Optical communications: ESAs plans for SPACE19+

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ESA-ESTEC

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ESA, ESTEC

Satellites of the future need optical communication technology

- Optical Communication Technology is a **disruptive technology** which requires **strategic long term investments**
- Commercial market is missing **ESA and its Member States to take the lead**
- Create right programmatic framework to address the associated **high technical and commercial risks**

What is ScyLight?
SeCure and Laser communication Technology

Optical Communication is a mature technology in some areas, but its capabilities and its market potential is not yet fully deployed !

- Optical communications are considered to be **one of the next major revolutions in satellite communication**, bringing unprecedentedly high levels of transmission rates, data security and resilience **=> NOT ONLY FOR DATA RELAY SERVICES.**
- Technical developments and early implementations **cannot demonstrate its full capabilities**, as the optical solution is mainly used in non-optimized (satcom) systems. **=> OVERALL SYSTEM APPROACH REQUIRED**.

New ARTES Framework called ***ScyLight*** (pronounce "skylight") was launched at ESA Council at Ministerial level (Dec. 2016) and will be enlarged at SPACE19+ to

ARTES Strategic Programme Line: Optical Communication - ScyLight

ScyLight
ARTES Strategic Programme Line

Industrial Excellence and Market Lead in Optical Communication Technology by 2025

- ***Component A: Common System and Critical Technologies Activities***

  ESA-initiated implementation roadmap and to characterize the environmental drivers for the disruptive technologies.

- ***Component B: Optical Communication and Quantum Technologies/Applications***

  Industry-initiated developments & in-orbit validation

- ***Component C: Optical Communication Projects/Cornerstone Missions***

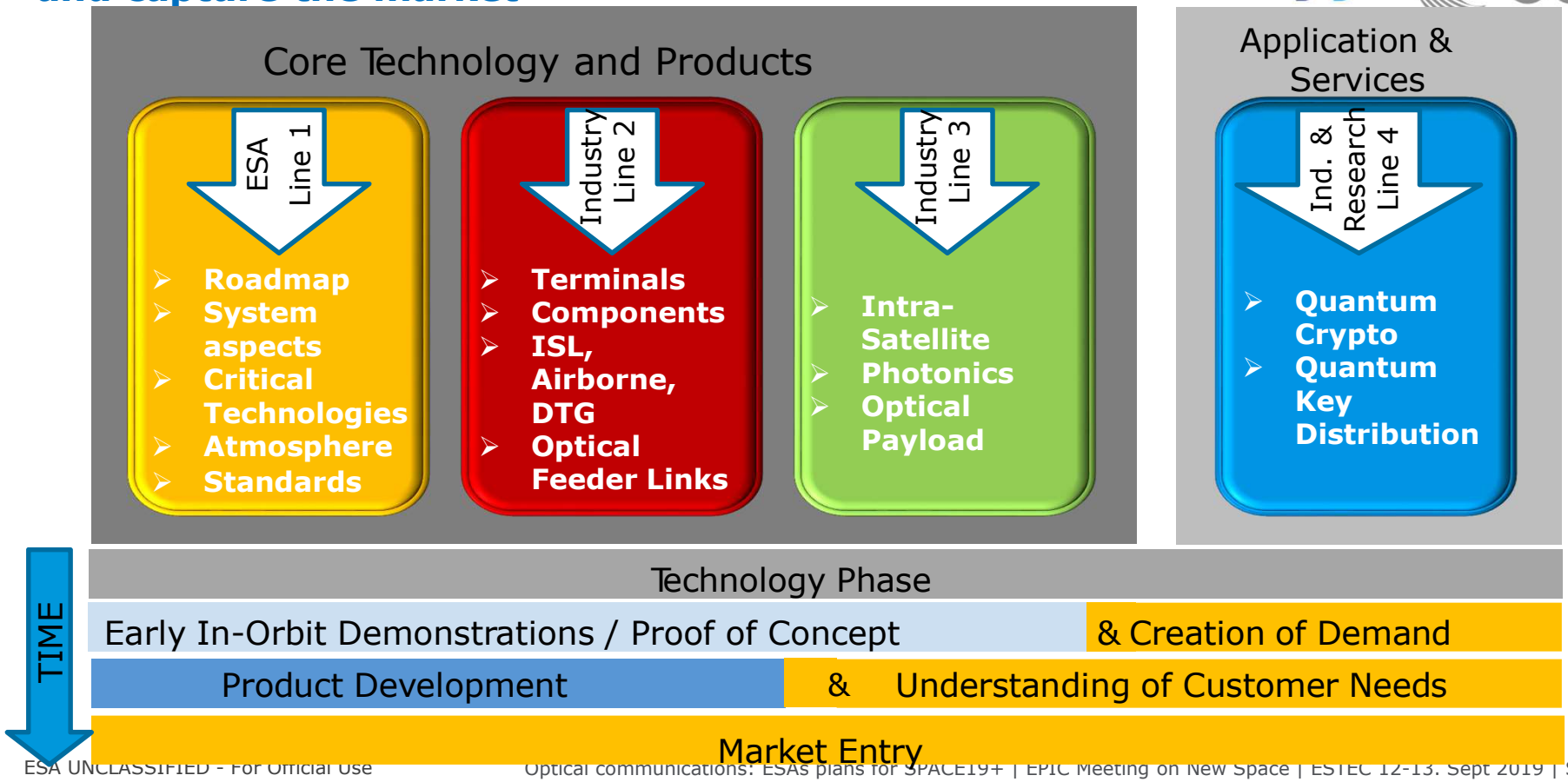
  ESA proposed & ESA led demonstration missions to foster the **build-up of industrial capabilities**

ScyLight - Objectives

The overarching objectives of ScyLight are:

- Address the development and use of innovative optical technologies for satellite communication as well as new market opportunities.
- Demonstrate the maturity of optical communication technology to the end user community.
- Support industry to develop capabilities and competitiveness in the field of optical technologies, targeting emerging market opportunities for products based on the newly developed technologies.

Demonstrate maturity to the end user and capture the market

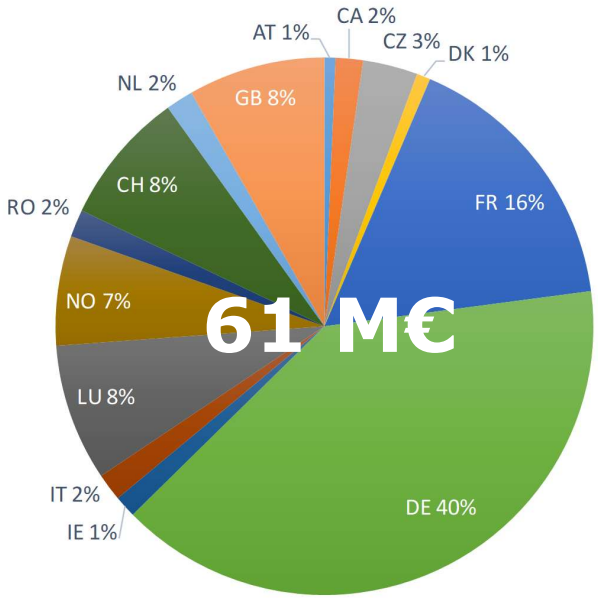


ScyLight – Evolution > 30% growth

Subscription Status

Creation at CMIN 11/2016

Subscription Status



2019: 14

Participating member states

>76% already committed

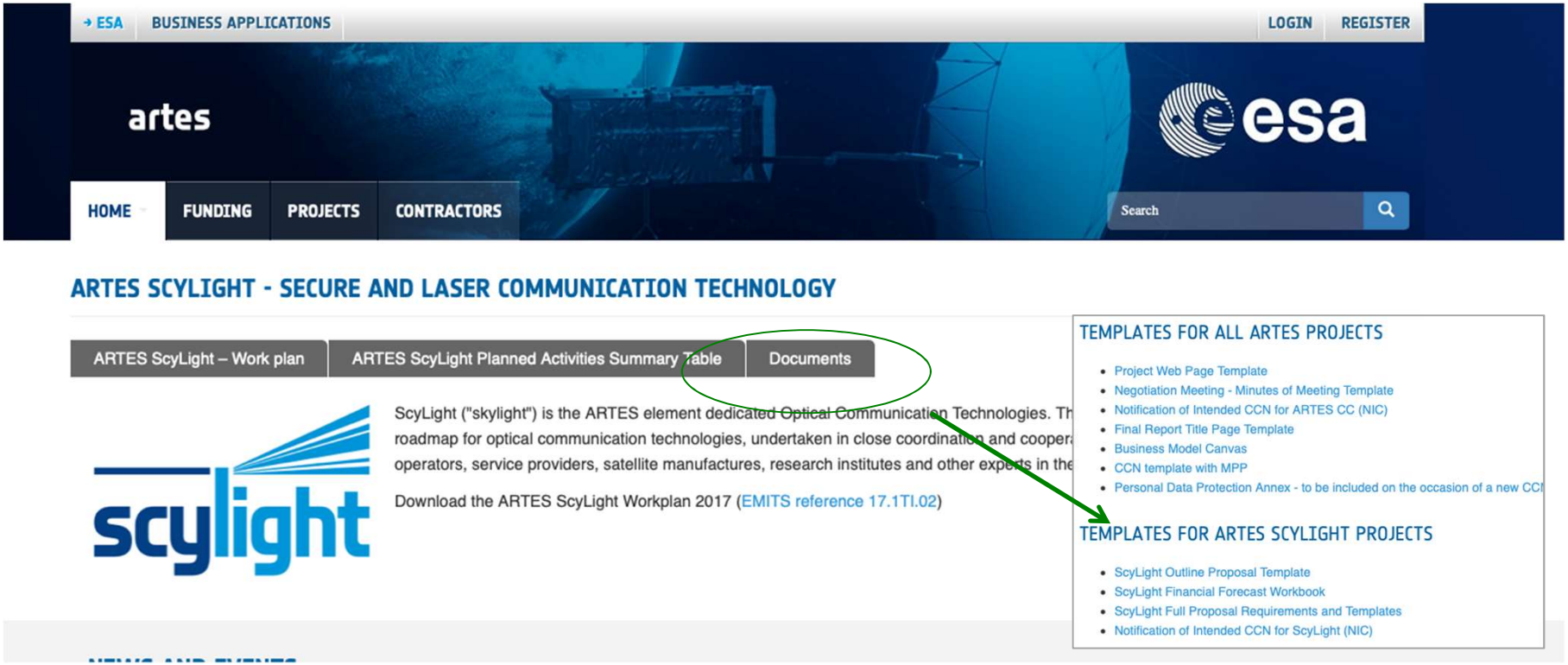
(industrial cost)

ScyLight – Activities on-going

- **ScyLight ITTs** are addressing unique topics like
  - the **future of SatCom Satellites** (OPTICAL TECHNOLOGIES FOR NEXT GENERATION COMMUNICATION SATELLITES (SCYLIGHT SL.001))
  - the **optical technologies for secure communications** e.g. **QKD** (SECURE OPTICAL COMMUNICATION TECHNOLOGIES TO PROTECT EUROPEAN CRITICAL INFRASTRUCTURE (SCYLIGHT SL.010))
  - **innovative optical concepts** (e.g. with PHOTONICS PHASED ARRAY FOR OPTICAL FEEDER LINKS (SCYLIGHT SL.009)
- or –for the first time-
  - the **long term evaluation** of the atmospheric effects to predict the link availability (ATMOSPHERIC MONITORING TO ASSESS THE AVAILABILITY OF OPTICAL LINKS THROUGH THE ATMOSPHERE (ARTES SL.005))

ARTES ScyLight on the ARTES website

https://artes.esa.int/scylight



Funding Levels in ARTES ScyLight : Industry

Development Phase	*Funding level up to*	
	Non-SME	*SME*
Definition Phase - up to 250 k€	75%	75%
Technology Phase	75%	75%
ScyLight Demonstration Phase	50%/75%*	75%
Product Phase	50%	50%

* Low/High technological or commercial risks identified

Note: Applications are only accepted from within ESA Member States participating in ARTES ScyLight

Funding Levels in ARTES ScyLight: Universities and Research Institutions

ARTES ScyLight Development Phase	Maximum Funding Level for Universities or Research Institutes
Definition Phase	100%*
Technology Phase	100%*
Product Phase	100%*
Demonstration Phase	100%*

* up to 30% of total contract cost

Note: Applications are only accepted from within ESA Member States participating in ARTES ScyLight

ScyLight
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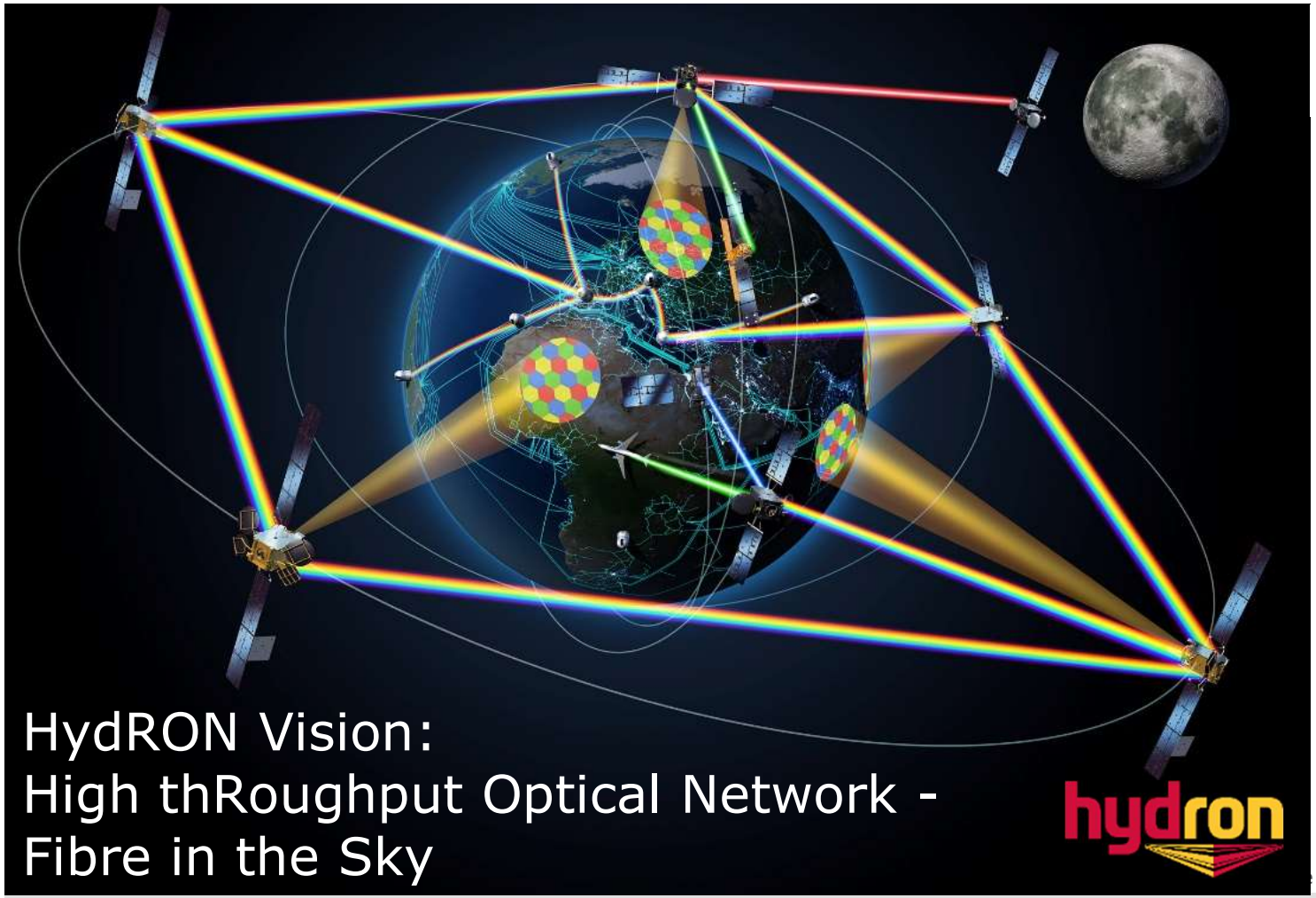
Optical Communication – ScyLight Cornerstone Mission:

HydRON

High thRoughput Optical Network



- Terabit Optical Transport Network in Space
- Terabit Space-Ground Links
- High speed optical routing
- Collection and distribution of end user data on-ground
- Seamless integration in terrestrial networks

HydRON–Impacting the future of SatCom

Mission and Vision Statement:

- ***"Fibre in the Sky" at Terabit capacity demonstrated by European and Canadian Industries by 2025.***

Strengthen the role of the satellite by Optical Coms

- **Seamless integration of Space and Terrestrial Networks is essential for many applications** (e.g. 5G).
- **HydRON –due to its network concept- will provide the means to**
  - ✓ **overcome the atmospheric dependencies** of optical feeder up/downlinks
  - ✓ **re-route traffic by switching capabilities on board**
  - ✓ **share optical infrastructure** on ground and therefore ease the use of optical for space

HydRON Objectives

- Foster the **implementation of the Optical Roadmap to ensure European and Canadian industrial capabilities** in the areas of:
  - ✓ Intra-Satellite Photonics
  - ✓ Optical terminals (Space and Ground)
  - ✓ Optical Network Concepts
  - ✓ Platform-Enhancements
- Provide **Framework** for Developments up to PFM/FMs **to ensure the strengthening of industrial capabilities**
- Provide **End2End Flight Opportunities** to **demonstrate maturity of technology AND the Industry**
- **Integrate end users** (primes, operators) at an early stage

Industrial capabilities in ESA member states (examples)

UNITED KINGDOM:
Gooch & Housego
Polatis Ltd
aXenic Ltd
Airbus Defence & Space Ltd
Bristol University
Inmarsat
Avanti
Surrey Satellites Technologies Ltd

NETHERLANDS:
Airbus Defence and Space NL
TNO
LioniX

IRELAND:
CSO mBryonics Ltd

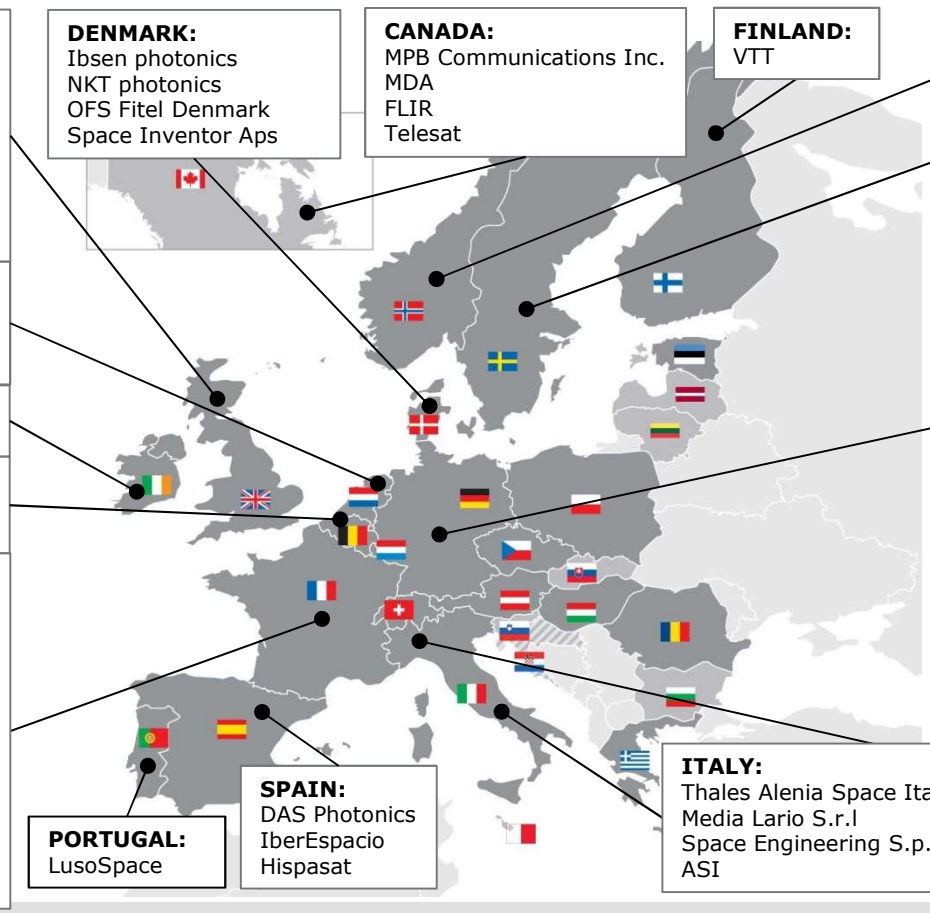
BELGIUM:
Xenics
IMEC

FRANCE:
Airbus Defence & Space
Thales Alenia Space France
iXBlue SAS
CILAS
Kylia
Sodern
Reuniwatt
Miratlas SAS
Lille University
ONERA
CNES
Eutelsat

DENMARK:
Ibsen photonics
NKT photonics
OFS Fitel Denmark
Space Inventor Aps

CANADA:
MPB Communications Inc.
MDA
FLIR
Telesat

FINLAND:
VTT



PORTUGAL:
LusoSpace

SPAIN:
DAS Photonics
IberEspacio
Hispasat

ITALY:
Thales Alenia Space Italy
Media Lario S.r.l
Space Engineering S.p.A
ASI

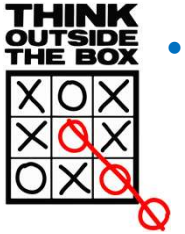
Norway:
Kongsberg Defence & Aerospace
Kongsberg Satellite Services AS

SWEDEN:
Swedish Space Corporation

GERMANY:
TESAT-SpaceCom GmbH & Co. KG
Berliner Glas GmbH & Co.
Hensoldt,
Fraunhofer FOKUS
Henrich Hertz Institute
Ferdinand-Braun-Institut
Eagleyard Photonics GmbH
SpaceTech Gmbh
Optics Balzers
Jenoptik
Mynaric
ST2C GmbH
Nothrop Grumman LITEF GmbH
DLR-IKN
OHB System AG
Airbus Defence & Space GmbH
Deutsche Telekom

SWITZERLAND
Thales Alenia Space Switzerland
Synopta
Sercalo Microtechnology Ltd
RUAG Schweiz AG
LiGenTec
LakeDiamond SA
Albis Optoelectronics

ESA Implementation approach



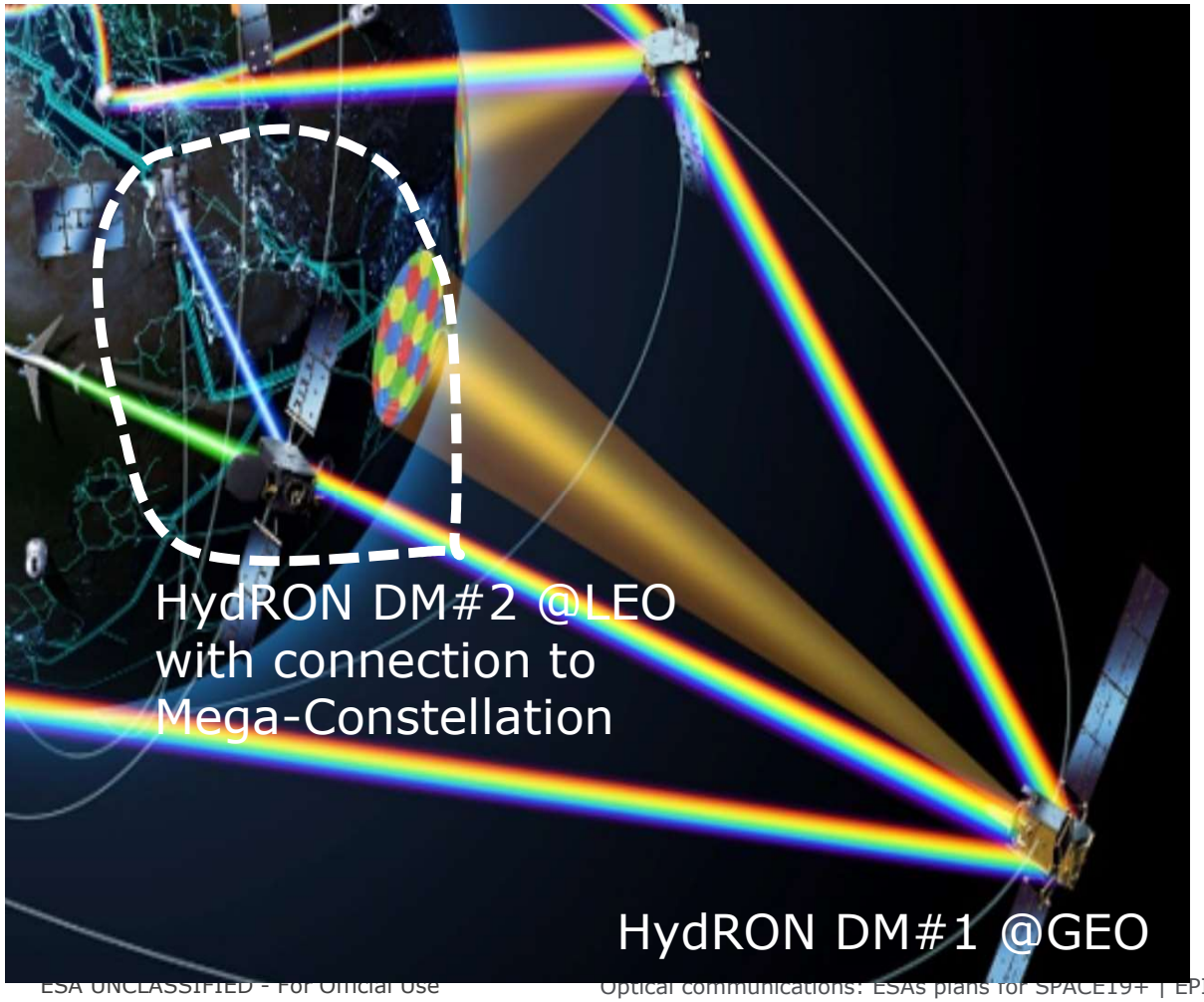
- **HydRON** is **beyond single Operators** planning horizon and the **maturity of the technology is low** => **ESA as System Architect**

- HydRON to be implemented by **multiple but self-standing *"HydRON Demonstrator Missions"*** *(HydRON DM#1 [GEO], DM#2 [LEO]).*

- ***M*ultiple implementations by multiple vendors/companies** by means of parallel place contracts

- **Advisory/user group** shall be established to support ESA in the definition and use cases

- **Integration into** the hosting platform of the **commercial mission**



HydRON DM#1 & DM&2

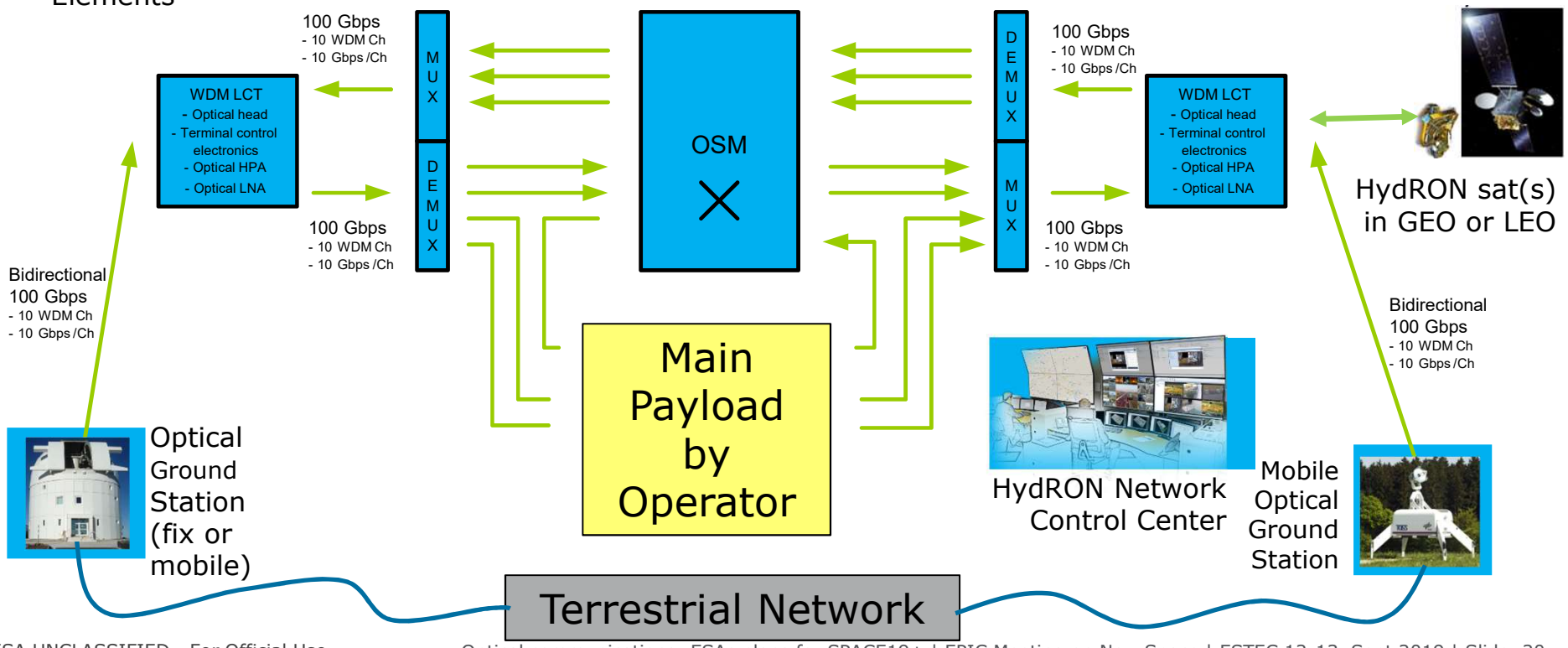
- GEO (HydRON DM #1) serving Mega-Constellation via HydRON DM#2 (LEO) to reduce Ground Segment

Benefits:

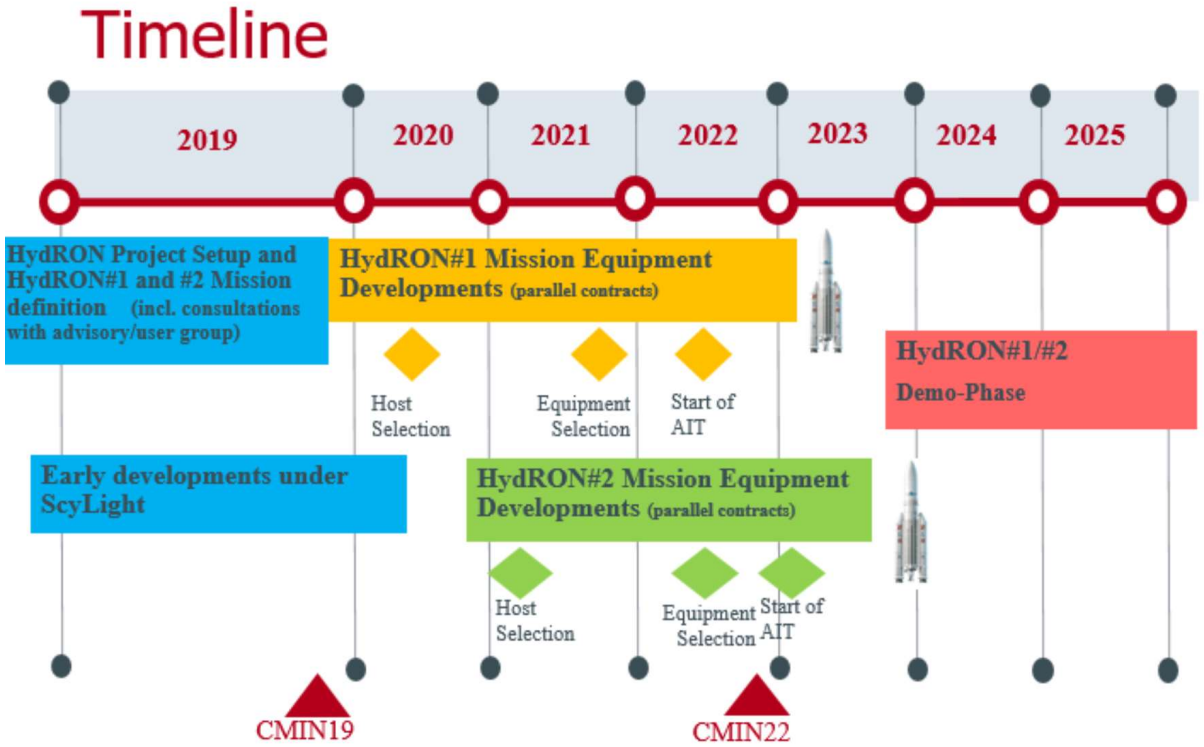
- Industry supported for LEO and GEO case
- Reduced cost for Demo

HydRON Concept

= HydRON#1 Elements



HydRON proposed Schedule



Strategic Programme Line:

Objectives

Strategic Plan of ScyLight

- ScyLight will establish a **roadmap on critical technologies**, e.g.
  - ✓ System level (Space for Optical Communication, Quantum Technology and Photonics & Integration with Terrestrial/Aeronautic)
  - ✓ Manufacturing techniques for mass production
  - ✓ Next Generation optical terminals (space/airborne/ground/modems)
  - ✓ Transmission technologies through the atmosphere / Optical feeder links
  - ✓ Quantum communication technology
  - ✓ **PHOTONICS:** Photonic in Digital PLs, Analog PLs, S/C platforms and in Aeronautics (SatCom related)

- **Standardisation Activities:** Optical Free Space Transmission, Optical Ground Networks and **PHOTONICS**

Space photonics standardisation

- Standardisation of RF space components has led to rapid assembly line manufacturing of telecommunication satellites.
- **Next generations of telecommunication satellites will be based on photonics components, which are currently custom solutions.**

- Standardisation is partly taking place:
  - CCSDS SLS-OPT for interoperability of the free-space link (focused on interoperability and cross support during operation)

- What is missing:
  - possibility to ease system design with and integration of photonics components

Space photonics standardisation

Standardisation of interfaces of photonics components can address this …

While balance between standardisation and innovation needs to be found.

- Suppliers of photonics components shall be able to establish products for space that fit into a standardised 'ecosystem' to lower the barrier of investment.
  For example:
  - Optical amplifier
    (22-37V unregulated bus, thermal interface, MiniAVIM optical connector, CAN bus for commanding)
  - Optical communication modem (28V regulated bus, coax electrical input, MiniAVIM optical connector)

ESA would like to trigger discussions how to establish photonics components interface standardisation in the industrial community.

SPACEVPX™ ….European photonics VITA 78 / SpaceVPX modules?


Space19
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