

DS-5 debug kernel of linux and android combine DSTREAM

ARM DS-5



| Version | Author | Modification | Check |
|----------------|--------|--------------|-------|
| V-0.1-20150203 | Payne | Init version | |
| | | | |



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1. Equipment

- 1) PC x 1
- 2) DS-5 Software Development Tools x 1
- 3) DSTREAM Emulator x 1
- 4) Kernel development board(Take cubietruck for example) x 1
- 5) Other Cables

note: The following operate in the linux operating system which is similar to the windows system, you need to pay attention to the paths.

2. Hardware Wiring

Hardwired is very simple, PC machine and simulation connect with the usb cable. The target board and emulator just connect to the following lines except VCC and GND.

| target board | emulator |
|--------------|--------------|
| MS < CK < | > MS > CK |
| DO < | > DO |
| DI < | > DI |

More details about DSTREAM hardware information, please visit ARM's official website: http://infocenter.arm.com/help/index.jsp

About pin figure of cubieboard hardware, please visit the official website : <u>http://cubieboard.org</u>







3. Add a new chip to the DS-5 Debug device list

3.1. Explanation

DS-5 supports all ARM processors, but most of the processors require them own database which support the target processor. All ARM target process was imported to the database were supported by DS-5. The database can set the features of the target device flexibly. Such as trace and memory-mapped registers, can reduce the additional connection steps.

We assume installed directory on DS - 5 :/usr/local/DS-5 , If you haven't installed DS - 5, please go to the arm's official website to download: <u>http://ds.arm.com/downloads/</u>

3.2. Steps

3.2.1.Create DS-5 Configuration Database

1) We need to connect the hardware according to the step 2, input in the terminal



\$ dbghwconfig

| 😣 🗐 🗊 Debug Hardware Co | onfig | | | | |
|--|----------|-------------------|----------------|-------------------|----------------|
| <u>F</u> ile <u>V</u> iew <u>H</u> elp | | | | | |
| D 🚅 🖬 🔲 🔋 | | | | | |
| No connection | Debug Ha | ardware browser | | | Scanning 📎 |
| | Access | Host Name | IP Address | Ethernet Address | Debug Hardware |
| | USB | DS000000706 | 192.168.10.115 | 00:02:F7:00:40:4E | DSTREAM |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | Other T | CD/ID Daviage | | | |
| | | | | | |
| | | ess / nost marrie | | | |
| | | | | | |
| | | Cor | nect | | |
| | | | | <u>I</u> dentity | |
| | | | | | |
| | | | | | |
| | | | | | |
| , | | | | | |

Selected device in the debug hardware browser, click "Connect", jump to the next step

| 😣 🗐 🔲 🛛 Debug Hardware | Config - * | | |
|---|-----------------------------------|--|---|
| <u>F</u> ile <u>V</u> iew <u>H</u> elp | | | |
| Connected to (USB:00 | | | |
| - Devices - ARMCS-DP - Cortex-A7 - CSPMU - Cortex-A7 - Advanced - Trace | TDI ICE B:000706 TDO | Cortex-A7 Cortex-A7_0 Device Index = 2 Device Index | 0 Cortex-A7 Cortex-A7_1 Device Index = 4 |
| | Debug System | Auto Configure | Devices |
| | Clock Speed 10.000 MHz | <u>Auto Configure</u> | Add Remove |
| | Select <u>P</u> latform | Use adaptive clock if detected | Move <u>L</u> eft Move <u>R</u> ight |
| | Trace Associations | Read CoreSight ROM tables | Properties Configure |
| table read failed for APB-A | AP at index 1 (base address = 0x8 | 30100000) unknown failure during memo | rv read at address 0x80113D00 |
| f ROM table | | | ., |
| atforms found that match | | | 2 |
| | | | |

Click on "Auto Configure" and will be appear a chip information (due to the hardware characteristics, please connect the cubietruck debug serial port as well, otherwise the emulator hardly read the chip information), save the configuration information then exit.

note: Here to do special configuration for different chip ,be sure to use the configuration files of A20 chip which we offer, the above steps is how to generate configuration files, and only for reference.



A20 configuration file download address: http://dl.cubieboard.org/developers/debug-tools/ARM-DS-5/source/AW_A7MP2NOETM.rvc

2) Generated configuration files combine dbghwconfig, run the configure database import tool, and use the appropriate parameters. usage :cdbimporter [-c config_db] [-t destination_db] rvc_file

config_db: The full path of the master DS-5 configuration database

destination_db: The full path of the new configuration database

rvc_file: The full path which hardware configuration tool to generate the RVC

Example:

\$ cdbimporter -c /usr/local/DS-5/sw/debugger/configdb -t /home/parker/cubie_configdb A20_chip.rvc

Select a core to modify (enter the index and hit return) or press enter to continue. [] : PRESS ENTER

Enter Platform Manufacturer [default:'Imported'] > COMPANYX

Enter Platform Name [default:'target'] > PLATFORMX

The files of the Import tool generated which stored in the specified target database, generated in this tutorial:

/home/parker/cubie_configdb

| Fou | ind 2 ARM core | s | |
|-------------------------|--|--|---|
| ID | Name | Definition | Associated TCF files |
| 1 3 | Cortex-A7_0 Cortex-A7_1 | Cortex-A7 Cortex-A7 | <none> <none></none></none> |
| Sel | ect a core to | modify (ent | er its ID and hit return) or press enter to continue. [] |
| Ent [de | er Platform M fault:'AW'] > | anufacturer | |
| Ent [de | er Platform N fault:'A7MP2N | ame OETM'] > | |
| Bui | lding configu. | ration XML | |
| Сге | ating databas | e entry | |
| Imp | ort successfu | lly complete | d |
| The has A r by | new platform been added t ebuild is don forcing a dat | will not be o the "User e either whe abase rebuil | visible in the DS-5 Debugger until the destination database Configuration Databases" list and the database has been rebuilt. n DS-5 is (re)started, a user configuration database is added or d. |
| To the the | force a rebui n expand the "Rebuild dat | ld or add a DS-5 group. abase" butto | database, select the "Window -> Preferences" menu item, To rebuild, select "Configuration Database", then press n. |
| To and | add a databas supply a sui | e to the "Us table "Name" | er Configuration Databases" list, click the "Add" button (E.g. Imported) and "Location" for the database. |
| | kacenackacı (u | | |



3) Start DS - 5, open the "Preferences" option under "Window" menu, a DS - 5 options, select "Configuration Database". Click "Add" button to add new configuration database.

| 😣 💿 Preferences | | | |
|---|--|--|--|
| type filter text 🗷 | Configuration Database | ♦ ▼ ▼ | |
| ▶ General ▶ C/C++ | Settings for the configuration database Default Configuration Databases | | |
| DS-5 ARM Assembler Configuration Database Debugger Developer Account General Scatter File Editor Streamline Target Configuration Editor Toolchains Updates Help Lava | Name Location Ø DS-5 Android and Linux application targets /usr/loca Ø DS-5 Linux and bare-metal targets /usr/loca | l/DS-5/sw/eclipse/dropins/plugi l/DS-5/sw/debugger/configdb | |
| | User Configuration Databases Name Location Ø /home/parker/cubie_configdb | | |
| | | Remove | |
| Library Hover PyDev Remote Systems | 6 | Down | |
| Run/Debug Team Terminal | Rebuild database Test platforms | Restore <u>D</u> efaults <u>Apply</u> | |
| (?) | | Cancel | |

As the same interface with the above , click "Rebuild the Database", to ensure that the new target Database load, then click "OK" to exit.

4. Using DSTREAM simulator debugging Android kernel

4.1. Add the kernel options

Description: We take the android kernel for example, the operation method of the Linux kernel are similar, need to pay attention to the path and the method of compilation.

Select a cubieboard kernel source code, execute "make ARCH = arm menuconfig".



Choose "kernel hacking">"Kernel debugging" option ,symbol is "DEBUG_KERNEL".

| <pre>[] Show timing information on printks (4) Default message log level (1-7) [*] Enabledeprecated logic [*] Enablemust_check logic (1024) Warn for stack frames larger than (needs gcc 4.4) [] Magic SysRq key [*] Strip assembler-generated symbols during link [] Generate readable assembler code [] Enable unused/obsolete exported symbols -*- Debug Filesystem [] Run 'make headers_check' when building vmlinux [] Enable [] Strip asset and mismatch analysis</pre> |
|---|
| -*- Kernel debugging [] Debug shared IRQ handlers [] Detect Hard and Soft Lockups [] Panic on Oops |

Choose "kernel hacking">"compile the kernel with debug info" option, symbol is "DEBUG_INFO".



After Configurate, press two times, prompt exit select < Yes > save and exit.

| to continue. | to save your | new cor | irigu | ration | <pre><< <esc><esc><</esc></esc></pre> |
|--------------|--------------|---------|-------|--------|--|
| | Mos N | | No | ~ | |
| | | | NO | | |



4.2. Compile the kernel

After modify the kernel configuration, we need to recompile the kernel and generate vmlinux, and use to this file later.

Compile methods don't elaborate on here, please read:

android: http://pan.baidu.com/s/1dDF5cVR

linux: <u>http://pan.baidu.com/s/1o6LYsDs</u>

4.3. Import the kernel source to DS - 5

Create a new project in DS - 5, named "MYD - SAMA5D3X_kernel" ,import the kernel source code.

Open DS-5, choose "File" > "New" > "Project...".

| 😣 🗈 New Project | |
|-------------------------------|--------|
| Select a wizard | |
| Create a new project resource | |
| Wizards: | |
| type filter text | × |
| 🔻 🗁 General | |
| 😂 Project | |
| ▶ 🗁 C/C++ | |
| CVS | |
| 🕨 🗁 Java | |
| PyDev | |
| | |
| | |
| 3 | |
| ? < Back Next > Cance | Finish |



Input the project name in the "project name", be named "cubie_kernel", then click "finish" to complete the project creation.

| 😣 🗈 New Project |
|--|
| Project |
| Create a new project resource. |
| Project name: cubie_kernel |
| ☑ Use <u>d</u> efault location |
| Location: /work/tools/DS-5-Workspace/cubie_kernel Browse |
| Choose file system: default 💠 |
| Working sets |
| □ Add projec <u>t</u> to working sets |
| Working sets: \$ |
| |
| |
| ? < Back Next > Cancel Finish |

Copy all the contents of compiled to the project directory(example:cp -a /lichee/linux-3.4/* /work/tools/DS-5-Workspace/cubie_kernel),then right-click project name, select "Refresh" to Refresh. The add file of DS - 5 will be displayed.





4.4. Debug configuration

Open the menu bar "Run" > "the Debug Configurations...", "DS - 5 Debugger" selected

"New_configuration". Choose "Select target" >> "Imported" > "database_file" "Linux Kernel and/or Device Debug" > "Debug Cortex-A7x2 SMP"(red font is the database directory name for you create, please find according to actual situation).Target "connections" click "browse..." Select search to DSTREAM simulator.

| 😣 🗊 Debug Configurations | |
|--|--|
| Create, manage, and run configurat | ions |
| | Here you can configure the name, use the default here |
| | A SHORE THE AND A SHORE AND A SHORE AND A |
| | Name: New_configuration |
| type filter text | 🚾 Connection 🛯 💀 Files 👫 Debugger 🖗 OS Awareness 🚧 Arguments 🖾 Environment |
| C/C++ Application C/C++ Attach to Application C/C++ Postmortem Debugger C/C++ Remote Application ★ DS-5 Debugger ★ New_configuration ★ Iron Python Run ✔ Iron Python unittest Java Applet Java Applet Java Application ✔ Jython run ♀ PyDev Django PyDev Google App Run ♀ Python Run ♀ Python unittest ℝ mote Java Application | Select target Select the manufacturer, board, project type and debug operation to use. Currently selected: Imported / database_file / Linux Kernel and/or Device Driver Debug / Debug Cortex-A7x2 SMP Filter platforms V Imported V database_file Bare Metal Debug Linux Application Debug V Linux Kernel and/or Device Driver Debug Debug Cortex-A7_0 Debug Cortex-A7_1 Debug Cortex-A7_2 SMP Target Connection DSTREAM DS-5 Debugger will connect to a DSTREAM to debug a Linux kernel. Connections Linux Kernel Debug Connection USB:000706 Browse |
| Filter matched 18 of 18 items | Apply Revert |
| ? | Close Debug |



Configure "Debugger" option below ,operation control "Run control" select "connect only" . Click on the "Execute the debugger commands" and input in the input box:

interrupt

add-symbol-file "/work/tools/DS-5-Workspace/cubie_kernel/vmlinux"

Click on the "Workspace..." button below"Paths" ,choose "cubie_kernel" project as DS - 5 source search path.Open the cubietruck power (or reset), let u-boot guide the kernel, and then click the "Debug" button at the DS - 5 to start debugging.

| Debug Configurations Create, manage, and run configurations (Connection): Configuration for connection | ype 'Linux Kernel Debug' Is not valid - Connection cannot be empty. | |
|---|--|-----------------------------|
| Connection: Conjugation for connection Townection: Conjugation for connection Type filter text (ype filter text (g) (/c++ Application (/c++ Application (/c++ Application (/c++ Application (/c++ Remote App | Name: New_configuration Image: New configuration Image: | File System Workspace |
| Filter matched 18 of 18 items | | Apply Revert Close Debug |



Finally, we will see an interface in the following . Represents the target plate and the simulator has been successfully connected, and you can start debugging.

| 😣 🔿 💿 DS-5 Debug - /work/android4.2_tablet_A20/lichee/linux-3. | 4/arch/arm/kernel/smp.c - Eclipse Platform | | | |
|---|--|------------------------------|--|--|
| File Edit <u>S</u> ource Refac <u>t</u> or Navigate Search Project Run Wind | low Help | | | |
| 📑 🕶 🖃 🕲 🚔 🕶 🔝 💁 🕶 🥭 🖋 🔹 🔌 🔄 🕫 | ▼ \$P \$P \$P \$P \$ \$ | Q Quick Access | | |
| 🏶 Debug Control 🛿 🗖 | 🖬 Commands 🛛 📓 📓 🏂 🔻 🎽 🗖 | 🚾 Re 🔀 👯 Ex f() Fu 🔲 Cac 🖓 🗖 | | |
| | 😫 Linked: cubie_kernel 🕶 | 1 | | |
| ~ | Signals handled by operating system Connected to running target AW - A7MP2NDETM on USB:000706 | 🕏 Linked: cubie_kernel - | | |
| | cd "/work/tools/DS-5-Workspace" | Name Value Size Access | | |
| • All filledus | directory "/work/tools/DS-5-Workspace/cubie kernel" | 🖶 🗁 Core | | |
| Swapper/o #2 scopped (PID o was running) | Source directories searched: /work/tools/DS-5-Workspace/cubie_kernel | - ● R0 0×0000000 32 R/W | | |
| Kchreadd #3 (PID 2) | interrupt | ● R1 0xC0/30200 32 R/W | | |
| ksoftirqd/0 #4 (PID 3) | On core Cortex-A7 0 (ID 0) | © R2 0x0000002 32 R/W | | |
| kworker/0:0 #5 (PID 4) | S:0xC00AA1C8 LDR r2,[r0,#0x10] | • R3 00000001 32 R/W | | |
| kworker/u:0 #6 (PID 5) | add-symbol-file "/work/tools/DS-5-Workspace/cubie_kernel/vmlinux" | e P5 0x0000000 32 P/W | | |
| Migration/0 #7 (PID 6) | Enabled Linux Kernel support for Version "Linux 3.4.39+ #28 SMP PREE Execution stopped at: S:0xC00AA1C8 | - e R6 0x0000006 32 R/W | | |
| Migration/1#8 (PID 7) | In thread 2 (OS thread id 0) | - 9 R7 0xC0721F68 32 R/W | | |
| kworker/1:0 #9 (PID 8) | S:0xC00AA1C8 2507,0 { | ● R8 0x4000406A 32 R/W | | |
| ksoftirgd/1 #10 (PID 9) | continue | - @ R9 0x410FC074 32 R/W | | |
| Couset #11 (PID 10) | thread 2 | - | | |
| | (())) | - R11 0x0000000 32 R/W | | |
| Cubie_kernel connected VM:0 | Command: Press (Ctrl+Space) for Content Assist Submit | ► @ R12 0x0000000 32 R/W . | | |
| □ page_alloc.c □ smp.c ⊠ □ core.c "1 □ □ | 해 Disassembly 23 린 Memory 를 Modules 를 Events 먎 Outline | | | |
| 520 | | | | |
| 521 local_fiq_disable(); | | | | |
| 522 local_ird_disable(); | Address Opcode Diskssembly | | | |
| 524 while (1) | 5:0xC0012830 F10C0080 CPSID 1 ipi cpu stop + 0x44 [inlined] | 6 | | |
| <pre>\$25 cpu_relax();</pre> | ♦ S:0xC0012834 EAFFFFFE B {pc}; 0xc0012834 | | | |
| 526 } | test_bit [inlined] | | | |
| 528 static coumask t backtrace mask: | r_{6} [pc.#164] : [0xC0012858] = 0xC07721 | B34 | | |
| <pre>529 static DEFINE_RAW_SPINLOCK(backtrace_lock);</pre> | | 5 | | |
| 530 | | | | |
| 531 /* "in progress" flag of arch_trigger_all_cpu_bac | App Console 🗖 Target Console 🥙 Error Log 🛛 | ,U U, V 🐘 🗶 🗎 🧭 🍸 🗖 🗖 | | |
| 533 | Workspace Log | | | |
| 534 void smp_send_all_cpu_backtrace(void) | | × | | |
| 535 { | | | | |
| 536 unsigned int this_cpu = smp_processor_id(); 537 int i: | Message Plug-In A I | | | |
| 538 | Unable to find platform "Imported - parker" com.arm.debugger.launcher2 | 2/3/15, 10:53 AM | | |
| 539 if (test_and_set_bit(0, &backtrace_flag)) | Unable to find platform "Imported - parker" com.arm.debugger.launcher2 | 2/3/15, 10:53 AM | | |
| | Inable to find platform "Imported - parker" com arm debunner launcher? | 2/3/15 10·53 AM | | |
| | | | | |
| | | | | |

4.5. Debug interface specification

The DS - 5 started to connect the development board, the view is as follows, all show the current name of debugging, and it can debug control.



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In the figure above, the function of each control button as follows:

- 💐 . Connect plate
- 💐 Disconnect
- X Delete the connection
- ➡ From the main function or entry point debugging
- Continue to run at full speed
- Stop running
- 🏊 🕵 🖄 Single step debugging
 - Choose according to the C program on the basis of single step debugging or assembler debugging

Command bar which can input command after "commands" and make development board runing, such as input "step" would doing single step debugging . The mouse is located in the input box, press "Alt + /" can obtain the command prompt.

| 🖬 Commands 🛙 | | | R | 6 | S | ∇ | 4 | ∇ | | |
|--|---|------------------------------------|------------------------------|---------------------|--|------------|--------------------------------------|----------------------|-----------------------|---|
| | 🔄 Linked: cubie | e_kern | nel - | | | | | | | |
| Signals handle Connected to r cd "/work/tool Working direct directory "/wo Source directo interrupt Execution stop On core Cortex S:0xC00AA1C8 add-symbol-fil Enabled Linux Execution stop In thread 2 (0 S:0xC00AA1C8 wait continue thread 2 | d by operating system unning target AW - A7MP2 s/DS-5-Workspace" ory "/work/tools/DS-5-Workspace/ ries searched: /work/too ped at: S:0xC00AA1C8 -A7_0 (ID 0) LDR r2,[r0,#0x10] e "/work/tools/DS-5-Work kernel support for versi ped at: S:0xC00AA1C8 S thread id 0) 2507,0 { | NOETM orkspa cubie ols/DS | A on ace" e_ke 5-5- | n US erne Wor | 5B:00 21" *kspi 2_ke 3.4.1 | oo7 ace | 706 ≯/cub <u></u> }!/vm +28 | ie_k linu ∶SMF | serne JX" > PRI | el ···································· |
| Command: Pres | s (Ctrl+Space) for Content As | sist | | | | | | | Subr | nit |



Assembler bar, display program corresponding the assembler, address and the operands, etc.



Register bar, shows all registers, the inside of the kernel, can be modifie register when debugging

| 🚥 Registers S | 🕱 👬 Expression | ns 🕫 Functions 🔲 Cache Data | - | |
|---------------|----------------|-----------------------------------|---|--------------------|
| | | | A | \bigtriangledown |
| | ÷. | Linked: cubie_kernel - | | |
| Name | Value | Size Access | | |
| 🖻 🗁 Core | | | | A |
| - ● R0 | 0x0000000 | 32 R/W | | |
| - ● R1 | 0xC0730200 | 32 R/W | | |
| - ● R2 | 0x0000002 | 32 R/W | | |
| - • R3 | 0x0000001 | 32 R/W | | |
| – 🔍 R4 | 0x0000000 | 32 R/W | | |
| - ● R5 | 0x0000000 | 32 R/W | | |
| - • R6 | 0x0000006 | 32 R/W | | |
| - • R7 | 0xC0721F68 | 32 R/W | | |
| - • R8 | 0x4000406A | 32 R/W | | |
| - • R9 | 0x410FC074 | 32 R/W | | |
| - • R10 | 0x0000000 | 32 R/W | | |
| - ● R11 | 0x0000000 | 32 R/W | | |
| - • R12 | 0x0000000 | 32 R/W | | - |
| | 0vc0721E40 | 32 D/M | | • |

About more detailed content, please refer to the document of the arm's official website: <u>http://infocenter.arm.com/help/index.jsp</u>