



Nuviso Concerto (NCO)

SDWAN solution based on Nuviso Symphony Suite

What Does Nuviso Networks Do?



Enables Network Agility for Enterprise and Telco Operations

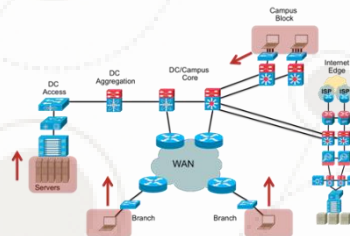


**Simplicity
Agility**

Define

Deploy

Scale

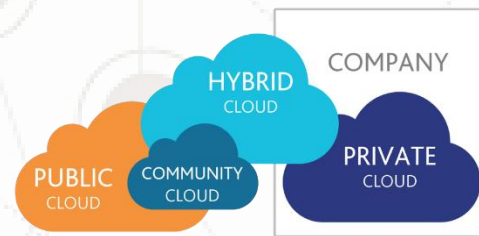


**E2E
Network**

Core/Transport

Branch/Edge

Cloud/DC



**Heterogeneous
Environments**

Physical

Virtual



**Varied
Deployments**

Brownfield

Greenfield

The Problem – Enterprise and Telco Networks are Complex; Available Solutions are Fragmented

Current Enterprise and Telco Pain Points

IDC:

- 42% time spent on maintaining legacy systems
- 5% time spent on business critical projects

Complex Networks



Past	Present
<ul style="list-style-type: none">• Physical End Points• Not Controller Based• Adequate for legacy application needs• Command Line based Management	<ul style="list-style-type: none">• Physical & Virtual End Points• Legacy & Controller Based• Need to adapt rapidly to workloads• Programmability & Service abstractions / API-based management



Fragmented Solutions



Telco/SP Pain Points

- Rapid enablement of new services and technologies (MEC, 5G, RAN Management among others)
- Lack of brown-field automation for easier infrastructure service deployment
- Need for Multi-vendor mediation for service and configuration
- Problem of Orchestration support for multi-domains
- No support for NFV Multi-cloud
- No easy way of migration for managed services

Enterprise Pain Points

- No intent Driven Configuration
- No coherent IT Operations story (both Net and Sec Ops)
- Complex branch Connectivity
- Silos of network Management
- No easier Cloud migration

The Nuviso Solution – A Few Steps to Automate Operations Across Any Infrastructure

DRAG/DROP NETWORK SERVICES OR APPLICATIONS FROM CATALOG

STEP

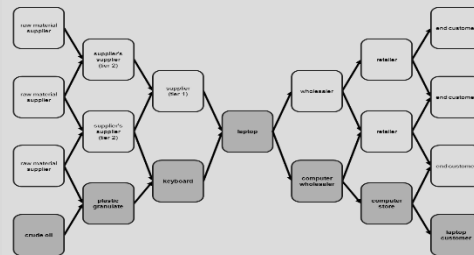
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CONNECT APPS AND NETWORK SERVICES

STEP

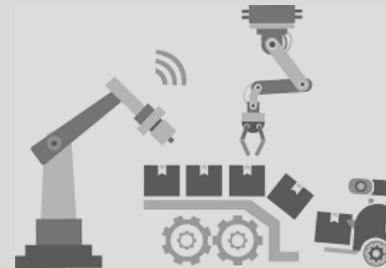
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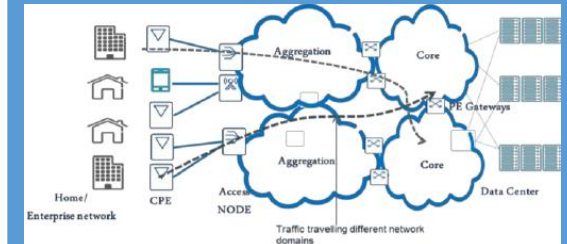
**CLICK TO AUTO DEPLOY E2E
NETWORK OR APPLICATION
SERVICES**

STEP

3



SERVICE DEPLOYED



- Applications
- Network Services

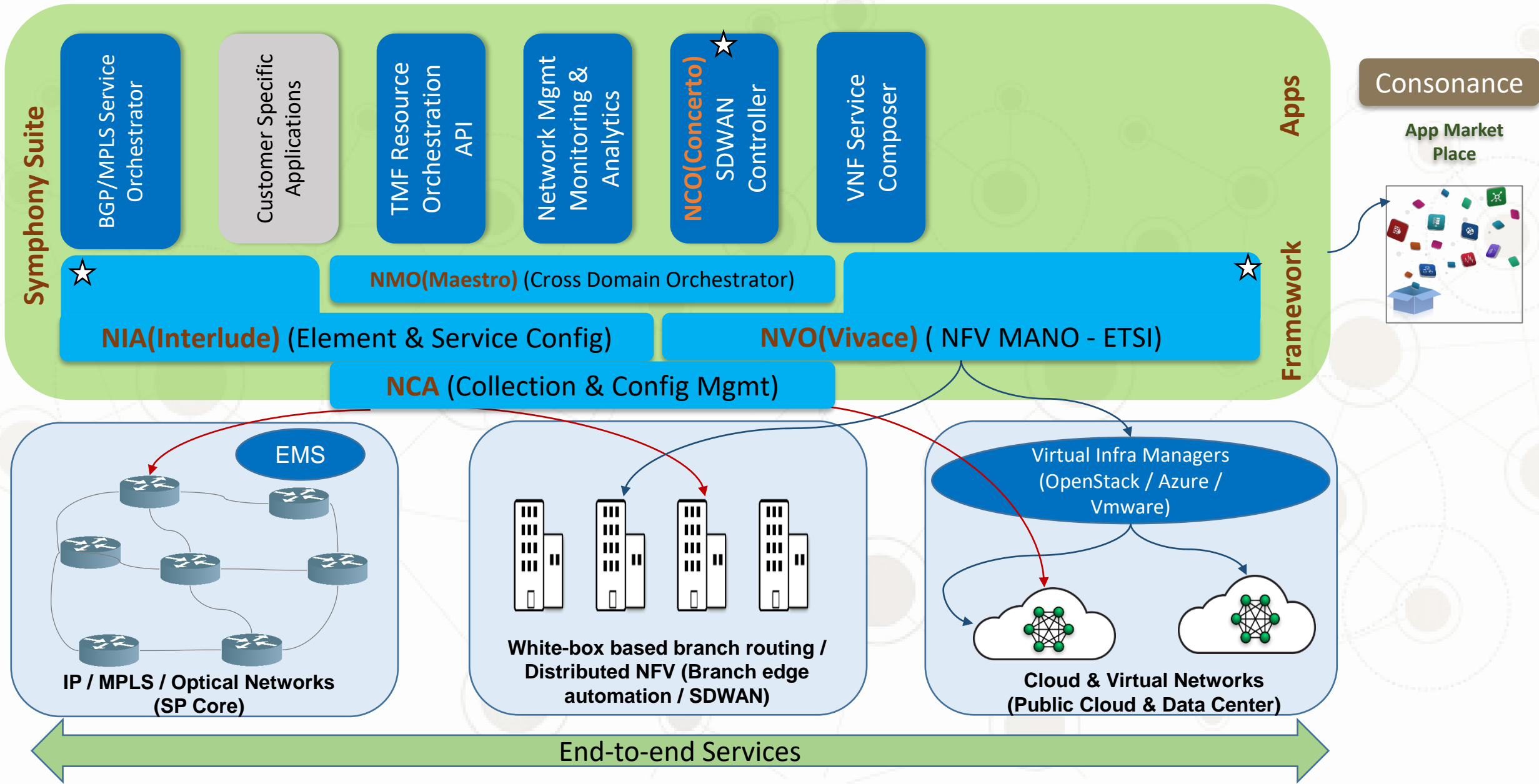
- *Stitching/Chaining*
- *Scale-out/Scale-in*
- *Analytics and Automation*

- *Deploy in any Domain*
- *Service Monitoring*
- *Auto Rollback*

- *Private/Public/Hybrid Clouds and Campus*
- *Scale and Adapt*
- *Performance Assurance*
- *Service Continuity*

Nuviso Products/Technology - Symphony SW Suite

API Driven and Integration Ready



Problem Statement

- Many enterprises that have multi-geography presence have often grown in an unplanned fashion, with each branch-office following their own IT model, ISP and policies
- In addition most of these branches have multiple service providers servicing each location, and private WAN meshes being used as well pushing up the cost.
- Each branch location follow their own policy and configuration to manage their campus network, as well as chose their Service Provider, resulting in a fragmented campus network across various establishments
- Concerto SDWAN is a solution that can be offered by Service Providers to public and private entities, that will better enforce policies in a uniform manner across all branches, as well as bring down overall IT costs
- Key difference from regular SDWAN solutions
 - Easy to use & deploy at very low TCO.
 - Nuviso Concerto framework can work with any vendor branch router (including existing CPEs)
 - Doesn't enforce a proprietary hardware & software combination
 - Offers tremendous flexibility to the service provider to use their existing installed branch gear
 - Supports centralized and distributed NFV functions along with SDWAN, thereby avoiding the need to integrate multiple systems and solutions from different vendors

Concerto Key Solution Highlights

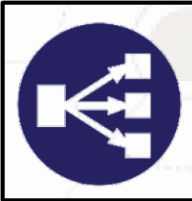


Centralized Control

Cloud and on prem support

Layered architecture

Zero touch provisioning



Automated branch provisioning and connectivity

Flexible branch functionality (physical or virtual form)



Future Proof

Service push using IETF/OpenConfig YANG models

NFV Management (fully complaint to ETSI MANO)

Flexible hardware support



No vendor lock in (uCPE/white box branch device)

Well defined REST API (for northbound support)

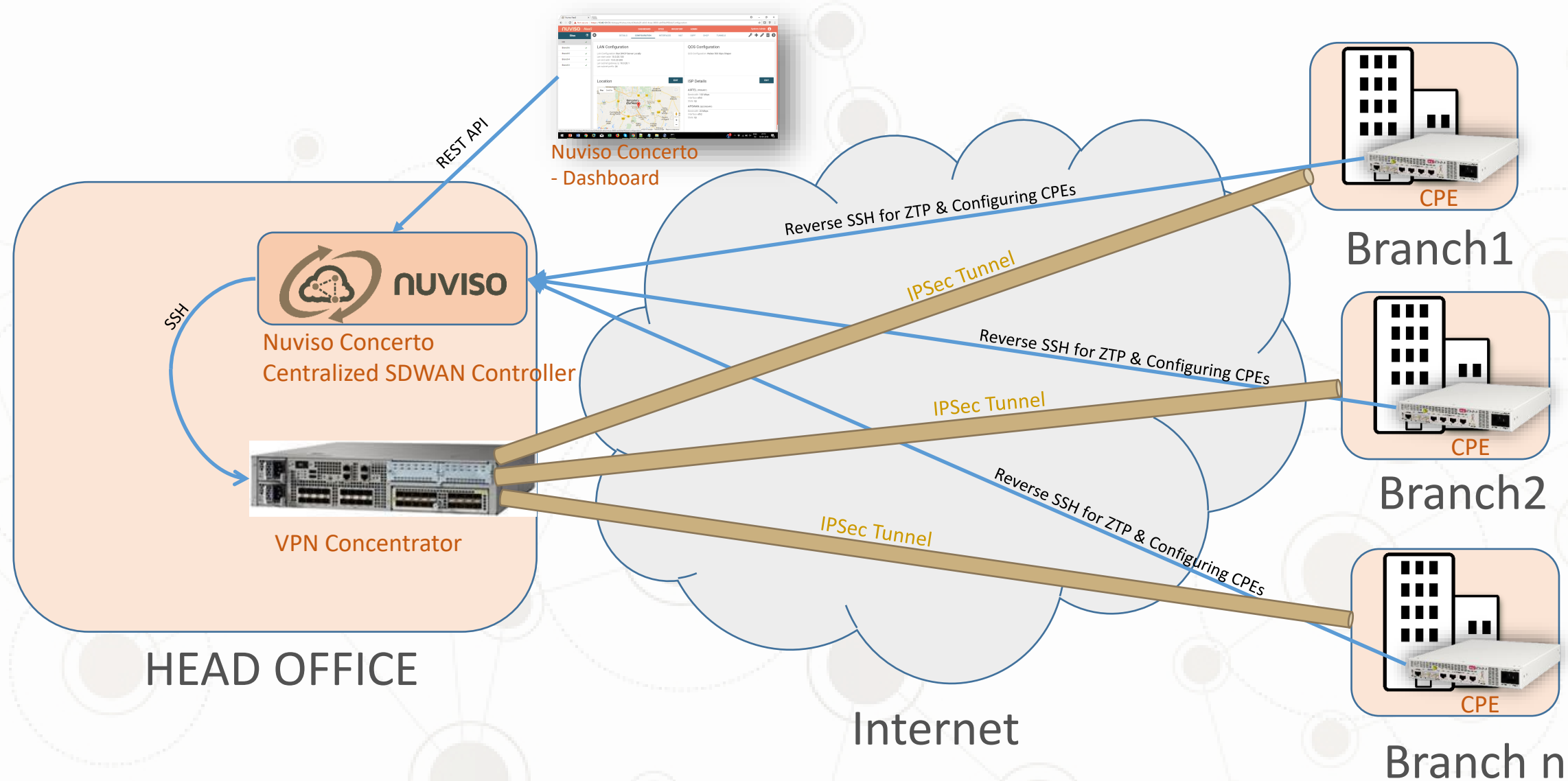


Multi-Tenant Support

Single installation for supporting multiple customers

Self service portal support for customers

Nuviso Concerto Communications Architecture



Nuviso Concerto Architecture Components

Component	Functionality	Example Hardware
CPE	Provide Connectivity to headoffice over IPSec tunnel. May have multiple WAN links for redundancy	RAD ETX-2v with Intel Atom C2358 Protectli(FW4A) with Intel Atom E3845 (Any white box uCPE with: x86/ARM, 1GB RAM, 16GB storage would work)
VPN Concentrator	Head end termination point for ipsec tunnels coming from CPEs.	Cisco ASR 1K
Nuviso Concerto Controller	Centralized controller for managing all the CPE and Head office boxes.	Linux VM with 16GB RAM, 512GB Storage
Nuviso Concerto Dashboard	User interface for Nuviso Concerto Controller	Web based UI (Chrome/Safari/Firefox/IE Edge)

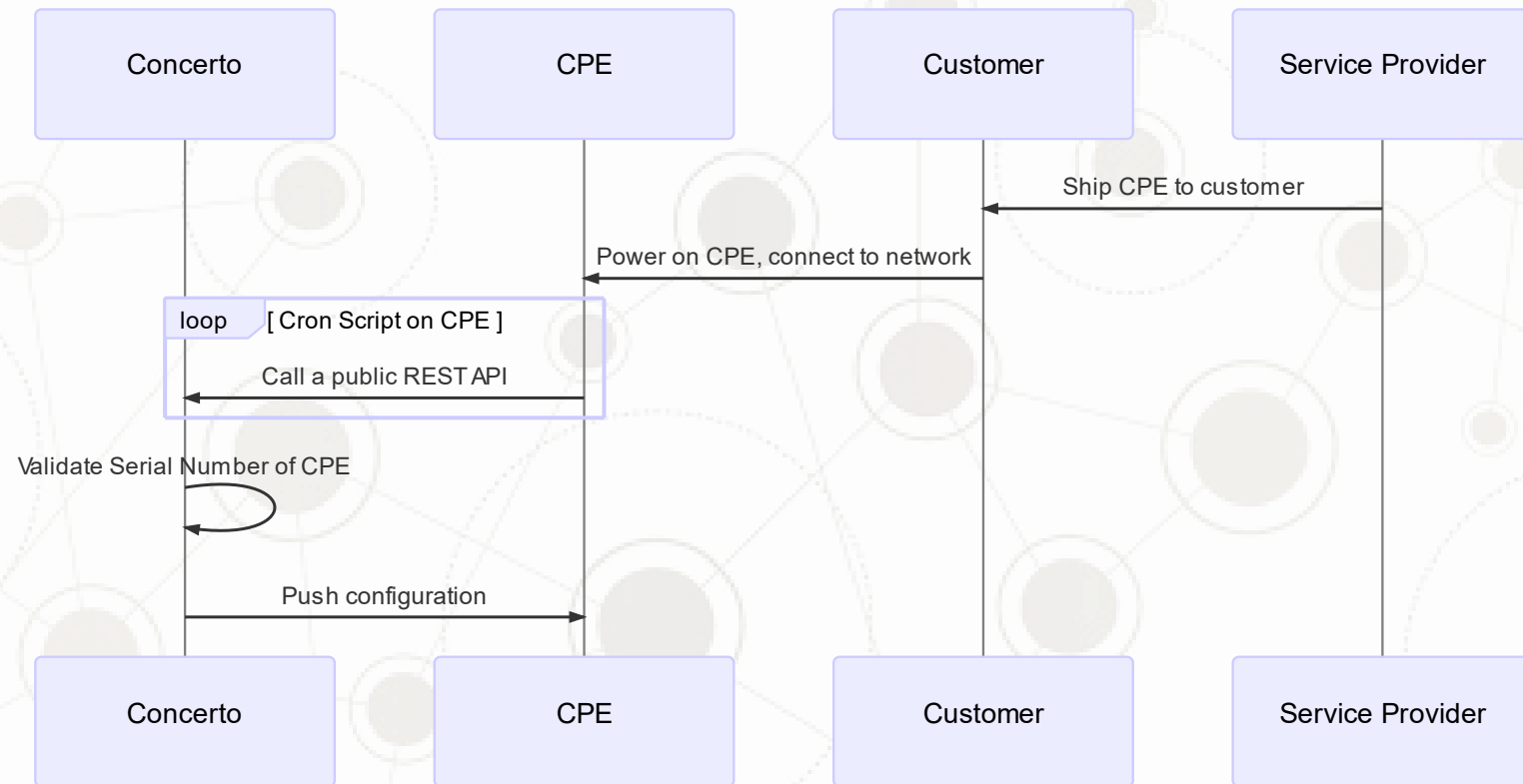
Detailed Technical Features

Technology Area	Features
SDN/NFV	ETSI compliant framework, YANG modeling, TOSCA templates, Zero Touch Provisioning, Northbound REST API, VNF Management, Service Chaining
Branch Router hardware	Whitebox architecture, x86 processor, Gigabit Ethernet, Wifi, LTE interfaces, Solid State Storage, Fan-less design (Or bring your own CPE e.g. NXP)
Branch Routing – core software	NAT, QoS, ACL, Security, VPN tunneling, Load Balancing, Overlay routing, Flow monitoring using SFLOW/NetFlow, Scripting based on event triggers
Branch Routing - Management	Device config using templates, Network Element Inventory, Topology, Policy Management, Certificate Management, AAA/Radius based authentication, SNMP, NTP, DHCP (client&server), Syslog, SSH, Zero Touch Provisioning
Controller	Centralized, Cloud Hosted / On-prem, North bound APIs based on YANG models, Dynamic extension of new models/devices/services, TM Forum API (roadmap) for OSS integration
Monitoring/Analytics/ Telemetry	Various statistics aggregated as a time-series database and summarized at different levels
Future expansion	Ability to bring in any new function as VNF and service chain with branch router VNF

Hardware choices

- Nuviso Concerto framework is multi-vendor capable by using abstract yang models from IETF/OpenConfig
- Easy to adapt to any hardware vendor
 - Standard solution offering is based on a universal CPE device (x86 or ARM based white-box) that boots Linux and capable of running any open-source routing function for branch-routing needs
 - For specific use cases, Nuviso has enabled usage of pre-existing branch routers, both in hardware and software form factors, to reduce solution capex. Can support vendors like Palo-Alto, Cisco etc, that have regular branch routing and VPN functions

Nuviso Conerto ZTP – Sequence



Nuviso Concerto ZTP- Highlights

Summary:

- Small cron script running on the CPE in the background.
- Calls publicly published REST API provided by Concerto
- Concerto validates serial number, creates the required configuration
- Concerto pushes the configuration to CPE over SSL connection

Advantages:

- CPE can be behind a firewall and/or NAT.
- CPE does not require to have a static public IP.
- Secure communication between Concerto and CPE over SSL with certificate
- User workflow to validate the configuration before moving the CPE to production stage.

SDWAN controller screenshots

The screenshot shows the Nuviso NaaS web interface. The top navigation bar includes 'DASHBOARD', 'SITES', 'INVENTORY', and 'ADMIN'. The 'SITES' tab is active, and the 'DETAILS' sub-tab is selected for the site 'HO'. The site status is 'PRODUCTION' with 4 Up and 0 Down tunnels. A workflow diagram shows the site progression: SITE ADDED (successful registration) → STAGING (successful configuration) → PRODUCTION (device in production). Below this, the 'Device Details' section lists: Name: HO, IP: 127.0.0.1, Call Home Port: 20434, S/N: VMware-42 04 1b fa b3 44 63 8c-43 94 e9 46 17 33 62 81, OS: VyOS, Version: 999.201803270337. To the right, there are two line graphs for 'CPU' and 'Memory' usage over the last hour, both showing 0% usage.

The screenshot shows the Nuviso NaaS web interface dashboard. The top navigation bar includes 'DASHBOARD', 'SITES', 'INVENTORY', and 'ADMIN'. The 'DASHBOARD' tab is active. The main area displays a network topology diagram with a central hub connected to many peripheral nodes. A tooltip for 'AP-WGW-ELURU-Router' shows its state as 'READY' and S/N as 'SSESXOQSFE'. On the right sidebar, there are statistics for 'ANDHRA PRADESH MUNICIPALITIES': 120 Sites and 10 Tunnels Down. Below this, the 'EVENTS' section shows a message for 'Branch4' dated 12 days ago: 'Tunnel to HO DOWN'. The 'ISP CONNECTIONS' section lists: AP SWAN (100 Primary, 10 secondary), AP FIBERNET (30 Primary, 20 secondary), AIRTEL (0 Primary, 12 secondary), and BSNL (0 Primary, 12 secondary).

SDWAN controller screenshots

The screenshot shows the Nuvisio NaaS SDWAN controller interface. The top navigation bar includes 'DASHBOARD', 'SITES', 'INVENTORY', and 'ADMIN'. The 'SITES' tab is active, and the 'CONFIGURATION' sub-tab is selected. The left sidebar shows a list of sites: 'HO', 'Branch6', 'Branch5', 'Branch4', and 'Branch3'. The main content area is divided into two columns. The left column contains 'LAN Configuration' and 'Location'. The 'LAN Configuration' section shows 'LAN Configuration: Run DHCP Server Locally', 'Lan start addr: 10.0.20.100', 'Lan end addr: 10.0.20.200', 'Lan subnet gateway ip: 10.0.20.1', and 'Lan subnet prefix: 24'. The 'Location' section shows a map of Bengaluru. The right column contains 'QOS Configuration' and 'ISP Details'. The 'QOS Configuration' section shows 'QOS Configuration: Webex 500 kbps Shaper'. The 'ISP Details' section shows 'AIRTEL (PRIMARY)' and 'APSWAN (SECONDARY)'. The bottom status bar shows the time as 23:13 on 18-04-2018.

NUVISO NaaS

DASHBOARD SITES INVENTORY ADMIN System Admin

Sites

HO ✓
Branch6 ✓
Branch5 ✓
Branch4 ✓
Branch3 ✓

DETAILS CONFIGURATION INTERFACES NAT OSPF DHCP TUNNELS

LAN Configuration

LAN Configuration: Run DHCP Server Locally
Lan start addr: 10.0.20.100
Lan end addr: 10.0.20.200
Lan subnet gateway ip: 10.0.20.1
Lan subnet prefix: 24

Location EDIT

QOS Configuration

QOS Configuration: Webex 500 kbps Shaper

ISP Details EDIT

AIRTEL (PRIMARY)
Bandwidth: 100 Mbps
Interface: eth0
State: Up

APSWAN (SECONDARY)
Bandwidth: 20 Mbps
Interface: eth2
State: Up

23:13 18-04-2018

The screenshot shows the Nuvisio NaaS SDWAN controller interface. The top navigation bar includes 'DASHBOARD', 'SITES', 'INVENTORY', and 'ADMIN'. The 'SITES' tab is active, and the 'INTERFACES' sub-tab is selected. The left sidebar shows a list of sites: 'HO', 'Branch6', 'Branch5', 'Branch4', and 'Branch3'. The main content area is divided into two columns. The left column contains 'Interfaces'. The right column contains 'Stats for vtun0'. The 'Interfaces' section shows a list of interfaces: 'eth0', 'eth1', 'lo', and 'vtun0'. The 'Stats for vtun0' section shows four graphs: 'Octets', 'Unicast', 'Multicast', and 'Discards'. The bottom status bar shows the time as 23:09 on 18-04-2018.

NUVISO NaaS

DASHBOARD SITES INVENTORY ADMIN System Admin

Sites

HO ✓
Branch6 ✓
Branch5 ✓
Branch4 ✓
Branch3 ✓

DETAILS CONFIGURATION INTERFACES NAT OSPF DHCP

Interfaces

eth0
eth1
lo
vtun0

Stats for vtun0 Last 1 hour

Octets

In Octets Out Octets

Unicast

In Unicast Out Unicast

Multicast

In Multicast Out Multicast

Discards

In Discards Out Discards

23:09 18-04-2018

SDWAN controller screenshots

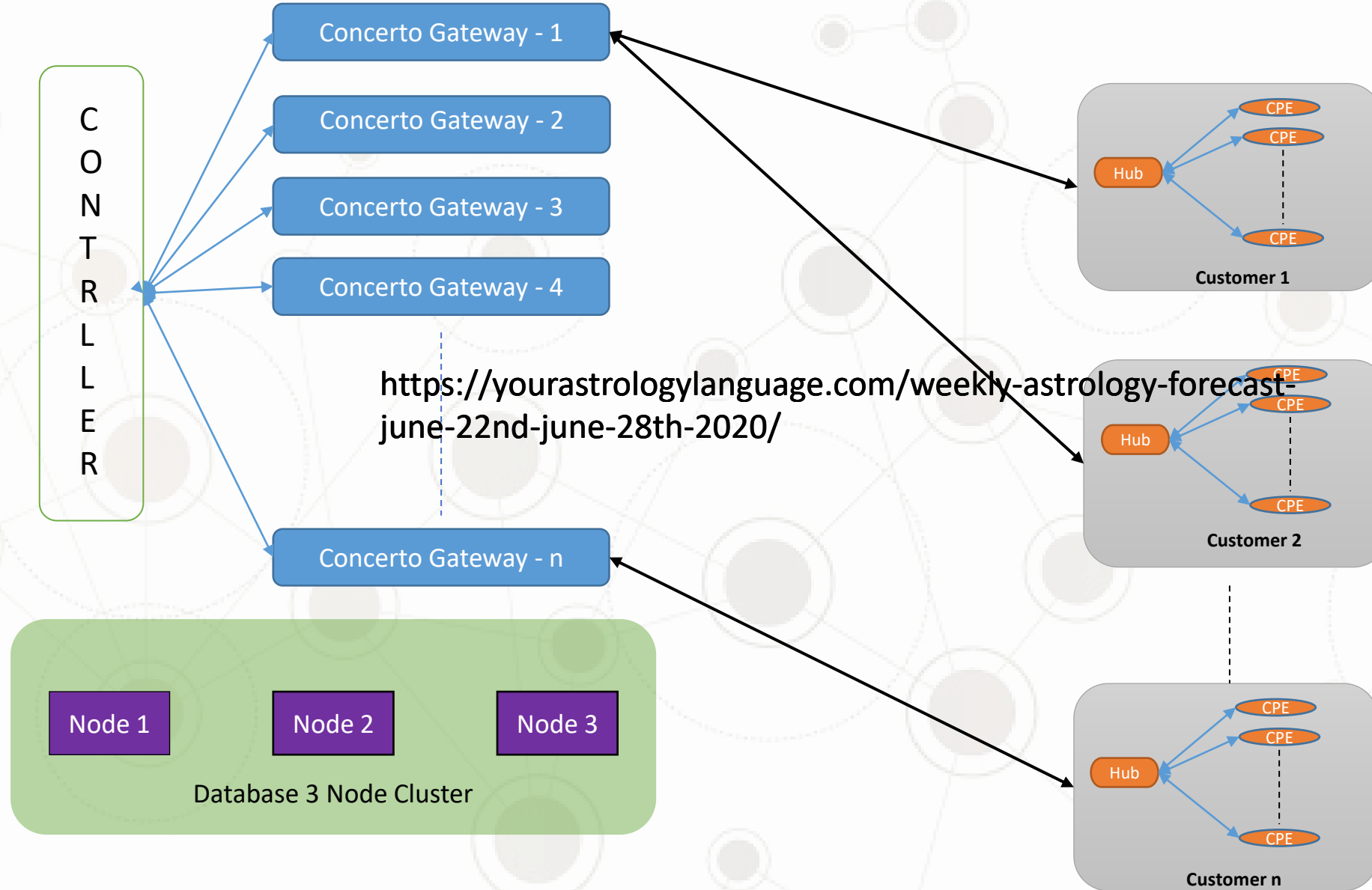
The screenshot shows the Nuviso NaaS SDWAN controller interface. The top navigation bar includes DASHBOARD, SITES, INVENTORY, and ADMIN. The SITES tab is active, displaying a list of sites on the left and a table of interfaces on the right. The interface table has columns for name, Description, IP Address, Prefix, MAC Address, Admin Status, and Oper Status. The 'lo' interface is marked as DOWN.

name	Description	IP Address	Prefix	MAC Address	Admin Status	Oper Status
eth0		10.10.3.116	24	00:50:56:84:f9:d6	UP	UP
eth1	HO	10.0.20.1	24	00:50:56:84:79:9a	UP	UP
lo				00:00:00:00:00:00	UP	DOWN
vtun28		172.16.5.1			UP	UP
vtun35		172.16.3.1			UP	UP
vtun68		172.16.4.1			UP	UP
vtun79		172.16.6.1			UP	UP

The screenshot shows the Nuviso NaaS SDWAN controller interface with the 'Running Configuration' modal window open. The modal displays the configuration for the 'lo' interface, including OSPF settings and parameters.

```
policy {  
  route-map OSPF-FILTER {  
    rule 10 {  
      action permit  
      match {  
        interface eth1  
      }  
    }  
    rule 90 {  
      action deny  
    }  
  }  
}  
protocols {  
  ospf {  
    area 0.0.0.0 {  
      network 172.16.6.0/24  
      network 172.16.5.0/24  
      network 172.16.4.0/24  
      network 172.16.3.0/24  
    }  
  }  
}  
parameters {  
  router-id 172.16.100.1  
}
```

SDWAN controller Scalability





NUVISO