Network Monitoring and Management

Introduction to Networking Monitoring and Management

Part I: Overview

Core concepts presented:

- What is network monitoring
- What is network management
- Getting started
- Why network management
- The big three
- Attack detection
- Documentation
- Consolidating the data
- The big picture

Network Management Details

We Monitor

- **System & Services**
  - Available, reachable
- **Resources**
  - Expansion planning, maintain availability
- **Performance**
  - Round-trip-time, throughput
- **Changes and configurations**
  - Documentation, revision control, logging

Network Management Details

We Keep Track Of

- **Statistics**
  - For purposes of accounting and metering
- **Faults (Intrusion Detection)**
  - Detection of issues,
  - Troubleshooting issues and tracking their history

- Ticketing systems are good at this
  - Help Desks are a good place to create, update, troubleshoot and resolve issues between your staff and end-users using a ticketing system.

Expectations

A network in operation needs to be monitored in order to:

- Deliver projected *SLAs (Service Level Agreements)*
- SLAs depend on policy
  - What does your management expect?
  - What do your users expect?
  - What do your customers expect?
  - What does the rest of the Internet expect?
- What's good enough? 99.999% Uptime?
  - There's no such thing as 100% uptime (as we'll see) →

“Uptime” Expectations

What does it take to deliver 99.9 % uptime?

30.5 days x 24 hours = 732 hours a month

(732– (732 x .999)) x 60 = 44 minutes

only 44 minutes of downtime a month!

Need to shutdown 1 hour / week?

(732 – 4) / 732x 100 = 99.4 %

Remember to take planned maintenance into account in your calculations, and inform your users/customers if they are included/excluded in the SLA

How is availability measured?

In the core? End-to-end? From the Internet?

Baselining

What is normal for your network?

If you've never measured or monitored your network you will need to know things like:

- Typical load on links (➔ Cacti)
- Level of jitter between endpoints (➔ Smokeping)
- Typical percent usage of resources
- Typical amounts of "noise":
  - Network scans
  - Dropped data
  - Reported errors or failures

Why do all this?

Know when to upgrade

- Is your bandwidth usage too high?
- Where is your traffic going?
- Do you need to get a faster line, or more providers?
- Is the equipment too old?

Keep an audit trace of changes

- Record all changes
- Makes it easier to find cause of problems due to upgrades and configuration changes

Maintain history of network operations

- Using a ticket system lets you keep a history of events.
- Allows you to defend yourself and verify what happened

Why network management?

Accounting

- Track usage of resources
- Bill customers according to usage

Know when you have problems

- Stay ahead of your users! Makes you look good.
- Monitoring software can generate tickets and automatically notify staff of issues.

Trends

- All of this information can be used to view trends across your network.
- This is part of baselining, capacity planning and attack detection.

The “Big Three”?

Availability

- Nagios — Services, servers, routers, switches

Reliability

- Smokeping — Connection health, rtt, service response time, latency

Performance

- Cacti — Total traffic, port usage, CPU RAM, Disk, processes

Functional overlap exists between these programs!

Attack Detection

- Trends and automation allow you to know when you are under attack.
- The tools in use can help you to mitigate attacks:
  - Flows across network interfaces
  - Load on specific servers and/or services
  - Multiple service failures

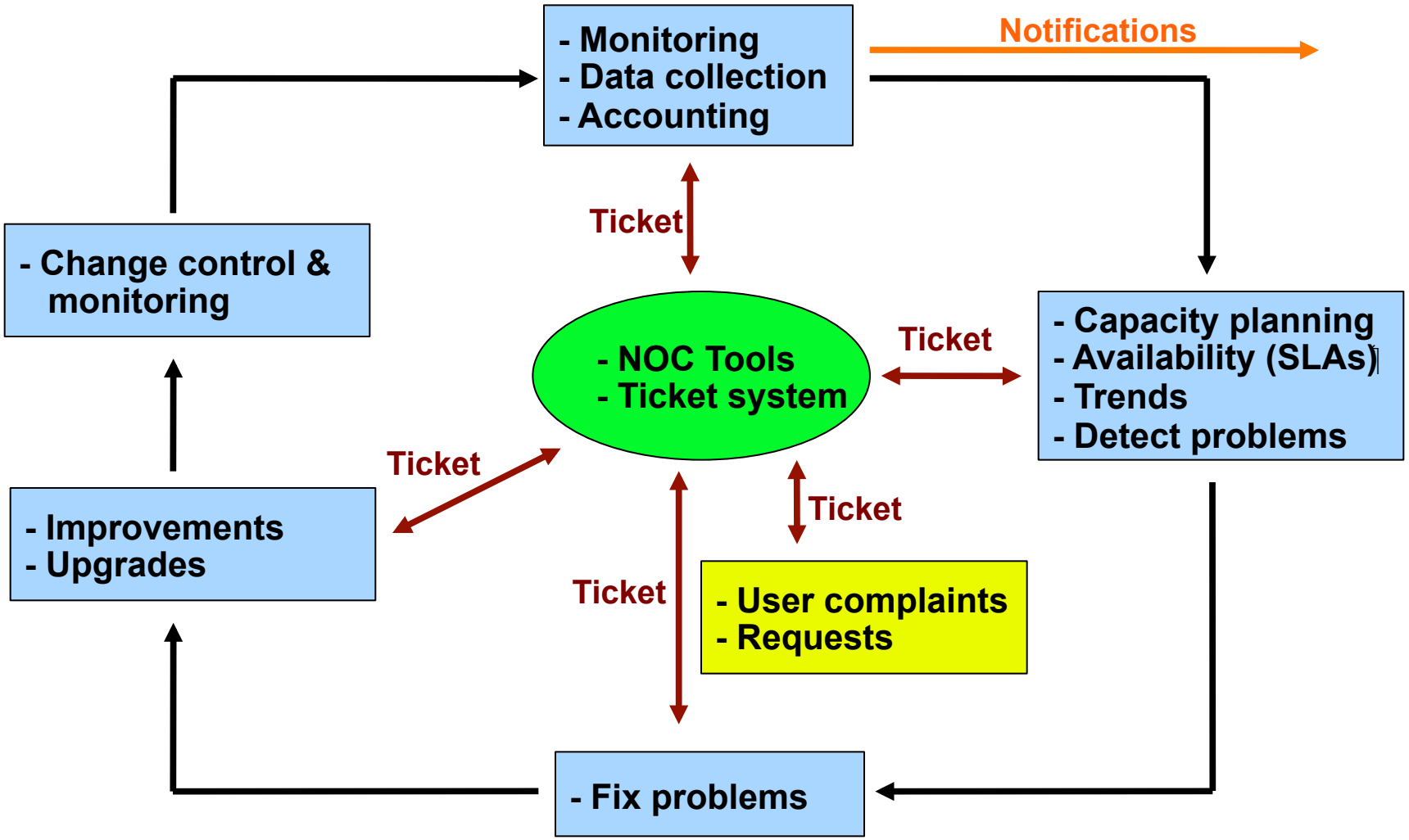
Consolidating the data

The Network Operations Center (NOC)

“Where it all happens”

- Coordination of tasks
- Status of network and services
- Fielding of network-related incidents and complaints
- Where the tools reside (”NOC server”)
- Documentation including:
  - Network diagrams
  - database/flat file of each port on each switch
  - Network description
  - Much more as you'll see.

The big picture



A *few* Open Source solutions…

Performance

- Cricket
- IFPFM
- flowc
- mrtg*
- NetFlow*
- NfSen*
- ntop
- perfSONAR
- pmacct
- RRDtool*
- SmokePing*

Ticketing

- RT*
- Trac*
- Redmine

Change Mgmt

- Mercurial
- Rancid* (routers)
- CVS*
- Subversion*
- git*

Security/NIDS

- Nessus
- OSSEC
- Prelude
- Samhain
- SNORT
- Untangle

Logging

- swatch*
- syslog-ng/rsyslog*
- tenshi*

Net Management

- Big Brother
- Cacti*
- Hyperic
- Munin
- Nagios*
- OpenNMS*
- Observium*
- Sysmon
- Zabbix

Documentation

- IPplan
- Netdisco
- Netdot*
- Rack Table

Protocols/Utilities

- SNMP*, Perl, ping

Questions?

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Part II: Details

Some details on the core concepts:

- Network documentation continued
- Diagnostic tools
- Monitoring tools
- Performance tools
- Active and passive tools
- SNMP
- Ticket systems
- Configuration and change management

Questions?

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Part III: Details

Some details on the core concepts:

- Diagnostic tools
- Monitoring tools
- Performance tools
- Active and passive tools
- SNMP
- Ticket systems
- Configuration and change management

Network monitoring systems & tools

Three kinds of tools

1. **Diagnostic tools** – used to test connectivity, ascertain that a location is reachable, or a device is up – usually active tools

2. **Monitoring tools** – tools running in the background (”daemons” or services), which collect events, but can also initiate their own probes (using diagnostic tools), and recording the output, in a scheduled fashion.

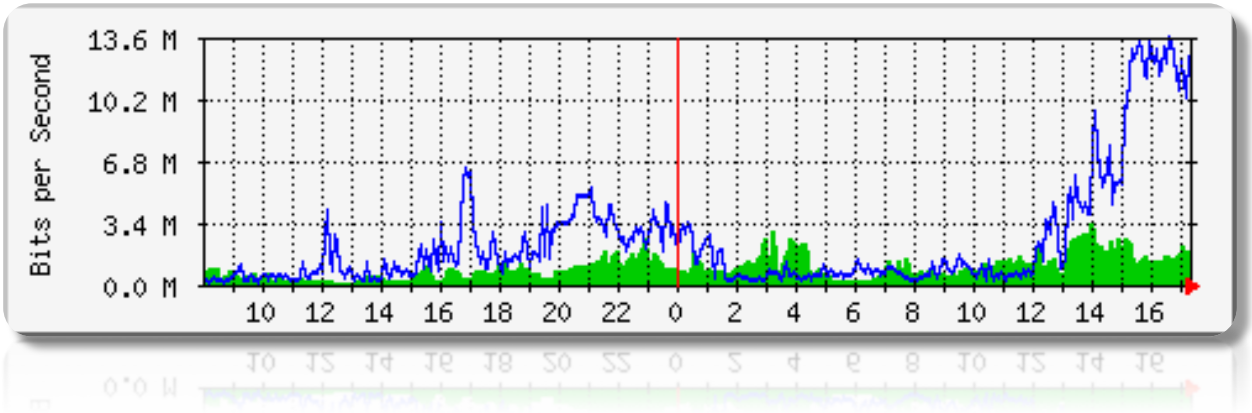
Network monitoring systems & tools

3. Performance Tools

Key is to look at each router interface (probably don't need to look at switch ports).

Two common tools:

- Netflow/NfSen: http://nfsen.sourceforge.net/
- MRTG: http://oss.oetiker.ch/mrtg/



MRTG = "Multi Router Traffic Grapher"

Network monitoring systems & tools

Active tools

- Ping – test connectivity to a host
- Traceroute – show path to a host
- MTR – combination of ping + traceroute
- SNMP collectors (polling)

Passive tools

- log monitoring, SNMP trap receivers, NetFlow

Automated tools

- SmokePing – record and graph latency to a set of hosts, using ICMP (Ping) or other protocols
- MRTG/RRD – record and graph bandwidth usage on a switch port or network link, at regular intervals

Network monitoring systems & tools

Network & Service Monitoring tools

- Nagios – server and service monitor
  - Can monitor pretty much anything
  - HTTP, SMTP, DNS, Disk space, CPU usage, ...
  - Easy to write new plugins (extensions)
- Basic scripting skills are required to develop simple monitoring jobs – Perl, Shell scripts, php, etc...
- Many good Open Source tools
  - Zabbix, ZenOSS, Hyperic, OpenNMS ...

Use them to monitor reachability and latency in your network

- Parent-child dependency mechanisms are very useful!

Network monitoring systems & tools

Monitor your critical Network Services

- DNS/Web/Email
- Radius/LDAP/SQL
- SSH to routers

How will you be notified?

Don't forget log management!

- Every network device (and UNIX and Windows servers as well) can report system events using syslog
- You **MUST collect** and **monitor** your logs!
- Not doing so is one of the most common mistakes when doing network monitoring

Network management protocols

SNMP – Simple Network Management Protocol

- Industry standard, hundreds of tools exist to exploit it
- Present on any decent network equipment
  - ➔ Network throughput, errors, CPU load, temperature, ...
- UNIX and Windows implement this as well
  - ➔ Disk space, running processes, ...

SSH and telnet

- It is also possible to use scripting to automate monitoring of hosts and services

SNMP tools

Net SNMP tool set

- http://net-snmp.sourceforge.net/

Very simple to build simple tools

- One that builds snapshots of which IP is used by which Ethernet address
- Another that builds shapshots of which Ethernet addresses exist on which port on which switch.
- Query remote RAID array for state.
- Query server, switches and routers for temperatures.
- Etc…

Statistics and accounting tools

Traffic accounting and analysis

- What is your network used for, and how much
- Useful for Quality of Service, detecting abuses, and billing (metering)
- Dedicated protocol: NetFlow
- Identify traffic ”flows”: protocol, source, destination, bytes
- Different tools exist to process the information
  - Flowtools, flowc
  - NFSen
  - Many more: http://www.networkuptime.com/tools/netflow/

Fault and problem management

Is the problem transient?

- Overload, temporary resource shortage

Is the problem permanent?

- Equipment failure, link down

How do you detect an error?

- Monitoring!
- Customer complaints

A ticket system is essential

- Open ticket to track an event (planned or failure)
- Define dispatch/escalation rules
  - Who handles the problem?
  - Who gets it next if no one is available?

Ticketing systems

Why are they important?

- Track all events, failures and issues

Focal point for helpdesk communication

Use it to track all communications

- Both internal and external

Events originating from the outside:

- customer complaints

Events originating from the inside:

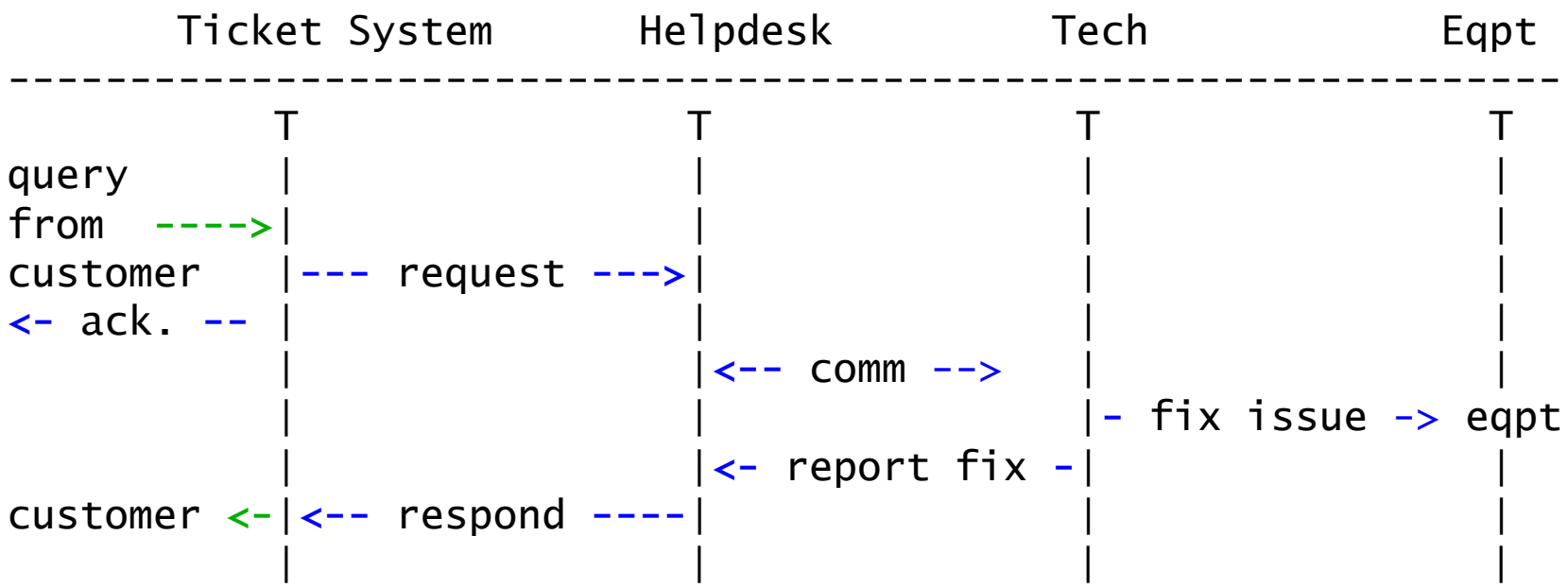
- System outages (direct or indirect)
- Planned maintenances or upgrades – Remember to notify your customers!

Ticketing systems

- Use ticket system to follow each case, including internal communication between technicians
- Each case is assigned a case number
- Each case goes through a similar life cycle:
  - New
  - Open
  - ...
  - Resolved
  - Closed

Ticketing systems

Workflow:



Ticketing systems: examples

rt (request tracker)

- Heavily used worldwide.
- A classic ticketing system that can be customized to your location.
- Somewhat difficult to install and configure.
- Handles large-scale operations.

trac

- A hybrid system that includes a wiki and project management features.
- Ticketing system is not as robust as rt, but works well.
- Often used for ”trac”king group projects.

redmine

- Like trac, but more robust. Harder to install

Network Intrusion Detection Systems (NIDS)

These are systems that observe all of your network traffic and report when it sees specific kinds of problems, such as:

- hosts that are infected or are acting as spamming sources.

A few tools:

- **SNORT** - a commonly used open source tool: http://www.snort.org/
- **Prelude –** Security Information Management System https://dev.prelude-technologies.com/
- **Samhain –** Centralized HIDS http://la-samhna.de/samhain/
- **Nessus** - scan for vulnerabilities: http://www.nessus.org/download/

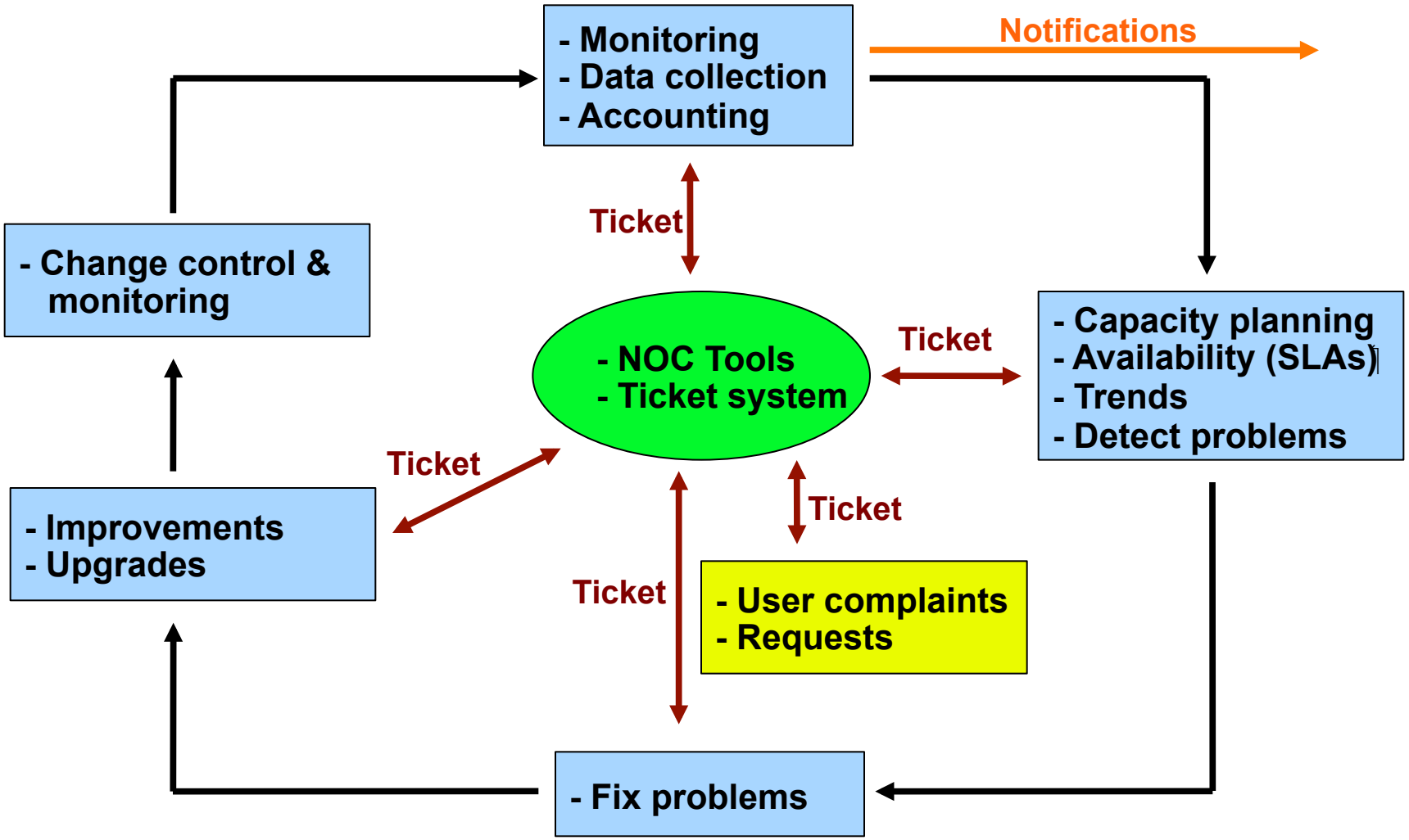
Configuration mgmt & monitoring

- Record changes to equipment configuration using *revision control* (also for configuration files)
- Inventory management (equipment, IPs, interfaces)
- Use versioning control
  - As simple as:
    ”`cp named.conf named.conf.20070827-01`”
- For plain configuration files:
  - **CVS, Subversion (SVN)**
  - **Mercurial**
- For routers:
  - **RANCID**

Configuration mgmt & monitoring

- Traditionally, used for source code (programs)
- Works well for any text-based configuration files
  - Also for binary files, but less easy to see differences
- For network equipment:
  - **RANCID** (Automatic Cisco configuration retrieval and archiving, also for other equipment types)
- Built-in to Project Management Software like:
  - **Trac**
  - **Redmine**
  - And, many other wiki products. Excellent for documenting your network.

The big picture revisited



Questions

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