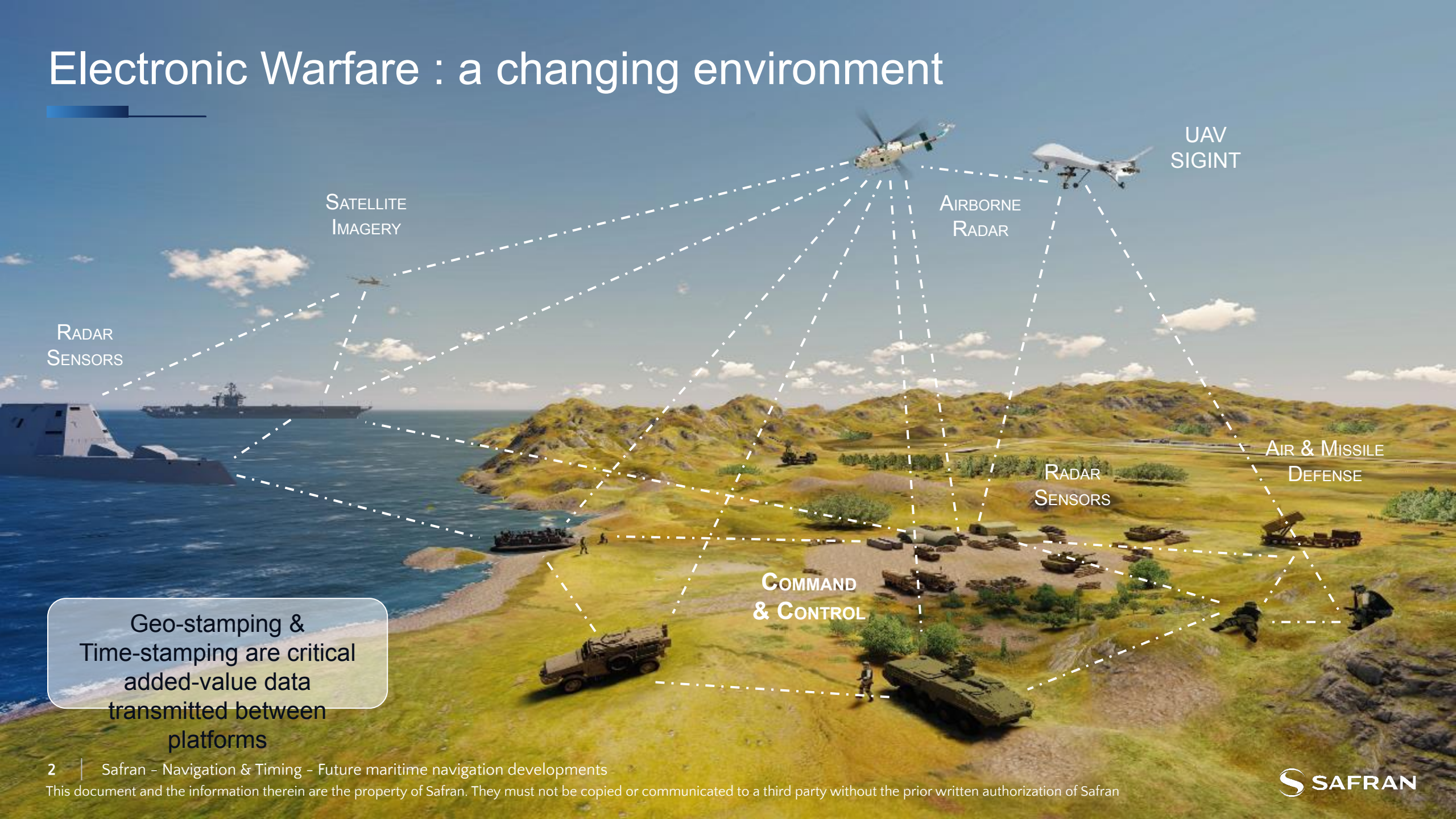
Future maritime navigation developments

SAFRAN

Electronic Warfare : a changing environment



Geo-stamping & Time-stamping are critical added-value data transmitted between platforms

What is PNT?

POSITIONING

Determine with precision the geographical position of a person or a platfom by collecting all information regarding its **geographical coordinates** and its **movements**.

NAVIGATION

Collect all information about a person or a platform related to its **trajectory**, its **orientation** and its **speed** to define its **position**.

TIMING

Acquire, maintain and autonomously monitor an **accurate time** from a **precise frequency reference**.

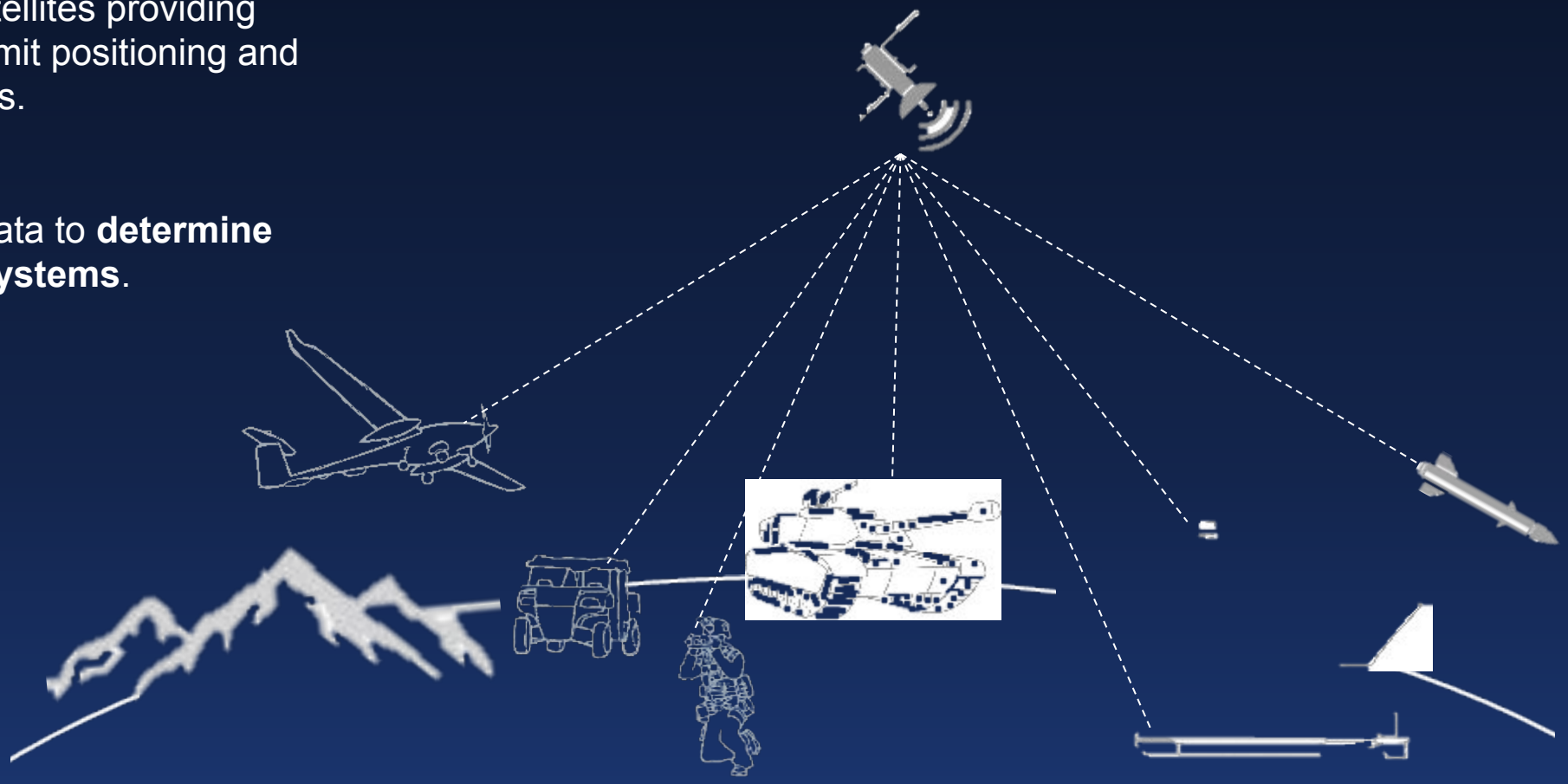
Required for **accurate time-stamping and data synchronization.**

PNT applications and capabilities provides **major** positioning, navigation and timing information to platforms, weapons, information, command-and-control and communication systems of armed forces (data link synchronization).

Nowadays PNT Data Mainly Relies on GNSS Signals

Global Navigation Satellite System (GNSS) refers to a constellation of satellites providing signals from space that transmit positioning and timing data to GNSS receivers.

The receivers then use this data to **determine location and synchronize systems**.



Identified Threats & Vulnerabilities on GNSS Signals

SPOOFING

Practice in which communication is sent from an unknown source disguised as a source known to the receiver.
Civilian signals are particularly affected by spoofing.

MEACONING

True signal from wrong place or time.

Meaconing is the interception and rebroadcast of navigation signals.

All signals (military and civilian) can be affected by meaconing.

JAMMING

Jamming devices are radio frequency transmitters that intentionally block, jam, or interfere with lawful communications, such as GNSS systems.

All signals (military and civilian) can be affected by jamming.

Development of low intensity networked jammers, that can be activated on demand.

ENVIRONMENTS

Unintentional lack of GNSS availability due to the environment physical characteristics:

- jungle
- urban area (indoor)
- Tunnels
- underground networks
- solar activity
- multipath
- wrong uploaded data

Jamming & Spoofing Attacks : A Worldwide Reality

Areas most affected by attacks (jamming/spoofing)

United Kingdom

August 2020 – Drone crash due to perturbations on the GNSS signals

Franc

February 2020 – Regular disturbances of GPS and Galileo signals impacting the factory of a high-precision GNSS equipment manufacturer.

Norway

June 2020 – Norwegian police reporting of GPS jamming incidents in the north of Norway, near the Russian border, affecting everything from ambulances to personal security alarms

Finland

2021 – Several incidents reported at the Russian-Finnish border through extensive use of satellite navigation jamming, using the Loran system.

United States

February 2020 – Report from a NASA light aircraft pilot suggesting the possibility of spoofing by a U.S. Department of Defense (DoD) drone.

Ukraine

Febrary 2022 – Multiple reports of GPS jamming at Ukrainian borders

Mexico

January 2020 – Law against jammers following the discovery of GNSS jammers being used in 85% of cargo vehicles' thefts in the country.

Israël

2019 – GPS interferences affecting flights at Ben Gurion airport in Tel Aviv, in the context of the Syrian war.

Iran

March 2020 – Spoofing reported in Tehran, near the Iranian army training college, by a GPS user whose device appeared to be moving in a circle when it was actually stationary.

China

December 2019 – Jamming interferences on Harbin Airport

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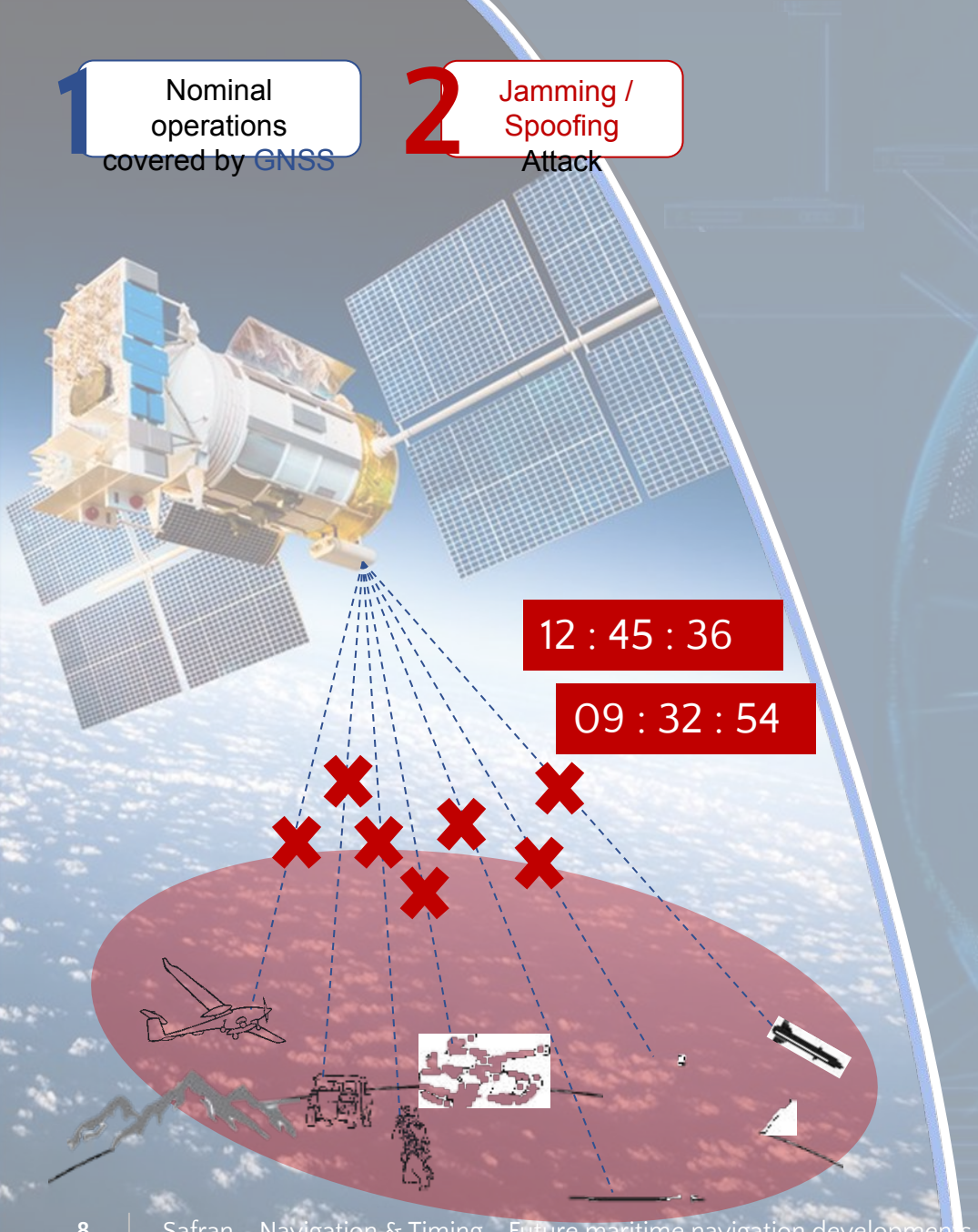
1 Nominal operations covered by GNSS

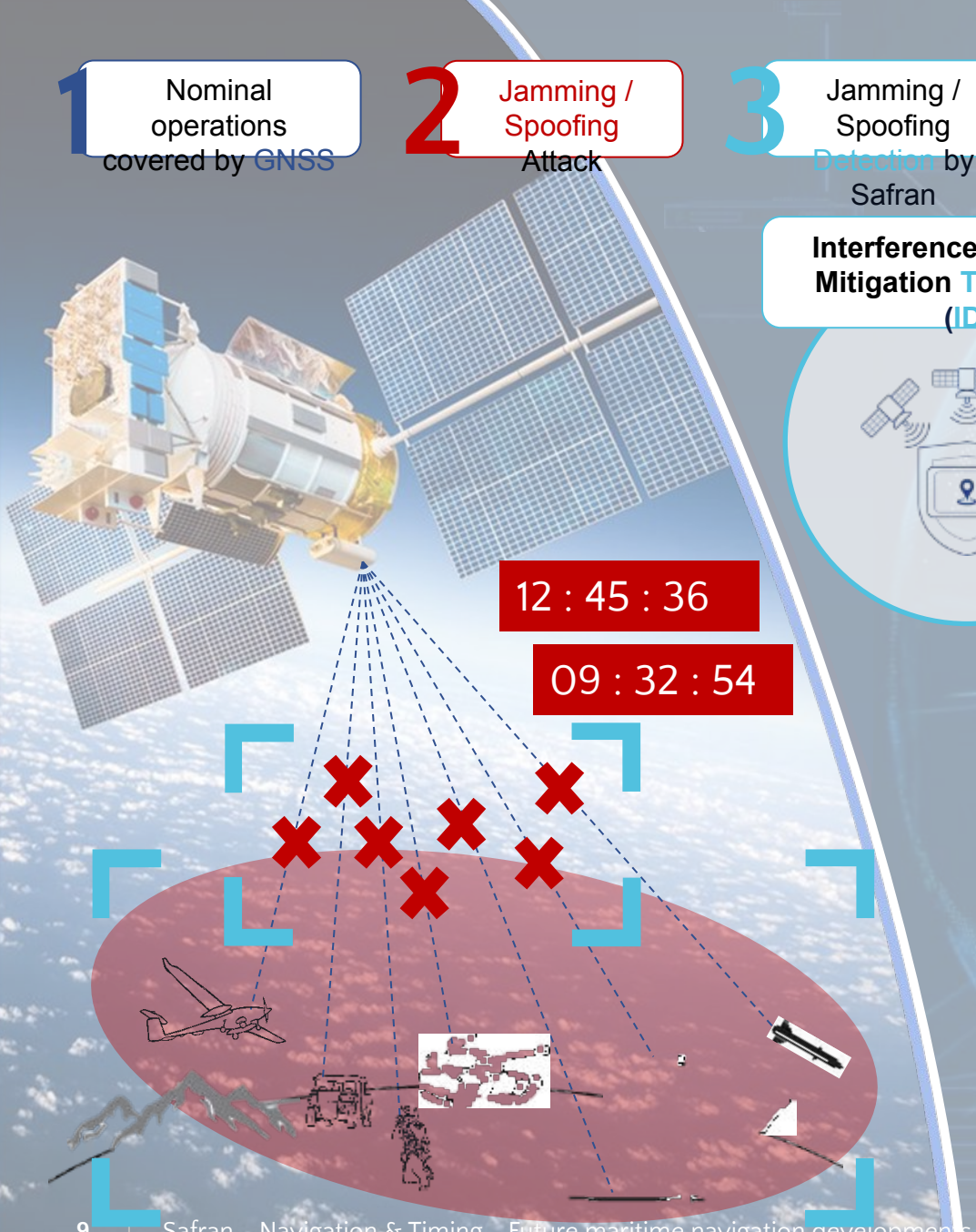


1 Nominal operations covered by GNSS

2 Jamming / Spoofing Attack

3 Jamming / Spoofing Detection by Safran

Interference Detection & Mitigation Technologies (IDM)



1 Nominal operations covered by GNSS

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4 Navigation (HRG) & Timing (Atomic Clocks) Relay

Interference Detection & Mitigation Technologies (IDM)

Hemispherical Resonance Gyroscope (HRG) & Inertial Navigation Units (INU)

Atomic Clocks & Time Servers

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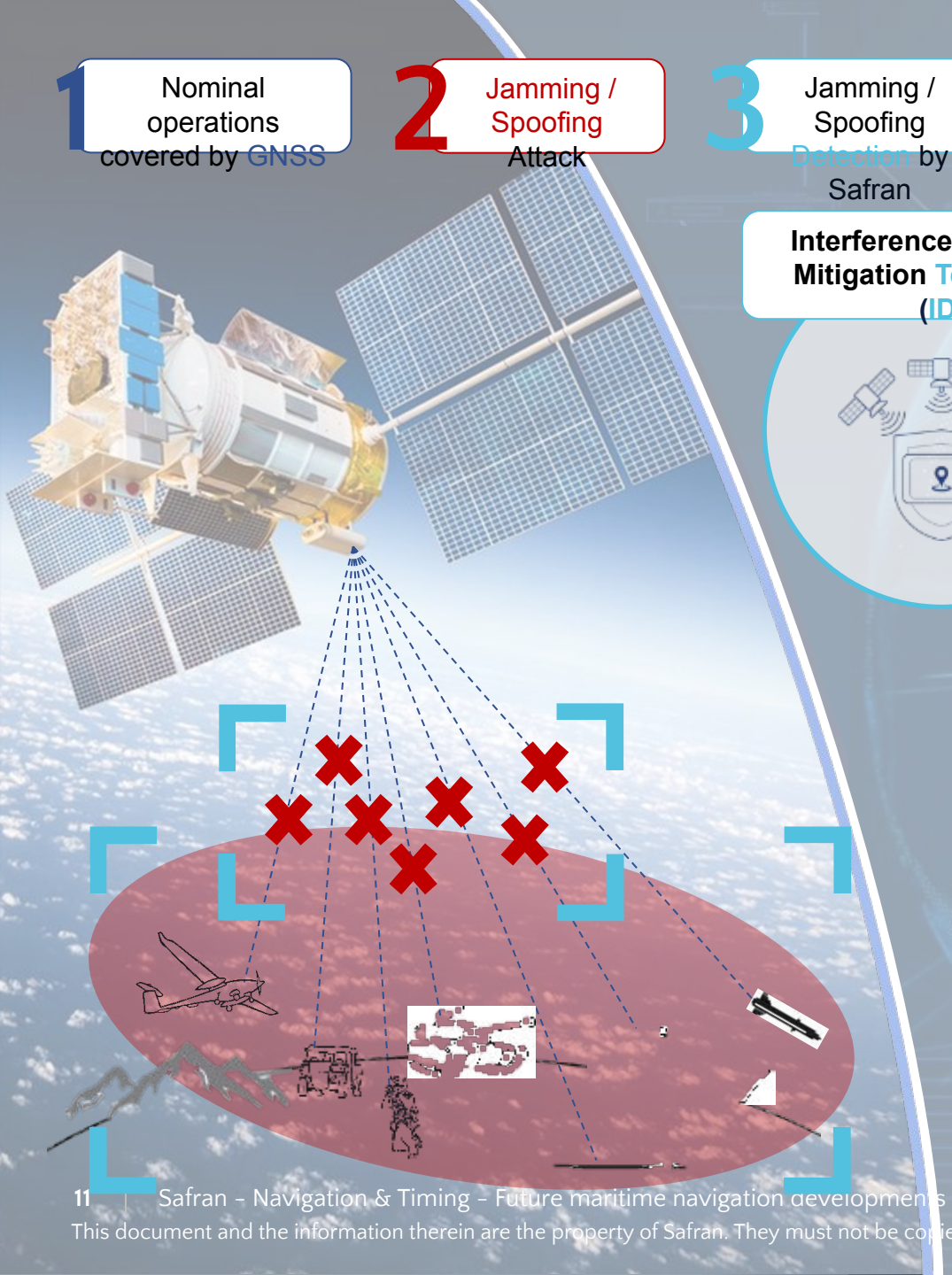
5 Global Monitoring through algorithms & GNSS resynchronization



Interference Detection & Mitigation Technologies (IDM)

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Atomic Clocks & Time Servers

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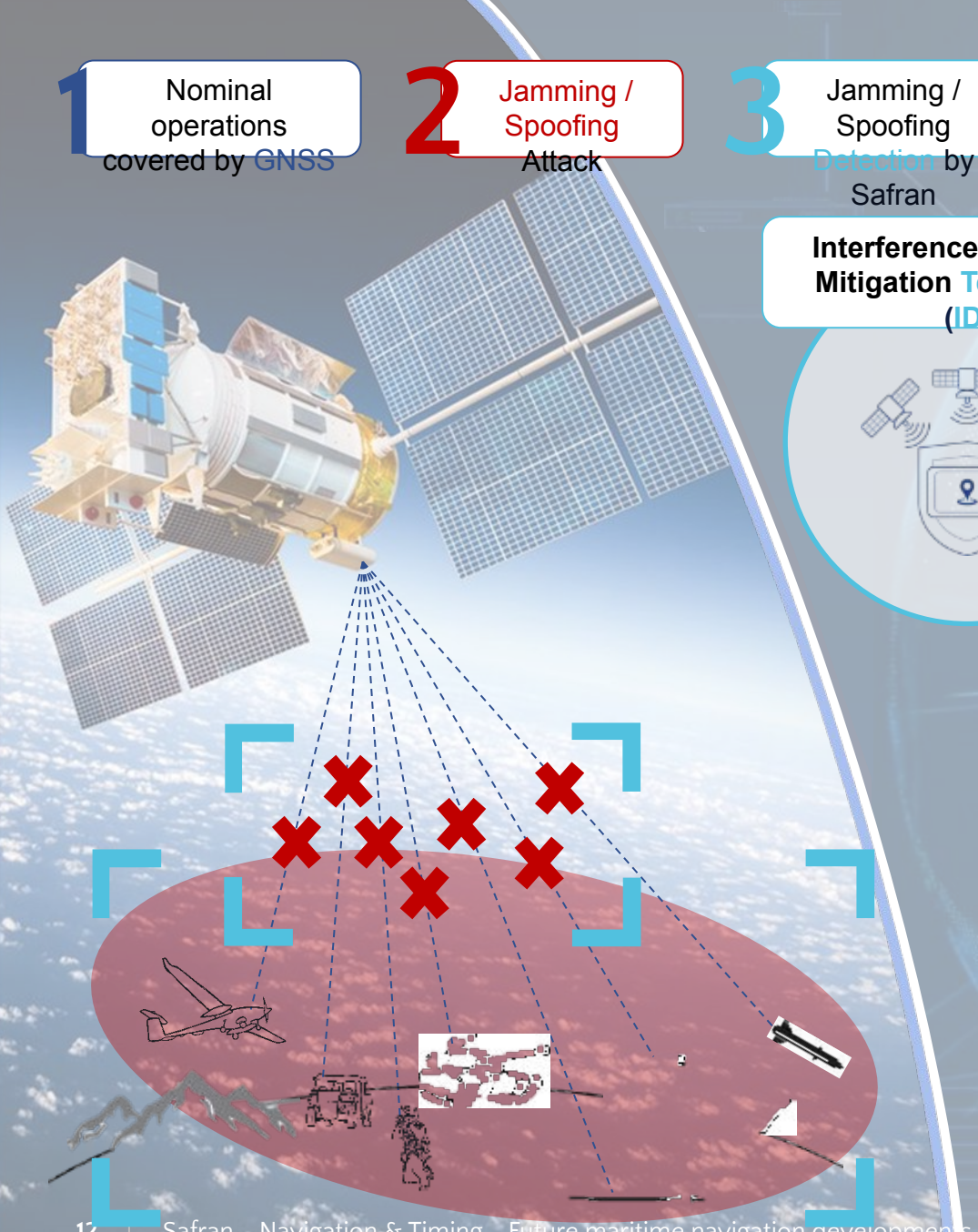

Interference Detection & Mitigation Technologies (IDM)

Hemispherical Resonance Gyroscope (HRG) & Inertial Navigation Units (INU)

Atomic Clocks & Time Servers

Special Operations Forces navigation: Any time, Any place

SPECIFIC MISSIONS

Beyond conventional military forces

Strike from and return to the sea

SPECIFIC TOOLS

GPS jamming / spoofing advanced notice

High-accuracy Inertial Navigation System

SPECIFIC NEEDS

Access to precise Positioning, Navigation and Timing at all time

Resilience in and out of GNSS-denied environments

Need for a lightweight ruggedized PNT solution

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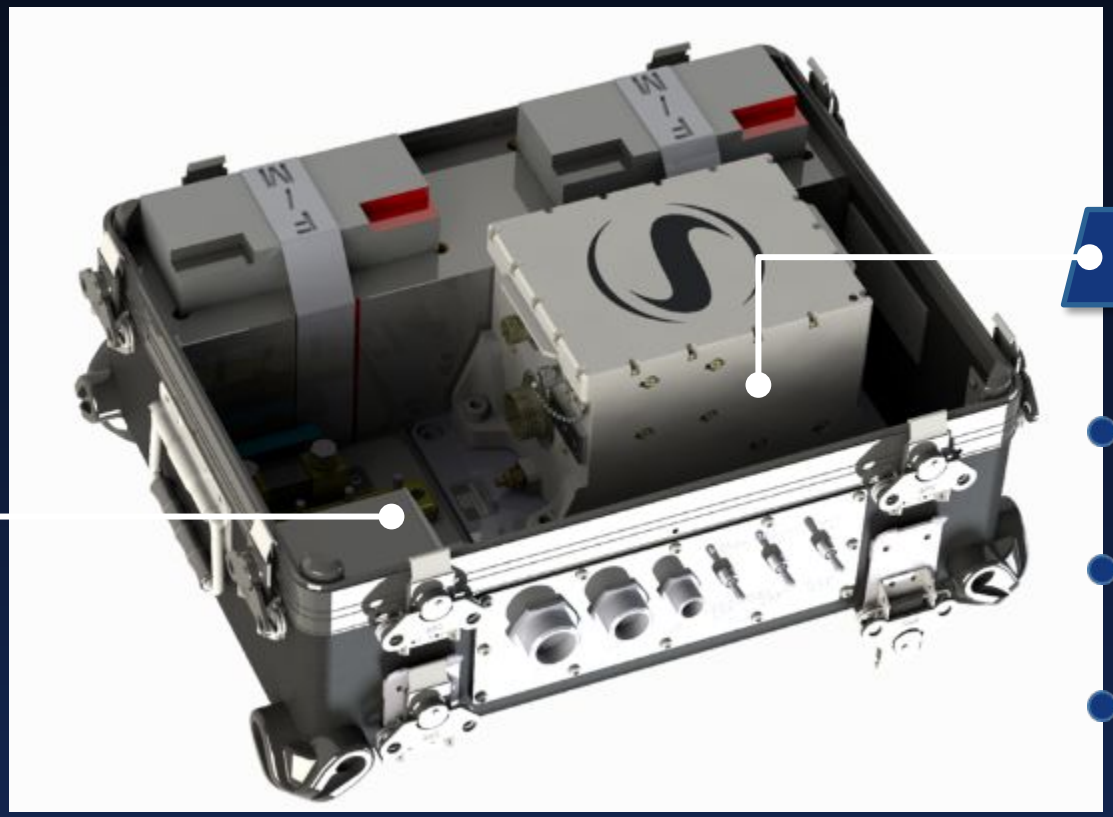
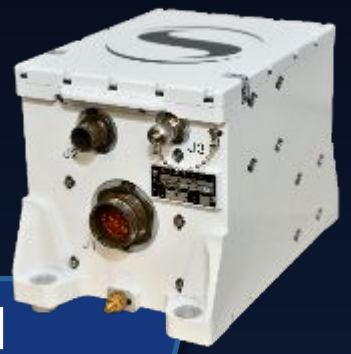
NAVKITE™





Geonyx™ M

Operational efficicency
High Precision Navigation & Pointing

PNT Resilience
Autonomous alignment without GNSS

Robustness and reliability
Optimized SWaP – MIL-STD-810

Versasync

PNT Resilience
GNSS spoofing/jamming detection

Flexible
GNSS master clock and NTP/PTP time server

Internal Timing Oscillators
OCXO, Rb, Microclock

Compact and ruggedized
Low SWaP, Tested to MIL-STD-810G CH1

Interference Detection & Mitigation
(Jamming & Spoofing)

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NAVKITE™: a success story

2022

Early 2022

The French SOF & its FUSCOLAB reached out to SAFRAN to collaborate on the development of a brand new solution integrating 2 Safran products : the GEONYX M and the VersaSync

2023

February 2023

Integration & deployment on the French Exercise "ORION/HEMEX"

March 2023

Official Launch of NAVKITE™ with the French SOF Commander at SOFINS

More to come

Integration in the French SOF BMS

Integration on more platforms

Integration with Vigy Engage ...

4D PNT: Availability, Integrity & Accuracy

4D PNT: Availability, Integrity & Accuracy

RESILIENCE LEVEL 1

TO ROBUSTIFY GNSS ACQUISITION

GNSS SIMULATION

ANTI-SPOOFING CRYPTO

ANTI-JAMMING ANTENNA

NAVWAR

MILITARY GNSS RECEIVER

PROPRIETARY IDM ALGORITHMS

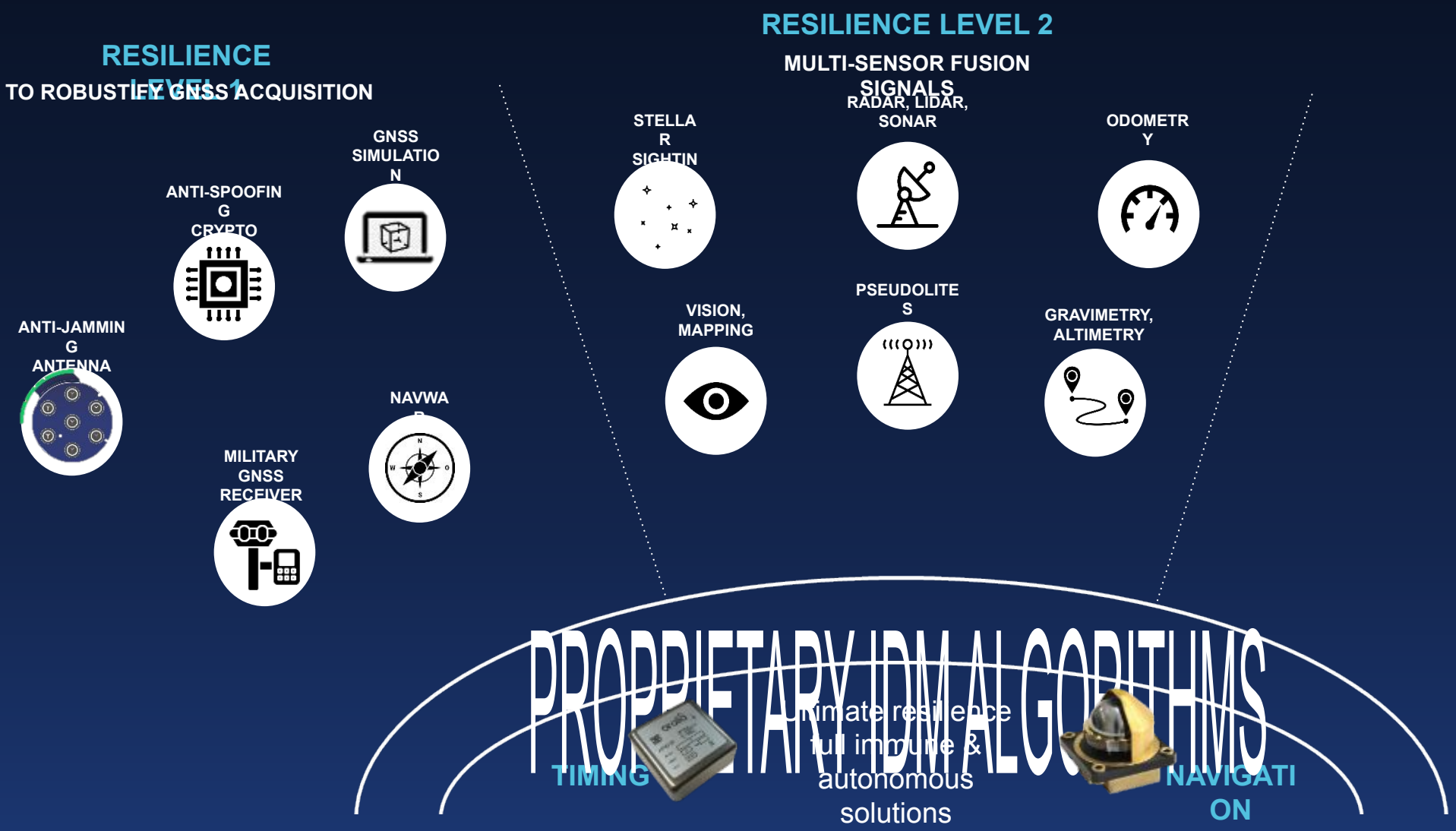
Ultimate resilience full immune & autonomous solutions

TIMING

NAVIGATION

SAFRAN

4D PNT: Availability, Integrity & Accuracy



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4D PNT: Availability, Integrity & Accuracy

RESILIENCE LEVEL 1

TO ROBUSTIFY GNSS ACQUISITION

ANTI-JAMMING ANTENNA

ANTI-SPOOFING CRYPTO

GNSS SIMULATION

MILITARY GNSS RECEIVER

NAVWAR

RESILIENCE LEVEL 2

MULTI-SENSOR FUSION SIGNALS

STELLAR SIGHTING

RADAR, LIDAR, SONAR

ODOMETRY

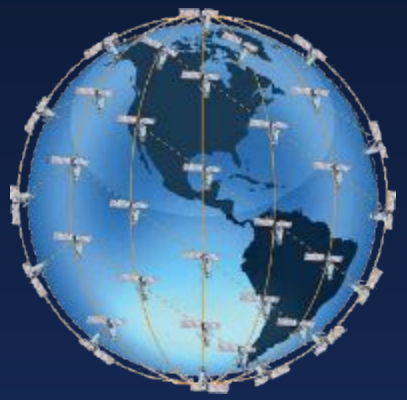
VISION, MAPPING

PSEUDOLITES

GRAVIMETRY, ALTIMETRY

RESILIENCE LEVEL 3

RF SIGNALS OF OPPORTUNITY

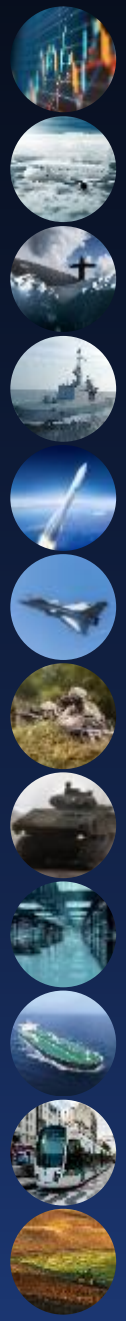


PROPRIETARY IDM ALGORITHMS

Ultimate resilience full immune & autonomous solutions

TIMING

NAVIGATION



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