



SCENARGIE®

Scenargie® 2.2

Base Simulator

User Guide

Space-Time Engineering, LLC
October 2017

Contents

Preface	1
1. Base Simulator Overview	2
2. Overview of simulator execution.....	3
2.1. Executable file	3
2.2. Command line execution.....	3
2.3. Sample scenarios.....	4
2.3.1. base_wirednetwork.....	4
2.3.2. base_aloha	6
2.3.3. base_itm	7
2.3.4. base_sensing	8
2.4. Running old sample scenarios	9
2.4.1. How to run sample scenarios shipped with Scenargie 2.1 r20721	9
3. Simulation Scenario	10
3.1. Syntax used in scenario files.....	10
3.2. Configuration file	11
3.2.1. Syntax of configuration file	11
3.3. Mobility file.....	17
3.3.1. Syntax.....	17
3.3.2. Dynamic node creation and deletion	18
3.4. Bit Error Table file /Block Error Table file	20
3.4.1. Syntax.....	20
3.5. Antenna file	27
3.5.1. File format.....	27
3.6. Statistics configuration file.....	29
3.6.1. Syntax.....	29
3.7. Static route file.....	30
3.7.1. Syntax.....	30
3.8. Moving object shape file.....	30
3.9. Material File.....	31
3.10. MIMO channel matrix file	32
3.10.1. File format.....	32
4. Output of Simulation Results	35
4.1. Statistics file	35
4.2. Trace File	37
4.3. Output to standard output and standard error.....	38

5. Customizing the simulator	39
5.1. Configuration for collecting statistics	39
5.2. Configuration of trace tags	43
6. Properties.....	46
6.1. List of properties	46
7. Statistics, Trace.....	122
7.1. List of default settings of statistics	122
7.2. Trace Event List	131
8. Bibliography	140
9. Appendix	142


Preface

This document describes how to use Scenargie 2.2 Base Simulator, a discrete event simulator.

Related documents

Installation Guide
Programmer's Guide
Base Simulator Model Reference
Visual Lab User Guide
Dot Eleven Module User Guide
Emulation Module User Guide
LTE Module User Guide
Sensor Module for BLE User Guide
ITS Extension Module User Guide
Multi-Agent Extension Module User Guide
Multi-Agent Extension Module Model Reference
Fast Urban Propagation Module User Guide
High Fidelity Propagation Module User Guide
Trace Analyzer User Guide

1. Base Simulator Overview

Scenargie 2.2 Base Simulator constitutes Scenargie 2.2 with Scenargie 2.2 Visual Lab (GUI) and extension modules. (Marked by  in Fig. 1-1)

Scenargie 2.2 Base Simulator includes the following items.

- Simulation engine
- Source code
 - Applications: CBR, VBR, FTP, MultiFTP[1], VoIP[1], VideoStreaming[1], HTTP[1], Flooding[12], IperfTCP[18], IperfUDP[18], BundleProtocol/BundleMessage, Sensing, TracebasedApp
 - Transport layer: UDP, TCP (NewReno, CUBIC, H-TCP, Vegas, Hamilton-Delay, CAIA-Hamilton-Delay, CAIA-Delay-Gradient)
 - Network layer: IP
 - Routing: Static routing, AODV [2], OLSR [3], nuOLSRv2[4]
 - MAC: Abstract Network MAC, ALOHA [20, 21]
 - Radio propagation models: Free space model [5], Two-ray ground reflection model [5], Okumura-Hata [6], COST231-Hata model [6], COST231 Indoor model [7], Wall count, ITU-R P.1411 [8], Taga model [9], [10], ITM[19], Two tier, Trace, TGaxIndoor [23], ITU-UMi [24]
 - Antenna models: Isotropic, Sectorized [11], Custom
 - Mobility models: Stationary, Random Waypoint, GIS-Based Random Waypoint, Trace File
- makefile
- Sample scenarios

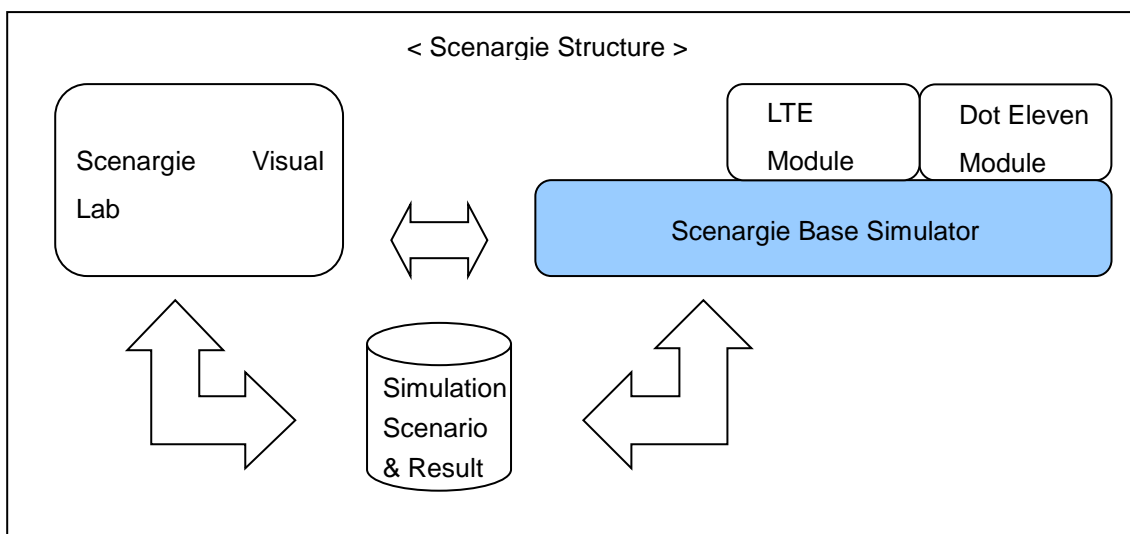


Fig. 1-1 Scenargie system structure

2. Overview of simulator execution

Scenargie has two ways of simulation execution. One is using Visual Lab, the GUI of Scenargie, to make simulation scenarios and to control simulation executions. Another is command line based execution, in which a user edits text-based simulation scenarios and executes the simulation using the command line interface. This document describes the command line based operation.

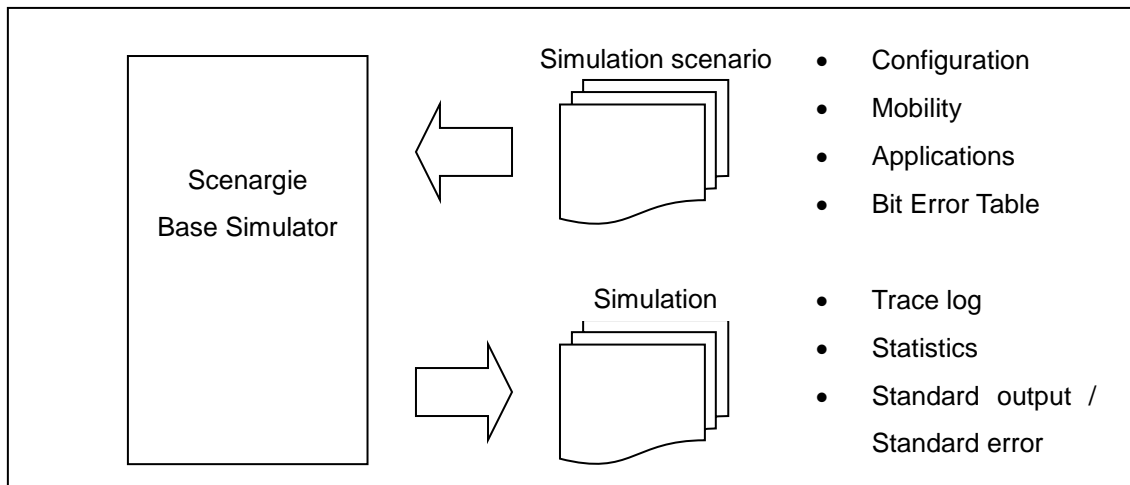


Fig. 2-1 Conceptual diagram for simulation execution

2.1. Executable file

In this document, we assume that the simulation executable file has already been created. For details about creating an executable file, refer "Scenargie Installation Guide".

We assume that the executable filename is "sim" in the Linux environment, or "sim.exe" in the Windows environment.

2.2. Command line execution

To run the simulator program, type a command as the following format

<Executable filename> <Configuration filename>

Example in the Linux environment:

```
$ ./sim sample.config
```

If you want to save the standard output and the standard error to a file (sample.log),

```
$ ./sim sample.config 1>> sample.log 2>&1
```

Example in the Windows environment:

```
> sim.exe sample.config
```

If you want to save the standard output and the standard error to a file (sample.log),

```
> (sim.exe sample.config 2>&1) > sample.log
```

2.3. Sample scenarios

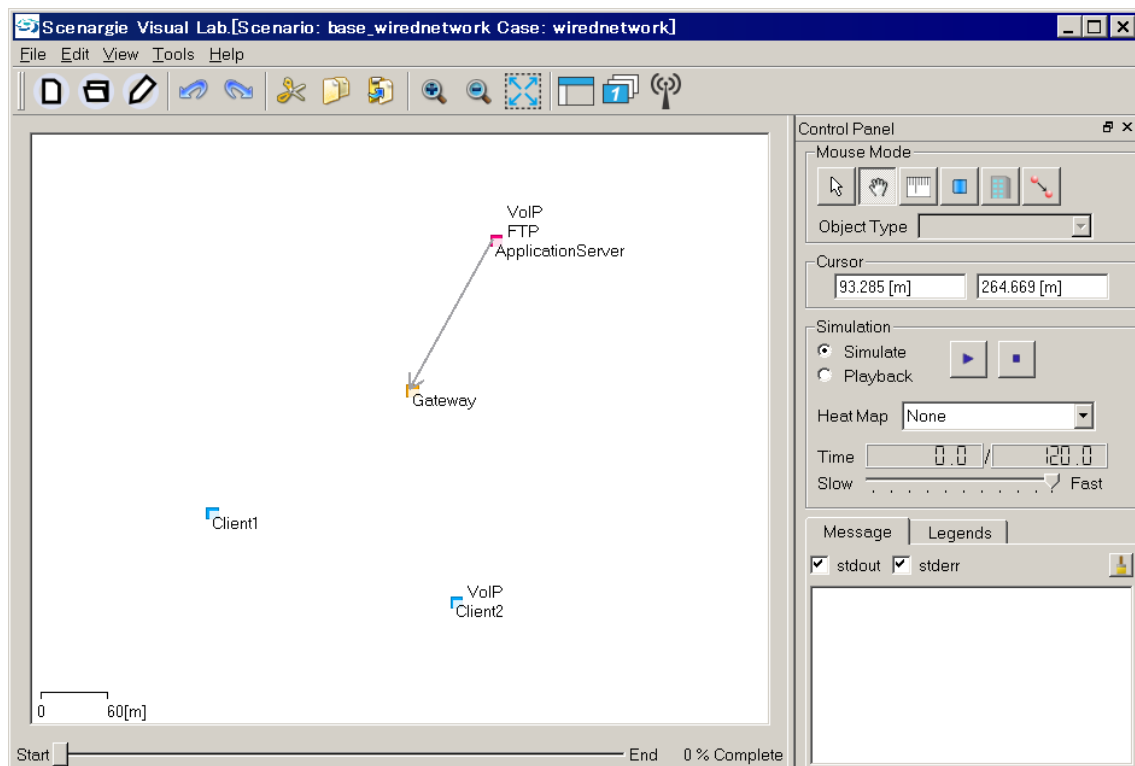
Sample scenarios files are created in the following directories after extracting the package (see Scenargie Installation Guide).

scenargie_simulator/2.2/scenarios_linux/

scenargie_simulator/2.2/scenarios_windows/

Sample scenarios of Scenargie Base Simulator are stored in the directories that the name starts with “base_”. Each scenario directory includes a file with a suffix .case which is for Scenargie Visual Lab. A scenario for command line execution is stored in a directory named “commandline” in each sample scenario directory.

2.3.1. base_wirednetwork



- Frame of scenario

Communication objects:

- ApplicationServer (stationary) x1
- Gateway (stationary) x1
- Client (stationary) x2

Application:

FTP : ApplicationServer → Client1

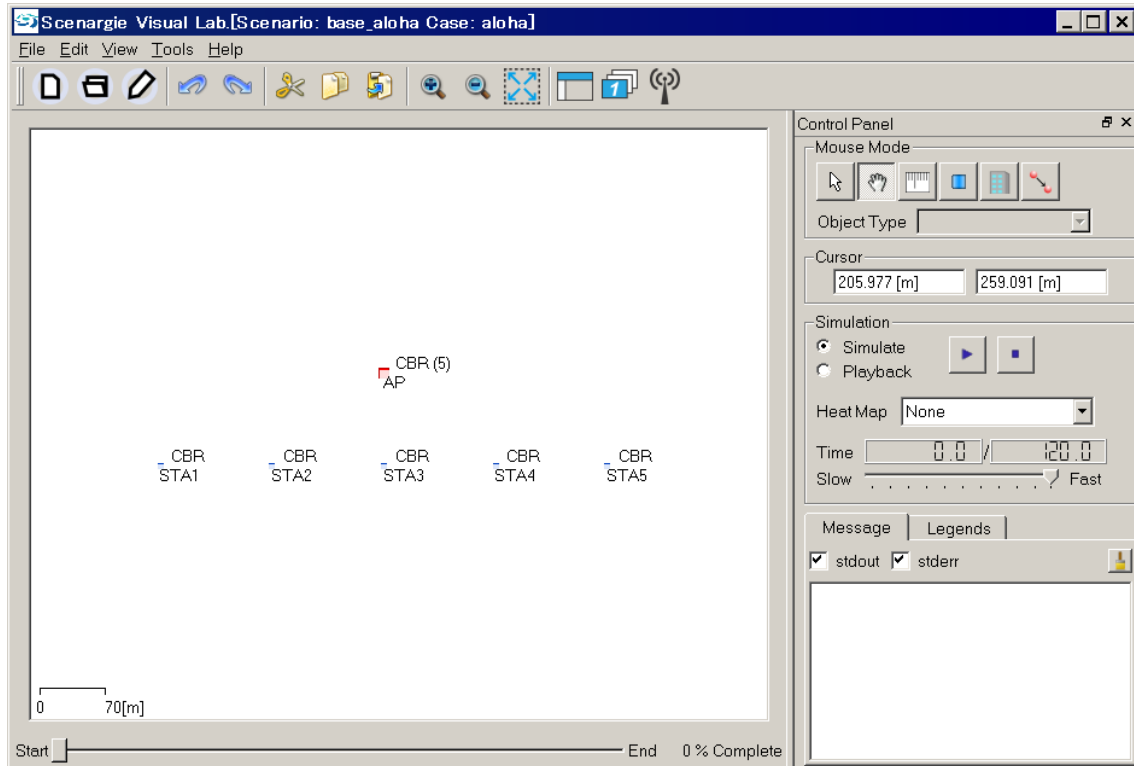
VoIP : ApplicationServer → Client2

VoIP : Client2 → ApplicationServer

- Description

This scenario simulates a wired network system. ApplicationServer and Clients are connected with wired inks via Gateway. A static routing setting file (wirednetwork.routes) is used for routing.

2.3.2.base_aloha



- Frame of scenario

Communication objects:

- APx1
- STAx5

Applications:

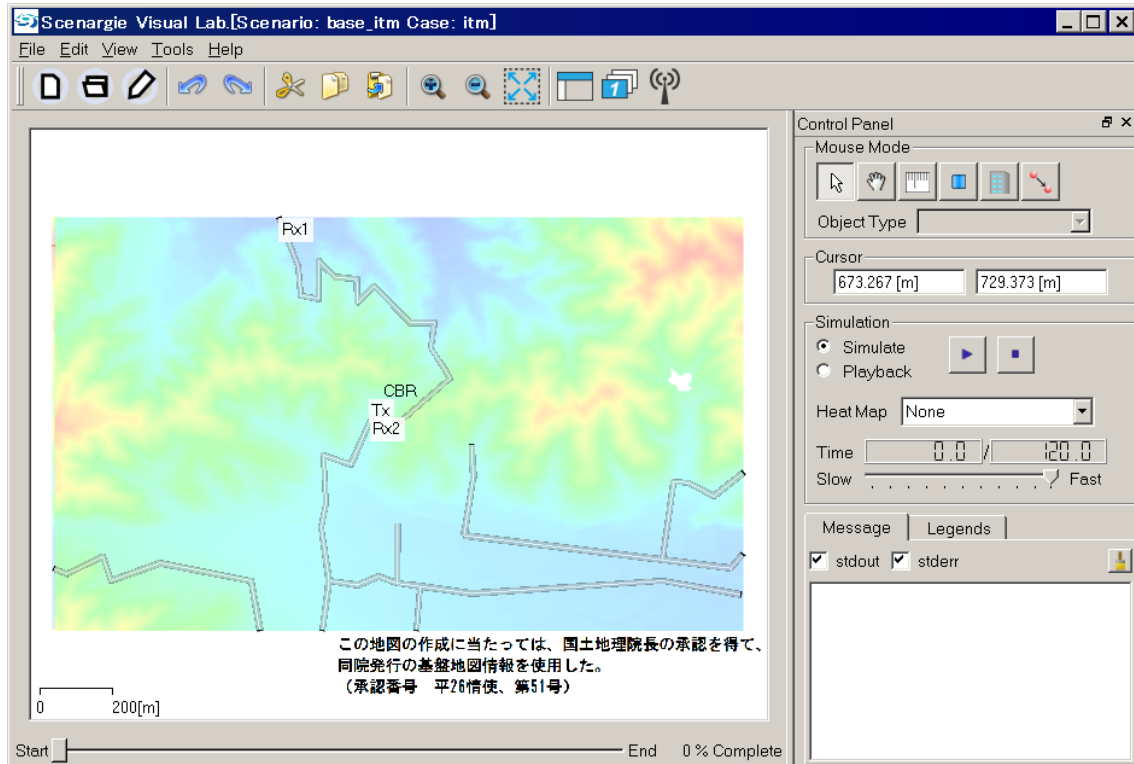
CBR : AP -> STA1...STA5

CBR : STA1...STA5 ->AP

- Description

This scenario is for wireless communication with ALOHA (Unslotted) protocol between an AP and STAs. STAs move around the AP according to the random waypoint mobility model.

2.3.3.base_itm



- Frame of scenario

Communication objects:

- Tx x1
- Rx x2

Applications:

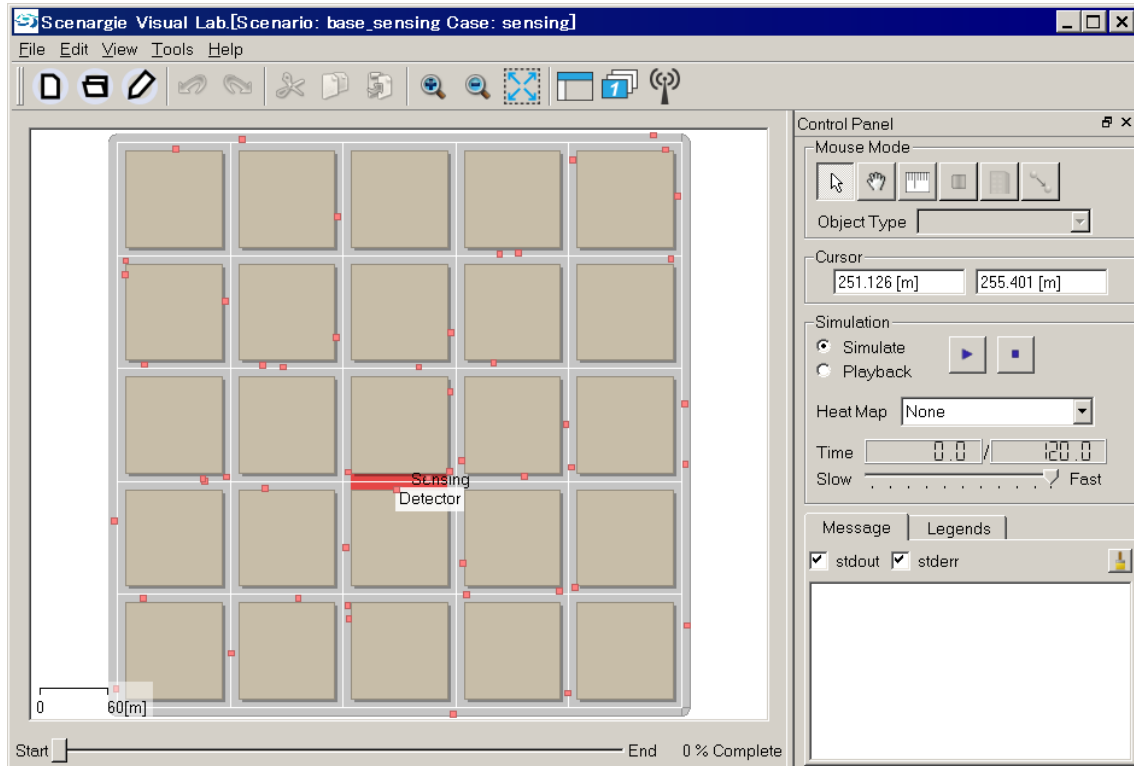
CBR : Tx -> * (Broadcast)

- Description

This scenario uses a map including elevation data and ITM radio wave propagation model. A communication object Tx placed at the roadside sends application data to another communication object Rx that moves on the road.

This map is based on the Fundamental Geospatial Data published by Geospatial Information Authority of Japan with its approval under the article 30 of The Survey Act. (Approval Number ZYOU-SHI No.51 2014)

2.3.4.base_sensing



- Frame of scenario

Communication objects :

- Sensing node (Detector) x 1
- Moving node (Vehicle) x 50

Application :

Sensing : The sensing node (Detector) monitors a road segment painted in red. Intersections at the both ends are also monitored.

- Description

The sensing nodes count the number of vehicles on a road segment at an arbitrary interval (1 second in the sample scenario). The vehicles move around on the roads on the map. You can activate a function to deliver messages to the monitored vehicles without simulating communication between them and add functions that are triggered by the sensing of vehicles.

2.4. Running old sample scenarios

This section describes how to run old sample scenarios with the latest Scenargie 2.2 Visual Lab and a simulation executable file newly built.

2.4.1. How to run sample scenarios shipped with Scenargie 2.1 r20721

Running sample scenarios for Visual Lab

No special operation is needed. Execute the scenario as-is.

Running samples scenarios for command line execution

No special operation is needed. Execute the scenario as-is.

3. Simulation Scenario

Simulation scenario is a collective term for files used for running a simulation. A simulation scenario consists of the following files. A simulation scenario has one configuration file. Other files are optional (depend on the simulation model).

- Configuration file (.config)
- Mobility file (.mob)
- Bit error table (.ber)
- Antenna pattern file (.ant)
- Statistics configuration file (.statconfig)
- Static route file (.route)
- Material file (.material)
- MIMO channel matrix file

3.1. Syntax used in scenario files

The common syntax used in simulation scenario files is as follows.

- 1 line per item.
- A line starts with # is a comment line.
- Use character codes for line breaks depending on the simulation environment. Windows: CR+LF, Linux and MacOS: LF.
- Use only ASCII characters

3.2. Configuration file

The simulation details are specified by the property definitions written in the configuration file. Simulation scenario files other than the configuration file are loaded by the simulator at runtime according to the file names specified in the configuration file at runtime.

3.2.1. Syntax of configuration file

Specify the properties for each communication object as follows.

```
[<Node_number>; Instance_name] <Property_name> = <Value>
```

```
[Instance_name] <Property_name> = <Value>
```

You can put spaces before and after '=', but tab[s] are not allowed. The instance name cannot include any spaces. Following letters are available for the instance name.

```
0123456789abcdefghijklmnopqrstuvwxyz_-.()
```

a) How to specify scope

The bracket "[" and "]" specifies a scope for a property. It is described as follows.

```
[<Node_number>; <Instance_name>]
```

If a property is specified without a scope, it means that the property is a global property. That is, the value specified the sentence is used by all nodes and interfaces.

Multiple node numbers can be included in a scope by writing them as a list of comma-separated values, e.g. [1,3,5]

You can use an expression that connects two node numbers with '-' to write sequential node numbers, e.g. [2-10].

Put a semicolon, ";", between the node number(s) and the instance name. e.g. [1;wifi].

b) Meaning of instance names

An instance name refers to an interface name or a group name depending on the property.

If the property is one configured for each node, the instance name refers an interface name.

If the property is related to channels listed as follows, the instance name refers a group name.

```
channel-frequency-mhz
```

```
channel-bandwidth-mhz
```

```
propagation-model
```

```
enable-propagation-delay
```

```
max-signal-propagation-meters
```

c) Relationship between an instance name and the method for specifying the scope

Different syntax is used depending on the target the instance name specifies.

Specifying scope for an interface name:

Three levels of detail for specifying the scope can be used. A property specified with more detailed scope overrides others.

Global	No scope
Node	[<Node number>]
Node+Interface	[<Node number>; <Instance name>]

Specifying scope for a group name (Channel related properties)

Two levels of detail for specifying the scope can be used. A property specified with more detailed scope overrides others.

Global	No scope
Group	[<Instance name>]

<Example of a configuration file>

```
#Instance general
#Component Simulation
seed = 123
mobility-seed = 123
simulation-time = 120.000000000
time-step-event-synchronization-step = 0.100000000
trace-output-mode = Text
trace-index-output = true
trace-output-file = simulation.trace
statistics-output-file = simulation.stat
statistics-output-for-no-data = true
allow-node-re-creation = false
network-static-route-file = simulation.routes
network-terminate-sim-when-routing-fails = false
progress-sim-time-output-interval-percents = 5.000000000
enable-unused-parameter-warnings = true

#Component GIS
gis-road-driving-side = Left
gis-los-break-down-curved-road-into-straight-roads = true
gis-number-entrances-to-building = 0
```

```

gis-number-entrances-to-station = 0
gis-number-entrances-to-busstop = 0
gis-number-entrances-to-park = 0
gis-road-set-intersection-margin = false

#Component Antenna/Propagation
number-data-parallel-threads-for-propagation = 1
antenna-pattern-two-2d-to-3d-interpolation-algorithm-number = 1
antenna-patterns-are-in-legacy-format = false

[1,3-4] is-member-of = WiredObjectType
[2] is-member-of = GatewayObjectType
#Instance general
#Component Channel

#Instance general
#Component Common

#Component Position

#Component CommunicationObject

#Component SimulationObject
[1-4] trace-enabled-tags = Application Network
[1-4] trace-start-time = 0.000000000

#Component Network (Node)
[1-4] network-hop-limit = 64
[1-4] network-loopback-delay = 0.000000001

#Component Transport

#Instance wired1

```


#Component Routing**#Component Network (Interface)**

```
[3-4;wired1] network-address = 192.168.0.0 + $n
[1-2;wired1] network-address = 10.0.0.0 + $n
[1-4;wired1] network-prefix-length-bits = 16
[1-4;wired1] network-subnet-is-multihop = false
[1-4;wired1] network-address-is-primary = false
[1-4;wired1] network-allow-routing-back-out-same-interface = true
[1-4;wired1] network-ignore-unregistered-protocol = false
[3-4;wired1] network-gateway-address = 192.168.0.2
[1-4;wired1] network-mtu-bytes = 1500
[1-4;wired1] mac-protocol = Abstract-Network
[1-4;wired1] interface-output-queue-max-packets = 1000
[1-4;wired1] interface-output-queue-max-bytes = 1000000
[1-4;wired1] network-enable-dhcp-client = false
[1-4;wired1] network-enable-dhcp-server = false
[1-4;wired1] network-enable-ndp = false
[1-4;wired1] network-enable-arp = false
```

#Component AbstractNetworkMac

```
[1-4;wired1] abstract-network-output-bandwidth-bits-per-sec = 100000000
[1-4;wired1] abstract-network-min-latency = 0.010000000
[1-4;wired1] abstract-network-max-latency = 0.010000000
[1-4;wired1] abstract-network-mac-packet-drop-rate = 0.000000000
```

#Instance wired2**#Component Routing****#Component Network (Interface)**

```
[2;wired2] network-address = 192.168.0.0 + $n
[2;wired2] network-prefix-length-bits = 16
[2;wired2] network-subnet-is-multihop = false
[2;wired2] network-address-is-primary = false
[2;wired2] network-allow-routing-back-out-same-interface = true
```

```

[2;wired2] network-ignore-unregistered-protocol = false
[2;wired2] network-mtu-bytes = 1500
[2;wired2] mac-protocol = Abstract-Network
[2;wired2] interface-output-queue-max-packets = 1000
[2;wired2] interface-output-queue-max-bytes = 1000000
[2;wired2] network-enable-dhcp-client = false
[2;wired2] network-enable-dhcp-server = false
[2;wired2] network-enable-ndp = false
[2;wired2] network-enable-arp = false

#Component AbstractNetworkMac
[2;wired2] abstract-network-output-bandwidth-bits-per-sec = 100000000
[2;wired2] abstract-network-min-latency = 0.010000000
[2;wired2] abstract-network-max-latency = 0.010000000
[2;wired2] abstract-network-mac-packet-drop-rate = 0.000000000

#Instance FTP1

#Instance VoIP1

#Instance VoIP2

gis-object-position-in-latlong-degree = false

#Component FTP
[1;FTP1] ftp-destination = 3
[1;FTP1] ftp-flow-start-time = 10.000000000
[1;FTP1] ftp-flow-end-time = 110.000000000
[1;FTP1] ftp-start-time-max-jitter = 1.000000000
[1;FTP1] ftp-flow-size-bytes = 5000000
[1;FTP1] ftp-priority = 0
[1;FTP1] ftp-auto-port-mode = true
[1;FTP1] ftp-use-virtual-payload = false

#Component VoIP

```

```

[1;VoIP1] voip-destination = 4
[4;VoIP2] voip-destination = 1
[1;VoIP1] voip-start-time = 10.000000000
[4;VoIP2] voip-start-time = 10.000000000
[1;VoIP1] voip-end-time = 110.000000000
[4;VoIP2] voip-end-time = 110.000000000
[1;VoIP1] voip-start-time-max-jitter = 1.000000000
[4;VoIP2] voip-start-time-max-jitter = 1.000000000
[1;VoIP1] voip-mean-state-duration = 1.250000000
[4;VoIP2] voip-mean-state-duration = 1.250000000
[1;VoIP1] voip-state-transition-probability = 0.016000000
[4;VoIP2] voip-state-transition-probability = 0.016000000
[1;VoIP1] voip-beta-for-packet-arrival-delay-jitter = 0.000000000
[4;VoIP2] voip-beta-for-packet-arrival-delay-jitter = 0.000000000
[1;VoIP1] voip-jitter-buffer-window = 0.000000000
[4;VoIP2] voip-jitter-buffer-window = 0.000000000
[1;VoIP1] voip-priority = 0
[4;VoIP2] voip-priority = 0
[1;VoIP1] voip-auto-port-mode = true
[4;VoIP2] voip-auto-port-mode = true
[1;VoIP1] voip-use-virtual-payload = false
[4;VoIP2] voip-use-virtual-payload = false

[1-4] mobility-model = TRACE-FILE
[1-4] mobility-trace-file = simulation.pos

statistics-configuration-file = simulation.statconfig

```

3.3. Mobility file

Node positions are written in chronological order in a mobility file.

3.3.1. Syntax

The position of a node at a given time is written in one line.

<Node number> <Time> <x-coordinate> <y-coordinate> <z-coordinate> <Angle of azimuth>
<Angle of elevation>

Note:

- If “-“ is written as time, it means that the position of the node is fixed.
- The unit of x-coordinate, y-coordinate, and z-coordinate (=height) is meters (m).
- The angle of azimuth is written as a clockwise angle from the positive direction of the Y-axis.
- The angle of elevation is written as an angle from the horizon. 0 means the angle is horizontal. A negative value means that the node is going down.
- The unit for angle of direction and angle of elevation is degree.

<Example of a mobility file>

```
# <Node Id> <Sim Time OR "-"> <X> <Y> <Height> <Azimuth> <Elevation>
# Units in Meters, Degrees (clockwise from north and up from horizon).

1 - 1000.00 1000.0 1.5 0 0
2 - 1000.00 1010.0 1.5 0 0
3 - 1000.00 1020.0 1.5 0 0
4 - 1000.00 1030.0 1.5 0 0
5 - 1010.00 1000.0 1.5 0 0
6 0S 1010.00 1400.0 1.5 0 0
6 13S 1010.00 1400.0 1.5 0 0
6 15S 1010.00 2000.0 1.5 0 0
6 23S 1010.00 2000.0 1.5 0 0
6 25S 1010.00 1400.0 1.5 0 0
7 - 1010.00 1020.0 1.5 0 0
8 - 1010.00 1030.0 1.5 0 0
9 - 1020.00 1000.0 1.5 0 0
10 - 1020.00 1010.0 1.5 0 0
11 - 1020.00 2200.0 1.5 0 0
```

3.3.2. Dynamic node creation and deletion

If the trace file mobility model is used and the dynamic node creation and deletion function is turned on, each node is generated at the timing written in the mobility file and deleted at the end of the simulation. If the dynamic node creation and deletion function is turned off, each node is placed at the first position written in the mobility file at the simulation time 0, and stays at the position specified from the last timing written in the mobility file until the end of the simulation.

The dynamic node creation and deletion function can be enabled and disabled as described below.

- If you execute the simulation by a command, edit the mobility file as follows
mobility-trace-file-supports-creation-and-deletion = true
- If you use Visual Lab, you can configure this function at the following menu item. The default value is “on”.
[Tools]-[Object Properties...]-[dot11]-[Mobility]-[Dynamic Object Creation] true

Examples of mobility files: Here, we assume that the simulation duration is 120 seconds.

Example 1: Node #1 is created at time 30s and deleted at time 60s.

```
1 30S 0.0 0.0 1.5 0 0
1 60S 100.0 0.0 1.5 0 0
```

Node #1 is created at time 30 seconds and placed at X=0.0, Y=0.0, then moves to a position X=100.0, Y=0.0, then reaches the position at time 60 seconds and is deleted.

Example 2: Node #2 is placed at the beginning of the simulation and moves to specified points, then is deleted at time 90s.

```
2 0S 0.0 0.0 1.5 0 0
2 40S 100.0 0.0 1.5 0 0
2 90S 100.0 200.0 1.5 0 0
```

Node #2 is created at the beginning of the simulation and placed at a position X=0.0, Y=0.0. Then it moves to a position X=100, Y=0.0 at time 40 seconds. Finally, it moves to a position X=100.0, Y=200.0 at time 90, then is deleted. Note that the positions during 0-40s and 40-90s are linearly interpolated.

Example 3: Node #3 is created at time 50s, and move around. It stays at the last position until the end of the simulation.

```
3 50S 0.0 0.0 1.5 0 0  
3 70S 100.0 100.0 1.5 0 0  
3 INF_TIME 100.0 100.0 1.5 0 0
```

If INF_TIME is specified as time, the node stays at its current position until the end of the simulation. In this example, node #3 is created at time 50 seconds and placed at X=0.0, Y=0.0. It moves to X=100.0, Y=100.0 at time 70 seconds, then stays here until the end of the simulation.

3.4. Bit Error Table file /Block Error Table file

These files defines bit error tables and block error tables.

3.4.1. Syntax

A set of one header line and multiple data lines (bit error/block error for each SNR value) is used for defining a bit error/block error table.

Bit error table

Header line: <Curve model name> <Mode name>

Data line: <SNR> <Bit error rate>

Block error table

Header line : <Curve model name> <Mode Name>

Data line : <SNR> <Block error rate>

Note:

- One file can contain multiple bit error tables or multiple block error rate tables.

<Example of a bit error table file>

```
# Data is from the 11ax Evaluation Methodology (IEEE 802.11-14/0571r8) Appendix
3.
# The combined "Average" column for BCC 32 Byte blocks from the spreadsheet is
used.
# with the BLERs converted to BER. For higher MCS's, BCC 1458 Byte block data is
used for
# the higher SINR values (see below).
#
# Note that these curves do not include OFDM power overhead of the "Guard Interval"
and
# subcarrier pilots and thus OFDM signal must be reduced with respect the AWGN
noise,
# for example, by (4/5 * 48/52) or about -1.32 dB.
#
# Curve Header Line Format   : <Curve Family Name> <Mode Name>
# Curve Data Line Format     : <SNR in dB> <Bit Error Rate>
# Note: Family names cannot start with a number and all name strings cannot have
```

spaces.

IEEE802.11 BPSK_0.5

-5.00	0.5
-4.90	3.46467E-02
-4.80	3.17350E-02
-4.70	3.01367E-02
-4.60	2.90922E-02
-4.50	2.84131E-02
-4.40	2.80717E-02
-4.30	2.80027E-02
-4.20	2.90097E-02
-4.10	2.93529E-02
-4.00	2.87574E-02
-3.90	2.89481E-02
-3.80	2.62658E-02
-3.70	2.42459E-02
-3.60	2.25452E-02
-3.50	2.06901E-02
-3.40	1.90809E-02
-3.30	1.72350E-02
-3.20	1.55907E-02
-3.10	1.39877E-02
-3.00	1.25941E-02
-2.90	1.12953E-02
-2.80	1.02244E-02
-2.70	9.16658E-03
-2.60	8.13442E-03
-2.50	7.23785E-03
-2.40	6.44006E-03
-2.30	5.66657E-03
-2.20	4.94794E-03
-2.10	4.35119E-03
-2.00	3.79662E-03
-1.90	3.26874E-03
-1.80	2.83163E-03

-1.70	2.41315E-03
-1.60	2.05545E-03
-1.50	1.72660E-03
-1.40	1.45044E-03
-1.30	1.21016E-03
-1.20	1.00170E-03
-1.10	8.29317E-04
-1.00	6.79114E-04
-0.90	5.41101E-04
-0.80	4.42441E-04
-0.70	3.56084E-04
-0.60	2.89325E-04
-0.50	2.28093E-04
-0.40	1.83569E-04
-0.30	1.48597E-04
-0.20	1.14656E-04
-0.10	9.06122E-05
0.00	6.93553E-05
0.10	5.44260E-05
0.20	4.28994E-05
0.30	3.31158E-05
0.40	2.56332E-05
0.50	1.94650E-05
0.60	1.37612E-05
0.70	1.02639E-05
0.80	7.09919E-06
0.90	6.06116E-06
1.00	3.90750E-06
1.10	4.02550E-06
1.20	2.96987E-06
1.30	2.34445E-06
1.40	1.75821E-06
1.50	1.44558E-06
1.60	1.17205E-06
1.70	7.81328E-07
1.80	5.46913E-07

1.90 4.29711E-07

2.00 2.73447E-07

3.00 0.0

IEEE802.11 BPSK_0.75

-2.00 0.5

-1.90 3.44577E-02

-1.80 3.15371E-02

-1.70 2.98710E-02

-1.60 2.87878E-02

-1.50 2.81128E-02

-1.40 2.77773E-02

-1.30 2.77643E-02

-1.20 2.89993E-02

-1.10 2.93479E-02

-1.00 3.06713E-02

-0.90 2.92387E-02

-0.80 2.80209E-02

-0.70 2.53852E-02

-0.60 2.31582E-02

-0.50 2.17781E-02

-0.40 1.98907E-02

-0.30 1.79690E-02

-0.20 1.62239E-02

-0.10 1.44678E-02

0.00 1.29827E-02

0.10 1.17020E-02

0.20 1.04167E-02

0.30 9.30337E-03

0.40 8.33979E-03

0.50 7.38716E-03

0.60 6.50328E-03

0.70 5.76979E-03

0.80 5.06313E-03

0.90 4.40186E-03

1.00 3.83074E-03

1.10	3.30676E-03
1.20	2.84102E-03
1.30	2.41220E-03
1.40	2.05641E-03
1.50	1.74050E-03
1.60	1.45481E-03
1.70	1.20796E-03
1.80	9.98085E-04
1.90	8.15956E-04
2.00	6.68457E-04
2.10	5.35711E-04
2.20	4.30110E-04
2.30	3.45969E-04
2.40	2.80370E-04
2.50	2.22915E-04
2.60	1.72315E-04
2.70	1.37776E-04
2.80	1.08284E-04
2.90	8.41555E-05
3.00	6.63043E-05
3.10	5.20731E-05
3.20	3.92499E-05
3.30	2.99101E-05
3.40	2.31543E-05
3.50	1.85058E-05
3.60	1.46476E-05
3.70	9.44684E-06
3.80	7.97233E-06
3.90	5.09190E-06
4.00	4.09400E-06
4.10	2.81351E-06
4.20	1.99269E-06
4.30	1.48466E-06
4.40	1.01576E-06
4.50	7.42258E-07
4.60	4.29711E-07

```

4.70  1.95317E-07
5.00  0.0

IEEE802.11 QPSK_0.5
1.0  0.5
1.5  2.63732e-001
2.0  3.76574e-002
2.5  5.10168e-003
3.0  7.21094e-004
3.5  1.12691e-004
4.0  1.87344e-005
4.5  3.03267e-006
5.0  4.42714e-007
5.5  5.51400e-008
6.0  0.0

```

<Example of a block error table file>

```

# Curve Header Line Format: <Curve Family Name> <Mode Name>
# Curve Data Line Format      : <SNR in dB> <Block Error Rate>
# Note: Curve family names cannot start with a number and all name strings cannot
have spaces.

# Datarate BW 10Mhz BPSK Coding=1/2

lte CQI1_1

-10.5  1.0
-10.25 0.990753
-10    0.928786
-9.75  0.865014
-9.5   0.824658
-9.25  0.672998
-9     0.600037
-8.75  0.494956
-8.5   0.320698
-8.25  0.242459

```

```

-8      0.171402
-7.75   0.115414
-7.5     0.0523853
-7.25    0.0267415
-7       0.0121141
-6.75    0.00551404
-6.5     0.00233009
-6.25    0.0015472
-6       0.0

```

```
lte CQI1_2
```

```

-13.452712  1.0
-13.202712  0.990753
-12.952712  0.928786
-12.702712  0.865014
-12.452712  0.824658
-12.202712  0.672998
-11.952712  0.600037
-11.702712  0.494956
-11.452712  0.320698
-11.202712  0.242459
-10.952712  0.171402
-10.702712  0.115414
-10.452712  0.0523853
-10.202712  0.0267415
-9.952712   0.0121141
-9.702712   0.00551404
-9.452712   0.00233009
-9.202712   0.0015472
-8.952712   0.0

```

3.5. Antenna file

This file specifies user-defined antenna patterns.

3.5.1. File format

Antenna pattern can be specified in two dimensions (2.5D format) or three dimensions (3D format).

Common format

Specify antenna name in first line

NAME <Antenna name>

2.5D format

Specify antenna gain for each degree in horizontal plane and vertical plane.

HORIZONTAL 360

<Degree in horizontal plane > <Antenna gain > [-179,...,180]

VERTICAL 360

<Degree in vertical plane > <Antenna gain > [-179,...,180]

Antenna pattern in 2.5D format is automatically converted into 3D antenna pattern in Scenargie. Please refer “Base Simulator Model Reference” to get the details about the conversion from 2.5D pattern to 3D pattern.

3D format

Specify antenna gain for each degree in elevation and azimuth.

<Degree in elevation> <Degree in azimuth> <Antenna gain>

Elevation: -90, ..., 90

Azimuth: -179, ..., 180

Note:

Multiple antenna patterns can be defined in a single antenna file.

<Example in 2.5D format >

#Custom Antenna 2.5d Format

```

#-----
#NAME (CustomAntennaName)
#HORIZONTAL 360
#-179 <gain value dBi>
#-178 <gain value dBi>
#.
#-1 <gain value dBi>
#0 <gain value dBi>
#1
#.
#180 <gain value dBi>
#VERTICAL 360
#-179 <gain value dBi>
#-178 <gain value dBi>
#.
#-1 <gain value dBi>
#0 <gain value dBi>
#1
#.
#180 <gain value dBi>

#format type: Scenargie 2.5d
NAME CustomAntenna1
HORIZONTAL 360
-179 -12.0
-178 -12.0
-177 -12.0
:
178 -12.0
179 -12.0
180 -12.0
VERTICAL 360
-179 -12.0
-178 -12.0
-177 -12.0
:

```

```

178 -12.0
179 -12.0
180 -12.0

NAME CustomAntenna2
HORIZONTAL 360
-179 -12.0
:
```

<Example in 3D format >

```

NAME customantenna1
#Elevation Azimuth GainDbi
#-----
-90 -179 -12
-90 -178 -12
-90 -177 -12
:
90 178 -12
90 179 -12
90 180 -12

NAME customantenna2
-90 -179 -12
:
```

3.6. Statistics configuration file

The statistics configuration file specifies the statistics names that are collected by the simulator.

3.6.1. Syntax

Statistics configurations are specified using the following format.

```
<Node number> <Statistics name> <Interval> [<Sampling start time>] [<Sampling end time>]
```

<Node number> is specified with one node number or '*' for specifying all nodes

<Statistics name> is specified with “<Model name>_<Statistics>”. You can spell out the model name and statistics like “CbrApp_PacketsSent” or use wildcard character “*” like “Cbr*” for specifying all statistic for the model.

<Interval> is specified with one of the following three types.

If INF_TIME is written here, only the last value is recorded.

If 0 is written here, values are recorded every time an event occurs.

An interval value other than those above is written, the value means the sampling interval in seconds.

<Example of a statistics configuration file>

```
1 CbrApp1_EndToEndDelay INF_TIME
3 CbrApp1_BytesReceived 1s
* CbrApp1_PacketsReceived INF_TIME
4 CbrApp1_PacketsSent 0.0
5 Cbr* INF_TIME
```

3.7. Static route file

This file defines the routing table used for static routing

3.7.1. Syntax

The routing table is written using the following format.

<Node number> <Destination IP address> <Address mask> <Next hop address>

<Example of a static route file>

3	192.2.0.4	255.255.255.255	192.1.0.1
3	192.3.0.5	255.255.255.255	192.1.0.2

3.8. Moving object shape file

This file specifies the shapes of moving objects. Each shape is defined with the name, length, width, height, and material.

Syntax:

<Shape name> <Length> <Width> <Height> <Material name>

- Suffix of the file name is “.oshp”
- Unit for the length, width, and height is meters (m).

- Spaces are used for delimiting the items
- If the object is not rotated, the length, the width, and the height correspond to the lengths in the Y-axis direction, the X-axis direction, and the Z-axis direction, respectively.

Example

```
# Format: name length[m] width[m] height[m] material(defined in ".material")

# Car size reference:
#
http://www.jari.or.jp/Portals/0/resource/pdf/H23_simyu/%EF%BC%88Ver1.2%EF%BC%
8920131010.pdf

car 4.7 1.7 2.0 structure_default
bigcar 12 2.5 3.8 structure_default
```

When using WalCount, Cot231Indoor, or FUPM (requires Fast Urban Propagation Module), setting of the shape of moving objects can be done with Visual Lab as follows.

- 1) Click [Tools]-[Object Properties]
- 2) Find a component "Antenna/Propagation" of "Global" object, then specify the file path of the moving object shape file to the property "Moving Object Shape File."
- 3) Specify the name of the moving object's shape to "Moving Object Shape Type" property of "Communication Object" Component of each communication object.

3.9. Material File

This file determines the name, type, and properties of material.

Syntax:

<Material name> Cost231Indoor <Loss in dB>

- Suffix of the file name is ".material"
- Spaces are used for delimiting the items

<Example of a material file>

```
# Format: name Cost231Indoor loss[dB]
# max size of name = 32

wall_default Cost231Indoor 10
```

When using Cost231Indoor for the radio propagation model, the setting of material can be done with Visual Lab as follows.

- 1) Click [Tools]-[Object Properties].
- 2) Specify the file path of the material file to "Material File" property of "Antenna/Propagation" component of the Global object.
- 3) Specify the material name to "Material" property of "Wall" component of the Wall object.

3.10. MIMO channel matrix file

MIMO channel matrix file specifies channel matrix for MIMO to use in Dot Eleven Module or LTE Module.

3.10.1. File format

The format for MIMO channel matrix is as follows.

- 1) Link information between node i and node j ($i, j \leq \text{\#node}$, $i < j$)

<Time><Node ID for node i ><Cell sector ID for node i ><Number of antennas for node i ><Node ID for node j ><Cell sector ID for node j ><Number of antennas for node j ><Number of subcarrier>

- 2) Channel response matrix for a subcarrier at specified time

$\{ \{ (H_{1,1}), (H_{1,2}), \dots, (H_{1,M}) \}, \dots, \{ (H_{N,1}), (H_{N,2}), \dots, (H_{N,M}) \} \}$
 ...
 $\{ \{ (H_{1,1}), (H_{1,2}), \dots, (H_{1,M}) \}, \dots, \{ (H_{N,1}), (H_{N,2}), \dots, (H_{N,M}) \} \}$

} Specifies matrixes for each subcarrier

M: Number of transmitting antennas, N: Number of receiving antennas.

$H_{k,i}$: Channel response between transmitting antenna i ($i \leq M$) and receiving antenna k ($k \leq N$).

$(H_{k,i})$ should be specified in real part and imaginary part of a complex number.

<Example of 2x2 MIMO for 5 nodes >

```
# 5 Nodes 2 x 2 antennas

0.000S 1 0 2 2 0 2 64
  {{(1.353105,0.234841),      (0.108512,1.024898)},      {(1.339471,-0.180439),
(-0.356140,0.362004)}}
  {{(1.354151,0.208817),      (0.124434,1.010578)},      {(1.333639,-0.174573),
(-0.366867,0.363177)}}
(snip)
```

```

    {{(1.245826,-0.219849),      (0.222394,0.365888)},      {(0.782616,-0.165846),
(-0.636744,0.551447)}}
    {{(1.232608,-0.228444),      (0.206243,0.355015)},      {(0.776259,-0.158455),
(-0.636169,0.552436)}}
0.000S 1 0 2 3 0 2 64
    {{(1.353105,0.234841),      (0.108512,1.024898)},      {(1.339471,-0.180439),
(-0.356140,0.362004)}}
    {{(1.354151,0.208817),      (0.124434,1.010578)},      {(1.333639,-0.174573),
(-0.366867,0.363177)}}
(snip)
    {{(1.245826,-0.219849),      (0.222394,0.365888)},      {(0.782616,-0.165846),
(-0.636744,0.551447)}}
    {{(1.232608,-0.228444),      (0.206243,0.355015)},      {(0.776259,-0.158455),
(-0.636169,0.552436)}}
0.000S 1 0 2 4 0 2 64
    {{(1.353105,0.234841),      (0.108512,1.024898)},      {(1.339471,-0.180439),
(-0.356140,0.362004)}}
    {{(1.354151,0.208817),      (0.124434,1.010578)},      {(1.333639,-0.174573),
(-0.366867,0.363177)}}
(snip)
    {{(1.245826,-0.219849),      (0.222394,0.365888)},      {(0.782616,-0.165846),
(-0.636744,0.551447)}}
    {{(1.232608,-0.228444),      (0.206243,0.355015)},      {(0.776259,-0.158455),
(-0.636169,0.552436)}}
0.000S 1 0 2 5 0 2 64
    {{(1.353105,0.234841),      (0.108512,1.024898)},      {(1.339471,-0.180439),
(-0.356140,0.362004)}}
    {{(1.354151,0.208817),      (0.124434,1.010578)},      {(1.333639,-0.174573),
(-0.366867,0.363177)}}
(snip)
    {{(1.245826,-0.219849),      (0.222394,0.365888)},      {(0.782616,-0.165846),
(-0.636744,0.551447)}}
    {{(1.232608,-0.228444),      (0.206243,0.355015)},      {(0.776259,-0.158455),
(-0.636169,0.552436)}}
0.000S 2 0 2 3 0 2 64
(snip)

```

```

10.000S 4 0 2 5 0 2 64
  {{(1.353105,0.234841),      (0.108512,1.024898)}},      {(1.339471, -0.180439),
(-0.356140,0.362004)}}}
  {{(1.354151,0.208817),      (0.124434,1.010578)}},      {(1.333639, -0.174573),
(-0.366867,0.363177)}}}
(snip)
  {{(1.245826, -0.219849),      (0.222394,0.365888)}},      {(0.782616, -0.165846),
(-0.636744,0.551447)}}}
  {{(1.232608, -0.228444),      (0.206243,0.355015)}},      {(0.776259, -0.158455),
(-0.636169,0.552436)}}}

```

If mimo-channel-model-enable-file-looping is set to true, the setting is utilized repeatedly.

Example:

If the setting includes from 0s to 10s:

0s, 1s, 2s, 3s, ..., 10s, 11s(=1s), 12s(=2s), 13s(=3s), ..., 20s, 21s(=1s), 22s(=2s),
23s(=3s), ...

* The data for 10s should be the same as the data for 0s.

4. Output of Simulation Results

The simulator outputs the results as statistics values and traces to files.

4.1. Statistics file

There are two types of statistics values, the counter type and the real type. The counter type is for integer values that are accumulated such as the number of received packets. The real type is for real values that may vary such as transmission delay and RSSI.

The format of the statistics file is as follows.

Counter type :

<Node number> <Statistics name> = <Last value> <Details>

Example) 1 CbrApp1_BytesReceived = 2560

Real type :

<Node number> <Statistics name> Avg= <Average> <Details>

Example) 1 CbrApp1_EndToEndDelay Avg= 0.00185669

If the statistics value has never recorded, the statistics value is written as "Avg= -"

<Details>

The content of the <Details> field depends on the <Interval> field in the statistics configuration file.

1) If <interval> field is INF_TIME:

No value is written.

2) If <interval> is 0:

All recorded target values for the statistics are listed with their recorded time.

<1st value's record time> <1st value> ... <n th value's recorded time> <n th value>

3) Other cases:

All recorded target values are listed after the start time of data collection and the interval.

<The data record start time> <Interval in seconds> <1st value> ... <n th value>

<Example of a statistics file>

1) Counter type: INF_TIME

2 CbrApp_cbr1_PacketsReceived = 10

2) Counter type: Interval

```

2 CbrApp_cbr1_PacketsReceived = 10  0.000000000 1.000000000 0 0 0 0 0 0 0 0
0 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0

```

3) Counter type: 0 (Zero)

```

2 CbrApp_cbr1_PacketsReceived = 10  10.380527330 0 10.380527330 1 11.380527225
1 12.380527138 1 13.380527106 1 14.380527151 1 15.380527238 1 16.380527347 1
17.380527463 1 18.380527580 1 19.380527701 1

```

4) Real: type: INF_TIME

```

2 CbrApp_cbr1_EndToEndDelay Avg= 0.0014284009

```

5) Real type: Interval

```

2 CbrApp_cbr1_EndToEndDelay Avg= 0.0014284009  0.000000000 1.000000000 - - -
- - - - - 0.001428403 0.001428298 0.001428211 0.001428179 0.001428224
0.001428311 0.00142842 0.001428536 0.001428653 0.001428774 - - - - -
-

```

6) Real type: 0 (Zero)

```

2 CbrApp_cbr1_EndToEndDelay Avg= 0.0014284009  10.380527330 0 10.380527330
0.001428403 11.380527225 0.001428298 12.380527138 0.001428211 13.380527106
0.001428179 14.380527151 0.001428224 15.380527238 0.001428311 16.380527347
0.00142842 17.380527463 0.001428536 18.380527580 0.001428653 19.380527701
0.001428774

```

4.2. Trace File

In the trace file, trace event information is recorded every time a trace event occurs. The target trace events to output are specified by trace tags.

The format out the trace file is as follows:

<common fields> <event specific fields>

Common fields

T=	Simulation time in seconds.
N=	Node number
M=	Model name
ID=	Model instance ID
Ev=	Event name

An event specific field depends on each event.

<Example of a trace file>

```
T= 10.265926466 N= 1 M= VoipApp Id= 3 Ev= VoipRecv Seq= 1 PktId= 4_1 Delay=
0.020011680 Pdr= 1/1
T= 10.274954038 N= 1 M= VoipApp Id= 2 Ev= VoipSend Seq= 2 PktId= 1_2
T= 10.274965718 N= 4 M= VoipApp Id= 2 Ev= VoipRecv Seq= 1 PktId= 1_1 Delay=
0.020011680 Pdr= 1/1
T= 10.285914786 N= 4 M= VoipApp Id= 3 Ev= VoipSend Seq= 3 PktId= 4_3
T= 10.285926466 N= 1 M= VoipApp Id= 3 Ev= VoipRecv Seq= 2 PktId= 4_2 Delay=
0.020011680 Pdr= 2/2
T= 10.294954038 N= 1 M= VoipApp Id= 2 Ev= VoipSend Seq= 3 PktId= 1_3
T= 10.294965718 N= 4 M= VoipApp Id= 2 Ev= VoipRecv Seq= 2 PktId= 1_2 Delay=
0.020011680 Pdr= 2/2
T= 10.305914786 N= 4 M= VoipApp Id= 3 Ev= VoipSend Seq= 4 PktId= 4_4
T= 10.305926466 N= 1 M= VoipApp Id= 3 Ev= VoipRecv Seq= 3 PktId= 4_3 Delay=
0.020011680 Pdr= 3/3
T= 10.314954038 N= 1 M= VoipApp Id= 2 Ev= VoipSend Seq= 4 PktId= 1_4
T= 10.314965718 N= 4 M= VoipApp Id= 2 Ev= VoipRecv Seq= 3 PktId= 1_3 Delay=
0.020011680 Pdr= 3/3
T= 10.325914786 N= 4 M= VoipApp Id= 3 Ev= VoipSend Seq= 5 PktId= 4_5
```


4.3. Output to standard output and standard error

Simulator outputs the progress of the simulation time to the standard output.

<Example of the standard output showing the progress of the simulation time>

```
Sim Time = 0.000000000
Sim Time = 18.100000000
Sim Time = 36.100000000
Sim Time = 54.100000000
Sim Time = 72.100000000
```

The frequency of showing the simulation time is specified as the percentage of the total simulation time as follows.

For example if the value is set to 5, every time simulation progress with 5% of the total simulation time, current simulation time is displayed. If 0 is set to the parameter, the simulation time is not displayed to the standard output.

progress-sim-time-output-interval-percents = 5

If an error occurs in the simulation, an error message is displayed to the standard error

<Example of output to standard error>

```
Error: Configuration File, bad Time parameter value for: dot11-slot-time Value
=
```

This message indicates that the parameter setting in the configuration file is wrong.

5. Customizing the simulator

5.1. Configuration for collecting statistics

Scenargie has interfaces for collecting statistics. By using these interfaces, users can handle user-defined statistics in Visual Lab and configure the setting of the statistics as the built-in statistics. Statistics in Scenargie are categorized into the following two types. Scenargie provides interfaces for each of them.

1) Counter Statistic:

Information that is represented by adding up integers

E.g. Number of received packets

2) Real Statistic:

Information that the values changes every time an event occurs

E.g. Received signal power

In the following, we describe the procedure for configuring user-defined statistics. As example, we present the configuration in `source/simulator/scensim_app_cbr.h`

Step 1 Definition of the new statistic.

In case the type of the statistic is Counter Statistic, describe as follows in the header file.

```
shared_ptr<CounterStatistic> packetsReceivedStatPtr;
```

In case the type of the statistics is Real Statistic:

```
shared_ptr<RealStatistic> endToEndDelayStatPtr;
```

Step 2 Creation of the instance of a class for storing the statistic.

In case of Counter Statistic:

```
shared_ptr<CounterStatistic> CreateCounterStat(
    const string& statName,
    const bool useBigCounter = false);
```

In case of Real Statistic:

```
shared_ptr<RealStatistic> CreateRealStat(
    const string& statName,
    const bool useBigReal = false);
```

If representing the value in dB, use `CreateRealStatWithDbConversion()` instead of `CreateRealStat()`dB.

```
shared_ptr<RealStatistic> CreateRealStatWithDbConversion(
    const string& statName,
    const bool useBigReal = false);
```

Step 3 Update of the statistic: Use the following functions.

In case of Counter Statistic:

```
void IncrementCounter(const unsigned long long int incrementNumber = 1);
```

In case of Real Statistic:

```
void RecordStatValue(const double& value);
```

Step 4 Build the simulator

Step 5 Describe the new statistic to the statistics configuration file, then run the simulator.

<1>

```
shared_ptr<CounterStatistic> packetsReceivedStatPtr;
shared_ptr<CounterStatistic> duplicatePacketsReceivedStatPtr;
shared_ptr<CounterStatistic> bytesReceivedStatPtr;
shared_ptr<RealStatistic> endToEndDelayStatPtr;
```

inline

```
CbrSinkApplication::CbrSinkApplication(
    const ParameterDatabaseReader& parameterDatabaseReader,
    const shared_ptr<SimulationEngineInterface>&
        initSimulationEngineInterfacePtr,
    const ApplicationId initApplicationId,
    const NodeId& initSourceNodeId,
    const NodeId& initDestinationNodeId,
    const unsigned short int initDestinationPortId,
    const bool initReserveBandwidthModeIsOn)
```

```

:
CbrApplication(
    parameterDatabaseReader,
    initSimulationEngineInterfacePtr,
    initApplicationId,
    initSourceNodeId,
    initDestinationNodeId,
    initDefaultApplicationPortId,
    initReserveBandwidthModeIsOn),
duplicateDetector(
    CalcDuplicateDetectorWindowSize(packetInterval,      (cbrEndTime      -
cbrStartTime))),
    numberPacketsReceived(0),
<2> numberDuplicatePacketsReceived(0),
    packetsReceivedStatPtr(
        simulationEngineInterfacePtr->CreateCounterStat(
            (modelName + "_" + initApplicationId + "_PacketsReceived"))),
    duplicatePacketsReceivedStatPtr(
        simulationEngineInterfacePtr->CreateCounterStat(
            (modelName      +      "_"      +      initApplicationId      +
"_DuplicatePacketsReceived"))),
    duplicatePacketOutOfWindowErrorStatPtr(
        simulationEngineInterfacePtr->CreateCounterStat(
            (modelName      +      "_"      +      initApplicationId      +
"_DuplicatePacketOutOfWindowErrors"))),
    bytesReceivedStatPtr(
        simulationEngineInterfacePtr->CreateCounterStat(
            (modelName + "_" + initApplicationId + "_BytesReceived"))),
    endToEndDelayStatPtr(
        simulationEngineInterfacePtr->CreateRealStat(
            (modelName + "_" + initApplicationId + "_EndToEndDelay")))
{
}

```

```

inline
void CbrSinkApplication::OutputTraceAndStatsForReceivePacket(
    const unsigned int sequenceNumber,
    const PacketId& packetId,
    const unsigned int packetLengthBytes,
    const SimTime& delay)
{
    if (duplicateDetector.IsInSequenceNumberWindow(sequenceNumber)) {
        if (!duplicateDetector.IsDuplicate(sequenceNumber)) {
            duplicateDetector.SetAsSeen(sequenceNumber);
            <3> numberPacketsReceived++;
            packetsReceivedStatPtr->IncrementCounter();
            bytesReceivedStatPtr->IncrementCounter(packetLengthBytes);
            endToEndDelayStatPtr->RecordStatValue(
                ConvertTimeToDoubleSecs(delay));
        }
        else {
            numberDuplicatePacketsReceived++;
            duplicatePacketsReceivedStatPtr->IncrementCounter();
        }
    }
    else {
        duplicatePacketOutOfWindowErrorStatPtr->IncrementCounter();
    }
    ...
} //OutputTraceAndStatsForReceivePacket//

```

5.2. Configuration of trace tags

Scenargie has interfaces for configuration of trace tags. By using these interfaces, users can handle the user-defined trace tags in the same manner of the built-in trace tags.

Step 1 Modification of source/simulator/scensim_user_trace_defs.h

Add the new tags' information to two locations. One is the definition of a new TraceTag constant and the other is a new element of userTraceTagNames array. The string added as the new element of userTraceTagNames is used as the tag name described in "trace-enabled-tags" in the simulation configuration file.

```
//
// This file is for Scenargie user's trace definitions and will not be changed
// by Space-Time Engineering so that the user can replace this file during
// Scenargie version upgrades without worrying about missing any updates.
//

#ifndef SCENSIM_USER_TRACE_DEFS_H
#define SCENSIM_USER_TRACE_DEFS_H

#include "scensim_trace.h"

namespace ScenSim {

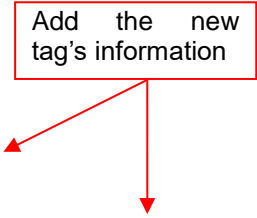
const TraceTag TraceExample1 = FirstUserTraceTag + 0;
const TraceTag TraceExample2 = FirstUserTraceTag + 1;
const TraceTag TraceExample3 = FirstUserTraceTag + 2;

const char* const userTraceTagNames[]={"example1", "example2", "example3"};
const int numberUserTraceTags = (sizeof(userTraceTagNames) / sizeof(char*));

const          vector<string>          userTraceTagNames(userTraceTagNamesRaw,
userTraceTagNamesRaw + numberUserTraceTags);

} // namespace

#endif
```



Step 2 Creation of a trace output function for each trace tag

In the example shown here, we make a trace output function `OutputTraceForExample3()` for "TraceExample3" trace tag, and call the function at the point for obtaining the trace in the simulation program.

Example: Definition of `OutputTraceForExample3()` in `scensim_app_cbr.h`

```
inline
void CbrSinkApplication::OutputTraceForExample3(
    const unsigned long int sequenceNumber,
    const PacketId& packetId,
    const unsigned int packetLengthBytes,
    const SimTime& delay)
{
    if (simulationEngineInterfacePtr->TraceIsOn(TraceExample3)) {

        ostreamstream outStream;

        outStream << "Seq= " << sequenceNumber << " PktId= " << packetId
            << " Delay= " << ConvertTimeToStringSecs(delay)
            << " Pdr= " << numberPacketsReceived << '/' << sequenceNumber;

        simulationEngineInterfacePtr->OutputTrace(
            modelName, ConvertToString(applicationId), "Recv", outStream.str());

    }//if//

    packetsReceivedStatPtr->IncrementCounter();
    bytesReceivedStatPtr->IncrementCounter(packetLengthBytes);
    endToEndDelayStatPtr->RecordStatValue(ConvertTimeToDoubleSecs(delay));
}
```

Checks if the trace-tag is selected for output.

Definition of the optional outputs.

Outputs the trace
Arguments : Model name, Instance name, Event name, and arbitrary string

Step 3 Call the trace output function

Place the trace output function defined in the step 2 at the point where the simulator outputs the trace.

Example: Call the trace output function in ReceivedPacket() in scensim_app_cbr.h

```
inline
void CbrSinkApplication::ReceivePacket(unique_ptr<Packet>& packetPtr)
{
    CbrPayloadType cbrPayload =
packetPtr->GetAndReinterpretPayloadData<CbrPayloadType>();

    SimTime delay = simulationEngineInterfacePtr->CurrentTime() -
cbrPayload.sendTime;

    Call the user-defined trace output function

    OutputTraceForExample3(
        cbrBroadcastPayload.sequenceNumber,
        packetPtr->GetPacketId(),
        packetPtr->LengthBytes(),
        delay);

    packetPtr = nullptr;

} //ReceivePacket //
```

Step 4 Build the simulator.

Step 5 Add the following description in the simulation configuration file, then run the simulator.

trace-enabled-tags = "example3"

trace-output-file = "<TraceOutputFileName>"

6. Properties

6.1. List of properties

The following tables show properties of Scenargie Base Simulator and can be specified with a configuration file.

Set a certain value for a parameter which does not have a default value (marked as “N/A”) because any model does not specify an initial value for the parameter.

Time type parameters must be written in the following format. Note that values without unit are treated as second.

[Time value] [Unit]

Examples

100 seconds : 100s or 100
 100 milliseconds : 100ms or 0.1
 100 microseconds : 100us or 0.0001
 100 nanoseconds : 100ns or 0.0000001

Note: Default values shown in tables are different from default values set by Visual Lab.

Simulation, Trace, and Statistics

Parameter name	Scope	Type	Default Value	Description (Range:Unit)
seed	Global	Integer	N/A	Random seed Range: [0, Maximum value of integers]
mobility-seed	Global	Integer	The value of parameter “seed”	Random seed used for mobility models Range: [0, Maximum value of integers]
simulation-time	Global	Time	N/A	Simulation time
time-step-event-synchronization-step	Global	Time	Simulation end time	Interval of synchronization events that are used by time-step based models

				such as interactions between agents in the Multi-Agent Extension Module and updating of positions of mobile objects in the Fast Urban Propagation Module.
trace-output-mode	Global	String	text	Trace output mode (Binary/Text)
trace-index-output	Global	Bool	false	Indication to output index file for trace
trace-output-file	Global	String	N/A	Trace output file (relative pathname or absolute pathname)
trace-start-time	Node	Time	0s	Trace start time
trace-enabled-tags	Node	String	N/A	Trace tags (Mobility, Application, Transport, Network, Routing, Mac, Phy, PhyInterference, Gis, and Mas). For specifying multiple tags, list the tag names using a space for the delimiter.
trace-gzip-output	Global	Bool	false	Output the text-based trace in gzip format.
statistics-configuration-file	Global	String	N/A	Statistics configuration filename (relative pathname or absolute pathname)
statistics-output-file	Global	String	N/A	Statistics output file (relative pathname or absolute pathname)
statistics-output-for-no-data	Global	Bool	true	Indication to output statistics for no data

allow-node-re-creation	Global	Bool	false	Indication to reuse statistics when node is recreated
progress-sim-time-output-interval-percents	Global	Real	0	Interval of displaying simulation progress in percent of the simulation time. E.g.) If this value is 5, simulation time is output every 5 percent of the simulation progress. If this value is 0, the simulation time is not output.
is-member-of	Node	String	N/A	Group name of the node (corresponding to Object Type in Visual Lab)
gui-portnumber-sim	Global	Integer	N/A	Port number used for the simulation data exchange with the GUI (Visual Lab)
gui-portnumber-pausecommand	Global	Integer	N/A	Port number used for the control message exchange with the GUI (Visual Lab)

GIS Data

Parameter name	Scope	Type	Default value	Description (Range:Unit)
gis-object-file-path	Global	String	N/A	Path to the directory including GIS data
gis-object-files	Global	String	N/A	File names of GIS data file. List multiple file names using a space for the delimiter

gis-object-position-in-latlong-degree	Global	Bool	false	Indicates whether to use GIS data in which coordinates are in latitude and longitude.
gis-latitude-origin-degree	Global	Real	35.65809 9222	Base position in degrees of latitude to covert from lat/long to X/Y.
gis-longitude-origin-degrees	Global	Real	139.7413 54417	Base position in degrees of longitude to covert from lat/long to X/Y.
gis-road-driving-side	Global	String	left	Driving side of road: Right or Left (available only with gis-based-random-waypoint and Multi-Agent Extension Module in the current version)
gis-los-break-down-curved-road-into-straight-roads	Global	Bool	false	Indicates whether to break down curved roads into connected straight roads This parameter has to be set to False when using the Multi-Agent Extension Module.
gis-number-entrances-to-building	Global	Integer	0	The minimum number of entrances of buildings
gis-number-entrances-to-station	Global	Integer	0	The minimum number of entrances of stations
gis-number-entrances-to-busstop	Global	Integer	0	The minimum number of entrances of bus stops
gis-number-entrances-to-park	Global	Integer	0	The minimum number of entrances of parks
gis-public-vehicle-file	Global	String	N/A	File path of a time table

				file for trains, buses, etc.
gis-road-set-intersection-margin	Global	Bool	false	Indicates whether to set margins on roads for intersections. This function coordinates the stop lines at intersections so that they can be at realistic positions if two roads with different width cross at the intersection. This parameter has to be set to True when using the Multi-Agent Extension Module.
moving-object-shape-file	Global	String	N/A	Moving object shape type name
material-file	Global	String	N/A	Material definition file (used with COST213Indoor, FUPM, and HFPM propagation models)
gis-trafficlight-pattern-definition-file	Global	String	N/A	Signal pattern definition file
gisobject-enable-time	Node (Object)	Time	N/A	Time when the GIS object is enabled.
gisobject-disable-time	Node (Object)	Time	N/A	Time when the GIS object is disabled.
gisobject-elevation-reference-type	Node (Object)	String	N/A	Reference point for Z coordinate GroundLevel: Z coordinate is a value from ground level (includes elevation). SeaLevel: Z coordinates is a vlue from sea level

				(excludes elevation)
--	--	--	--	----------------------

Antenna

Parameter name	Scope	Type	Default value	Description (Range: Unit)
custom-antenna-file	Global	String	N/A	Custom antenna pattern file (Relative and absolute path)
antenna-pattern-two-2d-to-3d-interpolation-algorithm-number	Global	Integer	1	2.5D to 3D interpolation algorithm number for custom antenna file. 1 or 2.
antenna-patterns-are-in-legacy-format	Global	Bool	false	Indicates whether the custom antenna file is in the legacy antenna pattern format or not. Set this property value True if the custom antenna file is in the format supported by Scenargie 1.7 r13769 or earlier versions.
antenna-model	Interface	String	N/A	Antenna model: Omnidirectional, Sectored, FUPM/HFPM, or Custom (FUPM and HFPM are valid only with Fast Urban Propagation Module, and High Fidelity Propagation Module.)
antenna-gain-dbi	Interface	Real	N/A	Antenna gain in dBi for omnidirectional antenna model

max-antenna-gain-dbi	Interface	Real	N/A	Maximum gain in dBi for secured antenna model
antenna-model-quasi-omni-mode-gain-dbi	Interface	Real	N/A	Antenna gain in dBi for quasi omni mode
antenna-azimuth-degrees	Interface	Real	0.0	Azimuth of the antenna relative to the direction of the communication object (clockwise)
antenna-elevation-degrees	Interface	Real	0.0	Elevation angle of the antenna from the direction of the communication object (Positive value means upward.)
antenna-height-meters	Interface	Real	0.0	Antenna height relative to the position of the communication object
antenna-offset-degrees	Interface	Real	0.0	Offset azimuth of the antenna from the position of the node (clockwise)
antenna-offset-meters	Interface	Real	0.0	Offset distance of the antenna from the position of the node

Channel

Parameter name	Scope	Type	Default value	Description (Range: Unit)
channel-frequency-mhz	Channel instance	Real	N/A	Channel center frequency in MHz
channel-bandwidth-mhz	Channel instance	Real	N/A	Channel bandwidth in MHz
mimo-channel-file-name	Channel instance	String	N/A	MIMO channel file
mimo-channel-model-enable-file-looping	Channel instance	Bool	true	Indicates whether to use the same channel file

				repeatedly.
freqselective-channel-file-name	Channel instance	String	N/A	Frequency selective channel file
enable-propagation-delay	Channel instance	Bool	false	Indicates whether to enable propagation delay
max-signal-propagation-meters	Channel instance	Real	Infinity	Maximum signal propagation distance in meters
propagation-allow-multiple-interfaces-on-same-channel	Channel instance	Bool	N/A	Indicates whether to allow multiple interfaces on the same channel
channel-count	Channel instance	Integer	1	Number of channels if multiple channels are used
channel-<No>-frequency-mhz	Channel instance	Real	N/A	Center frequency of channel <No> in MHz
channel-<No>-bandwidth-mhz	Channel instance	Real	N/A	Bandwidth of channel <No> in MHz
mimo-channel-<No>-file-name	Channel instance	String	N/A	MIMO channel file for channel <No>
freqselective-channel-<No>-file-name	Channel instance	String	N/A	Frequency selective channel file for channel <No>
first-channel-number	Channel instance	Integer	0	Initial channel number when using multiple channels
propagation-channel-interference-matrix	Channel instance	String	N/A	Inter-channel interference correlation matrix If two channels are used, and the inter-channel correlation is 0.5, the value of the property is written as "1 0.5 0.5 1"

				(CH0□CH0 CH0□CH1 CH1□CH0 CH1□CH1)
propagation-enable-mask-calculated-channel-interference	Channel instance	Bool	N/A	Indicates whether to enable spectral mask-based inter-channel interference calculation.
channel-<No>-transmit-spectral-mask-mhz-dbr	Channel instance	String	N/A	Spectral mask of channel <No> for calculating inter-channel interference correlation matrix. List pairs of the distance from the center frequency in MHz and the relative power in dBr. Example: 20MHz bandwidth-channel at 2.4GHz 9.0 0.0 11.0 -20.0 20.0 -28.0 30.0 -40.0
channel-<No>-channel-interference-nominal-transmit-width-mhz	Channel instance	Real	N/A	Nominal transmit bandwidth in MHz of channel <No> for calculating inter-channel interference correlation matrix
channel-<No>-channel-interference-receive-width-mhz	Channel instance	Real	N/A	Receive bandwidth in MHz of channel <No> for calculating inter-channel interference correlation matrix
propagation-inter-model-interference-destination-instance-id	Channel instance	String	N/A	Target channel ID for inter model interference (channel ID interfered

				by this channel) Example: 2.4GHzBand
propagation-inter-model-channel-interference-matrix	Channel instance	String	N/A	Inter model interference correlation matrix If Channel A (interferer) has one channel (0) and Channel B has two channels (0 and 1) and the inter model correlation is 0.5 from Channel A-0 to Channel B-0 and 0.1 from Channel A-0 to Channel B-1, the value of the property is written as "0.5 0.1".
propagation-enable-inter-model-propagation-delay	Channel instance	Bool	Same as enable-propagation-delay	Indicates whether to enable propagation delay for inter model interference
propagation-model	Channel instance	String	TwoRayGround	Propagation model: FreeSpace, TwoRayGround, OkumuraHata, COST231Hata, COST231Indoor, WallCount, ITU-R_P.1411, Taga, ITM, TwoTier, Trace, TGaxIndoor, ITU-UMi LTE_Macro, LTE_Pico, FUPM, or HFPM (Appropriate extension module is required to use LTE_Macro, LTE_Pico, FUPM, and

				HFPM.)
number-data-parallel-threads-for-propagation	Global	Integer	0	Number of parallel threads for calculation of propagation
channel-instance-id	Interface	String	N/A	Channel instance name

Radio propagation model: OkumuraHata

Parameter name	Scope	Type	Default value	Description (Range: Unit)
prop-okumurahata-environment	Channel instance	String	Urban_LargeCity	Assumed environment in OkumuraHata model (Urban_LargeCity, Urban_MediumOrSmall City, Suburban, Rural)

Radio propagation model: COST231Hata

Parameter name	Scope	Type	Default value	Description (Range: Unit)
prop-cost231hata-environment	Channel instance	String	Metropolitan	Assumed environment in COST231Hata model (Suburban, Metropolitan)

Radio propagation model: COST231 Indoor

Parameter name	Scope	Type	Default value	Description (Range: Unit)
propindoor-indoor-breakpoint-meters	Channel instance	Real	N/A	Breakpoint distance in meters

Radio propagation model: Wall count

Parameter name	Scope	Type	Default value	Description (Range: Unit)
propwallcount-baseline-propagation-model	Channel instance	String	N/A	Baseline propagation model
propwallcount-penetration-loss-dB	Channel instance	Real	N/A	Penetration loss per wall in dB

Radio propagation model: ITU-R P.1411

Parameter name	Scope	Type	Default value	Description (Range: Unit)
p1411-loss-calculation-policy	Channel instance	String	median	LOS calculation policy "median", "lower", or

				"upper"
p1411-nlos1-calculation-policy	Channel instance	String	urban	NLOS1 calculation policy "urban" or "suburban"
p1411-nlos2-calculation-policy	Channel instance	String	urban	NLOS2 calculation policy "urban" or "residential"
p1411-nlos800to2000-calculation-policy	Channel instance	String	upper	NLoS calculation policy for 800MHz-2000MHz: "lower", "upper", or "geometricmean"
p1411-shf-short-distance-meters	Channel instance	Real	20	Short distance at SHF in meters (>0)
p1411-building-height-differ-threshold-meters	Channel instance	Real	1	Threshold to determine the difference of height of buildings in meters (>0)
p1411-well-below-rooftop-height-meters	Channel instance	Real	3	Well below roof-top height in meters (>0)
p1411-below-rooftop-location-percentage	Channel instance	Integer	50	Below roof-top location percentage: 1, 10, 50, 90, or 99
p1411-below-rooftop-transition-region-meters	Channel instance	Real	20	Roof-Top transition region in meters (>0)
p1411-below-rooftop-calculation-policy	Channel instance	String	urban	Below roof-top calculation policy: "urban", "suburban", "dense urban", or "high-rise"
p1411-nlos2-extension	Channel instance	String	off	NLOS2 calculation extension: "off" or "UseInverseLargerLoss"
p1411-nlos2-use-larger-loss-at-nlos-bound	Channel instance	Bool	false	Whether to use the loss in LoS when the calculation result of loss

				in NLoS is smaller than that in LoS.
p1411-nlos2-use-policy	Channel instance	String	default	NLOS2 used policy "default", "AlwaysUse800To2000MHzCalculation", or "AlwaysUse2To16GHzCalculation" In case of "default", equation is selected according to the frequency band
p1411-enable-shf-los-calculation	Channel instance	Bool	false	Indication to utilize calculation model for SHF
p1411-shf-effective-road-height-meters	Channel instance	Integer	0	Effective road height at SHF in meters
p1411-enable-propagation-between-terminals-located-below-rooftop-height-at-uhf	Channel instance	Bool	true	Whether to enable calculation of propagation between terminals located below roof-top height at UHF
p1411-enable-building-based-los-calculation	Channel instance	Bool	false	Indicates whether to utilize building layout for LoS calculation
p1411-los-angle-degrees-between-roads	Channel instance	Real	1	LoS angle threshold in degrees
p1411-max-diffraction-count	Channel instance	Integer	1	Maximum diffraction count
p1411-nlos-max-distance-meters	Channel instance	Real	DBL_MAX	Maximum NLoS distance in meters
p1411-nlos2-loss-direction	Channel instance	String	Directional	Policy to select the path loss value from the calculation results of different directions: Directional,

				<p>BidirectionalLargeLoss, BidirectionalSmallLoss, SmallNodeIdToLargeNodeIdLoss, or LargeNodeIdToSmallNodeIdLoss</p> <p>Directional: Selects the path loss from Tx to Rx</p> <p>BidirectionalLargeLoss: Selects larger path loss of from Tx to Rx and from Rx toTx.</p> <p>BidirectionalSmallLoss : Selects smaller path loss of from Tx to Rx and from Rx to Tx.</p> <p>SmallNodeIdToLargeNodeIdLoss: Selects path loss from a communication object with smaller node ID to one with larger node ID.</p> <p>LargeNodeIdToSmallNodeIdLoss: Selects path loss from a communication object with larger node ID to one with smaller node ID.</p>
--	--	--	--	---

Radio propagation model: Taga model

Parameter name	Scope	Type	Default value	Description (Range: Unit)
proptaga-los-calculation-consts-csv	Channel instance	String	10.4,1.3,236,1,19.4,3.9,33.0	Coefficients used in the equation to obtain path pass at LOS (CSV

				format)
proptaga-nlos1-calculation-constants-csv	Channel instance	String	3.2,-0.033,-0.022,39.4	Coefficients used in the equation to obtain path pass at NLoS1 (CSV format)
proptaga-nlos2-calculation-constants-csv	Channel instance	String	-6.7,11.2,25.9,10.1,1,19.8,-3.8,57.7	Coefficients used in the equation to obtain path pass at NLoS2 (CSV format)
proptaga-los-angle-degrees-between-roads	Channel instance	Real	1	LoS angle threshold in degrees
proptaga-nlos-max-distance-meters	Channel instance	Real	DBL_MAX	Maximum NLoS distance in meters
proptaga-enable-building-based-los-calculation	Channel instance	Bool	false	Indicates whether to utilize building layout for LoS calculation
proptaga-nlos-loss-direction	Channel instance	String	Directional	<p>Policy to select the path loss value from the calculation results of different directions: Directional, BidirectionalLargeLoss, BidirectionalSmallLoss, SmallNodeIdToLargeNodeIdLoss, or LargeNodeIdToSmallNodeIdLoss</p> <p>Directional: Selects the path loss from Tx to Rx</p> <p>BidirectionalLargeLoss: Selects larger path loss of from Tx to Rx and from Rx toTx.</p> <p>BidirectionalSmallLoss : Selects smaller path loss of from Tx to Rx</p>

				<p>and from Rx to Tx.</p> <p>SmallNodeIdToLargeNodeIdLoss: Selects path loss from a communication object with smaller node ID to one with larger node ID.</p> <p>LargeNodeIdToSmallNodeIdLoss: Selects path loss from a communication object with larger node ID to one with smaller node ID.</p>
--	--	--	--	---

Radio propagation model: ITM

Parameter name	Scope	Type	Default value	Description (Range: Unit)
propitm-atmospheric-bending-constant	Channel instance	Real	350.0	Atmospheric bending constant
propitm-calculation-point-division-length	Channel instance	Real	1	Calculation point division length in meters (corresponds to the maximum granularity of calculation)
propitm-earth-conductivity	Channel instance	Real	15.0	Earth conductivity
propitm-earth-dielectric-constant	Channel instance	Real	0.005	Earth dielectric constant
propitm-enable-vertical-diffraction-path-calculation	Channel instance	Bool	false	Indicates whether to use the path loss calculation results of vertical diffraction path if it is less than the path loss obtained by the normal path loss calculation

				results in the ITM model.
propitm-fraction-of-situations	Channel instance	Real	0.5	Fraction of situations
propitm-fraction-of-time	Channel instance	Real	0.5	Fraction of time
propitm-polarization	Channel instance	String	HORIZO NTAL	Polarization: "HORIZONTAL" or "VERTICAL"
propitm-radio-climate	Channel instance	String	MARITIM E-TEMPE RATE-OV ER-LAND	Climate in ITM model: "EQUATORIAL", "CONTINENTAL-SUBT ROPICAL", "MARITIME-TROPICAL", "DESERT", "CONTINENTAL-TEMP ERATE", "MARITIME-TEMPERA TE-OVER-LAND", "MARITIME-TEMPERA TE-OVER-SEA"
propitm-enable-foliage-loss	Channel instance	Bool	false	Indicates whether to enable foliage loss

Radio Propagation Model: Two tier

Parameter Name	Scope	Type	Default	Description (Range: Unit)
proptwotier-primary-propagation-model	Channel instance	String	N/A	Primary propagation model name
proptwotier-secondary-propagation-model	Channel instance	String	N/A	Secondary propagation model
proptwotier-nodes-running-secondary	Channel instance	String	N/A	Nodes that use the secondary propagation model e.g.: If node 1–10, and 12 use the secondary

				model: "1-10, 12"
proptwotier-links-running-secondary	Channel instance	String	N/A	Links that use the secondary propagation model e.g.: If links between node 2 and 3, and between 10 and 12 use the secondary model, "2:3, 10:12"

Radio propagation model: Trace

Parameter name	Scope	Type	Default value	Description (Range: Unit)
proptrace-default-propagation-model	Channel instance	String	N/A	Default propagation model. This model is used if the trace is unavailable.
proptrace-filename	Channel instance	String	N/A	File name of a propagation trace file. If propagation-model is "Trace", this file is used for input. Otherwise, it is used for output.

Radio propagation model: TGaxIndoor

Parameter name	Scope	Type	Default value	Description (Range: Unit)
prop-tgax-indoor-freespace-breakpoint-meters	Channel instance	Real	N/A	Distance to break point in meters
prop-tgax-indoor-floor-attenuation-db	Channel instance	Real	N/A	Attenuation loss for floor(ceiling) in dB
prop-tgax-indoor-wall-attenuation-db	Channel instance	Real	N/A	Annenuation loss for wall in dB

Fading/Shadowing

Parameter name	Scope	Type	Default value	Description (Range: Unit)
fading-model	Channel instance	String	N/A	Fading model: "OFF", "rayleigh", "nakagami"
fading-nakagami-shape-factor-m	Channel instance	Integer	N/A	Shape factor m in the Nakagami-m distribution
fading-enable-selection-combining-diversity	Channel instance	Bool	false	Indicates whether to enable selection combining diversity
fading-enable-fixed-velocity	Channel instance	Bool	false	Indicates whether to use a fixed relative velocity when calculating the Doppler frequency
fading-fixed-velocity-km-per-hour	Channel instance	Real	N/A	Fixed relative velocity used for calculating the Doppler frequency in km/h.
fading-velocity-update-interval	Channel instance	Time	1s	Velocity update interval when using dynamic velocity, i.e. fading-enable-fixed-velocity is false.
fading-minimum-velocity-km-per-hour	Channel instance	Real	N/A	Minimum relative velocity when using dynamic velocity in km/h
fading-number-of-sub-path	Channel instance	Integer	20	Number of sub paths for generating fading waves
shadowing-model	Channel instance	String	N/A	Shadowing model: SimpleLogNormal
lognormal-shadowing-standard-deviation	Channel instance	Real	N/A	Standard deviation of log normal shadowing (Available only when shadowing model is SimpleLogNormal)
shadowing-site-id	Node	String	N/A	Site ID used in shadowing models

				<p>If this value is "\$n", the node ID is automatically used as the site ID.</p> <p>(Available only with LTE_Macro or LTE_Pico propagation model)</p>
shadowing-weighted-coefficient	Node	Real	N/A	<p>Shadowing weighted coefficient</p> <p>(Available only with LTE_Macro or LTE_Pico propagation model)</p>

Mobility

Parameter name	Scope	Type	Default value	Description (Range: Unit)
mobility-model	Node	String	N/A	Mobility model: "RANDOM-WAYPOINT", , "GIS-BASED-RANDOM-WAYPOINT", "TRACE-FILE", "STATIONARY"
mobility-need-to-add-ground-height	Node	Bool	true	Indicates whether to add the ground elevation to the Z coordinate of each object.
mobility-granularity-meters	Node	Real	1.0	Mobility granularity in meters (Minimum movement distance)
mobility-trace-file-object-id	Node	Integer	Node ID	Object ID of the node in the mobility trace file or the initial node positions file
mobility-trace-file-supports-creation-and-deletion	Node	Bool	false	Indicates whether to support the dynamic node creation and deletion function when using the trace file mobility model
mobility-init-positions-file	Node	String	N/A	Name of the initial node positions file used with RANDOM-WAYPOINT, GIS-BASED-RANDOM-WAYPOINT, STATIONARY
mobility-trace-file	Node	String	N/A	Name of the trace file used with the trace file mobility model (Relative

				path or absolute path)
mobility-rwp-movable-area-min-x y-max-xy-meters	Node	String	N/A	Movable area used with RANDOM-WAYPOINT model; the minimum XY coordinates and the maximum XY coordinates in meters e.g.: -250,-250,250,250
mobility-rwp-movable-area-gis-o bject-name	Node	String	N/A	Movable area used with RANDOM-WAYPOINT model; polygon's name of a Building, Park or Area object. e.g.: park1
mobility-wp-min-speed-meter-per -sec	Node	Real	0.0	Minimum speed in m/s in RANDOM-WAYPOINT and GIS-BASED-RANDOM- WAYPOINT models
mobility-wp-max-speed-meter-pe r-sec	Node	Real	5.0	Maximum speed in m/s in RANDOM-WAYPOINT and GIS-BASED-RANDOM- WAYPOINT models
mobility-wp-pause-time	Node	Time	0s	Pause time in RANDOM-WAYPOINT and GIS-BASED-RANDOM- WAYPOINT models in seconds
mobility-wp-start-time	Node	Time	0s	Start time in RANDOM-WAYPOINT and GIS-BASED-RANDOM-

				WAYPOINT models in seconds
mobility-gis-ground-object-type	Node	String	N/A	GIS object type in GIS-BASED-RANDOM-WAYPOINT model (Currently, only "Road" is available)
mobility-lane-offset-meters	Node	Real	0.0	Offset from the center of the lane in GIS-BASED-RANDOM-WAYPOINT model in meters
mobility-route-search-based-algorithm	Node	Bool	false	Indicates whether to use the route search based algorithm in GIS-BASED-RANDOM-WAYPOINT model

Application: CBR

Parameter name	Scope	Type	Default value	Description (Range: Unit)
cbr-destination	Instance	String	N/A	Destination node ID
cbr-destination-multicast-group-number	Instance	Integer	N/A	Destination multicast group number in IP multicast (Available only with Dot Eleven Module)
cbr-start-time	Instance	Time	N/A	Start time
cbr-end-time	Instance	Time	N/A	End time
cbr-start-time-max-jitter	Instance	Time	0	Maximum jitter of start time
cbr-payload-size-bytes	Instance	Integer	N/A	Payload size in bytes
cbr-traffic-defined-by	Instance	String	Interval	Indicates how to specify the amount of traffic: "Interval", "PacketsPerSecond", or "BitsPerSecond"
cbr-interval	Instance	Time	N/A	Transmission interval (used when cbr-traffic-defined-by is "Interval")
cbr-traffic-pps	Instance	Real	N/A	Number of packet transmissions per second (used when cbr-traffic-defined-by is "PacketsPerSecond")
cbr-traffic-bps	Instance	Integer	N/A	Transmission bits per second (used when cbr-traffic-defined-by is "BitsPerSecond")
cbr-priority	Instance	Integer	N/A	Priority
cbr-auto-port-mode	Instance	Bool	true	Indicates whether to use the auto destination port setting mode

cbr-destination-port	Instance	Integer	N/A	Destination port number used in the manual port number setting mode
cbr-use-virtual-payload	Instance	Bool	false	Indicates whether to use the virtual payload function

Application: CBR with QoS

Parameter name	Scope	Type	Default value	Description (Range: Unit)
cbr-with-qos-destination	Instance	String	N/A	Destination node ID
cbr-with-qos-start-time	Instance	Time	N/A	Start time
cbr-with-qos-end-time	Instance	Time	N/A	End time
cbr-with-qos-start-time-max-jitter	Instance	Time	0	Maximum jitter of start time
cbr-with-qos-payload-size-bytes	Instance	Integer	N/A	Payload size in bytes
cbr-with-qos-traffic-defined-by	Instance	String	Interval	Indicates how to specify the amount of traffic: "Interval", "PacketsPerSecond", or "BitsPerSecond"
cbr-with-qos-interval	Instance	Time	N/A	Transmission interval (used when cbr-with-qos-traffic-defined-by is "Interval")
cbr-with-qos-traffic-pps	Instance	Real	N/A	Number of packet transmissions per second (used when cbr-with-qos-traffic-defined-by is "PacketsPerSecond")
cbr-with-qos-traffic-bps	Instance	Integer	N/A	Transmission bits per second (used when cbr-with-qos-traffic-defined-by is "BitsPerSecond")
cbr-with-qos-baseline-bandwidth-	Instance	Real	N/A	Baseline bandwidth

bytes				(minimum bandwidth) in bytes/second
cbr-with-qos-max-bandwidth-bytes	Instance	Real	N/A	Maximum bandwidth in bytes/second
cbr-with-qos-schedule-scheme	Instance	String	N/A	Scheduling scheme for QoS guarantee: "PriBased"
cbr-with-qos-priority	Instance	Integer	N/A	Priority
cbr-with-qos-auto-port-mode	Instance	Bool	true	Indicates whether to use the auto destination port setting mode
cbr-with-qos-destination-port	Instance	Integer	N/A	Destination port number used in the manual port number setting mode
cbr-with-qos-use-virtual-payload	Instance	Bool	false	Indicates whether to use the virtual payload function

Application: VBR

Parameter name	Scope	Type	Default value	Description (Range: Unit)
vbr-destination	Instance	String	N/A	Destination node ID
vbr-destination-multicast-group-number	Instance	Integer	N/A	Destination multicast group number in IP multicast (Available only with Dot Eleven Module)
vbr-start-time	Instance	Time	N/A	Start time
vbr-end-time	Instance	Time	N/A	End time
vbr-start-time-max-jitter	Instance	Time	0	Maximum jitter of start time
vbr-payload-size-bytes	Instance	Integer	N/A	Payload size in bytes
vbr-traffic-defined-by	Instance	String	Interval	Indicates how to specify the amount of traffic: "Interval", "PacketsPerSecond", or

				"BitsPerSecond"
vbr- mean-packet-interval	Instance	Time	N/A	Average transmission interval (used when vbr-traffic-defined-by is "Interval")
vbr- mean-traffic-pps	Instance	Real	N/A	Average number of packet transmissions per second (used when vbr-traffic-defined-by is "PacketsPerSecond")
vbr- mean-traffic-bps	Instance	Integer	N/A	Average transmission bits per second (used when vbr-traffic-defined-by is "BitsPerSecond")
vbr-maximum-packet-interval	Instance	Time	N/A	Maximum transmission interval
vbr-minimum-packet-interval	Instance	Time	N/A	Minimum transmission interval
vbr-priority	Instance	Integer	N/A	Priority
vbr-auto-port-mode	Instance	Bool	true	Indicates whether to use the auto destination port setting mode
vbr-destination-port	Instance	Integer	N/A	Destination port number used in the manual port number setting mode
vbr-use-virtual-payload	Instance	Bool	false	Indicates whether to use the virtual payload function

Application : VBR with QoS

Parameter name	Scope	Type	Default value	Description (Range: Unit)
vbr-with-qos-destination	Instance	String	N/A	Destination node ID
vbr-with-qos-start-time	Instance	Time	N/A	Start time
vbr-with-qos-end-time	Instance	Time	N/A	End time

vbr-with-qos-start-time-max-jitter	Instance	Time	0	Maximum jitter of start time
vbr-with-qos-payload-size-bytes	Instance	Integer	N/A	Payload size in bytes
vbr-with-qos-traffic-defined-by	Instance	String	Interval	Indicates how to specify the amount of traffic: "Interval", "PacketsPerSecond", or "BitsPerSecond"
vbr-with-qos-mean-packet-interval	Instance	Time	N/A	Average transmission interval (used when vbr-traffic-defined-by is "Interval")
vbr-with-qos- mean-traffic-pps	Instance	Real	N/A	Average number of packet transmissions per second (used when vbr-with-qos-traffic-defined-by is "PacketsPerSecond")
vbr-with-qos- mean-traffic-bps	Instance	Integer	N/A	Average transmission bits per second (used when vbr-with-qos-traffic-defined-by is "BitsPerSecond")
vbr-with-qos-maximum-packet-interval	Instance	Time	N/A	Maximum transmission interval
vbr-with-qos-minimum-packet-interval	Instance	Time	N/A	Minimum transmission interval
vbr-with-qos-baseline-bandwidth-bytes	Instance	Real	N/A	Baseline bandwidth (minimum bandwidth) in bytes/second
vbr-with-qos-max-bandwidth-bytes	Instance	Real	N/A	Maximum bandwidth in bytes/second
vbr-with-qos-schedule-scheme	Instance	String	N/A	Scheduling scheme for QoS guarantee: "PriBased"

vbr-with-qos-priority	Instance	Integer	N/A	Priority
vbr-with-qos-auto-port-mode	Instance	Bool	true	Indicates whether to use the auto destination port setting mode
vbr-with-qos-destination-port	Instance	Integer	N/A	Destination port number used in the manual port number setting mode
vbr-with-qos-use-virtual-payload	Instance	Bool	false	Indicates whether to use the virtual payload function

Application: FTP

Parameter name	Scope	Type	Default value	Description (Range: Unit)
ftp-destination	Instance	String	N/A	Destination node ID
ftp-flow-size-bytes	Instance	Integer	N/A	Flow size in bytes
ftp-start-time	Instance	Time	N/A	Start time
ftp-end-time	Instance	Time	N/A	End time
ftp-start-time-max-jitter	Instance	Time	0	Maximum jitter of start time
ftp-priority	Instance	Integer	N/A	Priority
ftp-use-virtual-payload	Instance	Bool	false	Indicates whether to use the virtual payload function
ftp-auto-port-mode	Instance	Bool	true	Indicates whether to use the auto destination port setting mode
ftp-destination-port	Instance	Integer	N/A	Destination port number used in the manual port number setting mode

Application: FTP with QoS

Parameter name	Scope	Type	Default value	Description (Range: Unit)
ftp-with-qos-destination	Instance	String	N/A	Destination node ID

ftp-with-qos-flow-size-bytes	Instance	Integer	N/A	Flow size in bytes
ftp-with-qos-start-time	Instance	Time	N/A	Start time
ftp-with-qos-end-time	Instance	Time	N/A	End time
ftp-with-qos-start-time-max-jitter	Instance	Time	0	Maximum jitter of start time
ftp-with-qos-priority	Instance	Integer	N/A	Priority
ftp-with-qos-use-virtual-payload	Instance	Bool	false	Indicates whether to use the virtual payload function
ftp-with-qos-auto-port-mode	Instance	Bool	true	Indicates whether to use the auto destination port setting mode
ftp-with-qos-destination-port	Instance	Integer	N/A	Destination port number used in the manual port number setting mode
ftp-with-qos-baseline-bandwidth-bytes	Instance	Real	N/A	Baseline bandwidth (minimum bandwidth) in bytes/second
ftp-with-qos-max-bandwidth-bytes	Instance	Real	N/A	Maximum bandwidth in bytes/second
ftp-with-qos-baseline-reverse-bandwidth-bytes	Instance	Real	N/A	Baseline bandwidth (minimum bandwidth) for feedback in bytes/second
ftp-with-qos-max-reverse-bandwidth-bytes	Instance	Real	N/A	Maximum bandwidth for feedback in bytes/second
ftp-with-qos-schedule-scheme	Instance	String	N/A	Scheduling scheme for QoS guarantee: "PriBased"

Application: MultiFTP

Parameter name	Scope	Type	Default value	Description (Range: Unit)
multiftip-destination	Instance	String	N/A	Destination node ID
multiftip-max-flow-data-bytes	Instance	Integer	N/A	Maximum flow size in

				bytes
multiftftp-mean-flow-data-bytes	Instance	Integer	N/A	Average flow size in bytes
multiftftp-standard-deviation-flow-data-bytes	Instance	Integer	N/A	Standard deviation of flow size in bytes
multiftftp-mean-reading-time	Instance	Time	N/A	Mean interval between starts of flow transmissions
multiftftp-start-time	Instance	Time	N/A	Start time
multiftftp-end-time	Instance	Time	N/A	End time
multiftftp-start-time-max-jitter	Instance	Time	0	Maximum jitter of start time
multiftftp-priority	Instance	Integer	N/A	Priority
multiftftp-use-virtual-payload	Instance	Bool	false	Indicates whether to use the virtual payload function
multiftftp-auto-port-mode	Instance	Bool	true	Indicates whether to use the auto destination port setting mode
multiftftp-destination-port	Instance	Integer	N/A	Destination port number used in the manual port number setting mode

Application : MultiFTPwithQoS

Parameter name	Scope	Type	Default value	Description (Range: Unit)
multiftftp-with-qos-destination	Instance	String	N/A	Destination node ID
multiftftp-with-qos-max-flow-data-bytes	Instance	Integer	N/A	Maximum flow size in bytes
multiftftp-with-qos-mean-flow-data-bytes	Instance	Integer	N/A	Average flow size in bytes
multiftftp-with-qos-standard-deviation-flow-data-bytes	Instance	Integer	N/A	Standard deviation of flow size in bytes
multiftftp-with-qos-mean-reading-time	Instance	Time	N/A	Mean interval between starts of flow transmissions

multiftpt-with-qos-start-time	Instance	Time	N/A	Start time
multiftpt-with-qos-end-time	Instance	Time	N/A	End time
multiftpt-with-qos-start-time-max-jitter	Instance	Time	0	Maximum jitter of start time
multiftpt-with-qos-priority	Instance	Integer	N/A	Priority
multiftpt-with-qos-use-virtual-payload	Instance	Bool	false	Indicates whether to use the virtual payload function
multiftpt-with-qos-auto-port-mode	Instance	Bool	true	Indicates whether to use the auto destination port setting mode
multiftpt-with-qos-destination-port	Instance	Integer	N/A	Destination port number used in the manual port number setting mode
multiftpt-with-qos-baseline-bandwidth-bytes	Instance	Real	N/A	Baseline bandwidth (minimum bandwidth) in bytes/second
multiftpt-with-qos-max-bandwidth-bytes	Instance	Real	N/A	Maximum bandwidth in bytes/second
multiftpt-with-qos-baseline-reverse-bandwidth-bytes	Instance	Real	N/A	Baseline bandwidth (minimum bandwidth) for feedback in bytes/second
multiftpt-with-qos-max-reverse-bandwidth-bytes	Instance	Real	N/A	Maximum bandwidth for feedback in bytes/second
multiftpt-with-qos-schedule-scheme	Instance	String	N/A	Scheduling scheme for QoS guarantee: "PriBased"

Application : VoIP

Parameter name	Scope	Type	Default value	Description (Range: Unit)
voip-destination	Instance	String	N/A	Destination node ID
voip-mean-state-duration	Instance	Time	N/A	Mean state duration (Mean time between

				Active/Inactive state transmissions)
voip-state-transition-probability	Instance	Real	N/A	State transition probability
voip-beta-for-packet-arrival-delay-jitter	Instance	Time	N/A	Mean packet arrival delay jitter
voip-jitter-buffer-window	Instance	Time	N/A	Jitter buffer window
voip-start-time	Instance	Time	N/A	Start time
voip-end-time	Instance	Time	N/A	End time
voip-start-time-max-jitter	Instance	Time	0	Maximum jitter of start time
voip-priority	Instance	Integer	N/A	Priority
voip-use-virtual-payload	Instance	Bool	false	Indicates whether to use the virtual payload function
voip-auto-port-mode	Instance	Bool	true	Indicates whether to use the auto destination port setting mode
voip-destination-port	Instance	Integer	N/A	Destination port number used in the manual port number setting mode

Application: VoIP with QoS

Parameter name	Scope	Type	Default value	Description (Range: Unit)
voip-with-qos-destination	Instance	String	N/A	Destination node ID
voip-with-qos-mean-state-duration	Instance	Time	N/A	Mean state duration (Mean time between Active/Inactive state transmissions)
voip-with-qos-state-transition-probability	Instance	Real	N/A	Mean state duration (Mean time between Active/Inactive state transmissions)
voip-with-qos-beta-for-packet-arrival-delay-jitter	Instance	Time	N/A	Mean packet arrival delay jitter

voip-with-qos-jitter-buffer-window	Instance	Time	N/A	Jitter buffer window
voip-with-qos-start-time	Instance	Time	N/A	Start time
voip-with-qos-end-time	Instance	Time	N/A	End time
voip-with-qos-start-time-max-jitter	Instance	Time	0	Maximum jitter of start time
voip-with-qos-priority	Instance	Integer	N/A	Priority
voip-with-qos-use-virtual-payload	Instance	Bool	false	Indicates whether to use the virtual payload function
voip-with-qos-auto-port-mode	Instance	Bool	true	Indicates whether to use the auto destination port setting mode
voip-with-qos-destination-port	Instance	Integer	N/A	Destination port number used in the manual port number setting mode
voip-with-qos-with-qos-baseline-bandwidth-bytes	Instance	Real	N/A	Baseline bandwidth (minimum bandwidth) in bytes/second
voip-with-qos-with-qos-max-bandwidth-bytes	Instance	Real	N/A	Maximum bandwidth in bytes/second
voip-with-qos-schedule-scheme	Instance	String	N/A	Scheduling scheme for QoS guarantee: "PriBased"

Application: Video Streaming

Parameter name	Scope	Type	Default value	Description (Range: Unit)
video-destination	Instance	String	N/A	Destination node ID
video-frame-rate	Instance	Integer	N/A	Frame rate in fps
video-number-packets-in-a-frame	Instance	Integer	N/A	Number of packets in a frame
video-min-packet-payload-size-bytes	Instance	Integer	N/A	Minimum packet payload in bytes
video-max-packet-payload-size-bytes	Instance	Integer	N/A	Maximum packet payload in bytes

video-mean-packet-size-bytes	Instance	Integer	N/A	Mean packet size in bytes
video-min-inter-arrival-time	Instance	Time	N/A	Minimum inter packet arrival time
video-max-inter-arrival-time	Instance	Time	N/A	Maximum inter packet arrival time
video-mean-inter-arrival-time	Instance	Time	N/A	Mean inter packet arrival time
video-jitter-buffer-window	Instance	Time	N/A	Jitter buffer window
video-start-time	Instance	Time	N/A	Start time
video-end-time	Instance	Time	N/A	End time
video-start-time-max-jitter	Instance	Time	0	Maximum jitter of start time
video-priority	Instance	Integer	N/A	Priority
video-use-virtual-payload	Instance	Bool	false	Use virtual the payload function
video-auto-port-mode	Instance	Bool	true	Use automatic destination port number configuration mode
video-destination-port	Instance	Integer	N/A	Destination port number in manual configuration

Application: VideoStreamingWithQoS

Parameter name	Scope	Type	Default value	Description (Range: Unit)
video-with-qos-destination	Instance	String	N/A	Destination node ID
video-with-qos-frame-rate	Instance	Integer	N/A	Frame rate in fps
video-with-qos-number-packets-in-a-frame	Instance	Integer	N/A	Number of packets in a frame
video-with-qos-min-packet-payload-size-bytes	Instance	Integer	N/A	Minimum packet size in bytes
video-with-qos-max-packet-payload-size-bytes	Instance	Integer	N/A	Maximum packet size in bytes
video-with-qos-mean-packet-size-bytes	Instance	Integer	N/A	Mean packet size in bytes

video-with-qos-min-inter-arrival-time	Instance	Time	N/A	Minimum inter packet arrival time
video-with-qos-max-inter-arrival-time	Instance	Time	N/A	Maximum inter packet arrival time
video-with-qos-mean-inter-arrival-time	Instance	Time	N/A	Mean inter packet arrival time
video-with-qos-jitter-buffer-window	Instance	Time	N/A	Jitter buffer window
video-with-qos-start-time	Instance	Time	N/A	Start time
video-with-qos-end-time	Instance	Time	N/A	End time
video-with-qos-start-time-max-jitter	Instance	Time	0	Maximum jitter of start time
video-with-qos-priority	Instance	Integer	N/A	Priority
video-with-qos-use-virtual-payload	Instance	Bool	false	Indicates whether to use the virtual payload function
video-with-qos-auto-port-mode	Instance	Bool	true	Indicates whether to use the auto destination port setting mode
video-with-qos-destination-port	Instance	Integer	N/A	Destination port number used in the manual port number setting mode
video-with-qos-with-qos-baseline-bandwidth-bytes	Instance	Real	N/A	Baseline bandwidth in QoS guarantee
video-with-qos-with-qos-max-bandwidth-bytes	Instance	Real	N/A	Maximum bandwidth in QoS guarantee
video-with-qos-schedule-scheme	Instance	String	N/A	Scheduling scheme in QoS guarantee: "PriBased"

Application: HTTP

Parameter name	Scope	Type	Default value	Description (Range: Unit)
http-destination	Instance	String	N/A	Destination node ID
http-min-main-object-bytes	Instance	Integer	N/A	Minimum main object size in bytes

http-max-main-object-bytes	Instance	Integer	N/A	Maximum main object size in bytes
http-mean-main-object-bytes	Instance	Integer	N/A	Mean main object size in bytes
http-standard-deviation-main-object-bytes	Instance	Integer	N/A	Standard deviation of main object size in bytes
http-min-number-embedded-objects	Instance	Integer	N/A	Minimum number of embedded objects
http-max-number-embedded-objects	Instance	Integer	N/A	Maximum number of embedded objects
http-mean-number-embedded-objects	Instance	Integer	N/A	Mean number of embedded objects
http-min-embedded-object-bytes	Instance	Integer	N/A	Minimum size of embedded objects in bytes
http-max-embedded-object-bytes	Instance	Integer	N/A	Maximum size of embedded objects in bytes
http-mean-embedded-object-bytes	Instance	Integer	N/A	Mean size of embedded objects in bytes
http-standard-deviation-embedded-object-bytes	Instance	Integer	N/A	Standard deviation of the size of embedded objects in bytes
http-mean-page-reading-time	Instance	Time	N/A	Mean page reading time
http-mean-embedded-reading-time	Instance	Time	N/A	Mean embedded object reading time
http-start-time	Instance	Time	N/A	Start time
http-end-time	Instance	Time	N/A	End time
http-start-time-max-jitter	Instance	Time	0	Maximum jitter of start time
http-priority	Instance	Integer	N/A	Priority
http-use-virtual-payload	Instance	Bool	false	Indicates whether to use the virtual payload function
http-auto-port-mode	Instance	Bool	true	Indicates whether to use the auto destination port

				setting mode
http-destination-port	Instance	Integer	N/A	Destination port number used in the manual port number setting mode

Application : HTTP with QoS

Parameter name	Scope	Type	Default value	Description (Range: Unit)
http-with-qos-destination	Instance	String	N/A	Destination node ID
http-with-qos-min-main-object-bytes	Instance	Integer	N/A	Minimum main object size in bytes
http-with-qos-max-main-object-bytes	Instance	Integer	N/A	Maximum main object size in bytes
http-with-qos-mean-main-object-bytes	Instance	Integer	N/A	Mean main object size in bytes
http-with-qos-standard-deviation-main-object-bytes	Instance	Integer	N/A	Standard deviation of main object size in bytes
http-with-qos-min-number-embedded-objects	Instance	Integer	N/A	Minimum number of embedded objects
http-with-qos-max-number-embedded-objects	Instance	Integer	N/A	Maximum number of embedded objects
http-with-qos-mean-number-embedded-objects	Instance	Integer	N/A	Mean number of embedded objects
http-with-qos-min-embedded-object-bytes	Instance	Integer	N/A	Minimum size of embedded objects in bytes
http-with-qos-max-embedded-object-bytes	Instance	Integer	N/A	Maximum size of embedded objects in bytes
http-with-qos-mean-embedded-object-bytes	Instance	Integer	N/A	Mean size of embedded objects in bytes
http-with-qos-standard-deviation-embedded-object-bytes	Instance	Integer	N/A	Standard deviation of the size of embedded objects in bytes
http-with-qos-mean-page-reading	Instance	Time	N/A	Mean page reading time

g-time				
http-with-qos-mean-embedded-reading-time	Instance	Time	N/A	Mean embedded object reading time
http-with-qos-start-time	Instance	Time	N/A	Start time
http-with-qos-end-time	Instance	Time	N/A	End time
http-with-qos-start-time-max-jitter	Instance	Time	0	Maximum jitter of start time
http-with-qos-priority	Instance	Integer	N/A	Priority
http-with-qos-use-virtual-payload	Instance	Bool	false	Indicates whether to use the virtual payload function
http-with-qos-auto-port-mode	Instance	Bool	true	Indicates whether to use the auto destination port setting mode
http-with-qos-destination-port	Instance	Integer	N/A	Destination port number used in the manual port number setting mode
http-with-qos-baseline-bandwidth-bytes	Instance	Real	N/A	Baseline bandwidth in QoS guarantee
http-with-qos-max-bandwidth-bytes	Instance	Real	N/A	Maximum bandwidth in QoS guarantee
http-with-qos-baseline-reverse-bandwidth-bytes	Instance	Real	N/A	Baseline bandwidth (minimum bandwidth) for feedback in bytes/second
http-with-qos-max-reverse-bandwidth-bytes	Instance	Real	N/A	Maximum bandwidth for feedback in bytes/second
http-with-qos-schedule-scheme	Instance	String	N/A	Scheduling scheme for QoS guarantee: "PriBased"

Application: Flooding

Parameter name	Scope	Type	Default value	Description (Range: Unit)
flooding-destination	Instance	String	N/A	Destination node ID.

				This value has to be always '*'.
flooding-payload-size-bytes	Instance	Integer	N/A	Payload size in bytes
flooding-interval	Instance	Time	N/A	Transmission interval
flooding-max-hop-count	Instance	Integer	N/A	Maximum
flooding-min-waiting-period	Instance	Time	N/A	Minimum waiting period
flooding-max-waiting-period	Instance	Time	N/A	Maximum waiting period
flooding-counter-threshold	Instance	Integer	N/A	Counter threshold
flooding-distance-threshold-in-meters	Instance	Real	N/A	Distance threshold in meters
flooding-start-time	Instance	Time	N/A	Start time
flooding-end-time	Instance	Time	N/A	End time
flooding-start-time-max-jitter	Instance	Time	0	Maximum jitter of start time
flooding-priority	Instance	Integer	N/A	Priority
flooding-use-virtual-payload	Instance	Bool	false	Indicates whether to use the virtual payload function
flooding-auto-port-mode	Instance	Bool	true	Indicates whether to use the auto destination port setting mode
flooding-destination-port	Instance	Integer	N/A	Destination port number used in the manual port number setting mode

Application: IperfTcp

Parameter name	Scope	Type	Default value	Description (Range: Unit)
iperf-tcp-destination	Instance	String	N/A	Destination node ID
iperf-tcp-priority	Instance	Integer	N/A	Priority
iperf-tcp-start-time	Instance	Time	N/A	Start time
iperf-tcp-auto-address-mode	Instance	Bool	true	Indicates how to specify the destination address true: to use a node ID (with

				iperf-tcp-destination) false: to use the address (with iperf-tcp-destination-add ress)
iperf-tcp-destination-address	Instance	String	N/A	Destination address (available only when iperf-tcp-auto-address- mode is false)
iperf-tcp-auto-port-mode	Instance	Bool	true	Indicates whether to use the auto destination port setting mode
iperf-tcp-destination-port	Instance	Integer	N/A	Destination port number used in the manual port number setting mode
iperf-tcp-time-mode	Instance	Bool	true	Specifies data transmission mode: true: Time-mode. The instance sends data during the period specified by iperf-tcp-total-time. false: The instance sends data of specified size given by iperf-tcp-total-size-bytes .
iperf-tcp-total-time	Instance	Time	10s	Length of data transmission period (Effective only when iperf-tcp-time-mode is true.)
iperf-tcp-total-size-bytes	Instance	Integer	1310720	Total transmission data size in bytes (effective only when iperf-tcp-time-mode is

				false)
iperf-tcp-buffer-size-bytes	Instance	Integer	131072	Send buffer size in bytes
iperf-tcp-use-virtual-payload	Instance	Bool	false	Indicates whether to use the virtual payload function

Application: IperfTcp with QoS

Parameter name	Scope	Type	Default value	Description (Range: Unit)
iperf-tcp-with-qos-destination	Instance	String	N/A	Destination node ID
iperf-tcp-with-qos-start-time	Instance	Time	N/A	Start time
iperf-tcp-with-qos-time-mode	Instance	Bool	true	Specifies data transmission mode: true: Time-mode. The instance sends data during the period specified by iperf-tcp-with-qos-total-time. false: The instance sends data of specified size given by iperf-tcp-with-qos-total-size-bytes.
iperf-tcp-with-qos-total-time	Instance	Time	10s	Length of data transmission period (Effective only when iperf-tcp-with-qos-time-mode is true.)
iperf-tcp-with-qos-total-size-bytes	Instance	Integer	1310720	Total transmission data size in bytes (effective only when iperf-tcp-with-qos-time-mode is false)
iperf-tcp-with-qos-buffer-size-byt	Instance	Integer	131072	Send buffer size in

es				bytes
iperf-tcp-with-qos-baseline-bandwidth-bytes	Instance	Real	N/A	Baseline bandwidth in QoS guarantee
iperf-tcp-with-qos-max-bandwidth-bytes	Instance	Real	N/A	Maximum bandwidth in QoS guarantee
iperf-tcp-with-qos-baseline-reverse-bandwidth-bytes	Instance	Real	N/A	Baseline bandwidth (minimum bandwidth) for feedback in bytes/second
iperf-tcp-with-qos-max-reverse-bandwidth-bytes	Instance	Real	N/A	Maximum bandwidth for feedback in bytes/second
iperf-tcp-with-qos-schedule-scheme	Instance	String	N/A	Scheduling scheme for QoS guarantee: "PriBased"
iperf-tcp-with-qos-priority	Instance	Integer	N/A	Priority
iperf-tcp-with-qos-auto-address-mode	Instance	Bool	true	Indicates how to specify the destination address true: to use a node ID (with iperf-tcp-with-qos-destination) false: to use the address (with iperf-tcp-with-qos-destination-address)
iperf-tcp-with-qos-destination-address	Instance	String	N/A	Destination address (available only when iperf-tcp-with-qos-auto-address-mode is false)
iperf-tcp-with-qos-auto-port-mode	Instance	Bool	true	Indicates whether to use the auto destination port setting mode
iperf-tcp-with-qos-destination-port	Instance	Integer	N/A	Destination port number used in the manual port number setting mode

iperf-tcp-with-qos-use-virtual-payload	Instance	Bool	false	Indicates whether to use the virtual payload function
--	----------	------	-------	---

Application: IperfUdp

Parameter name	Scope	Type	Default value	Description (Range: Unit)
iperf-udp-destination	Instance	String	N/A	Destination node ID
iperf-udp-priority	Instance	Integer	N/A	Priority
iperf-udp-start-time	Instance	Time	N/A	Start time
iperf-udp-auto-address-mode	Instance	Bool	true	Indicates how to specify the destination address true: to use a node ID (with iperf-udp-destination) false: to use the address (with iperf-udp-destination-address)
iperf-udp-destination-address	Instance	String	N/A	Destination address (available only when iperf-tcp-auto-address-mode is false)
iperf-udp-auto-port-mode	Instance	Bool	true	Indicates whether to use the auto destination port setting mode
iperf-udp-destination-port	Instance	Integer	N/A	Destination port number used in the manual port number setting mode
iperf-udp-time-mode	Instance	Bool	true	Specifies data transmission mode: true: Time-mode. The instance sends data during the period specified by

				iperf-udp-total-time. false: The instance sends data of specified size given by iperf-udp-total-size-bytes.
iperf-udp-total-time	Instance	Time	10s	Length of data transmission period (Effective only when iperf-udp-time-mode is true.)
iperf-udp-total-size-bytes	Instance	Integer	1310720	Total transmission data size in bytes (effective only when iperf-udp-time-mode is false)
iperf-udp-payload-size-bytes	Instance	Integer	1470	Payload size of UDP packets in bytes
iperf-udp-rate-bps	Instance	Integer	1048576	Data rate in bits/s
iperf-udp-use-system-time	Instance	Bool	false	Indicates whether to use system time (real time) instead of simulation time
iperf-udp-use-virtual-payload	Instance	Bool	false	Indicates whether to use the virtual payload function

Application: IperfUdp with QoS

Parameter name	Scope	Type	Default value	Description (Range: Unit)
iperf-udp-with-qos-destination	Instance	String	N/A	Destination node ID
iperf-udp-with-qos-start-time	Instance	Time	N/A	Start time
iperf-udp-with-qos-time-mode	Instance	Bool	true	Specifies data transmission mode: true: Time-mode. The instance sends data

				during the period specified by iperf-udp-with-qos-total-time. false: The instance sends data of specified size given by iperf-udp-total-size-bytes.
iperf-udp-with-qos-total-time	Instance	Time	10s	Length of data transmission period (Effective only when iperf-udp-with-qos-time-mode is true.)
iperf-udp-with-qos-total-size-bytes	Instance	Integer	1310720	Total transmission data size in bytes (effective only when iperf-udp-with-qos-time-mode is false)
iperf-udp-with-qos-payload-size-bytes	Instance	Integer	1470	Payload size of UDP packets in bytes
iperf-udp-with-qos-rate-bps	Instance	Integer	1048576	Data rate in bits/s
iperf-udp-with-qos-use-system-time	Instance	Bool	false	Indicates whether to use system time (real time) instead of simulation time
iperf-udp-with-qos-baseline-bandwidth-bytes	Instance	Real	N/A	Baseline bandwidth in QoS guarantee
iperf-udp-with-qos-max-bandwidth-bytes	Instance	Real	N/A	Maximum bandwidth in QoS guarantee
iperf-udp-with-qos-schedule-scheme	Instance	String	N/A	Scheduling scheme in QoS guarantee: "PriBased"
iperf-udp-with-qos-priority	Instance	Integer	N/A	Priority

iperf-udp-with-qos-auto-address-mode	Instance	Bool	true	Indicates how to specify the destination address true: to use a node ID (with iperf-udp-with-qos-destination) false: to use the address (with iperf-udp-with-qos-destination-address)
iperf-udp-with-qos-destination-address	Instance	String	N/A	Destination address (available only when iperf-udp-with-qos-auto-address-mode is false)
iperf-udp-with-qos-auto-port-mode	Instance	Bool	true	Indicates whether to use the auto destination port setting mode
iperf-udp-with-qos-destination-port	Instance	Integer	N/A	Destination port number used in the manual port number setting mode
iperf-udp-with-qos-use-virtual-payload	Instance	Bool	false	Indicates whether to use the virtual payload function

Application: Bundle Message

Parameter name	Scope	Type	Default value	Description (Range: Unit)
bundle-message-destination	Instance	String	N/A	Destination node ID
bundle-message-send-interval	Instance	Time	N/A	Transmission interval
bundle-message-start-time	Instance	Time	N/A	Start time
bundle-message-end-time	Instance	Time	N/A	End time
bundle-message-max-jitter	Instance	Time	0	Maximum jitter of start time
bundle-message-size-bytes	Instance	Integer	N/A	Message size in bytes
bundle-message-lifetime	Instance	Time	Infinity	Message lifetime

Bundle Protocol

Parameter name	Scope	Type	Default value	Description (Range: Unit)
bundle-max-storage-size-bytes	Node	Integer	Infinity	Maximum storage size for bundles in bytes
bundle-transport-mode	Node	String	TCP	Transport protocol used for bundle transmissions: "TCP" or "UDP"
bundle-routing-algorithm	Node	String	Epidemic	Routing algorithm: "Epidemic", "Spray-And-Wait", "Direct-Delivery", or "MaxProp"
bundle-maximum-number-of-copies	Node	Integer	N/A	Maximum number of copies in Spray-And-Wait
bundle-spray-and-wait-binary-mode	Node	Bool	false	Indicates whether to use the binary mode in Spray-And-Wait
bundle-enable-delivery-ack	Node	Bool	false	Indicates whether to enable delivery ack
bundle-hello-interval	Node	Time	N/A	Transmission interval of Hello messages
bundle-hello-max-jitter	Node	Time	N/A	Maximum jitter of the start time of Hello message transmission
bundle-request-resend-interval	Node	Time	2S	Bundle request resend interval
bundle-control-packet-max-jitter	Node	Time	0	Maximum jitter to send control packet
bundle-data-packet-priority	Node	Integer	0	Priority of data packet
bundle-control-packet-priority	Node	Integer	0	Priority of control packets
bundle-max-control-packet-size-bytes	Node	Integer	1472	Maximum size of control packet

bundle-use-virtual-payload	Node	Bool	false	Indicates whether to use the virtual payload function
----------------------------	------	------	-------	---

Application: Sensing

Parameter name	Scope	Type	Default value	Description (Range: Unit)
sensing-start-time	Instance	Time	N/A	Start time
sensing-end-time	Instance	Time	N/A	End time
sensing-interval	Instance	Time	N/A	Sensing interval
sensing-coverage-shape-type	Instance	String	N/A	Sensing coverage shape type: "FanShape" or "GISObject"
sensing-coverage-distance-meters	Instance	Real	N/A	Horizontal sensing coverage distance in meters (Effective only when sensing-coverage-shape-type is "FanShape".)
sensing-horizontal-coverage-degrees	Instance	Real	N/A	Horizontal coverage angle in degrees (Effective only when sensing-coverage-shape-type is "FanShape".)
sensing-vertical-coverage-degrees	Instance	Real	N/A	Vertical coverage angle in degrees (Effective only when sensing-coverage-shape-type is "FanShape".)
sensing-height-meters	Instance	Real	1.5	Vertical coverage distance in meters (Effective only when sensing-coverage-shape-type is "FanShape")
sensing-azimuth-degrees	Instance	Real	N/A	Sensing azimuth in degrees (Effective only

				when sensing-coverage-shape-type is "FanShape")
sensing-elevation-degrees	Instance	Real	N/A	Sensing elevation angle in degrees (Effective only when sensing-coverage-shape-type is "FanShape")
sensing-coverage-area-gis-object-name	Instance	String	N/A	GIS object name for the sensing coverage area (Only Building, Park, Area, and Road GIS objects are acceptable) (Effective only when sensing-coverage-shape-type is "GISObject")
sensing-coverage-area-height-meters	Instance	Real	N/A	Vertical distance of the sensing coverage in meters (Effective only when sensing-coverage-shape-type is "GISObject")
sensing-detection-granularity-meters	Instance	Real	N/A	Sensing detection granularity for detecting GIS objects in meters.
sensing-position-error-standard-deviation-meters	Instance	Real	N/A	Standard deviation of sensing position errors in meters
sensing-detection-condition	Instance	String	N/A	Indicates whether the sensor detects objects in "LoS" or both "LoS/NLoS"
sensing-detection-target	Instance	String	N/A	Sensing detection target: one or more from "CommunicationObject", "Building", "Wall",

				"Road", "Intersection", "Railroad", "Station", "Signal", "BusStop", "Area", "Park", "Entrance", and "POI". If specifying multiple targets, use CSV format like "Building, Road"
sensing-detection-error-rate	Instance	Real	N/A	Detection error rate
sensing-transmission-condition	Instance	String	N/A	Indicates whether this instance can communicate with the detected communication node in "Simplex" mode (from the instance to the detected node) or "Duplex" mode
sensing-transmission-data-error-rate	Instance	Real	N/A	Transmission data error rate

Application: TraceBasedApp

Parameter name	Scope	Type	Default value	Description (Range: Unit)
trace-based-app-destination	Instance	Integer	N/A	Destination node ID
trace-based-app-start-time	Instance	Time	N/A	Start time
trace-based-app-end-time	Instance	Time	Infinity	End time
trace-based-app-start-time-max-jitter	Instance	Time	0	Maximum jitter of start time
trace-based-app-input-file-type	Instance	String	N/A	Type of the input trace file (Only "pcap" is available in the current version)
trace-based-app-pcap-input-file	Instance	String	N/A	Path of the input pcap file
trace-based-app-pcap-first-packet-time	Instance	Time	N/A	Time corresponding to the transmission of the

				first packet in the pcap trace file
trace-based-app-pcap-trimming-header-size-bytes	Instance	Integer	N/A	Size of the header trimmed from each packet in the pcap file in bytes. If trimming headers of udp (8bytes), IPv4 (20 bytes), and Ethernet (14bytes), set 42 to this property.
trace-based-app-priority	Instance	Integer	0	Priority
trace-based-app-auto-port-mode	Instance	Bool	True	Indicates whether to use the auto destination port setting mode
trace-based-app-destination-port	Instance	Integer	N/A	Destination port number used in the manual port number setting mode
trace-based-app-use-virtual-payload	Instance	Bool	false	Indicates whether to use the virtual payload function

TCP

Parameter name	Scope	Type	Default value	Description (Range: Unit)
tcp-cc-module-name	Node	String	NewReno	Name of the used congestion control module: "NewReno", "Reno", "CUBIC", "H-TCP", "Vegas", "Hamilton-Delay", "CAIA-Hamilton-Delay", or "CAIA-Delay-Gradient"
tcp-enable-cc-htcp-adaptive-backoff	Node	Bool	false	Indicates whether to enable the adaptive backoff function of HTCP [13]
tcp-enable-cc-htcp-rtt-scaling	Node	Bool	false	Indicates whether to enable the RTT scaling of HTCP [13]
tcp-cc-vegas-alpha	Node	Integer	1	TCP Vegas Alpha threshold in MSS [14]
tcp-cc-vegas-beta	Node	Integer	3	TCP Vegas Beta threshold in MSS [14]
tcp-cc-hd-qthresh	Node	Integer	20	Threshold of delay (qthresh) of Hamilton-Delay in a multiple of 10ms [15]
tcp-cc-hd-qmin	Node	Integer	5	Threshold of the minimum delay (qmin) of Hamilton-Delay in a multiple of 10ms [15]
tcp-cc-hd-pmax	Node	Integer	5	Maximum backoff probability of Hamilton-Delay in percent [15]
tcp-cc-chd-qmin	Node	Integer	5	Minimum backoff

				probability of CAIA-Hamilton-Delay in percent [16]
tcp-cc-chd-pmax	Node	Integer	50	Maximum backoff probability of CAIA-Hamilton-Delay in percent [16]
tcp-enable-cc-chd-loss-fair	Node	Bool	true	Indicates whether to enable shadow window of CAIA-Hamilton-Delay [16]
tcp-enable-cc-chd-use-max	Node	Bool	true	Indicates whether to use the maximum RTT as RTT in CAIA-Hamilton-Delay [16]
tcp-cc-chd-qthresh	Node	Integer	20	Delay threshold of CAIA-Hamilton-Delay in 10ms [16]
tcp-cc-cdg-wif	Node	Integer	0	Per RTT window increase factor in RTT used by CAIA-Delay-Gradient. If this value is zero, the congestion window is increased by 1MSS every 1RTT. [17]
tcp-cc-cdg-wdf	Node	Integer	50	Window decrease factor in percent used by CAIA-Delay-Gradient [17]
tcp-cc-cdg-loss-wdf	Node	Integer	50	Window decrease for packet loss in percent used by CAIA-Delay-Gradient [17]

tcp-cc-cdg-smoothing-factor	Node	Integer	8	Number of samples used in the moving average smoothing used by CAIA-Delay-Gradient [17]
tcp-cc-cdg-exp-backoff-scale	Node	Integer	3	Scaling parameter for the probabilistic exponential backoff used by CAIA-Delay-Gradient [17]
tcp-cc-cdg-consec-cong	Node	Integer	5	Number of consecutive delay gradient based congestion episodes which will trigger loss based CC compatibility. This value is used by CAIA-Delay-Gradient [17]
tcp-cc-cdg-hold-backoff	Node	Integer	5	Number of consecutive delay gradient based congestion episodes to hold the window backoff for loss based CC compatibility. This value is used by CAIA-Delay-Gradient [17]
tcp-hostcache-hash-size	Node	Integer	1	Size of TCP hostcache hash table
tcp-hostcache-bucket-limit	Node	Integer	30	Per-bucket hash limit for hostcache
tcp-enable-blackhole	Node	Bool	false	Indicates whether to ignore segments arriving to closed ports.

				If this value is false, the TCP sends RST.
tcp-enable-delayed-ack	Node	Bool	true	Indicates whether to enable delayed ACK.
tcp-timer-delayed-ack-time	Node	Time	100ms	Maximum delay for delayed ACKs
tcp-enable-drop-synfin	Node	Bool	false	Indicates whether to drop TCP packets with both SYN and FIN flags are set.
tcp-enable-rfc3042	Node	Bool	true	Indicates whether to enable RFC3042.
tcp-enable-rfc3390	Node	Bool	true	Indicates whether to enable RFC3390.
tcp-ss-flight-size-segments	Node	Integer	true	Slow start flight size in MSS. This is the initial size of the congestion window in slow start. If RFC3390 is enabled, this value is not used.
tcp-ss-local-flight-size-segments	Node	Integer	1	Slow start flight size for local networks in MSS. If RFC3390 is enabled, this value is not used.
tcp-enable-rfc3465-abc	Node	Bool	4	Indicates whether to enable RFC3465.
tcp-rfc3465-abc-l-var	Node	Integer	2	The maximum size of the congestion window in MSSs during slow start. This value is used only when RFC3465 is enabled.
tcp-enable-insecure-rst	Node	Bool	false	Indicates whether to accept RST packets with an invalid sequence number.

tcp-enable-auto-receive-buffer	Node	Bool	true	Indicates whether to enable automatic receive buffer sizing.
tcp-auto-receive-buffer-increment-bytes	Node	Integer	16384	Incremental step size in bytes of automatic receive buffer
tcp-auto-receive-buffer-max-bytes	Node	Integer	2097152	Maximum size of automatic receive buffer in bytes
tcp-enable-auto-send-buffer	Node	Bool	true	Indicates whether to enable to automatic send buffer sizing
tcp-auto-send-buffer-increment-bytes	Node	Integer	8192	Incremental step size in bytes of automatic send buffer
tcp-auto-send-buffer-max-bytes	Node	Integer	2097152	Maximum size of automatic send buffer in bytes
tcp-timer-keep-init-time	Node	Time	75s	Timeout time for establishing a connection
tcp-enable-keep-alive	Node	Bool	true	Indicates whether to enable keep-alive probes
tcp-timer-keep-idle-time	Node	Time	7200s	Idle time before keepalive probes begin
tcp-timer-keep-interval-time	Node	Time	75s	Interval of keep-alive probes
tcp-timer-keep-count	Node	Integer	8	Maximum count of keep alive probes before disconnection
tcp-timer-msl-time	Node	Time	30s	Maximum segment lifetime (MSL)
tcp-timer-retransmit-min-time	Node	Time	30ms	Minimum retransmission timeout
tcp-timer-retransmit-slop-time	Node	Time	200ms	Constant time added to

				the calculated retransmission timeout
tcp-enable-timer-fast-finwait2-timeout	Node	Bool	false	Indicates whether to enable fast FIN_WAIT_2 timeout
tcp-timer-finwait2-timeout-time	Node	Time	60s	Timeout time in case when fast FINWAIT2 timeout is enabled
tcp-timer-max-persist-idle-time	Node	Time	7200s	Maximum persist idle time (Maximum idle time length that the connection has zero-size window before disconnection)
tcp-reassemble-max-segments	Node	Integer	128	Maximum number of segments in a reassemble queue
tcp-enable-rfc2018-sack	Node	Bool	true	Indicates whether to enable RFC2018 SACK
tcp-rfc2018-sack-max-holes	Node	Integer	128	RFC2018 maximum number of SACK holes per connection
tcp-rfc2018-sack-global-max-holes	Node	Integer	65536	RFC2018 maximum number of SACK holes per node
tcp-max-timewait-count	Node	Integer	0	Maximum number of connection ends in TIME_WAIT state
tcp-mss-bytes	Node	Integer	536	Maximum segment size
tcp-min-mss-bytes	Node	Integer	216	Minimum segment size
tcp-enable-rfc1323	Node	Bool	true	Indicates whether to enable RFC1323
tcp-isn-reseed-interval-time	Node	Time	0	Initial sequence number calculation reseed interval. If this property is 0, the calculation is

				not reseeded.
tcp-enable-sc-syncookies	Node	Bool	true	Indicates whether to enable SYN cookies
tcp-enable-sc-syncookies-only	Node	Bool	false	Indicates whether to use only SYN cookies when SYN cookies function is enabled. If this value is true, SYN cache is not used.
tcp-syncookie-hash-size	Node	Integer	1	size of SYN cache hash table
tcp-syncookie-bucket-limit	Node	Integer	30	Per-bucket hash limit for SYN cache
tcp-enable-sc-rst-sock-fail	Node	Bool	true	Indicates whether to send RST if creating socket fails
tcp-send-buffer-bytes	Node	Integer	32768	Send buffer size in bytes
tcp-receive-buffer-bytes	Node	Integer	65536	Receive buffer size in bytes
tcp-max-sockets	Node	Integer	65535	Maximum number of sockets
tcp-buffer-max-bytes	Node	Integer	2097152	Maximum buffer size in bytes
tcp-enable-nagle	Node	Bool	true	Indicates whether to enable Nagle's algorithm
tcp-enable-options	Node	Bool	true	Indicates whether to enable TCP options
tcp-v6-mss-bytes	Node	Integer	1220	IPv6 maximum segment size in bytes

Network layer

Parameter name	Scope	Type	Default value	Description (Range: Unit)
network-static-route-file	Global	String	N/A	Name of the configuration file for static routing
network-terminate-sim-when-routing-fails	Global	Bool	false	Indicates whether to terminate the simulation when routing fails
network-hop-limit	Node	Integer	64	Hop limit. The initial value of the time to live (TTL) field in IP header.
network-loopback-delay	Node	Time	1ns	Delay when a loopback interface is used
mobile-ip-address	Node	Network address	N/A	Mobile IP address
mobile-ip-enabled-interface	Interface	Bool	false	Indicates whether to enable mobile IP function (client) on the interface
mobile-ip-home-agent-address	Node	Network address	N/A	IP address of the home agent of the node
mobile-ip-home-agent	Node	Bool	false	Indicates whether to enable the home agent function on this node.

DHCP

Parameter name	Scope	Type	Default value	Description (Range: Unit)
network-enable-dhcp-client	Interface	Bool	false	Indicates whether to enable DHCP client function.

network-enable-dhcp-server	Interface	Bool	false	Indicates whether to enable DHCP server function.
network-dhcp-model	Interface	String	N/A	DHCP Model abstract: abstract model isc: ISC DHCP
dhcp-client-packet-priority	Interface	Integer	0	Priority of DHCP client packets (Enabled when network-enable-dhcp-client is true and network-dhcp-model is "abstract".)
dhcp-server-packet-priority	Interface	Integer	0	Priority of DHCP server packets (Effective only when network-enable-dhcp-server is true and network-dhcp-model is "abstract")
dhcp-server-use-server-address-as-default-gateway	Interface	Bool	true	Indicates whether to use the server's address as the default gateway. (Effective only when network-enable-dhcp-server is true and network-dhcp-model is "abstract")
dhcp-server-default-gateway-network-address	Interface	String	N/A	Default gateway address (Effective only when network-enable-dhcp-server is true, network-dhcp-model is "abstract", and dhcp-server-use-server-

				address-as-default-gate way is false.)
iscdhcp-client-config-file	Interface	String	N/A	Name of the DHCP client configuration file (Effective only when network-enable-dhcp-client is true and network-dhcp-model is "isc")
iscdhcp-client-input-lease-file	Interface	String	N/A	File name of a DHCP client lease file for input. (Effective only when network-enable-dhcp-client is true and network-dhcp-model is "isc".)
iscdhcp-client-output-lease-file	Interface	String	N/A	File name of a DHCP client lease file for output. (Effective only when network-enable-dhcp-client is true and network-dhcp-model "isc")
iscdhcp-client-packet-priority	Interface	Integer	0	Priority of DHCP client packets (Effective only when network-enable-dhcp-client is true and network-dhcp-model is "isc")
iscdhcp-server-config-file	Interface	String	N/A	Name of the DHCP server configuration file (Effective only when network-enable-dhcp-server is true and

				network-dhcp-model is "isc".)
iscdhcp-server-input-lease-file	Interface	String	N/A	Name of the DHCP server lease file for input (Effective only when network-enable-dhcp-server is true and network-dhcp-model is "isc".)
iscdhcp-server-output-lease-file	Interface	String	N/A	Name of the DHCP server lease file for output (Effective only when network-enable-dhcp-server is true and network-dhcp-model is "isc")
iscdhcp-server-packet-priority	Interface	Integer	0	Priority of DHCP server packets (Effective only when network-enable-dhcp-server is true and network-dhcp-model is "isc")

Routing protocols

Parameter name	Scope	Type	Default value	Description (Range: Unit)
network-routing-protocol-name	Interface	String	N/A	Name of the routing protocol name, "kernel_aodv", "nrl_olsr", or "nu_olsrv2". If using kernel_aodv, set network-subnet-is-multi hop true.

aodv-active-route-timeout	Interface	Time	N/A	AODV ACTIVE_ROUTE_TIME OUT
aodv-allowed-hello-loss	Interface	Integer	N/A	AODV ALLOWED_HELLO_LO SS
aodv-hello-interval	Interface	Time	N/A	AODV HELLO_INTERVAL
aodv-my-route-timeout	Interface	Time	N/A	AODV MY_ROUTE_TIMEOUT
aodv-net-diameter	Interface	Integer	N/A	AODV NET_DIAMETER
aodv-node-traversal-time	Interface	Time	N/A	AODV NODE_TRAVERSAL_T IME
aodv-rreq-retries	Interface	Integer	N/A	AODV RREQ_RETRIES
aodv-cached-packet-expiration-i nterval	Interface	Time	3s	AODV Expiration interval for cached packets
olsr-flooding-method	Interface	String	s-mpr	OLSR flooding method "off", "s-mpr", "ns-mpr", "not-sym", "simple", "ecds," or "mpr-cds"
olsr-forward-delay	Interface	Time	0	Transmission jitter for OLSR packets (≥ 0)
olsr-hello-interval	Interface	Time	0.5s	OLSR HELLO_INTERVAL
olsr-hello-jitter	Interface	Real	0.5	Transmission jitter of OLSR HELLO packets [0.0, 1.0)
olsr-hello-timeout-factor	Interface	Real	6.0	Scaling factor for calculating neighbor node holding time in OLSR (>1.0)
olsr-shortest-path-algorithm	Interface	String	shortesth op	Shortest path algorithm used in OLSR

				("shortesthop", "spf", "minmax", or "robustroute")
olsr-tc-interval	Interface	Time	2.0s	OLST TC_INTERVAL
olsr-tc-jitter	Interface	Real	0.5	Transmission jitter for OLSR TC packets [0.0, 1.0)
olsr-tc-timeout-factor	Interface	Real	5.0	Scaling factor for calculating OLSR TOP_HOLD_TIME (Topology holding time) (>1.0)
olsr-willingness	Interface	Integer	3	OLSR Willingness [0, 7) Willingness to retransmit packets. If this value is large, the node tends to be selected as a member of an MPR.
olsrv2-attached-network-address-list	Interface	String	N/A	IP address list for external networks (Delimiter: space)
olsrv2-attached-network-mask-list	Interface	String	N/A	Subnet mask length in bits for external networks (Delimiter: space)
olsrv2-attached-network-distance-list	Interface	String	N/A	Hop count to external networks (Delimiter: space)
olsrv2-hello-interval	Interface	Time	2.0s	OLSRv2 - Maximum value of HELLO message interval
olsrv2-hello-max-jitter	Interface	Time	0.5s	OLSRv2 - Maximum jitter of transmissions of HELLO messages
olsrv2-hello-start-time	Interface	Time	2.0s	OLSRv2 - HELLO

				message transmission start time
olsrv2-link-quality-type	Interface	String	no	OLSRv2 – Link quality type "no": Link quality is not modified "hello": Link quality is modified based on HELLO message reception.
olsrv2-lq-hyst-accept	Interface	Real	0.8	OLSRv2 – HYST_ACCEPT The link quality threshold at or above which a link becomes usable.
olsrv2-lq-hyst-reject	Interface	Real	0.3	OLSRv2 – HYST_REJECT The link quality threshold below which a link becomes unusable
olsrv2-lq-initial-quality	Interface	Real	0.5	OLSRv2 – INITIAL_QUALITY The initial link quality of a newly identified link.
olsrv2-lq-initial-pending	Interface	Bool	false	OLSRv2 – INITIAL_PENDING If "true", then a newly identified link is considered pending, and is not usable until the link quality has reached or exceed olsrv2-lq-hyst-accept.
olsrv2-lq-hyst-scale	Interface	Real	0.5	OLSRv2 – Constant used to update link

				<p>quality</p> <p>When increasing:</p> $\text{quality} = (1.0 - \text{olsrv2-lq-hyst-scale}) * \text{quality} + \text{olsrv2-lq-hyst-scale}$ <p>When decreasing:</p> $\text{quality} = (1.0 - \text{olsrv2-lq-hyst-scale}) * \text{quality}$
olsrv2-lq-loss-detect-scale	Interface	Real	1.5	<p>OLSRv2 – Constant used to calculate the waiting time to detect the loss of a HELLO message</p> <p>Waiting time: $\text{olsrv2-hello-interval} * \text{olsrv2-lq-loss-detect-scale}$</p> <p>If a new HELLO message has arrived within the waiting time after the receipt of the previous HELLO message, the link quality is increased. Otherwise, the link quality is decreased.</p>
olsrv2-link-metric-type	Interface	String	none	<p>OLSRv2 – Link metric type</p> <p>"none" Link metric is not used.</p> <p>"etx" Link metric is calculated with HELLO messages</p> <p>"static" Link metrics are</p>

				read from a file.
olsrv2-lm-etx-memory-length	Interface	Integer	32	OLSRv2 – Memory length to hold old data for calculating the link metric Records of receipt of HELLO messages in the recent (olsrv2-lm-etx-metric-interval * olsrv2-lm-etx-memory-length) seconds are used. (Effective only when olsrv2-link-metric-type is "etx")
olsrv2-lm-etx-metric-interval	Interface	Time	1.0s	OLSRv2 – Interval of calculation of link metric (Effective only when olsrv2-link-metric-type is "etx")
olsrv2-lm-metric-list-file	Interface	String	N/A	OLSRv2 – Name of a file including the list of link metrics. The file format is as follows. [Source IP] [Destination IP] [Direction Flag] [Metric] [Direction Flag]: "-": Unidirectional "B" or "b": Bidirectional Example) 192.168.0.1 192.168.0.2 - 1000

				192.168.0.2 192.168.0.1 - 1000 192.168.0.1 192.168.0.3 B 2000 (Effective only when olsrv2-link-metric-type is "static")
olsrv2-tc-interval	Interface	Time	5.0s	OLSRv2 – Maximum value of TC message transmission interval
olsrv2-tc-max-jitter	Interface	Time	0.5s	OLSRv2 – Maximum jitter of TC message transmissions
olsrv2-tc-start-time	Interface	Time	5.0s	OLSRv2 – TC message transmission start time
olsrv2-tc-hop-limit	Interface	Integer	10	OLSRv2 – Hop limit of TC messages
olsrv2-willingness	Interface	Integer	3	OLSRv2 - Willingness
olsrv2-broadcast-priority	Interface	Integer	0	OLSRv2 - Priority of control messages used by nuOLSRv2 module

Communication interface

Parameter name	Scope	Type	Default value	Description (Range: Unit)
mac-protocol	Interface	String	N/A	MAC Protocol name ("abstract-network", "aloha", "dot11", "lte", etc.)
interface-output-queue-max-bytes	Interface	Integer	0	Size of output queue in bytes. If the value is zero, the size is infinite.

				(Effective when mac-protocol is "abstract-network", etc.)
interface-output-queue-max-bytes-per-subq	Interface	Integer	0	Size of output sub queue in bytes. If the value is zero, the size is infinite. (Effective when mac-protocol is "dot11", etc.)
interface-output-queue-max-packets	Interface	Integer	0	Size of output queue in packets If the value is zero, the size is infinite. (Effective when mac-protocol is "abstract-network", etc.)
interface-output-queue-max-packets-per-subq	Interface	Integer	0	Size of output sub queue in packets If the value is zero, the size is infinite. (Effective when mac-protocol is "dot11", etc.)
network-address	Interface	Network address	N/A	Network address of the node If it is written as "<Subnet address> + \$n", \$n is automatically replaced by the node ID (Example: 192.169.0.0 + \$n)
network-address-is-primary	Interface	Bool	false	Indicates whether the IP address given to the interface is primary.
network-gateway-address	Interface	Network	N/A	Network address of the

		k addres s		gateway
network-prefix-length-bits	Interface	Integer	N/A	The length of the network address in bits
network-mtu-bytes	Interface	Integer	1500	MTU (Maximum Transmission Unit) size in bytes
network-subnet-is-multihop	Interface	Bool	false	Indicates whether the subnet that the interface is connected is a multihop network. If network-routing-protocol-name is "kernel_aodv", this parameter must be set true.
network-allow-routing-back-out-same-interface	Interface	Bool	false	Indicates whether to allow forwarding a packet to the interface that the packet has arrived from.
network-ignore-unregistered-protocol	Interface	Bool	false	Indicates whether to ignore packets that use unregistered protocols or stop the simulation.

NDP

Parameter name	Scope	Type	Default value	Description (Range: Unit)
network-enable-ndp	Interface	Bool	false	Enable NDP (Effective when IPv6 is used.)
network-ndp-mode	Interface		N/A	NDP mode "host" or "router" (Effective only when

				network-enable-ndp is true and IPv6 is used.)
network-ndp-address-resolution	Interface	Bool	N/A	Enables address resolution (Effective only when network-enable-ndp is true and IPv6 is used.)
network-ndp-address-autoconfiguration	Interface	Bool	N/A	Enables address autoconfiguration (Effective only when network-enable-ndp is true, network-ndp-mode is "host", and IPv6 is used.)
network-ndp-gateway-autoconfiguration	Interface	Bool	N/A	Enables gateway auto configuration (Effective only when network-enable-ndp is true, network-ndp-mode is "host", and IPv6 is used.)
network-ndp-router-advertisement-interval	Interface	Time	N/A	Router advertisement interval (Effective only when network-enable-ndp is true, network-ndp-mode is "router", and IPv6 is used.)
network-ndp-router-advertisement-jitter	Interface	Time	N/A	Jitter of router advertisement transmissions (Effective only when network-enable-ndp is true, network-ndp-mode is "router", and IPv6 is used.)

ARP

Parameter name	Scope	Type	Default value	Description (Range: Unit)
network-enable-arp	Interface	Bool	false	Enables ARP
network-enable-proxy-arp	Interface	Bool	false	Enables Proxy ARP
network-arp-probe-wait	Interface	Time	1s	Maximum wait time to start probing
network-arp-probe-num	Interface	Integer	3	Number of probing operations
network-arp-probe-min	Interface	Time	1s	Minimum interval of probing
network-arp-probe-max	Interface	Time	2s	Maximum interval of probing
network-arp-announce-wait	Interface	Time	2s	Maximum waiting time to start announcement
network-arp-announce-num	Interface	Integer	2	Number of announcements
network-arp-announce-interval	Interface	Time	2s	Interval of announcements
network-arp-max-conflicts	Interface	Integer	10	Maximum number of address conflicts allowed before starting rate limiting.
network-arp-rate-limit-interval	Interface	Time	60s	Interval of probing in rate limitation
network-arp-packet-priority	Interface	Integer	0	Priority of ARP packets

Abstract wired network

Parameter name	Scope	Type	Default value	Description (Range: Unit)
abstract-network-mac-packet-drop-rate	Interface	Real	0.0	Packet drop rate
abstract-network-min-latency	Interface	Time	N/A	Minimum latency
abstract-network-max-latency	Interface	Time	Same as abstract-network-min-latency	Maximum latency
abstract-network-output-bandwidth-bits-per-sec	Interface	Integer	N/A	Output bandwidth in bits/sec

ALOHA

Parameter name	Scope	Type	Default value	Description (Range: Unit)
aloha-model	Interface	String	unslotted	Protocol model: "unslotted" or "slotted"
aloha-minimum-data-transmission-interval	Interface	Time	N/A	Minimum data transmission interval
aloha-maximum-data-transmission-jitter	Interface	Time	N/A	Maximum jitter of data transmission
aloha-slot-time	Interface	Time	N/A	Slot time. (Effective when "slotted" model is used)
aloha-minimum-retry-interval	Interface	Time	0s	Minimum retry interval (≥ 0)
aloha-maximum-retry-interval	Interface	Time	N/A	Maximum retry interval (≥ 0)
aloha-retry-limit	Interface	Integer	N/A	Retry limit (≥ 0)
aloha-datarate-bits-per-second	Interface	Integer	N/A	Data rate in bits/sec (> 0)
aloha-tx-power-dbm	Interface	Real	N/A	Transmission power in dBm
aloha-signal-rx-power-threshold-dbm	Interface	Real	N/A	Minimum receive power in dBm

aloha-phy-frame-data-padding-bits	Interface	Integer	0	PHY frame data padding size in bits (≥ 0)
aloha-phy-delay-until-airborne	Interface	Time	N/A	PHY delay until airborne (> 0)

7. Statistics, Trace

7.1. List of default settings of statistics

Layer	Model	Statistic	Description
Application	CbrApp	PacketsSent	Number of packets sent
		BytesSent	Number of bytes sent
		PacketsReceived	Number of packets received
		BytesReceived	Number of bytes received
		DuplicatePacketsReceived	Number of duplicate packets received
		DuplicatePacketOutOfWindowErrors	Number of duplicate packets that caused out of window errors
		EndToEndDelay	Delay in seconds
	VbrApp	PacketsSent	Number of packets sent
		BytesSent	Number of bytes sent
		PacketsReceived	Number of packets received
		BytesReceived	Number of bytes received
		DuplicatePacketsReceived	Number of received duplicate packets
		DuplicatePacketOutOfWindowErrors	Number of duplicate packets that caused out of window errors
		EndToEndDelay	Delay in seconds
	VoipApp	PacketsSent	Number of packets sent
		BytesSent	Number of bytes

			sent
		PacketsReceived	Number of packets received
		BytesReceived	Number of bytes received
		EndToEndDelay	Delay in seconds
		PacketsOutOfOrder	Number of packets out of order
		FreameSuccess	Number of successfully received frames
	VideoApp	PacketsSent	Number of packets sent
		BytesSent	Number of bytes sent
		PacketsReceived	Number of packets received
		BytesReceived	Number of bytes received
		EndToEndDelay	Delay in seconds
		FramesSent	Number of frames sent
		FramesSuccess	Number of successfully received frames
		FramesFailure	Number of unsuccessfully received frames
		PcketsOutOfOrder	Number of packets out of order
		PacketsBuffered	Number of packets buffered
		PacketsUnbuffered	Number of packets unbuffered
		EndToEndJitter	End-to-end jitter in seconds

	FtpFlowApp	BytesSent	Number of bytes sent
		BytesReceived	Number of bytes received
		TransmissionDelay	Transmission delay in seconds
	FtpApp	BytesSent	Number of bytes sent
		BytesReceived	Number of bytes received
		TransmissionDelay	Transmission delay in seconds
	HttpApp	BytesSent	Number of bytes sent
		BytesReceived	Number of bytes received
		TransmissionDelay	Transmission delay in seconds
	FloodingApp	PacketsBroadcast	Number of packets sent
		BytesBroadcast	Number of bytes sent
		PacketsRebroadcast	Number of bytes rebroadcasted
		BytesRebroadcast	Number of rebroadcasted bytes
		PacketsReceived	Number of packets received
		BytesReceived	Number of bytes received
		PacketsDiscarded	Number of discarded packets
		BytesDiscarded	Number of bytes discarded
		EndToEndDelay	End-to-end delay in seconds

	IperfUdpApp	HopCount	Hop count
		PacketsSent	Number of packets sent
		PacketsReceived	Number of packets received
		BytesSent	Number of bytes sent
		BytesReceived	Number of bytes received
		EndToEndDelay	Delay in seconds
	IperfTcpApp	BytesSent	Number of bytes sent
		BytesReceived	Number of bytes received
		BytesAcked	Number of bytes acked
	Bundle	BundlesGenerated	Number of bundles generated
		BundlesDelivered	Number of bundles delivered
		BundlesSent	Number of bundles sent
		BundlesReceived	Number of bundles received
		DuplicateBundleReceived	Number of duplicate bundles received
		BundlesDiscardedDueToLackOfStorage	Number of bundles discarded due to lack of storage
		BytesGenerated	Number of bytes of bundles generated
		BytesDelivered	Number of bytes bundles delivered
		BytesSent	Number of bytes of bundles sent

		BytesReceived	Number of bytes of bundles received
		BundleEndToEndDelay	Bundle end-to-end delay
		StorageUsageBytes	Storage usage in bytes
	SensingApp	DetectedCommObjects	Number of detected communication objects
		DetectedGisObjects	Number of detected GIS objects
	TraceBasedApp	PacketsSent	Number of packets sent
		PacketsReceived	Number of packets received
		BytesSent	Number of bytes sent
		BytesReceived	Number of bytes received
		EndToEndDelay	Delay in seconds
Transport	Tcp	BytesSentToUpperLayer	Number of bytes sent to upper layer from TCP
		BytesReceivedFromUpperLayer	Number of bytes received from upper layer
		BytesSentToLowerLayer	Number of bytes sent to lower layer
		BytesReceivedFromLowerLayer	Number of bytes received from lower layer
		BytesAacked	Number of bytes of data and control flags acked
		Rtt	Round trip time (RTT) in seconds

		Cwnd	Congestion window (cwnd) size in bytes
		Retransmission	Number of retransmissions
	Udp	BytesSent	Number of bytes sent
		BytesReceived	Number of bytes received
Network	NetworkLayer	BytesSent	Bytes of packets put into the output queue
		PacketsSent	Number of packets put into the output queue
		BytesReceived	Bytes received from the MAC layer
		PacketsReceived	Number of packets received from the MAC layer
		MaxPacketsQueueDrops	Number of dropped packets due to that the number of packets in the input queue exceeds the limit
		MaxBytesQueueDrops	Number of dropped packets due to that the data size of the input queue exceeds the limit
		NoRouteDrops	Number of packets dropped due to no route
		HopLimitDrops	Number of packets dropped due to that the number of hops

			exceeds the limit
		PacketsUndelivered	Number of packets undelivered due to the MAC layer
	Arp	PacketsSent	Number of packets sent
		PacketsReceived	Number of packets received
		FullQueueDrops	Number of packets due to input queue full
		IpConflicts	Number of IP address conflicts
	Ndp	NeighborSolicitationPacketsSent	Number of neighbor solicitation packets sent
		NeighborAdvertisementPacketsSent	Number of Neighbor advertisement packets sent
		RouterSolicitationPacketsSent	Number of router solicitation packets sent
		RouterAdvertisementPacketsSent	Number of router advertisement packets sent
		NeighborSolicitationPacketsReceived	Number of neighbor solicitation packets received
		NeighborAdvertisementPacketsReceived	Number of neighbor advertisement packets received
		RouterSolicitationPacketsReceived	Number of router solicitation packets received
		RouterAdvertisementPacketsReceived	Number of router advertisement

			packets received
		FullQueueDrops	Number of packets dropped due to queue full during address resolution
Routing protocol	Aodv	BytesSent	Number of bytes sent
		BytesReceived	Number of bytes received
		PacketsSent	Number of packets sent
		PacketsReceived	Number of packets received
	Olsr	BytesSent	Number of bytes sent
		BytesReceived	Number of bytes received
		PacketsSent	Number of packets sent
		PacketsReceived	Number of packets received
	Olsrv2	BytesSent	Number of bytes sent
		BytesReceived	Number of bytes received
		PacketsSent	Number of packets sent
		PacketsReceived	Number of packets received
MAC	AbstractMac	PacketsSent	Number of packets sent
		PacketsReceived	Number of packets received
		DroppedPackets	Number of packets dropped
	AlohaMac	DequeuedPackets	Number of packets

			dequeued from the network layer
		DroppedPackets	Number of packets dropped
		DataFramesSent	Number of data frames sent
		DataFramesReceived	Number of data frames received
		AckFramesSent	Number of ACK frames sent
		AckFramesReceived	Number of ACK frames received
PHY	AlohaPhy	FramesTransmitted	Number of frames transmitted
		FramesDropped	Number of frames dropped
		FramesReceived	Number of frames received
		FramesWithErrors	Number of frames received with errors
		ReceivedFrameRssiDbm	Signal strength of received frames in dBm

7.2. Trace Event List

Layer	Model Name	Trace Event	Details	Description
Mobility Tag name: Mobility	Node	NodePosition	X-coordinate, Y-coordinate, Height, Azimuthal angle, Angle of elevation	Current position of the node
		AddNode	-	Addition of a node
		DeleteNode	-	Deletion of a node
Application Tag name: Application	CbrApp	CbrSend	Sequence number, Packet ID	Sending a CBR unicast packet
		CbrRecv	Sequence number, Packet ID, Delay, Packet reception rate, Number of bytes received	Receiving a CBR unicast packet
		CbrBcSend	Sequence number, Packet ID	Sending a CBR broadcast packet
		CbrBcRecv	Sequence number, Packet ID, Delay, Packet reception rate, Number of bytes received	Receiving a CBR broadcast packet
	VbrApp	VbrSend	Sequence number, Packet	Sending a VBR unicast

			ID	packet
		VbrRecv	Sequence number, Packet ID, Delay, Packet reception rate, Number of bytes received	Receiving a VBR unicast packet
		VbrBcSend	Sequence number, Packet ID	Sending a VBR broadcast packet
		VbrBcRecv	Sequence number, Packet ID, Delay, Packet reception rate, Number of bytes received	Receiving a VBR broadcast packet
	VoipApp	VoipSend	Sequence number, Packet ID	Sending a VoIP packet
		VoipRecv	Sequence number, Packet ID, Delay, Packet reception rate, Number of bytes received	Receiving a VoIP packet
	VideoApp	VideoSend	Sequence number, Packet ID	Sending a VideoStreaming packet
		VideoRecv	Sequence number, Packet ID, Delay, Packet	Receiving a VideoStreaming packet

			reception rate, Number of bytes received	
		BufferSuccess	Sequence number, Packet ID	Successful buffering
		BufferFailure	Sequence number, Packet ID	Buffering Failure
		DecodeSuccess	-	Success of decoding
		DecodeFailure	-	Decoding failure
	FtpFlowApp	FtpStartFlow	File size	Start of transmission of FTP flow
		FtpEndFlow	Number of bytes sent, Transmission delay	End of transmission of FTP flow
	FtpApp	MultiFtpStartFlow	File size	Start of transmission of FTP flow
		MultiFtpEndFlow	Number of bytes sent, Transmission delay	End of transmission of FTP flow
	HttpApp	HttpStartFlow	Object size	Start of transmission of HTTP flow
		HttpEndFlow	Number of bytes sent, Transmission delay	End of transmission of HTTP flow
	FloodingApp	FloodingBroadcast	Sequence number, Packet	Broadcast of a flooding

			ID	packet
		FloodingRebroadcast	Sequence number, Packet ID	Rebroadcast of a flooding packet
		FloodingReceive	Sequence number, Packet ID, Delay, Packet reception rate, Number of bytes received	Receiving a Flooding packet
		FloodingDiscard	Sequence number, Packet ID, Delay, Packet reception rate	Discarding a received flooding packet
	IperfUdpApp	IperfUdpStart	Transmission time or Number of bytes sent	Start of transmission
		IperfUdpEnd	Transmission time, Number of bytes sent, Data Rate, Number of packets, Number of error packets, Number of packets out of order, Jitter	End of transmission
		IperfUdpSend	Sequence number, Packet ID	Sending a packet
		IperfUdpRecv	Sequence number, Packet ID, Delay,	Receiving a packet

			Packet Reception Rate, Number of bytes received	
	IperfTcpApp	IperfTcpStart	Transmission or Number of bytes sent	Start of transmission
		IperfTcpEnd	Transmission time, Number of bytes sent, Data rate	End of transmission
		IperfTcpRecv	Source node ID, Number of bytes received	Receiving data
	SensingApp	SensingDetection	Number of detected communication objects, Number of detected GIS objects	Detection of objects
	TraceBasedApp	TraceBasedSend	Sequence number, Packet ID	Sending a packet
		TraceBasedRecv	Sequence number, Packet ID, Delay, Packet delivery ratio, Number of bytes received	Receiving a packet
Transport Tag name: Transport	Tcp	TcpDataSend	Packet ID	Sending a TCP data packet
		TcpCtrlSend	Packet ID	Sending TCP

				control packet
		TcpRecv	Packet ID	Receiving a TCP packet
	Udp	UdpSend	Packet ID	Sending a UDP packet
		UdpRecv	Packet ID	Receiving UDP packet
Network Tag name : Network	NetworkLayer	IpSend	Packet ID	Adding an IP packet to the output queue
		IpRecv	Packet ID, Number of bytes received	Receiving an IP packet from the MAC layer
		FullQueueDrop	Packet ID	Drop of a packet due to queue full
		NoRouteDrop	Packet ID, Destination address	Drop of a packet due to no route
		PacketUndelivered	Packet ID	Drop of a packet due to unknown destination in the MAC layer
		IpAddrChange	Interface index, New IP address, Netmask	Change of IP address
Routing Protocol Tag name : Routing	Aodv	AodvTask	Task type	AODV Task type
		AodvSend	Packet ID, Message type, TTL	AODV control packet send
		AodvRecv	Packet ID, Message type, TTL	AODV control packet reception

		AodvAddEntry	Destination address, Netmask, Next hop address, Interface address	Addition of an entry to the routing table
		AodvDelEntry	Destination address, Netmask	Deletion of an entry from the routing table
	Olsr	OlsrSend	Packet ID, Message type, Validity time, Originator node's address, TTL, Hop count, OLSR message sequence number	OLSR control packet send
		OlsrRecv	Packet ID, Message type, Validity time, Originator node's address, TTL, Hop count, OLSR message sequence number	OLSR control packet reception
		OlsrAddEntry	Destination address, Netmask, Next hop address, Interface address	Addition of an entry to the routing table

		OlsrDelEntry	Destination address, Netmask	Deletion of an entry from the routing table
	Olsrv2	Olsrv2Send	Sequence number, Packet ID	OLSRv2 control packet send
		Olsrv2Recv	Sequence number, Packet ID	OLSRv2 control packet reception
		Olsrv2AddEntry	Destination address, Netmask, Next hop address, Interface address	Addition an entry to the routing table
		Olsrv2DelEntry	Destination address, Netmask	Deletion of an entry from the routing table
MAC Tag name: Mac	AbstractMac	Send	Packet ID	Transmission of a frame
		Drop	Packet ID	Frame Drop
		Recv	Packet ID, Received bytes	Frame reception
	AlohaMac	Dequeue	Packet ID	Dequeue
		Backoff_Start	Backoff time	Start of backoff
		Backoff_End	-	End of backoff
		Rx_Frame	Packet ID, Frame type	Frame reception
		Tx_DATA	Packet ID, Number of retransmissions	Frame send

		Tx_ACK	-	Ack send
		Drop	Packet ID	Frame drop
PHY	AlohaPhy Tag name: Phy	Tx_Start	Packet ID, Transmission power, Transmission rate, Transmission duration	Start of signal send
		Tx_End	-	End of signal send
		Tx_Failed	-	Transmission Failure
		Rx_Start	Packet ID, Reception power	Start of signal receive
		Rx_End	Packet ID , Packet Error (Occurred or not)	End of signal receive
		Noise_Start	Packet ID	Start of noise reception
	AlohaPhy Tag name: PhyInterferenc e	Noise_End	Packet ID	End of noise reception

8. Bibliography

1. *IEEE 802.16m Evaluation Methodology Document (EMD)*, C802.16m-08/004r5, 2009.
10. Traffic Models
2. NIST, *Kernel AODV* [Online]. Available: http://www.antd.nist.gov/wctg/aodv_kernel/
3. NRL, *NRL OLSR* [Online]. Available: <http://cs.itd.nrl.navy.mil/work/olsr/index.php>
4. nuOLSRv2, <http://www2.net.ie.niigata-u.ac.jp/nuOLSRv2/> (August 31, 2012)
5. T. Rappaport, "Wireless Communications, Principles, and Practice"
6. A. Goldsmith, "Wireless Communications," *Cambridge University Press*, 2005.
- 2.6.2 Hata Model
- 2.6.3 COST231 Extension to Hata Model
7. M. Rahnema, "UMTS Network Planning, Optimization, and Inter-Operation with GSM," *John Wiley and Sons Ltd.*, 2009.
- 3.4.2.8 Indoor Pathloss Modeling
8. RECOMMENDATION ITU-R P.1411-5, "Propagation data and prediction methods for the planning of short-range outdoor radiocommunication systems and radio local area networks in the frequency range 300 MHz to 100 GHz, " 2009.
9. Y. Ito, T. Taga, J. Muramatsu, and N. Suzuki, "Prediction of Line-of-Sight Propagation Loss in Inter-Vehicle Communication Environments", Proceedings of the IEICE General Conference, B-1-2 (March 2007). [in Japanese]
10. Y. Ito, and T. Taga, "Prediction of Non-Line-of-Sight Propagation Loss in Inter-Vehicle Communication Environments", Proceedings of the IEICE General Conference, B-1-61 (March 2007). [in Japanese]
11. W.C. Jakes, "Microwave mobile communications," *John Wiley and Sons Ltd.*, 1974.
12. S.-Y. Ni, Y.-C. Tseng, Y.-S. Chen and J.-P. Sheu, "The Broadcast Storm Problem in a Mobile Ad Hoc Network," *Proc. the 5th Annu. ACM/IEEE Int. Conf. on Mobile Computing and Networking*, Seattle, WA, 1999, pp. 151-162.
13. D. Leith, *Internet Draft "draft-leith-tcp-htcp-06"* [Online].
Available: <https://tools.ietf.org/html/draft-leith-tcp-htcp-06>
14. L. S. Brakmo and L. L. Peterson, "TCP Vegas: end to end congestion avoidance on a global internet," *IEEE J. Sel. Areas Commun.*, vol.13, no.8, pp.1465-1480, Oct. 1995.
15. L. Budzisz, R. Stanojevic, R. Shorten and F. Baker, "A strategy for fair coexistence of loss and delay-based congestion control algorithms," *IEEE Commun. Lett.*, vol.13, no.7, pp.555-557, 2009.

16. D. A. Hayes and G. Armitage, "Improved coexistence and loss tolerance for delay based TCP congestion control," *Proc. the 2010 IEEE 35th Conf. on Local Computer Networks*, Denver, CO, 2010, pp. 24-31.
17. D. A. Hayes and G. Armitage, "Revisiting TCP Congestion Control using Delay Gradients," *Proc. the 10th Int. IFIP TC6 Networking Conf. Part II*, Valencia, May 2011, pp. 328-341.
18. NLANR DAST, *Iperf* [Online]. Available: <http://iperf.sourceforge.net/>
19. NTIA/ITS Institute for Telecommunication Sciences, U.S. Department of Commerce, *Irregular Terrain Model (ITM) (Longley-Rice) (20 MHz – 20 GHz)* [Online]. Available: <http://www.its.bldrdoc.gov/resources/radio-propagation-software/itm/itm.aspx>
20. N. Abramson, "The ALOHA System - Another Alternative for Computer Communications," *Proc. the AFIPS '70 Fall Joint Computer Conf.*, Houston, TX, 1970, pp. 281-285.
21. L. G. Roberts, "ALOHA Packet System With and Without Slots and Capture," *ACM SIGCOMM Computer Communications Review*, vol. 5, no. 2, pp. 28-42, April 1975.
22. Japan Automobile Research Institute, Committee Promoting the Use of ITS Simulators, ITS Communication Simulation Evaluation Scenarios, 2012. (In Japanese) Available: http://www.jari.or.jp/Portals/0/resource/pdf/H23_simyu/%EF%BC%88Ver1.2%EF%BC%8920131010.pdf
23. "TGax Channel Models", IEEE 802.11-14/882r4
24. Report ITU-R M.2135-1, (12/2009), Guidelines for evaluation of radio interface technologies for IMT-Advanced

9. Appendix

This product includes software written and developed by Brian Adamson , Joe Macker and William Chao, Justin Dean of the Naval Research Laboratory (NRL).

