ISS Higher Rate Communications Upgrades

July 26, 2016

Presentation for the POIWG

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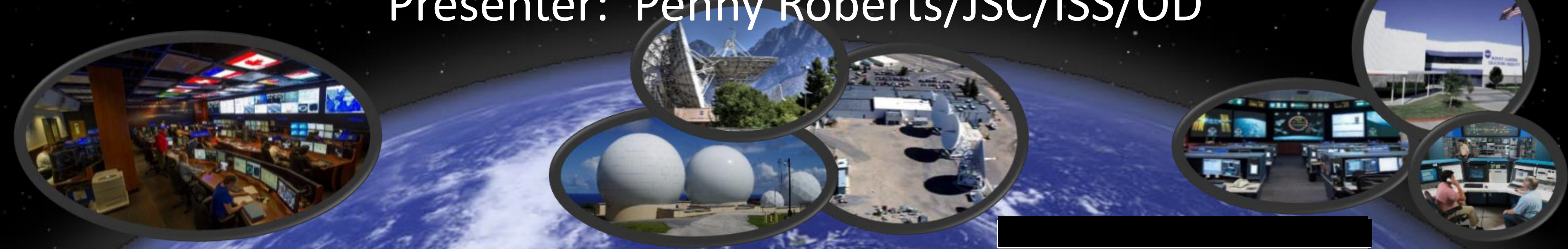

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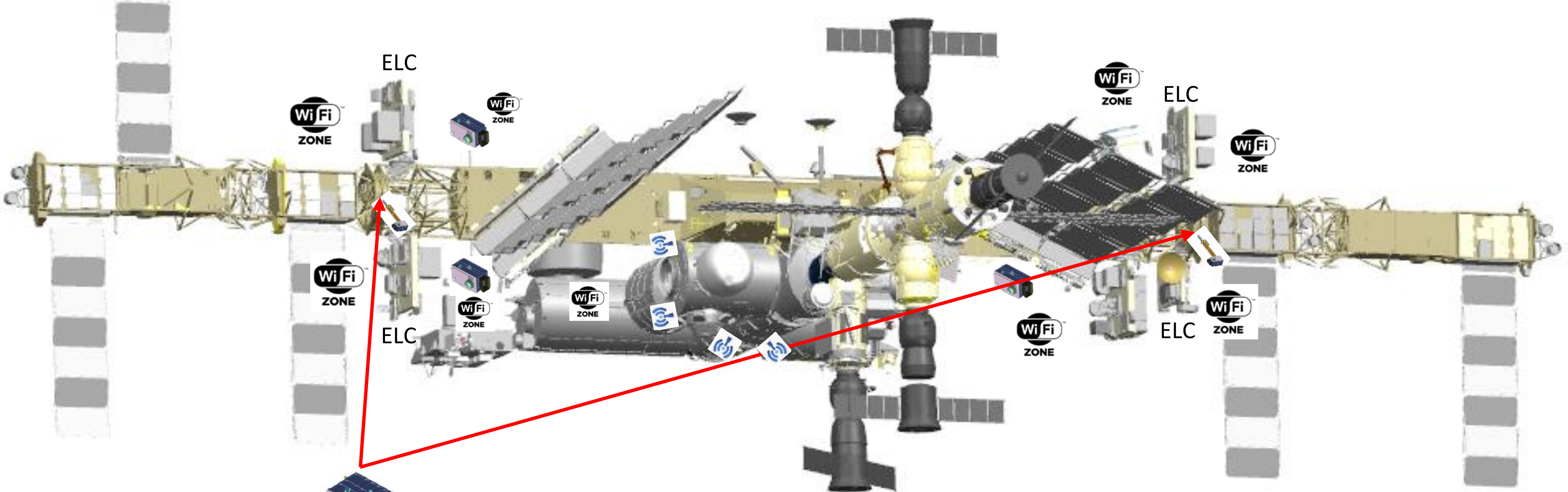
Increasing Data Rates from the ISS Payload to the Researcher

Increasing the data rates and data volume to the researchers by

1. Using higher order modulation and encoding schemes on the ISS and at the Space Network ground sites,
2. Using the Guam Space Network ground site and a high rate link to the CONUS,
3. Adding a Gig-E pipe to the ISS Local Area Network, and
4. Moving to higher rate ground network circuits from White Sands to MSFC.



Expanding Joint Station LAN (JSL) External Wireless Comminucations (EWC) coverage and user capacity by

1. adding antennas and Wireless Access Point (WAP) to Node 3,
2. using External High Definition Cameras (EHDCs) as WAPs, and
3. adding EHDCs/WAPs outboard of the Express Logistics Carriers (ELCs).

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Increasing Data Rates into the Downlink and to the Researcher and Increasing Realtime Coverage

Upgrades to the Ku-band space-to-ground link:

1. Increase the return link user data rate
2. Increase the user data rate into the Ku-band return link from the payloads
3. Increase the Ku-band coverage

Transition Readiness Date: 3/8/2018	Current	Upgraded
Return link rate Return link user data rate supported	300 Msps 259 Mbps	600 Msps 517 Mbps
Ethernet downlink data rate (max)	90 Mbps	517 Mbps
Coverage	~75% of orbit	~85% of orbit

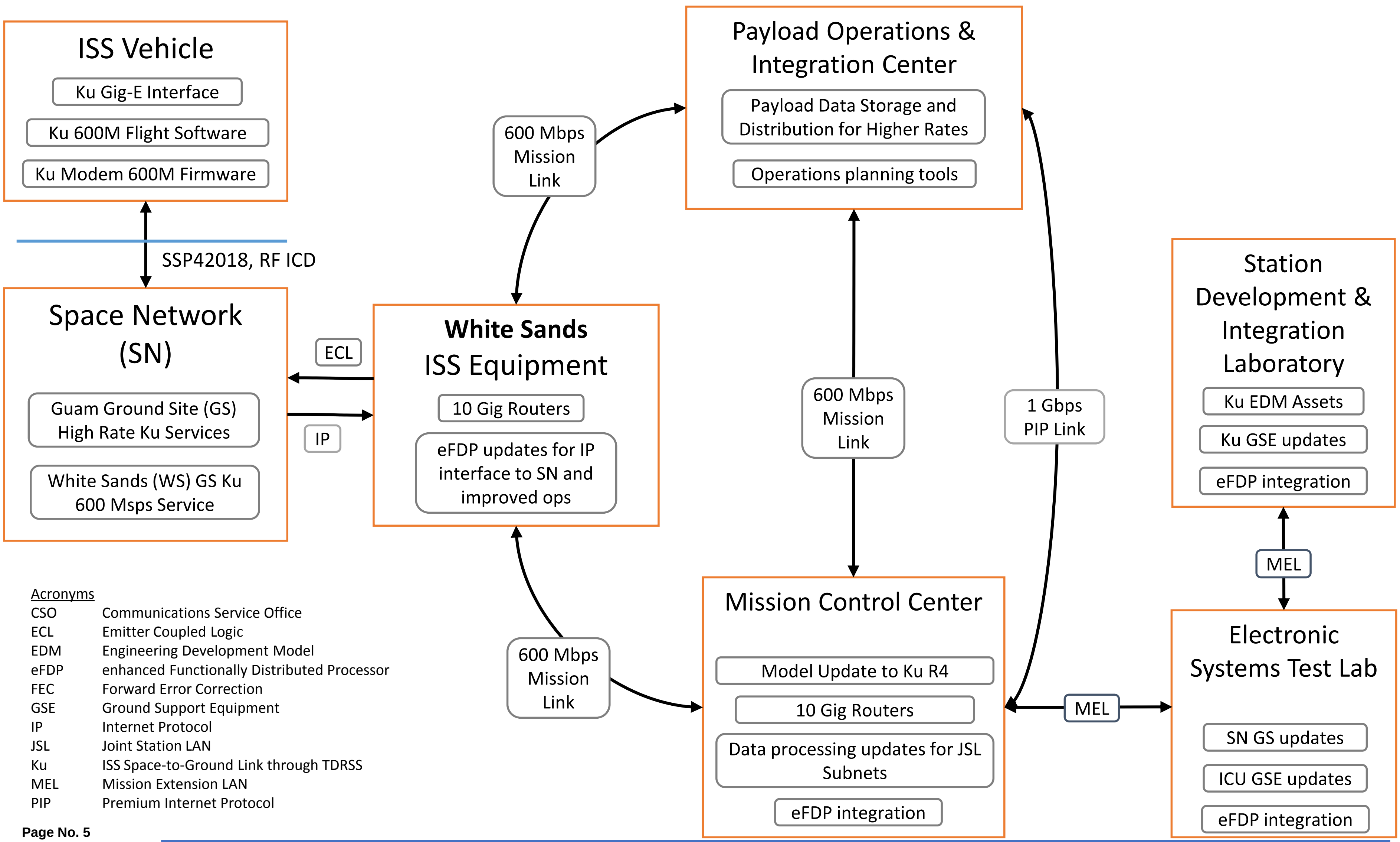
Msps: Mega symbols per second
Mbps: Mega bits per second

Realtime equals <1 second from data input to the ISS downlink system and arrival at MSFC distribution

Forward link user data rate remains at 21 Mbps (25 Msps link rate)

Scheduled completion date – March 2018

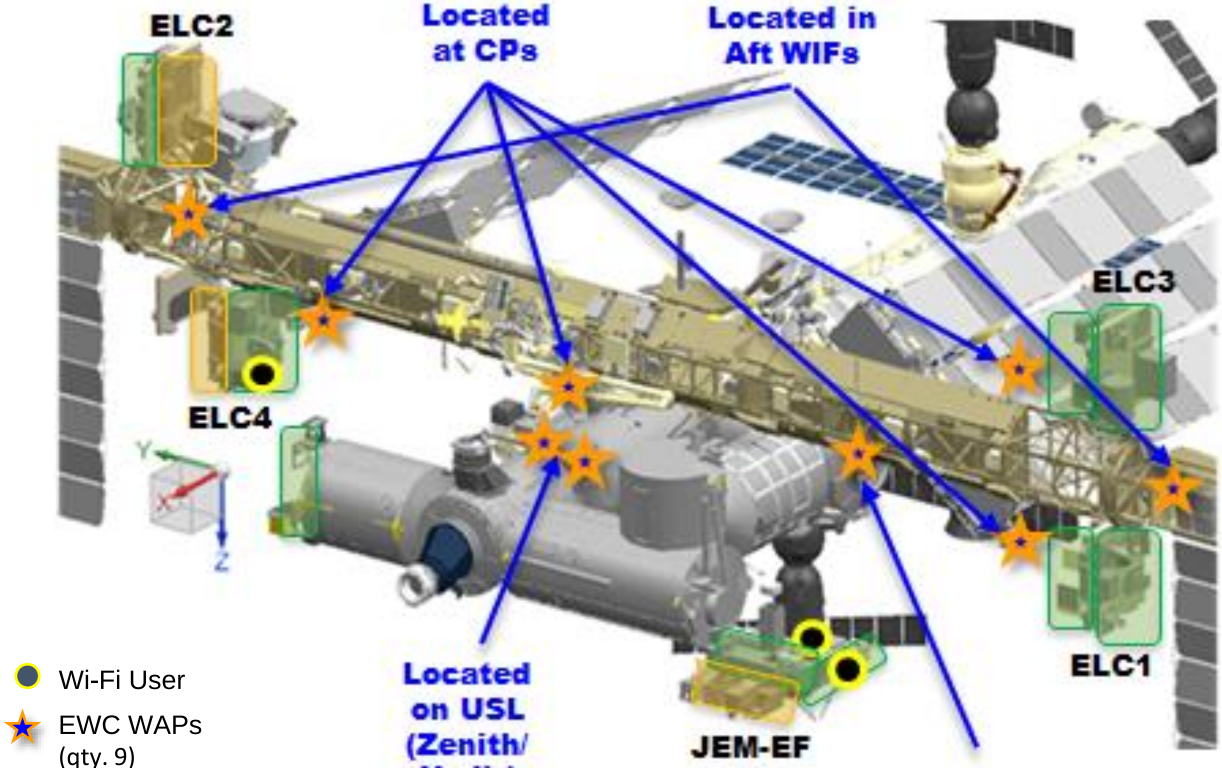
High Level Changes for Ku Upgrade

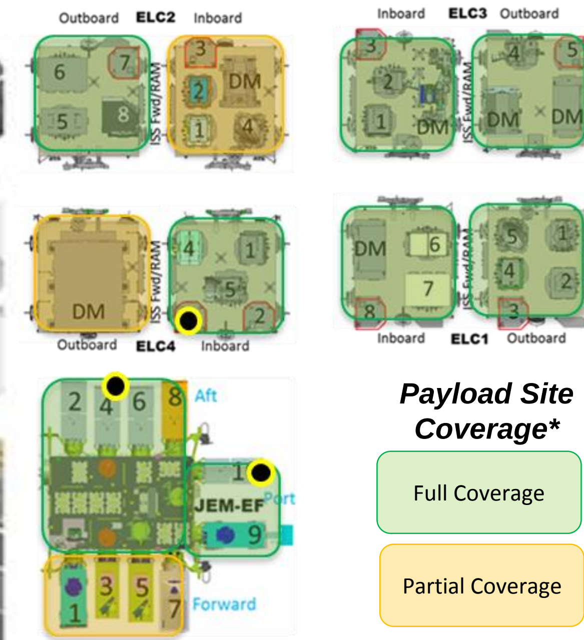


Acronyms

CSO	Communications Service Office
ECL	Emitter Coupled Logic
EDM	Engineering Development Model
eFDP	enhanced Functionally Distributed Processor
FEC	Forward Error Correction
GSE	Ground Support Equipment
IP	Internet Protocol
JSL	Joint Station LAN
Ku	ISS Space-to-Ground Link through TDRSS
MEL	Mission Extension LAN
PIP	Premium Internet Protocol

JSL EWC Payload Site Coverage





*Payload Site Coverage**

Full Coverage

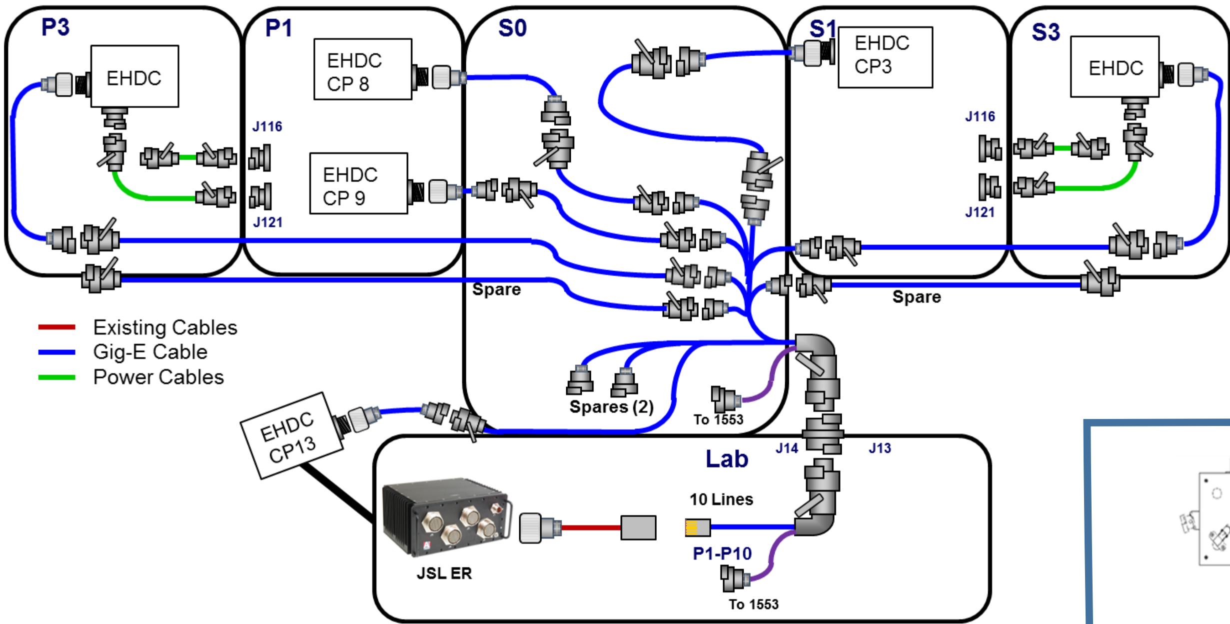
Partial Coverage

*Wi-Fi Coverage is also available at locations between antenna and covered payload site.

Features

- Removes the EHDCs as users of Wi-Fi freeing up bandwidth for more payloads
- More WAPs equals more capacity (# users, data rates) and more robustness in failure scenarios
- Improved ISS spherical coverage for mobile users and non-payload sites
- Maximize camera investment

Designing for Flexibility and Other Future Potential Uses

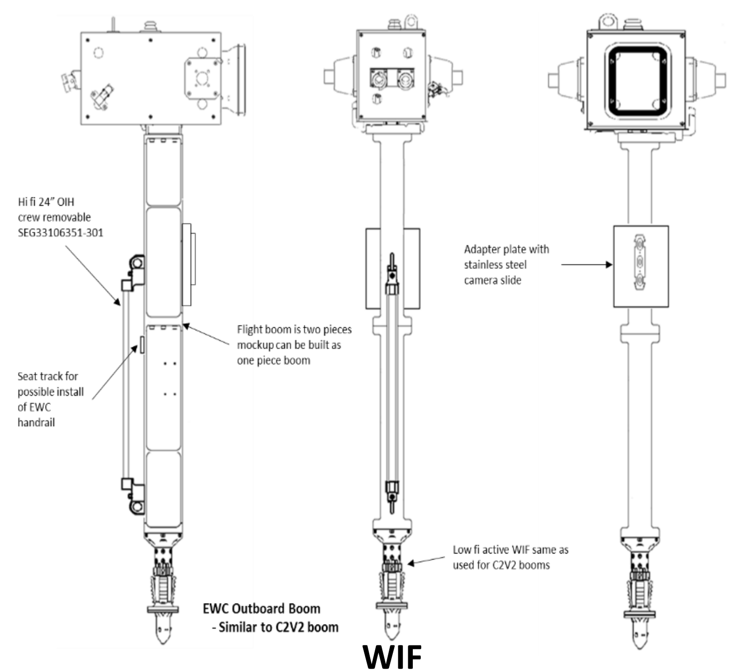


Incorporating spares where feasible

- *4 spare Gig-E lines*
- *2 spare power lines*
- *Maintaining 1553 lines*

Using a flexible boom design

- *Can be mounted in any available mounting site with WIF socket,*
- *Incorporating additional interfaces on the boom for mounting other items like an additional EHDC for redundancy,*
- *Two different boom lengths via segmented boom design, and*
- *Deployment based on need allowing flexibility in final WAP locations.*



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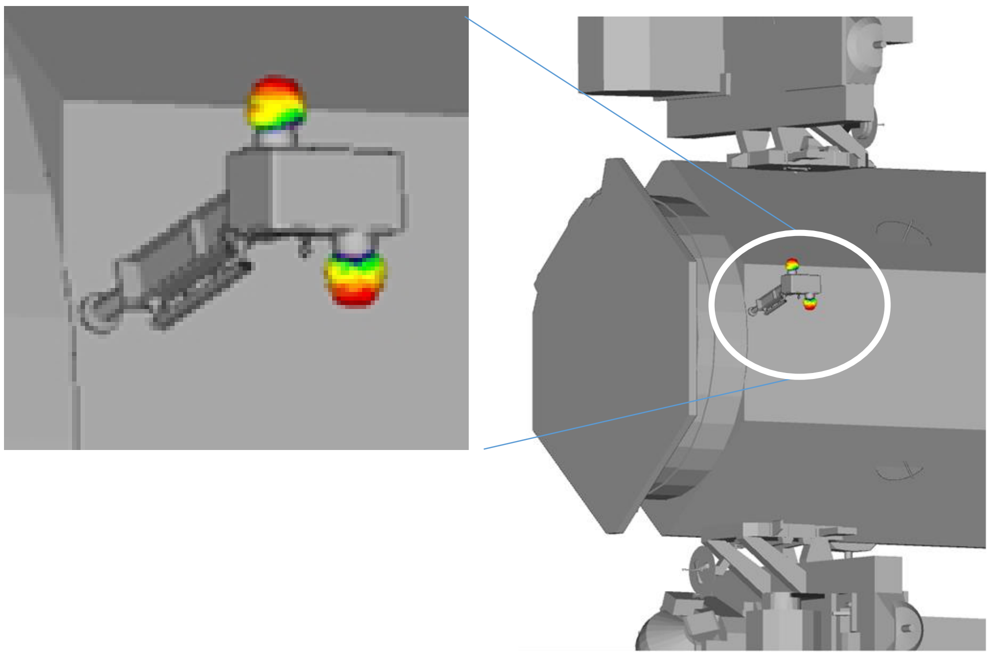
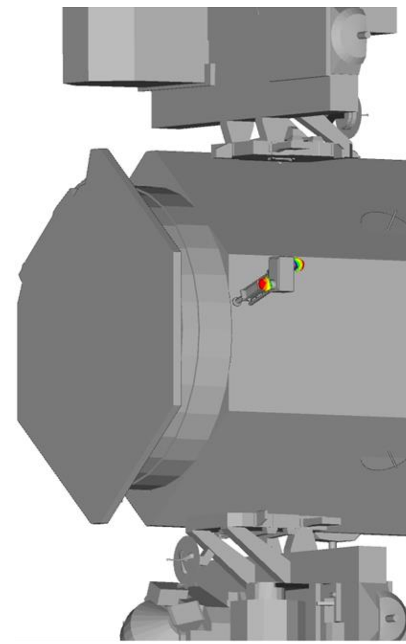
Port Mounting Locations and Orientations used for Analyses

RF and line of sight analyses were performed to assess the coverage expected at the outboard locations with various boom heights and camera orientations.



Zen/nad configuration

- **Two structure orientations were simulated for the port side of the main truss**
  - Antennas pointing zenith/nadir
  - Antennas pointing port/starboard



Port/stbd configuration

Closing Remarks

Future Upgrades being Considered

- Increasing EWC data rates
- Assessing opportunities to utilize partner- or payload-provided communications systems

Additional Data

- Ku upgrade and EWC expansion data can be found at the following Sharepoint sites:
  - https://iss.sp.jsc.nasa.gov/Int/OD/AADO/KuBand_Upgrade/SitePages/Home.aspx
    - ➢ Ku Upgrade Project Manager: Penny Roberts, penny.e.roberts@nasa.gov
  - https://iss.sp.jsc.nasa.gov/Int/OD/AADO/EWC_Expansion/SitePages/Home.aspx
    - ➢ EWC Expansion Project Manager: Mickey McElroy, christopher.mcelroy-1@nasa.gov
- EWC usage and coverage data can be found at the following Sharepoint site:
  - https://iss.sp.jsc.nasa.gov/Int/OD/EWC/SitePages/Home.aspx
    - JSL System Manager: Brett Willman, brett.m.willman@nasa.gov
    - JSL EWC POC: Thomas Basciano, thomas.e.bascianojr@boeing.com
    - JSL Payload POCs: (for JSL payload integration, requirements, test and verification)
      - ➢ Margaret Sterling, margaret.a.sterling@boeing.com
      - ➢ Andrea Kelly, andrea.kelly@boeing.com
      - ➢ Tremayne Dillard, tremayne.l.dillard@boeing.com