

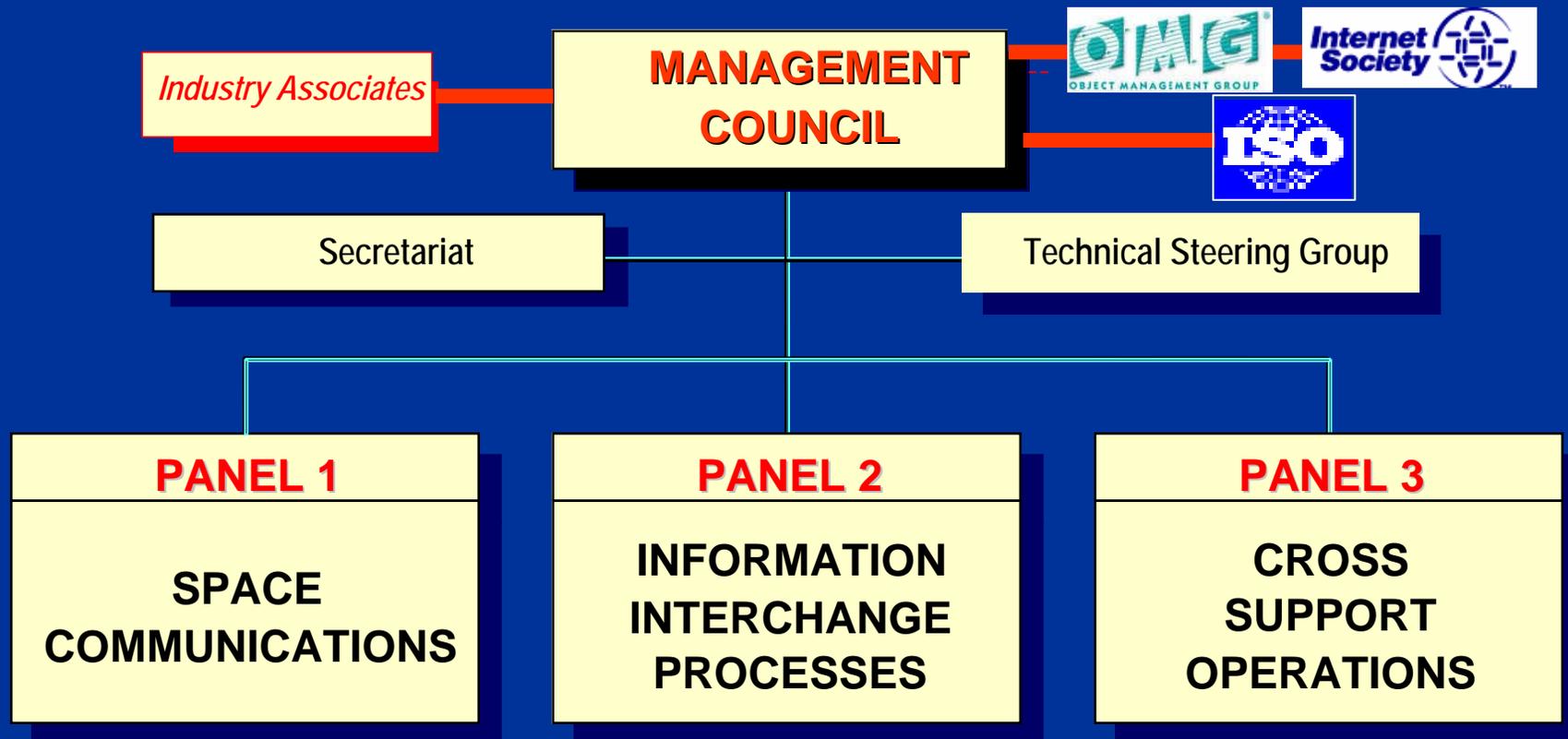
GSAW2001

OVERVIEW OF INTERNATIONAL SPACE STANDARDIZATION



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Consultative Committee for Space Data Systems (CCSDS)



Member Agencies

ASI/Italy *ESA/Europe*
BNSC/UK *INPE/Brazil*
CNES/France *NASA/USA*
CSA/Canada *NASDA/Japan*
DLR/Germany *RSA/Russia*

Observer Agencies

ASA/Austria *CTA/Brazil* *IKI/Russia* *NOAA/USA*
CAST/China *DSRI/Denmark* *ISAS/Japan* *NSPO/Taipei*
CRC/Canada *EUMETSAT/Europe* *ISRO/India* *SSC/Sweden*
CRL/Japan *EUTELSAT/Europe* *KARI/Korea* *TsNIIMash/Russia*
CSIR/South Africa *FSST&CA/Belgium* *KFKI/Hungary* *USGS/USA*
CSIRO/Australia *HNSC/Greece* *MOC/Israel*

CCSDS Strategic Themes

Develop Interoperable Onboard Interfaces:

"Network Ready" Spacecraft Devices and Subsystems



GSAW
Interoperable
NASA, DOD,
NOAA, Commercial
Space Infrastructure

Develop Missions as Extensions of the Earth's Internet:

*Interface with Near-Earth Constellations
Interface with Commercial Near-Earth Navigation Systems
Interface with Public Media Distribution Systems
Extension of the Internet into Near-Earth Vicinity
Extension of the Internet into Deep Space*

Develop Highly Efficient Communications in Resource-Constrained Environments:

*Single Aperture/Multi-User Links
Higher Frequency Communications
Efficient Modulation
High-Performance Coding
Proximity/In-Situ Communications Links
File Transfer Protocols
Security and Privacy
Advanced Data Compression*



Develop Standard Mission Operations Services:

*Space Link Access
Spacecraft Monitor and Control
Ground System Monitor and Control
Tracking and Navigation Services
Mission Planning Services
Telecommunications Services*

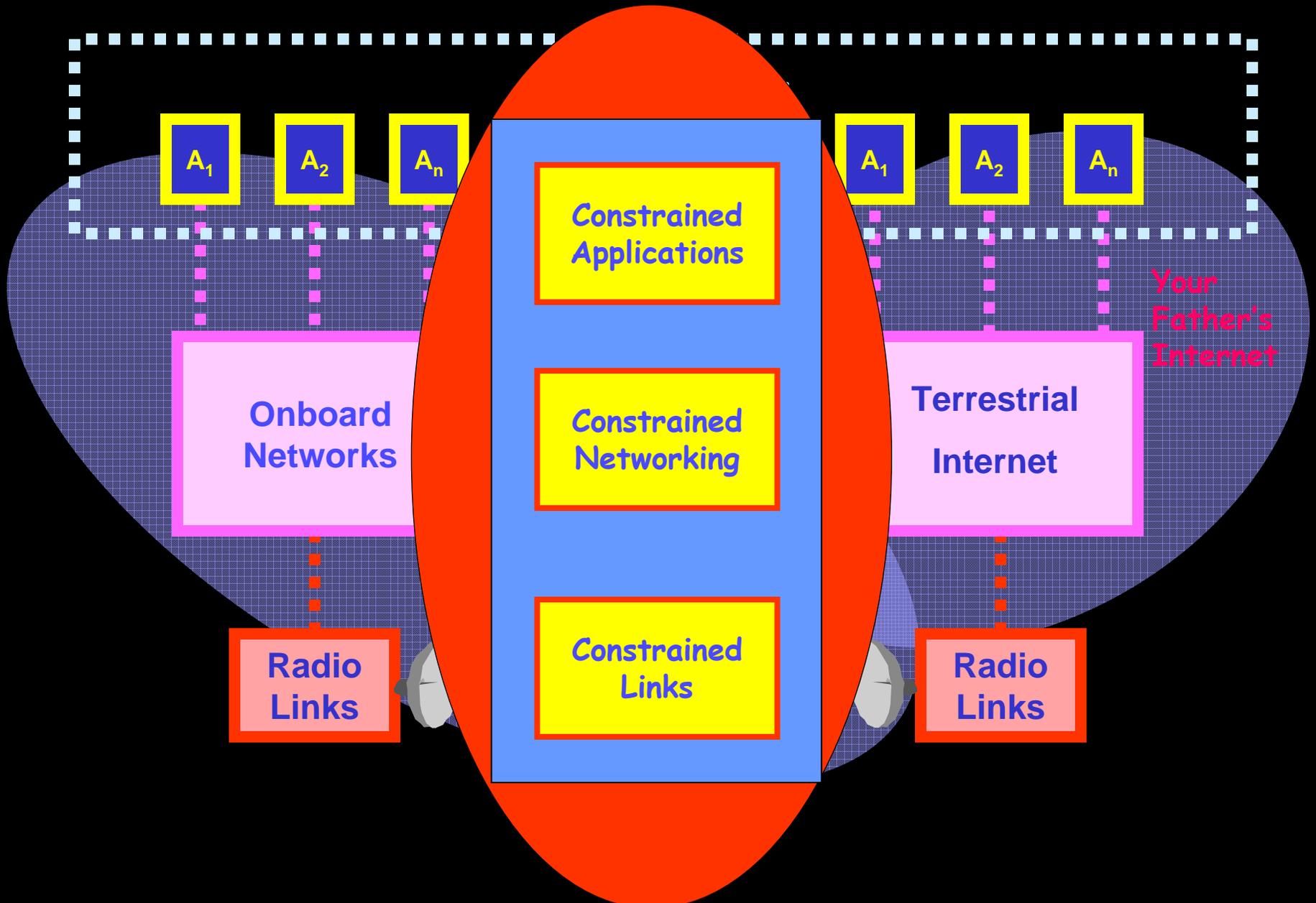


Develop Standard Data Interchange and Archiving Services:

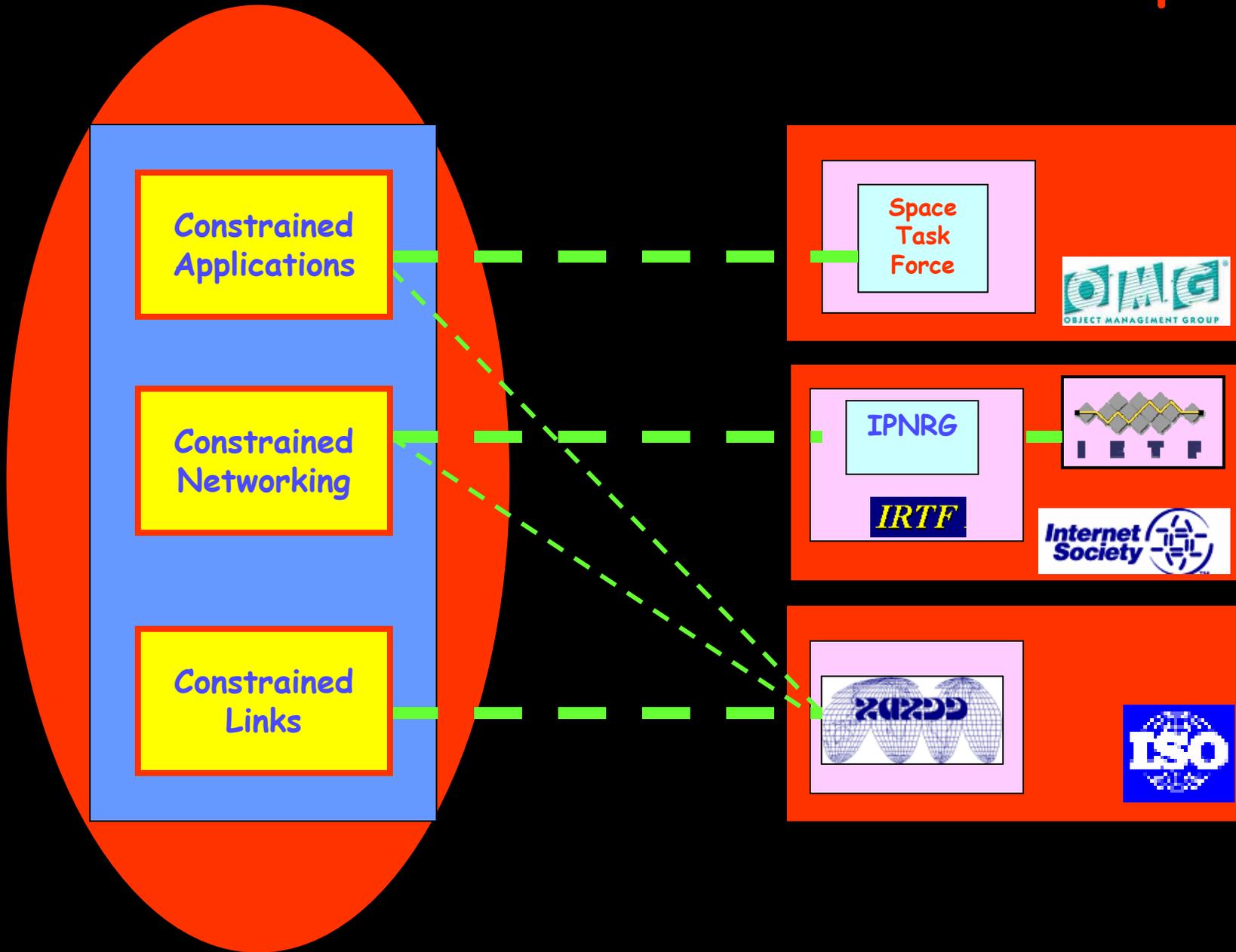
*Data Management Services
Information Architecture for Space Data
Space Data Archiving Techniques*



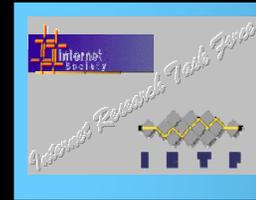
Model of Space/Ground Communications



Current Standardization Options



Opportunity for leverage



Terrestrial Internet Standards

FTP/TCP/IP

Fiber

Satellites

Short-haul communications

Cable

Mobile/Wireless

Nomadic

Self-organizing

WDM

*Terabit communications
low delay
Megabit communications
high delay*

*Similar Problems,
Common Solutions*

Mars Network

*Deep-space
Optical*

*File-based
Operations*

Long-haul communications

*LEO
Constellations*

Ka-band

Space Internet Standards

S-band

X-band



InterPlaNetary Internet Architecture

Operations driven
by power, weight,
volume

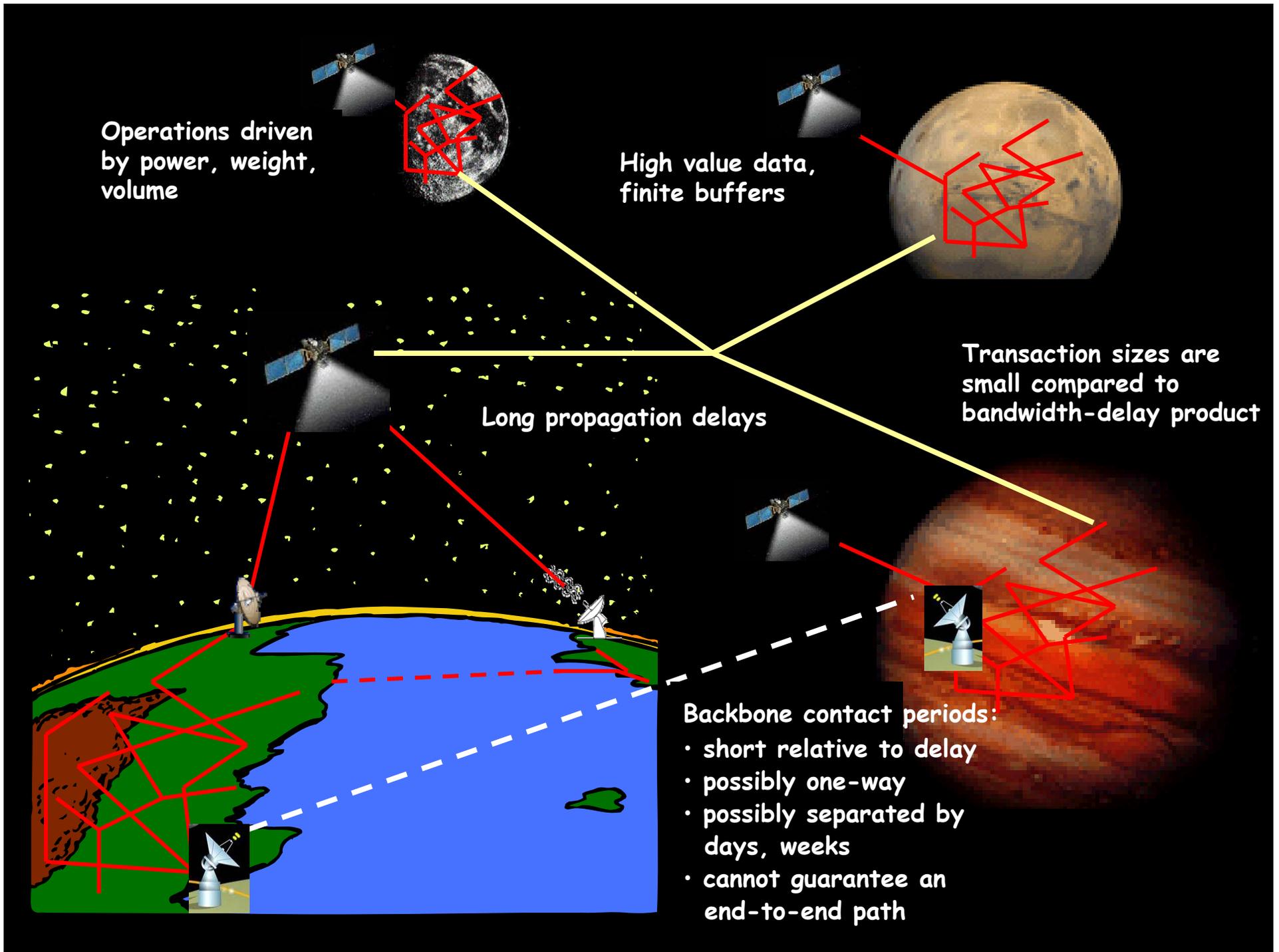
High value data,
finite buffers

Long propagation delays

Transaction sizes are
small compared to
bandwidth-delay product

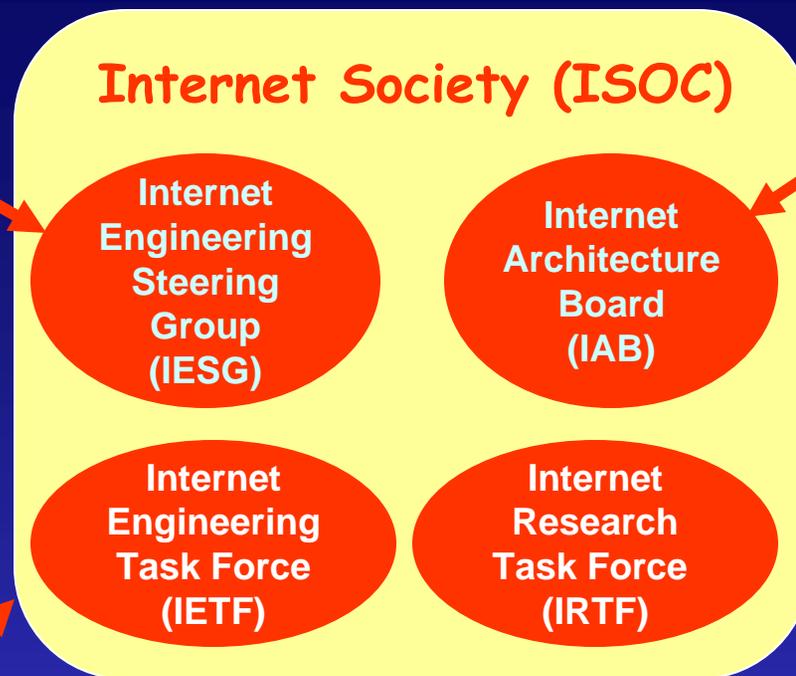
Backbone contact periods:

- short relative to delay
- possibly one-way
- possibly separated by days, weeks
- cannot guarantee an end-to-end path



The IESG is responsible for technical management of IETF activities and the Internet standards process. The IESG is directly responsible for the actions associated with entry into and movement along the Internet "standards track," including final approval of specifications as Internet Standards.

The IETF is a large open international community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet. It is open to any interested individual.



ICANN is the non-profit corporation that was formed to assume responsibility for the IP address space allocation, protocol parameter assignment, domain name system management, and root server system management functions

IAB responsibilities include:

1. IESG Selection,
2. Oversight of the architecture for the protocols and procedures used by the Internet.
3. Oversight of the process used to create Internet Standards.
4. Editorial management and publication of the Request for Comments (RFC) document series
5. External Liaison with other organizations concerned with standards and other issues relevant to the world-wide Internet.
6. Technical, architectural, procedural, and (where appropriate) policy advice to the Internet Society

IRTF Research Groups work on topics related to Internet protocols, applications, architecture and technology. Participation is by individual contributors, rather than by representatives of organizations. The Internet Research Steering Group (IRSG) may from time to time hold topical workshops focusing on research areas of importance to the evolution of the Internet.

Internet Research Task Force (IRTF)

Network
Management
(NMRG)

Name
Space
(NSRG)

Reliable
Multicast

Routing

Internet
Resource
Discovery
(IRD)

Authentication
Authorisation
Accounting
Architecture
(AAAARCH)

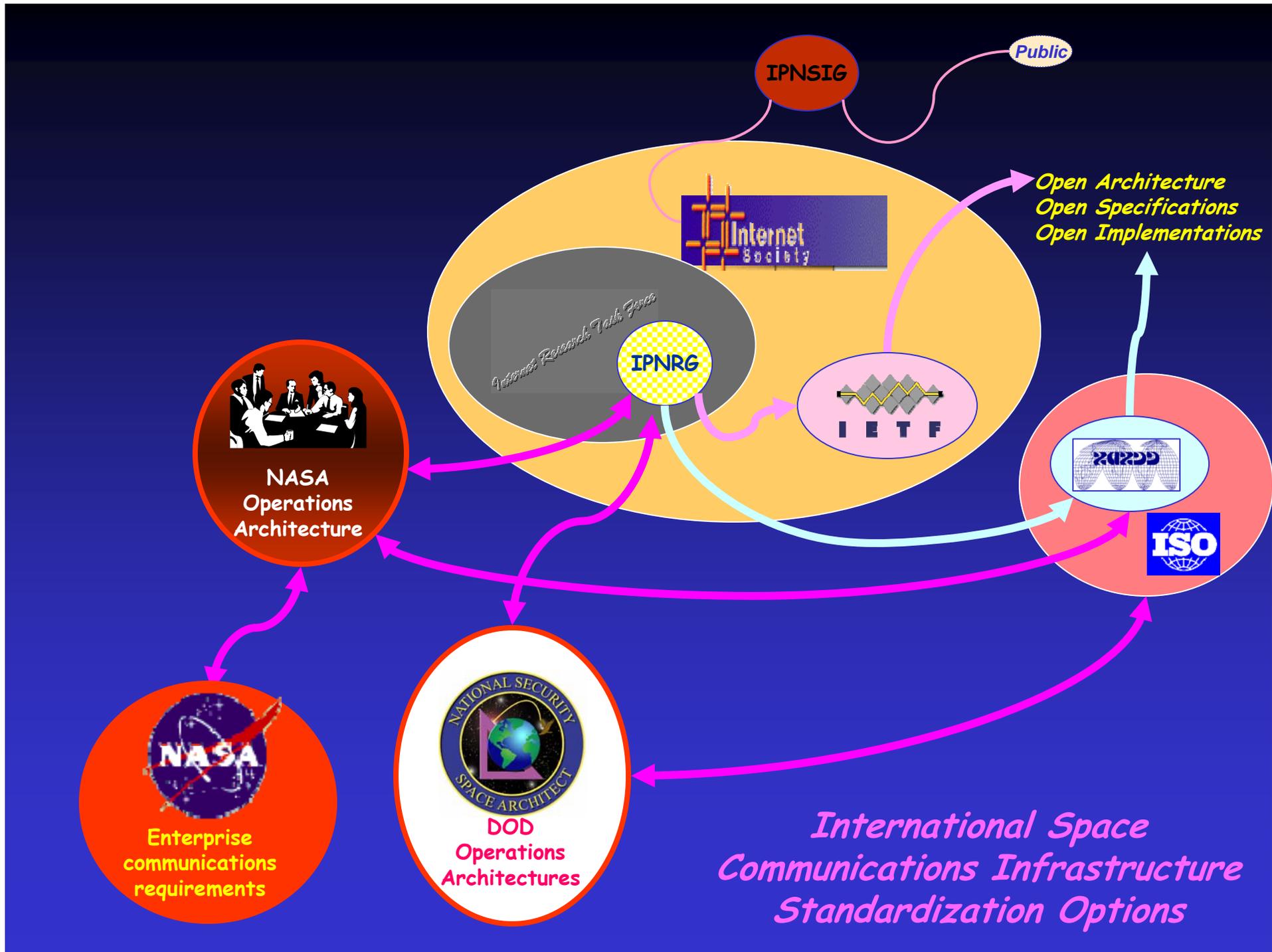
Building
Differentiated
Services
(BuDS)

Secure
Multicast
(SMuG)

Interplanetary
Internet
(IPNRG)

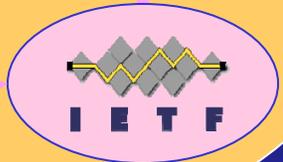
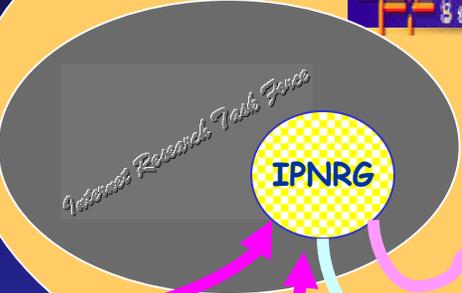
Services
Management

End-to-End
(E2E)



IPNSIG

Public



International Space Communications Infrastructure Standardization Options

*Open Architecture
Open Specifications
Open Implementations*



InterPlanetary Internet Research Group (IPNRG)

The IPNRG is chartered to address the issues associated with deploying and interacting with astronomically remote, self-sustaining fragments of the Internet. These "edge Internet" fragments are generally untethered with respect to the Internet backbone and can range from single nodes with intermittent external connectivity to well populated subnetworks and internets with extremely constrained connectivity. Such fragments include remote terrestrial internets using wireless and satellite links, and in-situ internets deployed at off-Earth locations such as the surfaces and vicinities of other planets. Fragments of Internet may be found on space vehicles in transit from Earth to other planetary/solar system bodies, and may return to Earth or not, depending on the mission. Among the challenges to be addressed are: extremely large delay for transmissions up to tens of Astronomical Units in size; severe asymmetry in the transmission capacity of bidirectional channels linking two communicating platforms; severe variation in interference experienced on the channel(s) - e.g. solar storms; episodic loss of connectivity owing to celestial motions of the platforms and the planets/satellites/asteroids with which they are associated. Adapting the existing or projected Earth Internet architecture to Interplanetary scale is a significant challenge however, it is also highly speculative and not yet mature enough to merit focused IETF attention as a whole. The primary focus of these efforts is:

1. To define mechanisms that support efficient operation and management of Internet fragments operating in non-traditional, resource constrained environments, so that available local resources are optimally utilized.
2. To investigate the impacts of episodic connectivity and nomadic operation on network transport and application layer operations.
3. To define strategies for allowing the remote Internet fragments to evolve at their own pace relative to the Internet as a whole, yet remain interoperable.

As progress on topics matures, the IPNRG may submit proposals for work items with existing IETF working groups where applicable or recommend to the IETF that a topic be advanced into a BOF and/or working group.