



# Space-based secure connectivity initiative: state of play



31 May 2021 - Virtual

# Agenda

**14:00-14:20**

## **Opening by the Commission**

- Keynote speech from the Director General of DEFIS
- Keynote speech from the Director General of CNECT

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**14:20-15:40**

## **Main building blocks**

- Presentation from the Commission (40')
- Feedback and discussion with Member States (40')

**15:40-15:50**

Break

**15:50-16:20**

## **Preliminary analysis of exploitation models**

- Presentation from the Commission (15')
- Feedback and discussion with Member States (15')

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**16:20-17:00**

## **Upcoming activities**

# Main building blocks



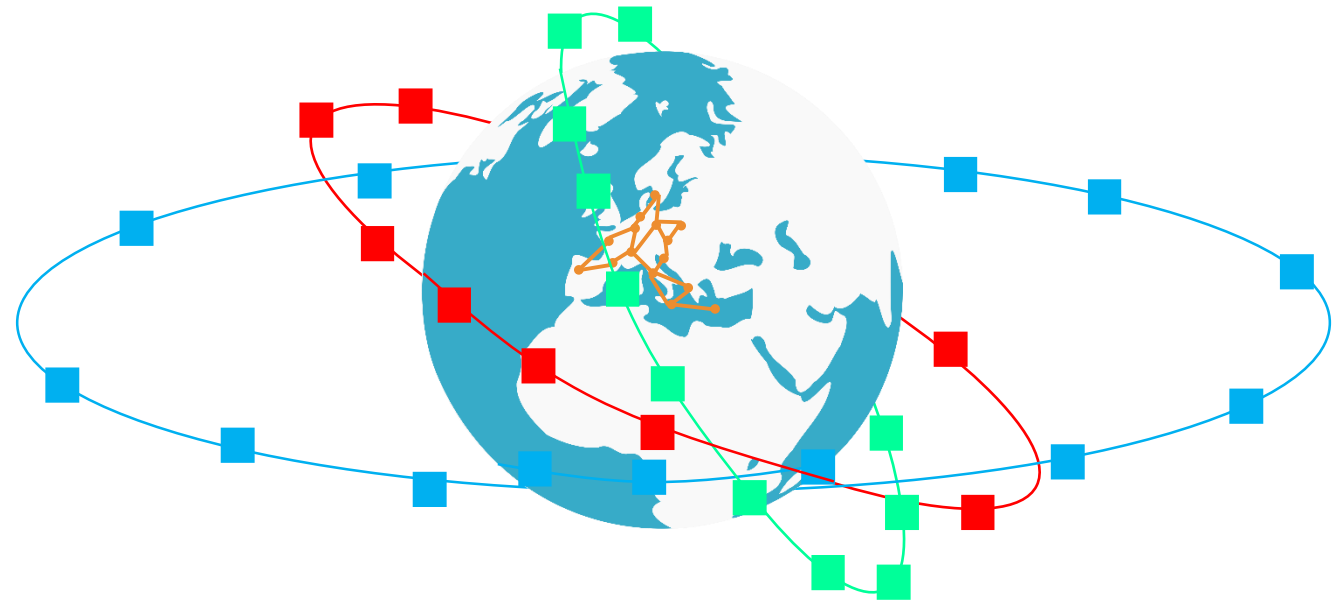


# A long-term, global, multi-orbital, secure architecture, built on GOVSATCOM and EuroQCI

REASSURINGLY SOVEREIGN AND  
RESILIENT

TECHNOLOGICALLY ADVANCED

COMMERCIALY COMPETITIVE



GEO

GEOSTATIONARY ORBIT

LEO

LOW EARTH ORBIT

Q

TERRESTRIAL NETWORK

MEO

MEDIUM EARTH ORBIT



European  
Commission

# Underlying game changing principles

**Multi-orbital constellation:** combining LEO, GEO, MEO

**Secure:** Strong encryption (Quantum), cyber resilience, proactive and reactive defence against cyber and RF threats, operational cybersecurity (SOC/GSMC)

**Coverage:** throughout Europe, and where strategic interest, e.g. Arctic

**Innovative:** system must integrate innovative/disruptive technologies and services, valorising European New Space

**Scalable:** adaptable to demand growth

**Synergistic:** combining/complementing existing space and terrestrial infrastructures

**Long-term approach:** operationally and commercial viability



**A space-based connectivity system designed, built, launched and operated by European stakeholders**



# Growing political consensus for an EU secure connectivity system



# Knowledge-building

## Connectivity study



## EU New Space study



- Start-ups,
- Mid-caps
- SMEs

## Other studies

ENTRUSTED

GOVSATCOM Hubs

Terrestrial EuroQCI

SAGA EuroQCI

4S NextGen (ESA)

# Knowledge-building

## Connectivity study



## Phasing

January  
–  
April

- Mission Consolidation
- High-level multi-orbital constellation architecture
- Frequencies
- Preliminary analysis on exploitation model

May  
–  
December

- Approach to the integration of EuroQCI and GOVSATCOM hub
- Synergies with Space Programme
- Service provision and exploitation models
- Space and ground segment design
- Security requirements
- Cost estimation





## The user requirements have been characterised against 7 criteria

### Capacity



Data rates expected by the users for the forward and return link and the associated commitment levels (minimum rate required)

### Coverage



Distribution of the data usages specified by region

### Criticality



Includes availability, resilience (to human or natural hazards), guarantee of access and strategic autonomy

### Security



Encompasses the notions of cryptography (of the satellite link) and resilience to jamming

### Flexibility



Level of variability and predictability of user needs in terms of capacity and geography, required level of interoperability

### Latency



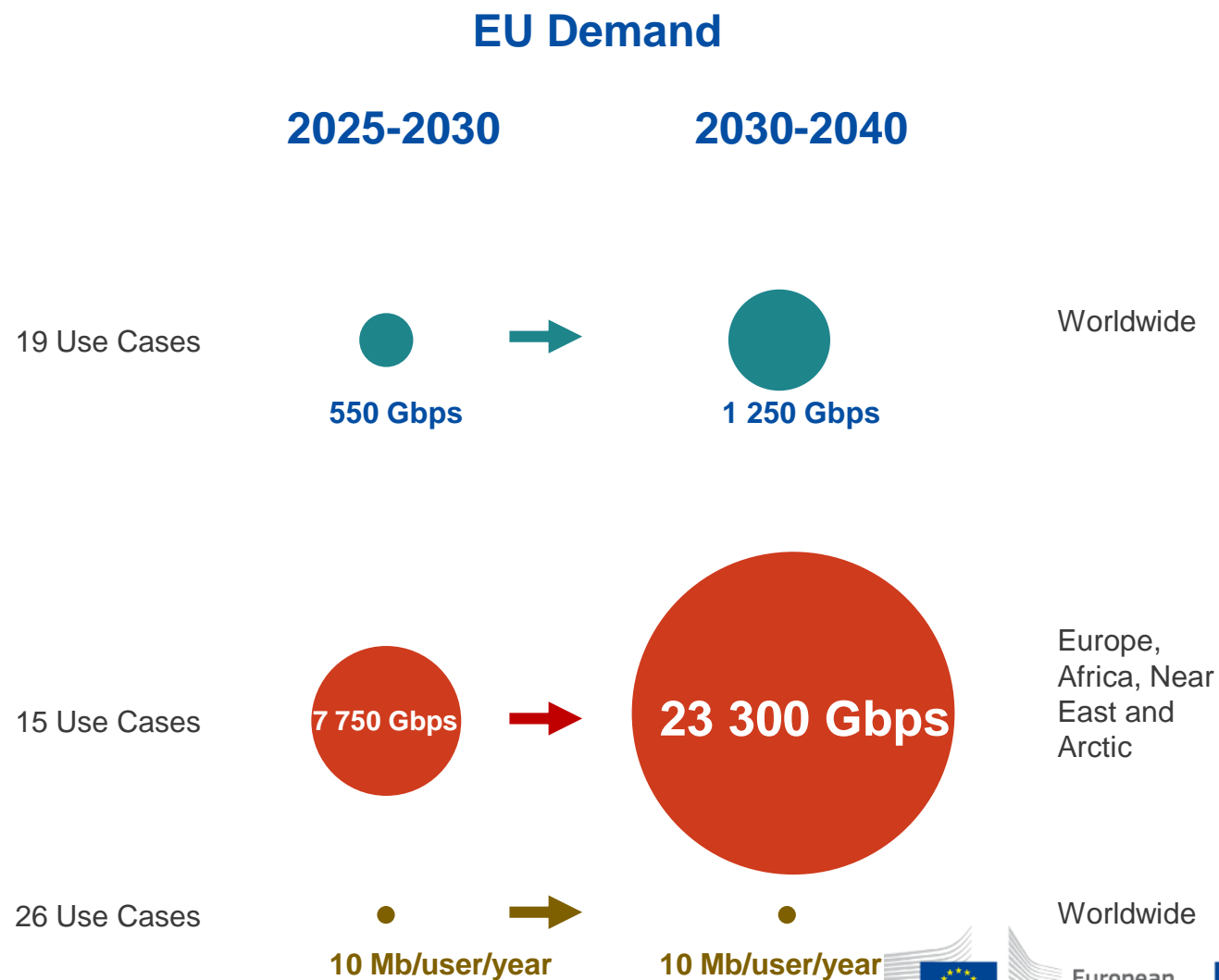
Required latency expected by end-users

### Terminal constraints



Terminal type, size, weight, ease of set up and price

# Security shield for Europe



## Governmental use cases:



### CONNECTING KEY INFRASTRUCTURES

Governmental & Institutional  
secure communications  
(Embassies, EUROPOL, ...)

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

—  
Galileo (augmentation),  
Copernicus (data relay)

—  
Command and control  
of smart grids and M2M  
(energy, finance, health,  
data centres...)



### CRISIS MANAGEMENT AND EXTERNAL ACTIONS

Civil protection  
—  
CFSP- CSDP – National  
missions

—  
Humanitarian aid

—  
Telemedicine

—  
Maritime emergencies  
(search and rescue)



### SURVEILLANCE

Border and remote  
areas surveillance

—  
Remote Piloted  
Aircraft systems

—  
Maritime surveillance

—  
Arctic region coverage

—  
Complement to  
military missions

—  
Space surveillance

## HIGHLIGHTS

- Leverage multiple sources, including:
  - GOVSATCOM High Level Civil Military User Needs for Governmental Satellite Communications
  - ENTRUSTED project, coordinated by EUSPA with participation of MS
  - Industry experience in national governmental projects
- 19 use cases considered: governmental needs are diverse, fragmented and based on multiple standards
- System design is driven by
  - Security and robustness
  - Flexibility
- System size is not driven by governmental bandwidth demand

## Commercial use cases:



### MASS-MARKET

5G / 6G integration

—  
Edge computing  
(edge in the sky)

—  
Autonomous driving

—  
e-health

—  
Smart working, education

—  
In-Flight, maritime connectivity

—  
Smart agriculture

—  
IoT

## HIGHLIGHTS

- Broadband and 5G use cases categorised into clusters:
  - **Mobile** Broadband
  - **Fixed** Broadband
  - Satellite Trunking for **B2B services**
  - Satellite access for **transportation**
  - Reinforcement of terrestrial networks (**resilience**)
  - **Cloud** based services
- Forecasted demand expected to quadruple by 2040:  
Satellite-based solution scalable to meet demand



## EuroQCI use cases



### EUROQCI

Government and  
institutional users

—

Data centres

—

Satellite communication  
networks

—

Terrestrial communication  
networks

—

Banking industry

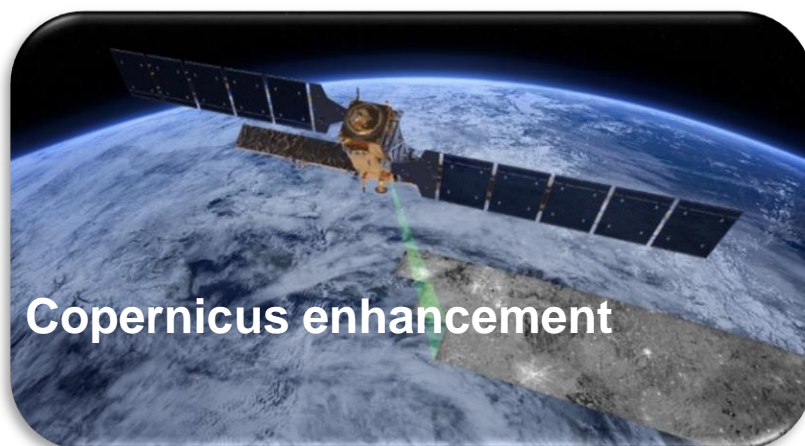
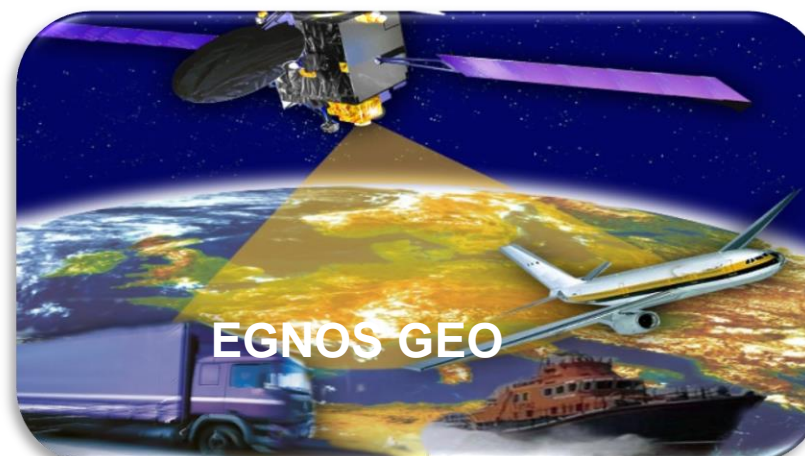
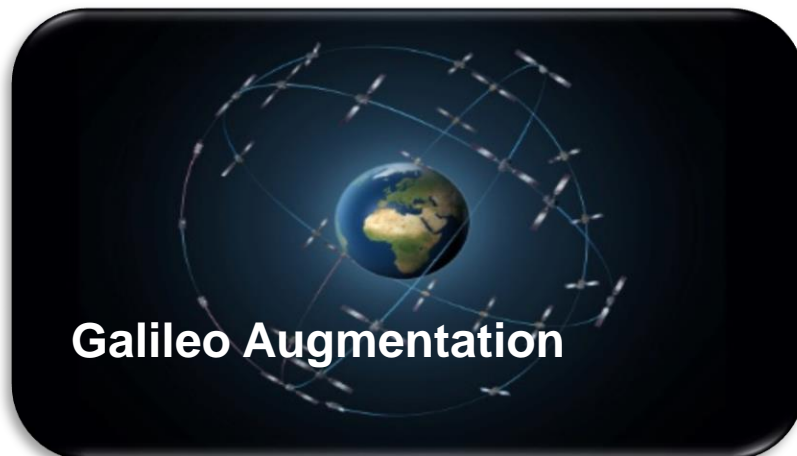
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Other industries

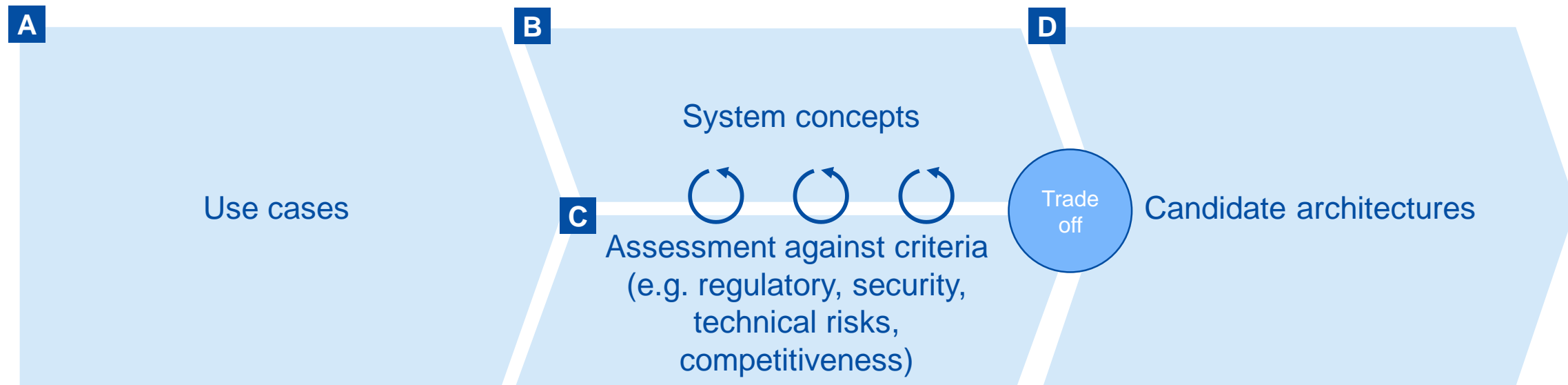
### HIGHLIGHTS

- User requirements for EuroQCI have been discussed with MS sherpas group
- Quantum encryption will serve both EU private and governmental users requiring the highest robustness against forthcoming cyber threats (incl. quantum computing)
- Limited bandwidth required – keys distribution only in a first stage
- Integration approach of EuroQCI in Secure Connectivity system being assessed

## Synergies and added-value



# Methodology



# Key frequency filings portfolio

## GOVERNMENTAL USE

- **Secured filing in the Ka-band (NATO)**
  - French filing elaborated in Summer 2020
  - Submitted to ITU October 2020
  - Confirmed regulatory status April 2021
  - Excellent regulatory priority
  - Supports up to 19,000 satellites in various LEO and MEO configurations

## COMMERCIAL USE

- **Ku-band LEO: negotiation in progress**
  - Filing has high priority, shared with another system
  - French authorities aim to enable the filing to be used by both systems
  - 200 satellites for EU use – more could be added via a new filing if needed
- **Ka and Q/V bands LEO:** options still under consideration
- **Ka-band MEO: capacity available for 24 satellites**
  - Already partially in use, good priority
- **Existing GEO capacity Ku, Ka, Q/V bands, 6-10 sats** (Various EU MS filings)
- Potential for other filings to be used for broadband including next generation frequencies (**Q/V band LEO** with excellent priority) – keeping options open
- Filing options identified for other specific use cases (e.g. ADS-B)

Filing governance similar to Galileo could be considered or other appropriate mechanism

## Four candidate architectures retained

## Components presentation

### GEO

- Rationale for the parameters**
  - GEO VHTS (Very High Throughput Satellite) design type
    - Maturity of Technology (to mission)
  - Proven architecture: proven and digital transparent approach providing flexibility
    - flexible to customer traffic and capacity can be concentrated where needed
  - Data connectivity: bidirectional
    - Flexibility in downlink coverage
- Coverage:**
  - Envision to reach global coverage (except polar regions)
- Waveform: radio-satellite Uplink**
  - Coverage over the EU is needed to cater post needs for the flights to the destinations
  - Alternatively over ECU, and considering the large field of view of the satellite, coverage traffic might be needed to some ECU better coverage of continental Europe
- Frequency:**
  - Use the 14 GHz Ka band, Single link in Ka and Q/V band
- Candidate flag:**
  - Preferred option for users frequency Ka and Ku: good priority situation
    - 14 GHz band: available for 2019-2020, 2020-2021, 2021-2022, 2022-2023, 2023-2024, 2024-2025, 2025-2026, 2026-2027, 2027-2028, 2028-2029, 2029-2030, 2030-2031, 2031-2032, 2032-2033, 2033-2034, 2034-2035, 2035-2036, 2036-2037, 2037-2038, 2038-2039, 2039-2040, 2040-2041, 2041-2042, 2042-2043, 2043-2044, 2044-2045, 2045-2046, 2046-2047, 2047-2048, 2048-2049, 2049-2050, 2050-2051, 2051-2052, 2052-2053, 2053-2054, 2054-2055, 2055-2056, 2056-2057, 2057-2058, 2058-2059, 2059-2060, 2060-2061, 2061-2062, 2062-2063, 2063-2064, 2064-2065, 2065-2066, 2066-2067, 2067-2068, 2068-2069, 2069-2070, 2070-2071, 2071-2072, 2072-2073, 2073-2074, 2074-2075, 2075-2076, 2076-2077, 2077-2078, 2078-2079, 2079-2080, 2080-2081, 2081-2082, 2082-2083, 2083-2084, 2084-2085, 2085-2086, 2086-2087, 2087-2088, 2088-2089, 2089-2090, 2090-2091, 2091-2092, 2092-2093, 2093-2094, 2094-2095, 2095-2096, 2096-2097, 2097-2098, 2098-2099, 2099-2100, 2100-2101, 2101-2102, 2102-2103, 2103-2104, 2104-2105, 2105-2106, 2106-2107, 2107-2108, 2108-2109, 2109-2110, 2110-2111, 2111-2112, 2112-2113, 2113-2114, 2114-2115, 2115-2116, 2116-2117, 2117-2118, 2118-2119, 2119-2120, 2120-2121, 2121-2122, 2122-2123, 2123-2124, 2124-2125, 2125-2126, 2126-2127, 2127-2128, 2128-2129, 2129-2130, 2130-2131, 2131-2132, 2132-2133, 2133-2134, 2134-2135, 2135-2136, 2136-2137, 2137-2138, 2138-2139, 2139-2140, 2140-2141, 2141-2142, 2142-2143, 2143-2144, 2144-2145, 2145-2146, 2146-2147, 2147-2148, 2148-2149, 2149-2150, 2150-2151, 2151-2152, 2152-2153, 2153-2154, 2154-2155, 2155-2156, 2156-2157, 2157-2158, 2158-2159, 2159-2160, 2160-2161, 2161-2162, 2162-2163, 2163-2164, 2164-2165, 2165-2166, 2166-2167, 2167-2168, 2168-2169, 2169-2170, 2170-2171, 2171-2172, 2172-2173, 2173-2174, 2174-2175, 2175-2176, 2176-2177, 2177-2178, 2178-2179, 2179-2180, 2180-2181, 2181-2182, 2182-2183, 2183-2184, 2184-2185, 2185-2186, 2186-2187, 2187-2188, 2188-2189, 2189-2190, 2190-2191, 2191-2192, 2192-2193, 2193-2194, 2194-2195, 2195-2196, 2196-2197, 2197-2198, 2198-2199, 2199-2200, 2200-2201, 2201-2202, 2202-2203, 2203-2204, 2204-2205, 2205-2206, 2206-2207, 2207-2208, 2208-2209, 2209-2210, 2210-2211, 2211-2212, 2212-2213, 2213-2214, 2214-2215, 2215-2216, 2216-2217, 2217-2218, 2218-2219, 2219-2220, 2220-2221, 2221-2222, 2222-2223, 2223-2224, 2224-2225, 2225-2226, 2226-2227, 2227-2228, 2228-2229, 2229-2230, 2230-2231, 2231-2232, 2232-2233, 2233-2234, 2234-2235, 2235-2236, 2236-2237, 2237-2238, 2238-2239, 2239-2240, 2240-2241, 2241-2242, 2242-2243, 2243-2244, 2244-2245, 2245-2246, 2246-2247, 2247-2248, 2248-2249, 2249-2250, 2250-2251, 2251-2252, 2252-2253, 2253-2254, 2254-2255, 2255-2256, 2256-2257, 2257-2258, 2258-2259, 2259-2260, 2260-2261, 2261-2262, 2262-2263, 2263-2264, 2264-2265, 2265-2266, 2266-2267, 2267-2268, 2268-2269, 2269-2270, 2270-2271, 2271-2272, 2272-2273, 2273-2274, 2274-2275, 2275-2276, 2276-2277, 2277-2278, 2278-2279, 2279-2280, 2280-2281, 2281-2282, 2282-2283, 2283-2284, 2284-2285, 2285-2286, 2286-2287, 2287-2288, 2288-2289, 2289-2290, 2290-2291, 2291-2292, 2292-2293, 2293-2294, 2294-2295, 2295-2296, 2296-2297, 2297-2298, 2298-2299, 2299-2300, 2300-2301, 2301-2302, 2302-2303, 2303-2304, 2304-2305, 2305-2306, 2306-2307, 2307-2308, 2308-2309, 2309-2310, 2310-2311, 2311-2312, 2312-2313, 2313-2314, 2314-2315, 2315-2316, 2316-2317, 2317-2318, 2318-2319, 2319-2320, 2320-2321, 2321-2322, 2322-2323, 2323-2324, 2324-2325, 2325-2326, 2326-2327, 2327-2328, 2328-2329, 2329-2330, 2330-2331, 2331-2332, 2332-2333, 2333-2334, 2334-2335, 2335-2336, 2336-2337, 2337-2338, 2338-2339, 2339-2340, 2340-2341, 2341-2342, 2342-2343, 2343-2344, 2344-2345, 2345-2346, 2346-2347, 2347-2348, 2348-2349, 2349-2350, 2350-2351, 2351-2352, 2352-2353, 2353-2

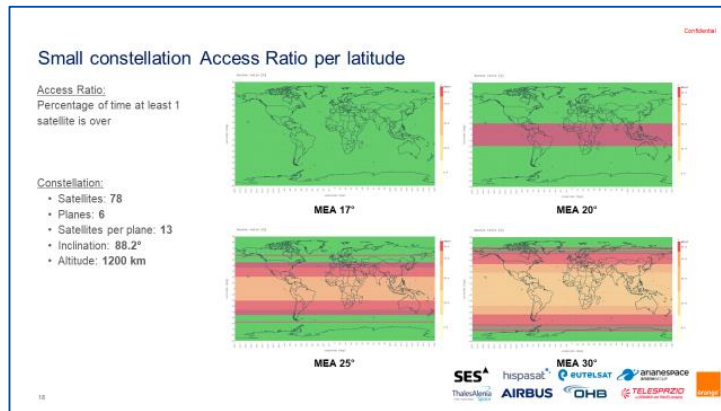
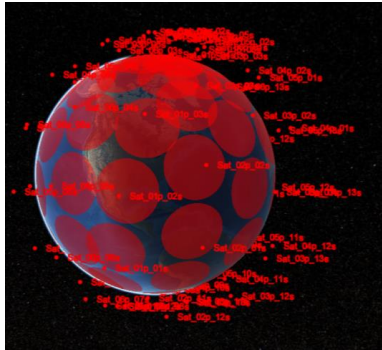
SCENARIOS			Coverage of Demand	
			2025-2030	2030-2040
1	Small LEO	<ul style="list-style-type: none"><li>• GEO</li><li>• MEO</li><li>• 80 LEO BB (700kg)</li></ul>	<ul style="list-style-type: none"><li>• Gov: 100%</li><li>• Com: 28%</li></ul>	<ul style="list-style-type: none"><li>• Gov: 100%</li><li>• Com: 4%</li></ul>
2	« Pivot » Large LEO	<ul style="list-style-type: none"><li>• GEO</li><li>• MEO</li><li>• 200 LEO BB (700kg)</li></ul>	<ul style="list-style-type: none"><li>• Gov: 100%</li><li>• Com: 100%</li></ul>	<ul style="list-style-type: none"><li>• Gov: 100%</li><li>• Com: 33%</li></ul>
3	« Pivot » + Very Large LEO	<ul style="list-style-type: none"><li>• GEO</li><li>• MEO</li><li>• 200 LEO BB (700kg)</li><li>• +1 000 (350kg) LEO BB</li></ul>	<ul style="list-style-type: none"><li>• Gov: 100%</li><li>• Com: 100%</li></ul>	<ul style="list-style-type: none"><li>• Gov: 100%</li><li>• Com: 67%</li></ul>
4	« Pivot » + 5G mobile	<ul style="list-style-type: none"><li>• GEO</li><li>• MEO</li><li>• 200 LEO BB (700kg)</li><li>• 440 LEO 5G</li></ul>	<ul style="list-style-type: none"><li>• Gov: 100%</li><li>• Com: 100%</li></ul>	<ul style="list-style-type: none"><li>• Gov: 100%</li><li>• Com: 33%</li></ul>



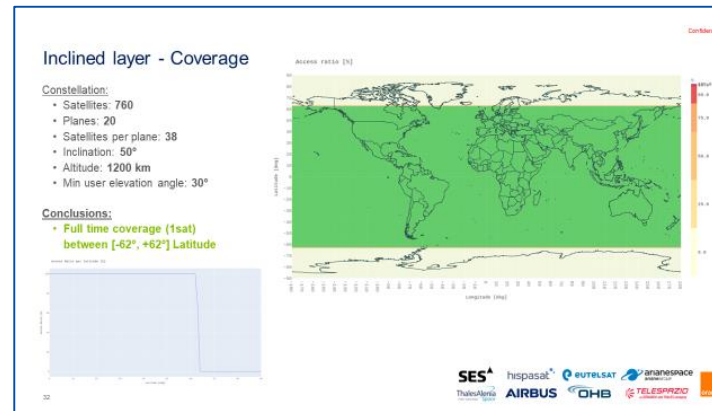
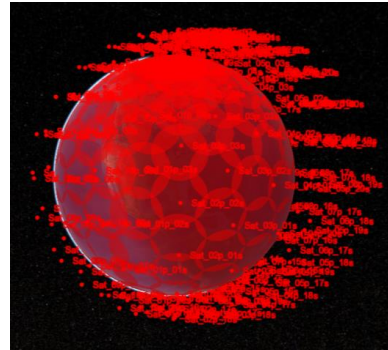
# The constellation geometry is currently being assessed for each candidate architecture

ILLUSTRATIVE

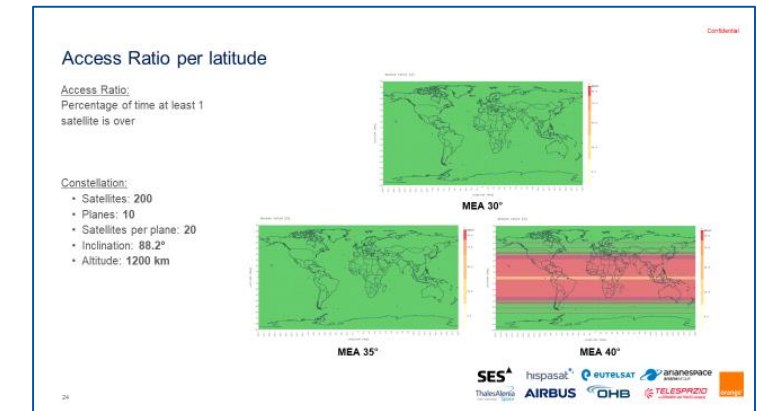
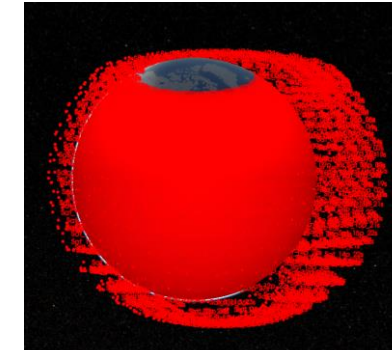
## 1 Small LEO Broadband



## 2 4 «Pivot» Large LEO / 5G

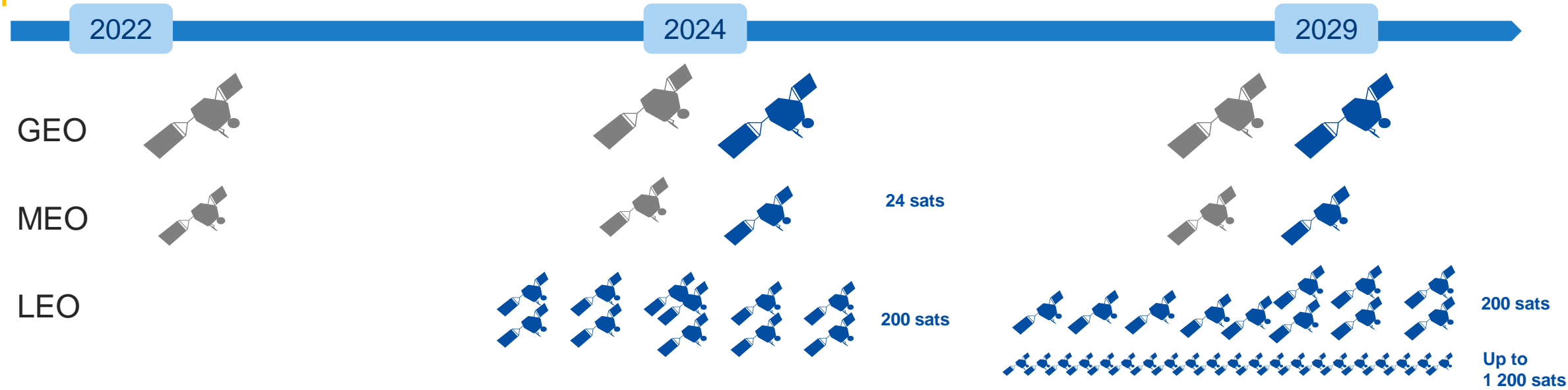


## 3 «Pivot» + Very Large LEO



# Potential incremental approach

ILLUSTRATIVE



## 3 ADVANCED MASS MARKET

- Increased capacity
- Full coverage of digital divide

## 2 SECURE AND RESILIENT BROADBAND

- Gov & Highly Secure
- Quantum for both gov. and commercial services
- Mass market, latency sensitive traffic (Cloud, Banking, mobility)
- Low data rate services (IoT, low rate services)
- Coverage: World (including Arctic)

## 1 LEGACY

- Existing / committed
- New
- Governmental
- Limited mass markets services
- Non latency sensitive bulk traffic
- Coverage: EU & partially Africa

# Secure by design : 360° approach

## TARGETED USER NEEDS

- Government and defence users:
  - Access guarantees and anonymity
- Commercial users:
  - Confidentiality/Privacy



## THREATS

- State sponsored and insiders attackers
- Emerging threats :
  - Quantum computers
  - Threat coming from space
- Supply chain risks



## REQUIREMENTS

- Relevant Norms and Standards from industry
- Approach for cybersecurity aligned with Galileo :
  - Cyber Hardening
  - Security Operation center (SOC)
- Inter satellite links



## DESIGN APPROACH

- End-to-end: Covers full life cycle of the system
- Anticipated since early concept
- Ready for accreditation



# Secure by design : study state of play and way forward

## USER NEEDS



- Assessment of user needs is mature
  - “GOVSATCOM type” requirements for governmental users
  - Privacy for mass market



## THREATS



- Threat sources considered up to highest level
- Construction of high level scenarios and associated risk treatments



## REQUIREMENTS



- Standards and policies injected
- Security architecture with key elements to be defined with the architecture



## DESIGN APPROACH



- Risk and threat analysis, Security classification guide and SSRS have been initiated
- To be refined with the architecture



# EuroQCI

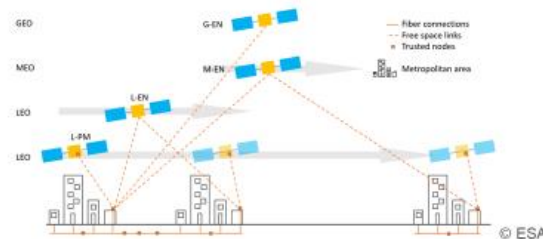
## Double link satellite QKD

## One way satellite QKD (BB84 or similar)

### One way satellite QKD

## EuroQCI Space Segment

### Different orbits and QKD concepts



G-EN GEO based Entangled QKD Satellite(s)  
 M-EN MEO based Entangled QKD Satellite(s)  
 L-EN LEO based Entangled QKD Satellite(s)  
 L-PM LEO based Prepare & Measure QKD Satellite(s)

## HIGHLIGHTS

- System design work in progress: different options of orbits and QKD concepts are being considered:
  - Quantum payloads embarked on-board the secure connectivity system satellites;
  - The EuroQCI space segment implemented separately from the space segment of the secure connectivity system as an overlay service, but fully interconnected and interoperating with the secure connectivity system satellites.
- Test satellite (Eagle1) foreseen in 2023
- Security risk assessment initiated



# A leading-edge technology roadmap to develop a breakthrough system

## Technology maturity assessment

		Added value to system		
		Low no major advantage	Medium will provide some advantages w.r.t. competition	High could reduce cost/ increase performance or may support additional services
Robustness of EU ecosystem	<b>Underdeveloped</b> No EU Ecosystem		<b>1 technology identified</b> <ul style="list-style-type: none"> <li>6G satellite radio protocol</li> </ul>	<b>2 technologies identified</b> <ul style="list-style-type: none"> <li>Q/V band user terminal</li> <li>Accommodation under launcher fairing without dispenser</li> </ul>
	<b>Growing</b> Few initiatives - EU ecosystem could be improved		<b>26 technologies identified</b> <ul style="list-style-type: none"> <li>DTN protocols</li> <li>Torrent protocols</li> <li>Network coding</li> <li>Low microvibration reaction wheel</li> <li>User terminals SDR modem</li> <li>Optical link acquisition without position knowledge of user terminal</li> <li>Mobile optical user terminals</li> <li>Cloud-based architecture Ground Segment</li> <li>Space - SIEM</li> <li>BIGSIS</li> <li>...</li> </ul>	<b>44 technologies identified</b> <ul style="list-style-type: none"> <li>4G NB-IoT radio protocol with NTN features</li> <li>5G New Radio protocol with NTN features</li> <li>Intent-based networking (IBN)</li> <li>Space cloud solution</li> <li>Themis reusability demonstrator</li> <li>Very high throughput broadband terminals</li> <li>User Terminal active antennas</li> <li>TT&amp;C SDR Modems</li> <li>Satellite Ka-band SSPA (higher efficiency)</li> <li>...</li> </ul>
	<b>Well developed</b> Strong heritage from EU - strong EU ecosystem already available	<b>1 technology identified</b> <ul style="list-style-type: none"> <li>Accommodation under launcher fairing using a dedicated dispenser</li> </ul>	<b>18 technologies identified</b>	<b>38 technologies identified</b>

# Summary

## Achievements

- Use cases have been thoroughly identified, characterised and consolidated
- Suitable frequencies identified
- Shortlist of candidate scenarios for system design have been defined
- EuroQCI/Govsatcom Hub in progress
- Technology roadmap charted
- Security needs identified

## Next steps

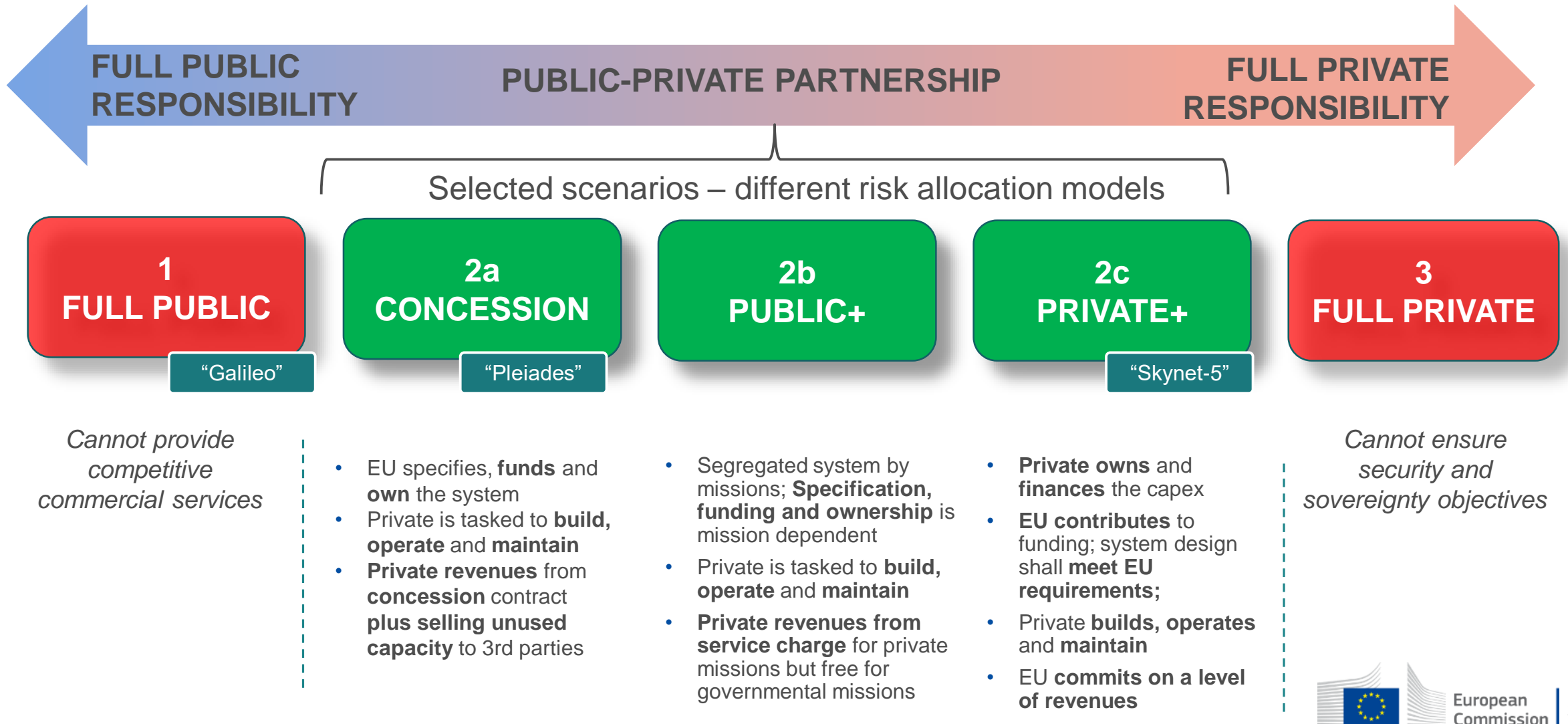
- Further assess Synergies with Space Programme
- Consolidate frequencies filings portfolio
- Refine, consolidate and narrow down scenarios taking into account technology choices
- Continue risk & threat analyses and prepare security requirements

# Questions and Answers

# Preliminary analysis of exploitation models

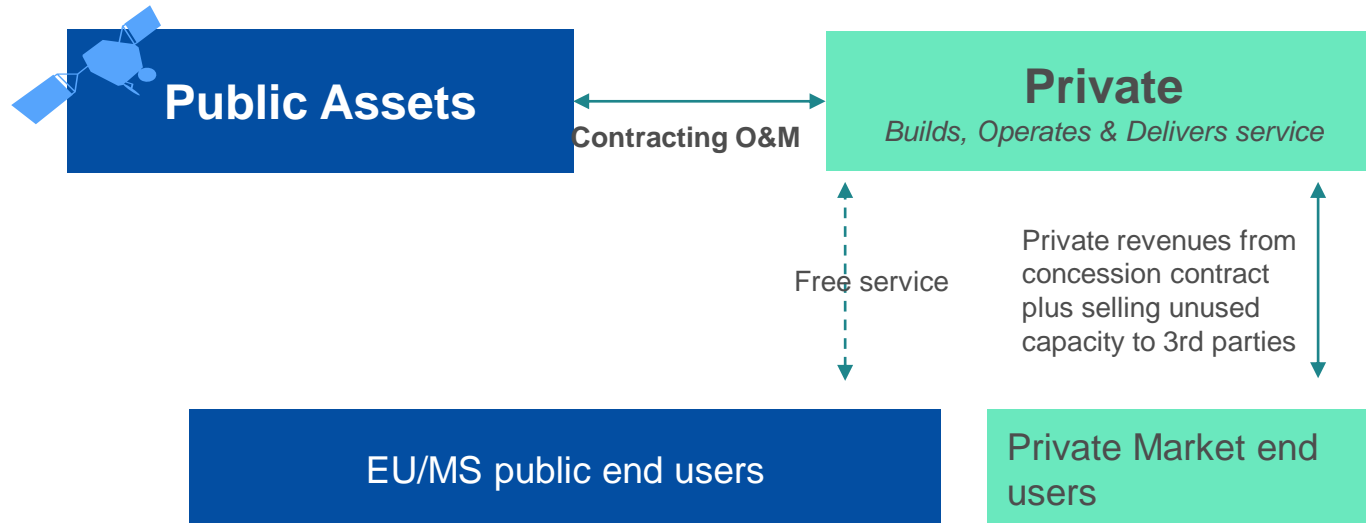


# Service provision and exploitation schemes





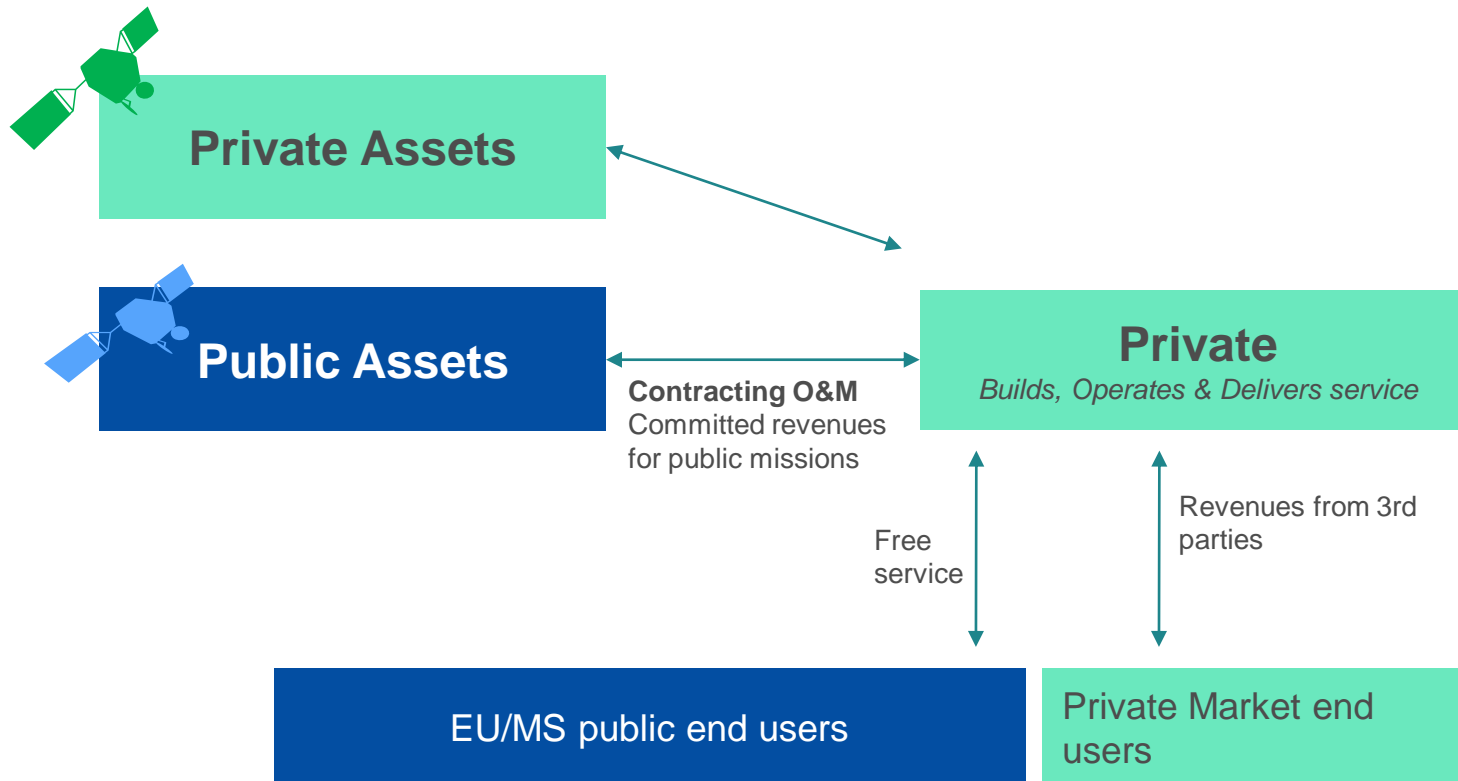
## 2a - CONCESSION – Main Hypotheses



### Who is responsible for & takes the risk of...

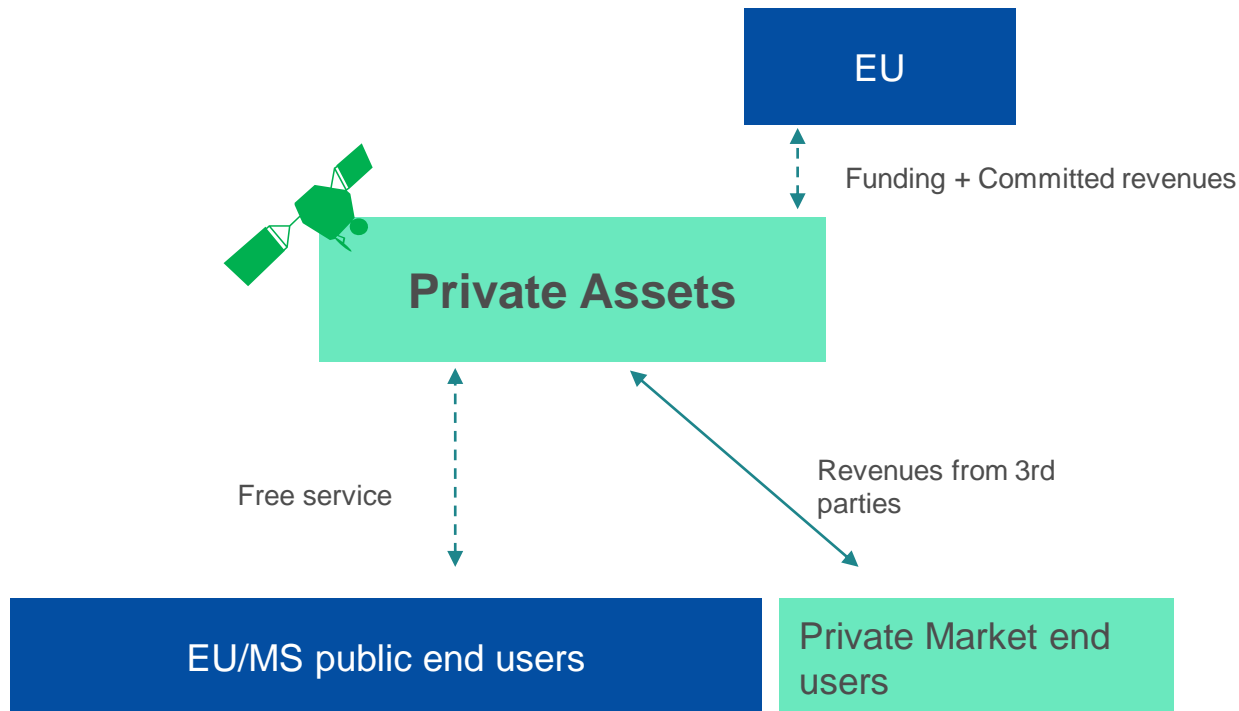
Funding	Public
Specification	Public
Procurement / Design to Spec	Public
Manufacturing	Private
Space	Public
Operation of infra & Service Delivery	Private
Maintain	Private
Go-to-Market	Private
Ownership	Public

## 2b - PUBLIC + – Main Hypotheses



Who is responsible for & takes the risk of...	
Funding	Mission Dependent
Specification	Mission Dependent
Procurement / Design to Spec	Mission Dependent
Manufacturing	Private
Space	Mission Dependent
Operation of infra & Service Delivery	Private
Maintain	Private
Go-to-Market	Mission Dependent
Ownership	Mission Dependent

## 2c - PRIVATE + – Main Hypotheses



Who is responsible for & takes the risk of...	
Funding	Public & Private
Specification	Public & Private
Procurement / Design to Spec	Private
Manufacturing	Private
Space	Private
Operation of infra & Service Delivery	Private
Maintain	Private
Go-to-Market	Mostly Private
Ownership	Mostly Private

# Summary

## Achievements

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- Various PPP models defined and aligned with technical scenarios
- Risk shareline principles defined

## Next steps

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- Principles to converge towards one preferred scenario to be decided
  - Governance of service provision and related legal arrangements
  - Security governance and operations
  - Cost/funding options and mechanisms

# Questions and Answers

# Upcoming activities





## Upcoming activities



EU New Space study

- Foster an opportunity for the participation of European New Space and enable networking
  - Interactive information exchange
  - 3 days matchmaking
- 
- To be launched mid-June