# Evolving Broadband Design in Australia

*Exploring Emerging Trends and Technologies*

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JUNIPER NETWORKS

# Agenda

- Trends
- Ecosystem
- BNG deployment options
- PPPoE vs DHCP
- BNG Resiliency
- Emerging Technologies
- Use Cases
- Takeaways

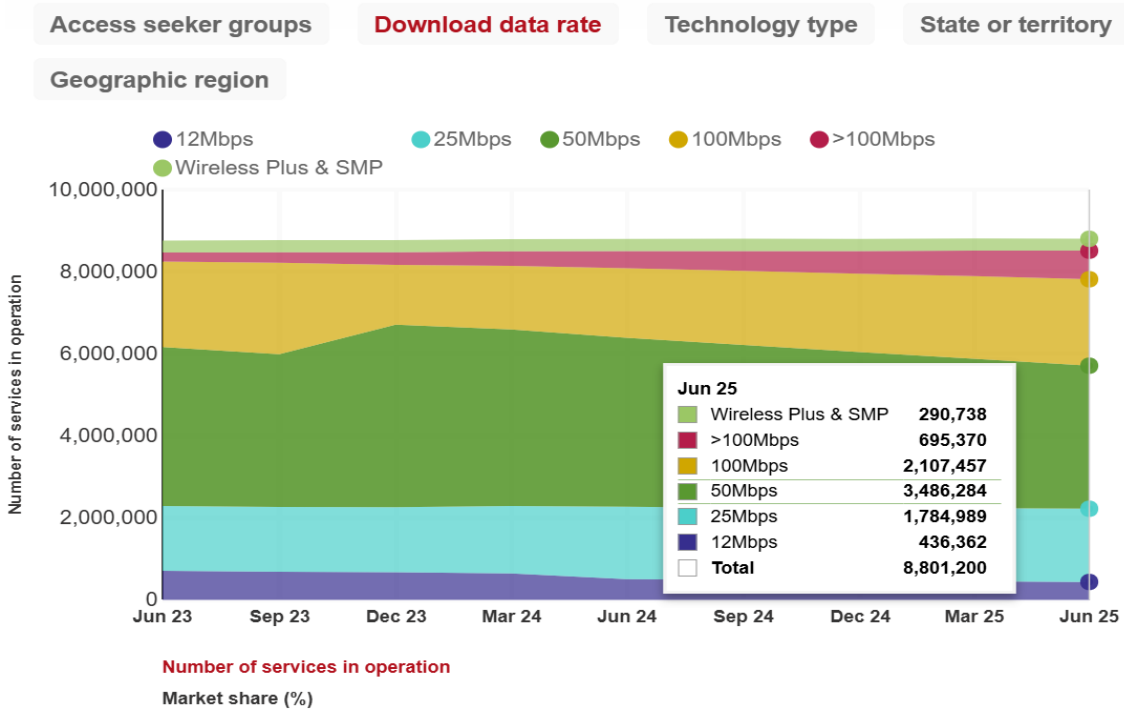
# Broadband : Global and Local Trends

- **Global Trends:**
  - Move towards Gigabit and multi-Gigabit speeds
  - Emphasis on low latency (critical for gaming, AR/VR, IoT and AI)
  - Subscriber termination and management models
    - Distributed Models
    - Cloudified?
    - 5G integration and hybrid access models

- **Australia-Specific Trends:**
  - Moving away from 12-25-50Mbps towards 100's Mbps and Gbps.
  - NBN and others push to 500Mb-750Mb-1G and beyond
  - 29% alternate/competitive last mile and growing
  - Regulatory influence (ACCC) for service performance benchmark and transparency

| Country | Avg BW per Sub BNG peak Mbps | Median Avg Line Speed Mbps |
|---|---|---|
| Australia | 5-6 | 85 |
| Philippines | 4-5 | 99 |
| UK | 5-9 | 141 |
| USA | 8-12 | 289 |

Statista avg fixed broadband internet speeds

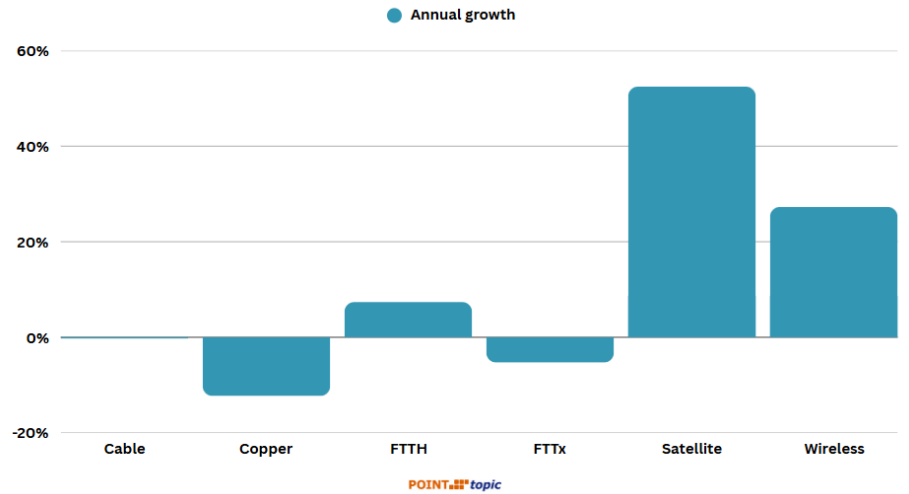


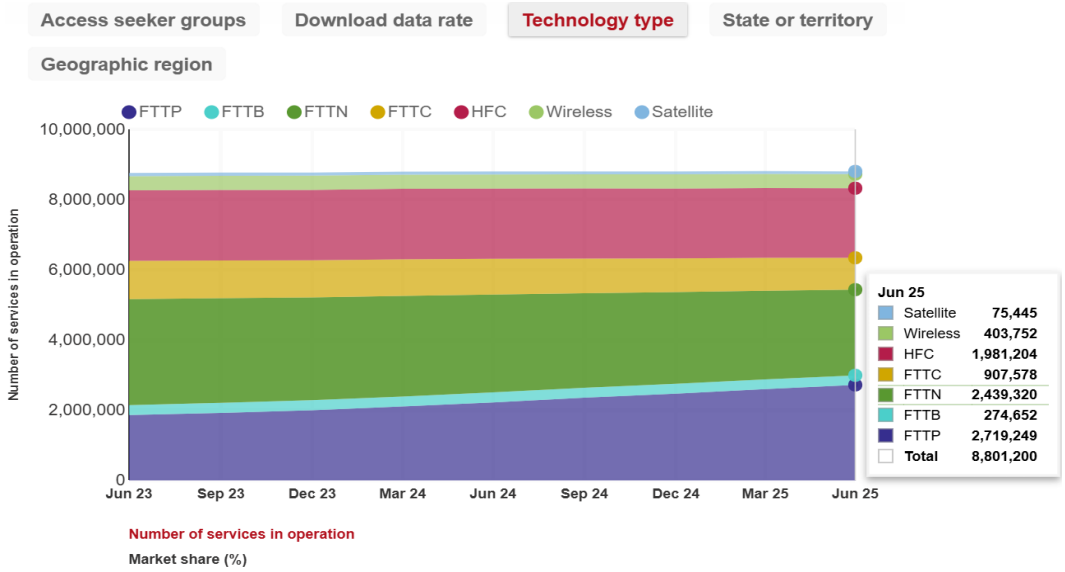

ACCC NBN Wholesale market indicators Jun 2025

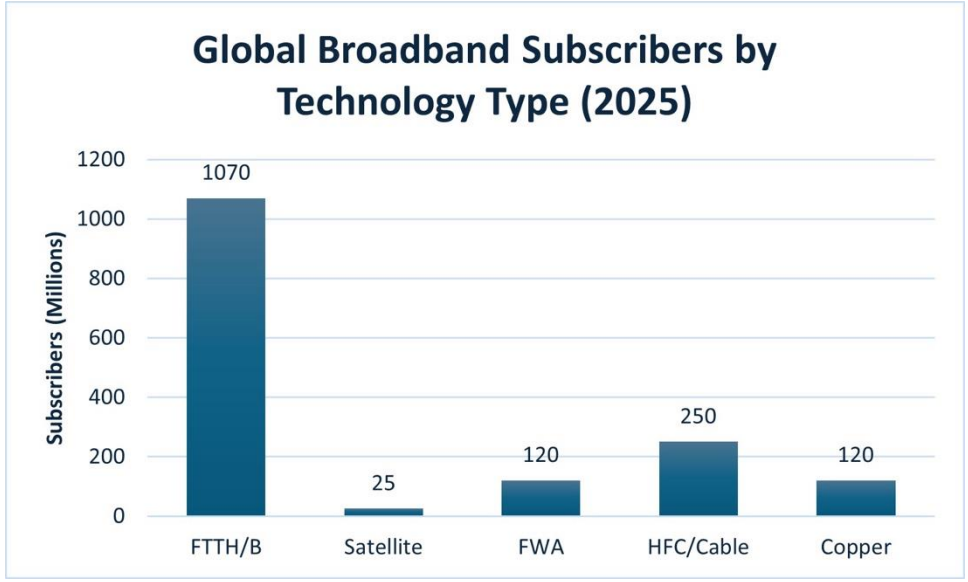
# Global and Local Trends

- **Access Methods in Transition:**
  - Decline of copper/DSL
  - Growth of FTTH
  - Rising use of FWA (Fixed Wireless Access) and LEO(low earth orbit) satellite constellations (e.g., Starlink)

- **Demand Drivers:**
  - Gaming and streaming services continue to grow → traffic volume
  - IoT(Internet of things)/Home automation → session volume
  - GenAI???/Augmented reality → potential disrupter

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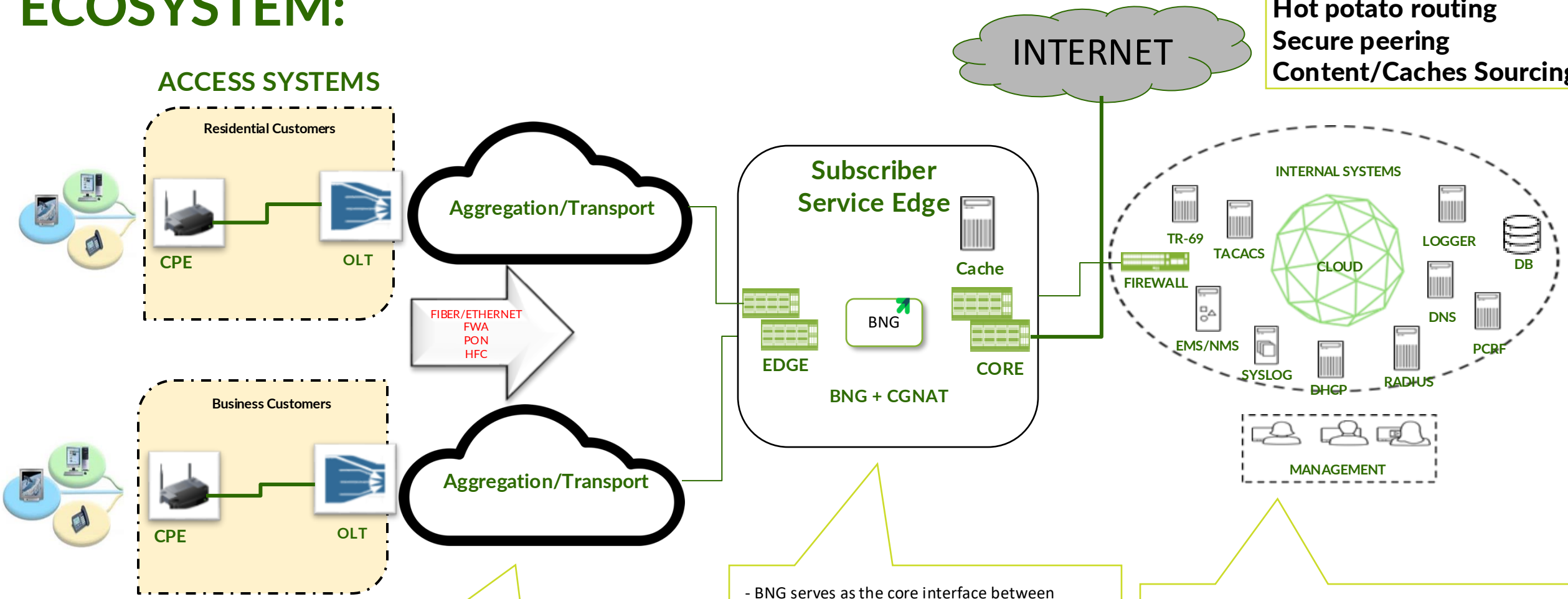
# ECOSYSTEM:



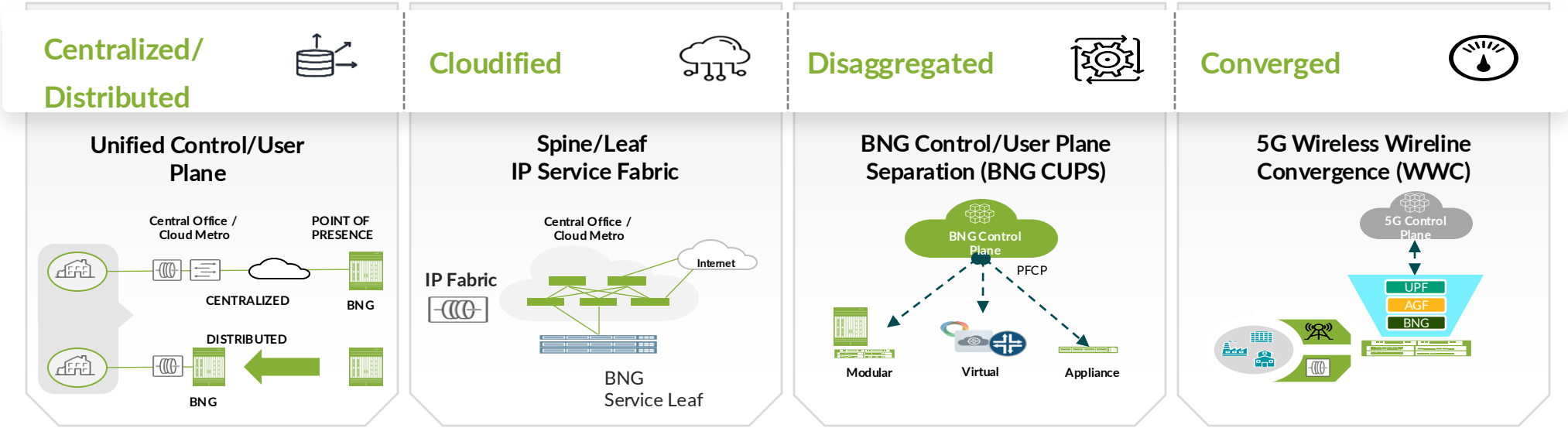

- Physical or wireless last mile connectivity
- Aggregates traffic
- Data integrity, reliability, and low latency
- Supports various service types (e.g., internet access, VoIP, IPTV, gaming)

- Establishes and manages connections
-Path Redundancy & high resilience
- Ensure reliable data delivery
-QoS Prioritizes data packets
- Scalability

- BNG serves as the core interface between subscribers and the service provider's network
- Subscriber Provisioning
- CGNAT - IPv4 pool sharing & logging
- Traffic Management & Routing
- Support for single stack or dual stack
- Security & Compliance

- Authentication & Authorization
- Policy enforcement & Quota Enforcement
- Subscriber provisioning
- Accounting and Billing
- Portal Redirection & Subscriber Analytics
- Monitoring performance, service availability, and customer satisfaction

# BNG deployment options



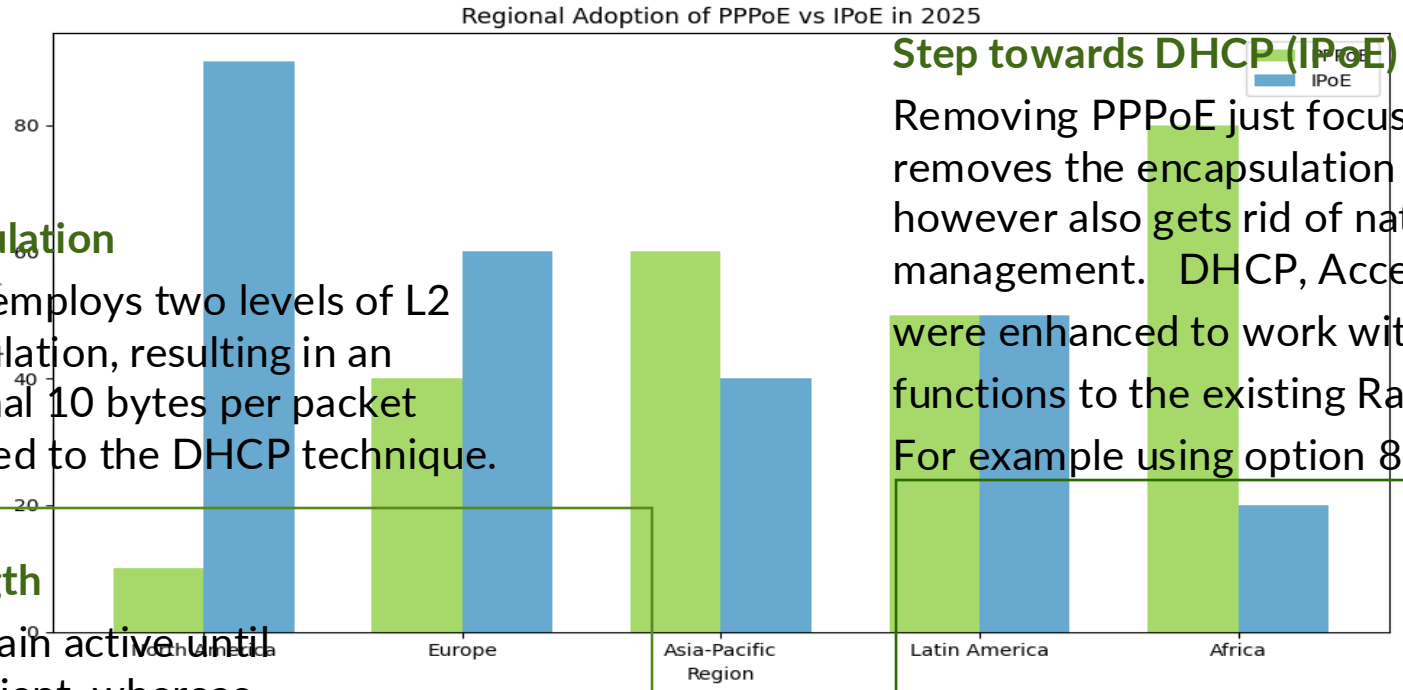

## Australia

- **Centralized – Scale-up Architecture:**
  - Easier to manage
  - Larger blast radius (single point of failure) 50-150K
- **Distributed/Scale-Out Architecture: ↑**
  - Local resiliency and scaling
  - Scale out platforms can be used for distributed based on demand.
  - Smaller blast radius (better fault isolation) 10-30K
- **Approach:** Mix of both, depending on geography and services

## Globally

- **Centralized – Scale-up Architecture:** Common
- **Distributed/Scale-Out Architecture:** Common ↑
- **Disaggregated:** Still hasn't hit mainstream. Competing priorities, and capability. Open BNG, DTA4, BC Fabric based design.
  - Disaggregated starting to hit deployments.
- **Converged:** Emerging markets where fixed line not widespread see value in WWC

# PPPoE & DHCP




## Encapsulation

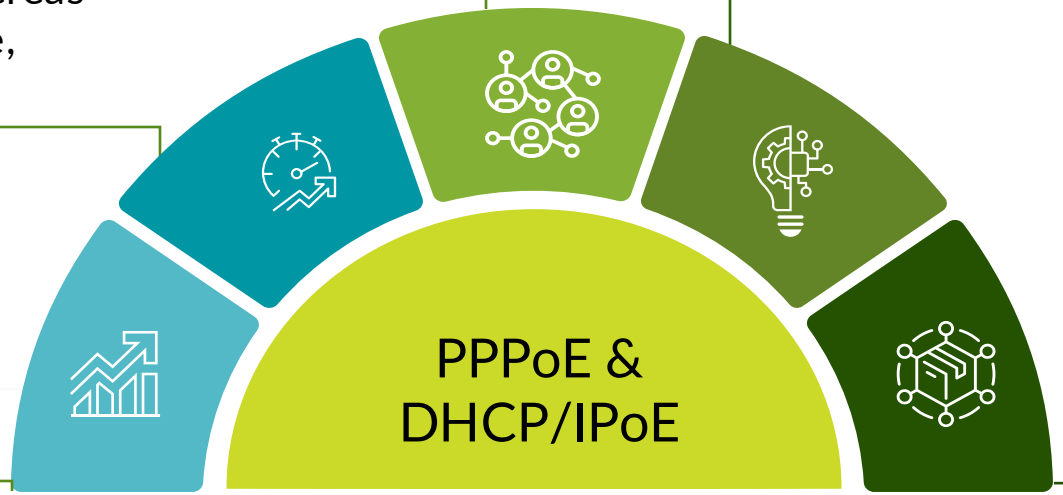
PPPoE employs two levels of L2 encapsulation, resulting in an additional 10 bytes per packet compared to the DHCP technique.

## Active sessions length

PPPoE sessions remain active until terminated by the client, whereas DHCP depends on lease time, regardless of user activity.

## Authentication

PPPoE necessitates a username and password for authentication, DHCP has no native authentication




## Step towards DHCP (IPoE)

Removing PPPoE just focuses on generic IP stack and removes the encapsulation overhead requirements however also gets rid of native PPP session management. DHCP, Access devices and BNGs were enhanced to work with the AAA functions to the existing Radius systems.

For example using option 82 for Auth.

## Emerging trend

- DHCP is gaining momentum owing to its simplicity, scalability, and redundancy.
- Inherently means different fail over triggers and control
- Both PPPoE and DHCP a requirement to support to prevent customer churn


# Agenda

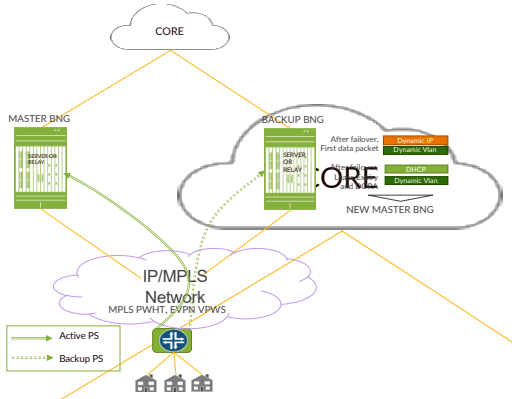
- BNG Resiliency
- Emerging Technologies
- Use Cases

# BNG Resiliency: Stateless → Stateful

Stateless

## Reconnect Model

- PPPoE PADO Delay




## Stateless Rapid Reconnect

- IPoE DHCP Packet Triggered based recovery via dynamic IP.
- PPPoE PADT

Stateful

## 1:1 Models

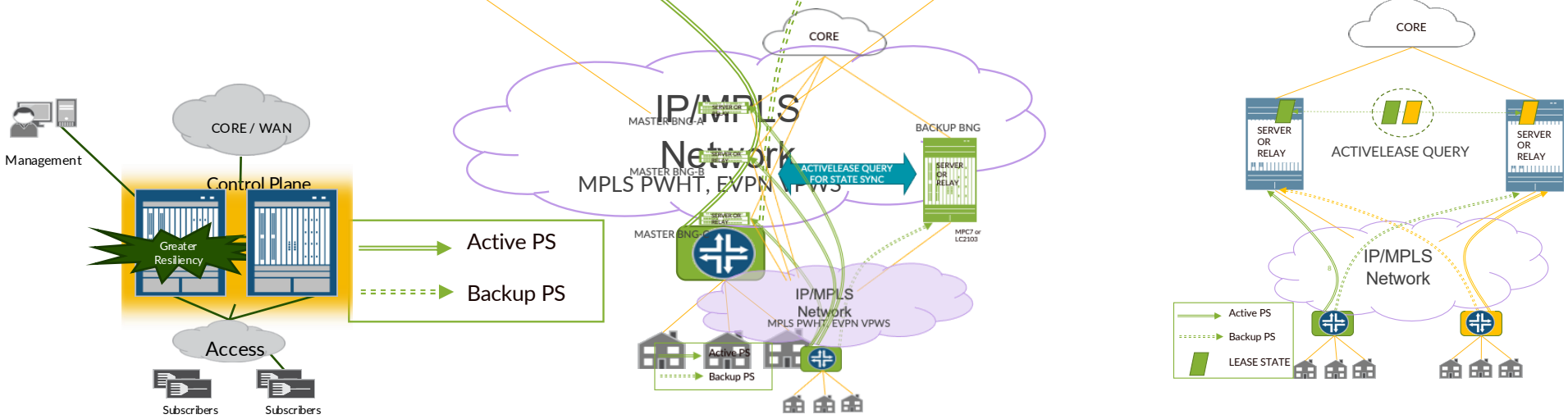
- Control Plane Resiliency
- Forwarding Plane resiliency
- Bulk-Lease Query(BLQ) for DHCP Relay

## N:1 Model

- Forwarding Plane Oversubscription

## M:N Models

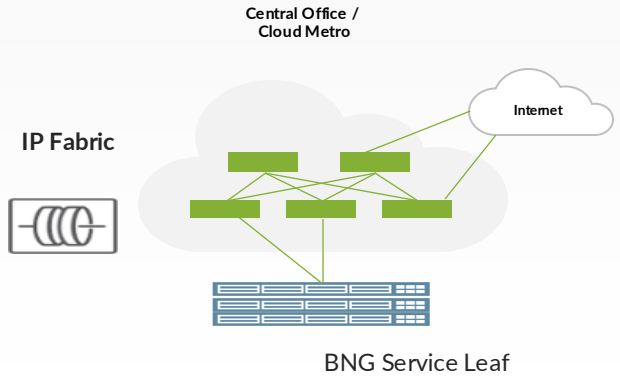
- Active-Lease Query(ALQ)
- Control plane Resiliency
- Multiple failure



# Emerging Technologies

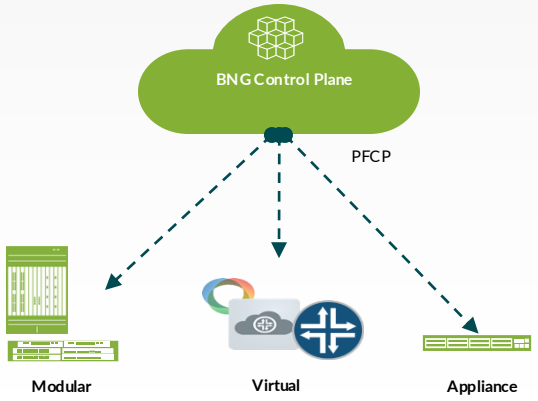
## Cloudified

### Spine/Leaf IP Service Fabric



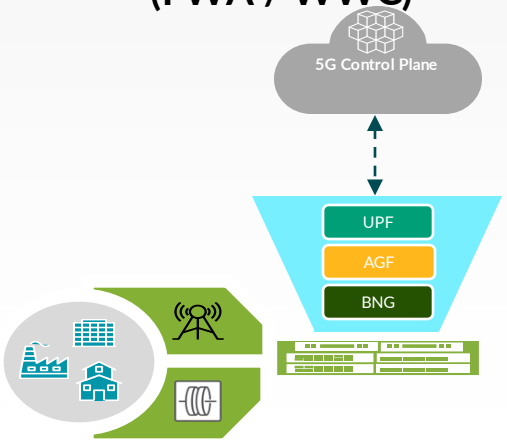

## Disaggregated

### BNG Control/User Plane Separation (BNG CUPS)




## Converged

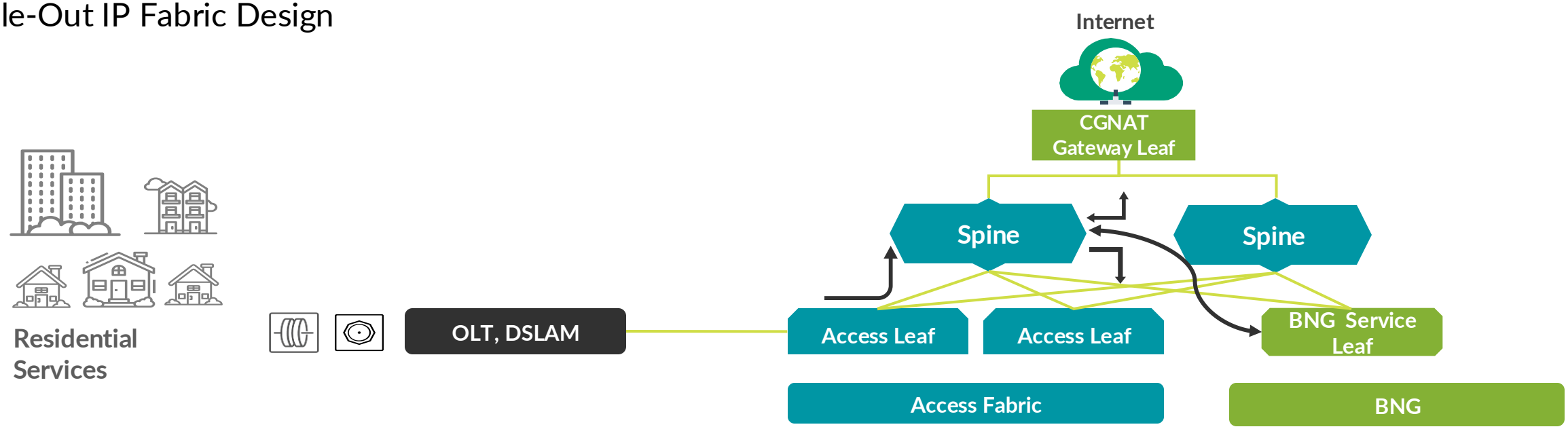
### 5G Wireless Wireline Convergence (FWA / WWC)




Operators are evaluating emerging cloudified, disaggregated and converged technologies to meet demand for low latency, scalability, and service agility.

# Cloudified : Emerging Distributed Broadband Architecture

## Scale-Out IP Fabric Design




### Subscriber Experience

Improved Latency and Performance

### Network Scalability

Scales out incrementally with services demand

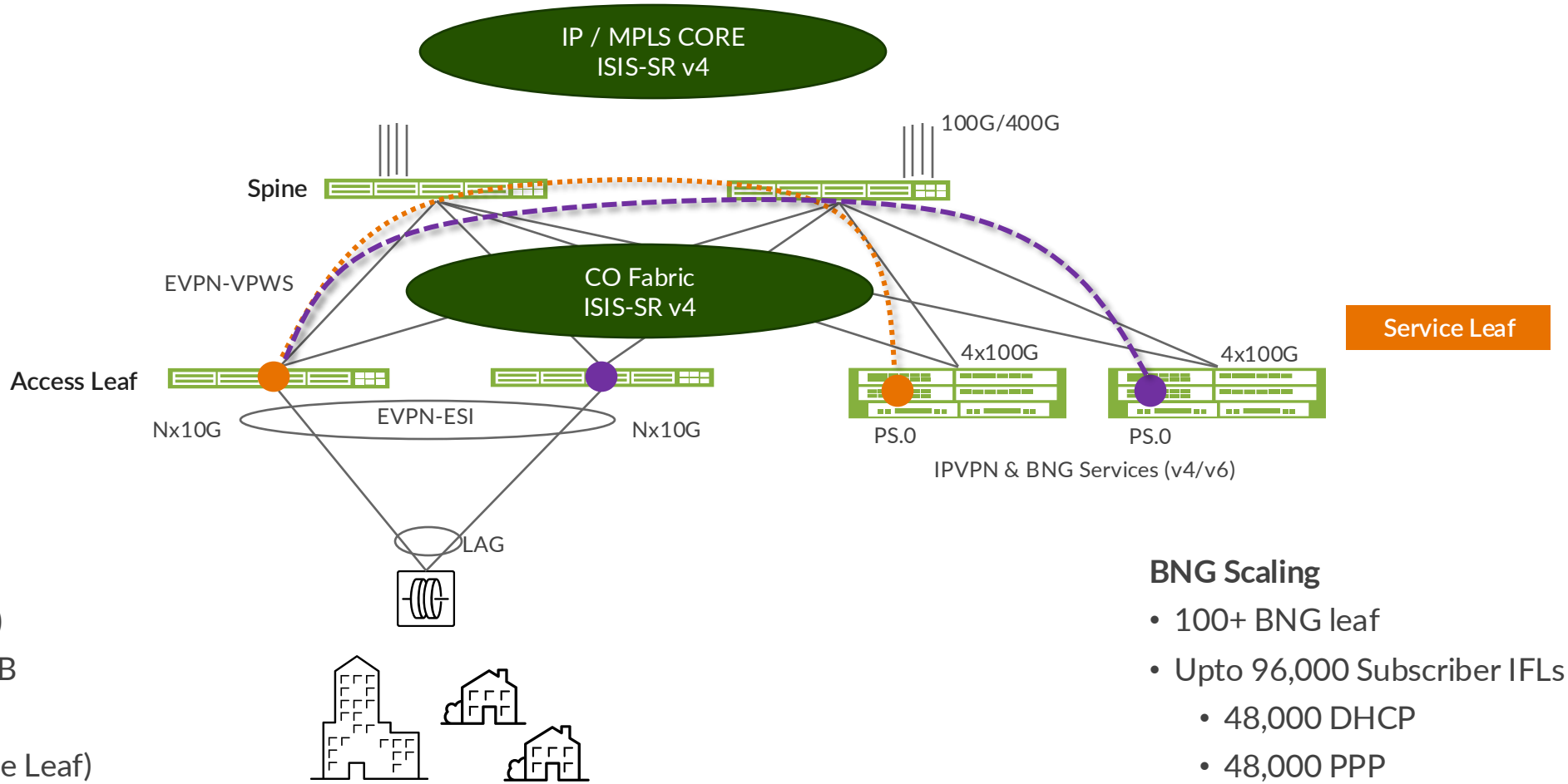
### Resilience Model

**Provide resilience on access , core and leaf side.**

### Simplified Operations

Reduced Failure Domains & operational simplified

# Use case – Cloudified NG-Edge Architecture



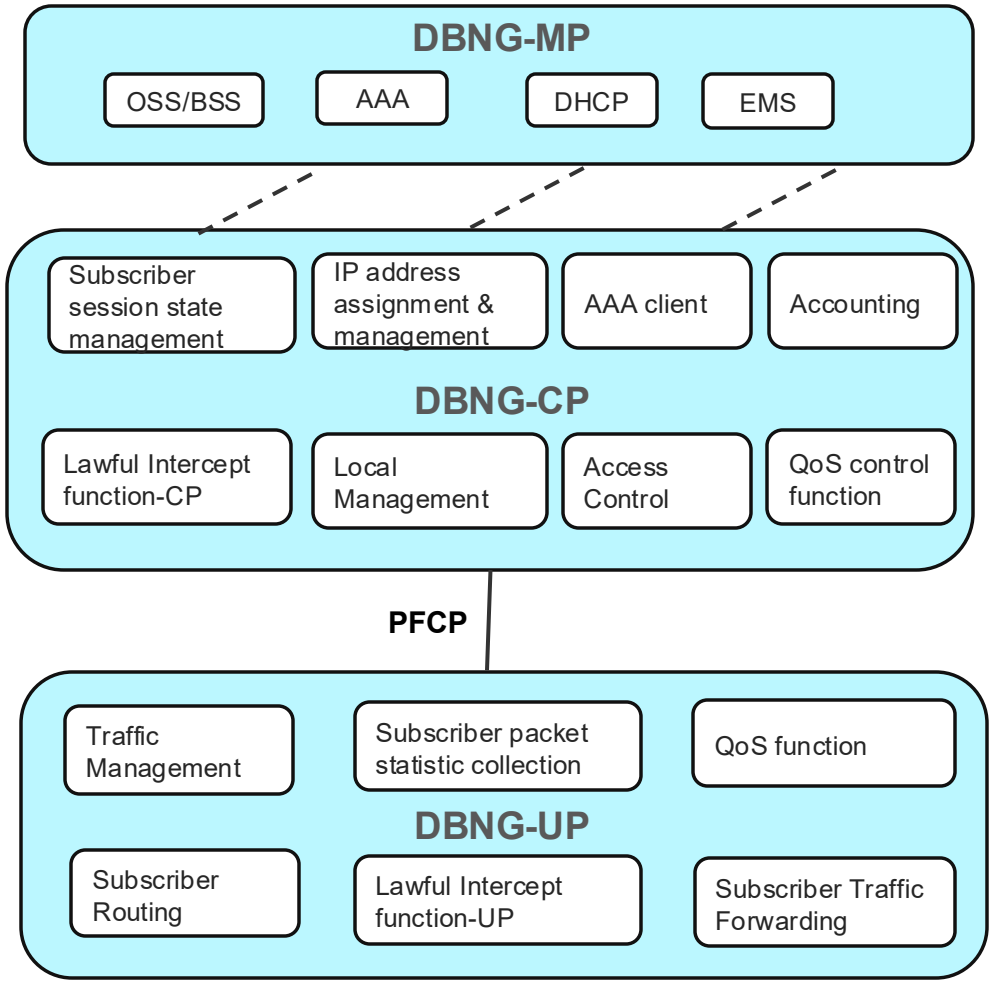

**Feature Set**

- ISIS-SR
  - SR-MPLS IPv4
  - TI-LFA (node/link)
  - Configurable SRGB
  - Services on SR
- PWE (Access + Service Leaf)
  - EVPN-VPWS
  - EVPN ESI

**BNG Scaling**

- 100+ BNG leaf
- Upto 96,000 Subscriber IFLs per leaf
  - 48,000 DHCP
  - 48,000 PPP
- 20Mbps / Home Target
  - Each home 2xIFL

# Disaggregated BNG CUPS




**TR459 Issue 1**

**TR459 .1** - Ref. Arch. (June 2020)
**TR459.2** - CGNAT (Oct. 2021)
**TR459.3** - IPTV Multicast (Aug. 2021)

**TR459 Issue 2**
(Published April 2023)

- **Focus on Multi-vendor Interop**:
- SCi improvements, DHCP Relay, Extend Data Model, Multi-Instance Control

**TR459 Issue 3**
(Published January 2025)

- **Work items:** Partial support for Multi-vendor firewall, Hierarchical QoS, Multi-vendor QoS, etc.

**TR459 Issue 4**
*(in progress)*

- **Full Multivendor QoS Support**
- Headless UP operation, WT–474 support, Other miscellaneous clean-ups

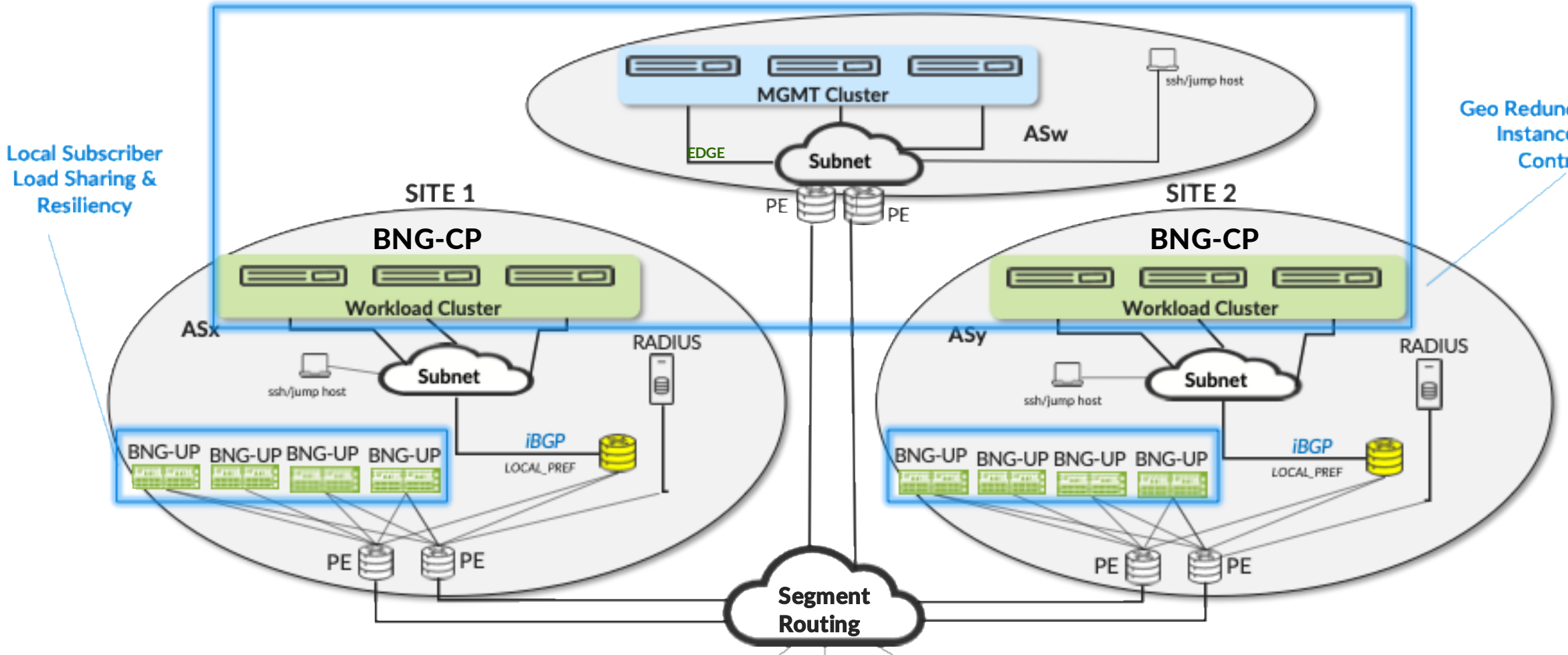
**WT-474**
*(in progress)*

- **BNG CUPS Service Steering**
- Use Case, Interface and protocol def., Load Balancing of subs across UPs

The disaggregation of the BNG into distinct Control Plane and User Plane functions, enables operators to independently scale signaling and forwarding resources.

# Use case – Disaggregated BNG CUPS

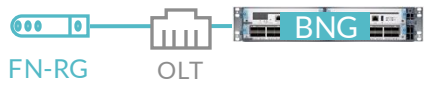
Intelligent Subscriber Load Balancing + Geo Redundancy




- Load Balancing within Data Center / POP
- Reconnect between Data Centers
- Multi Geography BNG CUPS Control Plane

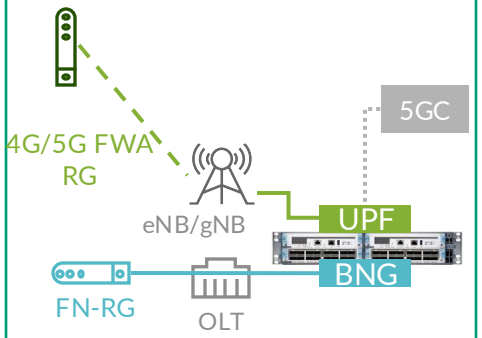
# Converged - FWA , an evolution step towards WWC

## BNG-Only



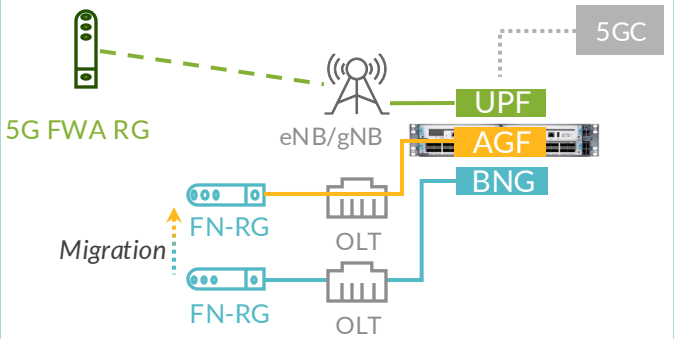

- **BNG on a standalone Router**
- Router can be used for other functionality

## FWA



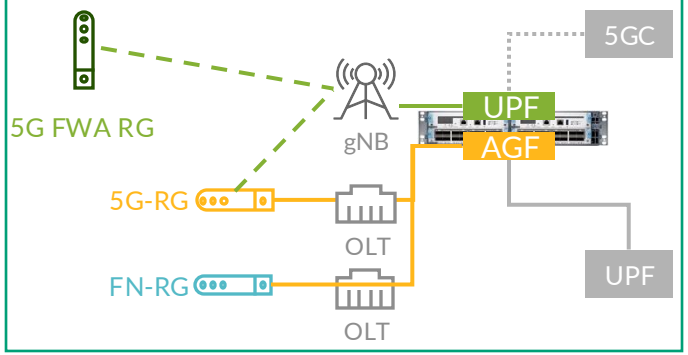

- FWA subscribers connecting via eNB or gNB
- Wireline subscribers via BNG through OLT
- Common user plane for Wireless and Wireline broadband traffic
- **Offloading high volume FWA traffic to hardware optimized appliance**

## Wireline Evolution




- **Hybrid solution with broadband users through BNG and AGF**
- Ease of migration (wireline to 5GC control plane)
- AGF+UPF co-location:
  - Superior ROI with lower TCO
  - Offering: Lower latency, Enhanced traffic steering capabilities & Local breakout

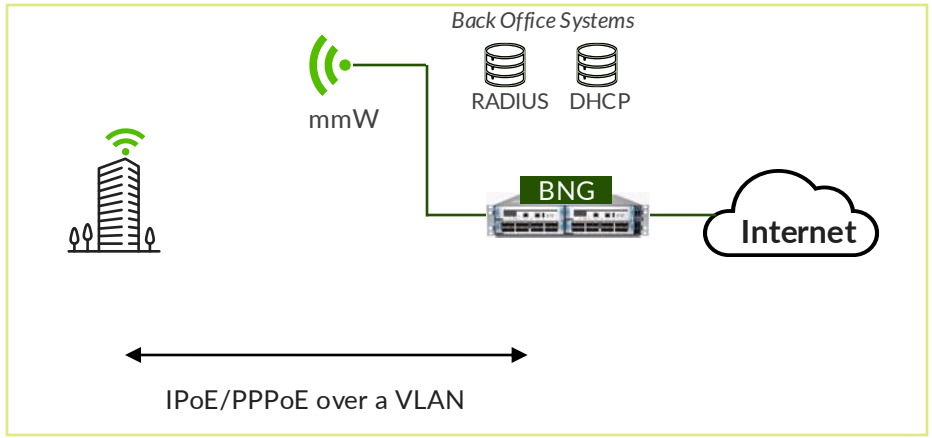
## Converged Edge with WWC




- **Converged Core = Wireline Interworking + Mobile Edge**
- Hybrid access
  - Multi-access(Wireless and Wireline)
  - ATSSS
    - Load balance
    - Active/standby
    - Priority
    - Latency based
    - Performance Measurement Function

# Use case - Converged FWA MDU Broadband Services

## MDU Broadband Service without 5G Core

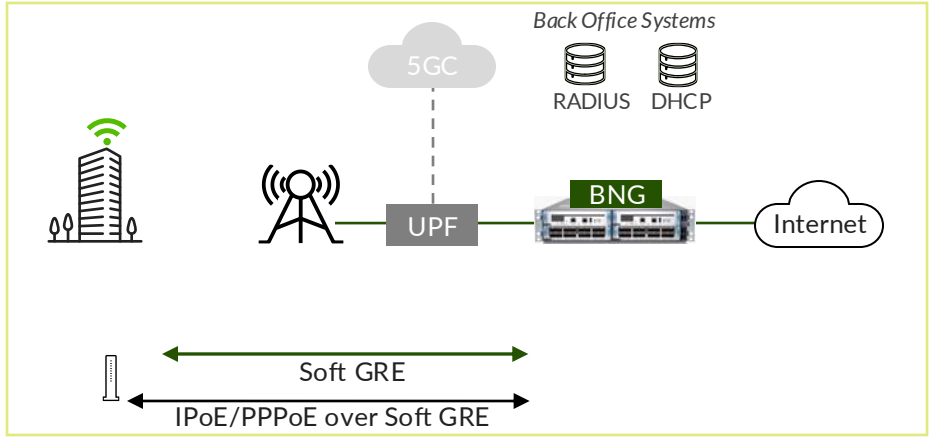



Delivering Broadband service to MDUs leveraging existing BNG with proprietary radio access (mmW)

Subscribers presented as VLANs to BNG (same as wireline subs), ability to leverage existing wireline infrastructure.

| | |
|---|---|
| Subscriber Management by BNG | ✓ |
| No integration required with Packet Core | ✓ |
| No dependency on Packet Core | ✓ |
| No capacity impact to Mobile Core and Radio | ✓ |

## MDU Broadband Service via wireless network




Delivering Broadband service to MDUs leveraging existing 4G/5G Packet Core and BNG.

Each ODCPE (Outdoor CPE) uses soft GRE to carry subscriber traffic.

Wireless access can be 4G, 5G

| | |
|---|---|
| Subscriber Management by BNG | ✓ |
| Use existing Radio (4G, 5G NSA & 5G SA) | ✓ |
| No integration required with Packet Core | ✓ |
| No dependency on Packet Core | ✓ |

# Takeaways

- Many other topics IPv6, QoS, Merchant, Automation
- Broadband in Australia is evolving with global parallels
- Many technology choices and options, cloudified and disaggregated.
- Deployment driven by business requirements of simplicity, resiliency, blast-radius, customer experience

**More information:**

https://community.juniper.net/blogs/horia-miclea/2024/05/13/juniper-bng-cups-architecture

https://community.juniper.net/blogs/horia-miclea/2023/04/04/new-subscriber-qos-for-next-generation-broadband

# Thank You & Questions

# H-Policing Vs H-Shaping

**Australian Trend:** Lower access speeds preference shaping to get best rates and forced public reporting of achievable speeds
**Global Trend: Some markets seeing rate-limiting/policing as meeting their needs with higher access rates**

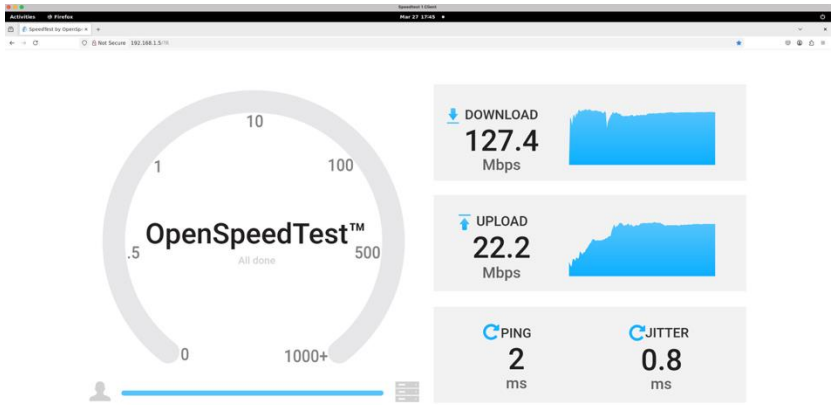
- Some SPs deploying simplified QOS model for broadband service delivery.
- Increased bandwidth & OTT services increasingly have adaptive QOS session management. Is heavy QoS handling still needed everywhere?

**Shaping:**
- Queues excess traffic
- Smooths traffic without dropping packets
- Suitable for customer traffic control
- Costly resources in terms of memory and processing

**Policing:**
- Drops or marks packets exceeding limits
- Enforces strict bandwidth limits
- Useful in peering and transit scenarios
- Lighter resource usage

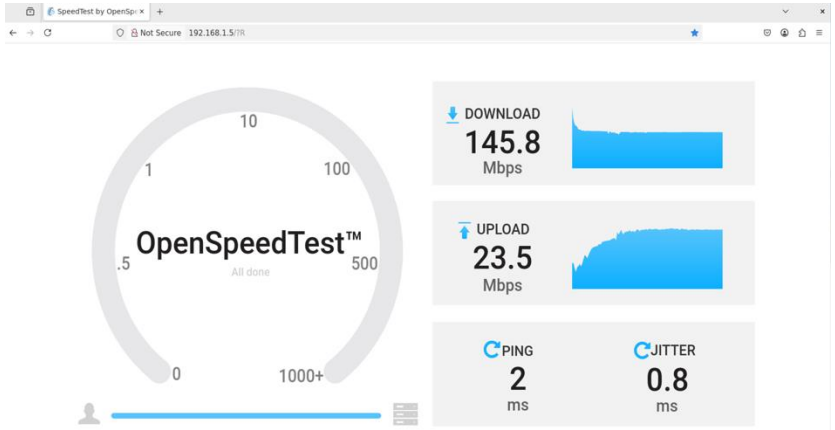
**Best Practices:**
- Use shaping for QoS-sensitive applications
- Use policing for enforcement at network edges

MX304, Open Speed Test, Policing DS




Upstream SLA: 25Mbps

MX304, Open Speed Test, Shaping DS




Downstream SLA: 150 Mbps