Marshall Space Flight Center (MSFC)
Payloads Operations and Integration Center (POIC) Status

Joseph Pirani
MSFC, Mission Operation Systems

MSFC GSCB POCs

◆ Joseph Pirani joseph.pirani@nasa.gov (256)544-5623	GCSB Deputy Chair, MSFC Ground Segment Representative
◆ Joseph Pirani (Acting)	MSFC Security Analysis Response Team (SART) Representative
◆ Vacant MSFC EO50 (256)544-xxxx	MSFC GSCB Representative,
◆ Dennis Botts dennis.botts@nasa.gov 256-544-9363	JAXA and ASI MSFC Systems Engineer
◆ Karl Roth karl.roth@nasa.gov (256)544-3539	Roscosmos, ESA, CSA MSFC Systems Engineer
◆ Bobbie Maples bobbie.a.maples@nasa.gov (256)544-7663	JSC MSFC Systems Engineer
◆ Lindsay Wiggins lindsay.wiggins@nasa.gov (256)544-0884	Commercial Customers Systems Engineer

Agenda

◆ MSFC Status

1. Payloads Ground Systems Services

a) Ku IP Services
b) Mobile Applications
   a) Voice
   b) Displays
c) TReK
d) On Demand Test Environment
e) Use of Internet2 networks
f) PGUIDD Updates

2. Partner Interface Status

a) JAXA, ASI
b) ESA, CSA, Roscosmos
c) JSC MCC21
d) Commercial Companies

3. ISS Program Reorganization at MSFC

1. Payloads Ground Systems Services

Ku-Band Internet Protocol Services for Payloads

- Lessons Learned from testing with Payload Developers (PDs)
  - The HOSC plans to characterize Ku-IPS Baselined Protocols available to all PDs.
    - PING, SSH (22/TCP), HTTPS (443/TCP), RDP (3389/TCP), LTP (1113/UDP), BP (4556/UDP) and CFDP (4560/UDP).
    - TCP must originate from the ground.
    - TCP originating on-board will be available as of Increment 50.

- PDs have the lead to characterize their unique data flows.
  - HOSC will incorporate PD data flow characterization and recommendations in the Ku-IPS Lessons Learned.
  - The HOSC is establishing a Ku-IPS mailing list.
  - Lessons Learned updates will be distributed after the POIWG
    - Interim updates distributed when necessary.
    - https://aeonsp.hosc.msfc.nasa.gov/sites/Remotes/KUIPLL/SitePages/Home.aspx

Ku-Band Internet Protocol Services for Payloads

- iPerf3 is recommended for Ku-IPS and UDP testing
  - PDs are encouraged to consider this tool for repeatable and shareable test results
  - TReK will host iPerf3 on their Windows and Linux on-board Demonstration Payloads
- Fragmentation
  - With Ku-IPS, fragmentation must be allowed when packets that are near the maximum transmission unit (MTU) limit are at risk of being discarded.
  - Verify this setting in operating system or commercial software package
  - *Payload to Generic User Interface Definition Document* (SSP 50305) and the *Payload Rack to ISS Software ICD* (SSP 52050) are underway to incorporate recommendations that fragmentation be allowed on-board and on the ground.

Ku-Band Internet Protocol Services for Payloads

- Ku-IPS Round Trip Time
  - The HOSC Ku-IPS to ISS RTT is 650 ms +/- ~50 ms.
  - The PD can determine their RTT to HOSC by pinging the HOSC VPN GW from their remote site. This RTT must be added to the HOSC-ISS RTT to determine the Total RTT.
    - The PD's Total RTT will be on the order of 900 ms.
    - **A Total RTT of ~900 ms is likely well outside the PD experience base and has major implications for TCP data flows.**
- TCP Bandwidth Delay Product (BDP)
  - Calculated to estimate desired TCP Window Size
  - Default TCP Window Size is likely inadequate for Ku-IPS
- Bit Error Rate and Packet Loss Rate
  - Assuming a 10^{-6} packet loss rate
  - Currently the packet loss rate in the HOSC Ku-IPS IVV Lab is worse than the Flight Ops and ORT packet loss rate.

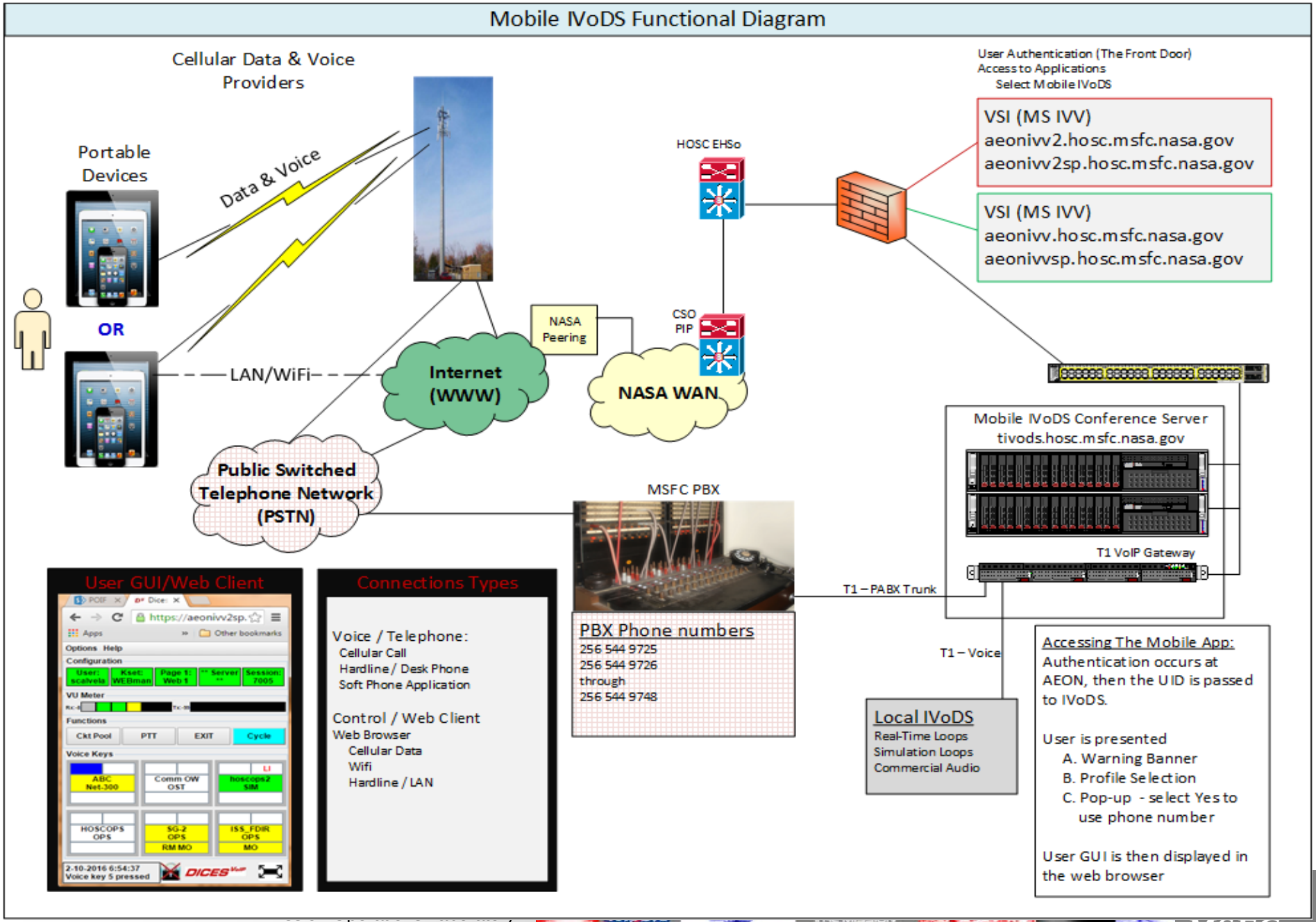
Mobile Applications

Purpose: This design effort is intended to allow users to utilize HOSC products from any device with modern web-browsing capabilities. Supported devices include:

- Desktops/Laptops
- Mobile Devices (iOS, Android, Windows, Blackberry, etc.)

- Current initiatives
  - HOSC Internet Voice Distribution System (IVoDS)
  - Mobile EHS Personal Computer (EPC) Displays

Mobile IVoDS Functional Diagram



Mobile IVoDS Schedule

START DATE	TARGET END DATE	REASON OR ACTIVITY DETAILS
December 1, 2014	September 10, 2015	Engineering Change Request and Quintron development
October 7, 2015	November 30, 2015	Engineering Preparation and Installation
January 4, 2016	April 8, 2016	Validation and Verification Phase I
April 11,2016	April 22,2016	Validation and Verification Phase II
	April 25, 2016	HOSC Acceptance Review
	May 5, 2016	Operations Readiness Review
May 24, 2016	June 3, 2016	Transition to operations window

Web Access for Real-Time Telemetry Displays

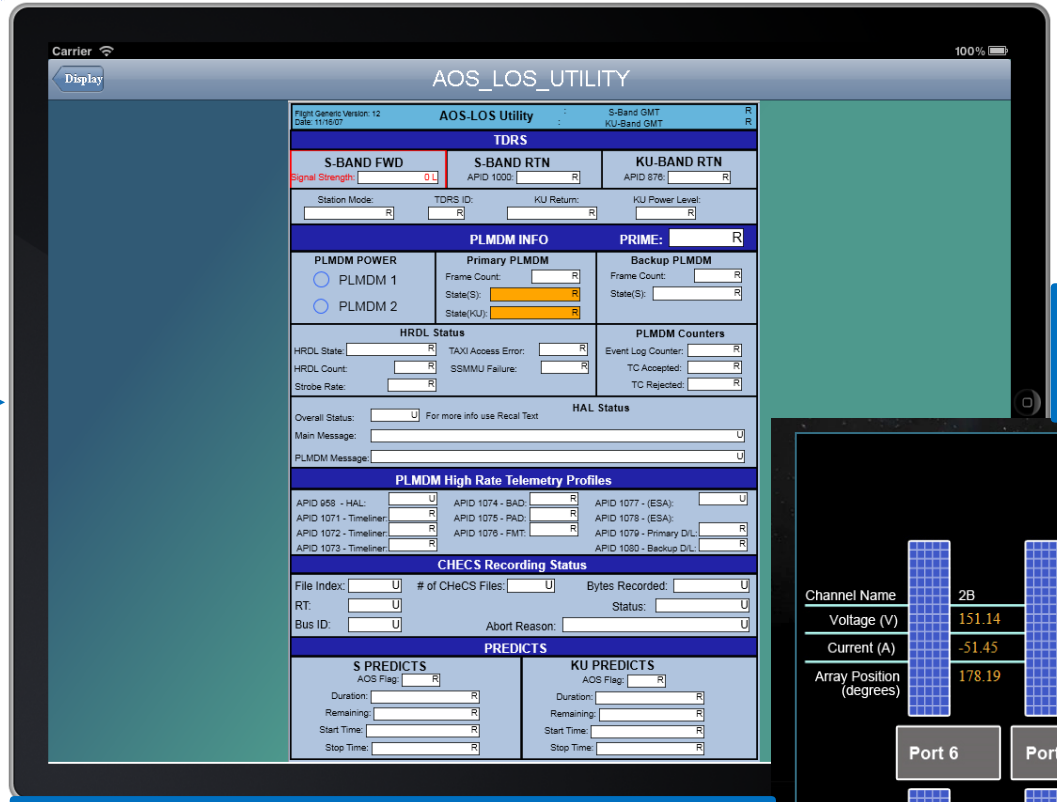
- Starting with **INC 50 (October 2016)**, remote users will be able to access real-time telemetry displays through the HOSC's web-based Advanced Engineering Operations Network (AEON) Portal from any device with a web browser.

- Payload developers will be able to view the following telemetry displays:
  - Displays they have created themselves using EPC
  - Any displays that another user (POIC Cadre/remote user) has shared with them
  - Any displays that the POIC has developed for all remote users

- In order to use the new **Real-Time Telemetry Displays web app**, a remote user must have an EPC Role and be able to logon to the AEON portal.

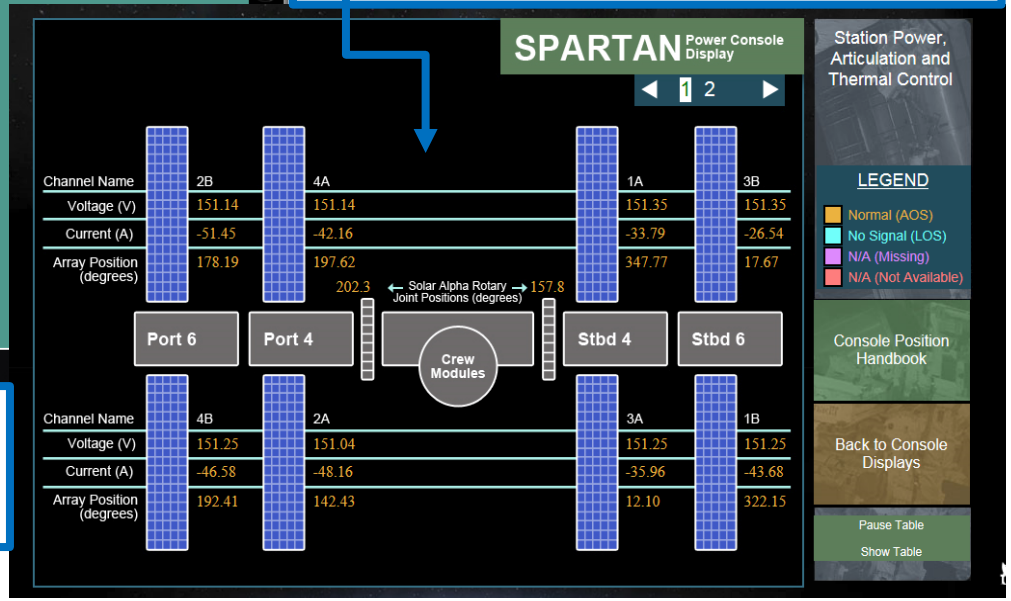
- In addition, the HOSC will be creating a set of displays similar to the ISS Live Displays available to the general public today and providing them to all remote users through this new web-based displays app.

Web Access for Real-Time Telemetry Displays



POIC Real-Time Telemetry Display on an iPad

Example of an ISS Live Display Available to Remote Users



On-Demand Test Environment (ODTE) for Payloads

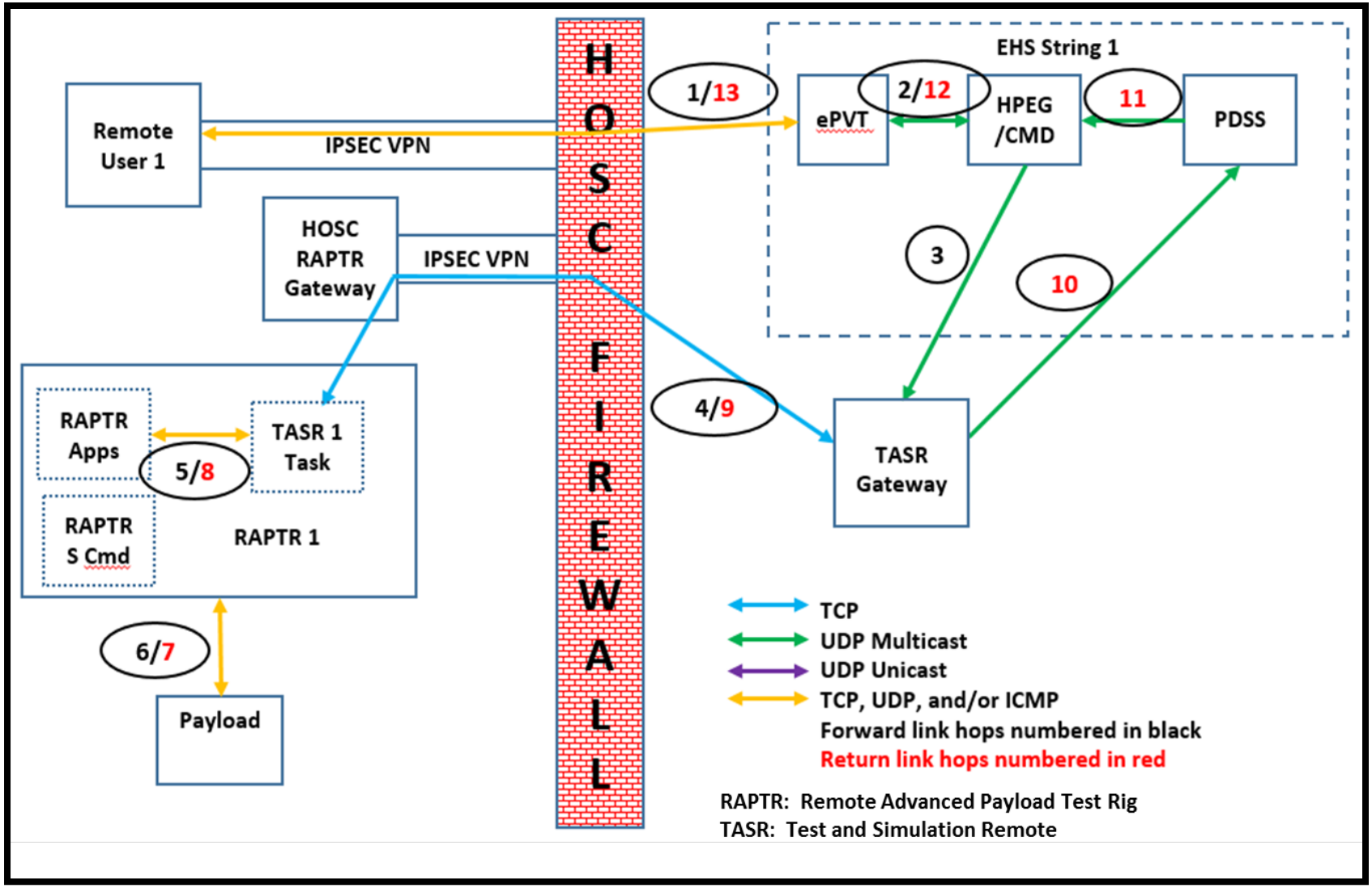
- Today, the POIC can only support one payload verification test with the HOSC at a time and that test must take place during a prime 8x5 shift.

- To support increased utilization of the ISS for science and research, the POIC is developing a new ODTE that will:
  - Support HOSC interface testing for up to **10** payload developers concurrently
  - Be available to payload developers any time they are ready, **24x7**
  - Require little/no assistance from POIC personnel

- The ODTE will support end-to-end connectivity between a payload and the HOSC, and back to the ground support equipment. The ODTE will enable KuIP Service testing and 10 payload developer sites at one time will be able to conduct HOSC interface testing using a Boeing Remote Advanced Payload Test Rig (RAPTR).

- The HOSC will be supporting these tests with virtualized private strings of equipment.

On-Demand Test Environment (ODTE) for Payloads



On-Demand Test Environment Schedule

COMPLETION DATE	REASON OR ACTIVITY DETAILS
April 30, 2016	Requirements Review
May 4, 2016	Design Review
August 12, 2016	Phase I Development and Development Test Environment Complete
September 2016	User Evaluations
October 14, 2016	Phase II Development and Development Test Environment Complete
	Initial Operational Capability for payloads who have telemetry definitions in PDL
December 2016	Integrate with Increment 52 development
April 2017	Initial Operational Capability for payloads with private telemetry databases

Raw Payload Health and Status Telemetry Packets

- Starting with **INC 50 (October 2016)**, remote users will have the option to retrieve the health and status (H&S) data from their payloads using a new **Raw Payload H&S Packet process** that can be launched off of EHS.

- Today, many users retrieve the H&S data for their payload using the Ground Support Equipment (GSE) Packet mechanism. To build a GSE packet, a user has to use a GUI to select all of the measurements to be included in the packet. Then, the GSE packet process puts status characters in the data field between all of the measurements in the packet.

- The new Raw PL H&S packet will contain only the user's PL H&S data with the appropriate EHS and CCSDS headers (no status characters between measurements).

TReK Release Schedule

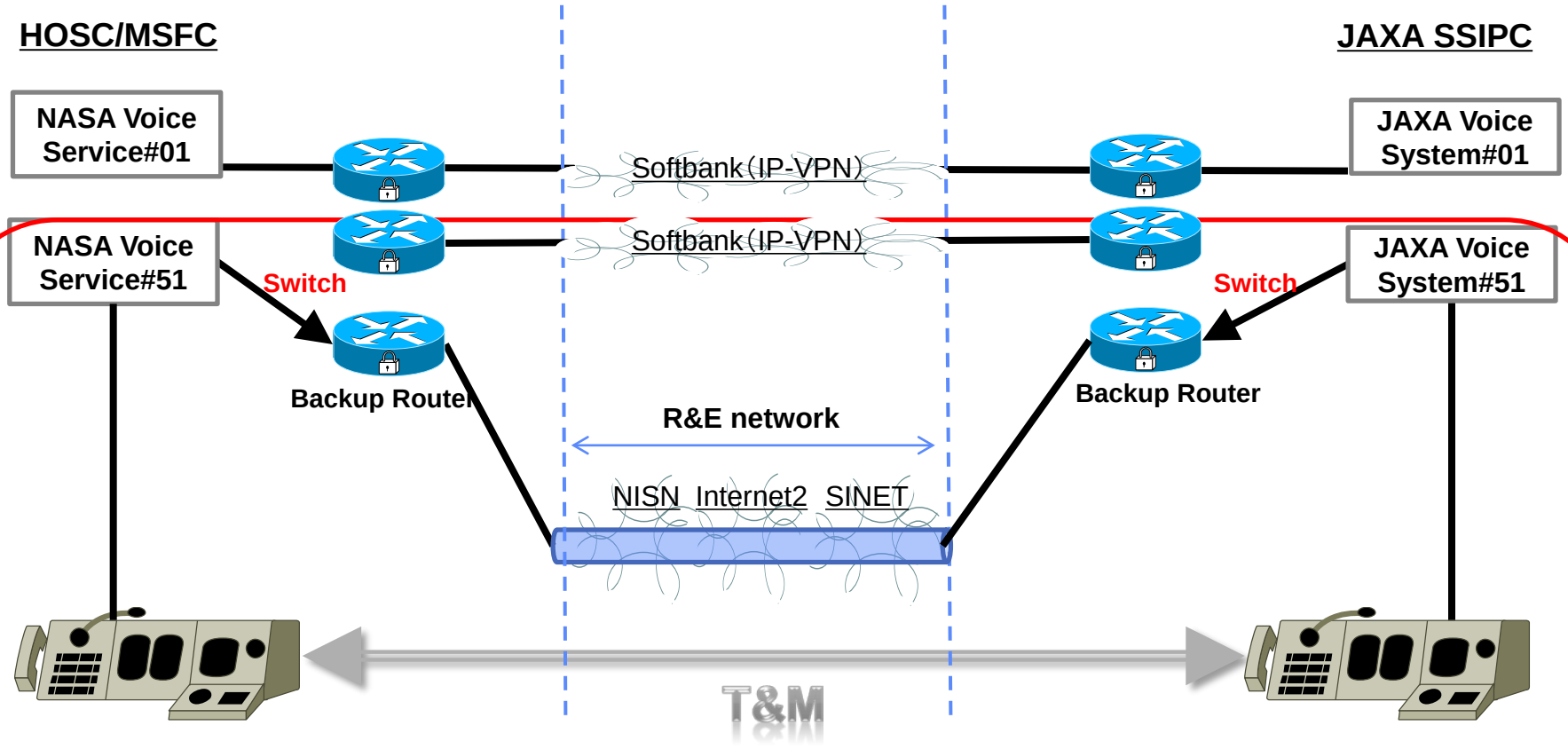
http://trek.msfc.nasa.gov/trek_schedule.htm

Software Release	Release Type	Target Date	Description
DTN Capabilities			
TReK 4.1.0	Operational	6-5-2015	This is the second operational release of the TReK Toolkit. This release adds support for Delay Tolerant Networking. See the TReK 4.1.0 page for release content information.
EXPRESS Capabilities			
TReK 4.2.0	Operational	10-23-2015	This is the third operational release of the TReK Toolkit. This release adds support for the EXPRESS Payload to ISS C&DH System Ethernet interface to the TReK Toolkit portion of the TReK software.
Ku IP Enhancements			
TReK 4.3.0	Operational	4-29-2016	This is a release of the TReK Toolkit that contains KuIP Enhancements. See the TReK 4.3.0 page for release content information.
Desktop Capabilities			
TReK 0.7.0	Beta*	10-17-2016	This is a beta release for the TReK Desktop. The TReK Desktop provides the complete set of TReK capabilities in a Windows and Linux environment. This release also contains TReK Toolkit capabilities since TReK Toolkit is a subset of TReK Desktop.
TReK 5.0.0	Operational	5-17-2017	This is an operational release of the TReK Desktop. This release also contains TReK Toolkit capabilities since TReK Toolkit is a subset of TReK Desktop.

Internet2 Connectivity to HOSC

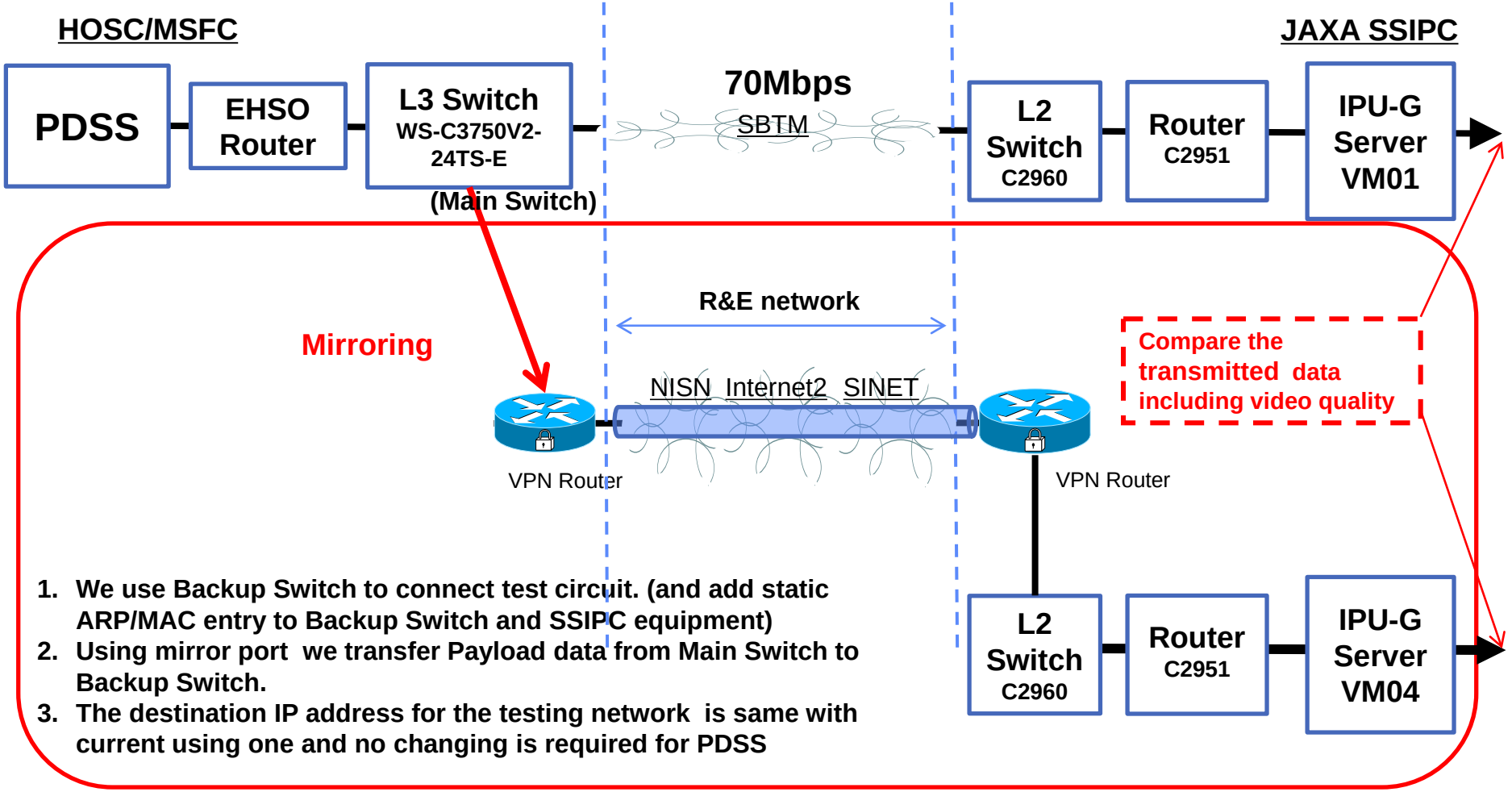
- JAXA testing Internet2 connectivity beween SSIPC and HOSC
  - Feasibility testing is to confirm the circuit connectivity, characteristics, data flow and demonstration test for voice and payload data
  - Possible cost savings in lieu of trans-Pacific circuits
  - Testing occurred March 22 – 28, 2016

Test Configuration of Voice circuit



1. We switch connect circuit from current circuit to R&E NW.
2. Perform voice data transmission and T&M

Test Configuration of payload science data



1. We use Backup Switch to connect test circuit. (and add static ARP/MAC entry to Backup Switch and SSIPC equipment)
2. Using mirror port we transfer Payload data from Main Switch to Backup Switch.
3. The destination IP address for the testing network is same with current using one and no changing is required for PDSS

Preliminary Test Results

- Voice
  - Marshall Comm and Tsukuba GC - 5x5 (good both ways) nothing abnormal was observed during the voice checks. This was the consensus of the HOSC IST who monitored as well.
  - Houston Voice and Tsukuba GC – The impression was that IPGC Test and ipgc2 sounded the same with no noticeable quality differences
- Data
  - Will add summary from Monday's data tests

PGUIDD Updates

- SSP 50305 Vol. 1 Rev. F includes the following ECR's/PIRNs:

ECR	ECR Title	Ground Segment Control Board PIRN
HM-3430	Ku-band Forward Access for Payload Operations	6003
HM-3436	Import Capability for GSE Packet Definition	6011
HM-3420	ODAR ICU Video Distribution system (VDS) Payload Video Distribution	6013
HM-3464	Delay Tolerant Network (DTN) Implementation on Joint Station LAN (JSL)	6014
HM-3427	EHS Telemetry Enhancements for Remote Users	6016
HM-3431	CPS Transition to OPTimIS	
HM-3508	Add Technical Name to NRT List Request	
HM-3367	Modify EHS To Replace FTP with a Security Acceptable Protocol	
HM-3370	Modify EHS to Replace Telnet & R-services Authentication With A Security Acceptable Protocol	
HM-3376	Secure File Transfer Protocol for HOSC/MCC Dropbox I/F	
HM-3463	Establish a SharePoint Environment Within HOSC Domain with Real-time Document Management Functions	
HM-3508	Technical Name in NRT List Request	
HM-3516	NASA Mandatory TLS Configuration	
HM3526	Packet Fragmentation Using the HPEG Service	6018
HM-3533	KuIP Services Capability Enhancement	6021

- Provided to IP's on ?MAR2016
- Ready for signature.

PGUIDD Updates

- SSP 50305 Vol. 2 Rev. C includes the following ECR's/PIRNs:

ECR	ECR Title	Ground Segment Control Board PIRN
HM-3430	Ku-band Forward Access for Payload Operations	6004
HM-3526	PGUIDD Update for MTU Packet Fragmentation	6012
HM-3464	Delay Tolerant Networking (DTN) Implementation on Joint Station LAN (JSL)	6015
HM-3145	Update Capability for CCSDS Command Header's	6017
HM-3239	Command Acknowledgment Response Text Modification	
HM-3314	Command Data Sets as UDE's	
HM-3343	Upgrade the payload Gnd Sys and DSRC CSCI to accommodate the ODAR Project	
HM-3370	Modify EHS to Replace Telnet & R-services Authentication With A Security Acceptable Protocol	
HM-3395	Command System Preventing Uplinks When No KU	
HM-3533	KulP Services Capability Enhancement	6022

- Provided to IP's on 14MAR2016
- Ready for signature.

2. Partners Interfaces Status

Partners Interfaces Status

CSA

- Working SSP 50853 - HOSC to CSA PTOC Interface Control Document updates regarding SSP 50305 PGUIDD updates.
- Working SSP 50853- HOSC to CSA PTOC Interface Control Document Appendix E updates regarding SSP 50305 PGUIDD updates.
- Supported HOSC Distributed video for CSA remote users at University of Waterloo.

ESA

- Integrated Ku-Band Internet Protocol Services (KuIPS) for MPCC (Multi-Purpose Control Computer) Phase I, supporting payloads, Haptics and MobiPV.
- Integrated Ku-Band Internet Protocol Services (KuIPS) Delay Tolerant Networking (DTN) supporting METERON/SupvisE payload.
- Working SSP 45026 - HOSC to ESA Ground Segment Interface Control Document updates regarding SSP 50305 PGUIDD updates and MPCC CR updates.
- Working SSP 45026 - HOSC to ESA Ground Segment Interface Control Document Appendix E updates regarding SSP 50305 PGUIDD updates and MPCC CR updates.
- Implemented HOSC Account provisioning and RSA Token distribution process for ESA Payload Users and Col-CC Flight Operators.
- Working ESA Col-CC/HOSC digital certificate exchange.

Partners Interfaces Status

JAXA

- ICD Status
  - Appendix D update PIRN submitted.
- Supported JAXA temporary R&D (Internet2) implementation and testing at the HOSC. (March 2016)
- Supported JAXA PTP replacement work at the HOSC (February 2016)
- Supported JAXA Pacific circuit work at HOSC which included an expansion of payload bandwidth from 50 Mbps to 70 Mbps (June 2015).

ASI

- Main Body of ICD in work (ASI USOC Relocation). Questions on Security section to resolved.
- PIRN in work for Appendix D.

RSA

- Nominal operations support

Partners Interfaces Status

SpaceX

- SpaceX equipment for BCC capabilities has been integrated into the HOSC
- ICD has been updated to incorporate the SpaceX BCC Interface at the HOSC and the changes that have been made to streamline the powered payload telemetry interface

Orbital

- Planned forward work for establishment of BCC interface

Partners Interfaces Status

- **BCC-HOSC Legacy**
  - **No plans for a BCC Legacy Certification to support the 2016 hurricane season**
  - **BCC Legacy will remain at HOSC Bldg. 4663, A286 through 03MAY2016**
    - Hardware will be dispositioned as identified in Engineering Instructions (EI) provided to HOSC to support JSC SR 70560

Partners Interfaces Status

- **HOSC BCC-MCE Support**

  - **HOSC Support of Backup Control Center – Mission Critical Environment (BCC-MCE)**
    - BCC-MCE will be used for 2016 hurricane season
      - System test activities are in-work
      - Functional C/O with External Partners, and Certification activities are TBD

  - **Sharp cut-over scenario training (complete)**
    - HOSC BCC controllers Training/Certification on the BCC-MCE configuration – complete
    - HOSC BCC controllers are working with JSC/FDOC Network Operations Controllers (NOC) to update the BCC-MCE Activation Procedures

  - **BCC-MCE Updates**
    - HOSC Systems Engineering working with JSC BCC Engineering team to implement 18 SR's now through CY17

Partners Interfaces Status

◆ HOSC MCC21 Support

◆ HOSC Support of the MCC21 Implementation

- ✦ HOSC SLEGW software was upgraded in response to MCC21 WSC Front End upgrades for S-band telemetry
- ✦ Parallel network interfaces established to support the MCC21 architecture
- ✦ Temporarily provide MER with real-time telemetry during contingency operations, until the Mission Support Environment is implemented in BCC-MCE.
  - ✦ Also in negotiations to temporarily provide MER with an archived telemetry capability.
- ✦ Test & operations anomalies are worked through the ServiceNow system
- ✦ MCC21 services are now requested through IdMAX/NAMS

◆ MCC21/HOSC Interface Validation

- ✦ All HOSC/MCC21 interfaces have been thoroughly validated through numerous NW Connectivity, ICD, MCEIE Isolation, and end-to-end tests
- ✦ Eight ISS Mission support activities provided the opportunity to execute internal transition procedures, and gain confidence moving forward with the final transition
- ✦ A total of six MCC21 IR's remain as open work following transition

3. ISS Program Reorganization (MSFC)

Payload Operations Integration

- New ISS program office located at MSFC
- Combines POIC (ground systems) and POIF (flight operations)
- These functions were managed in Research Integration Office (OZ)
- Manager: FP03/Chris Cianciola
  - POIC Manager: FP03/Melanie Bodiford
  - POIF Manager: FP03/Carmen Price

- Engineering and Operations support continues to be provided by Mission Operations Laboratory

Payload Operations Integration

- CR in work to change some documents
  - *SSP 50304: POIC Capabilities Document (PCD)*
  - *SSP 50305: Payload Operations Integration Center (POIC) Generic User Interface Definition Document (PGUIDD)*

- PGUIDD is being rewritten to combine volumes 1 & 2 into a single book:
  - Vol 1: Describes standard interfaces between remote users utilizing GSE to access POIC interfaces
  - Vol 2: Describes command uplink format and update interfaces. Vol 2 distribution is currently restricted
  - The PGUIDD's sensitive information needs to be reviewed by the Security Analysis and Response Team to ensure no sensitive information still exists in volume
  - Retain the PGUIDD Name/Number, dropping the Vol.1/Vol.2 reference

- PGUIDD is referenced in several of the HOSC to IP ICDs

Payload Operations Integration

- Request to change document management to be OPR controlled by the MSFC Payload Ops Integration Office
- Request for Process Improvement Change: Make for timely integrated revisions / updates to PGUIDD
  - Currently, Program Interface Revision Notices (PIRNs) distributed for IP concurrence
  - Once PIRN incorporated, PGUIDD is sent to IP's a second time for concurrence
  - Creates delay in revising
  - Change to make PGUIDD and its PIRN process managed by the POI Control board for efficiency in CM
  - Mandatory reviewers will include JSC and applicable IP's who have PGUIDD interfaces called out in relevant ICD's.
  - Interface changes will be documented in the ICD's between MSFC and respective partners
  - Will continue to be coordinated through GSCB
  - International Partner signatures only required for revisions (and JSC, MSFC, GSFC reps to GSCB) detailed in PIRNs
  - Document release impacted by time it takes to secure IP signatures for revisions
  - Removing IP concurrence and signature pages from PGUIDD will reclassify the document as unilateral (vs multilateral)

Backup Charts