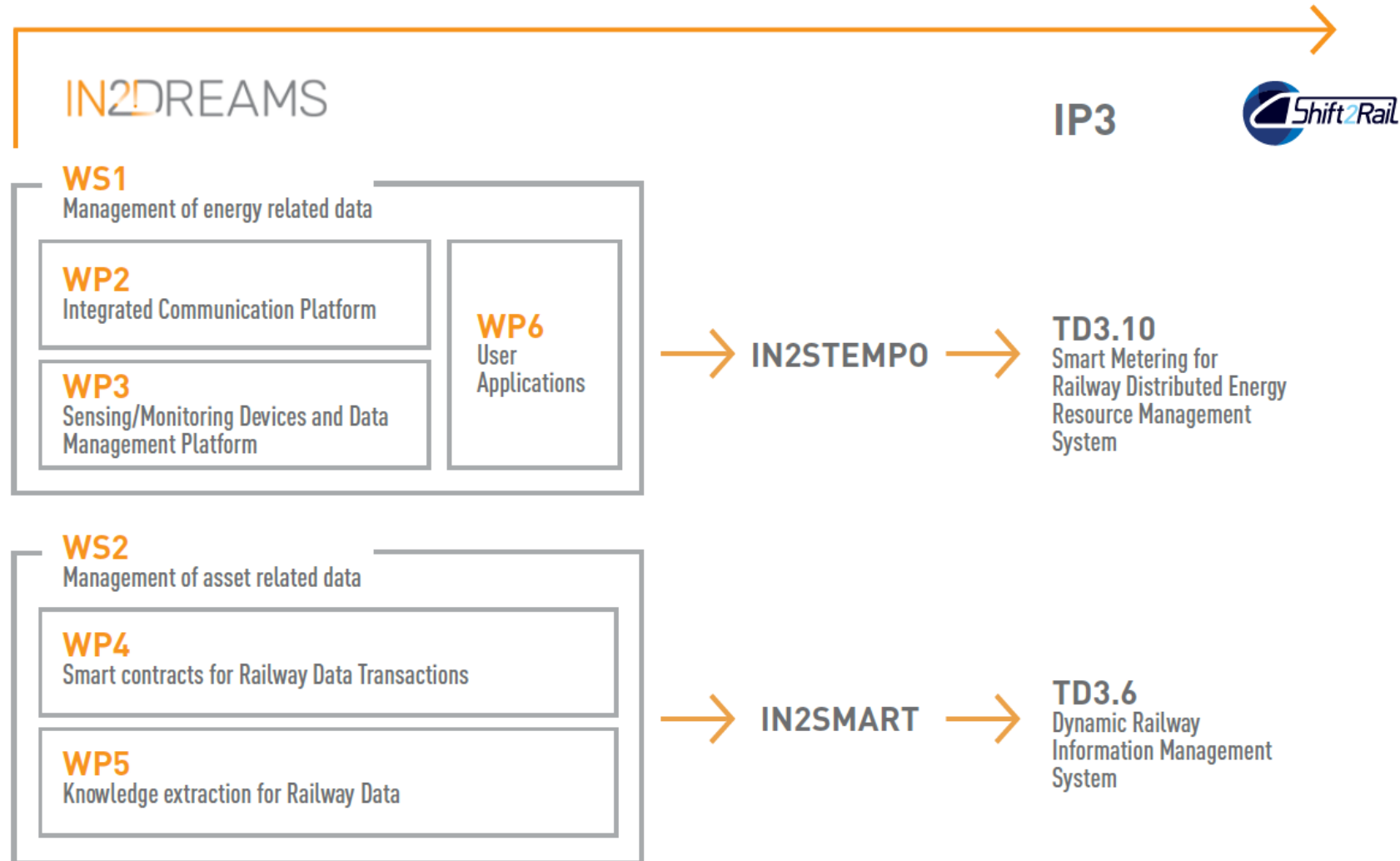
Work Stream 2 – Management of Asset-related Data

WS2 aims to improve efficiency and sustainability of the railway asset data management, by applying research advances in machine learning, data visualization and decentralized architecture with smart contracts.

IN2DREAMS Project Structure



IN2DREAMS Links with Shift2Rail





WORK STREAM 1 OVERVIEW

GUILLAUME PELLETIER (DOTVISION) – TECHNICAL LEADER

InnoTrans Presentation - 20/09/2018



WS 1 – Management of Energy-related Data. It aims to:

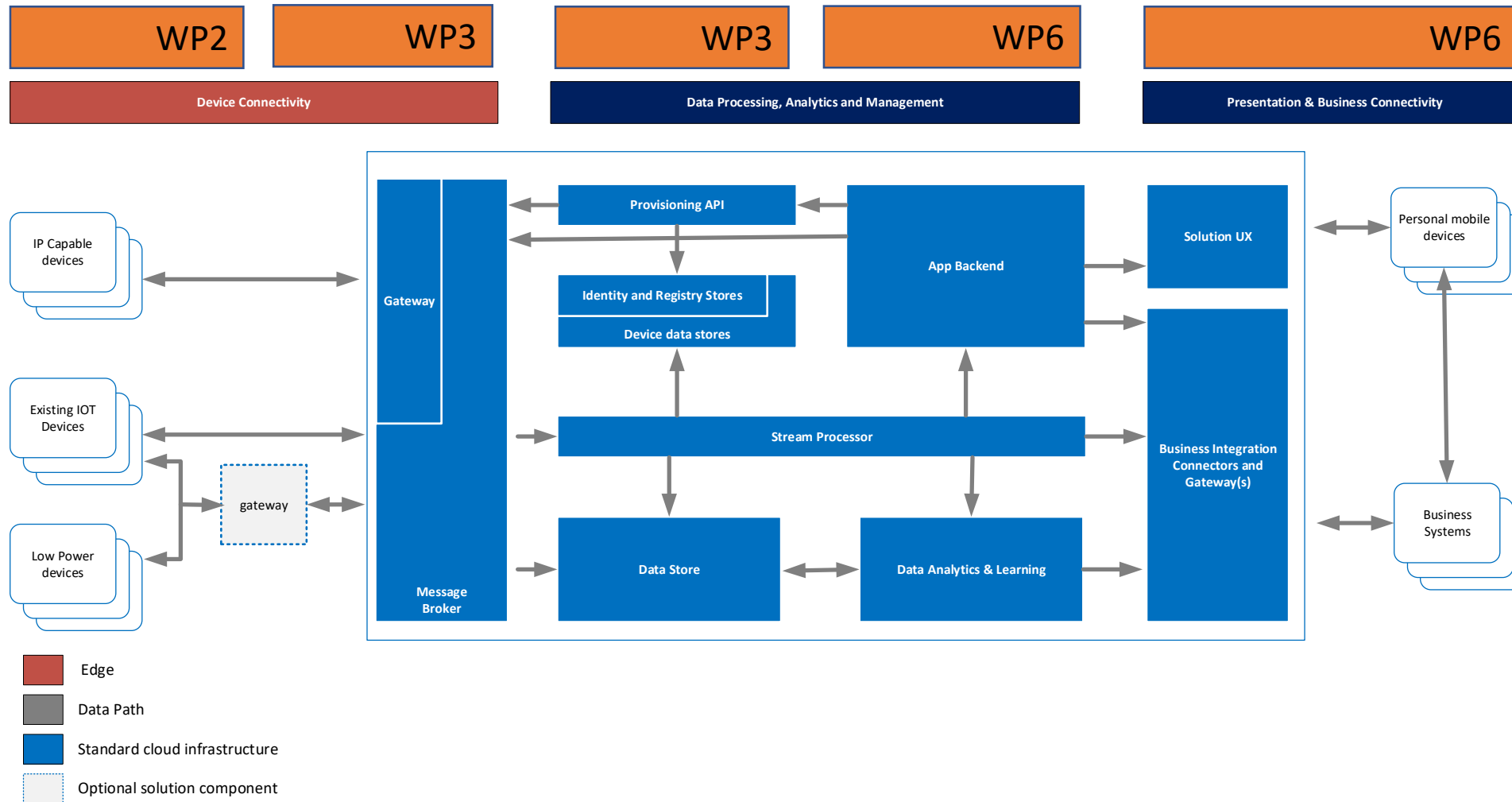
- Realize a non-intrusive Smart Metering sensor networks at Railway System level.
- Setting up an open system and interface for data collection, aggregation and analysis in an open source Operational Data Management (ODM) Platform.
- Providing a set of User Applications design and specifications. The Applications will exploit the energy analysis process with the aim of enhancing the energy decision making and the line operation patterns, as well as other possible improvements such as preventive maintenance.

IN2DREAMS WS1- Work package

WS1 proposes a dynamically re-configurable ICT infrastructure to facilitate both the operation and the services supported by the railway network

- WP2 : A heterogeneous telecommunication platform, consisting of both wireless and wireline systems converging energy and telecom services.
- WP3 An IOT and ODM platform for data collection, aggregation and analysis that scales with the railway operators needs.
- WP6: A set of users' applications with emphasis on fault detection / localisation and energy efficient optimization.

IN2DREAMS WS1- Industrial IT Architecture



IN2DREAMS WS1- Status

WP2:

- To date, the On-board and train-to-ground data transmission is operational on Reims POC and Bristol Based LTE network.
- Ground to operations is also supported using a combination of wireless and optical technologies
- IOT connectivity is completed

WP3:

- Delivered the Architectural overview of the solution.
- Launched the Data Management Platform.
- Built the Monitoring On Board Rugged Gateway (ALOHA).
- Successfully passed the first installation and security test on Reims Tramway

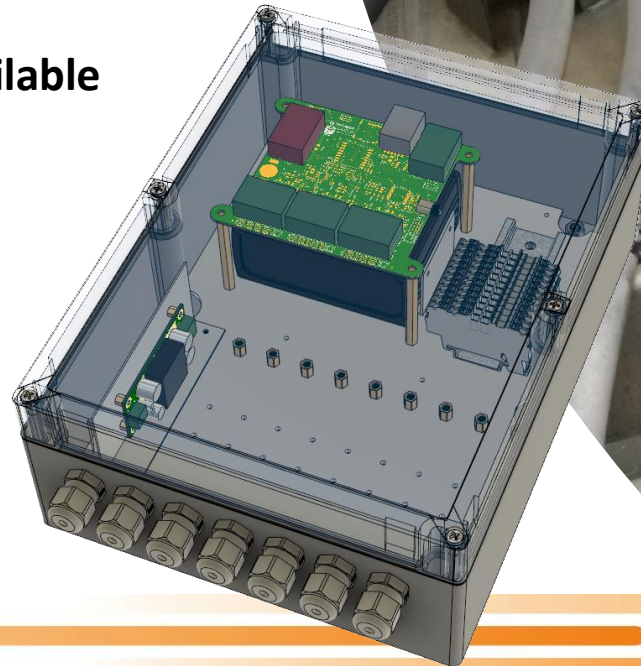
WP6:

- Architecture has been deployed and QMiner software has been installed. Forecasting models of energy consumption for trains
- Sub-stations are under development and will be implemented
- Moreover, a task to model energy data has started

IN2DREAMS

WS1- POC

- WS1 has started a Proof of Concept in Reims Tramway which encompass the WP2 WP3 physical devices and set of analysis from WP6
- Work in progress presentation is available at InnoTrans with AR support.





WORK STREAM 2 OVERVIEW

NADIA FABRIZIO (CEFRIEL) – WORK PACKAGE LEADER

InnoTrans Presentation - 20/09/2018



IN2DREAMS WS2- Management of asset related data

WS 2 – Management of Asset-related Data. It aims to:

- Define the necessary IT solutions and related methodologies for business security, economic sustainability and decision support in the field of data processing and analytics in **railway applications for asset management**.
- This work is directly related to the Technical Demonstrator TD3.6: Dynamic Railway Information Management System (DRIMS).
- Will address some of the challenges related to TD3.6 outlined in the S2R MAAP. This TD focuses **on interfaces with external systems**, maintenance-related data management as well as **data mining and data analytics**, asset degradation modelling covering both degradation modelling driven by data and domain knowledge and the enhancement of existing models using data/new insights.

IN2DREAMS Objective of WS2

Support data-driven methodologies applied in real world railway contexts

- Address fundamental topics of data and transactions security, safeguarding data ownership rights, railway specific structural contract mechanisms for information and knowledge exchange
- Extend the work carried out in the framework of the IN2RAIL project by studying, designing and developing data-driven IT tools and methodologies for explicit knowledge extraction, with particular reference to the derivation of data-driven descriptive, diagnostic, and predictive models
- Design and develop visual analytics tools for the interpretation of data and models by human operators and decision makers → WP5
- Design, develop and test a reference software architecture for implementation of smart contracts in railway ecosystem for data exchange. Address the legal aspects related to the adoption of smart contracts in the railway ecosystem. → WP4
- Develop tools and metrics for the (statistical) assessment and validation of data-driven models performance. → WP4
- Design and develop visual analytics tools for the interpretation of data and models by human operators and decision makers.
- Design and develop rule-based data analytics tools for the exploitation of the implicit knowledge stored in data-driven models.

SCOPE AND IMPACTS

Railway applications for asset management.

- **Focus is on**
 - **interfaces with external systems,**
 - maintenance-related data management
 - **data mining and data analytics** (asset degradation modelling covering both degradation modelling driven by data and domain knowledge
 - enhancement of existing models using data/new insights.

IMPACTS	
Improvement of capacity – a large improvement in line capacity due to a more effective asset maintenance management	1. future Intelligent Asset Maintenance, 2. Data-driven methodologies 3. holistic approach to asset management and decision support including diagnostics and prognostics
Improved Reliability: failure modes of current systems will be reduced/eliminated due to the new “intelligent asset management”	1. reduce unexpected maintenance interventions 2. thus increasing reliability and availability
Significant LCC savings	1. moving from reactive and preventive maintenance to prescriptive maintenance based 2. nowcasting and forecasting of asset condition and diagnosis
Improved safety	1. the number and magnitude of incidents will be reduced

IN2DREAMS WP4 identified scenarios

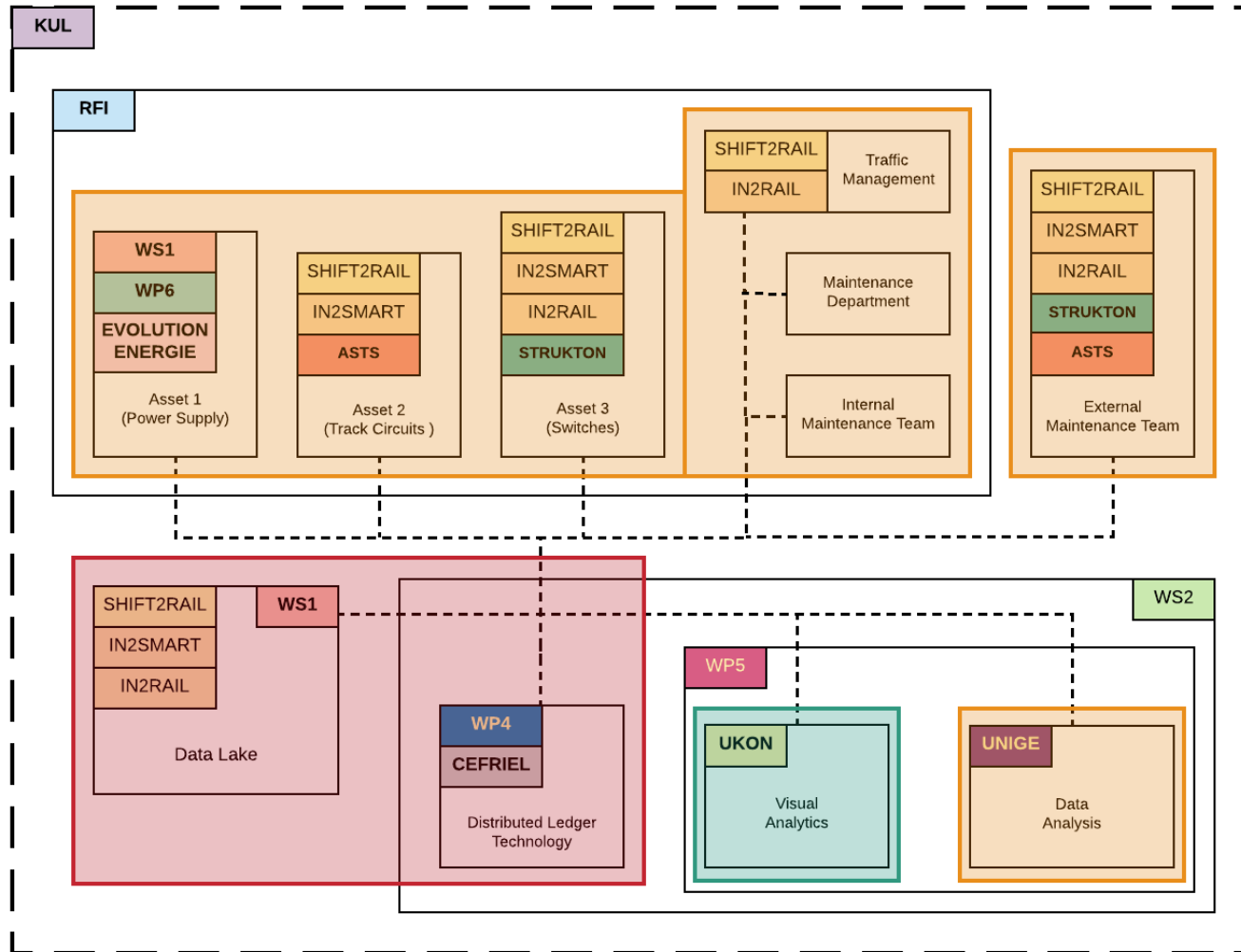
- **Asset Maintenance**-*Manage the maintenance jobs workflow through the employment of smart contracts, automatically enforcing the rules and clauses (like SLA) of the maintenance contracts between the IM and the Contractor.*
- *Public Procurement-Employ the blockchain as a notarization platform for public procurements, taking advantage of its immutability property.*
- *Data Monetisation-Monetize owned data creating an ecosystem able to manage the access (and relative payments) to the data of the ecosystem's participants, employing smart contract to manage both the access rights and the payments.*
- *Train Path Allocation-Manage the international allocation of train path through the employment of smart contracts and blockchain to automatize the administrative workflow.*

The Asset Maintenance use case is the selected one for a prototype implementation within IN2DREAMS

IN2DREAMS WP5 identified scenarios

- Cross-Scenario 1: Visualization in Control Center
- Cross-Scenario 2: Marketplace of Data and Data Monetization
- Specific-Scenario 1: Track Circuits
- Specific-Scenario 2: Train Delays and Penalties
- Specific-Scenario 3: Restoration Time
- Specific-Scenario 4: Switches
- Specific-Scenario 5: Train Energy Consumption

IN2DREAMS WP4 & WP5 links



Work of WP4 has been organized in synergy with WP5.

Restoration time, predicted for each maintenance job as part of one of the WP5 data analytics scenarios, will be stored on the blockchain, and showed to RFI operators, together with all the needed data and alerts (i.e. delayed maintenance) generated by WP4 prototype. This specific data visualization task will be tackled inside WP5 data visualization scenario

WP4

Identified use cases

- “Asset Maintenance “ selected use case

Select the appropriate DLT

- Hyperledger Fabric selected platform

Draft a preliminary architecture of the prototype

- Working prototype done In Hyperledger Fabric (Composer)

WP5

Definition of the data analytics scenario

Development and demonstration of tools “Machine Learning & Visualization” to demonstrate the feasibility of extracting knowledge from data

Study and develop POC architecture

Together with CEFRIEL & UKON

we discussed the most suited subject of the POC and we observed that

- CEFRIEL has a scenario about handling maintenances with blockchain
- UNIGE has a scenario about predicting the maintenances restoration time
- UKON has a scenario about visualisation in the control center (visualisation for maintainers and train dispatchers)

merging these three things together would be a good option

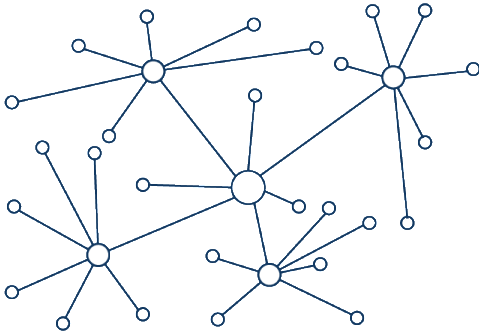
- CEFRIEL needs to ask to RFI information about 2-3 maintenances to use for the demonstrator
- UNIGE will provide the interpretable model for the predictions of the restoration time, the actual predictions, and the accuracy of the predictions
- UKON will implement three visualisations/monitors (1) for the maintainers, (2) for the dispatchers, and (3) for the director of the maintenance

maybe we can also include something else from the WP5 like the train delay predictions

The WS2 is developing a demonstrator on the selected scenarios

WP4 Scenarios

- Asset Maintenance



Cefriel
POLITECNICO DI MILANO

**Evolution
Energie**

WP5 Scenarios

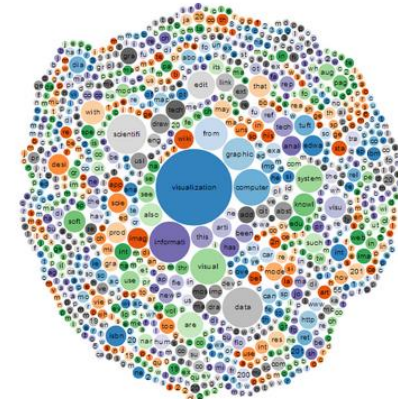
- Restoration Time
- Train Delay Prediction



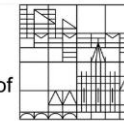
UNIVERSITÀ DEGLI STUDI
DI GENOVA

WP5 Scenario

- Visualization in Control Center



University of
Konstanz



Demonstrator

Thank you for your Attention!

Any Questions?

Visit us at:

www.in2dreams.eu