



# CCSDS and NASA Standards for Satellite Control Network Interoperability

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# The Fundamental Question



Everyone wants interoperability between satellite control networks, but what will it take to get?

**Are there standards and architectures that can meet both military and civil space needs?**

Will they emerge through the invisible hand of the market place, or do we need government planning and direction to achieve interoperability?

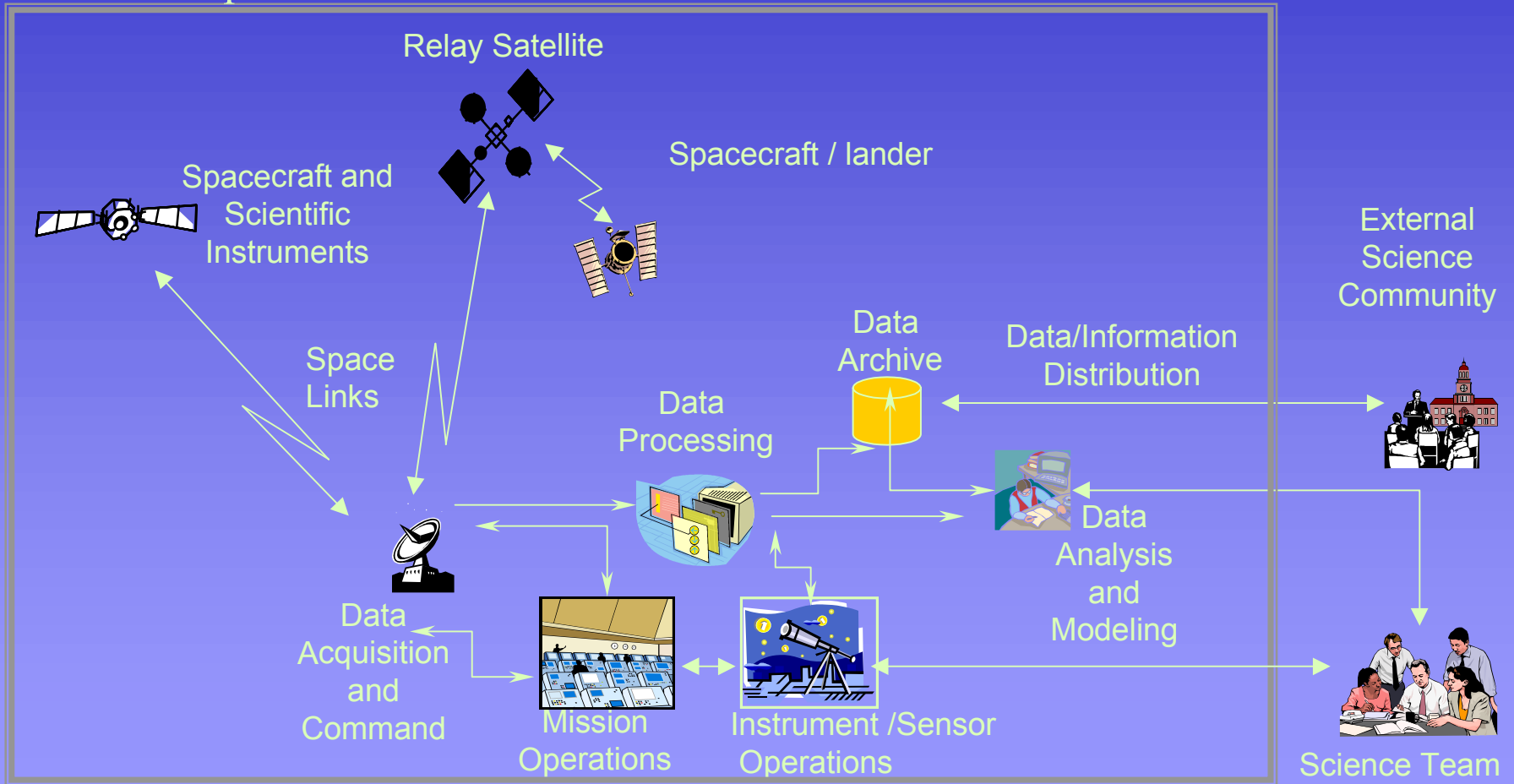
Will it bring cost savings or cost increase?\



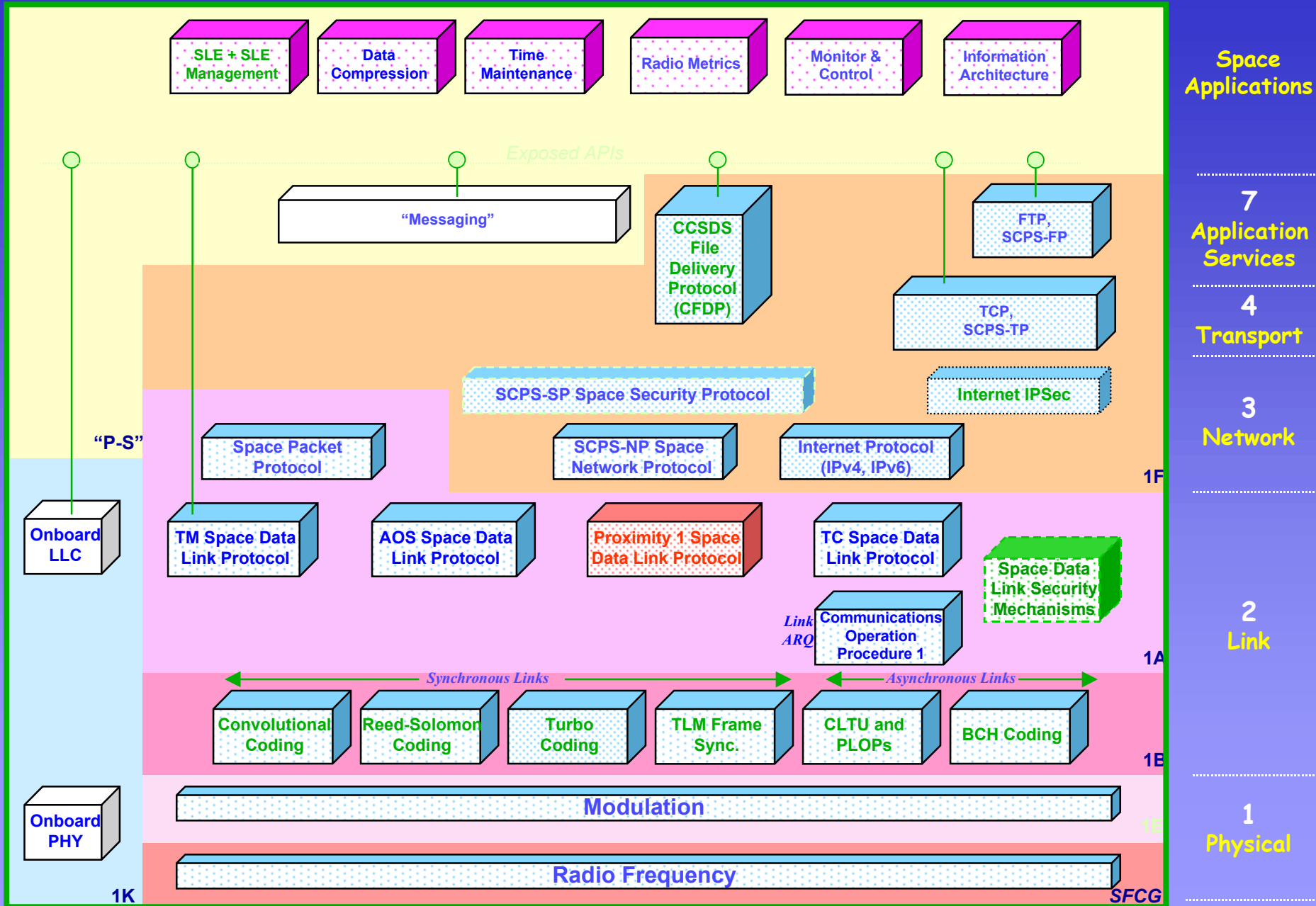
# Space Domain Functional Elements



## Problem Space



# View of CCSDS Space Communications





# Current JPL Program Content



## FY 02

### CCSDS File Delivery Protocol (CFDP)

- Reliable file delivery over disjoint networks

### Proximity 1 Link Protocol

- Dynamic link establishment and negotiation

### Space Communication Protocol Standard (SCPS)

- Internet protocols augmented for near Earth use in space

### Space Link Extension (SLE)

- Transfer services, service requests & management

### Spacecraft Onboard InterFace (SOIF)

- Message Transfer Layer, inter-S/C messaging

### And several other tasks

- Navigation interchange standards
- Bandwidth & power efficient coding and modulation
- Object Management Group (OMG) Space Domain Task Force
- XML Space Application Study

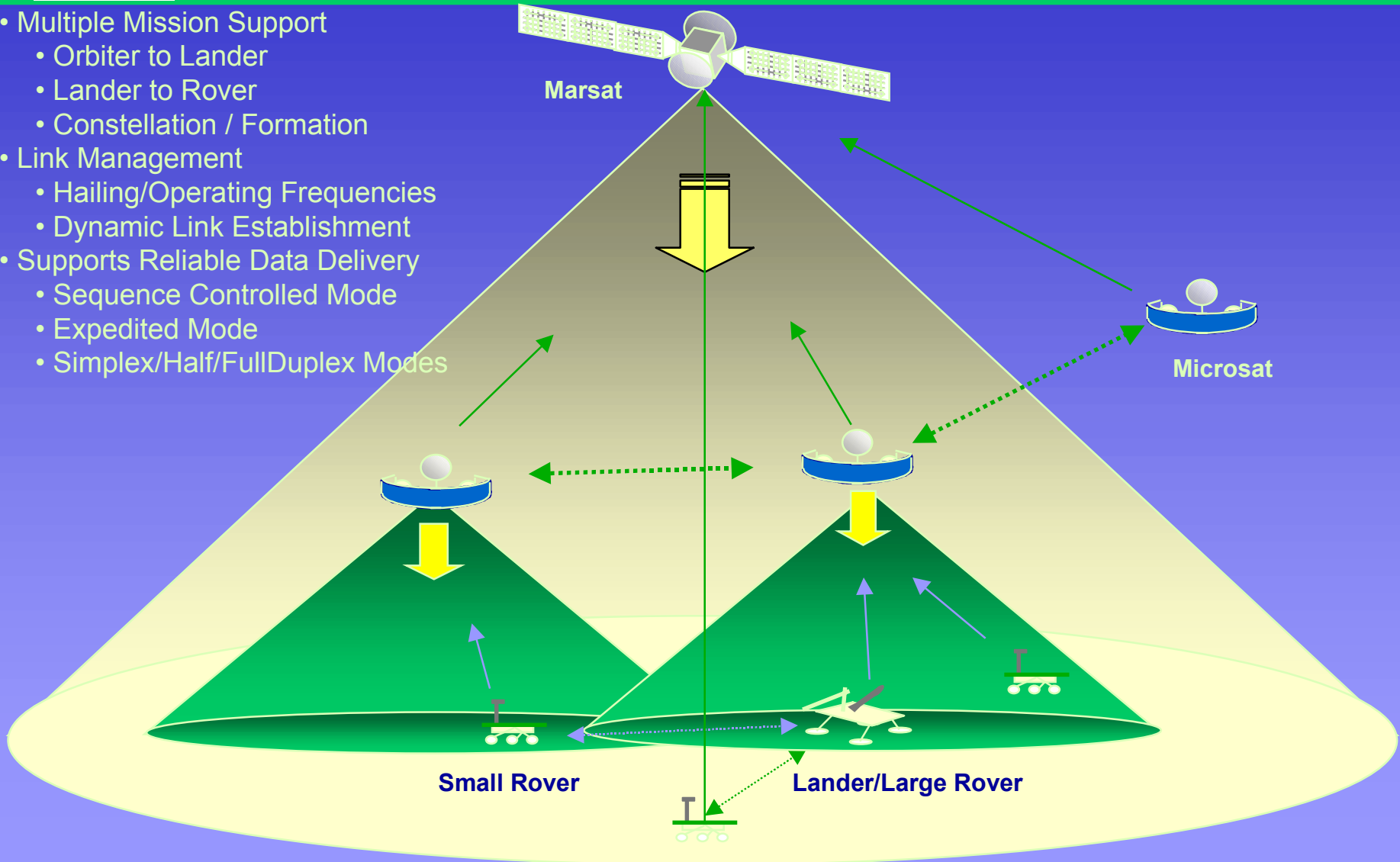


# Proximity - 1 Link Protocols



## Future Mars Environment

- Multiple Mission Support
  - Orbiter to Lander
  - Lander to Rover
  - Constellation / Formation
- Link Management
  - Hailing/Operating Frequencies
  - Dynamic Link Establishment
- Supports Reliable Data Delivery
  - Sequence Controlled Mode
  - Expedited Mode
  - Simplex/Half/FullDuplex Modes

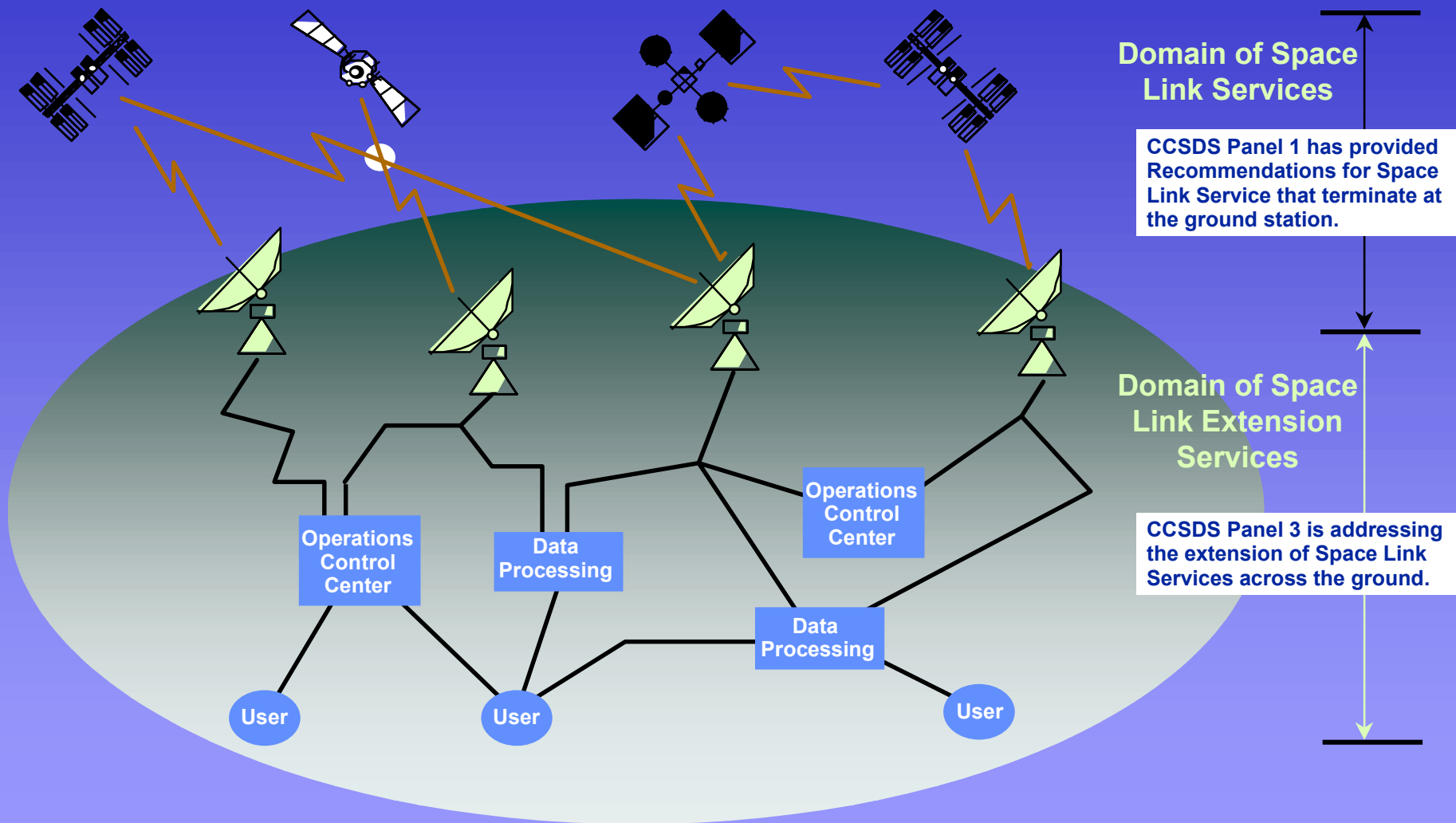




# CCSDS Space Link Extension (SLE)



## Domain of SLE Services



Domain of Space Link Services

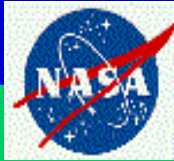
CCSDS Panel 1 has provided Recommendations for Space Link Service that terminate at the ground station.

Domain of Space Link Extension Services

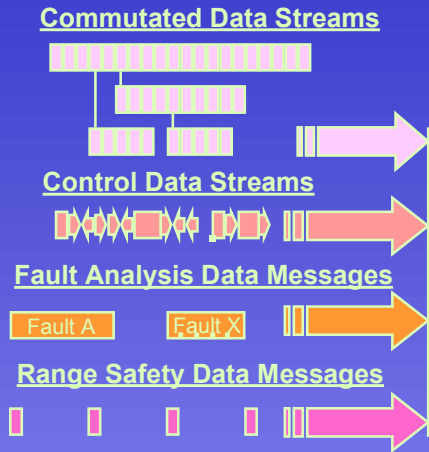
CCSDS Panel 3 is addressing the extension of Space Link Services across the ground.



# CCSDS PROTOCOLS



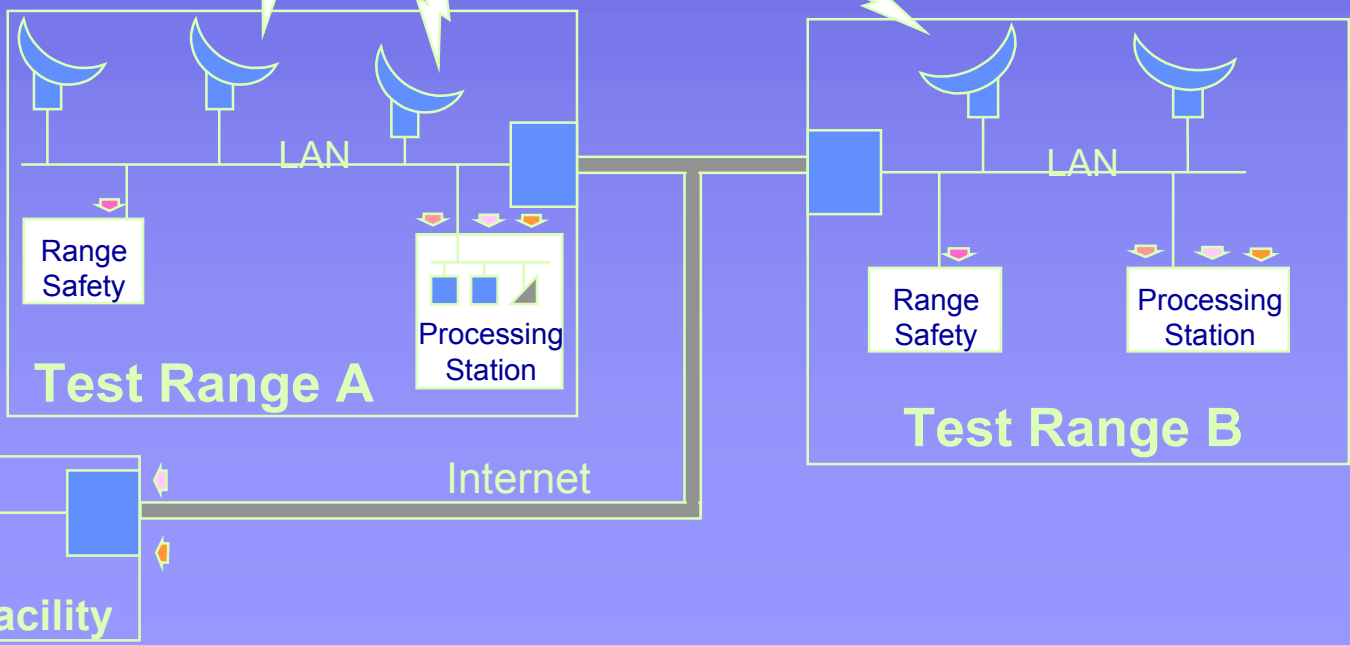
## TEST RANGE COMMUNICATIONS



Multiplexed Data Stream

Vehicle Communications

- Source Packets (data structuring)
- SCPS Network (on-board & link)
- SCPS Security (on-board & link)
- CCSDS Frames (comm link)
- Internet Packets (ground links)





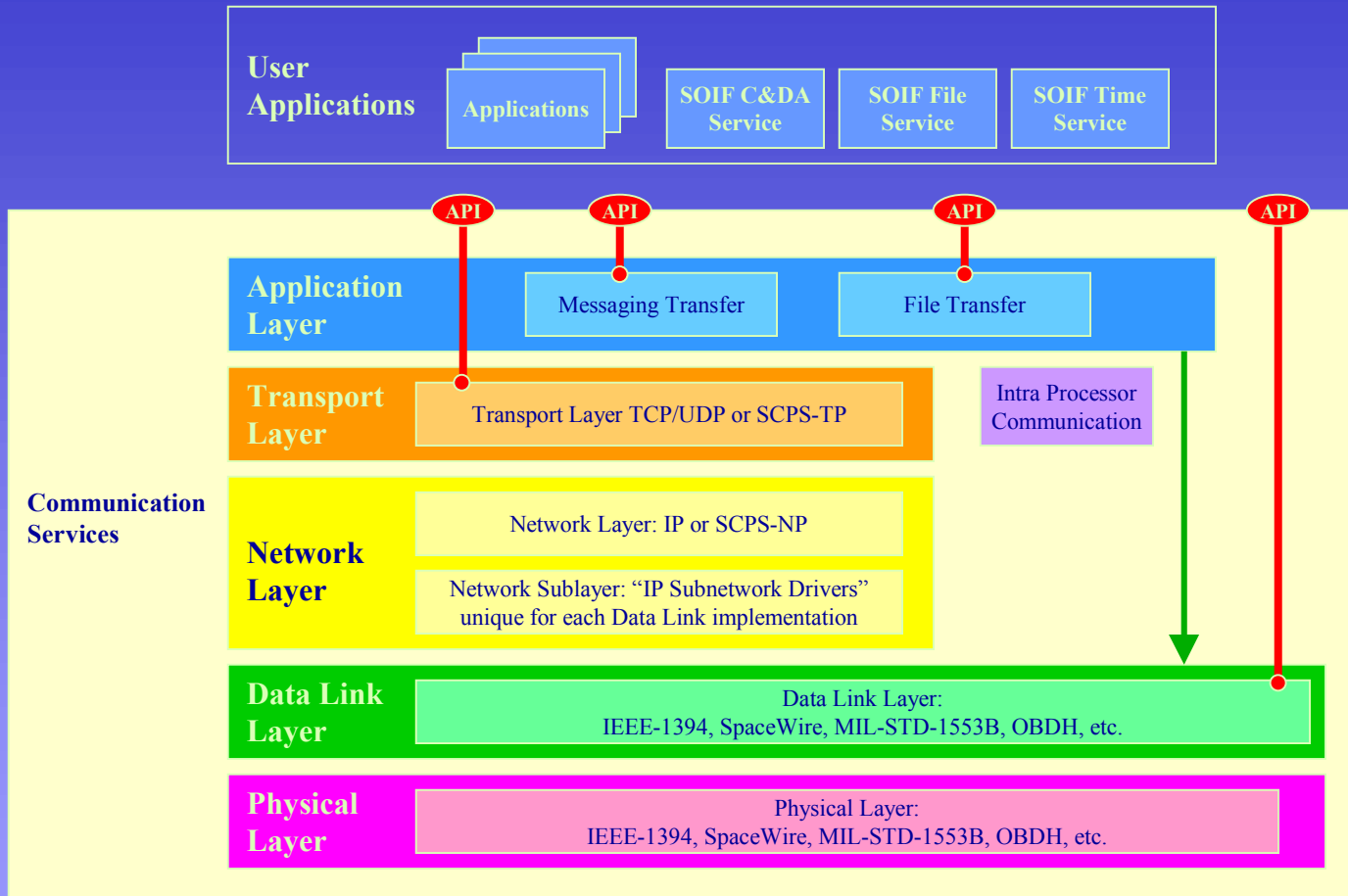
## Space Domain Task Force

### Distributed Mission Control System





# Spacecraft Onboard Interfaces Layered Implementation



NOTE: No security protocol is shown in order to simplify this diagram



# Summary



- **NASA interoperability standards for space communications can be applied to military spacecraft and their satellite control networks**
- **COTS products that implement these standards are available from more than 60 vendors**
- **New standards that support applications in stressed environments are in development**