AdSec: A System for Adaptive Network Security

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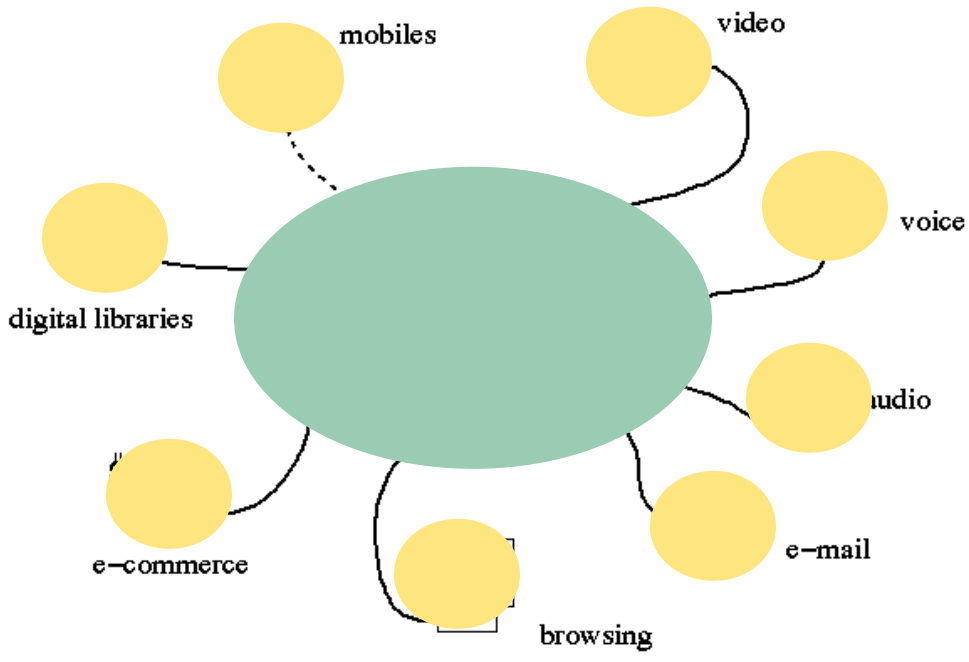
Motivation

- Network environment → Secure QoS



Motivation (cont.)

Goal Facilitate *Secure QoS*

- User plane protection
- Control plane protection
- Minimal footprint

Technical Challenges

- Integrate QoS & security architectures
- Minimize security footprint
- Fault-tolerance
- Programmability
- Interoperability

Approach

- User plane protection: end-to-end
  - Security services: confidentiality, integrity, authentication, access control
  - Property of cryptographic protocols

$\rightarrow$ well-understood

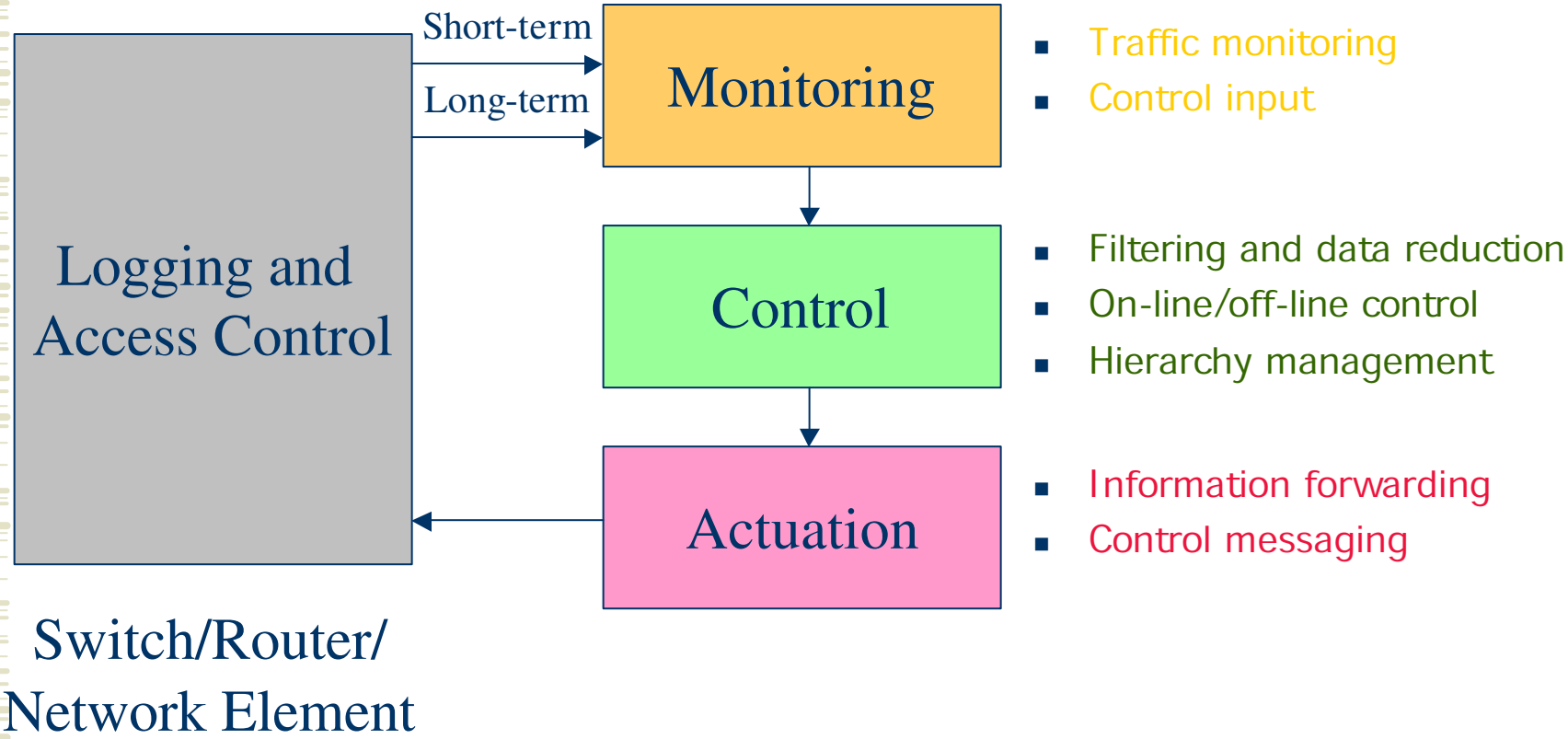
Approach (cont.)

- Control plane protection
  - Proactive: authentication/integrity of certain signalling
  - Reactive:
    - too costly to make 100% proactive (e.g., Gbps switching)
    - security-QoS trade-off
    - selective, controlled introduction of "security holes"
    - reactive management

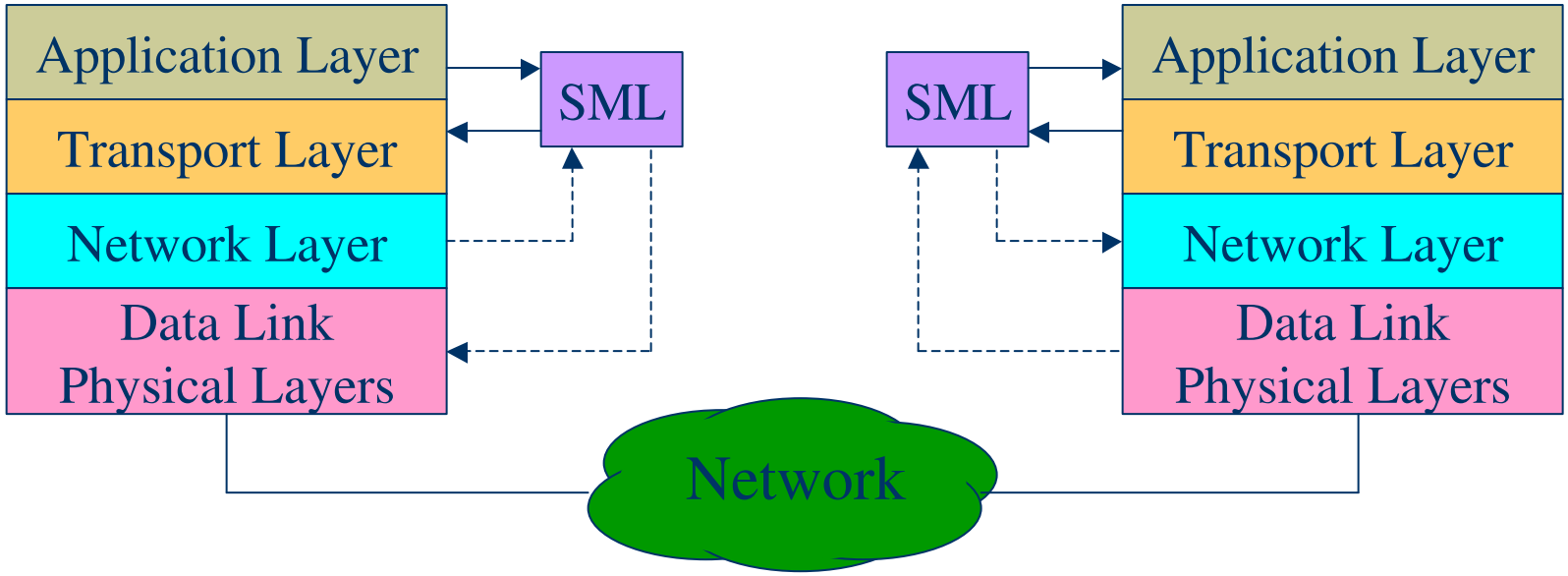
Approach (cont.)

- Adaptive security
  - Combination of proactive/reactive rendering of security services
  - Multiple levels of service
  - Monitoring, control, and actuation
  - Active resource management: control/scheduling
  - Deterrent effect

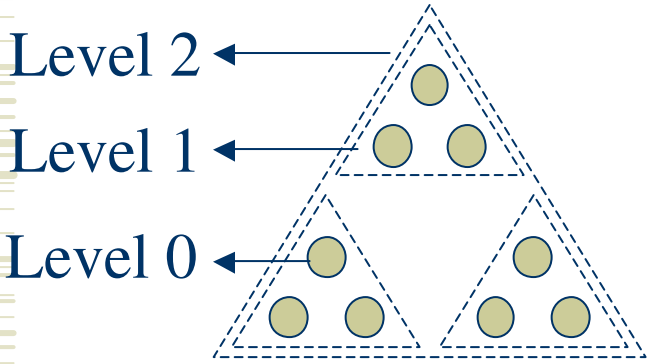
Adaptive Security Architecture

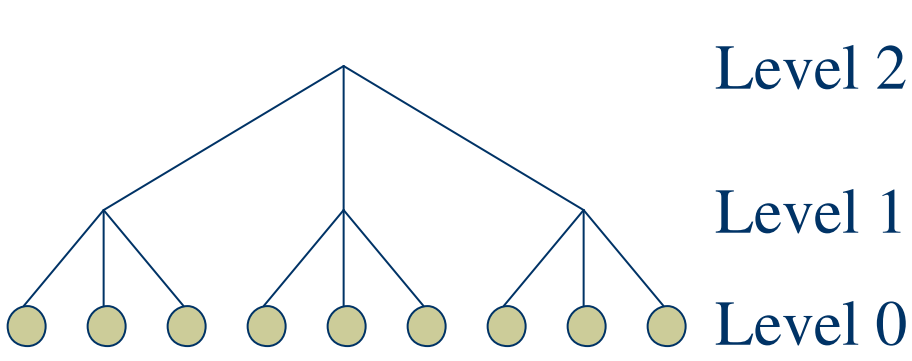


Security Middleware Layer



Monitoring & Control Hierarchy





- Hierarchical structure for resiliency and scalablity
- Byzantine agreement protocols (2/3 majority) for isolating compromised nodes

Overview of AdSec

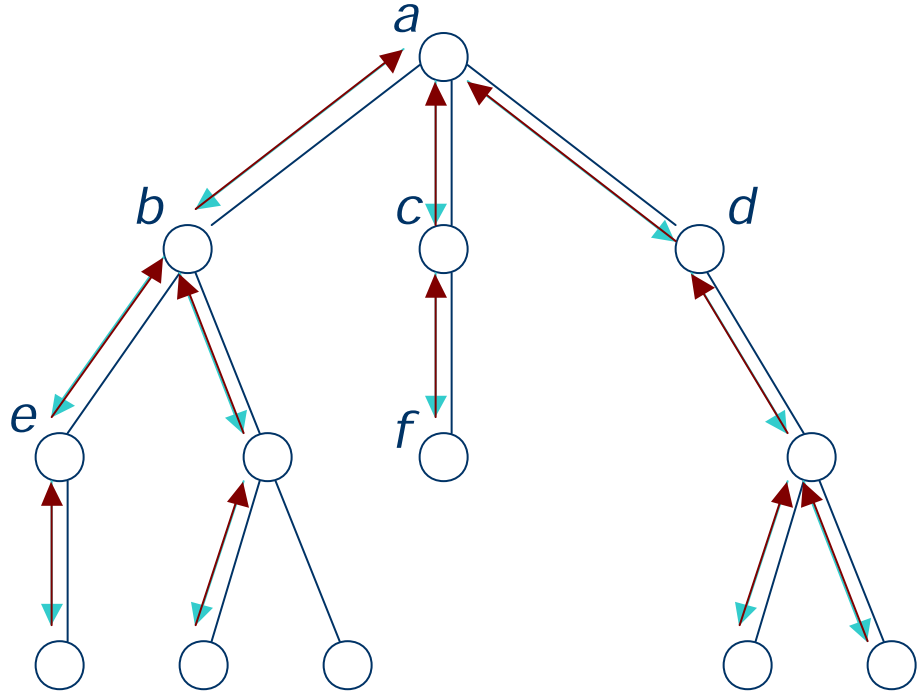
Function: Programmable network management system for adaptive network security

- Implementation of any logical hierarchy
- Monitoring, control, and actuation
- SNMP based
- User programmable

AdSec: Components

- MIB Dependency Relation (MDR) → config.
- Managers → snmpd
- Agents
- Monitor function → wrapper
- Control function → wrapper
- System libraries

MIB Dependency Relation



SNMP SET

SNMP GET

Monitor & Control Functions

- Monitor function *F* : SNMP GET
- Control function *G* : SNMP SET

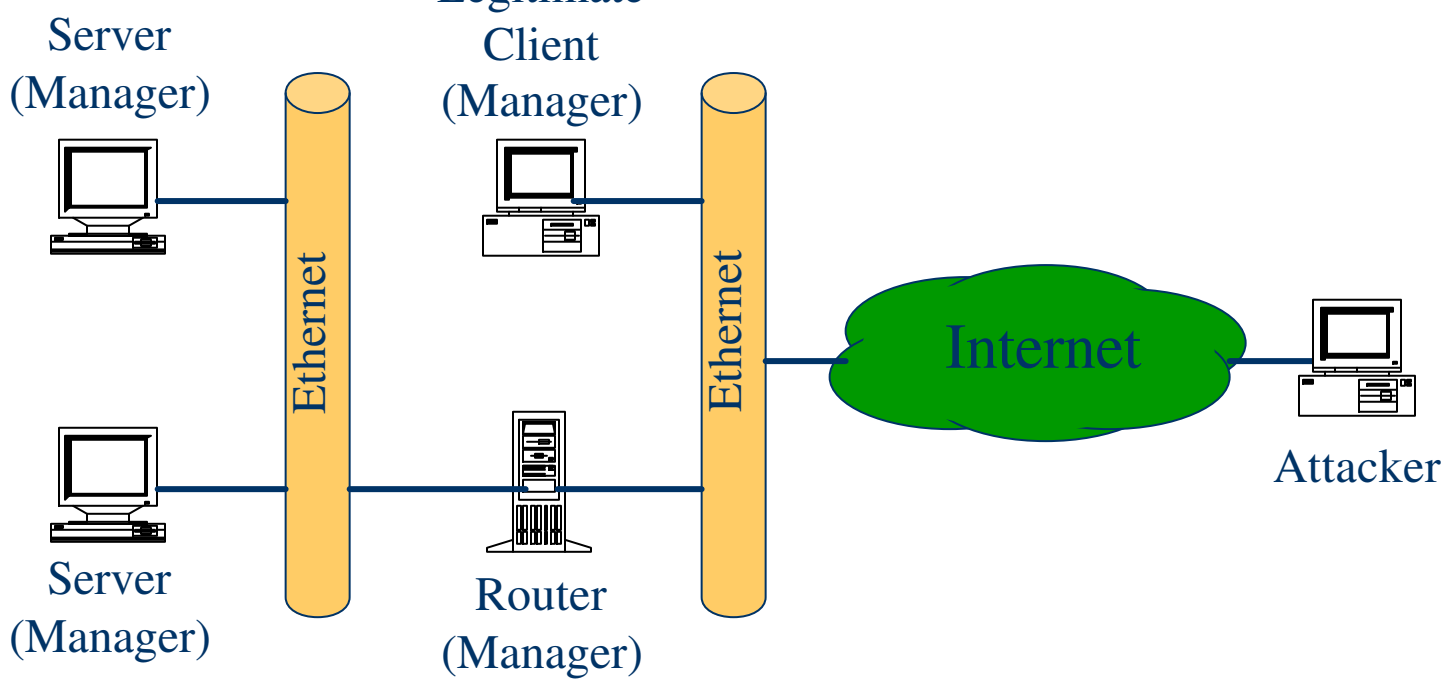
→ user programmable

- Function wrappers
- Transparent read/write
  - local vs. remote MIB
  - OID ↔ (IP, Port) → physical mapping

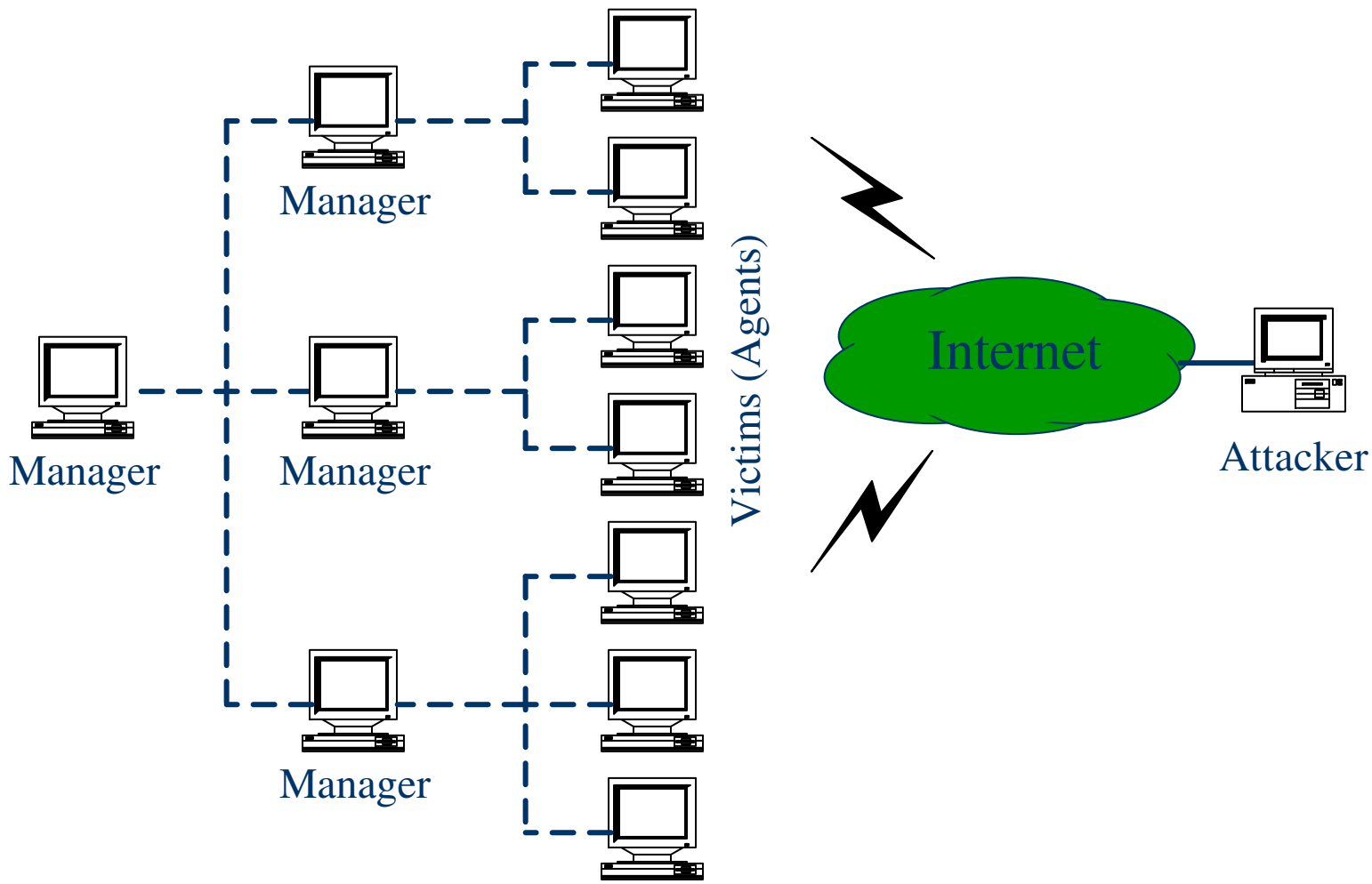
AdSec: Implementation Details

- Prototype system – SNMP version 1
- UC Davis **snmpd** implementation
  - Others (e.g., Sun Microsystems) possible
- CMU SNMP library
- Functions:
  - Intrusion detection
  - Anomaly detection
  - Automatic control

Benchmark: Set-up A



Benchmark: Set-up B



On-going & Future Work

- Asynchronous extension: SNMP Trap
- Extensive monitor/control function libraries
- Integration with network management
- Active resource scheduling
- Integration with QoS management