EUROPEAN SPACE-BASED SECURE CONNECTIVITY SYSTEM

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INTRODUCTION

- In the recent years, a number of mega-constellations have been proposed which are currently under development.
- Some of these constellations appear to have **viable business models** and, despite the **large capex requirements**, may have secured financing for their development
  - These business models are **particularly diverse** and often not easy to understand, especially if the construction and operation of the infrastructure is only one component of a **complex portfolio of services**, sometimes **not well defined** at the beginning of the program
  - These business models are first concentrated on creating scale and acquiring a critical mass of users and the shift to **making money from the network**
  - Traditional satellite operators are not ready to move into those business plans
- These constellations can be a threat to **European sovereignty** in **technology** and **information access**, but also an opportunity to **accelerate the Digital Society** and Industry 4.0, as the current pandemic has demanded.

CURRENT MAIN MEGACONSTELLATIONS PLANNED

System	Orbit Type	Orbital Planes			# of Planes	# Sats per Plane	# Sats per Shell	# Sats for final system*	Min Elevation Angle	ISL (Y/N)	Sat's coverage radius [Km]
		Altitude (Km)	Orbital Radius (Km)	Inclination (degrees)							
O3B 3rd-Gen (Modified)	Equatorial	8062	14436	0	1	10	10	34	15	Y	4.865
O3B 3rd-Gen (Modified)	Polar	8052	14426	90	4	6	24		15	Y	4.864
Telesat LEO (Modified)	Polar	1015	7389	98,98	6	13	78	298	20	Y	1.740
Telesat LEO (Modified)	Inclined	1325	7699	50,88	20	11	220		20	Y	2.067
Telesat LEO (Final)	Polar	1015	7389	98,98	27	13	351	1671	20	Y	1.740
Telesat LEO (Final)	Inclined	1325	7699	50,88	40	33	1320		20	Y	2.067
Telesat VLEO Incl	Inclined	1248	7622	37,4	5	9	45	117	20	Y	1.991
Telesat VLEO polar	Polar	1000	7374	99,5	6	12	72		20	Y	1.723
Amazon Kuiper	Inclined	590	6964	33	28	28	784		35		714
Amazon Kuiper	Inclined	610	6984	42	36	36	1296	3236	35	N	734
Amazon Kuiper	Inclined	630	7004	51,9	34	34	1156		35	N	755
SpaceX Starlink	**Inclined**	**550**	**6924**	**53**	**72**	**22**	**1584**		**25**	**N**	**937**
SpaceX Starlink	Inclined	1110	7484	53,8	32	50	1600		40	Y	1.027
SpaceX Starlink	Polar	1130	7504	74	8	50	400	4409	40	Y	1.042
SpaceX Starlink	Polar	1275	7649	81	5	75	375		40	Y	1.143
SpaceX Starlink	Polar	1325	7699	70	6	75	450		40	Y	1.177
SpaceX VLEO	Inclined	345,6	6719,6	53	51	50	2550		35	Y	446
SpaceX VLEO	Inclined	340,8	6714,8	48	49	50	2450	7500	35	Y	440
SpaceX VLEO	Inclined	335,9	6709,9	42	50	50	2500		35	Y	435
OneWeb	**Polar**	**1207**	**7581**	**87,9**	**12**	**55**	**660**	1980	**55**	**N**	**685**
OneWeb phase2	Polar	1207	7581	87,9	24	55	1320		55	N	685

STARLINK

- Close to **1,900 operational** satellites by February 2022.
- Acquired 145,000 beta **Consumer Broadband users** across 25 countries for Starlink satellite services. The **terminal is priced at $499** and **service at $99 per month**. Recently shipped 100,000 terminals and plans to achieve 500,000 subscribers in the next 12 months.
- Rolled out premium satellite services for **Enterprise Customers** at $**2,500 equipment price** and **monthly services at $500**. Unlike Consumer Broadband terminal, the premium terminal will be able to connect from any location. It also enables enterprises to order any number of terminals and manage locations under a single account. Advertised bandwidth is 150 Mbps to 500 Mbps and latency of 20 ms – 40 ms.
- Partnered with Microsoft Azure for cloud platform.
- Beginning to penetrate smaller markets like the Philippines via partnership route.

ONEWEB

- **390+ operational** satellites. Planned fleet size: 648
- The company is progressing in its service deployment plan through downstream **partnerships and acquisitions**:
  - Partners with Rock Networks to serve Canadian Armed Forces in Canada's Arctic Region utilizing Rock Networks hardware and services.
  - Acquired TrustComm to further propel into U.S. Government opportunities, looking particularly at northern latitudes.
  - Signed Broadband MoU with Northwestel for connectivity in Northern Canada.
  - Partnered with Galazy Broadband as distribution partner to Improve Connectivity across Canada and Arctic Region.
  - Signed distribution partner agreement with Alaska Communications to expand the company's connectivity solutions across Alaska.
  - Signed MoU with AT&T to create a framework to sell broadband services to businesses outside the area of its fiber network.
  - Partnered with BT for rural broadband plan in UK.
  - Partnered with the Kazakhstan government to digitize the country's economy by providing high-speed internet connectivity.
  - Collaborated with Hughes to deliver satellite broadband connections across India.
- **Russia's** space agency said Wed 2 March 2022 it will **not launch a batch of 36 OneWeb satellites** this week unless the UK government gives up its stake in the satellite internet company, a prospect the UK business secretary later confirmed won't happen.
  - Arianespace won a contract in 2015 to launch OneWeb's satellites on Russian Soyuz rockets. After several changes, the deal between Arianespace and OneWeb now covers 19 launches aboard Russian Soyuz rockets. The launch Fri 4 March was supposed to be the 14th of the 19 Soyuz missions on the contract.

OTHER CONSTELLATIONS

- The other major players such as Telesat, Kuiper and O3b mPower are relatively in **early stages**; however, NSR expects these players (in addition to Starlink & OneWeb) to likewise play a significant role in mid and long term.
- The **Telesat** Lightspeed constellation is **delayed due to supply chain constraints**, but on the positive side, the company has signed a $600 million agreement with the Canadian Government.
- NSR expects **Kuiper** service roll out to be around **2024-2025**, and the constellation is expected to massively benefit from inhouse AWS infrastructure.
- **O3b mPower** (2nd Gen) is expected to start launching satellites in **Q1 2022** – the asset is expected to benefit from SES's distribution channel and existing customer base.

EUROPEAN COMMISSION STUDIES

- The European Commission contracted a study at the end of 2020 that has been developed during 2021 with major players of the space industry
  - Airbus, Arianespace, Eutelsat, Hispasat, OHB, Orange, SES, Telespazio and Thales Alenia Space.
- At the end of 2021 the Commission contracted two additional studies with SMEs and New Space players
  - UN:IO: **leaded by Reflex Aerospace, Mynaric e ISAR Aerospace,** with GI Germany, CRN Management, Fraunhofer Institute for Applied Solid State Physics IAF, Fraunhofer Institute for Scientific and Technical Trend Analysis INT, Innovation Society of the Technical University of Braunschweig (iTUBS), Nanoavionics, Quantum Technology Laboratories, Space Applications Services, Swedish Space Corporation (SSC), Telefónica Germany and TTTech Computertechnik
  - New Symphonie: **leaded by Euroconsult y Unseenlabs,** with Aerospacelab (BE), Anywaves (FR), Avio (IT), Cailabs (FR), De-cix (DE), Exolaunch (DE), Exotrail (FR), Fresnel Alliance (FR), Gomspace (DK), Greenerwave (FR), Integrasys (ES), Ksat (NO), Loft Orbital (FR), Qest Antenna Technology (DE), Satconsult (FR), Secure-IC (FR), Sener (ES), Sitael (IT), Tesat (DE), Transatel (FR).

AIR & SPACE ACADEMY OPINION PAPER

- Digital transformation leads to competitivity. **Digital Society** and Industry 4.0 can only exist with a **seamless coverage across the territory** of high-speed connectivity and cloud access. The **timely and economically viable** achievement of that goal requires the inclusion of **satellites**. Moreover, high speed broadband throughout Europe without dead zones ensures cohesion within and across Member States.

- The **US mega-constellations** initiatives such as Starlink and Kuiper, as well as **Chinese** ones, are emerging to develop global connectivity through Space. There are several challenges associated to such systems, but a late **European** entry will have to **compete for orbital and frequency resources** and limit European ambitions in Space. Europe needs to **guarantee resilient, secure, and cost-effective governmental communications** to protect **critical infrastructures** from all kinds of threats and recover from disasters.

- **Security** is critical in the **communications** and **cloud access**. **Quantum cryptography** development, with the use of satellites for key distribution, will strengthen the sovereignty and autonomy of Europe.

- The first European steps have been taken regarding GOVSATCOM and 5G deployment. The **European Commission** is proposing another flagship program to be developed: “The **European Secure Connectivity Initiative**”, leveraging on existing capacity and deploying additional resources to integrate both Space and terrestrial infrastructures.

- In this context, the **“Air & Space Academy”** set up a **working group** with the aim of providing a ten page “advice” to the European Commission by the end of April 2021

KEY MESSAGES

- Strategic autonomy relying on EU technology and infrastrucutre
- Connectivity to bridge digital divide
- Multiorbit constellation developed and operated in Europe
- Integration with terrestrial infrastructure
- Integration of European private actors, companies and operators
- Participation of agile players, New Space actors should be encouraged
- Unlock the potential of quantum technology and cryptography
- Performance and cost-effectiveness are pre-requisites along with geopolitical ambition
- PPP should be considered, as a joint commitment would send a strong signal of long-term viability

SERVICES OF INTEREST FOR AN EUROPEAN SYSTEM

Public Safety

Crisis Management (First Responders)

Police, border control

Key infrastructure connectivity (ATM)

Governmental

Core Services (Tactical)

Extended Core Services (RPAS)

Welfare

Broadband Access

B2B

Residential

Aviation (IFC), maritime (passenger, crew, fleet mgt), Land (trains, buses, lorries)

Connected Devices

Machine-to-Machine (M2M)

Internet-of-Things (IOT)

Backhaul

5G

Cloud

Cloud connectivity

Secure Services

Precision Time applications (GNSS)

EO / Copernicus dissemination

REVIEW OF CURRENT AND PLANNED INFRASTRUCTURE

The GEO infrastructure partially covers needs and remains a key asset to be leveraged.

The high number of initiatives is requiring dramatically increased efforts in the area of frequency coordination.

Ubiquitous, low latency access to an EU controlled cloud is a growing necessity.

Quantum technology is not yet in the equation, giving Europe an opportunity to take the lead.

Govsatcom will be reinforced and leveraged by a secure European constellation.

KEY TASKS TO DEFINE THE CONSTELLATION

1

Perform a thorough Mission analysis

- provide secure governmental communications
- provide broadband Access
- secure European sovereignty
- provide access to the Cloud,

2

Select and secure the necessary frequencies

- consider frequency filings already agreed, and other constellation initiatives
- select & secure the right frequencies as a top priority task

3

Define the Governance

- define who does what in the development of the constellation and the associated relationships
- define the tasks and responsibilities during the exploitation phase

4

Anticipate the End Users Services

- services must be developed in parallel with the constellation and with the same level of priority.
- sovereignty depends not only on communications but also on the related content and services to be distributed to the end users

TECHNICAL CHALLENGES FOR A SUCCESSFUL DEPLOYMENT

Space Segment

- Spacecraft autonomy with integrated collision avoidance
- Space debris mitigation
- High performance On-Board Processing (OBP) with Deep Sub-Micron technology and radiation tolerance
- Optical Inter-Satellites links
- Millimeter Wave (Q/V & W frequency bands) technology
- Quantum communications with on board intricated photon sources and Quantum Key Distribution (QKD)

Ground segment

- Artificial Intelligence for system management
- Cyber-security management
- Cost effective user Terminals
- Photon detection & synchronization for QKD

EUROPEAN COMMISSION PROPOSAL FOR THE EU SECURE CONNECTIVITY PROGRAMME FOR 2023-2027

- On 15 Feb 2022, the European Commission set a Secure Connectivity initiative with the following considerations:
- The functioning of our economy and our security is increasingly dependent on **secure and resilient connectivity**. We see the emergence of various public supported or subsidized non-EU mega-constellations in the US, China and Russia, among others. At the same time, the geopolitical context, cyber and hybrid threats further prompt security and resilience concerns.
- There is thus **mismatch** between these rapidly evolving governmental needs and the **available EU solutions**, both at national and European level, in secure, reliable and diverse satellite communication services, notably enabled by the technological advances derived from **Medium and Low Earth orbits**.
- These security-related solutions **should be European** to ensure **guaranteed access** in an unrestricted manner, by avoiding dependencies on third-counties and reinforcing the **resilience of our value chains**.
- At the same time, there is **shortage of available frequency** filings and orbital slots due to the dramatic increase of mega-constellations. Absence of timely action at EU level would also endanger the competitiveness of EU industry in key technologies and markets.

EU SPACE-BASED SECURE CONNECTIVITY SYSTEM

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#EUSpace

THE NEED FOR A SECURE AND RESILIENT GLOBAL CONNECTIVITY INCREASES WITH THE DIGITISATION OF THE ECONOMY AND SOCIETY, AND THE INCREASING GEOPOLITICAL AND CYBERSECURITY THREATS.

Adapted from Factsheet - EU Secure Connectivity.pdf
https://ec.europa.eu/defence-industry-space/secure-connectivity-factsheet_es

EU SPACE-BASED SECURE CONNECTIVITY SYSTEM

INNOVATIVE MULTI-ORBITAL SPACE-BASED connectivity

RELIABLE, SECURE AND COST-EFFECTIVE communications

SPACE ENABLER FOR A DIGITAL AND RESILIENT Europe

KEY OBJECTIVES

- Ensure worldwide access to **secure governmental satellite communication** services for the protection of **critical infrastructures, surveillance, external actions and crisis management**.
- Allow for the provision of **commercial services by the private sector**, to enable the availability of **high-speed broadband** and seamless connectivity throughout Europe, removing dead zones.

MAIN FEATURES

- Multi-orbital, benefiting and using assets in Europe
- Integrating military needs
- Improving and expanding the capabilities and services of EU Space Programme components
- Governance and eligibility conditions to avoid any dependencies on third parties
- Expertise of EU industries, including New Space
- Allow connectivity over geographic areas of strategic interest (Africa, Arctic)

MISSIONS/USE CASES

A RELIABLE, SECURE AND COST EFFECTIVE GOVERNMENTAL COMMUNICATION SERVICE

Connecting key infrastructures

Command and control of smart grids (energy, finance, health, data centers...)

Management of Infrastructures (air, rail, road, traffic management)

Galileo (signal augmentation), Copernicus (data relay)

Institutional communications (Embassies, EUROPOL,...)

Telemedicine

Crisis Management and external actions

Civil protection

Common Foreign & Security Policy - Common Security & Defense Policy

Humanitarian aid

Maritime emergencies (search and rescue)

Surveillance

Border and remote areas surveillance

Remote Piloted Aircraft systems

Maritime surveillance

Arctic region coverage

Complement to military missions

MULTI-ORBITAL SPACE-BASED STATE-OF-THE-ART CONNECTIVITY SYSTEM

Allow Mass-market service

Mobile Broadband
Fixed Broadband
Satellite Trunking for B2B services

Satellite access for transportation – for ships, airplanes, drones, connected cars

Reinforcement of terrestrial networks (resilience) – as an alternative in cases of disruptive events

Cloud based services

EUROQCI

Encryption capability

Government and institutional users

Data centers

Satellite communication networks

Terrestrial communication networks

Banking industry Other industries

SPECIAL CHARACTERISTICS

SECURITY

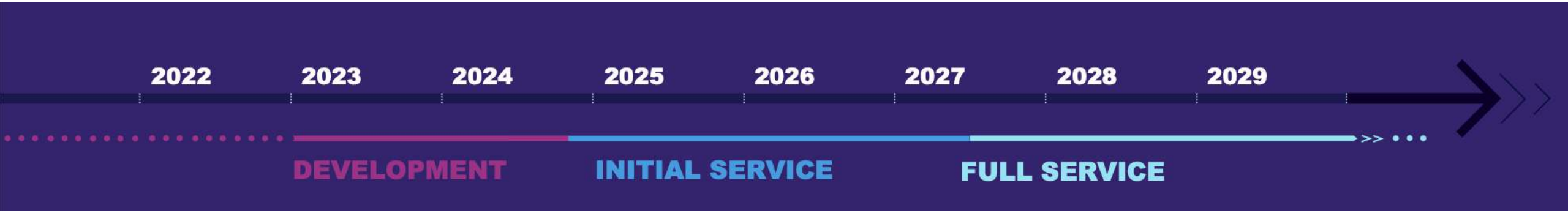
- increased cyber resilience by defending against cyber threats; and integration of the European Quantum Communication Infrastructure (EuroQCI) to enable secure transmission of cryptographic keys.

INNOVATION

- development of innovative and disruptive technologies and leveraging of the New Space ecosystem.

CAPABILITY

- enhanced capability stemming from multi-orbital services; and complementarity with existing connectivity assets offering redundancy. Also, enhancing the capabilities and services of other Union Space Programme components.



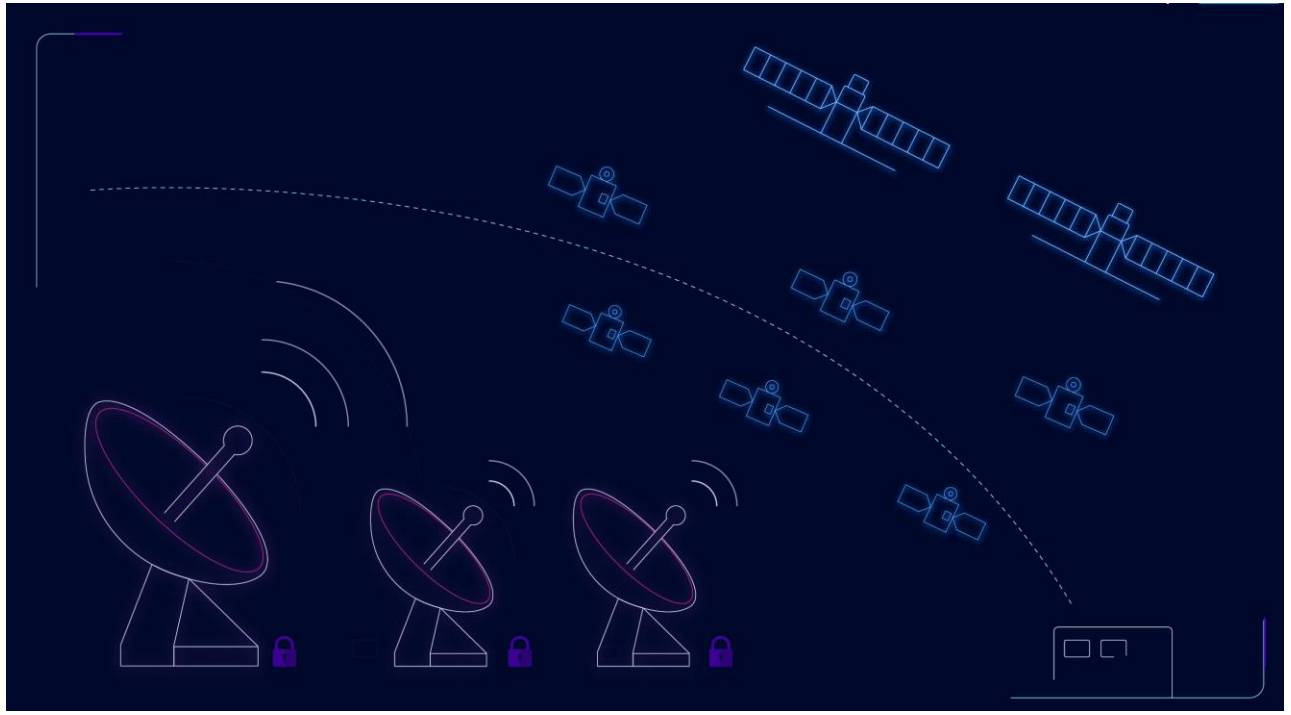
SECURE CONNECTIVITY IMPLEMENTATION SCHEDULE

PUBLIC-PRIVATE PARTNERSHIP

GOVERNMENTAL INFRASTRUCTURE (EU)

COMMERCIAL INFRASTRUCTURE

SHARED ELEMENTS



EU BUDGET of 2,4 M€ from various EU programmes relevant for Secure Connectivity.

MEMBER STATES either through in-kind contributions and/or their space national agencies.

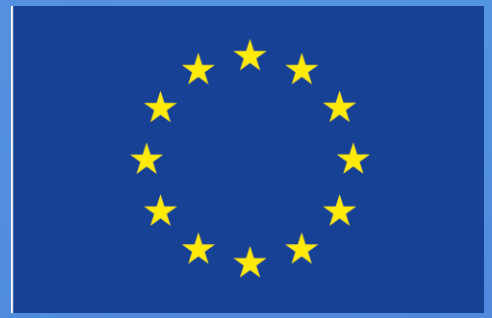
PRIVATE SECTOR, to leverage the mass-market component (InvestEU Strategic window, other private funding streams and/or in-kind contributions).

The blending of EU funds, Member States funds and private investments will be in the form of a **Public-Private Partnership.**

AN EU APPROACH FOR SPACE TRAFFIC MANAGEMENT

- CHALLENGES FOR A SAFE, SECURE AND SUSTAINABLE USE OF SPACE
  - MORE THAN 1 MILLION DEBRIS ITEMS larger than 1cm are orbiting around Earth, an ever increasing number! MORE THAN 20,000 ADDITIONAL SATELLITES will be launched in the next ten years.
  - INCREASING CONGESTION IN SPACE is threatening the viability and security of space infrastructure and operations.
  - THE SAFETY AND SECURITY of the European economy, society and citizens rely on space-based applications such as communications, navigation and Earth observation
- Space Traffic Management (STM) encompasses the means and the rules to access, conduct activities in, and return from outer space safely, sustainably and securely. The EU approach to STM proposes enhanced capabilities, norms and engagement while preserving EU interests in line with the respective competences of the Union and its Member States.
- EU to act collectively, swiftly, and resolutely for an EU contribution to a global challenge.
  KEY ACTIONS
  - Assessing STM requirements and impacts for the EU
  - Enhancing EU SST (Space Surveillance and Tracking) capabilities to support STM
  - Fostering the STM regulatory aspects
  - Promoting the EU STM approach at a global level

Adapted from Factsheet – Space Traffic Maangement.pdf
https://ec.europa.eu/defence-industry-space/space-traffic-management-factsheet_en



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THANKS