The Robots are Coming!
#include <std/disclaimer.h>

Views my own, not necessarily those of my employer’s!
Act 1

The Robots are Coming!
1991

$27,000 p.a. first full-time salary

vs

$40,000 NMS software
(HP Network Node Manager IIRC)
“Boss, that software is more than what I’m being paid! Pay me that and I’ll do what the software does!”

Boss:

“Trouble is Mark, you won’t work 24x7, you need to eat and sleep, and want to take holidays.”

(or something like that)
IOW, I am **not** a robot.
Robots are ...

much faster

much more accurate

much more consistent

when doing repetitive tasks.
AusNOG 2012

“Google Backbone monitoring. Localizing packet loss in a large complex network” - Google

AusNOG 2015

“ONE - One Network Engineer” - Facebook

AusNOG 2016

“Untrusting the Network” - Facebook
Robot operated networks.
Necessity rather or more than desire, given their scale?
Inevitable

(IMO)
James Douglas Muir Leno (ˈlɛnoʊ; born April 28, 1950)[1] is an American comedian, actor, writer, producer, and television host. After doing stand-up comedy for years, he became the host of NBC's *The Tonight Show with Jay Leno* from 1992 to 2009. Beginning in September 2009, Leno starred a primetime talk show, titled *The Jay Leno Show*, which aired weeknights at 10:00 p.m. ET, also on NBC.

After *The Jay Leno Show* was canceled in January 2010 amid a host controversy, Leno returned to host *The Tonight Show with Jay Leno* on March 1, 2010.[2] He hosted his last episode of *The Tonight Show* on February 6, 2014. That

<table>
<thead>
<tr>
<th>Birth name</th>
<th>James Douglas Muir Leno</th>
</tr>
</thead>
<tbody>
<tr>
<td>Born</td>
<td>April 28, 1950 (age 68)</td>
</tr>
<tr>
<td></td>
<td>New Rochelle, New York, U.S.</td>
</tr>
<tr>
<td>Medium</td>
<td>Stand-up, television, film</td>
</tr>
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<td>Alma mater</td>
<td>Emerson College</td>
</tr>
<tr>
<td>Years active</td>
<td>1976–present</td>
</tr>
<tr>
<td>Genres</td>
<td>Observational comedy, black comedy, surreal humor, sketch comedy, insult comedy, satire</td>
</tr>
</tbody>
</table>
"These things were built when technology was expensive and labour was cheap. Now labour's expensive, and technology is cheap."

- Jay Leno
Technology is used by organisations for 2 reasons ...

To **Save** Money

To **Make** Money
CPU - cheap and plentiful? ✔

RAM - cheap and plentiful? ✔

Network Bandwidth - (pretty) cheap and plentiful? ✔

Humans to operate them - cheap and plentiful (relative)? ✗
“Now labour's expensive, and technology is cheap.”
If Jay, a retired comedian has worked it out,

others will too.
This is why the robots are coming.
Act 2

What you Need to Know to Build Robots
Basic Tools
<scripting/programming languages>
Bourne Shell/Bash
Expect/Tcl (expect)

autoexpect
Python/Go?
Prefer general and common

- Bash/Python/Go -
Specialised tools for specialised jobs

- Expect/Tcl -
<unix utils>
cat /etc/hosts | tr -s " " | cut -d " " -f 2 | sort | uniq
<miscellaneous>
Regular Expressions

> man 7 regex
track and describe, possibly revert, source code changes - git, svn, mercurial -
$ for i in `seq 1 24`; do
> echo "interface Vlan$i";
> echo "no shutdown";
> echo "ip address 10.0.$i.1 255.255.255.0";
> echo "";
> done
interface Vlan1
no shutdown
ip address 10.0.1.1 255.255.255.0

interface Vlan2
no shutdown
ip address 10.0.2.1 255.255.255.0

interface Vlan3
no shutdown
ip address 10.0.3.1 255.255.255.0

...
$ sh -c 'echo -e "conf t\n\n"; for i in `seq 1 24`; do echo -e "interface Vlan$i\nno shutdown\nip address 10.0.$i.1 255.255.255.0\n\n"; done; echo "exit"' > 24vlans-10.0.x.cfg
$
$ cat 24vlans-10.0.x.cfg

conf t

interface Vlan1
no shutdown
ip address 10.0.1.1 255.255.255.0

...
Got RANCID?

$ clogin -x 24vlans-10.x.cfg l3sw1
Rules of Thumb
How do you eat an elephant?

One mouthful at a time.
break into small chunks
usable individually
design to plug together
best chunk choice:

- best faster value -

- best accurate and consistent value -
small benefits multiplied lots =

big benefits
ALL OR NOTHING?

10% automated, 90% manual?

Better Than Nothing!
Build to Leverage

- Build to be reused -

- Build to be an example -
Build a Library
So when?
Repeat same/similar task 5 or more times?

Consider (trivial or not) automation.
Back-of-Envelope Justification
Deploy 400 Routers

Manual Config, OSS Tasks

2 hours per device
manual config generation,
add to NMS,
add to backup system,
add to DNS

400 * 2 hours = 800 Hours.
Deploy 400 Routers

Automation of Config, OSS Tasks

3 weeks to develop and test config generation, add to NMS, backup system and DNS, at 5 hours dev time per day

30 minutes per device do config (manual parameter entry), NMS, DNS, etc.

3 x 25 + 400 * 0.5 hours = 275 Hours.
Deploy 400 Routers

800 hours manual verses 275 hours automated config, NMS, etc.

saving 525 hours or 105 days.

That’s a no brainer!

(And even much, much faster if config parameters come from a database)
Technology is used by organisations for only 2 reasons ...

To Save Money

To Make Money
Careless automation?
Blown up network!
Need to be said?

Use development and test lab (virtualised!)
More Focus on Failure Modes

How to avoid.

How to recover from.
Conservative
Incremental
Increasing Scale
Deployment
Enough to get you started?

Hopefully!
Act 3

“Where’s the driverless car for driving networks?”
“Where’s the driverless car for driving networks?”

SDN?
Software Defined Network?
Defined \(\sim\) Configured
Defined \(\sim\) Orchestrated

Defined \(\equiv\) Driverless Network?
SON?
Software Operated Network
Operated == Self-Managed
Self-Managed

Self-Configuration

Self-Optimisation

Self-Healing

Self-Protection
Autonomic Networking: Definitions and Design Goals

Abstract

Autonomic systems were first described in 2001. The fundamental goal is self-management, including self-configuration, self-optimization, self-healing, and self-protection. This is achieved by an autonomic function having minimal dependencies on human administrators or centralized management systems. It usually implies distribution across network elements.
individual node operated model

fleet of self-managed nodes model
Automatic OSPF ID

OSPF Enabled By Default

IPv6 Link-Local Addressing
OSPF bootstrapped automatically

OSPF discovers topology

OSPF will adapt to link failures
Small leap!
IP networking was initially designed with similar properties in mind. An IP network should be distributed and redundant to withstand outages in any part of the network. Routing protocols such as OSPF and IS-IS exhibit properties of self-management and can thus be considered autonomic in the definition of this document.
Operating the network?

Instructions to the fleet

- An “Intent”
We’re not going to be replaced robots.

We’re going to be their leaders!
Proof is in the pudding?
Autonomic Networking Configuration and Deployment Guide

Contents

Autonomic Networking
Finding Feature Information
Restrictions for Autonomic Networking
An Introduction to Autonomic Networking
The Vision of Autonomic Networking
Autonomic Networking Infrastructure
Deploying Autonomic Networking
Device Support
Deployment Considerations
Q: “Where’s the driverless car for driving networks?”
A: Autonomic Networks
AusNOG 2023?