Galileo High Accuracy Service (HAS) for Time Transfer Applications

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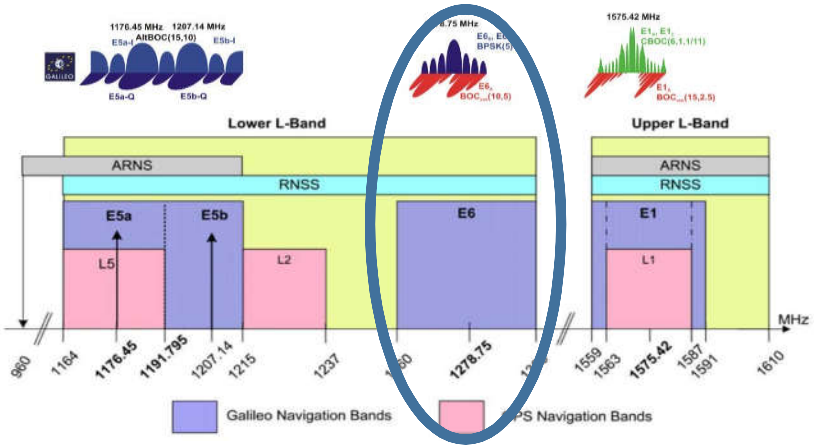
Galileo Frequency Plan



In Europe, a fairly radical and strategic decision was taken in March 2018, with the Implementing Decision by the European Commission, redefining the scope of the former Galileo Commercial Service.

The EC decision, recognizing the increasing demand for higher positioning accuracy by fast expanding sectors, such as autonomous vehicles, robotics and drones, introduced a "free-access" High Accuracy Service (HAS) on E_6 signal, allowing users "to obtain a positioning error at decimetre level in nominal conditions of use".

Signal and Data features

Frequency	1278.75 MHz
Signal	E6B
Min. Power	-158 dBW
Modulation	BPSK(5)
Chip Rate	5.115 Mcps
Code Length	1 ms
Symbol Rate	1000 sps
Data Rate	492 bps
HA Data Rate	448 bps (TBC)
Data Coding	FEC, as per Galileo OS SIS ICD, + interleaving 123 x 8
Spreading Code Encryption	No
Data Format	TBD, but based on an open ICD.
Data (TBC)	Orbit and clock corrections, code and phase biases, SQM, flags, ionospheric information.

The convergence time of this new service should be in the order of about five minutes, thus making it attractive for mass-market applications, including smartphones, but not in direct competition with "external" services such as RTK and PPP.

A growing demand for increased positioning accuracy is evident for mass-market applications, in areas such as:

IoT tracking devices
Wearable tracking devices
Automotive
UAV
Robotic vehicles

The PPP technique, as applied to time transfer, can be seen as a "One Way" time transfer approach. Experimental campaigns have demonstrated that this alternative synchronization technique offer high-level performance, comparable with state-of-the-art methods, such as "Two-Way Satellite and Frequency Transfer" (TWSTFT). As compared to TWSTFT, a "One Way" technique based on the Galileo HAS would be simple and low cost. Moreover, given the recent development of GNSS chip sets for high accuracy in mass-market applications, it can be expected in the near future a generation of multi-constellation, dual-frequency receivers, able to take advantage of the Galileo High Accuracy Service.

The availability of low cost, high performance receivers for time and frequency synchronization purposes could be an enabling factor for the development of the future 5G network infrastructure. As a matter of fact, the nodes of the 5G network will require synchronization accuracies between 5 and 20 nanosecond, almost one order of magnitude better than what presently achievable with a GNSS receiver (unless "Common View" techniques are used).

The multi-constellation, dual-frequency, HAS-enabled receivers could become the basis for affordable Primary Reference Time Clocks (PRTCs), possibly in combination with miniaturized atomic clocks, to provide high accuracy time and phase synchronization signals traceable to the UTC time standard, with good holdover performance for resiliency.