COSC 301
Network Management & Security

Lecture 19: Management Tools and Protocols

What is Network Management?

Monitoring, testing, configuring, and trouble-shooting network components to meet a set of requirements defined by an organization.

These requirements include the smooth, efficient, operation of the network that provides the predefined quality of service to users.

ITS Service Outage

Why we Manage?

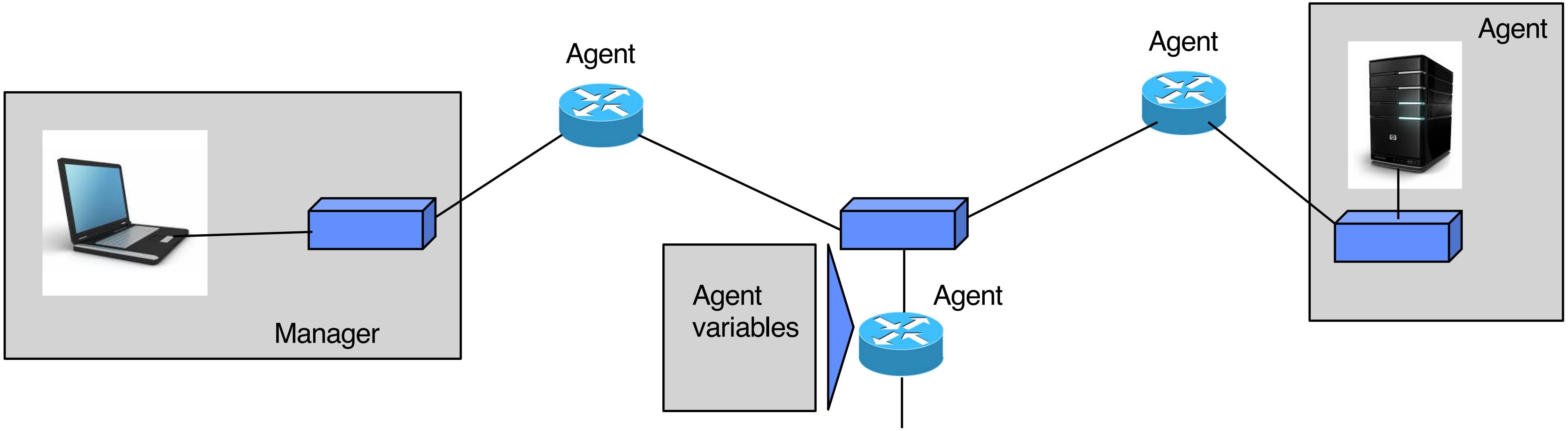
- Early Warning
  - Aim to preempt causes of downtime
  - Imminent failure: changes in rate of errors
- Planning
  - Trend analysis & capacity planning
  - Daily, weekly, yearly graphs.
  - Statistical tools
- Monitoring
  - Improve visibility of the network
  - Better alerting, anomaly detection

Areas of Network Management

- Configuration Management
  - Reconfiguration and documentation
  - Hardware, software, user-account
- Fault Management
  - Reactive: detect, isolate, correct, and record
  - Proactive: tries to avoid faults from happening
- Performance Management
  - Capacity, traffic, throughput, and response time
- Security Management
- Accounting Management
  - Control user's access to network resources through charges

SNMP (1)

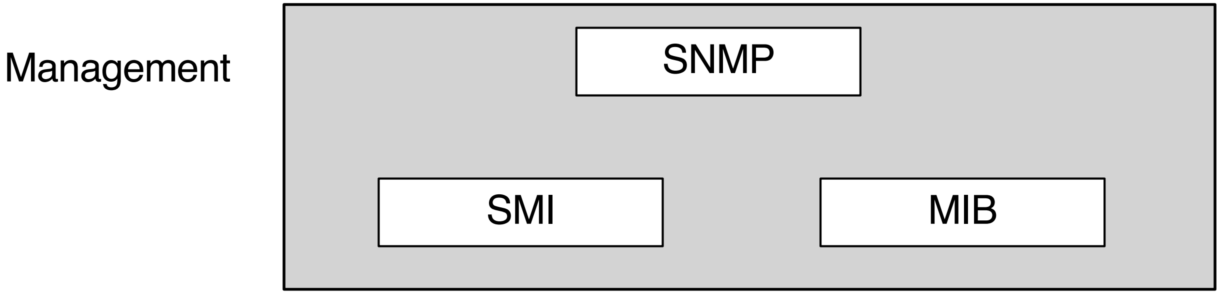
- Simple Network Management Protocol
  - A framework for managing devices in an internet using the TCP/IP protocol suite
  - Provides a set of fundamental operations for monitoring and maintaining an internet
  - Use the concept of manager and agent
    - Agent: a managed station (router or host) that runs SNMP server program
    - Manager: a host that runs the SNMP client program



SNMP (2)

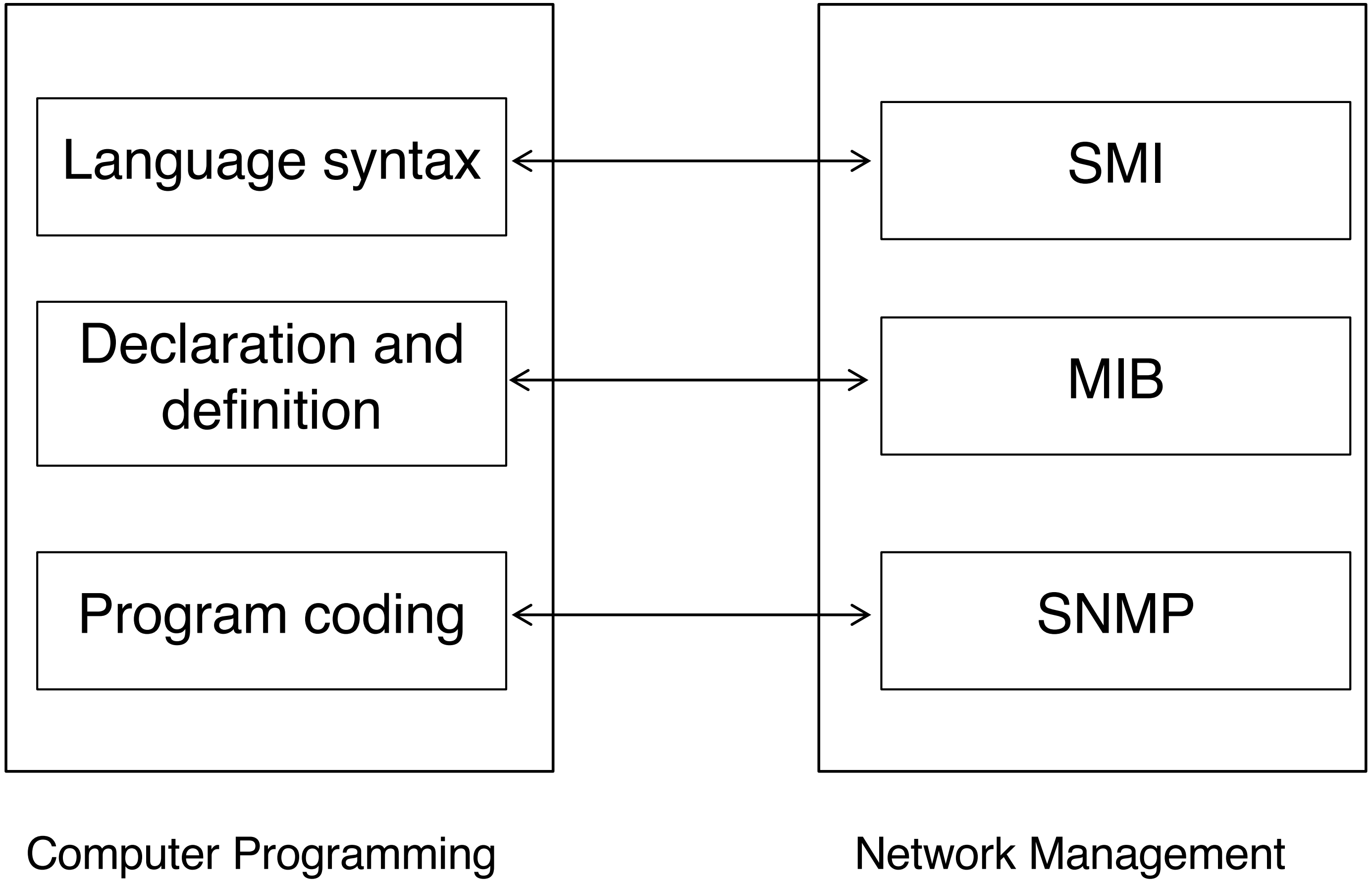
- Basic ideas for management with SNMP
  - SNMP is a “client pull” model
    - Each agent (server) keeps performance information in a database.
    - A manager (client) “pulls” data from the agent
    - A manager forces an agent to perform a task by resetting values in the agent database
  - SNMP is a “server push” model
    - An agent (server) “pushes” out a trap message to the manager process (client) by warning the manager of an unusual situation

Management Components



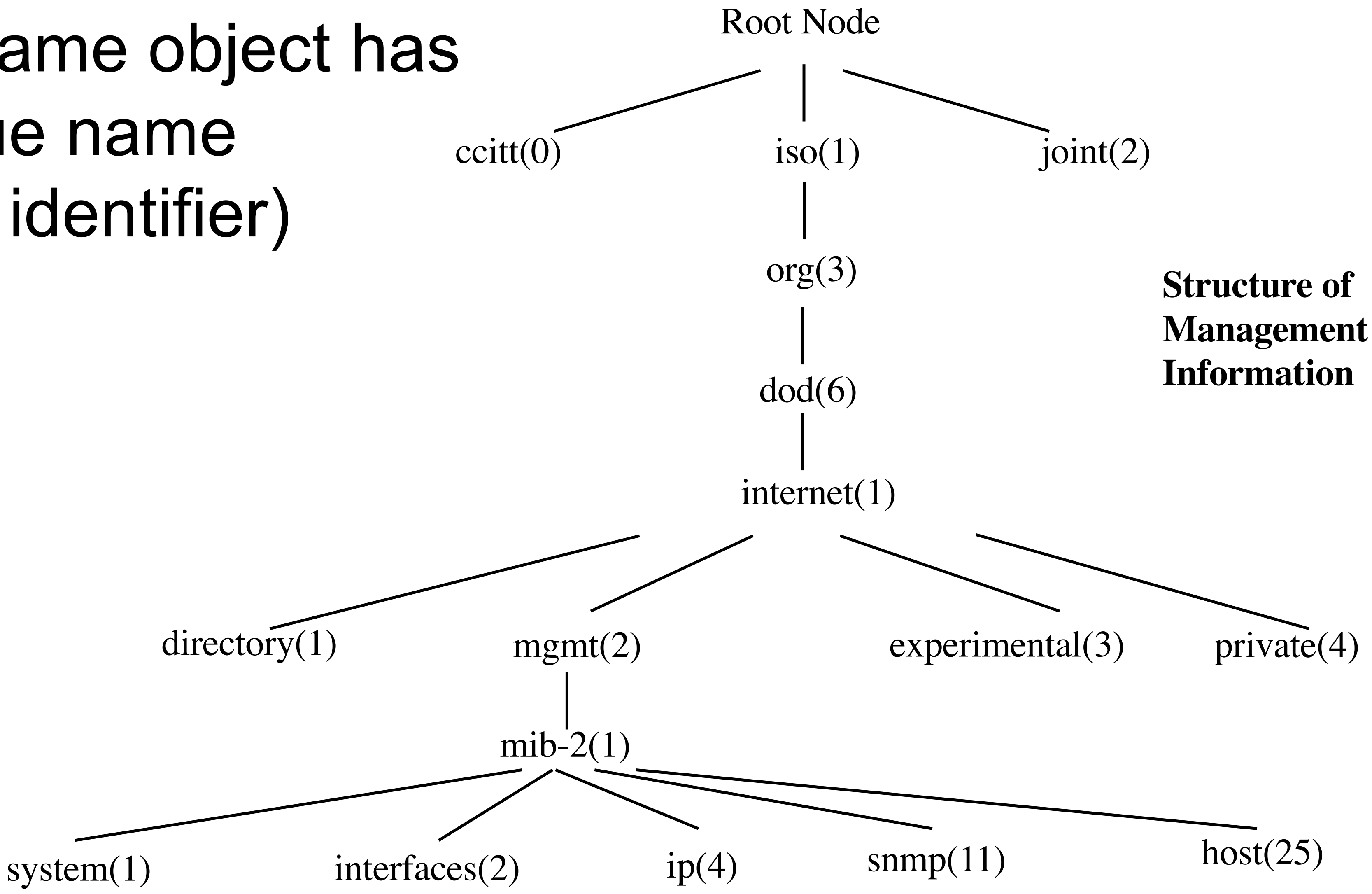
- SMI (Structure of Management Information)
  - Defines rules for naming objects, defining object types, and showing how to encode objects and values
- MIB (Management Information Base)
  - Creates a collection of named objects, their types, and their relationship to each other
- SNMP
  - Defines the format of packets exchanged between a manager and an agent
  - It reads and changes the status of objects in SNMP packets

An Analogy


Language syntax
Declaration and definition
Program coding
SMI
MIB
SNMP
Computer Programming
Network Management

SMI Tree

- Each name object has a unique name (object identifier)



Structure of Management Information

Tree Pointing (OIDs)

- Each object can be defined using a sequence of integers separated by dots (used in SNMP)
- Each object can also be defined using a sequence of textual names separated by dots (used by people)

iso.org.dod.internet.mgmt.mib-2 <--> 1.3.6.1.2.1

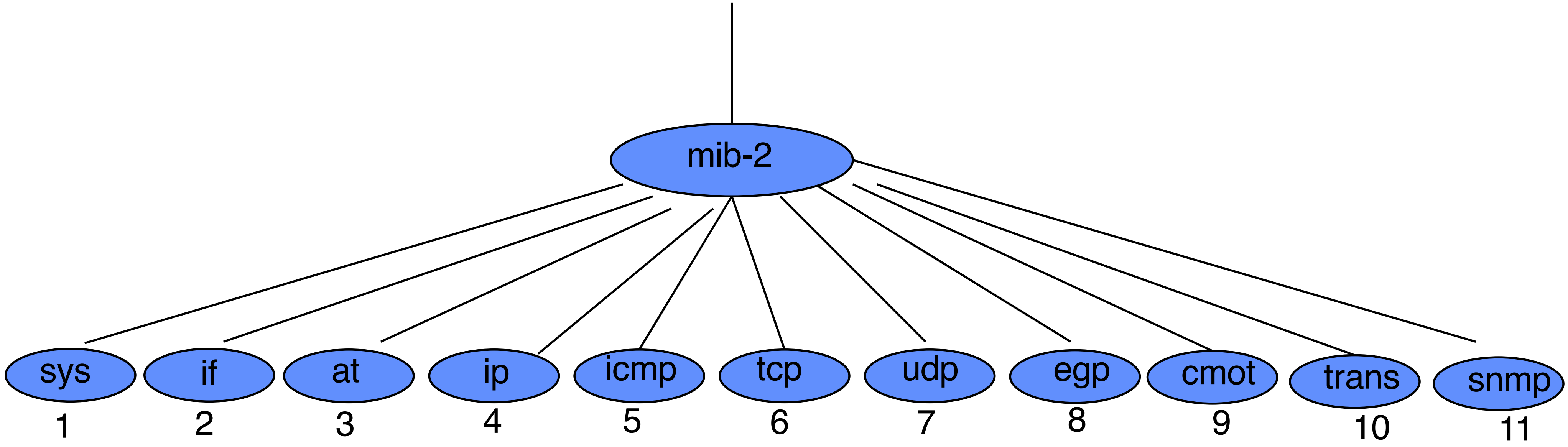
- The objects that are used in SNMP are located under the mib-2 object. So their identifiers always start with 1.3.6.1.2.1

Object Data Types

- Simple data types
  - INTEGER, OCTET STRING, IPAddress, Counter32, TimeTicks, …
- Structured type
  - **Sequence**: a combination of simple data types, not necessarily of the same type, Similar to a struct in C.
  - **Sequence of**: a combination of simple data types all of the same type or a combination of sequence data types all of the same type. Similar to an array in C.

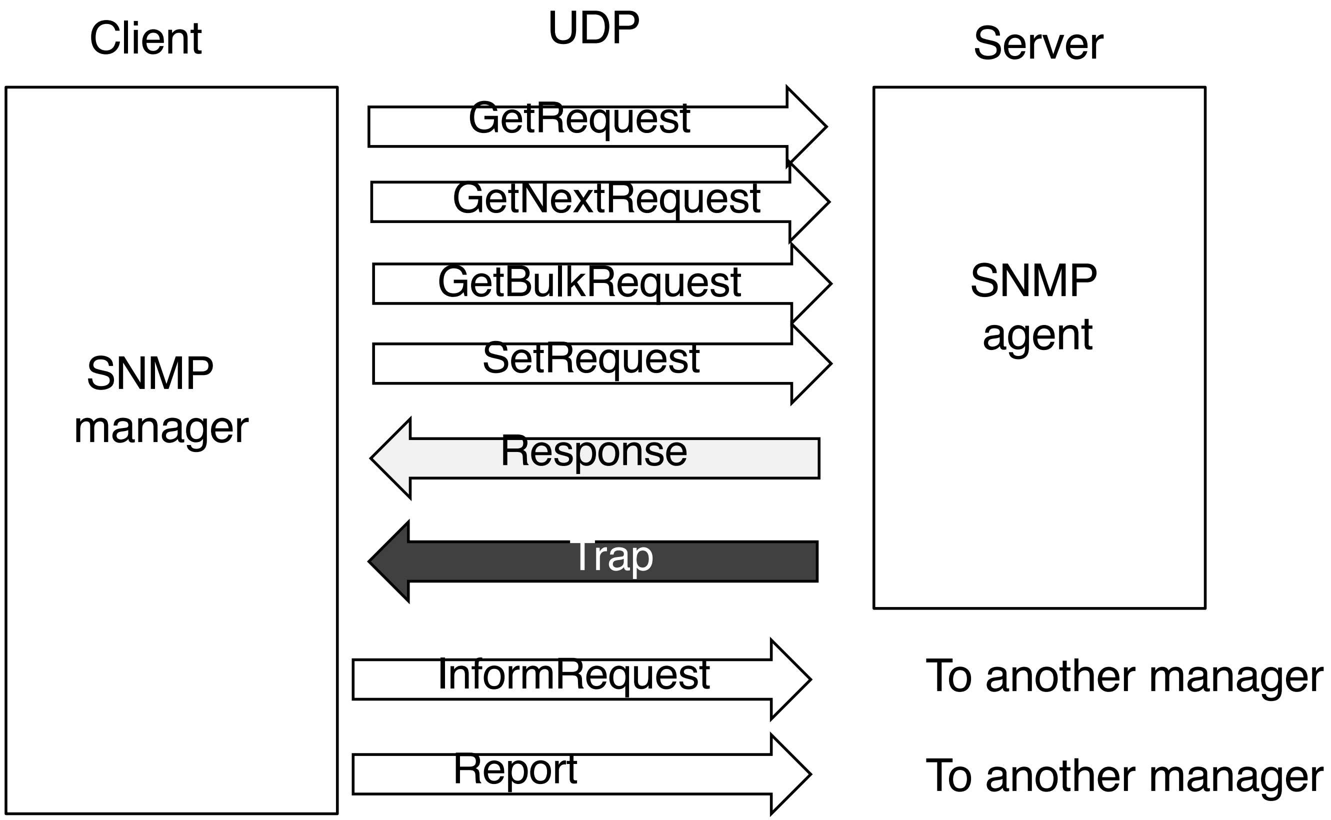
MIB

- Each agent has its own MIB, which is a collection of all the objects that the manager can manage
- The objects in MIB are categorized into several groups



SNMP

- Uses both SMI and MIB
- Uses UDP protocol on port 161 (agent) and port 162 (manager)
- Defines eight types of protocol data units

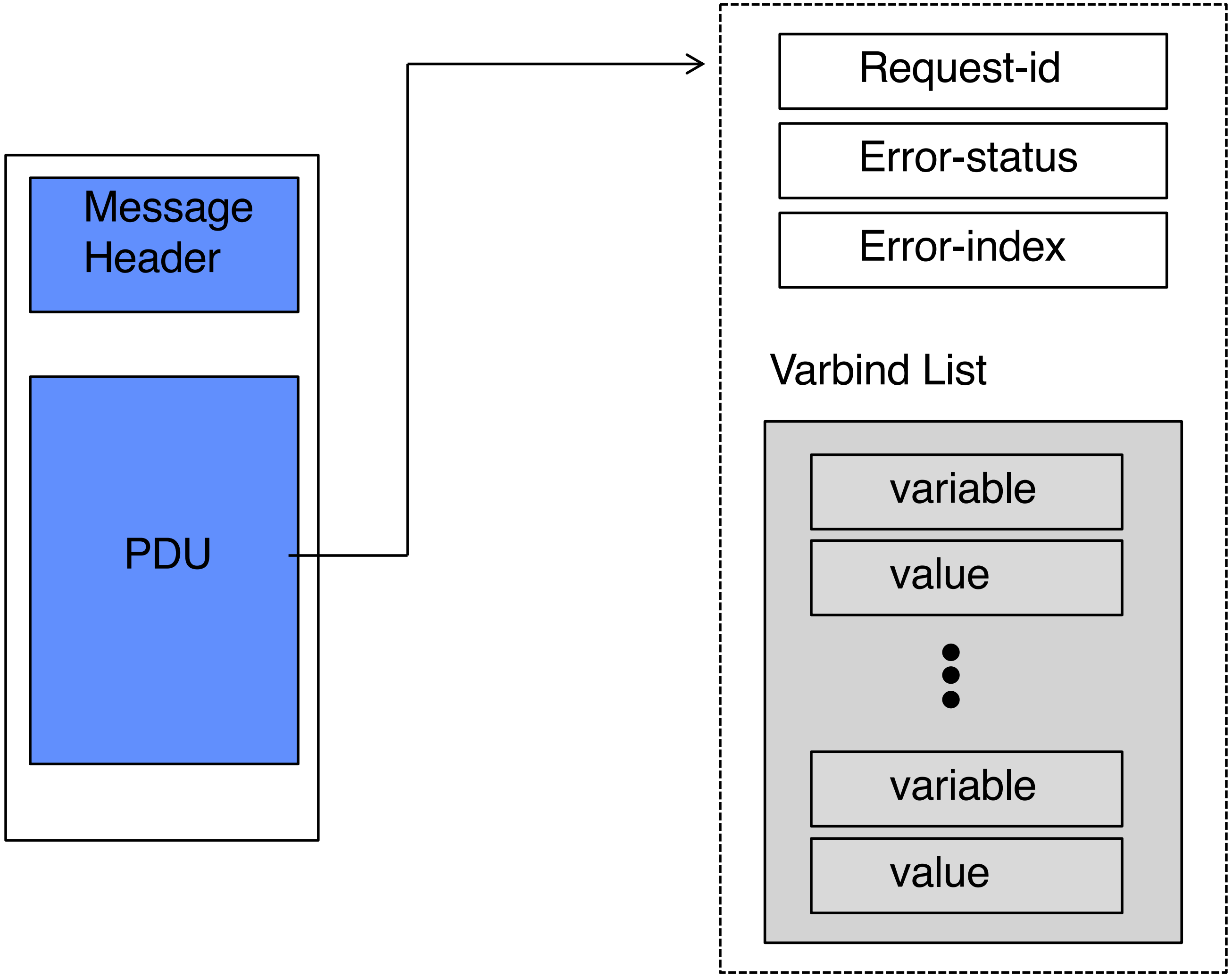


Trap

- Asynchronous notification from agent to network management station
  - When an interface changes state (up/down/testing)
  - Some threshold is exceeded (e.g error rate)
  - Authentication failure

Can we trust SNMP Trap?

SNMP Message



SNMP Versions

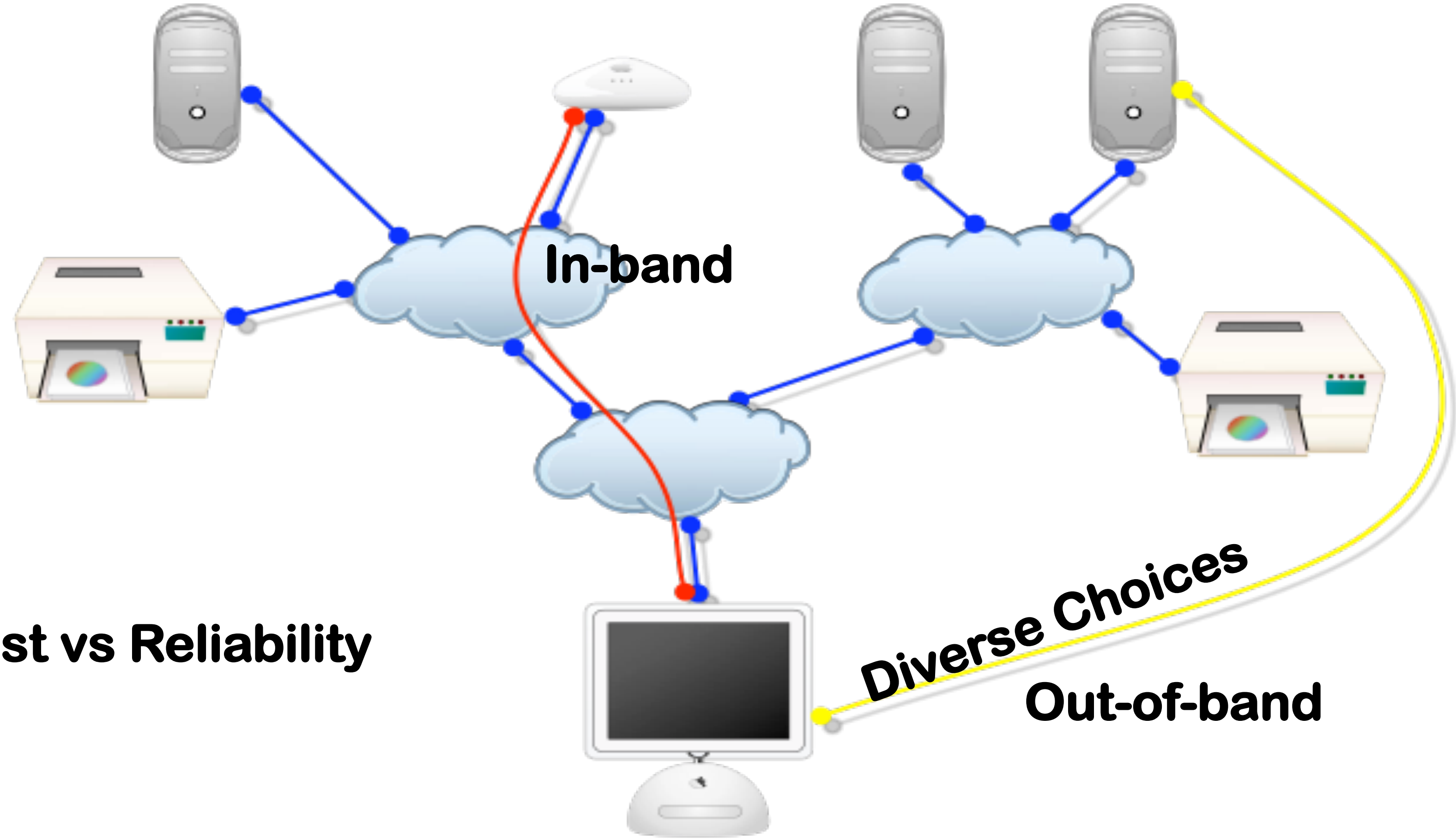
- Version 1
  - Very simple
  - No encryption.
- Version 2
  - Introduced bulk operations
  - Still no encryption
- Version 3
  - No changes to the protocol
  - Primarily added security and remote configuration enhancements
    - Changed architecture to user/view based access control with payload encryption.

Monitoring Architecture

- In-band or Out-of-band?
  - *Failover?* Use in-band
  - *Remote admin needs?* Use out-of-band

- Single or Distributed NMS?
  - Distributed can be useful when you have caretaker IT support outside of normal business hours.

In-band vs. Out-of-band



In-band

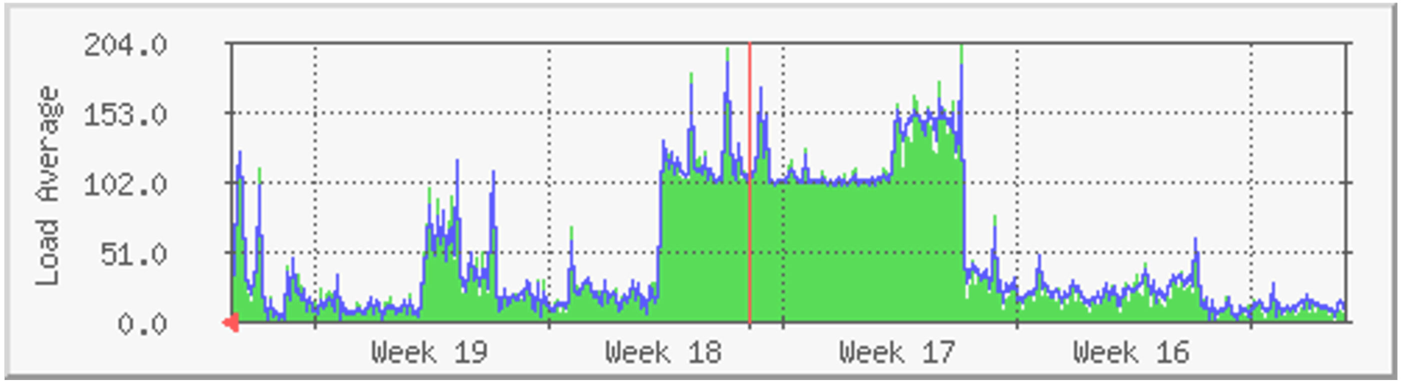
Cost vs Reliability

Diverse Choices

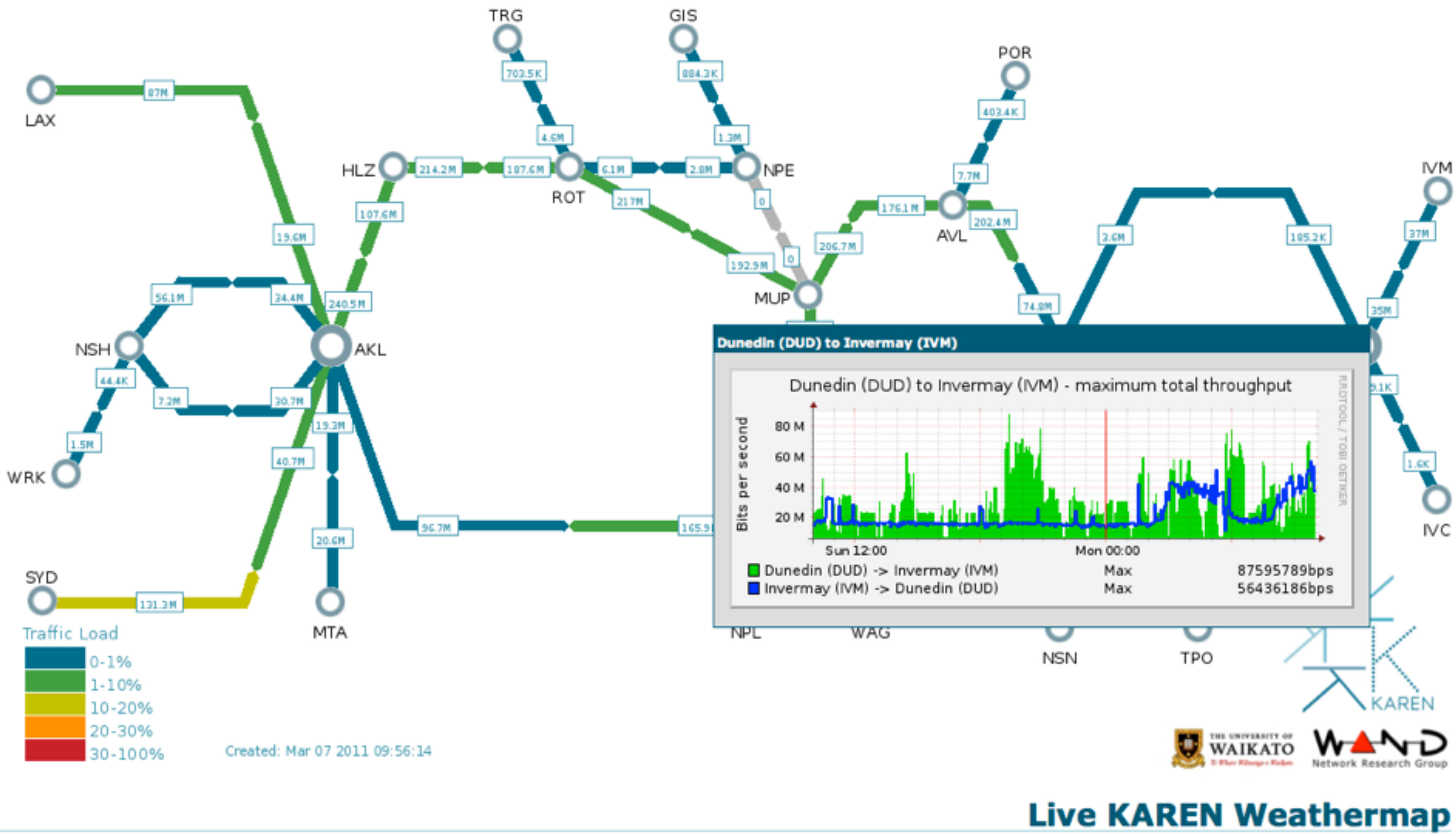
Out-of-band

NMS Applications

- NMS Suites
  - mapping, database storage, pager alerts, extensibility, trend analysis
- Element managers
  - generally configuration software that comes with the device, e.g. network printer admin utility
- Trend analysis
  - graphs, forecasting, weather maps



Example (PHP Weathermap)



Summary

- What is network management?
- Reasons to manage network
- SNMP
  - Ideas
  - Components
  - Architecture
- Applications of network management system