

ICCRTS 2005

BattleSpace Communications Network Planner and Simulator (BCNPS) System

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DSTA

Introduction

- With the prevalence of Integrated-Knowledge based Command and Control (IKC2) concepts, communication simulation systems are faced with surmounting challenges to provide accurate and timely information to military commanders for better sense-making.
- In particular, the accruing need for time-sensitive network centric simulations rendered advanced simulation systems to simulate and emulate tactical environment in near real-time speed.
- Only with this added capability would commanders be able to appreciate comms effects or deficiencies for greater awareness of the comms situational picture to facilitate operational concepts development.
- This presentation will focus on the discussion of the BCNPS architecture, in particular the real-time mechanism adopted to suffice users' requirements.

BCNPS Vision

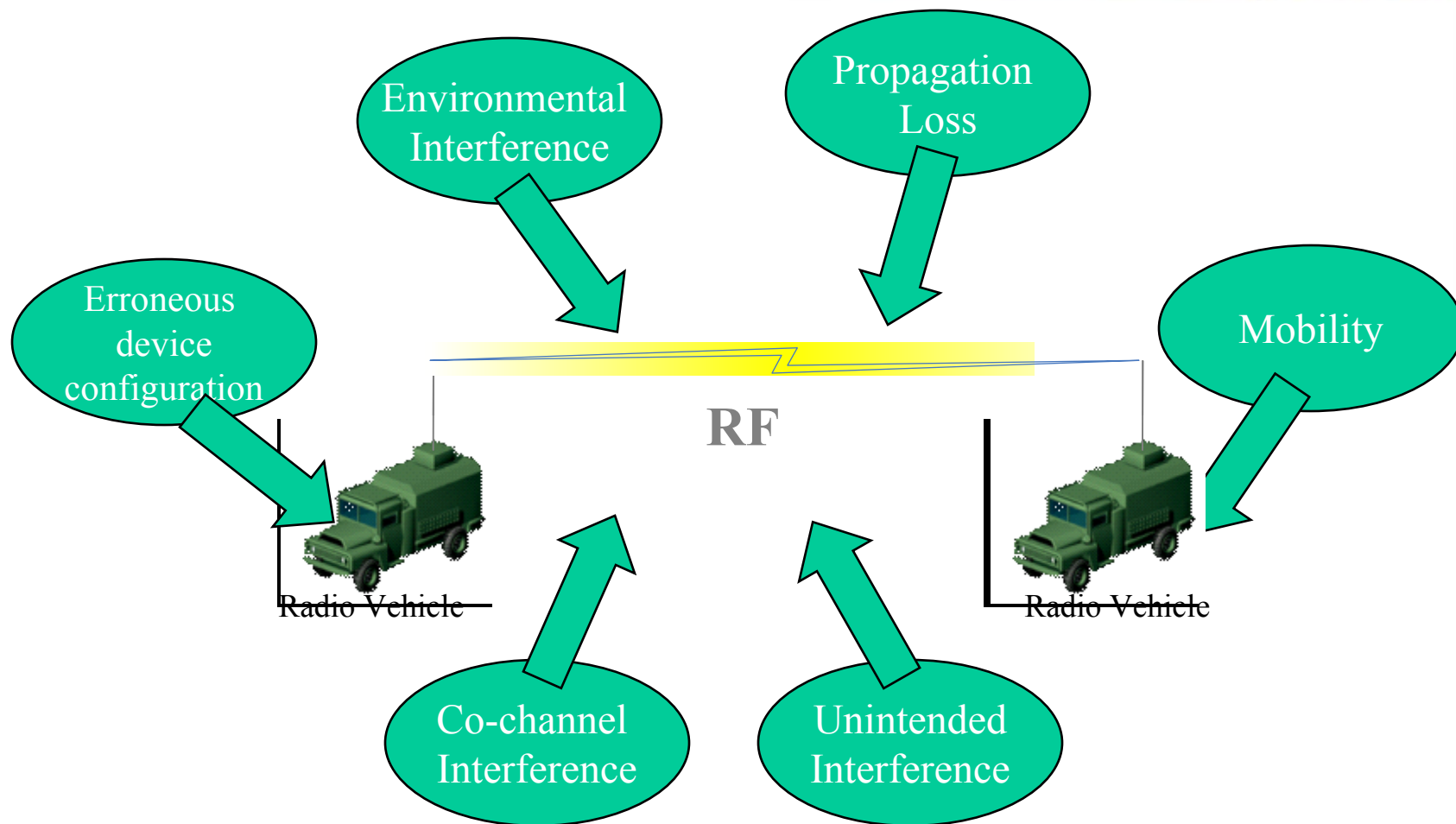
- The BCNPS was designed to enable military commanders “**see, walk through & feel**” the simulated comms scenario for greater sense-making of the dynamic tactical BattleSpace.
- BCNPS utilizes **OPNET as the core network computational engine**, based on an innovative and flexible architecture to overcome some of the most tenacious technical difficulties associated with near real time simulations of large tactical networks.
- The “real-time” OPNET engine was complemented with an **emulation** system that allows for **Man/Hardware-in-the-loop**.

BCNPS Objectives

- Enable accurate communications/network planning prior actual field deployment.
- Enable accurate assessment of communication/network behaviour for experimentation of next generation military concepts.
- Provide Command & Control (C2) application testbeds for C2 developers to assess software survivability prior actual roll-out.

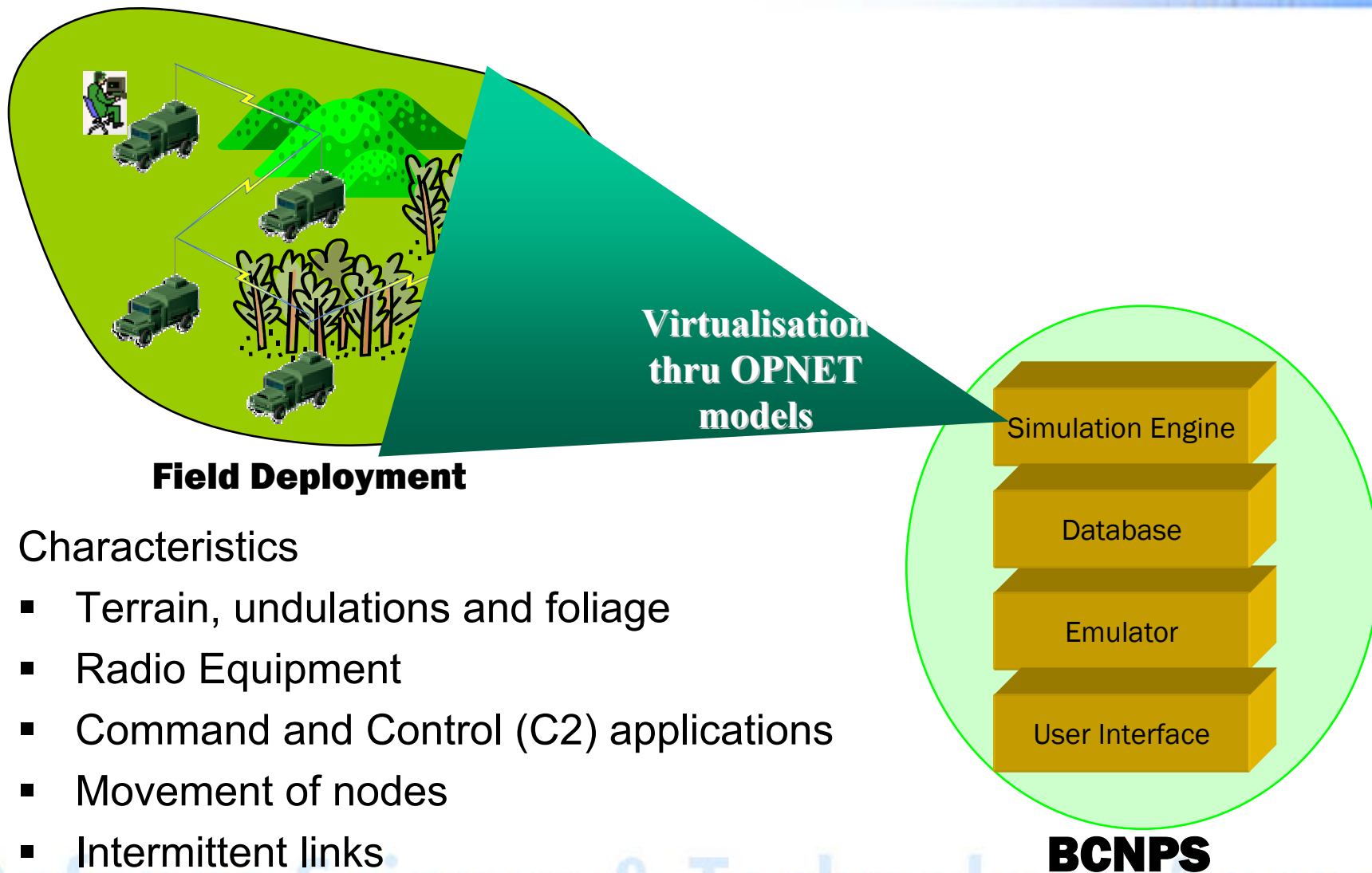


Wireless Communications Inhibitors





The BCNPS Concept Diagram



Field Deployment

Characteristics

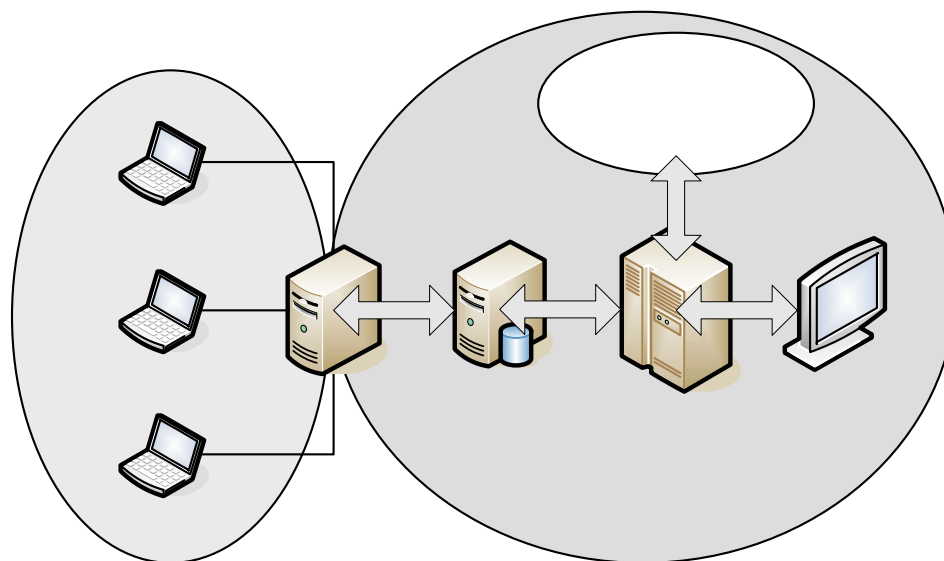
- Terrain, undulations and foliage
- Radio Equipment
- Command and Control (C2) applications
- Movement of nodes
- Intermittent links
- Interference

BCNPS



BCNPS System Architecture

- Man/Hardware in-the-loop feature to enable users experience the simulated communication conditions.
- Interoperability between real and virtual domain via advanced Emulator system, coupled with Database server.
- Customized simulation features to ensure OPNET compliancy with the requirement for near real-time simulations.

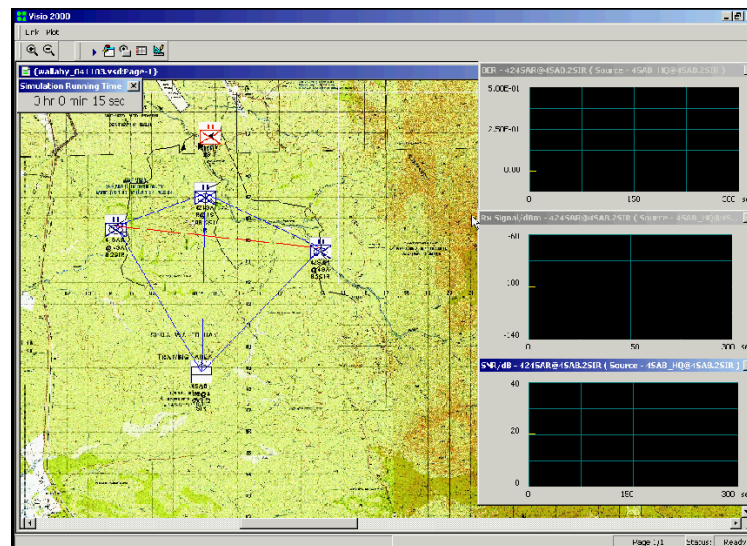


Architecture In Detail

- The Simulation Engine utilizes OPNET Modeler and provides the BCNPS System with a synthetic wireless platform where radio and equipment models can be virtually loaded.
 - Customised radio and propagation models to suit actual radio equipment and local terrain morphologies respectively. In the progress of performing VV&A.
- The Emulator performs as an interface between the C2 terminals and the rest of the system components. The Emulator induces simulated communications effects such as latency and link performance variations.
 - Denial or approval of messages sent from C2 applications based on the calculated results in the database depository.

Architecture In Detail

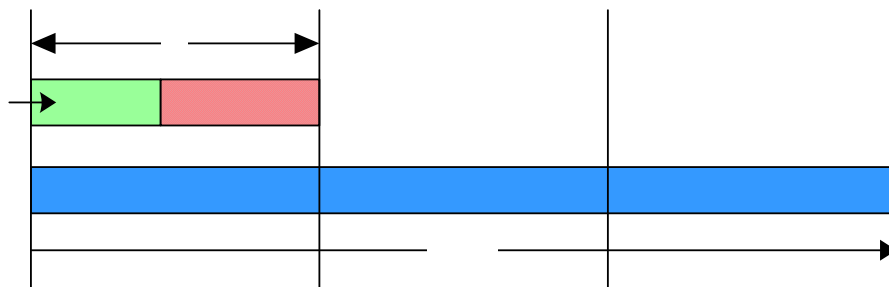
- The Structure Query Language (SQL) Database Servers serve as a facility for data depository and extraction.
 - Data from the Simulation Engine are transferred to the database thus allowing the Emulator to retrieve the information at a later instance.
- Intuitive and interactive real-life Animation system, allowing commanders to review comms links conditions





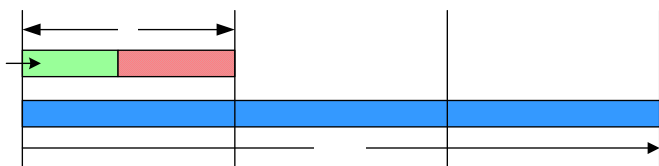
Time Synchronization

- Real-Time Adherence (RTA) feature - a time controller in the OPNET Modeler for optimal simulation accuracy and synchronization with real-time speed.
 - Users can define Δ value
 - Simulation time $< \Delta$, invoke idle routine to wait till $t + \Delta$.
 - Simulation time $> \Delta$, wait till $t + 2 \Delta$ for simulation to be completed. Slight degradations in accuracy are expected, e.g. extracting the previous calculated data. As such, RTA relies on the assumption for an initialization phase in all simulations to ensure valid data have been deposited in the SQL Database Servers prior to any extraction by the Emulator.

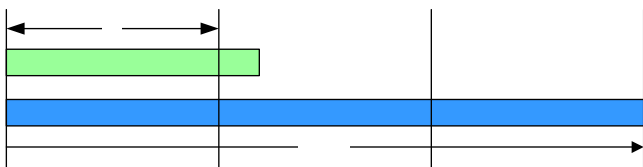
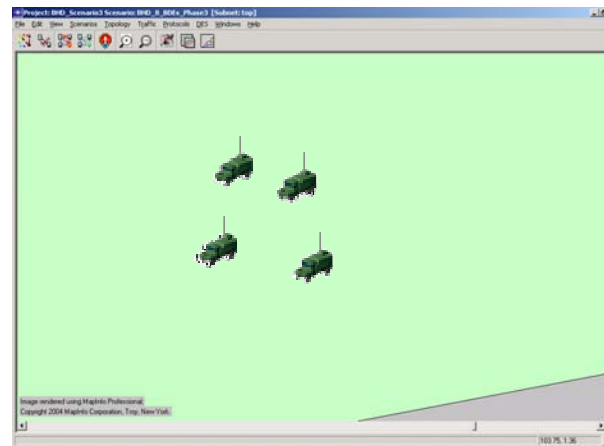




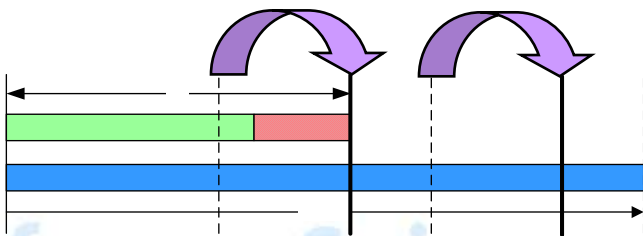
Dynamic Slot handling in RTA



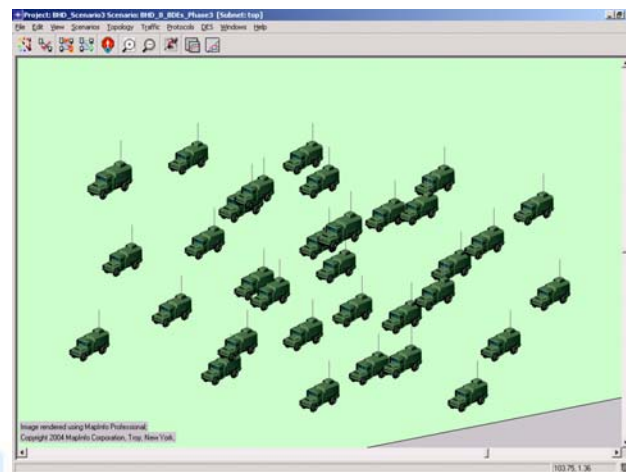
Sim Time < Real-time



Dynamic sizing of slots

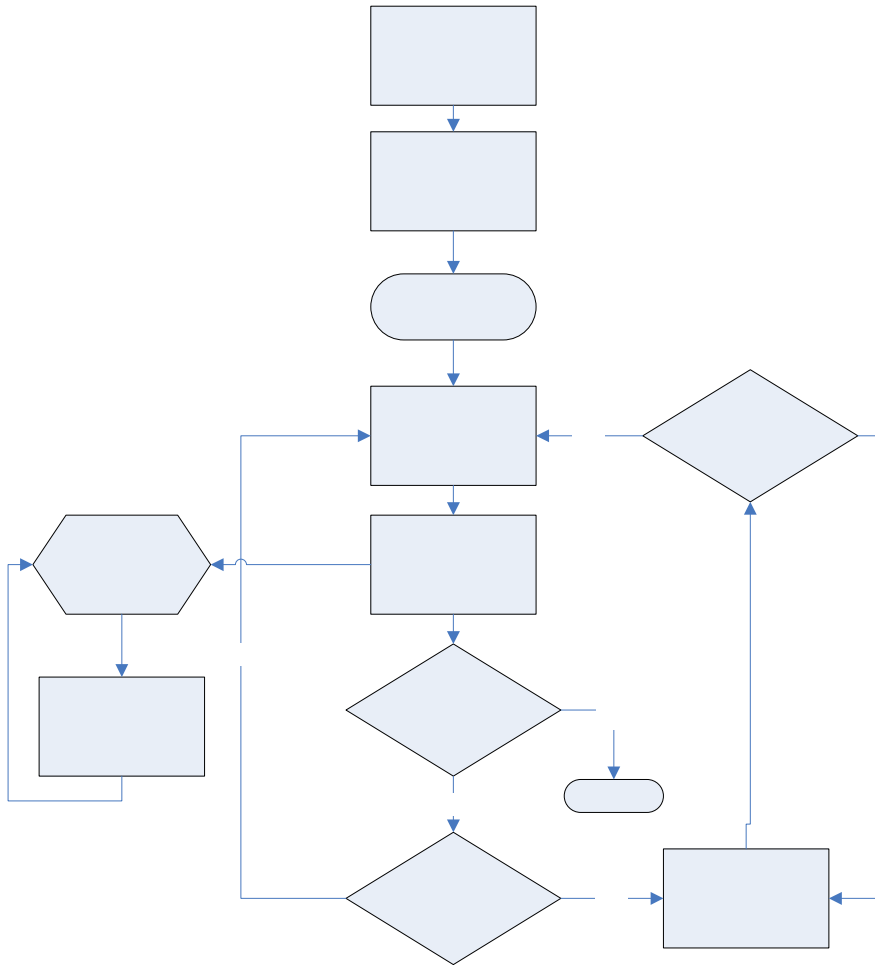


Sim Time > Real-time





System Process



- Real time



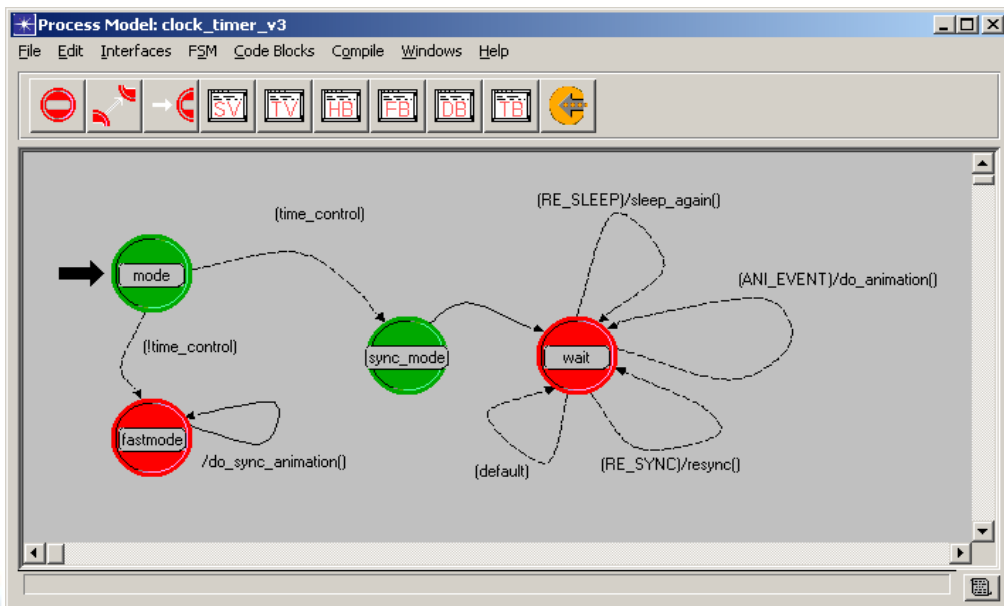
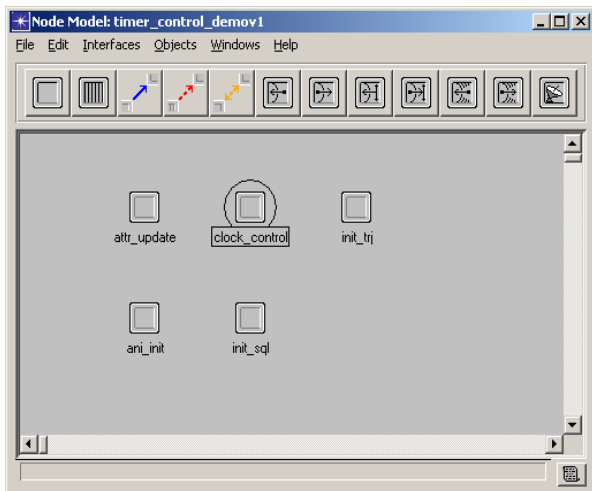
- Simulation Time

De
use



RTA Implementation

- ADO object library – For SQL read/write
- C++ Sleep() functions – To temporarily suspend simulation kernel



Conclusion

- BCNPS System served as a near real-time communication experimental test-bed for the purpose of pre-deployment planning, training and communication protocol evaluation.
 - Benefits: Provide operational advantages to military commanders in terms of cost effective and accurate BattleSpace information prior to actual battlefield engagements

- Further enhancements and evolutions to the BCNPS System are in the pipeline:
 - Support large scale war-gaming exercises
 - Provide economical communication test-beds for evaluation of emerging technology on military tactics and operational capabilities.