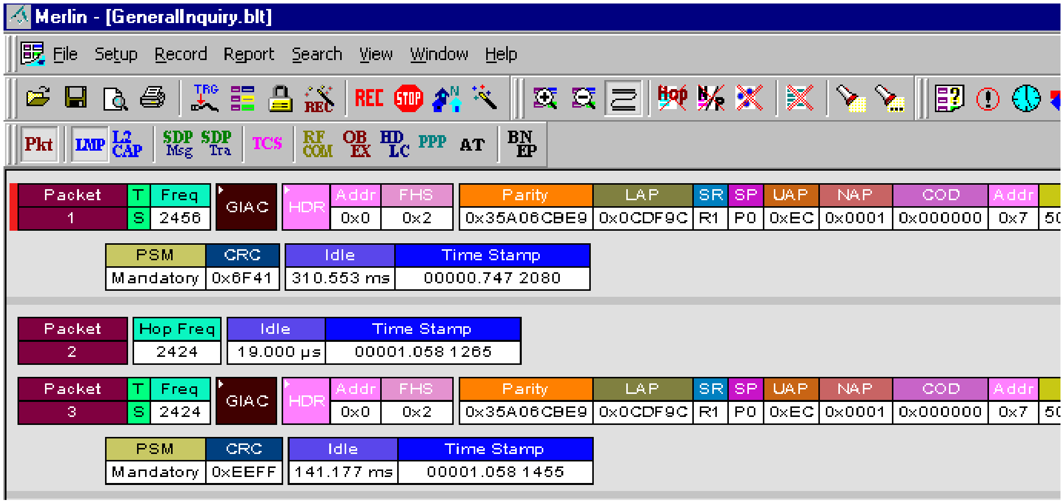
The wizard will close and your trace will display.



Packet	T	Freq			Addr	FHS	Parity	LAP	SR	SP	UAP	NAP	COD	Addr	
1	S	2456	GIAC	HDR	0x0	0x2	0x35A06CBE9	0x0CDF9C	R1	P0	0xEC	0x0001	0x000000	0x7	50

PSM	CRC	Idle	Time Stamp
Mandatory	0x6F41	310.553 ms	00000.747 2080

Packet	Hop Freq	Idle	Time Stamp
2	2424	19.000 μs	00001.058 1265

Packet	T	Freq			Addr	FHS	Parity	LAP	SR	SP	UAP	NAP	COD	Addr	
3	S	2424	GIAC	HDR	0x0	0x2	0x35A06CBE9	0x0CDF9C	R1	P0	0xEC	0x0001	0x000000	0x7	50

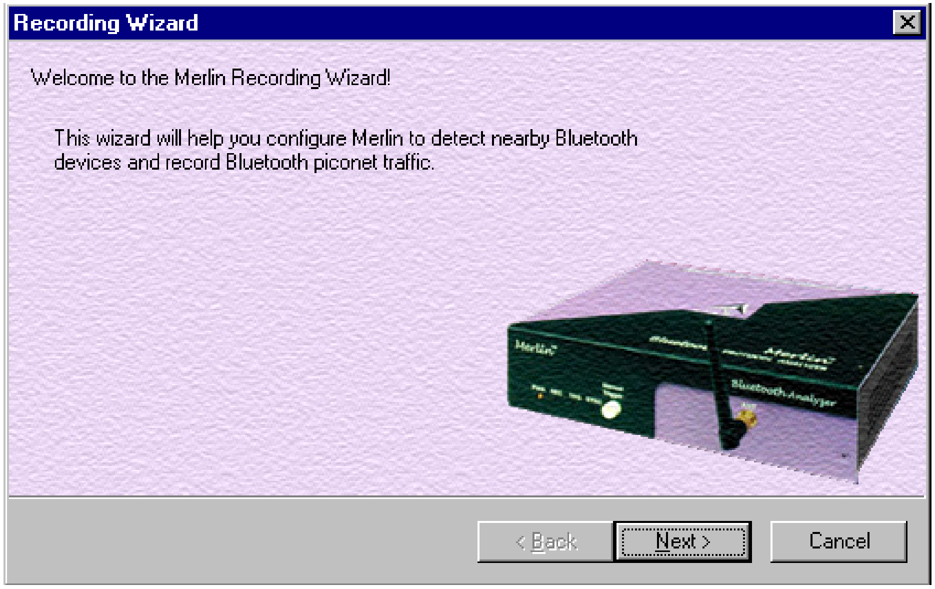
PSM	CRC	Idle	Time Stamp
Mandatory	0xEEFF	141.177 ms	00001.058 1455

6.2 Recording an Existing Piconet

Using Recording Wizard to record an existing piconet is similar to recording a new piconet. The main difference is that you will be asked if your Master device can support multiple slave devices and whether it can respond to pages once it has created a piconet with another device.

Step 1 To start the Recording Wizard, press REC or select **Setup > Recording Wizard** from the menu.

The Recording Wizard introductory page will open:



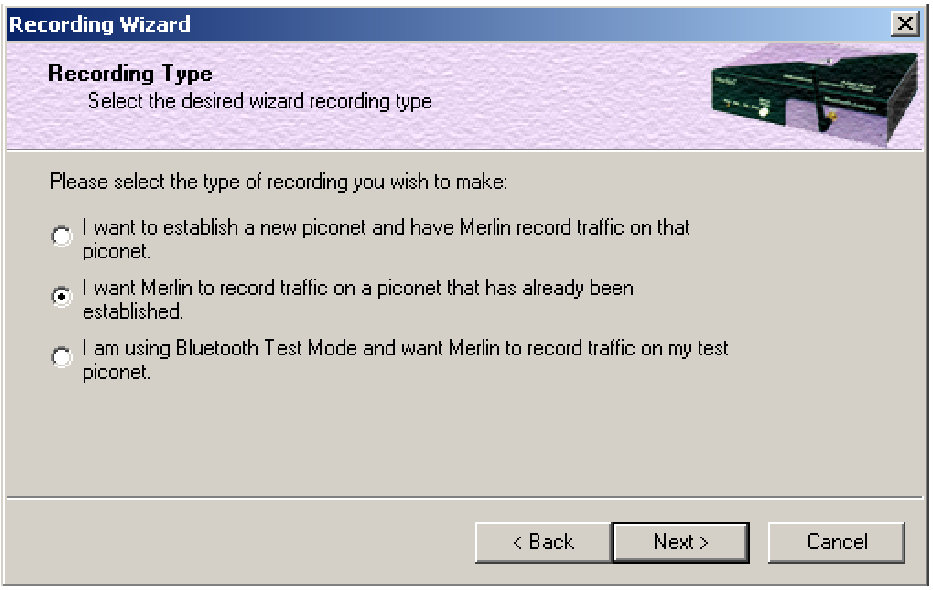
Recording Wizard

Welcome to the Merlin Recording Wizard!

This wizard will help you configure Merlin to detect nearby Bluetooth devices and record Bluetooth piconet traffic.

Step 2 Press **Next** to advance to the next screen.

You will see three choices:



Recording Type
Select the desired wizard recording type

Please select the type of recording you wish to make:

○ I want to establish a new piconet and have Merlin record traffic on that piconet.

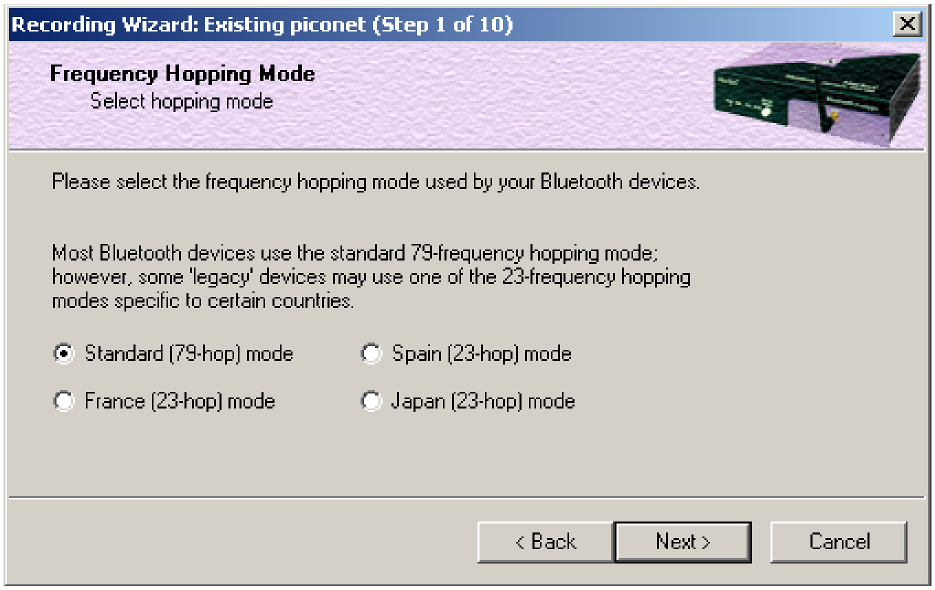
● I want Merlin to record traffic on a piconet that has already been established.

○ I am using Bluetooth Test Mode and want Merlin to record traffic on my test piconet.

Step 3 Select the second option: **I want Merlin to record traffic on a piconet that has already been established**.

Step 4 Press **Next**.

You will see four choices:



Frequency Hopping Mode
Select hopping mode

Please select the frequency hopping mode used by your Bluetooth devices.

Most Bluetooth devices use the standard 79-frequency hopping mode; however, some 'legacy' devices may use one of the 23-frequency hopping modes specific to certain countries.

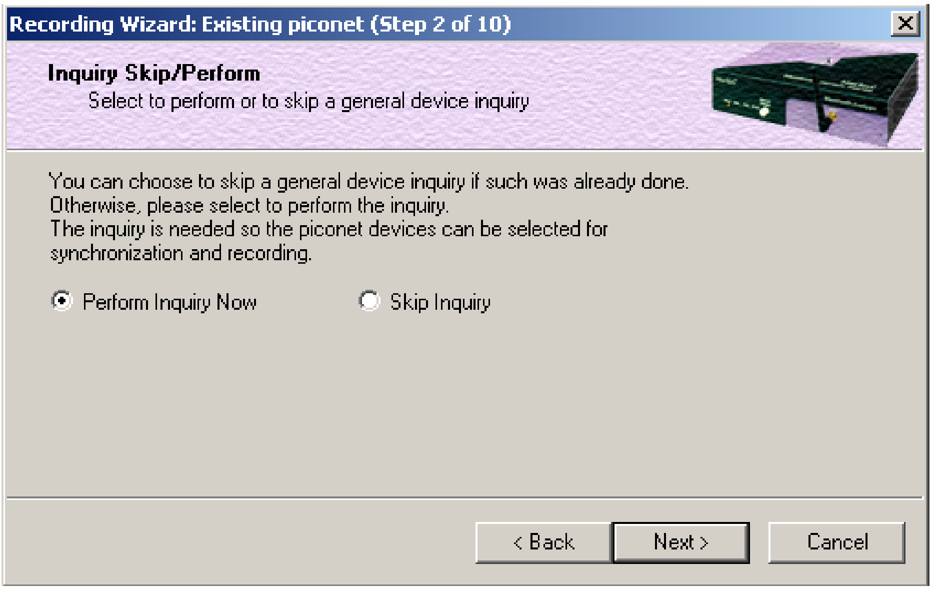
● Standard (79-hop) mode ○ Spain (23-hop) mode

○ France (23-hop) mode ○ Japan (23-hop) mode

Select the hop mode appropriate to your area.

Step 5 Select the hop mode appropriate to your area, then press **Next**.

You will see two choices:



Recording Wizard: Existing piconet (Step 2 of 10)

Inquiry Skip/Perform

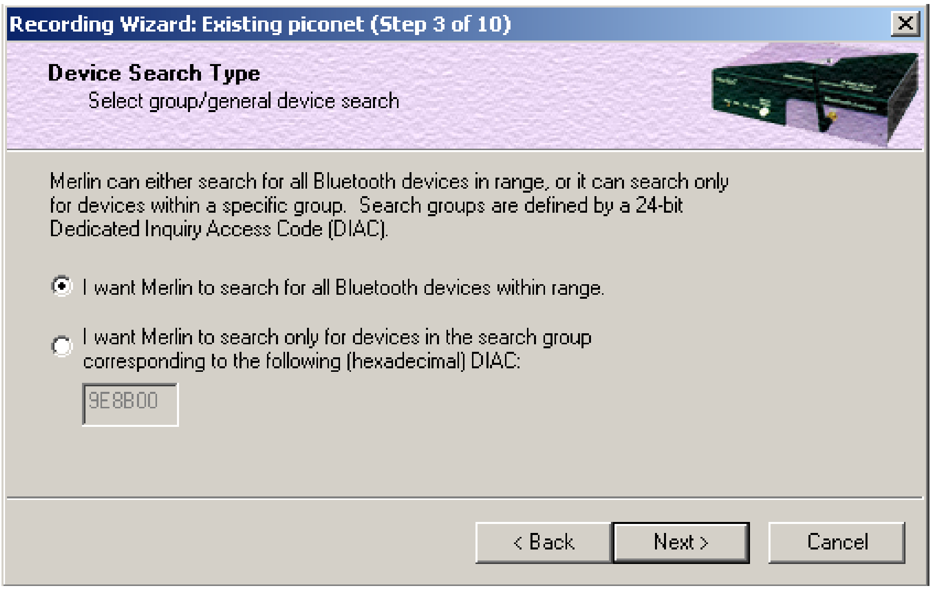
Select to perform or to skip a general device inquiry

You can choose to skip a general device inquiry if such was already done. Otherwise, please select to perform the inquiry. The inquiry is needed so the piconet devices can be selected for synchronization and recording.

● Perform Inquiry Now ○ Skip Inquiry

Step 6 Select **Perform Inquiry Now**.

You will see two choices:



Recording Wizard: Existing piconet (Step 3 of 10)

Device Search Type

Select group/general device search

Merlin can either search for all Bluetooth devices in range, or it can search only for devices within a specific group. Search groups are defined by a 24-bit Dedicated Inquiry Access Code (DIAC).

● I want Merlin to search for all Bluetooth devices within range.

○ I want Merlin to search only for devices in the search group corresponding to the following (hexadecimal) DIAC:

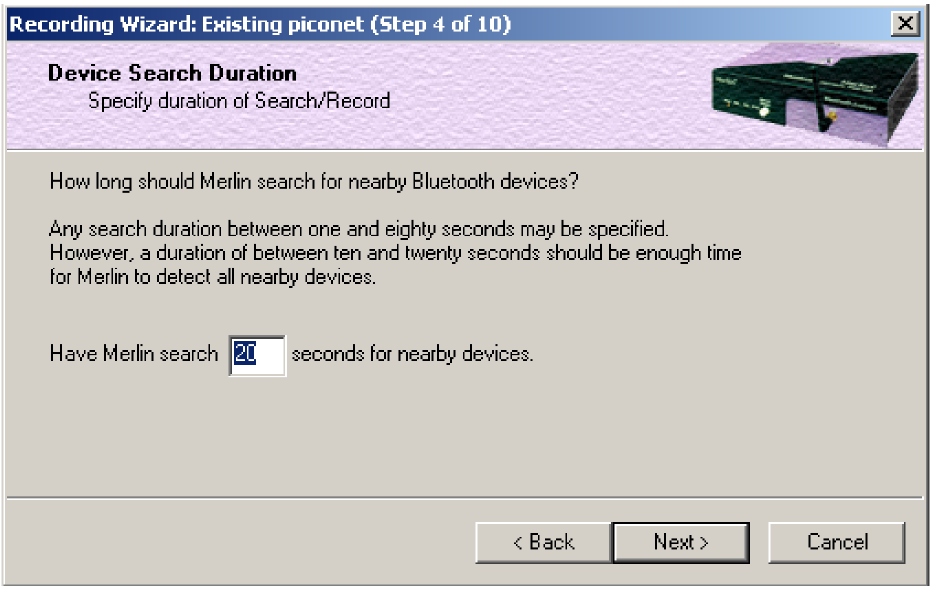
9E8B00

Step 7 Select the first option: **I want Merlin to search for all Bluetooth devices within range**.

If you want to limit the inquiry to a class of devices, select the second option and enter the hexadecimal value for the device class in the text box.

Step 8 Press **Next**.

You will see two choices:



Recording Wizard: Existing piconet (Step 4 of 10)

Device Search Duration

Specify duration of Search/Record

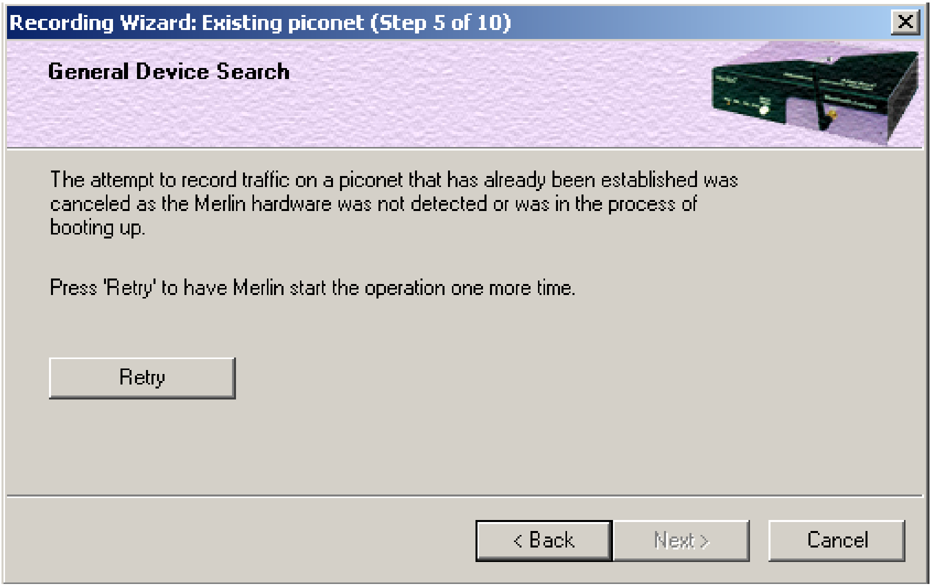
How long should Merlin search for nearby Bluetooth devices?

Any search duration between one and eighty seconds may be specified. However, a duration of between ten and twenty seconds should be enough time for Merlin to detect all nearby devices.

Have Merlin search 20 seconds for nearby devices.

Step 9 If you want to change the search duration, type in a new value into the text box. Otherwise, use the default value (20 seconds), then press **Next**.

The PC-Merlin hardware connection will be tested. If Merlin cannot be detected, the following message will display:



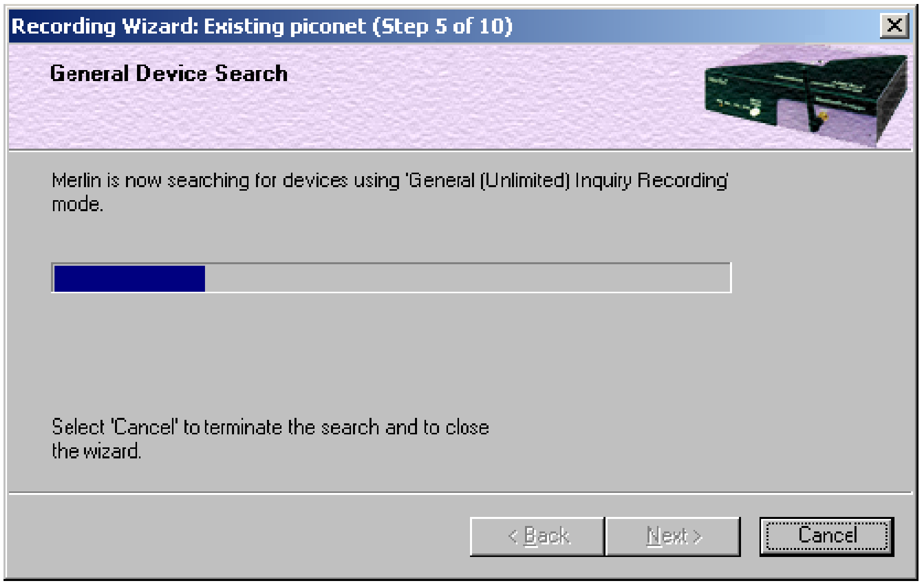
Recording Wizard: Existing piconet (Step 5 of 10)

General Device Search

The attempt to record traffic on a piconet that has already been established was canceled as the Merlin hardware was not detected or was in the process of booting up.

Press 'Retry' to have Merlin start the operation one more time.

If Merlin passes the hardware test, it will then goes onto conduct a General Inquiry to locate local Bluetooth devices.



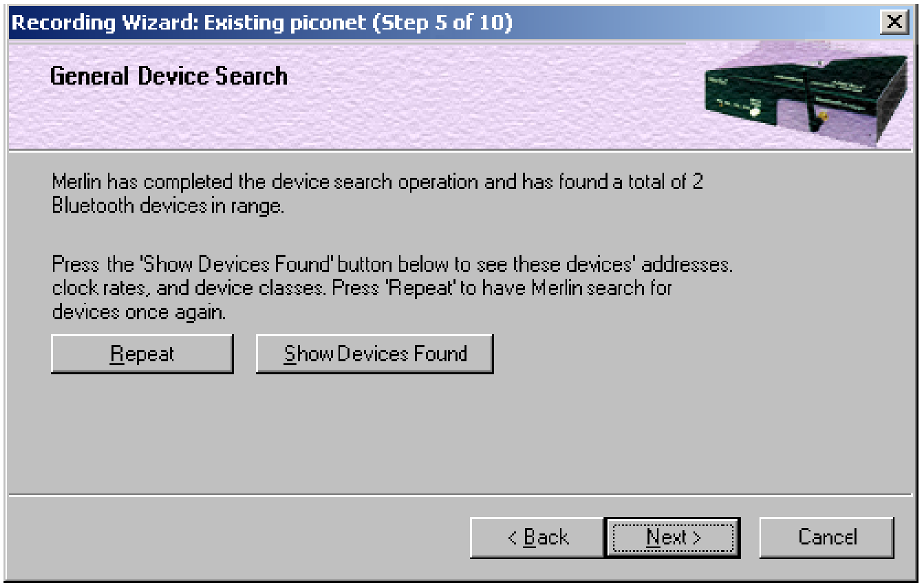
Recording Wizard: Existing piconet (Step 5 of 10)

General Device Search

Merlin is now searching for devices using 'General (Unlimited) Inquiry Recording' mode.

Select 'Cancel' to terminate the search and to close the wizard.

If Merlin finds Bluetooth devices, it will display the following message:



Recording Wizard: Existing piconet (Step 5 of 10)

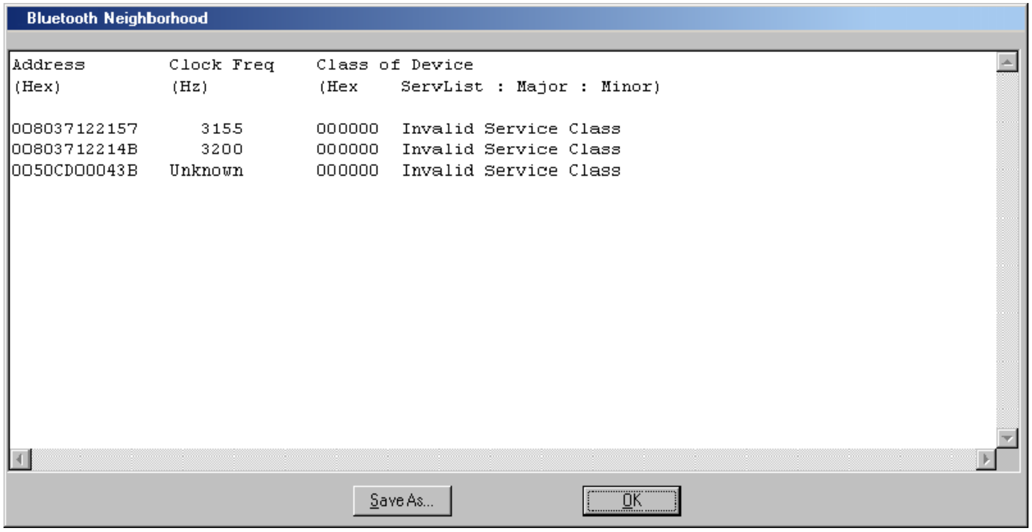
General Device Search

Merlin has completed the device search operation and has found a total of 2 Bluetooth devices in range.

Press the 'Show Devices Found' button below to see these devices' addresses, clock rates, and device classes. Press 'Repeat' to have Merlin search for devices once again.

Step 10 To display a list of the discovered devices, press the button marked **Show Devices Found**.

A screen will display showing the devices that Merlin discovered through the General Inquiry:



Bluetooth Neighborhood

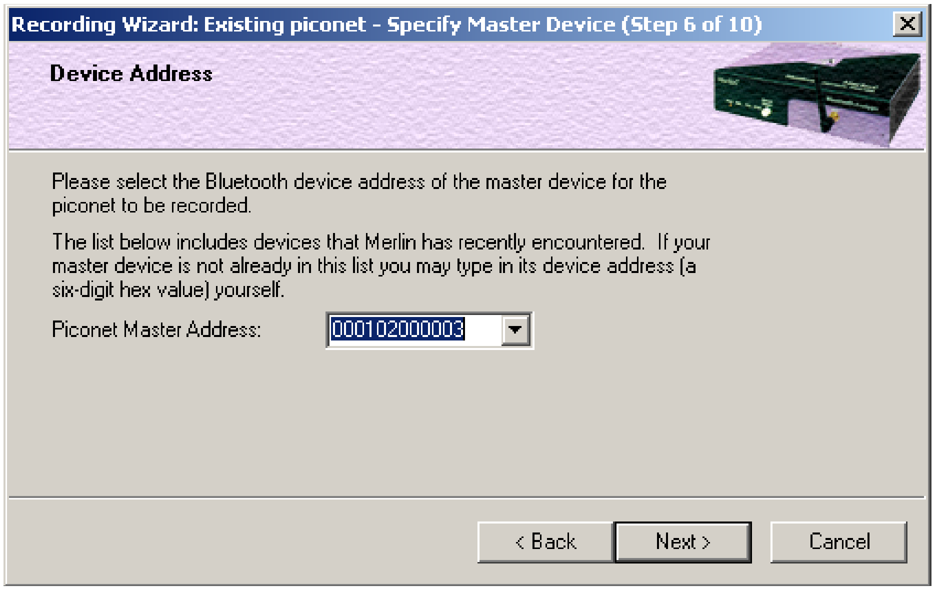
```
Address         Clock Freq    Class of Device
(Hex)           (Hz)          (Hex     ServList  : Major  : Minor)

008037122157       3155       000000   Invalid Service Class
00803712214B       3200       000000   Invalid Service Class
0050CD00043B    Unknown       000000   Invalid Service Class
```

If you feel that the list is incomplete, you can close this window and press the button marked **Repeat**. This will cause Merlin to repeat the General Inquiry and recollect information on local Bluetooth devices.

Step 11 Press **OK** to close the **Bluetooth Neighborhood** window.

Step 12 Press **Next** to advance to the next screen.

The following screen will prompt you for the Master device’s address. The address can be selected from the drop-down menu or typed into the box:



Recording Wizard: Existing piconet - Specify Master Device (Step 6 of 10)

Device Address

Please select the Bluetooth device address of the master device for the piconet to be recorded.

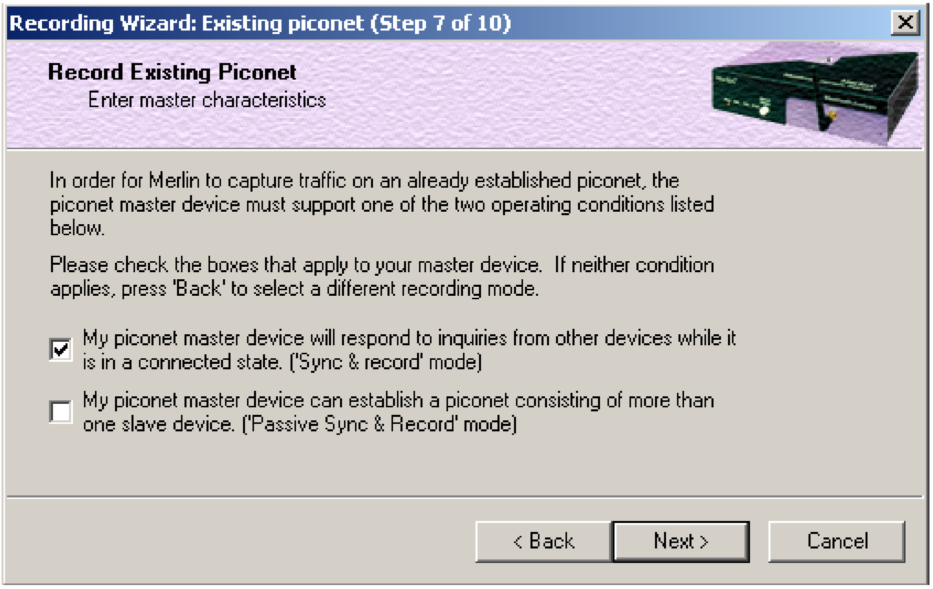
The list below includes devices that Merlin has recently encountered. If your master device is not already in this list you may type in its device address (a six-digit hex value) yourself.

Piconet Master Address: 000102000003

Step 13 Select or type in the Master device’s address into the box next to the label **Piconet Master Address**.

Step 14 Press **Next**.

The following screen will display. This screen asks you which of the following two options apply to your Master device. For some devices, both options will apply.



Recording Wizard: Existing piconet (Step 7 of 10)

Record Existing Piconet

Enter master characteristics

In order for Merlin to capture traffic on an already established piconet, the piconet master device must support one of the two operating conditions listed below.

Please check the boxes that apply to your master device. If neither condition applies, press 'Back' to select a different recording mode.

☑ My piconet master device will respond to inquiries from other devices while it is in a connected state. ('Sync & record' mode)

□ My piconet master device can establish a piconet consisting of more than one slave device. ('Passive Sync & Record' mode)

You can select either or both options. They are not mutually exclusive:

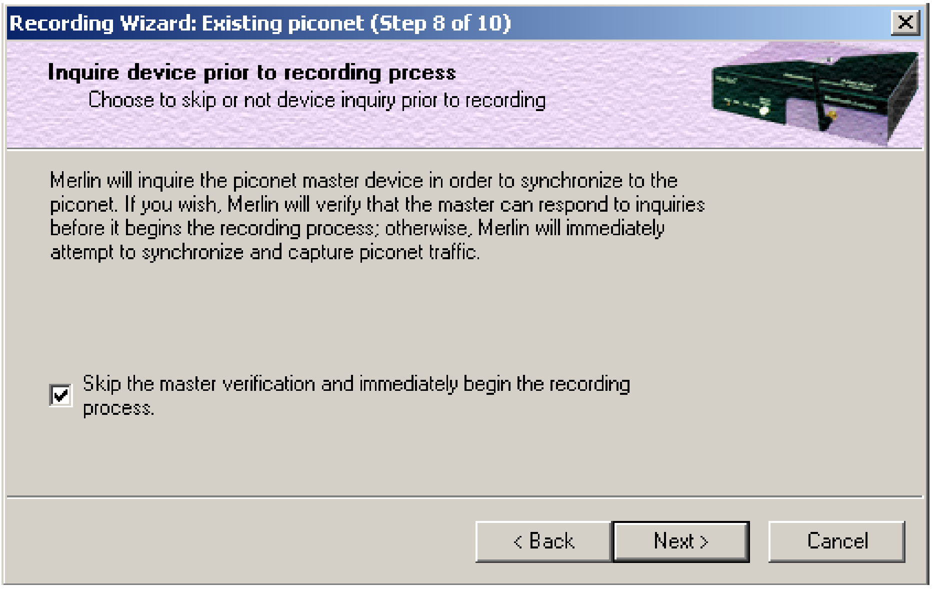
If the Master supports inquiries while in a connected state, select the first option. This will set Merlin to use the 'Sync & Record' mode in its attempts to synchronize to the Master. This will also cause the wizard to skip to step 8.

If the Master can support piconets with multiple slaves, select the second option. If you select this box alone (i.e., you leave the first box unchecked), Merlin will use the 'Passive Sync & Record' mode to synchronize to the Master. The wizard will then advance to Screen 8*.

If the first checkbox was selected, Merlin will use 'Sync & Record' no matter what was set in the second box.

Step 15 Select the options that pertain to your device, then press **Next**.

The screen that follows will depend on the options you selected above. If you selected the first option (=’Sync & Record’), the following screen will display. This screen gives you the option of verifying the presence of the Master device just before synchronizing.



Recording Wizard: Existing piconet (Step 8 of 10)

Inquire device prior to recording prcess

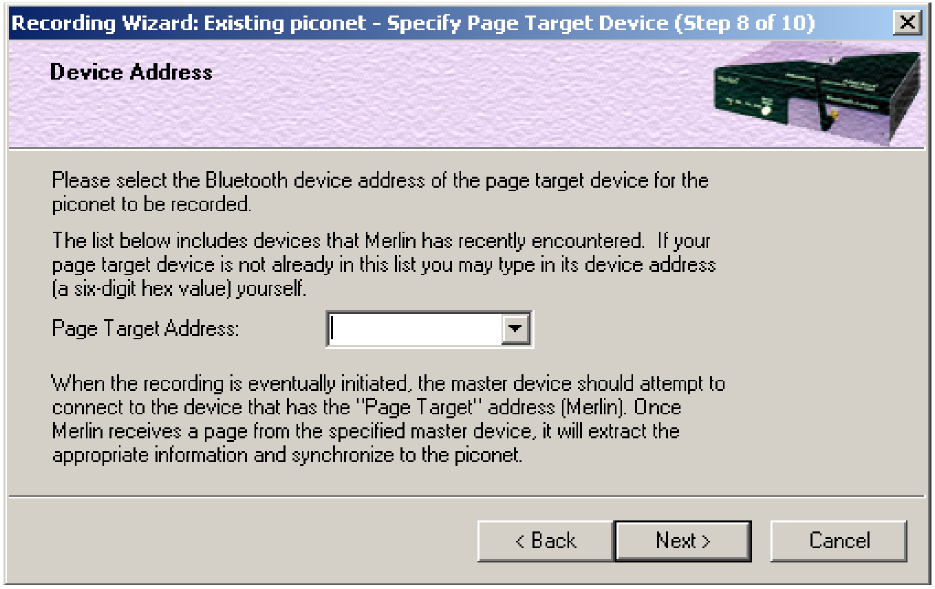
Choose to skip or not device inquiry prior to recording

Merlin will inquire the piconet master device in order to synchronize to the piconet. If you wish, Merlin will verify that the master can respond to inquiries before it begins the recording process; otherwise, Merlin will immediately attempt to synchronize and capture piconet traffic.

☑ Skip the master verification and immediately begin the recording process.

Step 16 If you want to skip the Master verification, put a check in the box. If you are in doubt, leave the box unchecked.

If you selected only the second option in Step 15 (=’Passive Sync & Record’), the following screen will display.



Recording Wizard: Existing piconet - Specify Page Target Device (Step 8 of 10)

Device Address

Please select the Bluetooth device address of the page target device for the piconet to be recorded.

The list below includes devices that Merlin has recently encountered. If your page target device is not already in this list you may type in its device address (a six-digit hex value) yourself.

Page Target Address:

When the recording is eventually initiated, the master device should attempt to connect to the device that has the "Page Target" address (Merlin). Once Merlin receives a page from the specified master device, it will extract the appropriate information and synchronize to the piconet.

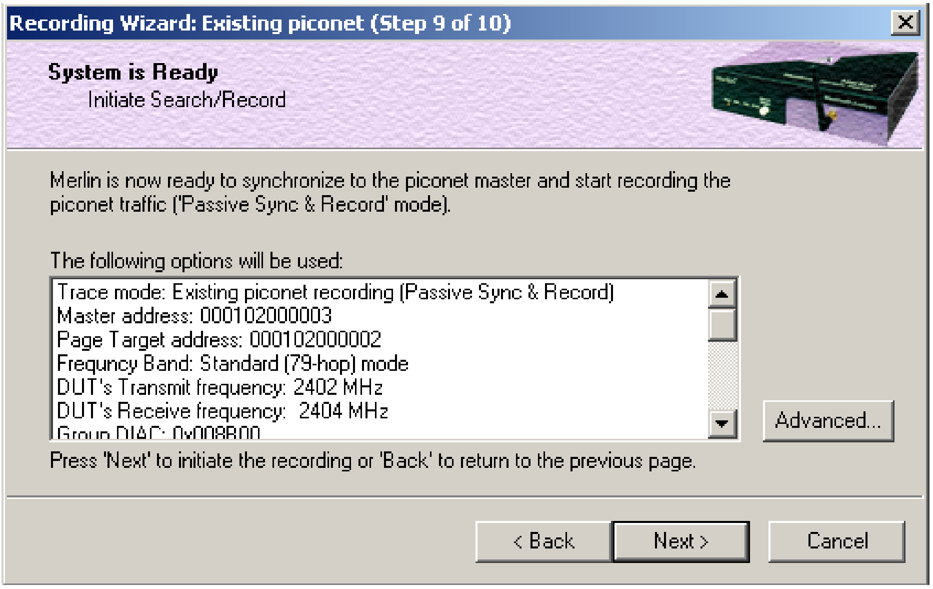
This screen asks you for the address of the Page Target device -- which in this case is Merlin. Since the devices in your piconet are not able to respond to inquiries, Merlin will not be able to page the devices and join the piconet. Instead, you will assign Merlin an address here in this screen, then direct your piconet Master device to connect to Merlin. The Master will attempt to connect to Merlin and therein give Merlin the information it needs to record the Master and slave devices.

Step 17 Type in an address of your choosing for Merlin (= Page Target).

You are making up an address for Merlin that the Master will use to try to connect to Merlin.

Step 18 Press **Next**

Merlin will then display your current settings.



Recording Wizard: Existing piconet (Step 9 of 10)

System is Ready
Initiate Search/Record

Merlin is now ready to synchronize to the piconet master and start recording the piconet traffic ('Passive Sync & Record' mode).

The following options will be used:

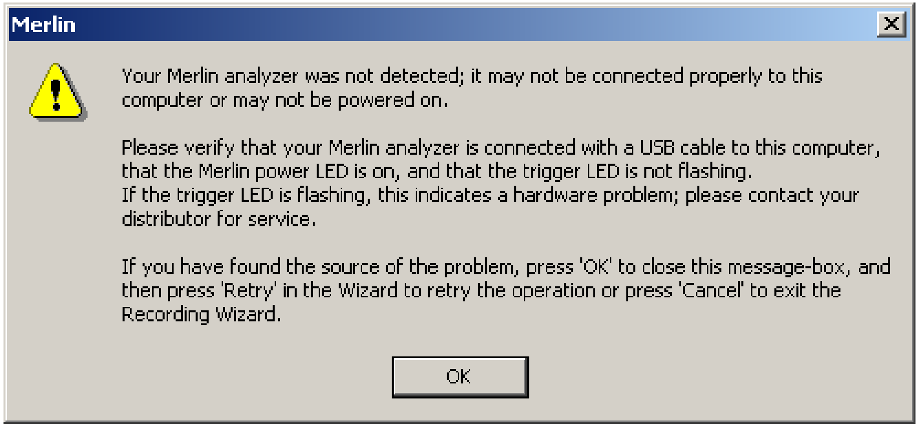
```
Trace mode: Existing piconet recording (Passive Sync & Record)
Master address: 000102000003
Page Target address: 000102000002
Frequncy Band: Standard (79-hop) mode
DUT's Transmit frequency: 2402 MHz
DUT's Receive frequency:  2404 MHz
Group DIAC: 0x008B00
```

Press 'Next' to initiate the recording or 'Back' to return to the previous page.

The **Advanced** button will open the Recording Options dialog box shown on page 42 and described in detail in Chapter 7.

Step 19 Press **Next** to begin the recording.

If the Merlin hardware is not ready or connected or is in the process of booting up, the following information message box will display:



Merlin

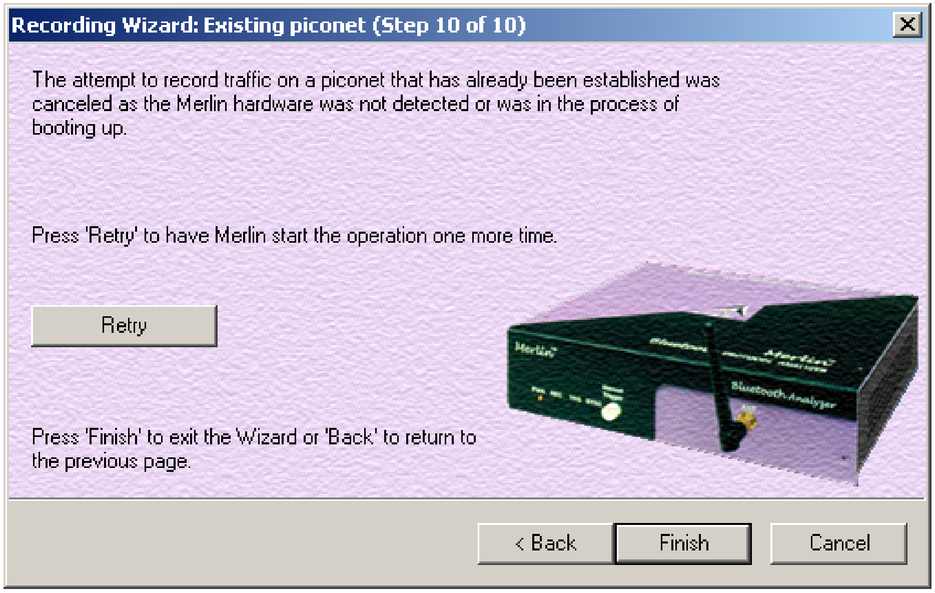
Your Merlin analyzer was not detected; it may not be connected properly to this computer or may not be powered on.

Please verify that your Merlin analyzer is connected with a USB cable to this computer, that the Merlin power LED is on, and that the trigger LED is not flashing.
If the trigger LED is flashing, this indicates a hardware problem; please contact your distributor for service.

If you have found the source of the problem, press 'OK' to close this message-box, and then press 'Retry' in the Wizard to retry the operation or press 'Cancel' to exit the Recording Wizard.

Step 20 If the above information box opened, press **OK** to close it.

The following dialog box will display:



Recording Wizard: Existing piconet (Step 10 of 10)

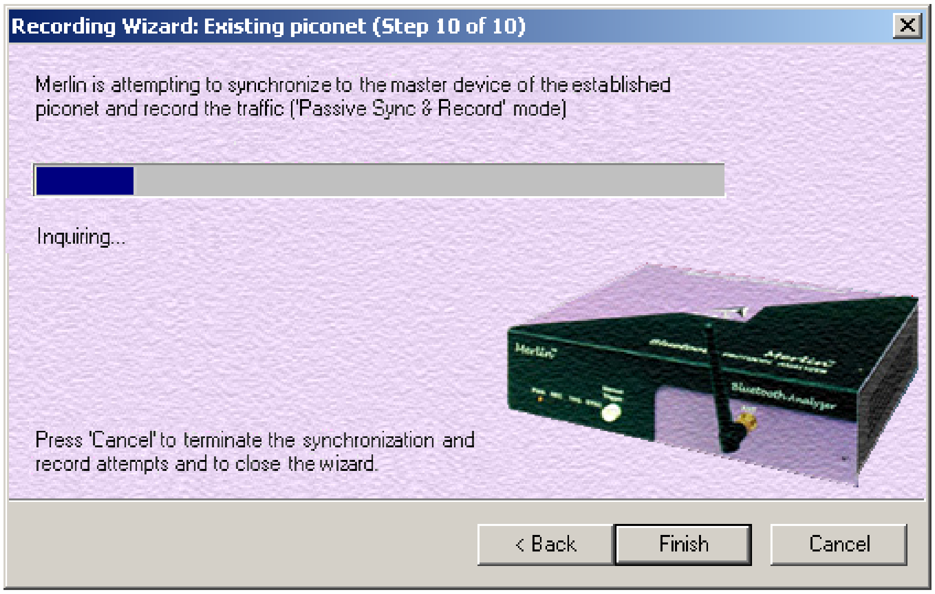
The attempt to record traffic on a piconet that has already been established was canceled as the Merlin hardware was not detected or was in the process of booting up.

Press 'Retry' to have Merlin start the operation one more time.

Press 'Finish' to exit the Wizard or 'Back' to return to the previous page.

Step 21 Press **Retry** or **Back** to re-attempt the process.

If the hardware failure described in Steps 20 and 21 do not occur, Merlin will conduct an inquiry. The screen will show that Merlin is going to attempt a recording in either 'Passive Sync & Record' mode as shown below or in 'Sync & Record' mode depending on the options you selected in Step 15.



Recording Wizard: Existing piconet (Step 10 of 10)

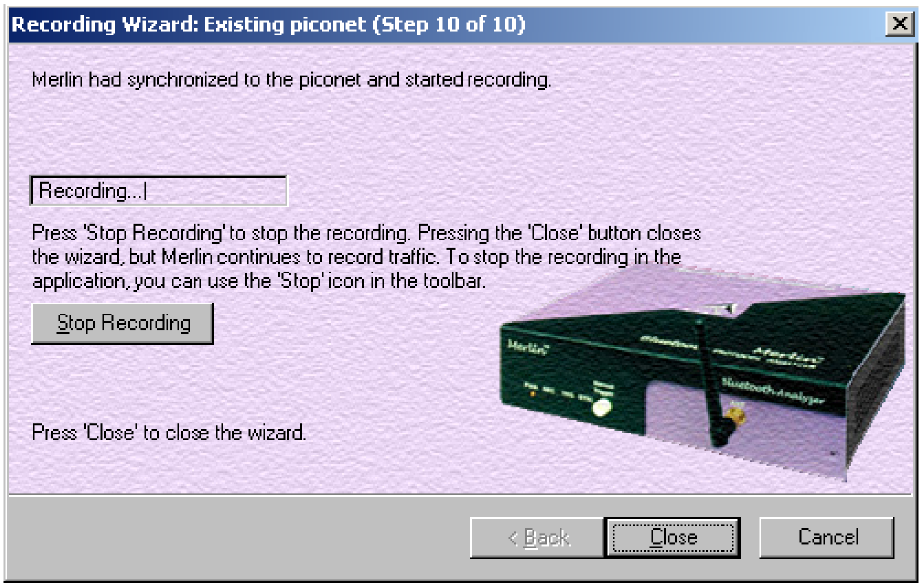
Merlin is attempting to synchronize to the master device of the established piconet and record the traffic ('Passive Sync & Record' mode)

Inquiring...

Press 'Cancel' to terminate the synchronization and record attempts and to close the wizard.

Step 22 If you are recording in 'Passive Sync & Record' mode, you will need to direct your Master device to attempt a connection to Merlin. This will provide Merlin with the information it needs to record the piconet.

Once Merlin has the information it needs, it will begin recording. The following screen will display:



Recording Wizard: Existing piconet (Step 10 of 10)

Merlin had synchronized to the piconet and started recording.

Recording...|

Press 'Stop Recording' to stop the recording. Pressing the 'Close' button closes the wizard, but Merlin continues to record traffic. To stop the recording in the application, you can use the 'Stop' icon in the toolbar.

Press 'Close' to close the wizard.

The recording will end following a trigger event or when you press **Stop Recording** button on the screen shown above or when you press the STOP button on the toolbar.

Step 23 When finished, press **Close** to close the Recording Wizard.

6.3 Recording in Test Mode

A Test Mode recording allows you to limit the frequency hopping range that Merlin will record. Two Test Modes are available: Reduced Hopping Mode and Single Frequency Mode. Reduced Hopping Mode limits Merlin's recording to the five frequency hops that are described in the Bluetooth Specification. Single Frequency Mode limits Merlin's recording to a single frequency range that you specify in the Recording Wizard.

Recording in Reduced Hopping Mode

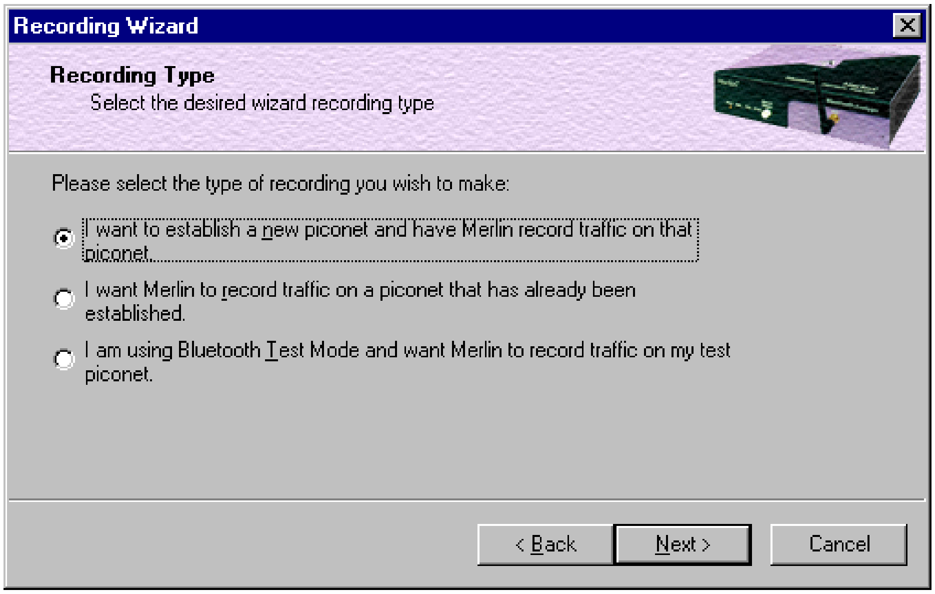
To record in Reduced Hopping Mode, perform the following steps:

Step 1 Start the Recording Wizard by either pressing the button REC or selecting **Setup > Recording Wizard** from the menu.

The Recording Wizard greeting screen will open.

Step 2 Press **Next** to advance to the **Recording Type** screen.

The following screen will display:



Recording Type
Select the desired wizard recording type

Please select the type of recording you wish to make:

● I want to establish a new piconet and have Merlin record traffic on that piconet.

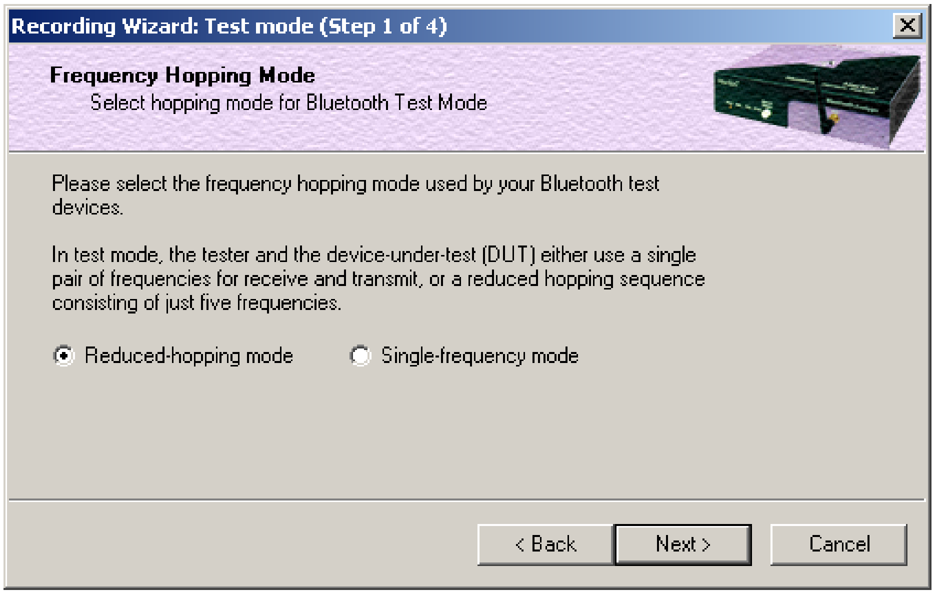
○ I want Merlin to record traffic on a piconet that has already been established.

○ I am using Bluetooth Test Mode and want Merlin to record traffic on my test piconet.

Step 3 Select the third option: **I am using Bluetooth Test Mode and want Merlin to record traffic on my test piconet.**

Step 4 Press **Next**.

The following screen will display:



Frequency Hopping Mode
Select hopping mode for Bluetooth Test Mode

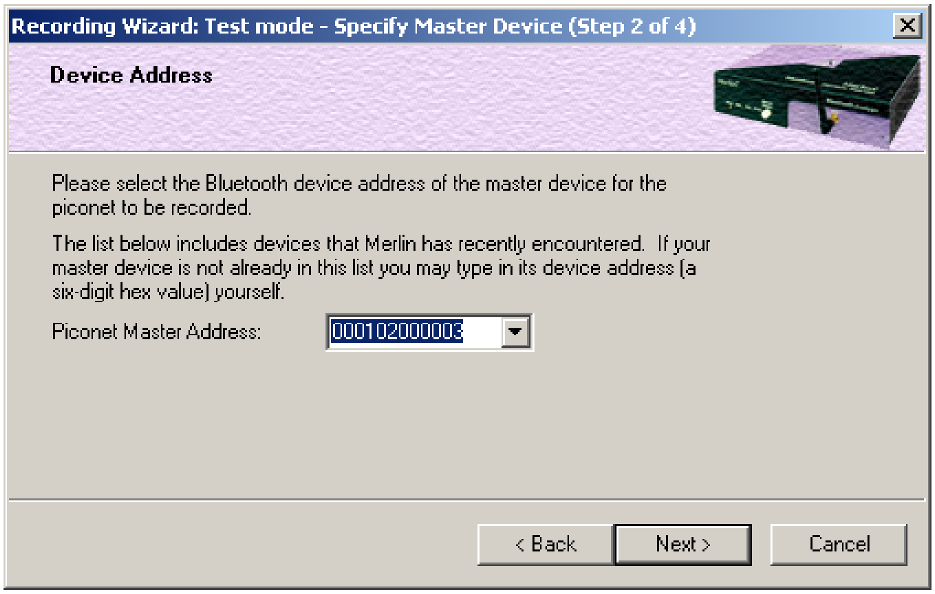
Please select the frequency hopping mode used by your Bluetooth test devices.

In test mode, the tester and the device-under-test (DUT) either use a single pair of frequencies for receive and transmit, or a reduced hopping sequence consisting of just five frequencies.

● Reduced-hopping mode ○ Single-frequency mode

Step 5 Select the option **Reduced-hopping mode**, then press **Next**.

The following screen will display:



Recording Wizard: Test mode - Specify Master Device (Step 2 of 4)

Device Address

Please select the Bluetooth device address of the master device for the piconet to be recorded.

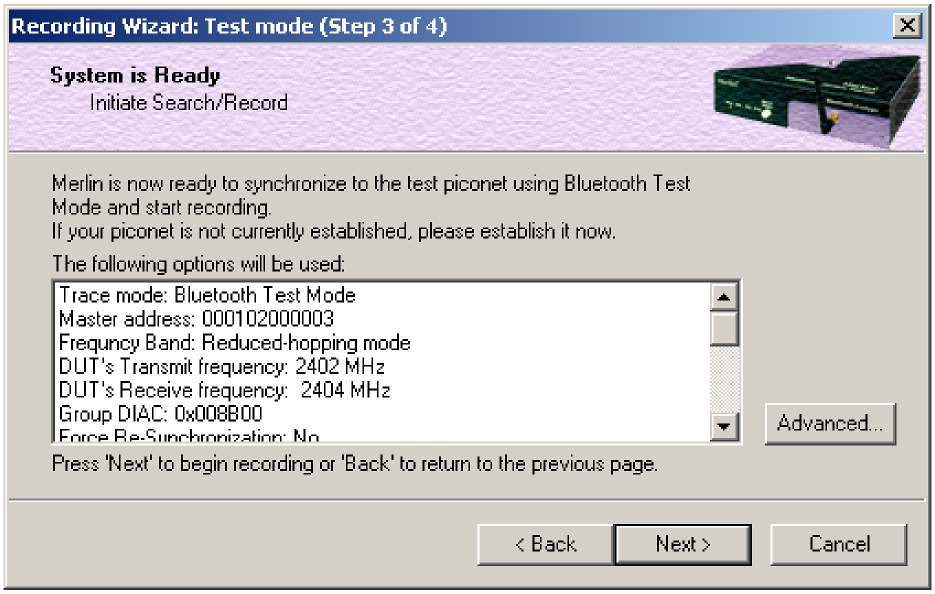
The list below includes devices that Merlin has recently encountered. If your master device is not already in this list you may type in its device address (a six-digit hex value) yourself.

Piconet Master Address: 000102000003

Step 6 Select the address for your piconet's Master device from the drop-down menu. If you prefer, you can type in the address into the box.

Step 7 Press **Next**.

The following screen will display. This screen will show the current settings for the recording:



Recording Wizard: Test mode (Step 3 of 4)

System is Ready
Initiate Search/Record

Merlin is now ready to synchronize to the test piconet using Bluetooth Test Mode and start recording.
If your piconet is not currently established, please establish it now.

The following options will be used:

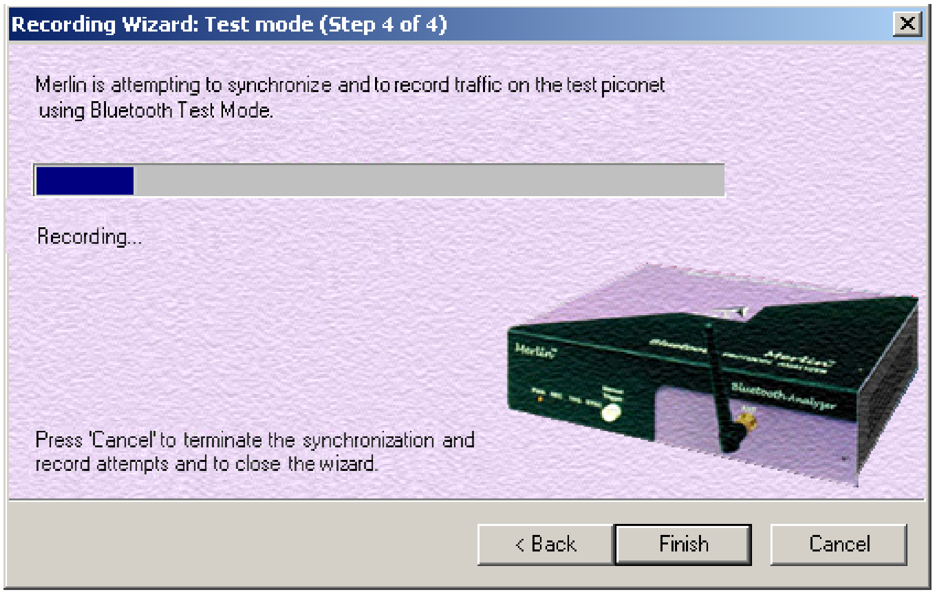
Trace mode: Bluetooth Test Mode
Master address: 000102000003
Frequncy Band: Reduced-hopping mode
DUT's Transmit frequency: 2402 MHz
DUT's Receive frequency: 2404 MHz
Group DIAC: 0x008B00
Force Re-Synchronization: No

Press 'Next' to begin recording or 'Back' to return to the previous page.

The Advanced button will open the Recording Options dialog box. See Chapter 7 for details on the Recording Options dialog box.

Step 8 Press **Next** to begin the recording.

The following screen will display:



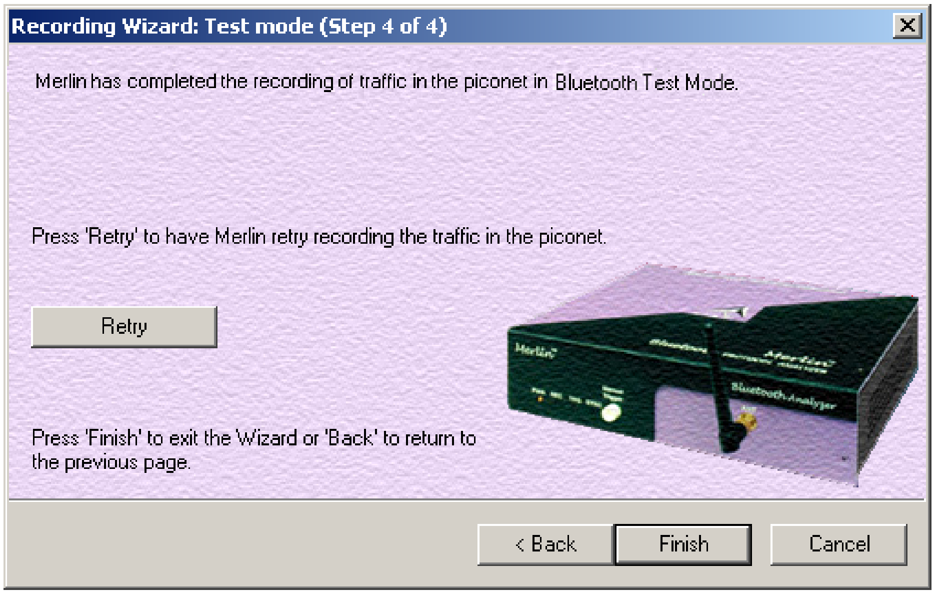
Recording Wizard: Test mode (Step 4 of 4)

Merlin is attempting to synchronize and to record traffic on the test piconet using Bluetooth Test Mode.

Recording...

Press 'Cancel' to terminate the synchronization and record attempts and to close the wizard.

Step 9 When the recording finishes, the following screen will display. You can repeat the recording by pressing the **Repeat** button.



Recording Wizard: Test mode (Step 4 of 4)

Merlin has completed the recording of traffic in the piconet in Bluetooth Test Mode.

Press 'Retry' to have Merlin retry recording the traffic in the piconet.

Press 'Finish' to exit the Wizard or 'Back' to return to the previous page.

Step 10 To close the wizard, press **Finish**.

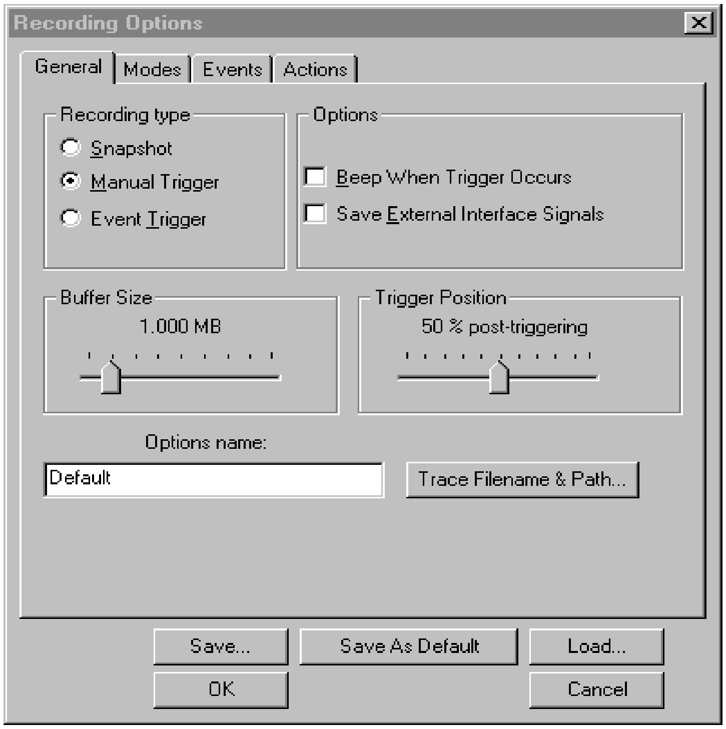
7. Recording Options

The **Recording Options** dialog box controls how Merlin records Bluetooth™ data. At the top of the Recording Options dialog box are four tabs that provide access to dialog boxes called General, Modes, Events, and Actions. Using these dialog boxes, you can configure Merlin to create event triggers, increase or decrease memory allocation for recording, and interact with other Bluetooth™ devices in different ways.

Opening the Recording Options Dialog Box

To open the **Recording Options** menu, click TRG on the Tool Bar or select **Recording Options** under **Setup** on the Menu Bar.

You see the **Recording Options** window:



Recording type
○ Snapshot
● Manual Trigger
○ Event Trigger

Options
□ Beep When Trigger Occurs
□ Save External Interface Signals

Buffer Size
1.000 MB

Trigger Position
50 % post-triggering

Options name:
Default

The **Recording Options** window has four tabs marked

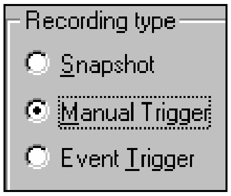
- **General**
- **Modes**
- **Events**
- **Actions**

7.1 Recording Options - General

The General tab opens a window shown in the previous illustration made up of four boxes marked *Recording Type, Buffer Size, Trigger Position,* and *Options*.

Recording type

The **Recording Type** box presents three options that allow you to set how Merlin begins and ends a recording. The options are: *Snapshot, Manual Trigger,* and *Event Trigger.*



Recording type

○ Snapshot

● Manual Trigger

○ Event Trigger

Snapshot

A Snapshot is a fixed-length recording whose size is determined by the "Buffer Size" box in the Recording Options dialog or by a manual click of the Stop button. Recording begins by clicking REC on the Tool Bar and ends when either the selected buffer size is filled or you press the Stop button.

Manual Trigger

A Manual Trigger recording is a one that is manually begun and ended. Recording is begun by pressing REC on the Tool Bar. Recording continues in a circular manner within the limits set by the buffer size. Recording ends when STOP is clicked on the Tool Bar or the Trigger button is pressed on the analyzer's front panel. If you press the Trigger button, recording will continue until the post-trigger memory has been filled.

Event Trigger

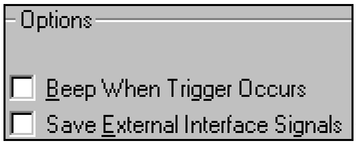
An Event Trigger recording is one that uses an event trigger to end the recording. Before recording begins, you define the event trigger in the Trigger Options dialog box. You begin the recording by clicking REC on the Tool Bar. Recording continues in a circular manner within the limits set by the buffer size. Once the trigger event occurs, some post-trigger recording occurs, then the recording ends.

Note In this mode, the recording can be stopped manually in the same way as for "manual trigger" mode.

Options

The Options box contains two options:

Beep When Trigger Occurs



Options

□ Beep When Trigger Occurs

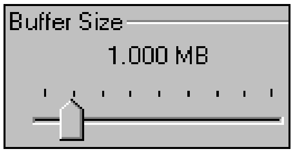
□ Save External Interface Signals

Will cause the PC to beep when a trigger event has occurred.

Save External Interface Signals

Will enable Merlin to record input signals from a breakout board as fields in a trace.

Buffer Size



Buffer Size

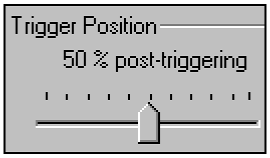
1.000 MB

The Buffer Size box has a slide bar for adjusting the recording buffer size from 0.1 megabytes to 128 megabytes.

The Recording Type option determines how this buffer is used. Although there are 128 megabytes of physical memory in the analyzer, the efficiency of the recording ranges from 2:1 to 4:1 ratios of physical memory to actual Bluetooth™ traffic. Shorter Bluetooth™ packets yield a less efficient recording. The non-traffic portion of physical memory is utilized for control and timing information.

Note The scale is not linear and affords more granularity in the smaller buffer sizes.

Trigger Position



Trigger Position

50 % post-triggering

The Trigger Position slide bar sets the amount of post-trigger recording that Merlin will perform. It also allows adjustment of the location of the trigger within the defined buffer. You can adjust the Triggering Position between 1 and 99% post-Trigger. **Trigger Position** is available only when **Manual Trigger** or **Event Trigger** is selected as **Recording type**.

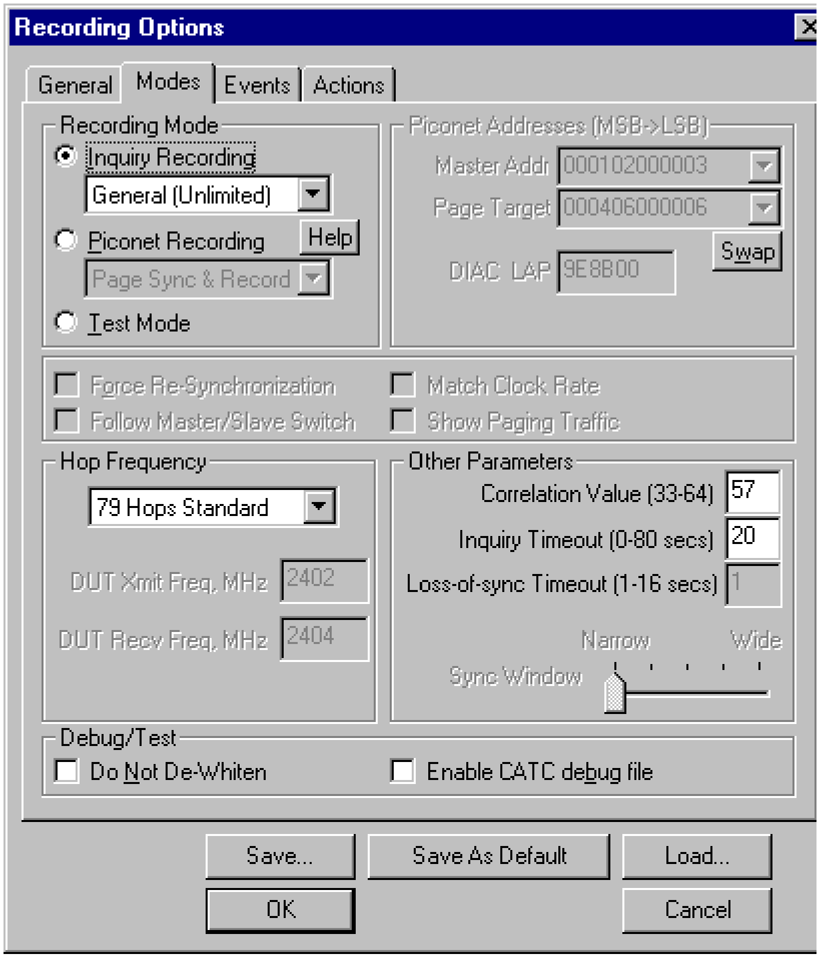
As an example, if the buffer size is set to 16MB, then for the following Trigger Position settings, the amount of pre- and post-Trigger data is

- 95% post-triggering: 0.8MB pre-trigger, 15.2MB post-trigger
- 75% post-triggering: 4MB pre-trigger, 12MB post-trigger
- 50% post-triggering: 8MB pre-trigger, 8MB post-trigger
- 25% post-triggering: 12MB pre-trigger, 4MB post-trigger
- 5% post-triggering: 15.2MB pre-trigger, 0.8MB post-trigger

Note When a Trigger occurs, recording continues until the post-Trigger amount of the buffer is filled.

7.2 Recording Options - Modes

The tab marked Modes opens a window for setting recording mode options. This window is divided into six boxes marked Recording Mode, Piconet Addresses, Hop Frequency, Other Parameters, and Debug/Test.



Recording Mode
● Inquiry Recording
General (Unlimited)
○ Piconet Recording
Page Sync & Record
○ Test Mode

Piconet Addresses (MSB->LSB)
Master Addr 000102000003
Page Target 000406000006
DIAC LAP 9E8B00

□ Force Re-Synchronization
□ Follow Master/Slave Switch
□ Match Clock Rate
□ Show Paging Traffic

Hop Frequency
79 Hops Standard
DUT Xmit Freq, MHz 2402
DUT Recv Freq, MHz 2404

Other Parameters
Correlation Value (33-64) 57
Inquiry Timeout (0-80 secs) 20
Loss-of-sync Timeout (1-16 secs) 1
Sync Window Narrow Wide

Debug/Test
□ Do Not De-Whiten
□ Enable CATC debug file

Recording Mode

To record Bluetooth™ traffic, the Merlin analyzer needs to synchronize to the piconet under observation. Merlin does not participate in the piconet and behaves as a passive listener. It needs, however, to communicate briefly with the devices in the piconet to learn the Master clock and frequency hopping sequence.

To synchronize to the piconet under observation, Merlin can be set up in different recording modes. Two drop-down menus present these modes: *Inquiry Recording* and *Piconet Recording*.

Inquiry Recording

The "Inquiry Recording" drop-down menu presents two choices for recording Inquiries: "General (Unlimited)" and "Dedicated (Limited)."

General (Unlimited)

"General" means "General Inquiry" and is used to search for ALL Bluetooth™ devices that are within range, for the amount of time specified in the Inquiry Timeout field. Completion of the inquiry process is indicated by illumination of the "trigger" light on the front of the analyzer. All responding packets will be displayed when data upload from the analyzer completes.

Dedicated (Limited)

"Dedicated" means a specific class or group of Bluetooth™ devices (designated by the DIAC field of the Recording Options dialog). Selecting "Dedicated" causes Merlin to search for all devices from a specific class or group that are within range, for the amount of time specified in the Inquiry Timeout field. Completion of the inquiry process is indicated by illumination of the "trigger" light on the front of the analyzer. All responding packets will be displayed when stop is selected.

Piconet Recording

The "Piconet Recording" drop-down menu presents three choices for recording piconet traffic: Sync and Record, Passive Sync & Record, and Page Sync & Record.

A Help button next to the menu briefly explains these options.

Page Sync & Record is the preferred option and should be used whenever possible. If Page Sync & Record can not be used, then Sync & Record should be used. Passive Sync and Record should be used only if the first two options can not be used.

Page Sync & Record

"Page Sync and Record" is the recommended method of recording. "Page Sync and Record" should be implemented before a piconet is established. This mode causes Merlin to perform a General Inquiry and collect sync information from the specified slave device when it responds. Merlin then waits for the Master to begin paging the Slave devices. When paging begins, Merlin synchronizes to the Master and begins recording.

Note In order for this mode to work, the intended Slave must support "inquiry scan".

The following steps describe the simplest way to use this mode:

Step 1 Place both the "intended master" as well as its first "intended slave" into inquiry scan mode.

Step 2 Have Merlin perform a General Inquiry. You do this by selecting "General (Unlimited)" from the "Inquiry Recording" drop-down menu on the "Modes" tab in the "Recording Options" window, and then depressing the "REC" button found on Merlin's toolbar.

Step 3 After the General Inquiry completes, as indicated by the automatic uploading and displaying of a CATC trace (approximately 20 seconds), reselect the "Modes" tab in the "Recording Options". At this point, the addresses of all Bluetooth™ devices that were in range will be listed in the pull-down windows in the "Piconet Addresses" area of this window. Using the pull-down windows select both your "Intended BT Master" as well as your "Intended Slave" address for display in their appropriate windows.

Step 4 After closing this window by pressing the "OK" button at the bottom of the window, once again depress the "REC" button found on Merlin's toolbar. After approximately 20 seconds, the "SYNC" light on the front of Merlin will begin to flash, meaning that Merlin has acquired all the information it needs to fully synchronize with the piconet about to be established. At this point, you should establish the piconet using the devices previously defined as master and slave.

Step 5 When the piconet is established, the "Sync" light on the front of Merlin will change from flashing to solid, indicating that Merlin is fully synchronized to the piconet and is currently recording all traffic within that piconet.

Note If the "sync" light on the front of Merlin does not change from flashing to solid it means that Merlin did not synchronize with the piconet when it was established.

Sync & Record

Sync and Record works just like "Page Sync and Record" except that Merlin takes its sync data directly from the Master instead of the Slave devices. With Sync and Record, Merlin conducts a General Inquiry to get hop frequency and clock information from the Master. Merlin then waits to detect piconet traffic from the Master device's piconet. When the piconet is established, Merlin is able to synchronize to the Master and begin recording. In contrast to "Page Sync and Record", "Page Sync and Record" can be run with or without an established piconet.

Note This mode can only be used to find master devices that support Inquiry Scan.

To perform a "Sync and Record", follow the steps below:

Step 1 Turn on the Bluetooth™ devices under observation, and set up the master device so it is ready to respond to Inquiry scan. For a typical recording, ensure that the Master and Slave device(s) are not yet connected.

Step 2 In the Modes tab under Recording Options, enter the Master Device's address.

Step 3 Start Merlin recording by pressing REC icon in the toolbar.

Step 4 When the analyzer is able to Sync up to the Piconet Master Clock, the Green **Sync** LED in the Merlin front panel will start blinking.

Step 5 Establish connection between the Bluetooth™ devices under analysis.

Step 6 When Merlin senses Piconet traffic, the Green **Sync** light goes ON solid, recording starts and the status bar in the bottom of the analyzer screen shows activity.

Recording may be stopped manually or when the recording buffer is filled.

Note After the Sync light starts blinking, a connection between the Bluetooth™ devices should be established within one (1) minute.

Passive Sync & Record

Passive Sync and Record is used in situations where the Master device and slave devices do not support Inquiry Scan mode. When selected, Merlin enters Inquiry Scan and Page Scan mode and waits for a page from the

Master device. When the piconet Master pages Merlin, Merlin obtains the information necessary for synchronization and then attempts to synchronize to the piconet controlled by that Master.

"Passive Sync and Record" is designed to be used with established piconets or *private device networks*.

Running "Passive Sync and Record" with Established Piconets

For most situations, "Passive Sync and Record" will be run after a piconet has been established. The steps are as follows:

Step 1 Establish a connection between two or more Bluetooth™ devices.

Step 2 Under General Recording Options, select "Passive Sync and Record."

Step 3 Under the Modes tab in Recording Options, enter the address for the piconet's master device.

Step 4 Make up an address for Merlin and enter it into the Page Target address in the Modes tab in Recording Options. Make sure you do not select an address for any other local device.

Step 5 Press the REC button on the toolbar in Merlin to start a recording session.

Step 6 If necessary, have Master "discover" Merlin through a General Inquiry.

Step 7 From the Master device, initiate a page to Merlin's address. This action will enable Merlin to synchronize to the piconet. However, the analyzer will not complete the page sequence from the Master. This will cause the Master to time out in this request.

Step 8 At the end of this sequence, the green **Sync** light will go on solid, recording will begin and activity will be displayed on the status bar in the bottom of the analyzer screen.

Running "Passive Sync and Record" with Private Device Piconets

Because *private device networks* do not allow other devices to join the network, Merlin needs to temporarily assume the identity of a slave in the network in order to join that network. To do this requires disabling the slave and beginning the operation without an established piconet. The following steps show the process.

Step 1 Turn the Master device on and the slave device off. You need the slave device turned off so that Merlin can take its place in the piconet.

Step 2 Enter the slave's address into Merlin's "Page Target" field in the Modes tab in the Recording Options dialog box.

Step 3 Run "Passive Sync and Record." The Master will then page the slave's address and Merlin will be able to sync.

Step 4 When Merlin synchronizes to the Master, turn the slave back on. When the Master re-pages the address the slave will be admitted into the private network. Since Merlin is passive in this mode, the slave and Merlin do not conflict over the shared address. Merlin is then able to record the traffic between the Master and slave.

Test Mode

Test Mode allows you to set Merlin's Hop Frequency to a some preset test frequencies. When "Test Mode" is selected, the parameters marked "Limited Hop" and "Single Frequency" in the list under “Hop Frequency” (described below) become selectable.

Hop Frequency

Until recently, local regulations in Japan, France, and Spain defined a Bluetooth™ frequency range that was different than the range used by the rest of the world. We have included the selections for organizations for testing of devices developed before all frequencies were made available on a world-wide basis.

To set Merlin to the correct Hop Frequency, select from the drop-down menu one of the following choices:

- 79 Hops Standard
- 23 Hops Japan
- 23 Hops Spain
- 23 Hops France
- Limited Hop - When "Test Mode" is selected (see above), the

Hop Frequency menu changes and displays two options called Limited Hop and Fixed Frequency. The "Limited Hop" setting restricts Merlin to five hop frequencies defined in the test mode specification of the Bluetooth™ Specification.

- Fixed Frequency - Allows the the transmit and receive frequency ranges to be specified. Selecting this option highlights the "DUT Xmit" and "DUT Recv" text boxes. Enter values into the two text boxes to the set the transmit and receive frequency ranges:
    - DUT Xmit Freq, MHz (+2402) – Allows the setting of the transmit signal for the Device Under Test
    - DUT Recv Freq, MHz (+2404) – Allows the setting of the receive signal for the Device Under Test

Force Re-synchronization

"Force Re-Synchronization" forces Merlin to re-synchronize at the beginning of each "Page Sync & Record," "Passive Sync & Record," or "Sync & Record" operation. By default, "Force Re-Synchronization" is disabled (i.e., unchecked).

Unchecking the "Force Re-Synchronization" checkbox tells Merlin to use its existing data on Bluetooth™ devices, thereby bypassing the synchronization process and saving a few seconds from the beginning of the trace. If you know that Merlin's data is correct, you can uncheck this checkbox and cause Merlin to try to use the existing data. If the data is incomplete or incorrect, however, Merlin will automatically perform a refresh.

To examine Merlin's Bluetooth™ data, open "BT Neighborhood" under the View menu.

Follow Master/Slave Switch

If enabled, this option allows Merlin to follow a role switch between a Master and Slave. This capability allows Merlin to keep track of changes in a device's role when it changes from one role to another.

Merlin is able to follow a role change by listening to the Slave device's Bluetooth clock and hop frequency as soon as it becomes a Master.

Match Clock Rate

Match Clock Rate is a useful option if the Master device's clock is inaccurate. Match Clock Rate causes Merlin to do a General Inquiry to determine the Page Target's clock rate prior to synchronizing to the piconet. If unchecked, Merlin will begin piconet synchronization without first doing a General Inquiry.

This option only works with Page Sync and Record mode.

Show Paging Traffic

Show Paging Traffic causes Merlin to capture paging traffic between the Master and Page Target devices. This option is used only with Page Sync and Record Mode.

Piconet Addresses (MSB -> LSB)

- **Master Add**r - Piconet Master Address for device under observation. Used for all Piconet recording modes.
- **Page Target -** User selectable address for the Merlin Analyzer. Used for Passive Sync & Record and Page Sync & Record.
- **DIAC LAP**- Device Inquiry Access Code. Used for Device Inquiry.
- **Swap** - The "swap" button swaps the addresses between the Master Addr and Page Target text boxes. This button will allow addresses to be swapped even if the boxes are grayed out.

Note GIAC - General Inquiry Access Code is hard-coded in the analyzer and does not require user selection.

Other Parameters

Correlation Value (33-64)

This value tells Merlin how many bits in the sync word of each received packet must be matched in order for Merlin to consider the packet valid and start recording.

Inquiry Timeout (0-80 secs)

Default value is 20 seconds.

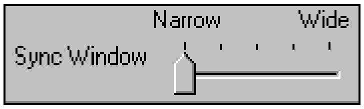
This value specifies how long Merlin should perform the Inquiry process for the General (unlimited) and Dedicated (limited) recording modes. After the specified time has elapsed, Merlin will illuminate the trigger light on the front of the analyzer.

Loss of Sync Timeout (1-16 secs)

This value specifies the amount of time that Merlin will wait for piconet traffic before determining that synchronization has been lost.

Sync Window

The Sync Window slide bar controls the amount of time that Merlin should wait between receiving an Inquiry Response (which will cause the Sync LED to blink) and detecting Master-Slave piconet traffic (which will cause the Sync LED to turn solid.)



A "Narrow" setting means that the wait time will be minimal, a "Wide" setting means it will be "maximal." The default is "Narrow" and this is suitable for most recordings. However, if significant drift occurs between Merlin’s clock and that of the Master, Merlin may not be able to sync properly to the piconet. Under these conditions, you should move the slide bar towards the "Wide" Setting. The slide bar has five discrete settings.

After sync is established, Merlin will remain in sync as long as there is piconet traffic.

Debug/Test

Do Not De-Whiten

Normally, all data packets sent between Bluetooth™ devices are whitened (scrambled) to eliminate DC bias in the transmitted data stream. For debug purposes or in the case where you have not integrated whitening into your design, this option can be turned off. If you check this box, Merlin will assume that none of the data it receives has been whitened, and will therefore not apply dewhitening (descrambling) to received packets.

Enable CATC debug file

Checking this box enables the creation of a file that can be used by CATC Support to aid in debugging. This option should always be disabled unless you are requested to enable it by CATC personnel.

7.3 Recording Options - Events

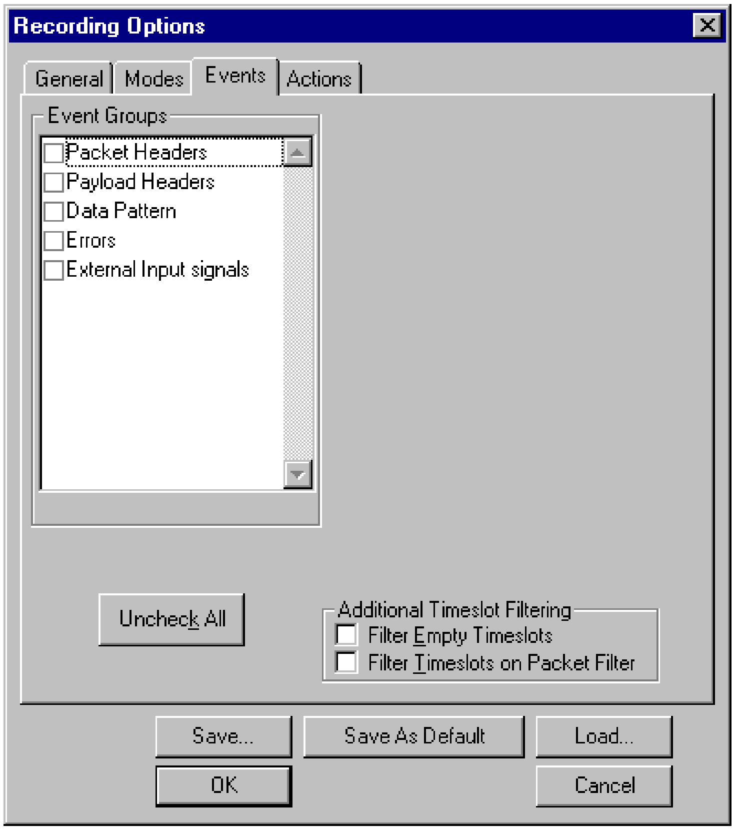
If you have selected **Event Trigger** mode under the **General** tab in the Recording Options screen, you may now select specific Bluetooth™ events using the **Events** tab on the **Recording Option** Screen. You can also use the **Actions** tab to define specific event sequences that will trigger Merlin to record a Bluetooth™ session.

In addition, the **Events** and **Actions** screens allow you to specify which packets you want to include or exclude from the recording.

Events Options

- Click the **Events** tab on the **Recording Options** screen.

You see the **Event Groups** window:



Event Groups

☐ Packet Headers
☐ Payload Headers
☐ Data Pattern
☐ Errors
☐ External Input signals

Additional Timeslot Filtering

☐ Filter Empty Timeslots
☐ Filter Timeslots on Packet Filter

The Event triggering and filtering options allow you to set event conditions for errors and/or a variety of packet characteristics.

Clicking a check box causes further options to display in the right side of the window.

Additional Timeslot Filtering

By default, Merlin records frequency hop and timestamp information for all time slots in the Piconet under analysis, regardless of whether the time slot contained a Bluetooth™ packet. This means that in instances where there is little piconet traffic, Merlin will display row after row of empty packets -- each representing an empty time slot. Through the use of timeslot filtering, these empty packets can be filtered out. Filtering out this information has the benefit of freeing memory so that more traffic can be recorded.

Filter Empty Slots

If "Filter Empty Slots" is checked, Merlin will exclude all empty time slots from a recording except for those that lie immediately in front of Bluetooth™ communications packets. These remaining empty packets are preserved to give timestamp and frequency hop reference data to the packets that follow.

Filter Slots on Packet Filter

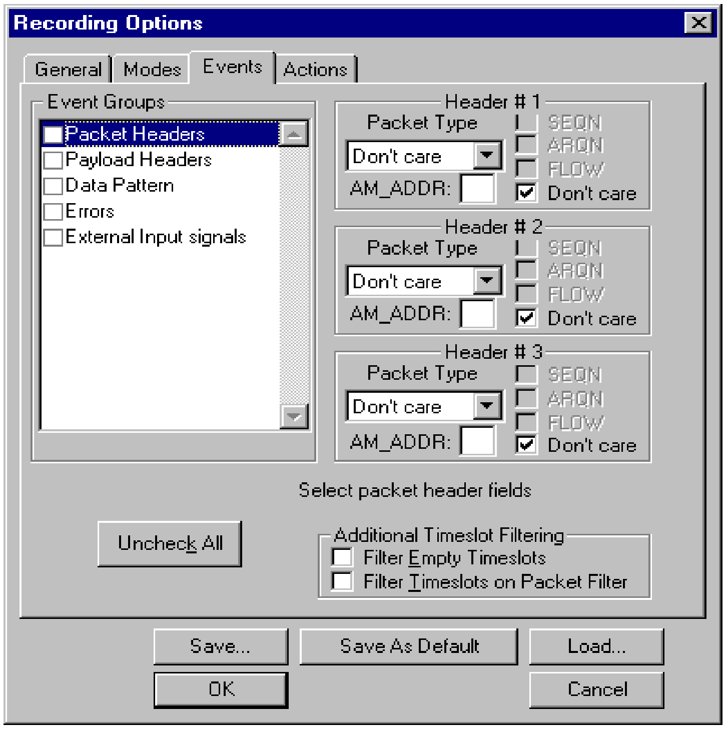
If filters are used to exclude FHS, DM1 or other packets, Merlin will exclude these packets from a trace and mark their locations with empty packets. The result can be rows and rows of empty packets. The option "Filter Empty Slots" will not exclude these empty slots because they lie immediately in front of Bluetooth™ communications packets - even though those packets were not recorded. To eliminate these empty packets, select "Filter Slots on Packet Filter."

Packet Headers

Clicking "Packet Headers" opens three sets of check boxes and menus on the right that represent fields within packet headers: Packet Type, Active Member Address, Flow Control, Acknowledgment, and Sequence Number.

- Select **Packet Headers** under **Event Groups.**

You see the **Packet Headers** window:



Event Groups:
☐ Packet Headers
☐ Payload Headers
☐ Data Pattern
☐ Errors
☐ External Input signals

Header # 1: Packet Type: Don't care; AM_ADDR: ; ☐ SEQN ☐ ARQN ☐ FLOW ☑ Don't care

Header # 2: Packet Type: Don't care; AM_ADDR: ; ☐ SEQN ☐ ARQN ☐ FLOW ☑ Don't care

Header # 3: Packet Type: Don't care; AM_ADDR: ; ☐ SEQN ☐ ARQN ☐ FLOW ☑ Don't care

Select packet header fields

Additional Timeslot Filtering
☐ Filter Empty Timeslots
☐ Filter Timeslots on Packet Filter

Packet Type

The Packet Type drop down menu lets you select the following packet types for filtering or triggering: NULL, POLL, FHS, DM1, DH1, HV1, HV2, HV3, DV, AUX1, DM3, DH3, 1100, 1101, DM5, or DH5.

Select “Don’t Care” if you want Merlin to ignore this field.

AM_ADDR

(Active Member Address) The AM_ADDR is a three bit slave address. To select packets from a particular slave device for filtering or triggering, enter an address into the AM_ADDR text box. You can target up to three devices using the three text boxes.

SEQN, ARQN, and Flow Control Bits

To set event conditions on SEQN, ARQN, and Flow control, uncheck "Don't Care." Unchecking "Don't Care" sets the event condition to SEQN=0 AND ARQN=0 AND Flow=0. This action also puts a checkmark in the box marked "Packet Headers." A checkmark next to SEQN, ARQN, or Flow changes the value of this field from zero to one. For example, if SEQN is checked, the event condition becomes "SEQN=1 AND ARQN=0 AND Flow=0.

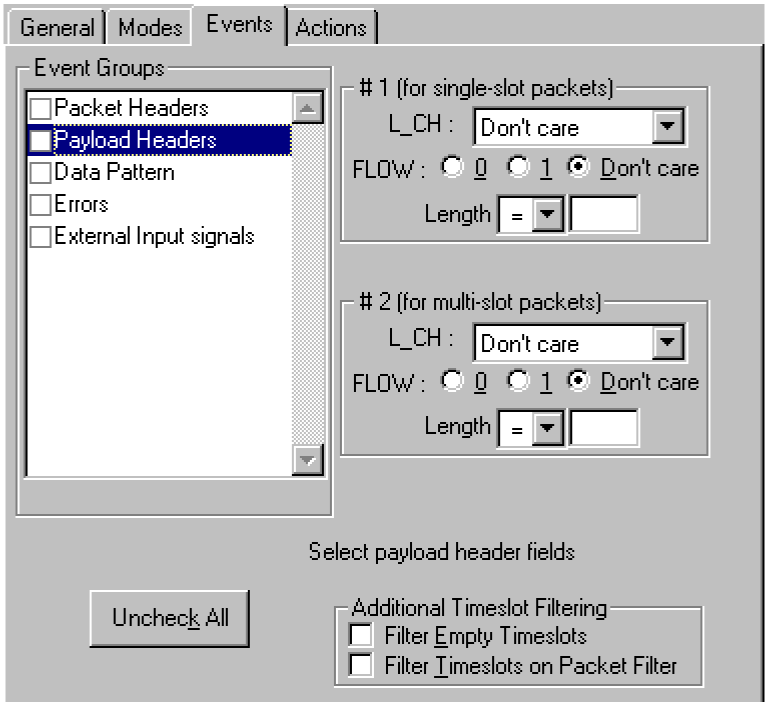
To cause Merlin to ignore this set of check boxes, choose "don't care."

Payload Headers

Clicking "Payload Headers" causes a series of options to display on the right for setting conditions on payload headers. You will see two sets of options - one for single slot packets such as DM1 packets and a second for multi-slot packets such as DM3 packets. Within each set is a menu for the Logical Channel and sub-options for Flow Control, and Payload length. These latter two options allow you to modify searches based on the Logical Channel. An example would be "Trigger on a start L2CAP message whose flow control bit is 1 and whose data field length is less than 20."

- Select **Payload Headers** under **Event Groups.**

  You see the **Payload Headers** window



□ Packet Headers
□ Payload Headers
□ Data Pattern
□ Errors
□ External Input signals

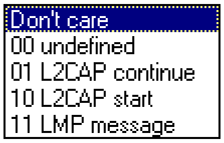
1 (for single-slot packets)
L_CH : Don't care
FLOW : ○ 0 ○ 1 ● Don't care
Length =

2 (for multi-slot packets)
L_CH : Don't care
FLOW : ○ 0 ○ 1 ● Don't care
Length =

Additional Timeslot Filtering
□ Filter Empty Timeslots
□ Filter Timeslots on Packet Filter

L_CH (Logical Channel)

The "L_CH" drop down menu presents five options for setting conditions on the Logical Channel:

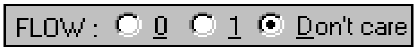


- Don't care
- 00 Undefined
- 01 L2CAP continue
- 10 L2CAP start
- 11 LMP message

Select "Don't care" if you do not want to set conditions on Logical Channel.

Flow

Three "radio buttons" are presented for setting conditions based on Flow control:


FLOW : ○ 0 ○ 1 ● Don't care

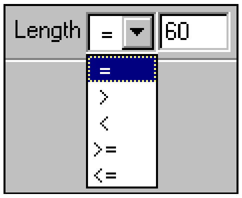
- 0
- 1
- Don't care

Flow works in conjunction with the Logical Channel (L_CH) menu - you select an option from the L_CH menu and then select an option under Flow.

Select "Don't care" if you do not want to set conditions on Flow control.

Length (in bytes)

Using both the drop down menu and the text box, you can set conditions based on data field length. The maximum length for a single slot packet is 29 bytes. The maximum length for multi-slot packets is 339 bytes.

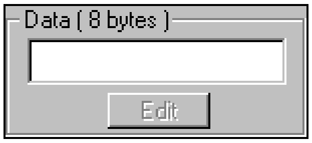


The drop-down menu gives you options for selecting operators such as "greater than" and "equal to." The text box to the right of the drop-down menu lets you enter values.

The Length option works in conjunction with the Logical Channel (L_CH) menu - you first select an option from the L_CH menu and then select an option under Length.

Data Patterns

Clicking "Data Patterns" causes a text box to appear for entering patterns to be matched in the raw payload data. Patterns of up to eight hexidecimal bytes can be entered.

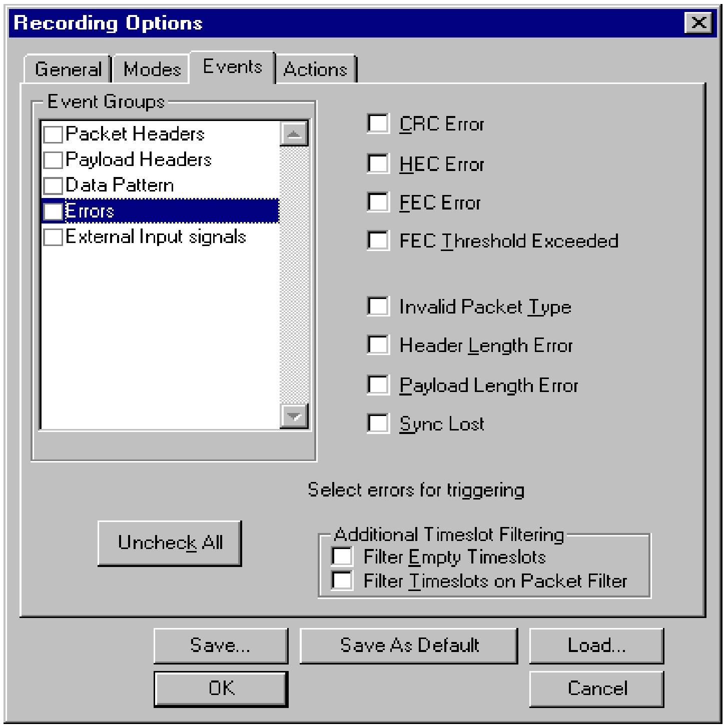


Errors

Clicking "Errors" causes check boxes to appear for setting conditions for triggering or filtering based on packet/signaling/protocol errors. You can select one or a combination of errors.

- Select **Errors** under **Event Groups.**

  You see the **Errors** window:



Use any combination of the listed packet/signaling/protocol errors as a Trigger.

CRC Error

A CRC error in the packet data payload of the previous Bluetooth™ data packet.

HEC Error

An HEC (header error check) error in the packet header for the previous Bluetooth™ data packet.

FEC Error

An uncorrectable FEC (Forward Error Correction) error in the packet header for the previous Bluetooth™ data packet.

Threshold Exceeded

Indicates that the number of single-bit FEC errors detected since the current recording started has exceeded the specified value.

Invalid Packet Type

An invalid value was detected in the 'packet type' field of the packet header for the previous Bluetooth™ data packet.

Header Length Error

Indicates that a received Bluetooth™ data packet was terminated before all bits of the packet header were received.

Payload Length Error

Indicates that the payload of a received Bluetooth™ data packet was either longer than expected, or that a Bluetooth™ data packet terminated before the expected end of the payload data.

Sync Loss

When set, indicates that a loss of piconet synchronization occurred during the frequency slot prior to this slot.

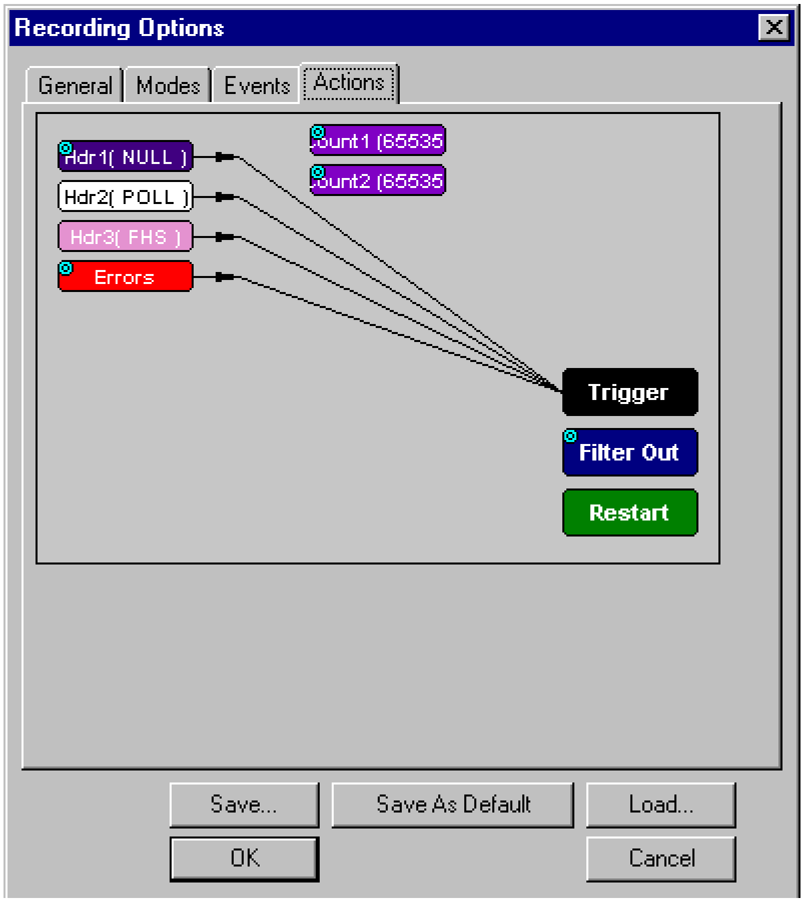
External Input Signals

Clicking "External Input Signals" causes two check boxes to appear for setting conditions based on breakout board input signals. The names of the two check boxes are the same ones you will find on the break out board:

- Trigger Input [TRIG IN]
- General Purpose Input [G.P. IN]

7.4 Recording Options - Actions

The **Actions** screen allows you to specify the type of action that Merlin should perform when it encounters the events specified in the **Events** window.



Actions Window Layout

The Actions window divides into three sections: a left, a center, and a right section.

The left section displays **Event** buttons such as Header buttons and Error buttons. The number of **Event** buttons displayed depends on the number of Events you selected in the **Events** window. If you selected no Events, no **Event** buttons will display. If all Events were selected, eight **Event** buttons will display.

The center section displays two Counter buttons marked **Count1** and **Count2**. These buttons are used for counting events and are permanent features of this section.

This center section can also hold **Event** buttons such as **Errors** and **Payload Hdr1**. Event buttons in this section are used to create triggers based on a sequence of Events. *Event Sequencing* is explained later in the chapter.

The right section has three permanent buttons for setting actions. These buttons are **Trigger**, **Filter Out/In**, and **Restart**. These buttons allow you to set actions such as triggering or filtering.

Arrows connect **Event, Counting,** and **Action** buttons. Arrows represent the current associations between actions and events. As will be described further on, these associations can be easily changed with the mouse.

Action Buttons - Their Functions

The **Action** buttons in the right side of the window provide the means of setting triggers, filters, and restarts. To set an action, you simply drag your mouse from an Event to an Action. As described further on, this movement will link the two via an arrow.

Trigger

The **Trigger** button enables event triggering.

Filter In/Out

The **Filter In/Out** button allows events to be filtered in or out of the recording.

Restart

The **Restart** button causes the two counters Count1 and Count2 to be reset to zero.

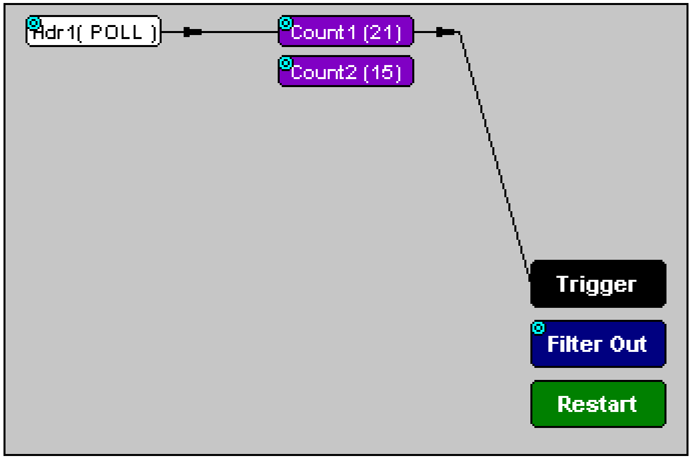
Counting Buttons - Their Functions

The center section of the **Actions** window has two buttons for counting events called **Count1** and **Count2**. Below these buttons, you can add **Event** buttons to create *Event Sequencing*.

Count1, Count2

Count1 and Count2 are counters for specifying how many events must occur before an event can cause a trigger. Counters allow conditions to be made such as "Trigger after the 21st Poll packet" (see screenshot below).

The Actions window showing a condition based on a Poll packet and a counter. This condition reads "Trigger after the 21st Poll packet."



Connecting Events to Counters

To connect an event to a counter, click an Event button, then click one of the two counter buttons. An arrow will appear that will join the Event to the Counter and then to a trigger.

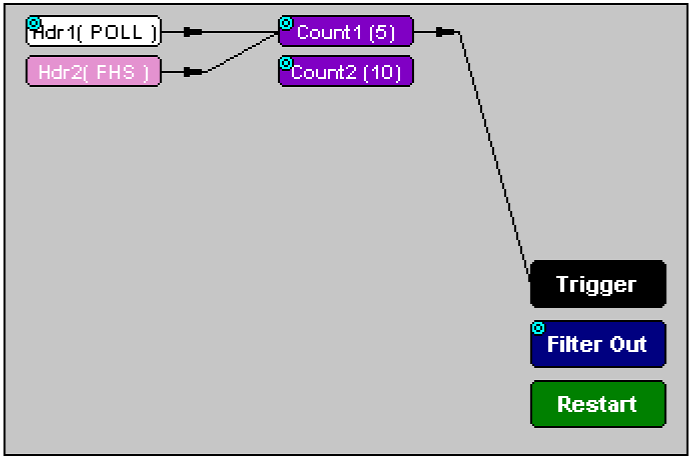
This latter connection between the Counter button and the Trigger button occurs because counters always work in association with triggers. Counters act as assistants to triggers.

Setting Multiple Conditions with Counters

You can create multiple event conditions by linking a counter to multiple events or by linking two counters to two or more events.

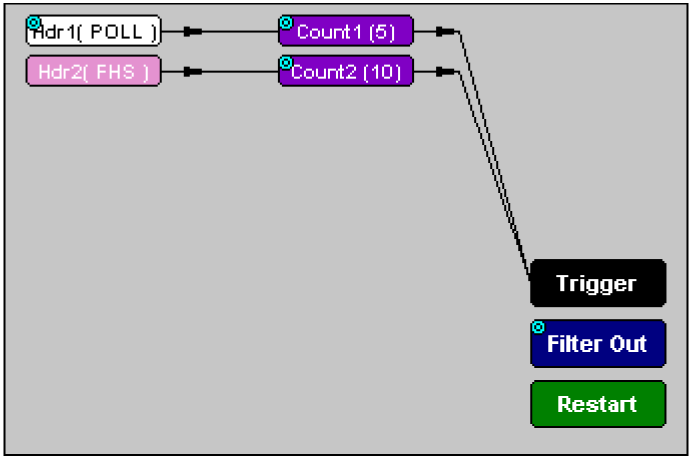
Linking Multiple Events to One Counter - When two or more Events are connected to a counter, it creates a condition that reads "Trigger when the counter value is reached by any combination of the specified events."

The following example reads "Trigger after any combination of 5 Poll packets and FHS packets have occurred."



Linking Two Events to Two or More Counters - If an Event is linked to **Count1** and a second event is linked to **Count2**, it creates an "or" statement. This statement reads "Trigger when Count1 OR Count2 has reached their specified values."

This example reads "Trigger when Count1 has counted 5 Poll packets or Count2 has counted 10 FHS packets."



Blue Dot Menus

Count1, **Count2** and a few other buttons in the **Actions** window have blue dots in their top left-hand corners that indicate the presence of context-sensitive menus. These menus let you set the button's values and/or operations. Click the left mouse button on a dot to open the menu.

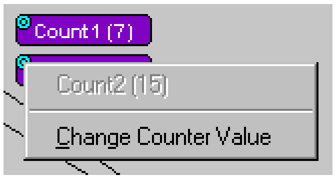
Counters Blue Dot Menu

The **Count1** and **Count2** blue dot menus allow the value of their counters to be changed. The value you specify here tells Merlin how many instances of an event must take place before a trigger occurs. The counter can be set between 1 and 65,535.

To set a Counter,

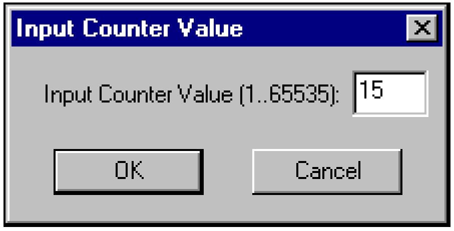
Step 1 Click on the blue dot in the upper left corner of the **Count** button.

You see the **Change Counter Value** menu:



Step 2 Click **Change Counter Value**

You see the **Input Counter Value** menu



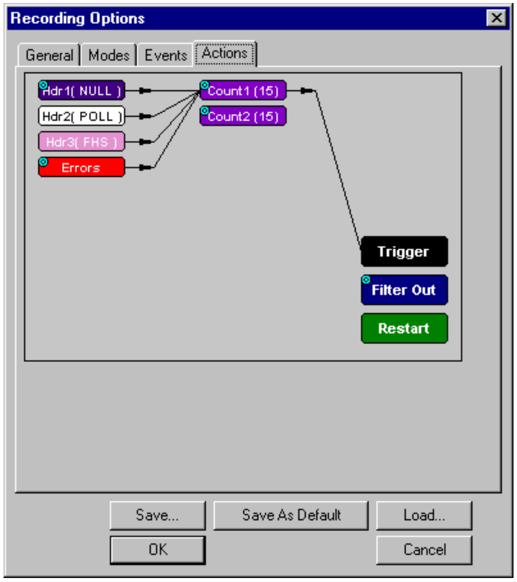
Input Counter Value (1..65535): 15

Step 3 Enter an input value to tell the Analyzer how many times this event must occur before triggering the end of a recording

Step 4 Click **OK**.

You may connect as many Event buttons to a counter as you like. However, the Counter does not treat each event as a discrete specification but treats them all as one event.

As an example, look at the specifications set in the following screen:



Counter 1 has been set to trigger four events after 15 occurrences. But the Counter does not count 15 occurrences for EACH event. It counts ALL events as they happen to occur until it reaches a total of 15 and then triggers.

Filter Out/In Blue Dot Menu

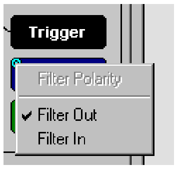
The **Filter Out/In** button toggles between "**Filter Out**" and "**Filter In**".

- **Filter In** records ONLY those packets related to the specified event.
- **Filter Out** records all packets EXCEPT those related to the specified event.

To filter an event in or out of a recording,

Step 1 Click the blue dot on **Filter Out**. (Note: the button may say **Filter In** depending on the last action specified.)

You see the **Filter Out/In** menu:



Use this menu to toggle the selection between **Filter Out** and **Filter In**.

Step 2 Select "**Filter In**".

The button changes to read "Filter In".

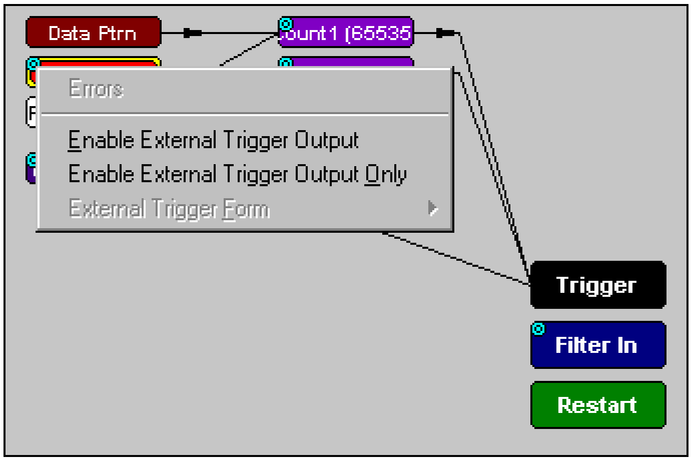
Blue Dot Menus for the Event Buttons

The **Errors** button and the first Headers button (marked "**Hdr1**") have the same Blue Dot menus. These menus allow Merlin to trigger external output.

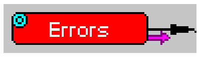
To enable or disable external trigger output,

Step 1 Click the Blue Dot on an Event button such as **Hdr1** or **Errors**.

A menu similar to the one below will open. Your menu may say "Disable" instead of "Enable."



Step 2 Select "**Enable External Trigger Output**" (or "**Disable External Trigger Output**" if that is the choice presented.)



If you have chosen "**Enable External Trigger Output**", a small arrow will appear on the right side of the button. This arrow indicates that a condition has been set for creating an external output signal. Choosing "**Disable External Trigger**" will cause the arrow to disappear.

Enabling High Pulse, Low Pulse or Pulse Toggle Signal Outputs

Once External Trigger Output has been enabled, you can configure the output signal to one of three formats:

Pulse High - This is the default format. The Pulse High setting causes the Analyzer to transmit a 5 volt, 16.66 nanosecond signal.

Pulse Low - This format causes the Analyzer to transmit a -5 volt, 16.66 nanosecond signal.

Toggle - This format causes the Analyzer to transmit a signal that will toggle with each trigger event between a continuous 5 volt signal and a continuous -5 volt signal.

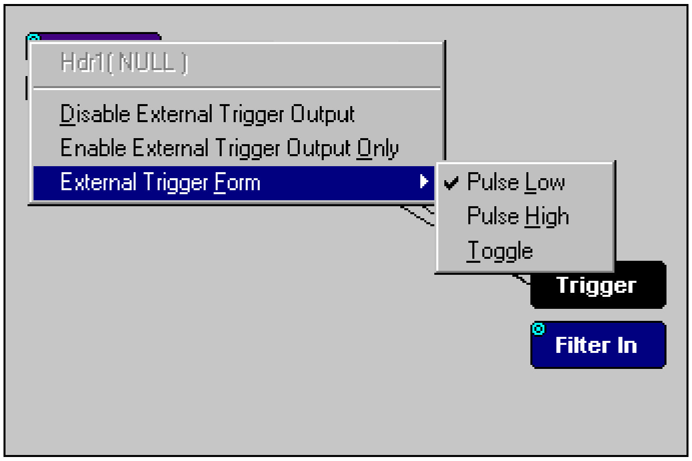
To configure the output signal,

Step 1 Click the blue dot on an Event button that has a small arrow attached to it like the one shown above.

A Blue Dot Menu will open. "**External Trigger Form**" should be a choice available. If it is not, you will need to choose "**Enable External Trigger**" and then reopen the menu.

Step 2 Choose "**External Trigger Form**"

A menu will appear with choices for "**Pulse Low**", "**Pulse High**", and "**Toggle**".



Step 3 Choose an option not currently selected.

The menu closes.

Step 4 Reopen the menu.

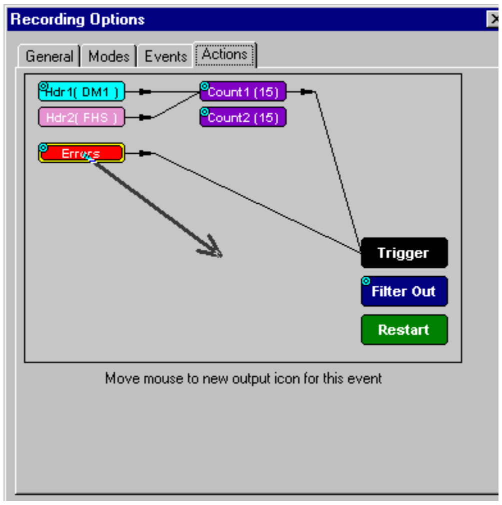
Note that your new selection is now checked.

Elastic Arrow

Elastic arrows allow you to associate Events, Counters, and Actions. To make an association,

Step 1 Click the left mouse button on an Event button such as **Hdr1** or **Errors**.

The elastic arrow appears.



Move mouse to new output icon for this event

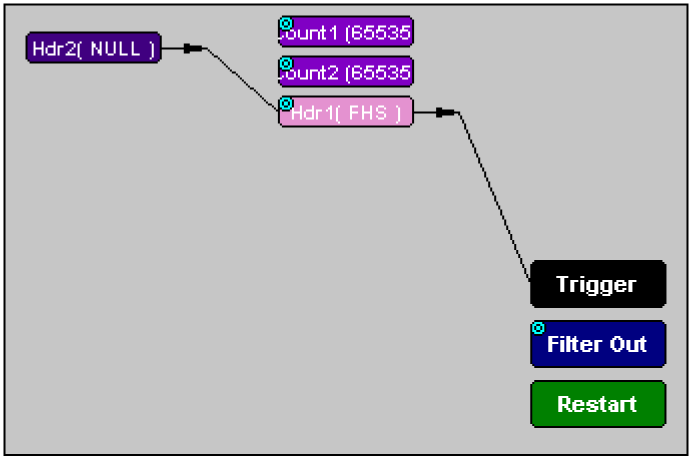
Step 2 Drag the arrow to the desired Action button.

Step 3 With the pointer over an Actions button, click again the left mouse button again.

The arrow is replaced with a black line connecting the Event button to the Action button.

Event Sequencing

If you drag your mouse from one event button to another, you will create a compound condition known as an *Event Sequence*. An event sequence is a condition that says "Trigger when you see the following sequence of packets." The example below may help to clarify.



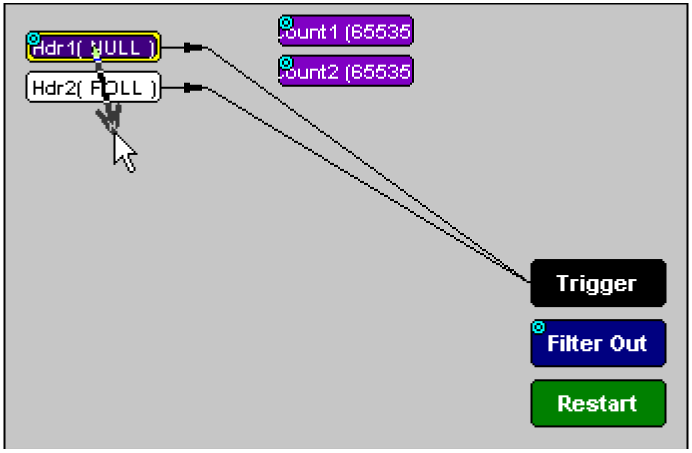
This example means "Trigger when you see a packet with an Null Header followed by a packet with a FHS Header."

To create an event sequence, perform the following steps:

Step 1 Select two events from the Events window

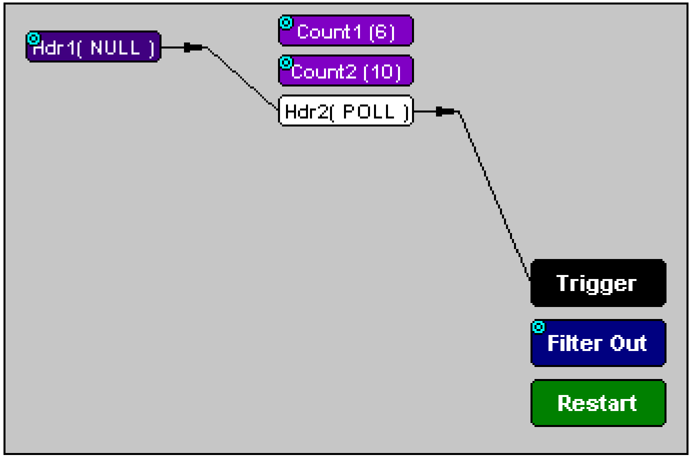
Step 2 Open the Actions window and click on one of the two Event buttons.

An elastic arrow should appear.



Step 3 Click on the other event.

The arrow should connect to the second button and the second button should instantly change locations to the center section of the window.



7.5 Saving Recording Options

To complete your Recording Options settings, use the features at the bottom of the **Recording Options** screen. These features remain the same no matter which of the three Recording Options screens you are working in.

- Click **Save** to save the currently specified Recording Options for use in future recording sessions. Any file name can be specified, though use of the **.rec** is recommended; if no extension is specified, **.rec** is added by default.

- Click **Load** to load a previously saved ***.rec** file, thus restoring a previous set of Recording Options.
- The **Save as Default** function is equivalent to the **Save** function, specifying the file name **default.rec.** Whenever you start up the Analyzer, it automatically loads the **default.rec** file if one exists.
- Click **OK** to apply any changes and close this dialog box.
- Click **Cancel** to cancel any immediate changes you have made and exit the Recording Options menu.

7.6 Recording Bluetooth™ Traffic

To start recording Bluetooth™ traffic once the appropriate Recording Options have been set,

Step 1 Select **Start** under **Record** on the Menu Bar

OR

Click REC on the Tool Bar.

Your recording session can continue until it has finished naturally or you may need to stop manually by clicking STOP on the Tool Bar, depending on how you set the Recording Options.

To manually stop recording,

Step 2 Select **Stop** under **Record** on the Menu Bar

OR

Click STOP on the Tool Bar.

Note The manual Stop Recording feature is primarily of use when recording low-volume traffic, which can take a long time to fill the recording buffer.

When the recording session is finished, the bus traffic is saved to the hard drive as a file named **data.blt** or whatever name you assign as the default filename.

To save a current recording for future reference,

Step 3 Select **Save As** under **File** on the Menu Bar.

OR

Click 💾 on the Tool Bar.

You see the standard **Save As** screen.

Step 4 Give the recording a unique name and save it to the appropriate directory.

8. Display Options

Use the **Display Options** menu to specify the way CATC Trace information is displayed.

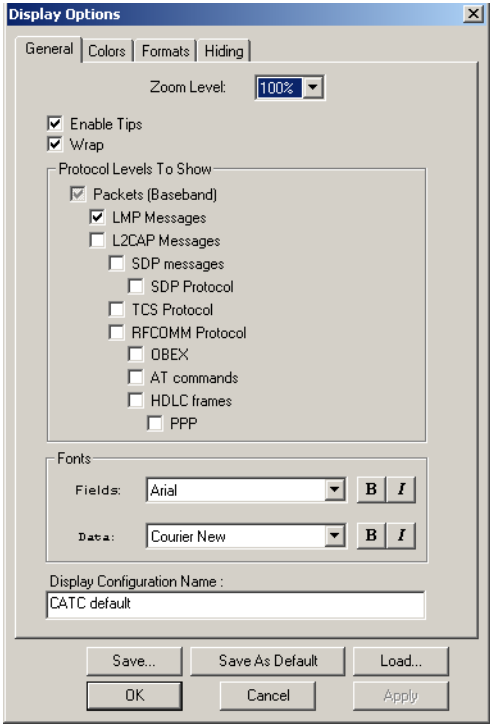
To open the **Display Options** menu,

- Select **Display Options** under **Setup** on the Menu Bar

  OR

- Click on the Tool Bar

  You see the **Display Options** window:



Zoom Level: 100%

☑ Enable Tips
☑ Wrap

Protocol Levels To Show
☑ Packets (Baseband)
☑ LMP Messages
☐ L2CAP Messages
☐ SDP messages
☐ SDP Protocol
☐ TCS Protocol
☐ RFCOMM Protocol
☐ OBEX
☐ AT commands
☐ HDLC frames
☐ PPP

Fonts
Fields: Arial B I
Data: Courier New B I

Display Configuration Name :
CATC default

The **Display Options** window always opens with the screen for the **General** tab displayed.

8.1 General Display Options

Use the General Display Options to specify the basic appearance of a Trace View.

- **Zoom Level**: Adjustable in discrete increments from 10% to 200% percent.
- **Enable Tool Tips**: Select to enable tool tips with explanation text to pop up when you position your cursor over various fields in the Trace View.

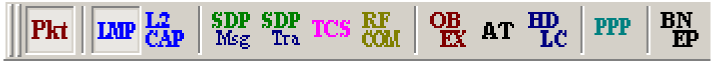
- **Wrap**: Inhibits carriage returns in packets when they exceed the width of the window.
- **Trace Viewing Level**: Enables different levels of transaction to be displayed.
- **Display Configuration Name**: A Comment field associated with the ***.opt** file containing the current Display Options values. You can also create and store your unique Display Options for future use.
- **Fonts:** Allows field fonts and data fonts to be changed. The fonts can be italisized and/or bolded by pressing the **I** and/or **B** buttons.

Trace Viewing Level

Trace Viewing Level allows Merlin to display ten levels of transaction:

- **Packet**
  Packet is the default selection.
- **LMP Messages**
- **L2CAP Messages**
- **STP Messages**
- **STP Protocol**
- **TCS Messages**
- **TCS Protocol**
- **RFCOMM Protocol**
- **OBEX Protocol**
- **AT Commands Protocol**
- **HDLC Frames**
- **PPP**
- **BNEP**

Changing the Trace View Level



To change the Trace Viewing Level, use the decode buttons on the toolbar or select a checkbox in the **Display Options** dialog box.

For further details on these viewing levels, see the Chapter 7: *Decoding Higher Protocols.*

Creating New Display Options Files

To create a new Display Options file,

Step 1 Enter a comment for the new file in the **Display Configuration Name** field.

Step 2 Click **Save**...

You see the **Save As** window.

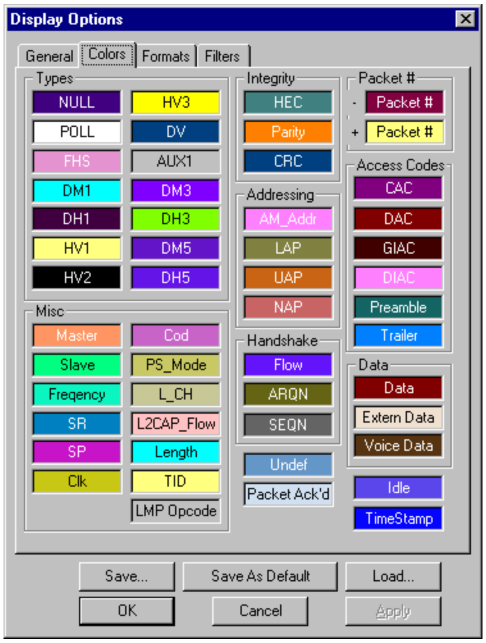
Step 3 Specify a filename (***.opt**).

Step 4 Click **Save**.

8.2 Color Display Options

- Click the **Colors** tab on the Display Options screen.

  You see the **Colors** screen:



Use this menu to customize the colors associated with each field in the Trace View. You can experiment with this option to achieve the color combination best suited to a particular graphic system. A brighter color might be appropriate for a specific field that should stand out in the display (e.g. the Packet Types).

Note The colors of the following packet types cannot be changed: Invalid Data (packet error) field (red) and Softbit Errors (yellow.)

Two color fields are provided for packet number displays to differentiate between pre-Trigger traffic and post-Trigger traffic.

- The packet that causes the Trigger and all the packets before it are colored with the **-** color.
- The packet that follows a Trigger is colored with the + color.

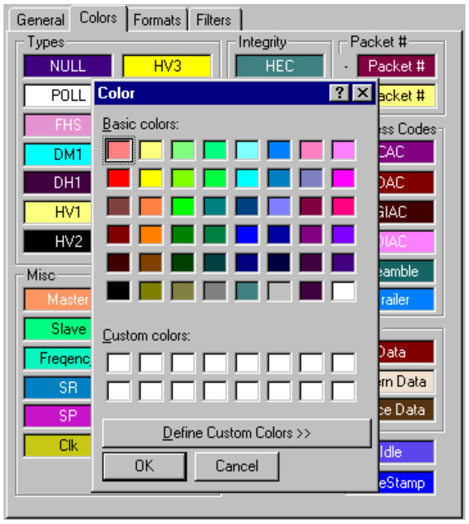
- All packets are colored with a + color when there is no Trigger.

Use the color buttons labeled + and **-** under the **Packet #** section of the Colors screen to select a Trigger color.

To select or change a color,

- Click the appropriate color button.

  You see the color palette:

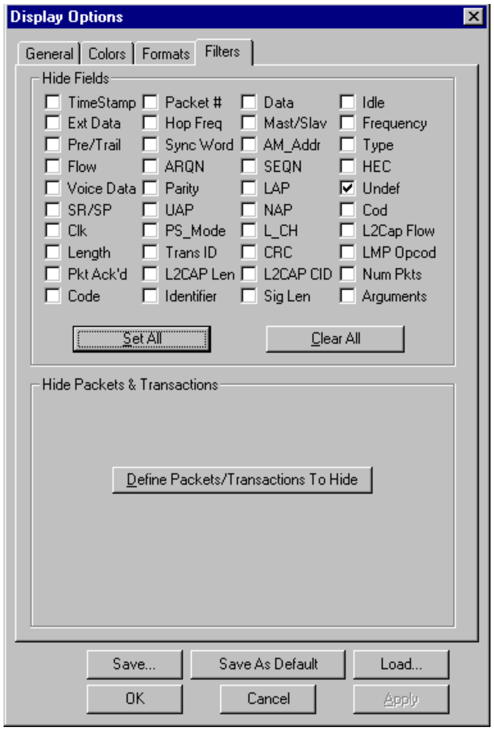


Use this palette to choose the desired color for the Packet Types, Miscellaneous, Integrity, Handshake, Packet #, Access Codes, Data, Idle and Timestamp.

8.3 Formats Display Options

- Click the **Formats** tab on the **Display Options** screen.

  You see the **Formats** window:



□ TimeStamp	□ Packet #	□ Data	□ Idle
□ Ext Data	□ Hop Freq	□ Mast/Slav	□ Frequency
□ Pre/Trail	□ Sync Word	□ AM_Addr	□ Type
□ Flow	□ ARQN	□ SEQN	□ HEC
□ Voice Data	□ Parity	□ LAP	☑ Undef
□ SR/SP	□ UAP	□ NAP	□ Cod
□ Clk	□ PS_Mode	□ L_CH	□ L2Cap Flow
□ Length	□ Trans ID	□ CRC	□ LMP Opcod
□ Pkt Ack'd	□ L2CAP Len	□ L2CAP CID	□ Num Pkts
□ Code	□ Identifier	□ Sig Len	□ Arguments

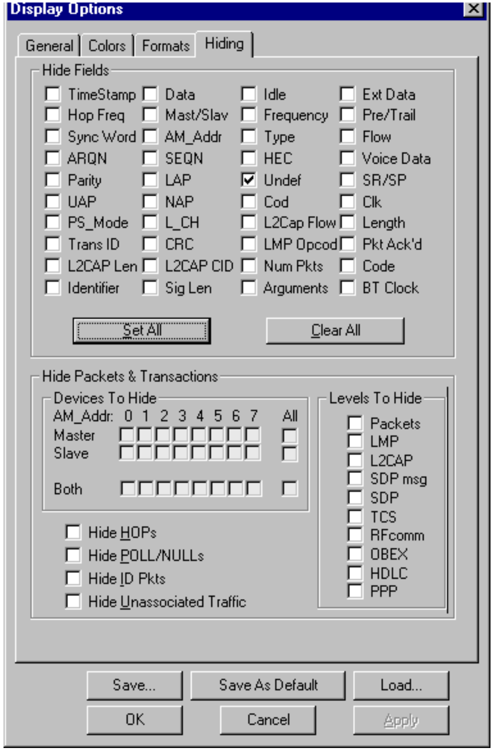
Set All
Clear All
Hide Packets & Transactions
Define Packets/Transactions To Hide
Save...
Save As Default
Load...
OK
Cancel
Apply

Select a number format corresponding to the column labels along the top of the screen for each number field that labels the rows along the left of the screen. The number format changes in the respective location in the packet view window. You can also select the bit ordering to be displayed. Not every number format is available for every number field.

8.4 Hiding

- Click the **Hiding** tab on the **Display Options** screen.

  You see the **Hiding** window:



Hide Fields

□ TimeStamp	□ Data	□ Idle	□ Ext Data
□ Hop Freq	□ Mast/Slav	□ Frequency	□ Pre/Trail
□ Sync Word	□ AM_Addr	□ Type	□ Flow
□ ARQN	□ SEQN	□ HEC	□ Voice Data
□ Parity	□ LAP	☑ Undef	□ SR/SP
□ UAP	□ NAP	□ Cod	□ Clk
□ PS_Mode	□ L_CH	□ L2Cap Flow	□ Length
□ Trans ID	□ CRC	□ LMP Opcod	□ Pkt Ack'd
□ L2CAP Len	□ L2CAP CID	□ Num Pkts	□ Code
□ Identifier	□ Sig Len	□ Arguments	□ BT Clock

Hide Packets & Transactions

Devices To Hide

AM_Addr:	0	1	2	3	4	5	6	7	All
Master	□	□	□	□	□	□	□	□	□
Slave	□	□	□	□	□	□	□	□	□
Both	□	□	□	□	□	□	□	□	□

□ Hide HOPs
□ Hide POLL/NULLs
□ Hide ID Pkts
□ Hide Unassociated Traffic

Levels To Hide

□ Packets
□ LMP
□ L2CAP
□ SDP msg
□ SDP
□ TCS
□ RFcomm
□ OBEX
□ HDLC
□ PPP

Use the Hiding window to hide various fields, packets, messages, and protocols from the Trace View screen. You can modify these settings at will to display a specific area of a Trace.

Hiding Fields

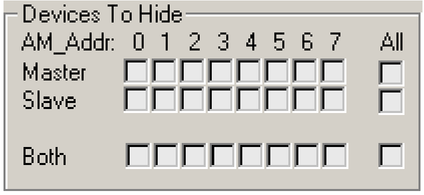
The "Hide Fields" checkboxes allow individual fields to be hidden within a trace. Click the checkbox(es) of your choice to hide one or more fields.

Hiding Packets, Messages, and Protocols

The "Hide Packets and Transactions" box contains two grids of checkboxes for hiding whole packets, messages, protocols, and traffic from individual devices. The grids are labeled "Devices to Hide" and "Levels to Hide".

Devices to Hide

The "Devices to Hide" grid lets you hide traffic according to device address. The grid devides into columns which represent different devices.



Devices To Hide

AM_Addr:	0	1	2	3	4	5	6	7	All
Master	□	□	□	□	□	□	□	□	□
Slave	□	□	□	□	□	□	□	□	□
Both	□	□	□	□	□	□	□	□	□

Columns labeled "**0**" through "**7**" and "**All**" represent the **Active Member Address** of a device. By checking one of the boxes in a column, you hide the traffic of the selected device (or traffic from all devices if you have selected **All**.)

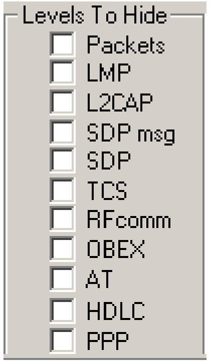
The row in which you place your checkmark determines whether you are hiding traffic going to or from a device.

- Master - Hide traffic from a Master to selected Slaves
- Slave - Hide traffic from selected Slaves to the Master
- Both - Hide all traffic between the Master and selected Slave

Example: to hide all traffic from a Master *to* a Slave device with an address of six, click the checkbox under column **6** on the row marked **Master**.

Levels to Hide

The "Levels to Hide" grid divides into rows which represent the different packet, message, and protocol levels. Clicking a checkbox will cause Merlin to hide all traffic of a selected level.



Levels To Hide

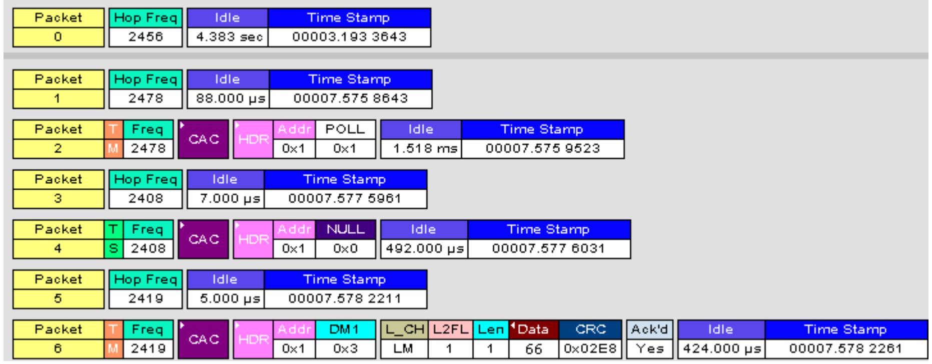
□ Packets
□ LMP
□ L2CAP
□ SDP msg
□ SDP
□ TCS
□ RFcomm
□ OBEX
□ AT
□ HDLC
□ PPP

8.5 Saving Display Options

To complete your Display Options settings, use the features at the bottom of the **Display Options** screen. These features remain the same no matter which of the four Display Options screens you are working in.

- Click **Save** to save the currently specified Display Options for use in future sessions. Any file name can be specified, but you must use the **.opt** extension. If no extension is specified, **.opt** is added by default.
- Click **Load** to load a previously saved ***.opt** file, thus restoring a previous set of Display Options.
- The **Save as Default** function is equivalent to the **Save** function, specifying the file name **default.opt.** Whenever you start up the analyzer, it automatically loads the **default.opt** file if one exists.
- Click **OK** to apply any changes you have made to Display Options and close this dialog box.
- Click **Cancel** to cancel any immediate changes you have made and exit the Display Options menu.
- Click **Apply** to apply your changes.

9. Reading a CATC Trace



Packet	Hop Freq	Idle	Time Stamp
0	2456	4.383 sec	00003.193 3643

Packet	Hop Freq	Idle	Time Stamp
1	2478	88.000 µs	00007.575 8643

Packet	T	Freq	CAC	HDR	Addr	POLL	Idle	Time Stamp
2	M	2478			0x1	0x1	1.518 ms	00007.575 9523

Packet	Hop Freq	Idle	Time Stamp
3	2408	7.000 µs	00007.577 5961

Packet	T	Freq	CAC	HDR	Addr	NULL	Idle	Time Stamp
4	S	2408			0x1	0x0	492.000 µs	00007.577 6031

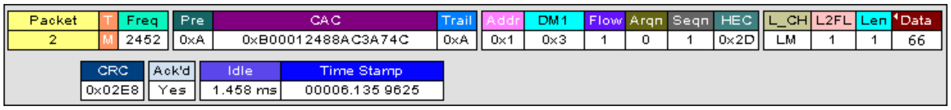
Packet	Hop Freq	Idle	Time Stamp
5	2419	5.000 µs	00007.578 2211

Packet	T	Freq	CAC	HDR	Addr	DM1	L_CH	L2FL	Len	Data	CRC	Ack'd	Idle	Time Stamp
6	M	2419			0x1	0x3	LM	1	1	66	0x02E8	Yes	424.000 µs	00007.578 2261

9.1 Trace View Features

- The Merlin packet view display makes extensive use of color and graphics to fully document the captured traffic.
- Packets are shown on separate rows, with their individual fields both labeled and color coded.
- Packets are numbered (sequentially, as recorded), time-stamped, and highlighted to show the device status (master or slave).
- Display formats can be named and saved for later use.
- Pop-up Tool Tips annotate packet fields with detailed information about their contents.
- Data fields can be collapsed to occupy minimal space in the display (which can in turn be zoomed in and out to optimize screen utilization).
- The display software can operate independent of the hardware and so can function as a stand-alone Trace Viewer that may be freely distributed.

9.2 Interpreting the Displayed Information



Packet	T	Freq	Pre	CAC	Trail	Addr	DM1	Flow	Arqn	Seqn	HEC	L_CH	L2FL	Len	Data
2	M	2452	0xA	0xB00012488AC3A74C	0xA	0x1	0x3	1	0	1	0x2D	LM	1	1	66

CRC	Ack'd	Idle	Time Stamp
0x02E8	Yes	1.458 ms	00006.135 9625

The following table describes the abbreviations used in the Merlin display. Packet #0 is described from left to right:

Packet:#	**Packet/Event Number**

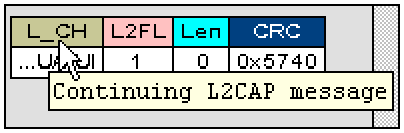
T/M, T/S	M =Master Device Transmitting
	S = Slave Device Transmitting

Freq	Current Hop Frequency (in MHz)
Pre	Preamble of the Sync word

Packet:#	**Packet/Event Number**
CAC	Channel Access Code
Trail	Access Code Trailer of the Sync word
Addr	Active Member Address
DM1	DM1 Packet Type
Flow	ACL Link Flow Control
Arqn	Acknowledgment Indication Flag
Seqn	Sequential Numbering
HEC	Header Error Correction Code
L_CH	LMP Message
L2FL	L2CAP Flow Control Flag
Len	Message Length in Bytes including Opcode
TID	LMP Transition initiated by Master
Opcode	LMP-host_connection_req
CRC	Cyclic Redundancy Check
Ack'd	Packet Acknowledgment based on subsequent packet's ARQN with same AM_ADDR
Idle	Idle Time in nanoseconds
Time Stamp	Decimal in Seconds.Milliseconds.Microseconds*10 This is the analyzer internal clock as a reference with resolution of 100 ns.

9.3 Tool Tips

You can get additional information about each field in a trace by holding your mouse pointer over a field. A tool tip will appear with details about the field.



L_CH	L2FL	Len	CRC
...U[illegible]I	1	0	0x5740

Continuing L2CAP message

9.4 Set Marker

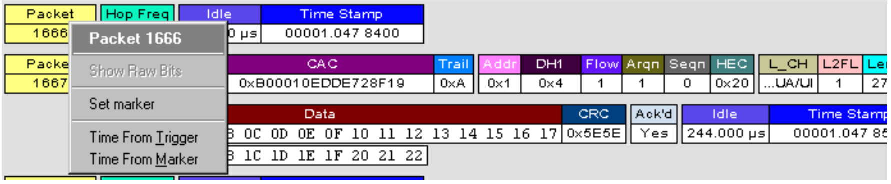
Note The **Set Marker** works in conjunction with the **Go to Marker** feature.

You can define a unique Marker for each packet.

To place a marker on a packet,

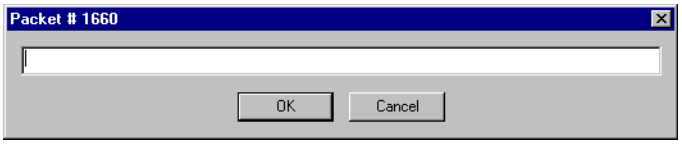
Step 1 Left-click on **Packet #** for the packet you wish to mark.

You see the **Packet** menu:



Step 2 Select **Set Marker**.

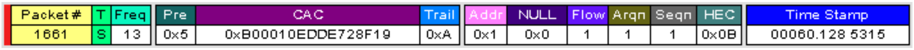
You see the **Edit Marker Comment** window where you can enter a unique comment about this packet.:



Step 3 Enter your comment.

Step 4 Click **OK**.

A marked packet is indicated by a vertical red bar along the left edge of the packet # block:



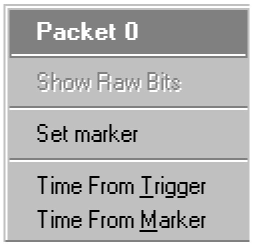
Packet #	T	Freq	Pre	CAC	Trail	Addr	NULL	Flow	Arqn	Seqn	HEC	Time Stamp
1661	S	13	0x5	0xB00010EDDE728F19	0xA	0x1	0x0	1	1	1	0x0B	00060.128 5315

9.5 Edit or Clear Marker

To clear or edit the comments associated with a packet marker,

Step 1 Left-click on **Packet #** for the chosen packet.

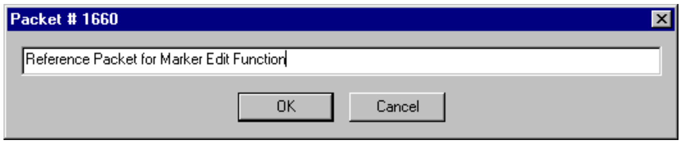
You see the **Packet** menu:



To edit the Marker Comment,

Step 2 Select **Edit marker**.

You see the **Edit marker comment** window:



Packet # 1660

Reference Packet for Marker Edit Function

Step 3 Edit the comment as desired.

Step 4 Click **OK**.

To clear a Marker,

Step 5 Click **Clear marker**.

The vertical red Marker bar disappears.

9.6 Expanded and Collapsed Data Formats

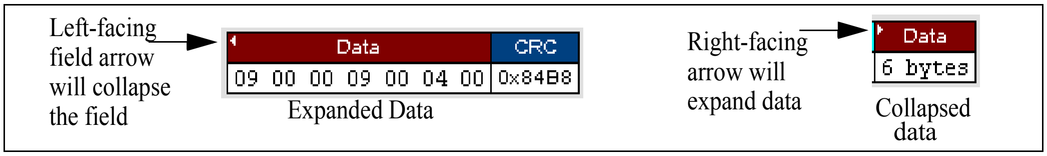
The data field can be expanded to display greater detail or collapsed to a compact view. The Expand/Collapse Data feature operates as a toggle. There are three ways to toggle between the two views.

Double-Clicking

You can expand or collapse a Data field by double-clicking anywhere in the Data field of a packet.

Left-clicking a Field Arrow

Many fields have small arrows in the top left corner. If you left-click this arrow, the field will toggle back and forth between collapsed and expanded views.



Left-facing field arrow will collapse the field
Data
CRC
09 00 00 09 00 04 00
0x84B8
Expanded Data
Right-facing arrow will expand data
Data
6 bytes
Collapsed data

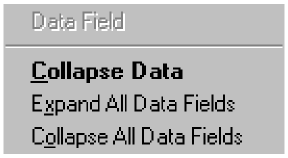
If you click and hold down the left mouse button on one of these arrows, you can collapse or expand the field for *ALL* packets, messages or protocols.

Using the Shortcut Menu

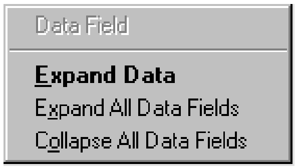
If you left-click on a **Data** field, a menu will open for expanding or collapsing data fields.

Step 1 Left-click on **Data** in the Data packet you want to expand or collapse.

If your Data Trace View is currently expanded, you see the **Collapse Data** menu:



If your Data Trace View is currently collapsed, you see the **Expand Data** menu:



Note that you can choose to expand or collapse

- **Only** the Data in the selected Data packet

  OR

- **All** Data Fields in the Trace View.

Step 2 Select the desired Expand Data or Collapse Data menu item.

The Trace View is repositioned with the selected packet(s) adjusted in the format you have specified.

9.7 Hide Frequency Hops

You can hide Frequency Hops (Hops) from a trace by pressing the **Hide Hops** button on the Tool Bar:

From the Tool Bar

- Click Hop to hide all Hop packets.

9.8 Hide Nulls and Polls

You can hide Nulls and Polls from a trace by pressing the **Hide Nulls and Polls** button on the Tool Bar.

From the Tool Bar

- Click N/P to hide all Nulls and Polls.

9.9 Hide Unassociated Traffic

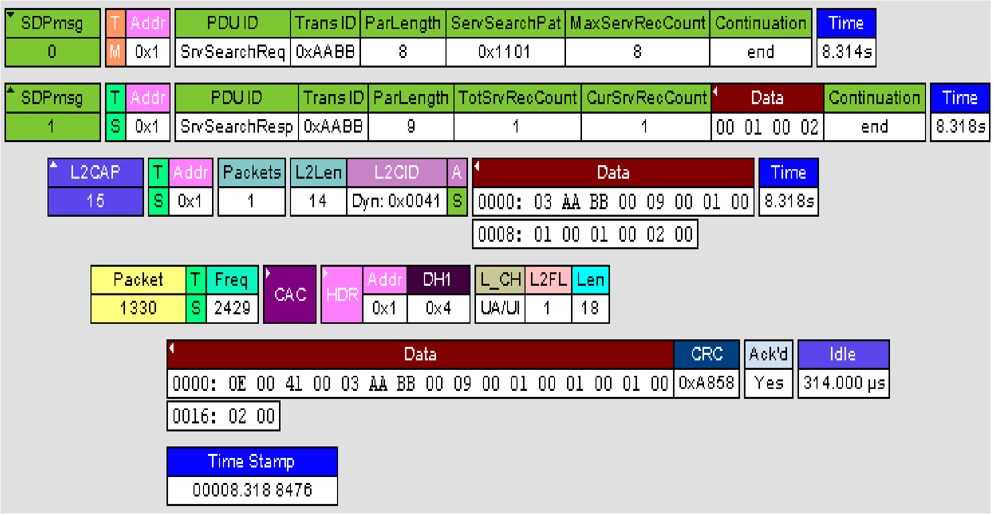
You can hide all traffic that is not associated with the current decode level by pressing the **Hide Unassociated Traffic** button on the Tool Bar.

From the Tool Bar

- First, click one or more decode buttons such as the **View L2CAP Messages** L2CAP. This button will cause Merlin to decode the trace and display selected level of decode.
- Next, click ☒ to hide all unassociated traffic.

The **Hide Unassociated Traffic** button will cause Merlin to hide all traffic except for the selected decode messages or protocols. In the example above, all packets would be hidden and only L2CAP messages would display.

10. Decoding Higher Protocols



SDPmsg	T	Addr	PDU ID	Trans ID	ParLength	ServSearchPat	MaxServRecCount	Continuation	Time
0	M	0x1	SrvSearchReq	0xAABB	8	0x1101	8	end	8.314s

SDPmsg	T	Addr	PDU ID	Trans ID	ParLength	TotSrvRecCount	CurSrvRecCount	Data	Continuation	Time
1	S	0x1	SrvSearchResp	0xAABB	9	1	1	00 01 00 02	end	8.318s

L2CAP	T	Addr	Packets	L2Len	L2CID	A	Data	Time
15	S	0x1	1	14	Dyn: 0x0041	S	0000: 03 AA BB 00 09 00 01 00 0008: 01 00 01 00 02 00	8.318s

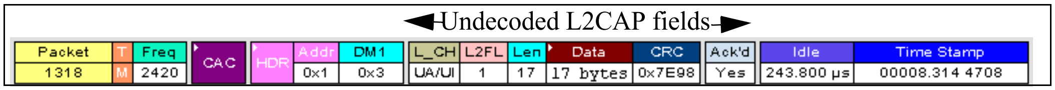
Packet	T	Freq	CAC	HDR	Addr	DH1	L_CH	L2FL	Len
1330	S	2429			0x1	0x4	UA/UI	1	18

Data	CRC	Ack'd	Idle
0000: 0E 00 41 00 03 AA BB 00 09 00 01 00 01 00 01 00 0016: 02 00	0xA858	Yes	314.000 µs

Time Stamp
00008.318 8476

10.1 Introduction

Merlin can decode LMP and L2CAP messages, and RFCOMM, SDP, TCS, HDLC, PPP, and OBEX protocols. The default is *packet level* decoding, which means that baseband packets will be displayed when you first view a trace. If these packets are carrying LMP, L2CAP or higher protocols, the protocols will display as undecoded fields such as the L2CAP packet below.



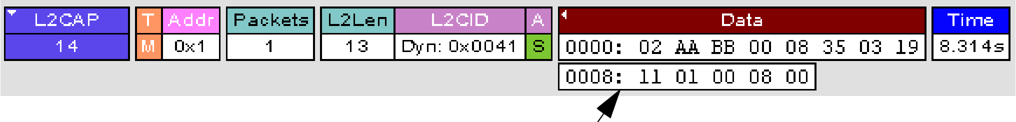
Undecoded L2CAP fields

Packet	T	Freq	CAC	HDR	Addr	DM1	L_CH	L2FL	Len	Data	CRC	Ack'd	Idle	Time Stamp
1318	M	2420			0x1	0x3	UA/UI	1	17	17 bytes	0x7E98	Yes	243.800 µs	00008.314 4708

By issuing a decode command, Merlin can decode these LMP and higher fields and display the data in summary statements called *LMP/L2CAP Messages*, *Protocols Messages, and Protocol Transactions*.

10.2 LMP and L2CAP Messages

LMP and L2CAP Messages are lines in a trace that summarize LMP and L2CAP actions such as an *LMP connection request.* LMP and L2CAP Messages summarize the type of action, the number of packets involved in the action, and the device performing the action. If the message is carrying higher protocol data such as RFCOMM, TCS, OBEX or SDP data, the message displays this data in an undecoded format that can be decoded later.



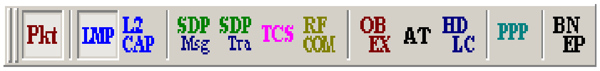
L2CAP	T	Addr	Packets	L2Len	L2CID	A	Data	Time
14	M	0x1	1	13	Dyn: 0x0041	S	0000: 02 AA BB 00 08 35 03 19 0008: 11 01 00 08 00	8.314s

Undecoded higher protocol data

10.3 Decoding and Viewing Higher Protocol Data

Higher protocol data can be decoded two ways: by clicking a decode button on the toolbar or by selecting a decode command from a pull down menu.

Decoding Via the Decoding Toolbar



The Decoding Toolbar has ten buttons for decoding packets, messages, and protocols:

- **Pkt** (Display Packets)
- **LMP** (Display LMP Messages)
- **L2CAP** (Display L2CAP **M**essages)
- **SDP Msg** (Display SDP Protocol Messages)
- **SDP** Tra (Display SDP Transactions)
- **TCS** (Display TCS Protocol messages)
- **RFCOMM** (Display
- **OBEX** (Display OBEX Protocol)
- **AT** (Display AT Commands Protocol)
- **HDLC** (Display HDLC Protocol)
- **PPP** (Display Point to Point Protocol)

For example, to display LMP messages, click LMP.

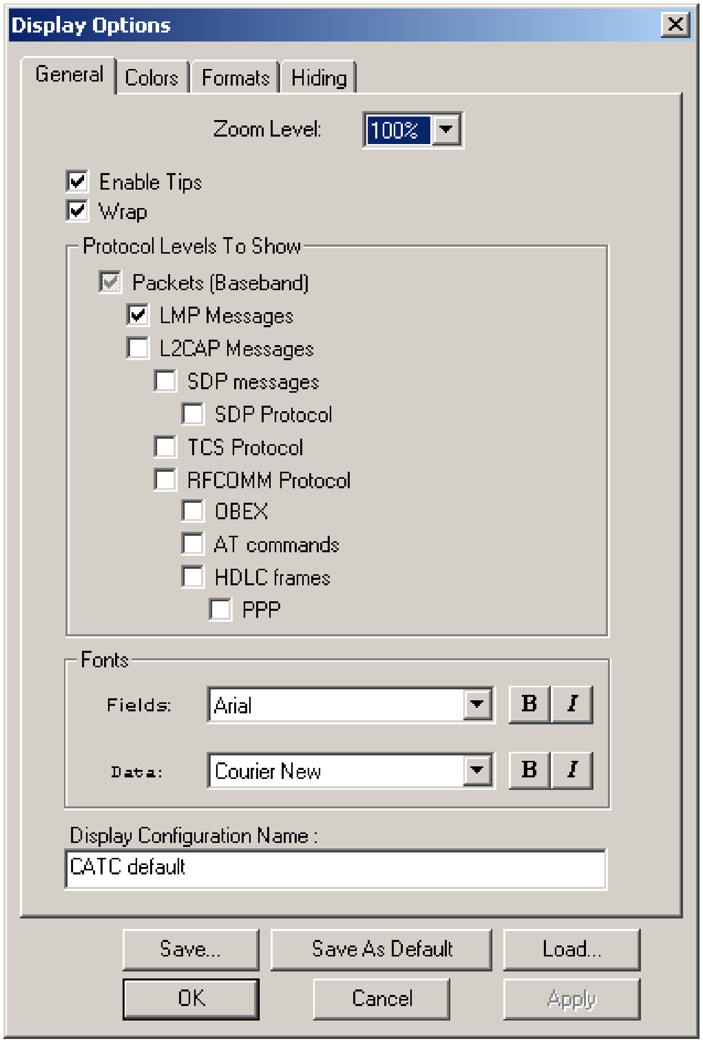
Note Once a decode has been performed, it will probably be necessary to scroll through the display to find the decoded messages or protocols. You can shorten your search by first clicking the Hide Unassociated Traffic button ☒ .

Decoding Via the Display Options Dialog Box

The Display Options dialog box has three options for issuing decode commands. To issue a command,

Step 1 From the menu bar, select

Setup>Decoding Options



Display Options

General | Colors | Formats | Hiding

Zoom Level: 100%

☑ Enable Tips
☑ Wrap

Protocol Levels To Show

☑ Packets (Baseband)
☑ LMP Messages
☐ L2CAP Messages
☐ SDP messages
☐ SDP Protocol
☐ TCS Protocol
☐ RFCOMM Protocol
☐ OBEX
☐ AT commands
☐ HDLC frames
☐ PPP

Fonts

Fields: Arial B I
Data: Courier New B I

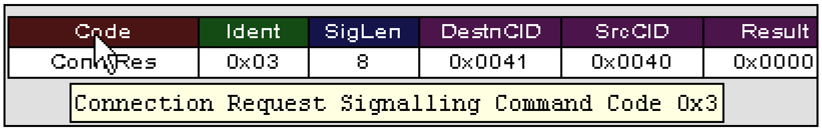
Display Configuration Name : CATC default

Step 2 Select the option for the desired level of decoding.

Step 3 Click OK or Apply.

10.4 Tooltips

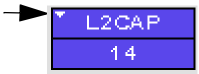
Additional information about fields can be attained by positioning your mouse pointer over a field of interest. A tooltip will appear that will provide details about the field. In some cases, there can be a considerable amount of information available.



Code	Ident	SigLen	DestnCID	SrcCID	Result
ConnRes	0x03	8	0x0041	0x0040	0x0000

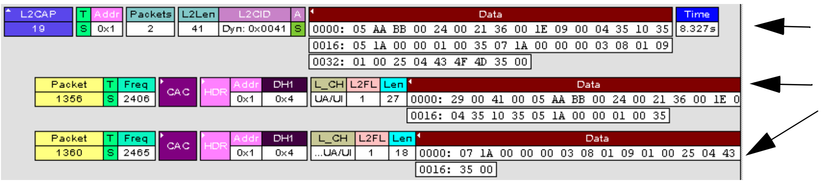
Connection Request Signalling Command Code 0x3

10.5 Viewing Packets in LMP and L2CAP Messages



L2CAP
14

LMP and L2CAP Messages can be "opened" to reveal their constituent packets by double-clicking the first cell in of the message or clicking once on the small arrow on that same cell. The packets will then display below the message. The following screenshot shows an example of a message and its packets.



L2CAP	T	Addr	Packets	L2Len	L2CID	A	Data	Time
19	S	0x1	2	41	Dyn: 0x0041	S	0000: 05 AA BB 00 24 00 21 36 00 1E 09 00 04 35 10 35 0016: 05 1A 00 00 01 00 35 07 1A 00 00 00 03 08 01 09 0032: 01 00 25 04 43 4F 4D 35 00	8.327s

Packet	T	Freq	CAC	HDR	Addr	DH1	L_CH	L2FL	Len	Data
1356	S	2406	CAC	HDR	0x1	0x4	UA/UI	1	27	0000: 29 00 41 00 05 AA BB 00 24 00 21 36 00 1E 0 0016: 04 35 10 35 05 1A 00 00 01 00 35
1360	S	2465	CAC	HDR	0x1	0x4	...UA/UI	1	18	0000: 07 1A 00 00 00 03 08 01 09 01 00 25 04 43 0016: 35 00

Message

Packets making up the message

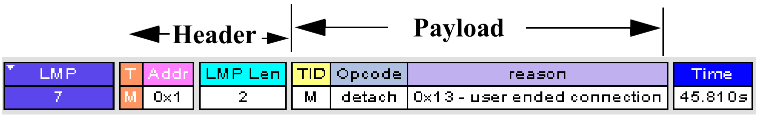
10.6 Types of LMP and L2CAP Messages

If you scroll through a trace, you will see three kinds of message:

- LMP Signalling Message
- L2CAP signalling Message
- L2CAP Data Transfer Message

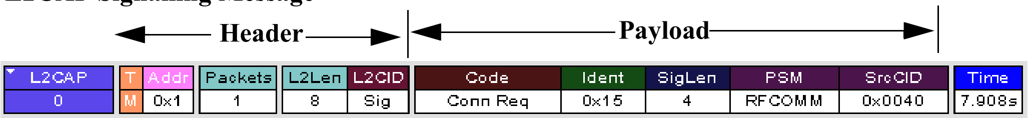
Each message has the same basic message header but differs in its payload.

LMP Signalling Message



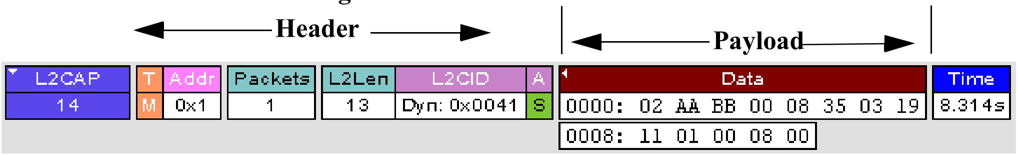
LMP	T	Addr	LMP Len	TID	Opcode	reason	Time
7	M	0x1	2	M	detach	0x13 - user ended connection	45.810s

L2CAP Signalling Message



L2CAP	T	Addr	Packets	L2Len	L2CID	Code	Ident	SigLen	PSM	SrcCID	Time
0	M	0x1	1	8	Sig	Conn Req	0x15	4	RFCOMM	0x0040	7.908s

L2CAP Data Transfer Message



L2CAP	T	Addr	Packets	L2Len	L2CID	A	Data	Time
14	M	0x1	1	13	Dyn: 0x0041	S	0000: 02 AA BB 00 08 35 03 19 0008: 11 01 00 08 00	8.314s

LMP and L2CAP Signalling messages have payloads of commands for establishing LMP and L2CAP channels. L2CAP Data-Transfer messages have a payload that may include RFCOMM, SDP, or TCS data. In order to view higher protocol data, you will need to decode the messages (shown in the next section). The decoded data will appear as new lines in the trace called "Protocol Messages."

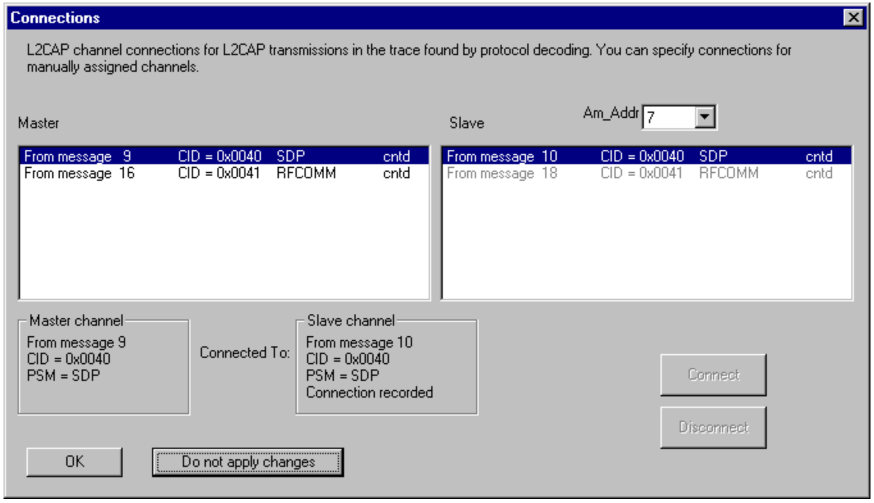
10.7 Viewing L2CAP Channel Connections

Once L2CAP messages have been decoded and displayed, you can check or change their L2CAP channel connections by opening the L2CAP Decoding Connections dialog box.

To view or change an L2CAP channel connection,

Step 1 Select from the menu bar
View>Decoding Connections

The following dialog box will open.



Connections

L2CAP channel connections for L2CAP transmissions in the trace found by protocol decoding. You can specify connections for manually assigned channels.

Am_Addr 7

Master

From message	CID	PSM	
From message 9	CID = 0x0040	SDP	cntd
From message 16	CID = 0x0041	RFCOMM	cntd

Slave

From message	CID	PSM	
From message 10	CID = 0x0040	SDP	cntd
From message 18	CID = 0x0041	RFCOMM	cntd

Master channel
From message 9
CID = 0x0040
PSM = SDP

Connected To:

Slave channel
From message 10
CID = 0x0040
PSM = SDP
Connection recorded

Step 2 Click on a channel assignment and then look at the Connect and Disconnect buttons on the far right of the dialog box.

If the Connect and Disconnect buttons are grayed-out, it means that Merlin made the channel assignments using data in the trace. You can verify that Merlin performed the assignments by looking at the text in the "Slave Channel" box in the lower left corner of the dialog box. If you see "Connection Recorded" it means that Merlin performed the channel assignments.

If Merlin was not able to make these channel assignments, then the Connect and Disconnect buttons on the right side of the dialog box will be active. You can then assign and edit channel connections.

Step 3 Open the drop-down menu labeled AM_Addr (Active

Member Address). If possible, select an address other than the currently displayed address.

The connections for the 'new' device should now display.

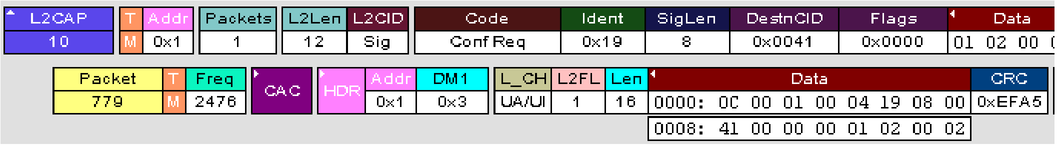
10.8 Viewing Protocol Messages and Transactions

By pressing a button such as SDP Msg or OB EX, you can cause Merlin to decode the higher level protocol data contained within L2CAP messages and display them as packet-like rows called *Protocol Messages*. Protocol Messages have headers marked "protocol" and fields that vary in appearance and content depending on the type of protocol.

Some Protocol Messages can be grouped into a higher level entity called a *Protocol Transaction*. A Protocol Transaction is a row in a trace that summarizes the higher level protocol data that is transmitted between a Master and Slave device when one sends a request and the other sends back a response. For example, if you press SDP Tra, Merlin will locate SDP requests and responses between a Master and Slave device summarize their data.

Viewing L2CAP Messages in Protocol Messages

If the protocol heading is double-clicked, the L2CAP data-transfer messages that make up the protocol will display below the protocol. You can also expand the protocol by left-clicking the small downward pointing arrow on the protocol header.



L2CAP	T	Addr	Packets	L2Len	L2CID	Code	Ident	SigLen	DestnCID	Flags	Data
10	M	0x1	1	12	Sig	Conf Req	0x19	8	0x0041	0x0000	01 02 00

Packet	T	Freq	CAC	HDR	Addr	DM1	L_CH	L2FL	Len	Data	CRC
779	M	2476			0x1	0x3	UA/UI	1	16	0000: 0C 00 01 00 04 19 08 00 0008: 41 00 00 00 01 02 00 02	0xEFA5

How to Decode

Decoding Protocol messages is the same process as decoding LMP and L2CAP messages.

Using the Toolbar - To decode using the Toolbar, press one of the protocol decode buttons such as: TCS . PPP OB EX .

Using the Menu - To decode using the menu, select:
Setup>Display Options

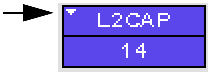
Then select one of the decode checkboxes.

Once a decode command has been issued, Merlin will create Protocol Messages in the trace. You will probably have to hide hops, polls, and null packets and then scroll through the trace in order to find Protocol messages.

Expanding Protocol Messages

Protocol messages can be expanded to reveal their constituent packets using any of the following methods:

- Left-click the small downward pointing arrow in the message/protocol header
- Double-click a message/protocol header
- Left-click the message/protocol header and choose "Expand Transaction" from the short-cut menu



10.9 Changing Protocol Assignments

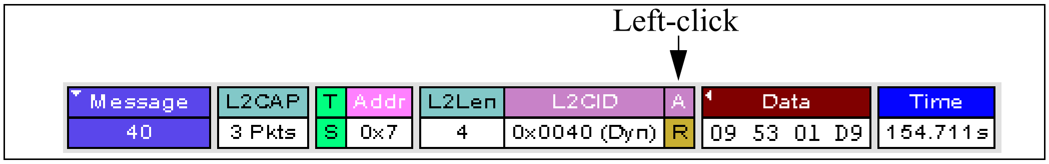
If a sequence of messages is assigned the wrong protocol, errors will display. To change or remove a protocol assignment, you will need to access the **Assignment** menu and issue an Add Assignment command.

Step 1 Click L2 CAP to display L2CAP messages.

Note You need to view L2CAP Messages in order to have access to the "**A**" field that permits reassigning protocols.

Step 2 Scroll through the trace until you have located an L2CAP message with a field marked "**A.**"

Step 3 Left-click the field marked "**A.**"

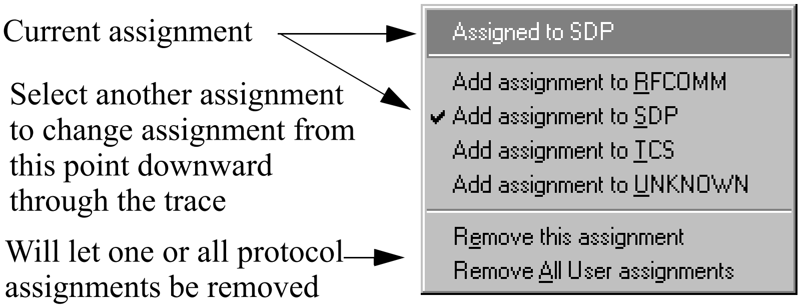


Left-click

Message	L2CAP	T	Addr	L2Len	L2CID	A	Data	Time
40	3 Pkts	S	0x7	4	0x0040 (Dyn)	R	09 53 01 D9	154.711 s

An **Assignment** menu will open for assigning, re-assigning, or un-assigning protocols to messages. This menu is context-sensitive and will vary in content depending on the protocols in the trace.

The Assignment Menu



Current assignment

Select another assignment to change assignment from this point downward through the trace

Will let one or all protocol assignments be removed

Step 4 From the menu, select one of the "Add Assignment" options not already selected.

At this point, the protocol assignment will change to your selection.

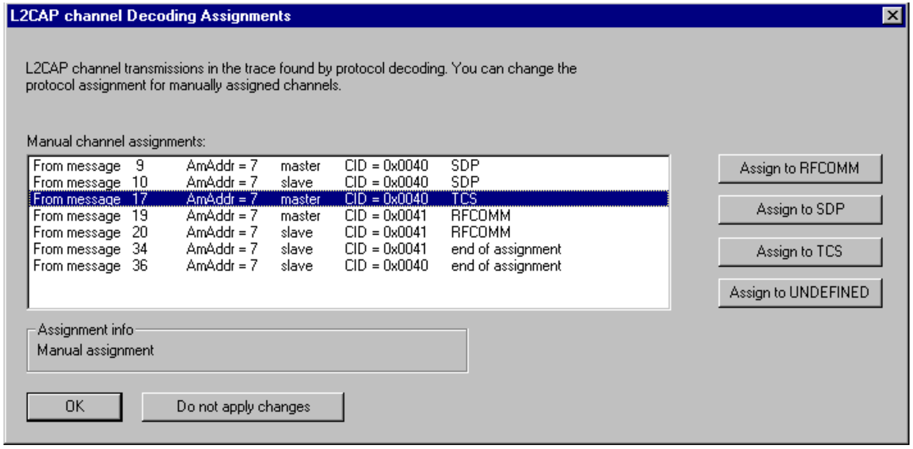
Using the Decoding Assignments Dialog Box

You can get a complete list of all protocol assignments by opening the Decoding Assignments dialog box. This dialog box will tell you which protocol assignments were made by Merlin and which are user-assigned. User-assigned protocols can be reassigned if need be using this dialog box.

To open the Decoding Assignments dialog box and reassign a protocol,

Step 1 Select from the menu
View>Decoding assignments

The Decoding Assignments dialog box will open. A status message in the bottom left corner of the dialog box will indicate who assigned the protocol.



L2CAP channel transmissions in the trace found by protocol decoding. You can change the protocol assignment for manually assigned channels.

Manual channel assignments:

From message	9	AmAddr = 7	master	CID = 0x0040	SDP
From message	10	AmAddr = 7	slave	CID = 0x0040	SDP
From message	17	AmAddr = 7	master	CID = 0x0040	TCS
From message	19	AmAddr = 7	master	CID = 0x0041	RFCOMM
From message	20	AmAddr = 7	slave	CID = 0x0041	RFCOMM
From message	34	AmAddr = 7	slave	CID = 0x0041	end of assignment
From message	36	AmAddr = 7	slave	CID = 0x0040	end of assignment

Assignment info
Manual assignment

Step 2 Click on one of the displayed assignments.

If the protocol was assigned by Merlin, the Assign buttons on the right will be grayed out and unavailable. If you want to change these assignments, you will have to use the pop-up menus described in the previous section. If a protocol has been manually assigned by a user, the Assign buttons will become active and allow you to make a change in assignment.

Step 3 If possible, click the appropriate Assign button.

Removing User-Assigned Protocol Assignments

As you practice assigning and reassigning protocols, you will find that one of the more useful commands is "Remove All User Assignments." This command allows you to undo all of your assignments.

To remove some or all user-assigned protocol assignments,

Step 1 Double-click any Protocol Message header to open view L2CAP messages.

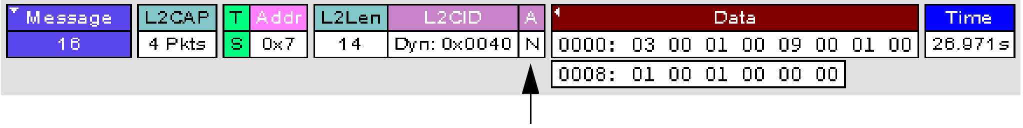
Step 2 Locate a message with a field marked "**A**."

Step 3 Left-click on the "A" field to open the Assignment menu.

Step 4 Select "Remove All User assignments" or "Remove this assignment."

Manually Assigning Protocols

If a recording does not capture the beginning of a dialog between a Master and Slave devices, Merlin may not have the L2CAP messages it needs to determine the correct protocol assignments. In this case, L2CAP messages will display an "N" in the Assignment field that means "Not Assigned."



Message	L2CAP	T	Addr	L2Len	L2CID	A	Data	Time
16	4 Pkts	S	0x7	14	Dyn: 0x0040	N	0000: 03 00 01 00 09 00 01 00 0008: 01 00 01 00 00 00	26.971 s

N=Protocol not assigned

An L2CAP message without a protocol assignment for the higher protocol data.

If you know what the protocol assignment should be for the missing assignments, you can manually add them by right-clicking your mouse over the A field shown above and selecting from the pop-up Assignment menu shown on the previous page.

Other Assignments: OBEX Client/Server Status

OBEX messages carry a status that indicates whether the transmitting device is an OBEX client or OBEX server.

To view an OBEX message’s client/server status,

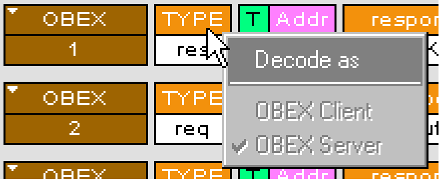
Step 1 Open an OBEX trace file such as the sample file "OBEXsample.blt" in C:\Program files\CATC\Merlin.

Step 2 Press Hop . N/R , and ☒ to hide Hops, NAKs, and unassociated traffic.

Step 3 Press OBEX to decode OBEX.

Step 4 Left-click your mouse over the field marked Type.

A pop-up menu will appear indicating whether the message was produced by an OBEX client or server. If the menu items appear grayed-out (as they do in this example) it means that Merlin assigned the client or server status based on data it found in the trace. If the menu items appear in black, it means that the user assigned the status and is therefore free to change the assignment.



Left-click over the Type field to open the OBEX Client/Server Assign menu.

Changing an OBEX Client or Server Status

If the beginning sequence of traffic is not recorded in a trace, the client/server status of the transmitting devices will not be preserved in the trace. In this case, the OBEX Client/Server pop-up menu will become active and you will be able to change the assignment.

Decoding BNEP (Bluetooth Network Encapsulation Protocol)

BNEP is a protocol that allows devices to encapsulate network protocols such as IP. Since BNEP can carry different types of network protocols, you need to tell Merlin what protocol the BNEP is going to be carrying. You do this via a script file called *bnep.dec* that is read during the initialization of the Merlin software. This file tells Merlin how to decode BNEP fields. Once read, BNEP can be correctly decoded by pressing the BNEP button on the toolbar or by selecting the **BNEP** option from the Decoding Options dialog box. If the decode file is not read at initialization, Merlin will display the data in an undecoded format.

For more information on BNEP decoding, see a supplemental document on BNEP in the support directory on the CATC web site:

http://www.catc.com/products/support/sup_merlinbluetooth.html

11. Other Features

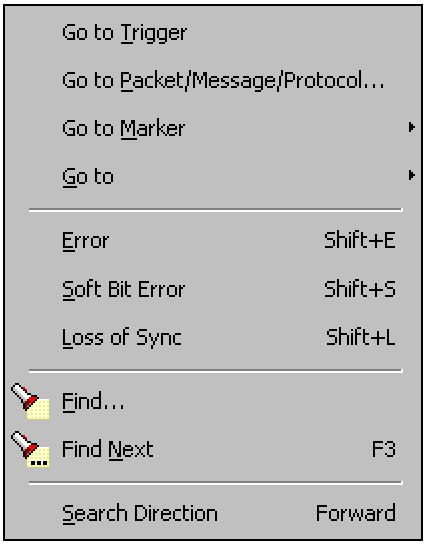
11.1 Search

The Search feature provides several options for searching through recorded traffic, allowing you to find specific packets based on triggering status, packet number, marking, or content.

To view the Search options,

- Click **Search** in the Menu bar.

  You see the Search drop-down menu:



Go to Trigger

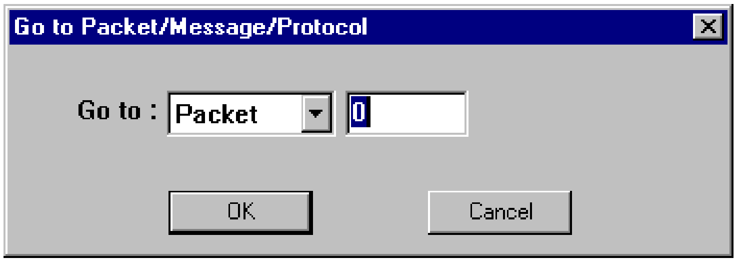
To display a triggering event, select **Go to Trigger** under **Search** on the Menu bar. The **Trace Viewer** display will reposition the trace to show the triggering event at the top of the screen.

Go to Packet/Message/Protocol

To display a specific packet, Message or Protocol

Step 1 Select **Go to Packet/Message/Protocol** under **Search** on the Menu Bar.

You see the **Go to Packet/Message/Protocol** window:



Step 2 Enter the number of the packet, message or protocol you want to display.

Step 3 Click **OK.**

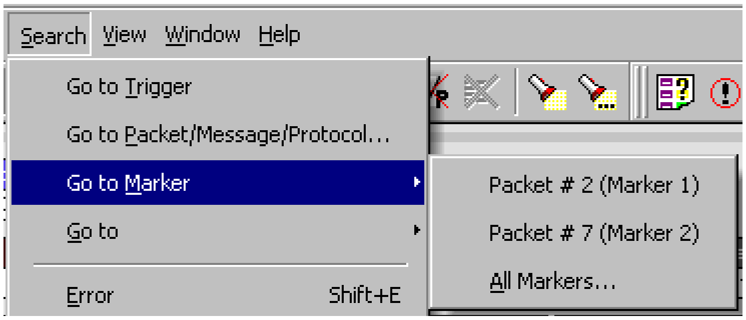
The Trace View repositions to show the packet at the top of your screen.

Go to Marker

To instruct the analyzer to display a marked packet,

Step 1 Select **Go to Marker** under **Search** on the Menu Bar.

You see a drop-down menu listing the marked packets in that Trace View:



Step 2 Select the desired packet from the displayed list.

The Trace View repositions to show the packet at the top of your screen.

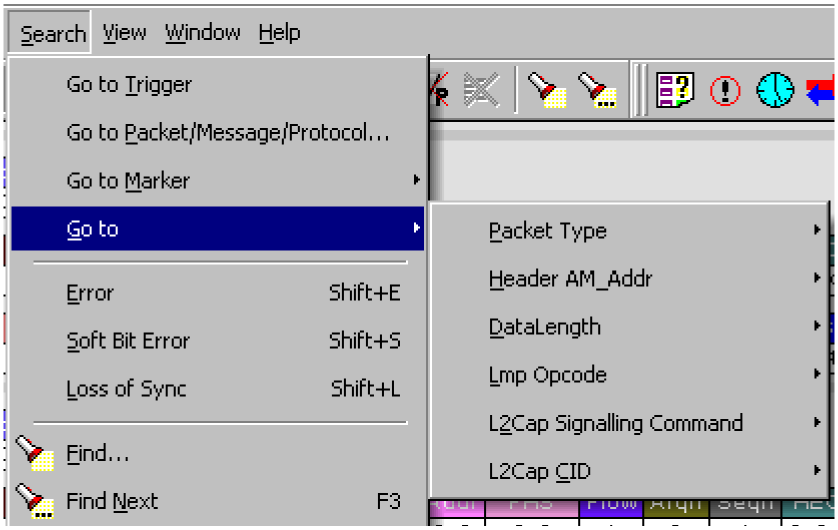
Note The **Go to Marker** feature functions in conjunction with the **Set Marker** feature. The comments within the parentheses following each marked packet are added or edited with the **Set Marker** feature.

Go to

The **Go To** feature takes you directly to an event in a Trace.

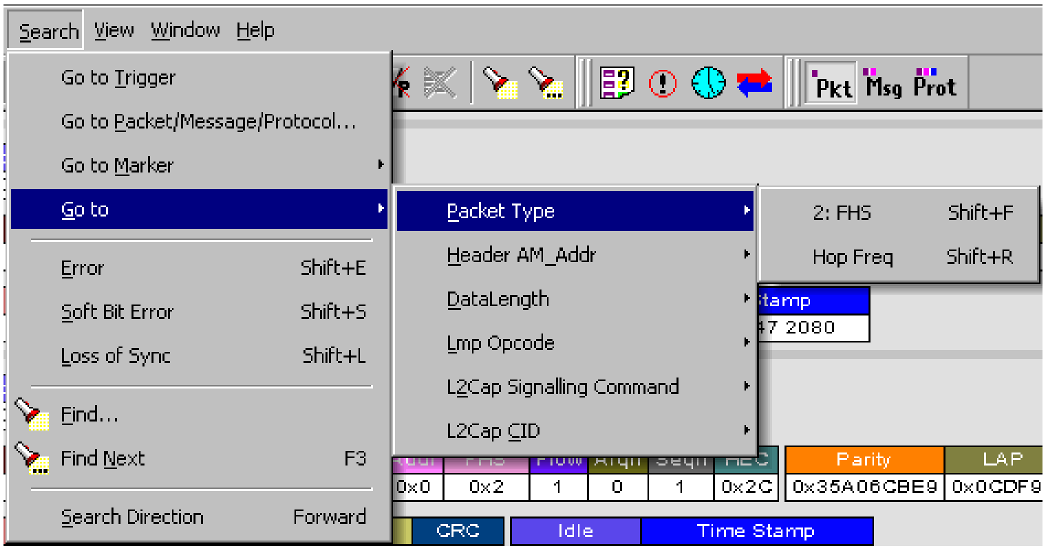
Step 1 Select **Go To** under **Search** on the Menu Bar.

You see the **Go To** drop-down menu:



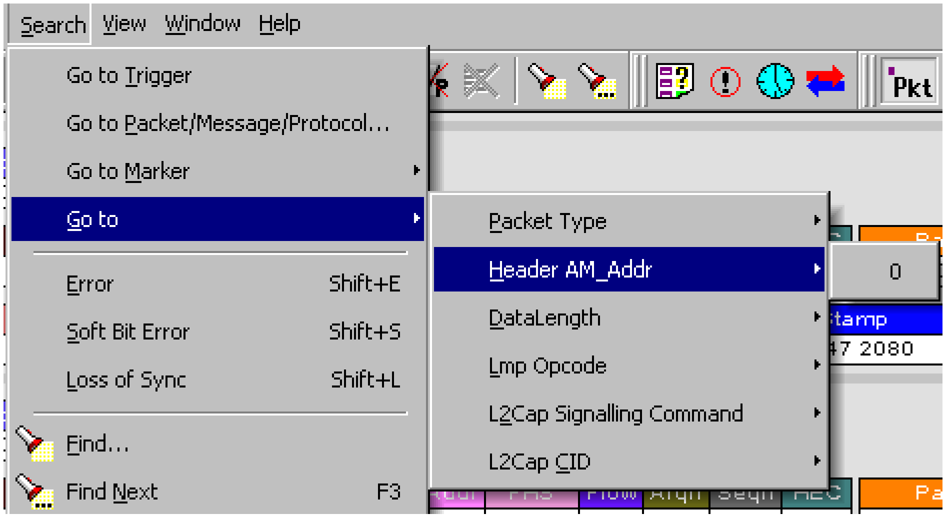
Step 2 Select the event you want to go to and enter the necessary information.

Packet Types



Select the type of packet you want to go to.

Header AM_Addr

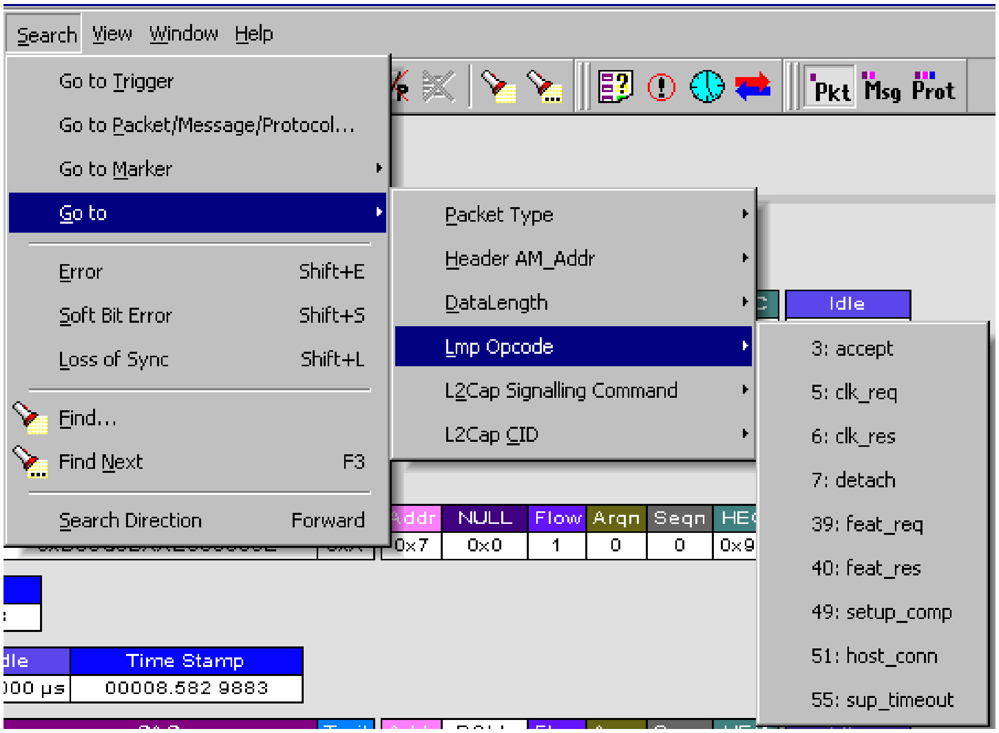


Select an Active Member Address from the list.

DataLength

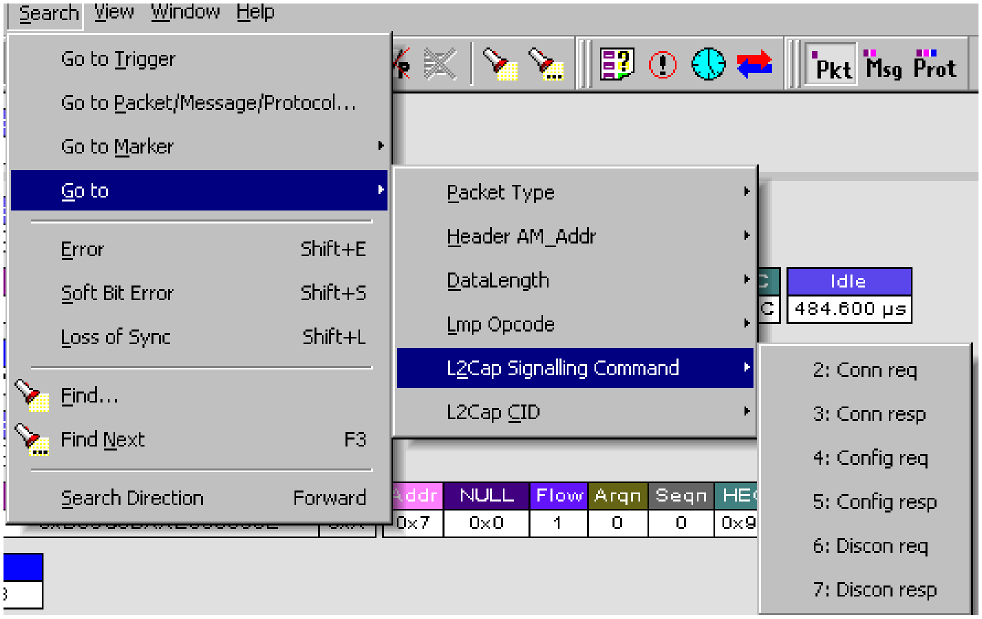
Not yet implemented. Will allow searching based on data length in bytes from the recording.

Lmp Opcode



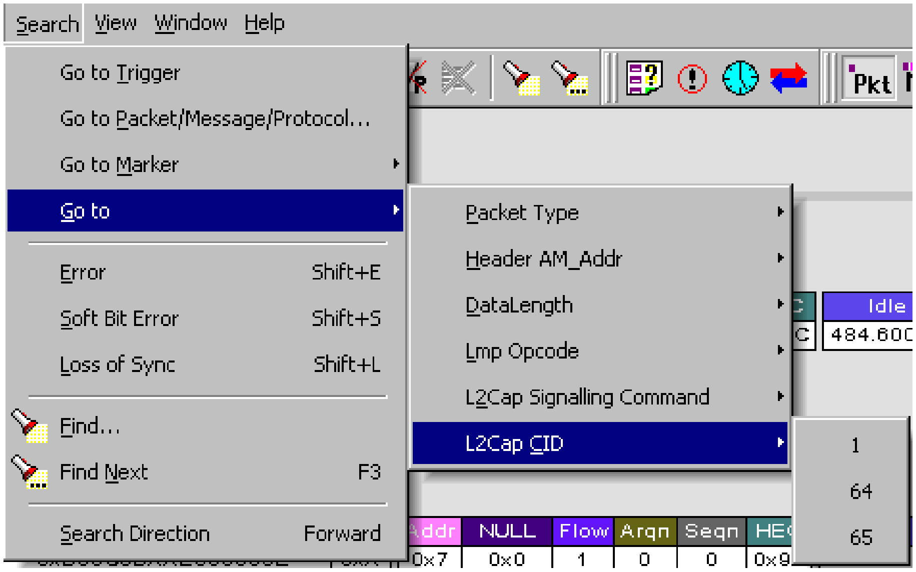
Select the Link Management Protocol Operational Code (Lmp Opcode) that you want to go to.

L2Cap Signalling Command



Select the type of L2Cap Signalling Command that you want to go to.

L2Cap CID



Select the L2Cap Channel ID (L2 Cap CID) that you want to go to.

Error

Moves trace view to next uncorrected error.

Soft Bit Error

Moves trace view to next soft (corrected) error.

Loss of Sync

Moves trace viewer to the next loss of sync.

Find

Find is a utility within Merlin that allows you to conduct searches of one or more events within a trace. Find allows you to search different hierarchical levels within the trace - packets, LMP Messages, L2CAP messages etc.

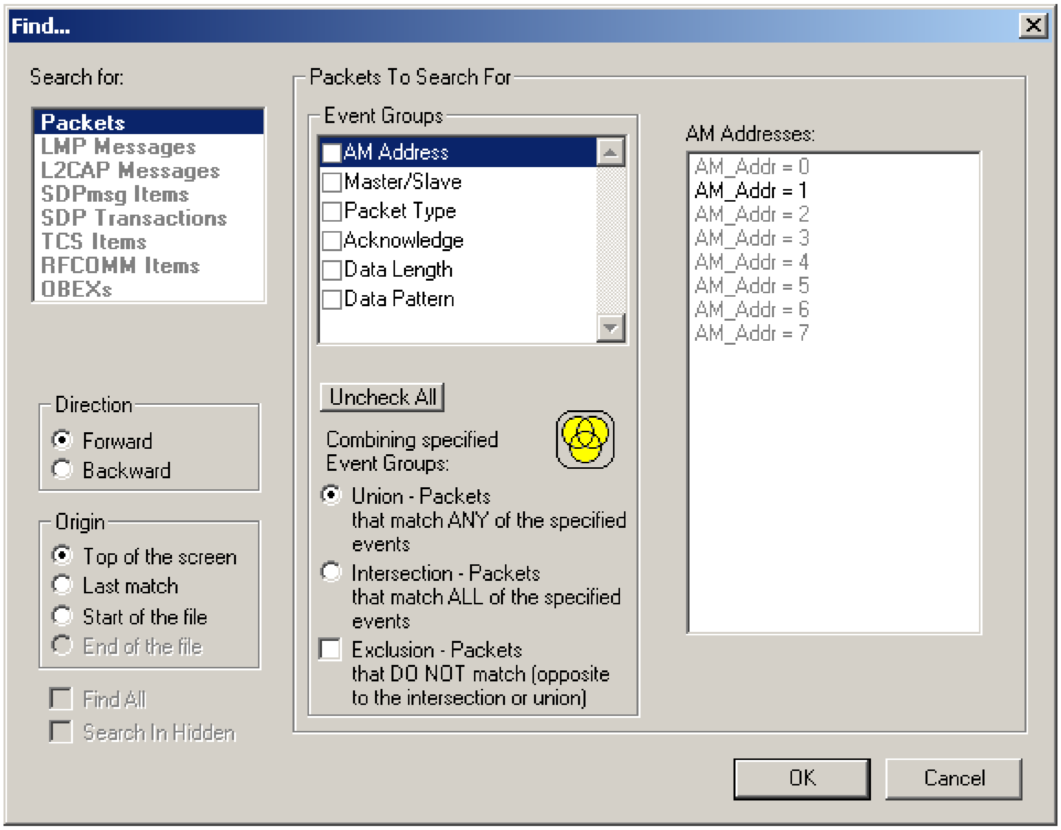
To start find,

- Select **Find...** under **Search** on the Menu Bar

  OR

  Click in the Tool Bar.

  You see the **User-Defined Find Events** screen:



The **Find** window divides into three areas:

Left area -- Controls the search level, search direction and search origin.

Center area -- Controls the event groups to be searched. The selection you make will display further choices on the right side of the Find window. At the bottom are three options called Union, Intersection, and Exclusion that are used with multi-criteria searches. These options are explained below.

Right area -- Controls the specific events to be searched within the trace. The box in this right section displays events from the selected Event Group.

The right area is context sensitive -- the Event Group selected in the Center area will determine what events will display on the right. For example, if you select **Packet Type**, the Right area will show you a list of packet types. Bold entries in the list represent items that actually occurred in the trace.

In the screenshot shown above, for example, AM Address is selected. On the right, you see that only Address 1 is in bold. This indicates that only a single device was transmitting traffic in the displayed trace.

Event Groups

Event Groups are categories of events that can occur in a trace. Clicking on an Event Group will display a list of Event types on the right side of the Find window that occur within each Event Group.

AM Address

Contains a list of seven Active Member addresses. Bold entries represent devices that occur in the trace.

Master/Slave

Contains two options labeled **Master** and **Slave**. Selecting an option will cause Merlin to search for traffic based on the selected role.

Packet Type

Contains a list of all Bluetooth packet types. If a packet type occurs in the trace, it will appear in bold.

Acknowledge

Contains a list of three Acknowledge types: **Explicit NACK**, **Implicit NACK**, and **ACK.** The three Acknowledge types are responses a device can issue to attempts to transmit packets to it.

A device can send an Acknowledgment in two ways: through setting the ARQN field to 0 (= explicitly not acknowledged), to 1 (explicitly acknowledged) or by sending an empty packet that does not have an ARQN field (= implicitly not acknowledged).

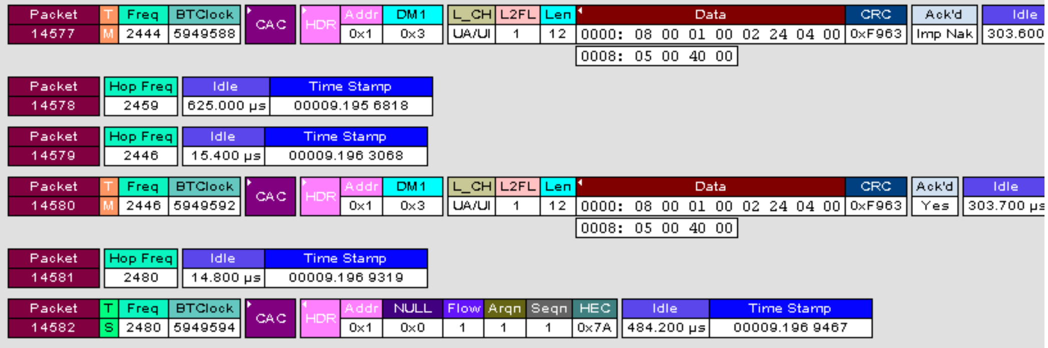
Explicit NACK - Explicitly not acknowledged. An Explicit NACK is an explicit response by a device that it did not receive a data packet. The Explicit NACK is transmitted in the ARQN field (=Acknowledgment Request Negotiation field). ARQN=0 means 'Explicit NACK.'

Implicit NACK - Implicitly not acknowledged. An Implicit NACK is a NACK that is implied rather than explicitly stated. If a device responds to a data packet by sending an empty packet, the NACK is implied.

ACK - Acknowledged. If a data packet is successfully transmitted to a target device, the target device acknowledges the received packet by setting the ARQN field to 1.

Acknowledgments are easily seen in Merlin traces because Merlin adds an **Ack’d** field on data packets of the transmitting device. This means that you do not have to hunt through the trace to see if the packet was acknowledged.

The following screenshot shows two examples of Acknowledgments.



Packet	T	Freq	BTClock	CAC	HDR	Addr	DM1	L_CH	L2FL	Len	Data	CRC	Ack'd	Idle
14577	M	2444	5949588			0x1	0x3	UA/UI	1	12	0000: 08 00 01 00 02 24 04 00 0008: 05 00 40 00	0xF963	Imp Nak	303.600

Packet	Hop Freq	Idle	Time Stamp
14578	2459	625.000 µs	00009.195 6818

Packet	Hop Freq	Idle	Time Stamp
14579	2446	15.400 µs	00009.196 3068

Packet	T	Freq	BTClock	CAC	HDR	Addr	DM1	L_CH	L2FL	Len	Data	CRC	Ack'd	Idle
14580	M	2446	5949592			0x1	0x3	UA/UI	1	12	0000: 08 00 01 00 02 24 04 00 0008: 05 00 40 00	0xF963	Yes	303.700 µs

Packet	Hop Freq	Idle	Time Stamp
14581	2480	14.800 µs	00009.196 9319

Packet	T	Freq	BTClock	CAC	HDR	Addr	NULL	Flow	Arqn	Seqn	HEC	Idle	Time Stamp
14582	S	2480	5949594			0x1	0x0	1	1	1	0x7A	484.200 µs	00009.196 9467

Implicit NACK - Packet 14577 is a data packet sent by the piconet Master device. Packet 14579 should have been a data packet with an acknowledgment. Instead, it is an empty packet. This Master interprets this empty packet as an **Implicit NACK** (i.e., implicitly not acknowledged). Merlin summarizes this packet exchange by adding an **Ack’d** field to the Master’s data packet and setting the **Ack’d** field to **Imp Nak**.

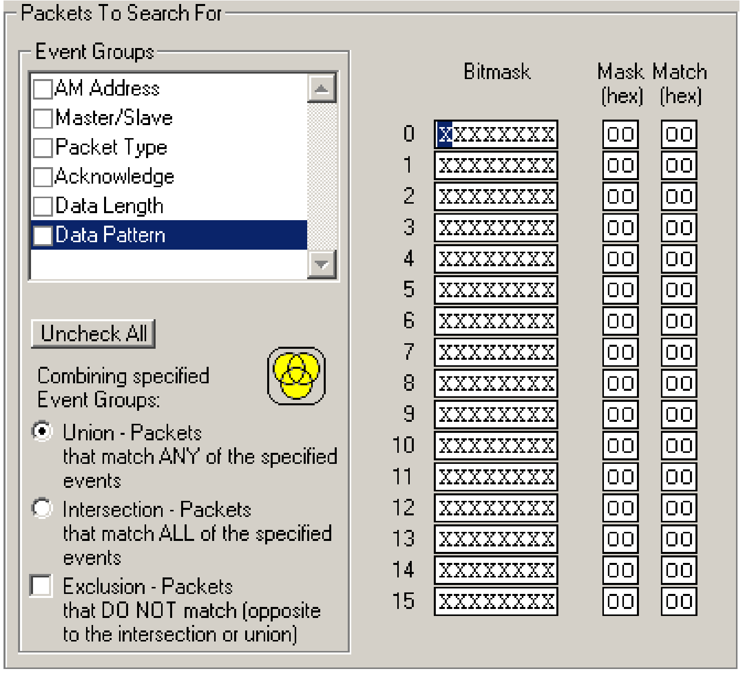
ACK - Packet 14580 is the Master’s retransmission of the data sent in packet 14577. Packet 14582 is the reply by the Slave device. This reply contains an ARQN field with a value of (= Acknowledge). Merlin summarizes this packet exchange by setting the **Ack’d** field on packet 14580 to **Ack**.

Data Length

Contains a list of all data lengths that occur in the trace.

Data Pattern

Contains a pattern editor for entering data patterns in binary or hexadecimal format. A pattern editor is a utility that allows you to search for a data pattern.



Packets To Search For

Event Groups

□ AM Address
□ Master/Slave
□ Packet Type
□ Acknowledge
□ Data Length
□ Data Pattern

Uncheck All

Combining specified Event Groups:

● Union - Packets that match ANY of the specified events

○ Intersection - Packets that match ALL of the specified events

□ Exclusion - Packets that DO NOT match (opposite to the intersection or union)

	Bitmask	Mask (hex)	Match (hex)
0	XXXXXXXX	00	00
1	XXXXXXXX	00	00
2	XXXXXXXX	00	00
3	XXXXXXXX	00	00
4	XXXXXXXX	00	00
5	XXXXXXXX	00	00
6	XXXXXXXX	00	00
7	XXXXXXXX	00	00
8	XXXXXXXX	00	00
9	XXXXXXXX	00	00
10	XXXXXXXX	00	00
11	XXXXXXXX	00	00
12	XXXXXXXX	00	00
13	XXXXXXXX	00	00
14	XXXXXXXX	00	00
15	XXXXXXXX	00	00

Searching for Bit Patterns

You search for a bit pattern by using the box labeled **Bitmask**. Enter one of the three following values:

- X = 'Don't care,'
- 0 = 'Match a 0',
- 1 = 'Match a 1.'

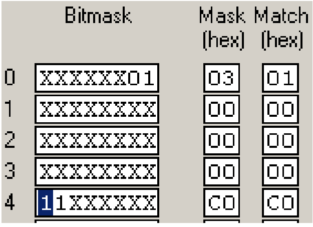
Example -- xxxxxx01 means 'Look for a data pattern where the first 6 bits can be any value but the last two bits must be 01.'

Searching for Long Patterns

You can search for long pattern sequences by entering patterns into multiple rows within the editor. Entering a pattern on one row and skipping several rows before entering the second pattern tells Merlin to search for the entire pattern between the two specified rows.

Example - Enter xxxxxx01 in row 1 and 11xxxxxx in row 2. This pattern means 'Look for the pattern xxxxxx0111xxxxxx.'

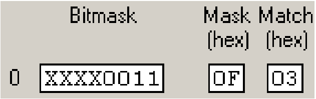
Example - If you enter xxxxxx01 into row 0 and 11xxxxxx into row 4, it means 'Look for the pattern xxxxxx01 xxxxxxxx xxxxxxxx xxxxxxxx 11xxxxxx.'



	Bitmask	Mask (hex)	Match (hex)
0	XXXXXX01	03	01
1	XXXXXXXX	00	00
2	XXXXXXXX	00	00
3	XXXXXXXX	00	00
4	11XXXXXX	C0	C0

Searching for Hexadecimal Patterns

The columns marked Match and Mask allow you to specify a pattern in hex. You enter the pattern you want to match in the column marked Match, and enter the mask in the column marked Mask. The Mask column allows you to specify which bits you are searching for.



	Bitmask	Mask (hex)	Match (hex)
0	XXXX0011	0F	03

Example - A Match of 03 and a Mask of '0F' tells Merlin that you are looking for the hex pattern of 03 occurring in the last four bits of the pattern. If you enter these values in the Match and Mask columns, the Bitmask section will automatically display the equivalent bit values: XXXX0011.

Union, Intersection, and Exclusion

If you select multiple events, you will need to use the options Union or Intersection to conduct the search.

Union is used to search for any selected event: "Find x or y." Union lets you tell the analyzer to search the trace for any of any of the selected items.

Intersection is used to search for all selected events: "Find x and y." Intersection lets you tell the analyzer to search the trace for any packet having all of the selected events.

Exclusion is used to exclude selected traffic from the trace. Exclusion is used with Union and Intersection --i.e., you select Exclusion with Union or Intersection.

- **Exclusion + Union** -- tells Merlin to exclude packets with any of the specified events.
- **Exclusion + Intersection** -- tells Merlin to exclude packets with all of the specified events.

Using Find

Step 1 Select the display level to be searched from the **Search For** box on the left side of the window.

For example, to search through L2CAP messages, select L2CAP. The display level that you select will affect options presented in the Events Group box.

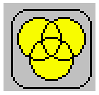
Step 2 Select a search direction and origin.

Step 3 Select one or more events from the **Events Group** box.

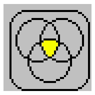
Your choices will affect options presented in the box on the right side of the screen.

Step 4 If you have selected two or more criteria, then select either :

- **Union:** Find all packets that match ANY of the specified events.

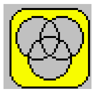


- **Intersection:** Find all packets that match ALL of the specified events.



If you want to selected events from the trace, then select:

- **Exclusion:** Exclude all packets that match any of the specified events.



Step 5 Click **OK**.

The search will then occur. Afterwards, the packets meeting the search criteria will display.

Some Find Examples

Search for all DM1 and Poll packets with an Active Member Address of 7.

Step 1 From the Event Group, select **Packet Types**.

Step 2 From the box on the right, select **DM1** and **Poll**.

Step 3 From the Event Group, select **Header AM_Addr**.

Step 4 From the box on the right, select **AM_Addr=7**.

Step 5 From the Center area, select **Intersection**.

Selecting Intersection tells Merlin to find packets with ALL of the selected traits.

Step 6 Press **OK**.

The trace should reposition to the first DM1 or Poll packet that has an Active Member address of 7.

Exclude all DM1 and Poll Packets with Active Member Addresses of 7.

Step 1 Select **Packet Types** from the From the Event Group

Step 2 Select **DM1** and **Poll** from the box on the right.

Step 3 Select **Header AM_Addr** from the Event Group.

Step 4 Select **AM_Addr=7** from the box on the right.

Step 5 From the Center area, select **Intersection and Exclusion**

Step 6 Press **OK**.

The trace will redisplay so that it excludes *DM1 packets with AM_Addr=7* and *Poll packets with AM_Addr=7*.

Exclude all packets with ANY of the following attributes: DM1, Poll, or AM_Addr=7.

Step 1 Select **Packet Types** from the Event Groups.

Step 2 Select DM1 and Poll from the box on the right.

Step 3 Select **Header AM_Addr** from Event Group.

Step 4 Select **AM_Addr=7** from the box on the right

Step 5 Select **Union** and **Exclusion**.

Selecting Union causes the analyzer to search for any of the selected events.

Step 6 Press **OK**.

The trace will redisplay so that it excludes *DM1s, Polls, or any packet with AM_Addr=7*.

Find Next

To apply the previous **Find** parameters to the next search,

- Select **Find Next** under **Search** on the Menu Bar

  OR

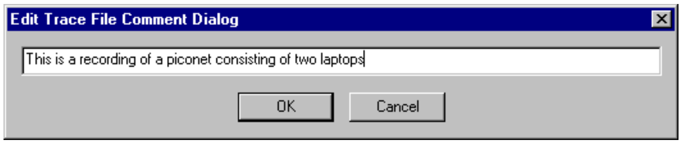
  Click 🔦 on the Tool Bar.

11.2 Edit Comment

You can create, view, or edit the 100-character comment field associated with each Trace file.

Step 1 Select **Edit Comment** under **File** on the Menu Bar.

You see the **Edit comment for trace file** window:



This is a recording of a piconet consisting of two laptops

Step 2 Create, view, or edit the comment.

Step 3 Click **OK**.

11.3 Reports

The Report menu provides several reports to assist you in analyzing Bluetooth™ traffic recorded by the analyzer.

File Information

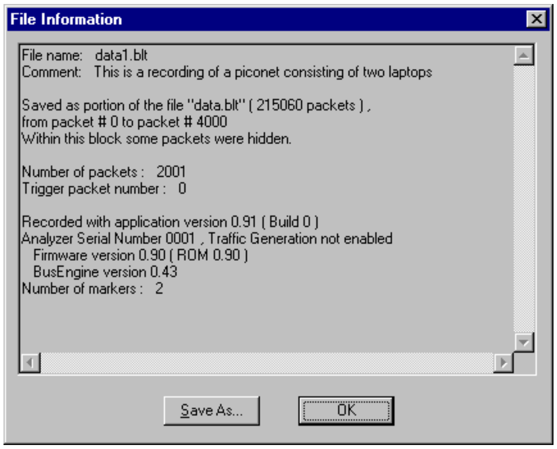
To display a File Information report,

- Select **File Information** under **Report** in the Menu Bar

  OR

  Click ▣ in the Tool Bar.

  You see the File Information screen:



```
File name:   data1.blt
Comment:   This is a recording of a piconet consisting of two laptops

Saved as portion of the file "data.blt" ( 215060 packets ) ,
from packet # 0 to packet # 4000
Within this block some packets were hidden.

Number of packets :   2001
Trigger packet number :   0

Recorded with application version 0.91 ( Build 0 )
Analyzer Serial Number 0001 , Traffic Generation not enabled
   Firmware version 0.90 ( ROM 0.90 )
   BusEngine version 0.43
Number of markers :   2
```

The File Information report provides valuable information about how the recording was made, what the buffer settings were, what the trigger options were, and what version of all the analyzer hardware was used to make the recording.

Error Summary

The Error Summary command displays an error summary of the current trace file and allows you to go to a specific packet, and save the error file to a uniquely named file.

Timing Calculations

Starts the modeless calculator dialog for calculating various timing and bandwidth parameters in the recording file.

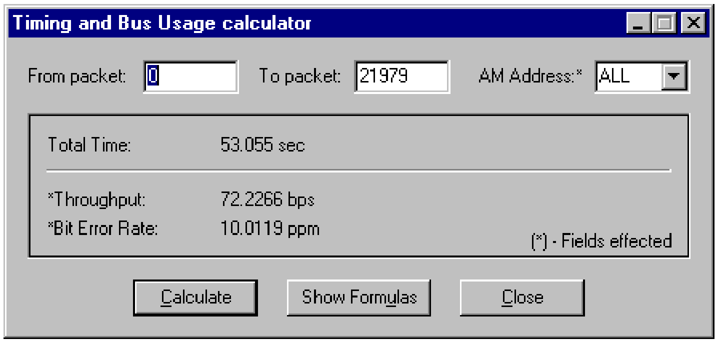
To display a File Information report,

- Select **Timing Calculations** under **Report** in the Menu Bar

  OR

  Click ⏱ in the Tool Bar.

  You see the File Information screen:



Timing and Bus Usage calculator

From packet: 0 To packet: 21979 AM Address:* ALL

Total Time: 53.055 sec

*Throughput: 72.2266 bps

*Bit Error Rate: 10.0119 ppm

(*) - Fields effected

To calculate bus usage and bit rate errors,

Step 1 Enter the range of packets to be examined in the text boxes marked "From packet" and "To packet."

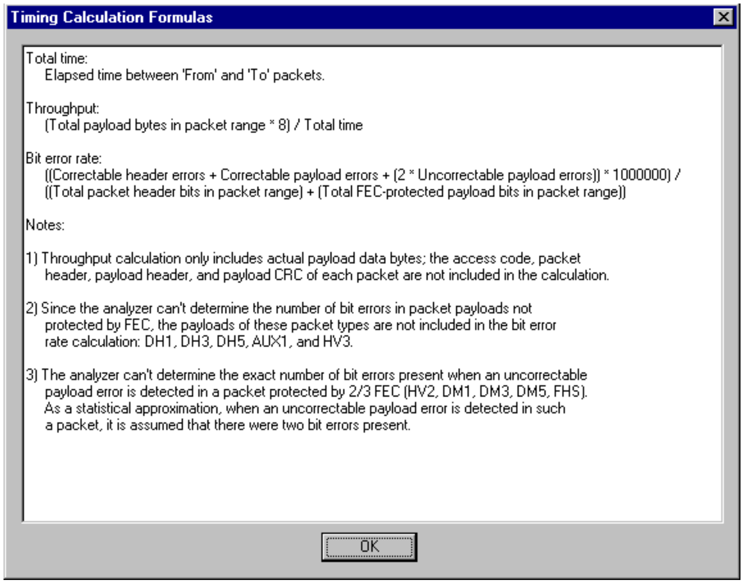
Step 2 If you wish to limit your calculations to a single device, select the device's address from the AM Address drop-down menu.

Step 3 Click the "Calculate" button.

At this point, bus usage will be calculated.

Show Formulas Button

At the bottom of the Timing and Bus Usage window is a button marked "Show Formulas." If clicked, the window shown below will open and describe how the bus usage calculations were performed.



Total time:
Elapsed time between 'From' and 'To' packets.

Throughput:
(Total payload bytes in packet range * 8) / Total time

Bit error rate:
((Correctable header errors + Correctable payload errors + (2 * Uncorrectable payload errors)) * 1000000) /
((Total packet header bits in packet range) + (Total FEC-protected payload bits in packet range))

Notes:

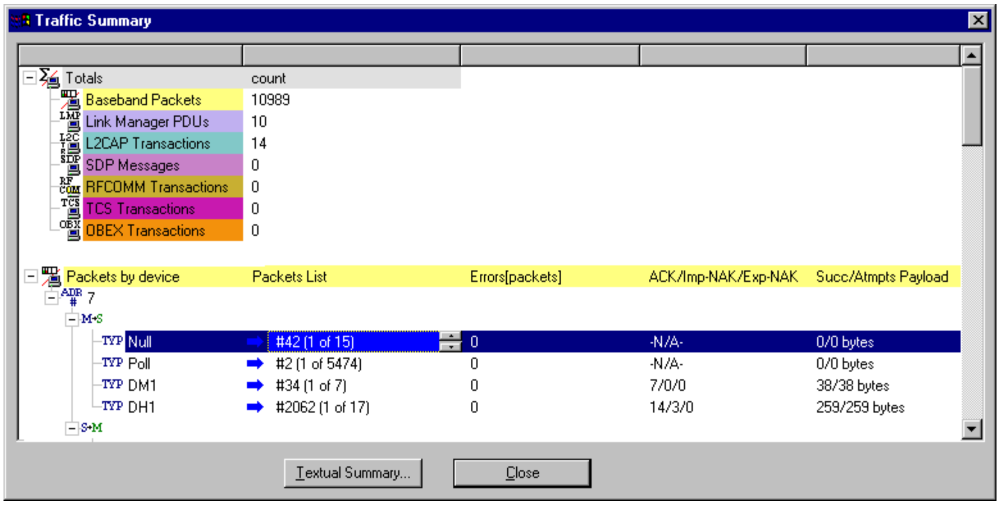
1) Throughput calculation only includes actual payload data bytes; the access code, packet header, payload header, and payload CRC of each packet are not included in the calculation.

2) Since the analyzer can't determine the number of bit errors in packet payloads not protected by FEC, the payloads of these packet types are not included in the bit error rate calculation: DH1, DH3, DH5, AUX1, and HV3.

3) The analyzer can't determine the exact number of bit errors present when an uncorrectable payload error is detected in a packet protected by 2/3 FEC (HV2, DM1, DM3, DM5, FHS). As a statistical approximation, when an uncorrectable payload error is detected in such a packet, it is assumed that there were two bit errors present.

Traffic Summary

The Traffic Summary command displays a text box with a summary of traffic captured in the current trace.

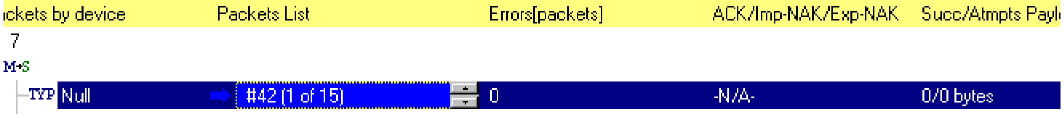


Totals	count
Baseband Packets	10989
Link Manager PDUs	10
L2CAP Transactions	14
SDP Messages	0
RFCOMM Transactions	0
TCS Transactions	0
OBEX Transactions	0

Packets by device	Packets List	Errors[packets]	ACK/Imp-NAK/Exp-NAK	Succ/Atmpts Payload
7				
M•S				
Null	#42 (1 of 15)	0	-N/A-	0/0 bytes
Poll	#2 (1 of 5474)	0	-N/A-	0/0 bytes
DM1	#34 (1 of 7)	0	7/0/0	38/38 bytes
DH1	#2062 (1 of 17)	0	14/3/0	259/259 bytes
S•M				

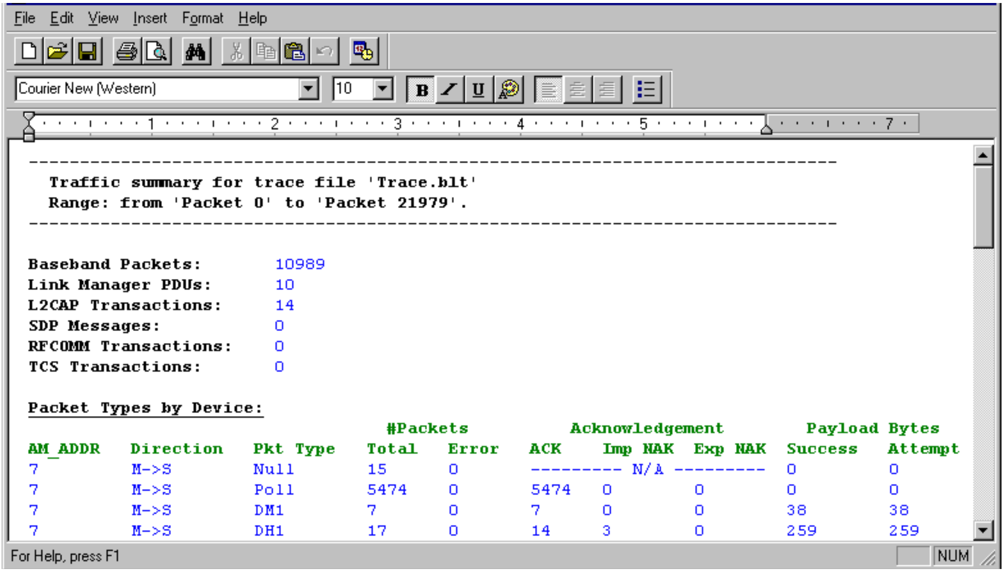
The Traffic Summary window divides into two main sections: a short top section (shown above in the top left corner of the window) that summarizes traffic for each protocol level, and a long section below describing the traffic details for each protocol level.

The second section is scrollable: click on an item below one of the headings to display scroll arrows. The arrows will allow you to scroll through the packets or transactions within that section. As you scroll, the trace will simultaneously jump to the packet or transaction that is listed.



ıckets by device	Packets List	Errors[packets]	ACK/Imp-NAK/Exp-NAK	Succ/Atmpts Paylı
7				
M↔S				
TYP Null	#42 (1 of 15)	0	-N/A-	0/0 bytes

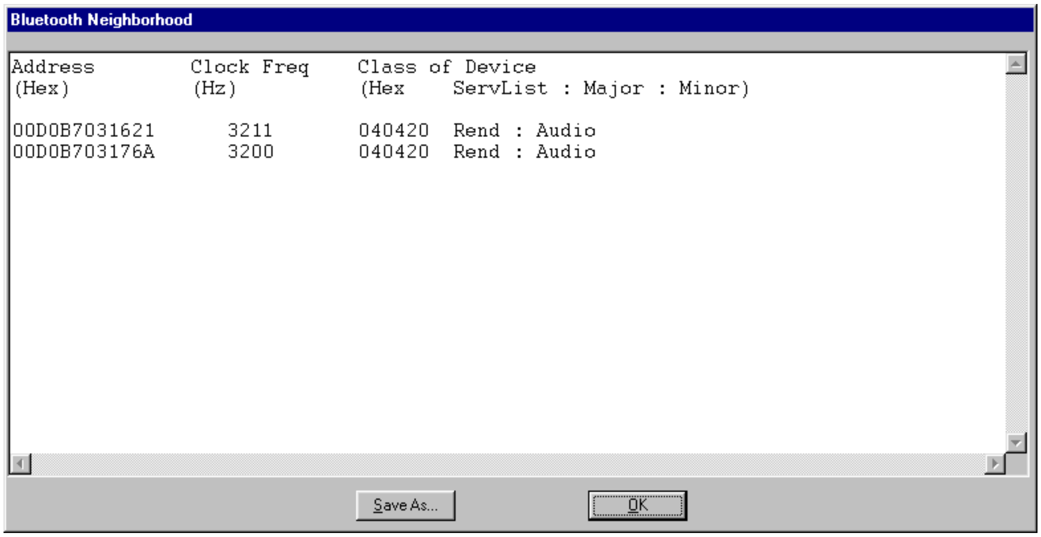
At the bottom of the Traffic Summary window is a button marked "Textual Summary." Clicking this button will cause WordPad to open and display the current Traffic Summary. This data can then be printed or saved.



```
-------------------------------------------------------------------------------
  Traffic summary for trace file 'Trace.blt'
  Range: from 'Packet 0' to 'Packet 21979'.
-------------------------------------------------------------------------------

Baseband Packets:       10989
Link Manager PDUs:      10
L2CAP Transactions:     14
SDP Messages:           0
RFCOMM Transactions:    0
TCS Transactions:       0

Packet Types by Device:
                                   #Packets          Acknowledgement        Payload Bytes
AM_ADDR   Direction   Pkt Type   Total   Error   ACK    Imp NAK  Exp NAK  Success   Attempt
7         M->S        Null       15      0       --------- N/A ---------  0         0
7         M->S        Poll       5474    0       5474   0        0        0         0
7         M->S        DM1        7       0       7      0        0        38        38
7         M->S        DH1        17      0       14     3        0        259       259
```

11.4 BT Neighborhood

The BT Neighborhood status box displays information about known Bluetooth™ devices. This command is accessible through the View menu in the menu bar. Three types of data are displayed: Device Address, Class of Device (COD), and the Bluetooth™ Clock Frequency for each discovered device. The expected Bluetooth™ clock frequency is 3200 Hz +/- 250 PPM.



```
Address        Clock Freq    Class of Device
(Hex)          (Hz)          (Hex    ServList : Major : Minor)

00D0B7031621     3211        040420  Rend : Audio
00D0B703176A     3200        040420  Rend : Audio
```

11.5 Encryption

Bluetooth encryption is a multi-staged process that provides devices with secure, encrypted communications. The process begins with a device prompting the user for a Personal Identification Number (PIN). When the right PIN is entered, the Slave begins an encryption setup dialogue with the Master. At the beginning of this dialogue, the Slave and the Master agree on a *Link Key.* A Link Key is a 128-bit value that the two devices use for authentication. When the Slave and Master agree on a Link Key, the Slave then negotiates for the transfer of the *Encryption Key* from the Master device. The Encryption Key is used to encrypt and decrypt messages. Once the Encryption Key is transferred, both devices use it to encrypt all subsequent communications.

In order for Merlin to decode encrypted traffic, it needs the *Link Key* for each Master-Slave connection for which encryption will be used. If you know the Link Key, you can enter the Key into the Encryption Options dialog box. If you do not know it, you give Merlin the PIN for a device and allow Merlin to discover the Link Key on its own. Once Merlin has the Link Key, it can capture the rest of what it needs by listening to the Master and Slave devices as they negotiate for the Encryption Key.

Configuring Merlin for Encryption

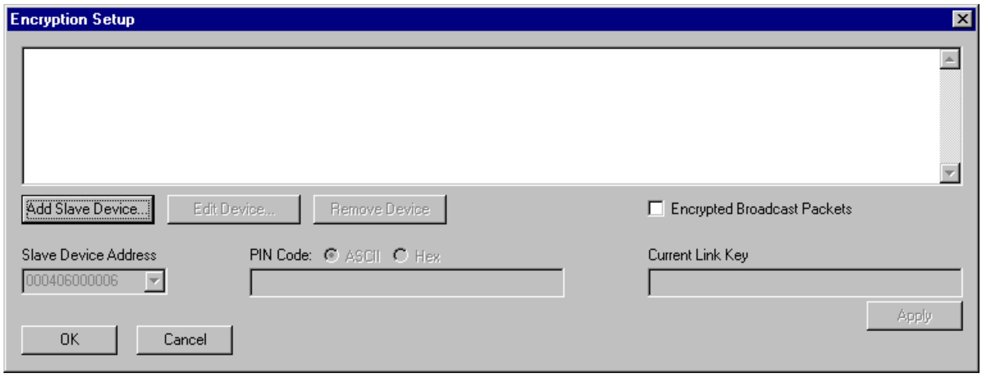
For Merlin to successfully decrypt traffic, two steps need to be performed: 1) Merlin needs to be given the PIN or Link Key for each Master-Slave connection; and 2) Recording needs to be begun *before* the Slave connects to the Master. If recording is begun prior to the creating the Master-Slave connection, Merlin will be able to obtain the encryption key and decode encrypted traffic.

The following steps show how to configure Merlin for encrypted traffic.

Note Be sure to begin the following process *prior* to connecting your Slave device to the Master or Merlin will not be able to capture the Link Key.

Step 1 Select **Setup >Encryption Options ...**

The following dialog box opens.



□ Encrypted Broadcast Packets

Slave Device Address: 000406000006

PIN Code: ● ASCII ○ Hex

Step 2 Click the button marked **Add Slave Device**.

When you click this button, a list of devices will appear in the **Slave Device Address** drop-down menu.

Step 3 Select an address from the drop-down menu marked **Slave Device Address** or enter the Device Address manually if it is not in the list.

Step 4 Enter the appropriate Personal Identification Number (PIN) for the selected device to the box marked **PIN Code**. This PIN allows Merlin to learn the Link Key. If you do not have the PIN, skip to Step 5.

Note The PIN you provide should be the same used by the Slave. For example, if your Slave device requires a PIN of "1234", then enter the same PIN in the dialog box shown above.

Step 5 If you do not have the PIN, or if the Master and Slave have already agreed upon the Link Key, manually enter a Link Key as a 128 bit (sixteen byte) hex value into the box marked **Current Link Key**. If you have the PIN, you can skip this step.

Note If the Master and Slave were previously connected, they may already agree on the Link Key. In this case, you will need to provide Merlin with the Link Key and not simply the PIN.

Step 6 Click **Apply**

The changes you have made are applied and the information is displayed in the dialog box as shown below. Four fields will display: Device Address, PIN, the Link Key, and Link Key status.

Link Key status may read:

Mstr (=Master unit's Link Key)

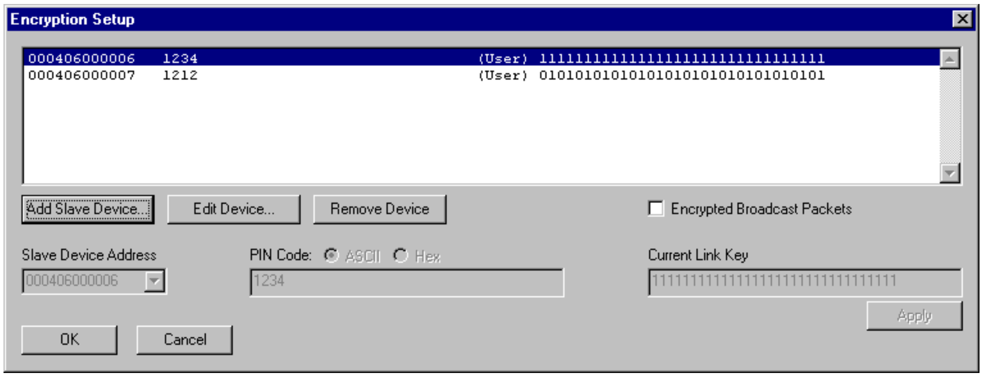
Slve (=Slave unit's Link Key)

Comb (=Combination Key)

Init (=Initialization Key)

Temp (=Temporary Key)

User (=User-defined Key)



Encryption Setup

```
000406000006   1234                              (User) 11111111111111111111111111111111
000406000007   1212                              (User) 01010101010101010101010101010101
```

□ Encrypted Broadcast Packets

Slave Device Address: 000406000006

PIN Code: ● ASCII ○ Hex

1234

Current Link Key: 11111111111111111111111111111111

Step 7 Click **OK**.

The dialog box closes.

12. How to Contact CATC

Type of Service	Contact	
Call for technical support…	US and Canada:	1 (800) 909-2282
	Worldwide:	1 (408) 727-6600
Fax your questions…	Worldwide:	1 (408) 727-6622
Write a letter…	Computer Access Technology Corp. Customer Support 2403 Walsh Avenue Santa Clara, CA 95051-1302	
Send e-mail…	support@CATC.com	
Visit CATC’s web site…	http://www.CATC.com/	

13. Warranty and License

Computer Access Technology Corporation (hereafter CATC) warrants this product to be free from defects in material, content, and workmanship, and agrees to repair or replace any part of the enclosed unit that proves defective under these terms and conditions. Parts and labor are warranted for one year from the date of first purchase.

The CATC software is licensed for use on a single personal computer. The software may be copied for backup purposes only.

This warranty covers all defects in material or workmanship. It does not cover accidents, misuse, neglect, unauthorized product modification, or acts of nature. Except as expressly provided above, CATC makes no warranties or conditions, express, implied, or statutory, including without limitation the implied warranties of merchantability and fitness for a particular purpose.

CATC shall not be liable for damage to other property caused by any defects in this product, damages based upon inconvenience, loss of use of the product, loss of time or data, commercial loss, or any other damages, whether special, incidental, consequential, or otherwise, whether under theory of contract, tort (including negligence), indemnity, product liability, or otherwise. In no event shall CATC's liability exceed the total amount paid to CATC for this product.

CATC reserves the right to revise these specifications without notice or penalty.