# Voipex VIBE 3 Report Featuring Spirent Axon Test Appliance

**A Broadband-Testing Report**
**By Steve Broadhead, Founder & Director, BB-T**

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# TABLE OF CONTENTS

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# EXECUTIVE SUMMARY

- Network - LAN and WAN - testing does not have to be complicated and expensive.

- Moreover, regular testing for troubleshooting problems - and providing pro-active solutions - is arguably a fundamental requirement for contemporary enterprise network management now.

- With its Axon product, Spirent is looking to make relatively complex testing as simple as possible, with a wizard-based interface that removes any requirement for scripting of any kind - replacing it with drag and drop functionality.

- We put the concept being Spirent Axon to the test, creating a network consisting of an emulated 8Mbps WAN link, initially simulating an ISP bandwidth problem, whereby the customer - us in this case - was only receiving 50% of the bandwidth we had subscribed to.

- Using the Axon appliance we were able to identify exactly how much bandwidth we were receiving, and then to validate that the full bandwidth was available once the error had been corrected by the ISP.

- We then brought in Voipex ViBE VoIP and data optimisation technology to see how its appliance-based solution could optimise our basic 8Mbps WAN connection.

- Using our "vanilla" network setup as the baseline, we found that ViBE could significantly increase the number of VoIP calls, the quality of those calls AND optimise data connectivity at the same time.

- Not only was ViBE able to massively optimise VoIP calls but overall utilisation of the WAN link was also hugely increased - meaning far more traffic was able to pass across the connection - and overall latency dropped by a factor of 45:1 - very impressive.

# INTRODUCTION: OPTIMISING TESTING - SPEED AND EASE OF USE

In some cases it can be argued that testing is a necessary evil.

But what's got to be done has got to be done - the question is, therefore, just how efficient can you actually make that testing? Historically, testing has been thought of as being complex, highly technical and a lengthy process. While this isn't absolutely the case, it is true to say that a certain level of expertise - a high one, basically - has been required in order to carry out anything beyond very simplistic tests, and timescales have tended to be lengthy.

Moreover, as more and more applications have erupted onto the IT scene, so those test requirements have got more and more complex. Simply carrying out basic traffic loading might have made sense in the 90's, but nowadays it does not create a realistic test scenario. Instead, we need to throw a true multi-mix of applications into the equation and in a way that enables us to simulate many different real-world scenarios as accurately as possible. It's not simply a case of pass or fail - it is essential to be able to model scenarios where just a slight change in behaviour, which might be a sign of major problems ahead, can be identified quickly enabling the problem to be resolved.

Another issue for many companies looking to carry out regular test procedures on their networks has been cost; historically test equipment has either been very expensive or very limited in functionality, as well as being time consuming to set up in many cases, or requiring expert knowledge operating system knowledge in the case of open source tools.

Yet it can be argued now that regular testing is a better form of trouble-shooting than traditional network management tools. Not only has network traffic changed in type, profile and scale but, equally, the networks themselves have changed in shape (topology) to the extent that - in many cases - traditional troubleshooting systems are now outmoded.

With Axon - the test appliance underpinning our testing of the Voipex ViBE products in this report - Spirent is looking to resolve all the traditional issues associated with testing and bring simplicity and efficiency to the fore, without losing out on any functionality or depth of capability. Moreover, it is designed for contemporary networks - LAN or WAN - not those from the '90s.

This latter point is being highlighted in the testing, where we look at optimising voice and data traffic using Voipex's ViBE appliance, while also using the Axon device to troubleshoot the network in the first place. Initially, the Voipex product was very much focused on VoIP optimisation - see previous Broadband-Testing reports - but with V3 of the ViBE technology, Voipex has made the product far more networking-centric, without losing any of the unique VoIP optimisation features it already had in place.

To find out if we did succeed in both cases, and prove that testing can be both comprehensive and simple, read on!

# SPIRENT AXON AND VOIPEX VIBE 3: PUT TO THE TEST

For the purposes of our testing here, our requirements were threefold and involved the emulation of an 8Mbps bundled WAN connection from an ISP:

➢ Over a period of time, the ISP customer begins to notice that it seems to be experiencing data/application speed degradation and VoIP call quality issues at the remote office at the other end of the WAN link. We therefore attempt to identify this issue and exactly how much bandwidth we are getting, using the Spirent Axon to run traffic tests across the connection.

➢ The ISP claims to have resolved the problem and restored full bandwidth availability so again, we use the Spirent Axon to prove this.

➢ Internal conversations at the company regarding the issue at the remote office initiate future plans of expanding and adding additional staff. The head count of the new staff members will oversubscribe the 8Mbps circuit and cause VoIP issues and general data/application performance limitations. This is due to occur in a very short time-frame and the lead-time to get new circuits installed is too long. Moreover - is it a realistic long term solution? The company decides to look at a WAN optimization solution, as a means of delivering the project on time for the new staff to move in. We then bring the Voipex ViBE technology into the network to test its capabilities to optimize VoIP and data traffic over that 8Mbps connection, using the Spirent Axon to generate the required test traffic.

**Note:** we also used an Itrinegy WAN emulator to emulate our 8Mbps WAN connection, with Gigabit connections between the Axon and the ViBE appliances and 100Mbps connections between the ViBE appliances and the WAN emulator, resulting in a network test topology as below:
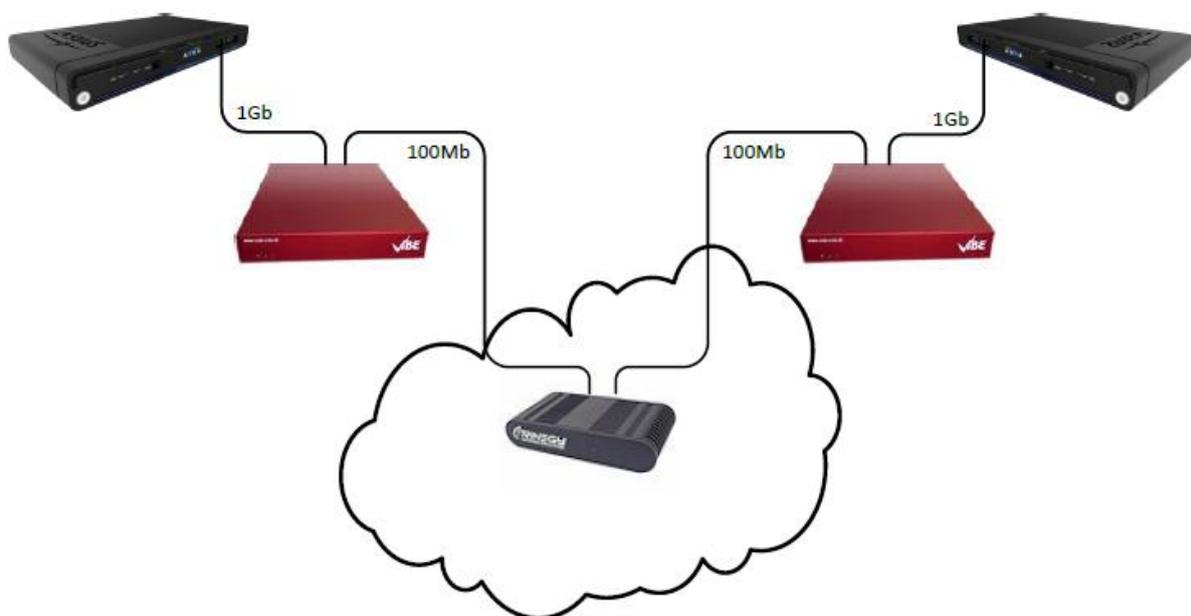


*Figure 1 – Our Test Topology*

## Testing: Phase I - Spirent Axon

Our starting point here was to get a baseline, clear result with the WAN emulator set to 8Mbps total bandwidth capacity.
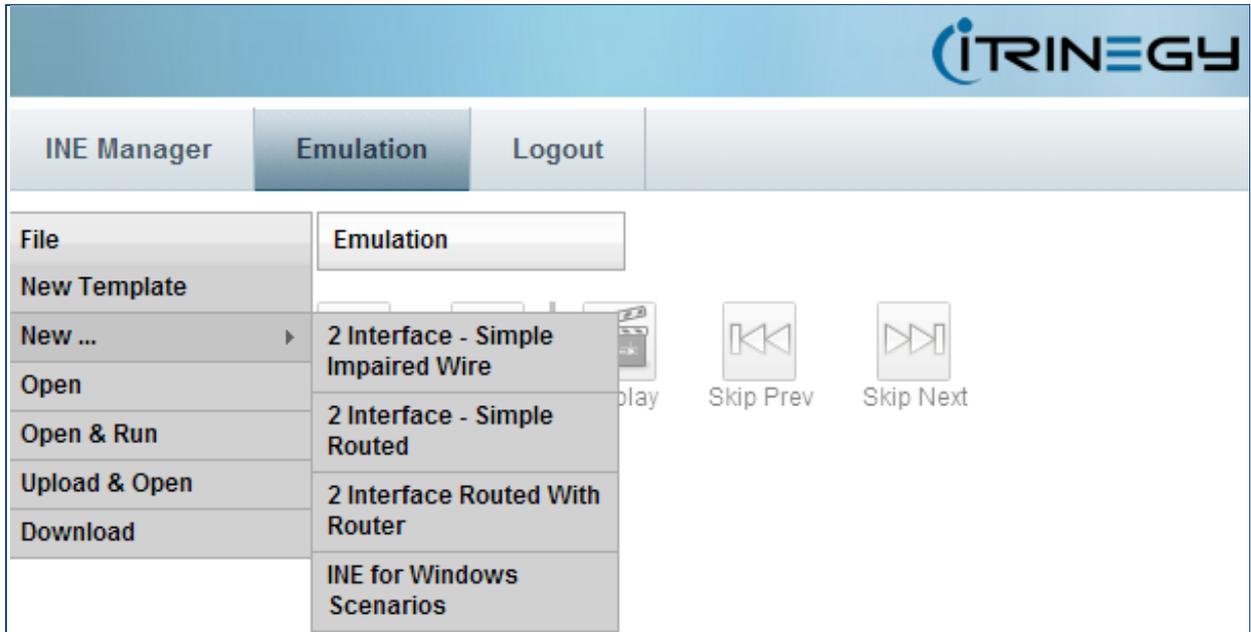


*Figure 2 – Configuring The iTrinegy WAN Emulator*

Configuring the iTrinegy emulator is simplicity itself. You simply choose an interface option and then set the bandwidth - outgoing and incoming - plus optionally set impairments, so you can emulate latency, jitter etc. Running at 8Mbps we ran some traffic tests on the Axon to match the bandwidth limit set by the WAN emulator and saw zero dropped packets.

| Track | PACKETS SENT (TX) | PACKETS RECEIVED (RX) | AVG RECEIVE RATE (BPS) | AVG JITTER (MS) | AVG LATENCY (MS) | PACKET LOSS |
|---|---|---|---|---|---|---|
| Frame: 128 Bytes | 30,442 | 30,442 | 595,338 | 0.089 | 0.291 | 0 |
| Frame: 512 Bytes | 3,370 | 3,370 | 236,844 | 0.088 | 1.047 | 0 |
| Frame: 1518 Bytes | 783 | 783 | 158,993 | 0.133 | 3.096 | 0 |
| Summary | 34,595 | 34,595 | 0 (PACKET LOSS) | | | |

*Figure 3 – Baseline Test Showing Zero Dropped Packets*

We then reset the WAN emulator to 4Mbps total bandwidth, to simulate the ISP error and monitored the test real-time on the Axon user interface.
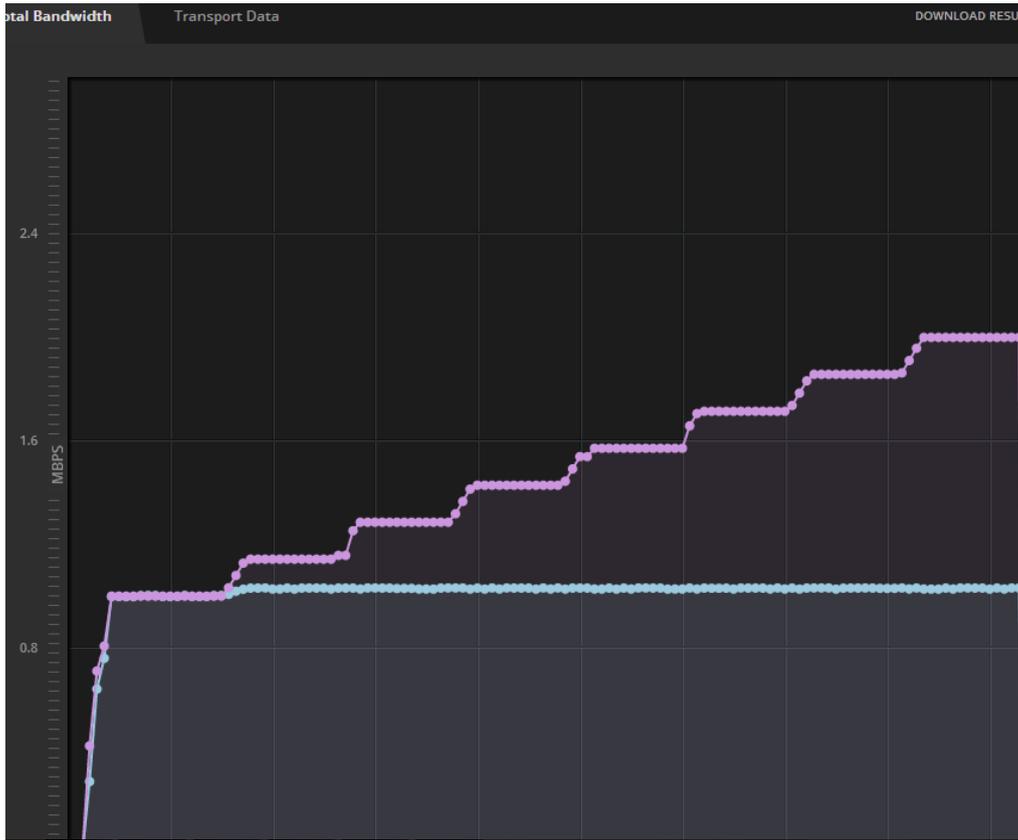


*Figure 4 – Bandwidth Cut By 50%*

As we can see from the graph above (translating Mbps into MBps), as we tried to go above the new limit in steps, we are bound by the WAN connection speed. This showed is that the ISP had created a real problem - half the bandwidth was unavailable.

On restoring the bandwidth we reran the original test and got the same result - zero packet loss and maximum bandwidth attained during the test.



*Figure 5 – Bandwidth Restored: Zero Packet Loss*

# TESTING: PHASE II- VOIPEX VIBE AND SPIRENT AXON

For the second phase of testing we created an all too familiar scenario - that of a company looking to increase their user base and therefore add WAN bandwidth. But can we prevent the need for that with a more cost effective voice and data optimisation solution? Enter Voipex ViBE...

First we looked at a number of typical office to office type scenarios without ViBE in place. Using the Spirent Axon appliance we created traffic application mixes including VoIP, HTTP 1.1 and FTP traffic and ran a series of tests to find the limits of the 8Mbps WAN connection without any optimisation in place. Our chosen traffic mix consisted of 500 FTP and 500 HTTP sessions, varying the number of VoIP calls, starting with the bare minimum number of calls we could achieve on our "vanilla" network, without dropping a call. Bear in mind our traffic is bi-directional. We then added the ViBE appliances into the network and reran the series of tests, comparing results - before and after.

The Axon device, in addition to providing a statistical breakdown of traffic performance - traffic sent and received, number of connections, dropped packets etc - also, for VoIP provides a MOS score for voice quality. MOS (Mean Opinion Score) is designed to obtain the human user's view of the quality of the network and call. Basically a score of four or above represents a satisfactory call quality. Below this mark becomes increasingly unacceptable. So we were looking to see MOS ratings of four and above, especially when ViBE was enabled.

## Test 1: 6 VoIP Calls

| Frame: 128 Bytes | PACKETS SENT (TX) | PACKETS RECEIVED (RX) | AVG RECEIVE RATE (BPS) | AVG JITTER (MS) | AVG LATENCY (MS) | PACKET LOSS | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 50,855 | 48,240 | 946,250 | 1.119 | 225.989 | 2,615 | | | |

| Player 2 | | | | | | | | | ⏱ Timing Accuracy: +/- 0.000 ms |
|---|---|---|---|---|---|---|---|---|---|
| **Track** | | | | | | | | | |

| Voice Call | CALLS ATTEMPTED | SUCCESSFUL | UNSUCCESSFUL | AVG CALLS PER SECOND ATTEMPTED | AVG CALLS PER SECOND SUCCESSFUL | AVG CALLS PER SECOND UNSUCCESSFUL | VOICE LOSS | AUDIO MOS | VIDEO MOS | VOIP MOS |
|---|---|---|---|---|---|---|---|---|---|---|
| | 12 | 12 | 0 | 0.2 | 0.2 | 0 | 1,043 | 0 | 0 | 3.4 |

| HTTP | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL | AVG RESPONSE TIME (MS) |
|---|---|---|---|---|---|---|---|---|
| | 6,854,586 | 762 | 761 | 1 | 492 | 492 | 0 | 16,692 |

| FTP | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL | |
|---|---|---|---|---|---|---|---|---|
| | 92,388 | 711 | 711 | 0 | 31 | 31 | 0 | |

| Summary | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL | |
|---|---|---|---|---|---|---|---|---|
| | 6,946,974 | 1,473 | 1,472 | 1 | 523 | 523 | 0 | |

*Figure 6 – Test: No ViBE, 6 VoIP Calls*

Without ViBE in place, when combining 500 ftp sessions with six (bi-directional) VoIP calls and 500 http sessions, we can see that - on the data side - latency was very high and packet loss was also very significant (around 4.4%).

VoIP traffic suffered significantly, even with such a low number of attempted calls with a high voice loss and a MOS of just 3.4 as a result. Response time for the http (web browser) sessions was also high.

| Frame: 128 Bytes | PACKETS SENT (TX) | PACKETS RECEIVED (RX) | AVG RECEIVE RATE (BPS) | AVG JITTER (MS) | AVG LATENCY (MS) | PACKET LOSS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 50,803 | 50,803 | 998,301 | 1.971 | 5.853 | 0 | | | | |

| Player 2 | | | | | | | | | | Timing Accuracy: +/- 0.000 ms |
|---|---|---|---|---|---|---|---|---|---|---|
| **Track** | | | | | | | | | | |
| Voice Call | CALLS ATTEMPTED | SUCCESSFUL | UNSUCCESSFUL | AVG CALLS PER SECOND ATTEMPTED | AVG CALLS PER SECOND SUCCESSFUL | AVG CALLS PER SECOND UNSUCCESSFUL | VOICE LOSS | AUDIO MOS | VIDEO MOS | VOIP MOS |
| | 12 | 12 | 0 | 0.2 | 0.2 | 0 | 0 | 0 | 0 | 4 |
| HTTP | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL | AVG RESPONSE TIME (MS) | | |
| | 6,105,748 | 500 | 500 | 0 | 419 | 419 | 0 | 20,745 | | |
| FTP | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL | | | |
| | 93,500 | 500 | 500 | 0 | 0 | 0 | 0 | | | |
| Summary | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL | | | |
| | 6,199,248 | 1,000 | 1,000 | 0 | 419 | 419 | 0 | | | |

*Figure 7 – Test: ViBE, 6 VoIP Calls*

With ViBE enabled, we saw zero packet loss and zero voice loss, with a MOS of 4 and a significant reduction in overall traffic latency and 12 out of 12 successful calls made. Web browser response was still high, but our focus here was on a one-time configuration (we made no changes to the VIBE configuration whatsoever between tests) to optimise voice and minimise packet loss.

In practise, it would be possible to optimise http traffic, if required, using ViBE. It all depends on what the actual requirements are, from an optimisation perspective. By default, the ViBE configuration prioritises small frames, which normally represent interactive traffic such as telnet, ssh or POS. The test results here show that, with the addition of ViBE, the latency of 128 byte frames drops from 225ms to 5ms while packet loss drops from 2615 frames to 0.

### Test 2: 40 VoIP Calls

| Frame: 128 Bytes | PACKETS SENT (TX) | PACKETS RECEIVED (RX) | AVG RECEIVE RATE (BPS) | AVG JITTER (MS) | AVG LATENCY (MS) | PACKET LOSS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 50,833 | 48,900 | 954,093 | 0.824 | 211.522 | 1,933 | | | | |

**Player 2** — ⏱ Timing Accuracy: +/- 0.000 ms

**Track**

| Voice Call | CALLS ATTEMPTED | SUCCESSFUL | UNSUCCESSFUL | AVG CALLS PER SECOND ATTEMPTED | AVG CALLS PER SECOND SUCCESSFUL | AVG CALLS PER SECOND UNSUCCESSFUL | VOICE LOSS | AUDIO MOS | VIDEO MOS | VOIP MOS |
|---|---|---|---|---|---|---|---|---|---|---|
| | 76 | 76 | 0 | 1 | 1.1 | 0 | 9,272 | 0 | 0 | 3.1 |

| HTTP | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL | AVG RESPONSE TIME (MS) |
|---|---|---|---|---|---|---|---|---|
| | 3,463,364 | 895 | 895 | 0 | 182 | 182 | 0 | 24,653 |

| FTP | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL |
|---|---|---|---|---|---|---|---|
| | 89,488 | 787 | 787 | 0 | 17 | 17 | 0 |

| Summary | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL |
|---|---|---|---|---|---|---|---|
| | 3,552,852 | 1,682 | 1,682 | 0 | 199 | 199 | 0 |

*Figure 8 – Test: No ViBE, 40 VoIP Calls*

Moving up to 40 calls, with no VIBE, we saw increased packet and voice loss, a significant increase in http response time, high overall latency and a reduced MOS of just 3.1. Also, only 76 calls were completed during the test period.

| Frame: 128 Bytes | PACKETS SENT (TX) | PACKETS RECEIVED (RX) | AVG RECEIVE RATE (BPS) | AVG JITTER (MS) | AVG LATENCY (MS) | PACKET LOSS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 50,836 | 50,831 | 996,473 | 1.97 | 6.956 | 5 | | | | |

**Player 2** — ⏱ Timing Accuracy: +/- 0.000 ms

**Track**

| Voice Call | CALLS ATTEMPTED | SUCCESSFUL | UNSUCCESSFUL | AVG CALLS PER SECOND ATTEMPTED | AVG CALLS PER SECOND SUCCESSFUL | AVG CALLS PER SECOND UNSUCCESSFUL | VOICE LOSS | AUDIO MOS | VIDEO MOS | VOIP MOS |
|---|---|---|---|---|---|---|---|---|---|---|
| | 80 | 80 | 0 | 1.1 | 1.1 | 0 | 0 | 0 | 0 | 4 |

| HTTP | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL | AVG RESPONSE TIME (MS) |
|---|---|---|---|---|---|---|---|---|
| | 4,404,422 | 500 | 500 | 0 | 255 | 255 | 0 | 24,934 |

| FTP | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL |
|---|---|---|---|---|---|---|---|
| | 93,500 | 500 | 500 | 0 | 0 | 0 | 0 |

| Summary | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL |
|---|---|---|---|---|---|---|---|
| | 4,497,922 | 1,000 | 1,000 | 0 | 255 | 255 | 0 |

*Figure 9 – Test: ViBE, 40 VoIP Calls*

Rerunning the test with ViBE enabled we saw perfect VoIP traffic flow, with a MOS of 4, and again a massively lower latency (7ms versus 211ms), consistent with the results in Test 1 and only five dropped packets in total, versus 1,933 without ViBE.

## Test 3: 80 VoIP Calls



| Frame: 128 Bytes | PACKETS SENT (TX) | PACKETS RECEIVED (RX) | AVG RECEIVE RATE (BPS) | AVG JITTER (MS) | AVG LATENCY (MS) | PACKET LOSS | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 50,797 | 49,615 | 972,509 | 0.76 | 198.795 | 1,182 | | | |

Player 2 — Timing Accuracy: +/- 0.000 ms

Track

| Voice Call | CALLS ATTEMPTED | SUCCESSFUL | UNSUCCESSFUL | AVG CALLS PER SECOND ATTEMPTED | AVG CALLS PER SECOND SUCCESSFUL | AVG CALLS PER SECOND UNSUCCESSFUL | VOICE LOSS | AUDIO MOS | VIDEO MOS | VOIP MOS |
|---|---|---|---|---|---|---|---|---|---|---|
| | 146 | 127 | 15 | 2 | 1.8 | 0.2 | 14,817 | 0 | 0 | 3.1 |

| HTTP | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL | AVG RESPONSE TIME (MS) |
|---|---|---|---|---|---|---|---|---|
| | 721,176 | 622 | 622 | 0 | 24 | 24 | 0 | 13,471 |

| FTP | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL | |
|---|---|---|---|---|---|---|---|---|
| | 93,795 | 573 | 573 | 0 | 16 | 16 | 0 | |

| Summary | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL | |
|---|---|---|---|---|---|---|---|---|
| | 814,971 | 1,195 | 1,195 | 0 | 40 | 40 | 0 | |

*Figure 10 – Test: No ViBE, 80 VoIP Calls*

Moving up to 80 VoIP calls, without VIBE we saw very significant voice loss (14,817) with 127 successful calls and a MOS of just 3.1.



| Frame: 128 Bytes | PACKETS SENT (TX) | PACKETS RECEIVED (RX) | AVG RECEIVE RATE (BPS) | AVG JITTER (MS) | AVG LATENCY (MS) | PACKET LOSS | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 50,941 | 50,387 | 983,608 | 1.965 | 11.335 | 554 | | | |

Player 2 — Timing Accuracy: +/- 0.000 ms

Track

| Voice Call | CALLS ATTEMPTED | SUCCESSFUL | UNSUCCESSFUL | AVG CALLS PER SECOND ATTEMPTED | AVG CALLS PER SECOND SUCCESSFUL | AVG CALLS PER SECOND UNSUCCESSFUL | VOICE LOSS | AUDIO MOS | VIDEO MOS | VOIP MOS |
|---|---|---|---|---|---|---|---|---|---|---|
| | 160 | 160 | 0 | 2.2 | 2.2 | 0 | 0 | 0 | 0 | 4 |

| HTTP | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL | AVG RESPONSE TIME (MS) |
|---|---|---|---|---|---|---|---|---|
| | 2,299,634 | 500 | 500 | 0 | 89 | 89 | 0 | 30,485 |

| FTP | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL | |
|---|---|---|---|---|---|---|---|---|
| | 93,500 | 500 | 500 | 0 | 0 | 0 | 0 | |

| Summary | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL | |
|---|---|---|---|---|---|---|---|---|
| | 2,393,134 | 1,000 | 1,000 | 0 | 89 | 89 | 0 | |

*Figure 11 – Test: ViBE, 80 VoIP Calls*

With VIBE enabled, we saw a flawless VOIP traffic performance - 160/160 successful calls and a MOS of 4, massively reduced packet loss and hugely lower latency again.

### Test 4: 180 VoIP Calls

| Frame: 128 Bytes | PACKETS SENT (TX) | PACKETS RECEIVED (RX) | AVG RECEIVE RATE (BPS) | AVG JITTER (MS) | AVG LATENCY (MS) | PACKET LOSS | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 50,908 | 48,490 | 946,658 | 0.733 | 201.994 | 2,418 | | | |

**Player 2** — Timing Accuracy: +/- 0.000 ms

**Track**

| Voice Call | CALLS ATTEMPTED | SUCCESSFUL | UNSUCCESSFUL | AVG CALLS PER SECOND ATTEMPTED | AVG CALLS PER SECOND SUCCESSFUL | AVG CALLS PER SECOND UNSUCCESSFUL | VOICE LOSS | AUDIO MOS | VIDEO MOS | VOIP MOS |
|---|---|---|---|---|---|---|---|---|---|---|
| | 321 | 200 | 88 | 4.2 | 2.8 | 1.1 | 28,989 | 0 | 0 | 3 |

| HTTP | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL | AVG RESPONSE TIME (MS) |
|---|---|---|---|---|---|---|---|---|
| | 389,042 | 678 | 678 | 0 | 18 | 18 | 0 | 12,783 |

| FTP | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL |
|---|---|---|---|---|---|---|---|
| | 90,091 | 573 | 573 | 0 | 21 | 21 | 0 |

| Summary | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL |
|---|---|---|---|---|---|---|---|
| | 479,133 | 1,251 | 1,251 | 0 | 39 | 39 | 0 |

*Figure 12 – Test: No ViBE, 180 VoIP Calls*

Four our final comparison test we upped the number of VoIP calls to 180, maintaining all other traffic parameters. Without VIBE in place voice loss doubled, with just 200 successful calls achieved and a MOS reduced to 3. Average latency was still very high.

| Frame: 128 Bytes | PACKETS SENT (TX) | PACKETS RECEIVED (RX) | AVG RECEIVE RATE (BPS) | AVG JITTER (MS) | AVG LATENCY (MS) | PACKET LOSS | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 50,947 | 23,515 | 466,474 | 1.825 | 96.03 | 27,432 | | | |

**Player 2** — Timing Accuracy: +/- 0.000 ms

**Track**

| Voice Call | CALLS ATTEMPTED | SUCCESSFUL | UNSUCCESSFUL | AVG CALLS PER SECOND ATTEMPTED | AVG CALLS PER SECOND SUCCESSFUL | AVG CALLS PER SECOND UNSUCCESSFUL | VOICE LOSS | AUDIO MOS | VIDEO MOS | VOIP MOS |
|---|---|---|---|---|---|---|---|---|---|---|
| | 360 | 360 | 0 | 4.8 | 4.9 | 0 | 0 | 0 | 0 | 4 |

| HTTP | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL | AVG RESPONSE TIME (MS) |
|---|---|---|---|---|---|---|---|---|
| | 620,632 | 466 | 466 | 0 | 5 | 5 | 0 | 27,369 |

| FTP | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL |
|---|---|---|---|---|---|---|---|
| | 63,855 | 467 | 467 | 0 | 1 | 1 | 0 |

| Summary | GOODPUT BYTES (RX) | CONNECTIONS ATTEMPTED | CONNECTIONS SUCCESSFUL | CONNECTIONS UNSUCCESSFUL | TRANSACTIONS ATTEMPTED | TRANSACTIONS SUCCESSFUL | TRANSACTIONS UNSUCCESSFUL |
|---|---|---|---|---|---|---|---|
| | 684,487 | 933 | 933 | 0 | 6 | 6 | 0 |

*Figure 13 – Test: ViBE, 180 VoIP Calls*

Even with the increase in calls, again we saw a flawless VoIP performance with 360/360 completed calls and a MOS of 4. Packet loss did increase on this occasion, but - as aforementioned - our configuration was set up optimise VoIP ahead of all else, the purpose of this set of tests. Also bear in mind that overall utilisation of the WAN connection is far greater that it was without ViBE.

BROADBAND
TESTING

# Test 5: ViBE Enabled - 50% Bandwidth Loss

| Player 1 | | | | | | | Timing Accuracy: +/- 0.000 ms |
|---|---|---|---|---|---|---|---|
| **Track** | | | | | | | |
| **Frame: 128 Bytes** | PACKETS SENT (TX) 50,804 | PACKETS RECEIVED (RX) 25,295 | AVG RECEIVE RATE (BPS) 488,079 | AVG JITTER (MS) 1.773 | AVG LATENCY (MS) 98.833 | PACKET LOSS 25,509 | |

| Player 2 | | | | | | | | | | | Timing Accuracy: +/- 0.000 ms |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Track** | | | | | | | | | | | |
| **Voice Call** | CALLS ATTEMPTED 360 | SUCCESSFUL 360 | UNSUCCESSFUL 0 | AVG CALLS PER SECOND ATTEMPTED 4.9 | AVG CALLS PER SECOND SUCCESSFUL 4.9 | AVG CALLS PER SECOND UNSUCCESSFUL 0 | VOICE LOSS 0 | AUDIO MOS 0 | VIDEO MOS 0 | VOIP MOS 4 | |
| **HTTP** | GOODPUT BYTES (RX) 756,444 | CONNECTIONS ATTEMPTED 180 | CONNECTIONS SUCCESSFUL 180 | CONNECTIONS UNSUCCESSFUL 0 | TRANSACTIONS ATTEMPTED 28 | TRANSACTIONS SUCCESSFUL 28 | TRANSACTIONS UNSUCCESSFUL 0 | AVG RESPONSE TIME (MS) 23,414 | | | |

*Figure 14 – Test: ViBE, 180 VoIP Calls*

We ran one final test, designed to really challenge ViBE's ability to optimise VoIP, with a combination of still 180 VoIP calls and 180 http sessions but running over just half the bandwidth - a 4Mbps connection. Despite the 50% bandwidth loss, we still saw a perfect VoIP performance with 360/360 successful calls, and a MOS of 4. Additionally, all 180 http connections were successful.

# SUMMARY & CONCLUSIONS

This was kind of a test within a test.

First and foremost we were putting Voipex's ViBE technology to the test but, equally, we were looking to see just how simple and efficient that test process can be using Spirent's Axon traffic generator.

Dealing with the latter first, we found that we could get through a huge number of test iterations in a very small amount of time, regardless of whether changes needed to be made between tests or not. If, as we argued earlier, that regular testing for troubleshooting problems - and providing pro-active solutions - is a fundamental requirement for contemporary enterprise network management now, then that augurs well for cost-efficient, regular testing.

Using the Axon appliance we were able to identify exactly how much bandwidth we were receiving from our "virtual" ISP, and then validate that the full bandwidth was available once our "deliberate error" had been corrected by the "virtual" ISP.

We then brought in Voipex ViBE VoIP and data optimisation technology to see how its appliance-based solution could optimise our basic 8Mbps WAN connection. Using our "vanilla" network setup as the baseline, we found that ViBE could significantly increase the number of VoIP calls, the quality of those calls AND optimise data connectivity at the same time.

Not only was ViBE able to massively optimise VoIP calls but overall utilisation of the WAN link was also hugely increased and overall latency dropped by a factor of 45:1 - very impressive stuff.

We can therefore make a dual recommendation here: those looking for a means of accelerating and simplifying their testing - as well as making it more cost-effective - should take a look at the Spirent Axon device.

And any company from SMB to ISP who wants to be able to optimise bandwidth consumed by a mix of VoIP and data - or simply VoIP alone - should invest in Voipex's ViBE technology. It really is that much of a no-brainer.

# APPENDIX 1: THE SPIRENT AXON TEST APPLIANCE

The Spirent Axon product is all about simplifying the process of testing without compromising on capability - a tough ask.



*Figure 15 – Spirent Axon*

It comes in the form of a compact chassis with two different port configuration options - either 4xGigabit or 2x10Gigabit (10GBASE-SR - standard, or 10GBASE-LR - optional). In addition there is an admin (management) port and two USB ports



*Figure 16 – Spirent Axon Dashboard*

The user interface is browser-based (any browser-supporting device can be used to control the software, such as a tablet) and reveals a dashboard as the "home screen".

Operation is largely wizard based, and basic test setup is a three-stage process. To get started, you simply choose a test from the library of pre-built tests. Next, you drag and drop the traffic types you want to model into your "playlist". You use sliders to mix traffic

types to reflect your specific environment, enter the maximum bandwidth or users to emulate and then hit "Play".
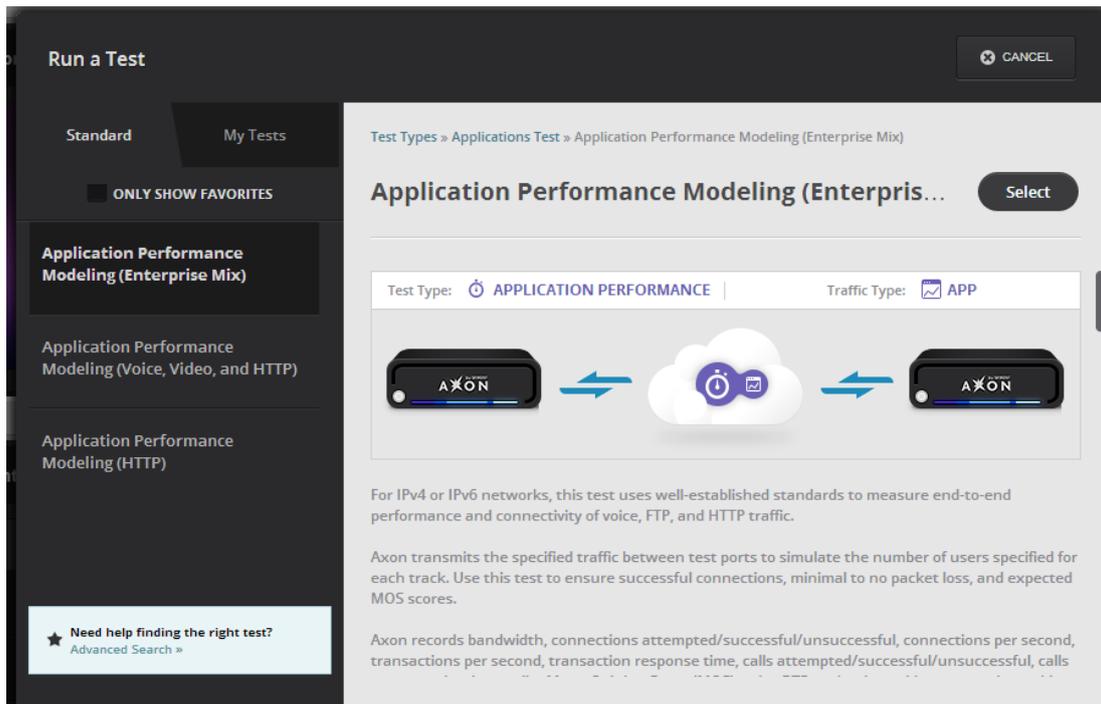


*Figure 17 – Setting Up A Test*

Axon includes a library of pre-built tests so you can simply run "off the shelf" traffic scenarios, such as:

➢ Layer 2/3 Network Performance Modelling IPv4 and IPv6

➢ Layer 2/3 Network Stress Test Ipv4 and Ipv6

➢ Enterprise Traffic Mix Performance Modelling (IPv4 and IPv6)

➢ Network QoS Performance Ipv4 and IPv6

➢ Site to Site Performance Test Ipv4 and IPv6

➢ Site to Site with SLA Verification

➢ Site to Site Application Performance

➢ Mixed Protocol Ipv4 and IPv6 Performance test

➢ HTTP Web Application Performance Test

# APPENDIX 2: THE DEVICE UNDER TEST - VOIPEX VIBE 3

Our Device Under Test (DUT) for this report - and a perfect vehicle for assessing the merits of the Spirent Axon test appliance - is Voipex's ViBE data/voice optimisation appliance.

Initially, the product was very much focused on VoIP optimisation but with V3 of the ViBE technology, Voipex has made the product far more networking-centric, without losing any of the unique VoIP optimisation features it already had in place. ViBE is now very much a WAN optimisation technology, designed to enhance the quality and performance of all data circuits and to deliver IP-voice services with superior quality and a multi-fold increase in call capacity. So, in addition to providing up to a 500% increase in IP call capacity, the technology is designed to enhance performance of cloud applications and all other IP communication services. Additionally, it provides a number of genuinely unique bandwidth stacking and resilience options, some of which are designed to reduce latency and packet loss to a minimum. For example, when using interactive TCP applications such as Citrix, Remote Desktop, SQL and Telnet as well as real-time UDP applications such as IP-voice, video and streaming data, packet loss can be virtually eliminated.

When VoIP traffic is transported over the network, invisible overheads are introduced. The overhead varies depending on the encoding of the VoIP traffic and the type of network it is travelling over – for example this may be Ethernet, ADSL, Satellite or 3G. ViBE removes the overhead, so you absolutely minimise the actual bandwidth use. ViBE also uses a number of methods to enhance the performance of data connections, be they for internet or WAN data. These include:

**RAIN mode** (i.e. a Redundant Array of Inexpensive Networks) utilises two or more data circuits to send duplicate data to the ViBE head end device. Utilising RAIN mode reduces packet loss as the packet will often pass on the duplicate circuit if dropped. RAIN mode also completely eliminates failover delay time as the secondary data circuit is always active with the mirrored data payload in transport. Note that many QoS-enabled routers and WAN optimisation devices actually induce latency in order to prioritise and optimise data traffic.

**Bandwidth stacking** delivers bonding beyond belief and combines multiple data links into one large data pipe. ViBE's bandwidth stacking differs from traditional link bonding as it doesn't become less efficient as more circuits are added and it doesn't suffer from out-of-order packets – the Achilles heel of link bonding. Additionally, bandwidth stacking is often more cost effective than purchasing a larger-capacity data circuit. ViBE is also able to efficiently bond links of differing type and speed, which allows greater resiliency to be designed into the solution by using different data service types or even a selection of service providers.

By combining Bandwidth Stacking and RAIN mode features you can utilises three or more data circuits to send duplicate data to the ViBE head end device and to increase the speed of the data connection.

**Active/Passive mode** is suitable for low-speed data circuit backup solutions, such as ISDN2 or 3G services. ViBE automatically tests the passive (redundant) link for

availability and can switch to the redundant link immediately. Active/Passive mode can be combined with any of the above modes to add a final level of failover.

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**How Is ViBE Deployed?**

For businesses, a ViBE router can be deployed behind DSL modems or connected directly to Ethernet services. The ViBE router can be configured as the main gateway router or it can sit within an existing infrastructure to provide ViBE-enabled services.

Businesses can connect to ViBE-enabled service providers, who would have a ViBE head-end installed within their infrastructure.

Additionally, for businesses wishing to use ViBE across a multi-site WAN, this can be delivered either via a ViBE-enabled service provider or by deploying a ViBE head-end within the corporate infrastructure.

There are a number of other options available for deploying ViBE, including VMware and ViBE embedded in third party devices.

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## The Products



*Figure 18 – ViBE 200 Series Routers*

Voipex produces a range of ViBE routers featuring the full technology spectrum.

The ViBE 200 series router is a full-functioned internet gateway router for businesses and is ready for connection to a ViBE-enabled service provider. The 200 series can also be used as a branch office router in enterprise deployments of ViBE. The 200 series routers feature three Ethernet ports. Typically these would be configured in a 1x LAN and 2x WAN arrangement that would allow two discrete WAN connections. The 200 series can also address multiple ADSL modems off a single Ethernet WAN port, which means solutions such as bandwidth stacking of multiple circuits can be achieved by simply plugging a bank of ADSL modems connected to a switch to the ViBE router's WAN port. The ViBE Dual Link 303 router has been designed to take full advantage of ViBE bonding (bandwidth stacking) functionality. The 2 x ADSL ports at the back of the 303 router mean that this is all the hardware required to bond two ADSL lines together. ViBE's unique RAIN mode is also fully supported by the Dual link 303, giving voice and data packets an extra level of resilience (critical for VoIP or real-time applications).

Utilising RAIN mode reduces almost all packet loss (for data & voice). As packets are mirrored over duplicate circuits, any dropped packets are simply recovered by the corresponding duplicate data packet.

The ViBE 500 series router offers additional features and functionality for enterprise deployments over multi-site WANs as well as added hardware resiliency by offering hardware failover. You can use a pair of ViBE 500 series routers to connect to a service provider for ViBE-enabled services and build additional resilience into data services by using hardware failover. When combined with multiple data circuits, a pair of resilient 500 series routers can ensure a business will almost always stay connected. Additionally, the ViBE 500 series router can act as a central point in a ViBE multi-site WAN deployment, bringing the advantage of a fully managed multi-site, bandwidth-optimised WAN into an IT management framework. The ViBE 500 series VMware router virtualises ViBE in a data centre using exactly the same software image that runs on the SPS-503 physical appliance, providing all the functionality of ViBE's hardware-based solutions with the flexibility of VMware.

### ViBE 600 Series Head End Router

Voipex also offers a ViBE 600 Series Head End Router. In this scenario the ViBE head end device is installed at either the service provider data centre, corporate head office or at one end of a point-to-point link. The head end device is a routing-concentrator that consolidates all ViBE traffic and offers the option to encrypt ViBE tunnels, have a stateful packet inspection firewall, SNMP traffic monitoring and policy-based routing or dynamic routing via BGP or OSPF for automatic injection of ViBE customer routes into the backbone network.

### ViBE-Max



*Figure 19 – ViBE-Max*

ViBE-Max  is aimed primarily at the private leased lines and backhaul markets and runs on Dell Power Edge servers, where the hardware configuration can be customised on a per client basis in order to add redundancy, resilience and other features required to maintain a high level of traffic. It can handle 12,000 calls per server and also has the option for integrating a STM-1 Card over which you can get 12000 G.729 calls over a single STM-1 circuit.