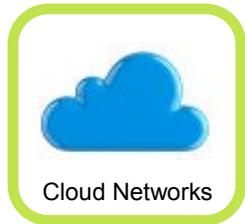




## White Paper

### Application Testing over Networks



Cloud Networks



WANs



Mobile Networks



Radio Networks



Satellite Networks

#### Introduction

With a trend towards server consolidation, virtualization, cloud computing, increased remote working and greater reliance on wireless technology, more applications are expected to work over Cloud, Wide Area Networks (WANs), ADSL, GPRS, 3G/4G, Radio or Satellite networks.

The problem is that software performance testing is still usually only conducted over the fast & reliable Local Area Networks (LANs) of the test lab. set up. Satisfactory application performance in these conditions is no guarantee of acceptable performance in non-LAN networks. It's also important to note that the amount of data being carried across LANs is light in relation to their capacity, and the distances the data travels (and thus the latency) is relatively very short.

In contrast, WANs (for the purposes of brevity please assume any further reference to WANs in this document also includes Wireless, Radio, Satellite and similar networks) are geographically disbursed networks of frequently lower capacity which are required to carry a high volume of data, compared with their capacity, over much greater distances. Thus WANs have low "available" bandwidths and high latencies.

So, its clear, LANs and WANs are really very different environments and any belief that conducting testing in LAN conditions can give you a good indication of how the same application is going to perform when placed in a WAN is plainly unrealistic.

#### Available Bandwidth

In LANs, available bandwidth is rarely an issue, but as WANs are expensive they have lower available bandwidths (i.e. they are rarely over specified). As there are more applications competing for space, the amount of bandwidth available to a particular application will be much lower and this may have a significant impact on its performance.

In addition, network administrators can (and do) set up their networks to favour certain applications like Voice over IP (VoIP) over "conventional" applications by setting up network QoS, This de-facto de-prioritises other applications and as a result, the software you are testing may have very restricted available bandwidth when placed in the production environment. Therefore, you need to factor bandwidth restrictions into your testing.

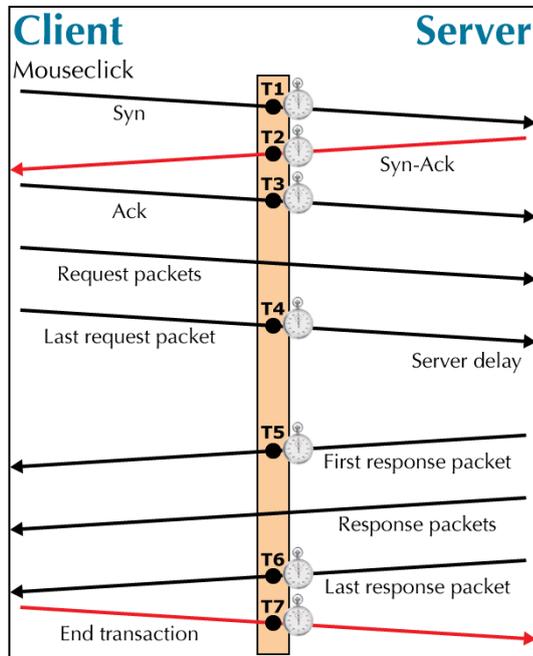
#### Latency

However, while the impact of limited bandwidth on applications is fairly obvious to all of us, the effect of other network conditions such as latency, jitter, loss and errors and even quality of service is not so straightforward to assess, but have a very significant impact, Unlike limited bandwidth you can't just go to your telco and buy your way out of these either.

Most WAN usage is split into TCP (a guaranteed delivery system for session based applications) and UDP (a connectionless, non guaranteed, delivery system usually used in VoIP, Live Video over IP and on-



line gaming). These respond to limited bandwidth, latency, jitter, loss etc., in different ways, with TCP based applications generally slowing down markedly as latency and loss increase, irrespective of bandwidth, and UDP based applications becoming less real time with latency and losing sound or bits of picture (blocking) or game positioning/control information with loss and errors.



The TCP/IP Transport Mechanism

TCP connections are responsible for handling http (www) traffic, ftp, Microsoft networking and most other general purpose traffic, including custom application protocols, and so these are all sensitive to higher latency (and loss), as described. As an example of the effect of latency: If you run a TCP based application over a network between London and New York, the network does not send the data all at once. Instead it divides the data into packets and sends as much as it is permitted before an acknowledgement (ACK) packet arrives back from the receiving end to confirm that the data arrived successfully as shown below. [The maximum amount of unacknowledged data at any time is controlled by the connection's TCP Windows Size parameter]. Thus the transmission is quite stop/start.

This clearly causes a delay - as the latency gets higher, the longer it takes for the ACK to arrive. From London to New York a round trip latency of 90ms is not uncommon; contrast this with less than 1ms in a LAN. Putting some numbers on this a 64 Megabyte file being copied from a Microsoft file server to a local machine in the LAN might take about 10 seconds (in a LAN with a 100 Mbit capability), whereas from London

to New York (even assuming you had a 100 Mbit WAN at your disposal) would take about 420 seconds (7 minutes)!

So, if you are testing (or planning for) software that is going to be accessed remotely from say, an Indian call centre or a branch office in the USA then you must ensure your test environment reflects these conditions.

### Packet Loss, Jitter, Error and Reordering

To complete the picture we also need to look at Packet Loss, Jitter, Error and Re-ordering. Today there are many companies utilizing streaming live applications such as VoIP and video over IP. These applications are dependent on the UDP protocols. As discussed, these aren't particularly affected by latency but they can be significantly impacted by jitter, loss and errors which in turn, are responsible for the break up of speech and the blocking of pictures and so on.

One of the reasons for this is that as the packets of data travel over the network they can be lost or reordered so that they arrive out of sequence, or don't arrive at all and UDP (unlike TCP) does not try to resend them. It's like sending a text message - you don't know whether it arrives at all or arrives changed or with characters missing and therefore may be useless when it reaches its destination.

Once again, reproducing these conditions in your test lab network isn't going to be possible if you confine your testing to using the internal LAN. And with Wireless Networks, Satellite and 3G/GPRS Mobile Phone networks (and even Wireless LANs) there is a far higher risk of loss and errors than with wired networks. The increased use of wireless networks within office buildings, hotspots etc., and as a way of allowing mobile "on-the-road" members of the workforce to receive data wherever they are, means that applications need to be developed to cope with this potential for latency, loss, erroring or reordering too.

### So how do you test application performance over the WAN?

Network emulation / network simulation technology, as supplied by companies like iTrinegy, behaves like a real WAN or wireless network environment but can be deployed in the same room as your normal test set up or even on your desktop. It allows you to recreate a



**NE-ONE Flex**  
Virtual Appliance Network Emulator



**NE-ONE**  
Desktop Network Emulator



**INE Enterprise**  
1Gbps Port Network Emulator



**INE Ultra**  
10Gbps Port Network Emulator

*iTrinegy Network Emulators are available in virtual, portable & rack-mount formats*

wide variety of different WAN or Wireless conditions and enables you to ensure that software can be tested during prototype, development, quality assurance and pre-deployment testing.

A network emulator also gives you complete control over the conditions that you run your testing in and the ability to reproduce these conditions time and again. This is something you cannot do if you use a live network. There is also the added danger with a live network that your testing may impact mission-critical business applications currently running on the network which isn't going to make you very popular, especially with your network manager!

### And what do you do if the performance isn't good enough after testing?

Well if it's a bandwidth limitation, which you can verify by increasing bandwidth in the emulator, your can buy more bandwidth from your ISP. But if it isn't don't waste your money. Instead, if you control the application development you could improve the way the application uses the network. But if you don't then the application may be significantly improved by using a network acceleration product. How well these

work depends entirely on the application, and you'll want to test this with a Network Emulator too.

### Conclusion

So in conclusion testing applications in a LAN environment should only be done if the applications will only traverse the LAN. If your applications are expected to work properly within other types of network then testing in an emulated environment is the only reasonable solution.

To find out more about how iTrinegy's network emulation solutions can help you please visit [www.itrinegy.com](http://www.itrinegy.com).

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