

Space File Delivery Protocols

Scott.Burleigh@jpl.nasa.gov

Some Alternatives

- Synchronous, conversational:
 - Standard FTP
 - SCPS-FP
 - SAFE
- Asynchronous, postal:
 - CFDP

FTP

- Runs over TCP/IP
- Familiar, proven, excellent in standard Internet environment
- Relies on ample bandwidth, stable connections, low propagation latency

SCPS-FP

- Nominally runs over SCPS-TP/NP
- Based on FTP but less bandwidth-hungry, tolerates disconnection:
 - pause/resume, automatic restart
 - operations on individual records
 - reduced conversational traffic

SAFE

(Simple Automatic File Exchange)

- Based on NFS; client/server model
 - stateless server
 - idempotent operations
 - remote read
 - remote write
- Typically runs over UDP/IP, does its own retransmission

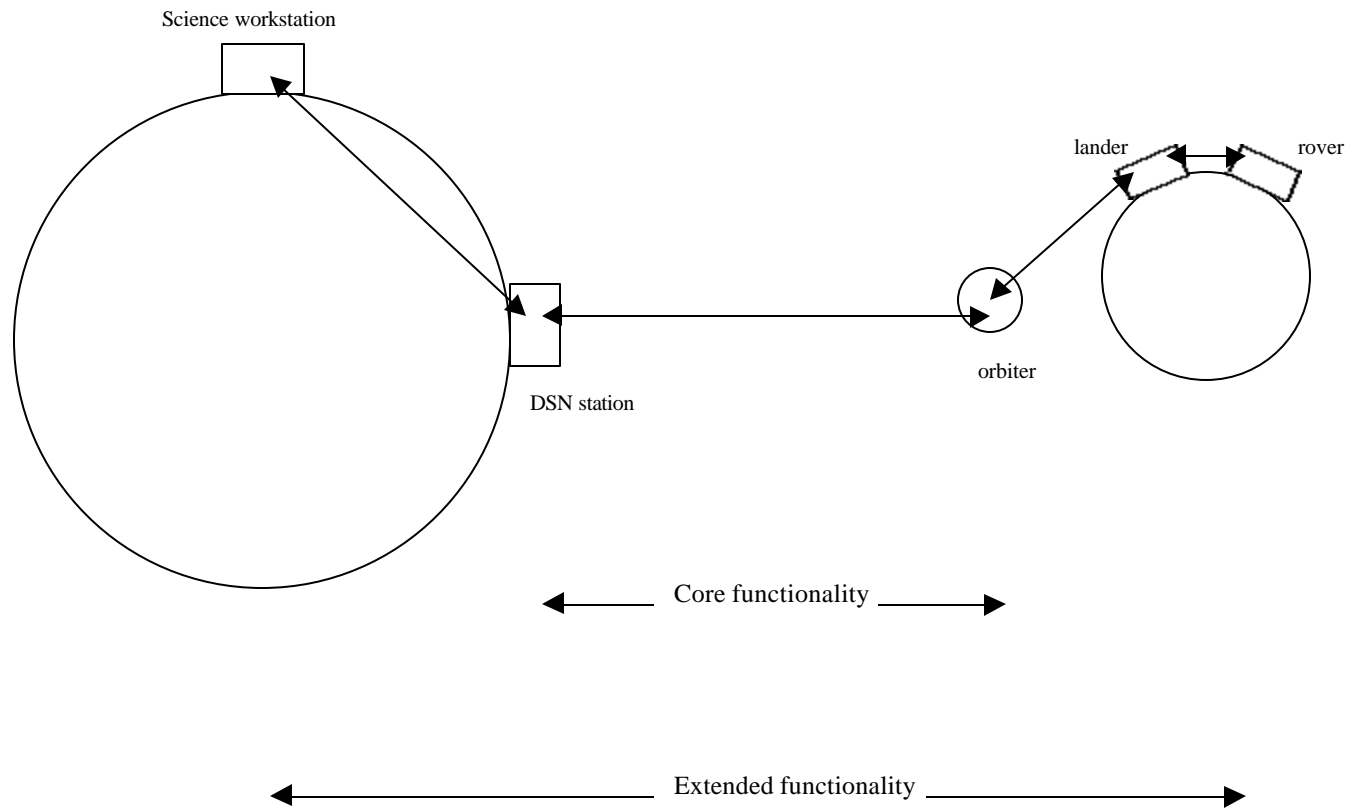
Earth Orbit vs. Deep Space

	<u>Terrestrial</u>	<u>Interplanetary</u>
Distance (light sec)	< .1	10 to 10,000
Connectivity	Structural, continuous	Operational (directed), intermittent
Medium	Copper, glass	Space
Deployment \$	“low”	Very high
Configuration, ops, mgt \$	“low”	High (electricity is scarce and expensive)
Repair, upgrade \$	“low”	Very high

Asynchronous File Delivery

- Return traffic (including retransmission) may not arrive for minutes, or weeks. So:
 - Parallel transmission.
 - Incremental delivery, possibly out of transmission order.
 - Declaration (not negotiation) of connection parameters.
 - Structural (not reactive) congestion control and flow control.
- The model is postal rather than conversational. Email with attachments.

CFDP Operations Scenarios



Core Features

- Reliable transmission of files, file system commands, metadata.
- Concurrent transactions, multiple retransmission buffers.
- Incremental (possibly out of order) delivery.
- Bandwidth management.

Extended features

- Multi-hop transfers.
 - Store and forward. (“Custody transfer”)
 - Retransmission is point-to-point, but transaction state is tracked end-to-end [e.g., rover to desktop].
- Simple routing across a network of relays (“waypoints”).

Extended features (cont'd)

- Deferred transmission: application can request a file delivery at any time, without knowledge of when the communication link will be available.