byteWIKI

Release 1.0

Jul 10, 2020

About

Welcome to the

»byteWIKI«

CHAPTER 1

About the company

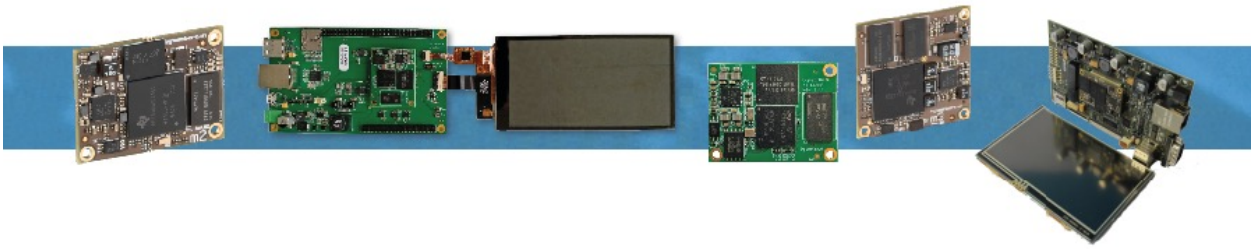
bytes at work is a modern Swiss Technology company specialized in industrial computing. Our focus lies on the development of hardware and embedded software, as well as customizing Linux systems. The entire development life cycle takes place in-house with transparent project management and customer involvement. This significantly reduces both development time and development costs.

We have years of experience in developing coordinated hardware and software solutions – from the prototype to the final product. We make your system usable end-to-end for your needs.

1.1 Our philosophy

Hardware and software for industrial computers have to fulfill an immense range of demanding challenges. They are used in completely different areas of industries and they have to be able to adapt unique and specific tasks. Our employees pay particular attention to each and every customer. That is why our products and services meet and even exceed our customers expectations.

We from bytes at work are aware that the current persistent industrial development also has its darker side. This is our motivation to be exemplary in terms of use of resources. No wonder that unconditional reliability, long service life and low power consumption are main features of all our products.

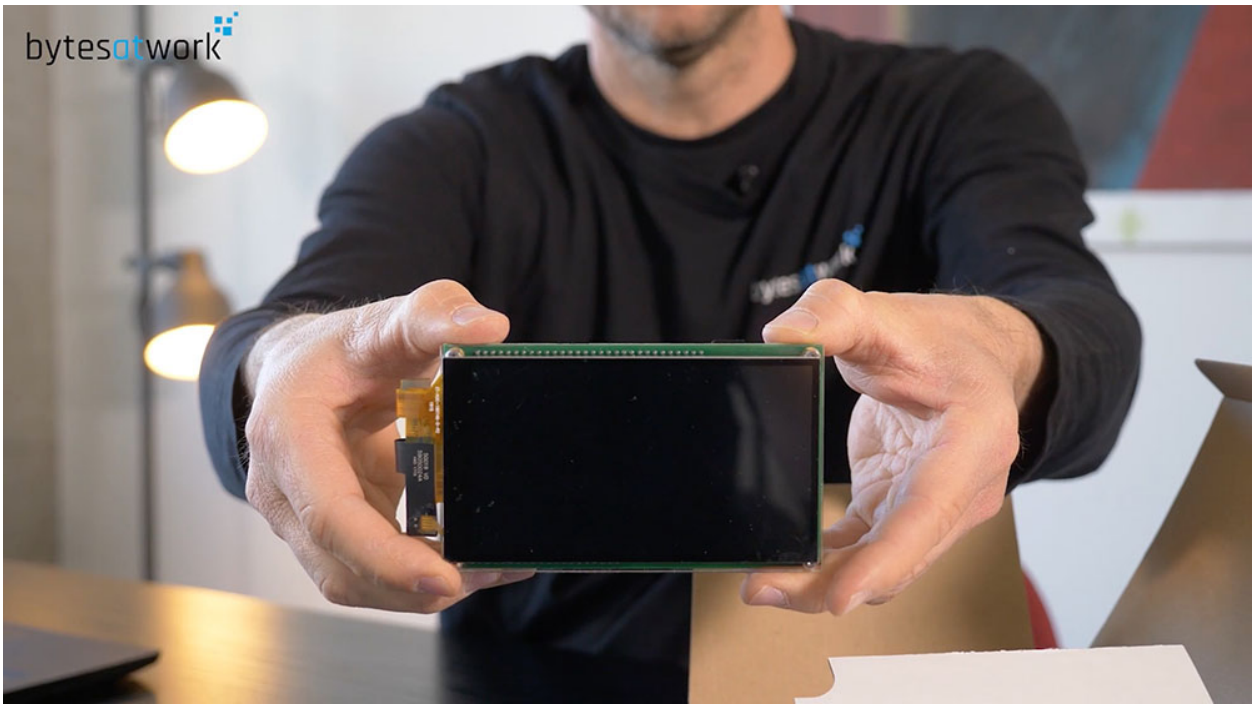


CHAPTER 2

Unboxing byteDEVKIT STM32MP1

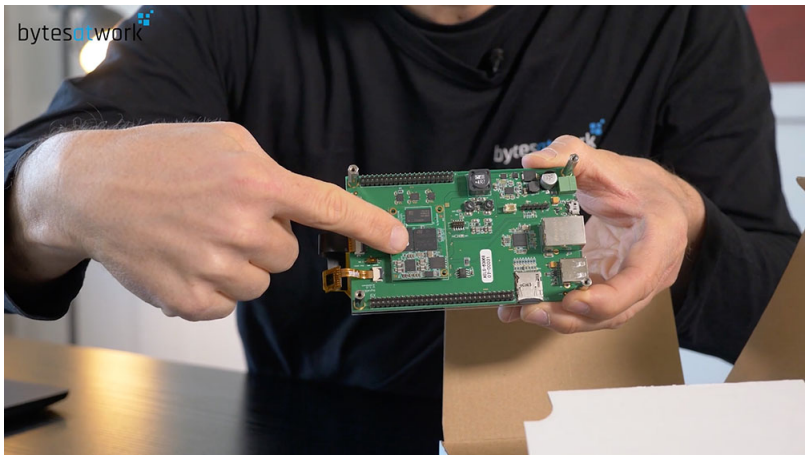
This guide delivers new users a brief overview of the package content and the functions of our byteDEVKIT STM32MP1. When unboxing you should find the following components:

- The byteDEVKIT STM32MP1 with a 5-inch touchscreen display

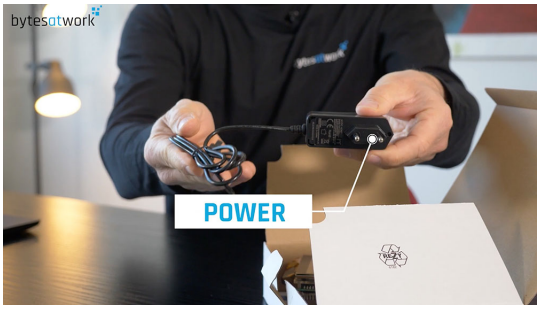


- The SOM STM32MP1x

Note: The SOM STM32MP1x is already connected with the byteDEVKIT STM32MP1.

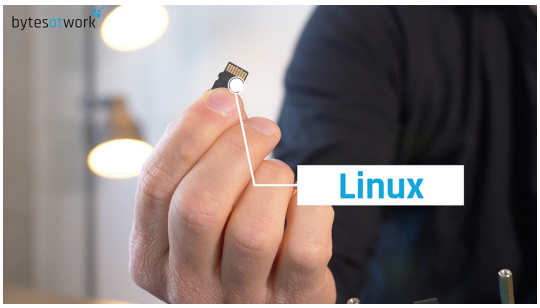


- The power supply for the byteDEVKIT STM32MP1



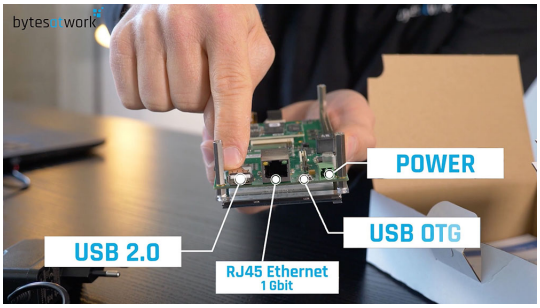
- The USB serial cable for the byteDEVKIT STM32MP1

- micro-SD card with preinstalled Linux

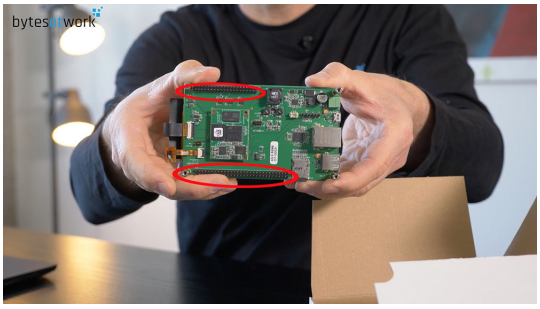


2.1 Technical overview byteDEVKIT STM32MP1

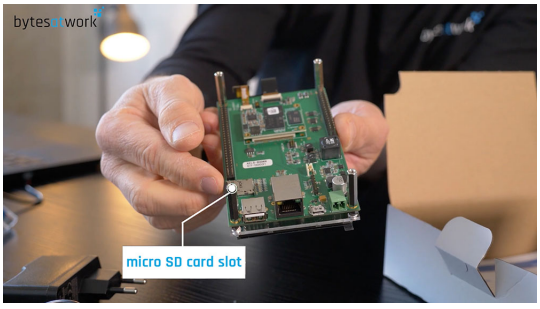
- The byteDEVKIT STM32MP1 offers the following connectors on the front side:
  - USB 2.0
  - RJ45 Ethernet 1 Gbit
  - USB OTG
  - Power connector



- You find the extension on the backside. The byteDEVKIT STM32MP1 offers:
  - 40 pin header compatible for the **rasperry pi**
  - 60 pin header with all the needed signals: **I2C, SPI, CAN, UART, I2S, LDC, GPIO and PWM**



- The micro-SD card slot contains a micro-SD card with preinstalled Linux OS:



Note: The micro-SD card is already slotted to the byteDEVKIT STM32MP1.

2.2 Unboxing Video Tutorial

CHAPTER 3

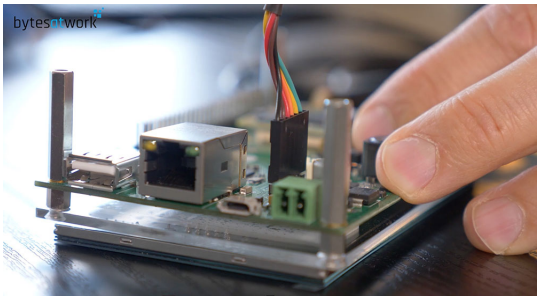
First start byteDEVKIT STM32MP1

This guide helps with the first start of the byteDEVKIT STM32MP1:

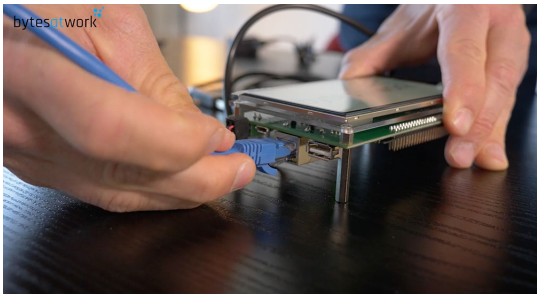
3.1 Connecting the Hardware and first Booting

- Prepare the USB serial cable for connection
- Locate the black cable of the serial connector.

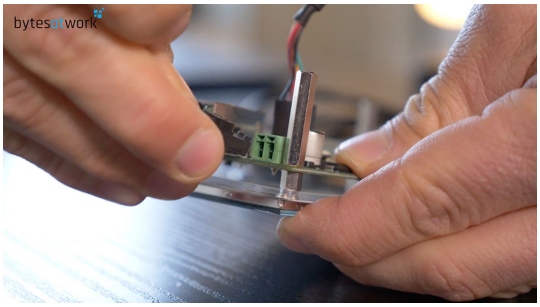
Caution: Connect the serial cable to the byteDEVKIT STM32MP1 as shown. The **black cable** must point towards the USB OTG connector.



- Connect the USB connector with USB port of your computer or laptop.
- Connect the ethernet RJ45 with the byteDEVKIT STM32MP1.

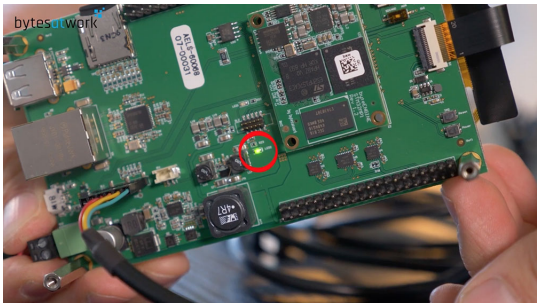


- Plug in the power socket.
- Connect the power supply cable to the power slot of the byteDEVKIT STM32MP1.



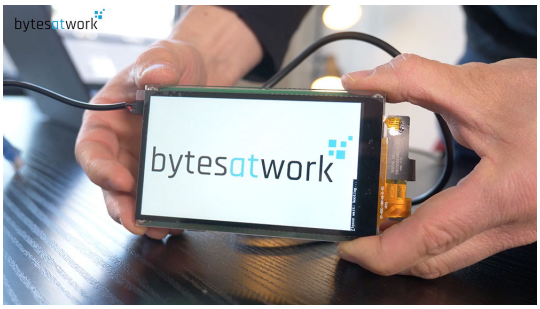
- A green LED on the backside of the byteDEVKIT STM32MP1 indicates the status of the power supply.

Attention: Your byteDEVKIT STM32MP1 is powered up, when the green LED lights up. If the LED doesn´t light up, check the connection of the power socket.



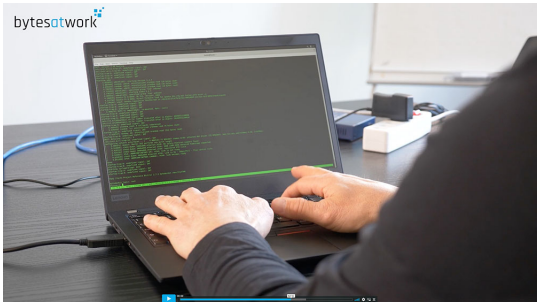
- The 5-inch touchscreen display shows the bytes at work-logo when booting.

Hint: The booting procedure will take a few seconds.



- Now you can access the byteDEVKIT STM32MP1 with your laptop.

Hint: For further information refer to: “Bring-up_byteDEVKIT_STM32MP1”.



CHAPTER 4

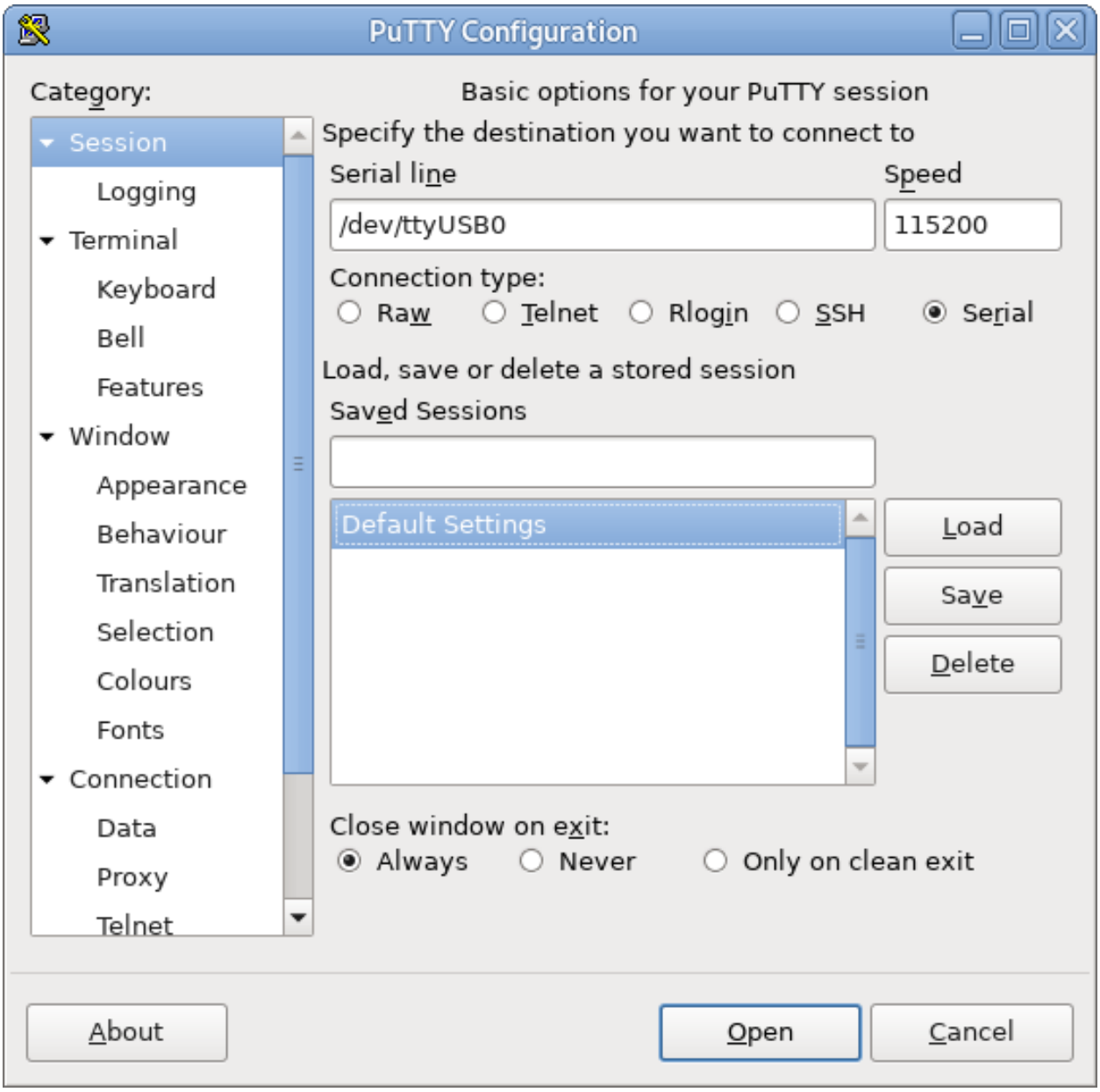
Bring-up byteDEVKIT STM32MP1

4.1 How do I connect to byteDEVKIT using the serial console?

- **Use the serial port to connect the byteDEVKIT STM32MP1:**
  - Connect the debug cable with the byteDEVKIT STM32MP1 and your computer/laptop
  - Start a serial communication program on your computer/laptop (‹putty›, ‹minicom› or something else)
  - Set to 115200, 8N1, no flow control
  - login with: **user: “root”** and **password: “rootme”**

4.1.1 LINUX

- Start PuTTY

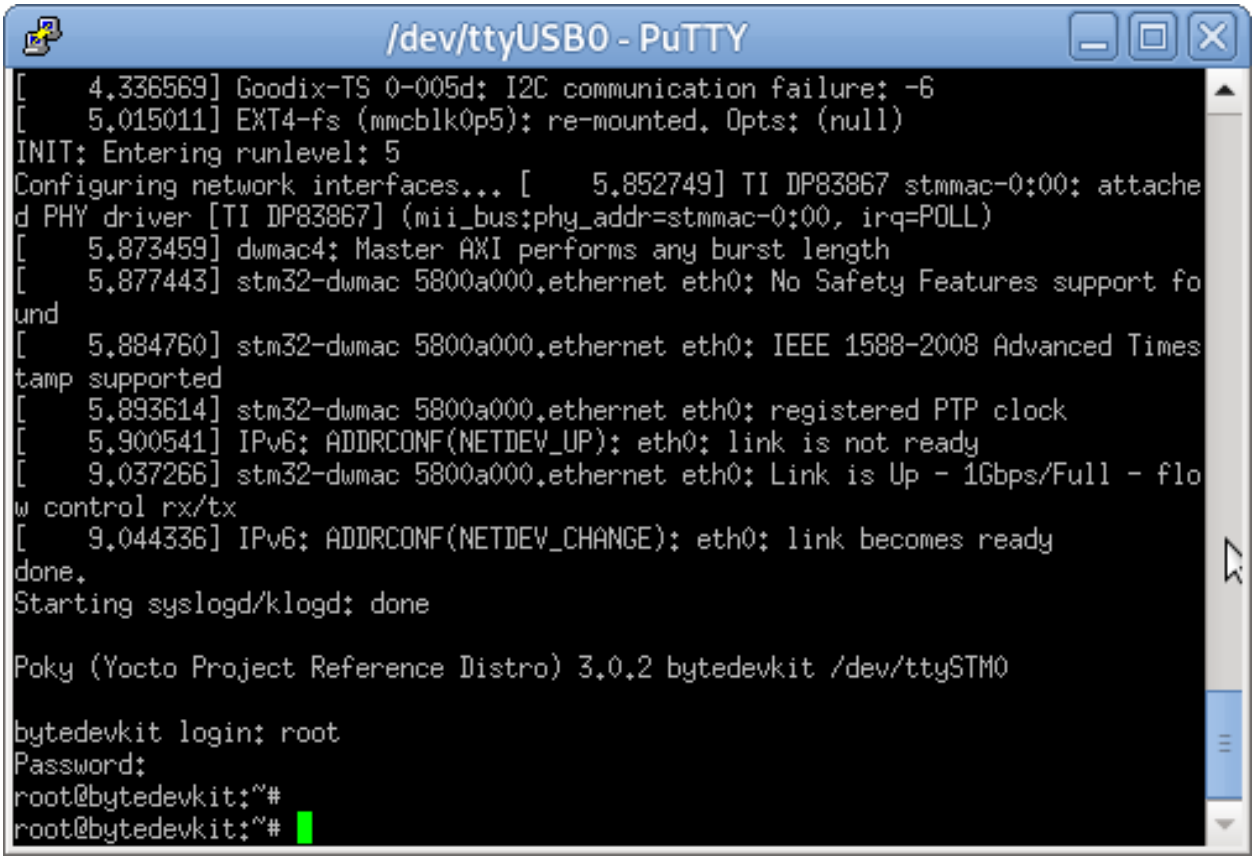


- Click “Serial”
- Change “Serial line” to “/dev/ttyUSB0”
- Change “Speed” to 115200
- Navigate to “Serial” in the menu “Connection”

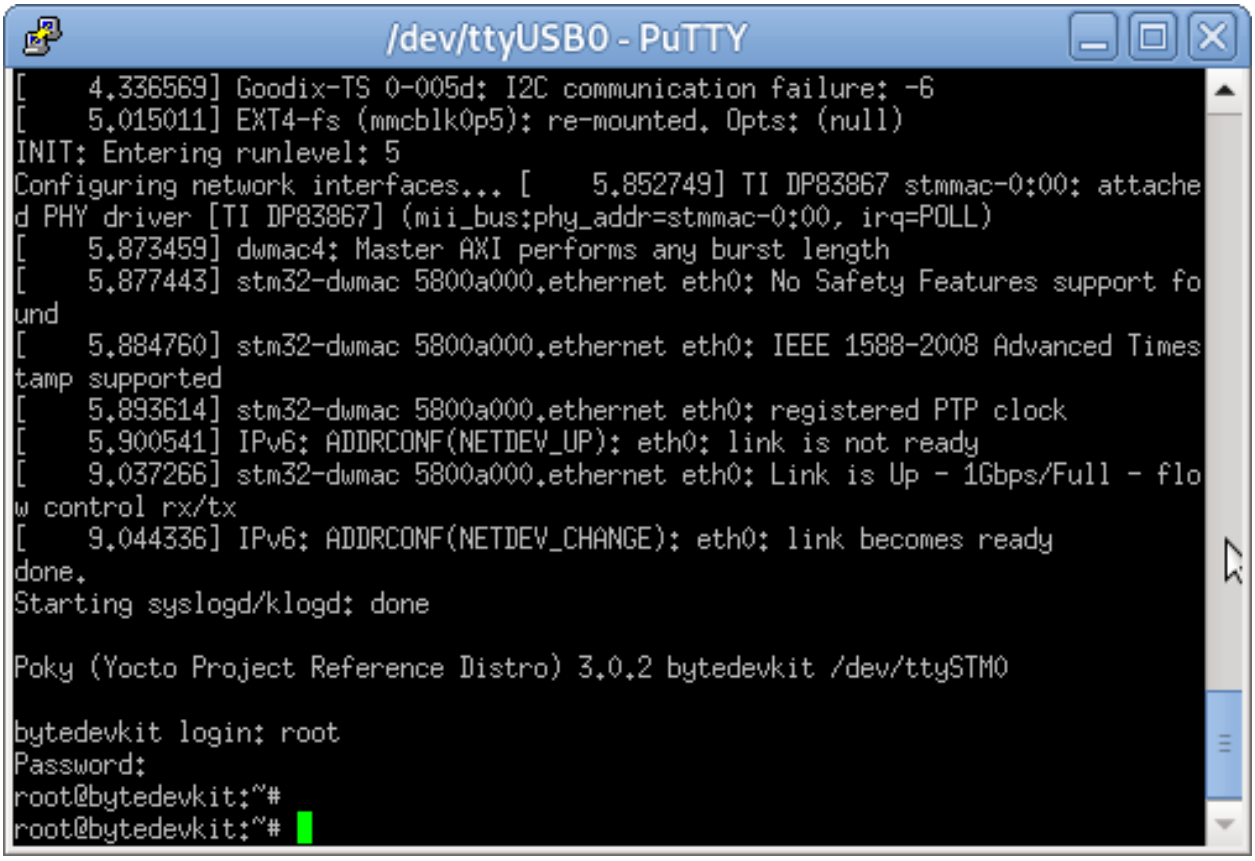
Hint: make sure you have Data bits set to 8, Stop bits set to 1, Parity to None, Flow control to None

- Click “Open”

- Power up the byteDEVKIT STM32MP1



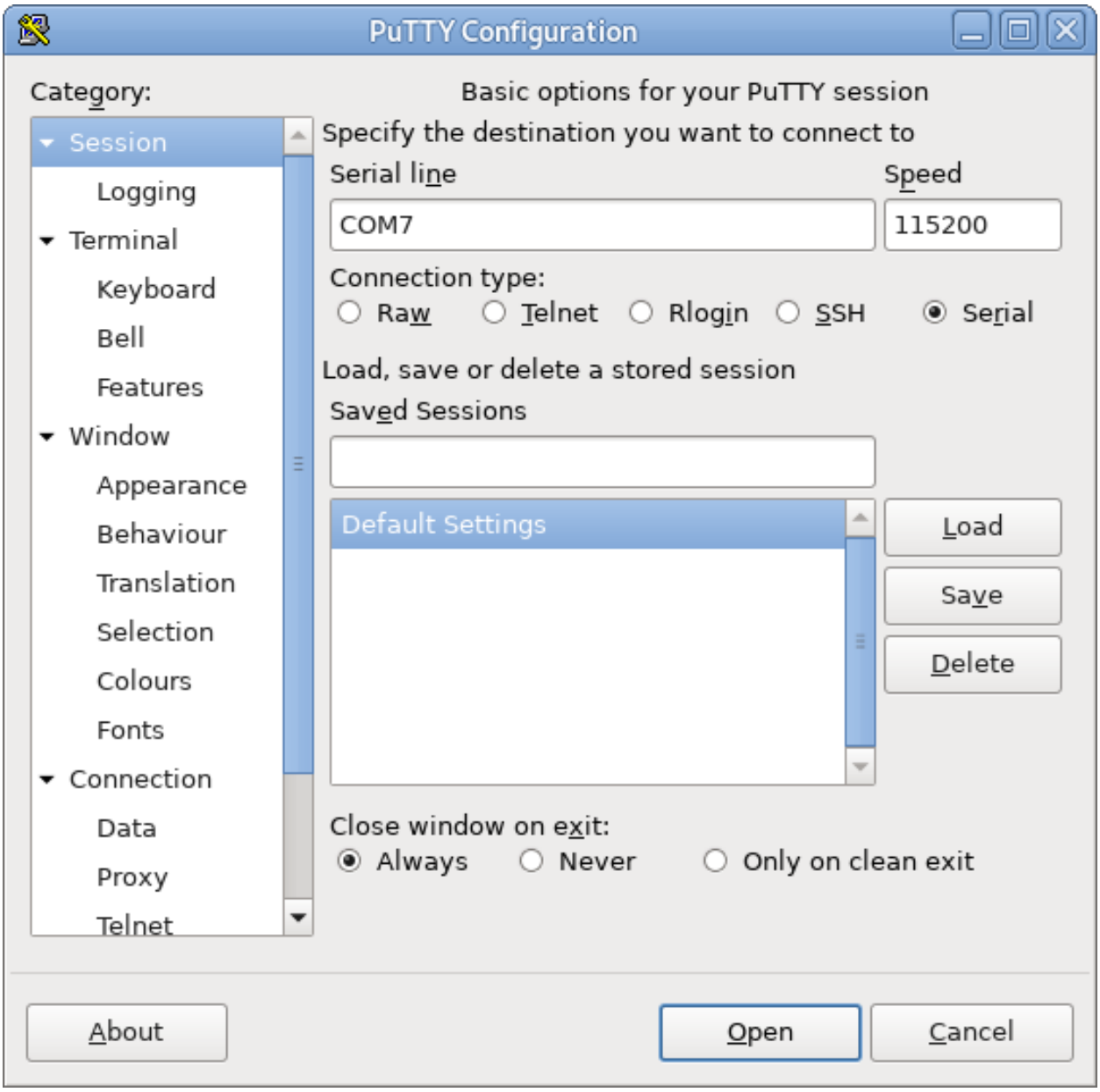
- Once the login prompt appears, login with user “root” and password “rootme”



Note: You are now succesfully connected to the byteDEVKIT STM32MP1

4.1.2 WINDOWS

- Connect the USB serial adapter to the computer
- Windows installs the driver automatically (if the windows doesn´t install the driver reconnect the serial adapter cable)
- Open device manager and navigate to “Ports (COM & LPT)”
- The serial adapter shows up in the device tree: “Prolific USB-to-Serial Comm Port (COM7)”
- “COM7” is your serial port
- Install a serial terminal application, e.g. PuTTY (version 0.59 and newer) *https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html*
- Start PuTTY

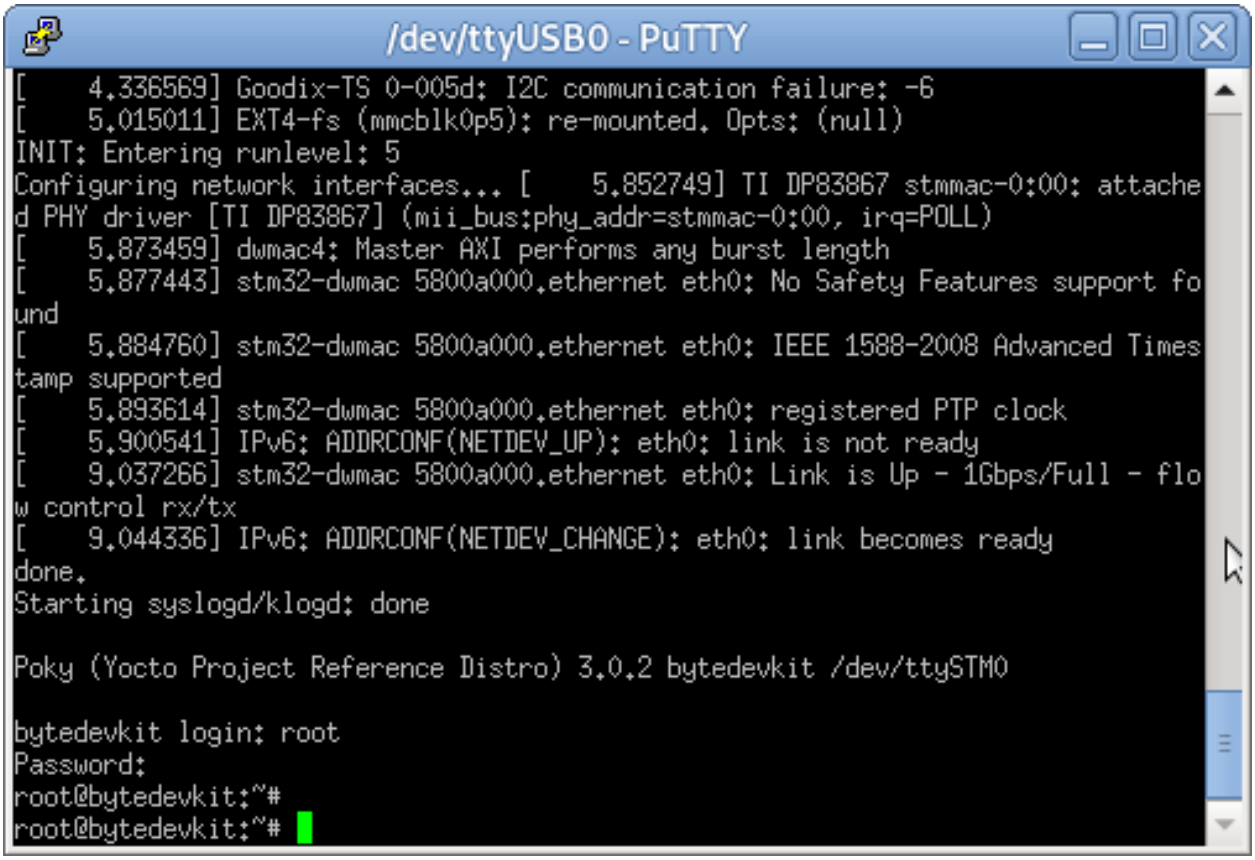


- Click “Serial”
- Change “Serial line” to serial port you found in device manager
- Change “Speed” to 115200
- Navigate to “Serial” in the menu “Connection”

Hint: make sure you have Data bits set to 8, Stop bits set to 1, Parity to None, Flow control to None

- Click “Open”

Power up the byteDEVKIT STM32MP1



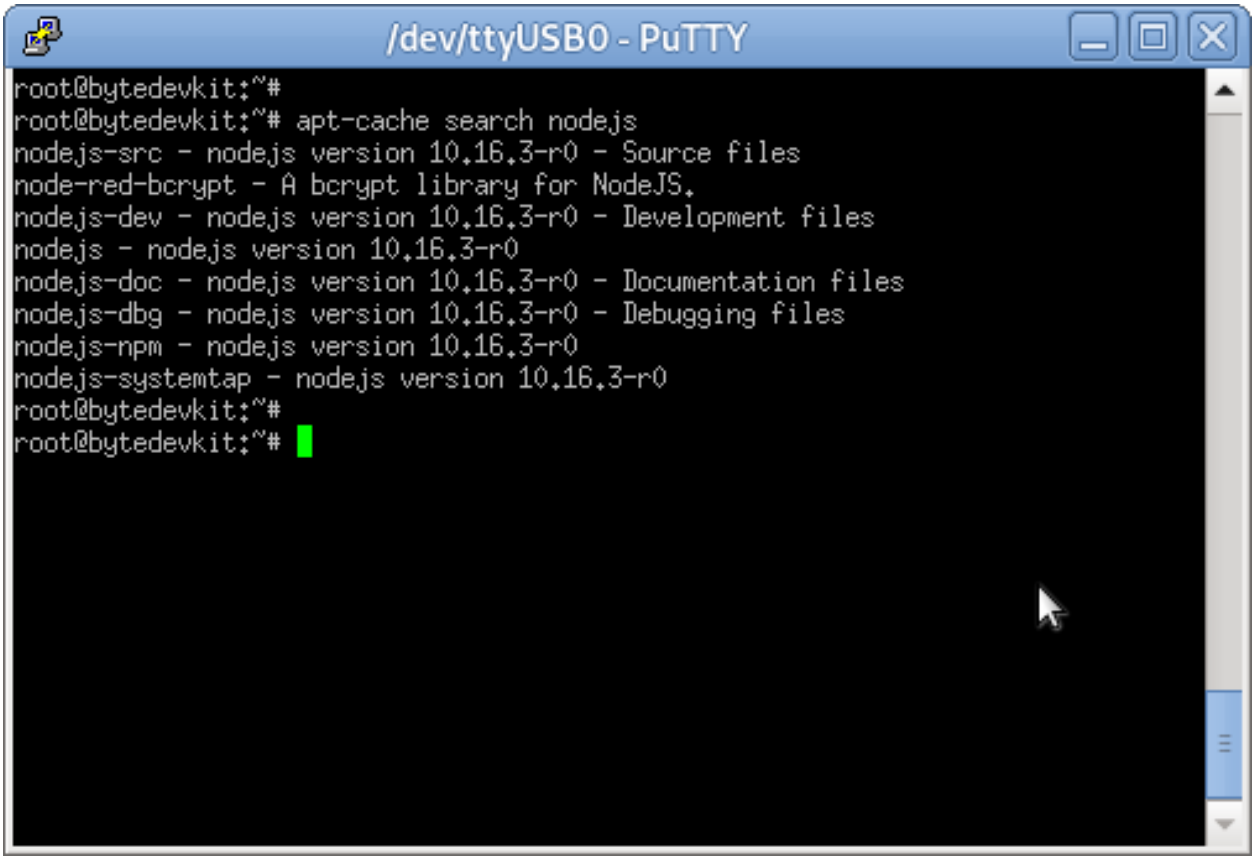
Once the login prompt appears, login with user “root” and password “rootme”

Note: You are now succesfully connected to the byteDEVKIT STM32MP1

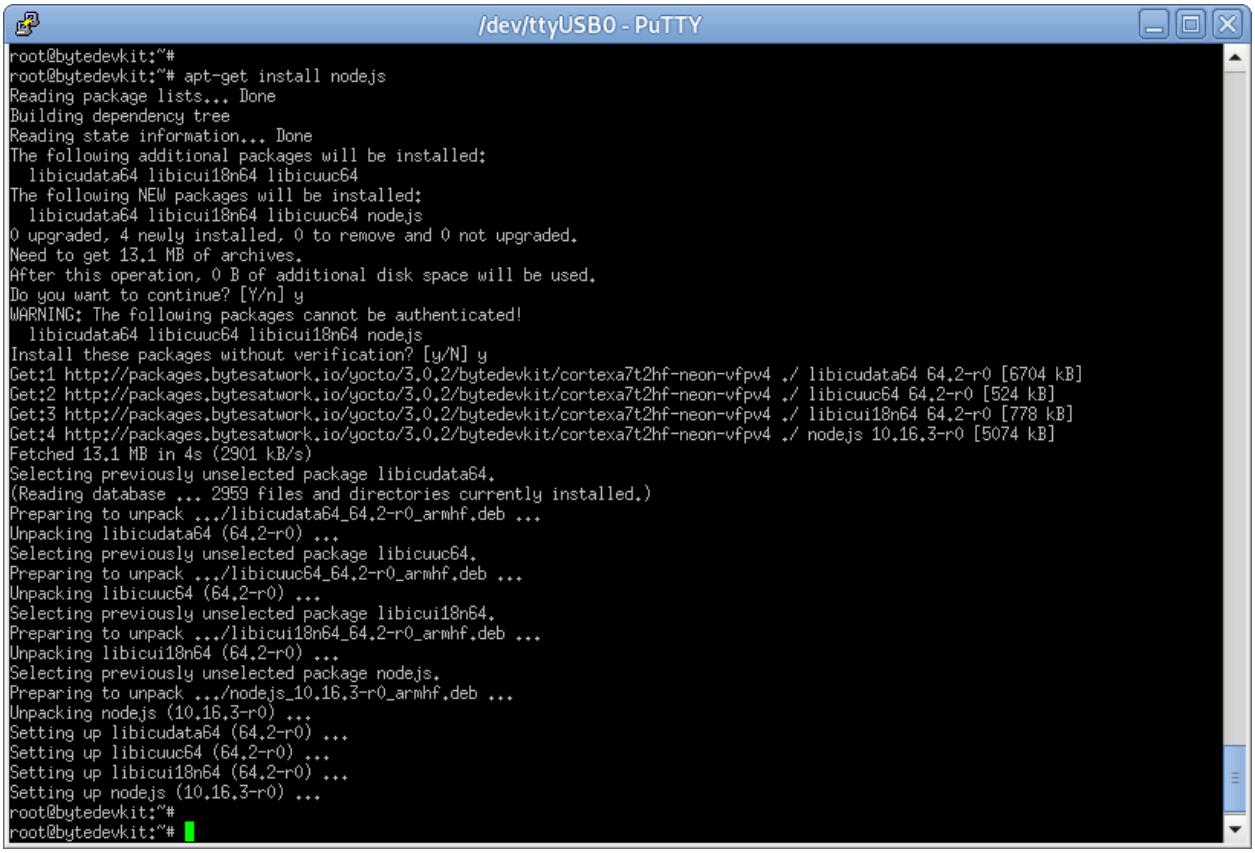
4.2 How to install additional software using apt

Hint: Follow the link for additional information about "apt": https://help.ubuntu.com/community/AptGet/Howto

1. Connect the embedded device's ethernet to your LAN
2. Run: *apt-get update*
3. Run: *apt-cache search <software component>* to search for available packages e.g.: *apt-cache search nodejs*



5. Run: *apt-get install <software component>* to install additional software e.g.: *apt-get install nodejs*


/dev/ttyUSB0 - PuTTY
root@bytedevkit:~#
root@bytedevkit:~# apt-get install nodejs
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
libicudata64 libicui18n64 libicuuc64
The following NEW packages will be installed:
libicudata64 libicui18n64 libicuuc64 nodejs
0 upgraded, 4 newly installed, 0 to remove and 0 not upgraded.
Need to get 13.1 MB of archives.
After this operation, 0 B of additional disk space will be used.
Do you want to continue? [Y/n] y
WARNING: The following packages cannot be authenticated!
libicudata64 libicuuc64 libicui18n64 nodejs
Install these packages without verification? [y/N] y
Get:1 http://packages.bytesatwork.io/yocto/3.0.2/bytedevkit/cortexa7t2hf-neon-vfpv4 ./ libicudata64 64.2-r0 [6704 kB]
Get:2 http://packages.bytesatwork.io/yocto/3.0.2/bytedevkit/cortexa7t2hf-neon-vfpv4 ./ libicuuc64 64.2-r0 [524 kB]
Get:3 http://packages.bytesatwork.io/yocto/3.0.2/bytedevkit/cortexa7t2hf-neon-vfpv4 ./ libicui18n64 64.2-r0 [778 kB]
Get:4 http://packages.bytesatwork.io/yocto/3.0.2/bytedevkit/cortexa7t2hf-neon-vfpv4 ./ nodejs 10.16.3-r0 [5074 kB]
Fetched 13.1 MB in 4s (2901 kB/s)
Selecting previously unselected package libicudata64.
(Reading database ... 2959 files and directories currently installed.)
Preparing to unpack .../libicudata64_64.2-r0_armhf.deb ...
Unpacking libicudata64 (64.2-r0) ...
Selecting previously unselected package libicuuc64.
Preparing to unpack .../libicuuc64_64.2-r0_armhf.deb ...
Unpacking libicuuc64 (64.2-r0) ...
Selecting previously unselected package libicui18n64.
Preparing to unpack .../libicui18n64_64.2-r0_armhf.deb ...
Unpacking libicui18n64 (64.2-r0) ...
Selecting previously unselected package nodejs.
Preparing to unpack .../nodejs_10.16.3-r0_armhf.deb ...
Unpacking nodejs (10.16.3-r0) ...
Setting up libicudata64 (64.2-r0) ...
Setting up libicuuc64 (64.2-r0) ...
Setting up libicui18n64 (64.2-r0) ...
Setting up nodejs (10.16.3-r0) ...
root@bytedevkit:~#
root@bytedevkit:~#

CHAPTER 5

Software Development

The entire development life cycle is done in-house with transparent project management and customer involvement. We have proven experience in a wide range of industries, including industrial automation and custom solutions for consumer electronics. This section helps you step by step initiating the software development process:

5.1 Image

5.1.1 Where do you get the SD card image?

Device	Yocto Version	Download	Checksum
byteDE-VKIT	Yocto 3.0	bytesatwork-minimal-image-bytedevkit.wic.gz (wic.bmap)	4ce5b056a78a0bfecae46ad6777a8b7bcfa0e5a679d4f536549
byteDE-VKIT	Yocto 2.7	flashlayout_bytesatwork-minimal-image_FlashLayout_sdcard_stm32mp157c-bytedevkit.raw.gz	7e62644473c21d200603b52d0080894a0ccfd950dd4a2f3c7c
bytePANEL	Yocto 3.0	bytesatwork-minimal-image-bytepanel-emmc.wic.gz (wic.bmap)	e3e166f28fb815b09c6372bbcae4b4c8fcd00f93e57e96084bc
bytePANEL	Yocto 2.7	devbase-image-bytesatwork-bytepanel-emmc-20190729194430.sdimg.gz	3b3e51d83c68f68d6ebbc2983d6b41b9e21d4878c1c957080

5.1.2 How do you flash the image?

Attention:

- You need a microSD card with **at least 8GB** capacity.
- **All existing data** on the microSD card will be lost.
- **Do not format** the microSD card before flashing.

byteDEVKIT

- **Yocto 3.0**

  Windows

  1. Unzip the file `bytesatwork-minimal-image-bytedevkit.wic.gz` (e.g. with 7-zip)
  2. Write the resulting file to the microSD card with a tool like Roadkils Disk Image

  Linux

```
gunzip -c bytesatwork-minimal-image-bytedevkit.wic.gz | dd of=/dev/mmcblk<X>␣
↪bs=8M conv=fdatasync status=progress
```

Hint: To improve write performance, you could use bmap-tools under Linux:

```
bmaptool copy bytesatwork-minimal-image-bytedevkit.wic.gz /dev/mmcblk<X>
```

- **Yocto 2.7**

  Windows

  1. Unzip the file `flashlayout_bytesatwork-minimal-image_FlashLayout_sdcard_stm32mp157c-byte` `raw.gz` (e.g. with 7-zip)
  2. Write the resulting file to the microSD card with a tool like Roadkils Disk Image

  Linux

```
gunzip -c flashlayout_bytesatwork-minimal-image_FlashLayout_sdcard_stm32mp157c-
↪bytedevkit.raw.gz | dd of=/dev/mmcblk<X> bs=8M conv=fdatasync status=progress
```

bytePANEL

- **Yocto 3.0**

  Windows

  1. Unzip the file `bytesatwork-minimal-image-bytepanel-emmc.wic.gz` (e.g. with 7-zip)
  2. Write the resulting file to the microSD card with a tool like Roadkils Disk Image

  Linux

```
gunzip -c bytesatwork-minimal-image-bytepanel-emmc.wic.gz | dd of=/dev/mmcblk<X>␣
↪bs=8M conv=fdatasync status=progress
```

Hint: To improve write performance, you could use bmap-tools under Linux:

bmaptool copy bytesatwork-minimal-image-bytepanel-emmc.wic.gz /dev/mmcblk<X>

- **Yocto 2.7**

  Windows

  1. Unzip the file `devbase-image-bytesatwork-bytepanel-emmc-20190729194430.sdimg.gz` (e.g. with 7-zip)
  2. Write the resulting file to the microSD card with a tool like Roadkils Disk Image

  Linux

```
gunzip -c devbase-image-bytesatwork-bytepanel-emmc-20190729194430.sdimg.gz | dd
↪of=/dev/mmcblk<X> bs=8M conv=fdatasync status=progress
```

5.1.3 How do you build an image?

byteDEVKIT

- **Yocto 3.0**

  Use `repo` to download all necessary repositories:

```
$ mkdir -p ~/workdir/bytedevkit/3.0; cd ~/workdir/bytedevkit/3.0
$ repo init -u https://github.com/bytesatwork/bsp-platform-st.git -b zeus
$ repo sync
```

  If those commands are completed successfully, the following command will set up a Yocto Project environment for byteDEVKIT:

```
$ cd ~/workdir/bytedevkit/3.0
$ MACHINE=bytedevkit DISTRO=poky-bytesatwork EULA=1 . setup-environment build
```

  The final command builds the development image:

```
$ cd $BUILDDIR
$ bitbake bytesatwork-minimal-image
```

  The output is found in:

```
~/workdir/bytedevkit/3.0/build/tmp/deploy/images/bytedevkit
```

Hint: For additional information about yocto images and how to build them, please visit: https://www.yoctoproject.org/docs/3.0/mega-manual/mega-manual.html#brief-building-your-image

- **Yocto 2.7**

  Use `repo` to download all necessary repositories:

```
$ mkdir -p ~/workdir/bytedevkit/2.7; cd ~/workdir/bytedevkit/2.7
$ repo init -u https://github.com/bytesatwork/bsp-platform-st.git -b warrior
$ repo sync
```

If those commands are completed successfully, the following command will set up a Yocto Project environment for byteDEVKIT:

```
$ cd ~/workdir/bytedevkit/2.7
$ MACHINE=bytedevkit DISTRO=poky-bytesatwork EULA=1 . setup-environment build
```

The final command builds the development image:

```
$ cd $BUILDDIR
$ bitbake devbase-image-bytesatwork
```

The output is found in:

```
~/workdir/bytedevkit/2.7/build/tmp/deploy/images/bytedevkit
```

bytePANEL

- **Yocto 3.0**

  Use `repo` to download all necessary repositories:

```
$ mkdir -p ~/workdir/bytepanel/3.0; cd ~/workdir/bytepanel/3.0
$ repo init -u https://github.com/bytesatwork/bsp-platform-ti.git -b zeus
$ repo sync
```

  If those commands are completed successfully, the following command will set up a Yocto Project environment for bytePANEL:

```
$ cd ~/workdir/bytepanel/3.0
$ MACHINE=bytepanel DISTRO=poky-bytesatwork EULA=1 . setup-environment build
```

  The final command builds the development image:

```
$ cd $BUILDDIR
$ bitbake bytesatwork-minimal-image
```

  The output is found in:

```
~/workdir/bytepanel/3.0/build/tmp/deploy/images/bytepanel
```

Hint: For additional information about yocto images and how to build them, please visit: https://www.yoctoproject.org/docs/3.0/mega-manual/mega-manual.html#brief-building-your-image

- **Yocto 2.7**

  Use `repo` to download all necessary repositories:

```
$ mkdir -p ~/workdir/bytepanel/2.7; cd ~/workdir/bytepanel/2.7
$ repo init -u https://github.com/bytesatwork/bsp-platform.git -b warrior
$ repo sync
```

If those commands are completed successfully, the following command will set up a Yocto Project environment for bytePANEL:

```
$ cd ~/workdir/bytepanel/2.7
$ MACHINE=bytepanel DISTRO=poky-bytesatwork EULA=1 . setup-environment build
```

The final command builds the development image:

```
$ cd $BUILDDIR
$ bitbake devbase-image-bytesatwork
```

The output is found in:

```
~/workdir/bytepanel/2.7/build/tmp/deploy/images/bytepanel
```

How to modify the image

The image recipes can be found in `~/workdir/<machine name>/<yocto version>/sources/meta-bytesatwork/recipes-core/images`

This is relative to where you started the `repo` command to fetch all the sources.

Edit the minimal-image recipe `bytesatwork-minimal-image.bb`

Add the desired software-package to `IMAGE_INSTALL` variable, for example add `net-tools` to `bytesatwork-minimal-image.bb`

Rebuild the image by:

```
$ cd ~/workdir/<machine name>/<yocto version>
$ MACHINE=<machine name> DISTRO=poky-bytesatwork EULA=1 . setup-environment␣
↪build
$ bitbake bytesatwork-minimal-image
```

How to rename the image

If you want to rename or copy an image, simply rename or copy the image recipe by:

```
$ cd ~/workdir/<machine name>/<yocto version>/build/tmp/deploy/images/
↪<machine name>
$ cp bytesatwork-minimal-image.bb customer-example-image.bb
```

Troubleshooting

- **Image size is to small**

  If you encounter that your image size is to small to install additional software, please have a look at the `IMAGE_ROOTFS_SIZE` variable under `~/workdir/<machine-name>/<yocto version>/sources/meta-bytesatwork/recipes-core/images/bytesatwork-minimal-image.bb`. Increase the size if necessary.

5.2 Toolchain

5.2.1 Where do you get the toolchain?

Device	Yocto Version	Download	Checksum
byteDE-VKIT	Yocto 3.0	poky-bytesatwork-glibc-x86_64-bytesatwork-minimal-image-cortexa7t2hf-neon-vfpv4-bytedevkit-toolchain-3.0.2.sh	50ac1ed18dcbbf8ff37854f6752af52e1e01aed1a26815f4
byteDE-VKIT	Yocto 2.7	poky-bytesatwork-glibc-x86_64-devbase-image-bytesatwork-cortexa7t2hf-neon-vfpv4-bytedevkit-toolchain-2.7.1.sh	61896873ac7c75ac711a0b8e439ded6721d1a794deec26
bytePANEL	Yocto 3.0	poky-bytesatwork-glibc-x86_64-bytesatwork-minimal-image-armv7at2hf-neon-bytepanel-emmc-toolchain-3.0.2.sh	a90763d7ff408e9e5f0556b051eccd3ea85c43406099c9a
bytePANEL	Yocto 2.7	poky-bytesatwork-glibc-x86_64-devbase-image-bytesatwork-armv7at2hf-neon-bytepanel-toolchain-2.7.3.sh	b25e4a3f764eaf583ad0e6a3e0edcac9a1a9314ab6d1f4aa

5.2.2 How do you install the toolchain?

Simply download the toolchain and execute the downloaded file, which is a self-extracting shell script.

Hint: If you encounter problems when trying to install the toolchain, make sure the downloaded toolchain is executable. Run `chmod +x /<path>/<toolchain-file>.sh` to make it executable.

Important:

The following tools need to be installed on your development system:

- `xz` (Debian package: `xz-utils`)
- `python` (any version)
- `gcc`

5.2.3 How do you use the toolchain?

byteENGINE STM32MP1x

Source the installed toolchain:

```
source /opt/poky-bytesatwork/3.0.2/environment-setup-cortexa7t2hf-neon-vfpv4-poky-
↪linux-gnueabi
```

Check if Cross-compiler is available in environment:

```
echo $CC
```

You should see the following output:

```
arm-poky-linux-gnueabi-gcc -mthumb -mfpu=neon-vfpv4 -mfloat-abi=hard -mcpu=cortex-a7 -
↪fstack-protector-strong -D_FORTIFY_SOURCE=2 -Wformat -Wformat-security -
↪Werror=format-security --sysroot=/opt/poky-bytesatwork/3.0.2/sysroots/cortexa7t2hf-
↪neon-vfpv4-poky-linux-gnueabi
```

Crosscompile the source code, e.g. by:

```
$CC helloworld.c -o helloworld
```

Check generated binary:

```
file helloworld
```

The output that is shown in prompt afterwards:

```
helloworld: ELF 32-bit LSB pie executable, ARM, EABI5 version 1
```

byteENGINE AM335x

Source the installed toolchain:

```
source /opt/poky-bytesatwork/3.0.2/environment-setup-armv7at2hf-neon-poky-linux-
↪gnueabi
```

Check if Cross-compiler is available in environment:

```
echo $CC
```

You should see the following output:

```
arm-poky-linux-gnueabi-gcc -march=armv7-a -mthumb -mfpu=neon -mfloat-abi=hard --
↪sysroot=/opt/poky-bytesatwork/3.0.2/sysroots/armv7at2hf-neon-poky-linux-gnueabi
```

Cross-compile the source code, e.g. by:

```
$CC helloworld.c -o helloworld
```

Check generated binary:

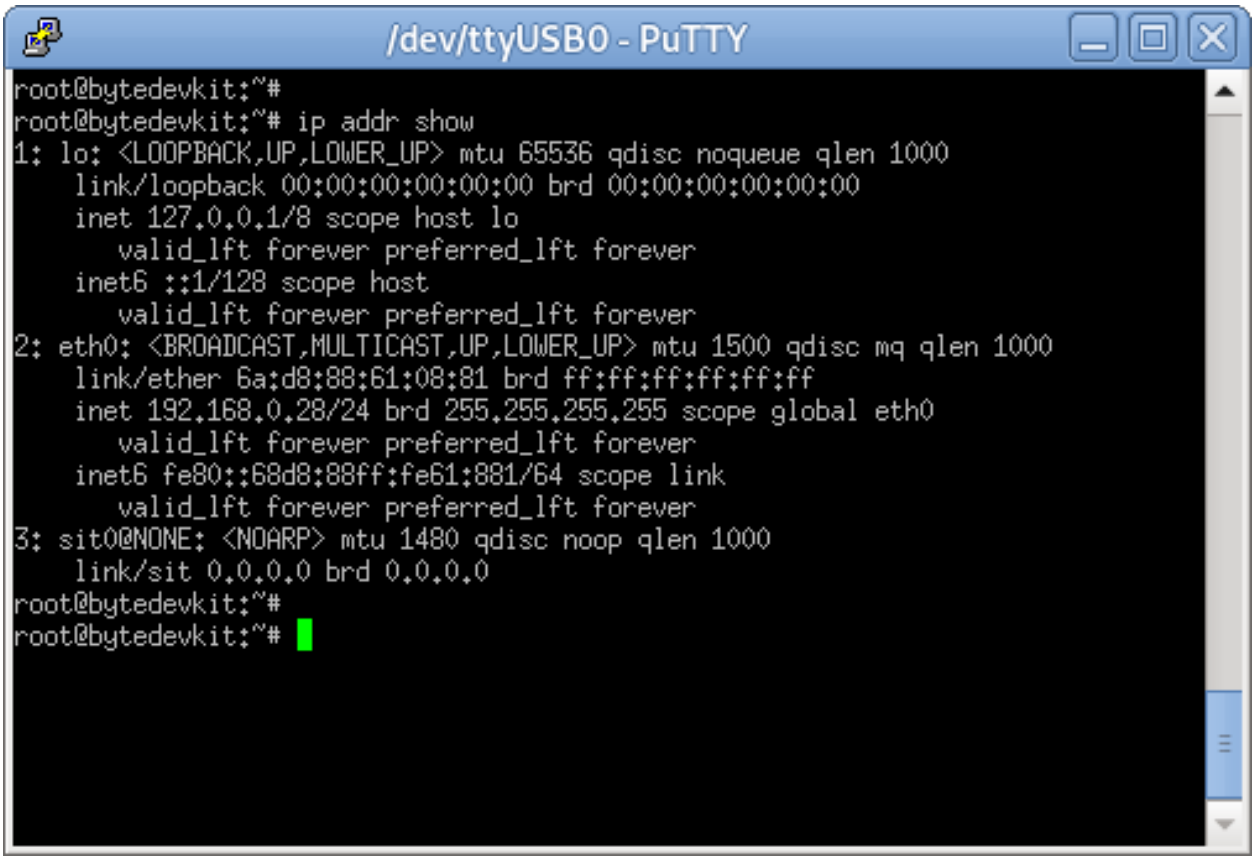
```
file helloworld
```

The output that is shown in prompt afterwards:

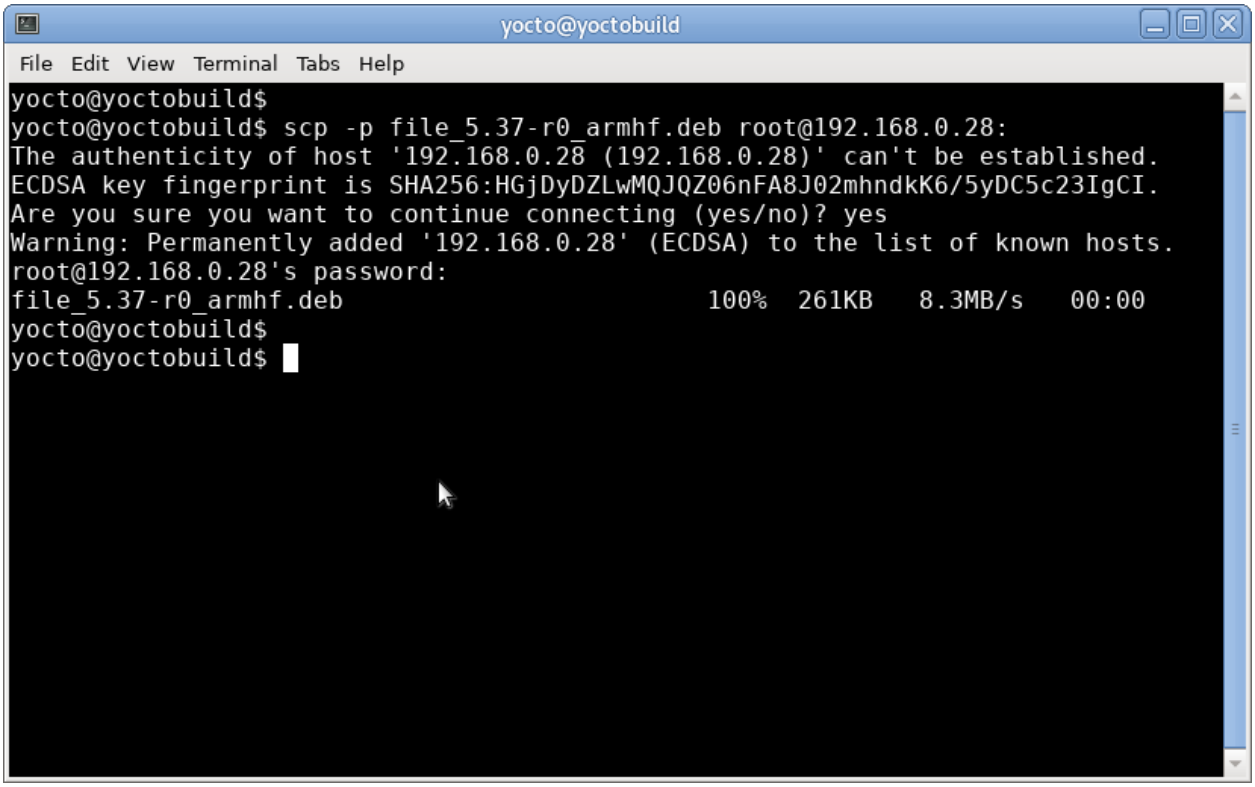
```
helloworld: ELF 32-bit LSB pie executable, ARM, EABI5 version 1
```

5.2.4 How to bring your binary to the target?

1. Connect the embedded device's ethernet to your LAN
2. Determine the embedded target IP address by `ip addr show`



3. Copy your binary, e.g. `helloworld` to the target by `scp helloworld root@<ip address of target>:/tmp`



4. Run `chmod +x` on the target to make your binary executable: `chmod +x /<path>/<binary name>`
5. Run your binary on the target: `/<path>/<binary name>`

5.2.5 How do you build a toolchain?

byteDEVKIT

- **Yocto 3.0**

```
$ cd ~/workdir/bytedevkit/3.0
$ repo init -u https://github.com/bytesatwork/bsp-platform-st.git -b zeus
$ repo sync
```

If those commands are completed successfully, the following command will set up a Yocto Project environment for byteDEVKIT:

```
$ cd ~/workdir/bytedevkit/3.0
$ MACHINE=bytedevkit DISTRO=poky-bytesatwork EULA=1 . setup-environment build
```

The final command builds an installable toolchain:

```
$ cd $BUILDDIR
$ bitbake bytesatwork-minimal-image -c populate_sdk
```

The toolchain is located under:

```
~/workdir/bytedevkit/3.0/build/tmp/deploy/sdk
```

- **Yocto 2.7**

```
$ cd ~/workdir/bytedevkit/2.7
$ repo init -u https://github.com/bytesatwork/bsp-platform-st.git -b warrior
$ repo sync
```

If those commands are completed successfully, the following command will set up a Yocto Project environment for byteDEVKIT:

```
$ ~/workdir/bytedevkit/2.7
$ MACHINE=bytedevkit DISTRO=poky-bytesatwork EULA=1 . setup-environment build
```

The final command builds an installable toolchain:

```
$ cd $BUILDDIR
$ bitbake devbase-image-bytesatwork -c populate_sdk
```

The toolchain is located under:

```
~/workdir/bytedevkit/2.7/build/tmp/deploy/sdk
```

bytePANEL

- **Yocto 3.0**

```
$ cd ~/workdir/bytepanel/3.0
$ repo init -u https://github.com/bytesatwork/bsp-platform-ti.git -b zeus
$ repo sync
```

If those commands are completed successfully, the following command will set up a Yocto Project environment for bytePANEL:

```
$ cd ~/workdir/bytepanel/3.0
$ MACHINE=bytepanel DISTRO=poky-bytesatwork EULA=1 . setup-environment build
```

The final command builds an installable toolchain:

```
$ cd $BUILDDIR
$ bitbake bytesatwork-minimal-image -c populate_sdk
```

The toolchain is located under:

```
~/workdir/bytepanel/3.0/build/tmp/deploy/sdk
```

- **Yocto 2.7**

```
$ cd ~/workdir/bytepanel/2.7
$ repo init -u https://github.com/bytesatwork/bsp-platform.git -b warrior
$ repo sync
```

If those commands are completed successfully, the following command will set up a Yocto Project environment for bytePANEL:

```
$ cd ~/workdir/bytepanel/2.7
$ MACHINE=bytepanel DISTRO=poky-bytesatwork EULA=1 . setup-environment build
```

The final command builds an installable toolchain:

```
$ cd $BUILDDIR
$ bitbake devbase-image-bytesatwork -c populate_sdk
```

The toolchain is located under:

```
~/workdir/bytepanel/2.7/build/tmp/deploy/sdk
```

How to modify your toolchain

Currently the bytesatwork toolchain is generated out of the bytesatwork-minimal-image recipe. If you want to add additional libraries and development headers to customize the toolchain, you need to modify the bytesatwork-minimal-image recipe. It can be found under `~/workdir/<machine name>/<yocto version>/sources/meta-bytesatwork/recipes-core/images`

For example if you want to develop your own ftp client and you need libftp and the corresponding header files, edit the recipe `bytesatwork-minimal-image.bb` and add `ftplib` to the `IMAGE_INSTALL` variable.

This will provide the ftplib libraries and development headers in the toolchain. After adding additional software components, the toolchain needs to be rebuilt by:

```
$ cd ~/workdir/<machine name>/<yocto version>
$ MACHINE=<machine> DISTRO=poky-bytesatwork EULA=1 . setup-environment build
$ bitbake bytesatwork-minimal-image -c populate_sdk
```

The newely generated toolchain will be available under:

```
~/workdir/<machine name>/<yocto version>/build/tmp/deploy/sdk
```

For additional information, please visit: https://www.yoctoproject.org/docs/3.0.2/overview-manual/overview-manual.html#cross-development-toolchain-generation

Troubleshooting

- **Errors when building the toolchain**

  If you get the error below, please revert commit: `179c5cb7fd0f06970135187f1203507aa55d6bde` in the poky repository (sources/poky). See also Bug 13338 https://bugzilla.yoctoproject.org/show_bug.cgi?id=13338.

```
ERROR: bytesatwork-minimal-image-1.0-r0 do_populate_sdk: Unable to install packages.␣
↪Command '/home/daniel/workspace/bytesatwork/yocto/ti-m2-zeus/build/tmp/work/
↪bytepanel_emmc-poky-linux-gnueabi/bytesatwork-minimal-image/1.0-r0/recipe-sysroot-
↪native/usr/bin/apt-get  install --force-yes --allow-unauthenticated openssh-ssh␣
↪openssh-sshd apt dpkg coreutils base-passwd dhcp-client target-sdk-provides-dummy␣
↪shadow openssh-scp packagegroup-core-standalone-sdk-target packagegroup-core-boot␣
↪vim openssh-sftp-server run-postinsts' returned 100:
Reading package lists...
Building dependency tree...
Reading state information...
Some packages could not be installed. This may mean that you have
```

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```
requested an impossible situation or if you are using the unstable
distribution that some required packages have not yet been created
or been moved out of Incoming.
The following information may help to resolve the situation:

The following packages have unmet dependencies:
 target-sdk-provides-dummy : Conflicts: coreutils
E: Unable to correct problems, you have held broken packages.
```

5.3 Kernel

5.3.1 Download the Linux Kernel

Device	Branch	git URL
byteDEVKIT	baw-v4.19-stm32mp	https://github.com/bytesatwork/linux-stm32mp.git
bytePANEL	baw-ti-linux-4.19.y	https://github.com/bytesatwork/ti-linux-kernel.git

5.3.2 Build the Linux Kernel

For both targets, an ARM toolchain is necessary. You can use the provided toolchain from *Where do you get the toolchain?* or any compatible toolchain (e.g. from your distribution)

Important:

The following tools need to be installed on your development system:

- `git`
- `make`
- `bc`

Note: The following instructions assume, you installed the provided toolchain for the respective target.

byteDEVKIT

Important:

The following tools need to be installed on your development system:

- OpenSSL headers (Debian package: `libssl-dev`)
- `depmod` (Debian package: `kmod`)

1. Download kernel sources

   Download the appropriate kernel from *Download the Linux Kernel*.

2. Source toolchain

```
source /opt/poky-bytesatwork/3.0.2/environment-setup-cortexa7t2hf-neon-vfpv4-poky-
↪linux-gnueabi
```

3. Create defconfig

```
make multi_v7_defconfig
scripts/kconfig/merge_config.sh -m -r .config arch/arm/configs/fragment-*
make olddefconfig
```

4. Build Linux kernel

```
make LOADADDR=0xC2000040 -j `nproc` uImage stm32mp157c-bytedevkit-v1-1.dtb modules
```

5. Install kernel and device tree

   To use the newly created kernel, device tree and/or module, the necessary files need to be installed on the target. This can be done either via Ethernet (e.g. `scp`) or by copying the files to the SD card.

Note: For scp installation: Don't forget to mount /boot on the target.

File	Target path	Target partition
`arch/arm/boot/uImage`	`/boot/uImage`	`/dev/mmcblk0p4`
`arch/arm/boot/dts/stm32mp157c-bytedevkit-v1-1.dtb`	`/boot/stm32mp157c-bytedevkit.dtb`	`/dev/mmcblk0p4`

Note:

After installing a new kernel, it often fails to load modules, as the _signature_ of the kernel changed and it fails to find its corresponding modules folder. This issue can often be resolved with a symlink:

```
ln -s /lib/modules/<EXISTING FOLDER> /lib/modules/`uname -r`
```

Otherwise, please follow the instructions to copy the kernel modules

---

6. Install kernel modules

   To copy all available modules to the target, it's best to deploy them locally first and then copy all modules to the target.

```
mkdir /tmp/bytedevkit
make INSTALL_MOD_PATH=/tmp/bytedevkit modules_install
```

   Now you can copy the content of the folder `/tmp/bytedevkit` into the target's root folder (`/`) which is partition `/dev/mmcblk0p5`.

bytePANEL

Important:

The following tools need to be installed on your development system:

- `u-boot-tools`

1. Download kernel sources

   Download the appropriate kernel from *Download the Linux Kernel*.

2. Source toolchain

```
source /opt/poky-bytesatwork/3.0.2/environment-setup-armv7at2hf-neon-poky-linux-
↪gnueabi
```

3. Create defconfig

```
make bytepanel_defconfig
```

4. Build Linux kernel

```
make LOADADDR=0x80008000 -j `nproc` uImage bytepanel.dtb
```

5. Install kernel and device tree

   To use the newly created kernel and device tree, the necessary files need to be installed on the target. This can be done either via Ethernet (e.g. `scp`) or in copying the files to the SD card.

   Note: For scp installation: Don't forget to mount /boot on the target.

File	Target path	Target partition
`arch/arm/boot/uImage`	`/boot/uImage`	`/dev/mmcblk0p1`
`arch/arm/boot/dts/bytepanel.dtb`	`/boot/devtree.dtb`	`/dev/mmcblk0p1`

CHAPTER 6

Hardware Development

We provide the development for a wide range of embedded systems, from small-scale embedded components to sophisticated embedded systems with increased security requirements. Our engineers are certified hardware experts and provide long experience in business.

6.1 byteENGINE AM335x

- **General Information**: The byteENGINE AM335x is a high performance industrial oriented computing module. It allows a short time-to-market, while reducing development costs and substantial design risks. The system on module (SOM) uses the Texas Instruments AM335x industrial applications processor family. The AM335x features a PowerVRTM SGX Graphics Accelerator Subsystem for 3D graphics acceleration. The Programmable Real-Time Unit and Industrial Communication Subsystem (PRU-ICSS) allows independent operation from the ARM processor. PRU-ICSS enables real-time protocols such as EtherCAT, PROFINET, EtherNet/IP, PROFIBUS, Ethernet Powerlink and Sercos.

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- **Datasheet AM335x**: https://www.bytesatwork.io/wp-content/uploads/2019/03/Datasheet_byteENGINE_AM335x-12.pdf
- **Prepared Pinmux file AM335x**: https://download.bytesatwork.io/documentation/byteENGINE/ressources/byteEngineM2-20160922.pinmux
- **Detailed pinout AM335x**: https://download.bytesatwork.io/documentation/byteENGINE/ressources/PinmuxConfigSummary_byteEngineM2-20160922.xlsx
- **Datasheet Connectors Neltron 2001S-100G-270-020**: https://download.bytesatwork.io/documentation/byteENGINE/ressources/Neltron_2000P.pdf

- **Schematic of the connectors X1 and X2**: https://download.bytesatwork.io/documentation/byteENGINE/ressources/m2-connector.pdf
- **Texas Instruments Sitara™ AM335x Processors**: http://www.ti.com/processors/sitara-arm/am335x-cortex-a8/overview.html
- **AM335x Technical Reference Manual**: https://www.ti.com/lit/ug/spruh73q/spruh73q.pdf
- **TPS65910x Integrated Power-Management Unit**: http://www.ti.com/lit/ds/symlink/tps65910.pdf

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6.2 byteENGINE STM32MP1x

- **General Information**: The byteENGINE STM32MP1x is a high performance industrial oriented computing module. It allows you a short time-to-market, reducing development costs and substantial design risks.

  The system on module (SOM) uses the STM32MP15xxAC devices which are based on the high-performance dual-core ARM® Cortex®-A7 32-bit RISC core operating at up to 650MHz/800MHz. The STM32MP15xxAC devices also embed a Cortex®-M4 32-bit RISC core operating at up to 200 MHz frequency. The Cortex®-M4 core features a floating point unit (FPU) single precision which supports ARM® single-precision dataprocessing instructions and data types.

  Furthermore, the STM32MP15xxAC devices embed a 3D graphic processing unit (Vivante® - OpenGL® ES 2.0) running at up to 533 MHz, with performances up to 26 Mtriangle/s, 133 Mpixel/s.
- **Factsheet STM32MP1x**: https://www.bytesatwork.io/wp-content/uploads/2019/04/Fact-Sheet-byteENGINE_STM32MP1x.pdf
- **Datasheet STM32MP1x**: https://www.bytesatwork.io/wp-content/uploads/2019/12/Datasheet_byteENGINE_STM32MP1x-6.pdf
- **Detailed pinout STM32MP1x**: https://download.bytesatwork.io/documentation/byteENGINE/ressources/byteENGINE-M5-pinout.xlsx
- **Datasheet Connectors Neltron 2001S-100G-270-020**: https://download.bytesatwork.io/documentation/byteENGINE/ressources/Neltron_2000P.pdf
- **Schematic of the connectors X1 and X2**: https://download.bytesatwork.io/documentation/byteENGINE/ressources/m5-connector-pinout.pdf
- **STMicroelectronics STM32MP1**: https://www.st.com/en/microcontrollers-microprocessors/stm32mp1-series.html
- **STPMIC1 power management IC**: https://www.st.com/en/power-management/stpmic1.html
- **Datasheet STM32MP157C**: https://www.st.com/resource/en/datasheet/stm32mp157c.pdf
- **STM32CubeMX Software Download**: https://www.st.com/en/development-tools/stm32cubemx.html
- **STM32MP1x prepared CubeMX Project**: https://download.bytesatwork.io/documentation/byteENGINE/ressources/byteENGINE_STM32MP1.ioc
- **Prepared project: step model STM32MP1x**: https://download.bytesatwork.io/documentation/byteENGINE/ressources/byteengine-m5.step
- **Altium Library Neltron 2001S-100G-270-020**: https://download.bytesatwork.io/documentation/byteENGINE/ressources/2001s-100G-270-020.zip
- **Altium Library byteENGINE STM32MP1x (X1/X2 position mask on layer 21)**: https://download.bytesatwork.io/documentation/byteENGINE/ressources/Footprint-byteENGINE-M5.zip


bytesatwork