Task Environment Development (SUMMIT-TED)

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Overview

- Objective
- Synthetic Task Environments
- Progress
  - Scenario
  - Measurement Issues
  - Testbed Software
  - Testbed Hardware

Objective

Develop a test bed (i.e., Synthetic Task Environment) for the study of macrocognitive team processes in one-of-a-kind collaborative scenarios that involve planning, problem solving, decision making, and strategizing in short-fuse, high-stress environments.

- Supports team tasks that involve macrocognition
  - Team decision making, COA selection
  - Time pressure; massive, uncertain, dynamic info; agents
  - Synchronous & asynchronous, distributed, cultural diversity, heterogeneous, unique roles
- *Provide environment for SUMMIT experimentation on macrocognition*
  - Two systems (AZ & FL) that can also support studies of distributed macrocognition

Synthetic Task Environments

"The Field"

Ground Control Station

CERTT Synthetic Unmanned Aerial Vehicle Testbed

- A middle ground between lab and field
- Bring much of the complexity of the field into the lab
- Allow some experimental manipulation and control capabilities
- Systematically exercise macrocognitive processes

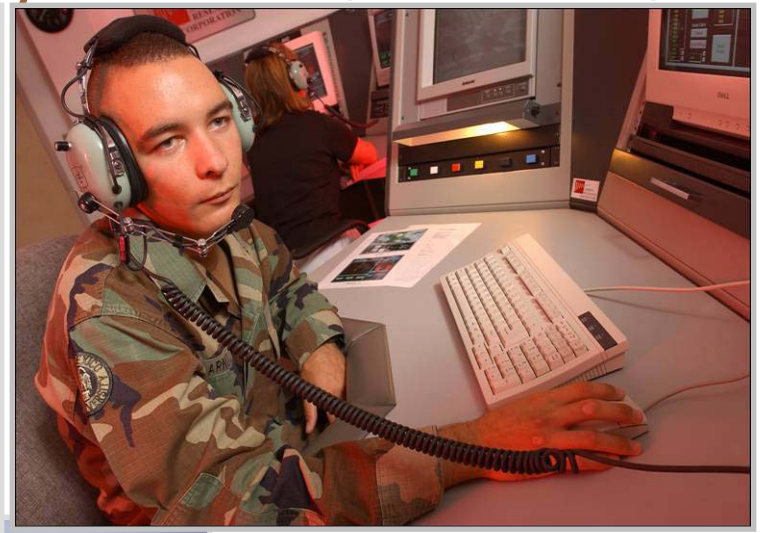
Synthetic Task Environments

Benefits

- Cognitive fidelity vs. physical fidelity
- Preserve complexity & realism
- Allow for experimental control & measurement

Example: UAV-STE

Uninhabited Air Vehicle Synthetic Task Environment



In our UAV STE three operators must coordinate over headsets in order to maneuver their UAV to take pictures of ground targets

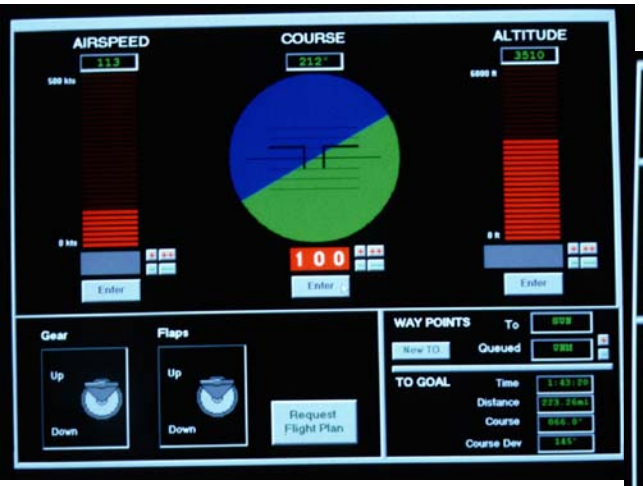
Example: UAV-STE

Three Team Members

Air Vehicle Operator
controls UAV airspeed, heading, and altitude and monitors air vehicle systems

Payload Operator
controls camera settings, takes photos, and monitors camera systems

DEMPC
navigator, mission planner, plans route from target to target under constraints



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Example: UAV-STE

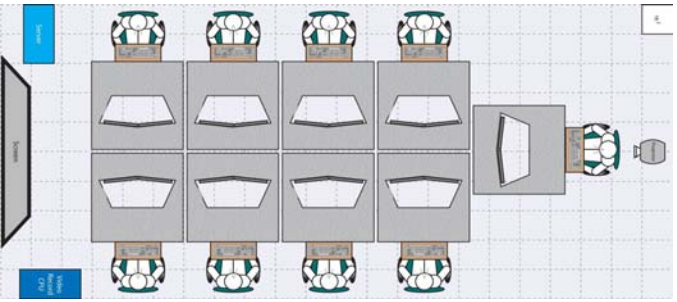
Task Fidelity

- Task based on CTA of Predator operations
- Task is faithful to the aspects of the operational task that pertain to team cognition
- Cognitive fidelity vs. physical fidelity
- Individuals learn their task in 1.5 hours
- Team task (taking photos of targets) requires team coordination
- Measurement and manipulation flexibility

SUMMIT-TED Synthetic Task Environment

"The Field"

NEO (Noncombatant Evacuation Operations) or Emergency Response Planning



Collaborative Mission Planning STE

Objectives

- Environment for multiple synthetic collaborative mission planning tasks
- Experimenter-friendly
  - Easy to manipulate and control
  - Easy to construct scenarios
  - Facilitate macrocognitive measurement
- Tasks
  - Multiplayer (3-8)
  - Time pressure
  - Uncertainty
  - Distributed
  - Heterogeneous
  - Decision making

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SUMMIT-STE vs. UAV-STE

	SUMMIT-STE	UAV-STE
Team Size	4-9	3
Sites	2	1
Task	Unstructured	Structured
Task	Strategic	C2
Communications	FTF, Chat, Email	Intercom & Headset
Flexibility	Multiple Tasks	Multiple UAV Scenarios

Survey of Existing Tasks

Rated these tasks…

Jane's Fleet Command
Virtual Battlefield Sim 1
Marine Air-Ground Task Force
Stability Operations
DARWARS
Quick Strike
Avant Guard
BC-2010
Decisive Action
Full Spectrum Command
Guard Force
UCF Hospital Task
SIMNET
TAC-OPS 4
Intelligence Ops
Incident Commander
Neocities
NavAir Testbed
Boarding Party
Interdiction
Sim City 4
Maid Marion
Full Spectrum Warrior
Neverwinter Nights
C3 Fire
NEO
ISEE
Networked Fire Chief

…on these features/dimensions

Fun/Engaging
3-10 People
Emergency Mgmt
Network Centric Warfare
Multi-cultural.
Teams of teams
Geo-distributed
Agile/Flexible teams
Transformational Teams
Heterogeneous knowledge
Hierarchical
Interdependent
Time critical decisions
Naturalistic decision-making
Information-intense
Some level of uncertainty
Ad-hoc problems
Learning
Internet capability
OS
Price
Hooks
HLA/DIS

SUMMIT-TED Test Environment

- *Modify the existing NEO task (extend complexity, no. team members)*
- *Develop scenario authoring language capable of generating different NEO scenarios best suited to the needs of the SUMMIT project*
- *Using the scripting language create a new genre of scenarios (emergency response)*

Progress: Scenario

Expansion of NEO Scenario

- 5 team members
  - Local Intel Specialist
  - Global Intel Specialist
  - Weather Specialist
  - Equipment Specialist
  - Logistics Specialist
- Paper-based →Computer-based
- Each mission has 7-10 operations (collaboration events)
- Integration of Measurement

Example of Collaboration

Operation 3: Replenish Supplies at Sarna

Global Intel Specialist

"Hold on. Radar malfunctions have grounded all flights from Ranyen for the next 3.5 hours. What is our timeline like? Should we hold out to use aircraft?"

"The winds between Sarna and Ranyen are 10 mph, which is normal. No rain in sight. Aircraft should be good to go."

Weather Specialist

"FYI - Rotary aircraft, fixed-wing aircraft, and boats are available for this operation."

Equipment Specialist

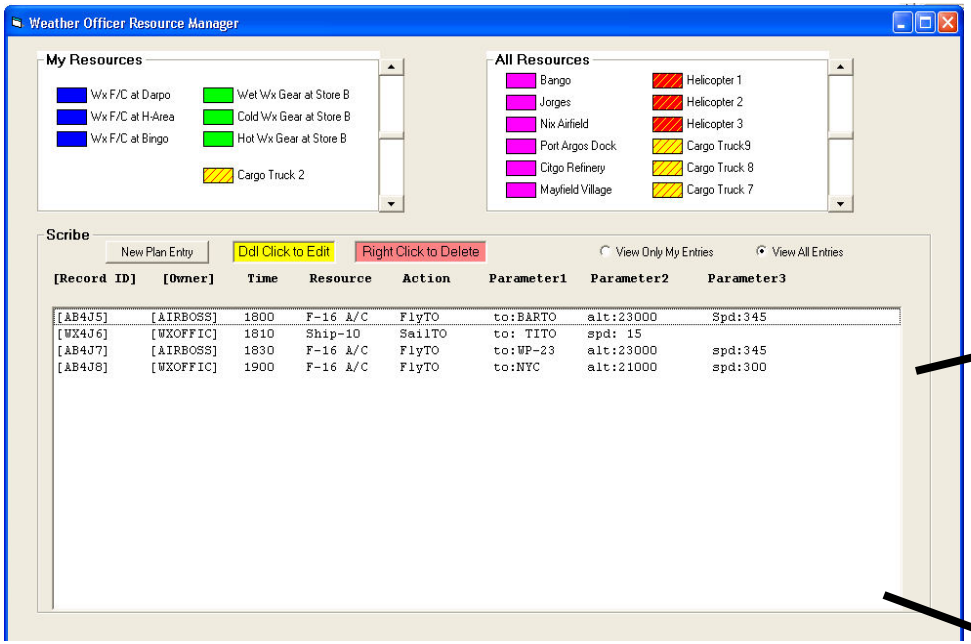
Local Intel Specialist

"It looks like 50 armed rebels are headed in the direction of Sarna. They were last seen about 125 miles away. Is there any way we can get there before they do?"

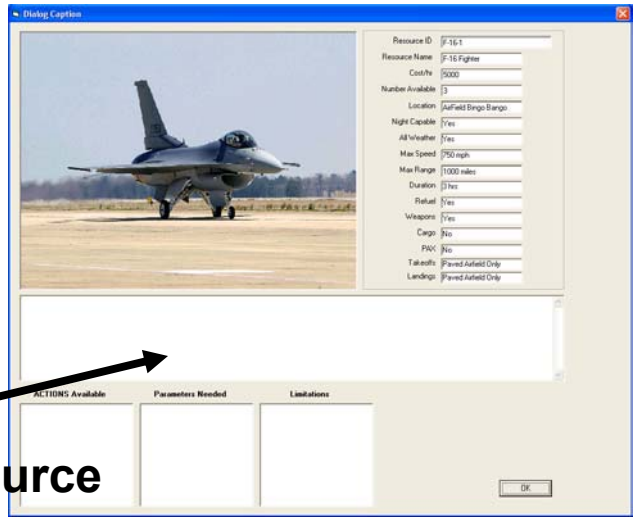
Logistics Specialist

"Well, the airplanes are at Ranyen. We can load the supplies and get them to the runway near Sarna in 3 hours. What is the weather like between these two areas?"

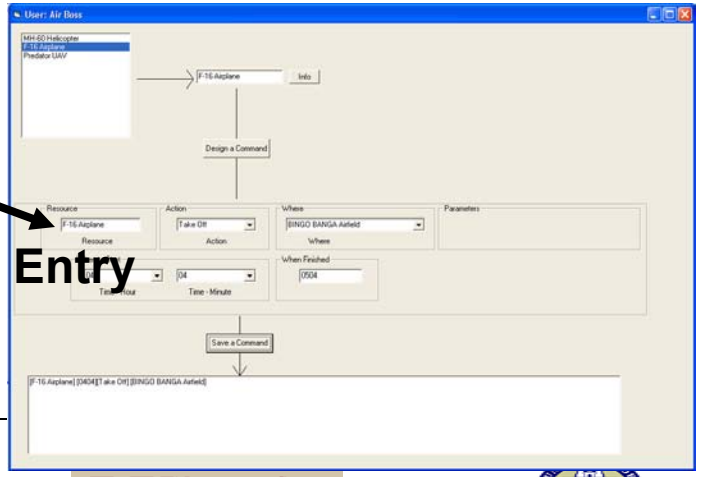
Participant Windows



Main Role Screen

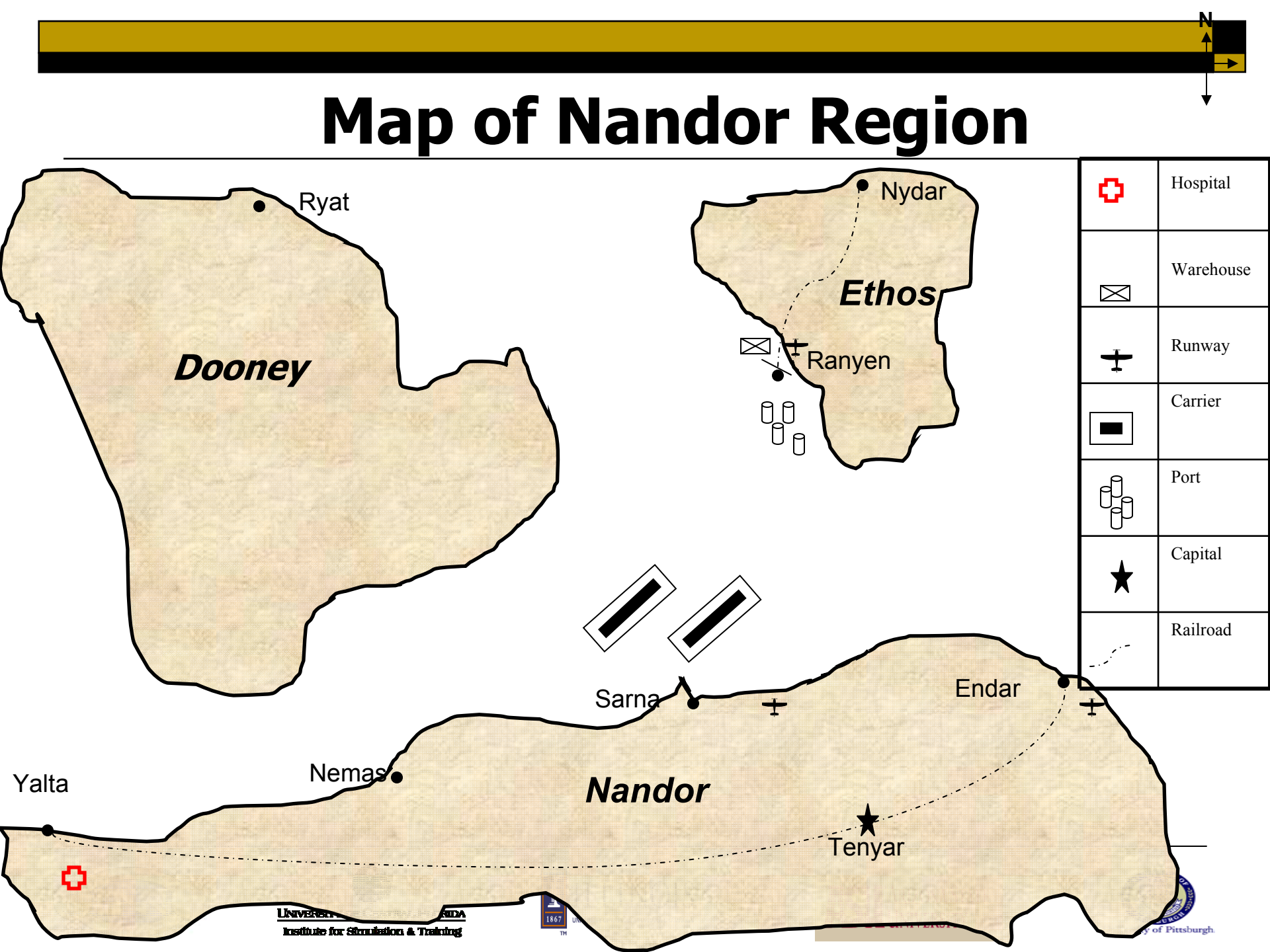


Resource Viewer



Plan Entry

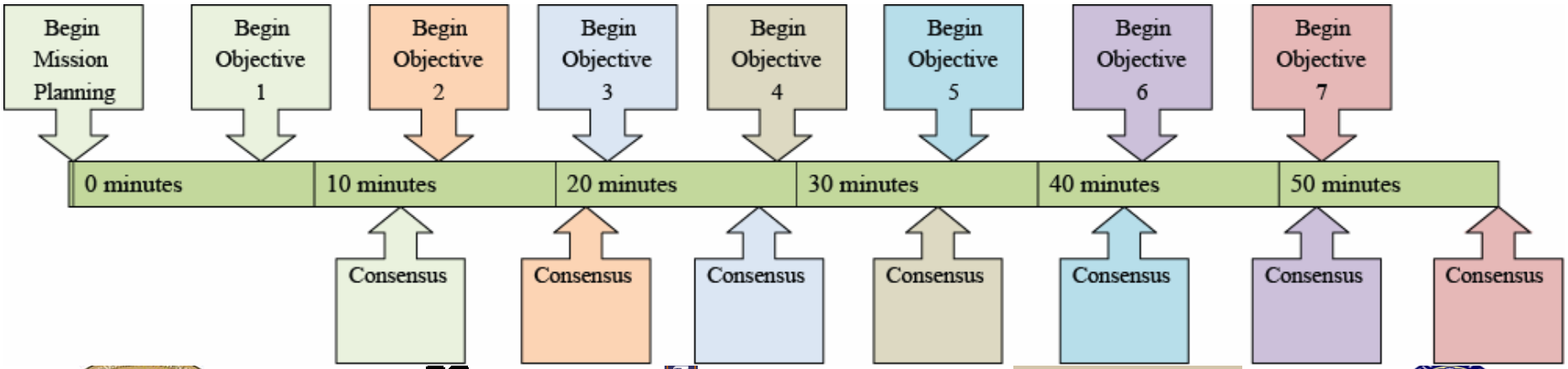
Map of Nandor Region



Tentative Timeline for Mission

Mission One (60 minutes):

- Mission Planning
- Operation 1: Establish a land-base at Ranyen
- Operation 2: Force Build-up at Nemas
- Operation 3: Replenish Supplies at Sarna
- Operation 4: Provide Supplies, Personnel, Security for Local Hospital
- Operation 5: Water Rescue of Refugees
- Operation 6: Rescue of Government Workers in Tenyar
- Operation 7: Provide Refugee Transport from Endar



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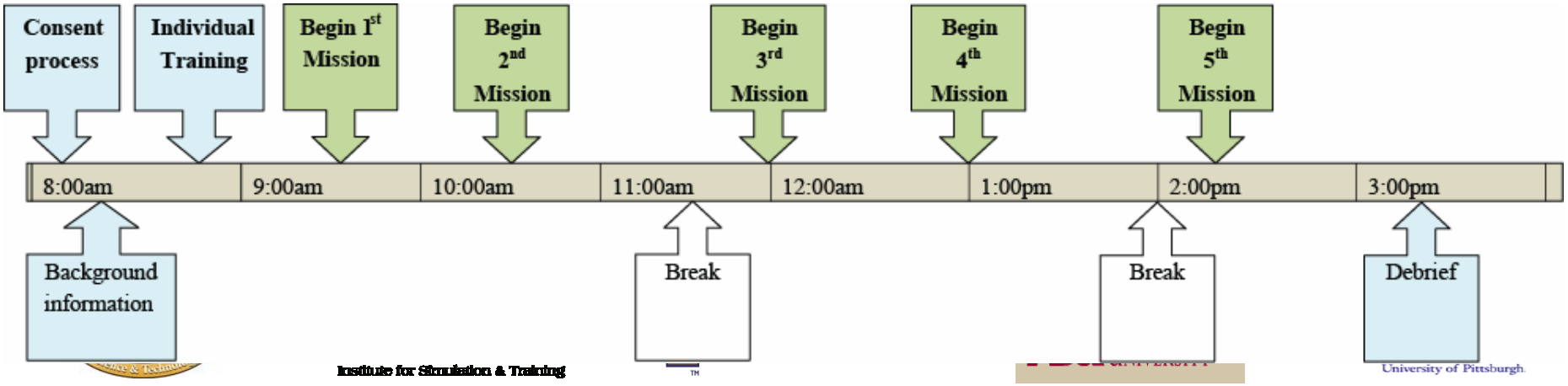
Tentative Timeline for Experimental Procedure

- Consent process
- Background information: Overview of mission and the team members roles
- Individual training: participant roles and the MACROCOG interface
- Mission 1 (7 collaborative operations)
- Mission 2 (7 collaborative operations)
- Break
- Mission 3 (7 collaborative operations)
- Mission 4 (7 collaborative operations)
- Break
- Mission 5 (7 collaborative operations)
- Debrief



Scenario Pilot Testing - Instances of Collaboration

Common Goal / Formulate Plan	Identifying Common Information	Providing Unique Information	Brainstorming & Negotiation	Reaching Consensus	Cumulative Time
Establish a Land Base at Location 3	4.75%	**50%**	40.5%	4.75%	4:30
Replenish Supplies at Location 5	5%	36.6%	**51%**	7.4%	8:00
Rescue Drowning Refugees at Location 8	12%	**52%**	28%	8%	10:45
Provide Supplies to Establish Medical Facility at Location 9	8%	39%	**42%**	11%	15:00
Rescue Government Workers at Location 7	7.7%	38%	**42.3%**	12%	18:00
Provide Transport for Refugees at Location 6	7%	**43%**	**43%**	7%	23:00

Progress

Measurement Issues: Integration of Measurement into Test Bed

Construct	Raw Data Collected	Locus of Data Collection	Potential Metrics Applied to Raw Data	On-line or Off-line
Performance	Values of discrete scenario variables	Scenario	Mission accomplishment (outcome), total resources used, number photos taken	On-line
	Snapshots of values of continuous scenario variables (altitude, airspeed, coordinates)	Scenario	ID of context or event or status, outcome score,	On-line
	User actions with interface	Scenario	Outcome score, frequency of actions, illegal actions, sequence of actions	On-line
	Time Stamps of Events	Scenario	Overall length of time, latency	On-line
	Likert scale ratings	Experimenter or Participant	ATPI, self ratings of performance	On-line or Off-line

Progress

Measurement Issues: Integration of Measurement into Test Bed (2)

Construct	Raw Data Collected	Locus of Data Collection	Potential Metrics Applied to Raw Data	On-line or Off-line
Process	Speaker/Listener time stamps	Scenario	Communication flow, ProNet	On-line
	Audio recording of communications	Scenario	Communication content, LSA	On-line
	Observation log	Experimenter	Team Process behavior, coordination	On-line
	Checklist	Experimenter	Targeted acceptable responses to generated events or tasks (TARGETS);Coordinated Awareness of Situation by Teams (CAST)	On-line
	Likert scale ratings	Experimenter or Participant	Process rating (communication, leadership); ATOM	On-line
	Response to prompts, queries, changes	Participants	Situation Awareness, Coordinated Awareness of Situation by Teams (CAST)	On-line or Off-line
	Cue relations	Participants	Judgment SA, Informity	On-line
	Eye Movements	Participants	Interaction patterns	On-line

Progress

Measurement Issues: Integration of Measurement into Test Bed (3)

Construct	Raw Data Collected	Locus of Data Collection	Potential Metrics Applied to Raw Data	On-line or Off-line
Knowledge	Queries, test questions, checklists, Likert ratings	Experimenter or Participants	Teamwork or Taskwork Knowledge; meta knowledge (team or individual level);SAGAT/SPAM; mental model; shared mental model	On-line or Off-line
	Conceptual Proximity data (sorting; pairwise ratings)	Participants	Teamwork or Taskwork Knowledge; meta knowledge (team or individual level);Situation Awareness Linked Indicators Adapted to Novel Tasks (SALIANT); Mental model, Shared mental model	Off-line
Workload/Stress	Likert scale ratings	Participants	NASA-TLX	Off-line
	Cortisol Swabs	Participants	Stress	On-line
	Voice Stress	Participants	Stress	On-line

Progress

Measurement Issues: Integration of Measurement into Test Bed

Need opportunities for measurement of collaborative constructs both within, and between, runs of STE scenario

Thus in the SUMMIT scenario there needs to be:

1) Multiple goals or subgoals embedded within a scenario

2) Overall outcome

Framework for integrating measures and task

What Data is needed?
How is it recorded?

STE needs to record the raw data for researchers to get were they want to go

STE needs to generate metrics from raw data automatically

Researchers need to get here

Data recorded by…	Raw Data	Online Metric	Post Process Metric
Task			
Participant			
Experimenter			

Progress

Measurement Issues: Importance of Real-Time and Embedded Measurement

Communication Log

713.125, <00000:00000:00000:00100:00000>
713.250, <00000:00000:00000:00100:00000>
713.375, <00000:00000:00000:00100:00000>
713.500, <00000:00000:00000:00100:00000>
713.625, <00000:00000:00000:00100:00000>
713.750, <00000:00000:00000:00000:00000>
713.875, <00000:00000:00000:00000:00000>
714.000, <00000:00000:00000:11000:00000>
714.125, <00000:00000:00000:11000:00000>
714.250, <00000:00000:00000:11000:00000>
714.375, <00000:00000:00000:11000:00000>

time

1 = channel open
0 = channel closed

Communication Logger timestamps participant's verbal interactions

Chat Logger timestamps participant's chat interactions

Progress

- Testbed Software – Named: MACRO-COG

STE Architecture

- MACRO-COG is not a typical STE
- MACRO-COG is an environment in which to Design, Build, and Run collaborative Mission Planning STEs
- No bounds on the type of tasks
- No bounds on the number of roles and participants
- STE Library allows many STEs to be saved in a ready-to-run configuration
  - Can be web based

STE Architecture

- All connectivity is IP based
  - Participants can be anywhere
- Unlimited number of scenarios can be designed, saved, and later activated with a single mouse click.
  - No hardware changes
- Can have a flexible number of participants
  - 1 to n …
    - Number of roles defined in scenario design

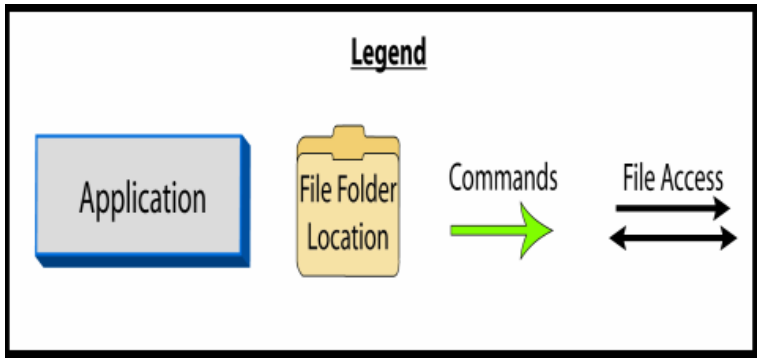
STE Architecture

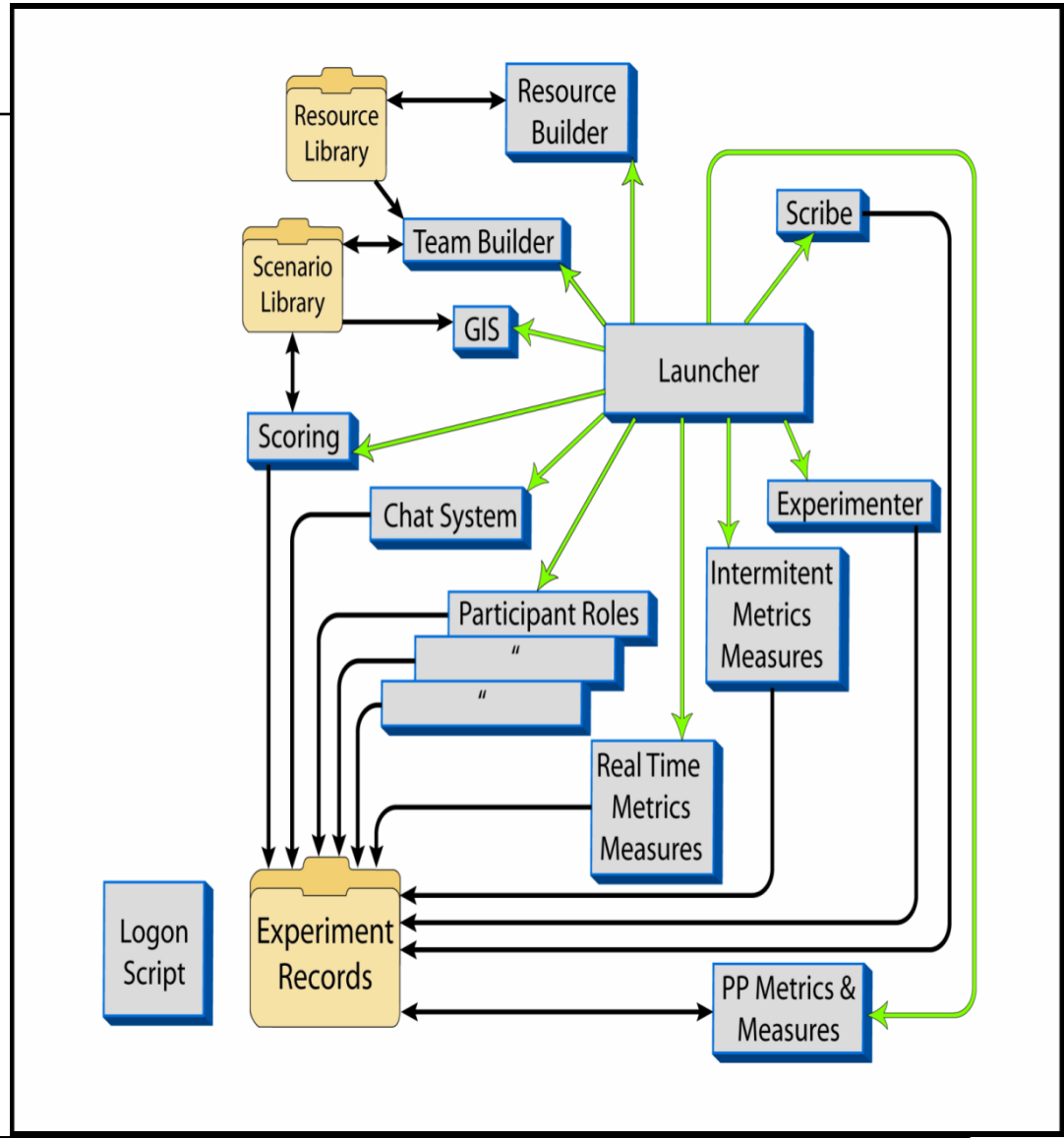
- MACRO-COG is an Object-Oriented architecture
- The MACRO-COG world is made up of a number of resources (objects).
- The various participant roles own a subset of these objects
  - Each object has one owner
- The objects each have actions (methods) and properties
- The participants plan the use of these objects in a mission plan

Properties of Objects

- Each object has properties
  - Participant can alter some properties
  - The system can set properties that the participant cannot change
  - Some other roles can view some properties, but only the owner can change

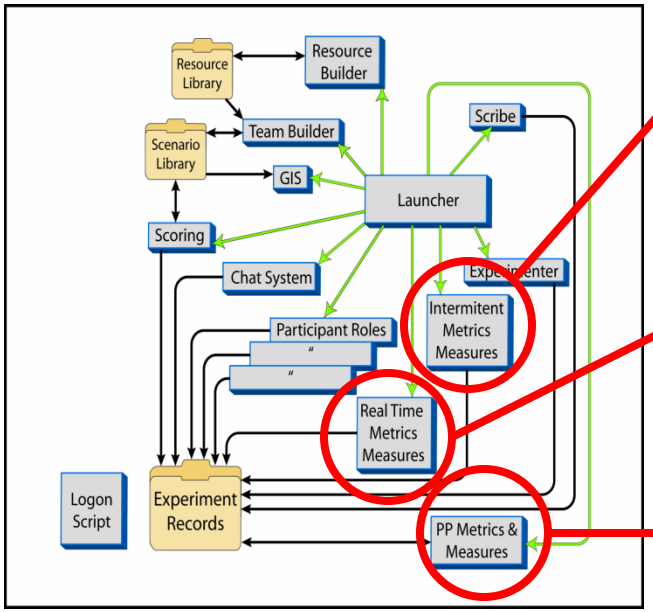
System Overview





Chat System

Designation of MACRO-COG Metric Types

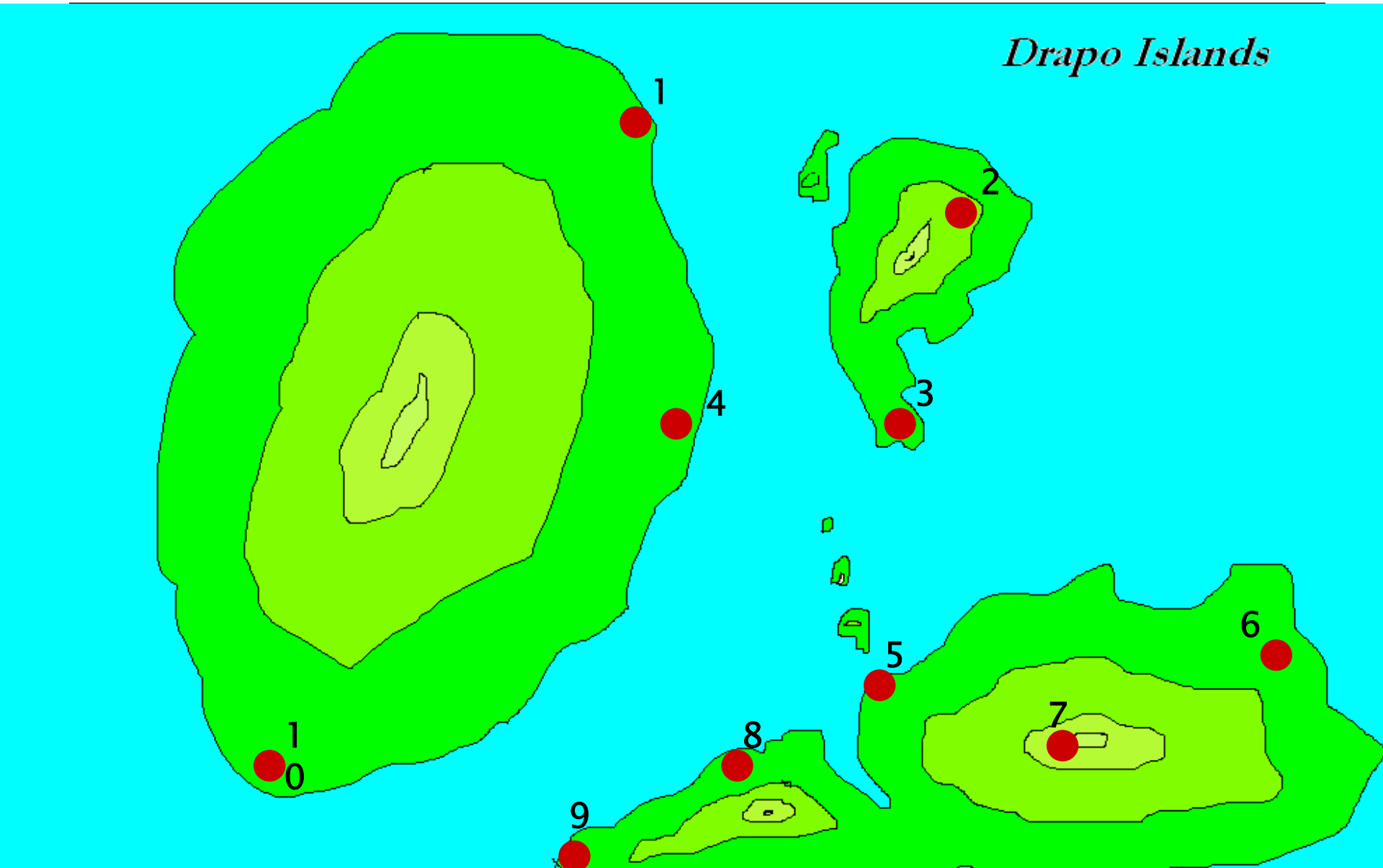


Intermittent – Metrics that require elicited/prompted participant input; e.g., SAGAT or NASA-TLX.

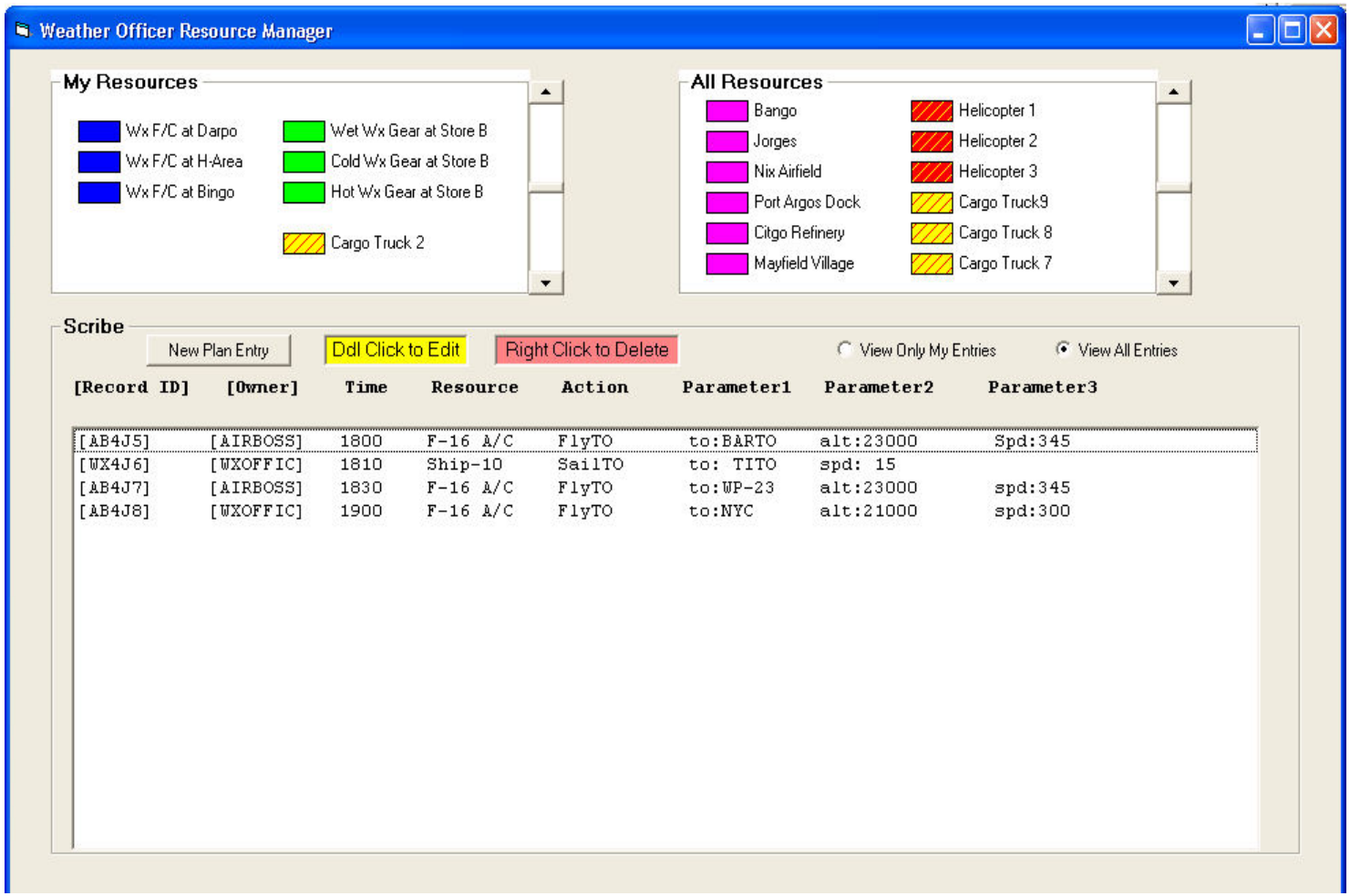
Real Time – Metrics that are produced while performing the task; e.g., communication & collaboration metrics.

Post Processed – Metrics that can be processed off-line; e.g., Inter-positional versus positional knowledge.

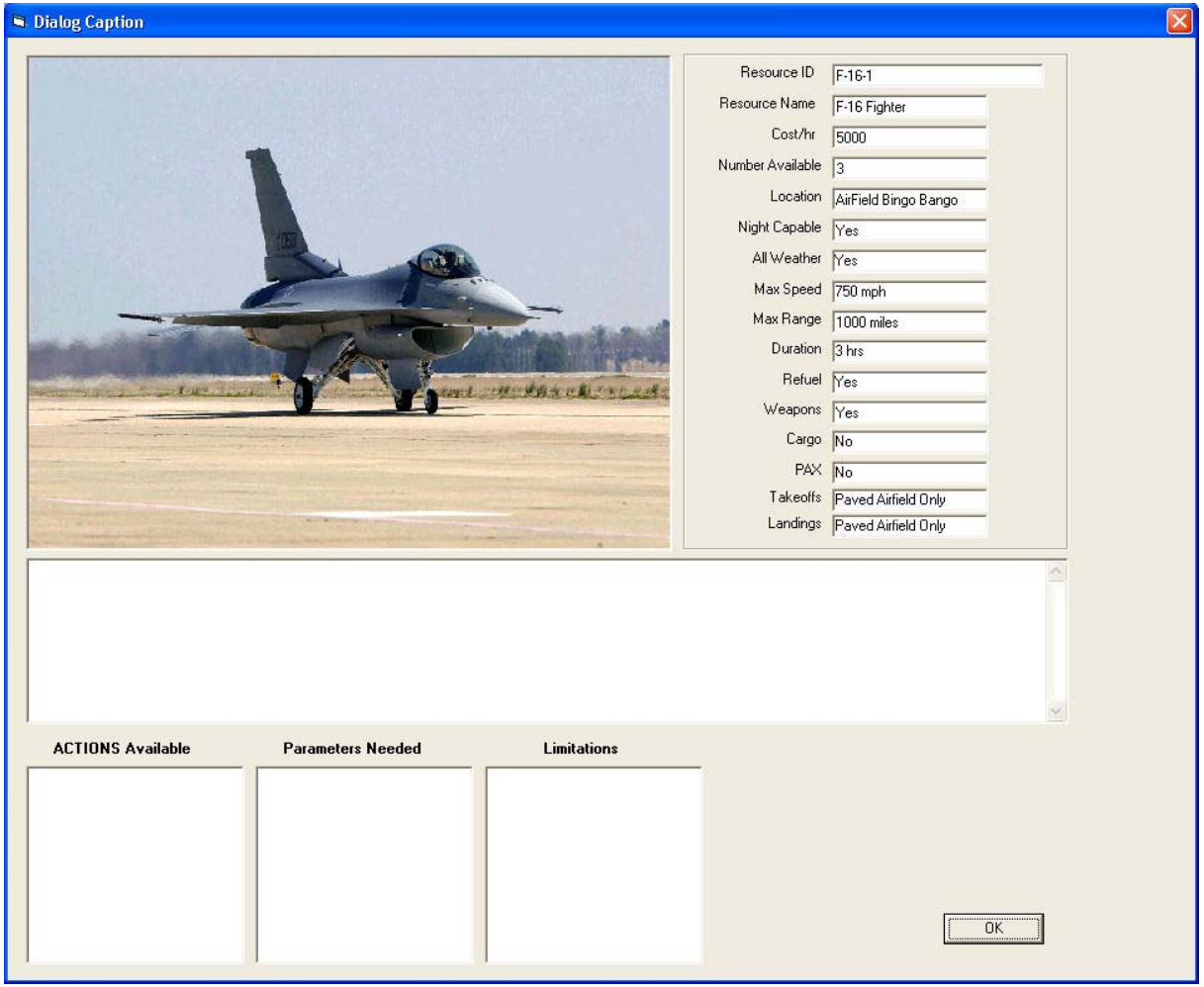
Common View (Projector Screen)



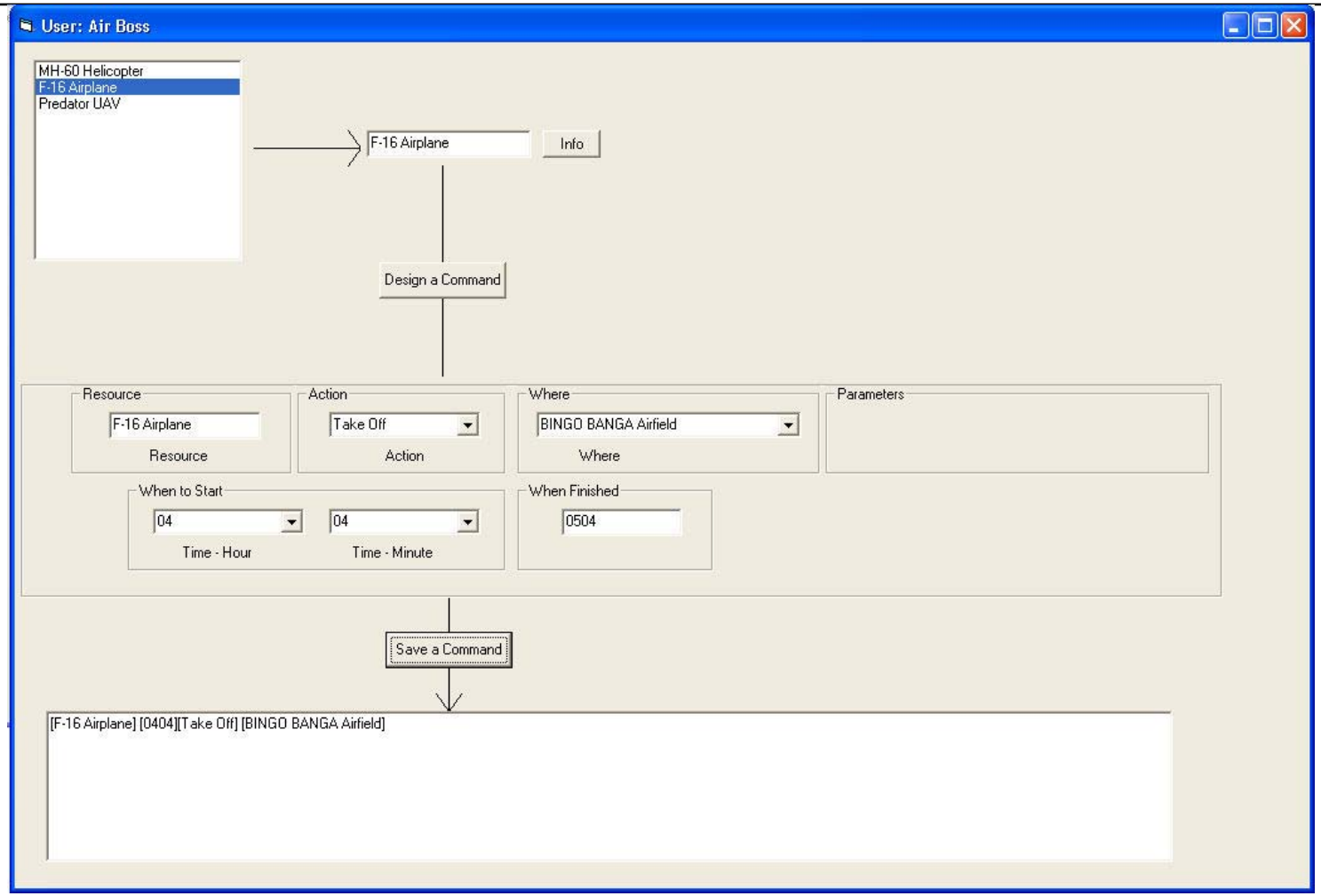
Role (Participant) Screen



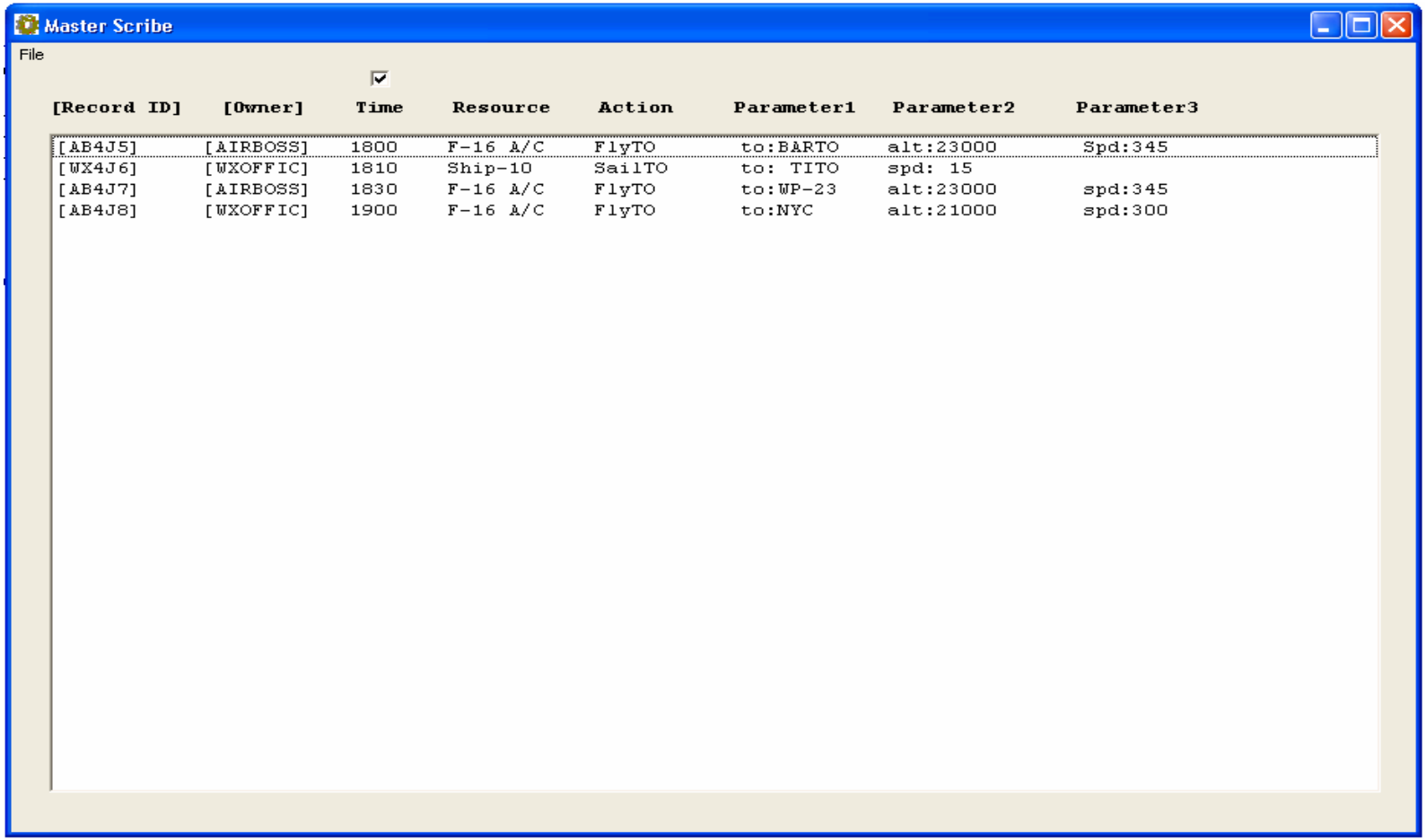
Participant – Resource Viewer



Participant - Plan Entry



Master Plan (Scribe)



Testbed Hardware

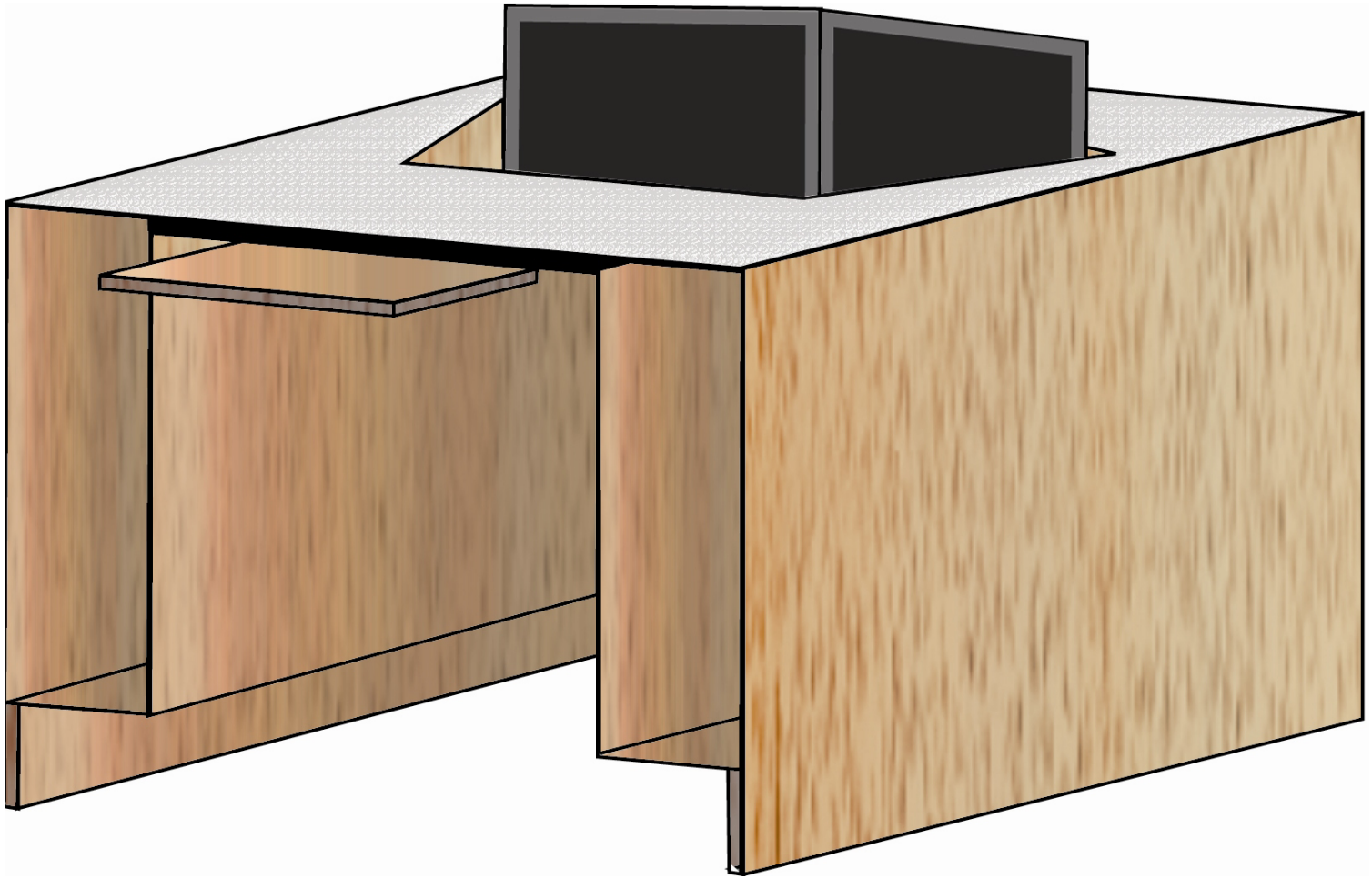
Hardware Deliverables

- 9 Workstations
  - Desk
  - Task Chair
  - 1-Computer
  - 2-monitors
  - 2- keyboards and mice
  - VOX Microphone

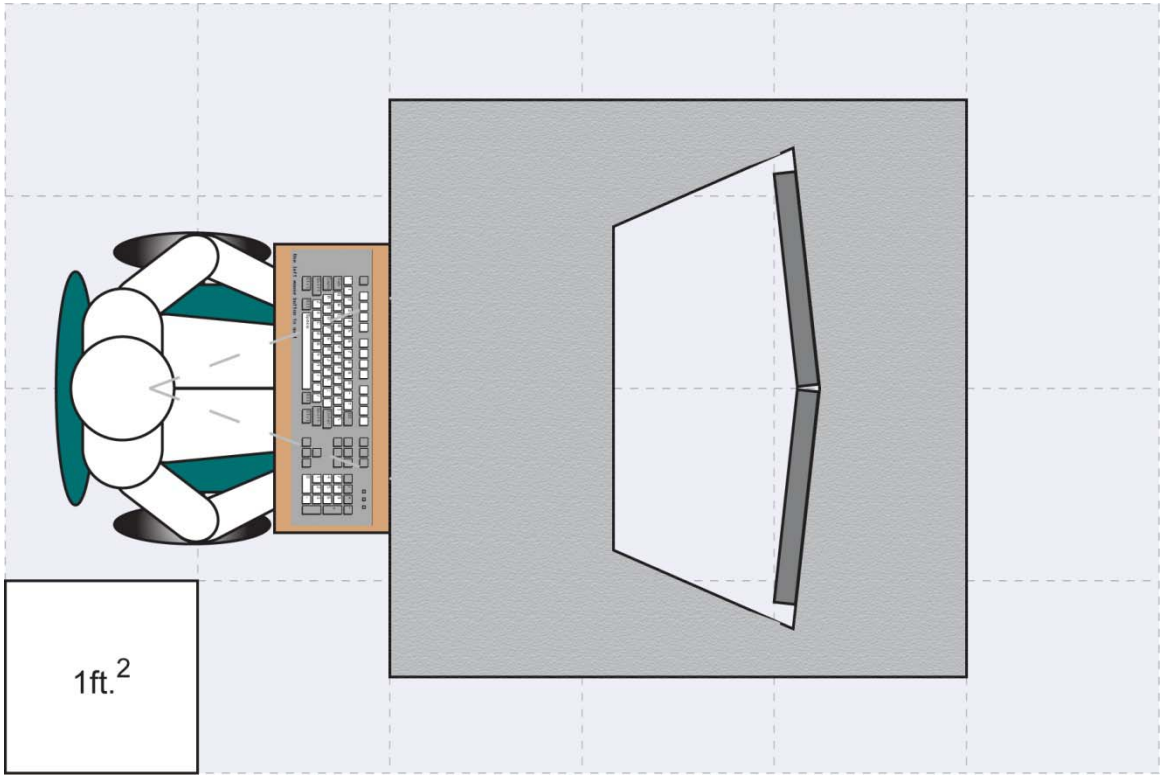
Hardware Deliverables (cont)

- Server
- Network Switch – 48 port
- VPN Router
- Audio/Video Capture Computer
  - Monitor
  - Keyboard & mice
- All Interconnect cabling
- Wall Mount Screen
- Projector

Participant Workstation



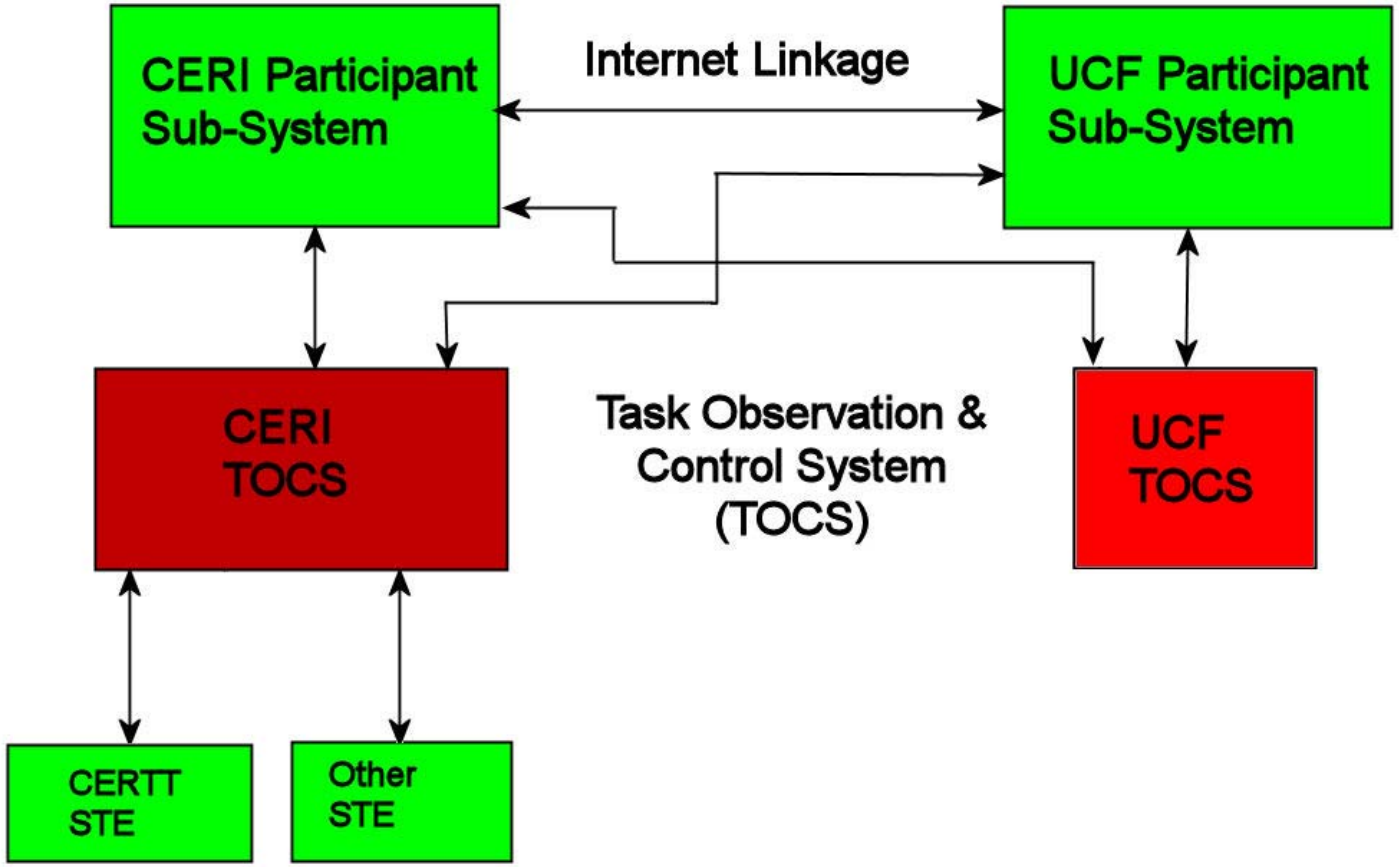
Participant Workstation



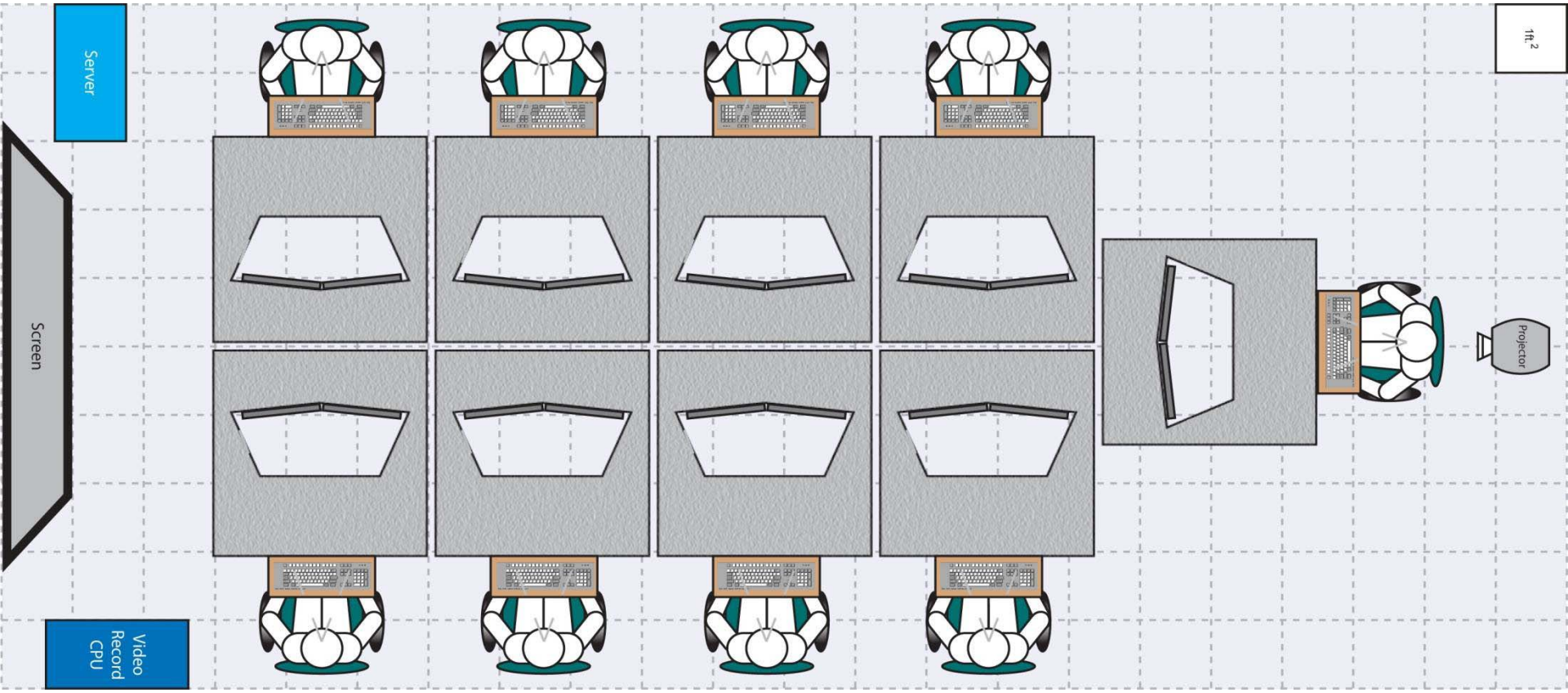
Desk measures 36 inches square

Envisioned Equipment

SUMMIT-STE Sub-Systems



Room Configuration



Conclusions and Next Steps

- Synthetic task environments allow for experimentation on macro-cognition in a setting with high cognitive fidelity
- The MACRO-COG architecture provides flexibility for hosting different task domains, scripting varied scenarios, and integrating measurement.
- Next steps include iteration on NEO scenario, completion of MACRO-COG, and final implementation of testbeds.