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National Nuclear Security Administration

United States
Department of Energy
National Nuclear Security Administration

International Nuclear Security

Assessment and Experience Using Open-Source NPP Environments for Cyber-Security Training

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INS International Nuclear Security
Reducing Risk of Nuclear Terrorism

Sandia National Laboratories
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Importance of Opensource

- Allows greater collaboration on multidisciplinary problems
- Grows the cybersecurity community
- Provides equal access to educational materials
- Produces projects with greater global impact
- Increases the longevity of tools and resources
- Reduces over all effort to produce and maintain tool sets

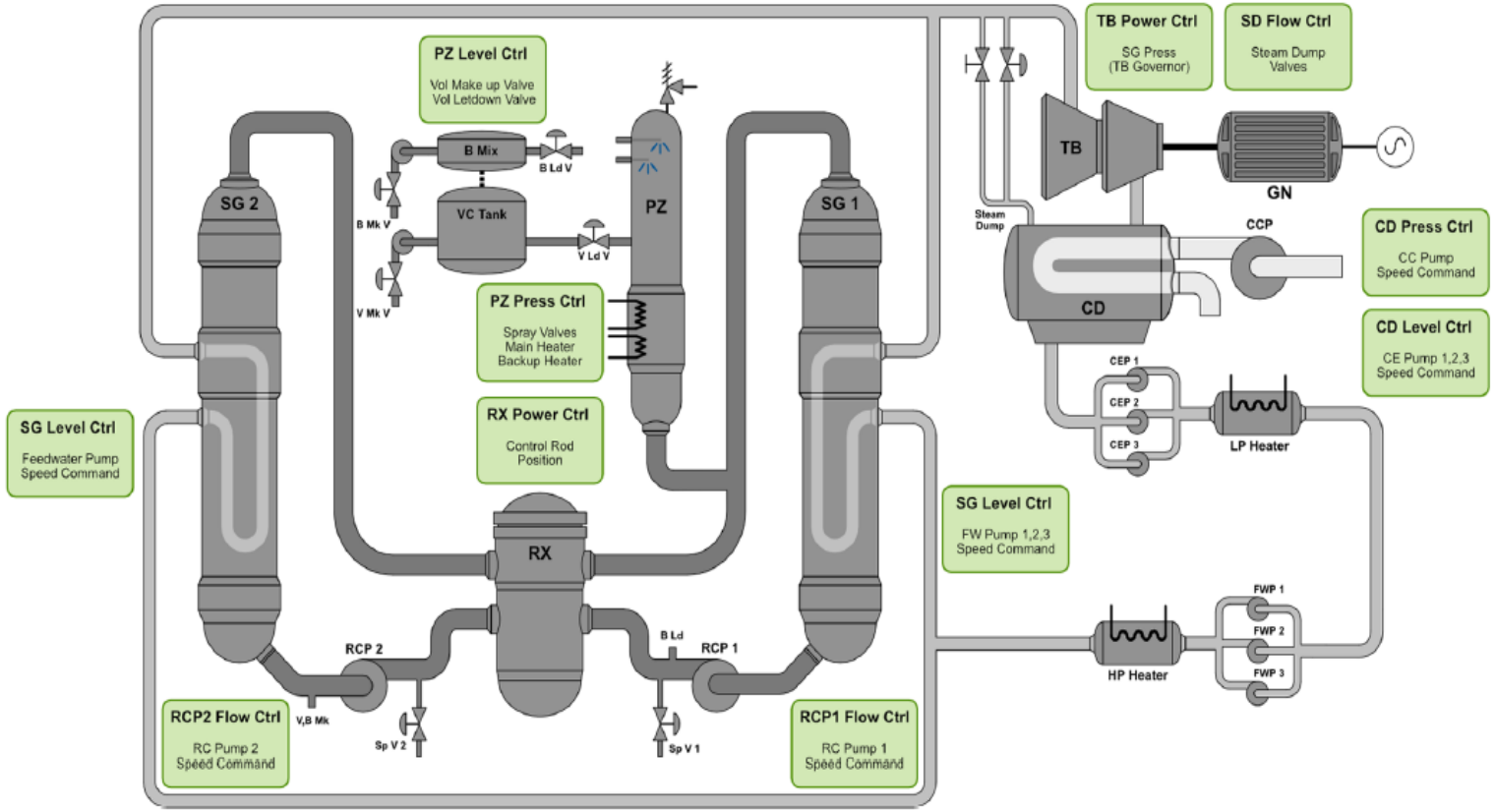


Image: Silva RB, Shirvan K, Piqueira JR, Marques RP. Development of the Asherah Nuclear Power Plant Simulator for Cyber Security Assessment. International Conference on Nuclear Security (ICONS), 10-14 Feb 2020 in Vienna Austria 2020.

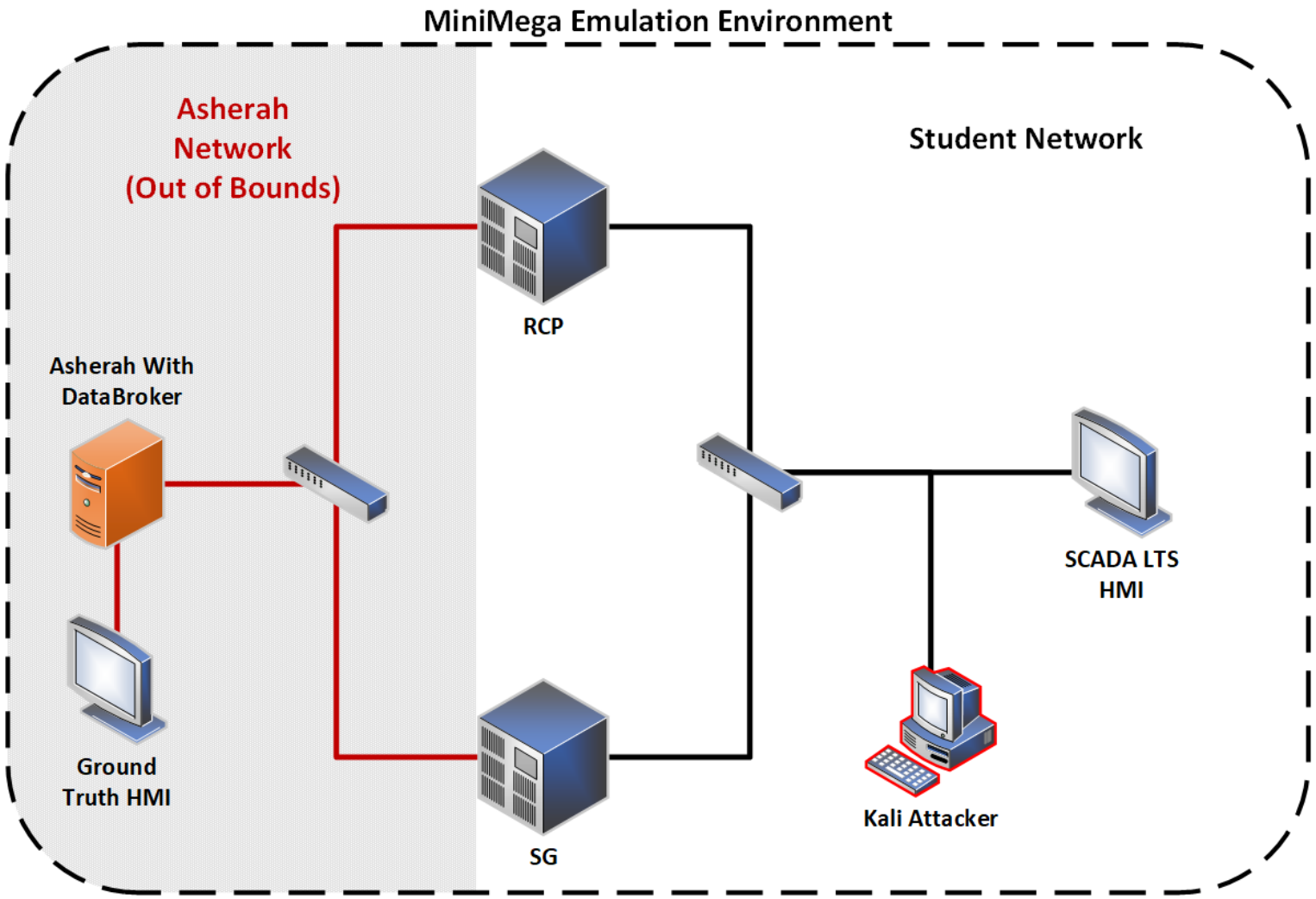
Key Platform Elements

Components	Technology
Virtualization Environment	minimega
Physics Integrator	Sandia DataBroker
Cyber Attack Simulator	ManiPIO & Kali Linux
PLC Runtime Environment	OpenPLC
SCADA Interface	scada-LTS
Physics Simulation	Asherah* Nuclear Power Plant Simulator

* Not Included

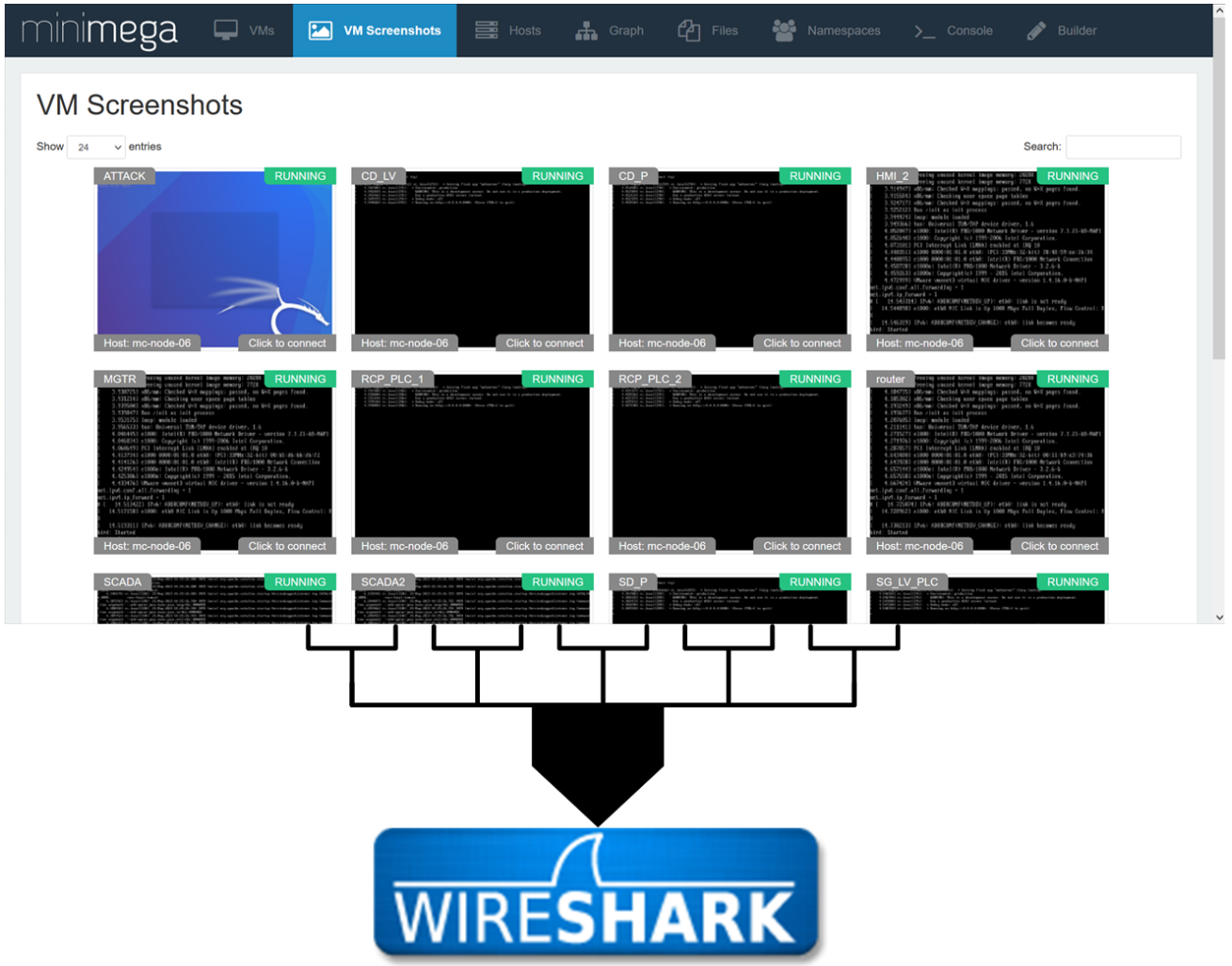
DOE-INS Brazil Course Environment

- Opensource
- Portable
- Stable
- Minimal hardware requirements
- Interactive control system and NPP physics
- Software defined network topology



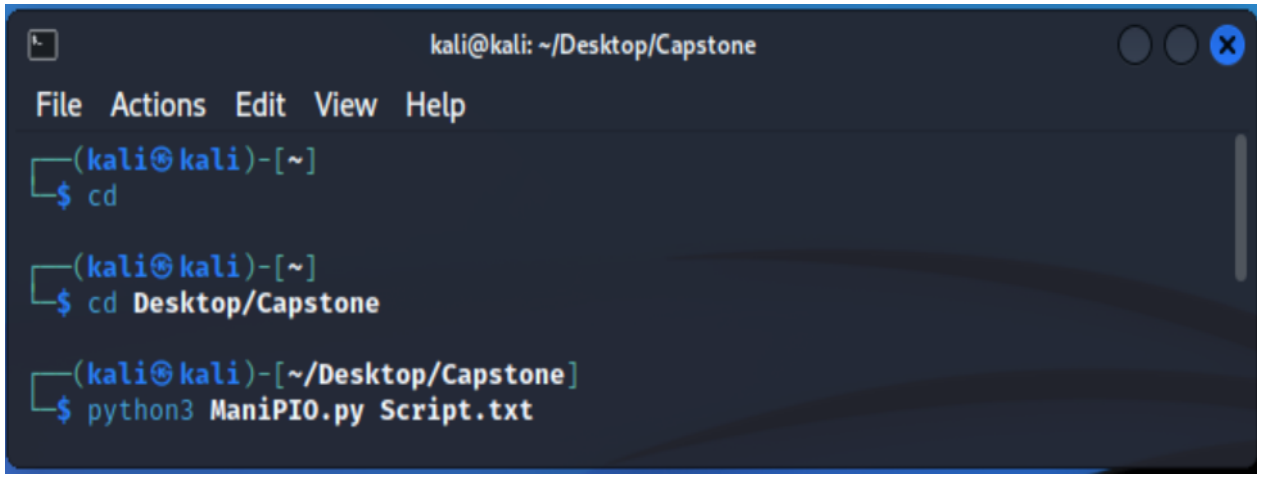
Minimega Transparency

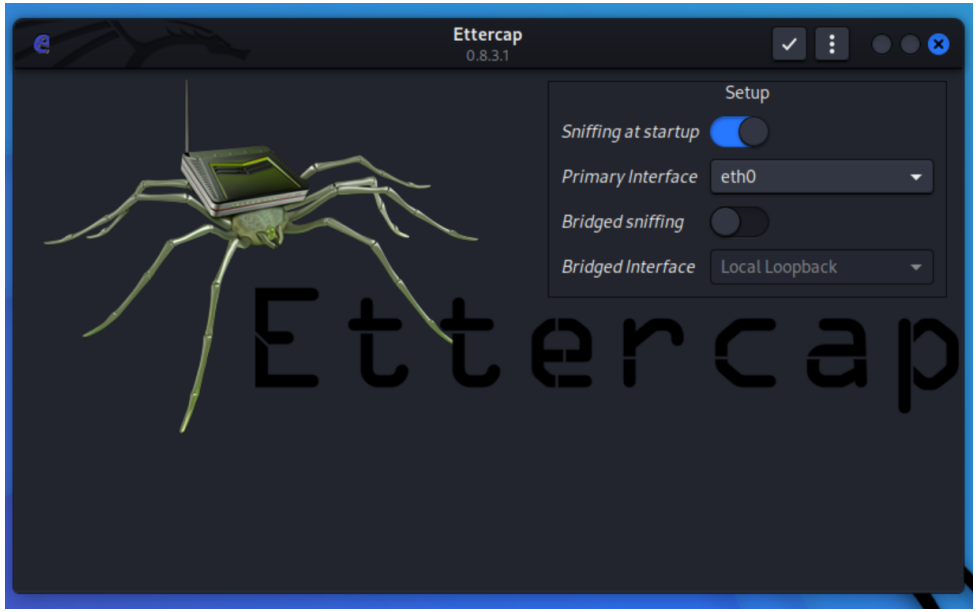
- All interfaces within Minimega are capturable
- Wireshark is used to view network traffic across the entire topology
- File structures and processes are inspectable live

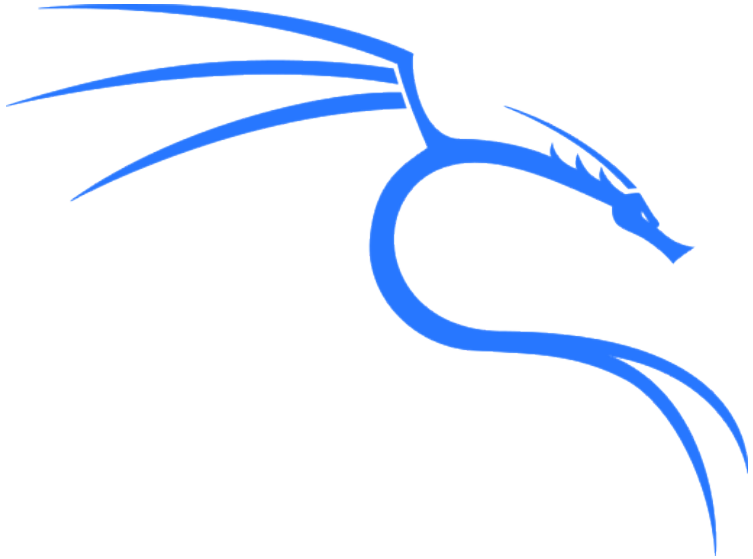


Course Objectives

- Students are asked to be a hacker in the class and perform a series of attacks
  - Alter memory values on Programmable Logic Controllers (PLCs)
  - Man-in-the-Middle attack against the SCADA Human Machine Interface (HMI)

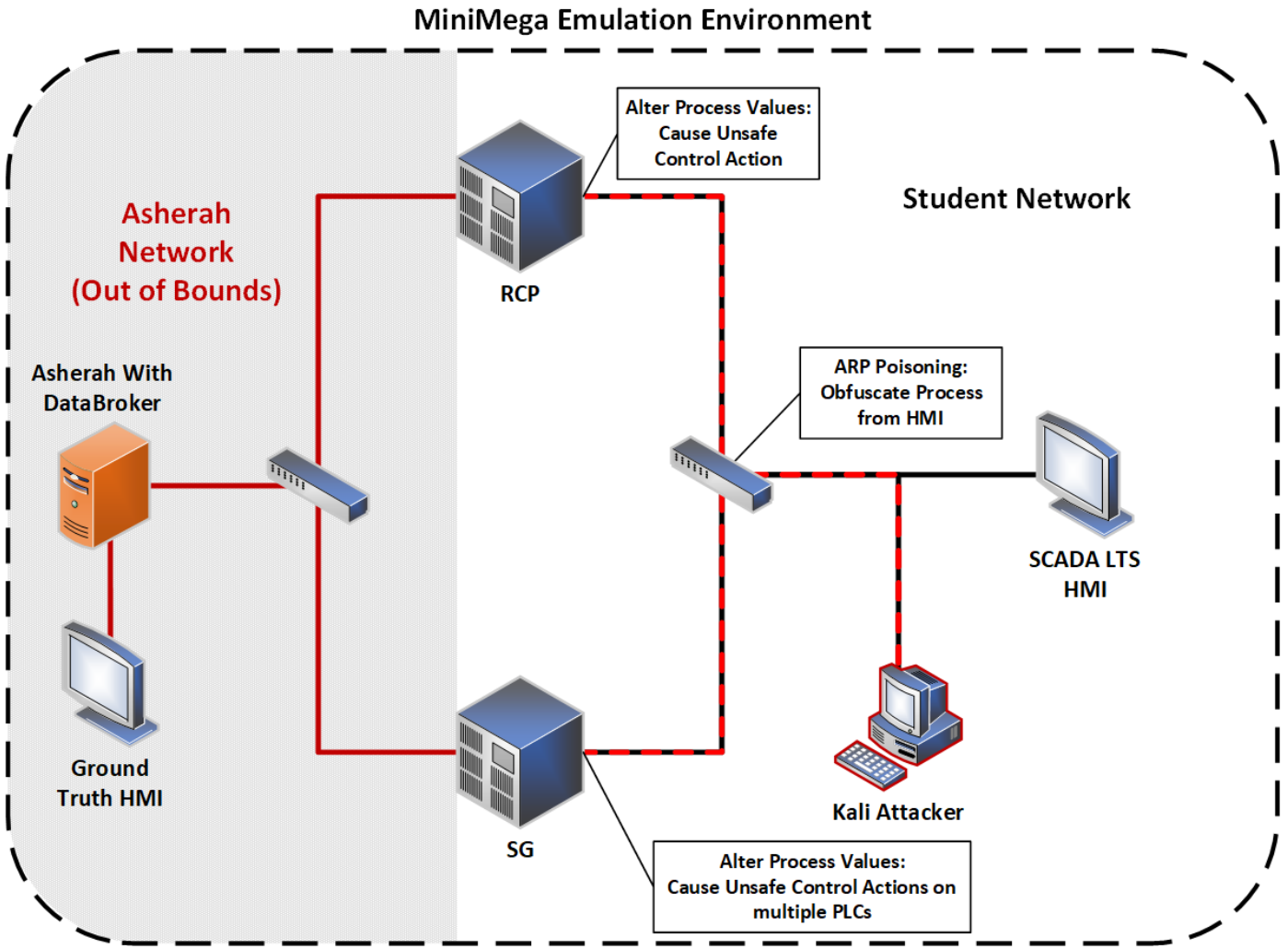






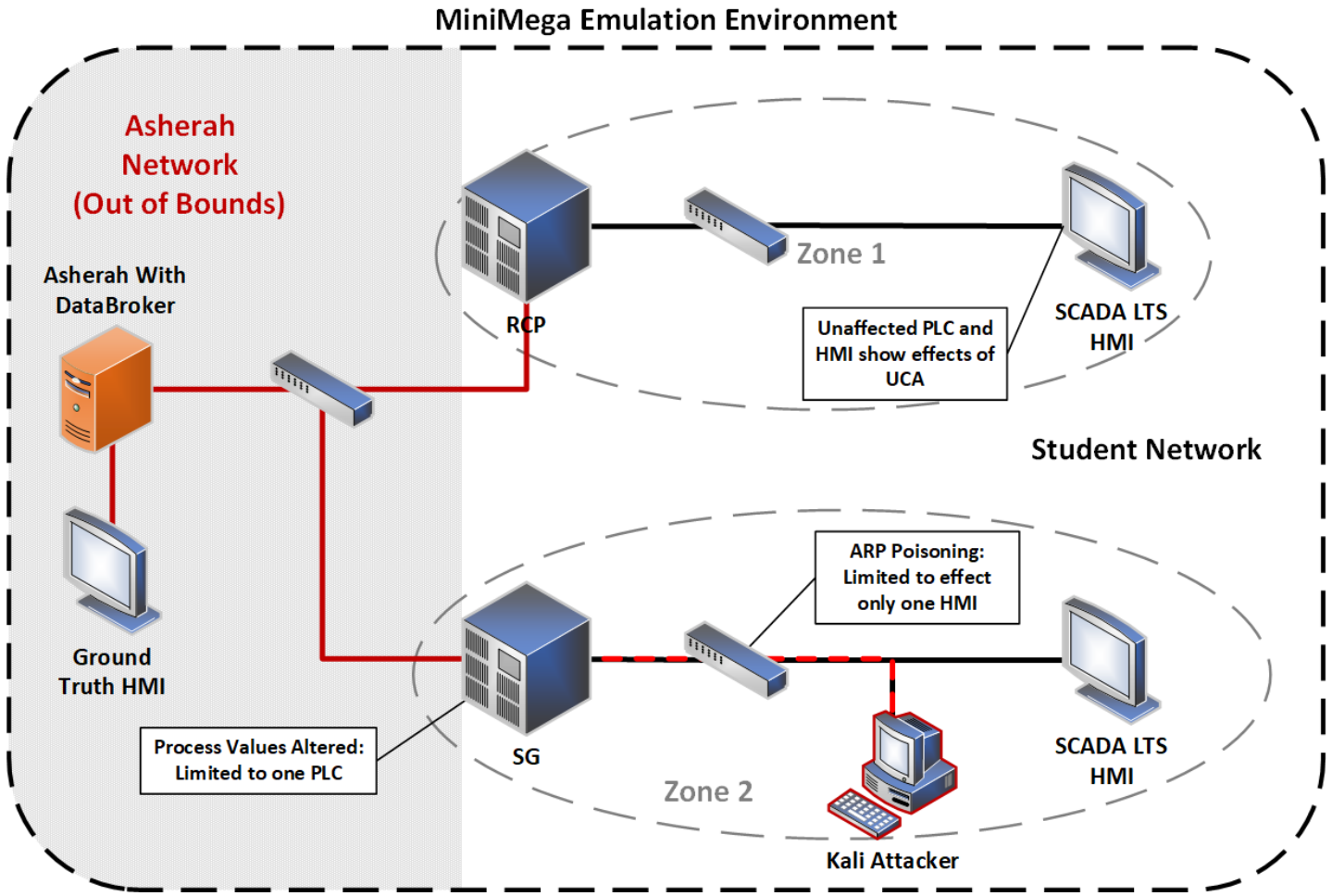
Attack Analysis

- What did this attack do?
  - Obfuscate information from the PLCs to the HMI
  - Altered sensor information on the PLCs to disrupt the plant
- How can this attack be prevented?
  - How can we make this attack impossible?
  - How do we give operators good information while making dangerous attacks as difficult as possible?



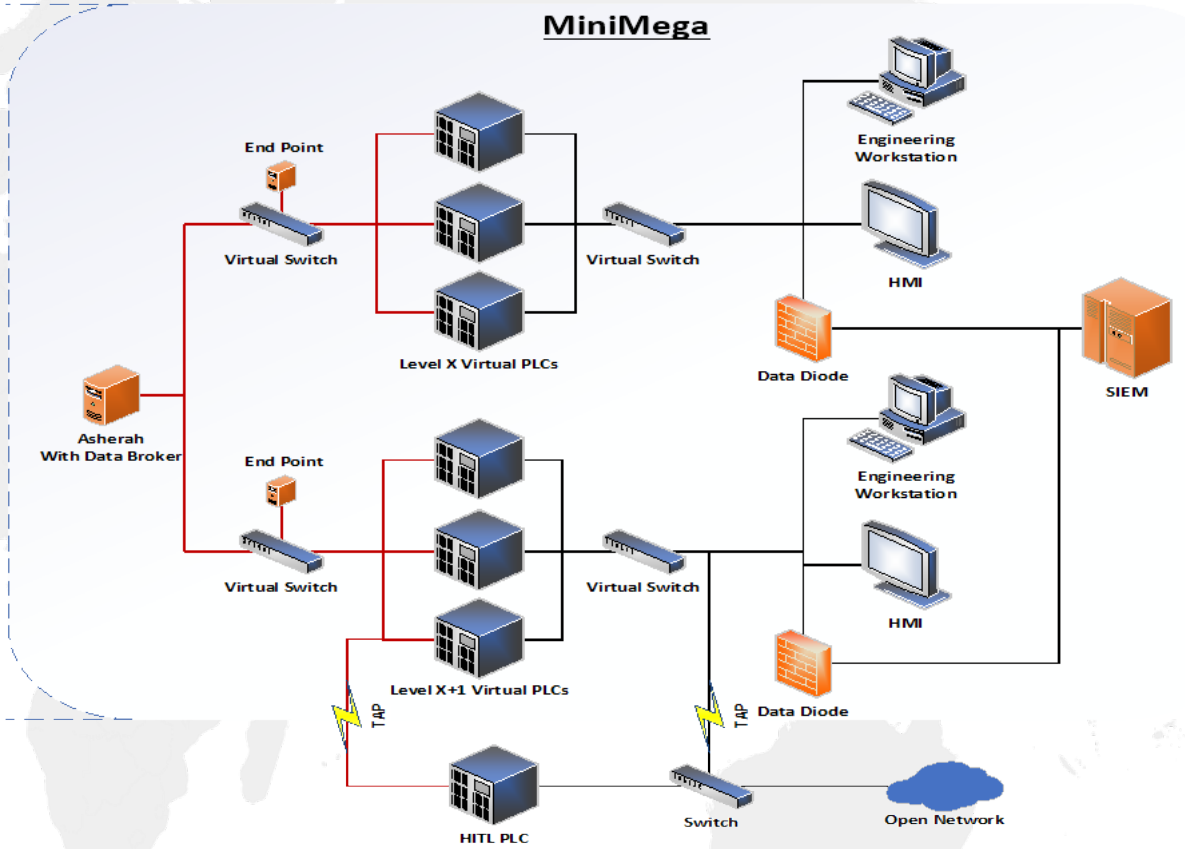
Protect Against Attacks

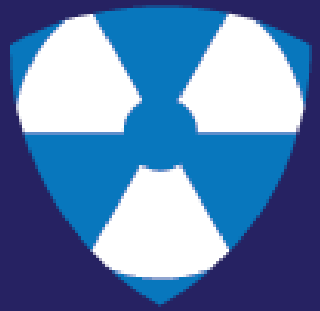
- Students must apply the knowledge from the course to create a better network
- Minimega allows the modification of the network on the fly
- Students run the attacks again on their modified network to see the difference



Current & Future Work

- Reducing size
  - Self-assembling system
  - Ease distribution
- Resource optimization
  - Containers
  - Larger more complex networks
- Automation
  - Scripts to reduce command line need
  - Pre-canned network topologies reduce complexity
  - Opensource GUI interfaces for Minimega





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