SBAS/QZSS Augmentation Signal Generation
EGNOS/WAAS/MSAS/GAGAN/QZSS

Principle of SBAS/QZSS

- Monitoring station at an accurately surveyed position receives GNSS signals and performs position estimation; the results are forwarded to the master station.
- At the master station, error correction data is calculated from the mismatch between the GNSS position and the actual position of the monitoring station.
- Augmentation data, including integrity information about the health status of the GNSS satellites, is transmitted to geostationary (GEO) satellites and provided to the user on L1.
- GNSS position estimate can be corrected for GNSS satellite orbit and clock errors as well as ionospheric disturbances at the receiver.
- No corrections of local effects, such as tropospheric effects, multipath and receiver inherent errors.

Satellite-Based Augmentation Systems (SBAS)

Implementations
- Europe: European Geostationary Navigation Overlay Service (EGNOS)
- North America: Wide Area Augmentation System (WAAS)
- Japan: MTSAT Satellite Augmentation System (MSAS)
- India: GPS Aided Geo Augmented Navigation system (GAGAN)

Features and benefits
- GEO ranging (only WAAS): additional GPS-like signals from GEO satellites to increase the number of navigation satellites available to users.
- Integrity service: information about the quality of the navigation service, including timely warnings in case the system performance becomes unreliable.

Quasi-Zenith Satellite System (QZSS)

Overview
- Covers East Asia and the Oceania region.
- Augmentation and complementary system to GPS.
- One geostationary and three geosynchronous satellites.
- Outlook: extension to a standalone Regional Navigation Satellite System (RNSS) with 7 satellites is under implementation.

Signal plan
- Differential corrections for GPS: L1-SAIF.
- Experimental signal: LEX (compatible with Galileo E6).
**Your challenge**

- The SBAS capabilities of each newly developed GNSS receiver have to be tested carefully.
- Full characterization of a receiver includes evaluating its ability to decode and apply correction data from SBAS signals.
- Testing the GNSS device’s response to integrity information and alerts provided by SBAS is also part of the evaluation process.
- Controlled and realistic conditions, considering satellite orbit and clock errors as well as ionospheric disturbances, are a prerequisite to obtaining conclusive test results.
- Tests cannot be performed in a real-world environment since this is time-consuming, costly and impossible to reproduce.
- Augmentation signals have a complex structure and are difficult to create manually.

**Our solution**

- Use the GNSS simulator in the R&S®SMBV100A or the R&S®SMW200A to simulate complex GPS/SBAS/QZSS scenarios in real-time with unlimited simulation time.
- Perform tests in the lab under controlled and repeatable conditions using simulated SBAS/QZSS signals.
- Apply accurate models of satellite orbit and clock errors as well as ionospheric disturbances for realistic SBAS scenarios.
- Generate signals for the following augmentation systems:
  - EGNOS (C/A), WAAS (C/A), MSAS (C/A), GAGAN (C/A), QZSS (C/A)

**Rohde & Schwarz solutions for GNSS signal generation**

- High-end GNSS constellation simulator for sophisticated multi-constellation, multi-frequency, multi-antenna and multi-vehicle testing (R&S®SMW200A).
- GNSS constellation simulator for single-frequency receiver characterization (R&S®SMBV100A).
- GNSS production tester (R&S®SMBV-P101).
- GNSS waveforms for basic receiver testing (R&S®WinIQSIM2).