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EUTERPE

EGNOS COMPATIBILITY

OUTLINE TEST PLAN

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1 INTRODUCTION

This document describes the test plan to be applied for the verification of compatibility of a receiver with the European Global Navigation Overlay System (EGNOS). EGNOS is a Satellite Based Augmentation System (SBAS) that provides via a GPS look-alike signal wide area differential corrections and integrity data for GPS and GLONASS from three geostationary satellites. This test plan is applicable for the testing of receivers European Test Centre for Receiver Performance Evaluation (EUTERPE) laboratory.

EUTERPE is an independent laboratory developed by the European Space Agency and is made available to receiver manufacturers and application developers for the verification of conformity with EGNOS of market receivers.

2 SCOPE

The purpose of the tests described in this procedure is to verify that the receiver does properly exploit the information provided by the EGNOS system on its data channel. The test plan is designed for GPS/EGNOS receivers for non-safety of life applications, thus integrity data and the receiver implementation of its handling is out of the scope of this document.

3 DEFINITIONS AND ACRONYMS

The definitions and acronyms used in this document are listed below:

Acronym	Meaning
EGNOS	European Global Navigation Overlay System
EUTERPE	European Test Centre for Receiver Performance Evaluation
FC	Fast Corrections
GIVD	Grid ionospheric vertical delay
IC	Ionospheric corrections
IGP	Ionospheric grid point
IODF	Issue of Data Fast Corrections
IODI	Issue of Data IGP Mask
IODP	Issue of Data PRN Mask
MT	Message type
MTfc	Message type fast corrections (i.e. MT2-MT5)

Acronym	Meaning
NPA	Non-precision approach
PRC	Pseudo-range corrections
RRC	Range rate corrections
RUT	Receiver under test
SBAS	Satellite Based Augmentation System
SC	Slow Corrections
UDRE	User Differential Range Error
WAAS	Wide Area Augmentation System

4 TEST CASES

The EUTERPE test plan is divided in a basic profile and an extended profile. The basic profile tests the compatibility of the receiver against the basic capabilities of the EGNOS system for non-safety of life applications. The extended profile provides a deeper compatibility with the EGNOS system, mainly the tests under the extended profile deal with PRN mask changes and interrelations between different messages (Issue of Data).

4.1 Basic profile

Test case	SBAS message involved	Purpose	Type of result
1	MT2-5	Fast corrections (Use of PRC and RRC).	Position fixes.
2	MT2-5	Satellites set to “do not use” or “not monitored”.	Position fixes.
3	MT2-5	Time out of fast corrections.	Position fixes.
4	MT6	Satellites set to “do not use” or “not monitored”.	Position fixes.
5	MT25	Use of slow corrections.	Position fixes.
6	MT25	Use of velocity code.	Position fixes.
7	MT25	Time out of slow corrections.	Position fixes.
8	MT24	Use of mixed fast and slow corrections.	Position fixes.
9	MT26	Use of GIVD.	Position fixes.
10	MT26	Grid points set to “do not use” or “not monitored”.	Position fixes.
11	MT26	Time out of ionospheric corrections.	Position fixes.
12	MT2-5	Switching GEO Satellites.	Position fixes.

4.2 Extended profile

Test case	SBAS message involved	Purpose	Type of result
13	MT1	PRN Mask assignments. Change in monitored satellites.	Implicitly taken care in tests 14 and 4.
14	MT2-5	Use of IODP.	Position fixes.
15	MT6	Use of IODF.	Position fixes.
16	MT25	Use of IODP.	Position fixes.
17	MT18	Ionospheric grid definition. Change in monitored grid points.	Implicitly taken care in test 18.
18	MT26	USE of IODI.	Position fixes.
19	MT2-5	Switching SBAS Operator (WAAS and EGNOS).	Position fixes.

5 BASIC PROFILE

This section describes the test cases that comprise the EUTERPE basic profile. For every test, a description of its purpose and SBAS messages involved is given.

5.1 Test case 1

Title:	Use of PRC and RRC
Messages involved:	MT2, MT3, MT4 and MT5
Purpose:	Fast corrections are used to correct for the quickly changing orbit and clock errors of the GPS satellites. Testing whether the receiver is implementing the RRC computations correctly is only possible with access to the correction data. It is assumed that receivers are using smoothing filters, which mask the effect of RRCs. What can be tested is whether the fast corrections are used at all.

5.2 Test case 2

Title:	Satellites set to “do not use” or “not monitored”
Messages involved:	MT2, MT3, MT4 and MT5
Purpose:	When GPS satellites are set to do not use or not monitored (UDRE tabular value set to 14 or 15) by the EGNOS system they should not be used for the position computation.

5.3 Test case 3

Title:	Time out of fast corrections
Messages involved:	MT2, MT3, MT4 and MT5
Purpose:	Fast corrections have a time out interval after which they should not be used and the satellite should not be used for position computation anymore.

5.4 Test case 4

Title:	Satellites set to do not use or not monitored
Messages involved:	MT6
Purpose:	When GPS satellites are set to do not use or not monitored (UDRE tabular value set to 14 or 15) by the EGNOS system using MT6 they should not be used for the position computation.

5.5 Test case 5

Title:	Use of slow corrections
Messages involved:	MT25
Purpose:	Slow corrections are used to correct for the slow changing orbit and clock errors of the GPS satellites. To test the fact that the receiver is implementing the satellite position computations correctly is only possible with access to the correction data. It is assumed that the receivers use smoothing filters, which will mask the effect of computational errors. What is tested is whether the slow corrections are used. For this purpose maximum correction values are simulated.

5.6 Test case 6

Title:	Use of velocity code
Messages involved:	MT25
Purpose:	Velocity code parameter of MT25 can set to 1, this will mean that the message includes clock drift and velocity component estimates besides the slow correction values.

5.7 Test case 7

Title:	Time out of slow corrections
Messages involved:	MT25
Purpose:	Slow corrections have a time out interval after which they should not be used anymore and the satellite should not be used for position computation anymore.

5.8 Test case 8

Title:	Use of mixed corrections
Messages involved:	MT24
Purpose:	To optimise bandwidth fast and slow corrections can be sent together in one message. It is assumed that if the implementation of fast and slow corrections, like time out and use of IODP work in the fast and slow correction messages, they will also work in MT24. It is therefore only considered necessary to test the correct implementation of MT24. What is tested is whether the mixed corrections are used. For this purpose maximum correction values are simulated.

5.9 Test case 9

Title:	Use of GIVD
Messages involved:	MT26
Purpose:	Ionospheric corrections are used to correct for the slowly changing ionospheric delays. Testing whether the receiver is implementing the ionospheric computations correctly is only possible with access to the correction data. It is assumed that receivers are using smoothing filters, which mask the effect of these corrections. What can be tested is whether ionospheric corrections are used at all. For this purpose maximum values are used.

5.10 Test case 10

Title:	Inospheric grid points set to “do not use” or “not monitored”
Messages involved:	MT26
Purpose:	When ionospheric grid points are set to do not use (GIVD equal to 63.875) or not monitored (UDRE tabular value set to 15) they should not be used for the position computation.

5.11 Test case 11

Title:	Time out of ionospheric corrections
Messages involved:	MT26
Purpose:	Ionospheric corrections have a time out interval after which they should not be used anymore and the satellite should not be used for position computation anymore.

5.12 Test 12

Title:	Switching GEO Satellites
Messages involved:	All
Purpose:	If more than one GEO is in view, the receiver should use the best GEO available. If one satellite stops transmitting the receiver should switch to the other GEO within 6s.

6 EXTENDED PROFILE

This section describes the test cases that comprise the EUTERPE extended profile. For every test, a description of its purpose and SBAS messages involved is given.

6.1 Test 13

Title:	PRN Mask Assignments
Messages involved:	MT1
Purpose:	Change in monitored satellites.

6.2 Test 14

Title:	USE of IODP (FC)
Messages involved:	MT1, MT2, MT3, MT4, MT5
Purpose:	If a new GPS satellite is commissioned, the PRN mask in MT1 has to be changed in order to be able to send corrections for this satellite. A new PRN mask will come with a new IODP value. The fast corrections have a pointer to the IODP of the PRN mask in MT1.

6.3 Test case 15

Title:	USE of IODF
Messages involved:	MT6, MT2, MT3,
Purpose:	When satellites are set to do not use or not monitored (UDRE tabular value set to 14 or 15) they should not be used for the position computation. MT6 can be used for this purpose. MT6 has a link to the fast corrections through the IODF parameter. If IODF is between 0 and 2 it corresponds to the fast correction messages with the same IODF. If IODF is equal to 3, it corresponds to the most recent fast corrections. The latter case (IODF=3) is assumed to be correct when the other values are working properly.

6.4 Test case 16

Title:	USE of IODP (SC)
Messages involved:	MT25
Purpose:	If a new GPS satellite is commissioned, the PRN mask in MT1 has to be changed in order to be able to send corrections for this satellite. A new PRN mask will come with a new IODP value. The slow corrections have a pointer to the IODP of the PRN mask in MT1.

6.5 Test 17

Title:	Ionospheric grid definition
Messages involved:	MT18, MT26
Purpose:	Change in monitored grid points.

6.6 Test 18

Title:	USE of IODI
Messages involved:	MT26
Purpose:	If a new ionospheric grid mask is used, the mask in MT18 has to be changed. A new grid mask will come with a new IODI value. The ionospheric corrections in MT26 have a pointer to the IODI of the grid mask in MT18.

6.7 Test 19

Title:	Switching SBAS Operator
Messages involved:	All
Purpose:	If the user travels e.g. by flight from the US to Europe, the receiver should switch automatically from WAAS to EGNOS. The baseline scenario should now be amended by a file recorded for the WAAS transmission on the same time window.

7 REFERENCES

Ref. 1. Minimum Operational performance Standards for Global Positioning System/Wide Area Augmentation System Airborne Equipment, RTCA/DO-229D, June 2006.