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Dependable positioning for demanding applications

Alain Suskind

March 8, 2017

Who is Septentrio?

- Your success is our success
  - Most accurate and reliable GNSS position and timing solutions in the most demanding industrial environments
- Our team is your team
  - International team of GNSS HW, SW and navigation experts developing all core elements of high-quality GNSS receivers.
- Focus on quality
  - Partner with you to provide high quality products with excellent integration, application engineering and service
- Global Presence
  - Leuven, Belgium with regional branches
    - Los Angeles, CA and Hong Kong.
  - Worldwide partner network

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Our roots

imec

Founded Septentrio in 2000.

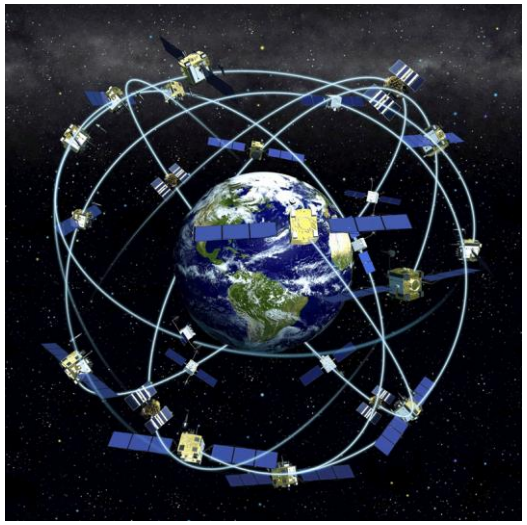
Major partner & shareholder.

Premier semiconductor research institute.

Unique infrastructure and talent.

Spider in strong eco-system.

esa
European Space Agency
Agence spatiale européenne



Long term strategic partner since 2002.

All Galileo test receivers designed and built by Septentrio exclusively (IOV & FOC).

Participated in numerous ESA projects in military, avionics & space.

Provided in-depth understanding of GNSS.

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Key application markets

Machine Automation

Marine

Construction

Mining

Logistics

Agriculture

Autonomous driving

Survey and Mapping

Survey

GIS

Mobile Mapping

Unmanned Systems

Scientific/Reference

Reference Receivers

Timing Receivers

Space Weather

Aerospace/Defense

Aerospace

Defense

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Customers

Machine Automation

PSA The World's Port of Call

RAVEN INDUSTRIES

bp

DEME Dredging, Environmental & Marine Engineering

JAN DE NUL GROUP

Boskalis Offshore

subsea 7

VALE

Survey and Mapping

Google

FLYING CAM

ESRI

IXBLUE DEEP INSIGHT. SHARPER SENSES.

PENTAX

Scientific/Reference

NASA

esa European Space Agency Agence spatiale européenne

USGS

UNAVCO

Aerospace/Defense

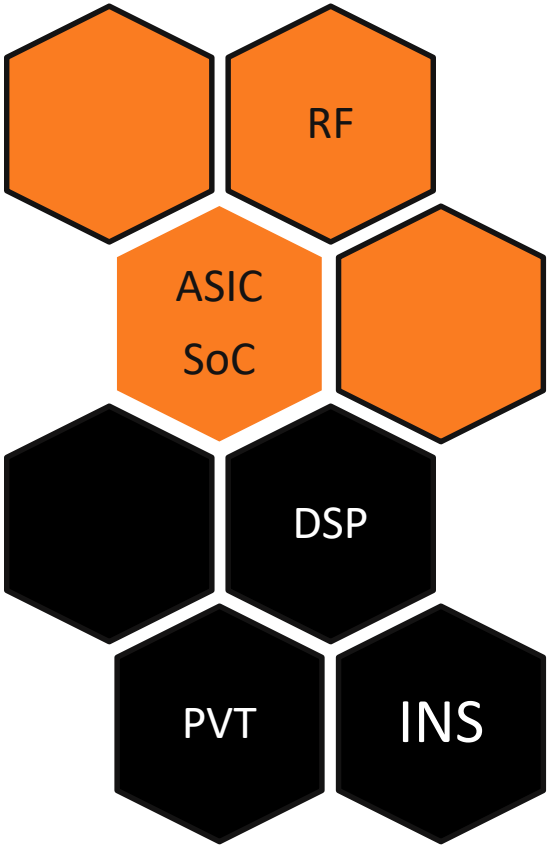
AIRBUS

Raytheon

MITRE

Technology for Success

We masters all technologies to reliably deliver accuracy in challenging and mission critical environment



- RF front-end and baseband SoC for all signal-in-space tracking
- High interference immunity
- Advanced multi-path mitigation
- Fast acquisition, high sensitivity and low measurement noise

- Scalable accuracy: sub-meter down to cm
- High dependability
- All GNSS positioning technologies (SBAS, DGNSS, RTK, PPP, SSR)
- GNSS/INS hybridization

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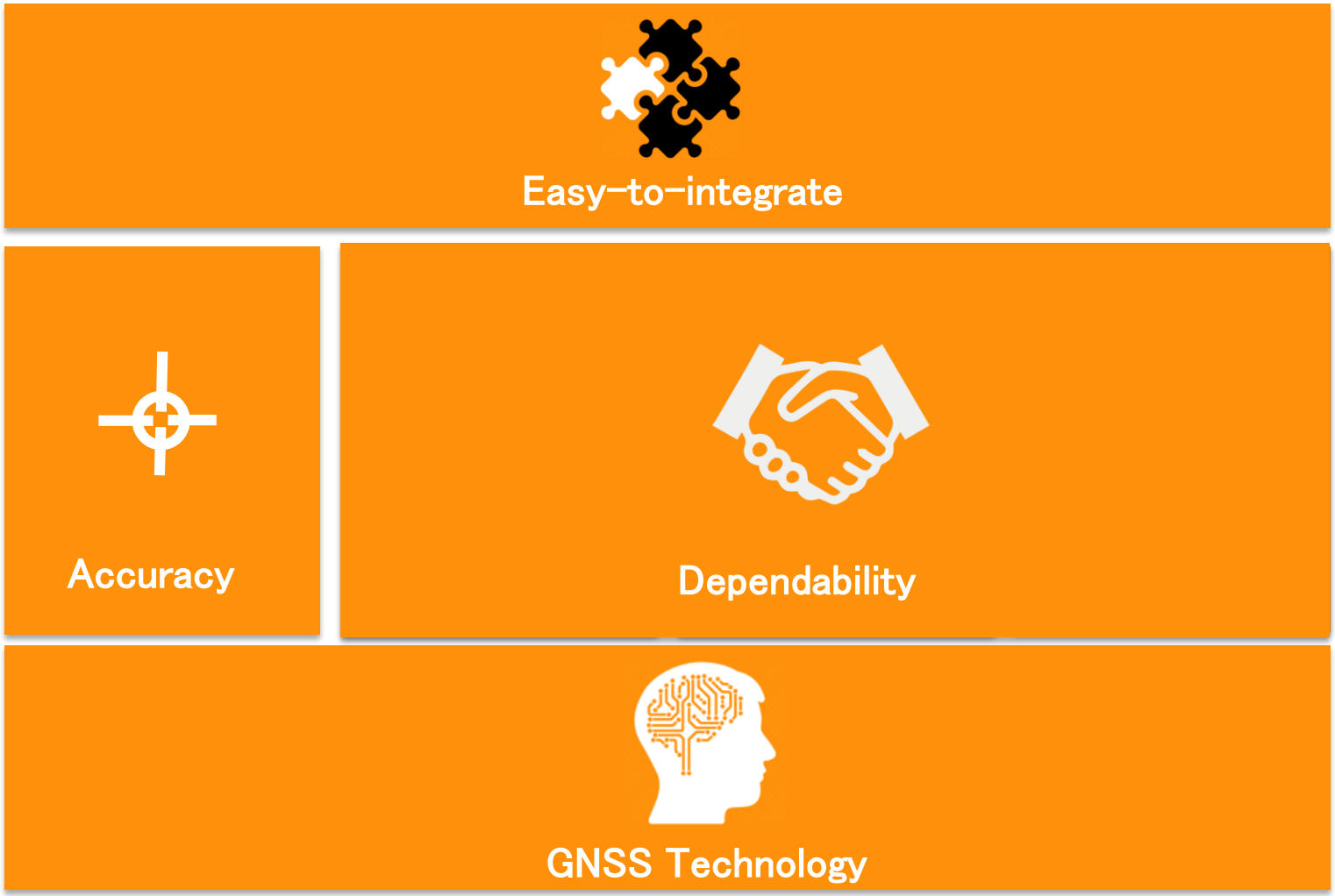
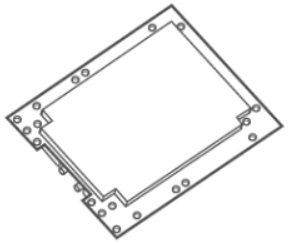
Septentrio Positioning and Timing Solutions

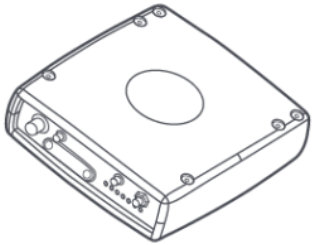


Our Professional Products

AsteRx

Rover Receivers and OEM boards for automation and machine control



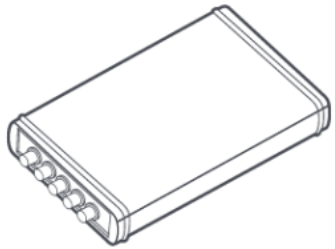


Altus

Smart antennas for GIS and survey

PolaRx

Reference receivers for science and networks



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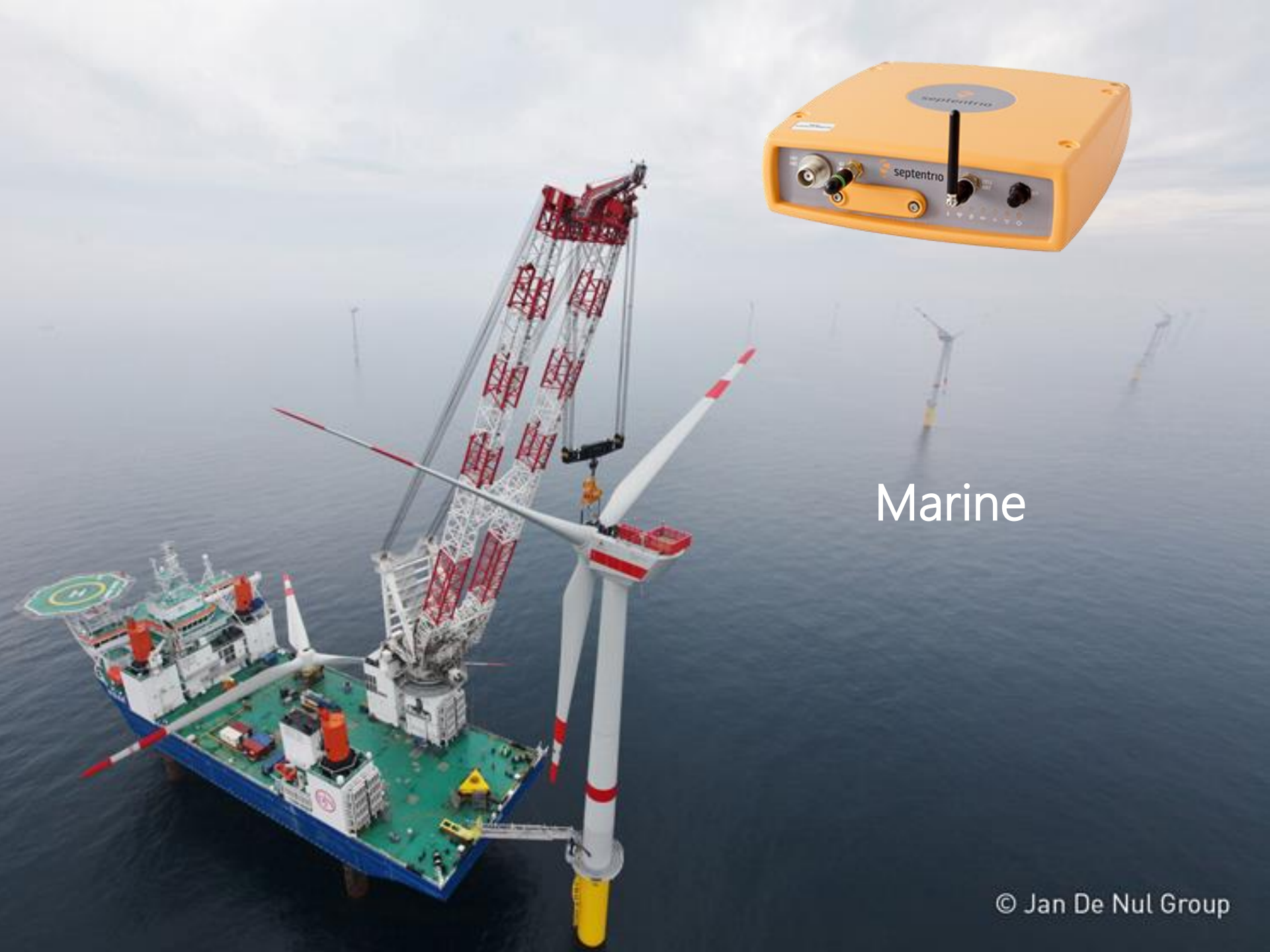
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Marine
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Mining & Construction

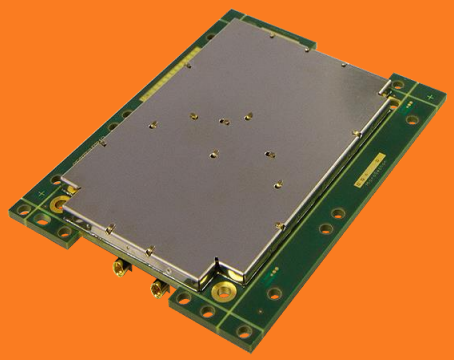
Machine Control

Agriculture

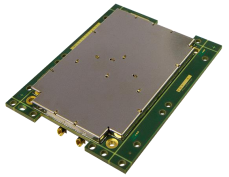
Autosteer

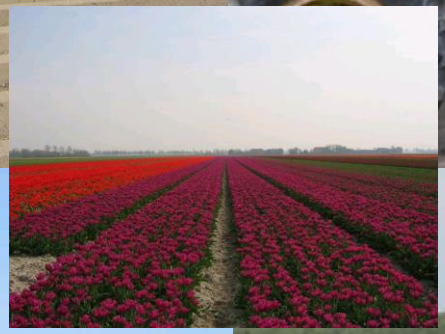
Tool control

Planting Trees



Autosteer and tool control





Planting trees

Dependable positioning in Automotive

Dependable positioning in Automotive

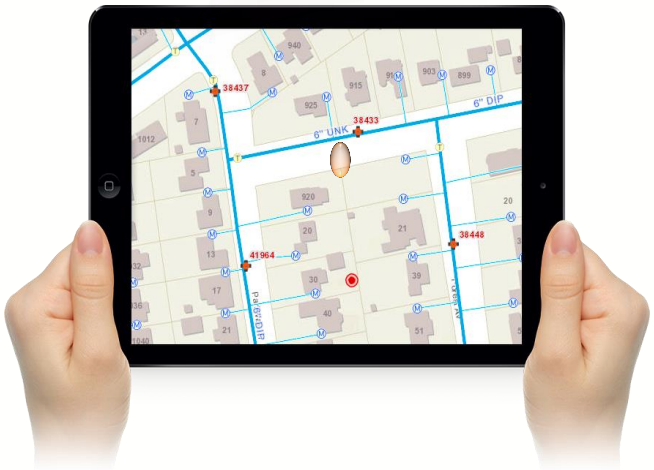
- Before: Road level positioning
  - On which road am I?
  - Use Autonomous GPS (accuracy ~5m) + projection on maps
- Now: Lane Level Positioning
  - On which lane am I?
  - Use GNSS + correction (e.g., EGNOS, accuracy ~1m) + maps
  - May use additional sensors: radar, camera, inertial
- (Close) Future: Autonomous Vehicles
  - Better than lane positioning
  - Dependability (availability, integrity)
  - Requires Sensor Fusion and High Precision GNSS

GNSS remains the only viable absolute positioning and timing source

Specific Absolute Positioning Requirements for Autonomous Vehicles

- Accuracy <1m 3-sigma
  - 3x better than EGNOS
  - Requires high precision GNSS
    - RTK: local augmentation data from infrastructure (differential)
    - PPP: global augmentation data from Geostationary Satellites (e.g., Inmarsat)
- Highest possible availability
  - Requires to use all available systems
    - GPS, GALILEO, GLONASS, BEIDOU, QZSS
  - "Dead reckoning" on other sensors when no satellites systems available (e.g., tunnel)
- Integrity
  - Essentially reliability of the error indicator
  - Need sensor fusion
- Functional Safety
  - ISO26262
- Security
  - Active anti-jamming and anti-spoofing
  - IT security

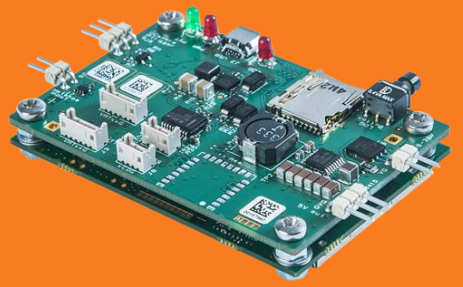
Survey & GIS: Altus products



Drones

Accurate Georeferencing

No Ground Control Points



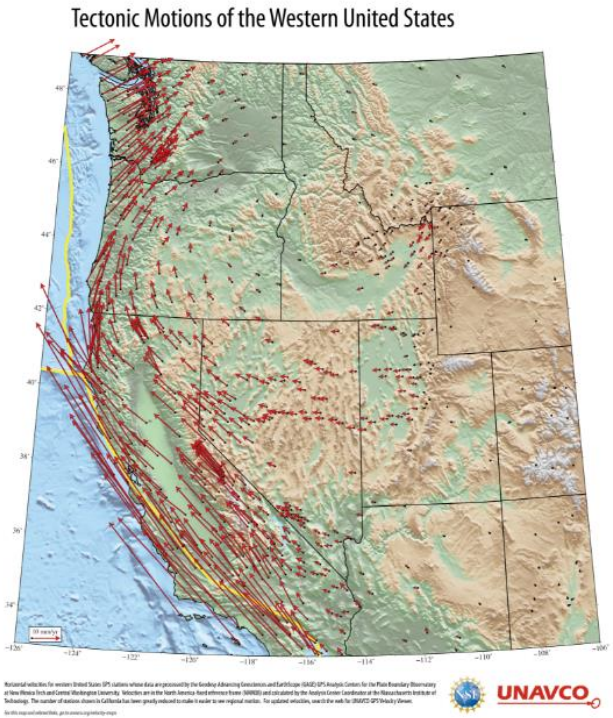
Scientific/Reference

PolaRx5

Scientific users & reference stations

PolaRx5S

Ionosphere monitoring



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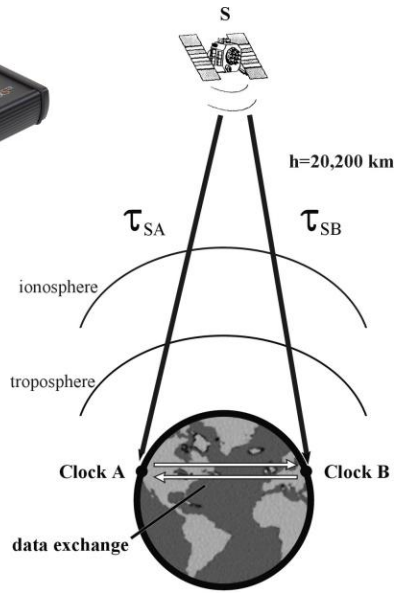
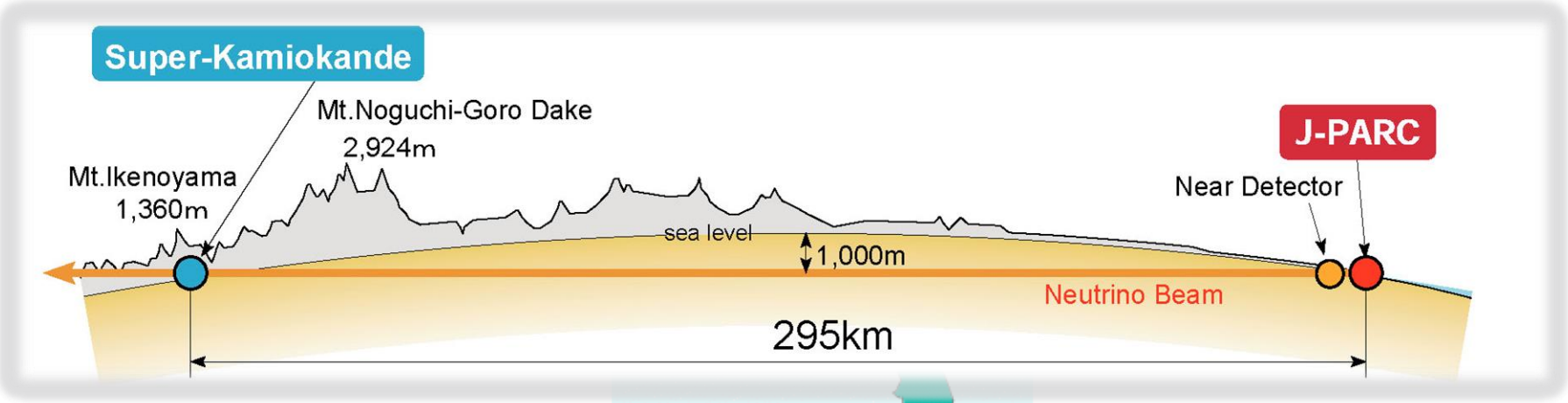


Precise timing application

Long-baseline neutrino experiments

http://t2k-experiment.org/t2k/

http://www.t2k.org/docs/poster/038/NeuTel13-T2KTOFposter



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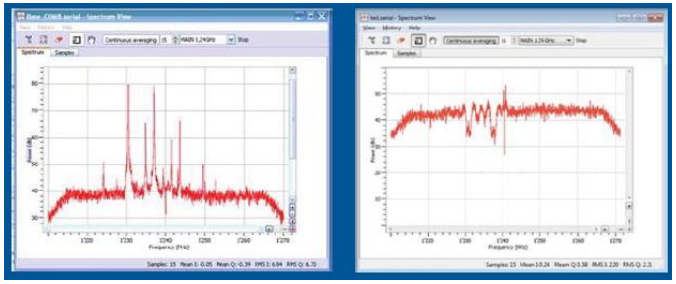
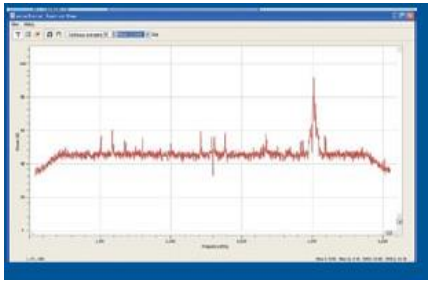
Interference issues

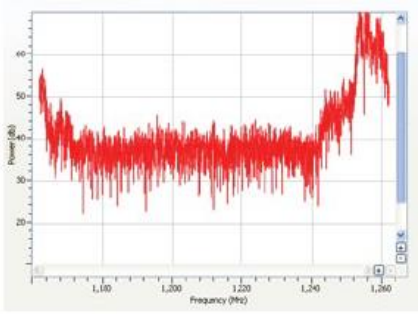
Tuymen Olbast, Russia

Hilversum, the Netherlands

Oostende, Belgium

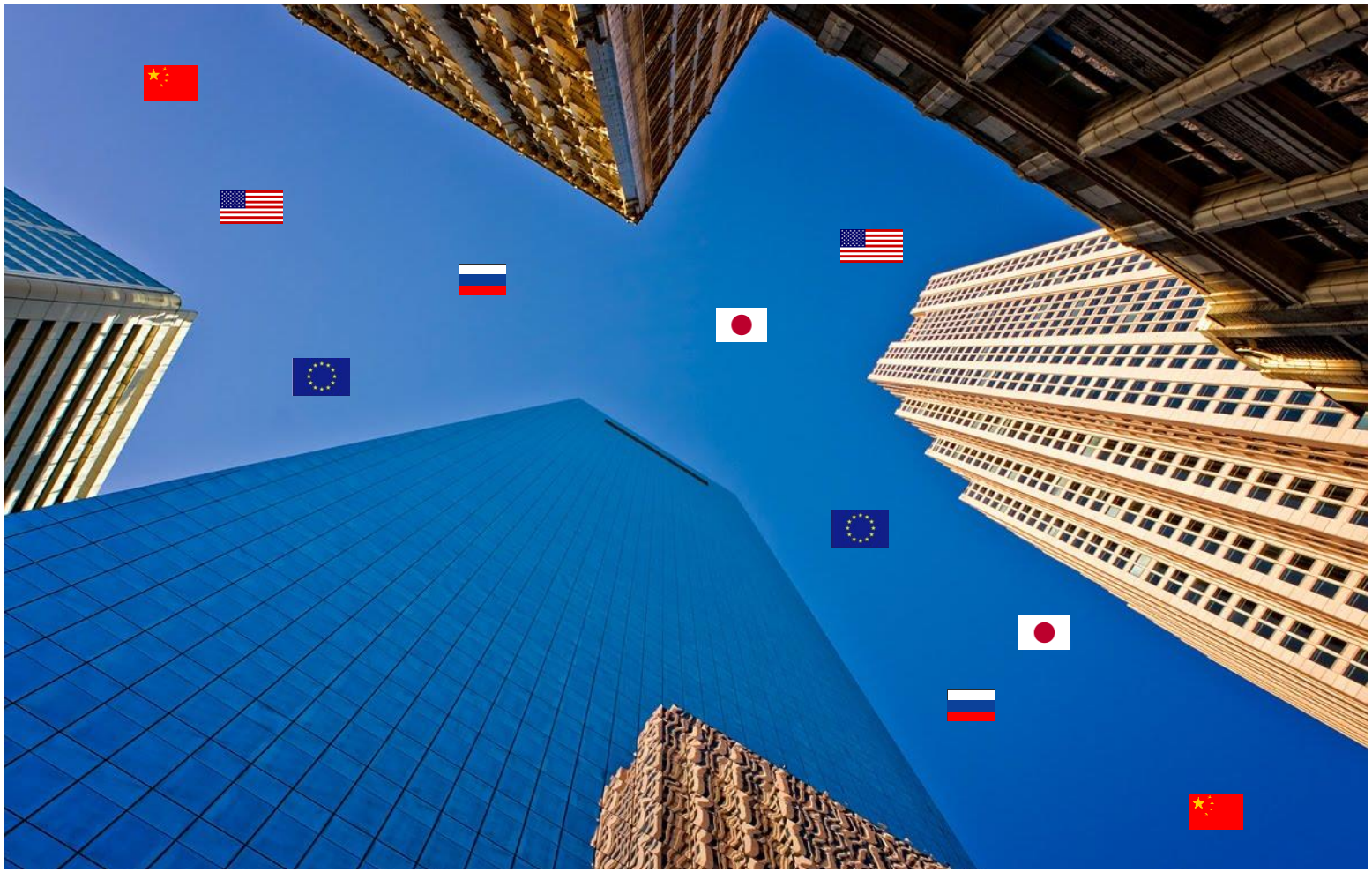






More satellites ?

GPS + GLONASS + GALILEO + BEIDOU + QZSS



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