Arm Development Studio

Learning Outcomes

At the end of this module, you will be able to:

Arm Development Studio overview

Arm Development Studio featuring Keil MDK

Complete suite of tools for Arm Cortex-A/R/M based devices

Earliest Arm core support

No one knows Arm better

Accelerates time to market

Everything you need to develop Arm based projects from tiny sensors to server grade multi-core SoCs

- Includes Arm Compiler 6, Debugger, Streamline performance analyzer, Mali Graphics Debugger and Fixed Virtual Platforms
- Includes Keil MDK for power optimized microcontroller software development
- Supports all SoC configurations: from single core to complex multi-cluster and multi-core

Investment protection

- Early and dependable support for new Arm hardware IP
- Used in Arm for architecture validation
- Developed over many years of continuous improvement with billions of shipped products built
- Technical support from the experts in Arm technology

Innovate earlier and develop faster for competitive edge

- Develop software pre-silicon
- Supports full development workflow from emulators to production hardware
- Software building blocks for fast application development including CMSIS, middleware and RTOS
- Targeted performance analysis for rapid software optimization

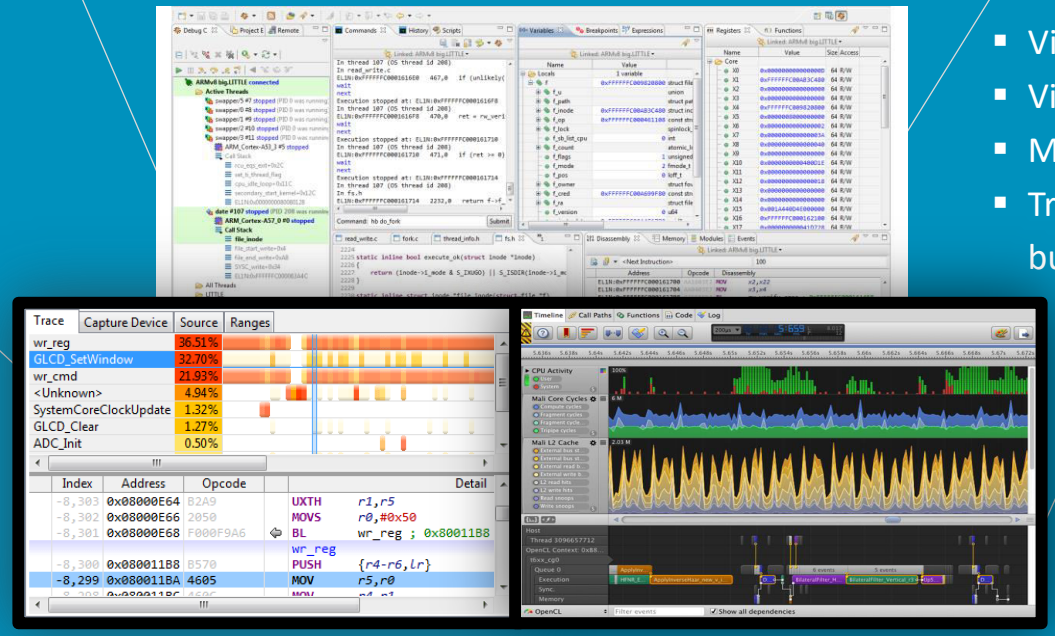
Arm Development Studio

Create & build Code

- Latest Arm processor support
- Optimized code generation and embedded libraries

Debug Code

- Inspect CPU state and execution
- Set breakpoints, run scripts, debug exceptions
- Cache/MMU/MPU visibility
- AMP, SMP, big.LITTLE, DynamIQ



Visualize Code

- View code history up to breakpoint
- View code instrumentation output
- Make sense of OS level events and threads
- Track GPU calls and reconstruct frame buffers

Speed Up Code

- Tune code for optimal cache usage
- Thread/process level visualization
- GPU usage vs CPU usage
- Energy use over time

Tools designed for the entire product lifecycle

Fast & Cycle Models

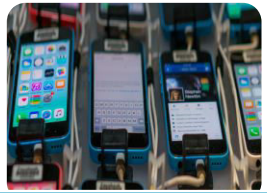
- Virtual platforms for architectural exploration and early software development

DSTREAM™

- Family of debug hardware for FPGA & board bring-up for complex SoCs

ULINK*pro* D

- Family of low-cost debug hardware for MCU & MPU



TCP/IP

- Application-level debug for BSP and reference design rollout

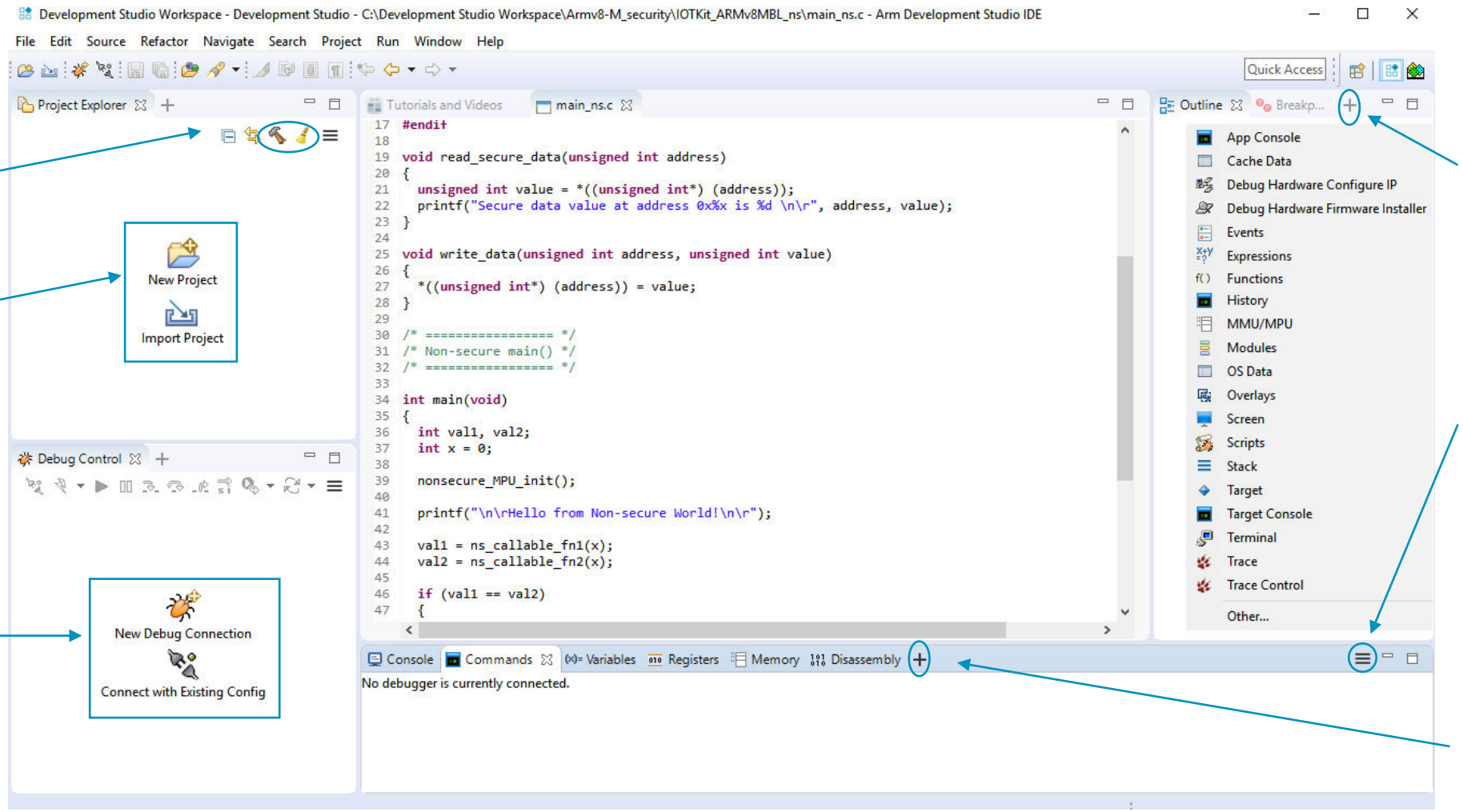
Arm Development Studio IDE

One perspective, simplified UI with easy and quick access

Quick access build buttons

Single click project\ example import

Single click debug configuration access

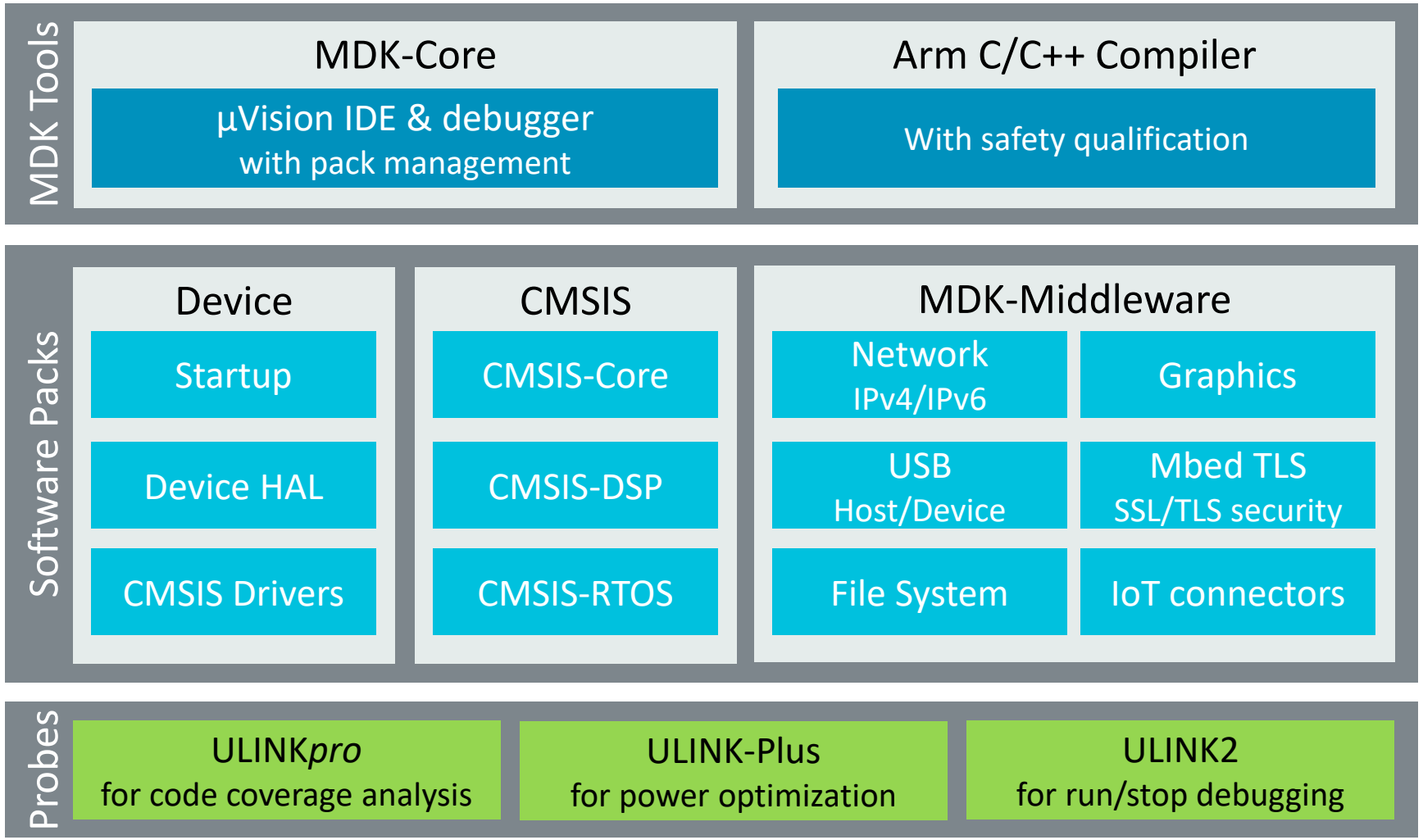


Quickly add or reopen new views

Hamburger icon (hidden menu options)

Quickly add or reopen new views

Keil MDK overview



Arm Compiler 6

Arm Compiler 6: Leading-edge C/C++ toolchain

Comprehensive support

Real performance

Safety qualified

- The only embedded compiler you'll ever need
  - Validated support for new Arm technologies significantly
  - Architecture validation
  - Developed and supported by Arm architecture experts
- Efficient and accurate code for bare-metal and RTOS
  - Finely tuned Arm proprietary embedded libraries and linker
  - Optimized for a wide range of applications, not just a single benchmark
  - Support for the most recent language standards
- Path to functional safety certification
  - TÜV SÜD qualified for software development to multiple safety standards
  - Comprehensive Qualification Kit provides essential supporting documentation
  - Long Term Maintenance from stable & isolated code branch

Basic armclang options

```
armclang -c --target=arm-arm-none-eabi -mcpu=Cortex-A9 -g -O2 foo.c
```

- `--target=` selects the execution state
  - `arch64-arm-none-eabi` for v8A AArch64
  - `arm-arm-none-eabi` for v8A AArch32, Cortex-M, and Cortex-R, and older CPUs
- Additionally require
  - `-march` and/or `-mcpu` to select specific architecture or core
  - `-mcpu=list` shows all available options (for specified target)

- `-On` to select optimization level (0≤n≤3)
  - Also `-Os`, `-Oz`, `-Ofast`, `-Omax`
  - `-O0` default (extremely poor optimization)
  - `-flto` to enable link-time optimization (implied with `-Omax`)

- `-g` to enable debug info

Basic armlink options

- `--cpu=` selects the CPU (or architecture)
  - Mainly used as a check when merging projects
- `--scatter` to specify scatter description file
  - Defines platform memory map
- `--entry` to specify entry point (symbol or address)
- `--lto` Link-Time Optimization (armclang objects built with `-flto`)

Arm Compiler 5 (armcc)

- Legacy compiler, no longer in development
  - No support for any Armv8 architectures
  - However 20+ years of history, many projects exist based on this compiler

- Recommend all projects start with (or migrate to) Arm Compiler 6 (armclang)
  - Thorough migration documentation available
  - For many users, C/C++ source code will simply be directly portable
    - Changes only to command options
  - armcc source containing embedded assembler must be re-written to GNU assembler (gas) format
    - Recommend rewriting with compiler intrinsics

Debug and trace

Arm Debugger key points

Full support of Arm IP

- Arm Debugger is developed alongside Arm IP
- Support for all Arm cores, including leading-edge support for cores that are not yet public
- Comprehensive support for all Arm debug and trace IP

Flexible architecture

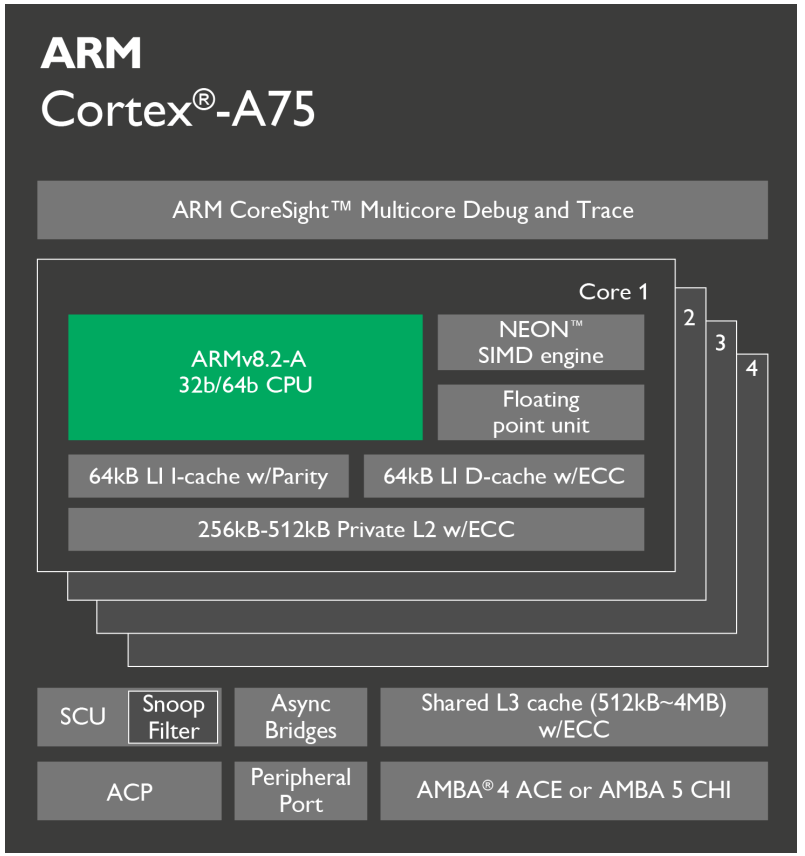
- Support for target complexity, challenging implementations, non-Arm IP
- Extension APIs – customize debugger functionality, integrate with other tools

Designed for productivity

- CMSIS-Pack compatibility
- Integrated with Eclipse and Python – both widely used
- Debugger views and functionality optimized for fast, efficient, and clear operation
- Advanced bring-up tools, expert support world-wide
- Comprehensive scripting support with shallow learning curve

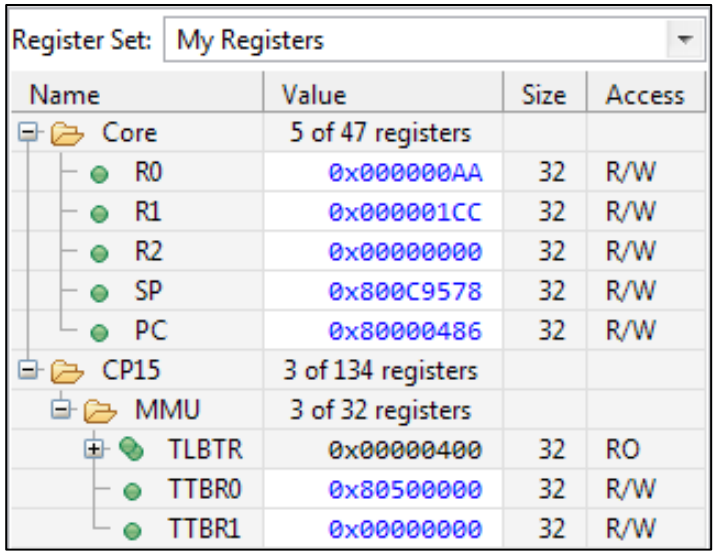
Comprehensive support for Arm cores

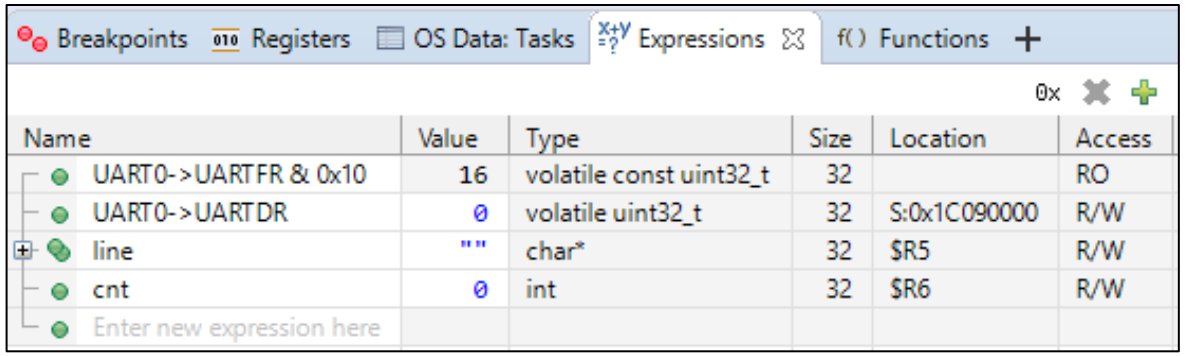
- Arm Development Studio is developed alongside Arm cores
- Debug support for cores and architectural extensions is developed as soon as it is practical
- Development Studio is used as part of the normal core development and validation process
- Debugger testing is carried out against Fast Models and early FPGA implementations of all Arm cores
- Tools available for leading-edge partners working with future cores which are not yet public

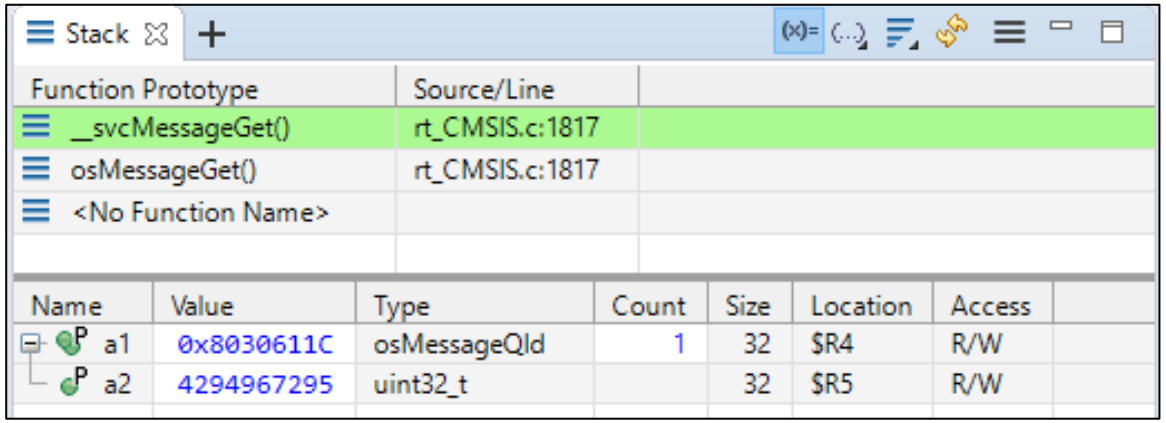


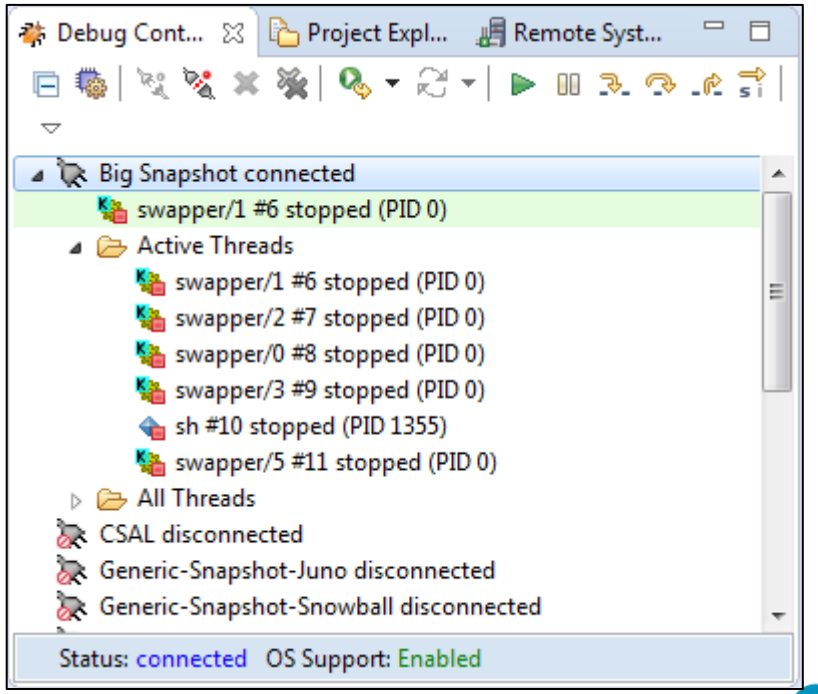
Advanced User Interface Design

Simplicity, visibility, and performance



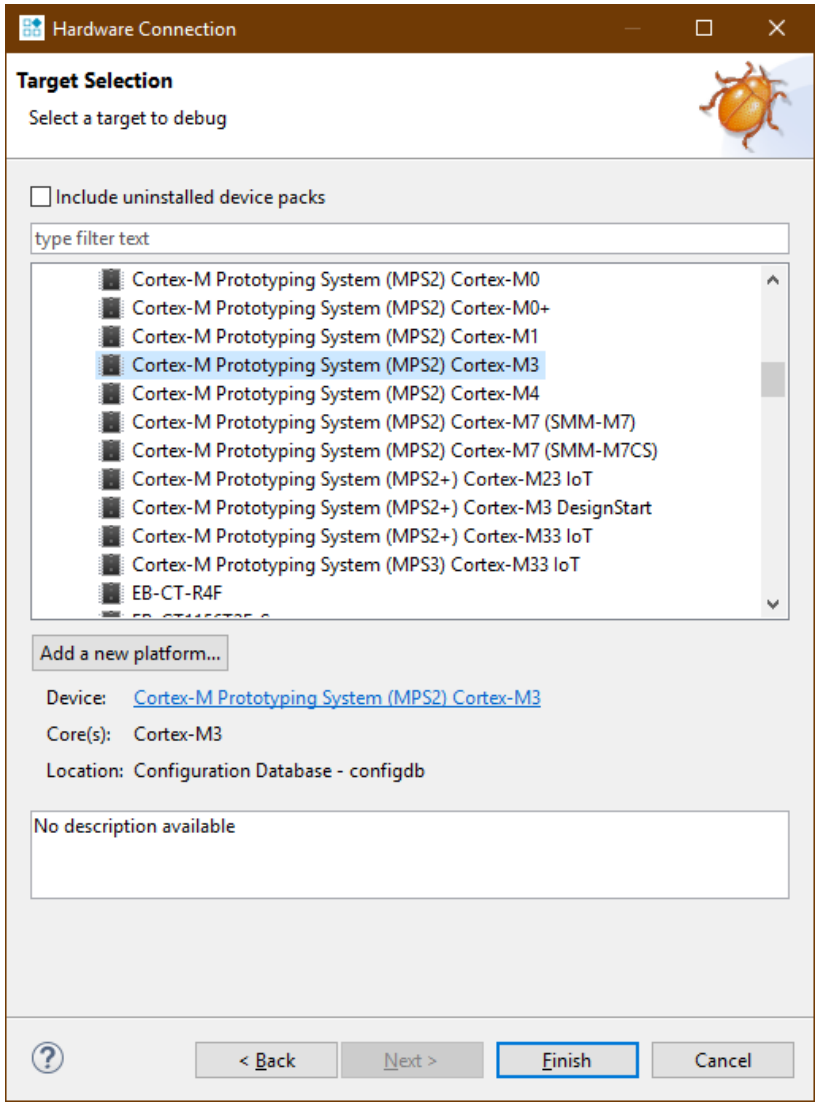






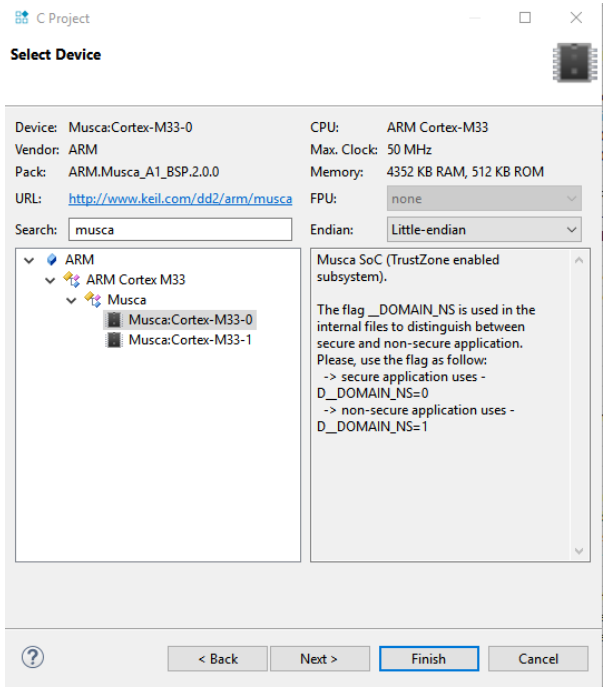
Target connection configuration

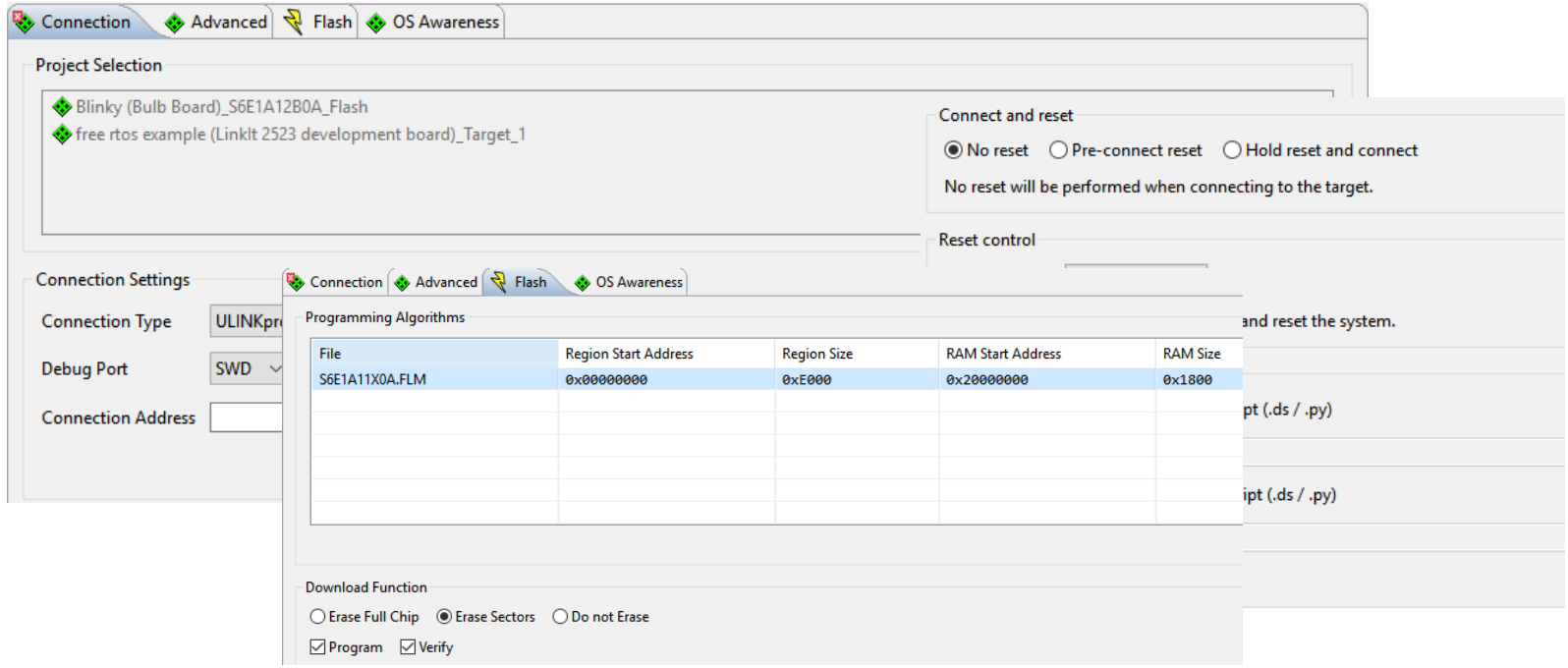
- Hardware and models connection wizard
- Select device, board or FVP easily
  - Recently used list
  - Add new platform if device not listed
  - Creates a new configuration with the platform configuration editor
- Configuration wizard generates an initial debugger configuration based on device information.



Debugger configuration with software packs

Device selection
based on packs





Advanced target connection, reset options

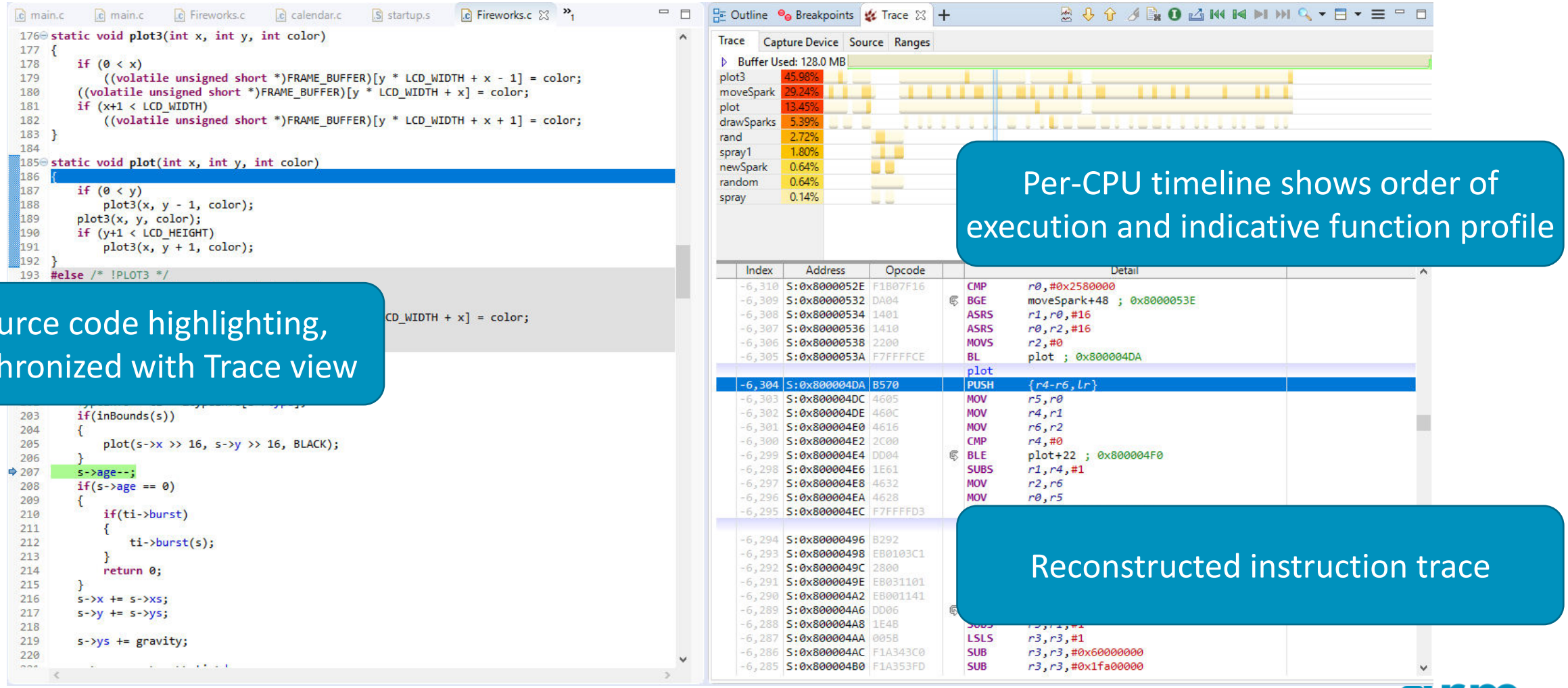
Flash programming with support for multiple flash regions

Trace – how it works

- CPU instruction execution history via ETM
  - Data load and store (certain CPUs)
  - Instrumented trace (ITM, STM)
- Arm trace data collected in
  - On-chip CoreSight trace buffer (ETB, ETF, ETR)
  - Off-chip debug probe via physical trace port on the target
- Rotating trace buffer fills in the background during a debug session
  - When a breakpoint is hit the content of the trace buffer is displayed

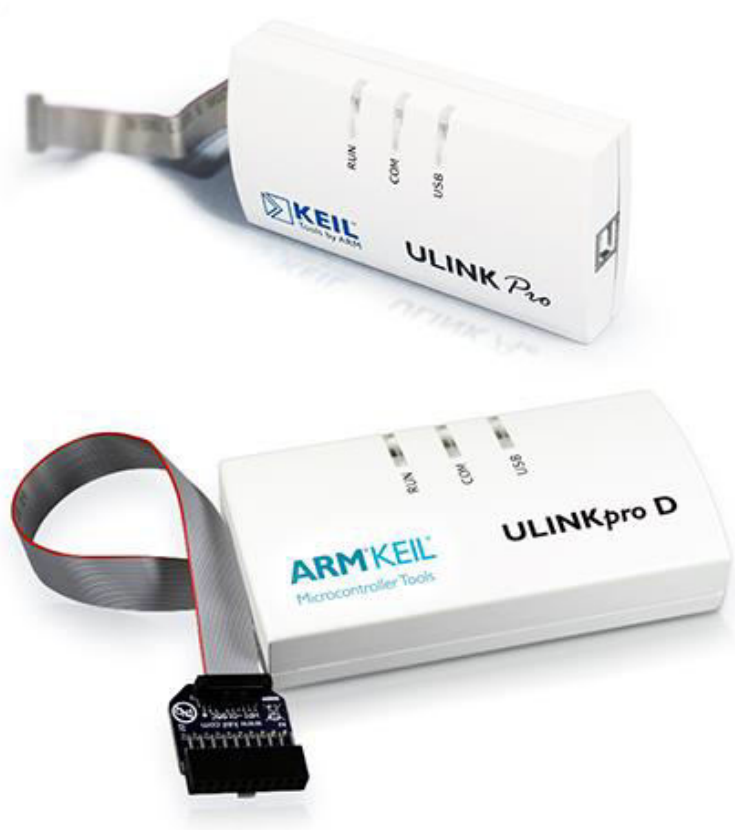
Trace view in Arm Debugger

A non-intrusive ‘flight recorder’ for your system



Debug probes

Range of probes to match your requirements



DSTREAM-ST family

Second-generation debug and trace probes

- New design featuring patented technology to address the needs of modern SoC's

Capabilities	DSTREAM-ST	DSTREAM-PT	DSTREAM-HT
JTAG / SWD	180 / 125 MHz	180 / 125 MHz	180 / 125 MHz
Download speed	Up to 12MB/s	Up to 12MB/s	Up to 12MB/s
Maximum CoreSight components	1022	1022	1022
Parallel trace pins	1 - 4	1 - 32	1 - 4
High-speed serial trace			Yes
Maximum trace bandwidth	1.6Gb/s	19.2Gb/s	60Gb/s
Host connectivity	USB 3.0 Gigabit Ethernet	USB 3.0 Gigabit Ethernet	USB 3.0 Gigabit Ethernet
On-probe trace store	Stream to host only	8GB	8GB

ULINK family

Simplicity	Just select a supported platform from the database and connect
	Consistent debugging experience across probes
Cost efficiency	Perfectly engineered to meet basic debug needs
	Supported by both Keil and Arm Development Studio tools to protect your investment

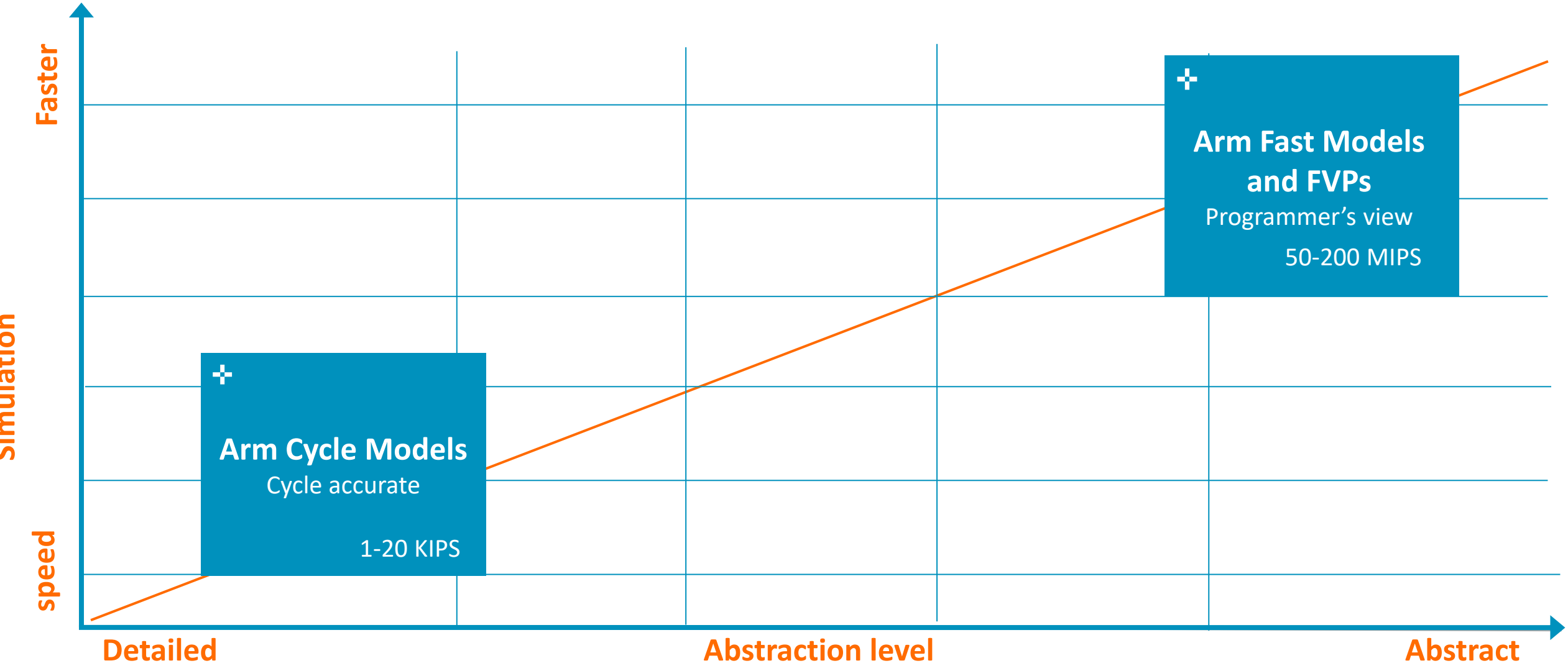
arm

Virtual platforms

Virtual prototyping solutions

- Fast Models
  - Instruction accurate, suitable for software development and test
- Cycle Models
  - Timing accurate models, derived from actual RTL
- Fully validated models of Arm IP
- Collection of Fixed Virtual Platforms (FVP) provided with Development Studio
  - Complete system models based on Fast Model technology

Virtual prototype solutions



arm

Arm Streamline performance analyzer

Arm Streamline Performance Analyzer

Speed Up Your Code

- Find out where the CPU is spending the most time
- Tune code for optimal cache usage

Drill down to the Source Code

- Break performance down by function
- View it alongside the disassembly

OpenCL™ Visualizer

Visualization of OpenCL dependencies, helping you to balance resources between GPU and CPU better than ever

Mali GPU Support

- Analyze and optimize Mali™ GPU utilization
- Monitor CPU and GPU cache usage

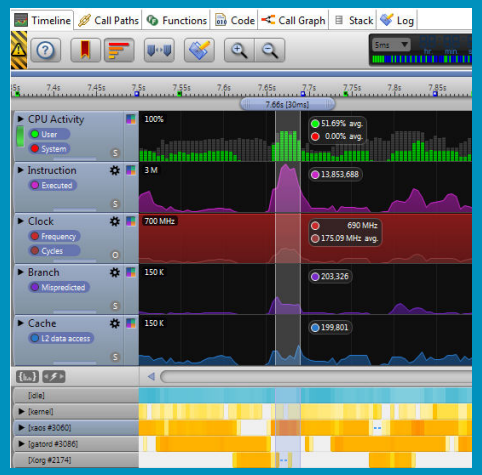
Optimize energy efficiency

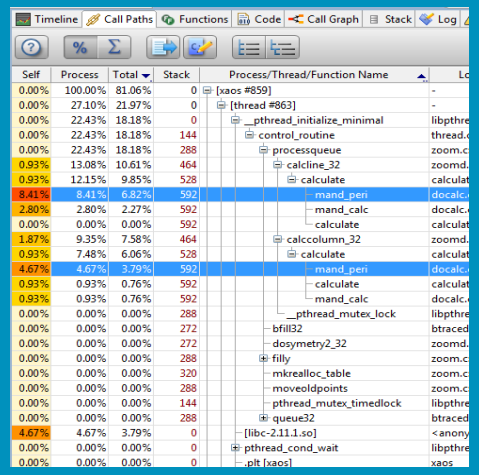
- Monitor actual power consumption with the Arm Energy Probe
- Correlate software execution to actual power consumption

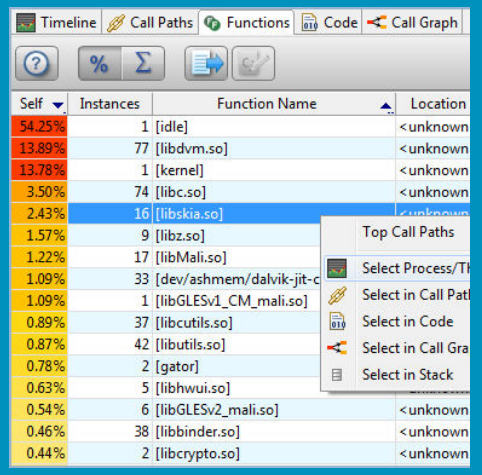
Customize it for Your System

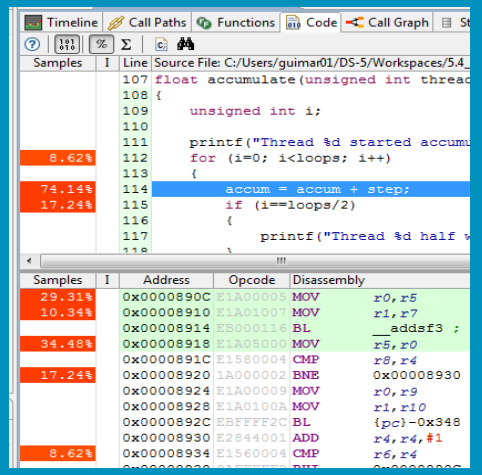
- Flexible architecture permits easy addition of new counters
- Open-source driver and daemon gives developers ultimate flexibility

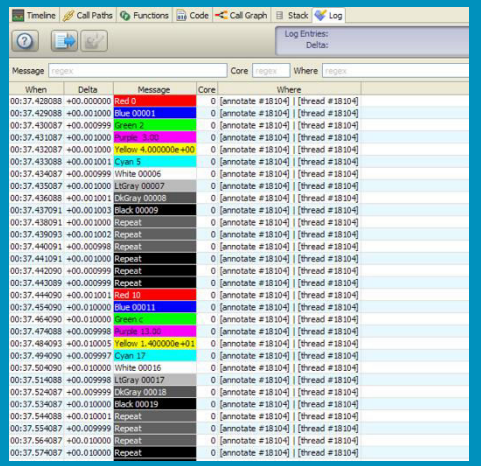
Process to Success











Timeline

Visualization of system performance metrics, software profile and system events over time

Call Paths

Hierarchical profile table, aggregating samples per process, thread, and function call chain

Functions

Flat software profile table, listing shared libraries and function hotspots

Code

Source and instruction level profile. Color coded source code lines for easy identification

Log

Chronologic list of text and graphic user annotations sent to Streamline, offering flexible filtering

We invite you to try it out for yourself

For more information see arm.com/development-studio