



Technical Architecture for Arctic Security

2014 NDIA Systems Engineering
Conference

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Today: Emergent Situation

- Existing international collaborations
- Insufficient navigation aids
- Limited communications
- Lack of basic infrastructure

Near term: Increased Traffic

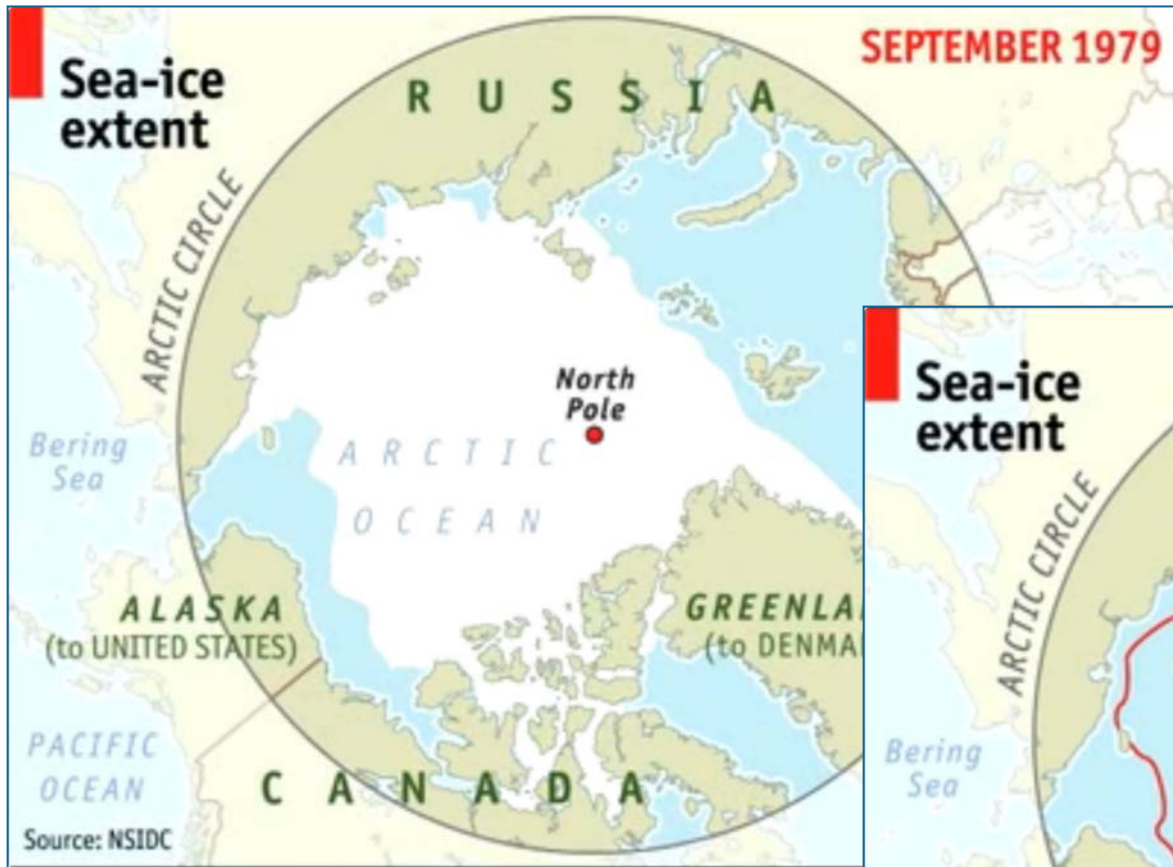
- Communication capacity
- Environmental impact
- Search & rescue authority/operations

Far term: Uncertainty

- Permanent exploitation assets
- Disputes over natural resources
- Increased international cooperation



Retreat of Summer Arctic Ice: 1979-2011



Arctic region warming faster than the rest of the planet



- Opens new, shorter routes
- Access to undiscovered resources

NATIONAL STRATEGY FOR THE ARCTIC REGION

“Foster partnerships with the State of Alaska, Arctic states, other international partners, and the private sector to more efficiently develop, resource, and manage capabilities, where appropriate and feasible, to better advance our strategic priorities in this austere fiscal environment .”

MAY 2013



- **Evolve Arctic Infrastructure and Strategic Capabilities** – We will carefully tailor this regional infrastructure, as well as our response capacity, to the evolving human and commercial activity in the Arctic region.
- **Enhance Arctic Domain Awareness** –endeavor to appropriately enhance sea, air, and space capabilities as Arctic conditions change, and to promote maritime-related information sharing with international, public, and private sector partners...

Arctic Security Initiative meeting

Monday, August 19, 2013

On August 15, the Arctic Security Initiative convened a Technology Working Group of policy and technical experts to discuss the continuing challenges of operating in the Arctic, one of a series focused on how best to help policy makers understand both the importance and the challenges of the US Arctic region. Today's discussions focused on navigation, communications, and response systems, all important aspects of Arctic operations but currently not as functional as they need to be. The group also discussed the application of new communication, navigation, and unmanned systems technology in a complex and changing Arctic environment, with the intention of creating concise policy recommendations that can be implemented in the High North to support US interests.



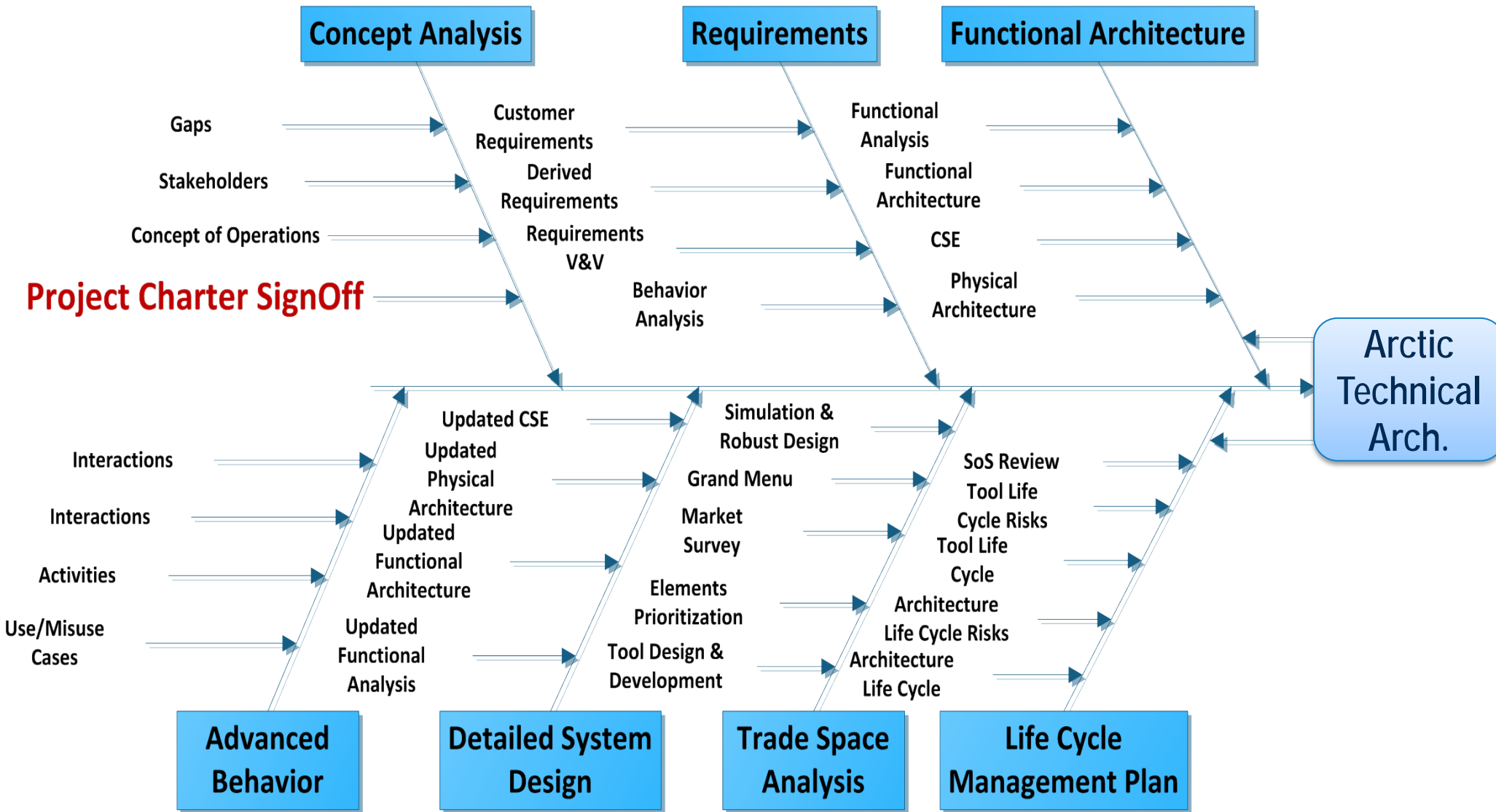
Image credit: Janet Chang

The changing global climate and the diminishing Arctic ice cap have made the Arctic more accessible now and in the foreseeable future.

When combined with economic and political developments, the changing Arctic is the most significant physical global event since the end of the last Ice Age. An unresolved strategic territory, the increased activity suggests that the region could become the subject of intensive negotiations and possible friction and confrontation relating to resources, ocean access, and sovereignty. In light of those changes and challenges, the Hoover Institution Arctic Security Initiative has been put in place to address the strategic and security implications of increased activity and to identify opportunities for shaping a safe, secure, and prosperous Arctic.

(<http://www.hoover.org/research-teams/arctic-security-working-group>)

- Complex architecture / problem space
- Evolutionary development, much uncertainty
- Many stakeholders, regional/commercial/military
- Multi-national agreements and cooperation
- System of system with many performance gaps
- Balance of priorities
- Need for technology roadmapping and investment strategy
- Lack of tradespace insight for policy making



Gap Analysis

Gap#1 Satellite Communications

Gap#2 Radio Communications

Gap#3 Aids to Navigation (AtoN)

Gap#4 Real-Time Navigation

Gap#5 Forecasting Messaging

Gap#6 Charting

Gap#7 Monitoring Arctic

Gap#8 Search & Rescue

Gap#9 Use of Situation Reports (SITREPS)

Gap#10 C3 Search and Rescue (SAR) Log

Gap#11 International Coordination

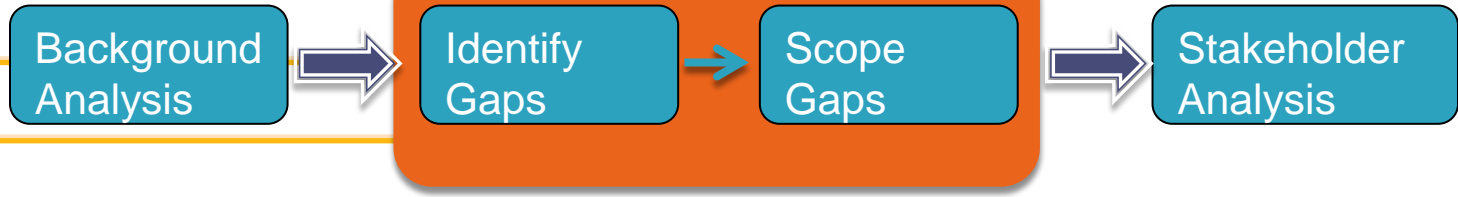
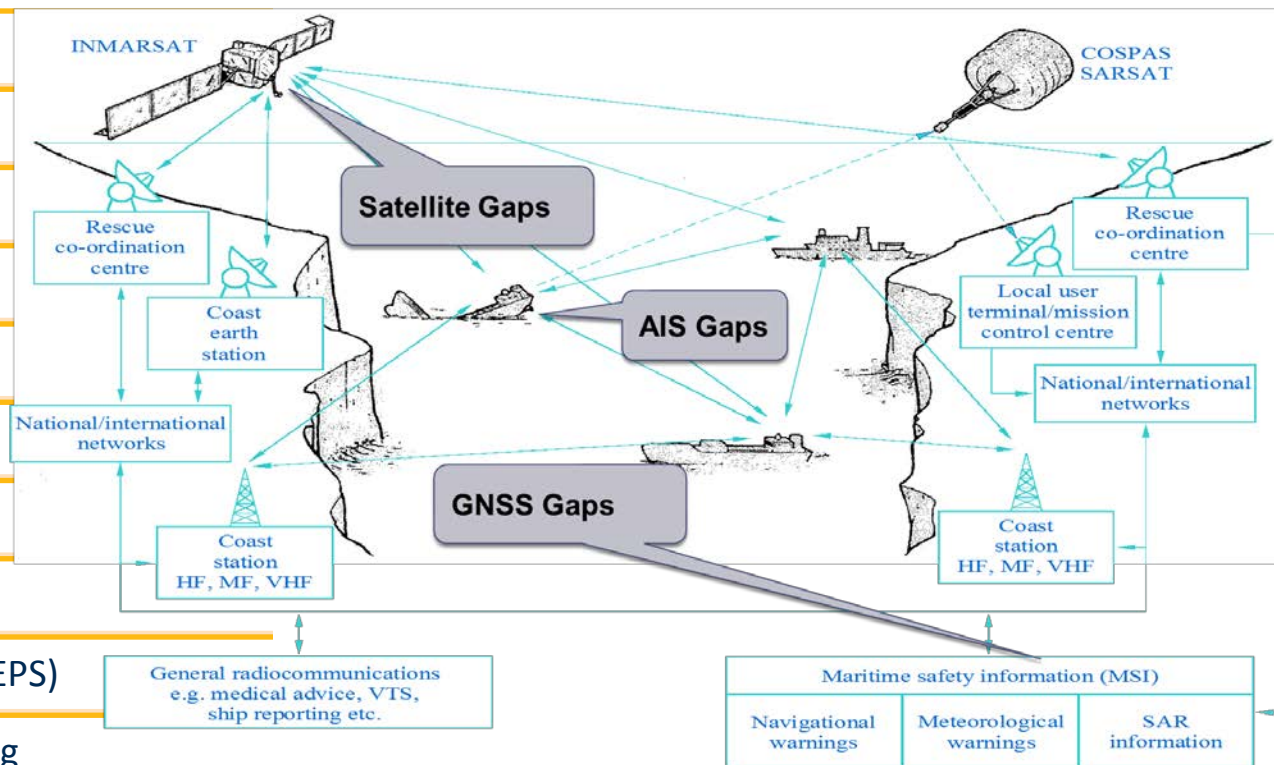
Gap#12 Interagency Coordination

Gap#13 Commercial capabilities

Gap#14 Scalability

Gap#15 User Friendly

Gap#16 Reliability



Satellite Gaps in the Arctic

	System	Characteristics	Polar (>80)	Sub-Polar (70 N - 80 N)	Other (< 70 N)
Terrestrial	HF, MF	<i>Safety related messages and voice communications</i>	Ok, but unsuitable for digital communications	Ok, but unsuitable for digital communications	Ok, but unsuitable for digital communications
	VHF, digital VHF, GSM, 3G	<i>Line-of-sight, voice and low data rate</i>	No base stations, Ok ship-to-ship	Few base stations, OK ship-to-ship	VHF is OK close to the coast, GSM/3G limited coastal coverage
Satellite	GEO satellites	<i>Medium capacity, low to medium latency</i>	Not available	Potential problems with quality and availability	OK (Except in special areas)
	LEO satellites, Iridium Open Port	<i>Currently max 128 kbps High and variable latency</i>	Potential problems with quality	Potential problems with quality	Ok, except for areas around equator
	HEO satellites	<i>Properties comparable to GEO. Currently unavailable</i>	Expected to provide good coverage, capacity and quality in the Polar and Sub-Polar areas. Spare capacity can be used in other sea areas. Not yet implemented		

Stakeholders

Stakeholder	Interests
Senior Arctic Official	Arctic Council senior member, chairs the council during host country term
U.S. Coast Guard (USCG)	Primary agency responsible for law enforcement and incident response in the region
Department of Defense	DoD agencies provide support to the Arctic through their normal missions and capabilities, which support the Arctic Theater although sometimes are limited by the environment.
U.S. Navy	Executive agency for Maritime Domain Awareness, provides global support as required
U.S. Air Force	Enhanced Polar Satellite communications, provides global support as required
U.S. Army, U.S. Marine Corps	Provides global support as required
National Oceanic & Atmospheric Administration (NOAA)	Science, services, and stewardship, including information and products
Dept. of the Interior, Bureau of Ocean Energy Management	Mineral Management Services
The Arctic Council	International governance, agreements, and priorities
Indigenous populations	Approval over changes to the infrastructure
Commercial marine traffic	Shipping, recreation, fishing, etc.
Commercial Oil & Gas, Mineral Industries	Development
Non-government Organizations	Stewardship and oversight of the region
Private Salvage /Search & Rescue industry	Commercial response services

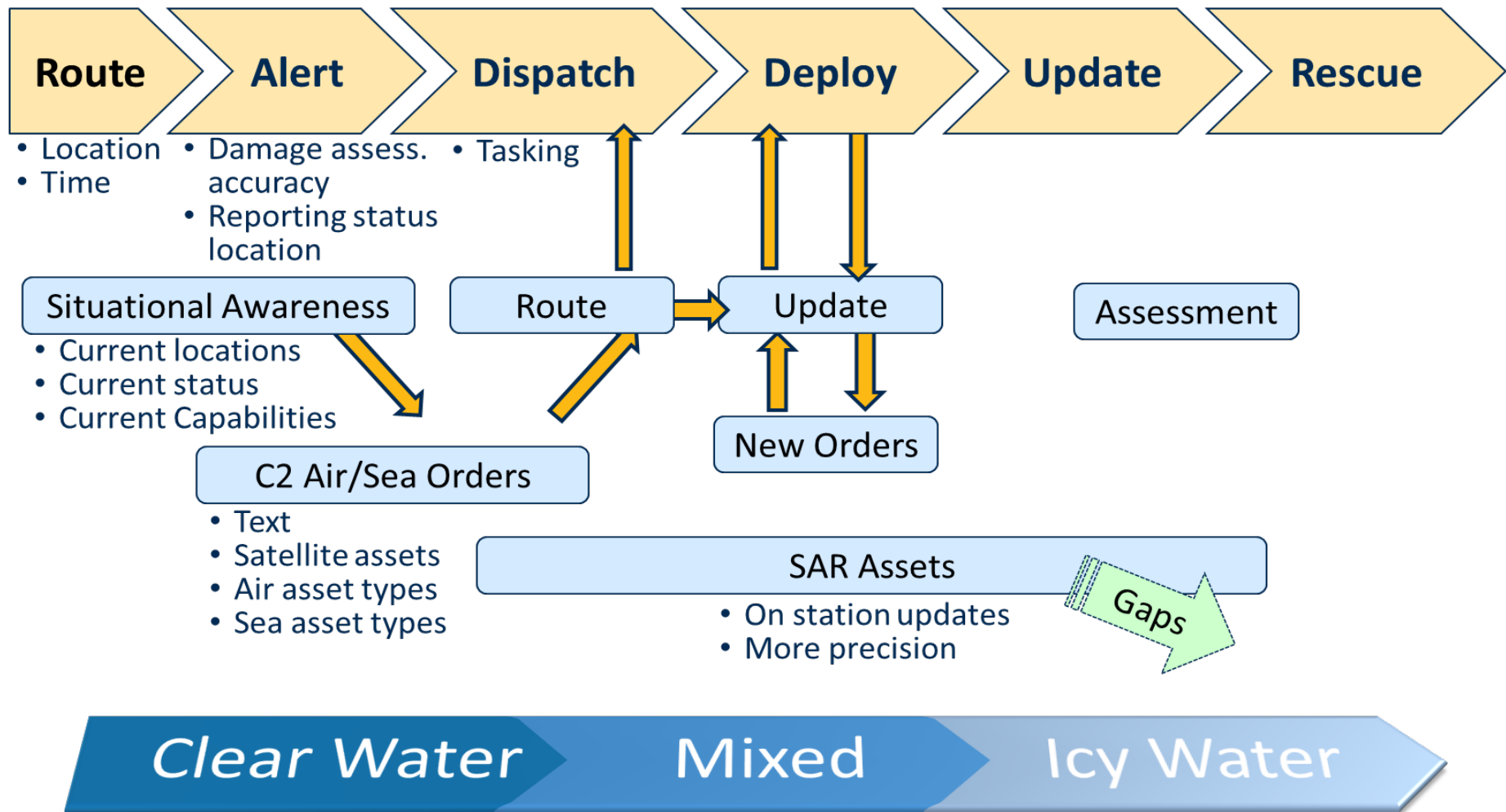
- Stranded ships
 - Tourist Cruise
 - Oil/mineral
 - Exploration team
 - Fishing
- Disruption of indigenous folkways
- Ecological disasters
 - Oil Spill



**Common thread: all result due to dynamic
“landscape” as ice melts**

- Primary: Search and Rescue (SAR)
 - Governed by IMO International Aeronautical and Maritime Search and Rescue (IAMSAR) guidelines, MSC.1/Circ.1367, 24 May 2010
- Primary: Maritime Domain Awareness (MDA)
 - Governed by US DoD Directive 2005.02E, August 27, 2008
- Primary: Maritime Transportation
- Supporting: Law Enforcement & Coastal Security
- Supporting: Marine Environmental Protection
- Supporting: Oceanographic Research
- Supporting: Environmental Forecasting (NOAA)

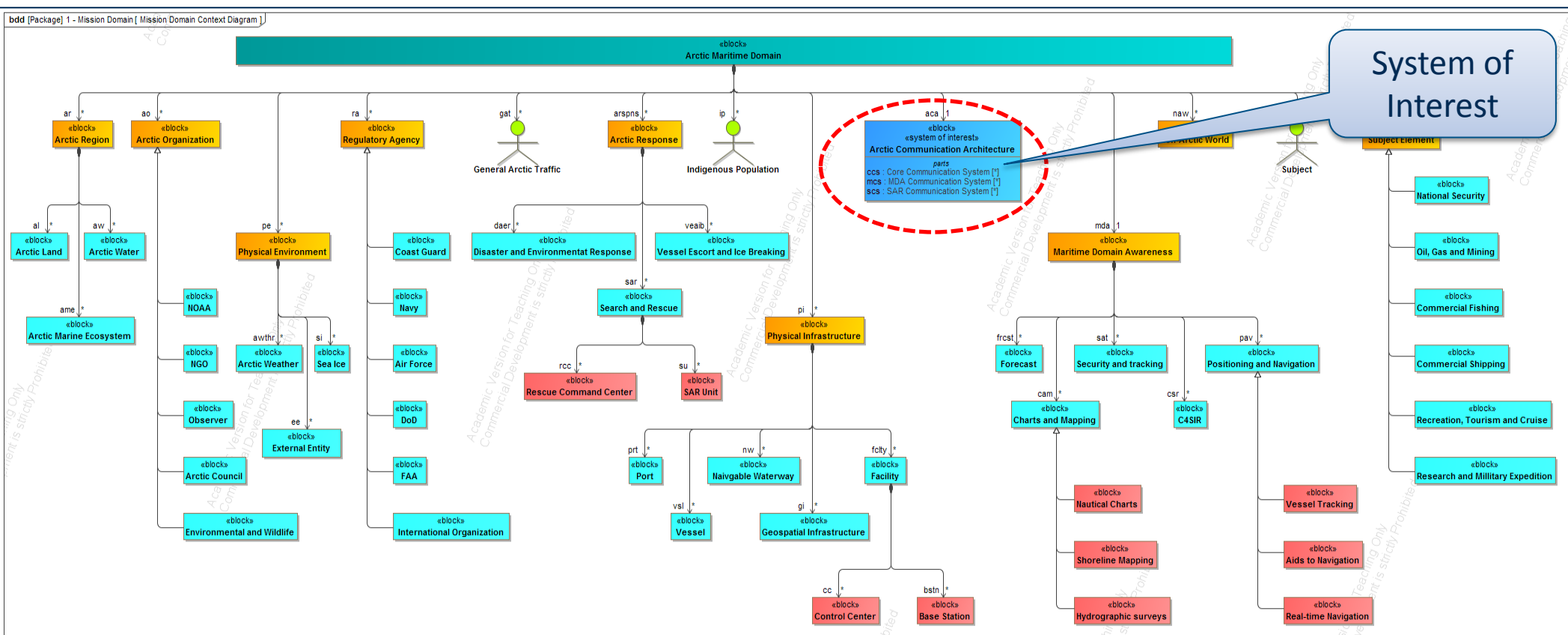
ARCTIC COUNCIL MANDATE: SUPPLY BASIC SAR CAPABILITY TO THE REGION



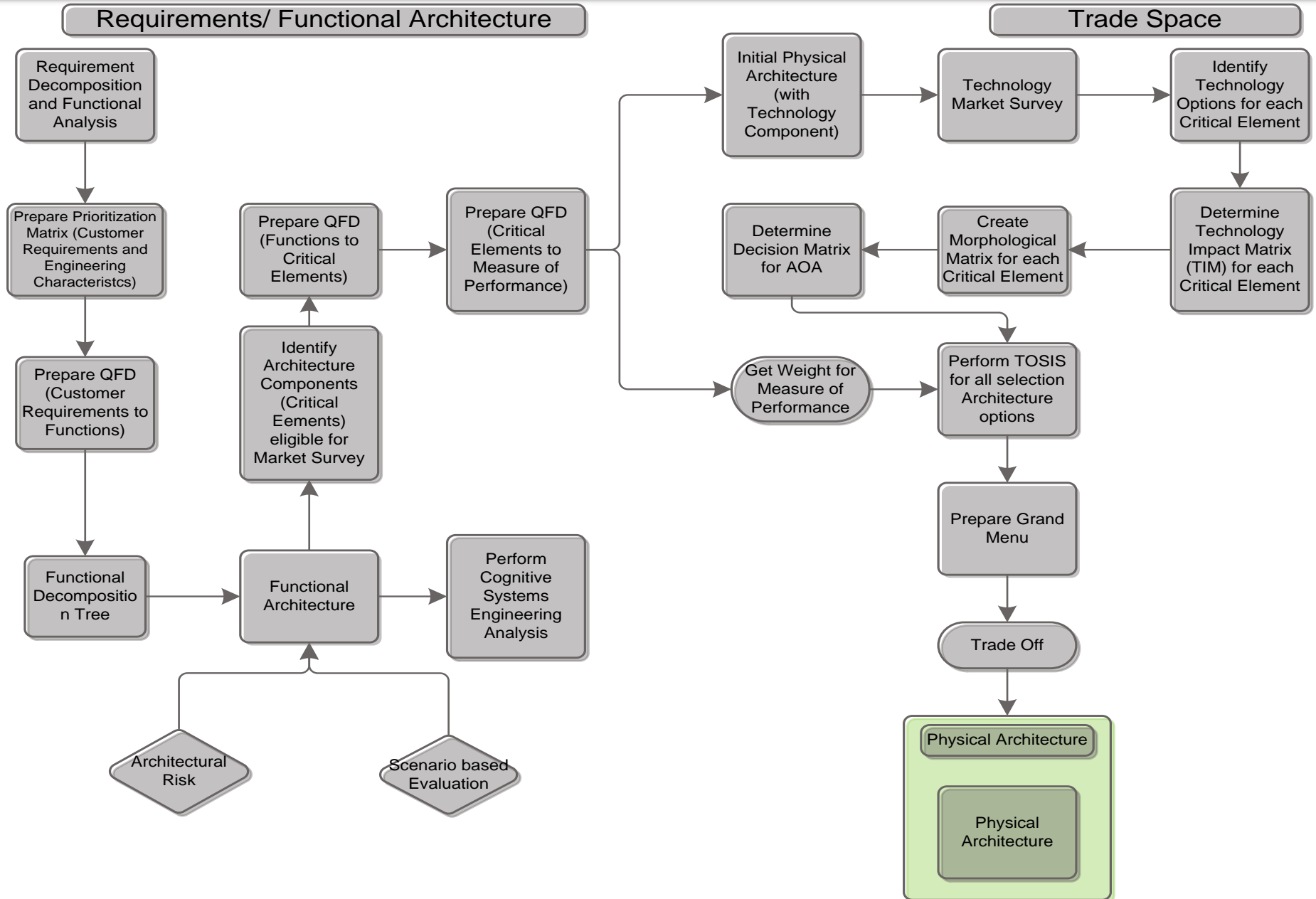
- **Reporting**
 - Unreliable vessel reports and tracking lead to false searches
- **Event location**
 - Weather
 - Distance to responding ships
 - Distance to responding aircraft
 - Accurate coordination and reporting of search areas
- **Communication**
 - Ship positioning/occlusion
 - Bandwidth/channels for data, particularly internet data
 - Effective C2 capability (operational picture)
- **Navigation**
 - Routing through or around ice
 - Real time updates
- **General**
 - Technology standardization and interoperability
 - Language and country unique operations

SySML Model for Arctic Communications

- Arctic Communication gaps form SoS capstone opportunity for Masters students
- Completed gap/capabilities analysis, SySML model, Tradespace analysis tool, initial simulation



Trade Space Analysis for Arctic Communications



- Evolving problem
- International stakeholders expecting US leadership
- Unique technical environment
- Limited budgets, higher priorities
- Lack of insight for policy-making
- Solid understanding of current/future technical architecture promotes:
 - Investment planning/technology roadmaps
 - Tradespace analysis
 - Multi-stakeholder decision making
 - Balance of support based on evolving needs



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