Cloud Pak for Network Automation: New features and capabilities

Sanil Nambiar

CTO, Telco network cloud offerings,

IBM Asia Pacific.

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Now part of IBM Cloud Pak Strategy

IBM delivers AI-powered software for specific use cases to **predict**, **automate**, and **secure** a smarter business. They are packaged as Cloud Paks that include: Containerized software, foundational services and Red Hat OpenShift.

	Predict			Automate				Secure
Use cases	• Data modernization • DataOps • AI Lifecycle Management	• Data Warehousing • Trusted and Distributed AI • Continuous Integrated Financial Planning	• Operational and IT Risk Management • Customer Service automation • Textual / Document analysis	• Customer experience • Business operations • Workforce management	• App and infrastructure stability • Platform operations • Optimize AIOps	• Hybrid cloud integration • Real-time interactions • Transactional integrity	• Site deployment automation • 4G/5G telco cloud platform • NFV lifecycle management	• Advanced threat detection • Data security • Incident response • Threat hunting • Risk management
IBM Cloud Paks	for **Data**			for **Business Automation**	for **Watson AIOps**	for **Integration**	for **Network Automation**	for **Security**
	• Data virtualization, Data Governance and Privacy • Transactional and Analytical databases • Data Integration / ETL	• AutoAI and Visual Data Science • Model Risk Management, Fairness and explainability • Build / Run Virtual Assistants (VA)	• Natural language processing • Agile planning with What-if Analysis and scenario modelling • Configurable workflows and assessments	• Workflow and decisions • Content services • Operational intelligence	• Application impact avoidance • Hybrid application management • Observability INSTANA	• Application integration • API management • Messaging and events	• Intent-driven orchestration • Closed-loop operations • Network optimization	• Threat intelligence • Federated search • Orchestration and automation • Security Information and Event Management • Data Activity Monitoring
				Automation foundation				
	Foundational services							
	Red Hat OpenShift							

IBM Cloud | AWS | Microsoft Azure | Google Cloud | VMware | Private | IBM **Z** IBM **LinuxOne** IBM **Power** Systems | End points

Deliver proactive telco network transformation

IBM Cloud Pak for Network Automation and IBM Cloud Pak for Watson AIOps

AI-powered preventive intelligence:

- Anomaly detection
- Patented AI entity linking
- Fault localization & blast radius
- Change risk management
- Runbook automation

IBM Cloud Pak for **Network Automation**

- Normalized lifecycle management
- Intent-driven orchestration
- Service design and testing
- Dynamic service assurance
- Closed-loop operations

IBM Cloud Pak for **Watson AIOps**

- Incident resolution
- Hybrid application management
- Observability
- Blast radius
- Metric and Log Anomaly detection
- ChatOps

INSTANA

Automation foundation

- Robotic Process Automation
- Natural language interactions
- Process and task mining
- Event detection
- Machine learning
- 3rd Party integrations
- Operational models

Red Hat OpenShift

IBM Cloud | AWS | Microsoft Azure | Google Cloud | VMware | Private | IBM **Z** / IBM **LinuxOne** / IBM **Power** Systems | End points

What is the IBM Cloud Pak for Network Automation?

Automate network and service design, deployment and operations with intent-driven orchestration and closed loop operations

Normalized lifecycle modeling

Intent driven orchestration

Service design and testing

Dynamic service assurance

Closed-loop operations

AI and machine learning

VNF/CNF certification and open multivendor ecosystem

Foundational automation services

- Robotic Process Automation
- Natural language interactions
- Process and task mining
- Event detection
- Machine learning
- 3rd Party integrations
- Operational models

Red Hat OpenShift

IBM Cloud

AWS

Microsoft Azure

Google Cloud

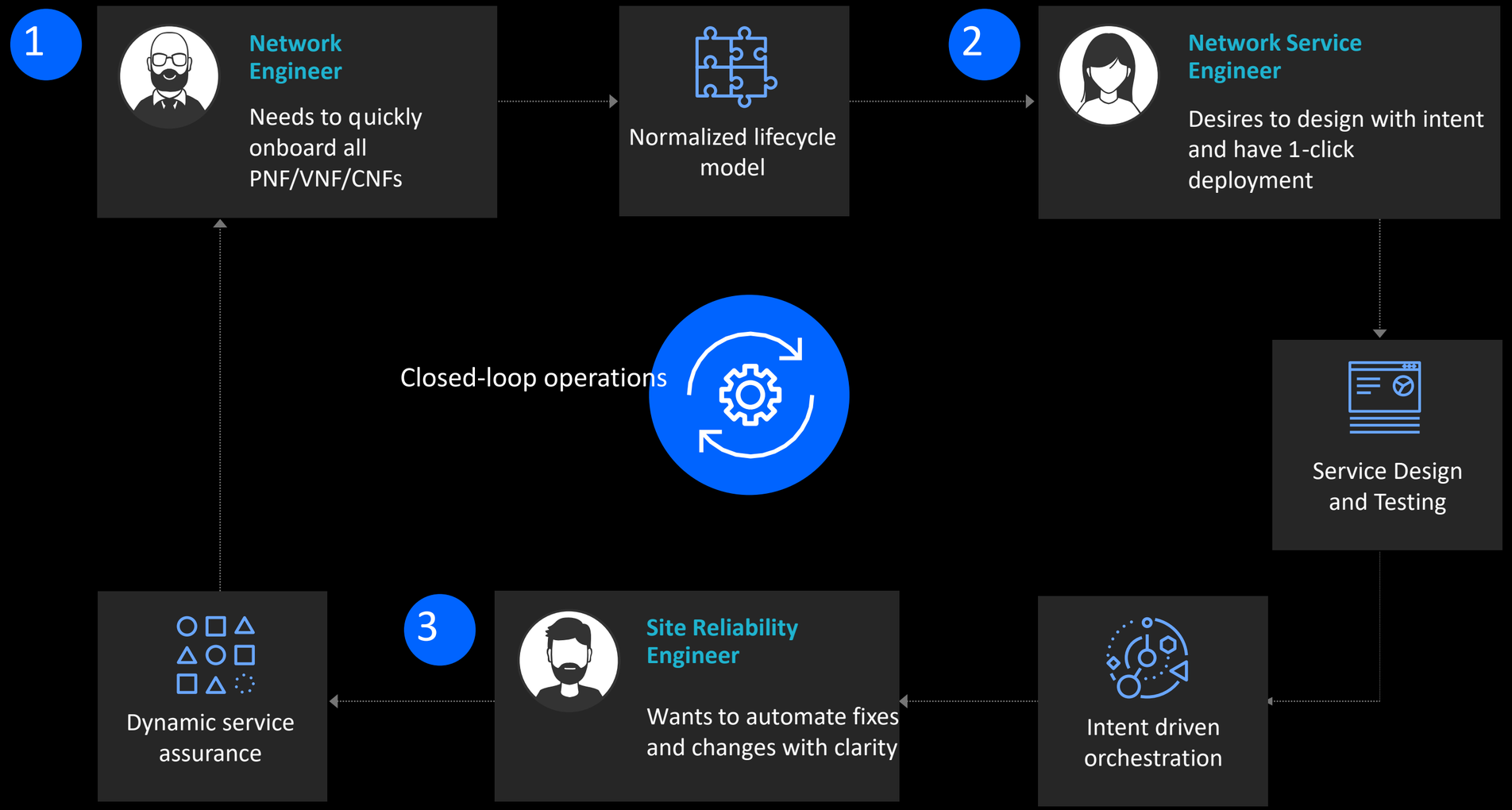
VMware

Private

IBM Z
IBM LinuxOne
IBM Power Systems

End points

Comprehensive service lifecycle management benefits all teams



IBM Cloud Pak for Network Automation **Offering Capabilities**

Declarative Machine-Driven Automation (intents)

Models the desired service operational state rather than pre-programming workflows

Automated Certification and Behaviour testing

Automation for the service itself and underlying resources for test, pre-production, and production environments

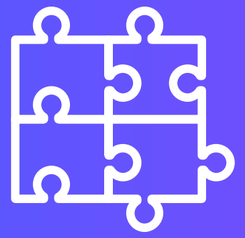
AI-driven Change Management

Automated feedback loop between assurance and orchestration to enable zero touch operations

IBM Cloud Pak for Network Automation **Use Cases**

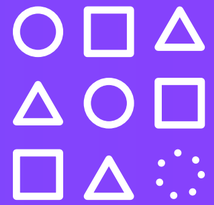
Network site deployment

Standardize and automate cloud buildout across multivendor infrastructures to speed service delivery



vRAN / Open RAN

Turnkey deployment and management of open and virtualized radio access networks across multi-vendor systems



5G Network Slicing

Automated lifecycle management for differentiated enterprise 5G virtual network services on top of a shared physical infrastructure

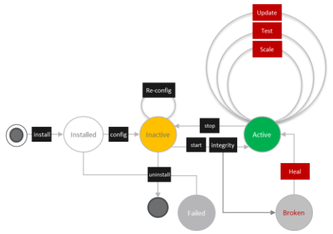
IBM Cloud Pak for Network Automation Offering Capabilities: **Declarative Machine-Driven Automation**

Comparison of automation approaches

	Code/Scripting	Imperative Workflow	Declarative Intent
Development effort	**High** All possible system lifecycle scenarios and their coordination across xNF tasks are engineered in scripts/code	**Medium** All possible system lifecycle scenarios and their coordination across xNF tasks are drawn in workflow.	**Low** No coding or workflows. CP4NA models relationships and dependencies between xNF lifecycles
Level of Errors	**Low** Well tested software development process can reduce risk of errors.	**High** Workflows for ad-hoc network services have high fallout rates.	**Low** Opinionated patterns are well productised, dramatically reducing errors.
Effort to cope with change	**High** Changing the topology of a CNF or Network Service is a major code re-write.	**High** Changing topology of a CNF or Network Service is a rewrite of all workflows.	**Low** Topology changes are supported with no code changes. Opinionated patterns manage change with no downtime.

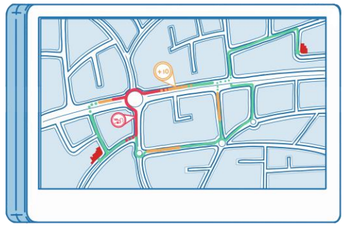
Applying Cloud Native techniques to the full network stack

xNF Standard Lifecycle



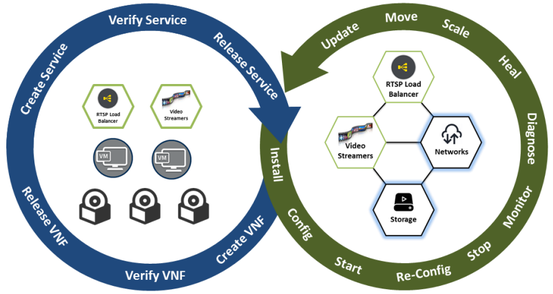
- Wrap VNFs/CNFs/PNFs with a self contained operational lifecycle
- Natively onboard autonomous CNF Operators

Intent driven Orchestration

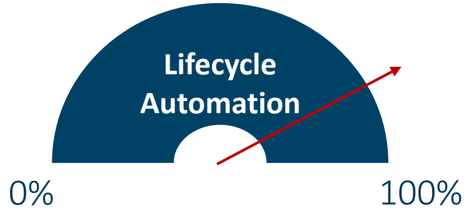


- Focus on modelling the network service rather than programming lifecycles
- Auto reconcile network services to cope with planned and unplanned xNF changes

Cloud based tool chain



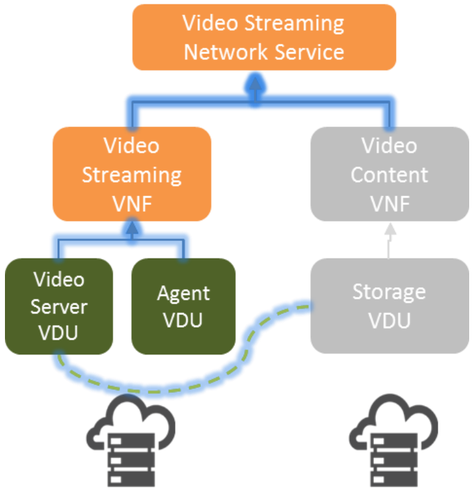
- Tools to enable automated onboarding and testing of xNFs and network services
- Self service network service/slice design and behaviour testing



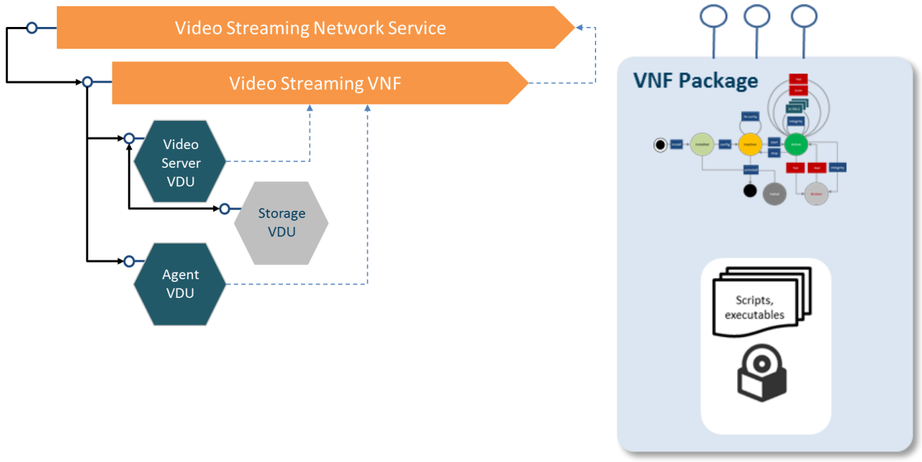
Intent Orchestrator generates execution plan based on desired network service state

Intent Engine → **Automated Lifecycle Execution**

Generate delta graph of desired state based on current topology and requested service

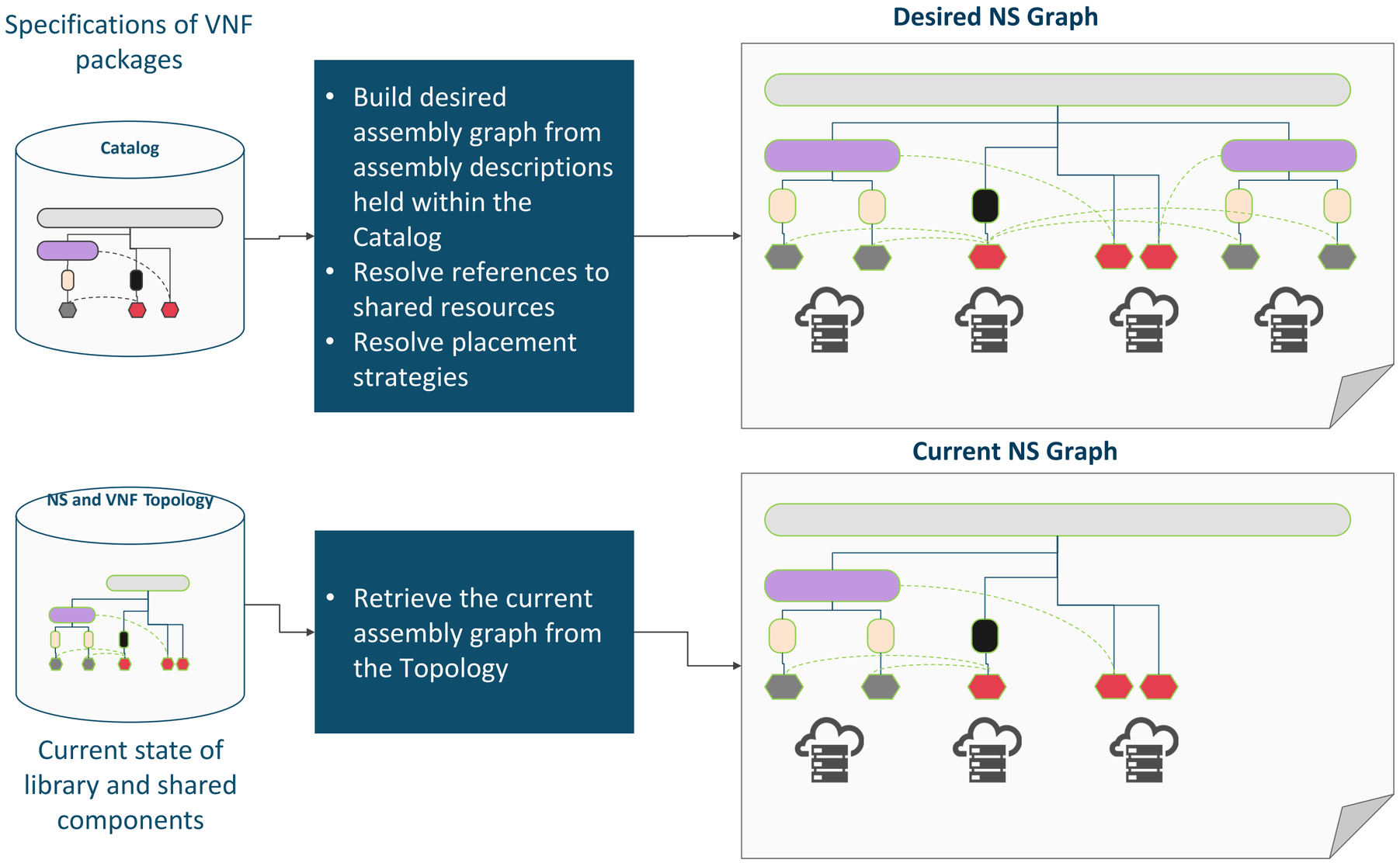


Automatically create execution plan of standard lifecycle tasks required to deliver delta

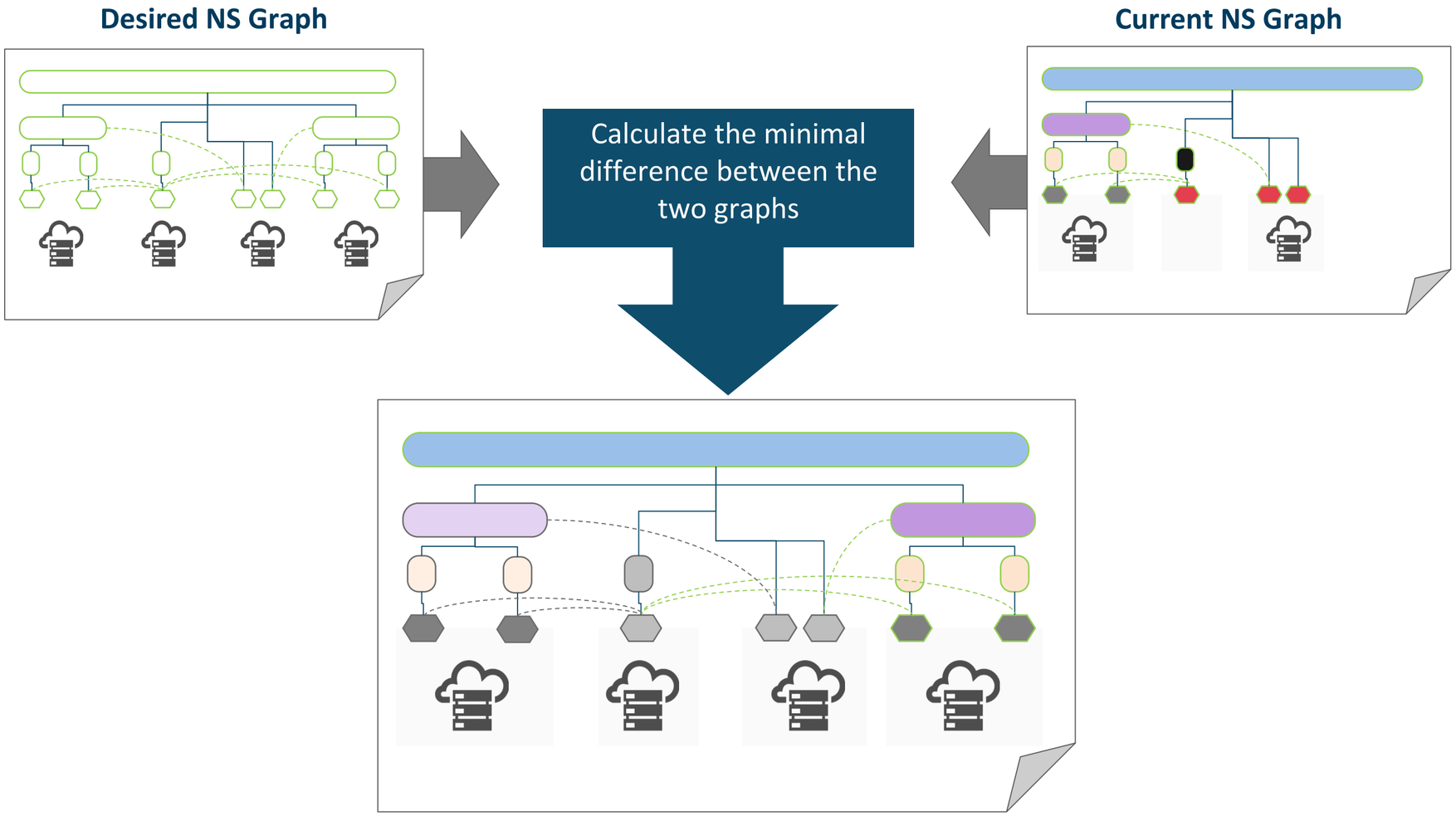


VNF component lifecycles are well tested, versioned and automatically orchestrated into being with no human intervention

First step builds a desired graph of assemblies and components resolving placement and identifying shared components

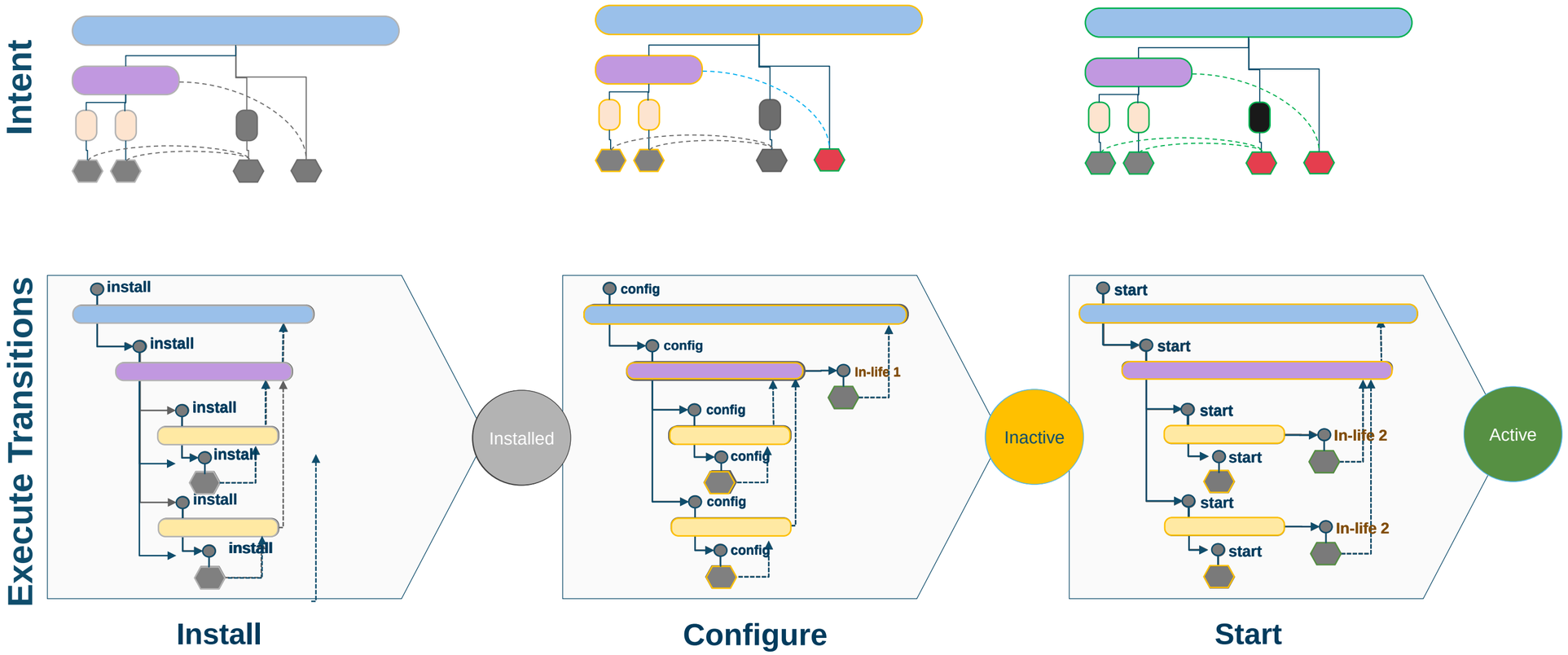


Second step calculates difference graph required to put the assembly into the desired state



Intent difference graph organises NS and VNF transitions and executes them

- Translate graph into a sequence of tasks to bring all Network Service and VNFs into desired state
- Organise sequencing of tasks based on relationships and property dependencies

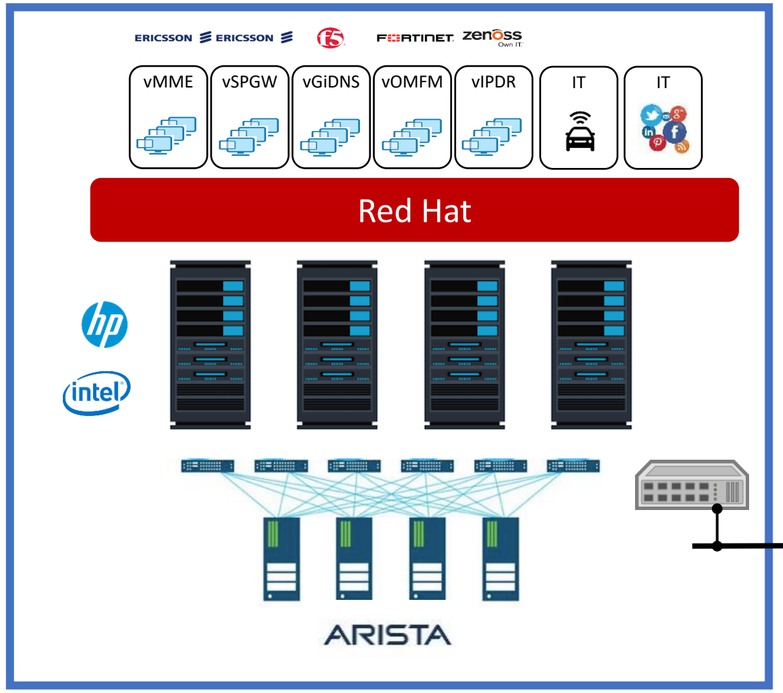


IBM Cloud Pak for Network Automation Use Cases:
Full Stack Network Cloud Automation with the CP4NA Site Planner.

Network Core Cloud & Edge sites

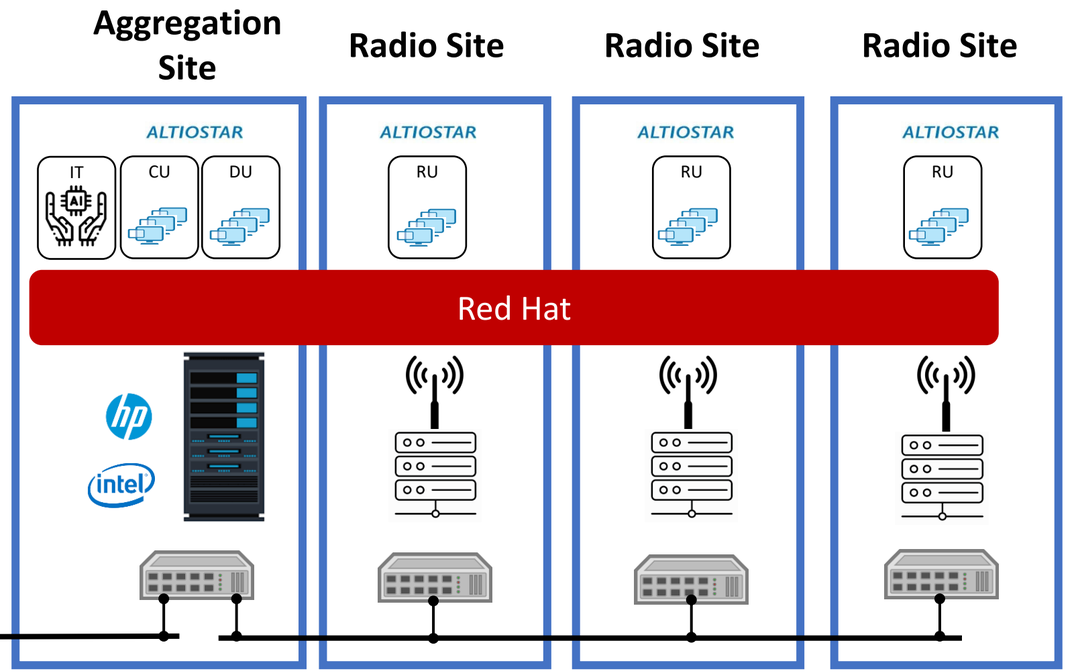
Core/IMS/EPC

Single Site



- Single site with 50-60 large compute nodes
- Dynamic design, tailored for multiple network workloads

vRAN/Edge

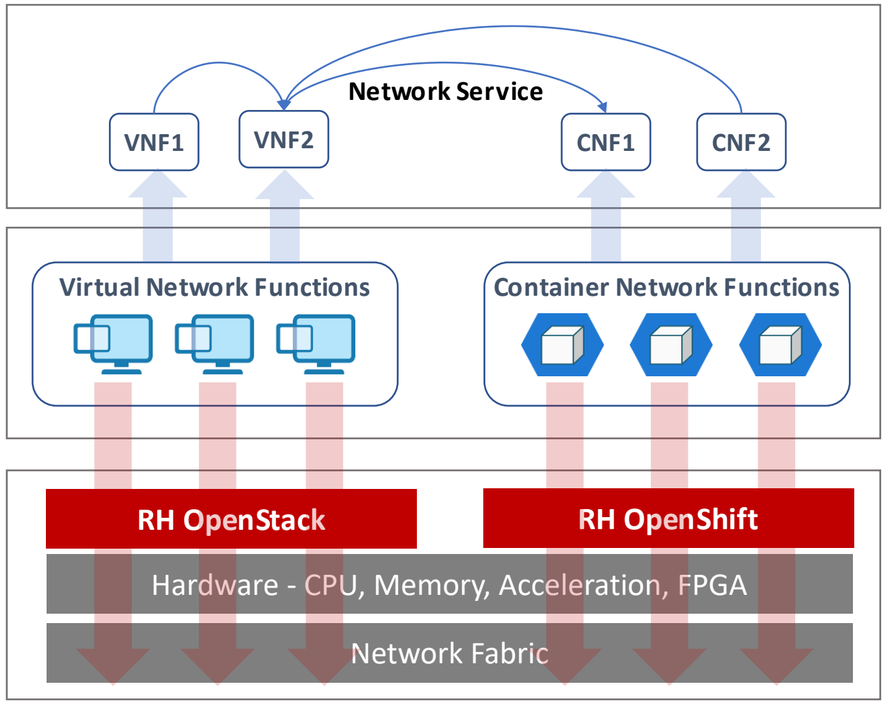


- Many thousands of sites with small servers
- Static network workload design

The Telco Hybrid Cloud platform has “special” requirements

Massive scale

Hundreds of thousands of network functions must be orchestrated in real time to deliver a holistic network service

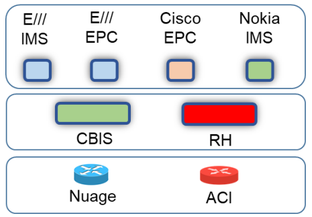


Highly accelerated workloads

All network workloads are accelerated to deliver *high performance very low latency packet processing* and analog to digital signal processing

Migrate 4G workloads to Hybrid Cloud

- Hundreds of core telco data centers delivering mobile broadband
- Complex Telco Data Center and network connectivity build taking > 160 days; Target is 72 hours



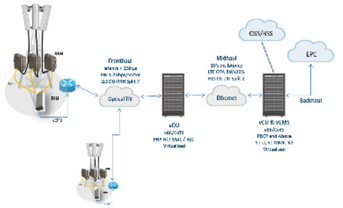
5G Network Slicing

- Customer self design and management of 5G networks,
- Auto placement and tuning of 5G network function
- Automated lifecycle of custom designed services

NOKIA · ORACLE · MATRIXX SOFTWARE · metaswitch · Hewlett Packard Enterprise · OPENET · AWS · vmware

Deploy Radio Access Network @ Scale

- Single click deployment and ongoing lifecycle management of many ‘000’s of ***Cloud Native*** virtual RAN turnkey systems



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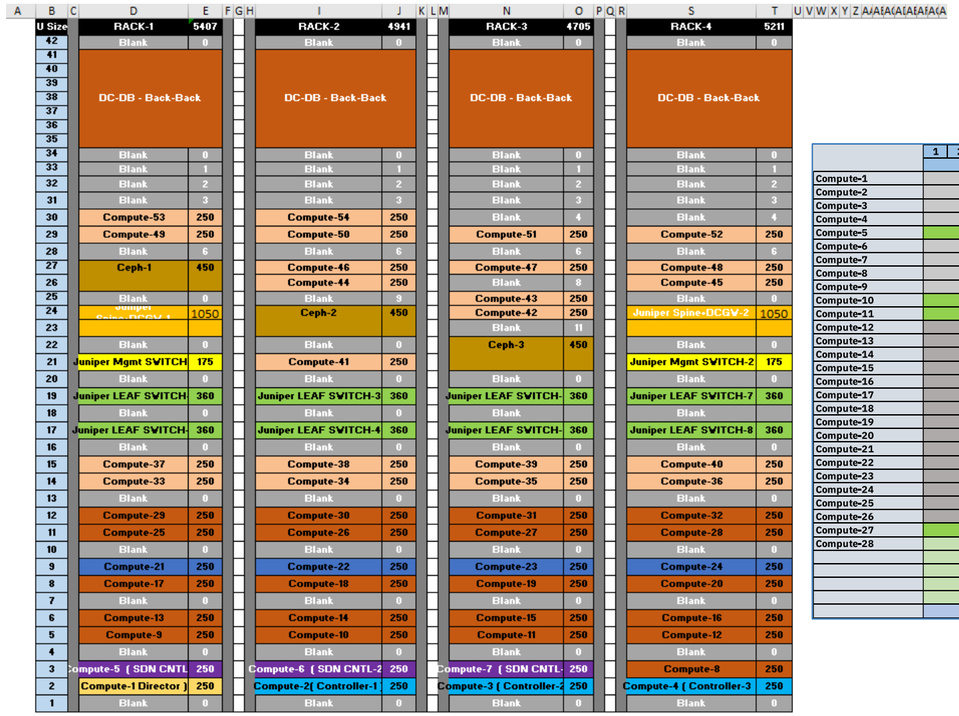
The Telco Hybrid Cloud platform has “special” requirements

Spreadsheets with 20+ tabs, including:

- Rack Layout
- Hostname Details
- BIOS Settings (for 54 Devices)
- Port Map Bonding
- Port Mapping & Bond Details
- VM Layout
- Disk Placement
- Server Ports
- Network Architecture
- Operating System and Repository requirements
- Tenants
- VM Flavours
- Compute Details
- Compute Roles
- IP Address Plan
- OpenShift/OpenStack Parameters
- Storage Volumes
- Applications (xNFs) placements



U Size	RACK-1	5407	RACK-2	4941	RACK-3	4705	RACK-4	5211
42	Blank	0	Blank	0	Blank	0	Blank	0
41	DC-DB - Back-Back		DC-DB - Back-Back		DC-DB - Back-Back		DC-DB - Back-Back	
40								
39								
38								
37								
36								
35								
34	Blank	0	Blank	0	Blank	0	Blank	0
33	Blank	1	Blank	1	Blank	1	Blank	1
32	Blank	2	Blank	2	Blank	2	Blank	2
31	Blank	3	Blank	3	Blank	3	Blank	3
30	Compute-53	250	Compute-54	250	Blank	4	Blank	4
29	Compute-49	250	Compute-50	250	Compute-51	250	Compute-52	250
28	Blank	6	Blank	6	Blank	6	Blank	6
27	Ceph-1	450	Compute-46	250	Compute-47	250	Compute-48	250
26			Compute-44	250	Blank	8	Compute-45	250
25	Blank	0	Blank	9	Compute-43	250	Blank	0
24	[illegible]	1050	Ceph-2	450	Compute-42	250	Juniper Spine-DCGW-2	1050
23					Blank	11		
22	Blank	0	Blank	0	Ceph-3	450	Blank	0
21	Juniper Mgmt SWITCH	175	Compute-41	250			Juniper Mgmt SWITCH-2	175
20	Blank	0	Blank	0	Blank	0	Blank	0
19	Juniper LEAF SWITCH	360	Juniper LEAF SWITCH-3	360	Juniper LEAF SWITCH-	360	Juniper LEAF SWITCH-7	360
18	Blank	0	Blank	0	Blank		Blank	
17	Juniper LEAF SWITCH-	360	Juniper LEAF SWITCH-4	360	Juniper LEAF SWITCH-	360	Juniper LEAF SWITCH-8	360
16	Blank	0	Blank	0	Blank	0	Blank	0
15	Compute-37	250	Compute-38	250	Compute-39	250	Compute-40	250
14	Compute-33	250	Compute-34	250	Compute-35	250	Compute-36	250
13	Blank	0	Blank	0	Blank	0	Blank	0
12	Compute-29	250	Compute-30	250	Compute-31	250	Compute-32	250
11	Compute-25	250	Compute-26	250	Compute-27	250	Compute-28	250
10	Blank	0	Blank	0	Blank	0	Blank	0
9	Compute-21	250	Compute-22	250	Compute-23	250	Compute-24	250
8	Compute-17	250	Compute-18	250	Compute-19	250	Compute-20	250
7	Blank	0	Blank	0	Blank	0	Blank	0
6	Compute-13	250	Compute-14	250	Compute-15	250	Compute-16	250
5	Compute-9	250	Compute-10	250	Compute-11	250	Compute-12	250
4	Blank	0	Blank	0	Blank	0	Blank	0
3	Compute-5 (SDN CNTL	250	Compute-6 (SDN CNTL-2	250	Compute-7 (SDN CNTL-	250	Compute-8	250
2	Compute-1 Director)	250	Compute-2(Controller-1	250	Compute-3 (Controller-2	250	Compute-4 (Controller-3	250
1	Blank	0	Blank	0	Blank	0	Blank	0

Rack Layout | PXE MAC & Hostname Details | Bl

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	NUMA-1														NUMA-2													
Compute-1	PP/LC-1														PP/LC-2													
Compute-2	PP/LC-3														PP/LC-4													
Compute-3	PP/LC-5														PP/LC-6													
Compute-4	PP/LC-7														PP/LC-8													
Compute-5	PP/LC-9														PP/LC-10													
Compute-6	GSC 1														sapc SC-1											RP-1		
Compute-7	CP-1														sapc SC-2											RP-2		
Compute-8	CP-2														sapc TP-1													
Compute-9	CP-3														sapc TP-2													
Compute-10	CP-4														sapc TP-3													
Compute-11	CP-5														sapc TP-4													
Compute-12	sapc TP-5														EMM-1													
Compute-13	sapc TP-6														EMM-2													
Compute-14	sapc TP-7														VNF-LCM-1													
Compute-15	sapc TP-8														VNF-LCM-2													
Compute-16	sapc TP-9														SC-1													
Compute-17	sapc TP-10														SC-2													
Compute-18	sapc TP-11														PL-1													
Compute-19	sapc TP-12														PL-2													
Compute-20	sapc TP-13														GiDNS-1											RPServ		
Compute-21	sapc TP-14														GiDNS-2											MGMTServ		
Compute-22	sapc TP-15														ZenOSS Control Center													
Compute-23	sapc TP-16														ZenOSS RM-1													
Compute-24	sapc TP-17														ZenOSS RM-2													
Compute-25	sapc TP-18														CP-6													
Compute-26	sapc TP-19																											
Compute-27	sapc TP-20																											
Compute-28	Extra Server																											
	VIM Controller-1																											
	VIM Controller-2																											
	VIM Controller-3																											
	VIM Director																											
	HP One View																											

Physical	Compute	Comment	SRIOV (off in system settings, on in NIC)	PXE (only on 2, 1G Ports)	Shared memory (NIC)	C3 Power state	C6 Power state	MLC Streamer	NLC spatial prefetcher	DCU data prefetcher	DCA	CPU power and performance	Memory RAS and Performance Config -- NUMA Optimized	Virtualization Technology	Intel VT-D	DL360 & DL380 OS Disk raid configuration (on All nodes) -RAID1	DL360 Disk configuration - RAID0	DL380 NVMe disk	Boot Mode	Boot Order
HPE-DL36	Director	Compute-1Director	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Controller-1	Controller -1	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Controller-2	Controller2	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Controller-3	Controller3	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Ceph-1	Ceph-1	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Ceph-2	Ceph-2	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Ceph-3	Ceph-3	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-8	Compute-8	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-9	Compute-9	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-10	Compute-10	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-11	Compute-11	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-12	Compute-12	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-13	Compute-13	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-14	Compute-14	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-15	Compute-15	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-16	Compute-16	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-17	Compute-17	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-18	Compute-18	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-19	Compute-19	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-20	Compute-20	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-21	Compute-21	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-22	Compute-22	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-23	Compute-23	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-24	Compute-24	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-25	Compute-25	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-26	Compute-26	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-27	Compute-27	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-28	Compute-28	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-29	Compute-29	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-30	Compute-30	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-31	Compute-31	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-32	Compute-32	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-33	Compute-33	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-34	Compute-34	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-35	Compute-35	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c
HPE-DL36	Compute-36	Compute-36	Off System, On NIC	Y	Disabled	Disabled	Disabled	Enabled	Enabled	Enabled	Enable	High Perf.	Enabled	Enabled	Enabled	RAID1(960*2)	RAID0	No RAID	Legacy Boo	1st RAID Disk, 2nd PXE Boot Port. eno5 on c

Sequence of CSP Network Engineering build tasks

Design

- Cloud HLD
- Infra deployment plan
- IP Networking Plan
- VNF Application HLD/LLD
- Security Cloud
- UAT
- Traffic Migration Plan
- Service and IP Networking Connectivity

Ship & Build

- Site BOQ, procurement and ship
- Transmission BOQ, procurement and provisioning
- Rack installation
- Power on and bios checks

Leaf Spine Configuration

- Network Firmware upgrade
- VLAN configuration
- Setup SDN Controller
- Create Fabric
- Validate Fabric

Cloud Build

- Server firmware upgrade
- iLOM configuration
- BIOS setting for NFVI
- Tune servers
- Undercloud deployment
- CEPH storage deployment
- Overcloud deployment
- NFVI testing and validation

VNF Onboard and Configuration

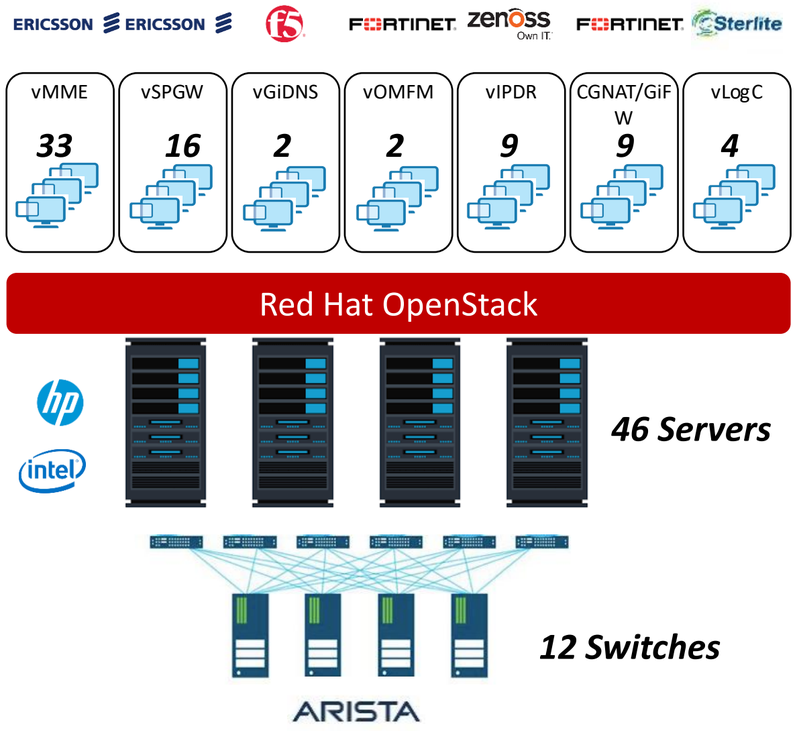
- Application onboarding
- VNF integration and reachability
- IP/Network Integration
- MME Pooling readiness
- Vendor acceptance test
- Legal Intercept test

Inter Site Integration

- SNOC Integration
- Security clearance
- IT readiness
- Traffic migration
- Handover to operations

Scaling Network Clouds

100gbps

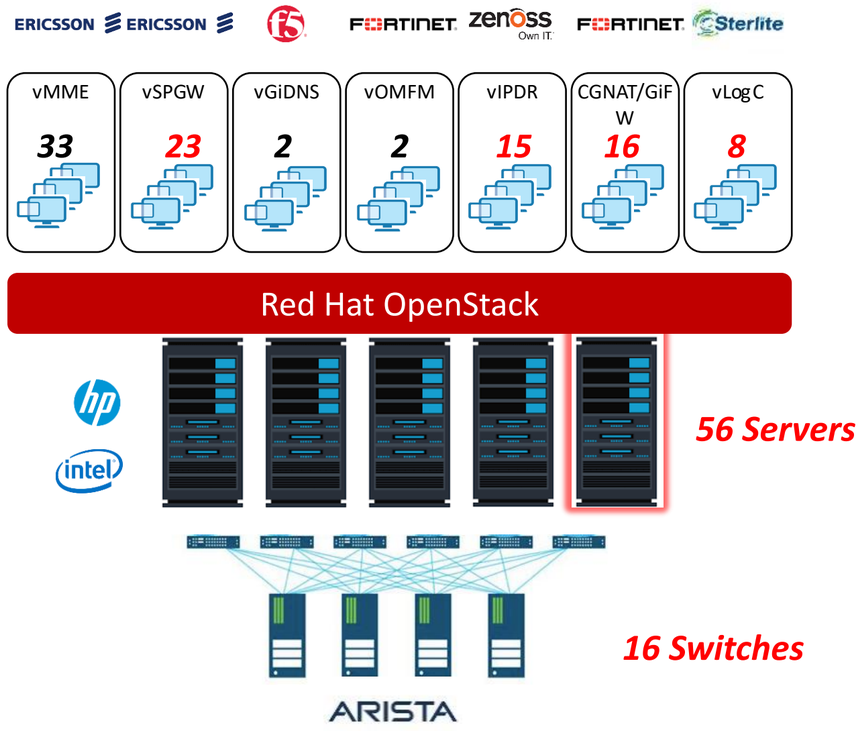


Target

- 5 days design per new site
- 3 days configuration and test per new site

Scale Out

200gbps



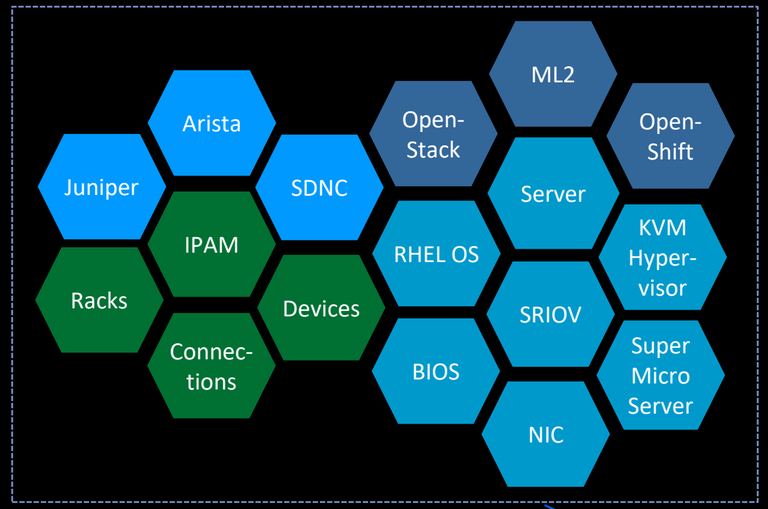
Target

- 4 days design per existing site
- 2 days configuration and test per existing site

Cloud Pak for Network Automation Factory Operating Model

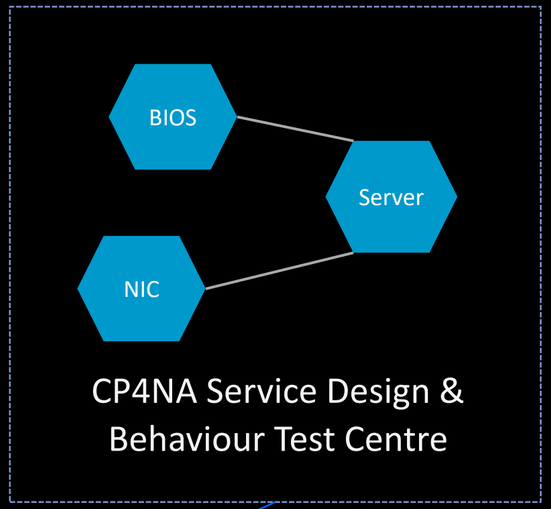
Reusable Automations

Create full lifecycle automation for each network, server, VNF and site integration component



Orchestration Models

Combine automations to build pre-integrated, reusable infrastructure

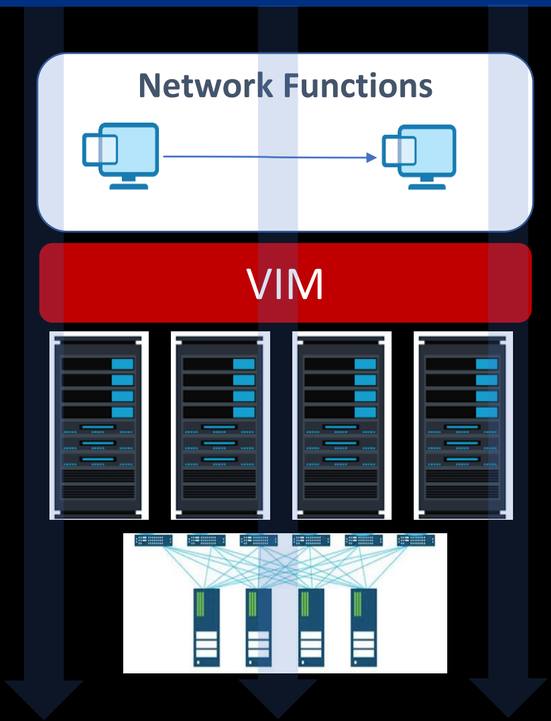


Site Plan and Build

Site design tooling integrated with Automation components and CP4NA orchestration engine to automate the deployment of the complete stack

CP4NA Site Planner

CP4NA Intent Orchestration Engine



Git Based CI Pipeline

Published library of Automation components

CP4NA enables a Network Cloud factory operating model

~5-20 days automation creation for new supplier

5 days service & site assembly rules per service & site type

5 days per new site
3 days to change existing site

4 days per new site configuration
2 days to change existing site configuration

Full lifecycle automation for each network, server, VNF and site integration component

*IBM/Red Hat to provide off the shelf component automations for common infrastrructure

Onboarding CI Pipeline

Orchestration & Assurance Model

LLD Packing Model

Published library of Automation components

Site | LLD Wizard | Ship & Build | Leaf Spine | Cloud | xNF | Inter Site integration

Site | LLD Wizard | Ship & Build | Leaf Spine | Cloud | xNF | Inter Site integration

Site | LLD Wizard | Ship & Build | Leaf Spine | Cloud | xNF | Inter Site integration

Site | LLD Wizard | Ship & Build | Leaf Spine | Cloud | xNF | Inter Site integration

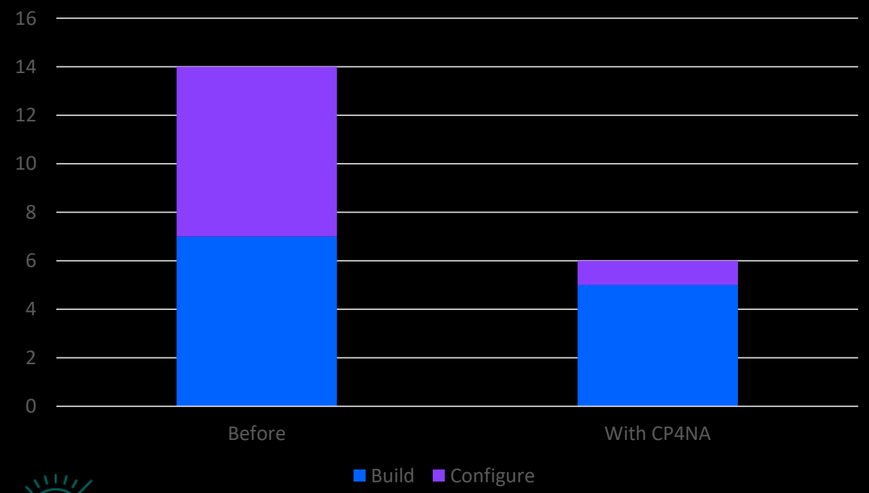
Common NOC Operating Tools & Model

Upgrade Site Components

Fix Existing Site Components

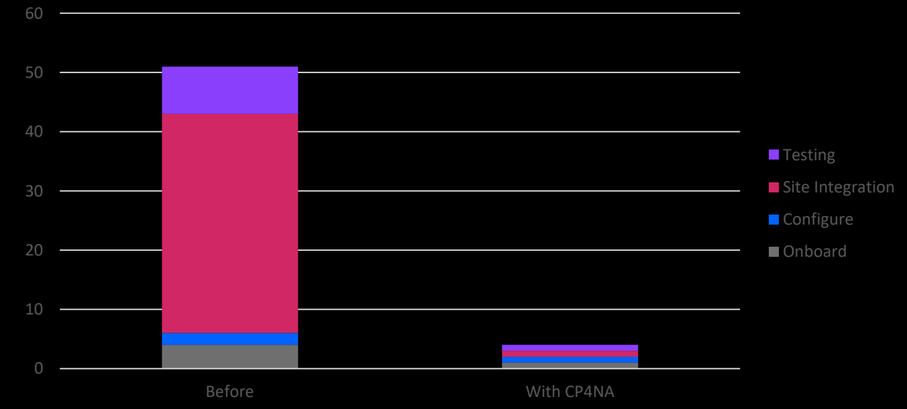
Benefits

Build & Configure Site



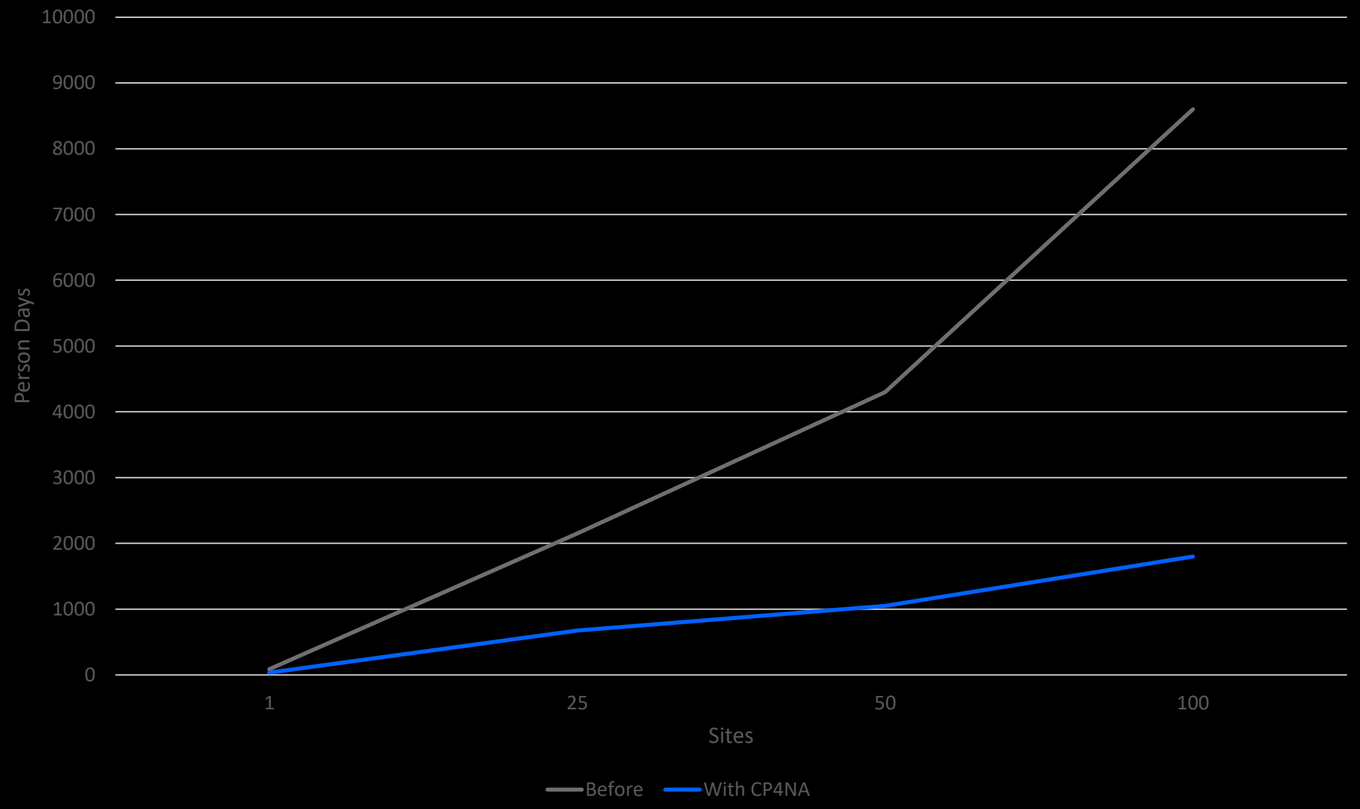
57% Reduction from 14 to 6 days

Integrate & Test VNFs



92% Reduction from 51 to 4 days

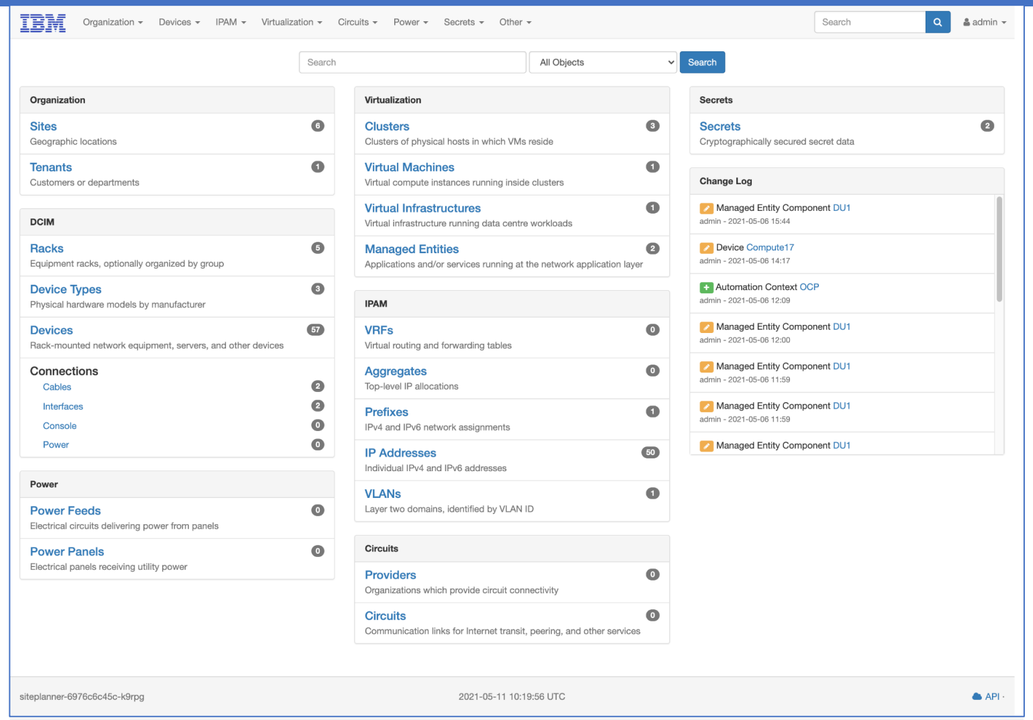
Cumulative person days effort for 100 site rollout

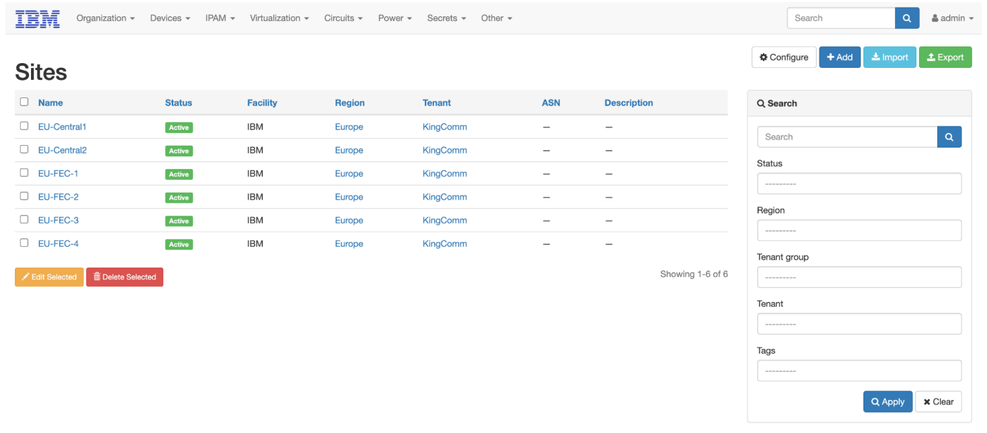


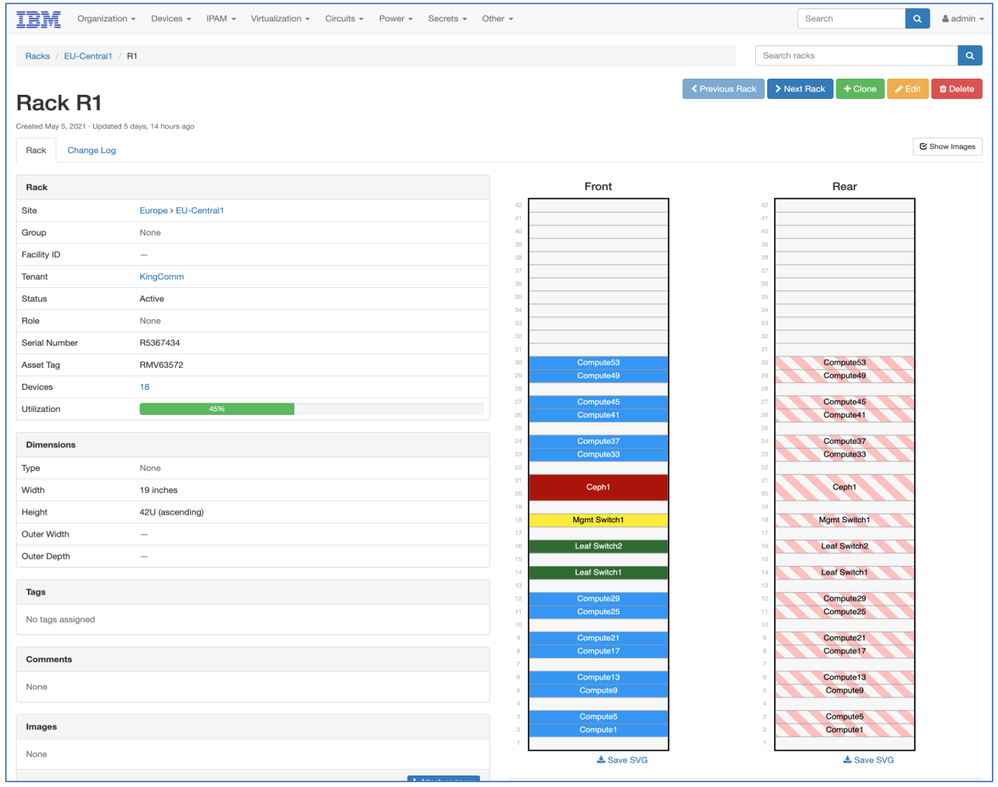
79% reduction in person days for software configurable tasks

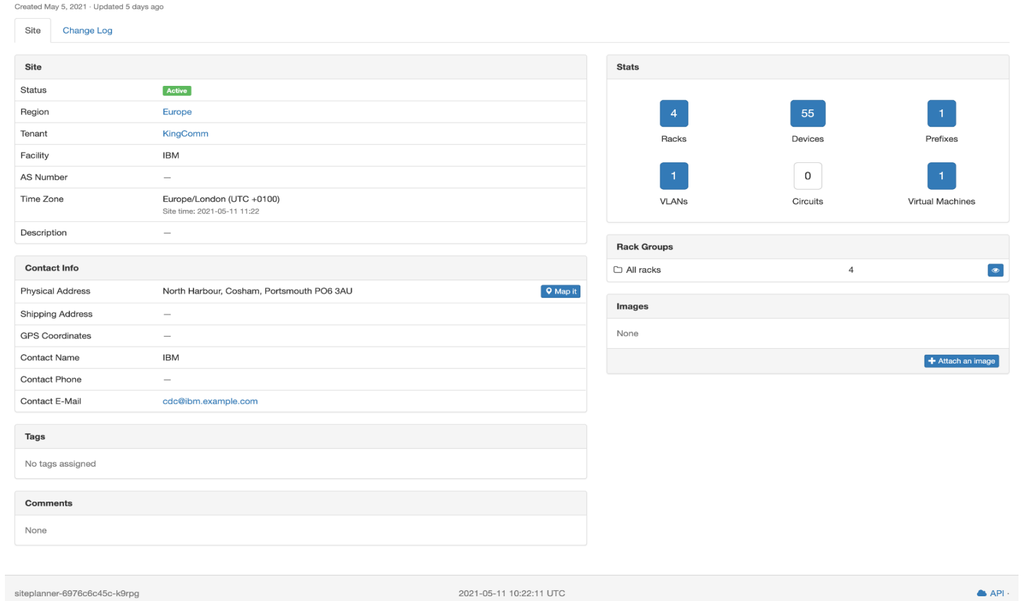
Assumed 45 new supplier equipment/software are automated in batches of 15 throughout the site rollout. New suppliers include leaf spine, SDN Controllers, VIM, servers, hardware OEMs, VNFs

Site planner screens

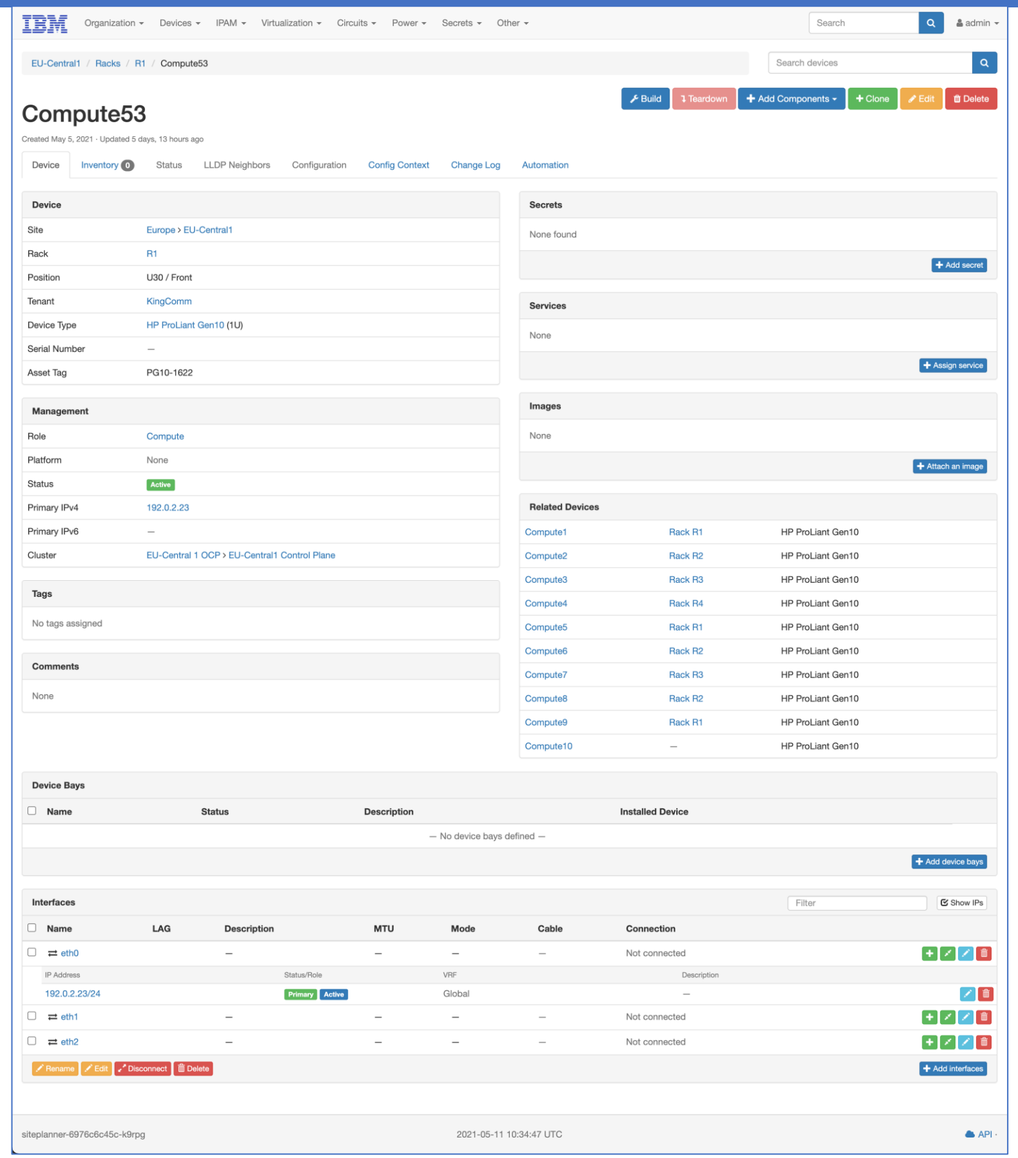


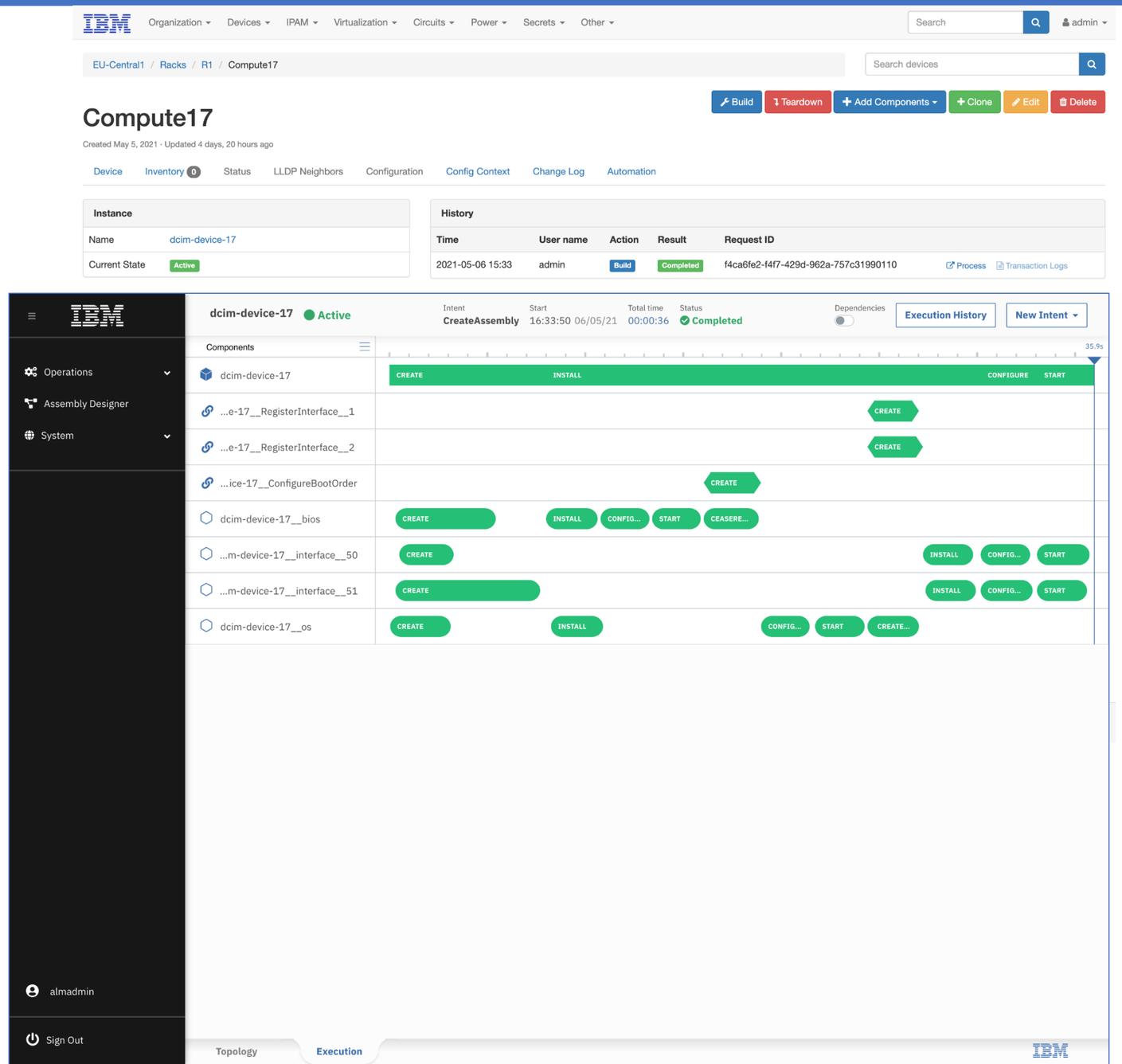






Site planner screens





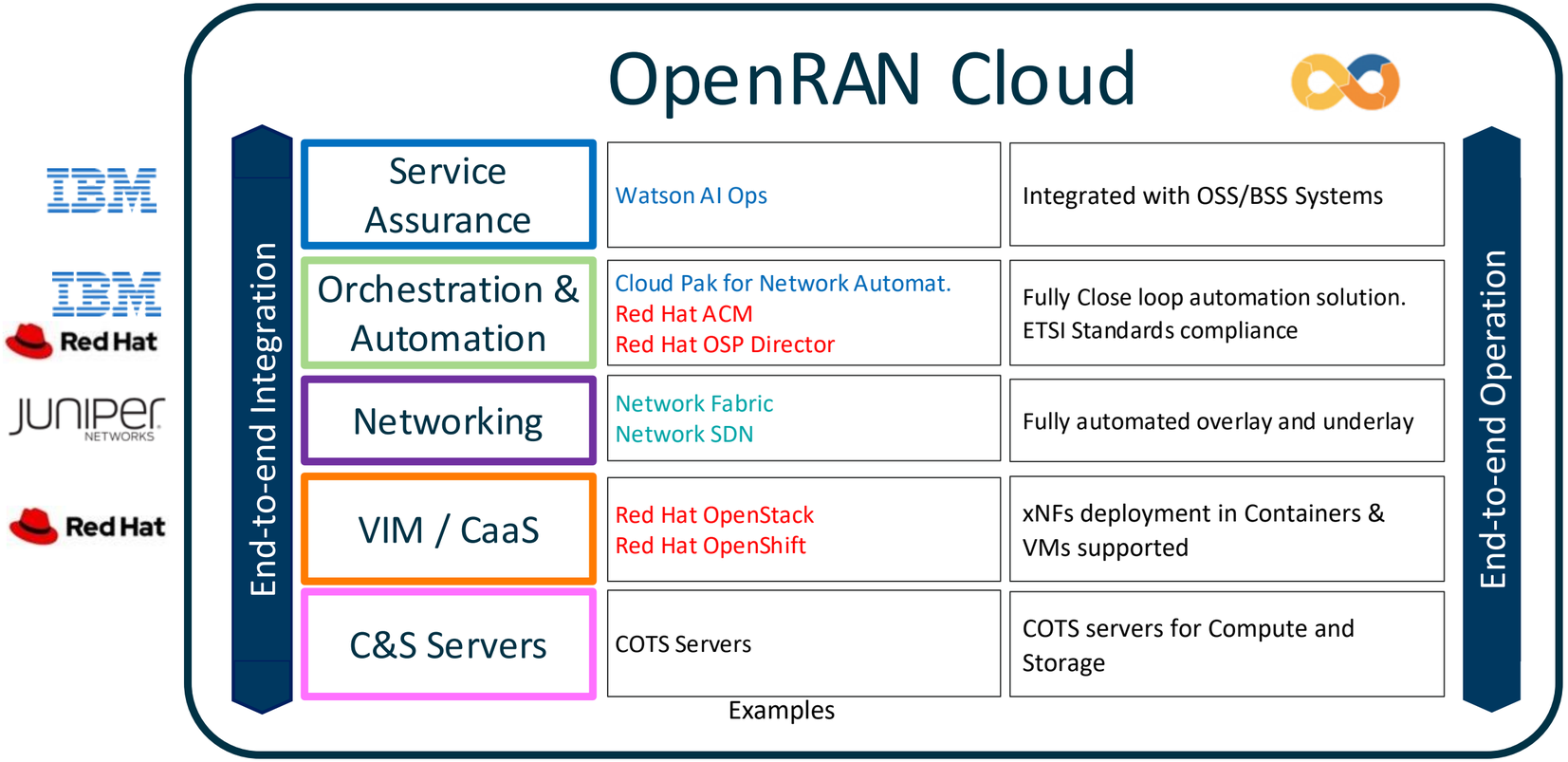
IBM Cloud Pak for Network Automation Use Cases:
Open RAN Zero Touch Provisioning

Enhanced features in this release of CP4NA

Open RAN solution

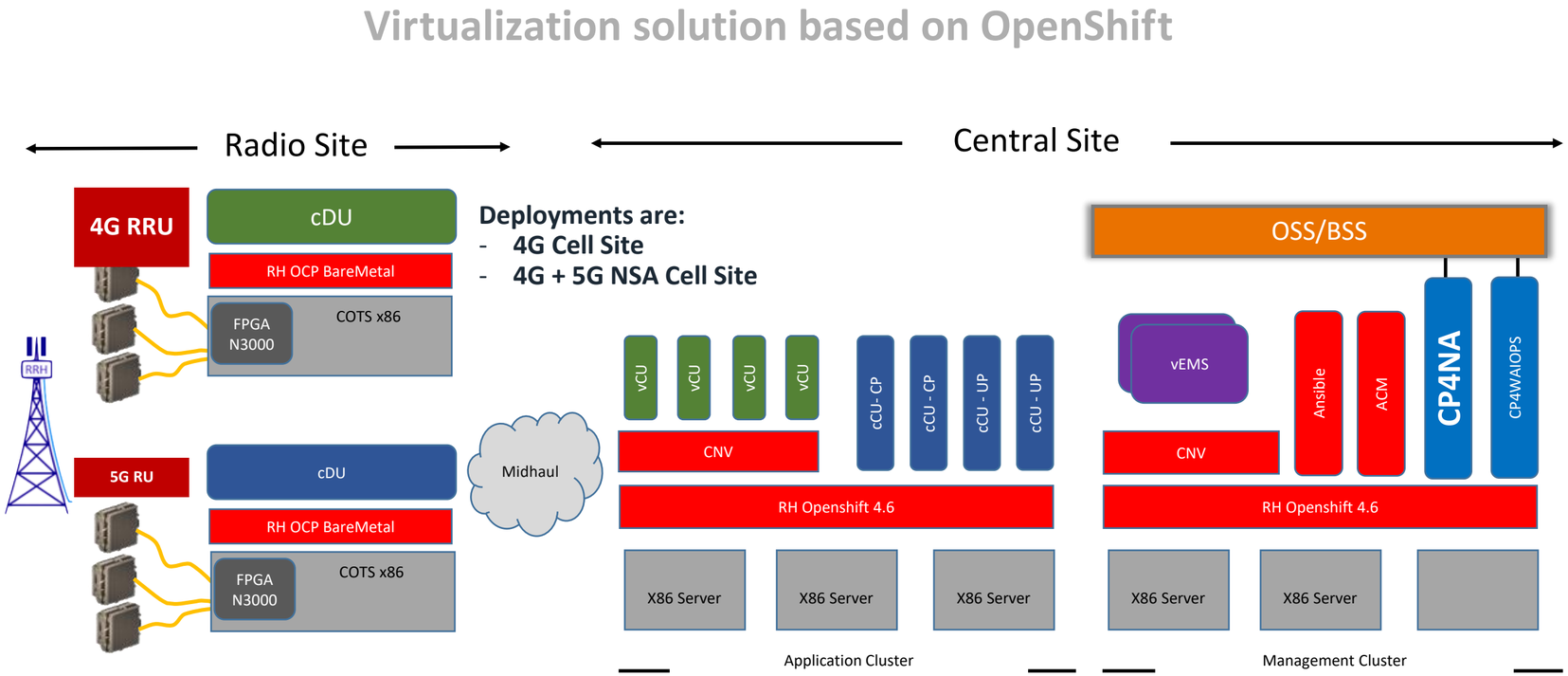
- **Zero Touch Automation** tools: CP4NA fully integrated with RAN vendor
- Including Open RAN **Assurance for Dynamic environments** VNFs/CNFs
- End-to-End solution, **based in Open Technology**: Red Hat OpenShift technology
- **Agnostic Assurance** solution
- Disaggregated architecture for easily adapting to new components and capabilities, no vendor lock in
- **Integrated testing of all the different components** in RAN vendor Lab in Bangalore and IBM Lab in Dallas for Automation
- Native Kubernetes solution with virtual machine capabilities
- **HA and DR** capabilities
- Possibility to **leverage other applications** ready to run on OpenShift, e.g. MEC, Edge.

Fully Integrated Open Architecture. Illustrative Building Blocks



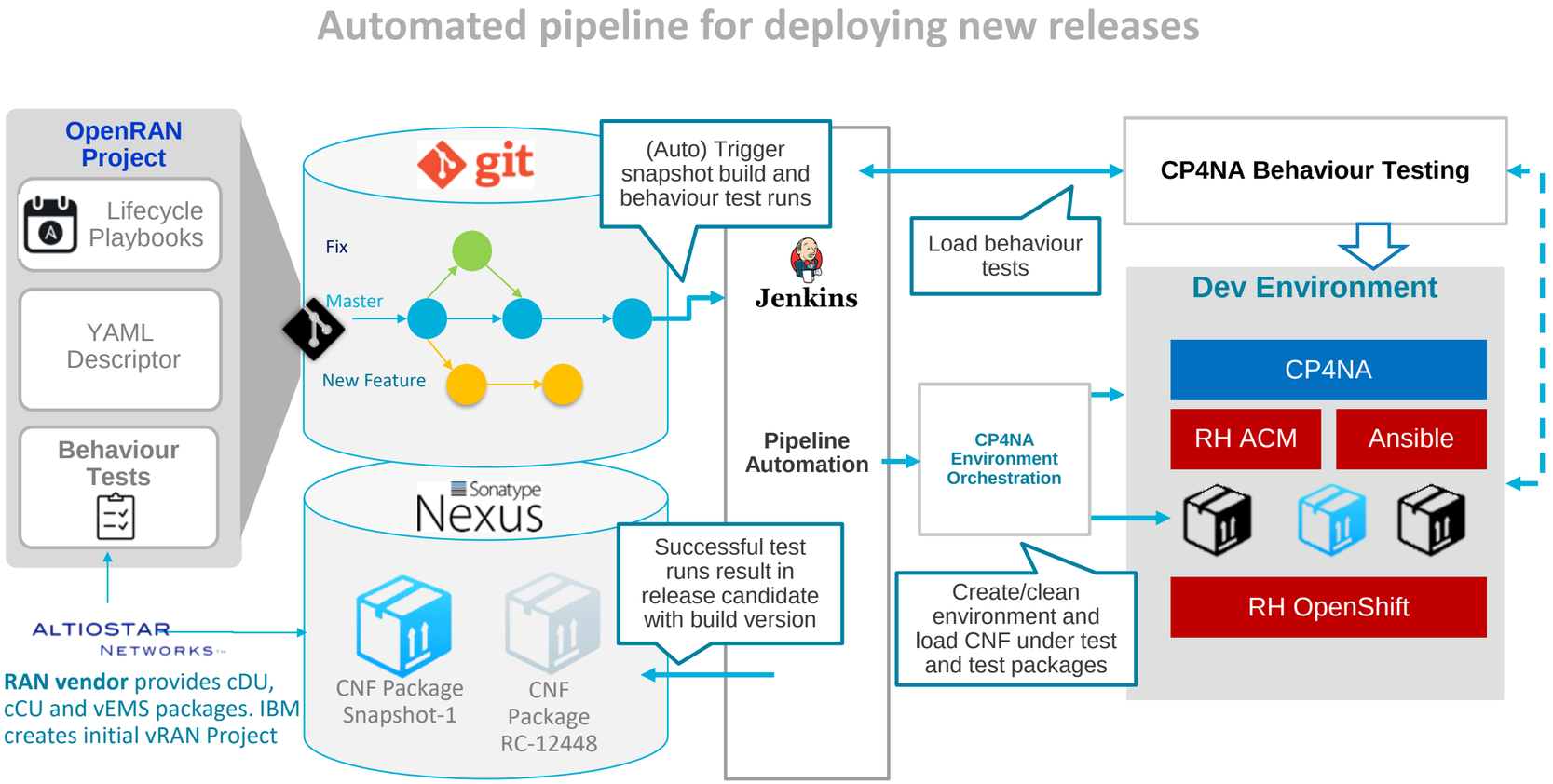
Open RAN Architecture Design

- **Kubernetes methodology** for a microservices and agile methodology architecture
- **OpenShift Virtual Machines** deployment capabilities to support RAN vendor vCUs and vEMS
- Solution **prepare to automatically managed and adapt** different configurations for the Cells Site
- OpenShift **Open Innovation** ecosystem
- **Prepared for additional locations**, e.g. Regional Sites
- **Baremetal deployment** for worker nodes in the Cell site
- **Agnostic orchestration** solution with CP4NA. Using Red Hat ACM provisioning tool integration
- **Integration of inventory and alarms** in CP4WAIOPS



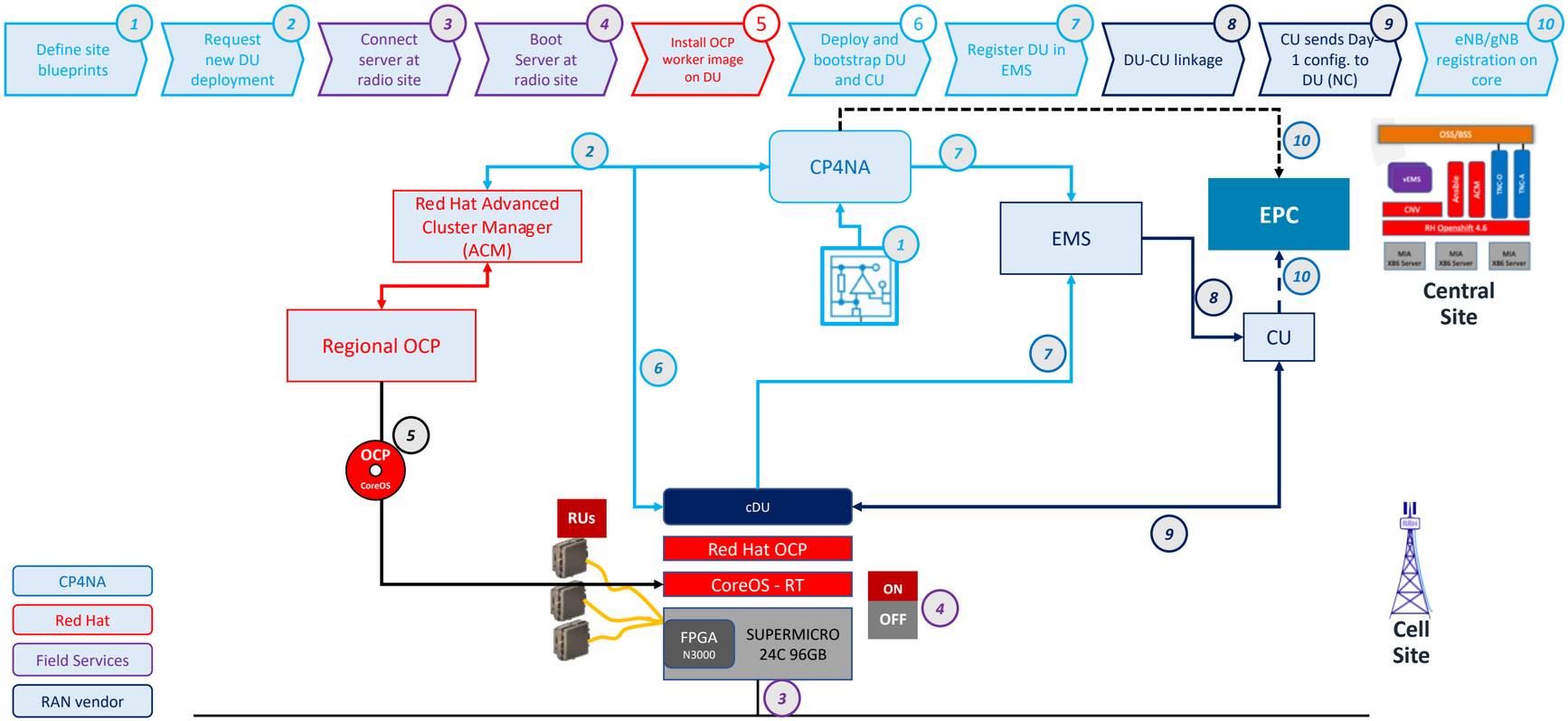
Solution Lifecycle of Software Components

- **Fully automated assembly line** (pipeline) to onboard new patches, release of software components
- **Control of dependencies** for deployment capabilities
- **Control of deployment order** for correct activation
- **Fully automated testing** with auto-provisioning of test scenarios
- **Auditable testing** results and behaviour testing
- **Managing multiple deployment scenarios** and adapting to new requirements and scenarios



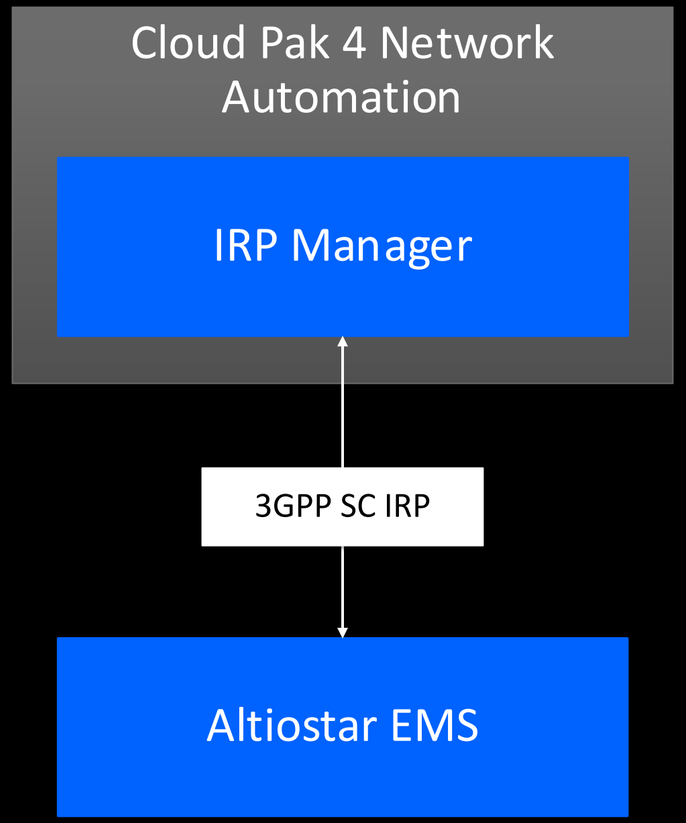
Zero Touch Provisioning with CP4NA

- CP4NA **inventory site designer** will be used for **designing and modelling** the infrastructure of vRAN platform
- After on-site installation and power-up, CP4NA instructs **Red Hat ACM to deploy automatically** the Openshift components
- CP4NA **automatically deploys the CU and DU software** on Kubernetes and applies their initial configurations
- CP4NA **coordinates with the EMS for activation** and automatically **notifies OSS or EPC to register new eNB/gNB**

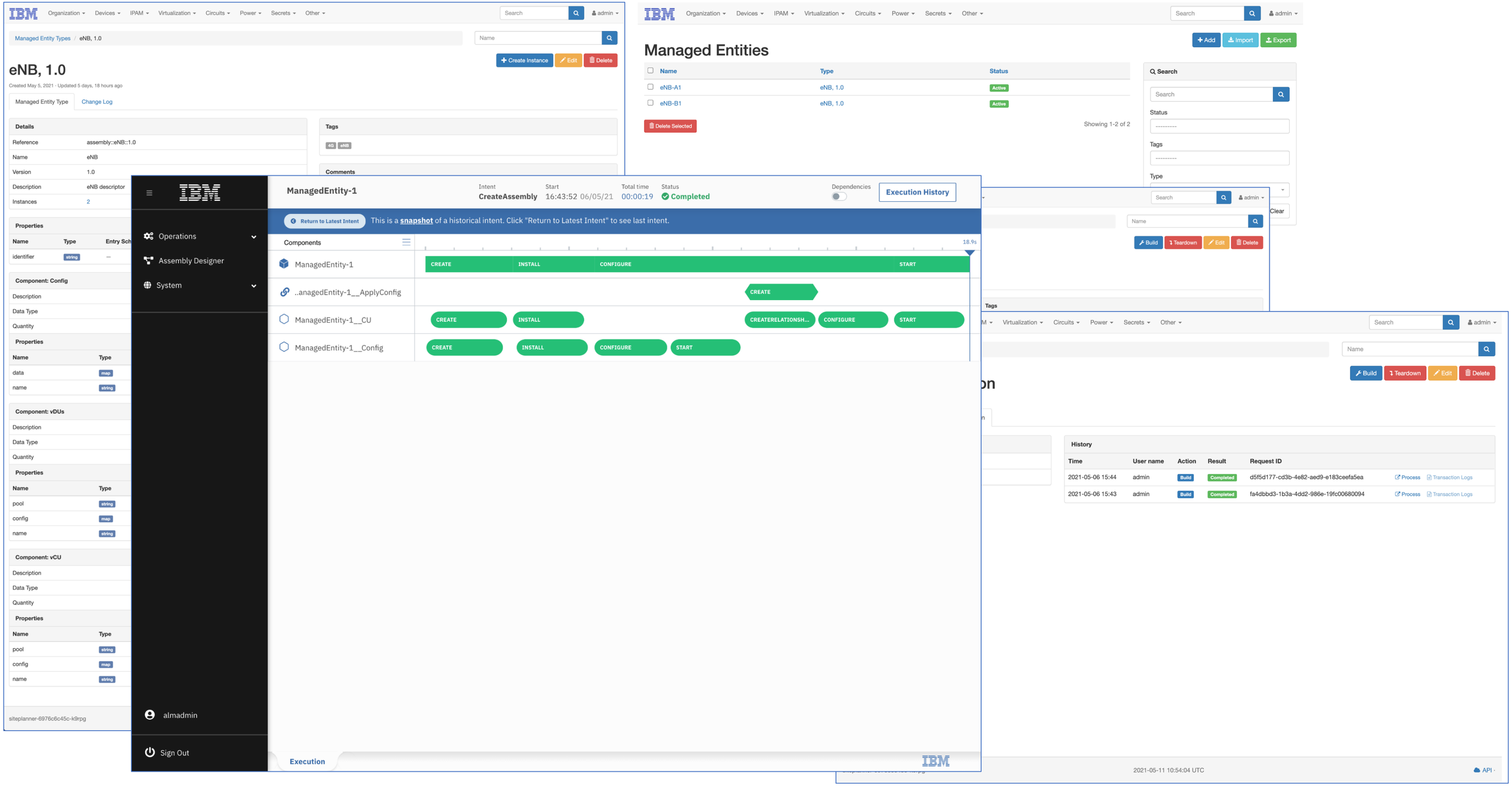


IRP Manager service

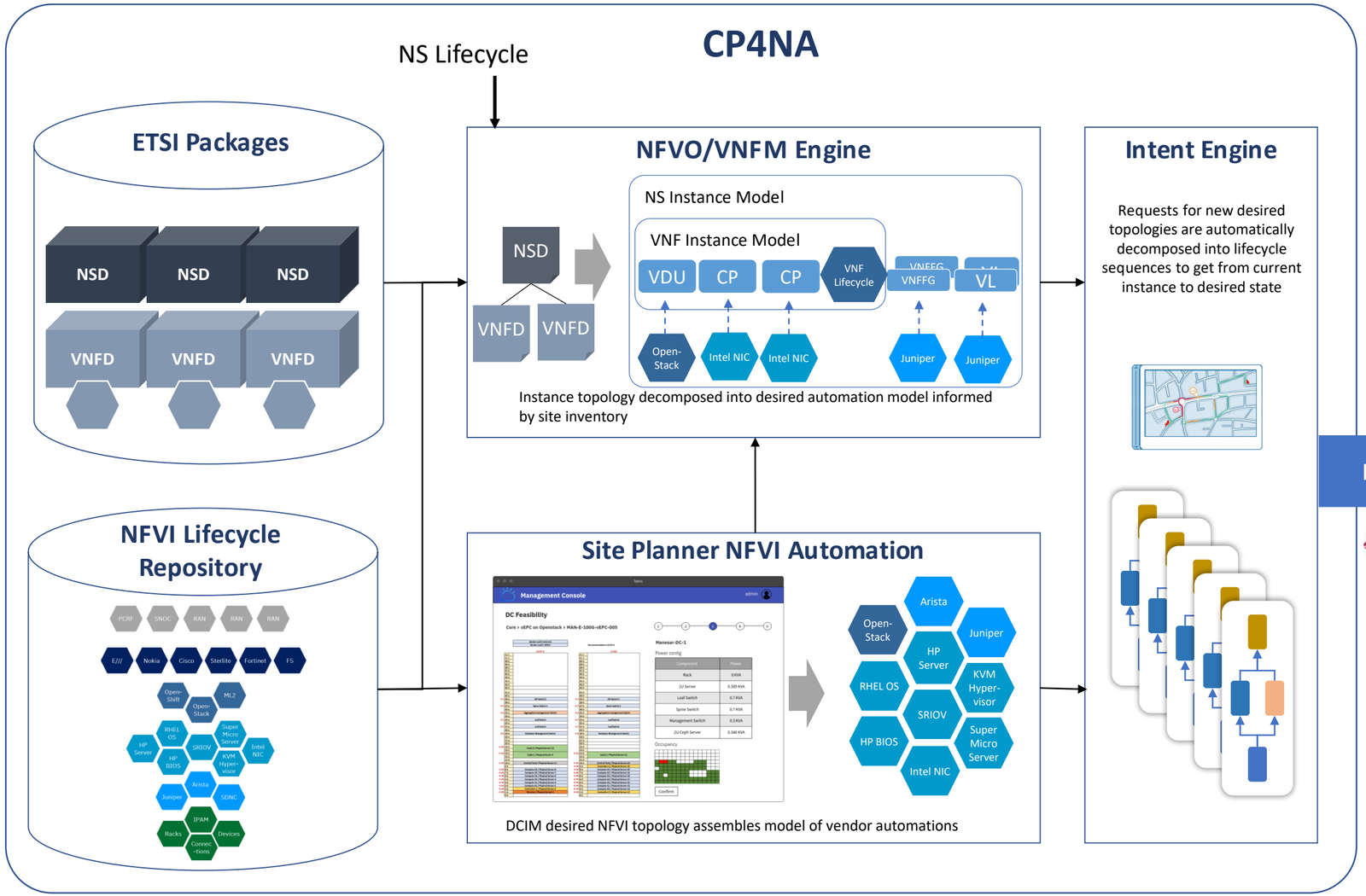
- Compliant with 3GPP Self-configuration IRP (integration reference point)
- Supports integration with Altiostar EMS for provisioning of 4G eNodeB configurations.
- Driven by configuration from Site Planner



Zero Touch Provisioning in CP4NA



CP4NA intent approach and automation building blocks

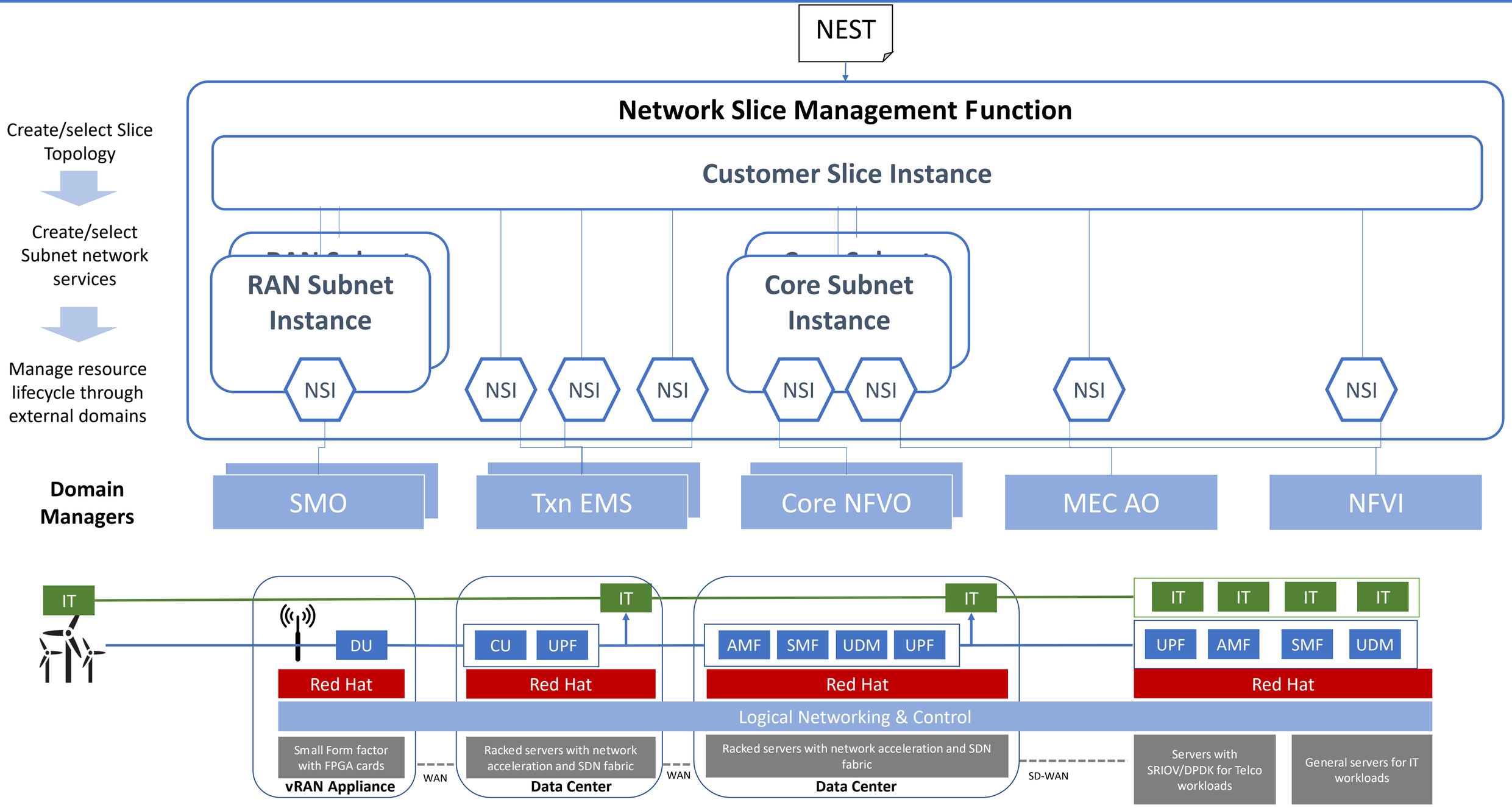


NFVI Sites can have different network, hardware, and controller software

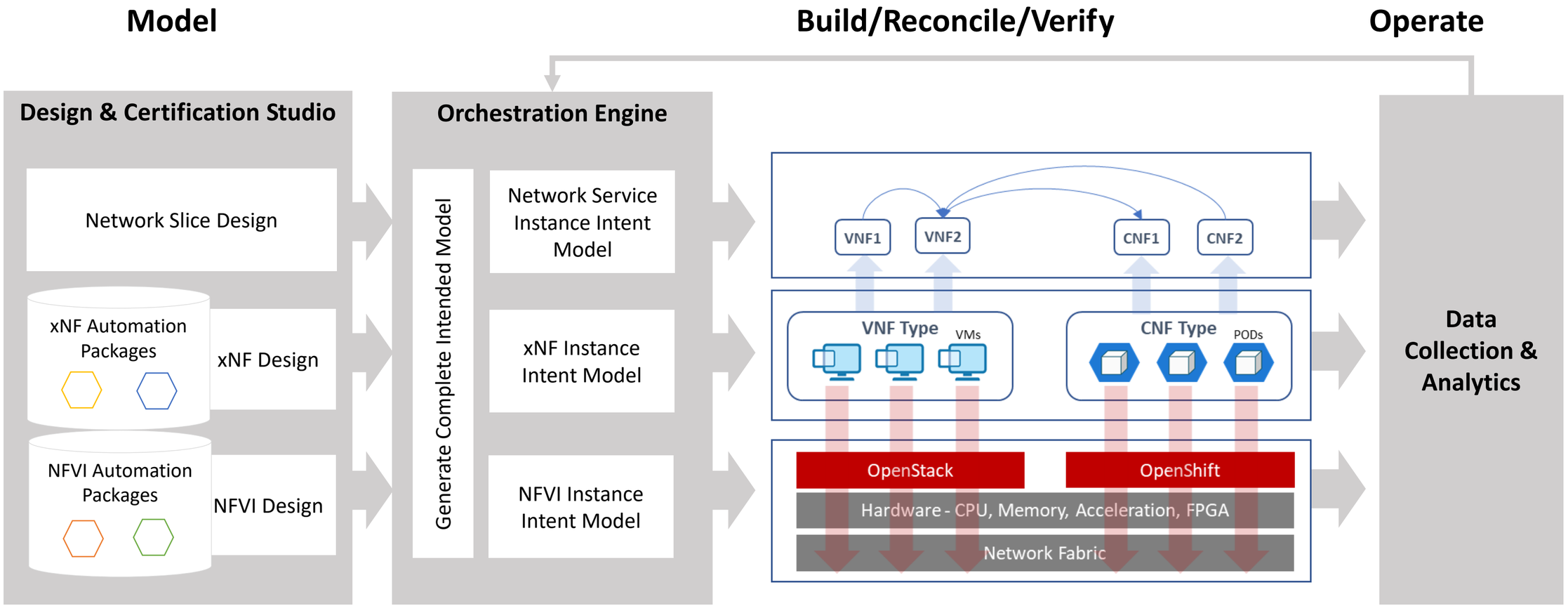
- ✓ IBM's site planner models the low level design of an NFVI from lifecycle building blocks. The intent engine assembles the model into a working NFVI
- ✓ Similarly for MANO, an NS request is decomposed into an instance model that is composed of xNF and infrastructure lifecycle building blocks
- ✓ The infrastructure building blocks are late bound from the inventory information in site planner

IBM Cloud Pak for Network Automation Use Cases:
5G Network Slicing

Network Service Slice Management as per 3GPP



Telco Network Cloud Automation Approach



- Small Device and xNF automation packages are loaded
- Design rules for assembling the automation packages are programmed

- Intent models are generated from the designs and are constantly reconciled

Programming CP4NA – Designs & Automation Packages

Slice Design

- Network Service Composition
- Placement rules

- Slice Profile
- Binding Policies
- Closed loop policies

Infrastructure Design

- Site Racks
- IPAM
- Device types
- Compute roles

xNF Design

- Flavour profiles
- Scaling/Healing policies
- Hardware dependencies/tuning parameters

NFVI Automation Packages

Standard set of automation types must be implemented to configure vendor NFVI devices as per site design

Fabric Packages

Switch

Server Packages

BIOS

NIC

HV

OS

Storage Packages

Ceph

VIM Package

RHOCP

RHOS

Redfish

kubernetes

xNF Automation Packages

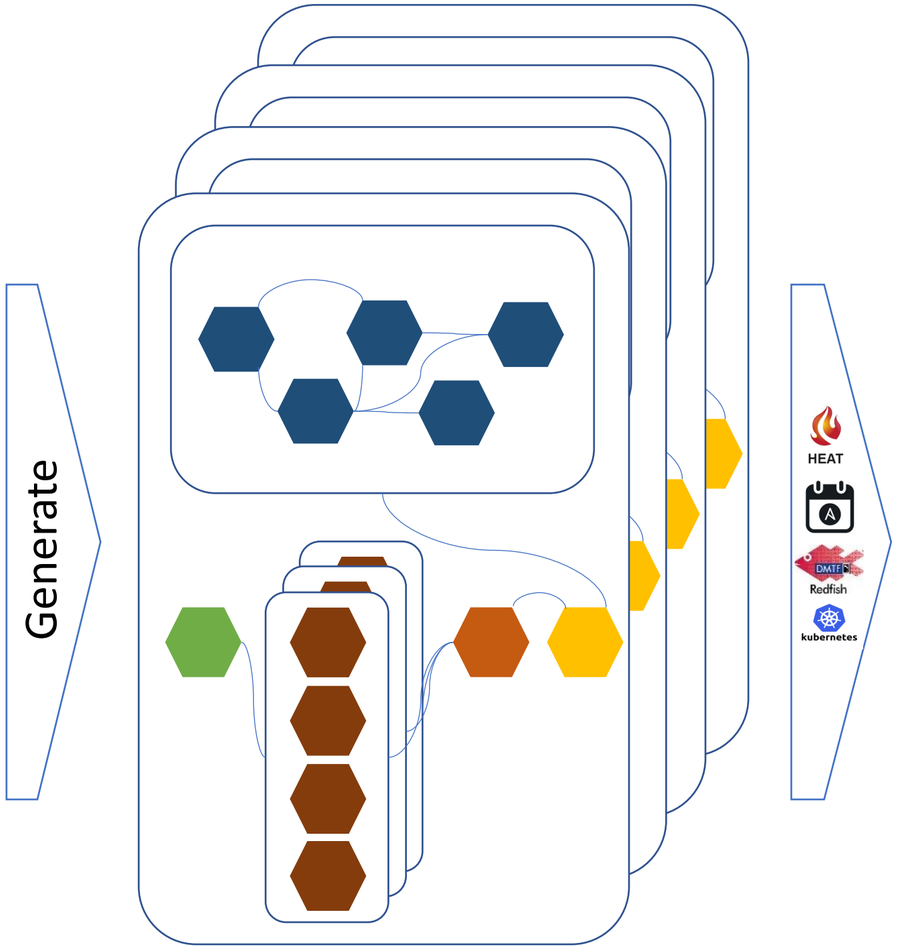
Vendor or SI compiled xNF automation package includes all software and information to deploy and manage its lifecycle

- Descriptor
- Lifecycle
- Metrics
- Tests
- Images

HEAT

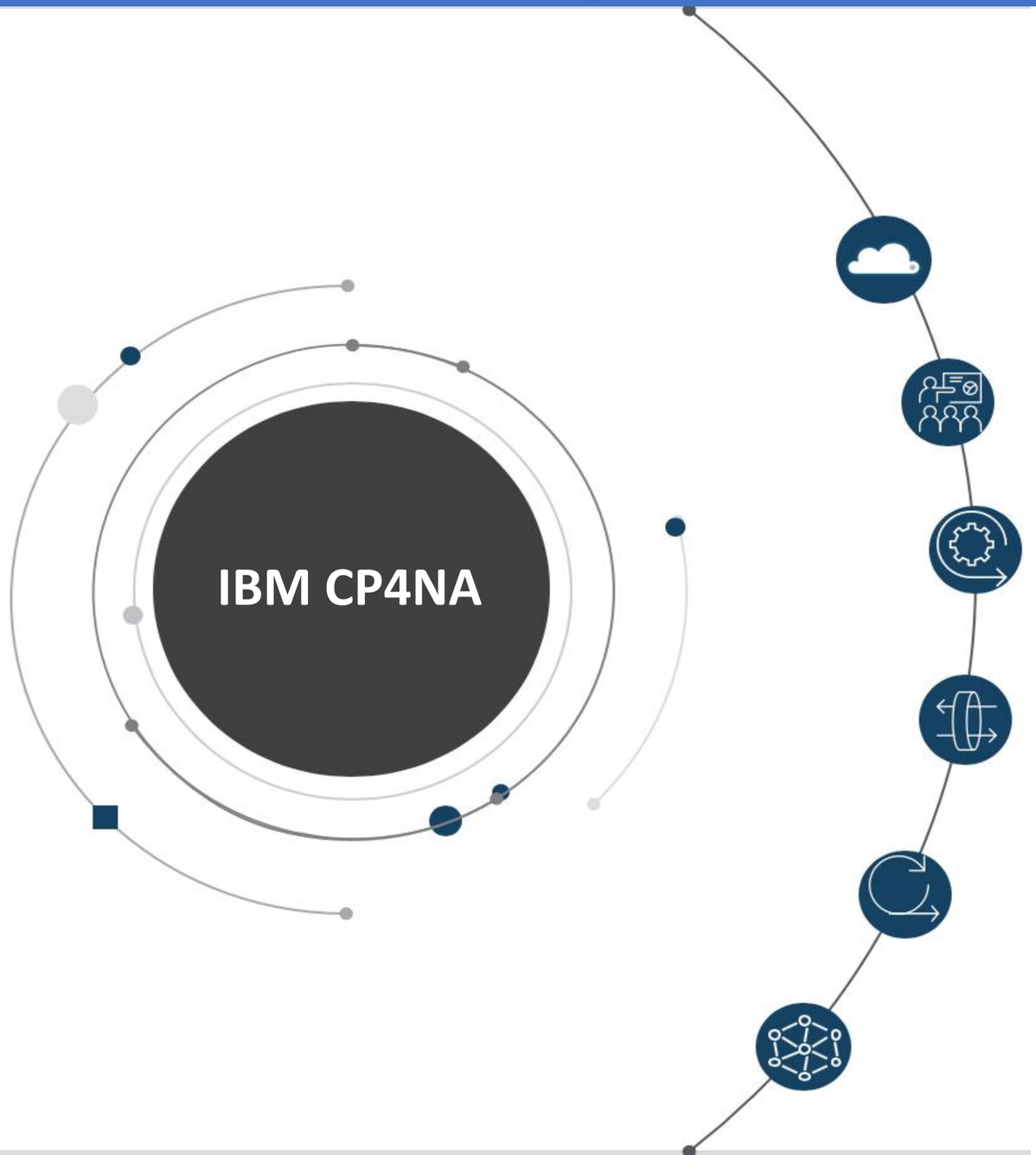
kubernetes

Generated Model runs the scripts in the automation packages in the calculated order



IBM Cloud Pak for Network Automation Summary

CP4NA differentiating features



Cloud native solution

Vendor and NEP neutral

Operational Intent engine

Technology agnostic

End to end unified lifecycle model

Growing ecosystem