

# Chimera Network Impairment Emulation

## Feature & Topology Support Evaluation

### Executive Summary

Unified Communication as a Service, UCaaS for short, has taken the world by storm of late. The Covid crisis necessitated remote working and remote working fueled UCaaS adoption. Assuring the quality of end-user experience (EUE) for VoIP and other UCaaS applications is an essential requirement. Understanding how VoIP and other apps behave under varying network conditions is a prerequisite for providing good EUE. Xena Networks Chimera provides sophisticated network impairment emulation to accomplish that task.

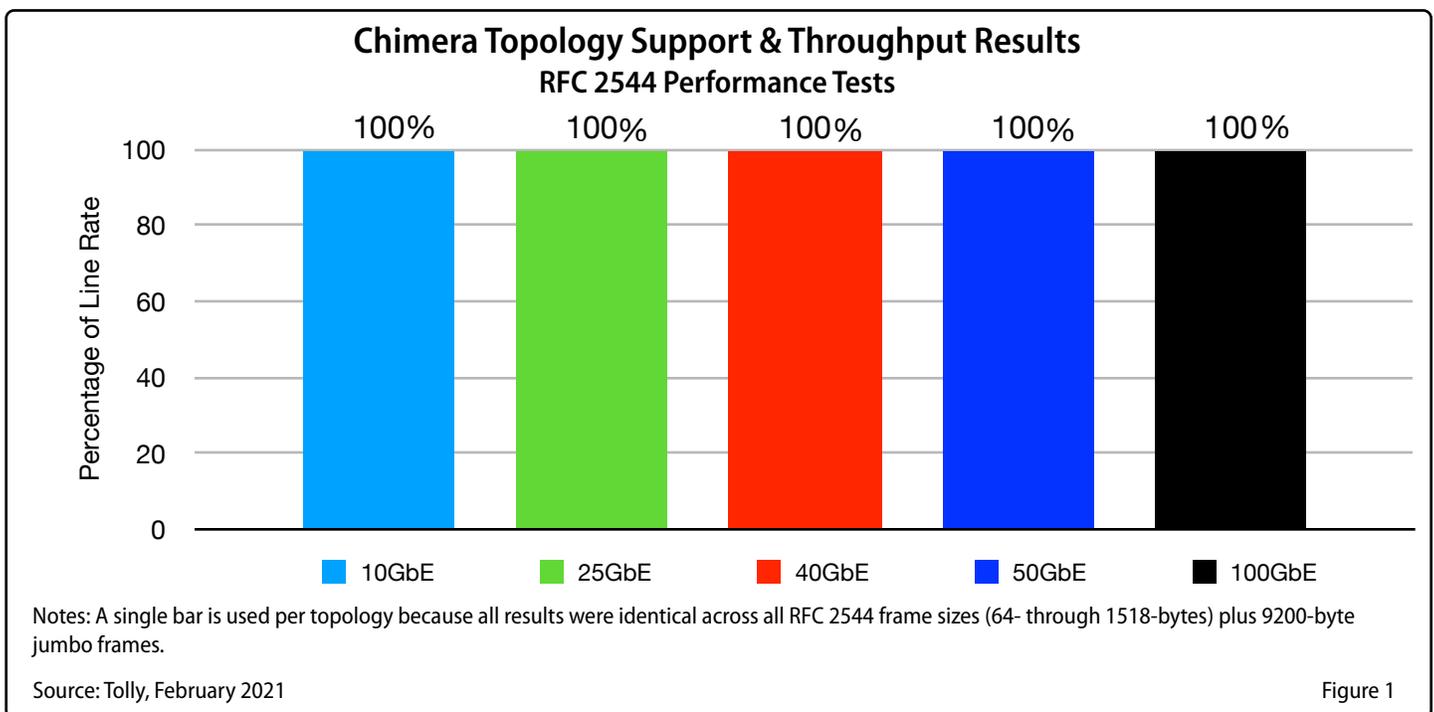
Xena Networks commissioned Tolly to evaluate the network impairment capabilities and topology support of Chimera. Chimera is available as a compact, 2-port standalone unit or as a module for greater port scaling in the Xena ValkyrieBay chassis.

Tolly tests confirmed the availability of a broad range of impairments that include drop, misordering, duplication, policing, shaping and others. Chimera also demonstrated flow corruption capabilities of IPv4 and also of the frame check sequence (FCS). Importantly, Chimera demonstrated transparent, line-rate traffic forwarding at 10, 25, 40, 50 & 100GbE link speeds. See Figure 1.

### The Bottom Line

Xena Network Chimera Network Impairment Emulation provides:

- 1 Line-Rate support of five topologies: 10, 25, 40, 50 & 100GbE
- 2 Comprehensive flow and port impairments that include: latency/jitter, drop/duplication, misordering, flexible distributions, bandwidth shaping and more
- 3 Ease-of-use and convenience and unified GUI through bundling with Xena Valkyrie traffic generation system
- 4 High-port density supporting up to 48 ports, which can be separately reserved, in a single 4U chassis
- 5 Easy test automation with Xena scripting commands





## The Need for Network Impairment Testing

Collaboration solutions such as Zoom and Microsoft Teams revolve around voice and video communications. Tolly tests have shown repeatedly that impairments such as packet loss and jitter can have significant negative impacts on voice and video applications.

Impairments, unfortunately, are a fact of life for networks around the globe both large and small. The only way to know how applications will respond to real-world situations is to test them with an impairment generator.

Impairments are not just limited to common occurrences such as packet loss, latency and jitter. Other issues can occur such as packet duplication and/or misordering that can degrade application performance and, thus, user quality-of-experience.

Issues can occur higher in the stack with flow corruptions with TCP and UDP and they can occur lower in the stack with issues like invalid frame check sequences.

A comprehensive test of likely impairments that an application will encounter is the best way to gauge the robustness of an application.

Furthermore, while many typically associate impairment testing with relatively lower-speed WAN links, it is important to be able to run impairment tests on any Ethernet topology that exists in your data center or global network.

## Testing With Chimera

This report is focused on providing proof-of-claims for key performance and impairment capabilities of Chimera. Tolly engineers worked with Xena Networks product experts to prove out a wide range of Chimera's capabilities. Chimera is a "bump in the wire" that emulates a network.

## Multi-Topology, Line-Rate Performance

Before introducing test impairments, an impairment emulator must be shown capable of carrying traffic at any speed transparently at line-rate. A product that failed to do this could be introducing unwanted impairments continually, so this is an important proof point.

Chimera is a high-performance device that has native support for 10, 25, 40, 50, and 100Gigabit Ethernet<sup>1</sup>.

The most common and most rigorous test for LAN switch performance is outlined in RFC 2544. This test calls for zero-packet-loss performance at all of a set of standard Ethernet frame sizes ranging from 64-bytes up through the largest standard frame size of 1518-bytes. This test expands upon RFC 2544 by adding the commonly used, non-standard "jumbo" frame size of 9200-bytes.

Chimera delivered 100% line rate throughput and impairments with zero packets lost across all frame sizes tested for all five topologies tested - from 10GbE right up through 100GbE. See Figure 1. This provides solid proof that Chimera not only handles topologies/speeds commonly

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Tested February 2021

found today but can already be used for high-speed, 100GbE environments.

## Impairment Capabilities

The core impairment capabilities of Chimera are impressive and span multiple areas including general flow impairments and shaping, flow corruption impairments, and port impairments. Impairments can be configured separately for multiple traffic flows across a single link. For a summary of Chimera impairment options, see Table 2 on the following page.

The various impairments can be used alone or in conjunction to build realistic and complex impairment scenarios. Importantly, many options provide useful variants such as setting fixed or variable rates based on either number of packets or percentage of traffic.

## General Impairments & Shaping

Chimera provides seven different categories of impairments within this group.

Drop (i.e., packet loss) is implemented with several variants available to the user. Drop can be implemented as a fixed burst of

<sup>1</sup> Chimera can be used in GbE environments via LAN Switch 10GbE uplinks.



packets or a fixed rate (percentage) of packets?

Latency/jitter can be specified as a fixed value, a uniform, Gaussian or custom distribution.

Misordering and duplication are two additional, related impairments available. It is becoming more common for these conditions to occur as companies migrate to SD-WAN solutions.

Typically, SD-WANs will respond to packet loss by sending duplicate packets. While such duplicates should be removed before reaching an application, that might not

always be the case. It is important to know how applications and even SD-WAN tunnels react to receiving duplicate or out-of-order packets.

Misordering can be specified as a fixed burst or fixed rate and duplication can use all distributions - including custom.

Additional options include a policer and a shaper function. Using these options the overall bandwidth available to the flow can be adjusted in various ways.

### Flow Corruption Impairments

Corruption is another important consideration in the realm of impairments.

At the most elemental level, the FCS can be corrupted for individual or multiple frames.

At the protocol level, flows can be corrupted at a fixed rate for both IPv4 and IPv6 flows both for UDP and TCP protocols.

### Port Impairments

Finally, Chimera can emulate a manual optical link flap or a logical link flap to help determine the response of systems when the link/port itself is impaired.

### Configuration & Flow

The configuration of impairments is done via a well-structured configuration screen that

## Summary of Chimera Impairment Capabilities Verified

### General Flow Impairments & Shaping

Category	Impairment Variant
Drop	Fixed Burst (e.g., 20 packets)
	Fixed Rate (e.g., 10%)
	Random Rate (e.g., 15%)
Misordering	Fixed Burst
	Fixed Rate (e.g., depth = 4, rate= 10%)
Duplication	Fixed Rate (e.g., 10%)
Policer	L1 CIR = XXX, CBS = 10K
	L2 CIR = XXX, CBS = 10K
Shaper	L1 CIR = XXX, CBS = 10K, Buffer = 1 MByte
	L2 CIR = XXX, CBS = 10K, Buffer = 1 MByte
Latency / Jitter	Fixed latency : 10 us / 1 ms / 1 s
	Uniform Gaussian

### Flow Corruption Impairments

Category	Impairment Variant
FCS	Fixed Burst
	Bit Error Rate (Stream bit errors)
	Fixed Rate (e.g., depth = 4, rate= 10%)
IPv4	Fixed Rate
IPv4 / UDP	Fixed Rate
IPv4 / TCP	Fixed Rate
IPv6	Fixed Rate
IPv6 / UDP	Fixed Rate
IPv6 / TCP	Fixed Rate

### Port Impairments

Category	Impairment Variant
Optical Link Flap	Manual control
Logical Link Flap	Manual control
	Use scheduler (500 ms, 1 sec)

Source: Tolly, February 2021

Table 1



provides access to all the general flow impairments on a single screen.

Figure 2 illustrates some of the configuration options available for latency/jitter impairments. Additional impairments can be configured by accessing the drop-down menu of each impairment category.

The flow of impairment emulation and flow processing is illustrated in Figure 3 on the following page.

## Deployment and Scalability

Customers large and small require impairment emulation. With that in mind, Xena provides Chimera in two form factors. See Figure 4 on the following page.

For customers needing only impairment on two ports, Xena ChimeraCompact provides that standalone capability.

For customers requiring traffic generation capabilities and/or scaling of Chimera ports, Xena offers Chimera as modules for its ValkyrieBay chassis where it can be combined with other modules in the Xena Networks product family.

## Port Density

Larger enterprise and service providers may have requirements for large-scale impairment testing.

Xena demonstrated support for 48 10GbE/25GbE ports of Chimera in a single, 4U chassis. Importantly, ports can be separately reserved allowing multiple individuals or teams to leverage the Chimera network impairment emulation infrastructure.

## Xena Chimera Pricing

Port for port, Chimera is attractively priced.

Factor in the Xena Value Pack and you're looking at serious value for money.

The Xena Value Pack means that with every Chimera solution you receive:

1. Three years of free software updates
2. Three years of free hardware warranty
3. Free technical support for the lifetime of the product
4. Free product training

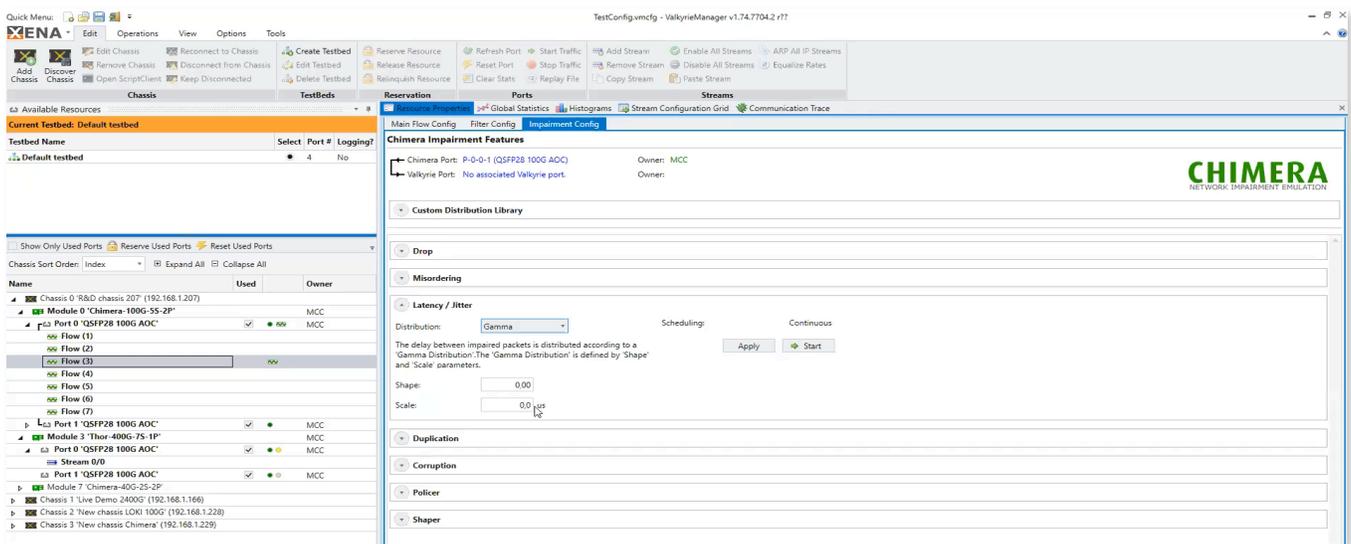
Source: Xena Networks

## Test Scenarios

For each of the areas discussed in this document, engineers ran tests appropriate to the feature.

For the performance tests, engineers used the Xena RFC 2544 test suite to generate traffic and collect throughput statistics.

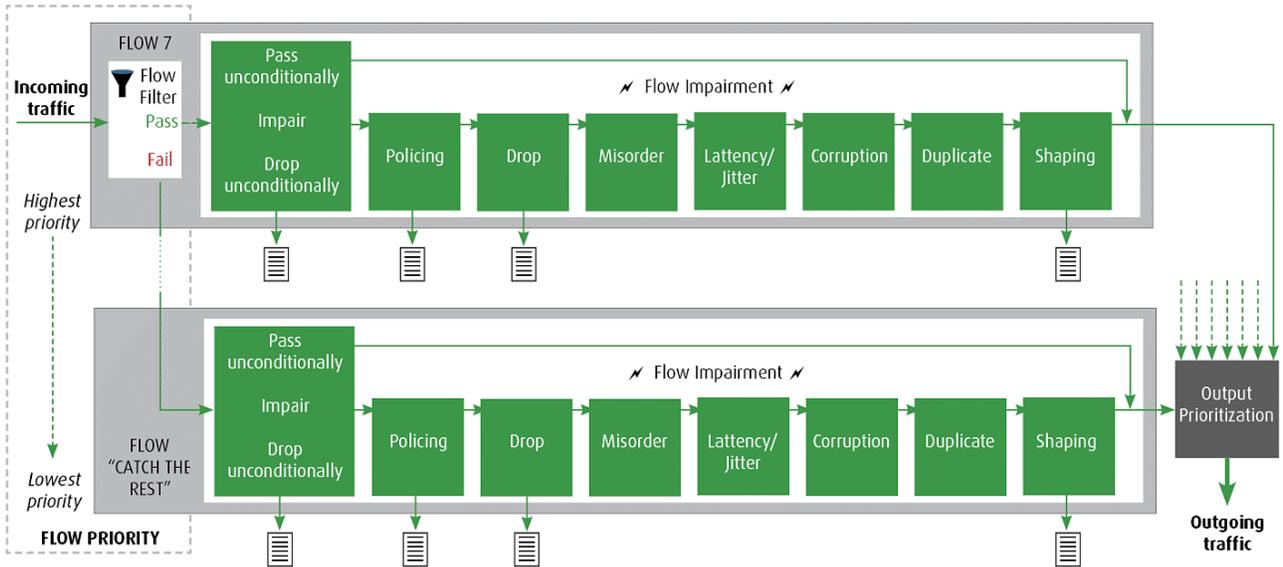
## Chimera Network Impairment Emulator GUI Example Configuring Latency/Jitter



Source: Tolly, February 2021

Figure 2

### Chimera Network Impairment Emulator Logical Flow of Traffic & Impairments



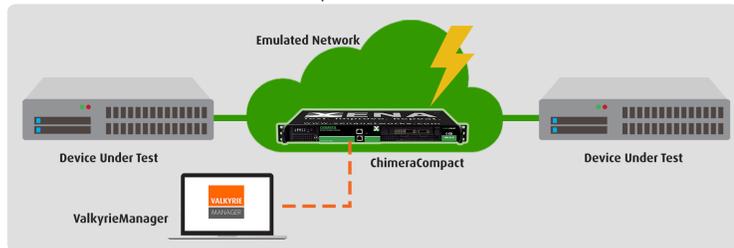
Source: Tolly, February 2021

Figure 3

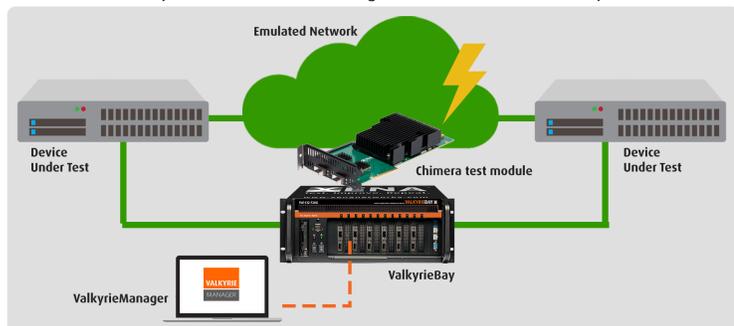
For the various impairment tests, engineers enabled the impairment and then used a variety of methods, as appropriate for the specific impairment, to ascertain that the impairment was in effect.

### Chimera Network Impairment Emulator Deployment Options: Compact (standalone) or Chassis

Chimera as a standalone network impairment emulator:



Chimera with Valkyrie for combined traffic generation and network impairment:



Source: Tolly, February 2021

Figure 4



## About Tolly

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