International Space Systems Standards & Interoperability
Critical enablers for International Space Mission Collaboration

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CCSDS Workshop
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**GEOSYNCHRONOUS ORBIT**
Approximately 36,000 km / 22,000 mi

**MID-EARTH ORBIT**
Approximately 2,000 - 36,000 km / 1,240 - 22,000 mi

**LOW EARTH ORBIT**
Approximately 2,000 km / 1,240 mi

**INTERNATIONAL SPACE STATION**
Distance: 400 km / 248 mi
Travel Time: 2 Days

**MARS**
Distance: 54,500,000 km / 33,900,000 mi
Travel Time: 6 Months

**MOON**
Distance: 382,500 km / 237,674 mi
Travel Time: 3 Days
International Manned Spaceflight – Apollo Soyuz

SPACE SHUTTLE
The International Space Station
The First Step In Exploration
International Space Station

- International Partnership
  ASI/ESA/JAXA/CSA since 1980s,
  Roskosmos since 1993
- Builds on long history of
  international cooperation
  - Shuttle
  - Numerous science
    missions
- Largest spacecraft ever built
  - 420,500 kg at completion
  - Over 40 assembly flights
- International crew
- International launch fleet
- International servicing vehicles
- Globally distributed operations

Image Credit: NASA. Pre-launch processing of the MIM1 module in Florida.
SWIFT

Objectives
- Study 100s of GRBs during mission
- Determine origin of GRBs
- Explore environment near GRBs
- Use GRBs to probe the Universe
- Perform all-sky hard X-ray survey
- Rapidly re-pointing spacecraft
  - ~ 1 minute automated response
- Quick response to Targets of Opportunity
- Data distributed immediately to astronomical community
- Burst alerts in seconds
- Follow-up observations in a day

First NASA mission to use SpaceWire
James Webb Space Telescope (JWST)

Organization
- Mission Lead: **Goddard Space Flight Center**
- International collaboration with **ESA & CSA**
- Instruments:
  - Near Infrared Camera (NIRCam) – Univ. of Arizona
  - Near Infrared Spectrograph (NIRSpec) – ESA
  - Mid-Infrared Instrument (MIRI) – JPL/ESA
  - Fine Guidance Sensor (FGS) – CSA
- Operations: Space Telescope Science Institute

Description
- Deployable infrared telescope with 6.5 meter diameter segmented adjustable primary mirror
- Cryogenic temperature telescope and instruments for infrared performance
- Launch June 2017 on an ESA-supplied Ariane 5 rocket to Sun-Earth L2
- 5-year science mission (10-year goal)

JWST Science Themes
- End of the dark ages: First light and reionization
- The assembly of galaxies
- Birth of stars and proto-planetary systems
- Planetary systems and the origin of life

www.JWST.nasa.gov
MARS EXPLORATION
Mars Science Laboratory

- MSL’s rover, Curiosity, landed on Mars on August 6 at 1:32 am EST. NASA’s Deep Space Communications Complex provides the communication support to Curiosity.
Curiosity Spotted by the Orbiter
Launched August 12, 2005, is on a search for evidence that water persisted on the surface of Mars for a long period of time. While other Mars missions have shown that water flowed across the surface in Mars' history, it remains a mystery whether water was ever around long enough to provide a habitat for life.

Launched on June 2, 2003, ESA’s Mars Express orbiter will play a key role in an international exploration program spanning the next two decades.

Both vehicles serve as internationally interoperable data relays.
SCaN Networks

Manned Missions

Sub-Orbital Missions

Earth Science Missions

Space Science Missions

Lunar Missions

Solar System Exploration

Alaska Satellite Facility
Fairbanks, Alaska

Poker Flat & North Pole, Alaska

USN Alaska

Partner Station: Gilmore Creek, Alaska

USN Hawaii
South Point, Hawaii

White Sands Complex
White Sands, New Mexico

Goldstone Complex
Fort Irwin, California

Merritt Island Launch Annex
Merritt Island, Florida

Wallops Ground Station
Wallops, Virginia

McMurdo Ground Station
McMurdo Base, Antarctica

Kongsberg Satellite Services (KSAT)
Svalbard, Norway

Swedish Space Corp. (SSC)
Kiruna, Sweden

German Space Agency (DLR)
Weilheim, Germany

Guam Remote Ground Terminal
Guam, Marianna Islands

USN Australia
Dongara, Australia

Canberra Complex
Canberra, Australia

Satellite Applications Center
Hartebeesthoek, Africa

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SCaN Future Goals and Challenges

Goal
To detail the high level SCaN integrated network architecture, its elements, architectural options, views, and evolution until 2025 in response to NASA’s key driving requirements and missions. The architecture is a framework for SCaN system evolution and will guide the development of program requirements and designs.

Challenges
• Forming an integrated network from three pre-existing individual networks
• Resource constraints
• Addressing requirement-driven, capability-driven, and technology-driven approaches simultaneously
• Interoperability with U.S. and foreign spacecraft and networks
• Uncertainty in timing and nature of future communications mission requirements
• Requirements for support of missions already in operation, as well as those to which support commitments have already been made
• Changes in high level requirements and direction
SCaN Network Architecture by ~2020
Enabling International Collaboration

SCaN represents NASA at international fora related to space communications and navigation issues. These include:

- Interoperability Plenary (IOP)
- Interagency Operations Advisory Group (IOAG)
- Space Frequency Coordination Group (SFCG)
- Consultative Committee for Space Data Systems (CCSDS)
- International Telecommunications Union (ITU)
- International Committee on Global Navigation Satellite Systems (ICG)
- Other foreign space agencies
Organizations Enabling International Interoperability

Legend:
- **Member**
- **Observer**
- **Subcommittee**
- **Requirements Organizations**
- **Standards Organizations**
500 Years of Exploration Technology
Human Space Exploration

Incremental steps to steadily build, test, refine, and qualify capabilities that lead to affordable flight elements and a deep space capability.
Exploration Systems Development

- The Space Launch System (SLS)
- The Orion Multi-Purpose Crew Vehicle (MPCV)
- The Ground Systems Development and Operations (GSDO)
Exploration, Continuing the Journey
Dreamers
The work the CCSDS does is fundamental to achieving International Space Missions.

Thanks for your important work and lets keep moving forward together!
For more information visit NASA:
www.nasa.gov
or
Space Communications and Navigation (SCaN):
www.spacecomm.nasa.gov