Intel® Quark SoC X1000
Board Support Package (BSP) Build Guide

Release: 0.9.0

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Contents

1 Before you begin

This guide contains instructions for installing and configuring the Intel® Quark SoC X1000 Board Support Package Sources.

This software release supports the following software and hardware:

- Board Support Package Sources for Intel® Quark SoC X1000 v0.9.0
- Intel® Galileo Customer Reference Board (CRB) (Fab D with blue PCB)
- Kips Bay Customer Reference Board (CRB) (Fab C with green PCB)
- Intel® Quark SoC X1000 Industrial/Energy Reference Design (Cross Hill)
- Intel® Quark SoC X1000 Transportation Reference Design (Clanton Hill)

Before you begin:

- You need a host PC running Linux*. Intel recommends a 64-bit Linux system.
- You need an internet connection to download third party sources.
- The build process may require as much as 30 GB of free disk space.
- To program the board you can use:
  - serial interface using `CapsuleApp.efi` (see Section 9)
  - DediProg* SF100 SPI Flash Programmer (or equivalent) and the associated flashing software (see Section 10)
  - Intel® Galileo IDE (Galileo board only; see the *Intel® Galileo Board Getting Started Guide* for details)

Note: Remove all previous versions of the software before installing the current version.

Individual components require very different environments (compiler options and others). **To avoid cross-pollution, the commands in each section below must be run in a new terminal session every time**.

Note: If these commands fail or timeout, it may be due to your proxy settings. You may find answers here: https://wiki.yoctoproject.org/wiki/Working_Behind_a_Network_Proxy

This release has been tested with Debian* Linux* 7.0 (Wheezy) but will work with most other Linux distributions.

This release is validated on 64-bit Linux* systems and may need additional steps for operation on 32-bit systems.

2 Downloading software

Download the BSP Sources zip file here:

https://downloadcenter.intel.com/Detail_Desc.aspx?DwnldID=23197

Note: If you are using an Intel Quark Reference Design board, see your Intel representative for the appropriate software download URL.

This release is comprised of:

- Board Support Package (BSP) sources:
  - `Board_Support_Package_Sources_for_Intel_Quark_v0.9.0.7z` (2.5 MB)

Note: The Capsule Update Utility `CapsuleApp.efi` is now built as part of the EDKII build from source, described in Section 3.

Debian provides a meta package called `build-essential` that installs a number of compiler tools and libraries. Install the meta package and the other packages listed in the command below before continuing:

```
# sudo apt-get install build-essential gcc-multilib vim-common
```

3 Building the EDKII Firmware

You need to build the open source EDKII firmware for Quark. Additional details may be found here:

- www.tianocore.sourceforge.net
- http://sourceforge.net/apps/mediawiki/tianocore/index.php?title=Getting_Started_with_EDK_II

Dependencies:

- Python 2.x
- GCC and G++ (tested with GCC 4.3 and GCC 4.6)
- `subversion` client
- `uuid-dev`
- `iasl`

The Clanton EDKII BSP is named `quark_EDKII_<version>.tar.gz`. Once it has been extracted, run the `svn_setup.py` script. The script fetches the upstream code required to build the firmware modules.

Open a new terminal session and enter the following commands:

```
tar -xvf quark_EDKII_*.tar.gz
cd quark_EDKII*
./svn_setup.py
svn update
```

Note: The `svn update` command can take a few minutes to complete depending onthe speed of your internet connection.

Note: If these commands fail, it may be due to your proxy settings. You may find answers about proxy settings here: https://wiki.yoctoproject.org/wiki/Working_Behind_a_Network_Proxy

Once `svn update` has completed, use the `buildallconfigs.sh` script to build the modules. The script has the following options:

```
buildallconfigs.sh [GCC43 | GCC44 | GCC45 | GCC46 | GCC47] [PlatformName]

    GCC4x         GCC flags used for this build. Set to the version of GCC
                  you have installed.
                  NOTE: Validated with GCC43; tested on GCC46
[PlatformName]    Name of the Platform package you want to build
```

Example usage:

```
./buildallconfigs.sh GCC46 QuarkPlatform # Create a build for Quark
                  Platform based on GCC version 4.6
```

Note: Ensure the selected version of GCC matches the one installed on the system by running the `gcc --version` command.

The build output can be found in the following directories:

- `Build/QuarkPlatform/<Config>/<Target>_<Tools>/FV/FlashModules/`

  Contains EDKII binary modules

- `Build/QuarkPlatform/<Config>/<Target>_<Tools>/FV/Applications/`

  Contains UEFI shell applications, including `CapsuleApp.efi`

where:

```
      <Config> = PLAIN | Secure
      <Target> = DEBUG | RELEASE
      <Tools> = GCC43 | GCC44 | GCC45 | GCC46 | GCC47
```

In Section 7 you will run a script that creates a symbolic link to the directory where the EDK binaries are placed.

For experienced users only:

```
quarkbuild.sh [-r32 | -d32 | -clean] [GCC43 | GCC44 | GCC45 | GCC46 | GCC47]
    [PlatformName] [-DSECURE_LD (optional)]

       -clean      Delete the build files/folders
       -d32        Create a DEBUG build
       -r32        Create a RELEASE build
       GCC4x       GCC flags used for this build. Set to the version of GCC
                   you have installed.
                   NOTE: Validated with GCC43; tested on GCC46.
   [PlatformName]  Name of the Platform package you want to build
   [-DSECURE_LD]   Create a Secure Lockdown build (optional)
```

Example usage:

```
./quarkbuild.sh -r32 GCC43 QuarkPlatform -DSECURE_LD # Create a Secure
                 Lockdown RELEASE build for Quark platform based on GCC
                 version 4.3
```

4 Building the GRUB OS loader

Note: GRUB is provided in two places: inside the meta-clanton Yocto BSP or independently.

If you will run Yocto, skip this section and use the file output by Yocto in this directory: `yocto_build/tmp/deploy/images/grub.efi`

If you are only interested in building a Flash image without Linux and not in using Yocto, then proceed through this section.

Tip: If you want to build a Flash image without a Yocto Linux system (for example, because you plan to boot a larger Yocto Linux system from an SD card or USB stick), you should modify the appropriate `layout.conf` file and delete the sections for `bzImage` and `core-image-minimal-initramfs-clanton.cpio.gz`.

Dependencies:

- GCC (tested with version 4.3.4 and 4.6.3, and libc6-dev-i386)
- `gnu-efi` library (tested with version >= 3.0)
- GNU Make
- Autotools (`autoconf` and `libtool`)
- Python >= 2.6
- `git`

This GRUB build requires the 32 bit `gnu-efi` library which is included with many Linux distributions. Alternatively, you can download the latest version from: http://sourceforge.net/projects/gnu-efi/files

Unpack and compile the `gnu-efi` library using the commands:

```
# tar -xvf gnu-efi*
# cd gnu-efi*/gnuefi
# make ARCH="ia32"
# cd -
```

To build GRUB, **first open a new terminal session**, extract the grub package, and run the `gitsetup.py` script. The script downloads all the upstream code required for grub and applies the patch.

Note: If you are not using Debian and had to manually install `gnu-efi` in a non-system location, then you must point `GNUEFI_LIBDIR` at the location where `gnu-efi` was compiled or installed.

Run the following commands:

```
# tar -xvf grub-legacy_*.tar.gz
# cd grub-legacy_*
# ./gitsetup.py
# cd work
# autoreconf --install
# export CC4GRUB='gcc -m32 -march=i586 -fno-stack-protector'
# export GNUEFI_LIBDIR=/full/path/to/gnu-efi-3.0/gnuefi/
# CC="${CC4GRUB}" ./configure-clanton.sh
# make
# cd -
```

Note: If these commands fail, it may be due to your proxy settings. You may find answers about proxy settings here: https://wiki.yoctoproject.org/wiki/Working_Behind_a_Network_Proxy

The required output from this build process is the `efi/grub.efi` file.

5 Creating a file system and building the kernel using Yocto

Dependencies:

- `git`
- `diffstat`
- `texinfo`
- `gawk`
- `chrpath`
- `file`

Note: `git` requires proxy configuration. If these commands fail, it may be due to your proxy settings. You may find answers about proxy settings here: https://wiki.yoctoproject.org/wiki/Working_Behind_a_Network_Proxy

Use Yocto to create a root file system and kernel that boots the system from an SD card or USB key. Do not run any of the commands in this section as root.

Note: See Section 6 to build development tools such as `gcc` for different host operating systems.

First, **open a new terminal session**, extract the yocto layer, and run the `setup.sh` script to download the external sources required for the yocto build:

```
# tar -xvf meta-clanton*.tar.gz
# cd meta-clanton*
# ./setup.sh
```

Note: The `setup.sh` script has changed and takes no parameters. To build the root file system and kernel for the Intel® Galileo board, see the commands below.

Next, source the `oe-init-build-env` command to initialize the yocto build environment, and run `bitbake <target>` to build the root file system and kernel. You will use SoC-specific `<target>` commands described below.

Two build methods are supported; the output is slightly different for each one. The commands are different for the Intel® Galileo board.

Note: You cannot perform the following build methods sequentially, they are mutually exclusive. If you want both builds, you must perform them on two completely different and isolated directories.

Build a small Linux for SPI Flash

For the Intel® Galileo board, run:

```
# source poky/oe-init-build-env yocto_build
# bitbake image-spi-galileo
```

For the Intel® Galileo board, output files are found in `./tmp/deploy/images/` and include:

- `image-spi-galileo-clanton.cpio.gz`
- `image-spi-galileo-clanton.cpio.lzma`
- `bzImage`
- `grub.efi`

For other supported boards (not Intel® Galileo), run:

```
# source poky/oe-init-build-env yocto_build
# bitbake image-spi
```

Output files are found in `./tmp/deploy/images/` and include:

- `image-spi-clanton.cpio.gz`
- `image-spi-clanton.cpio.lzma`
- `bzImage`
- `grub.efi`

Build a full-featured Linux for SD card or USB stick

Note: A complete yocto build can take several hours to complete, depending on your internet connection speed and your machine's specifications.

For the Intel® Galileo board, run:

```
# source poky/oe-init-build-env yocto_build
# bitbake image-full-galileo
```

For the Intel® Galileo board, output files are found in `./tmp/deploy/images/` and include:

- `image-full-galileo-clanton.ext3`
- `core-image-minimal-initramfs-clanton.cpio.gz`
- `bzImage`
- `grub.efi`
- `boot (directory)`

For other supported boards (not Intel® Galileo), run `bitbake image-full` as shown below:

```
# source poky/oe-init-build-env yocto_build
# bitbake image-full
```

Output files are found in `./tmp/deploy/images/` and include:

- `image-full-clanton.ext3`
- `core-image-minimal-initramfs-clanton.cpio.gz`
- `bzImage`
- `grub.efi`
- `boot (directory)`

The kernel and root file system (`bzImage` and `image-nnnn.gz`, respectively) can be copied onto a USB stick or SD card and booted from grub.

6 Building the cross compile toolchain

This section describes how to build an image that includes development tools for the following operating systems:

- Linux* cross compile toolchain
- Windows* cross compile toolchain
- MAC OS* cross compile toolchain

6.1 Linux* cross compile toolchain

The steps to build the cross compile toolchain are the same as the steps for the Yocto root file system and kernel build as described in Section 5, with the exception of the `bitbake` command arguments.

To build the tool chain, **open a new terminal session** and follow the steps in Section 5 but modify the `bitbake` command as follows:

```
# bitbake image-full -c populate_sdk
```

The same files can be used for both builds, however, you **must** source the `poky oe-init-build-env yocto_build` every time you use a new terminal.

The output of the build process is a script that installs the toolchain on another system:

```
clanton-tiny-uclibc-x86_64-i586-toolchain-1.4.2.sh
```

The script is located in `./tmp/deploy/sdk`

Note: The script may change your environment significantly, thus breaking other, non-Yocto tools you might be using (including anything which uses Python). **You must open a new terminal session** to `source` the Yocto environment and run `make`, and run all your other commands in other terminal sessions.

When you are ready to compile your application, first run the `source` command below to define default values for `CC`, `CONFIGURE_FLAGS`, and other environment variables, then you can compile:

```
# source  /opt/poky/1.4.2/environment-setup-x86_32-poky-linux
# ${CC} myfile.c -o myfile
```

or

```
# source  /opt/poky/1.4.2/environment-setup-x86_64-poky-linux
# ${CC} myfile.c -o myfile
```

For general details, see the Yocto Application Development Toolkit (ADT) information: https://www.yoctoproject.org/tools-resources/projects/application-development-toolkit-adt

Instructions about adding a package to the Linux build may be found here: http://www.yoctoproject.org/docs/current/dev-manual/dev-manual.html#usingpoky-extend-customimage-localconf

Quark Linux uses `uclibc`, which is a C library optimized for embedded systems. This enables a very small Linux that can fit into SPI flash with the UEFI bootloader and Grub OS loader.

If you do not have any size constraints, you can change the C library to a more fully featured C library. Detailed instructions are here: http://www.yoctoproject.org/docs/current/mega-manual/mega-manual.html specifically how to change the `TCLIBC` variable selecting the C library to be used.

6.2 Windows* cross compile toolchain

1. Follow all steps from Section 5.
2. Enter the commands below:
   ```
   cd ..
   git clone git://git.yoctoproject.org/meta-mingw
   cd yocto_build
   ```
3. Edit `conf/bblayers.conf` and add the full path to cloned `meta-mingw` layer.
4. Make sure the `conf/local.conf` file contains: `SDKMACHINE = "i686-mingw32"`
5. Enter the command: `bitbake meta-toolchain`
6. Toolchain will be created under `tmp/deploy/sdk`

6.3 MAC OS* cross compile toolchain

1. Follow all steps from Section 5.
2. Enter the commands below:
   ```
   cd ..
   git clone git://git.yoctoproject.org/meta-darwin
   cd yocto_build
   ```
3. Edit `conf/bblayers.conf` and add the full path to cloned `meta-darwin` layer.
4. Make sure the `conf/local.conf` file contains: `SDKMACHINE = "i386-darwin"`
5. Enter the command: `bitbake meta-toolchain`
6. Toolchain will be created under `tmp/deploy/sdk`

7 Creating a flash image for the board

Dependencies:

- GCC
- GNU Make
- EDKII Firmware Volume Tools (base tools)
- `OpenSSL` 0.9.81 or newer
- `libssl-dev`

7.1 Using the SPI Flash Tools

The SPI Flash Tools, along with the metadata in the sysimage archive, are used to create a `Flash.bin` file that can be installed on the board and booted.

Open a new terminal session and extract the contents of the sysimage archive:

```
# tar -xvf sysimage_*.tar.gz
```

Extract and install SPI Flash Tools:

```
# tar -xvf spi-flash-tools*.tar.gz
```

Note: Extract all files to a directory that does not include the original tar files.

The `sysimage*` directory contains a two preconfigured `layout.conf` files: one is for a release build and the other is for a debug build. Depending on what kind of image you want to build, you must be in either the `sysimage.CP-8M-debug` or the `sysimage.CP-8M-release` directory.

The `layout.conf` file defines how the various components will be inserted into the final `Flash.bin` file to be flashed onto the board. The `layout.conf` consists of a number of `[sections]` with associated address offsets, file names, and parameters. Each section must reference a valid file, so it is necessary to update the paths or create symbolic links to the valid files.

A script is provided that creates symbolic links. Run the script with the command:

```
# ./sysimage*/create-symlinks.sh
```

Ensure there is no whitespace around the values defined in the `layout.conf` file.

Note: If you are using the Intel® Galileo board, you may need to modify the `layout.conf` file in the `[Ramdisk]` section from `image-spi-clanton.cpio.lzma` to `image-spi-galileo-clanton.cpio.lzma` to successfully generate your `.cap` file.

Once a valid `layout.conf` has been created, run the SPI Flash Tools makefile with the command:

```
# ../../spi-flash-tools*/Makefile
```

The output of this build is a capsule file (`*.cap`) and other required files, located in either the `sysimage.CP-8M-debug` or the `sysimage.CP-8M-release` directory (depending on what kind of image was selected). The capsule file contains a BIOS, bootloader, and compressed Linux run-time system to allow a Quark-based board to boot. Use the capsule update mechanism described later in this document to program the SPI flash on your board. The build process also creates a recovery capsule that is board-specific. Contact your Intel representative for details on the recovery capsule.

Note: The same build process and same image files are used for both secure and non-secure board SKUs, however, secure SKUs have certain restrictions on where a capsule update can be performed. If you have a secure SKU board (Industrial/Energy or Transportation Reference Design), you **must** update your board using the Linux* run-time system (Section 9.2).

To program your board using the serial interface, proceed with *Programming the Flash* instructions in either Section 9 or Section 10.

The build output also includes a `Flash.bin` file. To program your board with the platform data tool and a Dediprog, continue with Section 8, then Section 10.

8 Defining the platform data file

Note: If you created a `*.cap` file in the previous section, a platform data file is not required and you can skip this section.

Platform data is part-specific, unique data placed in SPI flash. Every `Flash.bin` image flashed to the board must be patched individually to use platform data. A data patching script is provided in this release.

The platform data patching script is stored in the SPI Flash Tools archive. Before running the script, **open a new terminal session** and copy and edit the `platform-data/platform-data.ini` file to include platform-specific data such as MAC address, platform type, and MRC parameters.

On reference platforms, the MAC address to be programmed is printed on the product label.

Note: The Intel® Quark SoC X1000 contains two MACs and each must be configured with one address in the `platform.ini` file, even on boards (such as Galileo) that have only one Ethernet port.
For Galileo, MAC 0 is the only MAC wired out. The default MAC 0 address value in the `platform.ini` file is invalid and must be set to the value allocated to your system, typically this is identified on a sticker.
MAC 1 must also have a valid UNICAST MAC address and the `platform.ini` file contains a dummy but valid address for MAC 1.
If you do **not** set a valid MAC address, the following error message is returned:

```
HALT: Multicast Mac Address configured for Ioh MAC
```

Galileo / Kips Bay Fab D example is below, recommended values are shown in **bold** text:

```
[Platform Type]
id=1
desc=PlatformID
data.type=hex.uint16
# ClantonPeak 2, KipsBay 3, CrossHill 4, ClantonHill 5, KipsBay-fabD 6
data.value=6

# WARNING: the MRC parameters MUST match the platformID used above
[Mrc Params]
id=6
ver=1
desc=MrcParams
data.type=file
#data.value=MRC/clantonpeak.v1.bin
#data.value=MRC/kipsbay.v1.bin
#data.value=MRC/crosshill.v1.bin
#data.value=MRC/clantonhill.v1.bin
data.value=MRC/kipsbay-fabD.v1.bin

[MAC address 0]
id=3
desc=1st MAC
data.type=hex.string
data.value=001320FDF4F2   #replace with MAC address from sticker on board

[MAC address 1]
id=4
desc=2nd MAC
data.type=hex.string
data.value=02FFFFFFFF01
```

Next, run the script as follows:

```
# cd spi-flash-tools/platform-data/
# platform-data-patch.py -p sample-platform-data.ini \
  -i ../../sysimage_*/sysimage.CP-8M-release/Flash-missingPDAT.bin
# cd -
```

This creates a `Flash+PlatformData.bin` file to be programmed on the board.

To program your board using Dediprog, skip to Section 10.

9 Programming flash on the board using serial interface

Dependencies: `CapsuleApp.efi` (built in Section 3, located in `Build/QuarkPlatform/<Config>/<Target>_<Tools>/FV/Applications/`)

The BSP provides a mechanism to update SPI flash contents based on EDKII capsules. These capsules contain a BIOS, bootloader, and compressed Linux run-time system sufficent to boot a Quark-based board, such as the Intel® Galileo board.

The capsule update mechanism can be triggered from an EDKII shell (Section 9.1) or from a Linux* run-time system (Section 9.2). In both situations, you must have root privileges on the system.

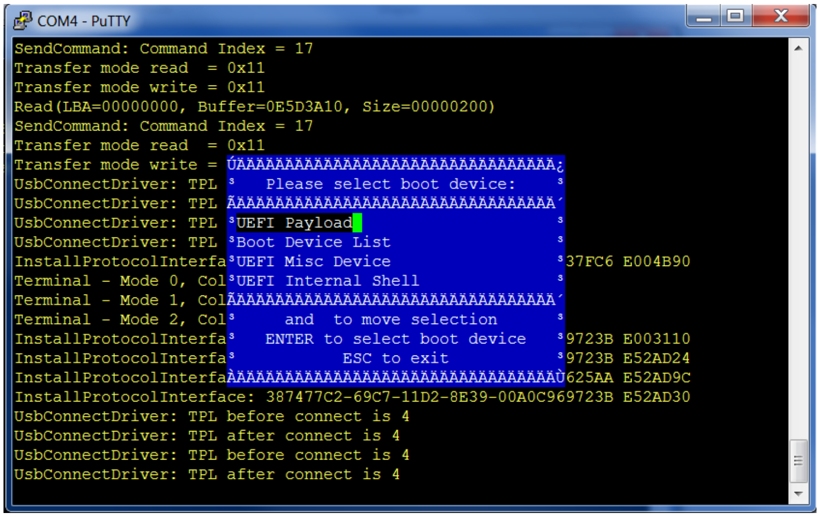
If you have a secure SKU board (Industrial/Energy or Transportation Reference Design), you **must** update your board using the Linux* run-time system (Section 9.2).

9.1 Programming flash using UEFI shell

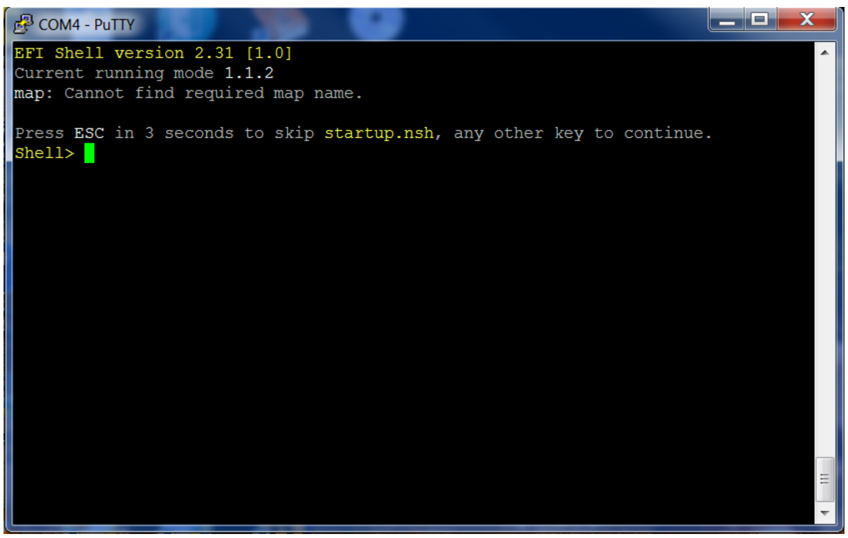
This procedure cannot be used for a secure SKU board (Industrial/Energy or Transportation Reference Design) because the UEFI shell is not available on secure SKU boards. Follow the Section 9.2 procedure instead.

Perform the steps below:

1. Use the files created in Section 7.
2. Copy `CapsuleApp.efi` and `Flash-missingPDAT.cap` to a microSD card (or USB stick) and insert it into the slot on the board.
3. Connect the serial cable between the computer and the board. Set up a serial console session (for example, PuTTY) and connect to the board's COM port at 115200 baud rate.
4. Configure the serial console session to recognize special characters. For example, if you are using PuTTY, you must explicitly enable special characters. In the PuTTY `Configuration` options, go to the `Terminal > Keyboard` category and set the `Function keys and Keypad` option to `SCO`.
5. Power on the board. Enter the EFI shell before grub starts by pressing F7.
6. The serial console displays a boot device selection box (below). Select `UEFI Internal Shell`.



You will see a display similar to this:



7. You will see a print out, the top line of which looks like this:
`fs0   :HardDisk - Alias hd7b blk0`

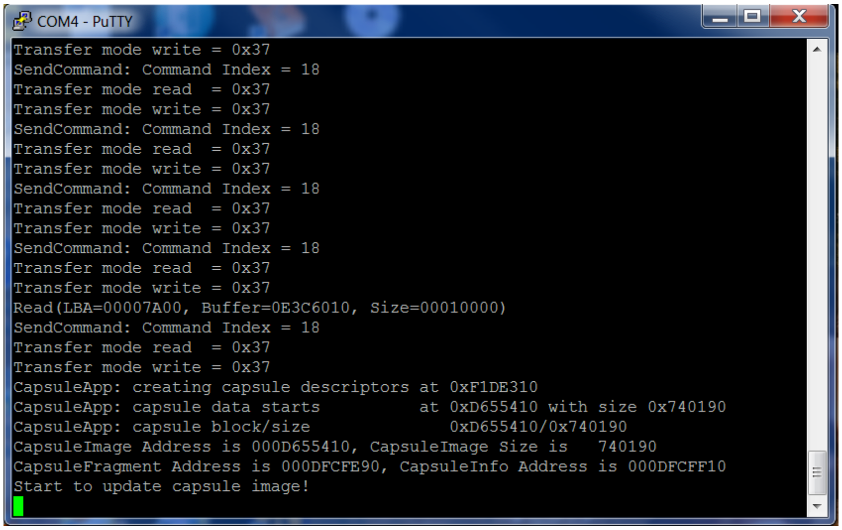
   This is your SD card. To mount it, type: `fs0:`

8. Verify you are using the correct version of `CapsuleApp.efi` by using the `-v` option. You **must** use version 1.01 or later.

9. Enter the following command:
`CapsuleApp.efi Flash-missingPDAT.cap`

Note: You must enter the full filename of the `Flash-missingPDAT.cap` file.

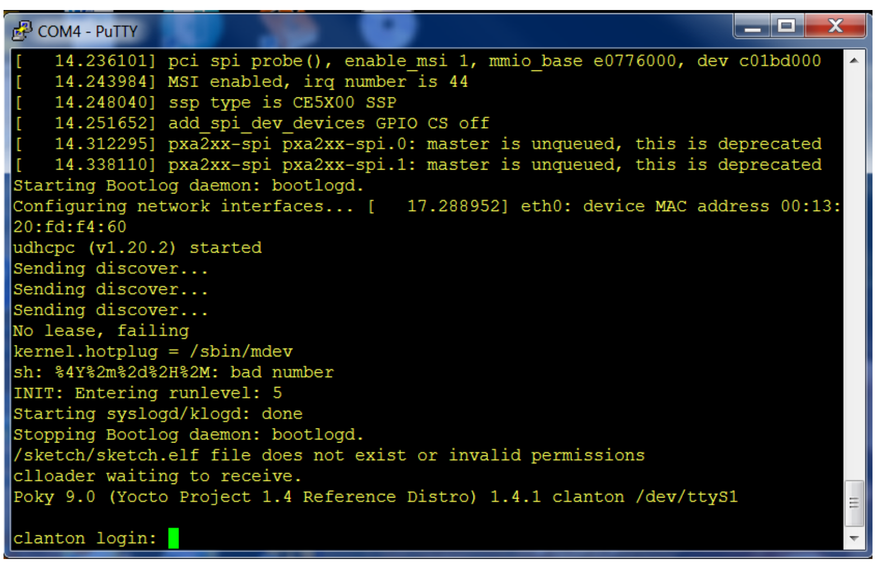
You will see a display similar to this:



The `CapsuleApp` will update your SPI flash image. This process takes about 5 minutes.

Warning: DO NOT remove power or try to exit during this process. Wait for the prompt to return, otherwise your board will become non-functional.

10. When the update completes, the board will automatically reboot. You will see a display similar to this:



9.2 Programming flash using Linux* run-time system

If you are updating from an earlier release of the BSP software (0.7.5 and 0.8.0), you need a release-specific kernel module. Note that a 0.7.5 kernel module cannot be loaded on a 0.8.0 BSP and vice-versa.

1. Use the files created in Section 7.
2. Copy `Flash-missingPDAT.cap` from the `sysimage` directory onto an SD card (or USB stick) and insert it into the board.
3. **Release 0.7.5 and Release 0.8.0 only:**
   Run the command:
   ```
   # insmod /tmp/<release>/efi_capsule_update.ko
   ```
   where: `<release>` = `0.7.5` or `0.8.0`
4. **Release 0.9.0 only:**
   Run the command:
   ```
   # modprobe efi_capsule_update
   ```
5. **All releases:**
   Run the following commands:
   ```
   # modprobe sdhci-pci
   # modprobe mmc-block
   # mkdir /lib/firmware
   # cd /media/mmcblk0p1/
   # cp Flash-missingPDAT.cap /lib/firmware/Flash-missingPDAT.cap
   # echo -n Flash-missingPDAT.cap >
       /sys/firmware/efi_capsule/capsule_path
   # echo 1 > /sys/firmware/efi_capsule/capsule_update
   # reboot
   ```

Note: Make sure you use the `reboot` command; removing/reinserting the power cable will **not** work.

Warning: It is critical to ensure that the older `sysfs` entries used by Release 0.7.5 and Release 0.8.0 are **not** used due to known issues:

```
/sys/firmware/efi/capsule_update
/sys/firmware/efi/capsule_path
```

The capsule update method for Release 0.9.0 uses the following corrected entries:

```
/sys/firmware/efi_capsule/capsule_update
/sys/firmware/efi_capsule/capsule_path
```

10 Programming flash on the board using DediProg

You can use a DediProg* SF100 SPI Flash Programmer and the associated flashing software to program your board.

Note: These steps require the `Flash+PlatformData.bin` file that was created in Section 8.

Once the software has been installed and the programmer is connected to the board, **open a new terminal session**, and run the DediProg Engineering application.

Use the following steps to flash the board:

1. Select the memory type if prompted when the application starts.
2. Select the File icon and choose the `*.bin` file you wish to flash.
3. Optionally select the Erase button to erase the contents of the SPI flash.
4. Select `raw` file format.
5. Select the Prog icon to flash the image onto the board.
6. Optionally select the Verify icon to verify that the image flashed correctly.

Note: Intel recommends that you disconnect the programmer before booting the system.

11 Booting the board from SD card

To boot your board from an SD card and enable persistent `rootfs`, follow these steps. You can also use this procedure to boot your board from a USB stick.

If you are using an Intel® Galileo board, this setup allows you to save your sketch to the board, so it will be able to repeat sketches after board power-down. This also enables a persistent `/sketch` folder and `rootfs`.

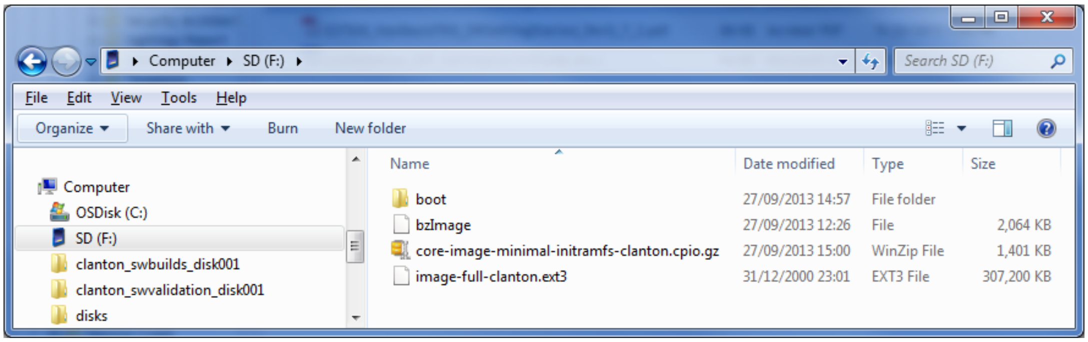
Dependencies:

- You ran the command `bitbake image-full` in Section 5 (or `bitbake image-full-galileo` if using an Intel® Galileo board)
- Your SD card must meet the following requirements:
  - SD card must be formatted as FAT or FAT32.
  - SD card size must be 32GB or smaller.

1. The output of the build process in Section 5 is found in `./tmp/deploy/images/`

   Copy the following kernel and root file system files to an SD card:
   - `boot (directory)`
   - `bzImage`
   - `core-image-minimal-initramfs-clanton.cpio.gz`
   - `image-full-clanton.ext3` or `image-full-galileo-clanton.ext3` for the Intel® Galileo board

   Be sure to set up your SD card with the files and structure shown below.



2. Insert the SD card, then power on the board.

Note: The first time you boot the board may take several minutes. This is expected behavior due to the SSH component creating cryptographic keys on the first boot.

Troubleshooting tips:
To boot from SD/USB, the grub instance embedded in the SPI flash is hardcoded to search for a `boot/grub/grub.conf` file in partition 1 on the SD/USB card. This is compatible with the factory formatting of most SD/USB devices. By default, the UEFI firmware does not try to boot from SD or USB, it is handled by grub.

If you use an SD or USB device that has been reformatted after manufacturing you might experience problems booting from it. First, try to boot with a different memory device and see if the problem goes away. If you isolate the problem to a specific SD card, you can restore the factory formatting using this tool from the SD association: https://www.sdcard.org/downloads/formatter_4/
It is not recommended to use normal operating system tools to format flash memory devices.

12 Signing files (secure SKU only)

This step is optional for most users; it is only needed for booting on a secure SKU.

Dependencies: `libssl-dev`

All files located by grub require signature files for verification. This includes kernel, `grub.conf`, `bzImage`, and `core-image-minimal-initramfs-clanton.cpio.gz`.

The SPI Flash Tools package includes the Asset Signing Toolset, an application used for signing assets for secure boot. Follow the steps below to compile the signing tool, then sign assets. For complete details on the Asset Signing Toolset, including all of the command line options, refer to the *Intel® Quark SoC X1000 Secure Boot Programmer's Reference Manual* (see Appendix A).

Open a new terminal session and use the following commands:

```
# cd spi-flash-tools
# make asset-signing-tool/sign
```

After compiling the signing tool, you can sign assets as shown in the following example:

```
# path/to/spi-flash-tools/asset-signing-tool/sign -i <input file>
-s <svn> -x <svn index> -k <key file>
```

The output for this example is a signed binary file called `<input file>.signed` in the same directory as the `<input file>`.

To create a separate signature file, pass the `-c` command line option which creates `<input file>.csbh` as output in the same directory as the `<input file>`.

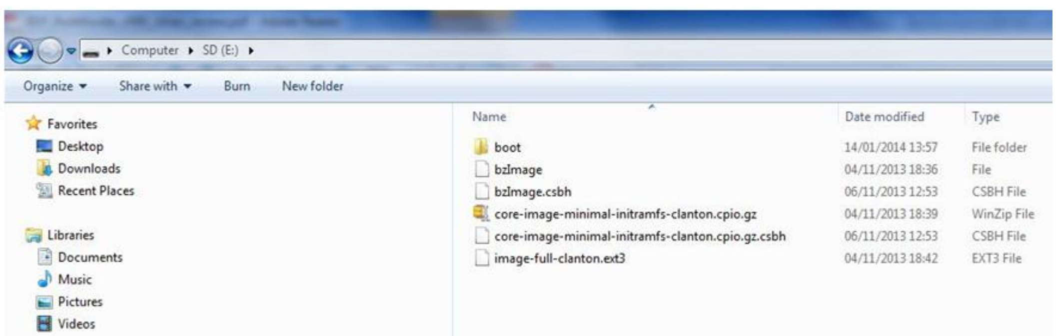
To get a full list of command line options, run the signing tool with no option.

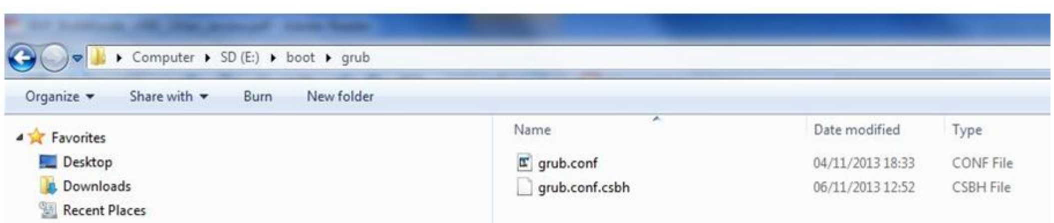
The signature files can be copied onto a USB stick or SD card and must comply with the following requirements:

- Each `.csbh` file must be in the same directory as the corresponding non-signed file.
- `grub.conf` must be located in the `/boot/grub/` directory.
- Other files can be placed anywhere as long as `grub.conf` is configured with their location.

The screenshots below show an example SD card with signature files:

- Copy signature files `core-image-minimal-initramfs-clanton.cpio.gz.csbh` and `bzImage.csbh` to the root directory.
- Copy `grub.cbsh` to the `/boot/grub/` directory.





13 Enabling the OpenOCD debugger

Complete instructions for using the OpenOCD debugger can be found in the *Source Level Debug using OpenOCD/GDB/Eclipse on Intel® Quark SoC X1000 Application Note*, see Appendix A.

Appendix A Related Documents

The documents below provide more information about the software in this release.

Document Name	Number
Intel® Quark SoC X1000 Board Support Package (BSP) Build Guide (this document)	329687
Intel® Quark SoC X1000 Software Release Notes	521235
Intel® Quark SoC X1000 BSP Programmer's Reference Manual	521233
Intel® Quark SoC X1000 Secure Boot Programmer's Reference Manual	521232
Clanton SoC UEFI Firmware Writer's Guide	517434
Clanton SoC UEFI Firmware Specification Update	539371
Source Level Debug using OpenOCD/GDB/Eclipse on Intel® Quark SoC X1000 Application Note https://communities.intel.com/docs/DOC-22203	330015
Intel® Quark SoC X1000 Datasheet https://communities.intel.com/docs/DOC-21828	329676
Intel® Quark SoC X1000 Core Developer's Manual https://communities.intel.com/docs/DOC-21826	329679
Intel® Quark SoC X1000 Core Hardware Reference Manual https://communities.intel.com/docs/DOC-21825	329678

Revision History

Date	Revision	Description
20 January 2014	004	General updates for software release 0.9.0 including: Added Section 3, Building the EDKII Firmware. Added Section 9.2, Programming flash using Linux* run-time system. Updated Section 12, Signing files (secure SKU only). Removed OpenOCD details because patch is now open source. Added Appendix A Related Documents.
15 November 2013	003	Added `CapsuleApp.efi` to Section 2, Downloading software.
07 November 2013	002	General updates for software release 0.8.0 including: Added supported boards to list of hardware. Section 7: Changed SPI Flash tools path from `clanton_peak_EDK2` to `Quark_EDKII` Moved Signing files (secure SKU only) section to later in the document.
15 October 2013	001	First release with software version 0.7.5.