NAVSEA WARFARE CENTERS

Helping Secure Undersea Superiority for Tomorrow's Fleet…
by
Actions Today

Virtual Worlds

Virtual Worlds for C2 Design, Analysis & Experimentation

for
16th ICCRTS, Quebec

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**NAVAL UNDERSEA WARFARE CENTER DIVISION, NEWPORT RI USA**

NUWC Mission Objectives

- To investigate, apply and adopt rapidly evolving and converging Virtual World technologies that have the potential to radically change the way the Navy approaches:

Collaboration & Innovation

- **FY08** began **investigation** of various virtual world technologies (i.e., Second Life, Open Sim , OLIVE and Wonderland) to fully understand their strengths, weaknesses and limitations.

- **FY09** began **experimentation** so that NUWC, its customers and sponsors can effectively apply this technology to specific Use Cases in support of undersea warfare mission areas. Limited investigation continued focusing on convergence to a single VWT.

- **FY10** began **adoption** and **integration** of mature virtual world technologies as a beneficial tool in employee services and program utilization. Experimentation in new USW use cases will continue as opportunity / fleet need requires.
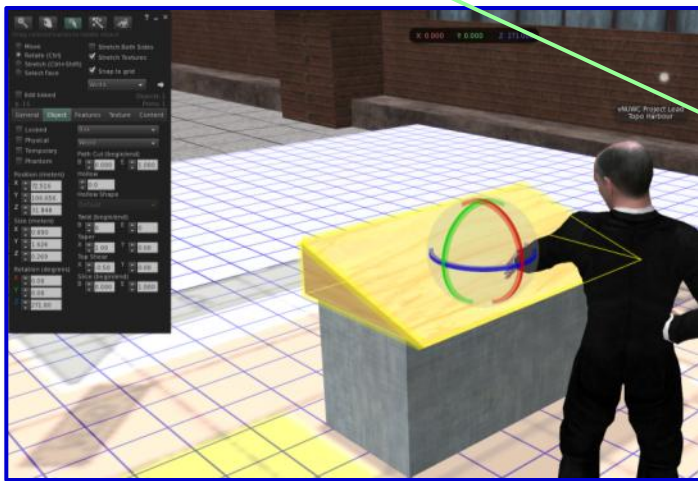
Virtual World Characteristics
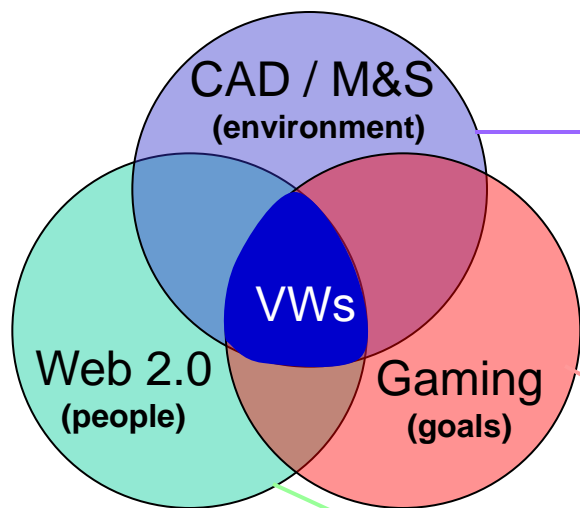
Information arranged in **3-D** and accessed via geo-spatial referencing or teleports

User **immersed** in information with unique representation in common virtual space and with an identified **goal**

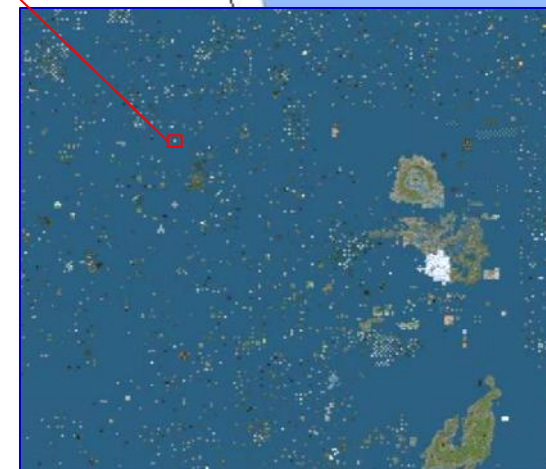Experience is **social** where users interact with each other (visual, chat, voice) and **user created**

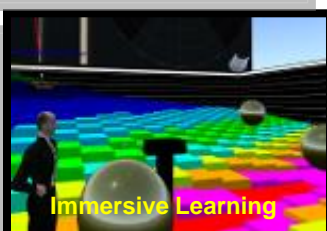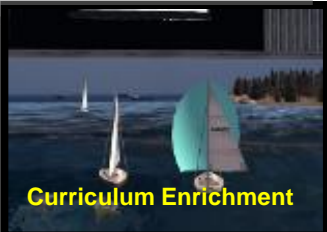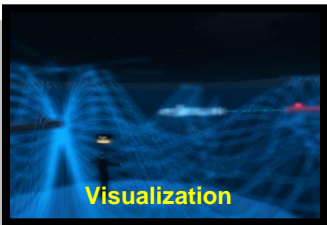VWs Are Rapidly Evolving Technology That Supports Full Spectrum RDT&E

Second Life™ Stats*

- **Area:** 1/2M *virtual* acres on 20,000 servers
  each server is 16 acres
- **Users:** 1.3M active / 70K concurrent
- **Use:** 40M hours in-world /mth
- **Content:** 270TB user created content
- **Fiscal:** US$1.5M /day exchanged

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Virtual Worlds Collaborative Environment

NAVSEA WARFARE CENTERS NEWPORT

Virtual Worlds

Visualization

Curriculum Enrichment

Immersive Learning

Command & Control

Distributed M&S

Outreach

Conferencing

International Collaboration

Joint Forces Collaboration

Scenario Simulation

Multiple Applications Occurring Simultaneous in a Single Environment
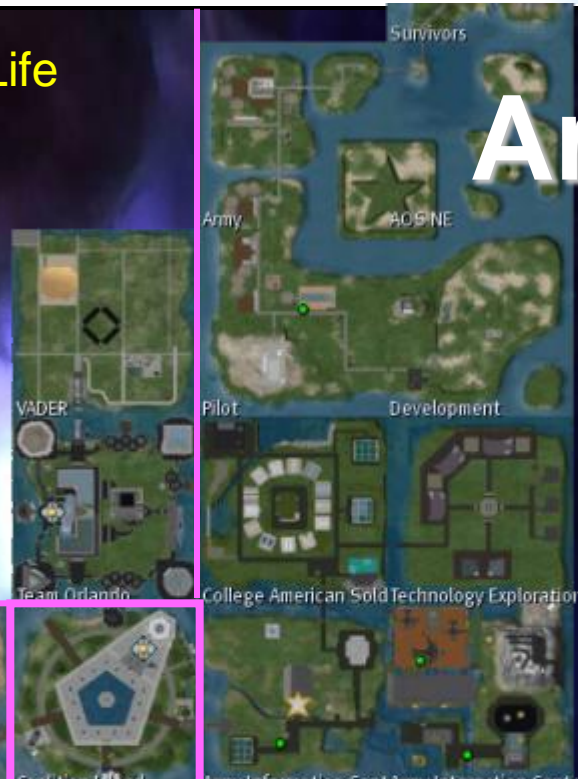
Virtual NUWC version 2.0 in Second Life™

Cross-DoD Collaboration

- NUWC initiated US Military Coalition in Second Life
- Military Users of Virtual Worlds Workshop
- Co-chair of Technical Working Group of Federal Consortium of Virtual Worlds
- Participating in OSD Virtual Worlds Policy Group

Army

Navy

Air Force

Vision: *"Implementation of a single, secure DoD virtual world training, in which each of the DoD Components build their specific pieces of a larger federated, virtual replication of the contemporary operating environment that can be used stand alone or interactively in near real time with external live and virtual platforms." – Mr. Frank DiGiovani, US Undersecretary of Defense for Training Readiness*

USW Applications

- Acquisition
  - Rapid Prototyping Environment
  - Model Pedigree
  - Virginia Block IV/V C2 Design
  - Procedural Design & Rehearsal
- Analysis
  - C2 Cognitive Walk-through
  - C2 Information Flow Playback
  - ASuW Innovation Cell
  - Theater C2 M&S
- Experimentation
  - Virtual C2 Demonstration
  - iBAL Experiment
  - Virginia Block IV CASEX / COOPEX
  - 360 Deg Periscope Human Factors
- Test and Evaluation
  - Virtual Mk48 ATE Facility
  - Virtual WAF
  - Fleet Reach-back
- Planning
  - TempAlt / OpAlt Planning

- Outreach and STEM
  - Virtual NUWC Conference Support
  - College Recruitment - Virtual Recruiters
  - High School Mentoring
  - UMASS CAPSTONE – Scenario Terraforming
  - UMASS CAPSTONE – Data Center Management
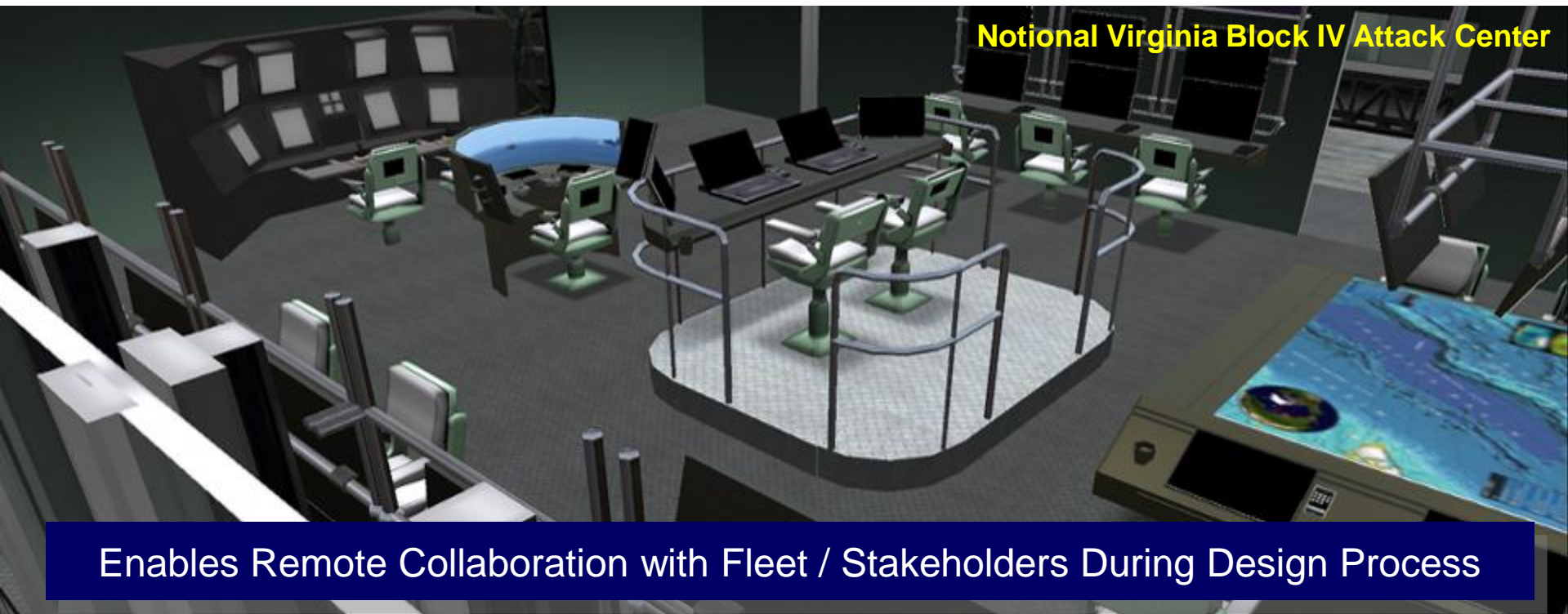 - NUWC Bring Child to Work Day
- Collaboration
  - Virtual LEAN Six-Sigma
  - DSTO-AUS AIS Tracking
  - US Milands Joint Forces Events
  - ERPTS Collaborative Design reviews
  - Virtual NUWC Library Demonstration
  - 4-D Data Visualization Toolset
- Training
  - Virtual Classrooms
  - Rules-Of-The-Road Curriculum Enhancement
  - Immersive TMA
  - Immersive Towed Array
  - Immersive Sound Propagation
  - Project Bluejacket – Scenario Simulation
  - ERP Training Simulation
  - Digital Tutoring via Bots

Collaborative Engineering
Future Submarine Command & Control Center (CACC)

- *Second Life® Enterprise* is being used to evolve Virginia Block IV attack center concepts supporting rapid prototyping and collaborative design
  - Fleet and designers **participate remotely** (to be accessible from SIPRNET)
  - Virtual layouts can be optimized against different missions and hypotheses
  - Concepts reviewed and changed in real-time
  - Allows prototyping of not yet available technology (e.g., 180 flexi-display)
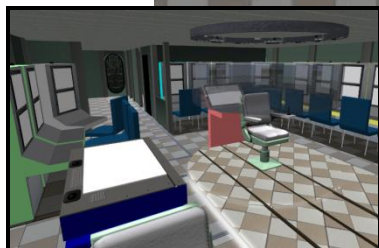 - Full concept evolution maintained with linkage to source material

Notional Virginia Block IV Attack Center

Enables Remote Collaboration with Fleet / Stakeholders During Design Process

ONR Future CACC Concept

PORT

AFT

FWD

Second Life Prototype

Design Attrib

STBD

C2 Design Concepts

Virginia Block III

Team Driven Concept

Technology Driven Concept

Command Driven Concept
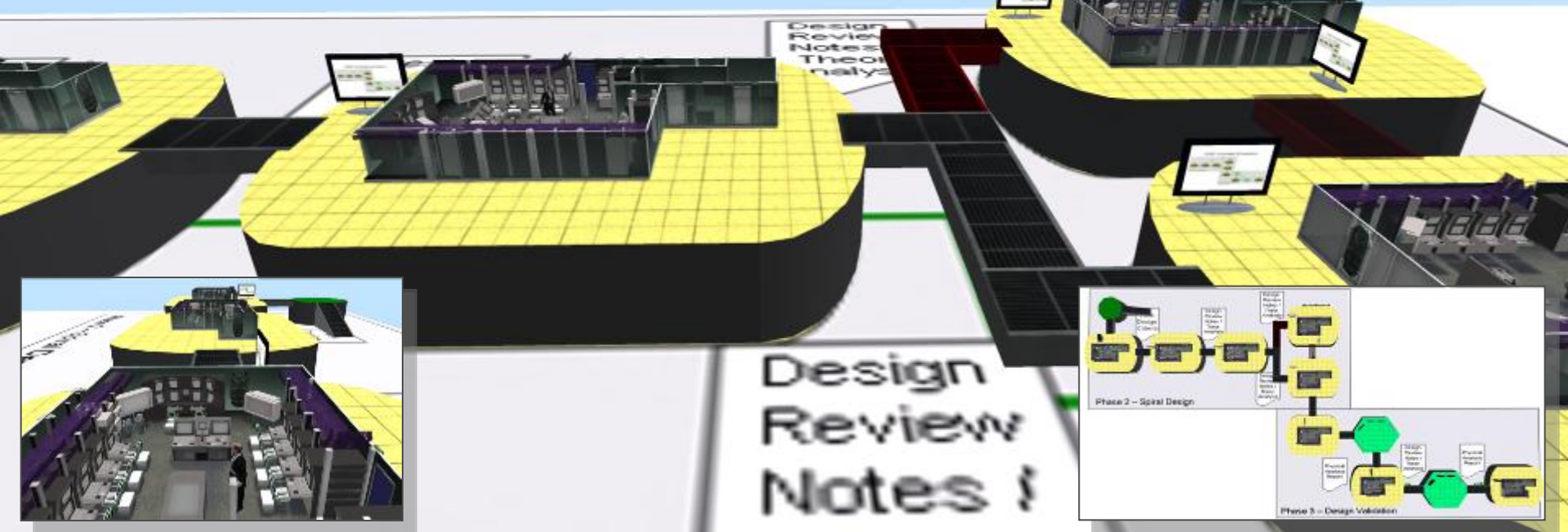
- 2-D concept evolution actually 3-D spatial environment

  - Each concept is represented by full model with optional information flow & analysis

  - Allows access remotely and collaboratively

  - Relationships / evolution preserved

  - Concept states link to supporting documentation / media / data

Design Review Notes !

Design is Not a Single Model But an Evolution with Linked Supporting Material

Visualizing Information

How do you know whether information is flowing effectively?
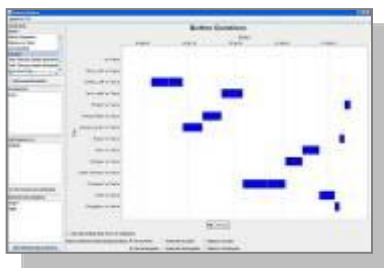

How Does This Kitchen Work?
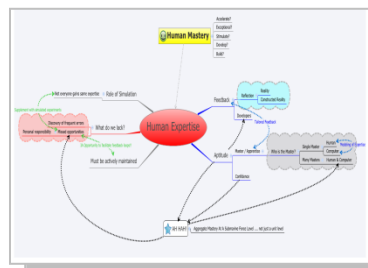

How Does This Attack Center Work?

- **Current methods can visualize some kinds of data …**

Verbal Communications

Thought Processes

Eye tracking

VWs Expose and Integrate Information Components

Visualization & Analysis
For Command Decision Making

- VWs being used to "expose" information flow within a C2 space by showing Visual, Audio, control and electronic transmission paths

Audio Flow

Visual Flow

**Control Flow**

Elect. Flow

Human Comms

Information Components

- VWs are not limited to simulating real-world components; they can also be used to visualize and expose information not typically available in a physical environment

- Allows analysts to visualize and query experimentation data and information
  - Information Flow
  - Team Structure
  - Task Flow
  - Decision Hierarchy
  - Algorithms
  - Doctrine
  - Data Sources
  - HSI
  - Human Comms
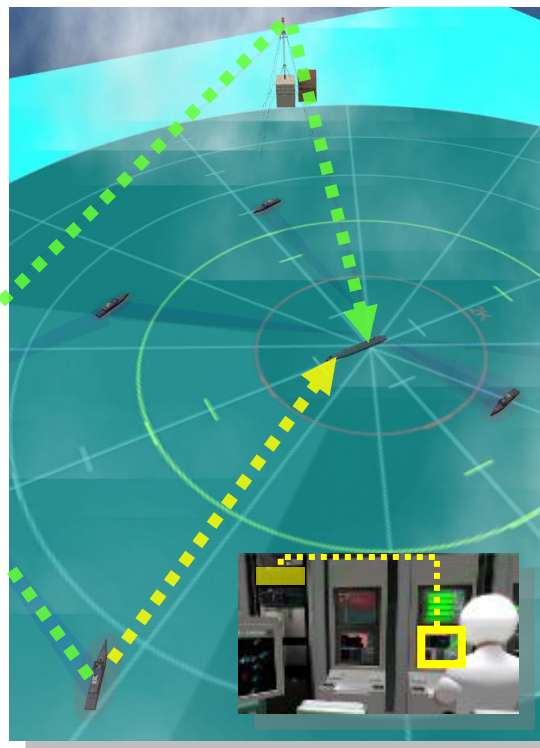
Contact Information Flow
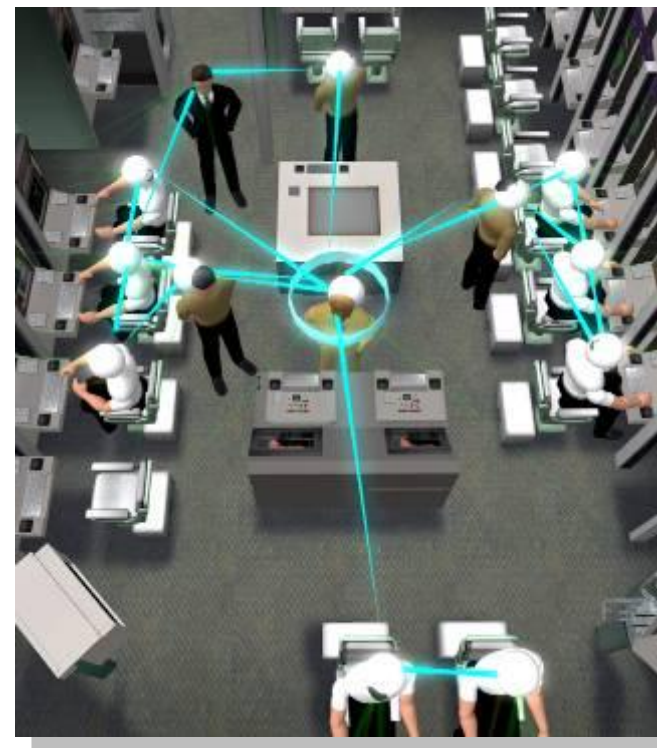
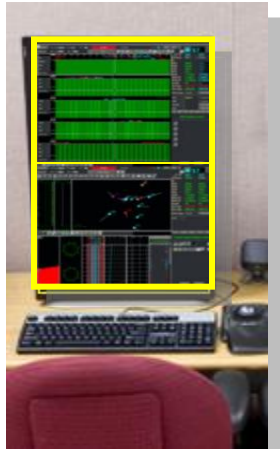Audio Paths in C2 Space

Virtual C2 Demonstration

Remote, Distributed Access

+ **+**

Virtual C2 Space

+

Actual Tactical Systems

Virtual C2 Supported Equivalent Performance as Physical C2
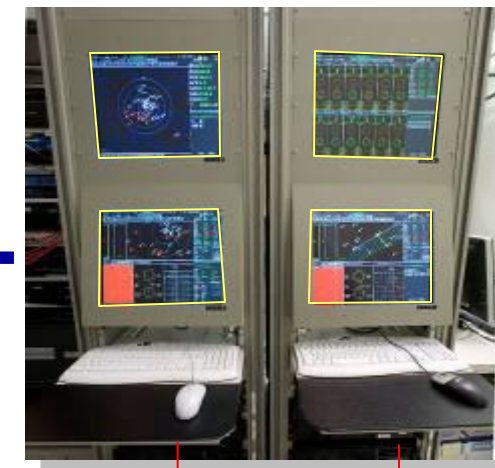
Team C2 on Tactical System

- **Supports distributed team dynamics**
- **Enables virtual COOPEX and team training**
- **Enables Integration of legacy and prototype components**

First Remote and Distributed Control of a Submarine CCS

Virtual C2 Implications

Implications:

- Can create <u>any virtual C2 environment</u> (platform level or theater level or combination), insert <u>real fleet operators</u> (all blue or blue on red), give them <u>access to actual tactical displays</u> (with real or simulated data) and prototyped functions and be able to <u>conduct experiments</u> assessing <u>team performance</u> or the <u>environment's performance</u> compared to a baseline

Shared BYG-1 TI-06 Screens

Training   VCCD   Future Concepts   VAST

*Run August 2009

COOPEX / CASEX

- Original USS Virginia Concept of Operations Experiment (COOPEX) conducted in 1995

  - Images depict actual fleet personnel as they conduct a mission specific experiment

  - Goal was to assess / validate the new attack center layout (Sonar combined with tactical control)

- Physical Experiments are Critical but Can Be Expensive & Time Consuming

- Virtual Worlds will support:

  - COOPEX planning and data collection plan

  - Focused "mini" experiments

 - Actual fleet experiments on real software / virtual configuration

Data Collection

- Because all human interactions are going through an electronic interface, data collection for metric generation and analysis can be much more efficient and comprehensive
- Data is recorded as *[Operator, Information, Time, X,Y,Z]*

Avatar Eye Tracker - A pointer tracks where the avatar is looking
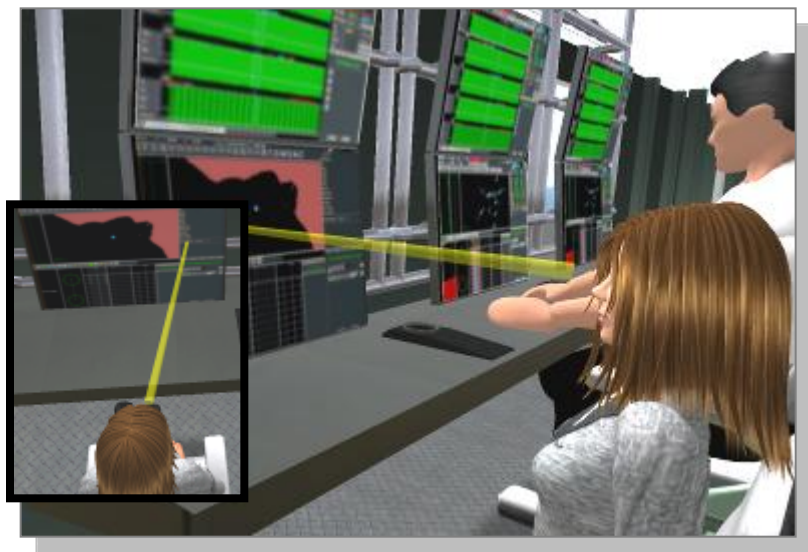
Mouse Tracker - A pointer appears where user clicked on screen

Loss in Human Performance Off-set by Gains in Data Collection

Multi-level C2 Environment
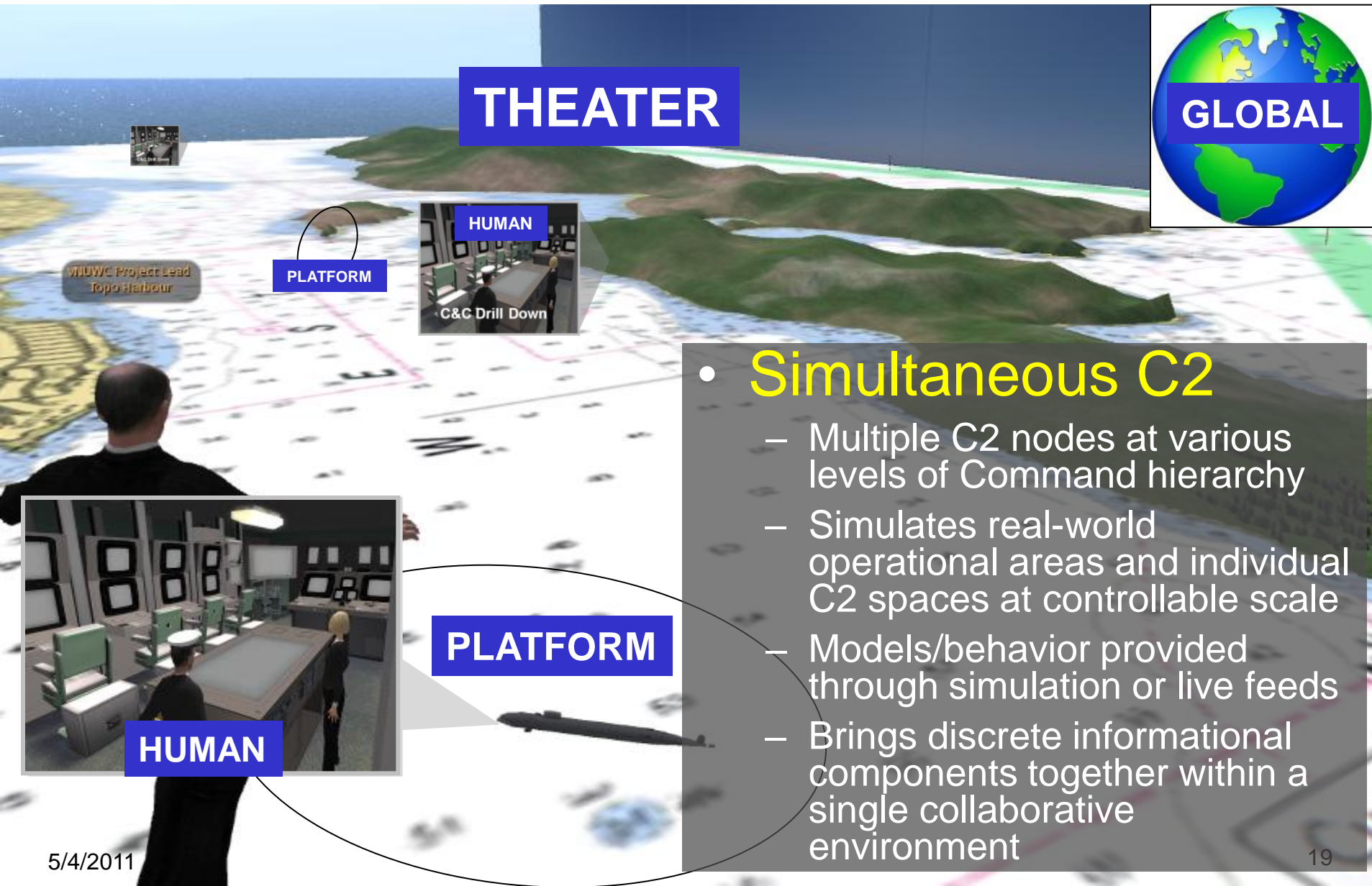
THEATER

GLOBAL

HUMAN

PLATFORM

C&C Drill Down

vNUWC Project Lead
Topo Harbour

PLATFORM

HUMAN

- ## Simultaneous C2
  - Multiple C2 nodes at various levels of Command hierarchy
  - Simulates real-world operational areas and individual C2 spaces at controllable scale
  - Models/behavior provided through simulation or live feeds
  - Brings discrete informational components together within a single collaborative environment

Summary

- Virtual Worlds today can support a diverse array of C2 and other military applications (most not yet investigated)

- Being demonstrated across DoD as a tremendously capable and flexible platform (Innovation & Collaboration)

- Need continuous R&D to match requirements to VW capabilities and to understand the cost/benefit trade-off

- Challenges like IA and assimilation are being worked

- "The future is here – it's just not yet widely distributed."

  - Dr. Mic Bowman, Intel, GameTech 2011

OS CRS **263** SPD **019** DP **030**

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