Rail to Digital automated up to autonomous train operation

D23.1 – List of user stories for the Onboard Communication Network

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EXECUTIVE SUMMARY

The present document constitutes the Deliverable D23.1 "List of user stories for the Onboard Communication Network" in ERJU's R2DATO WP23 T23.1.

The deliverable is the first 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 user stories serve as a common ground for both WP23 and WP24. This leads to a shared scoping, thus leading to matching specifications for communication functionality on the one hand and the corresponding management functionality on the other hand. In both WPs the user stories will serve as an input to ensure to include all the necessary communication/management functionalities to enable the realization of the user stories.

In this deliverable 42 user stories from all relevant stakeholders are presented. For these stories a total of 16 business drivers were identifies and the stories are clustered into 9 technical categories.

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
ERJU	Europe's Rail Joint Undertaking
ID	Identification number/token
PoC	Proof of Concept
R2DATO	Rail to Digital automated up to autonomous train operation
TOC	Train Operating Company[1]
WP	Work package

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[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.

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1   INTRODUCTION

The present document constitutes the Deliverable D23.1 "List of user stories for the Onboard Communication Network" in ERJU's R2DATO WP23 T23.1.

The purpose of WP23 and WP24 is to define the "Onboard Communication Network" for realizing CCS applications on top of it (in the sense of stacked communication architecture). The Onboard Communication Network serves as the communication backbone inside a train for those CCI applications. In contrast to a concrete application, the Onboard Communication Network's purpose is to define common technologies suitable for all kind of CCS applications.

The deliverable is the first 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 (this document).

- Next WP23 will take this scoping as guiding input for the requirements specification of the communication functionality itself.

- Later WP24 will take the same scoping but will concentrate on the technical management functionality and associated processes.

To sum it up, the purpose of this document is to give WP23 and WP24 the same scoping by sharing common user stories, thus leading to matching specifications later on. As the Onboard Communication Network shall provide communication functionality for CCS applications, the scoping will be used to select all the technology needed to cover CCS applications' communication needs.

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.

1.1   ON THE CHANGE FROM USE CASES TO USER STORIES

In "GRANT AGREEMENT Project 101102001 — FP2 - R2DATO", this deliverable's title is defined as "D23.1 – List of use cases for the Onboard Communication Network" (defined as deliverable on page 136, title also referred on pages 12 and 105).

In contrast to the Grant Agreement, the authors of this deliverable jointly decided to switch from Use Cases to User Stories for the following reasons.

First, it needs to be stated, that Use Cases don't have a consistent, universal definition. Martin Fowler[2] states "There is no standard way to write the content of a use case, and different formats work well in different cases." [3]

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[2] Martin Fowler is a British software developer, author and international public speaker on software development, specialising in object-oriented analysis and design, UML, patterns, and agile software development methodologies, including extreme programming.

[3] https://en.wikipedia.org/wiki/Use_case

According to Alistair Cockburn[4], Use Cases in their most extensive way typically define 13 properties[5], which ideally shall be described in an extensive way that one can ideally directly derive an implementation of it.

On the one hand, as the architecture and technology for the middle layers of the Onboard Communication Network will be the result of this WP, many of the details required for extensive Use Cases are not yet available. On the other hand, the purpose of this deliverable is to identify the usage scenarios for the Onboard Communication Network from the perspective of all the relevant stakeholders. This serves as an input for the requirements identification to avoid blind spots in the requirements gathering. The granularity of extensive Use Cases is neither required nor helpful for this purpose.

Fowler and Kent Beck[6] use a very stripped-down variant of Use Cases: Fowler states: "It is all about how people use cases. I've seen many people use cases in a very formalized manner. Kent (Beck) does his User Stories in a much more approachable manner. I do use cases the way Kent does User Stories. I call them to use cases to better communicate with other developers and to influence them to use a more lightweight approach."[7]

For the reasons laid out above, User Stories are the more adequate tool for the purpose of the document, the phase of the project, all without harming the value for effort/money spent. For the sake of clarity, the authors of this deliverable concluded to use the term User Stories. Therefore, the decision was made to provide "User Stories" instead of "Use Cases".

In the Grant Agreement, this deliverable's content is described as "Use cases from the perspective of all relevant stakeholders (manufacturers, sub system suppliers, railway undertakings)" (page 136). Independent from switching to User Stories, the deliverable needs to address the named stakeholders. Here, the deliverable goes beyond the Grant Agreement, using a finer grained role model (train manufacturer, train operating company (TOC), train driver, maintainer, 3rd party (subsystem suppliers)).

While switching to User Stories, the deliverable even goes beyond a usual User Story. Every User Story is enhanced by giving a motivation/driver for it, making it more comprehensible for the reader. Second addition made is giving an extra structuring/clustering from a technical perspective, thus supporting in deriving requirements and structuring them.

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[4] Alistair Cockburn is an American computer scientist, known as one of the initiators of the agile movement in software development.

[5] https://en.wikipedia.org/wiki/Use_case

[6] Kent Beck is an American software engineer and the creator of extreme programming and was one of the 17 original signatories of the Agile Manifesto, the founding document for agile software development..

[7] User Story And Use Case Comparison, http://wiki.c2.com/?UserStoryAndUseCaseComparison, Retrieved 19 January 2024

2   USER STORIES

2.1 STRUCTURE OF USER STORIES

The user stories presented in the following chapter follow an easy to comprehend structure:

1. ID: Identification number of the respective user story. Please note, that some numbers are missing in the enumeration. This is by intention and is a result of a consolidation of the intermediate list of collected user stories.

2. Actor: The acting role of the user story, respectively the mainly interested role. One or more of the following stakeholders:

    -   Train manufacturer

    -   Train operating company (TOC)

    -   Train driver

    -   Maintainer

    -   3rd party

3. User Story: The user story itself, written in the form: "As a <role>, I want <goal/desire> so that <benefit>"

4. Driver 1 and 2: One or two main drivers/motivation of the stakeholder for submitting the story. More from a business perspective than from a technical perspective.

5. Technical Cluster: In contrast to the more business-oriented drivers this category is a technical oriented clustering of the user stories, which will help to derive technical requirements in the following project phase. Mostly orthogonal to the drivers, but not completely.

2.2 UNIVERSAL ADDITIVE EXPLANATORY NOTES

For the following user stories please keep the following scoping and universal explanatory notes in mind:

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

2. Ubiquitous non-functional properties are not explicitly mentioned. These include, but are not limited to:

    a. **Security**: All activities must maintain an adequate level of security. Therefore, the onboard communication technology needs to support this.

    b. **Performance**: For any activity that is constrained by a certain execution time or requires certain performance properties, the onboard communication technology needs to support this.

    c. **Safety**: For any activity that is constrained by a certain security level, the onboard communication technology needs to support this.

Deliverable D23.2 will explicitly list those non-functional requirements that result from the here presented user stories.

ID	Actor	User Story	Driver 1	Driver 2	Technical Cluster
10002	TOC	As a TOC, I want to assess the health status of the network so that can decide whether corrective actions on network devices are necessary.	Corrective Maintenance	Monitoring	Monitoring
10003	TOC	As a TOC, I want to assess the health status of the end-devices so that can decide whether corrective actions on the end-devices are necessary.	Corrective Maintenance	Monitoring	Monitoring
10004	Train manufacturer / TOC	As a Train Manufacturer/TOC, I want to be able to add new end or network devices in the network without heavy/complex configuration tasks and without assistance (esp. from the manufacturer) so that PoC/new services deployment are made easy.	Extension	Interoperability	Network device changes
10005	TOC	As a TOC, I want to be able to add new end devices on the network without breaking the homologation status so that PoC/new services deployment are made easy	Extension	Regulation	RAMS
10006	TOC	As a TOC, I want to be able to deploy a service on board requiring communication with servers in the ground without heavy/complex configuration tasks and without assistance from the manufacturer so that PoC/new services deployment are made easy	Extension	Interoperability	Logical communication relations

ID	Actor	User Story	Driver 1	Driver 2	Technical Cluster
10010	TOC	As a TOC, I want to be able to allow/forbid data exchanges between different services/end-devices so that there are no irrelevant communications on the network	Operations	Maintenance	Logical communication relations
10012	Maintainer / TOC	As a maintainer or TOC, I want to block unauthorized devices so that they can neither use the network neither communicate with other devices	Operations	Maintenance	Security
10013	TOC	As a TOC, I want to be able to give priority to some flows over some others for a given end-device/group of end devices so that the available bandwidth is properly used. For e.g., a safety traffic should be given priority over monitoring traffic (NB: a given end-device may use both types of traffic)	Operations	Maintenance	Logical communication relations
10015	TOC	As a TOC, I want to be able to remotely upgrade/configure any end-device or network-device so that there is no need to send someone on board to perform this task or restarting the network.	Maintenance	Cost reduction	Maintenance
10016	TOC	As a TOC, I want to be able to access any end-device from a single physical connection to the consist network in order to perform maintenance tasks so that there is no need to move from one point to another while maintaining different systems/end devices connected to the network.	Maintenance	Cost reduction	Logical communication relations

ID	Actor	User Story	Driver 1	Driver 2	Technical Cluster
10017	TOC	As a TOC, I want to be informed when any unusual traffic occurs so that corrective actions can be taken	Maintenance	Monitoring	Monitoring
10018	TOC / train manufacturer	As a TOC I want to be able to power some end-devices through the communication cables to save cables/weight/space/costs	Maintenance	Cost reduction	Engineering
10020	Train driver / maintainer	As a train driver or maintainer, I want to power up the train (worst case: from a completely powerless state) so that the train becomes ready for operation, which implies that the onboard network and all its devices are configured and able to communicate with each other.	Operations		Power on / Power off
10021	Train driver / maintainer	As a train driver or maintainer, I want to power down the train (worst case: to a completely powerless state) without harming the onboard network devices.	Operations		Power on / Power off
10022	Train manufacturer	As a train manufacturer, I want to put end devices (or even network devices?) into a "non-communicating state" without disrupting the overall network functionality. Rational: putting devices into an energy saving mode for example.	Operations		Network device changes
10023	Train manufacturer / TOC	As a train manufacturer, I need uninterrupted network functionality and no impact on safety if network-devices or end-devices fail.	Operations	Safety	RAMS

ID	Actor	User Story	Driver 1	Driver 2	Technical Cluster
10024	Train manufacturer	As a train manufacturer, I want to dynamically "wake up" devices from a non-communicating state so that these devices can resume their normal operation incl. communication with peer devices.	Operations		Network device changes
10025	Train manufacturer / maintainer / TOC	As a train manufacturer/maintainer/TOC, I need to replace defective/obsolete network devices or end nodes without affecting the overall network functionality during the replacement process and without assistance from the manufacturer. This user story implies that the new device uses a different hardware or different hardware version compared to the original part.	Maintenance		Maintenance
10026	Train manufacturer / maintainer	As a train manufacturer or maintainer, I need to replace defective network devices or end nodes and these replacement parts able to communicate over the network immediately and without major configuration efforts.	Maintenance		Maintenance
10029	Maintainer / TOC	As a maintainer or TOC, I want to receive alarms if unauthorized devices have been added to the network so that I can take appropriate security measures.	Monitoring	Operations	Security
10030	Train manufacturer / maintainer	As a train manufacturer or maintainer, I want to be able to permanently remove a network device or end device from the network. Note: this user story is different from the "failed device" story because a "failed device" should be reported in the health monitoring while a "removed" device does not.	Maintenance		Network device changes

ID	Actor	User Story	Driver 1	Driver 2	Technical Cluster
10031	Train manufacturer / maintainer	As a train manufacturer or maintainer, I need to be able to get a list of all configured network devices and end devices along with their identities and the data models and/or services they provide.	Maintenance	Configuration	Discovery (Services / Models)
10032	Train manufacturer / maintainer	As a train manufacturer or maintainer, I need to be able to get a list of all configured network devices and end devices along with their health state.	Monitoring	Maintenance	Discovery (Services / Models)
10033	TOC / train manufacturer / maintainer	As a TOC or train manufacturer or maintainer, I need to be able to retrieve key performance indicators (e.g., bandwidth) of the network and its devices so that I can identify bottlenecks or other critical issues.	Monitoring	Maintenance	Monitoring
10034	Train manufacturer	As a train manufacturer I want to add new devices (with known characteristics) to the network without invalidating safety approvals or the homologation of existing devices in the network. These "known characteristics" could, for instance, be guaranteed by providing a suitable certificate.	Safety	Integration	RAMS
10035	Train manufacturer	As a train manufacturer I need defined and guaranteed network characteristics (e.g., throughput, error rates, network category, ...) so that I can include these characteristics in my safety cases and approval documents.	Safety	Integration	RAMS

ID	Actor	User Story	Driver 1	Driver 2	Technical Cluster
10036	Train manufacturer	As a train manufacturer I want to split my network into dedicated segments with defined "gateways / conduits" so that I can separate different application domains and/or security zones from each other.	Security	Integration	Security
10038	Maintainer / TOC	As a maintainer, I want to have a procedure to add or update a safe functionality, ensuring that all affected devices are updated and that the functionality is still safe after the update. That shall be proven and visible remotely.	Upgrades	Maintenance	RAMS
10039	Maintainer / TOC / 3rd party	As TOC, train manufacturer or 3rd party, I want to be able to integrate a new network-device or new end-device solely based on independently acquired certificates. These certificates are based on lab tests and the vehicle specifications.	Extension	Maintenance	Network device changes
10040	TOC	As a TOC, I want to be able to access any end-device with a URL on the consist network so that maintainers do not have to bother with IP addresses	Maintenance	Cost reduction	Logical communication relations
10041	TOC	As a TOC, I want to limit protocols to already standardised ones so that we do not end up with exotic protocols	extension	Cost reduction	Logical communication relations
10042	Train manufacturer	As a train manufacturer, I want to have a sense of time, so that the network components have the common base for sharing information reliably.	Operations	Maintenance	Logical communication relations

ID	Actor	User Story	Driver 1	Driver 2	Technical Cluster
10044	Train manufacturer	As a train manufacturer, I want to exchange video data through onboard network, so that passenger occupancy information is known.	Operations		Logical communication relations
10045	Train manufacturer	As a train manufacturer, I want to have access to DNS/DHCP services, so that the onboard network components can be identified.	Operations	Security	Logical communication relations
10046	Train manufacturer	As a train manufacturer, I want to transmit big amount of Perception data through the onboard network, so that GoA4 operations can be done.	Operations		Logical communication relations
10047	Train manufacturer	As a train manufacturer, I want end devices to exchange information safely on different SIL-Levels, so that end devices of any SIL-Level can be attached to the network.	Safety	Harmonization	RAMS
10048	Train manufacturer / TOC	As a train manufacturer / TOC I want as few networks / buses as necessary for all end devices, so that maintenance is simplified.	Harmonization	Simplicity	Maintenance
10049	TOC	As a TOC I want the network to be based on an open and standardized technology, so that components can be upgraded by anyone.	Obsolescence support	Upgradability	Maintenance
10050	Maintainer / TOC	As a TOC/Maintainer I want to have a fault tolerant update mechanism for the firmware/software/configuration of the network equipment.	Upgrades	Maintenance	Maintenance

ID	Actor	User Story	Driver 1	Driver 2	Technical Cluster
10051	TOC	As a TOC I want to prohibit unauthorized routing activities so that different network segments and security zones can't be accidently connected.	Security	Integration	Security
10052	TOC	As a TOC I want the network to be based on standard components that are commonly used and therefore produced on large quantities.	Costs	Obsolescence support	Maintenance

3   CONCLUSIONS

The present document constitutes the Deliverable D23.1 "List of user stories for the Onboard Communication Network".

The deliverable is the first 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 user stories serve as a common ground for both WP23 and WP24. This leads to a shared scoping, thus leading to matching specifications for communication functionality on the one hand and the corresponding management functionality on the other hand.

In this deliverable 42 user stories from all relevant stakeholders are presented. The user stories reflect these (business) drivers:

- Configuration
- Corrective Maintenance
- Costs
- Extension
- Harmonization
- Integration
- Interoperability
- Maintenance
- Monitoring
- Obsolescence support
- Operations
- Regulation
- Safety
- Security
- Simplicity
- Upgradability

In addition, the presented user stories are sorted into the clusters:

- Discovery
- Engineering
- Logical communication relations
- Maintenance
- Monitoring
- Network device changes
- Power on / Power off

- RAMS

- Security

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.

In the next step, task T23.2, technical requirements for the communication functionality will be derived. The user stories will serve as an input to cover all communication functionalities typically needed for the tasks of the user stories.