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GMPLS Monitor and Player

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1.1 GMPLS Monitors

In previous GMPLS Monitor in GLASS 1.0, all simulation results are stored in several directory structures. Although the SSFNet recommends the monitoring infrastructure, it is the most effective way to express the simulation result But this way make user be irritated at it. So, we enhance the GMPLS simulation result infrastructure with adapting the measurement infrastructure of SSFNet.

The supported monitors are shown in Table 1.

Table 1 GMPLS Monitor Description

Monitor	Description
LSP Monitor	Measure the statistic information of LSP. The measured parameters are categorized two types: network resource information, time information.
Queue Monitor	Measure the queue. Each LSP has its own queue to perform the traffic shaping and so on. Each queue is observed to support the queue statistic information.
NIC Monitor	Measure the NIC statistical information. _NIC class contains the related attributes. It also measures the fiber and lambda in ONIC.
OAM PM Monitor	Measure the OAM Performance Monitoring result.

All measured data are stored in one file named “resultFile”. It is specified in LSR or OXC graph configuration. The following shows the example to specify the result file.

```
LSRGraph [
        graph [
            ProtocolSession [name S_CRLDP use gov.nist.antd.mpls.signaling.crldp.S_CRLDP
                debug false ]
            ProtocolSession [name MPLSModule use gov.nist.antd.mpls.mgmt.MPLSMgmt
                _find .dictionary.mplsInit
            ]
            ProtocolSession [name te-app use gov.nist.antd.ospf_te.TEPath]
            ProtocolSession [name ospf-te use gov.nist.antd.ospf_te.sOSPF_TE]
            ProtocolSession [name ip use gov.nist.antd.ssf.os.IP]
            ProtocolSession [ name ospf    use SSF.OS.OSPF.sOSPF ]
            ProtocolSession [name probe use SSF.OS.ProbeSession
                file "resultFile"        # output file prefix
                stream result            # stream name
            ]
        ]
    ]
```

In LSR configuration section, the ProbeSession is defined. To see more specification information, look at the Internet Measurement Infrastructure in SSFNet.

1.1.1 LSP Monitor

LSP monitor function support to measure the statistical information of LSP. Two types of data are measured. One is related to LSP resource usage and the other is related to timing information. LSP is measured at different location; at the Ingress, Egress and intermediate node. For example, packet drop caused by traffic policy is measured each LSR except egress LSR. But, the end-to-end delay is measured at Egress LSR. Each LSP can be identified by the LSP ID and node ID. Table 2 shows the LSP monitor parameters and their measured location.

Table 2 LSP Monitor Parameter Description

Measured Parameter	Description	Measured Location
Packet Loss Ratio	Measure Packet loss ratio caused by traffic policy function	Except Egress LSR
Packet Loss Bytes	Measure Packet loss bytes caused by traffic policy function	Except Egress LSR
Utilization	Utilization of LSP. $Utilization = \frac{\text{measured sent traffic in given measurement interval}}{\text{Allocated LSP Bandwidth(PDR/CDR)}}$	Ingress LSR
Average End-to-End Delay	Measure the average end-to-end delay	Egress LSR
Throughput	Measure the throughput of LSP within the given measurement interval	Egress LSR
End-to-End Delay	Measure the end-to-end delay within the given measurement interval	Egress LSR
Jitter	Measure the jitter within the given measurement interval	Egress LSR
Min/Max Delay	Measure the max/min delay within the given measurement interval	Egress LSR

LSP monitor is specified in the MPLS Management section in DML configuration. The following box shows the LSP monitor configuration. In configuration section, we can specify the monitor class(gov.nist.antd.mpls.mgmt.lspMonitor), debug flag and monitoring interval.

```
mplsInit[
   lspMonitor [
      use gov.nist.antd.mpls.mgmt.lspMonitor
      probe_interval 1.0
      debug false
   ]
]
```

1.1.2 Queue Monitor

Queue Monitor supports the measurement of queue in each LSR. When the LSP is established, each LSR configures the queue that handles packet. Through the queue monitor, we can measure several parameters related queue statistic. Table 3 shows the monitored queue parameters

Table 3 Queue Monitor Parameter Description

Measured Parameters	Description
Incoming Packet Count	Measure packet count that enters the specific queue

Incoming Packet Bytes	Measure packet bytes that enter the specific queue
Incoming Packet Bit	Measure packet bits that enter the specific queue
Outgoing Packet Count	Measure packet count that get out of a queue
Outgoing Packet Bytes	Measure packet bytes that get out of a queue
Outgoing Packet Bit	Measure packet bits that get out of a queue
Drop Packet Count	Measure the dropped packet count
Drop Packet Bytes	Measure the dropped packet bytes
Drop Packet Bits	Measure the dropped packet bits
Queue Length (bytes)	The queue length in given measurement interval
Queue Length (bits)	The queue length in given measurement interval. Display it bits size
Average Queue Delay	Average queue delay of enqueued packet

Queue Monitor is specified in queue configuration section of MPLS management configuration section. The following shows the queue monitor configuration. Each queue is identified by node ID, Interface ID that the queue belongs to, LSP ID and queue ID.

```
mplsInit [
   Queue [
        name DropTail use gov.nist.antd.mpls.mgmt.mpls_interface.MPLSDropTailQueue
        BufferSize 30000
        monitor [
           use gov.nist.antd.mpls.mgmt.mpls_interface.QueueMonitor
           probe_interval 1.0
           debug false
        ]
   ]
]
```

1.1.3 NIC Monitor

NIC monitor measures the incoming/outgoing packet in specific NIC. In such case we want to measure the whole incoming and outgoing packet statistical information. It also specified in MPLS Management configuration section. Table 4 shows the monitored parameters.

Table 4 NIC Monitor parameter Description

Measured Parameters	Description
Incoming Packet Count	Measure packet count that enters the specific queue
Incoming Packet Bytes	Measure packet bytes that enter the specific queue
Incoming Packet Bit	Measure packet bits that enter the specific queue
Outgoing Packet Count	Measure packet count that get out of a queue
Outgoing Packet Bytes	Measure packet bytes that get out of a queue
Outgoing Packet Bit	Measure packet bits that get out of a queue

It also defined in MPLS management configuration section. The following shows the definition of NIC monitor in DML.

```
mplsInit [
   Queue [
        name DropTail use gov.nist.antd.mpls.mgmt.mpls_interface.MPLSDropTailQueue
        BufferSize 30000
        monitor [
           use gov.nist.antd.mpls.mgmt.mpls_interface.QueueMonitor
           probe_interval 1.0
           debug false
        ]
   ]
]
```

1.1.4 OAM Performance Monitoring function Monitor

The result OAM Performance monitoring function is stored by this monitor. Through the this monitor, we can measure the several performance-related parameters. Table 5 shows the measured parameters

Table 5 OAM PM monitor parameter Description

Measured Parameters	Description
Bandwidth	Measure the used bandwidth
Packet Delay	Measure data packet delay
Jitter	Measure the data packet jitter
OAM Packet Delay	Represent the OAM packet delay
OAM Packet Loss	Measure the OAM packet loss. To measure the Packet loss we use the sequence number in ShimMessage.
Sent Block Bytes	Measure the sent block bytes at ingress LSR
Sent Block Count	Measure the sent block count at ingress LSR
Received Block Bytes	Measure the received block bytes at egress LSR
Received Block Count	Measure the received block count at egress LSR
Throughput	Measure the throughput.
Utilization	Measure the utilization of LSP

The OAM PM monitor is defined in OAM definition section in DML. The following shows the OAM module configuration.

```
OAMInit [
        RevertiveMode      false
        PerformanceMonitoring [
             active true
             monitor [
                  use gov.nist.antd.mpls.mgmt.OAM.oamPMMonitor
             ]
        ]
        ContinuityCheck false
```

```
        PerformanceDegradationReport [
            EndtoEndDelayLimit 0.15        # End-to-end Delay limit(sec)
            JitterLimit 0.1                # Jitter limit(sec)
            PacketLossRatioLimit 10.0      # Packet loss ratio limit(%)
        ]
    ]
```

1.2 GMPLS Players

All measured statistical data are stored in one file. In order to view the result file, we support the players for four monitors. Each monitor produces the several result based on directory-based architecture. All measured parameters are represented by one file. And each file is located in directory. Figure 1 shows the result produced by the four players

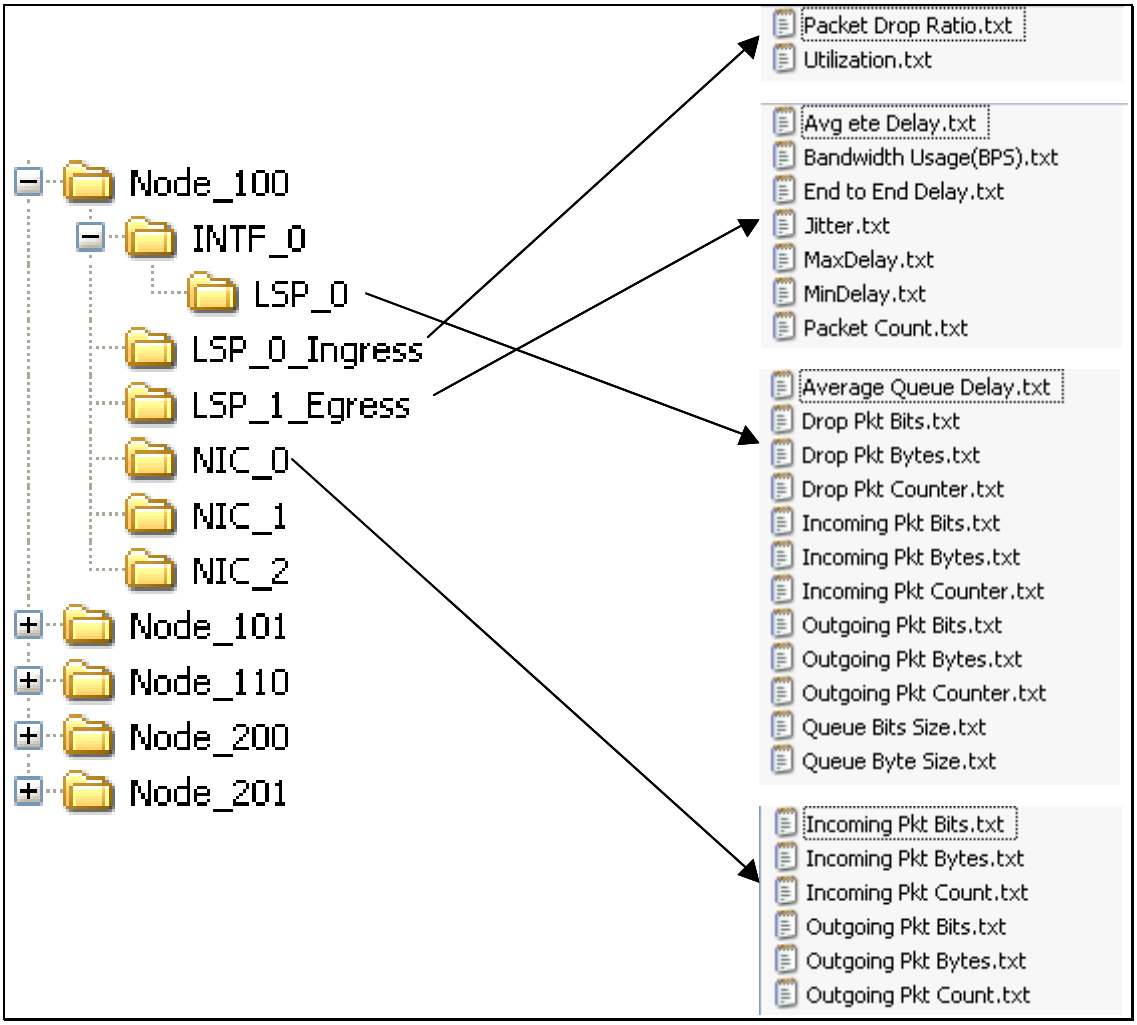

Figure 1 The Directory based monitored result

2. GMPLS Visual Player

The result produced by the player is not convenient to see it in visual way. We have to use other tool such as Excel, Matlab to see the result in visual. In order to see the result in visual way, we support visual tool that show the result visually. The supported tool reads the directories and files that the four monitors produced and shows the directory structure for user to select the considered parameter. User can specify the considered item from the list and select to view the result in graph mode.

2.1 Installation

To install and use the GMPLS plot we add new jar file "**gmplsPlot.jar**" in the lib directory. The location of newly added jar file in the classpath does not matter.

2.2 How to use

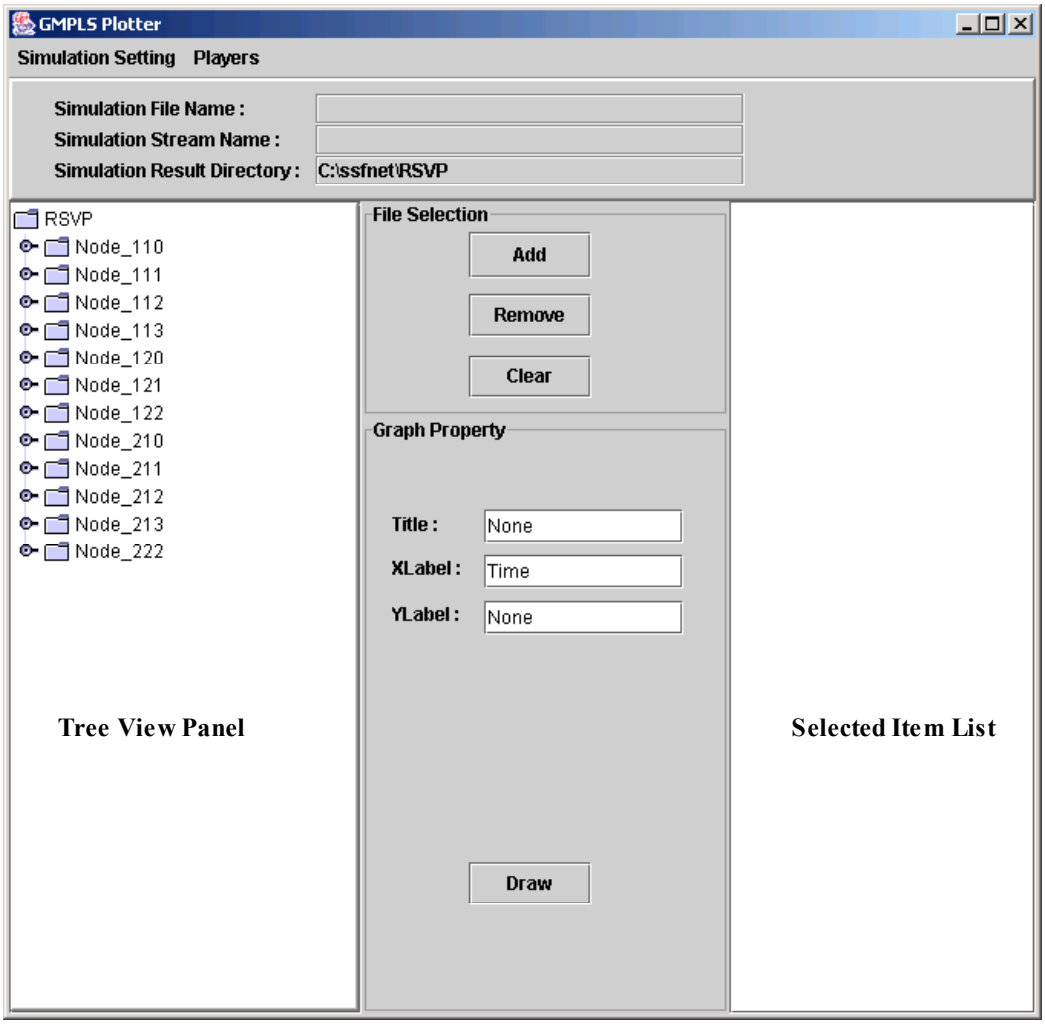

Figure 2 GMPLS Plot

Figure 2 shows the GMPLS plot application.

(1) Simulation Setting Menu – It contains three menu items: Set Sim Files, Set Stream Name, and Set Directory.

(a) Set Sim Files : Specify the simulation resutt file(ex. "resultFile.0")

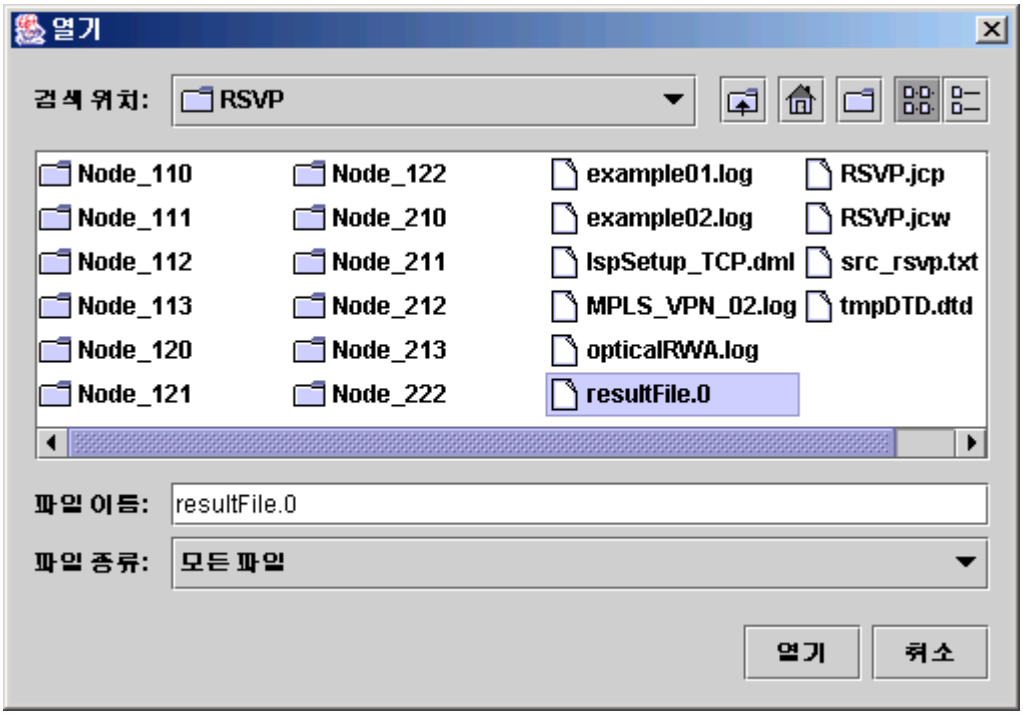

Figure 3 Open ResultFile Dialog

After selection of result file, file name is displayed in the "Simulation File Name" field.

(b) Set Stream Name : Specify the stream name(ex. "result.0")

Figure 4 Stream name Input Dialog

After enter the stream name, the stream name is also display in "Simulation Stream Name" field.

(c) Set Directory : Specify the simulation result directory. Simulation result directory is created by the four players that creates the directory-based result file.

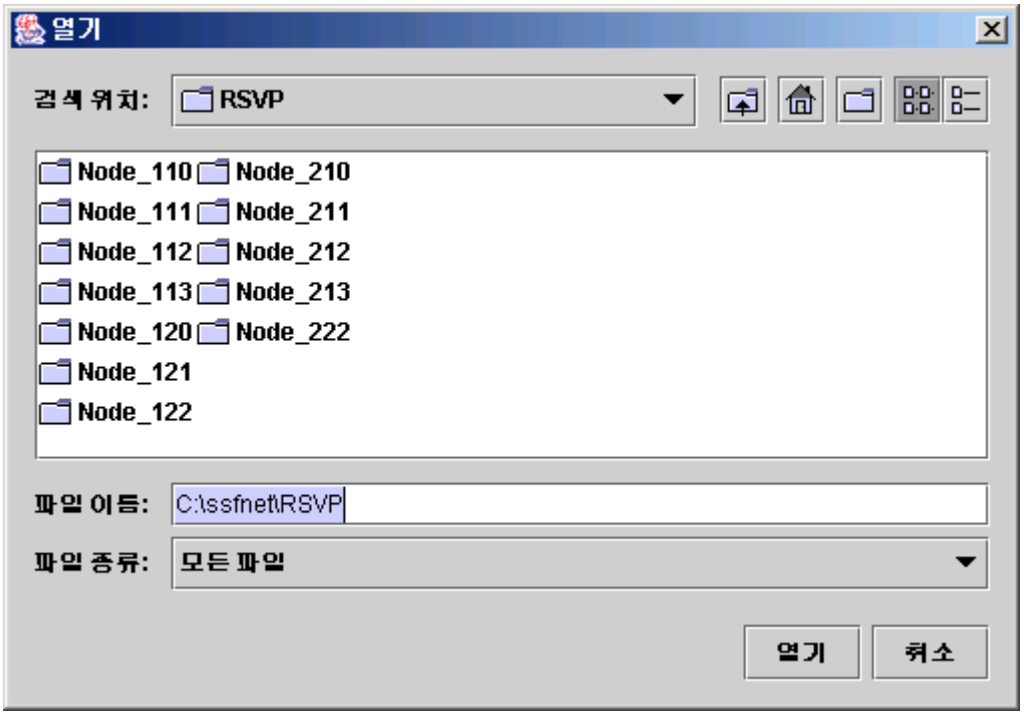

Figure 5 Select Result Directory Dialog

After specify the Simulation result directory, the contents of specific directory will be displayed in tree mode left panel. You can select the considered result.

(2) File Selection Group

In File selection Group you can add, remove clear the selected file list that is displayed left panel.

(a) Add – Add the considered item from the tree-view. You can select several items from the tree-view panel and draw it one graph.

(b) Remove – Remove the considered item from the list on the left.

(c) Clear – Clear the selected list.

(3) Graph property

When drawing with the selected item, you can specify the graph title, xLabel/yLabel caption. When you click the "Draw" button, another input dialog is displayed. If you want to draw several items, you must define the legend of the each items.

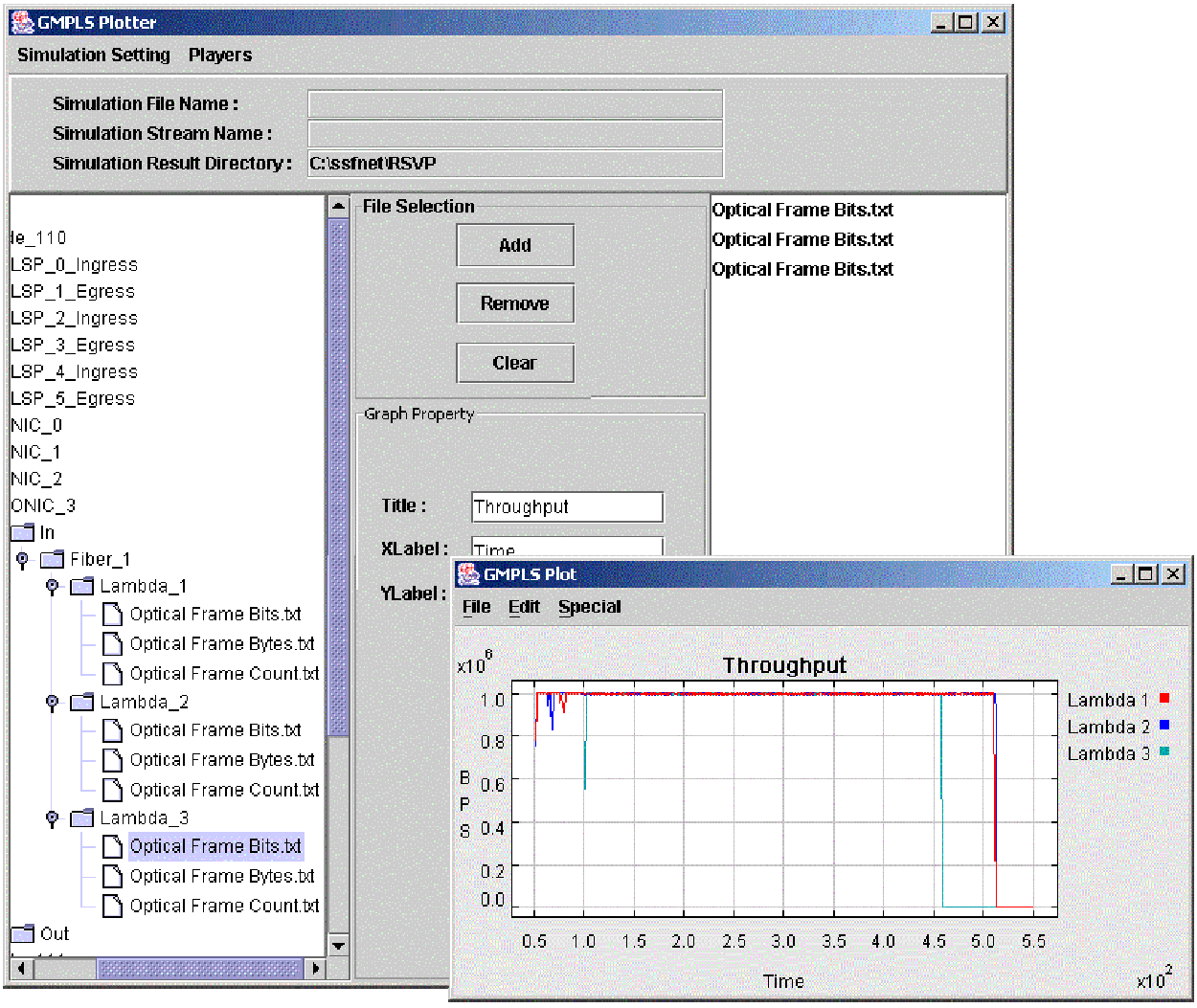

Figure 6 Example of multiple item draw with legend

(4)

2.3