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The Mindful IT Company
Born Digital . Born Agile

NETWORK DISAGGREGATION AND QUALITY ASSURANCE

A WEBINAR BY HAPPIEST MINDS

OUR SPEAKERS

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About Happiest Minds

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The Mindful IT Company
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Next Generation Digital Transformation, Infrastructure, Security and Product Engineering Services Company

IPO
In September 2020

- 100 % digitally executed IPO
- Heavily oversubscribed with healthy listing gains

Reflects

- Our growth and profitability
- Management Team & Corporate governance

97%
Digital

94%
Agile

'Born Digital. Born Agile'

173+
Active clients

46 Fortune2000 / Forbes200 / Billion $ corporations

87%+ of repeat business

31.2%
RoCE[1]

29.8%
RoE

Mission Statement
Happiest People. Happiest Customers

SMILES Values
Sharing, Mindful, Integrity, Learning, Excellence, Social Responsibility

3,228+
Happiest Minds
across 7 Countries

Great Place To Work
- Ranked **#4** - IT Services
- Top **50** India's Best Workplaces for Women
- Top **100** India's Best Workplaces
- Top **75** India's Best Workplaces for IT/IT-BPM

4.3
rating
on **Glassdoor**
#2 for Indian IT Services

Promoter

Ashok Soota

Great Place To Work. Certified APR 2020-MAR 2021 INDIA

RED HERRING ASIA 100 WINNER 2019

zinnov ZONES
Leaders – ER&D Services
Leaders - Education

PEOPLE FIRST IT'S ABOUT YOU!

HR Excellence Awards 2020

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Networking Innovation through SDN & NFV

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PROGRAMMABLE & DISAGGREGATED SYSTEMS

- System Design
- Drivers & Firmware Engineering
- Programmable Dataplane Engineering
- NOS Integration
- Protocols and Features Engineering
- Element and Network Management Systems

EDGE NETWORKING

- Edge Platform Engineering and Integration
- Protocol Engineering and Integration
- Edge Orchestration
- Edge Analytics

CLOUD NETWORKING

- Virtualized Network Functions
- Containerized Network Functions
- Container Networking
- Cloud Network Services Integration

NETWORK ORCHESTRATION & AUTOMATION

- Service Orchestration
- Management and Network Orchestration Engineering
- Intent Based Network
- Portals and Application Engineering
- Telemetry & Analytics
- SDN Controller & Application Engineering

System Design

Software Development

Testing

Big Data & Analytics

DevOps

ECOSYSTEM

DANOS, P4, OPEN DAYLIGHT, DPDK, Intel Network Builder, OPEN COMMUNITY, openstack, ONOS ON.LAB, EDGE X FOUNDRY, TELECOM INFRA PROJECT

WEBINAR AGENDA

01 Network Disaggregation

02 Key Challenges

03 The Importance of Quality Assurance

04 Use Cases Outlined

05 Our Contribution to LINUX Foundation - DANOS

Network Disaggregation

Network Systems Disaggregation

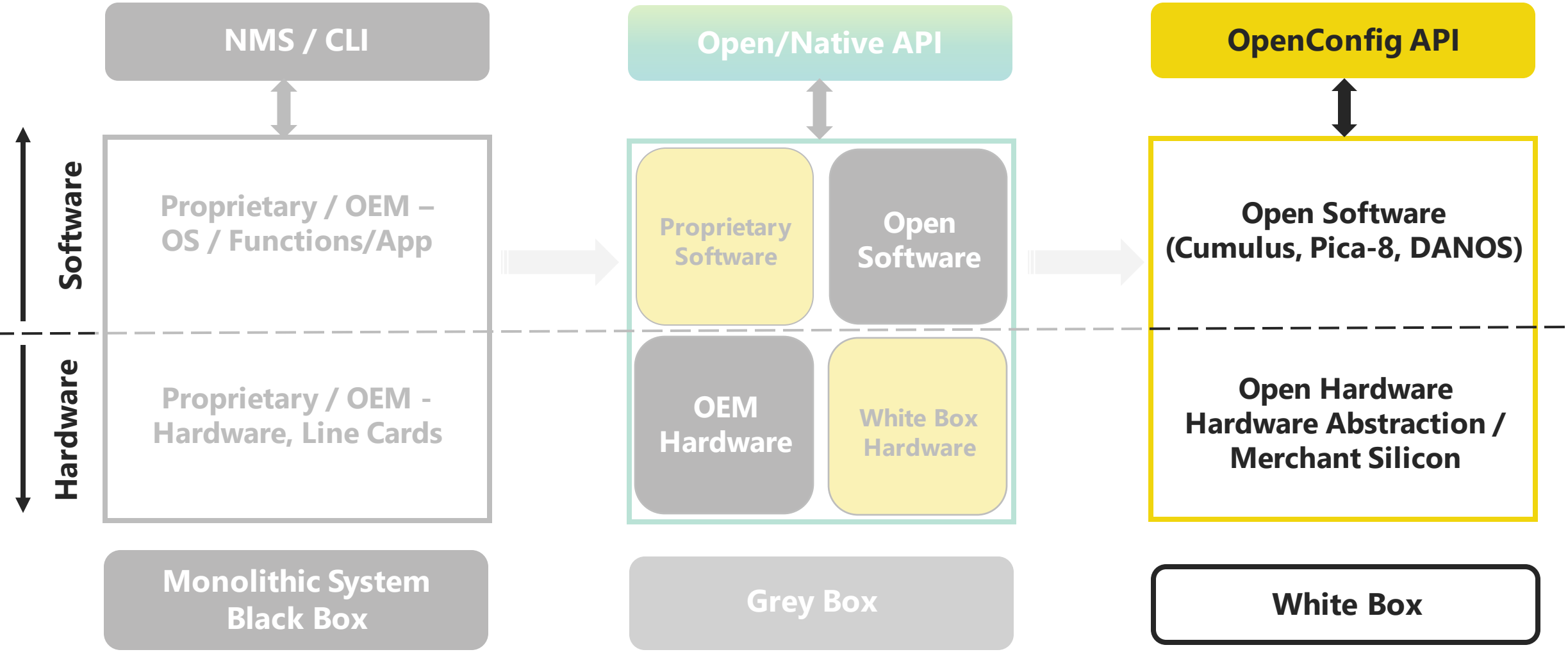
- Separation of Hardware from Software
- Open interfaces
- Simplified hardware based on Merchant Silicon

- Open Architecture
- Vendor Agnostic
- White-box, BareMetal
- Scalable Network Functions
- Virtualization of Physical Resources

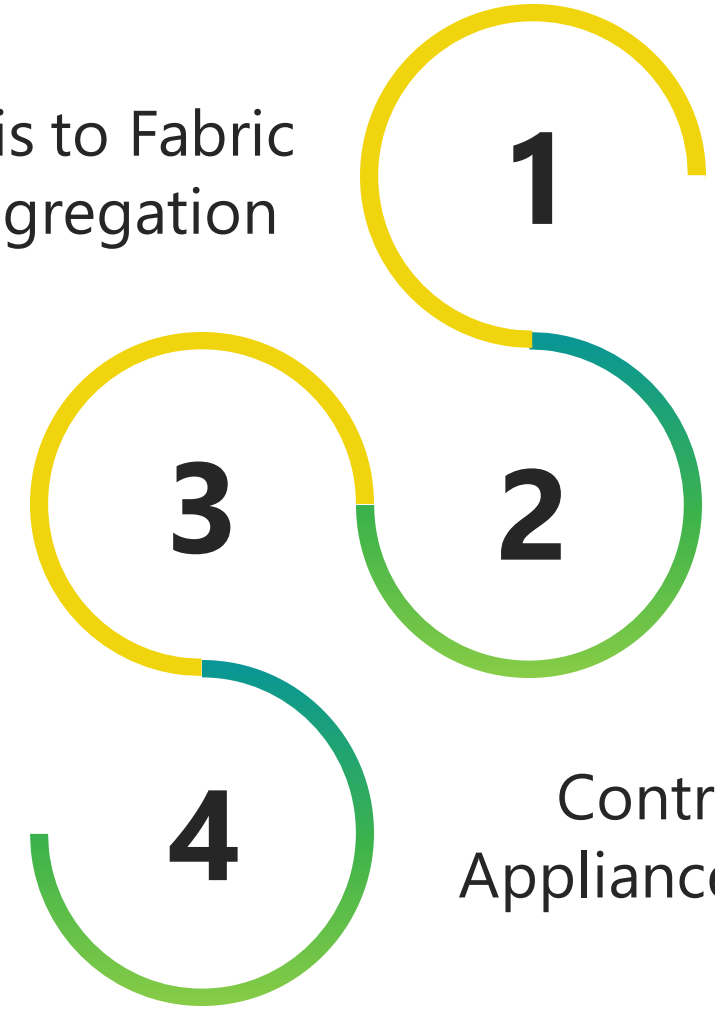
Disaggregation of Networks

- Hardware/White-box
- Virtualization
- Shared resource by multiple apps
- Cloud native based on Microservices and Containers
- System Orchestration and Management

Network Disaggregation – Evolution



Network Disaggregation Types



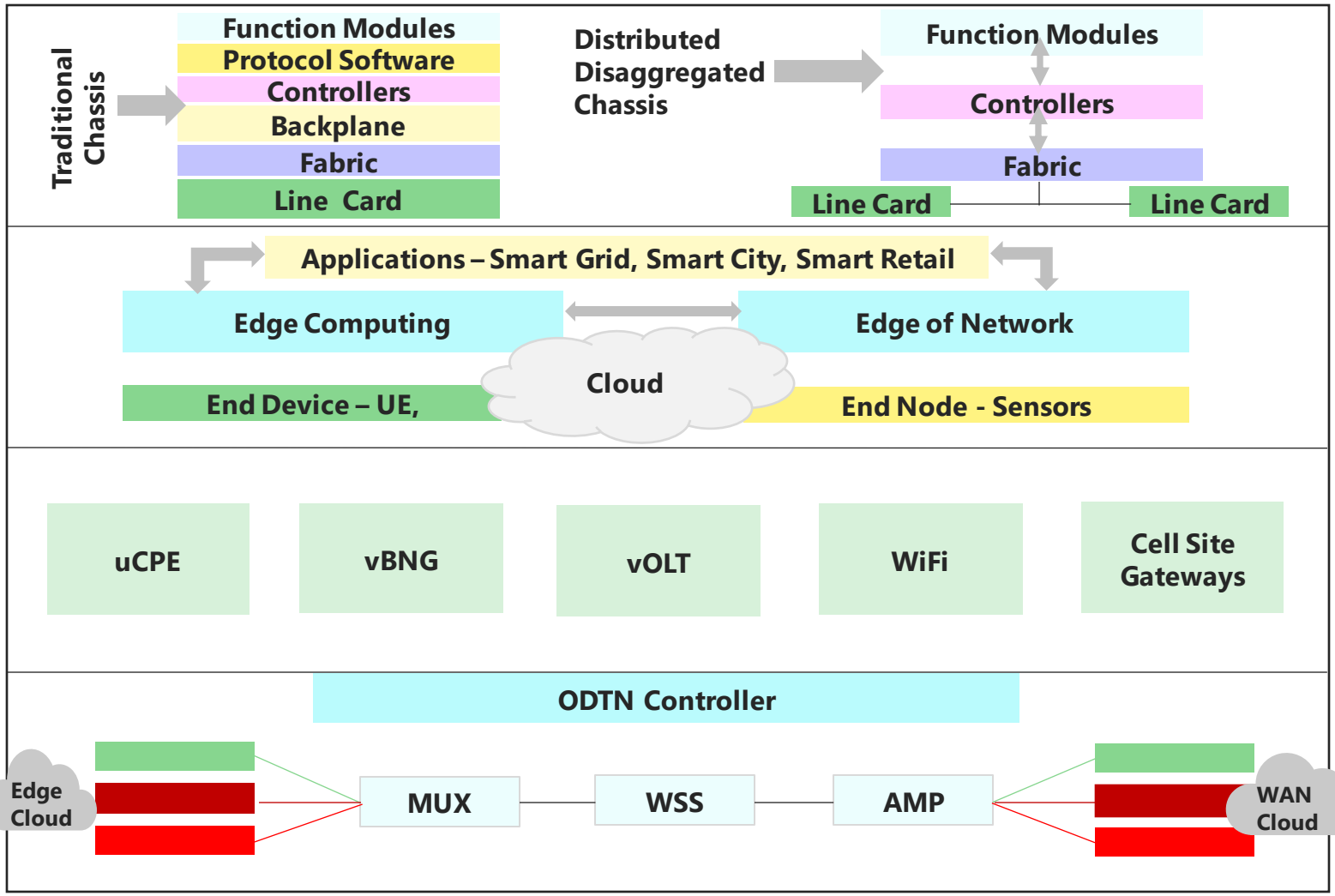
Chassis to Fabric Disaggregation

Software from Hardware Disaggregation

Function from Appliance Disaggregation

Control Plane from Appliance Disaggregation

Network Disaggregation – Access/Aggregation/Core/Transport



Core Layer

- Data center switching solutions based on modern workloads and virtualization environments
- AT&T's Distributed Disaggregated Chassis (DDC) using Broadcom's Jericho2/Ramon chipset, based on UFISpace h/w and Drivenets DNOS (OCP, TIP)

Edge Layer

- Improved solutions for Edge and WAN connectivity based on SD-WAN services
- Solutions based on open-source projects "Open Edge Computing, OPNFV, Intel Openness etc

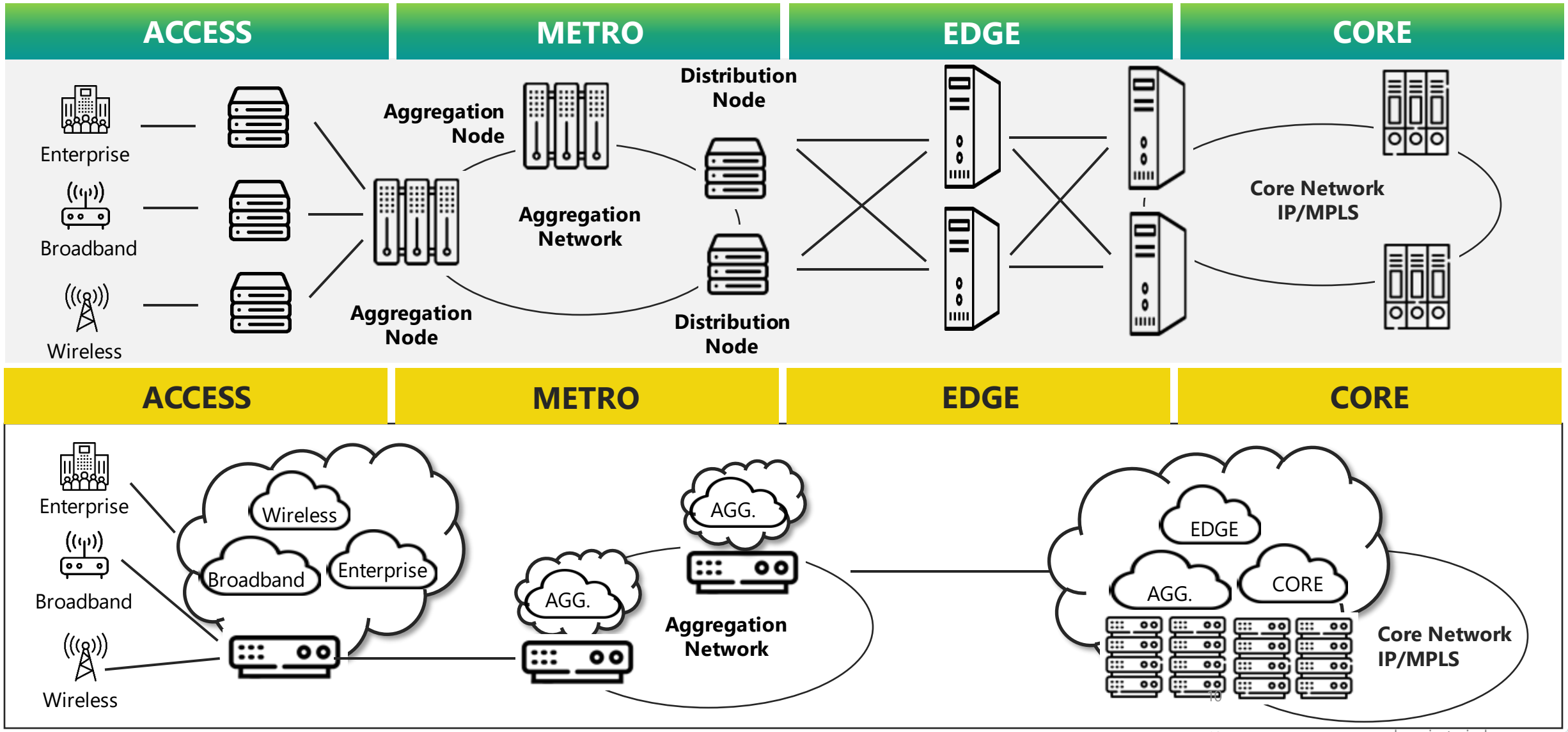
Access Layer

- Advanced uCPE solutions using modern x86 platforms, VNFs such as FW, NAT and VPN solutions
- Centralized management with Open APIs and effective E2E orchestration

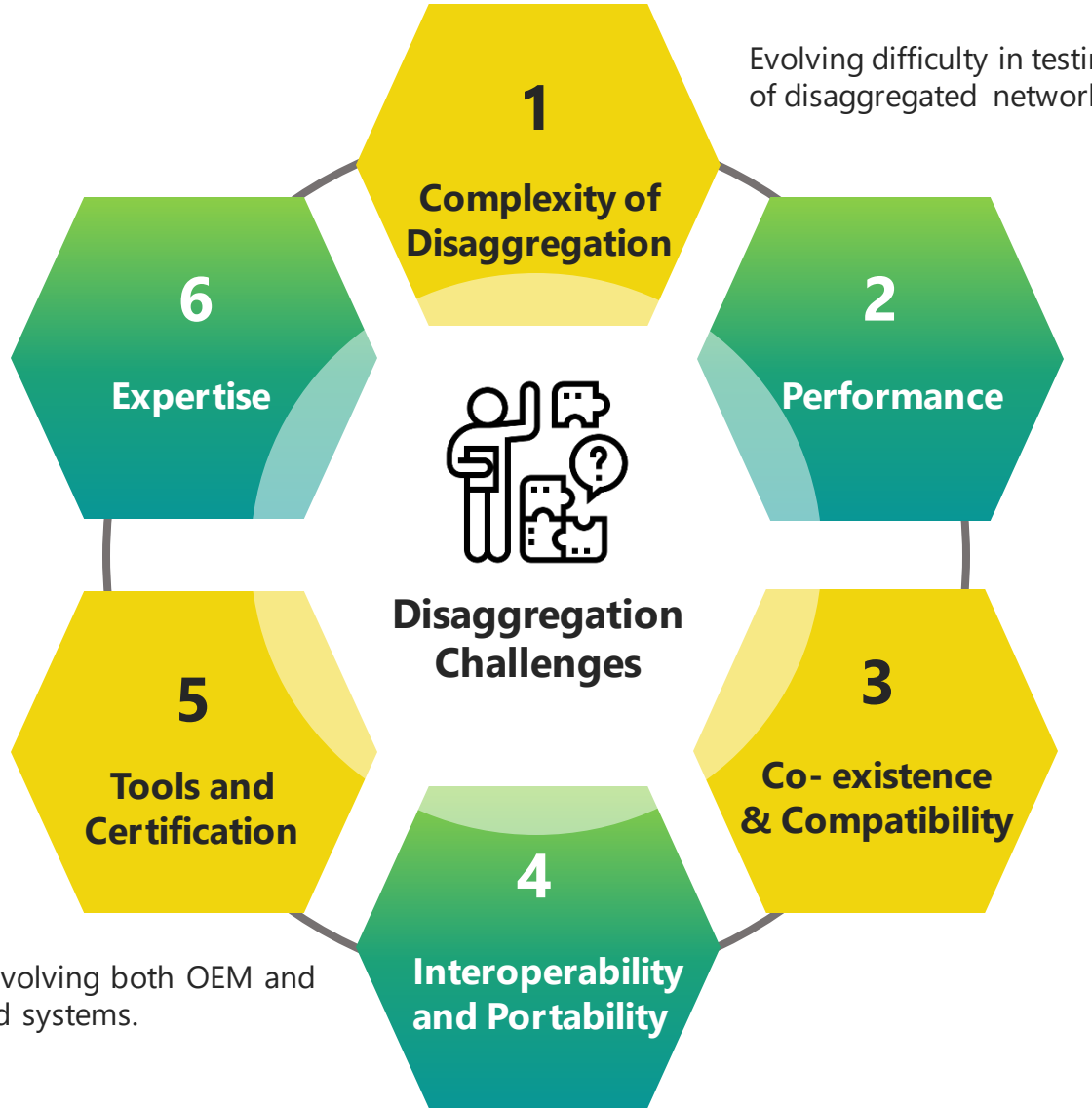
Transport Layer

- Disaggregated optical network architecture for SP to select multi-vendor components i.e., Transponders with different bandwidth, SLAa etc
- End-to-end DC/Cloud-to-DC/Cloud services for Enterprise and HCI customers

Disaggregation Infrastructure



Key Challenges to Disaggregation



Evolving difficulty in testing various parts of disaggregated networks manually.

New performance KPIs and testing methodologies to ensure similar non-functional SLAs.

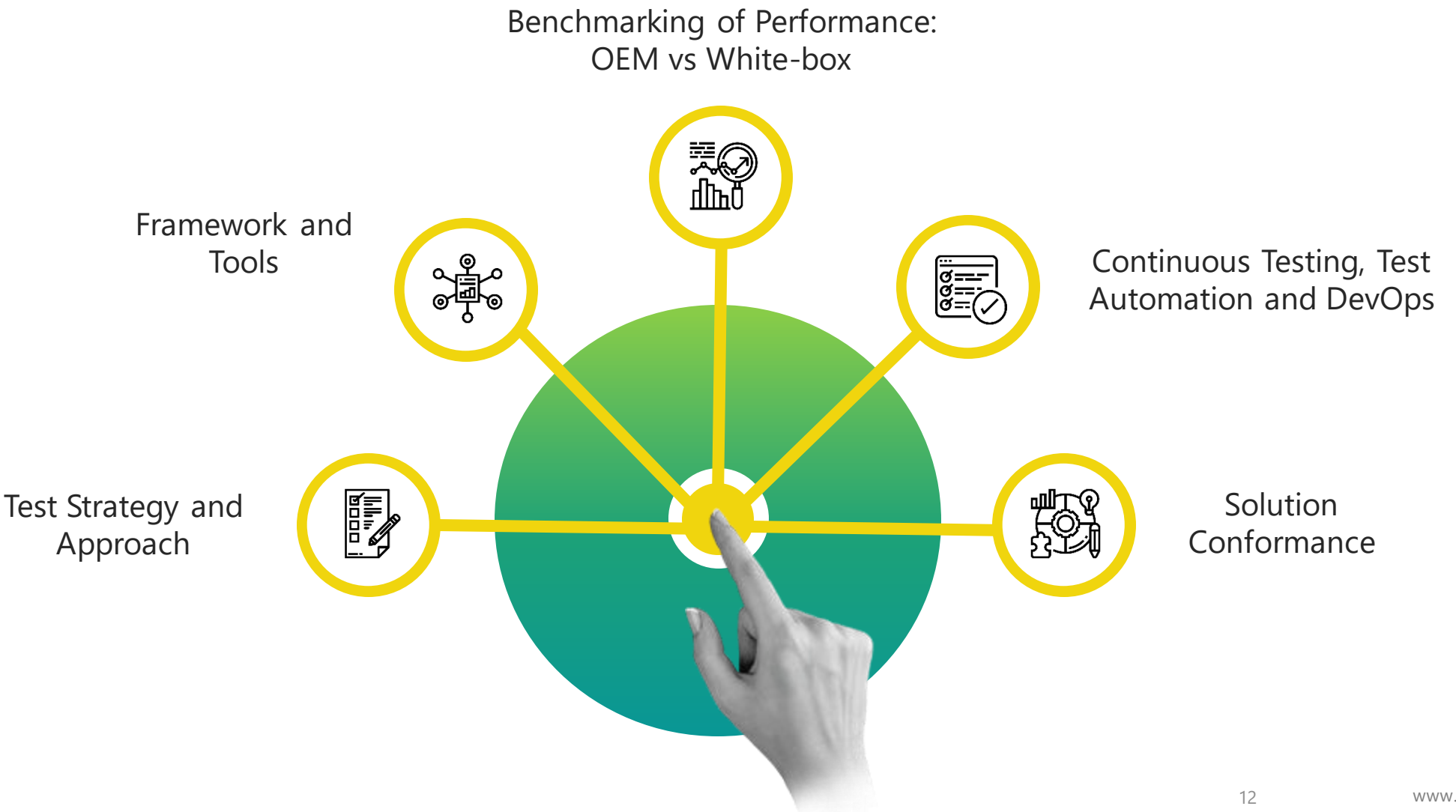
Ability to validate both CLI and REST / NetConf based micro services, E2E service orchestration.

Multiple elements involving both OEM and Open software-based systems.

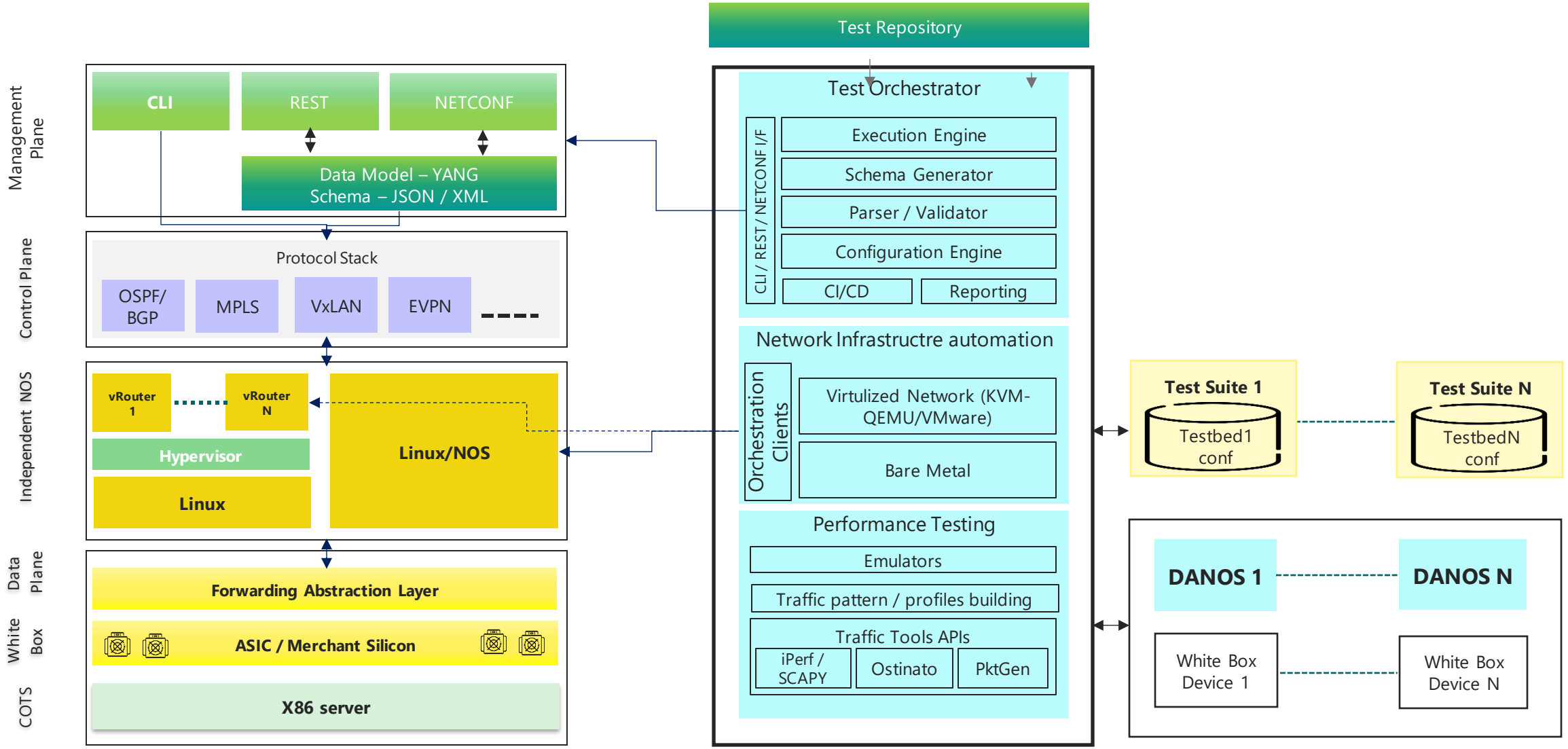
Absence or yet to be standardized test tools, frameworks to measure white box/disaggregated elements.

Limited availability of skilled manpower having networking test automation and NetOps skills.

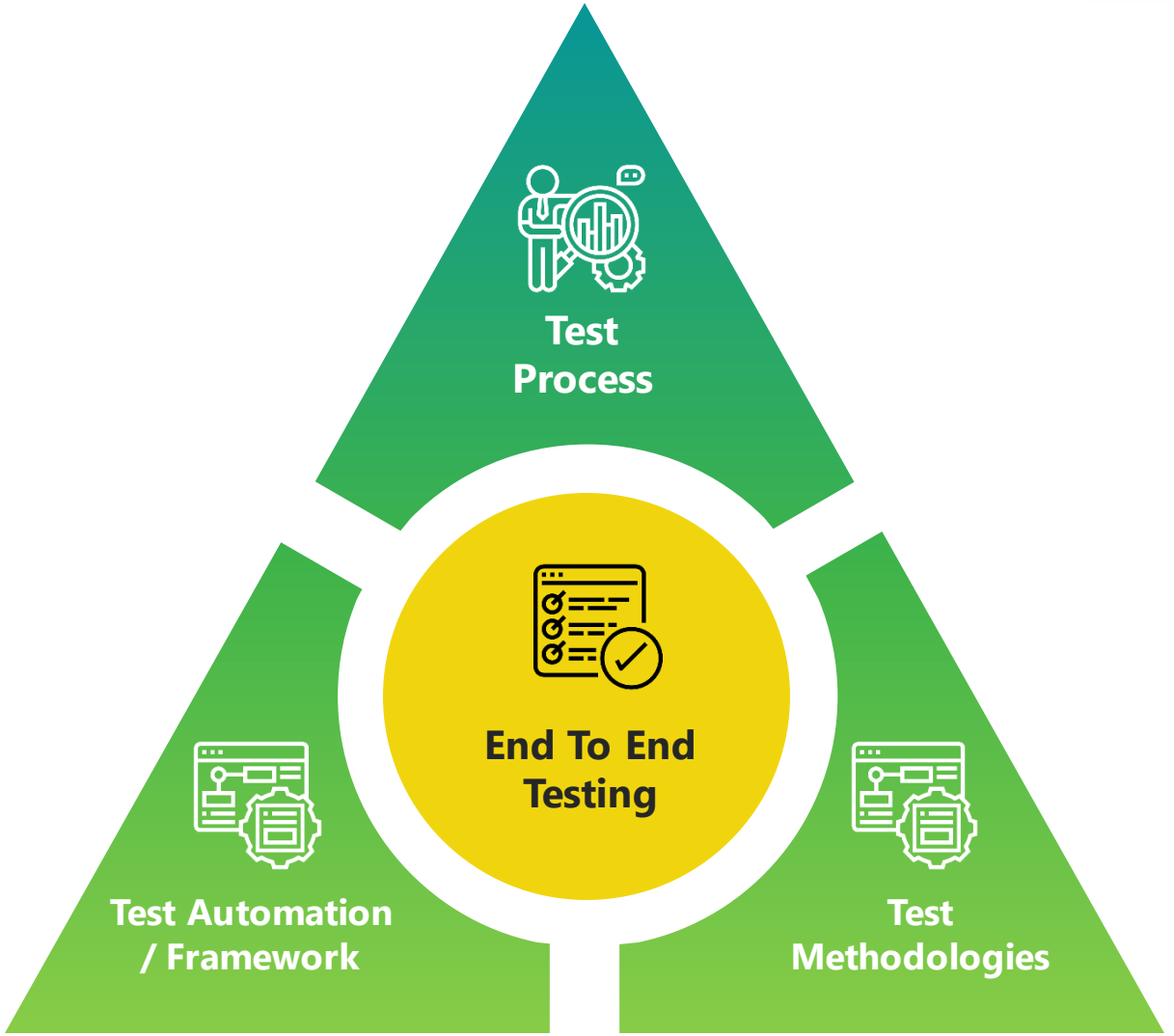
Success Factors for Disaggregated Deployments



Test Framework for Validated Disaggregated System



Quality Assurance



Quality Assurance – Approach (1 of 2)

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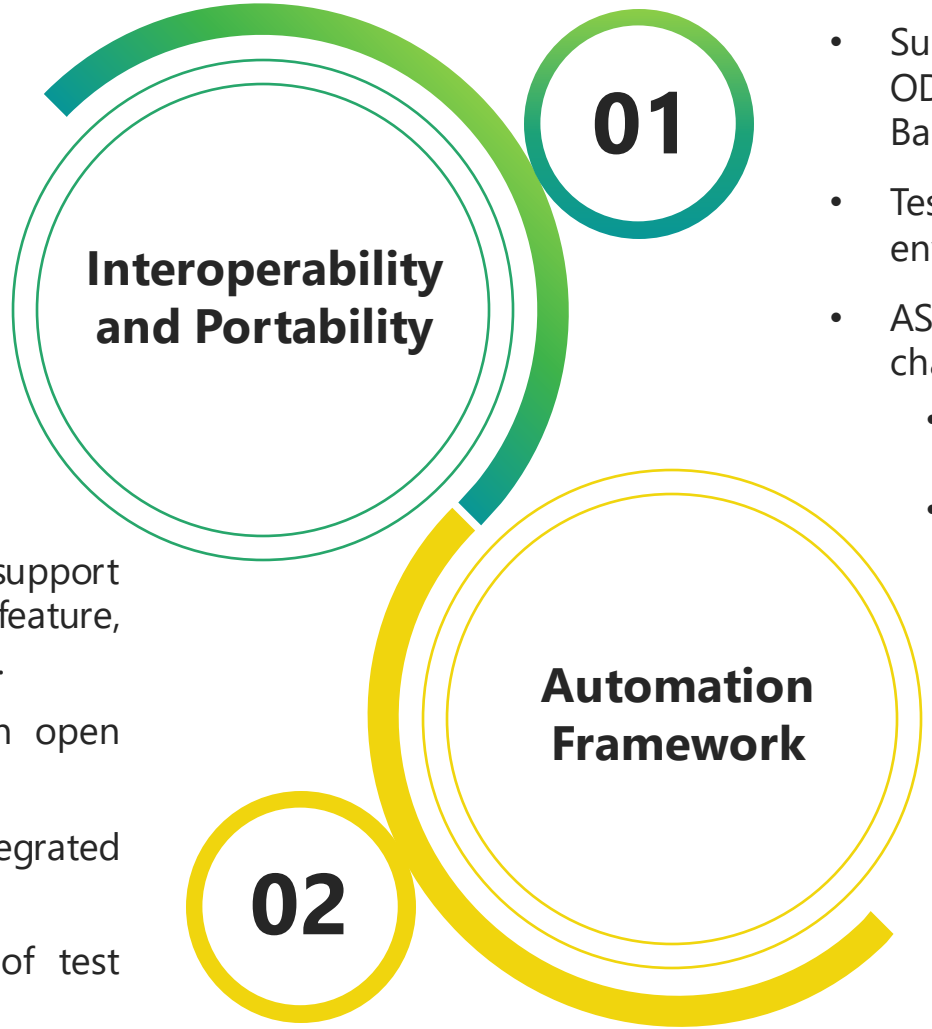
Applications / Control and Management Plane	• Layer-2/Layer-3 features, Security and VPN services • OpenConfig APIs - CLI, NETCONF, REST • Data Models - YANG
Network Virtualization / Cloud Native / Micro Services	• Services/Apps running as container / Micro services • BareMetal, VM, Virtualized Env (Cloud VM) • Interfaces - SRIOV, TAPI
Hardware Testing	• Forwarding and Hardware Abstraction Layer • Merchant Silicon based forwarding • 100G/200G port density testing for throughput/latency
Base OS (NOS)	• Compatibility with industry standard hardware • Upgrade/Patching, Process restart/termination
Transport	• Disaggregated devices – DWDM systems including Transponders, OLS, Amplifiers, MUX and ROADMs • Open-source network operating system • Open and common data models, APIs and protocols
Core	• Standard white-box from ODM • ASIC testing – Millions of flows, VxLAN support • Next-Gen IP/MPLS core routing support • Validation of 100G/400G fabric system
Aggregation / Edge	• BRAS/BNG/MPLS based solutions • MPLS based services – L2VPN, L3VPN testing based on open-source OS and APIs • OpenConfig API and Data model testing
Access	• Access solutions based on Broadband services like BBF-OBBAA, vOLT and vONU • TelCo solutions based on IP based solutions testing

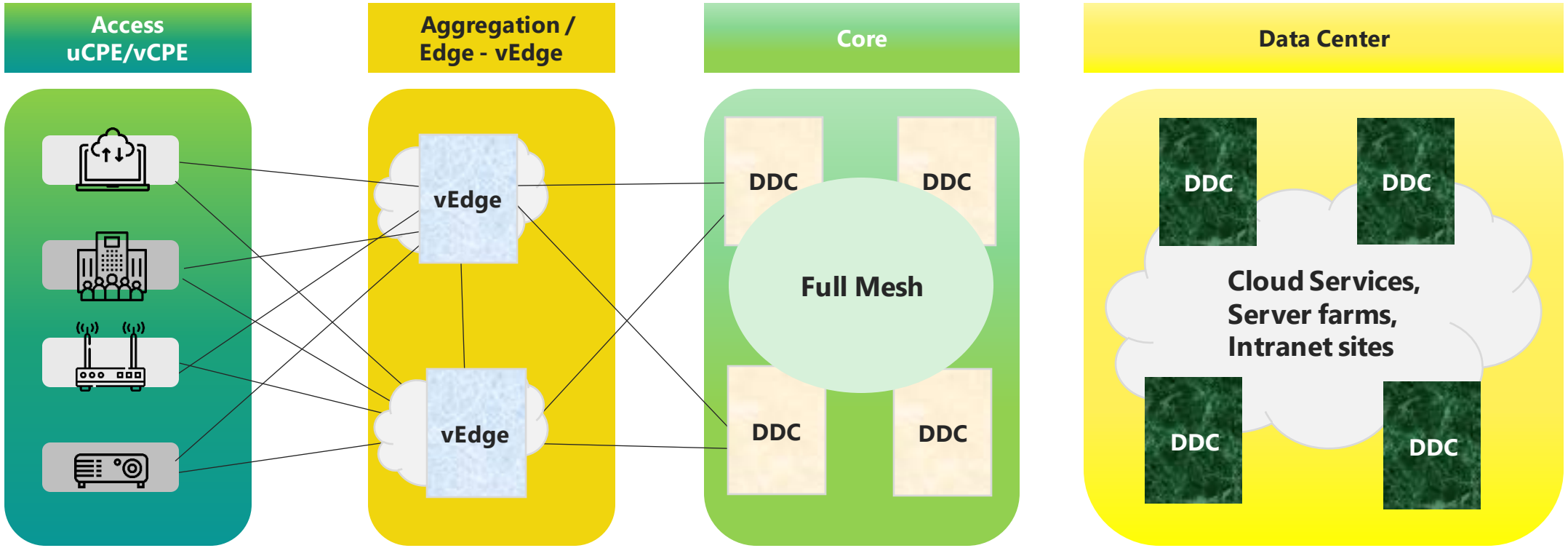
Quality Assurance – Approach (2 of 2)

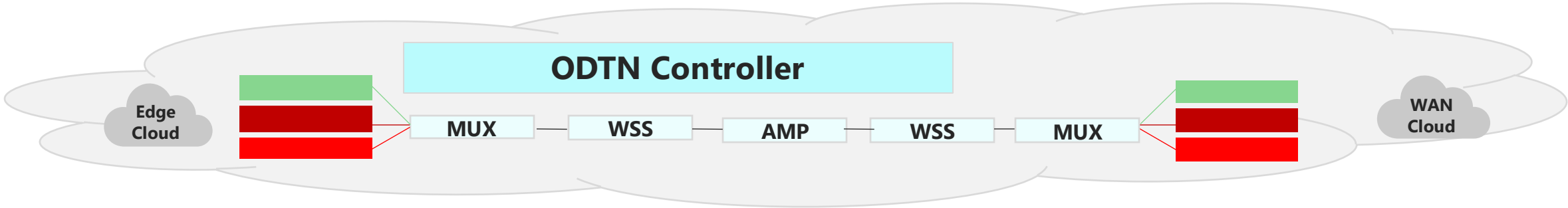


- Automation Framework to handle IN/OOB management based on
  - NetConf, REST and CLI
  - Support for Data Model testing
- Single Framework to manage or support multiple responsibilities including feature, sanity, performance testing and so on.
- CI/CD integration support based on open standards.
- Various traffic profile tests using integrated traffic generator tool to framework.
- Serial or Parallel based execution of test suites.

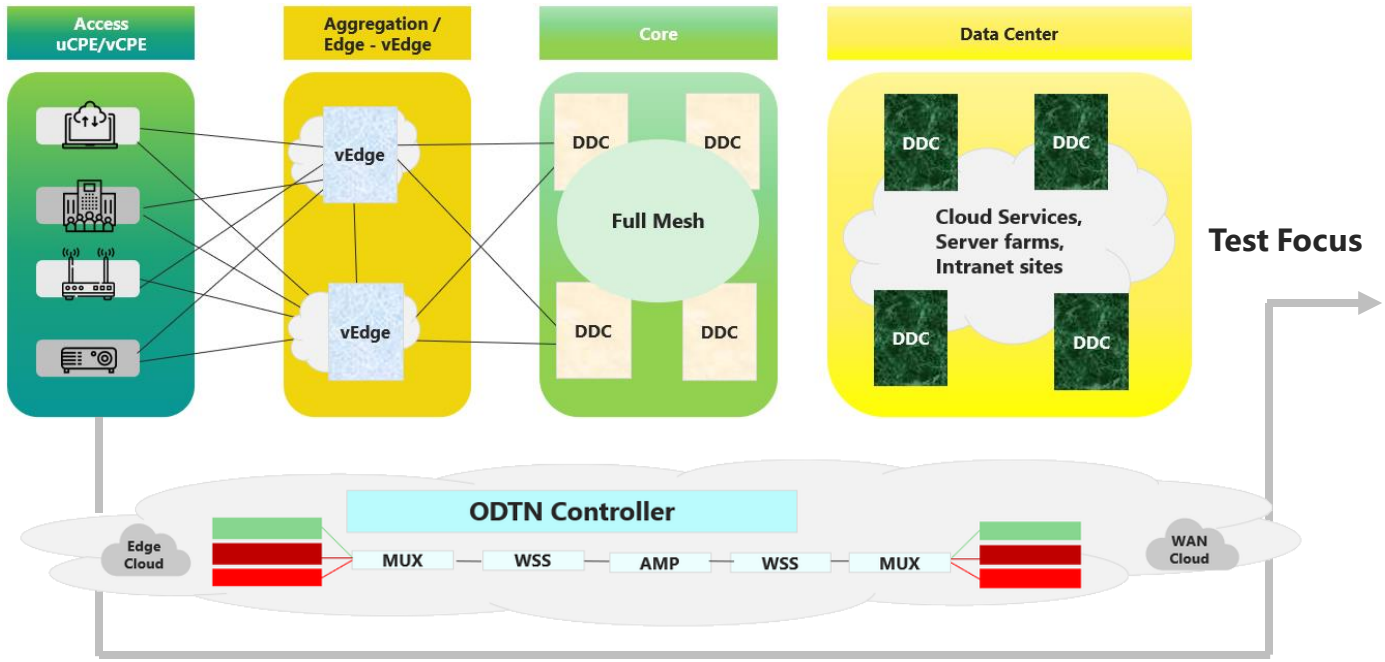
- Support and working of NOS on multiple ODM (UFI-Space, Accton, Quanta) and BareMetal (HP, Dell) vendors.
- Testing and validation of NOS virtualized environments for cloud-based services.
- ASIC validation and testing based on characteristics i.e. –
  - ASICs in DC offering VxLAN/EVPN features with Fabric system
  - ASICs handling millions of flows, encapsulation types such as GRE, MPLSoGRE, GTP, VRF etc

Use Case: Disaggregation Scenario





Test Areas – CPE



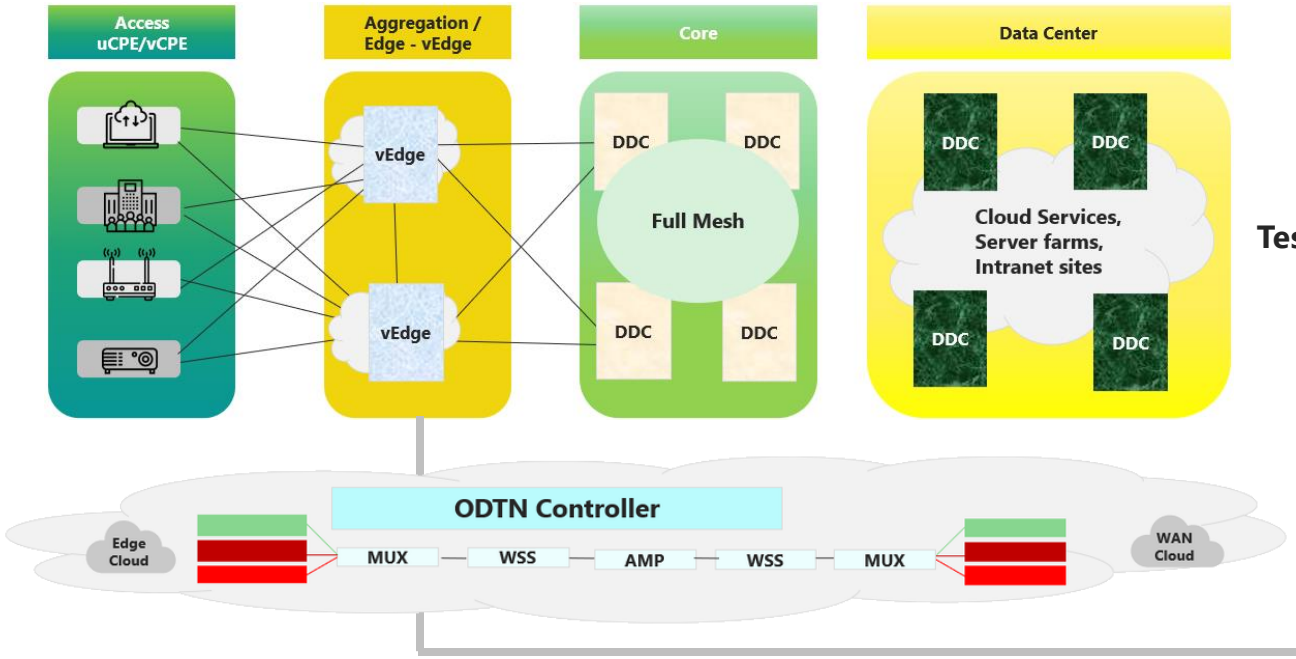
Industry Standard Routing protocols, VPN services, Security and forwarding features

- Template based testing and validation for Routing/Switching protocols
- OLT/ONU based FTTx services
- Native security (OpenSSH to Authentication) Stateful and Stateless FW, QoS, VPNs (IPSec)
- Service Orchestration, Deployment (Ansible/Chef/Puppet), Statistics and Monitoring

Performance/Scale testing

- NUMA layout, Pinning of forwarding threads, internal bus limits. Interfaces testing – SRIOV, number of cores available
- Throughput test–RFC-2544 and 8172 Performance testing.
- Traffic services based on encapsulation methodologies (GRE/VxLAN)

Test Areas – Aggregation / Edge



Test Focus

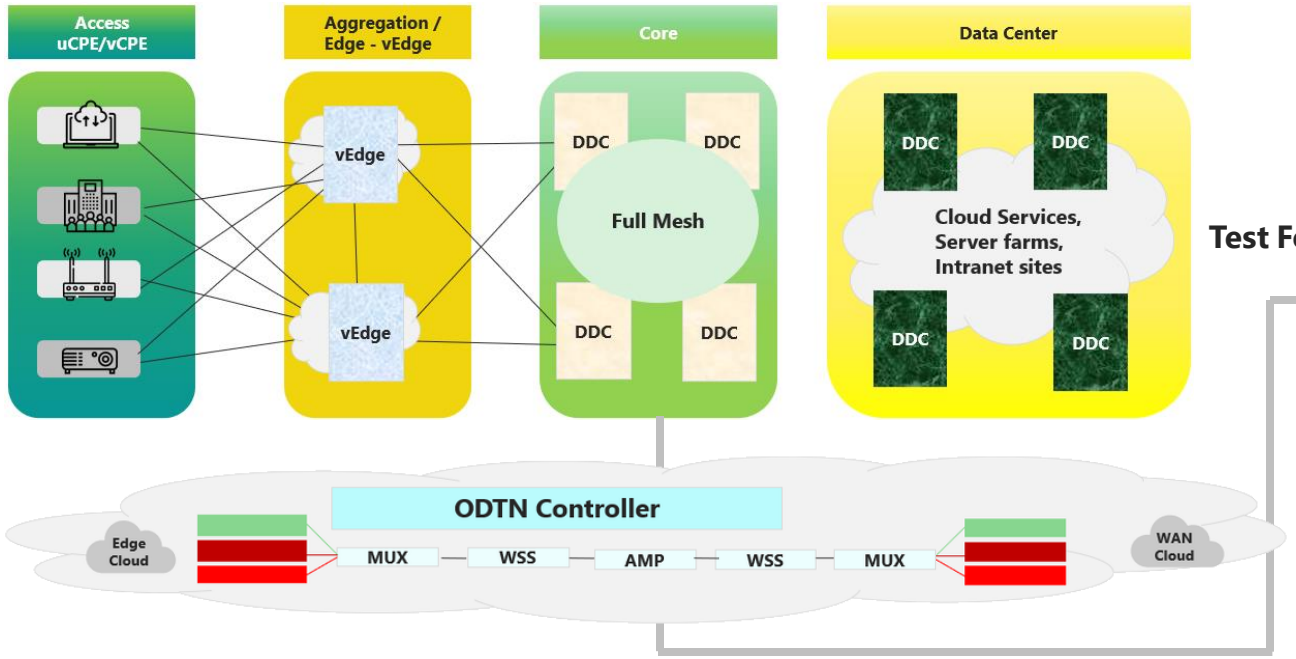
BRAS, BNG, FTTx, MPLS/IP:

- vBRAS services and testing (PPPoE/oA/oEoA)
- MPLS based services - L3VPN (Intra/Inter-AS), L2VPN (PW/VPLS), MPLS-TE
- RFC-4364 based BGP/MPLS IP VPNs VRF/VRF-Lite testing

Performance/Scale testing:

- Protocol Convergence tests, Graceful restart and FRR functionality, Full/Partial mesh tests
- High Availability, Switchover tests
- Protection types – Link/Node/Path protection

Test Areas – Core



Test Focus

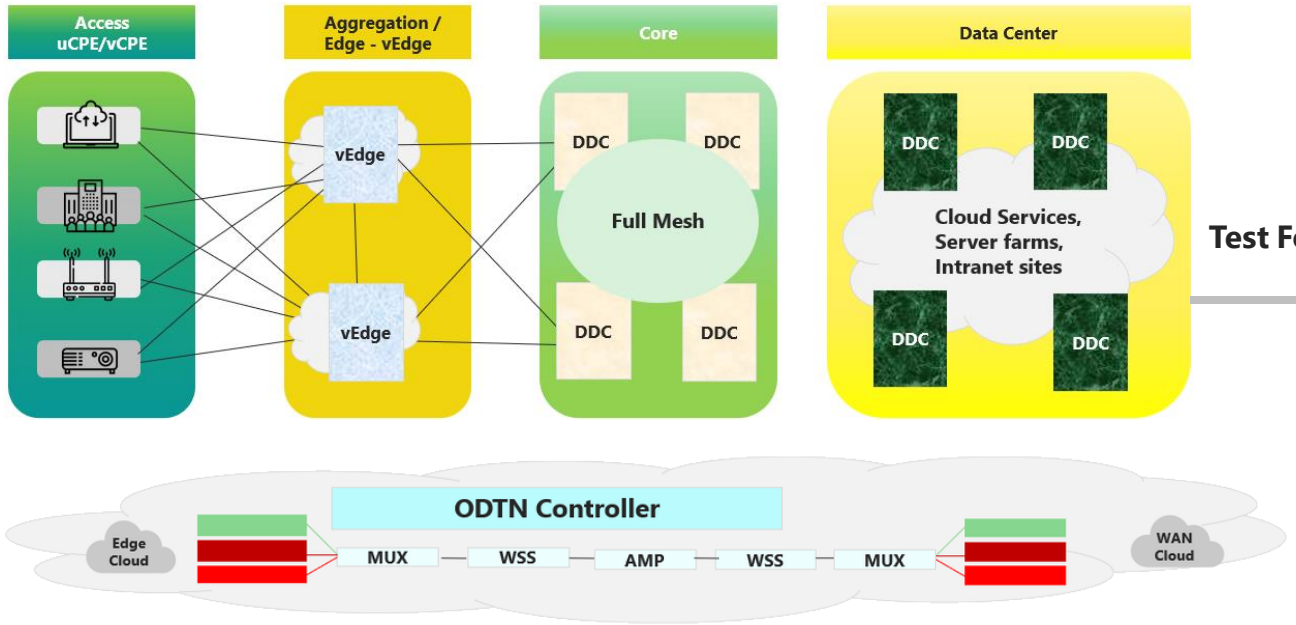
Distributed Disaggregated Core Testing

- Next-Gen MPLS/IP based Distributed Disaggregated Core
- IPVPN, PoP/MegaPoP, DCI, Cloud Connect and Cloud Access Gateway
- Internet - Global Internet
- High link speed testing based on 100G/200G/400G fat pipes

Performance/Scale Testing

- Disaggregated model-based testing
  - IGP Routing scale, Link/Node failure detection using BFD
  - RIB/FIB/LIB based testing
- Testing env
  - BareMetal, Virtualized (Cloud based Amazon / OpenStack), Network virtualization

Test Areas – Data Center



Test Focus

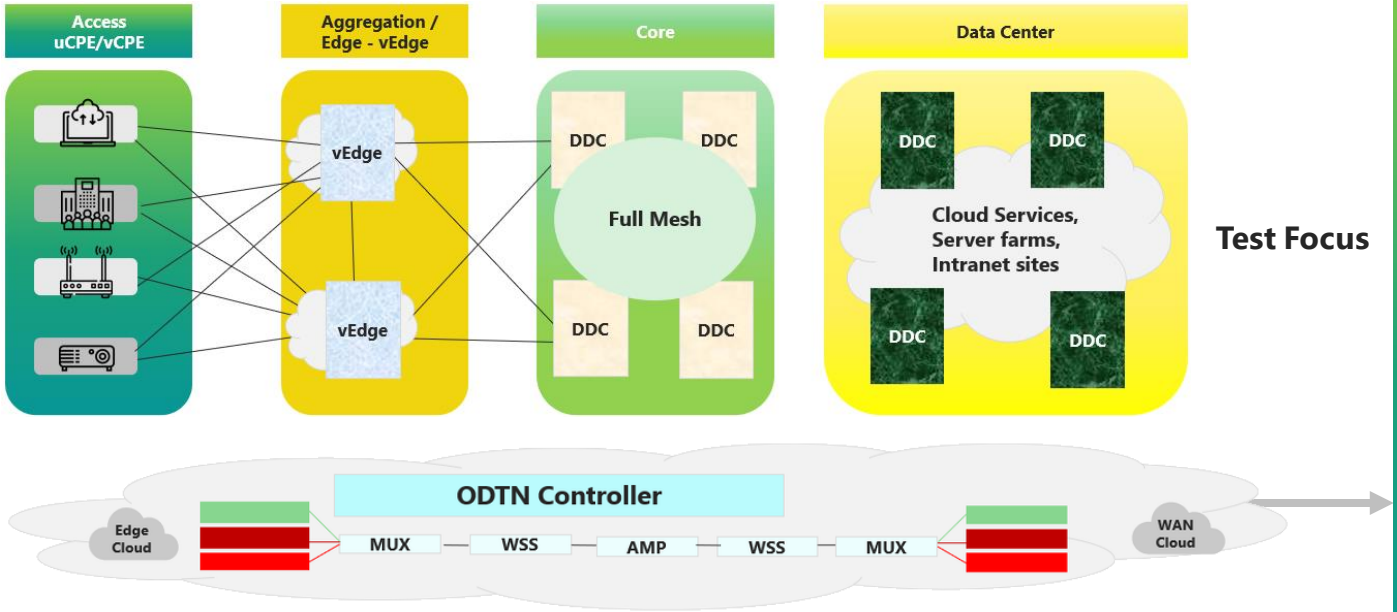
Switch Fabric /CLOS Model-Based Testing

- EVPN, VxLAN, Overlay/Underlay tunnels
- BGP-VPLS, BGP-LS, MP-BGP EVPN
- IGP – ISIS/OSPF

Performance/Scale Testing

- Disaggregated model-based testing
  - IGP Routing scale,
  - HCI based testing - VM Mobility tests (North-South and East-West)
- Testing env
  - BareMetal, Virtualized (Cloud based Amazon / OpenStack), Network virtualization

Test Areas – Transport

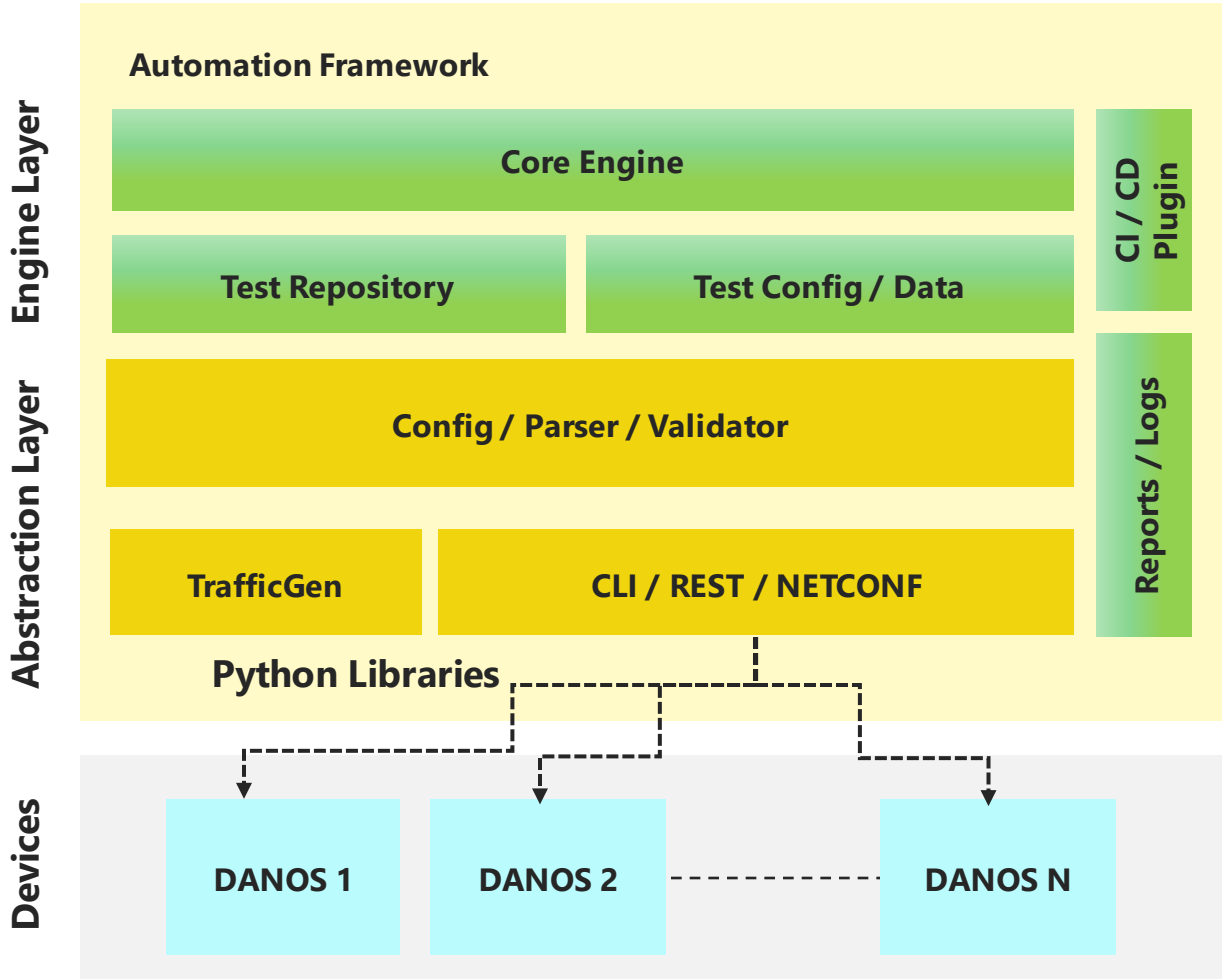


Test Focus

Transport / Optical Networks Testing – Open Disaggregated Transport Network

- Testing of a line system such as Transponders, ROADMs, amplifiers, etc. to validate interoperability among other vendors
- Testing of management interface and APIs of terminal devices and Open Line System (OLS)
- Validation of transport SDN controller to configure and adjust of transponders in real time
- Disaggregated ROADM with TAPI
- Service request APIs
  - NB and SB
  - Transponder APIs
- Scalability and Fault tolerance

LF-DANOS Contributions



Functional / Non-Functional Test scenarios

- Protocol suite: OSPFv2/v3, BGP, MPLS-LDP
- Security Features: NAT, Firewall
- VPN Services: IPSec
- Traffic profile: iMIX, Rando m Frame Size, TCP/UDP

Tech Stack and Test Tools

- ROBOT FRAMEWORK
- Python3
- Jenkins
- Scapy, IPERF3
- GITHUB

LF-DANOS Contribution
Test Scripts: https://github.com/danos/tests/tree/master/Test_Automation

Conclusion

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01 A new integrated and unified QA approach with an end-to-end test framework for automated continuous testing, incorporating domain, open-source software and commonly used test tools there by ensuring cycle time reduction and high-level automation.

02 QA methodology needs to be flexible to include OEMs/legacy systems along with disaggregated networks for successful transformation.

03 QA framework needs to be continuously evolved to support new services to ensure high test coverage via vendor agnostic plug-n-play approach.

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Thank You

WE ARE NOW OPEN TO QUESTIONS

business@happiestminds.com