CombiProbe

For fast output of important system information at runtime, some cores now have simple trace ports. These ports enable an application program to make user-defined data visible off-chip. For recording and processing this data, Lauterbach offers a new tool option called CombiProbe. Here we describe the hardware and operation of this new product.

Instrumentation

Most developers are familiar with test scenarios for which a simple printf() is the most efficient implementation. Typical examples are output of diagnostic information or logging of important system events, i.e., test scenarios where the application is already working as intended, and now operational tests have to be conducted. Usually, code instrumentation is used for these tests.

Two steps are necessary to make important system information visible with instrumentation at program runtime:

1. Instructions are inserted in the application program to provide the necessary information.
2. A way has to be found to make this information visible. An external communication interface such as RS-232 or Ethernet is usually used for this.

The great advantage of instrumentation is that only the information of interest to the tester is made visible. At the same time, however, large communication overhead is created since, as a rule, a further communication interface has to be operated by the operating system. If the interface is slow, considerable runtime problems can result for the actual application.

System Trace

The communication overhead created during instrumentation can be largely reduced if the core offers a separate trace port for the output of system information generated by the application program. As an IP provider, ARM offers such a solution as part of its CoreSight technology.

The *CoreSight Instrumentation Trace Macrocell* (ITM) basically works as follows:

1. The application program writes the information that has to be made visible to a 32-bit memory mapped register assigned to the ITM.
2. The ITM makes the information visible either directly over the *Serial Wire Output* (see Fig. 1) or together with other trace data over the *CoreSight Trace Port Interface Unit (TPIU).*

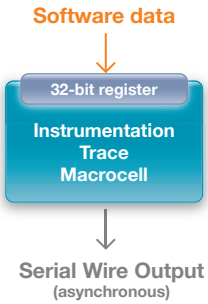

Fig. 1: CoreSight Instrumentation Trace over Serial Wire Output

Many mobile phone manufacturers are already working with similar proprietary solutions for their chips. However, to save money, they are interested in a uniform standard for such a trace port. In May 2007 the “Test and Debug” workgroup of the MIPI Alliance specified, under the name “System Trace”, a standard for a 4-bit trace port as well as a 34-pin debug and trace connector.

Along with the standardization, the functionality of the trace port was extended. Apart from the system information generated by the application program, the *System Trace* can now output hardware information too (see Fig. 2). A programmable bus watcher, e.g., can detect and display specific bus cycles, or a signal monitor can return the status of selected chip-internal signals.

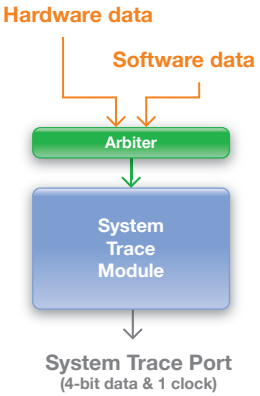

Fig. 2: System Trace specified by MIPI Alliance

CombiProbe hardware

As a “Test and Debug” workgroup member, Lauterbach took an active part in the *System Trace* specification and at the same time in the development of a suitable debug and trace option named “CombiProbe”. Since October 2007, Lauterbach has been marketing this new product.

CombiProbe is a combination of a special debug cable and 128-MB of trace memory. It can, for example, be plugged into the universal Lauterbach ⟩⟩

base hardware such as the POWER DEBUG INTERFACE / USB 2 (see Fig. 3). As target system connection, the 34-pin debug and trace plug from the MIPI Standard is used, comprising connectors for a JTAG port and a 4-bit *System Trace Port*. Lauterbach offer also adapters for other target system connectors.

Fig. 3: POWER DEBUG INTERFACE / USB 2 with a CombiProbe

Operating concept

Additionally to the traditional debug functions CombiProbe provides new configuration commands as well as commands for displaying and analyzing recorded trace information.

Configuration commands are:

- *ITM.<subcommand>* for configuring the *Instrumentation Trace Macrocell* of CoreSight technology (see Fig. 4)
- *STM.<subcommand>* for configuring a *System Trace Module*
- *SystemTrace.<subcommand>* for configuring the CombiProbe

The *SystemTrace* command is also used to analyze and process recorded trace data.

System information visible at the trace port can be recorded as usual into the trace memory of the CombiProbe and analyzed using TRACE32 commands. An intuitive analysis of system information is supported by formatting the raw trace data according to application with the help of the so-called *TRACE32 Protocol API.*

However, the size of the trace memory in CombiProbe limits the recording time.

To implement longer recording intervals, we offer a PIPE mode for the CombiProbe. In PIPE mode, the trace data is transferred directly to the host. In this mode the trace memory in the CombiProbe is used only as a buffer.

On the host, TRACE32 can be configured to write the trace data immediately to a file. After recording, the system information can also be formatted and analyzed by an external application.

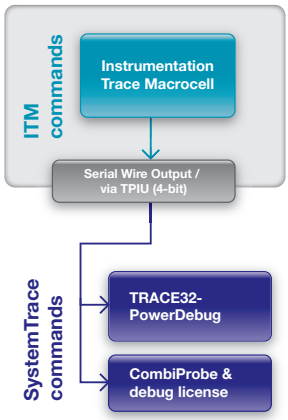

Fig. 4: ITM commands are used to configure the Instrumentation Trace Macrocell.
The System Trace commands enable recorded trace information to be displayed and analyzed.

As an alternative, external analysis software can be configured to collect the trace data over the *TRACE32 FDX API* and process it while recording (see Fig.5). ⟩⟩

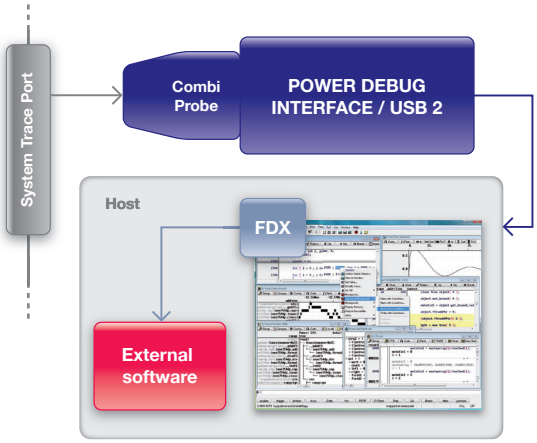

Fig. 5: CombiProbe can be configured so that external software can process trace information at recording time.

CombiProbe data

- Debug cable and 128-MB of trace memory
- JTAG support for ARM cores
  - Standard JTAG
  - Serial Wire Debug Port from ARM
  - cJTAG (IEEE P1149.7), planned
- Standard JTAG possible for other processor architectures
- Trace port support for
  - MIPI System Trace
  - ITM over Serial Wire Output
  - ITM over 4-bit CoreSight TPIU
  - 4-Bit ETMv3 in continuous mode, planned
- Bandwidth of 200 MBit/s per trace channel with up to 4 trace channels
- Voltage range 0.3 V to 3.3 V, 5 V tolerant
- 34-pin half-size connector to target hardware
- Adapters also for 10- and 20-pin half-size connector

Summary

The CombiProbe is a new tool option for recording runtime information in the broad Lauterbach product range. For complex test cases, CombiProbe can also be used in conjunction with TRACE32-PowerTrace. Since all Lauterbach tools share a common time base, important system information can be placed in a direct chronological context with the program/data flow of the core.