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Sandia National Laboratories

SCEPTRE Overview for Workshop 2016

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Why does SCEPTRE exist?

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- Live system testing is impractical
  - Potential damage to the real system and dangers to human life
- Traditional test beds are burdensome
  - Expensive to build, maintain, configure, and operate
- Lab-scale hardware testing setups are insufficient
  - Effective at testing devices in isolation, but detrimental effects might only be seen in the context of a larger, networked system
- Network simulation
  - Mapping network events to physical process effects is difficult
- **SCEPTRE provides a cyber-physical interface to show how cyber-initiated events affect the physical world (and vice versa)**

SCEPTRE Components

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- Control Systems devices
  - Low fidelity simulated ICS devices
    - RTUs, PLCs, protection relays, FEPs
  - Emulated PLCs, HMI services
  - Real hardware relays, PLCs, RTUs
- High fidelity SCADA protocols
  - ModbusTCP, DNP3, iec61850
  - Written to specification
  - Enabling technology that allows communication between real and simulated devices
- Process simulation
  - Leverage industry standard software where possible (V&V)
    - PowerWorld, PyPower, PSS/E
  - Develop our own simulated process when needed
    - Water treatment, refinery, natural gas pipeline, railroad signaling

SCEPTRE Operational Overview

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- SCEPTRE is an application that uses an underlying network (like Sandia's Emulytics™ Platform technology) to run
- ICS devices (simulated, emulated, real) communicate and interact via high fidelity SCADA protocols
- Process simulation data is provided to all the ICS devices
- All ICS devices are able to interact with the simulation, providing both updates and subscribing to the current state of the simulation
- When the simulation state updates, all devices receive the current state so there is a common view of the simulation
- Overall simulation is able to bridge multiple infrastructures into the same experiment to show interdependencies.
- Real-time vs discrete event simulations

SCEPTRE Deployment Pipeline

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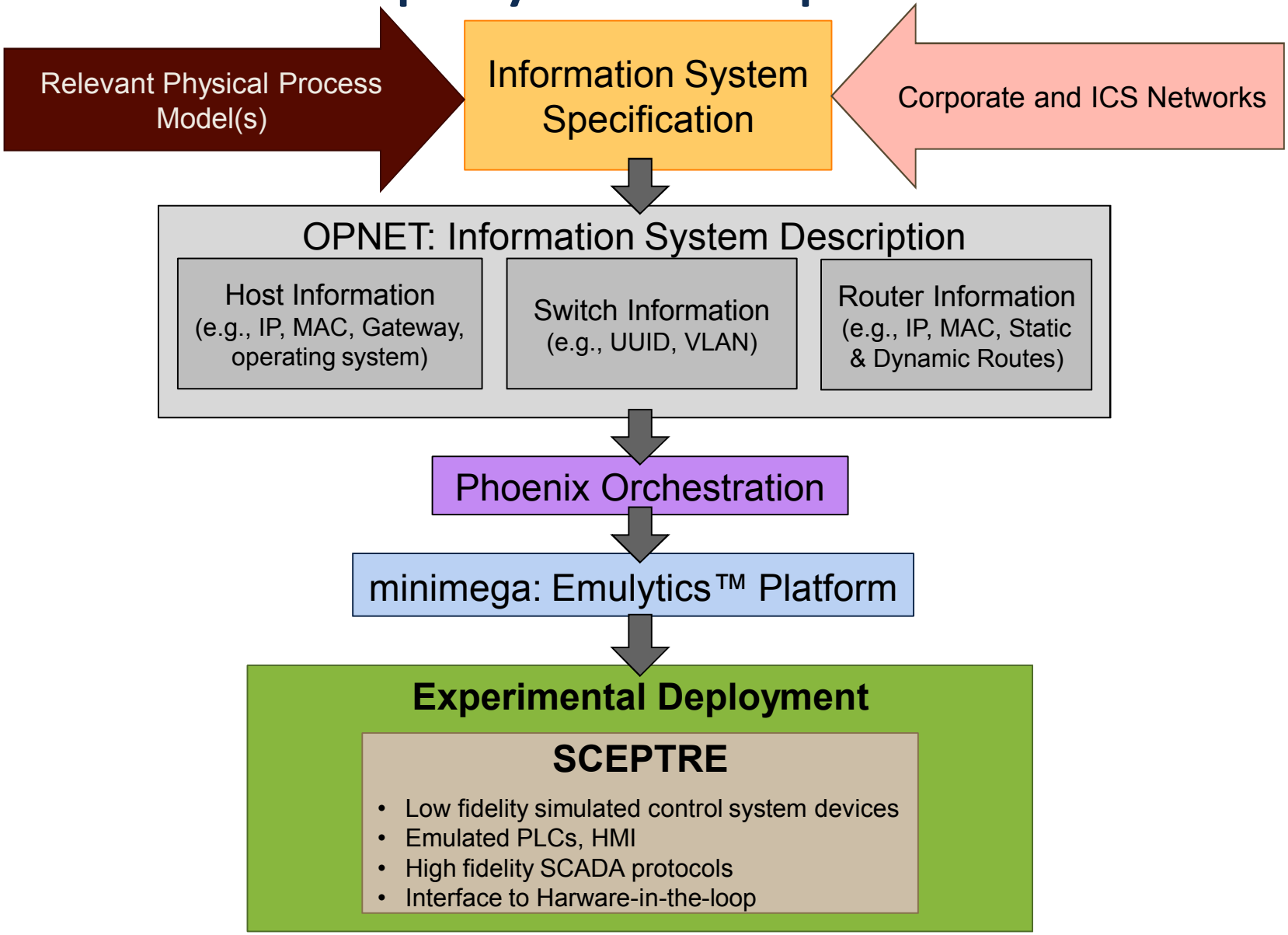
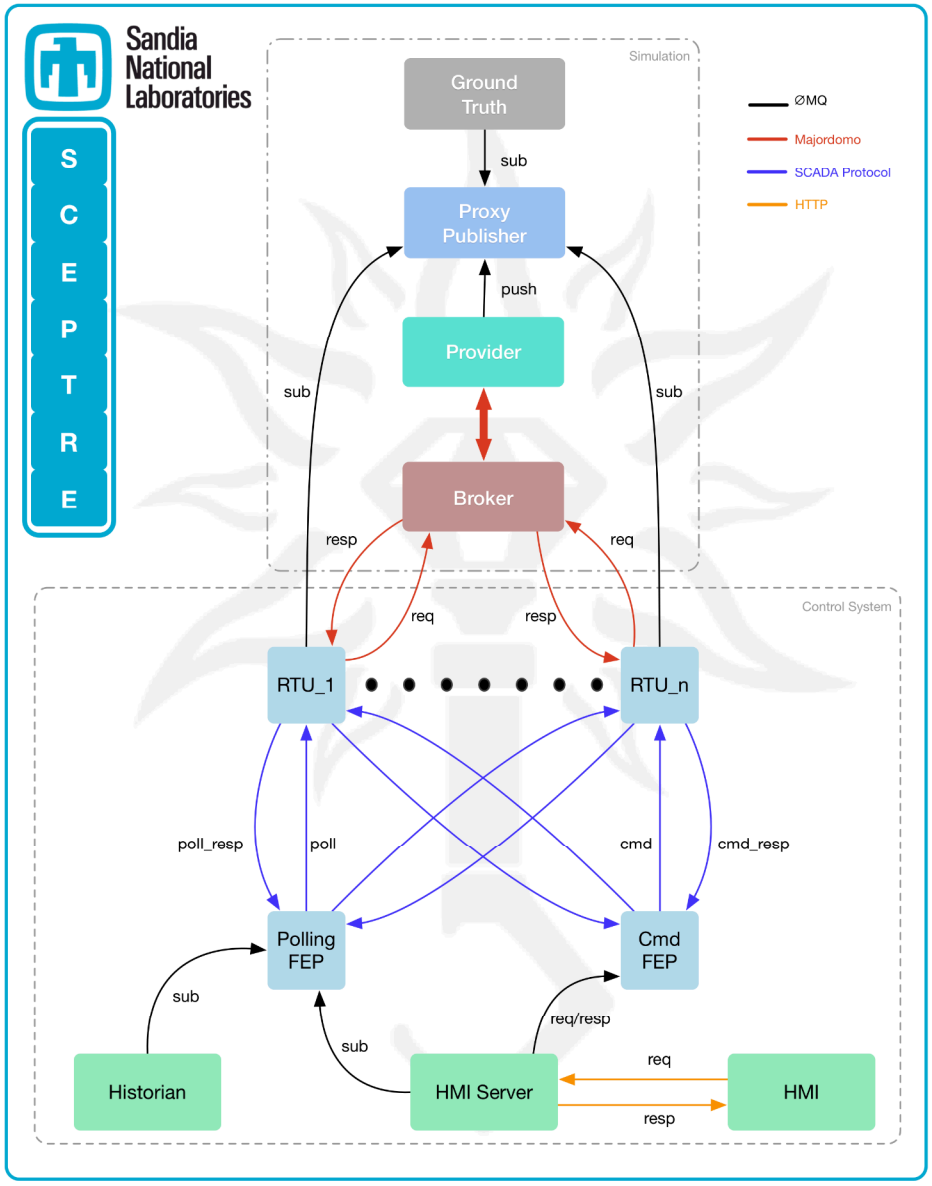


SCEPTRE Functional Structure



SCEPTRE Use Cases

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- Test and Evaluation
  - Hardware, architectures, TTP, technology solutions
  - Vary model fidelity depending on the questions being asked and scope
- Analysis
  - Deploy network of interest to understand vulnerabilities and exploitable avenues
  - Identify critical components on the control network and in the underlying infrastructure
  - Ability to model infrastructure interdependencies within the same simulation

SCEPTRE Use Cases (cont.)

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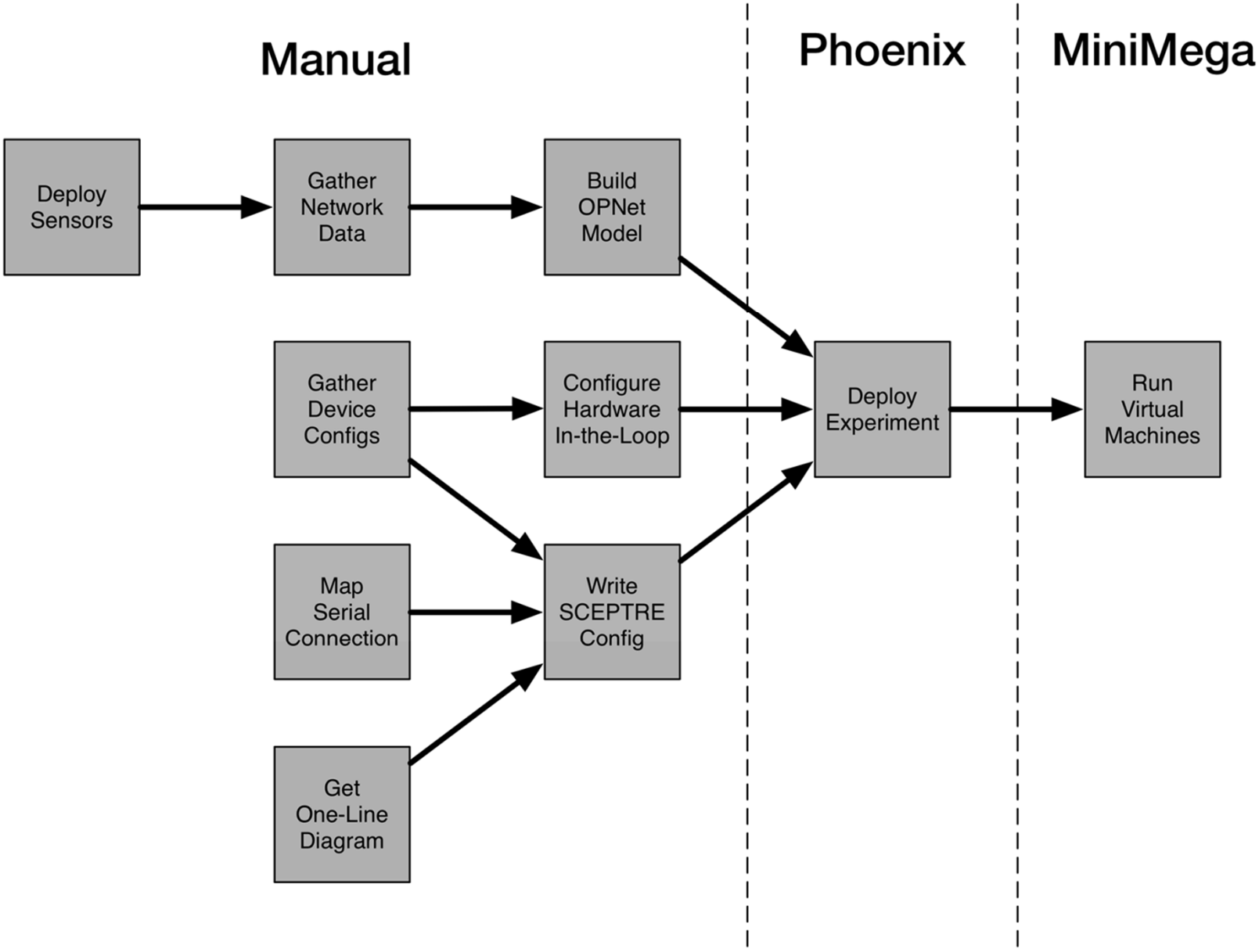
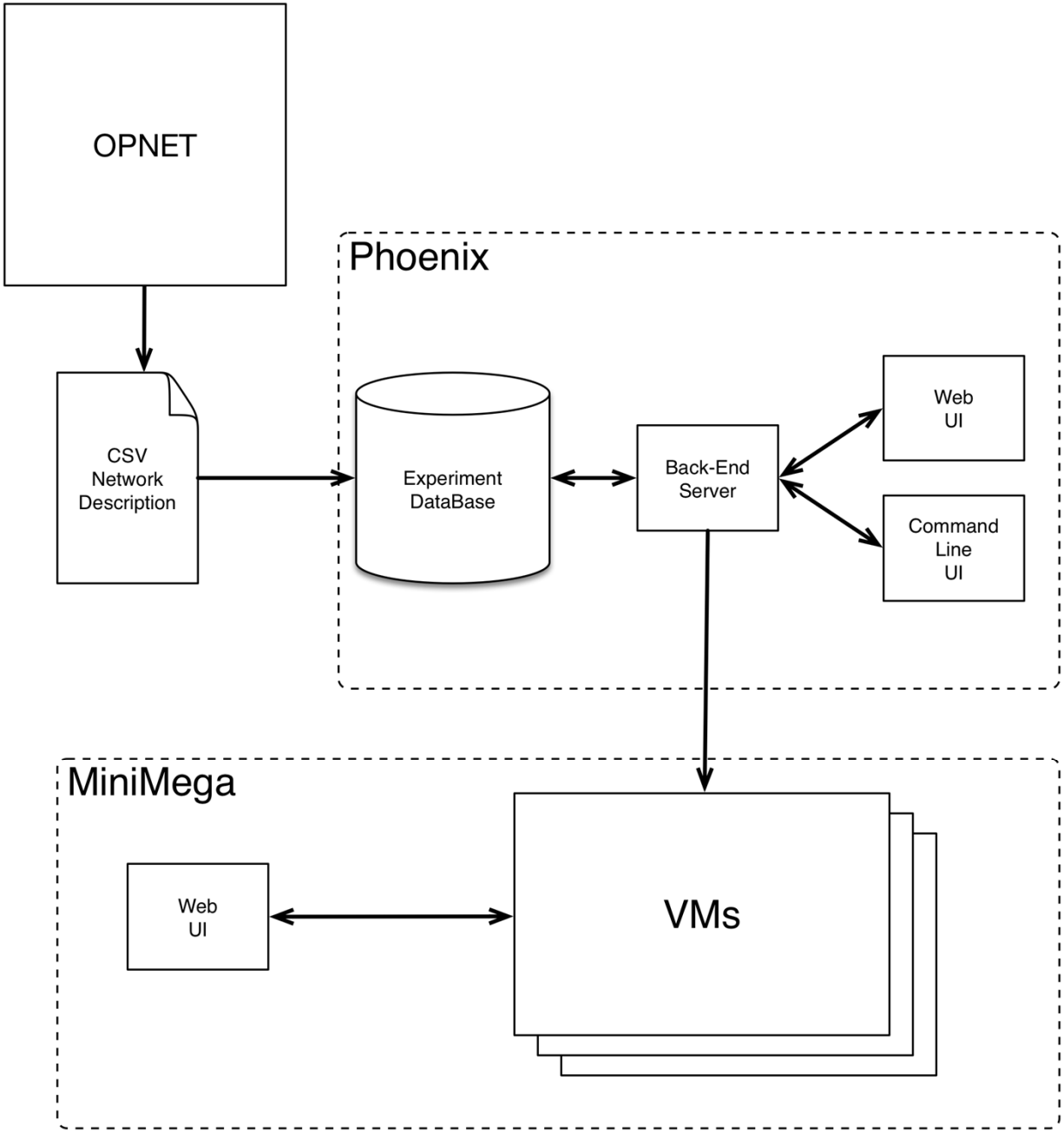
- Training and Exercise Support
  - Look-and-feel of real ICS networks by integrating industry HMI and service tools
  - Faithful protocol traffic for deeper network inspection
  - Ties to process models illustrate impacts of control system changes on physical systems
  - Provided SCEPTRE environments to support DoD exercises


Manual
Phoenix
MiniMega
Deploy Sensors
Gather Network Data
Build OPNet Model
Gather Device Configs
Configure Hardware In-the-Loop
Deploy Experiment
Run Virtual Machines
Map Serial Connection
Write SCEPTRE Config
Get One-Line Diagram


OPNET
Phoenix
CSV
Network
Description
Experiment
DataBase
Back-End
Server
Web
UI
Command
Line
UI
MiniMega
Web
UI
VMs