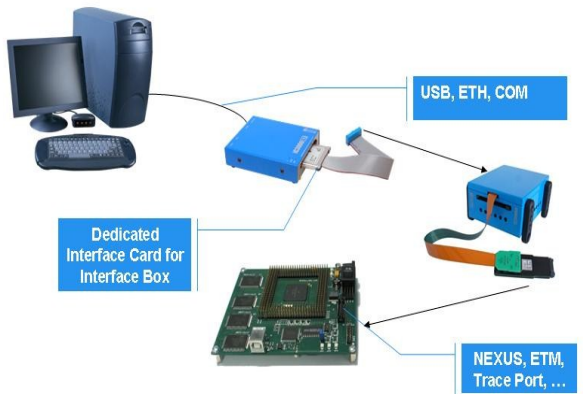
RAPITA SYSTEMS LTD

Technical Note

Rapi**Time** trace capture using iSYSTEM trace-enabled debuggers



Rapi**Time** from Rapita Systems is an automated performance measurement and timing analysis tool. Targeted at real-time, embedded applications, Rapi**Time** provides:

- Code coverage metrics.
- Detailed timing measurements at a range of levels of detail.
- Prediction of worst-case execution time (WCET), and identification of the path that results in this.
- Guidance for optimization efforts.

All of which can be done with significantly less effort than other approaches.

Rapi**Time** obtains its results by examining the timing of instrumentation points inserted into the application's source code. A particularly efficient integration of Rapi**Time** can be achieved using the iSYSTEM ic3000GT with the iTRACE GT as the mechanism for collecting the trace of instrumentation points.

Using iSYSTEM debuggers for trace capture

Using a trace port (NEXUS or ARM-ETM) the iSYSTEM iC3000GT/iTRACE GT or the iSYSTEM iC5000 can collect Rapi**Time** traces by monitoring writes made to a specific register or memory location. As each write is made, the debugger timestamps the value. Consequently, the implementation of an instrumentation point consists of writing a constant value (the Ipoint ID) to a specific location or register. Typically this can be implemented in a single machine instruction, as so is inherently thread-safe.

The Rapi**Time** User Guide gives examples of how to implement a suitable instrumentation point routine, as a macro or inline function.

Configuring iSYSTEM debuggers for trace capture

Configuration of the iSYSTEM tools for timing trace acquisition requires the following steps:

- **Hardware connection**: the iSYSTEM debugger needs to be attached to the target board's trace port using the provided connector.
- **winIDEA Configuration**: The iSYSTEM IDE (winIDEA) needs to be configured to capture writes of the Ipoint ID to the allocated variable or register. Setting a value for "Deep Trace File Size" will cause the trace data to be spooled directly to disk.

Technical Details

Tool requirements:

iSYSTEM iC3000GT and iTRACEGT or

iSYSTEM iC5000

Target requirements:

CPU with support for:

NEXUS Class 3 (e.g. Freescale PowerPC, National Semiconductor CRX)

ETM data trace (e.g. ARM Cortex-A)

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Once the source code has been instrumented using Rapi**Time**, compiled, and linked, it can be downloaded onto the target ready for testing. A trace of the software's timing behavior can now be obtained by running a series of tests on the target and capturing the trace data using winIDEA. Trace collection ends either when the target CPU is manually stopped or the trace collection is stopped and the CPU left running.

Once trace data has been captured, it needs to be exported by winIDEA to the host for processing by Rapi**Time** . This is done by performing a binary export selecting only timestamp and data fields.

The trace file then needs to be pre-processed using Rapi**Time**'s *traceutils* utility to convert it into the Rapi**Time** native format. This is done using the byte_reader filter to unpack the exported binary data. The filter to use depends on the endian-ness of the processor.

For big-endian devices such as PowerPC's, use:

```
byte_reader( B8 B9 B10 B11, B7 B6 B5
B4 B3 B2 B1 B0 );
```

For little-endian devices like the ARM use:

```
byte_reader( B11 B10 B9 B8, B7 B6 B5
B4 B3 B2 B1 B0 );
```

Summary

iSYSTEM tools provide a simple and effective means of capturing timing trace data for use by Rapi**Time**. This solution minimizes measurement overheads by supporting minimal instrumentation points (typically a single instruction) via the use of external time-stamping.

To find out more, or to arrange a web-based demo, contact enquiries@rapitasystems.com. Alternatively, contact your local distributor (see sidebar), or visit http://www.RapitaSystems.com

About Rapita Systems Ltd

Rapita Systems Ltd develops software tools to reduce the cost of measuring and optimize the timing performance large, real-time software systems, such as avionics applications.

Rapi**Time** is the only product on the market that can tell users exactly where to focus optimization effort to minimize worst-case execution time. Using Rapi**Time**, customers have been able to reduce the worst-case execution time of large scale, legacy applications by up to 50% with only a few days effort.

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About iSYSTEM

iSYSTEM offers expert knowledge based on more than 23 years of experience with embedded systems. They are pioneers in emulation and debug technology for 8-/16-/32-bit microcontroller architectures and FPGA based emulator hardware tools.

The modular system provided by iSYSTEM contains in-circuit and on-chip emulation hardware for more than 50 microcontroller families and their derivatives. iSYSTEM tools support all common trace ports such as NEXUS and ARM-ETM allowing conventional debug capabilities to be augmented with a rich trace of timed events leading up to and following key behaviours

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