GSAW 2003

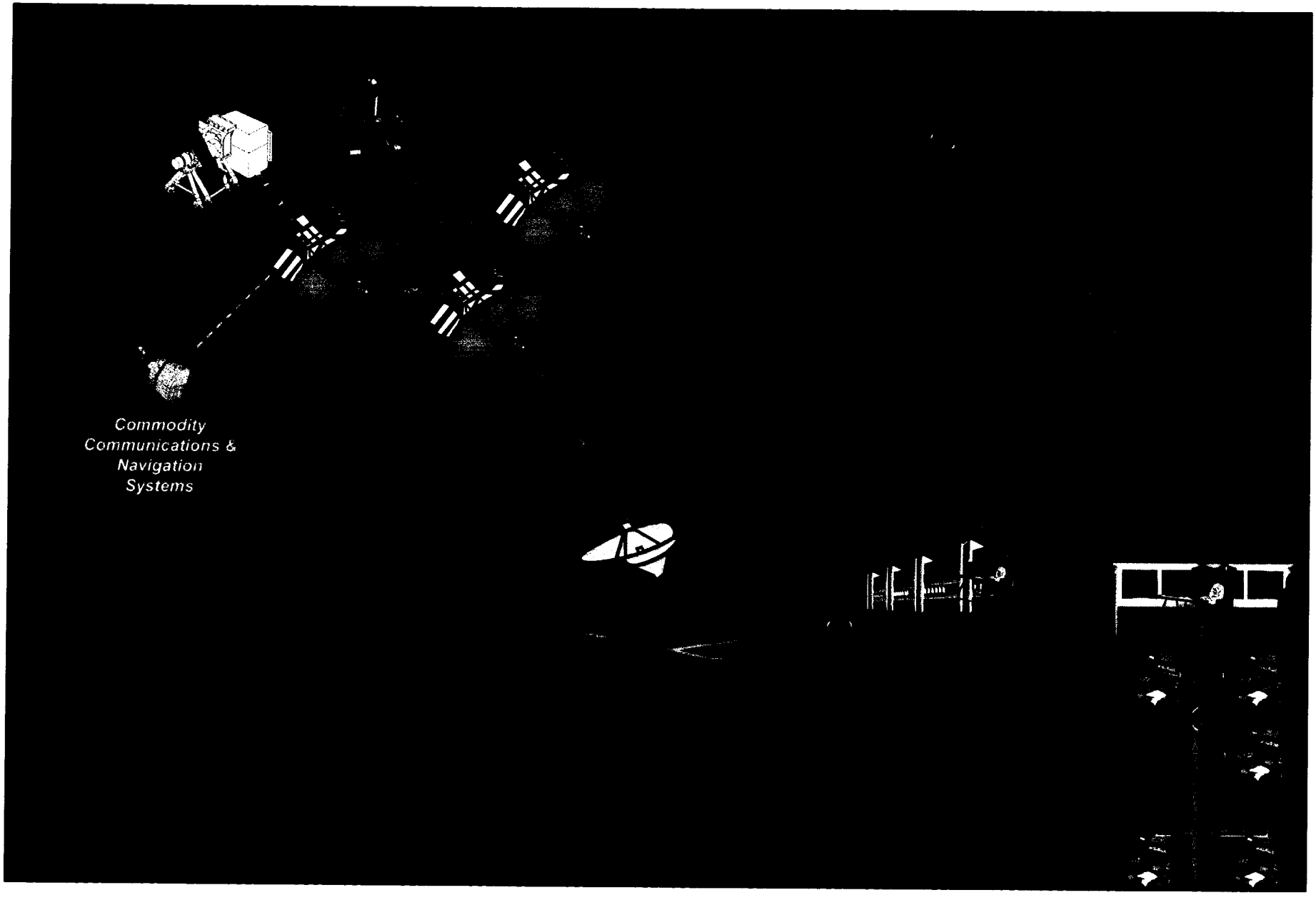
Session 3:

Advanced Internet Technologies for Spacecraft TT&C

Adrian Hooke / JPL
Jim Noles / GST
Keith Scott / MITRE
Mary Jo Zukoski / MITRE
Howard Weiss / SPARTA

04 March 2003

Consultative Committee for Space Data Systems
http://www.ccsds.org/implementations/implementation.html
NOAA-1
FUVE


Commodity
Communications &
Navigation
Systems

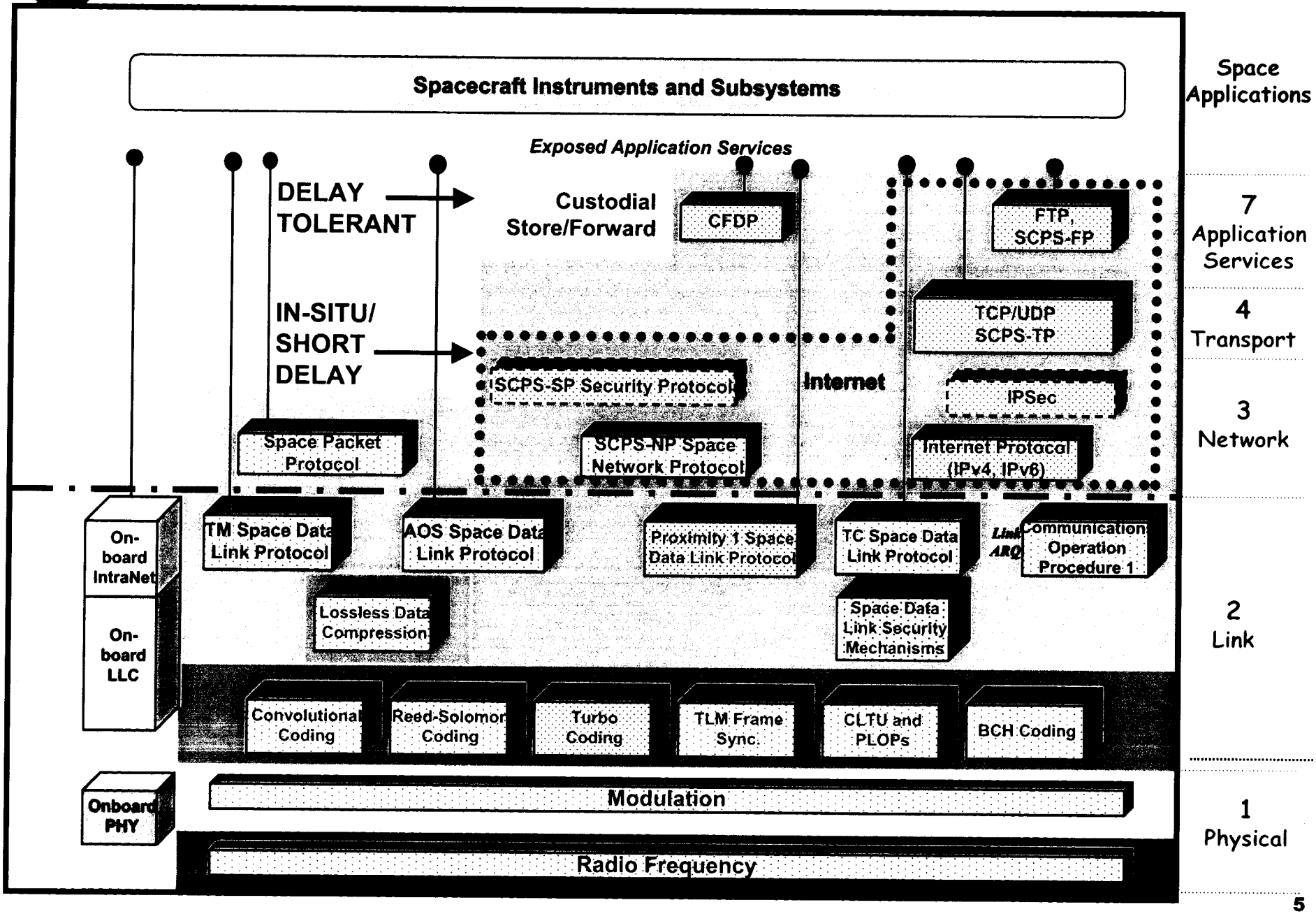
Ways of Communicating

- Current Mission Communications
  - Mainly non-real-time (instrument to PI)
  - Managed data flows

⇨ Next Generation Space Internet
  - Real-time, end-to-end communications
  - Dynamic data flows with resource arbitration
  - Secure, efficient, with QoS

- Delay Tolerant Networking
  - Non-real-time (but able to cope with intermittent connectivity and long delays)
  - Secure, efficient, with (delay-tolerant) QoS

Current Internationallly Standard Communications Protocol Architecture

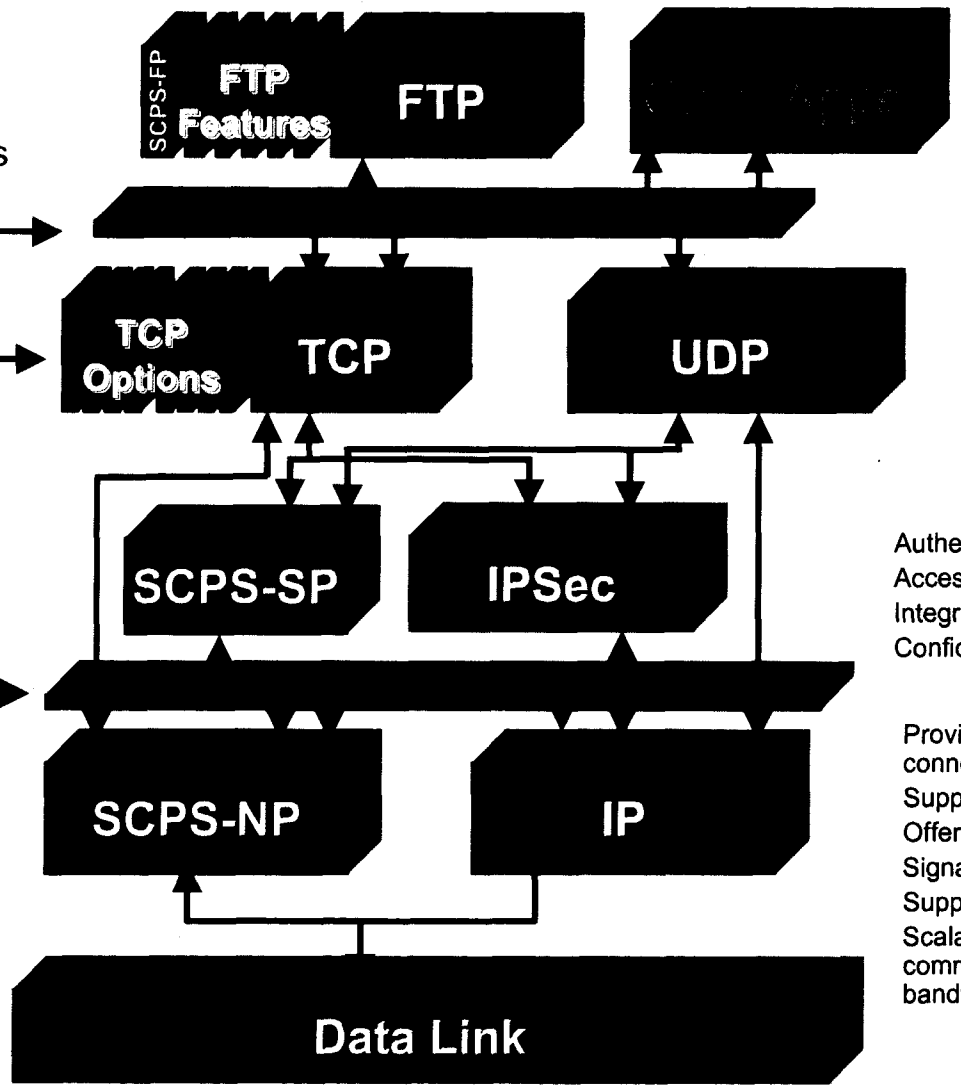


Current CCSDS Space Internet Protocol Options

Space extensions to the Socket Interface

TCP Tranquility options

Common Network-Layer Interface



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

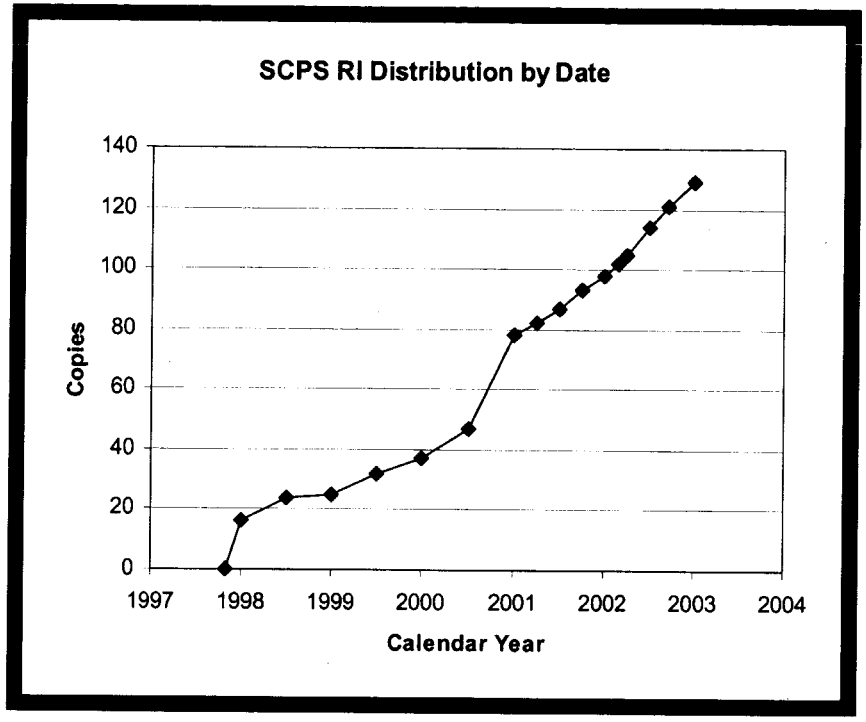
Congestion control appropriate for mixed-loss environments (congestion, corruption, outage);
Selective negative acknowledgment;
Robust header compression;
Partial Reliability service (BETS);
Delimitation of record boundaries;
RFC 1323: Window scaling, time stamps, sequence number extension

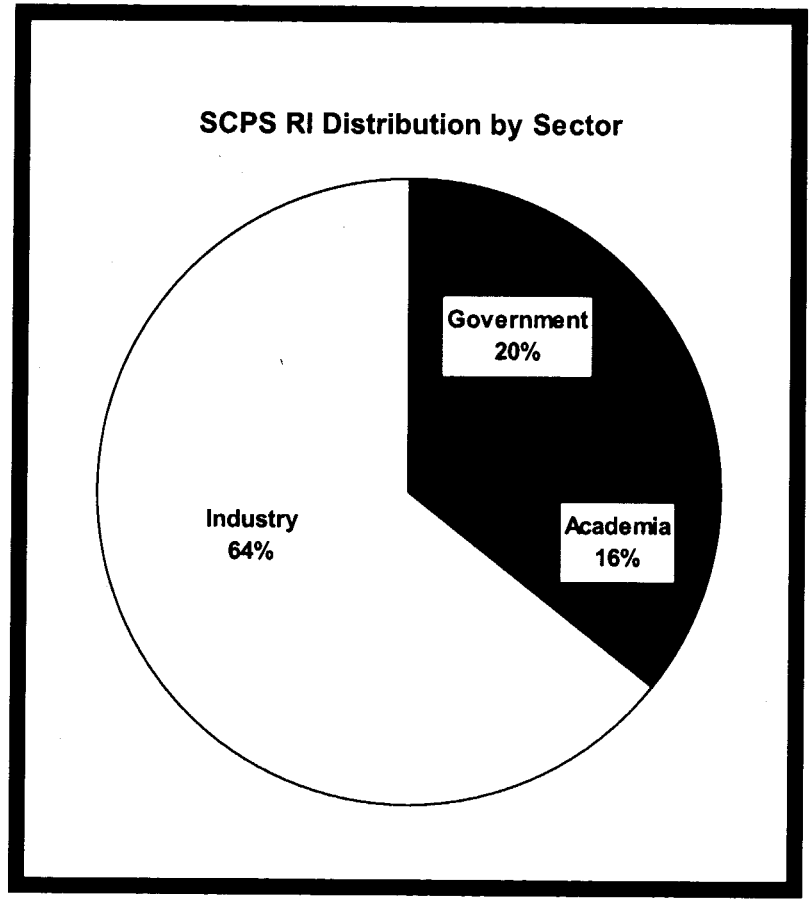
Authentication: guarantee of the identity of a source;
Access Control: prevention of unauthorized access;
Integrity: protection against modification;
Confidentiality: protection from disclosure.

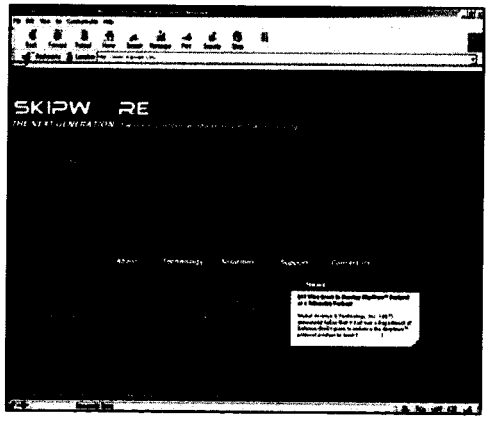
Provides both connectionless and managed-connection routing;
Supports precedence (priority) based handling;
Offer multiple routing options;
Signals errors to the layer above;
Supports packet lifetime control;
Scalable - tailor capability to need, e.g., high communications efficiency in constrained bandwidth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

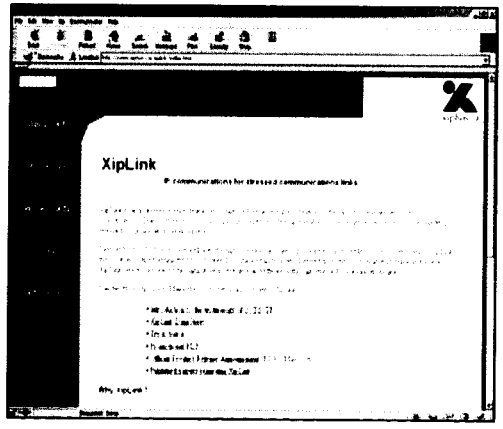
The CCSDS protocol suite supports either "native" or "space enhanced" Internet services, at the discretion of the Project organization

SCPS Reference Software







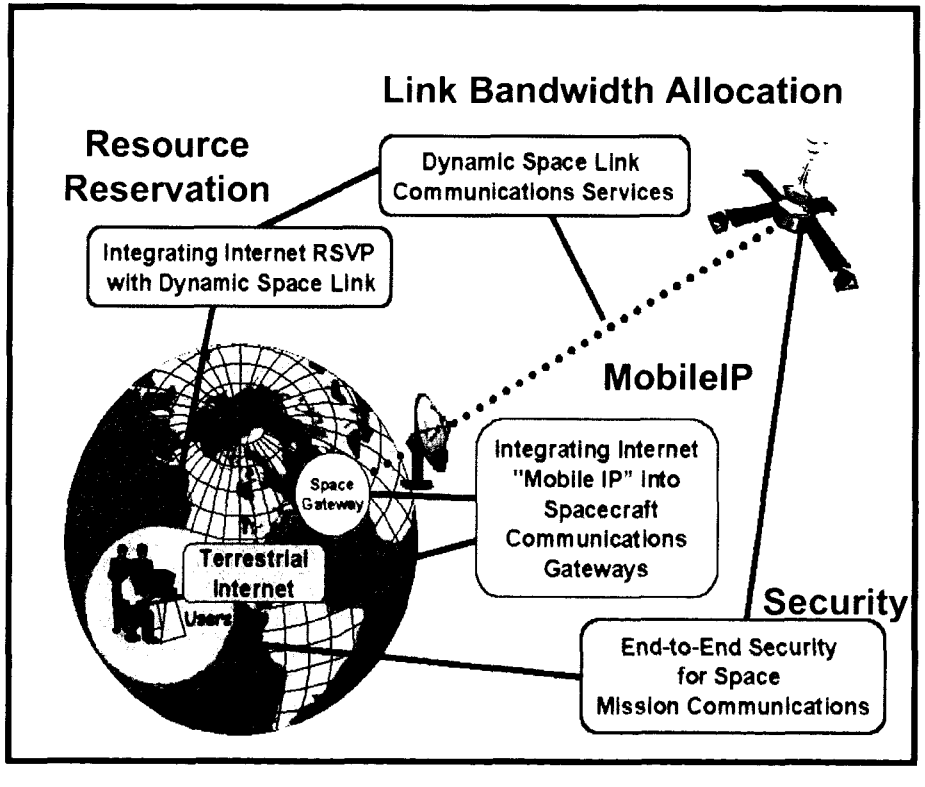


DISA Teleport System

New CCSDS Work: Next Generation Space Internet (NGSI) (including Security, MobileIP, RSVP)

Resource Reservation

Develop techniques and prototype software for spacecraft-to-PI communications by enabling end-to-end resource reservation across multiple providers



Link Bandwidth Allocation:

Develop new techniques, specifications and prototype software for rapid, adaptive and automated reconfiguration of space/ground and space/space data link transmission capacity

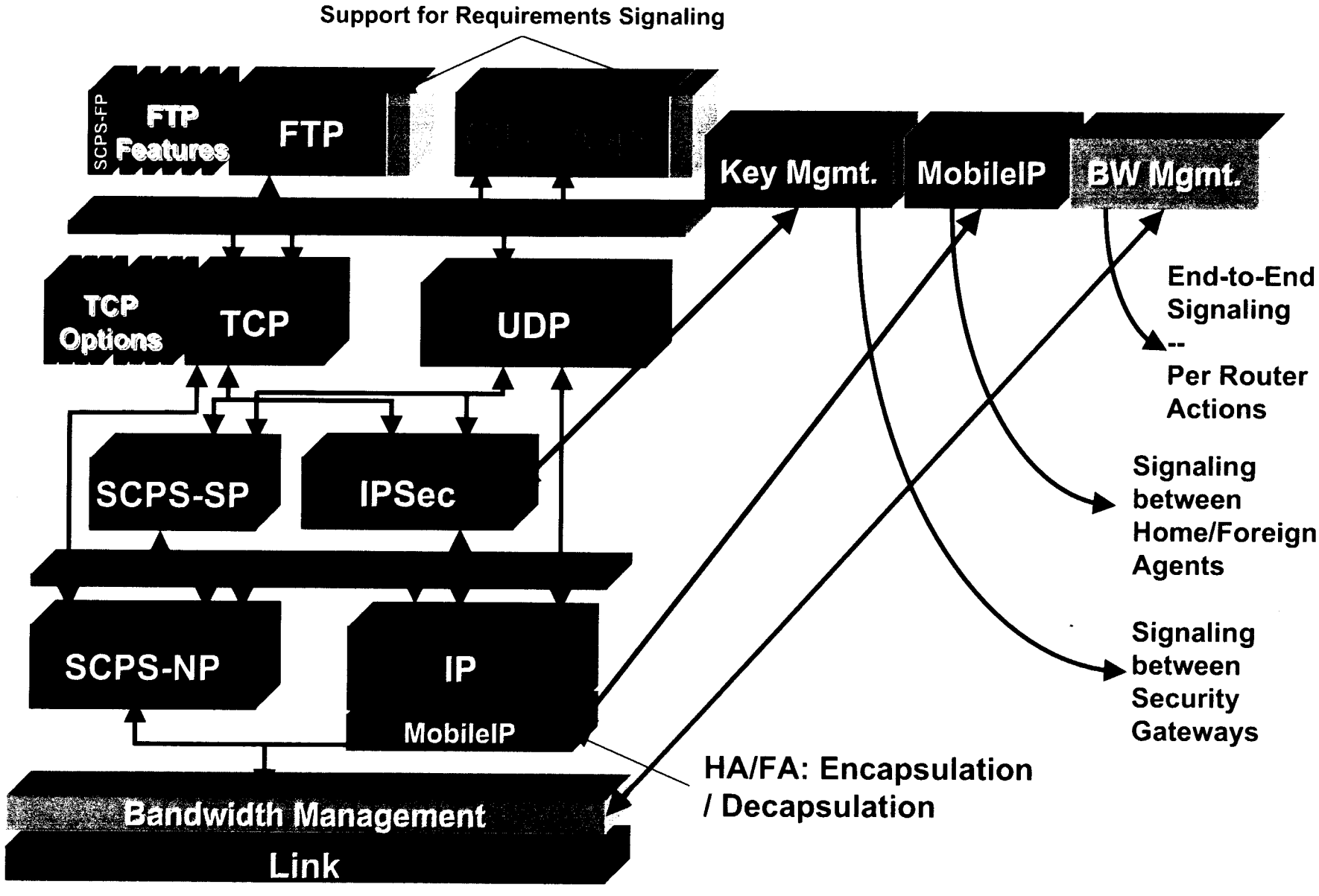
IP Mobility for Spacecraft:

Show viability of Spacecraft-to-PI Mobile IP and develop "proxy registration" capability in ground stations

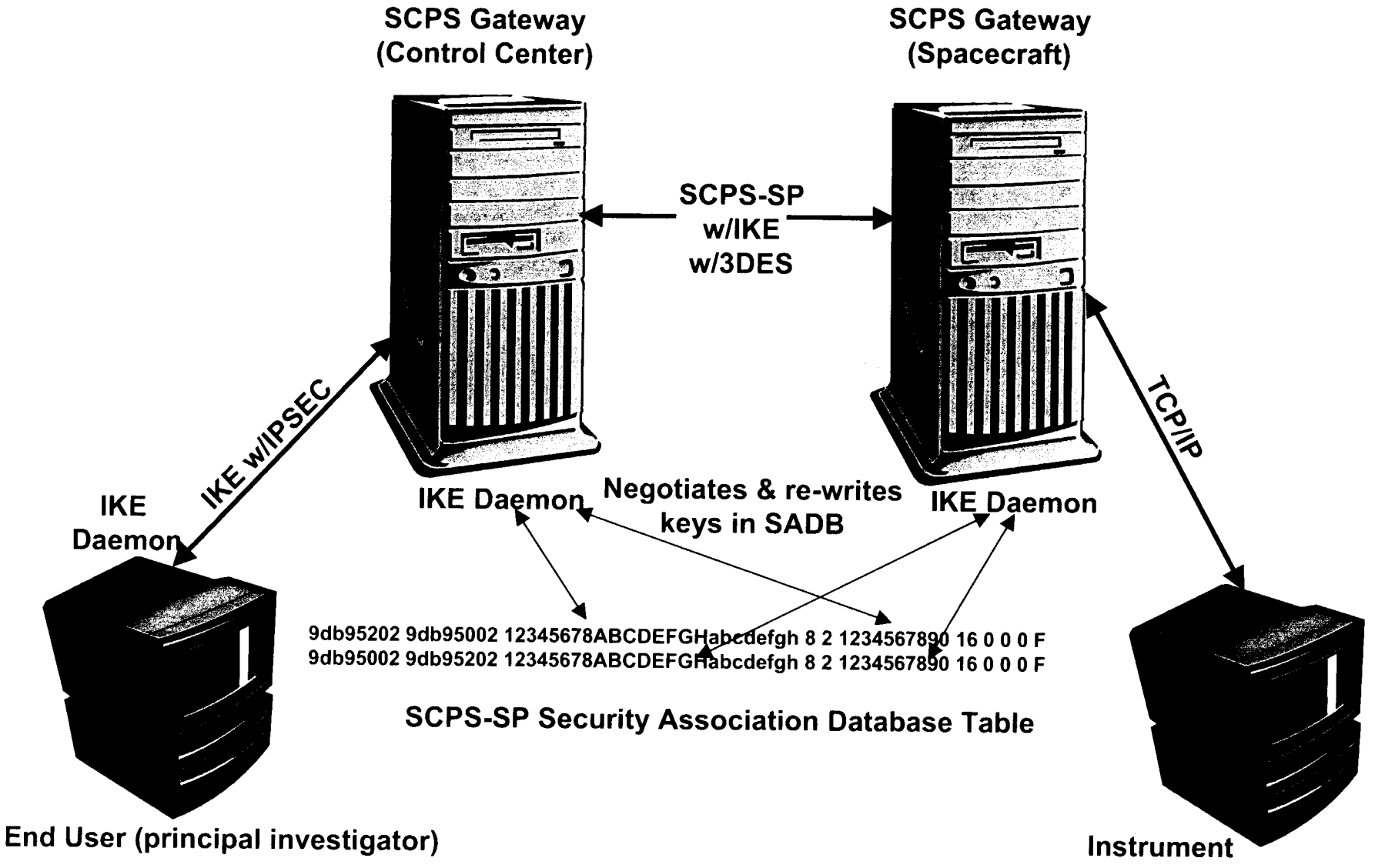
Security:

Standardize space community cryptographic key exchange and key management and enhance the SCPS gateways to provide a robust end-to-end security capability using both IPSec and SCPS-SP

NGSI Protocol Extensions

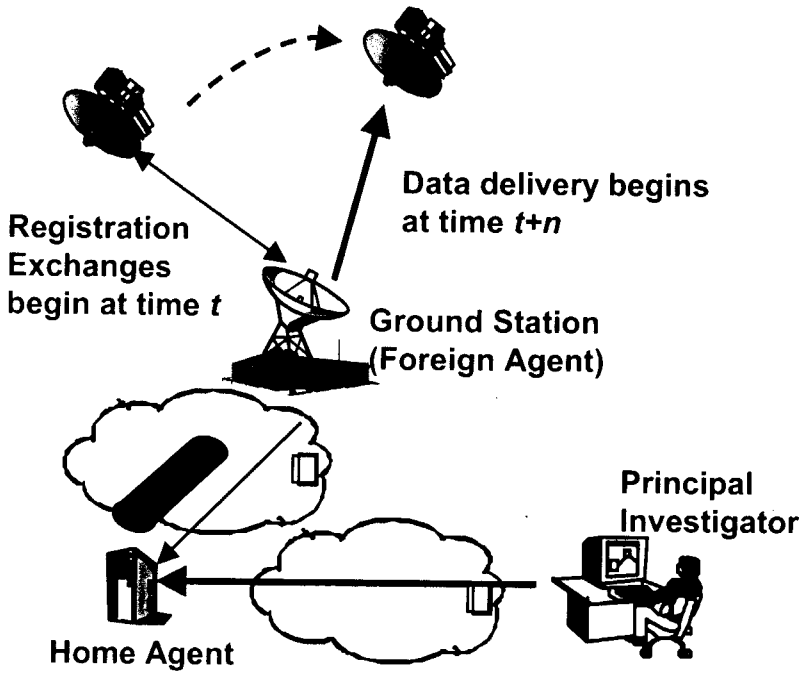


NGSI Security: Red Gateways Translate Between IPSEC and SCPS-SP

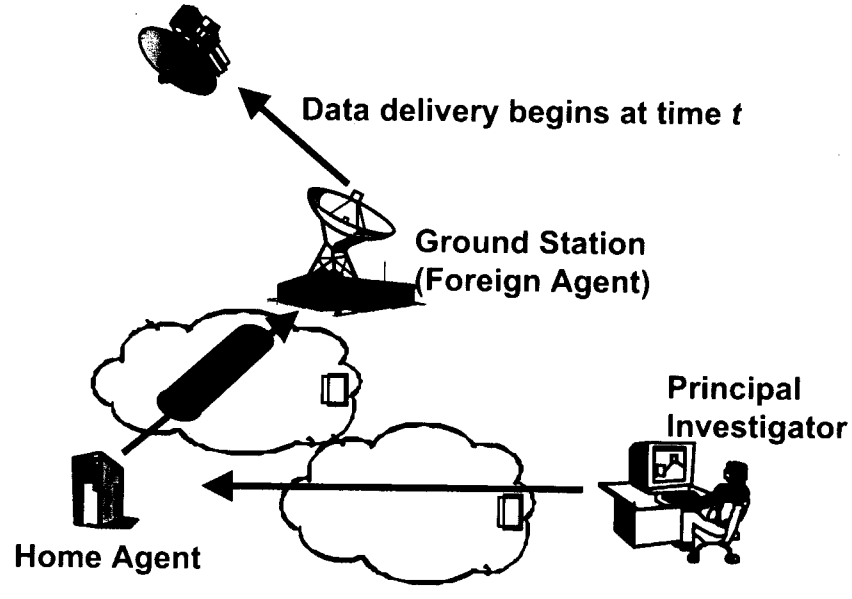


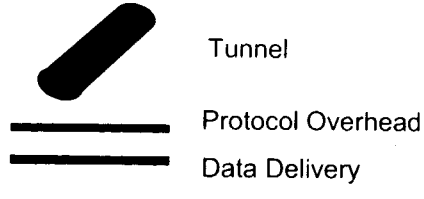
Open MobileIP Extensions for Space

"Standard" MobileIP

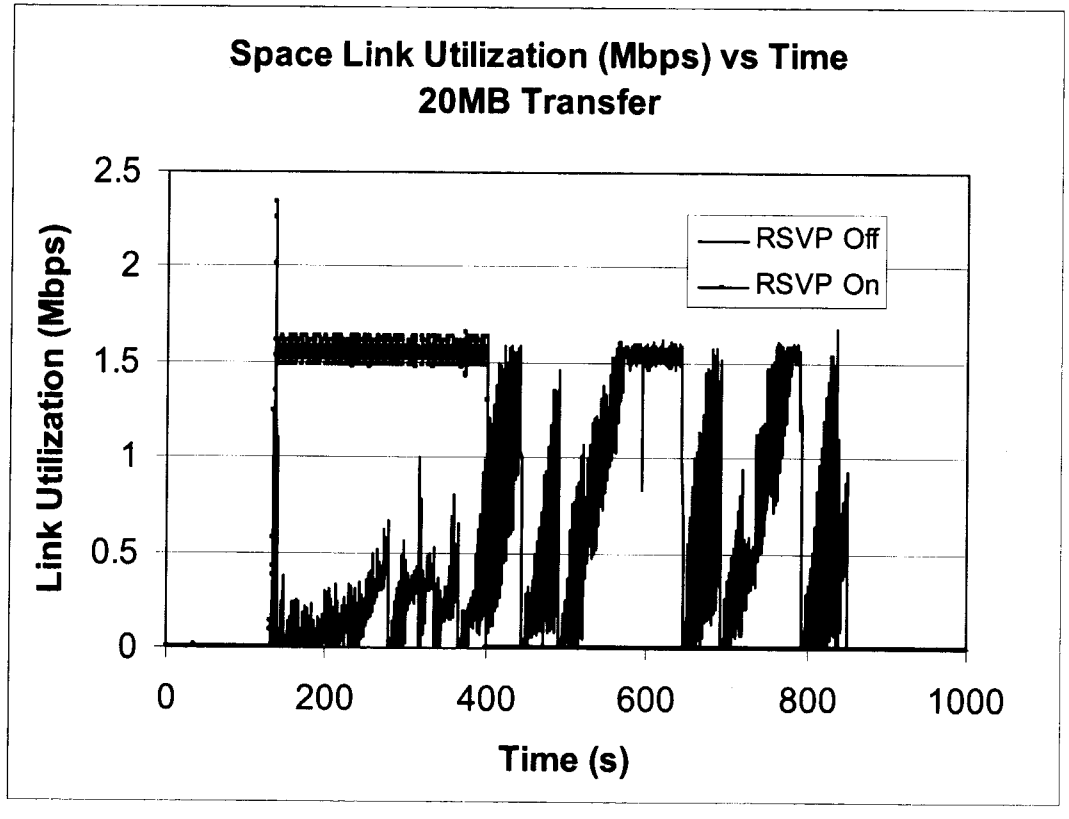


MobileIP with open NGSI Extensions





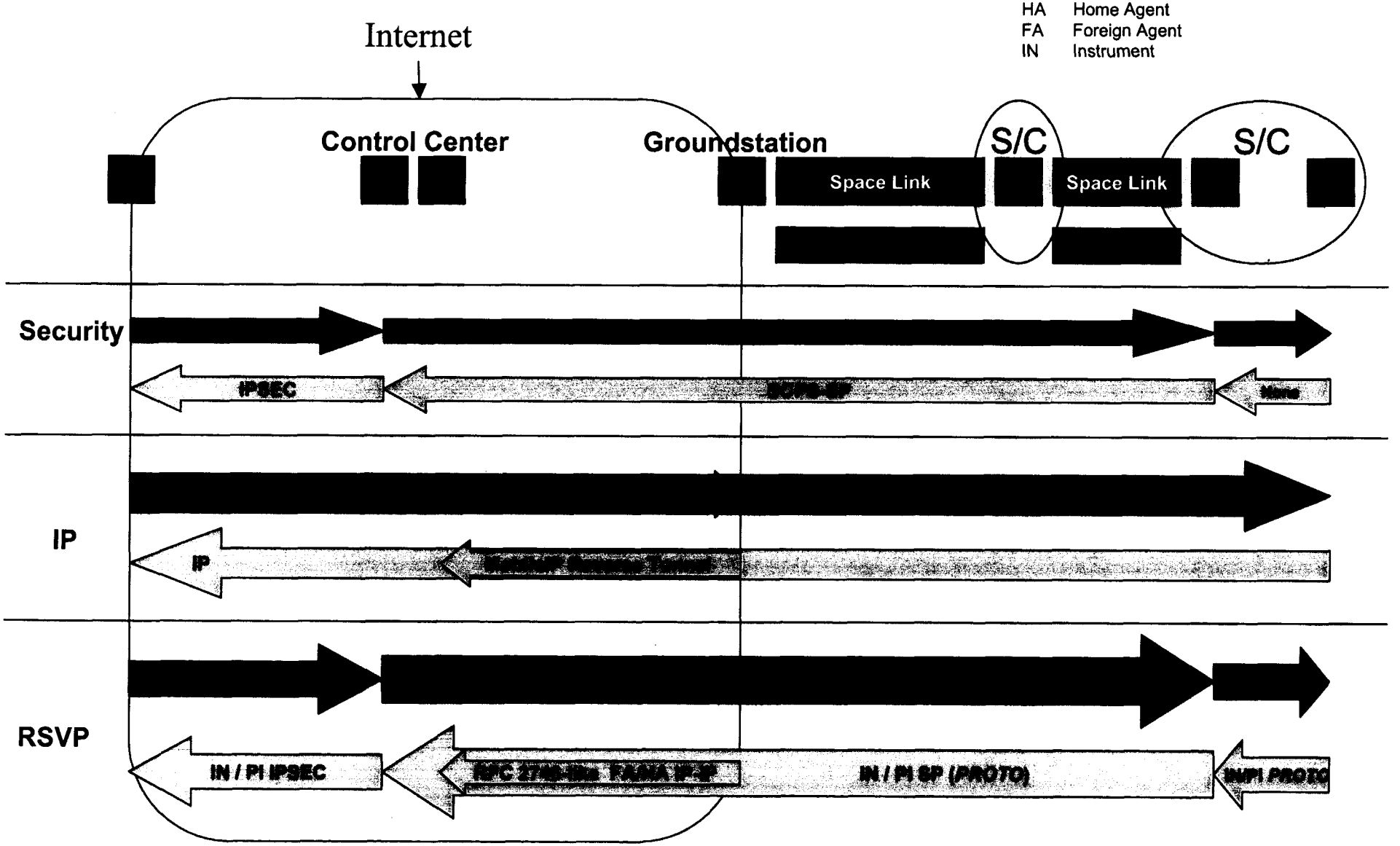
RSVP Performance



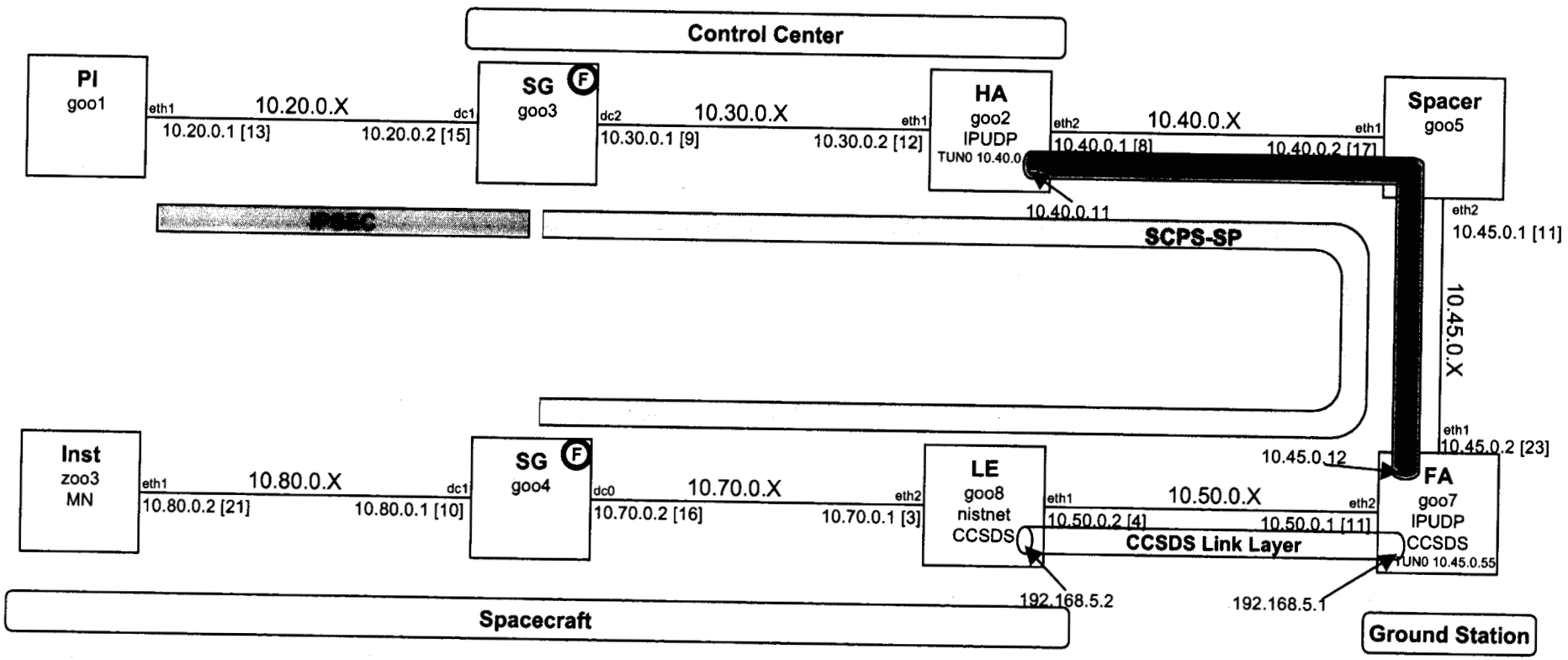
Delays typical of LEO via TDRSS access. Data congested by 10-user LAN doing FTP gets, 1 every 6 minutes, average 1MB size per user

NGSI Data Flows

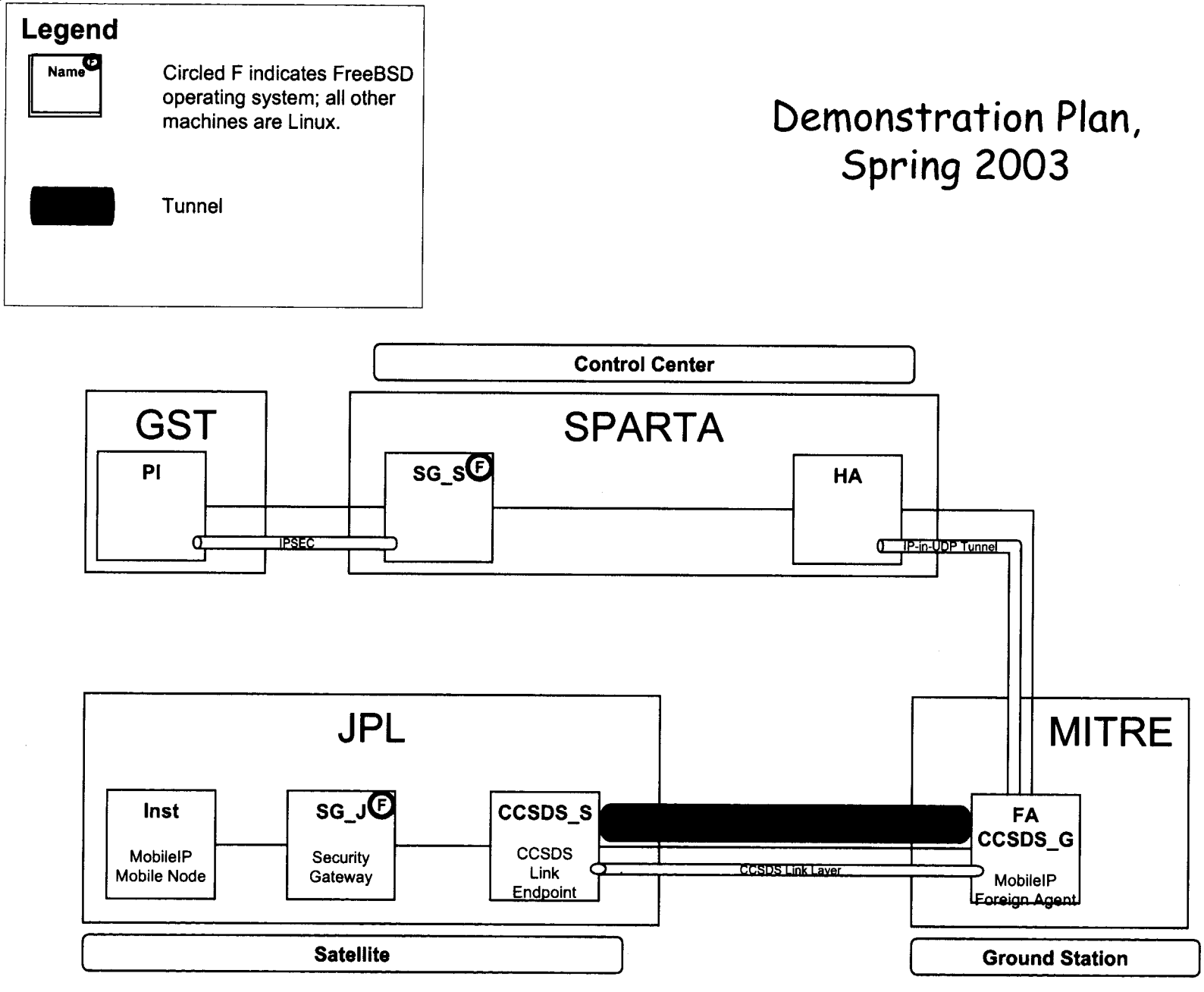
PI	Principal Investigator
SG	Security Gateway
HA	Home Agent
FA	Foreign Agent
IN	Instrument



NGSI Lab Prototyping Setup



Demonstration Plan, Spring 2003



NGSI Standardization

- NGSI work presented at Fall CCSDS Meeting (October 2002), Houston, TX

R02-05-05

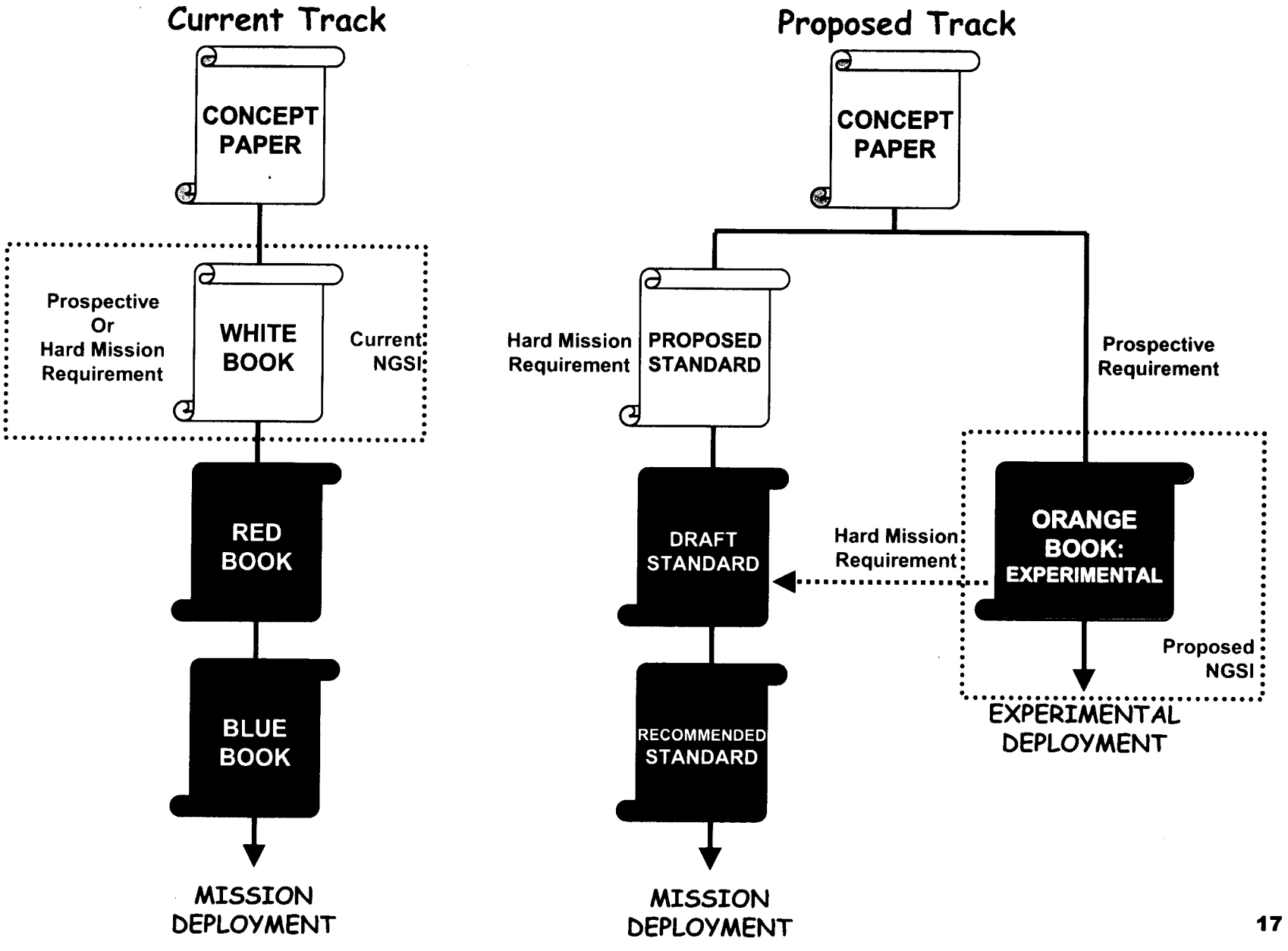
CCSDS Subpanel 1F resolves that the NASA work in "Next Generation Space Internet" (NGSI) protocol development is within the scope of the program of work of the Subpanel and recommends that NASA should prepare four White Books for review and discussion by the Subpanel

- Dynamic Space Link Communications Services
- End-to-end resource reservation
- Mobile IP extensions for space missions
- Key management and secure gateways for space

In addition, the following draft Green Book should be produced

- NGSII Concept Document

The goal is to convert the four specifications to Red Books at the Autumn 2002 meeting, with a formal Agency review to be completed by the Spring 2003 meeting.

http://www.aist-ngsi.org

CCSDS Standardization Proposal