

Keystone Advanced Debug

Agenda

- Debug Architecture Overview
- Advanced Event Triggering
- DSP Core Trace
- System Trace
- Application Embedded Debug Support
- Multicore System Analyzer (MCSA)



Indicates features that are new on the Keystone generation of the C6000 Family

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Debug Architecture Features

- Advanced Event Triggering
 - Hardware Breakpoints/Watchpoints
 - Event Monitoring/Counting
 - Core Trace Control
- DSP Core Trace
 - Export Program, Timing, Data, Event Info
- System Trace
 - Export Bus Statistics and Events
 - Export Software Messages
- Cross Triggering



Trace Data Capture Mechanisms

- DSP Core Trace
 - Debug Port EMU pins for export to an external receiver*
 - Dedicated TI Embedded Trace Buffer (TETB) 
 - 4Kb on each core

- System Trace
 - Debug Port EMU pins for export to an external receiver*
 - System Level TI Embedded Trace Buffer (TETB)
 - 16Kb per device



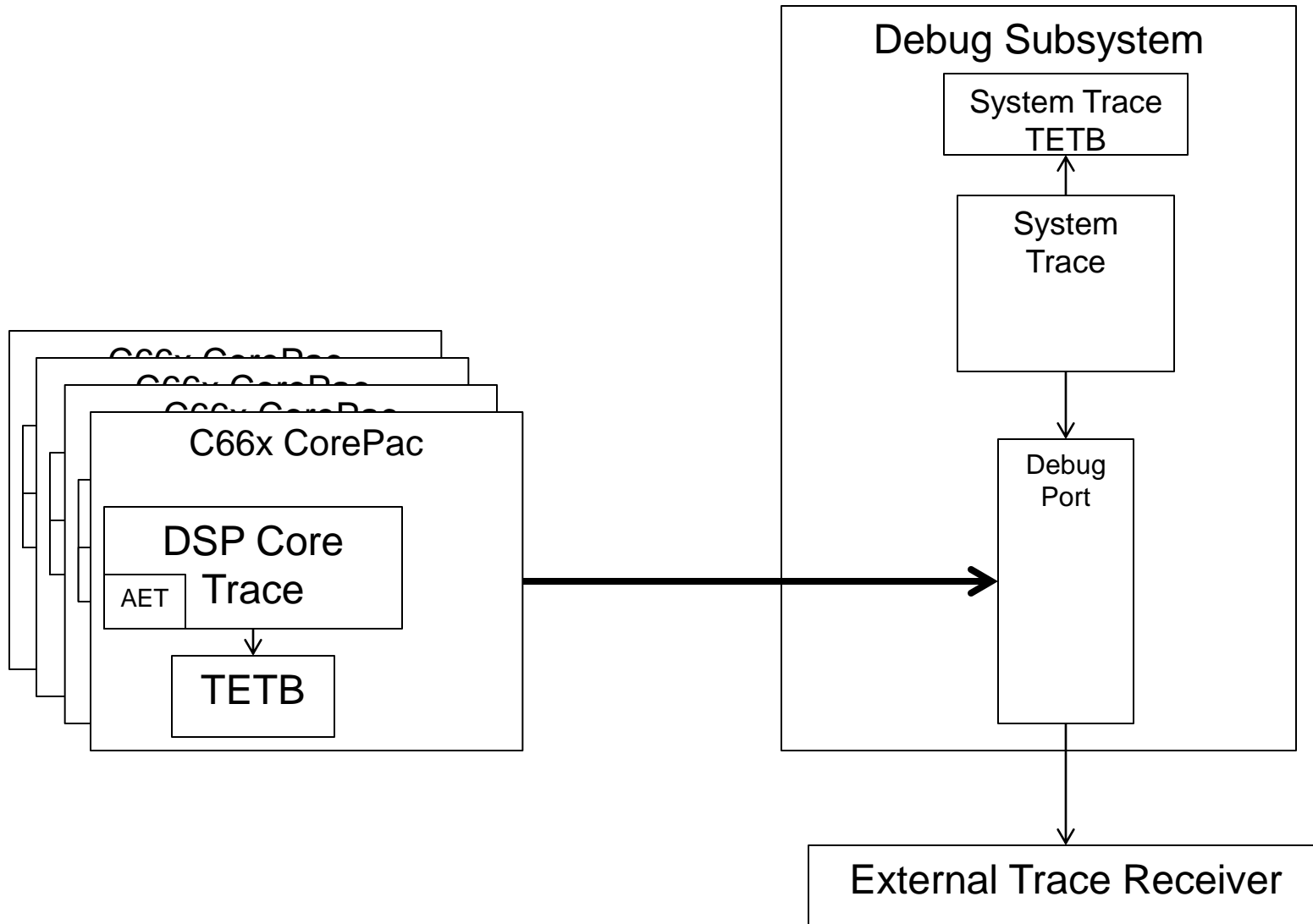
* XDS560v2 Pro (In Beta) = 2GB

Embedded Trace Buffer (TETB)

- Can be optionally drained “on the fly” to L2, shared, or external memories
- Can trigger event on ½ full status or full status
- Advantages
 - Virtually extends the limited ETB size
 - Data can be streamed from the device via Ethernet or any other transport



Debug Subsystem



Agenda

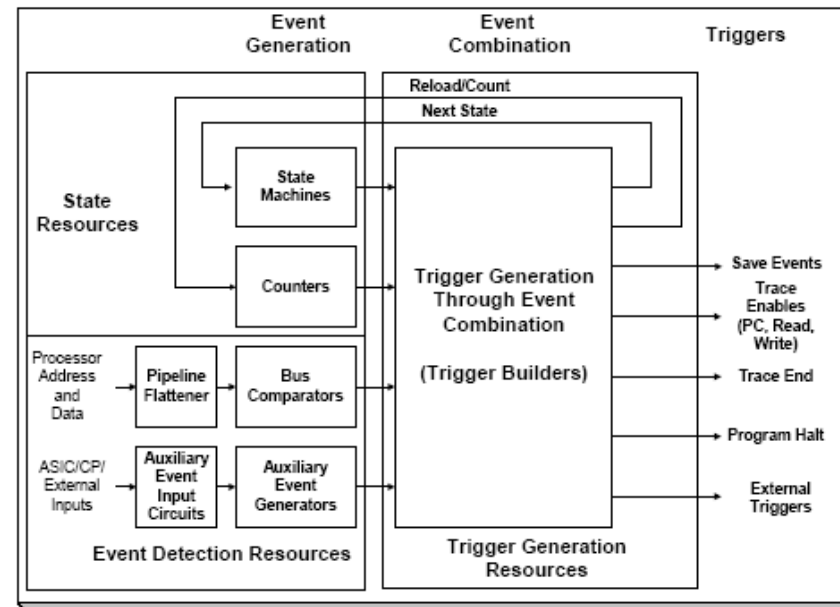
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Advanced Event Triggering (AET)

- Logic that can monitor
 - Program Bus Activity
 - Data Memory Bus Activity
 - System Events
- Non-Intrusive / Real Time
- Programmable at load or run time



Advanced Event Triggering Inputs

- Input Logic
 - 6 Dual Range Address Comparators
 - 4 Program/Data Address w/ Value Qualify
 - 2 Program Address Only
 - 4 Auxiliary Event Generators
 - 4 State Sequencer
 - 2 Timers/Counters
 - With Min/Max Watermark Capabilities
 -

Advanced Event Triggering Outputs (Triggers)

- Output Logic (Triggers)
 - CPU Halt Request*
 - Interrupt
 - Counter Inc/Dec/Reset
 - Timer Start/Stop
 - Store Trace Sample (7 Streams)
 - Start Trace (7 Streams)
 - State Sequencer Transition
 -

*Halt Request ignored when debugger not connected

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DSP Core Trace

- Core Trace (aka XDS560 Trace, CPU Trace)
 - Allows real-time, non intrusive, cycle accurate logging of PC (PC Trace) and Data (Data Trace) activity on the DSP Memory Buses.
 - Captured Trace data is compressed by on-chip hardware, passed either to the ETB or an external receiver, and then decoded on the host (with CCS or a stand alone decoder)
- Event Trace
 - Event Trace is similar to PC trace, but allows selection of a subset of events that are tagged within the Trace Output.

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System Trace

- Allows System Level monitoring of Application Events and Resources
- Two Options
 - Software Messages
 - Hardware Messages – Common Platform Tracer (CPTracer)

Software Messaging

- Enabled By System Trace Library (STMLib)
- Advantages over Standard Printf
 - Real-time
 - System Level Cycle aligned
- Up to 240 User Defined Channels
- Reduced capability library build (compact) also provided (< 1K)

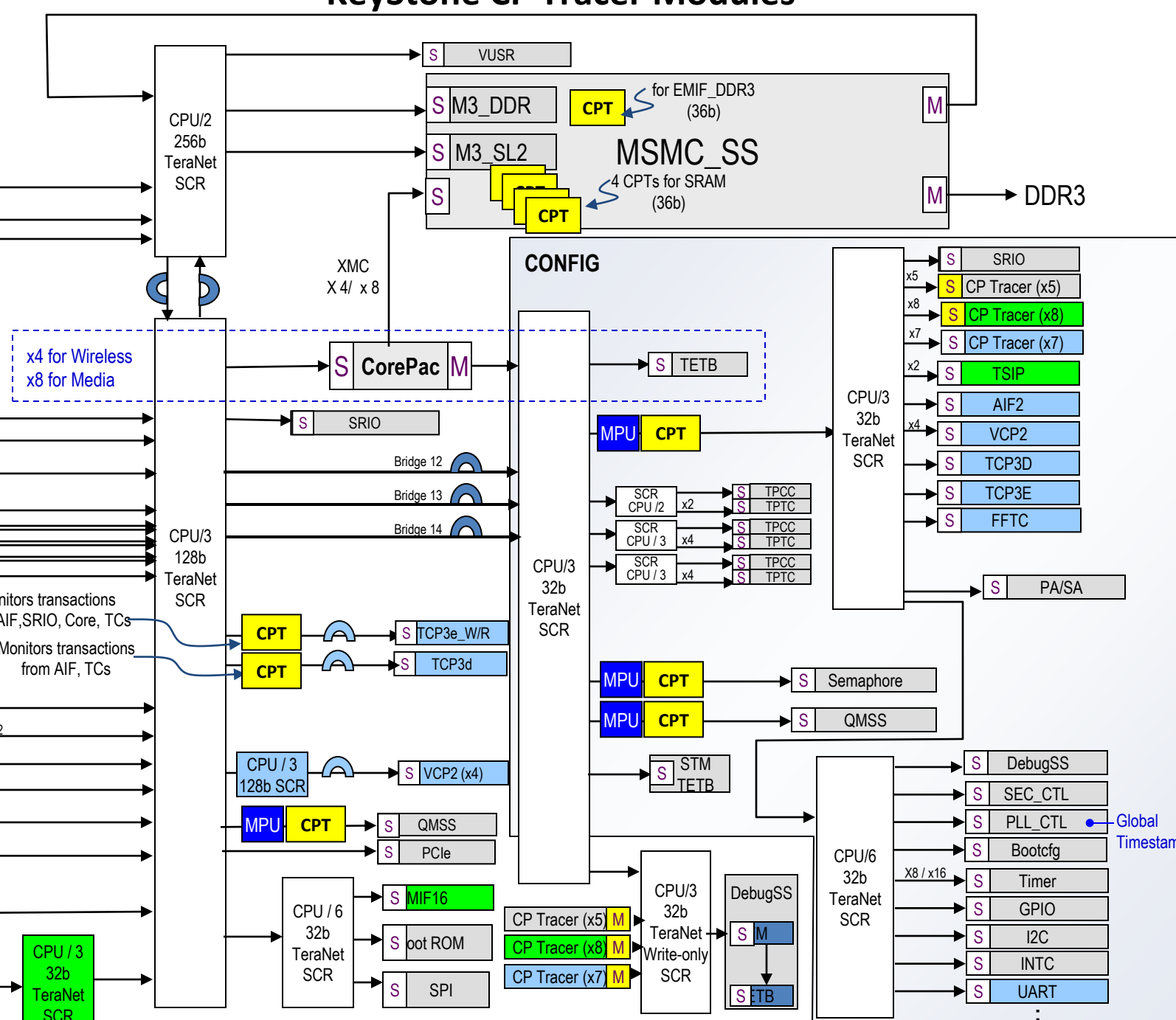
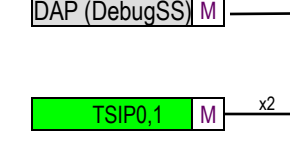
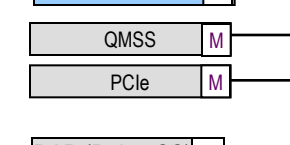
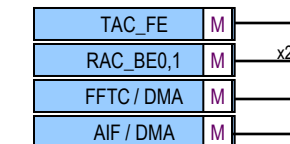
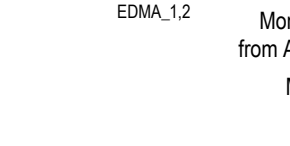
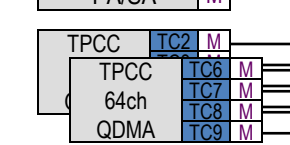
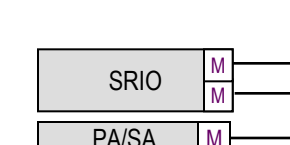
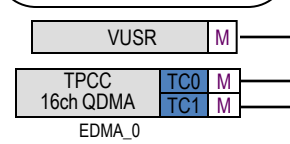
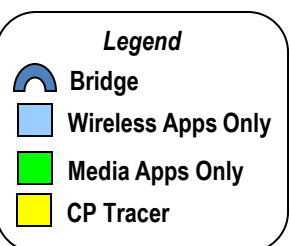
STMLib is a component of the CToolsLib Family of libraries

Download free via Gforge: <https://gforge.ti.com/gf/project/ctoolslib/frs/>

Common Platform Tracer (CPTracer)

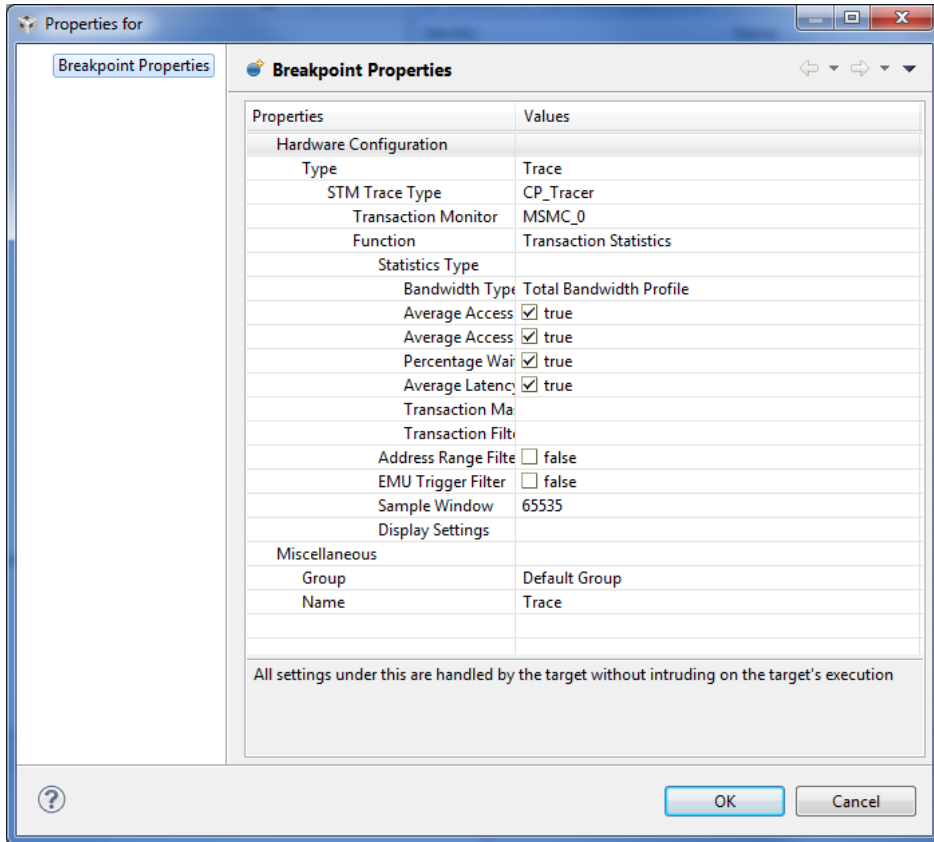
- CPT Modules - Provide data for slave buses.
 - Profiling: Periodically export STM Messages for statistics counters
 - Throughput Counter 0,1 – Bytes of slave acknowledged accesses
 - Wait Counter – Number of cycles a master access must wait for slave acknowledge
 - Access Counter – Number of unique transactions
 - Event Logging
 - New Request
 - Last Read
 - Last Write

KeyStone CP Tracer Modules



Configuration

- CCS Breakpoint Manager



- CPTTracer Library (CPTLib)
 - Use Case based APIs
 - Enable/Disable functions allow isolation of Trace Data generation

CPTLib is a component of the CToolsLib Family of libraries

Download free via Gforge:

<https://gforge.ti.com/gf/project/ctoolslib/frs/>

CPTracer Sample Output



http://processors.wiki.ti.com/index.php/CorePac_1_L2_CPT_-_CCS_setup_XDS560v2_System_Trace_Example

Cross Triggering

- Provides a means to propagate debug events from one processor to another.
- Other processors can generate actions upon cross trigger
- Sample Debug Events
 - Processor Entering Debug State
 - Watch Point Match
 - ETB Full
- Sample Debug Actions
 - Restart
 - Interrupt Request
 - Start Trace

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Application Embedded Debug Support

- CToolsLib – A suite of libraries that can be used for embedding debug elements into an application
 - AETLib
 - ETBLib
 - CPTLib
 - DSPTraceLib
 - STMLib

Available Free Via GForge: <https://gforge.ti.com/gf/project/ctoolslib/frs/>

AETLib

- Provides programmatic access to the Advanced Event Triggering logic
- Advantages
 - Reuse of limited AET resources (task stack monitoring)
 - More granularity for enabling/disabling AET/Trace at specific points of the application
 - Capture of Trace data from fielded devices

ETBLib

- Provides application access to configuration of the embedded trace buffer
- Advantages
 - ETB can be configured without Debugger connection
 - Dynamic draining of ETB is supported
 - Events generated on half full and full
 - Data can be moved from ETB into internal memory and passed off via any transport (Ethernet, Srio, etc)
 - Virtually extend the size of the ETB



System Trace Libraries

- STMLib
 - Application Interface to System Trace Software Messages
 - Advantages
 - Small function overhead
 - Real-Time
 - System Level Time Stamp
- CPTLib
 - Application Interface to Common Platform Tracer Configuration

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Multicore System Analyzer(MCSA)

- Suite of tools providing real-time visibility into performance and behavior of an application.
 - Information collected in various ways
- Advanced Tooling Features:
 - Real-time event monitoring
 - Multicore event correlation
 - Correlation of software events, hardware events and CPU trace
 - Real-time profiling and benchmarking
 - Real-time debugging

http://processors.wiki.ti.com/index.php/Multicore_System_Analyzer

Analysis Features

- Benchmarking: Finding out how long it takes some action to complete. Includes 'context aware' benchmarking for multi-threaded analysis
- CPU and Task Load Monitoring: real-time visibility into how busy your system really is
- O/S Execution Monitoring: monitoring task switches and the state of kernel objects such as semaphores
- Filtering events
- Multicore Event Correlation

Current/Future Features

Current

- Ethernet Transport
- JTAG Stop-Mode
- JTAG Run-Mode
- Execution Graph
- CPU Load
- Task Load
- Benchmark/Duration
- Context Aware Profile
- Statistics / Count Analysis

Future

- ETB Draining
- CPU Trace, STM, UIA Correlation
- Logging on Linux
- Realtime Config & Software Instrumentation Control
- USB Transport
- STM Transport
- Remote Debug
- Back Trace

[MCSA User's Guide](#)

System Analyzer 1.0

System Analyzer 1.1