Research Activities

Evolution of the GNSS Scenario

The worldwide scenario of the Global Navigation Satellite Systems has undergone lots of changes in the last decade and will continue evolving in the next future:

- Full civil use of GPS and start of the modernization plan
- GLONASS program reactivated and being modernized
- Start of GALILEO operation in 2014
- Start of COMPASS operation in 2015
- Regional systems (QZSS and IRNSS) being set and extended
More and more systems are sharing the extremely scarce spectral allocation foreseen for satellite navigation systems:

1) Need for **coordination among the different systems** for achieving RF compatibility, aiming also at interoperability (see next slide)

2) Investigation of **new frequency bands for GNSS**
   - 2 483.5 – 2 500 MHz S-Band (already allocated to RNSS in ITU Region 3)
   - 5 010 – 5 030 MHz C-Band (already allocated to RNSS also in ITU Region 1)

The **Institute of Geodesy and Navigation at the University FAF Munich** is doing many research activities investigating the feasibility of the provision of GNSS services in these two bands with special focus on:

- Identification of advantages and drawbacks for the service providers and for the users
- Interference issues with other services transmitting in the neighbor bands
Coordination: GNSS Compatibility & Interoperability

**Compatibility** refers to the ability of global and regional navigation satellite systems and augmentations to be used separately or together without causing unacceptable interference and/or other harm to an individual system and/or service.

- The International Telecommunication Union (ITU) provides a framework for discussions on radiofrequency compatibility. Radiofrequency compatibility should involve thorough consideration of detailed technical factors, including effects on receiver noise floor and cross-correlation between interfering and desired signals;
- Compatibility should also respect spectral separation between each system’s authorized service signals and other systems’ signals. Recognizing that some signal overlap may be unavoidable, discussions among providers concerned will establish the framework for determining a mutually-acceptable solution;
- Any additional solutions to improve compatibility should be encouraged.

**Interoperability** refers to the ability of global and regional navigation satellite systems and augmentations and the services they provide to be used together to provide better capabilities at the user level than would be achieved by relying solely on the open signals of one system.

- Interoperability allows navigation with signals from different systems with minimal additional receiver cost or complexity;
- Multiple constellations broadcasting interoperable open signals will result in improved observed geometry, increasing end user accuracy everywhere and improving service availability in environments where satellite visibility is often obscured;
- Geodetic reference frames realization and system time steerage standards should adhere to existing international standards to the maximum extent practical;
- Any additional solutions to improve interoperability are encouraged.
Research Activities

Coordination: GNSS Compatibility & Interoperability

The Institute of Geodesy and Navigation at the University FAF Munich is consulting the German Aerospace Centre (DLR), the Federal Government and Ministries and the European Commission in many coordination activities:

- ICG - International Committee on GNSS (Multilateral forum setting out the high level objectives and definitions of interoperability and compatibility)
- Bilateral forums with the different GNSS providers (Transfer of high level objectives regarding interoperability and compatibility into technical methodology and criteria)