Implementing Ethernet Services on the Payload Executive Processor (PEP)
Why Ethernet

• The Ethernet interface is more common and easier interface to implement for payload developers already familiar with Ethernet protocol in their labs
• The Ethernet interface allows for a more distributed payload architecture. Connections can be placed in locations not serviced by the PEP 1553 bus
• The Ethernet interface provides a new access port into the PEP so as to use the already existing services.
• Initial capability will include a subset of services with a plan to expand services later
Ethernet History on MDMs

- The desire by NASA Avionics and Software for Ethernet connectivity for the MDMs originated when we decided to build a new version of the MDM Processor card, called EPIC because of the expanding role of the Joint Station LAN.
- Even though we had no customer, we decided to include an Ethernet hardware port on the card.
- First use of the Ethernet interface was in CCS which is using it to dump over Ku any CVT data that has a Program Unique Identifier (PUI).
- Second use was PEP R11 providing a capability to selectively dump its memory over Ku.
- Third use will be in PEP R13 where we will be providing a subset of PEP services to Ethernet connected devices:
  - Ability to request PL Specific Ancillary Data Service
  - Ability to request preapproved Timeliner Bundle/Sequences
Boeing is currently in the design/implementation phase of adding Ethernet capabilities into the PEP (Payload Executive Processor) module.

This implementation will occur in phases. The upcoming release of PEP software (Rev 13) is part of the X2_R16 software transition currently scheduled for November, 2017. The subsequent scheduled release (Rev 14) will be part of the X2_R17 software transition currently scheduled in October, 2018.
PEP R13 Ethernet Content
X2_R16 software transition currently scheduled for November, 2017

• Implement the capability of a single Ethernet connect device

• Implement an Ethernet request from the connected device*
  – The request can be for a Timeliner service or to Start/Stop Ancillary Data
  – The Timeliner request can Start, Stop, Halt or Resume a loaded Timeliner bundle/sequence
  – The ancillary data request will start/stop the PEP module transmitting a set of data, to the requesting device, at a one hertz rate

* See backup charts for more detail
PEP Interface Requirements for R13 Release

• Ethernet interface via JSL
  – TCP/IP protocol
  – Device assigned fixed range of IP addresses

• Functional Interfaces
  – Ancillary Data Service
    • Same as payload ancillary data service
    • Device sends start/stop request to PEP
    • PEP then sends ancillary data set (up to 256 words) to device at 1 Hz
    • The ancillary data set contents will be defined by a new Ancillary Data Definition Table (config file)
  – Timeliner Request Service
    • Same as payload procedure execution service
    • Device sends start/stop/resume/halt request to PEP
    • PEP sends start/stop/resume/halt command to Timeliner
    • Authorizations defined in existing Procedure Information Table (config file)
Example JSL Architecture Diagram
Indicates an example device connected to PEP

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• Provide support for **multiple** Ethernet connected devices

• Add Health and Status data collection from Payload devices*
  - Payload H&S data would be included in existing PEP Ku-band downlink to POIC (APID 876)
  - Payload H&S data could then be monitored on-board via the existing PEP Limit Exception Service

• Add Pass-Thru commanding capability from the ground via a 1553-to-Ethernet implementation*

* See backup charts for more detail
Backup
PEP R13 Ethernet Content Details

• *Connected device* will be treated as a PL MDM payload on the LAN. A totally new service.

• *PL Specific Ancillary Data Service* - Can contain Core Systems Data, BAD, or other PL data in Payload Ancillary Data (PAD)), PEHG, APS, or PEP MDM status data
  – Rationale: highly likely ISS Payloads will need access to parameters provided by ISS

• *Processor Execution Service*. Payloads being able to request preapproved Timeliner Bundle/Sequences via the Procedure Information Table (PIT)
  – Rationale: being able to start, stop, halt or resume execution of a payload specific Timeliner bundle would be useful for payloads that require predefined external control.
Notional PEP R14 Ethernet Content Details

- **Payload Health & Status Service**
  - *Payload Health and Status Collection Service* common to the 1553 implementation from a Subset structure/service request/status viewpoint
    - Rationale: LAN based Payloads may need Payload MDM Services common to 1553 services or want the POIF PRO to take some action based on specific parameters in their PL H&S. Implementation similar to 1553 service would alleviate issues with a ground based solution to process Ku IP Service based health and status in addition to resolving automatic recording, downlink of the APID 876 stream

  - *Payload Limit Exception Service* would automatically exist if the Ethernet Payload Health & Status Service uses the Limit Check Data Table (LCDT) like it does for existing 1553 payloads.
    - Rationale: some payloads may want limit check capability in order for the system to take a corrective action (like powering down the payload or potentially starting a Timeliner Bundle). This would include Command Request Service be available for LAN connected payloads to send Command Request Commands (CRC).
Notional PEP R14 Ethernet Content Details cont.

• **Payload Health & Status Service (cont.)**
  – *The Payload Configuration Capability* (ability would automatically exist if the Ethernet Payload Health & Status Service uses the Payload Configuration Data Table (PCDT), and LCDTs like it does for existing 1553 payloads)
    • Rationale: Payload Operations will need common mechanism to edit Payload Configuration Files (PCF) for Ethernet based payloads

• **Pass through Command Distribution Service** – translated uplinked or Payload MDM generated commands for distribution to the intended payload via IP
  – Rationale: some Payloads may want PROs to have the capability (for example) to send a safing command (via S-band) or have their own ability to do so via S-band in which case having the command in the POIC Command Database would be required.
    • This could potentially provide a method for a payload user to send “hazardous” or “critical” commands via S-band/1553 and able to reach Ethernet-only destinations
Additional R14 Considerations

- **Multiple Device Support**
  - PEP R14 to support interfaces to multiple devices simultaneously
  - Additional device support and services will be throttled by MDM bandwidth capability and throughput analysis garnered during PEP R13 development and testing

- **File Transfer Service**
  - Same as payload file transfer service
    - From PL MDM to Connected Device
    - From Connected Device to PL MDM

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