

Introduction to Network Monitoring and Management

Network Startup Resource Center

www.ws.nsrc.org



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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 Systems

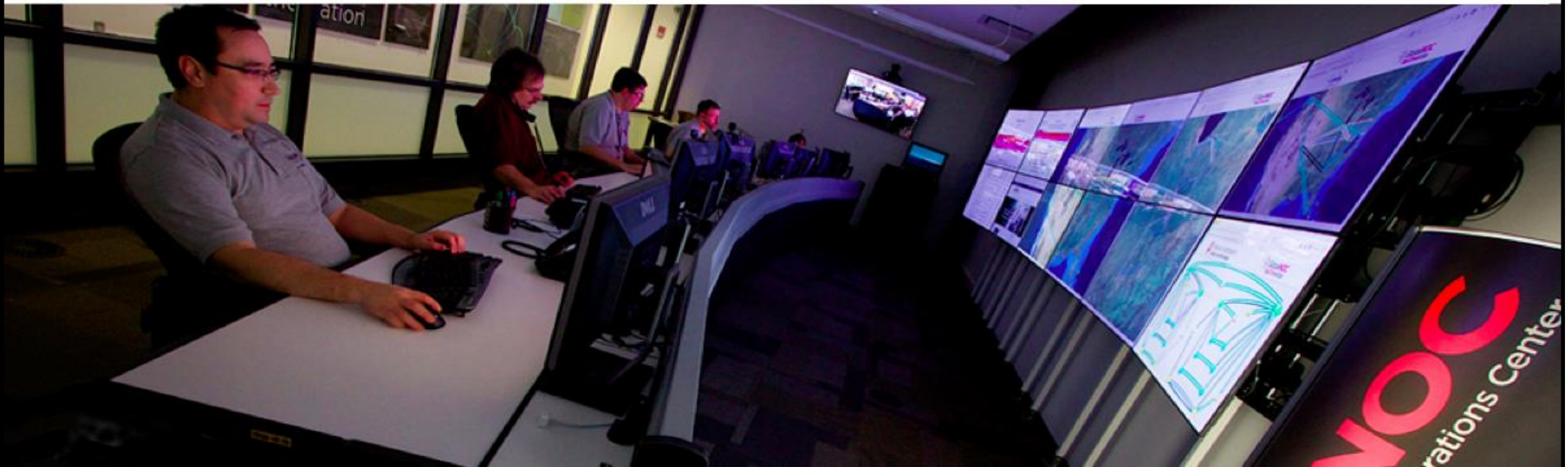
NOC = Network Operations Center

- 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 Systems

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



Network Monitoring & Management

Monitoring

- Check the status of a network

Management

- Processes for successfully operating a network

Monitoring Systems & Services

Systems

- Routers
- Switches
- Servers

Services

- DNS
- HTTP
- SMTP
- SNMP



What and why do 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 do 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
 - Is our network about to fail? Become congested?

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 $((732-4)/732 = .9945355\dots)$
- 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?

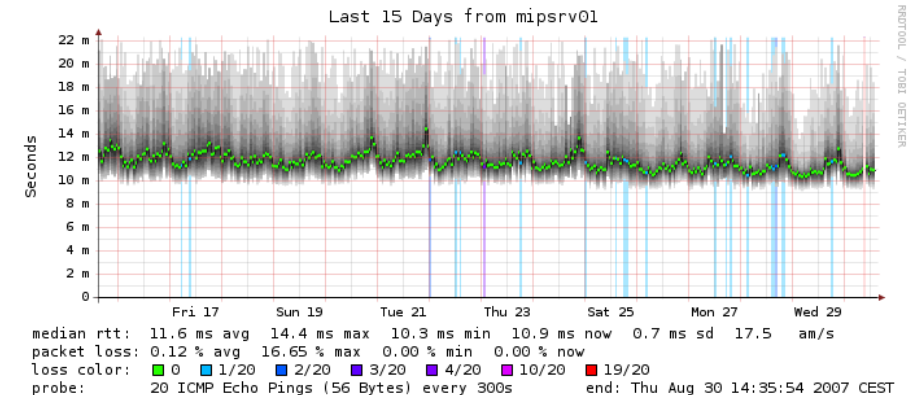


Establishing a Baseline

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

Baseline = What's normal for your network?

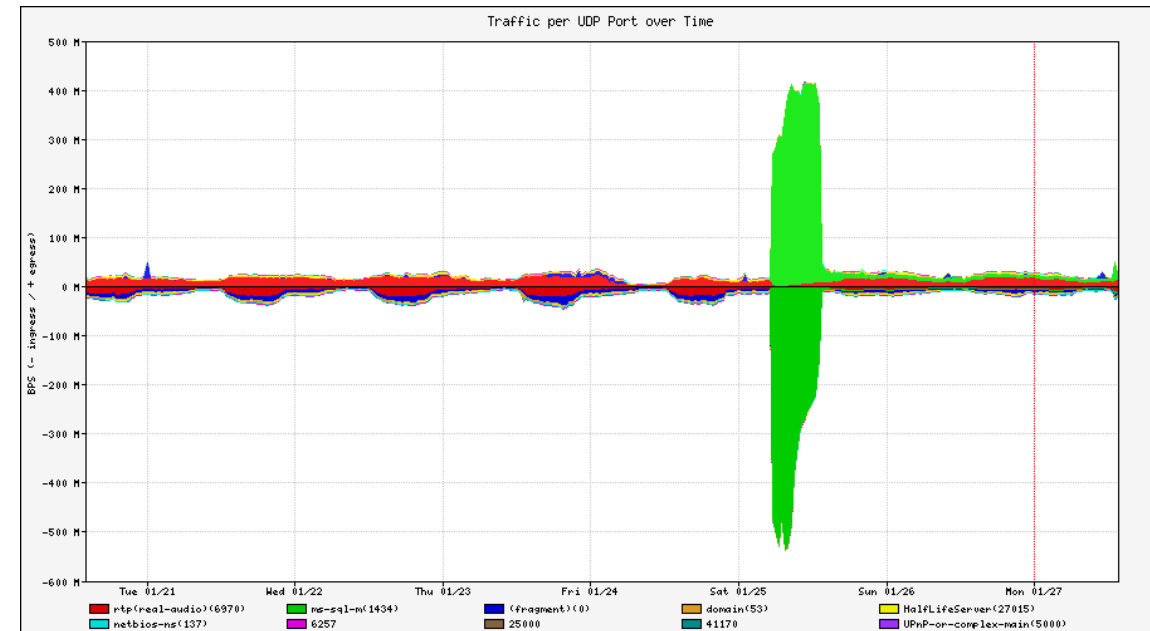
- Typical latency across paths
- **Jitter across paths**
- Load on links
- Percent Resource Utilisation
- Typical amounts of noise
 - Network scans & random attacks from the Internet
 - Dropped packets
 - Reported errors or failures



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



https://www.cisco.com/c/en/us/products/collateral/routers/1900-series-integrated-services-routers-isr/white_paper_c11_556320.html

These things could mean an attack



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

Integration & overlap exists between these programs!

**Each tool noted is just one example of several available tools*

Network Management Tools*

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

Integration & overlap exists between these programs!

**Each tool noted is just one example of several available tools*



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?”

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

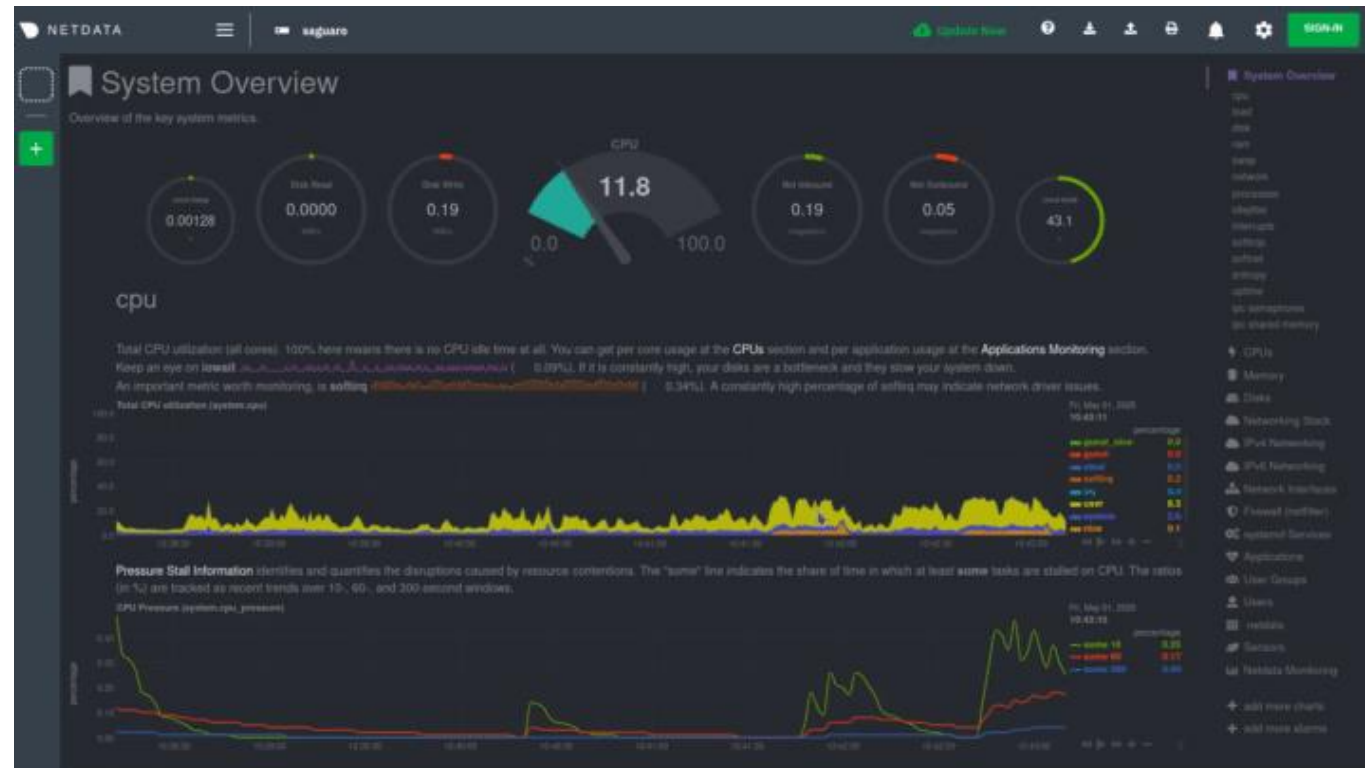
Some tools you may have heard mentioned:

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

One example in use

Netdata

- <https://github.com/netdata/netdata/wiki>
- Real-time, fine-grained, detailed host monitoring.
- <http://www.ws.nsrc.org:19999/>
- Don't all go at once! 😊





logstash



elasticsearch

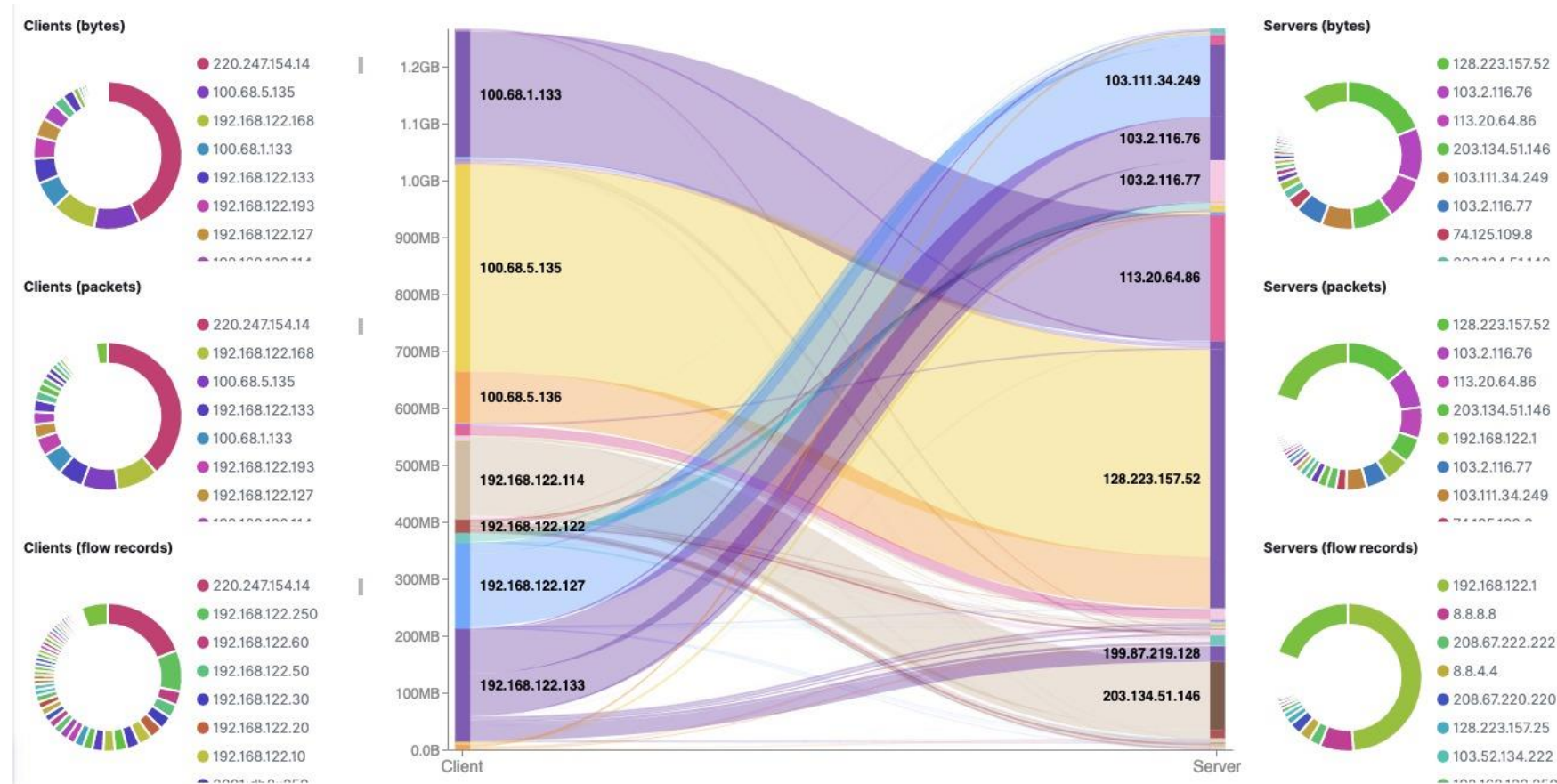


kibana

NMM 2.0: **ElastiFlow**

Takes the following flow protocols

- Netflow – IPFix – Sflow
- Instead of NfSen
- <https://github.com/robcowart/elastiflow>



NMM Review

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

Questions?



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