Title: POIWG 46 Space Acceleration Measurement System (**SAMS**) Splinter Session

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Space Acceleration Measurement System (SAMS)

Outline

1. Overview
2. Topology
3. Customer Support
4. ZBook Transition
5. Wireless Deployment
6. New Hardware
7. Backup Slides

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Overview

NASA Glenn Research Center (GRC) Acceleration Measurement Program Goals:

- provide timely and readily-accessible **acceleration measurement data**
- maintain an **archive** of microgravity measurement data from the International Space Station (ISS), including SAMS and Japan Aerospace Exploration Agency (JAXA) data
- provide routine/daily **analysis** plus custom services

SAMS Capabilities and Services:

- we can capable instrument & measure the local vibratory regime in **all 3 ISS labs**
- our goal is continuous, **24x7** operations
- nominal measurement frequency range: **0.01 < f < 200 Hz**
- primary customers are **scientific payloads**
- play a key role in daily ISS **structural dynamics monitoring**

As of 9/20/2019, SAMS has collected over 506,000 sensor hours (12.9 terabytes) of data on the ISS.

For questions, email: hrovatk@zin-tech.com OR pimsops@grc.nasa.gov

Overview

If I want to…	then…
download SAMS data from a particular sensor (location) and GMT span	visit https://gipoc.grc.nasa.gov/wp/pims/acceleration-archives -- *e.g. use the vibration measurements recorded by SAMS in your own models or correlate with your results*
read the binary acceleration data files that were downloaded	visit the link shown just below here to *see how you can start working with acceleration data* https://pims.grc.nasa.gov/plots/user/mohan/how2read_pad_binary_files.html
browse daily summary "roadmap" plots	visit https://gipoc.grc.nasa.gov/pims/roadmap -- *these roadmap plots show patterns, structure and boundaries in both time and frequency; plot span is 8 hours & these are updated daily*
browse acceleration catalog/handbook pages	visit https://gipoc.grc.nasa.gov/wp/pims/handbook -- *these are a collection of PDF files that briefly quantify & qualify various events, activities and various aspects of the microgravity acceleration environment*

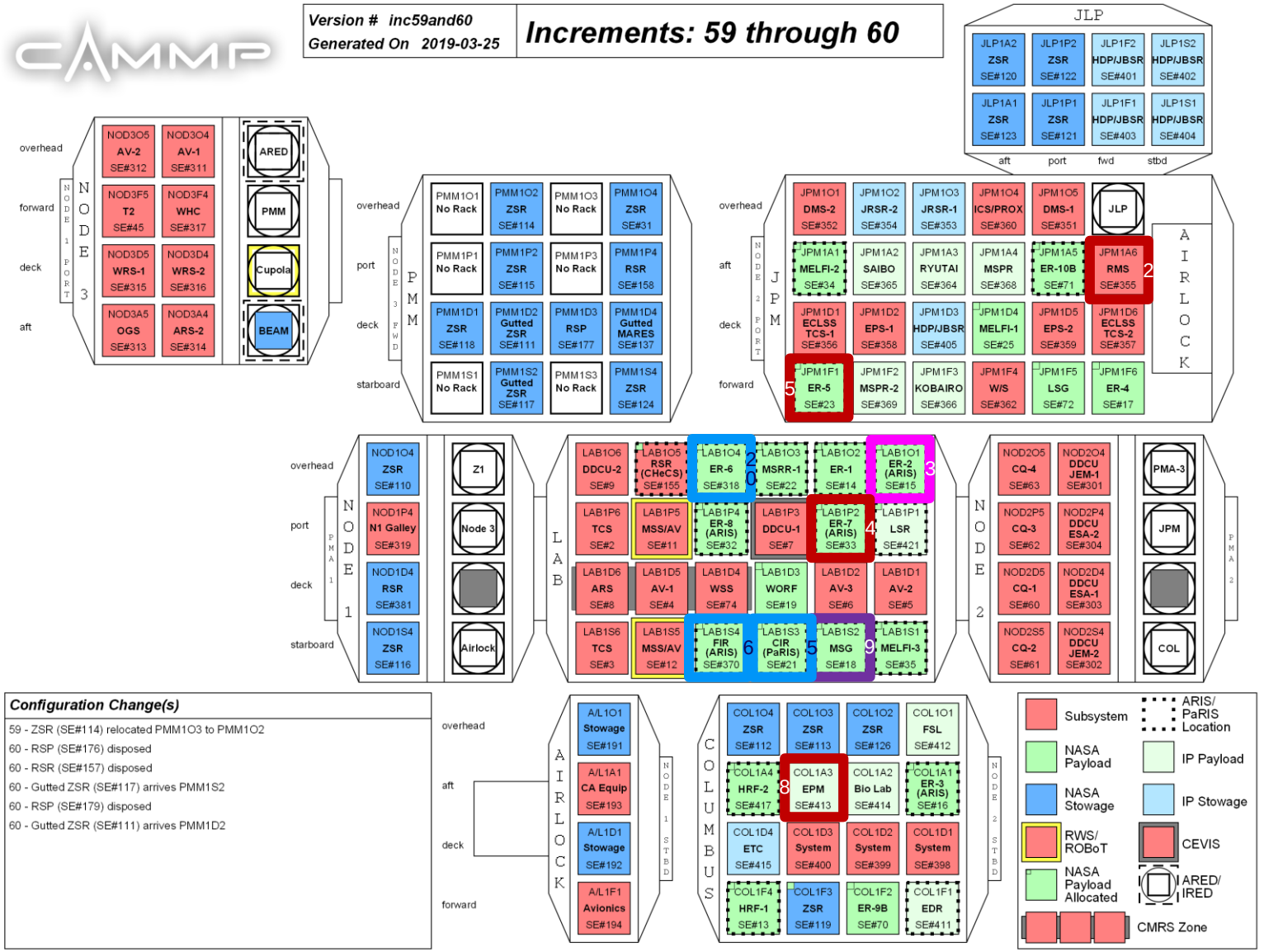
Topology: SAMS **Sensor Locations**, 2019-09-25

SAMS Sensor Head Locations

SE F02, JPM1A6, RMS Console, Seat Track (2)
SE F03, LAB1O1, ER2, Lower Z Panel (3)
SE F04, LAB1P2, ER7, Cold Atom Lab Front (4)
SE F05, JPM1F1, ER5, Inside RTS/D2 (5)
SE F08, COL1A3, EPM, near PK-4 (8)
TSH-ES09, LAB1S2, MSG (9)
TSH-ES05, LAB1S3, CIR (5)
TSH-ES06, LAB1S4, FIR (6)
TSH-ES20, LAB1O4, ER6, Hermes Door (20)
TSH-ES03, stowed spare

LEGEND:

Sensor that does not move
Sensor that has moved or may move
Sensor that has never moved
Stowed or not currently connected
MSG sensor gets installed for some payloads



Topology: SAMS ***Electronics Enclosures (EEs) & Cables***, 2019-09-25

Electronics Enclosures (EEs) Locations

EE-F01	LAB1P2	ER7	embedded (4)
EE-F02	**LAB1O2**	**ER1**	**RTS/D1 (3)**
EE-F03	**JPM1F1**	**ER5**	**RTS/D2 (2,5)**
EE-F04	COL1A1	ER3	embedded (8)
EE-F05	LAB1O1	ER2	embedded
EE-F06	Stowed		spare
EE-F07	LAB1P4	ER8	embedded

LEGEND:

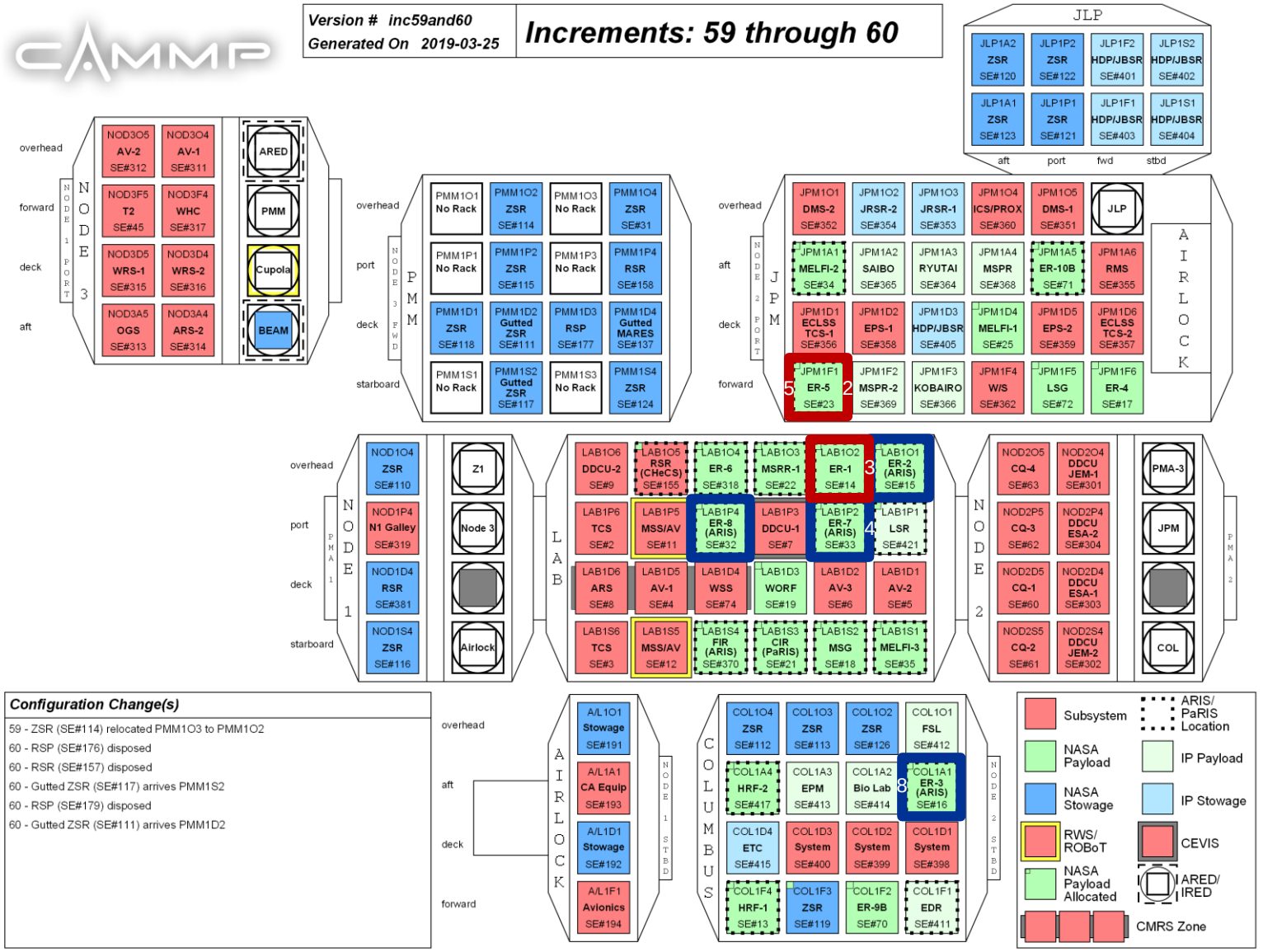
Embedded EE

EE Inside RTS Drawer

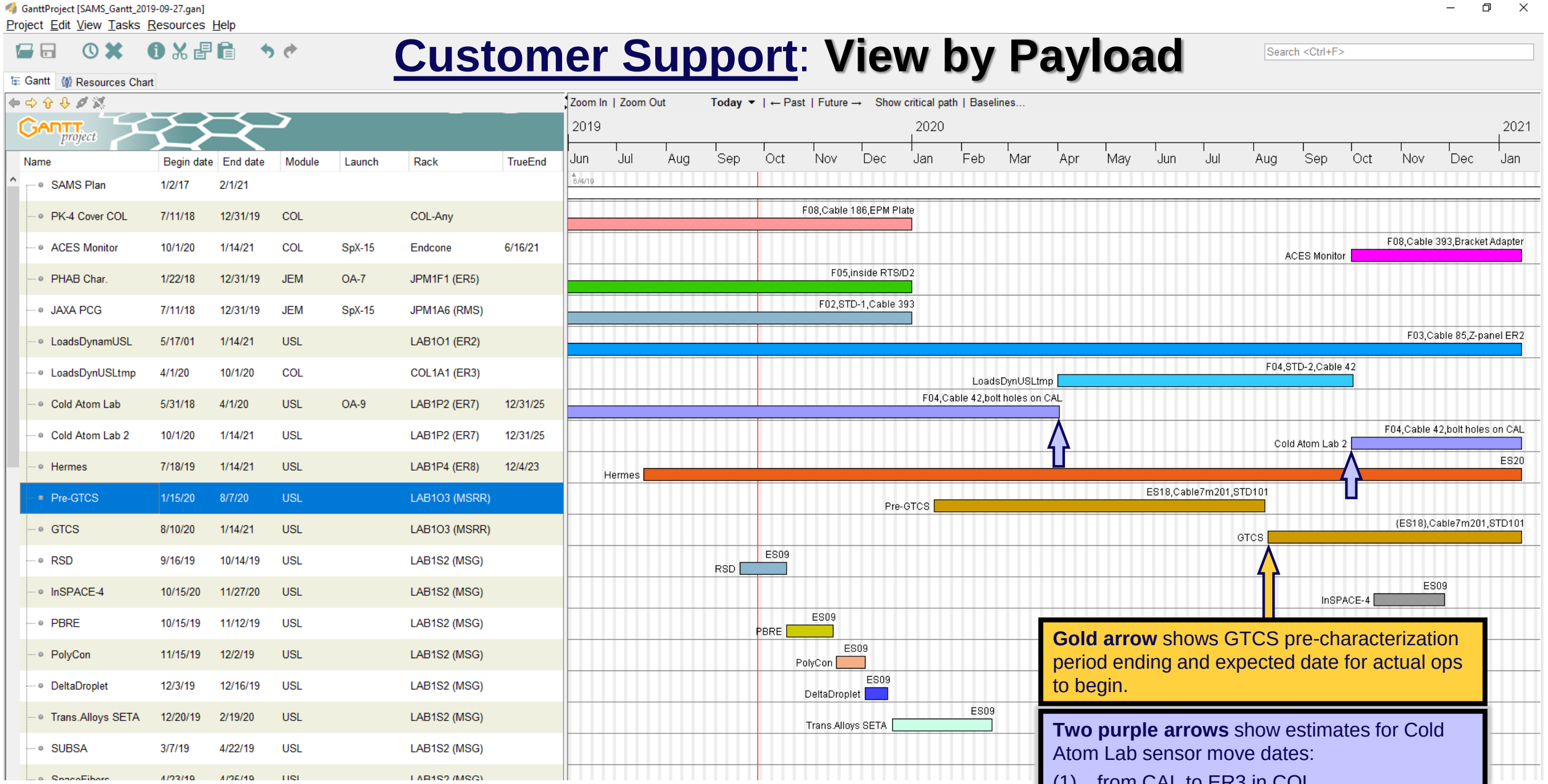
Spare EE

SAMS Cables' Locations

Length	Location	Supporting
42”	LAB	Cold Atom Lab
186”	COL	PK-4
393”	JEM	JAXA PCG



Customer Support: View by Payload



Name	Begin date	End date	Module	Launch	Rack	TrueEnd
SAMS Plan	1/2/17	2/1/21				
PK-4 Cover COL	7/11/18	12/31/19	COL		COL-Any	
ACES Monitor	10/1/20	1/14/21	COL	SpX-15	Endcone	6/16/21
PHAB Char.	1/22/18	12/31/19	JEM	OA-7	JPM1F1 (ER5)	
JAXA PCG	7/11/18	12/31/19	JEM	SpX-15	JPM1A6 (RMS)	
LoadsDynamUSL	5/17/01	1/14/21	USL		LAB1O1 (ER2)	
LoadsDynUSLtmp	4/1/20	10/1/20	COL		COL1A1 (ER3)	
Cold Atom Lab	5/31/18	4/1/20	USL	OA-9	LAB1P2 (ER7)	12/31/25
Cold Atom Lab 2	10/1/20	1/14/21	USL		LAB1P2 (ER7)	12/31/25
Hermes	7/18/19	1/14/21	USL		LAB1P4 (ER8)	12/4/23
Pre-GTCS	1/15/20	8/7/20	USL		LAB1O3 (MSRR)	
GTCS	8/10/20	1/14/21	USL		LAB1O3 (MSRR)	
RSD	9/16/19	10/14/19	USL		LAB1S2 (MSG)	
InSPACE-4	10/15/20	11/27/20	USL		LAB1S2 (MSG)	
PBRE	10/15/19	11/12/19	USL		LAB1S2 (MSG)	
PolyCon	11/15/19	12/2/19	USL		LAB1S2 (MSG)	
DeltaDroplet	12/3/19	12/16/19	USL		LAB1S2 (MSG)	
Trans.Alloys SETA	12/20/19	2/19/20	USL		LAB1S2 (MSG)	
SUBSA	3/7/19	4/22/19	USL		LAB1S2 (MSG)	

Gold arrow shows GTCS pre-characterization period ending and expected date for actual ops to begin.

Two purple arrows show estimates for Cold Atom Lab sensor move dates:

(1) from CAL to ER3 in COL

(2) from ER3 in COL back to CAL

ZBook for SAMS Control Unit (CU) Laptop

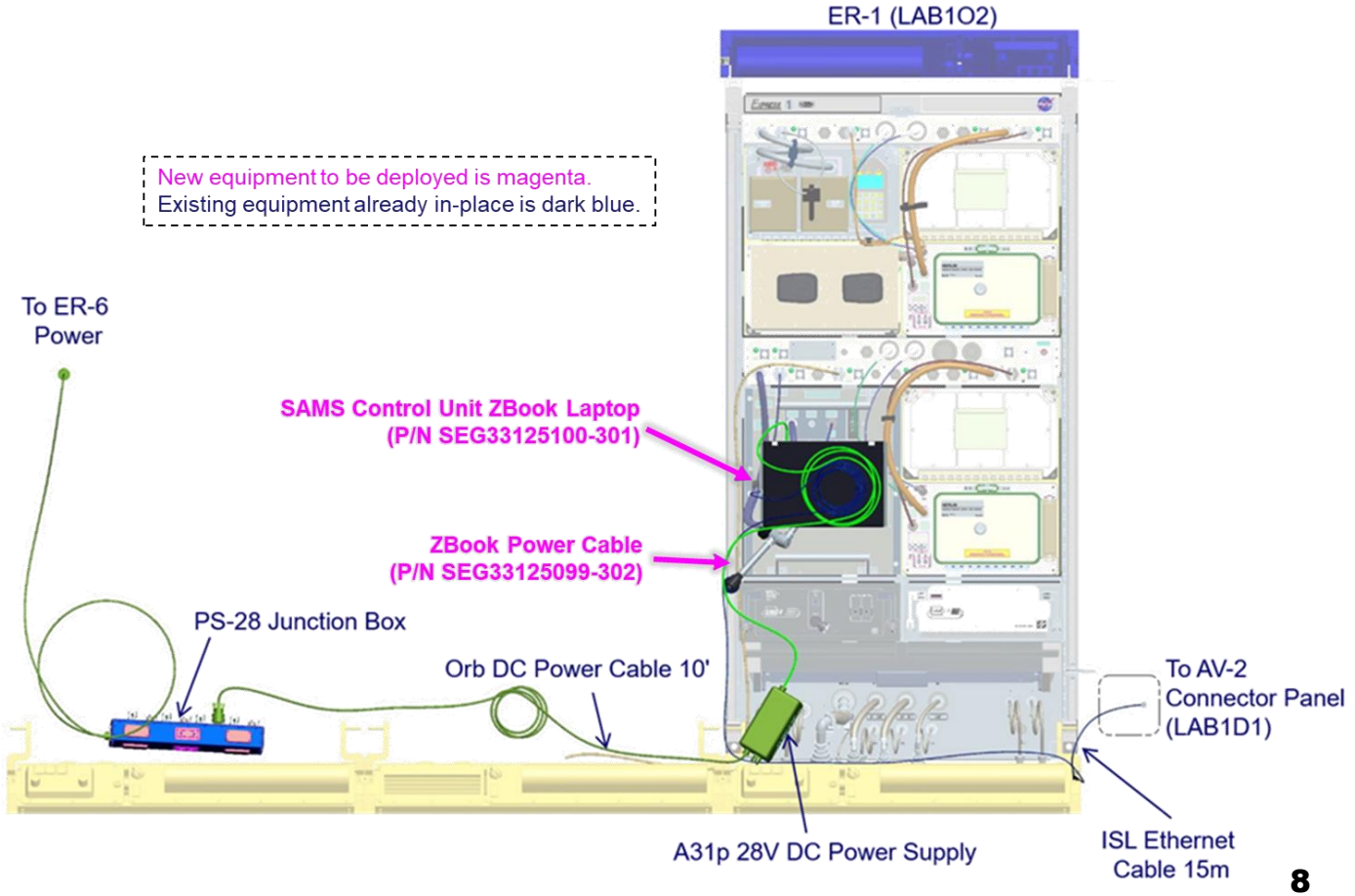
- **July 22, 2019** – Crew procedure went without a hitch to transition SAMS CU from T61p to Zbook…

  …much thanks to Bob McCormick & Rob Waymire – they helped us get this done

- **Sept. 17, 2019** – Our laptop battery kicked in and kept the SAMS CU laptop running for about 50-minutes during an ER6 issue. The issue removed power from Locker 3 location, which was supplying juice to our PS-28 junction box.

Wake-On-LAN

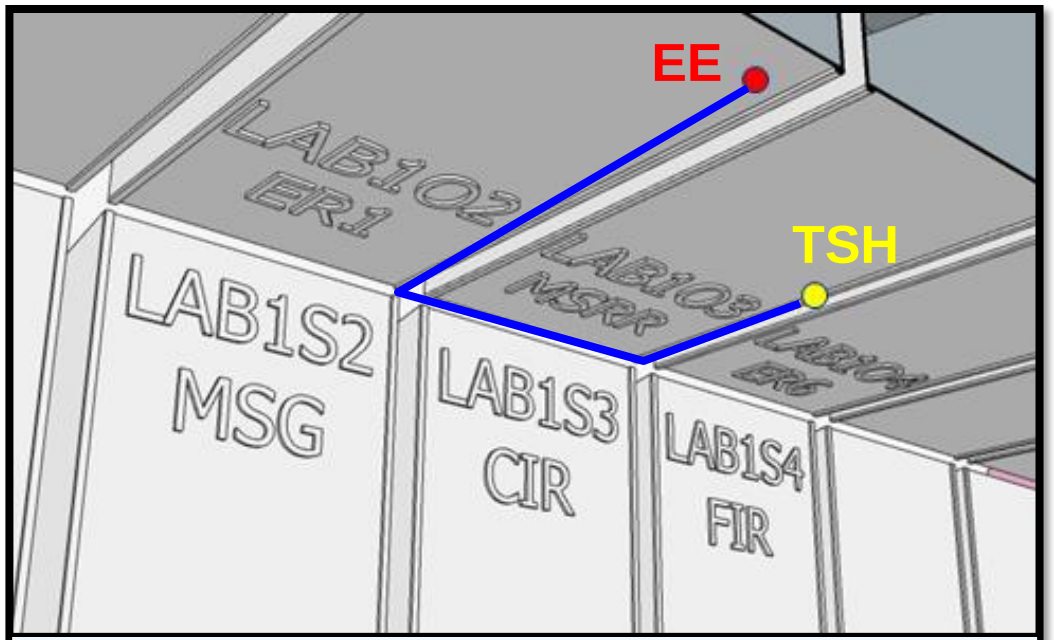
- We will probably ask PRO to try this feature on SAMS CU when good opportunity arises.
- This feature had worked for us on the ground with T61p, but it never worked on-orbit.
- Not tried yet with ZBook.
- The alternative for SAMS CU is to have crew manually intervene whenever we need to be powered back on.



Wireless Deployment of Triaxial Sensor Head - Ethernet Standalone

Supporting Growth of Ternary Compound Semiconductors (**GTCS**) in Materials Science Research Rack (**MSRR**)

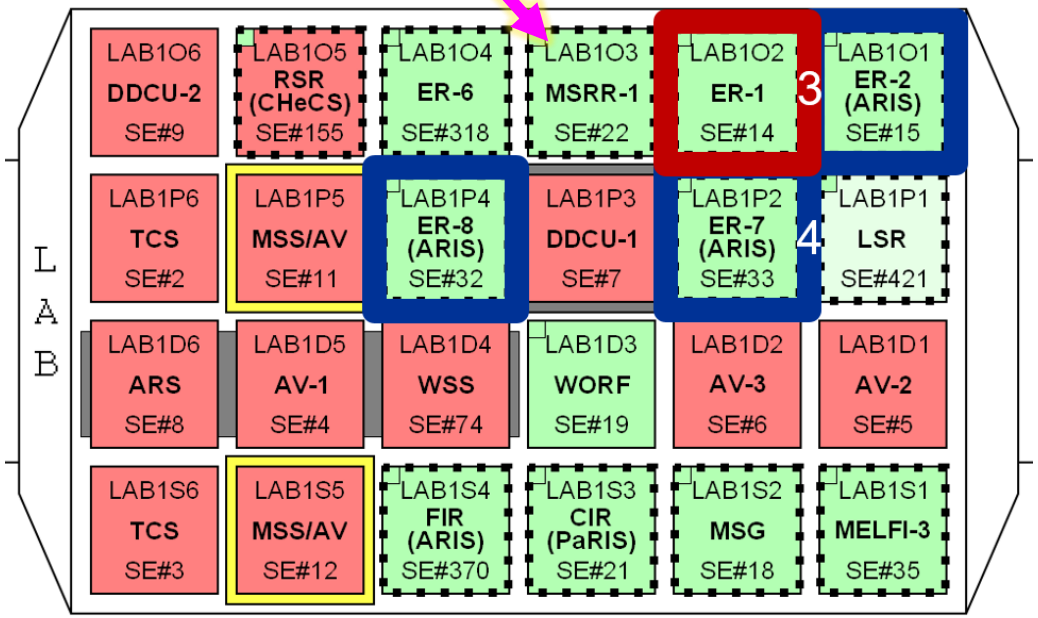
To begin ops sometime in 2020



crude image of **approximate cable routing** from **EE** in RTS/D1 (LAB1O2 = ER1) aftward to TSH seat track location for mounting sensor head on MSRR (LAB1O3)

TSH-ES S/N 18
on STD S/N 101

7m cable
connects TSH to EE in ER1
(or ER2, -7 or -8) for power



embedded EEs (blue)
EE in RTS drawer (red)

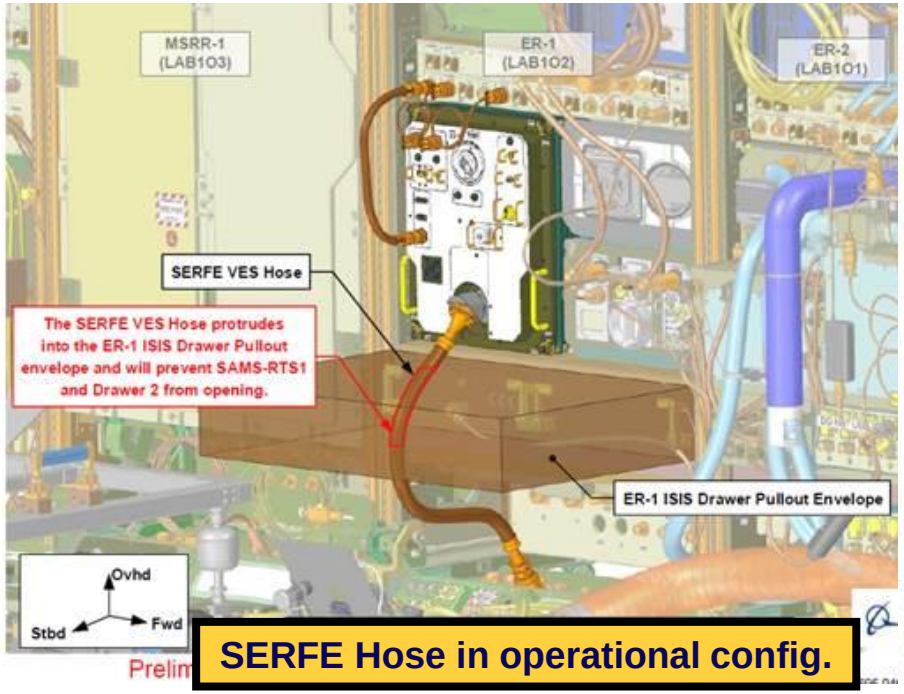
Wireless Deployment for GTCS

Feedback from Michelle Barnett:

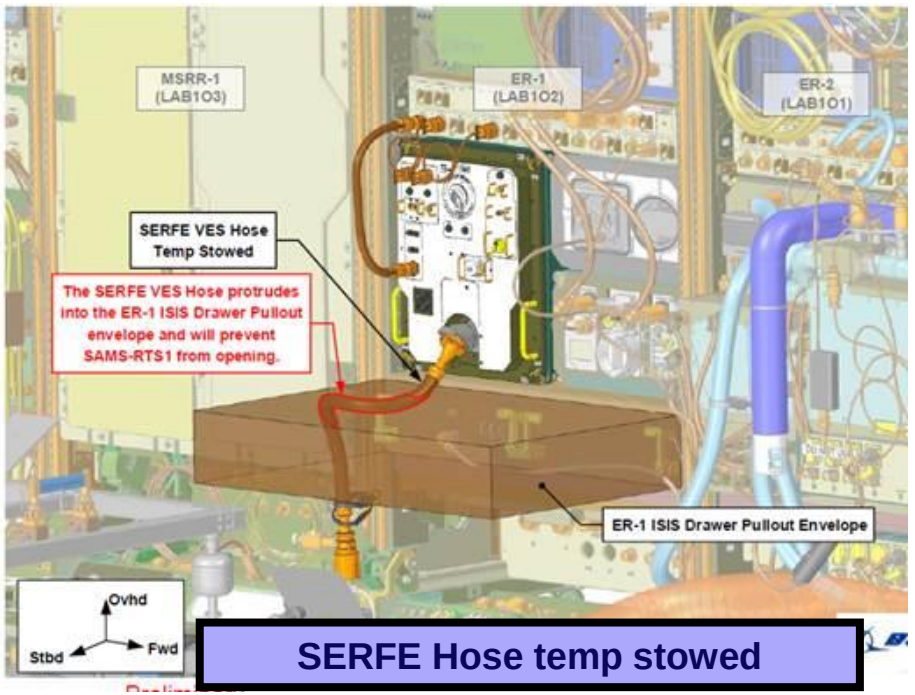
- GTCS is slated for manifest on SpX-21, August 2020.
- Regarding the sensor head mounting, a seat track will need to be used since the sensor cannot be bolted directly to MSRR.

Open Items:

- Currently, not 100% sure what impact of Spacesuit Evaporation Rejection Flight Experiment (SERFE) might be on SAMS plans to support GTCS. Feedback from ISS topology team suggests the only thing SAMS will not be able to do is pull RTS/D1 completely out. Still have access to connections on front of drawer, so this should not affect GTCS support, but it will impact semi-annual SAMS drawer screen cleaning.
- SAMS first wireless deployment needs ECR, but before that, we'll iterate to get good draft of crew procedure in place for review.



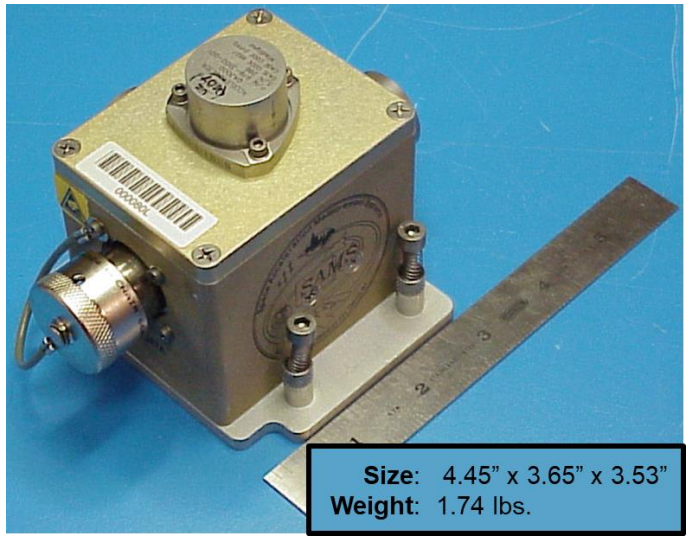
SERFE Hose in operational config.



SERFE Hose temp stowed

New Hardware (SpX-19 Flight)

Item	Quantity	Note
Triaxial Sensor Head – Ethernet Standalone (**TSH-ES**)	1	S/N 19 - spare for CIR, FIR, MSG or to deploy as needed.



Backup Slides

EE to TSH-ES (ET) Cable Assembly

Any SAMS EE
(this one's inside RTS Drawer)

SAMS Wireless EE-TSH Cable

SAMS TSH-ES Sensor Head

DONGLE

wireless adapter, which requires
2" clearance for comm. equipment

A
2m

B
7m or 10m

EE to TSH-ES (ET) Cable Assembly

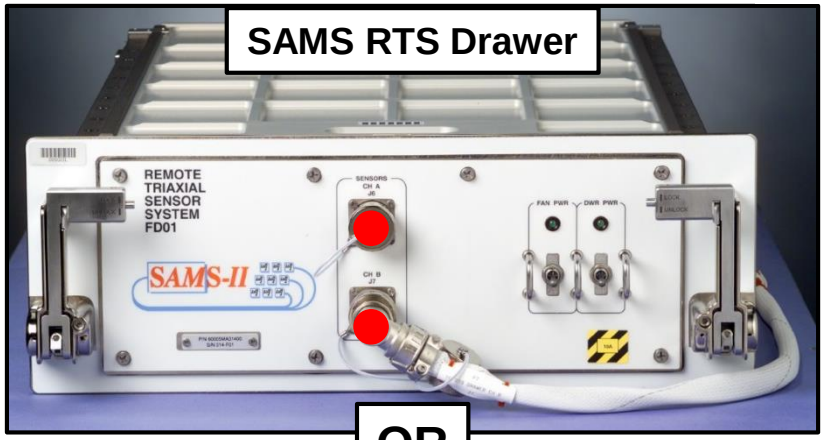
MS27467T15F35P
37 Pin
To SAMS EE (red dot) for power

provides wireless capability, if required; otherwise, it can use Ethernet connection

MS27467T13F35S
22 Pin
To ***TSH-ES sensor*** for power

2m

7m or 10m



OR

SAMS team has the understanding that **direct Ethernet connections** should be less problematic and more available **in COL and JEM** compared to LAB.

We expect to have to use the **wireless option** if a TSH sensor is deployed with this cable in the **LAB**.

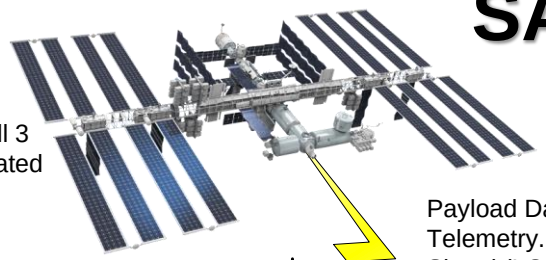
Micro USB

RJ45

GWU637
Ethernet-Wireless Adapter

Successful testing was performed at the Joint Station LAN (JSL) at Johnson Space Center (JSC) on May 16, 2018.

SAMS Data Flow



SAMS deployed in all 3 labs, with sensors located near experiments

Payload Data is delivered via Ku-band Telemetry. During satellite Loss-Of-Signal (LOS), payload data is stored on High-rate Comm Outage Recorder (HCOR) and played back at a later time.

SAMS Remote Triaxial Sensor (RTS) System
- Sensor Enclosure (SE)
- Sensor Enclosure (SE)
- Electronics Enclosure (EE)

RTS Drawer Health & and Status telemetry transmitted directly to ISS Communication Systems for downlink

EXPRESS Rack #1
- SAMS Control Unit (CU) Laptop
- Rack Interface Controller (RIC)

SAMS CU on ER1 bogen arm receives acceleration data from all active sensors through ISS Payload Ethernet & uses RIC for commanding

Facility (CIR, FIR, MSG, Hermes)
- TSH-ES

TSH ops controlled by payload

ISS Payload Ethernet
Provides payload connection to ISS communication systems for downlink

ISS Data Network
- MSFC
- White Sands
- JSC

MSFC Payload Data Services System (**PDSS**)

SAMS:
- operational flexibility to deploy and measure the local vibratory regime ($0.01 \leq f \leq 300$ Hz) in all 3 of ISS labs
- nominally operates continuously, 24x7

Principal Investigator Microgravity Services (PIMS) Microgravity Analysis Software System (MASS)

Two way read/write capability provides method for robust data manipulation & anlalysts.

PIMS Offline Analysis
- Post-Processing
- Analysis
- Handbook Generation

PIMS Real-Time
- PIMS Ground Support System at NASA GRC's TSC
- Acceleration Data Archive Server

Read only connection to data server provides world-wide access, while protecting critical data archives.

PIMS Web Services
- Real-time data plots
- FTP access to accel. archives
- PIMS web pages
- Custom Plots

MASS is designed to capture, display and archive acceleration data from ISS continuously.