Automatic Verification of Network Access Control Policy Implementations

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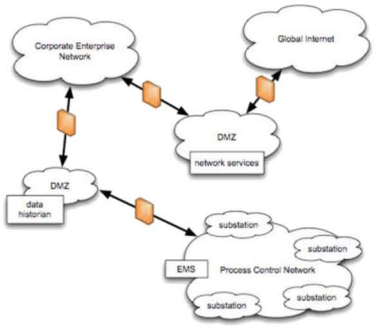
Goals

- Develop a highly usable, scalable, and effective tool for analyzing security policy implementation for conformance with global security policy specification for industrial control networks.
- Provide comprehensive analysis of compliance to make sure all access control mechanisms work collectively in harmony.

Fundamental Questions/Challenges



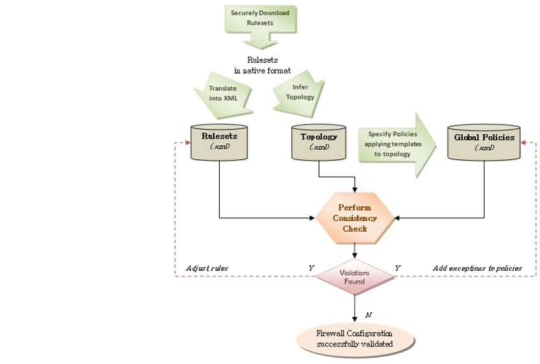
- Incorporate policy rules from a variety of sources.
- Automate and minimize user guidance.
- Ensure scalability with the size and complexity of the networks.
- Provide analytic and empirical demonstrations of efficacy.

Research Plan

- Develop ability to gather rules securely from routers, layer 3 switches, firewalls (e.g., Cisco PIX, Checkpoint, SonicWall, Juniper, Fortinet, Ruggedcom), and hosts (Windows, Linux) in control network and supporting enterprise.
- Develop algorithms for inferring the network topology from analysis of the configuration of various layer 3 devices.
- Optimize algorithms and supporting data structures for analyzing all accesses for compliance with global system security specification.
- Design a sophisticated, but easy-to-use, graphical front-end tailored for investigating networks.
- Provide analytic proofs for time and space complexity of the various algorithms (analysis and topology inference), and completeness of topology inference algorithms.
- Automatically generate random representative process control networks (and supporting enterprise networks) based on salient characteristics of observed real industrial control networks, and use them to study tool performance.

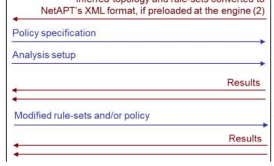
Research Results

- NetAPT has been implemented and released to select industry partners for evaluation.



Graphical Front-end

- Written in Java
- A lightweight and highly portable management console that can be run from any workstation
- Visualizes and customizes network topology, rule-sets, policies, and analysis setup and results

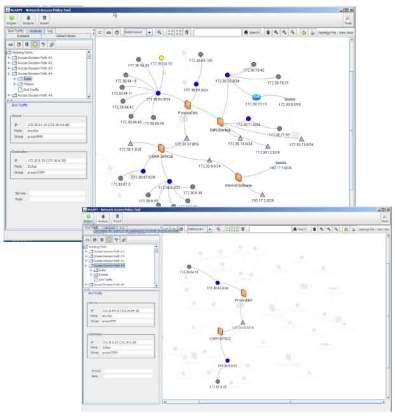


Analysis Engine

- Written in C++
- Runs on Mac OS X, Linux, and Windows
- Can be run on a powerful server
- Uses captured system state (firewall configs) to
  - infer network topology
  - generate connectivity map
  - find exceptions to global policy

NetAPT used for internal audit at major utility:

- Analyzed network with almost 100 firewalls and thousands of hosts.
- Helped produce comprehensive, highly visual reports to prove compliance with NERC CIP standards.
- Identified exceptions in firewall configurations that required policy review or changes.



Broader Impact

- In addition to industrial control networks, the techniques developed can be used for corporate, campus, and other enterprise networks.

Technology Transfer

- A contract from DHS S&T supports commercialization of NetAPT, and a company has been formed to license and support it.