QWRTY

A White Rabbit Switch v4 with Enhanced Holdover Capabilities

Ricardo Píriz
Time & Frequency Division – GMV NAV

White Rabbit

gmv INNOVATING SOLUTIONS

GMV COMPANY OVERVIEW

A GLOBAL TECHNOLOGY GROUP

Who we are

Multinational technology group

Headquarters in Spain (Madrid)

+3,300 employees

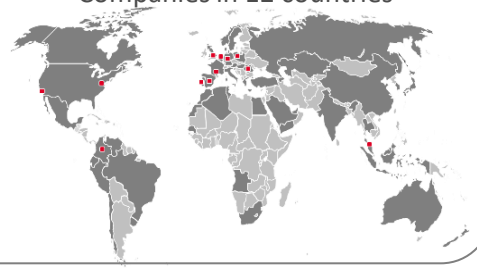
Roots tied to Space

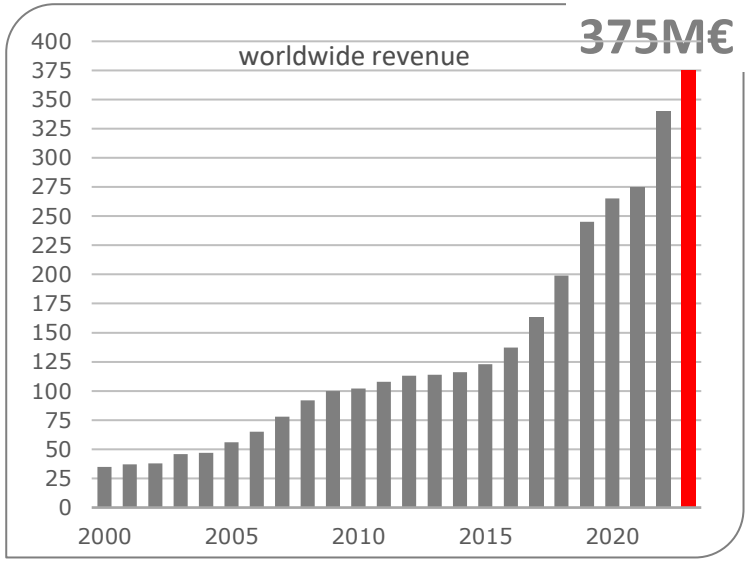
CMMI level 5

Private capital

Founded in 1984

Companies in 12 countries





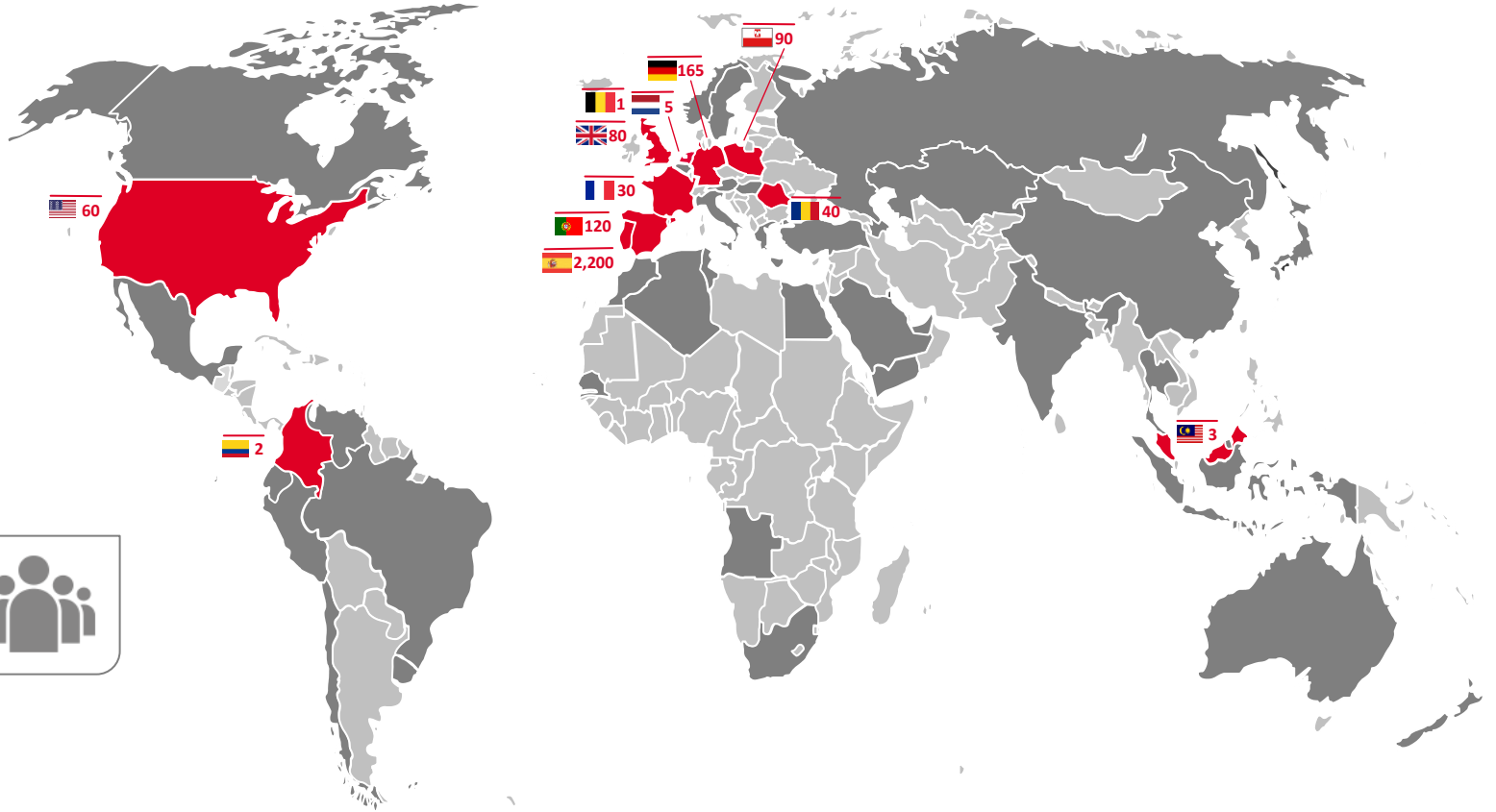
Space, Aeronautics, Defense & Security, Intelligent Transportation, Banking & Finances, ICT Industries

Space	Defense	IT	Transport
56%	11%	16%	17%

FULLY ESTABLISHED COMPANY IN EU

GMV TEAM WORLDWIDE

Who we are



+3,300
staff

ACTIVITIES IN NAVIGATION

30 YEARS OF EXPERIENCE IN GNSS

GMV in Navigation

GNSS Infrastructure

GNSS Services

GNSS User Segment

Time & Frequency

KEY PLAYER IN GALILEO

GMV in Navigation

- Ground Control Segment Prime Contractor for:
  - Galileo 1st Generation
  - Galileo 2nd Generation IOV
- Prime Contractor for Galileo 2nd Generation System Testbed
- Supplier of Key Facilities of the Galileo Mission Segment
- Prime Contractor for Galileo Service Facilities (OSNMA, High-Accuracy)

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ESA awards Galileo ground control upgrade to GMV

September 6, 2018 - By GPS World Staff
Est. reading time: 2 minutes
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News from the European Space Agency

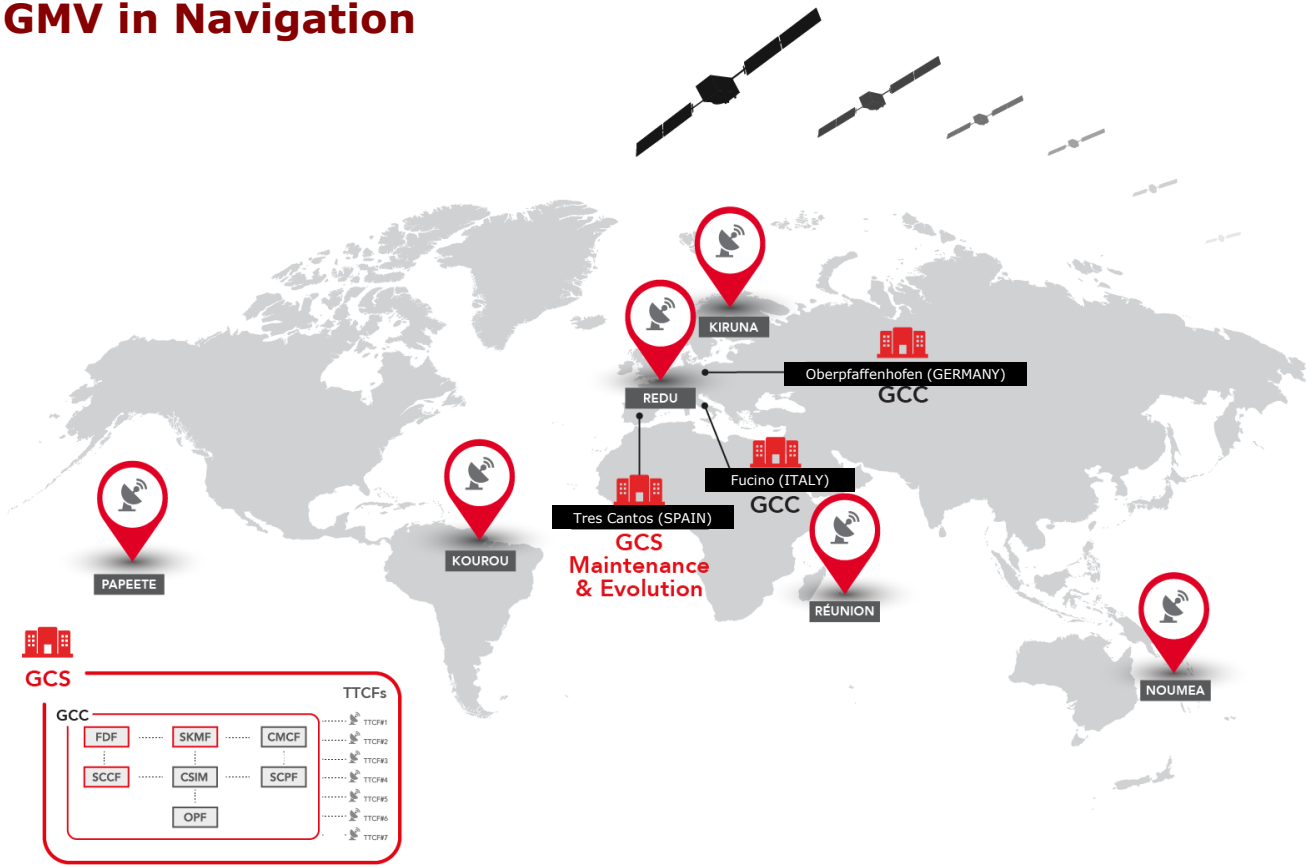
With Europe's Galileo constellation in space now expanded to 26 navigation satellites — and Galileo Initial Services available to users worldwide — the infrastructure on the ground that controls them is undergoing a corresponding expansion.

ESA has awarded a new work order for the Galileo Control Segment — that part of the Galileo system responsible for the monitoring and control of all the satellites in orbit — to GMV Aerospace and Defence, Spain.

The contract was signed by ESA Director of Navigation Paul Verhoef and Jesús B. Serrano Martínez, CEO of GMV, in a ceremony hosted at Spain's Ministry of Science, Innovation and Universities in Madrid, in the presence of Spanish Science Minister and former ESA astronaut Pedro Duque.

PRIME CONTRACTOR FOR GALILEO GCS

GMV in Navigation



1 out of 4
Largest Contracts
GALILEO

250 M
Biggest Contract
Spanish Industry
SPAIN

+200
Large Team

5
Year's Contract

+10
Companies
EUROPE

KEY
Responsibility

PRECISE & SAFE POSITIONING FOR BMW GROUP

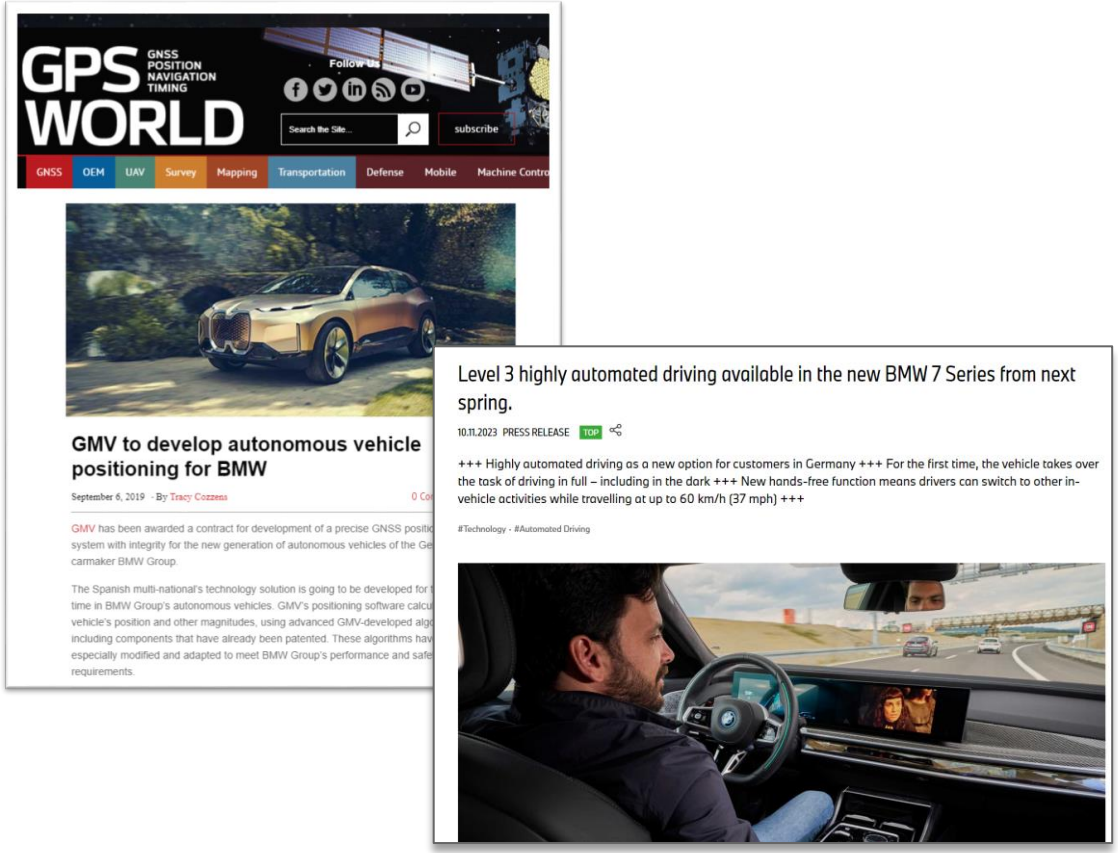
GMV in Navigation

- Contract (2019) for development of a **precise GNSS positioning system with integrity** for the new generation of autonomous vehicles of **BMW Group.**
- New contract (2025) for the provision of the solution for the **next ADAS generation.**

- System Components:
  - ASIL-B embedded SW Positioning Engine onboard the vehicle
  - ASIL-B Correction Service supporting by GMV's own global station network

- The proposed solution strongly relies on **Galileo**.

- GMV's solution is on the roads since summer 2023.



GMV'S GNSS STATION NETWORK

GMV in Navigation

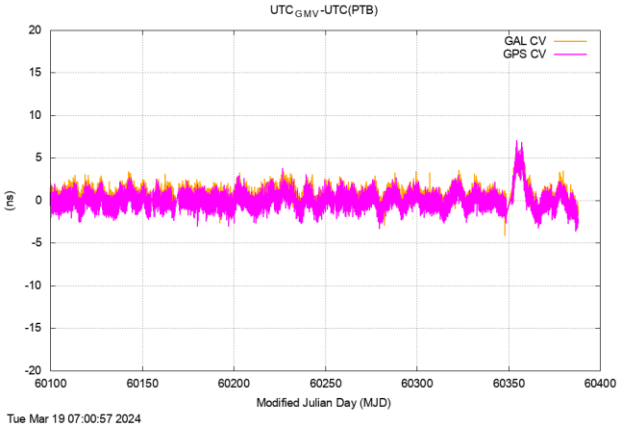
- 40 GNSS stations worldwide ensure GMV's full independence and autonomy to provide GNSS services

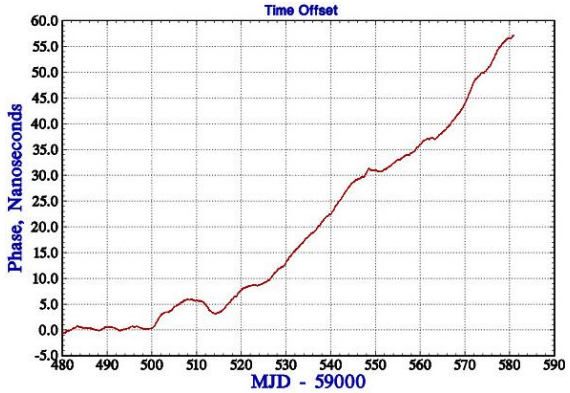
TIME AND FREQUENCY PROJECTS AND PRODUCTS

TIMESCALE (ESA NAVISP 2, SPAIN)

Time & Frequency

- UTC-like realization in Madrid, Spain (UTC_{GMV})
- Based on two Passive Hydrogen Masers (PHMs)
- PHMs steered to UTC(PTB) by means of GNSS time transfer (GPS and Galileo), and traceable to UTC(ROA)
- Network time distribution through a variety of protocols: White Rabbit, PTN (Net Insight), NTP





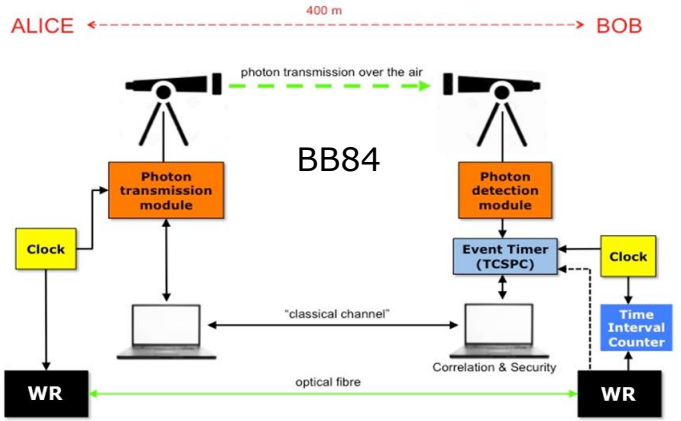
ePRTC BOX (ESA NAVISP 2, UK)

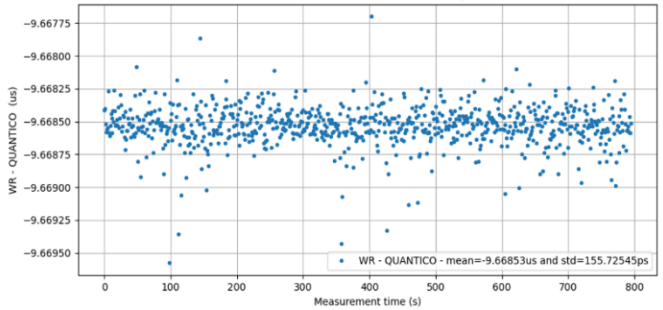
Time & Frequency

- Combines a high-end time-transfer GNSS receiver with a high-resolution frequency stepper in a single box
- Together with an external PHM or Cs clock generates a timescale aligned to UTC
- Fulfils ITU ePRTC standard connected to a PHM or Cs clock (±30 ns when locked to GNSS and ±100 ns after 14 days in holdover)
- Frequency microstepper based on an **open-hardware** design by Anders Vallin (VTT MIKES UTC-laboratory, Finland), licensed under CERN-OHL-S V2

SECURE QUANTUM PNT (ESA NAVISP 1, UK)

Time & Frequency





155 ps 1-sigma

THE SKA TIMESCALES PROJECT

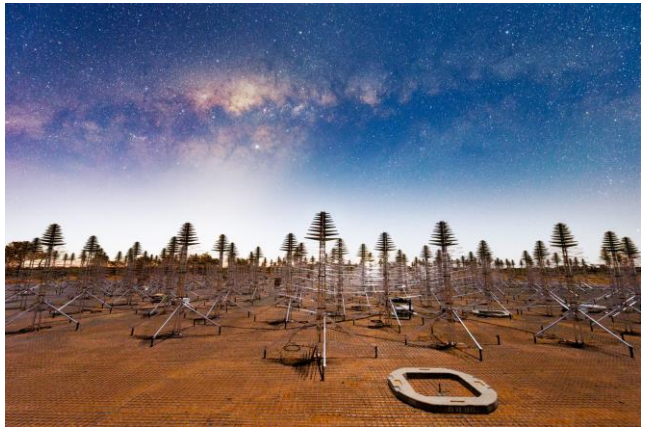
Time & Frequency

GMV has been awarded the contract to develop the SKA telescopes' Timescales

18/03/2024 Print Share

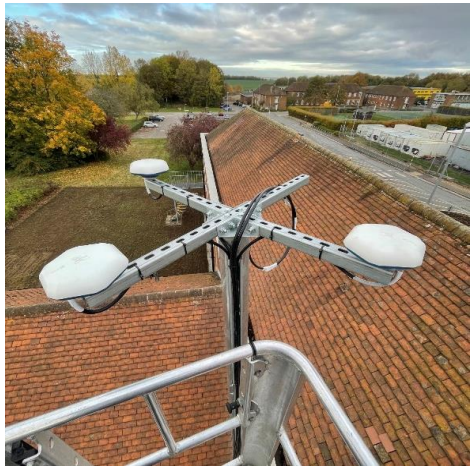
The SKA Observatory will be the largest radio-astronomy facility on Earth, with two telescope arrays currently under construction in remote areas of Western Australia and South Africa

The Timescale is the "heartbeat" of each telescope, generating highly stable time and frequency signals from atomic clocks, which are distributed to the remote antennas over optical fibre for synchronisation



TIME LAB IN HARWELL, UK

Time & Frequency



QWRTY

THE CONSORTIUM
QWRTY

GMV (GMV NSL Limited)
Long-standing experience in precision timing and frequency distribution, including world leading expertise Orbit Determination and Time Synchronization (ODTS), and a leading role in steering Galileo System Time (GST) to UTC, and monitoring the dissemination of Galileo time.

Consortium lead

IQD Frequency Products Limited
Market leader in the frequency control market. IQD offers one of the most comprehensive frequency product ranges available, from low cost commercial grade product to that used in high reliability industrial, aerospace and automotive applications.

ZYXT Technologies Limited
Provides consultancy services in the banking sector, specialising in high-performance market data and market connectivity, regulatory clocksynchronisation and information security.

Subcontractors

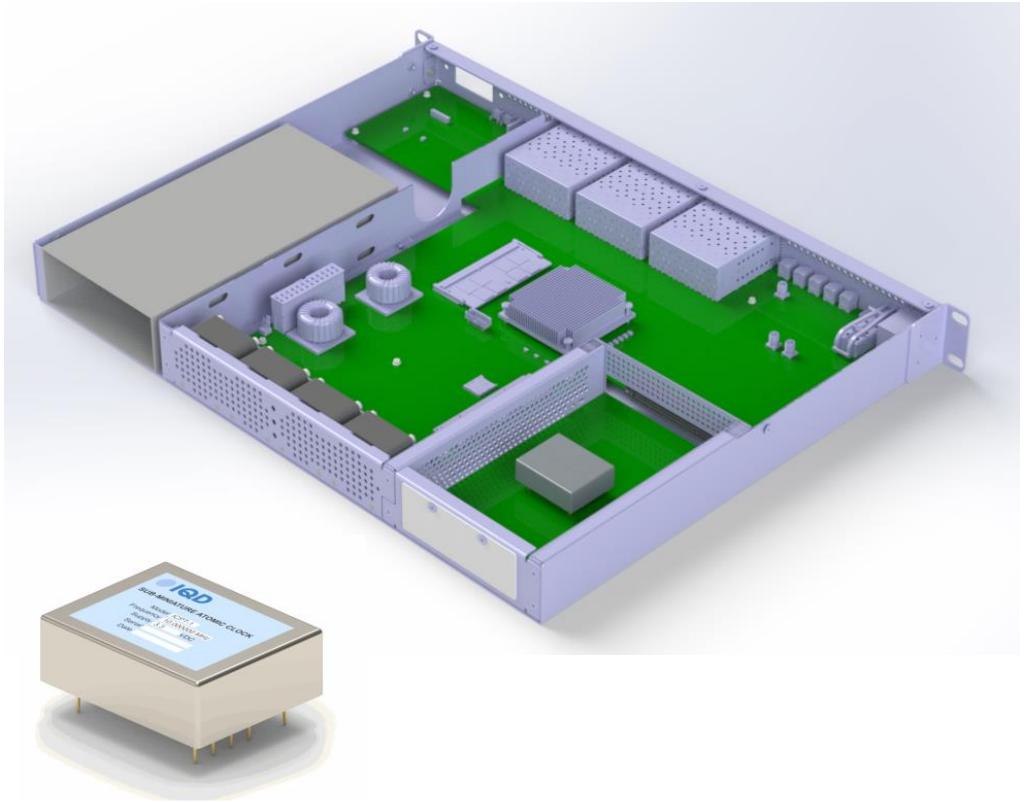
CERN
GMV is joining CERN's White Rabbit Collaboration program. Under this programme CERN aims at decreasing technology uptake time, providing training and dedicated support, and ensuring performance and interoperability defining and offering testing services with partner laboratories.

Support – not directly involved

A WRS V4 WITH EXPANSION BOARD

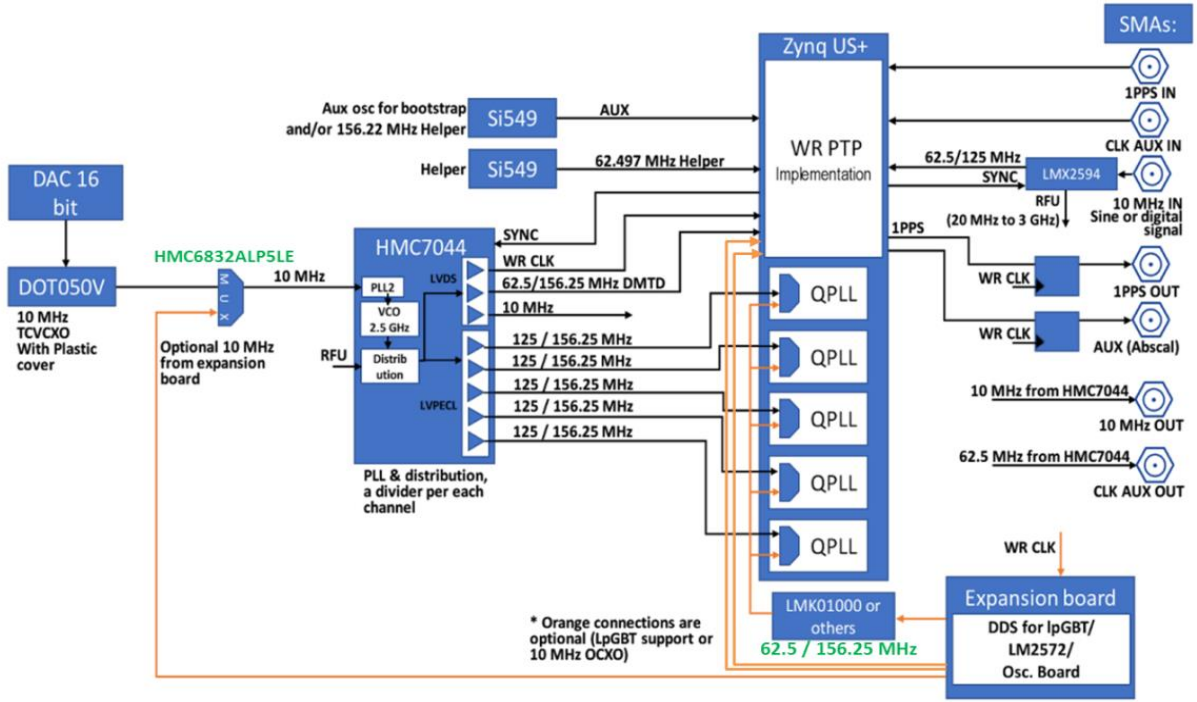
QWRTY

- Original WRS v4 design from CERN
- Expansion board being designed by GMV+IQD+CERN
- Board hosts a Rubidium clock for holdover on the client WRS in case the WR link is broken
- Typical holdover is 1.5 microseconds after one day
- Based on the existing ICPT-1 Rb clock from IQD
- GMV and IQD have agreed to make the design available as **open-hardware** under CERN license



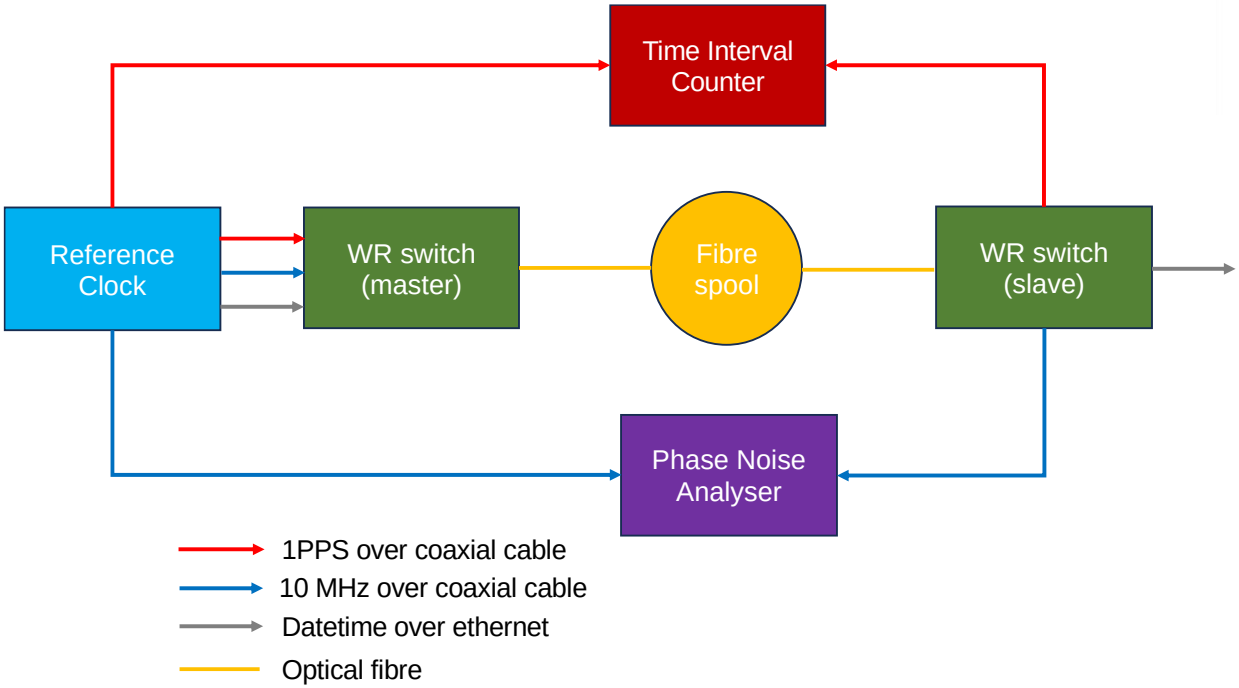
CLOCKING RESOURCES

QWRTY



VALIDATION TOOLS

QWRTY



Time Interval Counter

Phase Noise Analyser

Thank you