SYSTEM PILLAR – TRACKSIDE ASSETS CONTROL AND SUPERVISION

Trackside Assets publication overview

Mirko Blazic - TACS domain lead railways

Malik Benameur - TACS domain lead industry

1. Starting point

The Trackside Assets Control and Supervision (TACS) domain is responsible for the standardisation of the Trackside Assets. The starting point for the TACS domain are the sector agreed System Level 4 architecture from the ramp-up phase (Report on CCS/TMS/CMS high level architecture (Cesames), SC5 DP2.2 CCS/TMS/CMS top level target system architecture incl. Annex 2), EULYNX BL4 Release 1 including issued change requests and UNIFE comments, as well as SWOC inputs from Shift2Rail.

Additional task of the TACS domain is to bring the EULYNX specifications under responsibility of relevant domains of the System Pillar to avoid separate developments outside of the System Pillar. Primary interaction in this phase is with the Transversal CCS domain. Therefore, part of the scope related to diagnostics, maintenance and configuration management is managed together with the Transversal CCS (TCCS) domain, which is the responsible domain for the respective documents.

To ensure integrated work with suppliers, the TACS domain started with onboarding all new team members from the supplier side to the new working groups based on previous EULYNX clusters.

In accordance with the domain remit, the priority has been on the completion of EULYNX BL4 Release 2 in order to release sector agreed Trackside Assets interface specifications under the technical authority of the System Pillar, focusing on:

- High priority development topics and change requests
- All review comments and resulting change requests from UNIFE issued against EULYNX BL4 Release 1 or older baselines

The following subsystems and related interfaces are in the scope of Trackside Assets and are included in this joint SP/EULYNX BL4R2 release: Point (P), Generic IO (IO), Level Crossing (LC), Light Signal (LS) and Train Detection System (TDS).

Some of the interfaces of the EULYNX architecture are not in the scope of this joint SP/EULYNX BL4R2 release. These interfaces concern Traffic Management System (TMS), Traffic CS (Adjacent Interlocking and RBC) and Security. These interface specifications may be used as input documents in other SP domains.

2. Participants

The TACS domain is structured in individual working groups, focusing on generic subsystem architecture and on subsystem specific topics. In addition, the Railway and Industry Mirror Groups are in place with the role to review change requests and to review and endorse finalised deliverables.

The domain coordination team with domain leads Malik Benameur and Mirko Blazic is responsible for leading and coordinating the work in the domain.

Domain Working Groups (named domain members in blue, contributors in white)

WG Ref.Arch.	WG TDS	WG IO	WG Point	WG LC	WG LS
Alstom	Alstom	Alstom	Alstom	Alstom	Alstom
CAF	CAF	CAF	CAF	CAF	CAF
Hitachi	Hitachi	Hitachi	Hitachi	Hitachi	Hitachi
MerMec	MerMec	MerMec	MerMec	MerMec	MerMec
Thales	Thales	Thales	Thales	Thales	Thales
Thales	Thales	Thales	Thales	Thales	Thales
Siemens	Siemens	Siemens	Siemens	Siemens	Siemens
EUG/EULYNX	EUG/EULYNX	EUG/EULYNX	EUG/EULYNX	EUG/EULYNX	EUG/EULYNX
EUG/EULYNX	EUG/EULYNX	EUG/EULYNX	EUG/EULYNX	EUG/EULYNX	EUG/EULYNX
SNCF	SNCF	DB	Network Rail	SNCF	DB
RFI	DB	DB	CFL	DB	CFL
ProRail	DB	FTIA	DB	Network Rail	FTIA
DB	CFL	ProRail	DB	ProRail	Slovenske Zeleznice
Network Rail	Network Rail	SNCF	SBB	ProRail	DB
DB	Network Rail	DB	ProRail	Trafikverket	ProRail
BaneNor	ProRail	SBB	SBB	BaneNor	BaneNor
Trafikverket	ProRail		Slovenske Zeleznice	CFL	SNCF
FTIA	SNCF		SNCF	SBB	DB
Slovenske Zeleznice	SBB		DB	DB	SBB
DB	Trafikverket		DB	FTIA	
SNCF	DB		SNCF		
SBB	SBB				
DB					

Domain Mirror Groups

Railway Mirror Group	Industry Mirror Group
BaneNor	Frauscher
ProRail	ENYSE
Network Rail	Scheidt & Bachmann
RFI	Altpro
Trafikverket	Indra
DB	Mipro
Slovenske Zeleznice	Voestalpine
CFL	Alstom
FTIA	CAF
ÖBB	Hitachi
SNCF	MerMec
Infrabel	Thales
SBB	Siemens
RFI	
Sprava Zeleznic	

3. Overview of the results

The scope of the TACS domain is defined by the CCS/TMS/CMS top level target system architecture results from the ramp-up phase.

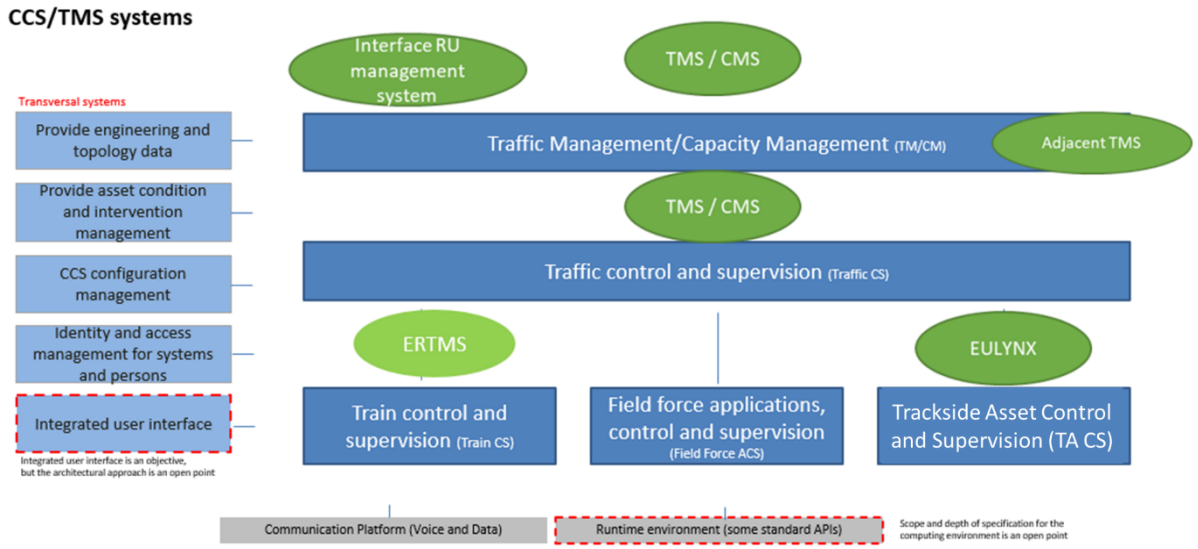


Figure 1: Overview of the target system architecture

The results are technical specifications on System Level 5 in the form of subsystem and interface specifications. In accordance with SEMP, the EULYNX methodology and platform have been applied, as the System Level 5 process in the System Pillar is still under development. With this approach, the traceability and referencing from previous EULYNX baselines is maintained. In future phases, the specifications will be integrated into the System Pillar toolchain to allow linking to higher System Levels of the System Pillar target architecture, meeting the top-down development of the target system.

For validating the defined modelled requirements, simulators for the subsystem and interface behaviour have been developed and are also provided by the domain.

System Description

The scope of the system Trackside assets control and supervision is the layer with trackside assets and respective objects controllers. The system is responsible for the control and supervision of the trackside assets to ensure safe track usage as required by the system Traffic Control and Supervision. The system supports diagnostic, maintenance and security functions as required by the system Transversal CCS.

The system architecture defines trackside assets (like points or signals) as subsystems with standardised interfaces to command and control physical objects.

The system is composed of following subsystems:

- Subsystem Point
- Subsystem Generic IO
- Subsystem Train Detection System
- Subsystem Level Crossing
- Subsystem Light Signal
- Subsystem Power supply

Each subsystem is specified with a set of generic and subsystem specific requirements specifications.

The subsystem Light Signal is defined as part of the Trackside Assets CS to support migration scenarios. National signalling is out of the scope of the System Pillar target architecture

The subsystem Power supply will be defined in future phases.

The system applies following types of interfaces:

- Standard communication interface (SCI): The process data interface which contains process and other information necessary for the exchange between the system Traffic CS and the subsystems of Trackside Assets Control and Supervision. The specification of the process data interface is supplier independent. This interface is also applicable for the exchange with digital interlockings/RBCs and provides an important future proof migration step until the target system Traffic CS will be developed.
- Standard diagnostic interface (SDI): The interface required for transmitting non-safety relevant diagnostic information. The interface definition is under the responsibility of the Transversal CCS domain, while the specific SDI interfaces are defined in close collaboration with the TACS Domain via a joint working group.
- Standard maintenance interface (SMI): The interface required for updating the engineering and configuration data, as well as software data of the subsystem. The interface definition is under the responsibility of the Transversal CCS domain.
- Standard security interface (SSI): The interface required for managing functionality related to IT security. This interface will be defined by the Security domain and is not in scope of BL4R2 of the System Pillar.
- Control interface: The control interface is used for control and supervision of the external systems in the field, connected to the subsystems (e.g. point machine, level crossing protection facility). The specification of the control interface is supplier dependent (the control interface may be a bus interface, DC interface etc.). Standardisation of the control interfaces will be evaluated in future phases.
- Maintenance/Operation/Display interface: The interface required for interaction with a subsystem, to visualise or change the subsystem behaviour. Further standardisation of this interface will be evaluated in future phases.
- Power supply: The interface providing the electrical energy to the subsystem. This interface will be evaluated in future phases, subject to decision process

following granularity decision rules and following the evaluation of the benefit versus costs according to the CBOs.

All functional requirements to ensure the transmission of information objects shall be provided by the Communication System, under responsibility of the Communications domain. Until the Communication System requirements are integrated in the System Pillar, the "Point of Service" requirement for information supply as defined by EULYNX will be applied.

The following interfaces are specified for communication with the Traffic CS:

- SCI-P for process data communication with the subsystem Point
- SCI-IO for process data communication with the subsystem Generic IO
- SCI-TDS for process data communication with the subsystem Train Detection System
- SCI-LC for process data communication with the subsystem Level Crossing
- SCI-LS for process data communication with the subsystem Light Signal

The following interfaces are specified for communication with the Transversal CS for maintenance and diagnostics:

- SDI-P for transmission of diagnostic data from subsystem Point
- SDI-IO for transmission of diagnostic data from subsystem Generic IO
- SDI-TDS for transmission of diagnostic data from subsystem Train Detection System
- SDI-LC for transmission of diagnostic data from subsystem Level Crossing
- SDI-LS for transmission of diagnostic data from subsystem Light Signal
- SMI-XX for communication between each subsystem and maintenance service functions

The Trackside Asset Control and Supervision System and related interfaces are managed and maintained by the System Pillar.

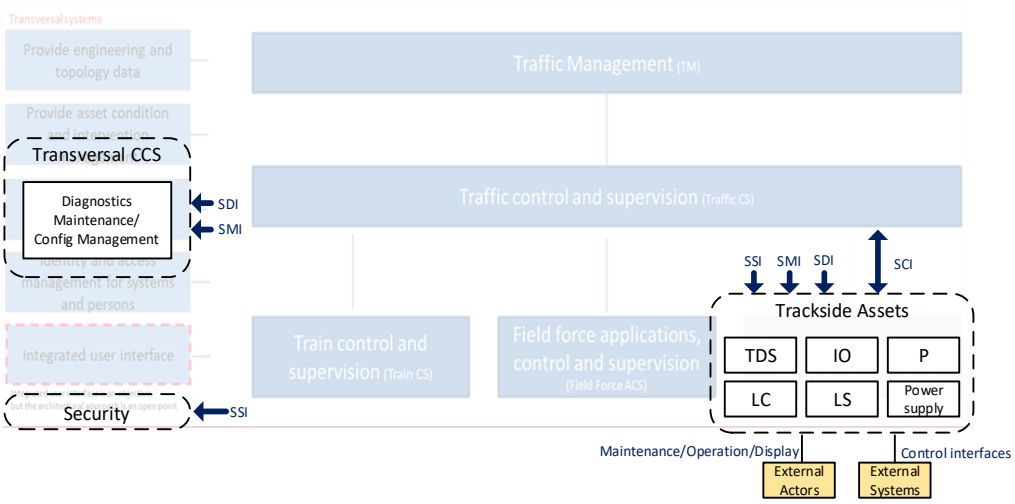


Figure 2: Overview of the Trackside Assets interfaces

4. Summary of discussed topics

Overview of new developments

The TACS domain focused on high priority development topics scheduled for BL4 Release 2, identified by infrastructure managers and/or previous feedback from industry.

Generic requirements:

- Safety timing requirements
  The defined overall safety timing requirements defined in BL4R1 were on one hand not fully achievable by available products, and on the other hand not consistently defined across relevant subsystems. Detailed analysis was made per relevant use cases and across supplier product platforms to reach a consensus. It was concluded to apply values as defined in EULYNX BL3 for the subsystem reaction times, and new reaction times were defined for subsystems TDS and LC. Overall safety time will not be defined.
- Handling special national migration needs
  Infrastructure managers have identified the need to extend the use of the applied architecture with national systems or to extend the interface with national information. This may be needed for migration purposes to resolve national deployment issues, and shall be managed in a non-conflicting way to the specifications. It has been agreed to reserve a value range for protocol types and a value range for message types to enable IMs to define solutions within these reserved ranges in the future without the risk of non-compatibility with specifications. The national values will not be part of the specifications, only a range has been reserved (similar concept as ETCS Packet 44).

- Juridical recording by object controllers
  Juridical recording by the object controllers has been identified as a potential use case, primarily in case of loss of communication. Diagnostic information may not be sufficient for juridical purposes. The use case is understood but requires more work on high level architecture requirements and on legal requirements and will not be managed in the current release. The discussion will require further evaluation and will be handed over to the ARC and TCCS domains.
- Diagnostic SDI data points update
  Restructuring and updating of diagnostic data points has been proposed to improve the SDI specifications. The aim is to develop a consistent generic diagnostic model as basis for SDI trackside assets specifications. Based on the model, the generic and subsystem specific data points will be updated and aligned. This work is ongoing and is performed by a joint taskforce of experts from TCCS and TACS. The resulting diagnostic model development already considers the later integration of the diagnostic information provided by trackside assets into an overall CCS diagnostic model, where the information from multiple domains will be aggregated.

Subsystem Point:

- Use case for 'Ability to move'
  The IMs identified a use case where the information that a point is not able to move is relevant for train operation. If the signaller/automatic route setting system has the information that a certain point has no power to move, it can avoid setting a route that requires certain point movement, saving time and improving performance. This functionality has been added to the specifications and will be applied as an optional functional package, as it will be applied by limited number of IMs.
- Point machine interface for 'common drive'
  Points with multiple drives may be implemented by a single engine driving multiple drives (hydraulic concept). The functionality differs from a concept with multiple individual engine drives and was not covered by BL4R1 specifications. This functionality has been added to the specifications and will be applied as an optional functional package.
- 4-wire point machine interface interpretation
  The interpretation of the 4-wire patterns on the point machine interface has been re-analysed and has been excluded from the scope of the model-based requirements. Instead, the input information on the 4-wire interface is expressed with abstract states defined by tables.
- Point movement start and timeout conditions for point detectors
  The detailed functionality for supervision of point movement start and timeout conditions with point detectors has been discussed and refined.
- Restructure functional packages of subsystem Point
  Revision of the functional packages has been made to simplify the basic packages and provide better flexibility to product portfolios. Defined are 4 parallel basic packages (non-4-wire point machine (PM) single, non-4-wire PM multiple, 4-wire PM single, 4-wire PM multiple) and 3 optional packages (Ability to Move as optional for all basic packages, Common Drive as optional non-4 wire PM multiple, Redrive for both non-4 wire basic packages).

Subsystem Light Signal:

- Refined functionality for signals with unchangeable luminosity
  The functionality related to luminosity for signals such as tunnel signals has been clarified and optimised.

Subsystem IO:

- Additional flashing period
  The flashing period for flashing output channels has been defined between 0,5 – 1,25 Hz in 0,25 Hz steps. The value of 0,75 Hz was not specified in BL4R1 and has been added due to specific requirements of IMs.

Subsystem Train Detection System:

- Remove Additional Information functionality
  Additional information from TDS (e.g. speed and wheel diameter) has been specified without a strong use case, and the domain agreed to remove the requirements. This is an indicative example of simplification, whenever possible. It shows that the domain is capable of simplifying some aspects of the specifications with consensus from the whole sector.
- Clarify reporting of negative filling level
  Reporting of a negative integer for the filling level was not possible by the byte structure, a new solution was agreed and specified.
- Report TDP Status on Maintainer interface
  The status of TVPS has been defined for display on the Maintainer interface, with addition of the Train Detection Point functionality in BL4R1, also the related status has now been added to this interface.

Subsystem Level Crossing:

- Failure report after booting - correction
  Error in specifications has been corrected.

Overview of UNIFE comments

On the 31.07.2022, UNIFE raised concerns around the EULYNX Baseline 4 Release 1 (BL4R1). The UNIFE letter adressed four critical topics:

1. Backwards compatibility
2. Functional packages
3. Number of comments by suppliers not incorporated in the BL4R1
4. IT Security in BL4R1

The Trackside Assets Control and Supervision domain agreed to treat UNIFE's critique comments as a high priority topic and as a precondition to the publication of the BL4R2. The four UNIFE critique points were addressed as explained below.

Backwards compatibility

Problem: One of the most important developments from the EULYNX BL3R8 to the EULYNX BL4R1 consisted in the introduction of the concept of Multi-Element Object Controller. This concept was introduced to allow the control and command of multiple trackside assets via one single Object Controller (Hardware). In contrast, the EULYNX BL3R5 had defined that each trackside asset would be controlled by a single Object Controller – The Single Element Object Controller.

Interlockings equipped with EULYNX BL4R1 can handle both Single-Element- and Multi-Element Object Controllers. On the contrary, interlockings equipped with EULYNX BL3R5 cannot communicate with trackside assets equipped with Multi-Element Object Controllers. This reflects the compatibility problem between EULYNX BL3R5 and EULYNX BL4R1.

Solution: it has been acknowledged that »Backwards compatibility« is a critical aspect for the specifications. Based on this, a »Backwards compatibility guideline« has been created and all TACS domain participants have agreed to pursue »Backwards compatibility« as a working principle. In fact, any new development (change request) undergoes a »Backwards compatibility check« to ensure this working principle is respected. Backwards compatibility is managed with the »Backwards compatibility guideline« and the version handling of different releases is ensured (via the PDI-versions). This supports the implementation of backwards compatible products.

Furthermore, a "compatibility matrix" will be introduced, to document specific compatibility relations between various releases including the compatibility between BL4R2 and BL4R1.

Conclusion The TACS domain has agreed on this way of managing compatibility. All involved railway companies and suppliers agreed to this consensus solution. The UNIFE comment is therefore considered solved. The TACS Domain will comply to backwards/forwards compatibility guidelines from the SP (yet to be defined).

Functional packages

Problem: One important development from EULYNX BL3R5 to EULYNX BL4R1 was the introduction of the concept of »Functional packages«. These packages define coherent blocks of capabilities that can be implemented in a product.

There are two types of packages related to the product capabilities:

I. 'Basic packages': Containing all necessary specifications needed for the function of a trackside asset. Grouped as one or more packages, at least one of them must be implemented. It is optionally allowed to combine and implement more than one 'basic package' in a product.
II. 'Optional packages': Containing additional specifications defining specific functions of a trackside asset. One or more packages can be optionally implemented in addition to (one of) the basic package(s).

The UNIFE Letter stated three critiques to the introduction of the functional packages:

1. The procedure (algorithm) how these packages have been formed is not explained.
2. The functional packages do not provide the visibility which infrastructure manager (market) intends to use which functionality.
3. The suppliers are facing two methods of requirement specifications: IM codes for adjacent systems (RBC, ILS, CC, LX) and Functional Packages for (Point, TDS, LS, IO, LC).

Solution: The introduction of functional packages had the goal to harmonise the EULYNX specifications. In fact, one of the earlier critique points to EULYNX was that it was a patch work of specifications including IM codes and could not be used as a standard. The answer to the three UNIFE critique points are formulated below:

1. It has been agreed within the TACS domain that the EULYNX BL4R2 Cover Document will contain a clearer description of how functional packages are used and the difference to the method with IM applicability.
   The functional packages have been built in a way such that:
   a. Basic packages contain all necessary specifications needed for the function of a trackside asset
   b. Optional packages contain functions needed by some IMs due to their operational rules (e.g. Point Redrive) or contain functions that are needed in a specific application (e.g. Flashing IO)
2. An Overview Table will be published with the Release to show the intended use of the functional packages per IM as follows:

		Type		NR	TRV	BN	SZ	DB	ÖBB	CFL	ProRa	SBB	SNCF	Infral	FTIA	RFI
SCI-LS																
	Basic Light Signal functionality	Basic		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
	Interface to ETCS trackside components	Optional		No	No	No	No	Yes	No	No	No	Yes	No	Yes	No	
	Interface to Legacy train protection system	Optional		No	No	No	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	
SCI-P																
	Basic non-4-wire single PM	Basic		Yes	Yes	No	No	No	No	No	Yes	No	Yes	Yes	No	
	Basic non-4-wire multiple PM	Basic		Yes	Yes	No	No	No	No	No	Yes	No	Yes	Yes	No	
	Basic 4-wire single PM	Basic		No	No	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	
	Basic 4-wire multiple PM	Basic		No	No	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	
	Reporting Ability to Move	Optional					No	No	No	No	Yes	No	No			
	Common drive functionality	Optional		Yes		No	No	No	No	No	Yes	No	Yes		No	
	Redrive functionality	Optional		Yes		No	No	No	No	No	No	No	No		No	
SCI-IO																
	Basic Generic IO functionality	Basic		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
	Flashing IO functionality	Optional		Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	
SCI-TDS																
	TDS for basic axle counter functionality	Basic		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
	TDS for Train Detection Point functionality	Basic		Yes	No	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	
	TDS for track circuit functionality	Basic		No	Yes	No	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	
	Handling FC-P and FC-P-A commands	Optional		Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	No	
	Handling 'update filling level'	Optional		No	Yes	Yes	No	No	No	No	Yes	Yes	Yes	No	No	
SCI-LC																
	Basic Level Crossing functionality	Basic		Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	No	
	Interface for local operator handover	Optional		Yes	No	No	No	No	No	No	Yes	No	Yes	Yes	No	

Figure 3: Overview of the functional packages per subsystem and IM

3. The use of IM codes on the adjacent systems has been kept as these systems rely heavily on the national signalling principles. The joint SP / EULYNX publication of the BL4R2 does not include these adjacent systems, in the context of the System Pillar only the Functional packages will be applied.

Conclusion: The TACS domain agrees that »bundling« the specifications in functional packages instead of country specific IM codes is well aligned with the System Pillar harmonisation goal. It is a first step towards harmonisation and shall be further pursued within the System Pillar until further standardisation is reached.

This UNIFE comment is therefore considered solved.

Number of comments by suppliers not incorporated in BL4R1

Problem: The review of EULYNX BL4 Release 1 was done in collaboration with UNIFE over 6 batches totalling 54 documents. The suppliers delivered a total of 417 comments via the UNIFE CCS-Platform (previous UNIFE-EULYNX collaboration platform). At the start of the System Pillar in October 2022, 129 comments were accepted while 288 were still open as postponed comments due to the short implementation time for BL4R1.

Solution: In order to systematically analyse the open comments, a dedicated review process has been introduced by the TACS domain. This review process was designed to ensure all comments are taken into consideration especially in this critical transition period to the new collaboration framework within the system pillar.

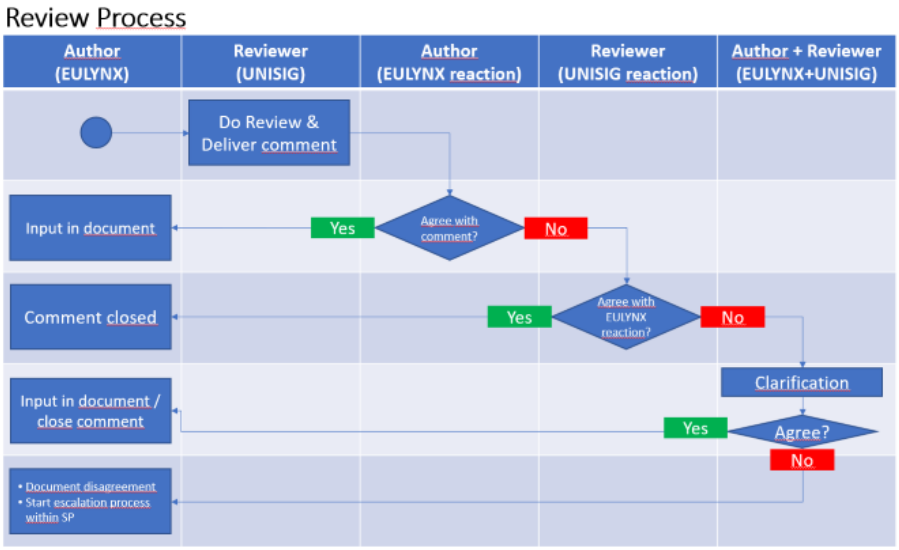


Figure 4: Review process designed by the TACS domain

This process has been followed systematically with the four companies that still had open comments (Alstom, ENYSE, Scheidt & Bachmann and Siemens). Multiple clarification meetings (40 hours) have taken place allowing to close all open comments. A comment is considered closed if:

- It is accepted and implemented in the BL4R2
- It is jointly agreed to withdraw it after clarification has taken place

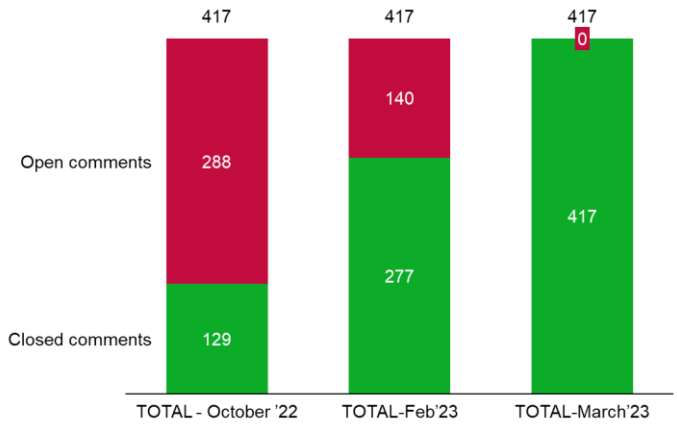


Figure 5: Evolution of the number of open comments, status 2023 Q1

Conclusion: All review comments and resulting change requests from UNIFE were assessed with the original reviewers, and accordingly classified and closed.

IT Security in BL4R1

Problem : A high number of comments on the EULYNX Security documents could not be incorporated in the EULYNX BL4R1. EULYNX and UNIFE agreed to publish a disclaimer that the BL4R1 security specifications may not be used for tendering without further detailed analysis on how to implement IT Security by the infrastructure managers.

Solution: For the work on BL4R2, an alignment with the »PRAMSS –Security« domain has taken place. It has been agreed that all relevant EULYNX Security documents will be reviewed and confirmed by the Security domain, but not yet published on behalf of the System Pillar. The contents will be used as input to specific SP Security documents which will be developed by the domain.

Conclusion: The SP will not publish any Security documents in this phase. This UNIFE comment is therefore not relevant for the System Pillar and is considered solved.

Modelling update

Several pending updates related to modelling notation are under discussion and alignment. It has been agreed to separate the concerns regarding functional changes and modelling updates into separate phases. Therefore, a modelling update will follow after the release of BL4 Release 2, addressing the open issues from modelling and notation perspective. The update will be functionally identical to BL4R2. This update will also provide an opportunity to prepare the specifications for an integration into the System Pillar platform.

5. Review Process & Planning of the BL4R2

To ensure sector consensus for the SP / EULYNX BL4R2, a review process has been introduced to allow different IMs and Suppliers to provide their feedback on this release. As the SP / EULYNX BL4R2 specifications consist in very detailed specifications for a total of 24 documents, it was decided to have two "review granularities":

- **Overview document (present document):** this review concerns a «high level» document which summarizes the content of BL4R2 incl. Overview of all Change Requests, critical points, review process, etc. Its audience is the SP Core Group (SPCG), the Architecture & Coordination Domain, the Architecture Circle and the SP Steering Group.

- **Specification documents**: this review concerns the detailed specifications documents. Its audience is the Domain Team/Working Groups and the Mirror Groups.

Roles and approval process

As the TACS domain works on the EULYNX toolchain, the approval process is not yet managed in Polarion. The approval process within the TACS domain is managed on 2 levels.

- **Approval by the domain working groups** (consisting of named experts and contributors). The domain approval is done together by railway and industry participants. As part of this process, the change requests are reviewed and approved, followed by the review and endorsement of finalised deliverables. Part of the approval process is also validation of the modelled requirements by simulation.
- **Approval by the Mirror groups:** The Railway Mirror group and Industry Mirror group review finalised deliverables, provide review comments and endorse the deliverables. The Mirror groups have broad representation, enlarging the number of companies involved in the domain itself. It is assumed that the representation in the mirror groups provides sufficient sector overview, involving in total 14 infrastructure managers and 13 supplier companies. Each approval decision takes place in dedicated meetings and is fully documented by meeting minutes.

Broad sector consensus outside the TACS domain is ensured by:

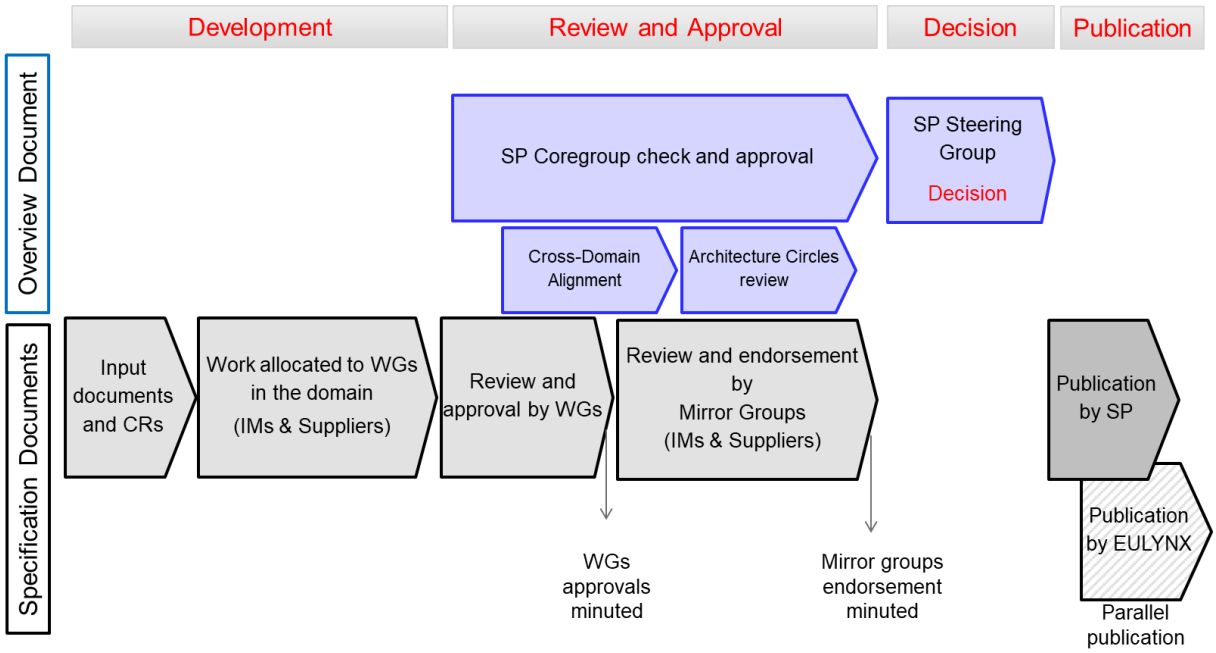
- **Approval by other domains:** as the TACS Domain defines interfaces between various subsystems, there exist dependicies to other SP domains. Close collaboration and alignment with the following domains was realized:

Architecture & Release Coordination, Traffic CS, Transversal CCS and PRAMSS – Security. The detailled position of each of these domains is documented below (see Table 1).

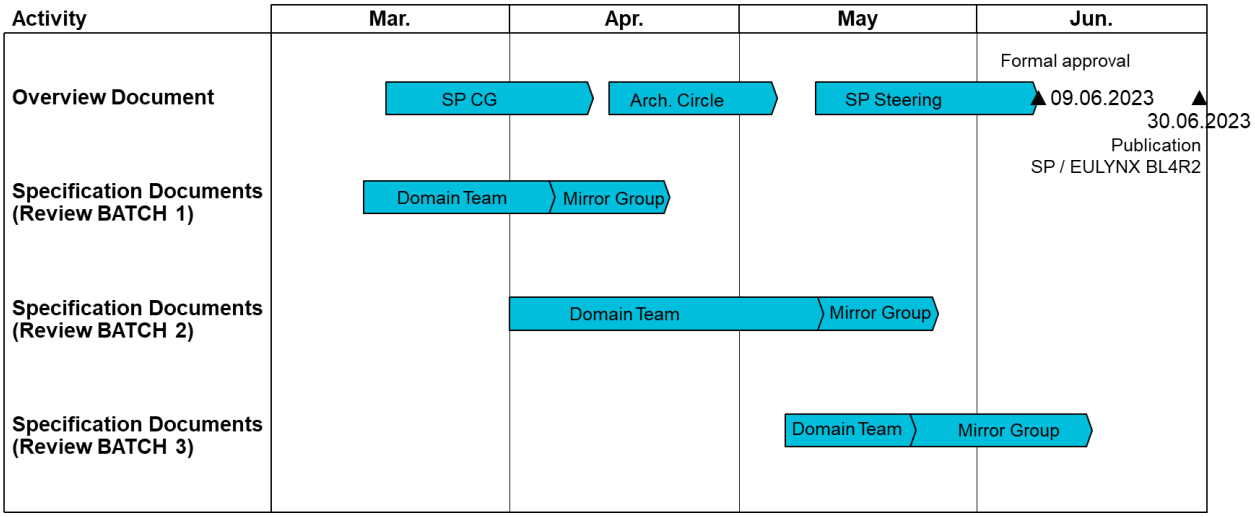
- **Presentation to the Architecture Circle:** to facilitate broad sector consensus, a review of the overview document is proposed to the architecture circle.

The the System Pillar approval of the overview document and the underlying detailed specifications consists of:

- **Approval by the SP Core Group:** the SP Core Group supports and guides the TACS domain on the process towards publication of this first deliverable. In addition, the SP CG reviews and decides if this deliberable is ready for submission to the SP Steering Group.
- **Approval by the SP Steering Group:** the SP Steering Group is the decision-making body for the System Pillar and is responsible for ratifying the deliverables of the System Pillar. A final review of the overview document is proposed to allow the decision on the publication of the SP / EULYNX BL4R2.



Planning


Activity
Mar.
Apr.
May
Jun.
Formal approval
Overview Document
SP CG
Arch. Circle
SP Steering
09.06.2023
30.06.2023
Publication
SP / EULYNX BL4R2
Specification Documents (Review BATCH 1)
Domain Team
Mirror Group
Specification Documents (Review BATCH 2)
Domain Team
Mirror Group
Specification Documents (Review BATCH 3)
Domain Team
Mirror Group

Results of Cross Domain Alignment:

The following table summarizes the approval statements from various domains.

Domain	Position
Architecture & Release Coordination	• It is confirmed that the planned release fully complies with sector agreed deliverables and System Level 4 architecture from the ramp-up phase (Report on CCS/TMS/CMS high level architecture (Cesames), SC5 DP2.2 CCS/TMS/CMS top level target system architecture incl. Annex 2). • The view of shared single set of specifications fitting EULYNX and SP is confirmed. • It is important that the deliverables are maintained in current format, maintaining document references, cross-references and traceability to requirement IDs. • The ARC Domain assessed the release based on an agreed SPCG remit. The Assessment's result is that the ARC Domain support this SP / EULYNX BL4R2 specifications release.
Traffic CS	• High level functional allocation and architecture is confirmed. TCS domain has no additional input at this point due to early development focus on operational and functional analysis. • CRs or additional interface requests from TCS to TACS may follow for later releases, expected to be managed as part of normal SP workflow • There is no need for additional review of BL4R2 deliverables by TCS domain, representatives of railways and industry are already involved in the work in the TACS domain.
Transversal CCS	• TCCS domain is responsible for documents related to interface definition of SDI, SMI and Maintenance and Data Management (MDM) (see chapter 6). It is confirmed that relevant documents are reviewed and agreed by TCSS and in compliance with the deliverables from Ramp-up phase. It is confirmed to have the view of shared single set of specifications fitting EULYNX and SP for BL4R2. • The SP top-down analysis and concept for diagnostics will be done by TCCS considering the current development (BL4R2) of SDI, SMI and MDM. • It is confirmed that Subset-149 is not in conflict with diagnostics developments for the trackside assets. • Identified topics for future releases are: a) further development of SMI; b) alignment of SMI with Traffic CS/interlocking.
Security	• Within the System Pillar context, the Security domain organises regular meetings with the TACS domain to exchange on planning and status of selected domain results. With this setup it is expected to detect and align potentially relating, conflicting or interfering work item results. The current BL4R2 specifications are aligned, focus for this release is on integrating security logging and security monitoring as part of the diagnostic logging (related to SDI). Identified topics for future releases are: a) Configuration management/software updates related to supply chain security, security operating and asset management; b) Multi-Element Controller related to system/component integrity and security endpoints. • Security related content is included in the EULYNX documents Eu.Doc.15, Eu.Doc.114, Eu.Doc.115, Eu.Doc.116, Eu.Doc.117, Eu.Doc.121 which are part of the EULYNX documentation set. For addressing security, System Pillar / EULYNX BL4R2 deliverables also require applying the EULYNX Security documents.

Table 1: Approval statements from cross-domain alignment

6. List of deliverables

Following deliverables are part of the proposed release. The deliverables a subject to domain approval categorized as follow:

- Approved: *Document review and approval*
- Endorsed: *Approval granted, detailed review not applicable as current development is on higher system level*

Document ID	Document Name	Responsible domain (status)	Cross-domain Approval (status)
Eu.Doc.20	Generic interface and subsystem requirements	TACS / approved	ARC / endorsed
Eu.Doc.119	Generic interface and subsystem requirements for SCI	TACS / approved	ARC / endorsed
Eu.Doc.120	Generic interface and subsystem requirements for SMI	TACS / approved	ARC / endorsed
Eu.Doc.92	Interface definition SCI	TACS / approved	TCS / endorsed
Eu.Doc.93	Interface specification SCI Generic	TACS / approved	TCS / endorsed
Eu.Doc.32	Requirements specification for subsystem Light Signal	TACS / approved	TCS / endorsed
Eu.Doc.33	Interface specification SCI-LS	TACS / approved	TCS / endorsed
Eu.Doc.36	Requirements specification for subsystem Point	TACS / approved	TCS / endorsed
Eu.Doc.38	Interface specification SCI-P	TACS / approved	TCS / endorsed
Eu.Doc.45	Requirements specification for subsystem Generic IO	TACS / approved	TCS / endorsed
Eu.Doc.46	Interface specification SCI-IO	TACS / approved	TCS / endorsed
Eu.Doc.43	Requirements specification for subsystem TDS	TACS / approved	TCS / endorsed
Eu.Doc.44	Interface specification SCI-TDS	TACS / approved	TCS / endorsed
Eu.Doc.108	Requirements specification for subsystem Level Crossing	TACS / approved	TCS / endorsed
Eu.Doc.109	Interface specification SCI-LC	TACS / approved	TCS / endorsed
Eu.Doc.18	Maintenance and data management specification	TCCS / approved	TACS / approved ARC / endorsed
Eu.Doc.76	Interface definition and specification SMI	TCCS / approved	TACS / approved ARC / endorsed
Eu.Doc.77	Interface definition SDI	TCCS / approved	TACS / approved ARC / endorsed
Eu.Doc.78	Interface specification SDI-LS	TACS / (approval in progress)	TCCS / (approval in progress)
Eu.Doc.94	Interface specification SDI Generic	TACS / (approval in progress)	TCCS / (approval in progress)
Eu.Doc.80	Interface specification SDI-P	TACS / (approval in progress)	TCCS / (approval in progress)
Eu.Doc.82	Interface specification SDI-IO	TACS / (approval in progress)	TCCS / (approval in progress)
Eu.Doc.81	Interface specification SDI-TDS	TACS / (approval in progress)	TCCS / (approval in progress)
Eu.Doc.110	Interface specification SDI-LC	TACS /(approval in progress)	TCCS / (approval in progress)

Table 2: List of SP/EULYNX BL4R2 deliverables (under SP Technical authority)

7. Overlap of deliverables in the System Pillar and EULYNX

Although the overall top-down development of the System Pillar target architecture is in an early phase, some of the domain results are already on a high technical readiness level due to previous developments in other initiatives. The TACS domain and the TCCS domain are delivering mature specifications, based on previous work by EULYNX. The integration and update of such developments within the System Pillar ensures broad sector acceptance.

Current large investment cycles of infrastructure managers lead to high amount of running and planned projects and corresponding industry developments, all requiring a stable and future-proof basis for procurements and developments. An early publication of available and mature System Pillar results provides the stable basis for current investments, ensuring both migration and compliance to the System Pillar target architecture.

The deliverables of the TACS and TCCS domain are applicable for both the System Pillar future target architecture and the current EULYNX architecture. The goal is to deliver a single set of specifications fitting both the System Pillar documentation set (*BL X.X TBC*) and the EULYNX documentation set for BL4 Release 2, under a single common publication by the System Pillar and EULYNX. The System Pillar is the technical authority for the listed deliverables of Table 2 and will ensure their maintenance.

Separate versions of specifications shall be avoided, and the deliverables shall be maintained in the EULYNX format, maintaining document references, cross-references and traceability to requirement IDs of previous releases already in use and development.

The deliverables of the TACS and TCCS domain which are based on EULYNX will be listed under two publishers: Europe's Rail System Pillar and EULYNX, in order to ensure the fit to both documentation sets. Similarly, the release notes will be prepared separately for the publication of the System Pillar documentation set and for the publication of the EULYNX documentation set. The deliverables will be listed in the System Pillar Standardisation and TSI input plan.

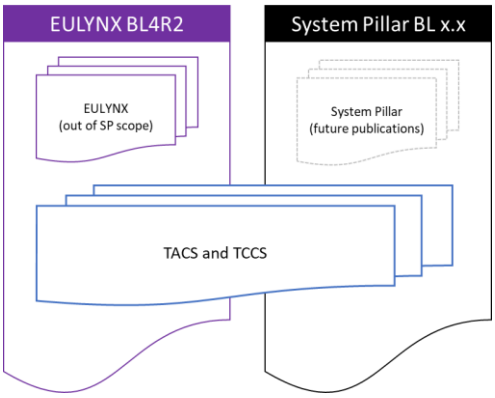


Figure 6: Representation of the single set of specifications from TACS/TCCS published by the System Pillar and EULYNX

8. Roadmap

The main target for 2023 has been to release sector agreed Trackside Assets interface specifications for the System Pillar target architecture (based on EULYNX BL4 R2) and to bring it to the standardisation process. The delivery of the EULYNX BL4 R2 including addressing UNIFE's open comments was therefore the priority for the TACS domain.

In line with the work remit, the TACS domain roadmap shall focus on the following main activities:

- Development and completion of certification test cases
- Investigation and preparation of a modelling update after BL4 R2 to include updates from the methodology perspective.
- Integration and import of the relevant specifications into the System Pillar engineering environment, primarily focussed on System Levels 1-4 in line with the SEMP.
- Contribution and support to the Standardisation and TSI input plan
- Finalise and propose the scope of connected trackside assets, analysing the need for standardised interfaces from the object controllers to the field devices
- Prepare the granularity decision related to the specification of the power supply and power management, accordingly leading to the development of the subsystem Power Supply
- Evaluate the approach of ETCS-compliant interface and protocol solution (together with other domains e.g. Migration) for border signals, fallback signals, and overlayed signals, "showing ETCS DMI information also trackside"

9. TACS alignment with CBOs

At the current state of work, the TACS domain outputs are considered as aligned with the Common Business Objectives of the System Pillar:

CBO	Justification of alignment
Meeting evolving customer requirements	Enable railways to deploy digital solutions by simplifying the access to information available in the standardized architectures: - The outputs from TACS directly contribute by providing standardised access to all available information for trackside assets on standardised interfaces
Improved performance and capacity	Better predict capacity needs of infrastructure - Actual diagnostic data contributes to the flexibility to adjust and optimise the railway service. -
Reduced costs	Reduce life-cycle cost - Standardised trackside assets subsystems and interfaces enable independence of lifecycles from other CCS systems, supporting management of migration, technical obsolescence, mitigating vendor lock-in and extending the lifetime of components with longer lifecycles. Compliant products to TACS interface specifications lead to component exchangeability and easier integration with reduced need for system testing. Deliver affordable system updates - The system design with the maintenance functions supports updates at minimum effort, facilitating migration and integration of updated or additional components Produce solutions that are economically attractive - Harmonised and standardised trackside assets specifications lead to reduction of Capex + Opex from railways and suppliers' points of view. - For suppliers, these enable reduction of country specific product portfolios to one generic European product portfolio allowing important cost reductions for development as well as for the lifecycle management.

	- For railways, these enable decoupling the lifecyles of trackside assets from the interlockings. This reduces cost of projects and adds flexibility for migration. - Market size is importantly increased, from national specific solutions to standard components for the full European market (and beyond)
More sustainable and resilient transport	Manage more efficient energy consumption - Solutions will be explore in later phases Propose proper cyber-security strategy and standards - suitable levels of cyber-security are integrated
Harmonised approach to evolution and greater adaptability	Harmonise operations and strengthen interoperability - With the harmonisation of the functionality, harmonisation of operations related directly to trackside assets becomes enabled (e.g. Train detection systems). This will be an important input to the overall operational design. Standardize architecture - TACS standardisation with modular architecture at European level, including standardisation of interfaces, communications and data exchange
Reinforced role for rail in European transport and mobility	Improve methods and tooling - TACS domain is working with model based systems engineering approach Fast migration and Rollout - TACS specifications enable a future proof migration strategy, where trackside assets investments are protected and backwards and forwards compatible
Improved EU rail supply industry competitiveness	Leverage on European rail technical expertise for other regional areas - Global interest and worldwide adoption promote the European railway system, as noted already on globally recognised EULYNX specifications, which form the basis for TACS specifications