Rail to Digital automated up to autonomous train operation

D23.2 – Definitive and aligned requirements set for Onboard Communication Network and Basic Services

Due date of deliverable: 2023-07-31

Actual submission date: 2023-07-31

Leader/Responsible of this Deliverable: Roelle, H.; SMO

Reviewed: Y

Document status		
Revision	Date	Description
01	2023-07-24	Submission from workgroup to TMT, reviewed by all WP members
02	2023-12-18	Submission from workgroup to SteerCo. Incorporated comments from TMT review. Not explicitly reviewed by whole group, as only minor comments (typos, wrong reference, minor clarifications) were given.
03	2024-08-19	Resubmission from workgroup to JU after incorporating review comments from JU and System Pillar.
04	2024-12-12	Resubmission to JU after correction of line breaks (MCP#2).

Project funded from the European Union's Horizon Europe research and innovation programme		
Dissemination Level		
PU	Public	X
CO	Confidential, restricted under conditions set out in Model Grant Agreement	

Start date: 01/12/2022

Duration: 42 months

ACKNOWLEDGEMENTS

REPORT CONTRIBUTORS

Name	Company	Details of Contribution
Moritz, M.	DB	System requirements, second opinion, review
De Paola, E.	DB	System requirements, second opinion, review
Ahmed, Z.	DB	System requirements, second opinion, review
Rozijn, P.	NS	System requirements, second opinion, review
Schuerch, S.	SBB	System requirements, second opinion, review
Knollmann, V.	SMO	System requirements, second opinion, review
Rahn, K.	SMO	System requirements, second opinion, review
Roelle, H.	SMO	System requirements, second opinion, review
Daniel, C.	SNCF	System requirements, second opinion, review
Roullier, S.	SNCF	System requirements, second opinion, review

Disclaimer

EXECUTIVE SUMMARY

The present document constitutes the Deliverable D23.2 "Definitive and aligned requirements set for Onboard Communication Network and Basic Services" in ERJU's R2DATO WP23 T23.2.

The deliverable is the second of a series of deliverables leading to a proposal for the next TSI 202x (after the release of that deliverable) for the future common onboard communication network.

The system requirements have a strong focus on WP23 but also contain a few high-level requirements pertaining to WP24, which focusses on the management of the Onboard Communication Network, in paragraph 2.5.Thus, this document paves the way for further elaboration of the communication functionality in WP23 and leaves the definition of the corresponding management to documents that will be created in WP24.

In this deliverable 88 system requirements from all relevant stakeholders are presented. Although a significant effort was made to make the list as complete as possible, changes or extensions might be necessary due to insights gained in later phases of WP23 or WP24.

ABBREVIATIONS AND ACRONYMS

ATO	Automatic Train Operation
CCS	Control, Command and Signalling
CCTV	Closed-Circuit Television
FRMCS	Future Rail Mobile Communication System
GoA	Grade of Automation
HW	Hardware
MAC	Media Access Control
OSI	Open Systems Interconnection
PoC	Proof of Concept
QoS	Quality of Service
R2DATO	Rail to Digital automated up to autonomous train operation
RPC	Remote Procedure Call
SIL	Safety Integrity Level
SW	Software
TCMS	Train Control and Management System
TOC	Train Operating Company[1]
TRL	Technical Readiness Level
TSI	Technical Specification of Interoperability
WP	Work Package

---

[1] The term "TOC" was chosen intentionally. To make clear that in commercial setups where responsibility for the track and responsibility for the trains is within different companies, that the interests of train running company are addressed.

TABLE OF CONTENTS

1   INTRODUCTION

The present document constitutes the Deliverable D23.2 "Definitive and aligned requirements set for Onboard Communication Network and Basic Services" in ERJU's R2DATO WP23 T23.2.

The deliverable is the second of a series of deliverables leading to a proposal for the next TSI 202x (after the release of that deliverable) for the future common onboard communication network.

To shape and guide the technical specification of WP23 and later WP24, WP23 takes a top-down approach first. This means:

- The WP's work starts from the application and stakeholder perspective to first define scope and cornerstones of the future work (top level view). Main deliverable here is as a comprehensive set of user stories (see deliverable WP23-D23.1).

- Based on the user stories as guiding input, a set of system requirements for the communication functionality has been derived (this document).

- Next steps and deliverables in WP23 will explore possible solutions for the system requirements presented here.

- Later WP24 will start from the user stories in the first WP23 deliverable and concentrate on the technical management functionality and associated processes. By using the common user stories both WP23 and WP24 share the same scoping, thus leading to matching specifications.

Although a significant effort was made to make the list as complete as possible, changes or extensions might be necessary due to insights gained in later phases of WP23 or WP24.

2   SYSTEM REQUIREMENTS

2.1 STRUCTURE OF SYSTEM REQUIREMENTS

The system requirements presented in the following chapters follow an easy to comprehend structure. First of all, the list of requirements is split into separate chapters for functional requirements (chapter 2.3) and non-functional requirements (chapter 2.4). Then each of these chapters contains a table of the requirements as such with the following attributes for each entry:

1. ID: Identification number of the respective requirement.

2. Category: a high-level scope criterion such as "Communication Patterns", "Security", etc.

3. The requirement text itself

4. Rationale / comment: background for the requirement and/or guidance how the requirement should be interpreted or applied.

5. Covered by TSI 2023: whether the requirement has already been considered by the TSI 2023.

Chapter 2.5 concludes the list with requirements that are in the scope of WP24 but that "should not be forgotten" for now.

2.2 UNIVERSAL ADDITIVE EXPLANATORY NOTES

For the following system requirements please keep the following scoping and universal explanatory notes in mind:

1. In all requirements, the term "network" refers to a train's Onboard Communication Network. It does NOT refer to the railroad network.

2. From FRMCS it has been advertised that there might be additional system security requirements added later in the project. As soon as they are available, they will be incorporated. As the system security requirements are presently already quite elaborate, the team of WP23 does not expect any significant impact caused by the late supplement.

3. The present list heavily builds up on the list of requirements developed in course of Subset-147 of TSI 2023. Thus, a solid base for continuity from TSI 2023 to the next release is ensured.

4. The requirements incorporate those from CONNECTA where applicable to the CCS domain and being solution agnostic.

5. The representatives of the OCORA group who participate in WP23 have explicitly confirmed that the OCORA requirements for a common onboard communication network are included in the present list.

Regarding traceability to User Stories of D23.1, the structure of this chapter delivers the following traceability:

1. In the first, the requirements of section 2.3 and 2.4 are universal to all User Stories. As the User Stories in fact will be addressed by the focus of WP24, the requirements deliver the basis for realizing the management functionality of the User Stories

2. Section 2.5 contain requirements specific for the User Stories and will be used in WP24. The individual traceability to the respective User Stories will be done by WP 24.

ID	Category	Requirement: "The Communication Infrastructure Technology Stack shall…"	Rationale / Comment	Covered by TSI2023
ComStackReq-Func-01	Scope	… enable consist-local communication.	Driven by EN 61375-3. Could be later extended to also cover inter-consist communication.	–
ComStackReq-Func-02	Scope	... define a communication model.	Main purpose for communication technology. Defining - communicating partners - communication mechanisms - syntax and semantics of protocol data structures and exchange formats on their respective OSI layers. Requirement is related to OSI layers 1 to 6. Implicit model already covered in Subset-147. Must be made explicit/eventually expanded.	–
ComStackReq-Func-03	Scope	… NOT take passenger entertainment/passenger internet access in scope.	Motivated by security, bandwidth and operational considerations; not to be confused with passenger information systems.	–
ComStackReq-Func-04	Communication Patterns	... support 1-to-1 communication patterns.		–
ComStackReq-Func-05	Communication Patterns	... support 1-to-many communication patterns.	Especially for process data communication this pattern is useful. Preferably realized on lower layers to avoid high load towards application layer. Makes higher layer protocols simpler if already available on lower layers, saves performance and is also more efficient in hardware use.	–

ID	Category	Requirement: "The Communication Infrastructure Technology Stack shall…"	Rationale / Comment	Covered by TSI2023
ComStackReq-Func-06	Power Supply Functions	… support the possibility to transmit power over the communication bus to the devices.	Reduce cabling. Using the bus supplied power must not be mandatory but optionally possible. Main driver to make it optional is to avoid unnecessary cost from having all switch ports to supply power.	X
ComStackReq-Func-07	Communication Functions	... enable train-local real-time data exchange for process data.	Overall interpretation of real-time: Motion-control quality is NOT intended. (See also non-functional requirements)	–
ComStackReq-Func-08	Communication Functions	... enable train-local non-real-time data exchange.		–
ComStackReq-Func-09	Communication Functions	… not prevent realization of future remote real-time data exchange for process data.	Very likely needed for higher GoA levels (e.g., for remote train operation).	–
ComStackReq-Func-10	Communication Functions	... enable remote non-real-time data exchange.	Needed for today's non-CCS-specific train/wayside connectivity (e.g., remote software updates, remote diagnostics, FRMCS services, etc.)	–
ComStackReq-Func-11	Communication Functions	... enable train-local process data communication.	Perspective of a generic use-case. Typically, with a cyclic communication pattern. Shall have real-time capabilities, as of ComStackReq-Func-07	–
ComStackReq-Func-12	Communication Functions	… enable train-local message data communication.	Perspective of a generic use-case. Typically, with a spontaneous/event driven/acyclic communication pattern.	–
ComStackReq-Func-13	Communication Functions	... enable train-local stream data communication.	E.g., audio and camera streams (not only for CCTV, also for higher GoA levels). Perspective of a generic use-case.	–

ID	Category	Requirement: "The Communication Infrastructure Technology Stack shall…"	Rationale / Comment	Covered by TSI2023
ComStackReq-Func-14	Communication Functions	... enable train-local bulk data communication.	E.g., file transfer. Perspective of a generic use-case.	–
ComStackReq-Func-15	Communication Functions	... enable train-local RPC communication.	Especially for network- and application-management functions. Especially to relief applications from relating request to replies.	–
ComStackReq-Func-16	Communication Functions	… allow/not prevent the realization of remote process data communication.	This is a "heads-up" requirement to remind of implications on remote communication, esp. for OSI layers >2	–
ComStackReq-Func-17	Communication Functions	… allow/not prevent the realization of remote message data communication.	This is a "heads-up" requirement to remind of implications on remote communication, esp. for OSI layers >2	–
ComStackReq-Func-18	Communication Functions	… allow/not prevent the realization of remote stream data communication.	This is a "heads-up" requirement to remind of implications on remote communication, esp. for OSI layers >2	–
ComStackReq-Func-19	Communication Functions	… allow/not prevent the realization of remote bulk data communication.	This is a "heads-up" requirement to remind of implications on remote communication, esp. for OSI layers >2	–
ComStackReq-Func-20	Communication Functions	… allow/not prevent the realization of remote execution communication.	This is a "heads-up" requirement to remind of implications on remote communication, esp. for OSI layers >2	–
ComStackReq-Func-21	Consolidation	... enable the consolidation of today's physical on-board communication networks into logical communication networks on a shared physical infrastructure.	Purpose of the "OneCommonBus" approach, reduce the number and variety of physical networks on a train.	X
ComStackReq-Func-22	Consolidation	... enable the consolidation of distinct zones of differing criticality on a shared physical infrastructure.	Purpose of the "OneCommonBus" approach, reduce the number and variety of physical networks on a train.	X

ID	Category	Requirement: "The Communication Infrastructure Technology Stack shall…"	Rationale / Comment	Covered by TSI2023
ComStackReq-Func-23	Consolidation	… provide appropriate separation mechanisms for consolidated (=former physically separated) on-train communication networks/zones.	Basic prerequisite for any consolidation is to realize an equivalent level of separation	X
ComStackReq-Func-24	Consolidation	… provide means to manage and configure QoS classes. Each class defines a set of typical QoS parameters such as bandwidth, delay and jitter.		–
ComStackReq-Func-25	Consolidation	… provide prioritization/QoS mechanisms based on the QoS class that is assigned to a given application or service.		–
ComStackReq-Func-26	Consolidation	… be able to consolidate FRMCS and CCS zones on the same on-train communication network on a shared physical infrastructure.	Zones serve here as an example, also number not limited	–
ComStackReq-Func-27	Consolidation	… be able to consolidate TCMS zone and OMTS zone on same on-train communication network on a shared physical infrastructure.	Zones serve here as an example, also number not limited. OMTS = Onboard Multimedia and Telematic Subsystem (new term from IEC 62580)	–
ComStackReq-Func-28	Consolidation	… enable building vehicles with a single on-train communication network consist over multiple cars.	Explicitly leave the vehicle architecture open for vendors to enable cost efficient designs. Be able to build up multiple car consists.	–
ComStackReq-Func-29		… allow/not prevent the interoperability of end devices of different vendors.	This shall be achieved by unambiguous specifications and possibly by establishing conformance tests. This includes the interoperability between end device and network device because w/o that interoperability the end-to-end communication wouldn't be possible.	–
ComStackReq-Func-30		… allow/not prevent the interoperability of end devices of different product generations.	This shall be achieved by downward compatible evolution of standards and suitable version management.	–

ID	Category	Requirement: "The Communication Infrastructure Technology Stack shall…"	Rationale / Comment	Covered by TSI2023
			This includes the interoperability between end device and network device because w/o that interoperability the end-to-end communication wouldn't be possible. The usage of legacy end devices might require gateway functionality.	
ComStackReq-Func-31		… allow/not prevent the interoperability of network devices of different vendors.	This shall be achieved by unambiguous specifications of network device capabilities and possibly by establishing conformance tests.	–
ComStackReq-Func-32		… allow/not prevent the interoperability of network devices of different product generations.	This shall be achieved by downward compatible evolution of standards and suitable version management and possibly by establishing conformance tests.	–

ID	Category	Requirement: "The Communication Infrastructure Technology Stack shall…"	Rationale / Comment	Covered by TSI2023
ComStackReq-NonFunc-01	Interoperability	… come with compliance testing and certification processes in a lightweight way.	Foster interchangeability and second source approach. Lightweight means, that that testing procedures shall be available from external sources (paid or unpaid) and applying them shall cause no significant extra effort in development, e.g. by implementing extra test cases during development.	–
ComStackReq-NonFunc-02	Maintainability	…ease failure detection for maintenance activities.	Improve defect handling and maintenance. Stems from maintenance scenarios where identifying a fault situation should be as easy as possible. Applies to end-devices and border-network-devices.	–
ComStackReq-NonFunc-03	Maintainability	… support an exchange of devices with low configuration effort. Low configuration effort means that no other end-device shall be affected and configuration activities shall be made centrally.	Improve defect handling and maintenance. Stems from maintenance scenarios where exchanging a faulty asset should be as easy as possible (e.g., no dependency on device MAC addresses). Applies to end-devices and border-network-devices.	–
ComStackReq-NonFunc-04	Compatibility	… provide mechanisms to enable / support compatibility management for any given set of functionalities.	Allow for future extension of protocol stacks or even hardware upgrades. Example: protocol version negotiation during the TLS handshake or 10/100/1000 MBit/s capabilities of Ethernet ports.	–

ID	Category	Requirement: "The Communication Infrastructure Technology Stack shall…"	Rationale / Comment	Covered by TSI2023
			Preserve compatibility while enabling innovation	
ComStackReq-NonFunc-05	Portability	… be platform-independent (HW from SW). There shall be no dependency to a specific CPU model or platform or specific ethernet hardware.	Decoupling and flexibility in hard- and software.	–
ComStackReq-NonFunc-06	Portability	… support different physical topologies such as star, ring, ladder and hybrids of these	Enable adequate topologies for different vehicle architectures	X
ComStackReq-NonFunc-07	Portability	… support at least links over copper cables.	Serves as the common base for interoperability.	X
ComStackReq-NonFunc-08	Portability	… support links over fibre.	Openness for future technologies.	X
ComStackReq-NonFunc-09	Portability	… use standardized physical connectors for devices.	Refers to a typical real-world problem. Solution shall refer to a standard like IEC etc.	X
ComStackReq-NonFunc-10	Adaptability	… not imply the use of a specific programming language/environment.	Leave the flexibility to realize cost effective solutions and enable innovation.	–
ComStackReq-NonFunc-11	Adaptability	… not enforce a specific operating system.	Leave the flexibility to realize cost effective solutions and enable innovation.	–
ComStackReq-NonFunc-12	Adaptability	… not imply specific types of hardware technology on components (e.g., CPU family).	Leave the flexibility to realize cost effective solutions and enable innovation.	–
ComStackReq-NonFunc-13	Adaptability	… be deployable and usable on a variety of (component) device classes, from low-end microcontrollers to high-end computing devices.	Leave the flexibility to realize cost effective solutions and enable innovation, especially for simple end devices like sensors.	–

ID	Category	Requirement: "The Communication Infrastructure Technology Stack shall…"	Rationale / Comment	Covered by TSI2023
ComStackReq-NonFunc-14	Safety	… support different levels of safety concurrently without forcing all entities to follow the highest safety level.	Enable cost effective solutions. Avoid unnecessary complexity for applications that only need lower safety levels.	–
ComStackReq-NonFunc-15	Safety	… support the implementation of safety layers for functions with safety requirements up to SIL 4.	Typically, such implementations involve the safety requirements of EN 50159:2010 for railway safety applications.	–
ComStackReq-NonFunc-16	Security	… support authentication of communication entities.	Only allow authorized devices. Base for authorization. Parts already addressed in TSI2023 SS147.	–
ComStackReq-NonFunc-17	Security	… support the auditing of communication activities.	Allow to build trace infrastructure on usage of illegal/offending devices	–
ComStackReq-NonFunc-18	Security	… provide optional encryption functionality towards the application layer to allow for data confidentiality. The necessary encryption functionality shall be available for all communication patterns and functions.		–
ComStackReq-NonFunc-19	Security	… provide optional disclosure of intentional data integrity violations towards the application layer. The necessary integrity checking functionality shall be available for all communication patterns and functions.	Prevent attacks based on data manipulation, man-in-the-middle attacks, replay etc. This requirement is independent from any checks to disclose unintentional changes e.g. by bit errors.	–
ComStackReq-NonFunc-20	Security	… support integrated authorization of communication activities.	Even if authorization decisions as such are made on higher layers, the enforcement of those decisions (esp. negative ones) shall be supported on the lower layers.	–

ID	Category	Requirement: "The Communication Infrastructure Technology Stack shall…"	Rationale / Comment	Covered by TSI2023
			Parts of this concept are already addressed in TSI2023 SS147. More details on this requirement are expected from ERJU System Pillar.	
ComStackReq-NonFunc-21	Security	… ease and support the management (distribution, renewal, revocation …) of authentication credentials (e.g., certificates)		–
ComStackReq-NonFunc-22	Security	… be resilient to (D)DoS attacks.	Base for consolidation	–
ComStackReq-NonFunc-23	Security	… support different levels of security concurrently without forcing all entities to follow the highest security level.	Enable cost effective solutions. Avoid unnecessary complexity for application that only need lower security levels.	–
ComStackReq-NonFunc-24	Openness	… be based on publicly available and open standards, developed by a transparent and standardized process.	Should be aligned with European Standardization Policies. Base for interoperability	–
ComStackReq-NonFunc-25	Cost	… avoid any unnecessary cost (e.g., royalties for standards).	Enable cost efficient solutions	–
ComStackReq-NonFunc-26	Adaptability	… able to provide different stages of features to enable cost effective, "fit-to-the problem" solutions.	Enable cost efficient solutions and/or application-specific feature profiles.	–
ComStackReq-NonFunc-27	Availability	… provide redundancy mechanisms to bypass failures of components of the on-train communication network component/link.	Realizing availability solely by component MTBFs would be very costly. Therefore, redundancy mechanisms shall be available. Partially handled by TSI2023 SS147.	–

ID	Category	Requirement: "The Communication Infrastructure Technology Stack shall…"	Rationale / Comment	Covered by TSI2023
ComStackReq-NonFunc-28	Availability	… define a typical upper limit for acceptable communication outage time (e.g., by redundancy switchover).	Needed by the application layer to provide mechanisms to cope with the downtime.	–
ComStackReq-NonFunc-29	Latency	… provide latency low enough to enable clock synchronization with an accuracy of 1ms between end devices (local consist scope!).	Typical use case in CCS applications; latency related.	–
ComStackReq-NonFunc-30	Latency	… provide latency limited to max 10 ms for process data (local consist scope!).	Typical use case in CCS applications; latency related.	–
ComStackReq-NonFunc-31	Latency	… provide latency limited to max 100 ms for spontaneous/event-driven communication (local consist scope!).	Typical use case in CCS applications; latency related.	–
ComStackReq-NonFunc-32	Jitter	… provide jitter low enough to enable clock synchronization with an accuracy of 1 ms between end devices (local consist scope!).	Typical use case in CCS applications; jitter related.	–
ComStackReq-NonFunc-33	Jitter	… provide jitter limited to max 10 ms for process data (local consist scope!).	Typical use case in CCS applications; jitter related.	–
ComStackReq-NonFunc-34	Bandwidth	… support a minimum link speed of 1 GBit/s on all shared links.	1GBit/s is current sweet spot of capacity/flexibility vs. Cost. 100 Mbit/s too slow for shared links.	X
ComStackReq-NonFunc-35	Bandwidth	… allow link speeds of 100 MBit/s for end devices, full and half duplex.	Enable migration of existing devices	X
ComStackReq-NonFunc-36	Bandwidth	… use cabling that is prepared for 10 GBit/s link speeds.	Cabling hard to change but (almost) at same price as for 1 Gbit/s	X

ID	Category	Requirement: "The Communication Infrastructure Technology Stack shall…"	Rationale / Comment	Covered by TSI2023
ComStackReq-NonFunc-37	Bandwidth	… use (passive) coupling devices (connector between coaches/cars) that are prepared for 5 GBit/s link speeds.	Couplers major cost drivers. Cost wise 5 GBit/s << 10 GBit/s, with 5 GBits/s likely to be sufficient for next five years. Topic not yet addressed in TSI.	–
ComStackReq-NonFunc-38	Bandwidth	… shall provide different link speeds towards end devices.	Migration scenarios. Forward/backward compatibility	X
ComStackReq-NonFunc-39	Scalability	… support at least 4000 nodes on one consist-local network.	Mostly TCMS-related requirement. CCS has a comparably low number of nodes.	–
ComStackReq-NonFunc-40	Scalability	… allow at least a physical distance between two nodes of 100 m.		X
ComStackReq-NonFunc-41	Scalability	… allow at least a total extent of a single consist (from leftmost to rightmost node) of 500 m.		(X)
ComStackReq-NonFunc-42	Maturity	… make use of functionality that is available on the market.	Avoid getting trapped by vaporware or delayed realization of standards. Example for a standard not being available on the market for now 10 years: 802.1X-2010	–
ComStackReq-NonFunc-43	Maturity	… make use of solutions that are available from multiple vendors.	No vendor lock in. Attractive price points.	–
ComStackReq-NonFunc-44	Maturity	… make use of proven technology.	Required base for reliable vehicles. Proof can come from a TRL-7+ either from the rail sector or a comparable level from a different sector.	–
ComStackReq-NonFunc-45	Maturity	… use components that are available in significant quantities.	Kind of heads-up requirement. Need to at least estimate market available quantities.	–

ID	Category	Requirement: "The Communication Infrastructure Technology Stack shall…"	Rationale / Comment	Covered by TSI2023
			Supply chain availability. Attractive price points.	
ComStackReq-NonFunc-46	Maturity	… be supported by a community approach.	Quality in use rises with support being available	–
ComStackReq-NonFunc-47	Maturity	… be supported by commercial consulting services.	Quality in use rises with support being available	–

2.5 ADDITIONAL SERVICE FUNCTION AND MANAGEMENT REQUIREMENTS

ID	Category	Requirement: "The Communication Infrastructure Technology Stack shall…"	Rationale / Comment	Covered by TSI2023
ComStackReq-Mngt-01	Service Functions	… provide health status of network devices.	Might be pushed to WP24 in the future.	–
ComStackReq-Mngt-02	Service Functions	… provide configuration support to add new network devices.	Might be pushed to WP24 in the future.	–
ComStackReq-Mngt-03	Service Functions	… provide service to give/control priorities/data flows.	Might be pushed to WP24 in the future.	–
ComStackReq-Mngt-04	Service Functions	… provide service to remotely upgrade/configure network devices.	Might be pushed to WP24 in the future.	–
ComStackReq-Mngt-05	Service Functions	… be able to replace defective network devices so that communication is continued and without major configuration efforts.	Might be pushed to WP24 in the future.	–

ID	Category	Requirement: "The Communication Infrastructure Technology Stack shall…"	Rationale / Comment	Covered by TSI2023
ComStackReq-Mngt-06	Service Functions	… provide a service to provide a list of all configured network and end devices along with their identities and data models and/or services they provide.	Might be pushed to WP24 in the future.	–
ComStackReq-Mngt-07	Service Functions	… provide a service to provide key performance indicators (e.g., bandwidth) of the network and its devices so that the identification of bottlenecks or other critical issues is possible.	Might be pushed to WP24 in the future.	–
ComStackReq-Mngt-08	Service Functions	… provide communication mechanisms for remote software updates.	Typical example for management functionality that must not be forgotten. Might be pushed to WP24 in the future.	–
ComStackReq-Mngt-09	Service Functions	… provide communication mechanisms for remote parameter setting.	Typical example for management functionality that must not be forgotten. Might be pushed to WP24 in the future.	–

Intern

3   OPEN POINTS

The first deliverable in WP24 will be D24.1 – Definitive and aligned requirements set for managing an Onboard Communication Network and concluded selection of suitable management Functionality. This deliverable overlaps partly with the requirements stated in paragraph 2.5 so requirements from paragraph 2.5 may be moved to D24.1 and updated./re-considered in WP24 as that work package will analyse the management part of the Onboard Communication Network in greater detail then WP23.

Requirements in this deliverable may be added or updated due to new insights from the later phases of WP23 and WP24.

4   CONCLUSIONS

The present document constitutes the Deliverable D23.2 "Definitive and aligned requirements set for Onboard Communication Network and Basic Services".

The system requirements have a strong focus WP23 but also contain a few high-level requirements pertaining to WP24 which are stated in paragraph 2.5 Thus, this document paves the way for further elaboration of the communication functionality in WP23 and leaves the definition of the corresponding management to documents that will be created in WP24. Requirements stated in paragraph 2.5 may be moved to D24.1 of WP24 which focusses on the requirements for management of the Onboard Communication network.

In this deliverable 88 system requirements from all relevant stakeholders are presented. Although a significant effort was made to make the list as complete as possible, changes or extensions might be necessary due to insights gained in later phases of WP23 or WP24.

By having completed T23.1 and T23.2, WP23 will now switch from the analysis in "problem space" into the phase of working in "solution space". With our two deliverables D23.1 and D23.2, a sound and dependable base is available for our next steps which include the following deliverables for WP23:

- Concrete candidates of technologies for OSI layer 3-6 and for assoc. basic services (D23.3)

- Proposal for Subset 147 of TSI202x for Onboard Communication Network (aka One Common Bus) on layer 1-6 (D23.4)

- Documentation of the realized proof-of-concepts for communication technologies (D23.5)

- Conceptual description on how homologation for a concrete Onboard Communication Network shall be done (D23.6)

WP24 will use the user stories from D23.1 and the requirements from this deliverable D23.2 as a starting point for the analysis of the management functions needed for the Onboard Communication Network.