

Automation in service delivery & policy implementation to enable SDN for carrier WAN's

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Strong growth drivers for SDN

- Strong growth drivers: *Related factors driving market dynamics*
 - Cloud computing
 - Data-hosting
 - Software as a service (SaaS)
 - Application-hosting

→ Remote delivery, virtualization & flexibility (pay-as-you-scale)
- Global SaaS market expected to reach \$106B by 2016 w 30% growth
 - ... Study by *Goldman Sachs (2015)*
 - Driving strong growth in Datacenter market
 - New business models: Infra as a Service (IaaS) or Platform as a Service (PaaS)
- Datacenters embracing SDN for flexibility & virtualization
- Telecom carriers and ISP's are exploring new revenue generation avenues through new platforms

SDN Market Opportunity

- SDN-enabled equipment market to exceed \$35B by 2018
 - Report from *SDN Central, Plexxi & Lightspeed Ventures (Apr, 2013)*
 - Market led by data-center hardware; 46% HW to be SDN-enabled
 - SDN products market expected to reach \$2.45B by 2018
 - Report by *Doyle Research & GigaOM (Feb, 2013)*
 - Enterprise-WAN would be significant part of SDN market by 2018
 - *“Moving SDN out of the data-center and into the WAN is a big challenge for enterprises” - Light Reading (Apr, 2014)*
- Leveraging existing network infrastructure of carriers or ISP’s is key to delivering SDN-WAN services to enterprise customers

SDN Beginnings

- SDN definition (*GigaOM Pro report, 2012*) :
 - Packet forwarding or Data plane is separated from Control plane
 - Centralized intelligence and control of switching (network devices)
 - Central programmability to
 - (i) change traffic flows
 - (ii) switch network partitions
 - (iii) control application-level quality
 - (iv) provide network flexibility
 - (iv) dynamically change priorities
- Data-center (DC) SDN: Initial driver of SDN market
 - On-demand application/data hosting (SaaS model) for Cloud services
 - On-demand, dynamic network connectivity between virtual servers, compute & storage resources
- Extension of SDN overlay to multiple DC sites for redundant access, geographic reach & mobility through data synchronization

- Enterprise customers require application performance delivery at remote delivery sites through private or hybrid WAN
 - SDN-DC is only one part, the other is WAN delivery
 - SDN-WAN allows on-demand, flexible service delivery
- WAN involves existing networks with diverse devices, technologies & services → Need effective SDN overlay for carrier NW's
- **“Achieving SDN in MAN/WAN is no trivial task. While DCs are simple, homogeneous and with essentially limitless bandwidth, carrier networks are complex, multi-vendor and subject to many technology and bandwidth constraints.”**
 - Alcatel-Lucent report on Cloud-optimized MAN & WAN SDN, 2013

Evolution of OSS for SDN-WAN

- **“In a telecom network, the maturing and evolution of its OSS/BSS system would be a pre-requisite to an end-to-end SDN implementation.”**
- Light Reading article by Deepak Kumar “SDN: Can Telco’s do ...” (Dec, 2013)
- **“At the heart of Service Provider SDN is software & a major transformation of the OSS layer creating a good abstraction of the entire network in terms of resources available in order to start software-controlling the network.”**
- Ulf Ewaldsson, Ericsson CTO in Light Reading by Michelle Donegan (Oct, 2013)
- **“The promise of SDN for telecom industry includes automated traffic management, improved bandwidth engineering, and ability to tailor the network "on demand" to customer needs/applications.”**
- Doyle Research article in NetworkWorld (Dec, 2012)

SDN-WAN Solution Blocks

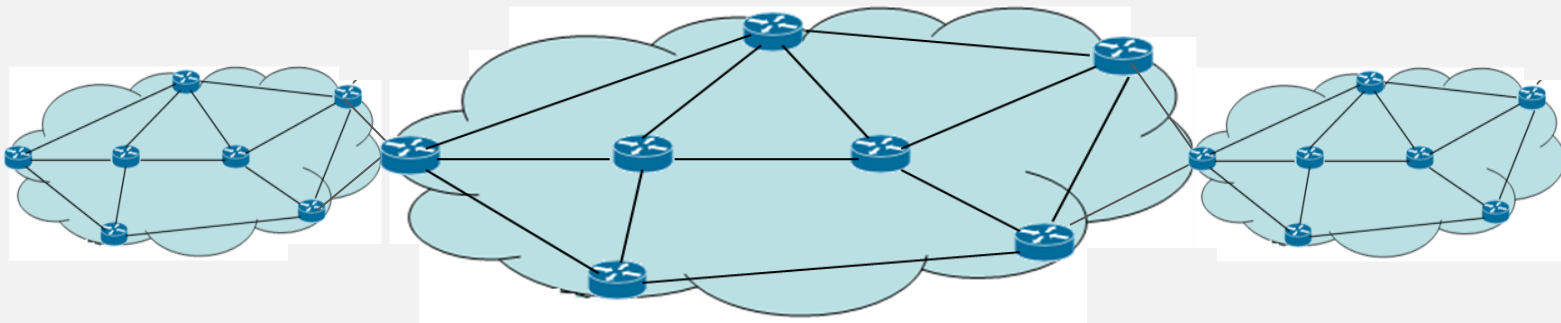
Building policy intelligence & programmability above OSS layer

SDN Control ↑ Openflow

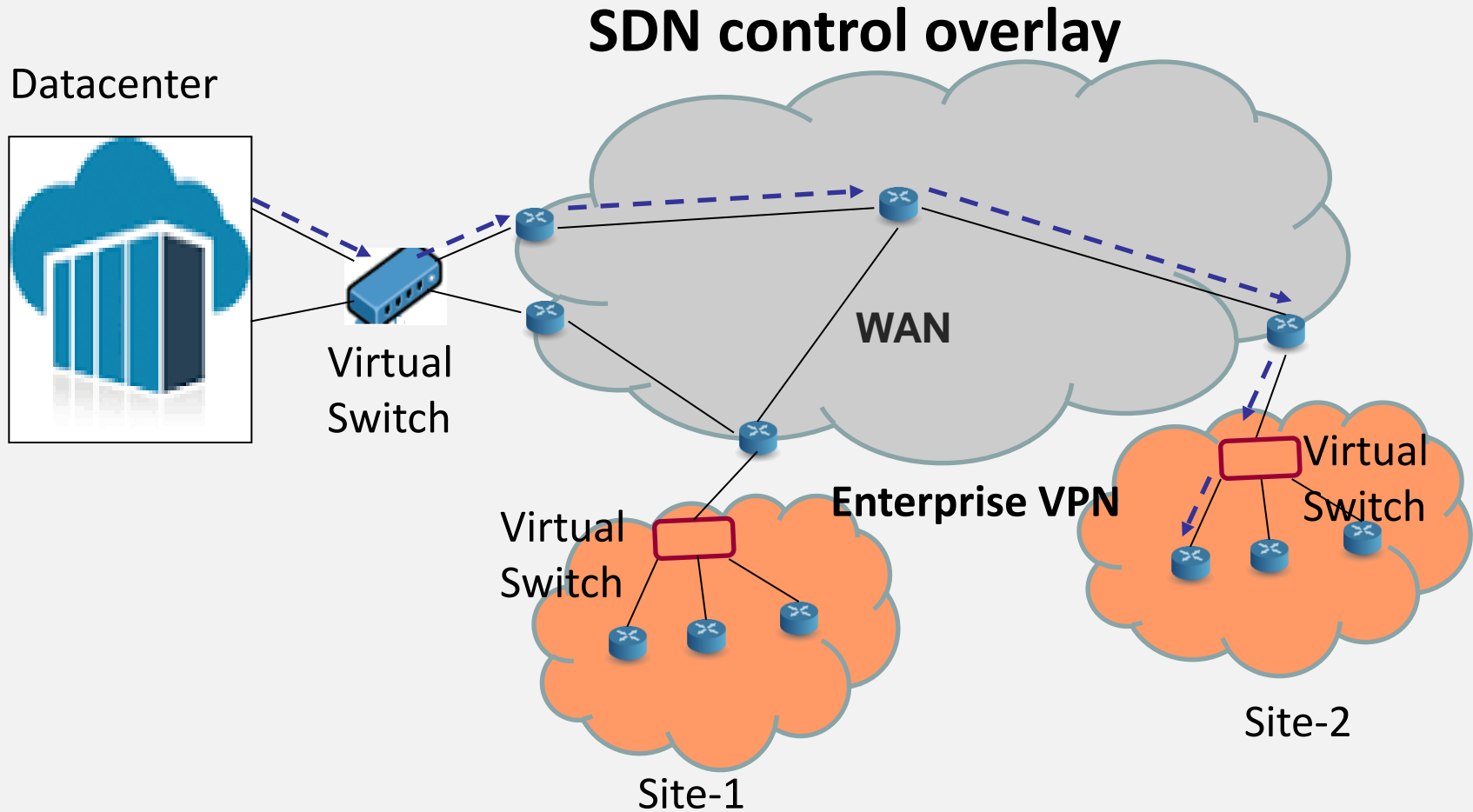
End-to-End Services- Control & Management

Policy Logic & Automation

Network Operations Control & Management



E2E WAN circuits



-----> End-to-end circuit from Datacenter to Site-2

Automating service provisioning

- Multi-vendor configlets for provisioning different types of services; VLAN, L2/L3-VPN, VPLS, VPWS, etc.
 - Pre-defined templates for each vendor & type of service
 - Parametric view of configurable parameters
 - Build logic for selecting parameters automatically
 - Create configlets for provisioning new services w selected parameters
 - Templates for configuring new routing/switching elements
 - Provide variety of policy templates - security/access/QoS
- Automated step-wise E-E circuit provisioning

Cisco VRF Config

SiMPLuS Report ANKITESH

localhost:8080/VPortal/ipmpls/success2.jsp?docdate=29-07-2015

VRF provisioning

CISCO TEXT VIEW 30th July 2015 | 4:12 PM

```

ip vrf A-T-E-ENTERPRISES-M
  rd 9730:14952
  maximum routes 80
  export map BHART-MANAGEMENT
  route-target export 9730:14952
  route-target import 9730:87
!
ip vrf ACCENT-SERVICES-M
  rd 9730:10957
  maximum routes 80
  route-target export 9730:10957
  route-target import 9730:10957
!
ip vrf ADITYA-AUTO-PRODUCTS-S
  rd 9730:15740
  maximum routes 80
  export map BHART-MANAGEMENT
  route-target export 9730:15740
  route-target import 9730:87
  route-target import 9730:15739
!
ip vrf ADITYA-WORLDWIDE-M
  rd 9730:12215
  maximum routes 80
  route-target export 9730:12215
  route-target import 9730:12215
!
  
```

SiMPLuS Report

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CISCO PARAMETRIC VIEW 30th July 2015 | 4:12 PM

NODE IP	SECTION NAME	PARAMETER	PARAMETER VALUE
203.122.27.100	ip vrf	A-T-E-ENTERPRISES-M	
203.122.27.100		rd	9730:14
203.122.27.100		maximum routes	5000 80
203.122.27.100		export map	BHART-MANAGEMENT
203.122.27.100		route-target export	9730:14
203.122.27.100		route-target import	9730:14
203.122.27.100		route-target import	9730:87
203.122.27.100	ip vrf	ACCENT-SERVICES-M	
203.122.27.100		rd	9730:10
203.122.27.100		maximum routes	5000 80
203.122.27.100		route-target export	9730:10
203.122.27.100		route-target	import 9730:10957
203.122.27.100	ip vrf	ADITYA-AUTO-PRODUCTS-S	
203.122.27.100		rd	9730:15
203.122.27.100		maximum routes	5000 80
203.122.27.100		export map	BHART-MANAGEMENT
203.122.27.100		route-target export	9730:15
203.122.27.100		route-target import	9730:87
203.122.27.100		route-target import	9730:15
203.122.27.100	ip vrf	ADITYA-WORLDWIDE-M	
203.122.27.100		rd	9730:12
203.122.27.100		maximum routes	5000 80

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Juniper VRF Config

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JUNIPER VIEW

```

routing-instances {
  WIPVOICE XX_FM {
    instance-type vrf;
    interface ae0.777;
    route-distinguisher 192.168.1.5;
    vrf-import WIPVOICE XX_FM_IMPORT;
    vrf-export WIPVOICE XX_FM_EXPORT;
    routing-options {
      static {
        route 192.168.1.2/32 next-hop 192.168.1.5;
      }
    }
  }
  community WIPVOICE XX_FM members target:55410.2004;
  policy-statement WIPVOICE XXXX_FM_EXPORT {
    term b {
      from {
        protocol static;
        route-filter 192.168.1.2/32 exact;
      }
    }
  }
  policy-statement WIPVOICE XXXX_FM_IMPORT {
    term a {
      from {
        protocol bgp;
        community [ WIPVOICE CEXXXX_FM ];
      }
    }
  }
}
    
```

SiMPLuS Report

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JUNIPER PARAMETRIC VIEW

Section	Parameter	Value
routing-instances		WIPVOICE XX_FM
	instance-type	vrf
	interface	ae0.777
	route-distinguisher	192.168.1.5
	vrf-import	WIPVOICE XX_FM_IMPORT
	vrf-export	WIPVOICE XX_FM_EXPORT
	routing-options	static
	route	192.168.1.2/32 next-hop 192.168.1.5
community		WIPVOICE XX_FM
	members target	target:55410.2004
policy-statement		WIPVOICE XX_FM_EXPORT
	protocol	static
	route-filter	192.168.1.2/32 exact
policy-statement		WIPVOICE XX_FM_IMPORT
	protocol	bgp
	community	WIPVOICE CEXXXX_FM

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Automating provisioning logic

Initiate auto-service provisioning from control layer or user-order

- Select service type, bandwidth & quality from controller/order info
- Select available interface, sub-interface or virtual interface
- Select WAN-IP address from available pool & register N/W info
- Select circuit-ID or interface description & aliases w policy logic
- Select vendor-specific provisioning template w given parameters
- Select network-specific parameters e.g. VRF, RD/RT, VLAN ...
- Ensure compliance to various policies e.g. security, access, QoS, ...
- Push / execute final provisioning configlet to routers/switches
- Verify execution success or log errors

Automated Service Provisioning

VPN provisioning
template

Input parameters through
DB/CSV/Excel or external API

IRDEI	CUSTOMER-NAME	ADDRESS	BANDWIDTH	VRF	RD	RT	CIRCUIT	VLAN	INTERFACE	WAN-IP	
1	101101	Noida	1024	3-1-M	9830:1010	9830:1010	3-1-30	645	G1/0/1	172.34.10.9	in
2	101102	Ludhiana	2048	3-1-M	9830:1030	9830:1030	L3-10-50	785	G2/0/1	172.34.10.90	in
3	101103	Gurgaon	1024	3-1-M	9830:1040	9830:1040	1-1-23	333	G1/0/10	172.34.10.80	in
4	101104	Nagpur	512	3-1-M	9830:1010	9830:1010	3-1-30	111	G1/0/1	172.34.10.123	in
5	98765	Shimla	10000	SH							

Final configlet for VPN
service provisioning

Destination IP (Column: DEST-IP)

```
203.101.87.229
202.123.47.120
203.101.87.229
203.101.87.229
202.123.47.120
```

Generated Template

```
ip vrf IOCL-ML3-1-M
rd 9830:1010
export map
route-target export 9830:1010
route-target import 9830:1010
route-target import 9730:87
maximum-routes 5000 80
!
router bgp 9730
address-family ipv4 vrf
no synchronization
redistribute connected
redistribute static
neighbor 172.34.10.10 remote-as 65500
neighbor 172.34.10.10 description
neighbor 172.34.10.10 activate
neighbor 172.34.10.10 maximum-prefix 1000 restart 15
exit-address-family
!
ip access-list extended
```

Are You Sure to execute commands on 1 router(s)?

Yes No

Jun 10, 2015 12:52:51

Push Now Close

Patch/upgrade Management

- ❖ Patch for security vulnerability or OS upgrade
 - ❖ New access/QoS policy implementation
 - ❖ Transition to new network design policy (e.g. from SNMP-v2 to v3)
 - Configuration upgrade to 1000's of devices as per policy or for patch
 - Devices listing selected based on vendor, model & OS number etc.
 - Policy compliance audit of entire N/W – List of noncompliant devices
 - Selective bulk push to dev-list – Auto-execute patch/upgrade in parallel
 - Intelligent summary of results – Success log & failure report
- Simplifies task from multiple hours / days to few minutes

SNMP Configuration

Browser window: SIMPLuS Report, localhost:8080/VPortal/ipmpls/success2.jsp?docdate=29-07-2015

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```

snmp-server view cutdown
snmp-server view cutdown
snmp-server view cutdown
snmp-server view cutview
snmp-server view cutview
snmp-server view cutview
snmp-server view cutview
snmp-server view cutview
snmp-server view cutview
snmp-server view cutview
snmp-server view cutview
snmp-server view cutview
snmp-server community b
snmp-server community a
snmp-server community i
snmp-server trap link ief
snmp-server trap link swit
snmp-server trap-source l
snmp-server ftp-server-lis
snmp-server enable traps
snmp-server enable traps
snmp-server enable traps
snmp-server enable traps
snmp-server enable traps
snmp-server enable traps
snmp-server enable traps
snmp-server enable traps
snmp-server enable traps
snmp-server enable traps
snmp-server host 125.62.
snmp-server host 125.62.
snmp-server host 125.62.
snmp-server file-transfer a
snmp ifmib ifalias long
snmp ifmib ifindex persist
    
```

Browser window: SIMPLuS Report, localhost:8080/VPortal/ipmpls/success2.jsp?docdate=29-07-2015

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CISCO PARAMETRIC VIEW

Section	Sub Section / Parameter	Value 1 / Flag	Value 2 / Flag	
snmp-server view	cutdown			
		internet	included	
		ip.21	excluded	
		cbQc	PoliceActionCfg	excluded
	cutview			
		at		excluded
		snmp	mMIB	excluded
		snmp	mMIB	excluded
		snmp	munityMIB	excluded
		ip.21		excluded
		ip.22		excluded
		ip.35		excluded
	snmp-server community	view cutdown	btsol	RO 75
		adrs	RO 50	
		ippms	RO 51	

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Security Policy Implementation

SiMPLuS Report

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CISCO SECURITY VIEW

no service finger	
no service pad	
no service tcp-small-servers	
no service udp-small-servers	
no ip identd	
no cdp run	
no ip source-route	
no ip bootp server	
no boot network	
no service config	
service tcp-keepalives-in	
service tcp-keepalives-out	
service sequence-numbers	
ip tcp synwait-time 10	
no ip http server	
no service dhcp	
mac-address-table aging-time 14400	
service password-encryption	
enable secret	
username <name> secret <password>	
ip domain-name	
crypto key generate rsa general-keys modulus 1024	

SERVICES	
service finger	✗
service pad	✓
service tcp-small-servers	✗
service udp-small-servers	✗
ip identd	✗
cdp run	✗
ip source-route	✗
ip bootp server	✗
boot network	✗
service config	✗
service tcp-keepalives-in	✓
service tcp-keepalives-out	✓
service sequence-numbers	✓
ip tcp synwait-time 10	✓
ip http server	✗
service dhcp	✗
mac-address-table aging-time 14400	✓
service password-encryption	✓
enable secret	✓

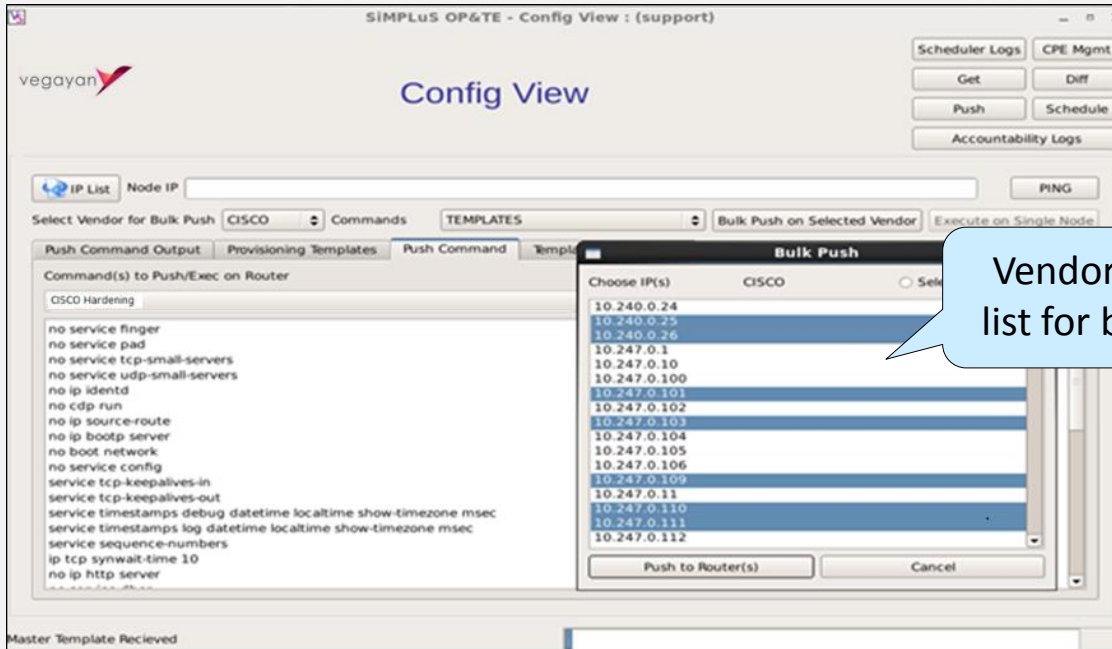
NODE ID	NODE NAME
10.40.1.X	CHENNAI CORE 1
10.44.1.X	HYDERABAD CORE 1
10.24.2.X	VIJAYWADA CORE 1
10.44.2.X	WARANGAL CCR 001
10.73.2.X	WARANGAL CCR 002
10.14.0.X	KOLKATA CCR 001

Web Reports powered by SiMPLuS

Push Command

The screenshot displays the SIMPLuS Operations - Config View interface. At the top, there are navigation tabs: View RD/RT Information, Load RD/RT CSV Into Database, Schedule, Scheduler Summary, and Accountability Logs. Below these are Device Management, Get, Diff, Push, Template Management, and Template Automation. The main area is titled 'Config View' and contains several input fields: IP List (Node IP: 202.1...20), HostName (RP/0/RSP...20), and buttons for RollBack and PING. A dropdown menu for 'Select Vendor for Bulk Push' is set to CISCO, and the 'Commands' field contains 'show version'. The 'Bulk Push on Selected Vendor' and 'Execute on Single Node' buttons are visible. The 'Push Command Output' tab is active, showing a 'Command ID' of 1 and 'Participating IPs' of 202.12...0. The 'Command' field contains: show interface ethernet 3/2, no switchport, bandwidth 2000, sh run int Ethernet 3/2. A callout bubble points to this field with the text 'Config command execution'. The 'Command Output (CISCO) (RP/0/RSP...20)' field shows the following output: Ethernet3/2 is up, Hardware: Ethernet, address: 0050.5652.a9ba (bia 0050.5652.a9ba), MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec, reliability 0/255, txload 0/255, rxload 0/255, Encapsulation ARPA, Port mode is trunk, full-duplex, 1000 Mb/s, Beacon is turned off, Auto-Negotiation is turned off. A callout bubble points to this output with the text 'Command output'. At the bottom, there are buttons for Save Output, Save All Outputs, a dropdown for -- SELECT Summary type--, a checkbox for Select for Diff, and a Diff Command Outputs button. The status bar at the bottom shows 'Master Template Retrieved' and '100% (1 / 1)'.

Bulk Push



SIMPLuS OP&TE - Config View : (support)

vegayan

Config View

Scheduler Logs CPE Mgmt
Get Diff
Push Schedule
Accountability Logs

IP List Node IP [] PING

Select Vendor for Bulk Push CISCO Commands TEMPLATES Bulk Push on Selected Vendor Execute on Single Node

Push Command Output Provisioning Templates Push Command Template

Command(s) to Push/Exec on Router

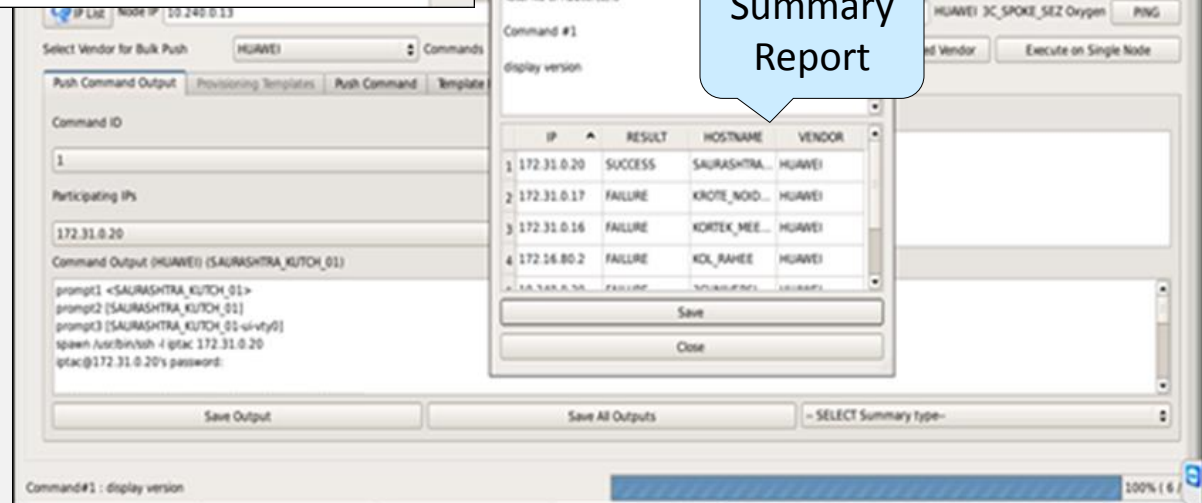
```
OSCO Hardening
no service finger
no service pad
no service tcp-small-servers
no service udp-small-servers
no ip ident
no cdp run
no ip source-route
no ip bootp server
no boot network
no service config
service tcp-keepalives-in
service tcp-keepalives-out
service timestamps debug datetime localtime show-timezone msec
service timestamps log datetime localtime show-timezone msec
service sequence-numbers
ip tcp synwait-time 10
no ip http server
```

Choose IP(s) CISCO

- 10.240.0.24
- 10.240.0.25
- 10.240.0.26
- 10.247.0.1
- 10.247.0.10
- 10.247.0.100
- 10.247.0.101
- 10.247.0.102
- 10.247.0.103
- 10.247.0.104
- 10.247.0.105
- 10.247.0.106
- 10.247.0.109
- 10.247.0.11
- 10.247.0.110
- 10.247.0.111
- 10.247.0.112

Push to Router(s) Cancel

Vendor specific list for bulk push



SIMPLuS Operations Push Commands Summary

Summary

Wed Sep 25 15:20:45 2013

Total No of Router(s) 6

Command #1
display version

	IP	RESULT	HOSTNAME	VENDOR
1	172.31.0.20	SUCCESS	SAURASHTRA_KUTCH_01	HUAWEI
2	172.31.0.17	FAILURE	KHOTE_NOD_	HUAWEI
3	172.31.0.16	FAILURE	KORTEK_MEE_	HUAWEI
4	172.16.80.2	FAILURE	KD_RAHEE	HUAWEI

Save Close

Save Output Save All Outputs - SELECT Summary type-

Command#1 : display version

Summary Report

Rollback Config

SIMPLuS Operations - Config View : (support)

vegayan **Config View**

View RD/RT Information | Load RD/RT CSV Into Database | Schedule | Scheduler Summary | Accountability Logs

Device Management | Get | Diff | Push | Template Management | Template Automation

IP List | Node IP: 203.129.229 | HostName: HYD-UP-229 | RollBack | PING

Select Vendor for Bulk Push: JUNIPER | Commands: CUSTOM COMMAND | Bulk Push on Selected Vendor | Execute on Single Node

Push Command Output | Provisioning Templates | Push Command

Command ID: 1

Participating IPs: 203.129.229

Command Output (JUNIPER) (HYD-UP-229):

```
telnet; connect to address 203.129.229
commit complete
+ interfaces {
+   ge-1/1/1 {
+     unit 0 {
+       family inet {
+         filter {
+           input mfg_plp;
```

Command :

```
rollback 1
commit
Show system rollback 3 compare 1
```

Router output

Save Output | Save All Outputs | -- SELECT Summary type-- | Select for Diff | Diff Command Outputs

Master Template Retrieved | 100% (1 / 1)

Automation in provisioning & policy implementation to enable SDN

- Network set-up is abstracted by a vendor-neutral layer
 - Network provisioning & policies are simplified in parametric form
 - Decision-making & parameter value selection is automated by logic building block with preselected rules
 - Logical rule selections capture N/W design criteria, human decision making steps & external information (through set interfaces)
 - Allows fast execution with ability to scale to 1000's of devices
 - Allows network-wide changes in policy or patch roll-out
- Automation provides dynamic & flexible WAN network control
Hides complexity in config syntax & N/W design policy criteria

Thank You

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