

Overview of International Space Standards

*Range and Spaceport
S&T Workshop*

Colorado Springs, CO

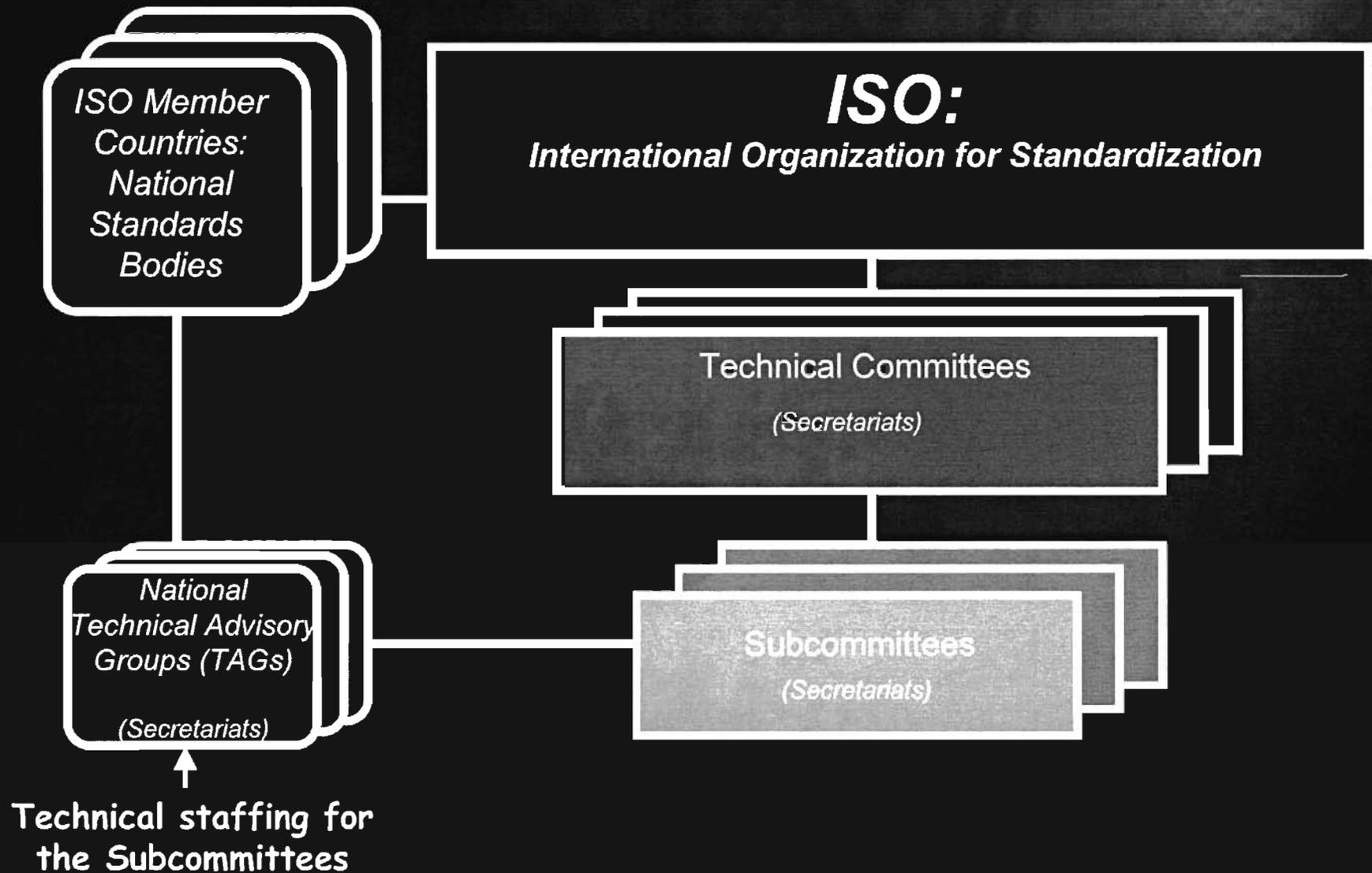
11 January 2005

Adrian Hooke

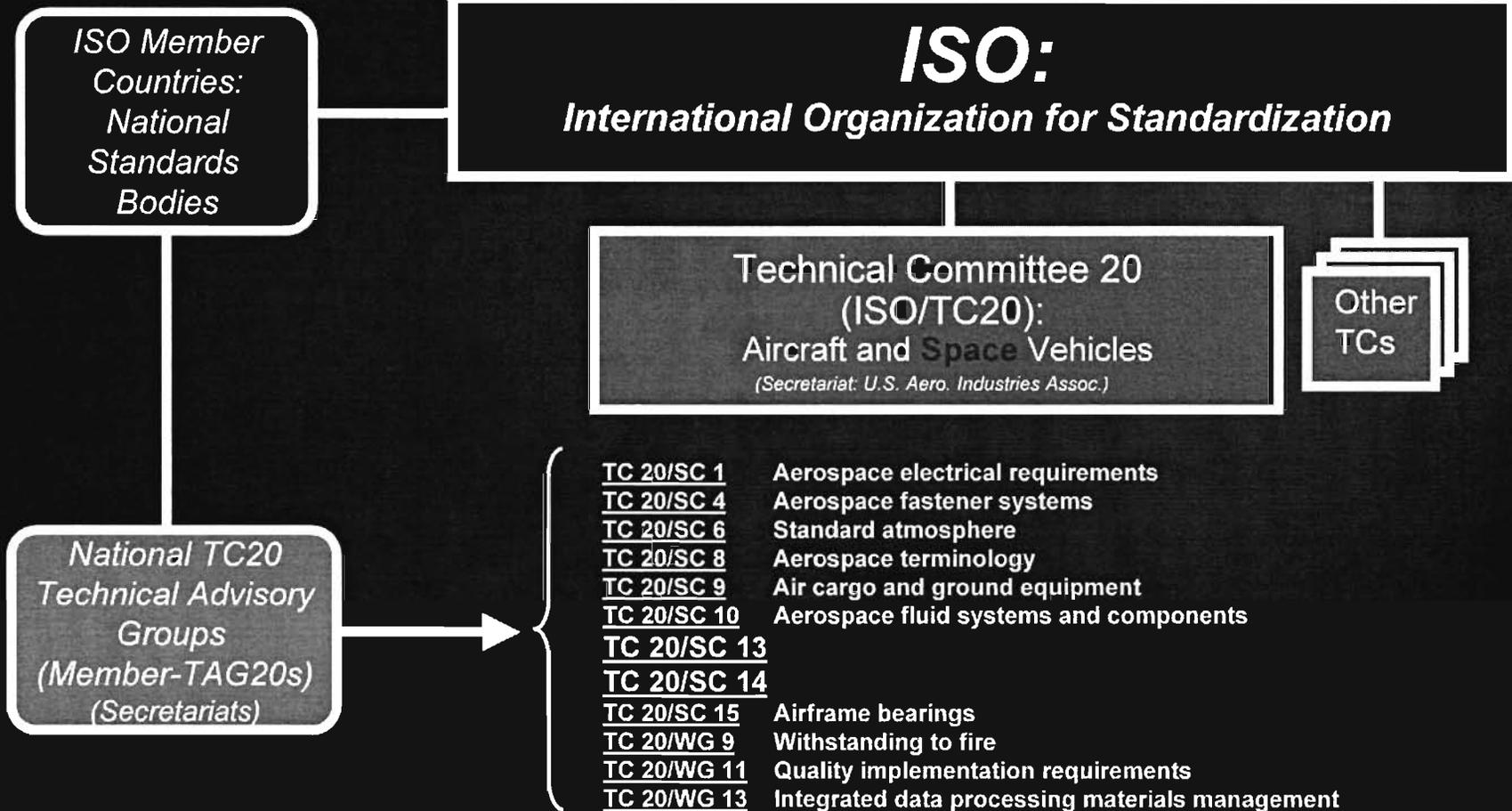
Jet Propulsion Laboratory

California Institute of Technology

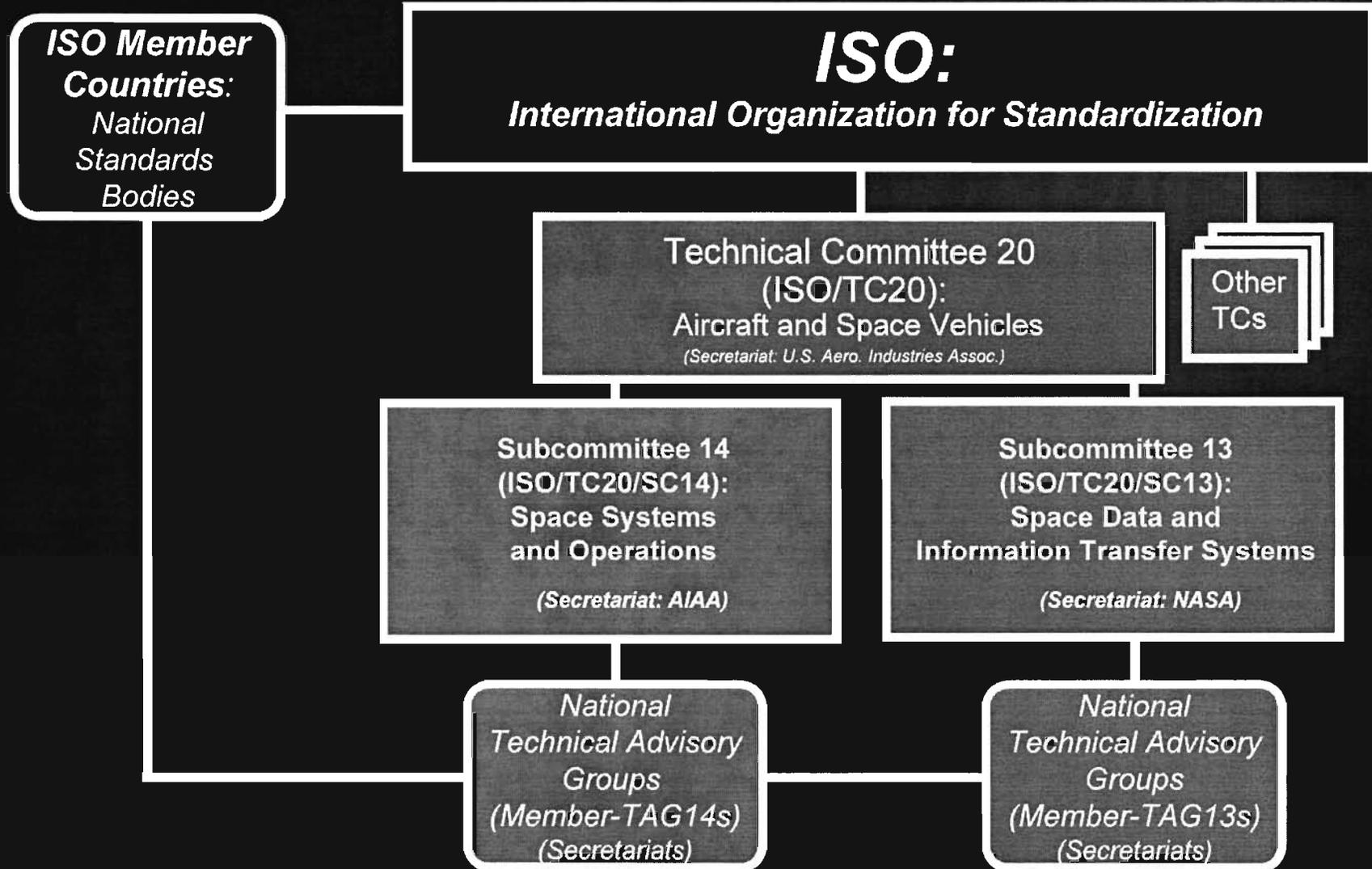
Basic ISO Standardization Structure



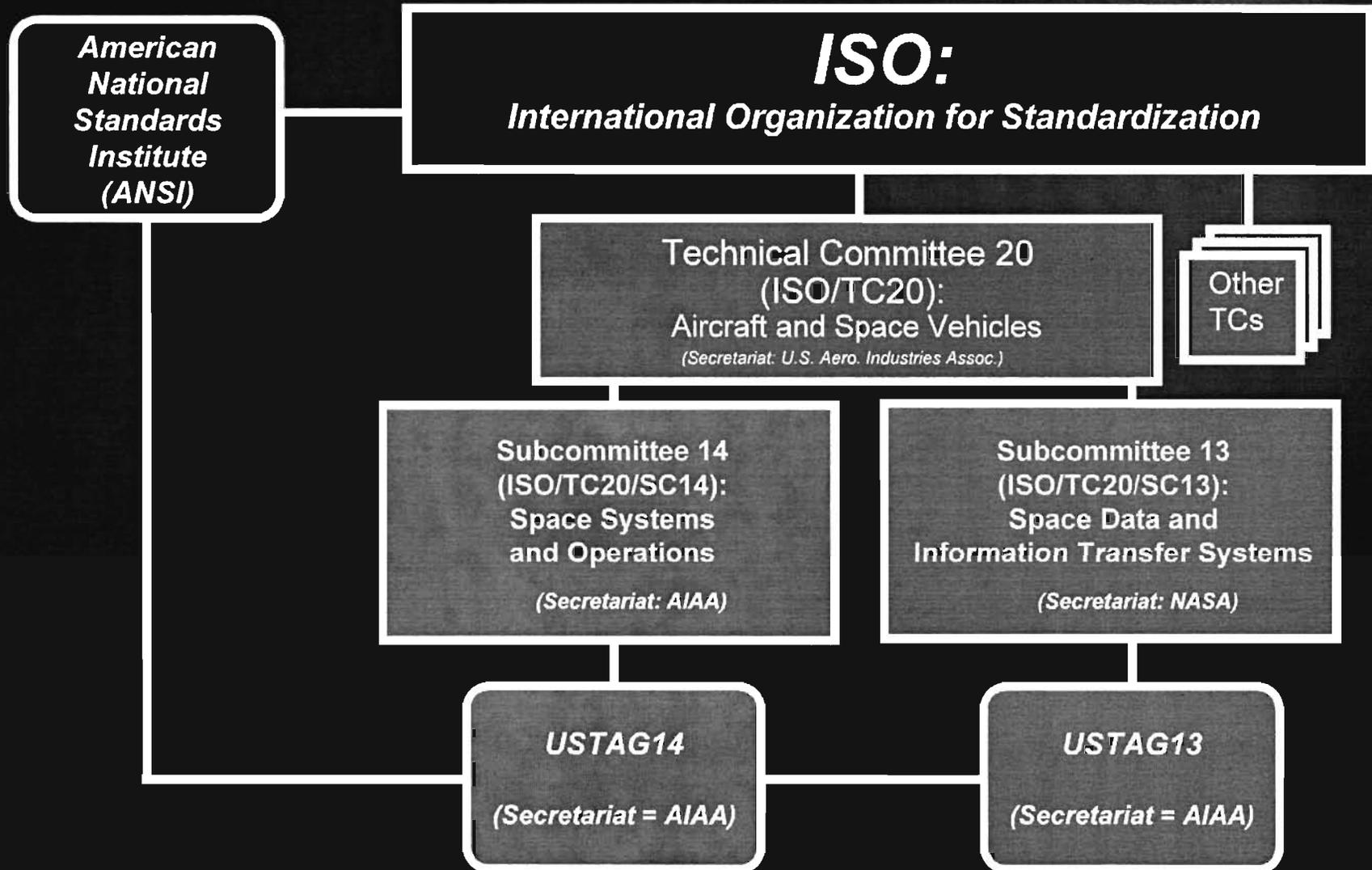
ISO Technical Committee 20: Aircraft and Vehicles



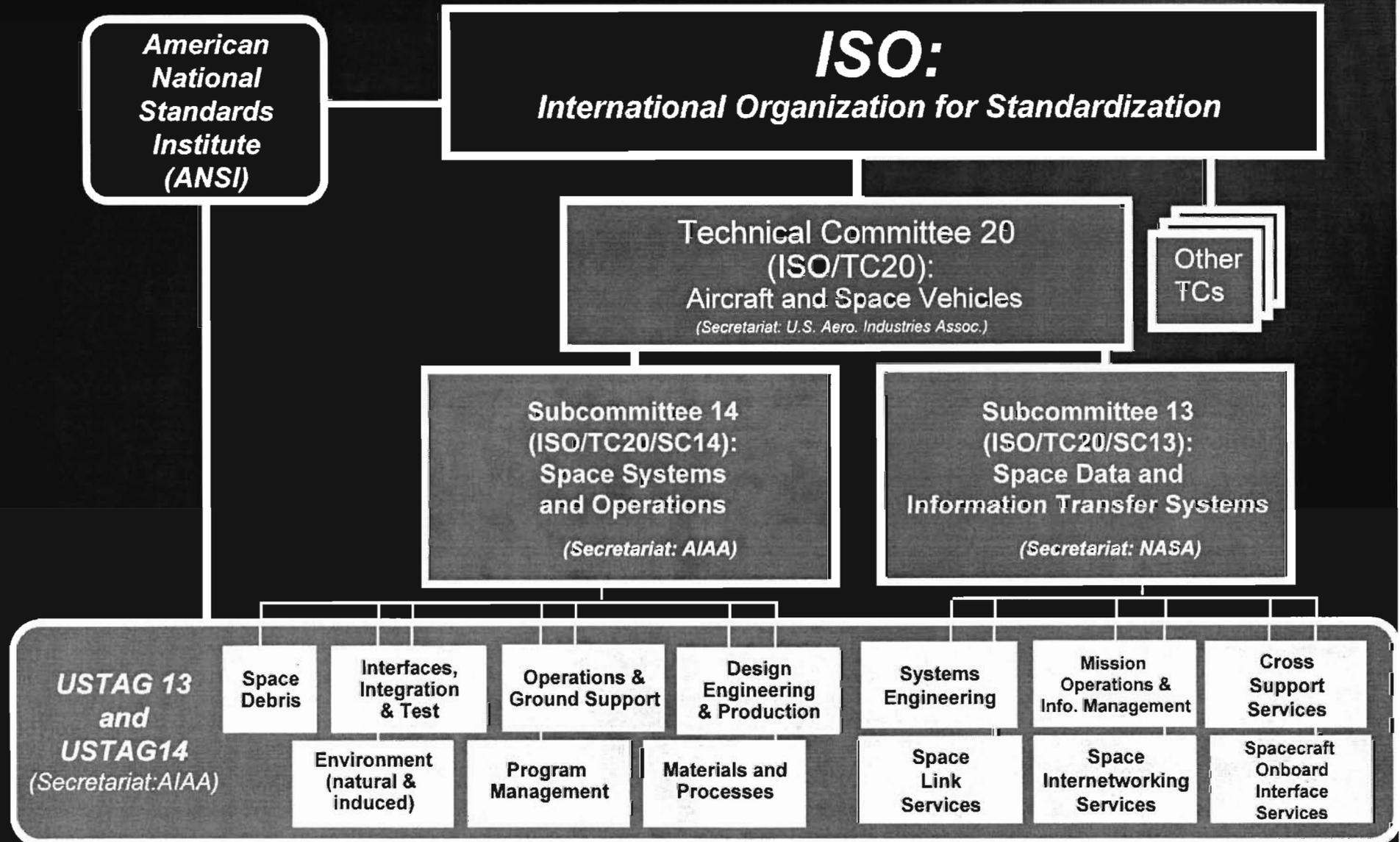
Current ISO Organization for Space Standards



Current United States Organization for Space Standards



Current United States Organization for Space Standards



PROPOSED: NEW "TECHNICAL COMMITTEE FOR SPACE"

ISO Member Countries:
National Standards Bodies

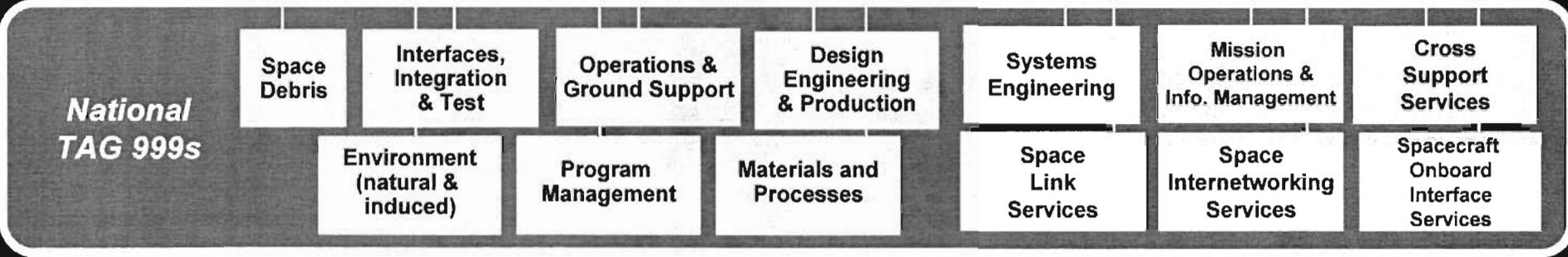
ISO:
International Organization for Standardization

Technical Committee "999"
SPACE SYSTEMS
(Secretariat: AIAA)

Other TCs

(Space Systems and Operations)

(Space Data and Information Transfer Systems)
(Secretariat: NASA)



United States Organization for Space Standards

**American
National
Standards
Institute
(ANSI)**

ISO:
International Organization for Standardization

**Technical Committee 20
(ISO/TC20):
Aircraft and Space Vehicles**
(Secretariat: U.S. Aero. Industries Assoc.)

**Other
TCs**

**Subcommittee 14
(ISO/TC20/SC14):
Space Systems
and Operations**
(Secretariat: AIAA)

**Subcommittee 13
(ISO/TC20/SC13):
Space Data and
Information Transfer Systems**
(Secretariat: NASA)

CCSDS

**USTAG 13
and
USTAG 14**
(Secretariat: AIAA)

**Space
Debris**

**Interfaces,
Integration
& Test**

**Operations &
Ground Support**

**Design
Engineering
& Production**

**Systems
Engineering**

**Mission
Operations &
Info. Management**

**Cross
Support
Services**

**Environment
(natural &
induced)**

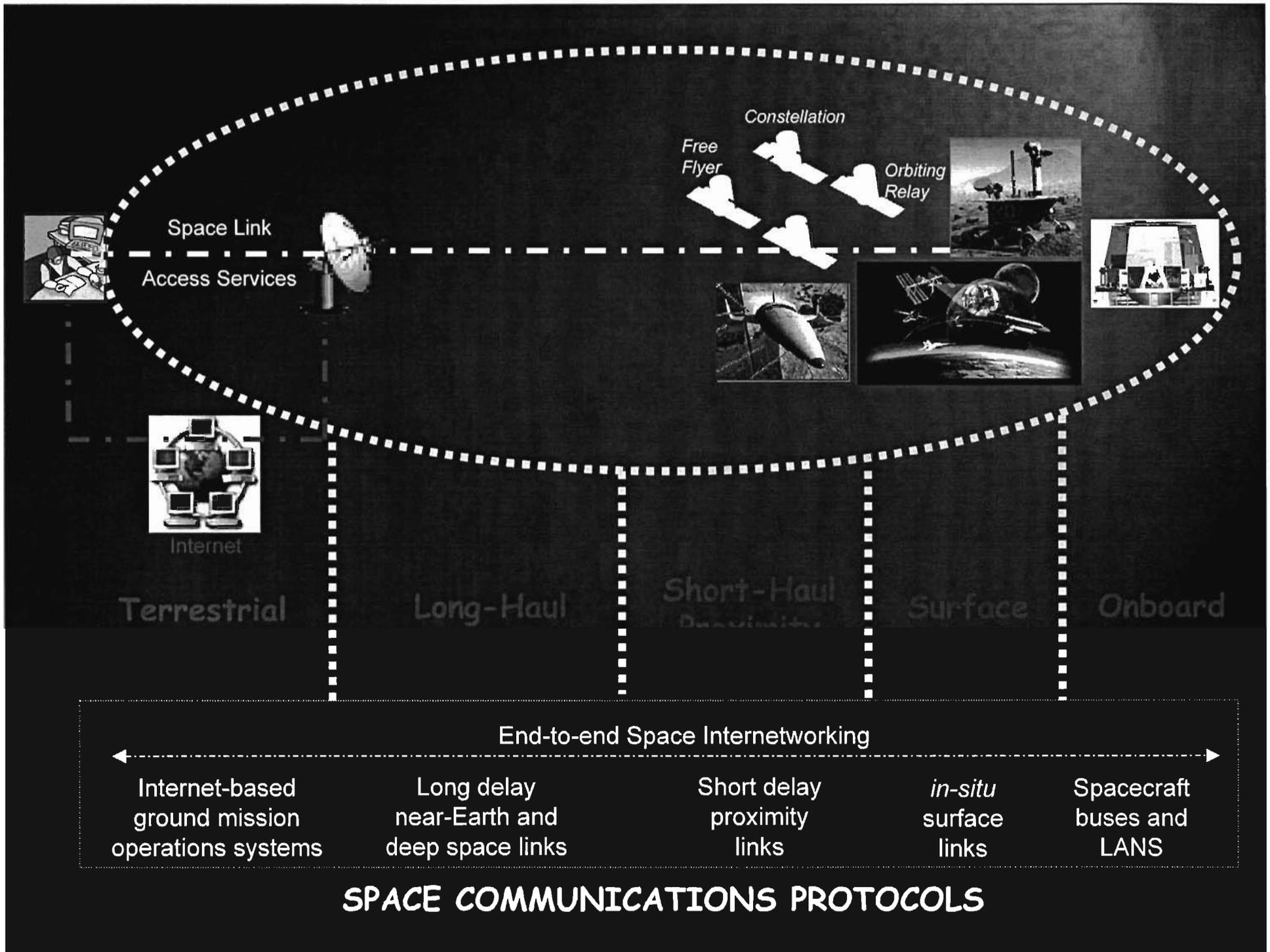
**Program
Management**

**Materials and
Processes**

**Space
Link
Services**

**Space
Internetworking
Services**

**Spacecraft
Onboard
Interface
Services**



SPACE COMMUNICATIONS PROTOCOL MODEL

End-to-End Space Applications

Space Middleware

Space Application Services

Space Transport Services

Space Networking Services

Space Link Services

Space Long-Haul Data Link

Space Proximity Data Link

Space Surface Data Link

Space Long-Haul Coding

Space Proximity Coding

Space Surface Coding

Spacecraft
data bus
Or LAN

Space Long-Haul Channel

Space Proximity Channel

Space Surface Channel

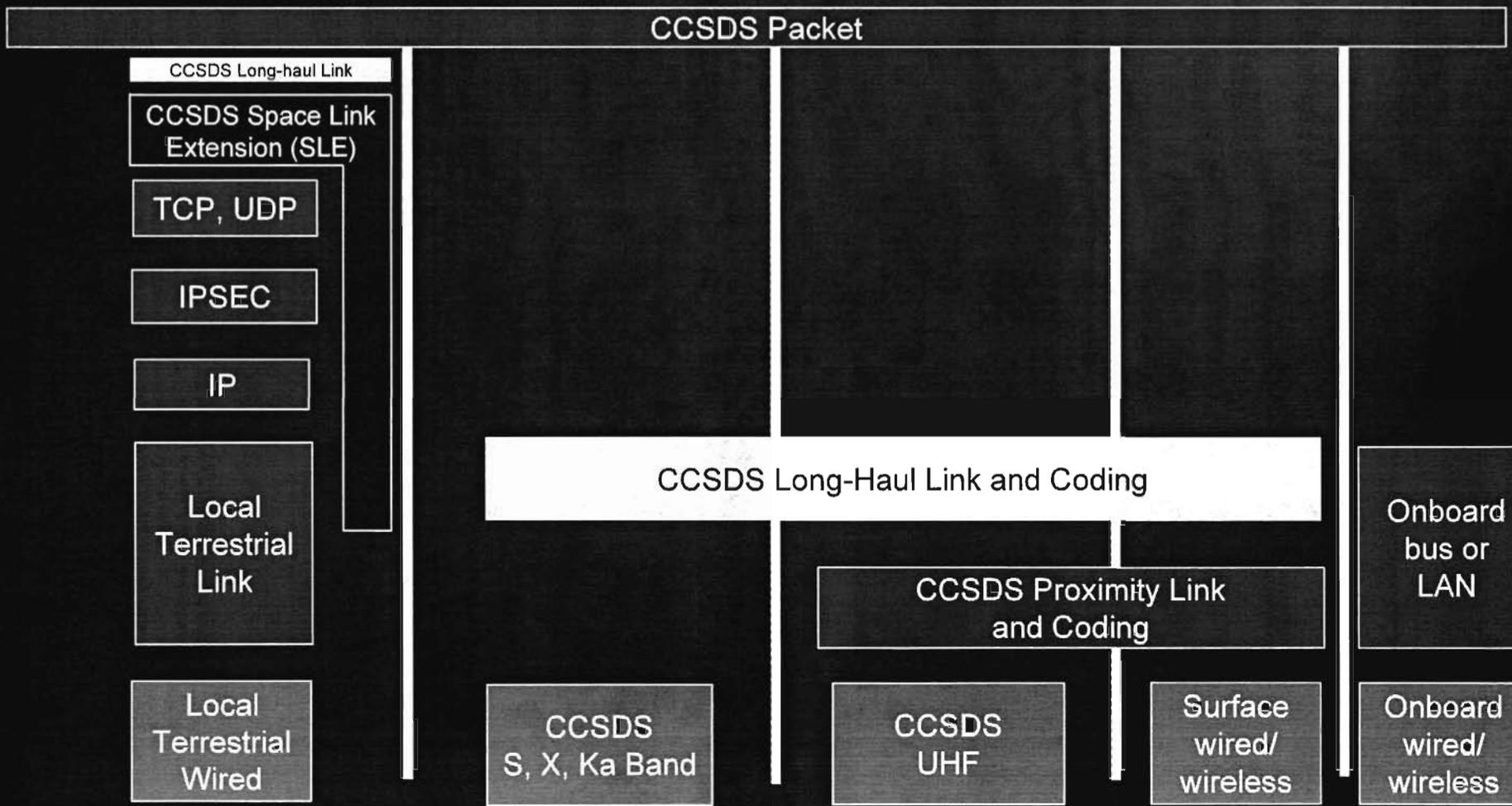
Space Long Haul

Space Proximity

Space Surface

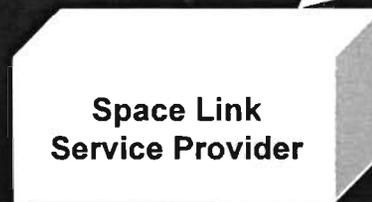
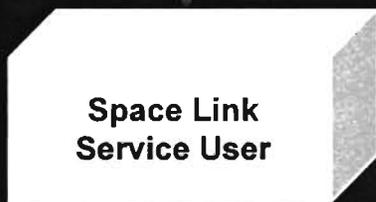
Spacecraft Onboard

1980s - now: standard "Packet Telemetry/Telecommand" space links





Data Transfer Service Management



Data Transfer Service

CCSDS "Space Link Extension" (SLE) Services



SPACE LINK ACCESS SERVICE MODEL

CCSDS: The Fleet

Space Domain
Spacecraft Platforms
On-Board Systems
Space Qualified ASICs

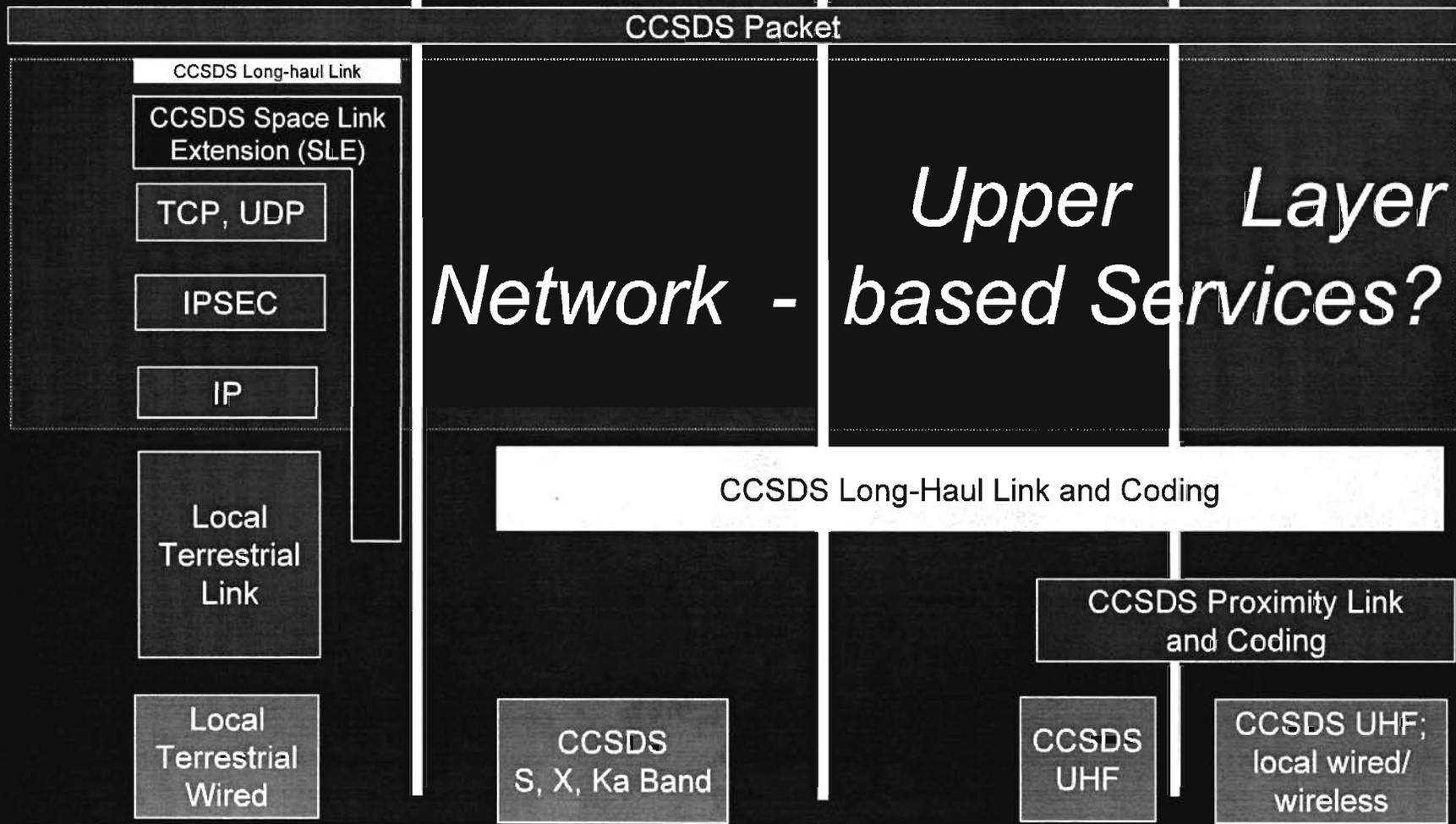
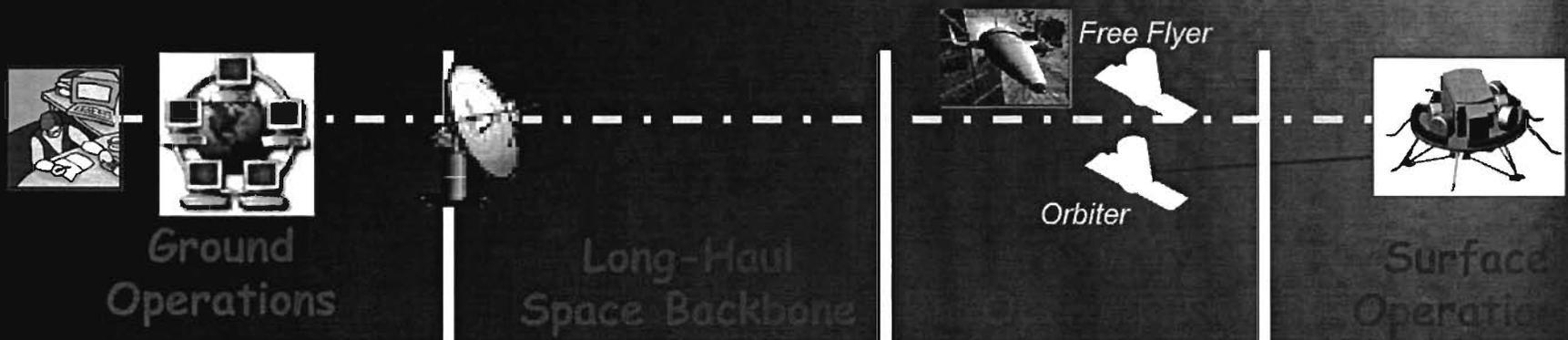
CCSDS
Consultative Committee for Space Data Systems

**303 Missions now using
CCSDS Space Link Protocols**
<http://www.ccsds.org/CCSDS/missions.jsp>

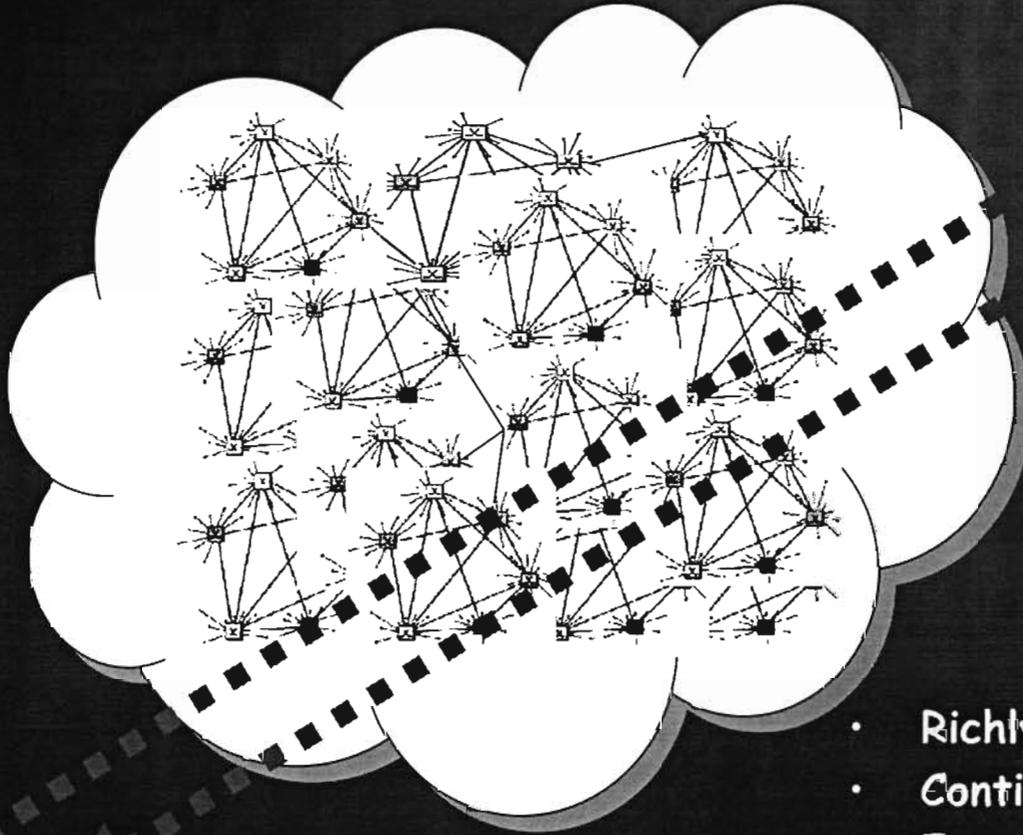
Ground Domain
Commercial Ground Networks
Command & Telemetry Data Processing

Shuttle CS Gateway

Mid-1990s: a focus on space internetworking

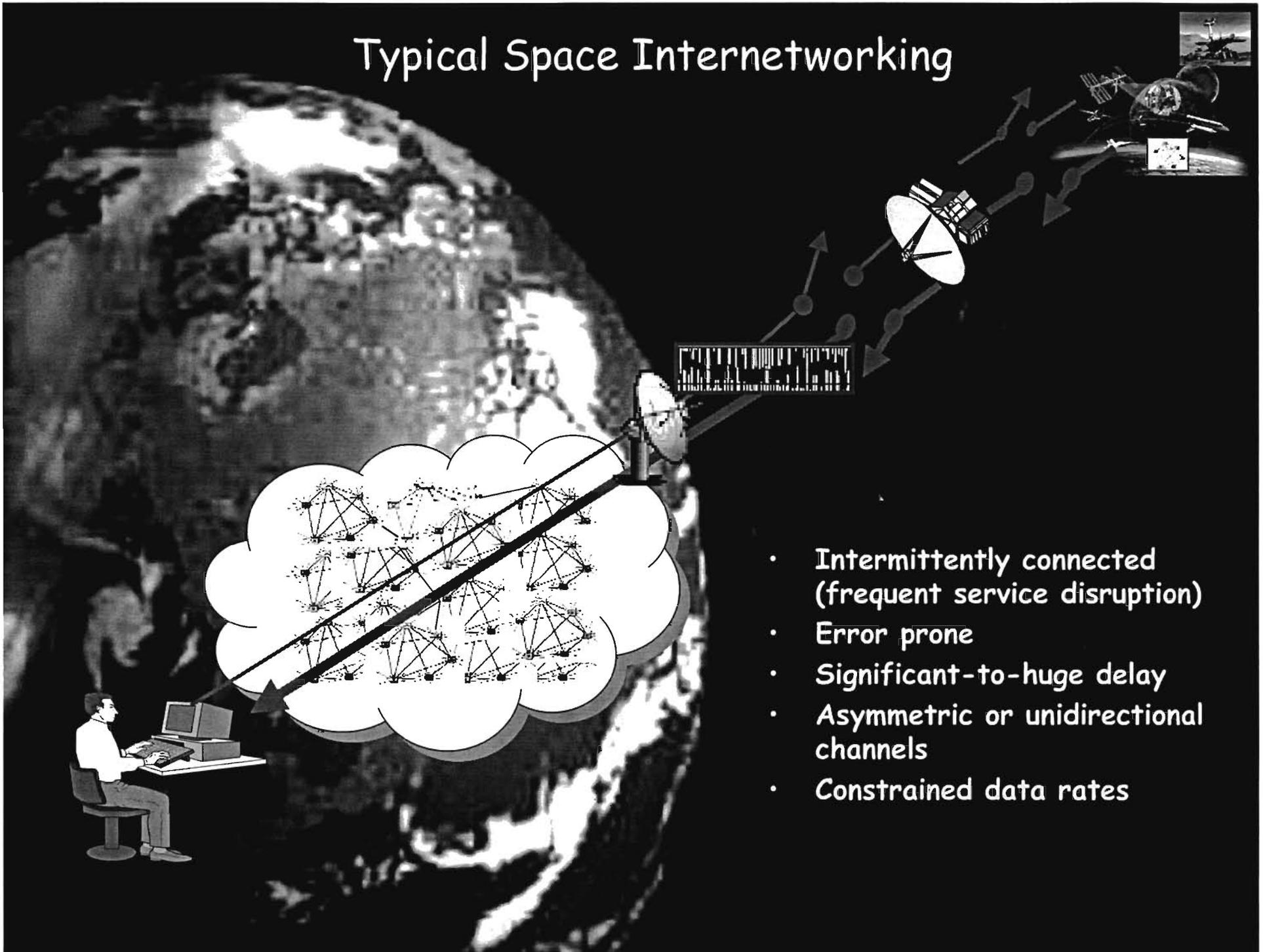


Conventional Internetworking



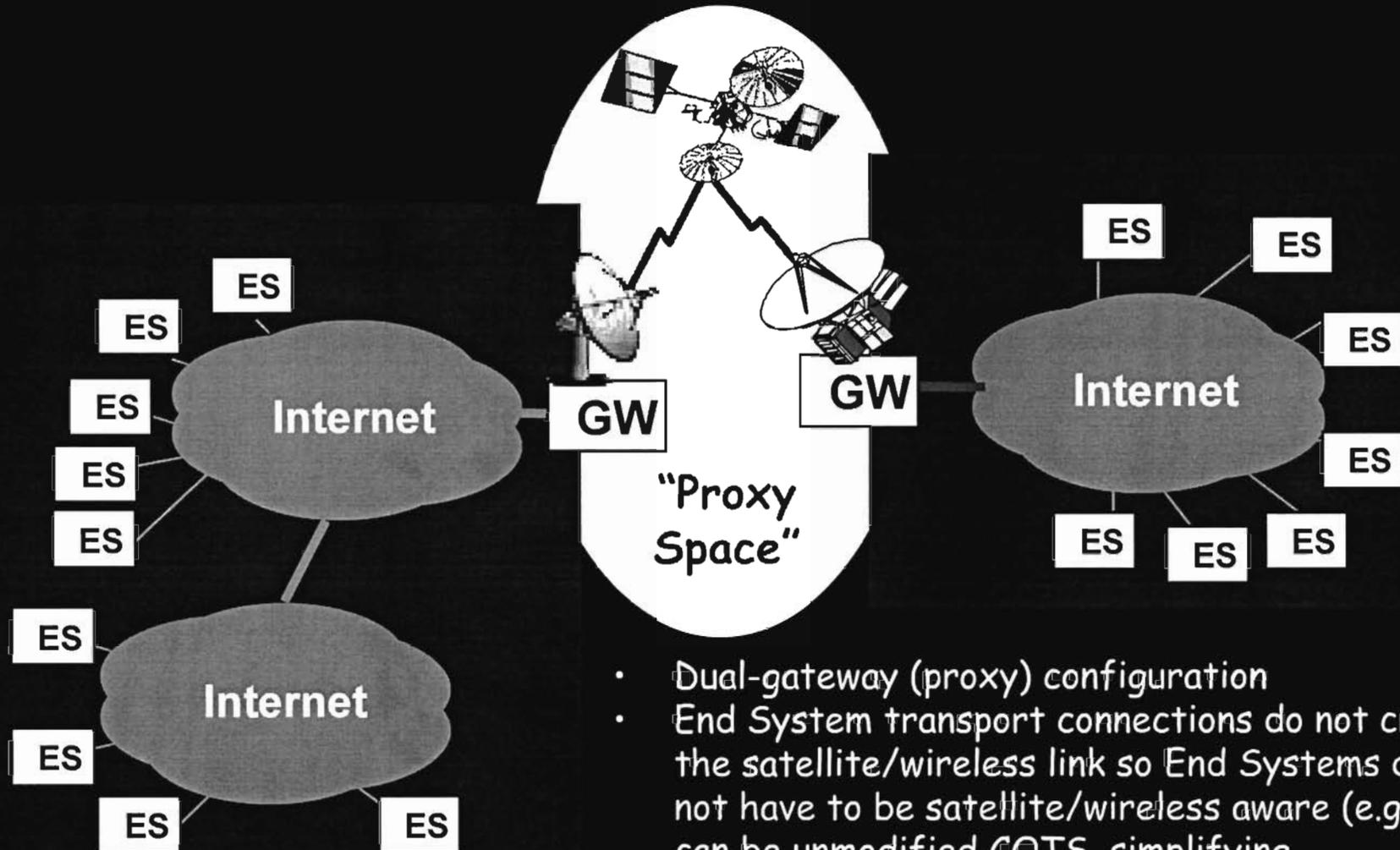
- Richly connected
- Continuous availability
- Error free
- Negligible delay
- Symmetric channels
- High data rates

Typical Space Internetworking



- Intermittently connected (frequent service disruption)
- Error prone
- Significant-to-huge delay
- Asymmetric or unidirectional channels
- Constrained data rates

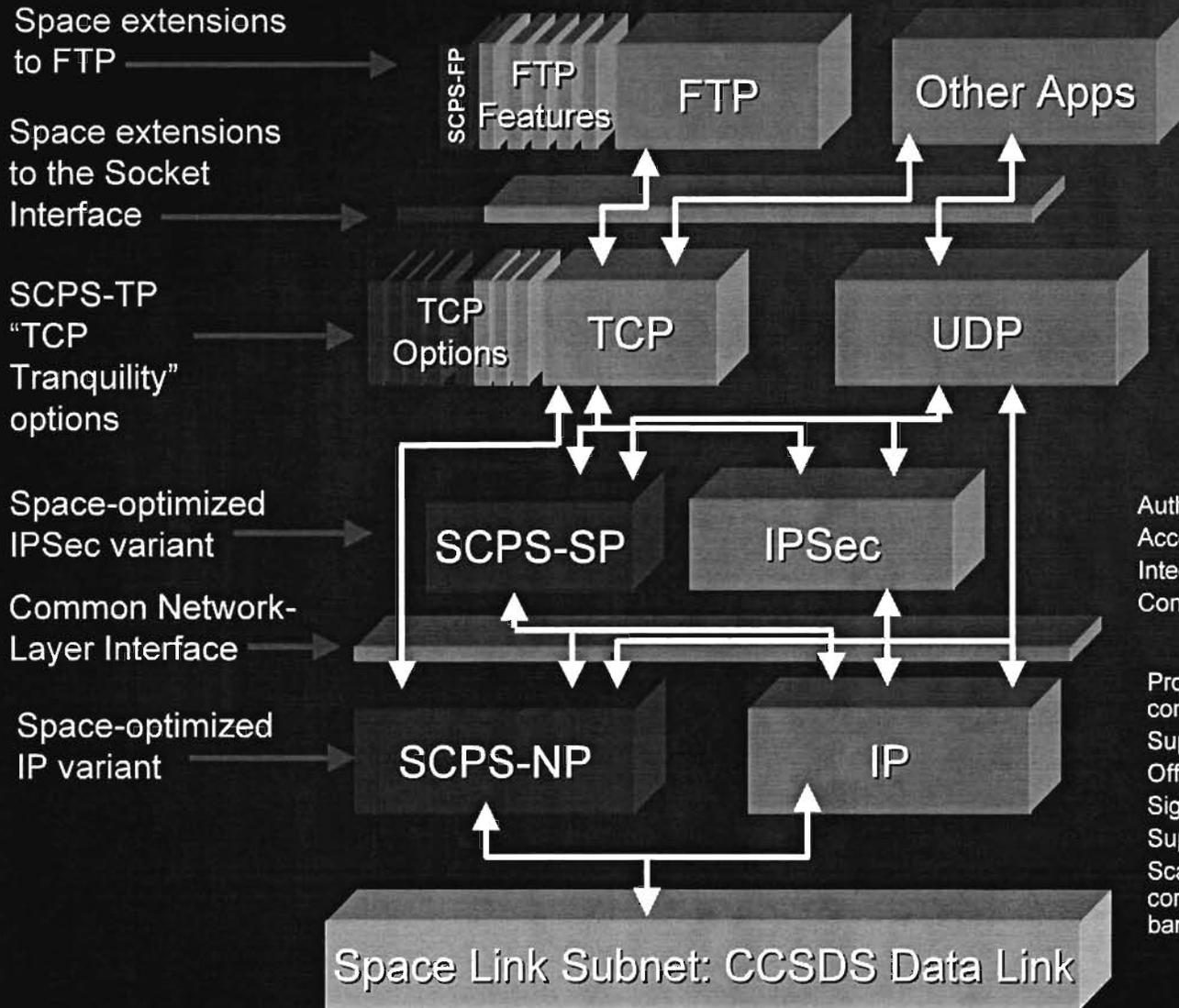
CCSDS approach to extending the terrestrial Internet into space Proxy-Based Operation



ES = End System
GW = Transport Layer Gateway (Proxy)

- Dual-gateway (proxy) configuration
- End System transport connections do not cross the satellite/wireless link so End Systems do not have to be satellite/wireless aware (e.g., can be unmodified COTS, simplifying deployment)
- Security above transport or via trusted gateways

Current CCSDS Space Internet Protocol Options



Record read & record update;
File & record Integrity;
Automatic restart;
User suspend/resume;
Suppress ASCII reply codes.

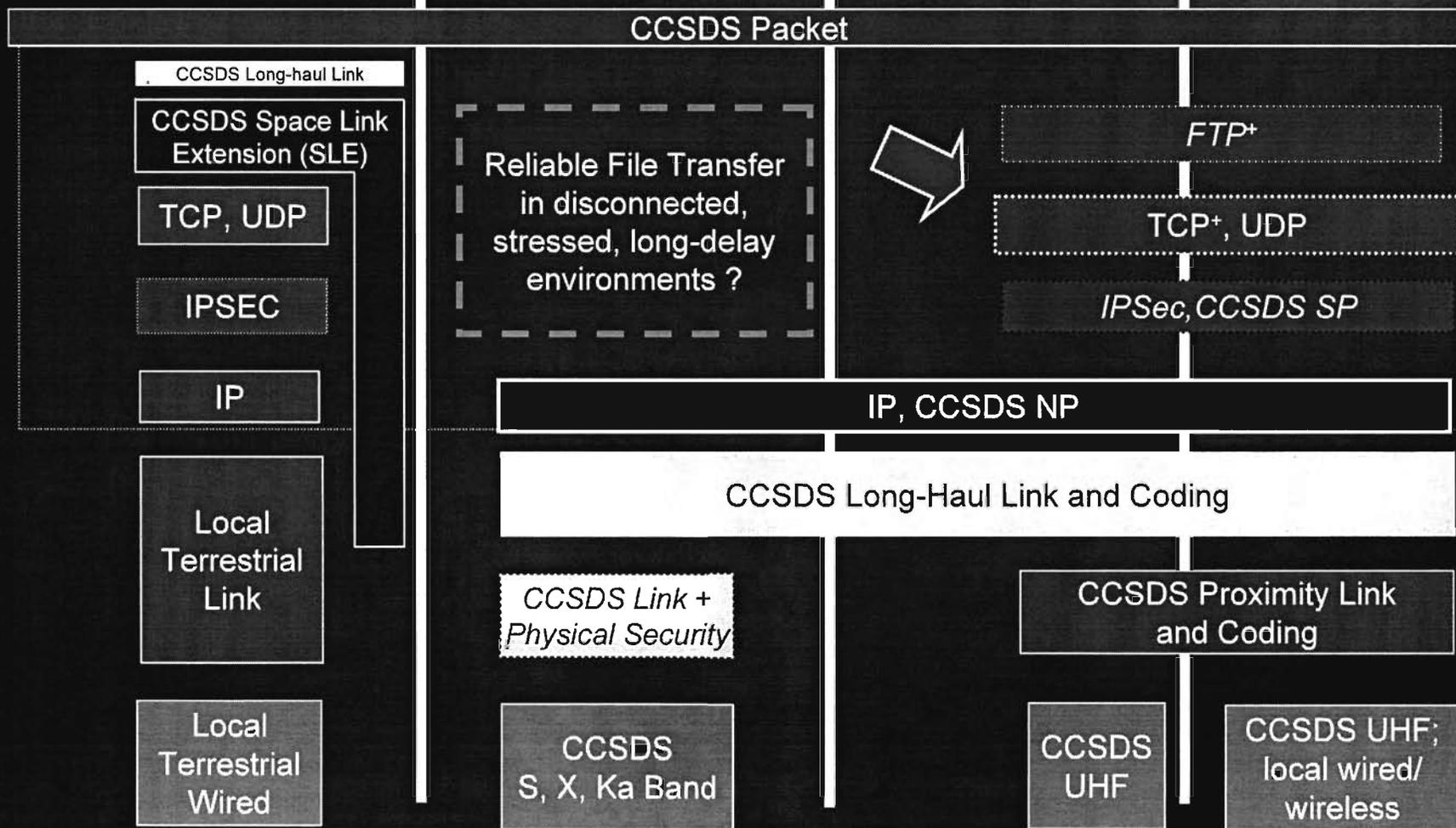
Congestion control appropriate for mixed-loss environments (congestion, corruption, outage);
Selective negative acknowledgment;
Robust header compression;
Partial Reliability service (BETS);
Delimitation of record boundaries;
RFC 1323: Window scaling, time stamps, sequence number extension

Authentication: guarantee of the identity of a source;
Access Control: prevention of unauthorized access;
Integrity: protection against modification;
Confidentiality: protection from disclosure.

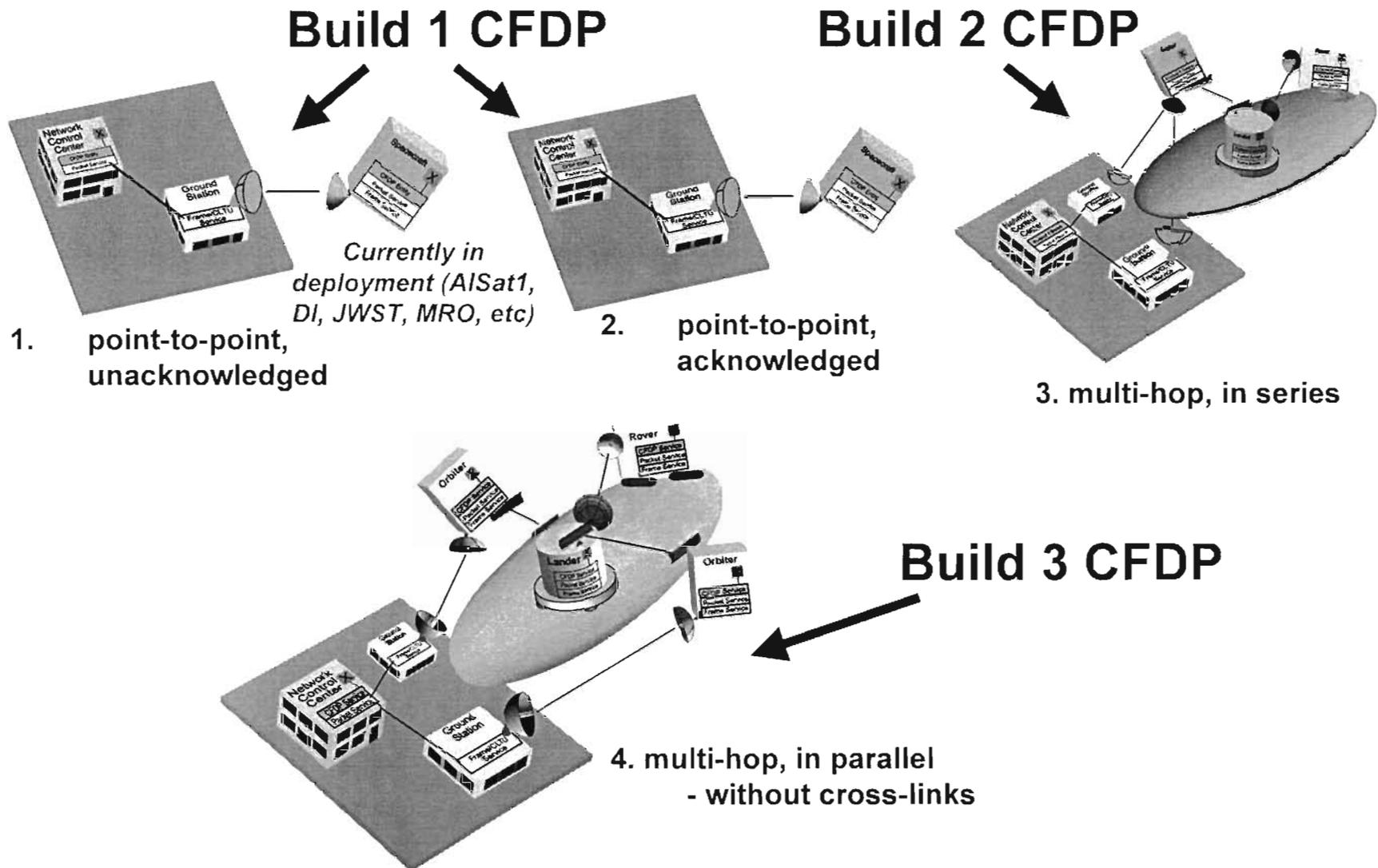
Provides both connectionless and managed-connection routing;
Supports precedence (priority) based handling;
Offer multiple routing options;
Signals errors to the layer above;
Supports packet lifetime control;
Scalable - tailor capability to need, e.g., high communications efficiency in constrained bandwidth conditions.

The CCSDS protocol suite supports either "native" or "space enhanced" Internet services, at the discretion of the Project organization

"Space Internet" CCSDS Protocol Scenario



CCSDS File Delivery Protocol (CFDP)



"CFDP-Era" (2005+) CCSDS Protocol Scenario

