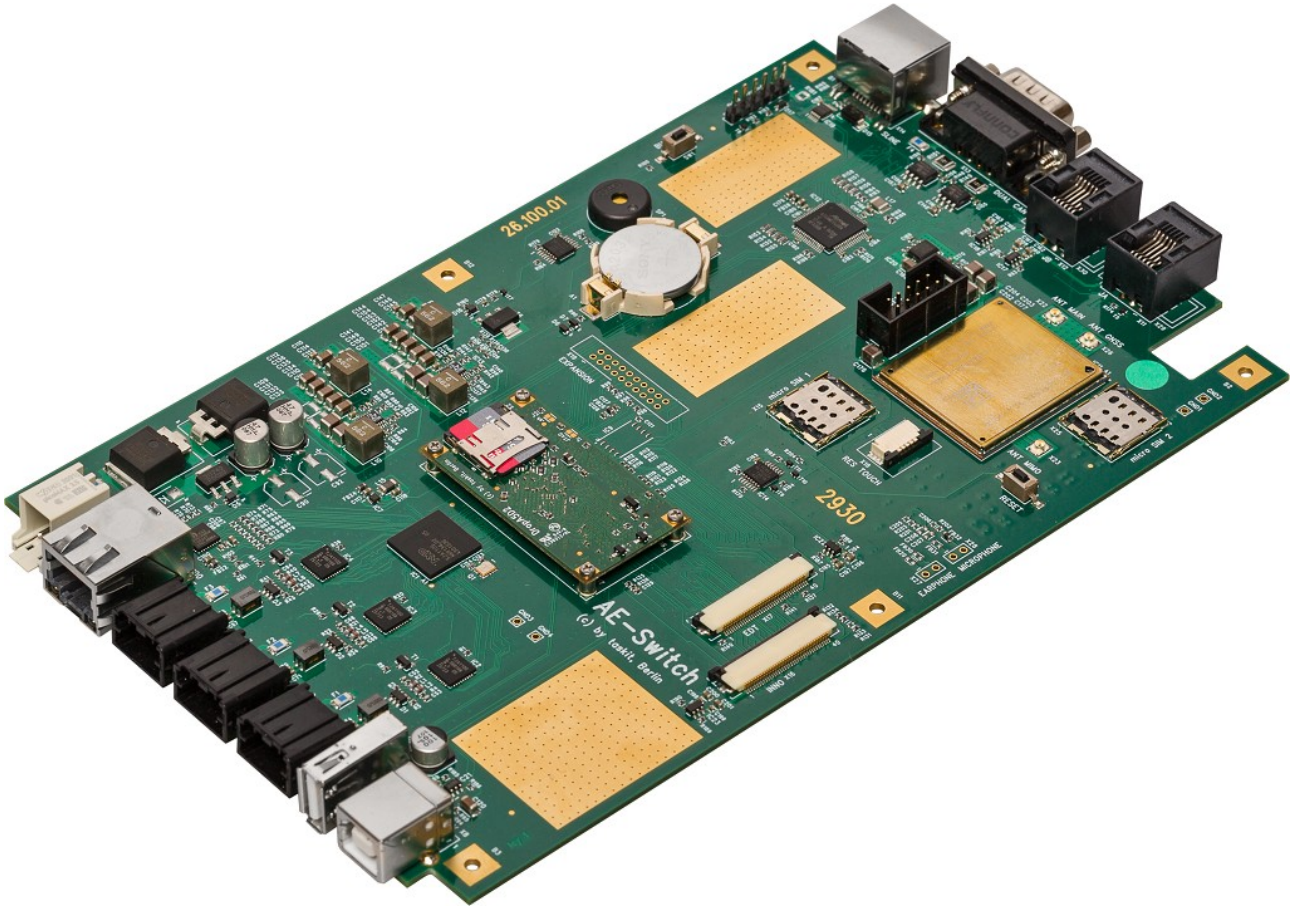
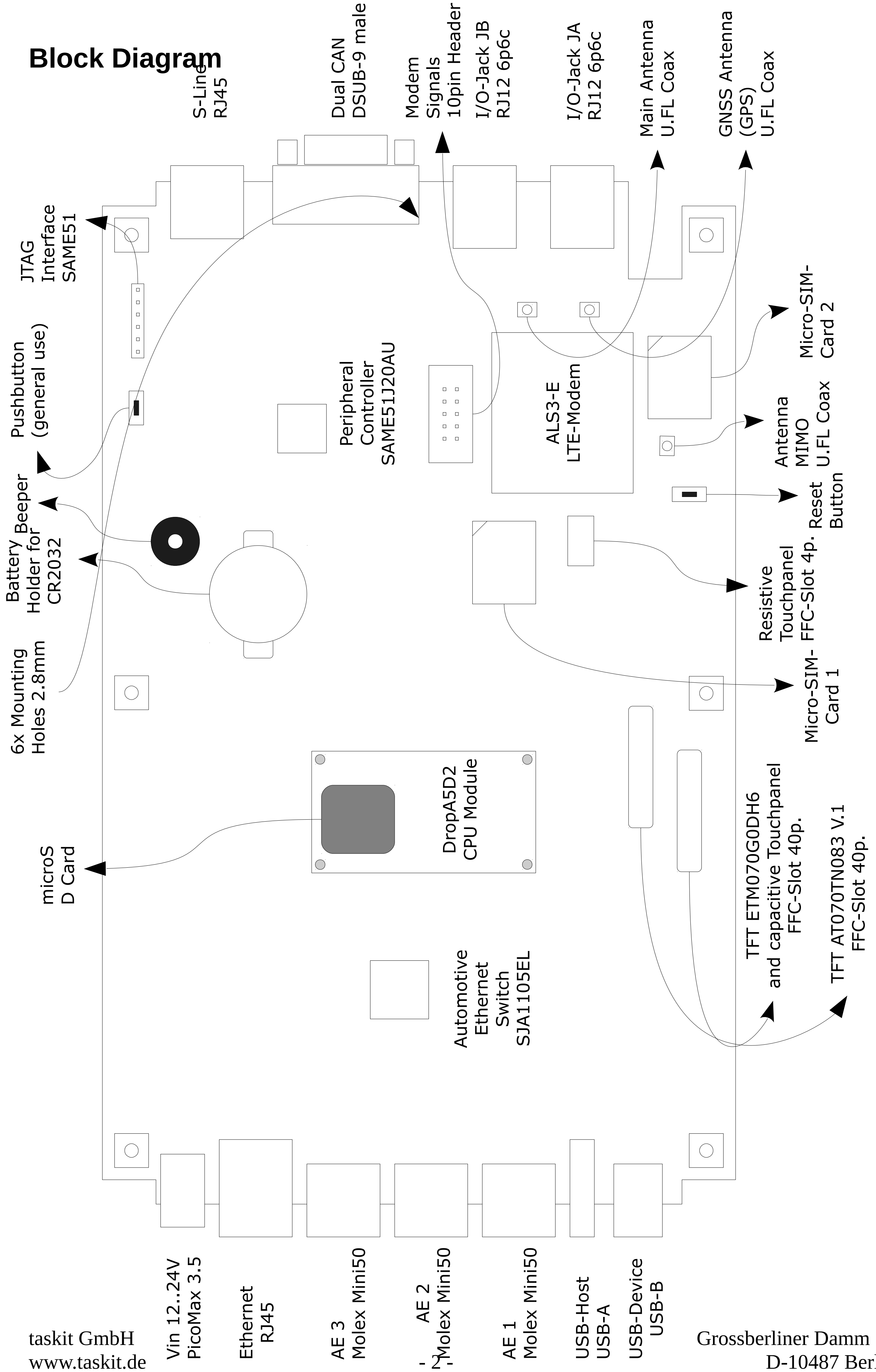
Appstacle Project Board



Block Diagram



Technical Data

Power Supply

8 ... 24V DC
Protection against Reverse Polarity
2-pole "PicoMax" terminal block (X5)
Overvoltage Protection (e. g. in case of "Load Dump"): Suppressor Diodes for up to 2200 W peak pulse power at a 10ms x 150ms test waveform
5A fast acting fuse (F5)

Optional Power Supply via CAN Interface or AE Interface
2A fast acting fuses on each Interface (F1, F2, F3, F4)
These optional power supply inputs must be handled with care. Only one of them must be used at a time, and the main supply connector X5 must not be used in this case.

Power Consumption:
4W Linux idle, 8W peak (including TFT, Ethernet and AE active, without LTE Modem)

LTE Modem:

< 5W	GSM, HSDPA, LTE
< 15W	peak power during GSM transmit burst at "voice call GSM900" - this is supposed not to apply here, but not 100% tested

CPU

"SAMA5D36" from Microchip
ARM Cortex-A5 Core, 498 MHz Clock

Interfaces

Ethernet 100Base-T
USB-Host
USB-Device (alternatively)
3x Automotive Ethernet, Molex MD50 Connectors
LTE-Modem "Gemalto ALS3-E", dual SIM, GPS
Dual CAN - one 9-pin male D-type connector
2x I/O-Jack - 6-pin RJ12 connector
1x RS422 - 8-pin RJ45 connector
TFT up to 800x480 resolution
Touchscreen capacitive or resistive

Abbreviations

UE	"User Equipment", the Appstacle Gateway Board
AE	Automotive Ethernet
W3C-VIS	World Wide Web Consortium Vehicle Information Service

CAN Interface Pinout (X13, DSub-9 male type)

Two distinct CAN busses are available on this connector (CAN1 and CAN2).

Pin	Description	Pin	Description
1	CAN2-L	6	GND
2	CAN1-L	7	CAN1-H
3	GND	8	CAN2-H
4	Reserved (not used)	9	+12..+24V Power Supply
5	Shield (GND)		

RS422/RS485 Interface (X14, RJ45)

Pin	Description	Pin	Description
1	TX-	5	+12V...24V
2	TX+	6	RX+
3	RX-	7	GND
4	+12V...24V	8	GND

The power supply on pins 4 and 5 is switchable (normally off) and intended for powering external peripherals.

Getting Started

A 12V wall cube power supply is provided with the Appstacle Gateway Board, as well as an adapter cable (DC-connector, red-black cable) to connect it to the PicoMax terminal block.

The connection to a PC terminal program is provided via USB. A "USB serial driver" has to installed on the PC. This installation will normally take place automatically on Windows PCs.

The terminal program "putty" can be downloaded from www.putty.org.

Linux Console

The USB host port is normally configured as a "USB gadget" in Linux and therefore accessible as device /dev/ttyGS0. This is the standard port for maintenance and development purposes. A connection via USB cable to a Windows or Linux PC and an appropriate terminal program (e. g. "putty") will serve this purpose.

Alternatively, an Ethernet console may be used. The UE looks for an DHCP server in the local network and requests an IP address. This IP address can be queried from any PC using the standard hostname of the UE:

```
ping kuksa-gateway.local
```

For Windows PCs, the "ping" option -4 (enforce IPv4) is necessary. However, some Windows versions may not support this functionality due to lack of support for MDNS (multicast DNS) or incomplete implementation.

USB Host / Device Switching

The USB host interface is only accessible if USB device is not activated in the device tree. To enable easy switching, there are two alternative device tree files. The activation takes place using a script command:

```
usb.sh host
```

or

```
usb.sh device
```

A reboot is required afterwards in order to let the changed settings come into effect.

Kuksa Demo with Automotive OBD2 Port

This demo requires a Bluetooth- oder CAN-connection to the OBD2 interface of a car. Currently, only the Bluetooth connection is workable. A Bluetooth USB-stick has to be plugged to the USB host connector of the UE, and a "ELM327" Bluetooth-to-OBD2 adapter has to be used.

The ELM327 driver is permanently listening on the Bluetooth interface and establishes a websocket connection to the "w3c-visserver" at the moment when it detects a Bluetooth-to-OBD2 adapter.

Applications using MQTT or HTTP may now transfer the collected data from the car to the Cloud. In the Kuksa case this means: to a Hono server.

LTE-Modem-Activation

The LTE modem is connected to the "DropA5D22" via USB. The modem interface creates five data channels as serial devices: /dev/ttyACM0 to /dev/ttyACM4.

ttyACM0 is the data port of the modem,
ttyACM1 is the command port of the modem (for AT commands),
ttyACM2 is dedicated to the GPS channel of the modem (NMEA),
ttyACM3 is dedicated to remote SIM-Card access (RSA),
ttyACM4 is not documented ("for internal use only").

Dial-up and connection to the Internet is managed by the "pppd" (point-to-point protocol daemon). This service may be started by the command

```
systemctl start ppp@ppp0
```

A SIM Card has to be installed in order to get access to any internet provider. The appropriate APN (access point name) and PIN (personal identification number) has to entered beforehand. The PIN might not be necessary if the SIM card was configured for use without PIN.

These entries have to be done in the file

```
/etc/chatscripts/ppap
```

This file carries out the dial-up communication "chat" between the CPU and the modem for establishing the connection to the internet provider. The following two commands are involved:

```
READY-AT+CPIN="0000"-OK AT
OK AT+CGDCONT=1,"IP","m2m.vodafone.de"
```

where "m2m.vodafone.de" might have to be replaced by the actual APN (retain the quotes!), as well as, in case, the "0000" PIN by the actual PIN.

As the modem has two SIM card slots, the appropriate SIM card slot has to be addressed. By default, the SIM card slot 1 ("micro SIM 1" on the legend printing of the board) is active. To switch to SIM card slot 2, the following AT command will apply:

```
AT^SCFG="SIM/CS",SIM_2
```

which has to be sent to /dev/ttyACM1. Afterwards, the SIM card slot 2 is active until the modem is switched back to slot 1. Rebooting does not affect this setting, as it is stored in the nonvolatible memory of the modem.

Ethernet and Automotive Ethernet

The Appstacle Gateway contains one standard 100Base-T Ethernet port ("ETH 100") and four Automotive Ethernet ports (AE1, AE2, AE3). These are connected to the Ethernet MAC of the CPU by IC1, an "Automotive Ethernet Switch" from NXP, namely the SJA1105EL.

The automotive Ethernet ports AE1 and AE2 are configured as "Master" via SMD jumper, AE3 as "Slave". The "Master" initializes the link in case of a cable connection, so a slave-to-slave connection will not work.

The SJA1105EL switch is by default in a promiscuous mode. Each packet that arrives on one of the five ports is forwarded to all four of the other ports. This behavior can be modified in various ways using the "sja1105-tool". The settings of the SJA1105EL are put down in the file

    /usr/bin/switch/appstacle.xml .

This file can be edited. Please refer to the "software user manual for the SJA1105EL", document UM10851 from NXP, if you like to change the settings.

The setting is downloaded to the SJA1105EL by using the "sja1105-tool". As the SJA1105EL has to be initialized after each reboot, the initialization is automated by the script

    /usr/bin/switch/switch.sh

This script can be called at runtime in order to have changes of the appstacle.xml file to take effect.

The sja1105-tool can also be used to read the configuration and current state of the switch, e. g.:

    sja1105-tool s p

whre "s" and "p" stands for status and port.

DHCP

In the normal configuration, the DHCP client function is active, ie. the UE obtains its IP address from a DHCP server in the local or non-local network. If necessary, the UE can also become a DHCP server.