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# Introduction to Network Monitoring and Management

UNIVERSITY OF OREGON



NSRC
Network Startup Resource Center

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# Objectives

**Introducing Core Concepts and Terminology**

- The NOC: Consolidating Systems
- Network Monitoring and Management
- What and Why we Monitor
- Uptime Expectations and Calculations
- Baseline Performance and Attack Detection
- What and Why we Manage
- Network Monitoring and Management Tools
- Network Monitoring and Management 2.0

# NOC: Consolidating NMM

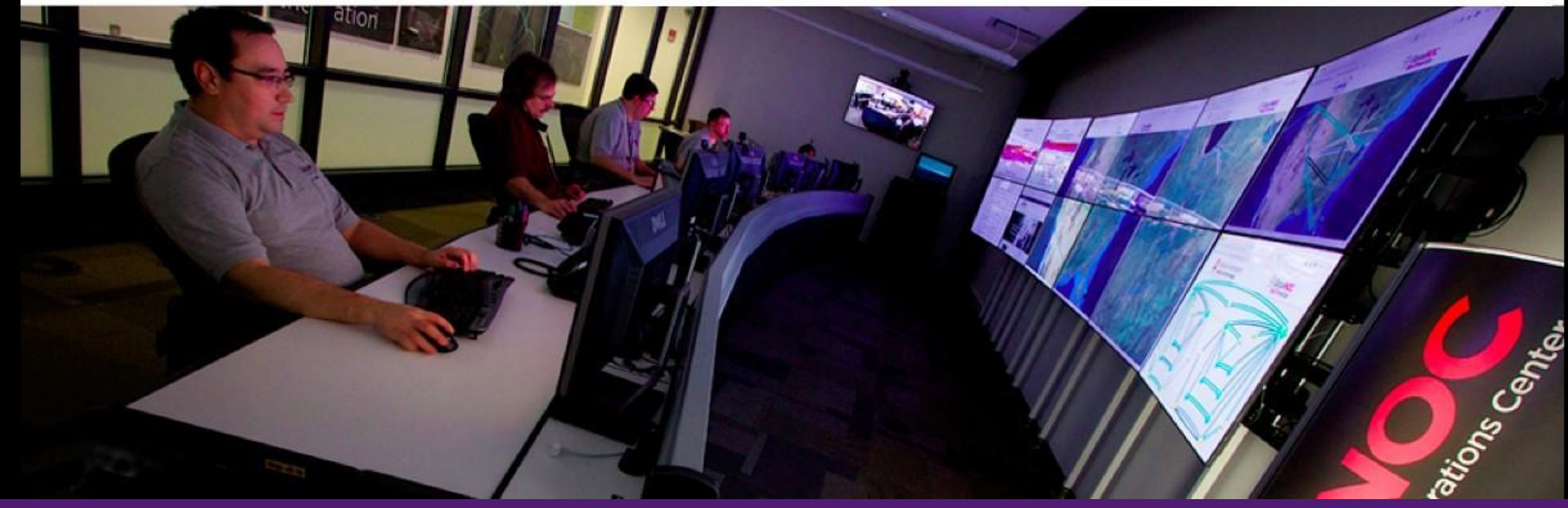
**NOC = Network Operations Center**

- Coordination of tasks, handling of network related incidents (ticketing system)
- Status of network and services (monitoring tools)
- Where the tools are accessed
- Store of Documentation (wiki, database, repository ==> network documentation tool(s))

# NOC: Consolidating NMM

## NOC Location

- NOC is an organizational concept
- Does not need to be a place, or even a single server
- Remote / Distributed NOC is valid with OOB Management(remotely controlling & managing critical IT assets & network equipment securely)


VOC

# Network Monitoring & Management

## Monitoring

## Monitoring

- Check the status of a network

## Management

- Processes for successfully operating a network

# Monitoring Systems & Services

## Systems

Routers
Switches
Servers
APs

## Services

DNS
HTTP/s
SMTP
SNMP
ICMP

# What and Why we Monitor?

- Are Systems and Services Reachable?
- Are they Available?
- What's their Utilisation?
- What's their Performance
- Round-trip times, throughput
- Faults and Outages
- Have they been Configured or Changed?
- Are they under Attack?

# What and Why we Monitor?

- Know when there are problems – before our customers!
- Track resource utilisation, and bill our customers
- To Deliver on Service Level Agreements (SLAs)
  - What does management expect?
  - What do customers expect?
  - What does the rest of the Internet expect?
- To prove we're delivering
  - Have we achieved Five Nines? 99.999%
- To ensure we meet SLAs in the future

# Uptime Expectations

- What does it take to deliver 99.9% uptime?
  - Only 44 minutes of downtime a month!
- Need to shut down one hour a week?
  - That's only 99.4% uptime ((732-4)/732 = .9945355...)
- Maintenance might be negotiated in SLAs
- What does it mean that the network is up?
  - Does it work at every location? Every host?
  - Is the network up if it works at the Boss's desk?
  - Should the network be reachable from the Internet?

# Establish a Baseline

- **Monitoring** can be used to **Establish a Baseline**

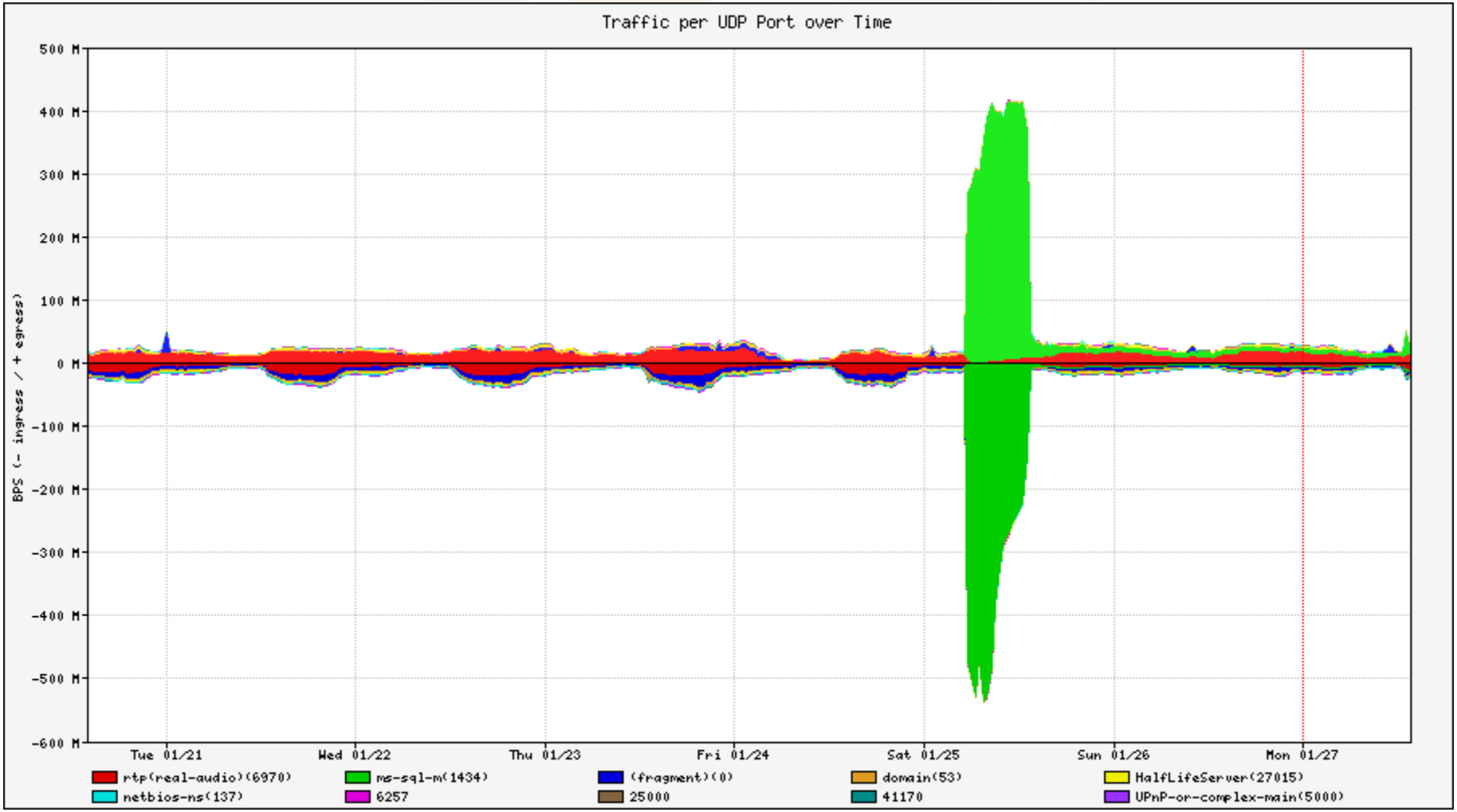
**Baseline** = What's normal for your network?

- Typical latency across paths
- Jitter across paths
- Load on links
- Percent Resource Utilisation
- Typical amounts of noise
  - Network scans & random attacks from the Internet
  - Dropped packets
  - Reported errors or failures

# Detecting Attacks

- Deviation from baseline can mean an attack
- Are there more flows than usual?
- Is the load higher on some servers or services?
- Have there been multiple service failures?

# Example of Anomaly-Based DDoS Detection Using NetFlow and Arbor Networks



# What do we Manage?

- Asset management: What equipment have we deployed?
  - What software is it running
  - What's its configuration (hardware & software)
  - Where is it installed
  - Do we have spares?
- Incident management: fault tracking and resolution
- Change management: Are we satisfying user requests?
  - Installing, moving, adding, or changing things
- Staff management

# Why do we Manage?

- To ensure we meet business requirements for service level, incident response times etc.
- To make efficient use of our resources (including staff)
- To learn from problems and make improvements to reduce future problems
- To plan for upgrades, and make purchasing decisions with sufficient lead time

# Network Monitoring Tools

- **Availability**: Nagios
  - for servers, services, routers, switches, environment
- **Reliability**: Smokeping
  - connection health, rtt, service response time, jitter
- **Performance**: LibreNMS
  - traffic, port utilisation, cpu, RAM, disk, processes

# Network Management Tools

- **Ticket Systems**: RT
  - Manage provisioning & support
- **Configuration Management**: RANCID, Oxidized
  - Track router configurations
- **Network Documentation**: Netdot, Netbox, GLPI
  - Inventory, Location, Ownership of Network Assets

# Other great alternatives*

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| NET MANAGEMENT | NETFLOW / IPFIX / SFLOW | LOGS / SIEM | DOCUMENTATION |
|---|---|---|---|
| Cacti | ElastiFlow | Beats | diagrams.net |
| LibreNMS | Filebeat | Elasticsearch | GLPI |
| Nagios/Icinga | NfSen | Fluentd/fluent-bit | InvenTree |
| Netdata | ntop | Loki | IPplan |
| OpenNMS | pmacct | OSSEC/Wazuh | Netbox |
| Prometheus | **SECURITY / NIDS** | Sagan | Netdisco |
| Sensu | Nessus | **TICKETING** | phpIPAM |
| Zabbix | Prelude | OSticket | Snipe-IT |
| **PERFORMANCE** | Snort | OTRS | **CHANGE MGMT** |
| perfSONAR | Suricata | RT | Oxidized |
| Smokeping | Zeek | Trac | RANCID |

# What about "NMM 2.0?"

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**Older practices:**

- Classic polling model using snmp, service query or pings
- Coarse data collection (5 minute intervals typically)

**Newer practices include:**

- "Streaming Telemetry" (network data)
- Pull methodology using http(s), agent-based or map to snmp
- Time series databases (large) often NoSQL based
- Collectors and parsers using metrics, gauges and counters

# What about "NMM 2.0?"

Some tools you may have heard mentioned:

- ELK, TICK, Kafka, Prometheus Stacks
- Grafana, InfluxDB, MongoDB
- Beats, Elasticsearch, fluentd, Kibana, Loki, etc...

**Don't go all at once! Start Small & Scale**

# NMM Review

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- Network Monitoring & Management
- What & Why we Monitor
- Uptime Expectations & Calculations
- Baseline Performance & Attack Detection
- Network Attack Detection
- •What & Why we Manage
- •Network Monitoring & Management Tools•The NOC: Consolidating Systems•NMM 2.0

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# Q & A

# Acknowledgments & Partners

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# THANK YOU

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