



EULYNX

Annual report 2018

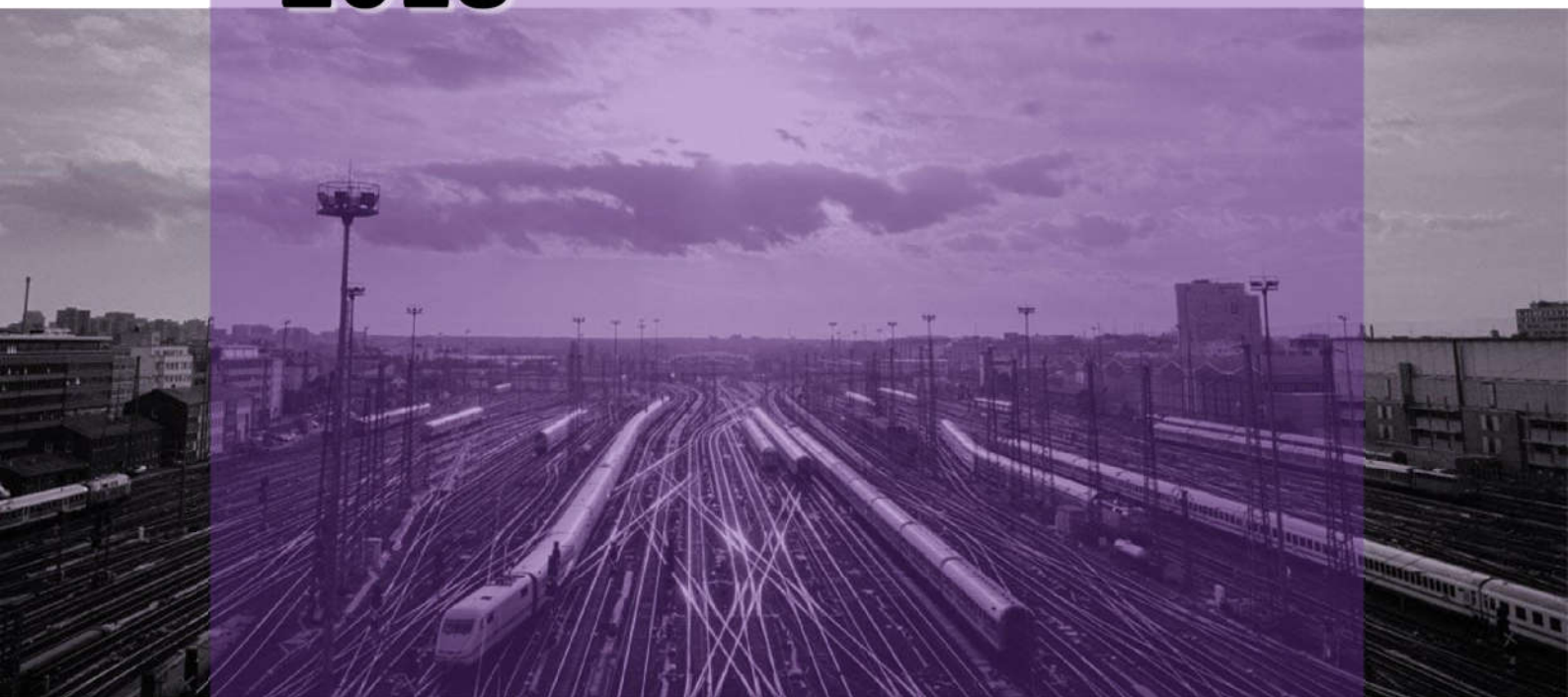




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Foreword



Significant progress has been made on the field of standardisation of signalling in European context. Many stakeholders will profit from the modular open signalling system that is evolving. EULYNX' present baseline has such a stability that IM's are able to take their responsibility in further realising their digital signalling strategy. Enlarging the scale of application will make railways more profitable and sustainable. The challenge is to accelerate in replacing their legacy signalling systems by state-of-the-art new technology with modern means of communication.

European IM's meet each other not only in the EULYNX cooperation, but also related to ERTMS. The combination of the always connected train and digital infrastructure paves the way for implementation of other game changers, like ATO, Hybrid Level 3 and FRMCS. This has brought the initiatives together in setting up a Reference CCS Architecture (RCA), contributing also to large national programs of many involved partners. And this makes it easier to work together with different European railway bodies and European initiatives. The industry will see advantages in a larger market volume of standard products.

The already reached results and planned progress in strategy, tendering and demonstrations is a solid basis for further success in 2019. The following reports will give further insight in the results reached.

Paul Hendriks, Chairman of the EULYNX Steering Committee

Introduction

The EULYNX consortium is completing the goal to reach standardised technical interfaces, leading to lower life cycle costs, more commercial off the shelf products and increased availability of the infrastructure for the member IMs.

As of 2018, EULYNX has become transformed from a project to a standing organisation in the form of a consortium. The consortium phase started with strong focus on the modelling work, deepening the existing models from Baseline set 2 with state machine models. The fundamental architectural specifications have been thoroughly discussed and refined. The year ended with successful publication of Baseline set 3, now covering majority of the EULYNX architecture interfaces and components.

Communication activities were strengthened, highlighted by the successful demonstration at InnoTrans 2018, with strong support from Deutsche Bahn and ProRail. As result, a lot of interest has been generated from railways and suppliers from all over the world.

EULYNX roll out has become tangible, implementations at EULYNX members are increasing and gaining visibility. Deutsche Bahn is preparing for EULYNX rollout with the implementation of the pre-series projects. BaneNor is actively working on the nationwide ETCS rollout with Siemens and Thales and has significantly contributed to the visibility and publicity of EULYNX. ProRail has received valuable feedback from the proof of concept, preparing the path toward EULYNX projects in the Netherlands. Input from first developments and implementations ensures that the interface specifications are continually updated to evolving technology.

Cooperation activities with the ERTMS Users Group were started based on a Memorandum of Understanding. As result, a white paper with a vision on common development of the future Reference CCS Architecture (RCA) has been prepared, providing a start for the RCA related activities. EULYNX and RCA form a single development path and ensure long term compatibility.

Cooperation with signalling suppliers is being established through UNIFE and its dedicated CCS platform group.

Progress and status

Reference Architecture and Security

Reference Architecture cluster defines the complete EULYNX system, describing the overall architecture, cross-cutting architectural concepts and all generic aspects of the system. The architectural deliverables have been mainly completed, with main focus in 2018 on completion of System Architecture Specifications. Outstanding items are related to network and communications – leading to completion of the deliverables on Point of Service – Signalling and System Maintenance Interface definition. Security cluster is in an early development phase, preparing the Security concept.

Interface clusters

Each interface cluster works on a dedicated interface, specifying the Requirements specifications and Interface specifications. All active clusters have delivered their respective specifications.

The modelling of the Generic functions, Light Signal and Generic IO is complete, including the state machine models, while other interface clusters continue on refinement with state machine modelling and validation of functionality. Cluster participants have been using the simulation for the validation of their functional requirements. Modelling support in the interface clusters is carried out by external modellers from engineering companies.

The interface toward LEU has been reworked and renamed to SCI-CEC (Centralised ETCS L1 Controller) and will be developed in 2019.

The interface SCI-TSS has focussed on analysing the functions needed for supporting the Trackworker Safety System functions. The specifications will be closely aligned to SCI-CC specifications, development is planned for 2019.

Data Preparation

Data Preparation cluster is working on the exchangeability of signalling engineering data between IMs and market parties. Data is collected in a data platform, which provides the basis for capturing and comparing the data between IMs. The exchange data format will be derived from a UML model, describing the classes of signalling objects and their mutual relations. The XML schema derived from the UML model will be the basis for the creation of XML data. Relationship to the railway infrastructure is based on the RailTopoModel.

UML data modelling is in progress, due to vast amount of collected data the modelling is spread over several years. A reference project is planned in Germany (Finnentrop/Meggen) as partial demonstration of the EULYNX exchange format.

The IMs involved both in EULYNX and in buildingSMART ensure that the EULYNX data model is also used as input toward openBIM specifications.

Assurance and Certification

EULYNX aims to deliver assured specifications that will be acceptable by all member organisations and their corresponding National Safety Authorities. To facilitate this crossborder approach, the assurance process is following the principles of CSM, tailored to the scope of delivering assured specifications rather than assured products. EULYNX assurance will demonstrate that hazards and threats within the scope of the EULYNX work have been identified and that suitable mitigations are in place.

Assurance justification of Baseline set 2 has been completed, assurance of Baseline set 3 will be completed in 2019.

EULYNX Certification will provide a formal confirmation that a product demonstrates required compliance to EULYNX specifications. Testing and certification processes are in development, focussing on open testing procedures and establishing a network of testing facilities. The processes are developed in close cooperation with DLR (German Aerospace Center).

Modelling and Testing

Modelling and Testing cluster provides the system engineering process and modelling methodology for development of EULYNX model based specifications.

Modelling standard and the Interpretation rules have been updated, taking into account the detailed modelling involving state machine models. Further restructuring of the Modelling standard and addition of supporting documents are planned in order to ease the onboarding into the modelling. The Modelling standard will also form the basis for RCA development work as a recognised system engineering approach in the CCS sector.

Cooperation activities

Reference CCS Architecture

The IMs organised in EULYNX and ERTMS Users Group (EUG) agree on a common goal to guide the developments in the CCS sector towards life cycle cost reduction, improved capacity and increased deployment speed. Collective effort and pan-European cooperation must be reached, and separated individual developments avoided.

Resulting formal cooperation between EULYNX and EUG was started first with a Memorandum of Understanding, and followed by publishing a white paper on Reference CCS Architecture (RCA) in July 2018. The white paper provided the first vision on common development of the future Reference CCS Architecture, highlighting the opportunities associated with IMs working together in a collaborative approach, utilising the ERTMS Users Group and EULYNX Consortium to provide the technical direction and the framework for development activities.

Work on RCA development has started in 2018. The contributing experts have prepared a first release of RCA documents, named RCA Alpha.

RCA will define standardised, evolvable interfaces for all major components of the future railway CCS, and introduce new technology and technological progress from other sectors in railway CCS. EULYNX is one central building block of the RCA. There is no separate development between EULYNX and RCA – thereby long-term compatibility is ensured.

UNIFE

EULYNX has invited the signalling industry to formal cooperation. Cooperation aims to address feedback to EULYNX specifications and allow change requests for error corrections, functional enhancements or steering of developments. Cooperation with signalling industry is being established through UNIFE. A group for addressing signalling issues has been formed within UNIFE under the name CCS Platform Group. Common goal is to define a cooperation agreement in 2019.

Communication

Communication activities in 2018:

Articles/conferences:

- PrivatBahn Media Berlin, "Professionelle Standardisierung für innovative digitale Bahnsysteme"
- Rail Business India, "Towards Harmonised Rail Standards"
- International Journal of Open Information Technologies, "BIM and engineering formalized ontologies on the European digital railway in the EULYNX - data economy"
- IET System Safety and Cyber Security conference, "EULYNX Assurance approach"

Signalling | standardisation



Standardising interfaces
The Eulynx consortium of European infrastructure managers (IMs) in 2014 to standardise signalling interfaces and elements. The first phase produced a full set of specifications, and Eulynx has now evolved into a permanent body for the standardisation of interfaces, based on a full baseline, with the publication in December 2017 of Baseline 2.

EULYNX was launched by 10 European infrastructure managers (IMs) in 2014 to standardise signalling interfaces and elements. The first phase produced a full set of specifications, and Eulynx has now evolved into a permanent body for the standardisation of interfaces, based on a full baseline, with the publication in December 2017 of Baseline 2.

The Eulynx project was an answer to the difficulties IMs were facing with ageing command and control signalling (CCS) installations, combined with the continual ageing of budgets which together made a toxic combination. Clear examples are DB Network's so-called "signalling zoo" where tens of different technologies must live together with serious implications for maintenance and knowledge management. Combined with a much shorter lifecycle for modern computer-based installations, this means that very old mechanical interlockings still perform their function while recently installed computer-based systems must be replaced due to the obsolescence of the processor and other electronic parts. The replacement how wave is becoming higher every year. The lack of human resources for designing, building

and maintenance of 10 to 20 years old 5th generation signalling systems is difficult, that also highly expensive. How the first cost. With interlock of it has different funding often cut than the cost (Op not cons possible). Open, in Reduce incompu also need there an variety a logistic As more than 70% of the cost of an interlocking resides in engineering, approval and installation of cables and field equipment, it does make sense to decouple the operational life expectancy of different elements. This means that

EULYNX

Professionelle Standardisierung für innovative digitale Bahnsysteme

EULYNX entstand aus einem Dilemma der Eisenbahn-Infrastrukturbetreiber und hat sich zur Chance mit bislang ungeahnten Möglichkeiten für digitale Bahnsysteme entwickelt.



Das Dilemma besteht zunächst in der Digitalisierung der Leit- und Sicherungstechnik der Bahnen. In wohl keinem anderen Bereich der Bahn war es so unregelmäßig, die Fehler in mechanischen Verriegelungen beziehungsweise elektrischen Relaiskombinationen abgebildet. Logik, komplexe Sicherungstechnik durch moderne Rechenarchitekturen zu ersetzen. Statt schwerer, teurer, voluminöser, bedienungs- und instanzhaltungsintensiver Technik reichten plötzlich Rechner für den Stellwerkskern und Module mit Bedienoberfläche für Fahrdienstleiter. Zu diesen Verbesserungen trat noch die Rationalisierungspotential hinzu, mehr Stellstellen von den Stellwerken aus, die Stellwerke selbst fernbedienbar und die Bedienung wesentlich erleichtert zu können. Was heißt nun konkret das Dilemma? Die Stellwerkstechnik der Vorga-

die Integration dieser Schnittstellen in das Gesamtpaket kein Problem. Nun aber drohen diese Schnittstellen eine dauerhafte Hersteller-Abhängigkeit für die Gesamtlösung zu verschaffen. Für die mit Bundeszuschüssen erstellten wertvollen Aufbauten wäre ein vorzeitiger Ersatz nicht denkbar und würde erheblichen wirtschaftlichen Schaden verursachen. Jeder vergleichsweise häufige Ersatz des Stellwerkskerns in Hard- und Software würde jedoch eine Anpassungsentwicklung zu den alten Aufbauten erfordern, den realisierbarerweise stets der Hersteller der Frontanlage leisten müsste. Damit besteht die Wahl zwischen einer Herstellerbindung für die häufiger zu erneuernden Innenanlagen oder einem vorzeitigen Ersatz von Aufbauten der Leit- und Sicherungstechnik. Dieses Problem wird noch durch den Ersatz der analogen Ansteuerung von Aufbauten durch die erheblich leistungsfähigere Ansteuerung und Überwachung mit IP-basierter Datenkommunikation zwischen Innen- und Außenanlagen verschärft. Doch wer wollte angesichts der erheblichen Potenziale an Leistungssteigerung, Diagnoseinformationen, Raum-, Gewicht- und Kostenersparnis, die mit der digitalen Steuerung und Übertragung verbunden sind, auf diese Vorteile vollständig verzichten? Die würde die Bahnen gegenüber der realen Zukunft von selbstem Autos, ferngesteuerten Drohnen und umfassender informeller Vernetzung im Internet of Things in demnachse Weise abhängen und ins Abseits manövrieren. Trotz unterschiedlicher Frontarchitekturen, verschiedener betrieblicher Anforderungen und bestmöglicher Migrationsoptionen stellt sich das Dilemma dem Grunde nach gleich für alle Bahnen auf dem Weg zur Digitalisierung.

Das Dilemma Solange Stellwerk und Außenanlagen im Paket erneuert werden konnten, war standard reference architecture, function allocation and communications protocol. It was also clear that we should follow the V-model of Cenelec 50126, as the end result should be a full set of standards covering the phases up

IRJ March 2019



Titelthema

Bereit für den Wandel?

Sind die Bahnen vorbereitet auf die Herausforderung, sich von einem „all inclusive package“ Konsortium zu einem Systemanbieter zu entwickeln? Nicht mehr und nicht weniger bedeutet es, die Verantwortung für Schnittstellen zwischen wesentlichen Komponenten einer Gesamtlösung mit Sicherheitsfunktionen zu übernehmen. Die Antwort fällt von Bahn zu Bahn nur graduell unterschiedlich aus. Bis auf Ausnahmen waren die Bahnen kaum vorbereitet und hatten keine ausreichenden internen Kompetenzen, um Datenchnittstellen und die relevante Systemarchitektur eigenverantwortlich zu definieren. Gemeinsame Herausforderungen

schweilen zusammen, und so war EULYNX zunächst eine gemeinsame Entwicklungsleistung der Bahnen. Die Probleme waren gemeinsam, die Anforderungen aus Betrieb und Ausgabekompatibilität unterschiedlich, und die Lösungsweg noch zu entwickeln. In dieser Situation haben die Bahnen ihre begrenzten Ressourcen gebündelt und durch eigene Expertise ausgereicht dort ergänzt, wo diese besonders noch nicht entwickelt war beziehungsweise nicht vorhanden ist. Konkret haben sich die Bahnen auf die Entwicklungsmethode der modellbasierten Systemengineering verständigt, was die Spezifikation mit formalen Methoden beinhaltet.



Ralph Maier
Leiter CCS-Forschungsprogramme
DB Netz AG

Die Stärke von EULYNX

Wie jedoch kann eine gemeinsame Datenchnittstelle die Vielfalt unterschiedlicher Systemanforderungen der Bahnen bedienen? Hier kommt nun die wahre Stärke des EULYNX-Standards zum Tragen: Die Variabilität der Anforderungen wird durch das Modell repräsentiert und filtert zu inkonsistenten Datenschnittstellen-Definitionen. Die Entwicklung von Innen- und Außenanlagen im Einklang mit dem komplexen Datenmodell ist ein Standard filtert zu hohen Skalierbarkeit. Wer dem Einsatz der Standardtechnik im Feld wird diese so

konfiguriert, dass zwischen Innen- und Außenanlagen nur die für die jeweilige Bahn notwendige Teilmenge der Daten des Standards übertragen wird. Eindeutigkeit in der Technik, Vielfalt in den Funktionen und damit umfassende Einsatz- und Integrationsfähigkeit. Der inklusive EULYNX-Standart zeigt darin seine enorme Überlegenheit gegenüber den traditionellen exklusiven Standards, die als Schnittmenge unterschiedlicher Anforderungen immer zu projektspezifischen Erweiterungen und damit zum Verlust der Standardisierungseffekte führen. Erste EULYNX-Stellwerke sind als Pilotanlagen in Betrieb und werden zunächst in großer Anzahl gebaut in Norwegen und dann in Deutschland und vielen weiteren Ländern implementiert.

Ralph Maier



Dr. Bernd Haveler, DB Netz, Leiter Digitale IS, erläutert EULYNX der zeitlichen Angebotsübergang und den Daten-Vorstand



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Videos:

- Paving the way for the digital revolution in railways, DB
- The use of formal methods in standardisation of interfaces of signalling systems, ProRail
- EULYNX formal methods, DB
- The making of EULYNX - InnoTrans 2018, Maarten van der Werff (ProRail)



Documents:

- White Paper Reference CCS Architecture Based on ERTMS
- EULYNX Baseline Set 3 Release 1



Communication activities planned in 2019:

Articles/conferences:

- Safety-Critical Systems Symposium, "Assuring EULYNX"
- International Railway Journal, "Standardising interfaces to reduce signalling costs"
- Signal & Draht "ProRail and industrial partners build the first EULYNX demonstrator"
- Signal & Draht "Validation and verification of model-based specifications"
- Aspect 2019, "EULYNX Data Preparation"
- Aspect 2019, "Proof of Concept / EULYNX experiences Innotrans"
- Aspect 2019, "Implementation of EULYNX Specifications after Proof of Concept – A Supplier Perspective"

InnoTrans 2018

EULYNX attracts railways and innovative industry

At InnoTrans 2018, the EULYNX members invited the railway audiences to a demonstration “Seeing is believing - The signalling strategy for Europe” and provided a real digital interlocking with field elements of different suppliers.

The EULYNX digital interlocking attracted railways and signalling industry from Europe and beyond. Representatives of European railways, industry, organisations and academia, specialised on CCS and IT, and also from other domains, took the opportunity of getting first-hand information and seeing the digital interlocking in operation. ProRail, Hima, Movares, Pilz, Sweco, VRS and Thales provided the equipment on display and were available for demonstration and detailed questions.



High ranking delegations and visitors from Korea, Taiwan, Japan, China and India discussed the EULYNX approach whilst seeing the digital interlocking in full operation. EULYNX started to cater for the needs of European railways, and has proven its potential during Innotrans 2018 for becoming a success story also beyond Europe.



Financial Report

For the financial year **2018**, available budget for consortium activities was **656.635 EUR**, based on the income from membership fees and surplus from financial year **2017**. Annual contribution fees of the 12 members amounted **593.500 EUR**, according to following fee apportionment: category small size network at **31.236 EUR**, category medium size network at **46.856 EUR** and category large size network at **62.474 EUR**.

Principal outgoings were the costs of the management and technical coordination, technical support to central clusters and assurance activities. Financial year **2018** closed within planned target, at 93% of the total planned costs. Unused amount of **50.707 EUR** is carried over into 2019 for covering Assurance activities of BL3.

For the financial year 2019, a number of cluster activities will be reduced as development is near completion. All modelling resources (architecture, interfaces, data preparation) will be centralised and financed through the core budget. New activities will be started related to deployment support, testing and certification. The consortium budget for financial year **2019** is forecast at **1.240.250 EUR**.



Members activities

BaneNOR



In 2018 BaneNor has awarded three ERTMS contracts, covering ERTMS Trackside, ERTMS Onboard and TMS (Traffic Management System). This is the first very large-scale project using the EULYNX specifications; it covers the complete network.

In the national ERTMS programme, BaneNor is implementing most of the EULYNX SCI and SDI interfaces. Both Siemens and Thales are working on the interfaces and BaneNor are expecting improvements and change requests on the specifications in 2019. As BaneNor are reviewing some operational aspects, the country specific applicability may be adjusted.

Société Nationale des Chemins de Fer Luxembourgeois



In 2017, CFL has launched a tender for the upgrade of the entire signalling system on a pilot line, including simplified trackside signalling. The tender included the development of the SCI-ILS and SCI-LX interfaces for the line block and level crossing. It was awarded to Scheidt & Bachmann in June 2018 and the system is planned to go into service in autumn 2020. These will be the first EULYNX SCI interfaces in operation in Luxembourg.

On a longer perspective, CFL is committed to connecting all trackside equipment to the interlocking core through standardized EULYNX interfaces in the framework of future renewal or upgrade projects on their signalling systems.

Network Rail



The Digital Railway programme of Network Rail has further developed its system-of-system and interface requirements, with input and review by industry, where EULYNX (or migration to it) is specified. A long-term deployment plan, based on asset renewals, has also been produced showing the roll out of the Digital Railway over the next few decades.

Network Rail has also tendered, and issued contracts for, a feasibility study and concept demonstrator of a Signal Controlled Warning System that is to be compatible with EULYNX.

DB Netz AG



In 2018 a full alignment was achieved between EULYNX specifications and DB Netz requirement documents on the SCI-TDS. DB Netz completely reworked the subsystem and interface specifications for TDS for use in the DB pre-series projects as agreed with our industry partners.

In 2018 DB decided to apply the EULYNX modelling standard also for the modelling work in the “Digitale Schiene Deutschland” (DSD) project, which takes place in tight alignment with the RCA development.

In 2019 DB plans to fully harmonise its subsystem and interface specifications with the EULYNX BL3 documents – namely SCI-P, SCI-LS, SCI-IO. Remaining interfaces will follow until 2020. The modelling work will take place within the same model environment using the identical model within PTC Modeler.

The digital planning & BIM pilot Fennentrop is proceeding well to provide early feedback to the EULYNX Data preparation cluster.

The EULYNX-modelling standard has also been applied to modelling work in Shift2Rail on verification of SCI-LX and for the ATO GoA 4 system specification.

Finnish Transport Infrastructure Agency (FTIA)



In 2018 FTIA (Väylä) launched a project to update Finnish signalling requirements to be in conformity with the EULYNX specifications. FTIA is committed in utilising the EULYNX solutions and in coming years it will first incorporate the EULYNX specifications into its existing Finnish Interlocking Requirements documentation and after that utilise the EULYNX requirements in future bidding. First competitive bidding utilising EULYNX could be launched in 2021.

In 2019 FTIA is in the process of preparing together with the Finnish Ministry of Transport and Communications a twelve-year investment programme, and the interlocking renewal projects within this programme would also contain a EULYNX pilot project in Finland.

Infrabel



Infrabel is on the way of defining the vision for the future, and developing the strategy for the next years. Using the EULYNX results will help to reach the needed objectives.

ProRail



ProRail has worked on a Proof of Concept to demonstrate the implementation of EULYNX in its network. The test set-up, built in the Railcenter, Amersfoort, was prepared using the ProRail PLC Interlocking and the specifications of the four types of field elements: point, level crossing, signal and train detection system. The efforts of ProRail engineers, Movares, Thales, VRS Rail, Pilz, Sweco, Hima and the Railcenter have succeeded in demonstrating the modular system architecture based on the latest EULYNX baseline.

In cooperation with DB Netz, the opportunity was offered to present the Proof of Concept results and the demonstration of the digital interlocking at InnoTrans 2018. This resulted in massive responses from around the world, fellow infrastructure managers, ministries and suppliers. InnoTrans showed that there is a real need for standard interfaces in the global field of signalling to speed up the automation and digitalisation of the railways.

Rete Ferroviaria Italiana



The work carried out within the Data Preparation Cluster in EULYNX, is helping RFI to implement its own Building Information Modeling (BIM) system that is becoming an EC mandatory requirement for the future tenders. The work carried out within RCA is helping RFI to implement its ERTMS based architectures for the digitalisation programme in Italy.

SNCF Reseau



SNCF Reseau has launched the ARGOS project with the goal to renew the old-generation interlockings. Object controllers will be more and more used by European IMs. The partial replacements of subsystems and the reduction of the renewal costs is only possible if IMs have a complete control of the interface between the object controllers and the interlocking core. EULYNX is recognised as a good opportunity to reach this goal.

In the scope of the ARGOS project, SNCF is evaluating the possibility to replace the existing axle counters with new systems capable to interact with interlockings from different suppliers. The requirements from SNCF will be included in the SCI-TDS specifications.

SNCF Reseau is strongly involved in EULYNX Data Preparation activities: SNCF considers that having a common signaling data model is very important to allow software editors to release engineering tools suitable to European IMs. A common data model is also a good opportunity to share good practices for data preparation among EULYNX partners.

Swiss Federal Railways (SBB)



SBB strives to introduce the first EULYNX-based train detection systems to be able to experiment with their capabilities, especially the remote diagnostics and maintenance functionalities. Further, it considers EULYNX-based trackside assets as promising candidates to foster the migration to the smartrail 4.0 interlocking system defined for the SBB and other railways, consistently with RCA.

SBB recognizes there is a potential and opportunity for more harmonized interface protocols. SBB strongly encourages addressing this issue and striving for harmonised specifications with the necessary flexibility. Smartrail 4.0 strives to have the corresponding adaptations of the EULYNX standard implemented with Baseline Set 4.

SŽ - Infrastruktura (SZ-I)



Slovenian railways have contributed and integrated their requirements in all EULYNX clusters, covering the field elements and interfaces required for their network.

Recently, Slovenian railways are devoting a lot of funds to modernise the railway network. SZ-I anticipate that the EULYNX specifications will be part of the tender documentation as the renovation of the infrastructure in Slovenia is underway, currently scheduled for 2020. Compliance to EULYNX will be required for field elements as well as for all interfaces.

Trafikverket



Trafikverket initiated their work with the definition of the Functional Product FP5.4.0, which tentatively will be the first Functional Product comprising functionality according to EULYNX and which will be released by the end of 2019, aiming to include SCI-ILS and SCI-TDS specifications.

FP5.4.0 will be the base for the first ERTMS commissioning on Södra Stambanan (ScandMed East), planned to take place during 2023.

In the following FP5.5.0, tentatively to be released end of 2020, Trafikverket is considering the introduction of SCI-LX and SCI-RBC.

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