

# Teil I

## Kernel

# Kernel

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## Ziele

### Neuer **kernel** auf **BeagleBoneGreen**

- ▶ Download
- ▶ Setup
- ▶ Konfiguration
- ▶ Kompilation
- ▶ Installation

# The Big Picture

## grosses Projekt

**Gegeben** Eine grosse Anzahl *source* Files

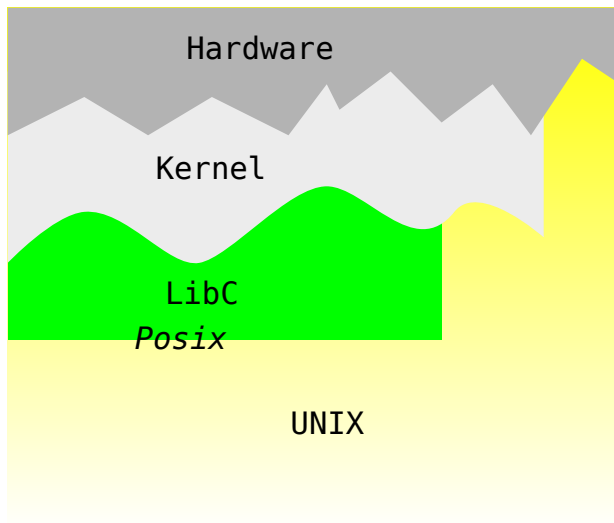
**Gesucht** 2 Files:

- ▶ das **Kernellimage**
- ▶ der *Devicetree*

**Lösung** Klassisches Verfahren

- ▶ Toolchain
- ▶ Makefile

## Die Schichten



## Kernel

### Grosses Projekt

#### Was ist einfach ?

- ▶ **kernel** hängt nicht von anderen Software Komponenten ab
  - ▶ stand alone
- ▶ Braucht nur `make` und `toolchain`

#### Was ist schwierig ?

- ▶ Konfiguration
  - ▶ Wahl der richtigen *source* Files für das Image

`github.com/beagleboard/linux`

Mehrere Möglichkeiten

- ▶ das ganze git repository
- ▶ → nur die letzten  $n$  Versionen `--depth= $n$` 
  - ▶ `git clone -b4.19 --depth=4 path_to_repository`
  - ▶ `git clone -b5.4 --depth=4 path_to_repository`
- ▶ zip File

## Tools

- toolchain**
- ▶ Download: → `tc-tinl-gcc-9.2.0-2019.10.09.tar.gz`
  - ▶ Prefix: `arm-linux-gnueabihf-`
    - ▶ beschreibt:
      - ▶ Architektur: `armv7`
      - ▶ **A**pplication **B**inary Interface: `gnueabihf`
- make** Normales `make`
- ▶ **kernel** Herstellung:
    - ▶ `make cmd`



## Wo ist was ?

```
tinL
├── 5-kernel
│   ├── build ..... generated kernel files
│   │   ├── .config ..... die aktuelle Konfiguration
│   ├── tools ..... for making
│   │   ├── kernel.sh ..... wrapper to kernel Makefile
│   ├── config
│   │   ├── config.sh ..... for kernel.sh
│   │   ├── kernel.config ..... 'gute' kernel Konfiguration
│   ├── tc ..... link to toolchain
├── resources
│   ├── beaglebone-black
│   │   ├── linux ..... the source tree
```

## Erste Konfiguration

- ▶ Hilfe
  - ▶ `./tools/kernel.sh help`
- ▶ Vordefinierte Konfiguration
  - ▶ `./tools/kernel.sh bb.org_defconfig`
- ▶ Anpassung der Konfiguration
  - ▶ `./tools/kernel.sh menuconfig`
  - ▶ `./tools/kernel.sh xconfig`

# Kompilation

- ▶ `./tools/kernel.sh zImage`
  - ▶ erzeugt `build/arch/arm/boot/zImage`
- ▶ `./tools/kernel.sh dtbs`
  - ▶ erzeugt `build/arch/arm/boot/dts/am335x-boneblack-wireless.dtb`  
*Devicetree*

Remark: *Devicetree* später behandelt

# Installation auf SD-Card

## ► Kopiere

**Image** `build/arch/arm/boot/zImage`

**Devicetree** `build/arch/arm/boot/dts/am335x-boneblack-wireless.dtb`  
auf

## ► SD-Card Partition 2:Root File System

```
/ ..... Partition 2
├── boot
│   ├── zImage
│   └── am335x-boneblack-wireless.dtb
```

## Workflow

### schrittweise Herstellung

#### 0 Setup der Toolchain

#### 1 Default Konfiguration (falls vorhanden)

▶ `sh tools/kernel.sh bb.org_defconfig`

#### 2 Herstellung

▶ `tools/kernel.sh zImage`

#### 3 Transfer/Start/Test auf **BeagleBoneGreen**

▶ Partition 2 `/boot/`

#### 4 (Re)Konfiguration

▶ `sh tools/kernel.sh menuconfig`

→ 2 `ev. cp build/.config config/kernel.config`

# Workflow

## ▶ **BeagleBoneGreen** *default* Konfiguration

- ▶ herstellen
- ▶ auf SD-Karte
- ▶ ausprobieren

## ▶ Die *default* Konfiguration ändern:

- ▶ Internet über USB:

Device Drivers

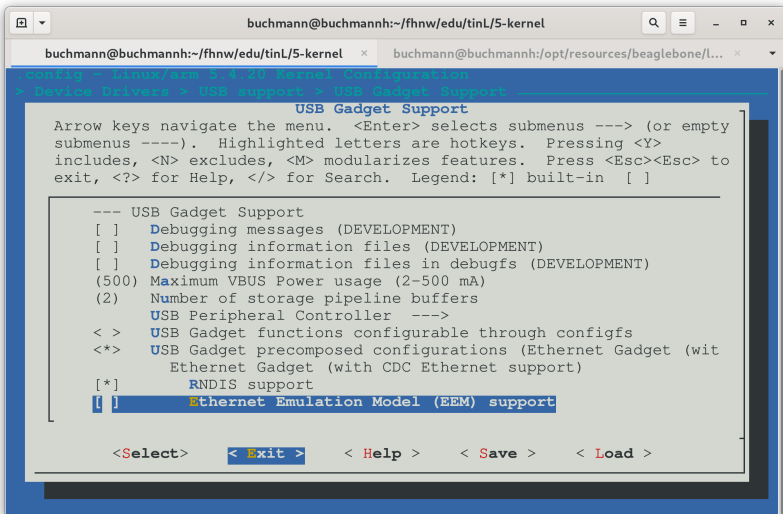
└─ USB support

└─ USB Gadget Support

└─ USB Gadget Drivers

- ▶ nur eine CPU
- ▶ keine ALSA Soundkarte
- ▶ ...

# USB-Gadget



The screenshot shows a terminal window titled 'buchmann@buchmannh:~/fhnw/edu/tinL/5-kernel'. The terminal displays the 'USB Gadget Support' configuration menu. The menu is a text-based interface where users can navigate and configure various USB gadget features. The current selection is 'Ethernet Emulation Model (EEM) support', which is highlighted in blue. The menu includes options for debugging, power usage, storage buffers, and various USB functions. At the bottom, there are navigation and action keys: '<Select>', '<Exit>', '<Help>', '<Save>', and '<Load>'.

```
buchmann@buchmannh:~/fhnw/edu/tinL/5-kernel
buchmann@buchmannh:~/fhnw/edu/tinL/5-kernel x buchmann@buchmannh:/opt/resources/beaglebone/... x
config - Linux/arm 5.4.30 Kernel Configuration
* Device Drivers > USB support > USB Gadget Support
USB Gadget Support
Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty
submenus ----). Highlighted letters are hotkeys. Pressing <Y>
includes, <N> excludes, <M> modularizes features. Press <Esc><Esc> to
exit, <?> for Help, </> for Search. Legend: [*] built-in [ ]

--- USB Gadget Support
[ ] Debugging messages (DEVELOPMENT)
[ ] Debugging information files (DEVELOPMENT)
[ ] Debugging information files in debugfs (DEVELOPMENT)
(500) Maximum VBUS Power usage (2-500 mA)
(2) Number of storage pipeline buffers
USB Peripheral Controller --->
< > USB Gadget functions configurable through configs
<*> USB Gadget precomposed configurations (Ethernet Gadget (wit
Ethernet Gadget (with CDC Ethernet support)
[*] RNDIS support
[ ] Ethernet Emulation Model (EEM) support

<Select> <Exit> <Help> <Save> <Load>
```

## Die beteiligten Files

- ▶ `zImage` der *kernel*
- ▶ `am335x-boneblack-wireless.dtb` der *device tree*



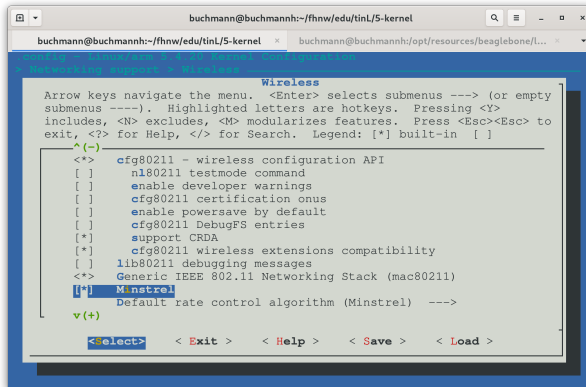
## Teil II

# WiFi-Kernel

## Konfiguration für WiFi

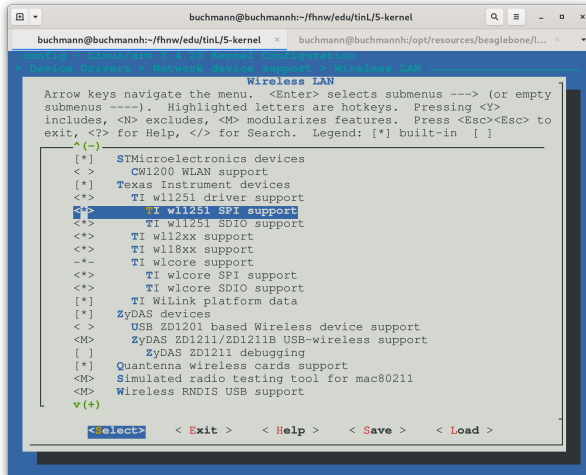
- ▶ Kern konfigurieren
  - ▶ firmware
- ▶ WiFi aufsetzen
  - ▶ Siehe **3-network** Wi-Fi

# Konfiguration Network

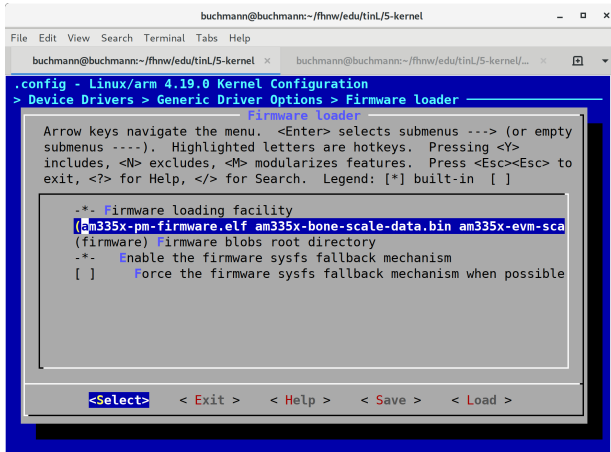


```
buchmann@buchmann:~/fhnw/edu/tinl/5-kernel
buchmann@buchmann:~/fhnw/edu/tinl/5-kernel x buchmann@buchmann:/opt/resources/beaglebone/... x
config -> Networking -> Wireless
Networking support -> Wireless
Wireless
Arrow keys navigate the menu. <Enter> selects submenus ----> (or empty
submenus ----). Highlighted letters are hotkeys. Pressing <Y>
includes, <N> excludes, <M> modularizes features. Press <Esc><Esc> to
exit, <?> for Help, </> for Search. Legend: [*] built-in [ ]
^(-)
<*> cfg80211 - wireless configuration API
[ ] nl80211 testmode command
[ ] enable developer warnings
[ ] cfg80211 certification onus
[ ] enable powersave by default
[ ] cfg80211 DebugFS entries
[*] support CRDA
[*] cfg80211 wireless extensions compatibility
[ ] lib80211 debugging messages
<*> Generic IEEE 802.11 Networking Stack (mac80211)
[*] Minstrel
Default rate control algorithm (Minstrel) ---->
v(+)
<select> < Exit > < Help > < Save > < Load >
```

# Konfiguration Driver



# Konfiguration Firmware



The screenshot shows a terminal window titled 'buchmann@buchmann: ~/fhnw/edu/tinL/5-kernel'. The terminal displays the 'Linux/arm 4.19.0 Kernel Configuration' menu. The navigation path is '> Device Drivers > Generic Driver Options > Firmware loader'. The 'Firmware loader' sub-menu is open, showing instructions and configuration options. The option 'am335x-pm-firmware.elf am335x-bone-scale-data.bin am335x-evm-sca' is highlighted. The bottom of the window shows navigation buttons: '< Select >', '< Exit >', '< Help >', '< Save >', and '< Load >'.

```
buchmann@buchmann: ~/fhnw/edu/tinL/5-kernel
File Edit View Search Terminal Tabs Help
buchmann@buchmann: ~/fhnw/edu/tinL/5-kernel x buchmann@buchmann: ~/fhnw/edu/tinL/5-kernel/... x
.config - Linux/arm 4.19.0 Kernel Configuration
> Device Drivers > Generic Driver Options > Firmware loader
    Firmware loader
    Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty
    submenus ----). Highlighted letters are hotkeys. Pressing <Y>
    includes, <N> excludes, <M> modularizes features. Press <Esc><Esc> to
    exit, <?> for Help, </> for Search. Legend: [*] built-in [ ]

    -* Firmware loading facility
    [am335x-pm-firmware.elf am335x-bone-scale-data.bin am335x-evm-sca
    (firmware) Firmware blobs root directory
    -* Enable the firmware sysfs fallback mechanism
    [ ] Force the firmware sysfs fallback mechanism when possible

    < Select >  < Exit >  < Help >  < Save >  < Load >
```

## Wi-Fi aufsetzen

- ▶ target-root-2018.10.24.tar.gz auf Partition 2 der SD Karte
- ▶ eigener *kernel* auf Partition 2 der SD Karte `/boot`
- ▶ Siehe **3-network**

# Wi-Fi

## Basics

- ▶ **3-network** Seite 14

## Connect

- ▶ **3-network** Seite 15

## Internet

- ▶ **3-network** Seite 16: `udhcpc -i wlan0`
- ▶ **3-network** Seite 12: route, DNS