SBAS Timescale Description
EGNOS

Definition of System

1. System timescale: ENT (EGNOS Network Time)

2. Generation of system timescale:
Independently computed by the EGNOS CPFs (Control and Processing Facilities) using the clocks of the RIMS (Ranging and Integrity Monitoring Stations).

3. Is system timescale steered to a reference UTC timescale?
No, ENT is steered to GPST but an estimation of its time offset to a reference UTC timescale is broadcast (cf. §5). Note that ENT – GPST is not broadcast.

a. To which reference timescale: GPST.

b. Whole second offset from reference timescale?
No whole second offset from GPST.

c. Maximum offset (modulo 1s) from reference timescale?
50 ns (5 σ)

4. Corrections to convert from satellite to system timescale?
Yes, 2 cases:
1/ GEO to ENT (GEO ranging currently not active)
2/ GPS to ENT
If yes:

a. Type of corrections given; include statement on relativistic corrections
1/ Linear coefficients
2/ Using GPS models plus EGNOS fast and slow corrections (linear coefficients) at user level

b. Specified accuracy of corrections to system timescale
1/ From GEO ranging : GEO Time – ENT accuracy shall be less than 10 ns (3σ).
2/ Using GPS models plus EGNOS fast and slow corrections at user level

c. Location of corrections in broadcast messages
1/ Message Type 9 and Messages 2 to 5 (fast).
2/ Messages 25 (slow) and Messages 2 to 5 (fast) and (optionally Message 24: mixed slow/fast)

d. Equations to correct satellite timescale to system timescale
cf. User Guide for EGNOS – Application Developers (Ed. 1.1, 07/30/2009
or RTCA MOPS DO229D – Appendix A.

5. Corrections to convert from system to reference UTC timescale?
Yes. The reference UTC timescale depends on the broadcast UTC identifier broadcast in Message Type 12.

UTC identifier	
0	UTC(CRL)
1	UTC(NIST)
2	UTC(USNO)
3	UTC
4	European UTC(k)
5-6	Reserved for future use
7	Not provided

Currently the UTC identifier is 3 but the reference UTC timescale is UTC(OP) thanks to a dedicated RIMS at Observatoire de Paris.

If yes:

a. Type of corrections given
Linear coefficients (bias and slope at a given epoch)

b. Specified accuracy of corrections to reference timescale
ENT – UTC(OP) accuracy shall be less than 10 ns (3 σ).

c. Location of corrections in broadcast messages
Message Type 12

d. Equations to correct system timescale to reference timescale
cf. User Guide for EGNOS – Application Developers (Ed. 1.1, 07/30/2009
or RTCA MOPS DO229D – Appendix A.

6. Specified stability of system timescale
None.

7. Specified stability of reference timescale
Stability of GPST

8. Specified stability of satellite clocks
No atomic clocks on-board, signal generated on ground and stability specified in RTCA MOPS DO229D – Appendix A.

9. Availability of System to GNSS Time Offset (GGTO)
No.

a. Systems for which corrections are given?

N/A.

b. Type of GGTO corrections given
N/A.

c. Stated accuracy of GGTO correction, if available
N/A.

d. Location of corrections in broadcast messages
N/A.

e. Equations used for GGTO message
N/A.

Describe the details of the system, i.e. locations of system and reference timescale clocks, generation of timescales, and other details.

EGNOS provides GPS regional augmentation services in aviation, maritime and land users by using transponder on board geostationary (GEO) satellites. The EGNOS Ground Segment consists of Ranging and Integrity Monitoring Stations (RIMS), which are connected to a set of redundant Control and Processing Facilities (CPF), in order to determine the integrity, ephemeris and clock differential corrections for each monitored satellite, to compute the ionospheric delays for each Ionospheric Grid Point (IGP) defined in the IGP mask, and to generate the GEO satellite ephemeris. The GEO satellite downlinks these data on the GPS L1 frequency with a modulation and a coding scheme similar to GPS.

As part of initial EGNOS functionalities, it was studied to provide GPS-like signals through GEO satellites (GEO Ranging), meaning that ENT would need to be accurately transferred on-board the GEO satellites. However, this function is not provided through the current qualified EGNOS versions.

All measurements and data are referred to the internal EGNOS Network Time (ENT) whose performance requirements were derived exclusively from navigation accuracy performance requirements.

RIMS clock synchronization is performed using a composite-clock technique in which ENT is defined as the implicit ensemble mean of a set of RIMS clocks and the synchronization process generates estimates of the time and frequency offsets of each RIMS clock relative to it. These estimates can then be used to reference all RIMS pseudo-range measurements to ENT. This synchronization process is necessary in order to allow simultaneously observed pseudo-range measurements from multiple RIMS to be combined in the function which estimates satellite clock errors.

Applying EGNOS corrections to GPS measurements, ENT replaces GPS Time (GPST) in the receiver navigation solution.

Describe how the timescale transfers from the reference timescale to the system timescale and finally to the satellites. Include the nominal rate of SV updates.

EGNOS satellite corrections are referred to ENT and are regularly refreshed (<120s). ENT is steered to GPST and EGNOS broadcasts its time offset to UTC(OP) in the Message Type 12 that is regularly refreshed (<300s).

If any other pertinent details exist concerning the generation and realization of system and/or reference time, include them as well.