Broadband Speed Claims

Submission to the ACCC

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1. Introduction

Sigma Solutions Pty Ltd and Telco One Pty Ltd have both enjoyed a long history in broadband quality of service monitoring and reporting.

Sigma Solutions previously developed a broadband quality of service monitoring application across four versions entitled the Line Speed Meter between 2001 and 2009. Version 4 of this product was highly successful and installed in over 80,000 installations across Australia and the world.

The information collected allowed users to compare RSP's quality of service at a national, state and postcode level. Statistics could be compared against various speed plans and connection technologies. The Line Speed Meter ran on the user's computer. It periodically performed a battery of quality of service tests providing invaluable information for both the user's own account and the RSP; including longitudinal information.

The Australian Communications and Media Authority (ACMA) realised the power of the Line Speed Meter's data and contracted Sigma Solutions and Telco One to report on many aspects of internet connectivity, including type of technology, geographic location, time of day and the customer's RSP. Due to the extremely large database, it was possible to cross-tabulate across these dimensions to identify the quality of the consumer's experience in specific situations.

At the completion of our final contact, Sigma Solutions was approached by a multinational company and the rights to the Line Speed Meter were sold. As part of the sale, Sigma Solutions was held to a lengthy non-compete clause which is now lapsed. Based on our previous experience in this field and the fact that insightful information into one's own internet connection is needed now more than ever; Sigma Solutions has developed a new application that embraces the latest technologies, visualisations, user engagement, remote support and quality of service testing.

Many of the issues raised in the discussion paper have been the source of great thought and research within Sigma Solutions. Through our experience we feel we have unique insights into many of the issues raised.

We are grateful for the opportunity to provide a submission to the ACCC on a topic that is critical to the development of high quality internet services in Australia.

2. Background

We acknowledge that there are eight broad issues that are flagged in the discussion paper. Several issues are targeted specifically at RSPs, their policies and technological capabilities.

Our submission will concentrate on issues 1,2 and 8, namely:

1. Network management and monitoring services delivered on NGNs
2. Presentation of speeds information to consumers
3. Mobile broadband speeds and representations

This submission also covers a number of issues not specifically mentioned in the discussion paper.

3. Importance of Measuring

You can't manage what you don't measure.

In our context, this old business adage could not be more appropriate. The discussion paper raises a number of questions similar to the following;

- How do users know if they are getting what they paid for?
- How do RSPs know they are delivering the service that they advertised?
- If a service is not sufficiently fast, how much is it missing by? Can this be used as the basis for compensation and if so, how much?
- How does the quality of service change during peak periods? When are the peak periods?
- Is a connection fast enough to handle SVOD? Can this be accurately determined before a user subscribes to a SVOD service?
- Has a service degraded or improved over time?
- Has the RSP suffered an outage? Or if there is an outage is the problem a local, state or national issue? Does it affect one particular RSP or a particular technology like HFC or a combination?
- Is there a problem within the RSP's network? How is this affecting the end user's quality of service?

In order to answer these questions an application is required that has features;

- Measures an array of quality of service metrics
- Empowers users to understand their own data.
- Provides RSPs with aggregated data on their performance
- Features a centralised intelligent "agent" to monitor data in real time to identify and report on outages and informing subscribed users of problems; possibly via Twitter or similar.
- Broad installation based

- Trusted
- Always on – periodic monitoring during network issues and periods that are issue-free.

The absence of such an application will render most efforts described in the discussion paper as unachievable or meaningless.

The presence of such an application will allow RSPs to responsibly and accurately advertise their services and the public will have confidence in this information. It will empower users with the information that they need to make informed decisions and give authorities the proof they need to ensure that RSP non-compliance is addressed.

In short, to achieve the objectives outlined in the discussion paper a nation-wide monitoring network is required.

4. Comparison of Quality of Service Testing Strategies

There are numerous quality of service testing applications on the market. SpeedTest.net, Akamai's backbone network monitoring and Netflix's speed test are but a few of the more popular ones.

The nature of these broadband monitoring technologies and their results need to put into context.

The Akamai results for Australia as reported in this recent Sydney Morning Herald article have the average Australian internet speed running at 8.2Mbps. However, a recent Netflix speed index report has the maximum streaming speed at 3.3Mbps (admittedly at peak times) for the fastest RSP with Telstra at 2.23Mbps. This data should be considered inflated when you consider that the Netflix dataset only includes people capable of getting Netflix; by definition it excludes all of those whose connection is not capable of streaming movies. Both of these monitoring techniques are server based and seemingly from reliable sources but both show significant speed differences.

The Akamai results are based on monitoring internet backbones. This data only includes data flowing through networks that Akamai are associated with. In addition, it will not feature quality of service metrics like ping, jitter, outages, DNS lookup times, etc.

The architecture of an application like SpeedTest.net would seem superior to that of the server technologies since it is better at revealing the user's end-of-the-wire quality of service experience. But Speedtest.net and many applications like it are also problematic since they are generally only used when there is a problem. It is rare for people to use SpeedTest.net when their connection is running reliably. Speedtest.net cannot be run periodically. Also to a large extent the Speedtest.net algorithms are closed source and not subject to external scrutiny. Also SpeedTest.net by default only tests against the user's RSP's servers. This is discussed in detail in the next section.

An application that is installed on a user's computer that runs periodically and centrally reports on a wide range of quality of service metrics is required.

5. Importance of open source algorithms

Any algorithm that is used must be open to scrutiny. The algorithm must be published and the source code open sourced. This will allow RSPs and the broader IT community to have confidence in the algorithm and understand its strengths and weaknesses. The exposure of the algorithms to public scrutiny will allow broad adoption of monitoring technologies and allow stakeholders to trust the results.

If the RSPs use the same algorithms, then RSPs could be readily compared against each other. The ill-defined terms of "quick", "fast", "high speed" could be supported by actual numbers.

To this end, Sigma Solutions has been inspired by the work the ACCC did on the Broadband Performance Monitoring and Reporting Program (BPMR). The proposed quality of service monitoring techniques described in this paper were of very high quality and wide ranging. The algorithms were well described. These algorithms could readily be used as the basis of an open source initiative.

RSPs could use these open source libraries to study their own network or third parties (like Sigma Solutions) could incorporate the libraries into larger testing ecosystems. This would allow legitimate comparison of data between RSPs.

However, it must be stressed that any government developed, supplied or sponsored network monitoring device or software package will fail to achieve any significant uptake. I understand that the following was in the context of BPMR pilot program but this architecture is always likely to represent a tiny proportion of the overall customer experience:

> *Volunteers installed a hardware probe on their home connection and the probe ran a series of network performance tests. The metrics selected for testing included download/upload speeds, web browsing time, latency, packet loss, video streaming, jitter and DNS resolution.*
>
> *https://www.accc.gov.au/regulated-infrastructure/communications/monitoring-reporting/broadband-performance-monitoring-reporting-program/pilot-program*

The public has a high level of concerns around security, privacy and government overreach – and for good reason.

6. The "Three Spheres of Concern"

People familiar with SpeedTest.net will know anecdotally that if one's internet connection is running slowly, SpeetTest.net may report relatively fast speeds. Why is this? It seems counterintuitive.

This will happen during peak periods where the backbones from the RSP to the wider internet are running at capacity. It is a clear demonstration of the RSP under investing in their own connectivity. RSPs will point to SpeedTest.net to demonstrate how fast they are but the day-to-day reality may not reflect this.

SpeedTest.net very clearly identifies the nearest server to the user. RSPs provide a multitude of SpeedTest.net configured servers throughout the countries in which they operate. This ensures that SpeedTest.net will inevitably find a server running a hop or two from the user's modem's gateway. SpeedTest.net is effectively measuring the speed of the "last mile" of copper wire (or HFC/fibre/etc).

The "last mile" is a vital part of the quality of service picture. The entire internet experience will be poor if the last mile is not operating correctly. However, it is unfortunate that the last mile has received so much attention in the speed testing landscape because this tends to understate the importance of other components of the internet environment.

In the past ADSL/cable connections were slow and the bandwidth requirements of our computers were relatively small. In 2016 with SVOD, multi-gigabyte operating system updates, and cloud backup of our phone's data, the speed of the last mile is less of an issue and the speed of the RSP's internet backbone to the wider internet is the area of focus. This is exacerbated during peak times.

This trend will continue as even higher bandwidth requirements are needed to support SVOD 4K UHD, virtual reality stereoscopic video steaming and next generation gaming consoles.

Speed testing needs to separate the internet into three zones or the "three spheres of concern".

Sphere of Concern #1 is the last mile. An algorithm similar to that of SpeedTest.net will readily solve this problem. This is where a server provided by the RSP that is only a hop or two away can readily saturate the connection to the end user.

Sphere of Concern #2 exercises the RSP's wider backbone connectivity. In order to test this a much more multi-threaded test is required where the user's computer runs multiple concurrent speed tests against multiple server's outside of the RSP's network but geospatially nearby.   When the RSP's backbone is running at capacity, this will result in a slower speed than the result of Sphere of Concern #1. If the backbone is not at capacity, then it will result in the same speed as Sphere of Concern #1.

Sphere of Concern #3 considers the connectivity of the user's country with that of other countries. This data can be used by national governments to identify when the transcontinental connectivity is lacking and how that is affecting the country's citizens and businesses. The impact that this is having on the economy can also be calculated. Sphere of Concern #3 is particularly relevant to Australasia and the Pacific countries where intercontinental connectivity can be problematic.

7. Raw Speed, Peak Speed and Organic Speed

As an aside to addressing the discussion paper directly, the raw speed associated with a SpeedTest.net-like results only tells part of the story.

The peak speed is also of interest. This is the maximum speed physically capable of being handled by the connectivity technology. It may only last for a second or two. A historical analysis of the peak speed may reveal congestion on the shared HFC cable or the effects of weather (like heavy rain) on the ADSL connections (as the pits fill with water).

Finally, the "organic" speed helps the user understand the moment-by-moment demands being placed on their internet connection. The multitude of applications running on a computer can all affect a user's internet experience.

8. Other Quality of Service Monitoring Considerations

The speed is the headline feature of any internet connection but it can be readily undermined when any number of other metrics perform poorly.

Poor ping times, dropped packets and jitter time are indicative of any number of problems either with the user's local network or router, the last mile, the RSP's network or some wider problem with the internet. When the ping times are poor, it is important to identify where the problem lies. This will pinpoint the problem and the responsible party can be contacted. Fortunately, this can be readily achieved through the nature of the ICMP protocol.

A higher level of abstraction includes SVOD testing. This type of test will exercise RSP's bandwidth throttling technology. Sigma Solution's previous product, the Line Speed Meter revealed a comical situation with Telstra's satellite technologies where the users had opted for a slower plan. A user would request a large internet resource, which would be initially downloaded at a great rate. The throttling algorithm would then kick in as it realised that the satellite had 'squirted' a large amount of data at the user. It was then waiting artificially so that the average internet speed would not exceed the plan's advertised rate. Then it would start sending data again and then again be held up.

Sigma Solutions was often contacted by frustrated users complaining that half the web page would load really fast, then it would stop and then the second half would finish loading seconds later.

An often overlooked quality of service metric is the DNS lookup time. A DNS server is generally provided by the RSP. When it is running poorly, a user may visit a web page and experience a long wait before any data is displayed. Then the page appears almost instantly. From our experience with the Line Speed Meter, this would happen on Sunday nights as the RSP's DNS servers were running at capacity.

9. Remote Support and Management

It's very difficult to remotely diagnose a computer with a poor internet connection since the supporting tools generally require vast amounts of bandwidth. These tools effectively interfere with the thing that they are trying to monitor. A tool is required in which a person can request help from another. The "helper" can then see the user's real-time internet quality of service but only consume a trivial amount of bandwidth.

We see this as being an invaluable tool for both RSPs supporting users and user-to-user support. RSP's diagnostic ability appears to be little more than "turn it off and turn it back on again" and running a rudimentary spectrum analysis on the phone line. A SpeedTest.net test may also be run which is subject to the problems previously described. Given this fails then a technician will be sent out on Wednesday week. The RSP's have little mechanism to understand the true nature of the user's actual quality of service experience.

Remote monitoring and support should be a critical feature any quality of service testing software.

10. Visualisation and User Engagement

The public's general knowledge of internet connectivity, IP, routing, etc in 2016 is remarkably high even if they don't know that they know. People generally understand the basics of switched packet networks, IP routing, hubs, switches and routers, internet connection technologies and their relative advantages and disadvantages, bandwidth and how much a gigabyte is.

Many of these topics were staples in my Information Technology degree in the 1990s and were entirely foreign concepts. Today this is the lingua franca of the youth.

However, the popular testing tools boil down quality of service to just two numbers; the upload speed and download speed.

The less popular testing tools are a full network analysis software package where the end user needs a degree of network engineering to understand the results. One of the most popular tools is advertised as being "designed for network administrators by network administrators". We see that there is a middle ground where the intricacies of internet working can be provided in an engaging and tactile experience for people who have broad ranging understanding of the basics of internetworking.

Data should to be provided in an understandable and compelling format. Users will then be more inclined to familiarise themselves with the nature of their connection and be in a position to make informed choices.

11. Longitudinal Analysis

Speed testing tools traditionally only provide rudimentary longitudinal analysis of the internet connection; or more commonly none whatsoever.

The ability to provide for a longitudinal analysis is crucial if there is to be a concept of compensation of poorly performing connectively. Also, the effect of network upgrades can only be measured if the speed before and after the change is known.

12. Past and Future Broadband Trends and Conundrums

The wireless spectrum is a desperately precious resource. But we find ourselves living in a world where fixed line services are often so poor that many users and companies see public wireless technologies (4G) as the best mechanism to support the heavy data lifting. It is like getting take away coffee in a disposable gold cups – yet we now take this for granted.

Another problem that we now dismiss as being common place is that ADSL connectivity is often slow yet Telstra Air connections are remarkably fast. My personal ADSL connection cannot exceed 6Mbps yet the nearby Wi-Fi provided by the pink Telstra Air box on top of the public telephone runs at about 40Mbps in both directions. Why can that technology be available to my house and how is it that a public telephone has access to such a large amount of bandwidth?

Here is the experience of one user of internet technology. He has lived in his house for 12 years. In that time his computer's speed has increased 20 fold, his hard drive capacity has increased 100 fold and its speed has increased 10 fold. During this same period, his internet connection has actually slowed. He lives 6km from the CBD of a major metropolitan city in Australia. The NBN construction was due to begin in H1 2016. To date nothing has happened and when but the NBN web site indicates that the rollout has not started in the area. Most everyone in Australia will share a similar story.

Imagine a virtual reality, real-time version of YouTube, where a stereoscopic, omnidirectional, high definition camera is placed on the head of someone on a great experience; canoeing down the Colorado River through the Grand Canyon, performing maintenance on the exterior of the International Space Station or even mounted on a robot visiting the Marianas Trench or exploring a volcano. Such an application will be available in only a few years. For this to work, each of the two 'cameras' will require 12 high definition video feeds that required about 5 Mbps each. So 2 x 12 x 5Mbps = 120Mbps. (https://help.netflix.com/en/node/306) If two people in the household wish to do something similar then it is not a stretch to think that 300MBps to 500Mpbs should be a standard connection speed in the not too distant future.

The discussion paper refers to Next Generation Networks as being in excess of 25 Mbps. Although this is appropriate for H2 of 2016, it is apparent that many consumers will soon be seeking speeds well in excess of 250 Mbps.

13. Regional and Remote Australia

The Discussion Paper does not refer to the different internet performances experienced by consumers in Rural and Regional Australia.

Contrary to some views that that 25 Mbps would be "good enough" for regional and remote users (http://www.zdnet.com/article/25mbps-nbn-is-good-enough-barnaby-joyce/), this notion may serve to perpetuate the "digital divide".

On example is an apple processing business based in Stanthorpe, Queensland. This particular operation uses apple grading machines that are internet connected, connect to a complex entire supply chain is internet connected and utilise land management software that is also internet connected. Their existing internet performance is not sufficient.

It could be argued that the bandwidth requirements of regional and rural Australia equal or exceed that of urban Australia.

The outcomes of the ACCC's discussion paper could well be applied equally to regional and remote users to that of urban Australia.

The earlier work undertaken for ACMA could distinguish between the internet performance in rural and urban areas.

14. Conclusion

Without a quality of service measuring infrastructure in place many of the points in the ACCC discussion paper will not result in meaningful outcomes. Preferably the testing algorithms needs to be open-source to allow for analysis and study and to allow RSPs to incorporate them into their own monitoring toolset.

The testing infrastructure needs to include at least Spheres 1 and 2 of the 3 Spheres of Concern. We need to consider the last mile (Sphere 1) as being a necessary, but not sufficient, test of quality of service. The testing needs to include other metrics including ping times, packet loss and jitter. The same testing algorithms should be applied for all RSPs so that a direct comparison between them is possible. The testing needs to include historical data so as to provide a longitudinal analysis.

At the request of the ACCC, Sigma Solutions and Telco One are able to provide further information about the methodology for better internet performance testing.