CB System Military Worth Assessment Toolkit

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Project Overview

- Overall goal: extension of the CB Sim Suite to better support military worth assessments
  - Support non-real-time simulations
  - Support platform through theater-level simulations
  - Support phenomenology effects
    - Collective Protection
    - MOPP
    - Decontamination

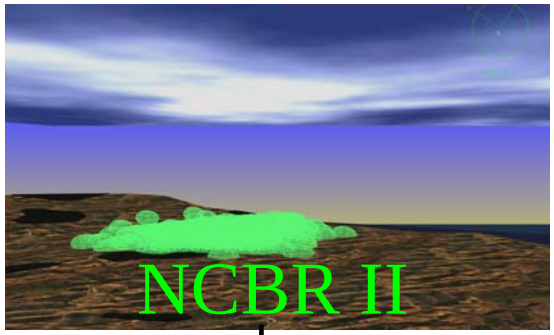
- Benefit to the Warfighter
  - Cost effective and timely means of analyzing the impact of CB defense materiel
    - Fixed sites
    - Mobile forces
  - Development of better-defined
    - System requirements
    - Tactics, techniques, and procedures

The CB Simulation Suite

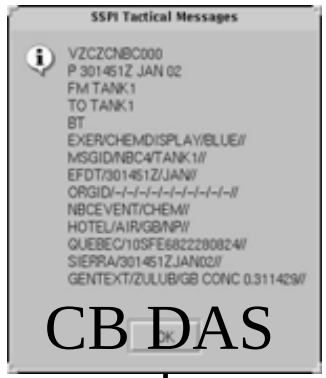
- Three principal distributed simulations
  - The Nuclear, Chemical, Biological, and Radiological Environment Server (NCBR II)
  - CB Dial-A-Sensor (CB DAS)
  - CB Exposure Toxicity Server (ETS)

CB Simulation Suite Architecture

Hazard Environment

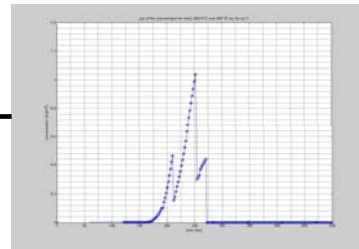


Sensors

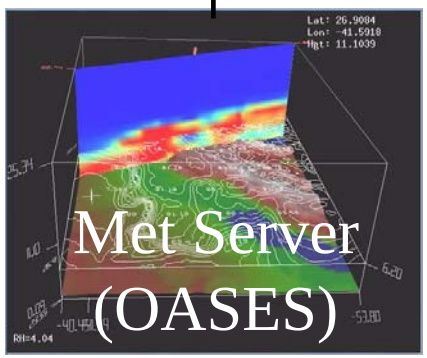


CB DAS

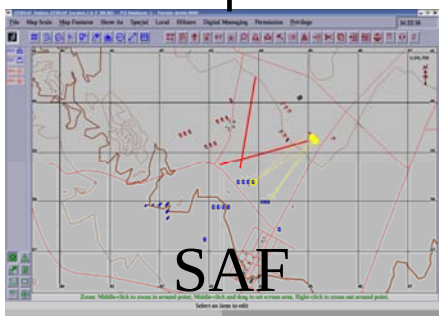
DIS Network / HLA RTI



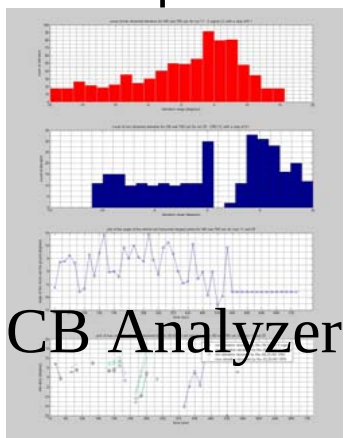
Exposure
Toxicity
Server



Environment



Platform



AAR

CB Sim Suite is a set of distributed simulation tools designed to represent all aspects of CB passive defense on the tactical battle field for application to analysis, testing, and training.

NCBR II

NCBR II

- Simulates multiple CB events simultaneously in real time
  - Now expanding for smoke propagation
- Validated physics-based models for hazard propagation
  - DTRA's SCIPUFF
  - NSWC's VLSTRACK
- Terrain and meteorology effects
  - 4D met—external/OASES or scripted feeds
  - 3D terrain (CTDB, OOS ERC)

Medium Range Missile GB release
yellow -> vapor green -> aerosol

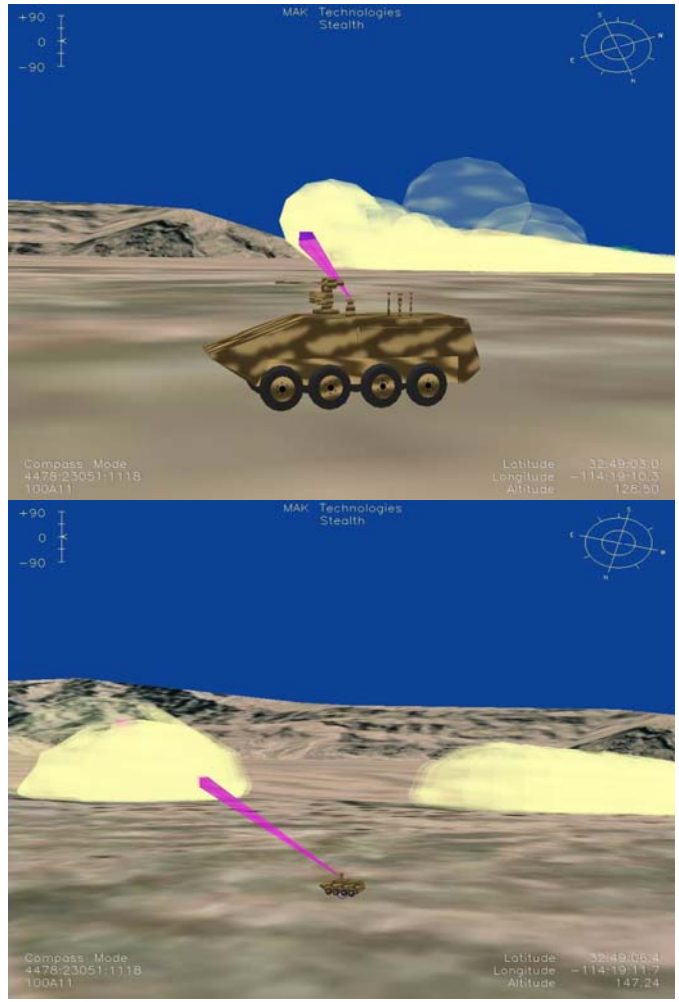
NCBR II

- Communicates environment information with other simulators
  - DIS, HLA compliant
  - XML hazard output (outputs gridded, 3D hazard data)
    - 3D Gaussian puffs (air concentration)
    - 2D conformal grids (concentration, dose, ground deposition)
  - Supports
    - Sensor modeling (point, standoff)
    - 2D/3D visualization
    - Exposure modeling (ETS)

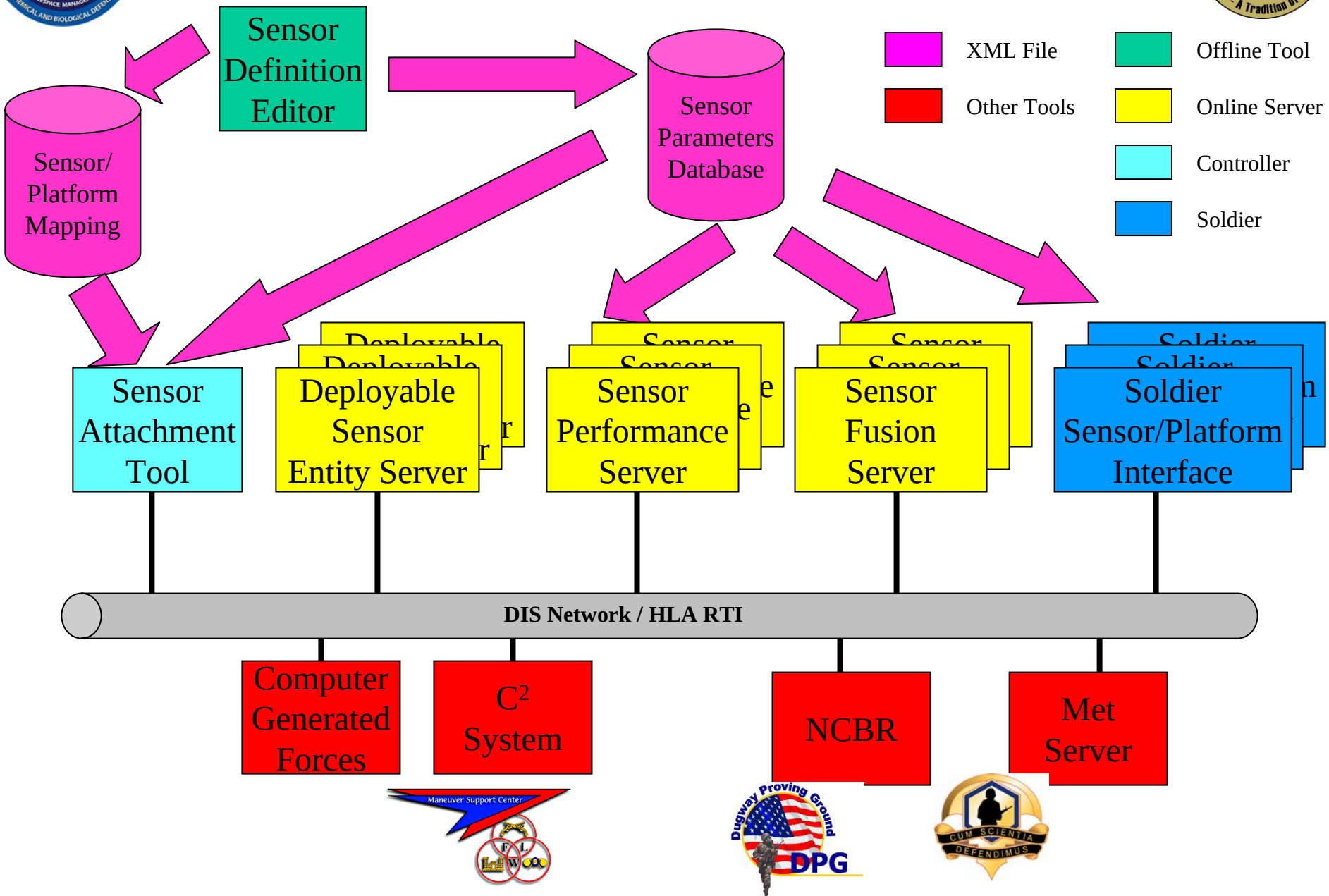
CB Dial-A-Sensor

CB Dial-A-Sensor

- Simulation tool (architecture) for representing any general technology class of CB particle and vapor sensors
  - Point and stand-off
  - Active and passive systems
- Capability to “dial” parameters to set performance characteristics for a known set of detector technology families
- Multiple data output mechanisms
  - Provide data to constructive simulations via DIS/HLA
  - Write data to a local file for analysis
  - Stimulate other system/operator software
    - Sensor user I/F
    - C2 messages



CB Dial-A-Sensor Architecture



Exposure Toxicity Server

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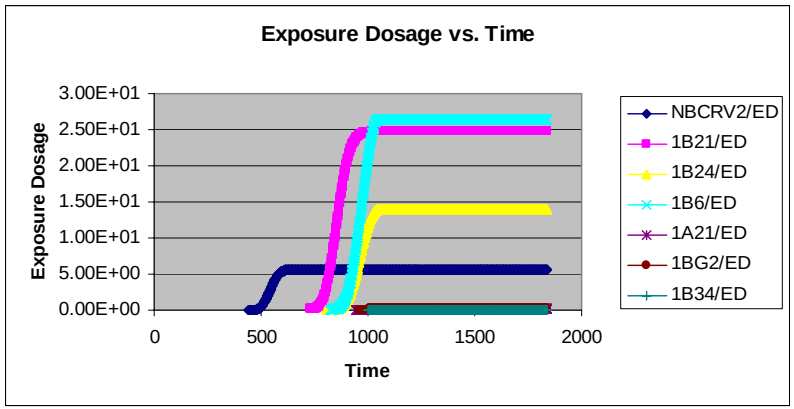
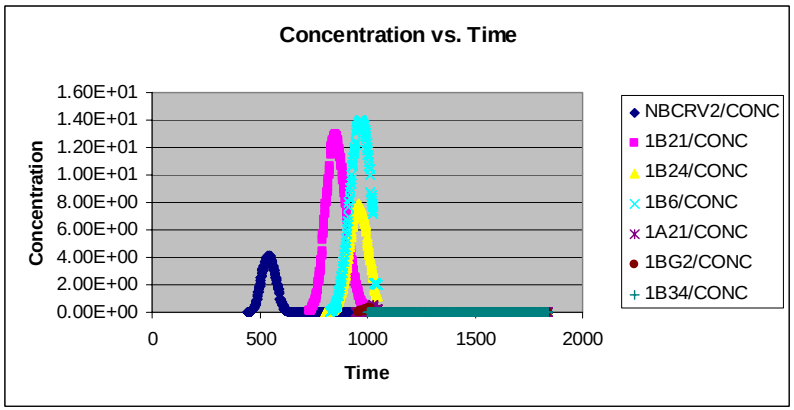




- Scalable methodology/tool for contamination and exposure tracking to support constructive simulation entity level simulation
- Selectable fidelity/methodology for human effects/lethality modeling
- Track effects status of entities in simulation

Exposure Toxicity Server

- Design Approach
  - Uses community accepted toxicity/lethality methodologies
    - Grotte/Yang for Chem
  - Allows user to select specific implementation (equation)
- Leverages/reuses CB Dial-A-Sensor infrastructure for exposure calculation, entity tracking and subscription
- Uses XML for interface to “accredited” underlying data (e.g., agent tox data)

Who Uses the CB Sim Suite?

- ECBC Research & Technology Directorate
- JPEO CBD JPM Contamination Avoidance
  - JSLSCAD
  - Artemis
- PM Recon (Fox NBCRV trainers)
  - Ft. Hood
  - Ft. Polk
- Aviation Technical Test Center (ATTC)
- Army Research Laboratory (ARL)

Who Uses the CB Sim Suite?

- US Army Training and Doctrine Command (TRADOC)
- Army Test and Evaluation Command (ATEC)
  Developmental Test Center (DTC)
  - Dugway Proving Ground (DPG)
  - Virtual Proving Ground
  - Future Combat System (FCS) Combined Test Organization (CTO)
- Army Maneuver Support Center (MANSCEN)
- OneSAF Objective System

Video showing the Sim Suite in action

Updating the CB Sim Suite

Updating the CB Sim Suite

- **Develop and integrate time management into CB Sim Suite elements using HLA time management services**
- Extend the existing ETS to include biological elements
- Develop and integrate additional representations and phenomenology
  - MOPP impacts
  - Collective protection
  - Support decontamination
- Develop an interface to widely-used constructive simulations

Development and Integration of Time Management into the CB Sim Suite

- Time management capabilities of HLA runtime infrastructure employed
- Updating components
  - ETS
  - CB DAS
  - NCBR
- Provides the ability to
  - Support slower- and faster-than real-time analyses
  - Support theater-level and aggregate-level simulations
  - Continue to support platform-level simulations
- The event manager class of each component is updated by utilizing time advance grants from the HLA runtime infrastructure
  - Overhaul of entire code

Time Management Defined

Time Management Definitions

- Coordination
  - Coordinated
    - Time advance is controlled via an external mechanism
  - Independent
    - Time advance is controlled by federates
- Advance
  - Constrained
    - Time advance rate is uniform (across all federates)
  - Unconstrained
    - Time advance rate is **not** uniform (within a federate and/or across federates)

Time Advance and Process Coordination Types

	Constrained	Unconstrained
Independent	•Real-Time and scaled Real-Time •DIS and non-Time Managed HLA	•**N/A** Meaningless in the Context of distributed simulations
Coordinated	•Not used in practice •Requires an external mechanism to control time	•HLA Time Managed •Federation driven time with non-uniform time advance

Time Advance and Process Coordination Types

	Constrained	Unconstrained
Independent	•Real-Time and scaled Real-Time •DIS and non-Time Managed HLA	
Coordina		•HLA Time Managed •Federation driven time with non-uniform time advance

All simulations in the exercise advance independently at the same rate using the same time scale (e.g., 1 sec = 1 sec) (constrained)

Each simulation in the exercise advances at its own (unconstrained) time scale as coordinated by an exercise time/event

Time Management Implementation

NCBR, DAS, & ETS Baseline

	Constrained	Unconstrained
Independent	•Real-Time and scaled Real-Time •DIS and non-Time Managed HLA	•**N/A** Meaningless in the Context of distributed simulations
Coordinated	•Not used in practice •Requires an external mechanism to control time	•HLA Time Managed •Federation driven time with non-uniform time advance

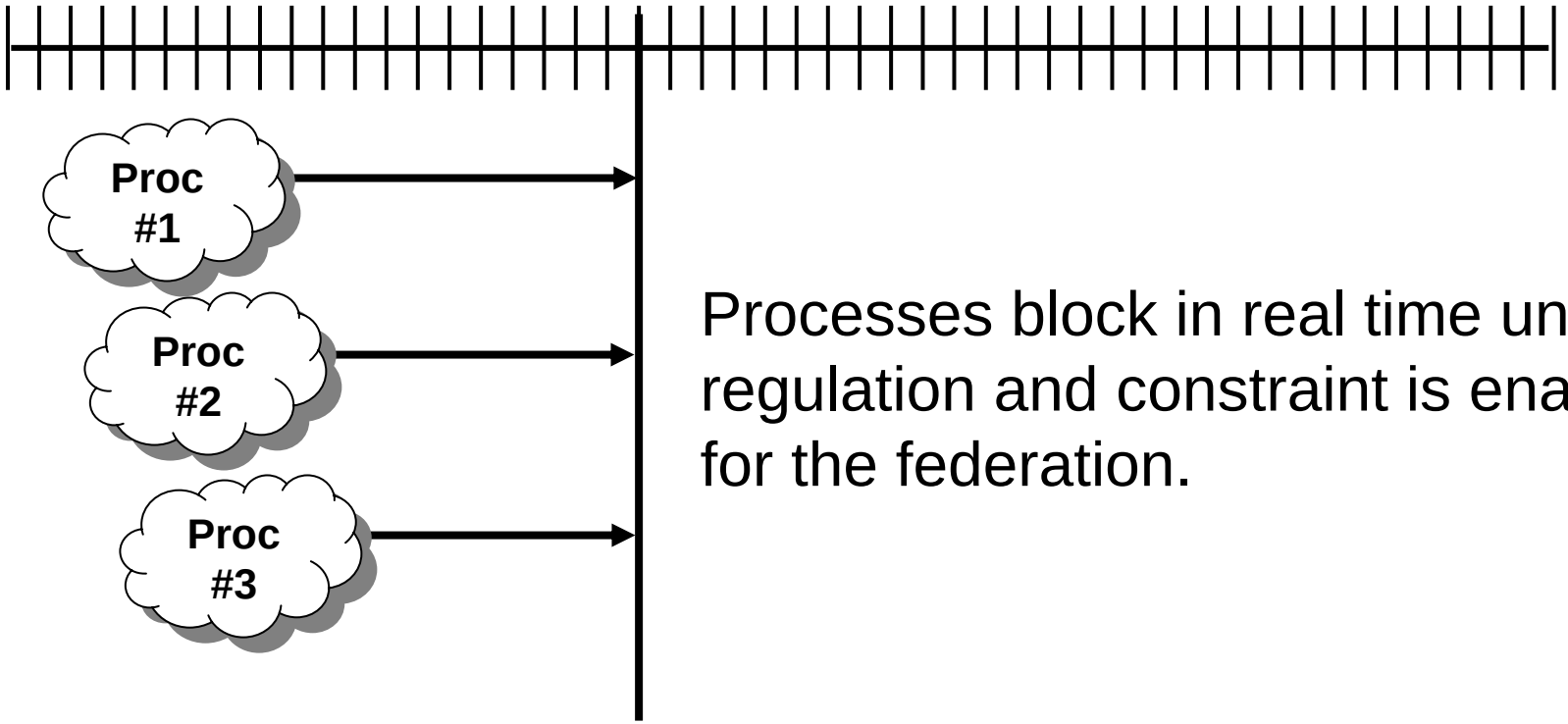
M&S Worth

NCBR, DAS, & ETS End State

How Time Management Works

Process Initialization

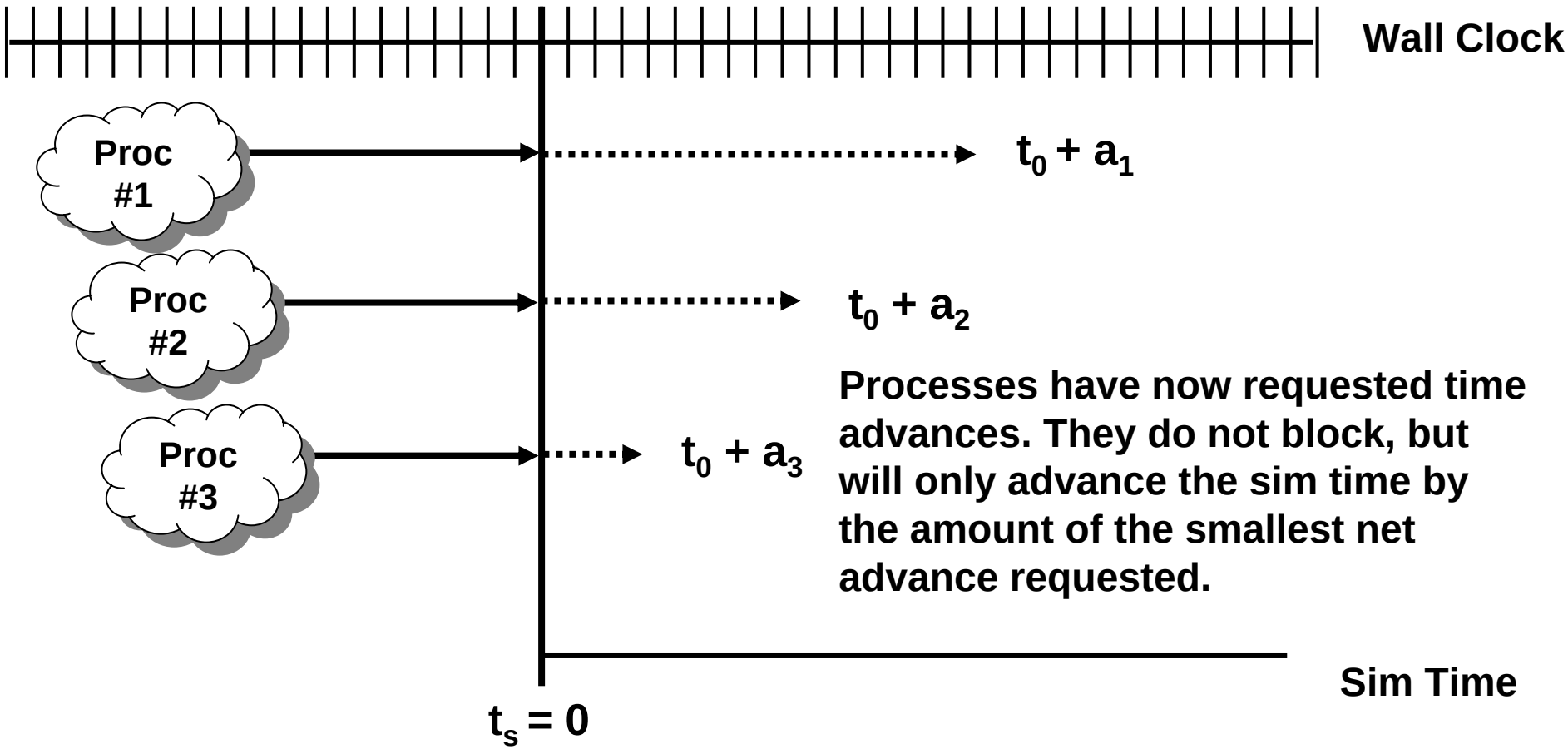
- **Initialize Process**
- **Request Time Regulation/Constraint**



Processes block in real time until time regulation and constraint is enabled for the federation.

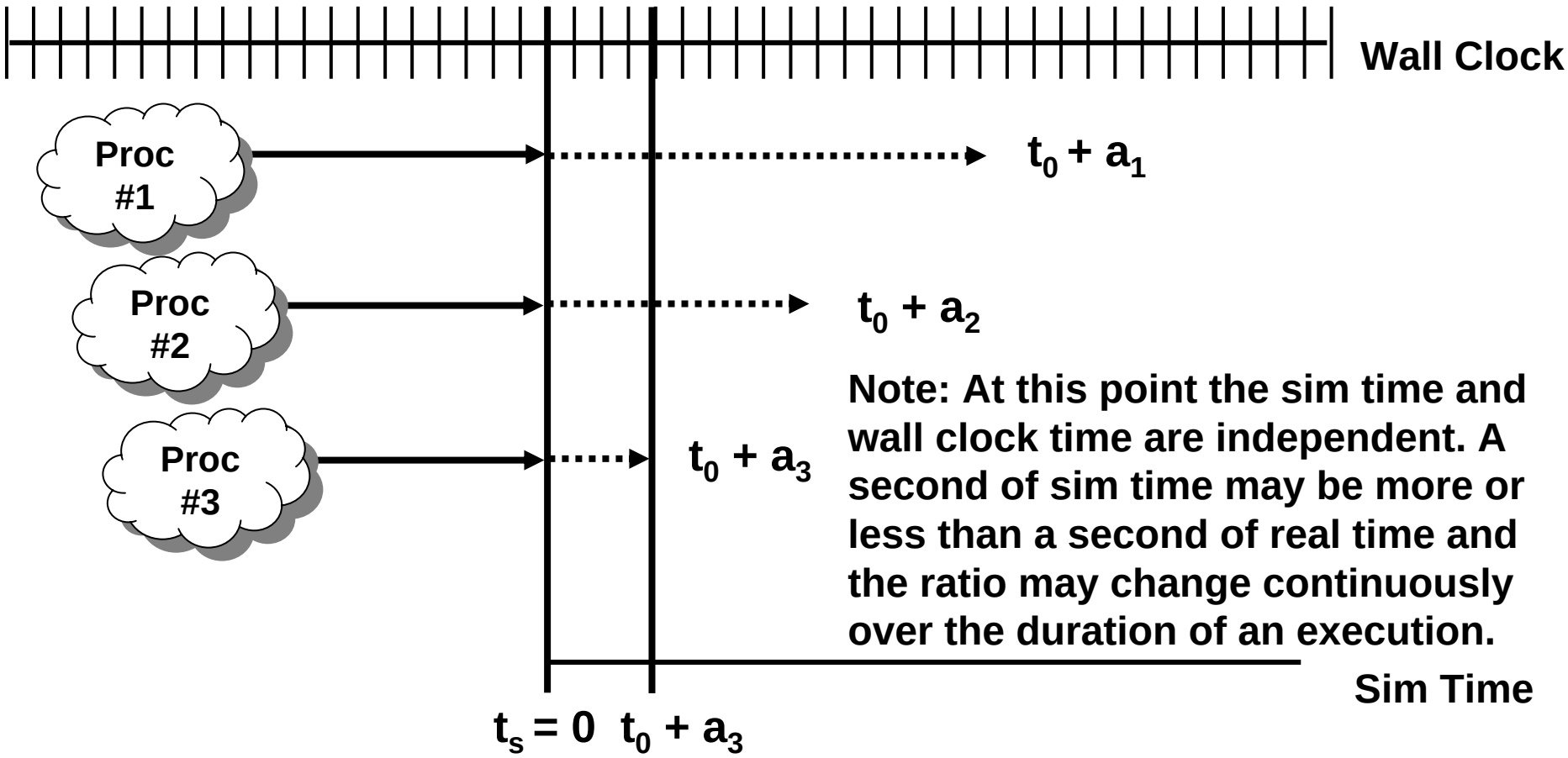
Process Execution

- **Time Regulation/Constraint started**
- **Request Initial Time advance**



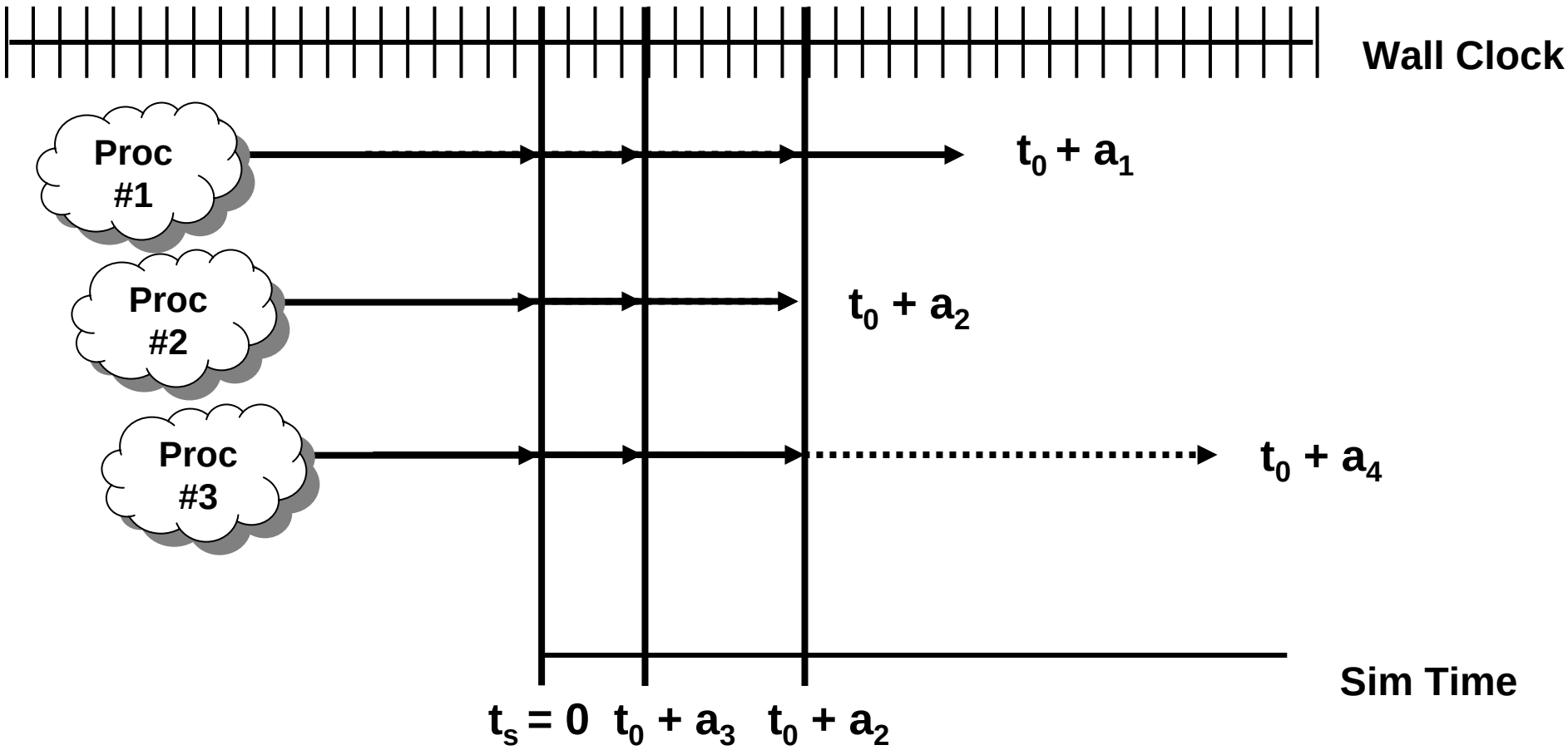
Process Execution

- **All the processes now complete any processing to get to time t0+a3**



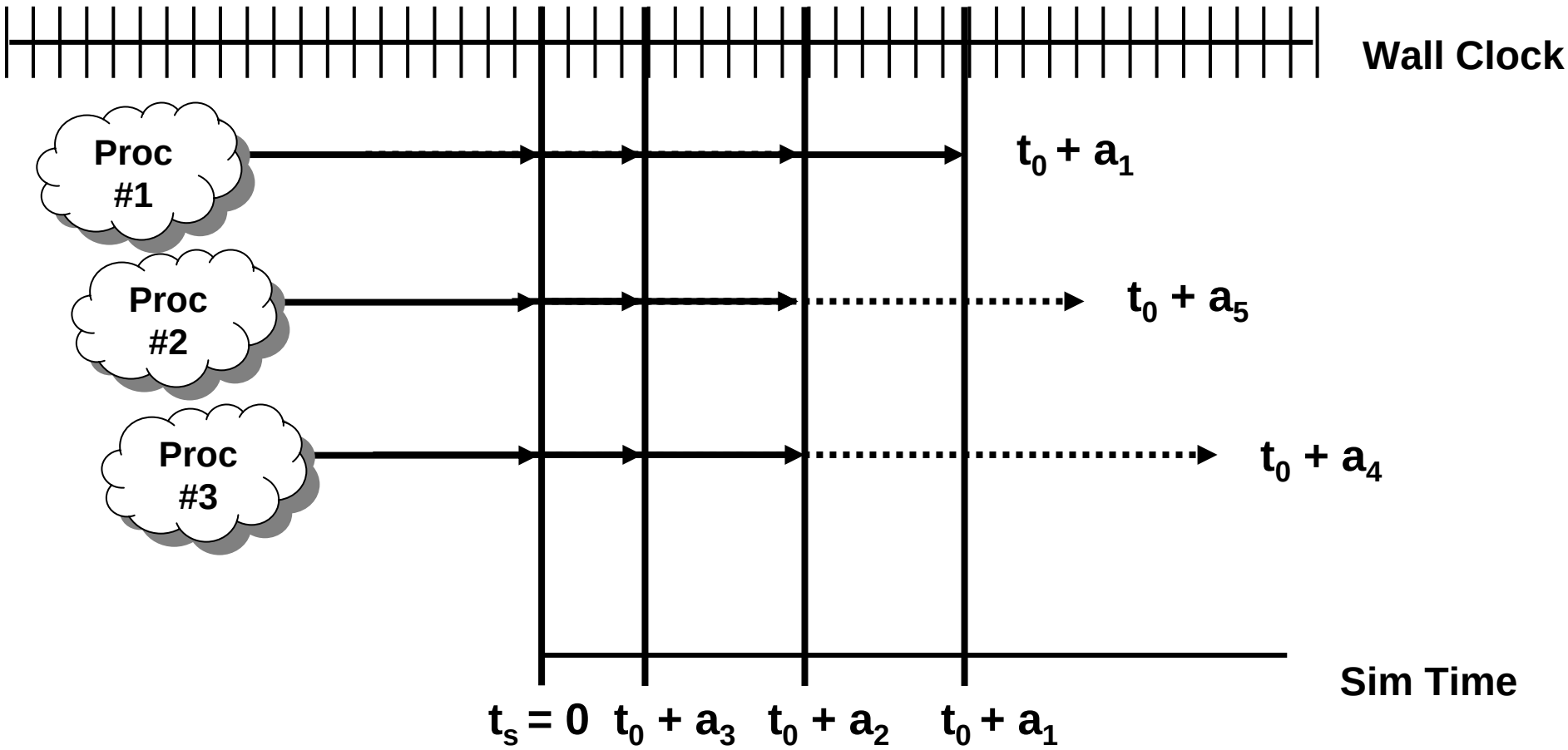
Process Execution

- **Proc #3 then issues another Time Advance Request**



Process Execution

- **Next Iteration**



Updating the CB Sim Suite

- Develop and integrate time management into CB Sim Suite elements using HLA time management services
- **Extend the existing ETS to include biological elements**
- Develop and integrate additional representations and phenomenology
  - MOPP impacts
  - Collective protection
  - Support decontamination
- Develop an interface to widely-used constructive simulations

Extend the existing ETS to Include Biological Elements

- Use a community-accepted toxicity model
  - LD_{50} and probit slope considered
    - Recommendation from senior community
  - Knowledge Acquisition Matrix Instrument (KAMI) technique also considered
    - Analyzes the effects of bioagent-induced diseases
- Bio effects occur over extended periods of time
  - Delay between exposure and onset of symptoms/impacts
  - Most simulations do not last long enough for onset of effects
  - Need the capability to work exposure portion then effects portion
    - Predosing
    - "Jump time" during simulation/non-real-time simulation
      - Non-trivial problem
      - Research area

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Develop and integrate additional representations and phenomenology

- MOPP Impacts
  - MOPP all functionality in ETS
    - “MOPPall” command
  - MOPP simulation effects need to be simulated in SAFs
    - Models need to be restructured to include
      - the loss of dexterity and mobility
      - greater effects of heat stress
      - increased protection to CB at an aggregate-level (scalable)
    - Dependent on SAF and interoperability means developed

- Collective Protection (preliminary work per this effort)
  - Movement of entities in and out of collective protection sites and contamination areas tracked
    - Dependent on SAF and interoperability means developed

Develop and integrate additional representations and phenomenology

- Support Decontamination (preliminary work per this effort)
  - A contamination module (extension of ETS) that determines the contamination of an entity (vs. dose) based on
    - the entity
    - contamination type
      - Vapor
      - Aerosol
      - Deposition
      - Interaction with the hazard
  - Contamination status reported as a function of
    - Decon technique
    - Duration of decon event
    - Level of contamination
  - Dependent on SAF and interoperability means developed

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Develop an Interface to Widely-Used Constructive Simulations

- Work continues on identifying a potential tool
- Viable candidate
  - OneSAF
    - Objective System (OOS)/WARSIM
    - Testbed (OTB)
- Modifications required on both sides of the interface
  - Inputs from the SAF drive the Sim Suite
    - Flags need to be added for MOPP, etc.
  - Outputs from the Sim Suite need to affect the behaviors of the SAF
    - Effects of CB insults need to be modeled in the SAF behaviors

Summary

- CB Sim Suite provides significant capability used across multiple domains
  - R&D
  - T&E
  - Training
- Ongoing effort rounds out phenomenology and increases applicability
- Follow-on program to mature CB Sim Suite for transition

Questions/Comments