

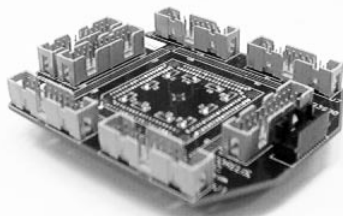
Distributed Emulation For Toshiba R3900 Family

Application Note

Overview

As embedded systems become more complex, the development project size grows. Each project member tends to work on one specific stage of the project. Because of this specialization, development tools must be selective in terms of function and cost. For example, application programmers require high-level language debuggers, but do not need to make real-time measurements and vice versa for hardware designers.

HP's Distributed Emulation solution offers a flexible development environment. Distributed Emulation provides each project member with the best tool at the lowest cost. It is also an investment for future product development because most elements in this environment are reusable. The Distributed Emulation solution for the Toshiba R3900 family consists of an HP logic analyzer, a Corelis preprocessor, an HP processor probe, the HP software analyzer and the MULTI Software Development Environment from Green Hills Software, Inc.



PI-R3900 preprocessor from
Corelis Inc.

Preprocessor

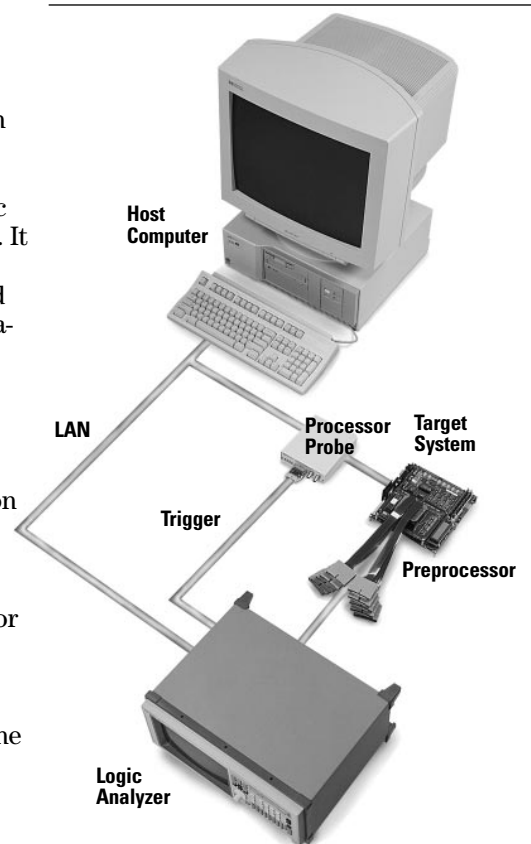
The PI-R3900 preprocessor from Corelis Inc. is a design for the TMPR3901F-50, a standard MPU in the R3900 family. A preprocessor provides the mechanical and electrical interface between a logic analyzer and the device under test. It simplifies connection to the target system. The inverse assembler and configuration files for HP logic analyzers are included with the PI-R3900. Using this preprocessor, you can easily probe all the necessary signals for external bus analysis. A connector for HP's processor probe is also mounted on the Corelis preprocessor.

The R3900 family is equipped with an internal cache. The preprocessor does not trace the processor's internal activity; that function is accomplished by the processor probe. However, disabling the cache is good practice at the initial hardware turn-on. In addition, the preprocessor can trace the write-data cycle because the R3901's cache is always write-through.

Logic Analyzer

A variety of HP logic analyzers can be used as part of the Toshiba R3900 Distributed Emulation solution. Depending on your measurement needs, you can choose from the low-cost HP benchtop logic analyzers or the powerful HP 16500B modular logic analysis system (see configuration on page 4).

Software design and debug solution with real-time trace



HP's Distributed Emulation for
Toshiba's R3900 family

Symbol Reader for the Logic Analyzer

With the symbol reader, you can create a symbol database in the logic analyzer from an ELF object module generated by Green Hills Software's MIPS compiler. The logic analyzer can display the symbols instead of absolute addresses in a trace list. The symbol reader lets you enter an offset to align the logical and physical addresses.

Software Analyzer

The HP B3740A software analyzer provides time-correlated source line referencing. You can easily compare the original high-level source code, such as C, with the real-time trace in the logic analyzer.

Processor Probe

The HP 3492B debug processor probe tool exploits the on-chip debug support unit of the R3900 family. It provides many of the traditional in-circuit emulator functions, such as, run control, high-speed code downloading, programming of target system flash memory, memory/register display and modification and real-time program counter trace. It does not provide emulation memory or the ability to take real-time traces of external bus cycles.



HP E3492B Processor Probe for Toshiba R3900

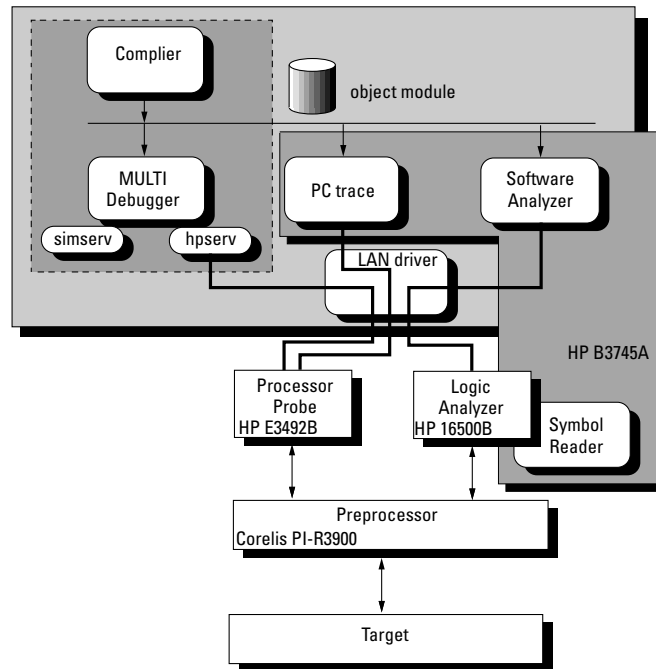
MULTI

The MULTI Development Environment from Green Hills Software, Inc. includes a builder, a version controller, and a high-level language debugger as well as other features.

Program Counter Trace Interface (PC Trace)

HP's PC Trace user-interface supports the processor probe features not supported in the MULTI debugger:

- Displaying the program counter trace list in C-source
- Setting trace conditions
- Setting hardware breakpoints
- Setting cross-triggering with the logic analyzer



Distributed Emulation block diagram

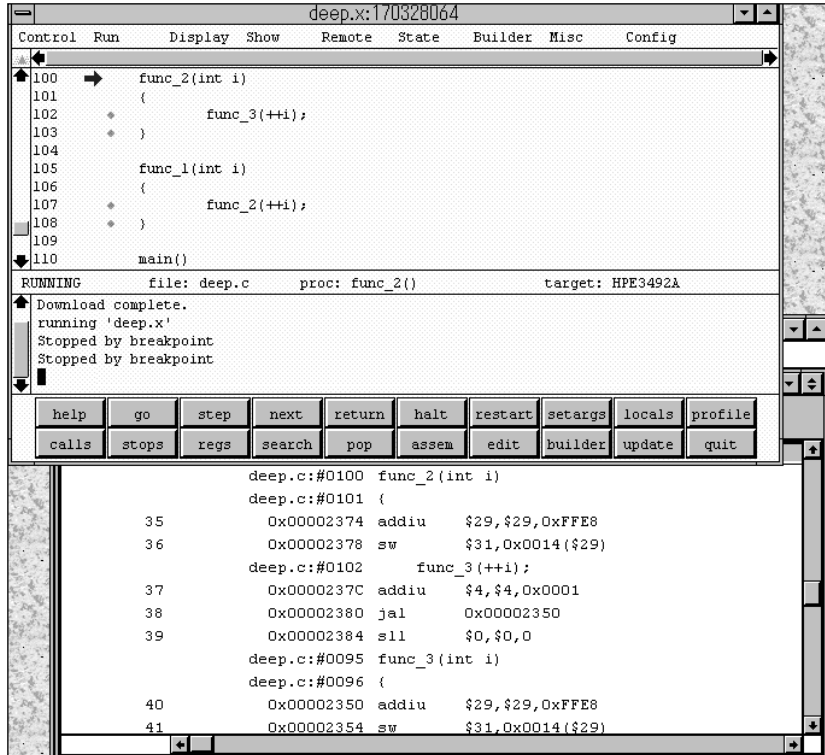
Label	ADDR	DATA	STAT
Base	Symbol	Symbol	Symbol
9	T:get_time+0010	absolute 10F0	READ
10	T:get_time+0012	absolute 40C4	READ
11	TIMER_2_CO+001E	absolute 0BF6	READ
12	T:get_time+0014	absolute 0010	READ
13	T:get_time+0016	absolute 50C4	READ
14	T:get_time+0018	absolute 0012	READ
15	system_sta+0FE8	absolute 4A80	WRITE
16	T:get_time+001A	absolute 00E6	READ
17	T:get_time+001C	absolute 0000	READ
18	system_sta+0FEA	absolute 0BF6	WRITE
19	T:get_time+001E	absolute 00CC	READ

```

212:  }
213:
214:  #define WITH FPPx
215:
216:
217: void get_time(void) {
218:     unsigned long rc, date, t;
219:     #ifdef WITH FPPx
220:         float a, b, c, d;
221:         a = 4195835.0;
222:         b = 3145727.0;
223:         d = 31.555;
224:     #else
225:         long a, b, c, d;
226:         a = 100;
227:         b = 7;
228:         d = 555555L;
229:     #endif
230:
231:
232:     rc = tm_get_f( (unsigned) 1,
233:                  (unsigned) 1,
234:                  (unsigned) 1,
235:
236: #ifdef WITH FPPx
237:     c = a / b;
238:     rc = ((a / 3.2) * ((a - 1)
239: if (c != 0.0) { /* PENTIUM

```

HP Software analyzer screens



MULTI and PC trace screens

Simulator

The Green Hills Software simulator makes software development possible without hardware. In the MULTI Development Environment, operations are identical regardless of whether the execution engine is a simulator or the HP processor probe.

Compiler

Green Hills Software also provides a compiler. MULTI and the HP software analyzer, symbol reader, and PC trace interface support an object module format (ELF) generated by Green Hills Software's C-cross MIPS compiler.

Host Computer

All the software mentioned in the previous paragraph runs on the HP 9000 Series 700 workstations, SunSparc workstations, and on IBM-compatible PCs. Please refer to HP publication number *5964-3958E* for the hosts supported by the software analyzer and PC trace (both are included in the HP B3745B interface software for

the HP 3492B). Please contact Green Hills Software, Inc. for the latest list of hosts supported by their products.

Cross-trigger

The HP 3492B processor probe and an HP logic analyzer can cross-trigger each other. For example, the logic analyzer sends a trigger to the PC trace of the processor probe when it detects a glitch. This shows where the program was executing when the glitch occurred. The processor probe can stop program execution and check variables when it receives the trigger from the logic analyzer.

The HP processor probe can also trigger the HP logic analyzer.

For example, when the HP processor probe detects the execution of a specific part of the program it causes the logic analyzer to trigger. The logic analyzer can show what was occurring as a real-time trace, timing information, or analog wave forms.

You can easily see what occurs in your target at any given point in your program. The timing of the cross-triggers is shown in the table at the bottom of this page.

Target Design

To connect HP's processor probe without the Corelis preprocessor, a dedicated connector is required on your target board. Please refer to the HP publication number *5964-3958E* for the connector part numbers. The length of the board trace between the microprocessor and the connector must be less than 100 mm (3.94 in).

To connect the Corelis preprocessor, the components under the preprocessor must be less than 12 mm (0.48 in) in height. The preprocessor is approximately 96 mm (3.78 in) by 76 mm (2.99 in). It is highly recommended to have two or four mounting holes on the target board to ensure good contact between the clip and the microprocessor. Please contact Corelis for the complete dimensions.

To reduce the footprint of the Corelis preprocessor, HP recommends the HP E5319A PQFP adapter which can be used with the Corelis preprocessor. The HP E5319A requires a clearance area of 6 mm (0.24 in) around the perimeter of the processor package. No components can be mounted in this area.

Processor Probe Cross-trigger Timing

From	To	Timing
PC trace trigger detected	BNC OUT	< 100 ns
Break detected	BNC OUT	< 50 ns
BNC IN	PC trace trigger	< 100 ns
BNC IN	Break request	< 50 ns

These timings are calculated assuming the processor speed of 75 MHz, and are for reference only. HP does not guarantee them as a part of product specification.

Tools Required at Each Development Stage

	Initial HW turn-on	Initial SW coding	Low- level HW driver	Application firmware	Integration, test and debug
Timing analyzer			•		•
State analyzer					
Preprocessor	•		•		•
Inverse assembler					
Compiler		•		•	•
Simulator		•			
Software analyzer			•		•
Processor probe			•	•	•
PC trace					
Debugger		•		•	•
Oscilloscope	•		•		•
Pattern generator					•

Project Services and Consultancy

Hewlett-Packard application engineers are available around the world to integrate measurement platforms and tailor solutions to your specific needs.

While Hewlett-Packard has tested the functionality of elements described in this application note, HP does not warrant the performance of non-HP products or their function with HP products.

However, HP application engineers can define project specifications and tailor some or all elements on a consultancy basis. This approach ensures a turn-key solution to your needs with an HP guarantee of compatibility. Please contact your local HP sales office for complete information.

Configuration

Please refer to specific product datasheets for specifications and characteristics of individual elements. Please contact the tool vendors listed on the following page for their respective datasheets.

Logic analyzers	HP 16500B, 1660C/CS Series, 1670A Series (up to 70MHz)
LAN Interface Module*	HP 16500H,
Timing and state analysis cards*	HP 16550A, 16554A, 16555A, 16556A
Preprocessor probe and Inverse assembler	Corelis PI-R3900
Compiler	Green Hills Software C-Cross MIPS Compiler
Debugger	Green Hills Software-MULTI and Green Hills Software HP server for processor probe
Processor probe	HP E3492B
Software analyzer and PC trace package	HP B3745B
Oscilloscope *	HP 16533A, 16534A
Pattern generator *	HP 16522A

*for use with HP 16500B only

Literature available from Hewlett-Packard

Element	Model Number	Literature Number
Logic analysis system	HP 16500B	5963-2118E
Benchtop logic analyzers	HP 1660C/CS Series 1670 Series(up to 70 MHz)	5964-3665E
State and timing analyzer modules	HP 16550A, 16554A, 16555A, 16556A	5962-7245E
Software analyzer	HP B3740A	5962-7114E
Symbol download utility	HP E2450A	5091-8516E
Oscilloscope module	HP 16533A, 16534A	5964-0238E
Embedded MIPS processor probe	HP E3492B	5964-3958E
Pattern generator module	HP 16522A	5964-2250E
PQFP adapter for 160-pin 0.5 mm package	HP E5319A	5963-5061E
Microprocessor and bus interfaces and software accessories for HP logic analyzers		5963-6854EUS

Corelis Inc.
12607 Hidden Creek Way, Suite H
Ceritos, CA 90703 U.S.A.
310-926-6727
310-404-6196 Fax
sales@corelis.com E-mail

Green Hills Software, Inc.
510 Castillo St.
Santa Barbara, CA 93101 U.S.A.
805-965-6044
805-965-6343 Fax

Literature available from Corelis Inc.

Preprocessors and Bus Analyzers

Literature available from Green Hills Software, Inc.

The MULTI Software Development Environment

C-Cross MIPS Compiler

For more information on Hewlett-Packard Test and Measurement products, applications, or services, please call your local Hewlett-Packard sales office. A current listing is available via World Wide Web through Access HP at <http://www.hp.com>. If you do not have access to the Internet, please contact one of the HP centers listed below, and they will direct you to the nearest HP representative.

United States:

Hewlett-Packard Company
Test and Measurement Organization
5301 Stevens Creek Blvd.
Bldg. 51L-SC
Santa Clara, CA 95052-8059
1 (800) 452-4844

Canada:

Hewlett-Packard Canada Ltd.
5150 Spectrum Way
Mississauga, Ontario
L4W 5G1
(905) 206-4725

Europe:

Hewlett-Packard
European Marketing Organization
P.O. Box 999
1180 AZ Amstelveen
The Netherlands

Japan:

Hewlett-Packard Japan Ltd.
Measurement Assistance Center
9-1, Takakura-Cho, Hachioji-Shi
Tokyo 192, Japan
(81) 426 48 3860

Latin America:

Hewlett-Packard
Latin American Region Headquarters
5200 Blue Lagoon Dr.
9th Floor
Miami, FL 33126
U.S.A.
(305) 267-4245/4220

Australia/New Zealand:

Hewlett-Packard Australia Ltd.
31-41 Joseph St.
Blackburn, Victoria 3130
Australia
131 347 ext. 2902

Asia Pacific:

Hewlett-Packard Asia Pacific Ltd.
17-21/F Shell Tower, Time Square
1 Matheson St., Causeway Bay
Hong Kong
(852) 2599 7070

Technical information in this document is subject to change without notice.