The Global Maritime Partnership: Networking Challenges and Opportunities

Building the Global Maritime Partnership Vision

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January 24, 2011
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.
Naval Coalitions in History
“The early advocates of networking were all naval and they saw wider distribution of information as a way of empowering lower-level leaders. These leaders would understand the overall plan, and they would ‘self-synchronize’ to make it work.”

Dr. Norman Friedman
Netting and Navies: Achieving a Balance
RAN Sea Power Conference
January/February 2006
Networking at Sea
“The basic notion of networking is not new. Networks have existed ever since the first human communities emerged in mankind’s dim prehistory…

…What is different today is the speed, precision, capacity and reach of the most advanced networks. That is truly unprecedented – so much so that they are transforming civilization.”

Dr. Loren Thompson

*Networking the Navy: A Model for Modern Warfare*
No Navy Stands Alone and Networking Navies Effectively is a Necessary Condition for a Global Maritime Partnership
“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
*RhumbLine*
September 3, 2008
“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
Commander, Joint Forces Command
Remarks at the Joint Warfighting Symposium
May 13, 2010
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
Networking the Global Maritime Partnership

- Navies working together to defeat terrorists 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
Technological Advances Among Navies Have Been Uneven – Impeding Effective Networking Between Navies
“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
“Is there a place for small navies in network-centric warfare? Will they be able to make any sort of contribution in multinational naval operations of the future? Or will they be relegated to the sidelines, undertaking the most menial of tasks, encouraged to stay out of the way— or stay at home?…The “need for speed” in network-centric operations places the whole notion of multinational operations at risk.”

Professor Paul Mitchell
Former Director of Academics
Canadian Forces College
*Naval War College Review* – Spring 2003
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 cannot 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
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?
We Have “Beta-Tested” and will Share one Methodology for Networking Navies More Effectively
“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
“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*
The Technical Cooperation Program

- Defense-wide organization with emphasis on S&T
- Stable vehicle for collaborative efforts between and among five allies
- Valuable worldwide network of scientists and engineers that delivers technical advice
- Facilitates interoperability downstream through S&T collaboration
TTCP Current 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)
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*
Maritime Action Groups

- AG-1: “Maritime Network Centric Warfare”
  ...morphed into...
- AG-6: “FORCEnet Implications for Coalitions”
  ….is morphing into…
- AG-11: “Harmonizing C4ISR Acquisitions”
Our “Beta-Test” Under the Auspices of The Technical Cooperation Program:
One Path to “Building the Networks”

One Model for International Defense Cooperation: MAR AG-1/AG-6
MAR Action Group 1: “Maritime Network Centric Warfare”
MAR Action Group 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
Two Component Studies

Study B (Tactical Level)
- TACSIT-based analysis (relevant, littoral)
- Sense-Decide-Respond
- Connectivity dependence
- Tactical MOEs/MOPs

Study A (Broad Issues)
- First Principles in NCW
- Quantitative analysis of alternative networking options in ISR/Operational Planning, as related to Study B TACSITS

Coalition Force Configuration

Equal Partnership

Unequal Partnership

Decision Time Scale

Short → Decision Time Scale → Long

Leverage Study B TACSITS
MAR AG-1 Study B
Tactical Level Analysis
1. **Arrival Pattern** describes the input to the queuing system and is typically specified by arrival rate or interarrival time.

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

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

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.

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.

**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.
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)

\[
P_{\text{ASW}} = P_{\text{DET}} \times P_{\text{CLASS}} \times P_{\text{LOC}} \times P_{\text{ATK}}
\]

- \( P_{\text{CLASS}} \) = probability that the target acquires classification service
- \( P_{\text{ACQ CLASS}} \) = 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 \( P_{\text{ASW}} \)

Effect Of Improved SSA and Service Time on \( P_{ACQ \ CLASS} \)

Improved SSA reduces the arrival of false contacts which increases the probability of successful target classification.
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 $\approx 9$.
- 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
MAR Action Group 6
“FORCEnet Implications for Coalitions”
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.
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.
### AG-6 Measures of Effectiveness

<table>
<thead>
<tr>
<th>High Level MoE:</th>
<th>Contributing Elements and Notes:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MoE1</strong></td>
<td><strong>Mission Outcome</strong> - no loss of major units (HVU) and successful completion of vignette mission</td>
</tr>
<tr>
<td>Mission Success</td>
<td></td>
</tr>
<tr>
<td><strong>MoE2</strong></td>
<td><strong>Minimise blue attrition</strong> - sum total of unit losses during vignette</td>
</tr>
<tr>
<td>Risk</td>
<td></td>
</tr>
<tr>
<td><strong>MoE3</strong></td>
<td><strong>Cost</strong>, for fuel and munitions expended in vignette</td>
</tr>
<tr>
<td>Economy of Effort</td>
<td></td>
</tr>
<tr>
<td><strong>MoE4</strong></td>
<td><strong>Time to Capability</strong> - gives credit for increased speed of integration of force for mission implied in vignette  Limits enemy’s ability to generate his own forces.</td>
</tr>
<tr>
<td>Time to Capability</td>
<td></td>
</tr>
</tbody>
</table>
Notional Coalition Order of Battle

<table>
<thead>
<tr>
<th>Australia</th>
<th>United Kingdom</th>
</tr>
</thead>
<tbody>
<tr>
<td>▼ 2 ANZAC Frigates</td>
<td>▼ 1 LPH/LPD</td>
</tr>
<tr>
<td>▼ 2 FFG</td>
<td>▼ 2 LSD</td>
</tr>
<tr>
<td>▼ 1 AWD</td>
<td>▼ 1 Replenishment Ship</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Canada</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>▼ 1 Destroyers</td>
<td>▼ 3 Amphibious Assault Ships</td>
</tr>
<tr>
<td>▼ 2 Frigates</td>
<td>▼ 1 Cruiser</td>
</tr>
<tr>
<td>▼ Replenishment Ship</td>
<td>▼ 2 Destroyers</td>
</tr>
<tr>
<td>▼ Submarine</td>
<td>▼ 3 Littoral Combat Ships</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>New Zealand</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>▼ 2 ANZAC Frigates</td>
<td></td>
</tr>
<tr>
<td>▼ 1 Replenishment Ship</td>
<td></td>
</tr>
<tr>
<td>▼ 1 Multi-role Vessel</td>
<td></td>
</tr>
</tbody>
</table>
AG-6 Summary of Findings

▼ Increased levels of FORCEnet are generally associated with higher levels of coalition effectiveness
  - Force effectiveness is higher when all units are at the same level of Fn

▼ There is no ‘sweet spot’ in Fn. Generally
  - Fn level 0 provides about a 10% gain over ‘do nothing’
  - Fn level 1 provides about a 35% gain over level 0
  - Fn level 2 provides about a 35% gain over level 1
  - Fn level 3 provides about a 20% gain over level 2

▼ Heterogeneous levels of Fn impact differently on vignettes, but differential Fn level greater than 1 degrade force effectiveness
  - Impact of differential is to marginalize elements at lower levels or to slow the overall C2 process and delivery of effect
  - Fundamental finding applicable to all NCW

▼ US sharing FORCE net roadmaps would better inform coalition acquisition and enable the Global Maritime Partnership
  - Coalition members will need to consider changes to their programs of record and POM programs to align with Fn opportunities

▼ US will need to maintain legacy C4ISR products during their Fn migration phases to ensure coalition backwards compatibility, whilst other nations catch-up
Summary and Conclusions...

...and a suggested road ahead
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.
“To function effectively, the 1,000-ship Navy will not only require high levels of international political support to foster the necessary levels of cooperation, but also will be heavily technologically dependent.”

Dr. Chris Rahman

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

Papers in Australian Maritime Affairs
“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
“We cannot talk about maritime power without talking about the cooperation between the U.S. Navy and our coalition partners.”

Admiral Gary Roughead
Chief of Naval Operations
NLUS Sea-Air-Space Symposium
Washington, D.C.
“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
Questions?
Backups
## Initial Modeling Results - Summary

<table>
<thead>
<tr>
<th>Summary</th>
<th>Operational Impact</th>
<th>MoE Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assembly</strong></td>
<td>Network capability limits time required to build force</td>
<td>Total force at Fn Level 1 reduced time required “in company” from 3 to 1 day</td>
</tr>
<tr>
<td><strong>FIAC</strong></td>
<td>Networking with increased ISR, flexible ROE enhances ability to counter</td>
<td>Fn level 0 or 1 little impact, Level 2 doubles size of swarm that can be countered</td>
</tr>
<tr>
<td><strong>ASW</strong></td>
<td>Increased networking impacts in both planning and common operational picture</td>
<td>Fn Level 1 allowed OTH sensor monitoring and increase in predicted HVU survivability from .55 to .85.</td>
</tr>
<tr>
<td><strong>Offload</strong></td>
<td>Networking shared landing craft resources speeds delivery of on-cal relief supplies</td>
<td>Fn Level 3 produced impact as all landing craft assets were able to service any supplying ship</td>
</tr>
<tr>
<td><strong>Fires</strong></td>
<td>Call-For- Fire process evolves from voice to digital data exchange</td>
<td>Time to engage reduced from 55 min (Fn Level 0) to 2 min (Fn Level 3)</td>
</tr>
<tr>
<td><strong>MIO</strong></td>
<td>Range of networked capabilities for detection, tracking, and search of CCOIs have potential for improved performance</td>
<td>Probability of acquiring CCOI increased from .1 to .7 with Fn Level 1. Fn Level 2 needed for enhanced database tool and ISR integration</td>
</tr>
</tbody>
</table>
“There’s no one in the Navy leadership who thinks that the Navy can do this alone…if we want to embrace the thousand-ship navy [concept] and maritime security initiatives, we have to make sure that we don’t leave a large majority of our partners behind.”

Vice Admiral Mark Edwards
Deputy Chief of Naval Operations for Communication Networks (N6)
*Seapower Magazine*
April 2008