Mars Interoperability 2008-2015

Options for Relay Orbiter Support to Mars Bound Assets

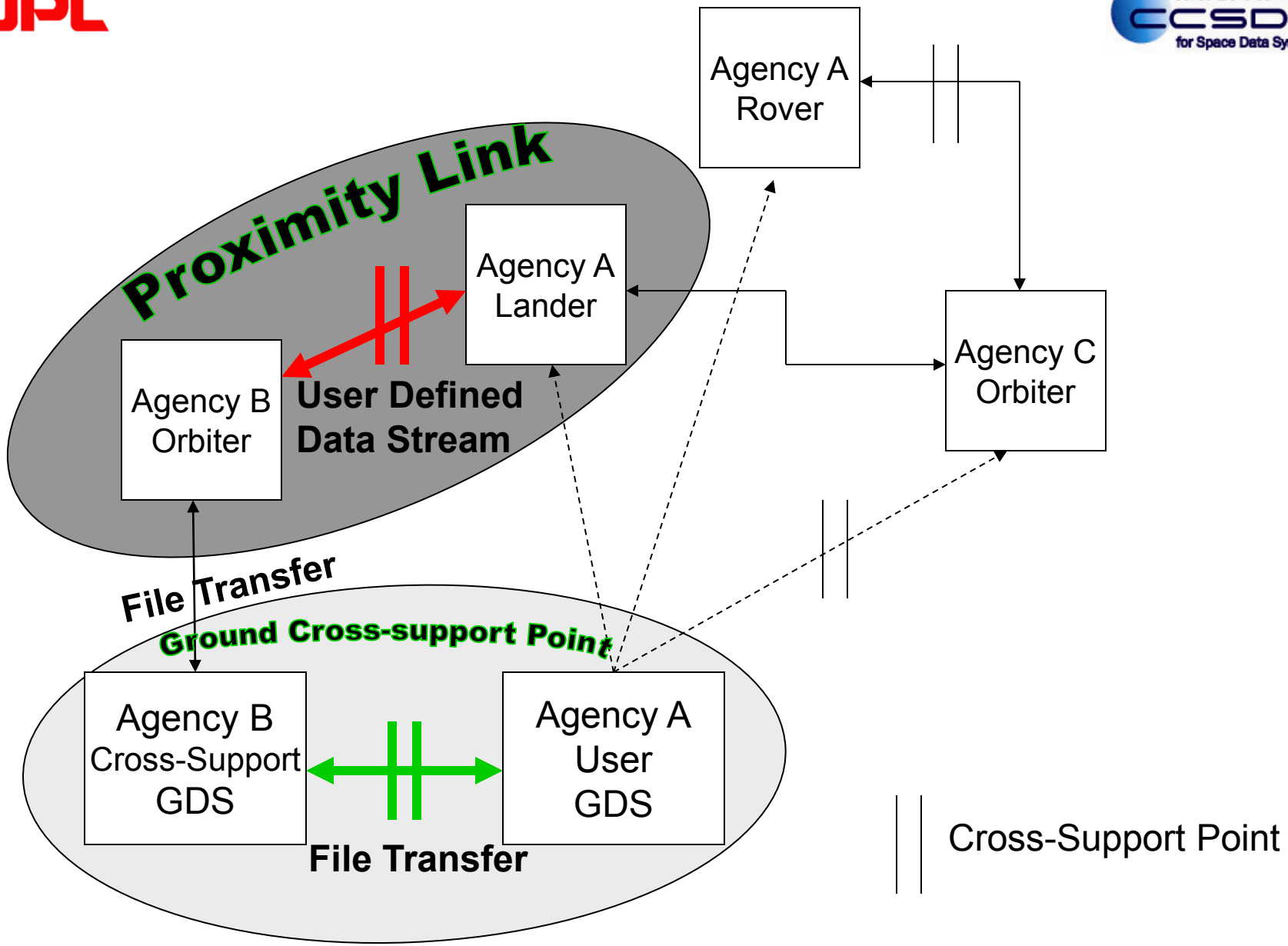
Greg J. Kazz

Ed Greenberg

NASA/JPL/Caltech

Agenda

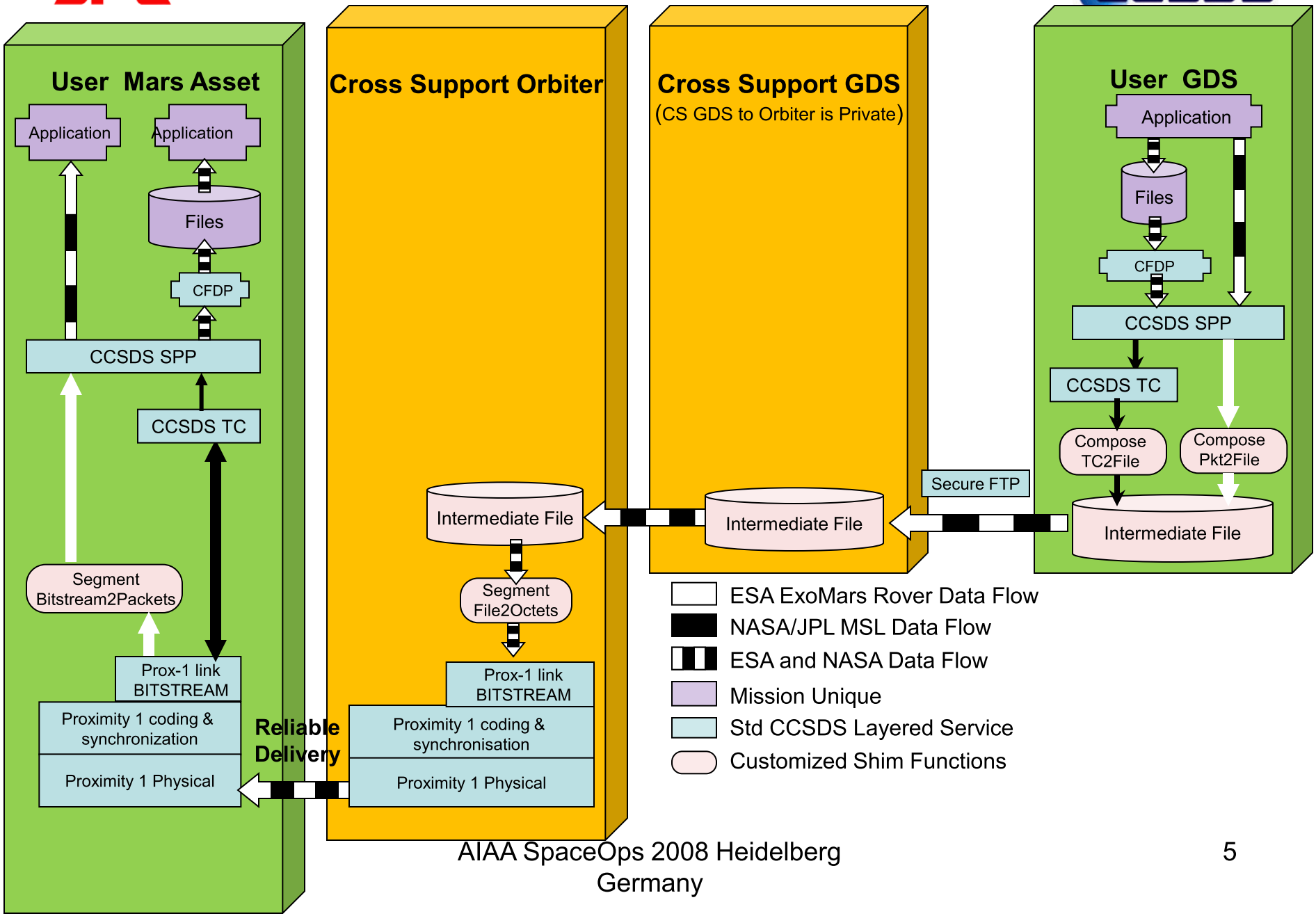
- Describe how the CCSDS recommendations have been implemented in existing infrastructure and current ongoing Mars missions
- Identify what should be included in future infrastructure elements, and possible upgrades to current ground and space infrastructure, for conducting cross support for future Mars missions


Agency A
Rover
Proximity Link
Agency A
Lander
Agency B
Orbiter
User Defined
Data Stream
Agency C
Orbiter
File Transfer
Ground Cross-support Point
Agency B
Cross-Support
GDS
Agency A
User
GDS
File Transfer
Cross-Support Point

Near term Forward Link

- Existing orbiter Cross-support service is Store & Forward with hop by hop transfer
- At the ground support point, a file transfer (FTP) takes place between the two agencies
- At the proximity link, data are transferred via a reliable bit-stream carried in Proximity-1 frames.
- It is the responsibility of User Mars Asset to parse the bit-stream and delimit the data structures sent from the User's GDS.
- Cross-support orbiter delivers the data in the file in order, without gaps or additions and provides verification of number of bytes transferred.

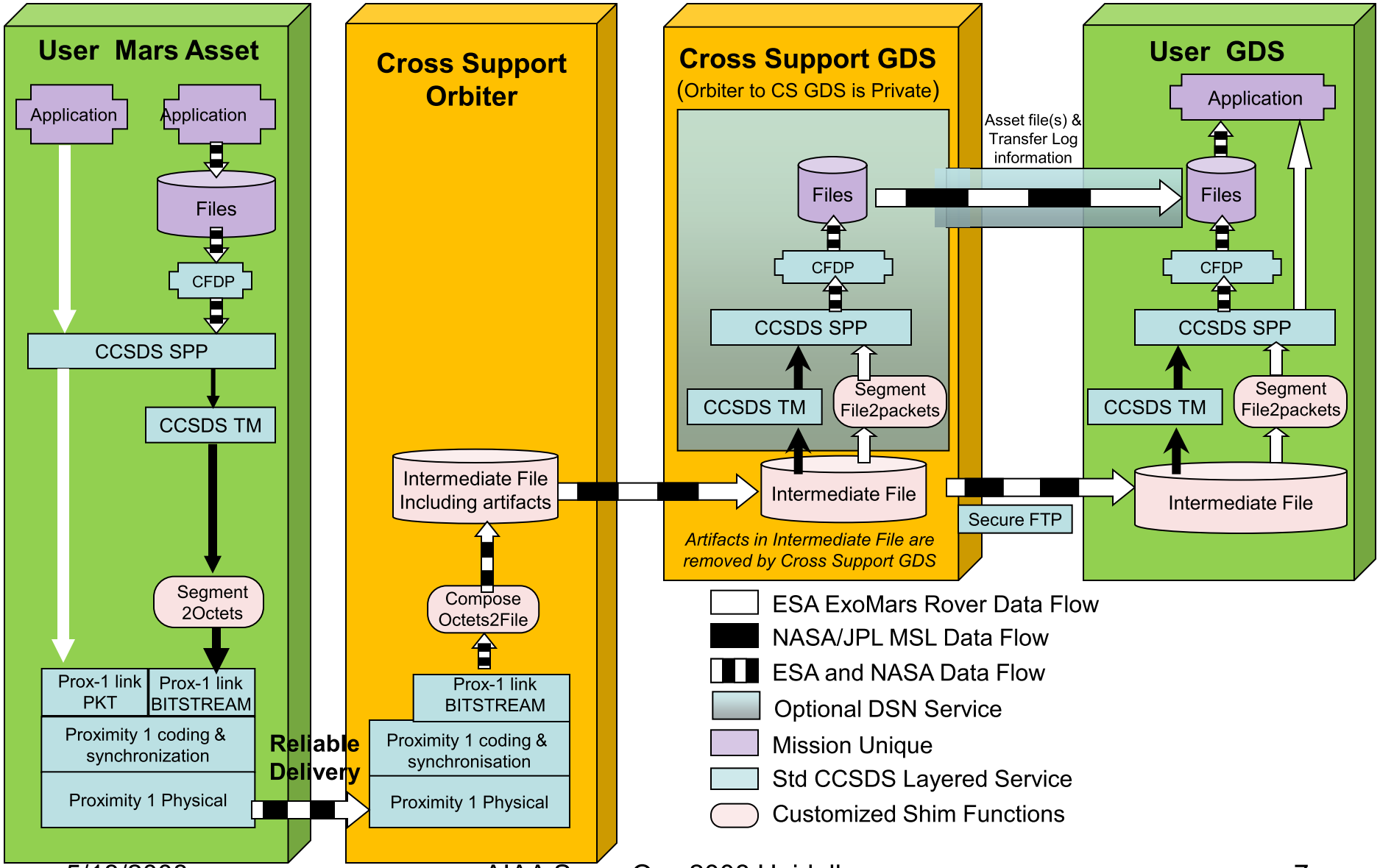
Current Forward Service



Near term Return Link

- Existing orbiter Cross-support service is Store & Forward with hop by hop transfer
- At the proximity link, data are transferred via a user-defined data stream carried in Proximity-1 frames.
- Data in mass store is transferred using unreliable CFDP over a reliable Prox-1 link
- A pass data file (containing User Asset data) is reconstructed at the Cross-support Orbiter GDS – removing transport artifacts
- The Cross support GDS either runs CFDP to regenerate the individual files or sends the pass data file to the User GDS using FTP.

Current Return Service



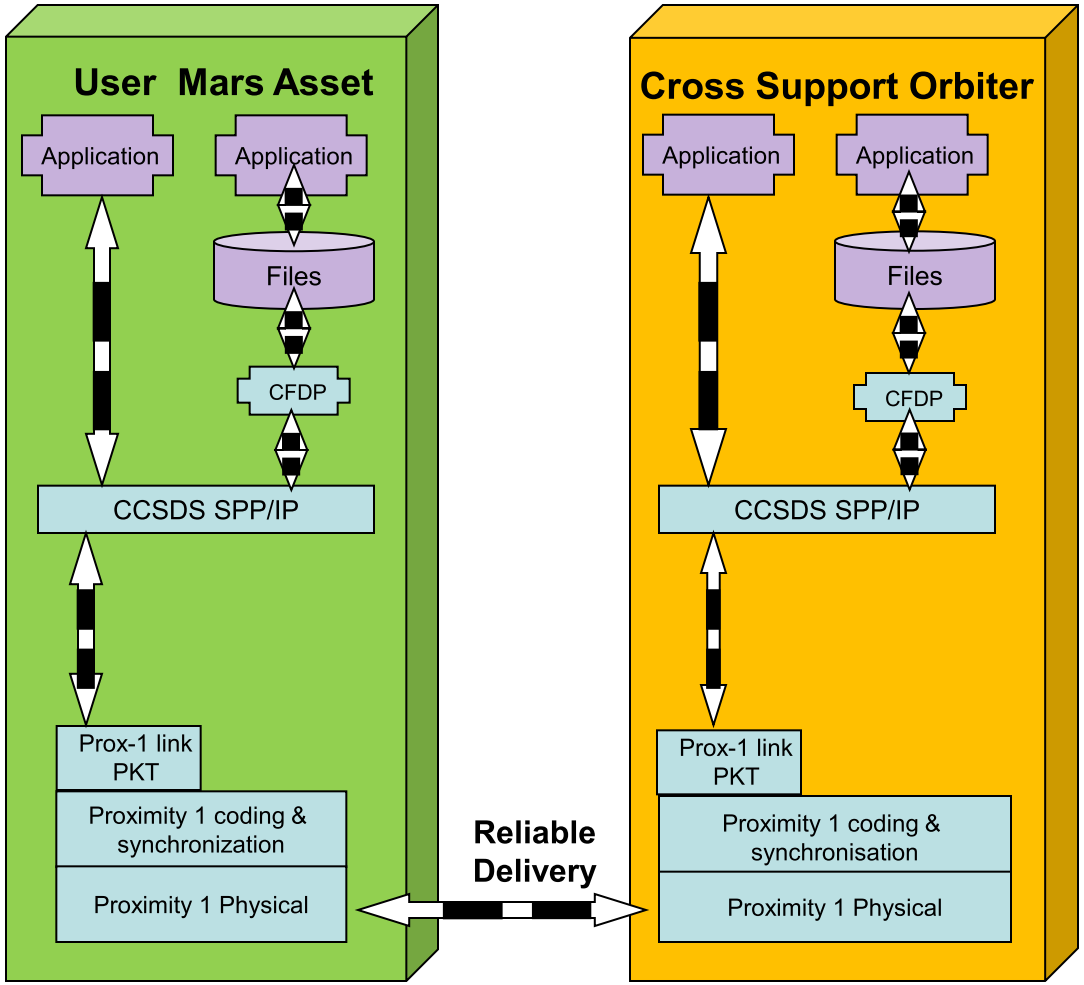
Possible Upgrades for Near Term Missions

- Relay orbiter prioritizes the files received from the Mars bound assets for transfer to Earth. To achieve this:
  - User Mars asset would transfer it's data to the orbiter contained within a CFDP PDU within a Space or Encapsulation packet
  - Two or more APIDs would be used for CFDP to communicate the desired priority
  - NASA MRO flight s/w would be changed to extract the packets from the file and use the APID value to signal the telemetry VCID to send the data on the DTE link.

Possible Upgrades for Future Missions

- Currently all the telemetry collected at Mars is relayed back to Earth as a single bulk file.
- Similarly forward command data assembled on Earth is relayed to the Assets in a file. This file can be assembled on NASA MRO from up to 20 preloaded files.
- Future provisioning of Network Services will enable inter-Mars communication
  - Control/Status Messages and files sent from a Mars asset to an application on the Relay (e.g., request for service)
  - Send Messages or files originating on the Relay to an asset (e.g. time correlation, broadcast, comm. schedule opportunities)
  - Enable User Asset to User Asset data transfer on Mars via the Relay (e.g., sharing scientific discoveries)

Future Added Mars Network Service Features



This added capability provides support for:

a) Asset <> Orbiter messaging
b) Asset <> Orbiter file transfer
c) Asset to Asset relayed file transfers using CFDP

Data Flows
Mission Unique
Std CCSDS Layered Service

Recommendations

- Key to these enhanced capabilities lies with the relay's ability to interrogate and understand the data type and routing needs of the user asset.
- Recommend that all data
  - Be packaged in CCSDS recognized packets i.e., Space packets or Encapsulation Packets,
  - Be addressed on the orbiter to a different output Proximity-1 port ID than the data destined for bulk transfer to Earth, and
  - Use the Packet per frame construction mode in Proximity-1.
- When sending files, use Class-1 CFDP and reliable Proximity-1
  - Inefficient to perform reliable Class-2 CFDP due to discontinuities in contact times
- Future Relays implement the complete Proximity-1 capabilities and be capable of merging data created on the relay (time, Doppler, engineering) with the data to be relayed to Earth.

Acknowledgement

- The authors also acknowledge the contribution of Peter Shames NASA/JPL/Caltech as well as Dai Stanton and Chris Taylor at ESA/ESTEC.