TEAM SPAWAR

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"Interoperability by Design"
An Alternative to Testing in Quality

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- Summary

Background – Past Motivators

1979 USS RANGER Message creates response to combat system integration problems, creates dedicated test facility

1998 USS HUE CITY and VICKSBURG issues result in NAVSEA interoperability lead with Distributed Engineering Plant dedicated test support. Interoperability improves in a number of areas

2005 Interoperability Certification Committee established to address continuing issues, standardize T&E and assessment process

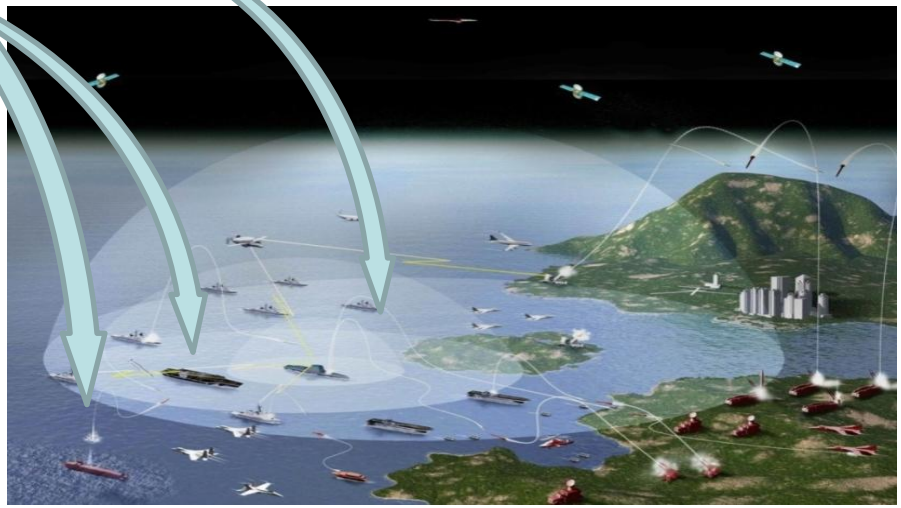
1982 Lack of program readiness for integration test causes NAVSEA to establish software quality initiatives and development gates; integration gradually improves

2010 Interoperability characterized, but still deploying warfare systems with interoperability issues, still trying to test for success

The US Surface Navy has struggled with warfare system performance as they became digital, integrated within, and interoperable between platforms.

Background – Technical Complexity

	Platform 1	Platform 2	. . .	Platform i
Combat Direction System A	X			X
Combat Direction System n		X		
Navigation System A		X		X
Navigation System m	X			
Radar A	X	X		
Radar x				X
Sonar A		X		
Sonar y				X
Weapon A	X	X		
Weapon z				X



The Surface Navy procures subsystems and uses them in various combinations to compose the warfare system (of-systems) for various platforms. Warfare systems are not developed top-down and configurations are numerous.

Background – Programmatic Complexity

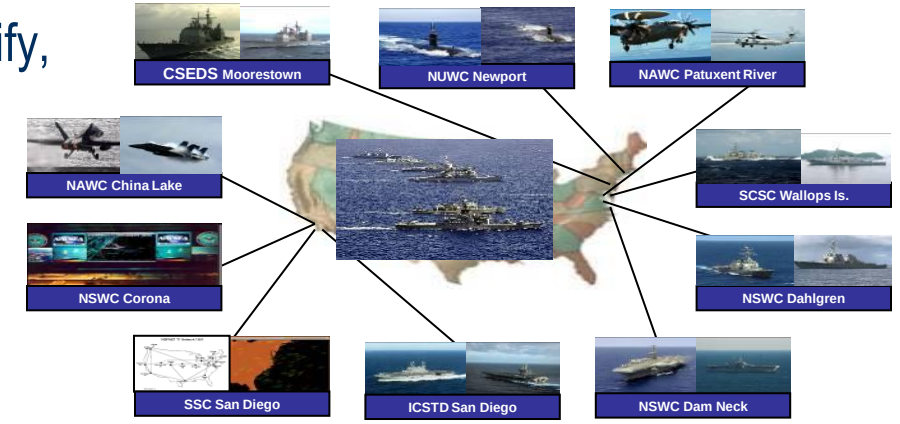
- Warfare systems composition is cross-SYSCOM and cross-PEO.
- Interoperable design today is a cooperative effort between PEOs and System Commands.
- Discovery of interoperability issues—even early in system design and development—may require prioritization of program issues given funding and schedule constraints.
- Authority higher than the Program Manager and PEO /SYSCOM is required to properly assess trade-offs and dictate resolution.

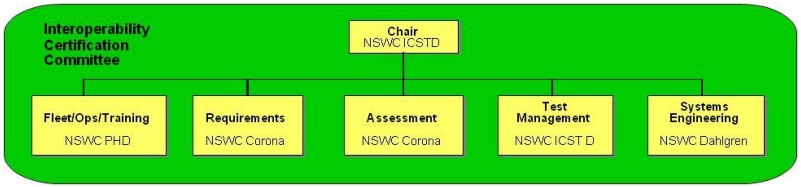
Warfare Systems

NAVSEA				SPAWAR		NAVAIR
ACDS	ESSM	NCDS/DDCN	TAS	NAVSSI	NGC2P	ADMACS
FODMS	NDDS	SPS-74	VLA	ADNS	NMT	IFF
ALIS	NFCS	SQQ-89	VLS	ADSI	SSEE/	JMPS
ASDS	GEDMS	SQS-53	ERDDS	AIS	COBLU/	MORIAH
AWS	GWS	NSSMS	SPS-67	CDF	TBMCS	TACAN
BEWT	HARPOON	NULKA	VMS	CANES	IBNS	SRQ-4
BFTT	PEP	SYS-2	DLS	CDLMS/C2P	JTT	TPX-42
BMD	IBS	RAM	SPS-49	CDLS	LINK11	TTWCS
BME	SACC-A	SSDS	WSN-7	Crypto	LINK16	MDS
CADRT	SGS/AC	TSSS	DBR	DCGS-N	NAVSSI	TCIP
SPS	SPS-73	SWAN	MK 38	DMR	ISNS	TTWCS
CDS/CEP	LRADDS	SLQ-32	SPS-48	EHF/TIP	HBSS	UPX-29
CEC	SM	USW-DSS	CV-TSC	EPLRS-DR	GCCS-M	
CIWS	MK 34	SPQ-9	MK 160			

Background - Prior Efforts

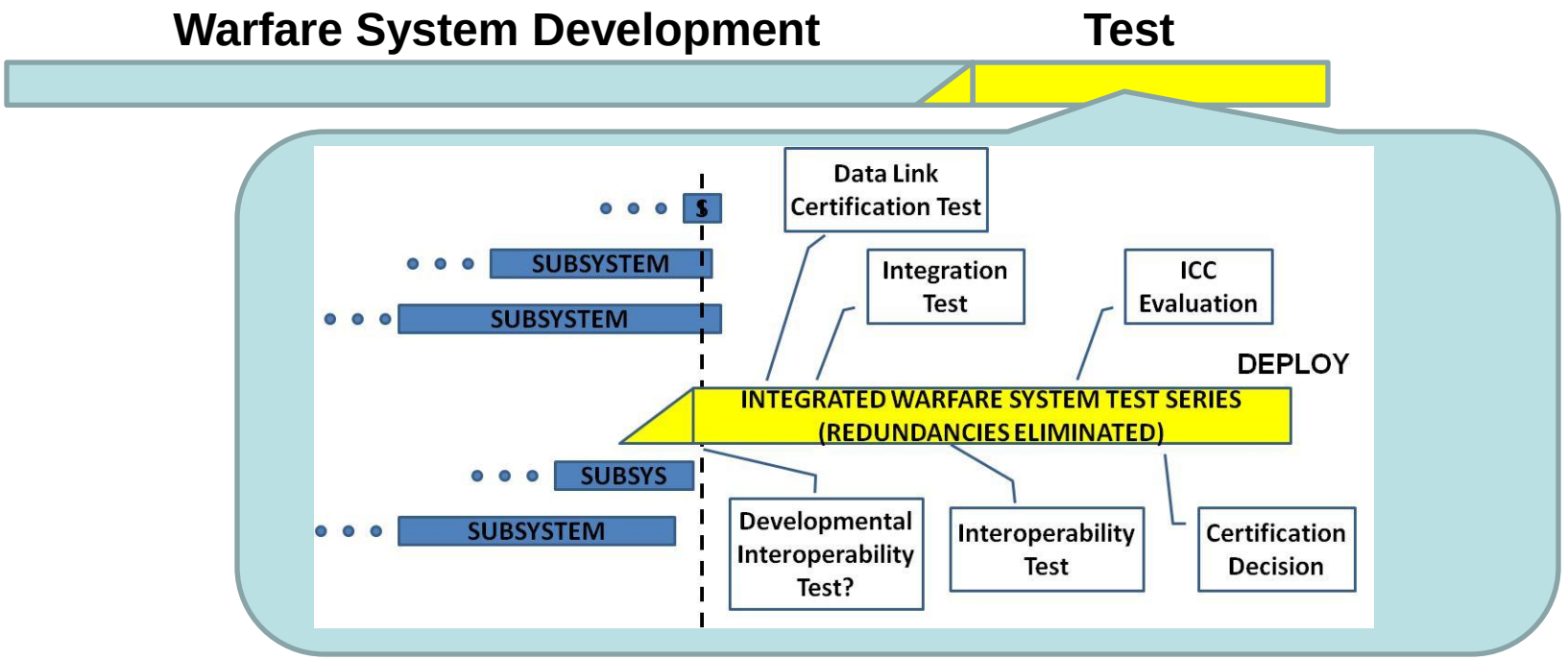
- Since 1998, OPNAV has funded the Strike Force Interoperability program to Asses, Certify, and **Improve** interoperability in the Fleet.
- SYSCOMs implemented a process to
  - Asses interoperability via a C5I Management Plan
  - Certify Warfare System interoperability via NWSCP
  - DEP and ICC improved assessment and characterization of interoperability issues.
- SYSCOM processes improved understanding of interoperability capabilities and limitations, but have not significantly **improved** interoperability
  - Discovered issues are not being fixed at a suitable rate due to technical and programmatic complexities
  - Operator workload is growing due to increasing number of "work-arounds" … and operator confidence decreasing.
- On-going budget cuts further compromise assessment and certification.





NWSCP = Naval Warfare Systems Certification Policy
DEP = Distributed Engineering Plant
ICC = Interoperability Certification Committee

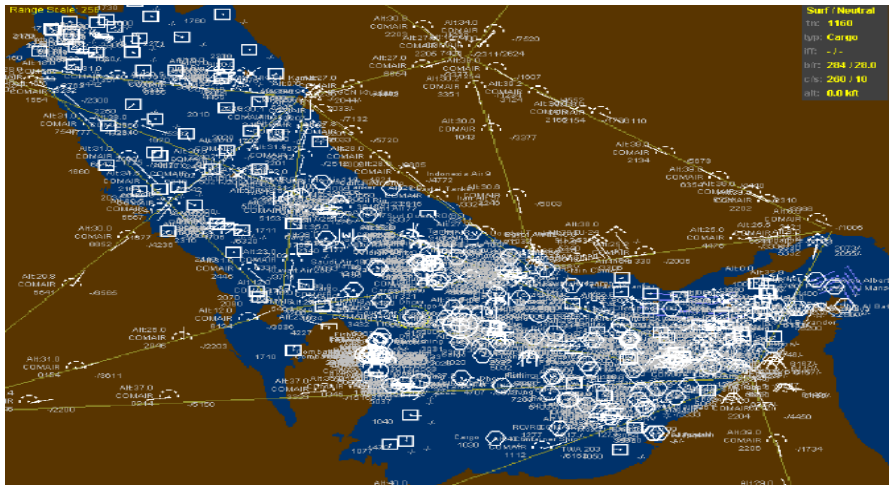
Background - Schedule Realities



All subsystems need to be complete enough to test. Delivery and support for each subsystem has to be synchronized with funding, schedule, and contract. Interoperability testing simply cannot be pushed earlier. There are also contract support issues for correction of problems identified after system acceptance.

Interoperability Challenge

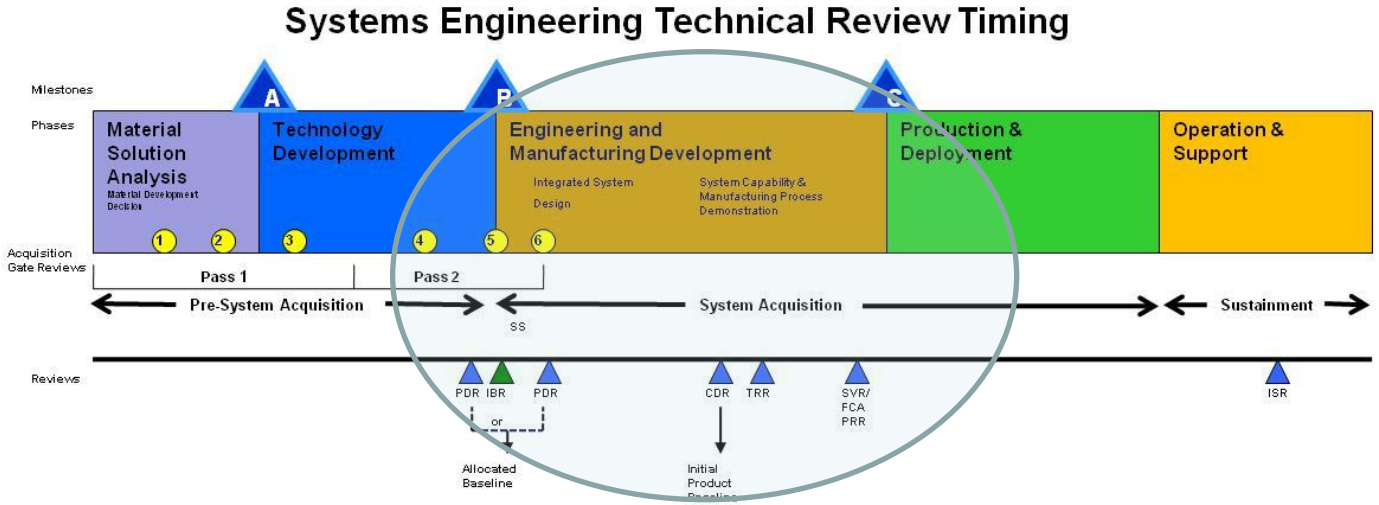
- Current subsystem design and engineering do not naturally lead to force interoperability.
- Because Navy surface warfare systems are composed after subsystem development, force interoperability gets addressed at that stage, almost always in warfare system or platform level test events.
- Efforts to effect interoperability design changes during development are frustrated by program funding, schedule, contract constraints, and program office imperatives.
- Efforts at interoperability testing earlier in warfare system development helped, but limit of early testing has been reached.



- *Fleet interoperability needs:*
  - ✓ *Complete, common, and accurate situational awareness picture*
  - ✓ *One track per object*
  - ✓ *Track number stability*
  - ✓ *Manageable picture with robust filtering*
  - ✓ *Intelligence information fused with tactical objects.*

Solution Approach

- The only approach remaining is to address interoperability as part of subsystem system engineering during development and upgrade.
- System design starts with operational requirements, but transitions to technical specification for procurement and development (Milestone B for new acquisitions).
- Interoperability issues tend to be operationally oriented, an area not familiar to most design engineers, and current instructions/requirements are vague.
- Interoperability awareness requires description of the interoperable context and injection of appropriate subject matter experts in the development process.



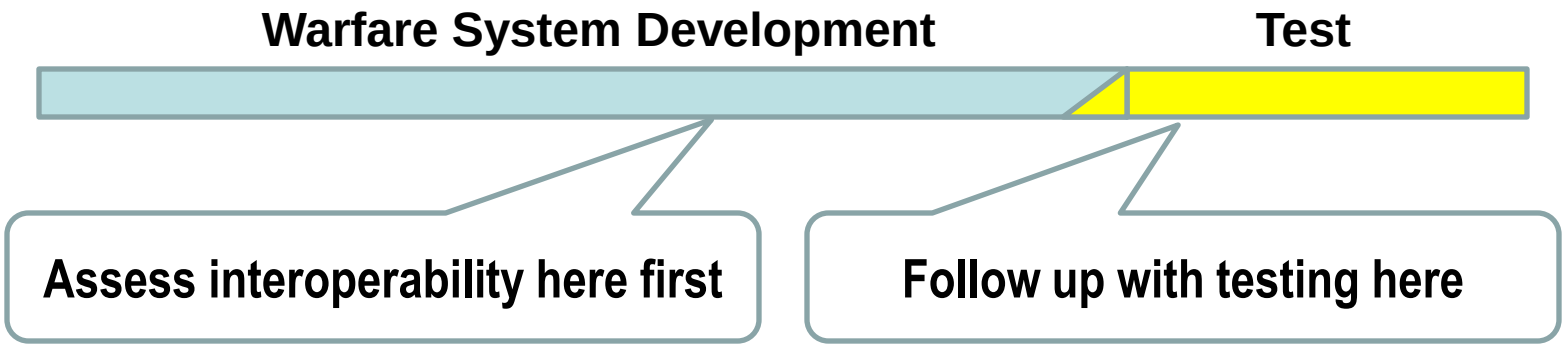
Strategy – What Is It?

- Stay within overarching direction and authorization (but clarify it).
- Provide usable fleet context for design and discussions.
- Establish processes to educate engineers on force-level interoperability influences, and monitor system development for compliance.

Strategy – Relationship to Testing

Interoperability engineering during development is a mental exercise focused by the operational context and supported by interoperability experts referencing system design documentation.

The context defined is similar to that used for interoperability testing. Design assessment flows smoothly into test.



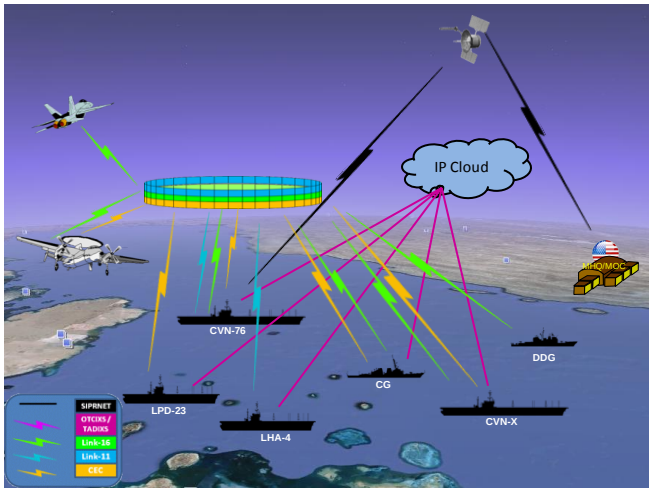
Strategy - Required Documentation

- Authorization already exists in instructions and directives.
- Directives that establish the minimum information required to support interoperability in Systems Engineering Technical Review (SETR):
  - Information exchange description that includes information originating from or being used on another platform
  - Cross-platform communication paths in system architecture
  - Explicit acknowledgement of redundant data paths or “duplicate” processing of Force data.
- Above interoperability detail needs to be reflected in both program and design documentation.
- Interoperability information is needed for legacy and legacy upgrades as well as for new systems.

Strategy – Context and Guidance

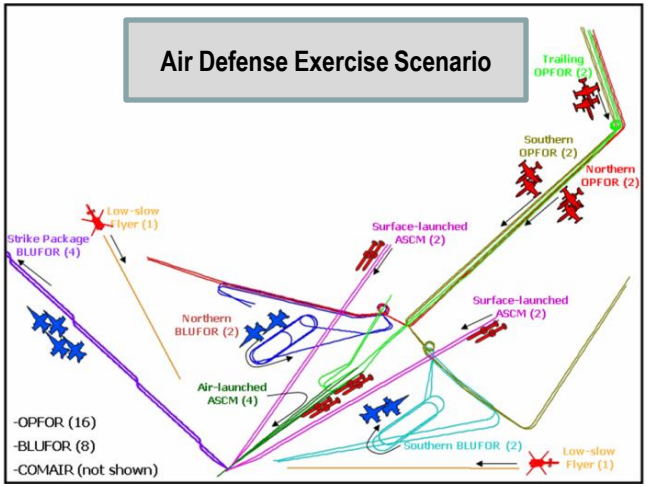
Reference Context

- Need “Reference Strike Group” to reduce scope of operational context for technical discussions
  - Define Strike Force makeup
  - Define communication architecture
- Describe scenarios for missions to be considered
  - Use same scenarios for test efforts
  - Limit to primary missions



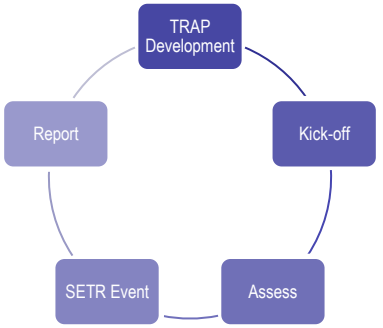
Provide guidance

- Concept of operations to provide operational context for technical discussions
- Guide to improve implementation to standards
  - Consistent interpretation
  - Lesson learned for best implementation practices
- Audit checklist in tutorial format
  - Systems Engineering use in advance of reviews
  - Interoperability Subject Matter Experts (SME) use during technical reviews



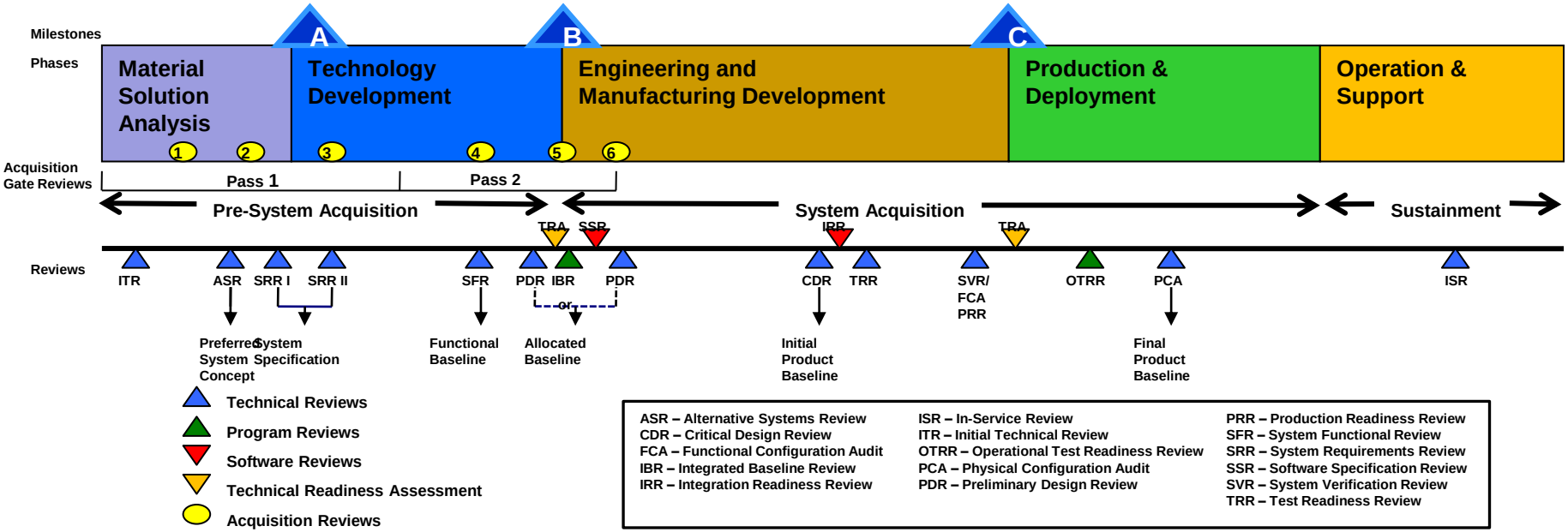
Strategy - Process

- Most SYSCOMs have effective Systems Engineering Technical Review (SETR) processes in place and staffed.
- Interoperability requires augmentation of SETR staff with interoperability Subject Matter Experts (SMEs).
- Interoperability SMEs need standardized documentation on which to base interoperability assessment.
- SETR will result in assessment of interoperability risk…conveyed in operational terms.
- Overarching authority for interoperability, working cross-SYSCOM/PEO, would be ideal.

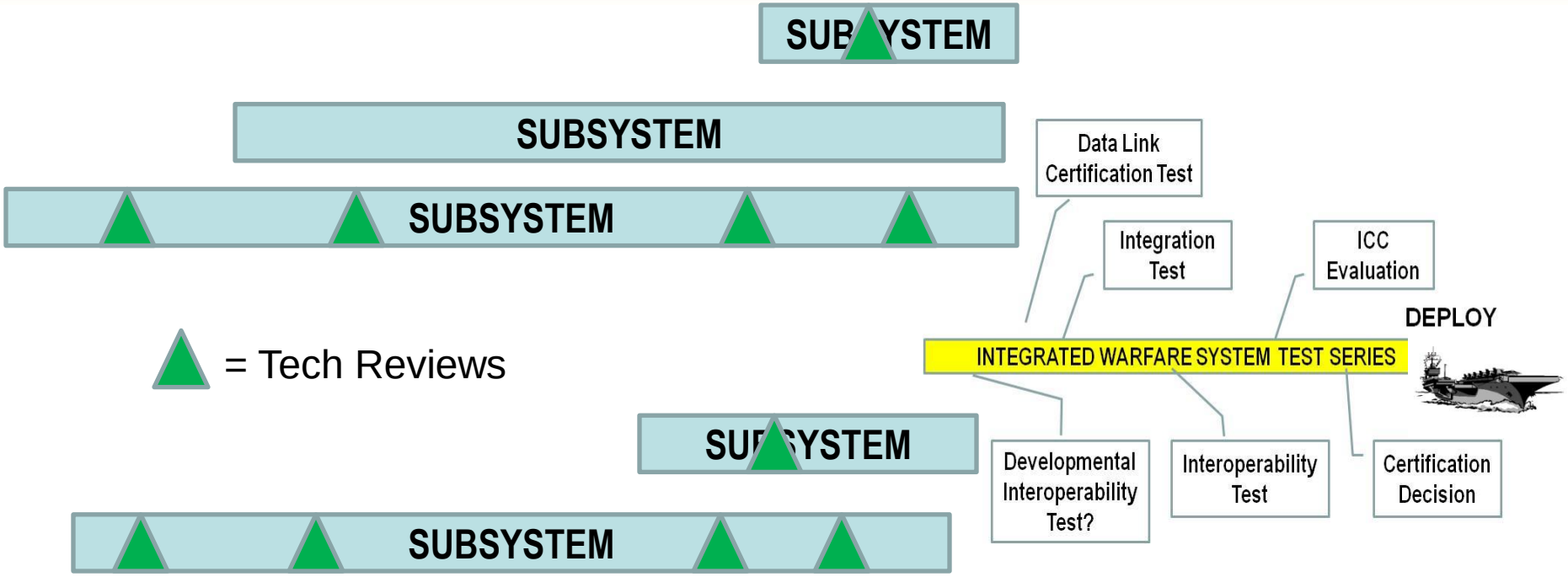


Strategy – Application Opportunities

- Utilize key design reviews
  - PDR, CDR, TRR, PRR, and ISR
  - Note that actual review dates are culmination of SME review and collaboration with Program Office
  - SETR team provides guidance, checklist, reference material, and expert support as required, including Fleet input.



Strategy - Results



This strategy moves interoperability forward in the overall schedule to permit time for issue correction in addition to identification…

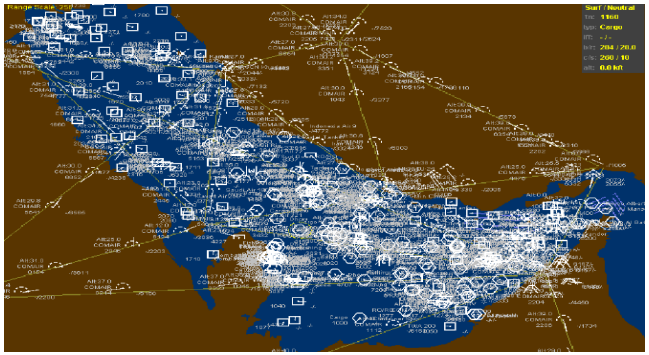
Because simply finding the problem is not enough.

Strategy - Challenges

- Data Management
  - Many databases; non-uniform data and issue assessment
- Subject Matter Experts
  - Rare and in high demand
- Collaboration
  - Key to assessment process but everyone can't keep travelling
- Transition Time
  - Must allow for FYDP and contractual adjustments and process execution (ROI return not in same year as investment)
- Funding
  - Always tough but now we need to fund systems believed to have been already paid for
- Designating Overall Authority

Summary

- The Navy has maximized the utility of test for achieving interoperability in the surface force.
- Testing alone has proven inadequate to achieve desired fleet interoperability state.
- Aggressive interoperability systems engineering is the next (and only remaining) step to achieving fleet interoperability.



By Design