Virtual Worlds for C2 Design, Analysis & Experimentation

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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

* from http://lindenlab.com/pressroom/releases/22_09_09
Virtual Worlds
Collaborative Environment

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

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
• 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

Enables Remote Collaboration with Fleet / Stakeholders During Design Process
ONR Future CACC Concept

Second Life Prototype

Design Attributes
C2 Design Concepts

Virginia Block III

Team Driven Concept

Technology Driven Concept

Command Driven Concept
C2 Evolution & Pedigree

- 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 is Not a Single Model But an Evolution with Linked Supporting Material
How do you know whether information is flowing effectively?

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.
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

Remote, Distributed Access

Virtual C2 Space

Actual Tactical Systems

Team C2 on Tactical System

Virtual C2
Supported Equivalent Performance as Physical C2

First Remote and Distributed Control of a Submarine CCS

• Supports distributed team dynamics
• Enables virtual COOPEX and team training
• Enables Integration of legacy and prototype components
Virtual C2 Implications

**Implications:**

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

*Run August 2009*
• 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 \([\text{Operator, Information, Time, X,Y,Z}]\)

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

- **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
• 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