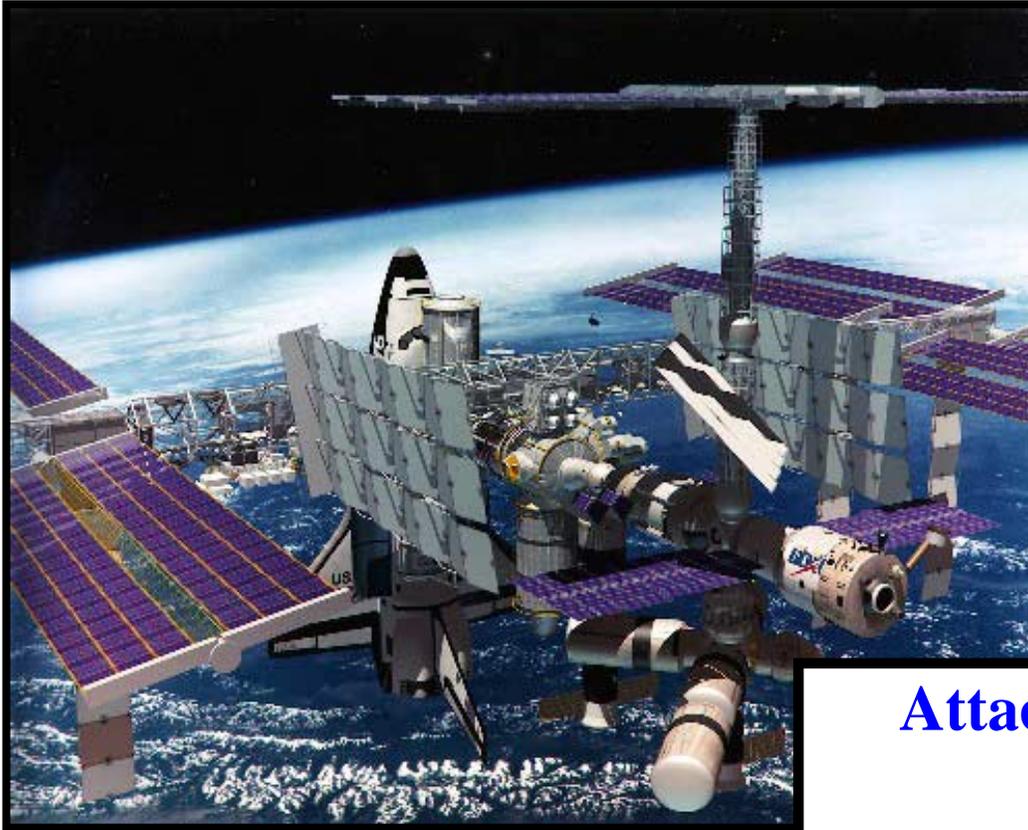




National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center

Space Station Utilization Advisory Subcommittee Summer Session 2003



Attached Payloads Program

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NASA/OZ3

International Space Station Payloads Office

Hardware Engineering Integration

29 July 2003



Purpose and Overview

- Purpose of Presentation – response to action from March 2003 SSUAS Winter Workshop:
 - “Requirements for the ExPRESS pallet should be re-evaluated in view of new technologies (e.g., wireless data links) and needs. An accelerated program should be studied for temporary mounting of small, attached payloads with autonomous solar power and wireless data links.”

- Presentation Overview
 - ExPRESS Pallet Status
 - Results of External Payload Attachment Study
 - Existing external payload attachment locations
 - Potential external payload attachment locations
 - Conclusions



ExPRESS Pallet Status

Pallet Overview

- Launched in Shuttle Payload Bay (pre-integrated with payloads for initial delivery)
- Employs Flight Releasable Attachment Mechanisms (FRAM) with different sized adapter plates
- Number of attached payloads and available services depends on adapter plate size:
 - 6 each Small Adapter Plate Assemblies (SAPA) or ExPRESS Plate Assemblies (ExPA) [power and data available], OR
 - 3 each Medium Adapter Plate Assemblies (MAPA) [no data, power only], OR
 - 2 each Large Adapter Plate Assemblies (LAPA) [no data, power only]

Pallet Design Status

- Design as completed by Brazil is at PDR level (approximately 10% maturity)
- Many design changes are required, and a complete design cycle (2-3 years) will be completed



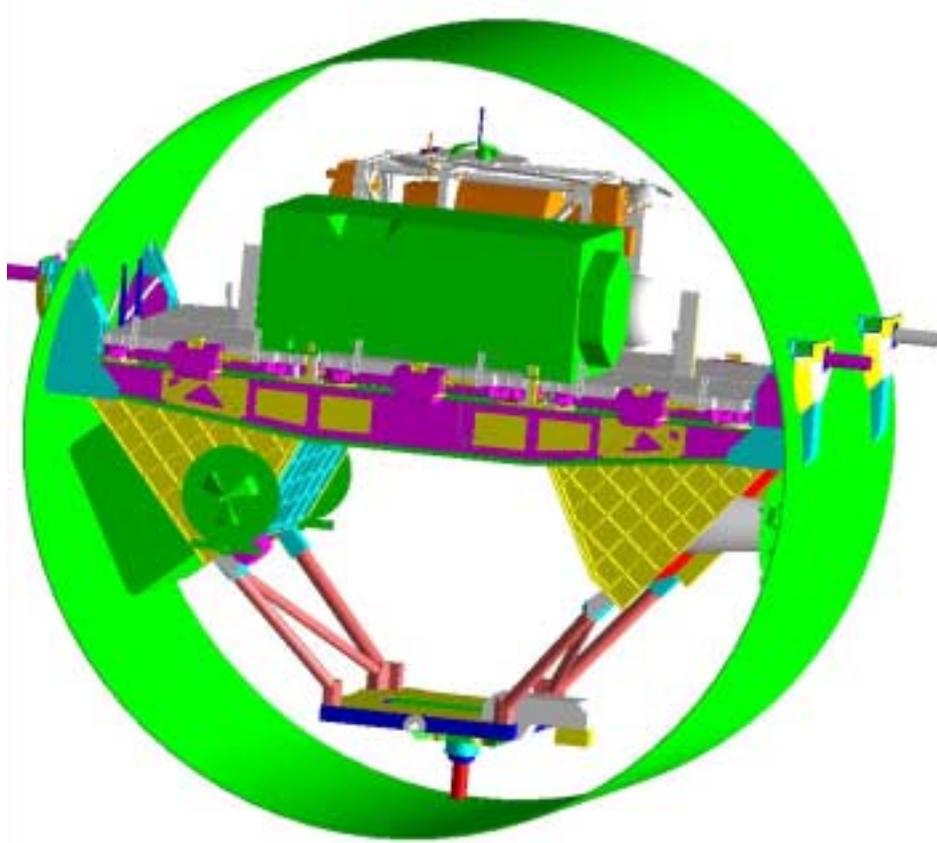
ExPRESS Pallet Status (cont.)

□ Pallet Project Status

- Currently covered by the Program Manager's Budget Recommendation
- Funds are in the Program Operating Plan for a FY '05 start
- Hardware to be procured:
 - 3 flight ExPRESS Pallets, 1 KSC test unit
 - TBD adapter plates
 - Spares and simulators as required
- Procurement efforts will begin in the first quarter of calendar 2004
- Authorization to proceed is planned for October 2004
- Delivery of the first unit is planned for October 2006 (flight opportunities are being evaluated)
- Remaining two pallets will be delivered at six month intervals after the first



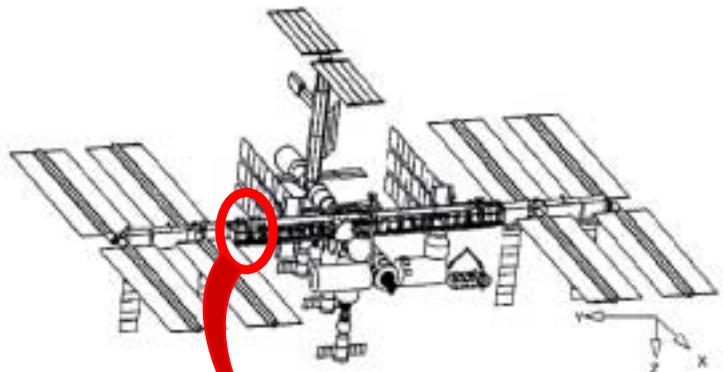
ExPRESS Pallet



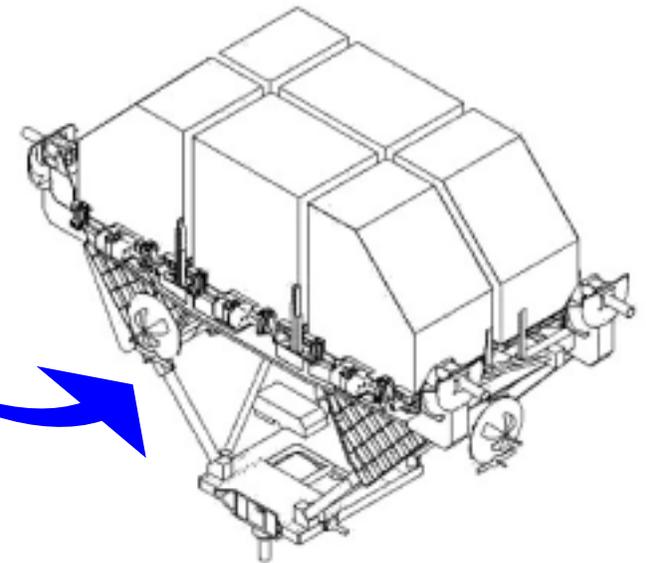
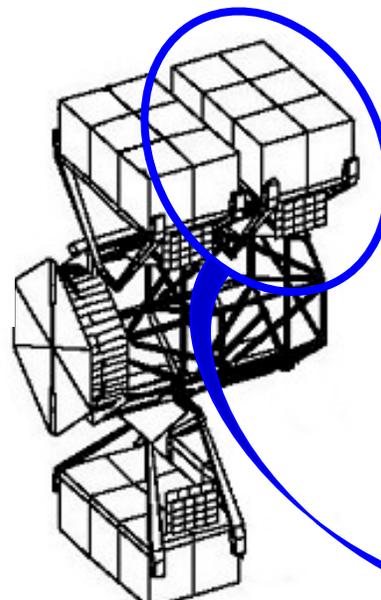
Integrated ExPRESS Pallet fits in Shuttle Payload Bay envelope



ExPRESS Pallet



ExPRESS Pallets can be
accommodated at any of the
Payload Attachment System (PAS)
sites on the S3 Truss



Single ExPRESS Pallet with 6 ExPA
payloads attached to FRAM sites



External Payload Attachment Location Study

- Task assigned to ISS Payload Integration Contractor
 - Within the constraints of existing/planned capabilities, assess potential on-orbit, external locations for attaching ISS Payloads
 - Assess potential availability of mass loading capability, power, and data resources at each location
 - Assess the potential availability of these locations related to current ISS assembly sequence

- Results
 - Existing and potential locations were identified and categorized by attachment concept
 - Available mass loading capability, power, and data resources listed for each of the existing and potential attachment locations



Planned External Payload Attachment Locations

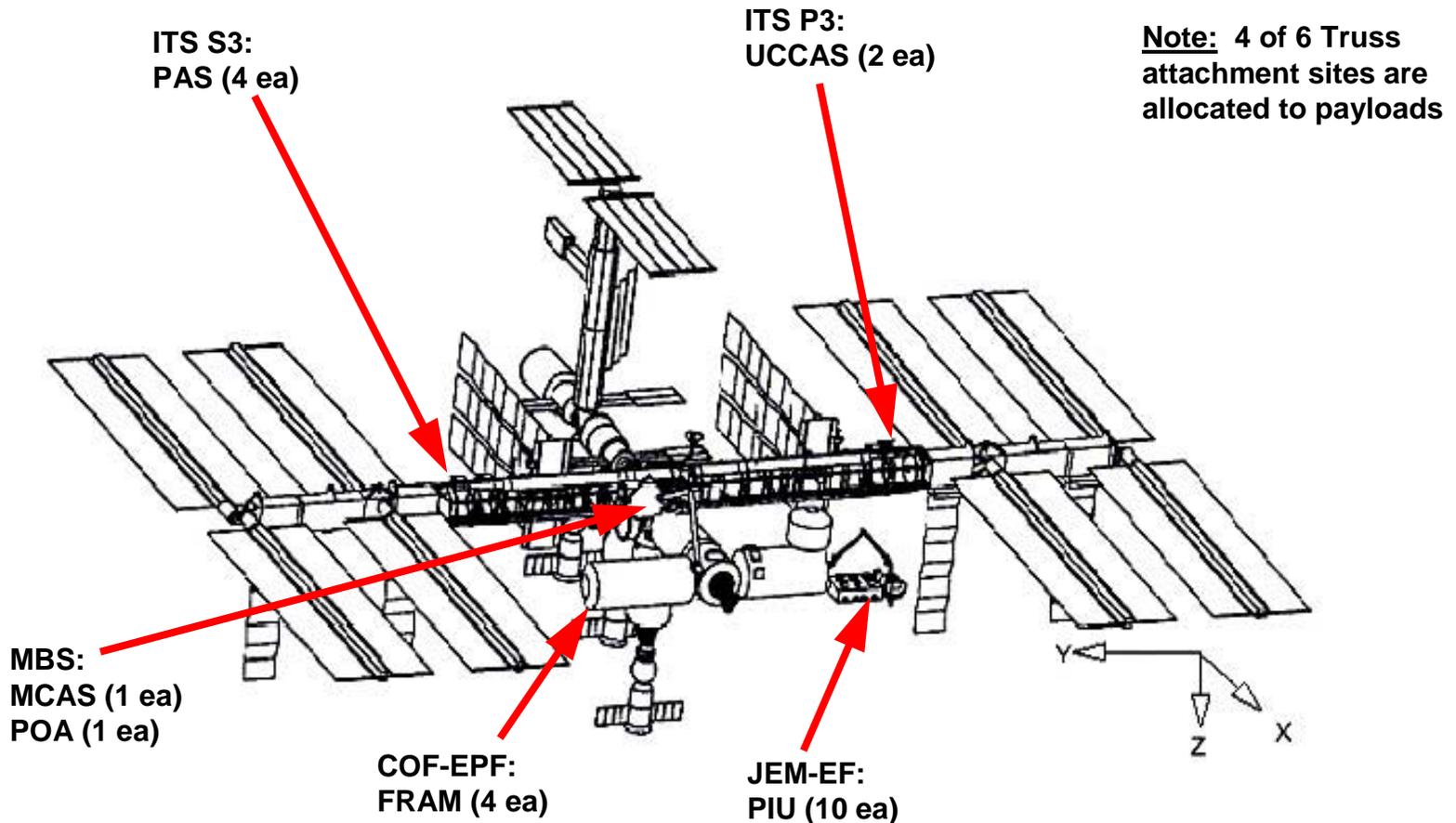
- ❑ Integrated Truss Segment (ITS) Starboard 3 (S3): 4 each Payload Attach System (PAS) sites
- ❑ Integrated Truss Segment (ITS) Port 3 (P3): 2 each Unpressurized Carrier Common Attach System (UCCAS) sites
- ❑ Mobile Remote Servicer Base System (MBS):
 - 1 each MBS Common Attach System (MCAS) site
 - 1 each Payload/ORU Accommodation (POA) site, using any of the following
 - Power and Data Grapple Fixture (PDGF)
 - Flight Releaseable Grapple Fixture (FRGF)
 - Power and Video Grapple Fixture (PVGf)
- ❑ *Columbus* External Payload Facility (COF-EPF): 4 each Flight Releaseable Attachment Mechanism (FRAM) sites (2 allocated to US Payloads)
- ❑ *Kibo* Exposed Facility (JEM-EF):
 - 12 each Payload Interface Unit (PIU)/FRAM sites; 10 for payload use (49% allocated to US Payloads)



ISS Attached Payloads Program



Planned ISS External Payload Attachment Locations



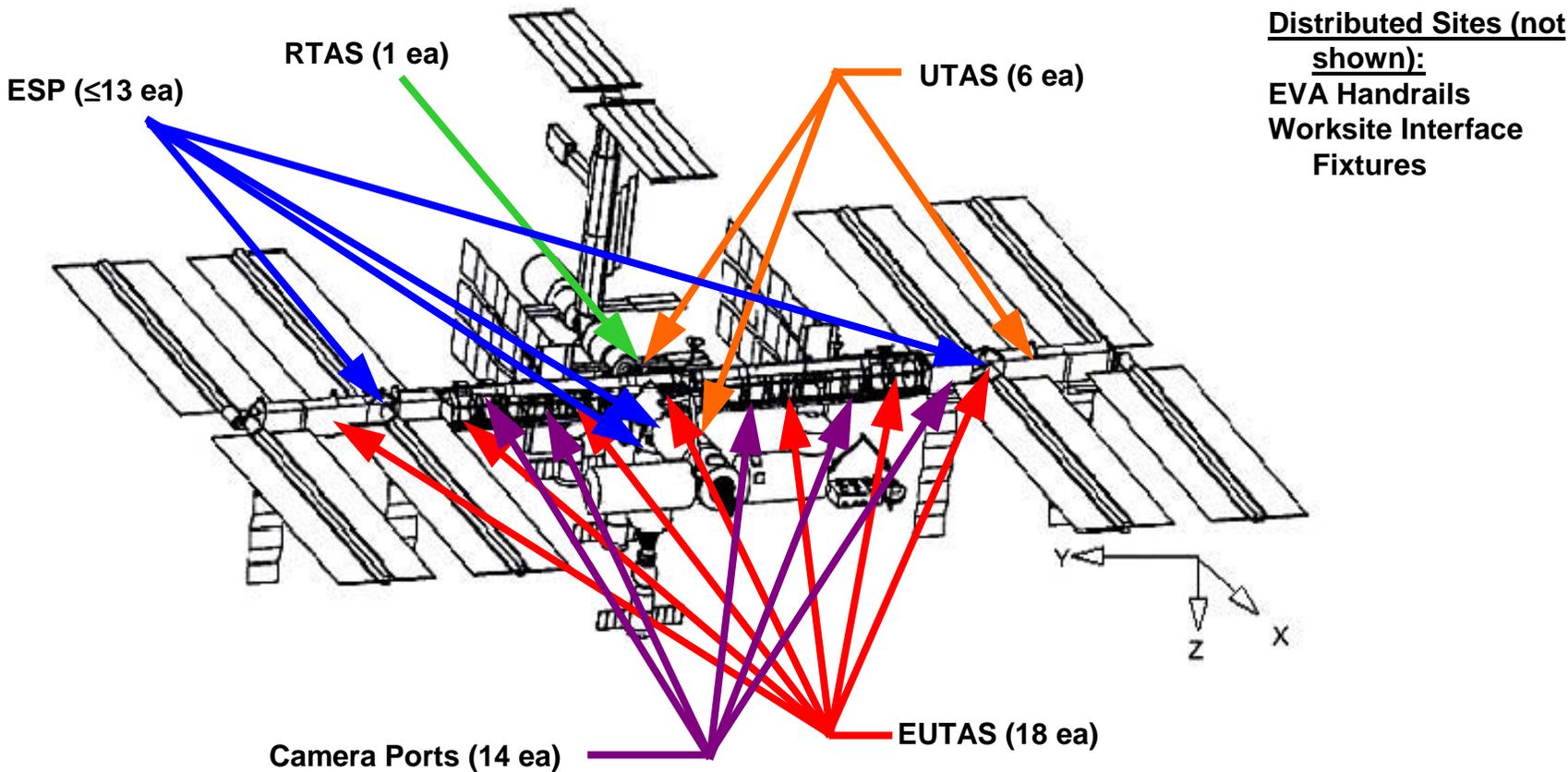


Other Potential External Payload Attachment Locations

- ISS Element Trunnions:
 - 6 each Universal Trunnion Attach System (UTAS) Sites
 - 18 each Enhanced Universal Trunnion Attach System (EUTAS) Sites
- Zenith Bulkhead (Z1): 1 each Rockwell Truss Attach System (RTAS) site
- External Storage Platforms (ESPs):
 - Note: Availability of these sites depends on program needs for spares/ORU storage
 - ESP1 (US Lab) – 2 each Square Grid Interface (SGI) Sites [currently unavailable]
 - ESP2 (Airlock) – up to 8 each FRAM Sites
 - ESP3 (TBD – CAS, MCAS, P3, P5, S3, or S5) - 3 each FRAM Sites
- Camera Ports - 14 each sites (10 on Truss & 4 on Modules)
- Extravehicular Activity (EVA) Handrails - Numerous Distributed Sites
- Worksite Interface Fixture (WIF) – Numerous Distributed Sites
- Crew and Equipment Translation Assembly (CETA) Cart – 1 SGI site



Other Potential ISS External Payload Attachment Locations





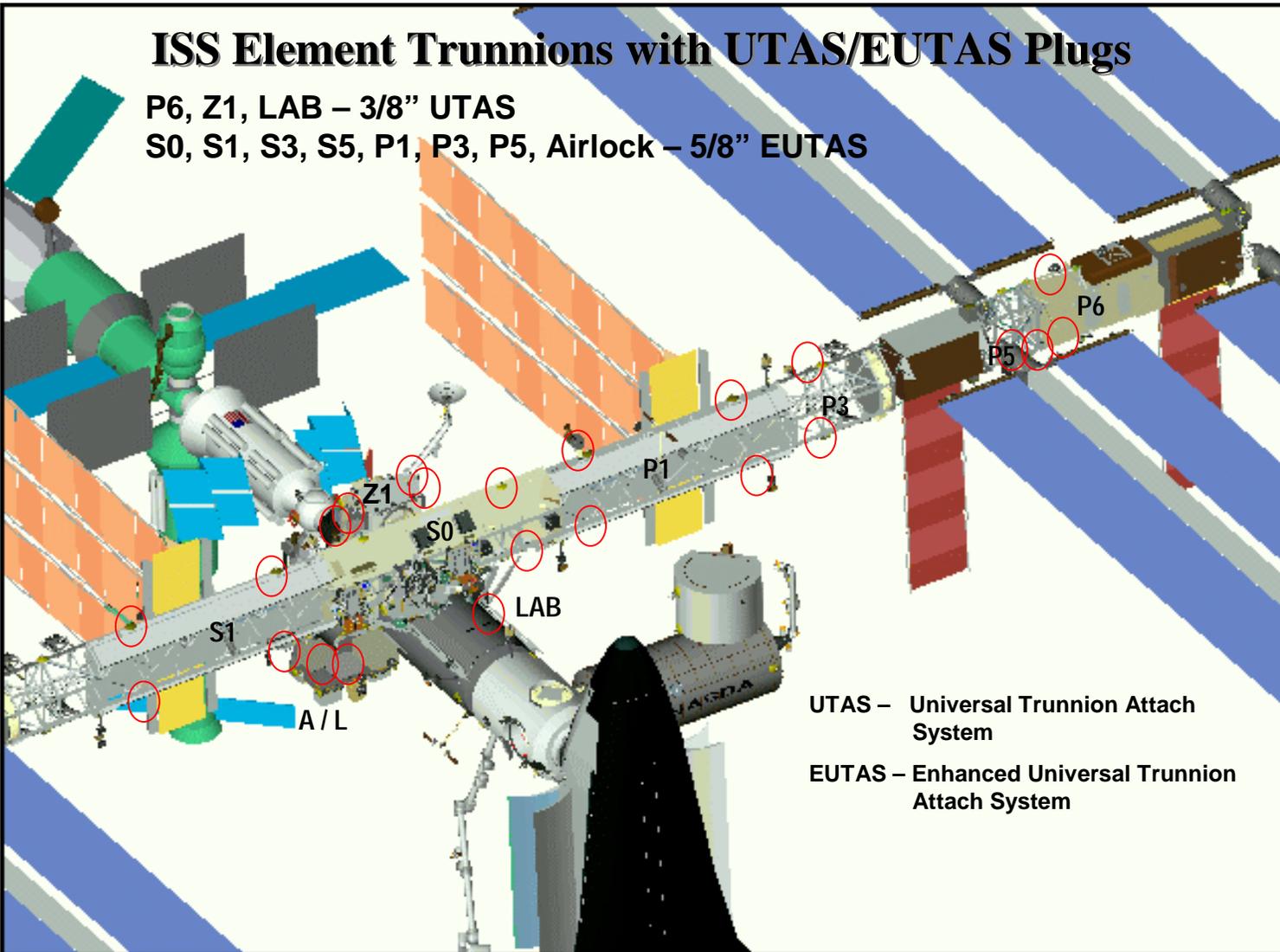
ISS Attached Payloads Program



ISS Element Trunnions with UTAS/EUTAS Plugs

P6, Z1, LAB – 3/8" UTAS

S0, S1, S3, S5, P1, P3, P5, Airlock – 5/8" EUTAS



UTAS – Universal Trunnion Attach System

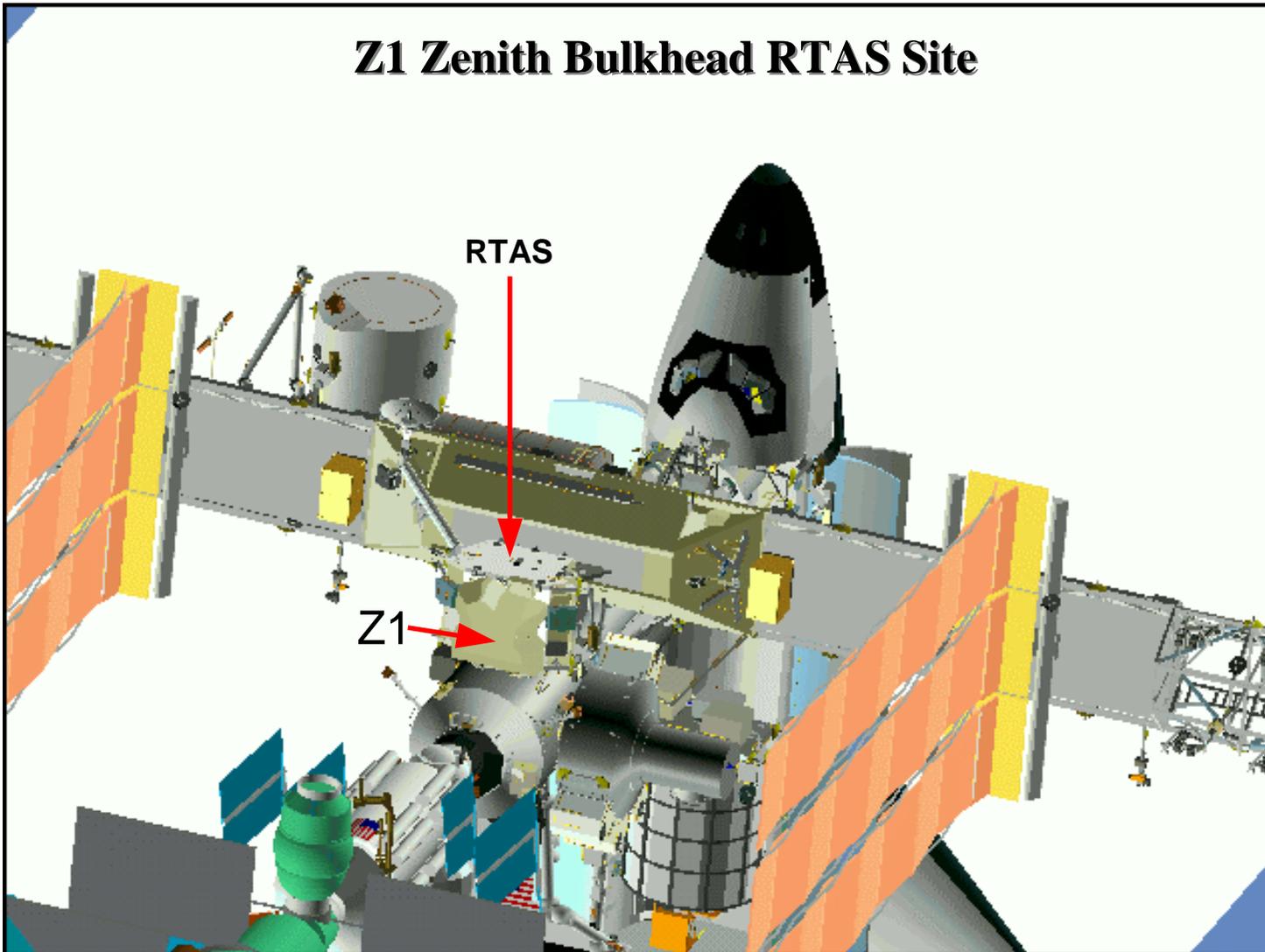
EUTAS – Enhanced Universal Trunnion Attach System



ISS Attached Payloads Program

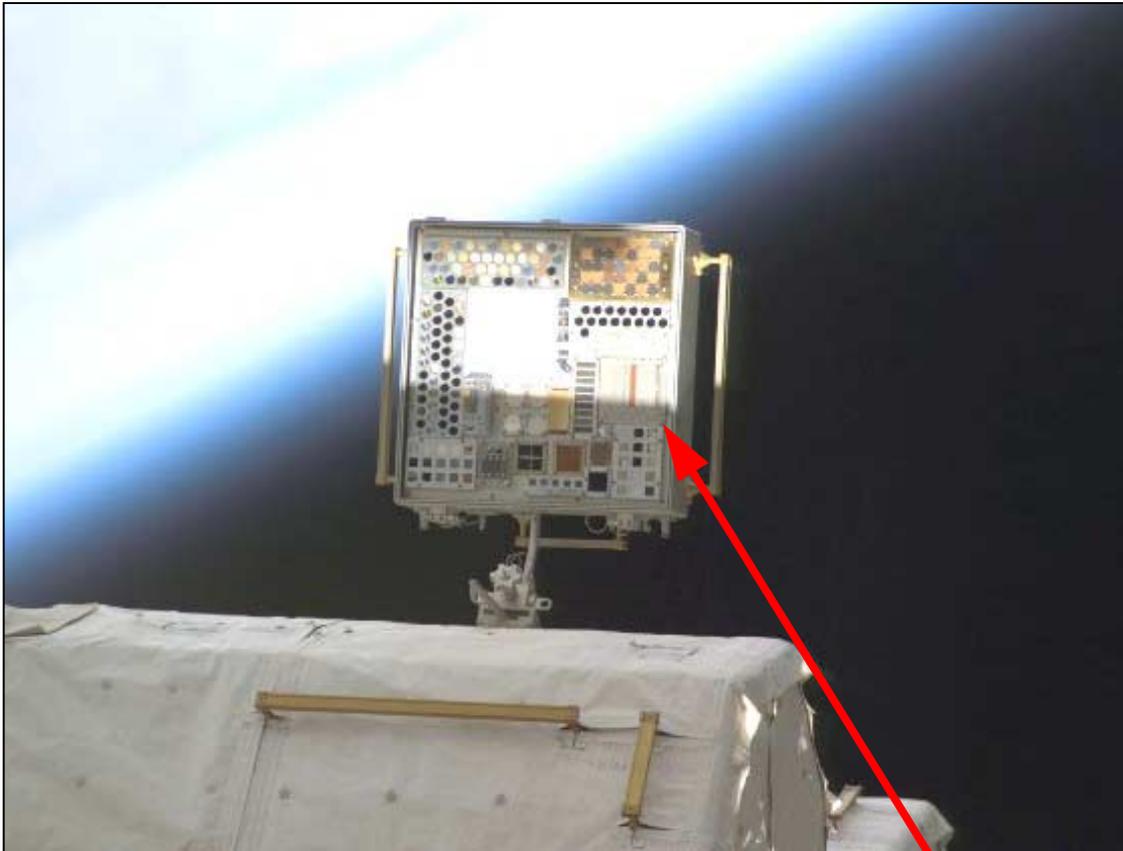


Z1 Zenith Bulkhead RTAS Site





EVA Handrail Sites



MISSE on Airlock Handrail



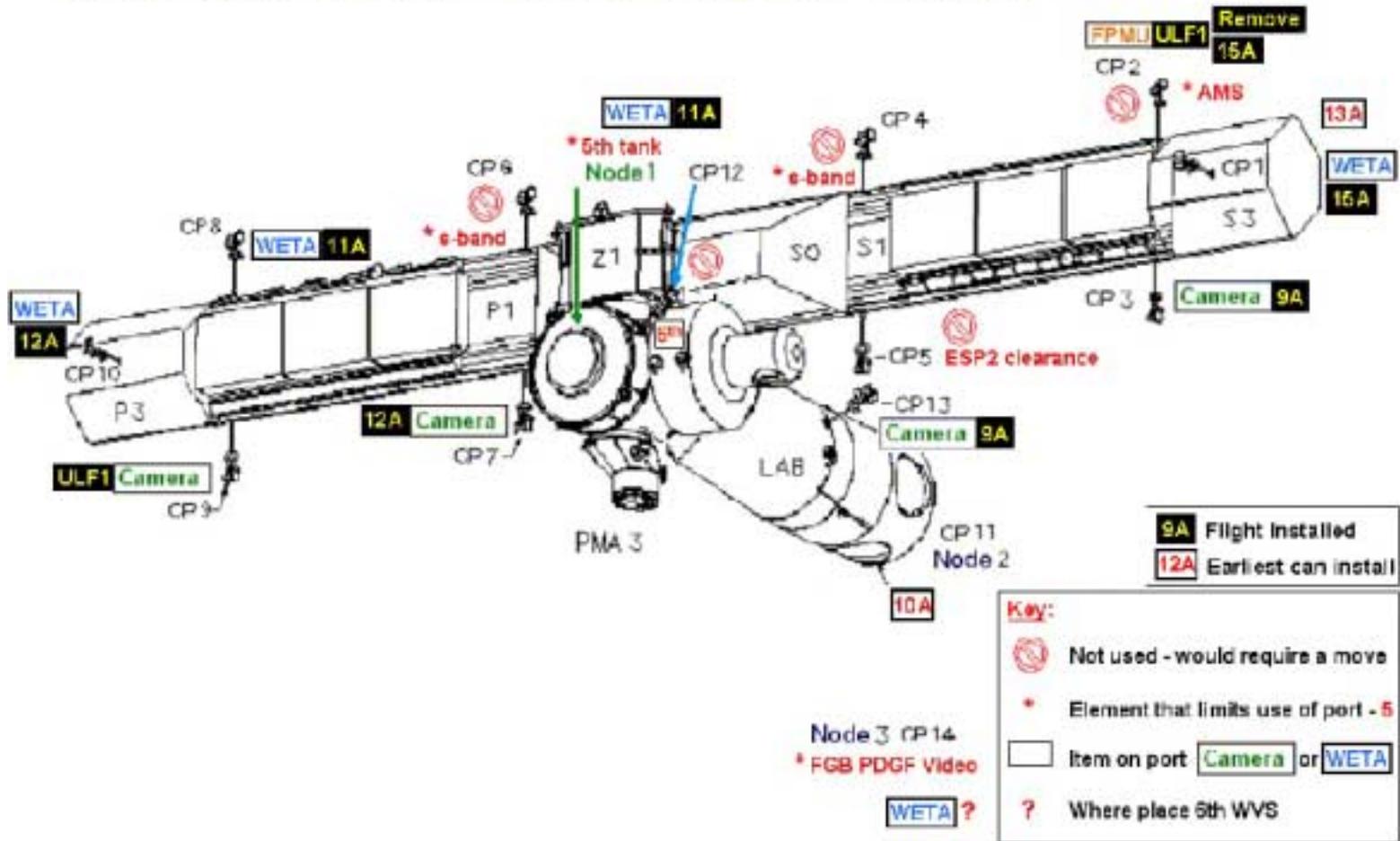
ISS Attached Payloads Program



External Camera Ports

D014/Neldon Costin - July 9, 2002

ISS External Camera and Wireless Video System (WVS) Antenna Planning





Caveats

- ❑ Payload compatibility at any specific site must be evaluated based on interface characteristics:
 - Power and data requirements
 - Mass properties and mass loading requirements
 - Dimensions/envelope
 - Viewing requirements
 - Passive thermal constraints
 - Environmental constraints (e.g. contamination, outgassing, water dumps)
- ❑ Power cables can be connected at specific points along Truss and at Module end cones via EVA installation
- ❑ Hardwired Payload Data is only available at CAS sites
 - Potential for interface at Truss element data system ports
 - Potential exists for use of video camera ports; needs further clarification
 - Wireless data transmission must be approved by NASA Frequency Manager and ISS Electromagnetic Effects Panel
- ❑ Need to evaluate EVA accessibility – not all sites identified may be accessible
- ❑ Use of attached payload sites requires extensive EVA time, which will be deducted from available utilization crew time



ISS Attached Payloads Program



ATTACHED PAYLOAD MECHANICAL, LOADING CAPABILITY, POWER, AND DATA HANDLING AVAILABILITY

ISS Location	Site Names	Loading Capability (each site) (lb)	Power Feed at PL Interface (each site) *						Data Handling at P/L Interface			On-Orbit Availability	Reference Presentation Page #
			Main (Primary)			Auxiliary (Keep-Alive)			H	M	L		
			Power (kW)	Voltage (Volt DC)	Current (A)	Power (kW)	Voltage (Volt DC)	Current (A)					
MT/MBS (At Stations)	CETA (SGI)	TBD	0.42	120	3.5	0.42	120	3.5				Exists	29, 35
	MCAS	10,000 - 19,000	1.5	120	12	1.5	120	12			✓	Exists	22
	POA (FRGF/PDGF/PVGF)	10,000	2	107.5-126	16.7		107.5-126	16.7			✓	Exists	22
Z1	Zenith Bulkhead (RTAS)	TBD	1.44	120	12		120	12				Exists	13, 34
			0.42	120	3.5		120	3.5					
U.S Lab Port AFT Trunnion	ESP 1 (SGI)	TBD	0.42	120	3.5		120	3.5				Exists	25
Airlock	ESP 2 (FRAM)	TBD	0.1	110-126	3.5	0.1	110-126	3.5				ULF-1	26
P3	UCCAS (2 sites)	19,000	3	120	25	3	120	25	✓		✓	12A	9, 21
S3	PAS (4 sites)	19,000	3	112.5-126	25	3	112.5-126	25	✓		✓	13A	9, 20
Columbus EPF	SOZ, SOX, SDX, SDN (4 FRAM Sites)	639 (Per Payload)	1.25	113-126	20	1.25	113-126	20	✓	✓	✓	1E	9, 23
JEM EF	10 EFU sites (PIU)	1,100 (Per Payload)	3	113-126	TBD	3	113-126	TBD	✓	✓	✓	1J/A	9, 24
Distribution (Truss/Module)	Trunnion (UTAS/EUTAS sites)/WIF/EVA Handrails (Unique FSE)	TBD	0.42	120	3.5		120	3.5				Available incrementally until Assembly Complete	12, 14, 28, 30-33
Truss/Module	Camera Ports (10 Truss/4 Modules)	TBD										Available incrementally until Assembly Complete	15
S3, P3, MCAS	ExPRESS Pallet (6 FRAM sites)	500 (Per Payload)	750	120	7.5, 5, 1	750	120	7.5, 5, 1				ExPA Build to Print	5-6
			500	28	15, 10, 5	500	28	15, 10, 5					
P5/S5, MCAS/P3/S3	ESP 3 (FRAM)	TBD	0.42	120	3.5		120	3.5				Design Concept	27

* Power shown is maximum capability. Actual Power availability depends on operational scenarios.



Conclusions

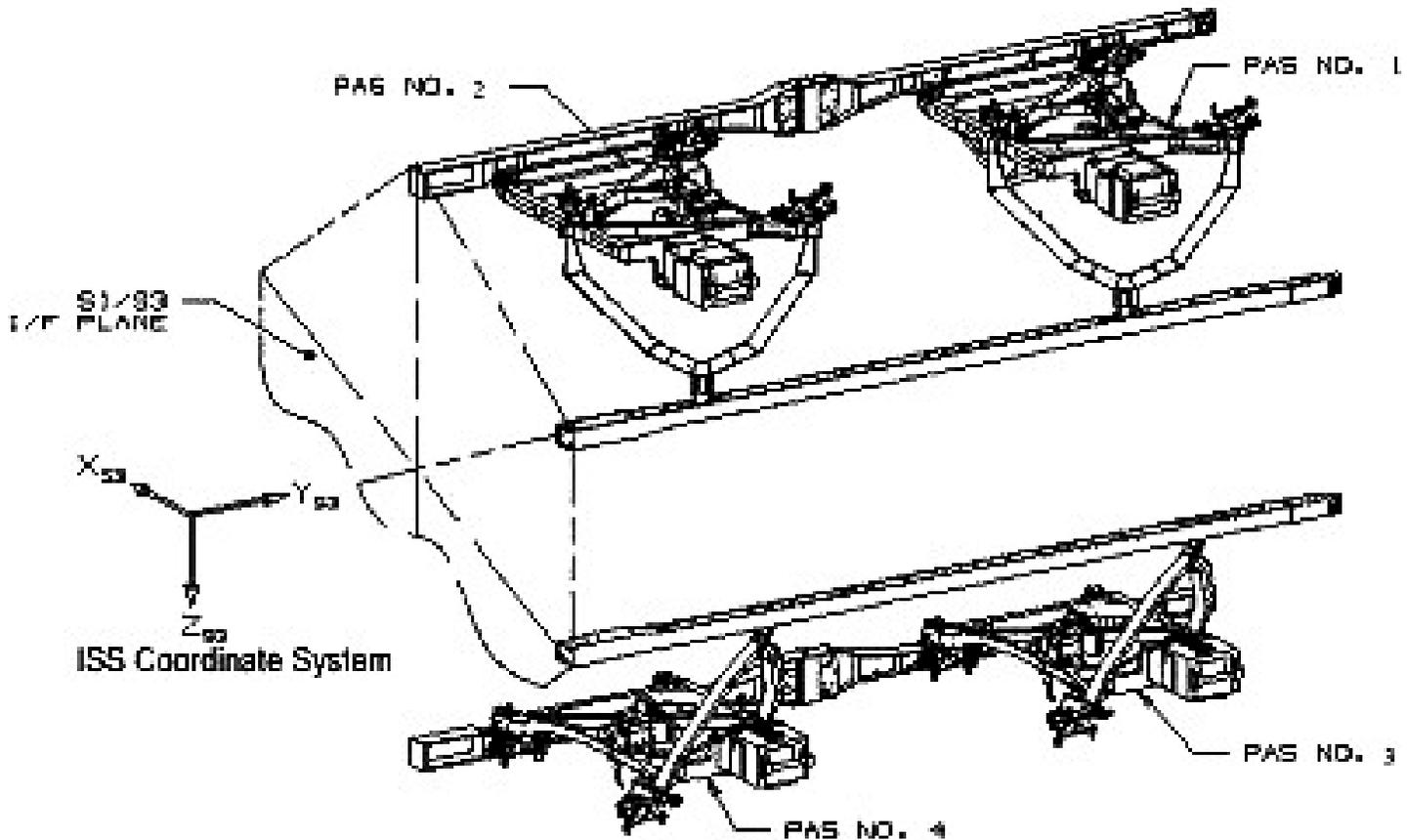
- ❑ ExPRESS Pallet development is moving forward again
- ❑ A variety of attached payload site options that are not dependent on ExPRESS Pallet are available
 - Use of non-standard interfaces requires additional development effort and funding
 - Non-standard sites are limited in capability
- ❑ Integration for all options can be carried out using existing processes and documentation templates
- ❑ Forward work:
 - Authority to proceed on ExPRESS Pallet
 - Evaluate EVA access of sites and determine viability with EVA and Crew offices
 - Resolve details for use of “potential” options; negotiate availability with ISS Vehicle Office
 - Identify manifest options in addition to ExPRESS Pallet availability



Back up Slides

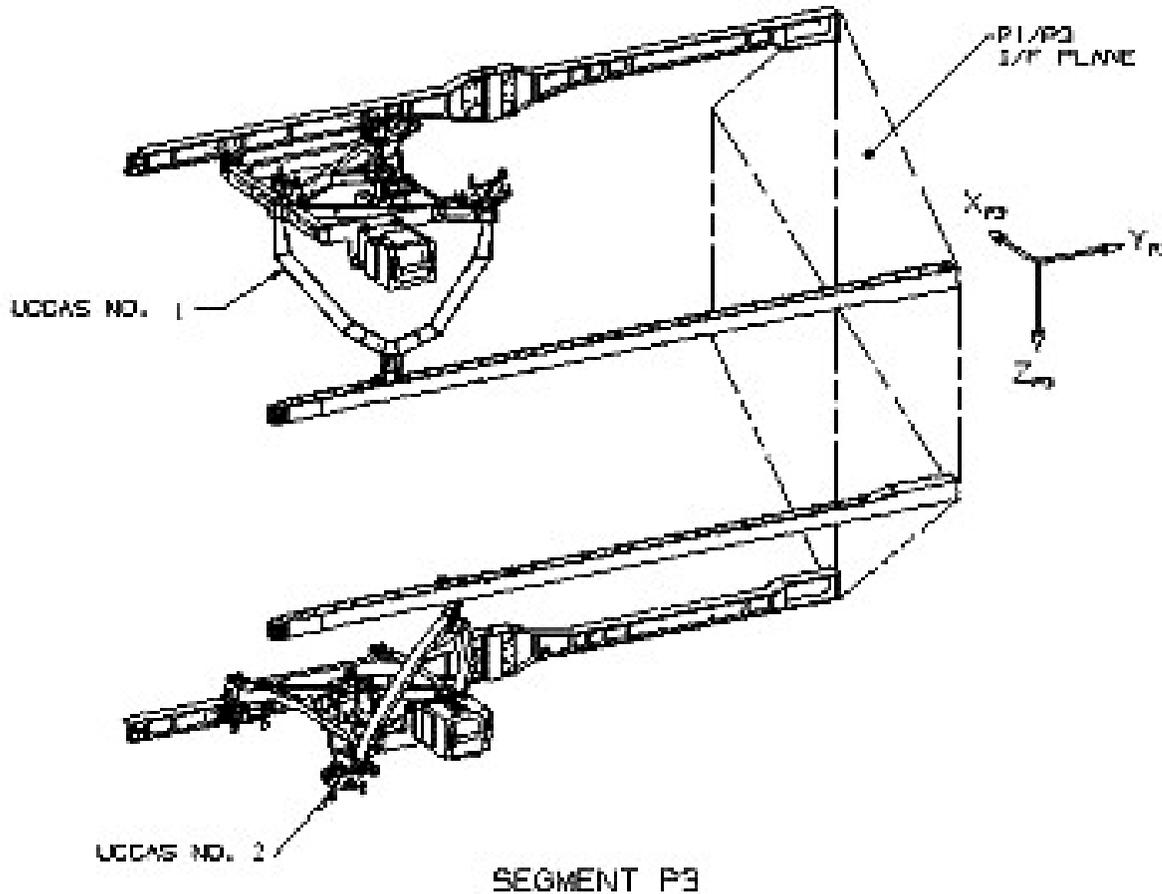


S3 PAS Sites



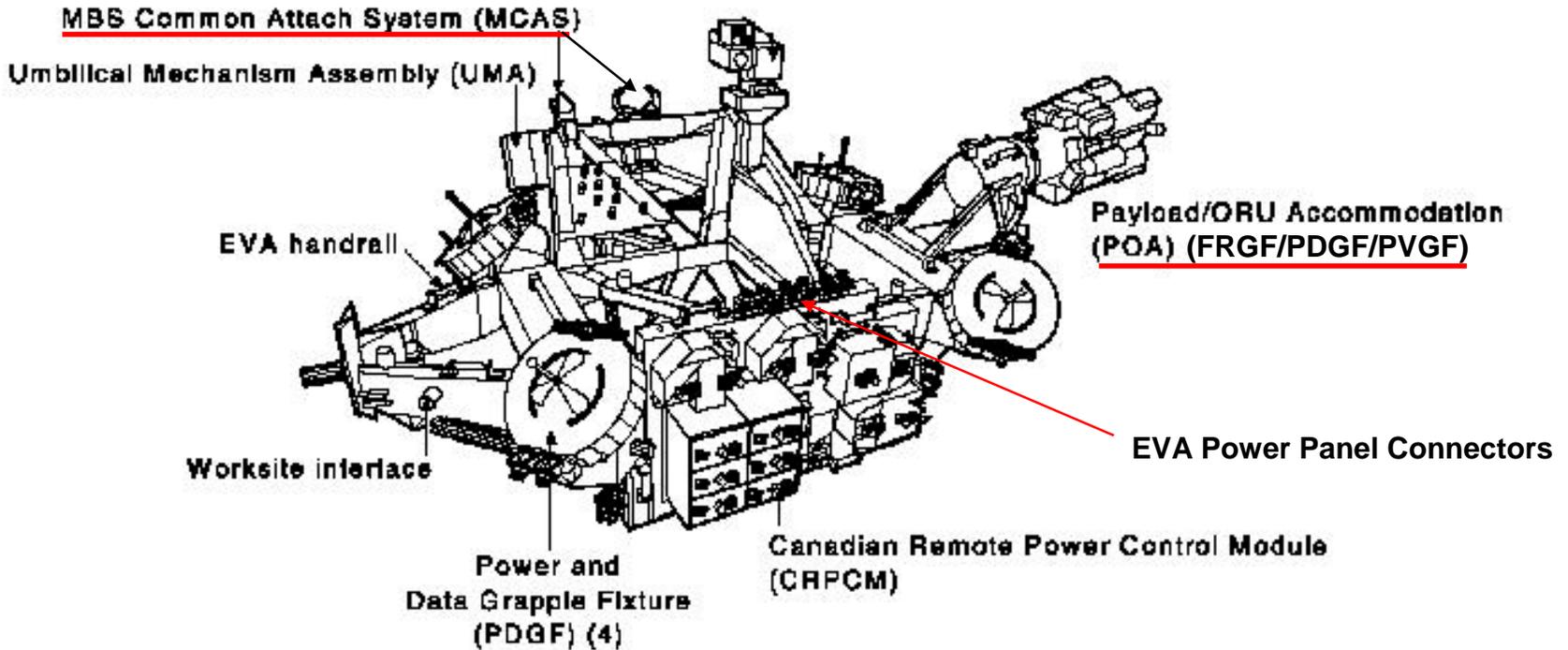


P3 UCCAS Sites





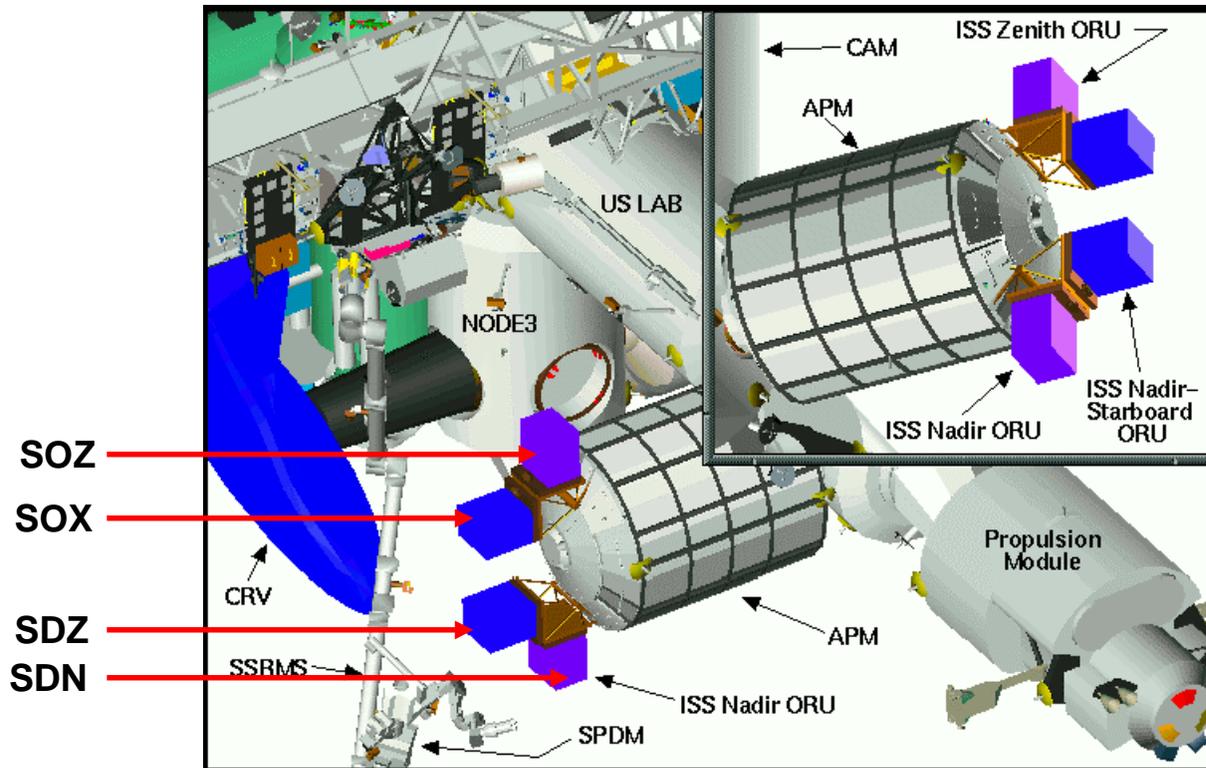
ISS Attached Payloads Program



Mobile Remote Servicer Base System (MBS)

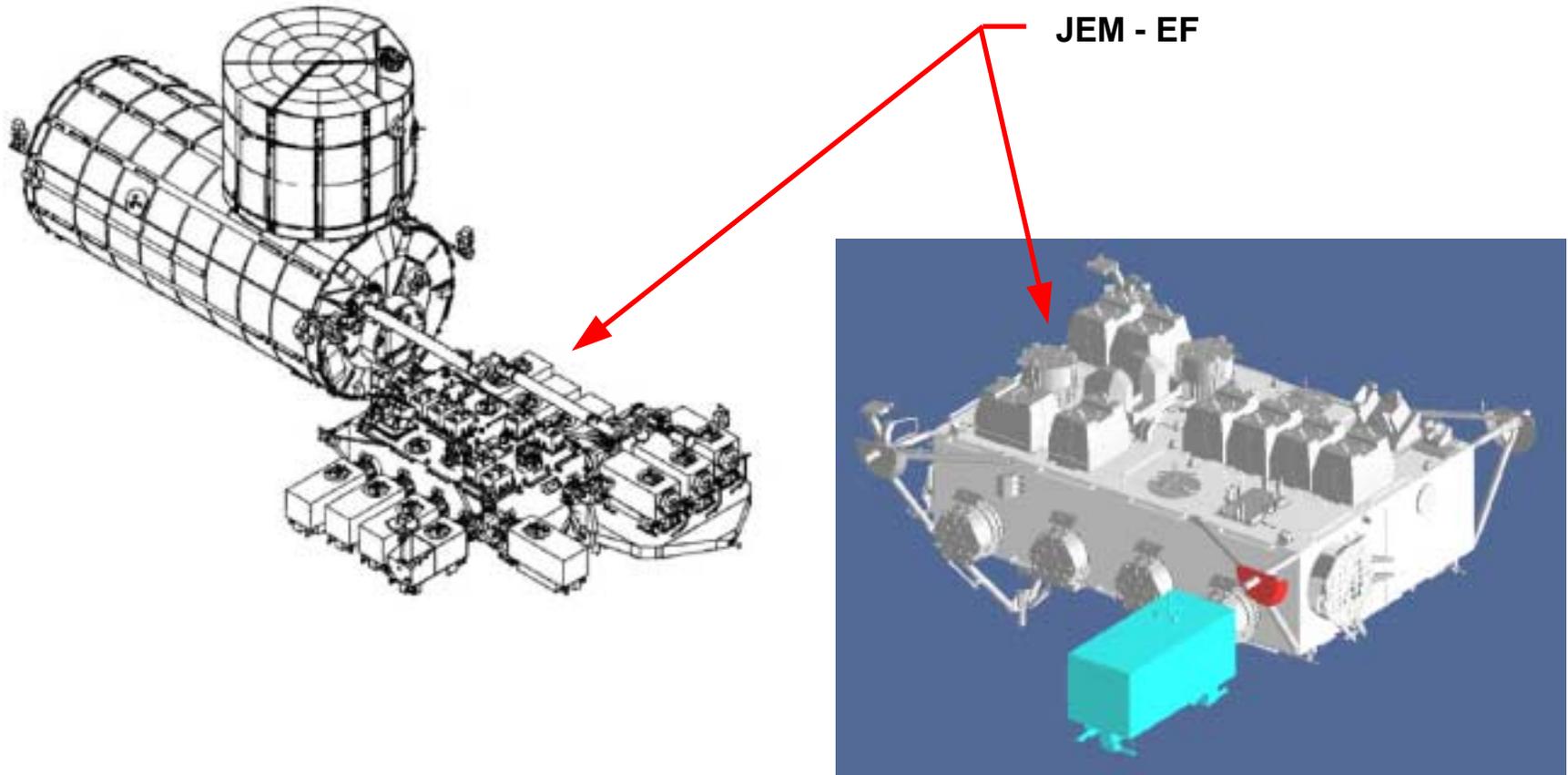


Columbus External Payload Facility



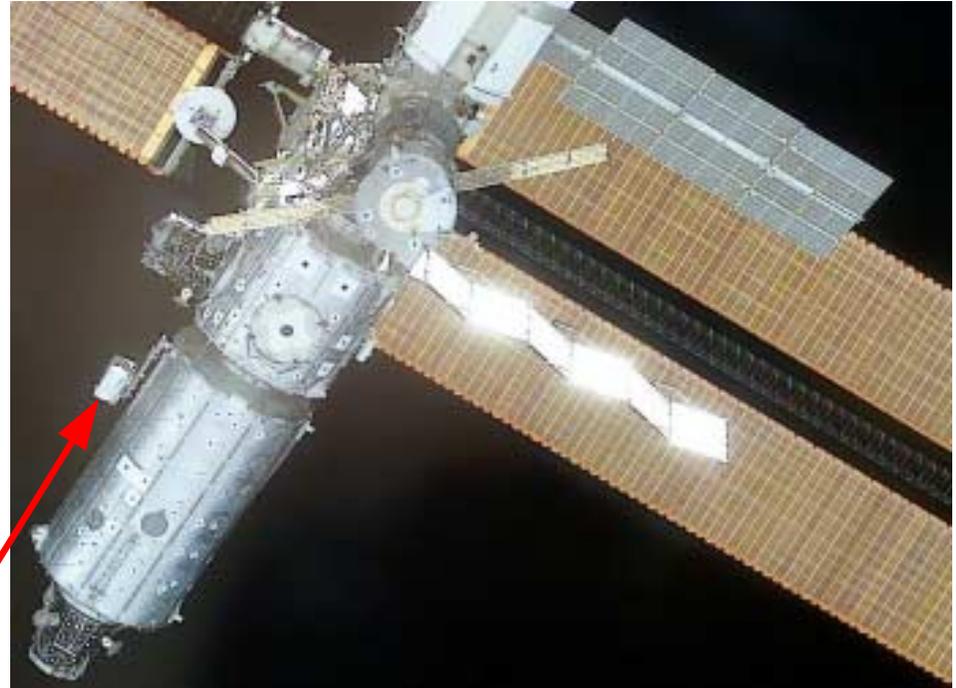
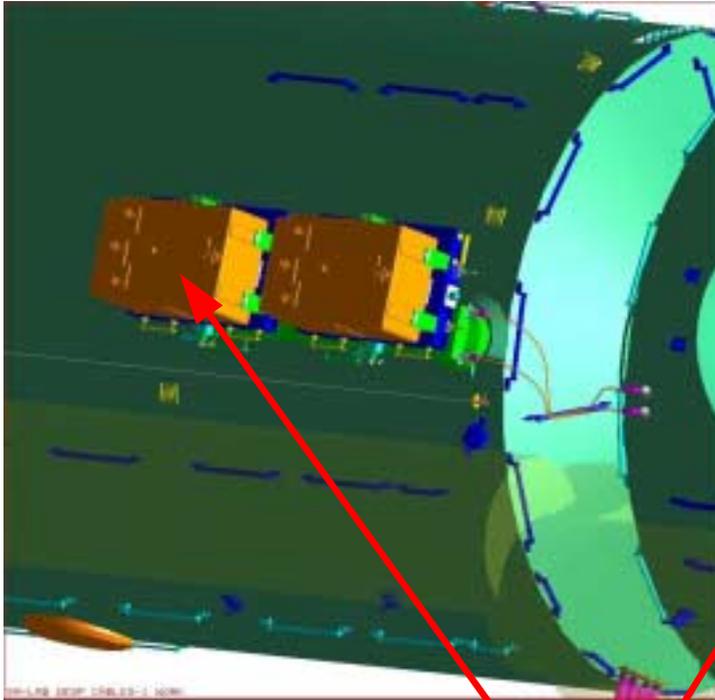


Kibo Exposed Facility Sites





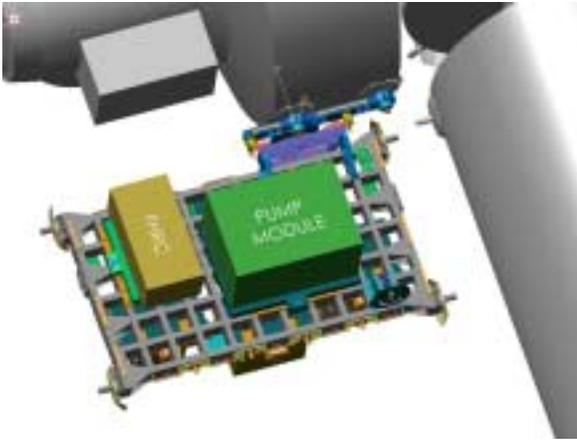
ESP1 (US Lab) SGI Site [Currently Unavailable]



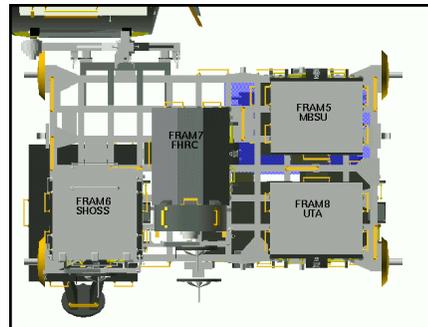
Modified FRAM / SGI Site



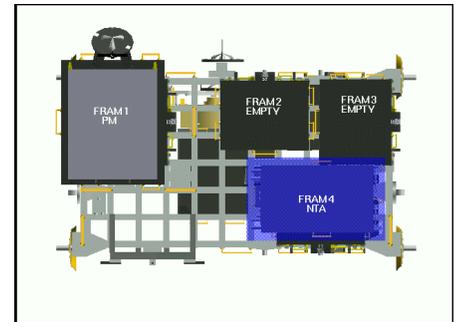
ESP2 (Airlock) FRAM Sites



ESP2 ON-Orbit ORU Stowage



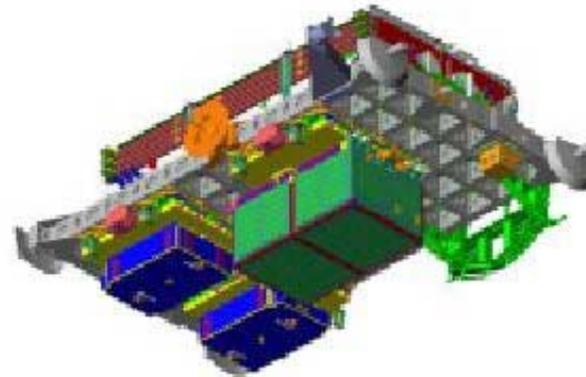
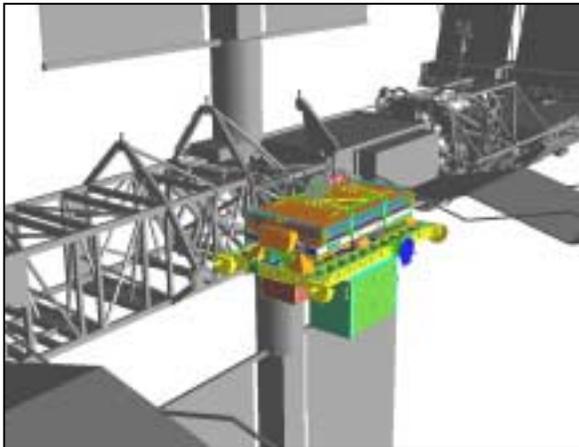
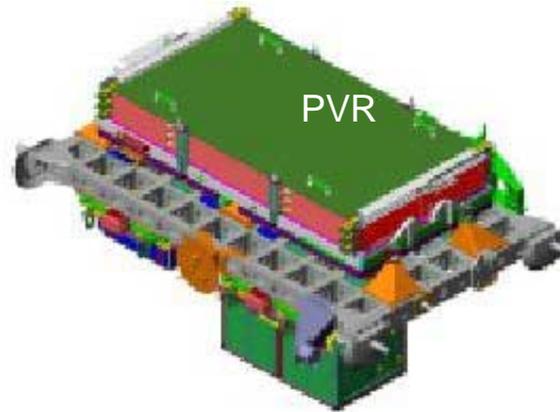
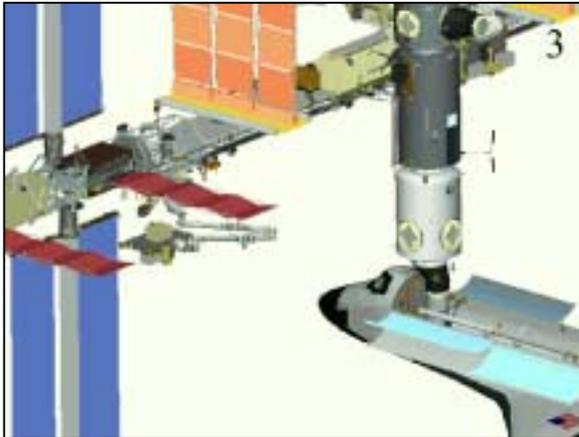
Top View



Bottom View



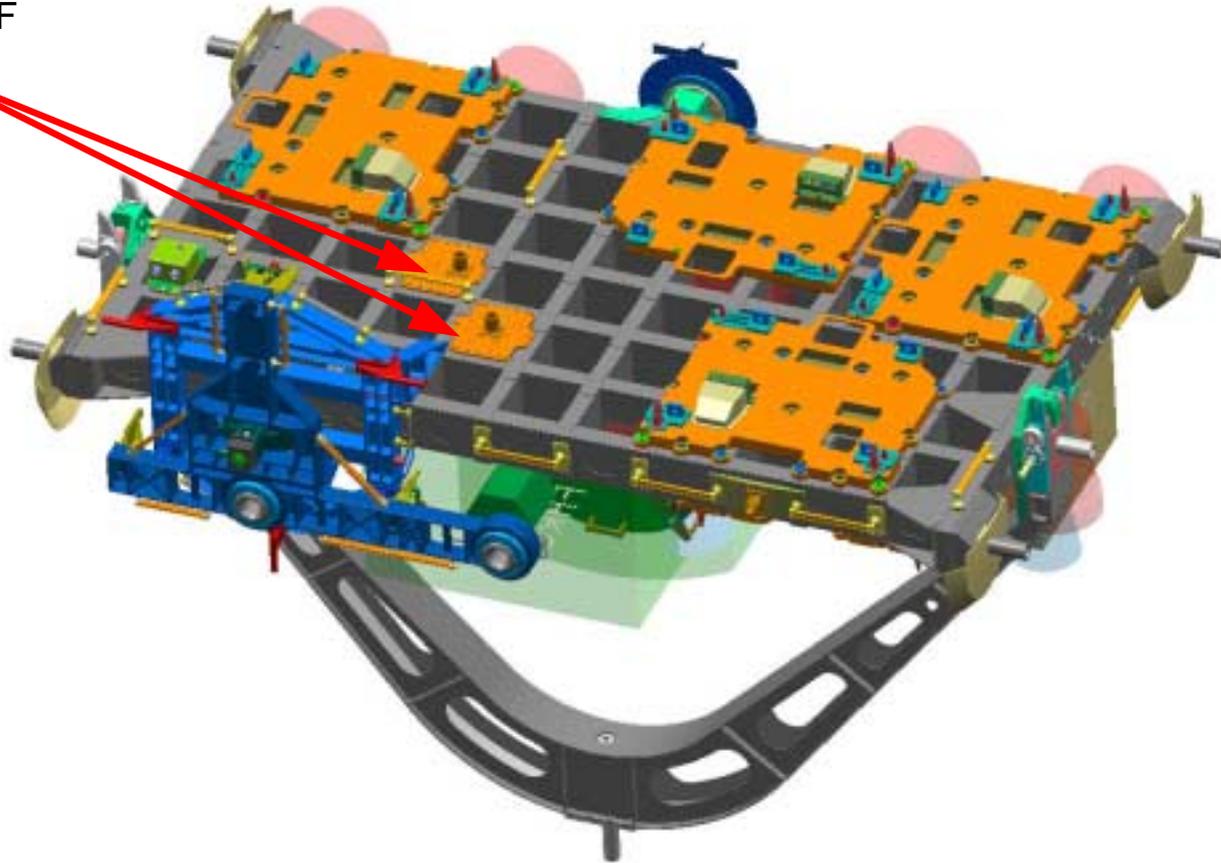
ESP 3 CAS/MCAS and P5 & S5 Sites





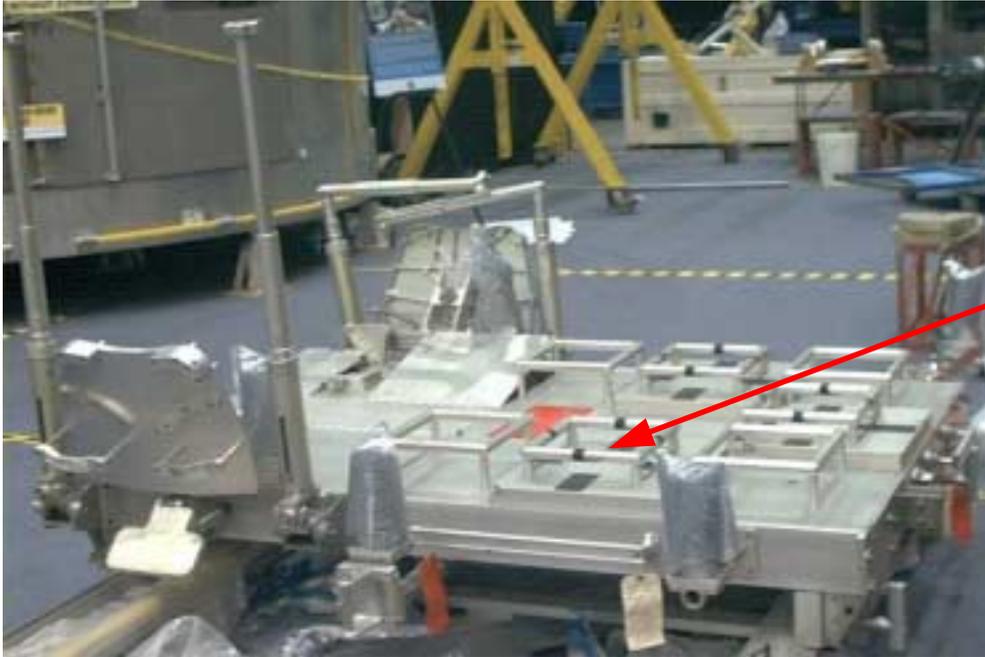
Worksite Interface Fixture Sites

Typical WIF
Sites

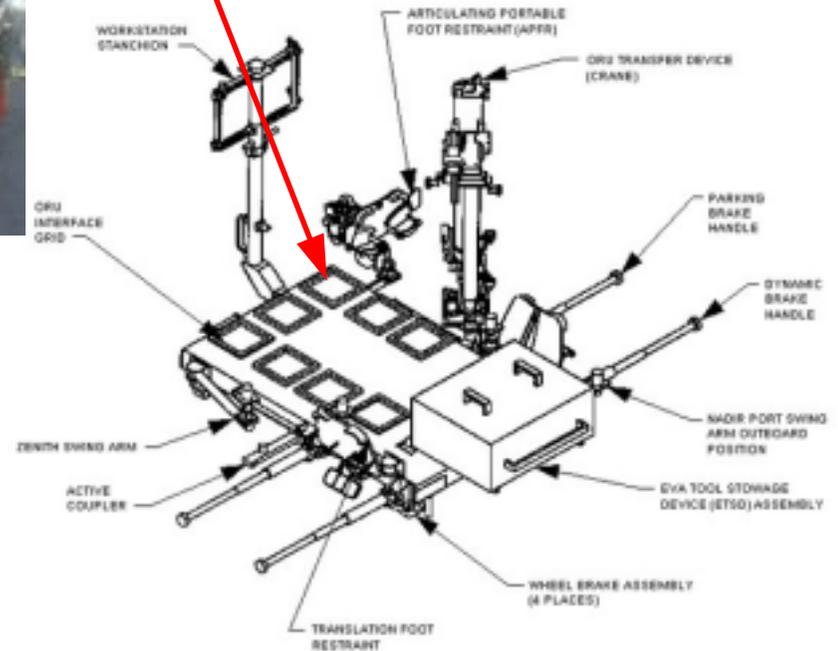




ISS Attached Payloads Program

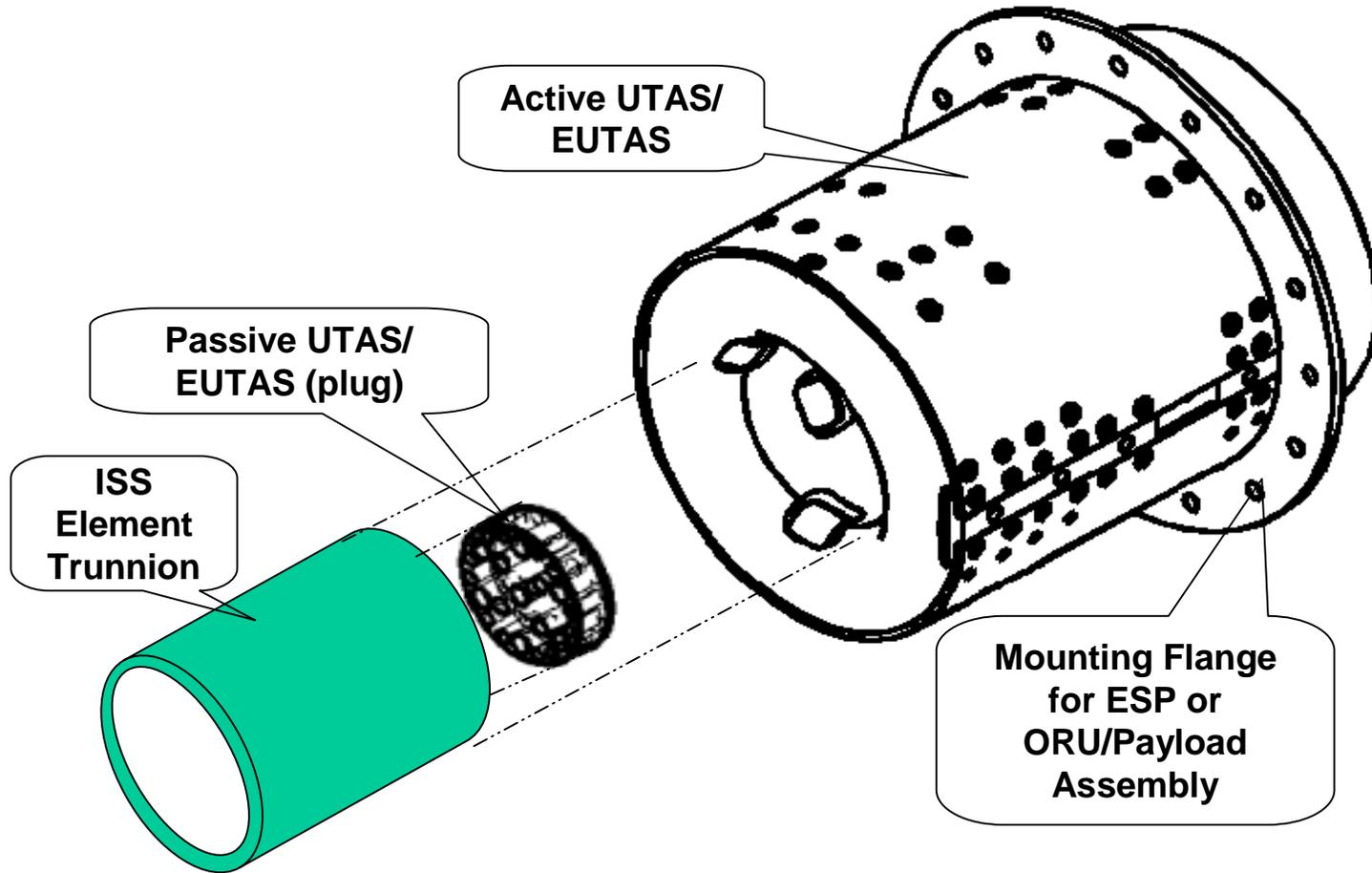


CETA Cart SGI Site



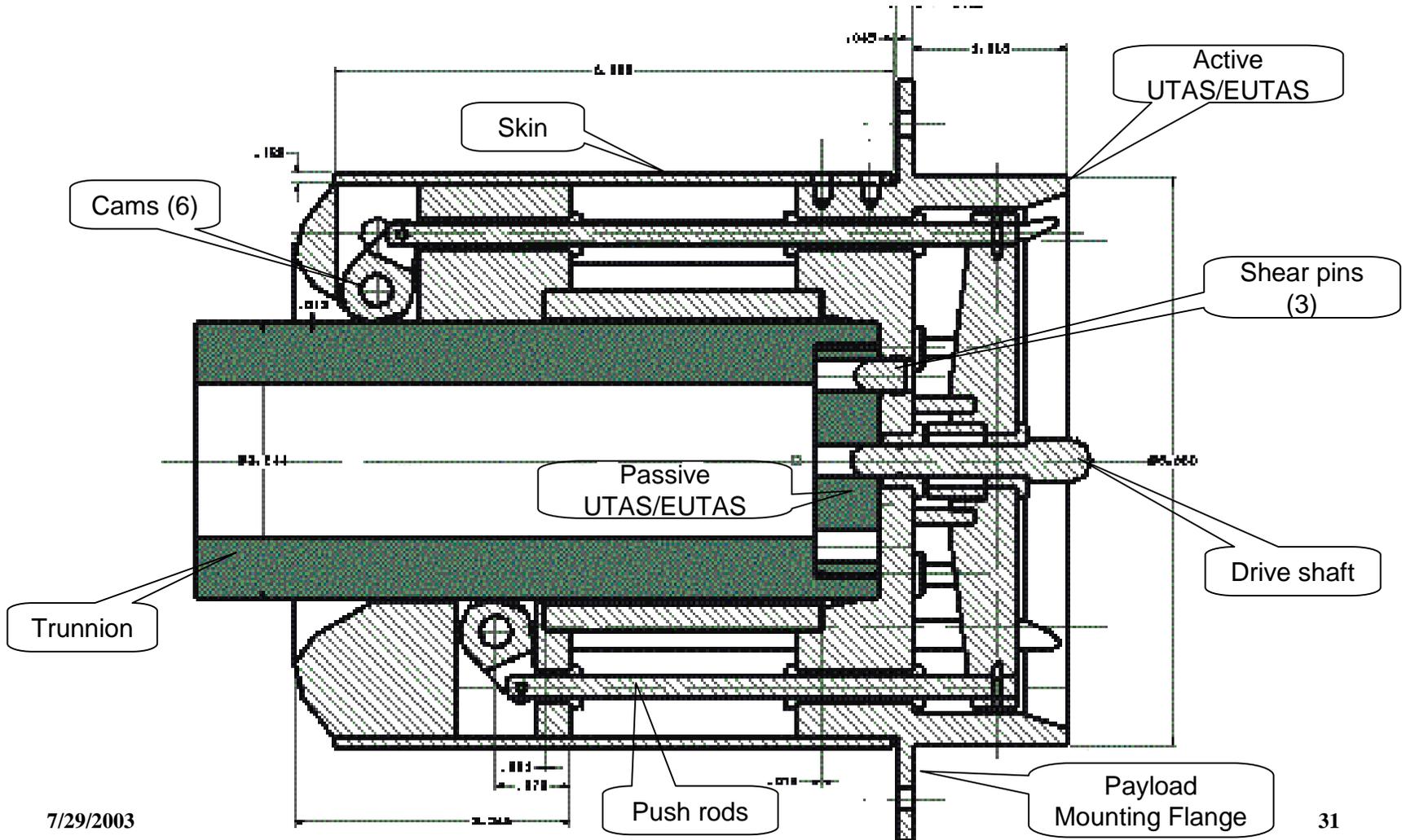


UTAS / EUTAS Components





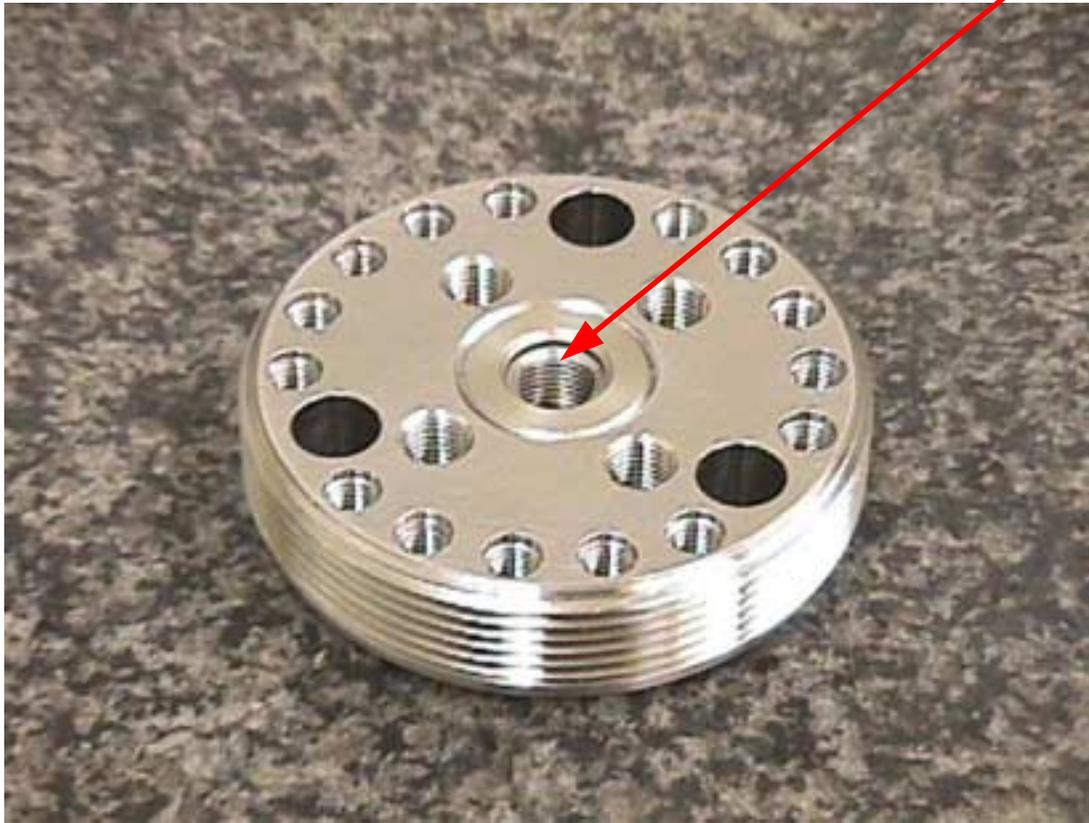
UTAS / EUTAS cross-section (engaged)





UTAS EUTAS Passive Plug

UTAS has 3/8" diameter Shaft / EUTAS has 5/8" diameter Shaft





Active UTAS / EUTAS (skin removed)

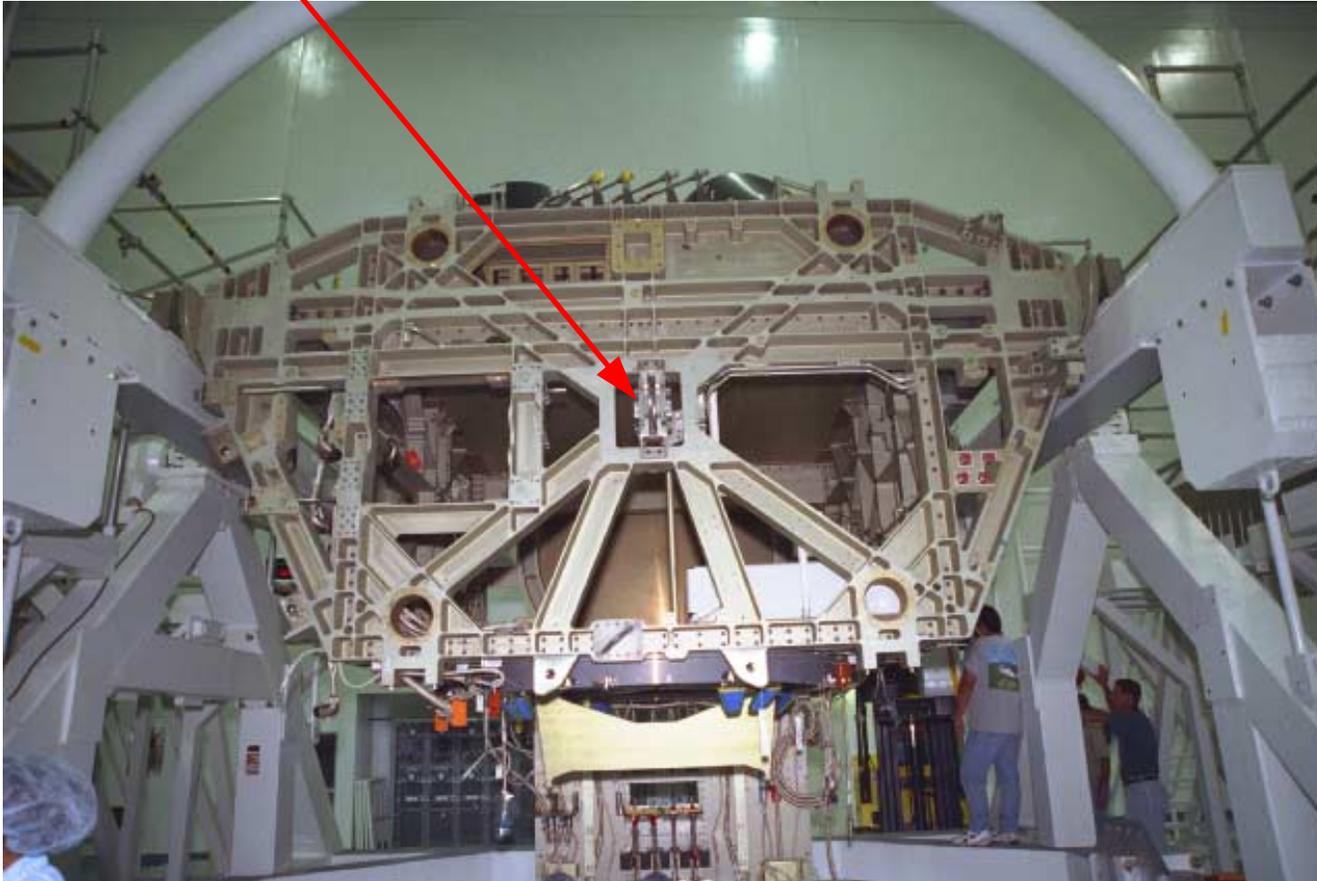
(UTAS has 3/8" diameter Shaft / EUTAS has 5/8" diameter Shaft)





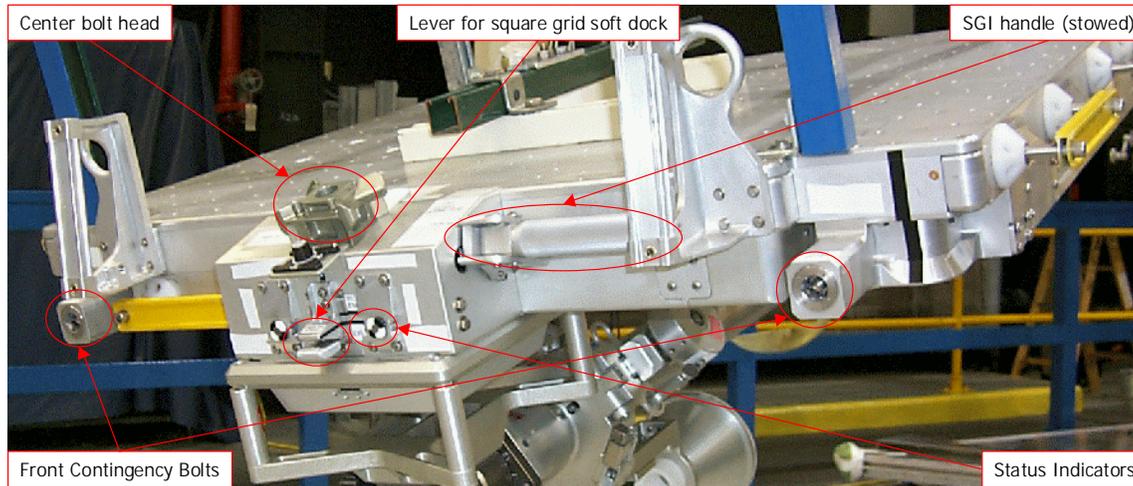
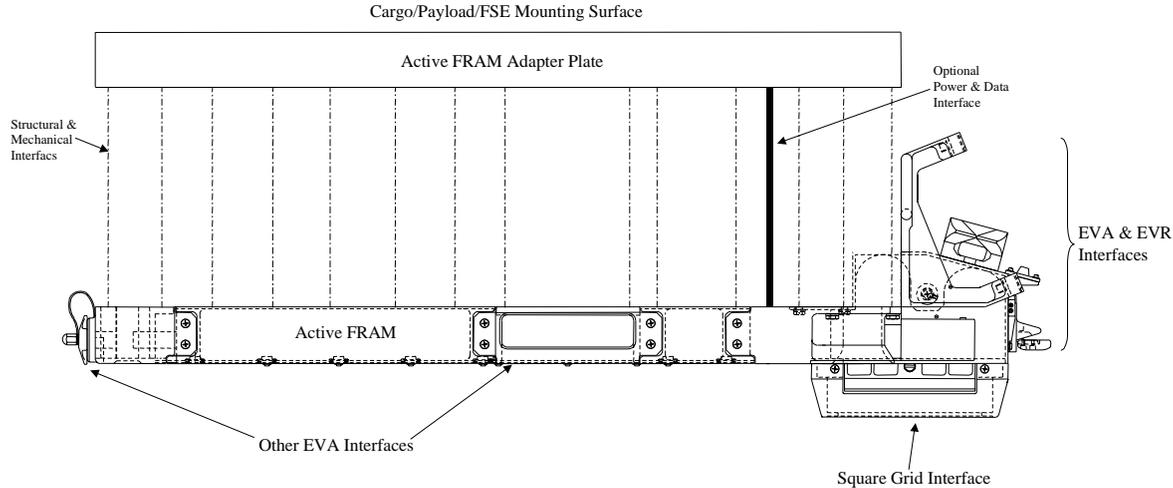
Z1 RTAS Site

RTAS Clamp





FRAM / SGI Attachment





CAS Site Data Transfer Rates

Type of Data Transferred	Payload to/from		by Data Link	
	Individual P/L Data Rate	Aggregate P/L Data Rate ⁵	LRDL	HRDL
commands (to payloads)	10 commands per second ³	8 commands per second ⁴	X	
health and status	18720 bps	192 kbps (s-band)	X	
C&W	160 bps	256 kbps (Ku-band)		
payload ancillary data	3840 bps	N/A	X	
broadcast ancillary data	8960 bps			
payload files	≤ 40.96 kbps	≤ 40.96 kbps	X	
low rate telemetry data ¹	≤ 10240 bps		X	
		100 kbps		X
high rate telemetry data ²	≤ 100 Mbps	≤ 20 Mbps		X

NOTE: Based on five (5) Payloads per LRDL

¹ low rate data is sent via the HRDL to the ground

² high rate data aggregate is total available after video

³ P/L MDM can support 10 commands per second (allows buffering of commands)

⁴ C&C MDM can support 8 commands per second (ground command through-put limit)

⁵ Aggregate payload refers to payloads on USOS C&DH System (internal and external P/Ls)



Alternate Power Source¹ Assessment

- At the Segment-to-Segment Attach System (SSAS) interfaces a number of unused 3.5 Ampere outputs have been identified by the EPS team¹
 - Up to 52 potential power outputs² will be freed-up during ISS assembly
 - 10 outputs at S0/S1
 - 10 outputs at S0/P1
 - 16 outputs at S1/S3
 - 16 outputs at P1/P3
 - Node End Cone electrical connectors may be available²

Note 1: Payloads attached at a non-CAS, POA, or FRAM site will need to plan for EVA attachable Power Cable from SSAS, MBS EVA Panel, or Node 1 End Cone connectors

Note 2: Utilization of these power resources will need to be negotiated with the EPS team