

# Polar Communications & Weather (PCW) Mission Overview

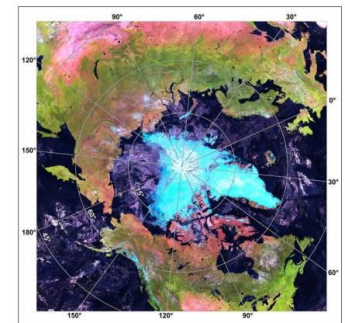
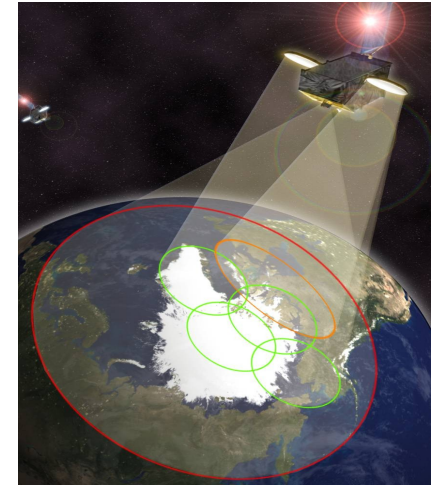


**Bastien Dufour**  
**(Canadian Permanent Delegate to ESA)**  
Presentation to Workshop on the  
Future of Space Cooperation in the Arctic Region  
8 December 2010



# Mission Objectives

- **Reliable communications services** (above 70° N) to ensure:
  - Security
  - Sustainable Development
  - Support to Northern Communities
  - Safety of the Air and Marine Navigation
  - Arctic Science
- **High temporal/spatial resolution meteorological data** (above 50° N) in support of:
  - Numerical Weather Prediction (short to medium range)
  - Environmental monitoring, emergency response
  - Climate change monitoring
- **Space weather monitoring**



# Users & Science Team

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## Canadian Members

- Communications Research Centre (CRC)
- Department of Fisheries and Oceans (DFO)/Coast Guard
- Department of Foreign Affairs and International Trade Canada (DFAIT)
- Department of National Defence (DND)
- Environment Canada (EC)
- Indian and Northern Affairs Canada (INAC)
- Natural Resources Canada (NRCan)

## International Members

- Transport Canada (TC)
- European Centre for Medium-Range Weather Forecasts (ECMWF)
- European Space Agency (ESA)
- Finnish Meteorological Institute (FMI)
- Joint Center for Satellite Data Assimilation (JCSDA)
- National Oceanic and Atmospheric Administration (NOAA)
- National Aeronautics and Space Administration (NASA)
- Sweden's Meteorological and Hydrological Institute (SMHI)



# Why Arctic Communications?

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- GEO satellites do not offer reliable connectivity above 70-72° latitude, especially for mobile applications.
- Polar orbiting LEO satellites do not offer adequate broadband communications.
- This leaves a part of the Canadian Area of Interest in the Arctic region without access to secure, highly reliable and high capacity telecommunications services.



# Comms Objectives

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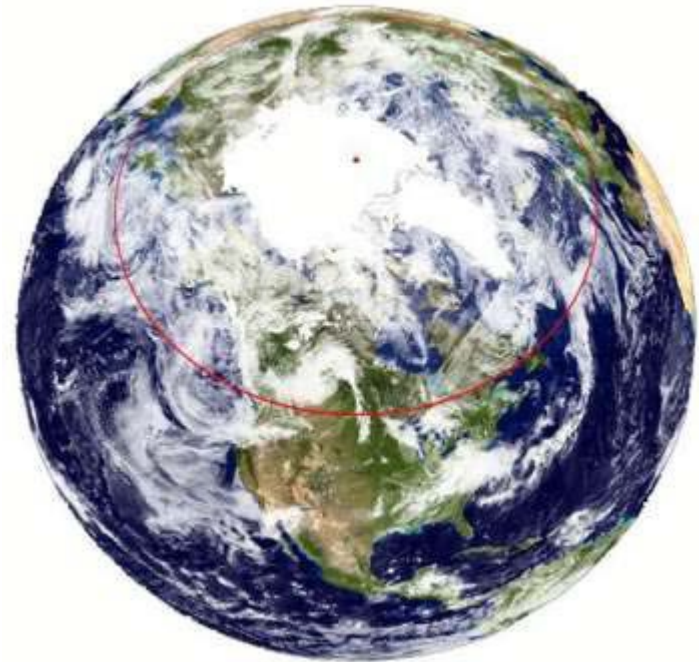
- Seamless 24/7 broadband, two-way connectivity to allow uninterrupted data (IP) transfer, as well as video-conferencing and imagery transfer.
- Support to science, resource exploration and exploitation activities, and Search and Rescue operations.
- Interoperability with existing communications services.
- Support to icebreakers and marine navigation in the Arctic.
- Potential support to Air Traffic Management (ATM) and E-Navigation.



# Why Met Measurements?

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- Continuous 24/7 meteorological observation of the entire Arctic with high temporal resolution is necessary for timely weather advisories and more specifically for obtaining information about tropospheric winds which define the atmospheric circulation around the circumpolar domain.





# Met Objectives

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- Improve weather forecasting, modeling and environmental monitoring:
  - by continuous observations of the Arctic to produce high quality radiometric data currently unavailable or available with insufficient spatial or temporal resolution.
- Improve monitoring of climate related variables:
  - to increase understanding of climate change and improve the capability to model feedback processes associated with it.
- Contribute to the monitoring and forecasting of space weather:
  - which refers to the continuously changing conditions in the energetic particle and electromagnetic environment in the vicinity of Earth and which have hazardous impacts on space-borne and ground-based infrastructure & human health.
- Enhance Canada's contributions to:
  - World Meteorological Organization's (WMO),
  - World Weather Watch (WWW), and
  - Global Earth Observing System of Systems (GEOSS).



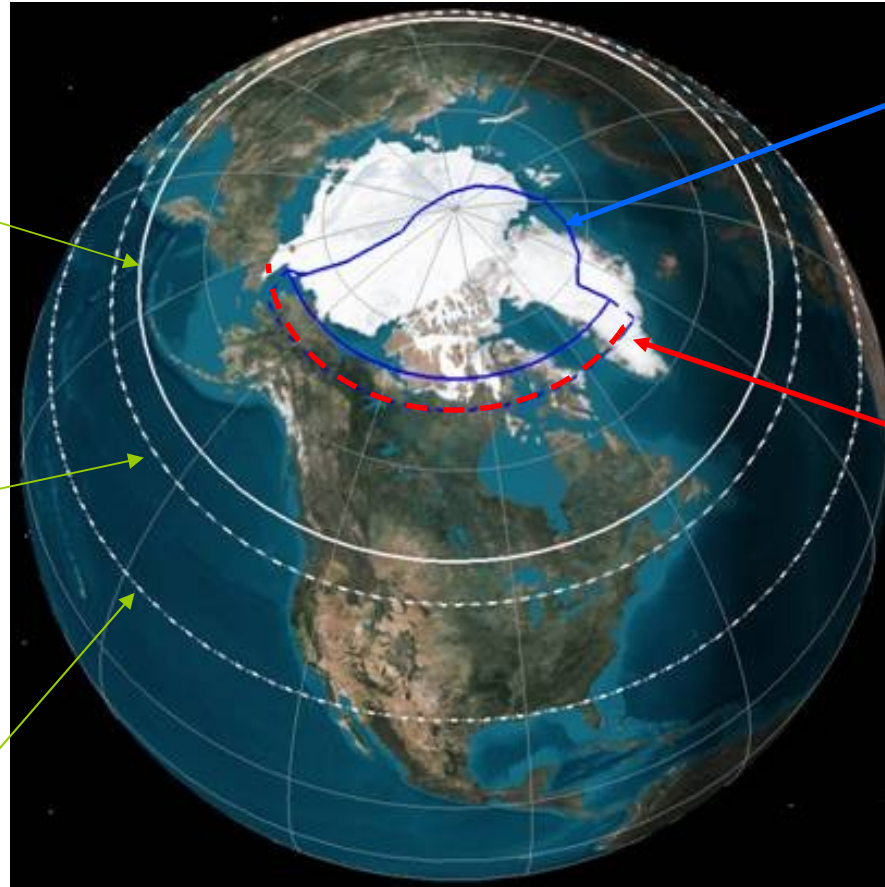


# Areas of Interest (AoI)

Meteorological  
AoI: requirement  
>50° N: will  
provide Level 1b  
and 1c data that  
meets quality  
requirements

Meteorological  
AoI: goal >45° N:  
will aim to provide  
Level 1b and 1c  
data that meets  
quality

Image quality  
requirements met  
for viewing angles  
(local zenith  
angle) >70°



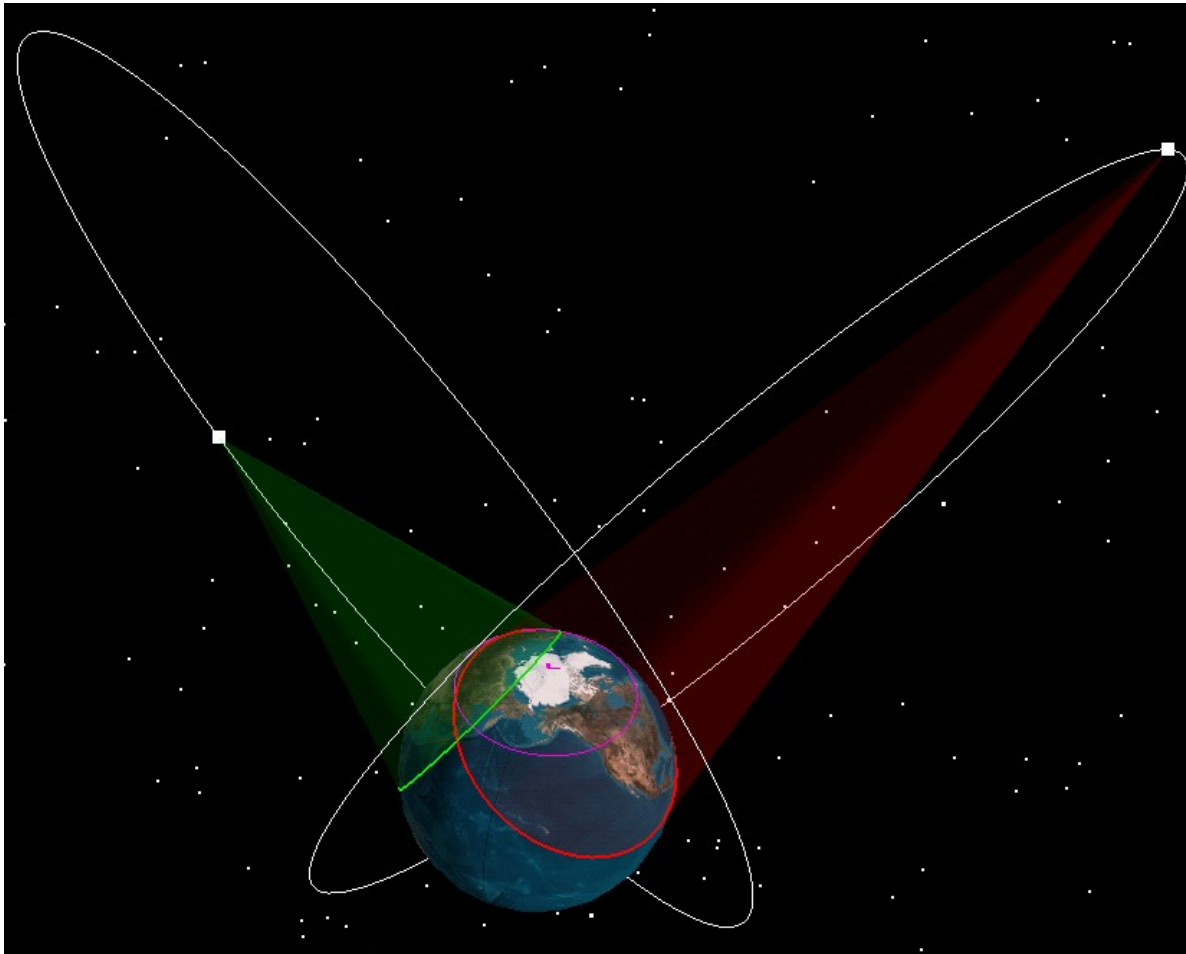
Communications AoI  
requirement >70° N  
and extending at  
least 1000 NM from  
Canadian land mass

Communications  
AoI Goal >66° N





# Mission Overview



## **2 HEO satellites to provide:**

Continuous GEO-like imagery above 50° N (refresh rate 15 minutes)

24/7 High data rate communication services in Ka-band and X-band

12h period

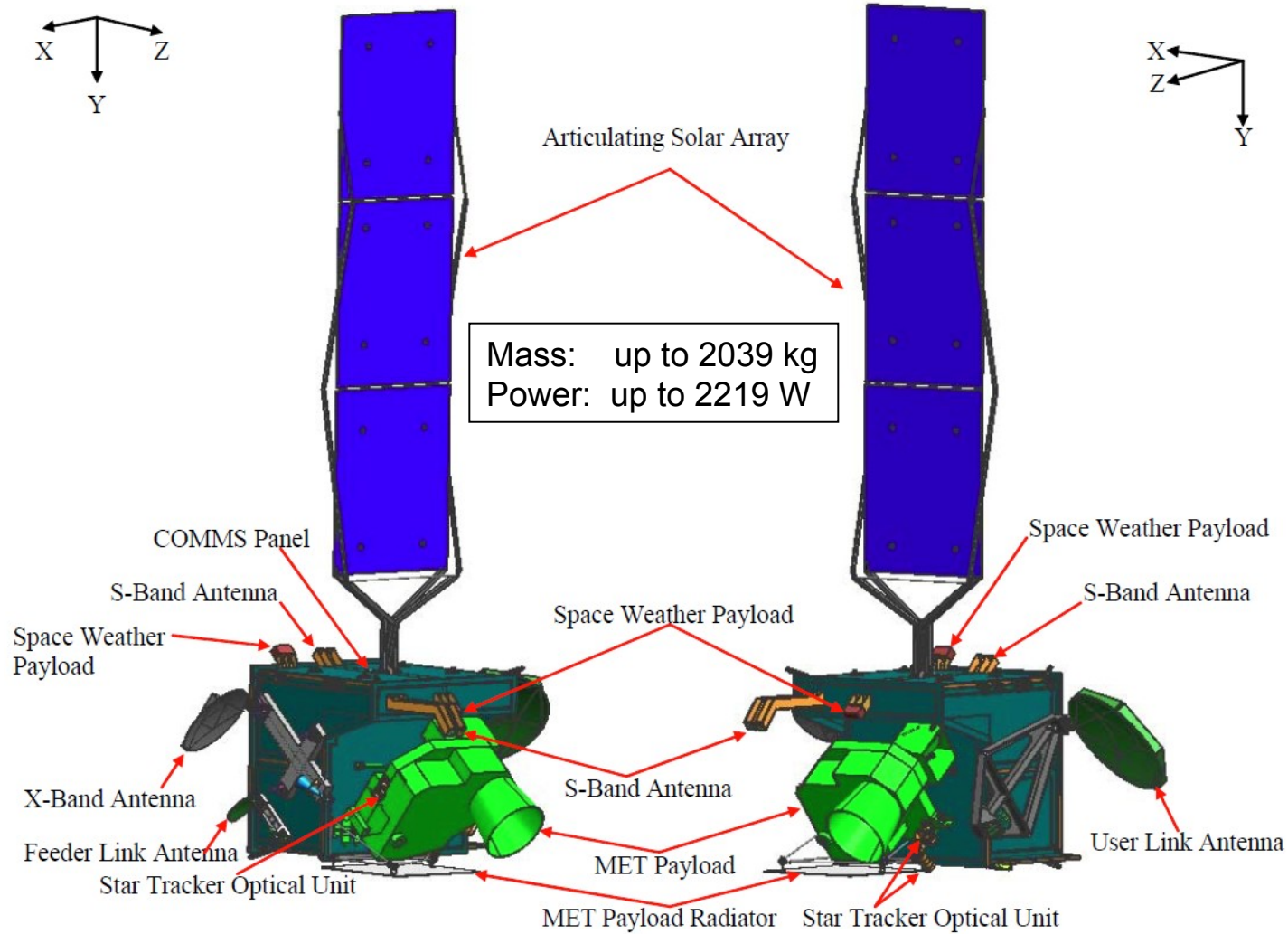
63.4° Inclination

Apogee: ~39,500 km

Perigee: ~550 km



# Spacecraft Concept





# Met Payload



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- Primary meteorological instrument will be an imaging spectroradiometer, similar to imagers now being developed for the next generation of geostationary meteorological satellites [e.g., NOAA GOES-R and European METEOSAT Third Generation (MTG) platforms].
- Space weather payload is intended to be a compact suite of instruments to monitor *in situ ionizing radiation*.
- Measurements to focus on:
  - Clouds (3 layers), including wind
  - Humidity
  - Sea surface temperature
  - Albedo of the surface
  - Ozone total content
  - Aerosol optical depth
  - Surface skin temperature
  - And more



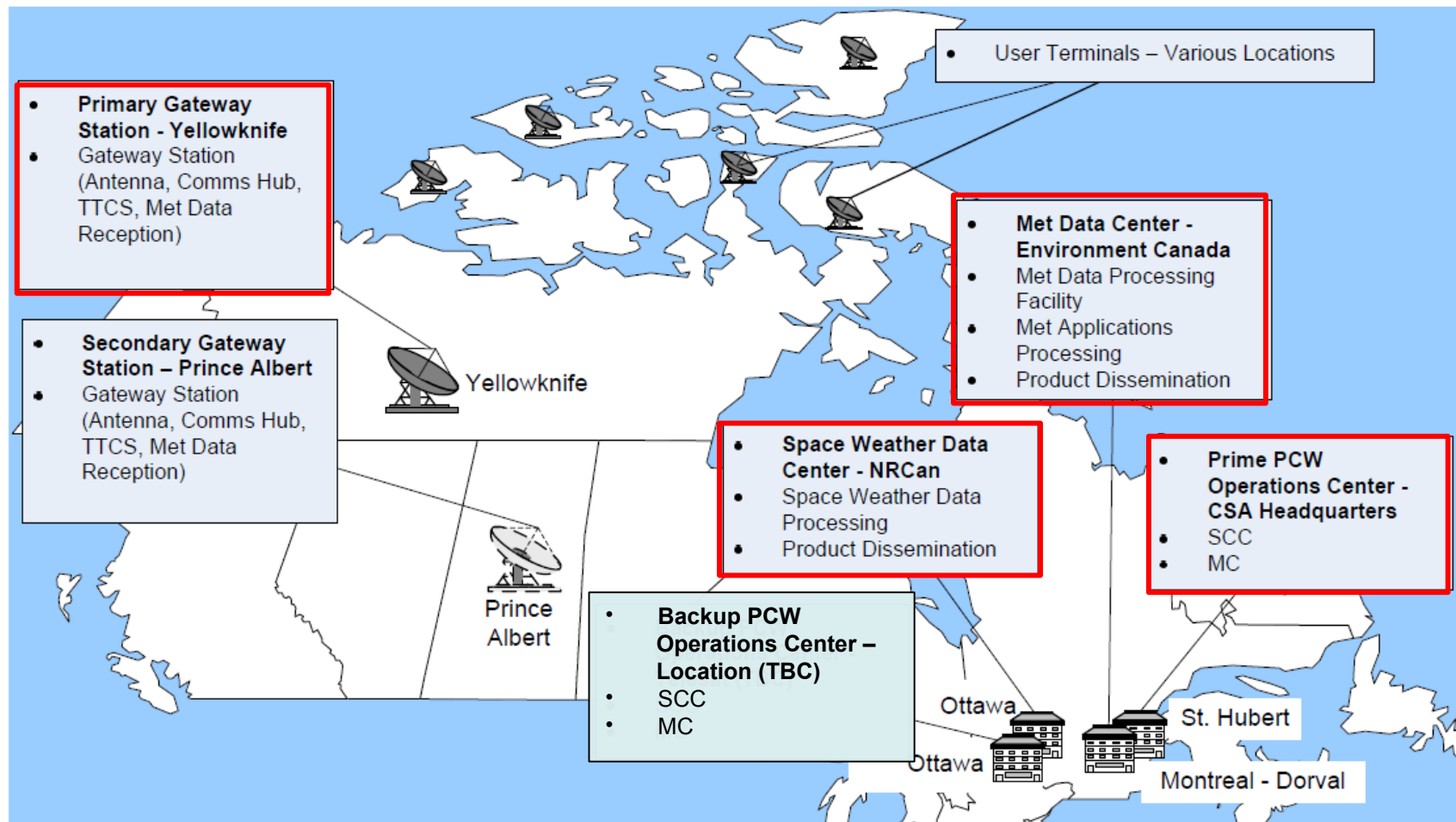
# Comms Payload

- X-band, commercial Ka-band, and government Ka-band planned.
- Ka-band is also to support downlink for met data.
  - Forward Link: 4 commercial channels + 4 government channels.
  - Return Link: 1 commercial channels + 1 government channel + 1 mesh channel.
- Coverage Areas
  - Ka-band: to be served by 4 user beams and one gateway beam.
  - X-band: to consist of one user beam with re-use of Ka-band gateway beam.

Frequency Band	Earth to Space 	Space to Earth 
Military X Band*	7.9 – 8.4 GHz	7.25 – 7.75 GHz
Commercial Ka Band	29.5 – 30.0 GHz	19.7 – 20.2 GHz
Military Ka Band	30.0 – 31.0 GHz	20.2 – 21.2 GHz



# Ground Segment





# Project Status

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- Phase 0 completed: September 2008
- Phase A Approved: November 2008
- Phase A contract awarded: July 2009
- Phase A contract close out: March 2011
- Critical Technologies development contracts award: January 2011
- Phase B/C/D contract award: April 2012 (TBC)
- Launches: 2017 (TBC)





# Potential Partnership Venues

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- Contribution to the U&ST:
  - Refine observation and communications requirements
  - Identify new applications and products
  - Ensure compatibility with GEO data and services
  - Explore opportunities in the areas of overlap of GEO and HEO coverage
- Launch procurement
- Spacecraft/payloads subsystems and/or critical components
- Enhanced mission's communications, GNSS, ATM, meteorological, science or technology demonstration payload and its data processing or service delivery
- Ground segment:
  - Back-up TT&C, data reception, and gateway stations
  - Data processing and applications



# Questions?

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