



NCW in Action:

Experimentation within a

Distributed and Integrated

Command Environment

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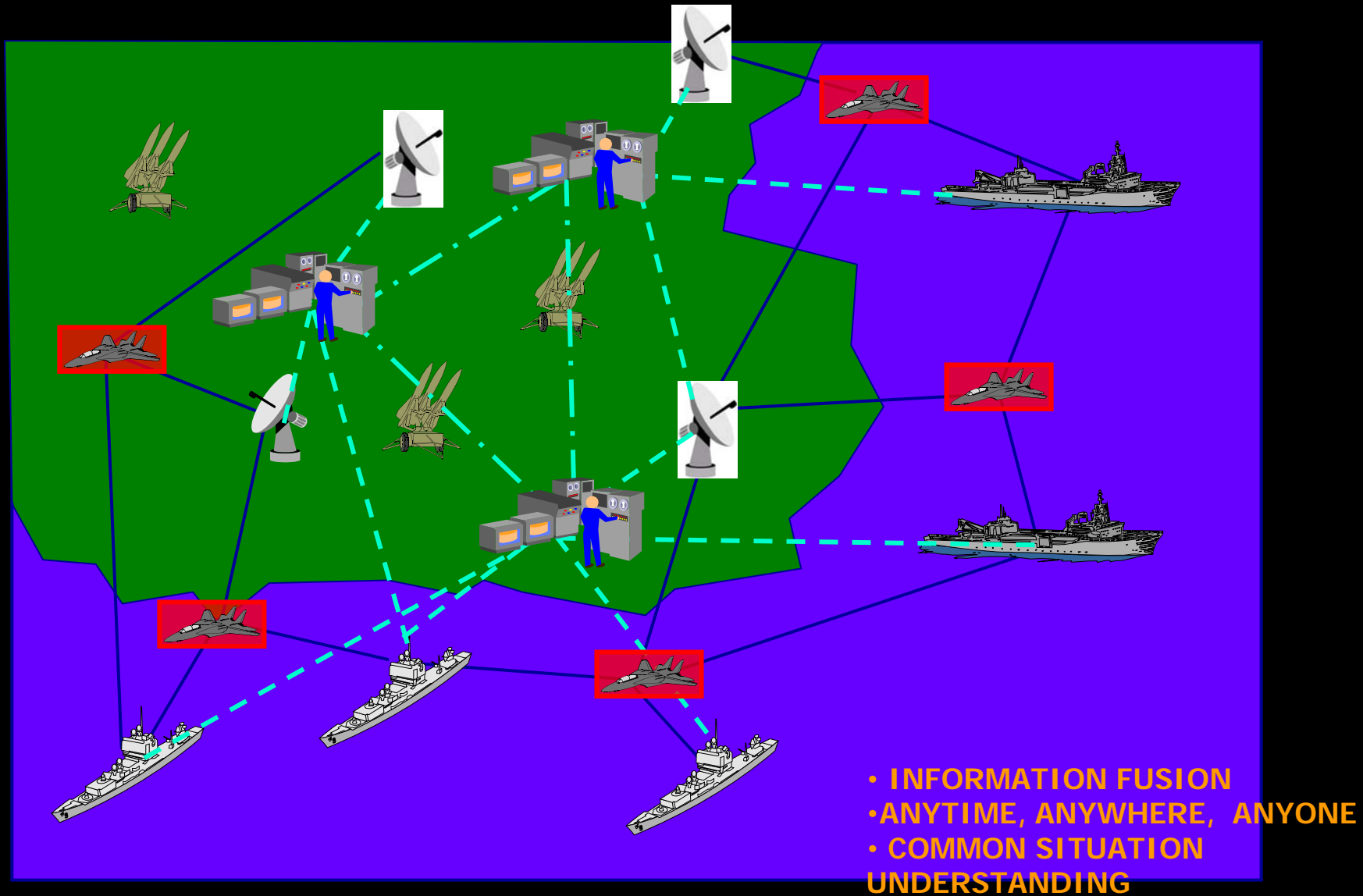


Overview

- Background research
- Measurement Framework
- The Experiment
 - Overview
 - Participants
 - Design
 - Measures
 - Scenario
 - Task C2 System
 - Results
 - Discussion of findings
- Conclusions

Background research

- Network-Centric Warfare... mere concept, or operational capability?



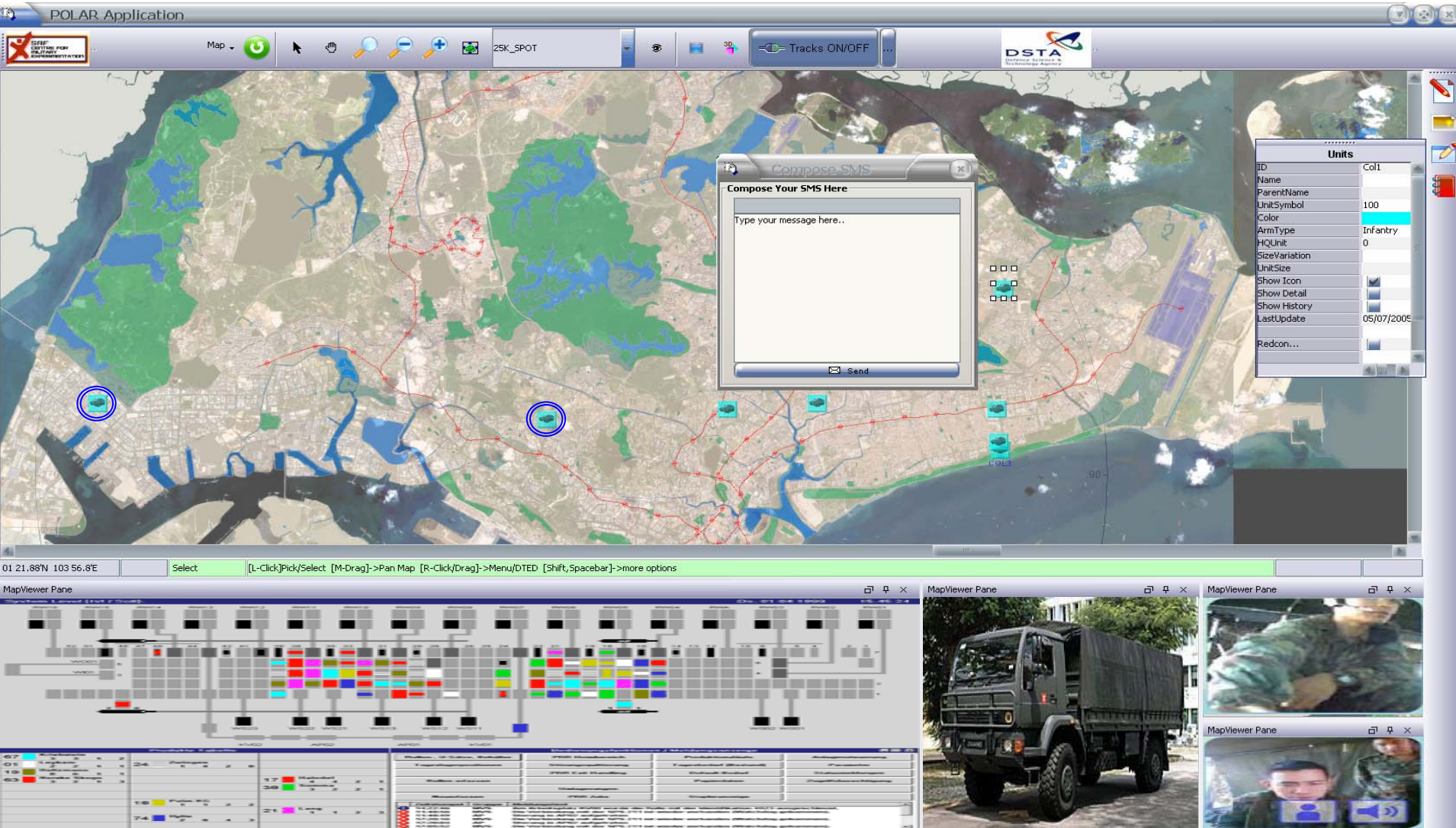
Network-Centric Warfare

*The Greatest Pitfall

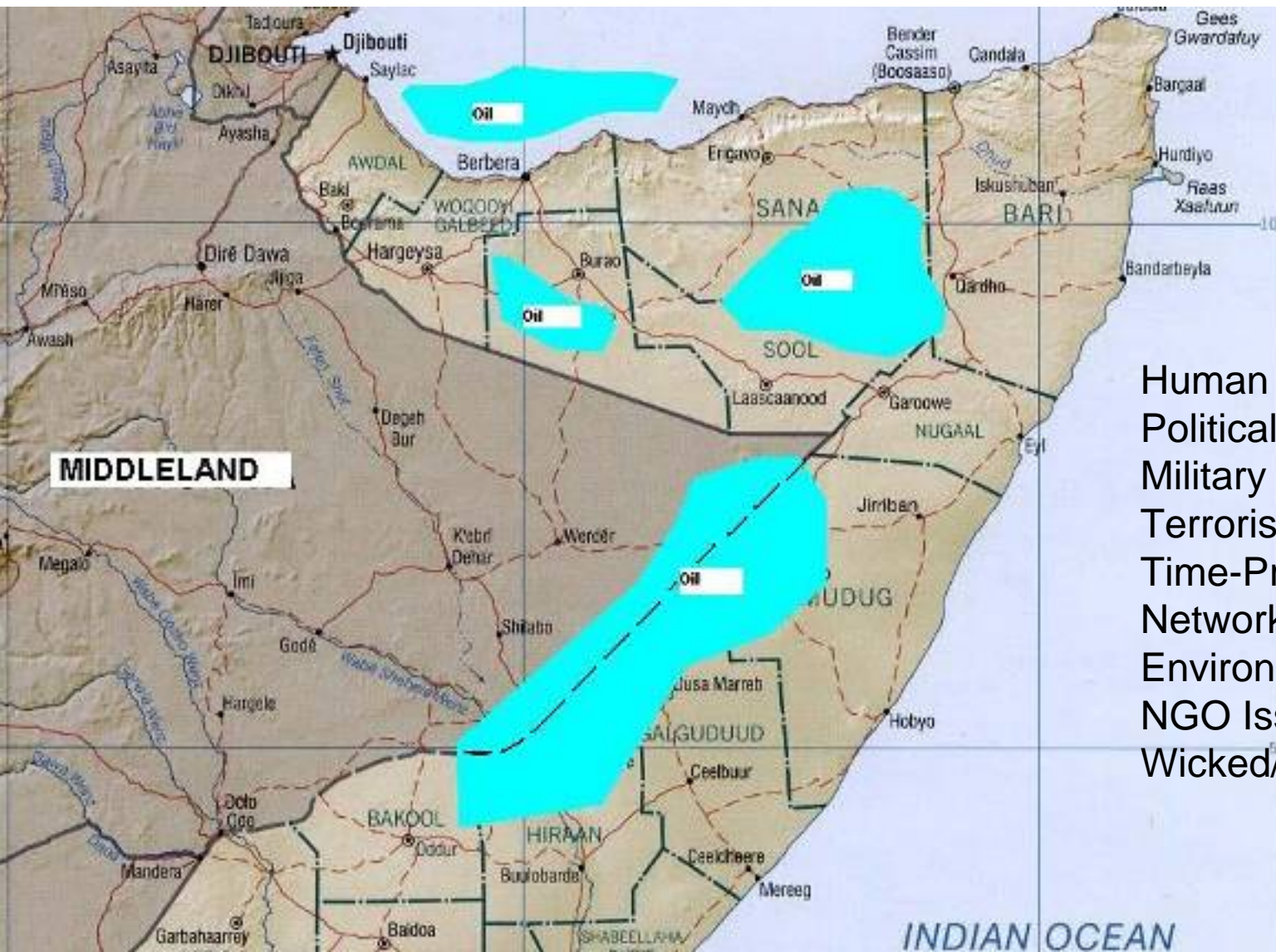
*Technology can never replace Humans



Situation Picture?



Complexity

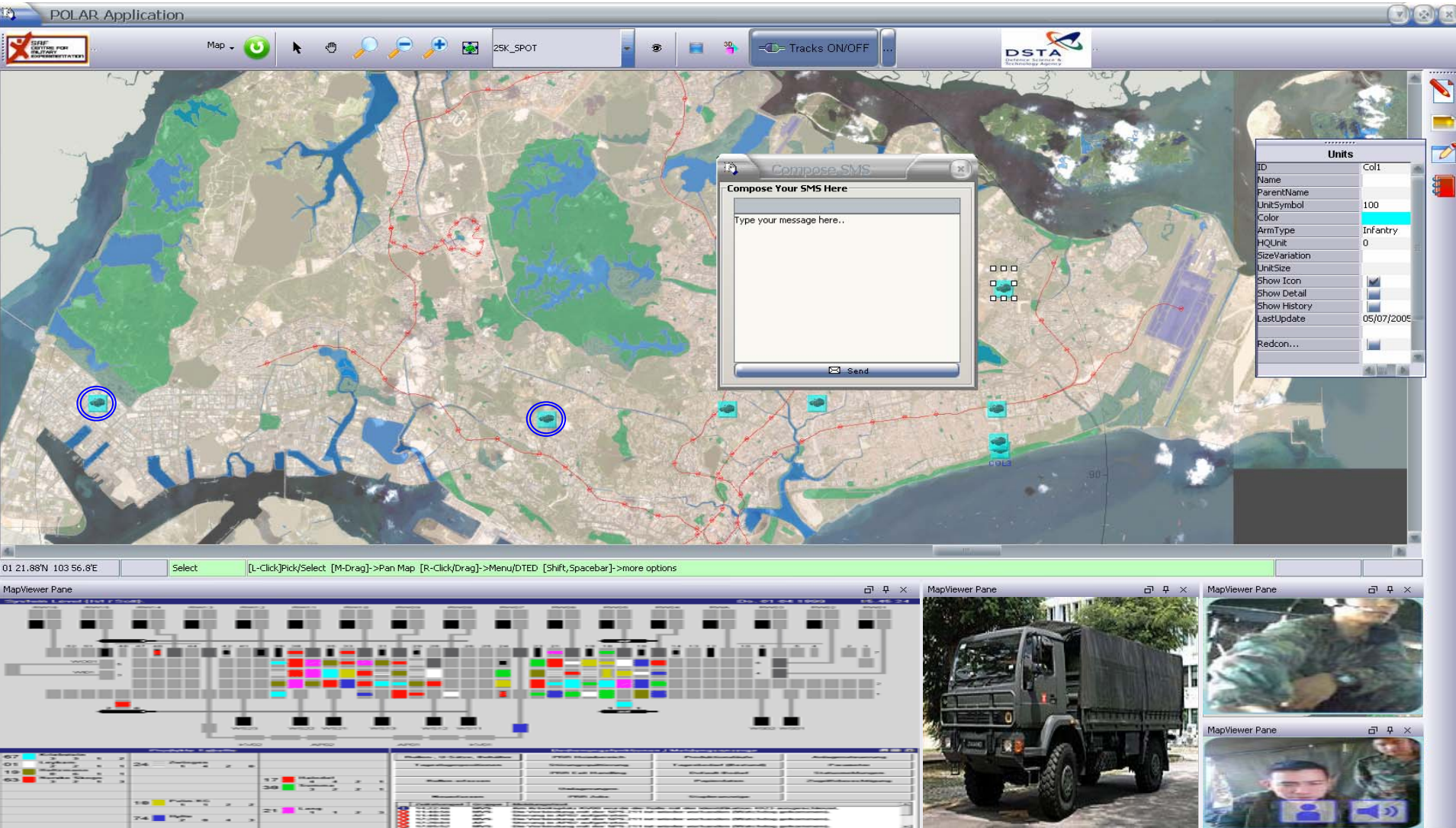


Human Social Issues
Political Issues
Military Coalition Issues
Terrorism Issues
Time-Pressure
Network Constraints
Environment Constraints
NGO Issues
Wicked/Smart Enemy



Changing face of threats....

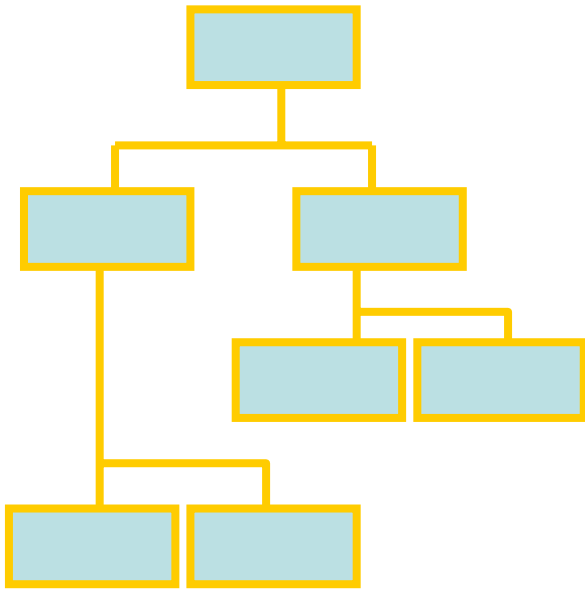
Situation Picture???



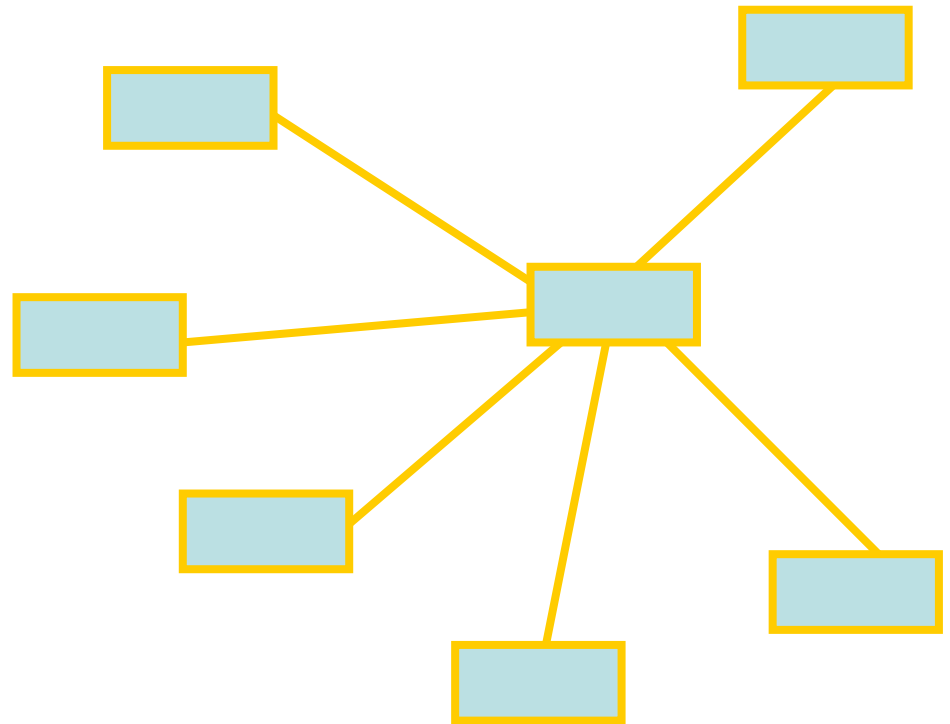
The New Frontier

- Current and future military cannot afford to be as disparate as the previous military organisation
- The Military needs to work with civilian partners to keep up with the changing ground rules
- The military should understand that the true situation picture is beyond the automated C2 System
- The military should start to understand issues by communicating with the People
- The Military's might and doctrine is getting less relevant
- The military should start to be adaptive in their roles, their processes and even their organisation.

Adapting Structures to Context



Hierarchical



Edge Organisation

Distributed and Integrated Command Environment



Measurement Framework

- Alberts and Hayes (2006): Value chain of network-centric enterprise

Robust networking =>

Information sharing and collaboration =>

Improved individual and shared awareness =>

Improved decision-making

and

Self-synchronization



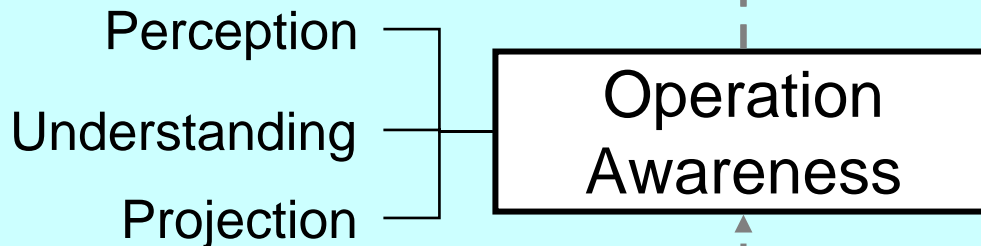
Desired outcomes

**Team
Collaboration**

Information, Action, Coordination
Requests / Transfers
& Anticipation Ratios

**Self
Synchronisation**

Social domain



Cognitive domain

Network-enabled

Reach ——— Richness

Characterisation
of Interactions

Information domain



The Experiment

- Overview
 - Series of 'live' field trials conducted by SAF in Nov 06 in Shoalwater Bay Training Area in Queensland, Australia
 - Networked warfighters to synchronize their own actions in a relatively flat command hierarchy in the context of dynamic heliborne operations
- Participants
 - Composite team of 4 Air Force and up to 24 Army officers
 - HHQ role-played by Experiment Control Team
- Design
 - Concept refinement experiment, with repeated measures
 - No independent variable

Success Indicators

- Network-enabled
- Operation Awareness
- Team Collaboration
- Self-Synchronization
- Decision Responsiveness

Asynchronous in space

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Asynchronous in time

Selectivity

Universality

Availability

Reach of
communications

Simultaneity

Network-enabled

Characteristics
of Interactions

Richness of
communications

Multi-Party

Interactive

Visual

Audio

Multimedia

Tools

Operation Awareness

- Loosely based on Endsley's construct of situation awareness
- Participants asked to complete questionnaire at the end of each run regarding:
 - Evolving battlefield situation (e.g. detected enemy units, own force operations)
 - Understanding of mission demands (e.g. updated tasks, changes in plans)
- Respondents also asked to rate their confidence level regarding each answer



Team Collaboration

- Collaboration requires communication => analyse communication stream at intermediate level of detail that incorporates both semantic and quantitative aspects:
 - Information Requests: *“where is the enemy location?”*
 - Information Transfers: *“landing point is HOT!”*
 - Action Requests: *“can you create the route in ForceMate?”*
 - Action Transfers: *“I am planning the route for us.”*
 - Coordination Requests: *“please check if any conflict...”*
 - Coordination Transfers: *“we will land in sequence... 1,2,3,4”*
 - Acknowledgements: *“roger”*
 - Comms checks: *“can you see my arrow?”*
 - Others
- Anticipation ratios = # of transfers / # of requests
 - team working well in general if anticipation ratio > 1



Self-Synchronization

- Further look at the breakdown of communication profile of each individual participant
 - compare comms profile of self-sync subordinate units versus that of HHQ
 - expectation is that HHQ comms would comprise more Information Transfers, whereas self-sync subordinate units would comprise more higher order comms, e.g. Action and Coordination Requests/Transfers



Decision Responsiveness

- Time taken to complete adjustment of plans in response to an event
- Only 1 aspect of adaptivity...
- Need to look into other classes of adaptivity in future:
 - Resilience
 - Flexibility
 - Agility

Scenario



Ops Plan

To Secure ZOS CONGO



Scenario Injects

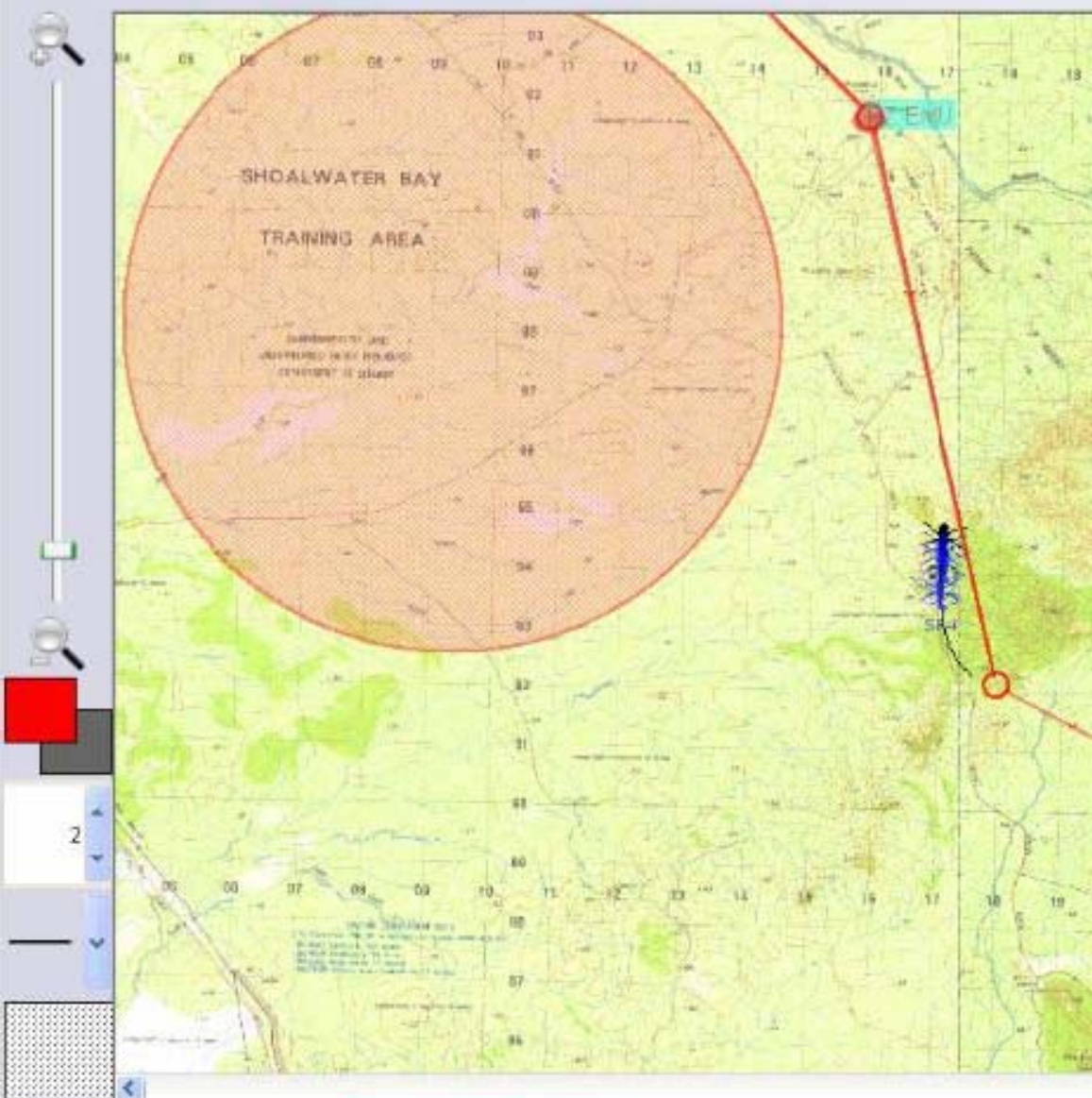
Concept of Operations: A Battalion Day Heliborne Operations, augmented by Light Strike Vehicles, in 2 waves of 4 SP, into Middleland North, to secure and establish 2 Block positions, with each Block Position held by a Company (-) and LSV, and a Company (-) in Reserve, so as to deny the Enemy Regiment Reserves (Coy+) from reinforcing or counter-attacking the enemy's Main Defence Line.

<u>Inject</u>	<u>Description</u>	<u>Expected action</u>	<u>Purpose</u>
1	Enemy patrol detected en route.	SPs expected to collaborate and adjust route.	Test of air-air coordination.
2	LPs reported to be HOT.	SPs to land at alternate LPs. Update pax (ground troops).	Test of air-air and air-ground coordination.
3	Change of flight plans issued at PZ.	Ad-hoc replanning (distributed).	Test of air-air coordination.
4	LPs reported to be HOT.	SPs to land at alternate LPs. Update pax (ground troops).	Test of air-air and air-ground coordination.
5	Enemy reported to be engaging Block Position.	Units to be re-tasked to reinforce Block Position.	Test of ground-ground coordination.



Task

- HPT issues injects to trigger jump-seat pilots to initiate adjustment of their flight routes and/or landing points within the overall mission assigned to them
- C2 System – ForceMate
 - Collaborative features that allowed all participants access to the team operational picture as well as communication via text chat
- Procedure
 - Preparations
 - Data collection



PowerChat: Common_Room

Close All Prompts

Welcome, JS 1!
You are currently in Common Room.

Auto [Voice Chat: Everyone]

Users Chat

Welcome to Exercise Wallab

Text Chat: Everyone

JS 1: thanks
[12 Nov 2006, 14:37:58]

JS4: too close
[12 Nov 2006, 14:38:18]

js 3: okok
[12 Nov 2006, 14:38:25]

head

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Send

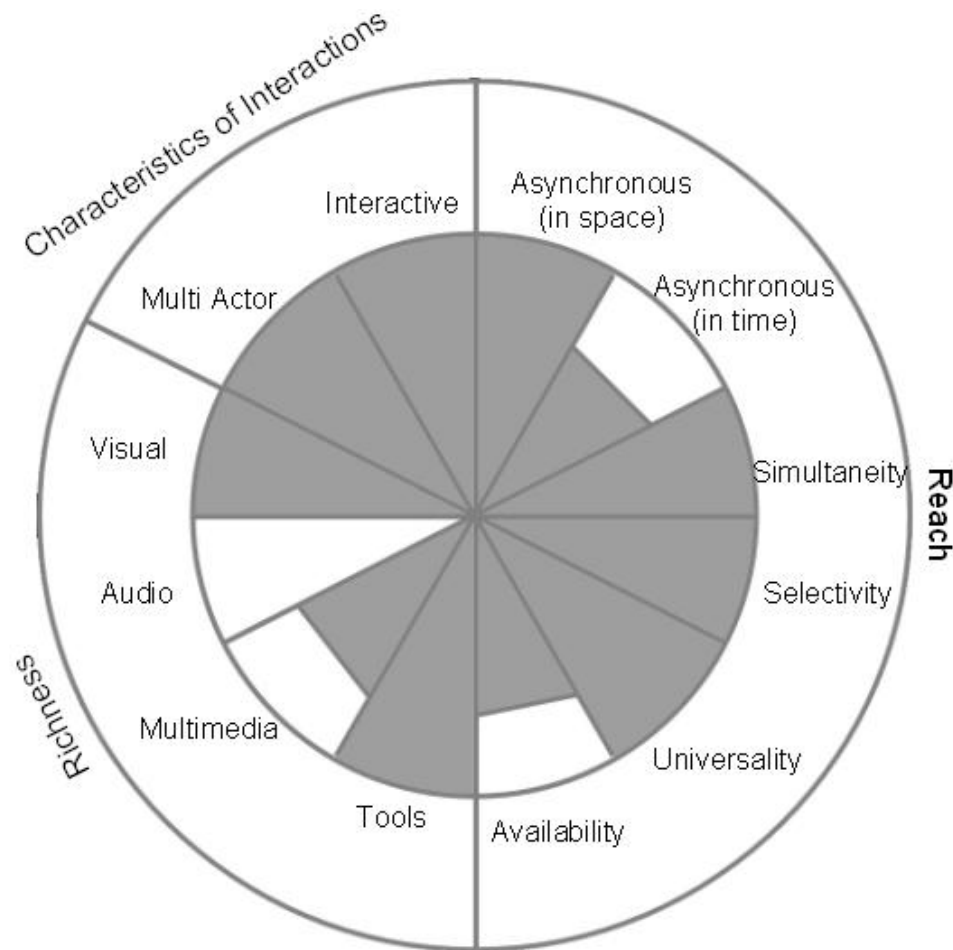
JS4 says to Everyone

JS4 says to Everyone:
so final plan.. deviating right of shoread threat and pres
sing with the red route drawn in there...

Reply



Results (1): Characterization of Network-Enabled





Results (2): Operation Awareness

	Run 1	Run 2	Run 3
Air Group	Awareness: 75% Confidence: 9.66 / 10	Awareness: 90.6% Confidence: 9.1 / 10	Awareness: 100% Confidence: 10 / 10

- Moderate to high level of awareness of the operational picture
- High level of confidence regarding their awareness



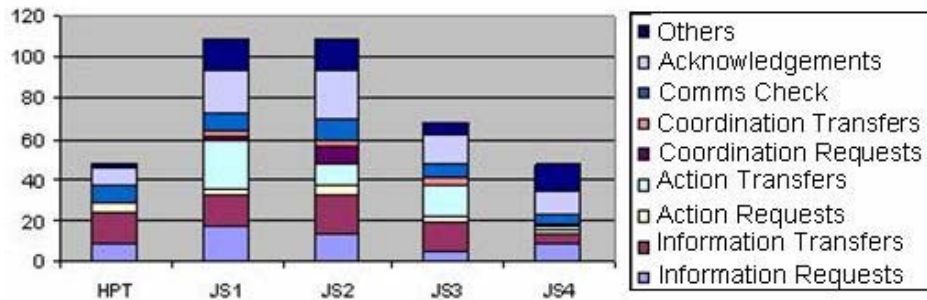
Results (3): Team Collaboration

	Run 1	Run 2	Run 3
No. Messages in total	438 (Broadcast)	349 (Air Group) 52 (Ground Group) 13 (Air-Ground Group)	406 (Air Group) 74 (Ground Group) 20 (Air-Ground Group)
Communication Types			
Information Requests (IR)	59	54	41
Information Transfers (IT)	83	63	70
Action Requests (AR)	22	17	11
Action Transfers (AT)	52	23	20
Coordination Requests (CR)	11	7	6
Coordination Transfers (CT)	10	19	41
Acknowledgements (ACK)	83	56	82
Comms Check (CC)	60	45	26
Others (O)	58	65	109
Communication Ratios			
Overall anticipation	1.57	1.35	2.26
Information anticipation	1.41	1.17	1.71
Action anticipation	2.36	1.35	1.82

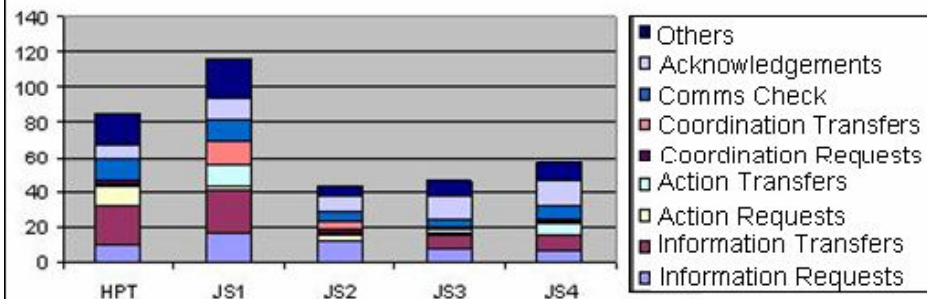


Results (4): Self Synchronization

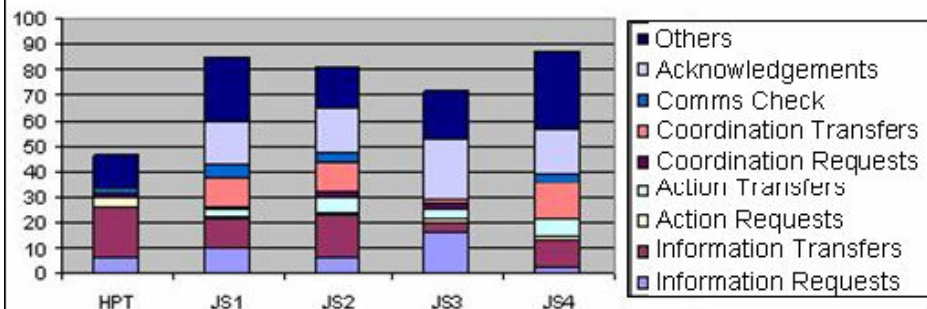
Run 1



Run 2



Run 3



- **Run 1:** Fair amount of action transfer; reliance on JS pilots 1 and 2 to take the role of mission leads
- **Run 2:** Again, reliant on lead aircraft (JS1). Increased amount of coordination transfers. Caveat: degraded network performance
- **Run 3:** Warmed up to concept of self-synchronization. Volume of communication from JS pilots far exceeds that of HPT, yet fairly equal. Increased amounts of coordination transfers.



Results (5): Decision Responsiveness

Inject description	Time taken to respond		
	Run 1	Run 2	Run 3
Deployments of enemy ADA sighted. Re-routing of flight plans to avoid enemy firing template.	11 min	16 min	9 min
Ad hoc secondary mission (heli-casevac)	NIL	25 min	NIL

- Ability of jump-seat pilots to collaborate and adjust their plans in response to the injects is in itself an improvement over the current way of doing things
- Decision quality not taken into account; JS pilots relatively junior and inexperienced
- Timings could possibly be shorter with more senior and experienced pilots, and with voice comms in addition to text chat



Discussion of Results

- Feedback: participants felt entrusted and empowered to make decisions regarding dynamic route (re)planning to divert from potential danger areas in a responsive manner
- Frees up higher command to devote attention to other critical areas (e.g. mission assurance and survivability)
- Challenge of Mission Command: potentially high workload on pilots/co-pilots
- Observation: change in pilots' mind-set; more aware of potential dangers and possible contingency plans. Key element of agility is to have warfighters who are primed to switch between different models of command and control.



Conclusions

- Purpose of Limited Objective Experiment was two-fold:
 - To refine the concept of applying DICE to facilitate collaboration and self-synchronization within an edge organization
 - To assess the usefulness of the DICE measurement framework as applied to a real experiment
- Experiment design did not allow for experimental comparisons across the various runs, but analysis of data collected serve as baseline for future trials of a similar nature
- Compared to present-day system, availability of datalink and collaborative C2 planning tool holds much promise
- Desired outcome of agility comes from putting in place networks and systems to allow well-conditioned team to adopt the C2 mode most suited to the mission at hand