VIAVI Solutions

TeraVM FAQ

Frequently Asked Questions

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1. Introduction

1.1 What is TeraVM?

We refer to TeraVM as a “Virtualized IP Test and Measurement Solution”. The key word in this description is “Virtualized”. TeraVM does not require any propriety hardware and can be run on industry-standard hardware. By this we mean any x86 based server from the likes of Dell, Cisco, IBM, HP, Huawei or others. The only requirement is that the industry-standard server have a hypervisor (e.g. VMware ESXi, KVM, etc.) installed on it. It also runs in Amazon and Microsoft Azure clouds.

TeraVM is used to emulate client and/or server traffic for the purposes of testing a discrete device (e.g. VPN firewall, video server, router, VoIP gateway etc.) or network to determine performance characteristics, limitations of features/functionality or any other similar type of testing.

TeraVM is also a mobile network emulator emulating either the RAN or Mobile Core for all generations of 3GPP standards.

1.2 What do you mean by industry-standard hardware?

Industry-standard hardware is the term we use to refer to so called “commodity” Intel x86 based servers that are sold by companies such as Dell, Cisco and others. Examples would be Dell PowerEdge or Cisco UCS just to name a few.

1.3 I don’t see the hardware/hypervisor I want to use listed, can you still help?

Yes, for customers unsure of their hardware/hypervisor selection or indeed want to use a unique configuration, we can offer the services of a highly experienced system integration team to deliver a highly performing test bed.

1.4 I have no interest in virtualization, can you still deliver to me a test system?

Yes, for customers who just want a plug’n’play like test bed we offer a high-performance test system delivered on Dell PowerEdge blade servers. For example, using the Dell R620 users of TeraVM gain maximum throughput capability of 40Gbps from the single rack unit (RU).

1.5 What are the advantages of a virtualized test solution like TeraVM?

Most customers will evaluate a virtualized test solution like TeraVM against traditional proprietary chassis/appliance-based solutions from the likes of Spirent and Ixia. Compared to those products a virtualized solution has a variety of advantages such as:

1. **Flexibility to select your favourite industry-standard hardware at a price you negotiate with the manufacturer.** For example, if you are a Dell customer you can leverage your buying power to purchase servers for test and measurement purposes just the same way your organization purchases them to deploy a web server or some other IT infrastructure.
2. **Flexibility to use the hypervisor of your choice at a price you negotiate.** Whichever hypervisor your company uses, and licenses can be leveraged for test and measurement as well.
3. **Scalability.** You can start with a small deployment and add more capacity by simply adding more industry-standard hardware.
4. **Portability.** This is arguably one of the biggest advantages of a virtualized solution. Gone are the days of having to ship or physically move proprietary test hardware from location to location. With TeraVM, licenses can be shared amongst test beds located all around the world. You can be testing with TeraVM in North America in one minute and in the next those licenses could be used by testers in India or China or in the lab next door.

We refer to portability as part of having an “elastic test bed”.

1.6 What do you mean by an "Elastic Test Bed"?

Like a rubber band, an elastic test bed can be stretched vertically or horizontally on demand. Stretching vertically means adding more industry-standard hardware to increase throughput from say 10 Gbps to 40 Gbps all the way to 1Tbps and beyond. This is often called scalability.
Stretching the test bed horizontally is the act of sharing licenses across multiple dispersed test beds around the world or around the corner. We often refer to this as portability.

1.7 I am NOT testing a virtual device, what good is TeraVM for me?

TeraVM is not used just for testing virtual devices such as a vSwitch or vFirewall. In fact, a large percentage of our customers test physical devices with TeraVM. Customers that have both a physical and virtual version of their product find TeraVM particularly useful because they are testing everything with the same product and therefore obtain similar results.

1.8 How scalable is TeraVM?

TeraVM can scale from 1 Gbps or less all the way up to several Terabits. Customers can start small and add more capacity by simply adding more industry-standard hardware. We also have customers that have started with a large test bed and then broken it down in to smaller test beds. Whether a single engineer needs to test basic features and functionality or a QA team needs to perform high scale regression testing, TeraVM can handle the requirement or anything in between.

1.9 What are the components of a TeraVM deployment?

Each TeraVM deployment has 4 separate components:

Figure 1 for a diagram of a typical deployment.

1. **TeraVM Controller (TVM-C**) – Central control point for a TeraVM deployment. All test configurations are built and executed from a TVM-C. In addition, all collected metrics, statistics, and reports are stored here.

2. **TeraVM Executive (TVM-E)** – Central control point for sharing data-centre cabinets and hardware by pooling hardware and software resources. The TVM-E ensures that the TVM-C uses the minimum amount of hardware and software licenses.

3. **TeraVM License Server (TVM-LS)** – A server that houses the license files which authorizes TeraVM usage such as the number of cores that can be used to emulate traffic or the number of TeraVM controllers that can be active.

4. **TeraVM (TVM)** – This is the test module that generates the actual emulated traffic (e.g. HTTP, FTP, VoIP etc.). We generally refer to this as just TeraVM without any post qualifier such as "Controller" or "License Server". It could also be referred to as "TeraVM Test Module" for completeness.

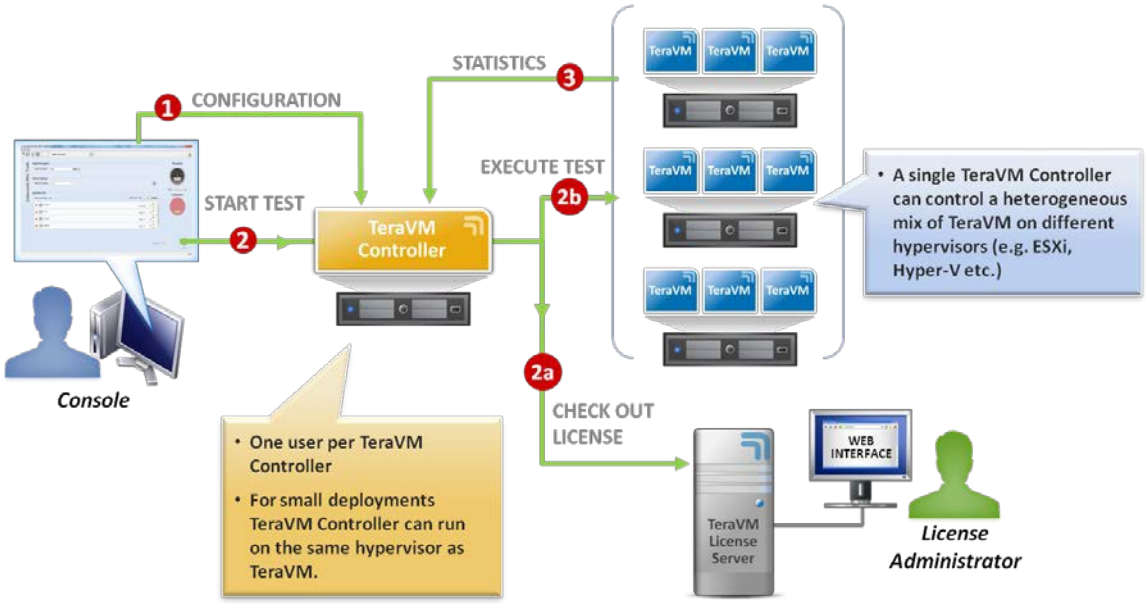

Figure 1: TeraVM Deployment

2 Features and Functionality

2.1 General

2.1.1 What application type testing does TeraVM support?

TeraVM supports stateful application testing with a variety of protocols. By stateful we mean the ability to take part in real conversations with live servers over an IP network (IPv4 and/or IPv6) and that the emulated entities adhere to network management messages such as TCP window re-sizing and requests originating at the application server.

TeraVM supports the following stateful traffic applications:

- DHCP/PPPoE
- DNS
- FTP
- HTTP/HTTPS
- HTTP Adaptive Video Streaming
- N1, N2, N3, N6, S1, SGi and all other 5G/4G/3G Core Interfaces
- Multicast (IGMP, MLD)
- SIP
- SMTP/POP3
- RTP/SRTP
- RTSP
- Telepresence Video Conferencing
- TWAMP
- VPN (Remote Access, IPsec, SSL, TLS, DTLS)
- VXLAN
- CoAP
- libPcap Replay
- 802.1x
- Cisco ISE & Netflow

2.1.2 What types of performance measurements are available?

TeraVM provides the industry's most comprehensive set of performance measurements, with over 3,000 unique metrics; ranging from application-based performance measurements to

protocol tunnelling down to simple port enabled performance testing with throughput and latency metrics.

Shown below are two tables of sample metrics. The tables highlight the fact that there are dedicated metrics for each application in TeraVM. Also, each table demonstrates the wide range of possible measurement points for each application.

Multicast IGMP/MLD Client Application	***Description***
In service	Client active as part of test
Client Out Bits/s	The number of bits/second sent out by the Client.
Client In Bits/s	The number of bits/second received in by the Client.
Client Out Packets/s	The number of packets/second sent out by the Client.
Clients In Packets/s	The number of packets/second received in by the Client.
Client Out of Sequence	The number of Out of Sequence Packets received by the
Packets	Client
Client Dropped Packets	The number of Dropped Packets received by the Client
Client Joins Initiated	The number of Joins initiated within this interval
Client Joins Completed	The number of Joins that completed within this interval
Client Mean Join Time ms	The mean Join time in milliseconds
Client Max Join Time ms	The max Join time in milliseconds
Client Min Join Time ms	The min Join time in milliseconds
Client Leaves Initiated	The number of Leaves initiated in this interval
Client Leaves Completed	The number of Leaves completed in this interval
Client Mean Leave Time ms	The mean Leave time in milliseconds
Client Max Leave Time ms	The mean leave time in milliseconds
Client Min Leave Time ms	The mean Leave time in milliseconds
Client In Packets After Leave	The number of packets received by the Client after leaving the multicast group.
Client In Bytes After Leave	The number of bytes received by the Client after leaving the multicast group
Client Duplicate RTP Packets	The number of duplicate packets received by this client.

Table 1: Multicast performance measurements

VoIP UA Application	***Description***
In service	Client active as part of test
UA In RTP Bits/sec	The number of RTP bits/second received in by this UA.
UA Out RTP Bits/sec	The number of RTP bits/second sent out by this UA.
UA In RTP Packets/sec	The number of RTP packets/second received in by this UA.
UA Out RTP Packets/sec	The number of RTP packets/second sent out by this UA.
UA RTP Out of Sequence Packets	The number of packets out of sequence sent out by this UA.
UA RTP Dropped Packets	The number of packets dropped by this UA.
UA Duplicate RTP Packets	The number of duplicate packets received in by this UA.
UA Out Calls Attempted	The number of calls out attempted by this UA.
UA Out Calls Established	The number of calls established by this UA.
UA Out Calls Rejected	The number of calls rejected by this UA.
UA In Calls Attempted	The number of incoming calls that this UA attempted to receive.
UA In Calls Established	The number of incoming calls established by this UA.
UA In Calls Rejected	The number of incoming calls rejected by this UA.

UA Calls Errored	The number of calls with errors logged by this UA.
UA SIP Out Messages	The number of SIP messages sent out by this UA.
UA SIP Messages Resent	The number of SIP messages resent out by this UA.
UA SIP In Messages	The number of SIP messages received by this UA.
UA In RTCP Packets	The number of RTCP packets received in by this UA.
UA Out RTCP Packets	The number of RTCP packets sent out by this UA
UA Registrations Attempted	The number of registrations attempted by this UA.
UA Registrations Successful	The number of successful registrations by this UA.
UA Registrations Rejected	The number of registrations rejected by this UA.
UA Registrations Errored	The number of registrations with errors logged by this UA.
UA Calls Received Ringing	The number of ringing calls received in by this UA.
UA Mean Time to Ringing (ms)	The average time for incoming calls to this UA to ring.
UA Min Time to Ringing (ms)	The minimum time for incoming calls to this UA to ring.
UA Max Time to Ringing (ms)	The maximum time for incoming calls to this UA to ring.
UA Calls Received RTP Packet	The number of messages with RTP packets received in by this UA.
UA Mean Time to RTP Packet (ms)	The Mean time for this UA to receive the first RTP packet.
UA Min Time to RTP Packet (ms)	The Minimum time for this UA to receive the first RTP packet.
UA Max Time to RTP Packet (ms)	The Maximum time for this UA to receive the first RTP packet
UA RTP Jitter (RFC 3350) ms	The Jitter per ms.
UA RTP Max Jitter (RFC 3350) ms	The maximum Jitter per ms.
RTP Video Frame Count	Number of frames
RTP Video Frame Jitter Mean ms	Average delay between frames
RTP Video Frame Jitter Max ms	Max delay between frames
RTP Send SSRC	SSRC Sending ID
RTP Receive SSRC	SSRC Receiving ID

Table 2: VoIP call performance measurements

2.1.3 What do you mean by “per flow” testing?

Per flow testing is the ability to test networks with the individuality of real network users and applications. TeraVM uses unique network user and traffic configurations which are scalable to create real world network load test cases. As TeraVM test cases use a per flow architecture, it’s possible to measure performance on a per user per application basis, which is known as per flow testing.

2.1.4 Why do I need the level of the granularity of per flow?

Per flow testing has significant advantages over aggregate type tests, aggregate tests assume proportional user usage, each user using the same endpoint configuration and using the same applications for a set duration of time. This would be equivalent to saying that all users will have the same device and use the same application at the same time, simply put this is not how networks are used. Per flow enables diversity i.e. users with different devices, using varying applications, at various times for varying durations, which more accurately represents real-world network usage.

2.1.5 What do you mean by stateful application traffic, can you give an example?

TeraVM’s emulated endpoints are stateful, that is they take part in real conversations on the network and can adhere to network management messages such as TCP window re-sizing.

An example interaction is TeraVM accessing a public server which has HTTP based redirects. TeraVM can be set to follow the redirect and to measure both the response times from the initial server and the final server response (actual content).

Another good example of the stateful nature of TeraVM is VPN client emulation, our VPN clients can establish secure tunnels with real VPN appliances from a number of vendors (Cisco, F5,

Fortinet, Juniper, etc) and pass real traffic flows over the secure tunnels through the appliance to the inside service or user.

2.1.6 Do you support real world activity in the test cases?

Yes, TeraVM emulates real world usage scenarios in which the applications are given sample user profiles such as: a multicast user zapping through a broadcast channel, a web user using social networking sites to upload images, or a person pressing the mute or call hold button during a call, etc.

2.2 TeraVM Layer 2-7 configuration

2.2.1 Is TeraVM focused on L4-L7 testing?

Yes, TeraVM is primarily focused on emulating applications to use in testing L4-L7 performance and functionality of devices such as an AMF, SMF, UPF, MME, S/P Gateway, HSS, Firewall/VPN, load balancer, DPI or IPS/IDS, WAN optimizer, video infrastructure, IMS Server, etc.

2.2.2 What L2-L3 functionality do you support?

TeraVM uses L2-3 capabilities to ensure L4-7 voice, video and application data flows are valid and reflect real world deployments. For example:

MAC Address

You can add individual MAC addresses for individual clients / individual virtual routers. This is used to test MAC address tables, plus any security functions (e.g. ACLs) enabled on MAC addresses.

Addressing Schemes

It's possible to use static or dynamic (PPPoE, DHCP) addressing for either v4 or v6 address schemes.

MTU Size

Enables support of standard and jumbo Ethernet frames. Test network fragmentation settings.

TCP Scaling

GUI control of TCP window scaling (up to 1,048,544,000).

VLAN, Double Tagged VLAN and Inner / Outer Tag ID and 0-7 Priority

Tagging can be set on a per endpoint basis. An endpoint can be an individual client device or a virtual router (with many clients behind it). All application clients running behind this virtual router will have the VLAN characteristics defined for that emulated router.

Activity Cycles

The layer 2-3 entity may be live or be active for a set of defined time intervals. When the interval time is up the entity enters an inactive state in which it attempts to gracefully terminate the running applications. In addition, activity cycles maybe provisioned to use profile ranges.

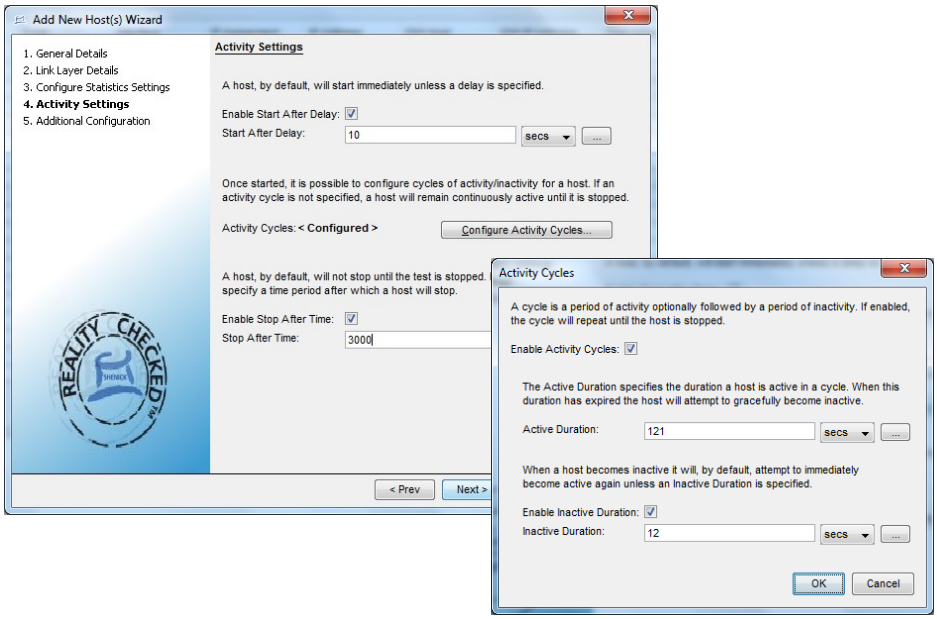

Figure 2: Activity cycles per endpoint

DHCP and PPPoE

A DHCP / PPPoE session is often the critical enabler for services. TeraVM measures functionality, performance and QoS of multiple individual voice, video and data application clients and stateful sessions behind each virtual router / VLAN after setting up real DHCP / PPPoE sessions, with appropriate DHCP and PPPoE options.

The DHCP configuration screenshot is below.

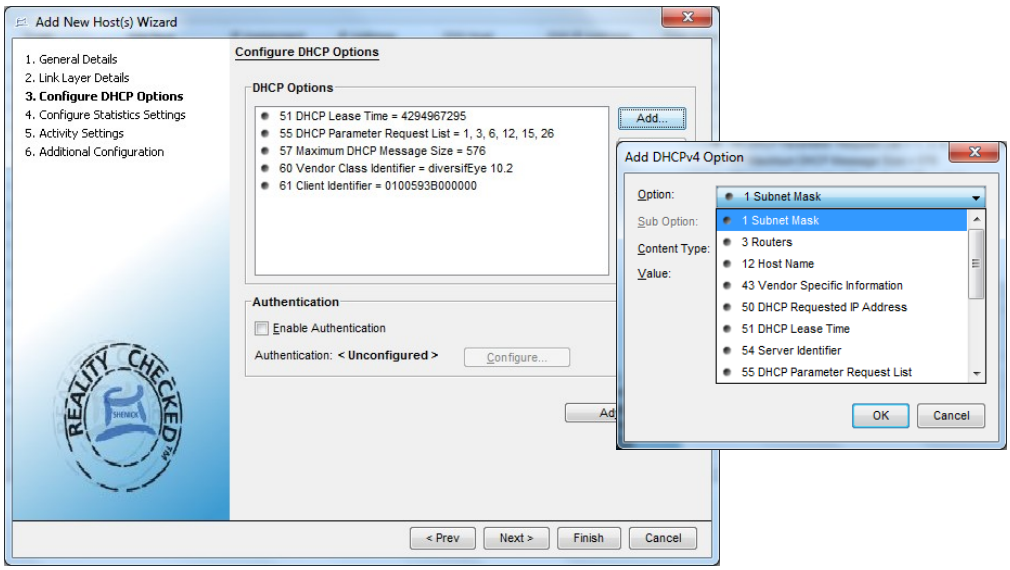

Figure 3: DHCPv4 address configuration with options

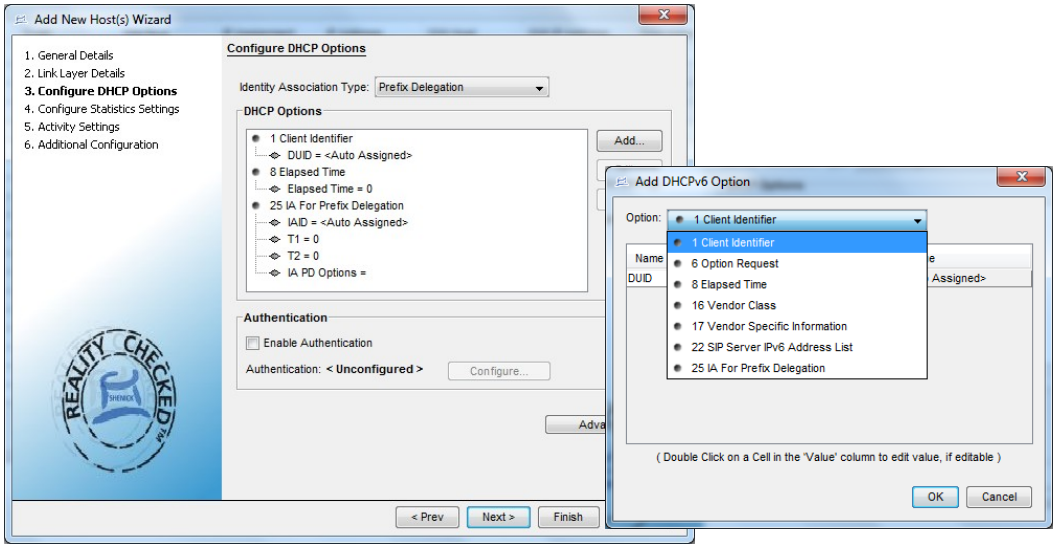

Figure 4: DHCPv6 address configuration with options

The following screenshot highlights the PPPoE configuration parameters, plus the ability to use PAP/CHAP authentication.

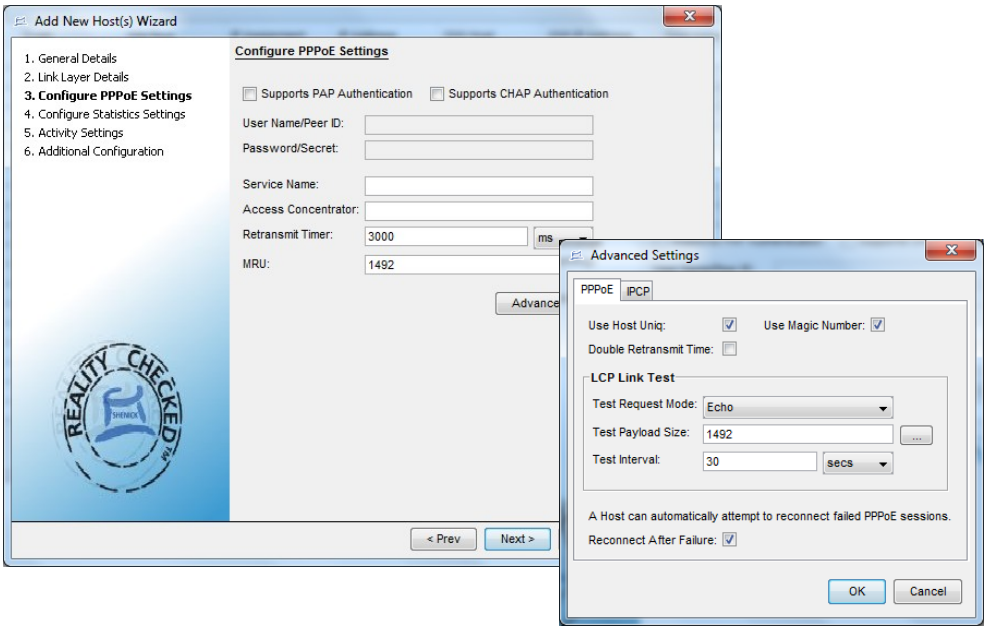

Figure 5: PPPoE configuration with options

Bandwidth Rate Limiting

You can limit the bandwidth of all application flows behind an emulated L2-3 endpoint. This allows you to create multiple endpoints which may have different access bandwidths, with multiple voice, video and data application types competing for bandwidth (as in real life).

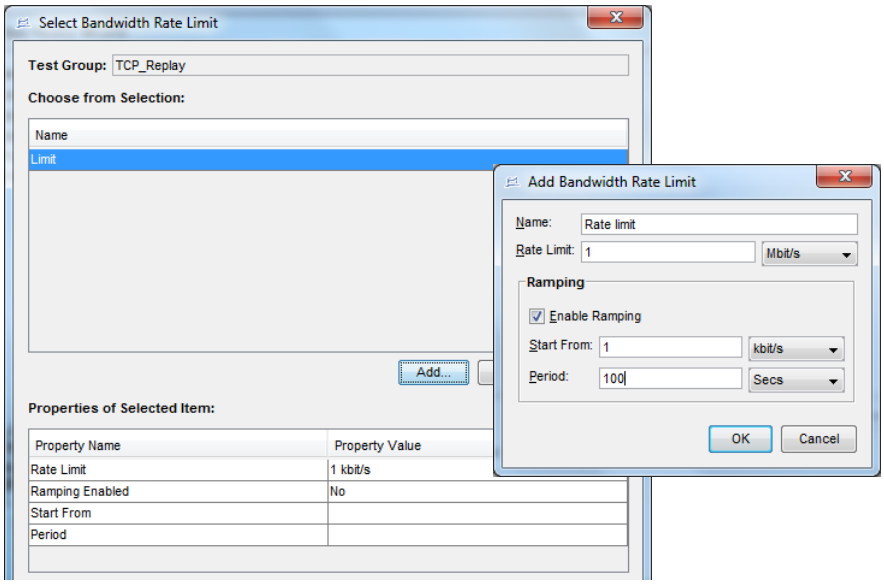

Figure 6: Bandwidth rate limiting per endpoint

2.2.3 Is it possible to add more than one application to the L2-3 entity?

Yes, it's possible to attach multiple applications to a single layer 2-3 entity or endpoint. A sample test scenario is to emulate a neighbourhood of traffic with triple play homes. In this case the endpoint emulates the residential gateway with voice, video and data traffic flows.

Key to the per flow architecture is the ability to measure application performance on each and every flow behind each and every emulated endpoint.

2.2.4 Can I rate limit the L4-7 activity on a per application per endpoint basis?

Yes, there a number of methods to control the activity of an application flow, the following are 3 typical management methods:

Start & Stop times: Setup a fixed or random start and stop delay per flow or per client to emulate clients starting up. That is configure a test so that the clients do not all at once send traffic (e.g. flood of HTTP GET requests at start of a test).

Set in/out service: During a live test run dynamically change the behavior of the application and/or endpoints by setting it in and out of service manually, without the need to stop the test run.

Connection Rate Limit: Rate limits may be applied to the L4-7 entity, additional configurations may include ramping up the number of flows per L2-3 entity.

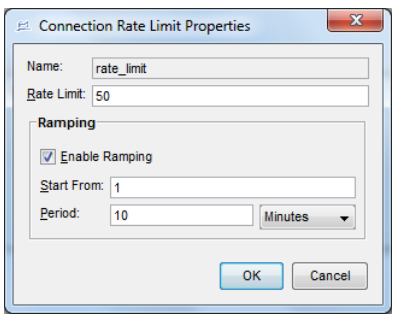

Figure 7: Rate limiting the connections per L4-7 entity

2.3 TeraVM TCP stack

2.3.1 What TCP/IP stack does TeraVM use?

TeraVM supports New Reno. The TCP stack characteristics can be modified per client or group of clients. Please see screenshots below:

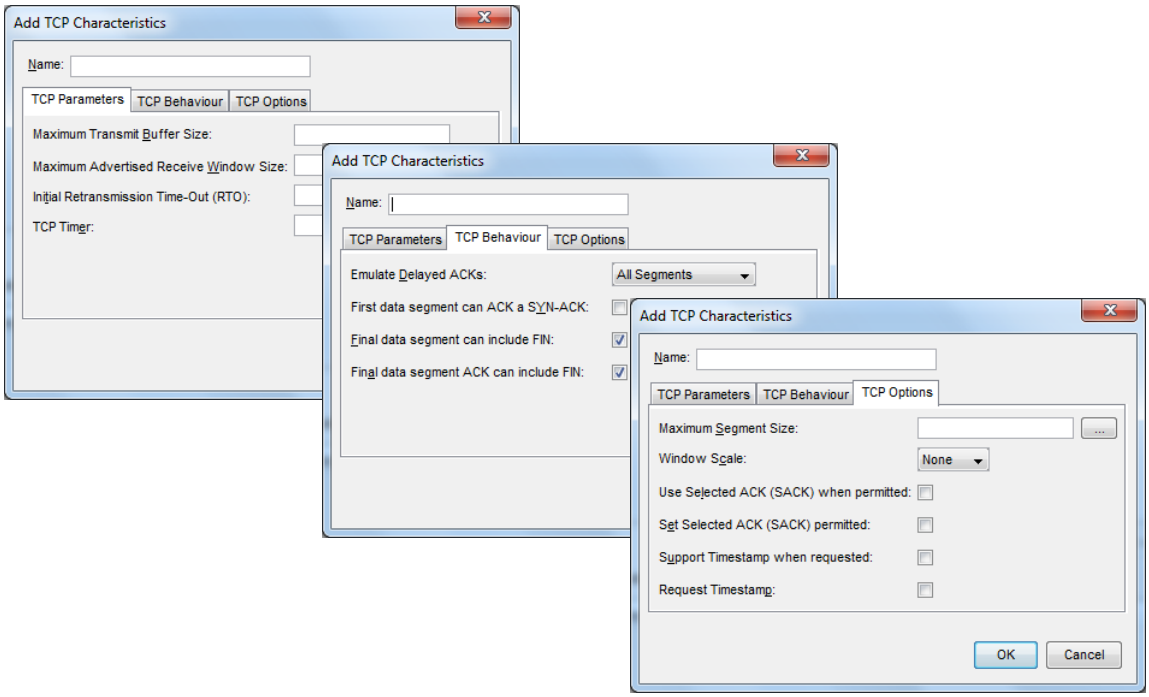

Figure 8: Additional TCP characteristic configurations

2.3.2 Does the TeraVM TCP stack support resend packets for lost frames?

Yes, TeraVM automatically resends packets if there is a failed connection (as one would expect TCP to do). TeraVM also provides the ability to create delay and or packet loss per endpoint or group of endpoints.

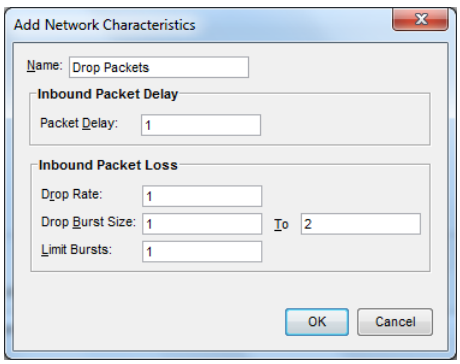

Figure 9: Simulate network characteristics of packet loss and latency

2.4 TeraVM IP addressing

2.4.1 Does TeraVM support IPv6?

Yes, TeraVM supports IPv6 and a number of IPv6 migration strategies such as Dual-Stack Lite and 6rd. In addition, TeraVM supports dual-stack hosts for applications such as voice and VPN tunnelling.

2.4.2 Can I test with IPv4 and IPv6 in the same test?
Yes, TeraVM enables concurrent testing with IPv4 and IPv6 from a single test case. TeraVM enables testing of IPv6 only networks and combined IPv4/IPv6 networks. In addition, TeraVM offers a number of unique capabilities for IPv6 including dual stack endpoint emulation.

2.4.3 Do you support testing of IPv6 migration strategies?
TeraVM's endpoints may be configured to use IPv6 transition technologies such as Dual-Stack Lite or 6rd.

2.4.4 What dynamic IP address schemes does TeraVM support?
TeraVM supports DHCPv4 (client and server emulation), DHCPv6 (client only) and PPPoEv4 (client and server emulation).

2.4.5 Can you generate DHCP requests or responses for active endpoints independent of the application traffic?
The test configuration is flexible, such that each emulated endpoint can individually establish the DHCP session following which it will transit application traffic, or the endpoint with the upper application layer can be set to idle or can establish DHCP sessions and have the clients wait for a random period of time before sending the initial traffic request.

2.4.6 Do you offer unique DHCP configuration items per endpoint?
Yes, the test configuration is flexible, so each DHCP session configuration can be modified on a per endpoint basis.

2.4.7 What is the duration before a DHCP enabled endpoint sends traffic?
As soon as the DHCP enabled endpoint receives an IP address it begins to send application traffic. The per flow architecture means that the individual endpoints are independent and do not wait for any other emulated endpoints to establish their DHCP sessions before trying to pass application traffic.

2.5 TeraVM Graphical Interface (GUI)

2.5.1 Is the GUI web-based? If not, what platforms does it run on?
The GUI is HTML5 and Java based. Supported platforms are Windows, Linux, and Mac OS X.

2.5.2 Is there a user interface for the first-time user?
Yes, TeraVM has both a standard and simplified graphical interface which requires minimal training and therefore greatly reduces the time required to build and execute tests, ideal for first time users.

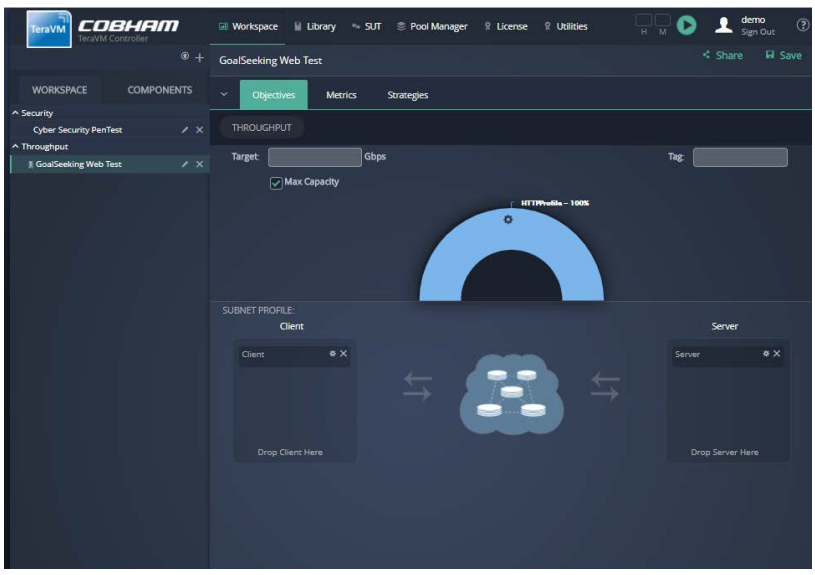

Figure 10: Simplified GUI for the first-time user

2.5.3 What refresh rate is applicable to result graphs?

Users can define how often a performance graph refreshes, typically its set to a 10 second interval, however a 1 second interval can be used.

2.5.4 Can I copy test configurations in TeraVM?

Yes, users of TeraVM can copy and paste test configurations.

2.5.5 Can I save and share test configurations?

Yes, TeraVM enables users to export tests to an xml file format, which can be imported and used by other users of the system. It is possible to share all test in a Central Test Library, which is accessible from all users within an organization.

2.5.6 Can I export my test results to a common format (e.g. csv)?

Yes, TeraVM enables export and post analysis of performance results, live during testing and also after the run completes. Export formats include csv, html and pdf.

2.6 TeraVM Automation

2.6.1 What automation capabilities does TeraVM have?

TeraVM is fully automatable where testbeds can be created and destroyed in virtual environments. It supports test automation via REST API, perl, Java and TCL and runs in Openstack environments. For test scaling, TeraVM supports the use of Perl for creating test configurations in XML format. For lab wide automation, TeraVM is integrated with the leading 3rd party automation tools e.g. iTest, CloudShell, etc. For event notifications from test results TeraVM supports SNMP MIB event notifications.

2.6.2 Does TeraVM support a PERL library?

Yes, TeraVM supports a dedicated PERL library which is upgraded for each release of the software.

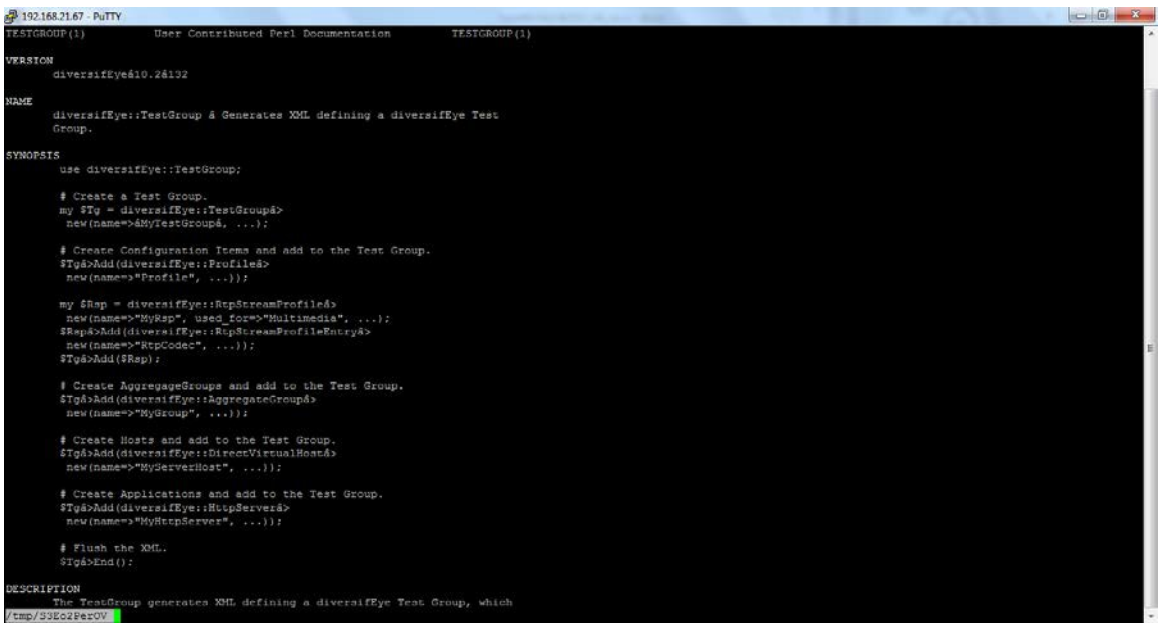

Figure 11: Command line interface with access to the PERL configuration library for TeraVM

2.7 TeraVM sample application features

2.7.1 VPN – what VPN client types does TeraVM support?
TeraVM supports remote access VPNs and site-site VPNs. TeraVM supports IPSec (IKEv1, IKEv2), SSL, TLS and DTLS 1.2.

2.7.2 VPN – what 3rd party VPN clients are supported?
TeraVM supports 3rd party VPN clients such as Cisco, AT&T SSLT, F5, Fortinet and Juniper.

2.7.3 VPN – can I pass real traffic in the VPN?
Yes, TeraVM enables encapsulation of real user traffic. Plus TeraVM provides performance measurements on both the secure tunnel and the actual traffic being secured in the tunnel.

2.7.4 Voice – does TeraVM support voice calls with real voice?
Yes, TeraVM has a complete set of pre-configured audio codecs. If a suitable codec is not available TeraVM enables users with a template to configure their own custom codec type.

2.7.5 Voice – does TeraVM support codecs for mobile calls?
Yes, TeraVM supports mobile or adaptive multi-rate codecs for narrow and wideband.

2.7.6 Voice – does TeraVM support calling profiles with busy hour attempts?
Yes, a profile can be assigned per client or group of clients to present busy hour attempts. In addition, VoIP clients can be assigned a profile in which a percentage of calls are declined based on a busy signal.

2.7.7 Voice – does TeraVM support call quality analysis?
Yes, TeraVM supports ‘no-reference’ (passive) analysis using TVQM. Quality scores are based on the Mean Opinion Scoring (MOS) model.

2.7.8 Video – what video applications are supported in TeraVM?
TeraVM provides client emulation for broadcast (IGMP and MLD), on demand (RTSP) and adaptive bitrate streaming (HLS, HDS, SMOOTH)

2.7.9 Video – can TeraVM connect with real content servers?
Yes, for example the adaptive streaming clients will parse the manifest file and will adopt a recommended stream based on the network conditions. Other examples of real activity with content servers include IGMP/MLD client zapping through channels and on demand clients using trick play features such as pause, rewind/fast forward and play.

2.7.10 Video – does TeraVM support quality scoring of received video content?
Yes, TeraVM supports no reference analysis using TVQM. Quality scores are based on the Mean Opinion Scoring (MOS) model.

2.7.11 Data – does TeraVM support requests to real or 3rd party servers?
Yes, TeraVM can be used to interact with 3rd party servers (e.g. DNS, FTP, HTTP, SMTP/POP3). An example interaction could be TeraVM accessing a public server which has HTTP based redirects. TeraVM can be set to follow the redirect and to measure both the response times from the initial server and the final server response (actual content).

2.7.12 Data – does TeraVM support secure applications (HTTPS) and secure logins?
Yes, TeraVM supports HTTPS using TLS and enables users to add login details (name and passwords) for basic authentication.

2.7.13 Data – does TeraVM support upload and download type requests?
Yes, users can implement a range of client side activity in both directions (e.g. HTTP: Post & GET and FTP: Put & Get).

2.7.14 Where can I get more details of the RFCs, features and functionality supported?

A comprehensive guide is available on request for feature support from layer 2 through 7, which highlights the RFC numbers. Please ask your local sales representative for a copy.

In addition a metric list guide is available, highlighting all the dedicated application based performance metrics available. Please ask your local sales representative for a copy.

2.8 PCAP Replay

2.8.1 For non-native applications, does TeraVM support PCAP file replay?

Yes, TeraVM can statefully replay PCAPs at scale or replay large PCAP files in excess of 1 Gigabit. TeraVM offers a number of replay types: TCP, UDP or raw port playback. In addition, TeraVM facilitates faithful PCAP capture of traffic.

2.8.2 Do you offer any PCAP libraries?

Yes, TeraVM PCAP replay can be linked to a repository which enables users bulk import PCAPs for use. A number of libraries are available the most notable is the Cybersecurity Threat Library containing 8,000+ threats.

2.8.3 Can a PCAP file be amplified or replicated?

Yes, we have the ability to upload a PCAP e.g. 1 TCP conversation, and 'multiply' that across thousands of clients, each client having unique IP address, source port, etc.

2.8.4 Can TeraVM replay traffic from many independent PCAP files at once?

Yes, TeraVM's per flow architecture enables users replay a unique PCAP per endpoint.

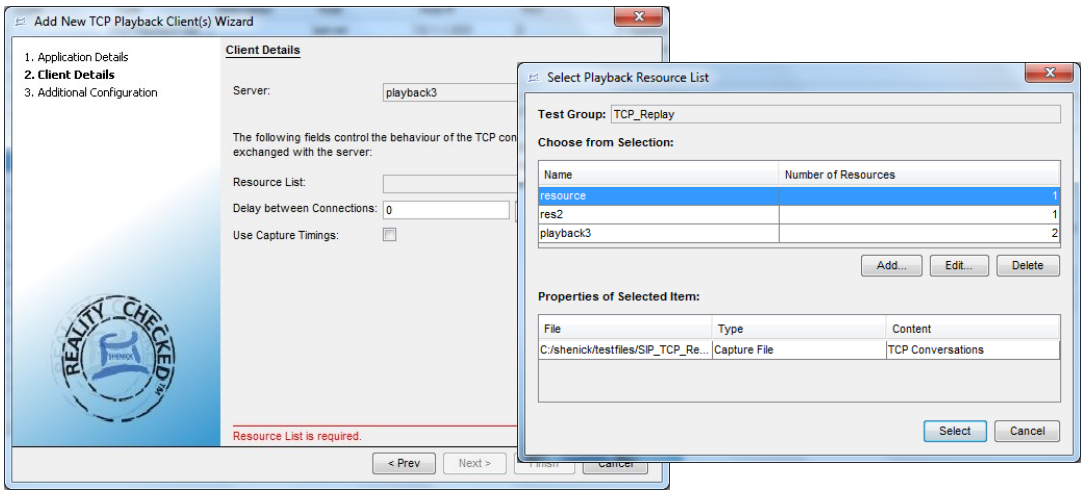

Figure 12: Replay function with PCAP selection option

2.8.5 Can I replay files across multiple interfaces?

Yes, TeraVM assigns the endpoints on a per test interface basis, enabling traffic replay of a single (or multiple) PCAP across multiple interfaces.

2.8.6 Can PCAP files be manipulated during replay?

Yes, TeraVM supports randomization in the payload through substitution of content using random string and integer variables. This functionality is ideal for testing packet inspection appliances.

2.9 CyberSecurity

2.9.1 Can TeraVM be used to test security functions?

Yes, TeraVM can be used to test performance of a number of security functions, everything from secure access appliances, Intrusion detection systems, data loss prevention systems to next generation firewalls.

2.9.2 Can TeraVM be used to assess firewall vulnerabilities?

Yes, TeraVM enables effective validation of security counter measures by emulating both the attacker and victim (devices and applications) and can also be used to emulate a range of attacks targeting both server and/or client-side endpoints.

2.9.3 Do you assess security vulnerability based on any standards?

Yes, TeraVM enables validation with Common Vulnerability & Exposures (CVE), the complete list of the CVE repository is in excess of 39,000+ threat and exploits. Full list is available on request.

2.9.4 Is the threat library kept up to date?

Yes, TeraVM's threat library is updated on a monthly basis with the latest threats

2.9.5 Is it possible to mix threat library traffic with other applications in TeraVM?

Yes, TeraVM is used to test security appliances using a mix of applications of good and bad, users can deliver DDoS type attacks alongside good application traffic.

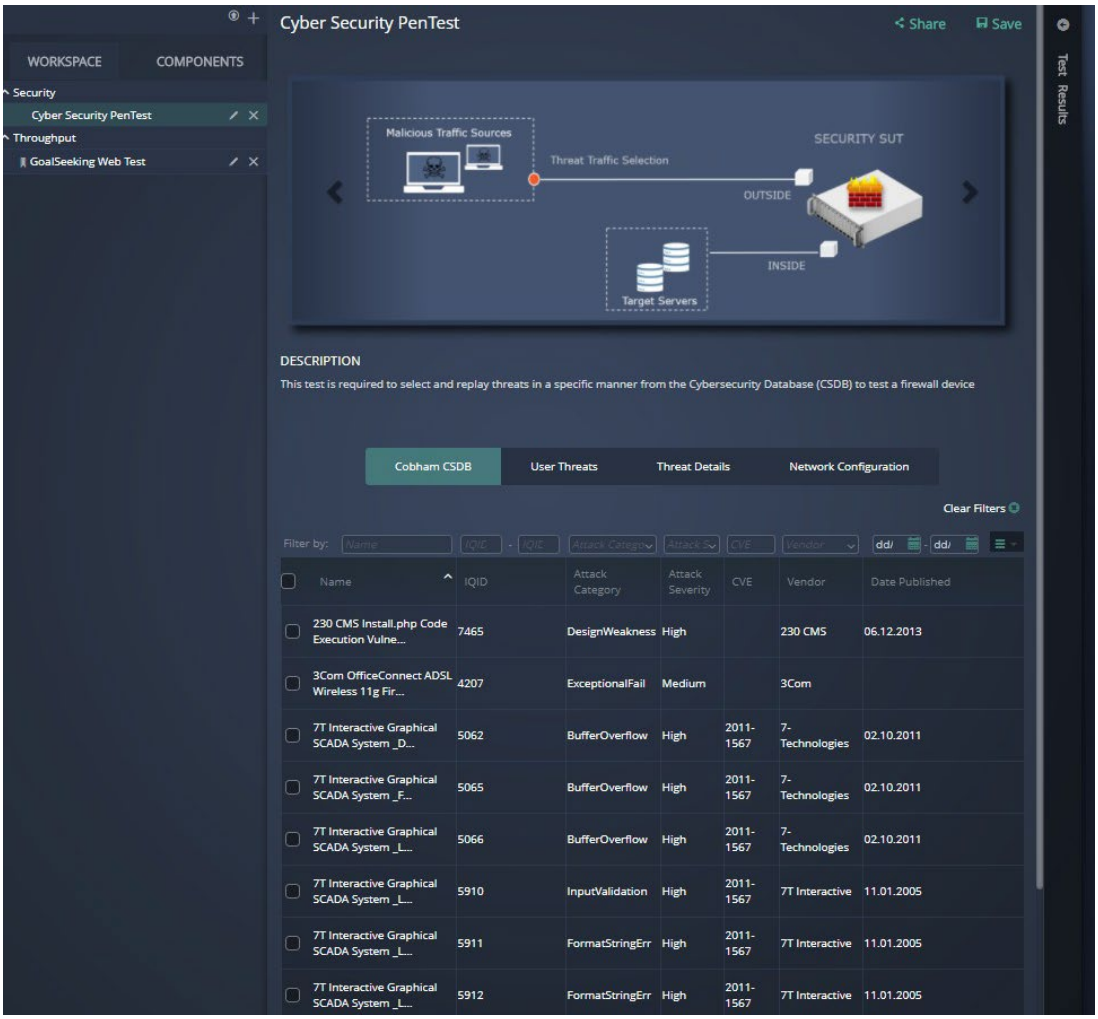

Figure 13: Simplified GUI to build security attacks using the TeraVM Cybersecurity Threat Library

3 TeraVM Controller (TVM-C)

See Figure 1 for a diagram that shows how a TeraVM Controller fits in to a typical deployment.

3.1 What is a TeraVM Controller (TVM-C)?

The central control point for a TeraVM deployment. All test configurations are built and executed from a TVM-C. In addition, all collected metrics, statistics and reports are stored here.

3.2 Can it run as a virtual machine?

Yes. A TeraVM Controller runs as a virtual machine.

3.3 Can it run on the same host as a TeraVM test module?

Yes, for small deployments. Once a customer has a test bed that consists of something more than a trivial number (e.g. 2 or 3) of industry-standard servers it makes sense to deploy the TeraVM Controller (TMV-C) on a separate host for ease of deployment reasons.

3.4 How many users can utilize a single TeraVM Controller?

A single TeraVM Controller (TVM-C) can have multiple users (each with their own username and password) that can access a pre-defined test bed. For example, if there is a host that has 10 CPU cores licensed and dedicated to TeraVM testing then different people can utilize that test bed via their own credentials. Of course only one user can utilize the test bed at one time.

If that 10 CPU core test bed was broken up in to 5 x 2 CPU core test beds and 5 different users wanted to utilize each 2 CPU core slice simultaneously then each tester would need their own instance of TVM-C.

3.5 How many TeraVMs can one TeraVM controller manage?

There is effectively no limit to the number of TeraVM test modules that a single TeraVM Controller (TVM-C) can manage.

4 TeraVM License Server (TVM-LS)

4.1 Do you use a third-party license server?

Yes. The product we call TeraVM License Server (TVM-LS) is actually developed by Reprise Software. The team at Reprise created the most widely-deployed license manager, FLEXlm. Customers should contact the TeraVM team directly for support.

4.2 Who do I call for support on TeraVM License Server (TVM-LS)?

Although we use a third-party product for license management, support is handled by the TeraVM team. All support related queries in the US can be made via phone or email.

4.3 Is there any charge for TVM-LS?

No. TeraVM License Server is included free of charge as part of your overall TeraVM purchase.

4.4 Where is the TVM-LS hosted?

The TVM-LS is designed to be installed directly within a customer network.

4.5 Do the TeraVM team have to or need direct access to an installed TVM-LS?

No. An installed TVM-LS is totally under customer control and the TeraVM team has no direct access to the server or its contents.

4.6 Where do I install TVM-LS?

The TVM-LS can be installed anywhere within your internal IP network. The only requirement is that the TeraVM Controller(s) be able to communicate directly over IP with the TVM-LS.

4.7 From where do I get the software download for TVM-LS?

The TeraVM team provides access to the download file along with detailed installation instructions.

4.8 Is TVM-LS installed in a virtual machine or physical server?

TVM-LS must be installed on a physical server. There is no virtual machine installation. This is done for security reasons.

4.9 What is the required server configuration for TVM-LS?

Although it is possible to run other applications on the same server used for TVM-LS, we recommend using a dedicated server that only functions as the license server.

The server can be relatively modest from a CPU and memory perspective so most any server will be fine.

The server must be running a 64-bit version of Linux on an x86 processor.

4.10 How do I administer TVM-LS?

As shown in Figure 1, administration is done entirely from a web interface.

4.11 What administrative functions need to be performed?

Generally speaking there is little administration required. The main administrative function is to add, delete or modify license files. In addition, licenses have to be explicitly assigned to or reserved for a specific TeraVM Controller.

4.12 How are licenses allocated or assigned?

Licenses are explicitly assigned (via the administrative web interface) to individual TeraVM Controllers. As shown in Figure 1, a TeraVM Controller has to query the TVM-LS to “check out” a valid license prior to executing a test. Purchased licenses can be reassigned to other TeraVM Controllers at any time via the administrative web interface.

4.13 Can there be multiple administrators for TVM-LS?

Yes. TVM-LS provides a role-based login mechanism. The master administrator can provide login accounts (username and password) to any number of other sub-administrators and can assign appropriate privileges such as the ability to only view the current license status but not to edit or assign licenses.

4.14 How do I obtain a TeraVM license file?

The TeraVM team will provide a digitally signed license file upon purchase of TeraVM. The file is typically emailed to the administrator of record.

4.15 How do I load a license file in to TVM-LS?

This is done via the web interface and is a simple import function which can be completed in a matter of seconds.

4.16 What does a TVM-LS license file look like?

It is a digitally signed, human readable, text file which contains easily understood information regarding what aspects of TeraVM have been licensed to the customer. For example, how many TeraVM Controllers are authorized or how many CPU cores for TeraVM have been authorized or which specific test applications (e.g. HTTP, VoIP) have been authorized.

4.17 Is any license management done from TeraVM Controller?

No. All license management is done directly by logging in to the dedicated TVM-LS web interface. The TeraVM Controller communicates directly with TVM-LS but this interaction doesn't require any input from the TVM-LS administrator.

4.18 What administration is required on a TeraVM Controller?

Each TeraVM Controller has to be provided the IP address and port number of the TVM-LS it is to rely upon. No further license administration is required from the TeraVM Controller.

4.19 Can test cases be configured without a license?

Yes. As shown in Figure 1, the TeraVM Controller only attempts to verify a proper license upon test execution. A user is free to configure any desired tests without a license, however in order to run any of the tests a valid license(s) is required.

4.20 Can I install a TeraVM test bed without a license?

Yes. There is no restriction on the number of TeraVMs you can install on available hardware. The only restriction is the number of TeraVM resources (e.g. number of CPU cores) that can be generating test application flows at any given time. This is of course restricted by the number of licenses purchased.

As an example, let's say you have 10 hosts with TeraVM installed on them in location A and 10 hosts with TeraVM installed in location B. Further let's say you have only purchased enough CPU core licenses to run 10 hosts at one time. You could run tests with hosts in location A on day one and the very next day run tests on hosts in location B, all without making any modification to the hosts or TeraVMs themselves. The only change required would be an update by the license administrator to assign the licenses to location B after location A was finished with them.

5 Pricing and Licensing

5.1 How is TeraVM licensed or priced?

TeraVM is fundamentally licensed by bandwidth generated or consumed. For simplicity customers can purchase by the total amount of bandwidth required.

Alternatively, TeraVM can be purchased as high performing hardware solution, which enables a fixed throughput capability and pricing model.

TeraVM comes with a base license which supports TCP, UDP, Multicast and applications like HTTP, SIP and RTSP. Beyond that customers can purchase premium license such as adaptive video streaming or 3rd party VPNs as required.

5.2 Is there an annual support and maintenance cost?

Yes. There is a 23% of purchase price charge to renew support and maintenance every year. In addition to customer support for technical issues, this contract also entitles the customer to all new software releases and access to a customer portal which contains valuable product information.

5.3 Are licenses tied to a particular TeraVM?

No. Licenses are assigned to an individual TeraVM Controller (TVM-C) and that controller can in turn use an available license for any TeraVM test module under its control. License assignment can be changed at any time by an administrator via the TeraVM License Server (TVM-LS).

5.4 Can TeraVM be purchased via a subscription model?

Although most customers purchase TeraVM via a perpetual license with annual support and maintenance renewal, other purchase arrangements are possible. Please consult with your TeraVM sales representative to discuss alternate licensing arrangements.

5.5 How is licensing enforced or administered?

We provide a TeraVM License Server (TVM-LS) at no cost for ease of license maintenance and update.

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End User License Agreement

The usage of the TeraVM product and documentation is subject to the Aeroflex Ireland Ltd standard Software Licence Agreement, which is available at TeraVM License Agreement. Please read the terms of the Software Licence Agreement carefully before using the documentation.