NE-ONE Emulator

Emulator Impairment Data Sheet

OVERVIEW

NE-ONE's comprehensive library of impairments enable you to easily mimic what happens in real-world networks. Each impairment is controlled by one or more parameters allowing you to customise its behaviour for your specific testing needs. NE-ONE's impairments are frequently updated based on evolving networks and customer needs.

LATENCY & JITTER

Gaussian (Normal Distribution) Delay
Description: Applies a latency to a packet based on the Mean Delay and the Standard Deviation, determined by the Gaussian (Normal) distribution. Latency will never go below Min Delay.

Parameters: Min Delay; Max Delay; Mean Delay; Standard Deviation.

Summary: This is probably the most real-world delay impairment but the minimum and maximum delay parameters ensure a base network latency (which is realistic) and rejects low probability but ridiculously high latencies. Creates Gaussian Jitter.

Step Delay Periodic
Description: Applies a step latency beginning at Min Delay and going up to Max Delay in milliseconds changing steps every specified amount of ms has elapsed. When Max is reached the steps come down to Min Delay and the process repeated.

Parameters: Min Delay; Max Delay; Step Delay; Step Duration.

Summary: Allows efficient stress testing of applications from a latency point of view to establish limits.

Step Delay Packet
Description: Applies a step latency beginning at Min Delay and going up to Max Delay in nanoseconds changing steps every packet. When Max is reached the steps come down to Min Delay and the process repeated.

Parameters: Min Delay; Max Delay; Step Delay.

Summary: Exposes any vulnerabilities to high latency and allows efficient stress testing to establish limits.

Fixed Delay
Description: Applies a fixed latency in nanoseconds.

Parameters: Delay.

Summary: Allows you to be exact about your delay (+- 10 microseconds in practice) which is useful when precision is required.

Fixed Delay with Jitter
Description: Applies a fixed base delay (latency) and random jitter (PDV).

Parameters: Base Latency; Max Jitter.

Summary: Allows you to separately control base delay and maximum jitter.

Random Delay
Description: Applies a random latency between Min Delay and Max Delay milliseconds.

Parameters: Min Delay; Max Delay.

Summary: Allows you to easily and quickly set random latency causing Jitter.

Inter Packet Gap Delay
Description: Applies a random inter-packet gap between Min Gap and Max Gap milliseconds.

Parameters: Min Gap; Max Gap; Delay.

Summary: Aimed at creating Jitter in high speed packet streams by specifying a definite inter-packet gap. Ideal for simulating flows being held up and then bunching which can be very useful for certain streaming tests.

LOSS

Random Drop with Burst
Description: Drop a sequence of packets on a Random (percentage) basis. The number of packets to drop is randomly chosen between Min and Max.

*Parameters: Loss Percent; Minimum Packets to Drop; Maximum Packets to Drop.*

Summary: A simple way (without programming) to create networks that suffer periodic noise or high losses to determine the impact on application performance.

Poisson Drop
Description: Drop on average Lambda packets in each Interval specified, using the Poisson Distribution (with mean Lambda).

Parameters: Lambda; Interval; Duration.

Summary: Drops packets according to the Poisson distribution to mimic patterns often seen in the real world.
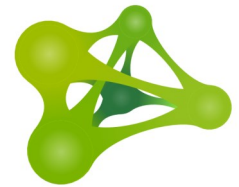
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Packet Error 1 in x Bits
Description: Drops packet if packet errored. This is based on bit errors. Specify loss as 1 in every x bits.

Parameters: Loss x.

Summary: This is common for networks that create bit errors. The drop simulates other equipment dropping the broken packet due to a checksum mismatch and is very realistic for mimicking satellite and certain wireless transmissions.

Burst Loss
Description: This function allows you to specify two loss levels— regular loss and a burst (usually higher) loss and choose how frequently and long to burst.

Parameters: Loss Percent; Burst Loss Percent; Burst Frequency; Burst Duration.

Summary: Developed for customers that needed a random burst rather than period burst for testing dropped packets randomly followed by dropping several in a row - a random burst. Provides a very realistic test network for random bursts of noise, for example in wireless networks.

Drop 1 in x
Description: Drops 1 in every x packets

Parameters: Loss x

Summary: Provides a steady drop of 1 in x packets which is good for early testing of protocols and whether they can recover from certain amounts of loss.

Random Drop
Description: Applies the percentage packet drop

Parameters: Loss Percent

Summary: The most commonly used drop function to simulate real world drops due to failure to queue etc. Provides a realistic symptoms of what happens when network links are busy and queues are full.

DUPLICATE

Packet Duplicate & Move
Description: Select a packet in the current stream on a random % basis (uniform distribution) then duplicate it and optionally move it between a minimum and maximum packet positions. A move of 0 packets means the duplicate occurs immediately after the original.

Parameters: Selection Percent; Minimum Move; Maximum Move.

Summary: Allows more realistic testing than simple duplication because the duplicated packet can be held and inserted randomly in the traffic flow and not

behind the original. Good for certain cyber/crypto testing.

OUT OF ORDER

Random Packet Move Offset
Description: Takes a packet out of the current stream on a random % basis (uniform distribution) - and moves it between a Minimum and Maximum packet position.

Parameters: Move Percent; Minimum Move; Maximum Move.

Summary: Used to test protocol resilience and exposes application inadequacies e.g. Jitter buffer ability to efficiently put packets back into order. It's likely that you would have to wait a long time to see this in the real world.

FRAGMENT

Fragment MTU
Description: Fragments a packet into multiple smaller size packets, transmits the smaller packets and drops the original packet

Parameters: MTU Limit; Don't Fragment Flag Option

Summary: Emulates what happens in the real-world and allows applications and protocols ability to efficiently reassemble the fragmented packet to be tested.

BIT ERROR

Error with Burst
Description: Applies bit errors— at the rate (and deviation interval) given. It has the ability to burst to a higher error if burst parameters defined.

Parameters: Error Rate; Error Rate Deviation; Burst Error Rate; Interval Between Bursts; Interval Deviation; Burst Duration.

Summary: Mimics a steady bit error rate and then a random burst on top providing realistic packet corruption when noise hits a network. Particularly good for wireless and satellite circuit testing.

Poisson Error
Description: Error on average Lambda bits in each Interval specified, using the Poisson Distribution (with mean Lambda)

Parameters: Lambda; Interval; Duration.

Summary: In the real world, when not bursty, bit errors occur according to the Poisson distribution as opposed to normal or uniform distribution.
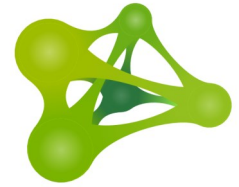
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Random Packet Error
Description: Select a packet for error on a random % basis (uniform distribution) - then randomly choose which bit to error.

Parameters: Packet Error Percent

Summary: Ensures a certain proportion of packets are corrupted and is as likely to corrupt a small packet as a big one. Good for stress testing in packet error situations to determine if the protocol or application can cope.

GENERAL LINK IMPAIRMENTS

Link Speed: Specify the network bandwidth from 1bps to 1Gbps so that you can exactly match a given real world circuit.

Queue Length: Define the link buffer size so that packet drops happen when buffer is full just as happens to routers, traffic shapers or WAN optimizers in the real network.

Overhead: Define the Layer 2 header size so that you can model other network types, not just Ethernet. Provides more realistic testing for non-ethernet network emulation.

Congestion: Set Link congestion as a % of the link capacity. Allows you to simulate actual usage of the link because in the real world networks carry other traffic. Enables you to get a realistic test without needing to use traffic generators to make the link look busy.

TTL Cost: Represent the number of network hops the packets will pass through so that the TTL is the same as in the real network. External routers make routing decisions based on TTL therefore setting the TTL increases testing realism.

SCENARIO BUILDER NETWORK TRANSITIONS

Transitions define what happens when changing between emulations (elements) in the scenario, for example changing from a 2G to 3G network.

None: Provides an easy method of a hard change from the previous Element to the new Element's parameters. This can be used to stress an application by providing a hard change in parameters.

Graduating: This transition changes all emulation parameters Gradually between the values of the Element before and the Element after it. Allows a gradual ramping up or down of any parameter without using scripting or programming.

Variable: This transition changes all emulation parameters Variably (in a random manner) between the values of the Element before and the Element after it. Allows a very easy method of creating a fluctuating or flaky network, for example changing from 2G to 3G network.

Outage: This transition creates an increasingly lossy network, leading to total loss before returning quickly but not instantly. Such a transition is highly representative of mobile networks when losing signal from one source and coming back with another e.g. wifi - leave building, pick up 3G.

GLOSSARY

Milliseconds: Thousandth (10^{-3}) of a second.
Microseconds: Millionth (10^{-6}) of a second.
Nanoseconds: Billionth (10^{-9}) of a second.

Lambda: The Poisson distribution is defined by one parameter:lambda (λ). This parameter equals the mean and variance. As lambda increases, the Poisson distribution approaches a normal distribution.

PDV: Packet Delay Variation is the difference in end-to-end one-way delay between selected packets in a flow with any lost packets being ignored. The effect is sometimes referred to as jitter.