



**TECHNICAL SOLUTIONS**  
FOR THE OPERATIONAL RAILWAY

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INTERNATIONAL UNION  
OF RAILWAYS

## FOREWORD BY GIANLUIGI CASTELLI UIC CHAIRMAN



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### UIC TECHNICAL SOLUTIONS FOR THE OPERATIONAL RAILWAY

Innovation, sustainability and competitiveness in the rail transport sector are best achieved through worldwide technical integration and the continuous improvement of safety.

This is even more true in the new global context – with all its complexity, uncertainty and opportunities.

As the only worldwide international railway organisation, UIC is first in line when it comes to fast-tracking the rail mobility revival.

The “UIC Technical solutions for the operational railway” are a tangible demonstration of our will to address the deep changes needed in this new environment, from an operations and technology perspective, at speed and at scale.

From creating new world standards for railways, to proposing new ways to improve multimodality, all while reducing costs and raising market attractiveness, this compendium covers a broad range and provides another important tool for harmonising rail transport and serving our members efficiently.

Thanks to the independent work of our experts from all UIC Regions, these guidelines retain their universal and global objective, while also incorporating regional variations.

Once more, their transfer of knowledge and sharing of best practices has resulted in a valuable output that will serve as a benchmark to all railway companies and relevant stakeholders in the world.

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## INTRODUCTION BY FRANÇOIS DAVENNE UIC DIRECTOR GENERAL



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A train arriving at a station seems the most natural thing in the world. Nevertheless, this daily event requires a plethora of complex, multidimensional technical solutions to all line up so it can happen in the right place, at the right time and safely.

When we think about railways, the image that comes to mind is that of a system of systems. Indeed, operating all the services associated with railway transport requires the combination of numerous different technologies, ranging from the rails themselves, to the trains, through to the sale and management of tickets – not forgetting the telecommunications and signalling systems in all their complexity.

When UIC was founded in 1921, it seemed natural to entrust the definition and development of the railway system to a global association of railway companies. This led to the development of a broad-ranging suite of descriptive voluntary sector standards known as 'UIC leaflets'.

Right from the moment when the first leaflet was published in 1928, they quickly became the benchmark for operational solutions and have long served as the foundation on which much of the railway system of today has been designed and constructed and continues to be operated and maintained.

The leaflets are based on a framework that allows the constraints and complexities of the railway system to be taken into account to the greatest extent possible:

- ▶ Requirements-gathering based on market needs;
- ▶ Development of specifications for both hardware (e.g. wagon specifications, braking systems) and software (GSM-R, FRMCS, integrated ticketing, etc.), based on the operational experience of the railways;
- ▶ Involvement in projects to prepare new operational rules and standards which are relevant to all areas

of the world and all types of railway operation, validating the operational effectiveness of the proposed solutions, and facilitating accelerated implementation in the operational railway;

- ▶ Implementation of large-scale product demonstrations;
- ▶ Dissemination of results;
- ▶ Operational implementation of innovative products.

More recently, the leaflets have been used as the basis for the elaboration of the general TSI/UTP regulatory framework. They also support standards such as ENs and/or national or regional regulations.

Today, with UIC being widely recognised as an SSO (Standards Setting Organisation) for the railway sector, the leaflets are being transformed into International Railway Solutions (IRSs). These IRSs are voluntary standards-like products that focus on system requirements and operations.

The work undertaken and the diverse topics considered showcase the extent of the solutions offered by UIC, and also provide an overview of further solutions being developed. Facilitating the delivery of safe, efficient and sustainable railway services, UIC has anticipated the EU concept of interoperability by standardising solutions and practices in its publications.

Moreover the IRSs provide contractual frameworks for issues relating, for example, to the exchange of wagons between users and networks (GCU) or data exchange between freight companies (RailData).

The overview provided here shows what constitutes the core of UIC's added value, and complements the UIC Code<sup>1</sup>, the online catalogue of all documents published by UIC.

Thanks to the ongoing support of its members, UIC's activities span a wide range of areas. This guide gives an account of the results delivered by UIC's 118 working groups, which work on a daily basis to develop technical solutions that meet the operational and commercial needs of end users and the other stakeholders of the entire railway sector: train operators, railway undertakings, carriers, infrastructure managers, keepers, maintenance suppliers, manufacturers, service providers, contracting entities, shippers, consignors, consignees, loaders, unloaders, fillers and unfillers.

As the main technical body serving not only railway operators, but the entire community of railway stakeholders, including research centres and universities, UIC is a natural forum for bringing together all these stakeholders and for developing collaborative European and global solutions to reach this objective.

This document, ranging from architecture to financial arrangements, provides an overview of the main achievements and developments in UIC.

Depending on one's different interests, it will give a synthetic description of operational solutions suited to market needs.

It will be an efficient tool for summarising in a few pages the added value of UIC spread in different instruments and workflows:

- ▶ 700 leaflets describing the entire railway system (with progressive conversion to +/- 300 IRSs);
- ▶ Technical Specifications;
- ▶ Qualitative and quantitative guidelines<sup>2</sup>;
- ▶ 118 working groups and more than 1,000 experts drawn from member companies;
- ▶ Regularly updated procedures, with a dedicated supervisory platform for standardisation.

## STANDARDISATION PLATFORM

**UIC's Standardisation Platform is a working body which acts as the supervisory platform for standardisation and the interface between member companies and the standardisation activity undertaken at UIC. Its steering committee is composed of companies holding active UIC membership status and meets four times a year. The Platform meets in plenary format once a year and is open to all UIC members, as well as external partners and other interested parties.**

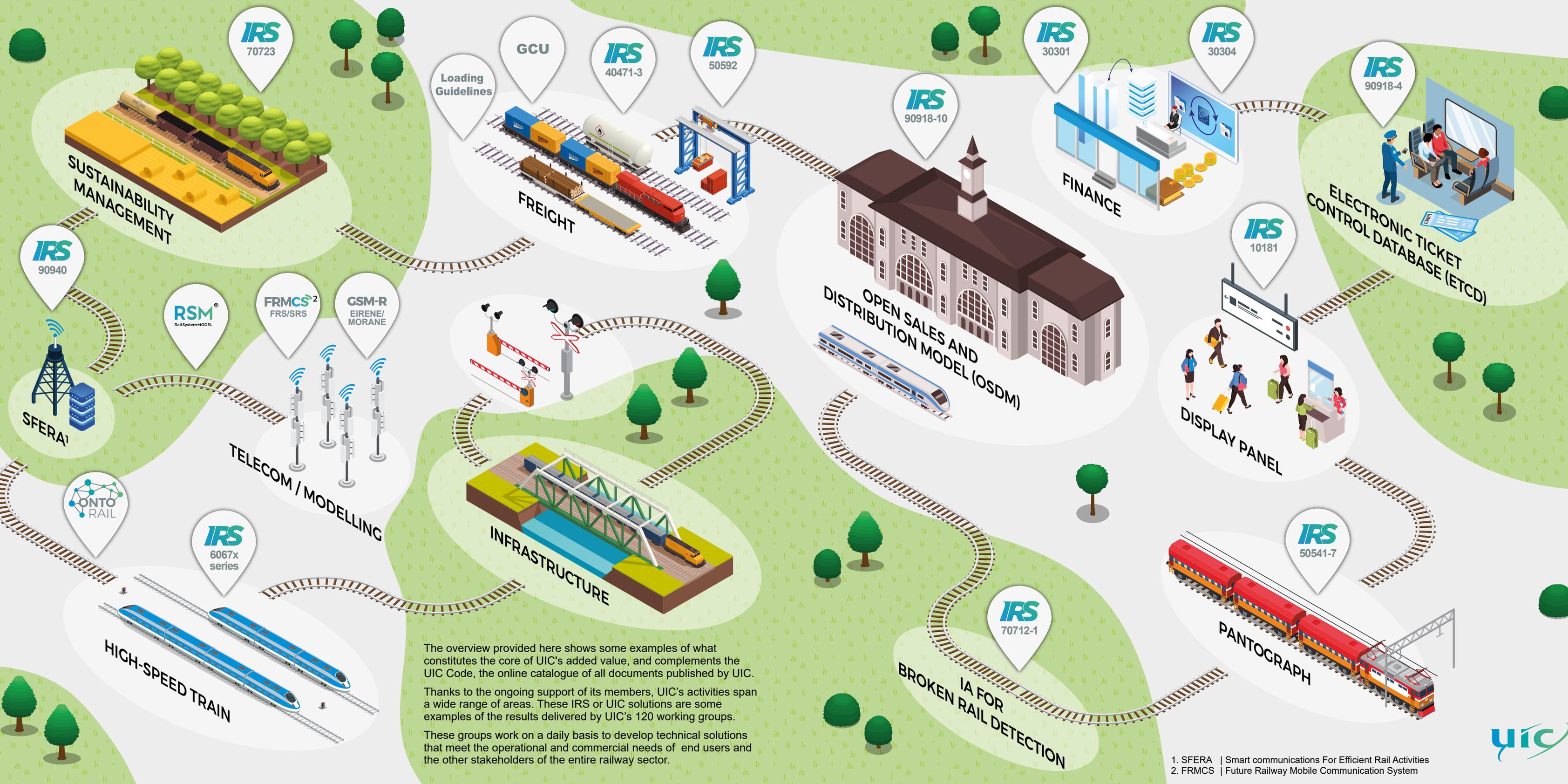
**The Standardisation Platform continues to attract new and proactive stakeholders who are passionate about standardisation. It holds an annual conference of international relevance, which provides an opportunity for discussion with external partners on important standardisation issues for the railways.**

**A systematic five-year review cycle is in place for IRSs to ensure that they are fit for purpose. This is an aspect of UIC's professionalism in standards that the platform supervises.**

**The Excellence in Standardisation Awards will be held for the first time in 2021.**

2. Some UIC leaflets/IRSs may be considered as guidelines, as defined by the European Union Agency for Railways and regional and international standardisation bodies.

1. <https://www.shop-ETF.com/en/leaflets-irs>



The overview provided here shows some examples of what constitutes the core of UIC's added value, and complements the UIC Code, the online catalogue of all documents published by UIC.

Thanks to the ongoing support of its members, UIC's activities span a wide range of areas. These IRS or UIC solutions are some examples of the results delivered by UIC's 120 working groups.

These groups work on a daily basis to develop technical solutions that meet the operational and commercial needs of end users and the other stakeholders of the entire railway sector.

1. SFERA | Smart communications For Efficient Rail Activities  
 2. FRMCS | Future Railway Mobile Communication System



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## SYSTEM VISION, ARCHITECTURE AND MODELLING

### A SYSTEM VISION ADAPTED TO DIGITAL RAILWAY

Operations is the key remit of UIC and encompasses all the processes and elements required to operate a train with passengers or freight, from service design to feedback. The new operational concept will involve a multidisciplinary team of UIC members' experts, who will work with each sector within the Rail System Forum and other UIC departments in order to manage the interfaces between the generic railway subsystems (defined in Europe by TSI) of infrastructure, energy, trackside control-command and signalling, on-board control-command and signalling, rolling stock, operation and traffic management, maintenance, and telematics applications for passenger and freight services<sup>3</sup>.

Developing such an operational concept will require the development of a concept for the rail system architecture. UIC proposes implementing a concept based on data transmission network architectural principles.

3. Official Journal of the European Union, (2016), 'Directive (EU) 2016/797 of the European Parliament and of the Council of 11 May 2016 on the interoperability of the rail system within the European Union (recast)', Annex II point 1, accessed 26 May 2016 at <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016L0797&from=FR>



Information and Communications Technology (ICT) is an important structural component of the 21<sup>st</sup> century railway. The concept has been developed and standardised through a basic reference model: the Open Systems Interconnection (OSI) model<sup>4</sup>. The OSI reference model aims to give data transmission end-users the impression of seamless or uninterrupted transmission, although several complex interfaces are actually involved.

4. International Telecommunication Union (1994), "Information Technology - Open Systems Interconnection - Basic Reference Model: the Basic Model - ITU-T Recommendation X.200".

To this end, the OSI reference model breaks down the various protocols required to transmit data into seven layers.

Each layer resolves specific problems in relation to data transmission and provides well-defined services to the layers above. The model's upper layers are those closest to the end user, while the lowest layer is closest to the physical components of the ICT network.

### THE OSI MODEL

The OSI reference model facilitates the description of the internal interfaces between its various layers and simplifies the drafting of the related standards, as only the interconnection aspects of these open systems would strictly need to be described<sup>5</sup>. Furthermore, it is sufficiently flexible to accommodate advances in technology.

If data packets are replaced with goods or passengers, it should be possible to obtain a suitable and efficient reference model for railway architecture<sup>6</sup> with the same strengths, and with only four layers:

- ▶ The upper layer is the service layer, enabling door-to-door passenger travel or seamless end-to-end freight transport services from shipper to consignee;

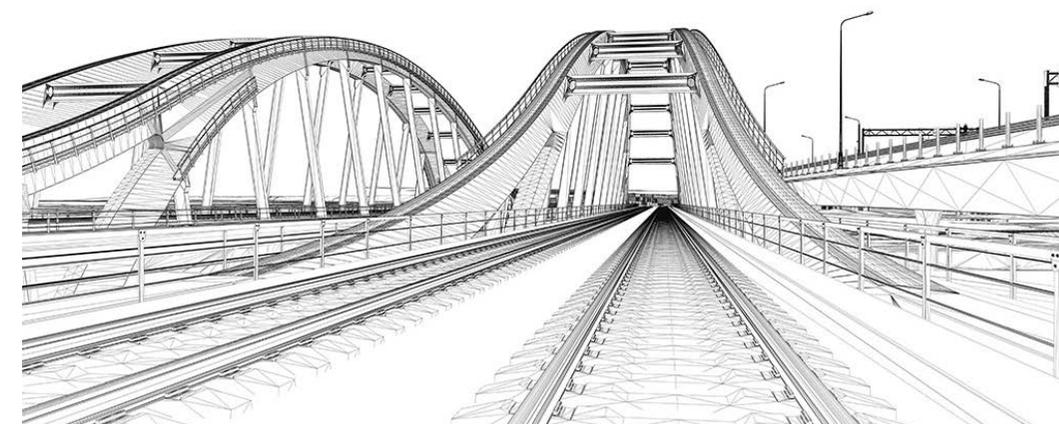
- ▶ The second layer is the network layer, corresponding to the procedures that enable end-to-end railway traffic management;
- ▶ The third layer is the transport layer, ensuring compatibility between the rolling stock and the network;
- ▶ The fourth and lowest layer corresponds to the physical layer of the OSI reference model. It includes standards for physical components, and those necessary to ensure compliance with the essential requirements listed in the Technical Specifications for Interoperability (TSIs).

The benefits of a layered railway architecture could include:

- ▶ **Simplification** of regulations, standards and other technical documents, making it easier to draft new texts focusing on a single layer.
- ▶ **Flexibility** for adopting innovations. The interfaces between the different layers are specified, so it is possible to innovate within one layer without any changes to the other layers. Innovations can be implemented more easily on a plug-and-play basis, using a staged approach to protect investments and accelerate market uptake.
- ▶ **Technical modularity** can be promoted in individual layers. Just as the four-layer concept specifies the interfaces between neighbouring layers, the modularity concept can be used to specify interfaces between neighbouring modules of similar layers. Each module should be described by its own features and by its interfaces with the other modules in the same layer.
- ▶ **Digitalisation** of the railway system can be facilitated. It is easier to create accurate protocols for data exchange when the interfaces between the different modules and layers have already been standardised and specified.

5. International Telecommunication Union (1994), 'Information Technology - Open Systems Interconnection - Basic Reference Model: the Basic Model - ITU-T Recommendation X.200', point 4.3.1, accessed July 1994.

6. Further explained in the chapter "Towards a new architecture for technical regulation on Europe's Railways", forthcoming in Finger, M. & J. Montero (eds.). Rail Regulation Handbook. Cheltenham: Edward Elgar.



### DIGITAL EVOLUTION OF RAILWAY SYSTEMS

#### Digital modelling: the foundation for a coherent evolution

Digital transformation represents a major lever for the future technical and economic performance of railway companies.

As in all advanced technical industries, time to market and performance are improved through digitalisation, from early design and simulation to optimisation in operation.

The train of the future is designed as a system of systems, encompassing several different domains such as infrastructure, rolling stock, signalling, telecoms, energy, artificial intelligence, and the environment. Due to the complexity of this system of systems and the need for open collaboration between the various stakeholders in the railway industry, a common language is required for detailed description and to ensure digital continuity along value chains.

The definition of a common modelling language for the global railway system is therefore an absolute must; the objective being to encompass all the key dimensions of the system:

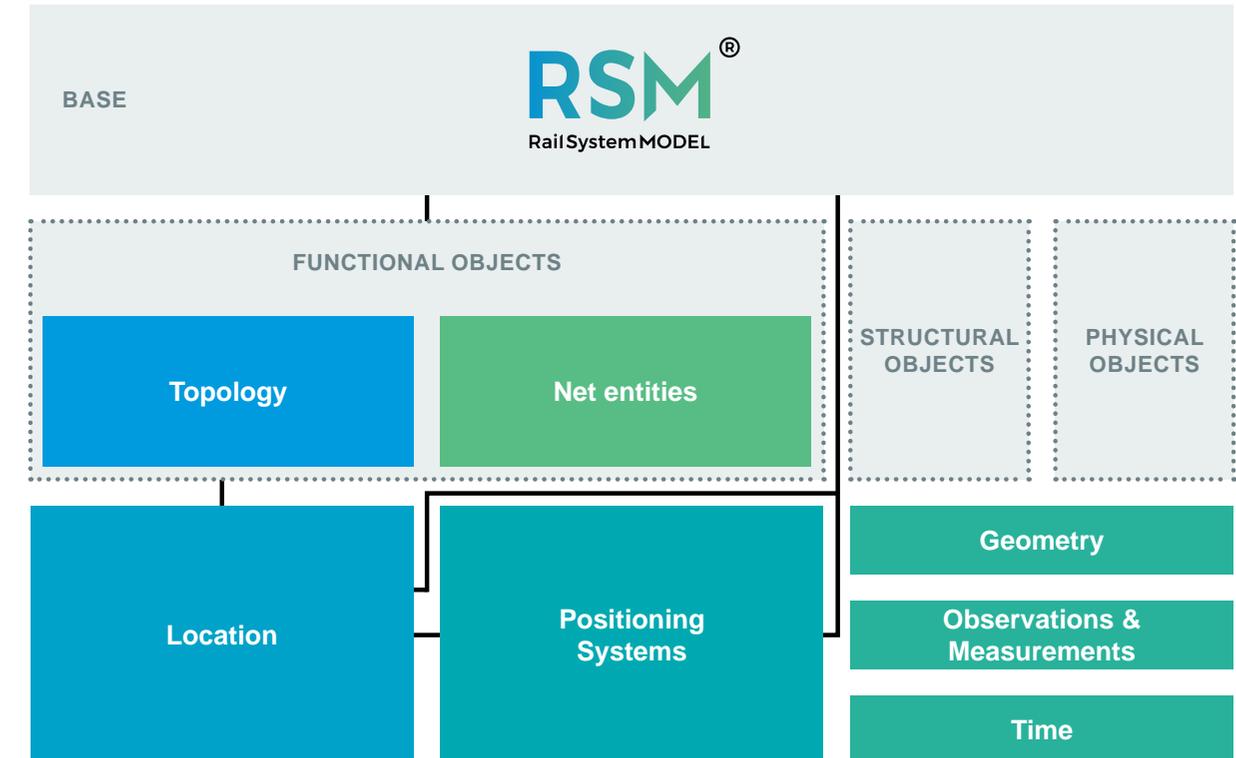
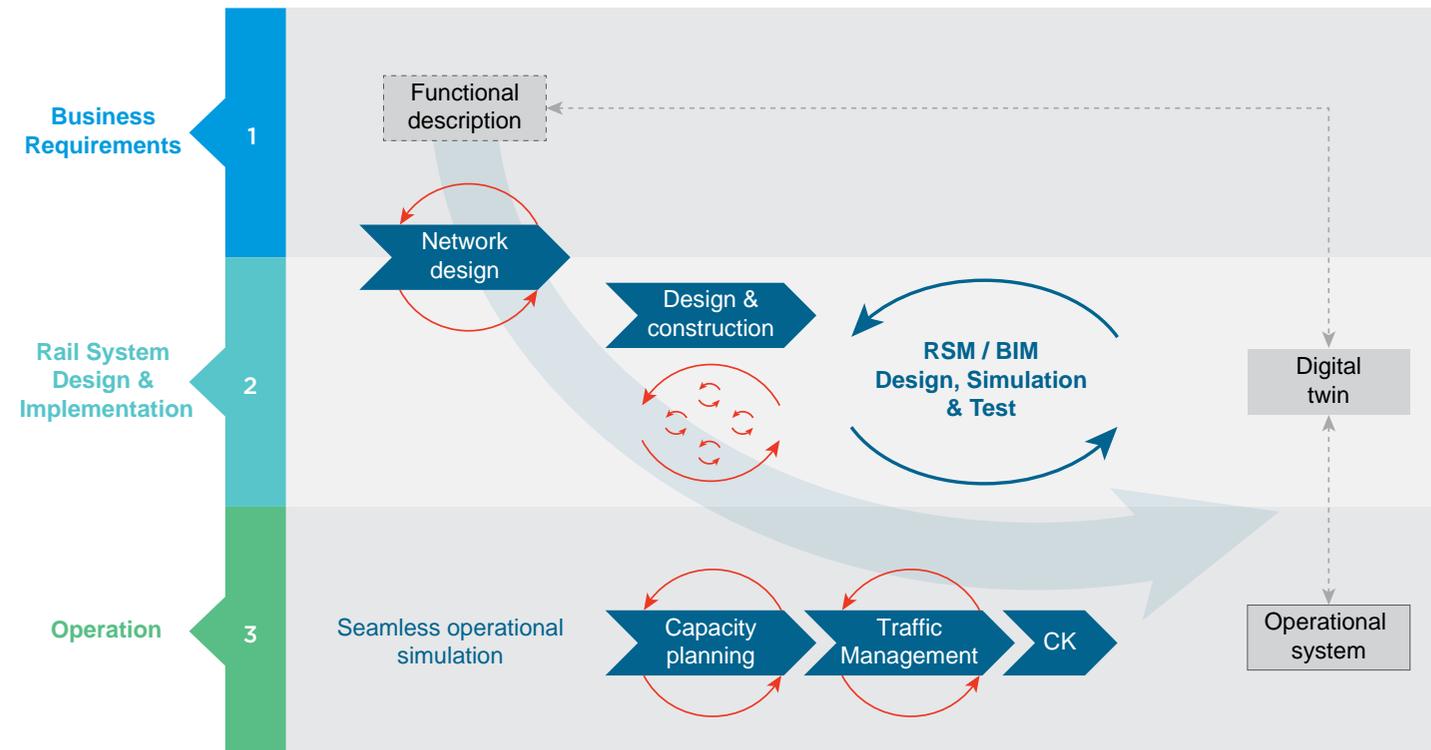
- ▶ Design and construction;
- ▶ Work planning;
- ▶ Traffic management and capacity planning;
- ▶ Functional diagrams or simulations.

Using “digital twins”, understood by all stakeholders, for railway elements and systems will not only dramatically reduce ownership and operational costs in the railway industry, but will also enable the removal of historical silos, which will in turn foster open collaboration between all parties involved.

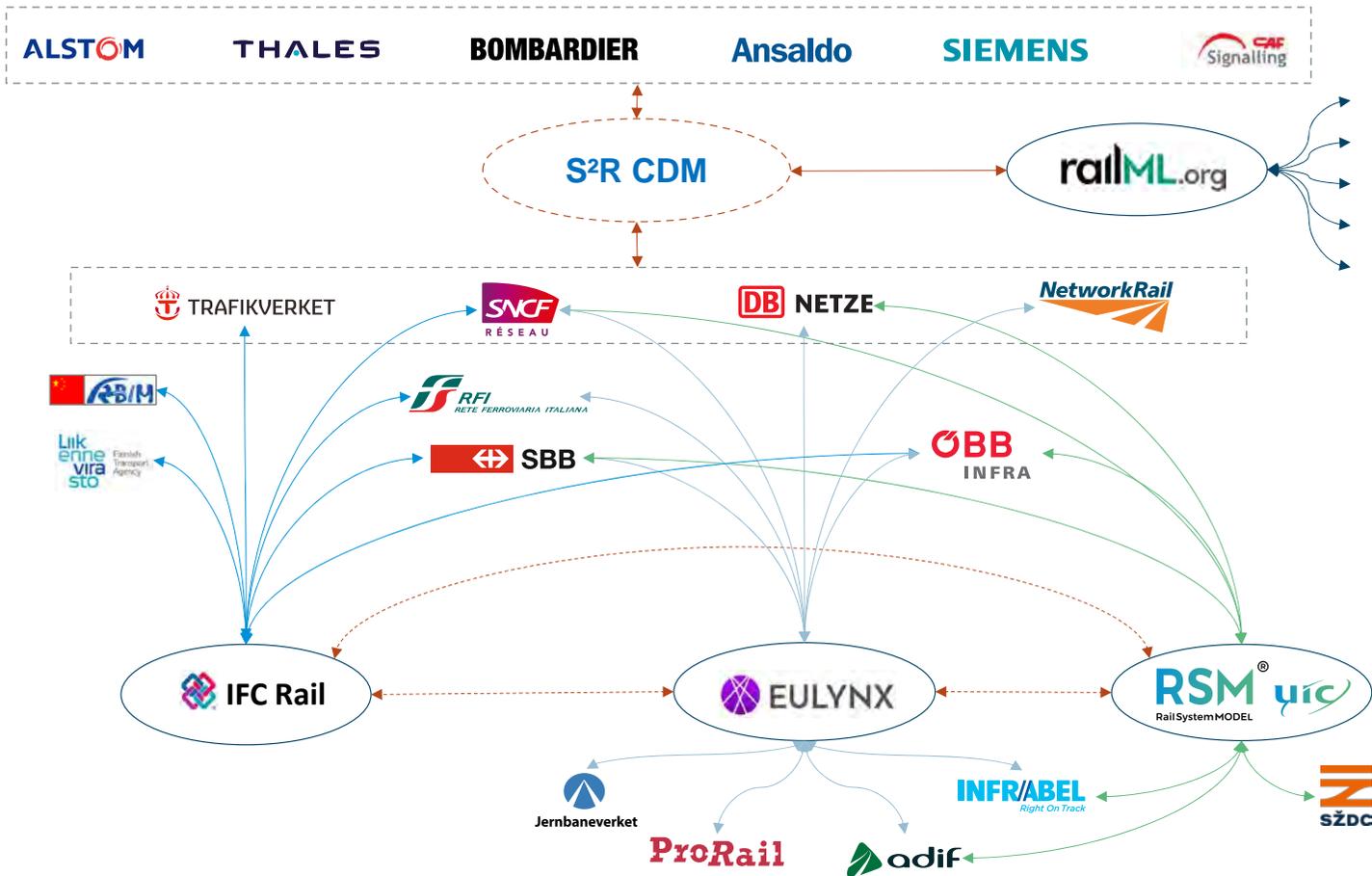
In 2013, with its **RailSystemModel (RSM)** project, UIC laid the foundation for such a common modelling language with the aim of functional continuity from design to operation (IRS 30100, published in 2016).

In the same vein, use of the RSM model to create digital twins is being considered for the Eulynx and IFC Rail digital standardisation projects in their respective domains of signalling and construction (building information modelling (BIM)).

### SIMULATION AND OPTIMISATION THROUGHOUT THE ENTIRE LIFE CYCLE



### RAILWAY DIGITAL STANDARDISATION: MAIN PROJECTS AND ACTORS



More recently, Shift2Rail has launched the LinX4Rail project to establish a “glue” between all the different initiatives for digital standardisation in the railways.

Another key activity within the scope of LinX4Rail is building coherence in the semantics of concepts and the definition of objects between existing modelling works. UIC is leading this activity with the aim of prototyping and implementing a solution to align railway modelling concepts and ontologies via an online dictionary named **OntoRail**.

Looking ahead, UIC’s objectives are to further develop its RSM and OntoRail activities in close collaboration with Shift2Rail and to develop ongoing and structured digital modelling activities within UIC, the overarching aim being to facilitate convergence within the railway sector towards a common digital modelling system.

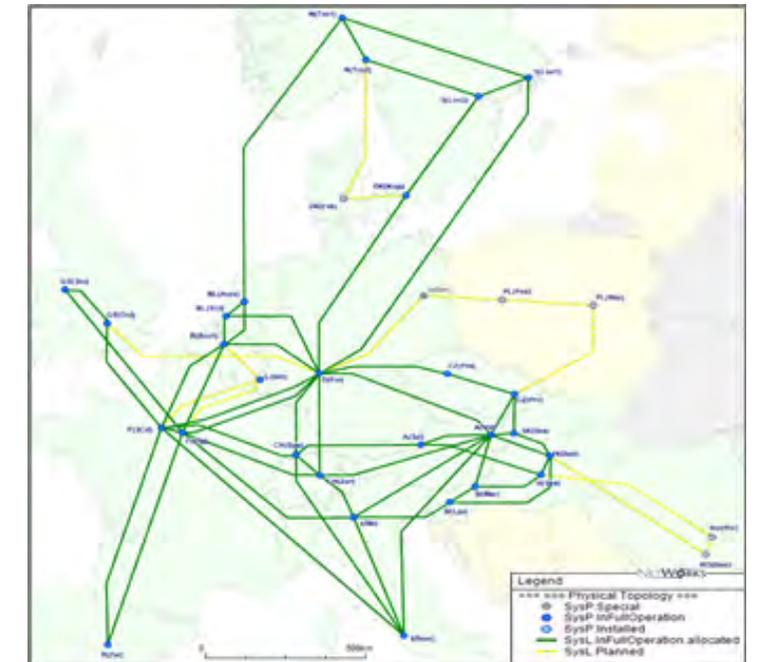
### TELECOMS: THE NEXT FRONTIER FOR SIGNALLING AND CONTROL-COMMAND SYSTEMS

The introduction of the European Railway Traffic Management System (ERTMS) strategy in Europe in the early 2000s paved the way for GSM-R, a major success story both in Europe and around the world.

Designed for European Train Control System (ETCS), the GSM-R system has rapidly been adopted by the majority of railways on account of its capacity in relation to key operational railway communications functions, to the extent that GSM-R now covers around 150,000 km of track in Europe and 210,000 km throughout the world.

Furthermore, the **EIRENE FRS** (European Integrated Railway Radio Enhanced Network Functional Requirements Specification) and **SRS** (System Requirements Specification) constitute the communications baseline for the European Control-Command System Technical Specifications for Interoperability (**CCS TSI**). UIC is working on an ongoing basis to ensure that they are maintained and developed. In addition, UIC ensures the management of the hubs for **GSM-R interconnection** in Europe through the European Network of Interconnection for Railways (ENIR), with 17 national networks taking advantage of smooth and transparent border crossings with regard to telecommunications for international trains.

However, GSM-R is approaching obsolescence, as railway telecoms suppliers will stop supporting the system by 2030. Consequently, the railways have begun efforts to develop a successor to GSM-R, the **Future Railway Mobile Communication System (FRMCS)**, launched by UIC as a project in 2014.



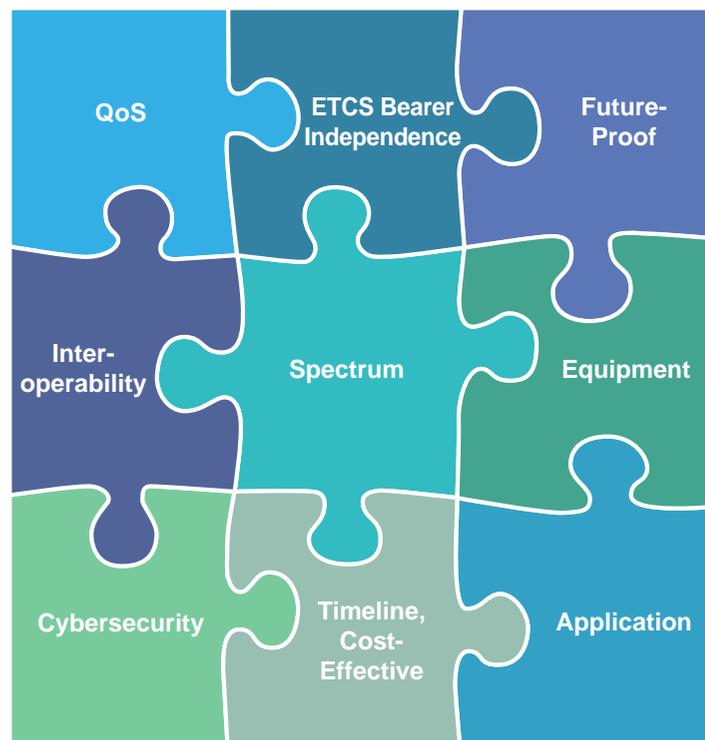
### FRMCS

FRMCS needs to be future proof, as the railways rely on a longer nominal system life than conventional mobile networks. FRMCS must meet the railways' specific requirements:

- ▶ Quality of service (coverage outages could result in stopped trains, or a failed railway emergency call in the worst-case scenario);
- ▶ Full interoperability;
- ▶ Mitigation of cybersecurity challenges.

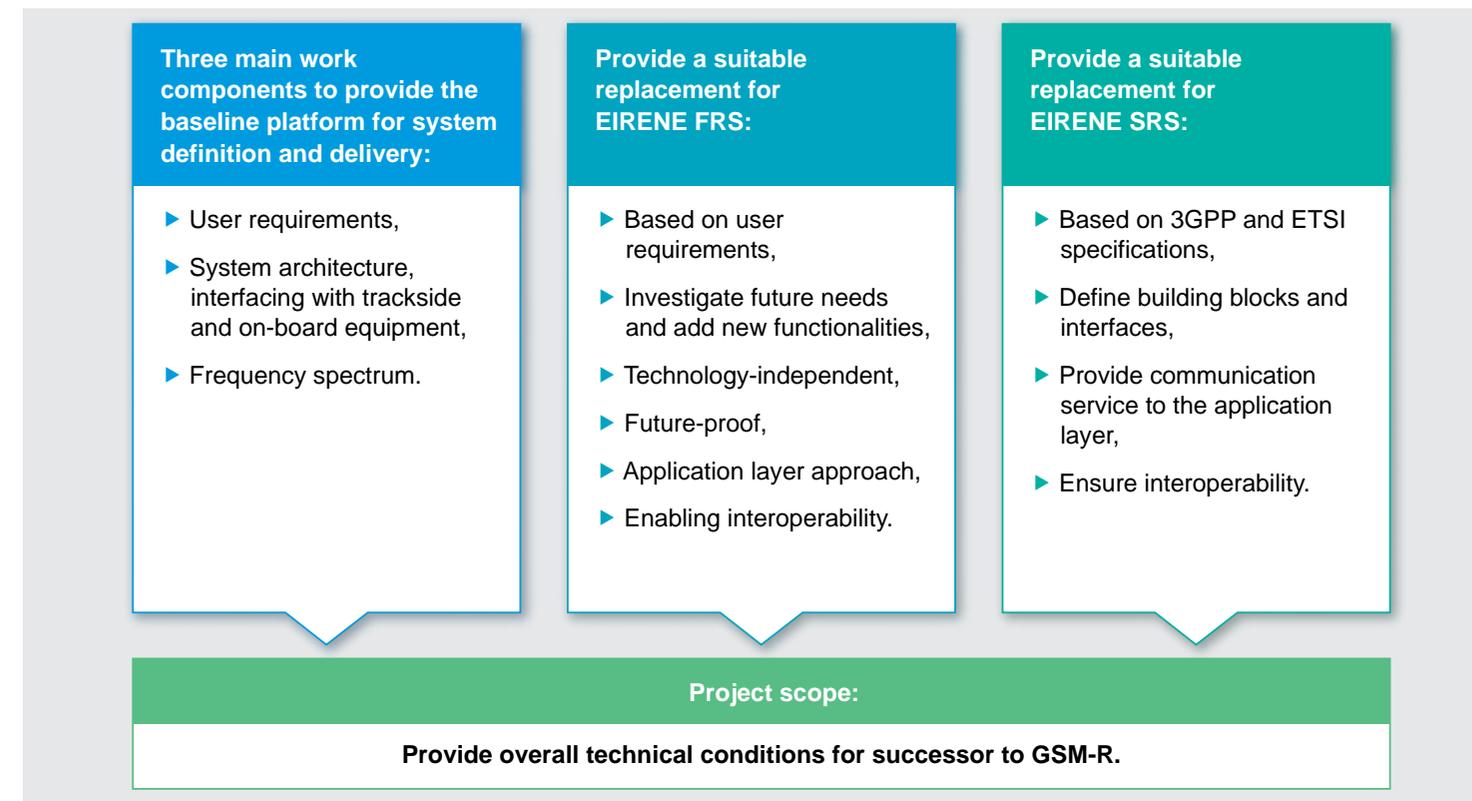
It is imperative that the relevant frequency bands are allocated to support essential FRMCS operating requirements. In the first phase, these need to be in parallel with GSM-R and they need to be part of the second phase, as emerging services for current and future rail operations, such as Automatic Train Operations (ATO) or Train Control and Monitoring Systems (TCMS), start to be developed. It is expected that the range of these new services and applications will increase significantly once users recognise the potential of this new railway system.

**FRMCS** is a key element of the European Commission's Game Changers Strategy for the Railways and is regarded as a **key digitalisation enabler** for the rail system.



### SPECIFICATIONS FOR SIGNALLING AND TELECOMS CONVERGENCE

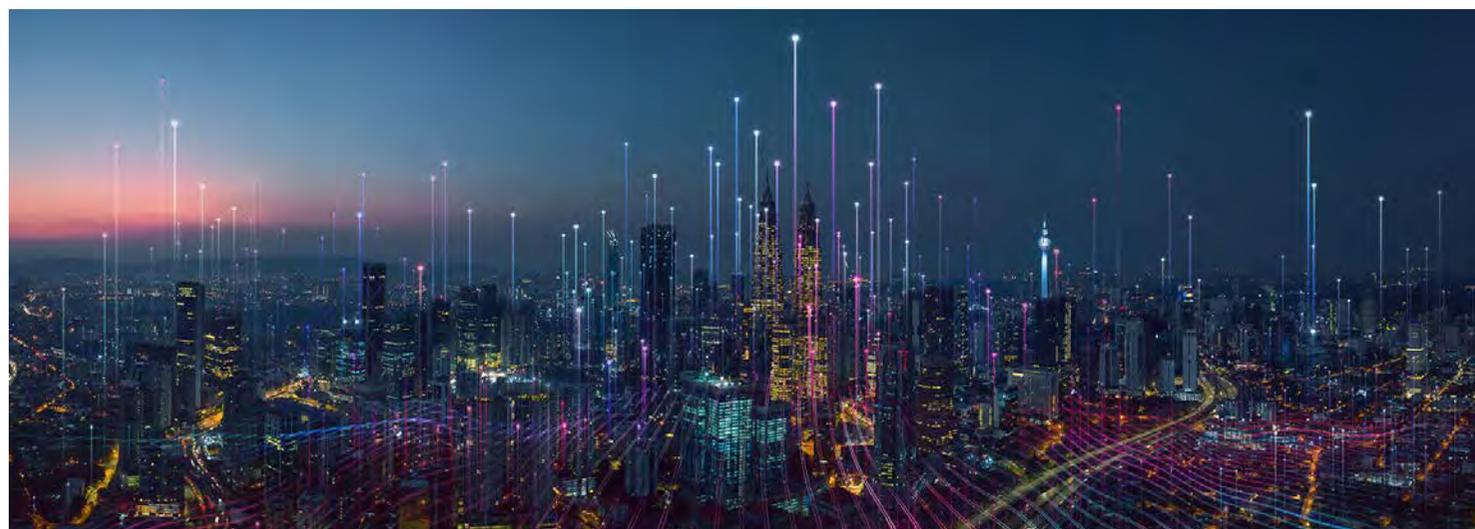
UIC's objective is to provide the overall specifications defining this promising system. The **UIC FRMCS URS** (User Requirements Specification) and the **UIC FRMCS reference architecture** have been developed and transferred to the ETSI TC-RT (Technical Committee for Rail Telecommunications) for further standardisation impact studies.



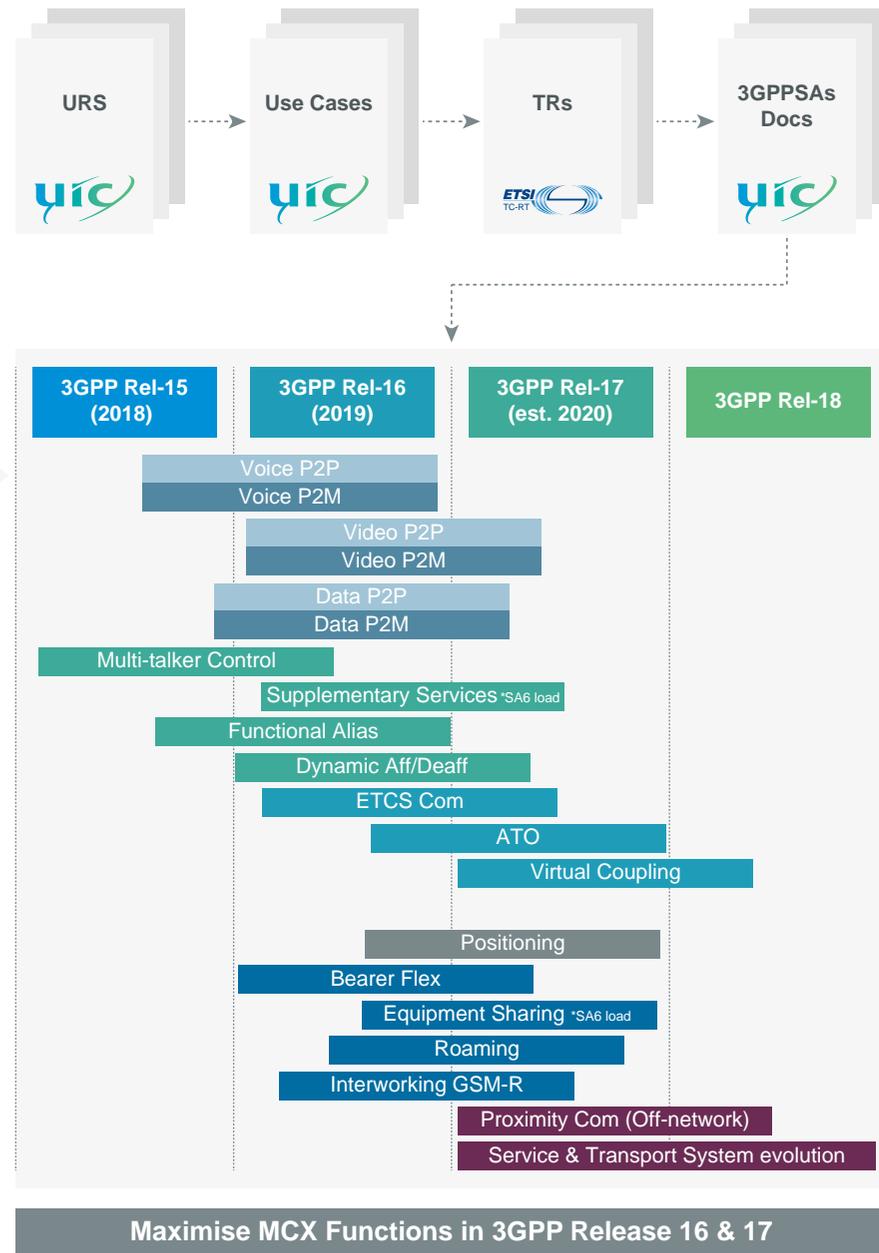
### UIC FRMCS FRS

The UIC FRMCS FRS (Functional Requirements Specification) is currently under review. Work to allocate frequency bandwidth for FRMCS in Europe is ongoing via the CEPT Working Group for Frequency Management (WG FM), which has appointed a specialist taskforce to deliver a set of reports on railway frequency band requirements and conditions for operation in the current frequency environment.

The first such report, currently undergoing public consultation, is very favourable to the railway industry, particularly regarding a recommendation for the allocation of a new spectrum band (10 MHz in the 1900 MHz), in addition to the current 900 MHz band. The European Commission has mandated the CEPT reports, which will serve as technical assessments for the harmonisation of future railway telecom bandwidth in Europe.



### FRMCS 3GPP STANDARDISATION MECHANISM



FRMCS is targeting **3GPP** (third generation public-private partnership) **5G technology**.

On behalf of the railway community, UIC makes user experience available to 3GPP working groups, which conduct analyses to identify gaps in existing 3GPP requirements in order to develop new or additional standardisation requirements.

It is expected that the essential requirements for the future 5G system for railways, **FRMCS version 1**, will be incorporated into **3GPP releases 16 and 17**.

### Migration aspects

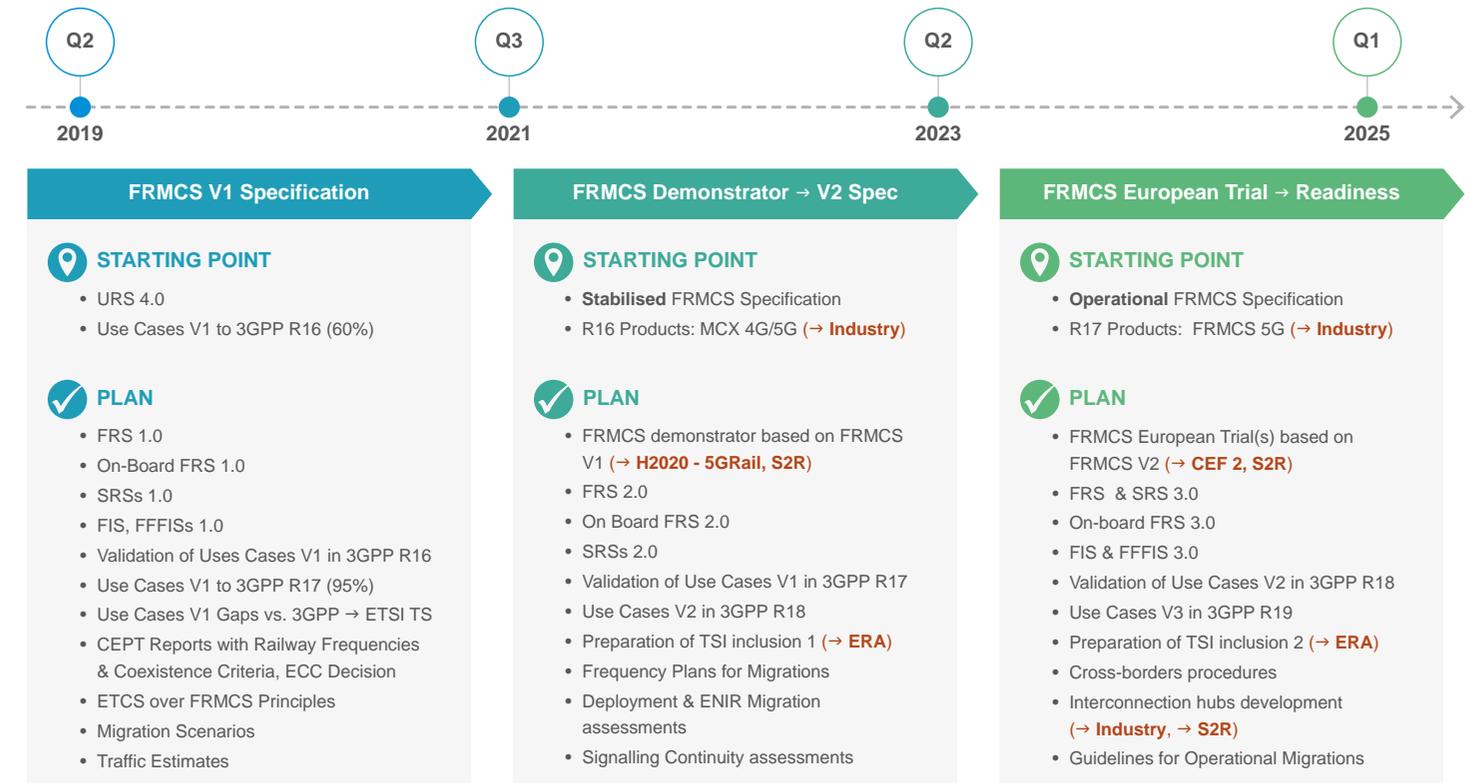
Meanwhile, UIC has also launched the **FRMCS Migration Scenarios (FMS)** project, focusing on telecom on-board architecture (TOBA), signalling operations continuity, migration spectrum needs, and GSM-R/FRMCS co-existence.

This project is starting to show significant results, the most notable being the delivery of the **“UIC Description and evaluation of possible FRMCS migration variants for legacy ETCS and cab radio on-board units”** (TOBA 7515) document, which provided a basis for discussions to determine the best on-board architecture to enable ETCS migration to FRMCS and to introduce the ETCS “bearer independence” concept. A similar process will be initiated for voice cab radio as a second step. A first draft of the **UIC On-Board User Requirements Specification** has recently been finalised and has been sent for consultation.

### Next steps

UIC’s FRMCS planning involves three main stages:

- ▶ Phase 1: Deliver an initial, stable version of the specifications (to be included in the European CCS TSI) and obtain frequencies (end 2021);
- ▶ Phase 2: Prepare and deliver the “FRMCS Demonstrator” on the basis of stable specifications and 3GPP R16/pre-R17 products (end 2022, with Horizon ICT funding from the European Commission (approval pending));
- ▶ Phase 3: Prepare and deliver a European trial of FRMCS on the basis of updated specifications and 3GPP R17 products (2024, most likely with funding from the European Commission), to be **ready for deployment by 2025**.



### SIGNALLING: A FIRST CONCRETE STEP TOWARDS AUTOMATIC TRAIN OPERATIONS

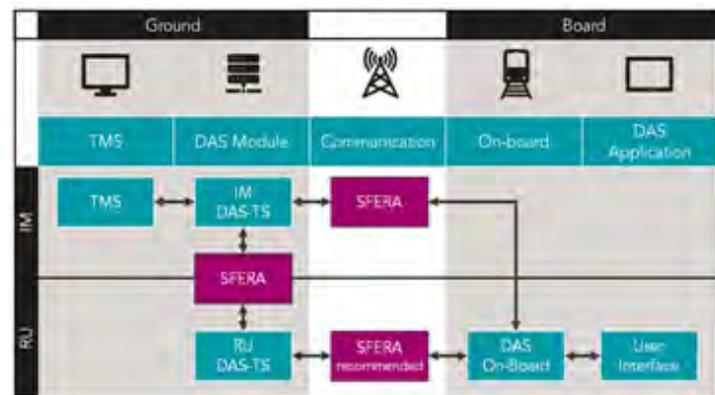
The SFERA UIC initiative (Smart communications For Efficient Rail Activities), actively supported by 12 railway companies in Europe, finalised the very first specification of an interoperable C-DAS (Connected Driver Advisory System).

In essence, SFERA (IRS 90940) can be seen as a simple messaging standard between IMs, RUs and on-board devices, adaptable on all ATP (Automatic Train Protection) systems, dedicated to the transmission of driving advice during the whole journey of a train, i.e. in a cross-border and interoperable context.

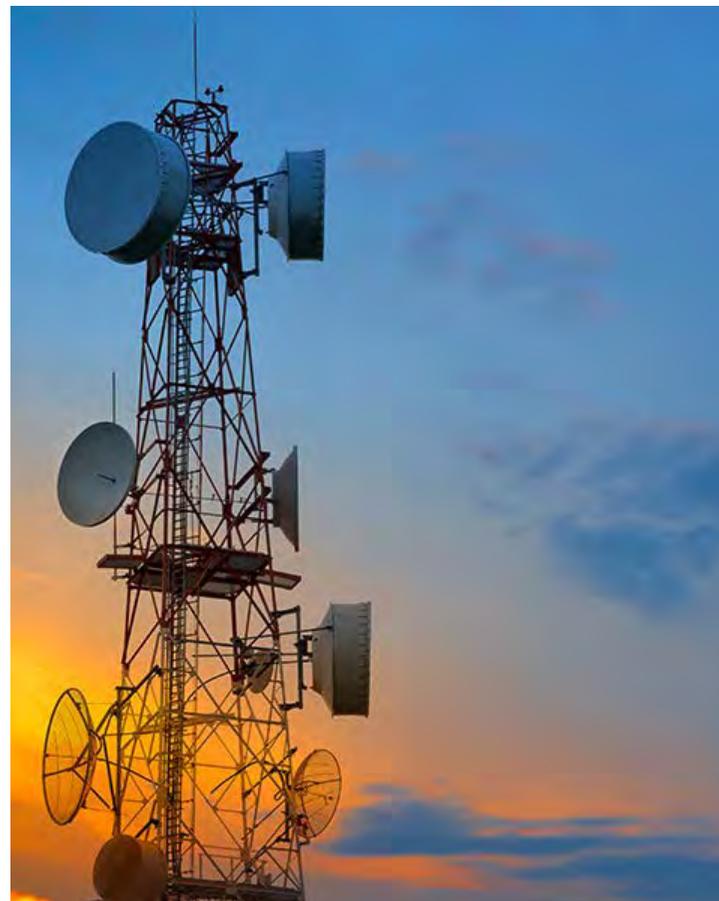
INTEROPERABLE DRIVER ADVICE ACROSS EUROPE



Its high operational advantages aside (improved driving conditions, improved security and optimised energy consumption), SFERA is also paving the way for all forms of ATO, including the future ATO over ETCS, by prefiguring the data stream definition and the various elements that will be used for ATO.



One of the objectives of SFERA was to clearly define a simple, scalable and affordable Driving Advisory System, with a functional logic very similar to the one of CCS subset 126, defining ATO over ETCS. Successfully tested in late 2018 to early 2019 with a Thalys crossing France, Belgium and Netherlands, the SFERA system is now at the pre-industrialisation stage, with the constitution of a User Group where several manufacturers have started to participate, and with the set-up of a technical group for follow-up, maintenance and evolution of the SFERA specification.



## INFRASTRUCTURE, ENERGY, ROLLING STOCK

### INFRASTRUCTURE

Maintenance of the railway system's fixed assets are a vital part of assuring business continuity.

#### Artificial Intelligence

The term 'Artificial Intelligence' (AI) is a suitcase word, not easy to define. AI could be a tool, an assistant, a peer, or even a manager for human beings.

AI must be measured by its capability to enhance the collective intelligence of a human-computer system. This human-computer system must help the railway sector achieve its business objectives and keep the railway system safe and secure.

AI covers various concepts such as massive computing, machine learning, supervised and unsupervised learning, image recognition, convolutional neural networks, deep learning, natural language processing, robotic process automation, etc.

Artificial Intelligence is developing rapidly around the world in many sectors, and in February 2020 the European Commission published both its strategy for data and its White Paper on Artificial Intelligence.

The railway sector will have to implement many use cases, such as sales prediction, voice-based assistants (chatbots) and virtual assistants for passengers, virtual assistants for freight clients, robotics (or collaborative robots, aka 'cobots') in railway stations and in rolling stock maintenance workshops, automation on operations, face recognition for commercial purposes or in the fight against terrorism, automated infrastructure inspections and maintenance activities through robots, predictive maintenance on railway infrastructures, predictive maintenance on rolling stock, etc.

Thus, UIC members will have to create their own strategy, anticipate any impact on employees, management and jobs, and upskill and/or reskill employees and managers for concretely implementing AI.

This is why UIC is committed to helping its members prepare for this breakthrough within their own companies. UIC proposes an initial focus in 2021 on AI-based predictive maintenance, both for infrastructure and rolling stock.

#### Train-Track Interaction (TTI) & Track & Structure (TS) Sectors

The infrastructure sector provides the **physical layer** of the rail system which, together with the other sectors at the RSD, ensures a safe and reliable railway system.

Currently, UIC Infrastructure **coordinates** 16 ongoing working groups organised into the sector's topics: infrastructure, the track and its elements, and the interaction between the different technical subsystems.



The common spirit of the groups is to work together with excellence and expertise to:

- ▶ **share and debate** best practices for the sector (benchmarking) and learn about other experience, e.g. the new IRS 70712-1 on broken rail detection systems, IRS 70727 on track superstructure decision making, and the MILA project, which explains new methodologies for infrastructure lifetime assessment;
- ▶ **collaborate with other UIC departments** to achieve excellence in the sector, e.g. the AT-WOOD project on the use of creosote for sleepers and its alternatives and the AERONOISE project, which analyses innovative measurement systems to characterise the aerodynamic noise of high speed trains. These projects are being developed in collaboration with the Sustainable Development Unit;
- ▶ **go in-deep** on a specific topic, e.g. the EOLE group on the impact of exceptional and overloads on existing infrastructures, and the Y/Q project on the effect of train running instabilities on track;
- ▶ **update** procedures and algorithms, e.g. the STABLETRACK study on track stability and prevention of buckling, and HARMO-TRACK, which aims to harmonise track quality description;

- ▶ **propose** new safety-related operational procedures for IMs and RUs, e.g. both the SAFIRST and CROSS-T projects, which deal with sidewind and crossing effects between trains, respectively;
- ▶ **explore** new opportunities, e.g. the DRONE4RAIL project which analyses the existing methods with drones for bridge inspections.

UIC Infrastructure also **contributes** to the plan to migrate the leaflets into new IRSs. The commitment to finish the process for 2021 has almost been achieved, with 10 IRSs to be published in 2020 and the rest to be migrated in 2021. All of them have been revised and updated by specific groups of experts to provide the whole rail system with up-to-date knowledge of technical recommendations and guidelines.

## ROLLING STOCK AND ENERGY

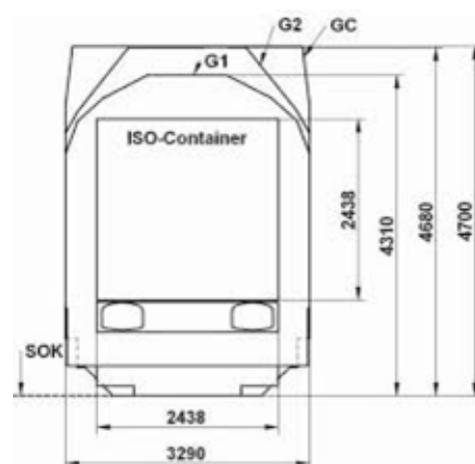
### Rolling stock

The UIC leaflets and IRSs on rolling stock cover all aspects of user requirement definition since the beginning of UIC activities in standardisation.

### Freight and combined transport

UIC has established a codification system for wagons, semi-trailers, containers and swap bodies that simplifies train operation over long distances and on various networks by limiting the use of exceptional transport (IRS 50596-5,

IRS 50596-6 and IRS 50571-4), taking into account constraints due to different gauges used on different networks.



Technical developments in relation to loading units, such as new tank containers for the chemicals industry, are also considered and outlined in the relevant IRSs.

A project to ensure the compatibility of UIC documents with CEN and ISO standards has been launched in cooperation with UIRR and is ongoing. UIC is also working with XRail on a project to increase the mass and length of freight trains in accordance with the objectives of DG MOVE.

In addition, TrainDy, a UIC software program, is now used to simulate braking curves of the trains, avoiding field tests.

### Passenger trains

A train's main electrical functions (doors, traction, air conditioning, etc.) are controlled by its control monitoring system. The UIC coupler described in UIC Leaflet 558 has been used on passenger trains for many years for local, national and cross-border traffic.

Thanks to the new technologies available and considering the increased need for data exchange in operations and maintenance, a specification for a new train network has been developed (IRS 50500). Use of this network for each function of the train will be outlined in a dedicated IRS.



### Braking issues

A working group of braking experts has specified the functions for a Direct Electro-Pneumatic (DEP) braking system. The DEP braking system controls the brake cylinder pressure coming from an air pipe using electrical and/or electronic technology, without the need for a brake pipe (IRS 50541-7).

Several members of the railway community have reported increased braking distances in harsh winter conditions. UIC is carrying out a study, at the request of the European Commission, for mitigating safety risks. A report on tests carried out during 2018-2019 was published in May 2020.



Further field tests were carried out during winter 2019/2020 in cooperation with the Swedish National Safety Authority (NSA) and Swedish Railway Undertakings (RUs), under the technical supervision of UIC/DB Systemtechnik.

Several other projects are ongoing:

- ▶ Exchangeability of K blocks (composite brake blocks with high friction coefficient) to reduce life-cycle costs for braking systems on new wagons equipped with K blocks.
- ▶ Prevention of loss of braking performance on certain types of passenger trains. The aim of this project is to identify the root cause of the problem and to modify the UIC test programme accordingly.
- ▶ Labelling of braking spare parts (pads, blocks, WSPs).

### Rolling gear

Key projects in this area include:

- ▶ CBB/wheel interaction (to prevent cracks on wheels in alpine conditions) in accordance with the conclusions of the JNS report on broken wheels.
- ▶ European standard freight wagon axle (ESFA) for 25 t. Specifications for a new axle shaft have been designed and studies for a new royalty-free patent are in progress. Further mechanical and thermo-mechanical calculations and tests will be carried out in 2020 in cooperation with a wheel provider.

### Passenger transport

The following documents are under review by the relevant experts:

- ▶ Interior outfitting, passenger comfort:
  - UIC Leaflet 845: Technical specification for the supply of elastomer flange connections for intercommunicating gangways.
  - UIC Leaflet 568: Loudspeaker and telephone systems in RIC coaches.
- ▶ Buffers:
  - UIC Leaflet 528-1: Buffers (crash-worthy buffers are to be added to the leaflet, taking into account technology widely used in Europe and China).
  - UIC Leaflet 528-2: Dumper device for automatic coupler (conditions for interchangeability to be identified).

- ▶ Door system:
  - IRS 50105: Describes the operation of train doors by train crew. The working group has prepared a draft.
  - IRS 50111: Defines the door function inside the TCMS of the train. The working group has prepared a draft describing the various operating situations.

### Traction and energy

Over the past years, many IEC standards and UIC documents have been checked by a joint IEC and UIC working group in order to avoid repetition and inconsistencies. This is an example to follow. Documents 70791, 70014 and 70015 are now being modified and published.

Several projects are nearly finished and the corresponding IRSs will be published at the end of 2020 or the beginning of 2021. But there are new items on which to work.

The next main projects will be as follows:

- ▶ Methods of energy storage in order to reduce power consumption.
- ▶ The use of hydrogen in railways operations. This will be joint with IEC.
- ▶ SF6-free switch gear is a potential proposal for OPTIN 2021.

Ongoing projects:

Energy management sector projects focus on the tools used to:

1. Ease the conception and maintenance of catenary systems
  - Evaluation of electromagnetic interference levels (ELITES) between different tractions systems.
  - Evaluation of catenary static quality and catenary-pantograph dynamic performance.
2. Reduce and control power consumption
  - Design of reversible substations
  - Method of energy storage
3. Handle security issues
  - Guidelines on recovery from substations in operation.

IRSs:

- ▶ 70782: Digital control system for substations.
- ▶ 80070: Technical guidelines for the use of grooved contact wires.
- ▶ 70797: Co-ordination of protection between sub-stations and traction units.
- ▶ 60608: Conditions to be complied with for the pantographs of tractive units used in international services.
- ▶ 70010: Energy System Architecture Framework. This IRS reviews the different requirements to be taken into account when electrifying a railway line, depending on the relevant geographical area. For Europe, it deals with the requirements detailed in the TSI.

## FUNDAMENTAL VALUES: ASCERTAIN SAFETY AND SECURITY

### MEASURING AND ENSURING SAFETY

Now more than ever, UIC has an important role to play in helping its members to develop harmonised or compatible measures within specific regions to safeguard the high levels of safety expected from the railways, in combination with greater flexibility and competitiveness. UIC also facilitates the exchange of information and lessons learned between regions in which contact between railways is otherwise limited. Like other forms of cross-border transport, few national rail systems can independently manage safety in their respective countries.

UIC's Safety Platform is an advisory body open to all UIC members. Its core objective is to put in place recommendations and actions to help control, mitigate or eradicate risks and eliminate their underlying causes and effects. In this context, its main added value is the exchange of key safety information between members to enable continuous improvement.

### System Safety Management Group (SSMG)

As the programme of work of the European Union Agency for Railways (ERA) is wide-ranging and is time-critical, given the need to comply with the European Commission's timescales, this group generally meets once a month. The SSMG assists the UIC Safety Platform and experts (CER- and EIM-appointed "speakers") sitting on the working groups in charge of safety issues at ERA, assesses topics, and proposes position papers to be adopted at CER and EIM level.

In addition, the SSMG/CER Safety Support Group regularly organises specific meetings with the EIM, ILGGRI (national safety authorities) and ERA to discuss specific topics and to develop a common understanding of European legislation and activities.

### The Safety Database

UIC publishes reports on safety performance each year. The latest is available at [https://safetydb.uic.org/IMG/pdf/sdb\\_report\\_2019\\_public.pdf](https://safetydb.uic.org/IMG/pdf/sdb_report_2019_public.pdf).

The UIC Safety Database has been collecting data since 2001 and currently covers 27 UIC members in Europe, Asia and the Middle East. The database is managed by UIC's Safety Unit. As well as serving as a depository for statistical information on accidents, it also offers extensive insight into the causes, circumstances and consequences of accidents and aligns with the classifications and definitions used in European regulations.

The purpose of the UIC Safety Database is to collect and distribute information on railway accidents to facilitate the ongoing monitoring of railway safety, benchmarking and analysis of trends and follow-up actions for UIC members. Database reports are compiled and made available in accordance with ERA guidelines and EU directives. The Safety Database contains information on more than 20,000 significant accidents in 20 European countries. It also registers critical events, suicides and suicide attempts.

Users can enter information on railway accidents/incidents, search for information, and compile statistics. The information stored in the database is used to:

- ▶ provide feedback and exchange information promptly;
- ▶ prepare safety cases;
- ▶ compile statistics;
- ▶ determine the railways' performance in relation to other transport modes;
- ▶ prepare risk assessments;
- ▶ facilitate proactive safety management.

### International Rail Safety Network (IRSN)

The IRSN strives to improve railway safety, taking operational processes into account, by exchanging safety experience and facilitating positive and trusting relationships between railway safety experts, and through mutual learning. These efforts culminate in in-depth information on a wide range of safety issues including, inter alia, shunting and measures taken to avoid collisions with buffer stops, radio alerts, campaigns to increase awareness of rules relating to railway tracks, trespassing and level crossings, SPADs, safety culture, and methodologies for the analysis of trespassing and suicide hotspots. The IRSN also benchmarks and conducts surveys to compare safety practices on numerous topics. Recent focal points have included railway accidents due to trespassing, measures taken to prevent on-track collision with animals, and the role and organisation of the safety department in companies, to name but a few.



### THE ISSUE OF LEVEL CROSSINGS

The International Level Crossing Awareness Day (ILCAD) brings together rail industry representatives, road authorities, academics and other stakeholders from around the world. ILCAD aims to raise awareness of the dangers associated with level crossings. Over 40 countries participate in the event each year, and **the annual campaign is typically launched at an international conference hosted by a partner country.** However, due to the Covid-19 pandemic, the next ILCAD launch conference will take place in June 2021 at the National Railway Museum in York, United Kingdom, hosted by Network Rail. **The worldwide campaign for 2020 is ongoing and was marked with a web conference held on 11 June 2020.** Beyond its communication on level crossings, UIC has been leading two technical projects both at European and global level.

**The first was the SAFER-LC project,** which received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 723205. The project, coordinated by UIC, brought together a consortium of 17 partners from 10 countries, including eight EU Member States and two associates, Norway and Turkey. The consortium was composed of railway infrastructure managers, train operators, road unions, research institutes, and technology providers.

The project focused on both technical solutions, such as smart detection systems and advanced infrastructure-to-vehicle communication systems, and human processes to adapt infrastructure design to end-users and enhance the coordination and cooperation between different stakeholders from different transport modes.

After three years of detailed development, the project recently came to an end. The final outcome is a toolbox of 48 different solutions, made freely available online with both practical and scientific aims. The toolbox summarises the most relevant and practical information collected and produced during the project. It provides an integrated overview of the road and rail safety requirements for the relevant actors

of the level crossing safety community (e.g. road and rail infrastructure managers, train operators, engineers, designers, scientists, decision-makers and policy makers) and detailed guidance on the implementation of integrated socio-technical solutions to increase safety at level crossings.

The SAFER-LC toolbox was developed by UIC and will continue to be maintained, updated and improved to make level crossings safer for the benefit of the road and rail community and society.

**The second project led by UIC is the “connected Level Crossing” project.** It was developed as part of the UIC DIGIM (Digital IMPacts on business processes) programme, which is a global, cross-functional programme aimed at leveraging new digital technologies to support business process development, improve railway safety and security, optimise operations, and make better use of existing data.

The aim of the first phase of the project is to optimise closing times at level crossing barriers by considering train speed, in order to minimise waiting times and create safer operating conditions at existing level crossings. The proof of concept was successfully tested and evaluated in Canada. A software application has been developed to provide drivers with real-time information on stations, level crossing closure times and estimated closure duration.

Moreover, another proof of concept is ongoing to safely stop connected trains at level crossings. The system is to be designed in four phases in partnership with Dassault Systems on the 3DXperience platform:

1. Innovation portfolio ideation;
2. Conceptual architecture definition;
3. Subsystem component development;
4. Continuous integration and validation.



## SECURITY

UIC Security Platform develops and disseminates worldwide analysis and recommendations for the protection of persons, information, goods and infrastructure from all forms of threat, ranging from everyday delinquency to terrorist attacks, in order to improve service quality and transport efficiency.

In addition to these guidelines, UIC's Security team has developed the **Rail Security Hub**, a free online platform that provides UIC members with a comprehensive catalogue of solutions to railway security issues (more than 50 security solutions are already available).

Members can also use the tool to interact with each other by leaving comments and ratings and sharing information. The online catalogue is continuously updated with the results of ongoing EU projects and members' contributions at various meetings, workshops and conferences.

The Security department meets the demands of UIC members either directly or by using responses to European projects which are of common interest. The value of developing recognised competence in this area has allowed UIC to become the sector's technical point of reference for the European Commission. This means it is easier to ensure that the interests of the RUs and IMs are better addressed.

UIC projects have issued guidelines that are widely applied in the following areas:

- ▶ **Human factors;**
  - Guidelines for managing suspicious items,
  - Preventive measures against terrorist acts on railway premises;
- ▶ **Station security;**
- ▶ **Rail High Speed Network Security Handbook;**
- ▶ **Security technologies and protective measures for railway assets;**
- ▶ **Crisis management.**

## European projects

This expertise has made it possible to position the UIC Security team as a coordinator or leader for the dissemination of a number of EU-funded research projects:

- ▶ **Terrorism targeting railways;**
  - Key lessons for the railway sector on PROTECTRAIL security architecture,
  - Database of terrorist attack scenarios in the railway sector (EU TETRIS and SHERPA projects);
- ▶ **Graffiti vandalism;**
  - Free online collaborative platform providing valuable resources for the prevention of graffiti in public spaces, including the transport sector (EU Graffolution project);
- ▶ **Suicide and trespassing;**
  - Free online toolbox of innovative solutions to prevent rail suicide and trespassing.



At European level, two EU-funded projects are currently ongoing and, upon completion, will deliver new guidelines and recommendations for the rail sector:

- ▶ The **SHERPA** (Shared and coHerent European Railway Protection Approach) project aims to improve the overall protection level for stations and trains in Europe against terrorist attacks.
- ▶ The **PROACTIVE** (PReparedness against CBRNE threats through cOmmon Approaches between security praCTitioners and the Vulnerable civil society) project will enhance preparedness against and response to CBRNE incidents through better harmonisation of procedures between various categories of practitioners, including rail, and a better understanding of the needs of vulnerable citizen groups.

## TRAINING AND EDUCATION

In addition to the “traditional” training sessions organised at global and regional level, UIC TEDP (Talent & Expertise Development Platform) has started developing online courses on ERTMS.

The online ERTMS training courses have proven to be quite successful, judging by the comments sent by the attendees, as well as the number of people connected and the geographical spread. Figures from 27 July to 25 August 2020 show that 1,793 users worldwide have registered for ERTMS, with a return rate of 62%.

### On global training

#### High speed training

Launched in 2004, the annual UIC Training Seminar on High Speed Systems (THSS) has been attended by more than 300 trainees to date. These training sessions offer an overall insight into the technical, commercial and management aspects of high speed systems. THSS Level I is held over one week in Paris and consists of a series of theoretical sessions and a technical visit. THSS Level II, held over one week in Madrid, aims to provide more in-depth discussion with the help of a specific software tool, “High-Speed Planner 4.0”, which is specially designed to simulate the implementation of a high speed line from A to B.

### On regional training

**Africa:** Two annual training sessions, dedicated to “track maintenance” and “safety and security”, were organised in 2019. Both sessions gathered 25 participants from 11 countries. Given the high rate of satisfaction of the participants, the region has been organising these training sessions every year since 2013. More than 70 participants attended the online “track maintenance” training session organised in June/July 2020.

**Middle East:** A seminar on “reducing infrastructure maintenance costs” was held at the end of 2018. The seminar was attended by over 120 people from amongst UIC's Middle East Region members, and aimed to benchmark the many aspects relating to the main topic.

### THE EMERGENCE OF CYBERSECURITY

With the emergence of fully IP-based networks within the rail system architecture, and with the future introduction of 5G, cybersecurity is fast becoming a key challenge for rail operators. UIC recognised this challenge at an early stage, first developing dedicated **guidelines for cybersecurity in railways** and, more recently, establishing a framework for two important initiatives in this domain:

- ▶ Hosting of a new railway platform fully dedicated to cybersecurity: the **ER-ISAC** (European Railways - Information Sharing and Analysis Centre) global observatory for the railway sector. The purpose of the platform is to share analysis and experience in relation to railway cybersecurity and to facilitate coordination between existing cybersecurity activities.

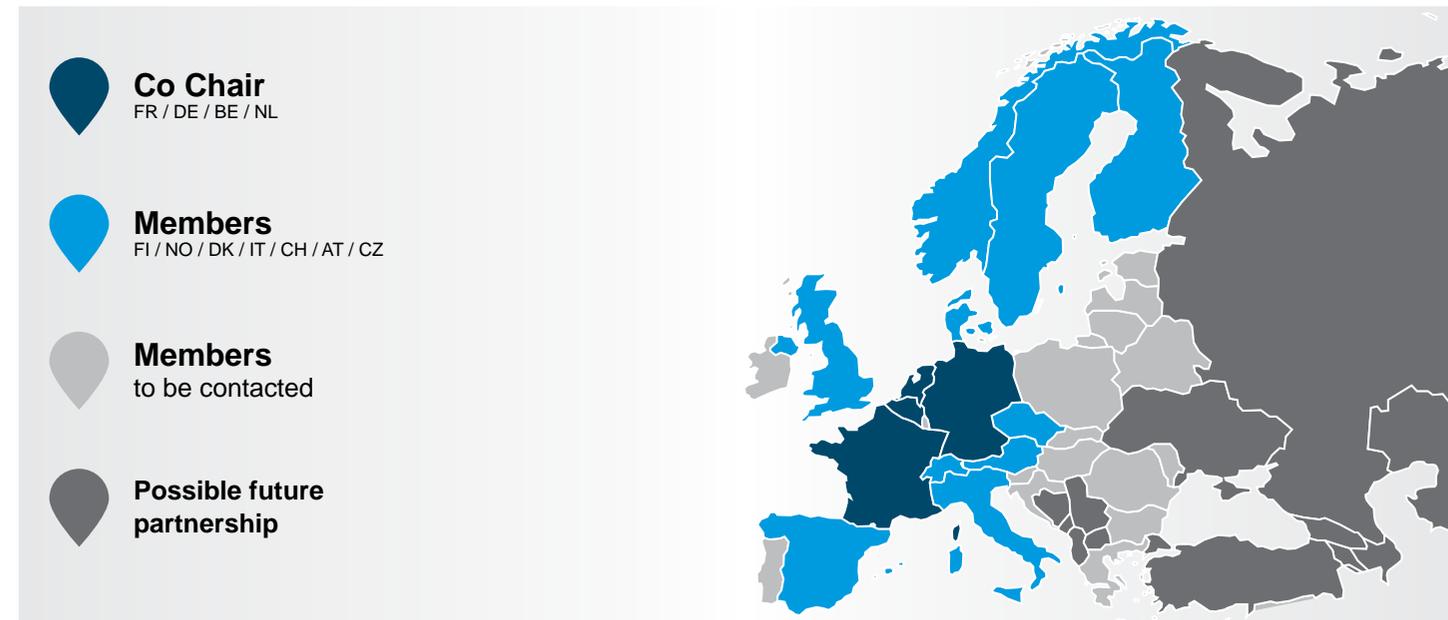
- ▶ Creation of a **Cybersecurity Solutions Working Group**, the objective being to identify and categorise practical solutions to cybersecurity threats in railway-critical networks on the basis of collaboration with renowned industrial companies in this specialised and fast-evolving domain. The group will also assess activities currently being developed in other sectors through participation in key multisectoral telecommunications cybersecurity groups.

**Guidelines developed as part of EU-funded projects with UIC involvement:**

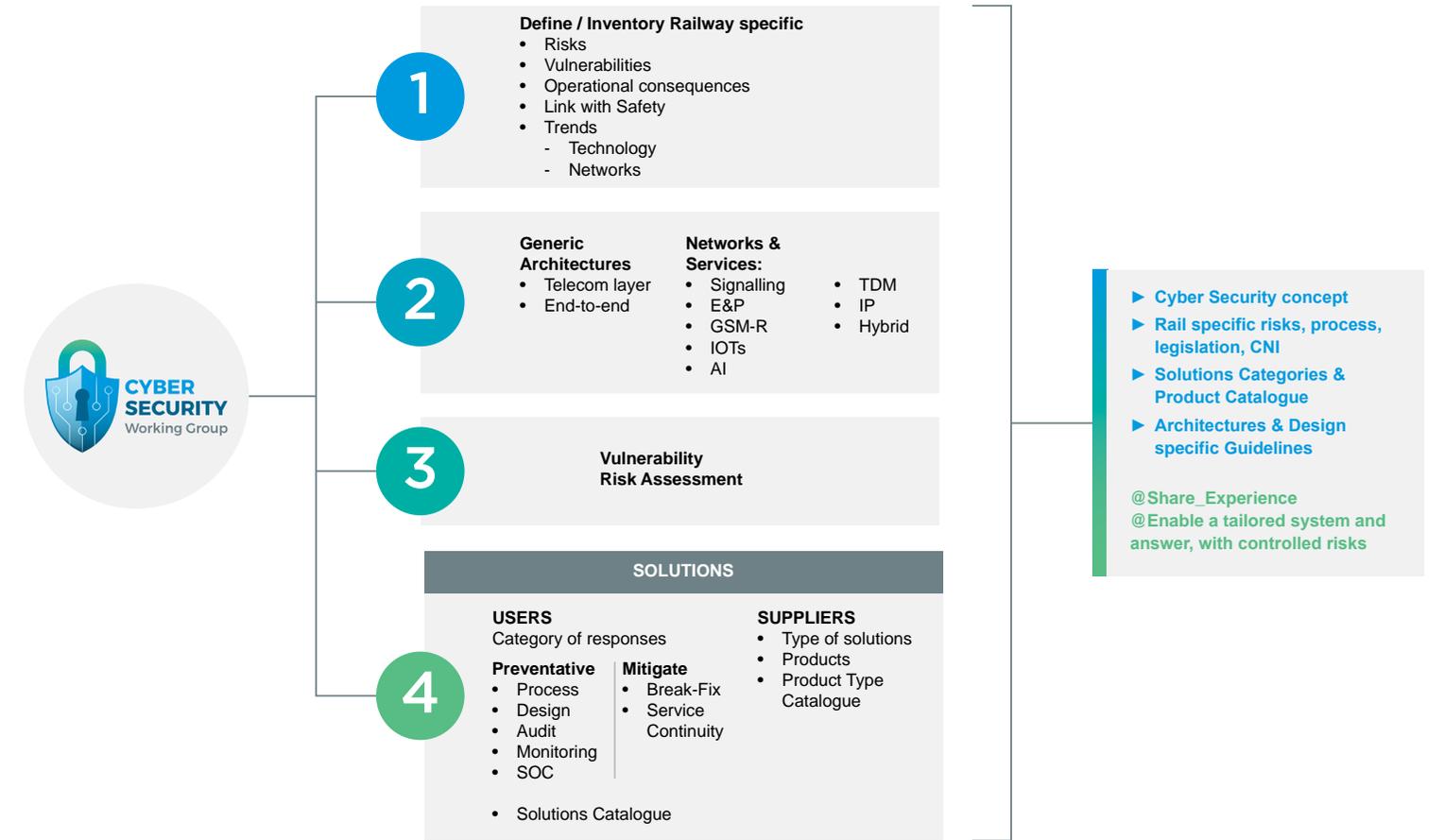
- ▶ Security of railways against electromagnetic attacks (EU SECRET project);
- ▶ Recommendations on cybersecurity of rail signalling and communication systems (EU CYRail project).

### Members per Countries (Oct 2019)

Nearly 52 organisations since foundation on 4<sup>th</sup> of June 2019



### CYBER SECURITY SOLUTIONS PLATFORM PROJECT



## COMPREHENSIVE TOOLS FOR PASSENGERS' BENEFIT

### TICKETING AND DISTRIBUTION SOLUTIONS

Interoperability is a key prerequisite for the further development of the railway market and is also crucial in positioning rail as an attractive alternative to other modes of transport. Consequently, UIC is investing in developing and updating a wide range of standardised technical and commercial solutions. These will enable tickets for international journeys to be distributed in a smooth and cost-effective way, whilst also addressing the railways' regulatory and business requirements. The key features of UIC's ticketing and distribution solutions include:

- ▶ Standardised message exchange for reservations and distribution;
- ▶ Standardised ticket layout and security.
- ▶ Standardised timetables and tariff data
- ▶ Harmonised sales and conditions of carriage

UIC's commercial groups are developing guidelines concerning the Special Conditions of International Carriage (SCIC), a set of travel and tariff conditions for international journeys covering, for example, the transport of children, animals, bikes, etc. in respect of non-reservation tickets, integrated reservation tickets and night trains.

All standards and guidelines are updated each year. UIC is currently working closely with IATA to address the distribution of combined air and rail journeys by airline sales channels, covering the entire process chain: shopping, booking, payment, fulfilment, aftersales, settlement and management information.

In addition, UIC is working with UITP on an integrated ticketing framework between railways and public transport to facilitate the development of integrated digital mobility solutions and an integrated digital ecosystem.

### MERITS

MERITS (Multiple East-West Railways Integrated Timetable Storage) is a B2B solution designed for international railway distribution and consists of a centralised database, owned by UIC, containing timetable data for most European countries and a number of non-European countries (Russia, Turkey and Belarus) and updated on a regular basis. MERITS contains data on timetables, services and facilities, coaches and seats, stations, tariffs, etc., and its format aligns with the EDIFACT standards defined in UIC Leaflet 916-1 (soon to be migrated to an IRS) and with ERA (European Union Agency for Railways) Technical Document B.4. MERITS is designed to give businesses rapid access to the data required for timetable production. The tool facilitates operations and journey planning and booking and is a significant contributor to interoperability at European level.

### OSDM

OSDM (Open Sales and Distribution Model) is a B2B exchange protocol based on a new UIC IRS 90918-10 which harmonises tariff terms and conditions and defines an API WebService.

It supports international rail distribution by merging two former tariff concepts (Non-Reservation Tickets and Integrated Reservation Tickets) into five new fare definitions (business, fully flex, semi-flex, non-flex and promo) and their combination possibilities (separate contracts, combined or clustered). Thus, it enables the distribution of two or more tickets in a single transport contract (through-ticketing). OSDM is developed and maintained with Full Service Model (FSM) Ticket vendor organisations and is retrospectively compatible with IRS 90918-1 messaging protocols, or any other bilateral protocol.

### ETCD

ETCD (E-Ticket Control Database) is a Software as a Service solution based on IRS 90918-4 specifications for the exchange of ticket control and annotation data for non-reservation tickets (NRT). It unlocks new capabilities for offline sales systems, such as security-in-system capability, real-time access and management of the ticket life cycle (control, usage), and issuing of electronic annotation in real-time (cancellation, validity extension, upgrades, etc.).

### INTERCITY AND HIGH-SPEED RAIL SOLUTIONS

UIC works continuously to support the development and operation of high-speed rail, addressing its many aspects, such as infrastructure, rolling stock, operations, socioeconomics, financing, etc. by providing both a platform for sharing expertise and knowledge and technical standards for existing and future systems.

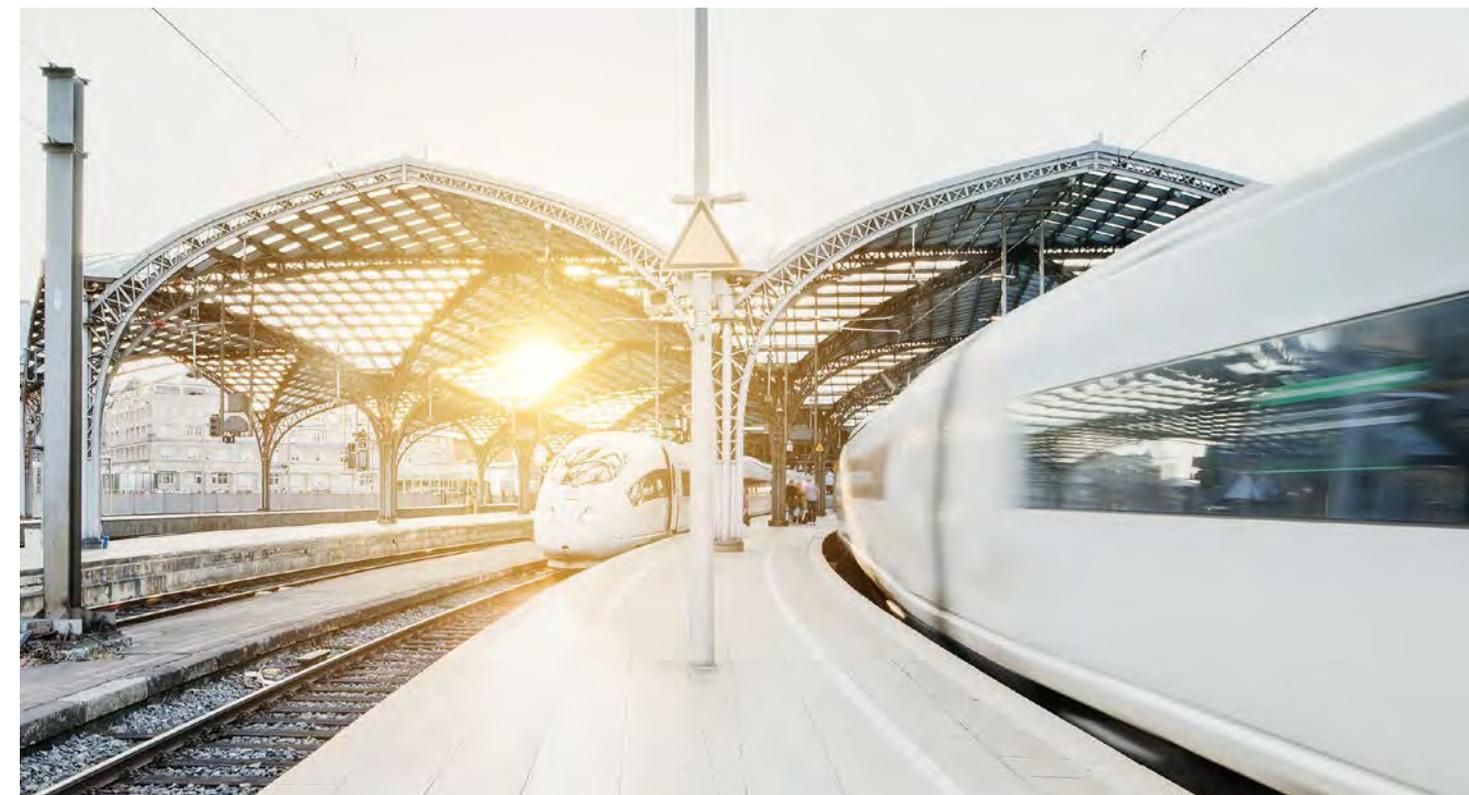
UIC is working with a multitude of stakeholders, including universities, railway companies and railway consultants, to develop new solutions with global reach for

the railway community, for publication in the next two to three years.

These will include the following guidelines **IRS 6068x - Design of a new high speed railway** series, a step-by-step guide covering infrastructure, rolling stock, energy, communications, etc. Focusing on operations, the **HSR operation in extreme climate conditions** series is a set of reports addressing the challenges of operating high speed rail in extreme weather conditions, such as high temperatures, snow, etc.

### IRS 6067X SERIES - IMPLEMENTATION OF A HIGH SPEED RAILWAY

Designing, constructing and operating new HSR systems is a complex task with many influences, stakeholders, requirements and objectives. This series of six IRSs offers guidelines for stakeholders and decision-makers during the five phases of implementation of such systems, i.e. emerging phase, feasibility phase, design phase, construction phase and operation phase.



## PASSENGER ACCESSIBILITY SOLUTIONS

The Passenger Accessibility Solutions Support and Action Group of Experts (PASSAGE) is the reference platform addressing PRM accessibility issues in European railways. Its main objectives are:

- ▶ benchmarking the current situation and existing services for PRM accessibility;
- ▶ creating a forum for discussion and exchange of best practices among member companies;
- ▶ developing software tools for PRM travel booking and assistance;
- ▶ maintaining cooperation with European bodies (CIT, CER, etc.) regarding PRM regulations.

## SOLUTIONS FOR STATIONS AND INTERMODAL HUBS

Stations are a key element of passenger transport: for customers (passengers, commuters, passers-by), the station is the single gateway to the rail system; for railway operators, it plays a major role in the overall passenger experience. Aside from their strategic value to the railways, stations are an essential element of urban development, particularly in the context of urban transformation and the emergence of personal mobility and MaaS. UIC is therefore focusing its efforts on providing solutions and guidelines for:

- ▶ new mobility and intermodality;
- ▶ station management;
- ▶ urban development around stations;
- ▶ sustainability.

In the next few years, UIC plans to publish guidelines and reports on transit-oriented development (TOD), sustainability models for stations, management of small stations, etc. as a part of a project focusing on the long-term development of railway stations.

## IRS 10180

IRS 10180 – Classification of rail passenger stations provides a methodology for the classification of railway stations in accordance with homogenous, quantifiable and objective criteria, such as number of passengers and trains per day, number of platforms, size, and intermodality, the aim being to help station managers to improve station management and organisation in terms of minimum levels of service, etc.

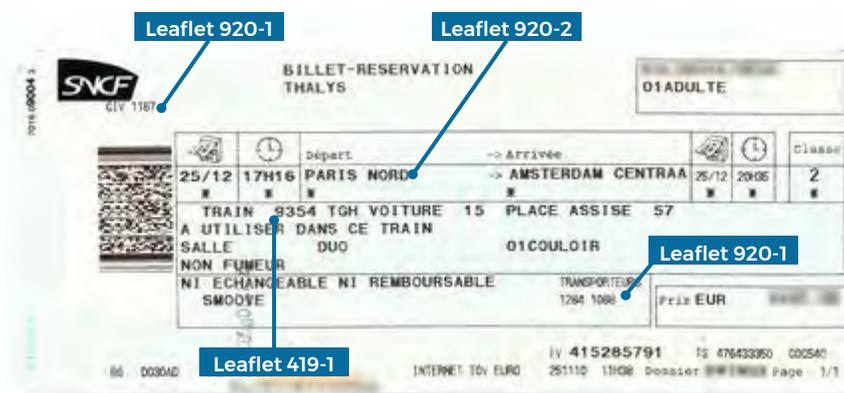
## IRS 10181

IRS 10181 – User information in railway stations describes the principles of wayfinding systems and provides instructions on how to put such systems into operation

in order to inform and direct local and international passengers for a better customer experience. It defines the typography, digital information, and pictograms and translations for commonly used messages and passenger information.

## UIC LEAFLET 140

UIC Leaflet 140 – Accessibility to stations in Europe (soon to be migrated to an IRS) defines a common framework governing the design of European stations to ensure consistency in the measures taken to facilitate access for people with reduced mobility (PRM).



## FACILITATING RAIL FREIGHT DEVELOPMENT

### ORGANISING THE LOGISTICS CHAIN

In the “30 by 2030” White Paper, European railway companies make it clear that the current challenge they face in terms of modal share is linked to three main factors:

- ▶ an expected change in goods structure;
- ▶ general logistical trends;
- ▶ strong innovation in the road sector.

Customer demands placed on transport providers are increasing, and it goes without saying that rail needs to be fully integrated in the overall logistics chain. However, this consideration is not limited to Europe. Rail freight must position itself as an international logistics partner in order to be able to grow and retain market share.

In this context, digital solutions will help to improve processes and interoperability as a whole. The growth of rail freight – more so than passenger services – is heavily reliant on international services for which operational fluidity (business continuity) is key. With this in mind, the working bodies and projects led by the UIC Freight Forum develop and keep up to date technical solutions that will bring about a “drive-through philosophy”, without which there is no sustainable future for the railway sector.



### STANDARDS FOR FREIGHT OPERATIONS

The scope of the UIC Freight Forum’s activities encompasses the following areas:

- ▶ safe rail operations, including cargo loading;
- ▶ codification in combined transport to support agile operations;
- ▶ continued safe carriage of dangerous goods;
- ▶ safe and secure wagon handling and exchange;
- ▶ data exchange.

The technical solutions developed for each of these areas take account of a wide range of core practices developed as part of the foundations of railway operations, but also respond to technological developments and evolving work practices in the railway sector. UIC provides three types of solution for rail freight:

- ▶ Guidelines;
- ▶ Leaflets and IRSs;
- ▶ Agreements.



### Guidelines

Several issues are addressed by the sector in the form of guidelines describing industry best practices for dealing with the challenges inherent in interoperability. Two key examples are the Loading Guidelines and the Guide for International Contingency Management.

Developed by UIC, the **Loading Guidelines** are a set of nationally and internationally valid regulations for loading goods in railway transport. They describe rules and stipulations for the usage and capacity utilisation of wagons and for the dimensions of the load. The UIC Loading Guidelines constitute an extremely valuable intangible asset, shared between all stakeholders. All such stakeholders must know and comply with the existing loading rules and directives, implement them correctly and use the appropriate equipment.

The experts involved in the dedicated UIC study group work to ensure that the guidelines are up to date and compliant with evolving legislation. The **Handbook for International Contingency Management** outlines harmonised international contingency measures to be applied in the event of major disruption on the European railway network. The handbook describes how railway undertakings should cooperate with each other and with infrastructure managers.

It is closely aligned with the Contingency Management Handbook of Infrastructure Managers. The handbook also outlines scenarios for pooling of resources between undertakings in order to effectively manage major incidents, and the regulatory mitigation measures that are needed to make this possible. Such measures would allow the rail sector to maximise the use of infrastructure capacity during a major international disruption.

### Leaflets and IRSs: tools to enable smooth, safe transport and trade

#### Dangerous goods

The transport of dangerous goods (TDG) is subject to specific regulatory measures. TDG safety on the railways is based on general railway operations safety. This area is managed by UIC in close consultation with its members and in cooperation with other stakeholders. Rules and regulations are updated on an ongoing basis in order to take account of experience and new types of goods arriving on the market. The harmonisation of rules between various modes of transport is increasingly important, with international trade and multimodal and intermodal transport all growing. Work to amend the various regulatory texts takes place within intergovernmental, European and international bodies.

UIC participates in this work with the status of a non-governmental organisation, allowing it to make observations and proposals. The two key documents in this context are IRS 40471-3 on consignment inspections and IRS 20201 on emergency planning for marshalling yards. The freight experts of the **Combined Transport Group** collaborate closely with the SET 3 experts of the Rail System Forum to continuously update all combined transport IRSs. These documents – IRS 50592, IRS 50596-5, IRS 50596-6 and IRS 50596-7 – provide the combined transport sector with the codification of lines, units and wagons that it needs to run trains without submitting an application for an exceptional consignment.

#### Hermes messages

The train composition message (TCM) is a key component for efficient train operations and is necessary for collecting wagon tracing/tracking and mileage data. In multilateral rail freight traffic, data on train movement, wagons and loading units must be provided to the RUs involved in the transport operation as a basis for efficient and economical operation. UIC Leaflet 404-2 (soon to be migrated to an IRS) provides a compendium of the information to be exchanged by railway undertakings when carrying out rail freight transport. Work on the leaflet is carried out by the GRU group of experts, who are currently working to ensure that messages are compliant with the TAF TSI.

### Agreements

UIC has developed a number of sector agreements governing wagon exchange at the request of its members.

The **Agreement on Freight Train Transfer Inspections** (ATTI) group is a UIC special group whose membership comprises both UIC and non-UIC railway undertakings. The ATTI has developed a set of rules to simplify wagon transfer between parties whilst ensuring the highest possible levels of safety. Since its creation in June 2014, the initial group of 44 participants has grown to 130 members, and a quality monitoring system has been put in place. The first pilot database of quality indicators for

ATTI members went live on 1 January 2018. Items monitored include wagon technical conditions as per Appendix 9 of the GCU, train formation and adherence to schedule (from 2019), and dangerous goods (from 2019). **General Contract of Use (GCU)** In 2006, following the liberalisation of the rail freight market, UIC, UIP and ERFA established the General Contract of Use for Wagons. The GCU is a single, multilateral contract between wagon operators and owners, specifying the

parties' mutual rights and obligations in order to facilitate cross-border activities. Since its inception, the GCU has grown to an impressive network of more than 600 signatories across 20 countries, with more than 600,000 wagons currently declared in the GCU wagon database. The GCU is an excellent example of the simple but effective solutions developed by the sector to enhance interoperability.



## SOLUTIONS TO SUPPORT CARBON NEUTRALITY AND OTHER ENVIRONMENTAL ISSUES

**Railways offer the most carbon efficient mode of mass transport for both passengers and freight. The transport sector accounts for more than a quarter of global greenhouse gas emissions, but rail represents only 3% of transport energy use. In order to urgently address the climate crisis, rail must be ready to take a much larger market share and also maintain its lead as sustainable travel by decarbonising operations.**

UIC is seeking to increase awareness among transport users of the consequences of their travel choices and to support decision-making on how to facilitate sustainable choices.

### REDUCING ENERGY CONSUMPTION

As energy consumption means costs for railway companies and has a direct impact on greenhouse gas emissions, UIC is developing IRSs and proposing workshops to encourage the sharing of best practices to boost energy efficiency for rolling stock, operations and infrastructure.

#### Traction Energy Settlement and Data Exchange: IRS 90930

In Europe, trains are increasingly equipped with Energy Metering Systems (EMS) that collect data on the traction units' energy consumption and location. The resulting data to be exchanged needed to be standardised for cross-border traffic, to avoid a situation whereby different metering systems were installed on the basis of national specifications. UIC Leaflet 930, "Exchange of data for cross-border railway energy settlement", 2009, was produced as an output of the first UIC project on this topic.

IRS 90930 updates UIC Leaflet 930 to take into account new technical specifications for interoperability (TSIs) adopted by the European Commission in 2014 (1301 and 1302),

referring to EN 50463 standard. IRS 90930 provides a standard model for data exchange regarding traction energy settlement. It defines the most effective procedure for processing energy consumption data, from on-board meters to the calculation of actual energy consumption and then billing. Application of the standard is a further step towards harmonised cross-border operations because RUs will experience facilitated and more accurate traction energy settlement, as cross-border traffic also means multiple energy suppliers. This allows both IMs and RUs to ease the process and get closer to automated data exchange.

#### Working with the International Energy Agency (IEA) for promoting rail

The International Energy Agency (IEA) and UIC are working together to create synergies by gathering information for databases focusing on the railway sector in order to support the IEA's development framework for energy-related transport trends. This collaboration has already resulted in significant output:

- ▶ Railway handbooks providing an extensive worldwide statistical overview of energy efficiency and emissions in the railway sector in comparison with other modes;
- ▶ The "Future of Rail" report, which assesses the status of railways worldwide and illustrates what the future might look like in the context of a "high rail scenario";
- ▶ The "Tracking Clean Energy Progress" report, which assesses each transport mode's progress toward decarbonisation.



### SUSTAINABLE FINANCE: SDG RAIL INDEX

The SDG RAIL INDEX (previously known as eco-scoring), aims to facilitate easier access to green bonds and sustainable finance instruments for railway undertakings and infrastructure managers.

It is intended to provide UIC members with a brand-new rating system and will serve as an online reporting tool based on 7 key United Nations Sustainable Development Goals (UN SDGs), assessing each railway undertaking's or infrastructure manager's contribution to the SDGs. It collates both quantitative and qualitative data across 24 key performance indicators for which data is either collected in UIC databases or provided by companies. SDGs rated as priority areas for action in Railways have a higher weighting in scoring and scores will be generated both against industry benchmarks as well as against the companies previous performance, rewarding companies that are improving.

The tool will be web-based and will be made accessible to UIC members via a secure portal. Several members have already submitted some data to test out the scoring methodology and the first version of the reporting tool is in development. The following are key features being developed in the tool, inter alia:

- ▶ Secure company login;
- ▶ 7 reporting forms for each of the SDGs;

- ▶ % Data completed;
- ▶ The company's performance over the previous three years;
- ▶ Ecoscoring rating A-D Beginner to Leader;
- ▶ A sector rating distribution, allowing recipients to understand how their companies perform against the sector average;
- ▶ The company's key strengths and weaknesses in terms of performance.

### SUSTAINABLE LAND MANAGEMENT AND PROTECTION OF BIODIVERSITY

Railways occupy a large network of land that connect people but also can connect wildlife and natural habitats as green corridors. In some instances railways can be a barrier to the movement of animals and animals and trees can cause significant operational safety risk. For rail to be the backbone of a sustainable mobility system, it must operate and maintain its land sustainably as well. We are working with our members to step up to this challenge and help halt and reverse the loss of global biodiversity through innovative ways of managing lineside vegetation and land.

UIC supports all its members' efforts to increase the effectiveness, sustainability and profitability of rail transport for the benefit of customers and society as a whole, as well as the environment.

#### Vegetation management

IRS 70723 is the result of collaboration between the Track Expert Group within the Rail System department and the Sustainable Land Use group within the Fundamental Values department. It assists railway infrastructure management and personnel in addressing the issue of vegetation control, including tree risk control on the railways, providing a single source of information and helping infrastructure managers to identify affordable and effective solutions for railway vegetation management.

**TRISTRAM** The Transition Strategy on Vegetation Management (TRISTRAM) project facilitates a transition from a single, method-based concept to an integrated, flexible, multimethod-based approach to vegetation management.

Multimethod vegetation control can be used to create a more productive and attractive landscape resource. The main objectives of this project are to minimise unwanted chemical deposits and reduce environmental impact and risks to human health.

**REVERSE** As the railways can contribute to biodiversity protection in various respects, the rEvERsE project, managed by UIC, aims to identify the ecological effects of the railways on wildlife and habitats, while also highlighting the positive impact that railways can have if managed in a biodiversity-sensitive way.

### MINIMISING THE HEALTH BURDEN RESULTING FROM RAILWAY NOISE AND VIBRATIONS

Noise and vibration remains an important issue for the European rail sector. This is due to growing concern for health, combined with increased traffic and plans for new and upgraded networks. This in turn results in complaints from lineside inhabitants about noise and vibration. In the current context, there is an urgent need to reduce railway noise emissions and noise exposure and to assess the health impact of railway noise.

The UIC Network Noise and Vibrations (NNV) promotes effective management of railway noise and vibration in the context of sustainability. It provides a technical lead on transport noise and vibration policy, in particular with regard to evaluation, review and guidance on new noise and vibration legislative initiatives and ideas and incentives in respect of mitigation policy, such as noise-differentiated track access charges, prohibition of cast-iron brake blocks, retrofitting with composite brake blocks, rail dampers, etc.



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### A REFERENCE FRAMEWORK FOR FINANCIAL TRANSACTIONS BETWEEN RAILWAYS

All the major European networks – DB, SNCF, FS, RENFE, DSB, ÖBB, PKP, etc. – operate in accordance with the UIC reference framework. More than 50 networks are members of the BCC, with payments between members amounting to three billion euros in 2019.

All IRSs/leaflets are in line with accounting, legal and fiscal obligations and commercial and IT requirements and are compliant with European regulations and the entry into force of liberalisation and competition rules. They are planned and reviewed so that they can be adapted to commercial, legal and European developments. The leaflets are available to all stakeholders on the basis of special agreements and can be adapted in some cases while respecting the interests of each party (e.g. Eurail business).

This reference framework offers three key benefits:

#### Significant IT processing cost savings

Harmonisation enables RUs in particular to process all of their European partners, as well as a number of OSJD members, using a single data format. The same structure is used for billing and settlement files for all RUs involved, with a single data format rather than thirty or so different formats.

#### Limitation of legal disputes by clarifying functioning, particularly for special cases

The IRSs/leaflets simplify, explain, observe and adapt the relevant provisions (of CIT or the COTIF, in particular) so that they can be applied more easily. Specific issues regarding international accounting processes identified by the various networks are resolved by consensus within the working groups. The solutions identified are incorporated into the IRSs/leaflets.

#### A quality, control-based approach

In terms of information quality and completeness, the leaflets propose actions that serve to prevent errors and malpractice, as well as corrective actions and data control methods. They also offer a procedure for quality testing of accounting files before application of any changes to distribution, reservation or accounting IR systems. An audit group was created in 1999 for the passenger transport domain, its role being to verify in situ that the rules are applied correctly, but also to ensure that they remain relevant.

#### International passenger transport leaflets (RCF 1 working group)

IRS 30301 contains accountancy regulations for international passenger transport. It provides rules for the creation of the accounts themselves, as well as more general rules developed and fine-tuned by experts in back office operations from some ten RUs within the RCF 1 working group over the past 30 years, in accordance with legislative, technical, economic and commercial developments.

UIC Leaflet 306 (migration to IRS planned in 2021) is managed by the RCF 1 working group and sets out the principles and framework agreements governing activities between passenger rail transport stakeholders regarding accounting and financial distribution of international transport and related services. In particular, it sets out the legal and financial responsibilities in relation to passenger transport activities.

UIC Leaflet 361 (migration to IRS planned in 2020), managed by the RCF 1 working group, sets out rules for safeguarding international passenger transport revenue. The objective is to safeguard revenue by reducing the risk of internal and external fraud and protect RUs and passengers from illicit or illegal activities. The leaflet covers passenger transport, information technology, internal audit and finance for RUs and associated partners involved in distribution channels (e.g. Eurail Group) or other related services (passenger ticket printing, storage, distribution, on-board checks, back office, IT services, etc.).

### International freight transport leaflets (RCF 2 working group)

IRS 30304, due to be published in May 2020, contains the accountancy and allocation regulations between carriers applicable to international freight transport, managed by the RCF 2 working group of back office experts.

The purpose of the leaflet is to set uniform rules to enable freight transport invoicing and business monitoring procedures applied by and for carriers in the context of liberalisation.

### International transport leaflets – finance (RCF 3 working group)

UIC Leaflet 311 lays down rules for financial relations between railway undertakings. The leaflet, managed by the RCF 3 working group of financial experts, sets out the general procedures applicable to financial relations between UIC members. Other RUs may also adhere to the procedures on the basis of special agreements. The purpose of the leaflet is to harmonise the accounting and financial processes regulating mutual services in accordance with the COTIF, European directives, UIC procedures and BCC (Brussels Clearing Centre, responsible for clearing monthly financial flows between RUs) procedures.



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