

OPNET/Riverbed Modeler: Collecting Simulation Statistics

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Lecture № 5

Outline

- 1 Simulation statistics
- 2 Selecting statistics
- 3 Draw style
- 4 Collection mode
- 5 'Reset' checkbox
- 6 Sample frequency
- 7 Glitch removal

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- **Simulation statistics** – a collection of one or more values that describe a certain aspect of the process behavior during simulation
- OPNET/Riverbed simulation statistics:
 - Output vector (ov)
 - Output scalar (os)
- **Output vector** – a series of values and associated times
- **Output scalar** – typically recorded only once per simulation
 - E.g., the sample mean, last value, time average, variance, and minimum or maximum value of the collected statistic of interest
- Each simulation scenario generates only one *.ov file that contains all vectors that are selected for the run

Simulation Statistics (cont'd)

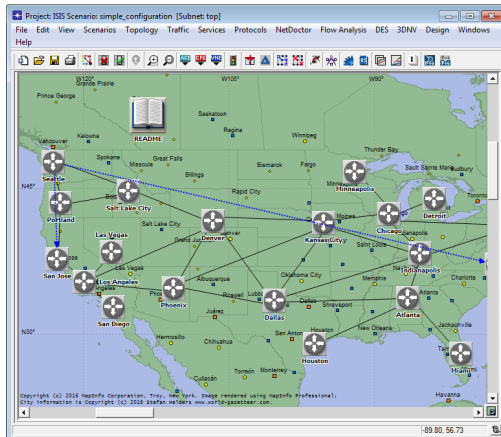
- OPNET/Riverbed statistics available for collection:
 - Object Statistics
 - Global Statistics
- **Object Statistics** – describes the process behavior within a specified object of the simulated system
 - Node Statistics
 - Link Statistics
 - Demand Statistics
- **Global Statistics** – describes the behavior of the particular protocol in the whole simulated system
 - All the objects in the simulation, which are of that specific type, contribute to the total value of the statistics

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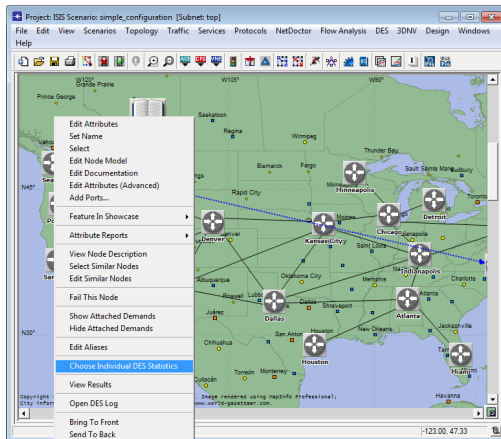
Selecting Statistics

- OPNET/Riverbed provides several methods for selecting statistics:
 - For some network object(s)
 - For all network objects of some type
 - For the whole scenario



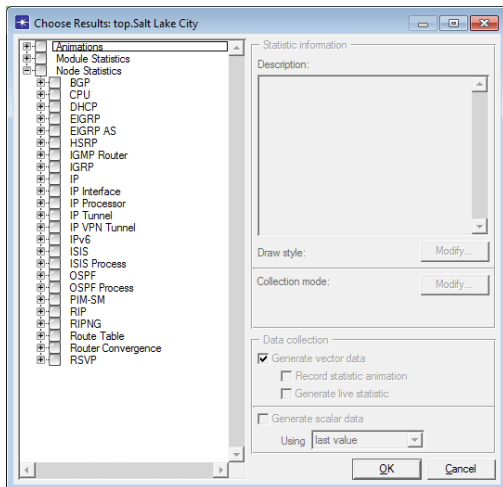
Selecting Statistics (cont'd)

- Right-click on the object of interest (Node/Link/Demand) ⇒ Choose Individual DES Statistics



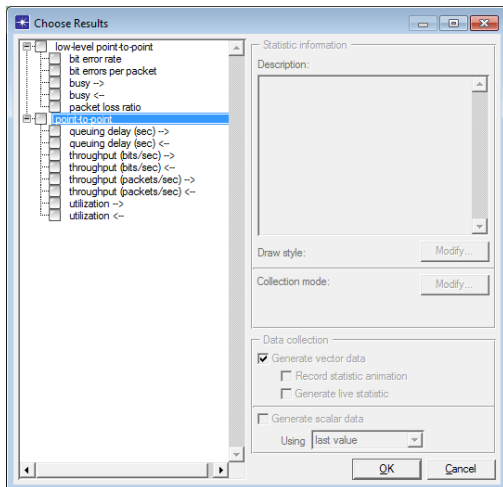
Selecting Statistics (cont'd)

- E.g., right-click on a **node** ⇒ Choose Individual DES Statistics



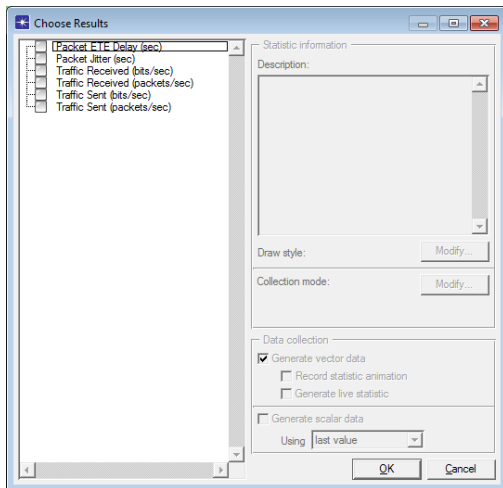
Selecting Statistics (cont'd)

- E.g., right-click on a **link** ⇒ Choose Individual DES Statistics



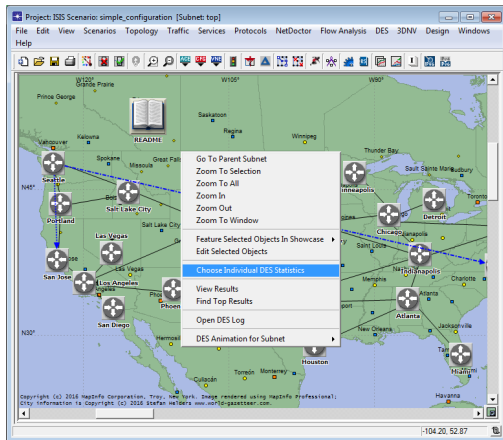
Selecting Statistics (cont'd)

- E.g., right-click on a **demand** ⇒ Choose Individual DES Statistics



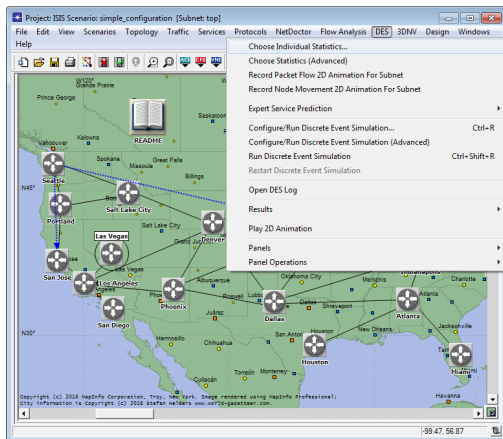
Selecting Statistics (cont'd)

- Right-click anywhere within the workspace \Rightarrow Choose Individual DES Statistics



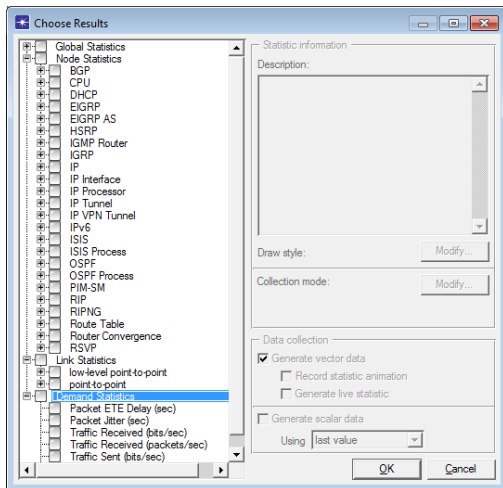
Selecting Statistics (cont'd)

- DES \Rightarrow Choose Individual Statistics...



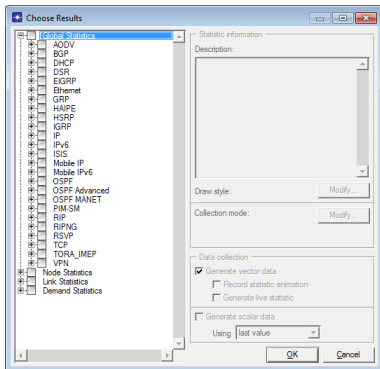
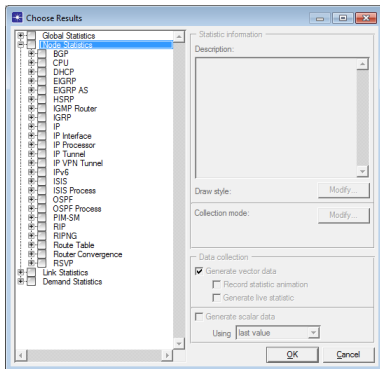
Selecting Statistics (cont'd)

- Selecting statistics for all the objects of a certain type (Node/Link/Demand)



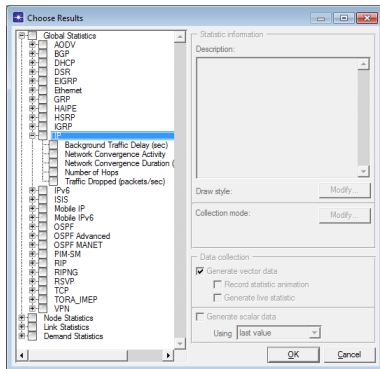
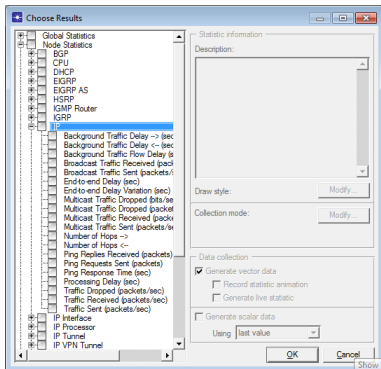
Selecting Statistics (cont'd)

- Node Statistics \neq Global Statistics
 - The number of entries varies from project to project



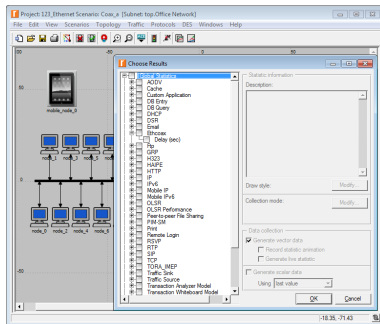
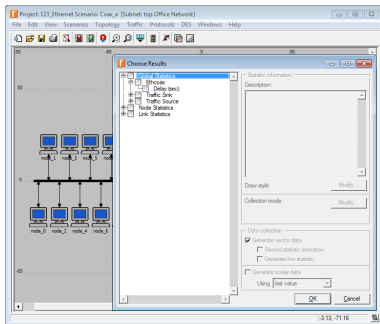
Selecting Statistics (cont'd)

- Node Statistics \neq Global Statistics
 - The number of entries for a given protocol is always the same



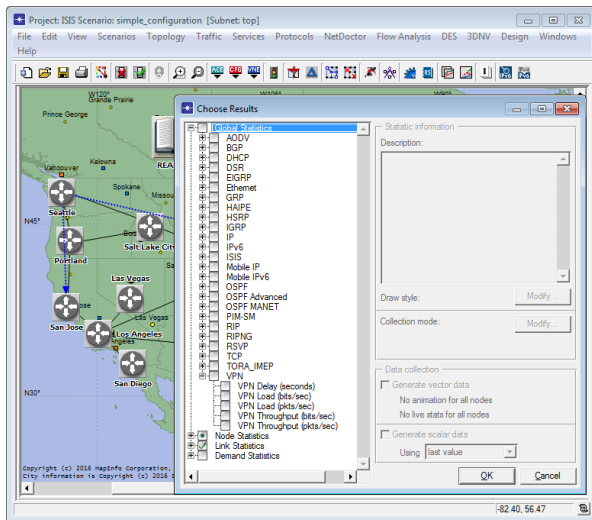
Selecting Statistics (cont'd)

- The contents of the 'Choose Results' window depends on the objects



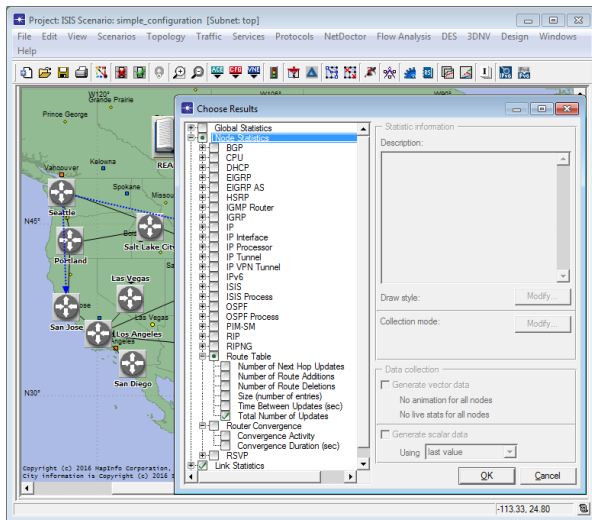
Selecting Statistics (cont'd)

- **Clear** = none of the statistics within the category are selected



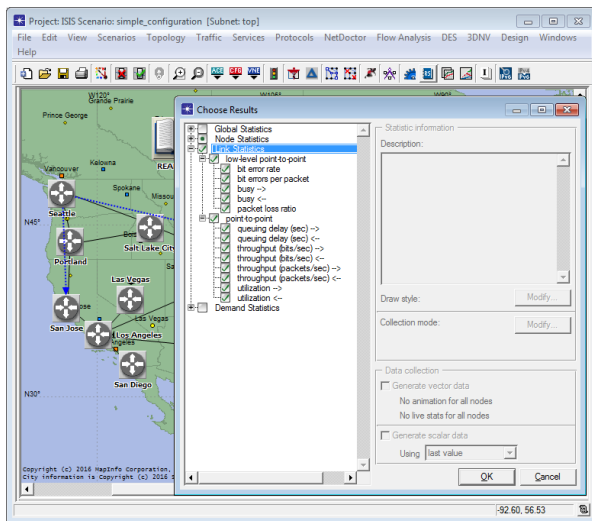
Selecting Statistics (cont'd)

- **Green dot** = some of the statistics within the category are selected



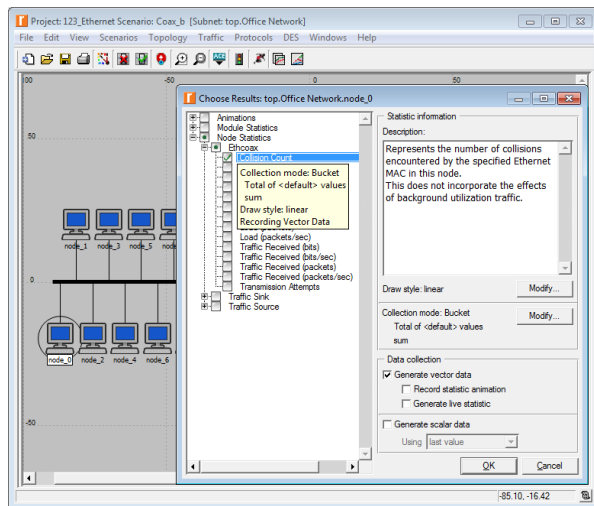
Selecting Statistics (cont'd)

- **Green checkmark** = all the statistics within the category are selected



Selecting Statistics (cont'd)

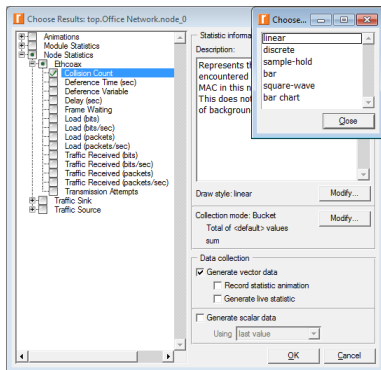
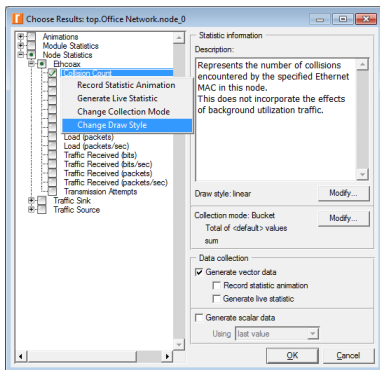
- **Description** – displays a brief description of the selected statistics



Outline

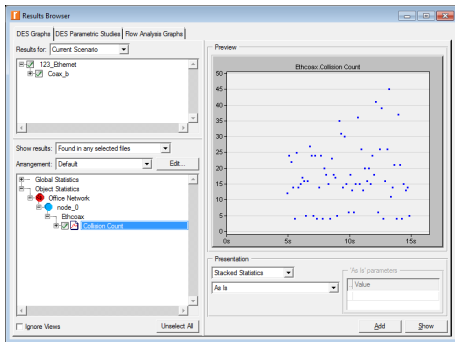
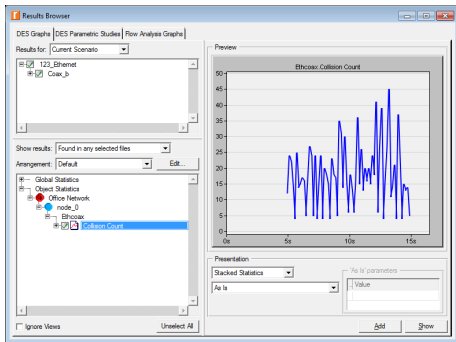
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- **Draw style** – controls how the statistics will be plotted in a graph



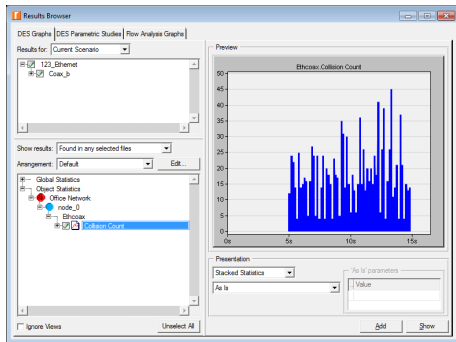
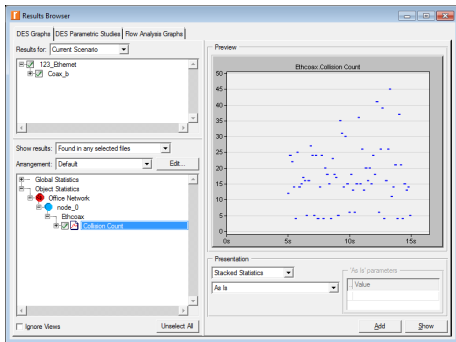
Draw Style (cont'd)

- **linear** vs. **discrete**



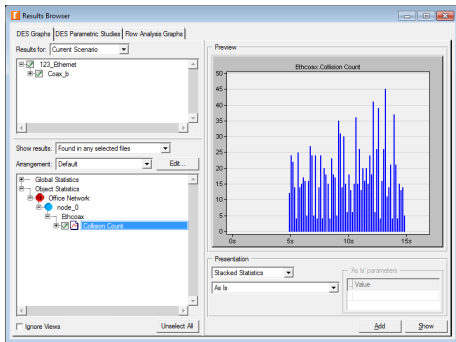
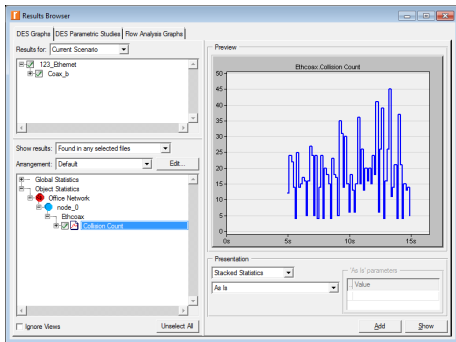
Draw Style (cont'd)

- sample-hold vs. bar



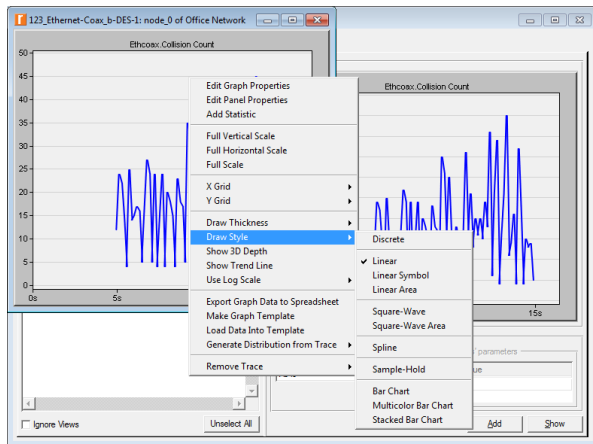
Draw Style (cont'd)

- square-wave vs. bar chart



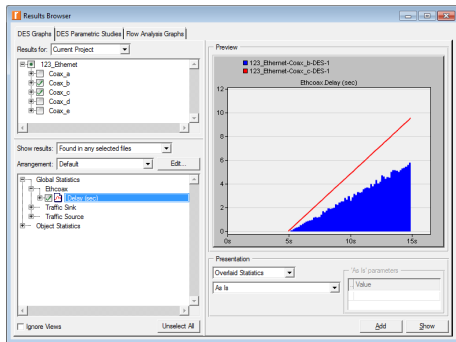
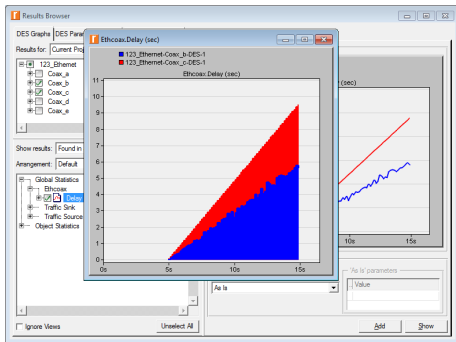
Draw Style (cont'd)

- DES \Rightarrow Results \Rightarrow View Results... \Rightarrow Show \Rightarrow Draw Style
 - **bar = Square-Wave Area**



Draw Style (cont'd)

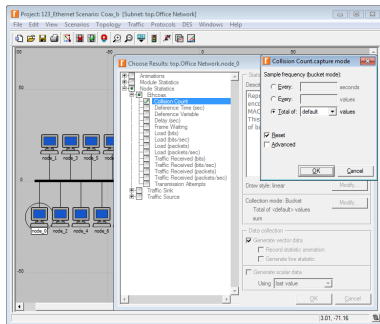
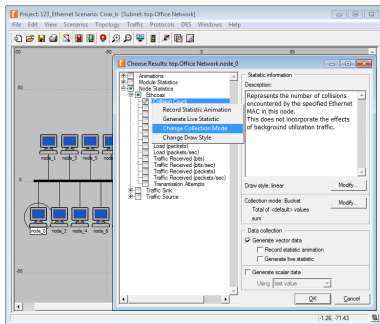
- Compare Results... ⇒ Show ⇒ Draw Style vs. **Change Draw Style**



Outline

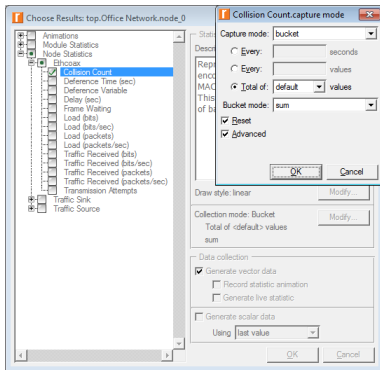
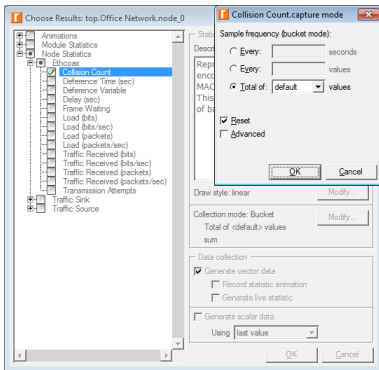
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- Collection mode – controls how the statistics will be collected



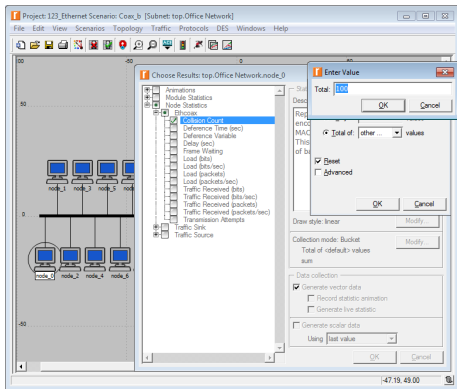
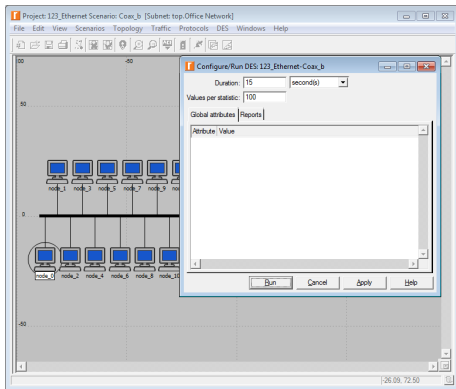
Collection Mode (cont'd)

- **Advanced** checkbox: unchecked vs. checked



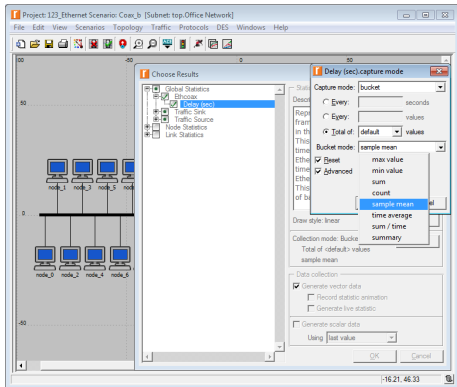
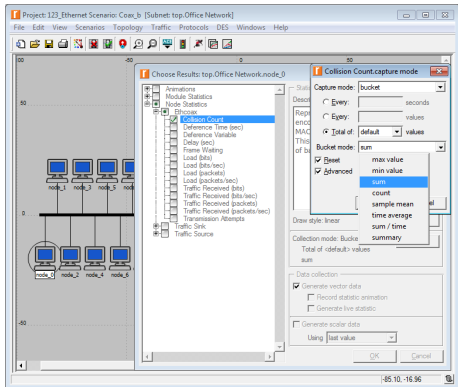
Collection Mode (cont'd)

- **Bucket** – the default collection mode that groups data points that occur within a period called a 'bucket' and then applies a statistical function to each group of values



Collection Mode (cont'd)

- Bucket mode statistical functions

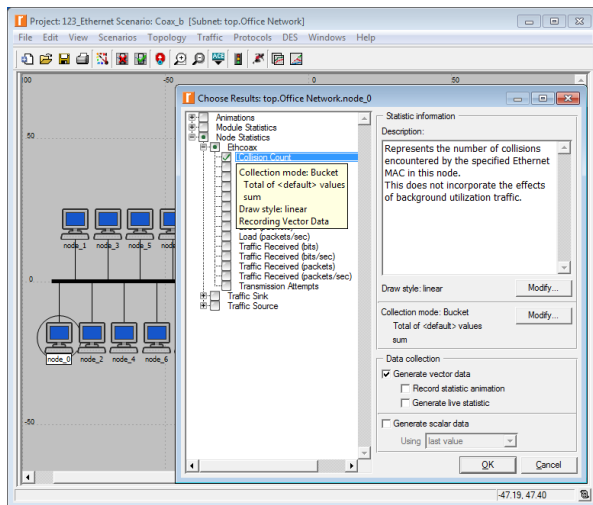


Collection Mode (cont'd)

- **max value** – records the largest value collected within the bucket
- **min value** – records the smallest value collected within the bucket
- **sum** – records the sum of the values collected within the bucket
- **count** – records the total number of data points collected within the bucket
- **sample mean** – records the average of the values collected within the bucket
- **time average** – records the time average of the values collected within the bucket
- **sum / time** – records the sum of all values collected within the bucket divided by the length of the bucket
- **summary** – records the following 5 values for each bucket: sample mean, min value, max value, standard deviation (stddev), and sample count (total number of data points)

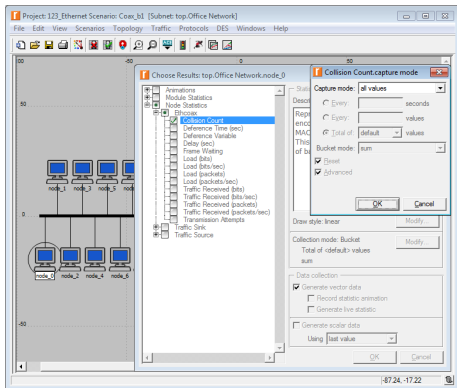
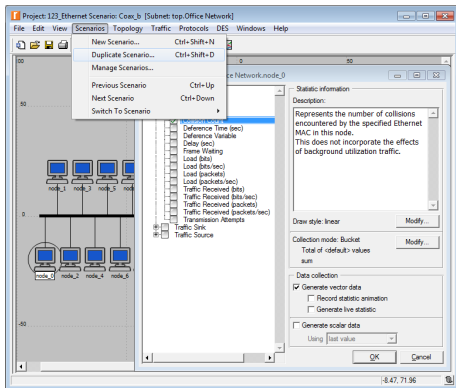
Collection Mode (cont'd)

- 3 methods to collect the same statistics in different collection modes



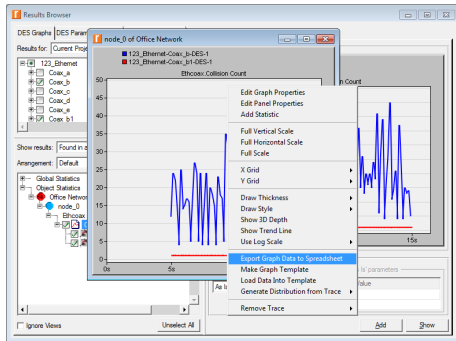
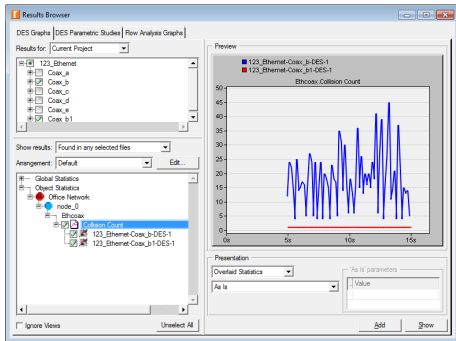
Collection Mode (cont'd)

1 Duplicate Scenario... ⇒ Change Collection Mode ⇒ Run ⇒



Collection Mode (cont'd)

1 ⇒ DES ⇒ Results ⇒ Compare Results...



Collection Mode (cont'd)

1 Bucket (default) vs. All values

123_Ethernet-Coax_b-DES-1_Off_0.txt - Excel

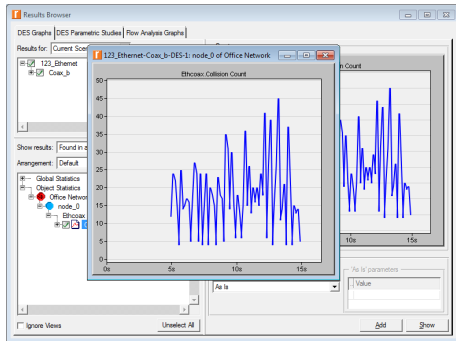
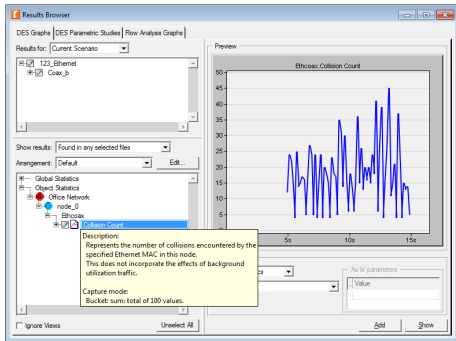
	A	B	C	D	E	F	G	H	I	J
1	time (sec)	123_Ethernet-Coax_b1-DES-1: Office Network_node_0.Ethcoax.Collision Count								
2	0	#N/A	#N/A							
3	0.15	#N/A	#N/A							
4	0.3	#N/A	#N/A							
5	0.45	#N/A	#N/A							
6	0.6	#N/A	#N/A							
7	0.75	#N/A	#N/A							
8	0.9	#N/A	#N/A							
9	1.05	#N/A	#N/A							
10	1.2	#N/A	#N/A							
11	1.35	#N/A	#N/A							
12	1.5	#N/A	#N/A							
13	1.65	#N/A	#N/A							
14	1.8	#N/A	#N/A							
15	1.95	#N/A	#N/A							

123_Ethernet-Coax_b-DES-1_Off_0.txt - Excel

	A	B	C	D	E	F	G	H	I	J
35	4.95	12	#N/A							
36	5	#N/A	1							
37	5.000014	#N/A	1							
38	5.000891	#N/A	1							
39	5.001768	#N/A	1							
40	5.002724	#N/A	1							
41	5.003588	#N/A	1							
42	5.005354	#N/A	1							
43	5.011616	#N/A	1							
44	5.015933	#N/A	1							
45	5.025829	#N/A	1							
46	5.044312	#N/A	1							
47	5.09497	#N/A	1							
48	5.1	24	#N/A							
49	5.133916	#N/A	1							

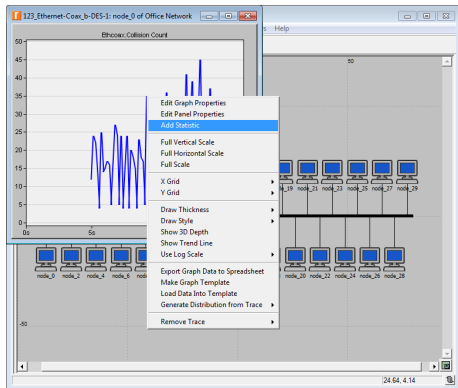
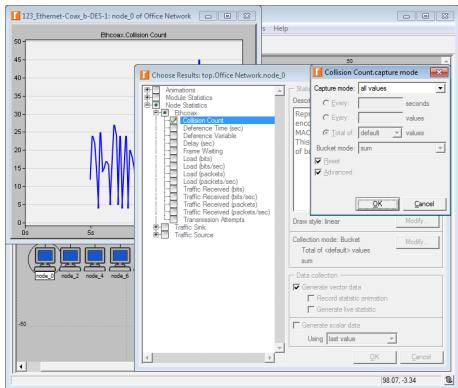
Collection Mode (cont'd)

2 Run ⇒ View Results... ⇒ Show ⇒



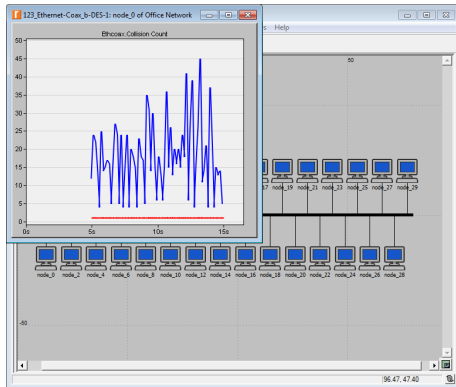
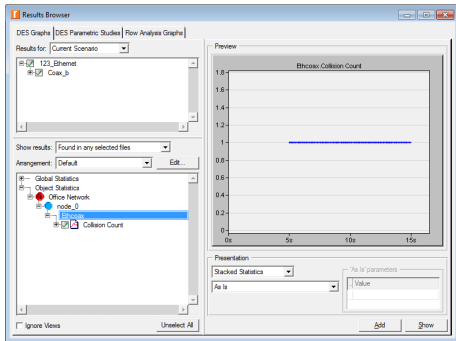
Collection Mode (cont'd)

2 ⇒ Change Collection Mode ⇒ Run ⇒ Add Statistic ⇒ Add



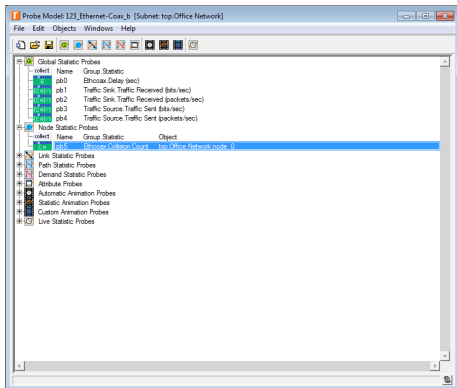
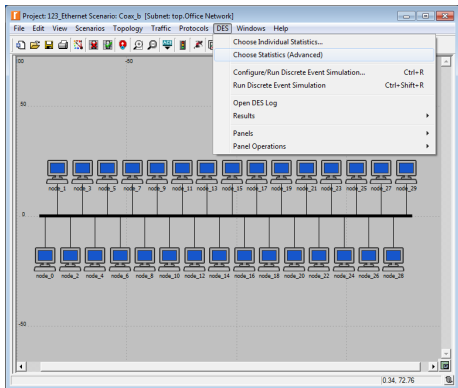
Collection Mode (cont'd)

2 Bucket (default) vs. All values



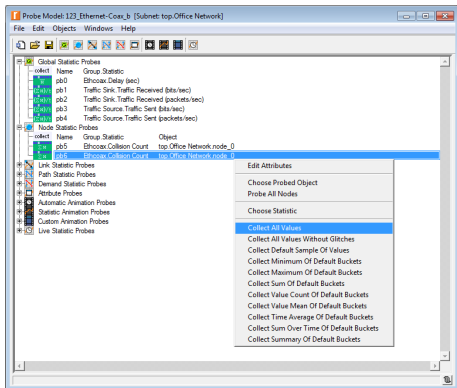
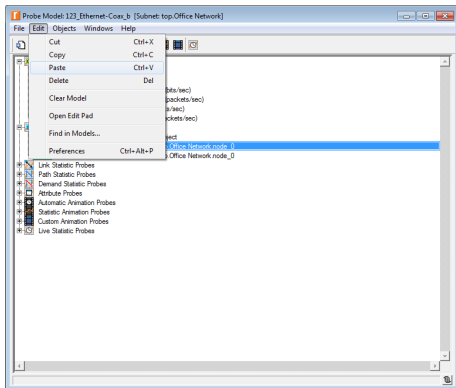
Collection Mode (cont'd)

3 DES ⇒ Choose Statistics (Advanced) ⇒ Select the probe of interest



Collection Mode (cont'd)

3 ⇒ Duplicate the probe of interest ⇒ Collect bla-bla-bla ⇒



Collection Mode (cont'd)

3 ⇒ Edit Attributes ⇒ Set 'tags' to different values for each probe ⇒

Attribute tag

Data type: string

Attribute properties: Private Public

Symbol	Value
1	
2	
3	
4	
5	

Default value: none

Units:

Comments: This attribute specifies a textual tag associated with results collected using this probe, to distinguish them from those collected using a different probe and capture mode.

Allow other values

OK Cancel

Filter

Match: Exact Substring RegEx

Look in: Names Values Possible values Tags

Apply to selected objects

OK Cancel

- threshold comparison disabled
- threshold value 0.0
- threshold percent 90
- tag none
- critical low value disabled
- warning low value disabled
- warning high value disabled
- critical high value disabled

(pb6) Attributes

Attribute	Value
-warn type	warn
-group	EthoCoax
-static	Collision Count
-ordinate label	
-vector data	enabled
-vector start	0.0
-vector stop	infinity
-scalar data	disabled
-scalar type	sample mean
-scalar start	0.0
-scalar stop	infinity
-capture mode	normal
-threshold comparison	disabled
-threshold value	0.0
-threshold percent	90
-tag	5
-critical low value	disabled
-warning low value	disabled
-warning high value	disabled
-critical high value	disabled

Filter

Match: Exact Substring RegEx

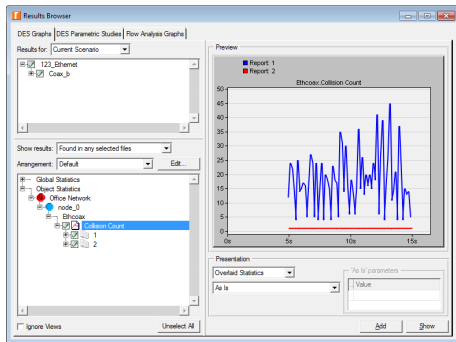
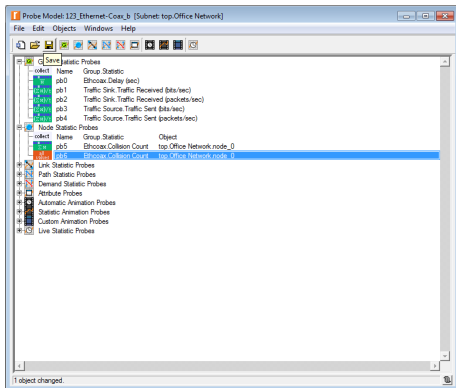
Look in: Names Values Possible values Tags

Apply to selected objects

OK Cancel

Collection Mode (cont'd)

3 ⇒ Save ⇒ Close ⇒ Run ⇒ View Results...

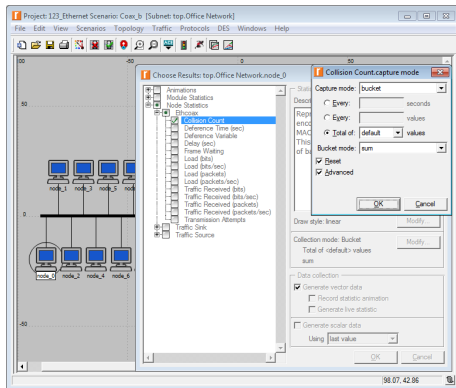
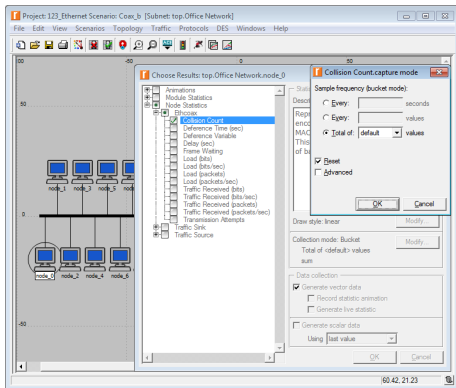


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- 6 Sample frequency
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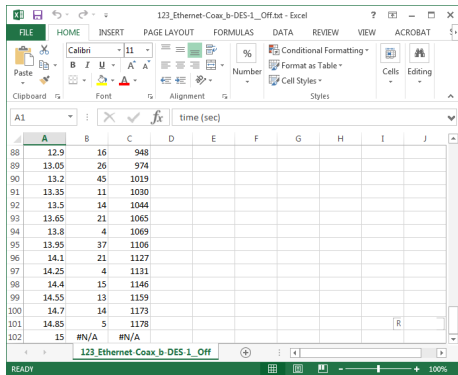
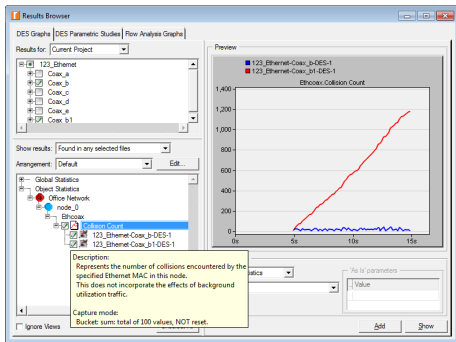
'Reset' Checkbox

- **Reset** – specifies if the bucket value from the previous period is reset to '0' before computation of the next bucket value



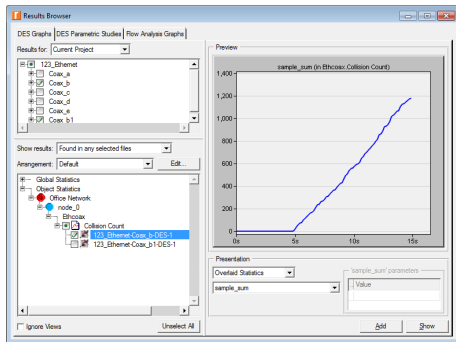
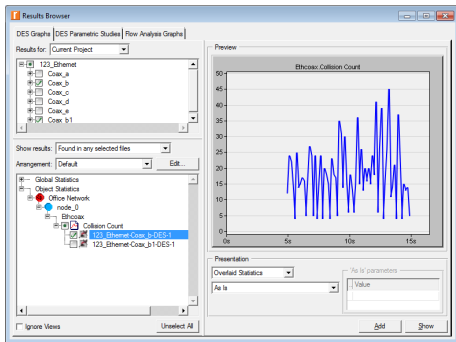
'Reset' Checkbox (cont'd)

- **Reset** checkbox: checked vs. unchecked



'Reset' Checkbox (cont'd)

- Bucket mode (sum): 'Reset' unchecked + As Is = **sample_sum**

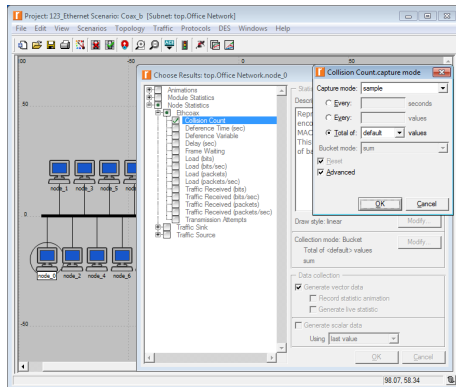
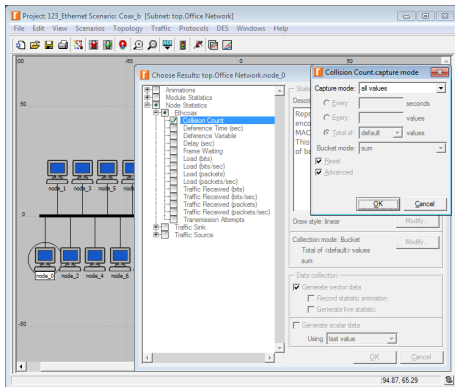


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- 1 Simulation statistics
- 2 Selecting statistics
- 3 Draw style
- 4 Collection mode
- 5 'Reset' checkbox
- 6 Sample frequency**
- 7 Glitch removal

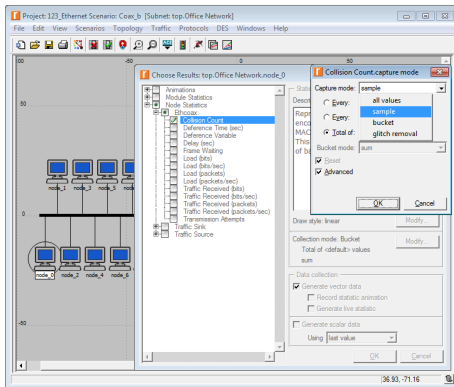
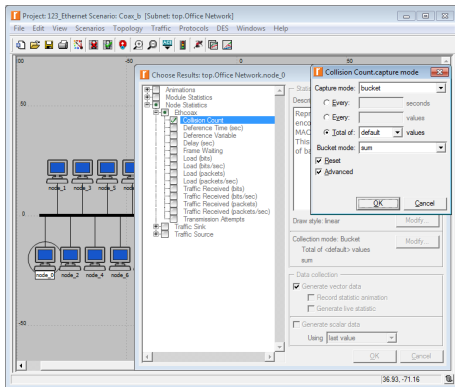
Sample Frequency

- **All values** – collects all data points
- **Sample** – records only certain data points and ignores others



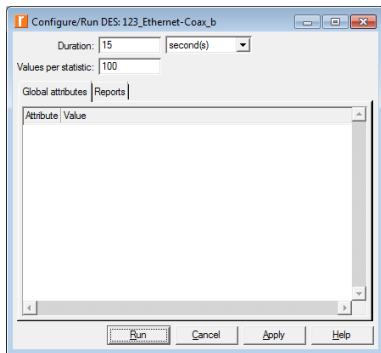
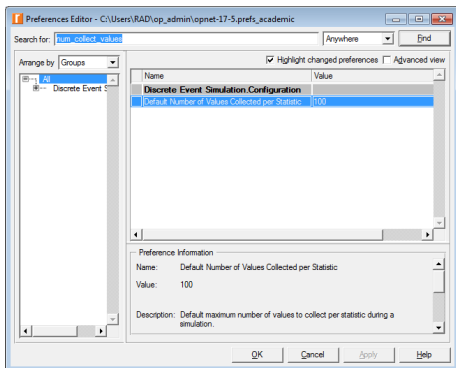
Sample Frequency (cont'd)

- **Every: ... seconds** / **Every: ... values** / **Total of: ... values**
 - Only applicable for the **Bucket** and **Sample** collection modes!



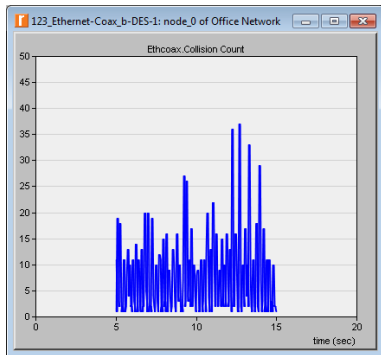
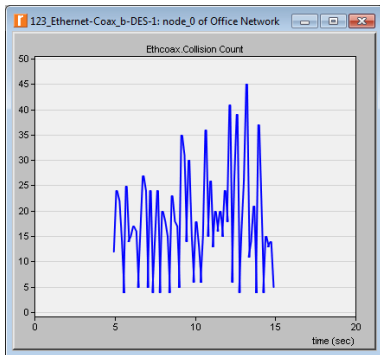
Sample Frequency (cont'd)

- **Every N seconds** = a value will be recorded after every N seconds
- **Every N values** = every N^{th} value will be recorded
- **Total of N values** = a value will be recorded every $\frac{\text{duration}}{N}$ time units



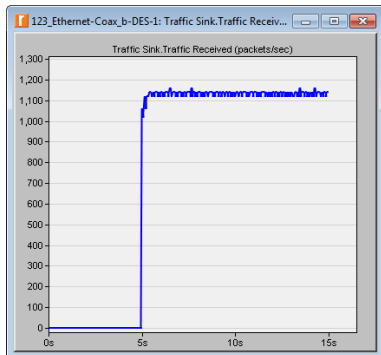
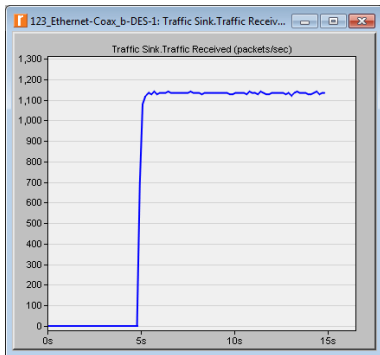
Sample Frequency (cont'd)

- Bucket mode: **Total of 100 values** vs. **Total of 300 values**
 - Collision Count = **sum**



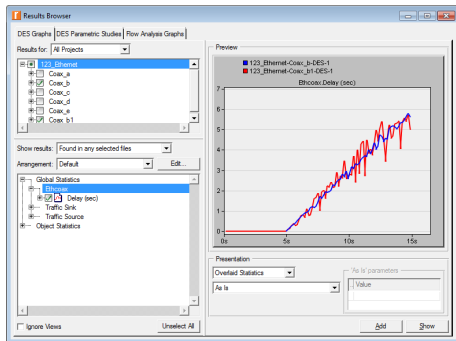
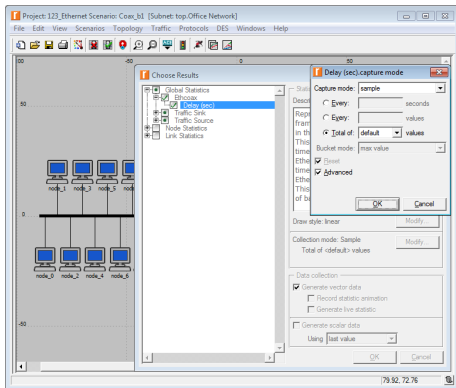
Sample Frequency (cont'd)

- Bucket mode: **Total of 100 values** vs. **Total of 300 values**
 - Traffic Received = **sum/time**



Sample Frequency (cont'd)

- **Bucket (default) vs. Sample (default)**



Sample Frequency (cont'd)

- Sample mode: **Every 0.1 seconds** vs. **Every 10 values**

Project: 123_Ethernet Scenario: Coax_b2 [Subnet: top.Office Network]

File Edit View Scenarios Topology Traffic Protocols DES Windows Help

Choose Results

- Global Statistics
- Ethoax
- Ethernet
- Traffic Sink
- Traffic Source
- Node Statistics
- Link Statistics

Delay (sec) capture mode

Capture mode: sample

Every: 0.1 seconds

Every: values

Total of: values

Bucket mode: max value

Detail

Advanced

Draw style: linear

Collection mode: Sample

Every 0.1 seconds

Data collection

Generate vector data

Record statistic animation

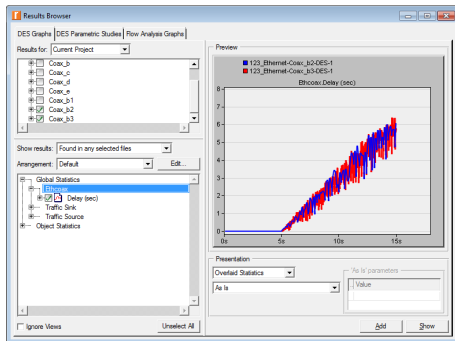
Generate live statistic

Generate scalar data

Using last value

OK Cancel

-1434, 5754

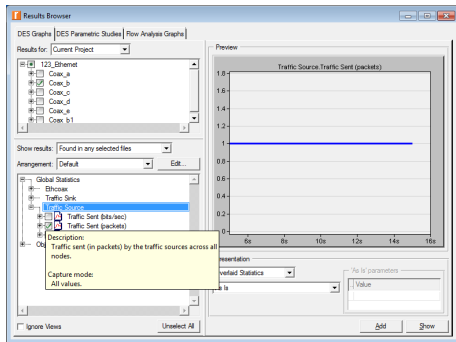
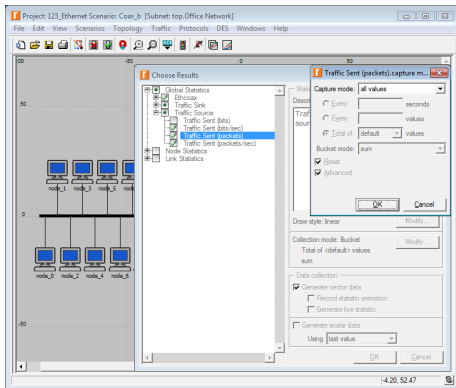


Outline

- 1 Simulation statistics
- 2 Selecting statistics
- 3 Draw style
- 4 Collection mode
- 5 'Reset' checkbox
- 6 Sample frequency
- 7 Glitch removal

Glitch Removal

- **All values** – all data points are recorded without modification



Glitch Removal (cont'd)

- **Glitch removal** – removes all duplicate data points retaining only the last value recorded

Project: 123_Ethernet Scenario: Coax_b1 [Subnet: top.Office Network]

File Edit View Scenarios Topology Traffic Protocols DES Windows Help

Choose Results

- Global Statistics
 - EthoCoax
 - Traffic Sink
 - Traffic Source
 - Traffic Sent (bits)
 - Traffic Sent (bits/sec)
 - Traffic Sent (packets)
 - Traffic Sent (packets/sec)
 - Node Statistics
 - Link Statistics

Traffic Sent (packets).capture m...
Capture mode: glitch removal

Every: _____ seconds
Every: _____ values
Total of: _____ values

Bucket mode: max value

Error
 Advanced

Draw style: Linear Modify
Collection mode: Glitch removal Modify

Data collection:
 Generate vector data
 Record statistic animation
 Generate live statistic
 Generate scalar data
Using: last value

OK Cancel

98.07.49.80

Results Browser

DES Graphs | DES Parametric Studies | Flow Analysis Graphs

Results for: All Projects

- 123_Ethernet
 - Coax_a
 - Coax_b
 - Coax_c
 - Coax_d
 - Coax_e
 - Coax_b1

Show results: Found in any selected files

Arrangement: Default Edit

- Global Statistics
 - EthoCoax
 - Traffic Sink
 - Traffic Source
 - Traffic Sent (bits/sec)
 - Traffic Sent (packets)
 - OK: Traffic sent (in packets) by the traffic sources across all nodes.
Capture mode: glitch removal.

Ignore Views Unselect All

Preview

Traffic Source: Traffic Sent (packets)

1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

0s 5s 10s 15s

Presentation: Stacked Statistics No Y parameters

Add Show

Glitch Removal (cont'd)

- All values (default) vs. Glitch removal (default)

The screenshot shows an Excel spreadsheet with the following data:

time (sec)	123_Ethernet-Coax_b-DES-1: Traffic Source.Traffic Sent (packets)
1	5
2	5
3	5
4	5
5	5
6	5
7	5
8	5
9	5
10	5
11	5
12	5
13	5
14	5
15	5

The first row (A1) contains the value '5' in column B, which is a glitch. The rest of the data is consistent.

The screenshot shows the same Excel spreadsheet as the left one, but with the glitch removed. The data is as follows:

time (sec)	123_Ethernet-Coax_b1-DES-1: Traffic Source.Traffic Sent (packets)
1	0
2	5
3	5
4	5.00122
5	5.001587
6	5.002161
7	5.002692
8	5.002711
9	5.00364
10	5.00408
11	5.005346
12	5.005388
13	5.005455
14	5.00576
15	5.006087

The first row (A1) now contains the value '0' in column B, indicating that the glitch has been removed. The subsequent rows show more precise time values.

Glitch Removal (cont'd)

- All values \approx Glitch removal

