BROADBAND TESTING

Voipex ViBE v3 Report

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

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Tel : +376 633010
E-mail : info@broadband-testing.co.uk
Internet : HTTP://www.broadband-testing.co.uk

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EXECUTIVE SUMMARY

- Here we are in 2013 and bandwidth limitations, notably on public/Internet connections are still creating problems.
- The "big data" hit and massive increase in bandwidth-hungry applications such as video are often eating up as much bandwidth as we can throw at them. Equally, other fundamental issues such as latency and jitter are creating enormous problems for real-time applications such as video and VoIP and for certain applications such as digital video transfer, where the sequencing during the transfer has to be absolutely correct.
- Meantime, the cloud and SaaS are effectively creating yet more potential bottlenecks while, admittedly, offering a cost-effective access and storage mechanism for applications in general.
- So, the requirement to control and optimise bandwidth, especially on public connections, has never been greater. At the same time, voice and data really have now converged, but while voice needs to be optimised as much as any other real-time "application" the traditional WanOp tools out there offer nothing beyond very basic QoS mechanisms, which are simply not enough in many cases.
- With its ViBE technology, Voipex has created an across-the-board optimisation solution for all applications and with truly unique VoIP capabilities, such as the ability to offer 5-8 times the number of calls that regular VoIP technology can, across the same connection.
- Moreover, ViBE is network agnostic, so applies equally to Satellite and mobile data networks - for example - as it does classic xDSL and leased line connections.
- Real-time connection monitoring capabilities such as ViBE's EsP functionality, mean that - regardless of the "real" bandwidth actually available at any one time - a connection is always optimised with real-time QoS applied on an ongoing basis.
- With RAIN mode enabled we were able to show - even in single-link format - zero packet loss capability and improved delivery, as well as no failover problems.
- Channel-bonding capabilities are taken way beyond their norm with multiple redundancy formats available and the means to bond across multiple different services.
- Overall, the ViBE technology offers something different to the mainstream WAN optimisation players, both in terms of its data management and the VoIP specific optimisation, so is therefore worth considering even if you have existing WAN optimisation solutions in place.

INTRODUCTION: BANDWIDTH NEEDS OPTIMISING MORE THAN EVER

So many IT commentators over the years have talked about the coming of networking nirvana - affordable, unlimited bandwidth.

In which case - where is it? Moreover, even where bandwidth is plentiful, this doesn't mean that *any* application can be delivered efficiently. The contemporary mix of applications are not only typically very bandwidth intensive but also very sensitive to latency (delay, flutter etc), voice and video especially so.

At the same time, more and more users are turning new cloud-based applications - a world that brings its own challenges in terms of performance, being primarily Internet-based, and these need to be addressed if cloud computing is to be a realistic way forward for most businesses. Even traditional wired connections are becoming significantly over-subscribed when described as high-speed; just witness the user complaints.

In other words, we need to effectively reduce the required bandwidth, in order to not grind to a complete halt, as more and more data intensive applications become in popular use. And this is not a new trend, just one that is becoming increasingly magnified. As long ago as 2008, 80% of all new PBX lines installed internationally were VoIP-based. And in 2011, according to Gartner, 53% of all Internet traffic was video-based. This puts a huge strain on available bandwidth and is a major issue when links have even remotely high latency. By default, network routers handle traffic on a first-come, first-served basis. Network routers on high volume traffic links may introduce latency that exceeds permissible thresholds for VoIP. Fixed delays cannot be controlled, as they are caused by the physical distance the packets travel. Methods such as DiffServ provide basic control in an attempt to minimise latency but are not enough by themselves in the VoIP world.

At enterprise level, in particular the classic hub and spoke central HQ/branch office environment that is favoured by many UK companies especially, having a reliable, cost-effective voice and data network in place is fundamental to the art of making business profitable. The question is, how do you maximise that bandwidth and ensure predictable, reliable delivery of voice and data without over-engineering the network and spending a fortune on bandwidth?

So, while there is always talk of the era of unlimited bandwidth, this simply isn't true. We regularly witness poor file service performance, suffer from excessive Internet backhaul, slow SSL encrypted SaaS applications and an inability to use thick-client applications over the WAN. Throw in the aforementioned issue with voice and video and we see that the traditional approach to problem solving – more bandwidth – is ineffective, since most networks are now bound by a more fundamental limitation: latency. In response, many IT organizations have begun to evaluate specialised solutions that can accelerate application delivery by overcoming latency and expanding throughput. However, many of these solutions address only part of the overall mix of challenges and we still come back to the broader issue of latency.

VOIPEX VIBE V3: PRODUCT OVERVIEW

The Technology

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 actually 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.

Stacked RAIN mode combines Bandwidth Stacking and RAIN mode features. It utilises 4 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.

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.

The Products

Figure 1 – 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.

Building on the robust feature set of the ViBE 200 series routers, 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. This allows virtualised deployment options for service providers and enterprises. The 500 series VMware router gives all the functionality of ViBE's hardware-based solutions with the flexibility of VMware. Virtualised services are easy to deploy and provide a saving over purchasing dedicated hardware. This version of the software supports up to 200 simultaneous calls.

ViBE 600 Series Head End Router

Depending on the deployment model, 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.

3rd Party ViBE Options

ViBE enabled firmware images are available for certain devices manufactured by third-party vendors. ViBE functionality is dependent on the underlying hardware. These include routers from Netgear, Mikrotik, Billion and Far South Networks.

In the case of ViBE being installed on a third-party device a separate licence is required to activate ViBE on that device.

ViBE Version 3 MPLS/VRF Integration and Replacement

With the introduction of version 3, ViBE adds the ability to more tightly integrate with VLAN, VRF and MPLS enabled networks.

Essentially, this feature allows for separation of customer network traffic within a single ViBE server device, and for the transportation of that traffic externally within separate physical or logical networks. In addition, these same features allow providers to supply MPLS-VPN type networks without the need for an MPLS core – using ViBE as a replacement for such a core. Version 3 allows the creation of multiple virtual interfaces which form the end points of traffic from customer CPE devices. CPE devices can each have their own virtual interface at the server end, or multiple CPEs can be assigned to each virtual interface.

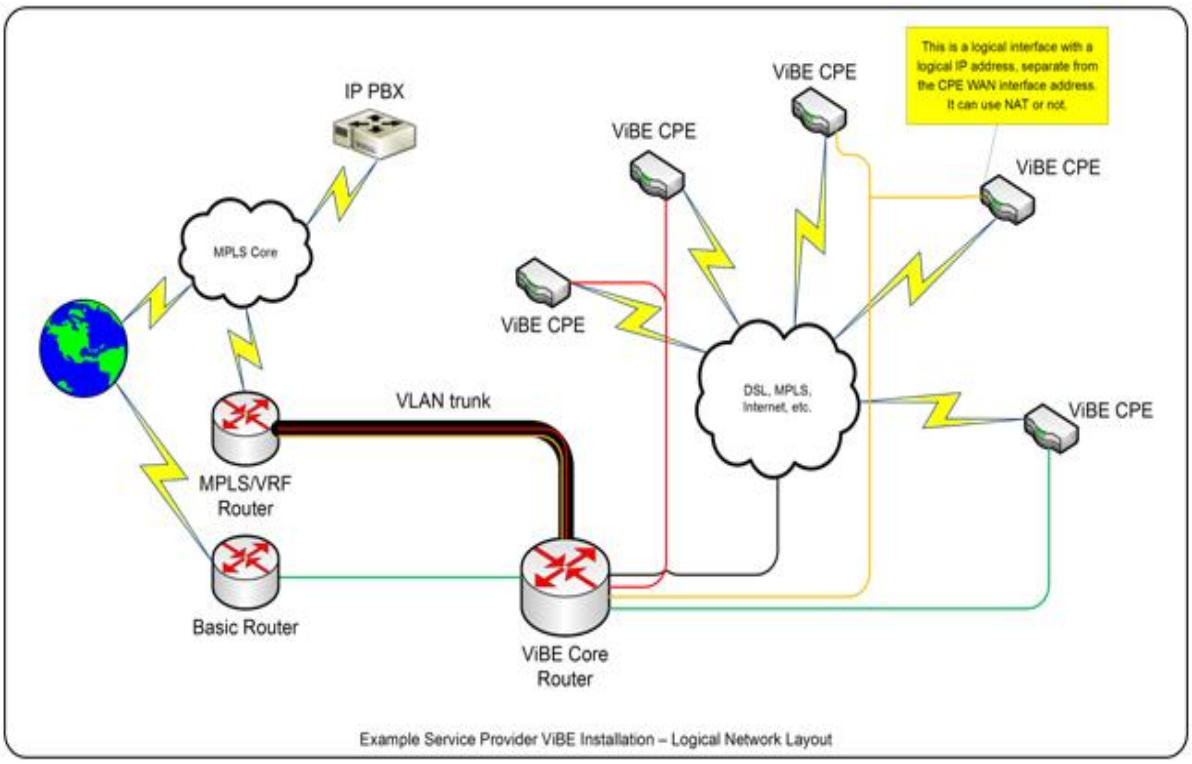


Figure 2 – EsP Impact on QoS and Jitter With Network Congestion

In the diagram above, the red, orange and green lines represent the virtual network paths over which traffic can flow to reach the LAN side of a CPE device, or networks beyond the ViBE core router. These virtual networks can consist of VLANs and ViBE tunnels, and are kept completely separate from each other until such time as they connect to a public network through a firewall.

The configuration in terms of network layout is extremely flexible. There is no reason, for example, why the cloud over which the ViBE protocol tunnels run could not be the same MPLS cloud that connects the PBX in the example above. Alternatively, that cloud could be the entire Internet, allowing the possibility of branch sites in international locations with no physical dedicated link.

VIBE V3 IN ACTION

UNIQUE QoS

Most companies typically allocate only around 70% maximum bandwidth because of the inherent overheads on the network and the need to provide some level of "safety net".

It's what we call the "lowest common denominator" way of guaranteeing network uptime. The simplest way to enhance performance here is - in theory - to apply traditional QoS methods, but these are extremely limited in terms of their capabilities. If we look at traditional QoS applied to a relatively low bandwidth link of 400kbps (i.e. not using ViBE at all) we can see what impact it has. This test is still relevant in today's world because many DSL links still have upload speeds of this order, and also things don't get a great deal better even at many times this bandwidth with contention-based technologies such as ADSL. The QoS profile employed gave highest priority to RTP, then next came ICMP (which we are using here to represent "real time interactive traffic" such as Telnet, SSH or some POS system) and finally bulk data, which in this case is just a single TCP stream. Note that the situation would be much worse if there were multiple TCP streams or indeed UDP streams which could potentially use all of the bandwidth.

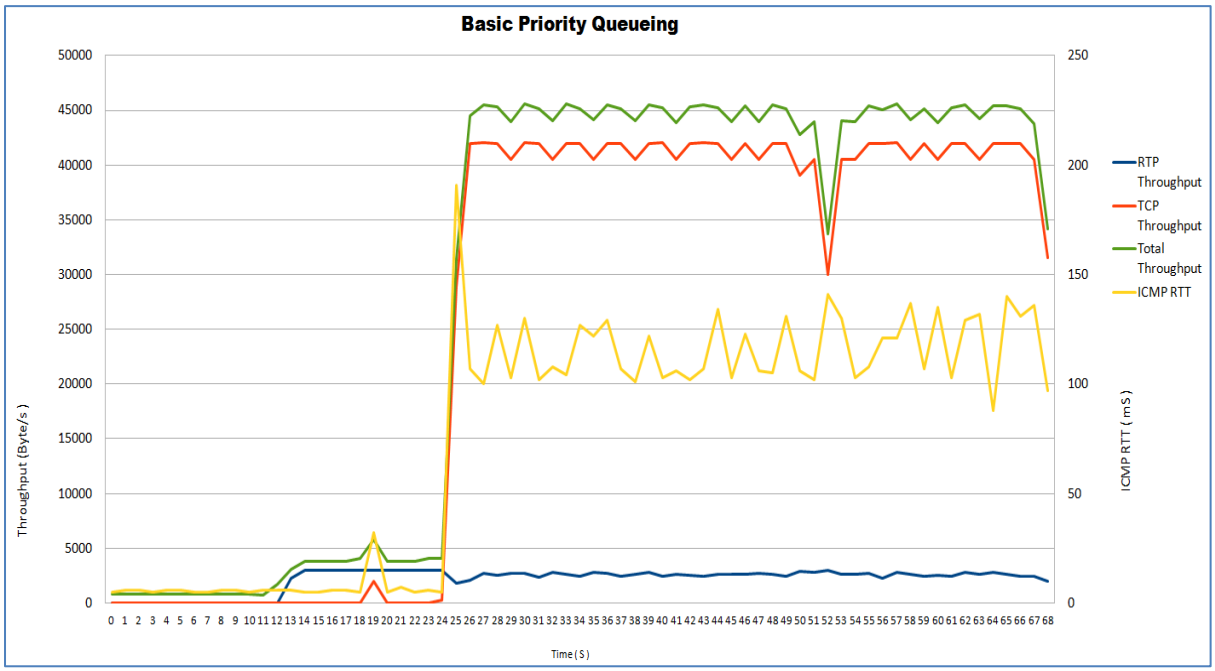


Figure 3 – Basic QoS Applied

From the graph you can see that ICMP RTT is badly affected, even though our QoS profile gave the second highest priority to that traffic (behind RTP) This is because packets already in the router send queue have to be sent before a slot is available for the ICMP. You can also see that the RTP is not "smooth" any more, though the next graph shows this in more detail. In this graph, the green lines represent the nominal spacing of the RTP, which in this case is 20ms. The black and the red represent jitter and differences from that nominal 20ms spacing. Again, you can see that it is quite bad, even though this is just a single call sharing a link with a single TCP stream – we could have made it look much worse!

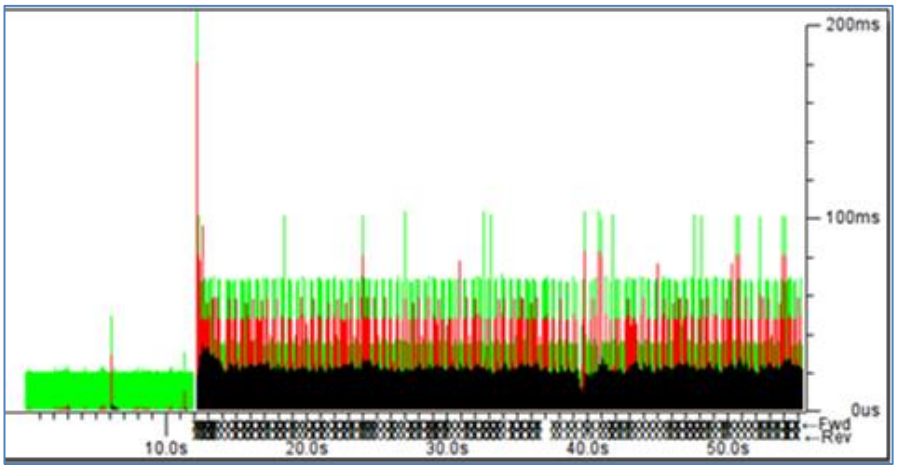


Figure 4 – Effects Of Basic QoS

For completeness, there is a trade-off that can be made in order to try to improve this situation. The MTU of the link can be reduced, thereby improving the theoretical latency and jitter for real time traffic, while reducing the efficiency for bulk traffic. The results of doing this follow:

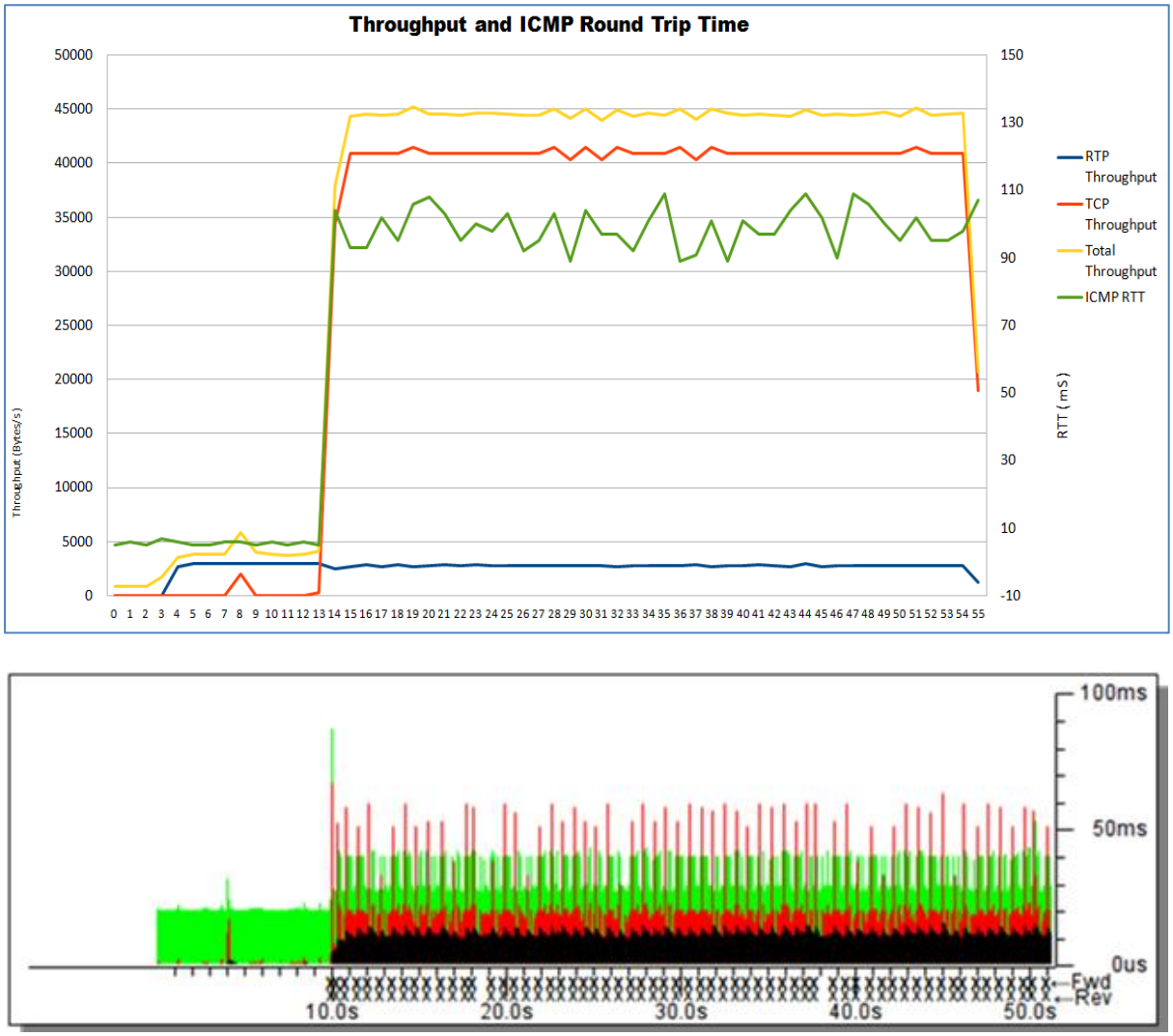


Figure 5 – Improved But Trade-Off

We can see that the situation has improved a little, but it still isn't great... plus we have lost some of our throughput. Also remember that this is a very artificial scenario – normally there would be many more data streams than a single TCP session.

Adding ViBE QoS at Low Bandwidth

The following two graphs show EXACTLY the same scenario above in terms of link and traffic, but now ViBE is applied across the link and traffic passed through its tunnel. There have been no tweaks to ViBE settings in terms of how it applies its QoS, this is pure "out of the box."

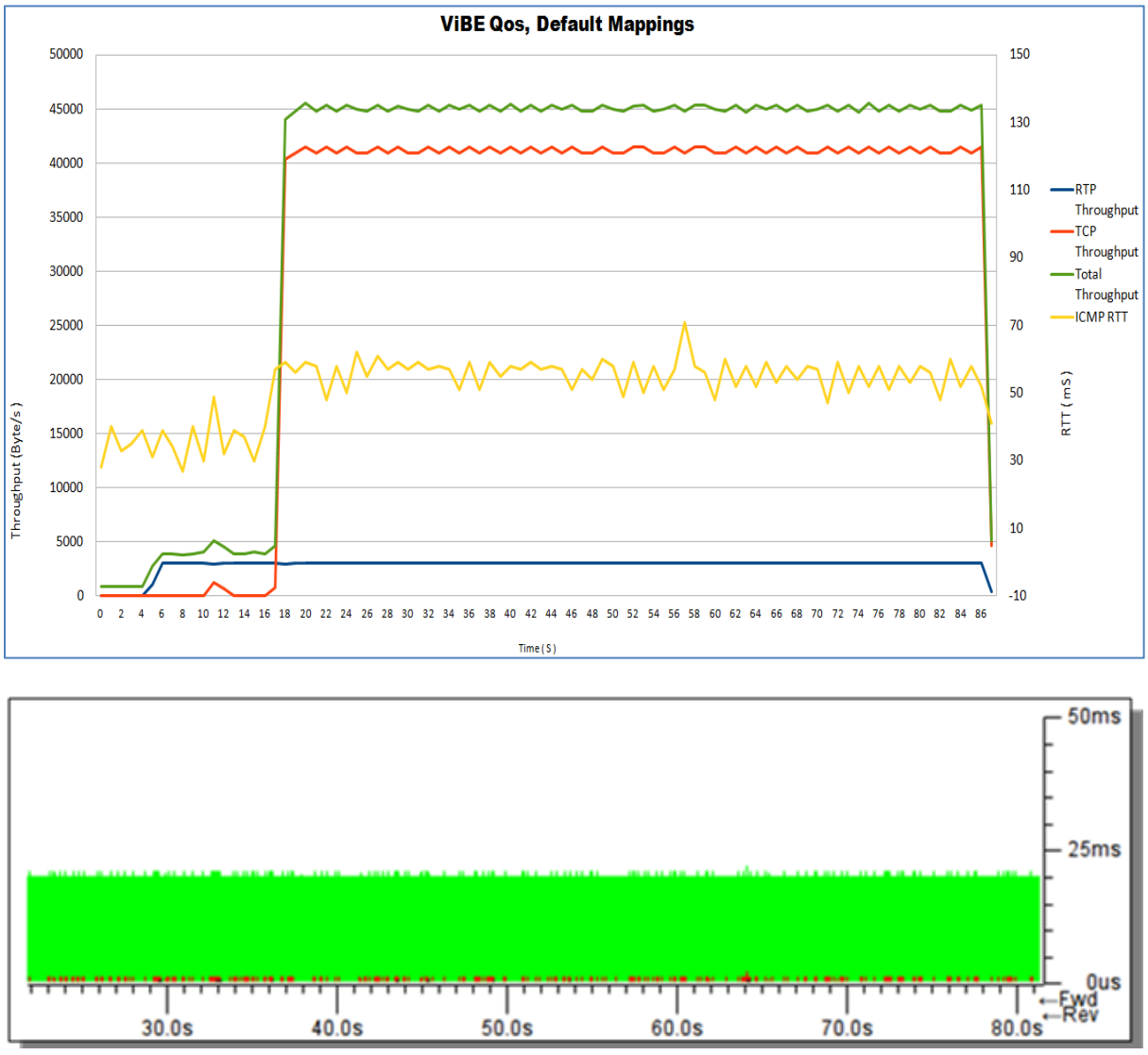


Figure 6 – Effect of ViBE QoS

Immediately we can see that the RTT of the real time traffic is affected very little by the presence of the TCP stream. In addition, the RTP is now obviously "smooth." One point to note here is that on this link, the RTT of the ICMP when there is NO OTHER TRAFFIC is slightly higher with ViBE around 20ms higher) but still only peaks at 45ms (note, graph scale is different to previous one). However, since in any real world case there would generally be other traffic on the link, the reality is that the latency will generally be less when using ViBE versus without. Also, with higher bandwidth links, this additional

quiescent RTT would be much lower (for a 2Mbps symmetrical link it would generally be around 5ms, for example.). We can now see that the jitter graph is as near perfect as it could be, with errors of the order of a couple of milliseconds maximum.

EsP (Estimated Performance)

Any QoS system needs to know the true throughput of a connection end to end in order to function, which is why such mechanisms generally need to be applied in the network core. However, much of the time, this is not possible, or is certainly an expensive option. So another new feature of ViBE is the ability to measure the bandwidth between a server and CPE so that it can adjust its QoS profiles accordingly. ViBE constantly monitors the link, so can estimate bandwidth available in real time all the time - what Voipex calls EsP or "estimated performance". It monitors received packets, works out what is late arriving and throttles back accordingly and ViBE QoS then cuts in as required.

Initially we put it to the test using iPerf. We set an artificial 13Mbps bandwidth limit and saw 11.9Mbps being consistently registered. We then added a token bucket filter of 1Mbps between the two ends of the network and saw bandwidth usage fall to 1075Mbps then down to 980Mbps, so ESP has effectively recognised the real bandwidth availability and adjusted the throughput accordingly. Obviously this was an artificial setup but it worked immediately.

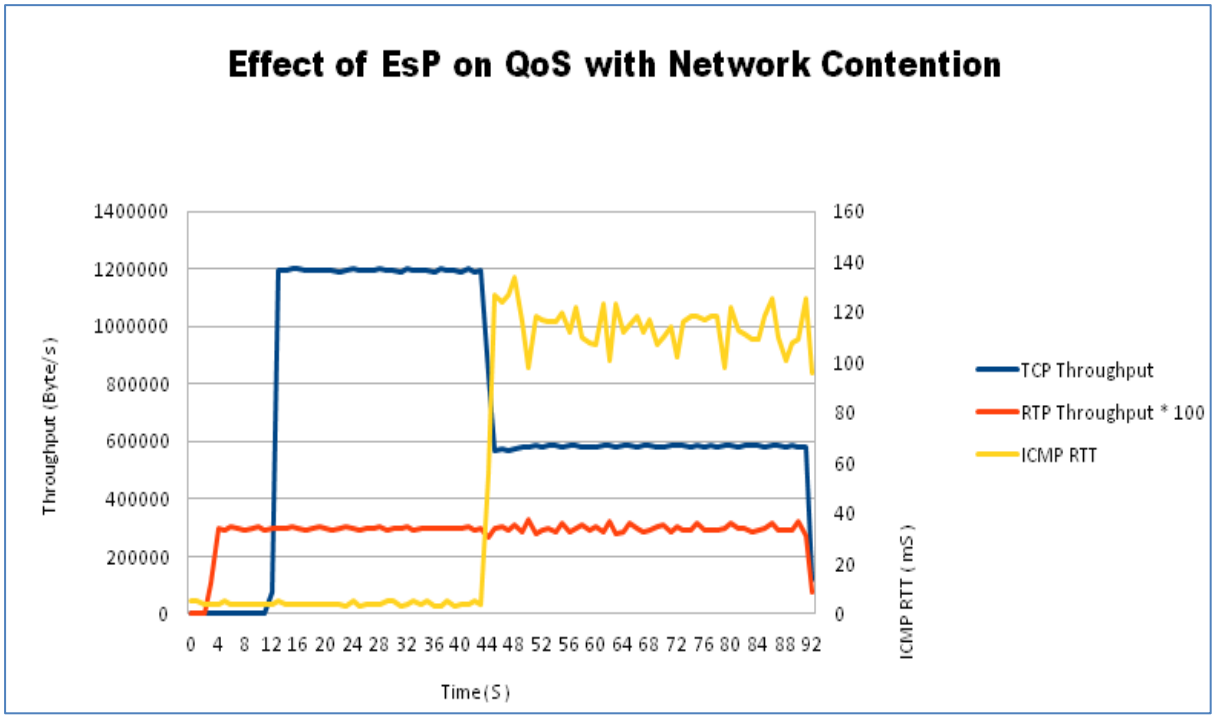


Figure 7 – ViBE Link With Severe Congestion

With a second test, the above graph shows what happens to a ViBE link which suffers severe congestion within its core network. This would, for example, be as a result of contention in an ADSL cloud. ViBE is actually already pretty good at coping with such events when it comes to VoIP – as we can see from the red line above (note that RTP throughput has been multiplied by 100 so that it is visible on this scale).

The true problem, however, can be seen in the RTT shown by the yellow line – remember that this is a 10Mbps symmetric link! Without using ViBE, the RTP of the voice call would suffer a similar fate.

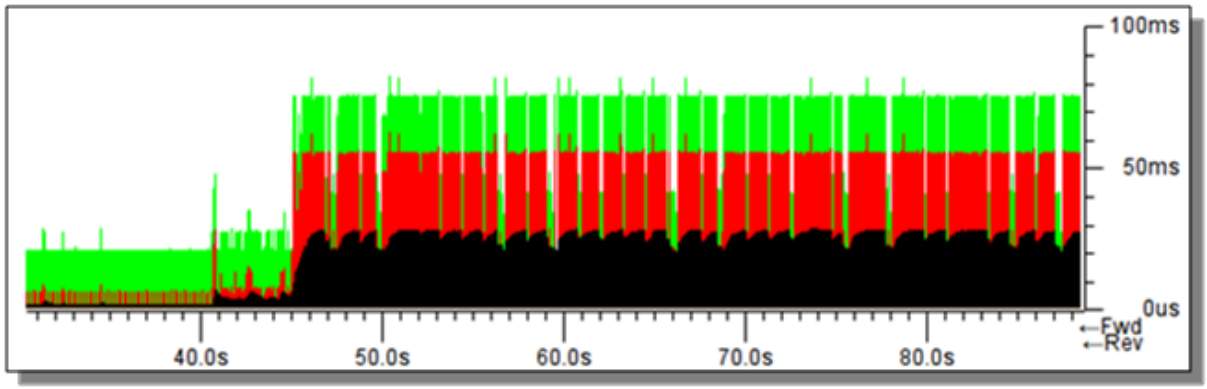
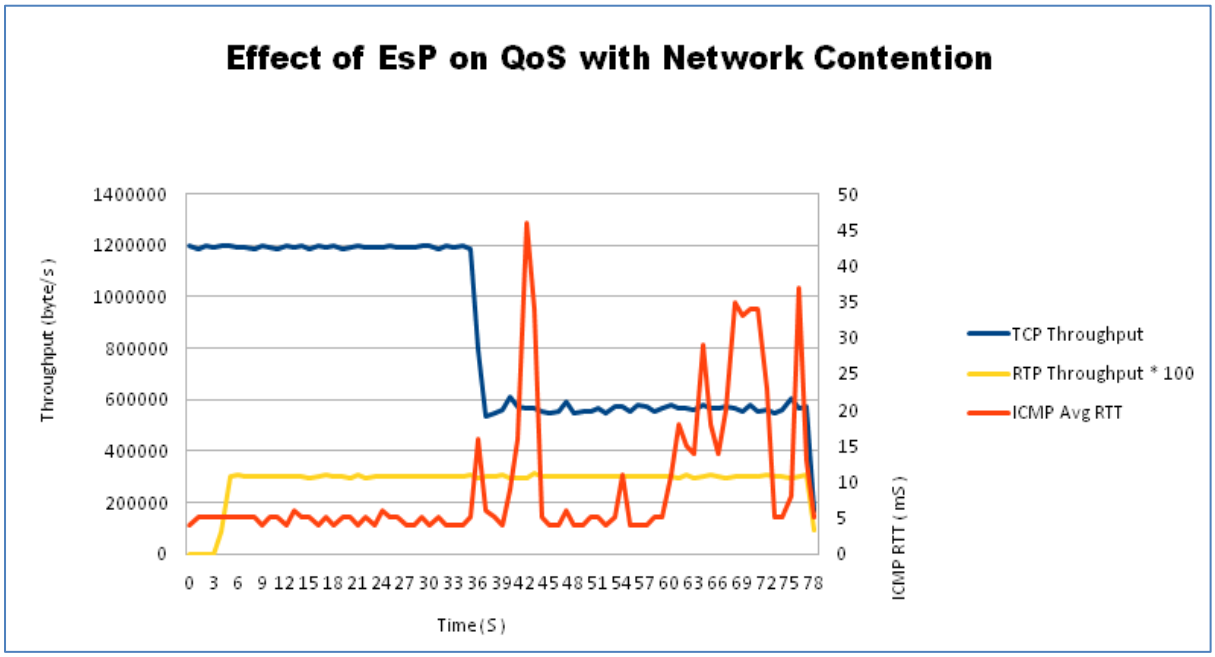


Figure 8 – The Jitter Problem

The RTP jitter graph above shows the extent of the problem... remember that this is a single call with a single TCP stream (plus a few pings) on a 10Mbps symmetrical link. Here is what happens when EsP is enabled:



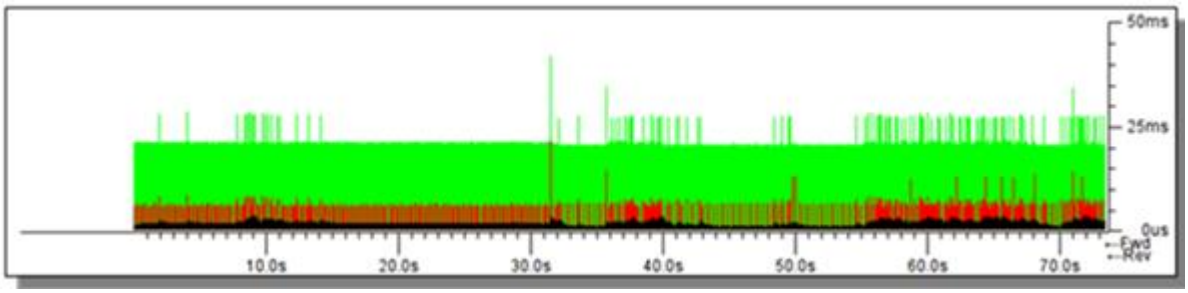


Figure 9 – EsP Impact on QoS and Jitter With Network Congestion

We can see that EsP has managed to maintain the QoS profile even under these conditions of bandwidth starvation.

The RTT of the link for real time traffic is still affected a little, but the average is still within perfectly acceptable limits. This is the result of ViBE trying to work out if there is actually more bandwidth there, which it can't do without trying! However, over time it will back off these attempts to increase its bandwidth usage a little, and so the RTT would become more stable when the available bandwidth is more permanently restricted.

BONDED LINKS

We also tested the bonded link capabilities of ViBE. On a per link basis, even when bonded we can see stats - RTT etc - and all in real time (updated within a second in the case of packet loss and around 20 seconds for RTT and jitter). It works on a per direction basis so, for example, we can kill a link and monitor constantly for changes. This is all fully configurable with thresholds deployed at whatever level you require.

Voipex claims ViBE is far better at bonding multiple links than most other methods. A key benefit is that it can use all available bandwidth for all links, no matter what their individual capacities – traditional methods struggle when the links are of different sizes. The graph below shows throughput for first a single 400kbps link, which then has an additional 1Mbps link added to it. We can see from this that ViBE is able to utilise all of the bandwidth even for a single IP stream. You can also see that it uses the links to reduce the RTT for real time traffic.

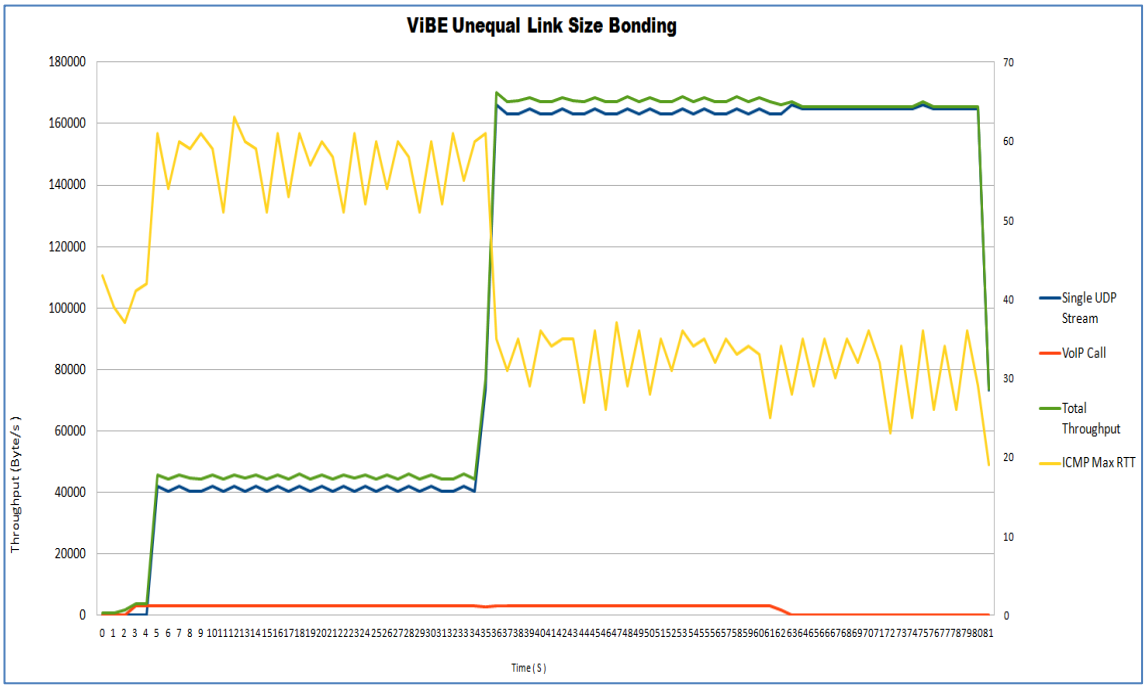


Figure 10 – Unequal Link Size Bonding

ViBE Dynamic Link Fail-over

One issue that traditional bonding methods face is that packet loss and latency issues in one of the set of links affects the overall quality experience.

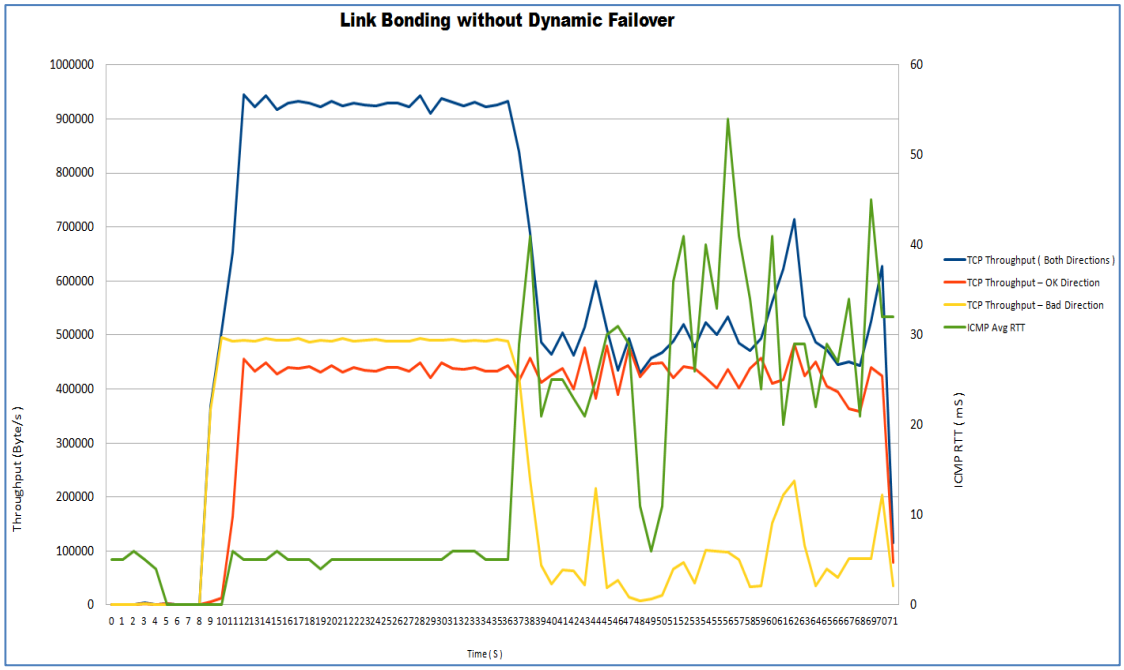


Figure 11 – Link Bonding Without Dynamic Failover

A new feature of ViBE is the ability to remove a link from a set if its quality falls below a defined threshold (which can include packet loss and jitter). Furthermore, it is able to do this in a unidirectional way, so that if the packet loss only affects, say, upstream data, then the link will still be used in the other direction. The graph above shows what happens without this dynamic fail-over active, when one link experiences high packet loss. Now, the same scenario but with dynamic fail-over:

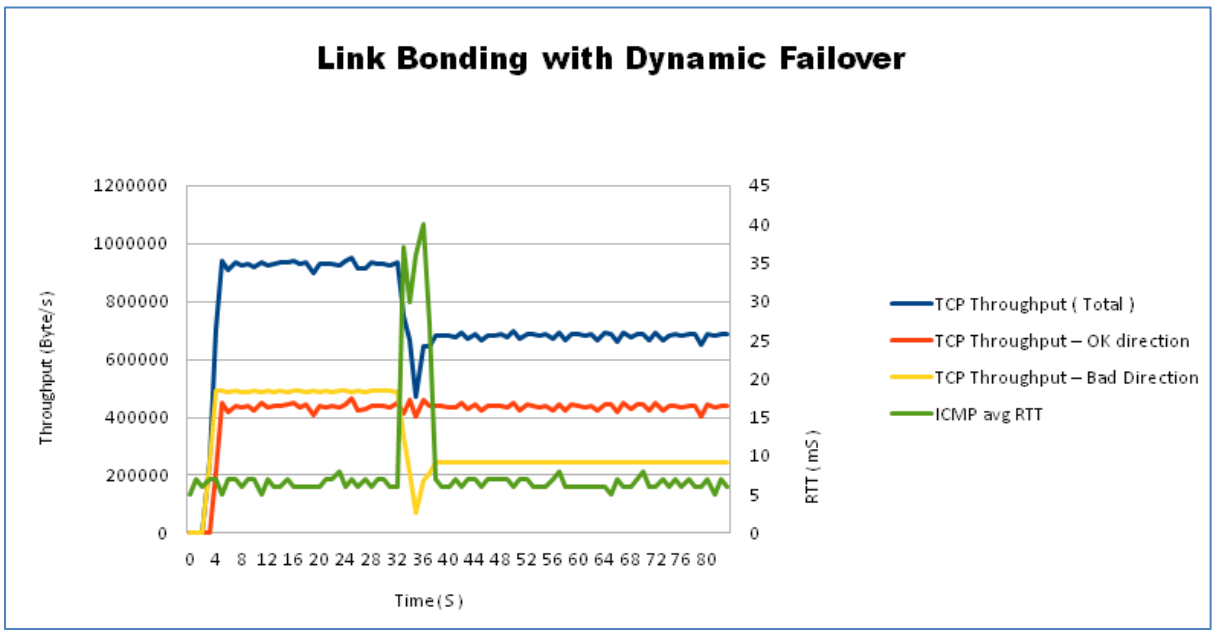


Figure 12 – Link Bonding With Dynamic Failover

We can see that ViBE very quickly stops using the link in the direction with packet loss. However, it still continues to monitor the link and give statistics, and will restore it once it has been above another configurable quality threshold for a configurable length of time.

```
      Destination        Status            Quality
       10.255.1.2            up          100%/100%
       10.255.1.1            up         100%/90.5%
```

RAIN Mode

As a reminder of what we explained earlier, RAIN mode typically utilises two or more data circuits to send duplicate data to the ViBE head end device though, as we will see, it can also be used on a single link. Utilising RAIN mode reduces packet loss as the packet will often pass on the duplicate circuit if dropped.

Enabling RAIN Mode is simply one line of configuration. It will then automatically duplicate packets down each link, resulting in zero failover and zero packet loss, the cost obviously being the bandwidth of one link.

However, we can also run RAIN Mode on a single link. Running duplicate packets on a single link means that random packet loss is improved; e.g. if every other packet is lost, then it doesn't lose any. So while, in real terms we might see 2-3% packet loss, there is none with RAIN mode, therefore random packet loss is improved, the trade-off being that bandwidth is halved of course.

Running some simple tests in multilink RAN mode, with a 50% packet loss in normal conditions, we got this down to 8% and latency went down from an unusable four seconds to a perfectly usable 350ms.

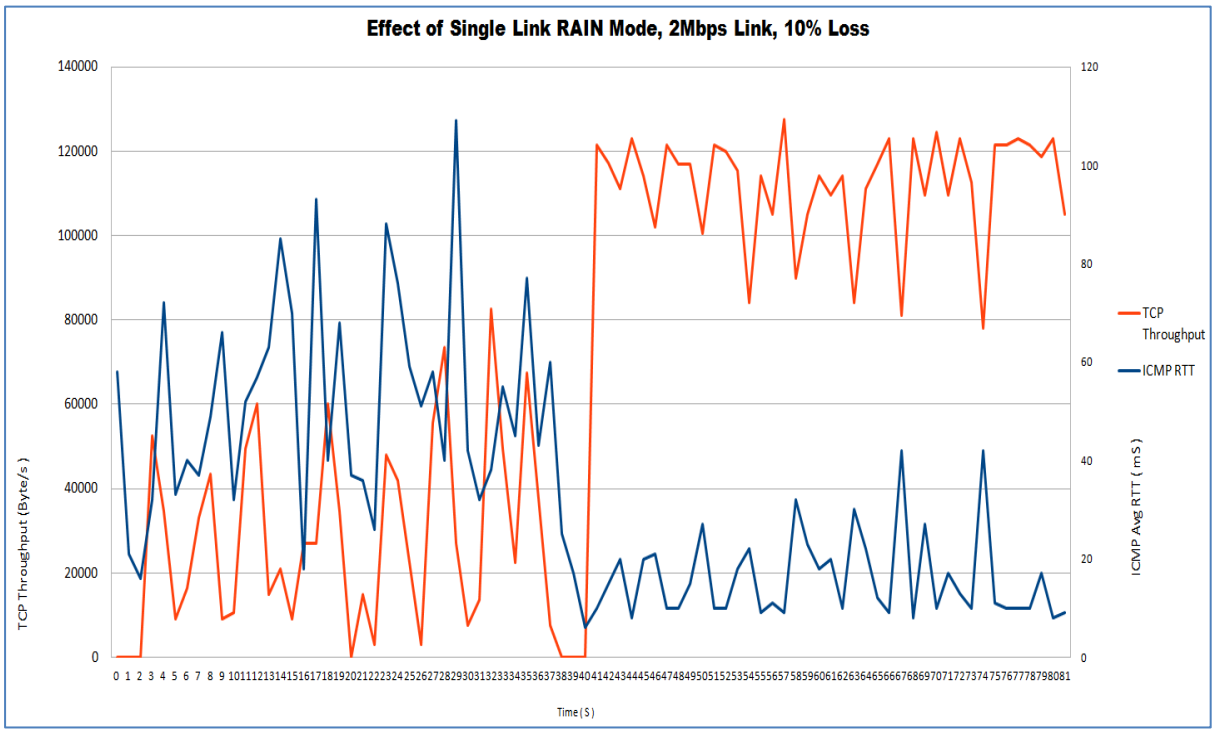


Figure 13 – Without and With RAIN Mode

ViBE's RAIN mode has obvious applications with multiple links, but its effect on poor quality single links can be, if anything, more dramatic. The following graph shows what happens on a link that has 10% loss, with and without RAIN mode activated. The bandwidth of this link is nominally 2Mbps.

We can see the dramatic effect that activating RAIN mode has. In fact, for a random 10% packet loss, the chances of BOTH of ViBE's duplicate RAIN packets going missing is one in one hundred, reducing the loss in theory from 10% to 1%. The consequences for a G.729 audio stream are that it goes from barely understandable to pretty much perfect (since G.729 can conceal 1% loss fairly well). Another benefit of ViBE is that it gives you real time monitoring of any links that it is deployed over. For confirmation of the link improvement in the above case, the "before" and "after" ping tests and ViBE statistics for the RAIN case follow:

```
root@test-asterisk:~# ping -I 10.130.0.1 10.128.0.1 -i 0.01 -c 1000
-q
PING 10.128.0.1 (10.128.0.1) from 10.130.0.1 : 56(84) bytes of data.

--- 10.128.0.1 ping statistics ---
1000 packets transmitted, 881 received, 11% packet loss, time
10397ms
rtt min/avg/max/mdev = 2.268/59.525/195.358/39.534 ms, pipe 13
```

```
root@test-asterisk:~# ping -I 10.130.0.1 10.128.0.1 -i 0.01 -c 1000
-q
PING 10.128.0.1 (10.128.0.1) from 10.130.0.1 : 56(84) bytes of data.

--- 10.128.0.1 ping statistics ---
1000 packets transmitted, 988 received, 1% packet loss, time 10004ms
rtt min/avg/max/mdev = 2.629/13.097/109.700/12.828 ms, pipe 11
       Destination        Status             Quality
        10.255.1.2            up         99.1%/90.1%
```

Note that the "Quality" in the ViBE stats is shown as two figures. The first is the quality experienced by traffic passing through the link, whilst the second is that of the underlying link itself. These figures are also shown on the web GUI of our device, and are also available via SNMP.

A feature will be introduced in the next few weeks which will allow ViBE to turn on RAIN mode for single links automatically if the quality drops below a certain threshold, giving maximum throughput when the link allows, and maximum reliability when it doesn't.

It is also possible to delay the duplicate packets if necessary so that the two packets don't appear immediately next to the each other in the stream. This means that bursty loss can also be coped with, the down side being that additional jitter is introduced because if the first packet is dropped, the second has to be waited for (at the receiving end) before other packets are processed. However, you can also limit how long ViBE waits for those packets, so can easily limit this affect. And in some cases, where links suffer from bursts of packet loss, having a small amount of additional jitter may be preferable.

VoIP Testing

We previously ran specific VoIP tests across an ADSL network - the result of which we are summarising here, but there are available in full, in a separate Voipex ViBE report available from www.broadband-testing.co.uk.

The asymmetric nature of the ubiquitous ADSL broadband technology means that uplink speeds are very limited, causing problems when trying to combine multiple voice calls with concurrent data activity. Despite voice compression techniques taking bandwidth requirements, per call, down to a mere 8Kbps, in reality the overheads involved in packaging the voice mean that each calls uses at least five times this bandwidth. At 40Kbps+ per call, a typical ADSL uplink cannot support many calls.

With no Quality of Service (QoS) available, any data transfer activity impacts hugely on voice calls, making true concurrent voice and data activity impossible beyond very low call/data levels. Even with standard QoS enabled, at typical ADSL uplink speeds, the impact of the QoS parameters is negligible. Worse still, some operators do not support QoS across all links and inherent limitations mean that the maximum number of concurrent calls that can be made is very low. With its ViBE technology, Voipex has created an alternative QoS technology that is designed to operate successfully at much lower bandwidth availability rates than standard QoS mechanisms. Using intelligent header compression and other optimisation techniques, Voipex claims that by handling voice as a very specific application, it really can minimise bandwidth usage down to the 8Kbps that a G.729 (compression standard) voice call technically requires and not the 40Kbps+ normally found in practise.

We tested the ViBE technology on a live ADSL network and were able to generate in excess of 40 calls up a 448Kbps (as measured by ourselves) ADSL uplink, with concurrent data traffic and recorded zero packet loss.

As more voice calls are brought up, the bandwidth made available to the data traffic is automatically reduced to allow bandwidth for the extra voice calls, but data applications were maintained throughout testing, with no failures. We confirmed voice call quality with live calls as part of the test and heard no sound degradation whatsoever, even with over 40 concurrent calls up.

We also saw the ViBE technology working as an integrated, additional application on a standard Netgear ADSL router, generating 28 calls up a 256Kbps ADSL uplink. Integration of the ViBE code with any Linux-based appliance is not only possible, but very uncomplicated.

SUMMARY & CONCLUSIONS

With v3 of ViBE, Voipex really has created a multi-faceted, overall network optimisation technology that still provides unique levels of VoIP optimisation (as it has from day one) but has added data optimisation and several layers of redundancy.

Flexibility is also exceptional, both in terms of being network agnostic and the ability to channel across disparate networks and operators and provide true N+1 redundancy.

Real-time connection monitoring capabilities such as ViBE's EsP functionality, mean that - regardless of the "real" bandwidth actually available at any one time - a connection is always optimised with real-time QoS applied on an ongoing basis. With RAIN mode enabled we were able to show - even in single-link format - zero packet loss capability and improved delivery, as well as no failover problems.

Overall, the ViBE technology offers something different to the mainstream WAN optimisation players, both in terms of its data management and the VoIP specific optimisation, so is therefore worth considering even if you have existing WAN optimisation solutions in place. Return on investment is also excellent on ViBE technology meaning, from a business perspective, it makes a huge amount of sense. Get more for less... why wouldn't you?