European Global Navigation Satellite Systems Agency

ERSAT GGC

WP5 **Assessment of the Enhanced ERTMS architecture and of the Survey process and related toolset**: Main Results

Alessandro Basili e Tommaso Ghiara – Bureau Veritas

Prague, 26 November 2019

Outline

- WP Description
- Synthetic Description of the Approval Process by an independent assessor and rules and activities allocation between BVI and ITCF
- Task Short Descriptions and related Deliverables
  - WP5.1: Assessment of the Enhanced ERTMS architecture. Main results
  - WP5.2: Assessment of the Survey Process for Classifying the Track. Areas Main results
  - WP5.3: Assessment of the related Toolset. Main results
- Next steps from the point of view of an Independent Assessor
- Conclusion

WP Description

WP title	Assessment of the Enhanced ERTMS architecture and of the Survey process and related toolset	
WP leader	Alessandro Basili	alessandro.basili@bureauveritas.com
WP deputy	Tommaso Ghiara	Tommaso.ghiara@bureauveritas.com
WP participants	BVI, RFI, ASTS, IFSTTAR, CEDEX, INECO, ITCF, ADIF, DLR, TRI, RDL	
WP start	T0+7	
WP end	T0+24	
WP objectives	• D5.1 Assessment report of the enhanced functional ERTMS architecture • D5.2 Assessment report of the survey process • D5.3 Assessment report of the related toolset	
Deliverables	• D5.1 @ T0+18 (Status 100%) • D5.2 @ T0+22 (Status 100%) • D5.3 @ T0+24 (Status 100%)	

Synthetic Description of the Approval Process by an independent assessor and rules and activities allocation between BVI and ITCF 1/4

- The Assessment process has been developed following the below main criteria:
  - Evaluation of the consistency of the project perimeter, evaluation of the consistency and completeness of the definition of the system scope, of the system functions and the related interfaces towards the systems/subsystems external to the ERSAT GGC project (e.g. the signals and communication systems providers).
  - The Safety architectures has been assessed against the Cenelec EN50128 and EN50129 standards. The functional decomposition of the subsystems and have been evaluated and the completeness of the internal interfaces definition analized.
  - The Risk Analysis and the related acceptance criteria have been assessed according principles of 402/2013/EU Regulation.

Synthetic Description of the Approval Process by an independent assessor and rules and activities allocation between BVI and ITCF 2/4

- The defined functional and safety requirements have been evaluated according to the following criteria:
  - Clearness of the definition and numeration method;
  - Quantitative instead of qualitative definition, when applicable;
  - No duplication;
  - Back traceability to the parent elements (Risk Analysis);
  - Consistency of the allocation (to the subsystem/product/…). Every requirement has been verified to be defined considering the inputs and outputs related to the new architectural components;
  - Testability;
  - Completeness and consistency towards the Risk Analysis and the functions to be implemented.

Synthetic Description of the Approval Process by an independent assessor and rules and activities allocation between BVI and ITCF 3/4

- The methodologies/procedures with a possible impact to safety have been evaluated according the following criteria:
  - Consistency of the Objectives and their definition;
  - Actions sequencing;
  - Executors Responsibility;
  - Evidences of the complete and correct process application;
  - Monitoring and Corrective actions when applicable.

Synthetic Description of the Approval Process by an independent assessor and rules and activities allocation between BVI and ITCF 4/4

- The “toolset to be developed for the evaluation of the Track Areas”, has been assessed according to the following criteria:
  - Completeness and consistency of the tool requirements allocated to track areas by the architecture;
  - Tool development/verification lifecycle;
  - Results analysis procedures.

WP 5.1: Assessment of the Enhanced ERTMS architecture

Task name	Assessment of the Enhanced ERTMS architecture
Duration	12 months
Participants	ITCF, INECO, CEDEX, RFI, ASTS, TRI, ADIF
Objectives	The scope of this Task is to assess the architecture of the Enhanced ERTMS, by comparing the standard train positioning function based on physical balises with the new one (virtual balises) based on GNSS
Notes	Assessor Stefano Benusiglio BVI

Output	D5.1 Assessment report of the enhanced functional ERTMS architecture
Description	This deliverable represents the Independent Safety Assessment Report associated with the Enhanced Functional ERTMS Architecture defined in D 2.1

WP 5.2: Assessment of the Survey Process for Classifying the Track Areas

Task name	Assessment of the Survey Process for Classifying the Track Areas
Duration	5 months
Participants	ITCF, BVI, RFI, ASTS, TRI, RDL, IFSTTAR
Objectives	The scope of this WP is to define and assess a standard process and a common methodology, acceptable for every ground situation, for evaluate the Track Areas and classify them as “Suitable” or “Not Suitable” for locating the virtual balises.
Notes	Assessor Claudio Evangelisti ITCF

Output	D5.2 Assessment report of the survey process
Description	This deliverable represents the Independent Safety Assessment Report associated with the Standard Process and Methodology defined in D 4.1.

WP 5.3: Assessment of the related Toolset

Task name	Assessment of the related Toolset
Duration	3 months
Participants	ITCF, BVI, RFI, ASTS, TRI, RDL, IFSTTAR, DLR
Objectives	The scope of this Task is to assess the toolset, in order to confirm that the tools are suitable for this Track classification and that they provide valid results even in different situations.
Notes	Assessor Claudio Evangelisti ITCF

Output	D5.3 Assessment report of the related toolset
Description	This deliverable represents the Independent Safety Assessment Report associated with the Survey Toolset defined in D 4.2.

WP 5.1 Main results

- The performed activities confirm that the proposed “ETCS architecture” is compatible the current ETCS trackside and on-board ETCS architectures for the introduction of the GNSS positioning in the railway context
- The performed activities confirm that the proposed enhanced architecture, when developed according to the identified safety requirements, appears able to assure a significant reduction of the Information Point nowadays present on the lines, assuring the respect of the same safety and functional targets nowadays assumed as reference for ETCS L2 applications.
- Some possible future developments:
  - Integration of the interoperability specifications with the detailed requirements of VBR, GAD and TV and related test specifications;
  - Development of detailed standard test specification for the “space + augmentation system interoperability interface”.

WP 5.2 Main results

- The track classification process for the definition of the areas suitable for virtual balise positioning has been evaluated as suitable for the objectives of the ERSAT GGC project and adequately flexible for all the specific applications.
- A list of techniques for the detection of the local hazard causes has been defined. These techniques can be employed in combination in order to minimize the possibility of errors in the process.
- The Tolerable Hazard Rates of some GNSS local hazard causes need to be quantified in the future in order to establish a quantitative safety target for the track classification process and then perform a detailed safety assessment according to a defined SIL. This can be reached in combination with the definition of detailed safety requirements for the VBR.

WP 5.3 Main results

- The toolset, defined in the deliverable D4.2, is a valuable output of the WP4 activities and it can be exploited both in the framework of the ERSAT GGC project and outside the project, with an high level of flexibility and configurability.
- After the future definition of the detailed ERTMS requirements at level of the GNSS architecture, it will be possible to perform a detailed assessment on the toolset according to the CENELEC norms, in particular the EN 50128.
- The toolset uses an amount of parameters that can be fine tuned in the course of the generic and related specific applications adopting the ERSAT GGC architecture. A safety analysis about the values of the parameters can be performed in the future, taking into account also the requirements of the specific applications.

Next steps from the point of view of an Independent Assessor 1/5

- With reference to the certification process of the proposed enhanced architecture it is necessary to underline that any proposal of change, or/and introduction of new technologies could not live aside the interoperability aspects and therefore that a certification of a trackside or/and on-board system which implements the "Enhanced Functional ERTMS Architecture" based on the Virtual Balise concept requires the introduction of the VB concept in the interoperability specifications.

Next steps from the point of view of an Independent Assessor 2/5

- With reference to this context the assessor confirms that the ETCS enhanced architecture submitted to the attention of the assessor allows to leave unchanged the structure of the interoperability specifications, but, to allow the development of interoperability applications by different suppliers, it seems necessary to integrate the interoperability specifications at least for the following:
  - It should be introduced the VBR, GAD and TV functions, their safety and functional requirements and test specifications as already available for other function like BTM and odometry;
  - The definition of the ETCS messages shall be reviewed, including in the interoperability specifications: the definition of the messages necessary to upload the track database, to disseminate the GNSS augmentation system data and to perform the Track Verification function because these information shall be make available to all the on-board systems in a standardized way.

Next steps from the point of view of an Independent Assessor 3/5

- At the scope of the future certification process, a further aspect that will be deepened is how to assess the safety performance of the algorithms in charge to validate the integrity of the GNSS system, including the SIS, and in charge to calculate the current position accuracy.
- This is a not immediate task also because each on-board supplier could implement different techniques as single/multi constellations receivers or implement either track constrained or track unconstrained solutions. Moreover, it shall also be taken into account that the safety of the VBR outputs depends also on the contribution given by the augmentation systems, contribution that, according to the interoperability principles, shall be supplied in a standard way from any interoperable trackside to any interoperable onboard.

Next steps from the point of view of an Independent Assessor 4/5

- A real help to assist the certification could arrive from the definition of a detailed standard test specification for the “space + augmentation system interoperability interface”. This test specification could be based on different scenarios of the satellite signals including error conditions, deletion of satellites, noise, that, jointly with the expected augmentation system data, could be used to exercise the VBR constituent.
- A criteria to evaluate the safety performance of the different implementations could be based on the comparison among the error of the position supplied by the EUT with respect the nominal position given by the scenario and the standard deviation of the position calculated by the equipment itself.

Next steps from the point of view of an Independent Assessor 5/5

- According to this criteria the implementation could be evaluated as safe whenever:
  - The position error is lower that the real time calculated standard deviation for at least 68% of the measurements. This will allow to validate the error standard deviation evaluated run time by the OBS;
  - Adequate evidence about how the location safe confidence interval is calculated from the GNSS standard deviation, also jointly with the contributes of any additional techniques, is supplied;
  - The same test specification could be also useful to evaluate the functional performances evaluating the average safety location confidence interval.

Conclusions

- Safety evaluation activities covered all the phases of this project: architectures proposed, design specification for the survey process and the related toolset
- The performed activities confirm that the proposed “ETCS architecture” is compatible the current ETCS trackside and on-board ETCS architectures for the introduction of the GNSS positioning in the railway context
- In the future separate specifications for the various components can be detailed, in order to guarantee safety and interoperability
- The tools defined in the context of the trackside classification process allow a good level of adaptability and flexibility, that can be exploited in the context of the generic application and related specific applications

Thank you for your attention!