Septentrio GNSS Solutions

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Contents and Goals of this Presentation

- Septentrio Profile

  - Company profile

  - Product overview

- Technology overview : robust GNSS for harsh environments (interference, multipath, spoofing, vibrations, ionospheric disturbances, etc.) with concrete examples

- PolaRx5 series – GNSS receivers for reference stations and scientific applications

- mosaic series – GNSS modules for large scale hi-accuracy applications

  - Overview

  - Evaluation kits and where to buy ?

  - Eco-systems

- Summary

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Company Profile

Septentrio, who we are?

- **Your success is our success**
  - ➤ Most accurate and reliable **GNSS position and timing solutions** in the most demanding industrial and scientific environments

- **Our team is your team**
  - ➤ Global 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 **robust high-quality GNSS positioning products** with excellent integration, application engineering and **service**

- **Global Presence**
  - ➤ Located in Leuven, Belgium with regional branches in Los Angeles, CA, Shanghai, Korea and Yokohama (near Tokyo), JPN.
  - ➤ Worldwide partner networks

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Welcome to Leuven, Belgium:

European innovation capital 2021
Center of excellence for education, innovation and semiconductor technology
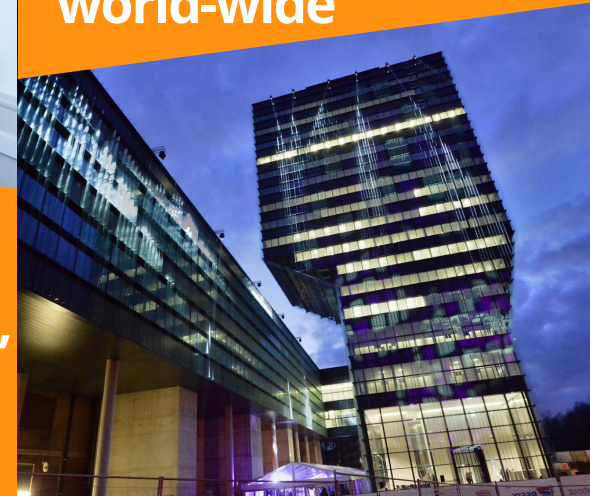
KU Leuven
Founded in 1425
46 000 students
16% international

#1
most innovative university in **Europe,**
ranked by Reuters

IMEC
5000 researchers
#1 semiconductor research institute world-wide

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LEUVEN MINDGATE

IMEC : Interuniversity Microelectronics Centre
KU Leuven : Katholieke Universiteit Leuven

Septentrio's Roots

In-depth understanding of designing and building advanced ASIC's and systems

In-depth understanding of GNSS and how to maximize its use

Founder & key shareholder of Septentrio.

Spin off from IMEC, Septentrio was founded in 2000.

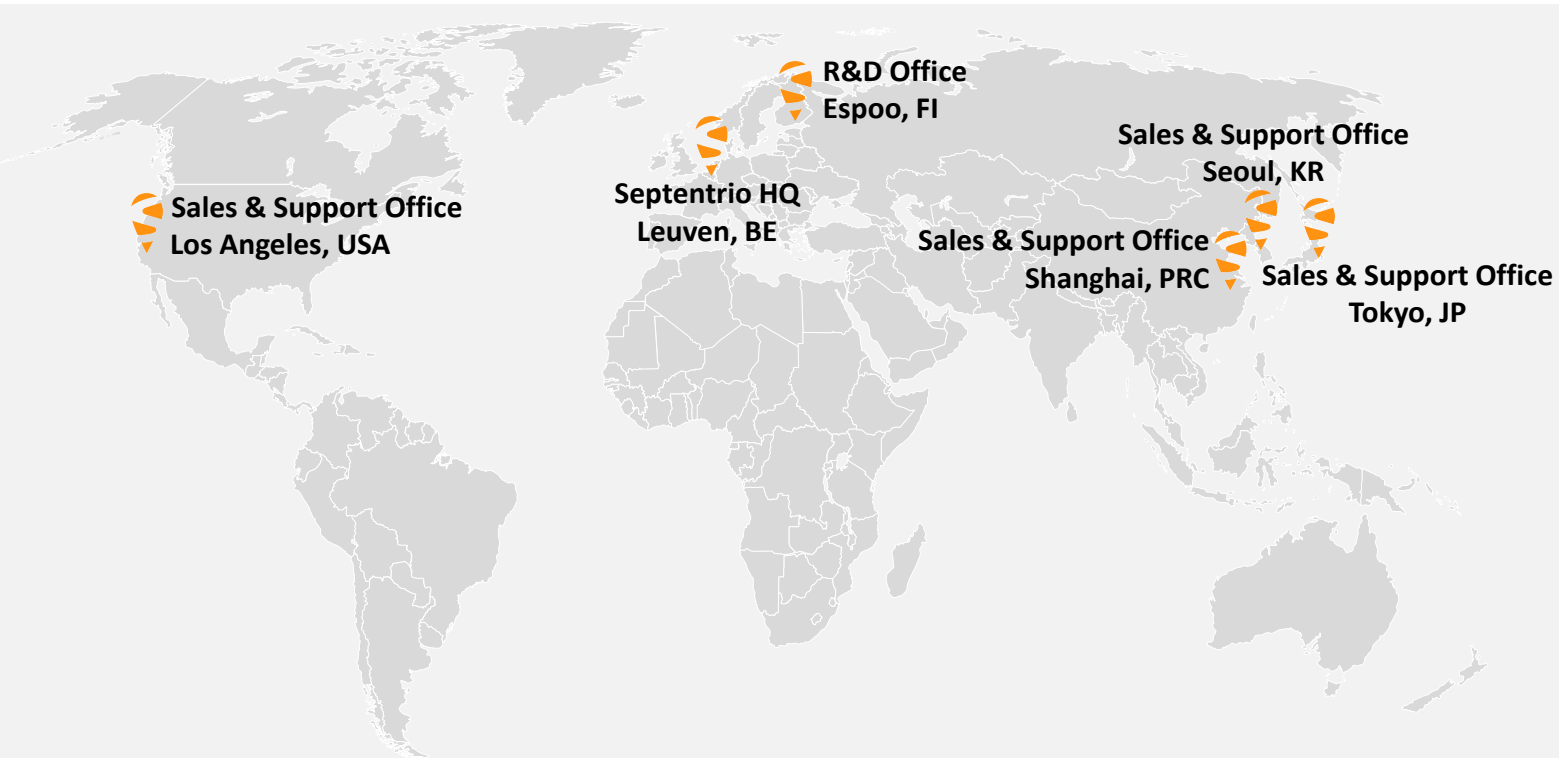Direct access to unmatched ecosystem for digital & analog ASIC design, production & testing.

Long term strategic partner since 2002.

All Galileo test receivers designed and built by Septentrio exclusively.

First ever Galileo Receiver made by Septentrio.

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

Provided in-depth understanding of GNSS.

Corporate Overview

R&D Office
Espoo, FI

Sales & Support Office
Seoul, KR

Sales & Support Office
Los Angeles, USA

Septentrio HQ
Leuven, BE

Sales & Support Office
Shanghai, PRC

Sales & Support Office
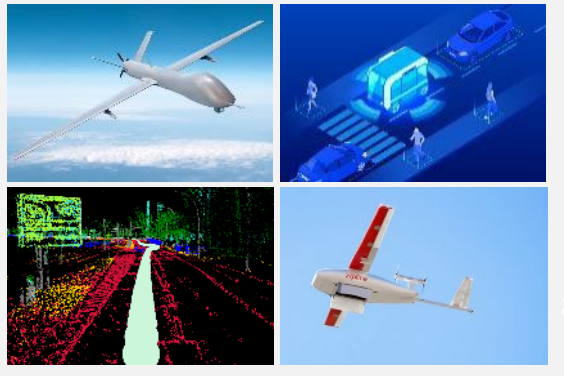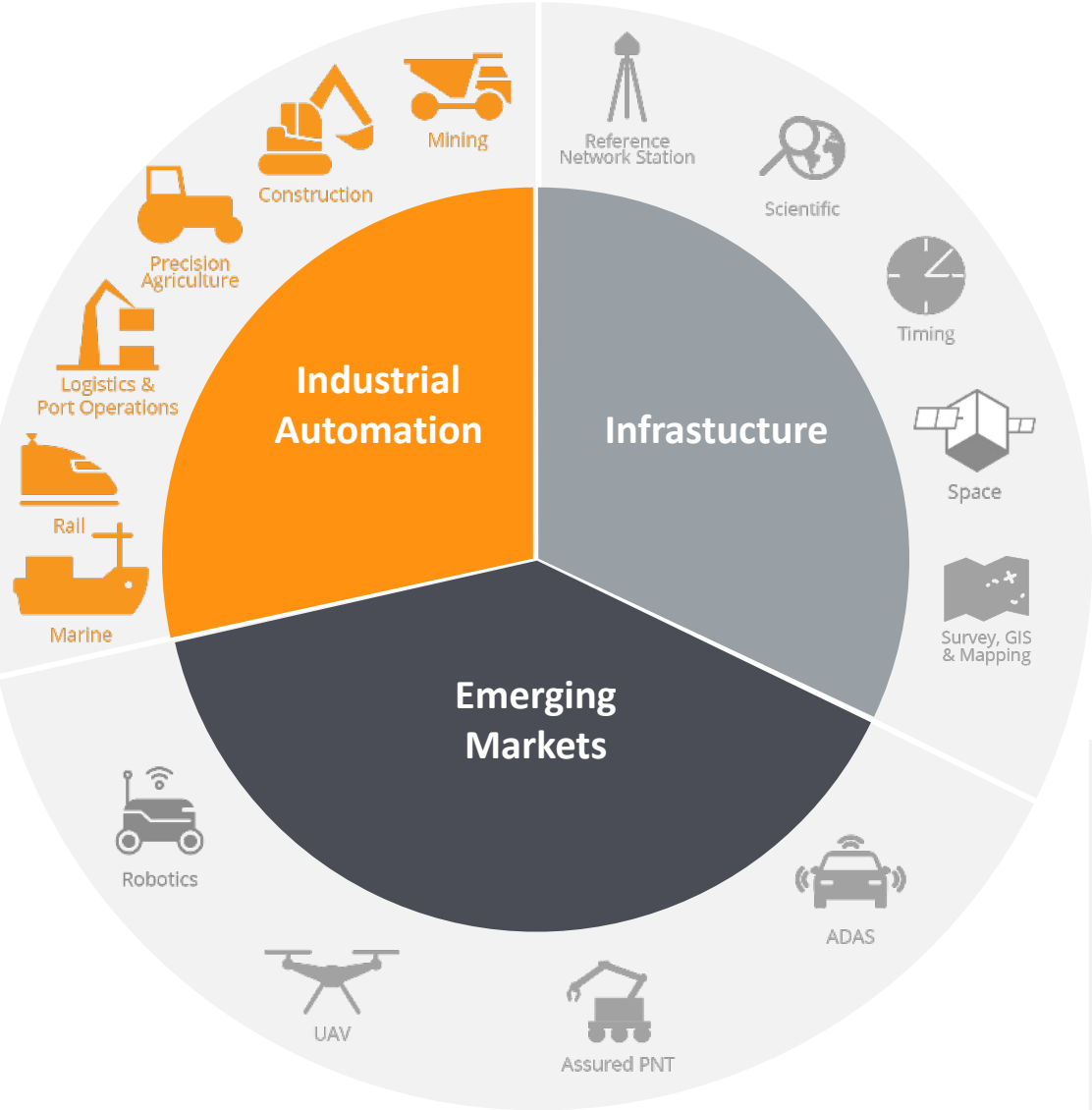**Tokyo, JP**

Headquartered in Leuven, Belgium

R&D centres in Belgium and Finland.

Global customer base, with sales and support offices close to the large industrial clusters

130 employees, 60 of which in R&D

ISO 9001 certified

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Key application markets

Industrial Automation
- Mining
- Construction
- Precision Agriculture
- Logistics & Port Operations
- Rail
- Marine

Infrastucture
- Reference Network Station
- Scientific
- Timing
- Space
- Survey, GIS & Mapping

Emerging Markets
- ADAS
- Assured PNT
- UAV
- Robotics

Product overview

Modules	Boards	Housed Receivers	Antennas	Scientific Receivers
mosaic-X5 *Single-antenna*	**AsteRx-m3** *Single- or dual-antenna*	**AsteRx-U3, U3 Marine** *Dual-antenna, all comms*	**AntaRx (Coming soon)** *Single- or dual- smart antenna GNSS or GNSS-INS*	**PolaRx5, PolaRx5e** *Reference & scientific*
mosaic-H *Dual-antenna*	**AsteRx-i3 D** *Non-tethered GNSS-INS*	**AsteRx SB3** *Single- or dual-antenna*		**PolaRx5S** *Ionospheric monitoring*
mosaic-T *Timing variant*	**AsteRx-i3 S** *Tethered GNSS-INS*	**AsteRx SBi3** *GNSS-INS*	**Various GNSS Antennae**	**PolaRx5TR** *Time and frequency transfer*
mosaic-CLAS *CLAS variant for Japan*	**Interface Board, Development kits**			

https://www.septentrio.com/en/products/gps-gnss-receivers/product-selector-finder

Technology overview

Robust GNSS for harsh environments (interference, multipath, spoofing, vibrations, ionospheric disturbances, etc.) with concrete examples

Technology overview of Septentrio GNSS receivers

All Satellites
GPS/GLO/GAL/BDS/
QZSS/IRNS

Low Power
~0.5W (Module)

~1W (Board)

~2W (Boxed-type)

High navigation rate, Low latency
100Hz (INS 200Hz)
Latency : ~10ms

Multi-Bands
L1,L2

L-band, L5, L6

Easy to use
WebUI (NTRIP Server/
Caster integrated, Spectrum
Analyzer integrated)
Open Format (SBF)
Free Tool : conversion, analysis

Rich HW Interface
Ethernet
Serial (3 and 4), USB
On-board Logging, PPS

Anti-interference, Anti-Jamming
Automatic notch-filter
Wide-band and chirp
interference

Anti-spoofing
Septentrio's patented
GNSS+ technologies
(Algorism)
OSNMA

Septentrio's patented GNSS+ technologies (Algorithms)
AIM+, IONO+, RAIM+, APME+, LOCK+, INS+

Performance mode
Stand-alone	SBAS	Differential
RTK	RTK-VRS	PPP(L-band)
Base	INS	

Makin (Norway)

Ionosphere Resilience at high latitudes

Interference Mitigation

Multipath of cliffs and excavator boom

Scalable accuracy

Reliable Position and Orientation – even when heavy vibrations

All-in-one, easy to use

Jan De Nul (Belgium)

Ionosphere Resilience

Interference Mitigation Inmarsat

Scalable accuracy PPP & RTK

Reliable Heading

Reliable Position and Orientation

AsteRx-U

Septentrio in Confidence

Kalmar (Norway)

GNSS signal reflections

Difficult environments
- Solution = GNSS/INS
- Powered by multiple GNSS constellations

Avoid accidents

Logistics automation

Naio Technologies (France)

IN-ROW WEEDING

Why Septentrio
- Altus NR3
- Reliability
- Ease of integration
- Support for SSR (L-band + NTRIP)

Renu Robotics (US)

Why Mosaic
o Multipath near solar panels
o Price
o Integrity info for IMU sensor.

ISRC (Japan)

Why Mosaic
- Multipath near dam
- Fix in limited sky visibility
- PixHawk plug-compatible

At Shikoku Dam

APME+ **Advanced Multipath Mitigation**

Measurement Engine

Available

Proven Performance

Multipath is the dominant error source in GNSS applications. It causes meter-level error on the measured satellite distances on both pseudoranges and carrier phases. It significantly degrades the position and time accuracy.

APME+ uses extra correlators in each tracking channel to estimate the multipath error on pseudorange and carrier phase measurements. Well, unlike most other techniques which only do code multipath estimation, APME+ support both code and phase multipath estimation. The measurements are then corrected by subtracting the estimated error. While most other multipath mitigation techniques involve modifying the correlators in the tracking channels, APME+ leaves the tracking channels unchanged. The multipath errors are estimated independently from the tracking of the signal.

On the other hand, APME+ is by design free of any bias. APME+ estimates the multipath error in real-time without modifying the underlying tracking loop.

Key Features

- Better against short delay multipath
- Estimates multipath without changing tracking loops
- Estimates multipath per satellite
- Indicates amount of multipath error
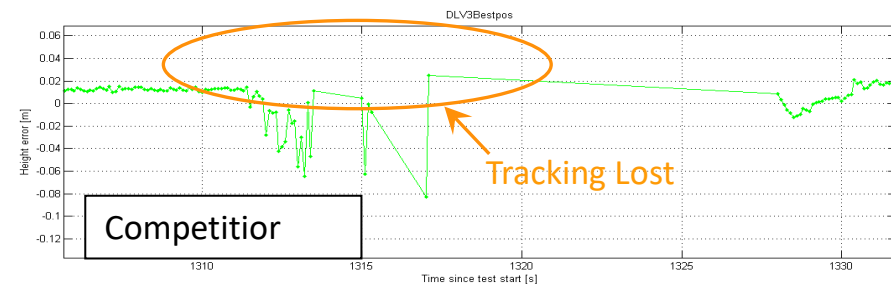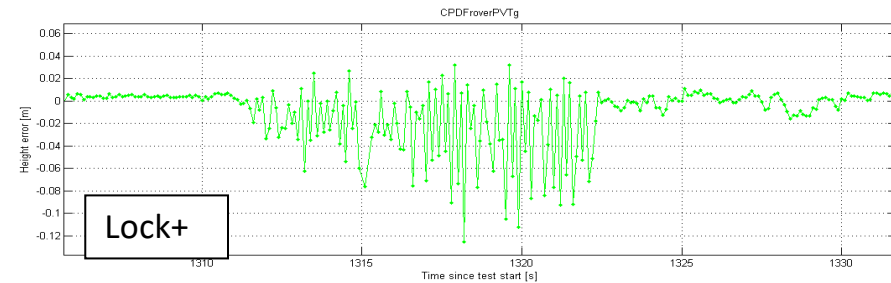- Allows phase multipath

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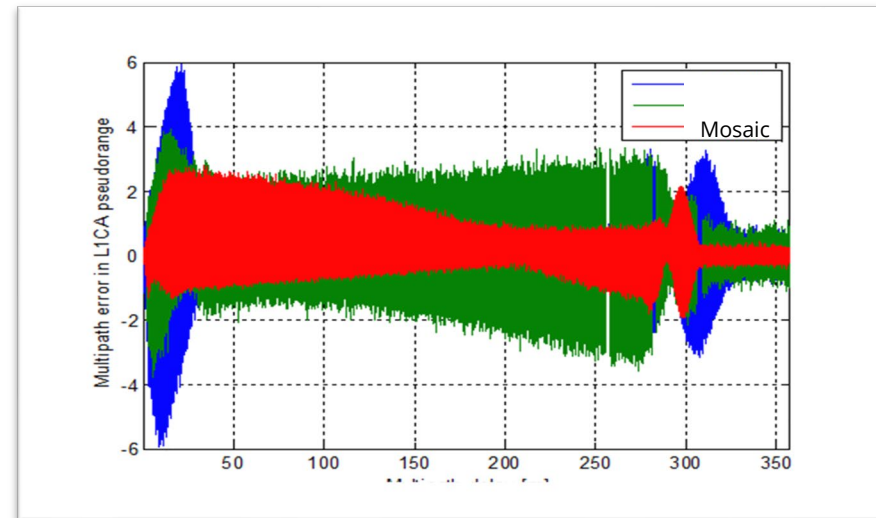
LOCK+
Superior Tracking Robustness

Machine vibration severely impacts tracking continuity which is harmful for RTK, PPP and heading positioning e.g. grade control

Special algorithms are implemented to maintain tracking under heavy vibrations.

AIM+ Advanced Interference Monitoring & Mitigation

Septentrio's **AIM+** technology, the most advanced on-board interference mitigation technology on the market. It can **detect** and **suppress** the widest variety of interferers, from simple continuous **narrowband** signals to the most complex **wideband** and **chirp** jammers. The radiofrequency (RF) spectrum can be viewed in real-time in both time and frequency domains .

- **Monitor the RF spectrum**
  You can monitor the RF spectrum in the Spectrum window of the GNSS menu.

- **Narrow-band interference**
  Narrow-band interference can be caused by electronic devices and effects only a small portion of the GNSS frequency spectrum. To mitigate the effects of narrow-band interference, 3 notch filters can be configured either in auto or manual mode. These notch filters effectively remove a narrow part of the RF spectrum around the interfering signal.

- **Wide-band and chirp interference**
  The L2 band, being open for use by radio amateurs, is particularly vulnerable to this type of interference. The effects of wideband interference, both intentional and unintentional, can be mitigated by enabling the WBIM mitigation system. The WBI system also reduces, more effectively than traditionally used pulse-blanking methods, the effects of pulsed interferers.

- **Inmarsat and Iridium satellite interference**
  The mosaic can suppress the interference from high-powered Inmarsat and Iridium satellite communications signals.

GPS completely jammed by chirp jammer

Band fully cleaned up by wideband interference mitigation unit
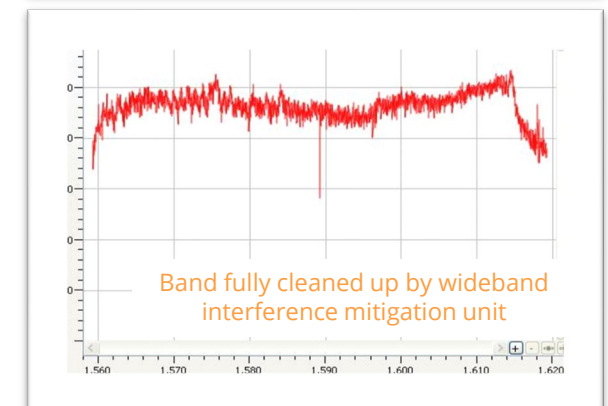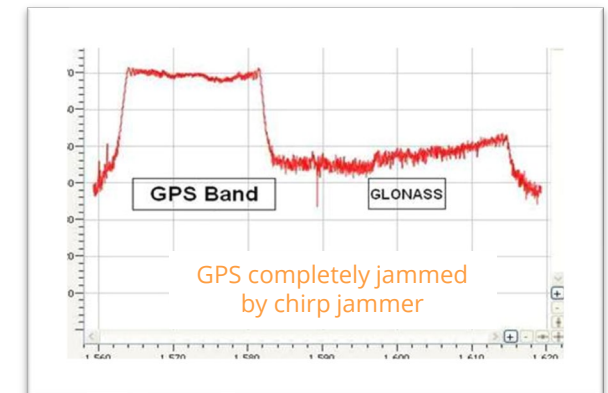
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Technology for Robustness – Spoofing

Spoofing is easy

Especially consumer/

L1
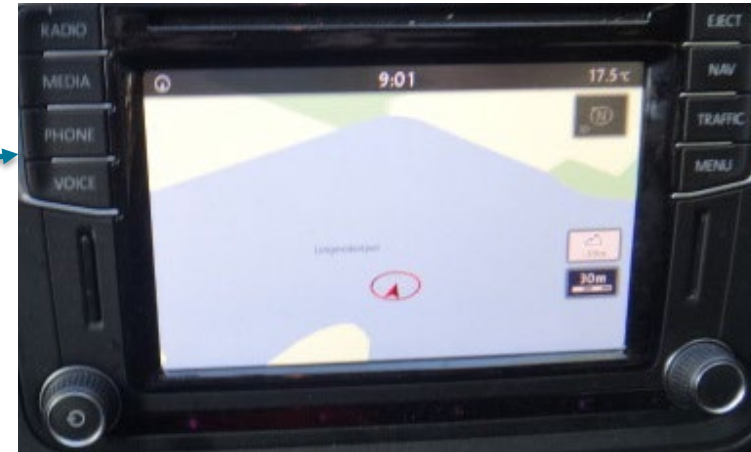
Septentrio :

- Several **built-in techniques** identify suspicious behavior
  - Built-in spectrum analysis
  - Signal characteristics & Timing
- And **compensate**
  - Reject suspected signal
  - Frequency diversity
- Continuously ongoing development

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Galileo OSNMA

- **Open Service Navigation Message Authentication**
  - **Spoofer detection** by adding authentication (signature) of satellite nav message
  - **Galileo** protected
  - First ever signal-in-space authentication!
  - Free of charge
  - Backwards compatible

- Timeline:
  - 2023 Initial service

Galileo OSNMA SIS ICD for Service Phase (v1.0)

GALILEO OPEN SERVICE NAVIGATION MESSAGE AUTHENTICATION (OSNMA) SIGNAL-IN-SPACE INTERFACE CONTROL DOCUMENT (SIS ICD)

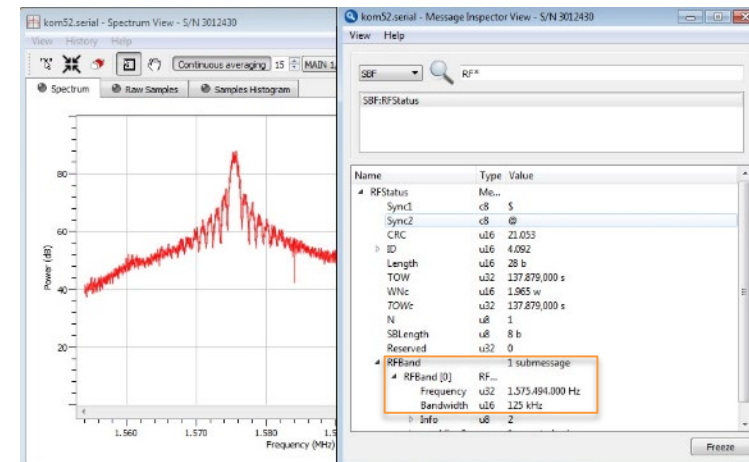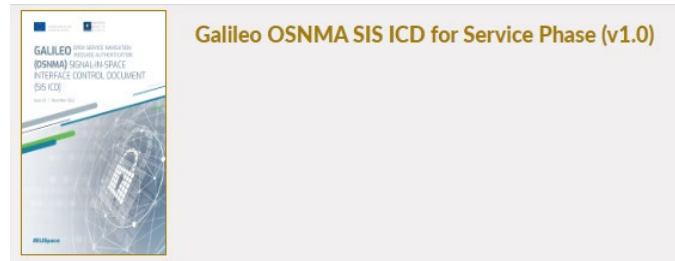|	L5/E5		L2	L6/E6		L1/E1	
GPS	L5		L2			L1CA/C	
Galileo	E5a	E5b		E6		E1	
BeiDou	B2a	B2b		B3		B1I	B1C
QZSS	L5		L2	L6		L1C/S	
NavIC	L5					L1C	
SBAS	L5					L1CA	
GLONASS		L3	L2				L1
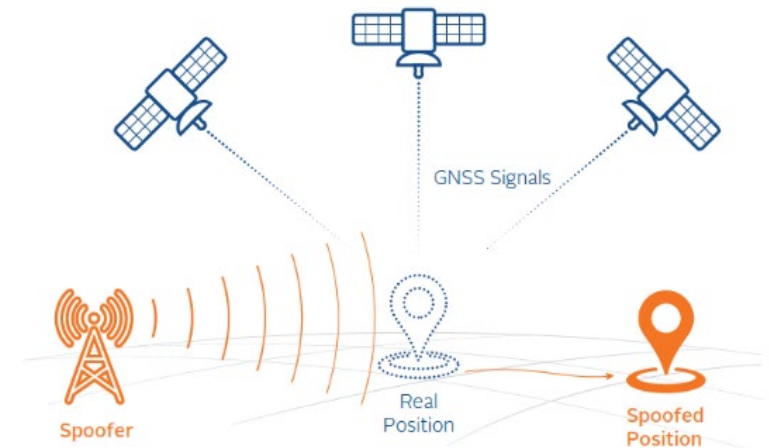
GNSS Signals

Spoofer   Real Position   Spoofed Position

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High navigation rate, Low latency

- While tracking all satellites and all signals, positioning, raw data and heading can be output at 100Hz.

- Bulldozer blade control cannot maintain a constant height without low latency.

	X module 10Hz	mosaic
GPS+GLO+GAL	75 ms	6 ms
GPS+GLO	50 ms	5 ms
GPS+GLO+GAL	75 ms	5 ms
GPS+GLO	50 ms	4 ms

PolaRx5 series

GNSS receivers for reference stations and scientific applications

PolaRx5 family
Multi-Frequency Multi-Constellation Reference Stations

PolaRx5 and PolaRx5e
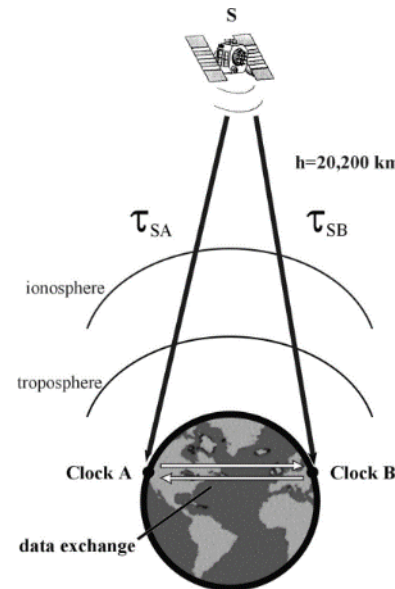**CORS and scientific reference stations**

PolaRx5TR
Time transfer applications

PolaRx5S
Scintillation and ionosphere monitoring

Tectonic Motions of the Western United States

S

h=20,200 km

τ_{SA} τ_{SB}

ionosphere

troposphere

Clock A   Clock B

data exchange

sep
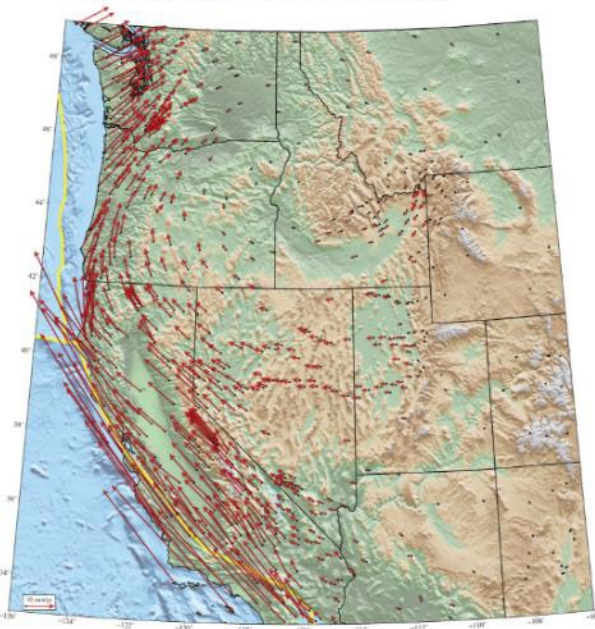
* **CORS** : Continuously Operating Reference Station

PolaRx5 – Differentiating Features

Best-in-class Measurement Quality

- High SNR, low cycle slips, high availability
  - Preferred UNAVCO GNSS Receiver
  - Evaluations 2015 http://kb.unavco.org/kb/file.php?id=745
- Provides GPS L1P and "real" raw data (no MP/smoothing)

APME+ Multipath estimation/mitigation

- Mitigates both code and carrier short-delay multipath
- Short-delay is most prevalent and damaging form of multipath
- Identifies amount of multipath present and can simultaneously provide unaltered data as well as with multipath eliminated
- Unaltered measurements, with no multipath estimated are provided also when APME is on (SBF MeasExtra)

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The UNAVCO Endorsement

- UNAVCO is the largest single operator of GNSS reference stations: ~2,000 receivers (mostly NA)

- Septentrio selected as Preferred Vendor for GNSS Reference Stations since 2015 following 15 week RFP and technical evaluation period

- Key findings:
  - Best performance, esp. in multi-constellation testing
  - Scalable power consumption significantly lower than the competition
  - "Miles ahead" on interference mitigation
  - Superior technical support

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https://www.unavco.org/

IGS Network
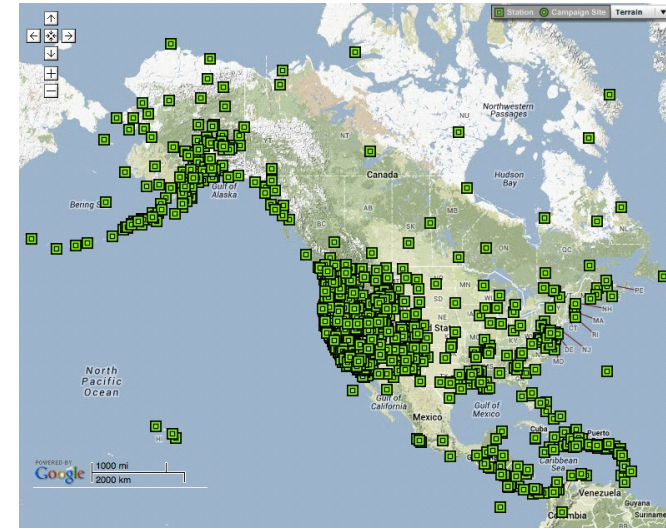
http://igs.org/network

1/3 of IGS GNSS network are PolaRx receivers.

Old PolaRx2/3 still active, demonstrating quality and durability of Septentrio receivers

|	Site Name	Country/Region	Receiver	Antenna - Radome	Sa
✈ ●	ABMF00GLP	🇫🇷 Guadeloupe	SEPT POLARX5	TRM57971.00 - NONE	GF
✈ ▲	ABPO00MDG	🇲🇬 Madagascar	SEPT POLARX5	ASH701945G_M - SCIT	GF
✈ ●	AC2300USA	🇺🇸 United Stat...	SEPT POLARX5	TRM59800.99 - SCIT	GF
✈ ●	AC2400USA	🇺🇸 United Stat...	SEPT POLARX5	TRM159800.00 - SCIT	GF
✈ ●	ACSO00USA	🇺🇸 United Stat...	SEPT POLARX5	TRM59800.80 - SCIT	GF
✈ ●	AGGO00ARG	🇦🇷 Argentina	SEPT POLARX5TR	LEIAR25.R4 - LEIT	GF
✈ ●	ALBH00CAN	🇨🇦 Canada	SEPT POLARX5	TRM59800.00 - SCIS	GF
✈ ▲	ALGO00CAN	🇨🇦 Canada	SEPT POLARX5	AOAD/M_T - NONE	GF
✈ ●	ALIC00AUS	🇦🇺 Australia	SEPT POLARX5	LEIAR25.R3 - NONE	GF
✈ ▲	ALRT00CAN	🇨🇦 Canada	SEPT POLARX5	ASH701945D_M - NONE	GF
✈ ●	AMC400USA	🇺🇸 United Stat...	SEPT POLARX5TR	TPSCR.G5C - NONE	GF

Show 25 stations

1 2 3 ... 8

Septentrio in Confidence

516 Stations as of Aug. 29, 2023   Legend ⓘ

47

mosaic series
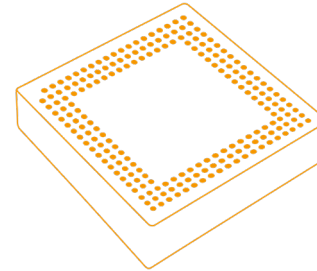
GNSS modules for large scale hi-accuracy applications

Small size with a wide array of HW / SW Interfaces

mosaic has a wide array of hardware and software interfaces in a **compact size** 3 x 3 cm LGA form factor working in a **industry temperature** environment. The USB device could be truned to 1 virtual ETH and 2 UARTs according to customer's OS. Together with 4 physical UARTs, 1 physical Ethernet, every interface could be used for SBF, NMEA, RINEX, RTCM, CMR input / output. If you use Ethernet interface, you could also use internal **UDP**, **TCP** Server/Client, **full-feature-ntrip** Caster / Server / Client. SDIO interface is very useful for **data logging** to a max. 32G TF card independent of your applications.

365
Maximize Uptime

Feature Rich

Easy-to-integrate

Lightweight

Package
Type : SMT solderable LGA
Size : 31 x 31 x 4 mm
Weight : 6.8 g

Environmental
Operational : -40 to +85 ° C
Storage : -55 to +85 ° C

Protocols
Septentrio Binary Format (SBF)
NMEA 0183, v2.3, v3.03, V4.0
RINEX v2.x, v3.x
RTCM v2.x, v3.x (MSM included)
CMR v2.0 (out/in), CMR+ (input only)

Interfaces
4 UART (LVTTL, up to 4 Mbps)
Ethernet (RMII/MDIO), 10/100 Mbps
USB device (2.0, HS)
SDIO (mass storage)
2 GPIO user programmable
2 Event markers
1 Configurable PPS out

SN19433058675
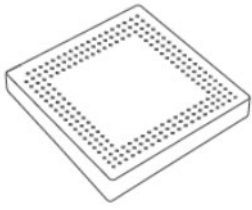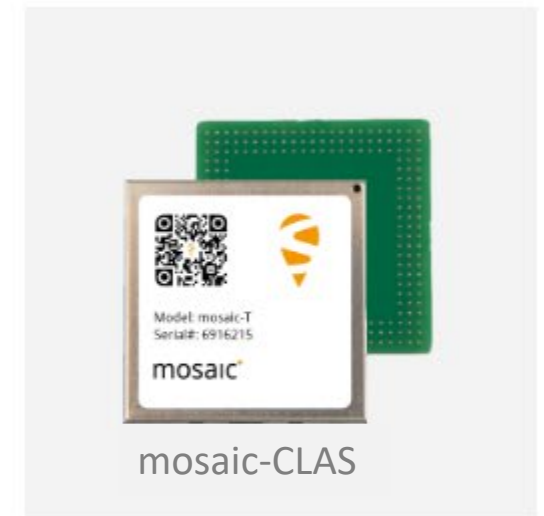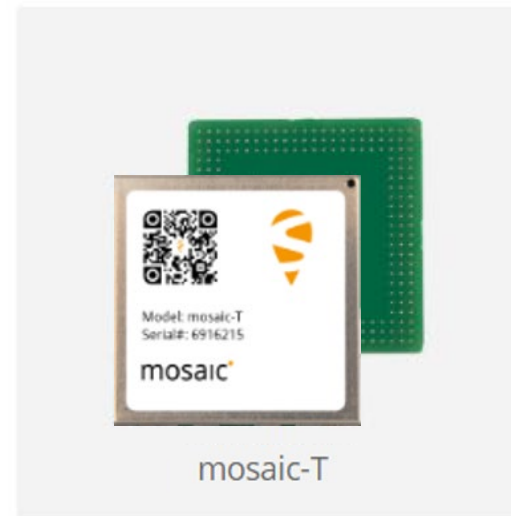mosaic

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GNSS modules

mosaic-CLAS the last from mosaic expansion

mosaic

GNSS Performance	Dual Antenna Heading	Timing	CLAS
mosaic-X5	mosaic-H	mosaic-T	mosaic-CLAS
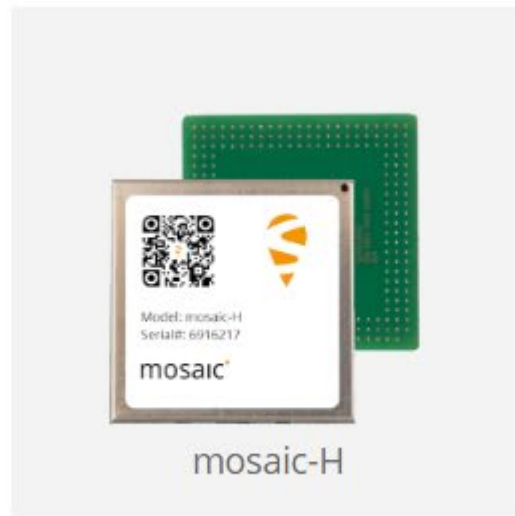
mosaic-CLAS, only in Japan

Available Signals > competition

mosaic-x5

448 Channels

SBAS				SBAS
L5				L1S
E5a	G3	L2C		L1C
B2a	B2I	L2P	G2P	L1
L5	E5b	L2C	G2C	E1
			B3I	E6

mosaic-x5 signals:
- SBAS
- L5
- E5a, G3, L2C
- B2a, B2I, L2P, G2P
- L5, E5b, L2C, G2C
- B3I, E6
- L6
- L-band, B1I, L1, G1
- SBAS, L1S, L1C, L1, E1, B1C

Competitor A

184 Channels

Competitor A signals:
- B2I, L2C
- E5b, L2C, G2C
- L1, E1
- B1I, L1, G1

Legend: GPS | GALILEO | GLONASS | BeiDou | QZSS | Augm. | other | SBAS
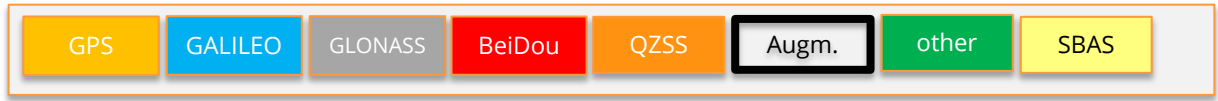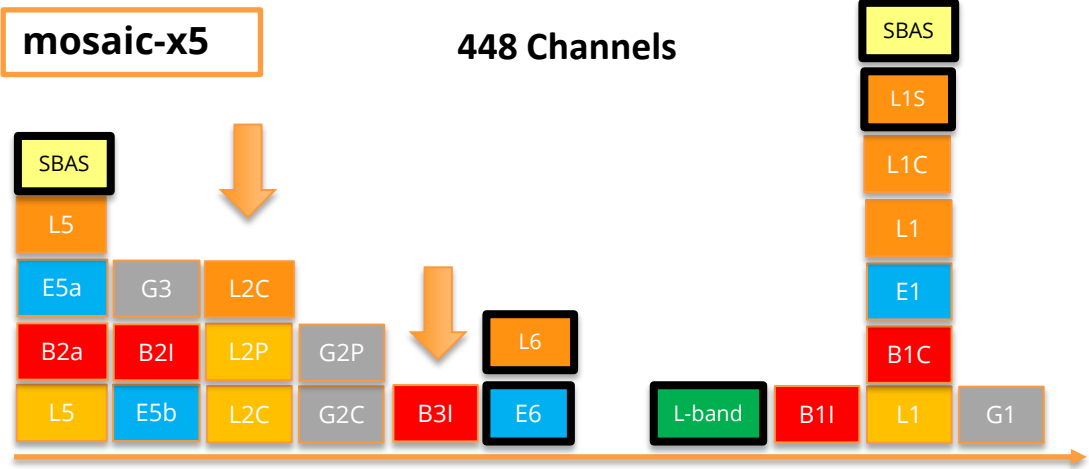
	mosaic-x5	Competitor A
Channels	448	184
L2P	○	✕
E5a	○	✕
B3I	○	✕

![Septentrio logo]

RTK Availability
with(out) P(Y) tracking

Test performed in an orchard in Torino, Italy on which the processing is based.

GPS L2P(Y) Code

RTK Fix :
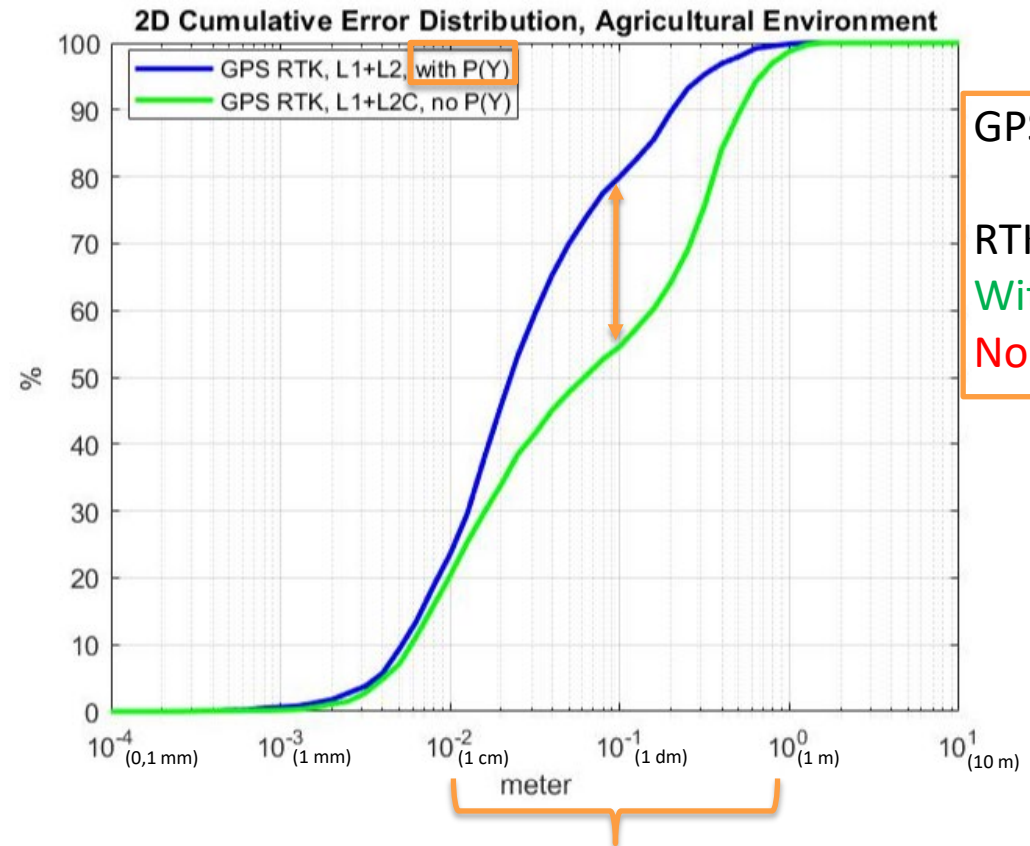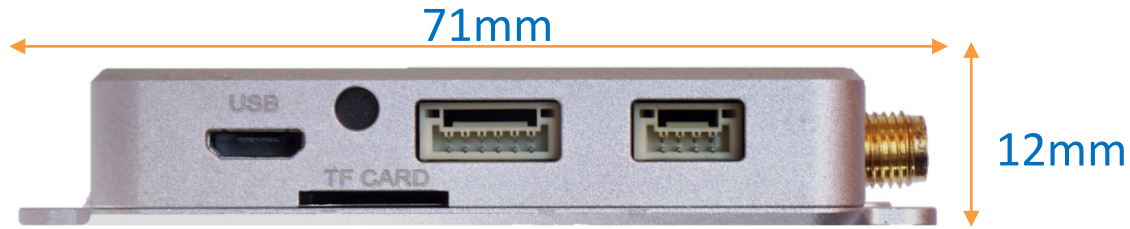With L2P : 80%
No L2P : 56%

P-Code greatly increases the chances of having RTK for accuracies from 1cm-1m (most applications)

(Whether or not L2P (Y) Code reception is supported has a large effect on the RTK Fix rate.)

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mosaic-go Evaluation Kit Product description

71mm

12mm

59mm

58 gramms

USB

TF CARD

RF-IN2

RF-IN1

LED

VCC GND TXD1 RXD1 PPS EVENT

NRST TXD2 RXD2 GND

RF_IN1 RF_IN2

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mosaic-go : 3 variants

1. mosaic-go is based on **mosaic-X5** one antenna connector

2. mosaic-go heading is based on **mosaic-H** Dual antenna connector

3. mosaic-go CLAS is based on **mosaic-CLAS** one antenna connector

Documentations

Mosaic-go DataSheet are available from Septentrio web site:

Mosaic Hardware Hardware manual (Ver 1.8) includes :

- Complete description of mosaic-go (both for standard version and heading version)

How to Video and mosaic-go introduction is available on Septentrio support site

https://shop.septentrio.com/en/shop/mosaic-go-gnss-module-receiver-evaluation-kit
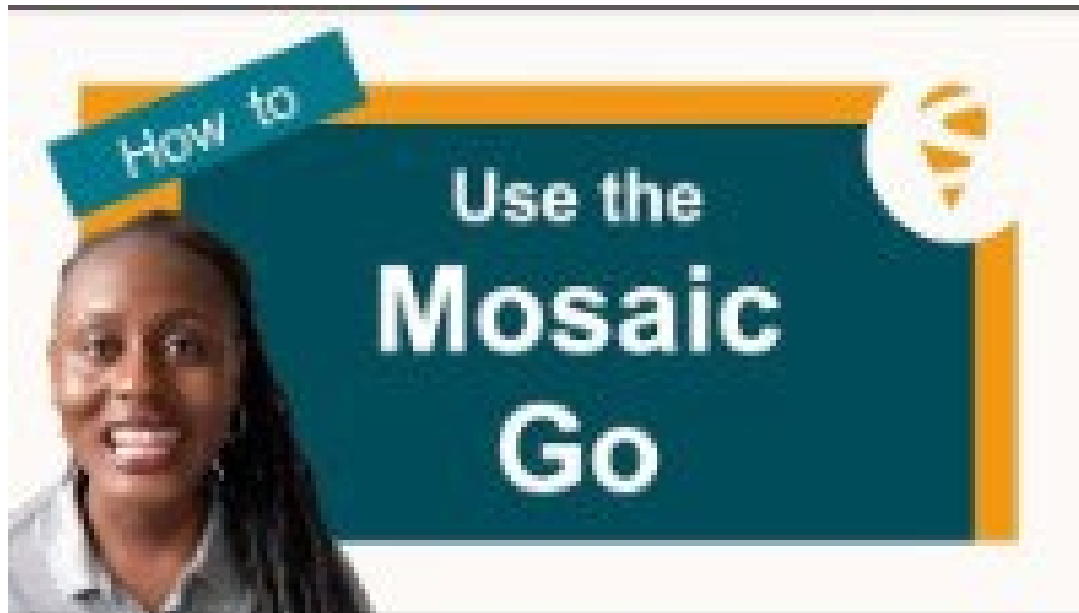
7 Evaluation Kit: mosaic-go

The mosaic-go Evaluation Kit is composed of the mosaic module soldered on an interface board inside a metallic housing.

Mosaic-go part number:
Single-antenna version, incorporating mosaic-X5: **410386** (including accessories).
Dual-antenna version, incorporating mosaic-H: **410397** (including accessories).

Dimensions: 71 x 59 x 12 mm ± 1 mm
Weight: 58 g ± 1 g

7.1 Interfaces

7.1.1 USB

This micro-B connector is used to access the mosaic-go over USB.

It can also be used to power the mosaic-go. See also section 7.4.

7.1.2 RSV USB

This connector is reserved and should not be used.

7.1.3 RF_IN1 and RF_IN2

These are the main and auxiliary antenna connectors, connected to the ANT_1 and ANT_2 pins of the internal mosaic. See section 3.2 for details.

https://www.youtube.com/watch?v=n1u5QZG4jls

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Septentrio WEB Shop

PRODUCTS

Results 1 - 6 of 6

745,00 €

mosaic-go CLAS GNSS module receiver evaluation kit

Highly accurate GPS / GNSS receiver module, designed for the Japanese market

Complete multi-frequency, multi-constellation GNSS module receiver evaluation kit: GPS, GLONASS, Galileo, BeiDou, QZSS, NAVIC, Dedicated for the Japanese market

More info ›

645,00 €

mosaic-go GNSS module receiver evaluation kit

Highly accurate GPS / GNSS receiver module

Complete multi-frequency, multi-constellation GPS module receiver evaluation kit: GPS, GLONASS, Galileo, BeiDou, QZSS, NAVIC

More info ›

745,00 €

mosaic-go heading GNSS module evaluation kit

Highly accurate GPS / GNSS receiver module

Complete multi-frequency, multi-constellation GNSS module receiver: GPS, GLONASS, Galileo, BeiDou, QZSS, NAVIC

More info ›

1.495,00 €

mosaic-H GNSS heading module development kit with 2 GNSS antennae

Highly accurate GPS / GNSS receiver module

Highly accurate GNSS - GPS heading module receiver evaluation kit for sale. Tracks GPS, GLONASS, Galileo, BeiDou, QZSS.

More info ›

1.195,00 €

mosaic-T GNSS timing module receiver development kit with GNSS antenna

GPS / GNSS Timing receiver module

Complete multi-frequency, multi-constellation GNSS module receiver: GPS, GLONASS, Galileo, BeiDou, QZSS, NavIC

More info ›

1.195,00 €

mosaic-X5 GNSS module receiver development kit with GNSS antenna

Highly accurate GPS / GNSS receiver module

Complete multi-frequency, multi-constellation GNSS module receiver: GPS, GLONASS, Galileo, BeiDou, QZSS, NAVIC

More info ›

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ArduSimple

simpleRTK3B Pro
Up to 100Hz RTK and down to 6mm accuracy with the most affordable L1/L2/L5 board in the market. Powered by Septentrio Mosaic-X5.

simpleRTK3B Heading
Dual antenna L1/L2/E5b RTK rover made simple for Position+Attitude up to 50Hz. Powered by Septentrio Mosaic-H.

simpleRTK3B mPCIe
The Septentrio Mosaic for embedded computers. In standard Mini PCI Express form factor.

simpleRTK3B Micro
The Septentrio Mosaic for small PCB integrators. In a re-usable through hole form factor so you don't risk it if something goes wrong with your PCB design or assembly.

RTK3B Boards
simpleRTK3B Pro
From USD $661.25

Select options

RTK3B Boards
simpleRTK3B Heading
From USD $862.50

Select options

RTK3B Boards
simpleRTK3B mPCIe
From USD $688.85

Select options

RTK3B Boards
simpleRTK3B Micro
From USD $688.85

Select options

Septentrio

All documented

mosaicHAT
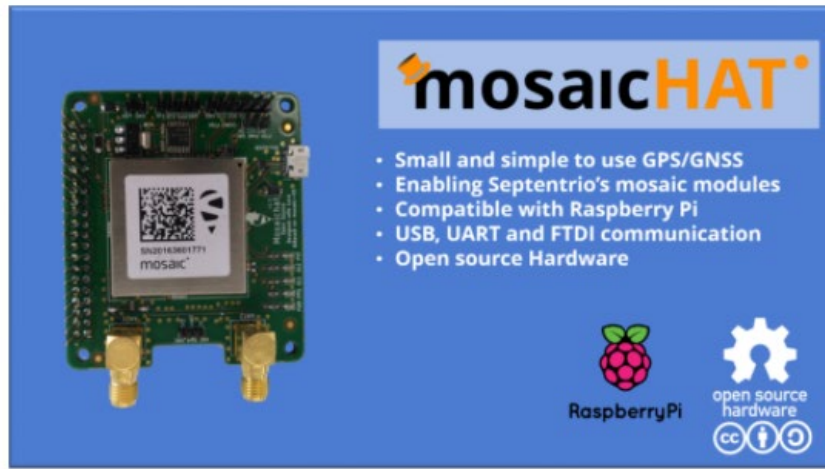An open source GNSS HAT for Raspberry Pi

mosaicHAT: A GNSS HAT for Raspberry PI
Author: (Jamal Sa'd) jamalhazem127@gmail.com
Maintainer: (Septentrio gnss github user) githubuser@septentrio.com
External website: https://github.com/septentrio-gnss/mosaicHAT
License: Creative Commons Attribution Share-Alike License. and Open Source HW

mosaicHAT°
- Small and simple to use GPS/GNSS
- Enabling Septentrio's mosaic modules
- Compatible with Raspberry Pi
- USB, UART and FTDI communication
- Open source Hardware

RaspberryPi   open source hardware

Click to watch this video introducing mosaicHAT

Table of contents

Intro for new people
What is mosaic, Septentrio, etc,.

User documentation

Designers

https://www.youtube.com/watch?v=5LeuElfyvIg

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mowi

INDICATION LEDS

BT   WIFI   LOG   GP1   GPL   PWR

MAIN GNSS
MMCX OR U.FL

AUX GNSS
MMCX OR U.FL

MOSAIC AND ESP
TTLV SELECTOR

ESP RESET AND
BOOT BUTTONS

SMA CONNECTOR
FOR ESP ANTENNA

Model:mosaic-H
Serial#:6916214

mosaic

PIXHAWK
JST CONNECTOR

MOSAIC
JST CONNECTOR

SHARED USB
MICRO B
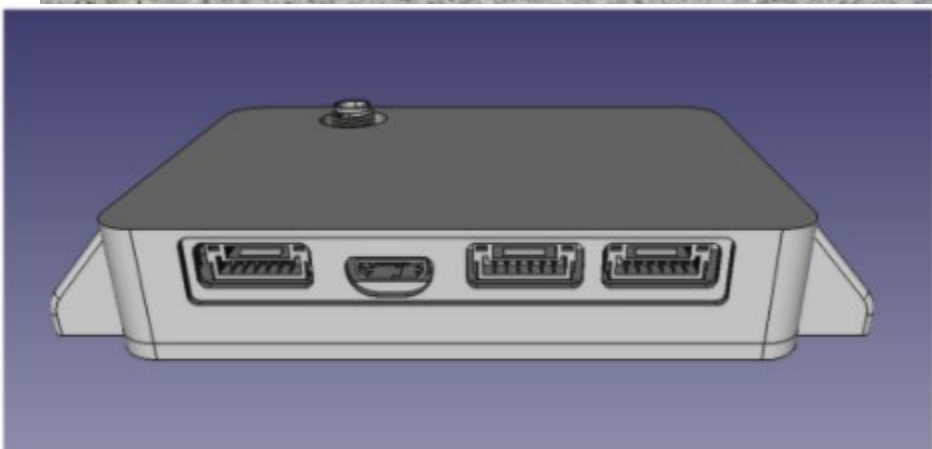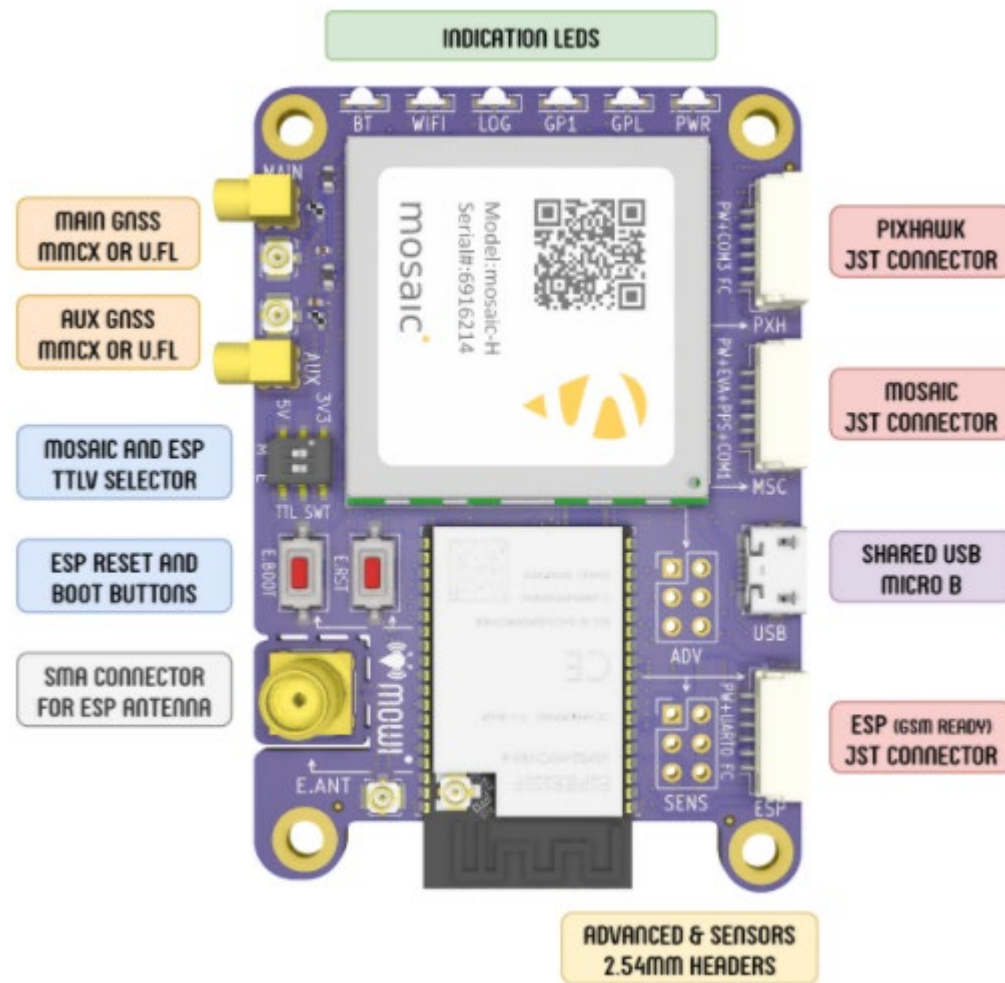
ESP (GSM READY)
JST CONNECTOR

ADVANCED & SENSORS
2.54MM HEADERS
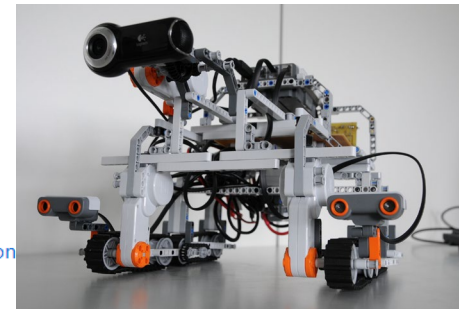
Pains when starting projects

Engineer wants **compatibility**
Engineer searches for **open source**
Engineer wants **ease** of test
Engineer wants to **source easily**

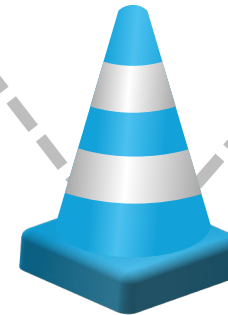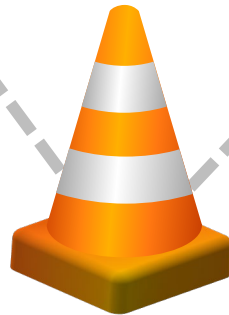septentrio
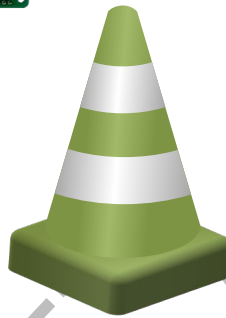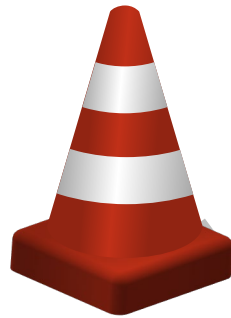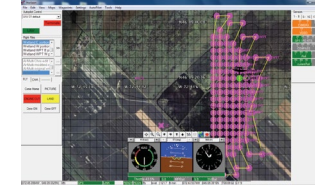
What we are doing to expand ecosystems?

OPEN SOURCE HW

- mosaicHAT
- Mowi

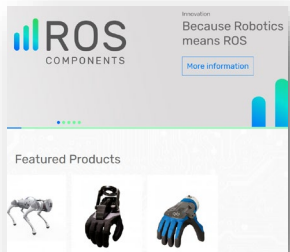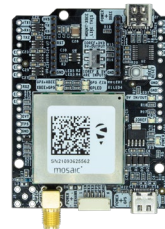**OPEN SOURCE SW (DRIVERS)**

- PX4
- Ardupilot
- ROS

CHANNELS

- Digikey
- ROS Components
- Spectroworks
- ....

MOSAIC HW ENABLERS

(EVAL SYS)

- Ardusimple
- Sparkfun
- GNSS Store (Elthes)
- Mikroelectronica

CO-MARKETING

- Micropilot
- Xsens
- ...

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https://www.septentrio.com/en/learn-more/community

NMEA Navsat driver This package provides a ROS interface for GPS devices that output compatible NMEA sentences. The driver is generic enough to work with several GNSS receiver types including Septentrio GNSS receivers. Please also take a look at the ROSaic project which offers full support for SBF.
Solution: ROS Driver
Product link: All Septentrio Products
Tags: #opensource, #ROS, #robotics #autonomous #rosdriver #nmea
Visit partner website

The **Pixhawk** flight controller board is a flexible autopilot intended primarily for manufacturers of UAV commercial systems. Its HW can be used with Septentrio receivers specially when in combination with Ardupilot SW.
Solution: Pixhawk
Product link: mosaic-X5, mosaic-H, AsteRx-m3, AsteRx-i3
Tags: #opensource, #autopilotsw, #uavs #flightcontroller
Visit partner website

PX4 autopilot is one of the largest commercially adopted open-source navigation control stacks, enabling an innovative community to build and maintain drone hardware and software in a scalable way. Septentrio AsteRx-m3 and mosaic receivers are compatible with PX4 autopilots, with both single antenna and dual antenna configurations, which offer either heading and pitch or heading and roll angles on top of accurate GNSS positioning. With this open-source copy of the official PX4 repository you can get started with Septentrio receivers working seamlessly with PX4.

Solution: PX4 Driver on GitHub
Product link: mosaic, AsteRx-m3
Tags: #opensource, #autopilotsw, #uavs #flightcontroller
Visit partner website

ROSaic is an open-source ROS driver for mosaic and other Septentrio GNSS receivers. The ROS driver is a ROS node that makes the Septentrio GNSS hardware accessible from ROS (Robotics Operating System). Robot Operating System is robotics middleware. Although ROS is not an operating system, it provides services designed for a heterogeneous computer cluster such as hardware abstraction, low-level device control, implementation of commonly used functionality, message-passing between processes, and package management. This page contains links to many resources to assist integration of GNSS in ROS, with the help of ROSaic.
Solution: ROS driver
Product link: mosaic-X5, mosaic-H, AsteRx-m3, AsteRx-i3, AsteRx SB3, AsteRx SBi3, AsteRx U3
Tags: #opensource, #ROS, #robotics #autonomous #ROSdriver
Visit partner website

Summary

- **High accuracy GNSS is a good place to be as a young engineer**
  - **Use will only increase.**
  - **GNSS is the key enabling technology to automate outdoor tasks.**
  - **LEO PNT being developed to complement GNSS**

- **Septentrio is a good choice**
  - Most accurate and reliable GNSS position and timing solutions in the most demanding industrial and scientific environments.
  - Web interfaces, tools and utilities, raw data, IMU/INS fusion.
  - Protection against interference.
  - Support for open-source eco-systems

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Thank you - Questions

![Septentrio logo]

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