



International Committee on GNSS,  
Workshop on Low Earth Orbit  
(LEO) PNT Systems

June 2023



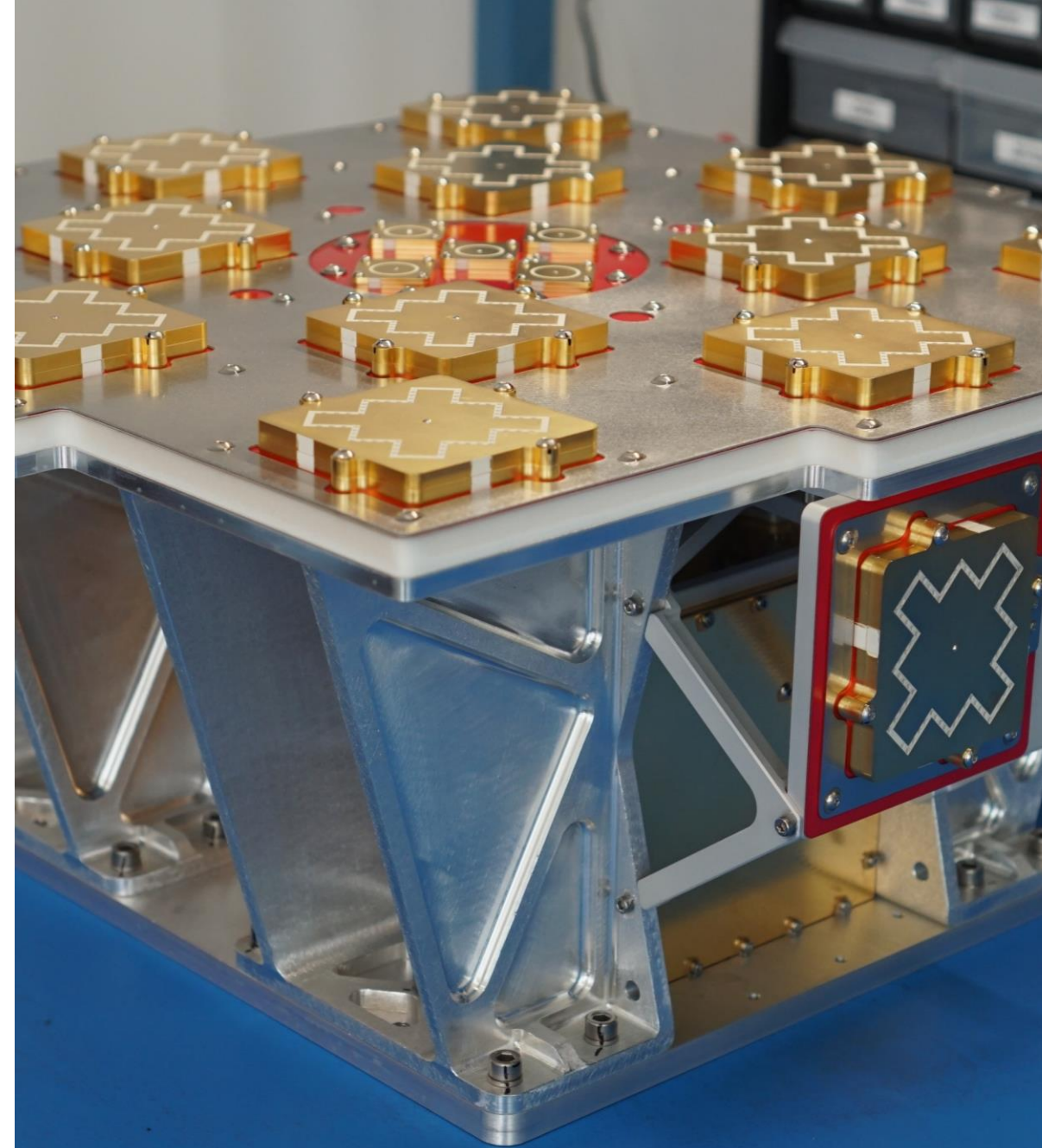


# XONA'S MISSION

Enable modern technologies to operate safely in any environment, anywhere on Earth.

Xona is building the first high-performance commercial satellite navigation system capable of supporting modern applications through existing user equipment.

BACKED BY



# THE INNOVATORS OF MODERN SAT NAV



We invented it. We patented it. We're building it.

Xona was founded by a team of navigation industry experts from the Stanford GPS Lab working on cutting edge PNT for autonomous solutions combined with fast-moving space pros from places like SpaceX and Blue Origin.

The team has authored the world's leading research in high-performance LEO PNT and contributed to over 100 successful space missions.

Now with over 45 full-time employees, Xona has attracted some of the world's most elite navigation, satellite, and space experts as employees, advisors, and investors.

# XONA LOCATIONS

Xona's Canadian operations are run out of our office in **Vancouver**.

The **UK** is the center for Xona European operations.



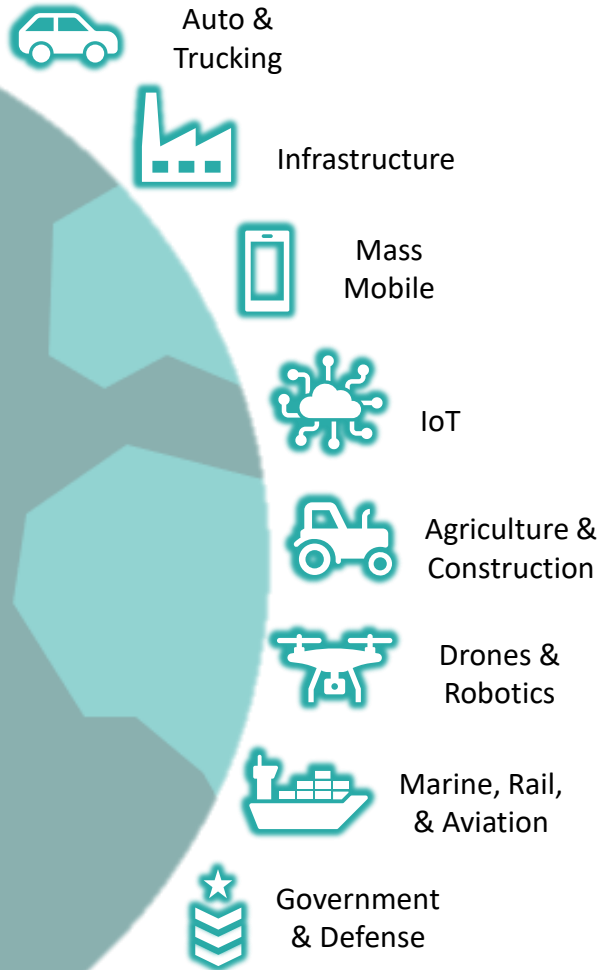
**Burlingame** is home to the US Headquarters



# XONA HEADQUARTERS



# WHY XONA EXISTS



Autonomy isn't safe in poor weather

The company was formed around the needs of the automotive world...



Precision agriculture is limited to wealthy farms

... but has found critical and growing needs in multiple other industries as well.



GPS interference is a major threat to our armed forces

# REQUIREMENTS START WITH THE USER

What does it take to support emerging and future applications?

Modern and adaptable security

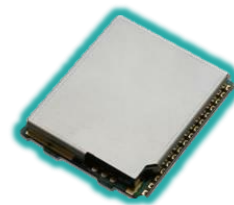
cm-level accuracy in seconds

Civil aviation level integrity

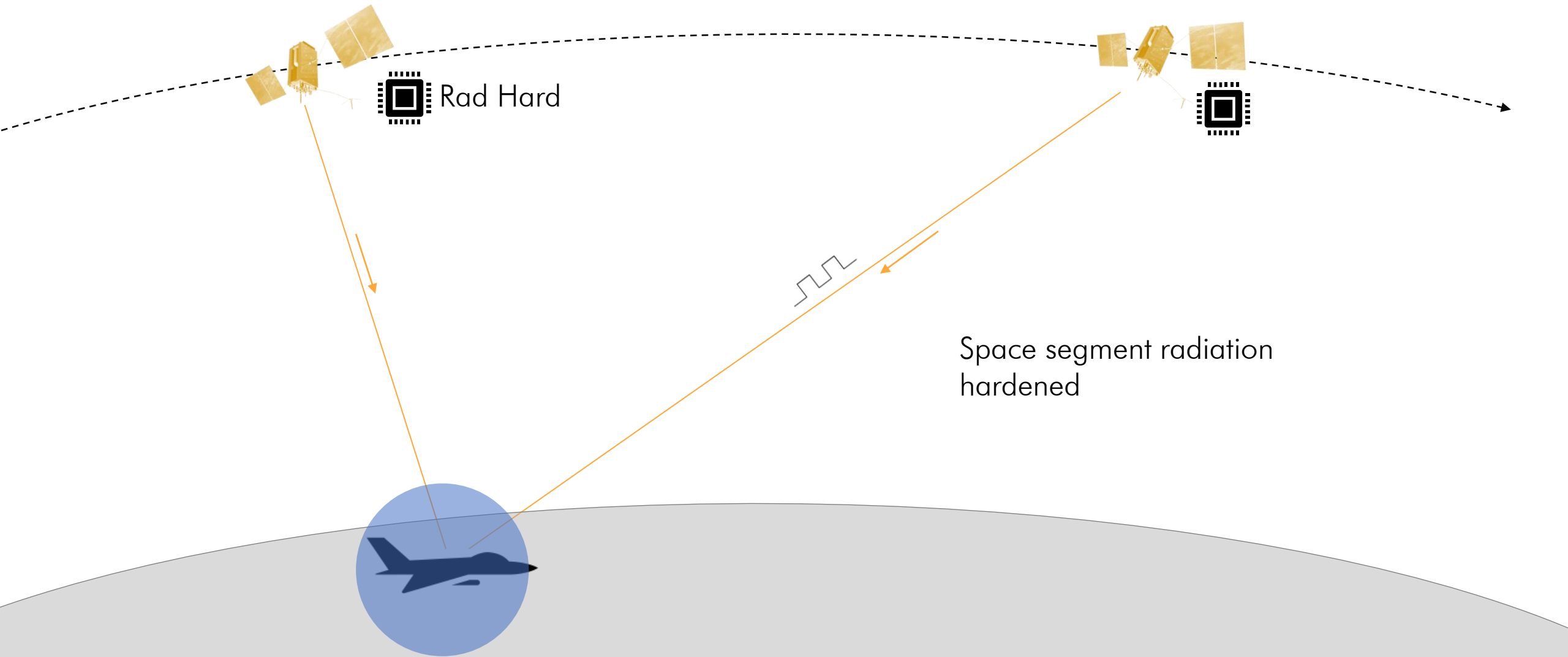
Enhancements for legacy GPS signals

Resistance to interference

**Must be easy to integrate into GNSS user equipment.**

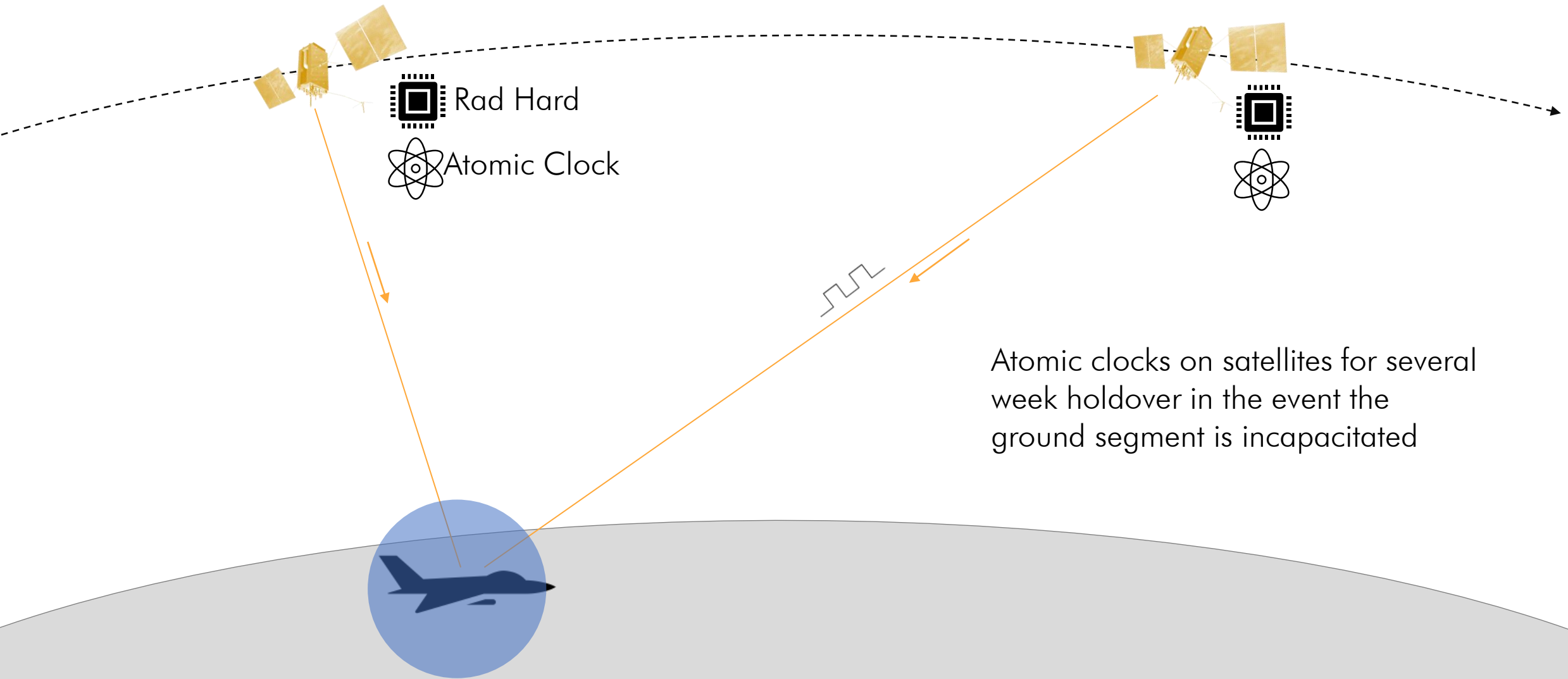


# GPS ARCHITECTURE

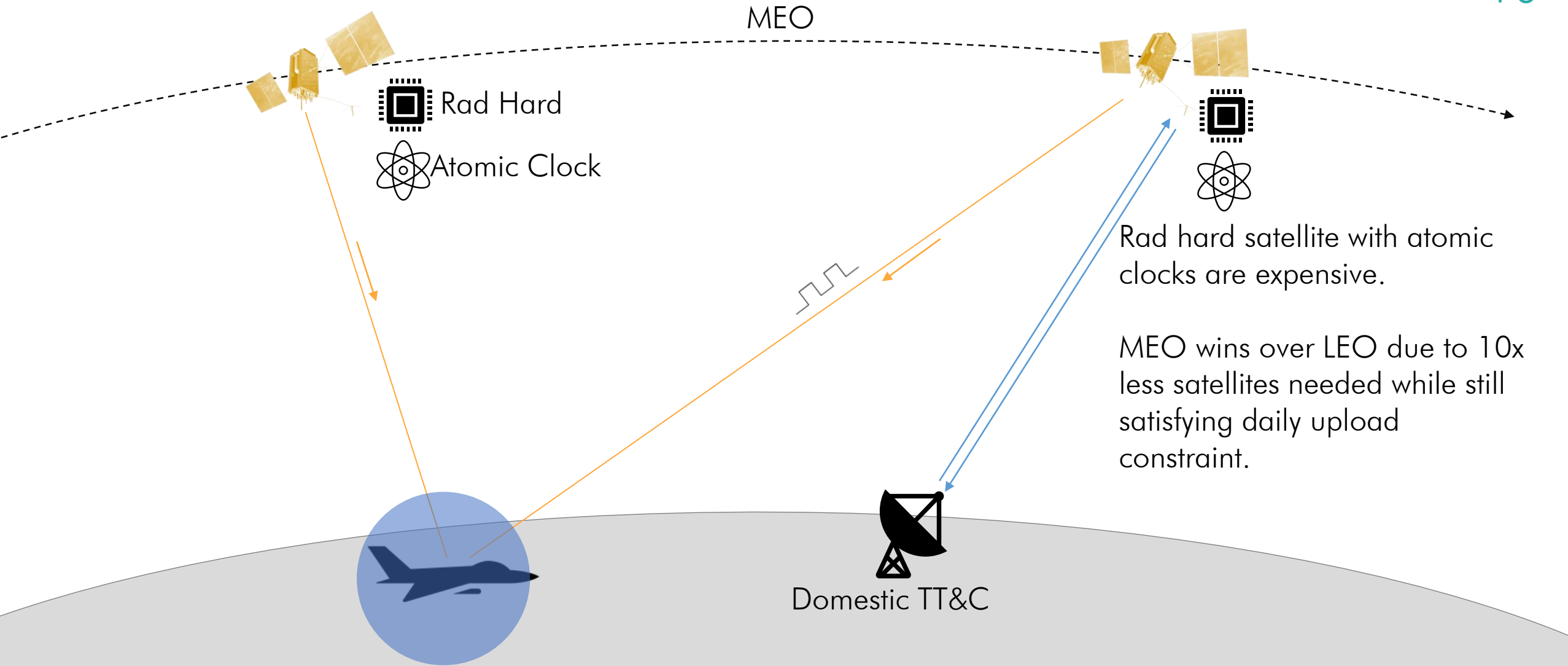




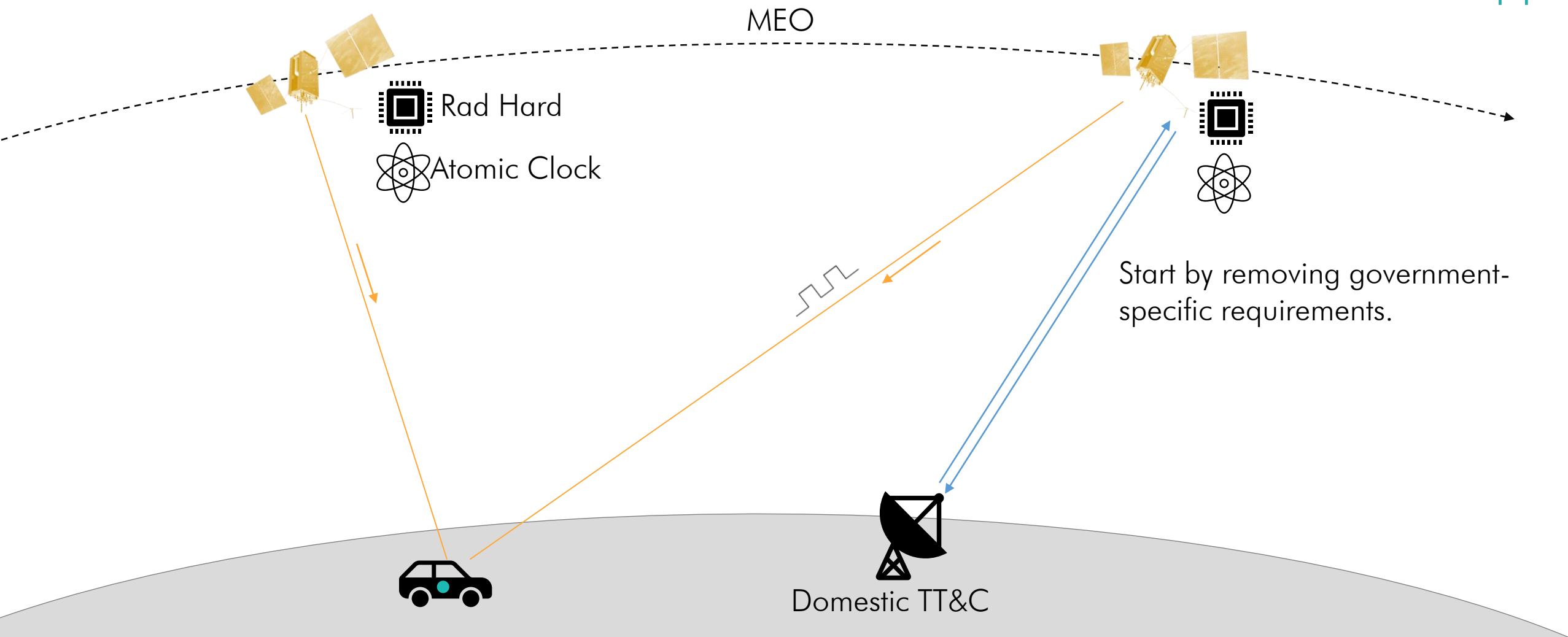
# GPS ARCHITECTURE



# GPS ARCHITECTURE

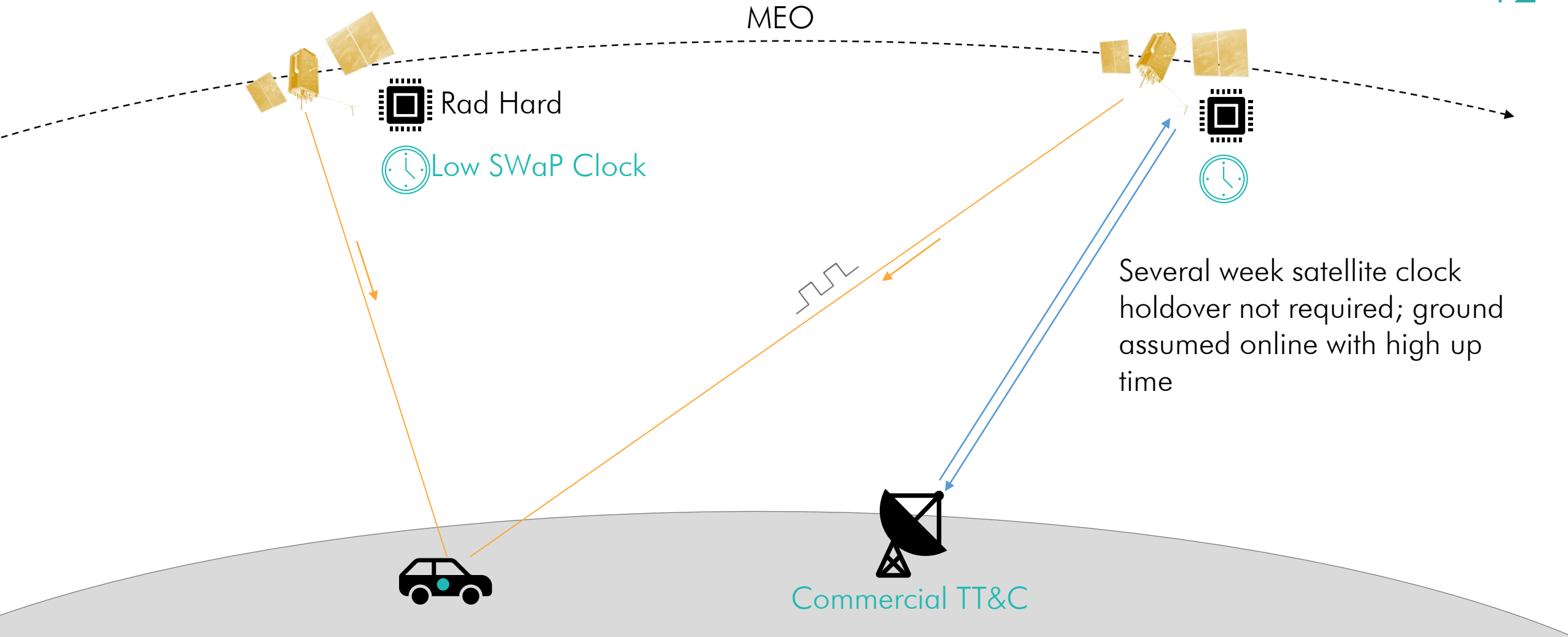


# SAT NAV TODAY

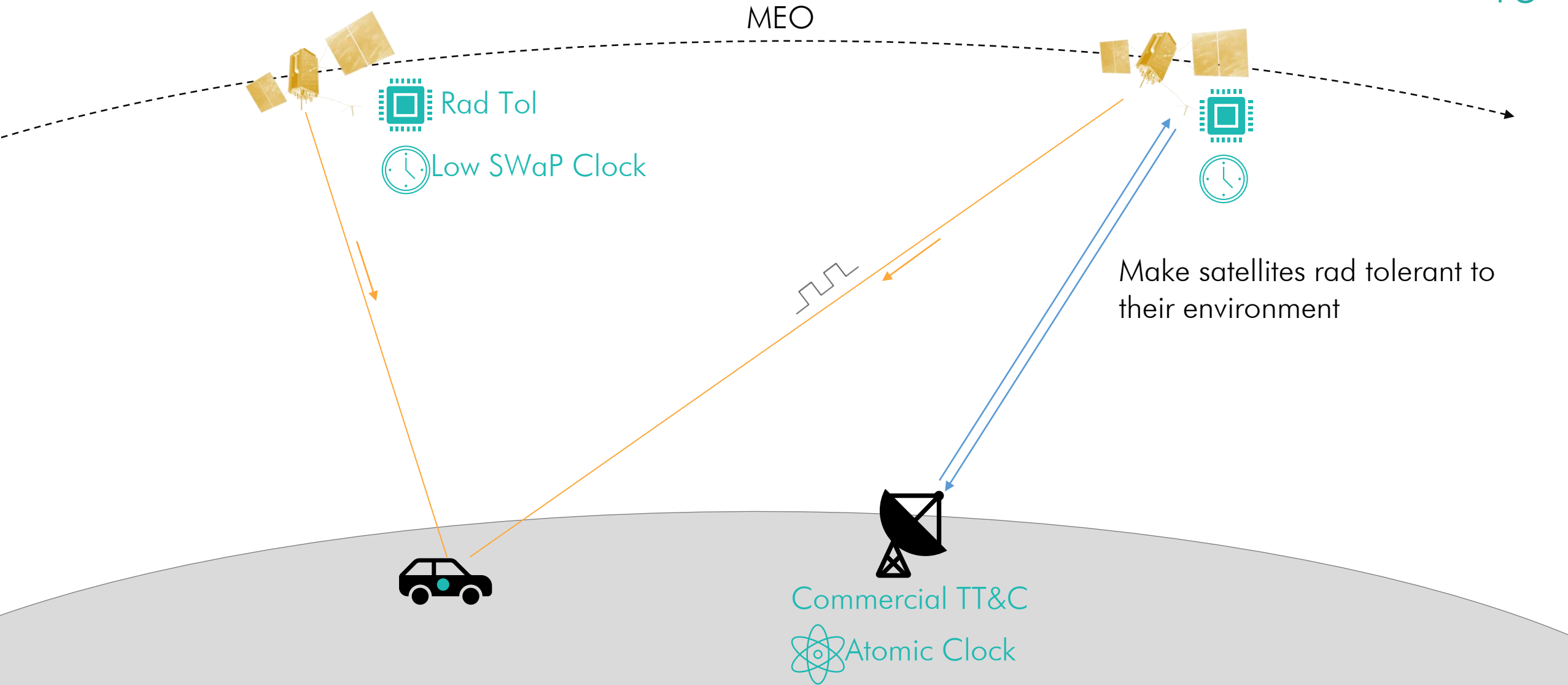




# SAT NAV TODAY



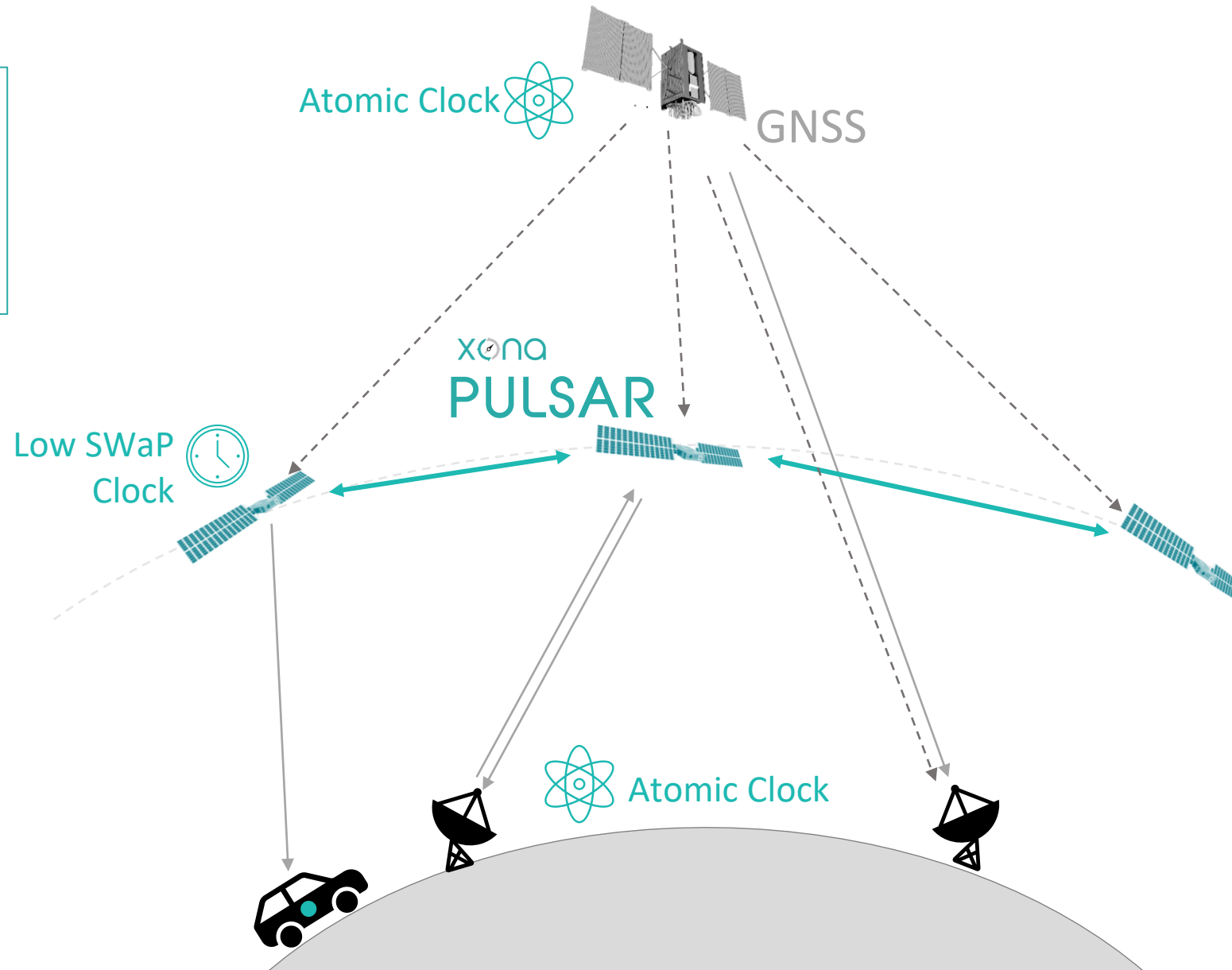
# SAT NAV TODAY



# TRANSLATING TO A SPACE ARCHITECTURE

14

- User range error at centimeter-level
- 100x stronger received power
- 100x higher data rate
- GNSS antenna and chipset compatibility
- Low-cost satellites and ground segment



## How? Move to LEO



PULSAR leverages modern LEO technology to provide high-performance PNT capabilities with minimal or no user hardware modification

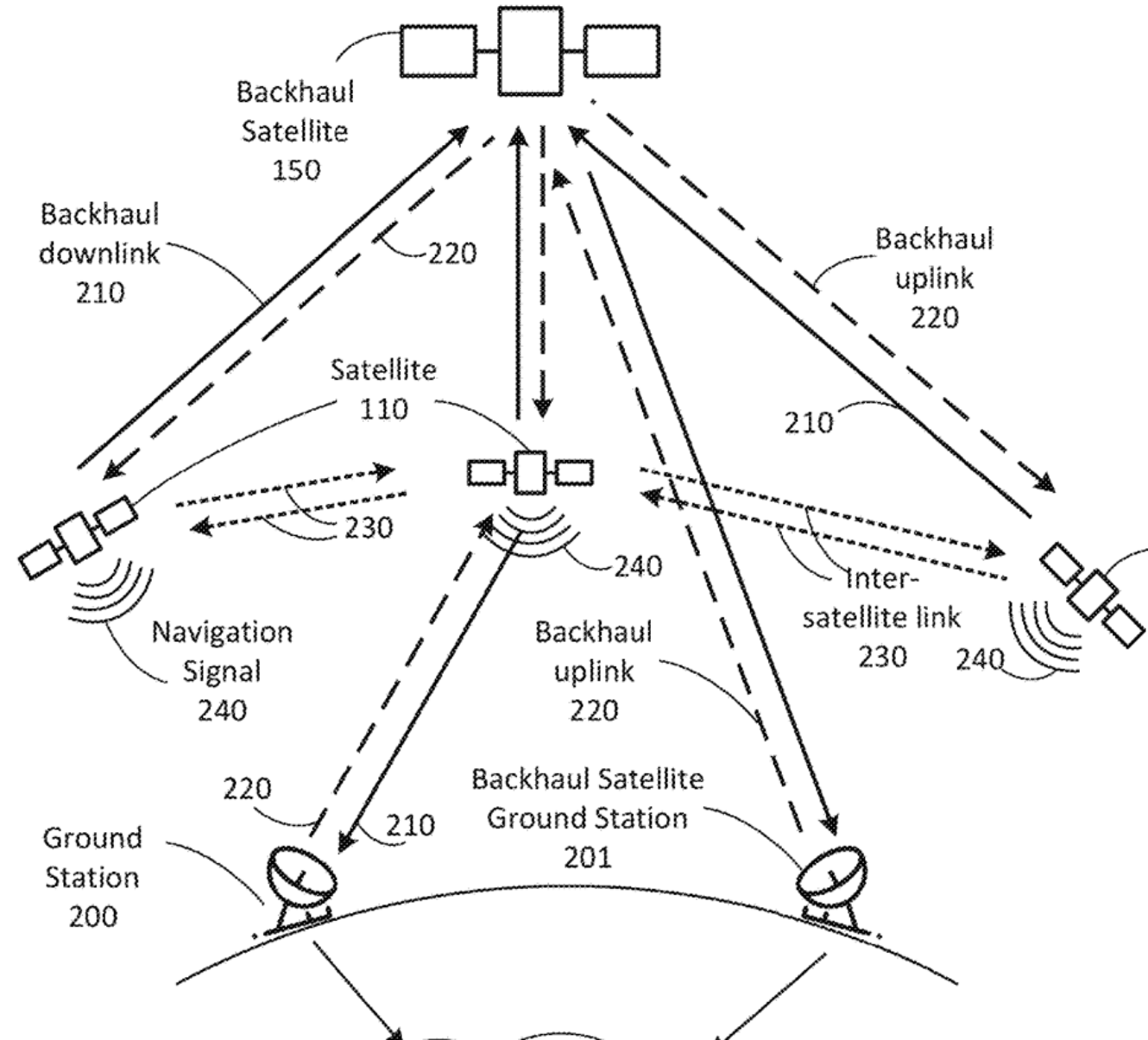




# DISTRIBUTED LEO SAT NAV IS PATENTED

- 2 US patents issued covering core concept
  - In review internationally
- Rapidly expanding portfolio of 30+ more in process

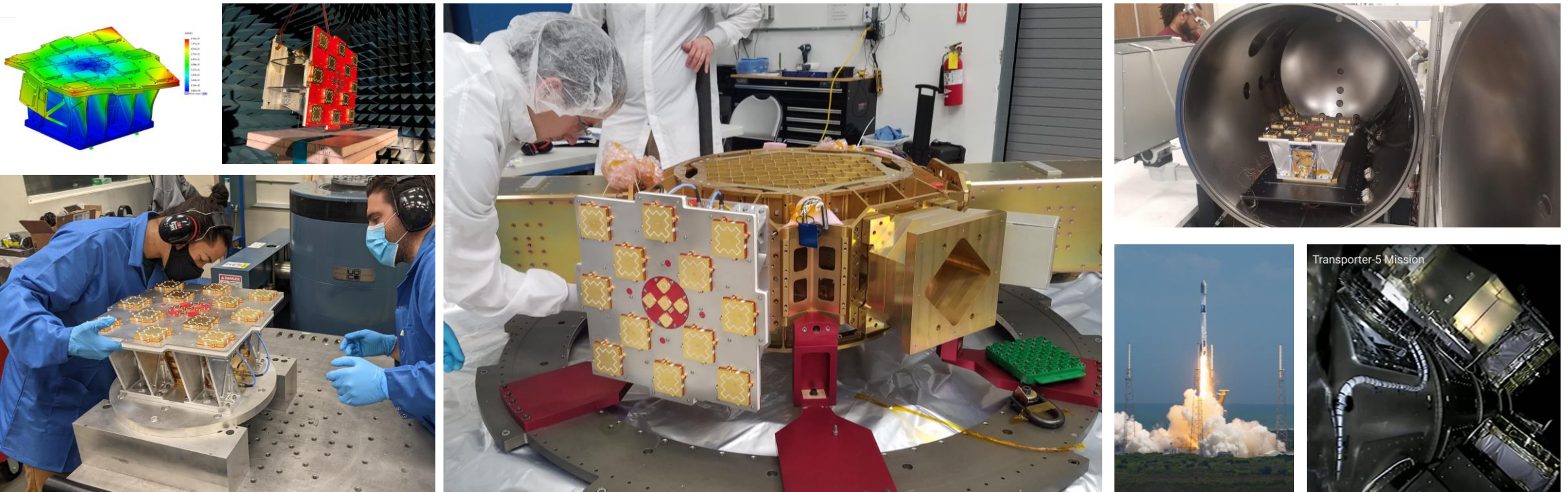
 US011640002B2	
(12) <b>United States Patent</b> Reid et al.	(10) Patent No.: <b>US 11,640,002 B2</b> (45) Date of Patent: <b>*May 2, 2023</b>
(54) <b>LOW EARTH ORBIT SATELLITE FOR FACILITATING ENHANCED POSITIONING</b>	(56) <b>References Cited</b> U.S. PATENT DOCUMENTS
(71) Applicant: <b>Xona Space Systems Inc., San Mateo, CA (US)</b>	6,329,950 B1 12/2001 Harrell et al. 10,048,382 B2 8/2018 Yunck
 US011513232B2	
(12) <b>United States Patent</b> Reid et al.	(10) Patent No.: <b>US 11,513,232 B2</b> (45) Date of Patent: <b>Nov. 29, 2022</b>
(54) <b>SATELLITE FOR BROADCASTING HIGH PRECISION DATA</b>	(56) <b>References Cited</b> U.S. PATENT DOCUMENTS
(71) Applicant: <b>Xona Space Systems Inc., Marquette, MI (US)</b>	6,329,950 B1 12/2001 Harrell et al. 10,048,382 B2 8/2018 Yunck (Continued)



# TECHNOLOGY PROVEN IN SPACE

Launched May 25, 2022

First ever commercially funded satellite navigation mission



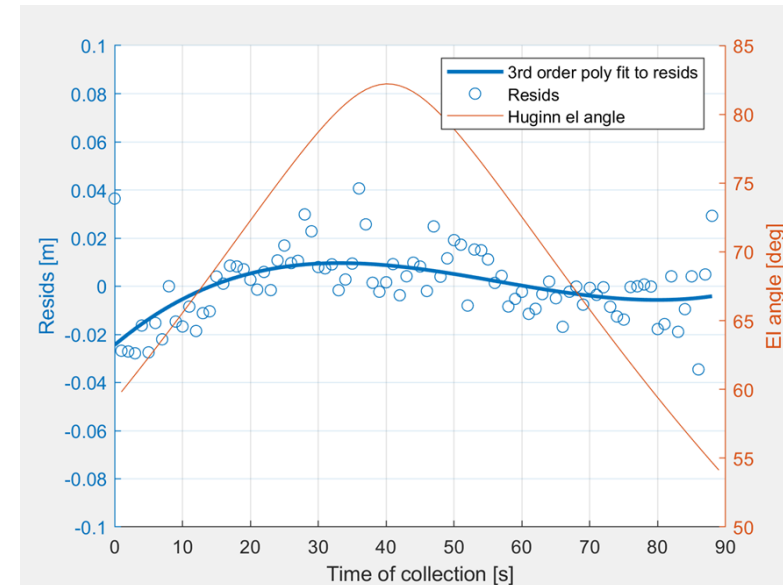
# ON-ORBIT PERFORMANCE VALIDATION

17

- Successfully transmitted precision LEO PNT signals from space to ground.
- Demonstrated cm-level ranging capability.
- Demonstrated the on-orbit re-programmability of Xona's proprietary digital navigation waveform generator.
- Validated Xona's patented distributed clock architecture.



Proven that precision satellite navigation is possible using low-cost commercial-off-the-shelf components



Example cm-level residuals from Xona Satellite Pass





# THE PULSAR ECOSYSTEM

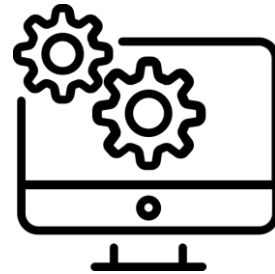
## Simulators

Consortium of Partners Including



Available Q3 2023

## SW Receivers



Software Reference Receiver

Available Now

## HW Receivers

Consortium of Partners Including



Prototypes in validation now



# GOVERNMENT GRANTS/PROGRAM HIGHLIGHTS <sup>19</sup>

## U.S. Government

- National Science Foundation SBIR Phase I and II
- National Geospatial Agency Accelerator, Inaugural Cohort

## Canadian Government

- Canadian Space Agency – smartEarth program

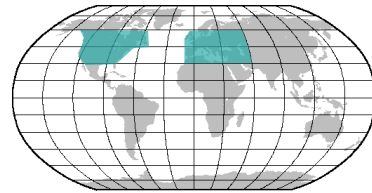


# SERVICE AVAILABILITY TIMELINE

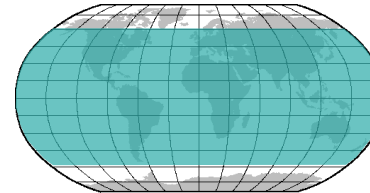
Phase 0: 2+ Satellites  
Complete production  
satellite designs, deploy  
ground ops.



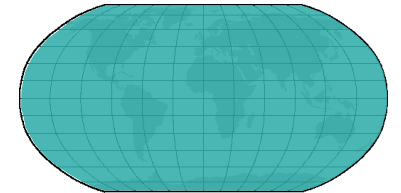
Phase 1: 32 Satellites  
Scale up to launch  
initial services over NA  
& EU starting late 2025.



Phase 2: 66 Satellites  
Expand services to cover  
all mid-latitudes.  
Enhanced services in NA  
& EU



Phase 3: 258 Satellites  
Deploy full global  
coverage of next-gen  
satellite navigation.



Both recurring and permanent subscription models available.  
Pricing is volume and feature dependent.

# INTERNATIONAL COORDINATION

- Started coordination efforts with known spectrum stakeholders in 2020.
- ITU Coordination Request filed.
- Participating in ITU WP 4C meeting in Geneva, Switzerland in June 2023.
  - Will be introducing PULSAR constellation to invite international coordination discussions.





# Xona

space systems

