Announcement of a planned testing campaign: 3rd Call

Testing campaign title: INAV improvements implementation testing campaign

The Galileo Open Service (OS) has been upgraded with three new features added to its I/NAV message, one of the four message types broadcast by Galileo satellites. Collectively referred to simply as "I/NAV improvements", these features are now available to all Open Service users.

On 12 August 2023, the gradual process of upgrading the operational Galileo FOC constellation satellites has been finalized, and the I/NAV improvements are openly accessible through the I/NAV message carried by the E1-B signal.

The European Union Agency for the Space Programme (EUSPA) offers again participation in a testing campaign for INAV improvements implementation and hereby invites external stakeholders to express their interest in participating in such testing campaign, having the following characteristics:

Subject-matter: The testing will cover any of the three I/NAV improvements (SSP, FEC-2, RedCED), that will be tested in laboratory using simulated realistic scenarios, including open sky as well as challenging environments, but also using Signal-in-Space. The tests will allow the participants to have confirmation of the correct implementation of the OSSISICD 2.0. A test report, including the results of the testing against defined key performance metrics, will be provided to each participant. The interested participants may be invited to provide their product(s) before 15 November 2023 or 15 March 2024 and June 2024 to the premises indicated below according to the terms and conditions that will be communicated by the Agency and be ready to provide any remote technical assistance needed during the testing as well as all the necessary interface documentation required for the testing. Any further detailed provision, including the possibility to provide the testing laboratories with ad-hoc receiver development platforms facilitating the testing activities, will be discussed with the interested participants.

Place of performance: The tests will be executed at the laboratories of the European Commission's Joint Research Centre[1] in Ispra, Italy, and of the European Space Agency ESA/ESTEC in Noordwijk, The Netherlands. Each applicant will be assigned by EUSPA to any of the two laboratories depending on the specific conditions and availability.

Estimated timeline for launch of testing (3rd call): 15 November 2023, 15 March 2024 and 15 June 2024

The EUSPA reserves the right to change the scope, and timeline of the procedure.

[1] See "JRC Testing and Demonstration Hub for the EU GNSS Programmes", https://publications.jrc.ec.europa.eu/repository/handle/JRC125180

If you are interested in participating in the testing campaign above, please express your interest by sending an email **at least 15 days before any of the testing windows indicated above** (i.e. 30/10/2023, 29/02/2024 and 31/05/2024, 17:00 (Prague local time) respectively) to the following email address: market@euspa.europa.eu. The subject of the email shall be "INAV improvements implementation testing campaign: 3rd Call".

Annex I – Background information

INAV Improvements

With the objective to enhance the Galileo services portfolio, three new features are provided to all the Open Service users. On 12 August 2023, the gradual process of upgrading the operational Galileo FOC constellation satellites has been finalized, and the I/NAV improvements are openly accessible through the I/NAV message carried by the E1-B signal.

These new features, whilst ensuring full backward compatibility with existing Galileo receivers, further improve the robustness of Galileo OS when retrieving the navigation data, in particular in challenging environments, and enhance the Galileo OS capability to solve the user clock uncertainty.

In that respect, a key performance metric of GNSS signals (especially when GNSS receivers operate in unassisted mode) is the time to receive Clock and Ephemeris Data (CED). Two of the newly introduced features contribute in different ways to improve the Time-To-CED, and therefore the overall Time to First Fix (TTFF):

1) Reduced CED (RedCED): A compact set of CED, called Reduced CED, provided within one single I/NAV word (new I/NAV word type 16). The Reduced CED concept allows for a fast initial position fix in exchange of an initial degraded accuracy, by only decoding one single I/NAV word rather than four I/NAV words carrying the full-precision CED. In this way, a Galileo only TTFF (95%) below 20 seconds can be achieved.

2) Reed-Solomon Outer Forward Error Correction (FEC-2): this additional error correction capability, offered on top of the legacy I/NAV CED words 1…4 and realised by means of a Reed-Solomon (RS) outer encoder, providing correction of residual errors and recovery of erased information. RS encoded information, providing within the new I/NAV words 17…20, increases demodulation robustness, and therefore the sensitivity in harsh environment. At the same time, it improves the time to retrieve the Clock and Ephemeris data (i.e. the Time-To-CED) thanks to its erasure property.

A third solution is also introduced which targets in particular application working in GNSS assisted mode, where navigation data is received from non-GNSS channels, and the user knowledge of the Galileo System Time is subject to a certain error, typically in the order of few seconds. In this context, it is key to solve the user clock uncertainty and increase the robustness of the time synchronisation.

3) Secondary Synchronisation Pattern (SSP) is introduced to allow the reconstruction of the Galileo system time as long as a coarse synchronisation of +/-3 seconds is already achieved. The correlation with the SSP sequence can be performed at symbol level without the need to demodulate the navigation message, which enables system time synchronisation with weak signals.

These three new features of the Galileo OS, provided through the E1-B I/NAV message, are described in detail in OS ICD 2.0, released in January 2021.