ESA Iris Programme: satellite communications for Air Traffic Management

Noordwijk, 10-11 October 2011
“To provide for and promote, for exclusively peaceful purposes, cooperation among European states in space research and technology and their space applications.”
ESA budget by programme (2010)

<table>
<thead>
<tr>
<th>Category</th>
<th>Budget 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programs and mandatory activities</td>
<td>3739.5 M€</td>
</tr>
<tr>
<td>European Cooperating States Agreement (ECSA)</td>
<td>5.2 M€</td>
</tr>
<tr>
<td>Total</td>
<td>3744.7 M€</td>
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**Programmes and mandatory activities**

- **Technology***: 2.3%, 84.8 M€
- **Launchers**: 15.1%, 566.6 M€
- **Robotic Exploration**: 2.7%, 102.0 M€
- **Human Spaceflight**: 8.8%, 330.4 M€
- **Microgravity**: 2.1%, 79.9 M€
- **Navigation***: 19.1%, 714.0 M€
- **ECSA**: 0.1%, 5.2 M€
- **Science**: 10.9%, 409.5 M€
- **Associated to General Budget**: 5.3%, 196.7 M€
- **Telecommunications***: 8.7%, 325.9 M€
- **Earth Observation***: 18.9%, 708.4 M€
- **General Budget**: 5.7%, 211.4 M€
Telecommunications

• Helping European industry to compete on the world stage;
• Supporting technological R&D and pioneering developments to bring new technologies near to market readiness;
• Building partnerships capable of creating wealth, jobs and new services for the citizens of Europe;
• Improving our daily lives, from health services to civil protection and rescue operations.

ESA’s Advanced Research in Telecommunications Systems (ARTES) programme promotes the development of technology, products and systems in partnership with industry.
Current ARTES missions

Alphabus – multipurpose platform exploited by European industry to build future high-power communication satellites. Its first mission, Alphasat, is due for launch in 2012 (in partnership with Inmarsat).

Small GEO – general-purpose small geostationary satellite platform, with subsequent mission with Hispasat. Will strengthen position of European industry in commercial medium-sized telecoms platform market.

Hylas – ‘Highly Adaptable Satellite’ project, launched in 2010 (with Avanti). A hybrid Ka/Ku band satellite with European coverage that uses generic, flexible and innovative payload technologies.
EDRS – the European Data Relay Satellite system. An independent European system to reduce time delays in transmission of large data quantities, making on-demand data available at the right place, at the right time.

Iris – developing a new air-to-ground communications system for air traffic management, the satellite-based solution for the Single European Sky ATM Research (SESAR) programme.

Integrated Applications Promotion - bringing together diverse space infrastructures to facilitate innovative solutions, leading to sustainable services.
Dedicated ESA programme to support SESAR under the umbrella of ESA’s ARTES programme (ARTES 10), named “Iris”:

- Commitment of ESA Member States in Sept. 2007
- Definition Phase (Phase 1) completed in Jan. 2009
- Development Phase (Phase 2) approved by ESA Member States in Nov. 2008, with funding committed for Phase 2.1 until 2012

Budget of Phase 2.1 is ca. EUR 42m

13 Participating States:
Austria, Czech Republic, France, Germany, Ireland, Italy, Norway, Portugal, Luxembourg, Spain, Switzerland, UK
+ Belgium joined in Sep. 2011
• User requirements are being defined by SESAR JU
• ESA translates them into system requirements, carries out design, development and verification (i.e. under ESA funding)
• SESAR will carry out the service validation end-to-end
ESA Iris Programme: status overview
Noordwijk, 10-11 October 2011
Why the need for Iris?

1. The shift from voice to ‘silent ATM’ will go ahead

   ⇒ Need to implement new air-ground links, in particular in the most dense traffic areas (i.e. TMA) as VDL2 cannot support all future requirements

2. Once datalink becomes primary means of communication, the performance requirements increase (availability, reliability, integrity, low latency...), and no single system can meet all requirements

   ⇒ Need for a multi-link, including satcom; SESAR performance requirements for air-ground links are based on COCR, which current satcom systems do not meet

   ⇒ Need for certification of the communication service provider and oversight of the service provision chain, which create requirements on the system & provider(s)

3. If the system shall be used by all in controlled airspace, it should have lower-cost user terminals + lower service price than today’s satcom

   ⇒ Need to change the service model of Satcom for ATM i.e. all ATS datalink services for a flat fee included in route charges

   ⇒ Terminal price based on mass-production, and affordable for any aircraft type
Airspace users expect the avionics for the ATC service to be installed once and be operational for the whole aircraft lifetime (25-30 years).

This lifecycle is much longer than commercial telecom products (which is less than 10 years); this requires open specifications to ensure maintainability with a long-term provision perspective (30+ years).

Airspace users would like to use the same communication equipment worldwide.

Open standard needed, agreed at international level, with specifications available to all, so that different world regions can implement their own interoperable infrastructure.

Need to allow the possibility of competition in the provision of services (i.e. avoid monopoly situation) so that aircraft fitted with a single user terminal can use any interoperable network.
Advantages of Iris design

1. Guarantee performance requirements defined in COCR for Satcom use in high-density continental airspace (not met by current satcom systems)

2. Allow lower-cost user terminals + lower service price wrt today’s satcom
   a. Business case analyses show that provision of all ATS+AOC services in European airspace can be financed for ca. EUR 5 /flight
   b. Terminal designed-to-cost with price based on mass-production; small omni-directional antenna; affordable for any aircraft type

3. Open standard with available specifications:
   a. Allow free adoption by any world region
   b. Allow standardisation at EUROCAE/RTCA and ICAO level
   c. Allow competition for industrialisation of products and for service provision (several providers of interoperable equipment and roaming between interoperable networks)

4. Use L-band: guarantee no interference from commercial systems by use of AMS(R)S frequency band allocated for safety services
Iris design activities: 2 approaches considered

**Purpose-built system and open service model**

- **ANTARES System Design Phase B study**
  - Preliminary Design Specifications
  - Aircraft terminal Preliminary Design
  - Preliminary Design Specifications

- **3 Satellite System Operations studies**
  - HERMES, OPERA, SIRIO

- **Interactions**
  - Develop Aircraft terminals (with industry)
  - Satellite system Phase C/D/E1 in Iris Phase 2.2

**Who operates what?**
- Who procures what?
- Financing scheme?
- (+) Partnership proposal of each team for Iris Phase 2.2

**Modified commercial system**

- **THAUMAS study**
  - Service provision + Business case model
  - 3 study teams

- **Use Inmarsat Satellites and SwiftBroadband Safety protocols (to be standardised)**

**Who operates what?**
- Who procures what?
- Financing scheme?
- (+) Partnership proposal of each team for Iris Phase 2.2

**ICA O Standardisation**
(by SJU/EC)
Iris design activities: requirements

Aircraft & avionics manufacturers
- THALES
- AIRBUS
- Honeywell

ATM Satcom Safety Board
- incl. EASA, national CAAs, Eurocontrol, SJU

Aeronautical stakeholders
- ANSPs, Airspace Users, ICAO, EUROCAE...

Main source of technical requirements

System purpose-built around aviation requirements
- ANTARES study

Adaptation of SwiftBroadband to aviation requirements
- THAUMAS study

Safety requirements + regulations

+ other requirements from aviation

(especially Project P15.2.6)
Stage of development by end of Iris Phase 2.1

**ANTARES**
1. Standard specifications
2. Verification Testbed (VTB)
   including physical testbed emulator and logical testbed emulator
   i.e. the communication protocols will have been implemented on the VTB
   and their performance verified, with each element implemented as either
   proof-of-concept or prototype: Ground segment (SW or HW) - space
   segment emulator – breadboarding of user terminals
3. Design of space+ground segments at level required for a Phase C/D tender

**THAUMAS**
1. Specifications of the amendments to Inmarsat’s SwiftBroadband (waveform,
   protocols, ground segment modifications)
2. Implementation of the modified waveform on a hardware testbed (proof-of-
   concept of modulator/demodulator and channel)
   + Simulator (from Astrium) to verify network performance
Calendar Iris, SESAR & system deployment

**2011**
- SESAR DEVELOPMENT PHASE

**2012**
- SESAR DEVELOPMENT PHASE
- SESAR Deployment Manager

**ca. 2015**
- Phase 2.1: Design Candidate System
- Phase 2.2: Develop System & Deploy Subset

**ca. 2016**
- Subset Payload
- End of Iris Programme: ESA assets transfer to System Owner

**ca. 2018**
- Subset deployed for system verification & validation

**ca. 2020**
- Operational Service

**2020**
- CHECKPOINT: ESA Member States funding decision

**2012**
- CHECKPOINT: EC to decide on SESAR deployment

End of Iris Programme: ESA assets transfer to System Owner

**OPERATIONAL SERVICE**

**European Space Agency**
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