Exploring the Potential of Virtual Worlds for Decentralized Command and Control

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Overview

- Decentralized Command and Control (DCC)
- *DECENT*: a prototype platform for research and experimentation with DCC
- Virtual worlds and physical places
- Platform for VW development: *OpenSim*
- Under-explored topics for DECENT
- Conclusions and recommendations for future studies

Decentralized Command and Control (DCC)

- DCC emerging as a new strategic thrust [DoD JOAC 2012]
- DCC encourages physically decentralized user practices, using low-cost/open source software.
- DCC operates as a *virtual enterprise*
  - Physically distributed, logically centralized
  - “Edge” of a multi-site organization [Albert and Hayes 2003]
- DCC accommodates peer-to-peer organizational decision-making and work locations
  - Crowd-sourced DCC may also be possible

DECENT: a prototype platform for research and experimentation with DCC

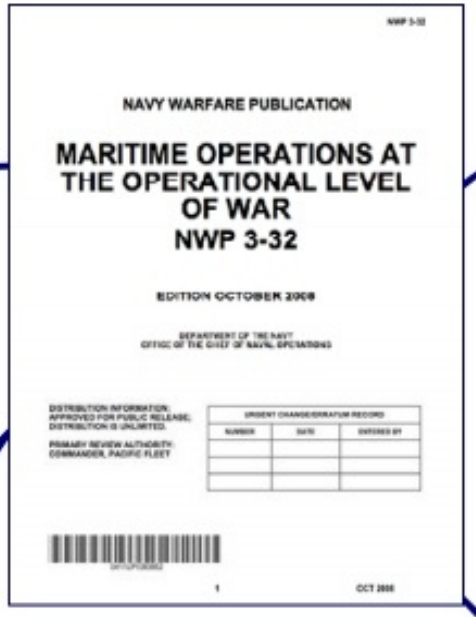
- DECENT is an online virtual world prototype and platform for experimentation with DCC
  - Used in early studies of C2 mission planning games
- Developed with low-cost, open source software for virtual worlds (OpenSim).
  - *Transformative*: Potential to dramatically reduce the cost of fielding C2 system capabilities
  - Few barriers to acquisition
  - Applicable to mission planning and coordination in physical and virtual applications (Cyberwarfare)

Current vision for advanced C2: C2RPC [2010]

C2BMC
MIPS

(i.e. BMD)

Planning



Monitoring
(SA)

GCCS (COP)

JFMCC Supporting Plan

To JTF Counterstrike
PLAN ALFA

PowerPoint slides
& Word Documents

Directing

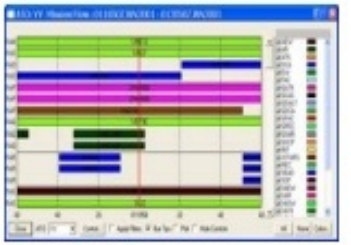
Execution

J/ADOCS
(Fires)

Outlook .PST files

Chat Windows

Excel Spreadsheets



TBMCS
(ATO)

Virtual worlds and physical places

- Virtual worlds (VWs) can be used to *mirror* physical spaces, actors (avatars), devices, activities and resources within them.
- DECENT models physical C2 worlds and many mission planning IT resources as found in C2RPC [2010] for web-based C2.
- DECENT integrates remote text, chat, speech, image and video stream servers/clients
- DECENT supports decentralized, networked users
  - C2 activities with physically distributed users, within logically centralized/shared VW

Physical C2 facility

Virtual world for C2: DECENt

ELICIT VW for team decision-making studies [Hudson and Nissen 2010]

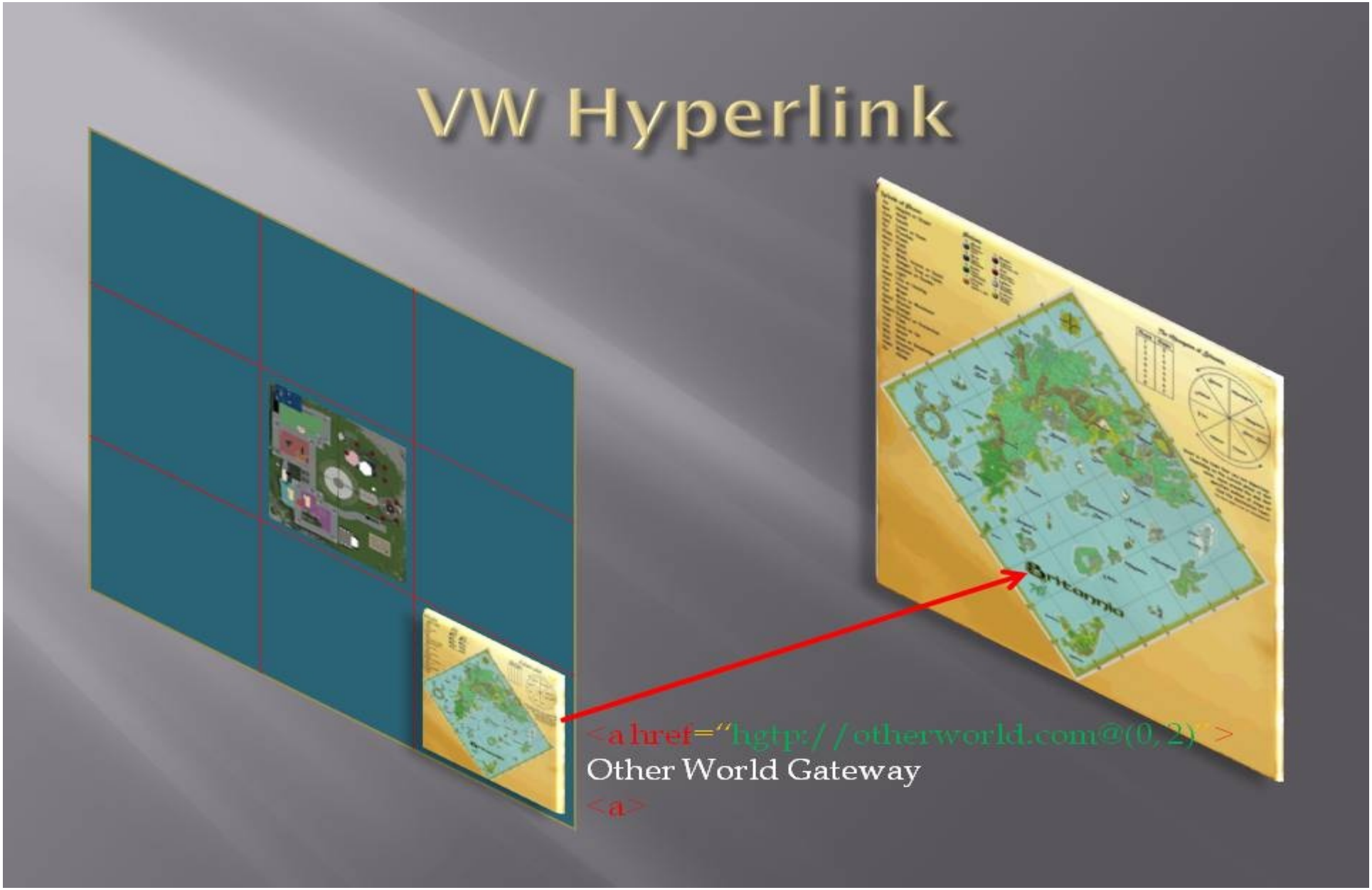
Physical factory, VW factory, smartphone world monitoring

Virtual chocolate factory at FXPAL [Back, Kimber, et al. 2010]

Platform for VW development: *OpenSim*

- DECENT based on OpenSim
- OpenSim is OSS workalike to *Second Life,* a large commercial, user-extendable VW with 20M+ users
  - Users can *mod*ify shared resources
- Lead OpenSim developers based at UCI [Lopes 2011]
- OpenSim *Hypergrid* [Lopes 2011] supports scalable, extendable VW grid
- Army's Military Open Simulator Enterprise Strategy (MOSES [2012]) and Naval Underwater Warfare Center [Aguirar and Monte 2011] using Hypergrid

VW *Hypergrid* [Lopes 2011]

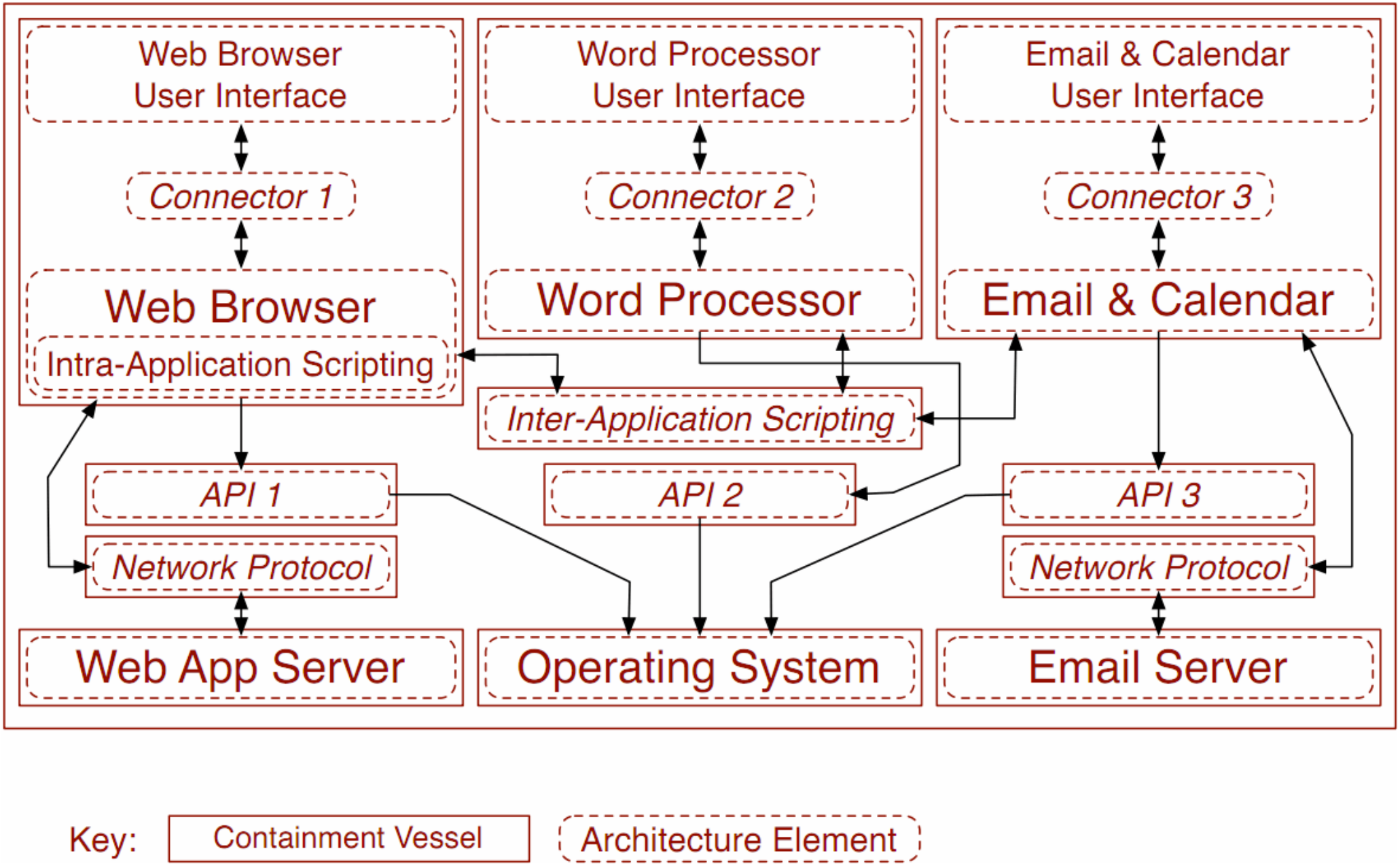


Army hypergrid: *MOSES* [2012]

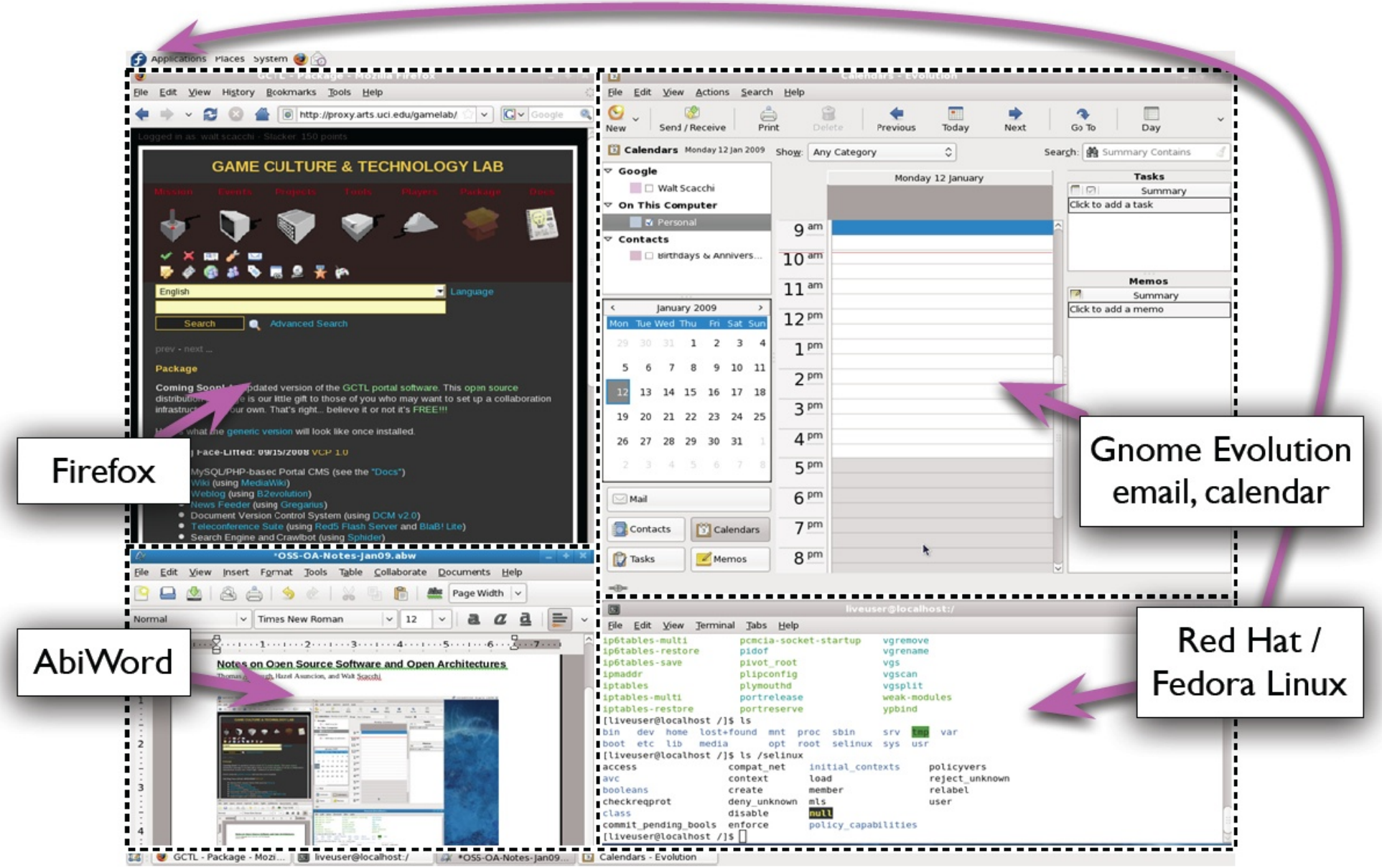
Under-explored topics for DECENT

- Most VW software technologies, including *OpenSim* and *Second Life* offer little/no ready support for *integration of external application programs or other software components*.
- *Securing a VW for military C2 applications* is a major concern in advancing this line of research and deployment.

Secure *software product line architecture* for generic applications for C2 [Scacchi and Alspaugh 2012]



Example run-time of securable C2 software product line application deployment



Conclusions and recommendations for future studies

- DECENT demonstrates a transformative reduction in cost of rapidly creating and deploying C2 systems supporting DCC
- DECENT can be deployed via pocket storage devices (flash storage thumb drives)
- Much remains to be studied using DECENT like technologies and approaches to DCC
- R&D should seek to demonstrate future benefits and articulate system/software risks (e.g., security of VWs is an open problem).

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