

Evolution of broadband services

Quality-of-service-experience, as
measured and delivered by Quality-of-
Outcome

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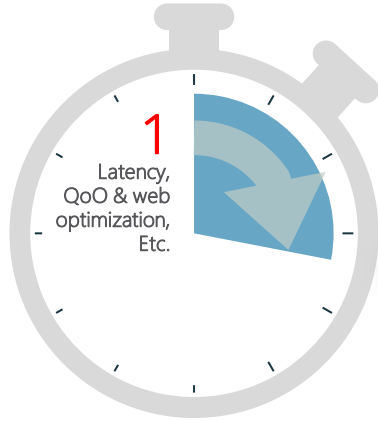
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Evolution of Broadband Services – Looking beyond bandwidth

The 3 Pillars of value-added applications and services for residential, SMB & Enterprise

Quality-of-Service-Experience and
QoO KPIs



Now is the time for service providers to be innovative and offer unique differentiation by catering to better on-boarding, better latency services, rich set of integrated features, and enterprise services in a residential context.

Monetization &
Revenue Generation



No longer are service providers looking at the CPE as a race-to-the-bottom pricing and sunken cost.

CSPs are now able to generate higher margins/ARPU by offering a variety of tailored services, each one with the ability to be managed individually and independently.

Service Assurance



Planned goals of targeted reductions of truck rolls by 25%, support calls by 25%, and CPE RMA by 25%

Evolution from network demarcation to ultra-edge computing



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Network demarcation shift enabling Edge Computing for all services

The Edge Gateway (CPE) is becoming the “ultra-edge computing” asset

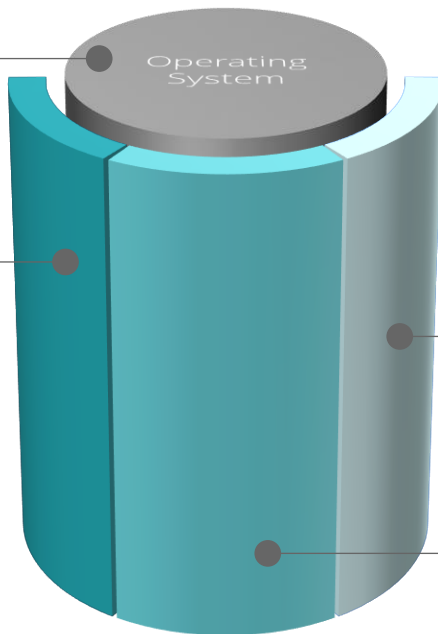
Open OS (OpenWRT, RDKB)

64bit, LXC 4.X support
Offers broad industry support and ease-of-integration



Powerful SOC

Quad Core ARM (A55 or better)
Performance >12000 DMIPS
100% hardware traffic acceleration, WIFI7



The “Edge Gateway” becomes the ultimate asset, not to counter webscale and OTT services, but to become crucial to their evolution and monetization (metaverse, AR/VR, etc.)

Flash Storage

4GB minimum, 8 GB recommended
>=100 000 write/erase cycles



RAM Storage

1GB minimum, 2 GB recommended
DDR4-1866 or better



Real-World examples

More or faster bandwidth isn't always
the answer.....

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Understanding consumers willingness to pay for more than just bandwidth

How much would you be willing to pay as a consumer for an enhanced and improved "Working-from-home" networking experience, or a better "gaming" experience?

1. 0 \$ / month	22,20%
2. 5 \$ / month	37,00%
3. 10 \$ / month	27,80%
4. 15 \$ / month	5,60%
5. 20 \$ / month	7,40%

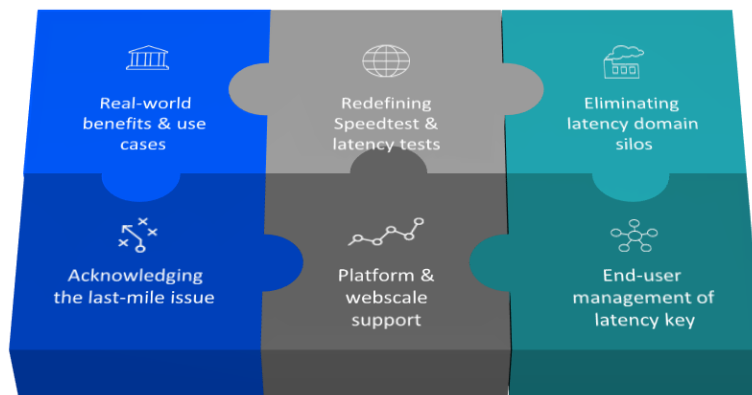
Source : Nokia sponsored LightReading webinar, April 2021

Would you rather have the service provider offer a custom broadband package tailored for certain latency needs (i.e. gaming, working-from-home, etc.) or should they provide the end-user the ability to self-manage this capability?

Service provider controlled latency	35%
End-user managed latency	65%

Source : Nokia sponsored LightReading webinar, September 2021

Common finding across multiple sources:
~80% of surveyed consumers are willing to spend between \$5-\$20/month for optimized services

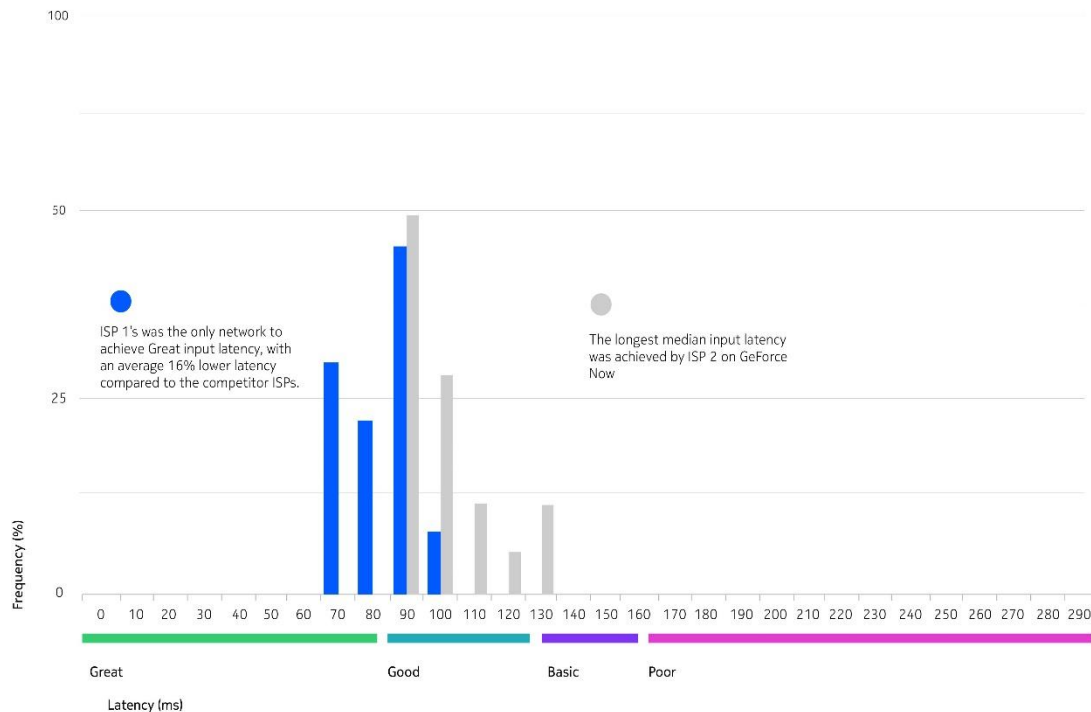


NAM Tier-1 Gaming Service Optimization – Field Audit results

Consistent latency is more important and impactful than just low latency

Median Input latency
distribution, Ethernet

- ISP
- Competition



Participant high-level trial survey summary

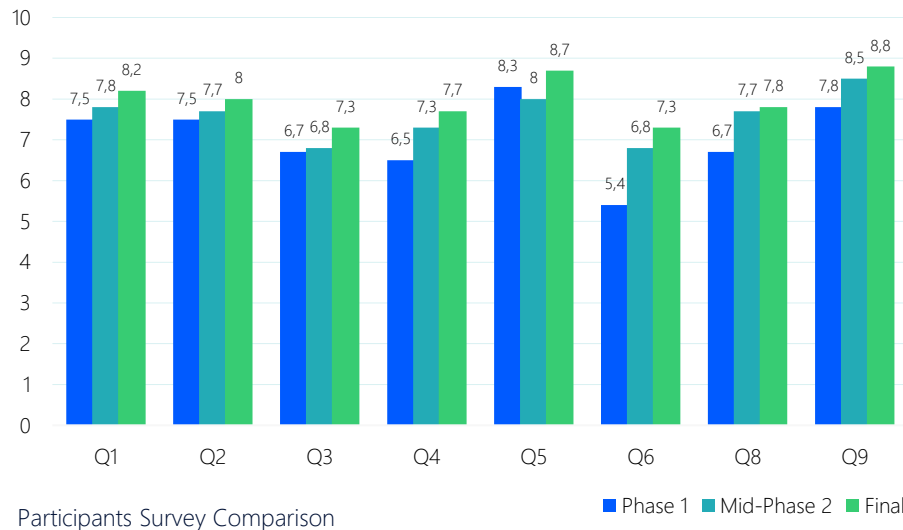
Deployed same survey initially, midpoint in the trial and a final survey to seek customer feedback

- **Phase 1:** Basic software functionality (2-weeks)
- **Mid-Phase 2:** PI2 and DOMOS enabled (survey for initial 4-weeks of 8-week trial testing)
- **Final:** Final trial survey for last 4-weeks of Phase 2

Positive improvement trend overall – best results with PI2 and DOMOS enabled; 50% of participants noted an improvement on fluidity on the final survey

Participant comments during final meeting:

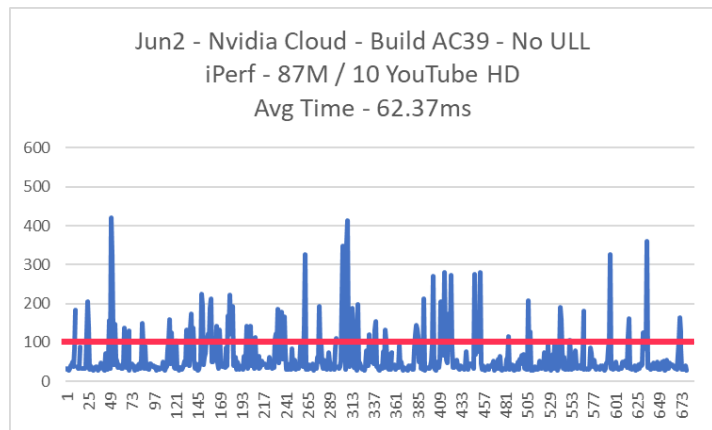
- Increased range on of WIFI connectivity
- Increased gameplay of cloud-gaming services
- Increased gaming experience during gameplay on the Nintendo and XBOX
- **Gaming satisfaction increased throughout the trial!**



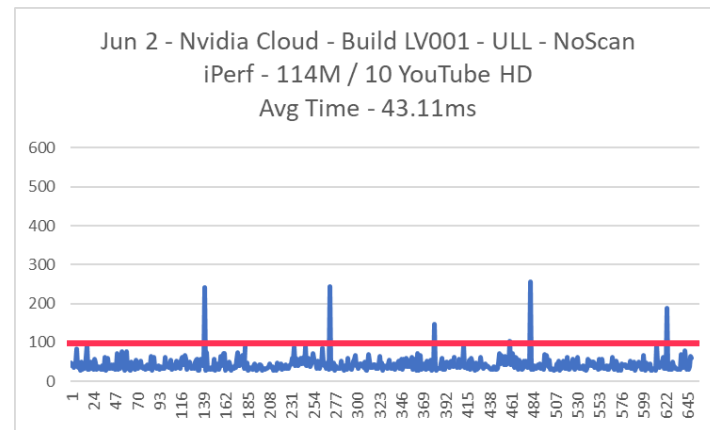
Advanced Queue Management (AQM) PI2 and L4S

NVIDIA GeForceNOW Cloud Gaming Real World results

- A household with lots of video streaming/activity while a game of Apex Legends (60 players battle royal) using the Nvidia GeForce now service. The ping times are between the gaming PC and the gaming server.
- First graph is a residential gateway WIFI Access Point without any advanced form of AQM. The second graph is the Nokia Beacon with PI2/L4S under traditional home network load. You are looking at a 30% improvement in the average latency, but more importantly the latency is very consistent with very little jitter above 100ms
- Some of the jitter spikes observed do not originate from the in-home network itself, but from the general internet and gaming service platform.



*Without AQM



*With PI2/L4S AQM

Demographics and spending habits....

The Fortnite generation









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Next-Generation Custom Tailored Broadband Service




Shifting from 'bandwidth' based packages to "a-la-carte" individualized broadband service

End-user Service Options (Monthly Fee)

	Symmetrical Gigabit	\$60
	SmartHome Security & IoT	\$50-80
	Managed Mesh WIFI (up to 3 AP)	\$10-20
	Firewall & Parental Controls	\$10
	Latency Optimization packages	\$10
	Cloud Storage (100GB)	\$10-20
	Elder Care (WIFI Sensing)	\$15
	Privacy & VPN service	\$5



Enterprise Services sold in a residential context

-  WIFI IoT Appliances Slice
-  WIFI Automotive Slice
-  Data Marketplace (anonymized data)
-  SDWAN
-  Metaverse Agent(s)
-  API Services
-  "Gaming" & Enterprise Network slices