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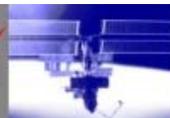


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Ku - Band, DTN, and enhanced payload utilization

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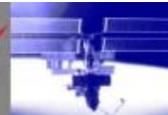
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WHAT CAN BE DONE TO MORE FULLY UTILIZE PAYLOADS ON THE ISS



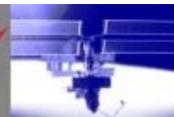
Historical payload perspective

- ◆ The ISS has two USA command paths
 - ◆ S-band
 - ◆ Ku-band
- ◆ Each path has limitations and benefits
 - ◆ S-band is slow
 - ✦ Utilizes 1553 commands
 - ✦ interfaces through payload MDM to express racks
 - ✦ HOSC has access only to US addressable payloads
 - ◆ Ku-band is faster
 - ✦ Has access to onboard VLANs
 - ✦ Bypasses MDMs
 - ✦ Access is limited to the Orbital Communications Adapter (OCA) and limited applicability to payloads now



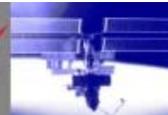
Future utilization perspective

- ◆ In the past few years a number of activities have been undertaken concurrently
 - ◆ Obsolescence Driven Avionics Redesign (ODAR)
 - ✦ Upgrade the ISS links and internal support
 - ✦ Extend the ISS life span to 2020 and beyond
 - ✦ Upgrade the CCSDS protocols to support better utilization (732.0-B-2, 133.0-B-1, and 133.1-B-2)
 - ◆ Delay (Disruption) Tolerant Networking (DTN)
 - ✦ Has been maturing through usage and expansion by the NASA DTN WG, ISS DTN WG, and CCSDS as well as other non-space related users
 - ✦ DTN uses a standards based store and forward model to accomplish this type of capability



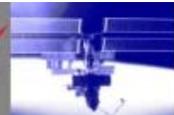
Ku - Band Utilization

- ◆ ODAR is nearing its final stages and as a result enhancements may be available to the payload community
 - ◆ Increased downlink
 - ✦ Up to 300 Mbps aggregate
 - ✦ Capability to downlink different protocols
 - ◆ Increased uplink opportunities designed in
 - ✦ Not only the ability to uplink via traditional S-band
 - ✦ Uplink can use new protocols on Ku-band
 - ✧ AOS standard (732.0-B-2)
 - ✧ IP Encap (133.0-B-1 and 133.1-B-2)
 - ✦ Ku-band uplink is not only for the Orbital Communications Adapter (OCA)
 - ✦ Payloads users can be provided access to devices on the payload VLAN via IP address



Ku - Band Utilization

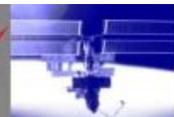
- ◆ A Change Request (CR #13351) is working its way through the system and will allow Ku-band access to payloads via internet protocols
- ◆ Ku-band forward helps extend the HOSC remote user model from the user directly to payloads and payload infrastructure
 - ✓ Allows the use of IPv4 protocols
 - ✓ CADRE command line access to infrastructure items such as iAPS, ICU, iPeHG
 - ✓ Payload users can uplink files to their platforms allowing repurposing of payloads without upmass and minimal astronaut support
 - ✓ Payload users can have direct access to the payloads by IP address
 - ✓ Expands the benefits of DTN without compromising current



DTN Utilization



- ◆ The NASA ISS DTN WG is defining requirements for onboard and ground DTN standard services
 - ◆ Stabilizing the DTN protocols and codifying them in CCSDS standards
 - ✦ Bundle protocol specification CCSDS 734.2-R-1 (RFC 5050, 6260, ECOS, ACS, various CLAs) is red-1
 - ✦ Licklider protocol (RFC 5326) is red-2
 - ✦ Several others (Contact Graph Routing, Bundle Security Protocol)
 - ✦ [Space Assigned Numbers Authority](#) (SANA) with registries for appropriate services
 - ◆ Utilizing world-wide experience and NASA's DTN Engineering Network (DEN) to exercise the capability



DTN Utilization

- ◆ DTN provides enhancements to operations via a standard set of protocols
 1. A DTN network architecture providing a standards-based, publically available, space networking protocol to provide bi-directional communications for payload C&T systems
 2. DTN significantly improves communication link efficiency by ensuring science is successfully received at the destination with the minimum amount of data transmission
- ◆ DTN can be utilized by gradually increasing onboard capability
- ◆ A Change Request (CR #nnnnn) is in work to provide limited DTN capability to ISS payload users based on CCSDS requirements



Ku-band forward and DTN Utilization

◆ Potential:

1. ODAR capabilities and DTN can be used to decrease payload user labor via automation of payload command and telemetry (C&T) transmission and receipt
2. Ku-band forward and the DTN network stack supports industry-standard application code reuse expanding the applicability of payload on the ISS

