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InteGRail

Intelligent Integration of Railway Systems

Instrument: Integrated Project

Thematic Priority: Priority 6.2 - Sustainable Surface Transport

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List of abbreviations

AEIF	Association Européenne pour l'Interopérabilité Ferroviaire
CEN	Comité Europeen de Normalisation (standardisation body)
CENELEC	Comité Europeen de Normalisation ELECtrotechnique (standardisation body)
CER	Community of European Railways
ERTMS	European Rail Traffic Management System
ETSI	European Telecommunications Standards Institute
EuRoMain	EUropean Railway Open MAINtenance system (FP5 project)
FP	Framework Programme
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile communications (ETSI standard)
GSM-R	GSM for Railways
GUI	Geographical User Interface
HTTP	Hyper Text Mark-up Language
ICOM	Intelligent Communication Framework
ICT	Information and Communication Technologies
IEC	International Electrotechnical Commission (standardisation body)
IEEE	Institute of Electrical and Electronic Engineers (standardisation body)
IGRIS	InteGRail Information System
IM	Infrastructure Manager
IMAIN	Intelligent Maintenance
IMON	Intelligent Monitoring
ISO	International Standard Organisation (standardisation body)
KPI	Key Performance Indicators
ODSS	Operation Decision Support System
OSI	Open System Interconnection (general framework for communication networks)
QoS	Quality of Service
RAMS	Reliability, Availability, Maintainability and Safety
RCM	Reliability Centred Maintenance
RDF	Resource Description Framework (W3C Standard)
RDO	Railway Domain Ontology (
ROSIN	Railway Open System Interconnection Network (TR1045: a TAP-FP4 project)
RU	Railway Undertaking
SCADA	Supervisory Control And Data Acquisition
SOAP	Simple Object Access Protocol
TAP	Telematics Applications Programme
TCN	Train Communication Network (standard IEC 61375)
TSI	Technical Specification for Interoperability
UIC	Union Internationale des Chemins de Fer (International Union of Railways)
UITP	Union Internationale des Transport Public
UML	Unified Modelling Language
UMTS	Universal Mobile Telecommunication System
UNIFE	Union of Railway Industries
VPN	Virtual Private Network
WOL	Web Ontology Language
W3C	World Wide Web Consortium
XML	eXtensible Mark-up Language

Section 1. InteGRail – The Vision

All railways have the same basic targets. Beyond a safe railway, they are all working to maximise the capacity at which they can operate their networks, minimise passenger and freight delays, maximise the reliability of the infrastructure and rolling stock, and do all of these at minimum cost.

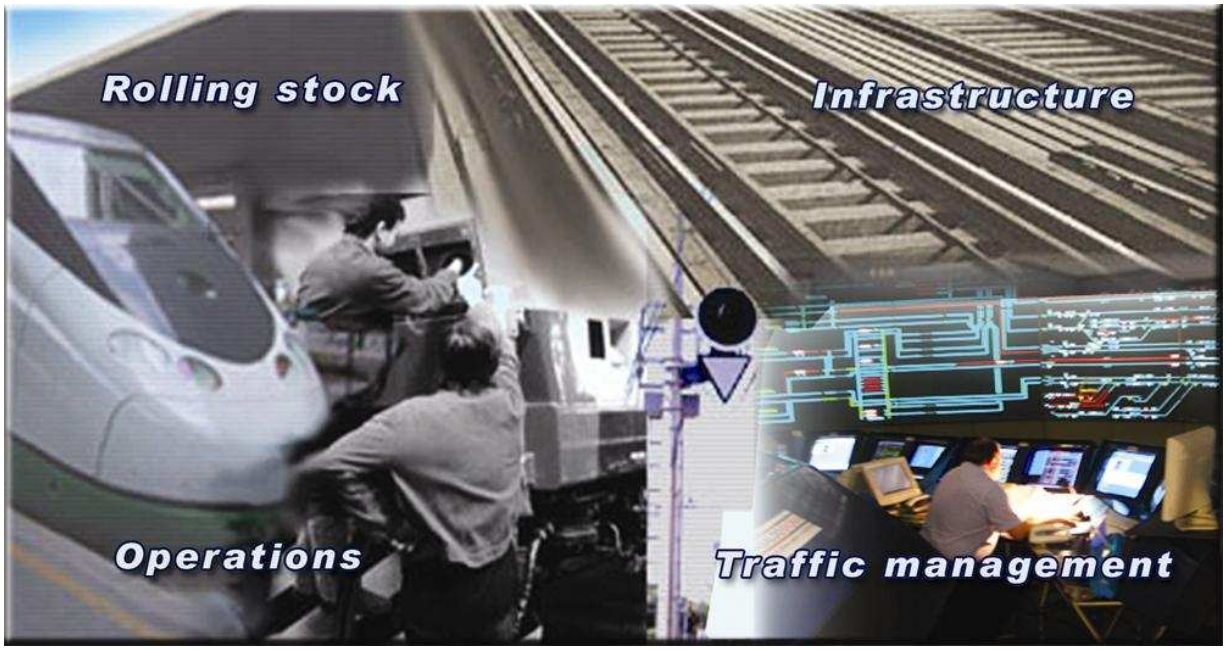
Many railways have improved their performance against these targets through a series of engineering and process improvements. But over time the level of improvement that can be achieved reaches a threshold beyond which further improvement by these means is minimal. Also, the separation of railways into Infrastructure Managers (IMs) and operating companies or Railway Undertakings (RUs) means that there is a limit to the improvement that can be achieved if IMs and RUs cannot work together effectively.

This is where InteGRail will make a difference. Sharing information between IMs and RUs allows the whole railway to be managed as a single system. That single system doesn't have to be restricted to only one country. InteGRail will allow IMs and RUs across Europe to act as a single system.

Over many years, the railway has worked on the basis of finding problems and faults and fixing them. A more efficient railway needs a method for predicting the condition of its assets and then intervening to prevent them from failing. This is possible if data is collected continuously from the infrastructure and rolling stock; if that data is transformed and processed into coherent information; and if trends in that information are monitored and analysed so that assets can be maintained just in time. Again, InteGRail makes that possible by defining a common standard for the information and sharing it. InteGRail is not a system but defines a set of standards and methods for information sharing and interpretation so that IMs and RUs can integrate their existing systems and suppliers to the railway industry can develop and market systems that will integrate. Integrating railway information through InteGRail will create a single view and allow the management of European railways as a single system. As a result, greater efficiency can be achieved within individual railways and across European railways. Better management of the rolling stock – infrastructure interaction will lead to greater reliability of those assets. In turn that leads to decreased maintenance costs and to improved punctuality. Reduced asset failure means that they are more available and so this leads to an increase in the usable capacity of the railway.

Also, InteGRail supports decision-making when a fault occurs, allowing traffic managers and operators to decide on the best course of action. Making the best decision leads to reduced delays. If recovery from a fault is made faster, trains can be timetabled closer together so again, the usable capacity of the railway can be increased.

On its own, InteGRail will not lead to greater efficiencies in the railway but it will supply the information to support better decisions. Applying this new decision-making capability with new processes will minimise passenger and freight delays; maximise the capacity at which we can operate the networks; maximise the reliability of the infrastructure and rolling stock; and do all of these for minimum cost.



InteGRail: an integrated system for a modern railway

Section 2. Project Execution

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2.2. Introduction

2.2.1. Railways and information & communication technology

The railway system is becoming more and more complex. Information & Communication Technologies have an increasingly vital role in ensuring that it can operate effectively, efficiently and safely. Therefore a good level of standardisation and interoperability between railway information systems is and will be required in order to control the complexity and allow further performance improvements.

The approach from the past applying specific solutions to solve individual problems proved to be too expensive and to bring limited results. The rail society has recognised that we need to found new solutions on a clear and sound general platform, which allows to easily integrate and manage different solutions and systems, while allowing their evolution according to the faster changing railway business models.

2.2.2. The InteGRail contribution

InteGRail defined such a platform, showing how it is able to support all main areas of the railway systems, integrating existing systems and paving the way for a new generation of systems.

By means of a modular architecture based on application and communication services, it was possible to achieve the envisaged targets in terms of integration, flexibility, decision support and possible evolution.

Applications implemented according to InteGRail rules can easily retrieve, elaborate and exchange information whenever needed. This became possible by the use of a common language, which avoids ambiguity and can automatically be processed, and of standard protocols (middleware), which enable communication between applications, wherever they are located.

During the project lifetime a number of example applications were developed, to demonstrate that the concepts developed in the project work. These example applications were demonstrated at the end of the project, to prove that the platform, the architecture and the common language strategy work and to prove that a real improvement of railway performance can be achieved by using this way to manage and share information.

2.2.3. The benefits of the InteGRail approach

Additional, richer information can support decision processes at all levels, helping to find and take the best decisions and optimise the overall system performance.

Open, standard interfaces can guarantee a controlled growth and evolution towards the future, in accord with advances in technology and adapting to the new needs of the railways.

The InteGRail approach will bring real benefits through better monitoring systems, optimised maintenance, improved decision support and more accurate evaluation of performance.

The system can be implemented gradually, bringing benefits even when implemented at a small scale, and expanded without limits, while ensuring that new parts are consistent with already existing ones.

2.2.4. What is still needed after InteGRail?

After March 2009, when the project will be finished, InteGRail deployment needs to go through additional steps like standardisation agreements, rules and business procedures for information exchange and establishing of new organisational models. In such context, new products based on InteGRail and existing products adapted using InteGRail guidelines can start building the railway system of the future.

Failing to take this opportunity will delay the evolution of railways, reduce their competitiveness, leading to the risk of missing the market targets of European transportation policies and strategies.

InteGRail partners hope their effort can represent an important contribution to the success of railways in Europe and invite you to carefully check, reading this introductory document, if and how the achieved results can be usefully deployed in your organisation.

2.3. Overview of InteGRail Objectives

2.3.1. Original Project Objectives

The success of railways in increasing their market share in the next years will strongly depend on the capability of the railways to satisfy the increased expectations of the end-users (passengers, shippers) in terms of capacity (availability of service), punctuality (reliability of service) and average speed (performance of service), which represent the key performance indicators perceived by railway customers.

Railways are composed of four dedicated domains being Rolling Stock Management, Operations, Traffic Management, and Infrastructure Management (*also referred to as sub-systems within the project*), each one devoted to a specific task, cooperating and interacting to achieve the targeted end result: to provide quality transport service for passengers and goods.

InteGRail aims at being an enabling concept for improving the performance of each of the Railway Sub-systems, while keeping in mind that the overall objective is the improvement of the System as a whole. In fact, the net benefit for the whole Railway System comes from two improvements:

- The improvement of the subsystem performance
- The improved cooperation of the different systems

Within this scope, the objective of InteGRail is to enable information and its context to be shared within the Railway and optimise decision making using these information to improve performance.

After having recognised the processes and the improvement potential, and following the definition of current and future states and the description of the problem to deal with, the next step is to measure the performance of railways by adequate monitoring of a number of Key Performance Indicators, related to rolling stock, infrastructure, train operation and traffic management. The impact on KPI resulting from the solutions developed can be analysed in order to take appropriate decisions about the future improvements. This will bring to an opti-

misation cycle which is iterated to enable continuous improvement of performance in the overall system.

The approach of InteGRail, is to support such methodology by improving the information exchange between the main processes (Recognise, Define, Measure, Analyse, Improve and Control) through the players of the different subsystems or domains (Rolling Stock, Infrastructure, Traffic Management, Operation) by means of more powerful, standardised and pervasive information and communication systems.

Accordingly with the Description of Work, InteGRail will:

- enable sharing of information to increase efficiency and quality and support the business objectives of the RU and IM ;
- ensure that the right information is available at the right time in the right place;
- identify ways of using the information more effectively for maintenance optimisation;
- identify ways of combining and using information effectively for management requirements;
- ensure that the information can be transmitted effectively to the decision makers;
- demonstrate that creating the right information and sharing it will enable performance improvement.

InteGRail will not replace existing systems. It will be used in conjunction with existing systems.

The Industry and the Business Groups have agreed that InteGRail will deliver the specification of a standard platform and protocol in order to interface existing or new information systems, so as to enable exchanging key information between subsystems, which are needed to improve the performance of the railway system. In practice, the following will be delivered:

1. the specification of information sharing;
2. the development of a protocol language as standard using Ontology and QoS oriented telecom resources.

2.3.2. Expected Main Project Deliverables

Accordingly with the Description of Work, at the end of the project lifetime, InteGRail was expected to develop a new holistic information concept and workable support applicable to the railway system, which is based on:

- Combination and aggregation of data from monitoring, diagnosis, and other information systems;
- Integration of information as needed;
- Use of existing information systems.

In order to fulfil its objectives, InteGRail aimed at delivering:

A. Proposals for Standard(s) for data and information models for Railway Operation, Rolling Stock, Infrastructure and Traffic Management

B. Architecture and information sharing platform for the railway domain, capable of:

    1. Provision of information adapted to the needs of the user;
    2. Efficiently using of state of the art Information and Communication Technologies (ICT);

3. Communication framework compatible with the innovation of communication technologies or solutions and following the stable migration directions in this field;
4. Example functions or information systems that use the architecture concept (IGRIS), the communication framework (ICOM) and the standardised information model (Railway Domain Ontology, RDO);
5. Demonstration Service to support On-line decision making;
6. Demonstration Service to support Strategic and Tactic decision making.

2.3.3. The Demonstration

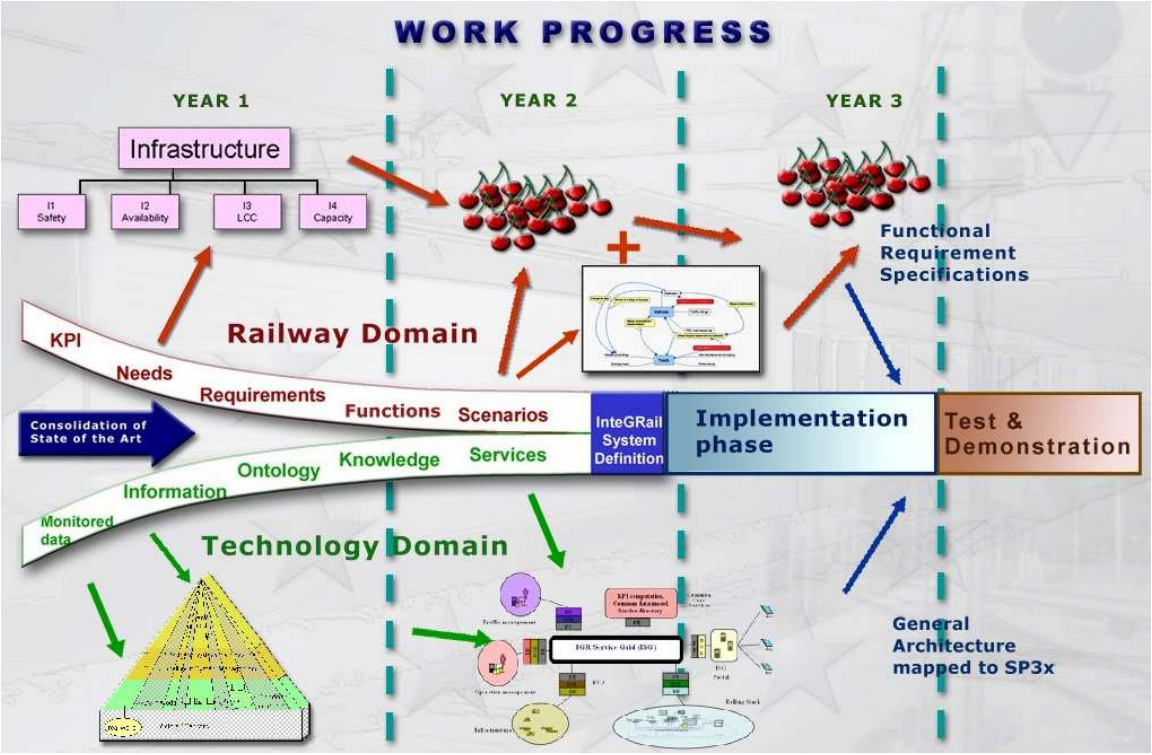
Proof of concepts for InteGRail were expected to be given through demonstration. This goal was expected to be achieved through four actions:

- To prove that the system of functions performs as specified
- To prove that the collaboration of IGRIS with 'pre-existing, legacy' information systems is workable effectively
- To prove that the IGRIS architecture can be reused across the demonstrations
- To measure the growth of performance of one or more railway business processes through Key Performance Indicators

2.4. Contractors Involved

Partici pant. Role	Partici-pant. Number	Participant name	Participant short name	Country	Date enter project	Date exit project
CO	1	UNIFE	UNIFE	Belgium	month 1	month 51
CR	2	ALSTOM	ALSTOM	France	month 1	month 51
CR	3	ANSALDOBREDA	ASB	Italy	month 1	month 51
CR	4	BOMBARDIER	BT	Germany	month 1	month 51
CR	5	SIEMENS AG	SIEMENS	Germany	month 1	month 51
CR	6	D'APPOLONIA	DAPP	Italy	month 1	month 51
CR	7	FAV	FAV	Germany	month 1	month 51
CR	8	DeltaRail	Delta	NL	month 1	month 51
CR	9	Ansaldo Trasporti Sistemi Ferroviari	ATSF	Italy	month 1	month 51
CR	10	CAF	CAF	Spain	month 1	month 51
CR	11	NORTEL Networks	NORTEL	Germany	month 1	month 51
CR	12	Laboratori G. Marconi	LABS	Italy	month 1	month 51
CR	13	ATOS ORIGIN	ATOS	Italy	month 1	month 26
CR	14	MERMEC	MERMEC	Italy	month 1	month 51
CR	15	TRENITALIA	TRI	Italy	month 1	month 51
CR	16	RFI	RFI	Italy	month 1	month 51
CR	17	ATOC	ATOC	UK	month 1	month 51
CR	18	Ceské dráhy, a.s.	CD	Czech Republic	month 1	month 51
CR	19	MAV	MAV	Hungary	month 1	month 51
CR	20	UNICONTROLS	UNIC	Czech Republic	month 1	month 51
CR	21	Strukton Railinfra	STRUKTON	Nether-lands	month 1	month 51
CR	22	Deuta-Werke GmbH	DWK	Germany	month 1	month 51
CR	23	Heriot-Watt University	HWU	UK	month 1	month 51
CR	24	IMEC	IMEC	Belgium	month 1	month 51
CR	25	OFFIS, University of Oldenburg	OFFIS	Germany	month 1	month 51
CR	26	Televic nv	TELEVIC	Belgium	month 1	month 51
CR	27	Seebyte Ltd.	SB	UK	month 1	month 51
CR	28	Kontron Modular Com-puters GmbH	KNT	Belgium	month 1	month 51
CR	29	University of Chile - Centro de modeliamento matematico	CMM	Chile	month 1	month 51
CR	30	INRETS	INRETS	France	month 1	month 51
CR	31	Wireless Future	WF	Italy	month 1	month 51
CR	32	University of Birmingham	UoB	UK	month 1	month 51
CR	33	Administrador de In-fraestructuras Ferrioviarias	ADIF	Spain	month 1	month 51
CR	34	Corridor X	AKX	Austria	month 1	month 51
CR	36	Network Rail	NetRail	UK	month 1	month 51
CR	37	Prorail	ProRail	NL	month 1	month 51
CR	38	SNCF	SNCF	France	month 1	month 51
CR	39	UIC	UIC	France	month 1	month 51
CR	41	Réseau Ferré de France	RFF	France	month 1	month 51
CR	42	FAR Systems	FAR	Italy	month 30	month 51

InteGRail methodology followed an approach combining Top-Down and Bottom-Up activities, which eventually converged in the definition of the final solution.



The Top-Down approach defined a high-level description of the railway system in terms of Key Performance Indicators (KPI). The result was a KPI-tree for each of the four subsystems (rolling-stock, infrastructure, operation, traffic management). Links between KPI's in the different trees have been identified and mapped.

Further analysis allowed derivation of user needs, which were expressed in terms of requirements. Finally, requirements have been prioritised, according to the evaluation carried out by railway stakeholders. These lists of items represent the Needs and Requirements Baseline (NRB) for the new InteGRail solutions, based on a common system architecture.
The NRB has been analysed in order to identify the needed functions (cherries), which had to be implemented in order to fulfil the requirements. The resulting list of functions was quite huge (around 200) and further filtering and selection (cherry picking) was needed. To help with such process, the 6 main railway business scenarios were identified and, from them, three base demonstration scenarios derived and mapped to the relevant processes, which define the structure of the InteGRail system: monitoring and control, maintenance, system management and communication. The related Subprojects could so be in charge of selecting a short list of functions to be implemented, deriving functional specifications for a number of applications.

This started in parallel with a Bottom-Up approach, which analysed the current practices and requirements starting from suitable questionnaires. Based on a state-of-the-art analysis, the InteGRail teams identified the items which in the future should be monitored by diagnostic facilities for rolling stock and infrastructure (including infrastructure-rolling stock cooperation

and interaction). This was the starting point to define how to improve the processes and satisfy the requirements.

Available technologies were analysed, in order to convert data into information and allow further intelligent processing. Emerging technologies in the Semantic Web area were chosen and mapped to the railway needs: specifically, the core part of a Railway Domain Ontology was defined and gradually extended, so as to cover all the concepts needed for the implementation of the selected functions.

The Ontology allows to represent the knowledge, storing it into suitable repositories and processing it by means of reasoners. Finally, knowledge can be accessed and made available by means of suitable services, following a Service Oriented Approach.
The step-by-step convergence brought to the definition of a system architecture, complete and flexible enough to allow the implementation of all envisaged applications, in the framework of their respective Demonstration Scenarios. The different subprojects could so have a common basis on top of which start the implementation work, which included both developing new applications and integrating legacy systems.

The Demonstration Scenarios were actually the driving objective of implementation, forcing a high level of integration, followed by extensive test and demonstration.
Final results are represented by the InteGRail Reference Technology Platform, which can bring to several new standards, and a number of application prototypes, which will bring to new products.

2.6. Performed Activities

Following the mainstream of the working methodology briefly described in the previous section, the project partners have performed the activities summarised below:

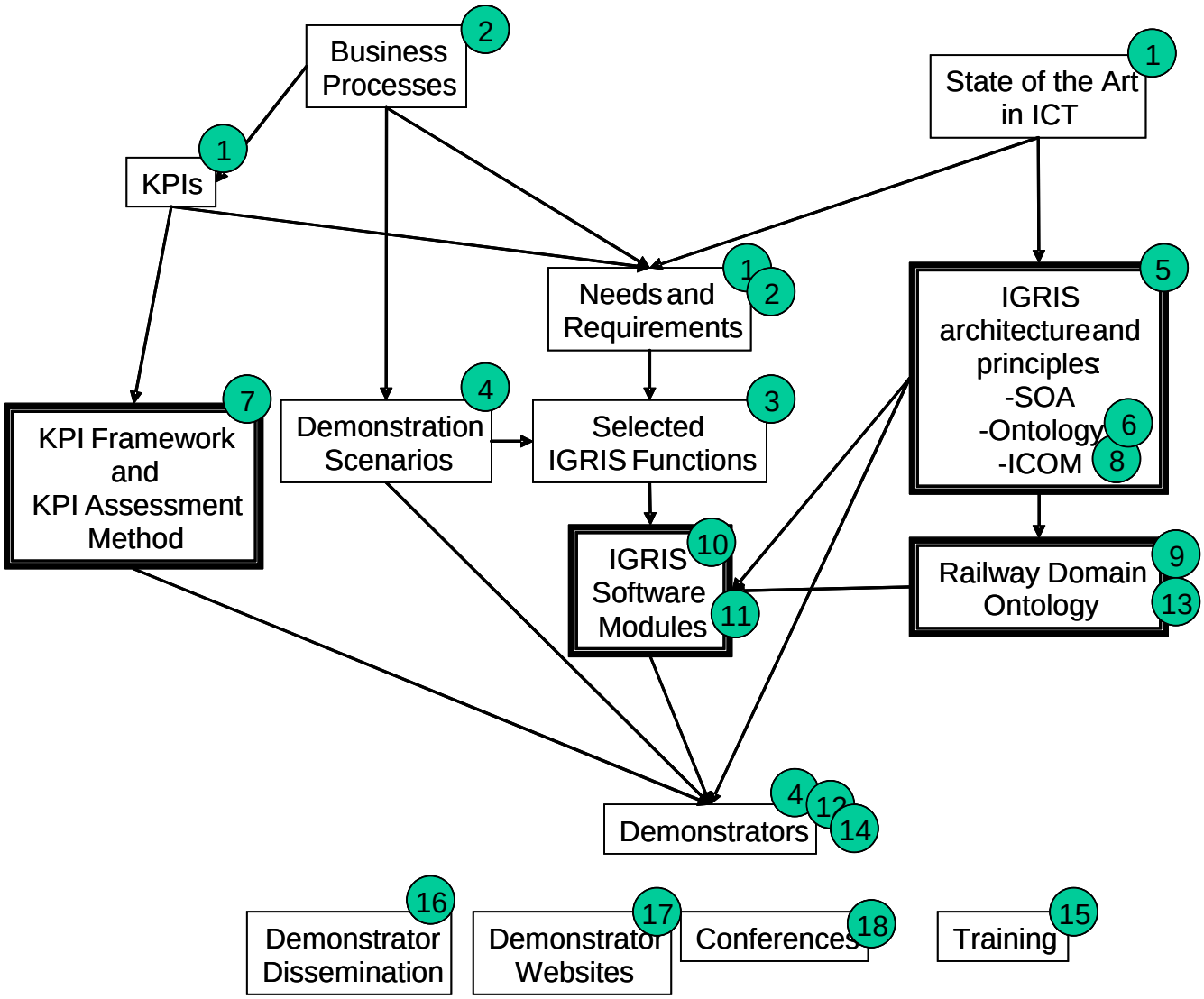
1. Analysis and conversion of the User Needs into the InteGRail Requirement Baseline, on the basis of a combination of Top-Down (Key Performance Indicator driven) and a Bottom-up (monitoring technologies and common practices driven) approaches.
2. User Needs have been prioritised, and grouped on the basis of their business relevance into 6 different business scenarios, which have been identified during a workshop organised in January 2006; in parallel to that, current and future Use Cases for monitoring and maintenance have been identified and analysed. These elements were used to describe the kind of Railway world will be possible by the application of InteGRail results.
3. The project originally addressed the whole railway domain; although its validity remained unchanged, there was a need to focus the attention on the most relevant functionalities to be covered by the project and by the Demonstrators. To do so, the partnership has performed a selection process to determine which functions to retain for specifications, and out of them which to implement for demonstration purposes Demonstration Scenario definitions were used to focus this selection process.
4. The definition of Demonstration Scenarios for the final project demonstration phase was achieved through consensus building between Industry and Railways. Demonstration Scenarios are built as the superimposition of three or more Business Scenarios, identified by the Railways in January 2006. the process of determining the Demonstration Scenarios took more than one year, to ensure full comprehension by the interested parties and coverage of real railway interests. The demonstrators combined the functions retained by the railways, under the storyline represented by the Business Scenarios. This procedure ensured a real interest for the demonstration, and prevented these demonstrations from being a mere research exercise.
5. Following a multiple refinement process and joint workshops between system and business architects from the consortium, the InteGRail reference architecture has been defined and agreed by the consortium. The architecture has been mapped into all technical developments of the project, including the demonstrators. InteGRail is a Service Oriented Architecture, since:
    a. It has a web-browsable front-end
    b. It is modular in construction, as it is made up of discrete components
    c. There is a Service Bus with defined protocol
    d. Legacy systems are integrated
    e. There are clear functional layers
    f. Processes are “orchestrated”, each one making use of functional components they need.
6. A Railway Domain Ontology was developed, extracted on the basis of Use Cases, aiming at building the corresponding ontology models. On that basis, and making use of the InteGRail architecture, the concepts of Intelligent Maintenance, Monitoring and Decision Support have been developed.
7. Analysis of Key Performance Indicators and potential improvements to the railway operation has been performed, producing a tree of KPI to combine measurements, es-

timates or expert judgements into a single value useful to measure the performance of the Railway domain, or one of it sub-systems.

8. Analysis of communication technologies and their application for train-borne, train to ground and train to train communication, in view to draft part of the lower layers of the ICOM architecture.
9. The Conceptual Data Model for the InteGRail system architecture has been developed, in view of a standardisation process to be pursued (standardisation of the railway Domain Ontology).
10. Design, development and realisation of the prototypes for the Intelligent Monitoring, Maintenance, and Decision Support together with the first characterisation of the Communication Framework have been performed, in view of the integration through the InteGRail architecture of the different tools into the demonstrators. This ended into different iteration of the demonstration prototypes.
11. Improvement of the existing services and provision of the distributed predictive monitoring service (i.e. to provide a model for automatic diagnosis and incipient fault detection based on ontology data models and ontology reasoning process).
12. Evaluation and verification of the final architecture for InteGRail system, and Railway Domain Ontology for intelligent integration of various architecture layers, and prototype implementations of the demonstration scenarios.
13. Searching for the effective railway domain ontology visualization methods and implementation of the visualization tool for training package of the InteGRail project.
14. Development of the final version of prototypes for all tools to be demonstrated (see Fact Sheets in section 3.2.5 for further information and full references).
15. Preparation of a training tool, to be used by the different consortium members to achieve awareness and improve knowledge about the project results, its benefits and its potential within their companies.
16. Preparation, planning, set-up, and verification of the demonstrators, and presentation of these demonstrators to public audiences at different moments in 2008 and 2009:
    a. Prague (11 and12/09/2008)
    b. Innotrans Berlin (22 to 26/09/2008)
    c. Friedrichshafen (2/10/2008)
    d. B-Cargo (26/11/2008)
    e. Villafranca di Verona (3 and 4/12/2008)
    f. KeyRail (18/12/2009)
    g. Project final conference in Brussels (2-3/03/2009)
    h. ProRail (25/3/2009)
17. Set up and maintenance of two project web pages:
    - www.integrail.info (document repository and main dissemination portal)
    - www.integrail.eu (hosting the demonstrators and their tools)
18. The participation to major conferences on Railways, and other scientific domains, as well as the organisation of dissemination seminars and events made it possible to raise expectations and increase the knowledge on the project results. The most relevant

event has been the Innotrans 2008, where InteGRail had its own exhibition stand and organised 4 different workshops in the Business Lounge of the fair.

This list of activities is visualised in the following scheme:



2.7. Results achieved

2.7.1. Introduction

Integration of information is key for further growth of railway transport volume. Decision makers will be able to make better decisions once they have the right information at hand about their own processes and information shared with their business partners for optimized business decisions. InteGRail is the project that developed an enabling technology to allow transparent access to existing information systems, be it databases, monitoring systems or existing user applications. For this purpose InteGRail defined a standard approach for architecture and common information representation on a European scale. Using this standard approach a number of example applications were developed.

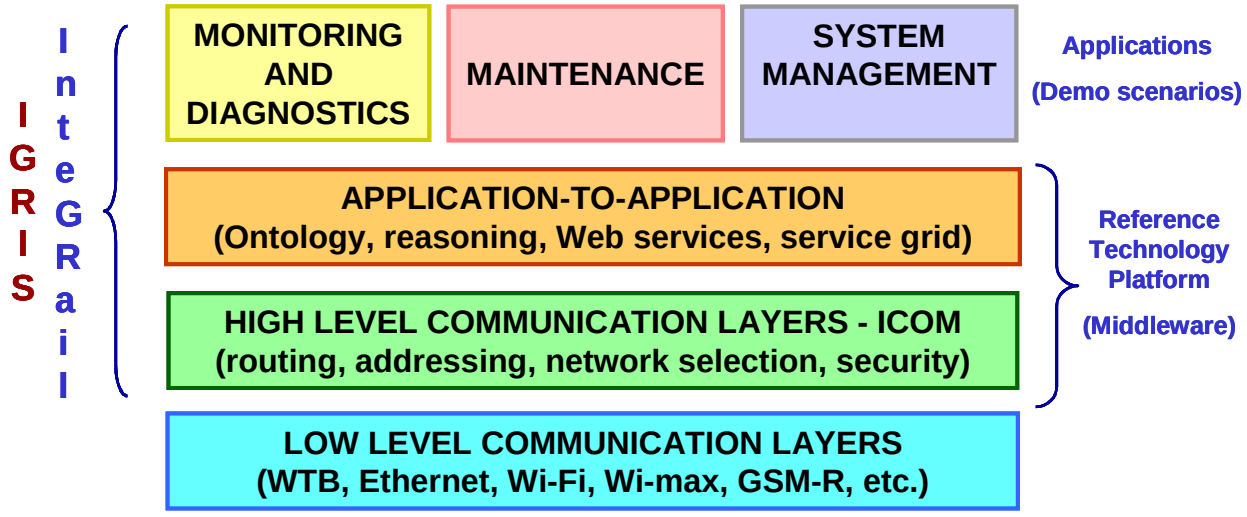
2.7.2. Type of results

InteGRail produced two types of results:

- a *Reference Technology Platform*, as an open railway specification, to become a standard
- a number of *Application Prototypes* in different railway areas where there is a potential for improvement

The Reference Technology Platform is the core of InteGRail solution and the basis for all InteGRail applications. It is a middleware providing a common interface between applications and the existing network infrastructure. It includes two main layers:

- the application-to-application layer, which defines how to properly represent, retrieve, process and finally understand information;
- the high-level communication layers (Intelligent Communication framework – ICOM), which are responsible for transferring information, moving it from an application to another, wherever they are located and independently from the available infrastructure.



A view of InteGRail main layers

Altogether, the Reference Technology Platform is able to provide a number of services, decoupling the applications from the details of the supporting networks and avoiding that each

time a new system interconnection is built, such services will again be developed from scratch. This brings to two main benefits:

- on the one hand, it allows to reduce the developing costs related to connecting together new or existing systems, as they can benefit from a standard, proved and reusable software interface;
- on the other hand, it enables compatibility between all information systems, as they are now based on the same common interface.

A major requirement for InteGRail was to show that the defined Platform could really be used in the world of railway business, supporting real applications. Therefore, applications were investigated in several key fields (Monitoring, Maintenance, System management), showing how they could be enhanced when advanced information management and sharing is made possible.
This allows to progressively build up a network of InteGRail-enabled applications, or an InteGRail Information System (IGRIS), where the applications can cooperate with each other, as part of a single railway system which needs to be globally optimised. Clearly, such integrated view involves all parts of the railway system, today often under different ownership and/or responsibility, and this requires to organise them transversally between the different areas (rolling-stock, infrastructure, operations, traffic management), according to a specific business context (scenario): this is the reason why InteGRail had to define and organise some specific demonstration scenarios.

In the following sections, the InteGRail Results are reported. First those results composing the Reference Technology Platform are presented, as listed below:

- Information System Architecture
- Railway Domain Ontology
- Distributed Reasoning
- ICOM – Intelligent Communication Framework
- The Key Performance Indicator assessment framework

Then, a selection of the Application Prototypes are reported, as in the following list:

- The Network Statement Checker
- The Infrastructure Availability Checker
- The Event Analyser
- The Wheel Trend Analyser
- The Track Trend Analyser
- The Symptom Agent
- The Predictive Maintenance Server
- The Intelligent Depot Tool
- The Operational Decision Support System
- The Traffic Re-Scheduler

A complete and comprehensive description of all the project results are reported in section 3.2.5, in the form of InteGRail Fact Sheets.

2.8.1. A standard Railway KPI structure

Railways need to evaluate their performance and have established systems to do it. Such systems are of course proprietary and different from one to another. This hinders possibilities like, for example, comparison of results between railways, calculation of predicted impact on performance of possible investments already done in another railway, performance definition in an international context (corridors), development of standard tools for performance measurement and assessment.

Performance is quantitatively defined by means of KPIs (Key Performance Indicators), which depend on other Performance Indicators and parameters, at lower levels, so creating a number of KPI trees, which relate each KPI to the parameters which have an influence on it.

Such relations represent the links in the KPI tree, but this is not enough, as to completely express them, a way to mathematically calculate such relation is needed as well. In this way, measuring same basic parameters in the railway system, it is possible to calculate the KPI linked to them and go up, along the tree, up to the top KPIs.

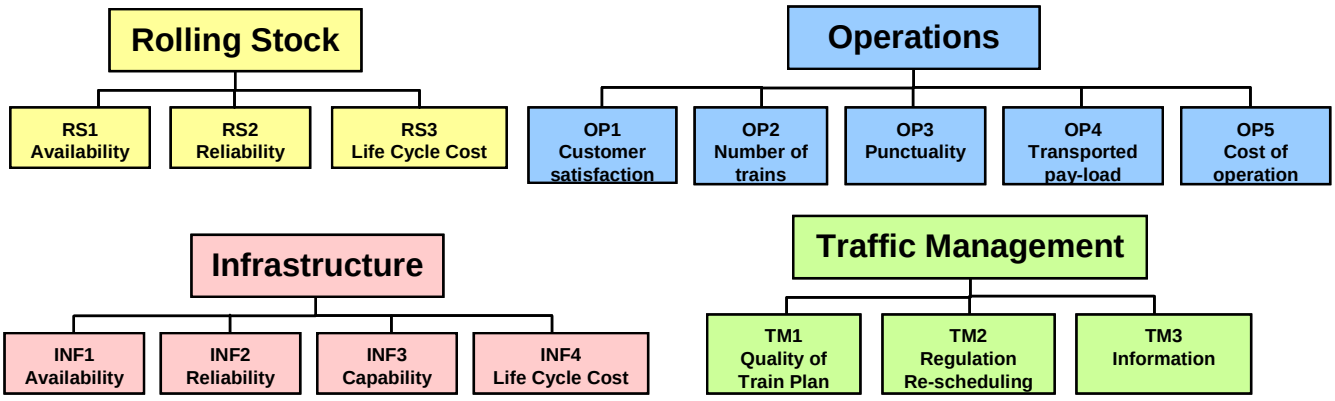


Figure 1 – Higher levels of KPI trees

InteGRail defined a number of KPI trees, addressing the four main areas of the railways (rolling stock, infrastructure, operations and traffic management). However, the formulas and quantitative weights associated to each link in the tree have not been defined, as it requires a huge work of discussion, agreements and consensus between all railway operators (RUs and IMs, but also Maintenance Operators, Train Owners, Energy Managers, etc.).

Starting from InteGRail results, complete standard KPI trees can be defined, which can be accepted by all railway administrations as a common standard. Some flexibility will be needed in order to accommodate current practices and smooth incompatibilities.

The KPI Assessment Tool, also developed within InteGRail, can help in testing the KPI model and check its consistency.

The resulting standard will improve the possibility for European railways to cooperate according to a common strategy.

2.8.2. Ontology based standard Railway Data Model

2.8.2.1. Overview

The Railway system is very complex and produces continuously huge quantities of data, most in proprietary formats, which are difficult to understand, elaborate and share. As a consequence, most data are archived for "future use" and never looked at, unless a specific need occurs. Vice versa, a lot of useful information could be extracted from available data, if this could be effective (bring to good results) and easily feasible (at low cost).

To achieve this scope, InteGRail produced a first kernel of a **Railway Domain Ontology (RDO)**, which provides a means of creating a machine interpretable conceptual model of physical components and domain data concepts. The model was created using the Web Ontology Language (OWL), which is a W3C standard for encoding knowledge. The proposed solution implements a semantically enabled network of reasoning nodes, where information is integrated and shared using the RDO and **distributed reasoning** over a service orientated architecture (SOA). The application of the RDO aims at solving the integration challenge within the railway environment, achieving two main goals:

1) transform data into information, which is not ambiguous and perfectly understandable also for computers;
2) allow for powerful elaboration of information, in order to analyse it quickly and automatically and extract only significant new information.

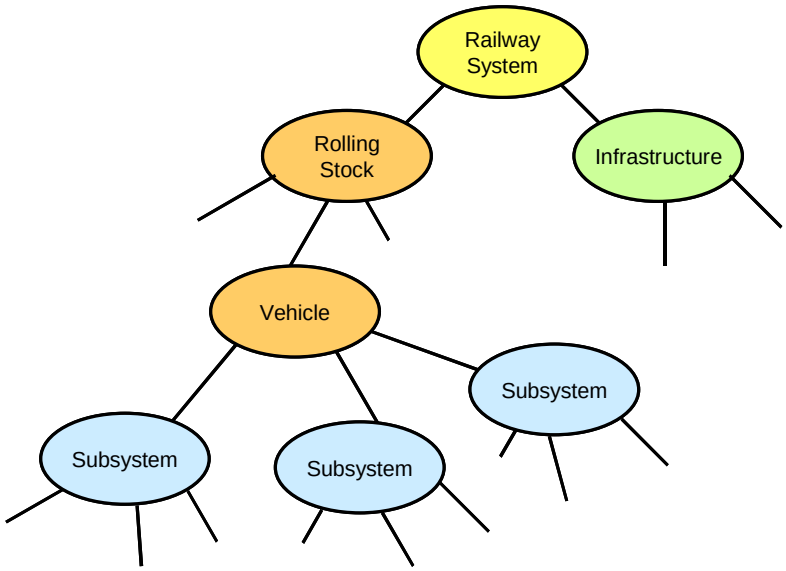


Figure 2 – Ontology concept

In order to fully achieve such goals, it is essential that there is only ONE STANDARD ONTOLOGY in a specific domain (e.g. RAILWAYS).

There is a need to refine and validate the current version of the RDO. Then it can be gradually expanded in the future, according to railway needs, in order to cover new concepts, while maintaining and **checking the consistency** of the overall model, so making its complexity manageable and reducing the costs of new applications and of maintenance of information.

2.8.2.2. Railway Domain Ontology

The RDO provides a generic solution for information interchange. It is particularly appropriate in an environment where there are numerous heterogeneous information sources. The ma-

jor players in the railway industry, who rely on numerous vendors for systems that produce and consume data, can offer the RDO as a standard interchange format. The vendors can use this standard to exchange data with other information systems and use reasoning features to enable applications to interpret that data. This is beneficial to the companies, as it addresses technical challenges associated with information interchange and integration. This solution offers other benefits associated with data analysis. OWL ontologies can be used to capture domain knowledge such that information that is implicit in data is inferred from explicit data. Since the RDO is machine interpretable, it means that applications can readily receive data from numerous systems, inferring implicit information from explicit statements. The benefit of this approach is considered in areas such as fault detection and diagnosis, where tacit knowledge can be captured and used during decision making tasks.

Ontologies have been implemented to solve integration and interchange problems in a number of domains. Organisations that have numerous information systems with similar concepts, but different data structures, appear to have yielded significant benefit. In particular, medical, military and automotive industries have undertaken significant work. However, to yield this benefit, these organisations have committed to some technological and organizational changes. The work undertaken in InteGRail has demonstrated that there are opportunities to take advantage of the features that ontologies offer. The first phase of ontology work has resulted in a set of domain ontologies that meet the requirements of the Demonstrations Scenarios within the project. These ontologies are now available. The future possibilities are dependent on stakeholders' willingness to commit to technological and organizational changes. The perceived possibilities are the creation of **semantically enabled railway applications sharing information** using a refined RDO set.

As applications utilising this technology are becoming more common, it is likely that in the future, ontology based systems and applications will become ubiquitous. As the internet and XML have been utilised by the railway community, the implementation of semantic technologies will form part of a natural progress.

2.8.3. Standard Railway Service Grid Architecture

2.8.3.1. Overview

Railways are based on a number of information systems, which support the different processes and activities. Most of them have poor or no capability to export/import data to/from other systems, as they use proprietary incompatible data formats and protocols. This hinders the possibility for related applications to cooperate in order to better fulfil their tasks. Moreover, when there is a need to interface two systems, this is achieved by means of a specific solution, which requires development of a suitable interface from scratch, with high costs and without solving the problem in general.

InteGRail solved such problem by defining an Integrated information system architecture: a platform for implementation of large scale integrated systems. Its key components are:

- InteGRail Service Grid (ISG) – a Web Service based communication backbone which provides a transparent information transport among the building blocks of distributed applications
- Flexible Communication Adapter (FCA) – a three layered architectural pattern which facilitates the interconnection of legacy systems operating on different platforms and using different types of communication links

The proposed architecture solves the problem of integrating information at system level:

- new applications based on such platform will embed the capability to cooperate, as part of a distributed system based on cooperating services;
- existing applications, where the sources of information are legacy components producing various and, by nature, incompatible data, can be fully integrated with a minimum effort, by means of a standard approach (the FCA) and reusable software.

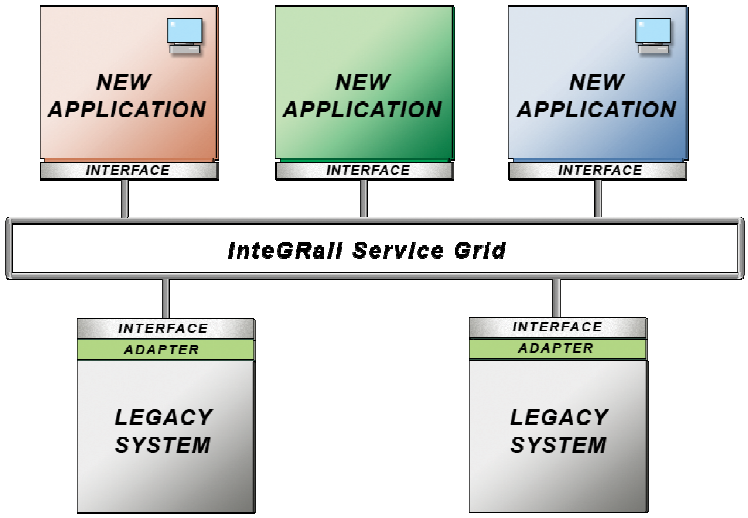


Figure 3 – InteGRail common architecture

The Service Grid is independent from the communication layers below it.

The problems solved by the proposed architecture are linked with the need of integration of information at the system level where the sources of information are legacy components producing various and, by nature, incompatible data. These data are incompatible in terms of presentation format, of access method and of variation over time.

In an integrated application which puts together many heterogeneous legacy sub-systems the produced information items are extremely different, yet should contribute to the same process. The platform architecture proposes a compromise solution which makes combination of data possible and relatively easy to realise. There are two key notions in terms of architecture which should help to provide the solution:

- Service Oriented Architecture (SOA)
- Executable Workflow Processes built on SOA

2.8.3.2. Distributed Reasoning

Distributed reasoning is a leading/modern IT technology provided as a sophisticated information processing platform for intelligent monitoring in the InteGRail project. As software components to serve different InteGRail applications for information harmonization, intelligent information interpretation and decision making, distributed reasoning serves complex queries and consistency checks over distributed, heterogenous data and allows information inference in order to make implicit knowledge explicit. This so-called reasoning process leverages the Railway Domain Ontology together with description logics as a formal logic foundation to dynamically create different integrated views on spatially distributed information.

Using distributed reasoning, applications have no more restrictions to isolated data of single stakeholders in the railway context but can rather bring added value by commonly understanding distributed railway domain information from different customizable points of view. For instance, door faults of multiple trains can be aggregated and interpreted together with

timetable data by using the added-value of integrating both data sources to reason about possible maintenance schedules.

Distributed reasoning represents a highly flexible way to combine Railway condition monitoring data with maintenance optimisation by the use of IT/Internet-Technology, and can be applied to all sectors of the railway domain. This technology helps to seamlessly integrate and interpret distributed information for rolling stock and infrastructure management, as well as for operations and traffic management. For this, the Railway Domain Ontology represents a common interface and supports a common understanding of shared data.

The key benefit of distributed reasoning is a gain of performance compared to centralized reasoning since lower-level data interpretation can already be initiated locally and interpreted in parallel on different information hierarchy levels. This additionally allows communicating less information – the local reasoning results – to subsequent higher-level reasoning nodes for further processing. This approach also supports means for data and process abstraction, which enables information to be disclosed limited to authorised information processing partners. To this effect, the encapsulation of stakeholder privacy allows to implement the “who needs to know” principle, which only allows stakeholders to access data if they are authorized and if they really require it. In addition, railway domain stakeholders can be provided with customized integrated views to access inter-enterprise information if requested.

2.8.4. Standard Railway Intelligent Communication Framework

2.8.4.1. Overview

Railway applications need to access, elaborate and exchange information, independently from where they are located: on a train, wayside or in a depot . They do not want to care about how the network is able to move information around, but they wish that the network provides a communication service, with a suitable level of quality.
Vice versa, the communication network does not care about the contents of the messages it transfers. It provides the communication service, using appropriately the available communication infrastructure and technology, transparently for all applications,.
InteGRail developed an Intelligent Communication Framework (ICOM), which allows to decouple applications from the details of the specific protocols and bearers, offering a common interface and a set of standard, parameterised services.
In this way, the communication network can be changed and improved without affecting the existing applications, while on the other end applications can be developed without knowing how the communication will be achieved.

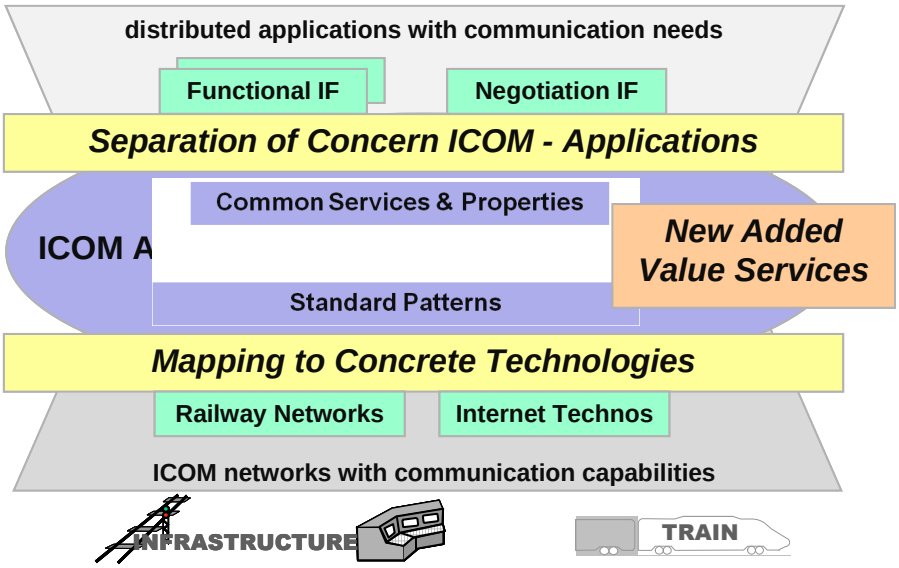


Figure 4 – ICOM structure

ICOM solves, once for all applications, all problems related to session management, qos, security, routing, scheduling, mobility, bearer selection, accommodating all available but heterogeneous networks and providing a complete end-to-end communication service.
It can bring essential benefits in train-ground communication and in international contests (railway corridors).

2.8.4.2. ICOM

ICOM is defined as a communication framework for railway integrated systems with:

- Physical Breakdown Structure, modelling of railway distribution in nodes and networks;
- Functional Breakdown Structure (detailed specification with over 300 requirements)
- and definition of ICOM Functional Interfaces;
- Identification of key Logical Entities (clear allocation of FBS functions) and standard patterns (services and protocol interfaces independent of implementation technology);
- Guidelines for deployment and interfacing of actual components.

This framework, to cover the very large scope of IGR (all European railways), harnesses complexity through multiple model views, functional abstraction and selective blindness. It marks a general shift from technology driven to application driven approach.

2.9. Application Prototypes

These results are closer to real products and can be divided into three areas:

2.9.1. Strategy and logistics

2.9.1.1. The KPI Assessment Tool

The KPI Assessment Tool is a PC based software tool that can be used to study the performance of the railways. Using a tree that represents the interactions between the individual railway processes, and their performance, the so-called Key Performance Indicators (KPI's), the tool allows to model, calculate and visualise the performance of a certain railway situation. A default tree is provided with the tool that represents a standard railway situation with a simple

service, simple network and limited fleet. But the default tree is editable, and the user can also choose to start with a completely new tree.

2.9.1.2. The Network Statement Checker

The Network Statement Checker is a web based application that allows on-line access to the Network Statements of national infrastructure managers. The user of the tool can select a route on the European railway map and can find information about the characteristics of each track section on a route. This tool provides information needed to determine whether a route can be used for a new future railway service an operator intends to offer to his customers.

2.9.1.3. The Infrastructure Availability Checker

The Infrastructure Availability Checker is a web-based application that allows on-line access to the infrastructure databases of national infrastructure managers with the actual and future planned availability. On the European railway map the user finds information about the availability of each track in a selectable timeslot. Selection of a specific track gives the user more detailed information about the restrictions in use. This tool provides information needed to:

- determine whether a route could be used for an actual or future railway service an operator intends to offer to his customers
- determine if the restrictions in availability affect the composition of a train running a planned path
- get (historical) maintenance information.

2.9.2. Monitoring and diagnostics

2.9.2.1. The Event Analyser

The Event Analyser is a semantically enabled application using InteGRail intelligent monitoring (IMON) distributed reasoning service which enables the registration of queries from applications to remote reasoning nodes. Queries are sent across a network of distributed repositories and data is exchanged using the Railway Domain Ontology (RDO) created within the project. Specifically, the Event Analyser registers queries with numerous condition monitoring information sources and integrates the results. Systems such as Hot Axle Box detectors (HABD) and Wheel Impact Load Measurement systems (WILM) and vehicle borne track measurement systems are integrated to give an overall view of the health of rolling stock or infrastructure. The machine interpretable nature of the ontology allows the event analyser to infer the appropriate response from the received data and produce a suitable response.

The Event Analyser also receives input from other applications. The Wheel Trend Analyser and Track Trend Analyser take the same source event data and use it to perform trending functions. When a trend is observed that implies some action is required, the event analyser is notified allowing it to use current information to infer a result for the user.

2.9.2.2. The Wheel Trend Analyser

The Wheel Trend Analyser is a software application that receives wheel status data from multiple monitoring systems. It executes an algorithm to establish if the rate of deterioration or the level of deterioration of a wheel, or wheel set, has reached a level that suggests closer inspection or maintenance is required. The objective of the application is to transform the data into a semantic format for interpretation by a decision support tool such as the Event Ana-

lyser. The Event Analyser can then integrate it with other information to prioritise maintenance and operational tasks.

2.9.2.3. The Track Trend Analyser

The Track Trend Analyser is a software application that receives data from multiple monitoring systems such as Wheel Impact Load Measurement (WILM) systems and on vehicle track data recorders. It uses the Railway Domain Ontology (RDO) to link measurement concepts to concepts representing real world infrastructure concepts. The purpose is to integrate the data and execute an algorithm to establish if the rate of deterioration or the level of deterioration of a section of track has reached a level that suggests closer inspection or maintenance is required. The objective of the application is to transform the data into a semantic format for interpretation by a decision support tool such as the Event Analyser.

2.9.3. Maintenance and Operation

2.9.3.1. The Symptom Agent

The Symptom Agent is a software component, which is able to interact with other agents to analyse particular situations. Especially the detection of fault situations by correlating symptoms depending on the current context is an important aspect in the railway domain. For instance symptoms referring to a train door malfunction, which is caused by intense sunlight at a station, might not be interpreted correctly in a shady environment such as in a maintenance depot.

Based on the Distributed Reasoning technology the Symptom Agent offers:

- collaborative symptom analysis: collaboration of distributed agents to efficiently detect observations that deviate from expected values
- context-aware fault detection: correlation of analysed symptoms depending on the current context provided by other agents in the environment
- distributed intelligence: intelligent inference of faults from given symptoms based on distributed data
- distributed data integration: utilization of the Railway Domain Ontology in combination with the Distributed Reasoning technology (see also corresponding fact sheets) to provide seamless data interoperability based on formal semantics
- strategy abstraction: capsulation of individual process steps for symptom and fault analysis strategies by collaborating agents with different capabilities
- support for uncertainties: consideration of probabilities in the fault analysis process
- performance: spreading of computational load between agents using divide & conquer techniques
- privacy: stakeholders can apply the need-to-know principle to keep control of exchanged data by defining constraints for agent collaboration
- extensibility: support for flexible integration of additional agents with new capabilities (e.g. trend detection and prediction, data mining, rule-based decision making, learning, etc.) with the symptom analysis process
- scalability: additional agents with possible new capabilities can be added to the environment at run-time resulting in new capabilities for the overall symptom and fault analysis process

In order to properly detect the fault and its root cause in such situations the symptom agent can interact with other agents (e.g. a weather station or depot agent) to integrate situation-dependent information such as temperature, wind speed, etc in the interpretation process. For seamlessly exchanging such information softwareagents can rely on agent communication and

interaction languages that are standardized by the Foundation of Intelligent Physical Agents (FIPA).

2.9.3.2. The Predictive Maintenance Server

The Predictive Maintenance Server is a ground software application that analyses all historical data in the fleet DB on ground in order to identify patterns which can bring to the occurrence of possible faults. The analysis, related to several vehicles, trains and fleets, is focusing on inferring new knowledge on devices behavior and fault possibility, and it could be triggered by an external event (symptom), by a maintenance operator (establishing some rules) or by routine procedure. The Predictive Maintenance Server is based on the modeling of the diagnostic rules well known among the maintenance engineers, with the goal to indicate the need to perform a maintenance action at a scheduled point in time when the maintenance activity is most cost effective and before the equipment fails. The main sources of information are ground repository storing the diagnostic information corresponding to relevant process and event data. The Predictive Maintenance Server is capable to work with standard legacy systems, such as relational databases or SQL servers, as well as ontology based repositories.

2.9.3.3. Intelligent Depot Tool

The Intelligent Depot Tool (IDT) is a web-based application that allows the on-line access to the Maintenance Tools for Rolling Stock. The user, after the login identification that includes the rights based on the user's profile, can access the Diagnostics applications (as the Symptom Agent) to identify symptoms that can become dangerous, and the tools for Maintenance (i.e. Condition Analyser, Unplanned Event Manager, Lean Maintenance Optimiser, and Predictive maintenance Server) in order to optimize the Maintenance interventions, planning them just in time, and with the best organization (i.e. resources, site, stop of the train when is really necessary and for the right time). It includes a Graphical User Interface (GUI) for the user interaction and the friendly provision of results.

2.9.3.4. The Operational Decision Support System

The Operational Decision Support System (ODSS) is a tool which will provide a procedure to be manually or automatically executed when a unplanned event occurs. This will be achieved through the following tasks:

1. Acquisition of alerts and alarms through the InteGRail communications architecture.
2. Applying reasoning to the collected data to identify the actual scenario and to estimate the possible disruption to the operation; the scenario is selected inside a knowledge base.
3. Identify rules and procedures to be followed to minimise the possible scenario disruption; it will require an appropriate knowledge base.
4. Interacting via the InteGRail communications architecture with existing and new systems to exchange required information with all actors involved in the decision making process.
5. Proposing a set of possible solutions to be evaluated and shared by all actors. The best solution will be selected.

The design of ODSS responds to a survey of user needs, and railway partners in the InteGRail project have contributed to the workflow and process analysis.

2.9.3.5. The Traffic Re-Scheduler

The Traffic Re-Scheduler is a tool used by railway traffic managers to handle the train service when disruption occurs due to train or instructive failures, or external events. These tools al-

low the traffic manager to view the planned and actual train timings, and allow re-scheduling of selected trains to reduce the overall disruption to the train service. Railways already use systems of this type, usually with a “train graph” type of graphical user interface. There has also been extensive research into algorithms for automated methods of conflict prediction and resolution, e.g. the European Funded Research Project TRIS.

The InteGRail information system architecture allows significant enhancement to this functionality through a capability to access a much wider range of data sources. This will enable problems to predicted earlier and more accurately, and allow more sophisticated criteria to be used in choosing the optimum solution.

2.10. Demonstrators

2.10.1. Introduction

Tools have been combined using the Reference Technology Platform, to show their effectiveness in a real business environment. In fact, they have been grouped together under the umbrella of 5 different Demonstration Scenarios, drawn and conceived on the basis of the Business Scenarios defined by the Railways.

Each demonstrator was conceived to be made up of:

- description of a setting where the scenario ‘happens’ (where in the world)
  1. countries
  2. actors (departments, people)
  3. the systems they use and that we have to liaise to
- description of operational context
- storyline of the scenario, describing what happens (how in time)
  1. once for the situation without IGRIS
  2. once for the situation with IGRIS
- functions of IGRIS to be demonstrated in this scenario (what to demonstrate)
  1. list of functions with a description of each in the context of the demonstrator
  2. explanation how this function can be proven
  3. demonstrator architecture description (deployment and component interactions)

The following demonstration scenarios have been agreed by the Industry and the Railway Business Groups through different consensus building meetings:

1. Freight Train between Rotterdam and Antwerp Harbours (Demonstration Scenario 1)
2. Vehicle – Infrastructure Cooperation with data exchange (Demonstration Scenario 2)
3. Passenger train monitoring and supervision (Demonstration Scenario 3)
    a. Handling of an unexpected fault on a passenger train
    b. Monitoring of supervision of a passenger train fleet

In addition to the aforementioned ones, and as a transversal mean for the system architecture and due to need to demonstrate innovative communication oriented functions, ICOM has been subject to specific and dedicated demonstration.

2.10.2. Planning and running a new freight service

In this Demonstration Scenario, the two phases of a new cross-border freight service are dealt with:

- the planning of the route including the check of the match of train and infrastructure characteristics in all countries on one side,
- the actual running of the service, where we have to deal with the expected and unexpected temporary situations of unavailability of infrastructure in each country.

This Demonstration dealt with both the preparation and the running of a new freight service, two information systems with these different timeframes were developed and have been demonstrated:

- Network Statement Checker: For the preparation phase a tool was developed that allows direct access to the national databases with the network characteristics (electrification, train protection system, maximum axle load). When used in combination with the rolling stock characteristics this information allows the selection of the appropriate route/train combination for the new service.
- Infrastructure Availability Checker: When the time has come to run the actual service, the operator can benefit from cross-border accessibility of information on actual availability on that day, or better: deal with unavailability, e.g. due to planned maintenance or an unexpected disturbance. Naturally, the information on planned maintenance can also be used for longer-term planning purposes.

2.10.3. Decision Support for Rolling Stock – Infrastructure Cooperation in the UK

This Demonstration Scenario was specifically aimed at dealing with two issues from the UK perspective: the interoperability of information systems within the domain, including the integration of data from those systems; and the accessibility/availability of data, providing maximum benefit from existing resources, to support decision making processes.

The main objective is to demonstrate that these systems, of which there are various types, can be integrated using a standardised technological solution, i.e. the semantic web. The Railway Domain Ontology (RDO) was proposed as a solution for the transport and integration of data from these systems. In this approach the ontology became the information standard to which applications could subscribe in order to exchange data. DS2 aimed at using the available technology (the Web, the Ontology Web Language (OWL), reasoner application (Pellet or RacerPro or other) and a Service Oriented Architecture (SOA) to demonstrate the solution.

In the current prototype, Wheel Impact Load Measurement systems (WILM), Hot Axle Box Detectors (HABD), train movement loggers, vehicle borne track monitors and on vehicle borne Train Management Systems (TMS) are considered. The demonstration aims to illustrate that different systems, producing similar data - such as WILD and HBD, can use the same ontology model. In addition, the extensible features of the approach means that news systems can be appended without the disruption of a major re-design. This is proposed as major benefit over database approaches.

2.10.4. Handling an incipient or real fault on an Intercity passenger train

This Demonstration Scenario applies the InteGRail approach to Diagnostics, Maintenance and Traffic Management integrating their information in the real operational environment of a train in passenger service in Italy:

- An advanced Diagnostics with incipient fault detection capabilities is built on 2 existing platforms (locomotives and coaches) showing the flexibility of the integration, that can be achieved at different levels, and feeding Information about the train criticalities to the complete system;
- A Condition Based Maintenance system, automatically planning maintenance activities on the basis of the real-time conditions of the vehicles, implements the complete maintenance process, till the preparation of the work orders;
- The InteGRail Operational Decisions Support System and Traffic Rescheduler support the Traffic Management allowing path rescheduling in real time when a train performance limitation occur.

Based on the Standard Reference Platform, including the RDO (Railway Domain Ontology) and a specifically developed Maintenance Ontology, a number of applications (allocated in different places and under different responsibility) can easily cooperate in order to achieve an effective, optimised fault handling behaviour.

Some applications run on board a locomotive, representing the first time that a semantic enabled application was demonstrated in the operating railway environment, integrated within a standard railway-grade computer device using existing train-ground communication. The device was installed on board a loco class E414 manufactured by Bombardier.

Coaches were involved as well, but with no application on board: data were collected and transferred to ground by the existing monitoring system, to be stored in a ground repository where they could be processed by IGR applications. This allowed to show full integration of a legacy system in the overall process.

The system was able to establish a complete information flow, promptly informing all interested actors about unexpected events and supporting operators and infrastructure managers in taking the best decisions, that is to minimise train disturbances and improve network capacity.

By using predictive and optimised maintenance techniques, it is further possible to minimise train unavailability due to stop time.

The demonstration goal was to show how InteGRail can bring innovation using legacy systems and new applications, so as to achieve a higher level of performance. In all cases, the final benefit for passengers is better information and reduced inconveniences.

2.10.5. Monitoring and supervision of a fleet of passenger trains

In this demonstration scenario (DS3b), which complements the wider DS3a, the integrated information system IGRIS used at passenger RS fleet in service, deals with the expected and unexpected temporary situations at two selected monitored functionalities which are “Doors” and “Active standby”. This DS also shows IGR applicability to international data exchange based on the same system model (door subsystem) used in two different environments (trains, countries, RS manufacturers).

DS3b demonstrates the integration of an existing legacy system into IGRIS. The legacy system is the TeleRail system, which is the remote monitoring and diagnostic system of CD, serves as real-world data source for the IGRIS ontology-based data models modeling the functionalities in question ("Doors", "Active standby"). The data models together with the real-world data constitute a knowledge base, physically stored in repositories, containing complete information which is to be exposed about these functionalities to the outer world. The DS3b data models are part of the railway domain ontology which is one of project's outputs. The information maintained in the repositories is retrieved via a common interface by distributed reasoning and processed by applications connected to the InteGRail Service Grid (ISG). The Supervision tool developed for DS3b, which is intended to be used in a Rolling Stock Depot, is one of these applications.

DS3b demonstrates the train supervision by means of IGRIS online, on the fleet of trains in routine operation that are equipped with TeleRail system. These trains of České dráhy, a.s. (ČD) are EMUs of the class 471. The monitoring of doors is extended to Trenitalia ES City train used in DS3a to show that owing to the use of the common data model the same information about doors of different trains can be retrieved by the same way, i.e. using the same queries.

2.10.6. ICOM Demonstrator

As a final demonstration of the capabilities and performances of the ICOM communication framework, a demonstration was organised in Friedrichshafen (Germany) attended by more than 60 persons.

The demonstrator aims to show the features or qualities that characterise the ICOM framework. As ICOM is considered as a low level service or a technical resource for the different applications, the demonstration of its different qualities requests a quite complex configuration that is not available in the different InteGRail demonstrators. Each of these InteGRail demonstrators implements one or more of the features but not all. Same, have a direct idea of the behaviour of the ICOM framework could not be shown easily to non specialists of communication systems. The ICOM demonstration was organised with the objective to present the qualities of a communication system, which is not obvious due to the embedded behaviour of the services.

ICOM demonstration platforms have been developed in order to reach ICOM demonstration objectives. These platforms have been defined to be representative of InteGRail scope and diversity. They cover thus both information exchanges between several railway operators and exchanges with and within an individual moving train.

Each of these platforms is built from:

- networking equipment according to platform scope,
- a mix of servers, desktops and embedded units: the platform ICOM nodes,
- actual ICOM communication components that instantiate logical entities defined in ICOM specification,
- stub applications that generate traffic/interactions representative of what ICOM should support in a real InteGRail system.

The ICOM management team has organised a specific demo at RSSB premises in London, March 5, 2009. During the conference, we have presented the results and the fundamentals of ICOM in the objectives of a standardisation. This last point is presented in the proposal for standardisation ICOM is proposing to IEC and Cenelec.

2.11. Standardisation activities

2.11.1. Standardisation proposals

2.11.1.1. General

Some of the main InteGRail results, specifically those related to the Technology Reference Platform, are well suited to become standardisation proposals.

1. A standard Railway KPI structure
2. Ontology based standard Railway Data Model
3. Standard Railway Service Grid Architecture
4. Standard Railway Intelligent Communication Framework: ICOM

Not only such standards will be very useful for the railway community, filling in existing gaps, but they are needed in order to achieve a real interoperability between railway information systems, in order to fulfil legal obligations (like those required by the TSIs) or to enhance the performance of railway systems (e.g. for Corridors operation, maintenance, etc.).

2.11.2. Available documents

2.11.2.1. Deliverables

- D2.6.1 – List of applicable standards to InteGRail: IGR-D-IQM-073-03 D2.6.1.doc
- D2.6.2 – Synchronisation with active standardisation groups outside InteGRail: IGR-D-IQM-107-02 D2.6.2.doc
- D2.6.3 - Standardisation proposals emerging from the InteGRail work: IGR-D-BTG-421-02 D2.6.3.doc

2.11.2.2. Other specific documents

- IGR-T-IQM-171-02 - Contribution to WG46 general architecture
    - Submitted to WG46
- IGR-D-OFF-016-02 - Railway Domain Ontology Proposal for Standardisation
    - Submitted to WG46
    - Alternatively can be interesting for CEN or CENELEC (WGB14)
- IGR-D-ALS-366-02 - ICOM proposal for standardisation
    - Submitted to WG43 and WG46

2.11.2.3. Overview of inputs for standardisation

See 3.1.3

2.11.3. Status and perspectives

2.11.3.1. Involved standardisation bodies

- IEC-TC9-WG43 and WG46
- CENELEC SC9Xb/SGB1 WGB14
- CEN

2.11.3.2. Situation today

Currently, the situation can be so summarised:

1. "A standard Railway KPI structure"

No standardisation activity currently in progress. The former idea to have it become a UIC leaflet was not carried out. Some railways have the opinion that it is now too early. The specification is not mature enough and the assessment work done in the project was limited. This can become, for the moment, a public specification, to be a reference in order to avoid that such work is done again in the future. The InteGRail product prototype KPI Assessment Tool can help in explaining, verifying and evaluating the KPI definitions.

It is proposed that the available document will become a TECREC (Technical Recommendation) supported by UNIFE and possibly by UIC.

2. "Ontology based standard Railway Data Model"

An idea is that this proposal can become a CEN norm, but it is now under verification the possibility to submit it to IEC-TC9-WG46 or to CENELEC-TC9x.WGB14, which are specifically in charge of railway standards. A proposal document is available as a draft and will be finalised soon. Even if correlated to the next proposal (3), such a standard can also be justified by itself as a way to define and coordinate all railway related concepts, within a consistent and manageable framework (supported by existing tools).

3. "Standard Railway Service Grid Architecture"

This proposal is closely related to the previous one. Some documents were submitted to IEC-TC9-WG43, but now they can better be forwarded to the newly founded WG46. A formal proposal has been prepared and included in the first Committee Draft, submitted at the end of July 2009. Interest of CENELEC-TC9x-WGB14 can be checked as well.

4. "Standard Railway Intelligent Communication Framework: ICOM"

After a preliminary submission to IEC-TC9-WG43, a full proposal has been prepared and will now be forwarded to WG43, which is without doubt the most suitable body to handle such issue. Some parts of it, related to the high-level architecture, have been submitted to WG46 and incorporated in the first Committee Draft.

Next steps are related to finalising the submission of the proposals and support the upcoming standardisation process, preparing presentations, clarifications and further documents. Further activities have to be included in the project deployment plan.

2.11.3.3. Perspectives

Important inputs from proposals 3 and 4 have been incorporated by WG46 into the first Committee Draft:

IECWG46_WD62580-1_ General Architecture.doc

This CD has been submitted to the Central Office at the end of July 2009 and will be circulated to all participating National Committees worldwide for comments.

All comments received will be taken into consideration and answered. It is expected , and also anticipated by the WG46 Convenor, that a second version of the Committee Draft will be needed. This is due to the short time available to properly integrate InteGRail contributions into the document. However, this will be also useful to include more and better described details into the draft.

More inputs from ICOM (proposal 4) are expected to be endorsed by IEC-TC9-WG43, as new subgroups will start their work soon, especially in the area of the Application Profile and Communication Profile.

ICOM can provide useful inputs also related to a standard train-to-ground segment.

CENELEC SC9Xb/SGB1 WGB14 is making very slow progress. It is not clear if this WG will be able to define and endorse a final standardisation proposal.

UNIFE work on standardisation can be important to support further steps.

The IGRING initiative can be very helpful as well.

2.12. Level of readiness for the market

InteGRail Domains and Results (exploitable knowledge/product)	Type	approx. level of readiness (1 - 9)
InteGRail Technology Platform		
InteGRail Vision	Public document	9
KPI Tree	Standard definition	7
IGRIS (InteGRail Service Grid Architecture)	Standard architecture	7
Ontology based Railway Data Model	Standard definition	6
Distributed Reasoning	Technology	8
IMON framework (Intelligent monitoring)	Standard definition	7
IMAIN framework (Intelligent maintenance)	Standard definition	7
ICOM prototype (Intelligent Communication Infrastructure)	Standard architecture	7
Demonstration Scenario 1		
KPI Assessment Tool	Software / Stand alone application	9
Network Statement Checker	Software / Web application	8
Infrastructure Availability Checker	Software / Web application	7
Demonstration Scenario 2		
Wheel Trend Analyser	Software application	7
Track Trend Analyser	Software application	7
IMAIN Event Analyser	Software application	6
Demonstration Scenario 3a		
Symptom Agent	Software	6
On Board Condition Analyser	Software embedded on COTS hardware	8
Ground Condition Analyser	Software	7
Intelligent Depot Tool	Software / Web application	5
Lean Maintenance Optimizer	Software	4
Predictive Maintenance Server	Software	4
Operational Decision Support System (ODSS)	Software	7
Traffic Re-scheduler	Software	8
Unplanned Event Manager	Software	5
Demonstration Scenario 3b		
Supervision Tool	Software application	8

2.13.1. Railway Perspective

Although Infrastructure Managers and Railway Undertakings have their own systems in place, they have the intention of exploiting the InteGRail results in order to enable collaboration and information exchange between and within the different companies.

Such companies focus on the improvement of performance they can gain from the application and deployment of InteGRail results. Improvement of performance can be translated into:

- Improvement of Railway Network Capacity
- Improvement of Punctuality
- Improvement of Availability
- Improvement of Reactivity to changes/ Reduction of time to recover from failures
- Reduction of Costs, within a system vision

Railway companies have the interest of improving their asset management by implementing InteGRail results on their equipment or in their organisation. Moreover, equipment developed according to the InteGRail concept will fit directly to systems already in place.

Concrete benefits that can be realised are:

- Cost reduction in railway operation: early information about train and infrastructure faults will help operators to adjust their schedules to the actual situation, choose a cost-effective solution and minimise delays.
- Cost reduction in maintenance: early warning through condition trend monitoring and predictive maintenance improves the effectiveness of maintenance activities. Providers of infrastructure and fleet owners can adapt their efforts and manpower according to actual situation and urgency.
- Minimise delays and disruption through more reliable infrastructure and rolling stock as a result of predictive maintenance procedures
- Increase of transport volume. The easy exchange of information will reduce problems through prediction of future events; will lead to faster recovery from problems; and so allow greater use of the available trains and infrastructure.
- Better feedback to customers as a result of easier exchange of information.
- Manage the railway as a single system – integrating information about infrastructure, rolling stock, operations and traffic management; and integrating information from different countries to create a view of the railway as a single system.
- Protect existing investment through easy integration of legacy systems.
- Cost reduction in information technology: information systems using a common “language” can be connected easily. There is no need for special interfacing, extra programming or dedicated connections between systems. This will reduce both the investments and the costs of maintenance and modifications.
- The implementation of TAF TSI and TAP

Example of benefits

Set up of a new transportation service requires currently a long time, involving many offices and organisations. Moreover, human errors are possible. InteGRail developed the Network Statement Checker, which can automatically check that the envisaged train is compatible with the infrastructure on the new international route.

TSI requires a common information backbone. The reference platform provided by InteGRail a should be considered as candidate solutions for tools to implement these TSIs.

- Standards for exchanging information can support multi-modal transport

2.13.2. Industry Perspective

The integration of information from the field (rolling stock, infrastructure), enable reduction of cost of products and services (re-engineering of products, retrofitting for existing products, improvement of maintenance schemes – especially for lean maintenance concepts).

Moreover, a better knowledge of the Railway System behaviour, formalised in a harmonised and standardised way will have positive effects on the railway industry.

The railway manufacturing industry is planning to use and exploit the project results by having more attractive and innovative products to be put in the market, strengthening the competitiveness of the European Supply Industry, such as:

- Monitoring Systems for infrastructure and rolling stock
- Agile communication systems
- Integration Software
- Decision Support Systems (e.g., in the field of optimised maintenance of rolling stock and infrastructure, response to changes in traffic fluctuations, adaptation to degraded operation situations)

Making use of InteGRail results, the industries involved in the project will be able to providing platforms for telematics applications, and to compete into new markets such as business related applications.

Section 3. Dissemination and Use

3.1. Exploitable Knowledge and its Use

3.1.1. Introduction

In general terms, the exploitation intentions of the Consortium are seen in two parts:

1) for results aimed at promoting new standards (like specifications) there will be a free dissemination of information, so as to favour a wide consensus and adoption of such solutions;
2) for results which are close to being at the stage of pre-competitive product, the participants contributing to such developments intend to exploit the results themselves, using internal resources or in collaboration with other participants in the project; cooperation with external third parties will be promoted.

More in detail, the exploitation strategy depends on the role and characteristics of the participants, whose behaviour, at the end of the project lifetime, could be grouped in the following:

1. system integrators intend to introduce to the market new products based on InteGRail concepts and standards, enabling cost benefits in terms of lower development costs, easier integration into the wider railway system, reduction in maintenance costs and shorter time to market;
2. railway operators and infrastructure managers will capitalise on the results of the project, to increase the efficiency of their systems, their competitiveness and market share, offering better services to passengers and companies, lowering operational costs and enhancing safety. It is also very important for operators to promote any technological improvement towards standardisation to pursue the Commission directives for interoperability;
3. SMEs will be in a position to address a wider market as new public specifications and standards lower existing barriers, allowing SMEs to offer interoperable products and constituents;
4. research centres and universities will increase their knowledge and expertise, which can be offered as consultancy and training services.

3.1.2. Overview Table on deliverables

The following table gives an overview on the deliverables which are relevant for the consortium or for further use outside the consortium. The table does not encompass all deliverables.

Result / Application	Deliverable ID reference	Deliverable description	Doc name	WP	Leader	Co-Authors	Internal	Public
Training Package	D1.3.7	Specification of the training package	IGR-D-IQM-162-02	WP1_07	UNIFE			public
Training Package	D1.3.8	Implementation of training material and delivery of the package	IGR-D-IQM-170-01	WP1_07	UNIFE			public
Training Package	D1.3.9	Report on training activities	IGR-D-IQM-170-01	WP1_07	UNIFE			public
LCC Tool	D1.5.1	LCC toolbox for common use in InteGRail	IGR-D-FAV-026-01;	WP1_05	FAV		Internal	
LCC Tool	D1.5.2	Schedule for LCC analysis within InteGRail	IGR-D-FAV-036-01;	WP1_05	FAV		Internal	
LCC Tool	D1.5.3	Report on LCC analysis intermediate results	IGR-D-FAV-037-01;	WP1_05	FAV		Internal	
Requirements Baseline	D2.2.1	InteGRail Needs Requirements Baseline	IGR-T-CSD-029-06	WP2_02	CD	ATC, AEA, ATS, MAV, MER, PRO, SCF, RFI, UNC, DEL		public
Requirements Baseline	D2.3.1	Report sheet of InteGRail Requirements Baseline assessment	IGR-D-RFI-003-01 & IGR-I-UIC-018-01	WP2_03	RFI		internal	
IGRIS	D2.4.1	System requirements specification for integrail system and model	IGR-D-ALS-043-08	WP2_04	ALSTOM	ALS, SIE, BT, DAP, DELTA	internal	
IGRIS	D2.4.2 / D2.4.5	INTEGRAIL system interface document (functional part) / Impact report regarding sys-	IGR-D-ALS- 370-02	WP2_04	ALSTOM	ALS	internal	

		tem interface						
IGRIS	D2.4.3 / D2.4.6	INTEGRAIL system design document / Impact reporting with regard to implementation of the INTEGRAIL reference architecture and data model	IGR-D-ALS-314-02	WP2_04	ALSTOM	ALS, BT	internal	
IGRIS	D2.5.1	Preliminary security analysis of InteGRail system	IGR-D-INR-054-01	WP2_05	INRETS	INRETS, ALS	internal	
IGRIS	D2.5.2	Security and System Hazard Analysis of InteGRail system	IGR-D-INR-056-01	WP2_05	INRETS	INRETS, ALS	internal	
Standards	D2.6.1	List of applicable standards to INTEGRAIL	IGR-D-IQM-073-03	WP2_06	ALSTOM		internal	
Standards	D2.6.3	Standardisation proposals emerging from the INTEGRAIL work	IGR-D-BTG-421-02	WP2_06	Bombar-dier		internal	
Deployment	D2.7.1	Deployment framework and strategy	IGR-D-UIC-048-01	WP2_07	UIC			public
Deployment	D2.7.2	General rules for operating InteGRail	IGR-D-UIC-049-01	WP2_07	UIC			public
IMON frame-work	D3A.1.1	Detailed system functional requirements for the diagnos-tic and monitoring system	IGR-D-SIE-028-03	WP3A_0 1	SIEMENS	ALS, ASB, BTG, CAF, DWK, HWU, IME, KON, MER, OFF, SBT, SCF, STR, TEL, TRI, UNC, UOB	internal	
IMON frame-work	D3A.1.2	Detailed system functional requirements for the train supervision system	IGR-D-SIE-029-02	WP3A_0 1	SIEMENS	ALS, ASB, BTG, CAF, DWK, HWU, IME, KON, MER, OFF, SBT, SCF, STR, TEL, TRI, UNC, UOB	internal	
IMON frame-work	D3A.1.3	Detailed system functional requirements for the train services (multipart document – sections aligned to specific services)	IGR-D-SIE-030-02	WP3A_0 1	SIEMENS	ALS, ASB, BTG, CAF, DWK, HWU, IME, KON, MER, OFF, SBT, SCF, STR, TEL, TRI, UNC, UOB	internal	

IMON framework Ontologies (Engineering Manual, Patterns)	D3A.2.1	Detailed system architecture & design requirements for the diagnostics and monitoring system	IGR-D-SIE-179-02	WP3A_02	SIEMENS	UoB	internal	
IMON architecture Reasoning	D3A.2.2	Detailed system architecture & design requirements for the train supervision system	IGR-D-SIE-180-02	WP3A_02	SIEMENS	HWU	internal	
IMON architecture Agents	D3A.2.3	Detailed system architecture & design requirements for the train service (multipart document)	IGR-D-SIE-181-02	WP3A_02	SIEMENS	BTG, ALS, TEL	internal	
Domain knowledge	D3A.3.1	Detailed Interface specification document (multipart document)	IGR-D-SIE-182-02	WP3A_3	SIEMENS	MER, UoB, CAF, BT, KTN, UIC, ASB		public
IMON architecture	D3A.3.2	Design of communication interfaces for operation, Diagnostics and Monitoring	IGR-D-SIE-183-02	WP3A_3	SIEMENS	---		public
Tools (Editors, Repositories, Reasoners)	D3A.3.3	Report on selected modelling methods and diagnostics tools	IGR-D-SIE-184-02	WP3A_3	SIEMENS	IME		public
Incipient Fault Detection Condition analyser Symptom agent	D3A.3.4	Report on chose approach to incipient detection, Condition Based Maintenance and Condition Based Operation	IGR-D-SIE-185-02	WP3A_3	SIEMENS	UoB		public
Distributed reasoning, dmonstration scenarios	D3A.3.5	Functional Prototype of designed basic components	IGR-D-SIE-186-02	WP3A_3	SIEMENS	KNT, UoB, HWU, SEE, IME		public
Conceptual Model	D3A.4.1	Refined Conceptualization Model and Services for intelligent Monitoring	IGR-D-UNC-009-03	WP3A_4	UNC		internal	
Refined Architecture	D3A.5.1	Refined Architecture and Model for intelligent Monitoring Services	IGR-D-UOB-077-07	WP3A_5	UOB		internal	

Distributed reasoning	D3A.6.1	Prototype for intelligent distributed reasoning Monitoring System	IGR-D-IME-036-03	WP3A_6	IME	SIE, U-oB,SEE,HWU,TEL,MER,UNC	internal	
IGR Ontology	D3A.7.1	Refined Ontology Model and Prototype	IGR-D-OFF-012-03	WP3A_7	OFF	MER, UoB, CAF, BT, KTN, UIC, ASB	internal (standard part)	public (IMON part)
Demonstration Scenarios IMON architecture Symptom agents Distributed reasoning	D3A.8.1	Integration of intelligent Information Sharing Monitoring	IGR-D-UNC-022-02	WP3A_08	UNC	ALS, ASB, BTG, SIE, HWU, SEE, CAF, MER, DWK, OFF, KNT, TEL, IME, UOB, STR		public
Demonstration Scenarios IMON architecture Symptom agents Distributed reasoning	D3A.9.1	Evaluation of intelligent Information Sharing Monitoring	IGR-D-SIE-286-07	WP3A_09	SIEMENS	SIE, SEE, IME, UNC, UOB		public
IMON Process Monitoring	D3A.10.1	Requirements Specification of a Monitoring and Diagnostics System	IGR-D-ALS-303-03	WP3A_10	ALSTOM	KNT, CAF, SIE, UNC, TEL, IME, BTG	internal	
IMON Process Monitoring	D3A.10.2	Architecture Specification of a Monitoring and Diagnostics System	IGR-D-ALS-313-06	WP3A_10	ALSTOM	CAF, SIE, UNC, IME, BTG	internal	
IMON Process Monitoring	D3A.10.3	Onboard Monitoring and Diagnostic System Demonstrator	IGR-D-BTG-363-03	WP3A_10	Bombardier	ALS, IME, UNC	internal	
IMON Process Monitoring	D3A.10.4	Functional Interface Specification of a Monitoring and Diagnostics System	IGR-D-BTG-382-03	WP3A_10	Bombardier	ALS, IME, CAF, SIE, UNC	internal	
IMAIN model	D3B.1.1	Maintenance System Functional requirements and Model	IGR-D-BTG-050-04	WP3B_1	Bombardier			public

LMO Predictive maintenance server Intellligent Depot tool Condition analyser (board/ground) Unplanned event manager	D3B.2.1	Specification of Intelligent RS Maintenance System	IGR-D-BTG-142-03	WP3B_2	Bombardier			public
Event analyser	D3B.3.1	System Requirement Specification for intelligent RS-infra cooperation	IGR-D-AEA-145-04	WP3B_3	DELTA		internal	
Infrastructure Availability Checker	D3B.4.1	Specification of intelligent infrastructure maintenance system and process	IGR-D-STR-036-05	WP3B_4	STRUKTON		internal	
LMO Predictive maintenance server Intellligent Depot tool Condition analyser (board/ground) Unplanned event manager	D3B.5.1	Prototype of Intelligent Maintenance subsystem for Rolling Stock	IGR-D-HWU-046-04	WP3B_05	HWU	FAR	internal	
Event analyser	D3B.6.1	Prototype or RS-infra cooperation subsystem	IGR-D-UOB-082-02	WP3B_06	UOB		internal	
Infrastructure Availability Checker	D3B.7.1	Prototype of Intelligent Maintenance subsystem for Infrastructure	IGR-D-MER-064-04	WP3B_07	MERMEC		internal	

LMO Predictive maintenance server Intellligent Depot tool Condition analyser (board/ground) Unplanned event manager	D3B.8.1	Verification of Intelligent Maintenance subsystem for Rolling Stock	IGR-D-HWU-062-02	WP3B_08	Bombardier	BT, HWU, SEE, FAR, DAP, MER, UOB	internal	
Event analyser	D3B.9.1	Verification of RS-Infra cooperation subsystem	IGR-D-UOB-112-02	WP3B_09	UOB	Alstom, BT, Delta	internal	
Infrastructure Availability Checker	D3B.10.1	Verification of Intelligent Maintenance subsystem for Infrastructure	IGR-D-AEA-329-01	WP3B_10	DELTA	Strukton, MerMec	internal	
ODSS	D3C.1.2	Map of train operation process improvement possibilities	IGR-D-AEA-063-03	WP3C_01	DELTA		internal	
ODSS IAB	D3C.1.3	Functional requirements: strategic and operational, data sharing	IGR-D-AEA-068-03	WP3C_01	DELTA	ATSF	internal	
ISMAN Strategic Specifications	D3C.2.1	ISMAN Strategic Specifications	IGR-D-AEA-188-03	WP3C_02	DELTA		internal	
ODSS	D3C.2.2	ISMAN Operational Specifications	IGR-D-ATS-035-04	WP3C_02	ATSF		internal	
Frontend specification	D3C.2.3	ISMAN Data sharing Specifications	IGR-D-STR-035-03	WP3C_02	Strukton		internal	
SDSS	D3C.3.1	ISMAN Strategic, Prototype	IGR-D-AEA-250-02; IGR-D-AEA-247-02	WP3C_03	DELTA	Strukton	internal	
SDSS NSC KPI assessment tool	D3C.3.2	ISMAN Strategic, Integrated Prototype (including NSC)	IGR-D-AEA-322-03 = umbrella	WP3C_03	DELTA	Strukton	internal	
KPI Tree Book	D3C.3.2	InteGRail KPI Tree	IGR-D-AEA-297-02	WP3C_03	DELTA	none		public
ODSS	D3C.4.1	ISMAN Operational, Prototype	IGR-D-ATS-052-01	WP3C_04	ATSF	DeltaRail	internal	

ODSS	D3C.4.2	ISMAN Operational, Integrated Prototype	IGR-D-ATS-068-03 (=umbrella report)	WP3C_04	ATSF	DeltaRail		
IGRIS (3C functions)	D3C.5.1	Service Agent Interaction Specification	IGR-D-AEA-248-03	WP3C_05	Delta	DeltaRail	internal	
NSC + ODSS ontology	D3C.5.2	Railway Geography and Planning Ontology	IGR-D-AEA-325-02	WP3C_05	Delta	DeltaRail	internal	
ICOM	D3D.2.1	Preliminary ICOM Specification: Interfaces and functional model and distribution architecture	IGR-D-AEA-188-03	WP3D_02	ALS	ALS, SIE, BT, CAF, NOR, LABS, WIF, INR	internal	
ICOM	D3D.2.2	ICOM Security Objectives reports	IGR-D-LAB-004-05	WP3D_02	LABS	LABS, INR, WIF, ALS, SIE	internal	
ICOM	D3D.2.3	Gap Analysis report between AEIF reference model and ICOM sub-system	IGR-D-ALS-066-03	WP3D_02	ALS	ALS, SIE		public
ICOM	D3D.3.1	Technology report on Railway Embedded Network solutions	IGR-D-INR-008-08	WP3D_03	INR	INR		public
ICOM	D3D.3.2	UWB Application report	IGR-D-WIF-007-06	WP3D_03	WF	WF, INR		public
ICOM	D3D.3.3	Specification of Train Communication Sub System	IGR-D-BTG-111-10	WP3D_03	BT	BT, ALS, CAF, SIE		public
ICOM	D3D.4.1	GSM-R Alternative study and ERTMS Impact Reports	IGR-D-NOR-005-14	WP3D_04	NOR	NOR, INR, WF, ALS		public
ICOM	D3D.4.2	Specification of Infrastructure <to> Train Sub System	IGR-D-NOR-022-05	WP3D_04	NOR	NOR	internal	
ICOM	D3D.5.1	Draft standards for interfaces and data dictionary	IGR-D-ATO-039-03	WP3D_05	ATOS	ATO	internal	
ICOM	D3D.5.2	RT Middleware Applicability Report	IGR-D-INR-015-06; IGR-I-CAF-017-01	WP3D_05	INR	INR, CAF, ALS		public
ICOM	D3D.5.3	Specification of Applicative Interface and Network Management Sub System	IGR-D-CMM-046-01	WP3D_05	CMM	CMM, ALS, SIE, BT, CAF, NOR, LABS, WIF, INR	internal	
ICOM	D3D.5.4	Proposal for standards for interfaces and data dictionary	IGR-I-ALS-361-01	WP3D_05	CMM	CMM, ALS, SIE, BT, CAF, NOR, LABS, WIF, INR		public

ICOM	D3D.6.1	ICOM On Board communication sub system components	IGR-D-CAF-042	WP3D_06	CAF	CAF, ALS, BT, INR, NOR, SIE		public
ICOM	D3D.6.2	ICOM Train to Train communication sub system components	IGR-I-ALS-3nn-01	WP3D_06	ALS	ALS	internal	
ICOM	D3D.7.1	ICOM Infrastructure to Train communication sub system components	IGR-D-NOR-072-04	WP3D_07	NOR	NOR, ALS, SIE, BT, CAF, LABS, WIF, INR	internal	
ICOM	D3D.8.1	ICOM Network Management Sub-System Components	IGR-I-LAB-026-01	WP3D_08	FAR	ALS, WIF, INR, BT, LABS	internal	
ICOM	D3D.8.2	ICOM Application Interface modules	IGR-D-FAR-072-01	WP3D_08	FAR	ALS, WIF, INR, BT	internal	
ICOM	D3D.8.3	ICOM Adapters Library modules	IGR-D-FAR-073-01	WP3D_08	FAR	ALS, WIF, INR, BT	internal	
ICOM	D3D.9.1	ICOM Train Demonstration Platform	IGR-D-CAF-069	WP3D_09	CAF	CAF, ALS, BT, INR, NOR, SIE, WF, LABS		public
ICOM	D3D.9.2	ICOM Train to Ground Demonstration Platform	IGR-D-NOR-077-01	WP3D_09	NORTEL	NOR, ALS, BT, INR, SIE, WF, LABS		public
ICOM	D3D.10.1	ICOM Demonstration Network Management System	IGR-D-FAR-074-01	WP3D_10	FAR	FAR, ALS, BT, INR, NOR, SIE, WF, LABS		public
ICOM	D3D.11.1	SP3D Outputs for SP4 IGR Demonstrator	IGR-D-ALA-305-07	WP3D_11	ALSTOM	ALS, SIE, BT, CAF, INR, FAR, NOR, WIF, LABS	internal	
ICOM	D3D.12.1	ICOM integration and deployment rules	IGR-D-ALS-365-01	WP3D_12	ALS	ALS	internal	
ICOM		IGR-D-ALS-366-02 ICOM proposal for standardisation	IGR-ALS-D-366-02	WP3D-10	ALS	ALS, BT, INR, NOR, SIE, FAR		public
	D4.3.1	Final demo report			RFI		internal	

3.1.3. Overview table on proposals and inputs for standardisation

The following deliverables will be proposed as new work item or as input to existing work items to European or International standardisation bodies. Before being presented for standardisation they will be set as candidates to become a UNIFE-UIC TecRec (Technical Recommendation).

Deliverable number	Conversion level (target)	Standardisation body (TC & WG)	Name	Scope
IGR-D-ALS-366-02	IEC	TCMS Working Group IEC TC9 WG43	Proposal for a standard Railway Communication Framework	Enable railway applications to use existing communication facilities (telecom services) through a standard middleware
IGR-I-OFF-012-03 part 2	IEC or CENELEC	IEC TC9 WG46	Proposal for a standard Railway Domain Ontology	Allow information exchange between railway application, based on semantic enhanced information description
IGR-D-LAB-004-05 ICOM security objectives	IEC	IEC TC9 WG43	Specification of security targets for railway communication	This deliverable analyses in detail the security problems and solution within ICOM
IGR-I-SIE-254-03: description of Web Service interface	IEC	IEC TC9 WG46	Service Oriented approach for railway applications	Higher level of the application interface based on Web services. They allow application-to-application information exchange in a distributed context. Such interface is described in textual and in a more formal way, by means of WSDL and XML. Finally, a simple example (first test) is presented, as well as the distributed reasoning concept.
IGR-D-ALS-303-02 Requirements (Mon & Diag)	IEC	IEC TC9 WG46	Requirements for an Intelligent Monitoring and Diagnostic system	This deliverable deals with Requirements Specification of a Monitoring and Diagnostics System for railways. It includes a comprehensive matrix of requirements
IGR-D-ALS-313-06 Architecture Specification (Mon & Diag)	IEC	IEC TC9 WG46	Architecture of an Intelligent Monitoring and Diagnostic system	This document represents the Architecture Specification of a Monitoring and Diagnostics System. It includes the gateway towards infrastructure systems.
IGR-D-ALS-314-01	IPR to be checked	IEC TC9 WG46 CENELEC WG B14	General InteGRail architecture	The Deliverable gives and overview of InteGRail General Architecture, as a platform enabling information exchange between applications.
IGR-D-BTG-050-04	IEC	IEC TC9 WG46	Maintenance System Functional requirements and Model	This deliverable can be a starting point for the identification of Operation and Maintenance oriented services
IGR-D-BTG-142-03	IEC	IEC TC9 WG46	Specification of Intelligent RS Maintenance System	This deliverable can be a starting point for the definition of Operation and Maintenance oriented services specifications
IGR-D-AEA-297-01	CEN?	tbd	InteGRail KPI Tree	Definition of KPIs as a standard way for measuring and comparing railway performance levels

3.2. Dissemination of Knowledge

3.2.1. Introduction

Dissemination activities are very important to support the deployment of project results, as they can adequately present the results with style and format suitable for the potential users and customers and can spread such information to a wide audience of interested partners, in order to create a network of contacts.

InteGRail devoted quite some resources on such points, defining and implementing a wide dissemination plan, which brought to results now available to support a realistic deployment plan.

It is estimated that several hundreds of people attended the events organised by the project or the conferences were the project was presented, representing a first basis for the contact network.

In addition, some training activities were planned and implemented, which brought to results (training package) extremely useful in order to support new users, introducing them to the concepts and technologies at the basis of InteGRail results.

3.2.2. Dissemination events

3.2.2.1. Demonstration plan

The following events occurred in year 2008:

- Demonstration in Czech Republic (DS3b) – September 11-12
- Demonstrations at InnoTrans (All) – September 23-26
- Demonstration in Friedrichshafen (ICOM) – October 2
- Demonstration in Verona (DS3a) – December 3-4

3.2.2.2. Other events

- InteGRail at Railtech – Utrecht - 31 March 2009
- InteGRail Final Conference - Brussels - 2-3 March 2009
- 2nd InteGRail dissemination seminar - Brussels - 19 April 2007
- InteGRail Seminar on Requirements, Key Performance Indicators and Technological Implementation – UIC – Paris - 6 October 2005
- InteGRail: a single language for EU Railways - POLIS Conference – Monopoli – 15 July 2005
- Preliminary Meeting – Brussels – 10 November 2004

3.2.3. Dissemination material

3.2.3.1. Material Produced

- Two project brochures
- Project presentation (regularly updated)
- Project Web site (www.integrail.info)
- Internal Newsletter: “The InteGRator”
- The public InteGRail newsletter: “The InteGRator”
- 26 Fact Sheets (5 at high level) describing all project results
- The InteGRator (origami)
- Web Portal to InteGRail results (www.integrail.eu)
- Some movies
- CDROMs (see following chapter)

3.2.3.2. Available CDs and DVDs

- Training Package DVD-ROM (by UNIFE) see chapter 3.2.5
- DS3a Conference CD-ROM (by UNIFE)
- ICOM Conference CD-ROM (by UNIFE)
- DS3b video DVD (by CD)

3.2.3.3. Papers produced

[1] P.Umiliacchi, P. Dings, D. van den Abeele, V. Recagno: “Turning Railways into an Intelligent Transportation System by Better Integration, Management and Exchange of Information” – ITS World Conference 2009 – Stockolm – 22 September 2009

[2] Danuše Marusičová: “Introduction into InteGRail” - Research Connection 2009 – Prague, 7/8 May 2009

[3] P. Umiliacchi, D. Nenutil: “InteGRail - An Opportunity For The Railways” – Railvolution – No. 2/2009 - 27 Apríl 2009 - Page 30

[4] P. Umiliacchi: “Top 10 benefits of the InteGRail project” – Rail-Tech Europe 2009 – Utrecht – 31 March 2009

[5] Helene Köpf: “A platform for information sharing and its potential for cross-modal deployment” - E-Freight Conference – Brussels - 17 Feb 2009

[6] Dan Otteborn: “Tracking Developments & Examining the Key Findings from the InteGRail project” - Driving Improvements in Fleet Reliability – London - 28-29 January 2009

[7] P. Umiliacchi: “InteGRail On Quest To Boost Performance” – EURail Magazine – No. 19

[8] R. Shingler, G. Fadin, P. Umiliacchi: “From RCM to predictive maintenance: the InteGRail approach” - 4th IET International Conference on Railway Condition Monitoring – Derby - 18 June 2008

[9] R. Lewis, J. Elphick, C. Roberts: “RCM Data Integration – Ontologies and the Third Tier…” - 4th IET International Conference on Railway Condition Monitoring – Derby - 18 June 2008

[10] G. Langer, R. Lewis, C. Roberts: “Ontology Driven Railway RCM Data Integration” - 4th IET International Conference on Railway Condition Monitoring – Derby - 18 June 2008

[11] P. Umiliacchi, U. Henning, G. Langer, R. Shingler: “Standardized Data Interchange Between Railway Systems: an Integrated Railway Information System” – WCRR 2008 – Seoul – May 2008

[12] D. van den Abeele, J. Szymanski, C. Gransart, M. Berbineau: “Innovative Data Sharing Platform for business performance improvement” - WCRR 2008 – Seoul – May 2008

[13] P. Dings, R. Bezemer, D. Marusičová, C. Weber: “Improving the performance of the railways” - WCRR 2008 – Seoul – May 2008

[14] D. Nenutil: “InteGRail: Project Overview” - International Rail Freight Conference – Prague – 5-7 March 2008

[15] Uwe Henning, Roger Shingler, Paolo Umiliacchi, Gerhard Langer: “Managing traction data according to a standardised approach: the InteGRail project” - RTS 2007 Conference – Tokyo – 14 November 2007

[16] D. van den Abeele: “InteGRail architecture” - UIC e-Business Applications - Paris, 12 October 2007

[17] Jérôme Billion, Didier Van den Abeele: “ICOM: A Communication Framework for Interoperable European Railways” – ITST - Sophia Antipolis – 6 June 2007

[18] P. Umiliacchi, G. Langer: “InteGRail: the intelligent Approach to Integration in Europe” – EURail Magazine No. 16

[19] Richard Lewis, Florian Fuchs, Michael Pirker, Clive Roberts, Gerhard Langer: “Using Ontology to Integrate Railway Condition Monitoring Data” – RCM-2006 – IET-International Conference on Railway Condition Monitoring - Birmingham – UK – 29-30 November 2006

[20] P. Umiliacchi, U. Henning, C. Roberts, R. Shingler: “Optimisation of the railway system through better integration and communication: first results from the InteGRail European project - ITS World Congress - London - 11 October 2006

[21] R. Lewis: “Using Protégé to develop an Integrated European Railway Information System” – Protégé Conference 2006

[22] P. Umiliacchi, R. Shingler, G. Langer, U. Henning: "A new approach to optimisation through intelligent integration of railway systems: the InteGRail project" - WCRR 2006 - Montreal - 7 June 2006

[23] P. Umiliacchi: “InteGRail Project Presentation” - SIAFI Europe – UIC - Paris – 19 September 2005

[24] P. Umiliacchi: “EC projects for railway interoperability “ – ITS Conference – Hannover – 2 June 2005

[25] F. Favo, V. Pertosa: “EC project InteGRail: Integration of intelligent information systems" - Track / Vehicle Interaction Workshop -UIC Paris - 17 February 2005

[26] Stijn Verstichel, Femke Ongenae, Léanneke Loeve, Frederik Vermeulen, Pieter Dings, Bart Dhoedt, Tom Dhaene, Filip De Turck: Efficient data integration in the railway domain through an ontology-based methodology - Transportation Research, to be published.

3.2.4. Summary table of workshops and events

Conference title	Venue	Date	Website	Organiser	Thematic scope of conference, short description	Target audience
ITS Conference 2005	Hannover, Germany	02/06/2005		ITS Germany	• Railway Interoperability	Intelligent Transportation Systems experts and stakeholders
UIC-SIAFI Seminar	Paris, France	19/09/2005	www.uic-asso.fr	UIC	• Information session on international railway activities	International Railway Stakeholders
1st InteGRail dissemination Seminar	Brussels, Belgium	06/10/2005	www.integrail.info	UNIFE	• Dissemination of activities performed and results achieved by the project after 9 months	
RailTech Conference 2006	Amsterdam, The Netherlands	05-06/04/2006	www.europoint.eu/events/?railconferences	Eurpoint BV	• Challenging Maintenance Concepts/Regional Rail Systems and New Technology	Experts in the fields of rail infrastructure, rolling stock, components and construction and maintenance techniques
Protegé Conference	Stanford, California	23-26/07/2006		Stanford University	• Discussion of research application using Protegé tool, future applications of Protegé approach	
Innotrans 2006	Berlin, Germany	19-22/09/2006	www.innotrans.de	Messe	• Experts briefing of integrail results	Main railway stakeholders
ITS World Congress	London, UK	09-12/10/2006	www.its2006.org/	ERICO/ITS UK	• Optmisation of railways system through better integration and communication	Transport IT experts
IEE International Conference on Railway Condition Monitoring	Birmingham, UK	29-30/11/2006	www.action-m.com/dis2006/		• Efficiency improvement of assets management due to increasing demands on the railway system	
7th World Congress on Railway Research (WCRR)	Montreal, Canada	04-08/06/2006	www.wcrr2006.org/	WCRR Organizing committee	Main topics: • Infrastructure • Rolling Stock • Operation • System interaction • Human factors • Global railway issues	Railway industries, research institutions and specialists from all over the world

Conference title	Venue	Date	Website	Organiser	Thematic scope of conference, short description	Target audience
The Future of European Rail	Berlin Intercontinental Hotel	13/03/2007 14/03/2007	http://www.marketforce.eu.com/eurail	The Adam Smith Institute	• Liberalisation of European rail freight • Reforming the European Rail Industry • Exploring opportunities for European Growth (E.g. Tenders and concessions across Europe, rolling stock leasing) • Trans European Networks – Challenges and successes • Revolutionising the railways for efficiency and growth • Cross-European Regulators Panel • Financing Investment in a 21st century railway	Building on the success of the past eleven years, this industry leading conference acts as a great forum for debate bringing together senior-level figures from government bodies, passenger and freight operating companies, infrastructure managers and suppliers from across Europe
Eurail Telematics	Berlin; Logenhaus	21/03/2007 22/03/2007	http://www.eurail telematics.com	EURAILPRESS eurailtelematics	• European Freight Car Logistics • Tracking of trains • Satellite based rail telematics • IT-Technology enables energy awareness for drivers	• Freight Industry • Logistic Industry • IT Industry • Operators • Engineering research • Goverment
Forum for European Railway Operators	Budapest	22/03/2007 25/03/2007	http://www.ferofo rum.com/	FERO	• Infrastructure maintenance and management - functioning efficiently, safely reduced cost • Passenger and freight security • Liberalisation of freight and passenger services • Standardisation and interoperability • Exploring options for financing infrastructure and rolling stock	• Operators • Government • Industry

Conference title	Venue	Date	Website	Organiser	Thematic scope of conference, short description	Target audience
Rail Tech Europe	Utrecht	27/03/2007 29/03/2007	http://www.europoint-bv.com/events/?railtech2007	Europoint	• international exhibition & seminars on rail technology • Interoperability • Switches design • Maintenance • ERTMS • Railway Station as a commercial aspect • Light rail systems • Level crossing safety – trespassing prevention • Integrated passenger information systems	• Industry • Operators • Consultants
ITST		06/06/2007	http://www.itst2007.eurecom.fr	Eurecom Institute	• The theme of this year's event is "ideas, visions, applications and engineering connected to ITS issues", due to the decreasing gap between fundamental research and industrial implementations.	ITS Industry
SIFER 2007	Lille, Grand Palais Exhibition Centre	12/06/2007 14/06/2007	http://www.sifer2007.com	Mack Brooks France	Technology for Europe's railways will be on show at SIFER on the subjects: • Rolling Stock • Track • Signalling • Equipment • Maintenace • Infrastructure Electrification	Transportation Industry: Government Operators

Conference title	Venue	Date	Website	Organiser	Thematic scope of conference, short description	Target audience
Protege Conference	Budapest	15/07/2007 18/07/2007	http://protege.stanford.edu/conference/2007	Stanford	• Ontology development (frame-based, OWL, and RDF) • Ontologies in Semantic Web applications • Ontology-driven software development • Medical applications • Plug-in development • Visualization tools • Reasoning and inferenc	The conference brings together researchers developing or using Protégé methodologies and tools and is the premier forum for discussion about current and future applications of the Protégé approach.
ITS 2007 -1	Aalborg, Dänemark	18/06/2007 20/06/2007	http://www.itsineurope.com/home/index.cfm	ERTICO	European Congress and Exhibition on Intelligent Transport Systems and Services • Traffic and travel information • Public transport systems and services • Traffic detection and monitoring • Active safety and driver assistance systems • Enforcement • Personal protection and security • Traffic management and control • Commercial freight and fleet management • Urban mobility • Positioning and navigation • Payment and toll systems	• Freight Industry • Logistic Industry • IT Industry • Operators • Engineering research • Goverment

Conference title	Venue	Date	Website	Organiser	Thematic scope of conference, short description	Target audience
ITS 2007-2	Birmingham, UK, National Exhibition Centre	17/04/2007 19/04/2007	http://www.its-uk.org.uk/smart_moving_2007.htm	ITS UK	International Conference on Intelligent Transport Systems • Urban Transport System • Security Systems • Passenger Information Systems • Ticketing	• Freight Industry • Logistic Industry • IT Industry • Operators • Engineering research • Goverment
ITSC 2007	Seattle, USA	30/09/2007 03/10/2007	http://www.ewh.ieee.org/tc/its/itsc2007	ITSS	• Travel and Traffic Management • Public Transportation Management • Commercial Vehicle Operations • Advanced Vehicle Safety System • Electronic payment • ITS Modelling and Analysis • Emergency Management and Transportation Security	• Freight Industry • Logistic Industry • IT Industry • Operators • Engineering research • Goverment
Railway Engineering 2007	London, University of Westminster	20/06/2007 21/06/2007	http://www.railwayengineering.com	Railway Engineering	• Permanent Way, Rail Maintenance, Signalling & Electrification • Railway Structures & Earthworks •	• Industry • Operator • Goverment
Infrarail 2008	Birmingham, UK	11/03/2008 13/03/2008	http://www.infrarail.co.uk	Mack Brooks Exhibitions	Exhibition and conferences/seminars on rail infrastructure technologies and products. At the last edition of Infrarail in 2005 more than 4.000 rail professionals took part.	• Infrastructure authority • Station operations • Train operations • Infrastructure services • Overhaul/maintenance services • Human resources • Consultancy • Government/regulatory or local authority

Conference title	Venue	Date	Website	Organiser	Thematic scope of conference, short description	Target audience
The Future of European Rail	Amsterdam, NL	11/03/2008 12/03/2008	http://www.marketforce.eu.com/eurail	Marketforce Communications	International conference with following thematic areas: • Assessing the development of the rail industry across Europe • Exploring new opportunities for freight and passenger business • Regulation across Europe: Supporting the growth of the rail industry • Looking to the future: What shape will the European rail industry take	Senior level decision makers from all areas of the rail industry and across Europe
UIC High Speed 2008 – 6th World Congress on High Speed Rail	Amsterdam, NL	17/03/2008 19/03/2008	http://www.uic-high-speed2008.com/	UIC, NS, ProRail	The most important event in the long distance passenger rail transportation and infrastructure business. Main topics are: • High speed rail and society • High speed rail in practise • From single lines to a high speed network • Strategic issues in high speed raiö • Meeting customers expectations • Innovations in fixed and mobile equipment	Policy makers, economy, financial institutions, industry and transport sector of the high speed business community

Conference title	Venue	Date	Website	Organiser	Thematic scope of conference, short description	Target audience
MetroRail 2008	Copenhagen, DK	31/03/2008 03/04/2008	http://www.terrapinn.com/2008/metrorail	Terrapinn Ltd.	Main topics: • Metro strategy and innovation • International new lines and projects • Planning and integration • Urban transport of the future • Finance and investment innovation • Alternative revenue streams • Operations, maintenance, safety and security • Automation and driverless metro	Decision makers representing global city metros, infrastructure managers, governmental officials and leading suppliers
8th World Congress on Railway Research (WCRR) 2008	Seoul, Korea	18/05/2008 22/05/2008	http://www.wcrr2008.org	KORAIL, KR, KRRI	Main topics: • Infrastructure • Rolling Stock • Operation • System interaction • Human factors • Global railway issues	Railway industries, research institutions and specialists from all over the world
EXPO Ferroviara 2008	Turin, Italy	20/05/2008 22/05/2008	http://www.expoferroviaria.com	Mack Brooks Exhibitions	Italy's only regular rail industry exhibition with accompanying seminars. The event covers every sector of the railway industry, including the major fields of • rolling stock technology, • track and infrastructure and • signalling and communications	• Main line railway operators • Urban rail operators • Rail infrastructure authorities • Equipment and product manufacturers • Track maintenance and infrastructure services providers • Specialists in vehicle maintenance • Representatives of government and regional/local transport authorities

Conference title	Venue	Date	Website	Organiser	Thematic scope of conference, short description	Target audience
ITS Congress 2008	Geneva, Switzerland	04/06/2008 06/06/2008	http://www.itsineurope.com/	Brintex Evants on behalf of ERTICO	7th European congress and exhibitions on Intelligent Transport Systems and Services The programme ranges from the strategic vision to the technical implementation of ITS applications, from research and planning to the operational use of systems and services. It covers the overall topics: • Sustainability for mobility • Co-modality • Traffic and transport management • Paying for mobility At the exhibition, world-class suppliers will present their latest ITS innovations including advanced vehicle control systems, travel information and traffic management systems, digital mapping, public transport applications, smart card and communication technology.	The Congress expects to attract delegates from all over Europe and the Middle East.

Conference title	Venue	Date	Website	Organiser	Thematic scope of conference, short description	Target audience
4th International Conference on Railway Condition Monitoring (4th IET RCM)	Derby, UK	18/06/2008 20/06/2008	http://conferences.theiet.org/rcm08/	The Institution of Engineering and Technology Railway Network and University of Birmingham and RRUK	The event on Railway Condition Management aims to provide a unique forum to showcase current research, product development and practical experience from academics, railway operators and railway system suppliers The main topics of the conference are: • Condition monitoring technology of all railway sub-systems • Intelligent infrastructure and asset management strategies • Event recording and data logging • Predictive analysis tools and techniques • State-of-the-art sensing techniques and non-destructive testing • Data management, standards, modelling and presentation • Condition-based maintenance and reliability-centred maintenance • System management and cost benefit analysis	Researchers and experts from rail supply industry and operators
COMPRAIL 2008	Toledo, Spain	15/09/2008 17/09/2008	http:///www.wessex.ac.uk	Wessex Institute of Technology, UK and the University of Castilla-La Mancha	Eleventh International Conference on Computer System Design and Operation in the Railway And Other Transit Systems The conference aims to update the use of computer-based techniques, promoting their general awareness throughout the business management, design, manufacture and operation of railways and other advanced passenger, freight and transit systems.	The meeting provides a forum for engineers, planners, designers, manufacturers and operators, to discuss how they can benefit from the latest developments. It will also provide a forum for transit and rail operators.
Innotrans 2009	Munich, Germany	Setpember 2009	www.innotrans.de	Messe	Presentation of InteGRail demo scenarios	

Conference title	Venue	Date	Website	Organiser	Thematic scope of conference, short description	Target audience
InteGRail final conference	Brussels, Belgium	02/03/2009 – 03/03/2009	www.integrail.info	UNIFE	Presentation to InteGRail consortium and to external auditors of the activities done in the scope of the project, and the final results achieved	Stakeholder potentially interested in InteGRail results
International Rail Freight Conference	Prague, Czech Republic	04-06 March 2009	http://www.irfc.eu/	Jerid	International Cargo Transport between Asia and Europe Legislation, Interoperability, Concepts Euro-Asian Land Bridge	railway cargo companies, Asian and European forwarding companies, Custom agencies
Rail-Tech Europe 2009	Utrecht, The Netherlands	31 March 2009	http://www.europoint-bv.com/events/?railtech2009	Europoint	Presentation of IGR final results in easy to understand terms	Technology experts and international railway stakeholders
ITS World Congress	Stockolm - Sweden	21-25 September 2009	http://www.itsworldcongress.com/	OTS Congress Association, Brintex, Ertico	16th Congress and Exhibition – Paper on InteGRail as an ITS	ITS, logistics and railway experts

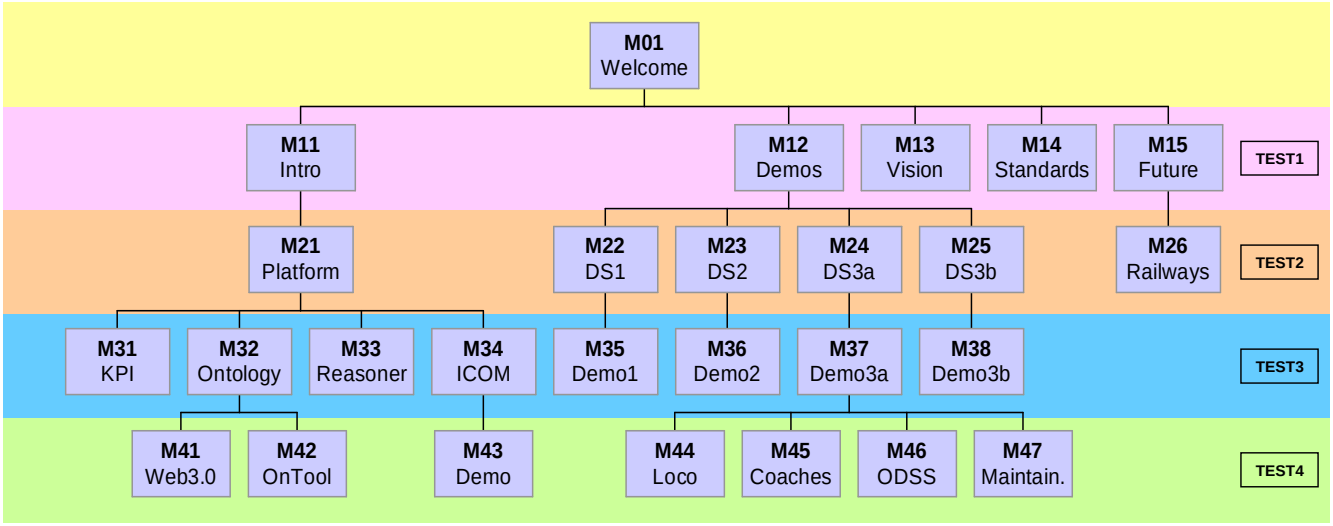
3.2.5. Training material

3.2.5.1. The Training Package

When it is necessary to go deeper into the InteGRail concepts and results, dissemination material is no more sufficient and it is necessary to switch to more appropriate training material, with the purpose of:

- having a clear explanation of the project concepts widely available inside and outside the project
- capturing the best didactical skills available in the project and document them in suitable material
- improving the coverage of project documentation, enabling also newcomers to quickly reach a good understanding
- supporting future exploitation and deployment activities

Training Package Module Map



The Training Package has been implemented as a useful tool in order to carry out training activities both within and outside the InteGRail project.

Video based modules presented by project experts can effectively explain each concpet from different points of view and with an increasing level of detail.

Module M42 includes and Ontology viewer application, for better understanding of such key concept.

It embeds a self-test application which allows users to check their level of understanding of the topics presented in the package.

3.2.5.2. Deliverables

- IGR-I-IQM-162-03 - D1.3.7 – Specification of the Training package
- IGR-I-IQM-163-03 - D1.3.8 – Implementation and delivery of the Training package
- IGR-I-IQM-170-02 - D1.3.9 – Report on Training Activities

3.3. Publishable Results

The following collection of public Fact Sheets summarises the content and the possible application of InteGRail tools and achievements:

InteGRail Technology Platform
InteGRail Vision
KPI Tree
IGRIS (InteGRail Service Grid Architecture)
Ontology based Railway Data Model
Distributed Reasoning
IMON framework (Intelligent monitoring)
IMAIN framework (Intelligent maintenance)
ICOM prototype (Intelligent Communication Infrastructure)
Demonstration Scenario 1
KPI Assessment Tool
Network Statement Checker
Infrastructure Availability Checker
Demonstration Scenario 2
Wheel Trend Analyser
Track Trend Analyser
IMAIN Event Analyser
Demonstration Scenario 3a
Symptom Agent
On Board Condition Analyser
Ground Condition Analyser
Intelligent Depot Tool
Lean Maintenance Optimizer
Predictive Maintenance Server
Operational Decision Support System (ODSS)
Traffic Re-scheduler
Unplanned Event Manager
Demonstration Scenario 3b
Supervision Tool

The “InteGRail catalogue” contains all fact sheets. It is available in the public area of the website www.integrail.info (IGR-A-FAV-034-01 – Catalogue of Factsheets)