AutoBaseliner™

USER'S MANUAL

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Chapter 1
Introduction

1.1 Overview

COMNET III is a powerful and flexible communication simulation tool that empowers the users to proactively plan network capacity and perform sophisticated "what-if" scenarios. Proactive network management is the key to maintain a competitive edge in today's market.

Today, many managers use Simple Network Management Protocol (SNMP) to monitor the status of the devices on their networks. Many networks also run client/server type of applications which introduces the need to monitor the network at the application-layer. Remote Network Monitoring (RMON) standard put together by the Internet Engineering Task Force (IETF) provides us with a mechanism to do just that. With the introduction of the RMON 2 specification, managers can now collect network status information beyond their local area networks (LANs). Hence, giving you access to new types of data about your network.

COMNET III allows you to utilize data gathered from all these different resources and empowers you to proactively plan and manage your network (figure 1.1). COMNET III, with its AutoBaseliner tool, can automate the task of building an accurate baseline model of your network. Once the baseline model is in the COMNET III environment, you can simulate, identify problems on your network and try out multiple "what-if" scenarios before implementing them.

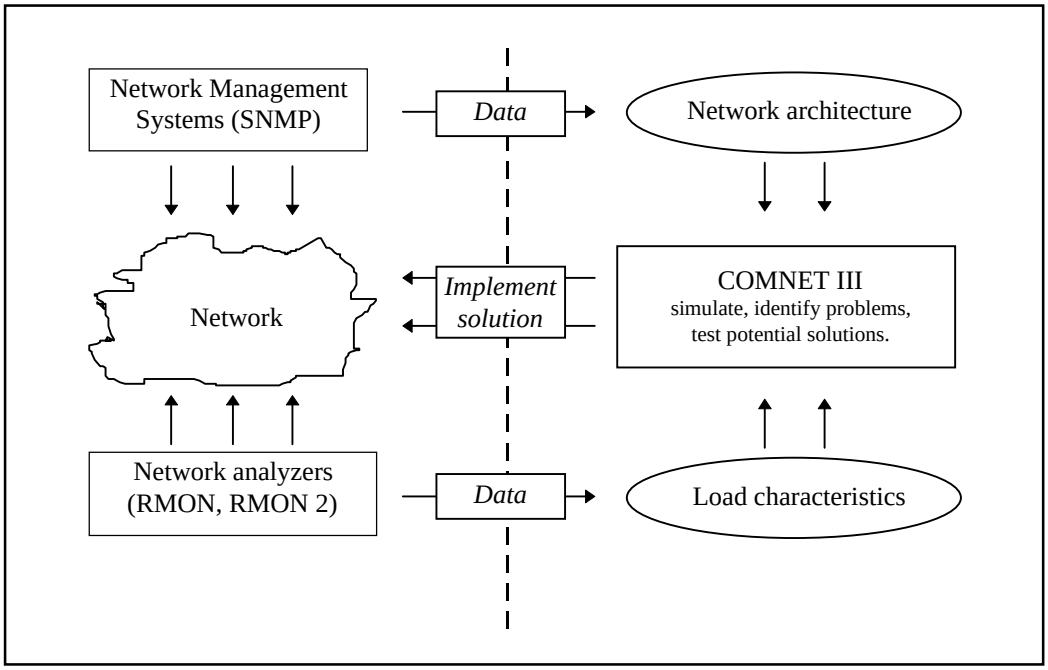

Figure 1.1: Proactive network management

1.2 The System Architecture

AutoBaseliner helps you build a baseline model of your network by transforming data collected from a variety of network management and monitoring tools, into COMNET III model information. The model building process in COMNET III, see figure 1.2, can be split into two phases:

(a) building a network architecture model and,

(b) building a network load profile for the resulting model network.

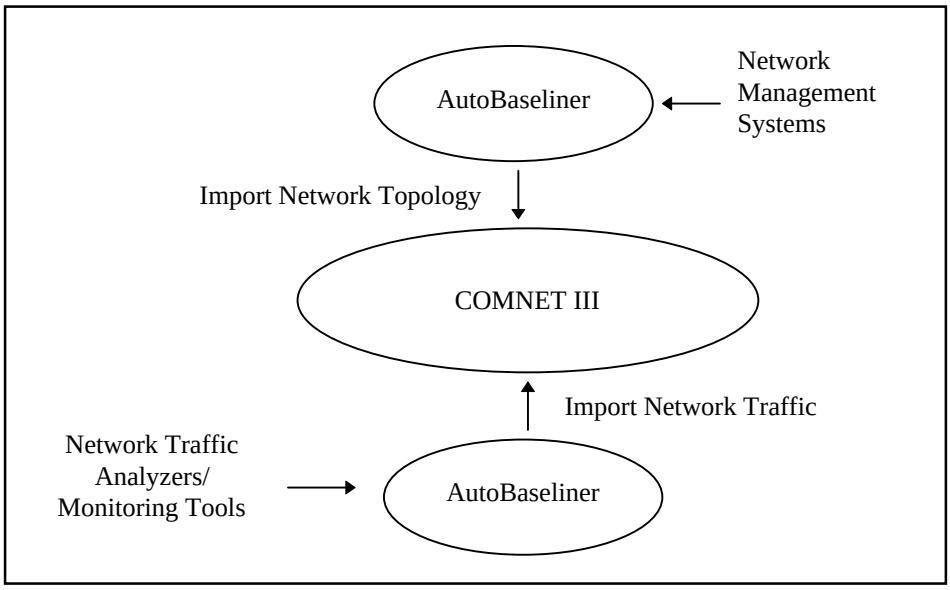

Figure 1.2: AutoBaseliner and its role within the COMNET III frame-work

1.3 Network Architecture

The first step of building a COMNET III simulation model is to construct a topology of the network under study. AutoBaseliner helps you build an accurate representation of your network architecture, by using the data captured by your existing network management tools. Currently supported Network Management Systems (NMS) include HP OpenView, Cabletron SPECTRUM, IBM NetView/6000 and Digital PolyCenter. It also provides an interface to basic SNMP tools such as Castlerock's SNMPc. AutoBaseliner extracts node and link information from the data, in the topology file, to automatically generate a COMNET III model file. Based on the data available, AutoBaseliner can identify different types of links, i.e. Ethernet, Token Ring, FDDI Ring or Point-to-Point (WAN) link. The import process may be tailored to suit your need in the advanced user mode. The node and link parameters, once in the COMNET environment, can be modified as needed.

1.4 Network Load Characterization

To represent your network further, AutoBaseliner also allows you to add "real" traffic to your network architecture model. This is achieved by transforming traffic captured by network analyzers or network monitoring tools into load characteristics for COMNET III. COMNET III provides interface to external traffic collected at various levels of detail. At the highest level, traffic data may be collected at the application-layer level containing data such as packet counts and bytes counts. Or it may be collected at the frame-level detail, containing information on individual packets.

With conversation pair traffic, representing the highest level of detail, the import process uses the interrupted poisson process for characterizing the traffic flow. In the scenario, where the import process does not have enough data available, it will use the default poisson process for characterizing the traffic. On the other end of the spectrum, such as event trace traffic, the events recorded in the data file govern the traffic flow during simulation. The type of problem under study would determine what kind of data to import. External traffic can include traffic from multiple sources being sent over multiple segments.

External traffic may be mixed with internal traffic within the model. Within the simulation, external traffic behaves similar to internal traffic. This is particularly useful for trying out multiple "what-if" scenarios.

1.5 Chapters Ahead

Chapter 2 describes the topology import process for generating a basic template of your network architecture model. The load characterization process is covered in Chapter 3, describing interface to different types of traffic data, the traffic profile definition process and the name matching process. Refer to the Appendices for information on how to capture or configure some of the network monitoring tools so that the data required for the import process is collected properly.

Chapter 2
Importing Network Topology

2.1 Introduction

In this chapter, we outline the topology import process for building a baseline model of your network architecture. The import process allows you to leverage on the topology data collected by SNMP based tools for network management. For small to medium scale networks, SNMP tools such as Castlerock's SNMPc is sufficient to manage the network. For larger networks, many utilize Network Management Systems such as HP OpenView, IBM NetView/6000 and Cabletron SPECTRUM. The import process extracts relevant information from the topology files to help you build an accurate model of your network architecture.

The topology import process can be used in two modes, default and advanced user. In the default mode, the import process transforms all the data stored within the topology file into COMNET III model information. This option is suitable to get the entire network topology at once to get the feel of the problem under study. However, in many cases, the specific problem under study would be constrained to some specific segments rather than the entire network infrastructure. The advanced user mode allows you to configure the import process parameters to suit your specific needs. The COMNET III model information generated in this mode reflects the user defined options such as, selective segment and/or node import. Once the topology file has been scanned for potential nodes and link segments, the topology import process will automatically generate and load the resulting network architecture model. The nodes and link segments identified, will be placed on the COMNET III canvas. The configuration of the nodes and links are set to default and may be customized in the COMNET III environment as needed.

2.2 Topology Import "walk-through"

The basic steps in creating a COMNET III model file (.c3) include:

- Export network topology (*.top,*.csv,*.ndb) file
- Import topology file
- Advanced user mode

2.3 Exporting Network Topology file

The network topology file is a text file representing your network. This file has to be exported from your NMS tool. The exact procedure to export the file depends on the NMS tool used at your site. Please refer to the appropriate section below for further details on how to capture and save network topologies from your particular NMS tool (also see Appendix C for an integrated interface).

2.3.1 Interfacing with NMS Tools

The steps described below, for exporting topology information from your existing NMS tool, are to be used as guidelines only. Different versions of the software might behave differently.

2.3.2 HP OpenView

To export the network topology from HP OpenView, type at the command line :

```
ovtopodump -l -r > topofile.top
```

where, the filename (topofile.top) may be replaced by any name of your choice. This command can be used even when HP OpenView is not running. This command does **not** work with HP OpenView for Windows.

2.3.3 Cabletron SPECTRUM

In order to export the network topology from Cabletron SPECTRUM, the topology command has to be installed within SPECTRUM. The format of the file which is installed is a tar file. This file can be expanded using the Extensions Tool-kit provided as part of the core SPECTRUM installation. If the core SPECTRUM is not present, the product will not be installed.

2.3.3.1 Where to find the tar file ?

The `Spectrum.tar` file is typically sent out with the COMNET III installation tapes. If for any reason, it is not included, then you may download the particular file from our ftp site: `ftp.caciasl.com`. You can login as an `anonymous` user (user_id) with your `e-mail_address` as the password. The `Spectrum.tar` file can be found under the following directory :

```
/pub/comnet/AutoBaseliner/topology/NMS/Spectrum/
```

2.3.3.2 Using SpectroINSTALL

Move the tar file (i.e. `topex1.0.tar`) from the COMNET III area to the top level of the SPECTRUM area. The file has to be installed using SpectroINSTALL. In order to invoke SpectroINSTALL, perform the following steps:

- Become root
- Type the following line at the command prompt:
  INSDK/Install.quick
- This will invoke SpectroINSTALL
- From here the SPECTRUM Installation Procedures can be followed, with one exception. **Note:** The only component that should be selected for installation is `topex1.0`(i.e. Topology Export).
- Exit root

This procedure would have added menu options within SPECTRUM. Select the command Export Topology, to capture the topological information of your network. For further details, please review the `README` file associated with `Spectrum.tar`.

2.3.4 IBM NetView/6000

The topology export commands for the IBM NetView/6000 are same as HP OpenView instructions described earlier. The same command line for topology capture is used.

2.3.5 Digital PolyCenter

The topology export commands for the Digital PolyCenter are same as HP OpenView instructions described earlier. The same command line for topology capture is used.

2.3.6 Castlerock SNMPc

You can directly use the file saved by the SNMPc tool which by default has an extension (*.ndb).

2.4 Topology Import Process

Invoke COMNET III, and select the menu option `File/Import/Network Topology`…. This will begin the topology import process, by displaying the Import Topology dialog (Figure 2.1).

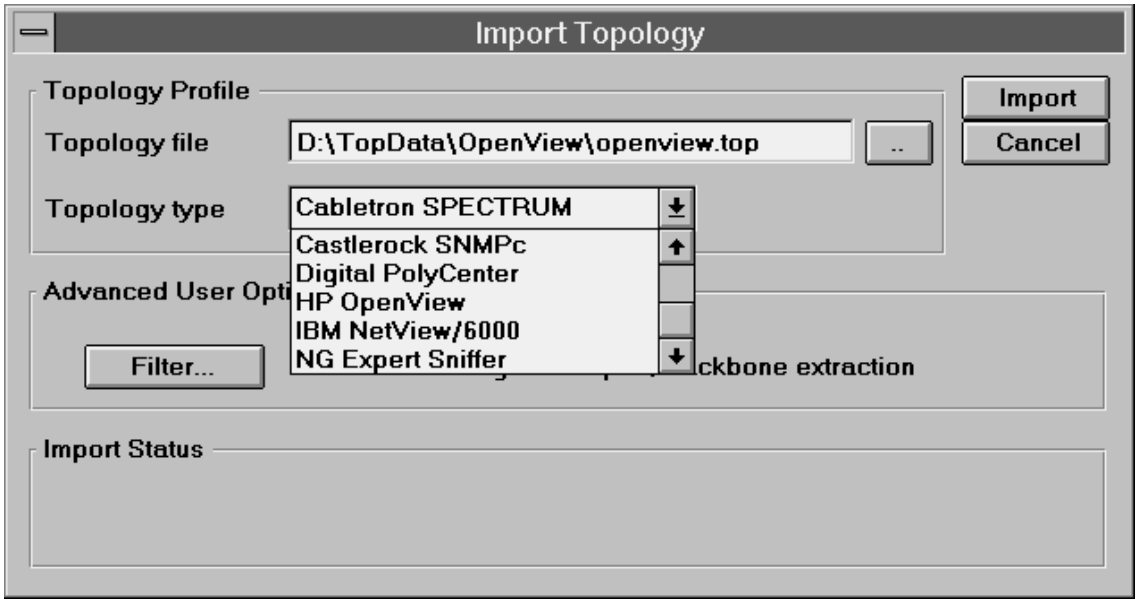

Figure 2.1 : Import Topology Dialog Form

2.4.1 Default Mode

- Select the appropriate `Topology type` specifying the NMS tool used to capture the topology file.

- Click on the file detail button `[..]`, to select the topology file captured in the previous section.
- Click on the `IMPORT` button.

The import status will display the number of link segments and network nodes found in the file. Once the file has been read completely, the resulting network topology will be placed on the COMNET III canvas. You can now interact with the topology elements as you would under the COMNET III environment.

2.4.2 Advanced User Mode

With large networks, the number of events generated would effect the speed performance of the simulation. While one can import a network of 1,000 link segments and 10,000 nodes, it would be too large to study the model effectively. Study of a model for a backbone might be a more practicable solution.

Hint: Select only the segments of your networks which are relevant for your study. The topology import process can be configured utilizing any one or all of the filtering options.

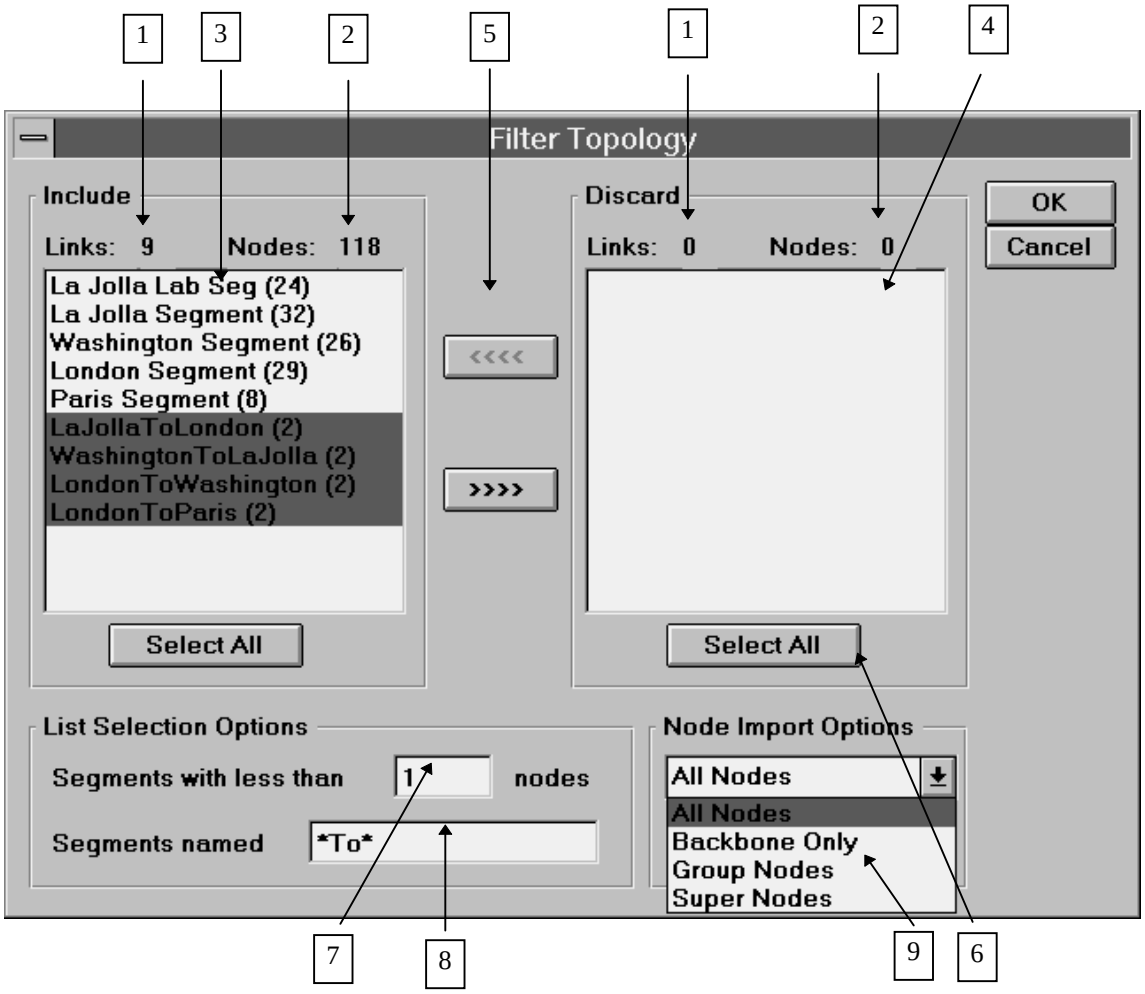

Figure 2.2 : Import Topology Filter Dialog Form

The first two steps of the advanced user mode are same as the default mode operation described above, i.e. choose the NMS tool utilized and select the resulting data file. The advanced user mode is invoked by selecting the `Filter...` button on the import dialog form. The topology file is scanned for nodes and links with the import status reflecting the number of elements found. The current status of the import process will be displayed on the Filter dialog form as shown in Figure 2.2. The basic principle is quite simple: the `Include List` contains all the candidate link segments for the Topology Import process; whereas, the `Discard List` contains all the segments which will be filtered out during the Import process.

Legend:

1. Number of link segments in the `Include List` (or `Discard List`).
2. Number of nodes which are attached to the link segments in the `Include List` (or `Discard List`).
3. The `Include List` shows all the link segments which are currently candidates for the import process. The number in the parenthesis show the number nodes attached to each segment.
4. The `Discard List` shows all the link segments which will be filtered out during the import process.
5. These two buttons, `[<<<<]` and `[>>>>]`, allow you to move selected link segments from one list to another. The appropriate button will become active when link segments are selected from the list.
6. The `Select All` option selects all the links in the particular list. To de-select the link segments, select one of the link segments in the list. To select multiple link segments, hold the `CTRL` key down while selecting different link segments using the mouse pointer. To select consecutive link segments in the list, hold the `SHIFT` key down.
7. This allows list selection based on the number of network nodes attached to a particular link segment. This value box allows you to select all the link segments which have nodes less than or equal to the value specified. This will select link segments in both lists. This is useful when you are only interested in heavily loaded segments only or vice-versa. **Note:** the link segments will only be selected once the `Return` (or `Enter`) key is detected. The list selection is applied to both the `Include List` and `Discard List`.
8. This allows list selection using a wild-card. This is useful for selecting all the link segments starting with a particular name, for example, selecting all link segments beginning with IP address 128.127.*. The allowed wild-card is the character `'*'`, which be may be used as pre-fix, post-fix or both. For example, "LaJolla*" filter option will select all the link segment names beginning with "LaJolla", where as

"*To*" will select all the link names containing the character "To". The list selection is applied to both the `Include List` and `Discard List`.

9. Node Import Options, by default is set to `All Nodes`. In many scenarios, the study of the network might only be related to the backbone architecture or the level of node detail might not be necessary. This import feature allows you to control how the nodes attached to the segment are represented in the resulting model.
    - `All Nodes`: On by default, this would import all the nodes attached to the segment.
    - `Backbone Only`: This option would import all the routers and segments attached to them.
    - `Group Nodes`: This option would import all the nodes attached to segment, however, they will all be represented as a single group node. The name of the group node shows how many nodes it represents. This option would be ideal for reducing the cluttering of the display for large networks while preserving the total number of nodes in the network. This would also assume that the nodes connected to the segments all behave similarly, hence we can collapse into a group node.
    - `Super Nodes`: This option is to be used for large enterprise-wide networks, where the nodes attached to the segment are collapsed into a single node, called the Super Node. This option is typically useful in a scenario where the individual conversations within the local segment is not important, but, the emphasis is on the inter-communication between various segments. Hence, all the traffic flow from one segment to other may be abstracted such that it happens between two such Super Nodes.

Once the topology import process is completed, the resulting file will be stored, by default, as `Traflink.c3` model file. You will be prompted to save the resulting file under whatever name you like.

The network architecture model created is based on the data inferred from the topology file. You might want to cross-check the model to see whether the topology reflects your existing network. As a "rule-of-thumb", all nodes which were part of multiple segments will be identified as **probable** routers. This might not be true under all circumstances, thus make the necessary modifications as required. In certain situations, the data exported by your NMS tool might contain multiple flags for the type of link segment(s). This would be another area where you should cross-check whether the type of link segment represented on the model reflects your "real" segment. Sometimes, it is not possible to find out the exact connectivity between segments, you might have to manually add additional point-to-point link(s) as necessary.

Chapter 3
Importing Network Traffic

3.1 Introduction

Once you have built a network architecture model, see Chapter two, the next step would be to define the load characteristics of your network. There are two ways of defining traffic within your network architecture: internal or external traffic. Internal traffic can be generated using the COMNET III traffic generators. COMNET III also allows you to import external traffic which are defined via a traffic data file. COMNET III has an interface to import traffic data from a variety of network analyzers and/or RMON monitoring tools. In this chapter, we outline how to import external traffic data, representing your "real" traffic, into COMNET III for building a baseline model of your network load. The import process transforms the data captured into traffic model information to represent the data flow within your network architecture. For networks spanning multiple segments, the import process allows you to merge multiple traffic data files collected over different segments, into a single traffic model file. Once the external traffic model is loaded, you may mix it with internal COMNET III traffic sources for "what-if" scenarios.

3.2 Traffic Import "walk-through"

The basic steps in creating a COMNET III baseline model include:

- Decide what type of traffic data to collect, conversation pair statistics or event trace traffic.
- Capture a network traffic file(s).
- Build a topology model using COMNET III (perhaps using Import Topology).
- Invoke the corresponding Traffic Import Process.
    - Select a traffic file, (.prn) or (.csv), captured using network analyzer tools such as Network General's SNIFFER, Hewlett-Packard's NetMetrix, Wandel & Goltermann's Domino Analyzer or RMON tools such as AXON Network's LANServant, Frontier's NETscout.
    - Define traffic file profile.
    - Match external names with model names.
- Create the external traffic model file for use by the simulation.

3.3 What type of traffic to collect ?

COMNET III provides interface to two different types of network load characteristics.

1. Conversation pair traffic import

    This data file would contain aggregated "end-to-end" network load information such as application name, packet counts and byte counts for each conversation pair. Based on these statistics, the import process builds a traffic distribution profile of your existing network. The resulting distribution, a hyper-exponential, is characterized by an interrupted poisson process which allows you to preserve the bursty nature of your

traffic[1]. In the event, where the import process does not have enough information, the traffic characteristics will be represented as a poisson process, resulting into an exponential distribution. Under the current release, this process only supports packet traffic, but you may mix it with internally generated call or session traffic.

2. Event trace traffic import

   This file would contain network load information in the form of individual conversations on the network, rather than summarized information. During simulation, the imported traffic profile would replay your captured network activity, on an event by event basis. This option would allow you to quickly verify, that the model behaves similar to your actual network activity.

It is important to understand the differences in the two approaches described above. With the event trace approach, the event scheduling mechanism during the simulation is controlled directly by the captured file, hence, the simulation time is limited by the capture interval of your traffic file. The capture duration in most cases is constrained by the buffer space on the network analyzer and is typically limited to couple of minutes based on your network activity. This approach is most useful when you have a particular (maybe, user defined) distribution of events which needs to be generated within COMNET III. You would have full control on how data flows within your network, allowing you to extend the event scheduling mechanism of COMNET III. This approach also allows you drive your external call and session traffic which may be derived from, for example, customer billing records.

The nature of problem under study would identify the type of import procedure to use. Typically, the conversation pair traffic data should be sufficient to model your network load characteristics. Internal traffic sources may be used in conjunction with external sources for various "what-if" scenarios. Both external and internal traffic sources behave similarly within COMNET III. Hence, one may mix user controlled traffic scheduling with internally generated events based on observations from a probability distribution.

3.4 Capture a Network Traffic File

A network traffic file is a text file representing your load characteristics. This file is generated by storing the data captured by your network analyzer. All the input data is assumed to be in an ASCII file which is in comma separated value (CSV) format. The traffic file may also be user defined as long as the specific import process requirements are met. Some of the typical network analyzers which may be used to capture the network load characteristics are identified below. However, this is by no means a complete list of tools from which traffic data may be imported.

(a) Conversation pair traffic import

This import process allows you to import data from Network General's Expert Sniffer and RMON tools such as AXON Network's LANServant and Frontier's NETscout Manager etc.

[1] Anatol Kuczura, "The Interrupted Poisson Process As An OverFlow Process", The Bell System Technical Journal, Vol. 52, No. 3, March 1973

Refer to Appendix A: Input file format for identifying the data fields expected by the import process.

(b) Event trace traffic import

This import process allows you to import data from Network General's Classic Sniffer, HP NetMetrix, Wandel & Goltermann's Domino Analyzer etc. The event records in the file are listed in a chronological order. Each field in the record must be separated either by a blank (.prn) or comma-separated (.csv). Refer to Appendix A: Input file format for identifying the data fields expected by the import process.

Fields may be in any order and the length of the fields may vary. Generally, you will need to define a configuration file for your network analyzer to get a file in the relevant format. Please consult your analyzer's user's manual for further information on how to capture and save traffic data (see Appendix B for network analyzer configuration information).

3.5 Building a COMNET III model

A COMNET III topology model must be created before traffic import process can be invoked. The base-line model of your network topology can either be manually created or automatically generated by using the Topology Import procedure described in Chapter 2. During the traffic import process COMNET III node names have to be matched with the names found in your external traffic file. This process allows you to have readable node names in your model which are mapped to the names found in your traffic file, typically consisting of MAC addresses.

3.6 Traffic Import Process

3.6.1 Conversation Pair Traffic Import

This is an open interface format for importing data files from various network monitoring tools. It provides a generic traffic profile definition process to map the data captured to the information required to complete the import process. The import process generates baseline load information from the data file using the packet rate matrix in COMNET III. By default, AutoBaseliner comes with a Generic profile format which can be configured (see traffic definition process) to fit the data file you have collected. It also comes with a pre-configured profile for Network General's Expert Sniffer. This is a specialized interface to the tool; hence eliminating the traffic profile definition process. This behaves similar to the Generic profile traffic data import, except for the traffic definition process.

To start the traffic import process, select the menu option, `File/Import/Network Traffic`. This would display the Traffic Import Dialog form (as shown in figure 3.1).

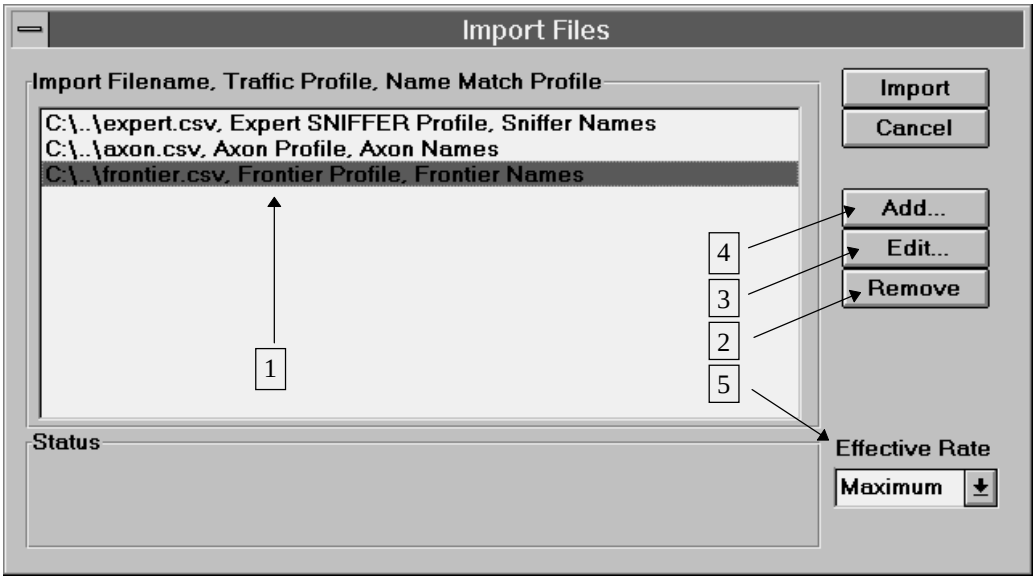

Figure 3.1: Import traffic file dialog

Legend:

1. Lists the candidate network traffic files, the associated traffic profile and the model to external name match profile. Multiple traffic files may be added by using the `Add` option.
2. To `Remove` selected external traffic file(s) from the import list.
3. To `Edit` the selected external traffic file form the import list.
4. To `Add` external traffic file(s) for the import process. On selecting the Add option, the traffic characterization dialog form will be displayed as shown in figure 3.2.
5. Effective Rate options: `Average`, `Maximum` or `Minimum`, allow you to control the resulting profile should look like. In many situations, there may be traffic files which are captured independently from different segments over the same period of time. In such a scenario, there may be overlapping data which is reported in more than one traffic files. In a conservative mode, you might want to select the least rate (minimum option) recorded in different traffic files. By default, the effective rate option is set to the Maximum rate.

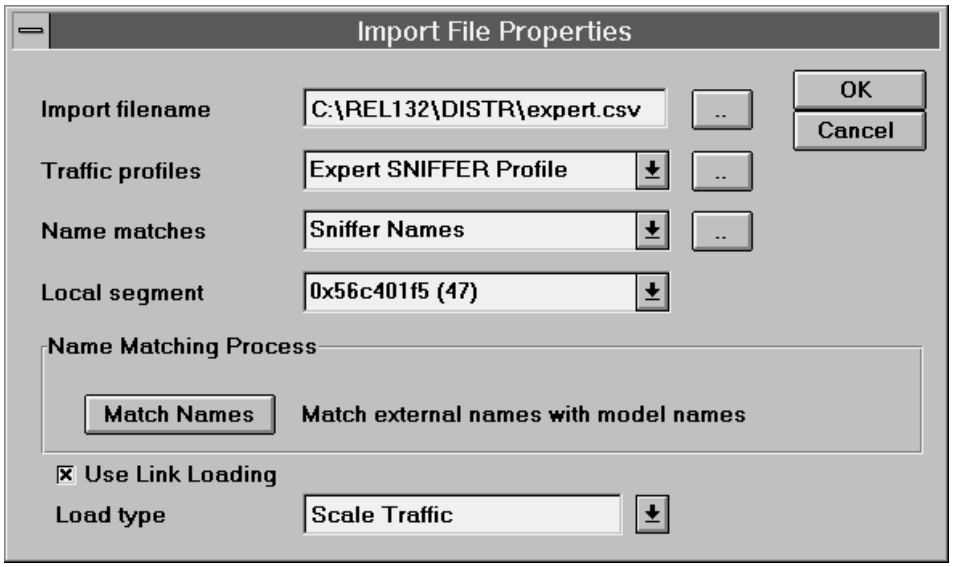

Figure 3.2: Traffic detail dialog

3.6.1.1 Adding Traffic Files

- Choose the `Import Filename [..]` button to select the traffic file captured using your network analyzer.
- Choose the `Traffic Profile` associated with the traffic file. You may select from a pre-defined profile set or you may define a profile for your traffic type using the `Traffic Profile [..]` button. Refer to Defining Traffic Profiles (Figure 3.4).
- Choose the appropriate `Name Match Profile` from the name match list, or use the `Default` option. Under the `Default` option, the names in the model are automatically matched with the names in the external file. Refer to Name Matching Process for further information.
- The `Match Names` button can be used to manually match the model names with the external names. Refer to Manual Name Matching (Figure 3.5).
- Segment name, by default is set to none. You have to identify the local segment on which the traffic data was captured.
- Optionally, Use Link Loading feature allows you to scale the incoming traffic profile to the actual load level of your network.
- Link-loading type:- Scale Traffic or Full Link-loading.
    - Scale traffic option allows you to compensate traffic load which cannot be modeled directly from the data file. One such scenario is to model Local broadcasts on a segment, the import process uses the link loading feature to generate background traffic on the segment. This would allow periodic loading of the segment due to broadcast messages. In the case of Expert Sniffer, where the tool only records

statistics on conversations which it classifies as "significant" or important traffic. This option allows you to model the rectified level of network load by using the link loading feature to compensate for the traffic on which there was no statistics collected along with the actual conversation statistics.

- Full-link loading allows you to model the external traffic completely by the link-loading process. This option would be useful, when one might only be interested in loading the network to its existing level and then adding new application(s) to see how it might impact the performance of the network.

- Select `OK` to add the traffic file to the import list, or `Cancel` to discard the traffic file.

3.6.1.2 Defining Traffic Profiles

A set of pre-defined traffic profiles come with COMNET III. These include profiles for AXON Networks' LANServant and Frontier's NETscout Manager. However, if your traffic data does not fit within the pre-defined set, you may add your own profiles by using the `Traffic Profile [..]` button, shown in Figure 3.3. On selecting the profile template, which you might want to `Edit` or `Add`, the conversation profile dialog will be displayed (Figure 3.4).

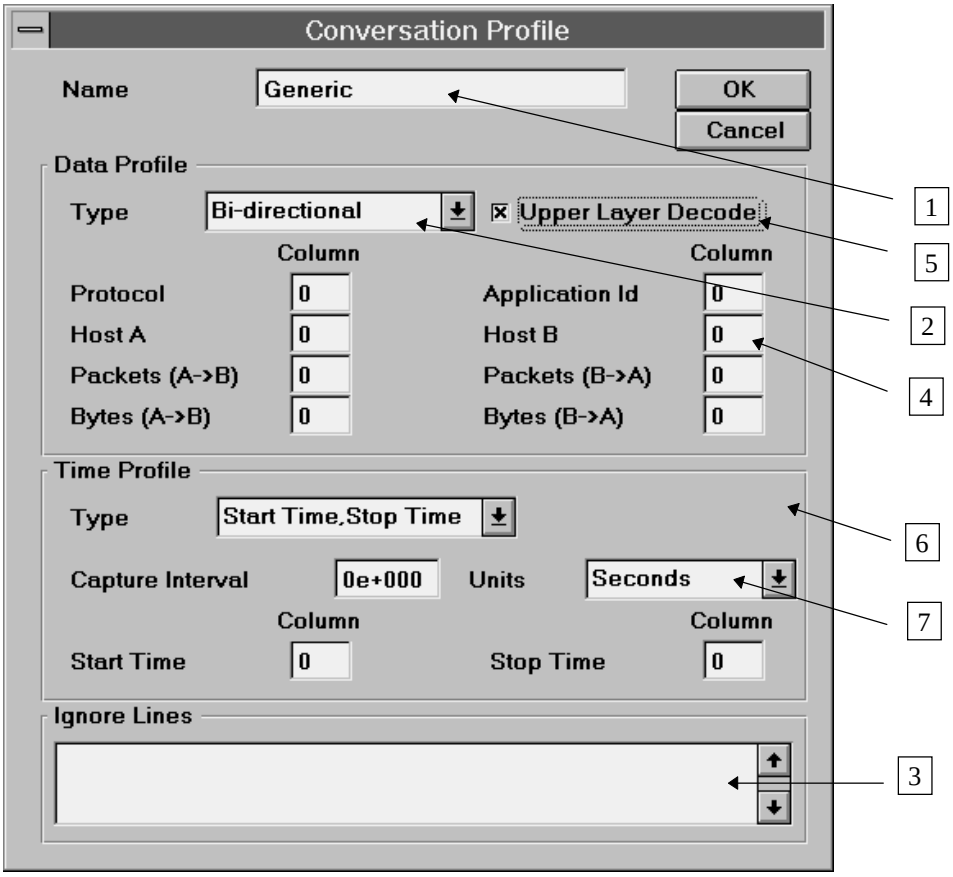

Figure 3.4: Conversation profile definition dialog

Legend:

1. Identifies the name of the Traffic Profile. Each Profile name should be unique and cannot be left empty.
2. Select the traffic type:- `Bi-directional` or `Combined data`. Many traffic analyzers collect information based on the total number of data transmitted between a pair of nodes, this would be represented by the Combined data type. Some tools collect data where they discriminate the data flow based on the direction it might be flowing - Bi-directional data type (see Appendix A).

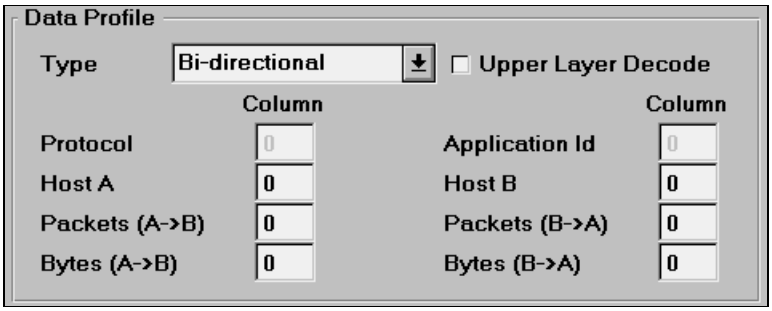

Figure 3.5(a): Detailed traffic data profile dialog

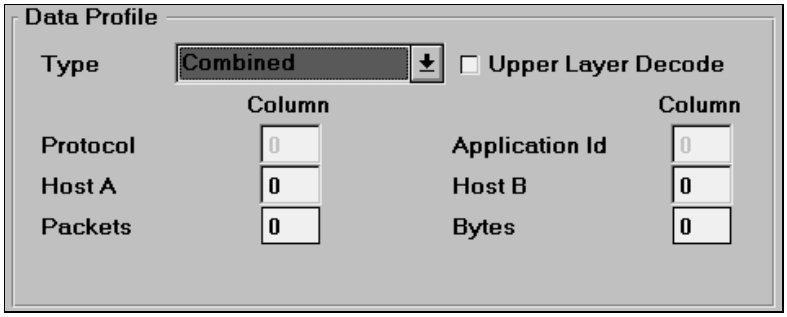

Figure 3.5(b): Aggregated traffic data profile dialog

3. All lines listed here will be ignored during the import process. **Note:** Ensure that each line listed here is separated by an end of line character (`Enter` or `Return`). There is also no need to list the entire line, the first few words of the line would be sufficient. By default, any lines beginning with the character "*" will be ignored.
4. `Columns` identify the position of the variable in each line of the file, i.e. Host A (source or sink), Host B (source or sink); Number of Packets (and bytes) transmitted between a node pair. The data file may also contain information about flow in each direction (see Appendix A).
5. `Upper Layer Decoding`, some traffic analyzers collect data about the name of the application running between a pair of nodes and what protocol they be using. Enabling this

check-box allows the import process to use this information. By default, this option is not active.

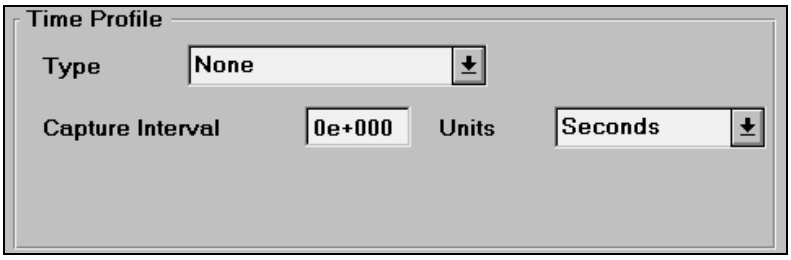

Figure 3.6(a): Time profile type None options

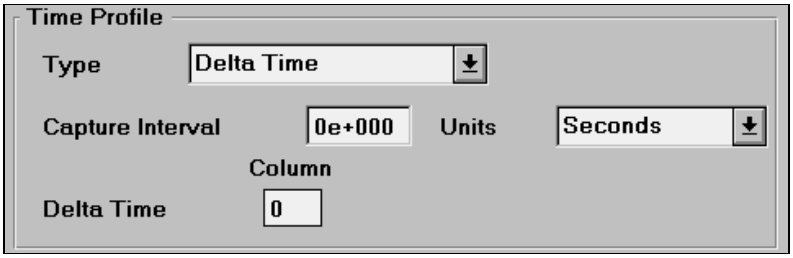

Figure 3.6(b): Time profile type Delta Time options

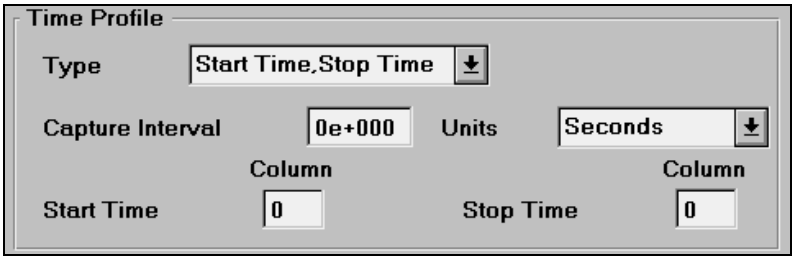

Figure 3.6(c): Time profile type Start Time, Stop Time options

6. Traffic `Time Profile` in the file may be given in `StartTime, StopTime` format, i.e., when start time and the stop time of the conversation duration is available. For such a scenario, the columns identifying the respective fields have to be defined. Or, the duration might be in `Delta Time` format, i.e. the value defines the actual duration of the conversation. Some tools don't store any information on the actual duration of the conversations, in this case, the `None` option may be selected. However, you still need to know the total capture duration of the data file. This is requisite for the import process to complete successfully. This would allow you to represent the burstiness of the traffic captured.
7. The traffic time `Units` can be either:- `Seconds, Milliseconds, Microseconds or Nanoseconds`. This is related to the capture duration and delta time profile type defined in 6.

3.6.2 Event trace traffic import

This is yet another open interface format for importing data files from various network monitoring tools. The emphasis here is to empower the user to control the event scheduling within COMNET while the simulation is in progress. The resulting load characteristics would be based on the events recorded in the files. This may be used to represent Message, Session and/or Call traffic.

Select the menu option, `Define/External Traffic/Messages` (or Sessions or Calls), based on the type of traffic you want to add to your model. This will invoke the external traffic dialog form (see Figure 3.7). The form shown in Figure 3.7 is for Message Traffic; similar forms will be displayed for session and call traffic. This form allows you to generate the external traffic model file via the `Import Traffic Files`... option. Refer to COMNET III user's manual for the use of the other two options.

Figure 3.7: External traffic dialog form

Check mark the `Use External File` option to inform COMNET III that an external traffic model file exists and to use it during the simulation. The external traffic can be scaled by varying the value in the Traffic Scale. On selecting the `Import Traffic Files` option, the Traffic Import Dialog form will be displayed (Figure 3.8). Alternatively, you can directly invoke the same dialog by selecting the `File/Import/Event Trace` menu option.

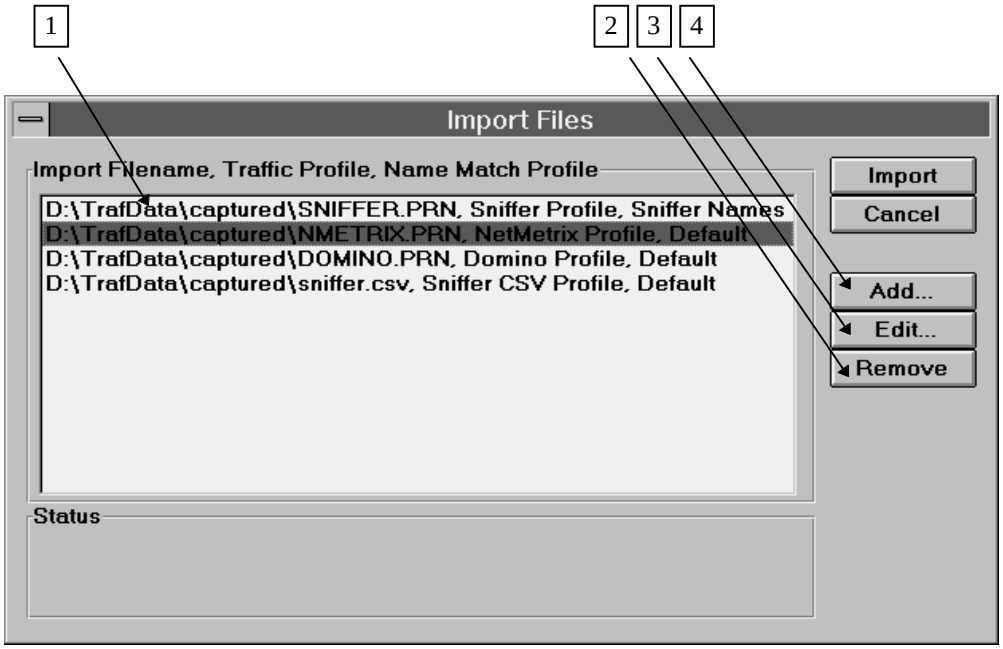

Figure 3.8 : Import traffic dialog form

Legend:

1. Lists the candidate network traffic files, the associated traffic profile and the model to external name match profile. Multiple traffic files may be added by using the `Add` option.
2. To `Remove` selected external traffic file(s) from the import list.
3. To `Edit` the selected external traffic file form the import list.
4. To `Add` external traffic file(s) for the import process. On selecting this option, a traffic characterization dialog form will be displayed (Figure 3.9).

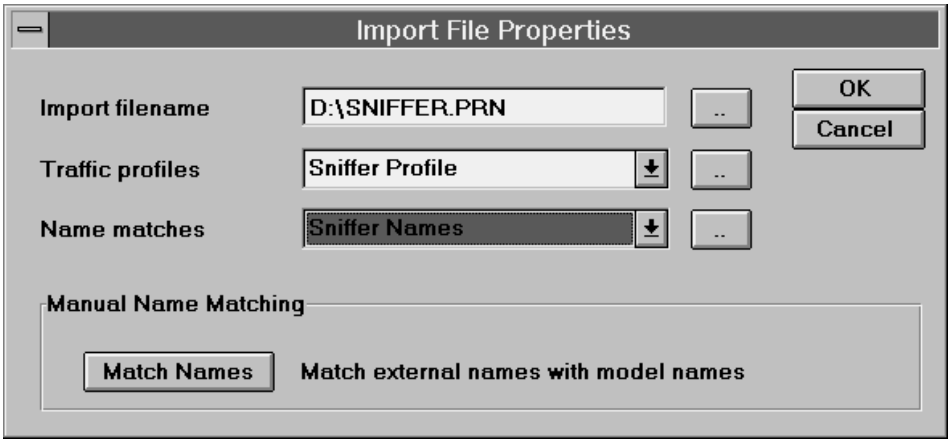

Figure 3.9 : Traffic characterization dialog form

3.6.2.1 Adding Traffic Files

- Choose the `Import Filename [..]` button to select the traffic file captured using your network analyzer.
- Choose the `Traffic Profile` associated with the traffic file. You may select from a pre-defined profile set or you may define a profile for your traffic type using the `Traffic Profile [..]` button. Refer to Defining Traffic Profiles (Figure 3.10).
- Choose the appropriate `Name Match Profile` from the name match list, or use the `Default` option. Under the `Default` option, the names in the model are automatically matched with the names in the external file. Refer to Name Matching Process for further information.
- The `Match Names` button can be used to manually match the model names with the external names. Refer to Manual Name Matching (Figure 3.11).
- Select `OK` to add the traffic file to the import list, or `Cancel` to discard the traffic file.

3.6.2.2 Defining Traffic Profiles

A set of pre-defined Traffic Profiles come with COMNET III. These include profiles for SNIFFER, NetMetrix and Domino Analyzer. However, if your traffic data does not fit within the pre-defined set, you may add your own profiles by using the `Traffic Profile [..]` button, shown in Figure 3.9.

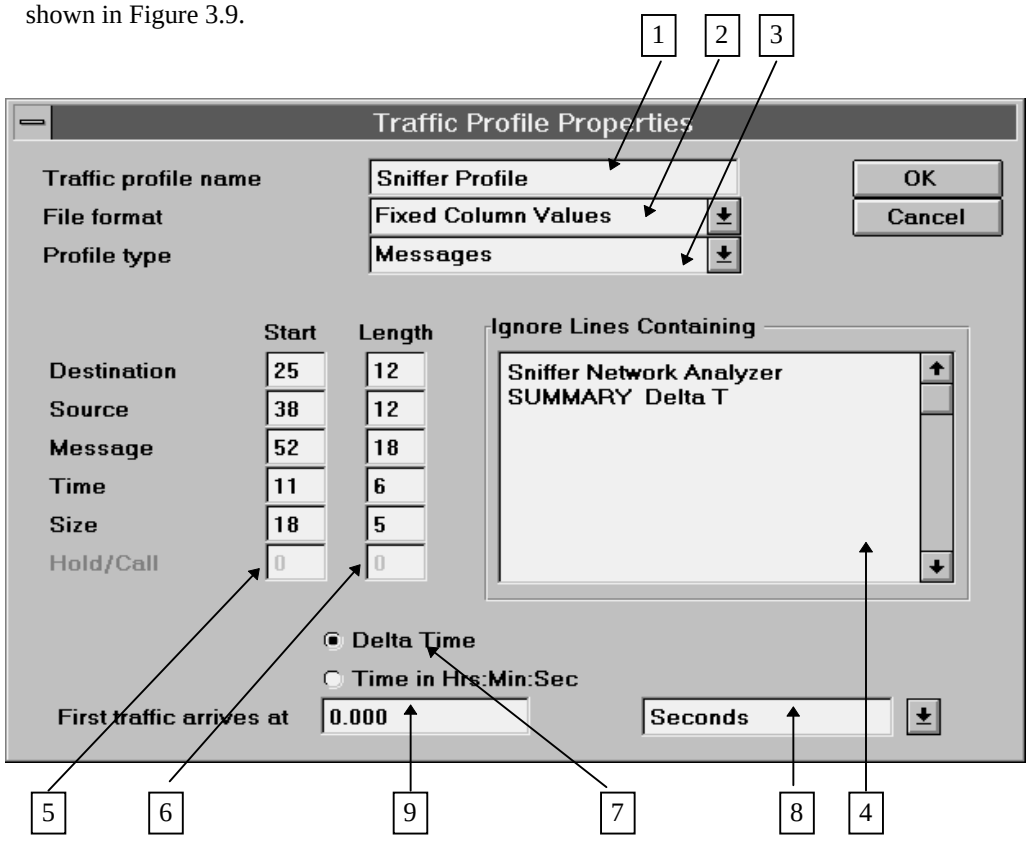

Figure 3.10: Traffic profile template

On selecting a Profile Template which you might want to `Edit` or `Add`, the Traffic Profile Dialog will be displayed (Figure 3.10).

Legend:

1. Identifies the name of the Traffic Profile. Each Profile name should be unique and cannot be left empty.
2. Select the File format:- `Comma-separated Values` or `Fixed-Column Values` (see Appendix A).
3. Select the type of traffic you are defining:- `Messages`, `Sessions` or `Calls`.
4. All lines listed here will be ignored during the import process. **Note:** Please ensure that each line listed here is separated by an end of line character (`Enter` or `Return`). There is also no need to list the entire line, the first few words of the line would be sufficient.
5. `Starting Positions` of each of the variable(s), i.e. Destination, Source, Message, Time, Message Size/Number of Sessions, Hold Time for Calls. For Comma-Separated Values (CSV) format files, this identifies the position of the variable in the line (see Appendix A).
6. `Length` of each variable, defined in Starting Positions (see 5). For example, if the Starting Position for the Destination is column 25 and the Length is 12 characters, then the Destination names are expected to be located in columns 25 to 36. These fields are not defined for CSV format files (see Appendix A).
7. Traffic `Time Stamp` in the file may be either absolute (Time in Hrs:Min:Sec) or relative (Delta Time).
8. The Traffic `Time Units` can be selected from either:- Seconds, MilliSeconds, MicroSeconds or NanoSeconds.
9. This parameter allows you to synchronize the incoming traffic with the model traffic. By default, the incoming traffic is set to start at 0.00 seconds. This may be modified, for example, to reflect some delay during simulation time, such as boot-up delay of the nodes such as hubs, routers, print-servers etc. Hence, the external traffic time is skewed based on the value defined for this parameter. The time units are same as those defined in Traffic Time Units.

3.7 Traffic Name Matching Process

The function of the Name Matching process is to establish a name map between node names found in the external Traffic file and the node names found in your model. The primary goal of this process is to allow user-friendly names to be used within the model and mapping them with the MAC addresses, typically found in the external traffic files. The Name Matching process also allows you to configure the external traffic model based on your specific requirements. For example, there might be a traffic profile consisting of all the nodes in the segment, however, the aim of the study might only be related to traffic conversation(s) held between specific nodes in the segment. The node name(s) of interest can be name-matched and the traffic nodes which are irrelevant to the current scenario can be filtered out. This allows multiple "what-if" scenarios by utilizing the same captured file.

The name matching process is invoked by selecting the `Match Names` option in the Traffic Characterization dialog form (Figure 3.9). Figure 3.11 shows the Name Matching dialog form.

3.7.1 How to Match Names ?

The `External List` (1) shows all the node names found in your Traffic File. This can be also used for cross-checking to see whether the Traffic Profile is appropriately defined. If the node names in the list do not reflect the names in the file, then you will need to modify the Traffic Profile parameters. The `Model List` (2) shows all the nodes found in your model, defined by the link segment(s) selected (3). All links in the model is the default option. In order to get a list of nodes connected to a particular link segment only, select the appropriate segment from the combo-list. The `Name Match List` (4) shows the current name mappings between the external names and the model names. In this example, external name 134.141.55.2 is mapped to model name 134.141.55.2, since both names are the same.

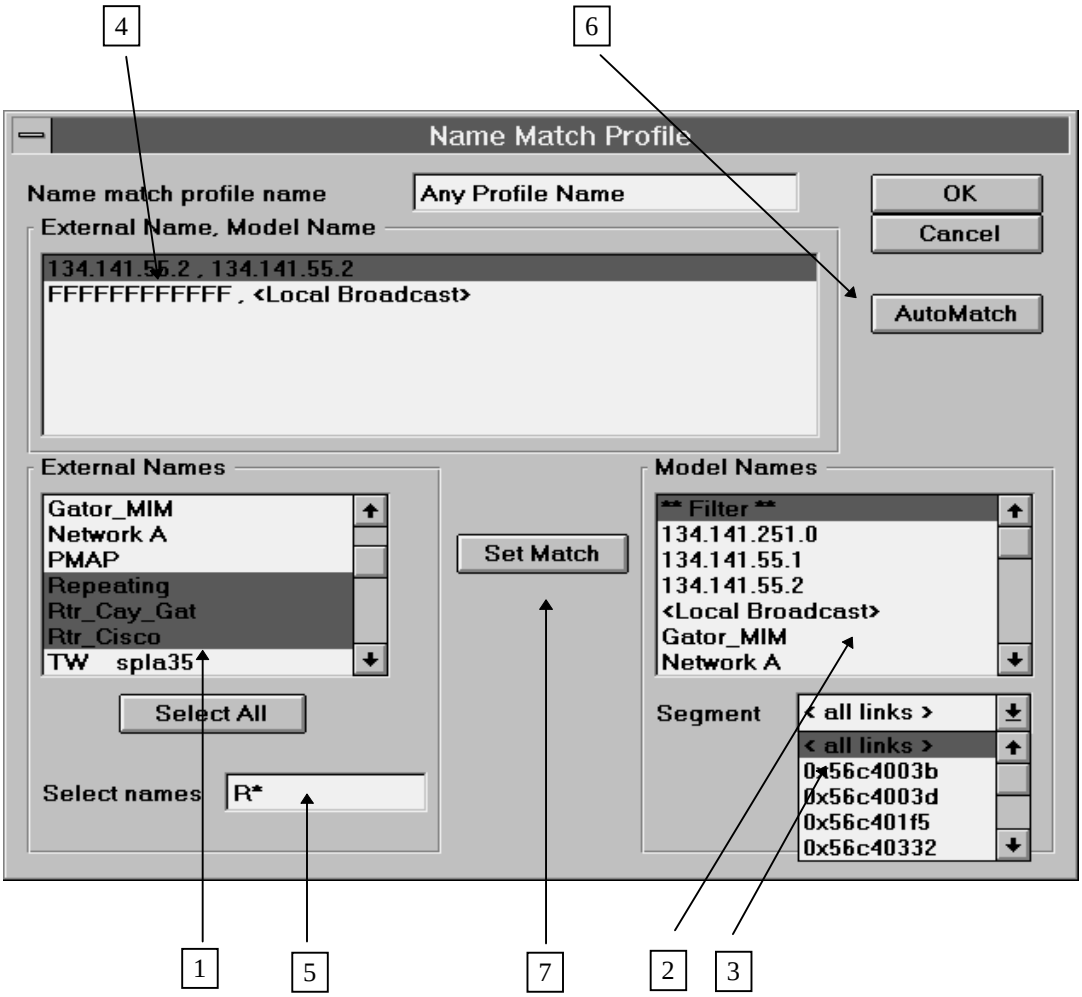

Figure 3.11 : Name Matching template

In order to add/modify a name mapping, select the appropriate node names from each candidate lists (1 and 2) and choose the `Set Match` (7) option. The `External Name List` allows multiple names to be selected for name matching. The `Model Name List` allows mutually exclusive name selection only. Multiple names may be selected by holding the `CTRL` key down while choosing the node names for matching. The `Select Names` (5) option allows you to use a wild-card in selecting the node names in the `External Name List`. This may be useful when multiple names in the `External Name List` need to be mapped to a single Model Name. This could also be useful, when you need to Filter traffic conversation(s) from a specific external node(s). In this example, all the external names starting with "R*" have been selected, and they may be filtered out on selecting the `Set Match` (7) button.

3.7.2 Automatic name matching

Automatic name matching(6) maybe utilized in a number of scenarios. For example, one might only be interested in the load on the network segment rather than who is loading the network. The following criteria is applied for automatic matching process: (a) if a Model Name(2) matches with the External Name(1) then they will be matched and placed in the Name Match List(4), (b) if the External Name(1) doesn't match with any Model Names(2) then it will be randomly matched with a Model Name. If a name map already exists between the two names, i.e., the Name Match List shows the name map, then the External Name will not be used for the automatic name matching process. Automatic name matching is also useful when key nodes of interest are mapped and then one might only be interested in background traffic from other nodes. The background traffic nodes may be matched automatically. This automatic name matching process is also utilized when the Name Match Profile is left as `Default`.

Once you are satisfied with the name mapping, choose `OK` to accept the configuration. Your new profile will be added to the list of Name Match Profiles, (Figure 3.12).

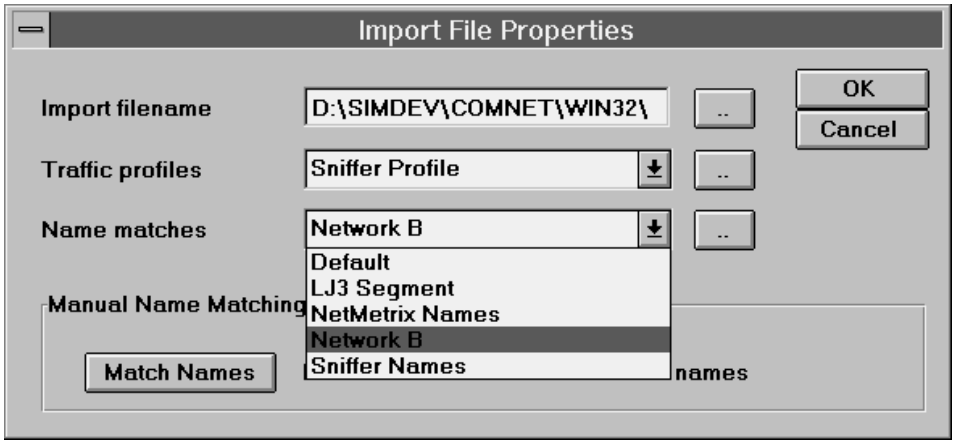

Figure 3.12 : Name Match profile list

3.8 External Traffic Model File

3.8.1 Conversation pair traffic model file

Once the network load characteristics have been defined, refer to Figure 3.2, the traffic import process can be started by selecting the `OK` option. The Effective rate combo-box option defines how to handle the double counting scenario. Since traffic from multiple segments may be defined, there might be situations where two files from different segments might have overlapping conversation statistics, for such a scenario, the effective rate combo-box option allows you to either select the maximum rate, minimum rate or the average rate defined by the overlapping conversations.

Figure 3.13: Confirm dialog for importing new load characteristics

At the conclusion of the import process, a confirm dialog (figure 3.13) would be displayed giving you the option of deleting all the previous, if they exist, externally imported profiles. If no is selected, then the traffic profiles will be merged together. The resulting traffic model file populates the Packet Rate Matrix in COMNET. To view the packet rate matrix, select the Define/Packet Rate Matrix menu option. You can now simulate the resulting baseline model of your network.

3.8.2 Event trace traffic model file

Once the network load characteristics have been defined, refer to Figure 3.8, the traffic import process can be started by selecting the `OK` option. At the conclusion of the traffic import process, an Import Status dialog form will be displayed (Figure 3.14). This particular status dialog reports that the external traffic model was generated without any errors. The traffic model will be begin scheduling events starting at simulated time `0 seconds` and the last event will be scheduled at simulated time `115.9 seconds`. **Note:** If both the start and finish times are identical, then the traffic profiles have not been defined correctly.

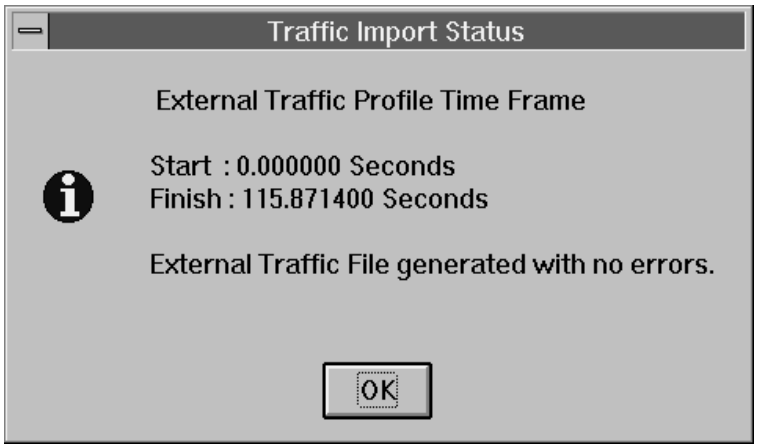

Figure 3.14 : Import traffic status dialog

Each simulation can have up to three external traffic model files:- one for messages (message.ext), one for sessions (session.ext) and one for calls (call.ext). COMNET III also provides you with an option to scale the level of external traffic to be introduced within your model. By default, the value is set to `1.00`. The value set here is used by COMNET III when it utilizes the traffic model during simulation. For example, in order to double the traffic level, set the value to `2.00`. The effect of this will be to halve the scheduling period between each external traffic events. Using the above example (Figure 3.14), now the last event will be scheduled at `57.95 seconds` but the number of events will remain the same.

Within the simulation, external traffic queues for links in the same manner as internal traffic. Normally, since the traffic captured was already on the link, it has the correct packet size and does not need to be broken down further into multiple packets. However, if the link that uses the traffic has a smaller packet size, it will be packetized appropriately. External message and session traffic can be used to trigger any application or traffic source that uses the received message scheduling. The default message text field for an external message source reflects the Message Id found in the external traffic model file (message.ext).

APPENDIX A
Traffic File Description

A.1 Overview

COMNET III provides interface to a variety of network analyzers and/or RMON monitoring tools for importing traffic data. This document outlines the data required by the traffic import process in COMNET III. The import process builds a traffic profile of your network activity based on the data captured. In order to model the traffic profile accurately, the import process needs specific data in the captured file.

Data collected from different tools vary in the level of detail used to characterize the network load. COMNET III provides an open interface which allows you to define the profile of the data collected. It provides interface to two types of traffic data:- Conversation pair traffic and Event trace traffic. The following sections briefly describe what type of data is expected by the import process.

A.2 Conversation Pair Traffic

There are two key sections which have to be defined for modeling the traffic properly. These are data profile definition and time profile definition.

A.2.1 Data profile definition

All the input data is assumed to be in an ASCII file which is in comma separated value (CSV) format. This would also allow you to generate your own traffic patterns from a spreadsheet or database applications to drive your simulation models. By default, all rows beginning with the character "*" would be ignored by the import process. This would allow you to have comments within your input traffic profile.

The traffic import process requires each row in the input file to contain, at least, the following information:

Data profile Type I: If the data contains **summarized** end-to-end conversation information

Example:

```
*Logfile: 18/04/1996 19:43:22 to 18/04/1996 19:54:22
* Probe, Time Index, HostA, HostB, Index, # Packets, # Bytes, # Errors, deltaTime (sec)
"probe ie0 (1)", 18/04/1996 19:43:22,[00000C3E7097],[00000C3E7096],1,1351,164822,0,360
"probe ie0 (1)", 18/04/1996 19:43:22,[002002E0098A],[00000C3E7085],1,301,15567,0,47
"probe ie0 (1)", 18/04/1996 19:43:22,[00800A4F8045],[002002E0098A],1,257,10822,0,98
```

Data profile Type II: If the data contains **detailed** end-to-end conversation information

Example:

```
*Logfile: 18/04/1996 19:44:22 to 18/04/1996 19:54:22
*Start,Stop,ApplId,Proto,HostA,HostB,#Pkts(A->B),#Bytes(A->B),#Pkts(B->A),#Bytes(B->A)
"18/04/1996 19:44:22","18/04/1996 19:45:22","WWW","ip","cacilj","solar",1351,33420,24,3678
"18/04/1996 19:44:03","18/04/1996 19:48:45","word","ipx","popfly","deadfly",144,233334,0,0
"18/04/1996 19:44:26","18/04/1996 19:50:20","nntp","ip","mars","ariadne",341,44400,46,432
"18/04/1996 19:45:34","18/04/1996 19:54:03","ftp","ip","cacilj","orion",1321,36482,25,3680
```

A.3 Event Trace Traffic

There are two types of data formats supported in this mode. (1) Fixed column delineated traffic file (*.prn) and (2) Comma separated values (*.csv).

A.3.1 Fixed Column Delineated Traffic File (.prn)

Figure A.1 represents a sample Traffic trace file captured using Network General's SNIFFER. Figure A.2 shows the corresponding Traffic Profile definition form.

Figure A.1 : Sample Sniffer Column delineated File

```
Sniffer Network Analyzer data from 29-Jun-95 at 09:06:16, file C:\CAPTURE\TEST2.ENC,Page 1

SUMMARY  Delta T  Size     Destination   Source        Summary

M    1    0.0000    60  WstDig8A1707 0000442DCF7D  NCP C Service queue 000200A7 job
     2    0.0009   106  0000442DCF7D WstDig8A1707  NCP R Bindery error
     3    0.0320    60  WstDig8A1707 0000442DCF7D  NCP C Service queue 000000CF job
     4    0.0009   106  0000442DCF7D WstDig8A1707  NCP R Bindery error
     5    0.0321    60  WstDig8A1707 0000442DCF7D  NCP C Service queue 000400E5 job
     6    0.0009   106  0000442DCF7D WstDig8A1707  NCP R Bindery error
     7    0.0321    60  WstDig8A1707 0000442DCF7D  NCP C Service queue 00010015 job
     8    0.0009   106  0000442DCF7D WstDig8A1707  NCP R Bindery error
     9    5.0846    60  WstDig8A1707 0000442DCF7D  NCP C Service queue 000200A7 job
```

```
000000000111111111122222222233333333344444444455555555566666666667777777778888888888
123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890
```

Field Length

Character Position in file

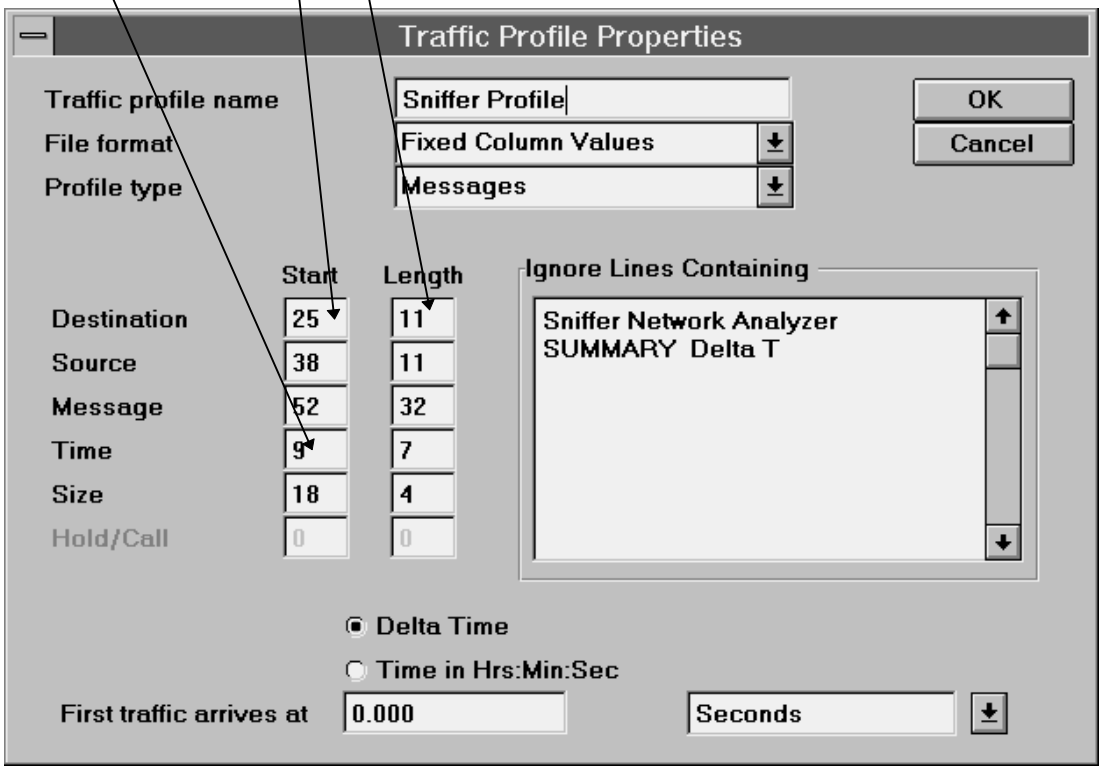

Figure A.2 : Sample Sniffer Traffic Profile based on figure A.1

A.3.2 Comma-Separated Traffic File (.csv)

Figure A.3 represents a sample Traffic trace file captured using Network General's SNIFFER. Figure A.4 shows the corresponding Traffic Profile definition form.

Figure A.3: Sample Sniffer CSV file

```
"Flags","Frame","Delta Time","Size","Destination","Source","Protocol","Summary"
" ",  160,        0,   88,"[37.54.3.4]    ","[192.9.235.166]","RPC","C XID=1610504895 P"
" ",  167,   0.0578,  696,"[192.9.235.166]","[37.54.3.4]    ","RPC","R XID=1610504895"
" ",  172,   0.0266,   88,"[37.54.3.4]    ","[192.9.235.166]","RPC","C XID=1610570431 P"
" ",  175,   0.0152,   72,"[192.9.235.166]","[37.54.3.4]    ","RPC","R XID=1610570431"
" ",  337,   1.0275,   88,"[37.54.3.4]    ","[192.9.235.166]","RPC","C XID=1610635967 P"
" ",  342,   0.0335,  344,"[192.9.235.166]","[37.54.3.4]    ","RPC","R XID=1610635967"
" ",  349,   0.0227,   88,"[37.54.3.4]    ","[192.9.235.166]","RPC","C XID=1610701503 P"
" ",  354,   0.0146,   72,"[192.9.235.166]","[37.54.3.4]    ","RPC","R XID=1610701503"
" ",  505,   1.0220,   88,"[37.54.3.4]    ","[192.9.235.166]","RPC","C XID=1610767039 P"
" ",  521,   0.0960, 1116,"[192.9.235.166]","[37.54.3.4]    ","RPC","R XID=1610767039"
```

1	2	3	4	5	6	7	8

Variable Number

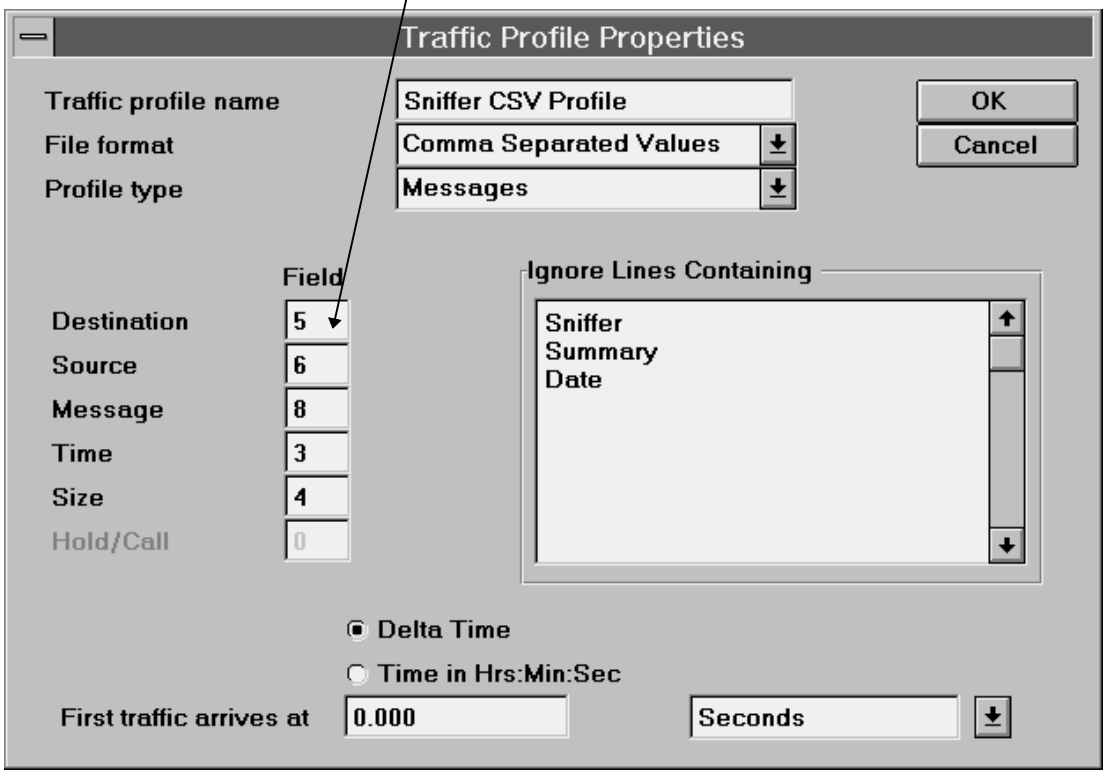

Figure A.4: Sample Traffic Profile based on figure A.3

APPENDIX B
The Network General SNIFFER

B.1 Overview

The steps described in this section in utilizing existing network analyzers with AutoBaseliner are to be used as guidelines only. Different versions of software might behave differently.

The following steps of collecting historical traffic files with Network General SNIFFER was tested using release 4.49w of the Expert SNIFFER software. Other releases should work identically.

B.2 Classic SNIFFER Instructions

AutoBaseliner can also be used with any other LAN analyzer or traffic monitoring tool that produces a historical traffic file in a similar format. The main requirement is that the historical traffic file have one line per packet. That line must include time, size, source, destination and some description of the packet.

1. Start the appropriate analyzer (such as the Ethernet II Analyzer)
2. Select `Capture`, then Expert Mode
3. Let Capture proceed until you have enough data
4. Press `F9` (pause)
5. Press `F5` (menu)
6. Select `Display`, then `Summary`. Turn off all fields except Delta Time, Bytes and DLC.
7. At menu, select `Display`, `Print`, `File`, `Plain Text Format`.
8. Then go back to `Print` and press Enter.
9. Give a file name but no type (**.prn** is the default type).
10. Your file now contains the trace in the format expected by AutoBaseliner.

B.3 Expert SNIFFER Instructions

This is procedure outlines the type of report to generate using the Expert Sniffer database which contains information about the topology and traffic patterns of your network. The resulting file is an ASCII file in Comma Separated Value (CSV) format. This file can be utilized for the Conversation Pair Traffic import process.

1. Start the appropriate analyzer (such as the Ethernet II Analyzer)
2. Select `Capture`, then Expert Mode
3. Let Capture proceed until you have enough data
4. Press `F9` (pause)
5. Press `F5` (menu)
6. Move to Files→Save→Expert data
7. The following sections of data is **required** from the Expert Sniffer database for the import process:
    - Header Information
    - Contents
    - Global Statistics
    - General Statistics
    - Network Objects
    - DLC Stations
    - Subnets
    - Subnet Pairs
    - Network Stations
    - Connections/Applications

APPENDIX C
Integrating COMNET III with NMS Tools

C.1 Where to find the NMS files ?

The Network Management System integration file(s) are typically sent out with the COMNET III installation tapes. If for any reason, it is not included, then you may download the particular file(s) from our ftp site: `ftp.caciasl.com`. You can login as an `anonymous` user (user_id) with your `e-mail_address` as the password.

For HP OpenView files look under the following directory:

`/pub/comnet/AutoBaseliner/topology/NMS/OpenView/`

For NetView/6000 (and Digital PolyCenter) files look under the following directory:

`/pub/comnet/AutoBaseliner/topology/NMS/NetView/`

For Cabletron SPECTRUM files look under the following directory:

`/pub/comnet/AutoBaseliner/topology/NMS/Spectrum/`

C.2 HP OpenView Interface

COMNET III may be installed so that it can be started from HP OpenView, version 2 and later. After installation, COMNET III will appear as a menu pick and on line help will be available. In addition, you can export your topology from OpenView to COMNET III by clicking on the Tools, COMNET III, Topology Export pull-down in the Root window. All of these installation instructions assume that OpenView is installed in the standard location, `/usr/OV`. If it is installed elsewhere, simply replace `/usr/OV` in the instruction examples with the directory in which you installed OpenView. In addition, you can extract the topology information from OpenView and import it into COMNET III.

In order to install COMNET III under OpenView, perform the following steps. You will need root permissions to write the files and create the necessary directories.

- Copy all files from the installation media into a temporary directory. (You will have already done this during the standard COMNET III installation procedure.)
- Edit the file `comnet.reg` found in the sub-directory OpenView which will be in the temporary directory that you just created. Edit the line after Action "start" to give the path to the COMNET III executable. Set the icon path for `comnet.gif` to the directory where COMNET III is installed.
- You may also want to edit the line after Action "topo" to direct the output from a topology export to somewhere other than `/tmp` or to direct it to a file whose name is different from c3.top.

  If your copy of OpenView is installed in `/usr/OV/bin`, you can simply typing install will put all files in the proper places and create needed directories. To install the OpenView to COMNET III interface manually:

- Copy `comnet.reg` to `/usr/OV/registration/C`
- Create the directory `/usr/OV/help/C/comnet/OVW/Functions`. Copy `comnet.fun` into this directory.
- Copy the file `comnet.tsk` into the directory, `/usr/OV/help/C/OVW/Tasks`.

C.2.1 What can you do?

- From the Root window menu bar, you can click on Tools, and then COMNET III: Simulation to start COMNET III.
- From the Root window menu bar, you can click on Help, Indexes, Applications. One of the applications that appears will be COMNET III. Click on COMNET III and the version, copyright and a brief description of the product will appear.
- From the Root window menu bar, you can click on Help, Indexes, Functions. One of the Functions that appears will be Simulation -> COMNET III. Select it for information on how to use COMNET III.
- From the Root window menu bar, you can click on Help, Indexes, Tasks. One of the Tasks that appears will be Using the CACI COMNET III program. Select it for information on the uses of COMNET III.
- Double click on the COMNET III icon on the Tools palette to start COMNET III.
- From the Root window menu bar, you can click on Tools, and then COMNET III, Topology Export to start an export of the topology of your network to a file whose name is specified in `comnet.reg`. By default, that file will be `/tmp/c3.top`. This file can then be read by COMNET III by selecting File, Import, HP OpenView and then specifying the export file name (/tmp/c3.top by default).
- Double click on the Export->COMNET III icon on the Tools palette to start an export of the topology of your network as described above.

C.3 IBM NetView/6000 Interface

The installation steps are same as HP OpenView instructions above, with the sub-directory OpenView replaced by nv6000. In IBM NetView/6000, COMNET III can be invoked from the menus as well as using the background icons.

You can import background icon bitmaps from `/usr/OV/bitmaps` to use in COMNET III as background icons via the following steps. The background icons in NetView/6000 are provided as `.gif` files, so the first step is to convert them to `.xwd` files. A public domain utility provided with COMNET III can do this. Simply type `giftoxwd` <icon file name> to run the conversion. Now start `Simdraw`, load the current COMNET III background icon file. Next import as a raster file the background icon that you just converted. Save the background icon library and the new icon will then be available to COMNET III.

C.4 Digital PolyCenter

The installation steps are same as IBM NetView/6000 instructions above.

C.5 Cabletron SPECTRUM

The following instructions can be found within the documentation, however, they have been included for completeness.

In order to export the network topology from Cabletron SPECTRUM, the topology command has to be installed within SPECTRUM. The format of the file which is installed is a tar file. This file can be expanded using the Extensions Tool-kit provided as part of the core SPECTRUM installation. If the core SPECTRUM is not present, the product will not be installed.

C.5.1 Using SpectroINSTALL

Move the tar file (i.e. `topex1.0.tar`) from the COMNET III area to the top level of the SPECTRUM area. The file has to be installed using SpectroINSTALL. In order to invoke SpectroINSTALL, perform the following steps:

- Become root
- Type the following line at the command prompt:
  INSDK/Install.quick
- This will invoke SpectroINSTALL
- From here the SPECTRUM Installation Procedures can be followed, with one exception. **Note:** The only component that should be selected for installation is `topex1.0`(i.e. Topology Export).
- Exit root

This procedure would have added menu options within SPECTRUM. Select the command Export Topology, to capture the topological information of your network. For further details, please review the `README` file associated with `Spectrum.tar`.