



Virtualized Networks at Terabit Speeds?

Yes!

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Agenda

- Benu Networks Overview
- Broadband Market Drivers & Required Architecture
- Benu + Intel Collaboration
- Performance Test Results & Scaling to 100 Terabits
- Unlocking Value Beyond Performance



Established in 2010



Global Sales, Headquartered in Boston



Industry Leader in SD-Edge Solutions



Engineering-led (>80% of employees)

BENU Products Deployed at Scale

7

Petabytes/Day

25M

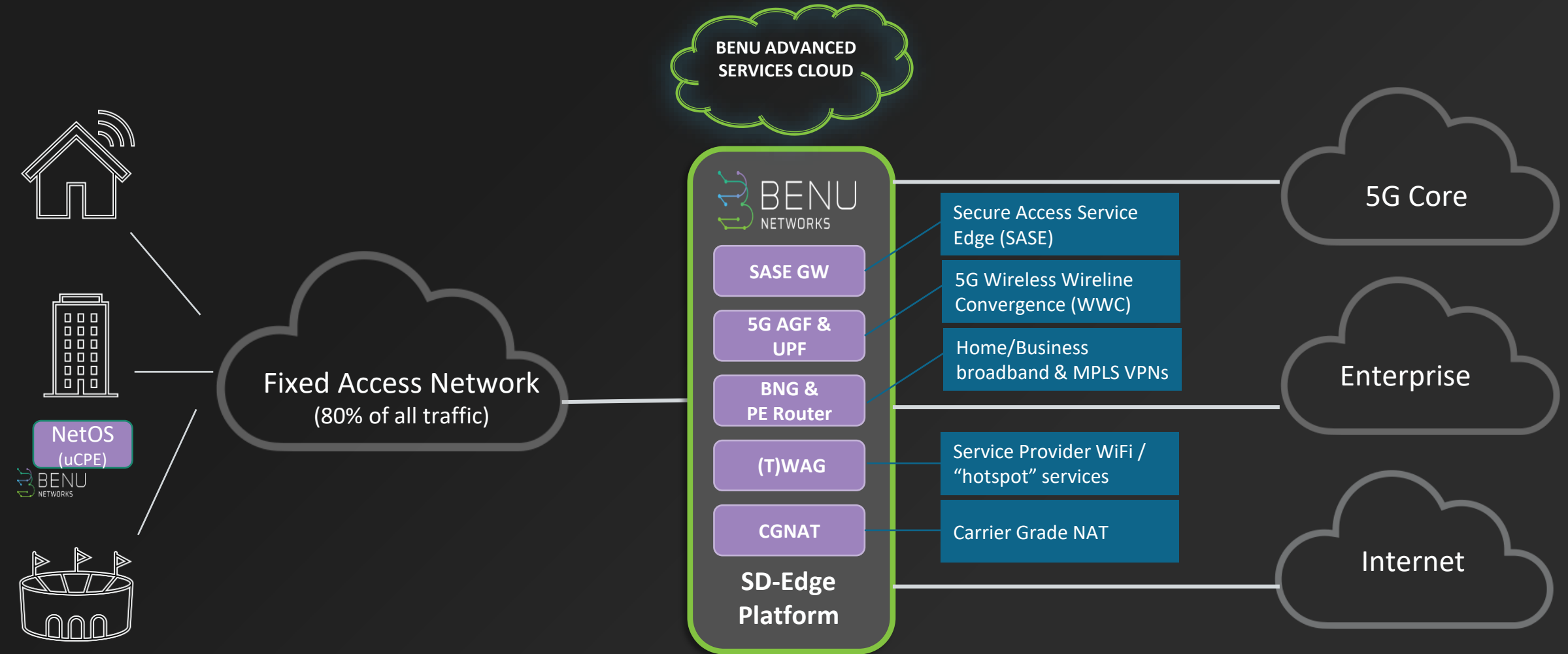
Connected Homes
and Businesses



Key Partners:



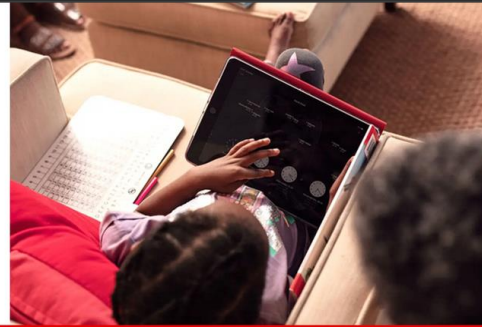
BENU SD-Edge Software Sits in the Most Strategic Part of Carrier Fixed Network



Benu Broadband Network Gateway (BNG): Open & Flexible

Open

Vodafone and partners in world first multi-vendor test of new broadband standard



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TELECOM INFRA
PROJECT

Shortlist for OpenBNG

Flexible Deployment

- Bare metal appliance
- Virtual Machines
- Containers
- Cloud



RED HAT
OPENSIFT
Container Platform



openstack.



VMware Tanzu



AmazonEKS



intel

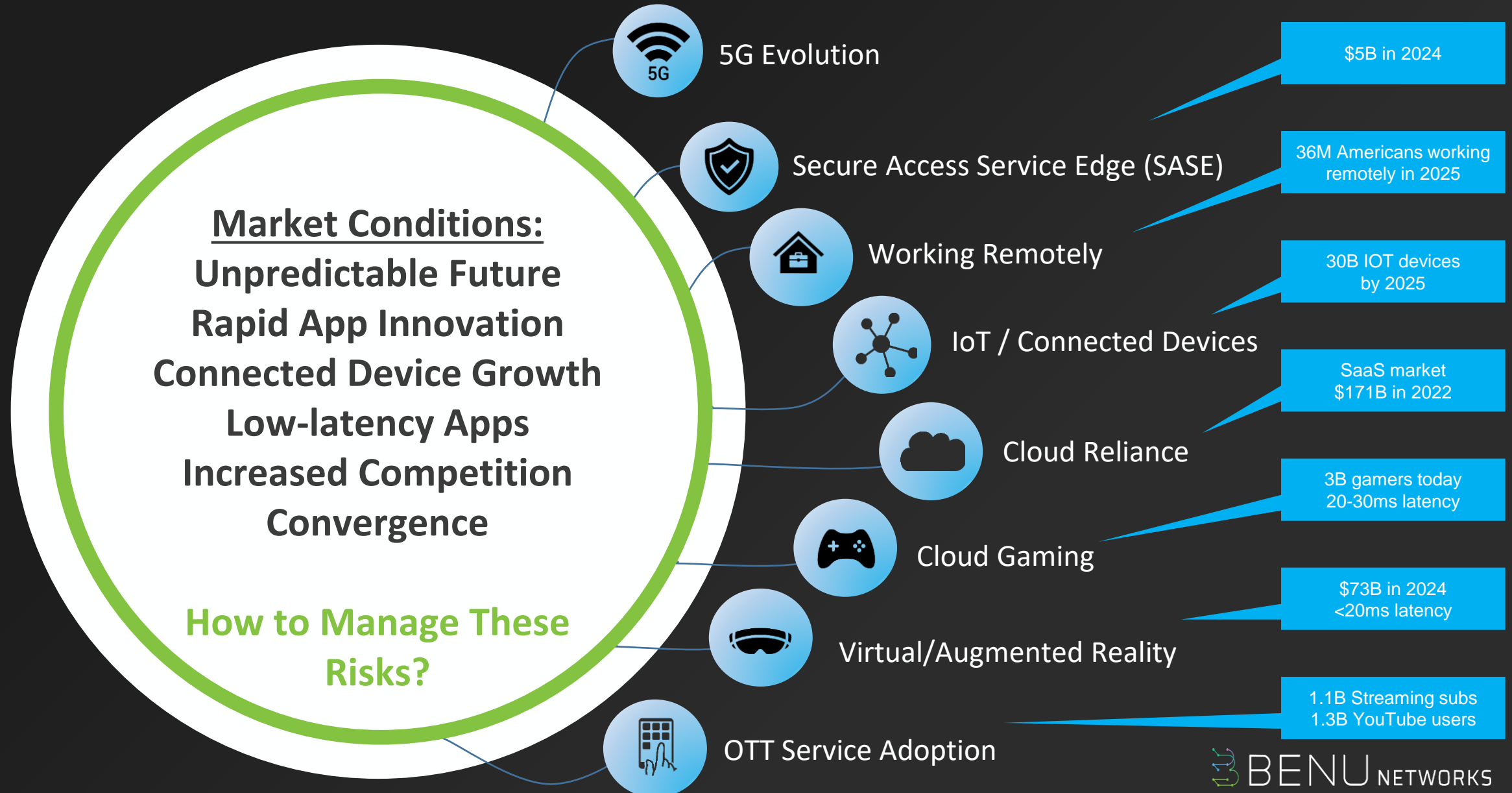


Market Drivers

How Many of These Did You Predict 10 Years Ago?

Application	Launch or Significant Date	Today
Amazon Alexa	2014	<ul style="list-style-type: none"> 100,000 smart home devices support Alexa
Slack	2014	<ul style="list-style-type: none"> Used by 600,000 organizations - \$900M in revenue
VR/AR	2012 (Oculus)	<ul style="list-style-type: none"> \$73B Market by 2024
Video Streaming	2007 (Netflix streaming)	<ul style="list-style-type: none"> \$419B Market in 2021
Telemedicine	2020 (COVID impacts)	<ul style="list-style-type: none"> \$397B Market by 2026
Cloud Gaming	2017 (Fortnight – only online)	<ul style="list-style-type: none"> \$14B (3 years)
Video Analytics <i>(e.g. facial recognition, security)</i>	2018 (AI + deep learning + analytics)	<ul style="list-style-type: none"> \$33B Market by 2026

Broadband is a Fast-Moving Unpredictable Market



Broadband Networks Require a New Approach

Market Conditions

BNG Requirements

Unpredictable Future

Adaptable

Rapid Application Innovation

Agility

Connected Device Growth

Scale Up

Low-latency Applications

Distributed Edge

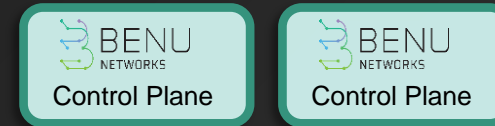
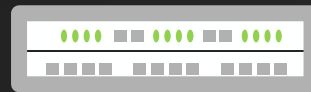
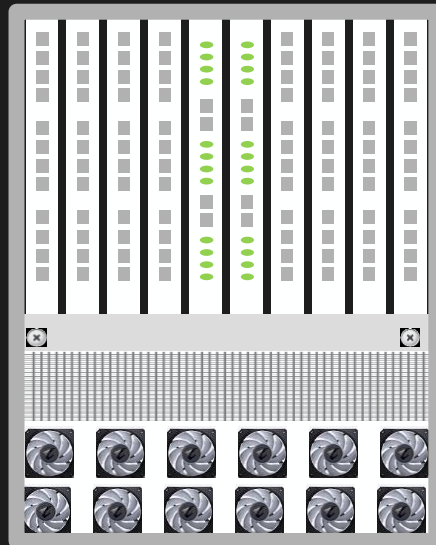
Increased Competition

Lower TCO and New Service Capabilities

Wireless Wireline Convergence

Evolvable to 5G AGF, 5G UPF & HAG

Legacy BNG vs Benu Networks BNG



Chassis-Based
Optimized to Move Bits

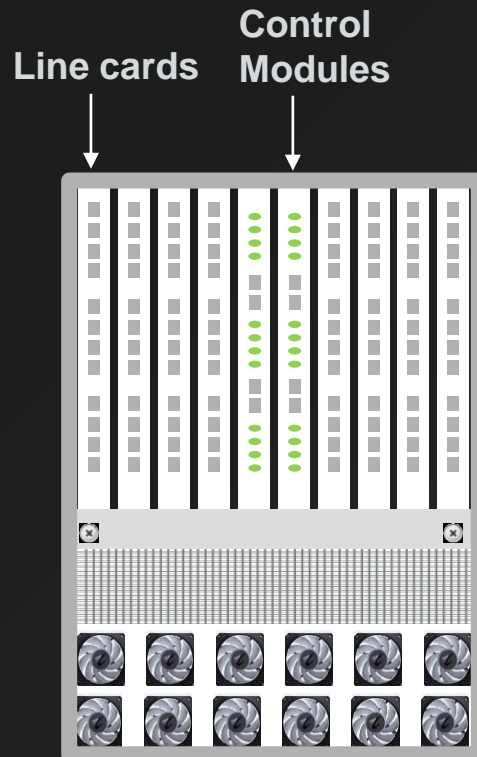
Architecturally Static & Constrained

Benu
*Optimized to Adapt, Scale, & Evolve
with Agility*

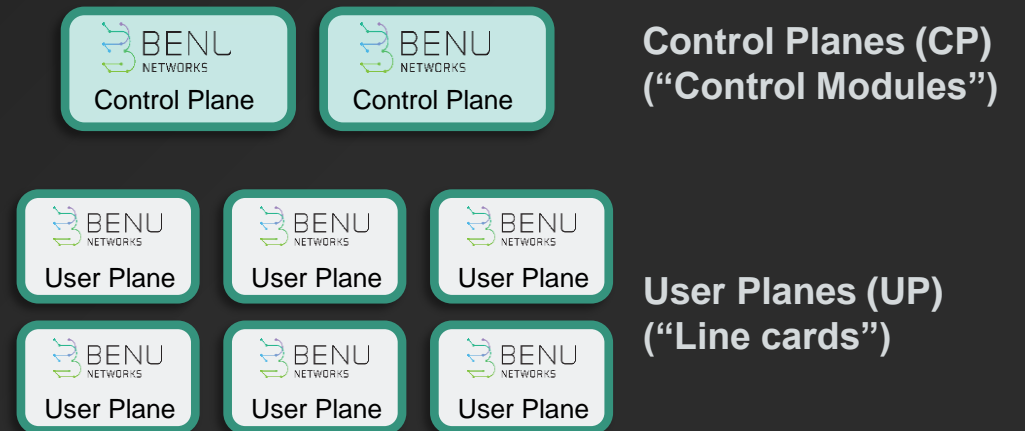
Architecturally Flexible & Open

Legacy BNG vs Benu Networks BNG

Legacy BNG (Chassis)



Benu vBNG (No Chassis)



System Scaling Comparison

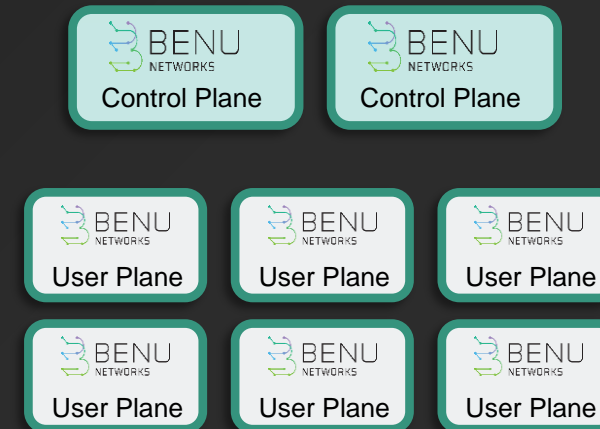
Legacy Chassis

- Limited slots, up to ~12
- Each chassis needs a control module



Benu BNG

- Up to 256 User Planes (UPs)
- UP size can vary based on need
- UP can be tuned for consumer, enterprise, low-latency



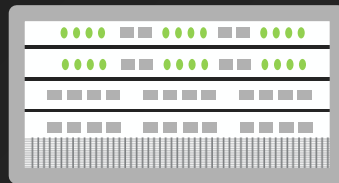
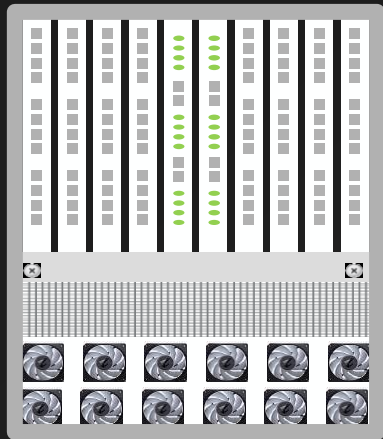
Scaling – Control Plane vs User Plane

Legacy Chassis

- To extend CP – add entire chassis
- To extend UP – add entire chassis
- No Independent Scaling

Benu BNG

- To extend CP – add only CPs
- To extend UP – add only UPs
- Independent Scaling



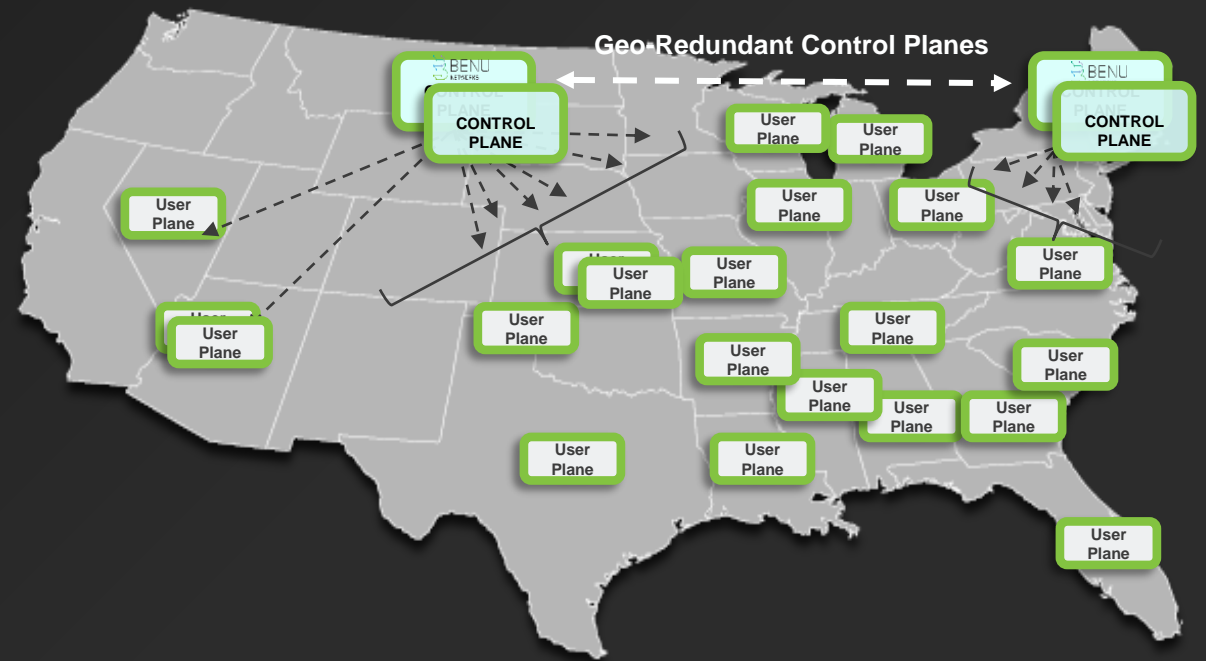
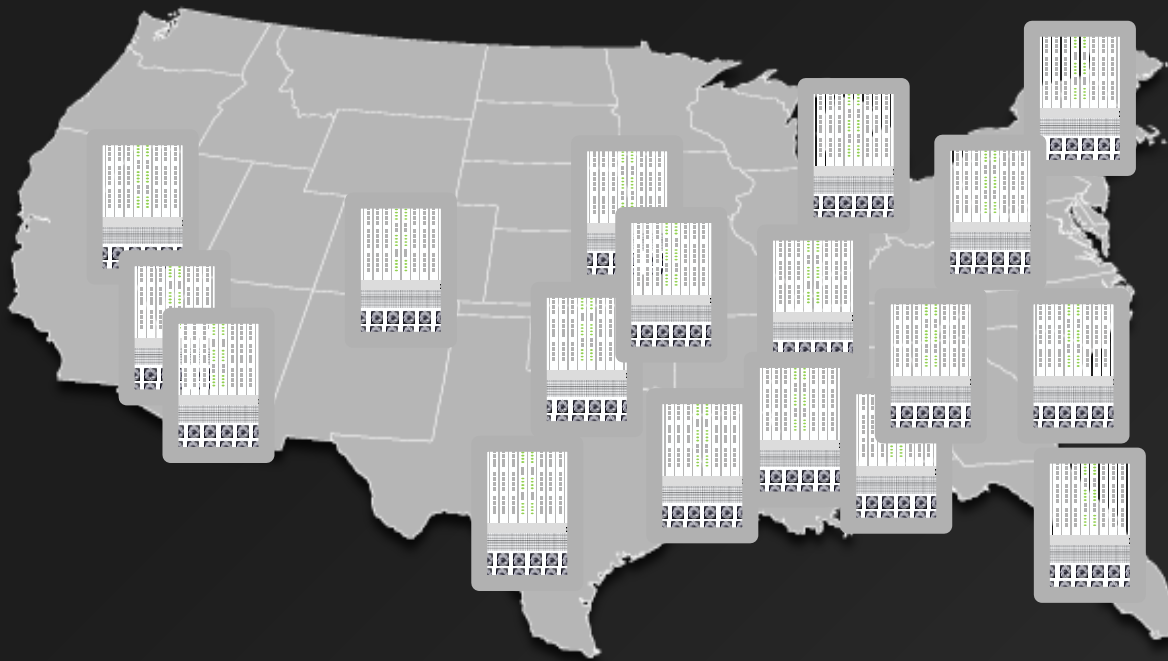
Network-wide Scaling & Network Resiliency

Legacy BNG

- Many independent systems to manage
- 1:1 redundancy
- No or limited geo-redundancy
- CP and UP must simultaneously failover

Benu BNG

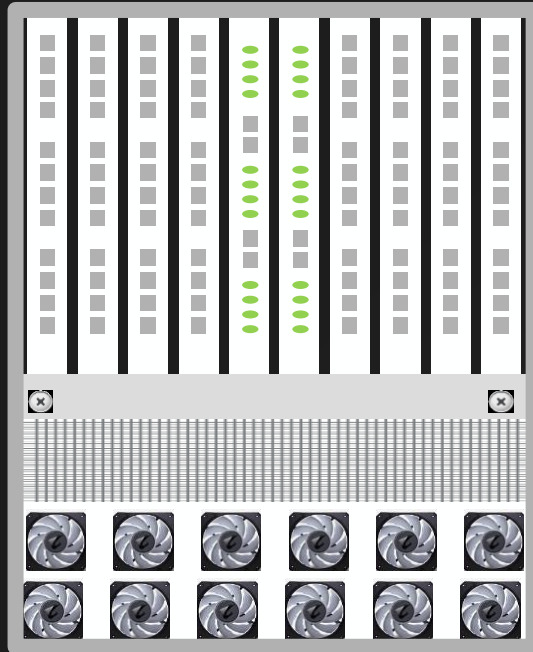
- 1 system to manage
- M:N or N:1 redundancy
- Geo-redundancy
- CP and UP have independent failover



Simplifies distributing UPs to the edge!

Ability to Add Services & Evolve

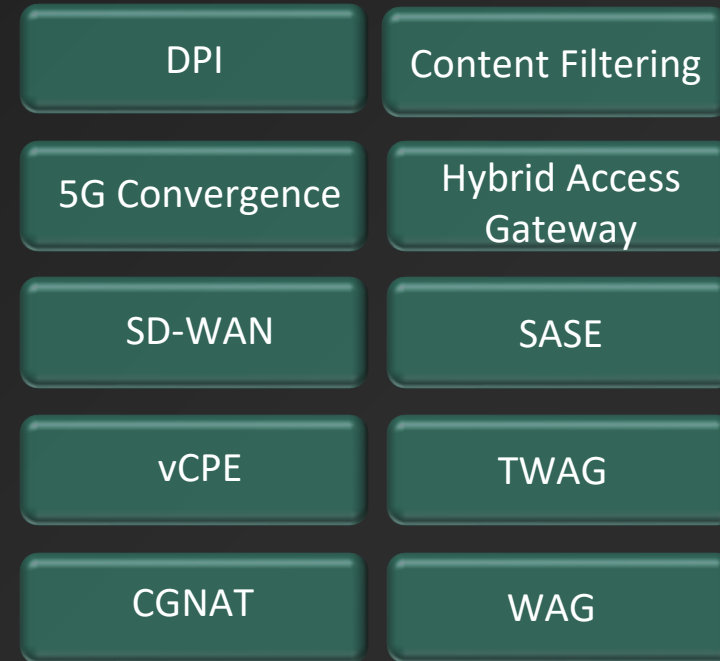
Legacy BNG



Closed Architecture Stifles Innovation

- Propriety ASICs limits features
- Hardware and software tightly coupled
- Lack of open APIs

Benu BNG



Open & Architected for Innovation

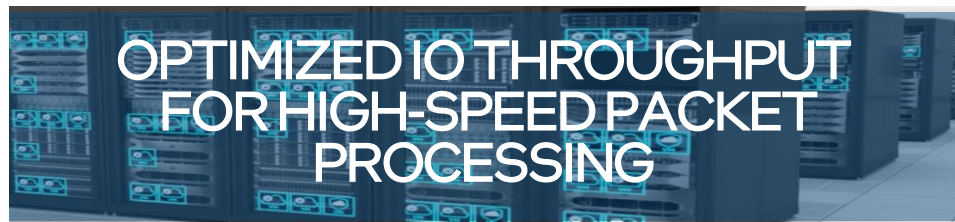
- Software-based – “Any Feature” support
- Hardware and software disaggregated
- Open APIs to integrate new services

Scaling Performance Results

Benu and Intel Deliver Performance

- 7-yr collaboration, generation after generation of CPUs
- Highest level (Titanium) in Intel Network Builders Program
- Benu + Intel engineering engaged bi-weekly
- Testing, tuning, and constantly improving performance

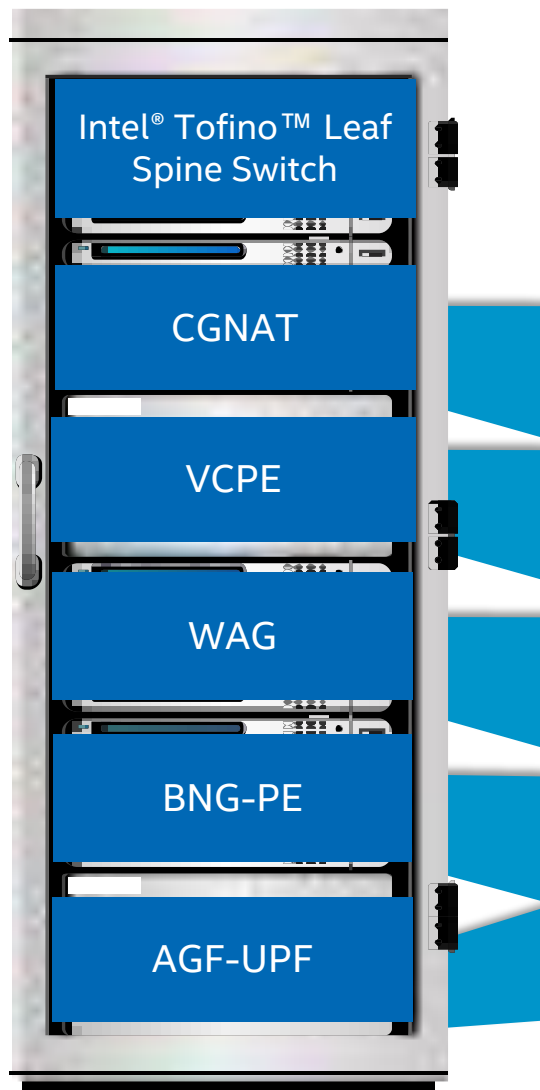
Intel's Wireline Edge Solution Portfolio



Intel® Select Solution for NFVI
Forwarding Platform



- Intel Invests in Switching, CPU, NiC, server platform and SW optimizations



Intel® QuickAssist
Technology

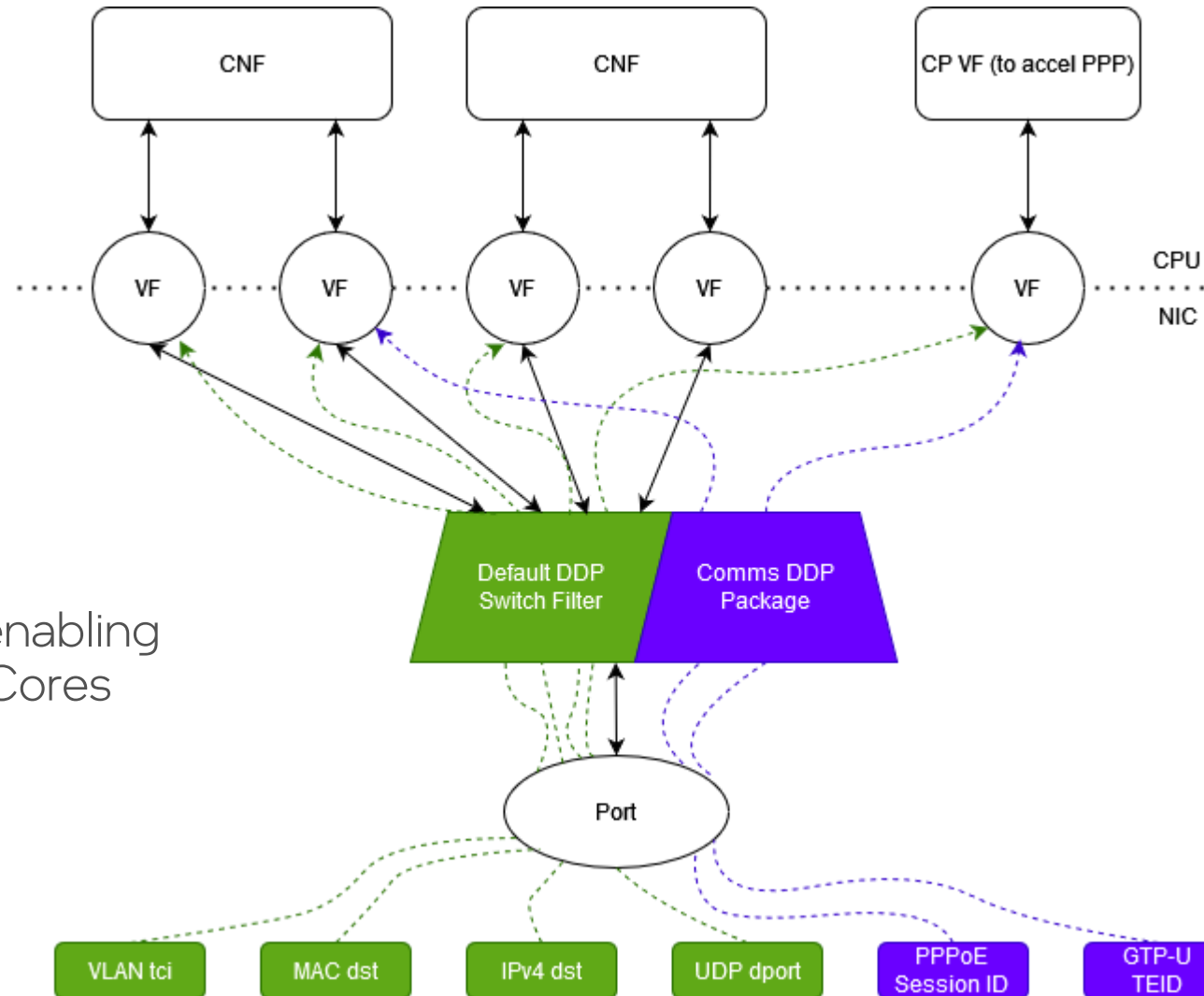


700 & 800 Series
Foundational NICs +
Dynamic Device
Personalization
(DDP)



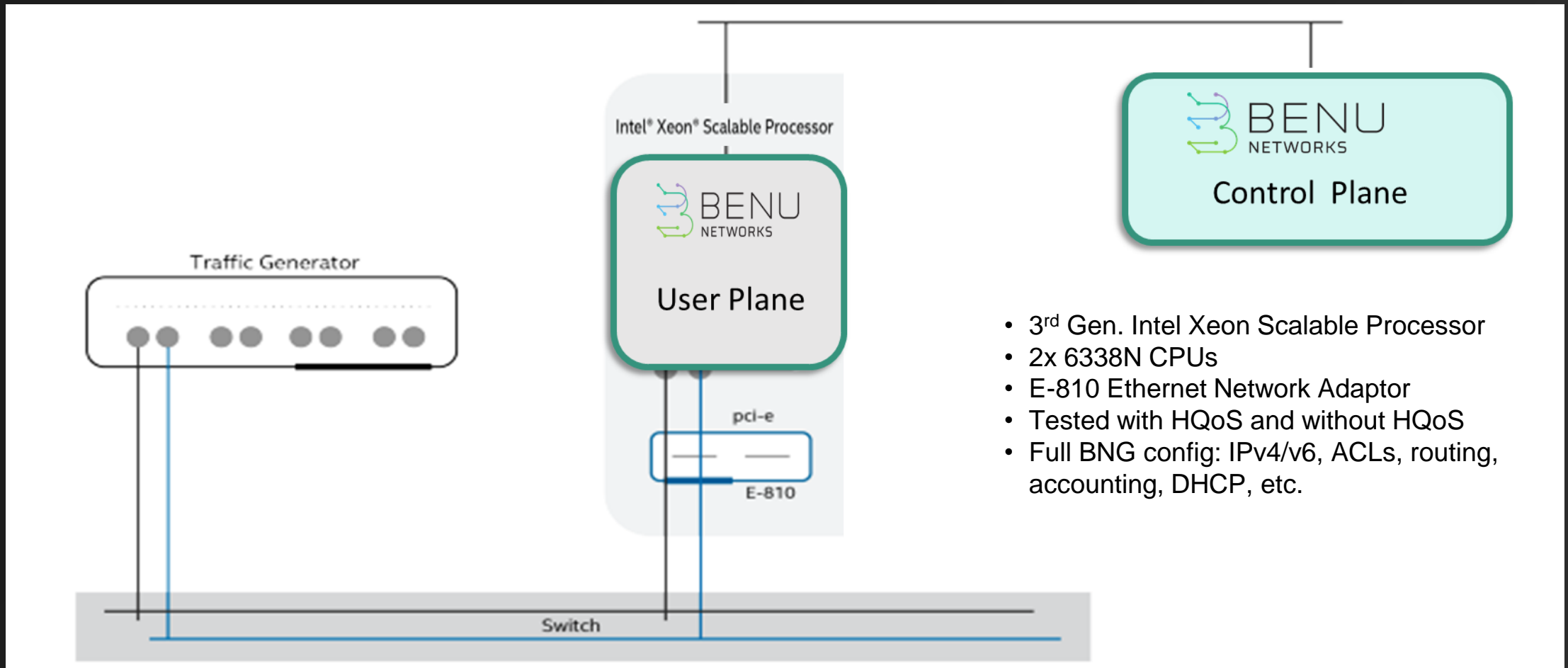
3rd Generation Intel®
Xeon® Scalable
processor & Balanced IO
to compute

E810 NIC – Dynamic Device Personalization

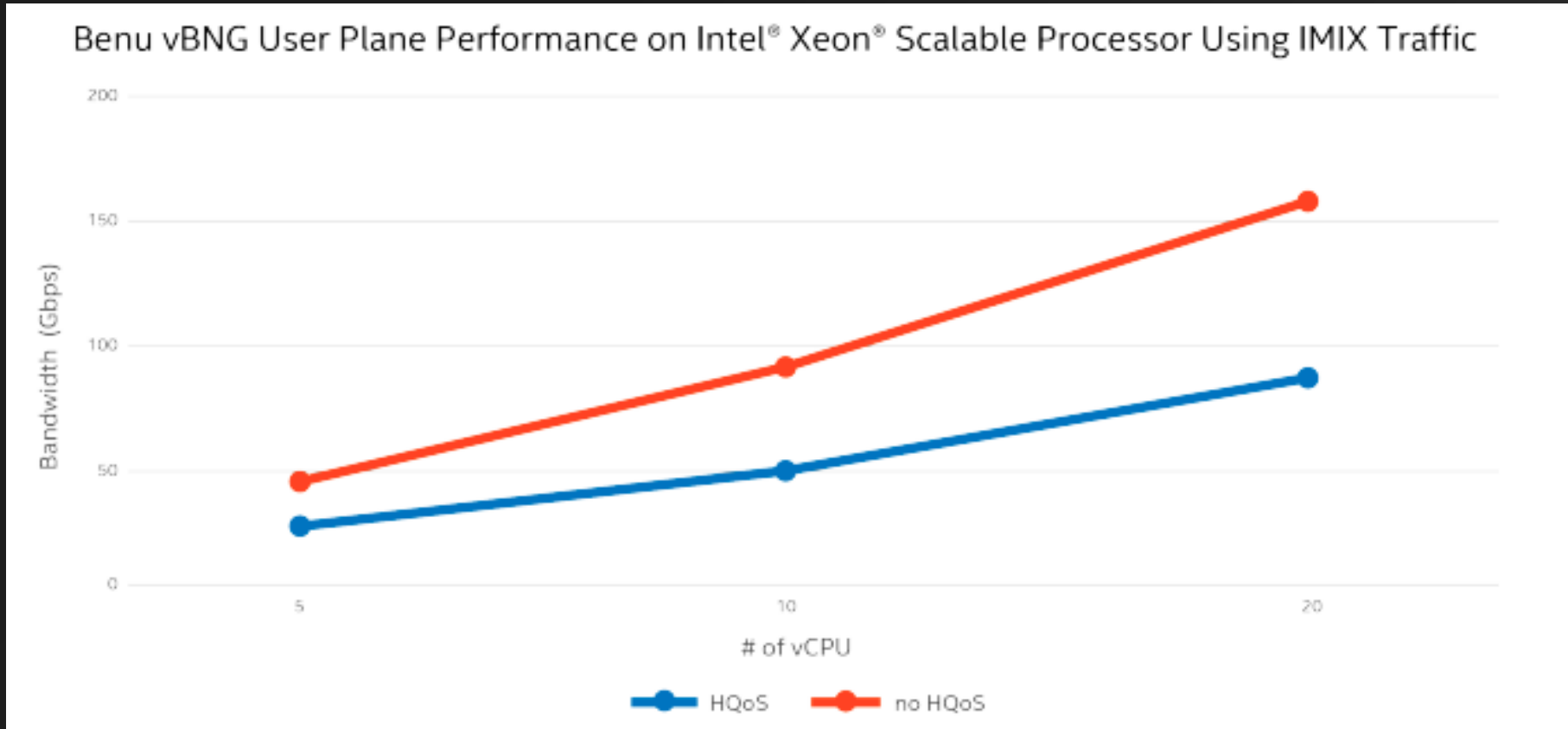


- 200G Capable NiC
- NiC Wireline Enhancements enabling performance scale with CPU Cores

Performance Testing Configuration



Performance Testing Results

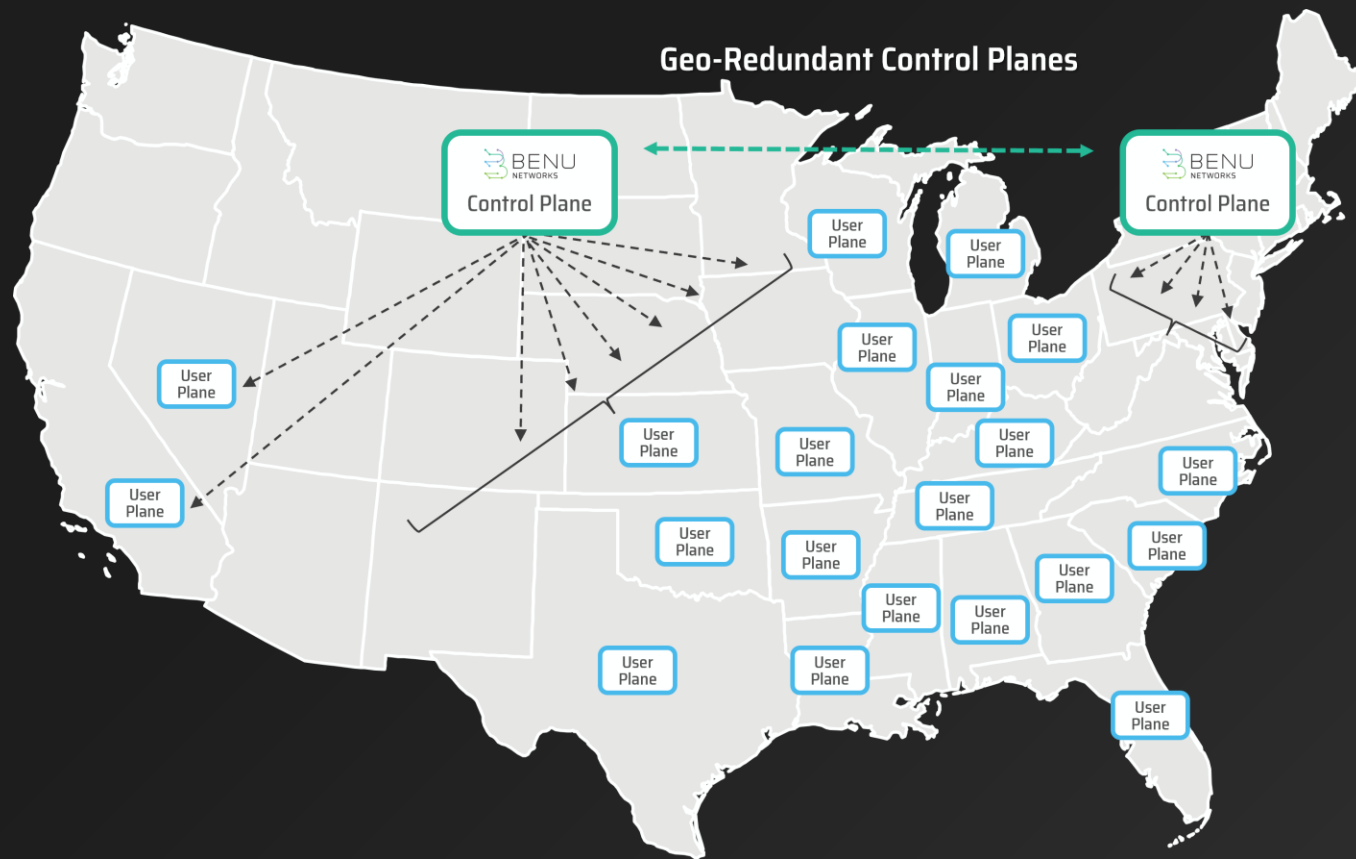


Roughly 5 Gbps per vCPU with HQoS

Approx. 10 Gbps per vCPU without HQoS

A large 2-socket server with 50 Cores
would support 400+ Gbps per user plane

The 100 Terabit Network BNG



- 400+ Gbps per UP
- CP Supports 256 UP
- **400+ Gbps X 256 = 100 Terabit Network BNG**
- Highly resilient
- Scale up / down anywhere as needed
- Move capacity as needed
- Tune user planes to specific needs

Software Unlocks Value

Hardware and Software Disaggregation

- **Runs on (COTS) server hardware**



- **Flexible lifecycle management & innovation**



- **Supply chain diversity & agility**



Software-Based Solution

- **5G-Ready and Cloud-Native Support**
- **Establish Footprint for Multi-Access Edge Compute (MEC)**
- **Future-Proof to Manage Risk & Capture Opportunities**



FUTURE PROOF

Future Proof Your Network

Market Conditions	BNG Requirements	Benu Networks
Unpredictable Future	Adaptable	<input checked="" type="checkbox"/>
Rapid Application Innovation	Agility	<input checked="" type="checkbox"/>
Connected Device Growth	Scale Up	<input checked="" type="checkbox"/>
Low-latency Applications	Distributed Edge	<input checked="" type="checkbox"/>
Increased Competition	Lower TCO and New Service Capabilities	<input checked="" type="checkbox"/>
Wireless Wireline Convergence	Evolvable to 5G AGF, 5G UPF & HAG	<input checked="" type="checkbox"/>

Download Our White Paper

[The 100 Terabit Broadband Network Gateway](#)

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