A “Virtual Out Of Band Channel”

RIPE-70
Amsterdam, May 2015

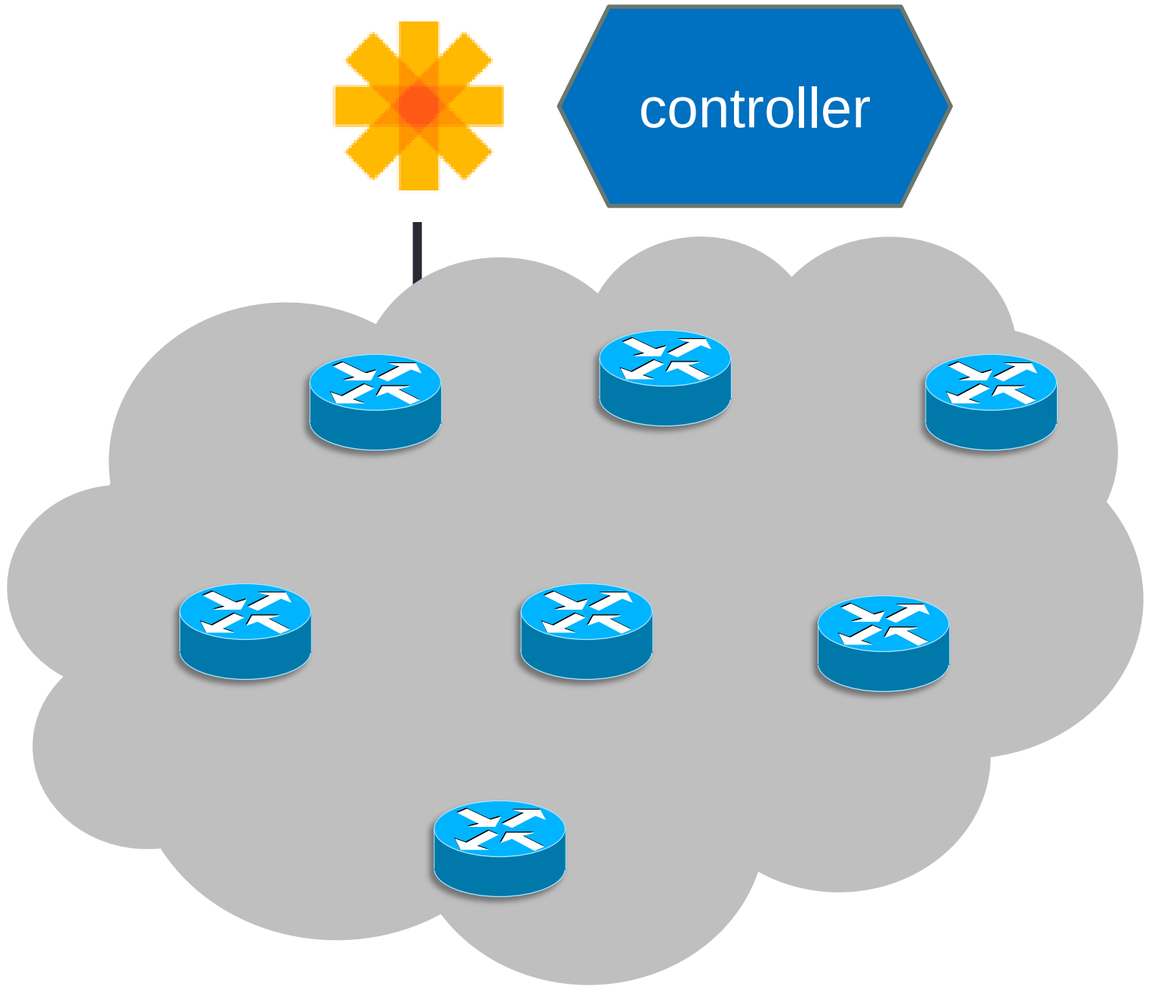
Michael Behringer

We all know:

SDN Will Save The World

Yes, but…

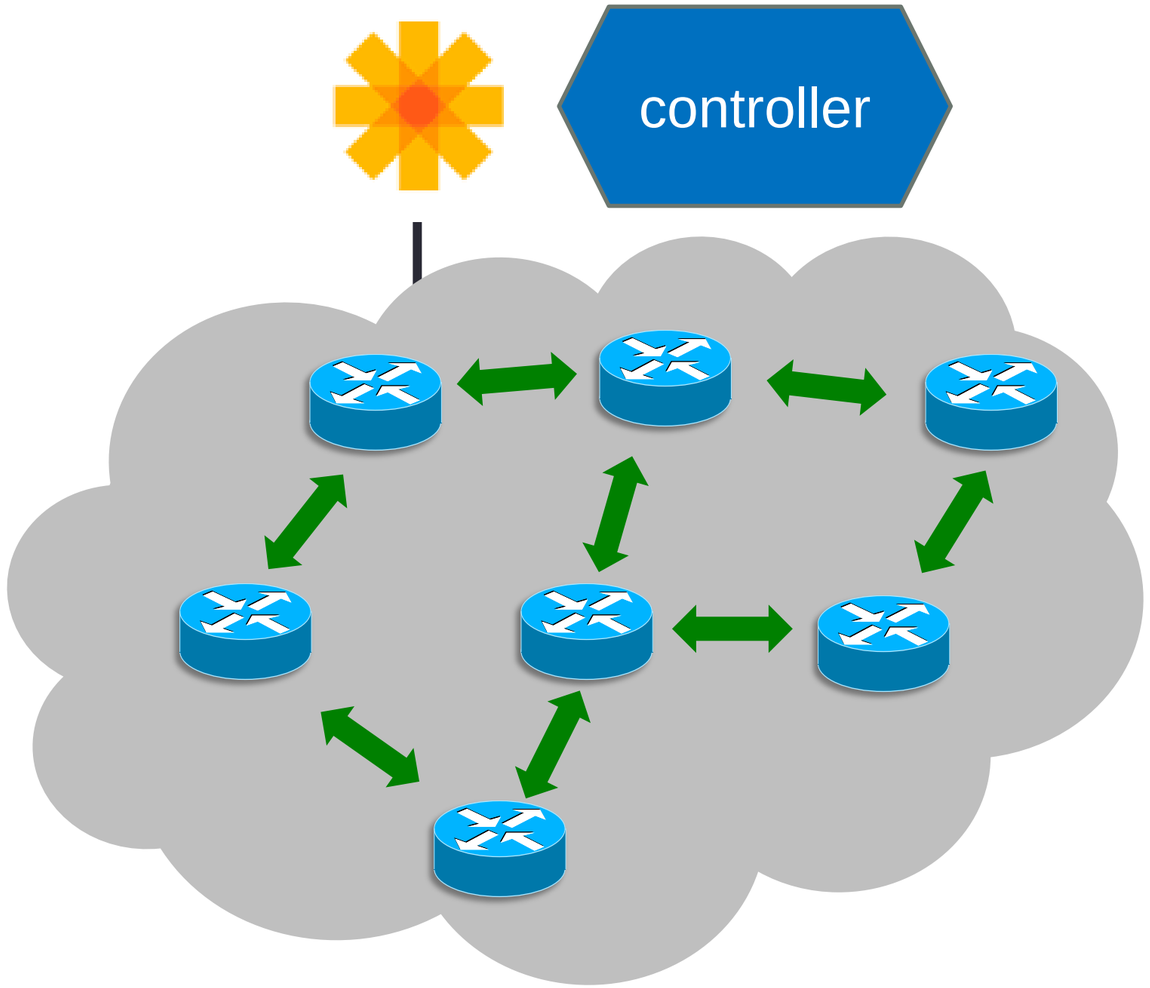
SDN – Unanswered Questions…



How does a Controller:

- Discover network elements?
- Enrol them securely? (without pre-staging?)
- Reach them consistently?

SDN – Unanswered Questions…



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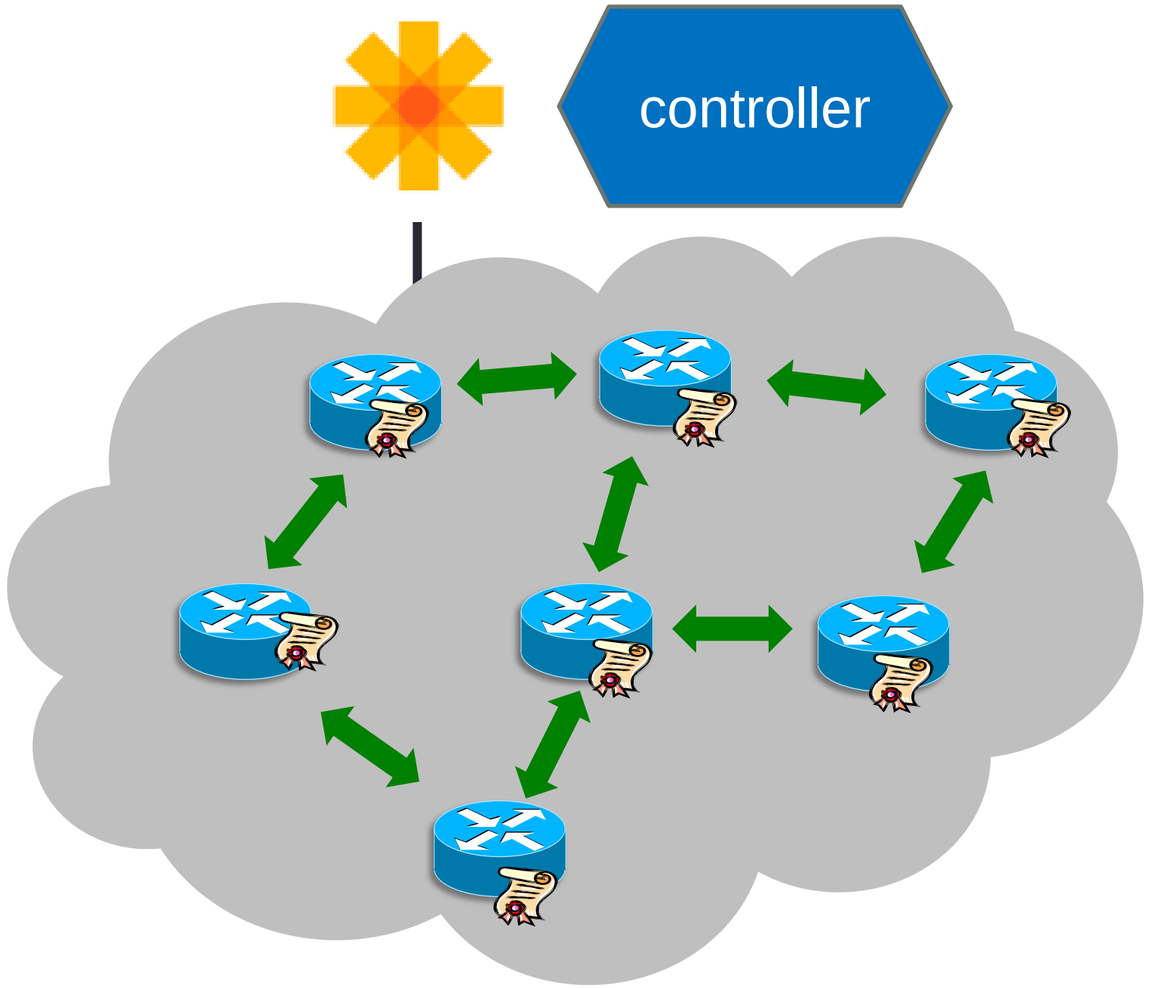
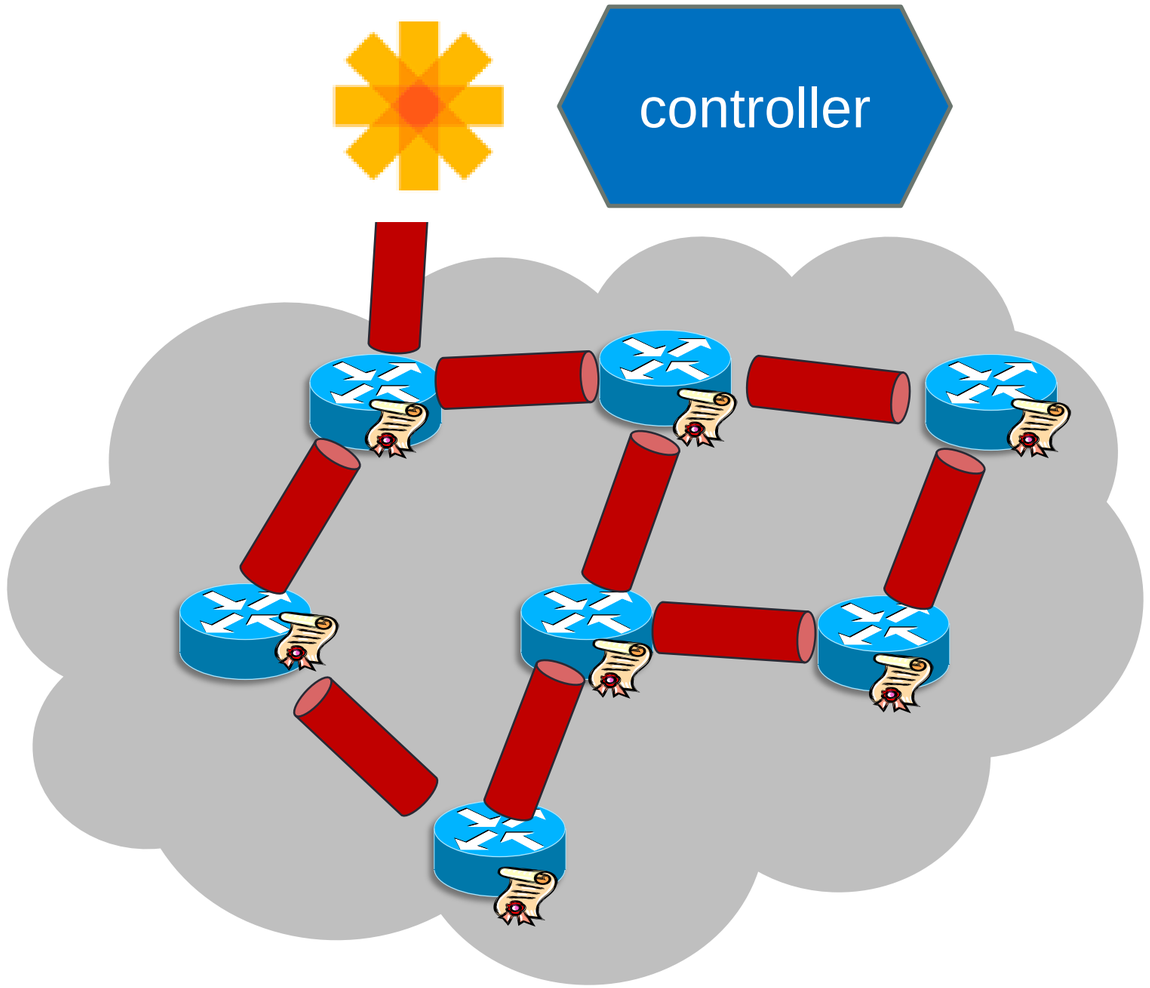


How does a Controller:

- Discover network elements?
  - Autonomic discovery
- Enrol them securely? (without pre-staging?)
  - Secure bootstrap process
  - → Domain certificates
- Reach them consistently?

SDN – Unanswered Questions…

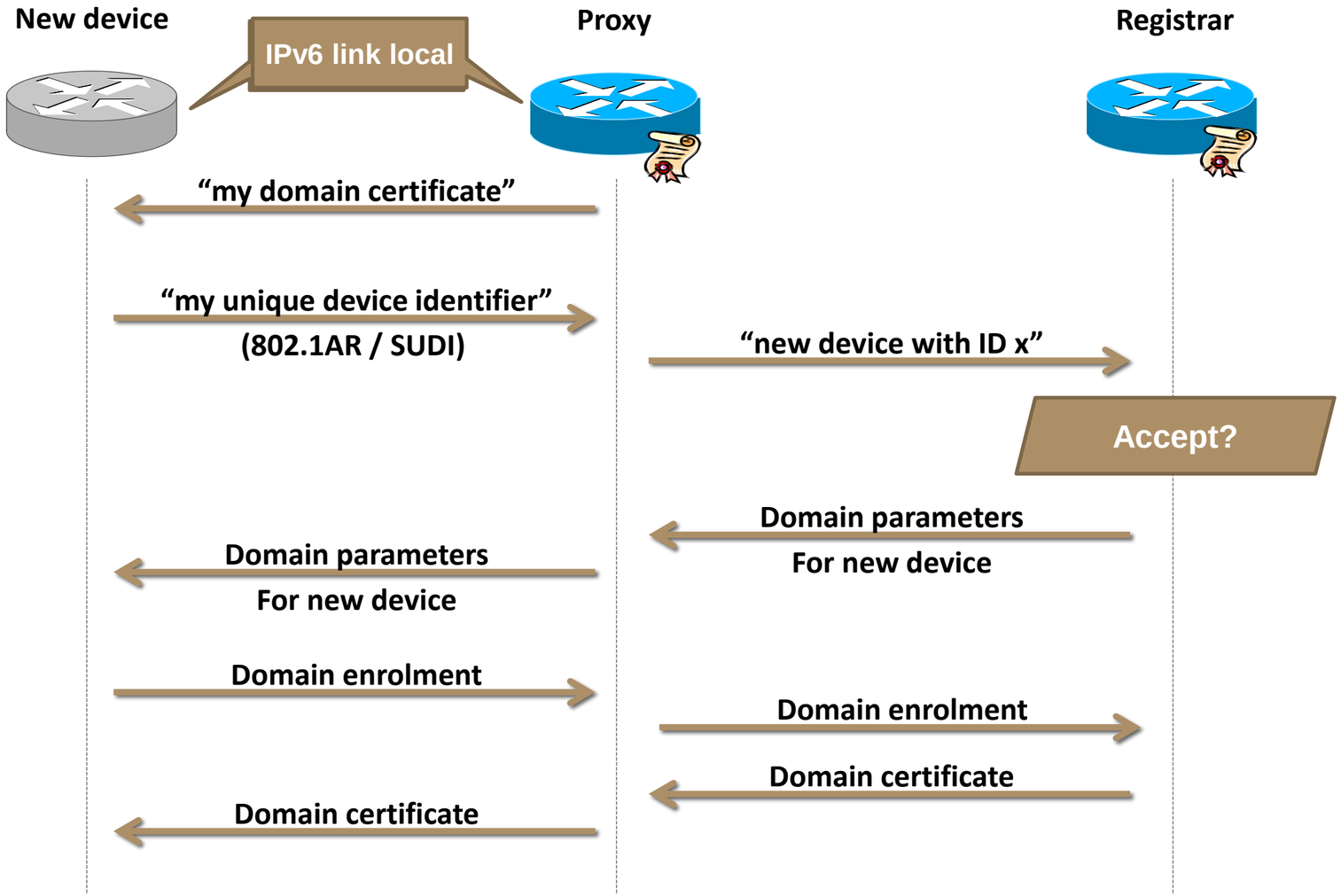


How does a Controller:

- Discover network elements?
  - Autonomic discovery
- Enrol them securely? (without pre-staging?)
  - Secure bootstrap process
  - → Domain certificates
- Reach them consistently?
  - Autonomic Control Plane
  - Independent of the data plane!

Bootstrapping Security

Secure Domain Certificate Enrolment

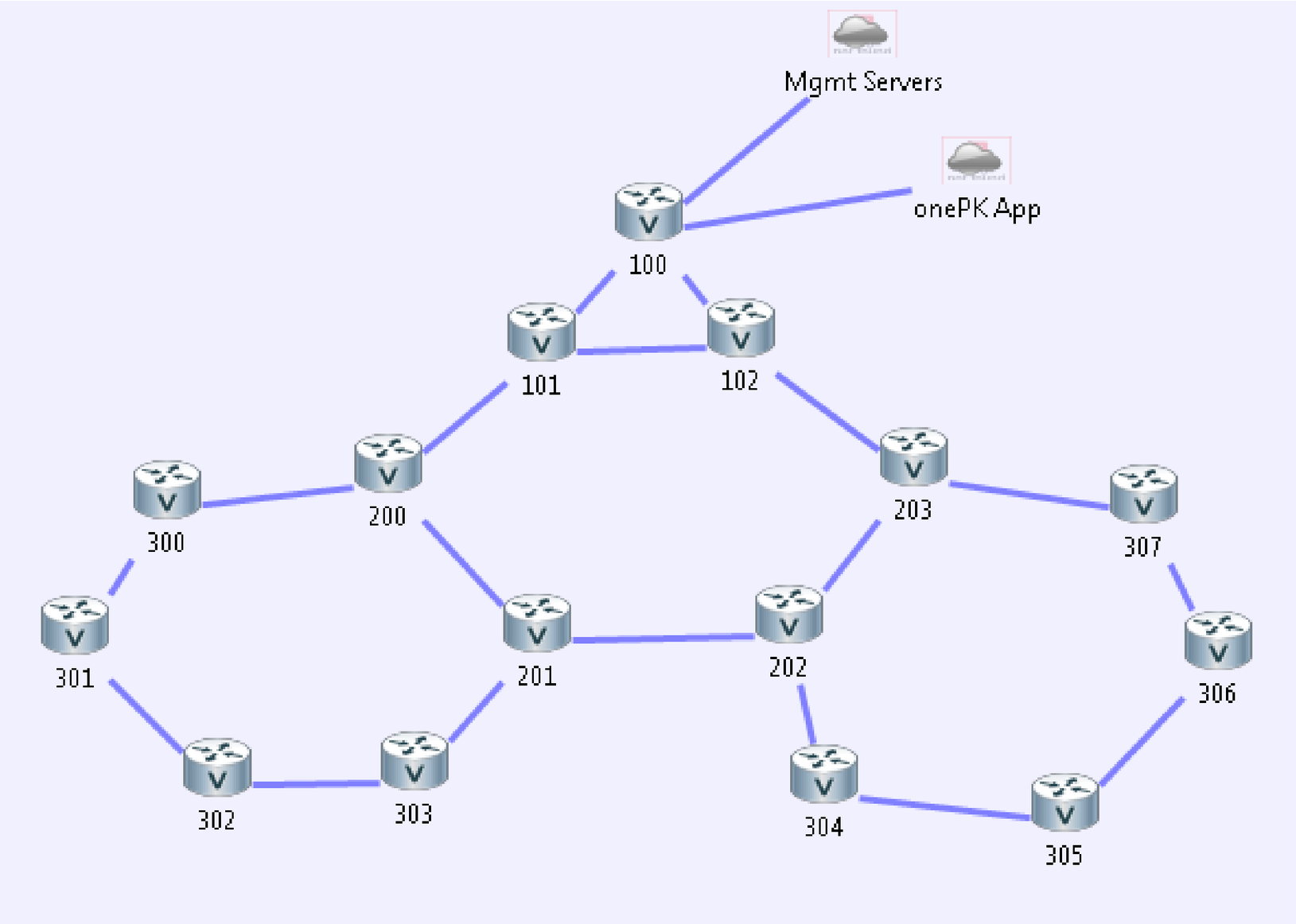


Fundamental Idea:

Using a secure vendor ID to bootstrap a domain ID

See: http://tools.ietf.org/html/**draft-pritikin-anima-bootstrapping-keyinfrastructures/**

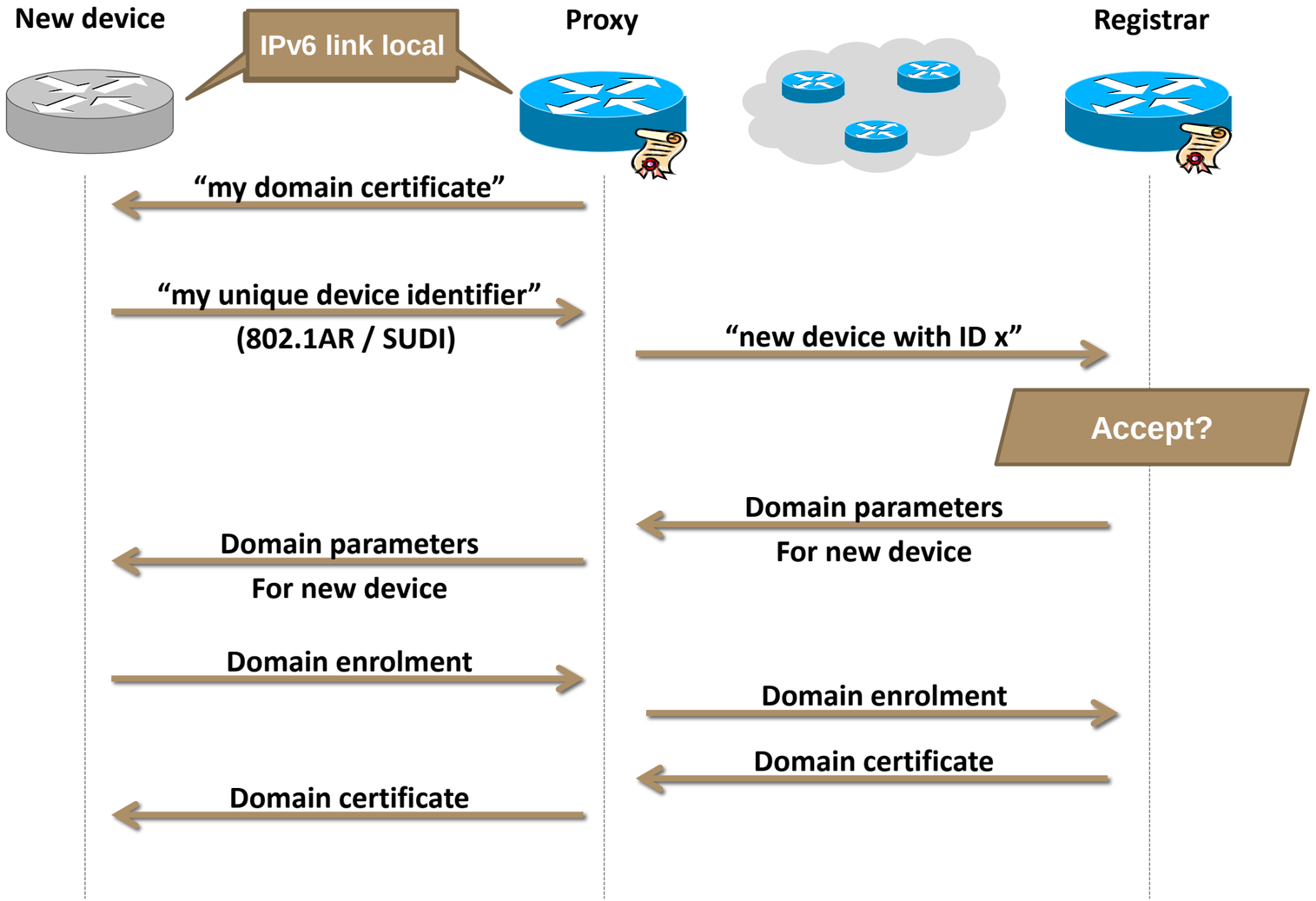
Demo 1: ***Secure*** Zero-Touch Bootstrap



- Minimal config on a central node
- Network bootstraps automatically
- AND: securely!

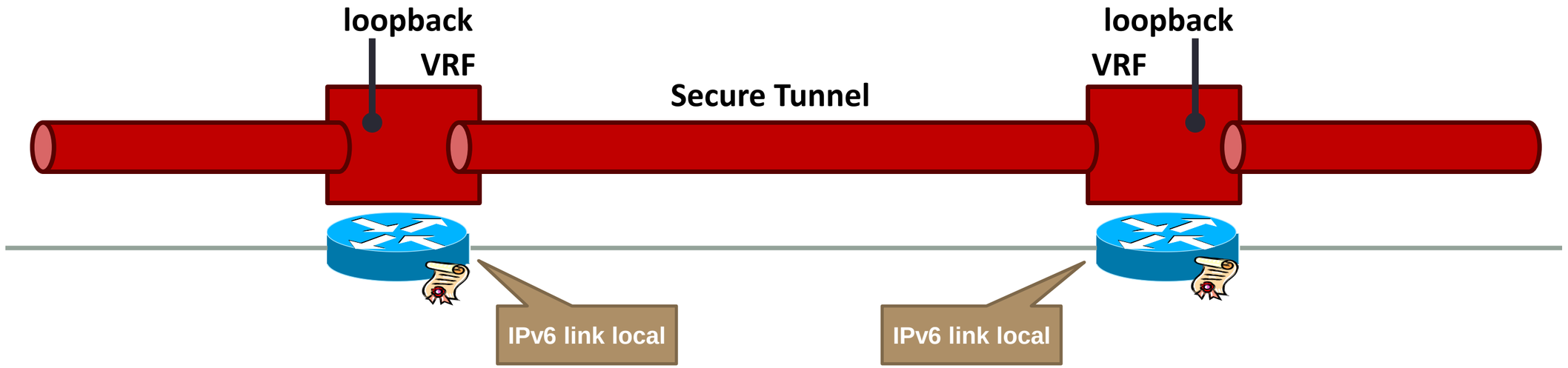
The “Virtual Out Of Band Channel"

Where Is The Catch?



How do nodes communicate without IP addressing?

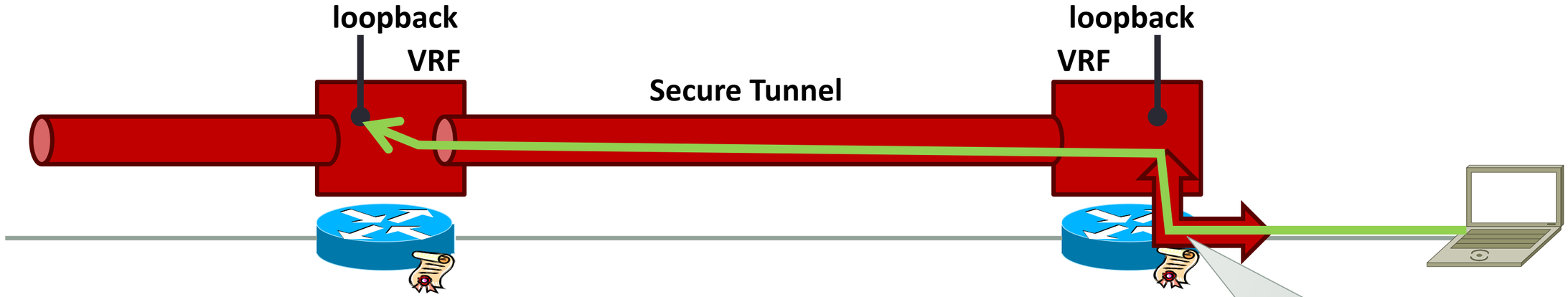
The Autonomic Control Plane



- Self-forming and self-managing
- Follows network topology
- Not dependent on config or routing table*

* Some exceptions apply

Connecting into the Autonomic Control Plane



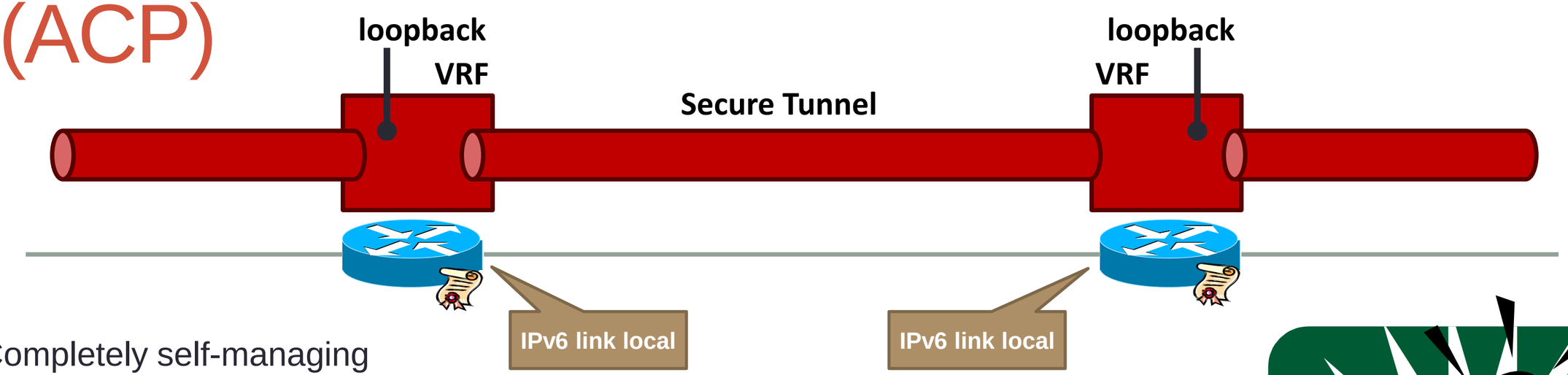
- Like normal “ip vrf forwarding” command
- All devices on this interface have full access to ACP

→Can SSH, SNMP, etc to loopbacks

- Long term: Servers will be autonomic devices

Interface eth 2
autonomic connect
ipv6 address 2000::10/64

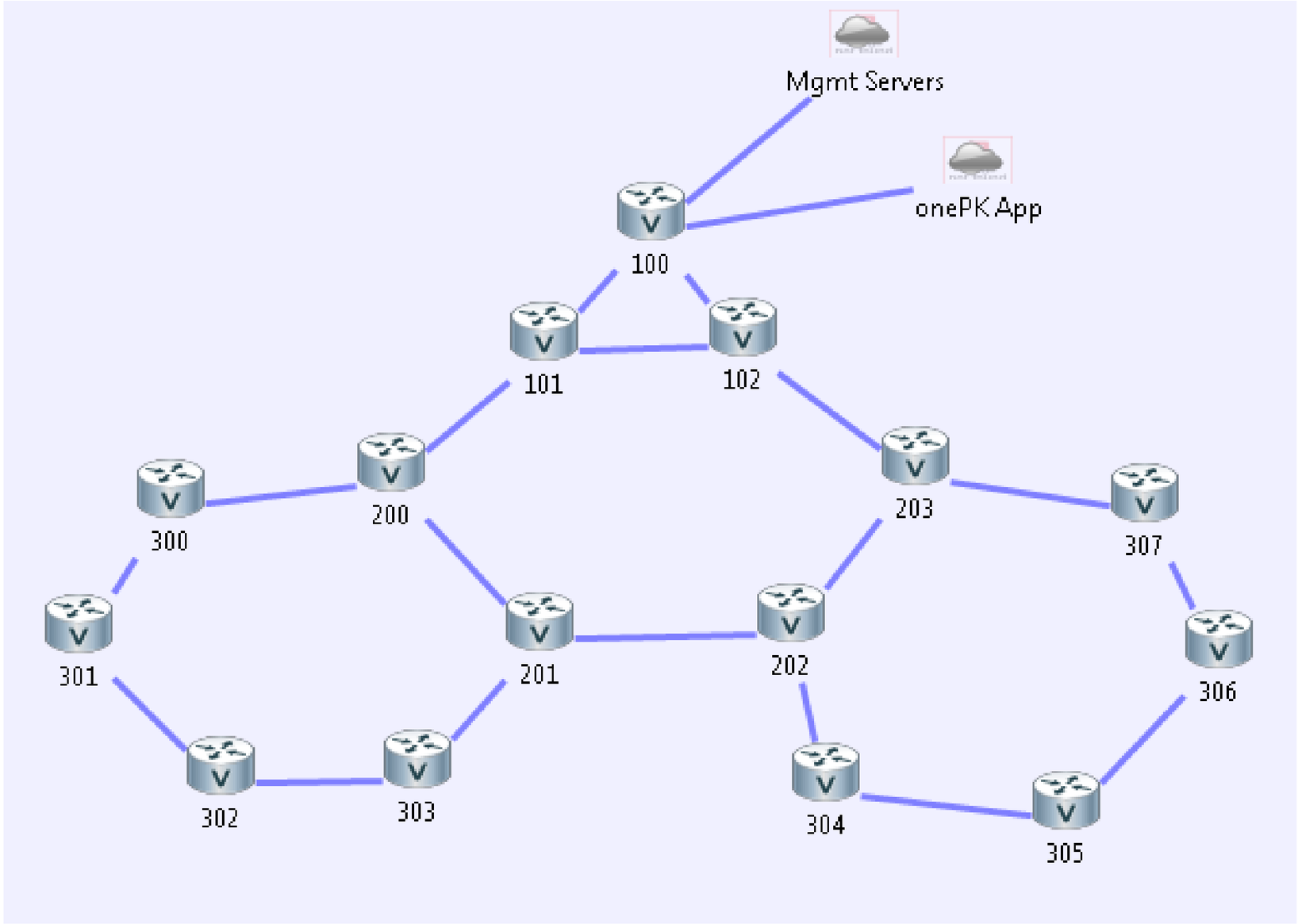
Advantages of the Autonomic Control Plane (ACP)



- Completely self-managing
  - No config!
- Secure
  - Separate (VPN) and encrypted (e.g., IPsec)
- Independent of Routing
  - Only depends on link local addresses
- Independent of Configuration
  - Only certificate visible in “sh running”
- Visible
  - Lots of show commands, debugs, etc.

Use as a “Virtual Out-Of-Band Channel”

Demo 2: The Virtual out of Band Channel



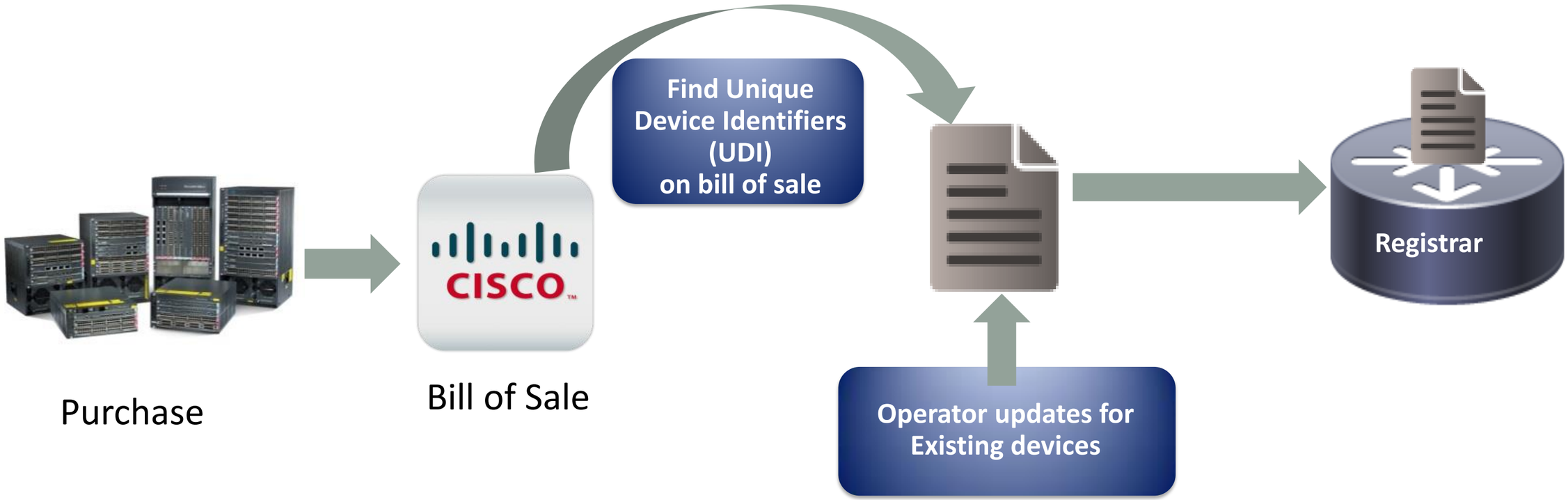
Reachability across the network

- Without addressing
- Without routing

Autonomic Networking Work Flow

Create a Whitelist

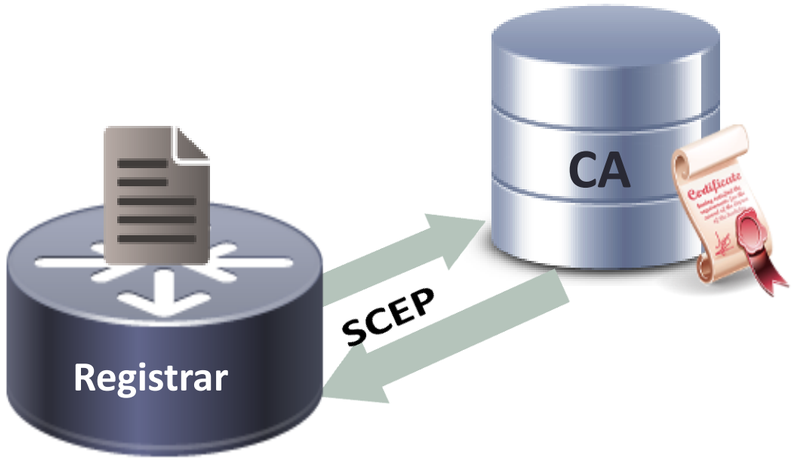
- Devices joining the domain must be validated before handing out certificates
- Create a whitelist (text file) of UDIs that are allowed to join
  - Automatically generated by Cisco (from Bill of Sale) for new devices
  - Updated by operator for existing devices
- Load whitelist on the Registrar (manually)



Configure a Registrar

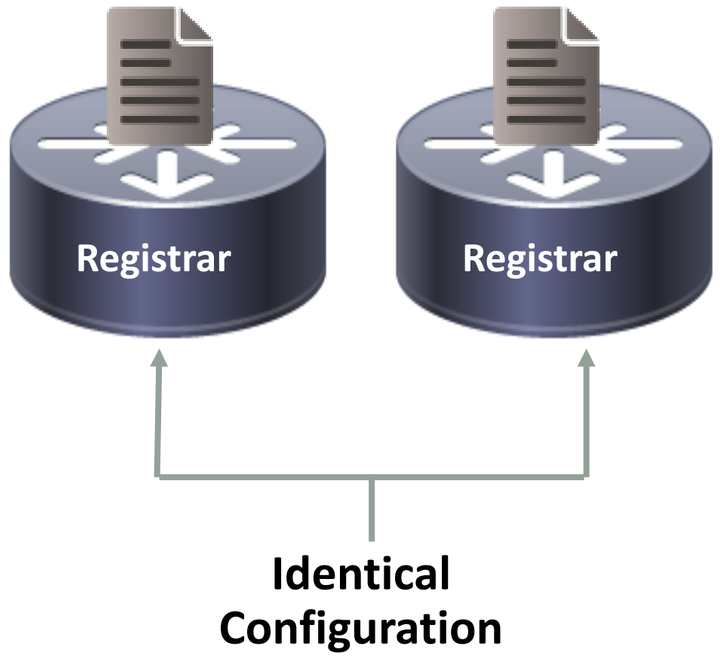
Router#configure terminal	
Router(config)#**autonomic registrar**	**Enter Autonomic Registrar Config mode**
Router(config-registrar)#**domain-id cisco.com**	**Configure domain-id – any name will do**
Router(config-registrar)#**whitelist disk:whitelist.txt**	**Specify a local whitelist (Optional)**
Router(config-registrar)#**ca url <>**	**Specify an external CA's url (Optional)**
Router(config-registrar)#**no shut**	**Unshut the Registrar – You're done!**

- Registrar also can run an IOS CA locally
- If a whitelist is not used– a deployment window is the recommended alternative



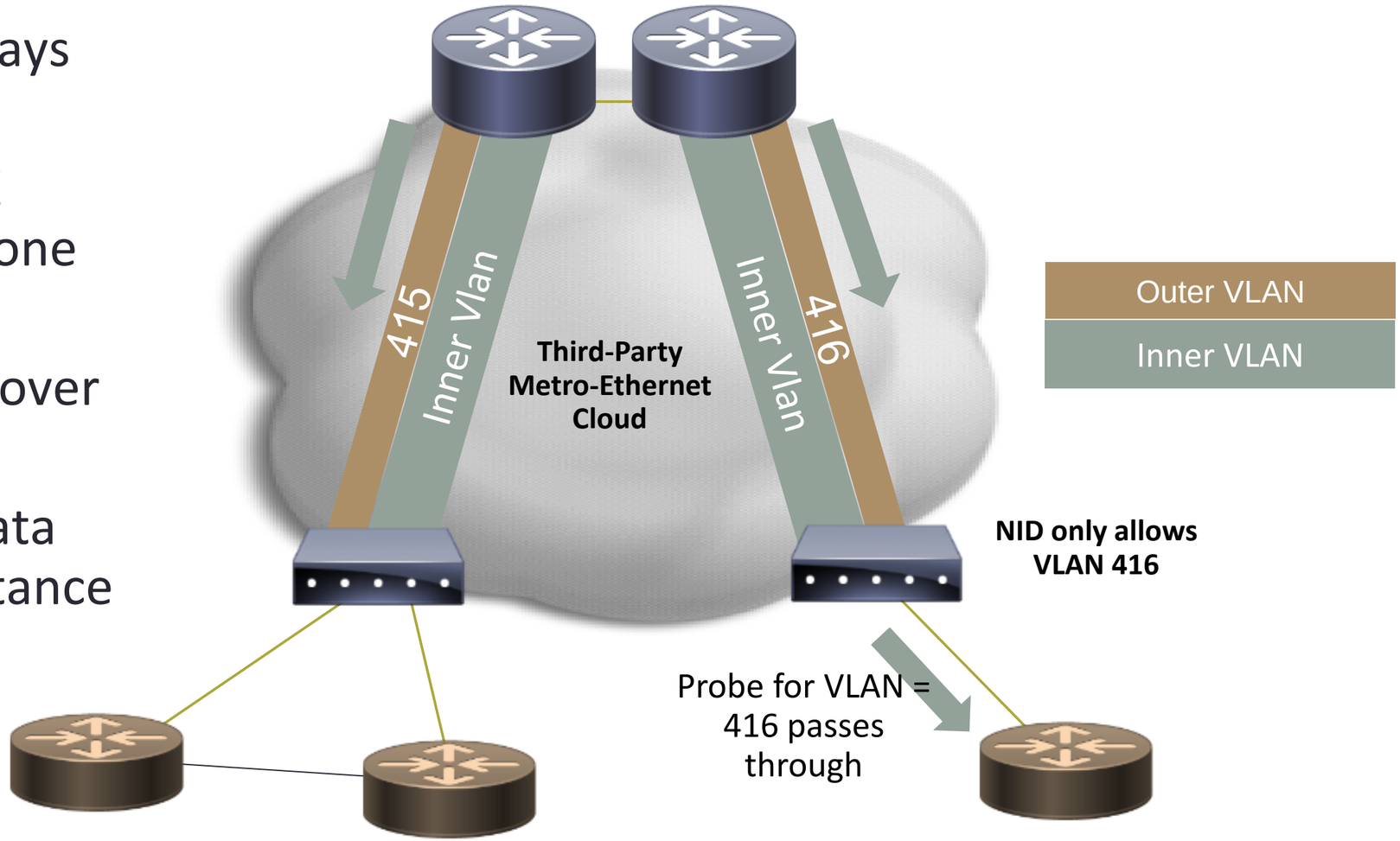
Registrar Redundancy

- A Registrar in an Autonomic domain:
  - validates new devices (whitelist)
  - Hands out domain certificate
- Registrar down → no new devices can join the autonomic domain!
- Good practice to configure multiple registrars
- Registrars can be distributed – no need to be neighbors!



Bring up Remote Sites: Channel Discovery

- Newly installed device is always passive
- Typically, VLAN based E-LINE services - each NID permits one VLAN
- Channel discovery helps discover the allowed VLAN
- ACP is kept separate from Data plane using QinQ service instance with fixed inner vlan = 4094



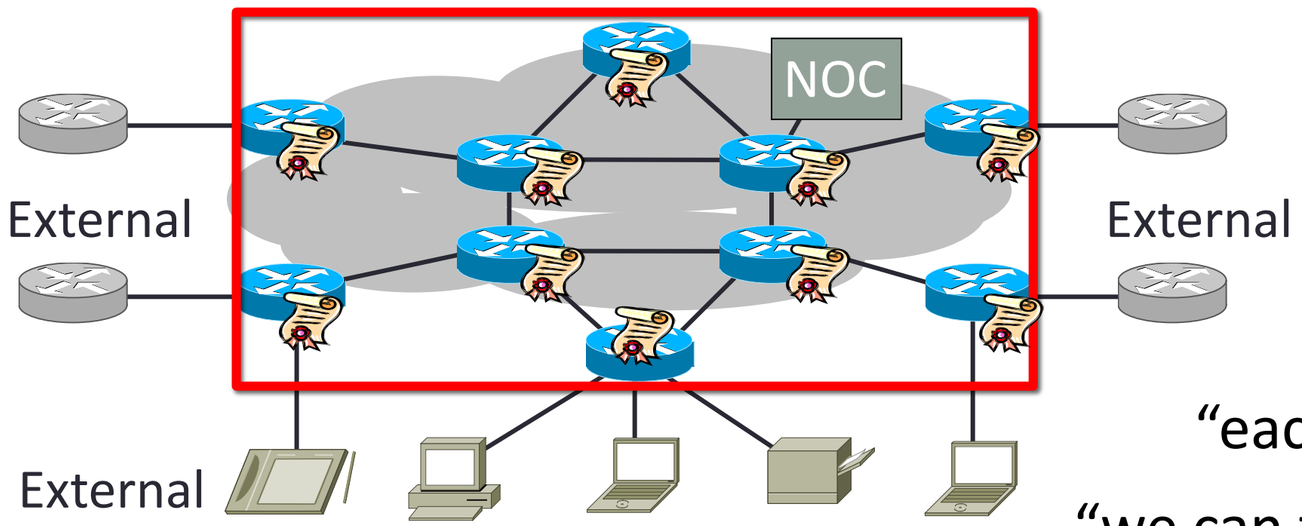
Restricting VLAN Ranges with Channel Discovery

- Intent configured on registrar
- Flooded through network


```
Router#configure terminal
Router(config)#autonomic intent
Router(config-intent)#control-plane
Router(config-intent)#vlan outer 400-420
Router(config-intent)#vlan inner 4092
```

Autonomic Networking Strategy

Possibilities With Domain Certificates



"we can now secure the network automatically"

"bring up OSPF automatically"

"… and PIM-SM!!"

"we could enable guestnet, if a policy says so"

"each device knows what to do"

"we can find BGP speakers automatically!"

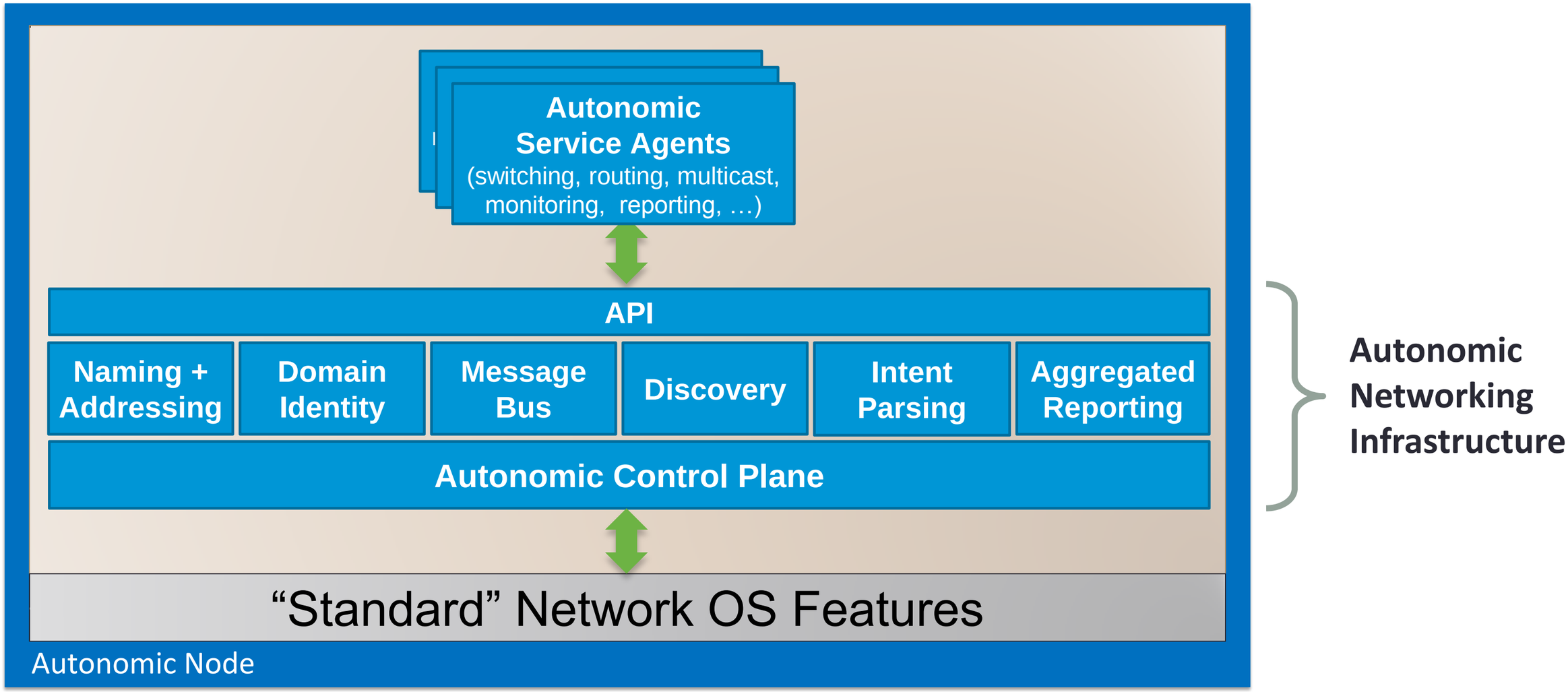
"… and secure the sessions!"

"the admin can detect unauthorised devices"

"reporting can be aggregated in the network"

See: http://tools.ietf.org/html/**draft-behringer-default-secure**

Autonomic Networking Layering Model



draft-irtf-nmrg-autonomic-network-definitions-04

Please Support Standardisation!

ANIMA Working Group: http://tools.ietf.org/wg/anima/

Early work

- A Framework for Autonomic Networking http://tools.ietf.org/html/draft-behringer-autonomic-network-framework
- Making the Internet Secure by Default http://tools.ietf.org/html/draft-behringer-default-secure

NMRG work

- Autonomic Networking: Definitions and Design Goals http://tools.ietf.org/html/draft-irtf-nmrg-autonomic-network-definitions
- Gap Analysis for Autonomic Networking https://tools.ietf.org/html/draft-irtf-nmrg-an-gap-analysis

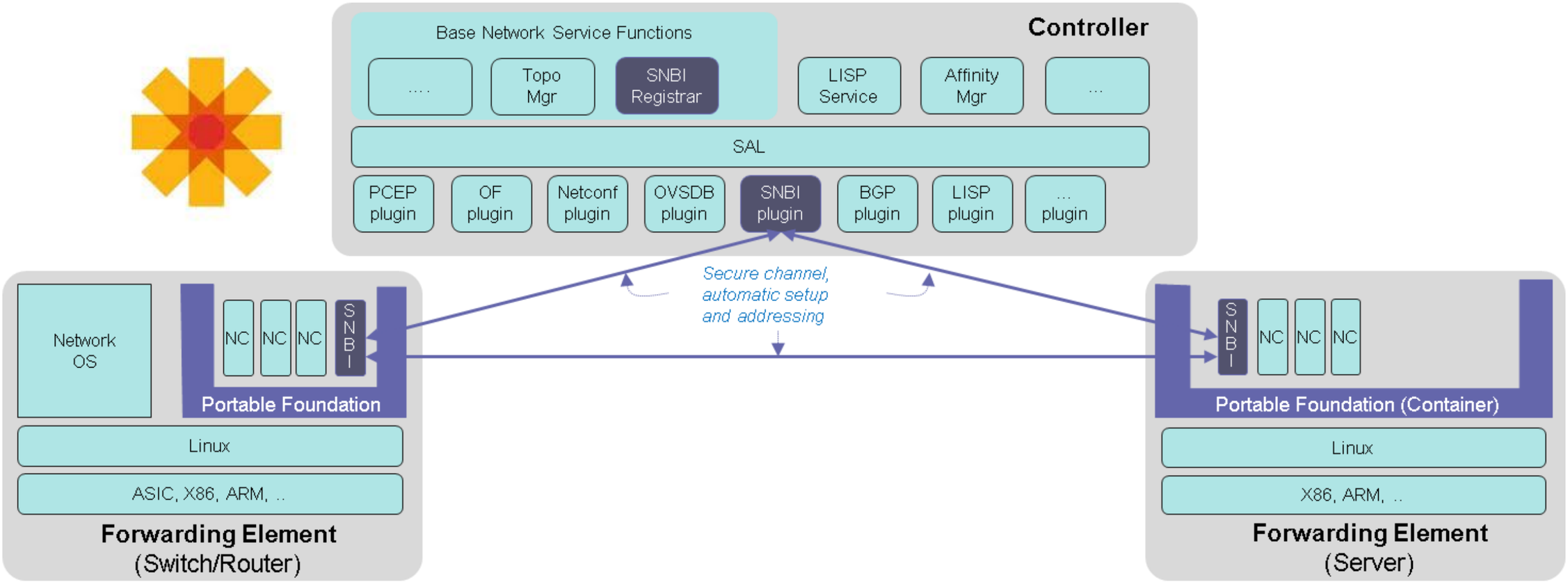
Use case drafts: Those are used to derive requirements for the Autonomic Networking Infrastructure

- Autonomic Networking Use Case for Network Bootstrap https://tools.ietf.org/html/draft-behringer-autonomic-bootstrap
- Autonomic Network Stable Connectivity https://tools.ietf.org/html/draft-eckert-anima-stable-connectivity
- Autonomic Prefix Management in Large-scale Networks https://tools.ietf.org/html/draft-jiang-anima-prefix-management

Solution drafts:

- An Autonomic Control Plane https://tools.ietf.org/html/draft-behringer-anima-autonomic-control-plane
- Bootstrapping Key Infrastructures http://tools.ietf.org/html/draft-pritikin-anima-bootstrapping-keyinfrastructures
- Bootstrapping Trust on a Homenet (this is in homenet, not ANIMA) https://tools.ietf.org/html/draft-behringer-homenet-trust-bootstrap
- A Generic Discovery and Neg. Protocol for Autonomic Networking https://tools.ietf.org/html/draft-carpenter-anima-gdn-protocol

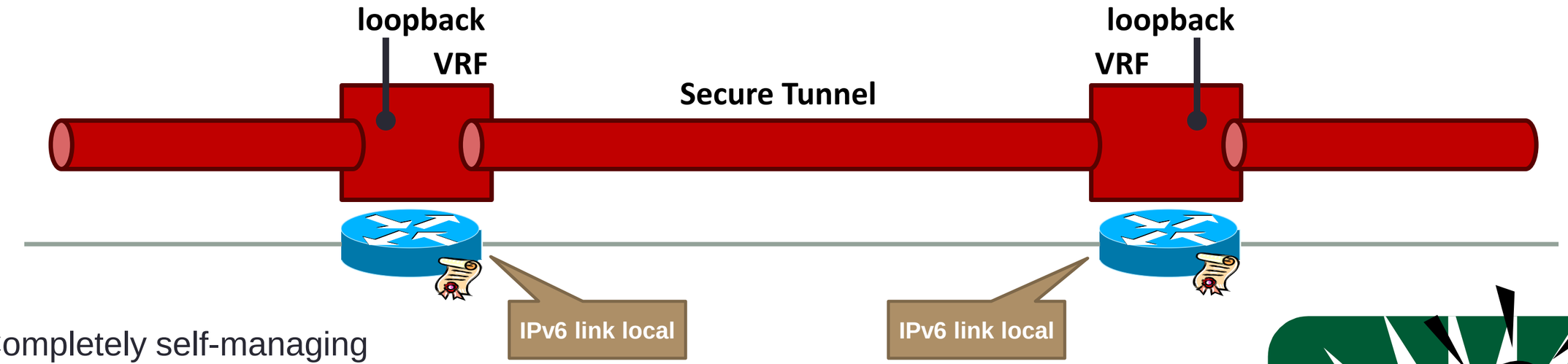
Please get involved: OpenDayLight: Secure Network Bootstrapping Infrastructure (SNBI)



https://wiki.opendaylight.org/view/SecureNetworkBootstrapping:Main

Summary

The Autonomic Control Plane (ACP)



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Cisco Device Support: SP, Enterprise and IoT

Supported today:

- ASR 901, ASR 901s, ASR 903, ASR 920, ME 3600, ME 3800
- Catalyst 2000, 3000, 4000, NG3k, IE 2000
- Open Source: Secure Network Bootstrap Infrastructure (SNBI; part of OpenDayLight Helium release)

Roadmap

- ASR 9000
- ASR 1000, CSR 1000, ISR-G2, ISR-4000
- (more to come)

References

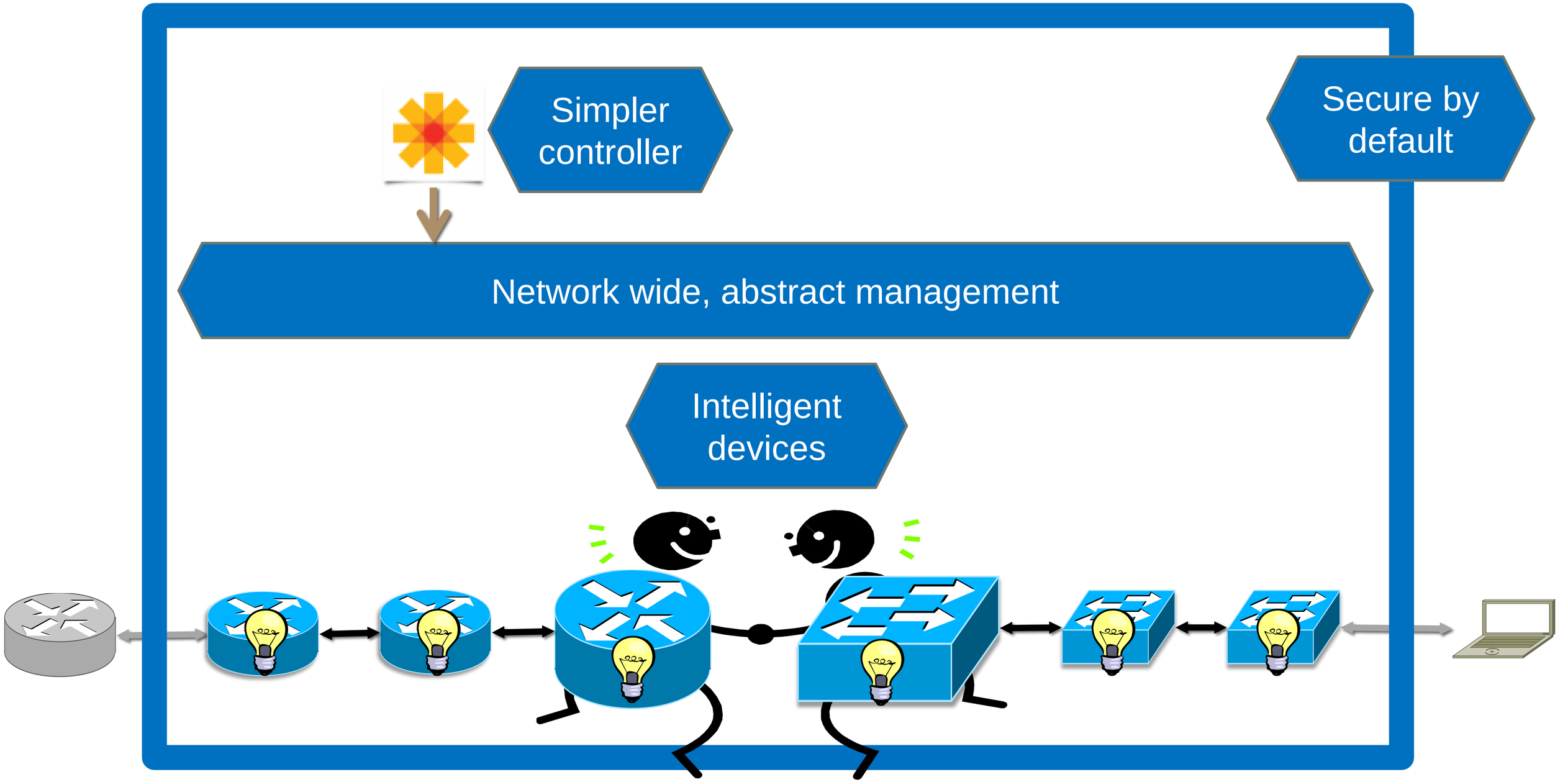
- www.cisco.com/go/autonomic/

- IEFT Drafts: See earlier slide
- OpenDayLight Project SNBI: https://wiki.opendaylight.org/view/SecureNetworkBootstrapping:Main
- Autonomic Networking Configuration Guide, Cisco IOS Release 15S www.cisco.com/en/US/partner/docs/ios-xml/ios/auto_net/configuration/15-s/an-auto-net-15-s-book.html
- Cisco IOS Autonomic Networking Command Reference www.cisco.com/en/US/partner/docs/ios-xml/ios/auto_net/command/an-cr-book.html

- **autonomic-team@cisco.com**

Backup Slides

Autonomic Networking: *The Self-Managing Network*



More Ideas…

Not committed

router bgp <as>
autonomic authentication

instead of

For each router:
For each neighbor:
- Configure static password at the same time as neighbor
- Regularly update all passwords, at the same time

router isis
autonomic authentication

instead of

For each router:
For each isis interface:
- Configure password or chain

For each area:
- Configure password or chain
- Regularly update all passwords

network-protection autonomic

instead of

Define Infrastructure ACL for your entire core address space
On each edge router:
- Install iACL
- Configure management plane protection
- Configure control plane protection

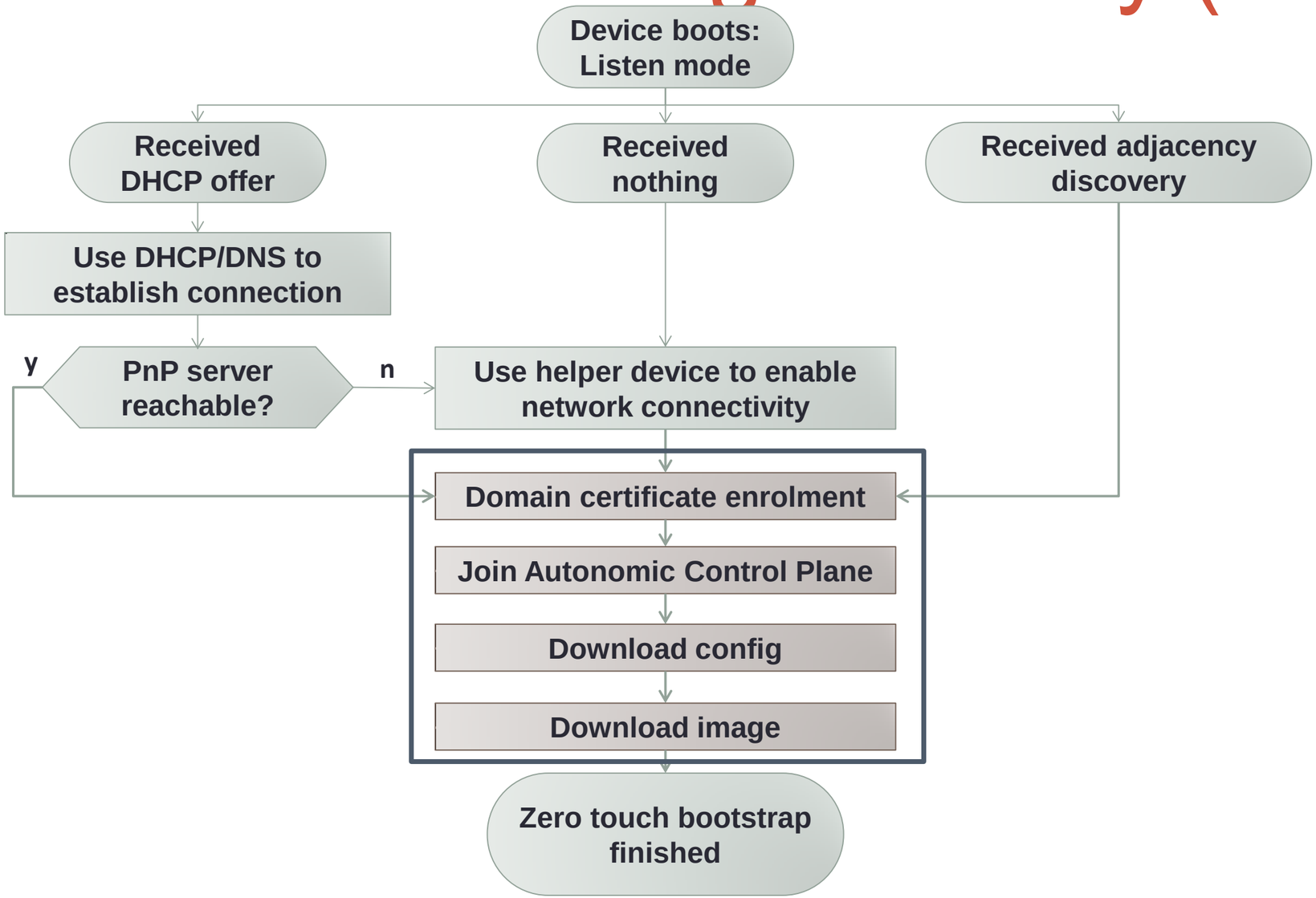
Update entire edge whenever address space changes

Secure remote device identification

<Your idea here….>

“Next Generation Plug and Play (PnP)”

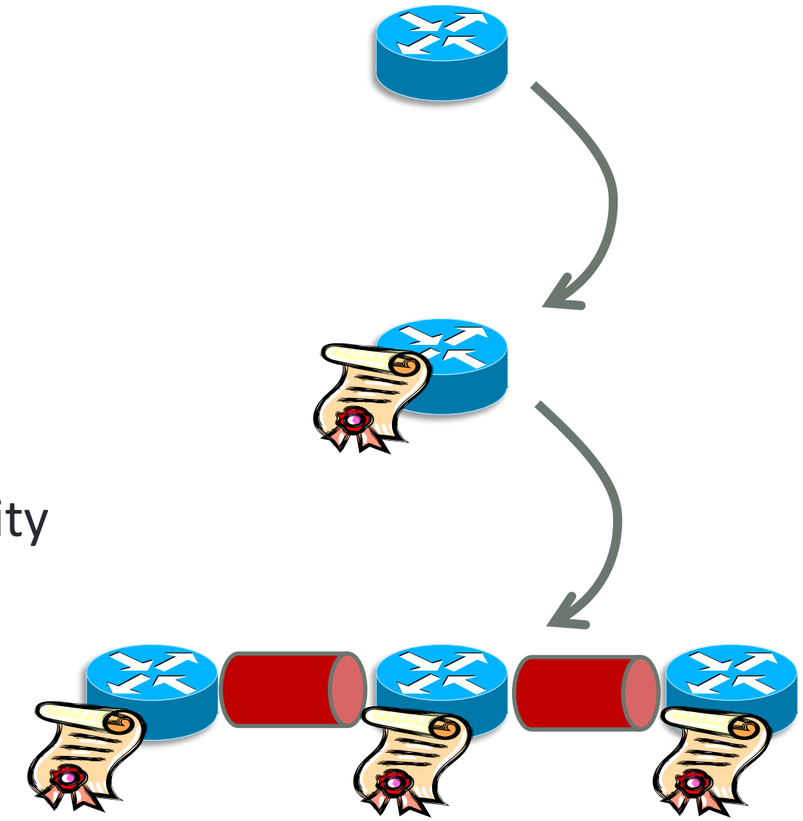
Work in Progress



Autonomic Networking Concepts Support SDN

1: Bootstrap security

2: Self-managing connectivity

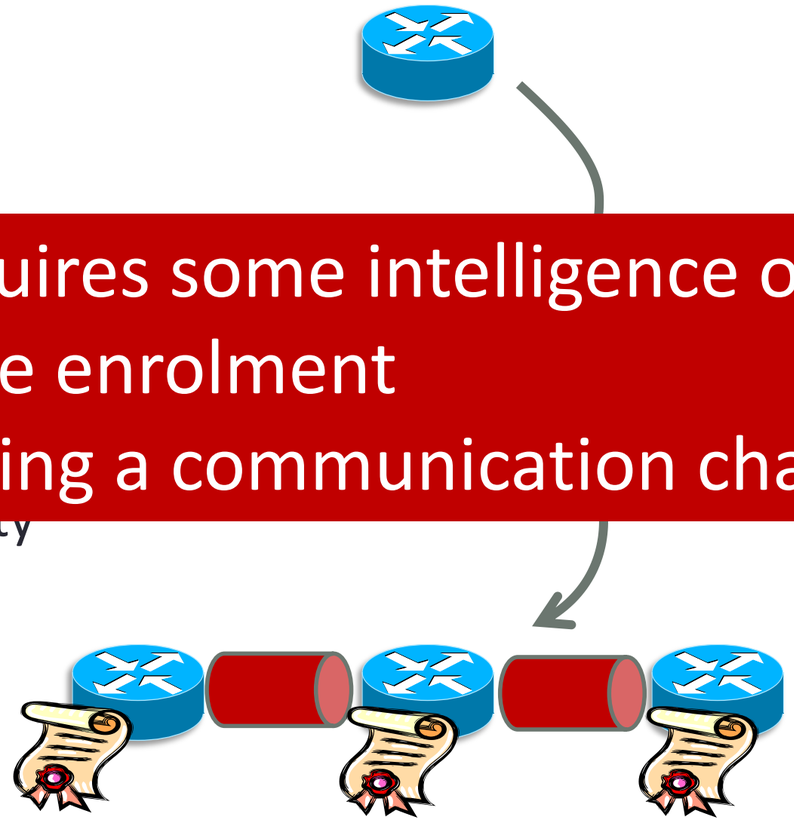


New, un-configured device

Device with domain certificate

Virtual out of band channel
With trusted neighbours

Autonomic Networking Concepts Support SDN



New, un-configured device

1: Bootstrap security

SDN requires some intelligence on devices
- Secure enrolment
- Enabling a communication channel

ith domain certificate

2: Self-managing connectivity

Virtual out of band channel
With trusted neighbours