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Differentiating Capabilities for Defense Against Cyber Threats – SNL Cyber Activities & Research

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U.S. DEPARTMENT OF ENERGY | NNSA National Nuclear Security Administration

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Internet Emulation & Large Scale Data Analysis

- Internet-scale network emulation and analysis tools (Emulytics™)
  - Large scale virtualization of Windows, Android, and other OS (10^5 – 10^6 VMs)
  - Tools to instantiate network topologies of interest
  - Tools to configure and manage large-scale experiments
  - Fuzzing
- Algorithms and computing architectures for large-data analysis
  - Expertise with large graphs (DARPA FEAST project, others)

Sandia been working on Emulytics™-for almost a decade

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- We've developed tools/techniques that enable:
  - Testing, evaluation
  - Performance Analysis
  - Training
  - Effects Based Analysis
  - Malware Analysis
  - Next-Gen Cyber Capability Development
- The ease and ability to do the following is critical to the success of future systems…
  - Pose a question/hypothesis/ reason
  - Standup an experiment
  - Test
  - Analyze the data
- Emulytics is still developing and evolving as a capability, a community, and as a science

Why Emulate? Why Create Environments?

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- Conducting high-fidelity testing (cyber and otherwise) is hard, expensive, or policy prohibitive
- Current tools and techniques do not provide the ability to:
  - create rapidly configurable, validated*, repeatable tests
  - create scalable solutions
  - quickly rollback to start state
  - test and evaluate technologies
  - heavily instrument the system (host, network app, …) to learn from system
  - understand the system

LIVE, VIRTUAL, CONSTRUCTIVE (LVC) Analysis

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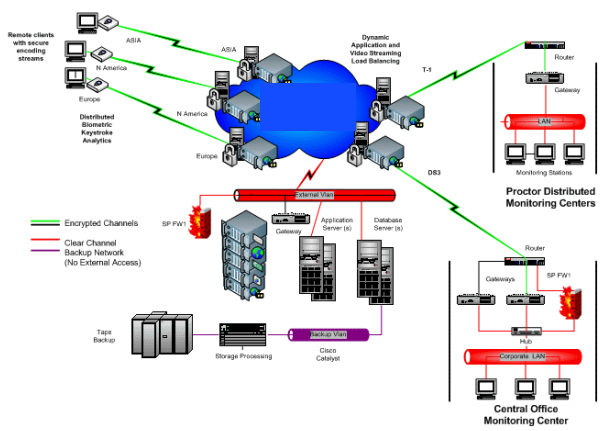
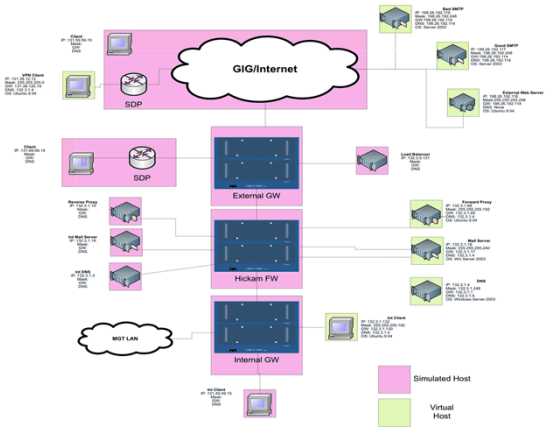
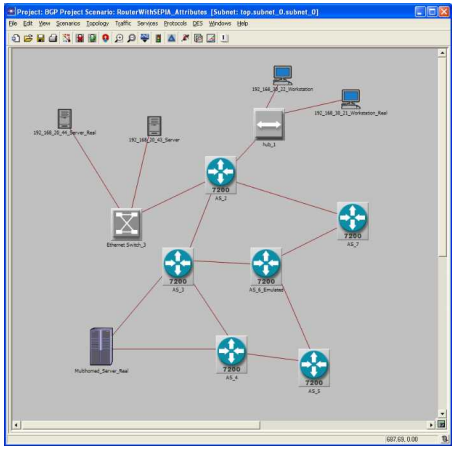






Actual System

LVC Testbed

M&S Testbed

Interoperability of live, virtual, & constructive in a single experiment

Live

M&S

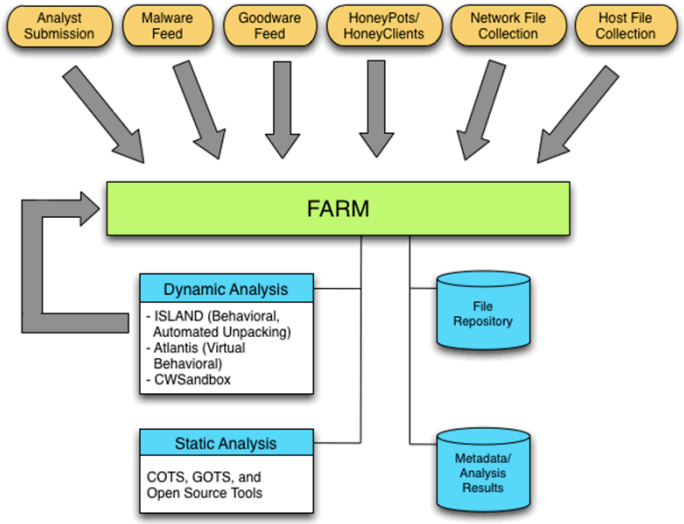
Increase Realism

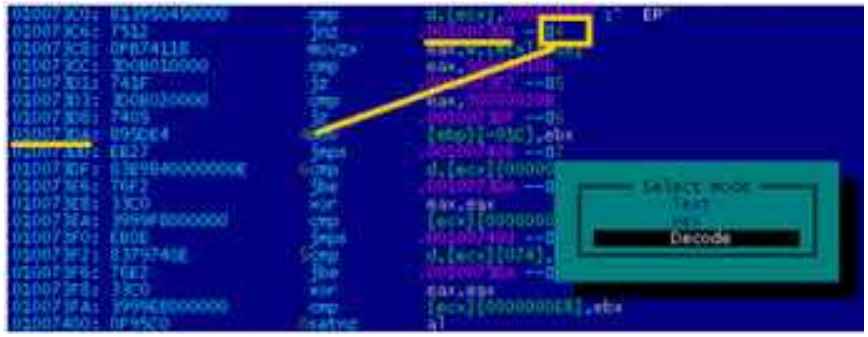
Decrease Cost

Decrease Time

Secure Cyber Networks and Systems

- Malware Analysis
  - Automated malware analysis and triage using static and dynamic analysis
  - Deep dive reverse engineering of malware
  - R&D in the area of file similarity detection
- Network Monitoring and Incident Response
  - Responsible for SNL enterprise cyber security (partnership between 8900 and 9300)
- Vulnerability Assessment
  - Red-teaming and penetration testing





FARM

- Forensic Analysis Repository for Malware
  - Sandia's automated malware analysis system
  - Modular – Easy to add **New Tools**
  - Growing repository of ~ 50 million (+ 100k / day)
  - Scalable framework based on cloud technology
    - Easy to add **Automated** analysis capacity
  - RESTful API – programmatic submission and data retrieval
    - Enables more complex analytics
  - Group permissions that control context
    - Enables **Information Sharing**
  - Email Alerting
    - **Focus humans resources**

Formal Methods R&D

- Formal methods are increasingly commonplace in industry and academia
- What outside parties do:
  - Verify reliability
- What they don't do as much of:
  - Verifying security
  - Assessing trust in engineering
  - Addressing complex scenarios (e.g., situational awareness, cascading failures)
  - Off-nominal conditions (e.g. effects of radiation on logic)

Quantum Information Sciences

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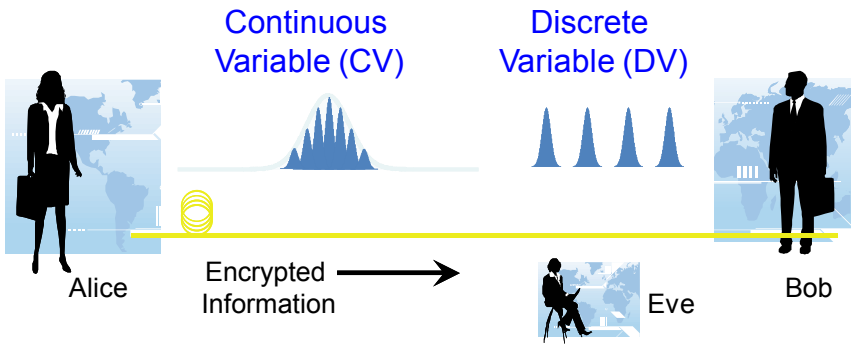
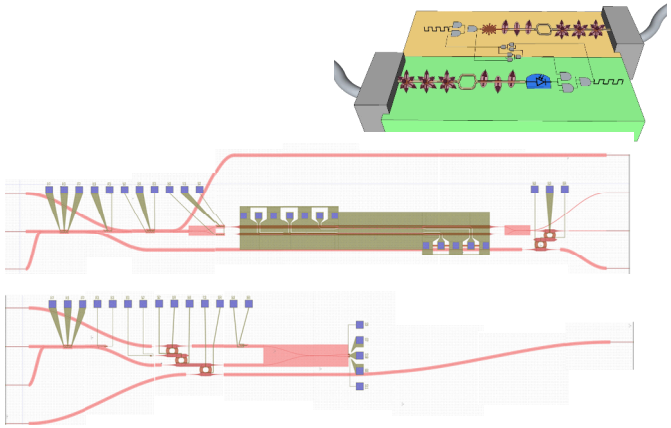
Improving Quantum Key Distribution

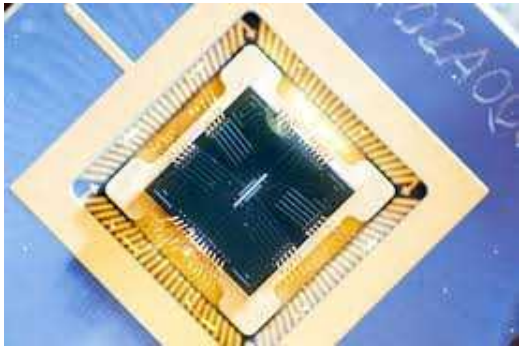




Transmitter design

Receiver design

Building components for future quantum computing platforms



Sandia on-chip ion trap

- Assembling well-characterized qubits
- Fault tolerance
- Control of quantum systems