

In2Rail

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Requirements for the Generic Application Framework

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Authors

		Details of contribution
Author(s)	AZD Praha s.r.o. (AZD) Bojda Martin Nováková Lenka Růžička Martin	Requirements matrix (Appendix 6.1) – Chapters 8, 12, 21 and 22
Contributor(s)	Ansaldo STS (ASTS) Gian Luigi Zanella	Requirements matrix (Appendix 6.1) – Chapters 1, 2, 7, 11, 12 and 22
	AZD Praha s.r.o. (AZD) Bojda Martin Nováková Lenka Růžička Martin	Requirements matrix (Appendix 6.1) – Chapters 8, 12, 21 and 22
	Bombardier Transportation (BT) Roland Kuhn Martin Karlsson	Requirements matrix (Appendix 6.1) – Chapters 1, 5, 6 and 22
	CAF Signalling (CAF) Carlos Sicre Vara de Rey Manuel Castro Viñas	Requirements matrix (Appendix 6.1) – Chapters 16, 17 and 22
	HaCon (HC) Sandra Kempf Rolf Gooßmann	Requirements matrix (Appendix 6.1) – Chapters 1, 2, 3, 4, 8, 10, 11, 13, 16, 21 and 22
	Siemens (SIE) Stefan Wegele	Requirements matrix (Appendix 6.1) – Chapters 9, 18, 19, 20 and 22
	Thales (THA) Hoi-Ting Chansavang Friant Jean-Yves	Requirements matrix (Appendix 6.1) – Chapters 12, 13, 14, 15 and 22

Executive Summary

The overall aim of the In2Rail project is to set the foundation for a resilient, cost-efficient, high capacity, and digitalised European rail network.

The In2Rail sub-project Intelligent Mobility Management (I²M) is one of the three technical sub-projects and includes Work Package 8, which deals with, among other subjects, the definition of the functional specification of future TMS/dispatching systems.

This document is the first deliverable in WP8 and describes the first part of work done in Task 8.2 – Generic Framework for Application - to produce a system requirements specification (SRS) for a standardized generic application framework allowing plug-and-play of service application modules.

To have a better overview of the research activity was started, see Chapter 3. All requirements are stored within a matrix that contains the structure of the functional breakdown. The structure has been adapted as necessary during the whole research process.

Besides the analysis of deliverables of other I²M Work packages and National projects, internal relevant knowledge adapted as necessary has been included in the scope of the investigation to establish the full set of requirements for a standardised application framework.

The research has been conducted by all partners of WP8 and the inputs consolidated to form a comprehensive set of requirements. The resulting requirements matrix has been subjected to a structured technical review process.

The actual requirements for the Application Framework are shown in an external document (see document attachment “Requirements Matrix” referenced in Appendix 6.1).

WP8 is concerned with the Integration Layer of the Intelligent Mobility Management system. The findings of WP7 and addresses and develops a standardised integrated ICT environment capable of supporting diverse TMS dispatching services and associated operational systems. WP8 includes Standard interfaces to external systems outside TMS/dispatching (for other railway management systems and transport modes) with a plug-and-play framework for TMS/dispatching applications.

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Abbreviations and acronyms

Abbreviation / Acronyms	Description
AF	A pplication F ramework
AL	A pplication L ayer
API	A pplication P rogramming I nterface
ARS	A utomatic R oute S etting
ATO	A utomatic T rain O peration
CDM	C anonical D ata M odel
CENELEC	The European Committee for Electrotechnical Standardization and is responsible for standardization in the electrotechnical engineering field
DB engine	D atab a se engine
DMS	D ata M anagement S ystem
EU	E uropean U ion
HMI	H uman- M achine I nterface
ICT	I nformation and C ommunication T echnologies
IF	I nterface
IL	I ntegration L ayer
IM	I nfrast r ucture M anager
I ² M	<p>Intelligent Mobility Management: Information developed as a strategically critical asset:</p> <ul style="list-style-type: none"> • A standardised approach to information management and dispatching system enabling an integrated Traffic Management System (TMS). • An Information and Communication Technology (ICT) environment supporting all transport operational systems with standardised interfaces and with a plug-and-play framework for TMS applications. <p>An advanced asset information system with the ability to 'nowcast' and forecast network asset statuses with the associated uncertainties from heterogeneous data sources.</p>
IMDG	I n M emory D ata G rid
I ² R	<ul style="list-style-type: none"> • In2Rail: Is to set the foundations for a resilient, consistent, cost-efficient, high capacity European network by delivering important building blocks that unlock the innovation potential that exists in SHIFT2RAIL
JSON	J avascript O bject N otation
KMS	K ey M anagement S ystem
LAN	L ocal A rea N etwork
MTBF	M ean T ime B etween F ailures
MTTR	M ean T ime t o R ecovery
OS	O peration S ystem

Requirements for the Generic Application Framework

Abbreviation / Acronyms	Description
SQL	Structured Query Language
SIL	Safety Integrity Level
SRS	System Requirements Specification
TAF	Telematic Applications for Freight trains
TAP	Telematic Applications for Passenger trains
TMS	Traffic Management System
TSI	Technical Standards for Interoperability
UIC	Union Internationale des Chemins de fer (International Union of Railways)
UML	Unified Modelling Language
VM	Virtual Machine
WAN	Wide Area Network
WP7	Work Package 7: System Engineering of Intelligent Mobility Management (I²M) of In2Rail.
WP8	Work Package 8: Integration and Application Layer of the Intelligent Mobility Management (I²M) of In2Rail.
XML	eXtensible Markup Language
XSD	XML Schema Document

1. Background

This document, Deliverable D8.5 “Requirements for the Generic Application Framework”, constitutes one of the project deliverables in the framework of the Project titled “Innovative Intelligent Rail” (Project Acronym: In²Rail; under grant Agreement No 635900).

The overall objective of Work Package 8 (WP8) is to develop the findings of WP7 in order to address and develop a standardised integrated ICT environment capable of supporting diverse TMS dispatching services and operational systems. Additionally WP8 deals with standard interfaces to external systems outside TMS/dispatching and with a plug-and-play framework for TMS/Dispatching applications.

The objective of establishing Requirements of the Generic Application Framework is to determine and describe the Application Framework which involves all the TMS applications and is connected to the Integration Layer in order to communicate to the external world. The Application Framework only comprises only those applications managing highly dynamic service related processes and hence communication traffic volumes have been designed to be as lean as possible.

The WP 8 includes two areas, the Integration Layer and the Generic Framework for applications. Each area is devoted to specific subtopics which are shown in Figure 1.1.

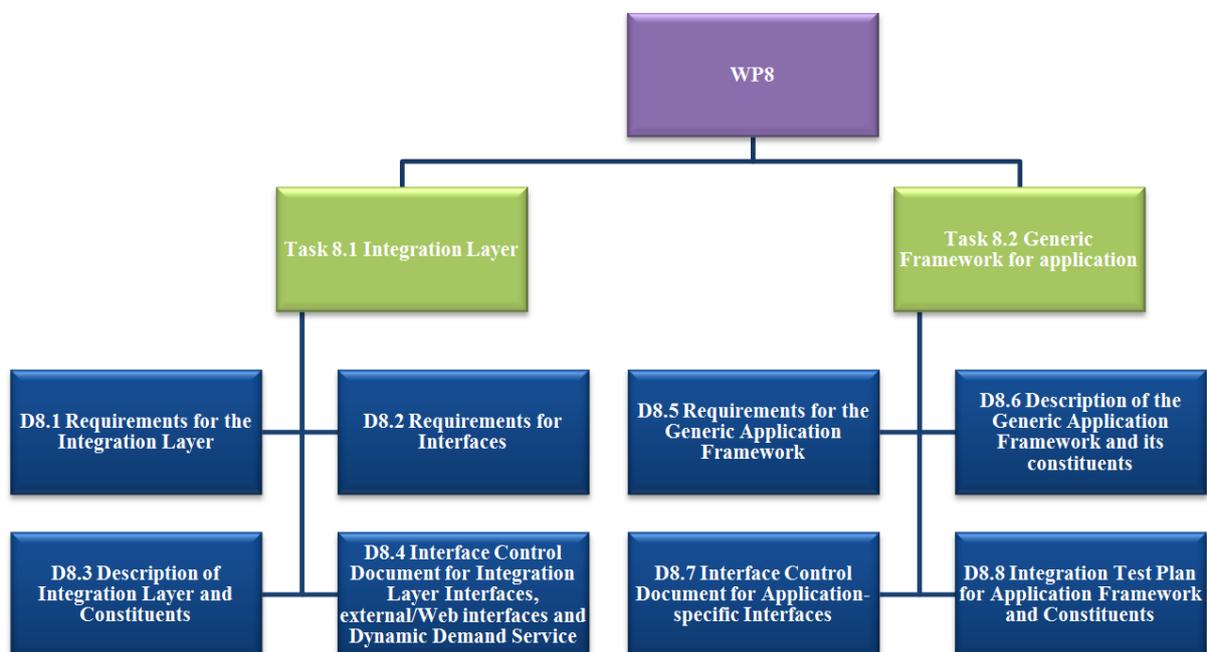


Figure 1.1 - Subtopics of WP8

The requirements have been created according to the best knowledge and skills of the WP8 partners. In addition some of the requirements are defined according to other documents which are referenced in the matrix including CENELEC Standards, Enterprise Integration Patterns, WP9 (now-casting and forecasting of assets).

2. Objective / Aim

The aim of this document is to determine and describe requirements for the TMS Application Framework.

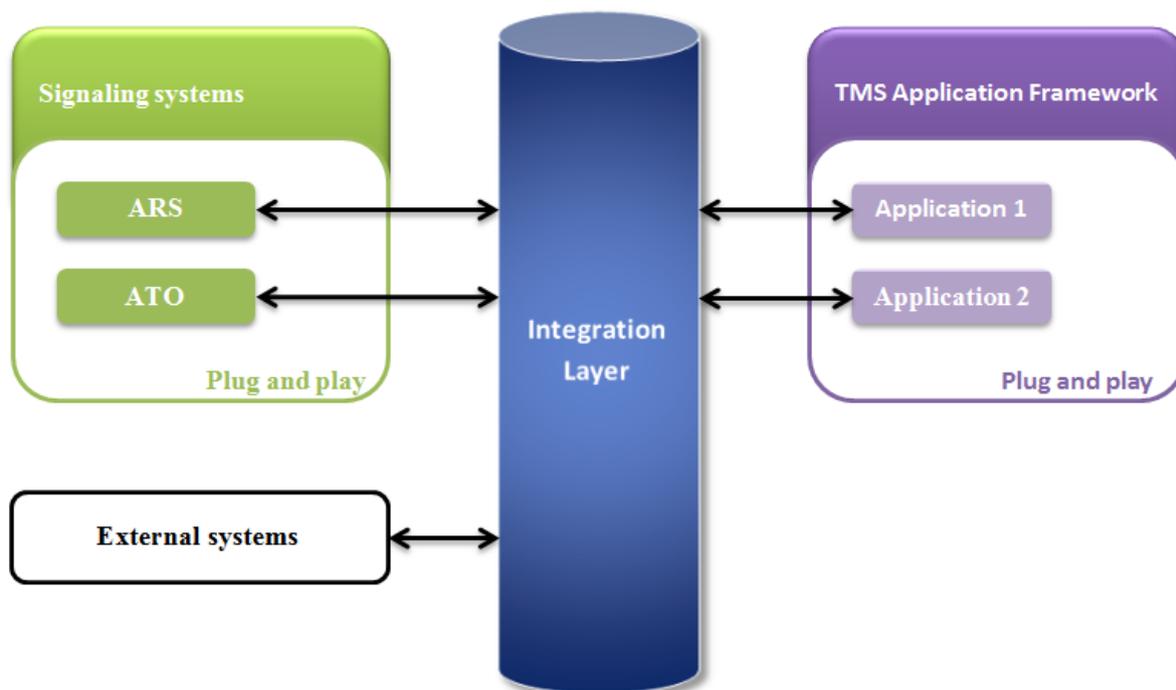


Figure 2.1 - Overview of integration of TMS Application Framework

The Application Framework shall comprise TMS core applications managing highly dynamic service related processes, associated communications and required system services to enable plug-and-play functionality.

The long term objective is to provide a *standardised* integrated ICT environment supporting diverse TMS applications that are connected to other multimodal operational systems.

The standardisation includes specification of the interfaces to external systems and plug-and-play mechanisms for the TMS-applications inside of the Application Framework. With the first version of the standard draft specified in D8.1 a change management mechanism will be initiated in order to support remaining activities of In2Rail project and the defined follow up activities in Shift2Rail project.

3. Requirements Breakdown Structure

The description of the requirements for the Generic Application Framework is located in the matrix, which is divided into the following three sections.

- Section 1 contains individual requirements and their short description. Additional important information such as data sources, collection date and comments are also included;
- Section 2 represents a list of documents used to collect the requirements;
- Section 3 is devoted to the description of the categories of the information used in matrix, such as description of status/importance of requirements.

In Section 1 the requirements are divided into several levels, which provide subsequent requirements and descriptions. In the matrix five levels are used in total of which level 1 contains the basic high level requirements.

For each collected requirement, the following information, is defined within the individual columns below:

- **Req. ID (Requirements identification):** an unique number in the global matrix;
- **Level:** number of nesting sections;
- **Title:** a designation for the requirement;
- **In2Rail Requirement Description:** description of the general purpose of the requirement or specification;
- **Collector:** a name of creator;
- **Date of collect:** date of creating requirement;
- **Source:** from which documents was gained information;
- **Status/Importance of the requirement:** description of importance by using letters, such as M (mandatory), R (recommended) etc.;
- **Comments:** any comments that allow clarification of the requirement or provide traceability of the requirement.

Requirements for the Generic Application Framework

All of the requirements are divided into these chapters:

ID	Chapter	Collector
1	Communication	BT, ASTC, HC
2	Availability, Performance	ASTS, HC
3	Data Management system	HC
4	Security of information system	HC
5	Requirements on Data Model (Topics of the Application Layer)	BT
6	SIL Requirements	BT
7	Start-up, Shut-down	ASTS
8	Synchronization/Time Management	AZD, HC
9	Directory (naming services, identifying services)	SIE
10	Requirements related to API-Type	HC
11	Requirements related to operating environment	ASTS, HC
12	Monitoring/profiling the Applications	THA, AZD, ASTS
13	Scalability	THA, HC
14	Scheduling	THA
15	Transactions	THA
16	Logging and traceability	CAF, HC
17	Alarms and Events	CAF
18	Workflow (technical workflow with human interaction), module orchestration	SIE
19	Backwards/version compatibility	SIE
20	Applicable Standards	SIE
21	Diagnostic and System Maintenance	AZD, HC
22	Manuals and documentation	WP8

4. Conclusion

The requirements specified in this deliverable provide the basis for the following activities:

- The proof of concept in WP7.3 will evaluate the results of AF-specification against the requirements of this deliverable;
- The specified requirements allow evaluation of existing middleware standards and implementation for their suitability for TMS Application Framework;
- The detailed specification of the Generic Application Framework and its constituents (D8.6) linked directly to the requirements of Application Framework;
- Requirements can be applied to future tenders for National Integrated TMS;
- Used as a basis for Shift2Rail development.

5. Common Glossary

Term	Definition
Application Layer	Common infrastructure that handles the system management of the applications; a communication framework that enables dynamic and flexible interaction between the TMS applications, an interface framework for implementing the application interfaces for interaction between the applications, a broker framework that allows for interaction of the TMS application with other systems via the Integration Layer.
Application Group	A set of applications that provides a Business capability
Broker	Software that manages Information distribution amongst the connected services between Application Layer and Integration Layer.
Data mart	Section of the Data Warehouse.
Data Warehouse	Central repository of integrated data from one or more disparate sources (services one of them being the TMS). The Data warehouse contains for each service specific data in different sections (data marts) presenting History, Now-cast and Forecast information.
Decentralized	Responsibility distributed, not one single entity has control over all the processing (See https://www.quora.com/Whats-the-difference-between-distributed-and-decentralized-in-Bitcoin-land).
Distributed	Physically distributed, not all the processing of the transactions is done in the same place (See https://www.quora.com/Whats-the-difference-between-distributed-and-decentralized-in-Bitcoin-land).
Execution Environment	A mechanism that provides a Sandbox to run Application Group.
Forecast	Estimate information in the future, deviations from the plan estimated.
I2M	Subproject under In2Rail focusses on the research and development of the system requirements specification and architecture for key elements of a future integrated rail service operation system.

Requirements for the Generic Application Framework

Term	Definition
Integration Layer	Communication link between the different Business Services.
Middleware	<p>Middleware is a general term for software that serves to "glue together" separate, often complex and already existing, programs. Some software components that are frequently connected with middleware include enterprise applications and Web services.</p> <p>Typically, middleware programs provide messaging services so that different applications can communicate using messaging frameworks like Simple Object Access Protocol (SOAP), Web services, Representational State Transfer (REST) and JavaScript Object Notation (JSON). The systematic tying together of disparate applications, often through the use of middleware, is known as enterprise application integration (EAI).</p>
Now-cast	Information about present situation on the railway.
Operating Environment	Where the application framework is hosted
Plug-in	<p>Entities that extract information from the data warehouse and deliver updated Information to the data marts. A Plugin shall generally contain:</p> <p>The interface to the Integration Layer.</p> <p>A functional module transforming application specific data structure and information into the standard Integration layer data format.</p> <p>Interface between plugin and Data warehouse which shall contain a "Translating Unit" for Data and function mapping in case a different data model and structure is applied in the data mart.</p>
Publisher	Entity that publishes messages to be consumed by one or more subscribers.
Publisher	Actor of a business process that publishes Topics (ie make available and updates).
railML	Data exchange format developed by the European consortium of railway companies, academic institutions and consultancy firms.
Silo	Repository of fixed data.
Static Data	Data that never change along time.
Subscriber	Entity that consumes messages sent by the Publisher.

Requirements for the Generic Application Framework

Term	Definition
Subscriber	Actor of a business process that receives updates about one or more different topics it has subscribed.
Topic	Information specific to a business process. A topic is made up of a structured collection of operational data.
Traceability	Ability to verify the history, location or application of an item by means of document recorded identification.

6. Appendix 1 - Requirements Matrix

The system requirements for the generic Application Framework have been defined in the document Appendix "Requirements Matrix". These requirements will continue to be further refined throughout the duration of the In2Rail project, but are contained in this Appendix to reflect the status achieved at the time of this project deliverable release.