Maritime Headquarters with Maritime Operations Center: A Research Agenda for Experimentation

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MOTIVATION AND OBJECTIVES

- A2C2 RESEARCH IS TRANSITIONING FROM A TACTICAL TO AN OPERATIONAL FOCUS WITH EMPHASIS ON MOC
  - MOC is adaptive: A2C2 research aligns with larger MOC PT goals
  - Visits to workshops, events, exercises give direction to the research
- 2009 MOC-1 EXPERIMENT OBJECTIVES
  - ➢ Continue/expand A2C2 program of model-based experimentation
  - ➢ Develop lab environment for A2C2/MOC empirical research
    - – Software tools, comms requirements, data collection, …
  - ➢ Determine appropriate pace and methodology for conducting laboratory-based experimentation at an operational level of war
    - – Slow time scale: Monitoring, assessing, **planning**, directing
    - – Need to abstract broad processes flowing through the overall MOC
      - **Aggregate** 10 -100's of staff to a few laboratory participants!
  - Form realistic linkage to MOC concepts and issues
  - Compare alternative organizational forms
  - Familiarize NPS students with MOC

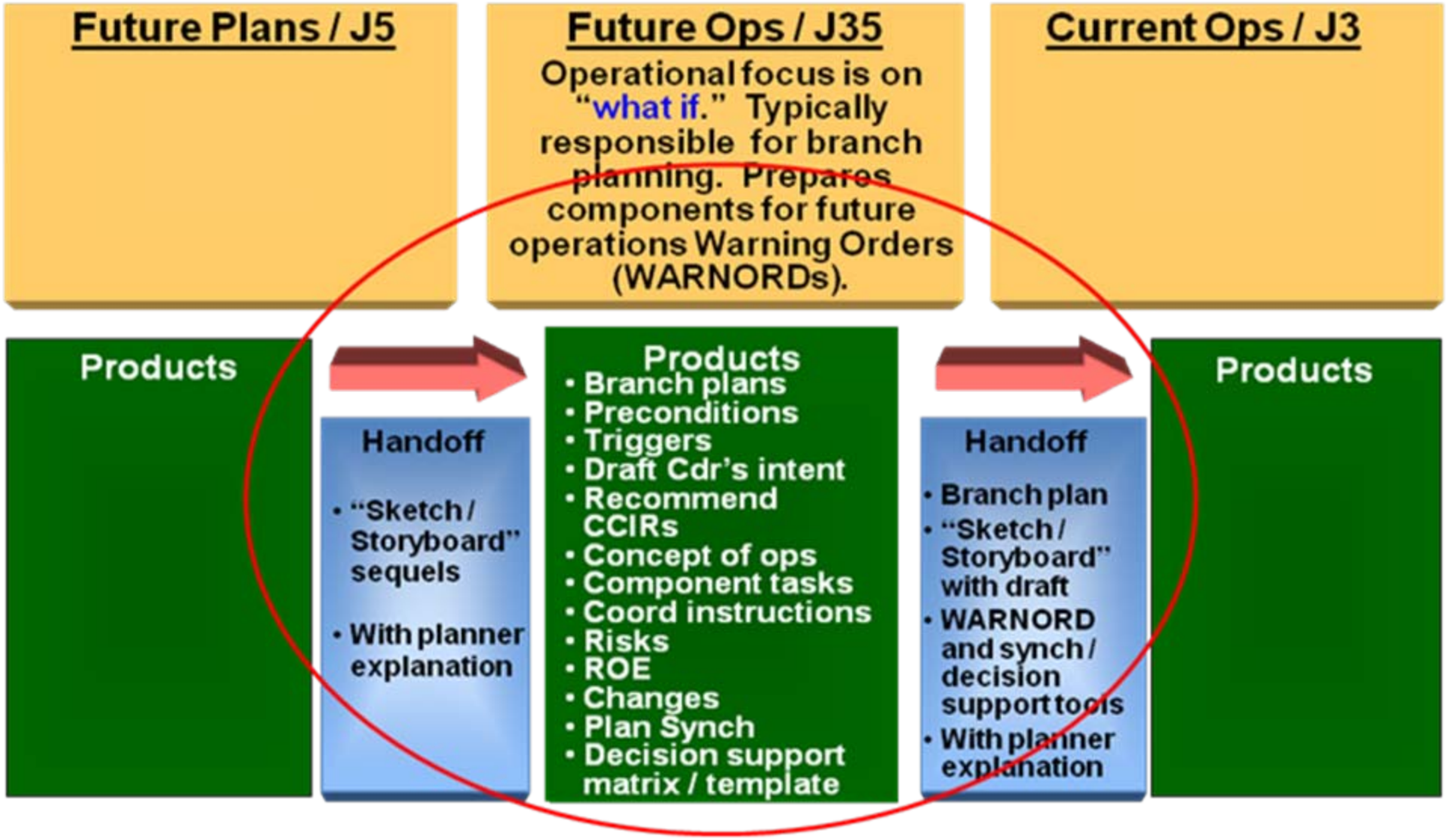
Increased Emphasis on ISR

- MOC designed to effectively integrate planning elements of Current Operations (COPS) and Future Operations (FOPS)
- ISR provides critical information to support COPS and FOPS
  - Important to determine most effective way ISR personnel should be organized to support effective planning and accurate resource allocation
- Critical to all phases of an operation
  - ISR assets are in high demand, short supply
- Way ISR assets are employed will need to evolve
- New framework views collection management as the “primary forcing function” for the pace, and quality of intelligence
- Intelligence supports the entire range operations
- Two organizations of ISR personnel: centralized / decentralized
  - Centralized: Tends to increase speed of response for stable and predictable environments
  - Decentralized: More rapid, time-critical responses in dynamic less predictable situations

MHQ with MOC Tasks in Prioritized Order

MHQ with MOC Capabilities-Based Assessment Identified Tasks	Weighted Value
Process and Exploit Collected Operational Information	217.53
Collect and Share Operational Information	215.25
Disseminate and Integrate Operational Intelligence	214.12
Produce Operational Intelligence and Prepare Intelligence Products	211.53

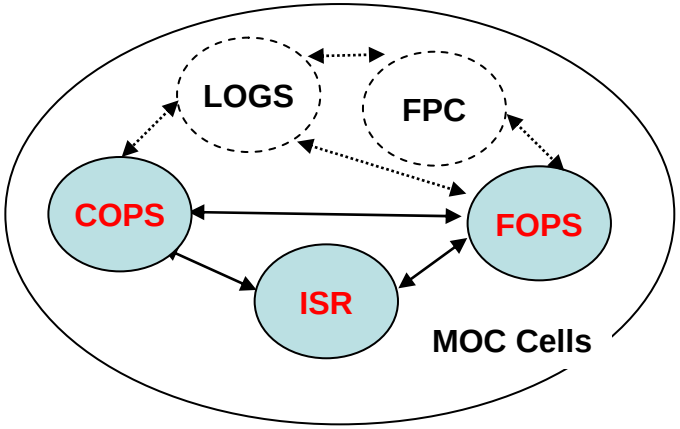
Managing Planning on Three Event Horizons



(From Selected Slides from VADM Marty Chanik Brief, Second Fleet, 25 Oct 07).

EXPERIMENT FOCUS: MOC-1

- MOC is A TEAM-of-TEAMS



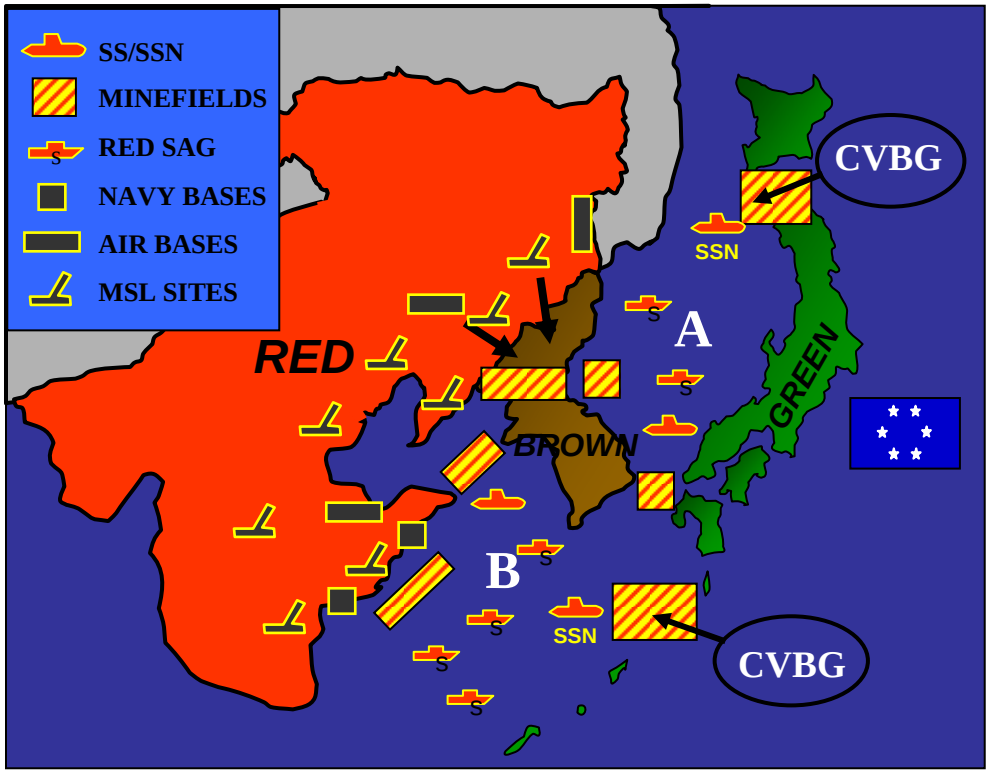
Cells support the MOC processes

- MOC-1: Examined interactions among 3 of the most vital cells
  - Current Operations (COPS)
  - Future Operations (FOPS)
  - Intel/Surveillance/Recon (ISR)
  - Focus was on **information flow** associated with **planning**

- INTER-CELL INFO FLOW
  - **FOPS:** Requires current information for best planning
    - Produces IPE requests (RFI)
  - **ISR:** Determines best ISR packages for satisfying RFI
    - Collects/disseminates info
  - **COPS:** Directs/ Monitors subordinates to support RFI

- MOC-1 RESEARCH TOPIC
  - Stand-alone vs. distributed (embedded) ISR capability within FOPS and COPS
    - Single IV experiment study
    - Motivated by current MOC concerns

SCENARIO

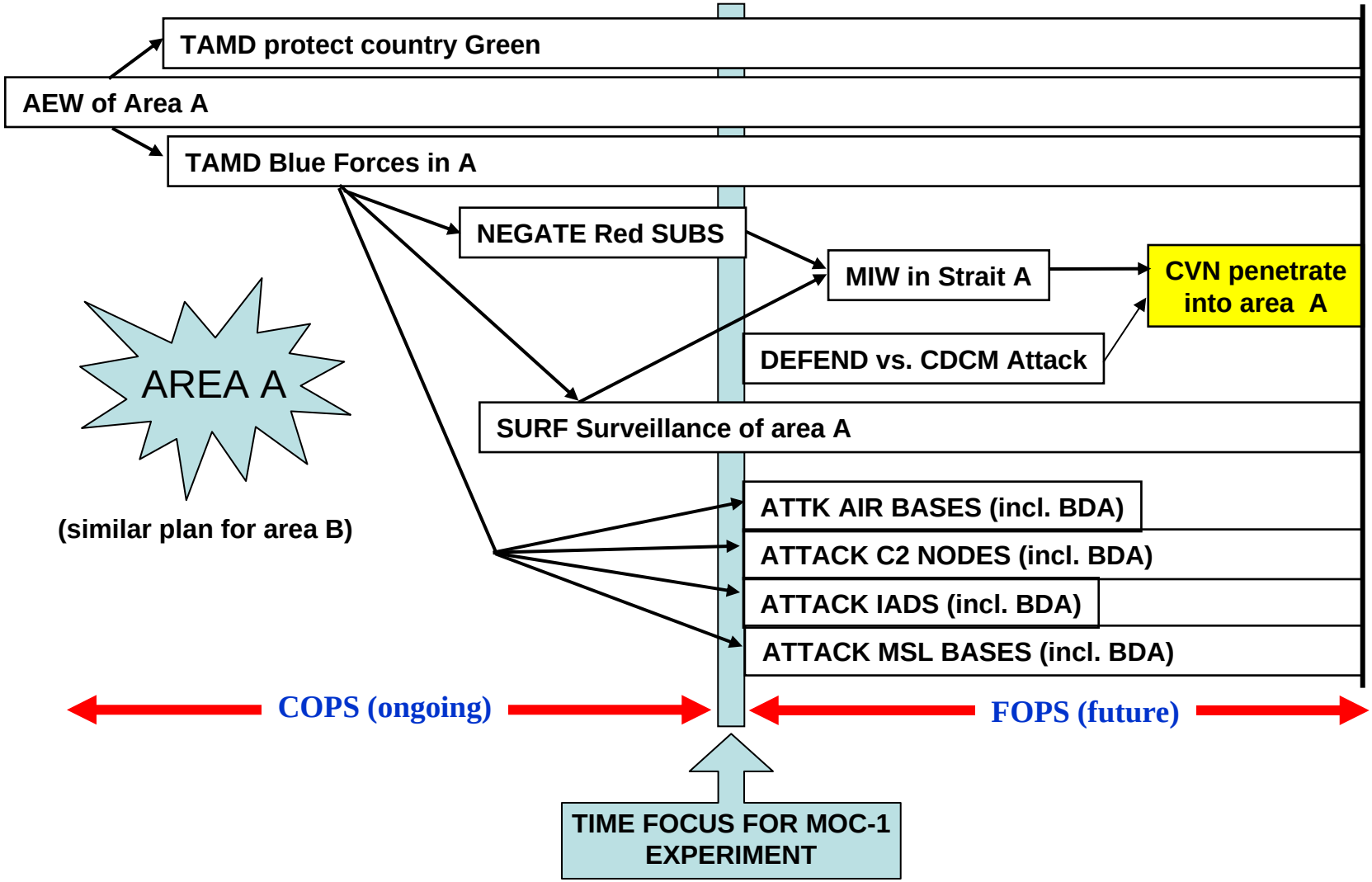


RED has declared a regional hegemony over **BROWN**

- Land invasion has begun
- Anti-access strategy in place for sea areas A and B
- Red will attempt to fire upon any **BLUE** assets that might be in areas A and B
- Red has threatened **GREEN** to not interfere
- Red has extensive ballistic and cruise missile capability

- BLUE'S PLAN: BRING CVBGs INTO AREAS A AND B
  - *First* establish AEW; air & sea superiority; TAMD; clear mines
  - *Defend and protect* ally GREEN from ballistic missile attack
  - *Destroy* key RED air and naval bases, ballistic and cruise missile sites
  - Prepare battlespace for introduction of follow-on forces

CAMPAIGN PLAN -- via FUTURE PLANS CELL (A)



BLUE ASSETS ORDER OF BATTLE

ASSETS in THEATER

Area A

2 CG, 2 DDG
1 AWACS
1 JSTAR, 5 P3
1 U2, 1 RJ, 2 UAV

Area B

2 CG, 1 DDG, 1 SSN
3 AWACS, 1 AEF
1 JSTAR, 1 P3
1 U2, 1 RJ, 2 UAV

TASK AND ASSET STATUS MONITORED BY COPS CELL
including
ASSETS REDIRECTIBLE FOR ISR

BASIS for PLANNING

ADDITIONAL ASSETS ENTERING THEATER

2 CVN
2 DDG
4 SSN
2 MH53
1 UAV
2 AEF

Area A → 1 CVN, 2 CG, 2 DDG
2 SSN, 1 MH53, 1 AEF
2 AWACS, 1 JSTAR, 2 P3
1 U2, 1 RJ, 2 UAV

A or B? → 1 DDG
1 SSN, (2 P3)
1 UAV, 1 AEF

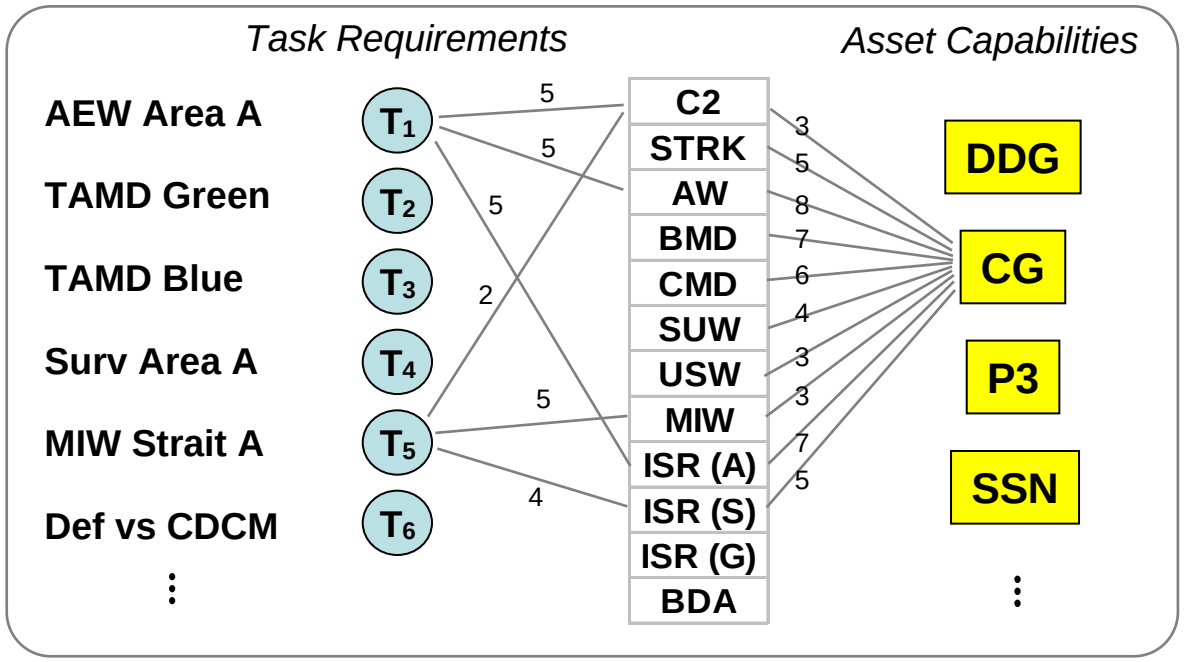
Area B → 1 CVN, 2 CG, 2 DDG
2 SSN, 1 MH53, 1 AEF
2 AWACS, 1 JSTAR, 2 P3
1 U2, 1 RJ, 2 UAV

?

?

TO BE ASSIGNED BY FOPS CELL TO FUTURE TASKS

ANALYTICAL FORMALISM: TASKS and ASSETS



TASKS AND ASSETS ARE LINKED VIA A COMMON SET OF RESOURCES

COMBINE ASSETS TO MEET TASK REQ'MTS

TASKS area A	option 1	option 2	option 3
AEW OF Area A	AWACS+CAP	CG+AEF	DDG+AEF
TAMD BLUE	CG+DDG + AWACSorRJ	2CG+AWACS or RJ	2DDG+AWACSorRJ
Survellance Area A	P3+AWACSorCGorDDGorRJ	CVN	2 of {CG, DDG }+AWACS
USW in Area A	2P3+DDG	SSN+P3+CGorDDG	2SSN+CGorDDG
MIW IN STRAIT A	2MH53+DDGorCG	MH53+CGorDDGorCVN	MH53+CGorDDGorCVN
CVN penetrate Area A	CVN+DDG+CGorDDG	CVN+CG+DDG	CVN+2CG
Attack RED MSL bases	CVN	AEF+UAV	DDG+UAV+RJ

- PROVIDES A CONCISE, **ANALYTICALLY TRACTIBLE**, WAY TO CONSTRUCT ALTERNATIVE TASK PROCESSING OPTIONS (asset packages)

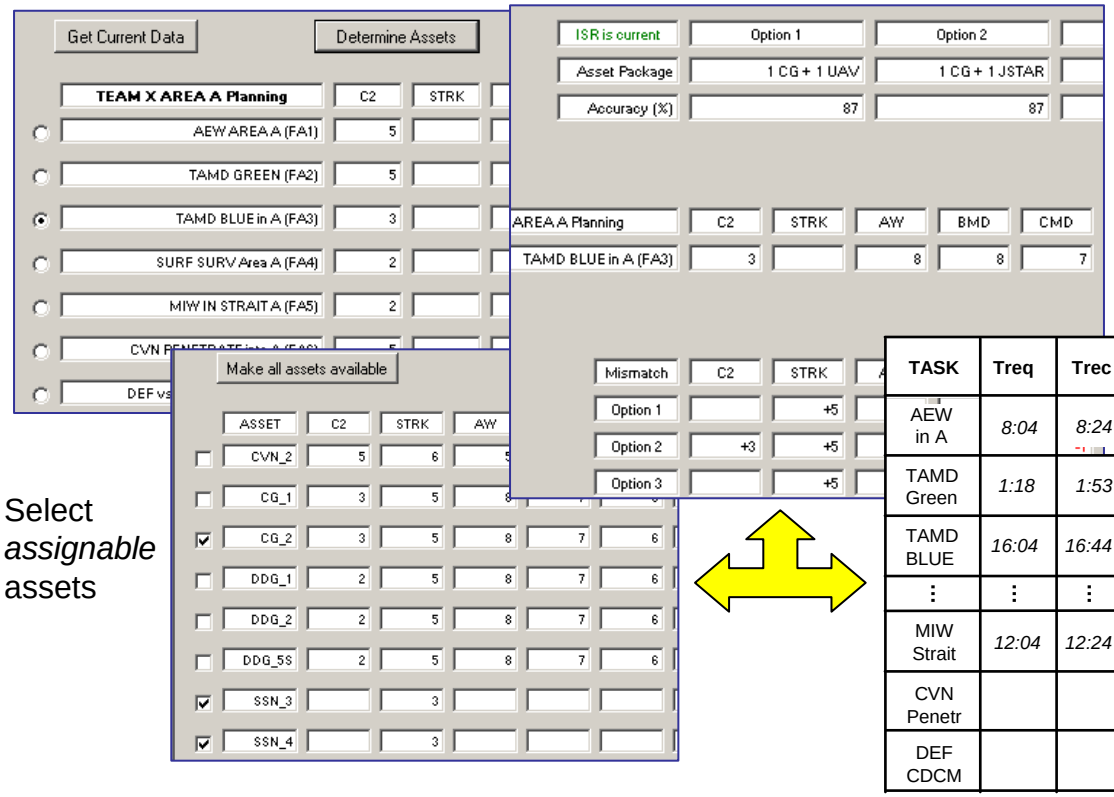
FOPS CELL PLANNING ACTIVITIES

1. **OBTAIN UPDATED TASK RESOURCE REQUIREMENTS**
   - Initial/prior task requirement data could be in error by +/- 30%
   - Issue RFI to ISR cell on a task-by-task basis
2. **ALLOCATE ASSETS TO MEET TASK REQUIREMENTS**
   - Commander's guidance: accuracy > 70%, critical tasks at 100%
   - Assign shared assets to *either* area A or to area B

- **<u>INTERACTIVE</u> PLANNING AID: Asset package options (UConn)**

Select a task

Up to 4 options with associated accuracies



Assign specific assets to specific tasks on Gantt worksheet

Select *assignable* assets

TASK	Treq	Trec	4	8	12	16	20	24	28	%
AEW in A	8:04	8:24	AWACS-4							100
TAMD Green	1:18	1:53	DDG-1, DDG-2, JSTAR-1							100
TAMD BLUE	16:04	16:44								
⋮	⋮	⋮	⋮							
MIW Strait	12:04	12:24								
CVN Penetr										
DEF CDCM										

ISR CELL ACTIVITIES

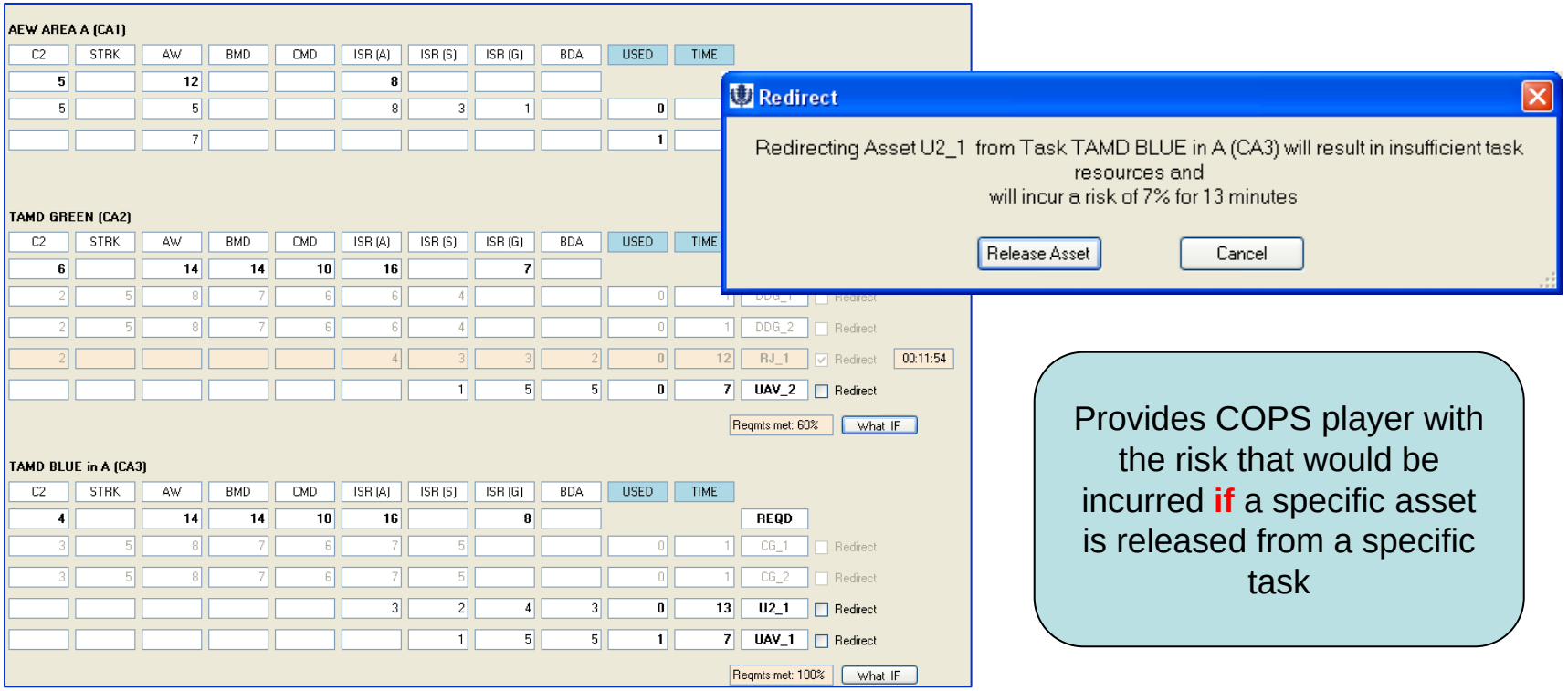
- RECEIVES AND LOGS RFI-IPE REQUESTS FROM FOPS
  - Requests are received on a task-by-task basis
- DETERMINES ISR PACKAGES THAT WOULD PROVIDE HIGHEST ACCURACY or Pr(success) ON THE FOPS REQUEST
  - ISR cell uses look-up table decision aid (models ISR "expertise")

FOPS Task ID	Area A Tasks	Option 1	Option 2	Option 3
FA1	AEW of Area A	AWACS **100**	RJ & UAV **65**	
FA2	TAMD Green	RJ & U-2 **95**	AWACS & UAV **70**	P-3 & JSTARS **30**
FA3	TAMD Blue in A	RJ & U-2 **90**	AWACS & UAV **70**	JSTARS & AEF **50**
FA4	Surf Surv Area A	JSTARS & P-3 **100**	UAV & P-3 **90**	AEF **40**

- ASSUMPTION: ISR ASSETS NORMALLY ALLOCATED TO FOPS IPE MISSIONS WERE "PULLED AWAY" BY HIGHER AUTHORITY
  - Increases inter-cell "stress" over ISR asset utilization
- NEGOTIATES WITH COPS TO RELEASE ISR ASSETS
  - logs COPS' actions
- PROVIDES UPDATED TASK DATA TO FOPS WHEN RFI MISSION HAS COMPLETED

COPS CELL – DIRECTS IPE MISSION

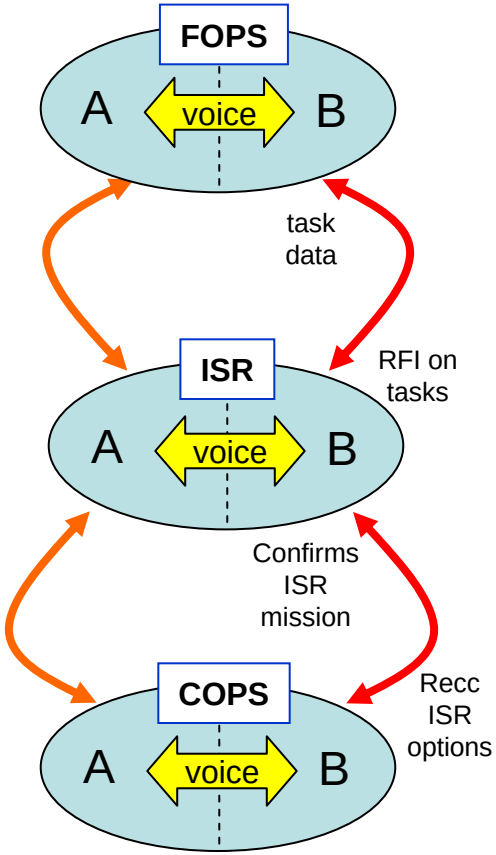
- RELEASES SPECIFIC ISR ASSETS, COORDINATING WITH ISR CELL
- SEEKS TO MINIMIZE RISK TO CURRENT/ONGOING OPERATIONS
  - Asset released for ISR comes at the expense of current task performance
  - Accuracy on a current task ↓ if an asset is removed; risk ↑
    - risk increases non-linearly with repeated use of *same* asset
- INTERACTIVE DECISION AID TO DETERMINE RISK (UConn)
  - Mimics interaction with lower-level forces



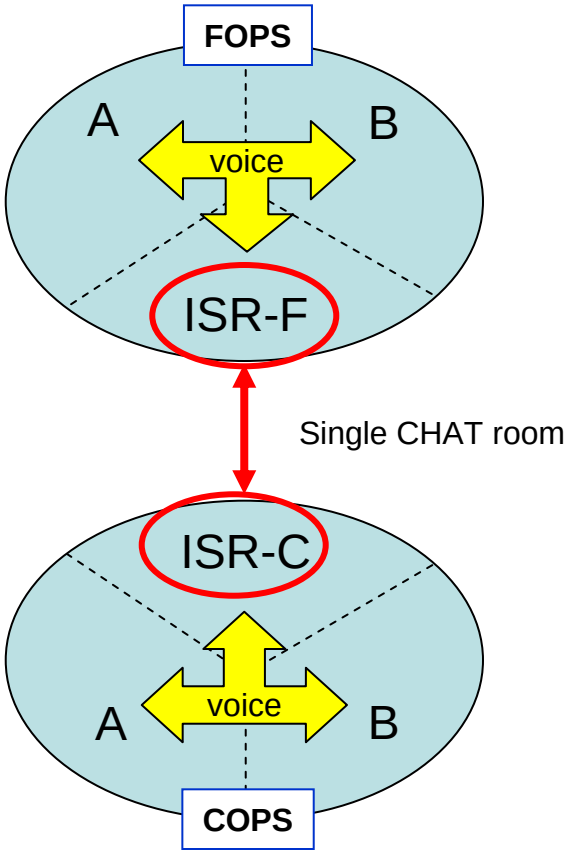
Provides COPS player with the risk that would be incurred **if** a specific asset is released from a specific task

INDEPENDENT VARIABLE: ISR ORG STRUCTURE

- CENTRALIZED ISR CELL
  - 3 cells of 2 players each
  - One CHAT room per area



- DECENTRALIZED ISR CELL
  - ISR embedded in COPS/FOPS cells
  - 2 cells of 3 players each



- CHAT USED BETWEEN CELLS; VOICE COMMS WITHIN A CELL

EXPERIMENT DESIGN: CONDUCT

- FOUR TEAMS OF 6 PLAYERS EACH
  - NPS students (O3-O4 level), some with MOC experience
  - 2 teams in each IV condition
- EXPERIMENT CONDUCTED IN 4 TWO-HOUR BLOCKS
  - Block 1: introduction to mission, training
  - Blocks 2 and 3: experiment runs (separated over 2+ days)
  - Block 4: Team and cell questionnaires, hot wash
- DATA COLLECTION (NPS, APTIMA, SDSU)
  - FOPS: Accuracy of plan by individual task assignments
  - ISR: Quality of ISR packages used
  - COPS: Total risk to ongoing operations
  - Temporal data on RFI process on task-by-task basis
  - CHAT logs, digitized voice recordings
  - Observer measures and subject self-reports
  - Eye-tracking data (SDSU)
  - Post experiment questionnaire
- DATA ANALYSIS PERFORMED BY APTIMA, Inc.

SELECTED MOC-1 RESULTS

- INDEPENDENT ISR CONDITION ⇒ HIGHER PLAN ACCURACY
  - 90% versus 82% (se ~ 2%)
- EMBEDDED ISR CONDITION ⇒ ENHANCED CELL COHESION
  - 6.8 versus 6.3 (se ~ 2.5%) for both social and mission cohesion

- POST EXPERIMENT SURVEY ON PACE AND METHODOLOGY
  - Easy to coordinate? (**100%**)
    - "Allow radio/voice comms between COPS and FOPS for direct coordination"
  - Adequate time to evaluate/compare options? (**92%**)
    - Pacing was good, players were engaged/challenged without feeling over-tasked
  - Reasonable abstraction of processes at OLW? (**73%**)
    - Separation of COPS and FOPS cells was artificial
    - "org structure we had was ideal and mostly close to my experiences"
  - Inter-team situation awareness (SA) needs improvement
    - Each watch-stander needs cognizance of responsibilities/status of other cells
    - Cross-cell prioritization of tasks and assets was not clear
    - Opening CHAT to include all cells would improve inter-unit awareness
    - Common operational picture (COP) to show locations & status of assets

THE ROAD AHEAD

- ONGOING DEVELOPMENT OF LAB ENVIRONMENT FOR EXPERIMENTS
  - Information environment: Networked visualization tools, COP, …
  - Aggregated (OLW) dynamic simulation (e.g., DDD) for “playout” of a plan
    - Simulate MOC interactions with lower-level forces
  - Automated data collection tools to capture planning process
  - Integration of agents and decision aids with human subjects
- EXPAND/MODIFY OPERATIONAL SCENARIO(S)
  - Include geography, subordinate task forces, …, other cells?
  - Consider a plan-execute-plan cycle (over multiple lab sessions)
  - Likely C2 focus: ISR integration during planning and execution
- REFINE ABSTRACTION/AGGREGATION OF MOC CELLS & PROCESSES
  - Increase subjects’ understanding of abstracted/aggregated processes
  - Embedded software to show “process” and time lines
  - Increase interdependency between FOPS and COPS
    - Comm structure (Voice, CHAT) should reflect/allow inter-cell processes
  - Use of agents – especially at tactical and subordinate force levels
    - Also for routine interactions within a MOC