Netpump Video SDK

Testing Review Report

July 2021

Interactive®

1. Document Control

Document Version:	1.0
Document Date:	20 July 2021
Document Classification:	Commercial in Confidence
Prepared by:	Interactive Pty Ltd Tower B, 39 Herbert St, St Leonards, NSW 2065
Prepared for:	Pacbyte Limited 2/30 Roma St, North Epping, NSW 2121

Document Control

Version	Date	Author	Description / Changes
1.0	20 Jul 2021	Jason Smith and Paul Ferry	First Release

Document Authors / Reviewers

	Name	Position
Written by	Jason Smith	Enterprise Architect
Written by	Paul Ferry	Principal Consultant
Reviewed by	Brad Wells	Director of Enterprise Sales

For further information, please contact:

Brad Wells
Director of Enterprise Sales
Interactive Pty Ltd
Phone: 02 9431 8000
Email: bwells@interactive.com.au

Table of Contents

Disclaimer

To the maximum extent permitted, Interactive accepts no liability for any damages from the use or inability to use this report or any of the material contained in it.

The results outlined in this report are from testing performed by Interactive Pty Ltd using its own network and computing resources and results from other networks, computing resources or file types may yield different results.

The opinions expressed in this document are those of the authors and do not represent the policy of Interactive or its affiliates.

2. Purpose

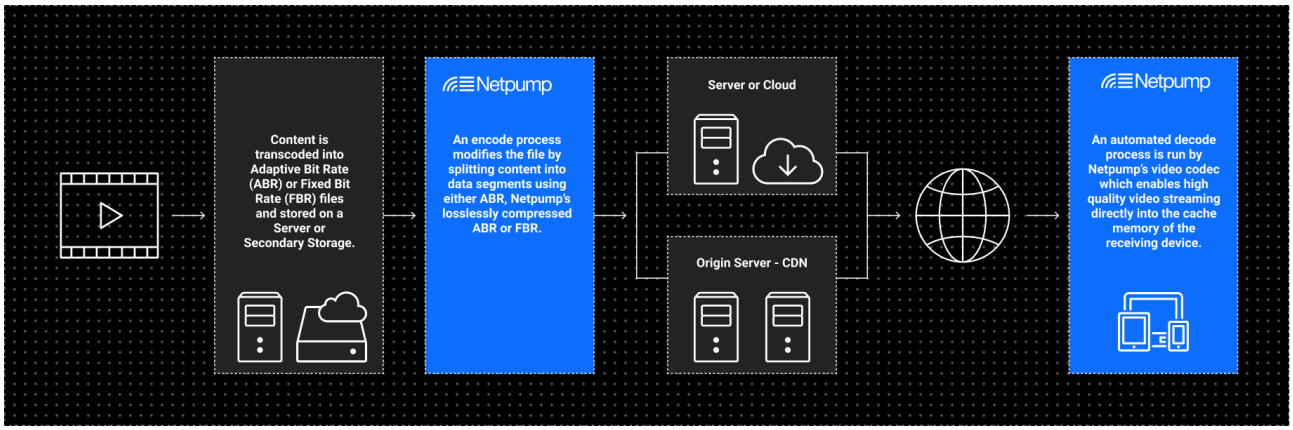
The purpose of this document is to provide an independent opinion on Netpump Video capabilities and experience quality as a use case for Subscriber Video On Demand (SVOD).

3. Context

Netpump Video is a software development toolset designed to plug into existing video players and operate using existing video storage and distribution technologies. Further it may deliver additional and improved compression capabilities to H.264 Adaptive Bit Rate (ABR) video content.

Netpump Video is a product sold into the market as a lightweight fully software enabled technology, that requires no dedicated or additional hardware for operation. It offers better Quality of Experience (QoE) for users, whilst offering reduced costs for SVOD providers. The software is installed on the devices receiving the video content, which includes iOS, Android, TVOS, Windows and MAC.

Netpump Video delivers content via Content Delivery Networks (CDN), cloud native storage and server-based data repositories.



The Netpump Video Client is typically distributed through the SVOD providers streaming application and may also be embedded within web pages or custom applications providing streaming content.

This evaluation of Netpump Video is to explore potential benefits of it being an add-on service that allows streaming service providers to reduce costs of data storage and network transmission.

4. Testing Methodology and Test Descriptions

The testing methodology employed was designed to validate that Netpump Video provides greater benefits in delivering video content assessed against the following criteria:

- Reduced jitter and improved user experience
- Reduced bandwidth utilisation
- Higher video resolution delivery, particularly over low bandwidth
- Reduced storage requirements
- Reduced data transfer

The testing involved taking key measurements and observations on data transmitted, time to play content, video playback resolution and video playback quality.

Testing was executed by simulating different network topology conditions and traffic profiles through the use of rate shaping.

Network connectivity was via the internet using Telstra and Optus Internet Service Providers (ISP) using various different types of simulated last mile access scenarios. Network Link technologies utilised included HFC, 4G, Fibre and Fixed Wireless with download speeds rate shaped to 2Mbps and 5Mbps respectively.

4.1. Testing Methodology

Testing comprised of video files with multiple encodings as follows:

- Fixed Bit Rate (FBR)
- H.264 Adaptive Bit Rate (ABR)
- H.264 ABR Compressed (ABRC) using Netpump's proprietary compression technology

Testing was conducted via 2 delivery methodologies as follows:

- Streaming via Content Delivery Network (CDN) on AWS Asia Pacific (Sydney) Region
- Streaming direct from S3 File Storage on AWS Asia Pacific (Sydney) Region

An SSL VPN was established between the Player PC and the Capture PC to ensure all traffic was routed via the Capture PC. Traffic was rate shaped at the Player PC using NetLimiter. Tests were run on the Player PC using the Netpump Player and the VLC Player.

4.2. Test Descriptions

4.2.1. Fixed Bitrate Testing

The objective of the FBR tests was to measure the time to play and observe the playback quality and performance of a 1 hour long (in duration) video file when comparing Netpump Video FBR delivery to standard video FBR delivery via VLC.

This was done by playing the same video over 3 different methods and measuring the time to play the video in full and by observing the video playback quality.

The 3 tests were repeated over 2 different network bandwidths, 2 Mbps and 5 Mbps. In each set of 3 tests the maximum possible video resolution was played over both 2Mbps and 5Mbps to fully saturate the available bandwidth.

The VLC tests were executed using VLC's default settings of 1 thread. Netpump Video tests were executed using Netpump Video's default settings of 3 threads.

4.2.1.1. FBR Test Set A – 2000Kbps Video Playing over 2Mbps Bandwidth

Test No.	Video Source	Network Bandwidth	Video Type	Video Player Used
A1	AWS CloudFront (CDN)	2Mbps	FBR - 540p 2000Kbps	VLC - (1 thread)
A2	AWS CloudFront (CDN)	2Mbps	FBR - 540p 2000Kbps	Netpump - (3 threads)
A3	AWS S3	2Mbps	FBR - 540p 2000Kbps	Netpump - (3 threads)

4.2.1.2. FBR Test Set B – 5000Kbps Video Playing over 5Mbps Bandwidth

Test No.	Video Source	Network Bandwidth	Video Type	Video Player Used
B1	AWS CloudFront (CDN)	5Mbps	FBR - 1080p 5000Kbps	VLC - (1 thread)
B2	AWS CloudFront (CDN)	5Mbps	FBR - 1080p 5000Kbps	Netpump - (3 threads)
B3	AWS S3	5Mbps	FBR - 1080p 5000Kbps	Netpump - (3 threads)

4.2.2. Adaptive Bitrate Testing

The objective of the ABR tests was to measure the data transmitted and observe the playback resolutions and quality of a 10 minute long (in duration) video file when comparing Netpump Video ABR and ABRC delivery to standard video delivery via VLC (simulated). Each ABR file segment was 2 seconds in duration.

This was done by playing the same video over 3 different methods and measuring the amount of data transmitted and by observing the video playback resolution and quality.

4 sets of tests were run a combination over 2 different network bandwidths, 2 Mbps and 5 Mbps, and 2 different video sources, AWS CloudFront and AWS S3 direct.

These ABR tests were also intended to measure the impact of Netpump's proprietary video compression encoding in respect to data transmitted and playback resolution achieved. VLC was simulated configuring the Netpump Video player to playback using only a single thread to match a

VLC player. Netpump ABR and ABRC tests were executed using Netpump Video's default settings of 3 threads.

4.2.2.1. ABR Test Set C – ABR Video Playing over 2Mbps Bandwidth from AWS CloudFront

Test No.	Video Source	Network Bandwidth	Video Type	Video Player Used
C1	AWS CloudFront (CDN)	2Mbps	H.264 ABR	Netpump - (VLC Simulation, single thread)
C2	AWS CloudFront (CDN)	2Mbps	H.264 ABR	Netpump - (3 threads)
C3	AWS CloudFront (CDN)	2Mbps	H.264 ABRC	Netpump - (3 threads)

4.2.2.2. ABR Test Set D – ABR Video Playing over 2Mbps Bandwidth from AWS S3

Test No.	Video Source	Network Bandwidth	Video Type	Video Player Used
D1	AWS S3	2Mbps	H.264 ABR	Netpump - (VLC Simulation, single thread)
D2	AWS S3	2Mbps	H.264 ABR	Netpump - (3 threads)
D3	AWS S3	2Mbps	H.264 ABRC	Netpump - (3 threads)

4.2.2.3. ABR Test Set E – ABR Video Playing over 5Mbps Bandwidth from AWS CloudFront

Test No.	Video Source	Network Bandwidth	Video Type	Video Player Used
E1	AWS CloudFront (CDN)	5Mbps	H.264 ABR	Netpump - (VLC Simulation, single thread)
E2	AWS CloudFront (CDN)	5Mbps	H.264 ABR	Netpump - (3 threads)
E3	AWS CloudFront (CDN)	5Mbps	H.264 ABRC	Netpump - (3 threads)

4.2.2.4. ABR Test Set F – ABR Video Playing over 5Mbps Bandwidth from AWS S3

Test No.	Video Source	Network Bandwidth	Video Type	Video Player Used
F1	AWS S3	5Mbps	H.264 ABR	Netpump - (VLC Simulation, single thread)
F2	AWS S3	5Mbps	H.264 ABR	Netpump - (3 threads)
F3	AWS S3	5Mbps	H.264 ABRC	Netpump - (3 threads)

5. Testing Results Summary

Testing demonstrates that Netpump Video delivers an increased video viewing experience where bandwidth limitations due to congestion or reduced speeds on last mile access exist.

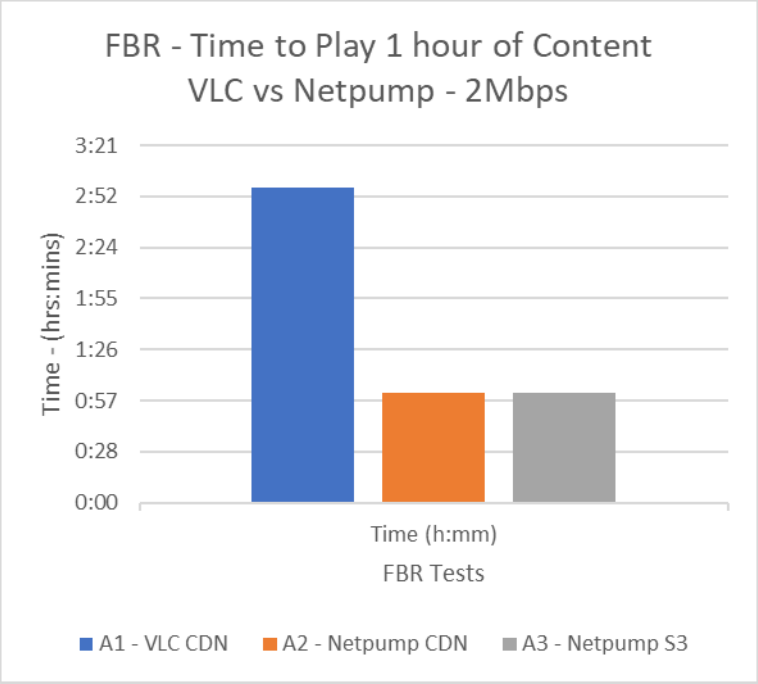
In each test Netpump showed the ability to transmit more data with reduced average speed and less packets than traditional technologies indicating that service providers would have the ability to influence the bottom line through reduced transmission cost without impacting viewer experience.

When comparing standard video compression technology to Netpump proprietary compression further cost reductions are expected with an average of 20% reduction in data storage and distribution requirements.

5.1. FBR Test Results

5.1.1. FBR Test Set A – 2000Kbps Video Playing over 2Mbps Bandwidth

These tests were designed to test video performance over very low network bandwidth. These tests used the maximum video bit rate possible (540p – 200Kbps) over the available 2Mbps bandwidth to test impact on playing time and quality.



5.1.1.1. FBR Test Set A – Observations

Test A1 – VLC via CDN:

Lots of jitter and constant pausing for the video to cache. The 60 minute video took 2h 58m to play the entire content due to the amount of jitter, almost 3 times longer than the video length itself. Resource usage on the Player PC was constantly up and down with the VLC process rapidly fluctuating between 10% and 25% constantly. The processor was observed to be around 9%

average with higher bursts in Windows task manager. Visual quality was very poor due to the constant jitter and pausing.

Test A2 – Netpump via CDN:

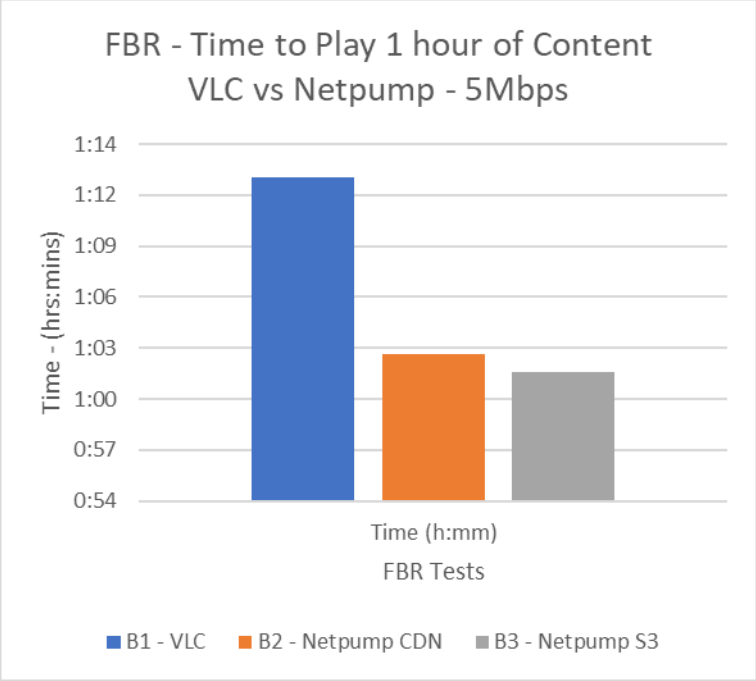
Almost no Jitter, only occasional bumps and pauses were noticed. The 60 minute video took 1hr 2m to play the entire content. Once the player cache was full network bandwidth appeared to reduce. At 2Mbps the network was generally consistently utilised. Network utilisation stopped towards the end of the video as remaining minutes of video were all in cache. Resource usage on the Player PC was constant with Netpump process fluctuating between 10% and 20%. The processor was observed to be around 3% average in Windows task manager. Visual quality was good.

Test A3 – Netpump via S3:

Almost no Jitter, very similar to test A2. The 60 minute video took 1hr 2m to play the entire content. Network utilisation and Player PC resource usage were observed to be the same as test A2. Visual quality good.

5.1.2. FBR Test Set B – 5000Kbps Video Playing over 5Mbps Bandwidth

These tests were designed to test video a high resolution and performance over a low to medium network bandwidth. These tests used the maximum video bit rate possible (1080p 5000Kbps) over the available 5Mbps bandwidth to test impact on playing time and quality.



5.1.2.1. FBR Test Set B – Observations

Test B1 – VLC via CDN:

Jitter and constant pausing for the video to cache was still present but much less than test A1. The 60 minute video took 1h 13m to play the entire content due to the amount of jitter. Resource usage on the Player PC was higher than test A1 and constantly up and down with the VLC process fluctuating between 30% and 60% constantly. The processor was observed to be around 10% to 24% with higher bursts in Windows task manager. Visual quality was poor due to the constant jitter and pausing.

Test B2 – Netpump via CDN:

Minimal jitter was observed, only occasional bumps and pauses were noticed. The 60 minute video took 1hr 3m to play the entire content. Similar to tests A2 and A3, once the player cache was full network bandwidth appeared to reduce and remain constant. At 5Mbps the network was generally consistently utilised. Network utilisation stopped towards the end of the video as remaining minutes of video were all in cache. Resource usage on the Player PC was constant with Netpump process fluctuating between 10% and 20%. The processor was observed to be around 3% - 6% in Windows task manager. Visual quality was good.

Test B3 – Netpump via S3:

Minimal jitter was observed, very similar to test B2. The 60 minute video took 1hr 2m to play the entire content. Network utilisation and Player PC resource usage were observed to be the same as test B2. Visual quality good.

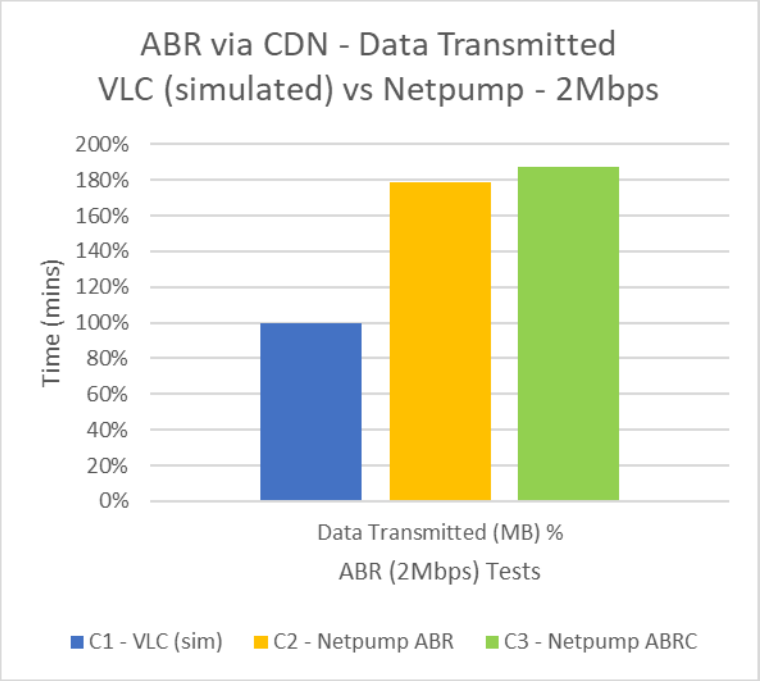
5.1.3. FBR Tests Summary

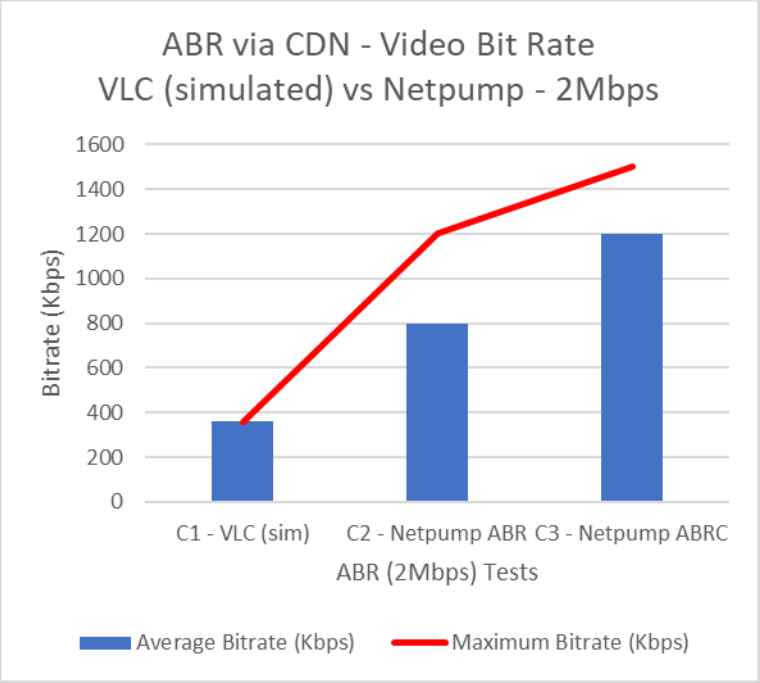
In all FBR tests Netpump Video produced a better outcome of the VLC player in all areas including time to play, resource usage and general watchability of the content. This is due to Netpump's ability to multi-thread video streams and its ability to ignore network packet errors and retry without waiting. This proprietary capability produced a better experience over a typical single thread player.

5.2. ABR Test Results

5.2.1. ABR Test Set C – ABR Video Playing over 2Mbps Bandwidth from AWS CloudFront

These tests were designed to test ABR video performance over very low network bandwidth of 2Mbps. These tests streamed a 10 minute ABR video file from AWS CloudFront and compared Netpump Video ABR and ABRC (compressed) delivery to standard video delivery. All tests played the content in 10 minutes. The amount of data transmitted and video resolution achieved was the variable between the tests. VLC was simulated by running the Netpump player with a single thread as VLC does not deliver ABR out of the box.





5.2.1.1. FBR Test Set C – Observations

Test C1 – Simulated VLC via CDN:

Lots of jitter and constant pausing for the video to cache was observed. This test transmitted the lowest amount of data in the test set as it could only play at the lowest resolution. The playback resolution stayed at the lowest 360Kbps and did not rise above this. Resource usage on the Player PC was constant with the process sitting around 20%. The processor was observed to be around 3.5% to 5.5% in Windows task manager. Visual quality was poor due to the constant jitter and pausing.

Test C2 – Netpump ABR via CDN:

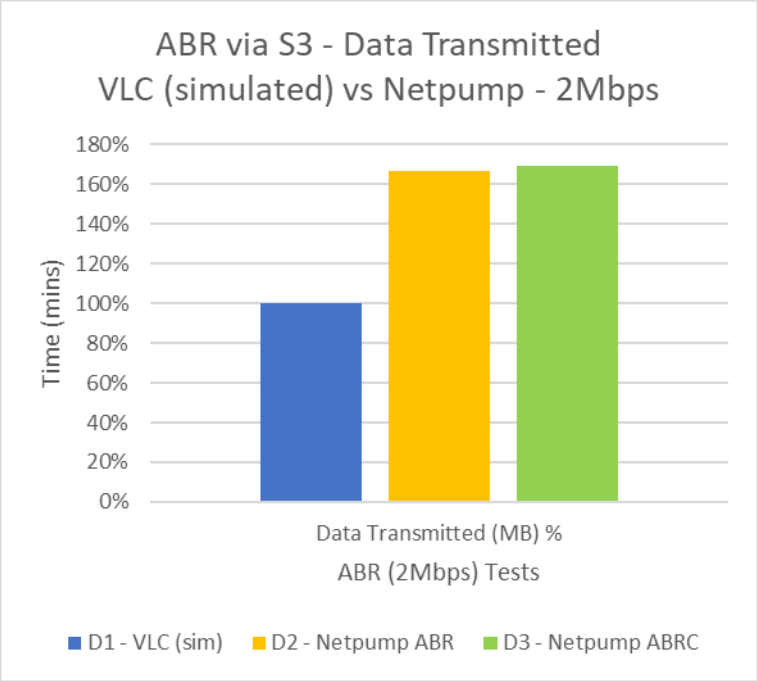
Minimal jitter was observed. The video stepped up through the video resolutions as expected. The video streamed at an average resolution of 800Kbps and reached as high as 1200Kbps. This test transmitted 79% more data that test C1 due to the higher video resolutions achieved. Resource usage on the Player PC was constant with Netpump process averaging around 20%. The processor was observed to be around 3.5% to 5% in Windows task manager. Visual quality was good.

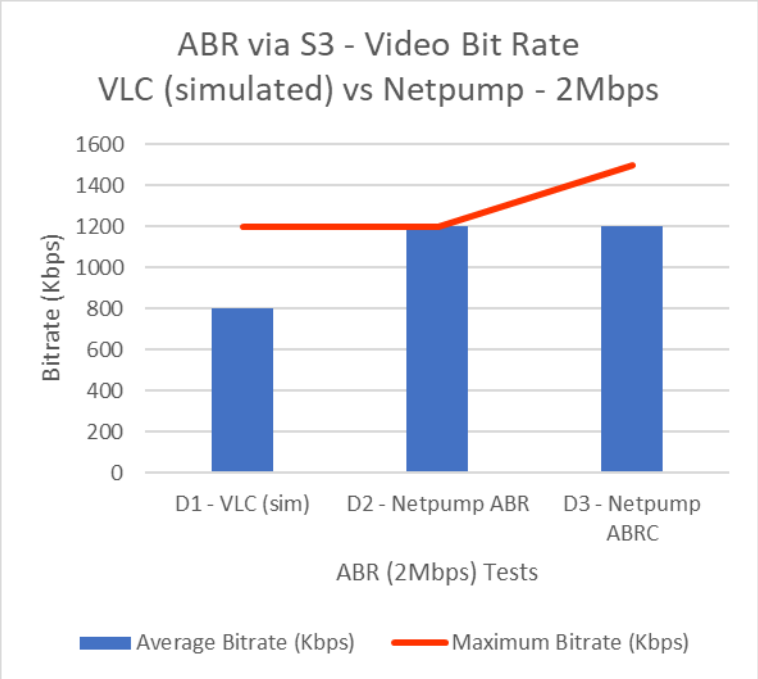
Test C3 – Netpump ABRC (Compressed) via CDN:

Minimal jitter was observed. The video stepped up through the video resolutions as expected and achieved the highest video resolutions in the test set. The video streamed at an average resolution of 1200Kbps and reached as high as 1500Kbps. This test transmitted 87% more data that test C1 due to the higher video resolutions achieved. Resource usage on the Player PC was constant with Netpump process averaging around 20%. The processor was observed to be around 3.5% to 5.5% in Windows task manager. Visual quality was good.

5.2.2. ABR Test Set D – ABR Video Playing over 2Mbps Bandwidth from AWS S3

These tests were designed to test ABR video performance over very low network bandwidth of 2Mbps. These tests streamed a 10 minute ABR video file direct from AWS S3 storage and compared Netpump Video ABR and ABRC (compressed) delivery to standard video delivery. All tests played the content in 10 minutes. The amount of data transmitted, and video resolution achieved was the variable between the tests. VLC was simulated by running the Netpump player with a single thread as VLC does not deliver ABR out of the box.





5.2.2.1. FBR Test Set D – Observations

Test D1 – Simulated VLC via S3:

Regular jitter and constant pausing for the video to cache was observed. The video stepped up the resolutions and streamed at an average resolution of 800Kbps and reached a peak of 1200Kbps. This test transmitted the lowest amount of data in the test set. Resource usage on the Player PC was constant with the process sitting around 20%. The processor was observed to be around 3.5% to 6% in Windows task manager. Visual quality was poor due to the regular jitter and pausing.

Test D2 – Netpump ABR via S3:

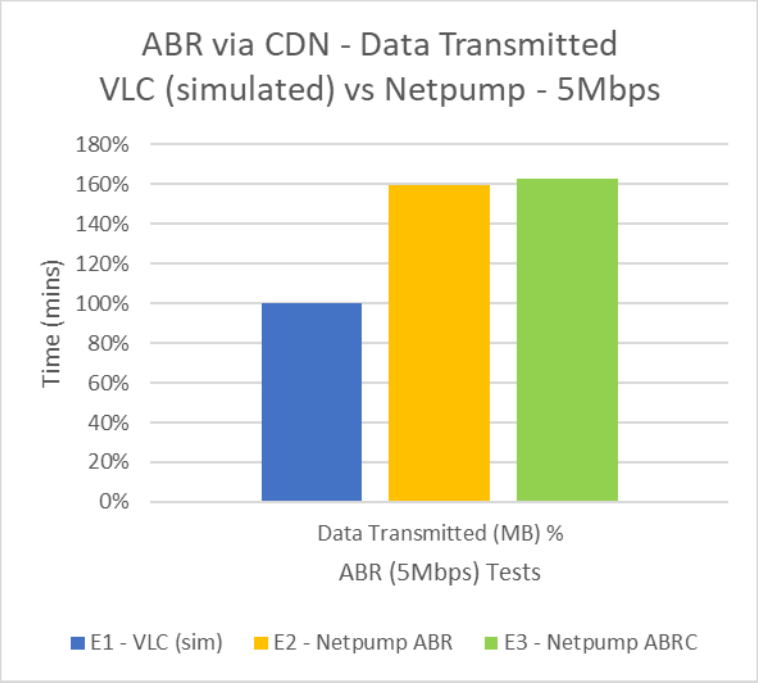
Minimal jitter was observed. The video stepped up through the video resolutions as expected. The video streamed at an average resolution of 1200Kbps, this was also the highest resolution achieved. This test transmitted 67% more data that test D1 due to the higher video resolutions achieved. Resource usage on the Player PC was constant with Netpump process averaging around 20%. The processor was observed to be around 3.5% to 5% in Windows task manager. Visual quality was good.

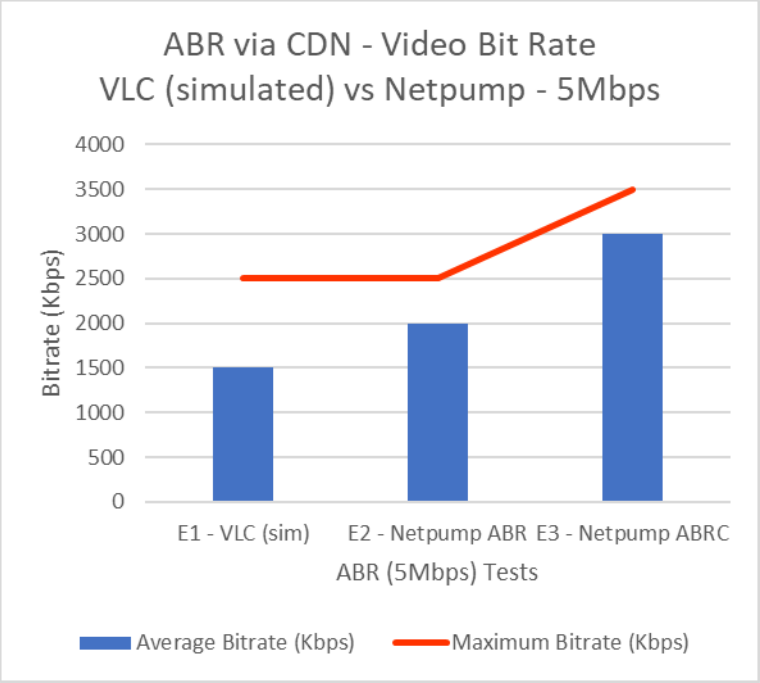
Test D3 – Netpump ABRC (Compressed) via S3:

No jitter was observed. The video stepped up through the video resolutions as expected and achieved the highest video resolutions in the test set. The video streamed at an average resolution of 1200Kbps and peaked as high as 1500Kbps. This test transmitted 70% more data that test D1 due to the higher video resolutions achieved. Resource usage on the Player PC was constant with Netpump process averaging around 20%. The processor was observed to be around 3.5% to 5% in Windows task manager. Visual quality was good.

5.2.3. ABR Test Set E – ABR Video Playing over 5Mbps Bandwidth from AWS CloudFront

These tests were designed to test ABR video performance over low to medium network bandwidth of 5Mbps. These tests streamed a 10 minute ABR video file from AWS CloudFront and compared Netpump Video ABR and ABRC (compressed) delivery to standard video delivery. All tests played the content in 10 minutes. The amount of data transmitted, and video resolution achieved was the variable between the tests. VLC was simulated by running the Netpump player with a single thread as VLC does not deliver ABR out of the box.





5.2.3.1. FBR Test Set E – Observations

Test E1 – Simulated VLC via CDN:

Minimal jitter and some pausing for the video to cache was observed. The video stepped up the resolutions and streamed at an average resolution of 1500Kbps and reached a peak of 2500Kbps. This test transmitted the lowest amount of data in the test set. Resource usage on the Player PC was constant with the process sitting around 20%. The processor was observed to be around 3.5% to 6.5% in Windows task manager. Visual quality was average due to the jitter and pausing.

Test E2 – Netpump ABR via CDN:

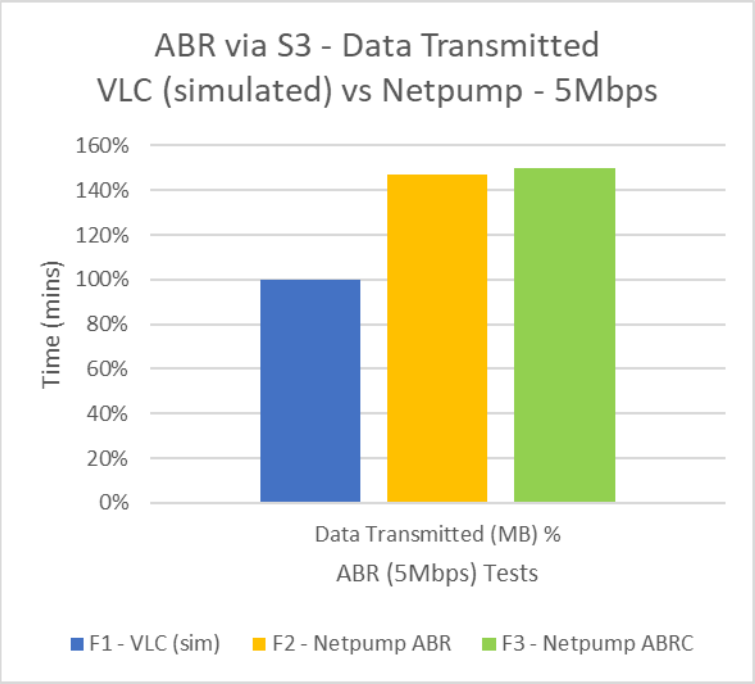
Minimal jitter was observed. The video stepped up through the video resolutions as expected. The video stepped up the resolutions and streamed at an average resolution of 2000Kbps and reached a peak of 2500Kbps. This test transmitted 60% more data that test E1 due to the higher video resolutions achieved. Resource usage on the Player PC was constant with Netpump process averaging around 20%. The processor was observed to be around 4% to 6% in Windows task manager. Visual quality was good.

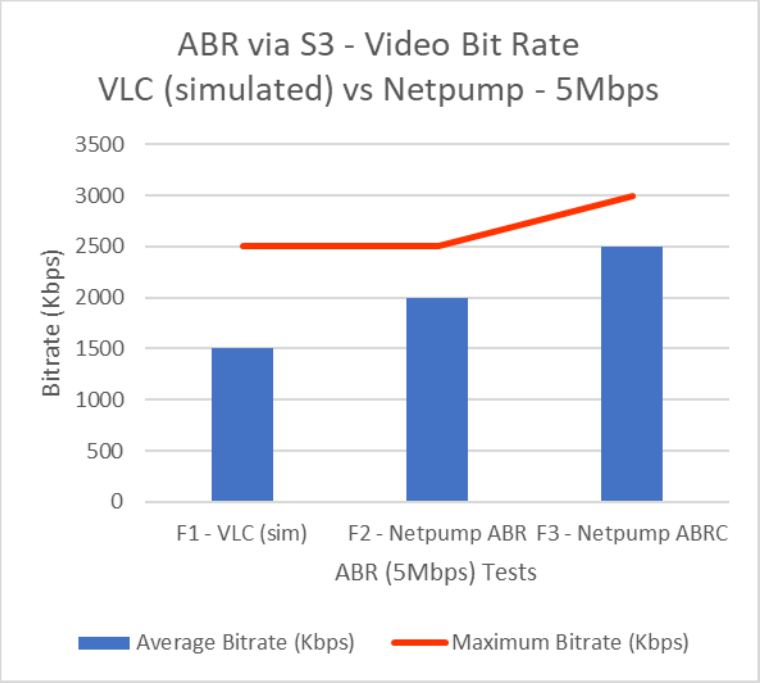
Test E3 – Netpump ABRC (Compressed) via CDN:

Minimal jitter was observed. The video stepped up through the video resolutions as expected and achieved the highest video resolutions in the test set. The video streamed at an average resolution of 3000Kbps and peaked as high as 3500Kbps. This test transmitted 63% more data that test E1 due to the higher video resolutions achieved. Resource usage on the Player PC was constant with Netpump process averaging around 20%. The processor was observed to be around 4.5% to 6.5% in Windows task manager. Visual quality was good.

5.2.4. ABR Test Set F – ABR Video Playing over 5Mbps Bandwidth from AWS S3

These tests were designed to test ABR video performance over low to medium network bandwidth of 5Mbps. These tests streamed a 10 minute ABR video file from AWS S3 Storage and compared Netpump Video ABR and ABRC (compressed) delivery to standard video delivery. All tests played the content in 10 minutes. The amount of data transmitted, and video resolution achieved was the variable between the tests. VLC was simulated by running the Netpump player with a single thread as VLC does not deliver ABR out of the box.





5.2.4.1. FBR Test Set F – Observations

Test F1 – Simulated VLC via S3:

Some jitter and pausing for the video to cache was observed. The video stepped up the resolutions and streamed at an average resolution of 1500Kbps and reached a peak of 2500Kbps. This test transmitted the lowest amount of data in the test set. Resource usage on the Player PC was constant with the process sitting around 20%. The processor was observed to be around 3.5% to 6.5% in Windows task manager. Visual quality was good.

Test F2 – Netpump ABR via S3:

Minimal jitter was observed. The video stepped up through the video resolutions as expected. The video stepped up the resolutions and streamed at an average resolution of 2000Kbps and reached a peak of 2500Kbps. This test transmitted 47% more data that test F1 due to the higher video resolutions achieved. Resource usage on the Player PC was constant with Netpump process averaging around 25%. The processor was observed to be around 3.5% to 6.5% in Windows task manager. Visual quality was good.

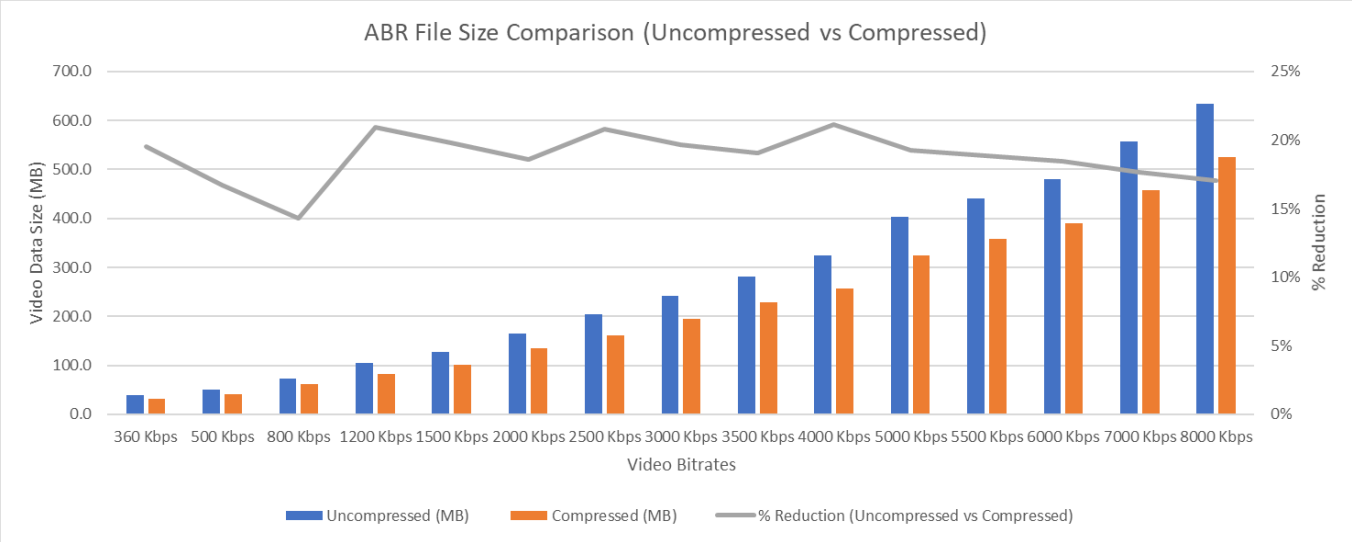
Test F3 – Netpump ABRC (Compressed) via S3:

No jitter was observed. The video stepped up through the video resolutions as expected and achieved the highest video resolutions in the test set. The video streamed at an average resolution of 2500Kbps and peaked as high as 3000Kbps. This test transmitted 50% more data that test F1 due to the higher video resolutions achieved. Resource usage on the Player PC was constant with Netpump process averaging around 20%. The processor was observed to be around 4.5% to 7% in Windows task manager. Visual quality was good.

5.3. ABR File Size Comparison (Uncompressed vs Compressed)

Netpump offers proprietary compression encoding for ABR video. The previous ABR test set results demonstrated in all cases that ABRC was able to achieve the highest data transmission over the 10 minutes and achieved the highest playback resolution with almost no jitter in all ABR test sets.

In addition to these performance results ABRC also results up to 20% smaller source file size in all ABR resolutions. This results in up to a 20% data storage and distribution saving.



6. Key Observations

1. Netpump player and Netpump SVOD encoding use a default 3 thread configuration which provides improved video streaming performance and visual quality over standard single thread video delivery.
2. Netpump FBR tests clearly demonstrated that Netpump Video can deliver a better-quality video experience over low network bandwidth. As network bandwidth increases higher resolutions can be achieved with improved performance over standard single thread delivery.
3. Netpump ABR tests clearly demonstrated that Netpump Video can deliver higher data transmission and higher video resolution over low bandwidth. This resulted in a better-quality video experience over standard single thread video delivery. As network bandwidth increases higher resolutions were achieved.
4. Netpump's ABRC (compressed) encoding yielded the best results in all ABR test sets. ABRC produced the highest data transmissions resulting in the highest video resolutions. Visual quality of the ABRC tests were also noticeably the best with practically no jitter.
5. Netpump's ABRC (compressed) encoding yields reduced video file sizes. This in turn results in reduced storage requirements.
6. Netpump's ABRC (compression) allows a choice in SVOD delivery resolution quality. ABRC Video content may be configured to deliver highest possible resolution which will optimise data transmission volumes and deliver a higher bitrate to the end user. Alternately ABRC video can be configured to current delivered resolutions which will result in reduced data transmissions, which will yield cost savings on data transmissions and network bandwidth utilisation.

7. Summary

Netpump Video offers several use cases for SVOD providers to improve SVOD delivery while saving on delivery and storage costs. Netpump's multi thread video delivery provides an improved performance and bandwidth utilisation in both FBR and ABR video delivery. Netpump's ABRC (compressed) video delivery offers the highest performance gains and cost savings due to the combination of multi-tread delivery and small video file sizes achieved through Netpump's proprietary compression encoding.

As video resolutions tend towards 4K and above, storage and transmission costs will continue to increase. The cost benefits of utilising Netpump are significant enough to provide benefit to SVOD providers and also storage service providers with customers that store large video files. It is estimated that cost savings arising from data storage and distribution of around 20% could be achieved.