Past SWSI Panel Projects

NSRP
NATIONAL SHIPBUILDING RESEARCH PROGRAM
Taking Shipbuilding and Repair to the Next Level
Proudly Celebrating 50 Years of Innovation

Past SWSI Panel Projects

- Alternate False Deck Design Optimization and Qualification
- Electrical Connector Standardization
- Fusion Splice Enclosure at Equipment
- Design of a SIFD Principal Unit and Development of an EQT Strategy
- Variant Reduction for Shipboard Installed Connectors
- Ship Specification Review of the Various Surface Ship Spec's to Identify the Technical Gaps between the Elements of Flexible Infrastructure and the Ship Spec. Requirements
- Advanced Composite False-Deck Material Systems for Rapid Modular Compartment Reconfiguration
- Ship Warfare Systems Interface Description
- Standardized Foundations Database for Combat Systems
- Optimizing the Design/Manufacturing of FI Interface Adapters with a Focus on Cost, Weight and Reusability
- Benefit Assessment and Development of Standard Drawing for Interface to Flexible Infrastructure (FI) Track Systems
- Standardizing Warfare System Interfaces to Reduce Integration Costs During Ship Construction, Modernization, and Maintenance
- Flexible Infrastructure Bulkhead Track Improvements
- Cost Model-Based Network Design and Testbed Performance Analysis: Demo of Optical Network Paradigm for Ships' Flexible Communications Infrastructure
- TRITON Dynamic Network Paradigm
- Paradigm for Optical Networks in Ships: Flexible Communications Infrastructure
- Extension Basis for 72-inch Physical Open Architecture Enclosure Systems to DDG and CG Ships
- **Combat Systems Standard Foundations Qualification and Optimization***
- **Performance Improvement for 25Hz DSSM Spring Tray***
- **MCI Alternate Deck Wear Surface Evaluation and Qualification***

System Fundamentals

Standardizing Warfare System Interfaces to Reduce Integration Costs During Ship Construction, Modernization, and Maintenance

F. Scott Parks

15 March 2016

Document No. SFI-16-001

Commercial Best Practices - Design

Reliability through redundancy is cheaper than designing it into the box.

Always use open standards – and don't tailor them.

Always use standard component configurations.

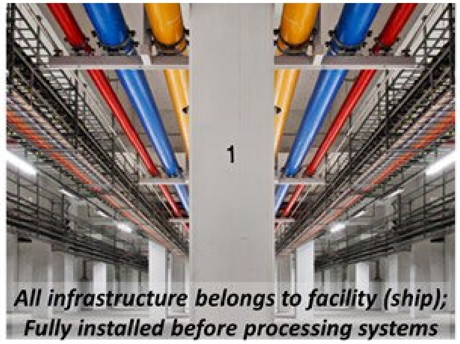
Assume standard rack size, weight & power

Establish fixed rack SWAP-C allocations.

Rack mitigates shock and vibration

All shock and vibration loads are mitigated by the facility and rack enclosures.

Commercial Best Practices - Facility



All data, power, and cooling infrastructure belongs to the facility.

Always use open standards – and don't tailor them.

All data, power, & cooling installed and fully configured before data processing components installed.

Color code everything – cables, HVAC, pipes.

Install far more FOC than you think you need.

Recommendations

- Conduct a formal standards tailoring review of ASHRAE Technical Committee 9.9 Datacom Series for application to maritime systems
- Conduct a detailed review of shock and vibration requirements in IBC 2012, ASCE 7-10, ASHRAE Datacom Volume 5, and Telcordia GR-63-CORE to ensure full compliance with MIL-STDs -167-1A and -901D and NAVSEA Report 0908-LP-000-3010.
- Define ship system interface with two questions:
  - *How many independent networks do we need?*
  - *How many racks of equipment will we have?*

Flexible Infrastructure Bulkhead Track Vibration Testing Update

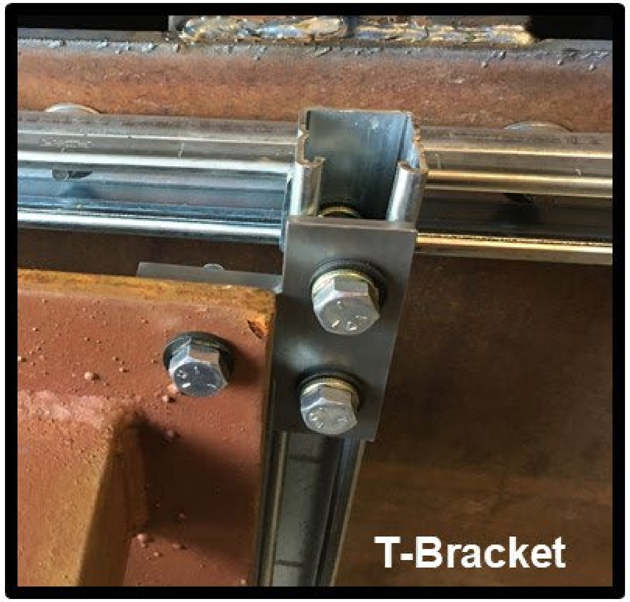
Bulkhead Track Testing (February 2017)

- Modifications
  - Upgraded attachment hardware (saddle nuts and hex head bolts) from 3/8″ to ½″ for larger payloads
  - All vertical track to horizontal track connections upgraded to ½″ hardware (1/2″ saddle nuts and socket head cap screws)
  - Utilized HII designed T-brackets for large dummy weights
  - Changed the test requirement to 4-25 Hz to attempt qualification for LHA, LPD, DDG and CVN applications (most failures occurred above 30 Hz)
- Test Procedure
  - Two vibration test series performed on 11 test items
    - Exploratory (4 – 25 Hz in increments of 1 Hz, for 15 secs each)
    - Variable (4 -25 Hz in increments of 1 Hz, for 5 minutes each)
    - Endurance (at least 2 hours at resonant frequency or 1 hour at each resonance if two exist, if more than two, each frequency at 40 minutes)
- Major failure classified by the following:
  - Dummy masses attached to Flexible Infrastructure becomes adrift
  - Flexible Infrastructure tracks become detached from test pedestal

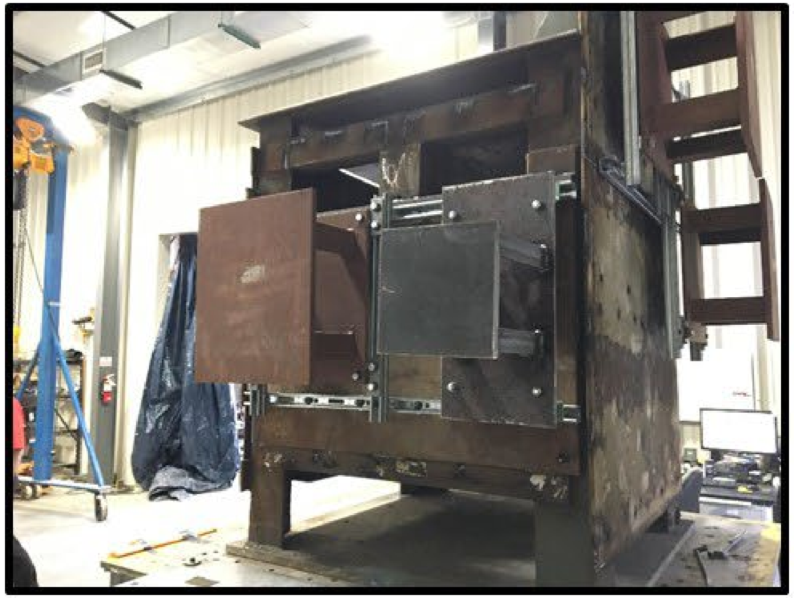
Test Items / Results

Item #	Item Description	Dummy Weight	Result
5a	Qty 2 Saddle Nuts (3/8") with Flat Bar, Vertical Track, Max CG 6"	10	PASSED (see note - stronger strut connections)
6a	Qty 2 Saddle Nuts (3/8") with Flat Bar, Vertical Track, Max CG 6"	15	PASSED (see note - stronger strut connections)
11	Z mount 11" - 1 pair vertical track, 2 tracks 22" spacing, 1/2" saddle nuts, Max CG 6.5"	80	FAILED - 18 Hz Resonance caused the vertical track to split
14	Z mount 11" - 1 pair horizontal track, 2 tracks 22" spacing, 1/2" saddle nuts, Max CG 6.5"	80	PASSED by reducing the CG of the dummy weight to 6.5"
17	Qty 8, 1/2" Saddle Nuts (4 per track) on 2 Horizontal Tracks Spaced 22" Apart	300	PASSED
18	Qty 2 Horizontal Hilti Tracks Spaced 22" Apart installed on 3" Tall EFPMs (5/8" studs, 3/8" hardware) with 200 lb Dummy Mass, 1/2" Saddle Nuts	200	PASSED
19	Qty 2 Horizontal Hilti Tracks Spaced 22" Apart installed on 6" Tall EFPMs (5/8" studs, 3/8" hardware) with 200 lb Dummy Mass, 1/2" Saddle Nuts	200	PASSED
23	Qty 2 Saddle Nuts (1/2") on 1 Vertical Hilti Track, Method 816-NG	40	PASSED - upgraded 3/8" to 1/2" hardware attachment to track
24	Qty 4 Saddle Nuts (1/2") on 2 Vertical Hilti Tracks spaced 12" apart, mounted on T-brackets	120	PASSED - added T brackets, doubling connections to track
24a	Qty 4 Saddle Nuts (1/2") on 2 Vertical Hilti Tracks spaced 12" apart	120	PASSED - proved T brackets not required
25	Qty 4 Saddle Nuts (1/2") on 2 Vertical Hilti Tracks spaced 12" apart, mounted on T-brackets, cantilevered on vertical track	120	PASSED - added T brackets, doubling connections to track. T-brackets required for cantilevered situations?
Note:	Vertical track was attached to horizontal track using 1/2" saddle nuts, socket head cap screws, lock / flat washers; torqued to 60 ft-lbs		
	Saddle Nut Hardware: All 1/2" bolts were torqued to 60 ft-lbs. All 3/8" bolts were torqued to 30 ft-lbs.		

Test Setup



Test Setup – On the Test Machine



Results / Conclusions

- 3/8” attachment hardware may be used for items up to 25lbs
- ½” hardware must be used for items heavier than 25lbs and for all vertical to horizontal track connections
- Horizontal, bulkhead track can support payloads up to 300 lbs
- Vertical, bulkhead track can support payloads up to 120 lbs
- Tracks installed on EFPMs can support payloads up to 200 lbs. The new EFPM designs were successful
- T-brackets are only required for large cantilevered payloads
- Z-mounts cannot be used on vertical track
- Further testing may be desired to prove that T-brackets increase the weight capacity of bulkhead track (vertical and horizontal)

Exec Brief: Project/Roadmap for WDM Network

Benefits, Design and Qualification Testing

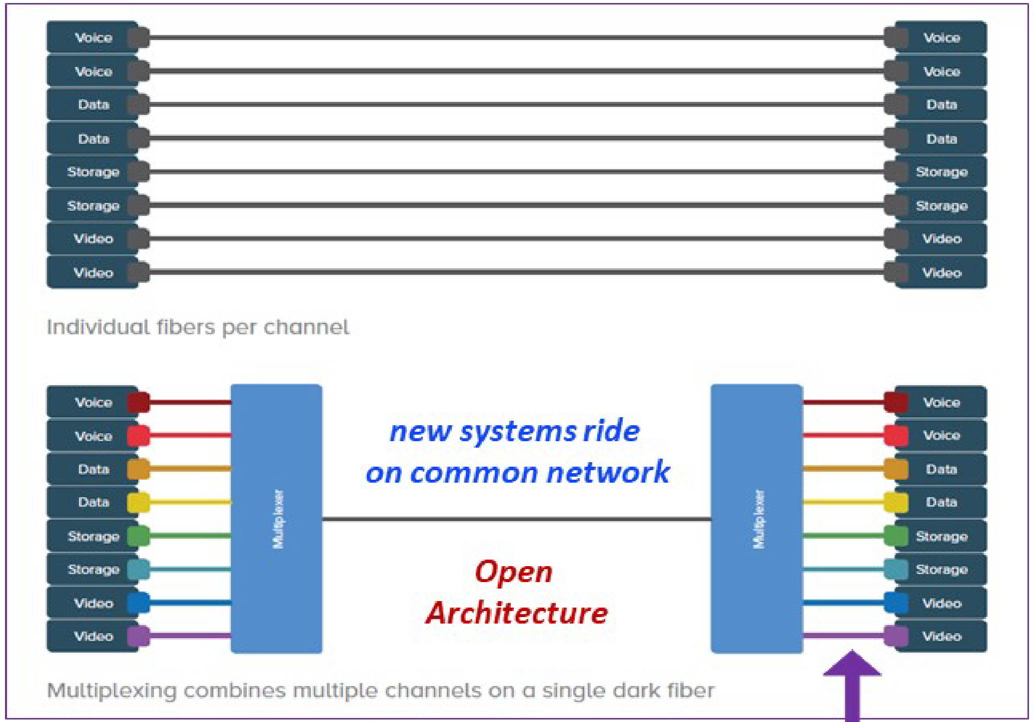
POCs

John Walks - HII-Ingalls Shipbuilding
Jason Farmer – HII-Ingalls Shipbuilding
Sarry Habiby – Perspecta Labs
John Mazurowski – Pennsylvania State University ARL

The Solution – New Paradigm

Shipyard installs optical backbone network using NAVSEA standard components and methods.

The optical backbone network uses Wavelength Division Multiplexing (WDM) to greatly reduce cable types and quantity in a future proof cable infrastructure.



From: smartoptics.com

Large # of fibers only needed for short distance within equipment bay

Fusion splicing used to decrease use of fiber optic connectors for increased connection stability.

From: http://www.fiber-optic-tutorial.com

Equipment traffic rides on the network. Suppliers continue to adapt to WDM network architectures. Reduced supplier involvement in ship production.

Wavelength allocation and network management and control cover redundancy, capacity allocation, mission changes, and equipment upgrades.

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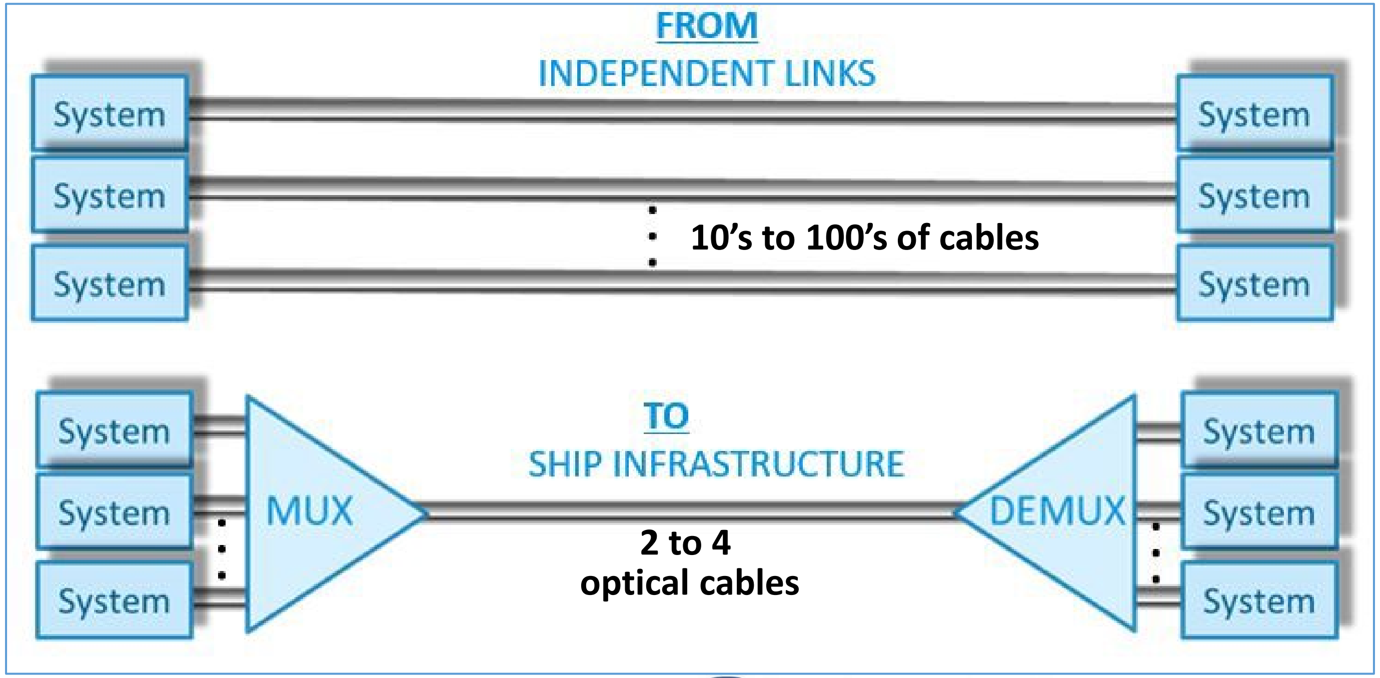
Background / Key Results to date

- Current Navy ship cables are diversely routed (port/starboard and by ship levels) using point-to-point links.
- Resilient WDM Network provides seamless cable network connection with redundancy, enables:
  - ❖ Built-in flexible common redundant network infrastructure
  - ❖ Reduction in cable count, cost and weight (e.g. See TRITON BCA results) ***for redundant/protected systems***
  - ❖ Dynamic Allocation of infrastructure (Fiber) capacity match changing system/mission requirements
- WDM – Proven technology (25+ yrs) widely used in Telecomm/Data Comm industries, TRL-9
  - ❖ Technology demonstrated in DARPA WDM MONET project (1995-2000) high speed network implemented across telecommunication industries (15+ yrs)
  - ❖ Scalable technology deployed in commercial long-haul, metro & DoD networks (GIG-BE: since ~2005)

→**NSRP Business Case Analysis (BCA):**
WDM Network for combat systems Integration - life cycle cost savings

$25M based on systems analyzed



Status of WDM Network Components

NAVSEA SPECIFIED COMPONENTS

SPECIFICATION	DESCRIPTION	
M49291	Optical Fiber	✓
M85045	Cable, Fiber Optic	✓
M29504	Terminus, Fiber Optic	✓
M28876	Connector, Fiber Optic	✓
M24623	Protection Sleeve, Fusion Splice	✓
M24728	Tray, Fusion Splice	✓
M24728	Enclosure, Fusion Splice	✓

NEW COMPONENTS REQUIRED FOR WDM

DESCRIPTION
DWDM compatible Optical Transceivers
16:1, 32:1, and 40:1 Optical Multiplexers (8:1 ✓)
Media Converters to convert electrical signals to optical signals
Protocol Adapters for conversion of non-compatible link protocols
Optical switching for dynamic capacity allocation ✓

✓ = Mil Qualified

(Others are TRL 9 commercial)

Benefits

Summary of initial benefits of a WDM solution / Optical Network Paradigm

- Cable & component count reduction (use case, savings to-date):
  - ❑ 90% reduction -- number of cables **and cable types.**
  - ❑ 80-90% reduction -- cost of cables & connectors
  - ❑ 75-80% reduction -- system weight
  - ❑ ~60-70 improvement in **installation efficiency** *(continue to update)*
  - ❑ Continuously update ROI & cost savings going forward
- Improved protection / redundancy at reduced cost (compared to current approach)
- Reduced Complexity, reduced cost of managing non-standard components
- Savings in managing different fiber and component types -- acquisition, installation, inspection and training

BCA RESULTS

Five subsystems analyzed (NSRP)

$25M Savings

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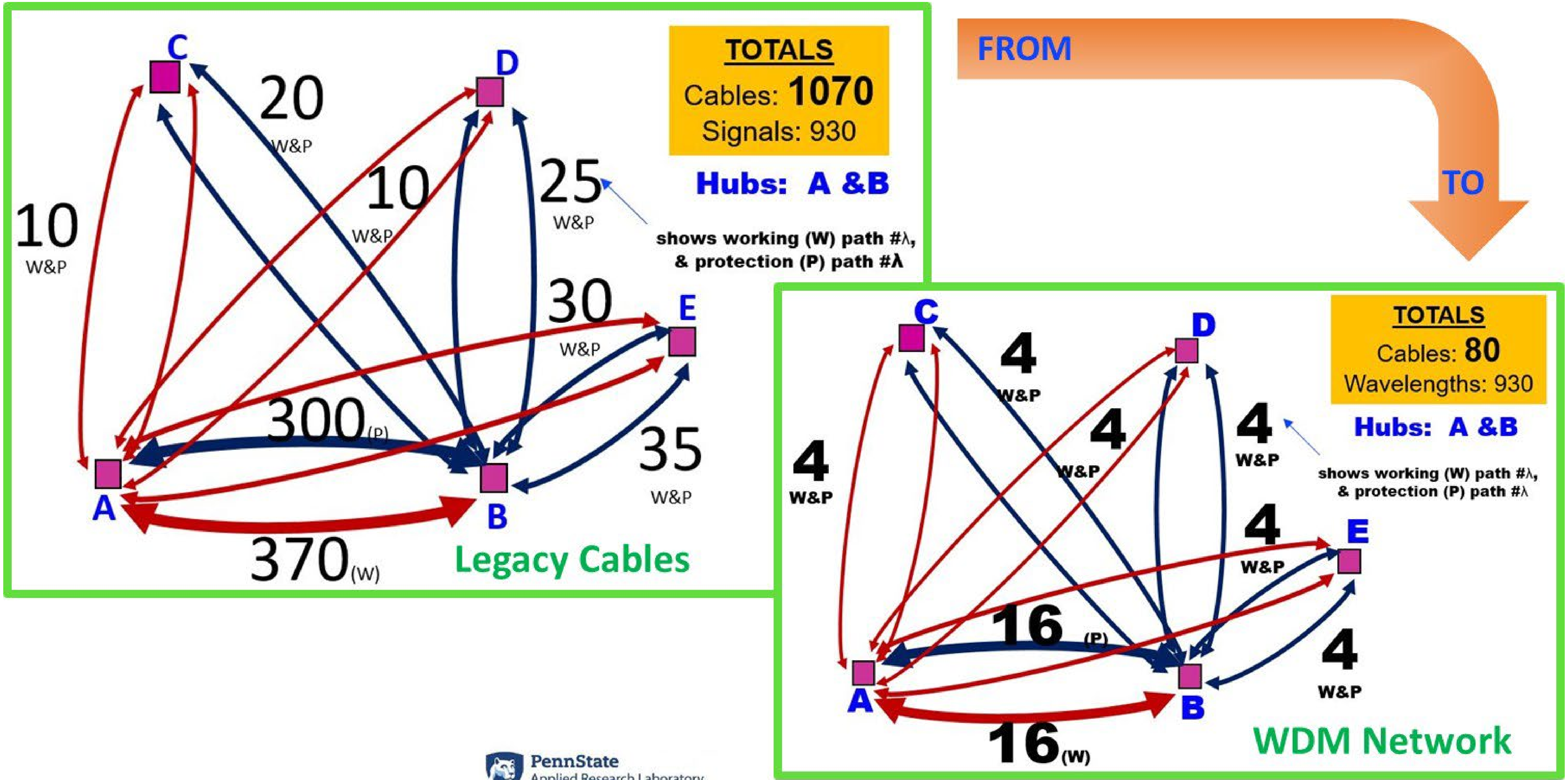
BCA for WDM Optical Network – *connecting system nodes A through E*



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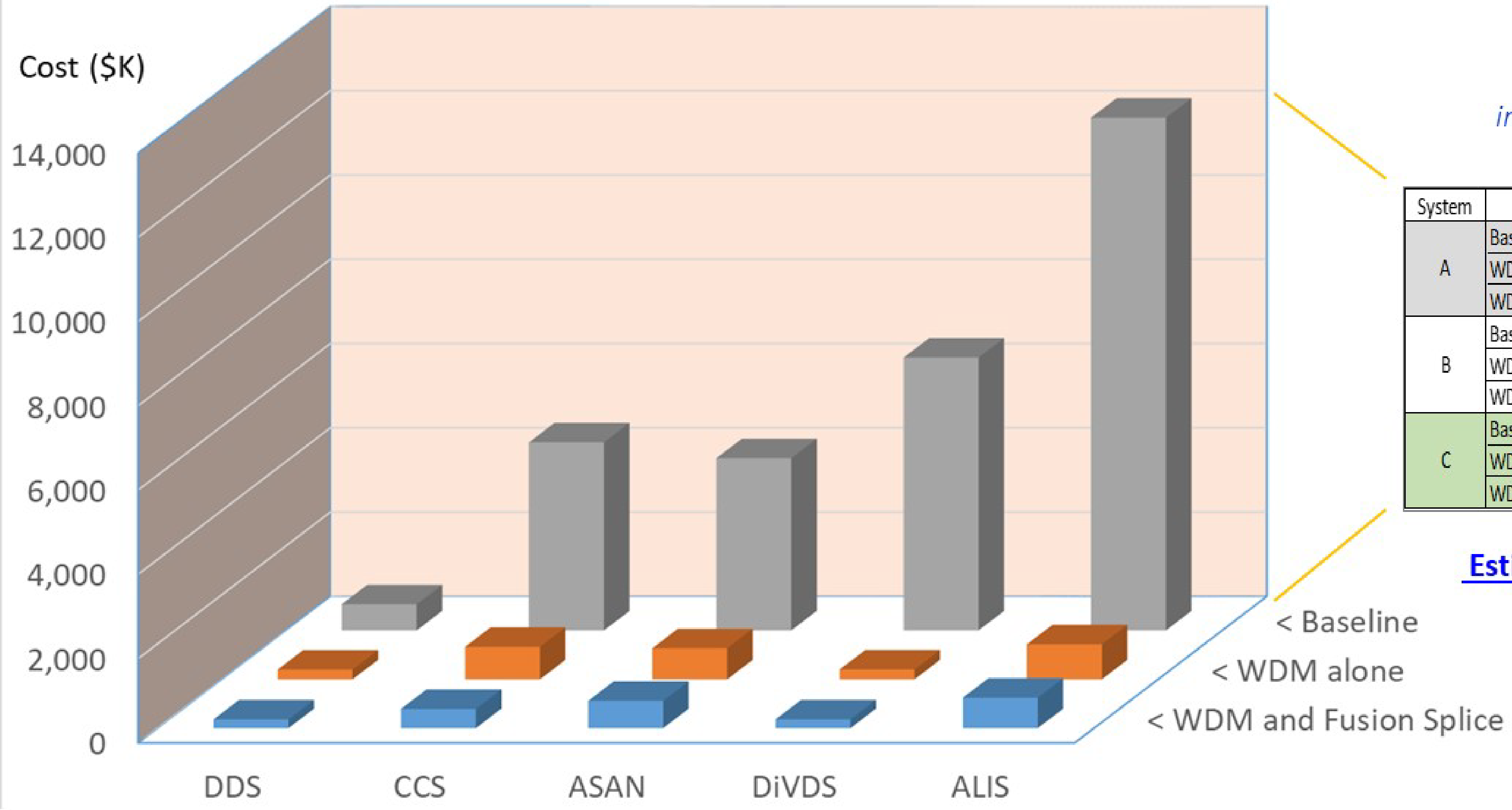
BCA for WDM Optical Network – *DDG / AEGIS Case Study*

NSRP 2018-427 TRITON: COST MODEL-BASED NETWORK DESIGN

- replace cables with Optical Network using WDM
- replace Fiber Optic Connectors with Fusion Splices

Assumes use of Inter-compartment & intra-compartment WDM links



Substantial Savings in Maintenance & Upgrade costs compared to baseline

System	Approach	TOTAL	Acquisition	Maintenance	Upgrade
A	Baseline	100%	45%	9%	45%
	WDM-Connector	17%	82%	13%	5%
	WDM-Fusion Splice	10%	88%	7%	5%
B	Baseline	100%	45%	9%	45%
	WDM-Connector	18%	82%	15%	3%
	WDM-Fusion Splice	16%	89%	9%	2%
C	Baseline	100%	45%	9%	45%
	WDM-Connector	7%	73%	10%	17%
	WDM-Fusion Splice	6%	75%	6%	19%

Estimated Cost

Baseline	$28 M
WDM alone	$4 M
WDM and Fusion Splice	$3 M

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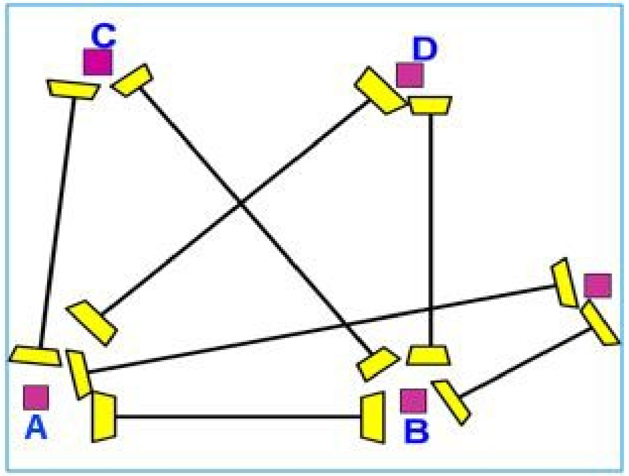
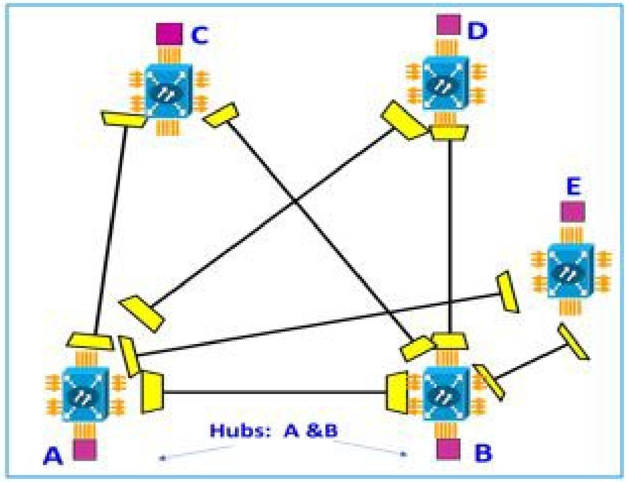
Fiber – WDM Based Connectivity
→ Proposed Dynamic network solution

STATIC NETWORK >
- topology optimized for peak capacity
- lowest cost



DYNAMIC NETWORK >
- add switching for capacity re-allocation
- slightly higher cost



<u>Key functions enabled by network management and control architecture:</u>

- Network monitoring
- Network configuration / provisioning (wavelength allocation)
- Fault isolation: Protection &restoration

<u>Benefits of Dynamic / Switched WDM</u>

a) Network capacity and configuration changes track mission-dependent demand variations

b) Flexible addition of new applications in multiple cabins/nodes

c) Optical Switches enable automated protection & restoration

d) Efficient use of network resources: Wavelength allocation, transport system access and aggregation

<u>COST</u>

Capabilities that add cost:

a) Switch Hardware / Programmability

b) Network management and control (SW) to enable transport capacity resource allocation, protection and restoration.

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Extension Basis for 72 Inch POA Enclosure Systems to DDG and CG Ships

SWSI Panel Meeting
March 24, 2021

Michael Talley, D.Sc. and Lisa McGrath
Ship Survivability
Newport News Shipbuilding

Project Goals, Objectives, & Deliverables

- Proposer Identification:
  - Prime: HII-NNS, Michael Talley, D.Sc.
  - Participants: HII-Ingalls, John Walks and BIW, Nat Bedford

- Goals to Achieve
  - Ability to easily insert cutting edge technology as it evolves
  - Commonality and extendibility of components among systems and ships
  - Flexibility in varying physical system configurations
  - A reduction in acquisition and life-cycle costs by buying components at the drawer level
  - Reduced test time and costs

- Objectives
  - Provide a basis for extending 72 Inch POA Enclosure Systems to DDG and CG ships
  - Define processes, skill levels, and organizational responsibilities for implementing 72 Inch POA Enclosure Systems

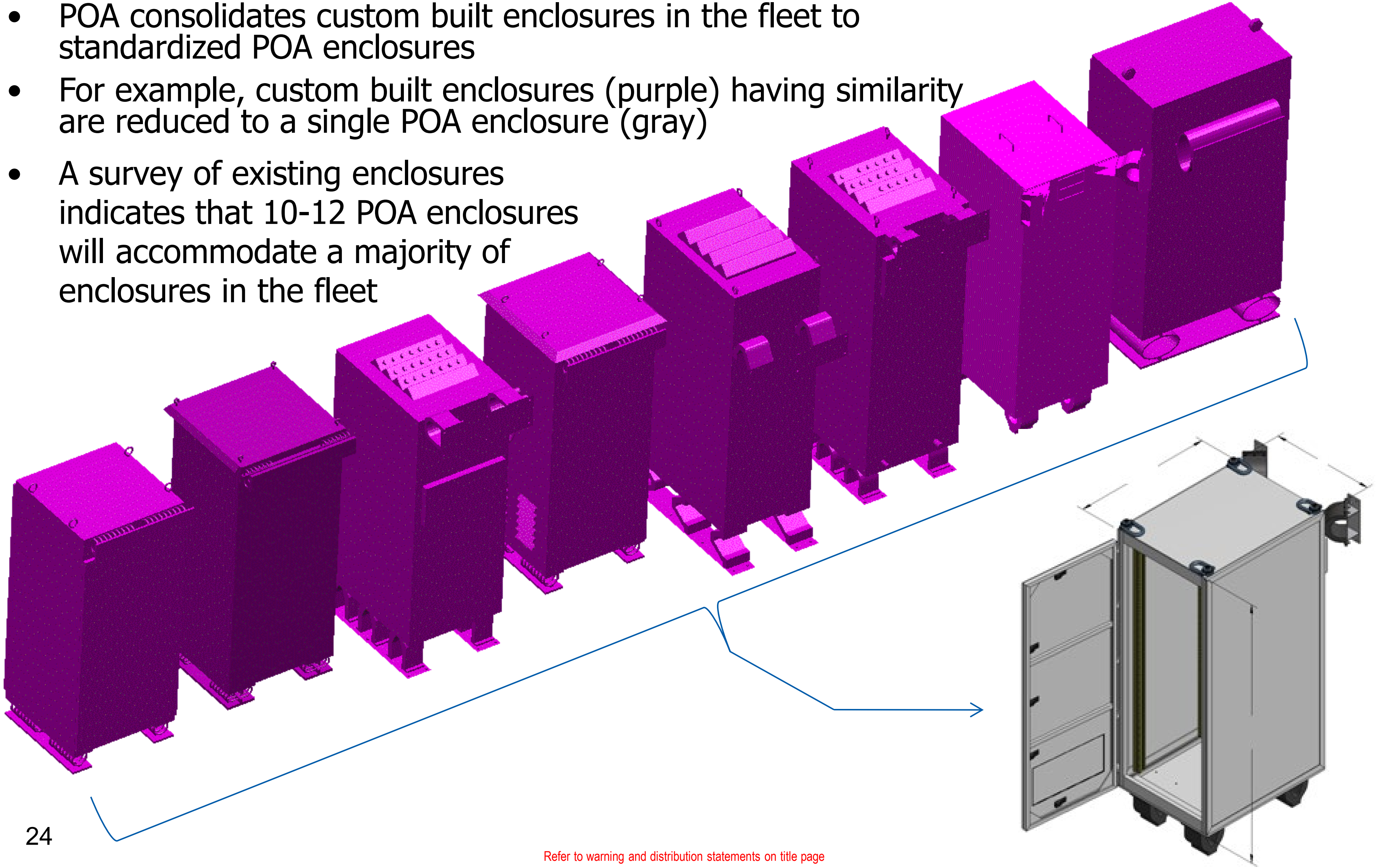
- Deliverables
  - Final report documenting basis for extending 72 Inch POA Enclosure Systems to DDG and CG ships, processes, skill levels, and organizational responsibilities for implementation
  - Presentations at workshops to showcase results

What is Physical Open Architecture (POA)?

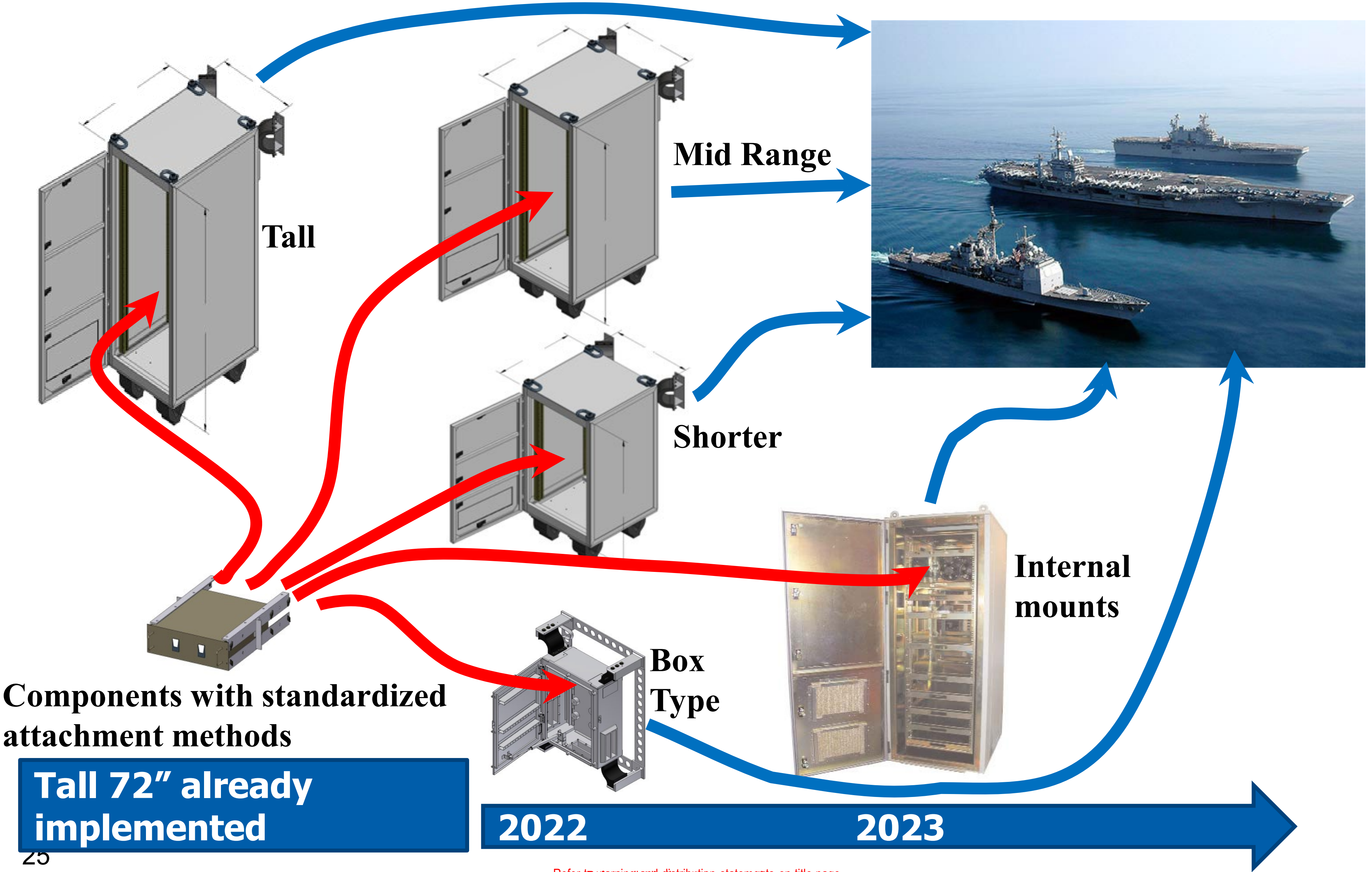
- POA is a flexible mounting methodology enabling use of open architecture systems (plug-and-play, common components, modular design, COTS, etc.), while meeting Navy shock and vibration requirements
- POA is implemented by standardizing physical attachments and qualification procedures, including the following:
  - Enclosures
  - Shipboard interfaces (i.e., foundations)
  - Shock mount solutions
  - Component attachment methods
  - Environmental test processes and procedures
- POA's flexible mounting methodology provides the ability to install components in different positions stacked within a rack enclosure, and install enclosures in different configurations such as multi-packs

Previous Work: Standardized POA Enclosures and Ship Interfaces

- POA consolidates custom built enclosures in the fleet to standardized POA enclosures
- For example, custom built enclosures (purple) having similarity are reduced to a single POA enclosure (gray)
- A survey of existing enclosures indicates that 10-12 POA enclosures will accommodate a majority of enclosures in the fleet

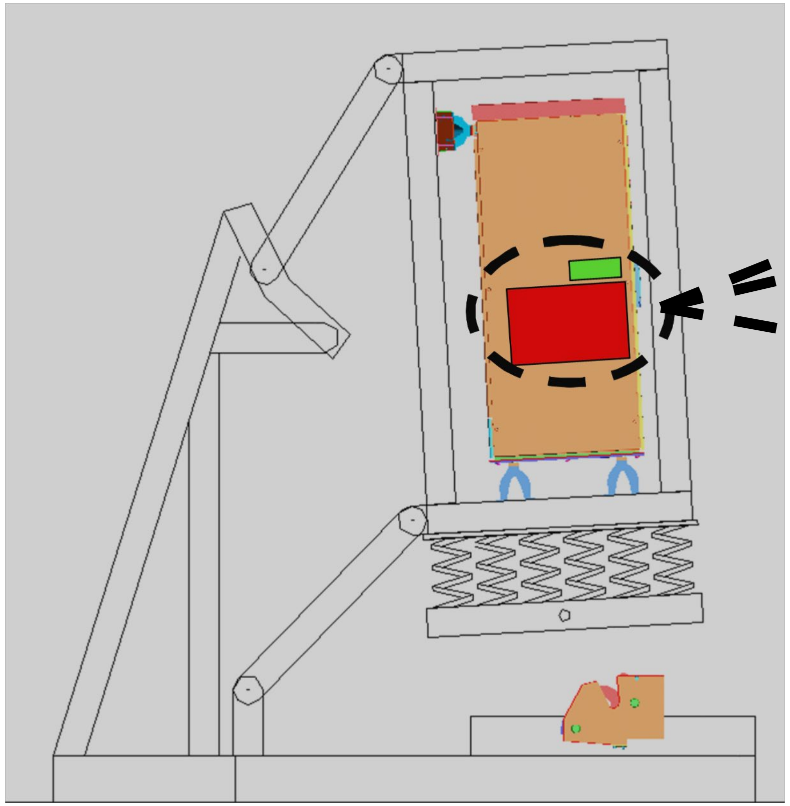


Roadmap for Anytime and Anywhere at the Drawer or Component Level Using POA Enclosures

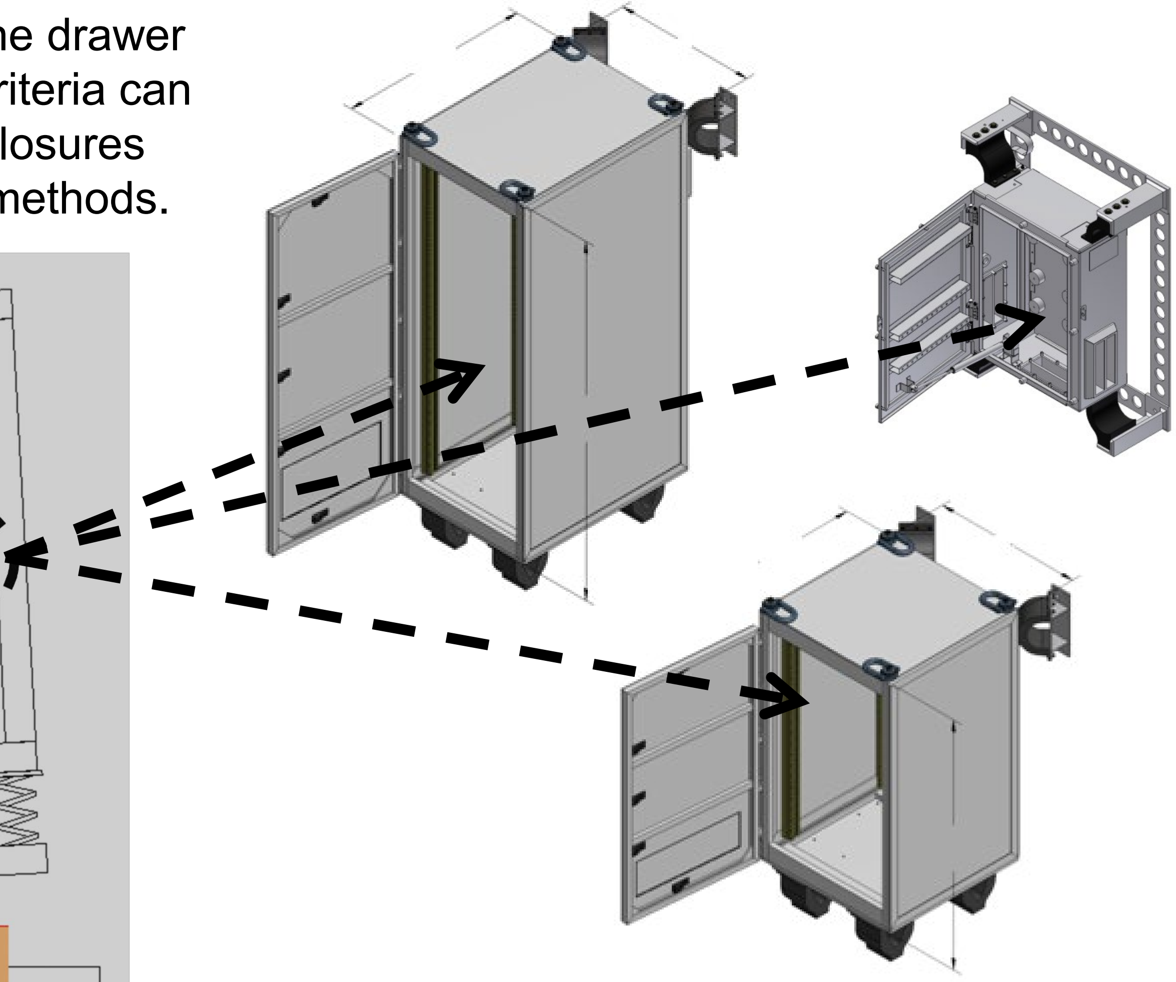


Standardized Environmental Test Processes and Procedures

Shock tests of Components at the drawer level satisfying prescribed test criteria can then be installed in the POA enclosures using standardized attachment methods.

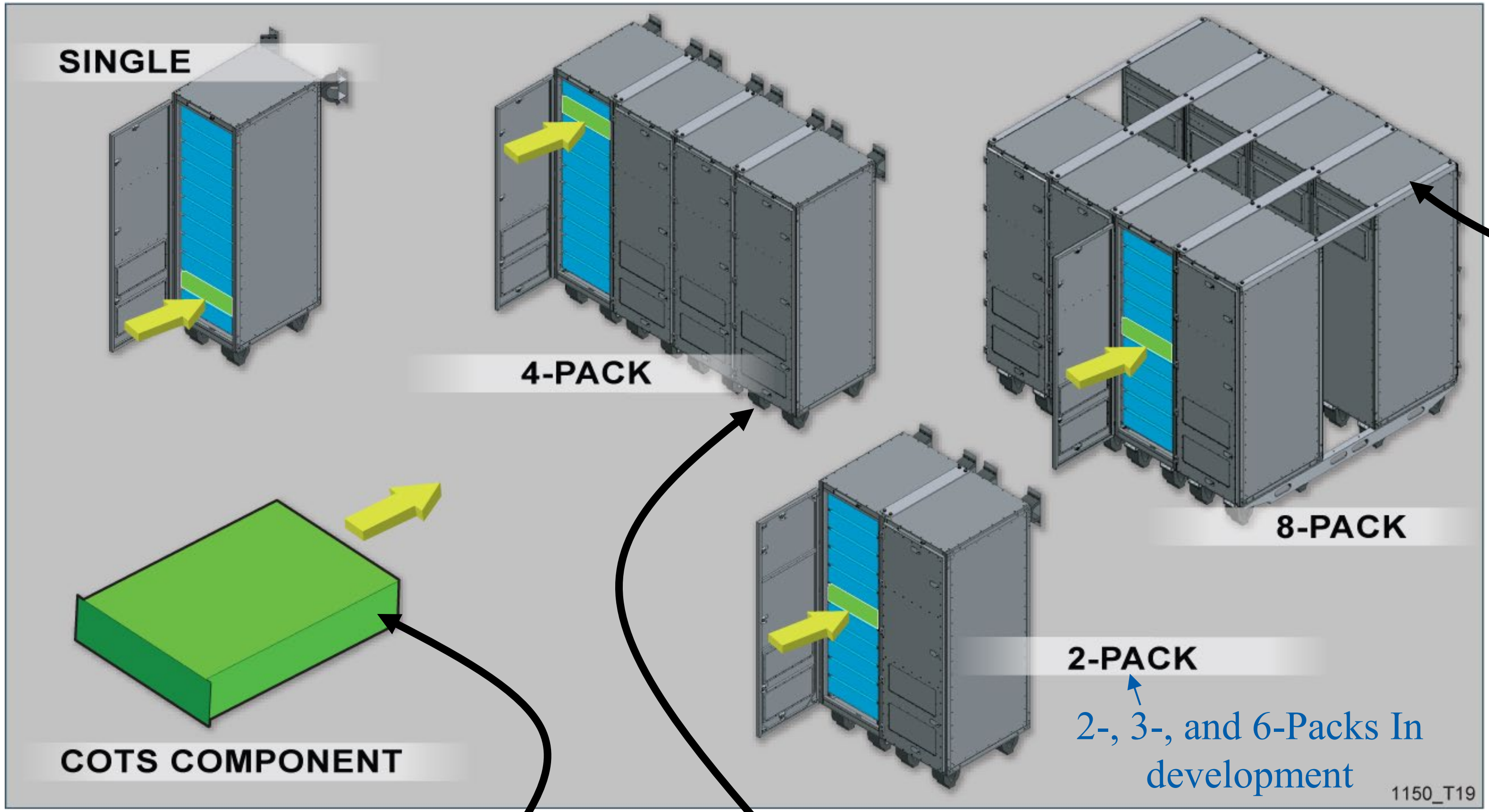


Deck Simulating Shock Machine (DSSM)



Already implementing process for 72" tall enclosures

Previous Work:
Approved 72” POA Packaging Methods

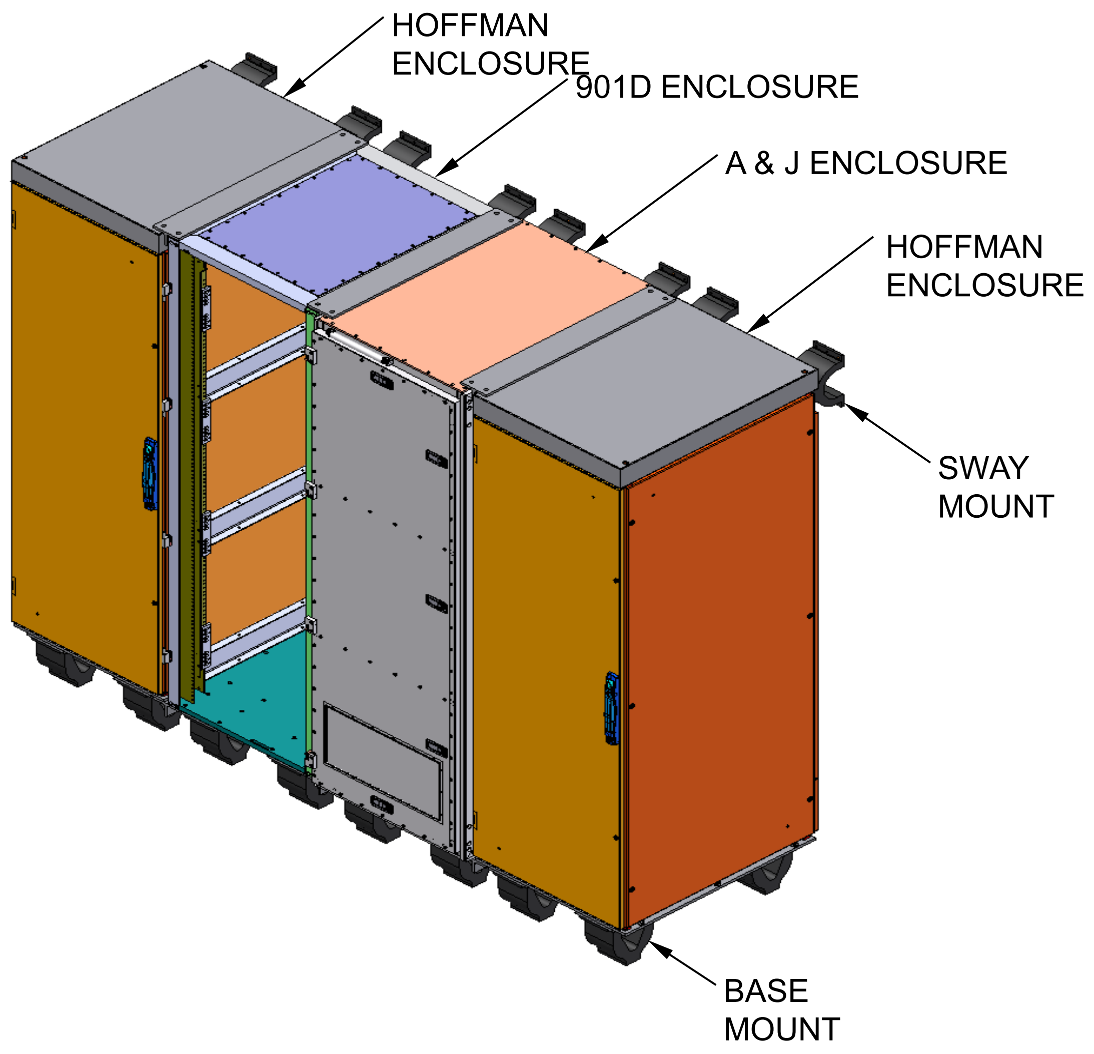


State of the art components with standardized attachment methods may be hosted anywhere within POA enclosures, bringing the ship interface to the component level.

All mounts have standardized solutions and interfaces for ships

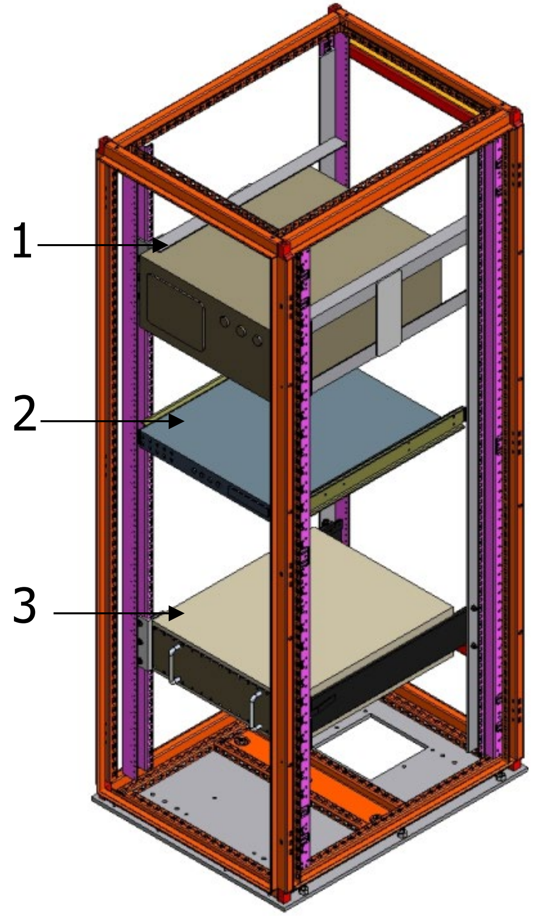
No sway mounts on 8-packs

Previous Work: Standardization Enables Interconnectivity of Enclosures from Multiple Suppliers

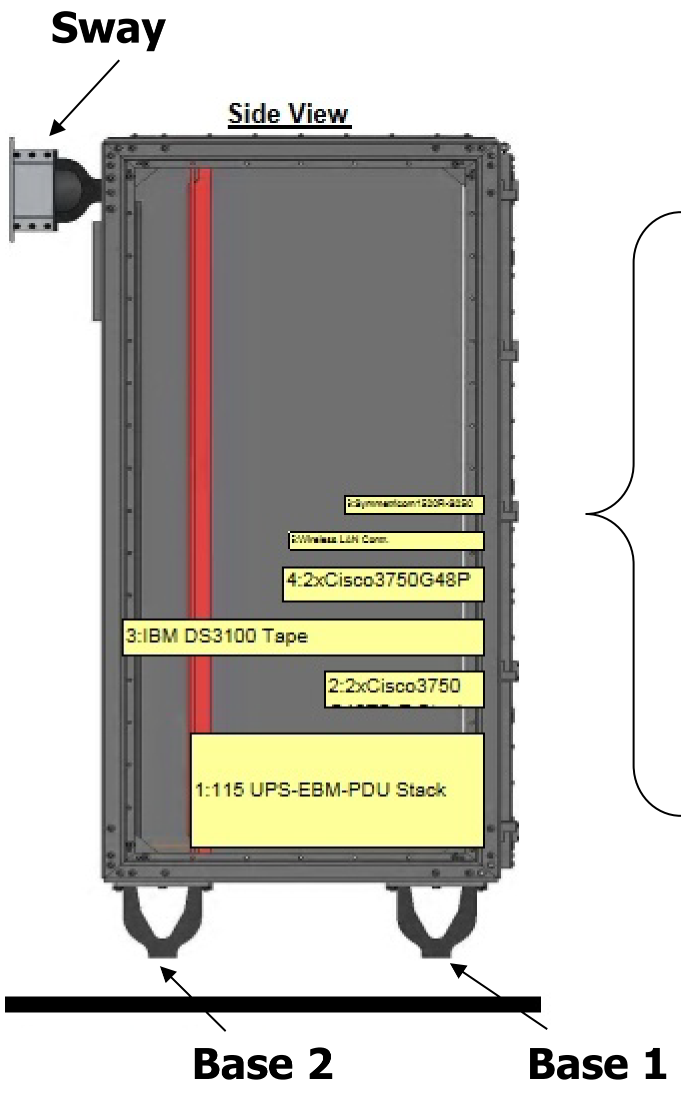


Previous Work: Examples of Standardized Attachment Methods

1. NNS Angle Frame
2. Jonathan 128QD-22
3. General Devices CTHRS-222



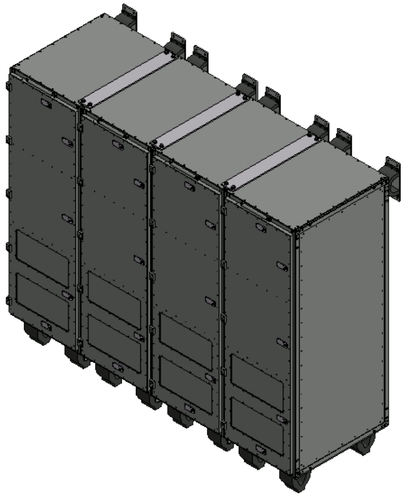
Previous Work: Engineered Mount Sets for 1-pack



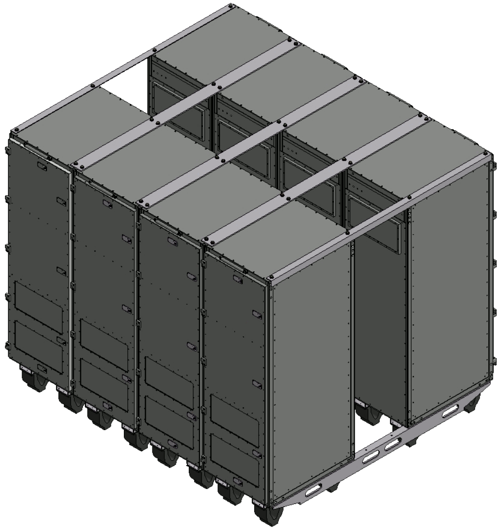
Mount Set	Enclosure Weight Range (lb)	Vertical CG Range (in)	Base 1	Base 2	Sway
1	630-770	19-30	70776-45	70776-15	70535-3
2	630-770	30-38	70776-45	70776-15	70535-4
3	770-890	19-30	70776-65	70776-25	70535-3
4	770-890	30-38	70776-55	70776-15	70535-4
5	890-1087	19-30	70776-85	70776-35	70535-3
6	890-1087	30-38	70776-50	70776-15	70535-5
7	1087-1230	19-30	70776-85	70776-25	70535-4
8	1087-1230	30-38	70776-80	70776-15	70535-5

All mount part numbers are ShockTech

Previous Work:
Engineered Mount Sets for 4- and 8-packs



4-pack Mount Set	Enclosure Weight Range (lb)	Base 1	Base 2	Sway
1	550-650	70776-20	70776-15	70535-3
2	650-750	70776-35	70776-15	70535-3
3	750-900	70776-50	70776-15	70535-3
4	900-1050	70776-45	70776-15	70535-4
5	1050-1200	70776-65	70776-15	70535-4
6	1200-1350	70776-80	70776-15	70535-4



8-pack Mount Set	Enclosure Weight Range (lb)	Base 1	Base 2
1	555-610	70776-65	70776-20
2	610-755	70776-85	70776-20
3	755-950	70776-85	70776-40
4	950-1070	70776-85	70776-55
5	1070-1300	70776-85	70776-80

Previous Work: Standardized NNS Cable Methods

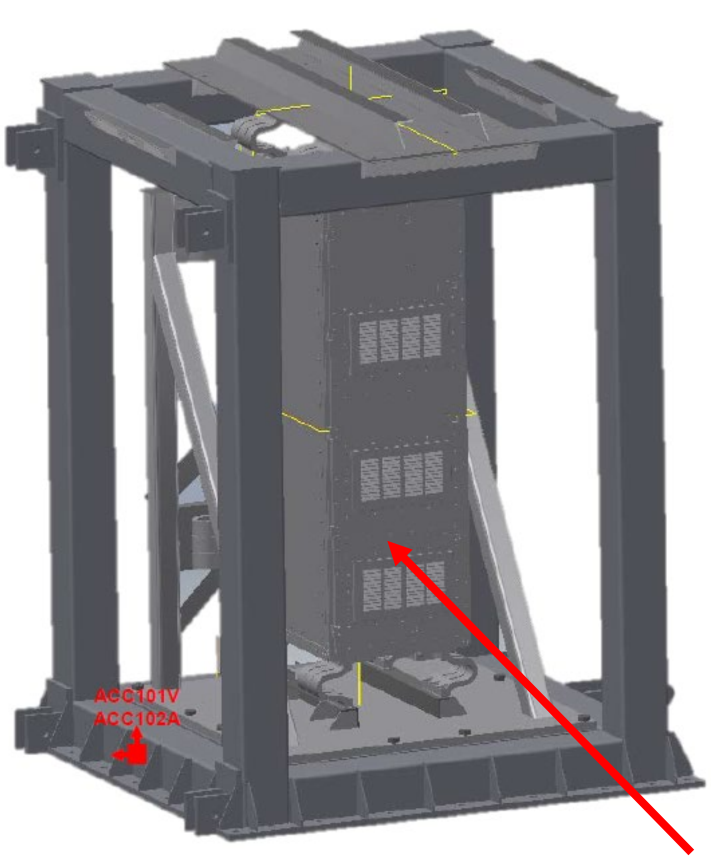
Cable Installation Methods	
101/102-NG	Trapeze Cableway 6-26 inch width
108-NG	Cable Retention
117-NG	Supporting Cableway Bundles
123-NG	Typical Cableway Installation
Cable Penetration Methods	
206-NG	Packing MCT and RMCP Transits
210-NG	Clear Holes in Stiffners and Beams
401-NG	Cable Clamps
403-NG	Nylon Stuffing Tubes
406-NG	Multi-Cable Transit

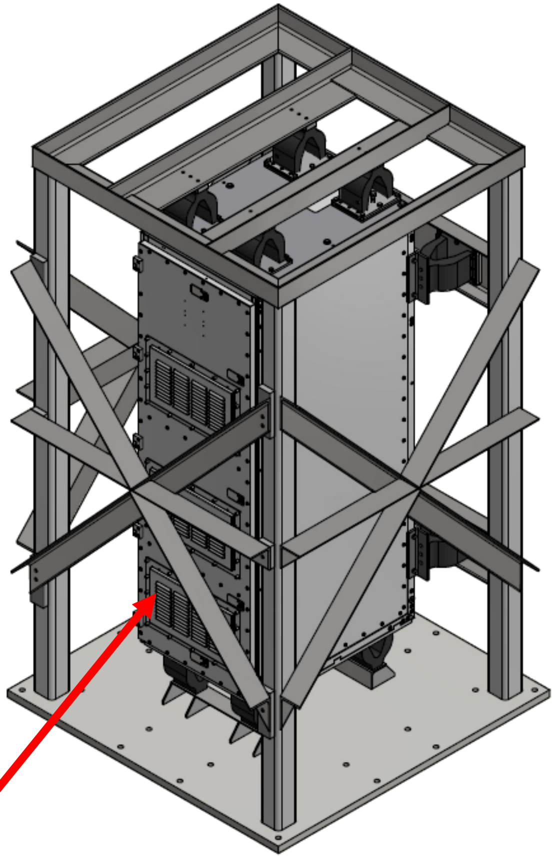
Methods are developed IAW DOD-Std-2003.

Previous Work:
4 Phase Approach to Carrier Shock Qualification

- **Phase A:** Heavyweight shock testing of worst case simulated Principal Unit Assemblies
  - ✓Completed 2008
    - Single Racks
    - 4-Pack Multipack
    - 8-Pack Multipack
- **Phase B:** Heavyweight shock testing of representative components
  - ✓Completed 2008
- **Phase C:** Type B shock testing in Shock Mounted Standardized Enclosure (SMSE) on Deck Simulating Shock Machine (DSSM)
  - ✓First Tests Completed 2010
  - ✓Over 10 tests performed for Carrier components so far
- **Phase D:** Shock Qualification Extension Packages
  - ✓Part A – General Extension – First Approved 2012, Revised as needed, Most recent Revision: Rev. 3, 2017
  - ✓Part B – Specific Extension – First Approved 2012, Revised as needed

Previous Work:
Phase C Shock and Vibration Testing





Shock Test Setup

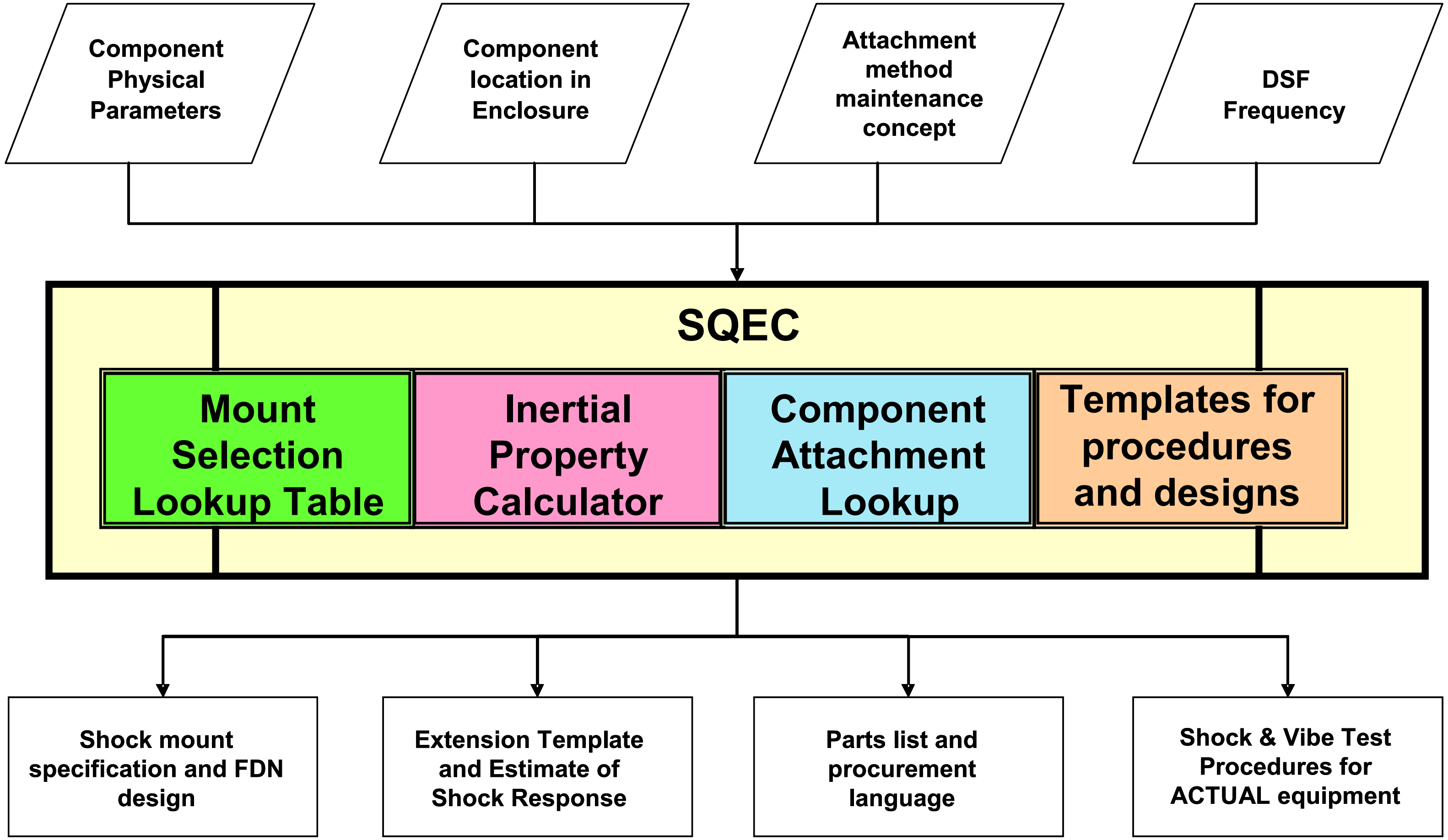
Shock Mounted Standardized Enclosure (SMSE)

Vibration Test Setup

Previous Work:
Phase D: Shock Qualification Extension Packages

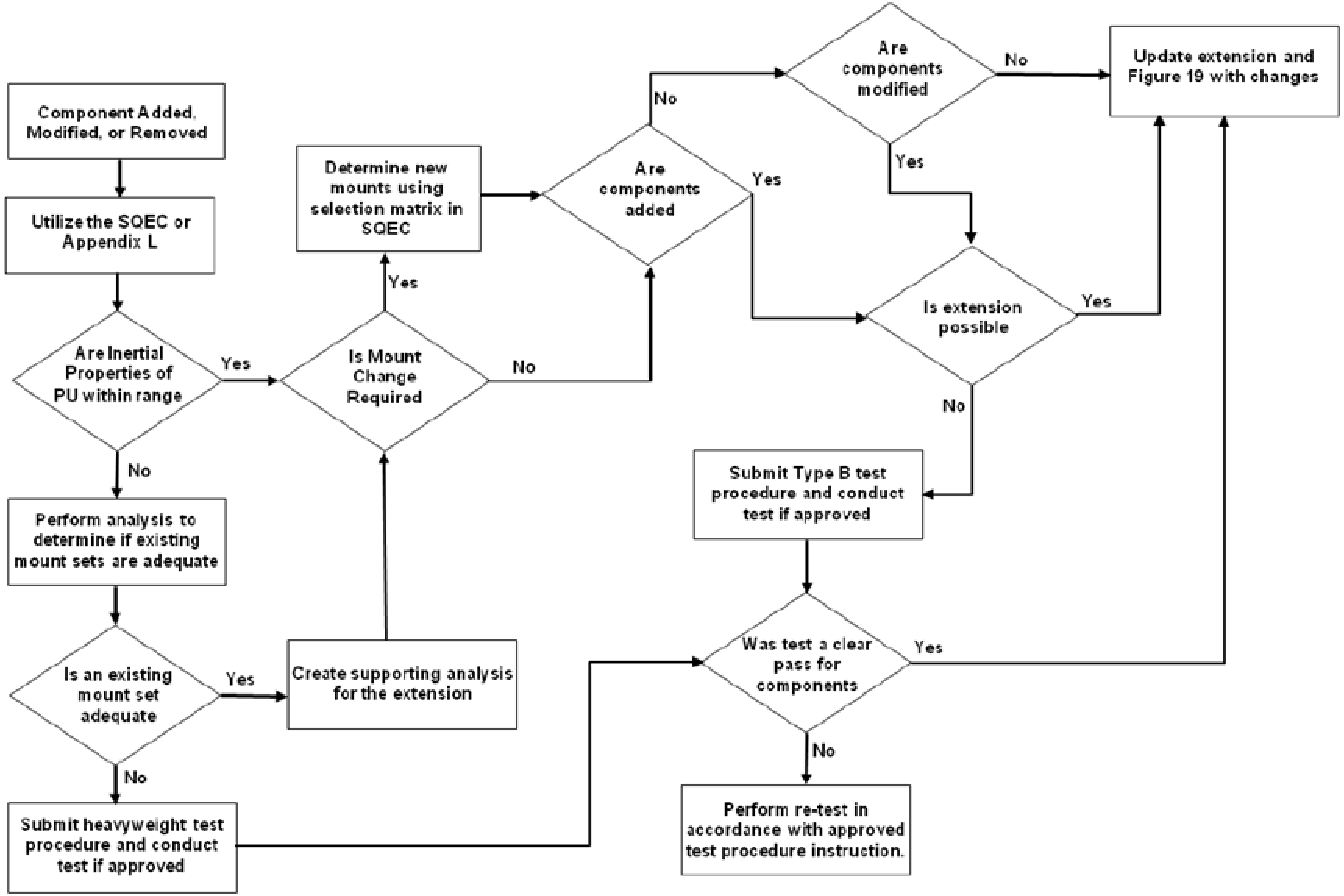
- The extension for equipment is done in two parts.
- Part A is the Generic Extension, which applies to every enclosure. This contains the general rationale for extensions based on Phases A, B, and C, and has already been approved by NAVSEA.
- Part B is the Specific Extension for each unique enclosure.
  - Provides information required by 901E and DI-ENVR-80706, “Shock Test Extension Request for the similar extension of the specific assembly created by combining the Enclosures tested in Phases A and B of the Four Phased Approach with the Equipment tested in Phase C.
  - Fulfills requirements of Phase D of the four phase approach to shock qualify equipment.
  - Fig 19’s are created for each subsidiary component and unique rack assembly.

Previous Work:
Shock Qualified Enclosure Calculator (SQEC)



Enables cost effective design efforts and configuration management

POA Life Cycle Configuration Management Approach

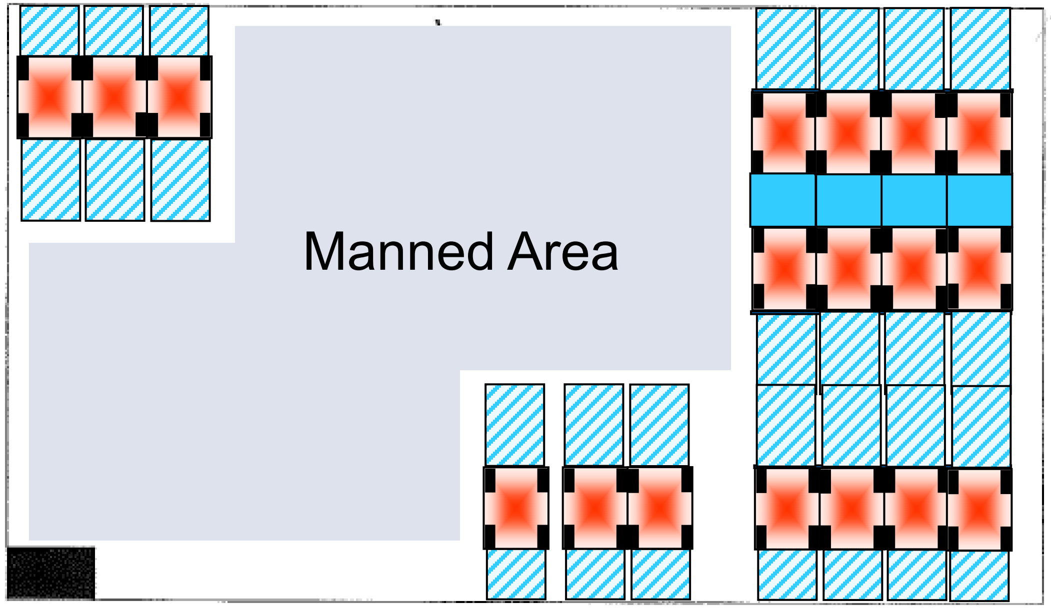


Methods and Procedures Required for Accomplishing Goals and Objectives

- Identify DDG and CG spaces that will benefit from 72 inch POA enclosures: HII-Ingalls shall perform
- Identify environmental requirements gaps between CVN, DDG, and CG (e.g., higher frequency vibe testing, rack height, EMI variances, etc.): HII-NNS performs and HII-Ingalls participates
- Develop initial rearrangement concepts for each space using POA enclosures: HII-Ingalls shall perform
- Develop analysis & test plan to close gaps and submit to NAVSEA for approval: HII-NNS performs and HII-Ingalls participates
- Define ordering and supplier information for POA enclosures, hardware, and mounts for DDG and CG platforms: HII-NNS performs and HII-Ingalls participates
- Define processes, skill levels, and organizational responsibilities associated with POA enclosure builds, testing, ship outfitting, and enclosure configuration management
- BIW shall provide reviews and comments to all NSRP reports

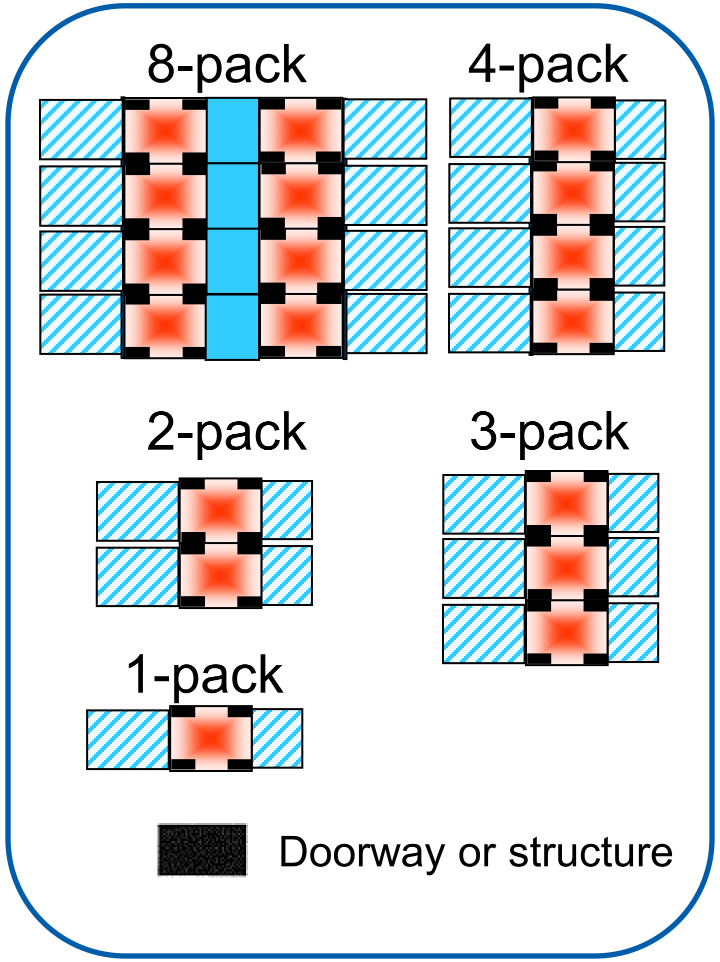
Develop Initial Rearrangement Concepts

Space rearrangement example



Rearrangements will be iterated considering constraints and requirements

Legend



Status, Next Steps, Future Work

- Status
  - DDG: ~8 spaces containing 36 enclosures identified for potential rearrangements using POA enclosures
  - CG: ~37 spaces containing 124 enclosures identified for potential rearrangements using POA enclosures

- Next Steps
  - Develop analysis & test plan to close gaps and submit to NAVSEA for approval
  - Define ordering and supplier information for POA enclosures, hardware, and mounts for DDG and CG platforms

- Future Work
  - Pursue funding to achieve “Roadmap for Anytime and Anywhere at the Drawer or Component Level Using POA Enclosures”

Discussion / Questions

Questions

Common Interface Pilot Project (CIPP)

Mr. Perry Haymon, SWSI Panel Chair
Ms. Stefanie Doyle, PEO IWS 2.0

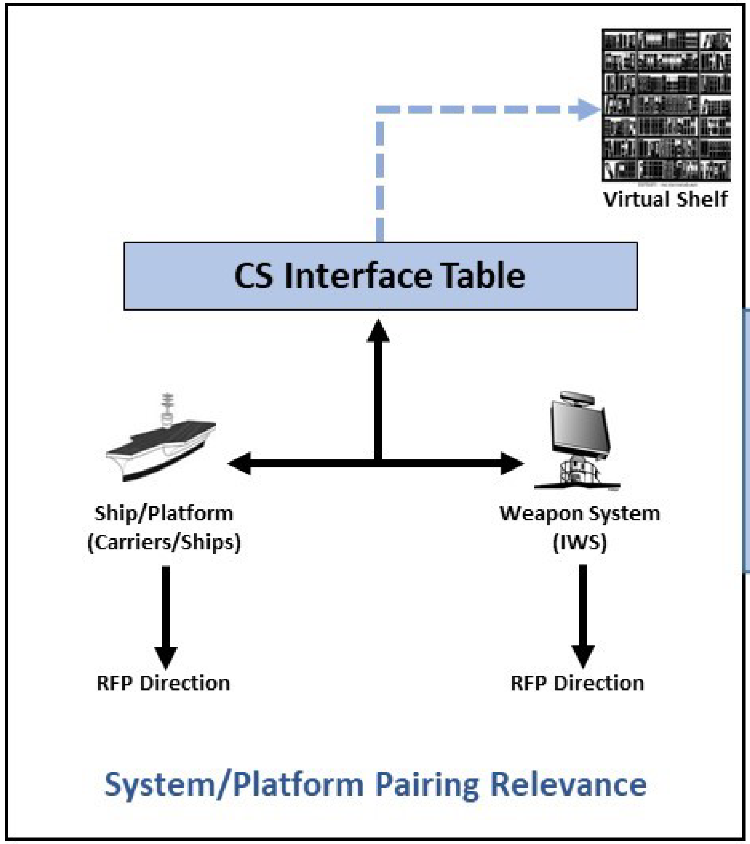
Background

- During the 18 Aug 15 NSRP Program Review with ASN RDA, Mr. Stackley emphasized the need for "game changing" or major cost reduction projects
  - Recommended a "Target" Pilot Project* to develop Common Interface Standards to address topside and below deck flexible design considerations and to reduce ship platform ownership costs, specifically the cost of system forward fit, backfit, upgrade
- Conducted Workshop 3 Nov 15, in conjunction with SNAME, Providence, RI, with the following objectives
  - Define both enablers and obstacles to effectively and efficiently install C5ISR equipment either Just-In-Time or during Post Delivery on new construction ships or backfit on in-service hulls
  - Provide details to aid in scoping a "special" NSRP project proposal to be released to industry in the December 2015 timeframe

CIPP Goals & Benefits

- Goals
  - More efficient and effective capability insertion
  - More efficient technology refresh to overcome obsolescence
  - Greater mission flexibility and adaptability
  - Increased efficiencies in acquisition, ship design, construction, and logistics
  - Enable just-in time delivery of C5I systems with state of the art technology without negatively impacting new construction cost and schedule
- Benefits (Shipyard)
  - Early involvement by the shipyards in a future change
  - Ability to reuse existing designs/structure for future ship capabilities/variants
  - Supports standardization between shipbuilder-provided distributed systems/components and Government Furnished Equipment (GFE)
  - Accelerate learning efficiencies through serial production of common interfaces for more consistent and repetitive ship configurations
- Benefits (Navy)
  - Reduced acquisition costs (design, construction time, labor)
  - Provides methods for technology insertion/refresh
  - Reduced operations & maintenance cost
  - Improved ship availability
  - Decoupled scheduling for the combat system
  - Off-board system integrated test
  - Cross-ship commonality

Phase I Combat Systems Interface Table



Common Interface Table
"Menu"

CS Equipment
- ❑ Requirements
- ❑ Interfaces
- ❑ Consoles
- ❑ Racks
- ❑ Topside

Modular Concepts
- ❑ Flexible Infrastructure
- ❑ Modular Deck Systems

Ship Impacts
- ❑ Space
- ❑ Weight
- ❑ Power
- ❑ Cooling
- ❑ HM&E

CS Topside NTE

CS Interfaces
- ❑ Radar
- ❑ EW
- ❑ Comms

Focus on Near Term Opportunities to Support EASR Integration

CIPP Phase I Scope

Subgroups

Power & Cooling	Ship Physical Interfaces	Combat Systems Interfaces	Programmatic
Lead(s): ***J. McGlothin, 320*** **Lead(s):** ***J. Walks, Ingalls*** Focus: Power distribution /conversion, cooling / HVAC / ventilation, cabling	**Lead(s):** ***C. Carlson, IWS*** **Lead(s):** ***G. Dorsey, NNS*** Focus: Accessibility; infrastructure; mounts; connectors; foundations;	**Lead(s):** ***W. Veazey, NSWC*** **Lead(s):** ***B. Lang, Ingalls*** Focus: Digital interfaces, non-power cabling, signals,	**Lead(s):** ***G. Kwak, 06*** **Lead(s):** ***R. Wilson, Ingalls*** Focus: BCA; Contract/ Ship Spec Language; Metrics; Comms Plan; Instructions

Responsibilities/Deliverables

Power & Cooling	Ship Physical Interfaces	Combat Systems Interfaces	Programmatic
• Power and Cooling Interface Standards • Oversizing and Margins Report • Power interfaces switchboards/panels/ load centers • Growth Margin Management • SWAP-C Management	• "Standardization" of HM&E Interfaces for Topside and Below Decks • Common racks/integrated enclosures; common connectors/re-use • Equipment removal routes/ • FI considerations • Topside trade space	• Existing SPS-48G radar interfaces for reuse • Common interface panels - equipment connections • Common radar panel for all ship platforms • Standardization of peripheral systems • Open, modular interfaces for CS upgrades / backfit	• Business Case Analysis (BCA)/Return on Investment (ROI) - Value Proposition • Contract incentives / language • Acquisition Guidance • Integration Governance Boards

Participants

Industry: Ingalls, NNS, EB, NASSCO, BIW
OEMs: **Raytheon**, Lockheed Martin, Northrop Grumman (ES)
Other: Pit Stop Engineering, Gibbs & Cox
Navy: PEO IWS, Ships, Carriers; SEA 05/06; PMS 320/317; NSWC Carderock/Dahlgren; PSU EOC

Currently over 70 active project participants!

Emergent Benefits

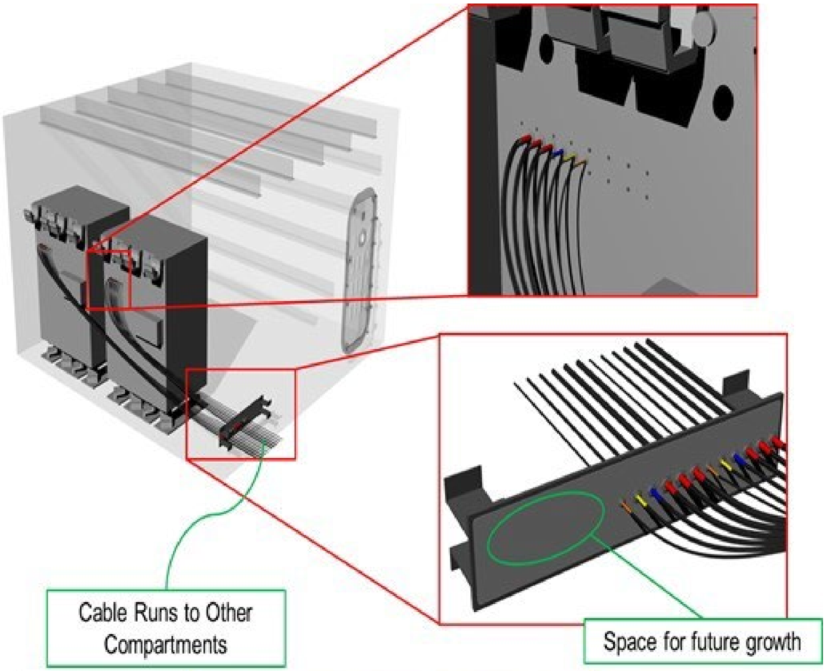
ECP Risk Reduction

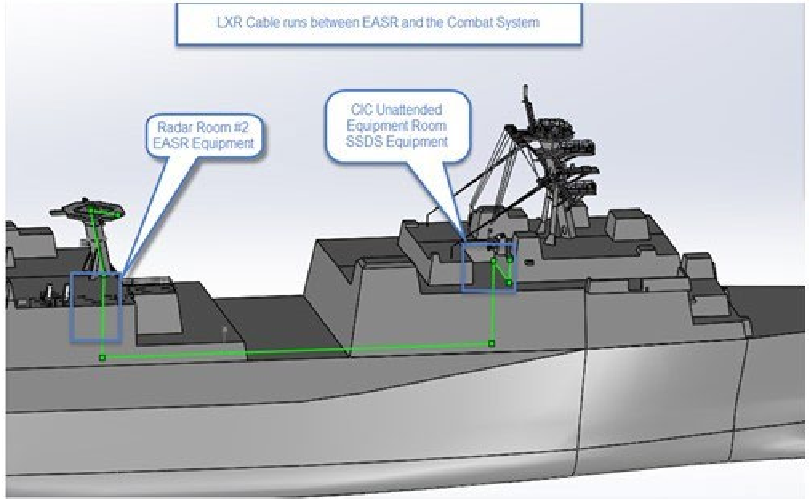
- Identified discrepancies with requirements for power that could have driven significant change to the distribution on the CVN
- Identified hatchability concern with proposed EASR hardware - effort being examined by EASR program
- Identified to Shipyard (NNS) of the Classification requirements of the array face. Classification verified by EASR program
- Working with the EASR program to verify power conversion requirements: 440 VAC to 1000 VDC vs 4160 VAC to 1000 VDC

Unknown or Not Understood Requirement Drive Costs of ECPs

Phase I Accomplishments

- **Programmatic**
  - General Ship Specification language for FI
  - Communications Plan
  - Initial OEM SOW language for hatchability/accessibility
  - Developed BCA Tool – Conducted demo 23 Jun 17
- **Ship Physical Interfaces**
  - Developed recommendation for:
    - Common Hatchable Racks/ Enclosures
    - Below Deck Equipment Access
    - Integrated Enclosure
    - Equipment Interfaces
    - Tolerances
- **Combat Systems Interfaces**
  - Developed Ship Distributed Interface Panel (SDIP) Design
    - Common Mounting Plate – point to point connections
    - Use of Fiber Optic LAN – significantly fewer cables/ future growth space
- **Power and Cooling**
  - Power and Cooling Interface Standards document
    - Power distribution: local level and system level
    - Cooling: air and liquid systems





Questions?

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