Flight Test requirements to GNSS reference networks

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Eurocopter Deutschland GmbH
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eurocopter
an EADS Company

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- Present usage of GNSS reference networks
- Flight Test requirements for extended usage of GNSS reference networks
  - System
  - Service
  - Process

EADS Group and Flight Test activities

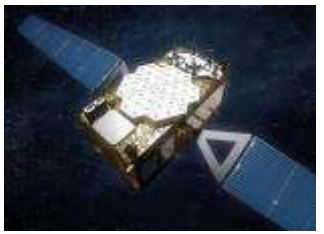
EADS

AIRBUS AN EADS COMPANY

eurocopter an EADS Company

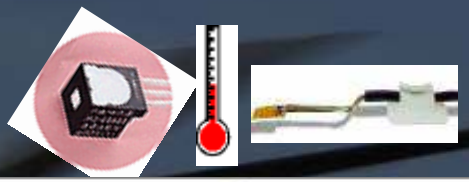
EADS DEFENCE & SECURITY

EADS astrium



Flight Test and FT Instrumentation

Analogue parameters
Bus data
Video & Hot Mike



Onboard test data
and crash recording

Real-time visualisation in
FT Ground Station

Present real-time usage of GNSS in Flight Test

Timing

- Distribution of timing signals within the FTI system for **precise correlation** of the acquired measurement data
- Point to point: 1PPS together with:
  - IRIG-B (~ AM sinus) or
  - Serial data: e.g. NMEA
- Ethernet / networks: Precision Time Protocol IEEE-1588 v1 (2002)

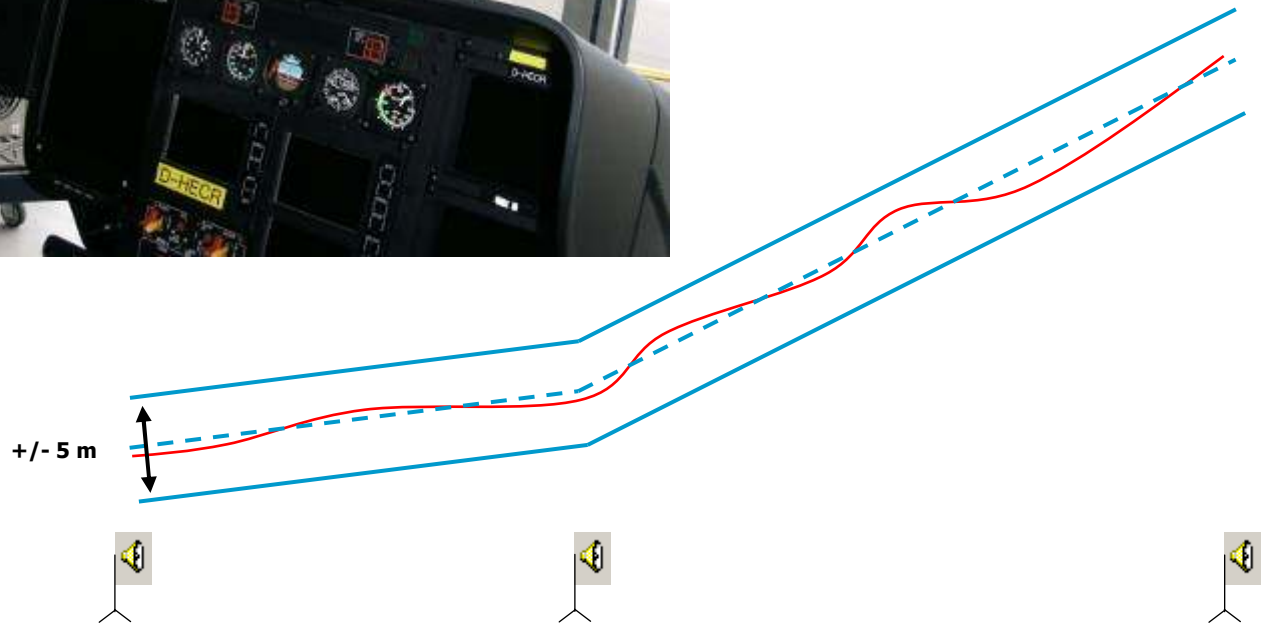
- Requirements: time-to-fix < 1 min, accuracy « 1 us

Positioning

- Support for flight test **guidance and safety**, e.g. firing clearance on range or noise campaign
- Telemetry tracking

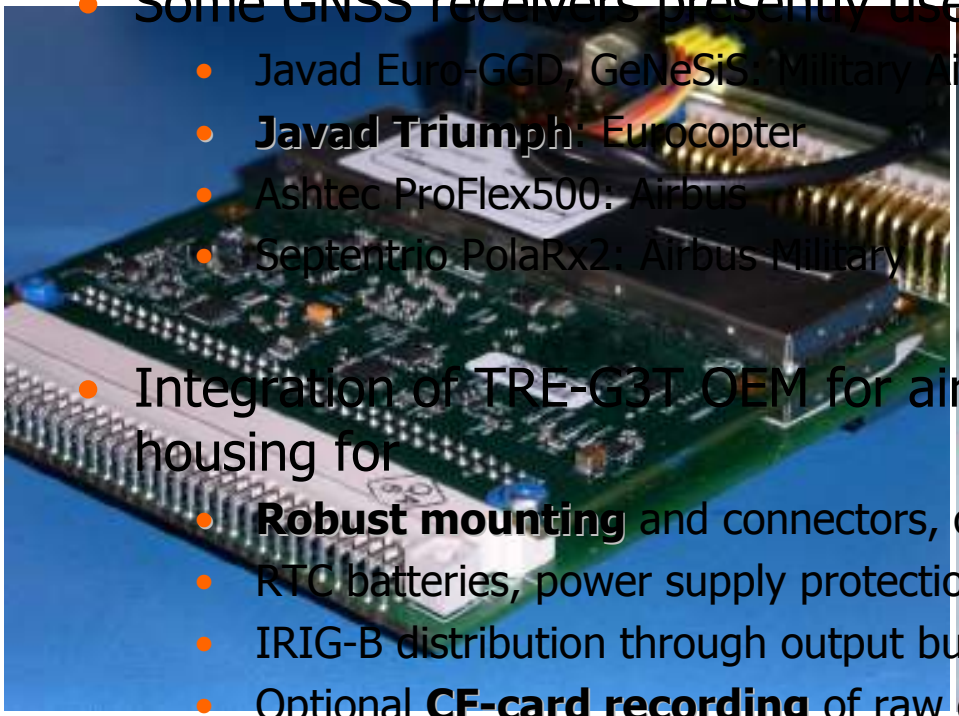
- Requirements: accuracy < 3 m

Example: flight guidance PDA for noise measurement flights



Present receivers

- Some GNSS receivers presently used in EADS group
  - Javad Euro-GGD, GeNeSiS: Military Air Systems, Eurocopter
  - **Javad Triumph**: Eurocopter
  - Ashtec ProFlex500: Airbus
  - Septentrio PolaRx2: Airbus Military
- Integration of TRE-G3T OEM for aircraft environment in home made housing for
  - **Robust mounting** and connectors, one-side-front
  - RTC batteries, power supply protection
  - IRIG-B distribution through output buffer
  - Optional **CF-card recording** of raw data



Present usage of GNSS reference networks in Flight Test

- Post-flight processing necessary for positioning requirements with **improved accuracy**, e.g. autopilot certification or validation of noise campaign with authorities

Reference networks mandatory for:

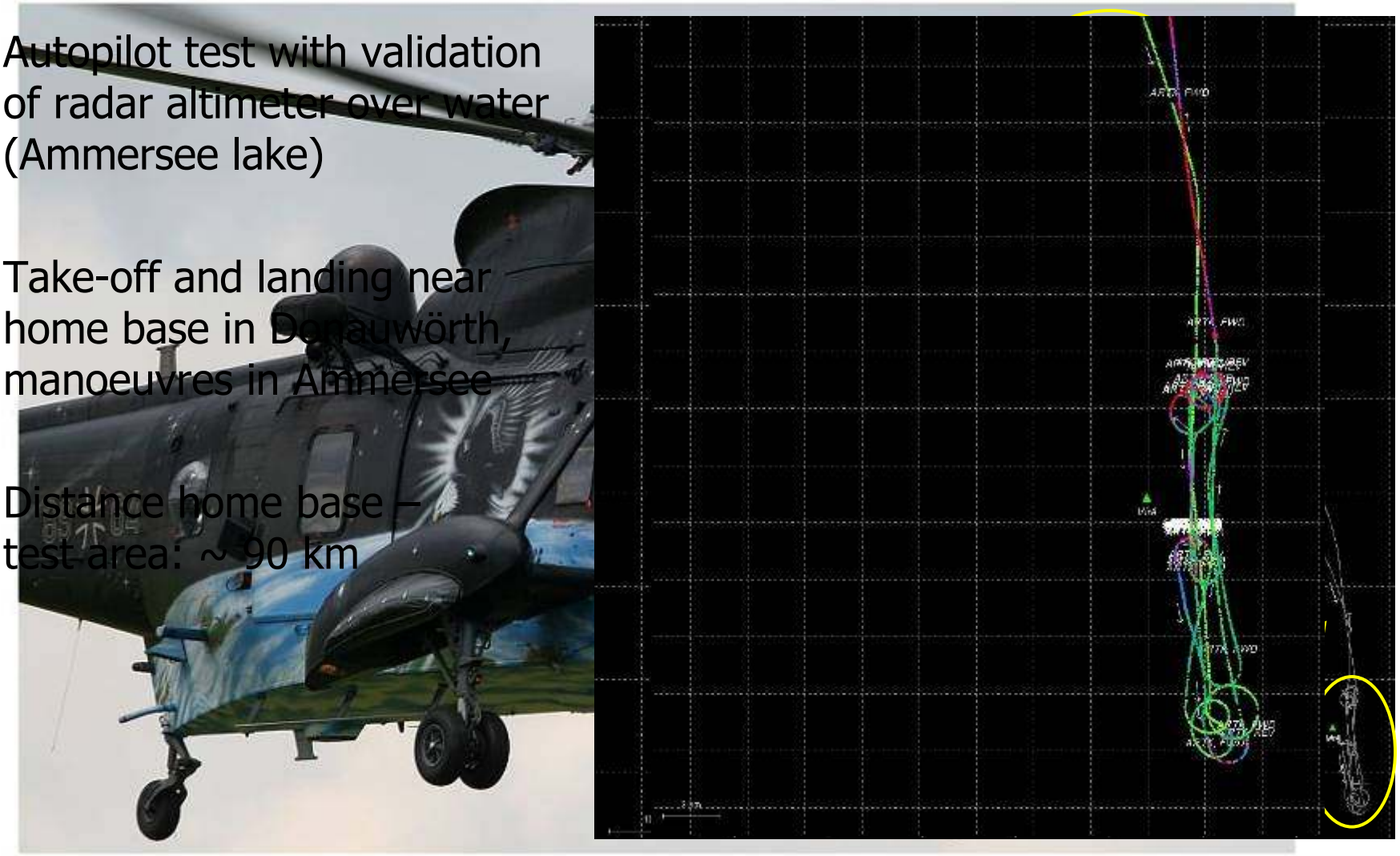
- Long-range flights with **multi-base** processing
  - E.g. Airbus tests on Atlantic and Mediterranean coasts in France
  - Limited number of bases
  - Data link over IP
- External test campaigns without local base
  - E.g. firing range in North Germany
  - SAPOS / ASCOS / TERIA-EXAGONE networks
  - Data link over manual web download

Presently:

- Data rates of max. 1 Hz of GPS / GLONASS systems
- Used format for base data: proprietary or RINEX
- Limited data availability in time frame after test

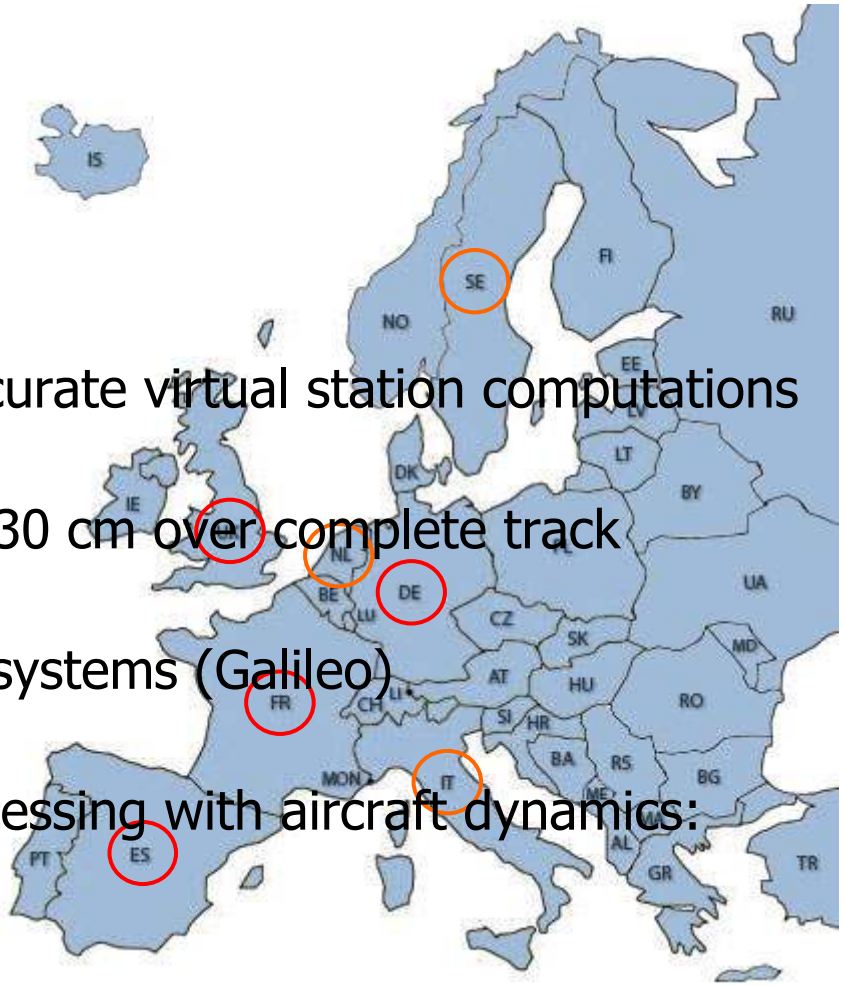
Example: test flight of Sea King MK-41 in Bavaria

- Autopilot test with validation of radar altimeter over water (Ammersee lake)
- Take-off and landing near home base in Donauwörth, manoeuvres in Ammersee
- Distance home base – test area: ~ 90 km



Flight test requirements to GNSS networks - System

- Coverage over Europe for EADS group
  - Germany
  - France
  - Spain
  - England
  - But also: Italy, Sweden, Netherlands
- Geographical density of stations for accurate virtual station computations
- Accuracy of post-processed solution < 30 cm over complete track
- Reference data for GPS and GLONASS systems (Galileo)
- Data **update rate** for robust post-processing with aircraft dynamics: helicopter, airline, fighter
  - ➔ minimum 5 Hz, best up to 20 Hz



Flight test requirements to GNSS networks - Service

- **Quality of Service** committed and guaranteed
  - Repetition of test flights expensive!
    ➔ over 99,7% availability
- System status: forecast, monitoring and report
- Certification / validation of network systems
  - Data recording
  - Virtual station computation
- Data **availability** extended to > 3 months
- Costs

Flight test requirements to GNSS networks - Process

Reference network data imported in presently existing tools and processes for test data processing

- Data format compatibility to present systems **mandatory**
  - PNAV, RINEX
- **Automatic** or semi-automatic processes
  - ~ 3000 trajectories computed in TLS in 2009
- Data access managed by automatic tools
  - e.g. over FTP for post-flight download
  - Streaming for real-time processing (rover data transmitted to ground station over telemetry)

Questions?

Thank you for your attention!

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Back-up

- Back-up slides / Details

Réseau TERIA / EXAGONE

reseau-teria.com

GPS (+ GLONASS in development)

GPS Top Counter Device

- Data streams recorded during one test flight: from 1 Mbps up to 200 Mbps
  ⇒ 3 hour-test = 270 GB

- Efficient data analysis and archiving need event markers – "tops"

- Tops: pre-flight calibrations, test points, flight manoeuvres, post-flight calibrations

- Top Counter device: Eurocopter self-made cockpit control for top definition through pilot or flight test engineer
  Push & release = 6 second-top
  Push & maintain = top as long as pushed

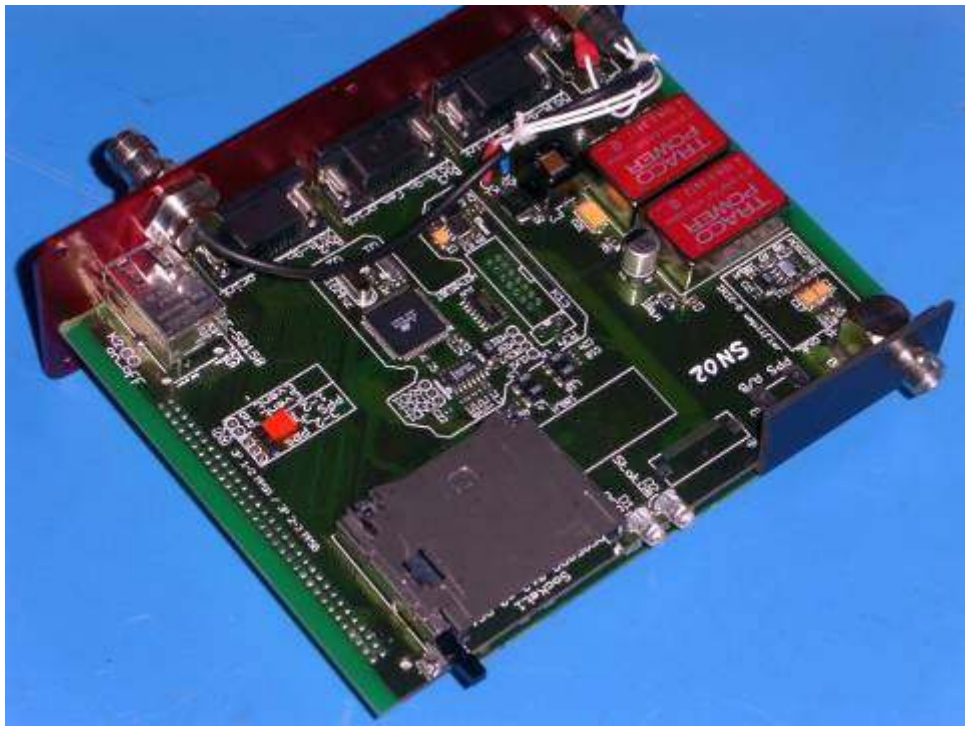
- Top list saved on flash card

- Time synchronisation through internal GPS receiver (Type Jupiter T30-140-xx) or free running RTC

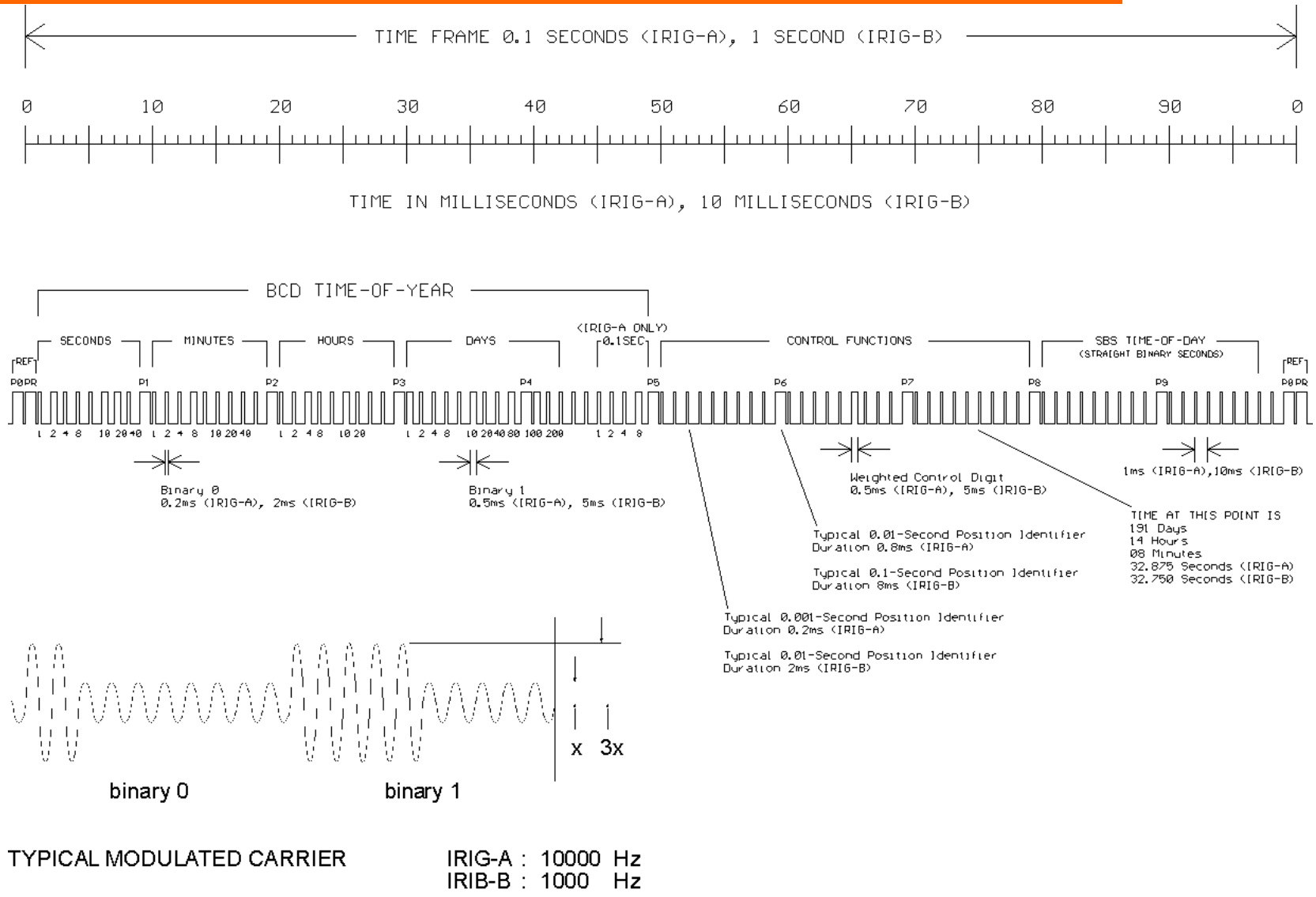
- Outputs:
  IRIG-B for FTI sub-systems
  Azimuth base – A/C for antenna tracking

Javad GeNeSiS @ Eurocopter

- Integration of GeNeSiS OEM board in flight capable housing
- Additional CF-slot for storage of jps data on mobile medium



IRIG-B



TYPICAL MODULATED CARRIER

IRIG-A : 10000 Hz
IRIB-B : 1000 Hz