



**Ensuring PNT Robustness, Resiliency, & Interoperability: the upcoming Galileo *Signal Authentication services & Anti-spoof Techniques.***

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**National Space-Based Positioning, Navigation, and Timing Advisory Board**

November 21<sup>st</sup>, Cocoa Beach, Florida



System Engineering & Cybersecurity

R&D

Scientific Missions



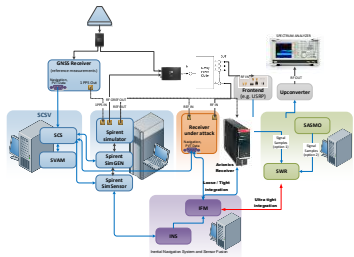
Advanced Navigation Systems



GNSS simulation  
Universal Threat Management



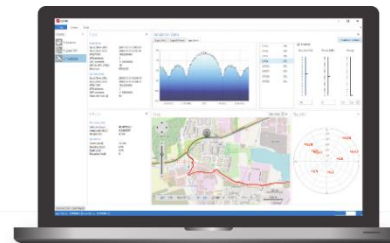
Cyber attack detection & response



Security Testbed



GNSS SDR

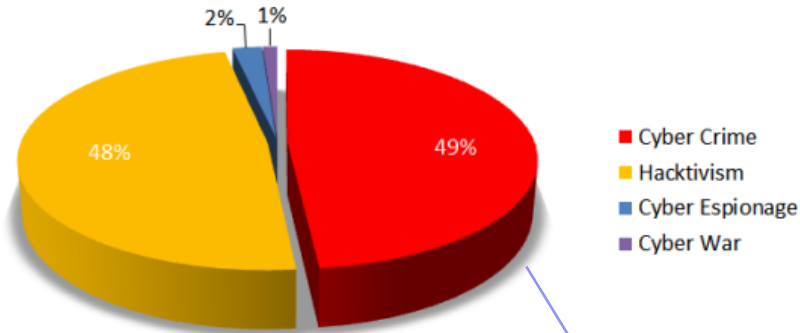


Cybersecurity Simulation

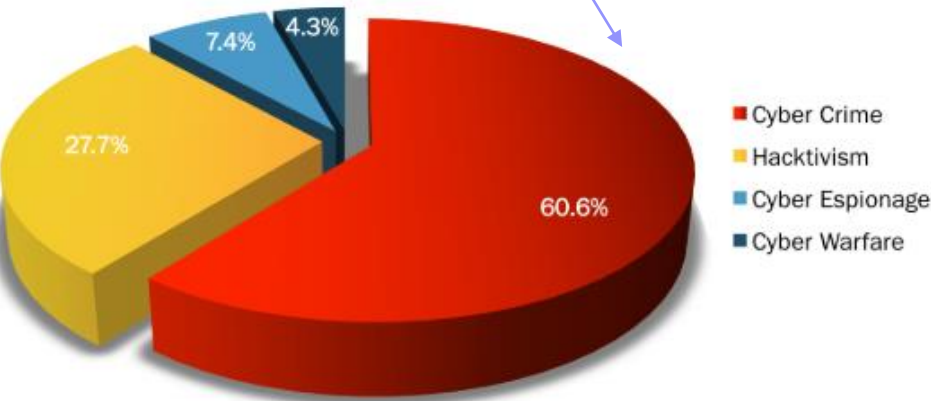


Jam/SpooF monitoring

## ICT cyber attacks

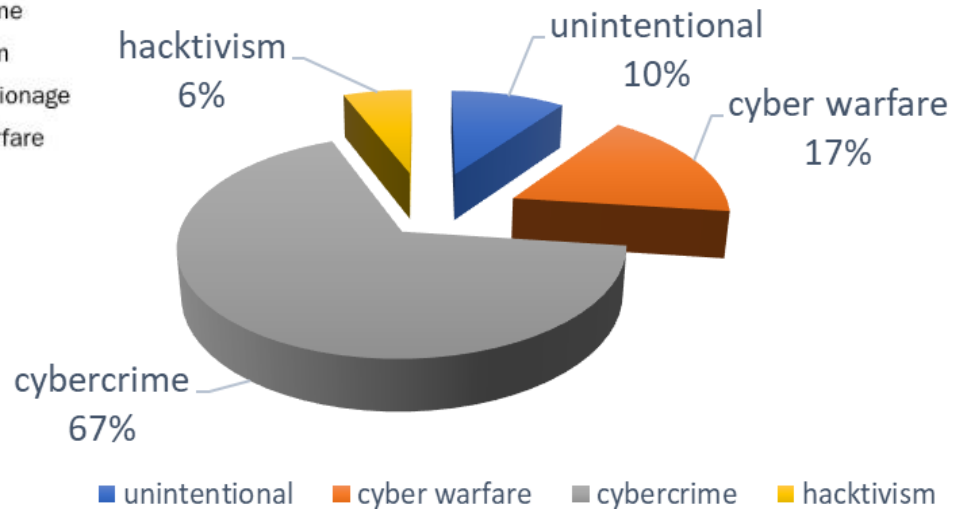


*Cybercrime is the most growing threat in the network and computer security domain*



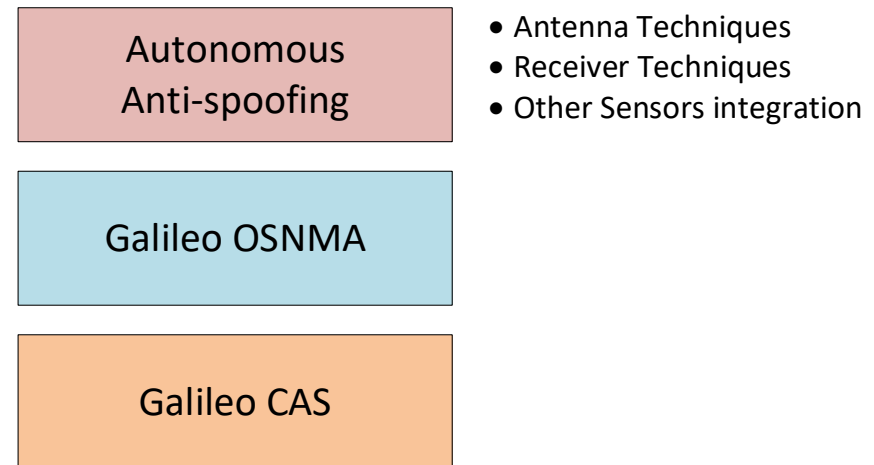
Source:web

## GNSS cyber attacks (2018-2019)

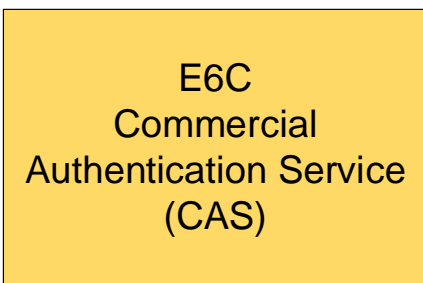


- Computer networks: 400 to 500 millions attack per year.
  - 18M\$ cost per service as average
  - total world wide cost expected to reach 6 trillion\$
- GNSS: 10 to 20 attacks per sector reported annually in the public?
  - What is the total cost of GNSS spoofing attacks to date?
- Growth of attacks mainly proportional to:
  - Political Cyberwarfare context
  - Financial payments that rely on GNSS
- Shall we consider the risk probability mainly proportional to a potential motivation of the attacker?

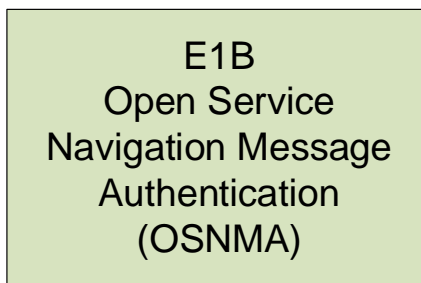
- Currently there are two trends:
  - User protection, with autonomous anti-spoofing techniques
    - Implementations available since the last 5 years in the market
  - System based services
    - Galileo Authentication services
    - SBAS Authentication
    - Others: GPS CHIMERA proposals



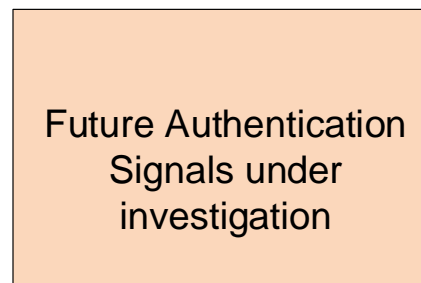
- Galileo Authentication developments foresee signals on
  - E6C: Galileo Commercial Authentication Service (CAS)
  - E1B: Galileo Open Service Navigation Message Authentication (OSNMA)



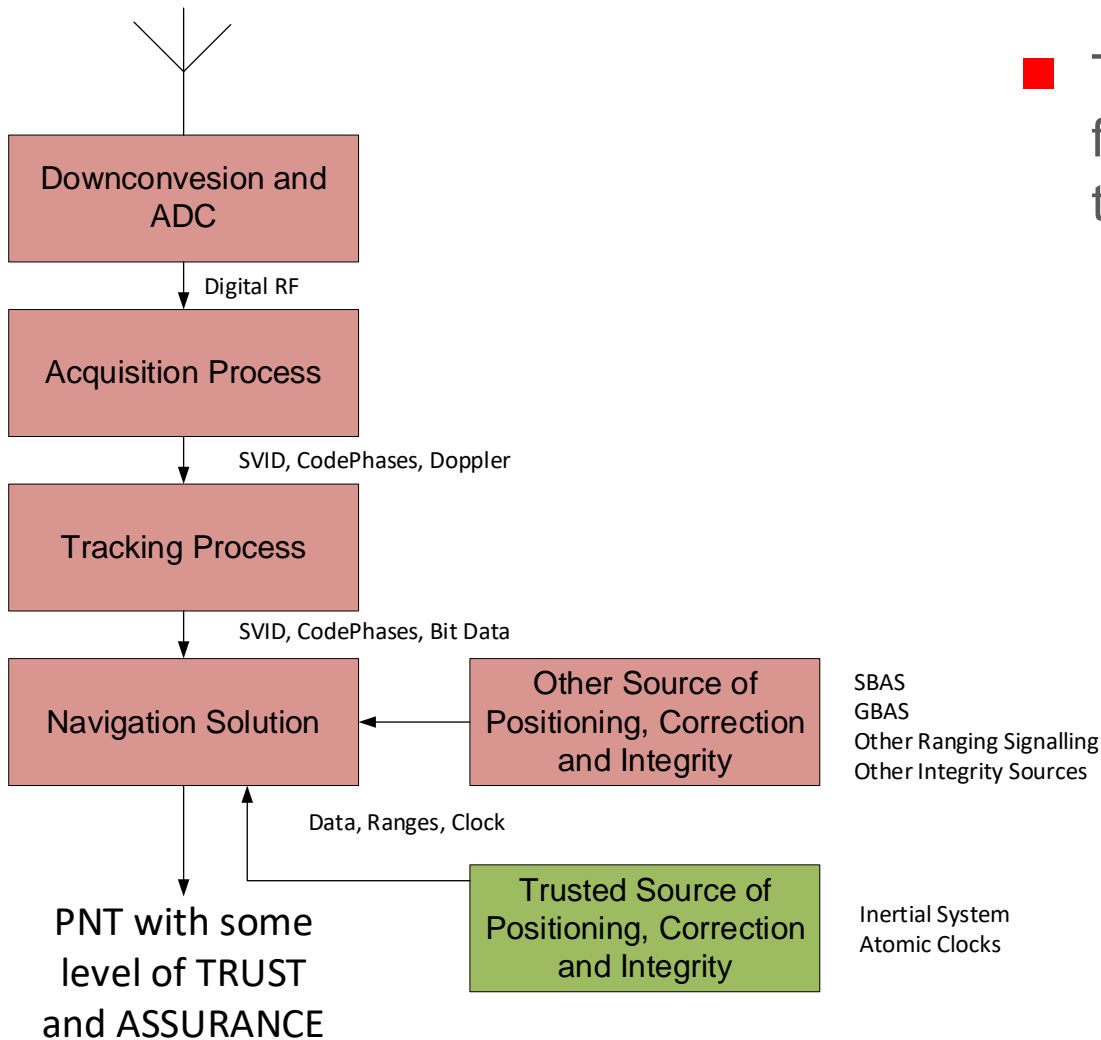
Date TBD



IOT starting in 2020

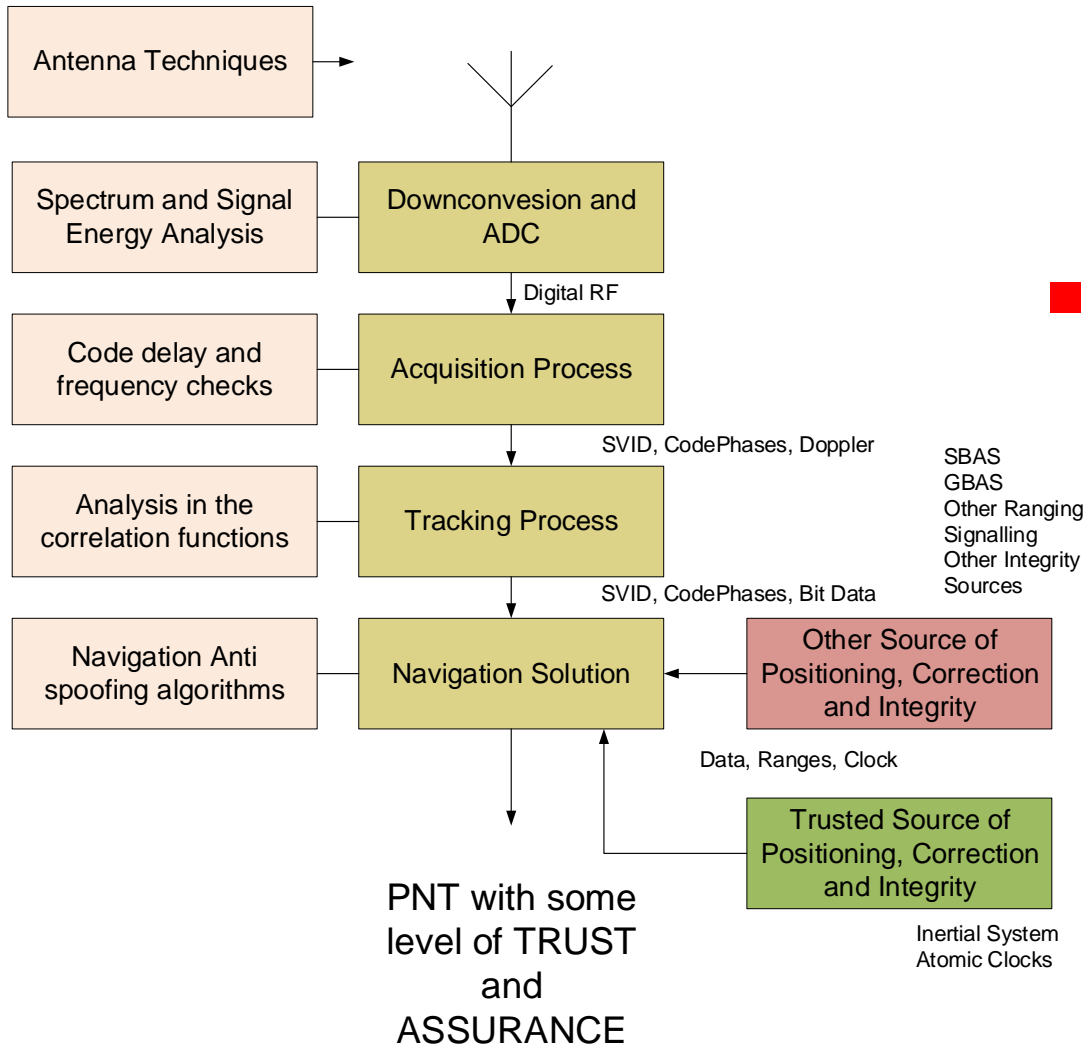


# Overall Spoofing likelihood of success



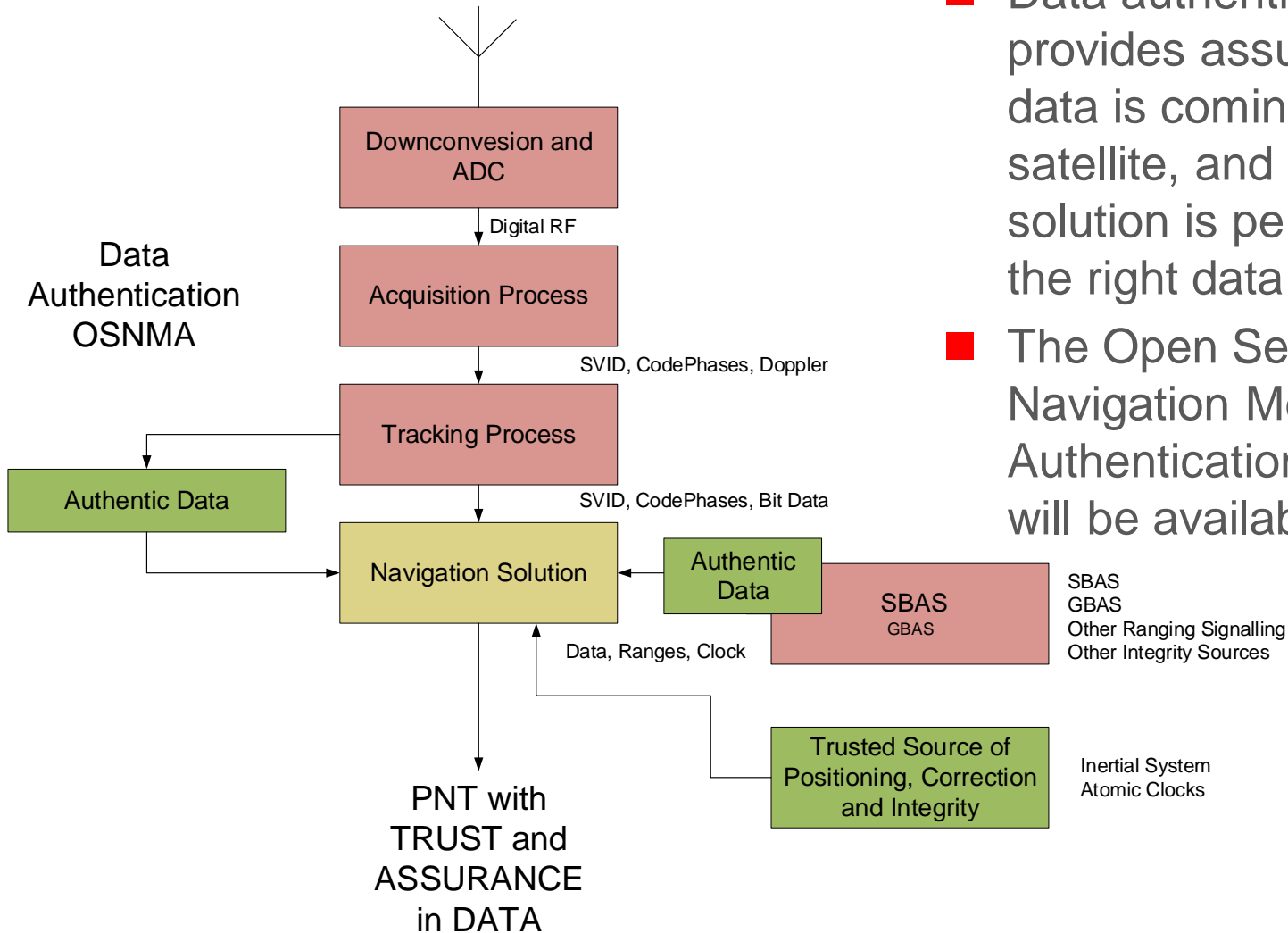
- The probability of success for the spoofing attacker is the combination of :
  - The probability to enter at the right power in the first radio stage
  - The probability to capture the right dynamic in the acquisition and tracking and shift with intelligence
  - The probability to bypass all sanity and integrity checks in the navigation solution, and to stay within the other nav and time systems accuracy boundaries

## Anti Spoofing Techniques



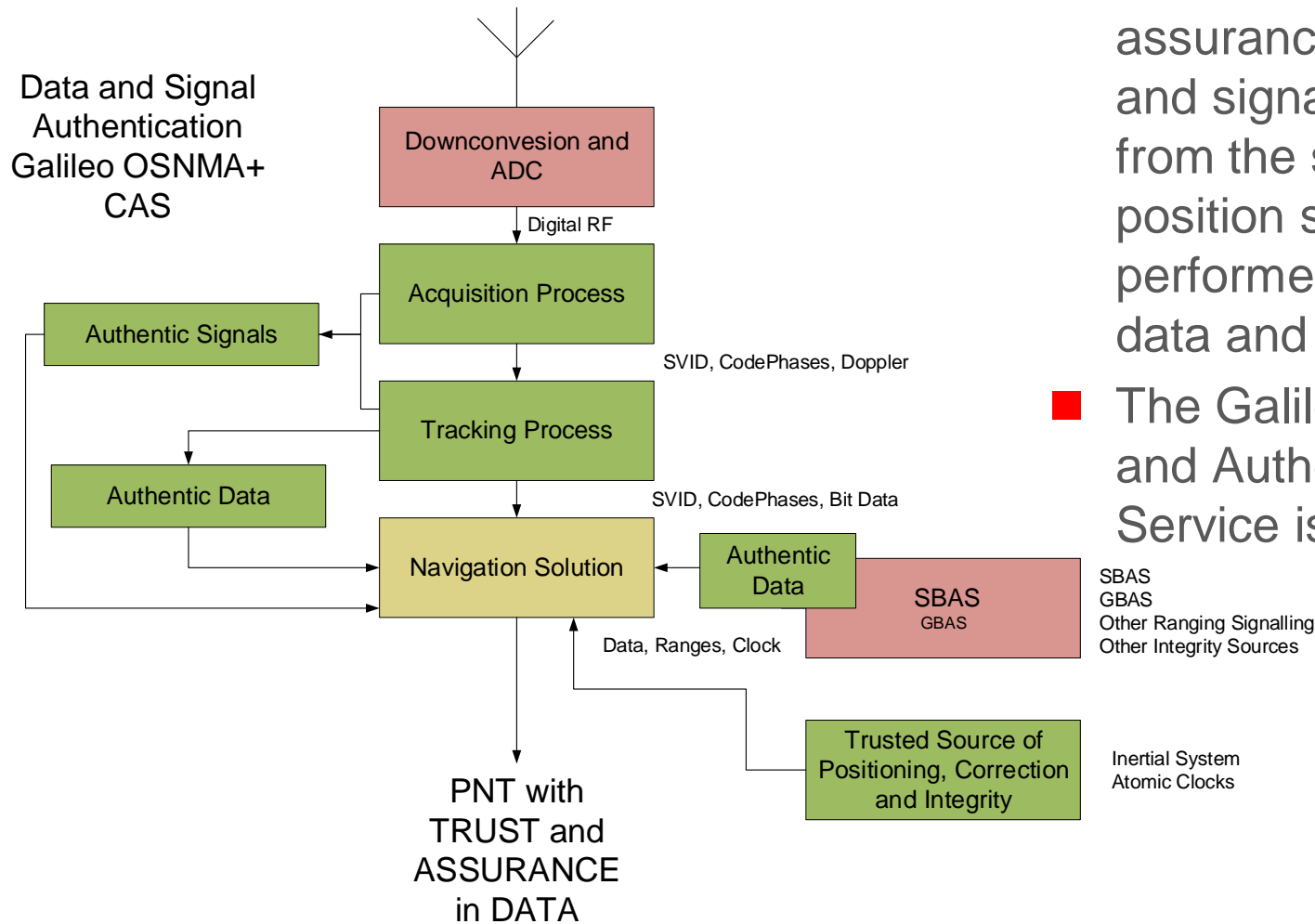
- Autonomous anti-spoofing techniques can provide detection and mitigation in a number of stages of a navigation system
- They are evaluated by statistical, detection timing and security performances





- Data authentication provides assurance that the data is coming from the satellite, and position solution is performed with the right data
- The Open Service Navigation Message Authentication (OSNMA) will be available in 2020

- Ongoing activities for SBAS



- Data and signal authentication provides assurance that the data and signals are coming from the satellites, and position solution is performed with the right data and ranging

- The Galileo Commercial and Authentication (CAS) Service is under definition

- Ongoing activities for OS auth evolutions

- Combined GPS Galileo solutions provides advantages in a number of domains:
  - Space and deep space applications, capability to track more signals and perform longer integration on combined GPS and Galileo signals
  - Increase robustness in critical applications by:
    - Use of Galileo upcoming Galileo signals
    - Slightly Increased difficulty for attackers to simulate 3 frequencies, dual constellations, with a total of up to 100 signals (at least with SDR)
    - The need to hide more live constellations without jamming the receiver
  - Increased availability indoor and urban canyons, backup in case of outages (The recent Galileo one, and previous short GPS ground time glitch)
  - Use of future Galileo CS signals in snapshot mode, both for ground and space applications



GPS/GALILEO  
receiver for the ISS



**Qascom**  
Trust is Nice, Control is Better.

**Thank you!**

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**National Space-Based Positioning, Navigation, and Timing Advisory Board**  
Date: November 21st  
Cocoa Beach, Florida

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