The Agilent Technologies E2920 PCI/PCI-X Series

Application Note 3

Analyze how efficiently a device uses PCI/PCI-X resources

The Agilent PCI/PCI-X Performance Optimizer, a combination of testcard and software, provides help regarding performance analysis of extensive systems or single devices.
If you perform benchmark tests, the Agilents PCI/PCI-X Performance Optimizer helps you to quickly evaluate the performance of your system. Predefined measurements such as efficiency, throughput and utilization lead to quick results.
If you are a device designer, the Agilents PCI/PCI-X Performance Optimizer helps you not only to evaluate the performance of a particular device, but also shows you where you can improve it.

Aims of this Application Note

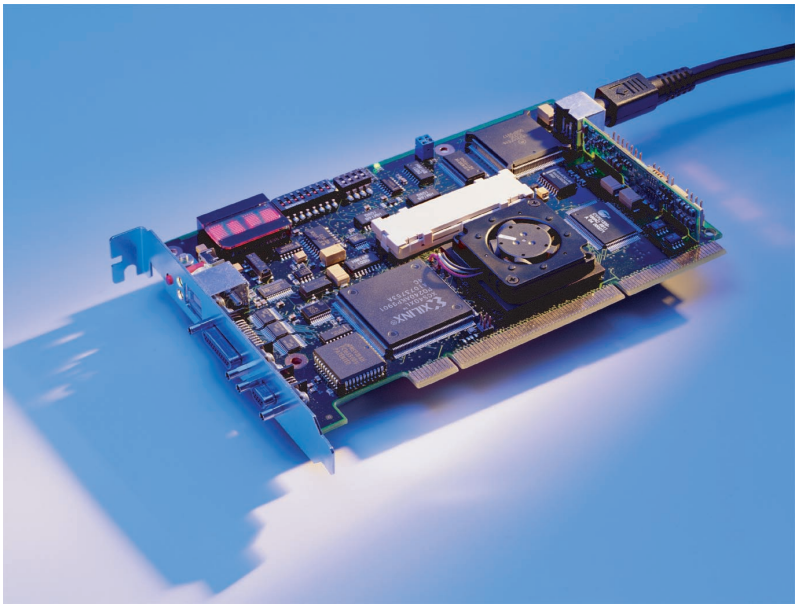
- To test the overall system performance.
- To analyze and optimize the performance of a particular device pair.

Questions that can be answered with the help of the SVP

- Real-time performance measurements for benchmarking:
  - How efficiently is the system operating?
- Post-processed analysis:
  - How efficiently is the device operating?
  - How can I optimize performance?

Benefits of the Agilent Product

- Real-time performance:
  - Pre-defined measurements are available.
- Post-processed performance measurements:
  - Detailed measurements are provided.
  - Parallel measurements are provided.
  - Performance analysis is possible.



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Viewing the Overall System Performance for PCI

The Agilent E2920 PCI software can calculate and display two performance measures simultaneously. Each measure can either show one of the predefined measurements (efficiency, throughput, utilization and retries), or can be programmed manually for advanced performance measurements.

Note:
The software provides eight performance measurements-the GUI provides direct access to two of them. The others can be accessed through the C-API.

Setting Up a Predefined Performance Measurement for PCI

Task

Set up the software so that the performance measurements PCI Utilization and PCI Efficiency are displayed.

Procedure

1. Open the Real Time Measurement Setup dialog box by selecting Real Time Counter Setup... in the Performance menu.

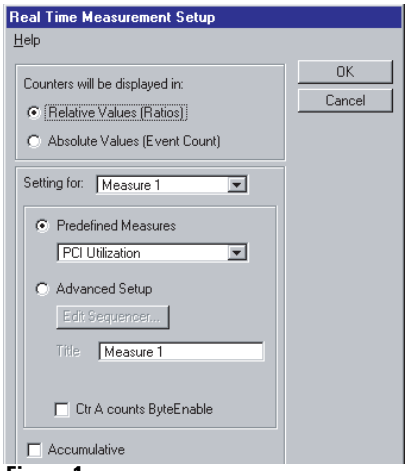

Figure 1.

2. Use the default settings for Measure 1 to measure the PCI Utilization.
3. For Measure 2, from Predefined Measures, select PCI Efficiency.

Viewing the Results

1. Open the Real Time Counter Result window by selecting Real Time Counter Results... in the Performance menu.

2. Click Start.
   The results are displayed in Momentary view, which shows the results of the last measurement time interval.
   To view the result history over time, select the Time History tab.

Advanced Performance Measurement for PCI

For each advanced performance measurement, two programmable counters (A and B) can be set up to count particular events on the bus, such as idle states, retries, and so forth.
To specify the events, pattern terms are to be defined. The counters A and B are controlled by sequencers; you have to define these in the sequencer description table.
Additionally, there is a reference counter for counting bus cycles.

For details about programming the counters, please refer to the Agilent PCI Analyzer User's Guide.

Viewing the Overall System and Card Performance for PCI-X

The Agilent E2920 PCI-X Series software provides two different user interfaces for real-time performance and post-processed measurements.
To access the user interface for real-time performance analysis, select:
Start > Programs > Agilent E2920 PCI-X > PCI-X Real Time Performance GUI

The PCI-X Real-Time Performance software can calculate and display two performance measurements simultaneously. The software provides standardized predefined measurements to be run either for the card the system, or both. Each measurement can either show the predefined measurements efficiency, throughput and utilization, or the retry rate or the split rate.

Setting Up a Real-Time Performance Measurement for PCI-X

Task

Set up the performance measurement so that utilization, efficiency, throughput and split rate for the whole system are displayed.

Procedure

1. Open the RTP Measurement Setup window by selecting Setup Measurement... in the Setup menu.
2. For System Performance, select only the following:
- Efficienc, Throughput and Utilization
- Retry
Note that you may have to clear any other selected measurements first

The RTP Measurement Setup window looks as follows:

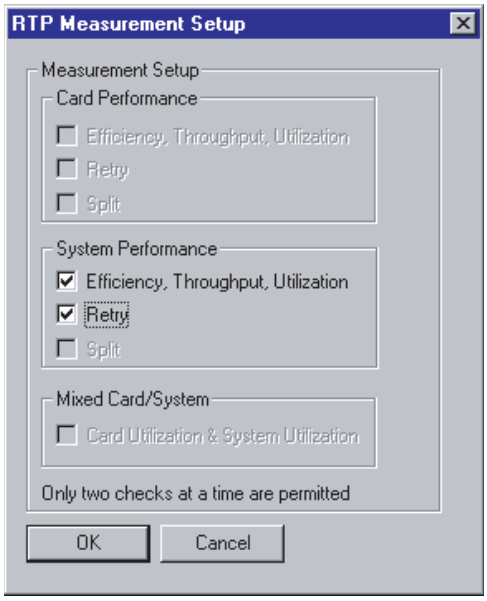

Figure 2.

Viewing the Results

Click Run in the PCI-X Real Time Performance window.The results are displayed by default as Bar Graphs, which show the results of the last measurement time interval.

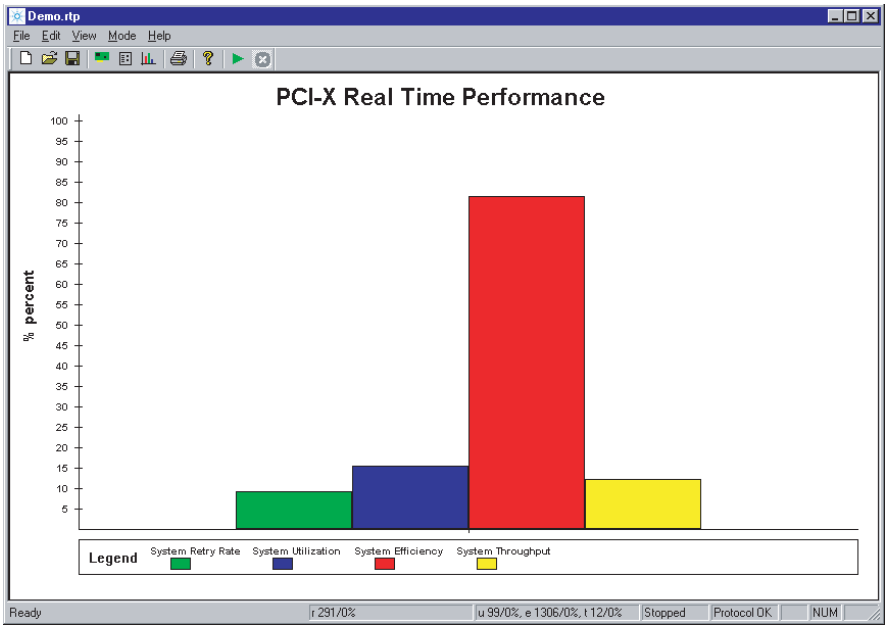

Figure 3.

You can change the display and measurement options in the RTP Options dialog box, which you open by selecting Options in the View menu. This dialog box allows you to modify the measurement update interval, to create a report file and to configure the display of the results.

Post-processed Performance Analysis Test

You can use the post-processed performance feature to analyze the performance of a particular PCI/PCI-X device. The results helps you to optimize your device.

The following is required to set up a post-processed performance analysis test:

1. Enable post-processed performance analysis (valid only with the Agilent E2920 PCI software).
   The software has to run in performance capture mode.

2. Identify the device(s) under test.
   To enable the Agilent PCI/PCI-X Performance Optimizer to identify particular devices communicating on the PCI/PCI-X bus, you need to specify them in the setup. This differs for the device under test, as described below:

Master Identification

The testcard can only identify masters that are correctly connected to it. The GNT# of the master must be connected to one of the testcard's external trigger input pins-if necessary, by soldering a wire. If you also want to run latency tests, the REQ# lines of the respective masters need to be connected to the testcard's external trigger input pins as well.

Target/Completer Identification

Target and completer devices are specified by their address space.

Requester Identification

To identify the requester, you need the bus, device, and function number of this device. To determine these numbers, run the performance measurement and view the performance report (available from the Performance menu). The software does a configuration scan on the whole PCI-X bus system. Subsection 1.1 in this report lists all requesters found on the bus with their corresponding bus, device and function numbers.

3. Set up the data capture.
   A trigger has to be set up for a particular event on the bus. For example, the PCI/PCI-X Analyzer can be set up to trigger when the device under test is accessed. The software then sets up the Analyzer so that only data important for performance calculations is captured in the trace memory. Thus, the trace memory is used very efficiently.

4. Select the device pair.
   The Performance Optimizer allows you to focus the performance test on a single device or a single master/target pair, or requester/completer pair respectively.

5. Start the measurement, and view and analyze the results.

Note:
Because the test setups for PCI and PCI-X devices are very similar, the differences are described in each section.

The setup of a post-performance analysis test is now described by means of an example.

Task

The performance of a graphic card is to be analyzed. Only write accesses to the card are to be captured. The measurements are to be restricted to memory commands. The accesses of all available master devices to this target are to be captured and analyzed.

Enabling Post-Processed Performance Analysis

To enable post-processed performance analysis, set the mode as shown in the following figure.

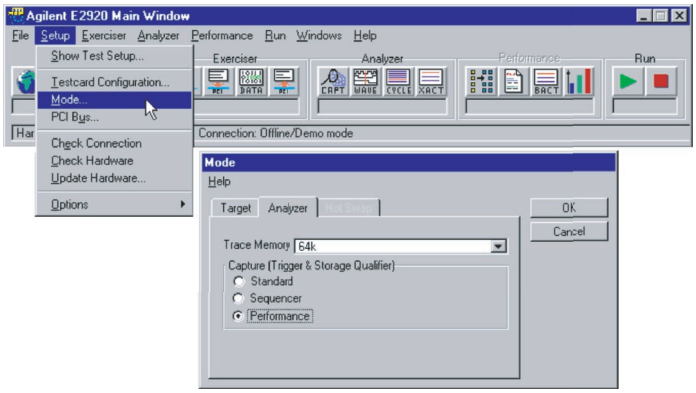

Figure 4.

Setting Up the Device Identification

To identify the target:

1. Open the Performance Setup window by selecting Performance Setup... in the Performance menu.
2. Select the Target Identification tab.
3. Enter the target's base address and memory size in the Target Identification window.
4. Restrict your measurement to traffic using memory commands by selecting MEM from the Command list.

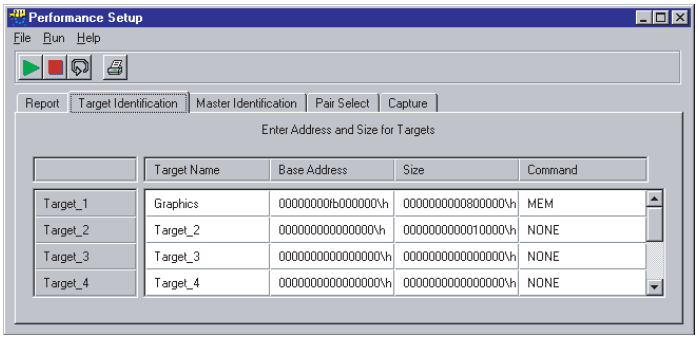

Figure 5.

Note:

To identify a PCI-X completer device, use the Completer Identification page and specify it by its address space just as for a PCI target.

Identifying particular masters is not necessary in this example, because all masters are analyzed.

Note for Identifying Masters and Requesters:

Identifying Masters (valid only with E2920 PCI software)
To identify particular masters, select the Master Identification tab.
After you have connected the GNT# and REQ# lines of the masters to the external trigger input pins of the testcard (if necessary, by soldering wires to them):

1. Enter the trigger port numbers that these masters' GNT# lines are connected to into the respective GNT# Pin fields.

2. Enter the trigger port number that these masters' REQ# lines are connected to into the respective REQ# Pin fields. Entering zero (0) means that GNT# and REQ# are not connected.

Identifying Requesters (valid only with E2920 PCI-X software)
To identify particular requesters, select the Requester Identification tab and enter the corresponding bus, device and function numbers.

Specifiying the Data Capture

To set up the trigger for data capture in the trace memory:

1. In the Performance Setup window, select the Capture tab.
2. Select Edit... in the Trigger on group.
   This opens the Capture window.

For a PCI device, proceed as follows:

3. In the Capture window, select trigger on Pattern and click Edit ....
   This opens the Pattern Editor.

4. In the Pattern Editor:

- For signal AD32, enter the target's address to trigger when this target memory space is accessed.

- For signal CBE3_0, enter xxx1\b to trigger on write commands.

- For signal b_state, enter Addr to trigger on address phases.

For a PCI-X device, proceed as follows:

3. In the Capture window, select trigger on Bus pattern, click Edit ... and enter the line:
   AD32=fbxxxxxx\h &&
   CBE3_0=xxx1\b &&
   b_state=Addr

Select the Device Pair to be tested

In this performance test, the accesses from all masters (or requesters) to the device under test (graphic card) are to be analyzed:
In the Performance Setup window, click the Pair Select tab and select the pair All Masters (or All Requesters) and Graphics.

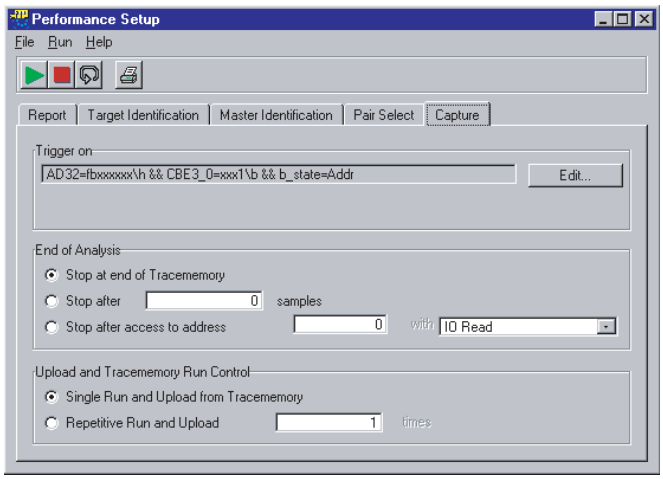

Figure 6.

Viewing and Analyzing the Results

For viewing the results, proceed as follows:

1. Start the Performance Optimizer by clicking Run in the Performance menu.

2. Open the Performance Charts window from the Performance menu.

As an example, the PCI Usage chart looks as follows (valid only with Agilent E2920 PCI software):

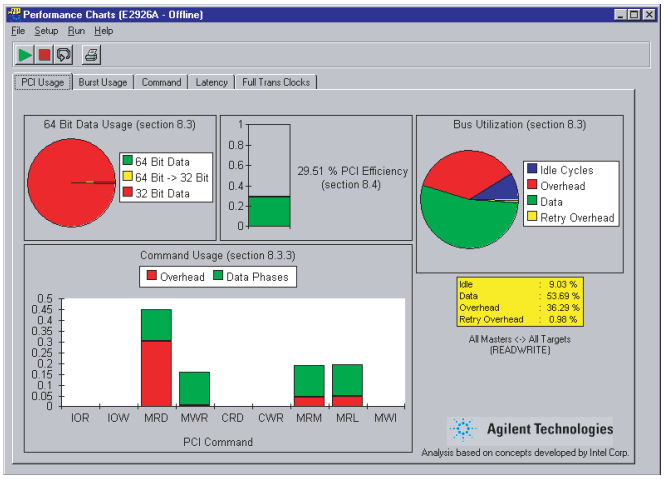

Figure 7.

Note:
Move the mouse over the pie charts to view the values of the various pie slices.

In the Command Usage chart, you can see that memory read command (MRD) causes the most overhead. It shows that using this command is not as efficient as on the extended commands memory read multiple (MRM) and memory read line (MRL).
The Command tab provides further information about the command usage.

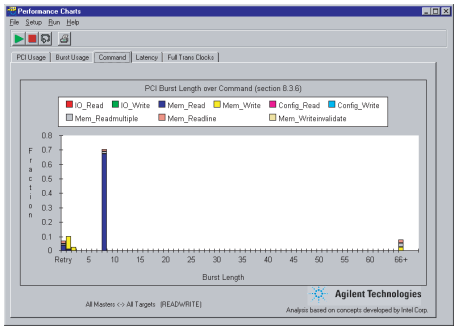

Figure 8.

This chart shows that the bus was mainly occupied with memory reads. Most of the memory read accesses were terminated by the target after 8 Dwords. When using MRM and MRL, transfers with burst lengths of over 66 Dwords are possible. Most of the data transfers were performed by using these extended commands.

Conclusion

Analyzing this performance charts helps you optimize the performance of the device under test. In this case, if more extended commands used, PCI Efficiency and PCI Utilization would increase.
The PCI Efficiency would increase, because more bytes could be transferred in less time.
The PCI Utilization (the relation between busy and idle bus time) would increase, because when using read multiple accesses, the host bridge realizes that large data transfers are initiated. As a result, the bridge performs prefetching and needs fewer wait states, retries and idle states.

Glossary

Completer A PCI-X device addressed by a transaction (other than a Split Completion) on the PCI-X bus.

Pattern Term The pattern terms are programmable for recognizing bus events (signal patterns on the bus). They are part of the testcard's Analyzer.
The output of pattern terms (always 1 or 0) can be used in Analyzer functions, for example, to trigger trace memory or to count bus events.

Performance Measure The performance measures are circuits consisting of sequencer-controlled counters. They count different bus events and calculate specified ratios. For example, busy cycles of transfers can be counted and divided by all cycles, thereby calculating the bus utilization.

Requester A PCI-X device that first introduces a transaction. If the completer or a bridge terminates the transaction with Split Response, the requester becomes the target of the subsequent Split Completion.

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Related Agilent Literature

- Agilent E2925B 32bit, 33 MHz, Agilent E2926B 32/64bit, 33 MHz PCI Exerciser & Analyzer, technical specifications, p/n 5968-3501E
- Agilent E2928A 32/64bit, 66 MHz, PCI Exerciser & Analyzer, technical specifications, p/n 5968-3506E
- Agilent E2929A PCI Exerciser & Analyzer, technical specifications, P/n 5968-8984E
- Agilent E2922A PCI-X Master Target Card, technical overview, p/n 5968-9577E
- Agilent E2940A CompactPCI Exerciser & Analyzer, technical overview, P/n 5968-1915E
- Agilent System Validation Pack, Agilent System Test Library, technical overview, p/n 5968-3500E
- Agilent E2920 Computer Verification Tools, PCI Series, brochure, p/n 5968-9694E
- Intel discusses basic concepts of PCI performance and efficient use of PCI with the Agilent E2920 series, case study, p/n 5988-0448ENDE
- HP NSD stabilizes server designs quickly and completely with the Agilent E2920 PCI Series, case study, p/n 5968-6948E
- HP HSTC speeds high-end server testing and reduces engineering costs with the Agilent E2920 PCI Series, case study, p/n 5968-6949E
- Agilent E2920 Verification Tools, PCI Series gives Altera Corporation competitive Advantage, case study, p/n 5968-4191E

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