



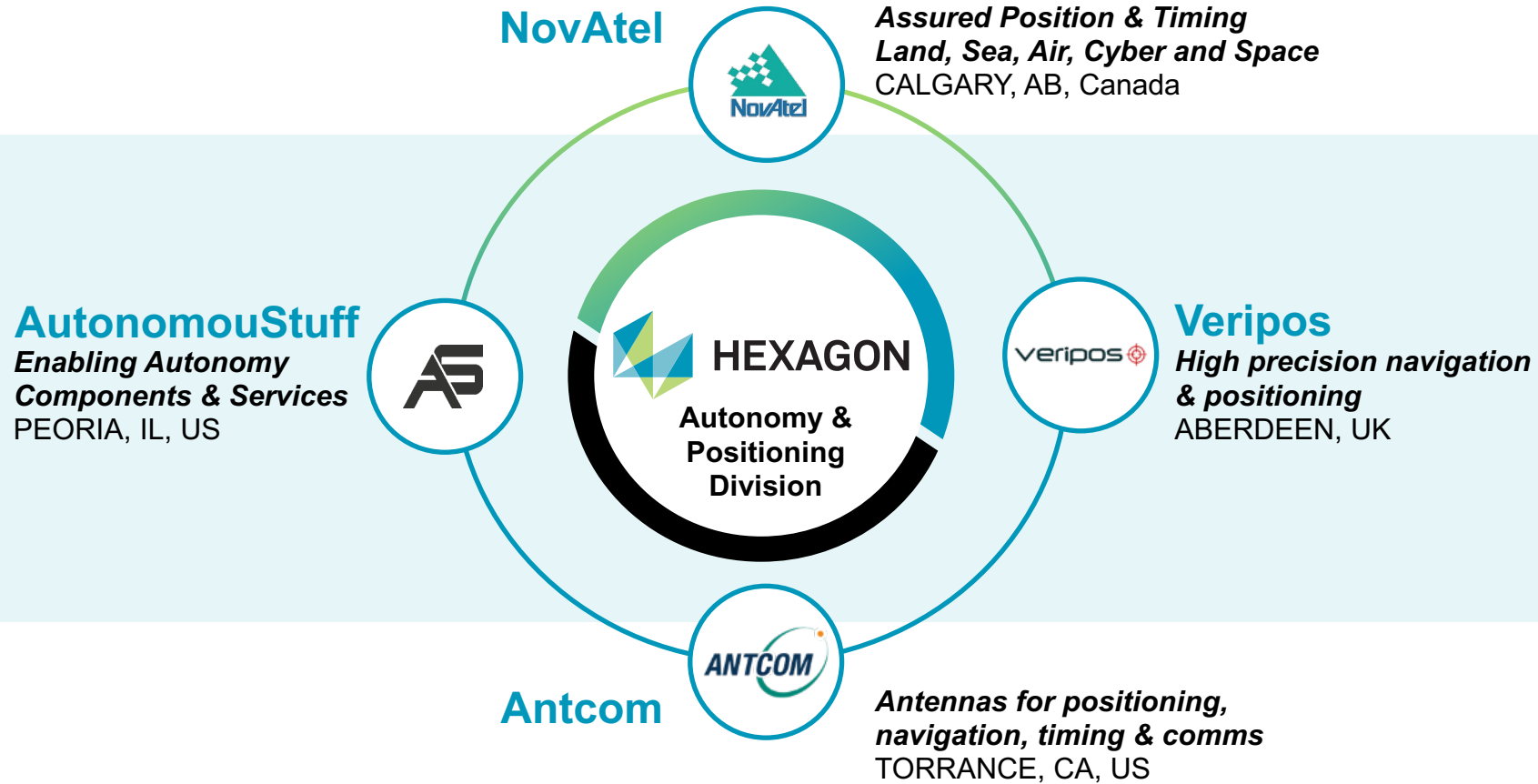
HEXAGON



Robust PNT: Detection and Protection of GNSS Jamming

The appearance of U.S. Department of Defense (DoD) visual information does not imply or constitute DoD endorsement

Hexagon Autonomy and Positioning



Industries include: Defence, Aerospace, Agriculture, Automotive, Critical National Infrastructure, Construction, Survey, Mapping & Geospatial, Marine, Mining, Oil & Gas, Transport

hexagon.com/company/divisions/autonomy-and-positioning

NovAtel - Trustworthy Civil and Defence PNT Experience

Assured Position, Navigation & Timing (PNT)

- OEM7 Multi-GNSS receivers
- GPS Anti-Jam Technology (GAJT)
- SPAN GNSS+INS
- Space Segment

Factory in Calgary, AB, Canada

- Fast, responsive production
- Worldwide Support





High speed versions OEM Boards for LEO/ MEO satellites



Threat



GPS/GNSS Jamming & Spoofing Incidents on the Rise

Prolific Nuisance Jamming

"Personal Protection Devices" (PPD)



2016-18 EU STRIKE 3. www.gnss-strike3.eu
50,000 GNSS denial events.

Serious Tactical Jamming



2017-20 "Syria ... most aggressive EW on the planet ..." Commander US SOCOM

International Events



2017-2018 Norway jammed by Russia on ZAPAD 17 & NATO Trident Juncture exercises.

Spoofing



2019 C4ADS. Russia: "a comparative advantage in ... GNSS spoofing".

Civil Missions not Exempt



2014-20 Ukraine. OSCE monitoring attacked with intentional, offensive, targeted jamming

Naval and Civil Marine



2017-20 GPS attacks affecting civil marine and naval operations worldwide

Cyber Electromagnetic Activities: “CEMA”

Covers Cyber Operations, Electronic Warfare (EW), Spectrum Management, & Info Operations

	PROTECT	INFORM	EFFECT
COGNITIVE LAYER	<p>Protect CEMA <i>Cognitive</i></p>	<p>Inform CEMA <i>Cognitive</i></p>	<p>Effects CEMA <i>Cognitive</i></p>
VIRTUAL LAYER	<p>Protect CEMA <i>Virtual</i></p>	<p>Inform CEMA <i>Virtual</i></p>	<p>Effects CEMA <i>Virtual</i></p>
PHYSICAL LAYER	<p>Protect CEMA <i>Physical</i></p>	<p>Inform CEMA <i>Physical</i></p>	<p>Effects CEMA <i>Physical</i></p>

- Human / AI Interface
- Overall context
- How are the data used?

VIRTUAL LAYER

- Sensor data
- Displays
- Networks/Transmission

PHYSICAL LAYER

NovAtel's OEM focus:

- **Protect:** OEM7, GAJT, SPAN
- **Inform:** GRIT & GAJT SA
- **Effect:** For testing & training

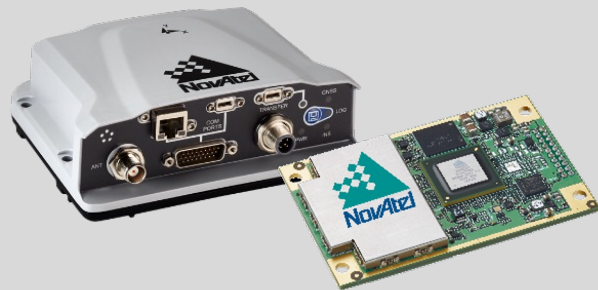
GNSS Situational Awareness

GNSS Receivers

OEM7 – Multi-Constellation, Multi-Frequency

Spectrum Analysis.

GNSS receiver used as a spectrum analyser



GNSS Resilience & Interference Technology (GRIT):

- Spoofing Detection
- Interference Toolkit
- Time-Tagged Digitised Samples

Anti-Jam Antennas

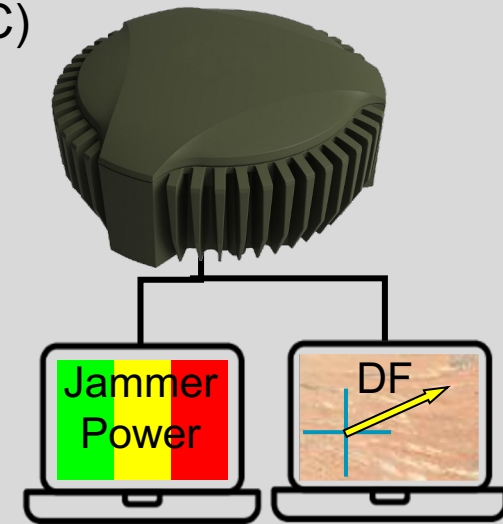
GPS Anti-Jam Technology (GAJT)

Jammer Power

- Automatic Gain Control (AGC)
- All GAJTs
- Awareness of jamming even when protecting

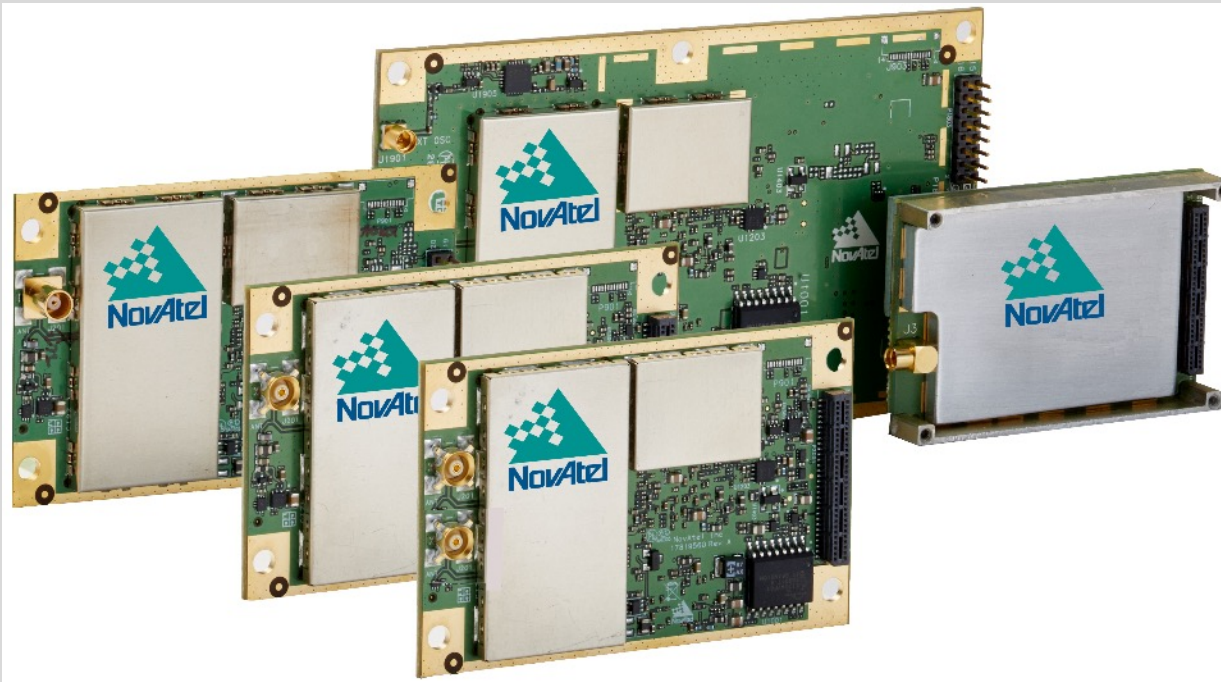
Direction Finding

- Course DF
- Land & Marine GAJTs
- (Optimised for anti-jam)

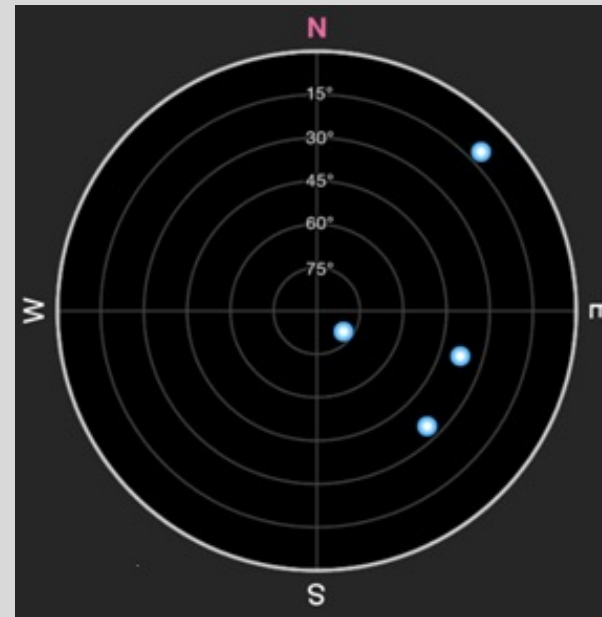


OEM7 GNSS Receivers

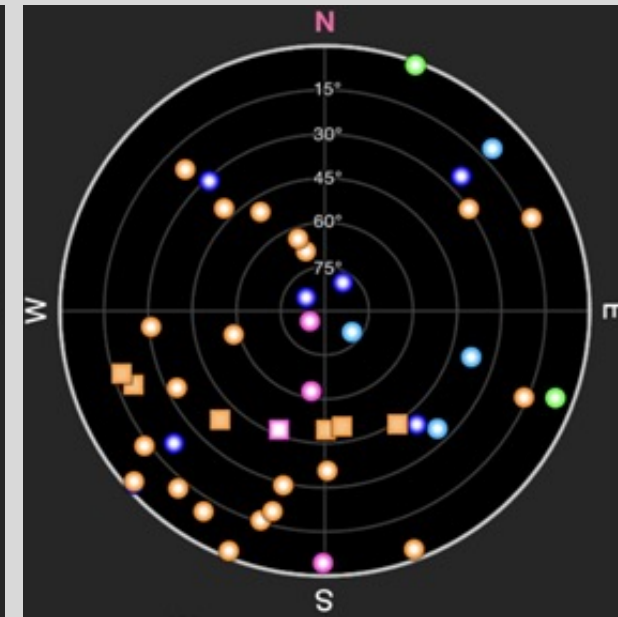
OEM7 Receivers
Multi-Constellation – Multi-Frequency (MCMF)



The Importance of MCMF



GPS only



GPS, Galileo, GLONASS,
NavIC, BeiDou, QZSS

Sky view from Calgary, Alberta on 27 Mar 2023 at 13:35 UTC

GRIT - GNSS Resilience & Integrity Technology

NovAtel.com/Products/GRIT

Available on all OEM7 platforms, including SPAN, GRIT Enables:

1. GNSS Spoofing Detection

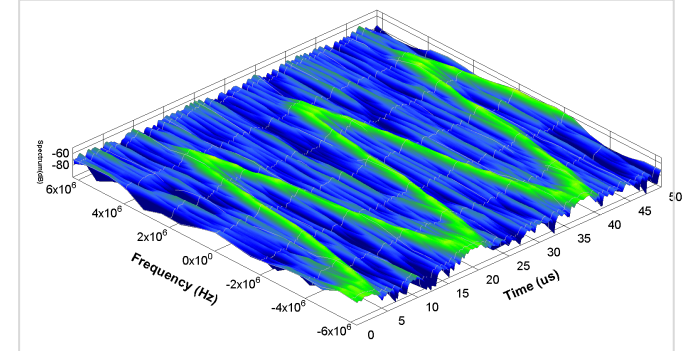
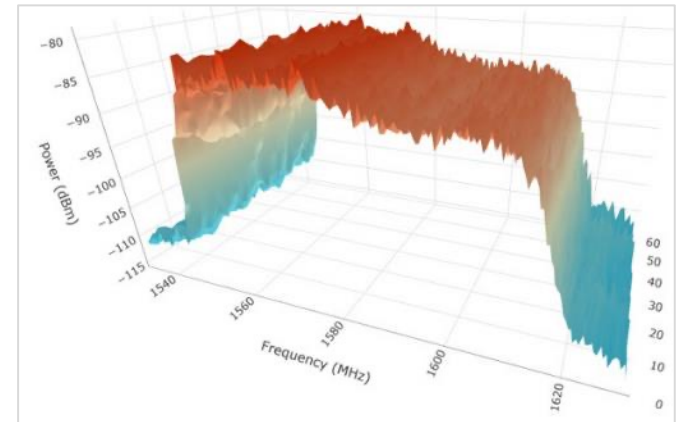
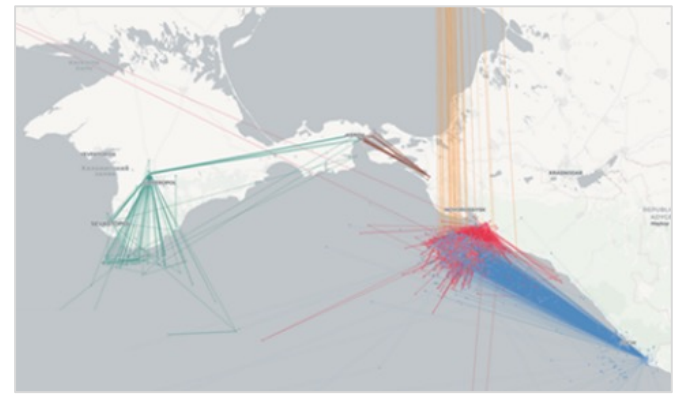
- Enhanced RF situational awareness
- Spoofing alerts, including before receiver is 'captured'

2. GNSS Interference Toolkit

- View the spectrum; inspect interference
- Filter out interference

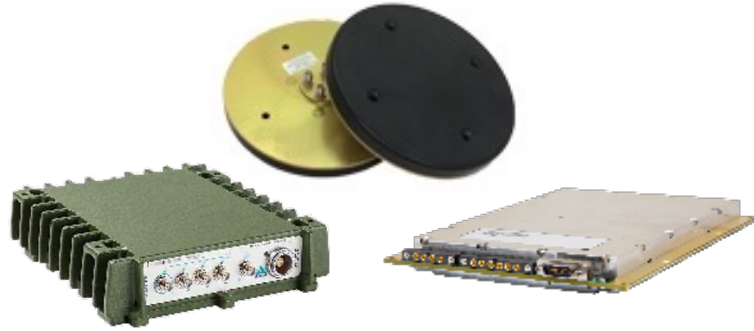
3. Time-Tagged Digitized Samples

- For building customized interference location systems
- SIGINT applications



Assured PNT – GAJT

GPS Anti-Jam Technology (GAJT)



GAJT-AE

Air, UAS, Complex Weapons



GAJT-410

Smaller Land & Sea Platforms



GAJT-710

Armoured Vehicles, Ships & Marine Installations

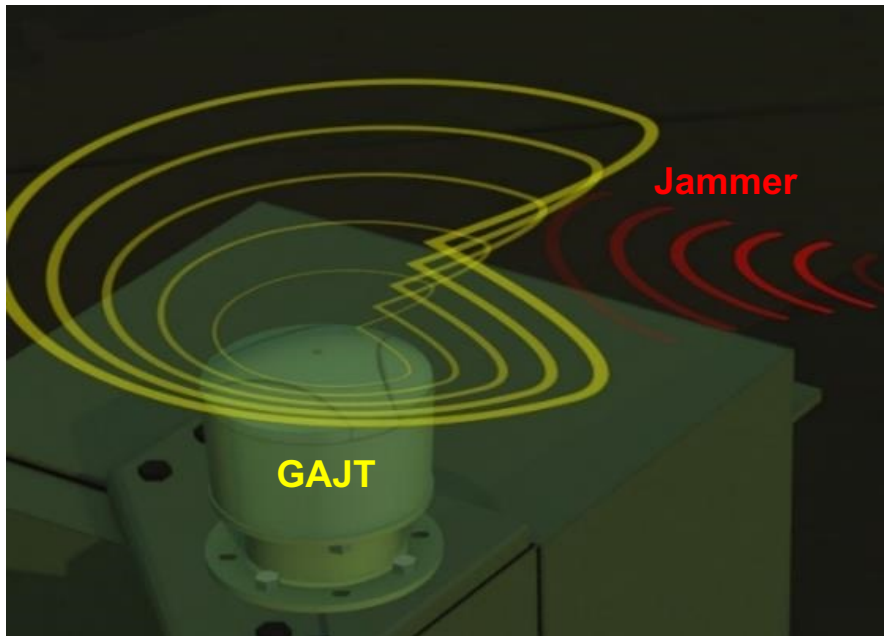
In service worldwide.

- Protection of military & civil receivers
- Situation Awareness (Power & Direction Finding)
- Commercial Off The Shelf (COTS)
- Dual Use (available for certain civil applications)

How GAJT Works

Nulls out the jammers
Good GNSS signals preserved

- **7 elements** (GAJT-710ML/MS): up to 6 nulls
- **4 elements** (GAJT-AE & GAJT-410): up to 3 nulls
- **SFAP* algorithm.** Added degrees of freedom



GAJT Benefits

- **Up to 60 dB interference suppression.** (Varies with models)
- **Situation Awareness.** Message shows that jamming is there – even if GAJT is defeating it.
- **Direction Finding.**



* SFAP: Space-Frequency Adaptive Processing.

GAJT – GPS Anti-Jam Technology

Protection

- GPS L1 & L2 (incl M-Code & SAASM), Galileo E1, QZSS L1 & L2, and SBAS L1
- GAJT-AE2 also protects GPS L5, Galileo E5a, SBAS L5 and **NavIC L5**
- Fixed latency choices (good timing performance)
- Simultaneously counter multiple jammers

Situational Awareness

- Jammer power indication
- Jammer Direction-Finding

In Service & Available Now

- Land, Sea and Air. TRL-9
- Thousands operational worldwide
- Mature supply chain. Short lead-time. Reliable.



GAJT-410ML / GAJT-410MS
4-element CRPA



GAJT-710ML / GAJT-710MS
7-element CRPA



GAJT-AE-N/R & GAJT-AE2
Separate 4-element CRPA

GAJT Product Family

The same powerful anti-jam algorithm for diverse applications

Land Vehicles,
Fixed Installations

GAJT-710ML

7 elements



GAJT-410ML

4 elements



Ships, Boats,
Littoral Installations

GAJT-710MS

7 elements



GAJT-410MS

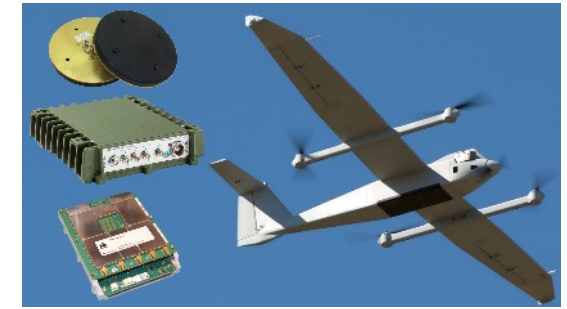
4 elements



Air, Unmanned, Small Platforms
and Complex Weapons

GAJT-AE-N/R

4 elements



GAJT-AE2

4 elements

Adds L5



““ Important Points:

1. NovAtel/A&P group has local technical support Engineers in India.
2. Class II supplier under MAKE IN INDIA program.

PNT. Assured.

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