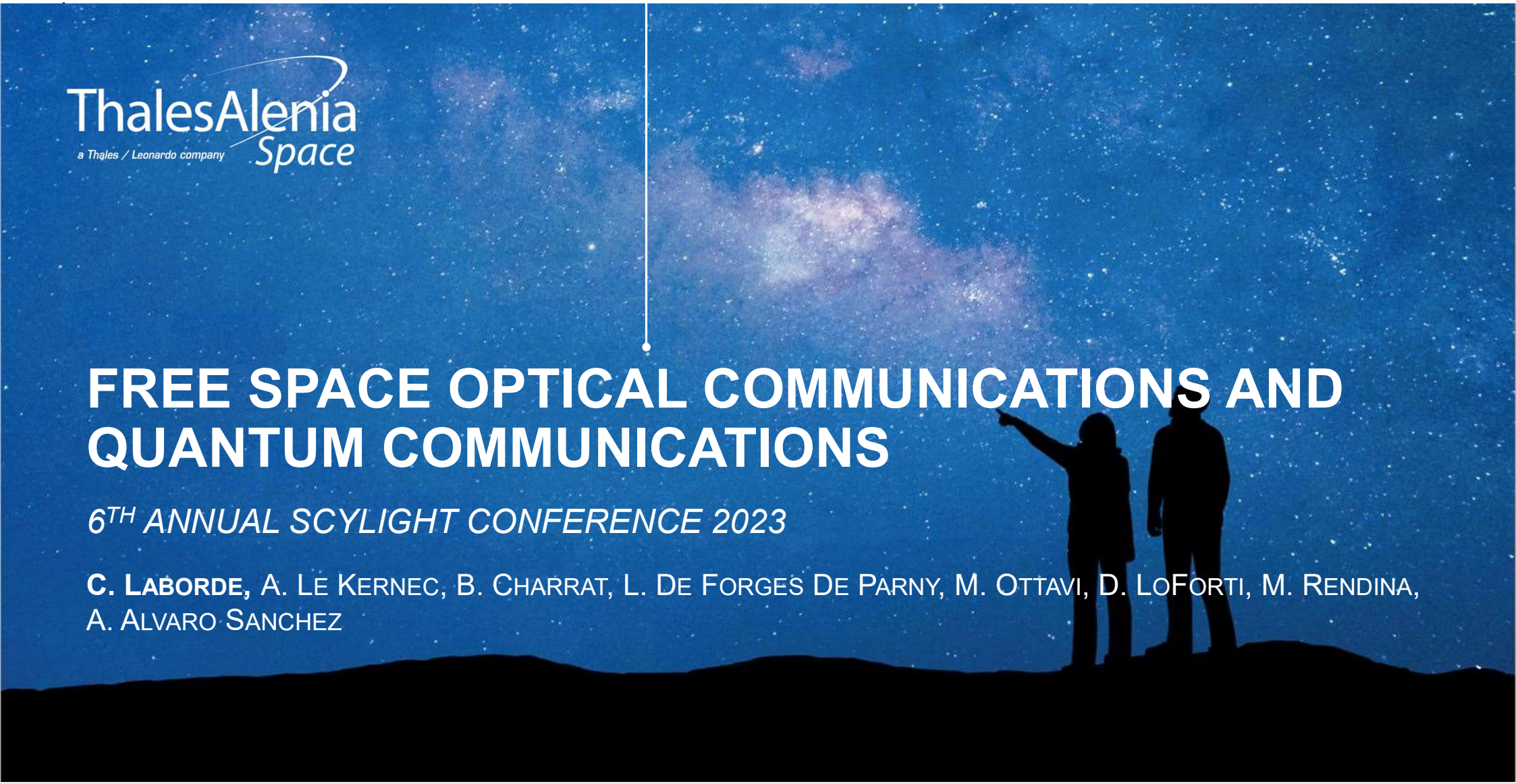

FREE SPACE OPTICAL COMMUNICATIONS AND QUANTUM COMMUNICATIONS

6TH ANNUAL SCYLIGHT CONFERENCE 2023

C. LABORDE, A. LE KERNEC, B. CHARRAT, L. DE FORGES DE PARNY, M. OTTAVI, D. LOFORTI, M. RENDINA, A. ALVARO SANCHEZ

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PRE CO-OP - Very High Throughput Satellite-Ground Optical Link

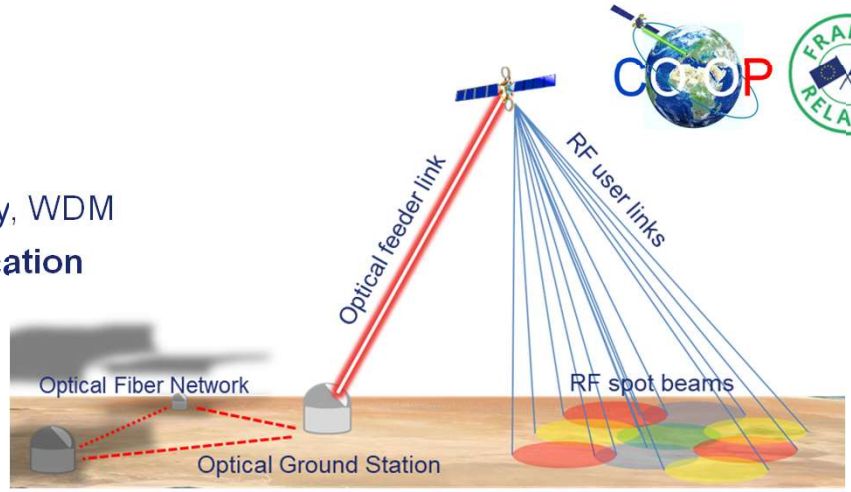
/// Develop building blocks for GEO VHTS Optical Feeder links

/// (V)HTS Feeder Links

- Asymmetric bidirectional link
- 38 000 km incl. atmosphere
- Capacity class : 100 Gbps – 1 Tbps
- Feeder link availability : > 99.9 %

/// Comm link technology

- C+L-band, 1550nm technology, WDM
- **Coherent Optical Communication**



/// Consortium

- **Under CNES supervision**, funded by the French « Plan de relance »
- System primes: ADS, TAS, SAFRAN (OGS)
- 17 partners, ADS Leading the consortium

✓Building Blocks in 2024

/// TAS

- **System Architecture, Digital Signal Processing, Digital Processing Unit, Optical Front End, Telescope**
- **Optical Head Unit developed in TAS CH through ESA/ARTES**

TAS Telescopes product line

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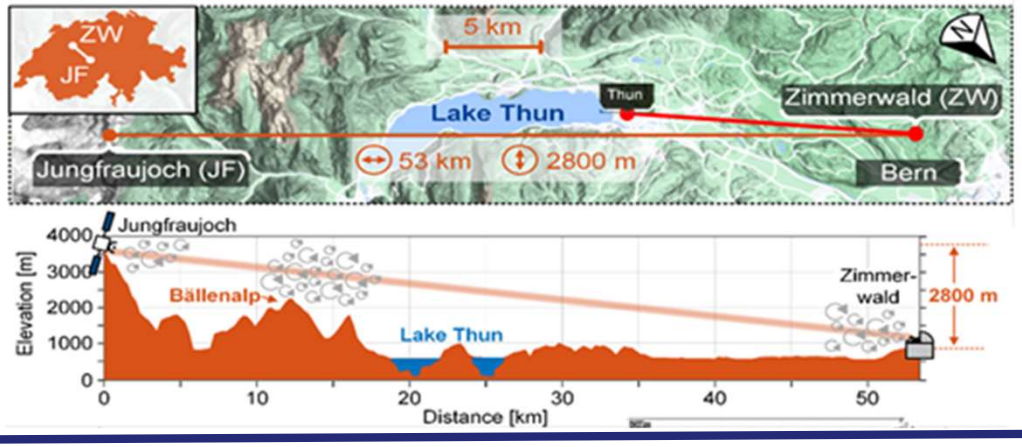
VERTIGO - VERy high Throughput Satellite-Ground Optical Link

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 822030

/// 2 RECORDS :

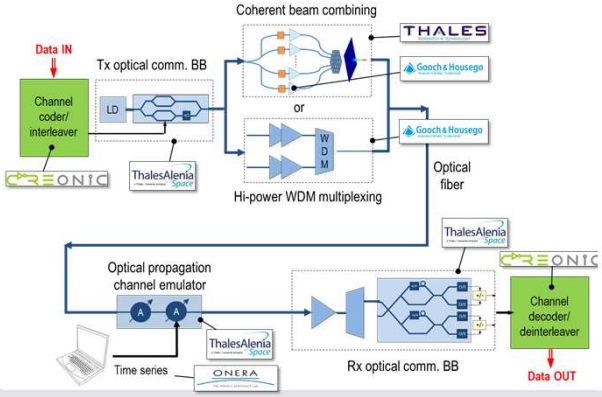
- **1 Tb/s Line rate over 53 km optical path**
  - Jungfraujoch (Space Terminal Emulator) and
  - Zimmerwald (Single aperture OGS with Adaptive Optics)
  - **Coherent transmission QPSK, 16 and 64QAM modulation formats**

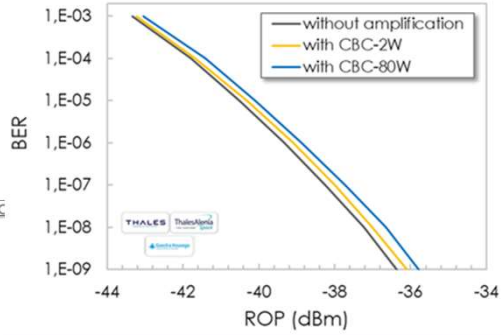
✓Adaptive Optics



- **High power telecom transmission with coherent beam combining**
  - DPSK 25G transmission at 97W at single wavelength

✓Coherent Beam Combining





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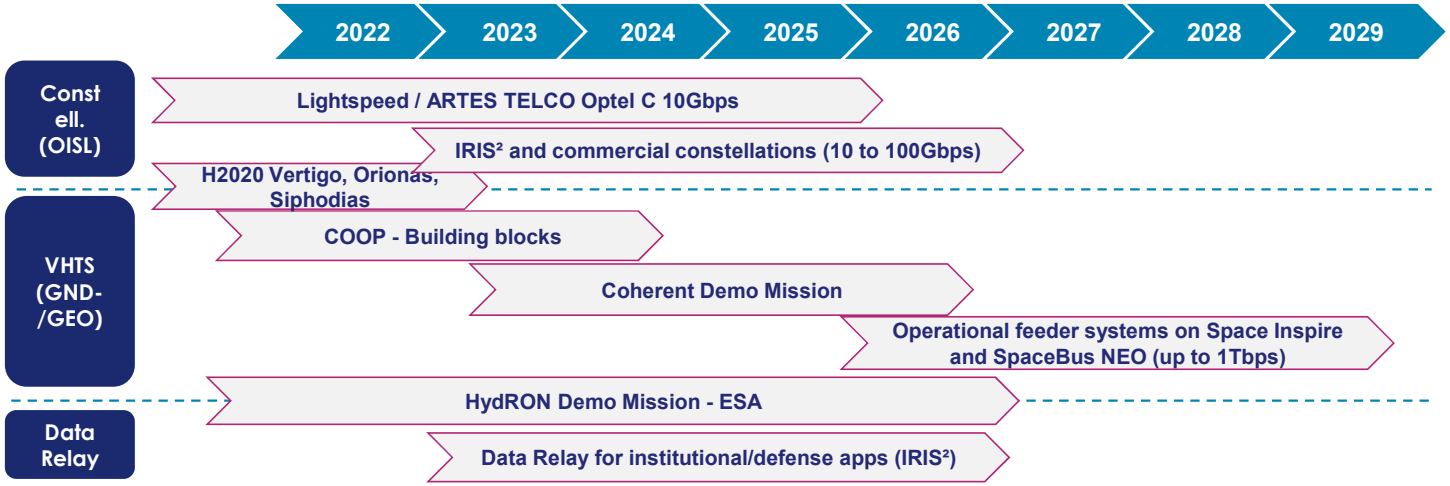
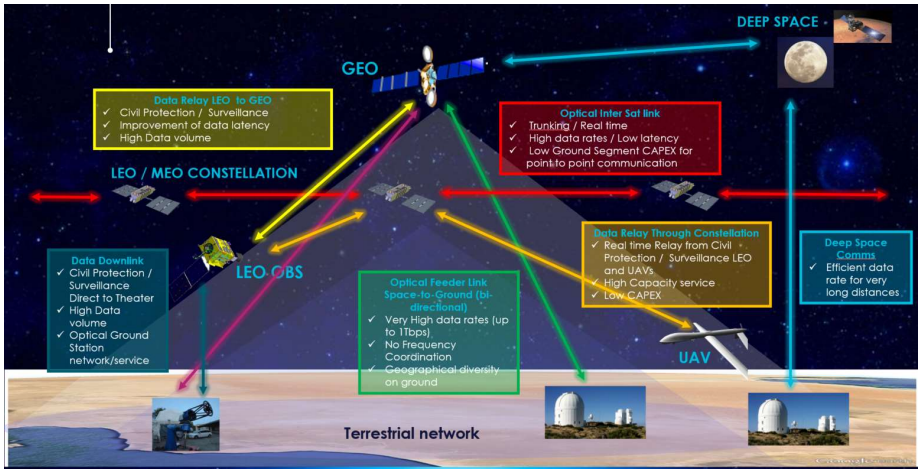
FREE SPACE OPTICAL COMMS ROADMAP



✓Game changers
On going



/// IRIS² and commercial constellations

- ISL maturity & mass production
- Data relay competitive service

/// VHTS Demo Mission

- Bi directional GEO/GND link
- Coherent, multi wavelengths system – Adaptive optics on ground

/// HydRON Demo Mission

- GEO/LEO/GND network demonstrator to prepare “Fiber in the sky”
- Building blocks with standards/interoperability objective

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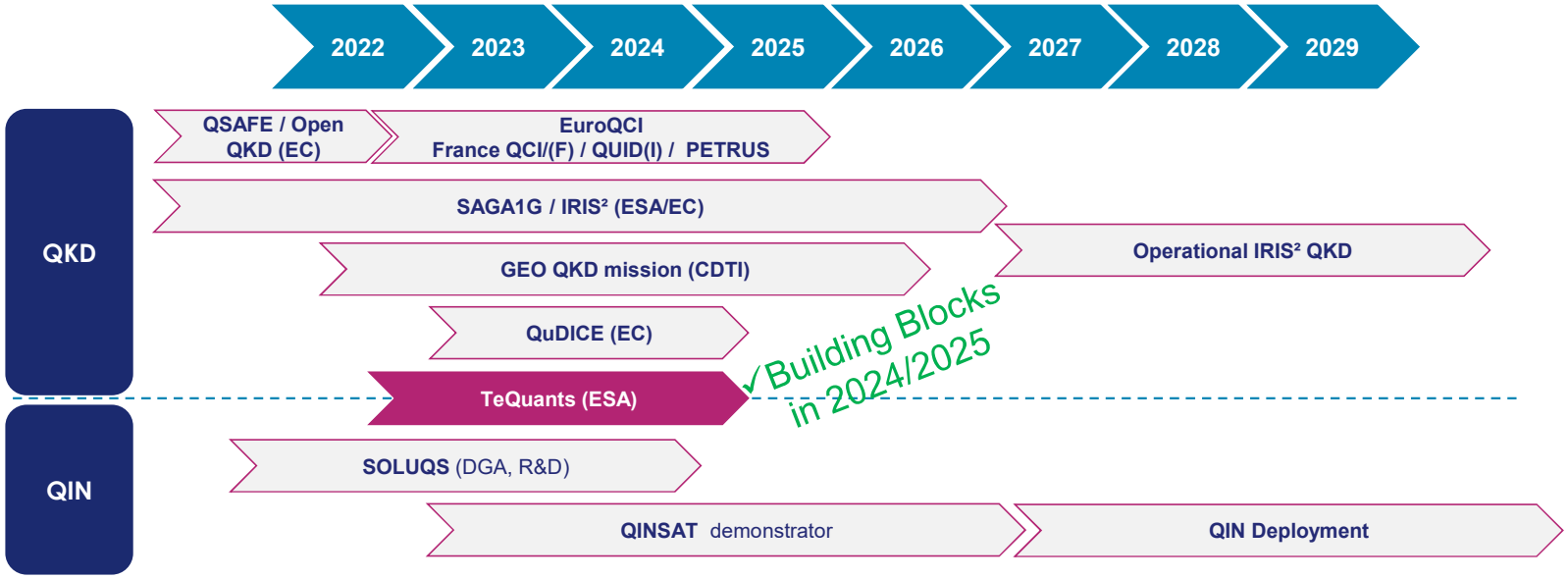
TeQuants Quantum Technologies

/// Team managed by Thales Alenia Space in ESA/ARTES

/// Addressing both *Quantum Key Distribution (Prepare and Measure and Entangled Based systems) and Quantum Information Network* Applications



/// Roles and Objectives :

- **SYSTEM DESIGN**
  - TAS & ADS
- **ON BOARD OPTICAL TERMINAL**
  - ADS / BERTIN
- **QUANTUM SUB SYSTEM**
  - TAS / AUREA / SIGMAWORKS
- **OPTICAL GROUND STATION**
  - OGSTech/ALPAO
- **PHOTONS SOURCES & DETECTORS**
  - AUREA
- **ATMOSPHERIC METROLOGY**
  - MIRATLAS
- **EXPERTS SUPPORT**
  - LIP6 / INPHYNI / QTLabs

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OPTICAL COMMS AND QUANTUM IN TAS & THALES

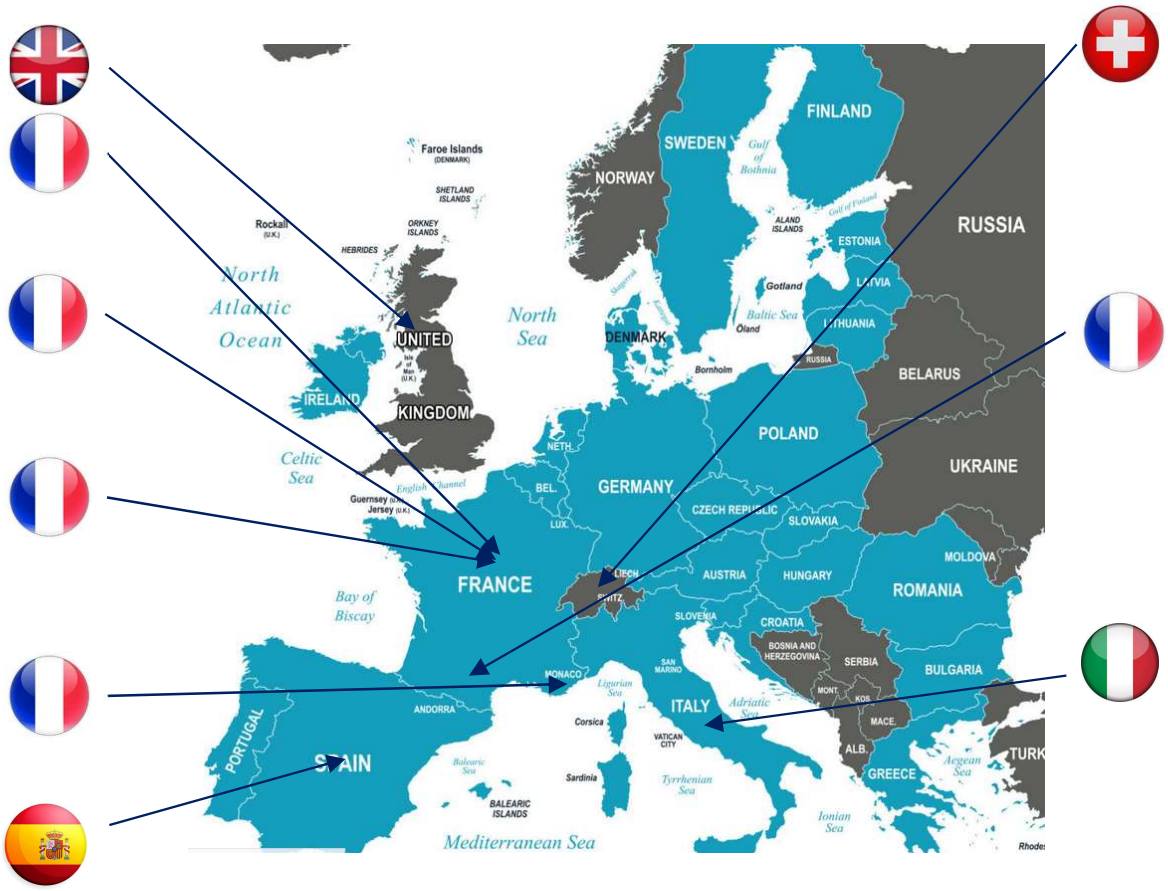
THALES LAS
- Large series AIT + air, naval and ground market

THALES SIX
- Optical comms air,naval, ground systems and Quantum Ground systems, Security
- FRANCEQCI, PETRUS, QKISS

THALES R&T
- PIC, CBC, Test lab
- VERTIGO

TAS in F
- Telescopes for GEO apps
- COOP

TAS in S
- GEO QKD system design
- CARAMUEL



TAS in CH
- Optical Terminals
- TELCO for OPTEL C
- T-OFL for GEO apps
- VERTIGO
- SAGA

TAS in F
- Constellations, GEO , and Quantum systems and architecture
- Photonics units
- Cybersecurity
- DYSCO, COOP, VERTIGO, TEQUANTS
- TEQUANTS, FRANCEQCI, PETRUS

TAS in I
- Optical comms systems and quantum systems
- HYDRON
- SAGA, QuDICE, QUID

Team for Secured and Efficient Communications

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THANK YOU FOR YOUR ATTENTION

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