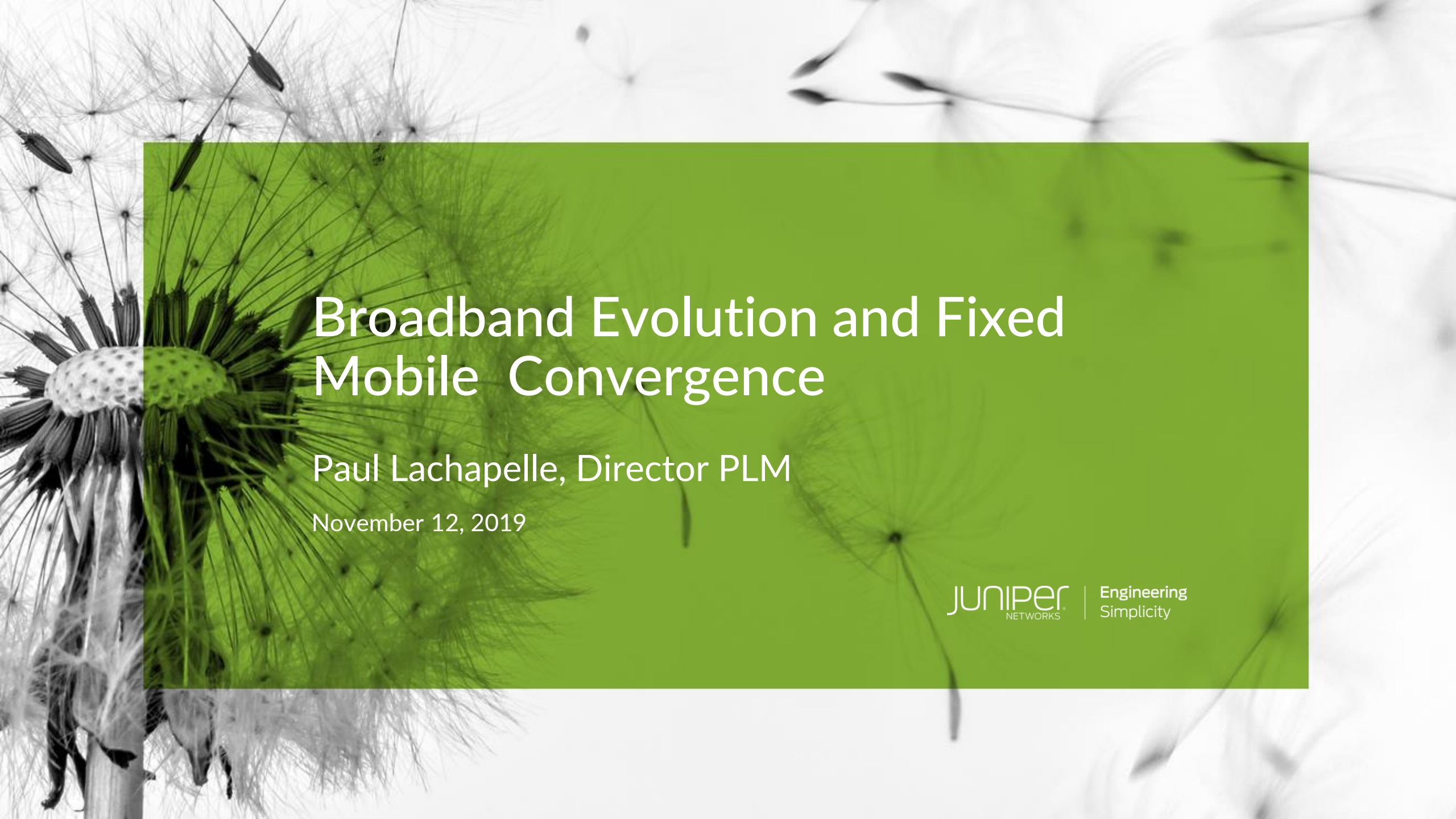


Broadband Evolution and Fixed Mobile Convergence

Paul Lachapelle, Director PLM

November 12, 2019

JUNIPER NETWORKS | Engineering Simplicity

AGENDA

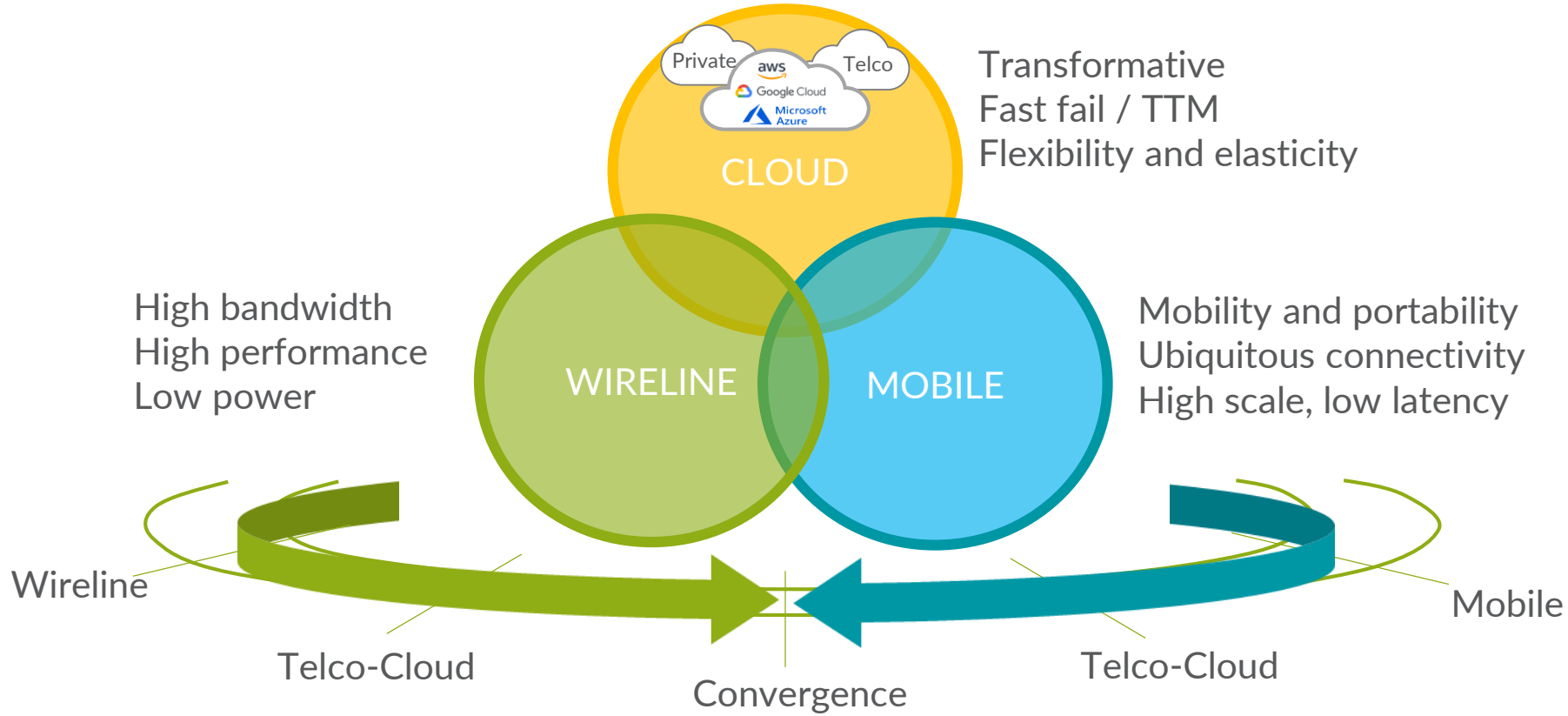
Broadband Market Inflections and Evolution

BNG Disaggregation and Convergence Standards Update

BNG Disaggregation via CUPS Overview

Fixed Mobile Convergence

SP TRANSFORMATION AND NETWORK CONVERGENCE



BROADBAND MARKET INFLECTIONS AND EVOLUTION

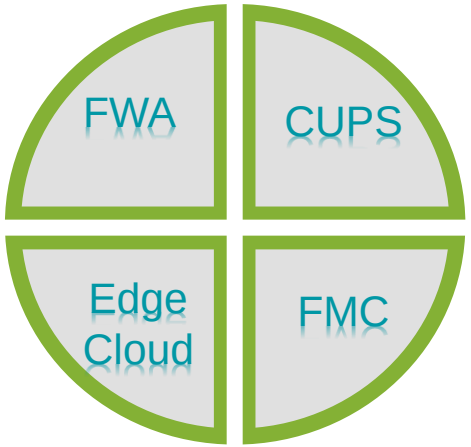
TODAY

Vertically integrated BNG solutions for wireline BB

Shifting Architectures

Distribution
Disaggregation
Convergence

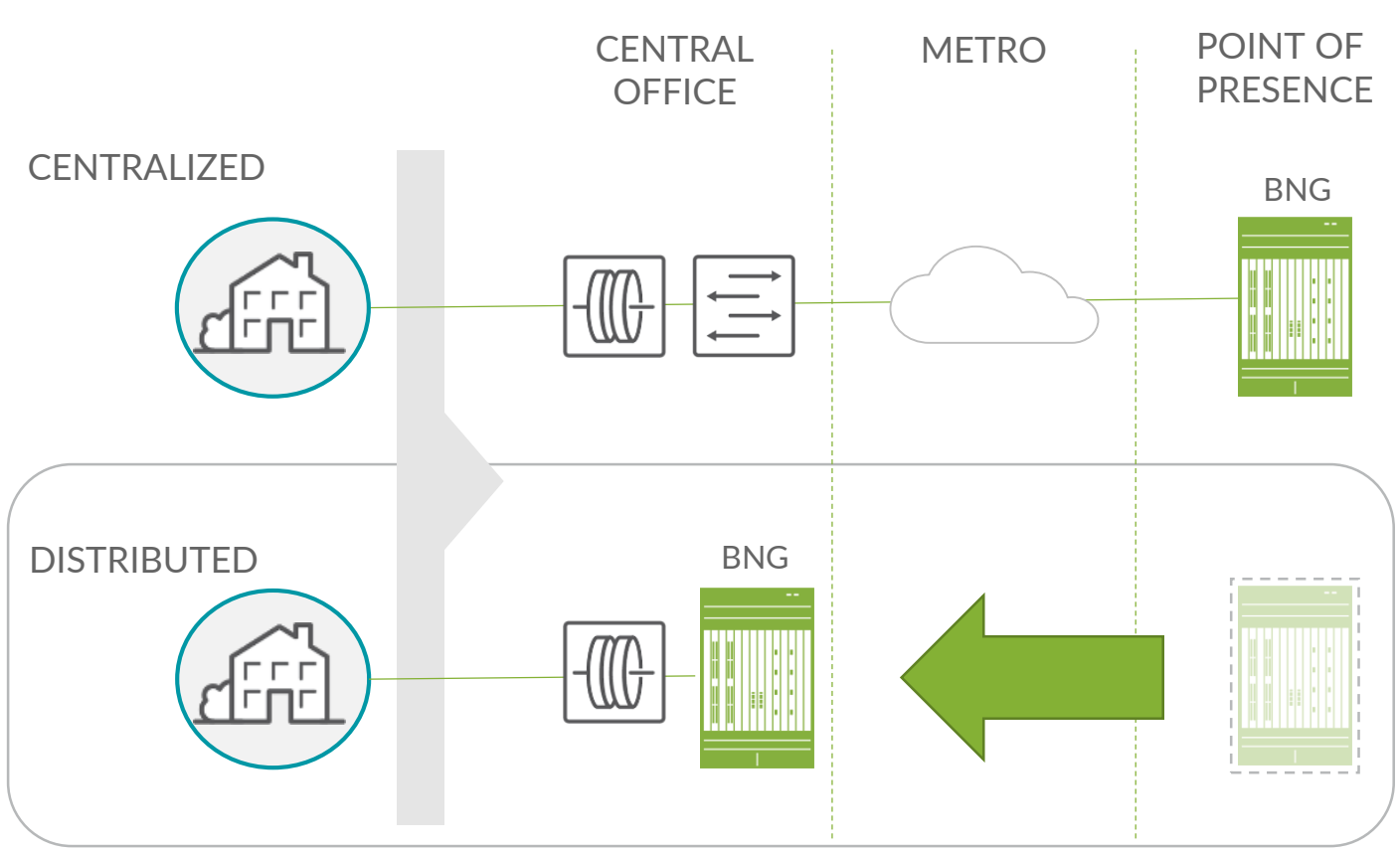
TOMORROW



More Bandwidth	More Devices	Network Evolution	New Architectures
Video leading way to 1Gbps+ to the home	Smart Homes, Connected “X” IOT, M2M	5G Mobile, Satellite, WiFi, Cable, FWA, G.FAST	Cloud/NFV, Mobile/FWA, Disagg/CUPS

Google Stadia Game Streaming Service
35Mbps / user unicast, plans for 8K video

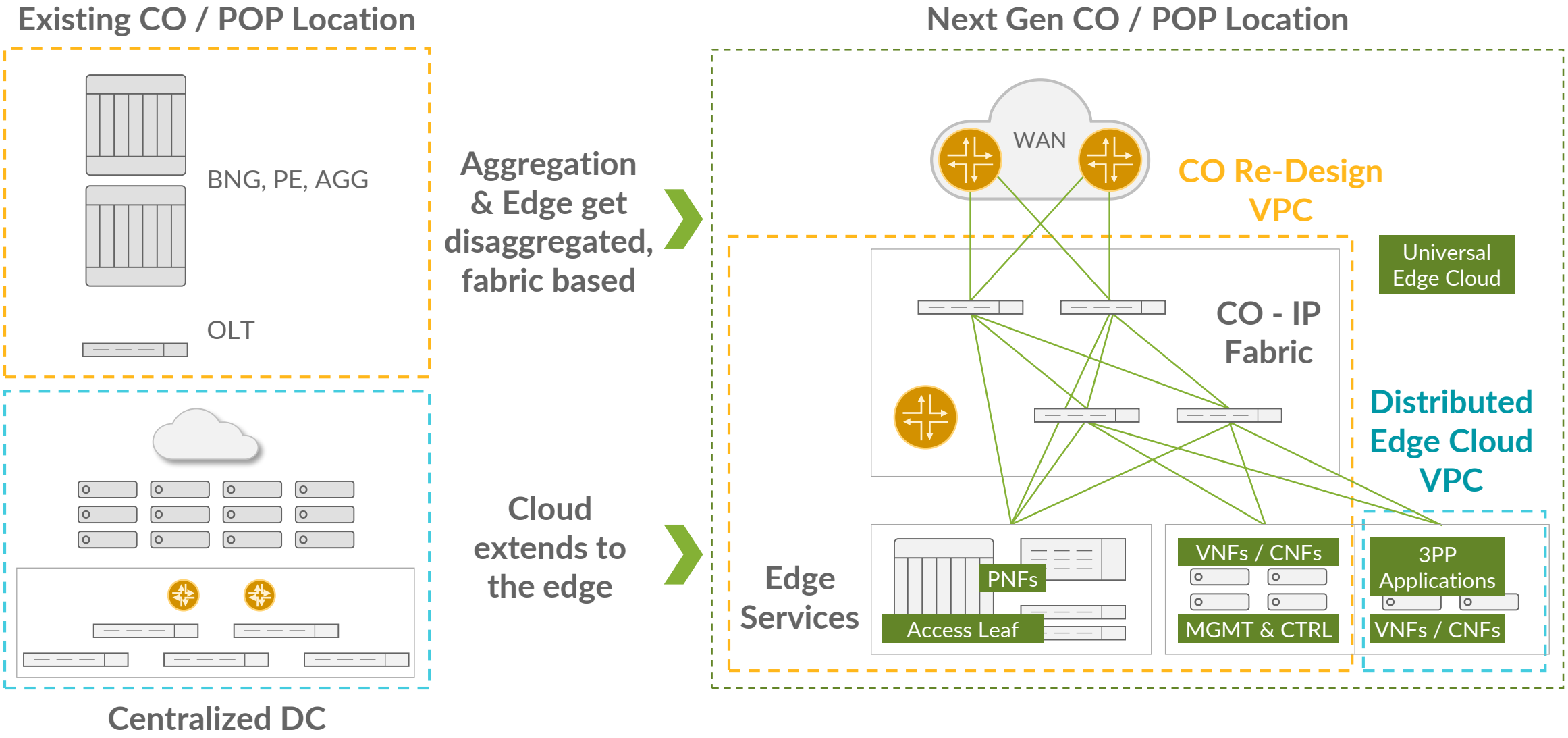
ARCHITECTURAL SHIFT TO DISTRIBUTE THE EDGE



- Deliver IP services closer to the user
  - High performance
  - Low latency
  - Local caching and content to reduce transit costs
  - Smaller failure domain
- Scale-out economics
  - Platform optimization (capacity, scale, redundancy, density, cost)
  - JIT Inventory / PAYG
  - Precision investments
- Possible direct connect (no agg layer)
  - Simplified architecture
  - Lower TCO

NEXT-GENERATION CO EDGE CLOUD

RE-DESIGN OF EDGE SITES FOR UNIVERSAL EDGE CLOUD



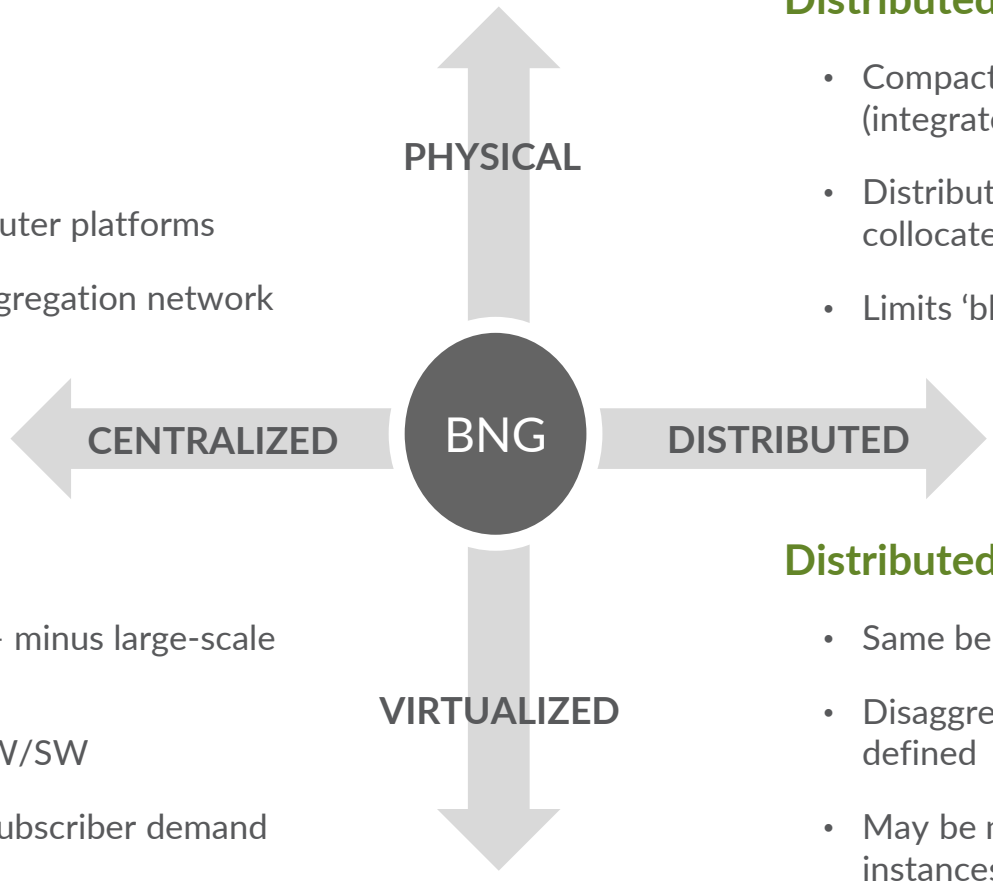
ARCHITECTURAL CHOICES FOR THE RESIDENTIAL EDGE USE CASE

Centralized/Physical

- Traditional BRAS/BNG architecture
- Simplified operations (fewer 'nodes')
- Requires large-scale (expensive) IP edge router platforms
- Adds extra backhaul and latency 'tax' in aggregation network

Distributed/Physical

- Compact, fixed form factor (1-2 RU) BNG platforms (integrated)
- Distributes broadband edge closer to subscriber and/or collocated with video cache / peering router
- Limits 'blast radius' in event of an outage



Centralized/Virtualized

- Similar benefits/challenges as centralized – minus large-scale router platforms
- Extra requirement of integration across HW/SW
- TCO challenged at scale due to high BW/subscriber demand for BNG use case

Distributed/Virtualized

- Same benefits as distributed/physical
- Disaggregates HW (x86) from SW leveraging software-defined scale out
- May be more difficult operationally due to number of instances to be managed

New flexible architectural approach needed to realize most benefits with fewest trade-offs

STANDARDS IN PLAY – BNG CUPS & CONVERGENCE

broadband forum

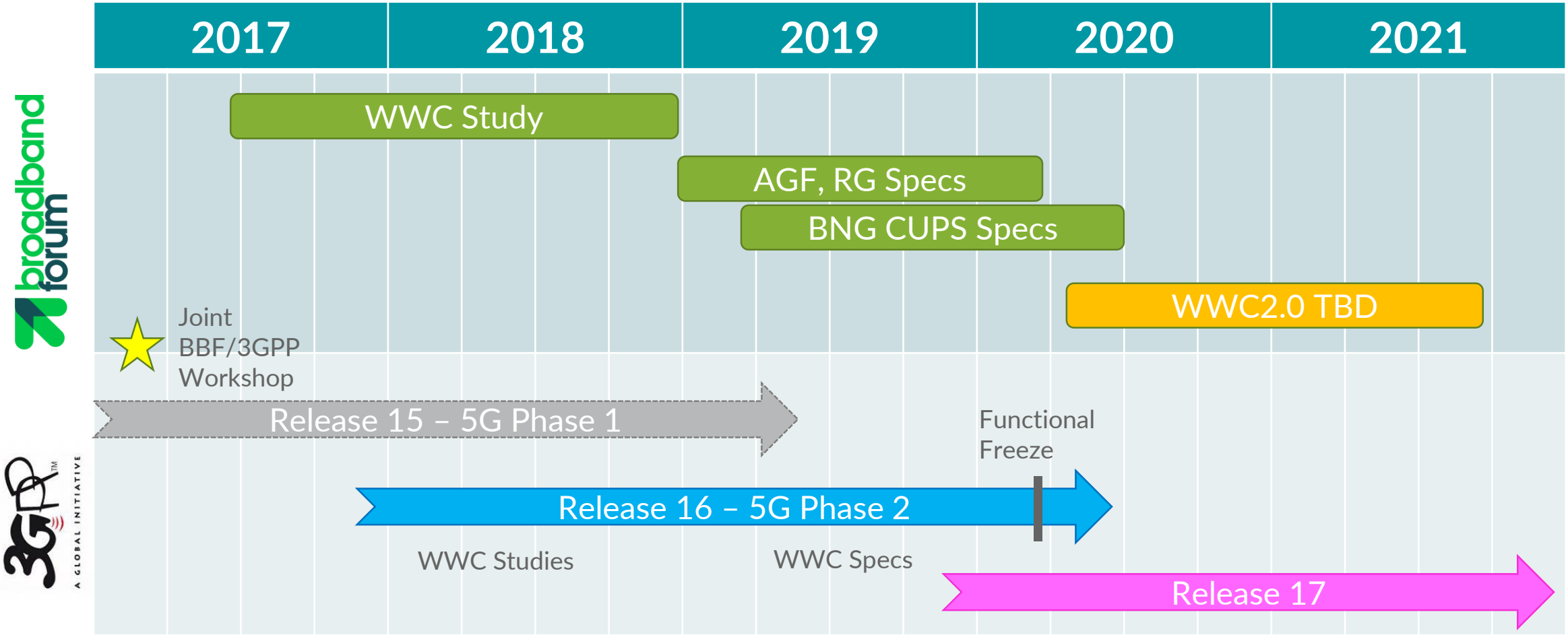
- WT-459 – control and user plane separation for a disaggregated BNG
- PFCP is chosen by BBF as the ONLY protocol between CP and UP for BNG CUPS
- WT-458 5G fixed mobile convergence
- WT-456 AGF functional requirements

3GPP

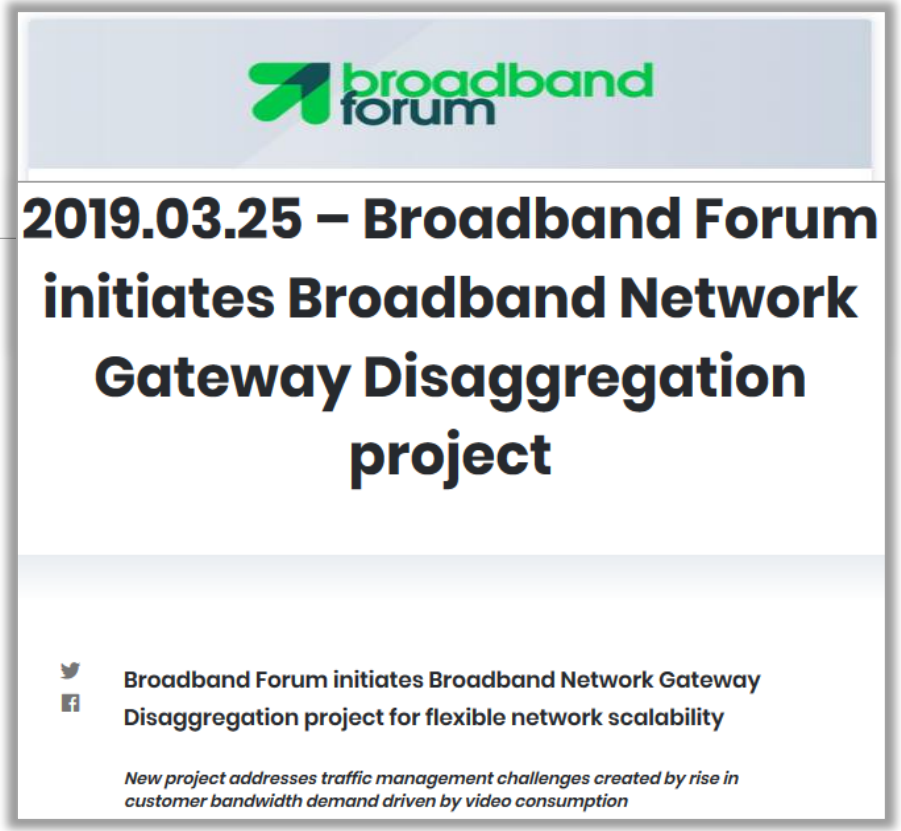
- Wireless and wireline convergence access support for the 5G system (TS 23.316)
  - PFCP – Sx (Release 14)
  - PFCP – N4 (Release 15)
  - Release 16 work-in-progress ← AGF ATSSS
- Study on hybrid access / ATSSS for 5G (TR 23.793)

ATSSS: Access traffic steering, switch and splitting

WIRELESS WIRELINE CONVERGENCE ROADMAP



BROADBAND FORUM (BBF)
WT-459 - DISAGGREGATED BNG UPDATE



Control and User Plane Separation for a Disaggregated BNG

Sponsors of Project Stream:

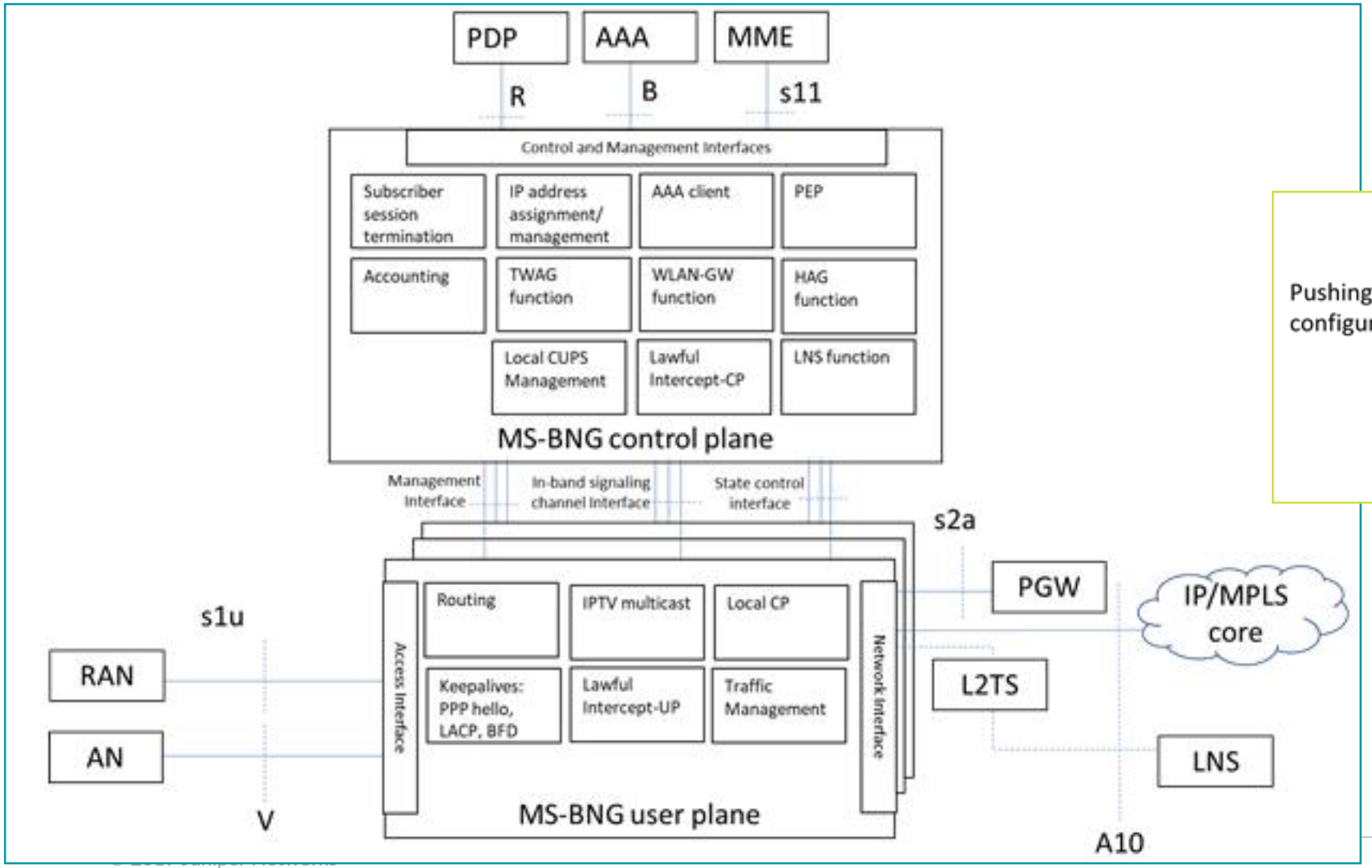
- Juniper, Nokia, DT, Vodafone, Ericsson

WT-459 Scope:

- Use cases, deployments & business drivers for BNG CUPS
- Functional requirements and reference architecture
- Specify interface(s) between BNG control plane and user plane
- Control plane and user plane resiliency
- Specify protocol for control plane and user plane separation for defined interfaces
- Define information model exchanged between control plane and user plane interfaces
- Subscriber Management, Policy Mgt, Accounting
- Management architecture / interfaces

Target completion date: 1H 2020

BNG CUPS BBF REFERENCE ARCHITECTURE



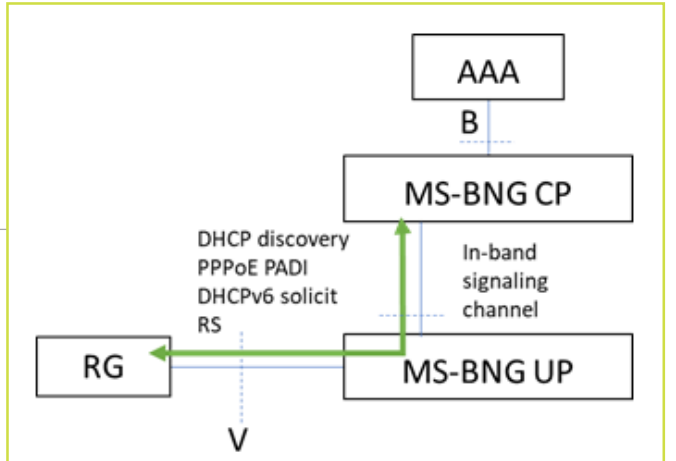


Figure 5: Control Packet Redirect Interface

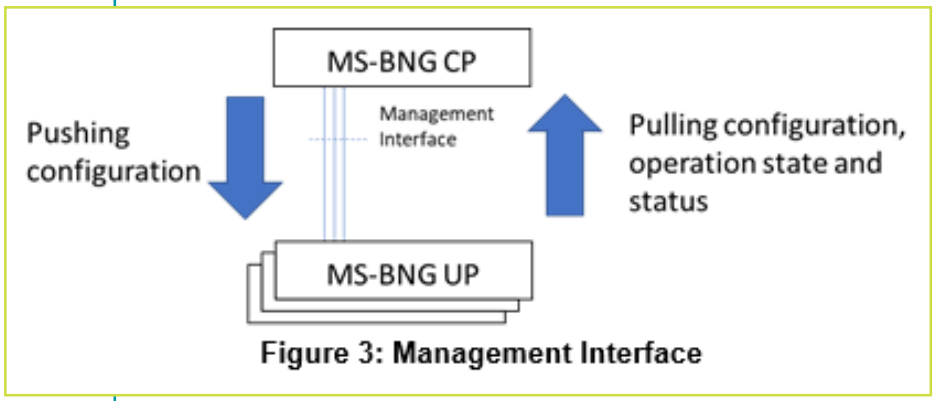


Figure 3: Management Interface

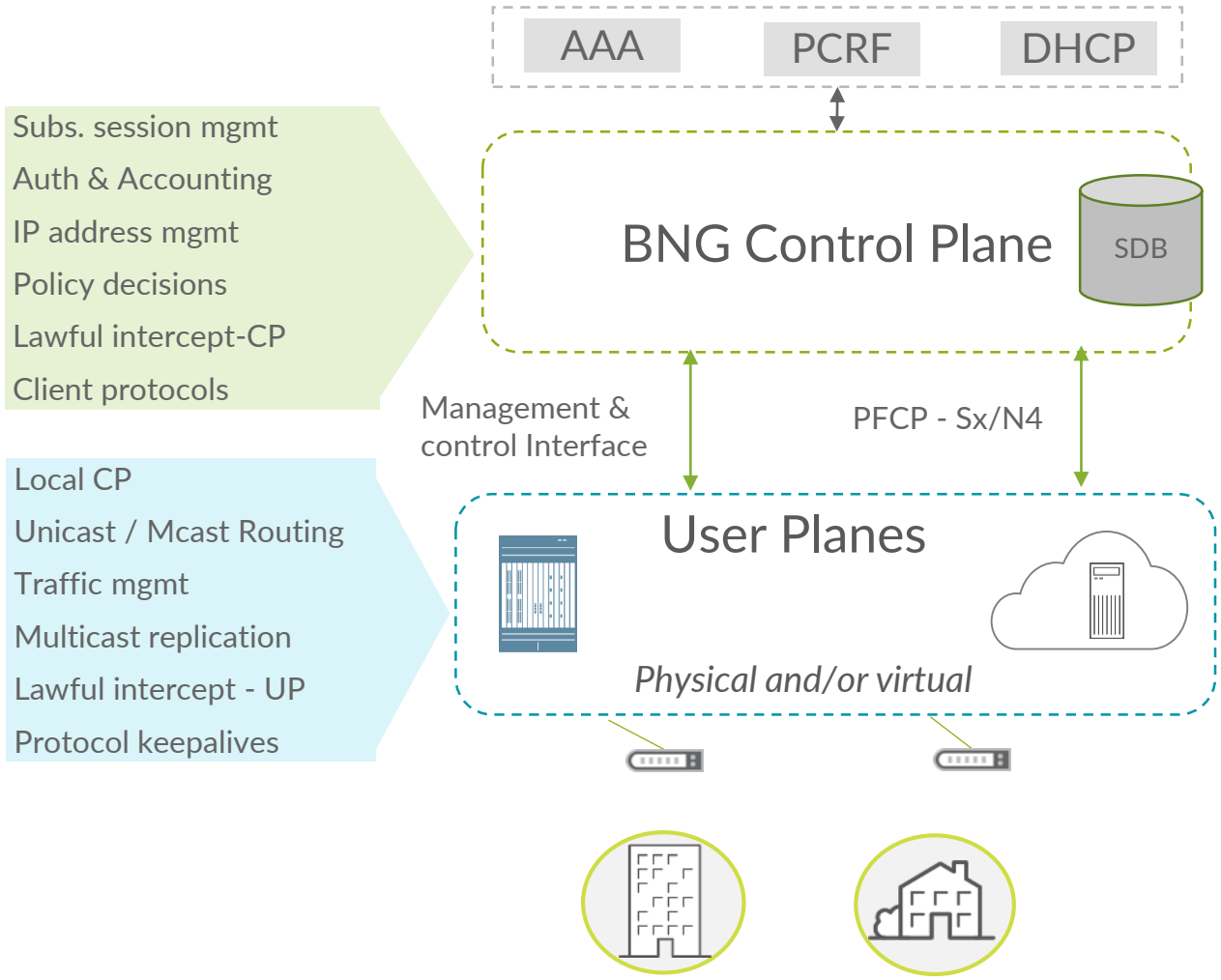
PFCP – Packet Forwarding Control Protocol

Simple extensions to PFCP for BNG CUPS

Standardized in 3GPP for EPC and 5GC

- Forwarding state for subscriber sessions
- QOS enforcement for subscriber sessions
- Usage tracking and reporting (credit-control)
- Stats reporting
- CP to UP heartbeat for liveness detection

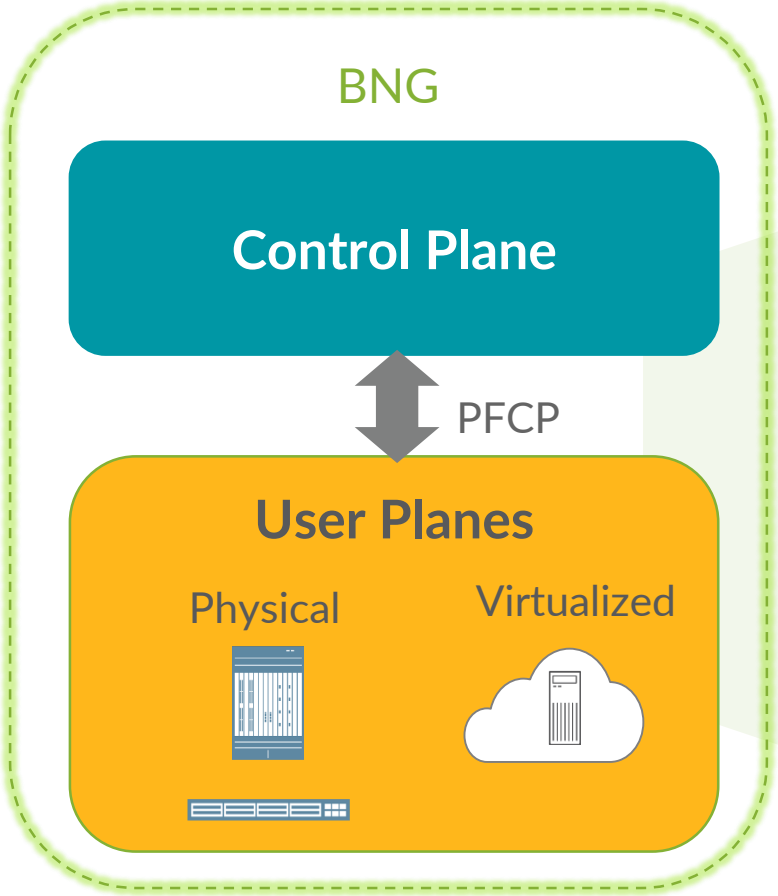
BNG CONTROL AND USER PLANE SEPARATION (CUPS) OVERVIEW



A cloud deployed management function that controls and monitors multiple BNG UPs

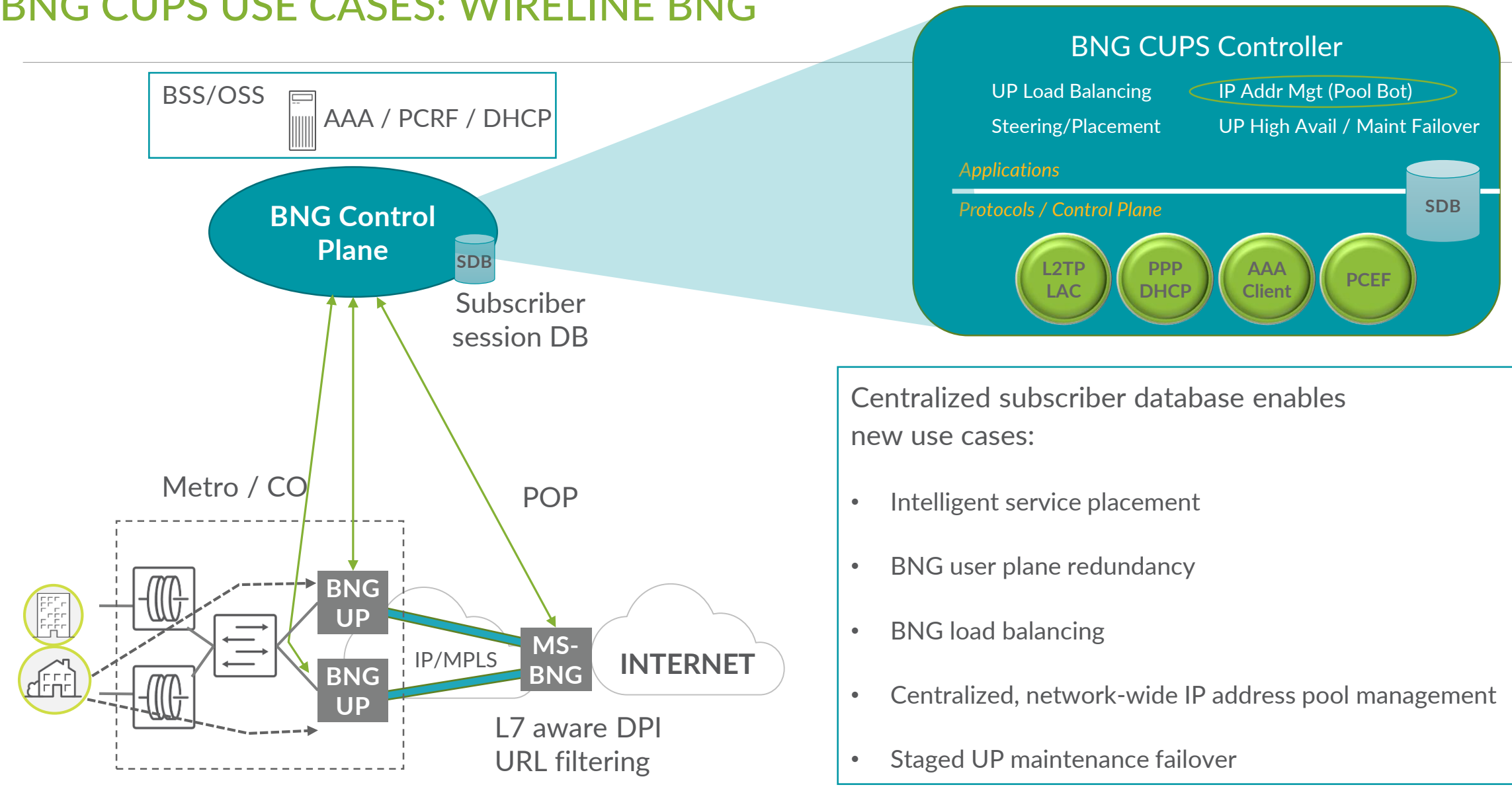
- Cloud deployed control and management plane (1 CP: Nx UPs)
- Centralized redundant, cloud deployed subscriber database
- Standards CP-to-UP protocol and management information model – PFCP extensions
- Single CP interface into BSS/OSS

BENEFITS OF BNG DISAGGREGATION / CUPS



- Independent CP/UP scaling
- Simplifies control plane scale-out and failure recovery through cloud-native deployment
- Operational efficiencies via centralized management and control (1 CP to Nx UPs)
- Distributed edge compute
  - High throughput / low latency
  - ‘Best fit’ user plane selection
- Single I/F to OSS (e.g. RADIUS, PCRF, etc)
- New Use Cases

BNG CUPS USE CASES: WIRELINE BNG



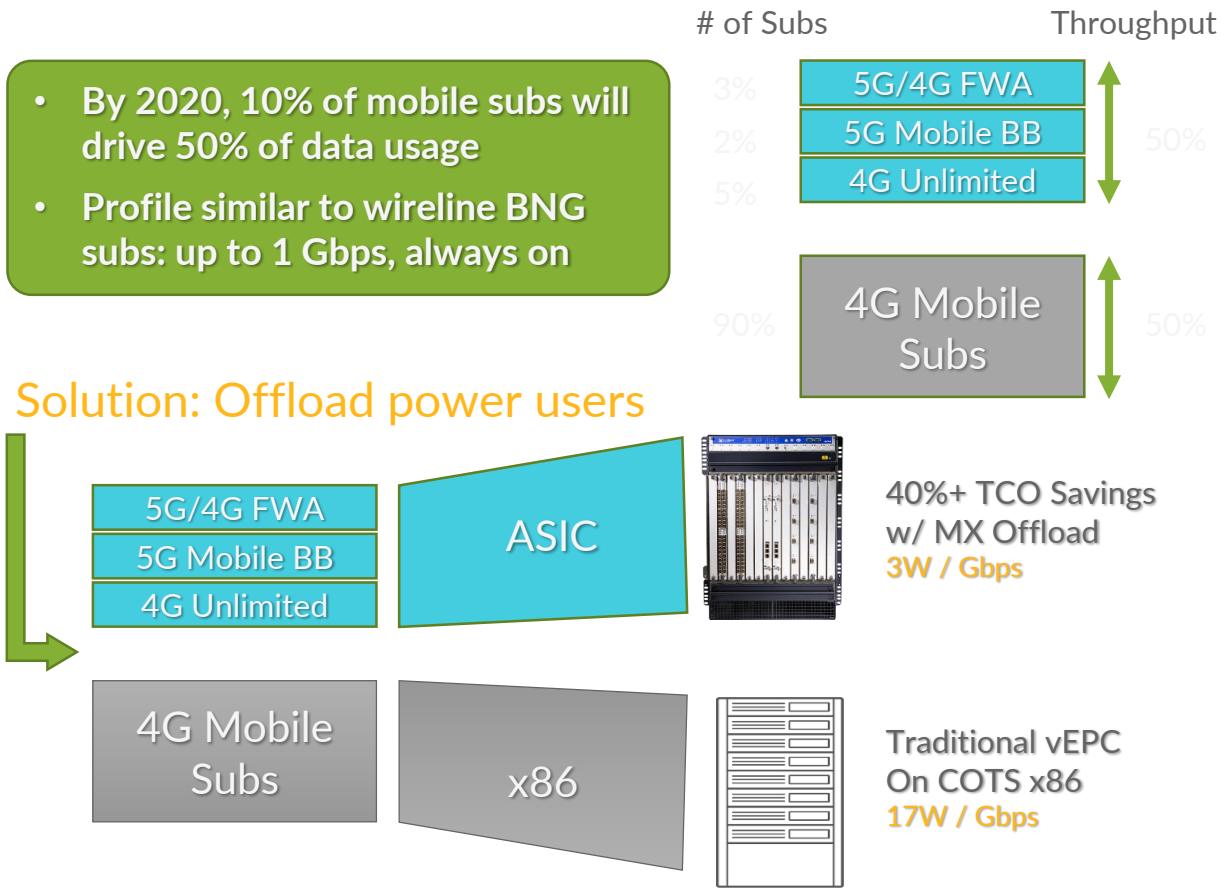
Centralized subscriber database enables new use cases:

- Intelligent service placement
- BNG user plane redundancy
- BNG load balancing
- Centralized, network-wide IP address pool management
- Staged UP maintenance failover

SUBSCRIBER SERVICE CONVERGENCE: WIRELINE + WIRELESS

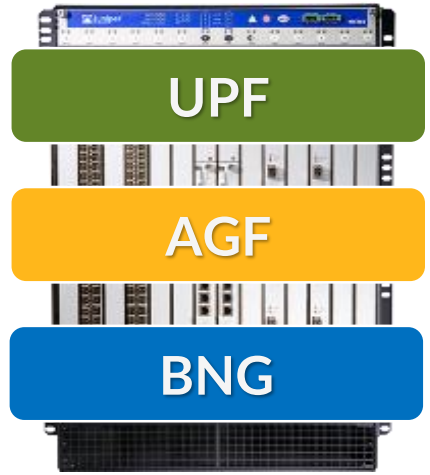
Fixed Wireless Access (FWA) Offload with the MX
First Step Towards Fixed + Mobile Convergence (FMC)

- By 2020, 10% of mobile subs will drive 50% of data usage
- Profile similar to wireline BNG subs: up to 1 Gbps, always on



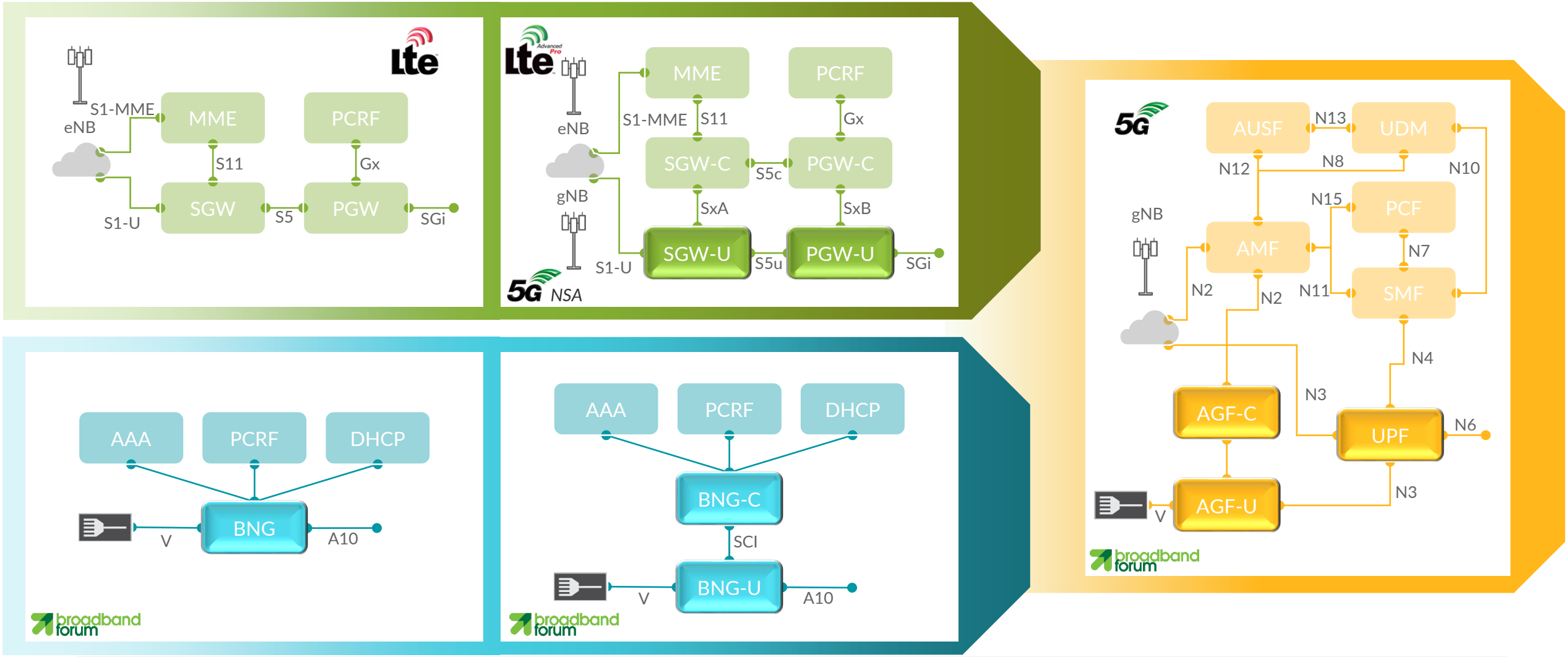
Converged Subscriber Core with the MX
Service Convergence of Wireline BNG + Wireless 5G AGF/UPF

- Convergence enables seamless migration from legacy to 5G
- Investing in CUPS
  - MX: silicon-based user plane for speed, capacity
  - Junos: cloud-native BNG control plane for operational parity
- Leverages advantages of MX
  - Hierarchical QoS for FMC
  - Network slicing for biz service
  - Integrated security
- Open standards-based ecosystem for mobile core control plane



MX Router

NETWORK EVOLUTION & CONVERGENCE



MULTI ACCESS USER PLANE FUNCTIONS & PLATFORMS

Partner Subscriber Management & Signaling Functions

Authentication, Mobility Management, Policy, Subscriber Profiles, Accounting, Lawful Intercept, etc.

Control Plane Functions

BNG-C *Juniper* | SAEGW-C | SMF | AGF-C *Juniper*

3GPP/BBF/IETF standardized Interfaces

SCI | SxAB | N4 | SCI*

Juniper Multi-Access User Plane Functions

BNG-U | SAEGW-U | UPF | AGF-U

SCI = session control interface

Container based control functions:

BNG-C & AGF-C

Dense User Plane:

- MPC7: up to 480 Gbps (240Gbps anchor)
- MPC10: up to 1.5 Tbps (500 Gbps anchor) *(future)*

Mobile Session Scaling

- Up to 1M Session per MX (RE solution)
- Up to 8M sessions with SPC3 *(future)*

MX204 | MX10003 | MX960 | MX480 | MX240


THANK YOU
JUNIPER NETWORKS
Engineering
Simplicity