NETROPY® CLOUD EDITION

USER'S GUIDE

APPOSITE
TECHNOLOGIES

Netropy® Cloud Edition User's Guide

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CONTENTS

1 OVERVIEW

Thank you for purchasing the Apposite Technologies Netropy Cloud Edition network emulator. This *User's Guide* describes the configuration and operation of the Netropy product. A separate *Installation Guide* provides a walk-through for first time configuration.

The NetropyCE network emulator runs on the AWS cloud platform and simulates the bandwidth, delay, loss and other conditions of the wide-area network to test application performance.

1.1 NetropyCE Configuration

The NetropyCE network emulator is usually configured through the browser-based Netropy GUI (Graphical User Interface). The GUI is accessible through a dedicated management port from any PC or other device with a standard web browser using HTTP or HTTPS.

In addition to the GUI, the NetropyCE network emulator includes a RESTful API for configuring automation. For automation it is recommended you use the RESTful API as it supports 100% of the WAN emulation functions.

1.2 NetropyCE Operation

Configuration and operation of the NetropyCE network emulator via the browser-based GUI requires only a few simple steps:

1. **Open the GUI**
   Connect to the NetropyCE through the IP/Hostname assigned to the management port.

2. **Add Paths**
   Create separate WAN paths to carry packets between the two ports.

3. **Configure WAN conditions for each path**
   Configure each path with the bandwidth, delay, loss, and other WAN conditions.

4. **Create Endpoints**
   Assign IP address, IP range, IP subnet, VLAN, or TCP/UDP ports to the paths created in step 3.

5. **Start the Emulation Engine**
   Turn on emulation to begin testing.

6. **Monitor traffic**
   View the graphs and link statistics to monitor application performance.

7. **Change configuration**
   The configuration can be changed on the fly by adding or deleting paths, modifying path conditions, or updating endpoints.

2 Installation and Set-Up

The NetropyCE's management interface (Eth0 in AWS) is set to DHCP. Please be sure to assign an IP address to the interface when creating the instance. Once your instance is booted up insert the IP address into your web browser (Chrome recommended) to gain access to the browser-based GUI.

*Note 3 Network Interfaces are required by the NetropyCE image

2.5 Network Installation

The NetropyCE Emulation Engine is installed between two LAN segments and acts as a layer 3 bridge between those two segments. Packets received on one port of the Emulation Engine are subjected to configured emulation conditions before being forwarded or routed to the opposite port.

Install the Engine between two separate subnets and configure static routes to pass traffic through the Engine.

3 CONFIGURATION

Configuration of the NetropyCE network emulator is aided by understanding a few basic concepts and terminology.

3.1 Emulation Engine

The NetropyCE Emulation Engine forwards packets and applies the configured emulation conditions between ports 1 & 2.

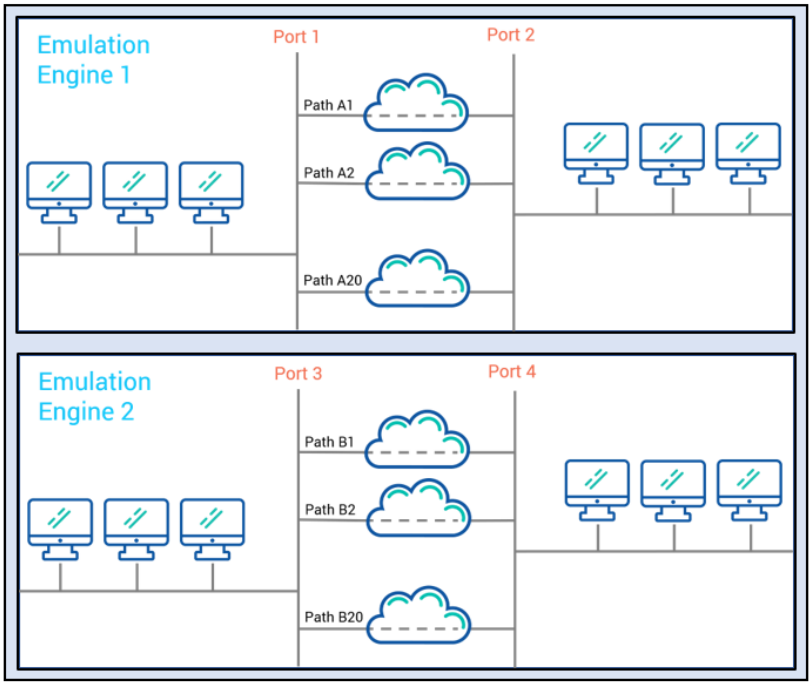


Figure 1: Two separate Emulation Engines, each with 20 paths between each pair of ports.

3.2 Paths

A path is a single configuration of bandwidth, latency, loss, and other network properties. NetropyCE can have up to 20 separate paths.

In the default single-link mode, each path represents a single WAN link, and all traffic using the path is aggregated over the path. In per-client emulation mode, each path represents one set of emulation parameters, but the traffic to and from each separate IP address is allocated its own separate bandwidth.

Each path consists of three components: a WAN access link connecting the LAN to the WAN on each side and traversal over the WAN in the middle.

Each WAN access link connects a LAN to the WAN. Bandwidth constraints and conditions that affect bandwidth availability are configured in the WAN access link. The traversal over the WAN is characterized primarily by its latency, jitter, and loss conditions.

See Section 5 for more details on configuring paths.

3.3 Endpoints

Endpoints are filters that specify which IP, IP Network, VLAN, or Ports are sent over which paths. Most users will assign Endpoints by IP address or IP range.

See Section 7 for more details on configuring Endpoints.

3.4 GUI & API

Most users will find the browser-based graphical user interface to be the most convenient way to configure and operate the NetropyCE network emulator. However, a RESTful API is also available for integration with test automation tools.

4 EMULATION ENGINE

4.1 Overview of Emulation Engines

The NetropyCE Emulation Engine forwards packets and applies the configured emulation conditions between a pair of Ethernet ports.

NetropyCE contains one Emulation Engine. The engine has a network architecture that may include multiple paths and classifiers, and traffic statistics and graphs.

The Emulation Engine can be turned on or off. Emulation is initially turned off after reboot or power cycle. Emulation can be turned on or off from the main page of the GUI or through the API. When emulation is off, all packets are forwarded directly between the Emulation Engine's two ports, bypassing any emulation.

Throughput graphs and statistics can be viewed for emulated paths, as well as for the bypass traffic.

The entire configuration of the Emulation Engine can be downloaded to a local file from the Save tab of the Administration window.

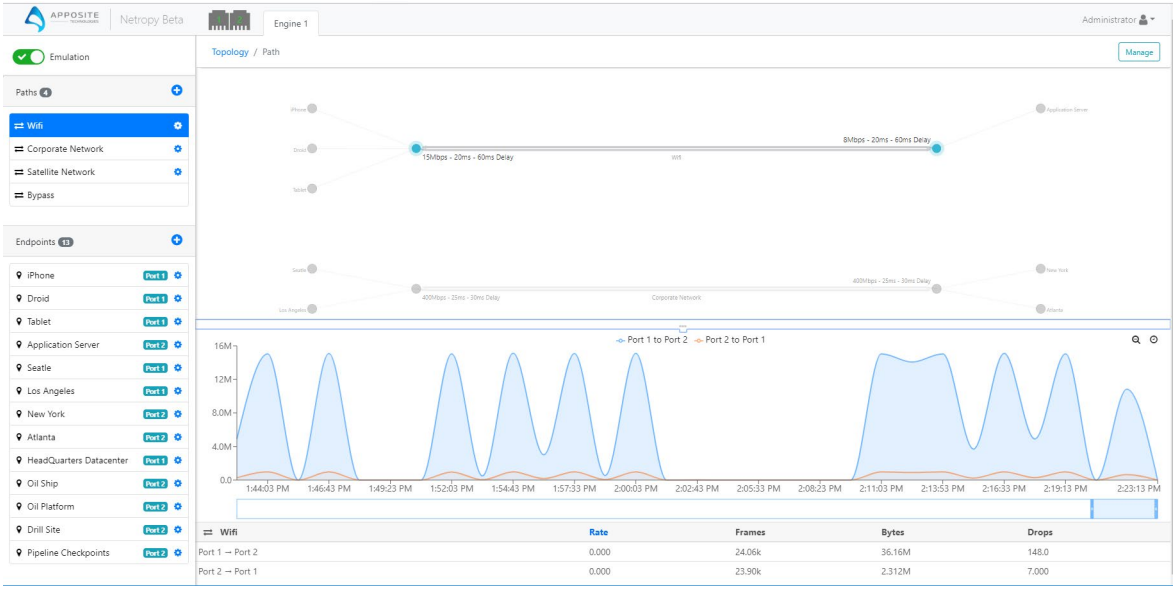


Figure 2: Main Page of the GUI

5 PATHS

5.1 Overview of Paths

A path is a single configuration of bandwidth, latency, loss, and other network properties. The Emulation Engine can have up to 20 separate paths. In the default single-link mode, each path represents a single WAN link, and all traffic using the path is aggregated over the path. If per-client emulation mode is enabled, each path represents one set of emulation parameters, but the traffic to and from each separate IP address uses a separate WAN access link with separate bandwidth. Except where otherwise indicated, the descriptions in this User Guide refer to the default single-link mode.

Each path consists of three sections:

- WAN access link connecting a local network (in single-link mode) or individual devices (in per-client emulation mode) to the WAN line or cloud.
- WAN line or cloud.
- WAN access link connecting the WAN line or cloud to a local network.

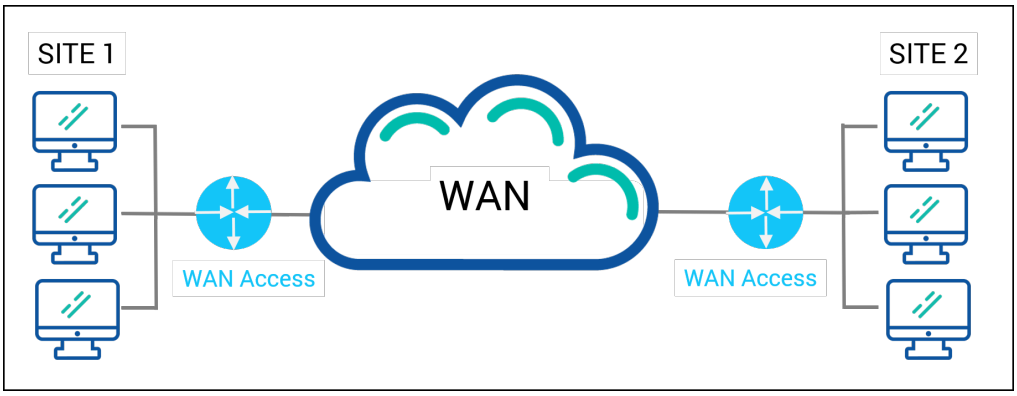


Figure 3: Path Components

The WAN can be any type of wide-area network connection between two sites including terrestrial private lines, shared networks such as the Internet, and specialized satellite or wireless networks. The WAN is characterized primarily by its latency, jitter, and loss conditions.

Each WAN access connects a local network or individual client connected to the WAN. Bandwidth constraints and conditions that affect bandwidth availability are configured for the WAN access.

5.2 Path Types

Most network connections can be characterized as either point-to-point or cloud-based.

Private lines such as T1 or OC-3 lines directly connecting two sites are point-to-point connections. The bandwidth out-bound from one site is the same as the bandwidth in-bound at the other site, and typically the latency is constant. On these links, the bandwidth is throttled in the outbound direction from each site, and there is generally no need to configure the in-bound WAN access parameters.

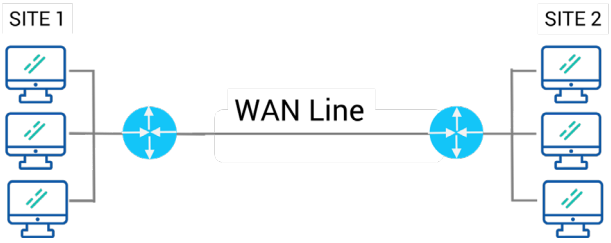


Figure 4: Point-to-Point Line

Network connections that consist of an access link to a shared network such as the Internet, an MPLS network, or a Metro Ethernet ring, can be thought of as a cloud. Cloud networks typically have limited bandwidth access to a high-speed WAN, and frequently different speed access to the WAN at each site. In these situations, traffic can hit a bandwidth bottleneck both out-bound from a site to the WAN and in-bound from the WAN to the other site, making it necessary to configure both out-bound and in-bound WAN access parameters. Similarly, if there is variable delay in the WAN cloud, it may be necessary to configure the in-bound WAN access parameters to rate-limit the resulting flow.

Figure 5: Cloud Network

5.3 Configuring Paths

Each path is displayed on the main page of the NetropyCE GUI using an arrow labeled with its name. To configure a path, click on the arrow or click on the path in the left margin then choose manage.

The Path Configuration window is used to rename the path, choose whether the path is bi-directional or uni-directional, and configure the WAN and WAN access conditions of the path.

To rename a path, click in the text box at the top of the path configuration to edit it.

When finished with WAN settings, click the *Apply Changes* button. If the Path Configuration window is closed without clicking the *Apply Changes* button, any unapplied changes will be lost.

Changes to the WAN and WAN Access conditions can also be made from the RESTful API.

5.4 Adding and Deleting Paths

To add a new path, click the *"+"*button on the main page in the left margin Path area.

To delete an unneeded path, click the path in the left margin or the arrow in the topology view. Then choose "manage" and use the delete button at the top to remove. Paths cannot be deleted while they are being used by an Endpoint.

6 Path Parameters: Configuring Emulation Conditions

6.1 Configuring Path Parameters

Each path consists of three sections:

- WAN access link connecting a LAN to the WAN
- Traversal of the WAN line or cloud
- WAN access connecting the opposite LAN to the WAN

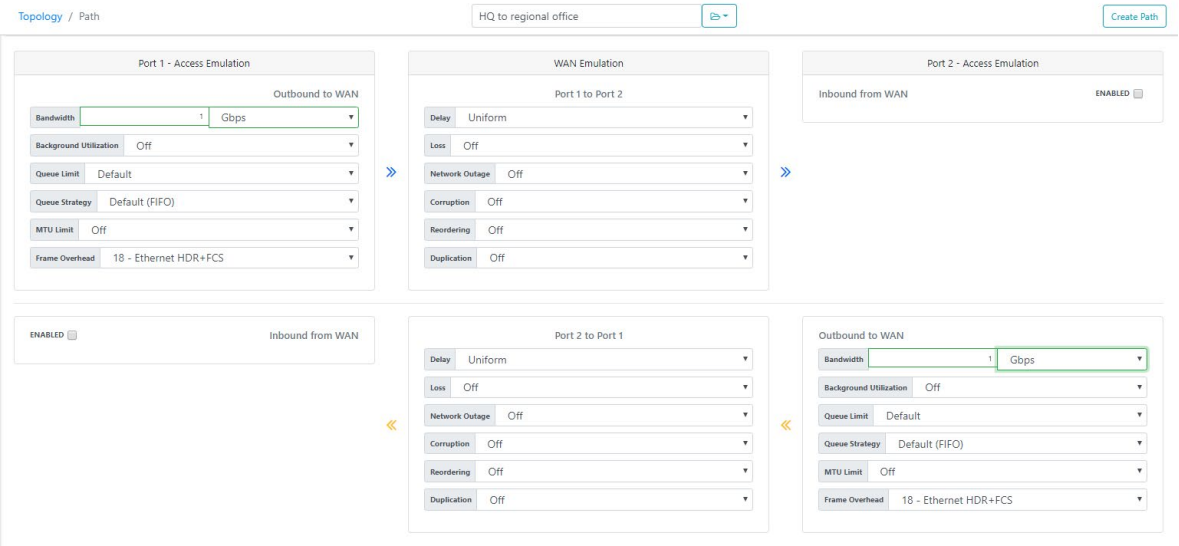


Figure 6: Path Configuration Window

The active configuration is not modified until the *Apply Changes* or *Create Path* button is pressed. The *Apply Changes* button is grayed out when there are no changes to apply or if there are any invalid entries.

Final validation of the configuration is performed when the *Apply Changes* or *Create Path* button is pressed. If there are no errors in the configuration, the new configuration immediately takes effect. If there are any errors in the configuration, a red box is displayed around the invalid panel. Hovering over the panel displays a description of the error.

6.2 WAN Access Parameters

The WAN Access panel configures the parameters that affect bandwidth availability for traffic outbound from the LAN to the WAN, and optionally for traffic inbound onto the LAN from the WAN. There are separate panels for the WAN Access link on both sides of the WAN.

The WAN access link configuration can either be a single amount of bandwidth shared by all traffic over the WAN access link (single-link mode) or a set of emulation parameters that are applied independently to the traffic from each separate IP address (per-client emulation mode.) See Section 5.2 for more information on link types.

In single-link mode, all WAN access emulation parameters are available. In per-client emulation mode, only the WAN access parameters of bandwidth, queue limit, and frame overhead can be emulated. Background utilization, queuing strategy, and MTU limits cannot be emulated and are not displayed in the GUI.

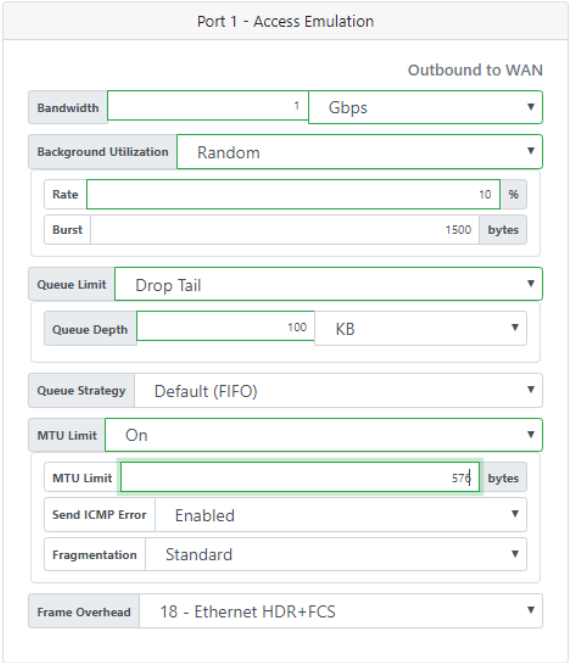


Figure 7: WAN Access Configuration Panel

6.2.1 Bandwidth

The Bandwidth panel is used to configure the rate of the WAN access link.

The bandwidth is set in increments of 1 bit per second, with a minimum rate of 100 bps and a maximum rate determined by the maximum port speed (1 Gbps or 20 Gbps depending on version).

A series of values for bandwidth changing over time can be added in a Recording file and played using the Playback feature. See Section 8 for details.

If the entered bandwidth is higher than the maximum port speed or higher than the license key, a red error box will be drawn around the panel when the *Apply Changes* button is pressed and the changes will not be applied.

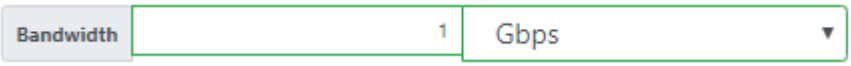


Figure 8: Bandwidth Panel

6.2.2 Background Utilization

The Background Utilization panel is used to create extra traffic that competes for bandwidth with the real application traffic passing through the WAN access link. Background traffic only affects the WAN access link on which it is configured, and is not transmitted through the other components of the path or outside the NetropyCE. To have background traffic compete for bandwidth on the opposite WAN access link, create an identical background traffic configuration on the WAN access link inbound to the opposite port.

Background traffic can be useful for testing the performance of particular applications over links that are congested with other traffic, and for inducing jitter to test real-time applications. Background traffic can either be created with random packets based on an average link utilization rate or by replaying imported PCAP packet capture files.

6.2.3.1 Random Background Traffic

The NetropyCE Emulation Engine can generate random background traffic to compete with the real application traffic for bandwidth across the emulated WAN link. Random background traffic is specified as a link utilization rate and a traffic burst size.

The link utilization rate specifies the average percentage of bandwidth consumed by the background traffic. The link utilization rate can be set to 0 – 100% of the bandwidth in increments of 0.01%.

The burst size sets the size of the background traffic blocks and is specified in bytes from 64 – 2,000,000 bytes. The default value is 1500 bytes. Larger bursts of background traffic induce greater jitter in the actual traffic.

Random background traffic is modeled as a Poisson process in which bursts of data of a fixed size are transmitted at an average rate such that the bandwidth will be occupied at the specified link utilization rate. Because it is a random process, over short periods the actual background utilization rate may vary from the configured value.

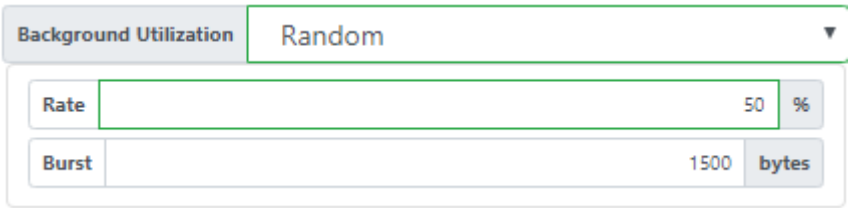


Figure 9: Background Utilization - Random

6.2.3 Queue Limit

The Queue Limit panel is used to select the queue management algorithm and configure the associated queuing parameters. The queue management algorithm controls the buffering and discarding of packets when they arrive faster than the rate of the WAN access link. The queue management algorithm and parameters can be set to match the configuration of an existing WAN access router.

There are three choices for the Queue management algorithm:

- Drop Tail
  The Drop Tail algorithm (also called tail drop) is a simple FIFO queue of a configured maximum size. When the buffer is full, any additional packets that arrive are discarded. Using Drop Tail, specify the size of the buffer in KB or packets.

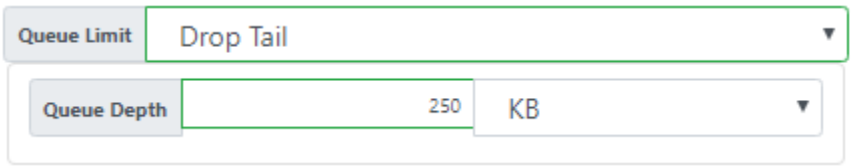


Figure 10: Queue Limit – Drop Tail

- RED
  Random Early Detection (RED) is an active queue management algorithm that monitors the average queue size and begins randomly dropping a small number of packets before the queue is full to create smoother flows and fairer drops. RED begins dropping packets at the configured minimum threshold, with the probability of drop increasing linearly until the configured maximum threshold, after which all packets are dropped. Configure the total buffer size, minimum threshold, and maximum threshold in KB or packets. For more details on RED, see http://www.icir.org/floyd/red.html. The value used for max_p is 0.1 and for w_q is 1/512.

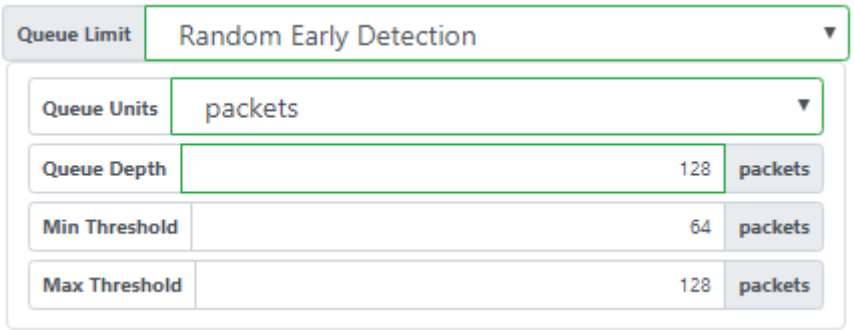


Figure 11: Queue Limit – RED

- Default
  The default option sets the queue management algorithm to Drop Tail and configures the queue depth to the equivalent of 250 ms at the currently configured bandwidth rate. For example, if the bandwidth is set to 100 Mbps, the default queue depth will be 3.125 MB. Changes to the bandwidth will automatically adjust the queue depth.

If priority queuing is selected under Queuing Strategy, the specified queue limits apply separately to the queue for each priority level.

All entries for queue depth and thresholds are limited to 100,000 packets or 100,000 KB.

6.2.4 Queuing Strategy

The queuing strategy panel determines the manner in which packets are queued and transmitted. The three options are a single FIFO queue, Priority queuing, and Round Robin.

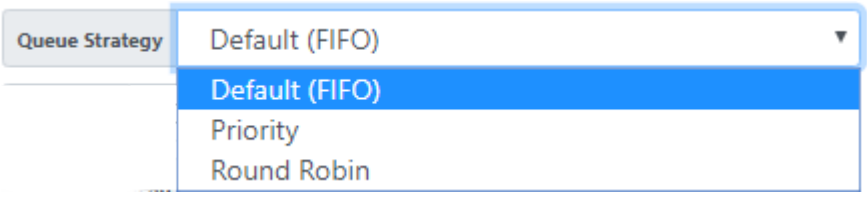


Figure 12: Queuing Strategy

- Default (FIFO)
  The default option uses a single FIFO queue. Packets are transmitted in the order they arrive, with no prioritization of packets.

- Priotity
  For class of service prioritization, incoming packets can be directed onto eight separate priority queues based on the priority setting in the packet. Packets are transmitted based on strict priority: if there are any packets on a higher priority queue, they will be transmitted before any packets on a lower priority queue. Queues are numbered from highest (7) to lowest (0).

The queue management algorithm and settings specified in the Queue Limit panel applies separately to each of the eight priority queues. For example, if Drop Tail is selected with a queue depth of 100 KB, each of the eight priority levels will consist of its own 100 KB queue.

There are two options for specifying the field to use for the priority level of the packets:

IP Precedence: the three bits of precedence in the ToS field of IPv4 packets, or the three bits of precedence in the traffic classifier of IPv6 packets.

VLAN PCP: the three bit Priority Code Point field in the VLAN header.

- Round Robin

Similar to Priority queuing, incoming packets are directed onto eight separate queues based on the IP Precedence or VLAN PCP priority value of each packet. Packets are pulled from each queue and transmitted in round robin order.

As in Priority queuing, the queue management algorithm and settings specified in the Queue Limit panel applies separately to each of the eight queues.

6.2.5 MTU Limit

The MTU limit panel allows the setting of a path MTU (Maximum Transmission Unit), specifies whether ICMP error messages are sent, and specifies whether IPv4 packets larger than the MTU limit are fragmented.

If MTU limits are enabled, any IPv4 packet that exceeds the MTU can either be dropped or fragmented, depending on the IP Fragmentation setting:

Figure 13: MTU Limit

- Standard
  IPv4 packets without the Don't Fragment (DF) bit set are fragmented and all other packets are dropped.

- Never – Drop Only
  Packets larger than the MTU limit are always dropped.

- Always – Ignore DF
  Packets larger than the MTU limit are always fragmented regardless of the setting of the DF bit. This option should only be used when specifically required for testing.

All non-IPv4 packets larger than the MTU limit are dropped. IPv6 packets are never fragmented.

The MTU limit can be set to any value between 68 bytes and 9216 bytes.

The sending of IPv4 ICMP Destination Unreachable Fragmentation Needed or IPv6 PKTTOOBIG error messages to the originator of the packet can be enabled or disabled. When enabled, ICMP error messages are transmitted out the interface on which the original packet was received switching the source and destination Ethernet and IP addresses of the original packet.

ICMP error messages are limited to 15 packets per second (per path per direction), with short term bursts of up to 15 packets.

6.2.6 Frame Overhead

- This feature is not supported in NetropyCE

6.3 WAN Parameters

WAN delay, loss, link outage, corruption, reordering, and duplication parameters are configured on the WAN section of the Path Configuration window. The conditions are set separately for the two directions.

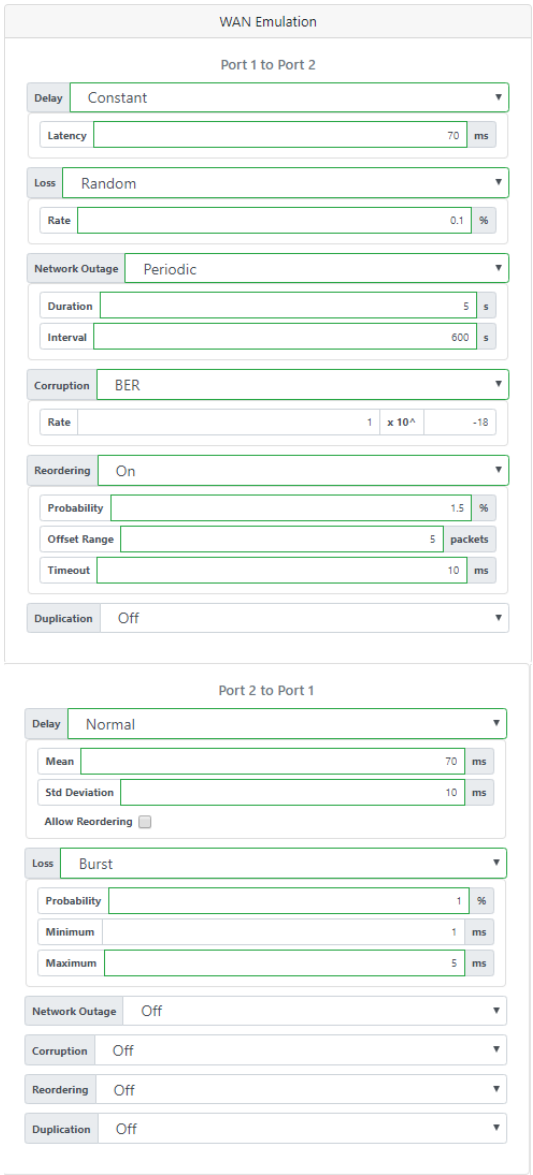


Figure 14: WAN Parameter Configuration Panel

6.3.1 Delay

The Delay panel sets the latency and jitter in each direction. For variable latency distributions, a short delay applied to a later packet may cause it to have a calculated transmission time prior to that of earlier packets with a longer delay. By default, packets are transmitted in the order received, which can skew the actual amount of delay applied. If “Allow Reordering” is selected, the order of the packets can be changed.

- Off: No latency added.
- Constant: A single, fixed value for latency.

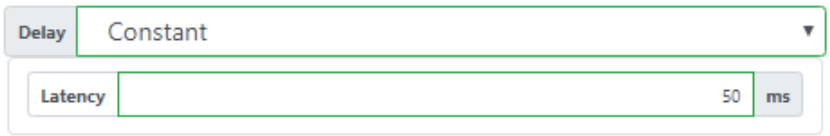


Figure 15:
Delay - Constant

- Uniform: A uniform distribution of latency ranging between the configured minimum and maximum values. The Minimum value must be less than or equal to the Maximum.

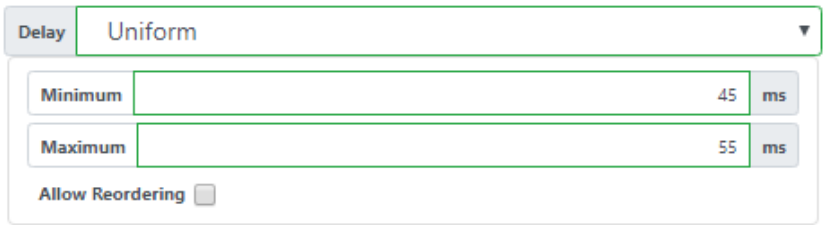


Figure 16:
Delay – Uniform Distribution

- Exponential: An exponential distribution curve, with a specified minimum and mean.

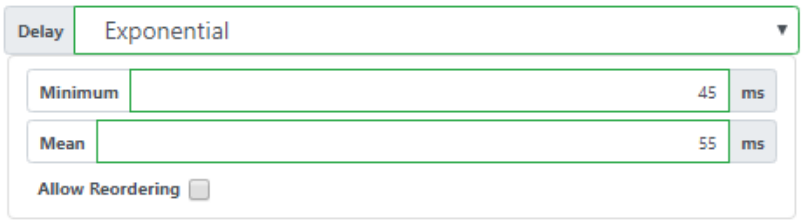


Figure 17:
Delay – Normal Distribution

- Normal: A normal (Gaussian) distribution, with a specified mean and standard deviation (jitter). To avoid negative latencies, the mean must be at least 3 times the Std Deviation.

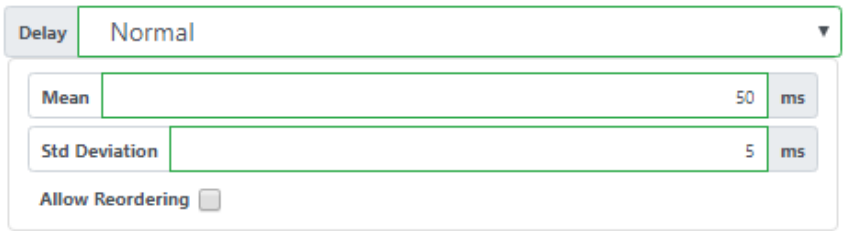


Figure 18:
Delay – Normal Distribution

- Accumulate & Burst: Packets are held until either a packet count or time threshold is reached, then optionally delayed by an additional configured 'extra delay,' then transmitted as a burst. The timer for the time threshold is started when the first packet in the burst is received. The maximum packet count threshold is 1000 packets, and the maximum time threshold is 10000 ms (10 seconds).

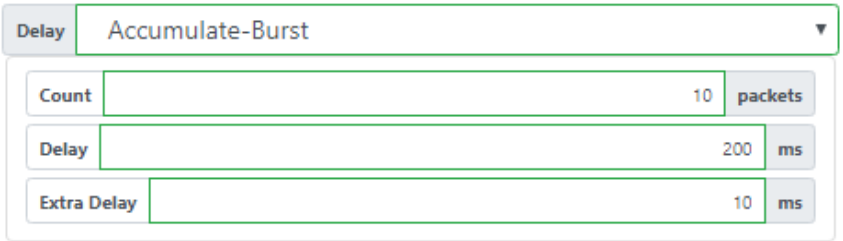


Figure 19:
Delay - Accumulate and Burst

All delay values are specified in milliseconds in increments of 0.01 ms.

In addition to specifying the latency using this delay panel, a series of values for latency that change over time can be added in a Recording file and played using the Playback feature. See Section 8 for details.

By default, frames are not reordered even if subjected to differing delays using a uniform or normal distribution. To allow packets to be reordered, check the “Allow Reordering” option. For example, if the delay is set as a uniform distribution between 10 and 100 ms and the first frame is subjected to a 90 ms delay and the second frame is subjected to a 20 ms delay, by default, the second frame cannot be transmitted until after the first frame has been transmitted. If “Allow Reordering” is selected, (and assuming no congestion) the second frame will be transmitted 20 ms after arrival and the first frame will be transmitted 90 ms after arrival, causing the order of the packets to be switched.

To specify jitter, use either the normal or uniform distribution. Use the normal distribution to specify jitter as the standard deviation from the mean delay. Use the uniform distribution to specify peak-to-peak jitter between the minimum and maximum values of delay.

The various Netropy hardware models have different limits on the ability to process high packet rates combined with large latencies.

☞	The end-to-end round trip time (RTT) is a combination of four separate delays in each direction: the propagation delay, transmission delay, queuing delay, and reordering delay.

6.3.2 Loss

The Loss panel configures packet loss each direction. The options are:

- Off: No packet loss.
- Random: Random packet loss. Specify a single value for the probability that each packet will be lost. Rates can be set from 0 – 100% in increments of 0.0001%.

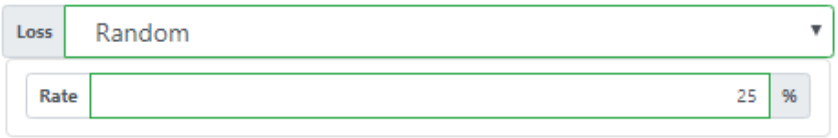


Figure 20:
Loss - Random

- Burst: Burst loss. Specify the probability that each packet will begin a burst of lost packets, and a minimum and maximum number of packets that will be lost in sequence. For a fixed burst size, set the minimum and maximum to the same value. Probabilities can be set from 0 – 100% in increments of 0.0001%.

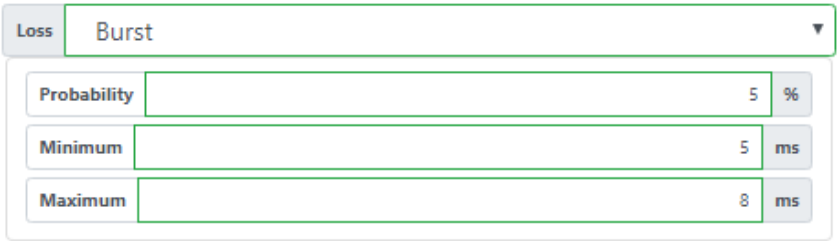


Figure 21:
Loss - Burst

- Gilbert-Elliott: Gilbert-Elliott two-state loss. Specify the packet loss rates for the "good" and "bad" states, and specify the per-packet probability of transitioning from each state to the other. All rates are specified as percentages set from 0 – 100% in increments of 0.0001%. When Gilbert-Elliott loss is first configured and each time emulation is subsequently turned on, loss starts in the good state.

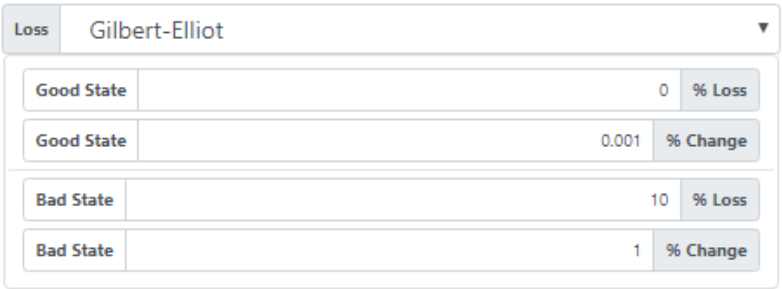


Figure 22:
Loss – Gilbert-Elliott

- Periodic: Periodic packet loss. Specify the loss period and burst size in numbers of packets. For example, a period of 1000 packets with a burst size of 10 packets would result in a fixed pattern of 990 packets forwarded followed by 10 packets dropped.

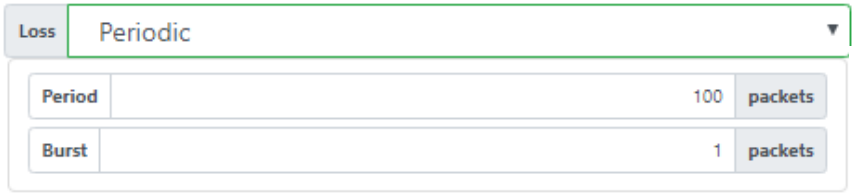


Figure 23: Loss - Periodic

- BER: Loss due to bit errors. Set the coefficient and exponent. Bit error rates can take values of $1x10^{-18}$ or greater and are entered in scientific notation. The coefficient of the rate must be entered as a value greater than or equal to 1 and less than 10. All packets that contain a bit error are discarded – to transmit corrupted packets, use the Corruption emulation.

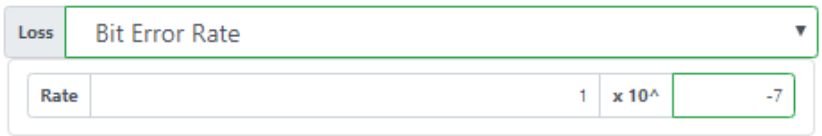


Figure 24: Loss - BER

In addition to the specifying the loss using this panel, a series of random loss rates that change over time can be added in a Recording file and played using the Playback feature. See Section 8 for details.

6.3.3 Network Outage

The NetropyCE Outage panel simulates a periodic link outage causing 100% packet loss for a specified duration and interval. The interval is the amount of time between the beginning of successive outages, not the amount of time between the end of one outage and the start of the next outage.

Both the duration and interval can be set as single values or ranges of values separated by a hyphen. Values can be set from 1 ms (0.001 seconds) to 1 week (604,800 seconds) in seconds in increments of 0.001 seconds. If the duration is set to a value that is longer than the interval, the outage will be continuous.

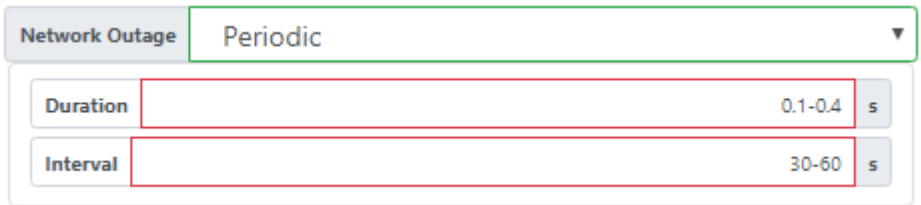


Figure 25: Network Outage

6.3.4 Corruption

The Corruption panel is used to insert bit errors into forwarded packets at the specified bit error rate. Set the BER coefficient and exponent. Bit error rates can take values of $1x10^{-18}$ or greater and are entered in scientific notation. The coefficient of the rate must be entered as a value greater than or equal to 1 and less than 10.

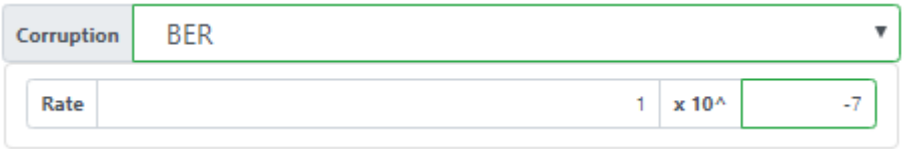


Figure 26: Corruption

Corruption only affects the contents of received Ethernet frames. Neither the Ethernet header (including EtherType and optional VLAN tag) nor the Ethernet FCS will be corrupted.

6.3.5 Reordering

The Reordering panel specifies the probability for each packet that it is reordered, and how far back in the data stream the reordered packet is moved from its original position. If a packet is randomly selected for reordering, it is held until the offset number of packets arrive and reinserted into the data stream at that point. For example, if the offset is 5 packets, any packet that is reordered will be held and reinserted after the fifth subsequent packet.

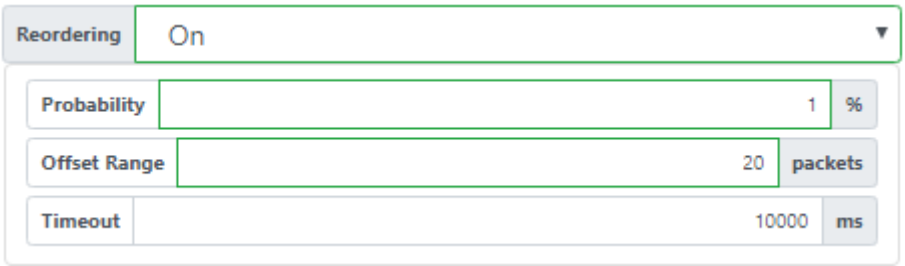


Figure 27: Packet Reordering

To configure packet reordering, set:

- Probability: the likelihood that each frame will be reordered. Probability can be set from 0 – 100% in increments of 0.0001%.
- Offset Range: the number of packets that the reordered packet is moved back in the data stream. Either a single value or a range of values can be configured. To specify a range, input the minimum and maximum reordering offsets separated by a dash, i.e. 5-12.

- Timeout: the maximum amount of time to wait for the number of offset packets to arrive. For example, if the offset is set to 1000 packets and the timeout set to 5 ms, if 1000 packets do not arrive within 5 ms, the packet will be reinserted in the packet stream at that expiration of the 5 ms period. The default value for timeout is 10,000 ms. The timeout value is specified in ms in increments of 0.01 ms.

Only one packet can be held for reordering at any time. While a packet is waiting for reinsertion, the arriving packets are not subject to reordering. For example, if a packet is randomly selected for reordering with an offset of 5 packets, the next five packets that arrive cannot also be reordered.

6.3.6 Duplication

The Duplication panel specifies the probability for each packet that it is duplicated.

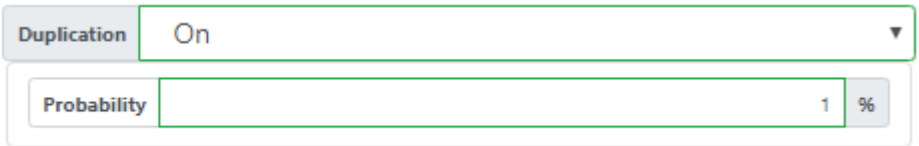


Figure 28: Packet Duplication

Duplicate packets are inserted into the data stream immediately after the original packet. Duplicate packets are then subjected to delay, loss, and reordering independently of the original packet.

The duplication probability can be set from 0 – 100% in increments of 0.0001%.

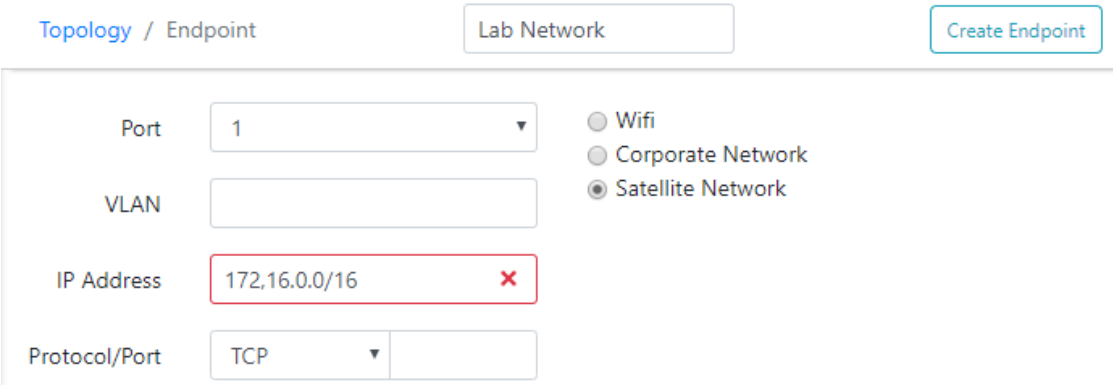
7 ENDPOINTS

7.1 Overview of Endpoints

Endpoints are visual representation of devices, networks, or ports that assign packets to specific paths.

Endpoints can be matched with a path by IP Address, IP Range, IP Subnet, VLAN tag, VLAN Range, or TCP/UDP port. Packets that match the endpoint will then be assigned to the path specified in the Endpoint creation process.

To configure an Endpoint, on the left margin in the endpoints row click the "+" button. This will open the Endpoint configuration menu.



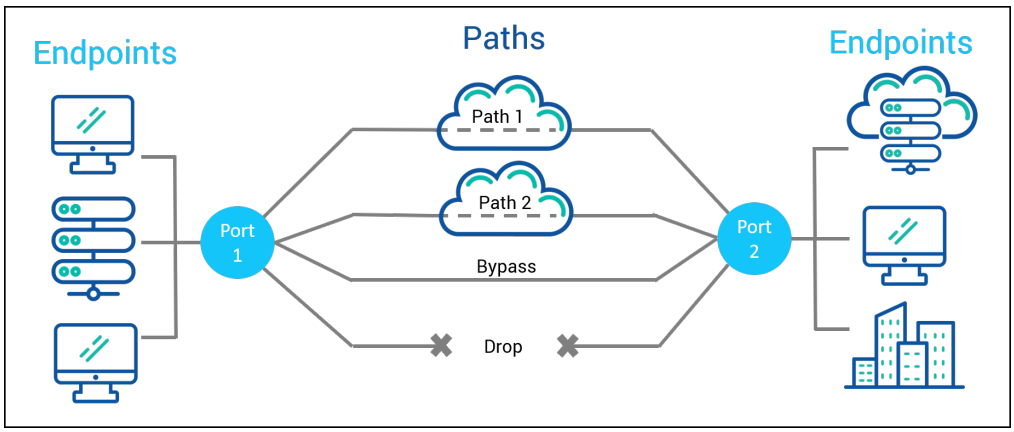
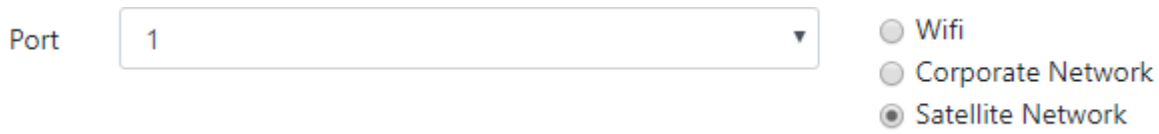


Figure 29: Endpoints

7.2 Endpoint Identifiers

Endpoint can be identified by IP address, IP Range, IP Subnet, VLAN tag, VLAN range, or TCP/UDP ports. These settings are used for the NetropyCE to identify what paths the traffic is assigned to.

7.2.1 Port & Path Selection



The port selection dropdown is used to specify the source port of the Endpoint. This is the physical port the IP, Network, VLAN, or TCP/UDP port is plugged into on the NetropyCE.

Path selection is how you assign the Endpoint to the correct path.

7.2.2 VLAN Identifier

The VLAN identifier allows you to assign a specic VLAN or a VLAN range to a path. You can specifiy a single VLAN or a range of VLANS by using "-". For example, "1000-1350" would specify that 350 VLANS starting at VLAN 1000 and ending at 1350 would be assiged to the desired path.

7.2.3 IP Identifier

The IP identifier allows you to assign a spacific IP, IP range, or IP subnet to a specific path. You can specify a single IP address, an IP Subnet in CIDR format, or a range of IPs using "-". For example, "192.168.100.10-192.168.100.20" would specify 11 IP addresses starting at 192.168.100.10 and ending with 192.168.100.20.

NetropyCE does support IPv6 addressing.

7.2.4 Protocol/Port Identifier

The Protocol/Port identifier allows you to assign a specific port or a range of ports to a specific path. You can specify a single port or a range of ports using "-". For example, "80-180" would specify 100 ports starting at 80 and ending at 180. These can be set as TCP or UDP ports.

8 Monitoring & Statistics Download

The GUI displays real-time statistics and throughput graphs for the traffic over each of the emulated links.

8.1 Graphs

The data visualization section of the main window displays a graph of any of the traffic statistics, such as throughput, over any path. Use the drop-down menus to select the statistic and path to view. The graph can display the statistics in either direction of a path or overlay both directions.

Statistics for background traffic is shown separately from real traffic entering the Engine from external sources.

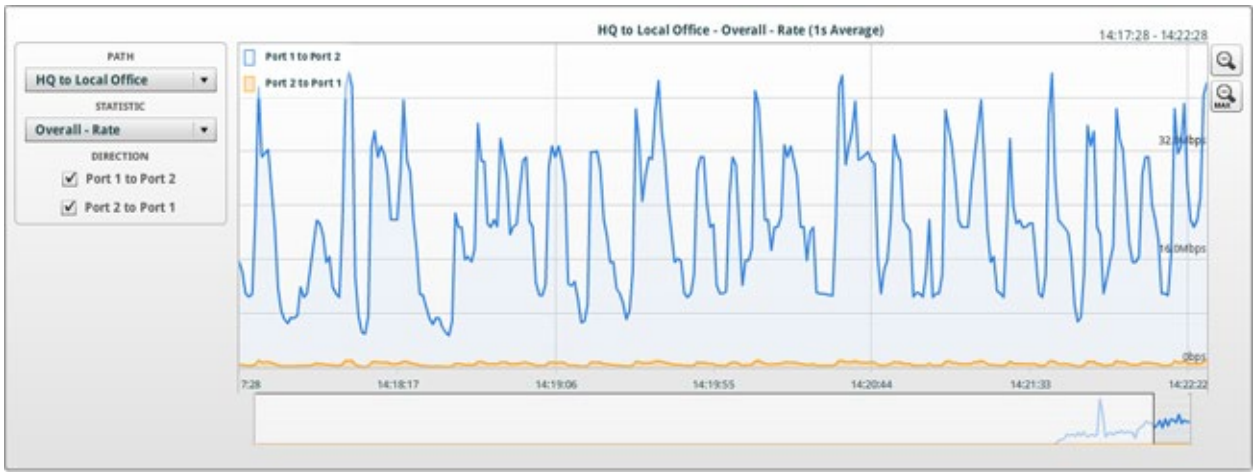


Figure 30: Statistics Graph

To zoom on any portion of the graph, place the cursor over the edge of the area of interest and click and drag to zoom onto that segment. Use the slider under the graph to pan to earlier or later time periods, and use the *zoom out* buttons to reduce the zoom level. When fully zoomed out, the graph displays the previous two hours.

☞	A 24 hour graph of any statistic with zoom and pan controls is also available by clicking the Download Statistics button in the statistic panel, then clicking

	the Time Picker button.

8.2 Statistics

The statistics section of the main window displays statistics for each path and for bypass traffic. By default, only overall throughput rate, frames and bytes transmitted, and packets dropped are displayed. To view other statistics, click the column configuration icon to the right of the table.

Rates are displayed as averages over the past one second interval. Counters are displayed as cumulative values since the last reset. Rebooting or power cycling the instance resets all values. The *reset totals* button resets values displayed in the statistics panel.

Path	Overall			
	Rate	Frames	Bytes	Drops
[Bypass]	0	50	3,200	
[Bypass]	0	50	3,200	
HQ to Local Office	42,127,536	941,447	1,429,104,256	417
HQ to Local Office	992,320	493,957	35,018,784	0
HQ to Home via DSL	1,882,320	141,321	214,525,278	663
HQ to Home via DSL	43,680	79,244	5,719,076	188
HQ to Remote Backup	0	0	0	0
HQ to Remote Backup	0	0	0	0

Figure 31: Path Statistics

☞	The *reset totals* button resets statistics for its browser window only. Opening a new browser window or reloading the current page will restore the statistics. Use the *erase statistics* button on the Statistics Selection and Download window to reset all values permanently. A reboot or power cycle of the Netropy unit will also reset all values.

⚠	Statistics cannot be recovered after a reboot or power cycle of the device.

Data available for display for each path in each direction are described in the table below.

Segment	Statistic	Description
Overall	Rate	current transmission rate for traffic delivered across the WAN over the previous 1 sec. interval.
	Bytes/Frames	cumulative number of bytes and packets delivered across the path.
	Drops	cumulative sum of packets dropped as a result of queuing limits on both the outbound and inbound WAN Access links and the frames dropped due to configured WAN loss parameters.
WAN Access	Tx Rate	current transmission rate for traffic delivered across the WAN Access link over the previous 1 sec. interval. Does not include background traffic.
	Tx Bytes/Frames	cumulative number of bytes and packets transmitted over the WAN access link. Does not include background traffic.
	Queue Length – Bytes/Frames	number of bytes and packets currently in the transmit queue, including estimated queue occupancy of background utilization traffic, when configured.
	Queue Drops	cumulative number of packets dropped due to configured queuing limits. Does not include drops of background traffic.
	Background Bytes/Frames	cumulative number of bytes and packets injected as background traffic on the WAN Access link.
	Background Queue Drops	cumulative number of packets of background traffic dropped due to configured queuing limits.
WAN	Loss Drops	cumulative number of packets dropped due to configured loss parameters.
	Frames Reordered	cumulative number of packets reordered.
	Duplicated	cumulative number of packets duplicated.
	Corrupted	cumulative number of packets that contain one or more errors.

9 ADMINISTRATION

The NetropyCE network emulator is administered via a separate window accessed by clicking the *Administration* link at the top of the main page.

9.1 Network Settings

The IP address of the management interface of the NetropyCE and other network settings are configured in the Network Settings tab.

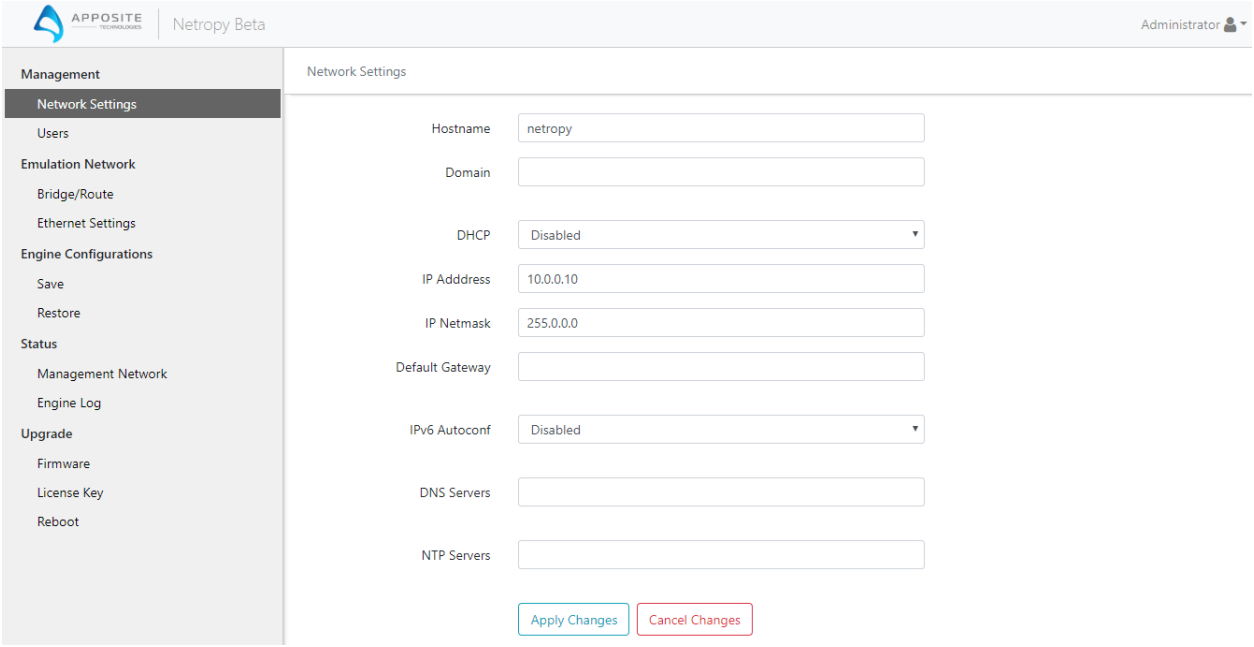


Figure 32: Network Settings Tab

IPv4 address, netmask, and default gateway, as well as DNS and NTP servers may be configured manually or using DHCP. A default gateway is optional.

All IPv4 addresses are entered in dotted-decimal notation. Entries are checked for validity and consistency before changes are applied.

The device can also be managed using IPv6. When IPv6 Autoconf is enabled, a link-local IPv6 is created and the device attempts to obtain a global IPv6 address and default gateway. The assigned IPv6 address is shown on the Management Network status tab.

When the IP address is changed, connectivity to the device will be lost and must be reestablished using the new address.

Up to 3 DNS servers and up to 3 NTP servers may be configured. DNS or NTP servers configured manually will override any servers set automatically through DHCP.

If you cannot regain connectivity to the device after changing the network settings, use the CONSOLE interface to verify or change the network settings.

9.2 Users

Usernames and passwords are administered in the Users tab.

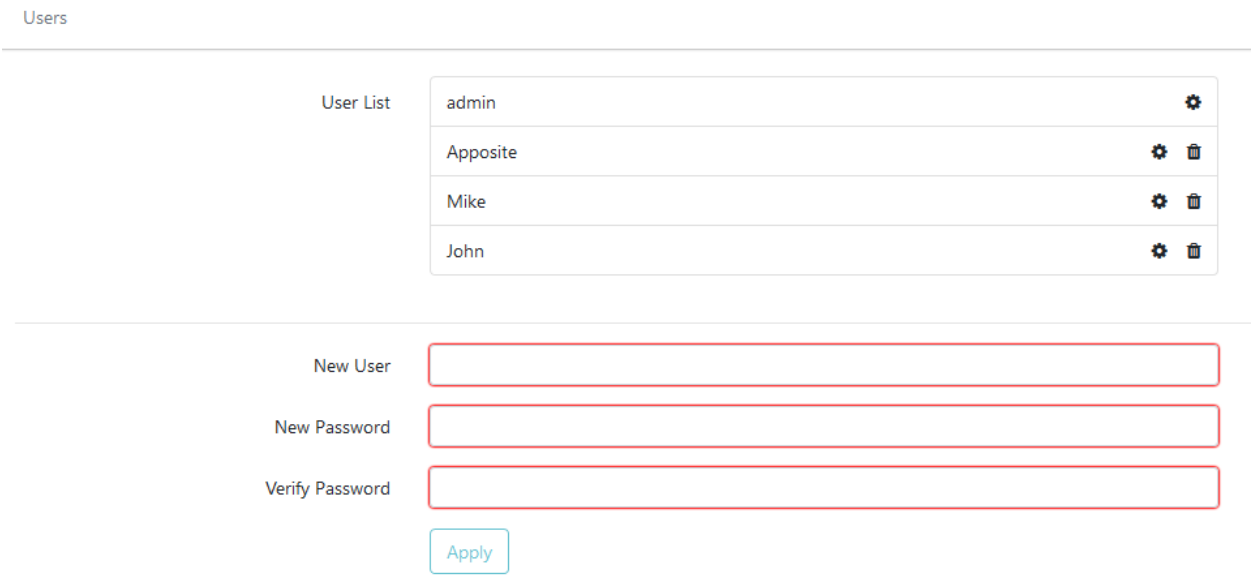


Figure 33: User Administration Tab

Initially, the device has a single user, *admin*, with instance ID as the password. Additional users can be added or deleted by *admin*. Passwords for each user can be set or cleared by the individual user or by *admin*.

Users other than *admin* are unprivileged, and can make configuration changes but cannot make system administrative changes.

10.3 Route

NetropyCE uses Routing mode due to the fact that cloud providers do not allow for Layer 2 manipulation. NetropyCE can only be used in Routing mode.

In Routing Mode, the NetropyCE Engine functions as a router between the Ethernet segments connected to the two ports of the Engine. Configure the IP address and netmask of the two interfaces. If necessary, add static routes to off-link destinations. All addresses are entered in dotted-decimal notation.

Routing Mode supports only the forwarding of IPv4 frames and does not support multicast forwarding.

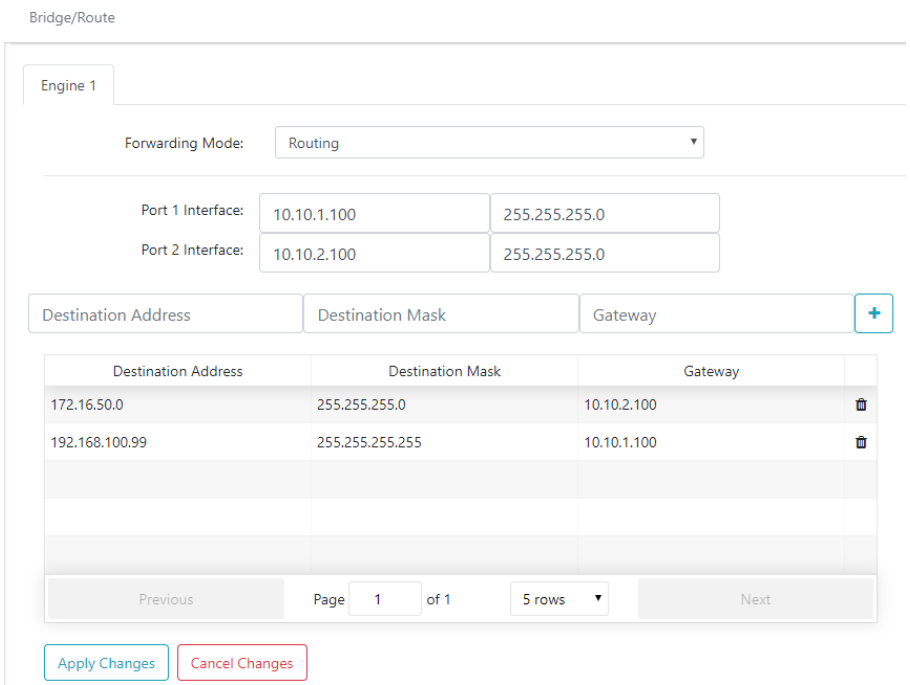


Figure 34: Route Tab

10.7 Save and Restore Engine Configurations

The configuration of a selected Emulation Engine can be saved to a file on the management PC from the Save tab. The stored configuration file can then be loaded into a different Netropy unit regardless of model. The restore operation overwrites the current configuration of the Engine.

Recording and PCAP files are included in the configuration file if they are used in any path in the Engine. This can cause configuration files to be very large.

The bridging or routing settings are saved with the Engine configuration and are updated when a saved Engine configuration is restored.

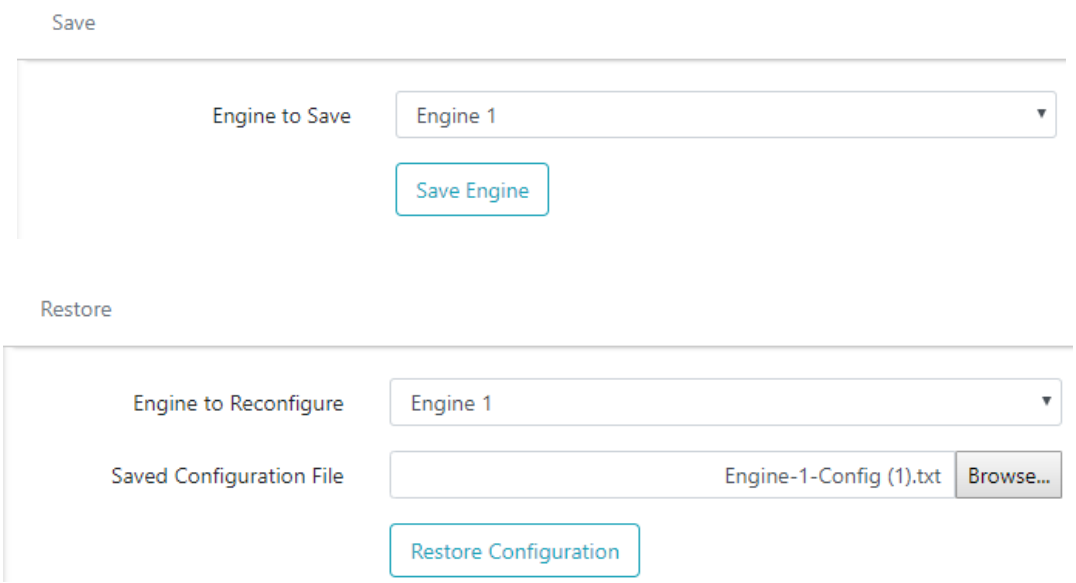


Figure 35: Save and Restore Tabs

10.8 Management Network Status

The Management Network status screen shows the current configuration for the IP address and netmask, default gateway, network domain, and DNS and NTP servers. Press the refresh button to update with the latest status.

10.9 Engine Log

A log file of error messages and warnings is shown on the Engine Log tab. A separate log is

maintained for each Engine. Each line includes a sequence number and the time in GMT. Log messages will be generated at most once per second.

If there are any error conditions that could affect the validity of the test results, the LEDs on the Engine tab on the main configuration window remain red until the log message has been marked as read or the log cleared.

Error conditions reported in the log are:

```
timing error exceeded <#>us
```

The engine has detected that the error in emulation timing has exceeded the indicated number of microseconds.

```
<#> frames lost
```

The engine has been overload and was unable to process all received frames, with the indicated number of frames dropped.

```
out of buffers - <#> events
```

The engine ran out of buffer space to receive new frames from the network. The number of failed attempts to allocate buffer space is reported.

```
automatic engine shutdown
```

Emulation was aborted. The current engine configuration requires more resources than supported by the hardware.

11 Apposite Support

1.1 Customer Support

If you experience any problem with the NetropyCE, please contact Apposite Support.

support@apposite-tech.com

When contacting Apposite Support, please include the following information:

- Your e-mail address and phone number
- A detailed description of the problem

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Beta 3.1

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PureMVC

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Python-lxml

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Python-pam

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