Civil Aviation GNSS Receiver Standards

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Civil Aviation Use of GNSS

- **Civil aviation is a sizeable, global industry:**
  - Over 300,000 general aviation aircraft
  - Over 30,000 air transport aircraft
  - In 2012, nearly 3B passengers flew the world's airlines
- **Significant number of civil aircraft are GNSS-equipped**
  - Primarily GPS or GPS plus Satellite-based Augmentation System (SBAS), but some GLONASS-capable also
  - Well over 130,000 certified receivers sold to date
- **Safety is paramount for certified avionics**
  - Standardization/development/certification is time-consuming and costly (least expensive GNSS avionics are ~$10k)
  - Users expect lengthy service life (20+ years) to amortize

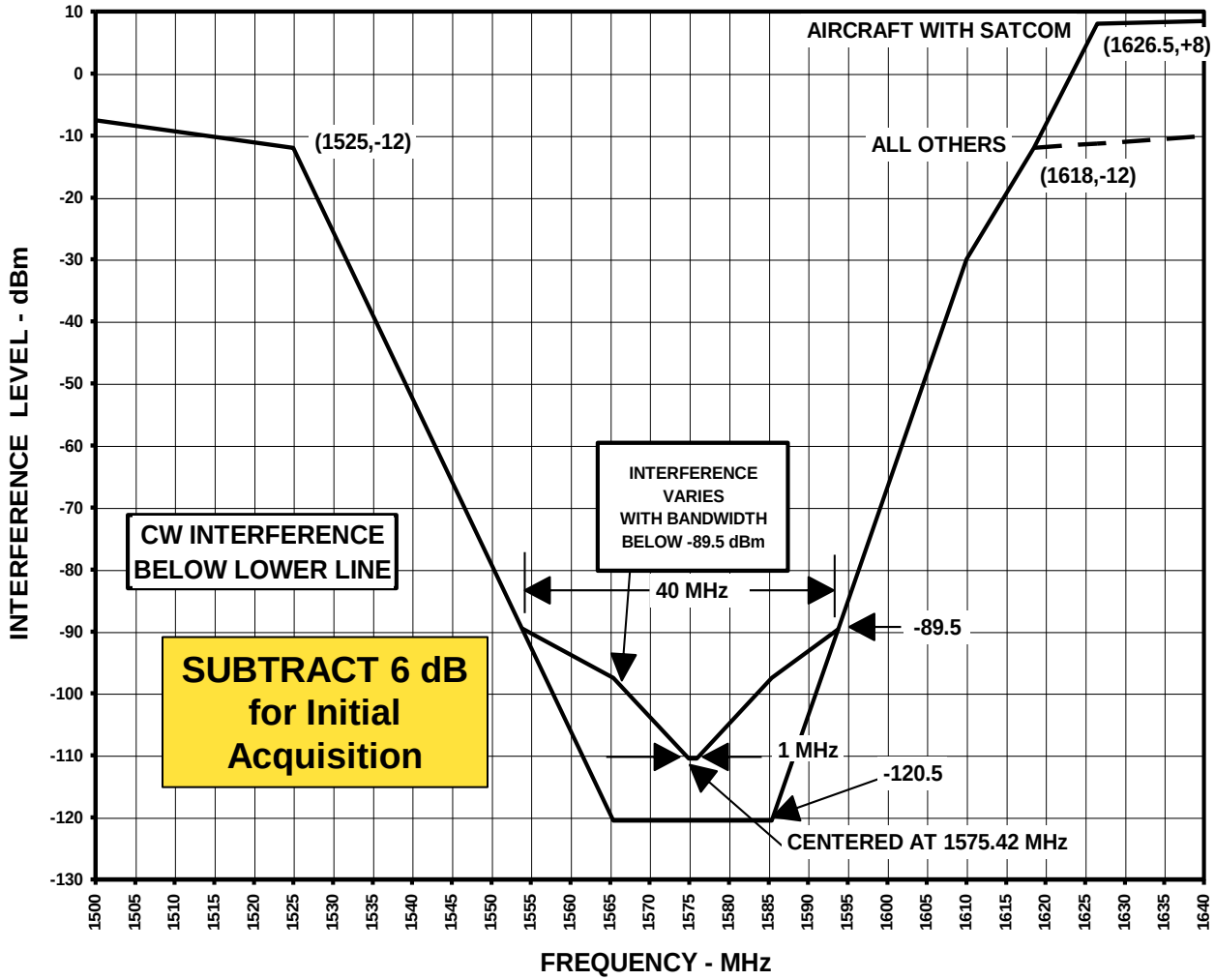
International Civil Aviation Organization (ICAO) Standards

- **International GNSS Standards and Recommended Practices (SARPs) first adopted in 2001**
  - First version in Amendment 76 to Annex 10, Vol. 1, to the Convention on International Civil Aviation
  - Many updates, with latest in Amendment 88 (applicable Nov. '12)
- **Current SARPs address:**
  - Two core constellations: GPS and GLONASS
  - Augmentation systems: Aircraft-based (ABAS), ground-based (GBAS), satellite-based (SBAS), and ground-based regional (GRAS)
- **ICAO Navigation System Panel (NSP) is updating SARPs to add:**
  - CAT II/III GBAS, L5, GLONASS evolution, Galileo, BeiDou

Aviation GNSS Receiver Standards

- **RTCA, Inc. and EUROCAE standards are most widely used**
  - Consistent with ICAO SARPs
  - Invoked by many certification authorities
- **Some relevant standards**
  - GPS/ABAS: DO-208, DO-316, ED-72
  - GPS/GBAS: DO-246, DO-253, ED-95, ED-114, ED-144
  - GPS/SBAS: DO-229, ED-97
- **All standards include interference mask**
  - 1991+: First-generation (DO-208) equipment utilized 2 MHz passband - sufficient for non-precision approach (556 m, 95% accuracy)
  - 1996+: Current-generation (DO-229/253/316) equipment uses 20 MHz passband (see next chart) to enable more demanding applications
- **Now in progress**
  - RTCA and EUROCAE are working mainly on dual-frequency standards for GPS, Galileo, and SBAS
  - On-going discussions on adding support for other core constellations (GLONASS and BeiDou)

RTCA Aviation Receiver Interference Standards



- Current GPS mask first published in 1996 (DO-229)
- Harmonized mask in ICAO SARPs
- ICAO SARPs also include GLONASS L1 mask

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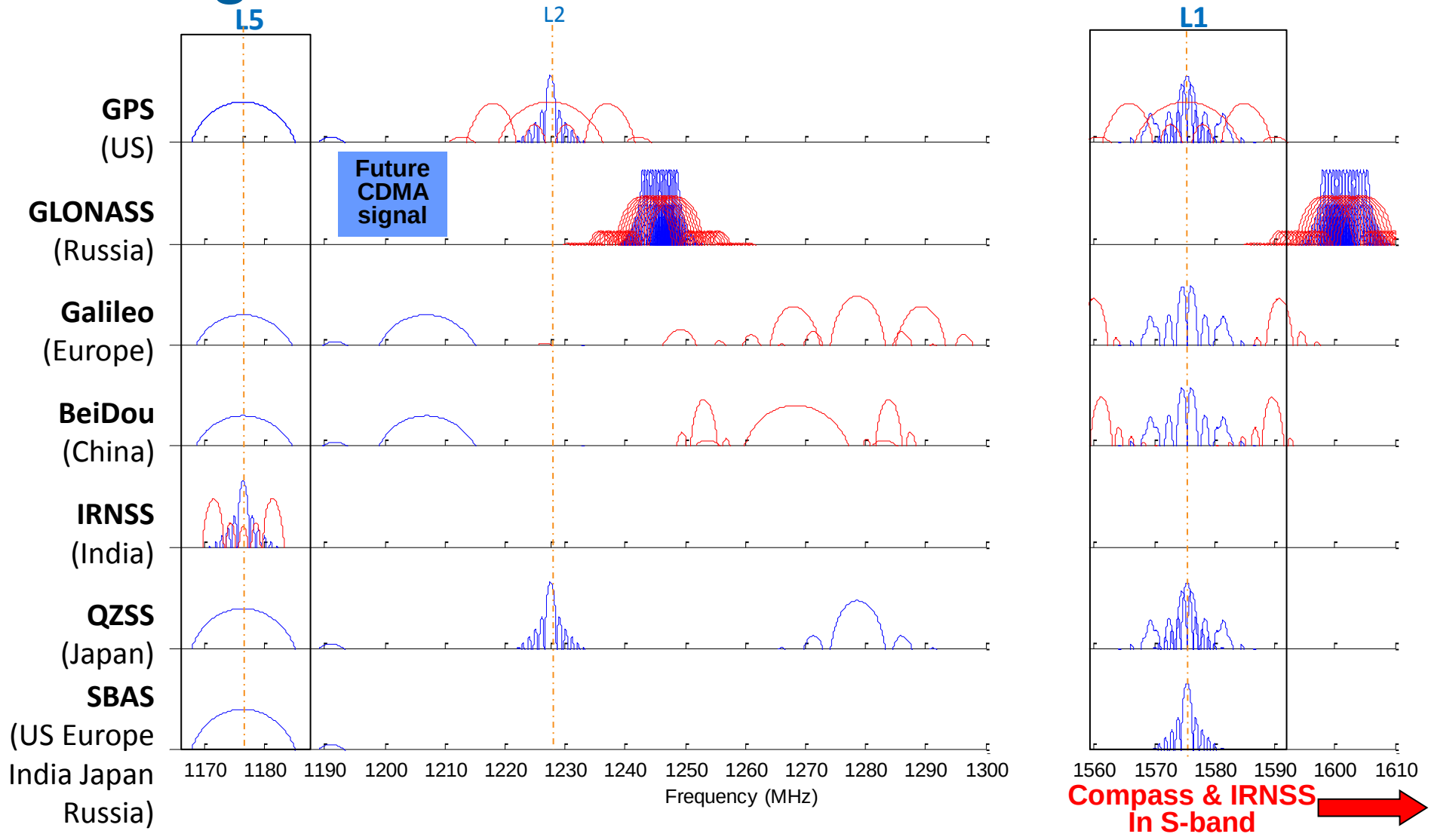
Next-generation Aircraft Receiver Standards



- **Next-generation standards planned for ~2018**
- **Focus is on dual-frequency (1575/1176 MHz) and multi-constellation**