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16th ICCRTS: Collective C2 in Multinational Civil-Military Operations

Networking the Global Maritime Partnership

Track 9: Networks and Networking

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Mr. George Galdorisi
Dr. Stephanie Hszieh

June 22, 2011

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Outline

- Background
- Perspective
- The Challenge of Naval Coalition Networking
- Tell It To The Labs: Achieving Coalition Networking
- A Way Forward

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Background

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"Partnerships are an integral part of our Maritime Strategy today. From the highest level of warfare to the humanitarian assistance missions, Global Maritime Partnerships are playing a decisive role in keeping the peace."

Admiral Gary Roughead
Chief of Naval Operations
Rhumb Lines
September 3, 2008

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"In this age, I don't care how tactically or operationally brilliant you are, if you cannot create harmony – even vicious harmony – on the battlefield based on trust across service lines, across coalition and national lines, and across civilian/military lines, you really need to go home, because your leadership in today's age is obsolete."

General James M. Mattis
Then Commander, Joint Forces Command
Remarks at the Joint Warfighting Symposium
May 13, 2010

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Networking the Global Maritime Partnership

- Globalization has brought nations closer together and increased world-wide prosperity
- Navies under-gird the ability of nations to trade across the global commons
- Globalization has facilitated all forms of international terrorism
- No one navy can police the global commons – a Global Maritime Partnership is needed

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Networking the Global Maritime Partnership

- Navies working together to police the global commons must be effectively networked
- This networking is crucial to develop a common operational picture and to self-synchronize
- Emerging C4ISR technologies are critical to networking navies
- The fact that navies have led networking at sea often obscures technological challenges

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Perspective

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"When John Fisher became First Sea Lord in 1904, his main pledge was to solve this intractable problem … Fisher in effect invented picture-based warfare. He created a pair of war rooms in the Admiralty, one built around a world (trade) map, the other around a North Sea map."

Dr. Norman Friedman

"Netting and Navies: Achieving a Balance"

Sea Power: Challenges Old and New

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H.M.A.S. SYDNEY

"Most think that bigger, faster, and more is best when talking about providing technology to naval forces. But this is not always the case. What matters in not how *much* you communicate, but rather getting the right information to the right people at the right time."

Professor Nicholas Rodger
Exeter University
Keynote Address
2007 King Hall Conference

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Perspective

- Maritime coalitions have existed for at least two and a half millennia and navies have communicated at sea for at least that long
- Over time, the need to *communicate* at sea has morphed to the need to *network* at sea – and this networking has a rich, century-long history
- Understanding this history is important in our efforts to successfully network coalitions at sea in the future
- The globalization of commerce has made the need for a global maritime partnership (GMP) an *urgent* requirement to support worldwide prosperity
- Networking navies is a *necessary condition* for a GMP but technological advances among navies have often been uneven – impeding effective networking
- We have “beta-tested” and will share one methodology for networking navies more effectively

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The Challenge of Naval Coalition Networking

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"In today's world, nothing significant can get done outside of a coalition context, but we have been *humbled* by the challenges of devising effective coalition communications."

Dr. David Alberts
Director of Research
Assistant Secretary of Defense for
Networks Information Integration
U.S. Department of Defense
7th International Command and Control
Research and Technology Symposium
September 2002

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"Information sharing is a fundamental requirement for meeting most of the current challenges to international maritime security. The notion of a regional maritime partnership in the American continent and the Caribbean demands effective information-sharing capabilities in order to become a reality."

Commander Alberto Soto, Chilean Navy
"Maritime Information-Sharing Strategy"
Naval War College Review
Summer 2010

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Technological Advances and Networking

- Coalition partners working with the U.S. Navy often want to know the "price of *admission*"
- From the U.S. perspective it is more about the "price of *omission*" if we can not work together
- It is not ship hulls or aircraft airframes that enable this – but C4ISR technologies
- If each coalition partner develops these technologies independently, chaos can ensue

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Technological Advances and Networking

- The “need for speed” often drives each navy to push technology forward independently
- Coordinated technological development in parallel offers one promising solution to this
- This must then translate to parallel acquisition of systems that are mutually compatible
- This sounds great in theory, but is there a “best-practice” model that we can examine?

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Tell It To The Labs:
Achieving Coalition Networking

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"What we build and what we subsequently sell to foreign navies used to be low priority for the Naval Sea Systems Command. Today, with the Thousand Ship Navy and the Global Maritime Partnership, this is now a huge part of what we do."

Vice Admiral Paul Sullivan
Commander, Naval Sea Systems Command
NLUS Sea-Air-Space Symposium
Washington, D.C.
March 20, 2008

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"The Technical Cooperation Program (TTCP), a longstanding forum for defence science and technology cooperation between Australia, Canada, New Zealand, the United Kingdom and the United States, has, for example, established an initiative to consider the 'FORCEnet Implications for Coalition Partners.'"

Dr. Chris Rahman

The Global Maritime Partnership Initiative: Implications for the Royal Australian Navy

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Tell it to the Labs: Achieving Coalition Networking

- Effective nation-to-nation defense laboratory cooperation has been going on for over a half-century under the auspices of The Technical Cooperation Program (TTCP) and other entities
- TTCP leadership has recognized the challenges to effective coalition networking at sea
- In 2001, the TTCP Maritime Systems Group commissioned a team to address this issue
- This five-nation cooperative effort has completed two three-year efforts and future work is planned
- We are sharing our results as one best-practices model for all nations represented here

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Our "Beta-Test" Under the Auspices of The Technical Cooperation Program: One Path to "Building the Networks"

One Model for International Defense and Networking Cooperation: MAR AG-1/AG-6

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MAR Action Group 1:
"Maritime Network Centric Warfare"

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MAR AG-1

- Maritime Network Centric Warfare
  - Open ended
- Focus on “bounding the problem”
  - Good product
- Proof of concept through multilateral analysis
- Warfighting scenarios with traction for all
- Two Studies
  - Broad Issues: First Principles of NCW
  - Tactical Level Analysis: MIO/ASW/ASuW

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AG-1 Membership

Chairman

Mr. R. Christian (US)

Australia	Canada	New Zealand	United Kingdom	United States
Dr. C. Davis (NL)	Mr. P. Sutherland (NL)	Dr. D. Galligan (NL)	Mr. A. Sutherland (NL)	Mr. J. Shannon (NL)
Ms. S. Andrijich (M)	Mr. R. Burton (M)	Mr. C. Phelps (M)	Mr. P. Marland (M)	Dr. R. Klingbeil (M)
Ms. M. Hue (M)	Mr. M. Hazen (M)		Mr. R. Lord (M)	Dr. S. Dickinson (M)
Dr. I. Grivell (M)	Mr. B. Richards (M)			Mr. G. Galdorisi (M)*
Dr. D. Sutton (M)				
Dr. M. Fewell (M)				

Notes: NL = National Leader
M = Member

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MAR AG-1 Study B
Tactical Level Analysis

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ASW TACSIT Analysis

Improving ASW Effectiveness – NCASW Concepts and Hypotheses

1 Shared Situational Awareness (SSA)

Network- enabled Shared Situational Awareness (SSA) can reduce false contact loading thereby increasing ASW effectiveness.

2 Collaborative Information Environment (CIE)

Sensor operators in a network-enabled collaborative environment can reach-back to ASW experts to improve target and non-target classification performance.

Queueing Theory can provide an intuitive mathematical and physical framework for the analysis of any military system or operation that can be characterized as a "waiting line" or a "demand-for-service."

Metric for SSA Concept Analysis

Reduce false contact loading on the ASW system by improving Shared Situational Awareness (SSA)

$P_{ASW} = P_{DET} * P_{CLASS} * P_{LOC} * P_{ATK}$

$P_{CLASS} = P_{ACQ\ CLASS} * P(T|t)$

$P_{ACQ\ CLASS}$ = probability that the target acquires classification service

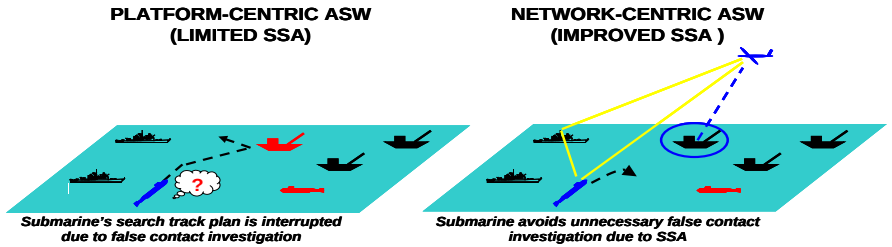
$P(T|t)$ = probability of recognizing the target contact as the actual target of interest (experimental data required)

T = THREAT DECISION

t = true target

There are queueing aspects (waiting line/demand for service) in each of the terms in P_{ASW}

False Target Reduction Concept

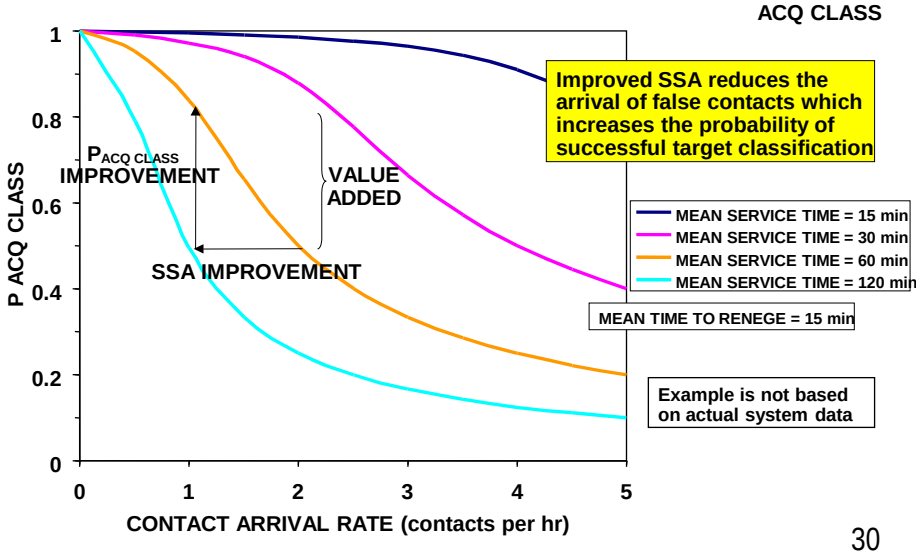


- Congestion of sonar, high workload
- Time to investigate false contacts
- Reduction of effective search rate
- Missed detections of targets

- Information is essential
- System to remove specified sensor contacts
- Can possibly lower detection threshold
- Increased probability of target detection

- Use sensor correlation across all appropriate platforms in a task group to reduce the number of non-target contacts presented to sensor operators.
- Reduce non-object false contacts, such as reverberation spikes and wrecks, by using acoustic models, in situ data, and local data bases.

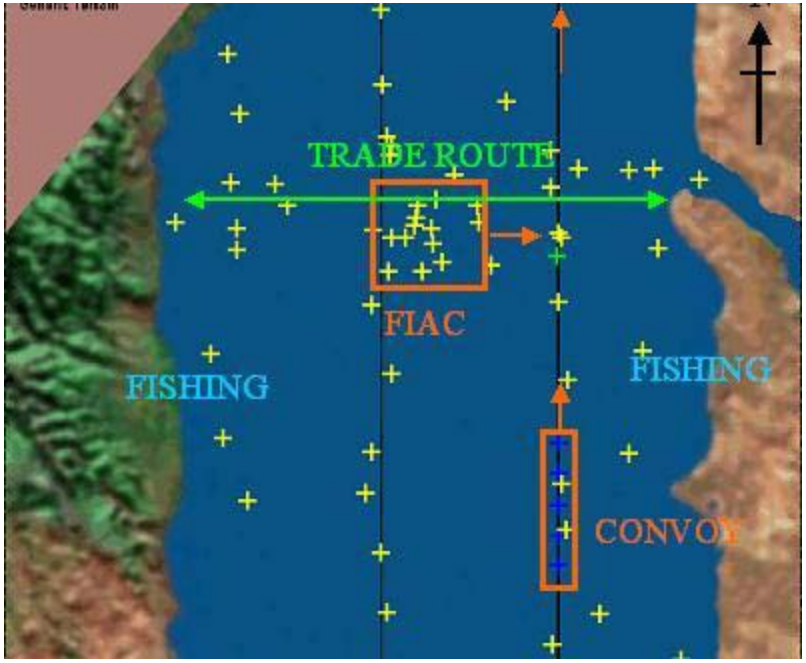
Effect Of Improved SSA and Service Time on P



ASuW/Swarm TACSIT Analysis

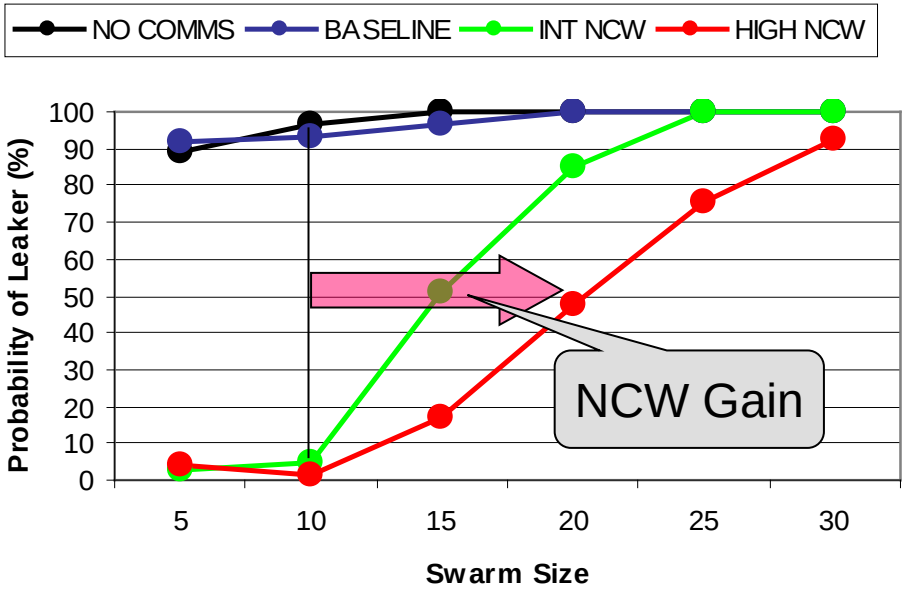
Tacsit: Blue force in restricted sea room is attacked by a swarm of FIAC. Network enabled Blue shared situational awareness and distributed targeting reduces the number of 'leakers.'

Metrics: Probability of one or more FIAC reaching firing position against HVU. Fractions of FIAC leaking, and of Blue escorts damaged. Collateral damage.



Study has used MANA agent based model to represent the Swarm's dynamic tactics, with four levels of Blue networking capability.

Sample Results: (30 knot FIAC)



- Intermediate and High levels of networking increase Force survivability versus Type 1 FIAC by factor of ≈9.
- Full results include dependencies on Red speed (leakers increase at 40 knots).

AG-1 Study “Takeaways”

- Any analysis must begin with the recognition that there will likely be a significant networking capability gap between U.S. and coalition partners
- This analysis must evaluate the impact of technology insertion on a networked coalition naval force
- Networking would most benefit coalition naval forces in planning and re-planning, training, and reach-back to better intelligence
- More study is needed….

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MAR Action Group 6: "FORCEnet Implications for Coalitions"

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MAR AG-6

- Leverage AG-1 work
- Build on AG-1 work but added:
  - More specificity regarding ops and force structure
  - More granularity to analysis and modeling
- Work within a realistic operational scenario that all member nations would participate in
- Produce a product that informs national leadership and acquisition officials

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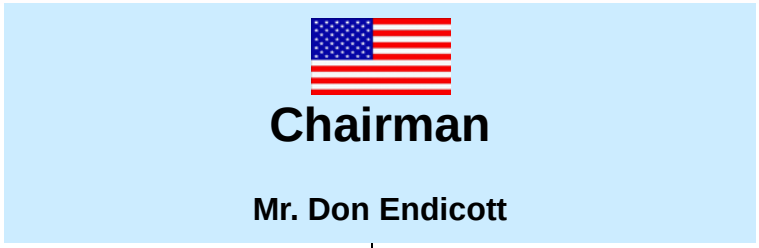
AG-6 Membership



Australia	Canada	New Zealand	United Kingdom	United States
Dr. A. Knight (NL) Ms. R. Kuster (M) Ms. A. Quill (M) Mr. M. Coombs (M)	Mr. R. Mitchell (NL) Mr. M. Maxwell (M) Dr. M. Lefrancois (M)	Dr. D. Galligan (NL)* LCDR W. Andrew (M)	Mr. A. Sutherland (NL) * Mr. P. Marland (M) * Mr. M. Lanchbury (M)	Mr. D. Endicott (NL) Mr. G. Galdorisi (M)* Mr. P. Shigley (M) Ms. M. Gmitruk (M) Mr. T. McKearney (M) Ms. M. Elliott (M)

Notes: NL = National Leader
M = Member
* = Former AG-1 member

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What is FORCEnet?

FORCEnet is an "…operational construct and architectural framework for naval warfare in the information age, integrating warriors, sensors, command and control, platforms, and weapons into a networked, distributed combat force."

Admiral Vern Clark
Then Chief of Naval Operations
U.S. Naval Institute Proceedings
October 2002

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Premises

- FORCEnet will empower warfighters at all levels to execute more effective decision-making at an increased tempo, which will result in improved combat effectiveness and mission accomplishment.
- The warfighting benefits of FORCEnet in a coalition context can be assessed through analysis and quantified to provide input to national balance of investment studies of the five member nations.
- It is necessary that FORCEnet address current and near term information system requirements that support operations in the joint and coalition environments. **Coalition Communications was the clear number one priority** of all numbered fleet commanders and is a critical enabler in leveraging coalition partners in the GWOT.

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Hypothesis

- Conducting modeling and simulation and detailed analysis to demonstrate the enhanced warfighting effectiveness of coalition partners (in this case – the AUSCANNZUKUS nations) netted in a FORCEnet environment can help inform national naval C4ISR acquisition programs.

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Notional Coalition Order of Battle

Australia	United Kingdom
▼2 ANZAC Frigates ▼2 FFG ▼1 AWD	▼ 1 LPH/LPD ▼ 2 LSD ▼ 1 Replenishment Ship
Canada	**United States**
▼ 1 Destroyers ▼ 2 Frigates ▼ Replenishment Ship ▼ Submarine	▼ 3 Amphibious Assault Ships ▼ 1 Cruiser ▼ 2 Destroyers ▼ 3 Littoral Combat Ships ▼ 1 Attack Submarine
New Zealand	
▼ 2 ANZAC Frigates ▼ 1 Replenishment Ship ▼ 1 Multi-role Vessel	

Operational Scenario

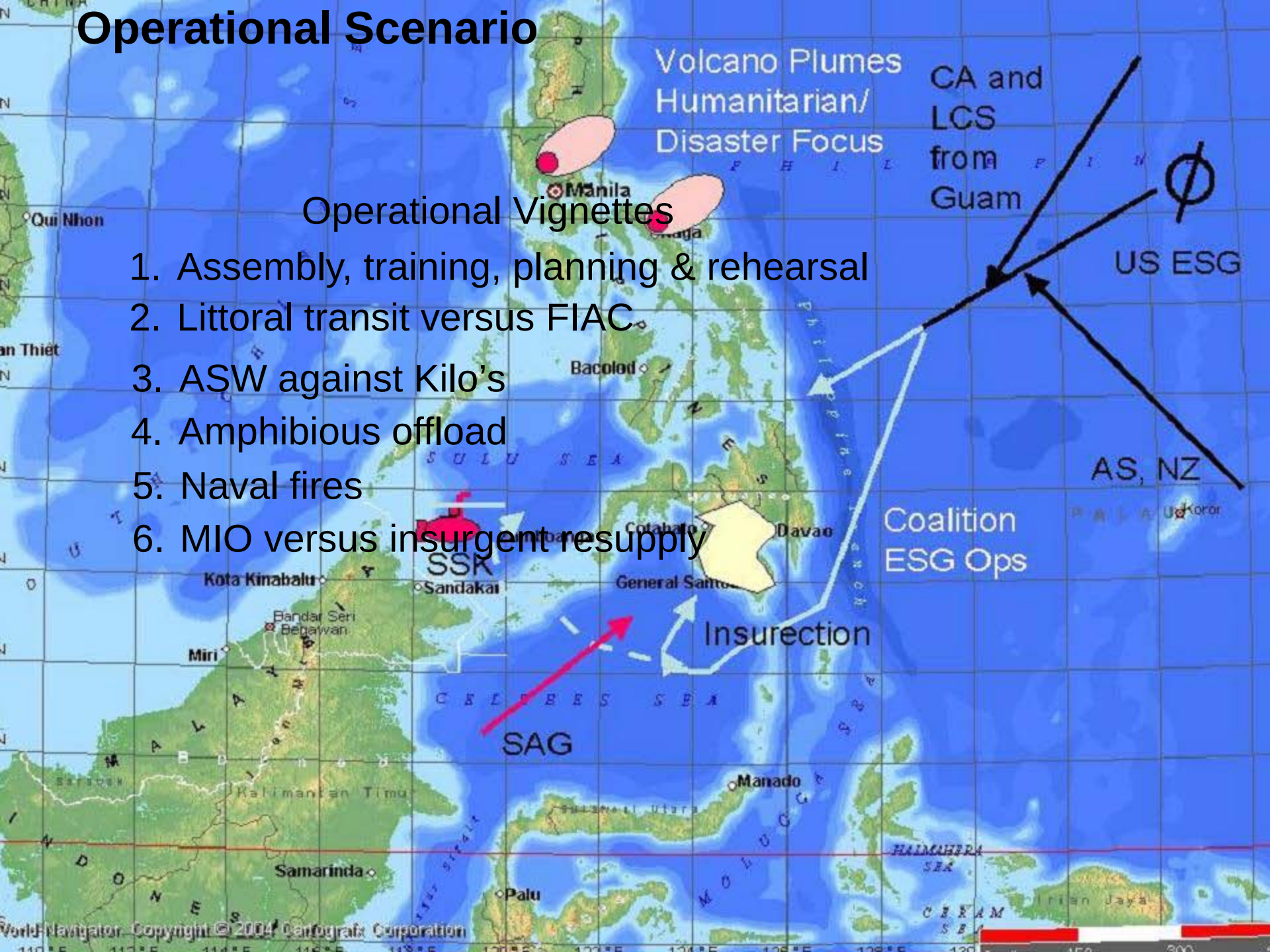
Disaster Relief/Humanitarian Assistance

Dealing with Terrorist Insurgency

Conflict with Southeast Asian Military

World Navigator. Copyright © 2004 Cartografx Corporation

Operational Scenario



Summary of Key Findings

- FORCEnet improves military performance in every vignette assessed
- Improvements primarily in process time, decision making, information availability and planning
- Force effectiveness higher when all coalition units operate at same FORCEnet level

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A Way Forward

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"We will win – or lose – the next series of wars in our nation's laboratories."

Admiral James Stavridis
SOUTHCOM Commander
"Deconstructing War"
U.S. Naval Institute Proceedings
December 2005

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"Haiti showed us once again that we must be interoperable to be effective."

Vice Admiral Adam Robinson
Chief, Bureau of Medicine and Surgery
Remarks at the Navy League of the
United States Sea-Air-Space Symposium
May 4, 2010

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Summary and Conclusions

- Over time, especially in the past several decades, the need to *communicate* at sea has morphed into the need to *network* at sea
- Today no navy stands alone & networking navies effectively is a necessary condition for a global maritime partnership
- Technological advances among navies have been uneven – impeding effective networking between navies
- We have “beta-tested” one methodology for networking navies more effectively and this model can be extrapolated to other nations and navies

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A Way Forward

- The rich history of naval cooperation to secure the global commons offers good examples of how our navies can cooperate today while raising the bar for how these navies work together in the future
- Today, globalization and a wide range of challenges mean that no navy stands alone and all navies must work together even more closely in peace and in war
- Networking navies effectively via C4ISR technologies *concurrently developed* is a *necessary* condition for mutual security and prosperity via an effective global maritime partnership
- The AUSCANNZUKUS example of naval cooperation under the auspices of The Technical Cooperation Program offers one example of how to begin to tackle C4ISR interoperability challenges at the lab level

"Since 2002, the Technical Cooperation Program has focused the efforts of its Maritime Systems Group (MSG) on "Networking Maritime Coalitions" and "FORCEnet and Coalitions Implications." The MSG has become an important link among national naval C4ISR acquisition programs … For that very reason these [Latin American and Caribbean nations] should tenaciously strive to become involved in initiatives like MSG."

Commander Alberto Soto, Chilean Navy
"Maritime Information-Sharing Strategy"
Naval War College Review
Summer 2010

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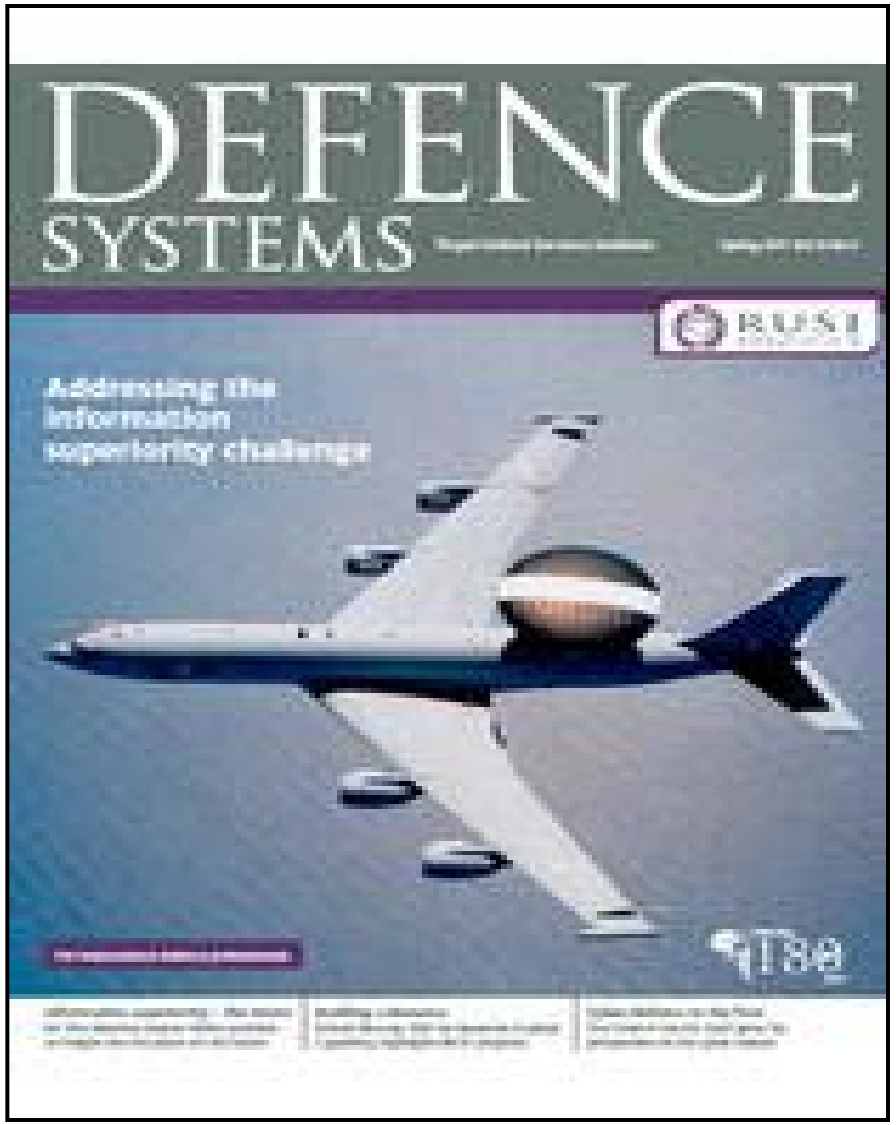
DEFENCE
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Addressing the information superiority challenge

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Questions?

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Backup

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Initial Modeling Results - Summary

	Summary	Operational Impact	MoE Analysis
Assembly	Network capability limits time required to build force	Force can plan in advance of rendezvous, training time reduced	Total force at Fn Level1 reduced time required “in company” from 3 to 1 day
FIAC	Networking with increased ISR, flexible ROE enhances ability to counter	Gain in reducing probability of FIAC “leaker” attacking HVU	Fn level 0 or 1 little impact, Level 2 doubles size of swarm that can be countered
ASW	Increased networking impacts in both planning and common operational picture	Gains realizes in better networking of sensors and ISR assets (MPA, helo)	Fn Level 1 allowed OTH sensor monitoring and increase in predicted HVU survivability from .55 to .85.
Offload	Networking shared landing craft resources speeds delivery of on-cal relief supplies	Flexibility in delivering supplies to beach as HA mission unfolds	Fn Level 3 produced impact as all landing craft assets were able to service any supplying ship
Fires	Call-For- Fire process evolves from voice to digital data exchange	Reduced time allows for improved initial accuracy, less chance of targets escaping	Time to engage reduced from 55 min (Fn Level 0) to 2 min (Fn Level 3)
MIO	Range of networked capabilities for detection, tracking, and search of CCOIs have potential for improved performance	Better CCOI tracking through enhanced planning, asset management. Boarding party tools for personal safety and reachback into HQ databases	Probability of acquiring CCOI increased from .1 to .7 with Fn Level 1. Fn Level 2 needed for enhanced database tool and ISR integration

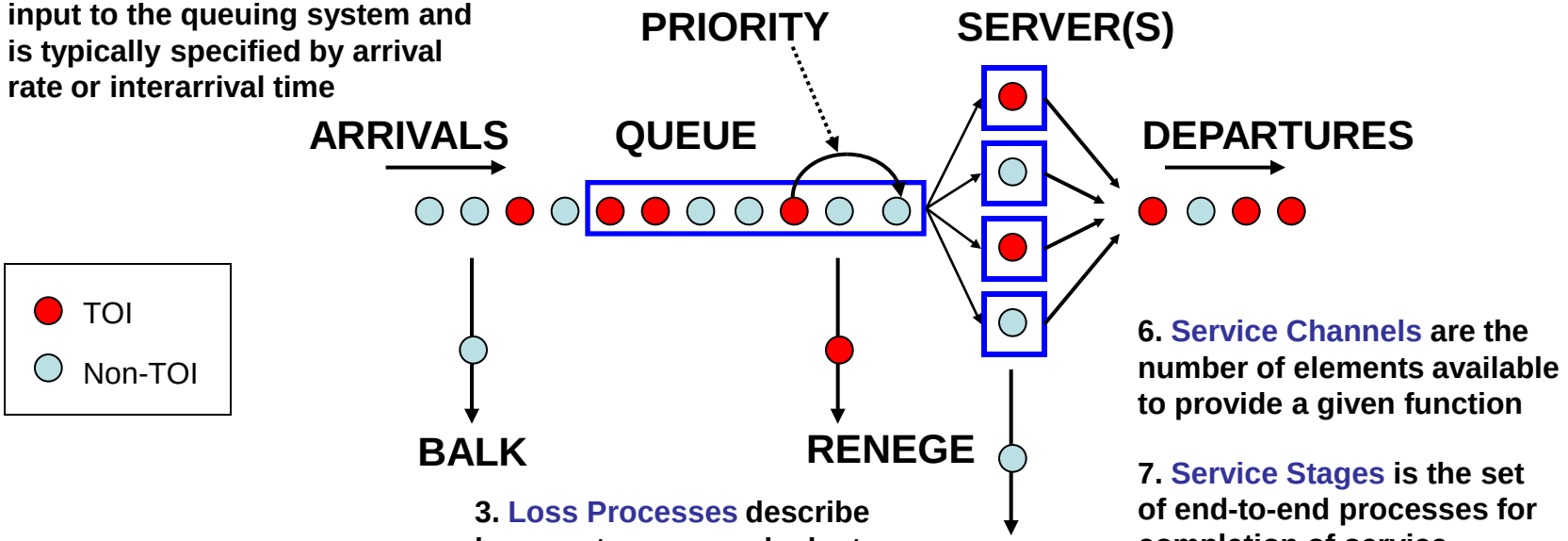
Queuing System for MIO

4. **Queue Discipline** describes how a customer is selected for service once in queue (FIFO, priorities, etc.)

5. **System Capacity** is the maximum size of a queue; finite or infinite

2. **Service Pattern** is described by service rate or service time

1. **Arrival Pattern** describes the input to the queuing system and is typically specified by arrival rate or interarrival time



6. **Service Channels** are the number of elements available to provide a given function

7. **Service Stages** is the set of end-to-end processes for completion of service

3. **Loss Processes** describe how customers can be lost (balking and reneging)

KEY QUEUEING METRICS:
- **Probability of a customer acquiring service**
- **Waiting time in queue until service begins**
- **Loss rate due to either balking or reneging**

Queueing Theory interrelates key system characteristics and can be used to identify where investment should be made to improve performance and effectiveness

TTCP Groups

- Aerospace Systems (AER)
- Command, Control, Communications, & Information Systems (C3I)
- Chemical, Biological, and Radiological Defense (CBD)
- Electronic Warfare Systems (EWS)
- Human Resources and Performance (HUM)
- Joint Systems and Analysis (JSA)
- Land Systems (LAN)
- **Maritime Systems (MAR)**
- Materials and Processes Technology (MAT)
- Sensors (SEN)
- Conventional Weapons Technology (WPN)

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MAR Construct

- **Technical Panels:**
  - TP-1: C2 and Information Management
  - TP-9: Sonar Technology
  - TP-10: Maritime ISR & Air Systems
  - TP-13: Mine Warfare and HF Acoustics
- **Action Groups:**
  - AG-1: Net Centric Warfare Study*
  - AG-2: Novel Maritime Platform Systems
  - AG-3: Torpedo Defense
  - AG-4: Surface Ship Air Defence Systems
  - AG-5: Force Protection
  - AG-6: FORCEnet Implications for Coalitions*

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