Network Automation 101

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Who is Ivan Pepelnjak (@ioshints)

Past

- Kernel programmer, network OS and web developer
- Sysadmin, database admin, network engineer, CCIE
- Trainer, course developer, curriculum architect
- Team lead, CTO, business owner

Present

- Network architect, consultant, blogger, webinar and book author

Focus

- Network automation and SDN
- Large-scale data centers, clouds and network virtualization
- Scalable application design
- Core IP routing/MPLS, IPv6, VPN

CISCO CCIE EMERITUS

vmware vEXPERT

Every Well-Defined Repeatable Task Can Be Automated

What Would You Automate?

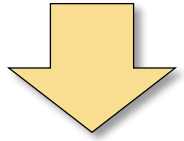
Common answers:

- Device provisioning
- Service provisioning (= device configurations)
- VLANs
- ACLs
- Firewall rules

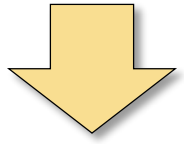
How about…

- Troubleshooting
- Consistency checks
- Routing adjustments
- Failure remediation

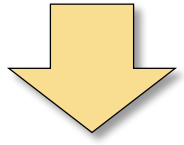
Automation



Repeatability



Consistency



Validation

Automation = Eliminate Repeatable Manual Tasks

Orchestration = Group Automated Tasks in Coordinated Workflows

A Few Reasons for Lack of Network Automation

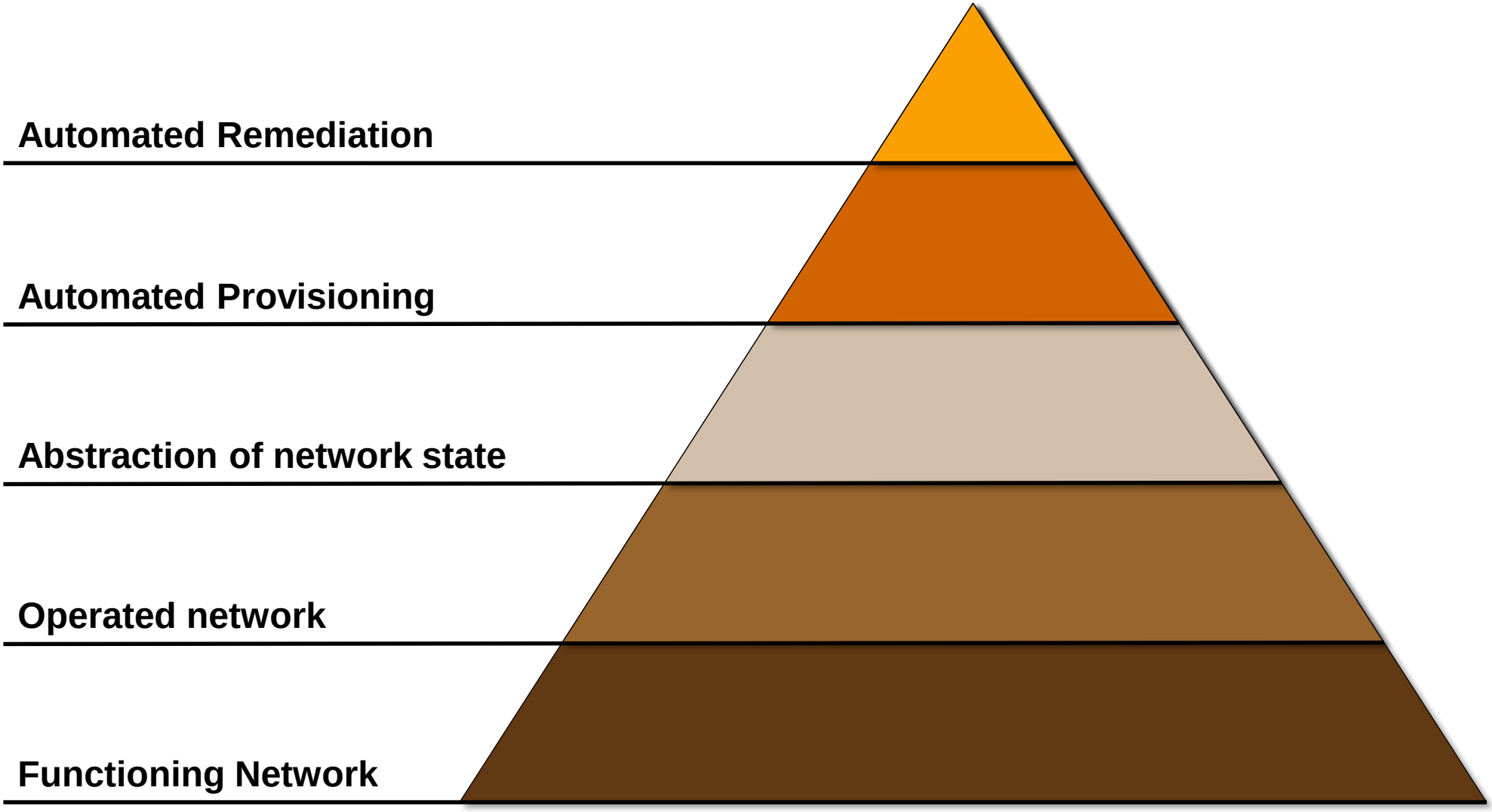
Major ones

- Mission-critical nature of the networks
- Unique snowflakes that are impossible to automate
- Ad-hoc solutions and non-standard kludges
- Blast radius
- Lack of trust

There's also

- Lack of programming skills
- Lack of reliable automation tools and programmatic interfaces
- Lack of (semi)standardized multi-vendor configuration schema
- Lack of affordable test environment

Hierarchy of Network Needs

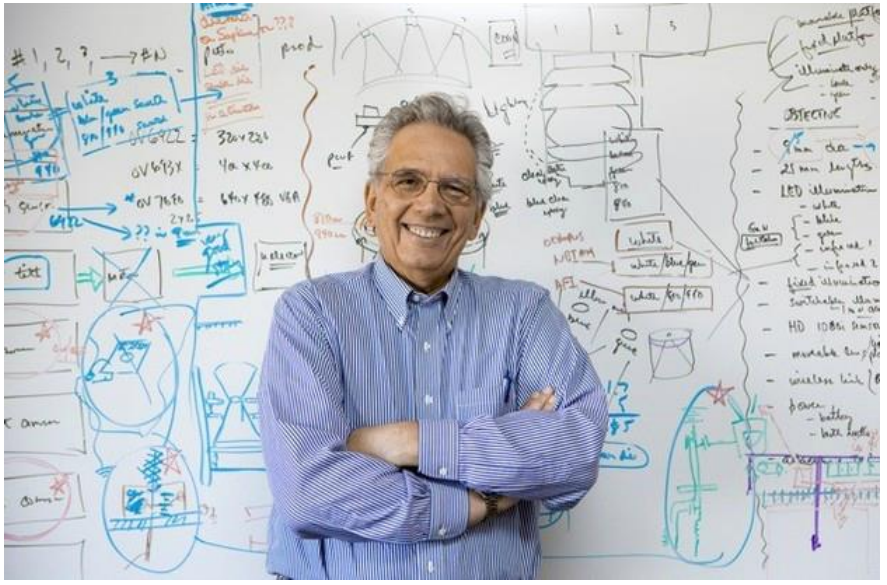


Source: Jeremy Stretch, packetlife.net

Operated Network

Operated Network

- Box-by-box mentality
- Manual configuration through CLI
- Relationships between boxes are managed in brain-space
- Tight control of changes and maintenance windows due to inherently unreliable configuration processes



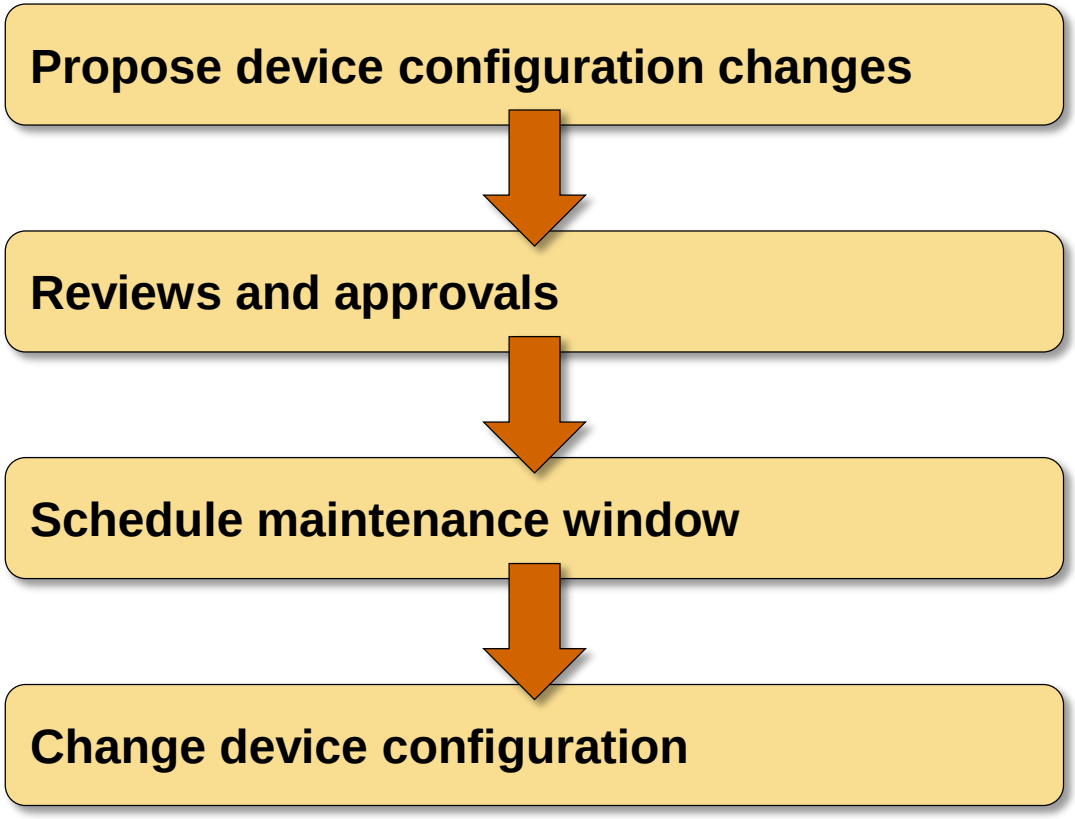
Immediate improvement opportunities

- Configuration repository = single source of truth
- Change tracking (version control)
- Configuration changes tied to user requirements or business needs

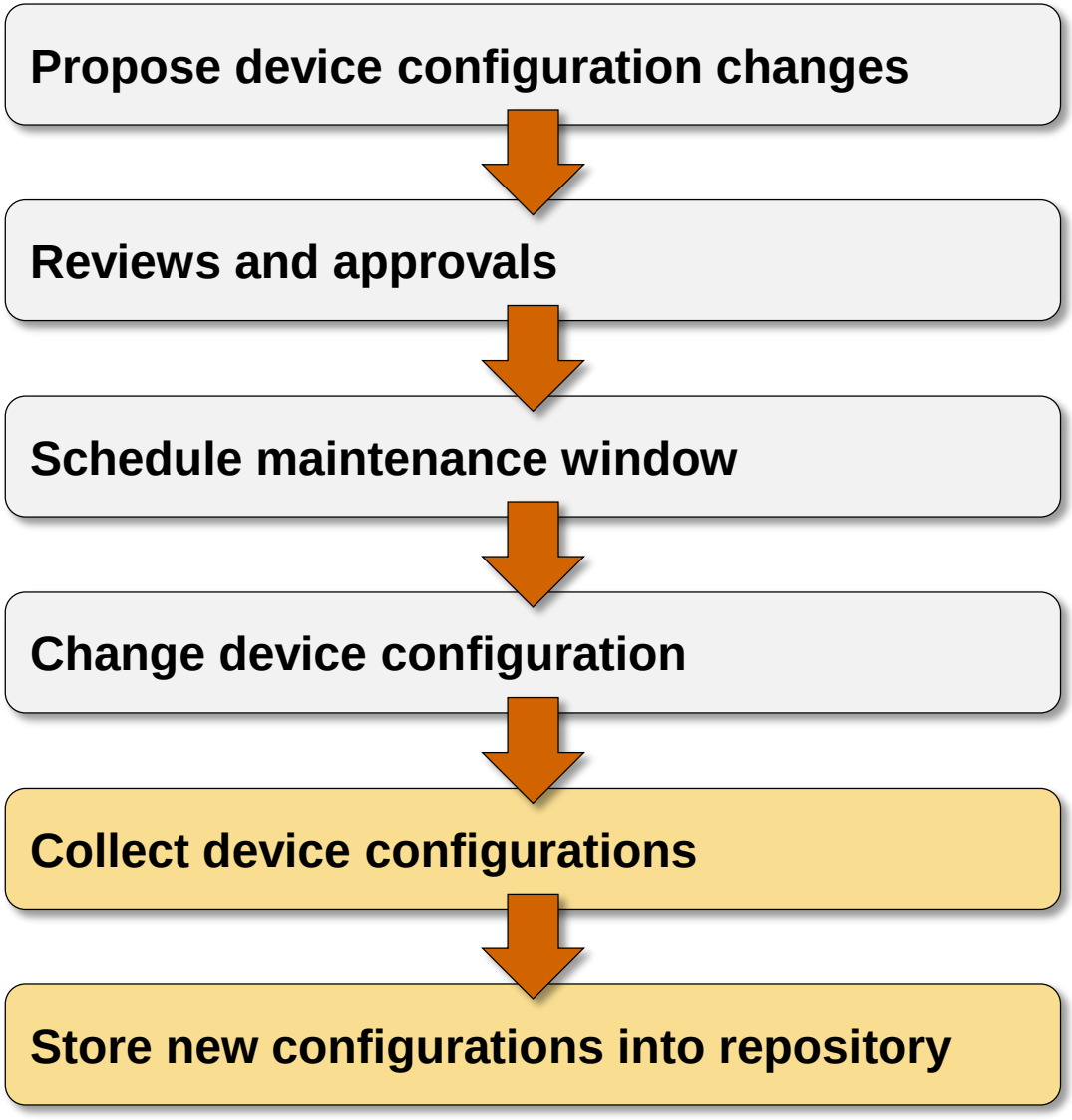
Tools to use

- RANCID – collect network configurations
- Subversion or Git – version control

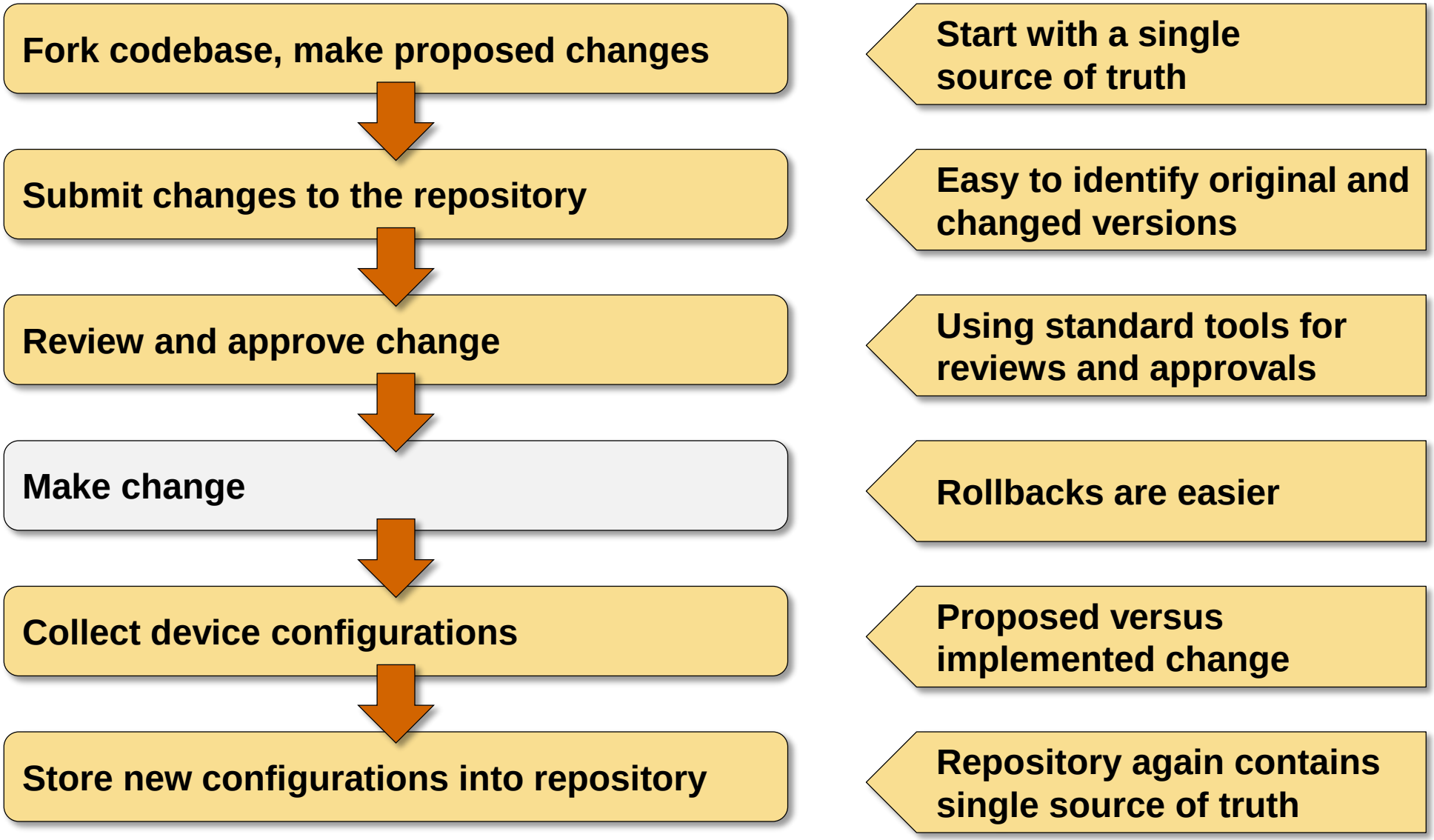
Typical Workflow



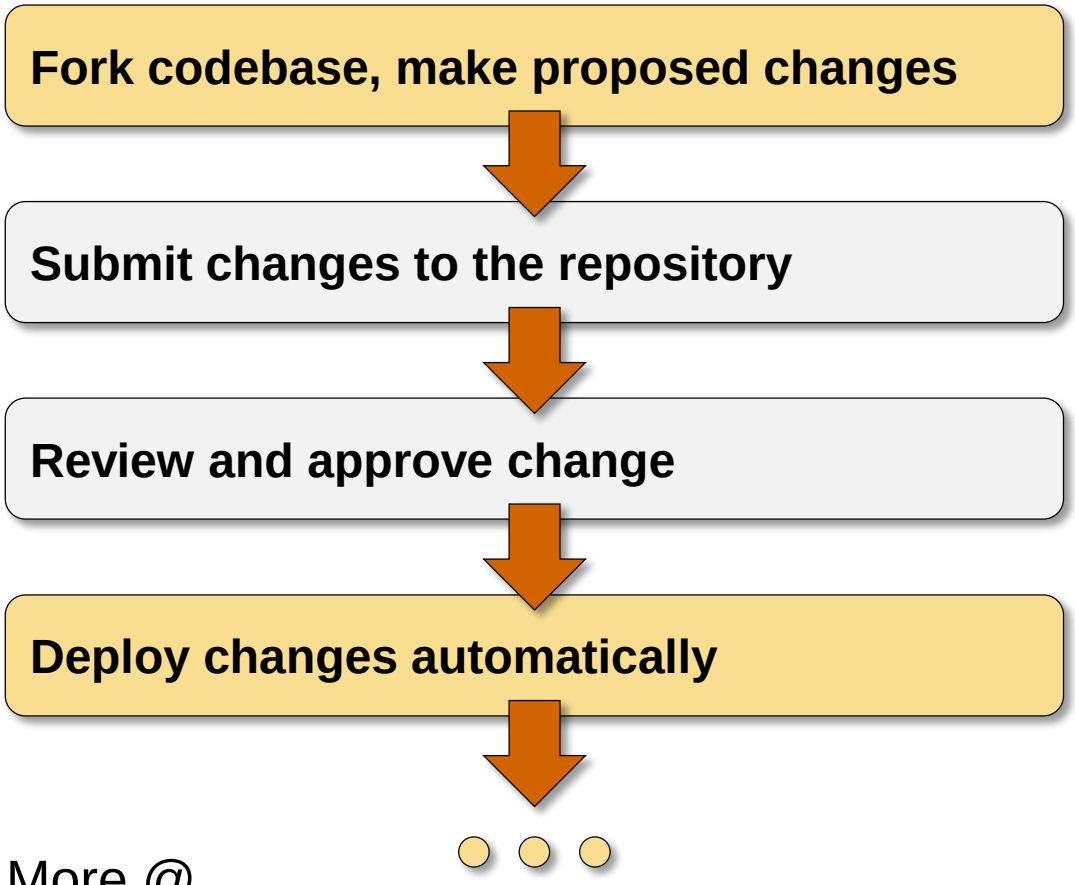
Store Device Configurations in a Repository



Start with Configuration Repository



The Final Twists



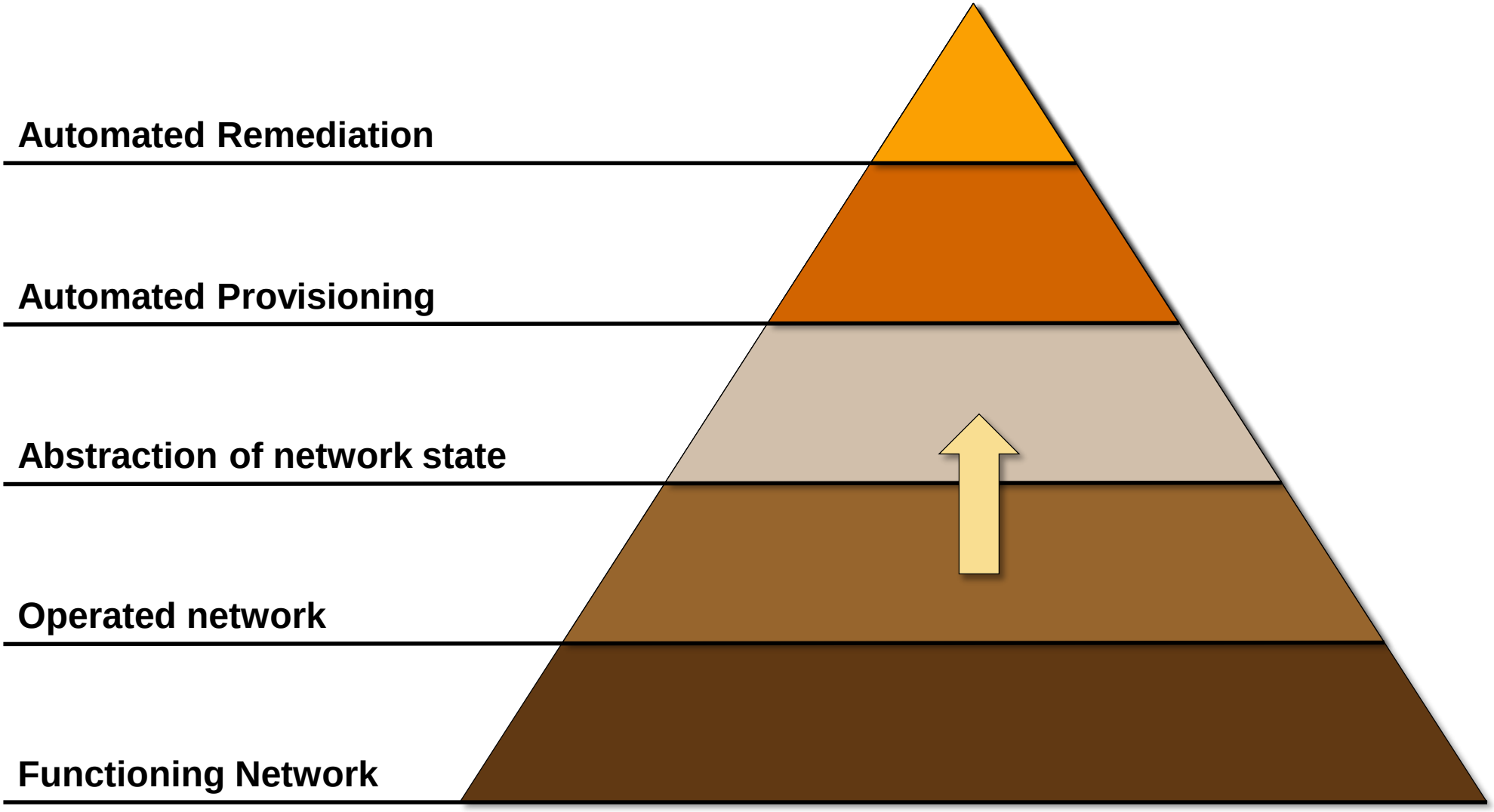
Allow your customers to propose changes

More @

- *What Is NetDevOps? Why?* – Leslie Carr (SFMIX), RIPE71
- *NAPALM* –Elisa Jasinska & David Barroso, NANOG64

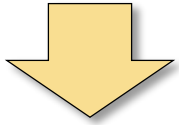
Abstraction of Network State

Hierarchy of Network Needs

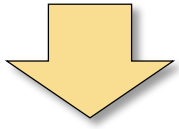


Source: Jeremy Stretch, packetlife.net

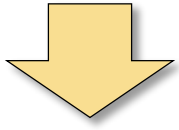
Simplify



Standardize



Abstract



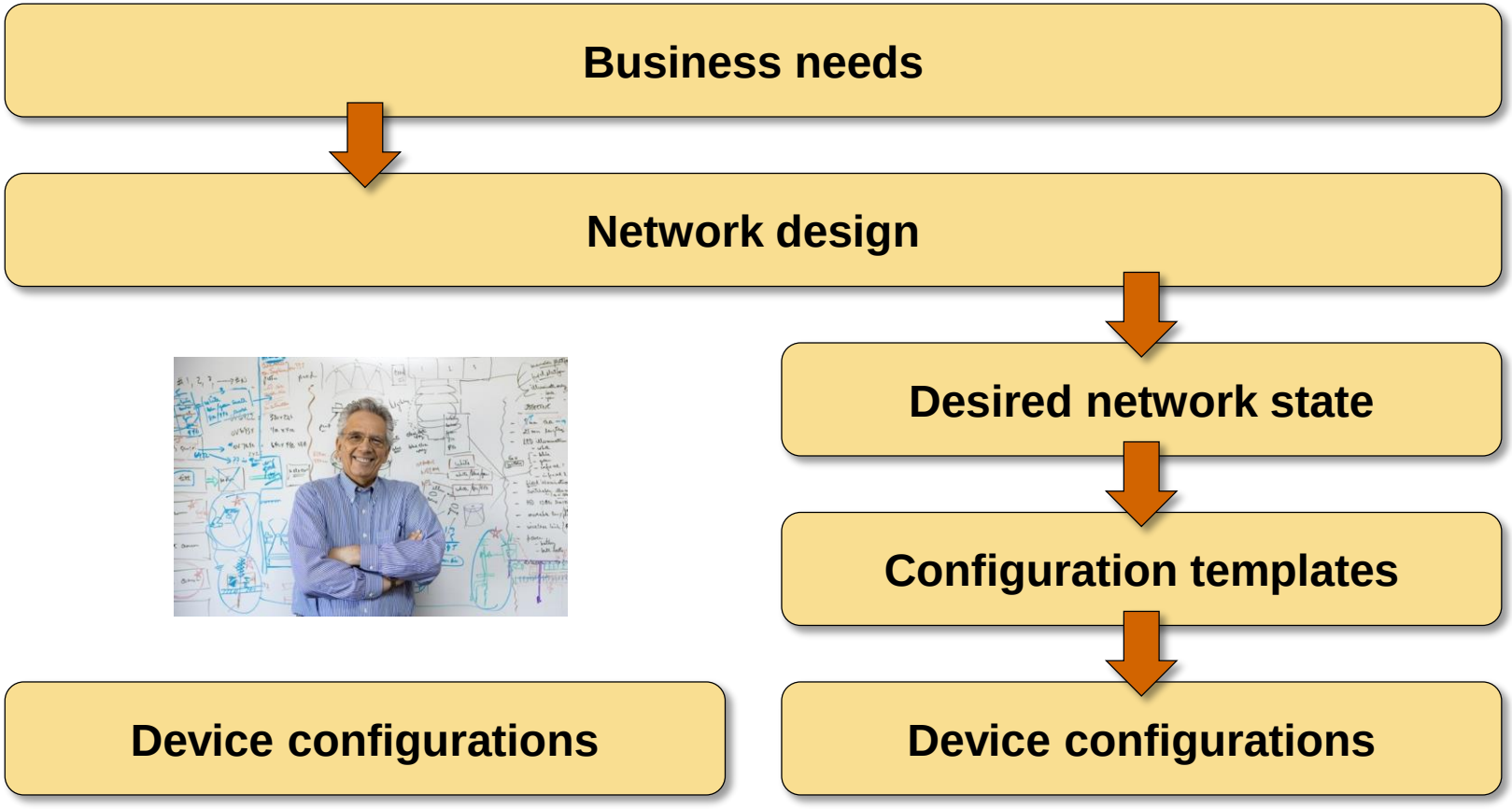
Automate

Network State Abstraction: Before and After

```
upgrade fpd auto
version 15.0
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R2
!
boot-start-marker
boot-end-marker
!
logging buffered 4096
!
no aaa new-model
!
interface Loopback0
 ip address 10.0.1.5/32
 !
!
interface Fa0/0
 ip address 172.16.11.1/24
…
```

```
hostname: 'R2'
loopback: { ip: 10.0.1.5 }
LAN:
  interface: 'Fa0/0'
  ip: 172.16.11.1
```

Network Deployment: Before and After

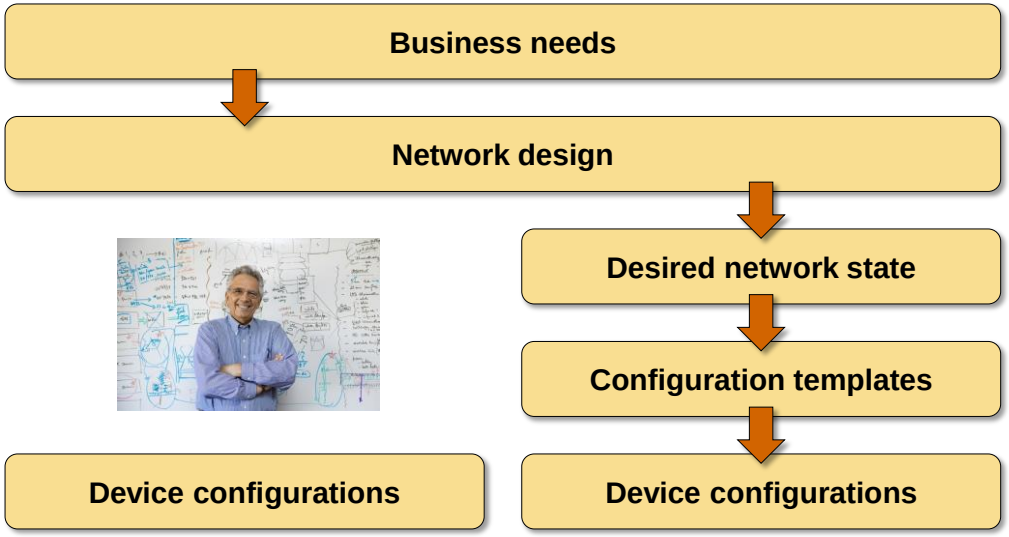


Benefits of Abstracted Network State

- Explicit mapping from network design to desired state and device configurations
- Separation of infrastructure state and service state
- Simplified multi-vendor deployments

Easier to:

- Validate configuration compliance
- Compare current state with desired state
- Identify mismatches or manual changes
- Change device configurations

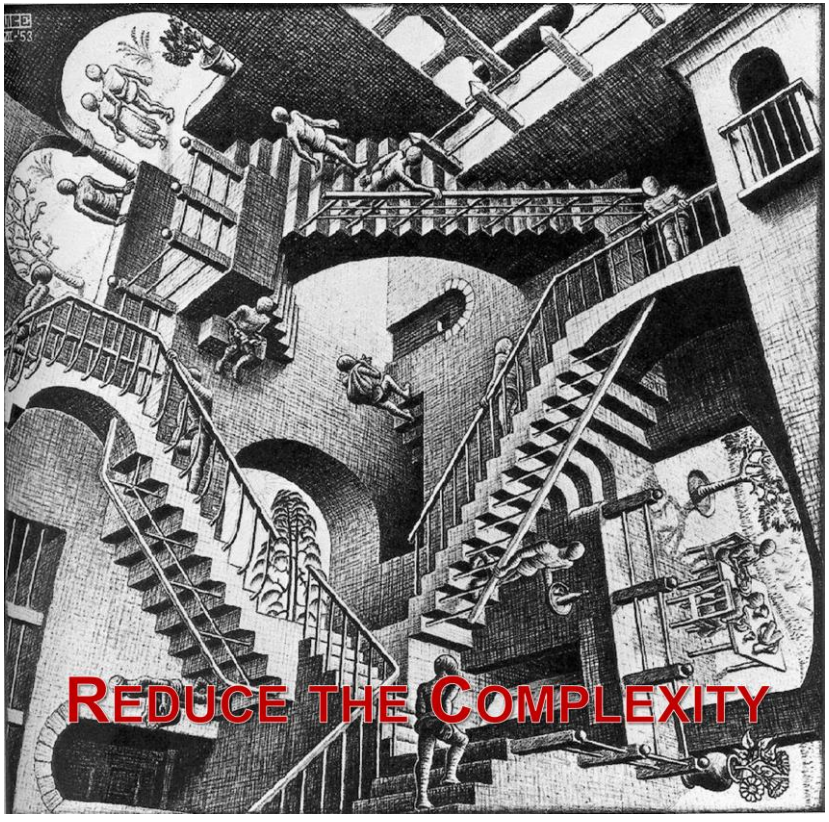


Automatic Provisioning

Automated Network and Service Provisioning

Automation required by

- Large scale deployment
- Self-service requirements
- Faster service deployment
- Need to improve reliability



Prerequisites

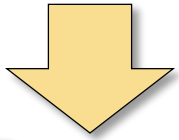
- Standardized services, configurations and deployment processes
- Reliable method of configuring and monitoring network devices (API)

Tools to use

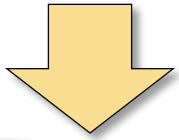
- Configuration state management tools: Chef, Puppet
- Automation frameworks: Ansible
- Workflow and continuous integration tools: Gerrit, Jenkins

Go for Low-Hanging Fruits

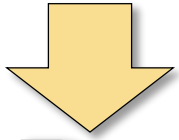
Read-Only Access



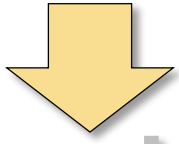
Device Provisioning



Service Provisioning



Traffic Rerouting



Real-Time and Data Plane

Automated Remediation

Automated Network Remediation

Holy Grail: Networks that fix themselves or adapt to changes

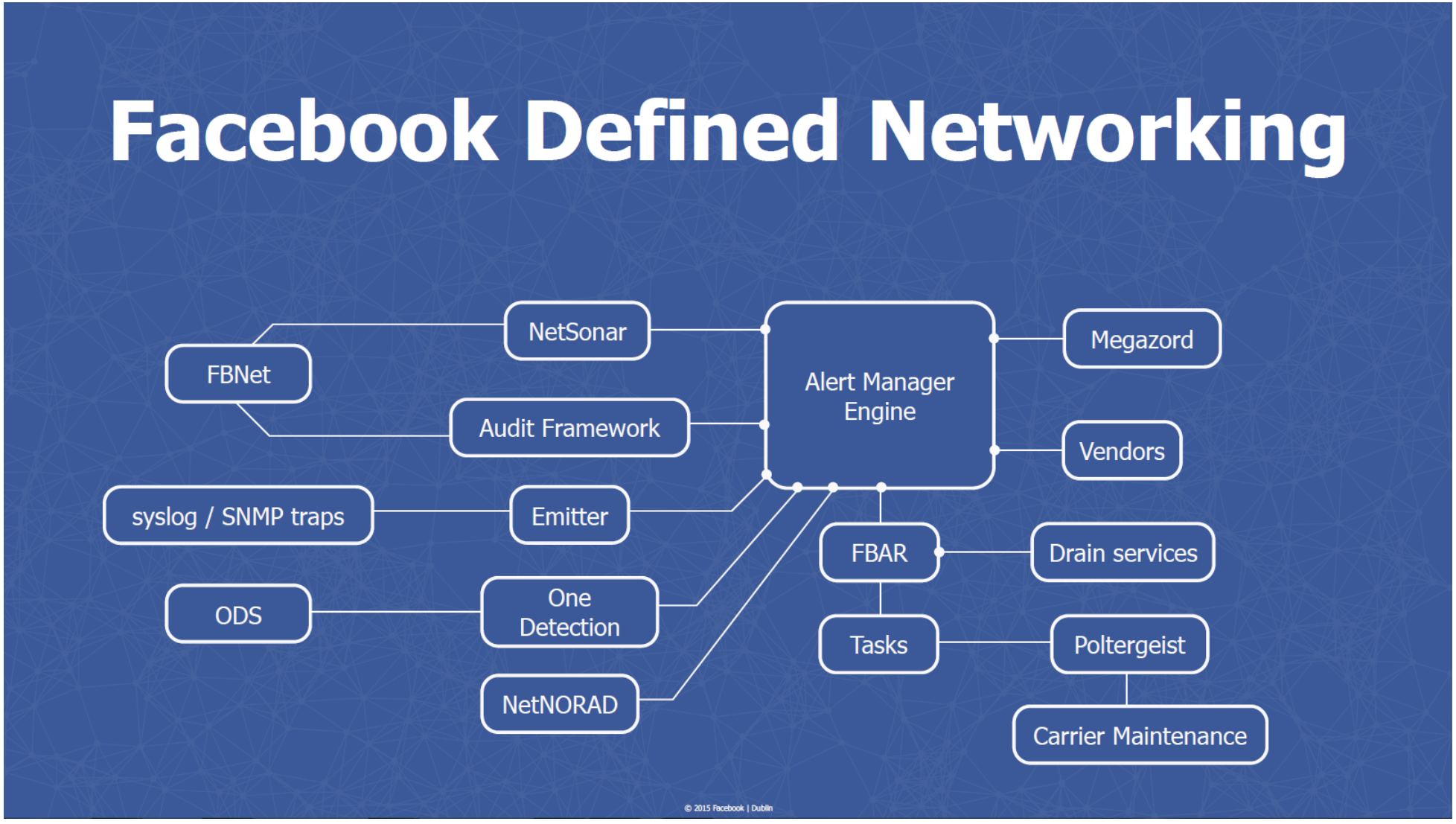
A few examples:

- Identify links with degraded performance ➔ reroute traffic
- Identify router problems (memory leaks) ➔ drain the traffic, reload the device
- ToR switch failure ➔ migrate the virtual machines

Getting there:

- Don’t expect a vendor-supplied miracle
- Someone will have to do extensive customization
- Try to use small, reusable components

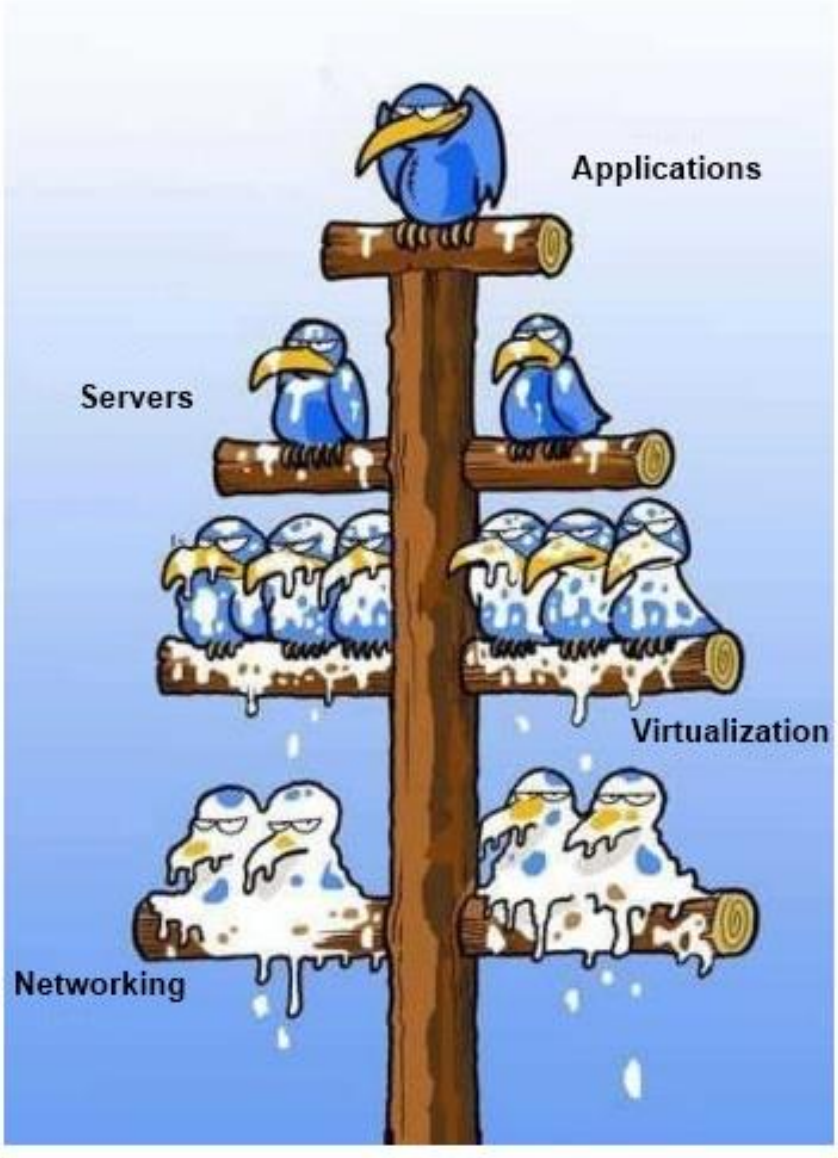
Example: Facebook-Defined Networking



Source: How Facebook Learned to Stop Worrying and Love the Network (Jose Leitao, David Rothera, RIPE 71)

Network Automation Caveats

This is what makes networking so complex

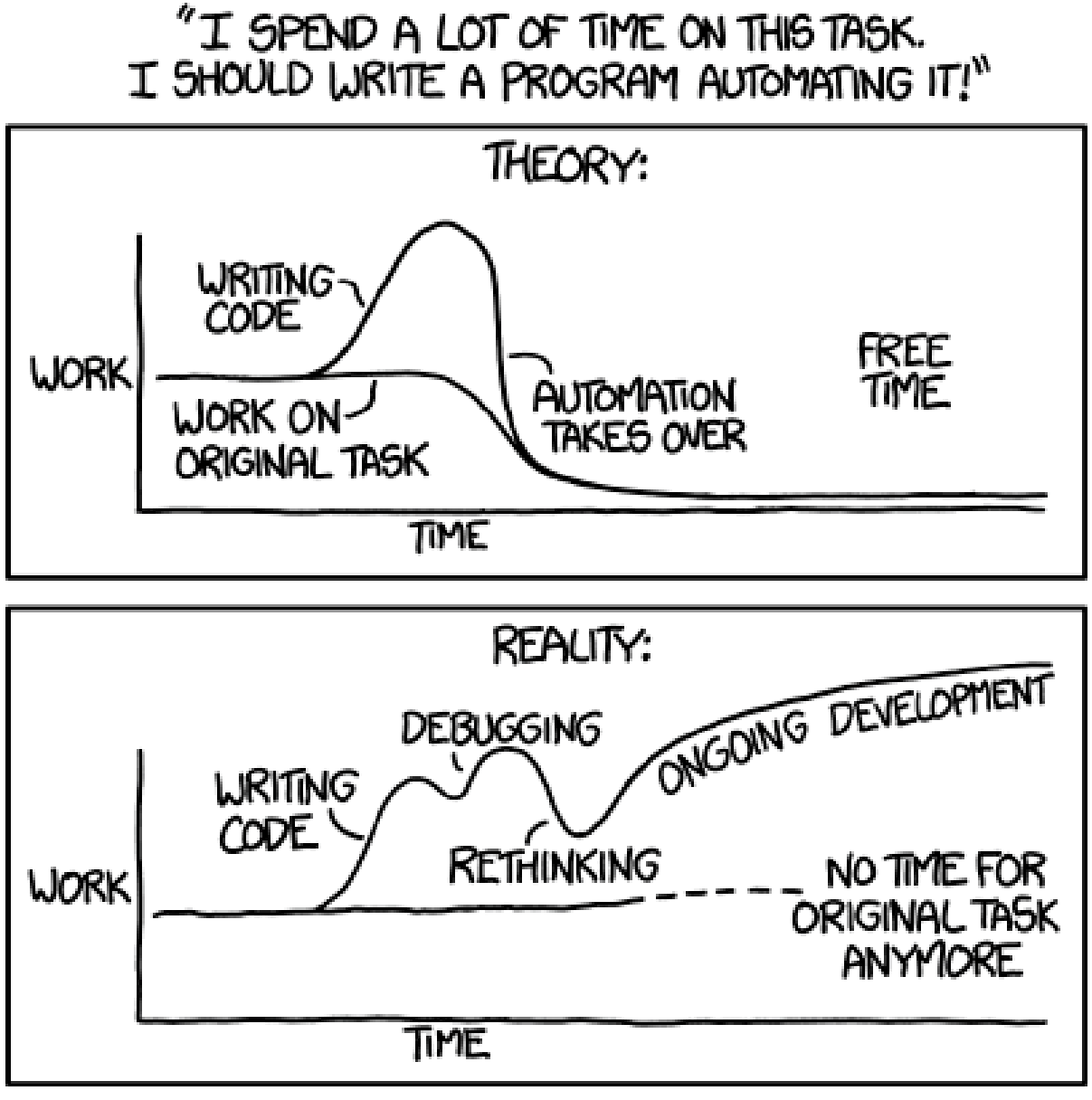


NoSQL Borat

@NoSQLBorat

Follow

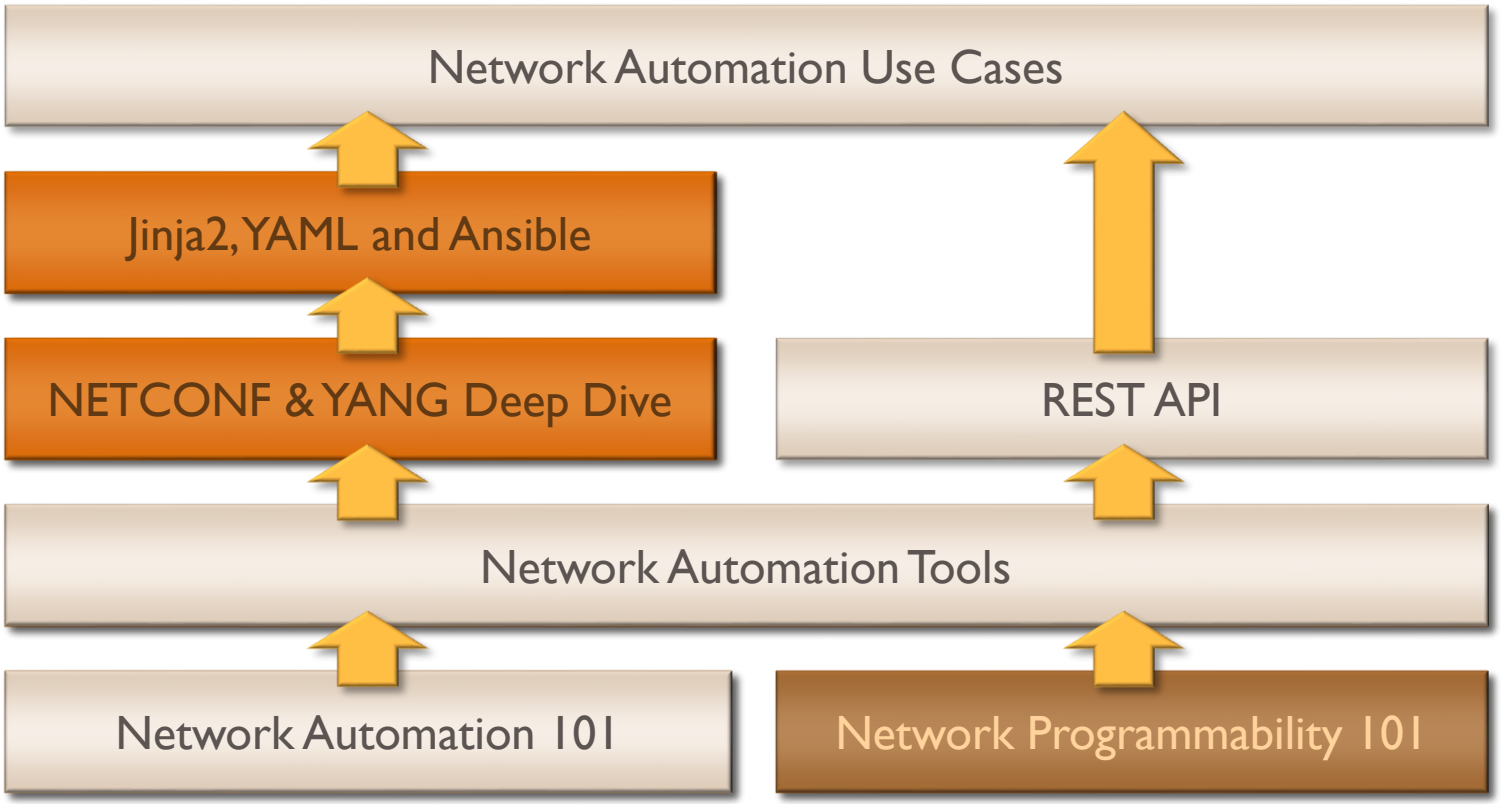
To make mistake is human. To automatically deploy mistake to all of servers is DevOps.



Source: http://xkcd.com/1319

More Information

Network Automation Track



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SDN, OPENFLOW AND NFV RESOURCES ON IPSPACE.NET

Software-defined networking (SDN) can mean anything, from programmable network elements to architectures in which control- and forwarding planes reside on different devices.

The resources listed on this page will help you understand SDN, its implications and its applicability in your environment.

SDN TRAINING AND CONSULTING

- On-site and online consulting
- SDN, OpenFlow and NFV Workshop
- Software Defined Data Centers (SDDC) Workshop
- Advanced SDN Training
- Introduction to SDN
- Customized webinars and workshops

INDIVIDUAL SDN WEBINARS

- NETCONF and YANG
- Network Programmability 101
- SDN Architectures and Deployment Considerations
- VMware NSX Architecture

MORE SDN WEBINARS

SDN-RELATED BOOKS

- Overlay Virtual Networks in Software-Defined Data Centers

BUY NOW

- SDN and OpenFlow

BUY NOW

PRESENTATIONS

- SDN - 4 Years Later (video)
- What is SDN?
- Should I program my network? (video)
- Virtual Routers
- From Traditional Silos to SDDC (video)
- What Matters is Your Business (video)
- Automating Network Security, Troopers 15

MORE SDN PRESENTATIONS

MORE SDDC PRESENTATIONS

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Even More to Explore

Blogs and web sites:

- Matt Oswalt (keepingitclassless.net)
- Scott Lowe (blog.scottlowe.org)
- Michael Kashin (networkop.github.io)
- Jason Edelman (jedelman.com)
- Chris Young (kontrolissues.net)
- Patrick Ogenstad (networklore.com)
- Josh O'Brien (staticnat.com)

Github repositories:

- NAPALM (https://github.com/napalm-automation)
- David Barroso (https://github.com/dbarrosop/) – SIR, NAPALM demos
- Jason Edelman (https://github.com/jedelman8)
- Patrick Ogenstad (https://github.com/networklore/)

Questions?

Send them to ip@ipSpace.net or @ioshints