Pacbyte Software Pty Ltd (PacSoft) netPump™ Product Claims, Demonstrated and Evaluated by accessUTS

Authors *Professor Robin Braun and Pakawat Pupatwibul Ph.D.*

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Introduction

PacSoft's network optimisation technology, netPump™, is a method for transmitting and receiving a data file to a remote device over a network. It comprises modifying the data files for served data, and an application to receive the data at the remote client device. More particularly but not exclusively, it relates to methods for streaming audio and video data files.

Delivery of video online has created a phenomenon in demand upon network infrastructure, and performance demands by the consumer. The volumes and size of data being delivered is growing exponentially, as more and more users demand premium HD and Ultra HD content, or a more robust delivery to mobile devices while on the move. It is widely acknowledged that globally, many subscribers connect at speeds that are likely to be subjected to a diminished quality of services during peak hour network congestion, or that have less capacity for multiple devices to stream video or access other internet services from a single connection. Also, mobile and WiFi connections are even more susceptible to drops in available bandwidth – not just during peak congestion periods - due to the variables of a changing location and the limits of wireless technology. Due to the file size and real time requirement of streaming video online, performance enhancements are of particular interest, as impaired network conditions have a direct impact on a business's ability to deliver a consistent, commercial quality viewing experience. Additionally, as user demand grows, network operators continue to seek new technologies that can defer capital expenditure, and maximise the capacity of existing infrastructure.

Key Findings and Conclusions

In summary, the Findings of each Test confirmed the PacSoft claims. Fundamentally, the Findings indicate that netPump™ technology accelerates the performance of the network, and increases the available capacity by accessing levels of the network that remain underutilised without it. The Findings indicate in a number of tests that netPump™ was able to access network bandwidth that was simply not available to the software comparisons, or the testing devices. The benefits derived from an increase in performance are identified in each of the Tests. At the most basic level, the Tests show a materially faster file transfer to a client device than through file transfer methods under native TCP/IP or FTP (internet) protocols. These were further supported by reductions in overall network traffic during the duration of video streaming and/or file transfer.

netPump™ performance claims	Conclusion
Up to 300% increase in efficiency and up to 75% tolerance to drops in bandwidth when compared to streamed video bit rate	Confirmed (Tests 1 to 3)
Over 50% reduction in CPU usage	Confirmed (Test 4)
Moves 10% to 60% more data per second	Confirmed (Test 5 and 6)
Superior performance in context of fairness measures	Confirmed (Test 7)
Improves the quality of the viewing experience at a lower connection threshold	Confirmed (Test 8)

This paper analyses the performance netPump™ to verify PacSoft's product claims in terms of efficiency, data per second, bandwidth, CPU utilisation, and network traffic.

1. Test Bed Description

The primary target of this report is to provide a side by side performance comparison between a netPump™ video delivery with other methods of conventional and premium Over the Top ('**OTT**') video delivery methods, and data delivery methods using internet protocols (TCP/IP and FTP).

Test bed components

The comparative test bed setups included a laptop with AMD® A6-5200 APU with Radeon ™ HD Graphics @2.00 GHz 8 GB of RAM under a 64bit operating system on Windows 10 Home Edition ('**Windows PC**') and an Apple MacBook Pro 2.3GHz Intel Core i7 with 4GB of memory on Mac OS 10.8.6 ('**MacBook Pro**'). Most tests accessed the internet via a Vodafone WiFi 4G R216 ('**Vodafone WiFi**') which can produce a theoretical maximum connection speed of up to 29.45 Mbps. Other tests accessed the internet via a shared hotspot sourced from an iPhone 6S, with a theoretical maximum of well above 100 Mbps however was much slower, due to the location of the laboratory and local network conditions. On the Windows PC, the netPump™ application ran via Firefox web browser with a VLC video player plugin.

The netPump™ applications used in these tests were each demonstration platforms, not versions intended for commercial release, so fast forward and rewind functions were disabled as well as other restrictions. These applications also required manual installation, setting up of the required video player and disabling security features. However, the netPump™ application tested on the Windows PC did provide access to configuration optimisation settings such as the 'Speed' (number of threads), 'Wait' (number of segments held in buffer) and 'Buffer' (size of buffer in megabytes – MB). Unless otherwise stated, the Windows PCs running netPump™ ran the default settings for these parameters, which were Speed = 2 threads, Wait = 10 segments and Buffer = 40 MBs.

The Windows PCs that were tested using netPump™ were configured to stream video content at a Fixed Bit Rate ('**FBR**'), of 2.5 Mbps, 5 Mbps or 8 Mbps.

Other test setups included Samsung Galaxy Tab 4s running Android 4.4.2 and 5.0.2 ('**Android Tablets**'), which also used the netPump™ demonstration platform – requiring manual installation and setup of the third party video players – MX Player and VLC. The Android Tablets were each able to be configured for an Adaptive Bit Rate ('**ABR**') delivery, which allowed netPump™ to switch automatically between video streams of 500 Kbps, 1 Mbps, 2 Mbps, 4 Mbps and 6 Mbps, while delivering a 720p resolution. The bit rate of the video being accessed was easily identified by the visual watermark burnt into each of the separate video streams. The resolution of the videos streamed from YouTube was verified simply by monitoring the resolution display included in the YouTube settings menu.

Measure of performance

The connection speeds used for this paper were determined by instruction to replicate the 'real world' conditions experienced on an average domestic connection. In this regard, consideration was given to Akamai's '*State of the Internet*' report for Q4 2015, where it stated that the global average connection speed was 5.6 Mbps.

The performance of a typical domestic link with a connection line speed of approximately 25 Mbps, will typically be reduced by physical impediments, distance from exchange, and user environments. These conditions often result in a reliable, actual download speed as low as 8 to 12 Mbps. Additionally, WiFi and connected mobile devices are even more susceptible to performance loss in download speeds and bandwidth variations.

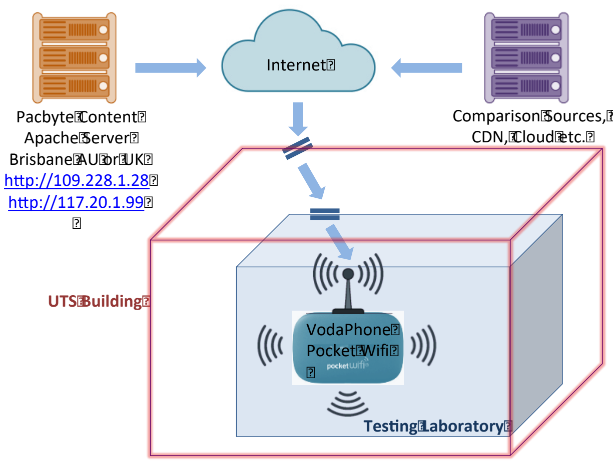
To assist replicating average domestic conditions, testing was conducted in a laboratory where the internal walls and building structure would impair the connection of the Vodafone WiFi. Further choking on the connection was then achieved by simply running multiple instances of video streams from the same Vodafone WiFi. This method of choking was used as it provides the most realistic network conditions and characters.

It is important to note that it is not an effective way to replicate a typical heavily congested domestic connection by 'artificially shaping' or 'software choking' a high speed connection down to lower bit rates. An example of these techniques is shaping a data flow from a line connection speed of say, 8 Mbps down to 2 Mbps. These techniques may significantly reduce the normal fluctuations and peaks that characterise realistic network conditions, as well as deliver a flat line connection which reduces averages over a period of time. The higher the ratio of the original connection speed to the artificially choked output speed, the greater the likelihood of removing those naturally occurring fluctuations and peaks.

Australian server testing

Before commencing the tests, a test was performed to measure the speed of the connection. The indicated actual download speed during delivering video from the Australian servers, was around 6.75 Mbps. Latency tests were also performed by pinging the server 5 times, the average value showed the server's latency in milliseconds (Minimum = 82ms, Maximum = 110ms, Average = 93ms). The topology of the test bed setup can be seen in Figure 1.

Figure 1



UK server testing

To test netPump™ performance under extreme latency and congestion conditions, further testing was undertaken using content sourced from a server in Gloucester, United Kingdom. To increase the effect of latency and congestion, the UK tests were conducted at 10.30pm Sydney local time (12.30pm UK time) on March 29th, 2016. The tests were repeated for two hours to ensure that the UK link was accessed during the hours of heavier internet use. To allow the unit to access a higher feed, the Vodafone WiFi was also relocated to a space outside of the laboratory however, still within the UTS building.

The speed tests were run 5 times to take the average rate as the result. The average Line speed at that time was 18.08 Mbps, whereas the average Download speed was 5.75 Mbps. The latency induced by the geographical distance was determined by pinging the UK source server 10 times to get the average value as the result: Minimum = 423ms, Maximum = 430ms, Average = 427ms.

The tests carried out using the UK links, accessed the 5 minute / 303.2 MB version of PacSoft's '*Aerial Boundaries*' video.

Wireshark was the network analyser tool used to record and measure the results. However, Wireshark was disabled during testing of the actual CPU utilisation.

2. Test Methodology

Based on the Test Bed referred to above, the tests conducted accessed a real productive network using either the Vodafone WiFi or Apple iPhone 6S. As described in Section 1, the mobile connection was impaired by the physical location of the laboratory.

netPump™M instances used PacSoft's demo video titled "Aerial Boundaries". This content was transcoded from a 1080p25 Apple ProRes (HQ) 82 GB Master, and provided in the variants at the bit rates noted in each test ('*Bit rate*' Mbps). Verification of the bit rates of PacSoft's demo video were easily verified using WireShark or simply accessing the Tools/Properties menu in the device's video player controls. Where side by side comparisons were required between netPump™ and online video content providers, an equivalent or higher bit rate of Aerial Boundaries was used to ensure a like for like comparison of the data being transmitted.

On any connected device, there is inevitably a level of background activity that occurs on a network connection even when no specific download or upload activity is being undertaken by the user – referred to as background activity. Testing measurements sought to adjust for background activity when comparing total network traffic activity. Connection speeds were measured using www.speedtest.net, www.testmy.net or www.ozspeedtest.com as an indication of connection speed at the subject client device.

Note that three or more deliveries for each test were setup to account for inevitable variations in link performance, then the finding of each delivery time and relevant measurements for each test was recorded.

3. Verifications

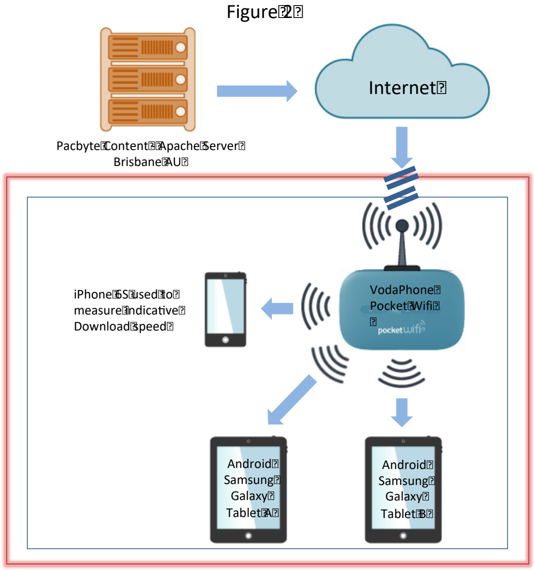
The PacSoft claims about netPump™ to be verified per the scope of work are itemised below, each with relevant comments set out in the evaluation notes. Where required, a number of different tests were used to determine whether the performance and findings were consistent.

Test 1: Up to 300% increase in efficiency, and up to 75% tolerance to drops in bandwidth when compared to the streamed video bit rate

Connection: Vodafone WiFi

Speed: Variable from 500 Kbps to 4 Mbps
Devices: 2 x Samsung Tablets – '*Galaxy Tab4*'
Source: PacSoft AU server

Figure 2



Abstract

As shown in Figure 2, two instances of netPump™ video deliveries were started simultaneously on two Android Tablets. In order to ensure that both Tablets were subject to the same network conditions, both sourced the internet connection from the Vodafone WiFi. Performance was evaluated by monitoring the video feed for any buffering, jitter, stutter or drop out effects in the content, and noting any change in resolutions from the visual indicators.

Observations

The connection was significantly impaired before loading by the building structure and internal location of the testing lab, and was measured at 7.39 Mbps. The actual download speeds during testing were erratic. These were measured at intervals using an iPhone connected to the same WiFi, and returned between 500 Kbps and 4 Mbps. During the tests netPump™ delivered a robust and stable video stream to the two Android Tablets; Tablet (A) delivering an FBR of 5 Mbps and Tablet (B) set to an ABR delivery, which varied between 1 Mbps to 4 Mbps. These 2 threaded netPump™ applications started playing after 6 seconds with PacSoft content. At times the connection dropped to speeds as low as 500 Kbps however, netPump™ was able to deliver a minimum combined video stream of between 6 Mbps.

Findings

During video streaming, netPump™ was able to deliver in excess of three times the video bit rate compared to the minimum indicated download speed, supporting PacSoft's claim of increasing network efficiency during video streaming by up to 300%.

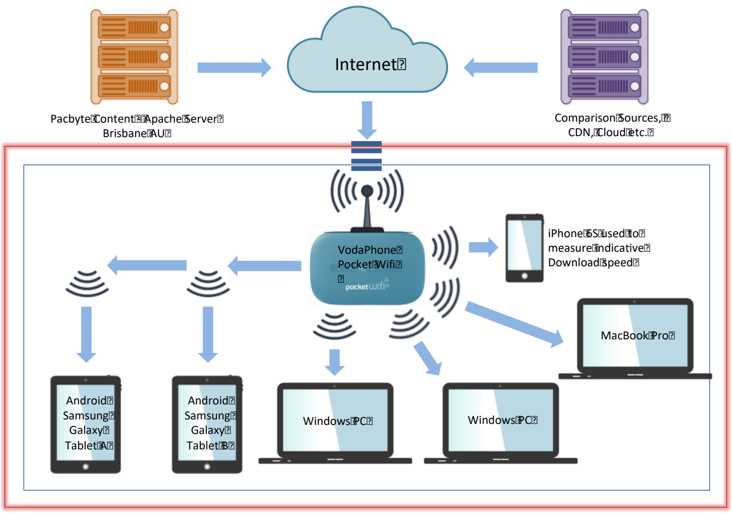
When download speeds dropped to as low as 500 Kbps, netPump™ was able to deliver a robust video stream at a minimum average rate of 6 Mbps. This finding confirms PacSoft's claim that netPump™ can tolerate drops in bandwidth well in excess of 75%, when compared to the bit rate of the video being streamed.

Test 2: Up to 300% increase in efficiency and up to 75% tolerance to drops in bandwidth when compared to the streamed video bit rate

Connection: Vodafone WiFi

Speed: 3 Mbps to 7 Mbps
Devices: 2 x Android Tablets
2 x Windows PCs
1 x MacBook Pro
Source: PacSoft AU server,
CDN

Figure 3



Abstract

The setup illustrated in Figure 3 was used to test how multiple instances of netPump™ performed under heavier network loads, while streaming YouTube and Netflix simultaneously. Streaming multiple videos from the same connection simultaneously ensured that all devices were subject to exactly the same network conditions of the Vodafone WiFi. The netPump™ instances were configured for a FBR of8 Mbps delivery on the Windows PC, a FBR at 2.5 Mbps delivery on the Tablet A, and an ABR delivery on Tablet B, while starting Netflix on the MacBook Pro and YouTube on the second Windows PC simultaneously. Performance was assessed by monitoring the video feed for any buffering, stutter or drop outs, and noting changes to resolutions by the visual indicators.

Observations

While the connection speed varied between 3 Mbps and 7 Mbps, netPump™™ deliveries each started as quickly after around 20 seconds, and in some instances sooner than Netflix, which began after around 30 seconds. The MacBook Pro displayed when Netflix switched between SD and HD streams in the scroll bar of the video window. Netflix could not maintain a constant HD stream and frequently reverted to an SD stream. YouTube at 720p also buffered and stuttered, while the netPump™ instances ran stably at the same time, collectively streaming content at a minimum rate of 11.5 Mbps.

Findings

Under heavier network loads and during video streaming, netPump™ was able to deliver up to three times the video bit rate compared to the indicated download speed, supporting PacSoft's claim of increasing network efficiency during video streaming by up to 300%.

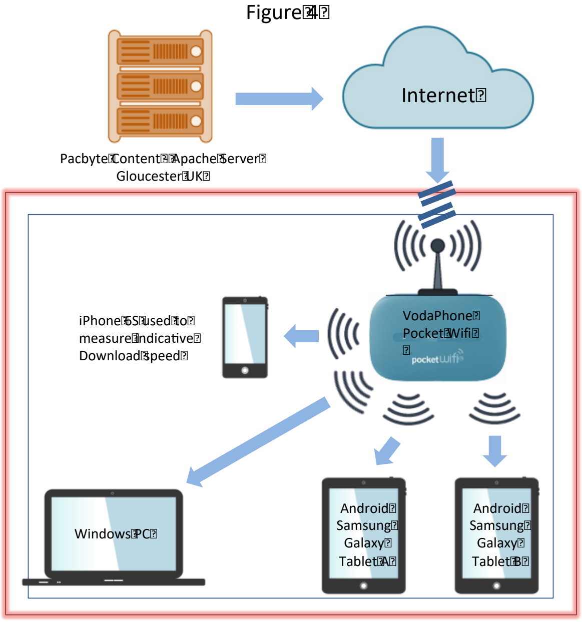
Further, netPump™ was able to deliver a robust video stream at a minimum average rate of 11.5 Mbps, even when download speeds dropped to as low as 3 Mbps. This finding confirms PacSoft's claim that netPump™ can tolerate drops in bandwidth well in excess of 75%, when compared to the bit rate of the video being streamed.

Test 3: Up to 300% increase in efficiency and up to 75% tolerance to drops in bandwidth when compared to the streamed video bit rate

Connection: Vodafone WiFi

Speed: 5.25 Mbps to 6.75 Mbps
Devices: 1 x Android Tablet
1 x Windows PC
Source: PacSoft UK server

Figure 4



Abstract

Further tests were conducted using the set up shown in Figure 4. These tests connected to the PacSoft UK server during UK peak hours to stream the PacSoft video. netPump™ was configured for FBR deliveries of 5 Mbps and 8 Mbps on Tablet B and a Windows PC respectively, while running YouTube simultaneously at 720p on the Android Tablet A.

Observations

Even during heavily loaded bandwidth utilisation, the different instances of netPump™ were still able to stream smoothly at their respective FBRs of 5 and 8 Mbps, while YouTube sometimes automatically reconfigured its quality from 720p (approximately 4 Mbps) down to 480p and 360p.

Findings

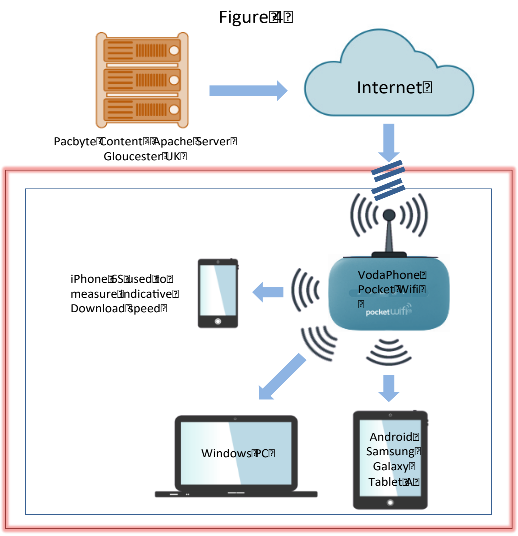
netPump™ was able to deliver a robust stream totaling a combined minimum average bit rate of 16 Mbps of video content, including the additional instance of YouTube. The findings confirm that netPump™ was able to enable a maximum delivery up to three times the combined video bit rates, compared to the indicated download speed, supporting PacSoft's claim of increasing network efficiency during video streaming by up to 300%.

Further, netPump™ was able to deliver a robust video stream at a minimum average rate of 13 Mbps on a connection that was shared with a YouTube delivery of between 720p and 360p, while the download speed dropped to as low as 5.25 Mbps. This finding confirms PacSoft's claim that netPump™ can tolerate drops in bandwidth well in excess of 75%, when compared to the total available download speed.

Test 4: Over 50% reduction in CPU usage

Components: **As per Figure 4**

Connection: Vodafone WiFi
Speed: 5.25 Mbps to 6.75 Mbps
Devices: 1 x Android Tablet
1 x Windows PC
Source: PacSoft UK server - Gloucester



Abstract

Using the setup shown in Figure 4, further testing was carried out to compare the CPU usage of netPump™ with VLC, on a Windows PC. PacSoft's demo video was streamed from the UK server during UK business hours, while other computer functions and WireShark on the Windows PC were disabled to minimise the effect of background activity that would impact on comparative measurements. The CPU Monitor of the Windows operating system was used to track and capture the CPU usage for the period indicated.

Observations

While streaming video using the UK links during peak hours, the CPU utilisation by netPump™ was relatively stable at around 3 to 6% (see Figure 5), while the VLC player consumes CPU capacity of between 10% - 20%, with a larger number of longer duration peaks of up to in excess of 30%. Both methods utilised VLC under the Firefox browser to ensure a like for like comparison. Figure 6 shows some peaks and lows as a result of the high buffering and wait time of VLC.

Figure 5: *netPump™ CPU Utilisation*

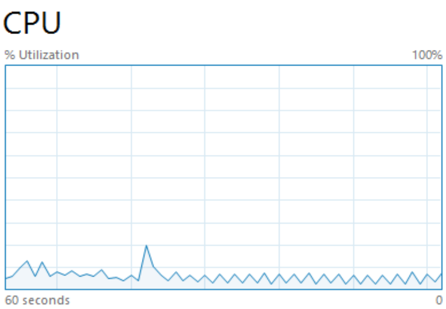
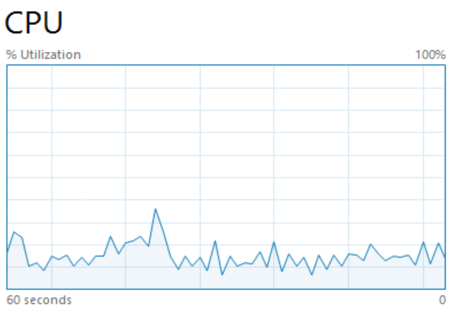


Figure 6: *VLC Player CPU Utilisation*

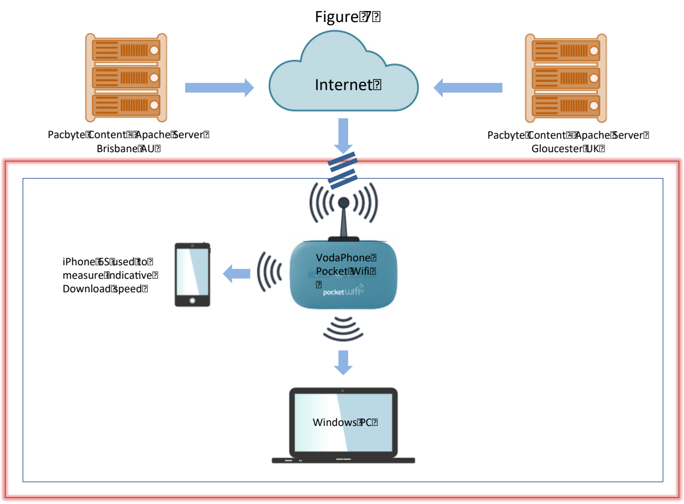


Findings

netPump™ used 50% or less of the Windows PC CPU's capacity than was required by VLC to deliver the same video streaming content on the same link.

Test 5: Moves 10% to 60% more data per second

Connection: Vodafone WiFi
Speed: 5.25 Mbps to 6.75 Mbps
Devices: 1 x Windows PC
Sources: PacSoft AU & UK servers



Abstract

As shown in Figure 7, a number of tests were run to verify PacSoft's claim of netPump™ moving 10% to 60% more data per second. This test sought to compare the network efficiency and use of resources of each method. The same source file was used to ensure that the *total* network traffic (the file size at completion of delivery) was identical, regardless of delivery method. The time taken and the access to network resources to deliver the same file were measured. Tests using the UK server were carried out late at night in Sydney, and AU testing was done during local business hours, to ensure that normal traffic conditions for each location would be recorded. The download speed was measured at around 5.25 Mbps – 6.75 Mbps.

Further comparisons were made between netPump™ at its default Speed, Wait and Buffer settings, and the adjusted settings for an "Accelerated" netPump™* delivery. The adjusted settings are indicated in the Tables.

Observations

The results in Table 1 show the time netPump™ took to deliver the 303.2 MB file in comparison to the FTP, TCP and VLC direct streams. The netPump deliveries were much faster than the conventional VLC video delivery and indeed, faster than a direct download by both FTP and TCP/IP.

The VLC player was more than two times slower than the netPump™ accelerated delivery to download a 5.00 minute duration file. Direct downloads via FTP and TCP were almost as slow.

TABLE 1: UK Link-Tested during UK peak hours, 5:00 minutes duration, 303.2 MB in size		
Content Source: PacSoft AB_8 Mbps	Buffer (Min:Sec)	Complete Download (Min:Sec)
FTP	-	13:25
TCP	-	12:33
VLC	0:15	14:09
netPump™ Standard	0:39	6:20
netPump™ – Accelerated Settings (Threads = 6 Wait = 40 Buffer=100)	1:03	5:16

Other tests were performed connecting to the Brisbane server to deliver the same 300 second version of Aerial Boundaries. The results in Table 2 shows similar performances as the UK links where netPump™ deliveries are faster than other straight downloads.

TABLE 2: Brisbane (AU) Link-Tested during Sydney peak hours, 5:00 min. duration, 303.2 MB in size		
Content Source: PacSoft AB_8 Mbps	Buffer (Min:Sec)	Complete Download (Min:Sec)
FTP	-	10:22
TCP	-	9:46
VLC	0:15	10:55
netPump™ Standard	0:39	5:21
netPump™ – Accelerated Settings (Threads = 6 Wait = 40 Buffer=100)	1:03	5:11

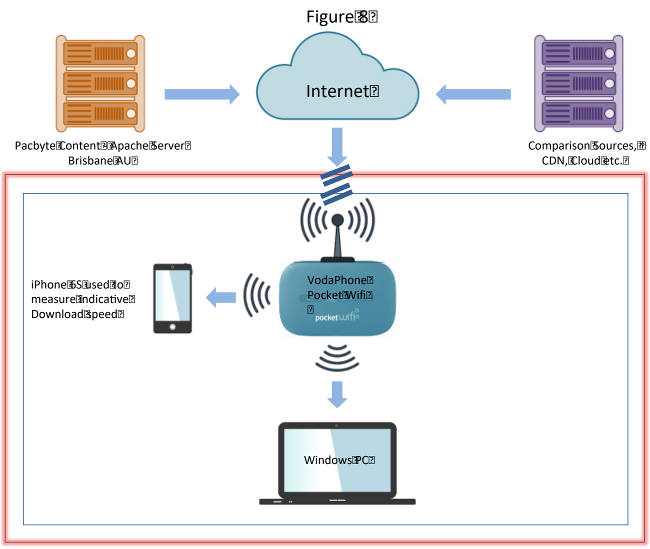
The tests connecting to the Brisbane server took less time to complete each video movie file download than the UK server, due to the greater geographical distance and higher latency of the UK server.

Findings

The Complete Download times shown in Tables 1 and 2 confirm the findings that netPump™ increased the efficiency of the network by a minimum of 44.92% and a maximum of 63.37%, resulting in an accelerated delivery of the source file in considerably less time.

Test 6: Moves 10% to 60% more data per second

Connection: Vodafone WiFi
Speed: 5.25 Mbps to 6.75 Mbps
Devices: 1 x Windows PC
Sources: PacSoft AU server, CDN



Abstract

The set up shown in Figure 8 was used to compare the amount of data and the network traffic generated among a number of different deliveries. The methodology used was to terminate the connections of each of the Netflix, VLC and netPump™ deliveries at 5 minutes, and examine the WireShark captures.

Observations

The below graphs summarise the Wireshark findings for Netflix, iTunes, straight VLC and TCP transfers via the Brisbane links. Reduced access to network resources was observed while using netPump™.

Figure 9 shows the extracted WireShark grabs of the network traffic generated by netPump™ - PacSoft_AU_8Mpbs_300s (Accelerated settings)

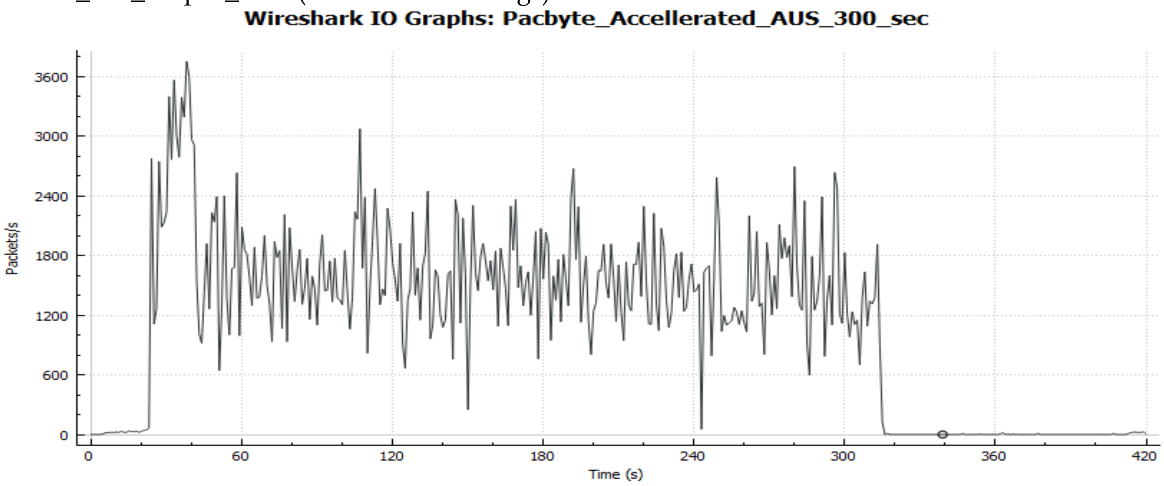


Figure 10 shows the extracted Wireshark grabs of the network traffic generated by conventional streaming on VLC.

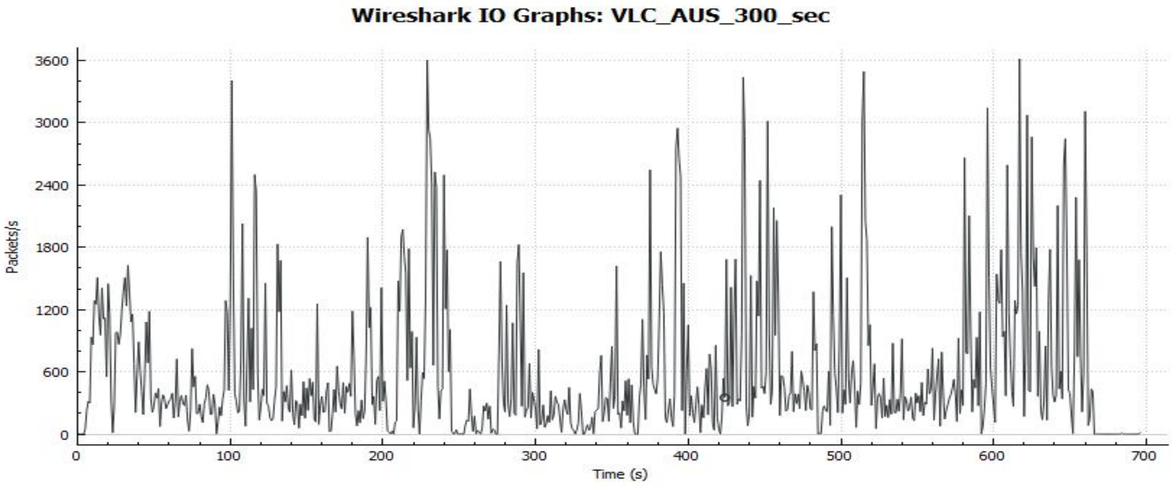
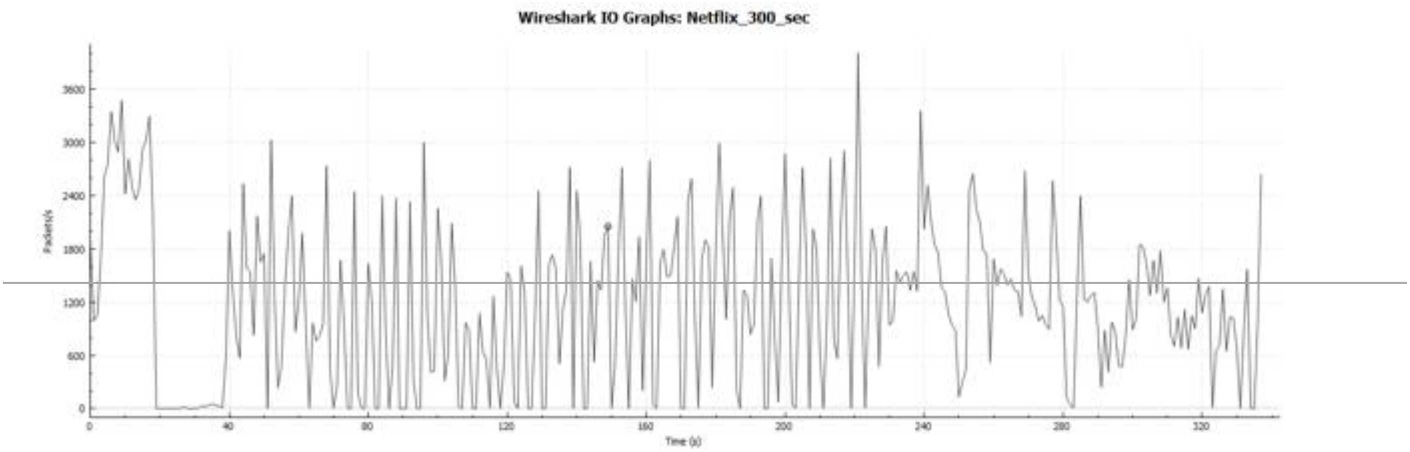


Figure 11 shows the extracted Wireshark grabs of the network traffic generated by Netflix.

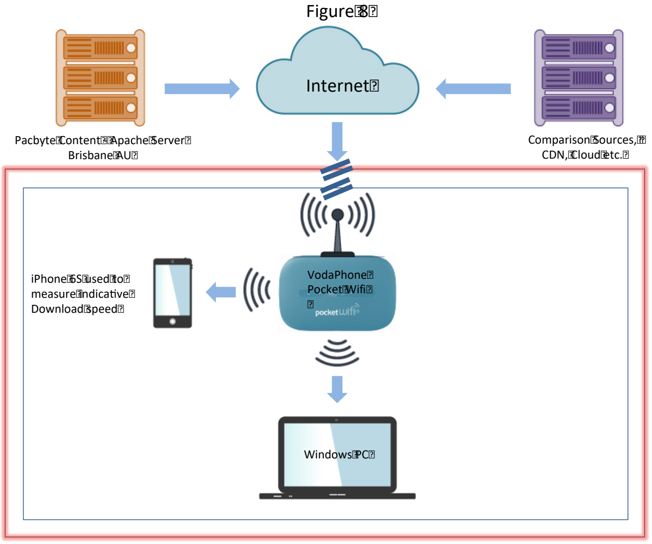


Findings

By extracting and examining the Wireshark grabs, the records show netPump™ pulled through more data more efficiently than the comparisons, and created less network traffic for the same video within the given time than the comparisons (refer to Appendix B). The finding confirms that netPump™ can increase the network efficiency and moves 10% to 60% more data per second, and does so without saturating the connection.

Test 7: Superior performance in context of fairness measures

Connection: Vodafone WiFi
Speed: 5.25 Mbps to 6.75 Mbps
Devices: 1 x Windows PC
Sources: PacSoft AU server, CDN



Abstract

Fairness measures are used to ascertain whether users or applications are not exceeding their fair share of network resources – or sometimes referred to as "saturating the connection" to an extent that prohibits the transmission of other data. In accordance with the setups and graphs in *Test 5* and *Test 6* above, further examination was carried out to compare the level of saturation of the connection during the comparisons of Netflix, VLC and netPump™ deliveries.

Observations

Evaluating less saturation of the connection as well as the total amount of data pulled through at the end of the test duration when connection is terminated, examination of Tables 1 and 2 in *Test 5* above, show that netPump™ is receiving a fair share of system resources. In addition, while the Wireshark grabs in *Test 6* demonstrate similar access to resources, the average bit rate pulled through by netPump™ is less than comparatives. However, netPump™ still had pulled through more data by the time the network connection was terminated.

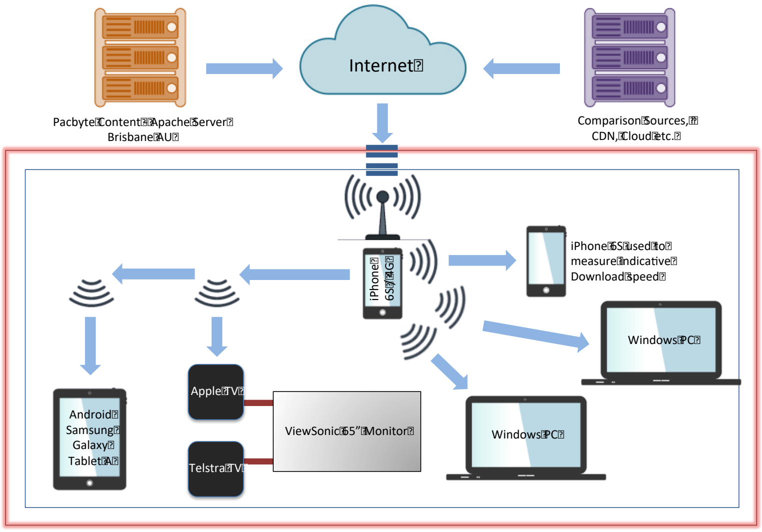
Findings

netPump™ manages network traffic by sending optimised data packets to a client app that enables that data to be received at more efficient levels. Given that more data was pulled through in less time while still only accessing the same amount of network resources as the comparisons, netPump™ does not saturate the connection or use the network resources in a way that would breach fair measure best practice.

Test 8: Improves the quality of the viewing experience at a lower threshold

Connection: iPhone 6S/4G
Speed: 6.42 Mbps
Devices: Android Tablet A
Apple TV (V3)
Telstra TV (Roku)
2 x Windows PC
Sources: PacSoft AU server, Cloud, CDNs

Figure 12



Abstract

Subscribers on broadband plans at less than 15 Mbps will often experience drops in video resolution during peak hours in the evening, or while running multiple video streams from a single home connection. This drop in bit rate results in a visible drop in the quality of the video being streamed. However, most premium OTT deliveries employ an ABR delivery method to ensure the best available video delivery for the connection speeds prevailing at that time. PacSoft's claim relates to netPump™ being able to deliver a higher quality video by comparison to other video deliveries, on that same network.

The setup shown in Figure 12 allowed comparison tests between netPump™, Apple TV delivering HD content purchased from iTunes, and Telstra TV (Roku) delivering content from Stan and BigPond Movies. The mobile broadband connection was sourced via an iPhone 6S connected to the Telstra 4G network (Figure 12).

The average download speed of 12.07 Mbps was reduced further by using combinations of video streams from YouTube and netPump™ on the Windows PCs. This reliably choked the feed down to about 6.42Mbps. Multiple instances of video streams were run between combinations of netPump™, Apple TV and Stan or BigPond Movies on Telstra TV. The quality was monitored via an HDMI connection to a 65-inch ViewSonic HD monitor, so any reductions in resolution were apparent and easily monitored.

Observations

While two instances of YouTube were used to choke the feed, netPump™ on Android Tablet A was run simultaneously with an instance of Apple TV iTunes (*'Kingsmen – The Secret Service'*) and then Big Pond Movies on Telstra TV (*'Victor Frankenstein'*).

The FBR 5 Mbps netPump™ delivery was selected on the Android Tablet, as 5 Mbps is typically the highest HD bit rate offered by premium online video providers. netPump™ happily delivered a robust stream starting after 16 seconds, whereas Apple and the Telstra TV started later after 50 and 24 seconds respectively.

A second instance of YouTube was started on the second Windows PC while simultaneously starting netPump™ on the Android Tablet and Apple TV (*'Fast and Furious 7'*), and then Stan (*'San Andreas'*) on the Telstra TV.

netPump™ started playback after 20 seconds while Apple TV buffered for about 10 minutes, starting with a higher quality buffered image for a few minutes then dropping to an SD low resolution video. Stan on Telstra TV started playback much sooner after 24 seconds buffering, but delivered a low resolution SD image.

Apple (iTunes) and Telstra TV (Stan) did not switch up from a low resolution SD image. During streaming the videos, the speed was measured as low as 4.75 Mbps.

The YouTube and the netPump™ video streams were stopped after the 5-minute mark. After approximately 30 seconds, both Apple TV and Stan on Telstra TV switched up to HD due to the increased available bandwidth, measured at 7.15 Mbps.

Findings

The testing validates the claim that netPump™ is able to deliver a better quality viewing experience at lower download speeds due to its ability to start more quickly than the comparisons under a heavily loaded connection, and its delivery of a higher bit rate video while the comparisons remained at a lower bit rate and resolution image.

4. Conclusions

This paper evaluates the performance of PacSoft's netPump™ technology by referring to the claims to be verified, the test methodologies and the topology of the setups. Broadly, it assessed the method for transmission over a data network to enable data files to be transmitted at more efficient levels, with further efficiencies gained by managing the receipt and process of the data file by the netPump™ application on the client device.

The gain in CPU efficiency is due to the fact that netPump™ is a true streaming method for video delivery - it does not require writing data to storage. The gain in CPU efficiency are of most benefit to portable devices, as they rely on long battery life to reduce the need for frequent charging.

The paper further discusses netPump™'s performance while multiple streams of data are fed through the same single connection, at the same time the tests are being undertaken. By measuring and comparing the time and bitrates netPump™ takes to deliver with other conventional and premium video streaming technologies, the results indicate that netPump™ increases the quality of the user experience by delivering a more constant, robust stream with far more tolerance to reductions in bandwidth.

For consumers, this reduces the impact on viewing experiences caused by congestion, distance from exchange, environmental factors and other impediments. Even with a 25 Mbps link there is a noticeable difference between a direct stream and the netPump™ delivery.

The network efficiency gains cannot be derived by any other reason other than netPump™ was able to access additional network capacity that were demonstrably inaccessible by the comparisons during testing. By analysing the data captured by Wireshark, it is apparent that the material improvement in accelerating file downloads using netPump™ also results in considerable reduced network load. This indicates a considerable increase in total network capacity is possible by deploying netPump™ on existing infrastructure without needing to spend additional capital on physical upgrades. Alternatively, netPump™ allows for more data to be delivered by increasing the throughput within existing network provisioning.

Robin Braun
Professor of Telecommunications Engineering,
School of Computing and Communications
University of Technology, Sydney
Member, A/DRsch Ctre for Real-Time Information Networks
Core Member, CRIN - Centre for Realtime Information Networks
BSc (Hons) (Brighton), M.Sc (Eng) (UCT), PhD (UCT)
Senior Member, Institution of Electrical and Electronic Engineers

Pakawat Pupatwibul (Ph.D.)

Appendix A

Links used:

109.228.1.28/media/DemoClip/DemoClip1.html	(Standard netPump™ for AB_8mbps_100MB.mp4)
109.228.1.28/media/DemoClip/DemoClip1S.html	(Accelerated. netPump™ for AB_8mbps_100MB.mp4)
109.228.1.28/media/DemoClip/DemoClip2.html	(Standard netPump™ for AB_8mbps.mp4)
109.228.1.28/media/DemoClip/DemoClip2S.html	(Accelerated. netPump™ for AB_8mbps.mp4)
109.228.1.28/media/Demo-Clip/AB_8mbps_100MB.mp4	(Direct download)
109.228.1.28/media/DemoClip/AB_8mbps.mp4	(Direct download)
109.228.1.28/media/DemoAerial.html	
109.228.1.28/media/DemoAerialS.html	

Appendix B

Wireshark captures
https://www.dropbox.com/sh/4p1qzbykg10vz7j/AAC8eVwDKdg-XnUBdOjyvq6da?dl=0