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Whither Network Automation?

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Network Automation

What is it?

What's the state of the art and practice?

Why is it an important problem?

What are the benefits of network automation?

What are some of the open problems and research opportunities?



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Potential basis for all aspects of network operation

Design

Deployment

Configuration management

Availability monitoring

Performance monitoring

Event tracking & correlation

Capacity planning

Upgrade & expansion



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What is Network Automation?

Philosophy, as much as anything else

- Network as planned entity

- Rather than organically grown entity

Configs generated & distributed automatically

- Network devices (routers, switches, etc.)

- Monitoring systems

...

Policy- and design-driven network expansion



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Comparison to System Administration

Over past 15 years or so, much sysadmin research has focused on automation

Conferences like LISA, SANE, NSDI

Tools like cfengine

Generally accepted that you don't manage 10k (or 100k, or 1k) hosts manually

Instead, you use ideas like templating to manage definitions of hosts

Then use tools like cfengine to instantiate

Networking world seems 10-15 years behind that



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Why does automation for networks lag for systems?

Compared to hosts, network devices are generally

- More specialized in role

- Less standardized in configuration

- Fewer in number

- More varied in configuration paradigms

Which translates to

- Harder to automate (diversity, specialization)

- Less obvious bang for buck (fewer in number)

Strong temptation to “just do it by hand”

- False economy; short term vs. long term



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What about “Network Management”?

Today, most “network management” systems are really just SNMP-based network monitoring systems

They monitor device availability and performance, but don’t actually do anything to the devices they monitor

Term “network management” has been co-opted to mean less than it should



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What should Network Management entail?

Config generation

Config installation/updating

Software/firmware updating

Availability & performance monitoring

Capacity planning

Diagram generation

Ongoing network design



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How is this done today?

By hand, mostly

Most vendors provide “network management” tools which are really “element management” tools

- Only work with that vendor’s gear

- Only install/backup hand-generated configs

- Don’t integrate well with other tools

Some tools automate generation of some parts of config (esp. ACLs), but not all



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What's wrong with network management by hand?

Error-prone

Time-consuming

Gratuitous inconsistency

Requires very expert staff

- Only they can troubleshoot complex problems

 - And more problems are complex

- Distracts them from doing other stuff only they can do, like design/architecture

- Problems when they go on vacation, or leave

Doesn't scale well



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What are the benefits of network automation?

Luke A. Kanies captured benefits well in great essay at <http://www.onlamp.com/pub/a/onlamp/2001/12/20/sysadmin.html>

- 1) Reducing the amount of time a given task requires
- 2) Reducing the opportunity for error in a given task
- 3) Reducing turnaround time for a given task
- 4) Enhancing and perpetuating configuration consistency across multiple systems
- 5) Providing a limited kind of process documentation

Critical if your goal is to offer a reliable service
(increasing MTBF and decreasing MTTR)



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Why is automation hard?

Device function diversity (router, switch, VPN server, firewall, load balancer, ...)

Vendor diversity (Cisco, Juniper, Extreme, ...)

Version diversity, even for single vendor

Config paradigm/model/method diversity

How config is structured, how you interact with it

Most networks grow organically

By the time somebody wants to automate, it's too late, network is too big a mess



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What's the state of the art?

Concept/philosophy not yet well accepted

No comprehensive free systems available

- Some have adapted host-oriented tools: cfengine

- Some domain-specific tools: RANCID, ACL tools

Some commercial systems available

- Opsware (formerly Rendition), others

- None have much market penetration

Most vendors offer element management systems

- Specific to their own products; don't integrate well

Some large operators have built own systems



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What are the challenges to adoption?

Awareness & acceptance

Most networking professionals don't have systems background, & aren't programmers

Practical

How to apply to existing networks

Networks not designed for ease of automation

Lack of tools

Lack of examples



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What tools exist today?

Comprehensive commercial systems
(Opsware, etc.)

- Want everything done “their” way

- Difficult to retrofit to existing networks

 - Work best in “green field” situations

Vendor element management systems

- Specific to that vendor’s equipment

- Tend to be inflexible and of limited functionality

- Difficult to integrate with other systems



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What's wrong with today's tools?

Limited selection

- Not much to choose from

- Often limited to particular vendors (element management) or particular problem domains (firewall ACLs)

Limited functionality

- Don't do what you want

Limited flexibility

- Want everything done "their way"

- Difficult or impossible to retrofit into existing networks



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What's missing?

Standard for describing network topologies

NetML <http://www.dia.uniroma3.it/~compunet/netml/>

Standard method for configuring devices

SNMP is de facto read-only; not useful for read-write

IETF NETCONF working group

<http://ops.ietf.org/netconf/>

Freely available automation framework

Enable experimentation/learning without risking \$\$\$

Tools based on all of these

Config gen/mgmt, monitoring, planning, etc.



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Where can I learn more?

Network-automation mailing list

<http://www.greatcircle.com/network-automation>

Waypoints blog, Network Automation section

http://www.greatcircle.com/blog/network_automation



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