OpenOCD support for AArch64 targets

Omair Javaid
Introduction

- An introduction of JTAG/SWD based hardware debugging
- An introduction of OpenOCD and its architecture
- What Linaro has been doing with OpenOCD
- Work in progress and future plans
JTAG/SWD Debugging - Introduction

- Development Hardware
  - Runs software to be debugged - Firmware, Bootloaders, Kernel, User apps etc.
  - Provides a hardware debugging interface like JTAG or SWD
  - JTAG/SWD interface allows use of run-control and other debug facilities provided by the core.
JTAG/SWD Debugging - Introduction (cont...)

- Debug Adapter or Probe
  - Communicates with hardware board by using JTAG/SWD signaling
  - Communicates with host computer using USB, Ethernet etc
  - May host a on-board JTAG/SWD driver and a gdb stub
Host Computer - Runs debug tools like GDB
  ○ GDB communicates with debug adapter directly over ethernet using RSP protocol or using OpenOCD

OpenOCD - Interface between debug adapter and GDB
OpenOCD Architecture - Introduction

- **User Interface**
  - GDB connected OpenOCD GDB stub
  - Telnet client

- **Target Interface**
  - Debug probes via drivers or libraries

- **Target Management**
  - Halt/Resume, Step, Break etc
  - Memory and Register access
  - Cache and MMU management
  - Flash Programming
  - JTAG/SWD configuration

### OpenOCD Architecture

- GDB Server
- Telnet Server
- TCL Scripting Interface
- JTAG Abstraction (jtag.h)
- Target Abstraction (target.h)
- JTAG Drivers
  - Wiggler, ZY1000, FT2232 ...
- Target Specific code
- Target Board
- Flash Programming
OpenOCD Architecture - Introduction (cont…)

- TCL Scripting Interface
  - Describe new targets variant boards
  - Describe new debug interfaces
  - Perform scripted initialization
  - Event based command operation
  - Accessible via GDB monitor commands

![OpenOCD Architecture Diagram]
Linaro’s OpenOCD Efforts

- **Architecture Specific**
  - Verify Arm v7-a support
  - Verify Arm v8-a support
  - Verify Arm v7-m support
  - Compare Arm v7-a and Arm v8-a

- **Board specific**
  - Verify Hikey 96 Board
  - Verify Nitrogen 96 Board

- **GDB Integration**
  - GDB testsuite using OpenOCD stub
  - GDB testsuite results comparison
    - Arm v7-a vs Arm v8-a (AArch64 Mode)
    - Arm v7-a vs Arm v8-a (AArch32 Mode)
Linaro’s OpenOCD Efforts (cont…)

- **Hardware Configurations**
  - AArch64:
    - Bus Blaster v4 + Hikey Board
  - AArch32:
    - Bus Blaster v4 + Raspberry Pi 3
  - Arm v7-A (Cortex A):
    - Flyswatter2 + BeagleBone Black
  - CMSIS-DAP:
    - Nitrogen Board
Linaro’s OpenOCD Efforts (cont…)

- Upstream Contributions
  - OpenOCD Generic
    - Fix load + run failure bug in GDB
    - Make OpenOCD generate target xml with architecture defined data types
  - Arm v8-A
    - Read/Write of AArch64 SIMD-Floating-point registers
    - Read/Write of AArch32 SIMD-Floating-point registers
  - Arm v7-A
    - Read/Write of VFP v3 Neon SIMD-Floating-point registers
Linaro’s OpenOCD Efforts (cont…)

- In-Progress Contributions
  - OpenOCD Arm and AArch64 Semihosting
    - Verify Arm semihosting support with NewLib plus OpenOCD
    - Add support for AArch64 semihosting in OpenOCD
    - Fix Bugs in Arm support
Future Wish List

- Arm v8-M support
- LLDB and OpenOCD
- Improvements in OpenOCD GDB stub
- Fix bugs and improve stability
- Improve OpenOCD testing
Thank You

#HKG18
HKG18 keynotes and videos on: connect.linaro.org
For further information: www.linaro.org