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Assessing Broadband Experience Beyond Mbps.

An Australian Perspective

CANOPUS NETWORKS

Contents.

Executive Summary.

Billions of people globally are confined to their homes by the pandemic, relying on their broadband Internet for everything from work and education to entertainment and shopping. Amazingly, telecommunications networks globally have taken on the extra load without buckling. If there is so much spare capacity, it is worth asking why we still get poor experiences when we stream video, play online games, or teleconference? Indeed, why does the Telecoms industry perform so poorly in Net Promoter Scores (NPS), ranking below even Logistics and Banking?

Part of the problem is that we have been conditioned to focus solely on speed (aka Mbps). However, with broadband approaching 100 Mbps and beyond, speed is becoming an increasingly poor proxy for user experience, and other factors like latency, loss, and stability become more important. We need to accordingly evolve our thinking and put new regimes in place to measure user experience. Without this, investments will be misplaced, infrastructure will be tuned suboptimally, pricing will not reflect value, and users will be frustrated. With its $50B National Broadband Network (NBN), Australia can lead the way in meaningful broadband measurement.

Our Misguided Obsession with Speed.

Speed increases are now imperceptible: For decades, we have been conditioned to think of broadband in terms of Mbps. This made sense when we had dial-up Internet over which web pages took many seconds to load, and when DSL lines could only support poor video resolutions. But once broadband speeds approach and exceed 100 Mbps, users cease to perceive the higher speeds, as shown in Fig. 1.

Australians do not lack speed: In Australia, more than 75% of NBN services are at 50 Mbps or higher today, which is more than sufficient to support 4K video, cloud gaming, and virtual reality streams. We are not starved for speed — indeed Australian consumers have collectively bought 410 Tbps on their speed plans, while actual peak traffic tops out at 23 Tbps, implying that we use less than 6% of the speed we pay for! Our demand is in fact for more volume, due to increasing time spent online — the average Australian household consumed 355 GB per month in 2020 — a 59% jump from the year before. Our Internet usage now resembles a marathon runner gradually adding more and more miles to their training distances, rather than a sprinter reaching higher and higher top speeds.

Speed reporting has lost its meaning: Broadband measurement and reporting needs to adapt to the way broadband is being used and perceived. Current reporting regimes are focused on speed testing, as illustrated by Fig. 2 taken from the ACCC's Measuring Broadband Australia (MBA) program report from August 2021. There is little meaningful information here for consumers, beyond the fact that the speed gap between ISPs is very narrow, in fact lower than the measurement noise shown as error bars.

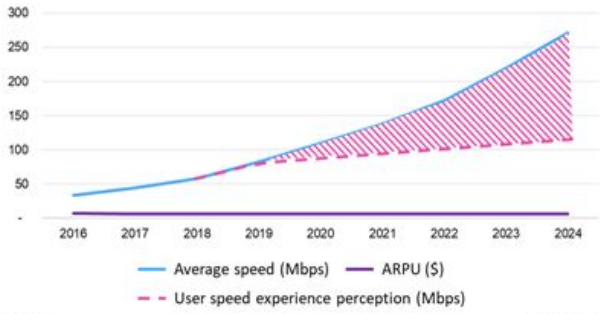

Fig. 1: Increasing speed has diminishing returns for users and generates little additional revenue for operators [Omdia 2020]

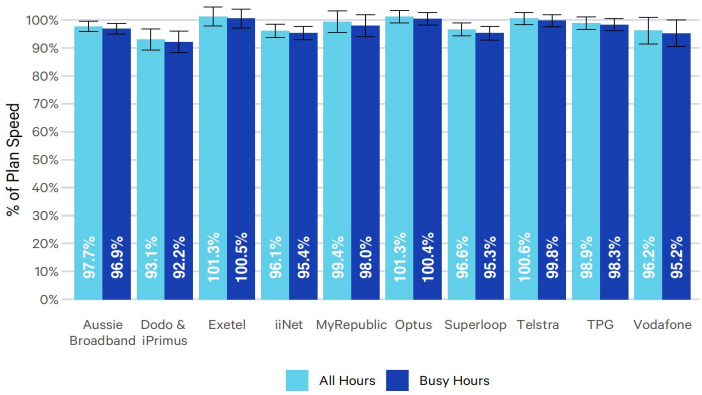

Fig. 2: Average download speed by ISP, taken from the ACCC MBA Report 14, Aug 2021.

- Speed tests are 10-second sprints which produce synthetic blasts of traffic, whereas most modern applications regulate their behaviour. Measuring the former does not say much about the latter.
- Speed results are susceptible to test conditions such as server distance, test duration, TCP variant & threads.
- Speed tests are intrusive on wireless broadband due to the heavy load they impose on expensive radio spectrum.
- Incentivising network operators to optimise their networks for speed test superiority (e.g. by tuning shaper buffers) increases jitter and degrades user experience on latency-sensitive applications (e.g. gaming, conferencing).

"Speed Tests are unrealistic, unsustainable and create perverse incentives"

— Vijay Sivaraman
CEO, CANOPUS Networks

Shifting the Focus to Application Experience.

Broadband measurement needs to *evolve* to become meaningful, accurate, and pervasive:

- ***Meaningful*** to the students attending online lessons over Zoom, Teams, or other platforms; to the fans streaming live sport; to the gamers participating in eSport tournaments; and to those working from home;
- ***Accurate*** so averaging does not smooth or wash out conference glitches, video spinning wheels, and gaming lag spikes that may be last only a few seconds or less but can ruin the user experience;
- ***Pervasive*** so it can scale nationally across all broadband services, rather than relying upon inferences from very small samples.

Measurement needs to be performed for popular applications in their *natural operating environment* instead of under synthetic conditions, and via *passive observation* making it risk-free to network operations and without imposing additional network load. Further, this has to be done with high accuracy, capturing *every sub-second degradation* in each stream, and at *national scale* in a very cost-effective manner. The measurement regime should be able to assess the experience for *every subscriber*. In what follows we illustrate how experience can be captured and depicted meaningfully for the major application categories including video streaming, gaming, and conferencing.

Video Streaming Experience.

A user streaming video, such as, Netflix, YouTube, Twitch, or Prime cares about two things:

1. Is my video playing at the best possible resolution for my device? E.g. SD, HD, HDX/4k
2. Will my viewing session be free of any 'video freezes' (spinning wheels)?

Fig. 3(a) illustrates how various ISPs can be compared in their ability to serve video at the highest possible resolution during busy hour. ISP3 is the highest serving 96.2%, and ISP5 the lowest serving 80.1% of streaming hours in the highest resolution. Fig. 3(b) shows how ISPs can be compared in video freeze events during busy hours. Again ISP3 is the best averaging 36.7 seconds of freeze per hour of streaming, and ISP5 is the worst at 68.0 seconds. These meaningful comparisons help users select the ISP to best suit their streaming needs.

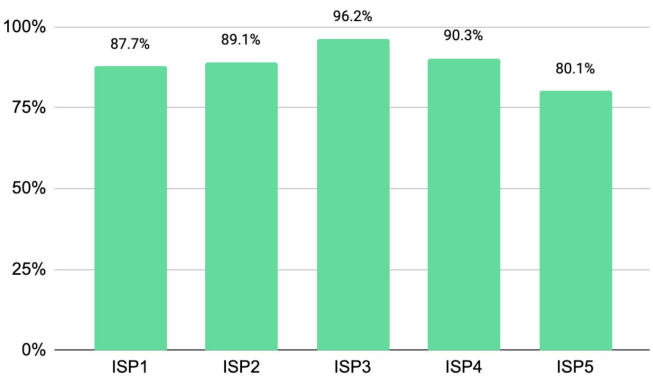

Fig. 3(a) Comparing ISPs by percentage of time delivering the maximum video streaming experience

Fig. 3(b) Compares ISPs in terms of the average number of seconds of freeze experienced per hour of video viewing.

Gaming Experience.

Most online games are latency sensitive -- speed is rarely an issue. A latency variation (also known as "lag spike" or "jitter") of a few tens of milliseconds in CS:GO, a shooting game, can lead to gunshots not taking effect, or "teleportation" in the game. Fig 4(a) shows how ISPs can be compared on 95 percentile jitter values for the CS:GO games played over their network. Fig. 4(b) shows how gaming experience across popular shooter games (CS:GO, Fortnite, CoD, Apex Legends) can be categorized as low, medium, or high, and compared across ISPs. Similar comparisons can be done for other genres such as sports, role-play, and strategy.

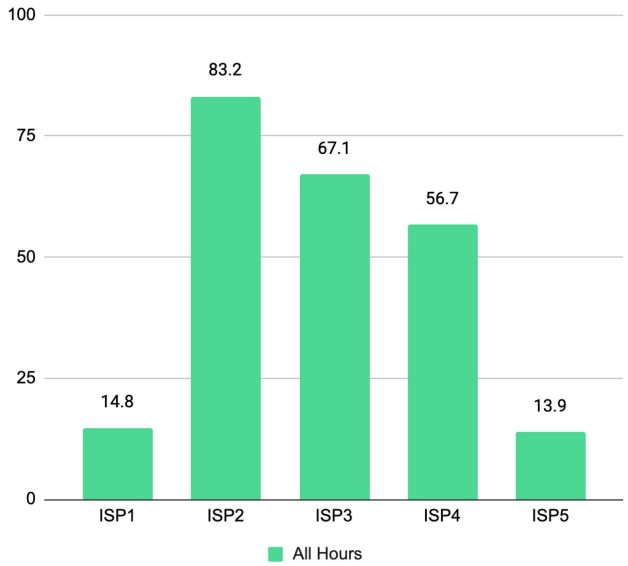

Fig. 4(a) ISP comparison of 95%-ile jitter (ms) for CS:GO shooter game. ISP5 offers the most stable latency (lowest jitter).

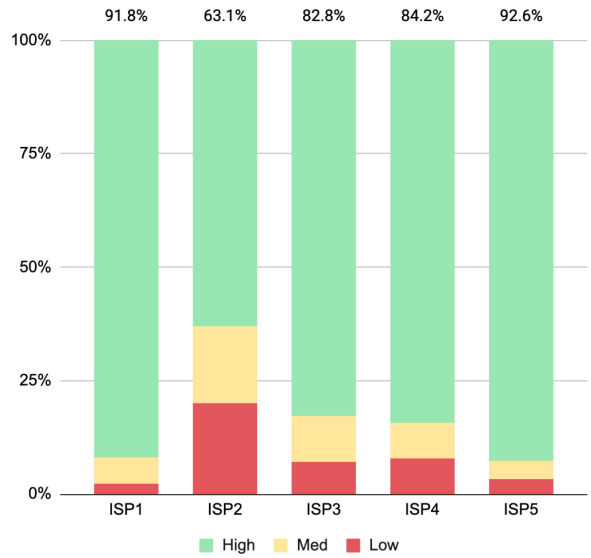

Fig. 4(b) Gamer experience for shooter genre games. ISP5 offers the highest percentage of time delivering "high" gaming experience.

Conferencing Experience.

A poor teleconferencing experience is often the result of 'stutters' in the audio and video. Measuring the 'stutters' per hour for the major conferencing platforms such as Zoom, Microsoft Teams, WebEx, Google Meet, WhatsApp, and Discord, can provide a meaningful indication of the conferencing user experience. Fig. 5(a) depicts the average stutters experienced per-hour of teleconferencing across the ISPs, while Fig. 5(b) shows how they compare in experience on Zoom categorised into high, medium, and low levels.

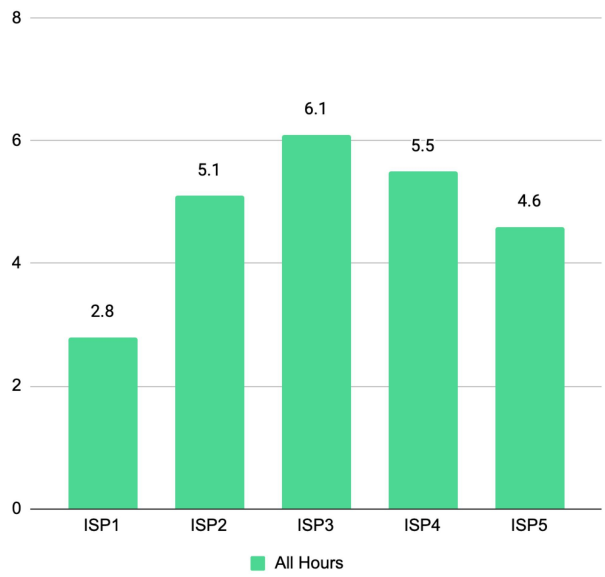

Fig. 5(a) Average conferencing stutters per hour

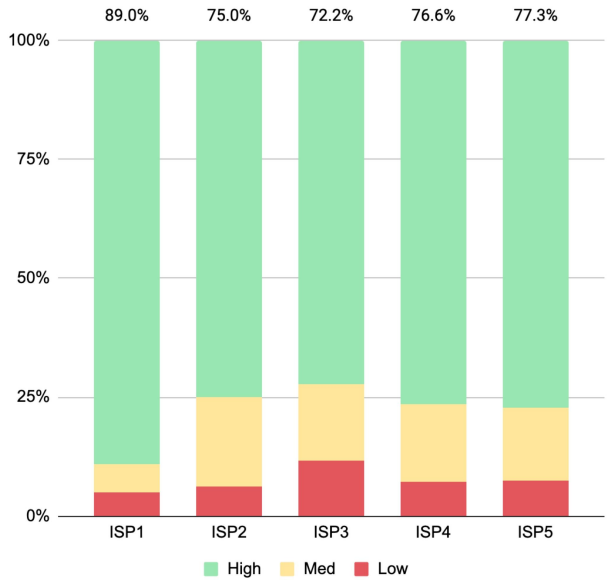

Fig. 5(b) Zoom user experience

Assessing Experience using FlowPulse™

Assessing user experience measures for specific applications, as illustrated in the previous section, is possible today by analysing network traffic using Programmable Networks and Artificial Intelligence technology. A typical Netflix video stream loads up the client playback buffer initially, and then fetches chunks periodically, as depicted in the "pulse" in Fig. 6. The height, width, and spacing of the chunks in the pulse are dependent on video resolution, client payback buffer health, and network conditions. Machine Learning on large volumes of such FlowPulse™ data under various conditions is used to train an AI model that correlates Netflix network behaviour with user experience (resolution and buffer health). The unique FlowPulse™ of every application, be it a Skype conferencing stream or an Xbox download (Fig. 6), allows AI engines to assess experience measures of relevance for a broad range of applications.

Canopus is an Australian company with deep skills in network traffic analysis to:

- Assess user experience on many popular applications via patented AI technology;
- Analyse encrypted traffic using FlowPulse™ behavioural models that do not look into packet contents;
- Scale to Terabits-per-second speeds using state-of-the-art hyper-scale Programmable Network switches;
- Support deployment in Tier-1 to Tier-3 Telco networks.

Fig. 6 Flow pulses of Netflix streaming, Skype conferencing and Xbox download .

Summary.

Australia's $50B+ NBN investment has given Australians an enviable high-speed broadband infrastructure, which will no doubt continue to evolve and co-exist with emerging 5G-based wireless access. Speed ceases to be a reliable measure of broadband performance, as it no longer correlates with user experience on streaming, gaming, and conferencing applications. New platforms are now available that use Programmable Networking and Artificial Intelligence technologies to measure user experience accurately and meaningfully at scale. Australia has an opportunity to leverage local skills in these technologies to lead the world in meaningful evaluation of broadband infrastructure. Australian ISPs will benefit from the deep insights into user experience information for every application, for every subscriber — not just aggregates. This will enable them to focus on what really matters to their subscribers — user experience — and compete accordingly, with the Australian consumer as the ultimate beneficiary.