Impact of New CCSDS File Delivery Protocol on JPL Telemetry and Command Ground System Architecture

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Motivations

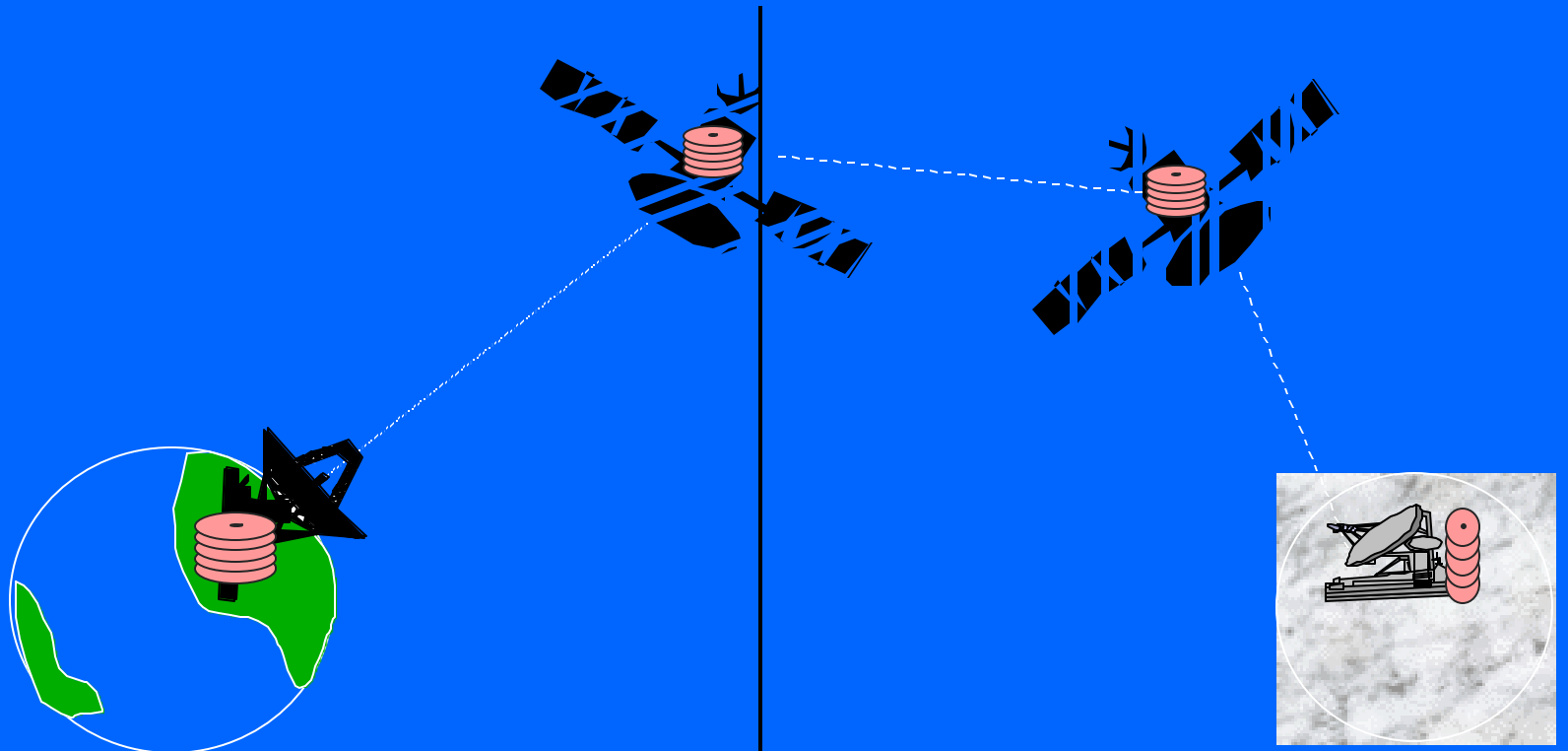
- **CFDP specification and JPL technology validation implementation mature**

- **Future projects to fly CFDP including JPL Deep Impact and Starlight**
  - Expecting simplified on-board storage and data recovery

- **JPL Deep Space Mission System service improvement initiative to develop interoperable file delivery service through the JPL ground system**
  - Standard multi-mission file delivery service rather than continuing to support mission specific designs
  - Expecting reduced mission operations costs related to data transport management and monitoring when using reliable data delivery services

- **JPL Mission Data System** (MDS) **next generation flight-ground frameworks for data transport and data management**
  - End-to-End design and implementation based on transporting objects
  - Radically symmetric architecture requiring reliable data delivery

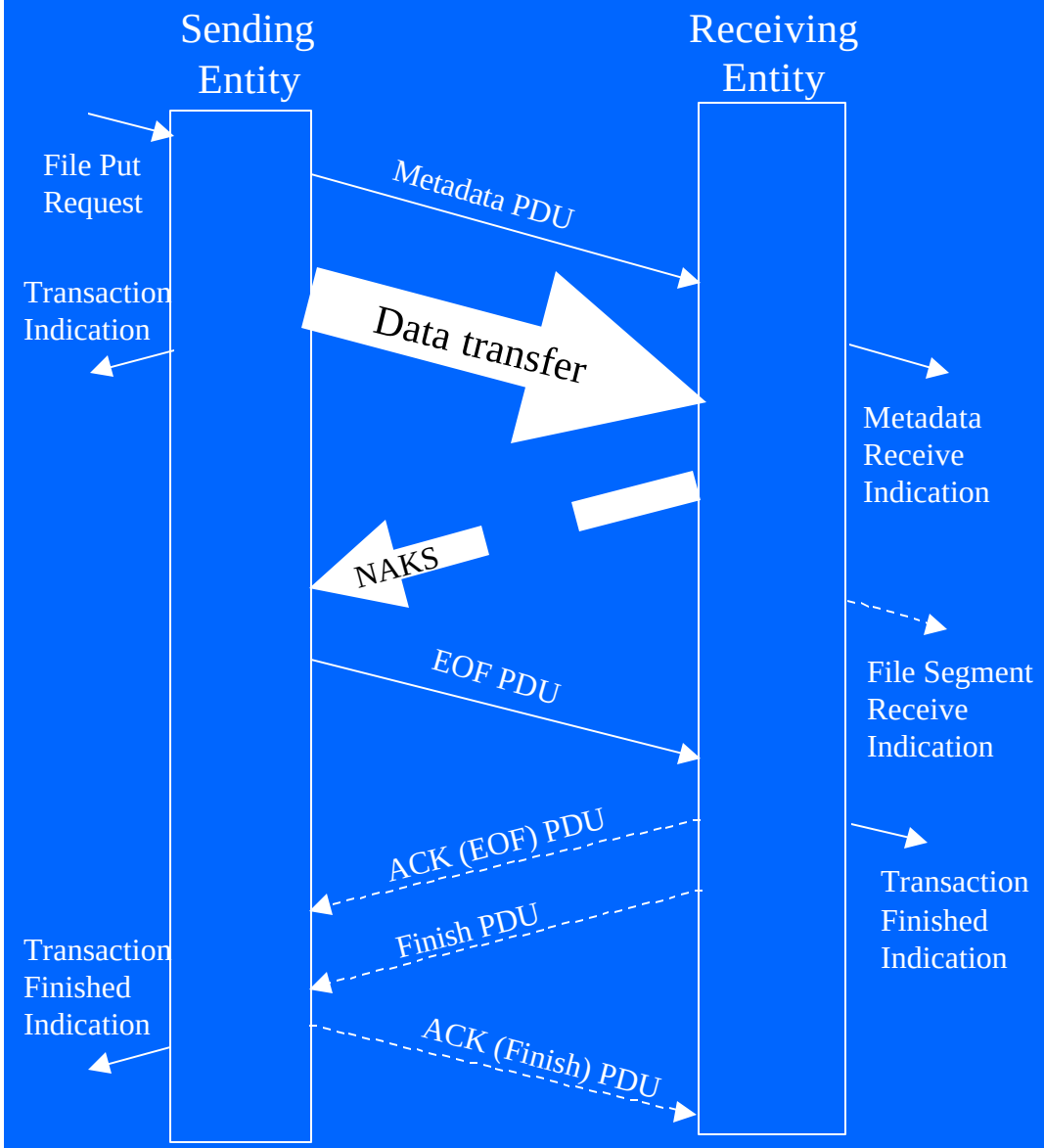
Protocol Context (big picture)



- Core operations providing file delivery capability across a single link

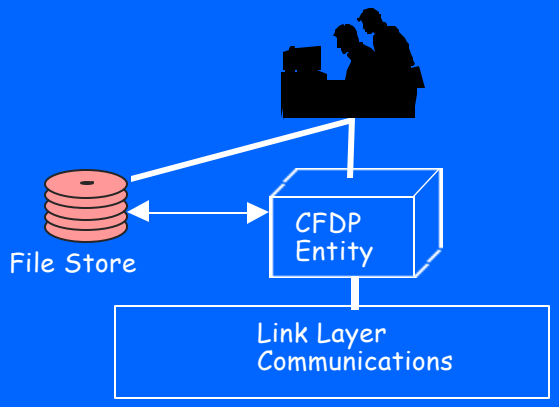
- Extended operation providing store and forward capability across an arbitrary network of links

Protocol Basics (core)

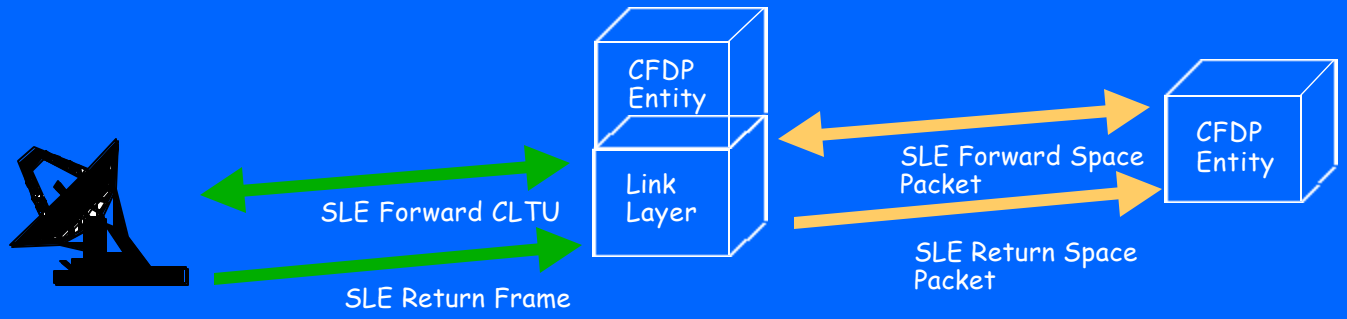


- Protocol is non-interactive and designed to minimize round trip handshaking between entities
- Only Put requests with Remote Put used to effect get
- Unacknowledged and Acknowledged modes with immediate, deferred, prompted and asynchronous negative acknowledgements (NAKs)
- Keep Alive Procedures
- CRC Procedures
- Suspend/Resume/Cancel Procedures
- Report Procedures
- File Store Procedures

Changing Architectural Themes (data link interface)



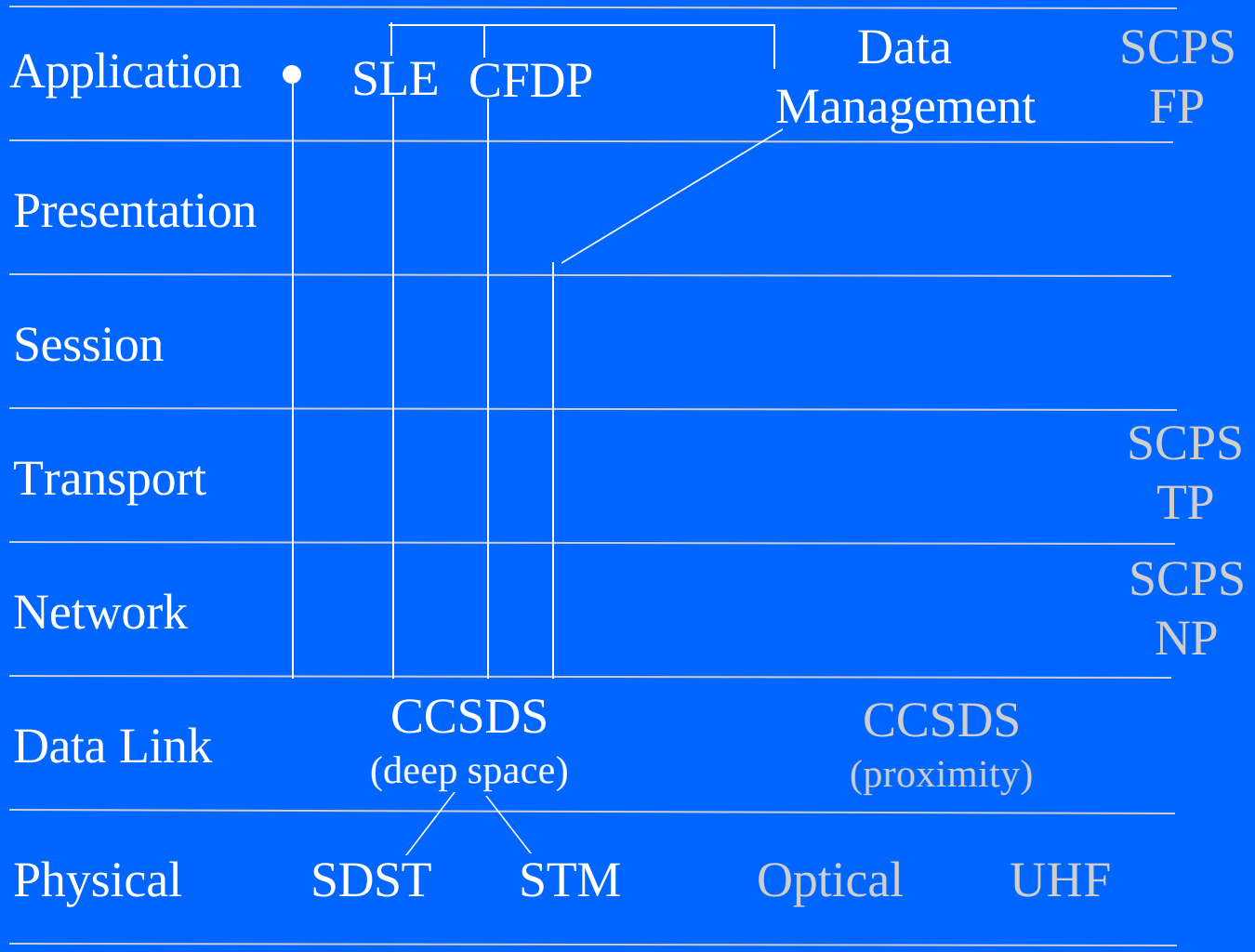
- CFDP will tunnel into any link layer communications protocol, hiding that protocol from applications
- Traditional Link Layer Packet Identifiers or Virtual Channel Identifiers not used to route data to or among applications nor serve as mission data set



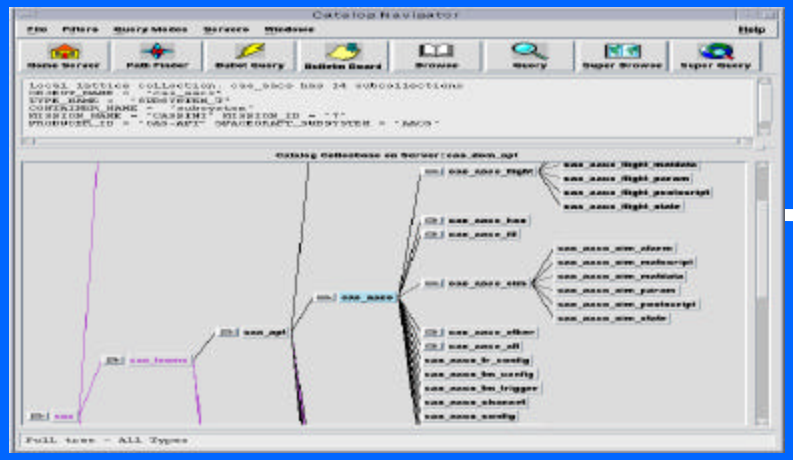
- With a CFDP entity in your Mission Operations Center, the Space Link Extension (SLE) services can be the interface for interoperability across ground stations

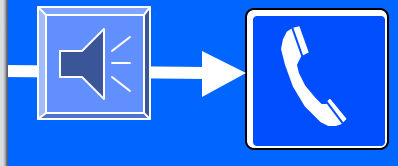
Changing Architectural Themes (data link interface)

- **Space Link Transport Collaborations**



Changing Architectural Themes (application transport interface)





- Product management systems for interfacing to users beyond that traditionally provided by SLE, file stores or packet distribution (file notification/subscription etc.)

- Product design (file content) and transport policy critical to efficient use of the telecommunications bandwidth

- Selective replication vs. deterministic one-way data delivery

- Delivery automation and control through link session management particularly with long one-way light times or intermittent contacts

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Changing Architectural Themes (application frameworks)

- CFDP provides symmetric reliable data transport enabling the traditional lines between flight/ground and command/telemetry to be blurred

- Reshaping telemetry and command to take advantage of generalized delivery, specialization of data and on-board operating systems
  - ⇨ Individual value histories rather than traditional commutated values
  - ⇨ Scripts and control objects rather than commands and command sequences

- Using serialized objects and live objects seamlessly across flight/ground architecture

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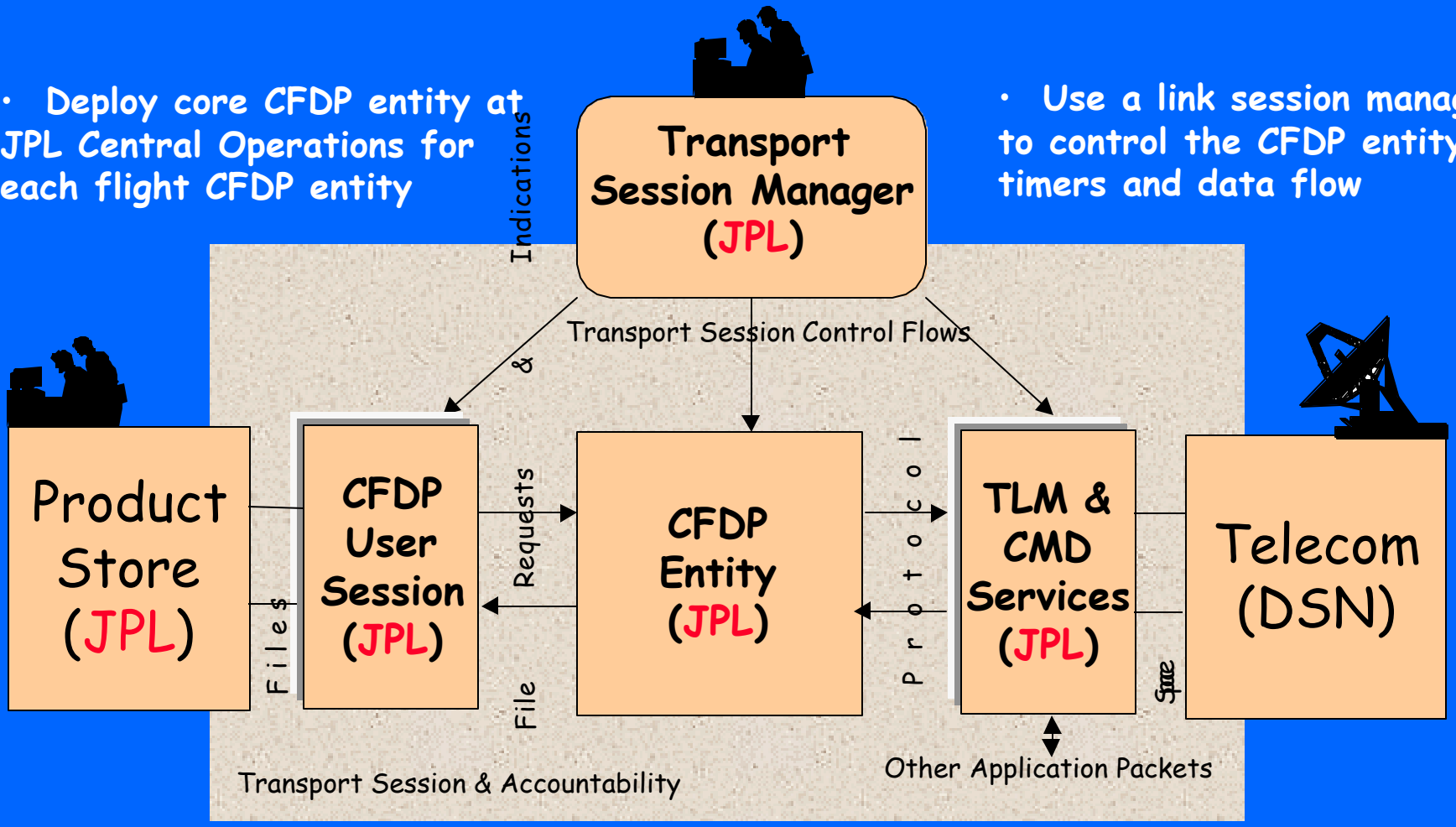
Changing Operational Themes

- File data delivery vs. near real-time stream data delivery
  - ⇨ Latency
  - ⇨ Time ordering
- File request transactions vs. link level packet delivery and accountability
  - ⇨ Fidelity of control at file level not packet level
- User control vs. software application control (automation)
  - ⇨ Protocol Data Units automatically inserted into traditional command stream

Design Overview

- Deploy core CFDP entity at JPL Central Operations for each flight CFDP entity

- Use a link session manager to control the CFDP entity timers and data flow



- Use existing multi-mission command, telemetry and data management services including unique application packet ids (APID) for CFDP PDU

- Use Space Link Extension services for communicating with DSN where appropriate

Plans for FY 2001

- ✓ Provide CFDP entity supporting core procedures for flight and ground system integration
- ✓ Deploy Class-1, unacknowledged mode procedures, for Deep Impact GDS and Flight system downlink integration
- ✓ Deploy Class-2, reliable mode procedures, for Deep Impact GDS and Flight system uplink integration
- ✓ Provide manual link session management through Deep Space Command Radiation service
- ✓ Provide a GDS adaptation integrating the CFDP core procedures with the JPL Command and Telemetry Mission Services