Reimagine Mobile Edge Computing
Content Delivery

Eliminating Backhaul Bottleneck
Creating Additional Bandwidth
Adding Resilience
Mobile Video Delivery Struggles

Source: Opera Software
Challenges in Mobile Content Delivery

• Majority of mobile video traffic (YouTube, Netflix) is unicast (personal) in nature; multi-cast is not going to help with this type of content.

• Content delivery/caching needs to address encrypted videos as well:
  • Need to work with a provider to enable caching of encrypted videos.

• MEC caching content and delivery/acceleration (even close to the user) gets affected by backhaul bottleneck.
Our Solution
Enhanced MEC Content Caching

• **Mobile Edge Computing Platform** → bringing content and services closer to the user, while maintaining mobile NW functionality

• **Mobile-Edge Content Accelerating** → MEC product for hosting and accelerating content closer to the user. Promoting content and CDN caching, and MEC vCDNs

• **NEW**: License assisted backhaul enabled by SDN wireless mesh → solving backhaul bottleneck for delivering MEC Content to the end user
Mobile Edge Computing & Mobile Edge Caching were already announced. What is New?

1. **CWS base station (3G, 4G, Wi-Fi + integrated backhaul)**
   - 2X GigE, 2X built-in mesh radios, LTE macro backhaul, custom
   - Full-featured third generation mesh technology

2. **Two Solution Modes**
   - **License assisted backhaul (LAB)** enabled by SDN wireless mesh backhaul
     - Similar to LAA
     - Aggregates LTE and unlicensed spectrum for backhaul and makes decisions as to what spectrum to use to deliver guaranteed Quality of Service for different types of applications (VoLTE, mobile video, etc.).
     - Enhances existing MEC Content-caching solution:
       - Enhances existing MEC Content-caching CDN and accelerating solution
       - Opportunity to host future existing additional MEC applications
       - Additional capacity and efficiency, additional bandwidth savings as one content caching solution can serve a whole mesh cluster
   - **Unlicensed Assist Backhaul (ULA)**
     - ULA works with unlicensed spectrum
     - Complements existing wired backhaul to provide additional backhaul capacity
     - Software-Defined Networking (SDN)-enabled resilience.
     - Dynamic content routing
• SDN mesh backhaul links can be configured for mesh deployment multi-point to multi-point scenarios or long haul point to point links
• Only few CWSs need wired backhaul or LTE backhaul from macro
• Can be extended with linking and daisy chaining
• Creates “free” backhaul and eliminates a bottleneck
Caching Solution Detailed Architecture

License Assisted Backhaul

- CWS provides backhaul incl. mesh
- HNG runs on COTS server
- HNG manages SDN mesh fabric and aggregates backhaul, enables:
  - License Assisted backhaul to eliminate backhaul bottleneck and add backhaul capacity
  - Dynamic content re-routing based on mesh conditions
- Multi-point-to-multi-point mesh within the cluster with ideal backhaul for each node → same user experience on each node/no latency or delay
- Signaling handoff optimization
- Bandwidth savings and better user experience
Solution Detail: LAB

Eliminating a Bottleneck/Creating Backhaul Capacity

- Non-ideal backhaul **is not** a choke point
- Each CWS:
  - Capable of up to 450 mbps capacity
  - Creates more backhaul capacity over licensed spectrum that is not used or unlicensed
  - Transport pipe becomes much **larger**
- Cached content delivery improves
  - No latency
  - More available capacity
- Dynamic Content Routing
  - Resilience
  - QoS
Dynamic Content Rerouting

- Multi-point to multi-point mesh
- HNG manages:
  - SDN mesh fabric
  - SDN-based dynamic content rerouting based on mesh conditions
    - On downlink → pushes routes for certain type of traffic
    - On uplink → manages CWS profiles to route in resilient and most cost-effective way
    - Most direct path might be not the best quality one
    - Rerouting in case of failure
    - In traditional scenario if backhauls is compromised content is not delivered
- Result: Caching + optimization
Multiple Mesh Clustering

MEC: Content hosting and accelerating (vCache, vCDN) + License Assisted SDN enabled wireless mesh/management and dynamic routing

Non-ideal backhaul

Optional:
- Can serve both clusters

CWS #1
- CWS enabling License Assisted Backhaul

CWS #2
- SDN-enabled wireless Mesh cluster

CWS #3
- CWS #4
- CWS #5
- Mesh cluster # 2

CWS #2/"backhaul hub" enabling License Assisted Backhaul

Non-ideal backhaul
Traditional Macro Solution

Not Enough To Share …

Non-ideal backhaul creates a choking point/bottleneck at fiber hub

- i.e. **150 Mbps** has to be shared between each node (in this picture: between 3 nodes)
- Each node ends up with barely **40 mbps** to provide capacity
- If node is sectored, each sector gets one third of the 3rd (barely **15 mbps**)…

Backhaul to cache content is constrained

- Contend delivery gets compromised
- Latency increases
- QoS gets reduced
Our Solution

Mesh Fabric/Unlicensed Assist as Alternative Backhaul

- Adding unlicensed spectrum to existing framework
- CWS = backhaul provider
- Each CWS:
  - Capable of up to 450 mbps capacity
  - Creates more “free” backhaul capacity over unlicensed spectrum
  - Transport pipe becomes much larger
  - Enables resilience in case of fiber cut
  - Can be primary or back up
  - HNG can enable dynamic routing over fiber or mesh backhaul
- Can be used in caching to optimize delivery
- Helps with constrained spectrum

150 Mbps

Fiber hub

1 3
NEW: Mesh Fabric, LAB and ULA

- Self-configuring
- Self-optimizing
- Self-healing
- Flexible backhaul options, including LTE and wireless mesh
Converged Wireless System
Software-defined, Multi-mode, Multi-band

- More functionality in one unit
  - Integrated: 3G, 4G, Wi-Fi Access and flexible backhaul (LTE, wired, NLOS/LOS mesh, Wi-Fi)
  - Combines NodeB/RNC for 3G Functionality, eNodeB for 4G
  - Solves backhaul challenges: only a few nodes require wired backhaul
  - RAN simplification

- Leverages latest silicon
- Reduced network costs and operations with integrated access/backhaul design

- Backhaul Capabilities
  - Each integrated 40 MHz Mesh Radio delivers ~200Mbps capacity using 2X2 MIMO. Capable of 450Mbps capacity with 3X3 MIMO.
  - "Multi-point" to "multi-point" (no server node or client node)
  - Multi-homed – any egress (wired or LTE) on a given node is available to full mesh cluster. E.g. 10 meshed cluster of CWS has 3 Ethernet backhaul that terminates on 3 of the 10 CWS, this backhaul is shared among all 10 nodes.
  - CWS can provide Ethernet backhaul to external devices: external Access Points, traffic camera, etc.

- Reduced CapEx with commodity components and flexible backhaul
- Install, power-up and go with zero touch configuration via HNG
- Reduced Opex with resource optimization and traffic mitigation via HNG
- Seamless user experience between 3G/4G/Wi-Fi technologies
- Secure, carrier-grade
- Standards-based
Example CWS Install
Havre, MT, US

- Wi-Fi Access Antenna
- LTE/3G Antenna
- Backhaul Antenna
- GPS
- CWS
- Power
- Performance Indicators
- Mounting bracket

No Ethernet coming in
Deployment and Business Cases
One Solution – Many Use Cases

• Content Caching + Optimization
• Retrofitting an existing network for additional level of resilience:
  • For Public Safety Grade networks
  • To create “free” bandwidth for offloading where it is cost-prohibitive or logistically difficult to install more fiber or fixed backhaul
• Greenfield deployments
• Backhaul only
Summary

- 2 solution modes: Licensed Assisted and Unlicensed Assist backhaul on CWS + HNG providing SDN-enabled routing
- 3rd generation mesh
- Solves latency and backhaul bottleneck
- Content caching and delivery benefits from improved backhaul capacity
- Unlicensed Assist Backhaul on CWS can be retrofitted over existing macro for additional free capacity and resilience
Thank You