NAVAL
POSTGRADUATE
SCHOOL

MSSE Project 2005: FORCEnet Implications for Coalitions

NUWC Keyport Cohort 1 and

NSWC Port Hueneme Cohort 3

MSSE Capstone Project

Background - Stakeholders

- The Technical Cooperation Program
  - US, UK, Canada established in 1957; Australia & NZ joined in 1960's
  - Foster cooperation in S&T for conventional national defense – mostly R&D
  - Organization - 10 permanent Groups focused on a warfare area or a technical functionality supported by technical panels & action groups within each permanent group
- AG-1: Net Centric Warfare Study - Oct 2001
  - Provide guidance & analysis on the implications of NCMW for coalition maritime force capabilities, C4I interoperability and to help shape national acquisition strategies
  - AG-1 products are being recognized as ground-breaking seminal work in coalition NCMW
- AG-6: FORCEnet Implications for Coalitions – Sep 2004
  - Examine implications & way ahead for realizing coalition capabilities compatible with USN's FORCEnet
  - Define, in functional terms, levels of coalition interoperability and assess the incremental value of higher levels of interoperability for national balance of investment studies

Background – This Project

- Overall Purpose:
  - To provide analysis and guidance on the tactical and technical requirements for coalition maritime warfare interoperability
  - Emphasis placed on the alignment of coalition national acquisition strategies with FORCEnet
- Project Goal:
  - Develop a high-level system architecture to accomplish the specified missions in a true network-centric fashion.
    - Presented in the form of a CDD (interim deliverables)
    - Supporting products from the DoD Architecture Framework
    - Other artifacts of the systems engineering process
  - Extend the work of TTCP's AG-1 & AG-6
- Approach:
  - Define in functional terms various levels of interoperability with FORCEnet
  - Assess the incremental value of higher levels of interoperability
  - Provide input to national balance of investment studies

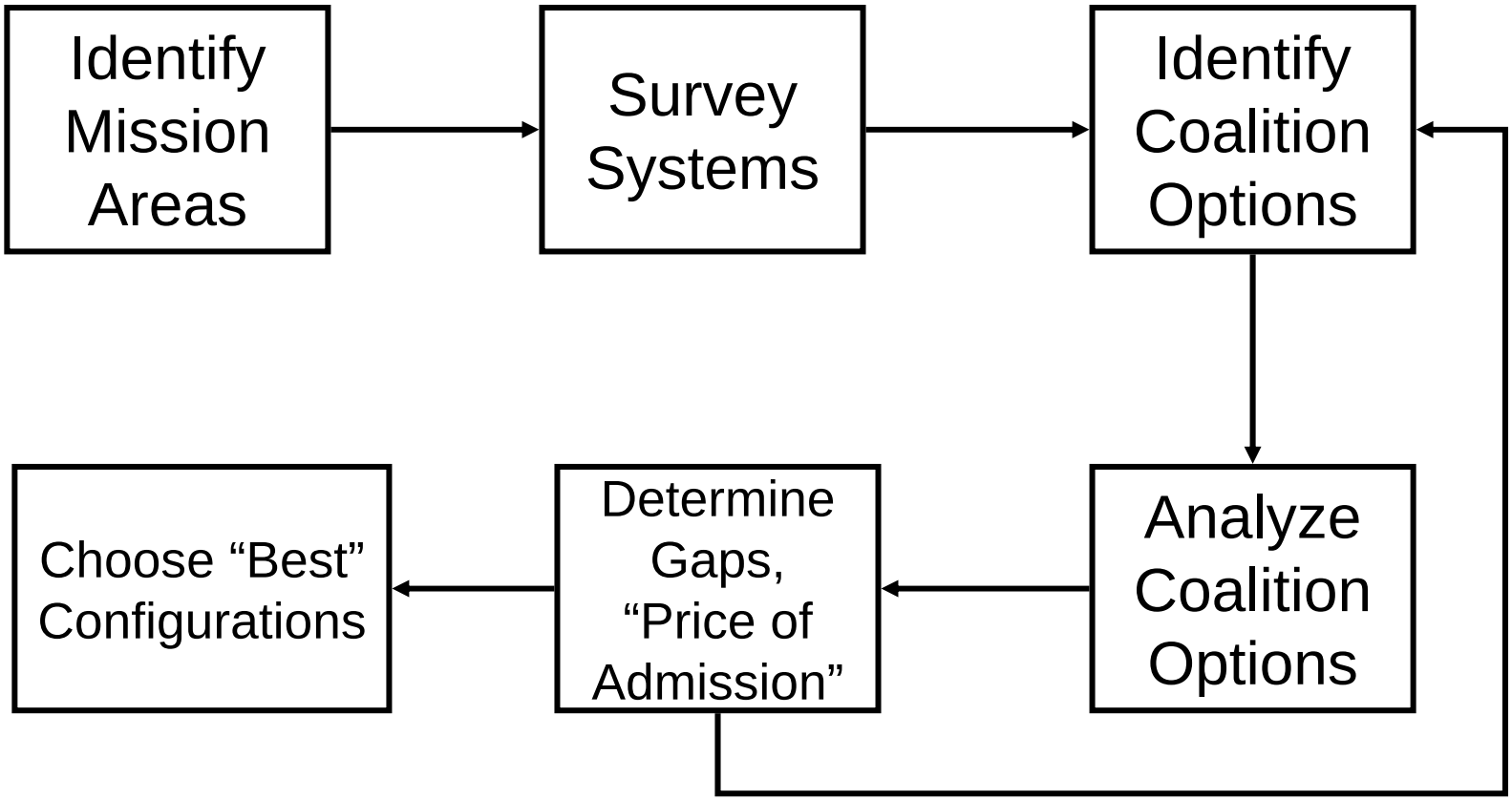
Task Scope

- Military operations emphasis: maritime coalition littoral warfare operations
- Initial warfare domain emphasis: surface (ASUW, MIO, ISR), air (AAW, ISR) undersea (ASW, MIW, ISR)

NSWC CSG	NSWC ESG
NUWC CSG	NUWC ESG

- Forces: Non-nuclear coalition forces opposed by current and emerging threats. Size of force appropriate to the tactical situation
- Operational timeframes: Current to 2015 forces
  - Intended to affect 2010-2015 forces, intended to affect 2008 systems and hardware investment decisions
  - And near-term tactics, techniques, procedures, and training

Study Approach



Tactical Situation Review

- TACSIT 1
  - East Timor NEO with a substantial hostile threat (PRC supports anti-government faction)
  - Five coalition nations operating in Fn-enabled way
- TACSIT 2
  - Repel a potential invasion of Palawan Island by PRC forces
- TACSIT 3
  - Re-establish Indonesian sovereignty of Kepulauan Natuna
- Focus on:
  - Executing mission
    - Evacuation
    - Defense
    - Attack
  - Commanding, coordinating, positioning naval assets in AOR
  - Minimize friendly exposure to threat

The scenarios described here are unclassified. They are for academic purposes only and do not represent any official DoD operational plan or the official policy of the US Government.

Tactical Situation Review

ESG

1 LHD
2 LPD-17
5 LCS
2 CG-47
3 DDG-51
2 FFG – Aus
1 FFG – NZ

Will also use land-based maritime patrol and MIW aircraft.

CSG

1 CVN
2 CG-47
2 SSN
1 AOE
1 DDG – UK
2 FFG – Can

Will also use land-based maritime patrol and MIW aircraft.

Questions to Answer

- What is the minimum level of common systems architecture required to participate effectively in each of the warfare areas?
- To "systems engineer" a net-centric force
  - As-Is architecture based on RIMPAC 04 & TW04
  - To-be architecture emphasized capabilities-based integration vice named h/w & s/w
- Run simulations
  - Coalition force not networked
  - Coalition force with FORCEnet
  - Coalition force with degraded FORCEnet (if possible)
- Quantify differences
  - Measures Of Effectiveness
  - Cost
- Analyze data & provide recommendations

4 Groups – similarities & differences

- Like products – focused on C2 in D-C-E paradigm and OODA loop
- Common assumptions
  - Bandwidth & latency
  - P_d for sensors and P_k for weapons
  - System failures & lost asset replacement
  - Information assurance
- 2 models
- MOEs not all the same, comparison differences

NSWC PHD ESG

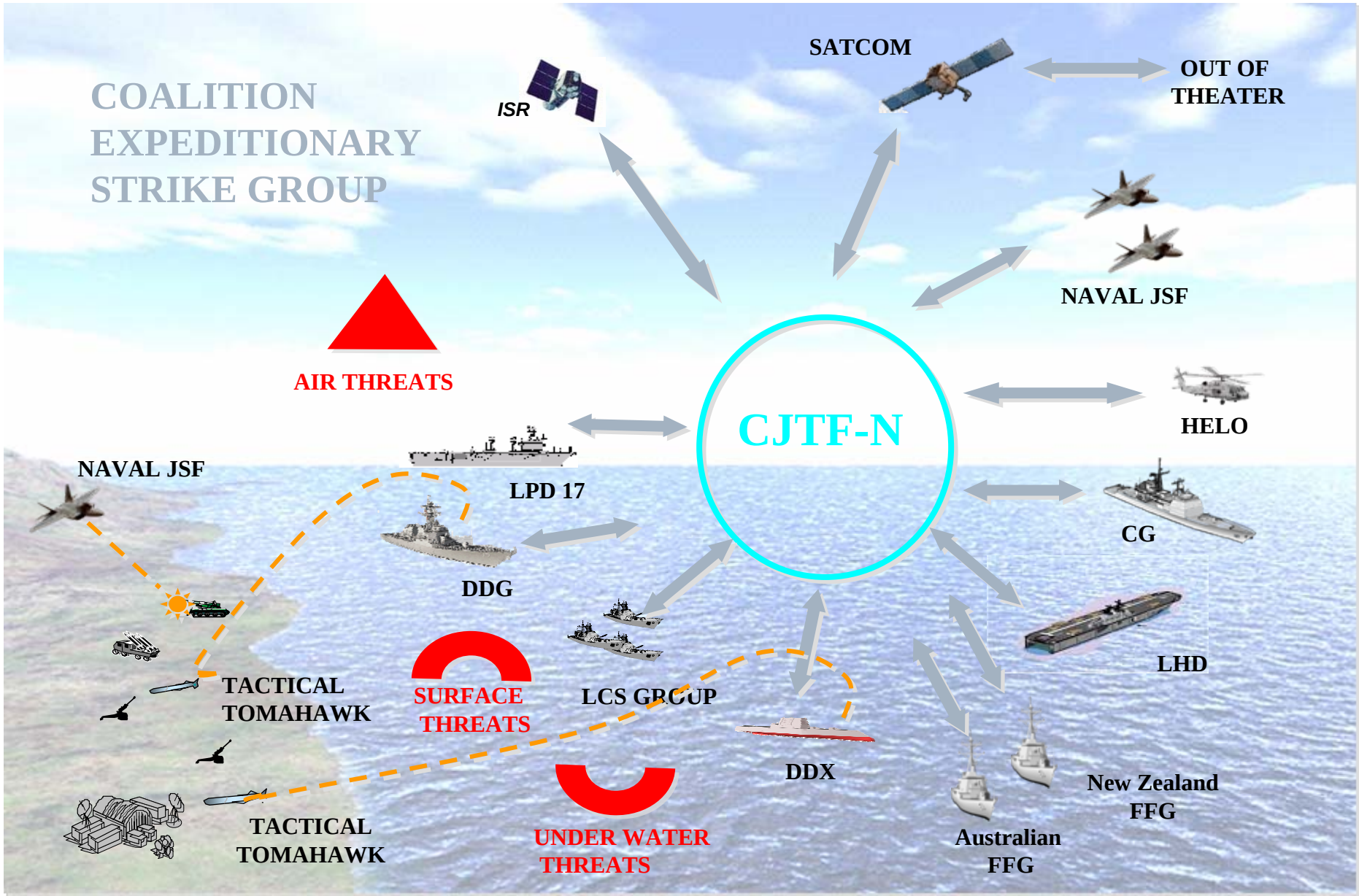
DoDAF product key elements

Model overview

MOEs

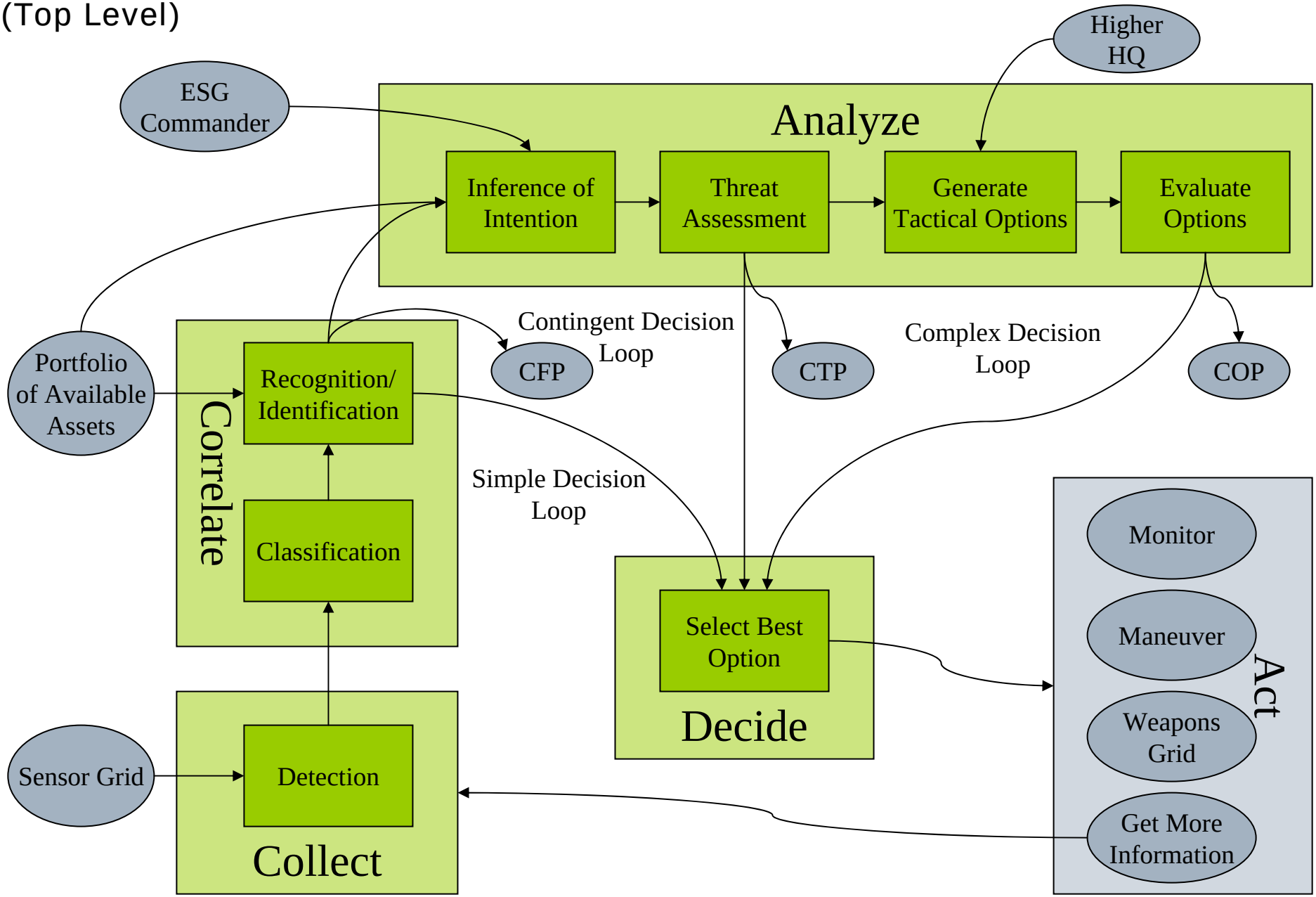
Results & Conclusions

OV-1: Operational Concept



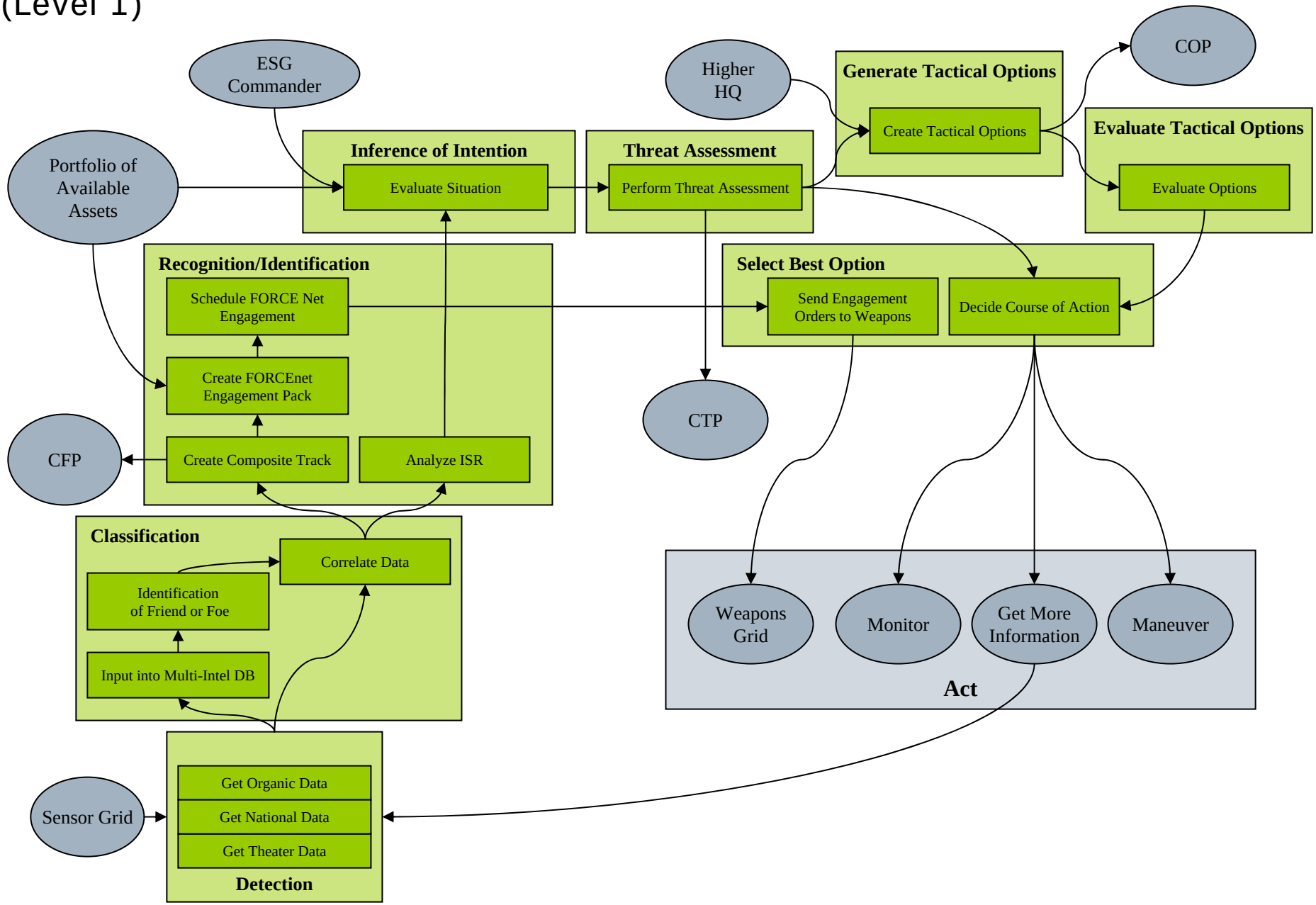
OV-5: Operational Activities Model

(Top Level)

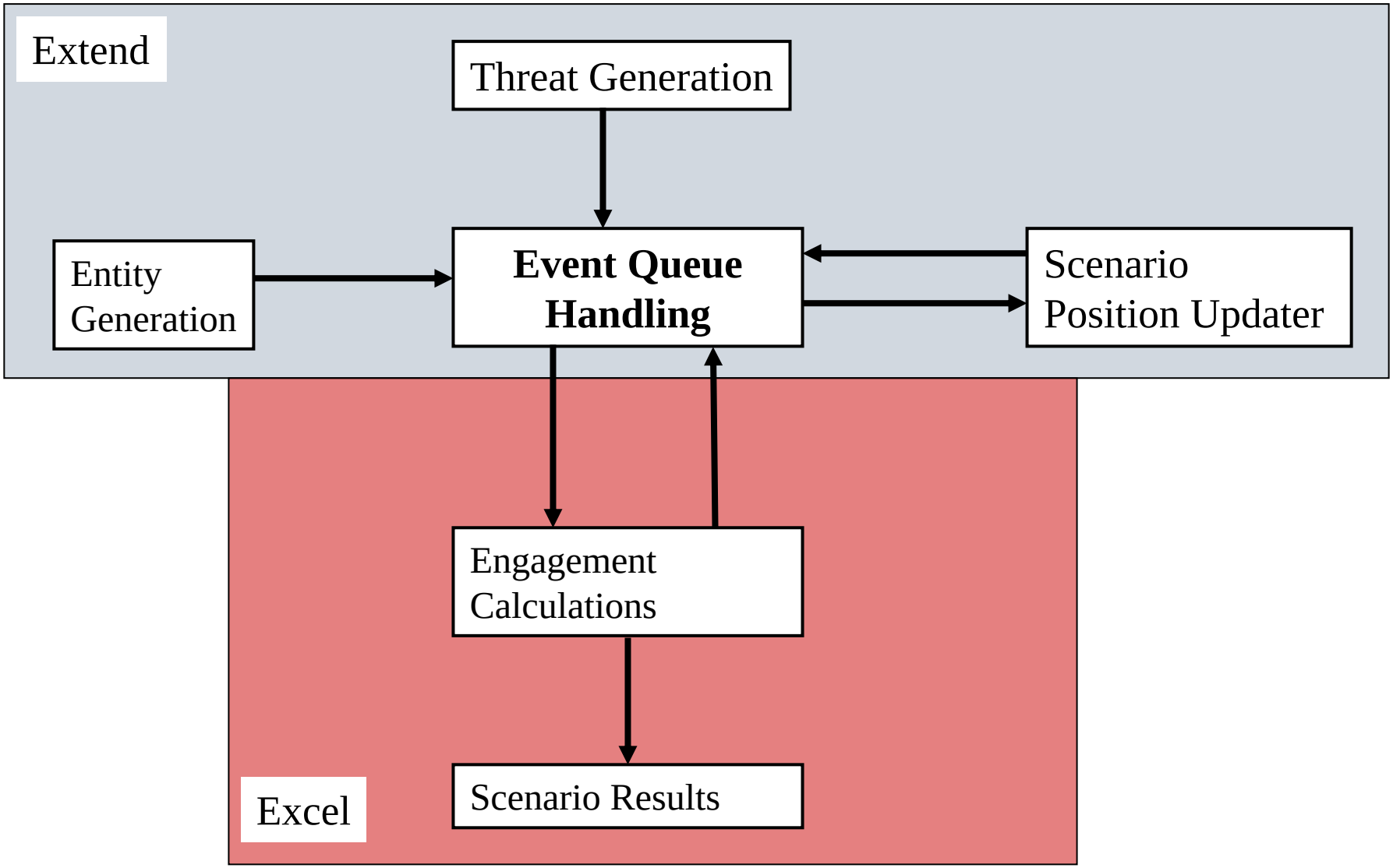


OV-5: Operational Activities Model

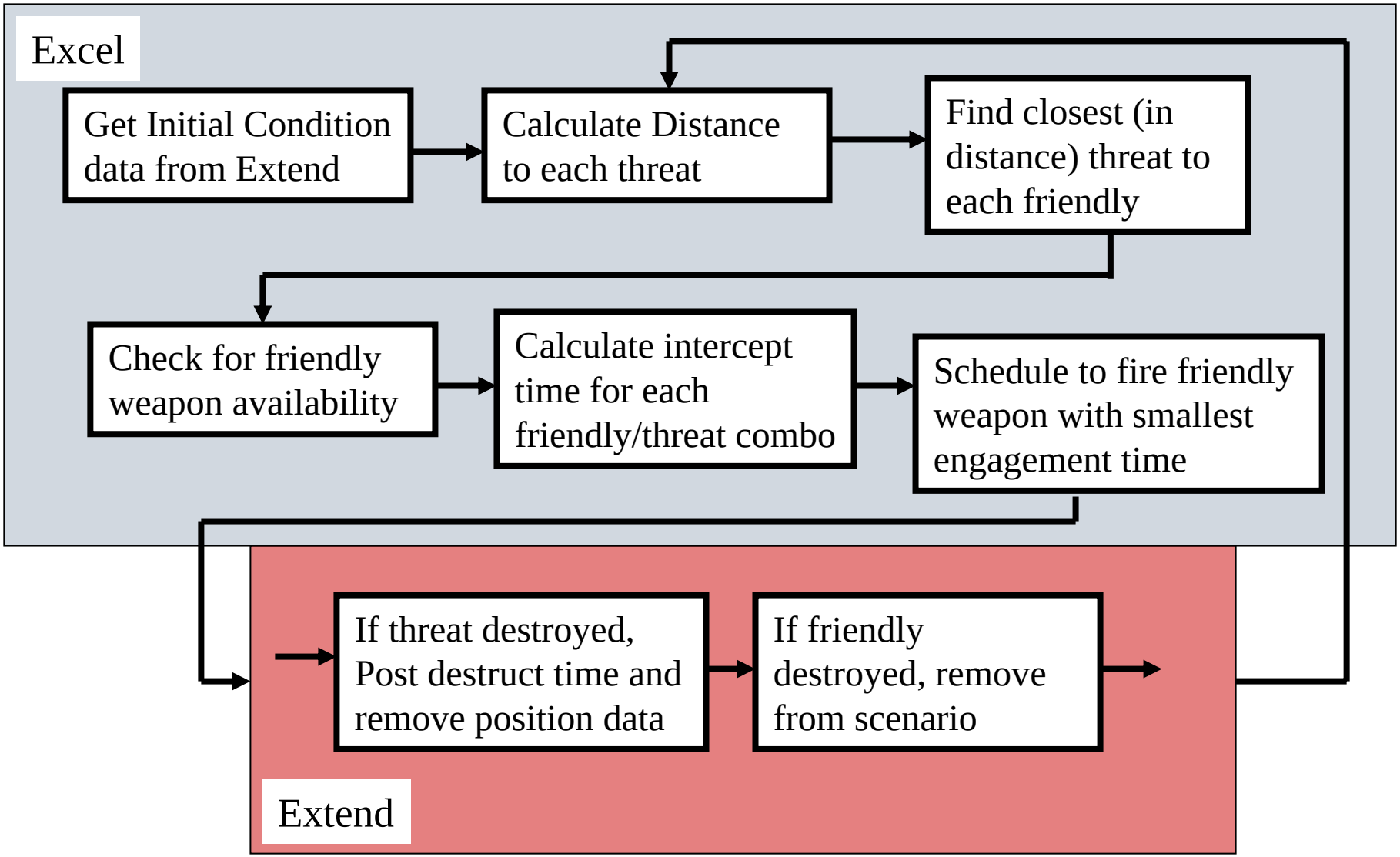
(Level 1)



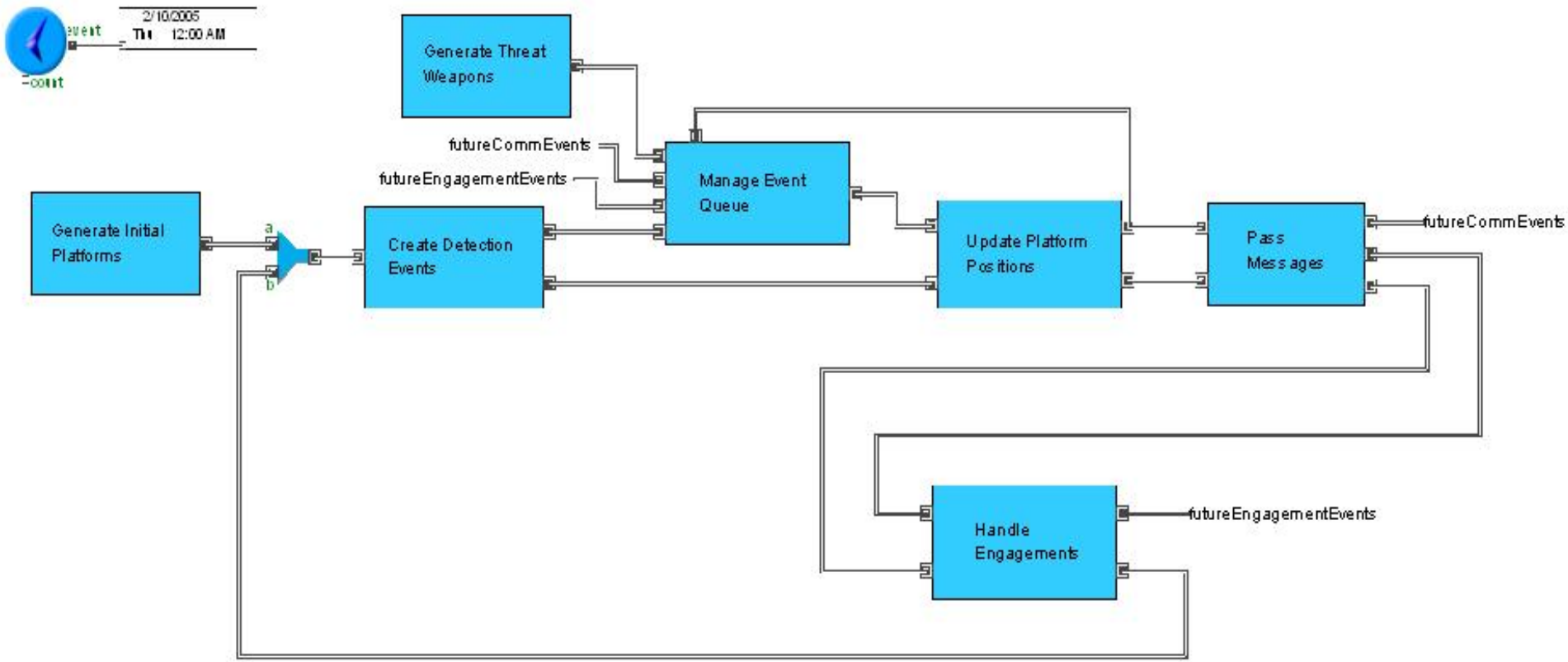
Simulation Block Diagram



Excel Block Diagram



Extend Model



NSWC PHD ESG MOEs/MOPs

- MOE 1: Percent increase in engagement effectiveness (engagement with higher probability of success is selected)
  - MOP: Engagement opportunities per target.
- MOE 2: Percent of increase in ability to handle larger raids
  - MOP: Percent increase in engagement rate.
  - MOP: Percent increase in engagement sustainability.
- MOE 3: Minimize Probability of unintentional over-engagements
- MOE 4: Probability of all units holding same COP Decrease confusion and clarify conflicting data

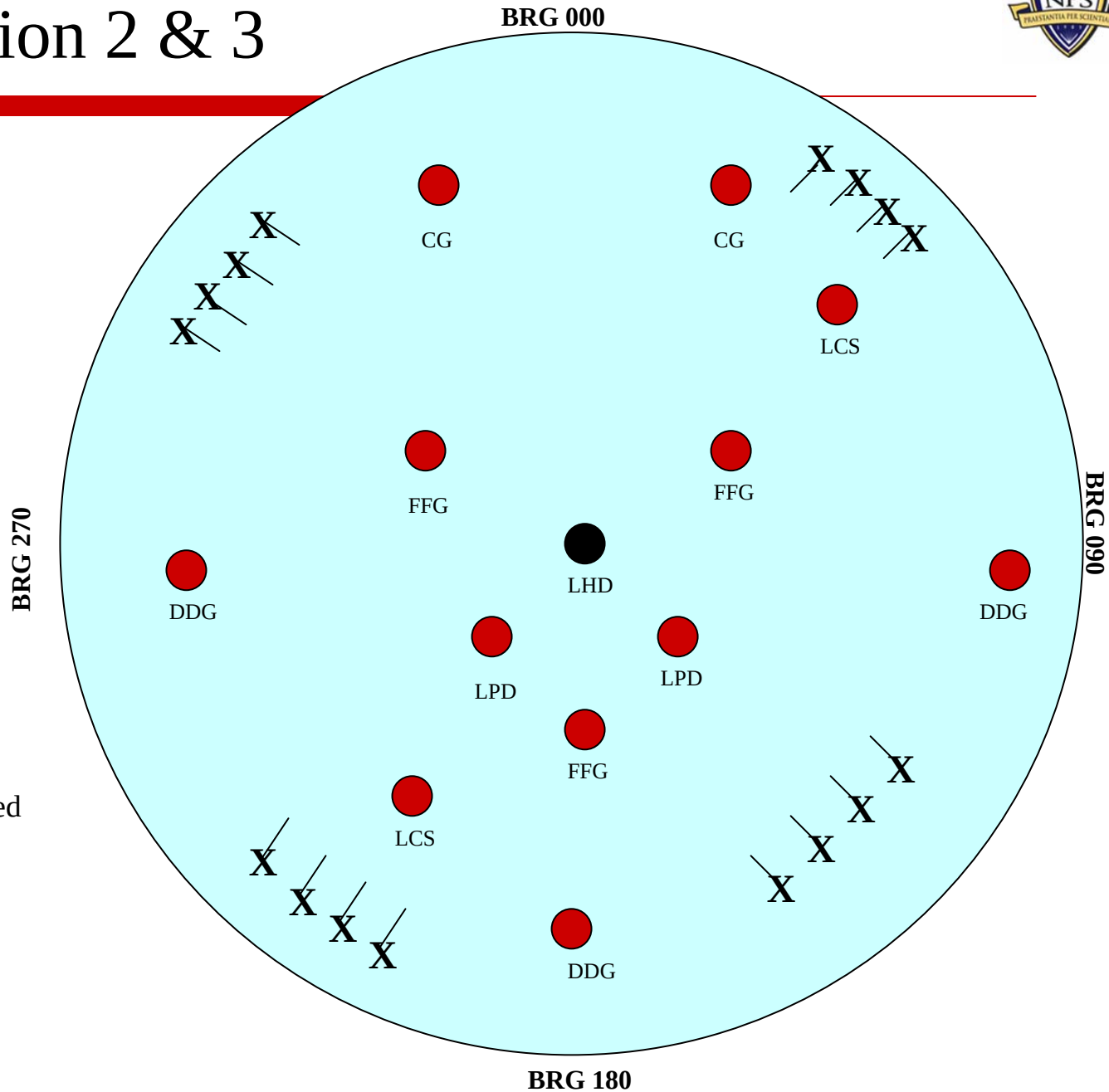
Tactical Situation 2 & 3

Modeling Objective:

1. Ability to handle larger raids
2. Engagement sustainability
3. Measure amount of over-engagements

Simulation Run Cases:

1. "As Is"… Mix of Link 11/16, can only engage organic tracks (no Integrated Fire Control)
2. All units have FORCEnet communication, and can engage if capable



Modeling and Simulation Results

- MOE 2: Analyzed percent of increase in ability to handle larger raids
- MOE 3: Analyzed probability of unintentional over-engagements
- MOE 1 and 4 were deferred and are recommended for further study

Analysis of MOE 2

- To evaluate MOE 2, analysis of MOP 2.1 and 2.2 was necessary:
  - MOP 2.1 is evaluated by the average survival time of the HVA while FORCEnet is enabled divided by the average survival time while FORCEnet is disabled. Percent decrease in engagement sustainability: 6.786sec ÷ 6.751sec = 0.51%.
  - MOP 2.2 is evaluated by an average of threat weapons killed while FORCEnet is enabled divided by the average number of threat weapons killed when FORCEnet is disabled. Percent Increase in the threat weapons killed: 7.3 threats ÷ 6.6 threats = 10.6%.
- When FORCEnet is engaged, the ESG can engage more threats while using fewer assets defending the high-value asset

Analysis of MOE 3

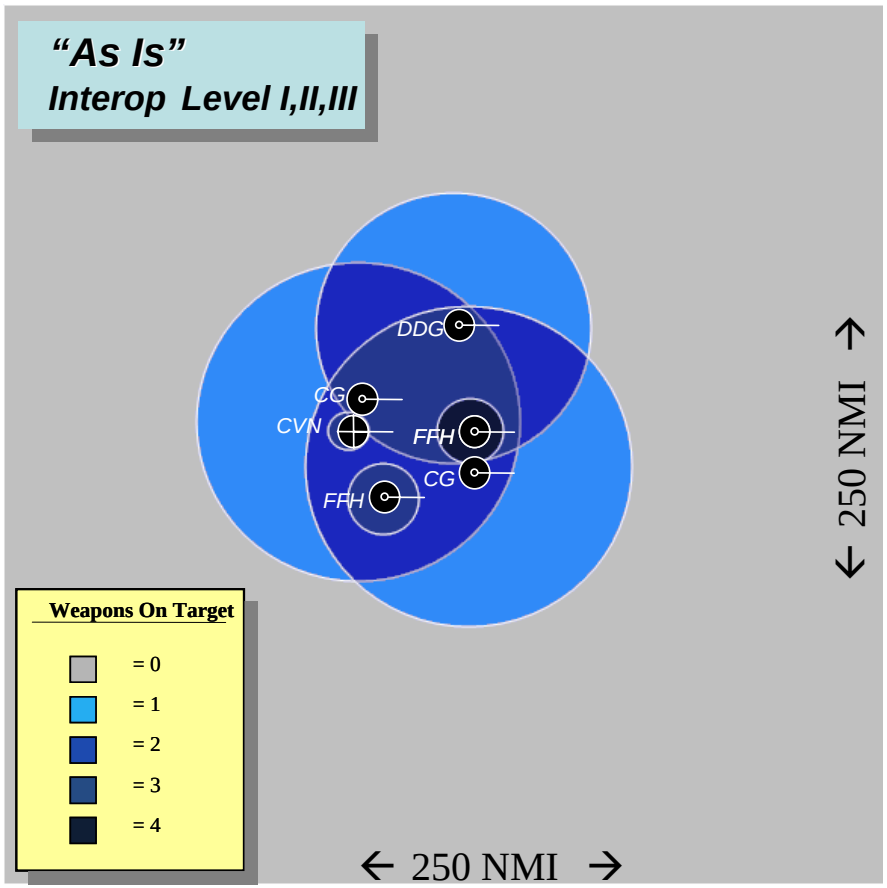
- Minimize Probability of unintentional over-engagements
- When FORCEnet is engaged, HVA can destroy more incoming threats and use fewer assets
  - MOE 3 is evaluated by the average number of friendly weapons launched while FORCEnet is engaged divided by the average number of friendly weapons launched while FORCEnet disabled.
- 59.5% decrease in over-engagement: (28 ÷ 69 = 59.5%)

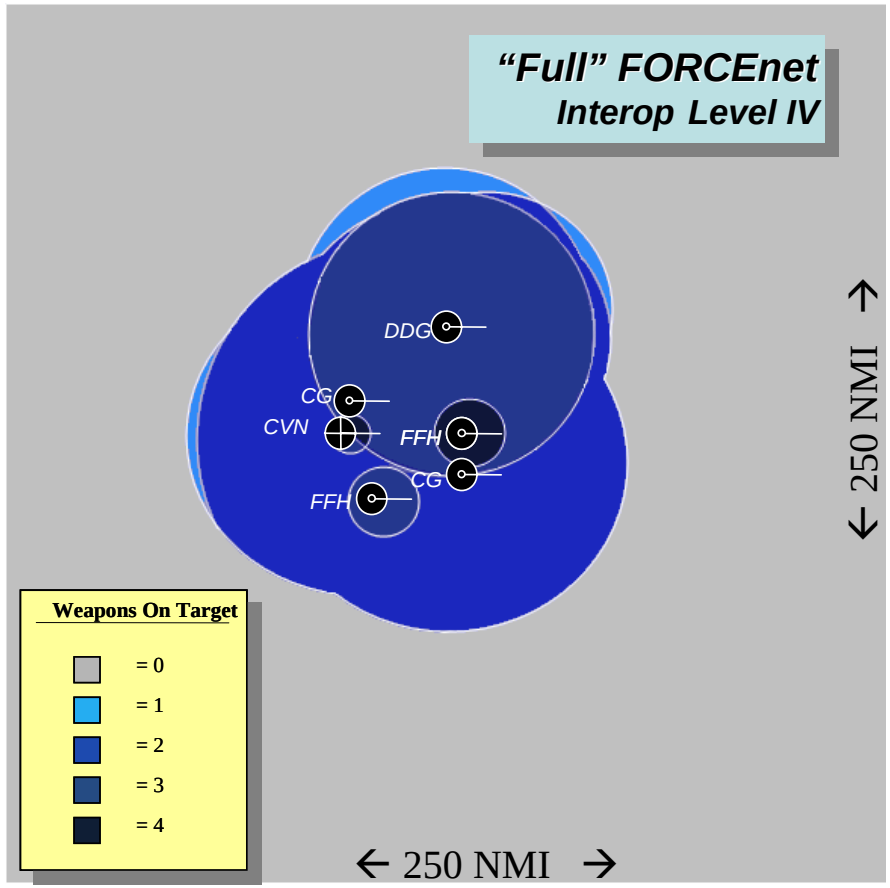
NSWC PHD CSG

Results & Conclusions

MOP 1.2: Increase in Weapons Coverage

AAW TacSit 2, 1000 ft target





Results

Implementation of Fn Concepts to a Coalition Force…

- Increase in Combat Reach
  - Increase in Effective Engagement Envelope (E3)
  - Increase in Probability of Raid Annihilation
- Decrease in Time to Establish Common Picture
  - Reduced time from initial detection to all units holding track
- Scenario design important
  - Some inconclusive results

What's the Cost of Admission?

- Compatibility with FORCEnet standards
  - Systems under development
- Commensurate Weapons and Sensor integration
  - Take full advantage of potential kill chains and capabilities that ALL units bring
- Will Coalition Initiatives (e.g. UK's NEC) be compatible?
  - Particularly important if capabilities such as ability to use non-organic sensor info for engagement are in the plan

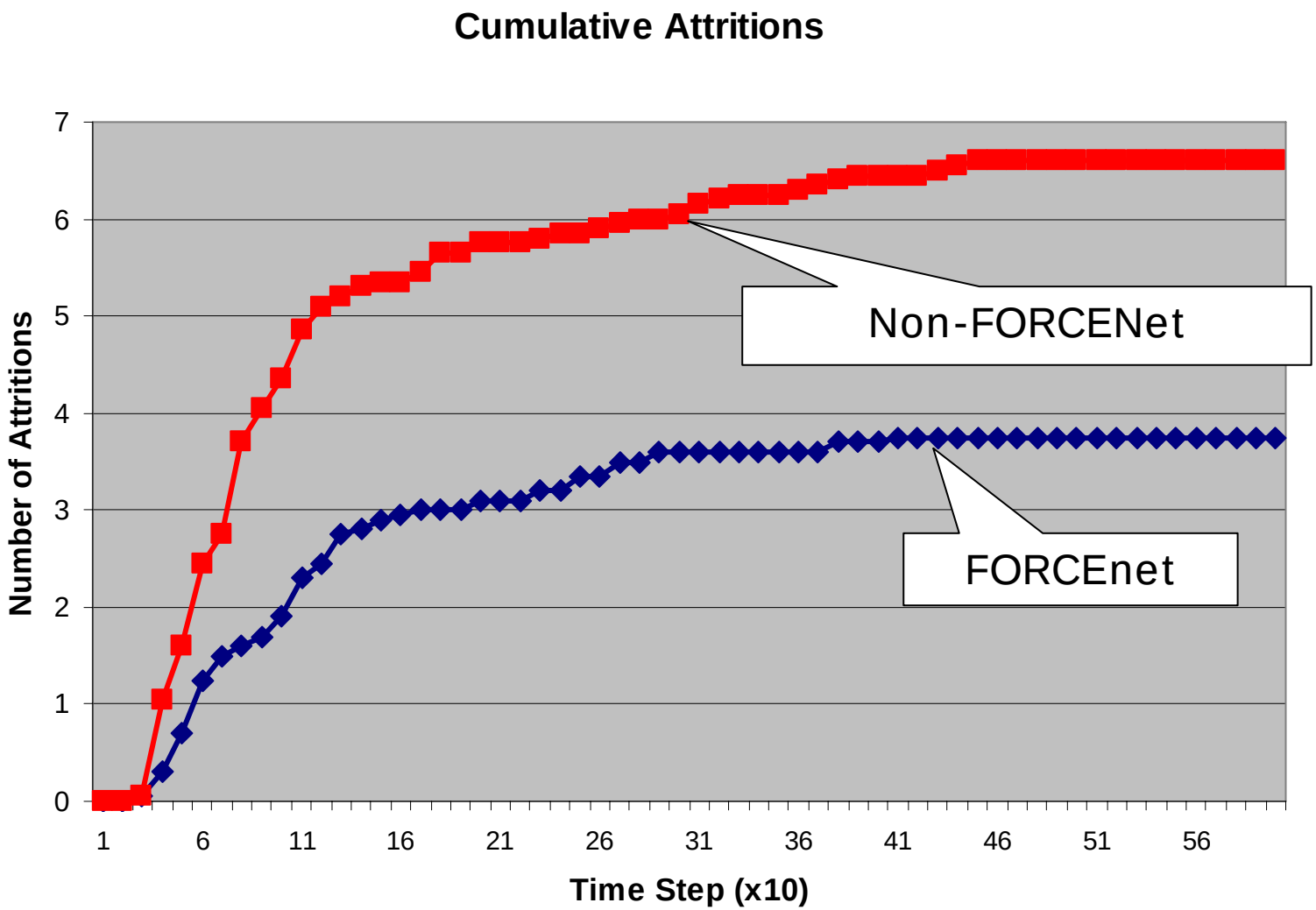
What's the Cost of Omission?

- Reduced Platform Effectiveness
  - Inability to participate in the kill chain
  - Inability to utilize readily available information to make decisions
  - Potential loss of tactical communications
- Reduced Force effectiveness
  - Coalition forces may not be considered for key warfare roles (Alpha Xray, Alpha Whiskey, Alpha Sierra, etc.)
  - Inability to support timely passing of data to other units who need it
  - Potential inefficient use of bandwidth due to legacy platforms

NUWC Keyport CSG

Results & Conclusions

Attrition


Cumulative Attritions
Number of Attritions
0
1
2
3
4
5
6
7
1
6
11
16
21
26
31
36
41
46
51
56
Time Step (x10)
Non-FORCENet
FORCEnet

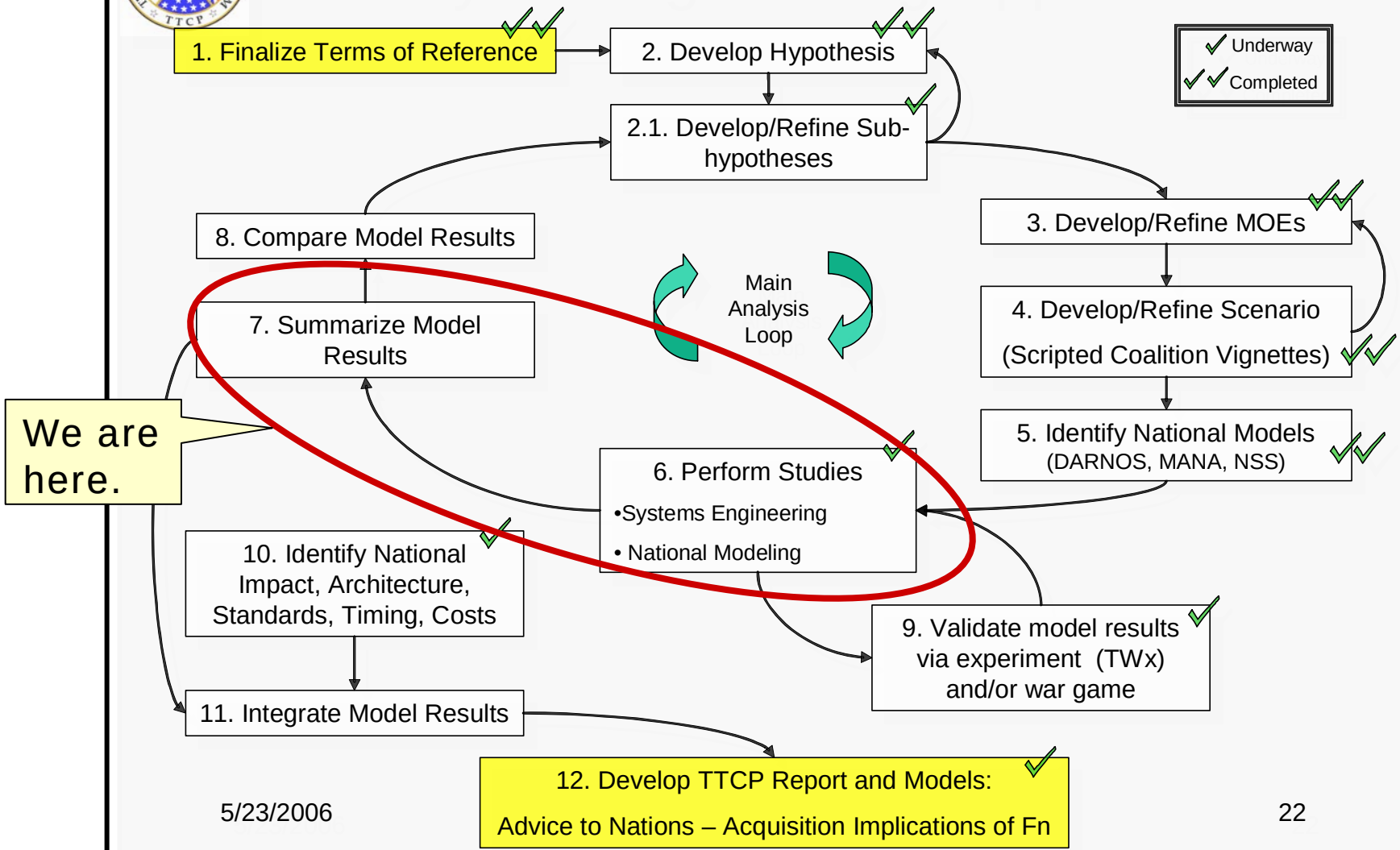
Extend Modeling Results

- Statistical improvements with FORCEnet:
  - Attrition
  - Detection
  - Engagements
- Statistically worse with FORCEnet:
  - Time to transmit Information
  - Kills (cumulative)

The Way Ahead

From AG-6 Brief to TTCP

Analysis/Engineering Approach



5/23/2006

22

Next Group – NSWC PHD Cohort 4

- Timing of capstone project: PHD Cohort 4
  - Planning Nov/Dec 2005 - complete
  - Start Jan 2006
  - Finish Sep 2006
- Will start with *FORCEnet for the Coalition Hypothesis* model
- New scenario – humanitarian relief
  - Eight vignettes – more granularity
    - Starts with OTW
    - Extends to include ASuW, ASW, AAW, MIO
  - Planned coalition "C2 Order of Battle"
    - Platforms provided
    - Working systems & capabilities

From AG-6 Brief to TTCP

NCW Capability Stepping Stones
Levels of FORCEnet

Based on Fn Concept Document

Full IT21
"Online"

- IP Reach Back
- Local Area Networks
- Wideband Receive
- RF Management
- Survivable comms

Level 0

Today

Net Connected
"Improved decision making"

- Web-based services
- Improved network reliability and performance
- Increased bandwidth
- Improved coalition operations and data sharing
- Tailorable situational awareness tools
- Standardized data exchange between domains
- Defense in depth

Level 1

FY07

Net Enabled
"Network based command and control"

- Multi-path and improved transport reliability
- Dynamic bandwidth mgmt
- Customized applications and data sources
- Common infrastructure and data exchange standards
- Improved data exchange across domains
- Enterprise management for asset analysis and repair
- Initial knowledge management and automated decision aids
- Assured sharing
- Distributed command and control operations
- Modular and open architecture

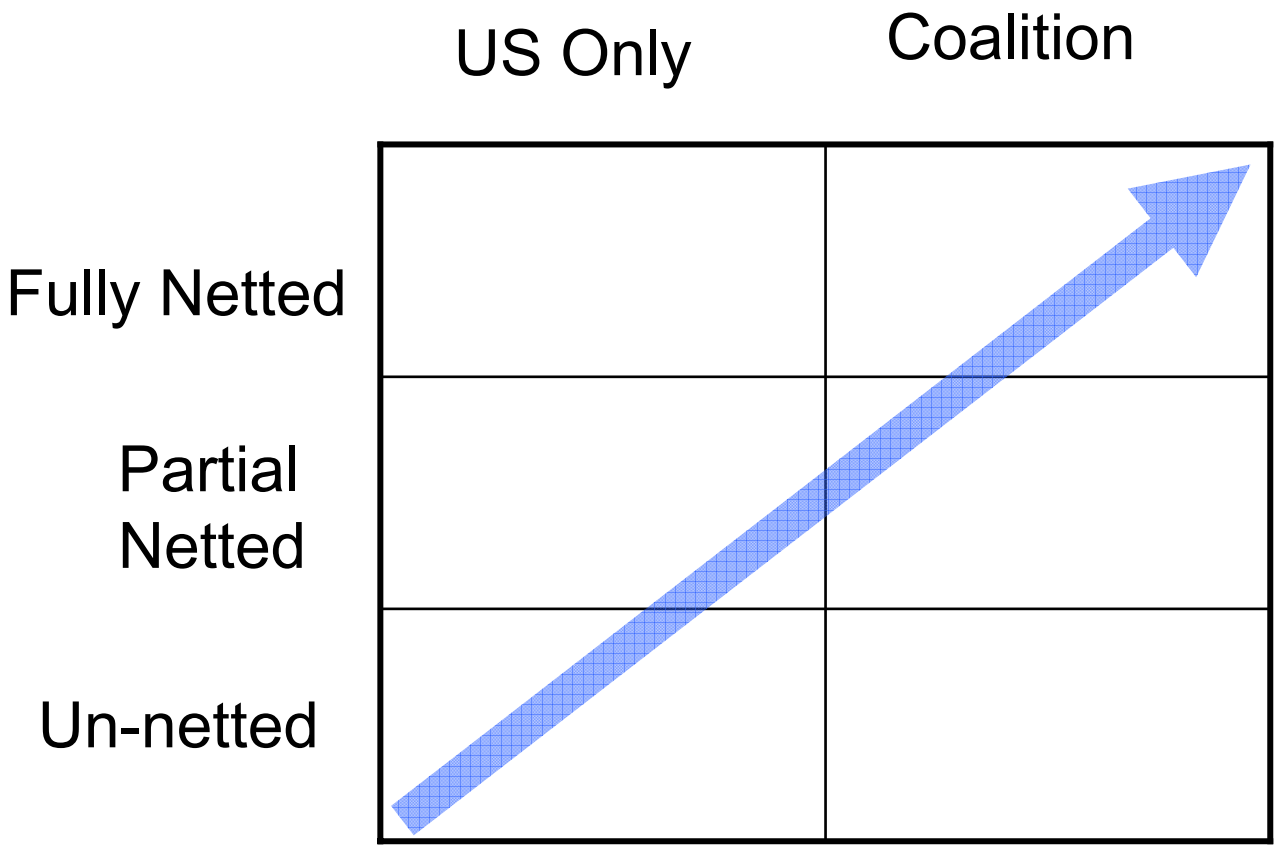
Level 2

FY10

Fully Net Ready
"Decision-making under undesirable conditions"

- Robust, reliable communication to all nodes
- Reliable, accurate and timely information on friendly, environmental, neutral and hostile units
- Storage and retrieval of authoritative data sources
- Robust knowledge management capability with direct access ability to raw data
- User-defined and shareable SA
- Distributed and collaborative command and control
- Automated decision aids to enhance decision making
- Information assurance
- Seamless cross-domain access and data exchange.
- Interoperability across all domains and agencies
- Autonomous and disconnected operations
- Automatic and adaptive diagnostic and repair
- Modular architecture to expedite new capabilities

Level 3

FY14

FORCEnet for the Coalition Hypothesis