IND Cross Support, International, Commercial Collaboration & Strategic Planning

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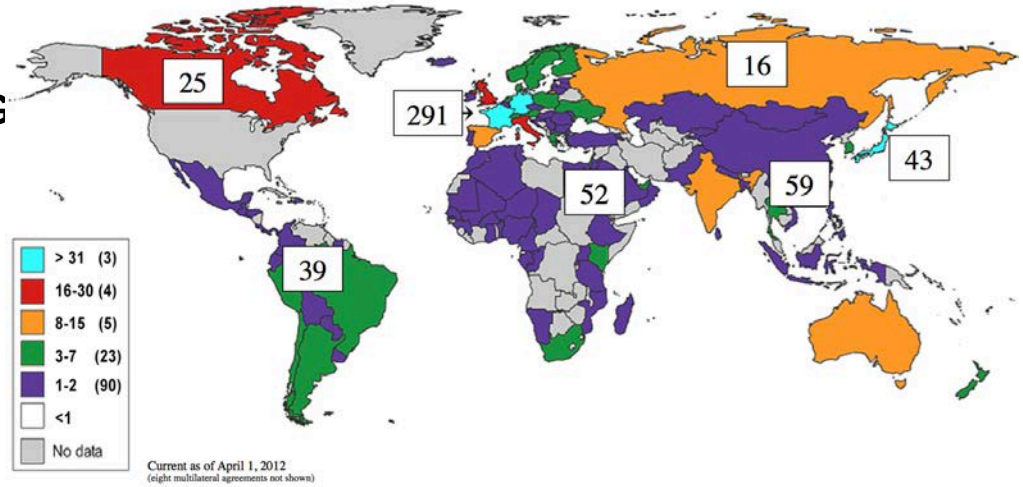
International Collaboration at NASA

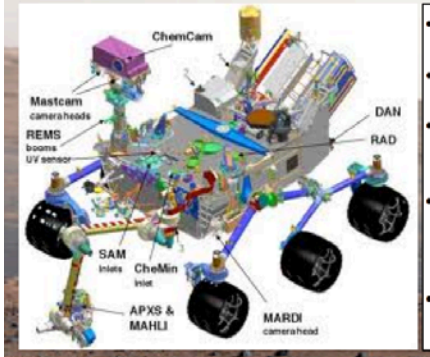
- **International collaboration has been part of NASA since its inception**
  - **Directed by the 1958 National Aeronautics and Space Act**
    - **NASA will cooperate with other nations & disseminate information broadly**
  - **Goal of the 2010 National Space Policy: Expand international cooperation on mutually beneficial space activities to**
    - **Broaden and extend the benefits of space**
    - **Further the peaceful use of space**
    - **Enhance collection & partnership in sharing of space-derived information**
  - **Reaching out to non-traditional partners with more limited national resources**
- **Current international collaboration**
  - **~600 active international agreements**
  - **8 partners account for 50% of agreements (France, G ESA, Japan, UK, Italy, Canada, Russia)**
  - **2/3 are in science missions**
  - **1/2 are with partners in Europe**



Guidelines & Challenges

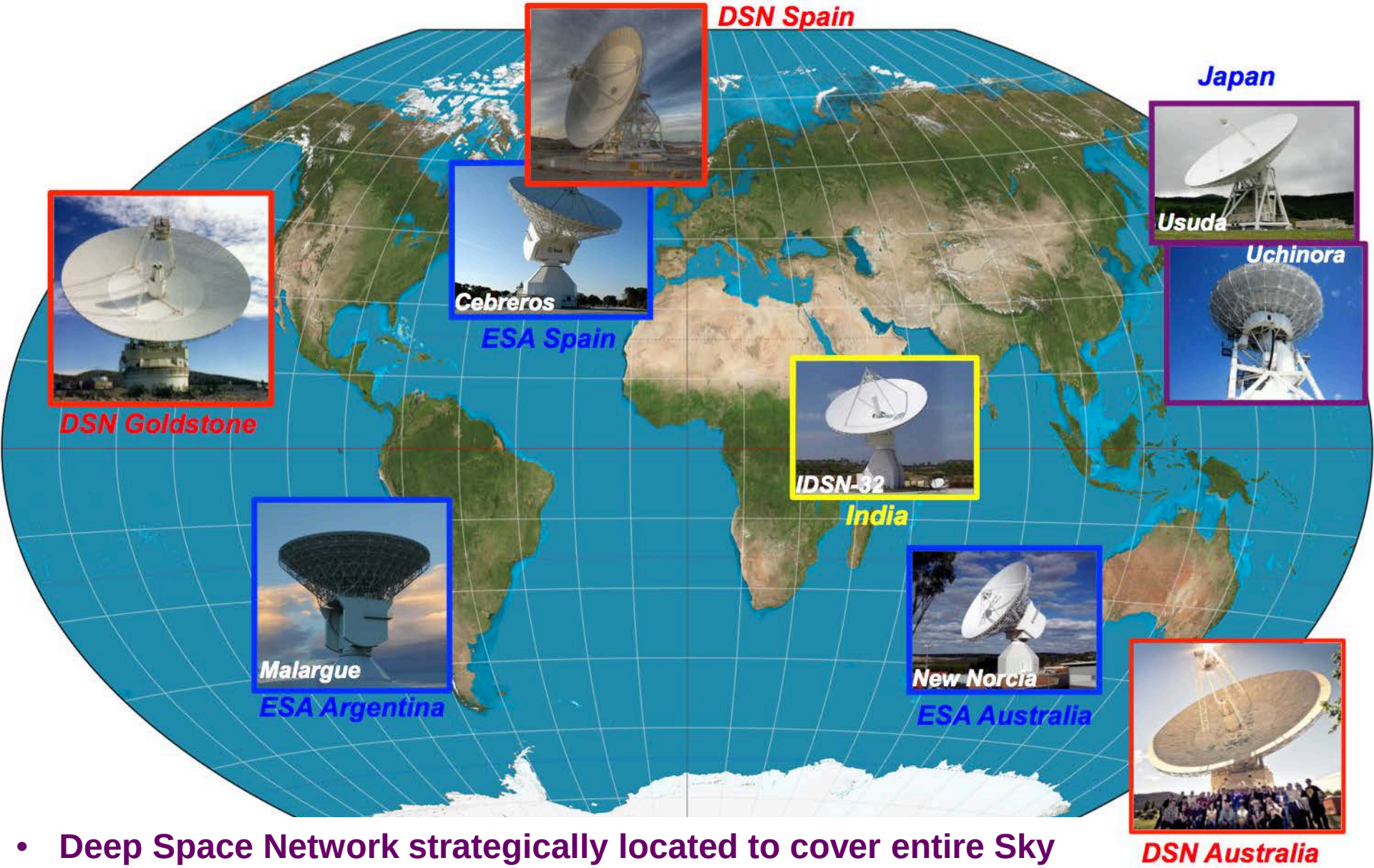
- **Guidelines**
  - NASA international partners are government agencies due to the significant level of investment and legal requirements
  - Each partner funds respective contributions, but need not be equivalent
  - Cooperation must be consistent with U.S. foreign policy objectives
  - Must have scientific and technical merit & demonstrate benefit to NASA
  - Structured to protect against unwarranted technology transfer
  - Establish clearly defined managerial and technical interfaces
  - Binding agreements closely coordinated with other U.S. government agencies
- **Challenges**
  - Management complexity & communications difficulties
  - Difficulty to monitor progress
  - Political and budgetary uncertainties
  - Missile technology and other non-proliferation concerns

Mars Science Laboratory includes international involvement from 13 countries with instrument contributions from 5



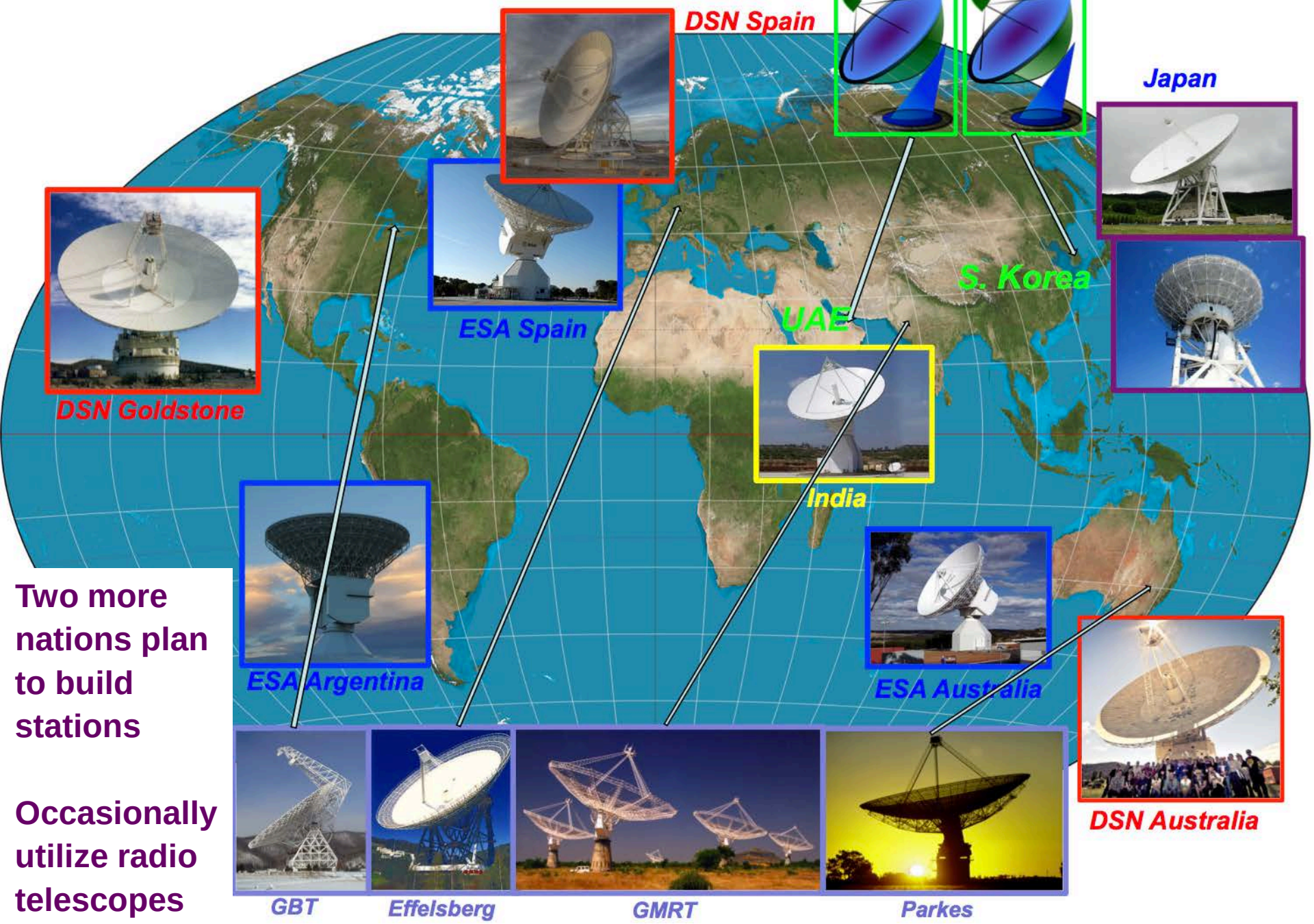
- Russia: Dynamic Albedo of Neutrons (DAN) Investigation
- Canada: Alpha Particle X-Ray Spectrometer (APXS)
- Spain: Remote Environmental Monitoring Station (REMS) and High-gain Antenna Hardware
- France: Significant contributions to the Chemistry and Micro-Imaging (ChemCam) and Sample Analysis at Mars (SAM) Instrument Suites
- Germany: Contributions to the Radiation Assessment Detector (RAD)

IND / DSN International Collaboration I



- Deep Space Network strategically located to cover entire Sky
- Three partner agencies added deep space stations

IND / DSN International Collaboration II

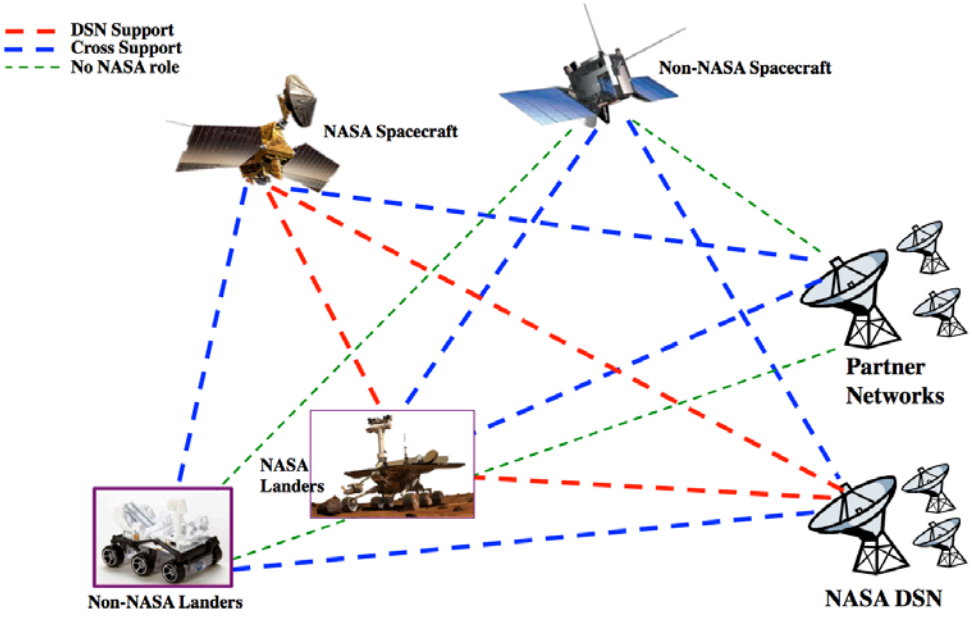


Two more nations plan to build stations

Occasionally utilize radio telescopes

Benefits of International Collaboration

- **Cost Benefits**
  - Meet redundancy requirements for critical events or DDOR
  - Agencies utilize existing partner assets to balance their needs
- **Mission Benefits**
  - Quick response to reduce risks
  - Enable or enhance science
- **Collaborative Benefits**
  - Foster international collaboration to benefit agencies and science community
  - Share valuable experience and share in discoveries and excitement



NASA's Cross Support Agreements

- Space Communications and Navigation (SCaN) is responsible for arranging all bi-directional cross-support services as well as proposed MOUs or LOAs
- SCaN is responsible for ensuring all communications support for NASA missions, whether using SCaN assets or non-NASA assets
- **Cross-Support Agreement (CSA)** is a SCaN umbrella **Space Act Agreement** for a quid pro quo trade (provisions for partial exchange of funds)
- CSA ensures a SCaN representative is responsible for negotiating service requests in both directions
- Bilateral cross-support agreements are the logical first step towards a long-term vision for deep space communications via a confederation of International Partners, an ***international village of tracking services***
- SCaN would like to eventually move to a confederated space communications network with ESA, JAXA, ISRO, and others

Advantages of a Cross-Support Agreement

In addition to benefits listed above (cost, risk, collaboration), CSA:

- Enables provision of DSN services for non-NASA missions and the exchange of cross-support services by alternate assets for NASA mission
- Ensures SCaN is single POC for cross-support requests in either direction
- Ensures uniform policy and parity for agreements across all agencies and missions
- Ensures generic, standardized cross-support interfaces for reduced costs
- ***Avoids making mission-to-mission agreements for network services***
- Allow potential transfer of funds between agencies and/or the exchange of service

- **Drawbacks of Some Existing Practices**
  - Individual mission-specific agreements sometimes lack input from SCaN or JPL
  - Technical feasibility and network availability are not fully assessed
  - Poor overall equitable exchange of services and lack of accounting and specificity
  - Difficult to plan for the needed support
  - Challenge for auditors to assess how NASA is balancing its agreements

NASA vs. JPL Responsibilities

- SCaN is the responsible program office for all of NASA's space communications activities, including network cross-support services, including:
  - Requesting tracking service cross-support from non-DSN assets for NASA missions
  - Responding to cross-support requests from non-NASA missions for SCAN services
  - Owning the network cross-support processes and policies
  - Acting as the HQ Liaison Officer for requesting and arranging bi-directional cross-support services, regardless of agreement mechanism (MOU or CSA)

- The DSN is responsible for:
  - Establishing technical need and feasibility of non-NASA assets to meet requirements
  - Establishing generic infrastructure and standardized data and operations interfaces for cross-support services
  - Supporting SCaN CSA Liaison Officer with cross-support requests, technical requirements, high level guidelines, implementation and accounting policy decisions
  - Providing planning, integration, implementation, validation, and execution of bi-directional, network cross-support services for NASA and non-NASA missions

Key Points

- **International Collaboration & Cross-Support serves the conditions**
  - **NASA missions needing non-DSN support, foreign or domestic**
  - **Non-NASA missions, foreign or domestic, needing DSN support**
- **Three Categories**
  - **Reimbursable**
  - **Generic Cross Support Agreement (only ESA so far)**
    - **No exchange of funds but provision for partial exchange**
  - **Stand-alone agreements (common but trending to future CSA)**
    - **Exchange can be science payload or access to science data, etc.**
- **Organizations**
  - **US or foreign; government, commercial, or non-profit**
- **Government Documentation**
    - **Technical Assistance Agreement or Commerce equivalent**
    - **Space Act Agreement**
- **Terminology**
  - **Some literature & international forums use “cross-support” differently**
  - **NASA definition specific to Cross Support Agreements**

IND Office 903 Strategic Planning

- **Cross Support & International Collaboration Manager is**
  - **Point of contact for technical assessment and interfaces' negotiation**
  - **Point of contact for strategic planning and monitoring high level agreements**
- **Documentation & Products in Collaboration with NASA**
  - **Agency to Agency Cross Support Agreements**
  - **Generic (cross support) Operational Interface Control Document**
  - **Cross Support Implementation Policy documents**
  - **Memoranda of Understanding**
  - **Letters of Agreements**
  - **Technical Assistance Documents**
  - **Commercial license documentation**
  - **Task Plans and Costing**
  - **Abstracts**
  - **Assist NASA HQ in preparing Space Act Agreements**
  - **Selection of spacecraft and station ID with DSN system engineering**
  - **Trade studies between agencies/projects on use of DSN**
  - **High level requirements vs. DSN capability**

Historical Mission List

Cross Support & Int'l Collaboration

S. Asmar, June 2016, Various Agreements

Blue is anticipated future work

NASA Missions using ESA Network:

- Dawn
- Juno
- Curiosity
- Opportunity & Spirit
- MAVEN
- Phoenix
- SOHO
- STEREO
- VLBI Quasar Catalog
- Cassini
- InSight
- JWST
- Mars 2020 Relay
- *Inquires from Europa and ARRM*

NASA Missions using JAXA Network:

- MRO
- *InSight – deleted for 2018*
- Human Exploration

Google Lunar Prize: multiple

EM-1 CubeSat payload: multiple

Commercial, Space X, etc.: not known

ESA Missions using DSN:

- Cluster
- Integral
- ExoMars 2016
- ROSETTA
- VEX
- XMM
- Ulysses
- Giotto
- SMART
- ExoMars/TGO 2020
- BepiColombo
- JUICE

ISRO Missions using DSN & Nav:

- Chandrayaan-1
- Mars Orbiter Mission (& extensions)
- Chandrayaan-2
- Mars Orbiter Mission-2
- Aditya solar mission

JAXA Missions using DSN & Nav:

- SELENE
- Hayabusa-1
- Hayabusa-2
- Planet-C

UAE using DSN: 2020 Mars Mission (EMM)

S. Korea using DSN: Lunar (KPLO)

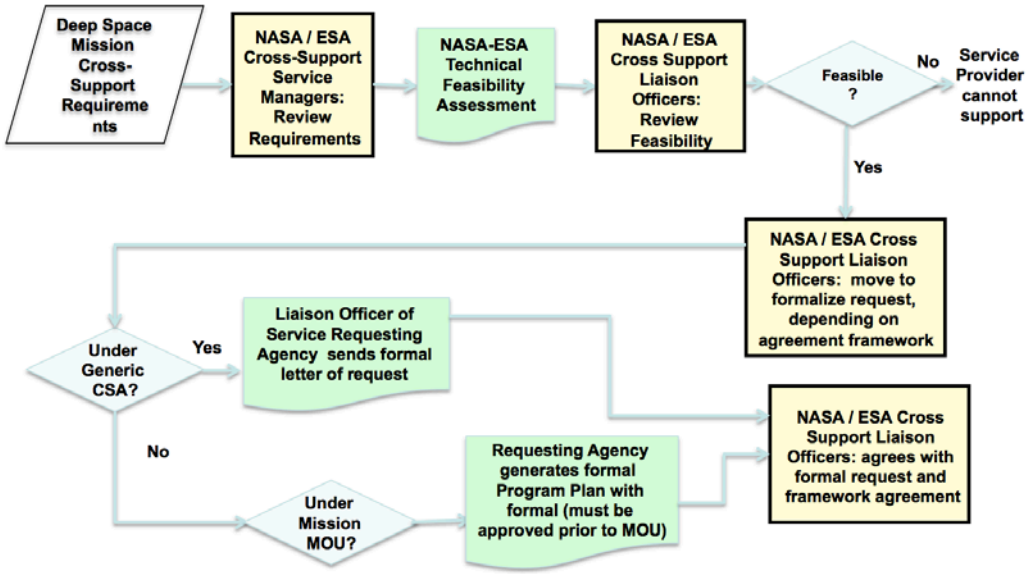
Game of

Which Document Goes with Which process

Example of complex processes and documentation

Consult your local Cross Support Manager

Space Act Agreement	
Cross Support Agreement	Memorandum of Understanding
Abstract	Letter of Agreement
Task Plan	Technical Understanding
Technical Assistance Agreement	Technology Cross Support Agreement
Generic Cross Support Interface Control Document	Generic Navigation Cross Support Interface Control Document
Management Policy Document	Commerce License
Mission-Specific Implementation Arrangement Document	Mission-Specific Interface Control Document



Accomplishments, Outlook & Goals

Accomplishments

- A generic Cross Support Agreement (CSA) with ESA
- Interest in CSA from ISRO & JAXA (exiting facilities)
- Interest from KARI & UAE-SA (possible future facilities)
- Reimbursable work with ISRO & mission-specific cross support with JAXA

Outlook

- Domestic commercial deep space missions, e.g., SpaceX to Mars
- Foreign commercial deep space missions, e.g., Lunar Google Prize
- Human space flight support
- CubeSat deep space missions, foreign & domestic

Goal

- Make process invisible to mission users
- Carry collaboration forward in the era of optical communications