

TTS-3, MULTI-CHANNEL, MULTI-SYSTEM GPS/GLONASS/WAAS/EGNOS RECEIVER

J. NAWROCKI, P. NOGAŚ, R. DIAK, A. FOKS, D. LEMAŃSKI
Space Research Centre of Polish Academy of Sciences,
Astrogeodynamic Observatory, Borowiec, Poland
e-mail: nawrocki@cbk.poznan.pl

1. INTRODUCTION

The Astrogeodynamic Observatory (AOS) of the Space Research Centre, following a popular TTS-2, has developed a new high-performance Time Transfer System - 3 (TTS-3). The TTS-3 allows observations of GPS, GLONASS, EGNOS and WAAS satellites simultaneously in multi-channel, multi-frequency mode. The following codes are used: C/A-code for GPS, WAAS, EGNOS and GLONASS, P-code for GLONASS, and reconstructed P-code for GPS. In future the receiver will be a base for a new generation TTS-4, observing also GALILEO satellites. The receiver hardware, the treatment of the observations, and the output data fulfil the recommendations of the CCTF Group on GNSS Time Transfer Standards (CGGTTS). Data in RINEX format are also provided.

2. THE TTS-3 PERFORMANCE

The TTS-3 consists of a PC industrial computer, a PC card time interval counter, a GNSS 40-channel, appropriate software, an antenna and connecting cables.

Main technical specifications of the receiver are:

- full conformability to CCTF recommendations for common-view multi-channel, multi-system and multi-code GNSS time transfer technology;
- 40 channels, all-in-view, L1 GPS, L1/L2 GPS, L1/L2 GLONASS, WASS, EGNOS;
- full-duplex 10BASE-T Ethernet port;
- two 1 PPS output (LVTTTL) synchronized to GPS time, GLONASS time or UTC;
- two Event Marker inputs;
- time interval resolution of the counter: 100 ps;
- external reference frequency 10 MHz;
- local 1 PPS input connector.

On request the TTS-3 can be equipped with a temperature-stabilized chamber for the GNSS board, and a temperature stabilized antenna.

3. APPLICATIONS OF TTS-3

The present applications of TTS-3 include comparisons of very stable ($1e-15$) atomic clocks between the NMI, UTC laboratories participating to TAI, military and research precise time and frequency centers. TTS-3 will be used by the Galileo Time Service Provider and the Galileo Precise Time Facility.

4. TTS-3 EVALUATION

The on-site comparisons and multi-system time-transfers between the AOS and the BIPM prove the high performance of TTS-3. The time transfer results:

- GPS C/A RMS 2.0 ns,
- GPS P3 RMS 0.6 ns,
- GLONASS P RMS 0.5 ns.

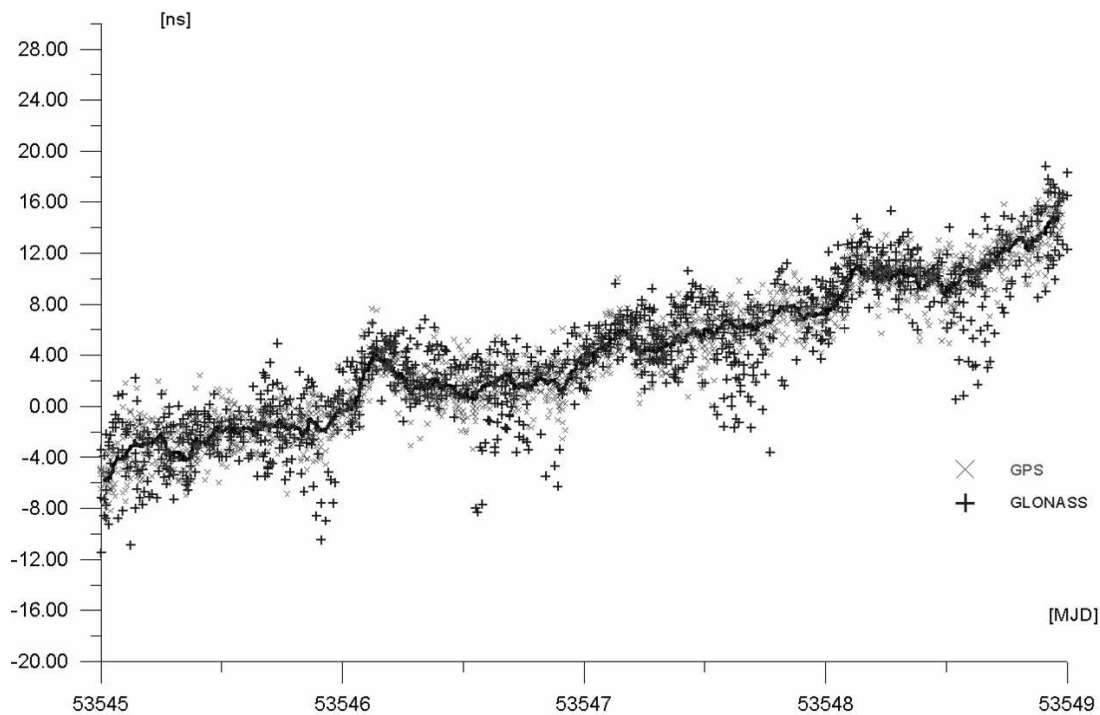


Figure 1: AOS/BIPM common-view, GPS+GLONASS P1 CODE

5. SUMMARY

The TTS-3 receiver integrates observations of all available navigation satellites: GPS, GLONASS, WAAS and EGNOS. Besides it serves as a base for TTS-4 observing also Galileo (under development). It uses GPS and GLONASS C/A-code, GLONASS P-code, GPS reconstructed P-code and P3 modes. The precision in multi-channel reconstructed GPS P-code mode, when using measurements of ionosphere and precise ephemerides should reach 1 ns for intercontinental and continental time links.

The system works under LINUX, providing multitasking and integration with networks and Internet and allows an easy upgrade of presently available and future options.