Whither Network Automation?

Brent Chapman
brent@greatcircle.com
Great Circle Associates, Inc.
http://www.greatcircle.com
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?
Potential basis for all aspects of network operation

Design
Deployment
Configuration management
Availability monitoring
Performance monitoring
Event tracking & correlation
Capacity planning
Upgrade & expansion
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
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
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
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.
What should Network Management entail?

- Config generation
- Config installation/updating
- Software/firmware updating
- Availability & performance monitoring
- Capacity planning
- Diagram generation
- Ongoing network design
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
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
What are the benefits of network automation?


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)
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
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
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
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
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
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.
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
Please support disaster relief groups such as Radio Response
http://www.radioresponse.org

These slides will be available at
http://www.greatcircle.com/presentations/

Brent Chapman
brent@greatcircle.com
Great Circle Associates, Inc.
http://www.greatcircle.com