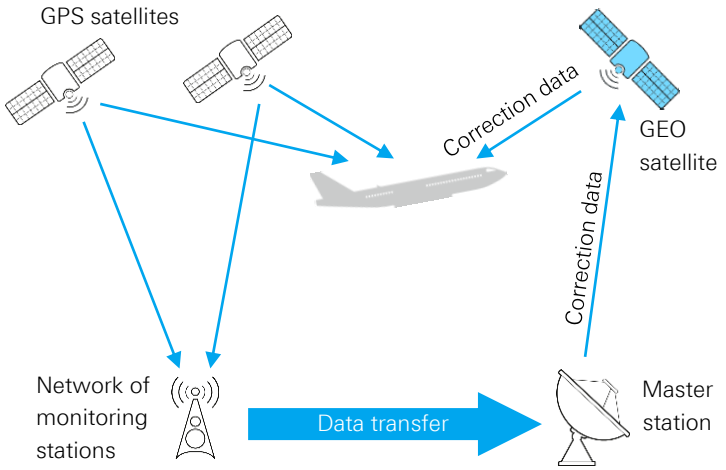
SBAS Signal Generation

WAAS

Principle of WAAS



- Monitoring station at an accurately surveyed position receives GPS 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 GPS position and the actual position of the monitoring station
- Augmentation data, including integrity information about the health status of the GPS satellites, is transmitted to geostationary (GEO) satellites and provided to the user on L1
- The user can correct its GPS position estimate for GPS satellite orbit and clock errors as well as ionospheric disturbances
- No corrections of local effects, such as tropospheric effects, multipath and receiver inherent errors

Wide Area Augmentation System (WAAS)

WAAS is a combination of ground based and space based systems that augments the GPS Standard Positioning Service (SPS). It provides the capability for increased availability and accuracy in position reporting as well as integrity monitoring of GPS Satellites. The development was mainly driven by civil aviation. WAAS is certified for so-called localizer performance with vertical (LPV) guidance approaches.

Typical applications

- Civil aviation
- Precision farming

Features and benefits of WAAS

Differential corrections: Corrections of satellite orbit/clock errors and ionospheric disturbances

GEO ranging: GPS-like L1 signals from GEO satellites to augment the number of navigation satellites available to the users

Integrity service: Information about the quality of the navigation service, including timely warnings in case the system performance becomes unreliable

WAAS accuracy

Accuracy	GPS accuracy Requirements	GPS actual performance*	WAAS LPV-200 accuracy requirements	WAAS LPV-200 actual performance*
Horizontal 95%	36 m	2.9 m	16 m	0.7 m
Vertical 95%	77 m	4.3 m	4 m	1.2 m

*GPS and WAAS performance is monitored and measured by the FAA WAAS Test Team.

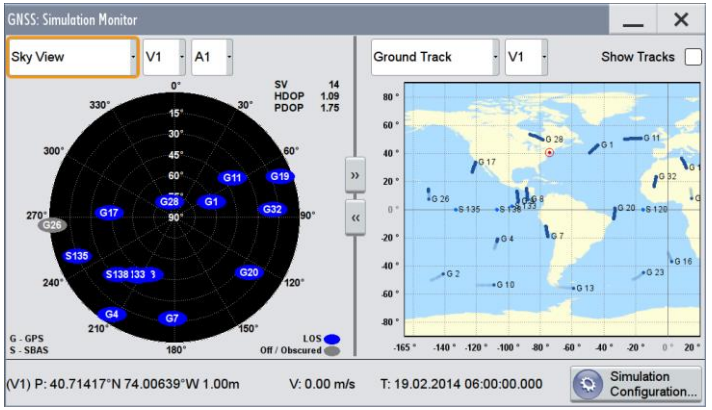
Your challenge

- The GPS/WAAS capabilities of each newly developed GPS receiver have to be tested carefully
- Full characterization of a receiver includes evaluating its ability to decode and apply correction data from WAAS signals
- Testing the GPS device's response to integrity information and alerts provided by WAAS 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/WAAS scenarios in realtime with unlimited simulation time
- Perform tests in the lab under controlled and repeatable conditions using simulated WAAS 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:
  - WAAS (C/A)
  - EGNOS (C/A), MSAS (C/A), GAGAN (C/A), QZSS (C/A)

GPS/WAAS simulation in the R&S®SMW200A



Combined GPS/WAAS simulation performed by the R&S®SMW200A.

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)

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