

ESA activities on satellite communications for high latitude regions

Frank Zeppenfeldt,
frank.zeppenfeldt@esa.int
European Space Agency – Satellite Communications

- ESA
- Air Traffic Management communications at high latitudes
- Future satellite communication systems for the Arctic
- ESA study on Future Arctic Communication Requirements

Purpose of ESA: “To provide for and promote, for exclusively peaceful purposes, cooperation among European states in space research and technology and their space applications.”

ESA Member States:

- Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Norway, the Netherlands, Portugal, Spain, Sweden, Switzerland and the United Kingdom.
- Canada takes part in some projects under a cooperation agreement.
- Hungary, Romania and Poland are European Cooperating States.
- Estonia and Slovenia have recently signed cooperation agreements with ESA.



All Member States participate (on a GNP basis) in activities related to Space Science and in a common set of programmes (Mandatory programmes).

Member States choose their level of participation in Optional programmes:

- Space science
- Human spaceflight
- Exploration
- Earth observation
- Launchers
- Navigation
- Telecommunications



ESA'S 'CATALYST' ROLE

ESA is responsible for R&D of space projects. On completion of qualification, they are handed to outside entities for production and exploitation. Most of these entities emanated from ESA.

Meteorology: Eumetsat

Navigation: Galileo (with EU)

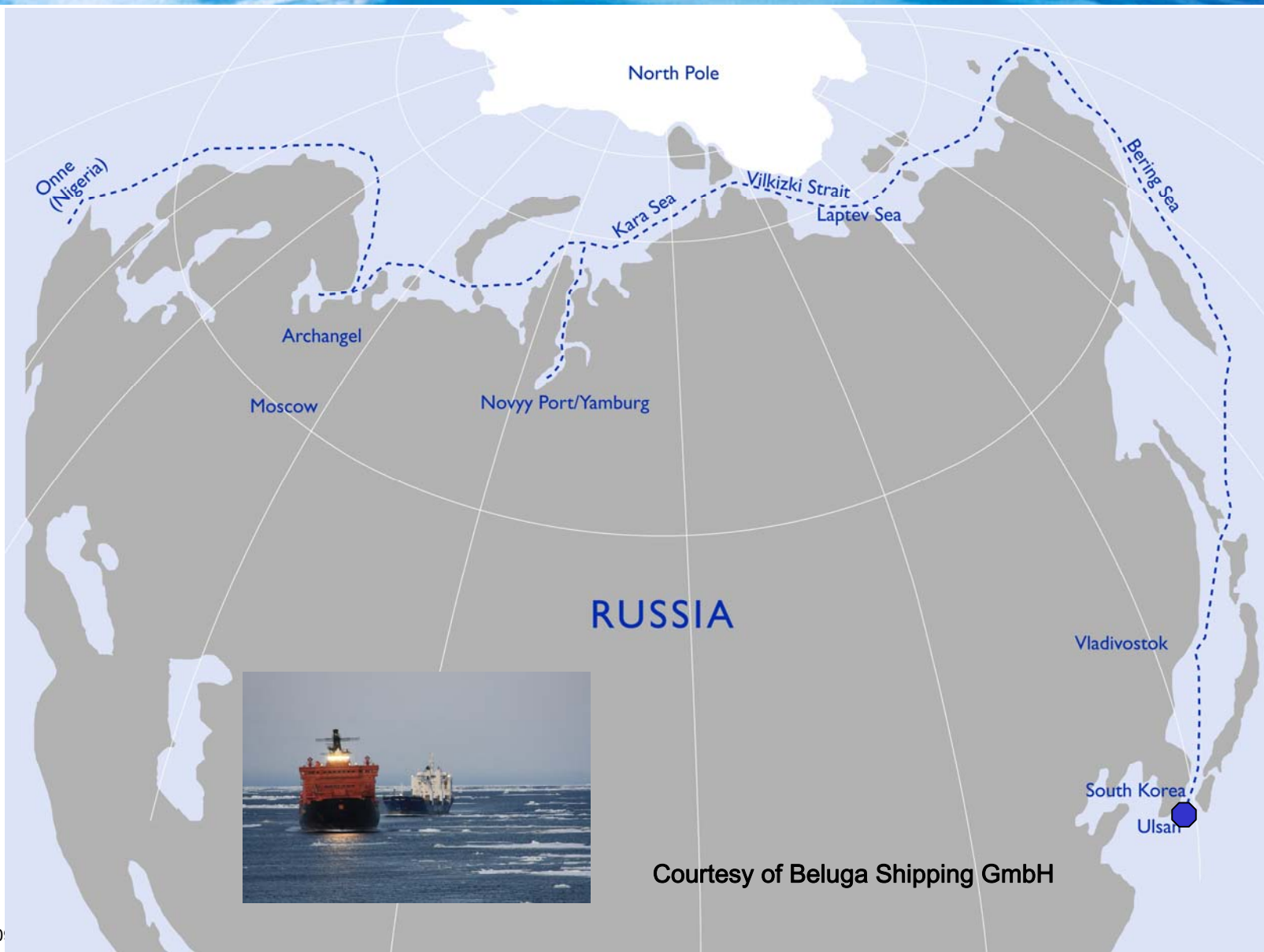
Launch services: Arianespace

Telecommunications: Eutelsat and Inmarsat



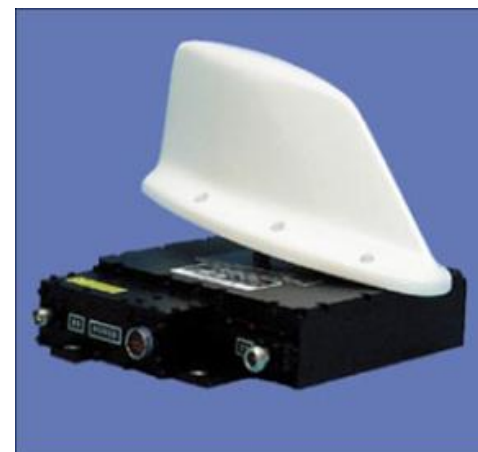
- Telecommunications gaps identified by e.g. Nordic, Canadian and Russian Arctic policies
- Arctic Council's Arctic Marine Shipping Assessment AMSA 2009 has highlighted specifically the "*...serious limitations to radio and satellite communications for voice and data transmission in the Arctic...*"
- Joint IMO/IHO/WMO Correspondence Group on the lack of proper telecommunications at higher latitudes for maritime safety, navigation and security purposes
- Gaps identified by e.g. Norwegian Space Centre/SINTEF study on user needs in the Arctic, concluding that "*there is a multitude of parties from various sectors that have an interest in improved communication means in the Arctic*"
- EC and national funded studies (e.g. MarCom, MarSafe,) have identified telecommunications gaps in the Arctic
- Increase of aircraft movements at high latitudes require improved Aeronautical Traffic Services and Aeronautical Operational Communications
- Emerging commercial shipping activity in the North East Passage (e.g. Beluga voyage Korea to river Ob via Bering street - Oct 2009)

First commercial North-east passage – September 2009

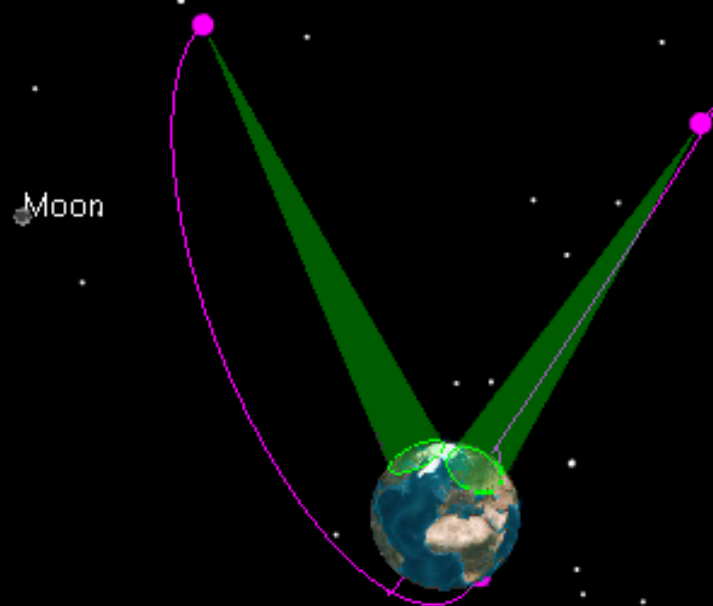


Courtesy of Beluga Shipping GmbH

- In 2006, the European Commission launched the definition phase of the SESAR Programme, which resulted in the creation of the ATM Master Plan
- Iris is a dedicated ESA programme to support SESAR, and aims to develop and validate a new System specifically designed for aeronautical Air/Ground Satcoms
- Iris' focus is on SES/ECAC service area but the communication system is foreseen to become a worldwide ICAO standard so that other world regions could implement compatible systems using the very same terminals on-board aircraft



- Iris Phase 1 concluded a.o.:
 - Communication protocols to be designed to operate with different types of satellites (GEO, LEO, HEO) so that interoperability between operators is possible
 - Costs trade-off points towards a GEO solution, but Nordic countries' request for high-latitude coverage led to consider complementary capacity from 3rd party satellites in Highly Elliptical or Low Earth Orbit.



- To investigate what is required to cover the Nordic countries and the Arctic a system study was initiated with



- Basic questions
 - What are ATM communication requirements in the Arctic?
 - What will be the typical aircraft population at high latitudes?
 - How could you implement these requirement with a satellite system?

1925 Peak Instantaneous Aircraft

Count (PIAC) = 2

1937 Valery Chkalov made a 63 hour flight from Moscow to U.S: the first polar crossing



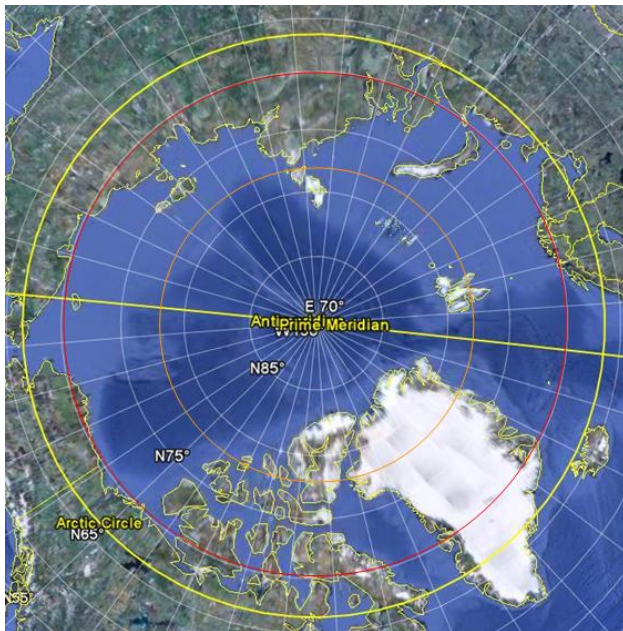
1954 SAS opens Copenhagen to Los Angeles route – taking 22 instead of 36 hours

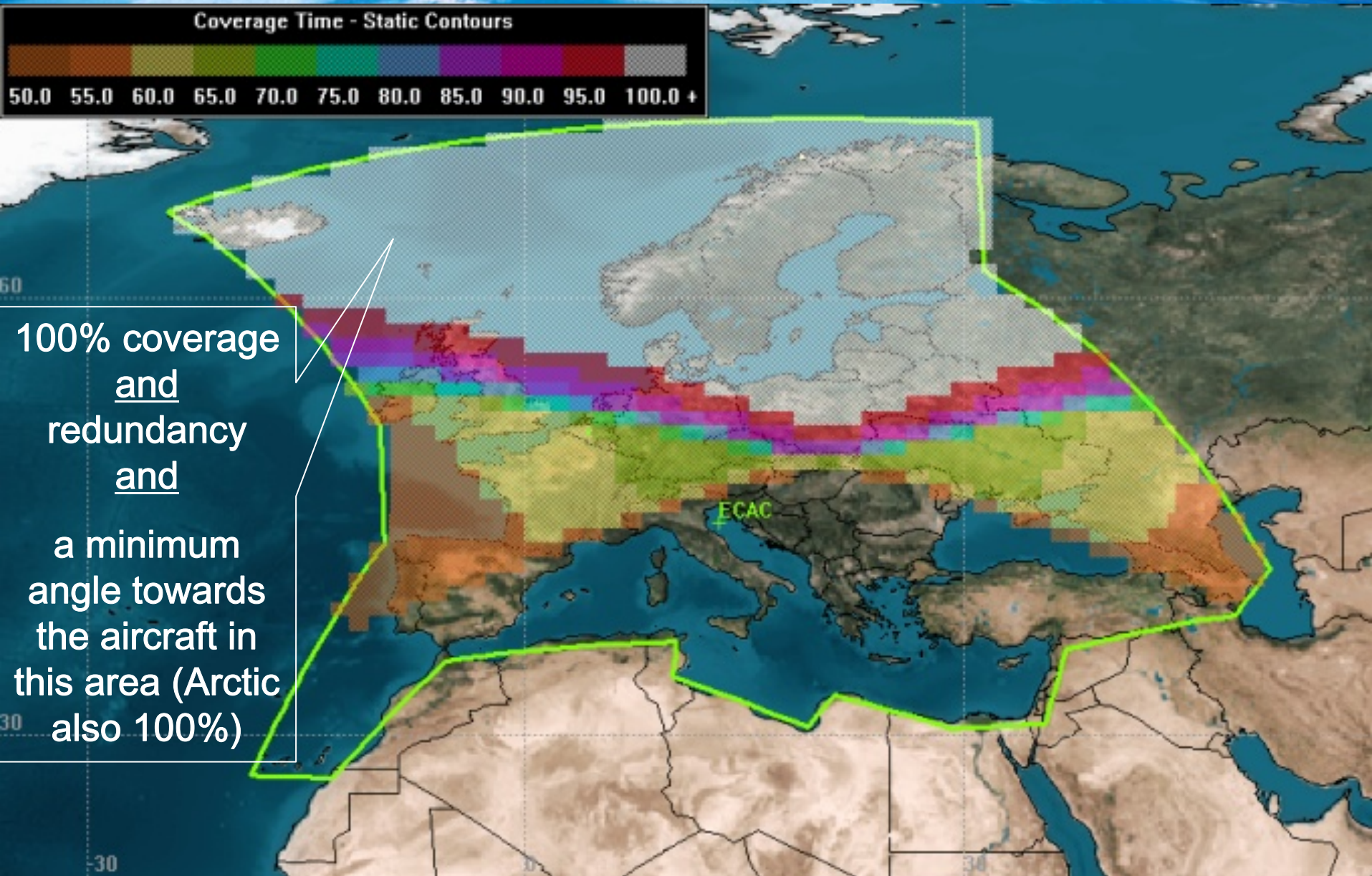
Current PIAC is between 70 and 100

In 2030 the expected PIAC=200 for 70 deg N
(assuming certain growth scenarios, and including helicopters, general aviation,...)

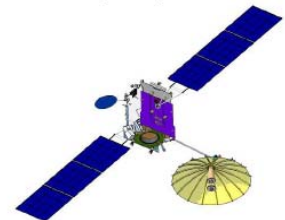
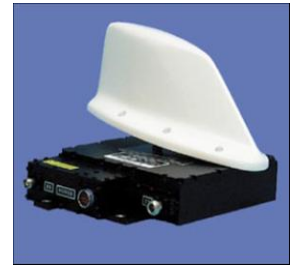
- Various categories of air traffic in the Arctic:
 - Scheduled flights incl. cargo flights
 - Non-scheduled flights incl. ambulance and SAR flights
 - General Aviation (small aircraft)
 - Helicopter flights incl. continental shelf flights
 - Military flights
- A (scheduled and non-scheduled) flight needs more or less:
 - 34 kBytes from Air Traffic Control to the aircraft
 - 16 kBytes from the aircraft to Air Traffic Control
- E.g. a helicopter going to an oilfield needs:
 - 13 kBytes from Air Traffic Control to the helicopter
 - 3 kBytes from the helicopter to Air Traffic Control

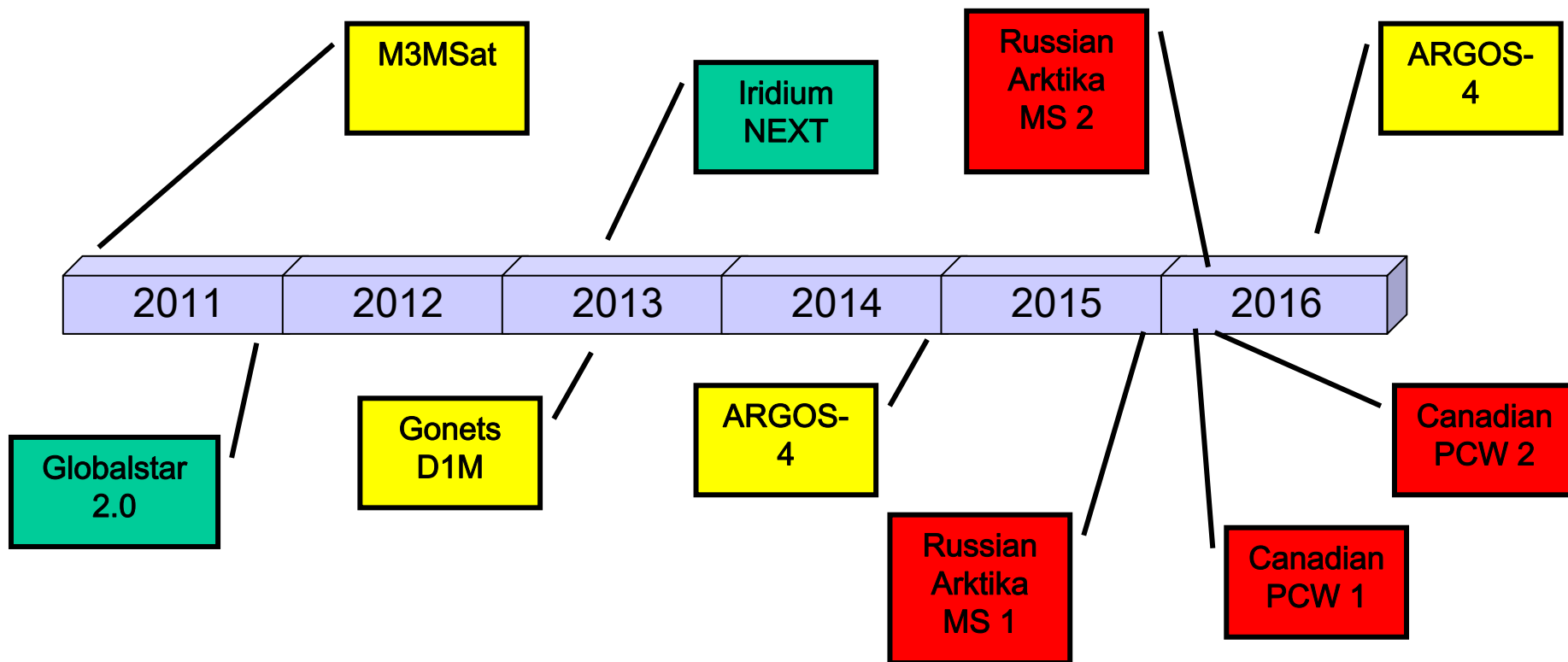
- **Required Service Coverage areas :**
 - Nordic countries: Island, Denmark, Finland, Norway and Sweden, including airspace over the ocean controlled by Norway.
 - Polar Region: mostly covered by the arctic ice-cap and ocean, which is the area above 70° N.





- To provide the required availability four satellites are required
- A fairly large satellite payload is required to provide ATM communications in the Arctic, when using the same small aircraft antennas as are foreseen for the GEO system
- Allows to start small:
 - Two satellites for covering only the polar areas to validate and certify
- Issues:
 - Need for further user requirements consolidation
 - Need to keep track of HEO requirements that might impact the GEO system (and vice versa)





Dates from public domain – could be inaccurate....

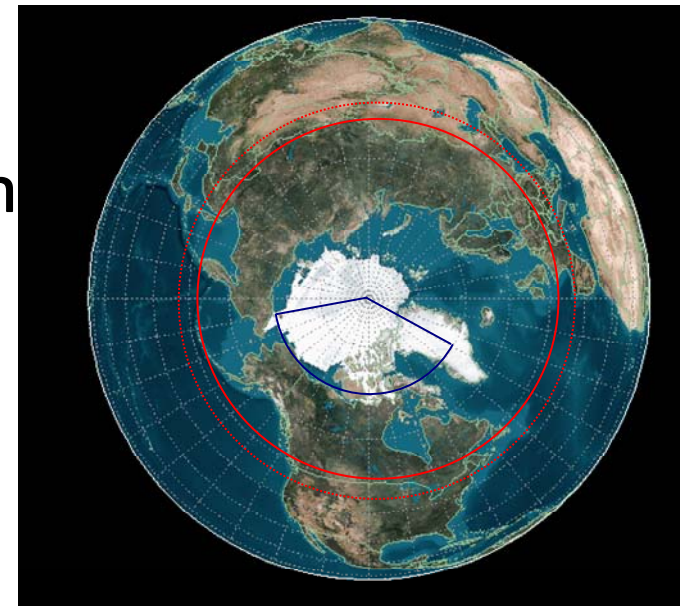
LEO –
medium bandwidth

LEO –
Messaging

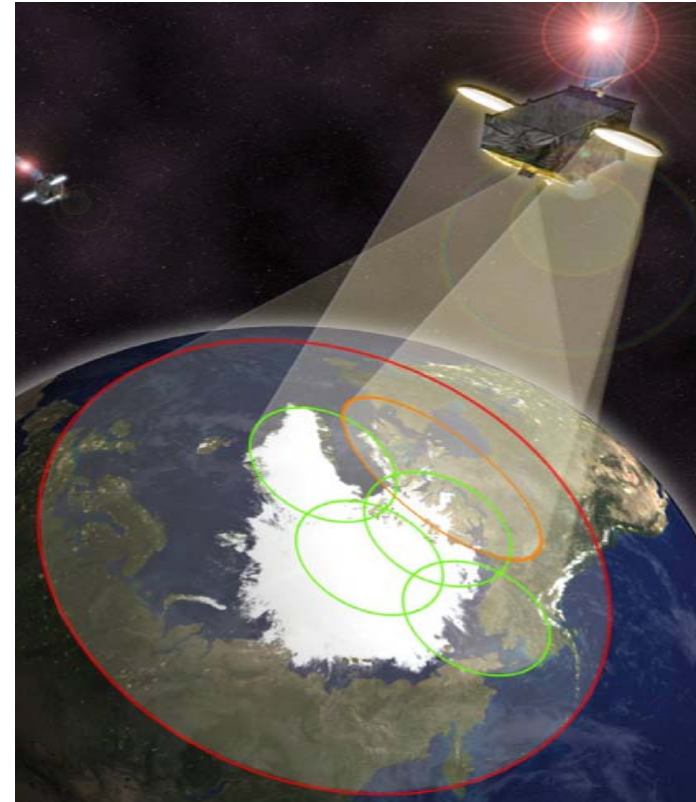
HEO –
Broadband



- **Mission Objectives Reliable communications in the high latitudes (North of 70°) to ensure:**
 - Security
 - Sustainable Development
 - Support to Northern Communities
 - Air and Marine Navigation
- **Provide high temporal/spatial resolution meteorological data above 50° N in support of:**
 - Numerical Weather Prediction
 - Environmental monitoring, emergency response
 - Climate monitoring

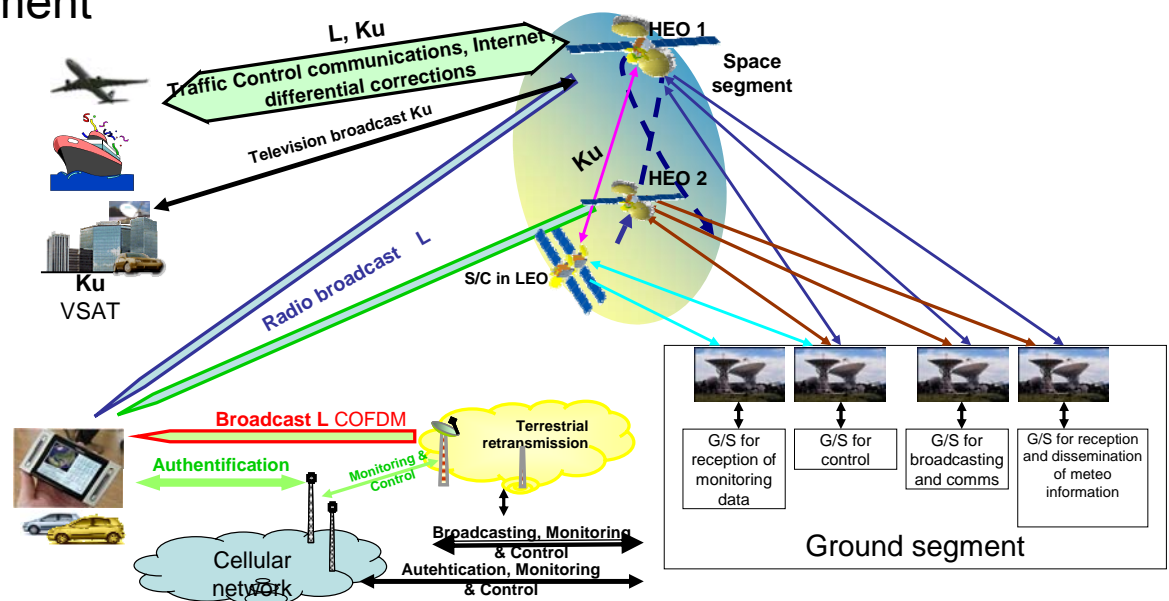


- Two satellites in Molniya orbit (12 hrs)
- Various Canadian stakeholders involved:
 - Environment Canada (EC), Dept. of National Defense (DND), Natural Resources Canada, Canadian Coast Guard, Transport Canada, NavCanada, Dept. of Indian and Northern Affairs, Gov. of Nunavut
- Ka-band communications
- Status
 - Phase A initiated
- Launch 2015 and 2016
- Cooperation opportunities
 - User requirements consolidation
 - New applications
 - Secondary payloads
 - Ground segment
 - ...

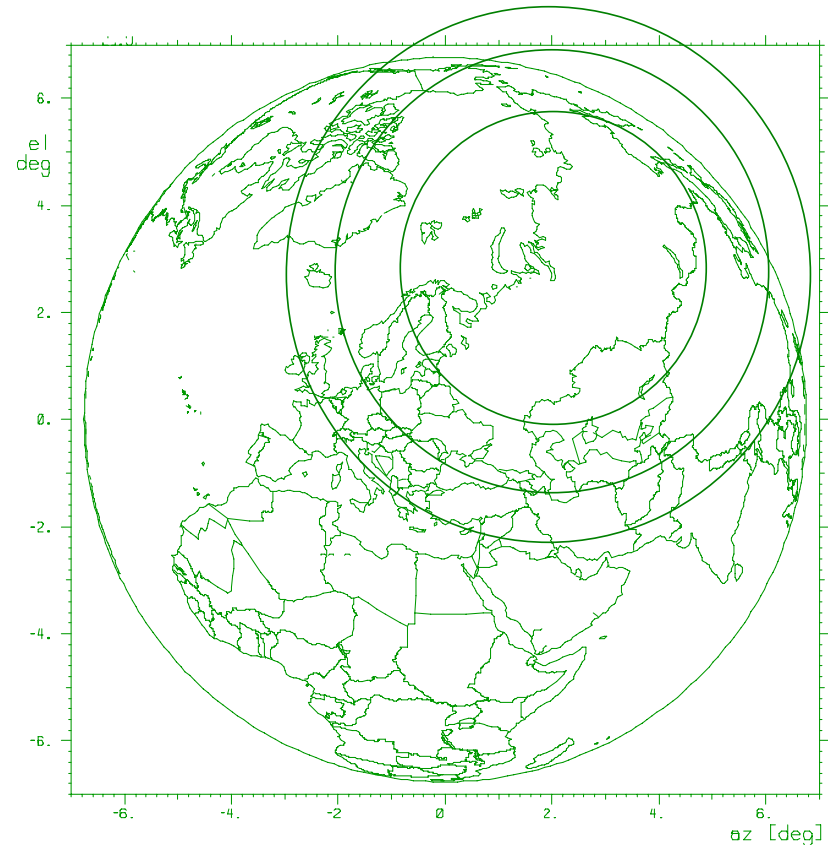


- Mission objectives

- radio and TV broadcasting to mobile and fixed receivers in L-band;
- mobile communications in L-band;
- Direct TV broadcasting in Ku and C-bands;
- Communications and data transmission in Ku and C-bands;
- Transmission of service information, differential corrections of "GLONASS";
- Vessel Traffic management
- ATM communications



- **Status**
 - User Requirements being consolidated by Ministry of Transport, Communications, ...
 - Exchanges between ESA – Russian Ministry of Communications on ATM requirements
- **Exact orbits and coverage unknown to ESA**



Proposed coverage for aeronautical communications (source: RSCC)

- **Development of wearable/textile antennas**
 - Completed development August 2009, tested with Iridium
 - Well suited for e.g. future Iridium netted-comms operations (SAR, expeditions) in Polar areas

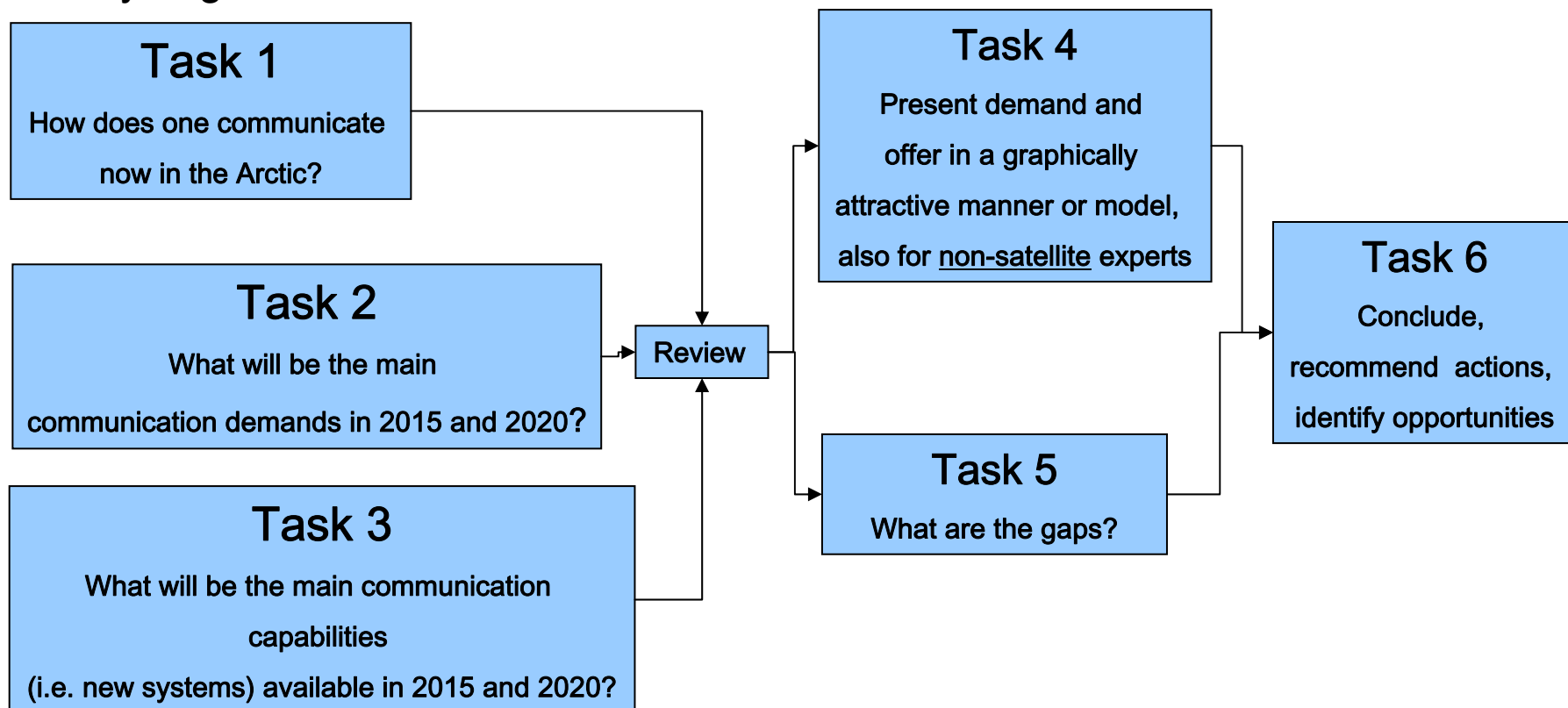


- **Worn antenna development for lower frequencies (UHF, COSPAS-SARSAT)**
 - Tender just closed – fully funded project

- Taking into account various demands as in this conference ... and a number of systems that will be operational in 2015-16
 - Will there a be general communication gap in the Arctic in 2015 or 2020?
 - Are the planned systems sufficient to satisfy European demands ?
 - If not, is there anything in which Europe and European industry can contribute?
- ESA Telecommunications will initiate a small study (200 k€) to investigate this

- Objectives
 - provide a status quo of satellite communications needs and practices in the Arctic
 - describe in detail the communication needs in 2015 and 2020 for maritime, security, safety, navigation, commercial shipping, exploration, environmental, purposes
 - describe in detail which of those demands can be met using satellite systems that are operational in 2015 and 2020
 - illustrate in a graphically attractive and interactive manner the demand and the offer
 - highlight the gaps that cannot be fulfilled by systems operational in 2015 and 2020
 - propose actions for European industry and ESA

- Duration 6 months, 200 k€, fully funded
- Invitation to Tender out 1st week of November, study start Jan 2010
- Study Logic



- We will design a geostationary satellite system for ATM communications: this system will need to be interoperable with a future system over the Polar areas.
- It is not likely that an “ATM-only” HEO satellite will ever be launched: therefore we encourage “intelligent” combination of e.g. hosted payloads, systems complementing each others coverage,
- Whatever new applications or requirements will be stated for the Arctic: communications will always be part of it and is often the glue of future systems
- We want to understand more about possible communication requirements which cannot be solved with planned systems; we will launch a study on this in two weeks: comments/criticism/suggestions very welcome !

- More information on ESA's Iris Programme on <http://telecom.esa.int/iris>
- General ESA telecom information on: <http://telecom.esa.int/>
- Invitation to Tender for Arctic Communications study will be on: <http://emits.esa.int/>
- **Contact information:**
Frank Zeppenfeldt (frank.zeppenfeldt@esa.int)
ESA Satellite Telecommunications
PO Box 229 Noordwijk NL-2200AG
T: +31 71 565 4376