Workshop
ARTES PPP Opportunities CM16

10/06/16
FFG - Vienna

Current PPPs

Iris

- ARTES PPPs-

Space for safe skies
ESA's Iris Programme of satellite communication for ATM

Why a modern Air Traffic Management ?

Air Traffic Management is under pressure

1. The European air navigation system is **worth €8.6 billion a year**

2. In 2010, the European ATM system controlled **9.5 million flights** and on busy days, 33,000 flights. The forecast foresees this increasing to **nearly 17 million flights per year by 2030** and 50,000 flights on busy days

3. In 2010 there were **19.4 million minutes delay** for en-route flights. On average, each flight was **49km longer** than direct flight

4. **Estimated costs of fragmentation of airspace amounts to €4 billion a year.**

Source: European Commission, SESAR

Modern ATM benefits enabled by Iris

1. **Airlines benefits:** enhanced operations and lower fuel cost, with optimized airplane trajectories

2. **Passengers benefits:** reduction in flight times and less delays

3. **Environmental benefits:** lower CO_2 emission (10%)

4. **EU economy and society benefits:** 434,000-818,000 jobs foregone by 2035 and additional annual GDP between €28 - € 52 billion at EU level[1]

[1] European Observatory on Airport capacity and quality – 2015

Why SATCOM for safe skies ?

1. **No one single system can meet all future requirements**
    a. Higher safety standards
    b. Higher performance requirements

2. **SATCOM system (ground, space, user terminals)** is an excellent candidate to be part of the the future Air Traffic Management system:
    a. High capacity
    b. Wide and homogeneous coverage
    c. Modular for regional and global system deployment

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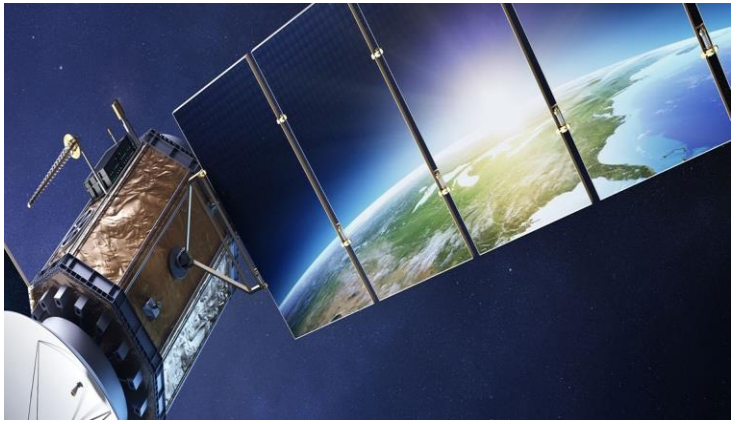
Iris high level satcom industrial opportunities

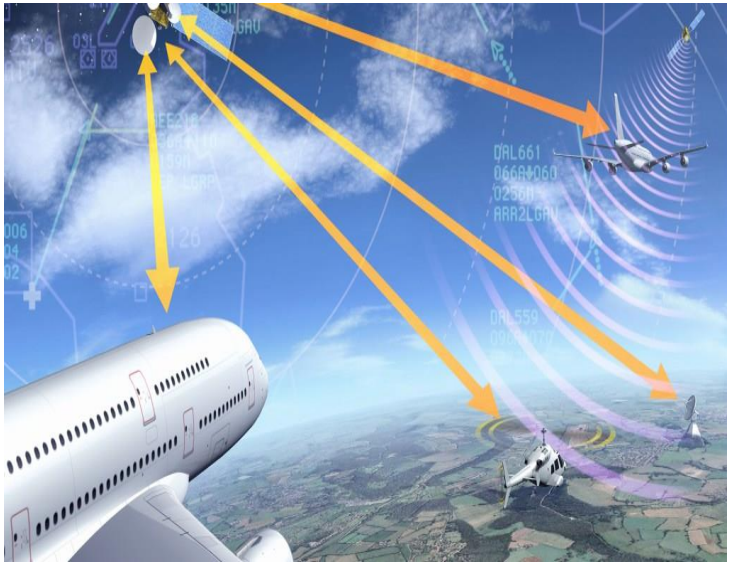
1. Position the **European Industry at forefront** for the worldwide deployment (all segments involved)

2. Valid solution **for different market segment** (full range of aircraft and rotorcraft)

3. Enable immediate revenue **ATM applications and services**

4. Develop a **safe and cyber-secure** solutions portable to different domain





European Space Agency

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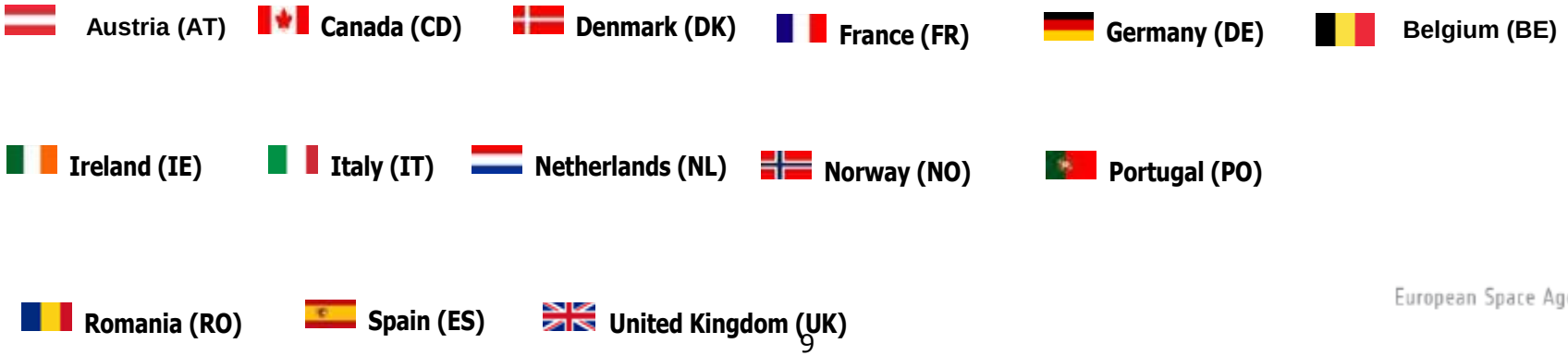
Iris opportunities everywhere in Europe

1. **Iris is crucially complemented by commercial drivers**
    a. Leadership of a prominent satellite operator (Inmarsat)
    b. Prime contractorship of a prominent satellite manufacturer (Thales Alenia Space Itialia)

2. **Leveraging the Iris Consortium experience**
    a. Currently 35 companies from 14 ESA Member States and US (Boeing), expecting a substantial growth in European industry participation
    b. 5 major European ANSPs and 1 Airline (Alitalia)



PPPs
- ARTES 10 Iris

Iris Mission

To provide a validated SATCOM solution(s) for a safer and more efficient European Air Traffic Management (ATM) infrastructure

How

Iris is ONE single initiative

Iris Precursor

- based on Inmarsat's network technology
- complementary to legacy services
- Pre-operational in 2018 (target)

Iris Long-Term

- Reaching out from Iris Precursor
- Evolving in practical steps, adding new features and services
- Pre-operational in 2025 (target)

Iris Service Evolution study
Convergence with

ANTARES

European Space Agency

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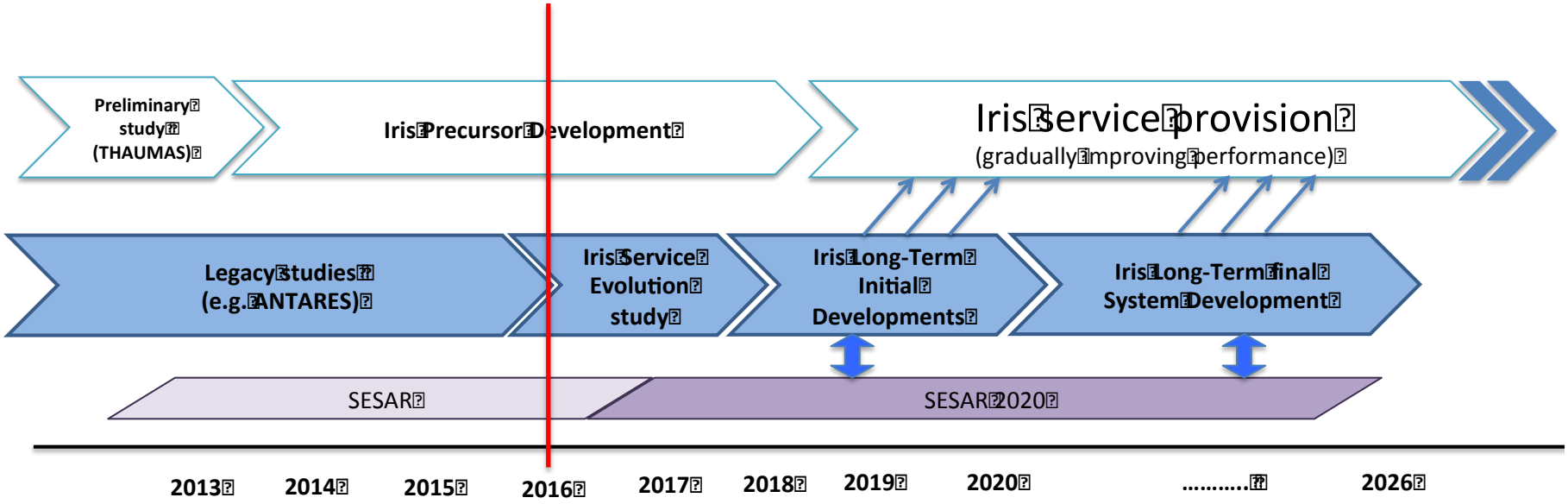
Iris roadmap



Iris Long Term Initial Developments is the critical programmatic element to timely unlock the future Iris system development:

- Sustain the renewed interest in the aviation community
- Support industry readiness for pre-operations in 2025+
- Maintain programmatic, technical and financial continuity

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PPPs
- ARTES 10 Iris - timeline

1. **2013 - 2018: Iris Precursor**
   - Development of a SATCOM system with performance equivalent to or exceeding the current terrestrial infrastructure (VDLm2)
2. **2016 – 2017: Iris Service Evolution study**
   - Definition of Iris Precursor evolution to fulfil long-term objectives, based on ANTARES results
3. **2017 - 2020: Iris Long-Term Initial Developments**
   - Based on the outcome of Iris Service Evolution Study
   - Implementation of an early version of the Iris Long-Term system to support SESAR JU on the verification of long-term performance
4. **2020 - 2025+: Iris Long-Term technical validation**
   - Development of the end-to-end system ready to support large scale demonstration in collaboration with SESAR JU and EC

ARTES PPPs
- ARTES 10 Iris - C-M16 support activities

Implementation of an early version of Iris Long-Term:

- ✓ **Iris Long-Term System Design and Technology Roadmaps**
  - Consolidation of the Iris Service Evolution Study results
  - Support to standardization
- ✓ **Implementation of new features and services**
  - Evolution of Iris Precursor as intermediate steps towards Iris Long-Term, by developing and gradually introducing mature technology (e.g. ATN/IPS)
- ✓ **Development of new and critical technology**
  - Development and validation of technology critical in time and complexity, for future inclusion in the final Iris System
- ✓ **Support to pre-operational validation activities** (shared with SESAR)
  - Validation of 4D trajectory management (starting with Iris-Precursor)
  - Definition and validation of the multi-link concept

ICE

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ARTES PPPs
- ICE benefits

Through ICE PPP, **Inmarsat** has started **a deep and broad strategic transformation program** to shape their Next Generation of Mobile Satellite Services.

- The ICE program with ESA is the **vehicle to enable innovation** introduction in this transformation program at all levels from **infrastructure to service and applications** and bring Inmarsat assets to the leading edge of where the communication industry will be in 2020

- It thus provides **opportunity for industry from all segments and domains to be part of the new supply chain ecosystem**

- Industry involved will be also able to **leverage on the ICE phase 2 developments** to compete on similar markets outside of the INMARSAT ecosystem (mobile broadband, M2M, etc)

ARTES PPPs
- ICE - phasing

- ✓ **Phase 0:** July 2014 – September 2015
  - Preparatory phase: program definition, preliminary feasibility analysis and market assessment

- ✓ **Phase 1:** July 2015 to 2017
  - Services & applications definition
  - System architecture design
  - Critical technologies and applications development
  - Early technology validation

- ✓ **Phase 2:** Q1 2017 to 2020
  - System implementation (Space Segment, Ground Segment)
  - Additional technology developments
  - System/service/applications operational validation

ICE status

- Phase 1 on going and addressing the preparation of phase 2 (concept and pre-development phase of ICE)
- Phase 2 (subject to Min 2016 funding release) addressing various stream implementation at different maturity stages and with different opportunity interests

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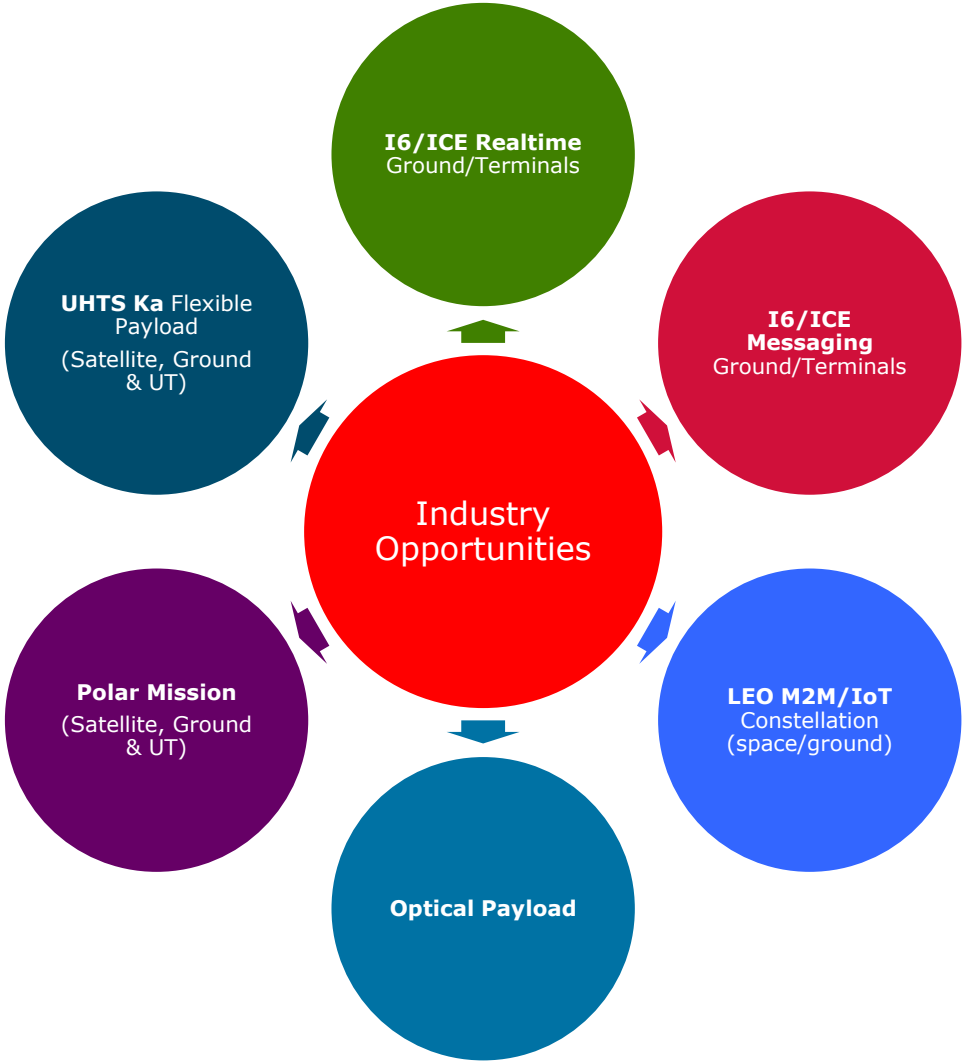
ARTES PPPs
- ICE – Phase 2 prospects



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ICE main lines

Space elements

ICE-Optical
LOW COST SOLUTION
Low priority, possibly not part of ICE

ICE-GX2.0
Ka mission for broadband connectivity

ICE-RealTime
Expanding safety services at sea and in the air

POLAR ICE
Ka and safety services for polar region – Medium priority but possibly not part of ICE

Global IoT

ICE-M
Low cost IoT service for L-band GEO

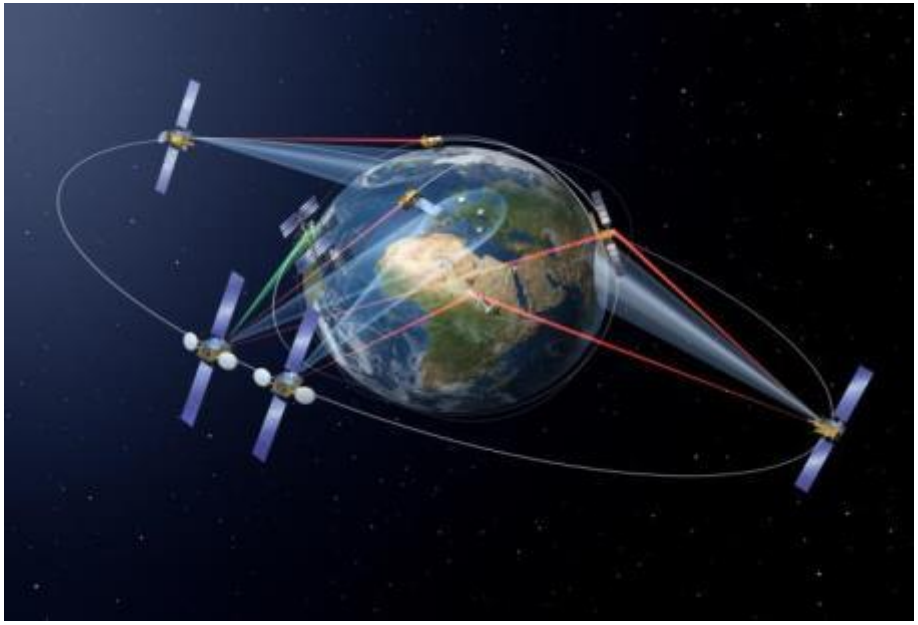
ICE-Cube
Global LPWAN overlay for terrestrial devices from LEO

Downstream applications

ICE Apps Elevator
Scale-up and scale-out support for early stage companies and SMEs

Opportunities

GlobeNet



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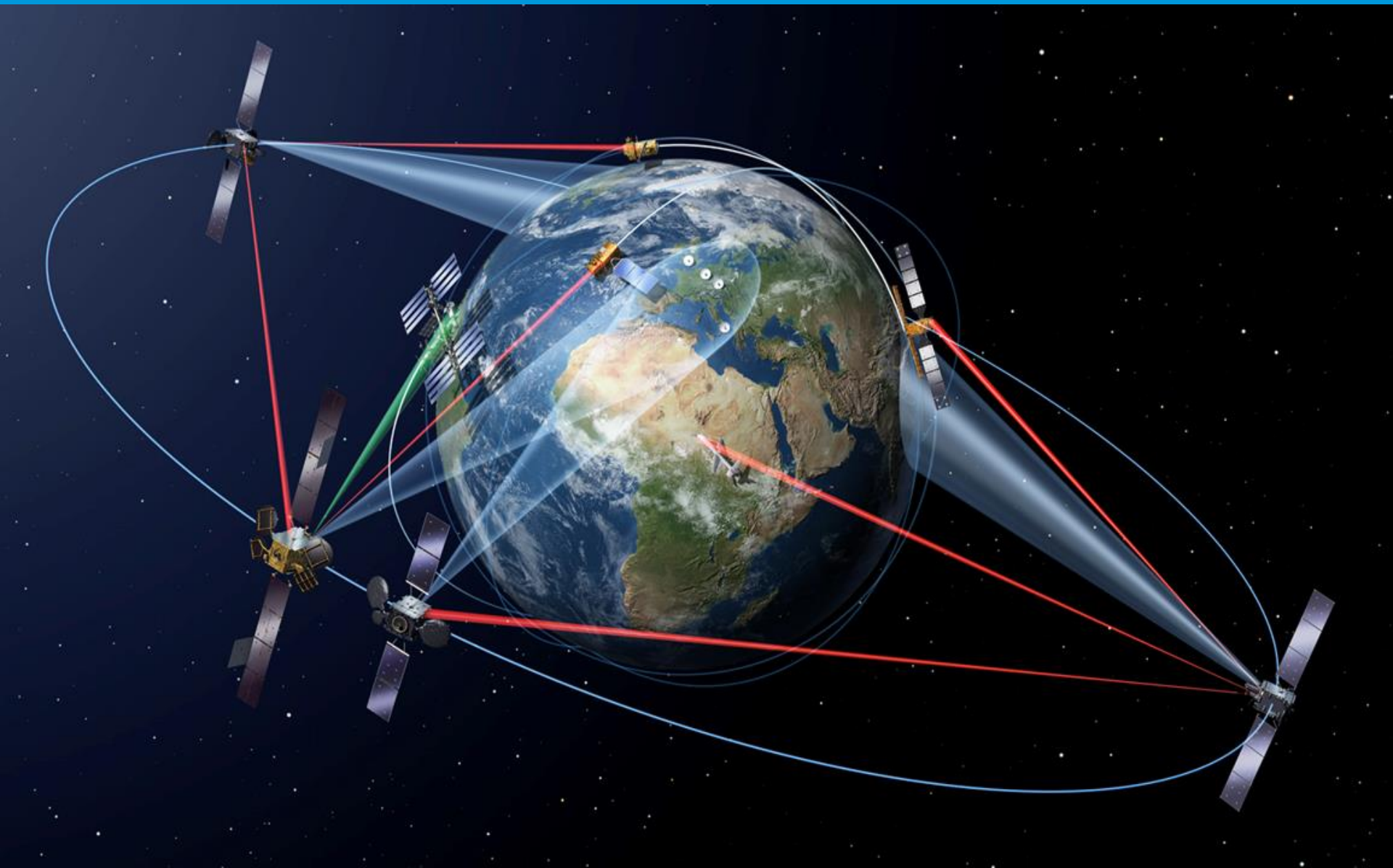
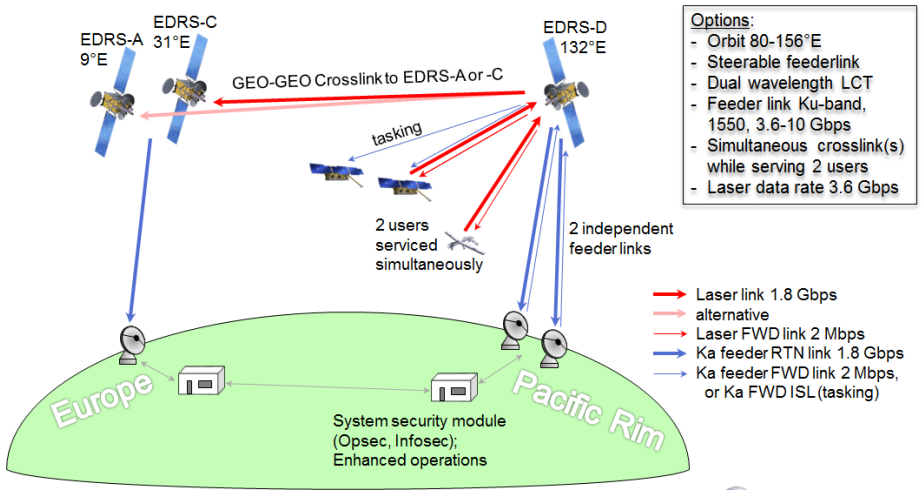
EDRS – GlobeNet
Global Real-Time Earth Observation



GlobeNet System Concept

GlobeNet shall complement the EDRS Constellation towards a global, continuous data relay coverage of the Earth.

It shall consolidate the sustainability of the EDRS Services and to further stabilize the overall EDRS PPP Programme.



Features:

- "Security-certified" GEO node in the Asian region by 2020
- Service capabilities to UAV/RPAS
- Dual-wavelength capacity for optical communication
- GEO-to-GEO link for independent and secure Asia-Europe data transfers

Opportunities:

- secure MOC and upgrades on (secure) Ground Segment/Antennas
- P/L PrimeShip and P/L equipment
- Development and potential flight opportunities for user terminals

GlobeNet Benefits

- Secure LCT as world standard & support competitiveness of European industry
- Establish EDRS as European strategic asset improving European independence (e.g. by GEO-to-GEO Intersatellite links back to European territory).
- Foster User/Optical Terminal Developments (reduce cost of ownership, by adapting the performance = Low Cost Terminals)
- Provide world-wide Real-Time communications to maritime surveillance, disaster monitoring and other time-critical user applications (e.g. COPERNICUS)
- Respond to requirements of security applications and governmental SATCOM including RPAS (e.g. GOVSATCOM)

ARTES Opportunities
- GlobeNet - How

EDRS PPP partnership

- Cost share ESA/Airbus
- Potential share by EC DG GROW

  - new EC requirements expected Q1/2016, in-line with Defence Action Plan

Hosted Payload approach:

- Potential ESA-JAXA Interagency Agreement incl. capacity share e.g. ALOS-3
  - Working Group Meeting planned for Jan/2016
  - Industry dialog started Q4/2015
- Host opportunities in U.S.

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GlobeNet Industrial Opportunities

Item	Comment	Nation	
Enhanced P/L architecture	Integrate multiple LCTs, dual wavelength, enhanced fwd tasking		CAN, DE
Security Module/Encryption unit	New State-of-the-art protection methods (OpSec, InfoSec), supports Copernicus concept		UK, BE, FR, CH, DE
Modulator	Development and Implementation of new modulation- and encoding schema (e.g. QPSK)		IT, FR, ES, UK NO, BE, DE

GlobeNet Industrial Opportunities

Item	Comment	Nation	
P/L Control Computer	Enhanced processing unit including interaction with satellite platform		FR, ES, IR, SE, DE
DPU	Support ≥ 2LCTs		UK, CAN, FR, ES, IT, DE
Fixed and Steerable antennas	Feeder downlink, GEO => LEO		CAN, E, IT
MPM/PCT CAMP TWTA 120 W	Feeder downlink data rate ≥ 3.6Gbps		FR, BE, DE

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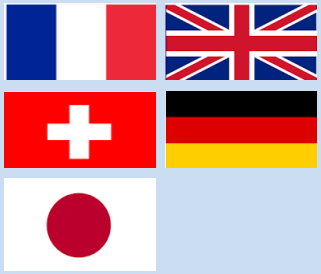
GlobeNet Industrial Opportunities

Item	Comment	Nation	
LCT Upgrade: Additional 1550 RX/TX Modules	GEO-LEO/Airborne and/or GEO-Ground		FR, UK, CH, DE, JP
LCT upgrade	dual wavelength, reliability improvement, GEO-Ground, Enhanced FWD link (ASK)		DE

GlobeNet: Potential Areas for Technology Demonstrators

- ✓ Quantum-Cryptography Demonstration: Upgrades and tests services for applications using Quantum Cryptography
- ✓ 1550 Terminals: GEO-LEO/Airborne and/or GEO-Ground Feederlinks
- ✓ (Transportable) Optical Ground Station: Optical Feederlinks Demo (GEO to Ground and Ground to GEO in 1064 and 1550nm)

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GovSatCom Precursor

ARTES Opportunities
- GOVSATCOM - Context

The people of Europe ask for security

Immigration waves at unprecedented scale call for solutions. The most recent terrorist attacks aim at de-stabilising our society. This represents a major challenge for European defence and security. European countries are expected to cooperate more and better to respond to the very real concerns of their citizens.

ARTES Opportunities
- GOVSATCOM

- Dec 2014, the EU Council underlined the need to avoid fragmentation of demand and to foster civil-military synergies for the preparation of the next generation of governmental satellite communication, through close cooperation among Member States, EDA, the EC and ESA

- Recently the EC - as one of its priorities - included GOVSATCOM in its European Defence Action Plan 2016

Crisis management

Infrastructure Monitoring

Border surveillance

Security Solutions Independence

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ARTES Opportunities
- GOVSATCOM – EU action

- EDA has initiated supporting study focused on military aspects and plans by end 2016 to propose a comprehensive programme for implementation of GOVSATCOM

- EC is conducting a study focused on civilian needs and has established a related user group (EC services, EEAS, EDA, ESA)

- EC plans to identify new activities that could be proposed in the EU's Space Program, including co-funding from the Horizon 2020 for activities related to the development of SATCOM for security space technologies.

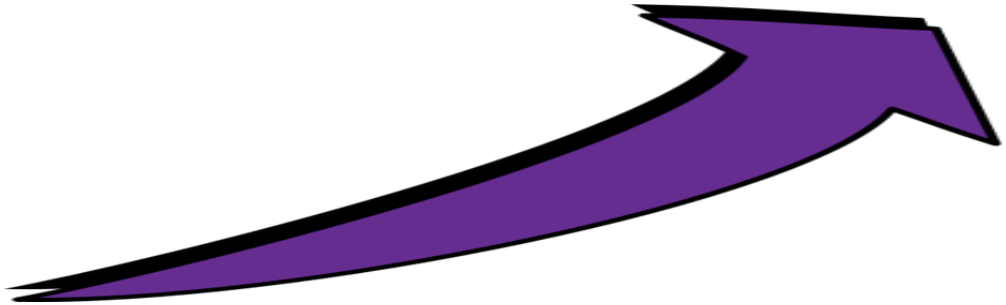
- Recently the EC - as one of its priorities - included GOVSATCOM in its European Defence Action Plan 2016

ARTES Opportunities
- GOVSATCOM – Typical User Needs

EDA and EC have identified an initial set of requirements for governmental satellite communications in the following domains:

- Crisis management, e.g. civil protection, humanitarian aid, common security and defence policy (CSDP) missions
- Surveillance, e.g. border and maritime
- Key infrastructure monitoring, e.g. transport (air, rail), space infrastructure, institutional communications
- Emerging domains, e.g. RPAS, data relay, artic communications

ARTES Opportunities
- GOVSATCOM - in 3 steps



1

2015-2016
Preparatory Studies

(ESA/EDA/EC)

EC/EDA: User requirements

ESA: Assessment of

- system architecture, techno
- Implementation scenarios
- Existing/planned Satcom systems as possible future elements of GOVSATCOM ESA precursor

C-MIN 16

2

2017-2019

GOVSATCOM
ESA Precursor

3

2020/2021 …
European Commission
GOVSATCOM
implementation

ARTES Opportunities
- GOVSATCOM - ESA precursor (Step 2)

2017-2019 GOVSATCOM ESA precursor activities

- ✓ early R&D, IOV and demonstrators, in support of the specification and operational concepts validation of the GOVSATCOM system
- ✓ early support to European industry to develop technology as well as applications solutions
- ✓ demonstration of pre-cursor services relating to the development of future GOVSATCOM services, which may be provided under commercial service level agreements.

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ARTES Opportunities
- GOVSATCOM - ESA precursor
Announcement of Industrial Opportunity

Precursor Announcement to Industry issued 26.2.2016

Two phases

- ✓ Notification of Intent by 23.3.2016 with outline of intended precursor and description of innovative elements
- ✓ Outline proposal by 6.5.2016 following classical ARTES scheme of Outline Proposals and including cost and funding plan

13 Notifications by industry received with one or more project outlines each

- ✓ Good share between Operators & Manufactures (8&5)
- ✓ Good distribution over MS (BE; DE(2); ES(2); FR(3); IT; LUX; NO; UK(2); NO)
- ✓ Good share of use of existing assets (innovation in GS and services) and new space assets (6&7)

ARTES Opportunities
- GOVSATCOM - scope

- Pooling & Sharing is the main activity of the GSC-Precursor, based on existing European asset. However there is a need to:
  - Enhance the security aspect of the existing ground stations,
  - create a Meta Mission center to federate requests from customers and allow adequate planning of these requests across the pool of satellites.
  - Additionally the GSC-Precursor will provide demonstration of new services supported by new multi band terminal to be developed.

- New Space Assets
  - are required to stretch to world wide coverage the GSC services, not covered by existing Geo satellite assets.
  - will provide independence from US/Privately owned constellations especially for access to polar region.
  - will secure future global coverage for the future GSC with reasonable cost (benefit from low cost Leo sat P/F developed for Oneweb…)

ARTES Opportunities
- GOVSATCOM - Benefits

GOVSATCOM will potentially mobilise substantial institutional budget to implement a Satcom infrastructure and provide associated services

A Highly attractive opportunity for Satcom industry

ESAs role focused on enabling the emergence of Secure Satcom segments and positioning ESA MS Space industry for this market

- ✓ **Ensure ESA MS industry are taking the initial steps to be able to respond to the GOVSATCOM requirements (technology and services) from EC and potential other secure Satcom worldwide demand**
- ✓ **Proof of concept to the GOVSATCOM stakeholders**
- ✓ **Demonstrate a model of cooperation with the Commission in establishing and implementing partnerships in the institutional domain**

Pioneer

ARTES Opportunities
- Pioneer

Providing Low Cost and Timely Access to Space for Proof of Concept (PoC) Satcom technologies, systems, services & applications

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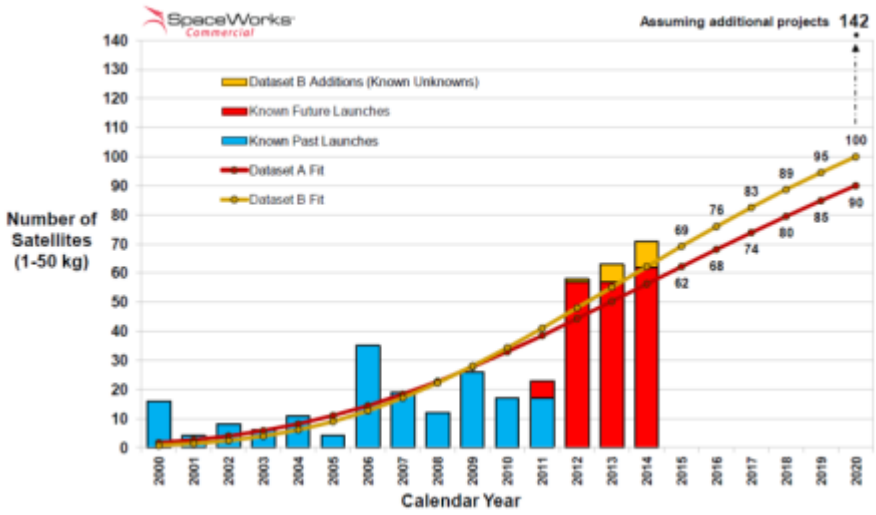
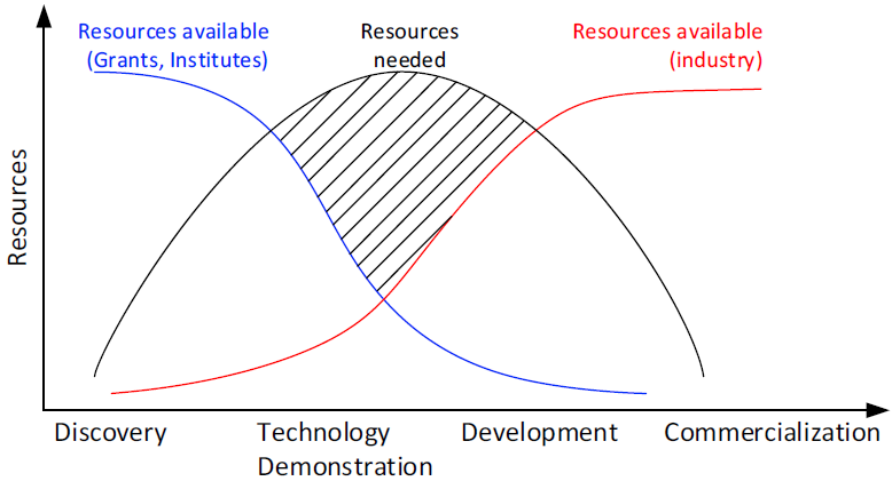
ARTES Opportunities
- Pioneer - Context

Low cost small sat technologies maturing into operational missions (Cubesats, microsats, minisats - big push with Megaconstellations)





Satcom innovative technologies and also services/applications **not maturing due to missing IOD/IOV step**

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ARTES Opportunities
- Pioneer – problem to solve

Many Satcom initiatives not maturing because of a **too high entry barrier** (high cost, complexity & risk to shift from the idea to the full system/service deployment)

Need fast cost-effective in-orbit show case to validate the service/techno idea

Allows a stepped approach to finance the initiatives

ARTES Pioneer
Rationale

Quite a few "IOD/IOV" related initiatives BUT mostly

- Based on rare opportunistic flights or
- Isolated/National initiatives with mission specific flights

Expensive, Infrequent, Slow, Long, Ad-hoc organisation

Need a European wide initiative to achieve sustainability

The necessary ingredients for an IOV/IOD initiative

Affordable ticket to fly

Regular and flexible launch services
(if you miss it, take the next one)

Well known initiative
across many communities
(including non telecom / non satellite)

E2E system definition skill
(from the item/service to the system needed)
E2E system operations
Provision of access to spectrum

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ARTES Opportunities
- Pioneer – Objectives & Benefits

Objectives:

- **Stimulate new Satcom business initiatives (through affordable and fast in orbit service/applications trials)**
- **Facilitate Innovative Satcom technology entry to a competitive market**

Benefits:

- Boost the **development of new ESA MS Industry and attract new players** (eg: emerging small satellites providers sub-systems suppliers needed for providing flight opportunities)

- **Wide impact on all Satcom Upstream and Downstream domains**: Ground, Payload, System, Platform, Service, Applications

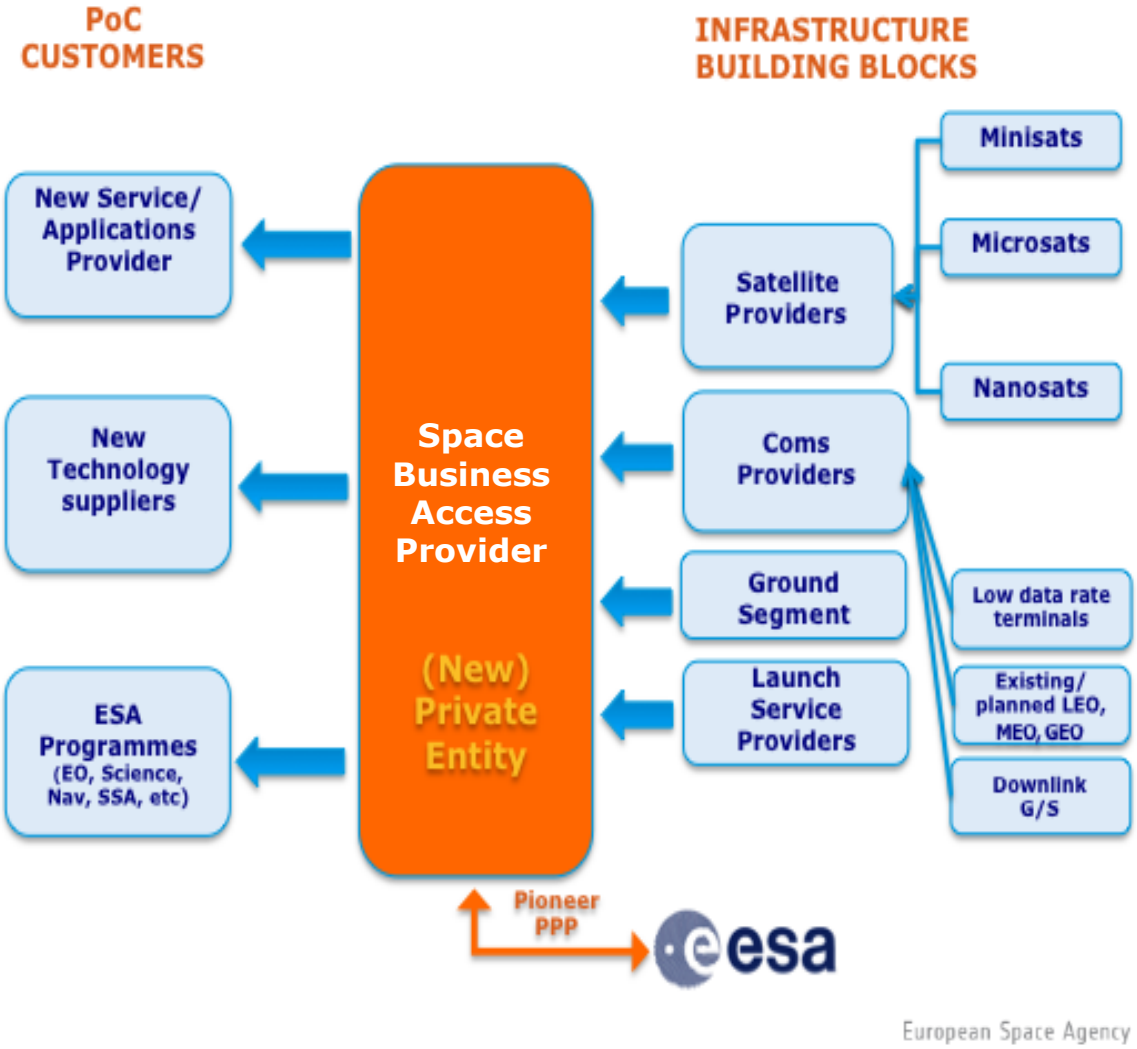
- **Synergies across domains within and beyond Satcom**

- with on going ARTES programs (e.g. EDRS, Mega Const., future PPPs)
- with other ESA directorates EO, NAV, Science, Space Situational Awareness, etc.
- and outside the Agency

ARTES Pioneer
New Approach: relying on private sector entity(ies)

The SBAP is the single interface point for customers willing to demonstrate/validate their solutions solutions in a representative environment including in orbit asset(s).

To offer one-stop-shop services, candidate SBAPs will need to be equipped with a full set of **capabilities, competences and infrastructure building blocks.**



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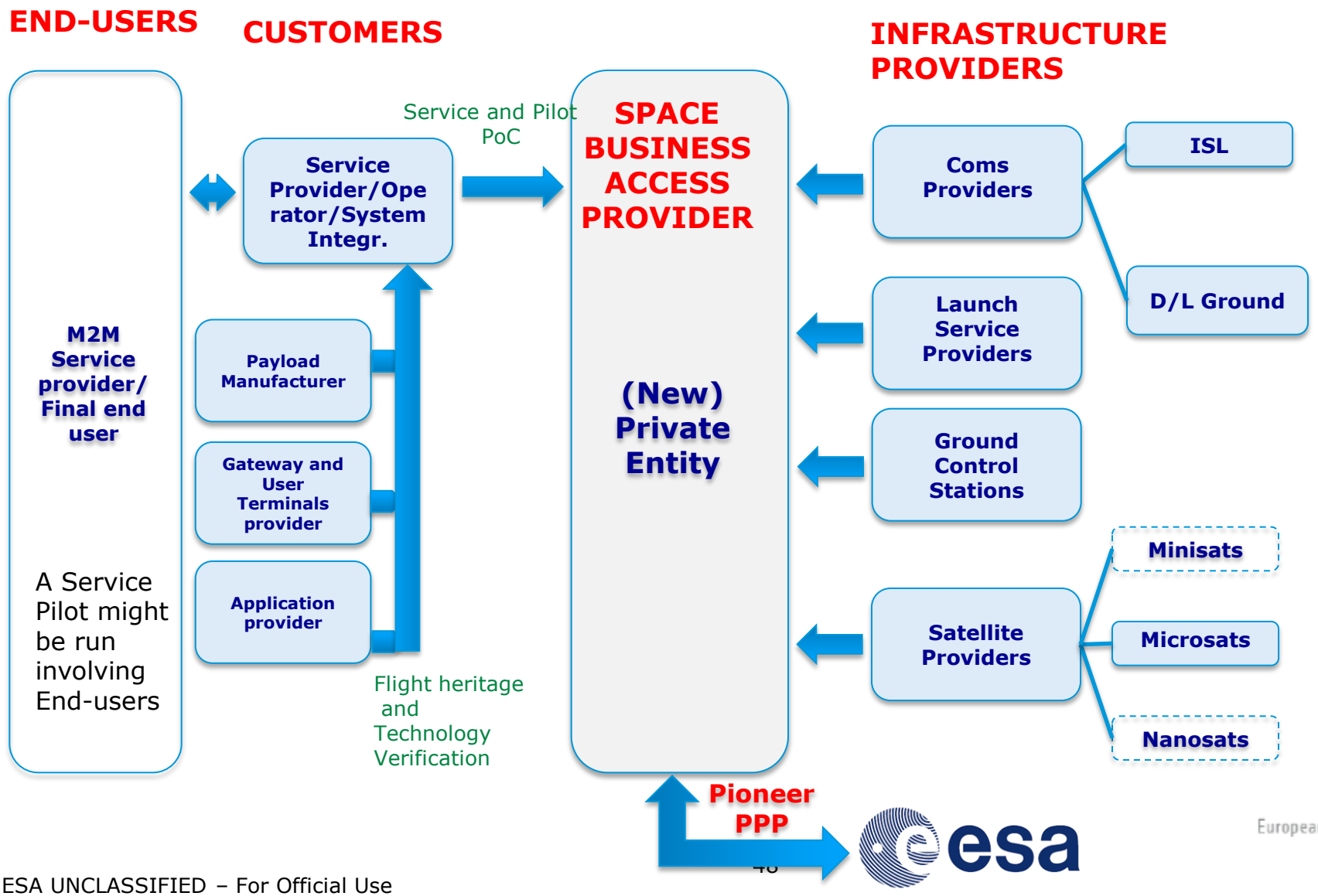
Pioneer Example 1
M2M system/Service Proof of Concept



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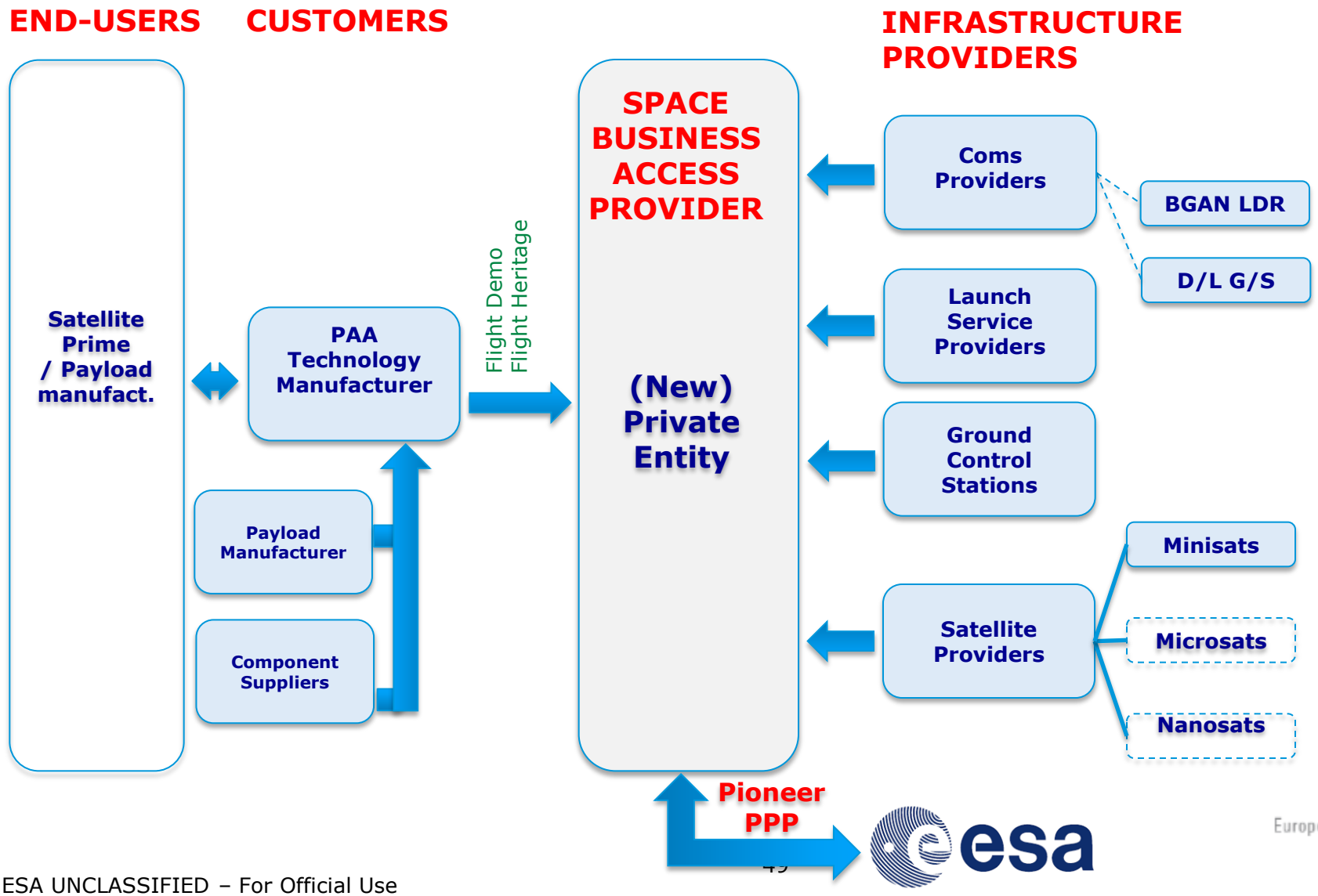
Pioneer Example 2

Technology Proof of Concept (Satellite Phased Array Antenna)



European Space Agency

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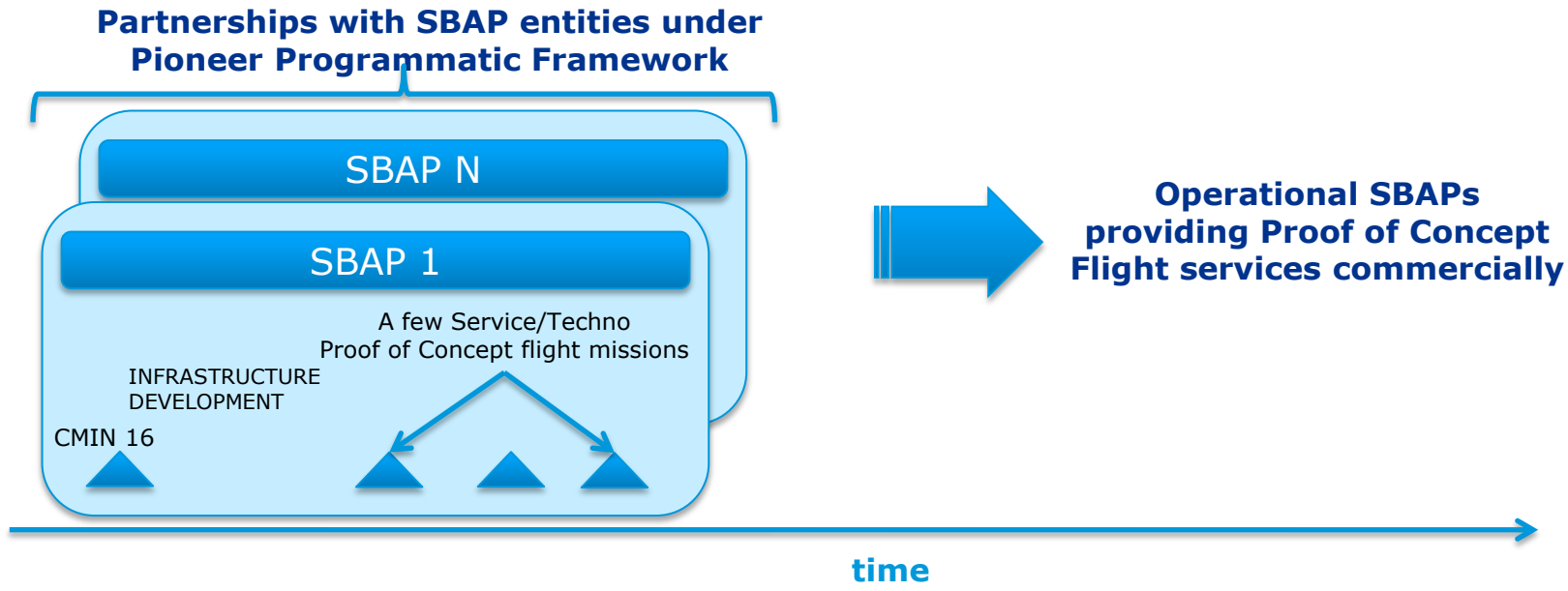
ARTES Pioneer
Implementation

- ✓ Pioneer is a **time limited** initiative aiming to support the emergence of Space Business Access Provider(s).

- ✓ Once the Pioneer initiative is completed, SBAPs are fully operational and able to provide Proof of Concept Flight services commercially to any entities (private/public)



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Eligible Activities

✓ *ESA will **support the following set of activities**:*

- **Development and Validation of the SBAP (building blocks) Infrastructure;**
  - Satellite Platforms, Inter Satellite Link (ISL), communications, Ground Segment
- **Development and Validation of the SBAP Service capabilities**
  - end-to-end system engineering and mission design support tools, service portals, interface standardization and service management tools.
- **SBAP Validation Mission(s): proposed by SBAP and/or ESA and participant MS**
  - contribute to validate the full set of "access to space" services with a customer and with a real showcase thus providing credibility and enabling potential future opportunities
  - Mission definition design and development, deployment and operations

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ARTES Pioneer
…Post Pioneer

*Pioneer completed and **SBAP(s) will run commercial operations** by providing access to space to private and public entities.*

- ✓ ESA ARTES program will make use of the SBAP services for Satcom technologies/system/service/application Proof of Concept missions through ARTES "Competitiveness & Growth" funding program
- ✓ …at conditions agreed in the form of ESA <-> SBAP(s) SLAs
- ✓ ARTES will support the maintenance of solution providers' building blocks (next generation/advances etc..) through ARTES C&G funding program.

ARTES Opportunities
- Pioneer – Stakeholders benefits

Demo Flight Customers

Time and cost efficient access to pilot Systems / Services / Techno PoC/IOV

Affordable demo sat system to convince final users/customers

Establish commercial partnership ahead of service roll-out

Institutions, Member States can affordably boost innovation and disruptive services and technology without major cost and risks

SAP

Private sector able to achieve lower prices through commercial negotiations

Establishment of a service delivery model, initial business and project /customer reference

Several SAPs in initial phase to cover different geographical / sat-size or other segments

Market regulation or competition in mature stage

Infrastructure Solution Providers

Develop industrialised building blocks for Satcom with co-funding

Enable commercial and/or competitive products to spin-off in new market

Enable standardisation linked with IOD/IOV

Establish relation with SAP + Flight Candidates leading to future business

Additional PPPs in ARTES PARTNER

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ARTES PPPs - C/M 16 PPPs

ESA is currently in discussion with 8 Satellite Operators and industry entities for setting up potential PPPs with various level of maturity

Addressing:

- Very/Ultra High Throughput satellites systems
- Advanced Ka band payload with a high degree of flexibility (including processing capabilities and active antenna solutions)
- Flagship programs
- In orbit servicing solutions
- Advance Q/V band payload
- potential flight opportunities for Neosat PFMs

Some of these are expected to mature in Q2 2016 and will likely mobilise Industry across ESA MS