

STEVE

Satellite Test bed for EGNSS based Vehicle Localization Validation (STEVE)

Executive Summary Report (ESR)

De-Risking Activity

Document Code		01.00	A
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FIRST ISSUE

Date	03-08-2020
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TRACEABILITY OF THE REVISIONS

Rev.	Date	Author/Contributor/Reviewer	Verifier	Approver	Authorizer	Revision Description
01.00A	03-08-2020	Pietro Salvatori, Alessandro Neri	Pietro Salvatori	Alessandro Neri	Alessandro Neri	First Issue

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1 INTRODUCTION

1.1 PURPOSE

The main goal of the report is to provide an executive summary of the STEV Project de-risking activities requested by ESA before to proceed with the detailed project.

1.2 APPLICABILITY

The document can be used as a reference by all the deliverables produced in this project.

1.3 TERMS, ACRONYMS AND ABBREVIATIONS

The following tables provide definitions for acronyms and abbreviations and for terms used in this document.

1.3.1 Acronyms and Abbreviations

Terms, Acronyms and Abbreviation	Definition
COTS	Commercial Off The Shelf
GNSS	Global Navigation Satellite System
PVT	Position Velocity and Time
UUT	Unit Under Test

1.3.2 Terms

	Definition
-	

1.4 REFERENCE DOCUMENTS

1.4.1 Contractual Documents

Ref.	Source	Code	Rev.	Title
[CRef 1]	Document	00	Final	STEV de-risk contract
[CRef 2]	Document	00	Final	Minute of Meeting of the Negotiation Meeting
[CRef 3]	Document	00	Final	Minute of Meeting of the SRR Meeting

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1.4.2 Project Documents

The latest versions of the reference documents listed below shall be followed, except where a specific revision number of a reference document is indicated.

Ref.	Source	Code	Rev.	Title
[PRef 1]				

1.4.3 Reference Documents

The latest versions of the reference documents listed below shall be followed, except where a specific revision number of a reference document is indicated.

Ref.	Source	Code	Rev.	Title
[Ref 1]				

1.4.4 Standards and Regulations

Ref.	Source	Code	Rev.	Title
[SRef 1]				

1.5 DESCRIPTION OF CHANGES FROM THE PREVIOUS REVISION

Description of change	Chapter(s) affected by the modification(s)

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2 OVERVIEW

2.1 FRAMEWORK

Connected and autonomous cars represent by far the hugest potential community of PNT beneficiaries in the next years able to create remarkable opportunities in the industry and research organizations, in particular for highly qualified skills. The challenge is the validation and certification of PNT solutions for the automotive ecosystem - a mandatory requirement for their actual integration. In fact, there is a general warning of the automotive stakeholders on how to use PNT systems for connected and autonomous vehicles, since these technologies touch everything impacting safety. Pressure is also mounting with the surge of technological innovations that are producing an unprecedented stack of multi-sensors based products.

GNSS high integrity positioning devices for connected and autonomous cars will have to undergo a validation and certification process to prove their compliance with safety requirements. STEV aims at implementing a test-bed that allows to extensively test and to support the validation and certification process of high accuracy and integrity multi-sensor LDS platform EGNSS-based for connected and autonomous driving.

STEV is part of a strategic initiative in Italy linked to the EMERGE program - coordinated by Radiolabs to develop the Positioning, Communication and Cybersecure platforms for the connected vehicles. This program is harmonized with FCA-CRF projects co funded by the Ministry of Economic Development and the Government of Abruzzo region that hosts SEVEL - the largest manufacturing facility of VANs in Europe, the Fucino space center with Galileo assets, the Radiolabs laboratory, the University of L' Aquila with its Center of Excellence on Connected Vehicles (Ex-EMERGE) and a consolidated city-wide experimental 5G trial. SEVEL participates to and leads the Innovation Pole for Automotive in Abruzzo – involved in STEV.



Figure 1. STEV and related projects

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Project name	Coordinator	Funding	Relevance
EMERGE Navigation	Radiolabs	MISE	User requirements, operational scenarios, tests results, vehicles
Ex-EMERGE Center	Univ. l' Aquila	CIPE	Reference user: Center of Excellence and exploitation
SCALA	FCA-CRF	MISE	Reference stake-holder
5G@l'Aquila	Wind-TRE	MISE	Use of 5G for experimentation of positioning applications
HELMET	Radiolabs	GSA	Harmonization of road, rail, UAV requirements for PNT
STEV	Radiolabs	ESA-GSTP	Test Bed for GNSS automotive use cases

2.2 TEST BED DESCRIPTION

The aim of STEV is the definition, development and deployment of the test-bed as part of the future Center for the validation of high integrity GNSS based localization and navigation systems for automotive applications. The main usage of the STEV platform will follow 2 streams: On-field testing and laboratory testing. The test bed will allow to feed the unit(s) under test with either signals recorded in real environment or synthetic signals. The data acquired on field can be used in two different ways: Direct streaming and system modelling. The STEV test-bed in Phase 2 will be designed and developed taking into account also the emerging international standards as:

- CEN/CENELEC, EN16803: “Use of GNSS-based positioning for road Intelligent Transport Systems (ITS)”;
- ETSI TS 103 246 1-5: “Satellite Earth Stations and Systems (SES), GNSS-based Location Systems (GBLS)”.

The STEV platform is defined by three main operational blocks, namely: the groundtruth segment unit, the recording unit and the ground segment unit. These three entities will be mostly based on the integration of COTS devices.

The groundtruth segment unit has been thought in STEV test-bed to absolve to the problem of the groundtruth generation for the UUT in order to evaluate the unit itself performance directly in position domain.

The ground segment is the entity mainly devoted to the analysis of the raw data acquired by the recording unit and the data modelling.

The recording unit is the module responsible for acquire and forward the signals provided by the sensors.

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3 USE CASE IDENTIFICATION AND TARGET USER IDENTIFICATION

One of the objective of the de-risk activity was to show the involvement of the identified target user. Particularly, exploiting the liaison with the EMERGE initiative, the requirements and the operational scenarios have been agreed with FCA-CRF and IAM. Particularly, three main operational environments have been identified:

1. Highway
2. Urban in small village
3. Urban in cities

The design phase has then been carried out taking into account the indications received by the stakeholders.

The Unit Under Test considered in the test bed can be either a black box or a grey box. In the first case, neither the sensors installed on board nor their interfaces are a-priori known; in the second case the sensors installed on-board may not be known, but at least their interfaces are known and there is the possibility to record and inject the sensors raw data.

3.1 TEST DESCRIPTION

In this de-risk activity, a testing infrastructure has been deployed as depicted in Figure 2. Particularly, a set of IQ samples recorded with a COTS SDR platform deployed by RadioLabs is a previous project has been used. The acquisition have been carried out with a sample rate of 8 MSamples/s. Both the In-phase and the Quadrature components are then quantized with a 16 bit resolution. Since the deployed recording unit were able to simultaneously record 4 IQ streams coming from the 4 elements of an antenna array, the four streams have been used to carry out 4 tests. An overview of the stream acquisition is shown in Figure 3. These IQ samples stream have then been played back (one by one) as a RF signal that is sent to a COTS GNSS receiver. This operation is shown in Figure 4.

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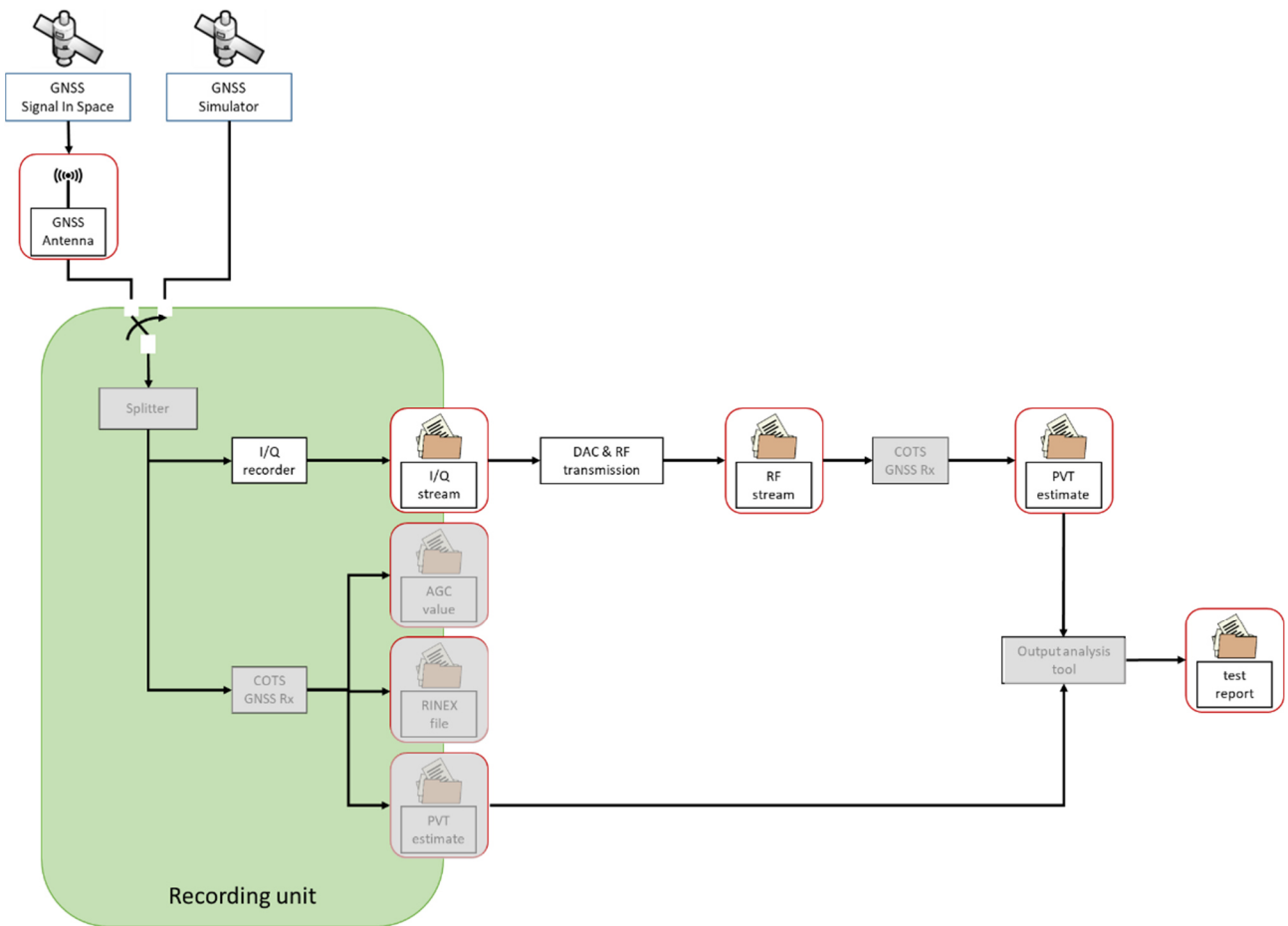


Figure 2: Recording unit test procedures

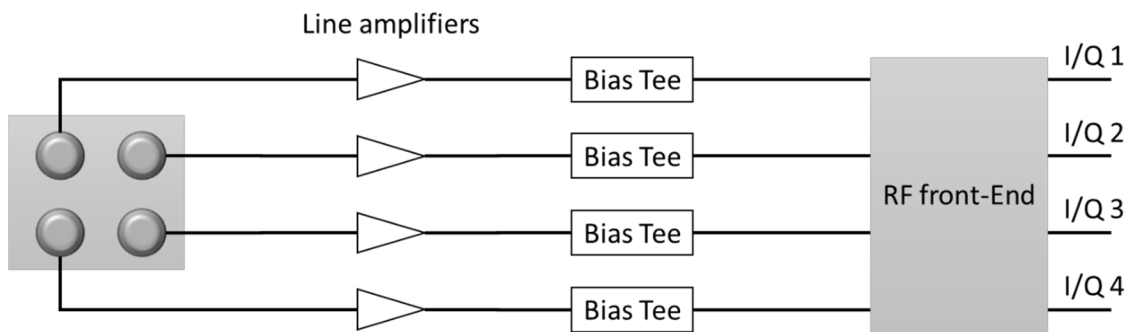


Figure 3. Acquisition scheme



Figure 4. Data playback

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4 CONCLUSIONS

This document has proven the technical feasibility and the role of the test bed to be realised in the STEV project. A close relationship has been realized with FCA-CRF as a representative stake-holders and IAM (Innovation Automotive Pole in the Region Abruzzo). The operational scenarios, requirements and the reference architecture have been defined with this stake-holders, thus confirming the basic functions to be tested. Furthermore we have shared with ASI the importance of the STEV Test Bed facility for leveraging the adoption of GNSS-based applications for the automotive sector exploiting the Region Abruzzo peculiarities such as: the biggest European manufacturing facility of VANs and the synergy with the EMERGE program co-funded by Ministry of Economical Development. We also point out that some of the tests we planned were not carried out due to the severe restrictions caused by the COVID – 19. However, other tests were performed, also in that scenario, and the results have contributed to reduce the risks.

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