Implementing Ethernet Services on the Payload Executive Processor (PEP)

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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

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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*

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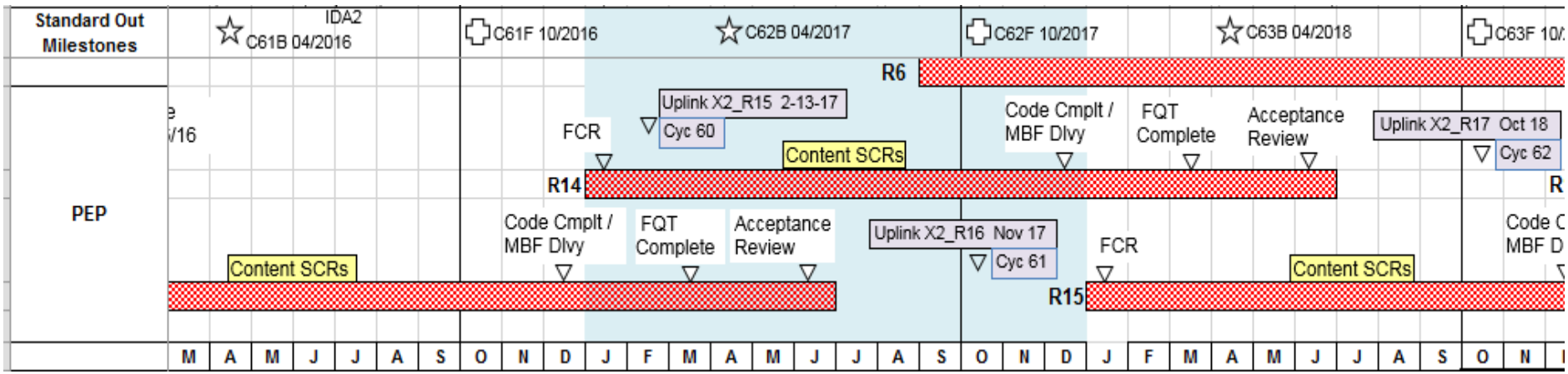
PEP Ethernet Implementation

- 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



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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*

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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)

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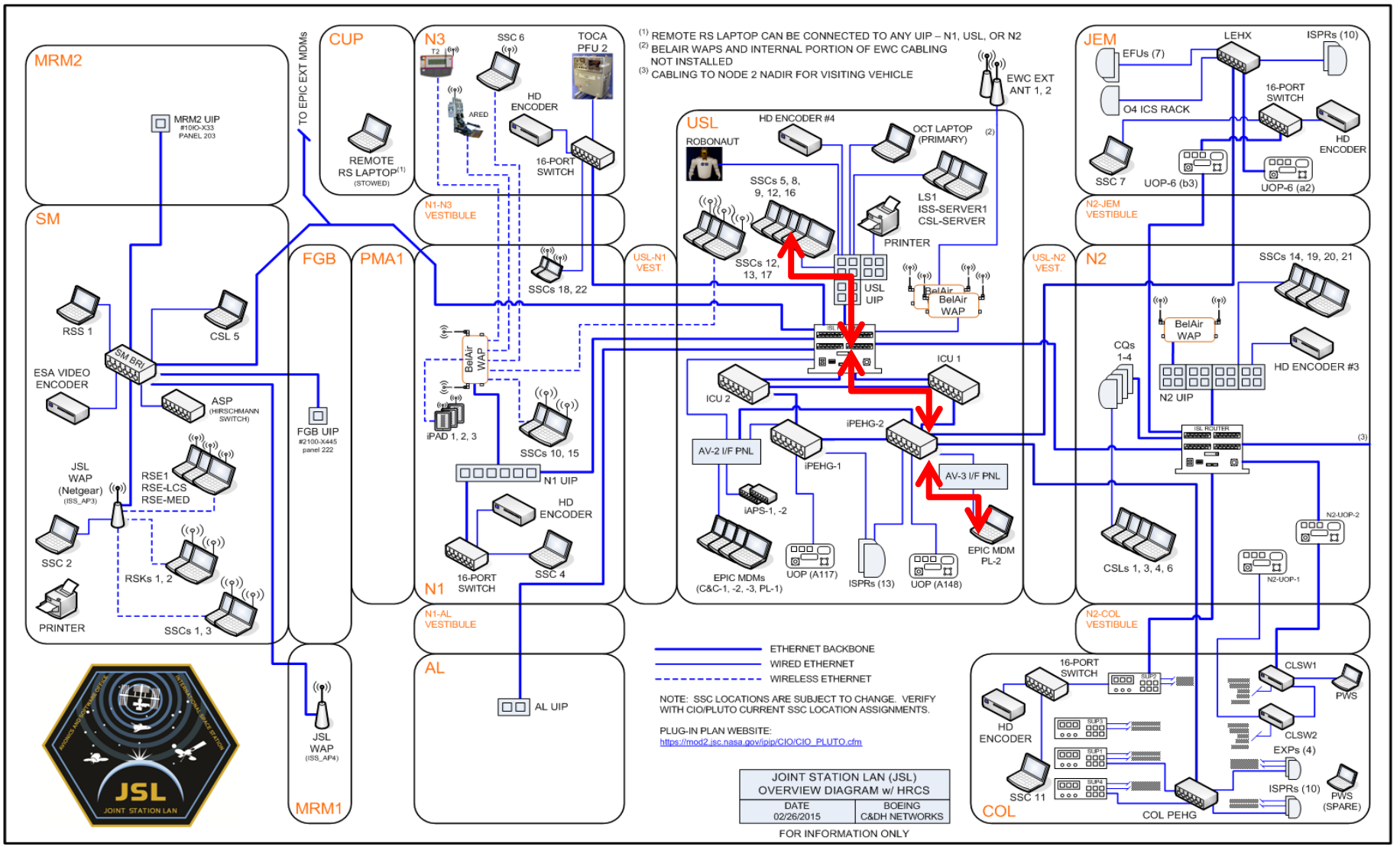
Example JSL Architecture Diagram

Indicates an example device connected to PEP



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Notional PEP R14 Ethernet Content

X2_R17 software transition currently scheduled for October, 2018

- **Provide support for <u>multiple</u> 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*

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Backup

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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.

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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).

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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

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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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