Aranea LAN/LTE/Outdoor

Manual

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1 Introduction

The components of the *Aranea* family enable the remote control of SARAD measuring devices with the help of the SARAD application software *Radon Vision 8*, *dVision 4* or *ROOMS* as well as the handover of measuring data to monitoring software of third party providers.

Depending on the device and service option, different tasks can be performed:

Aranea LAN Remote control within an Ethernet-based local area network (LAN)

Aranea LAN with SARAD MQTT Broker Remote control of measuring devices in a LAN via the internet

Aranea LTE Remote control via mobile communications and the internet

Aranea Outdoor Remote control via mobile communications and the internet, with weather-proof LTE modem

On the hardware side, *Aranea LAN* is a Raspberry Pi mini computer with an uninterruptible power supply (UPS, *StromPi 3*), which is documented in detail under [7]. In the housing of the *StromPi 3* only a LED to indicate the operating status and a DC socket have been added. With *Aranea LTE* or *Aranea Outdoor* this computer is extended by a LTE USB modem for use inside or outside buildings, respectively, so that remote control and telemetry are possible via mobile communications and the internet regardless of the presence of LAN infrastructure.

In addition to the micro USB socket, the *StromPi 3* has a wide-range input for 6 V to 61 V, which is easily accessible with the DC socket added to the housing. This is the standard input to be used with the supplied plug-in power supply. The integrated real-time clock is programmable so that you can create schedules to switch on your *Aranea* system only at certain times and thus to save energy on battery-operated systems.

On the software side, all *Aranea* devices are almost identical. The Raspberry Pi runs a Linux operating system configured appropriately for the intended use (Raspberry Pi OS) and the *SARAD Registration Server Service*. The latter is preconfigured at the factory but can be configured in a variety of ways depending on the intended use. Details on how you can customise this configuration to your requirements can be found in the manual for the *SARAD Registration Server Service* [5]. In the following it is assumed that the *SARAD MQTT Broker* is used, which allows the information transfer via the internet.

At the other end of the communication line, the Windows PC running the SARAD application software must also have *SARAD Registration Server Service* installed, as described in the relevant software manual. If the *SARAD MQTT Broker* service option has been ordered, the key for using this service must also be installed.

2 Putting into operation

2.1 Scope of delivery

2.1.1 Aranea LAN

- *Aranea LAN* basic equipment with integrated SD card
- power supply unit, 12 V
- software CD-ROM

2.1.2 Service option SARAD MQTT Broker

- software CD-ROM containing MQTT key for the installation on a PC
- MQTT key preinstalled on *Aranea* ex works

2.1.3 Aranea LTE

- *Aranea LAN* basic unit with integrated SD card and preinstalled MQTT key
- power supply unit, 12 V
- LTE USB modem (surf stick)
- SIM card of the provider 1NCE with 10 years operation time and 500 MB flat rate, already integrated in the LTE USB modem
- USB extension (1.5 m) for LTE USB modem
- software CD-ROM containing MQTT key for the installation on a PC

2.1.4 Aranea Outdoor

- *Aranea LAN* basic unit with integrated SD card and preinstalled MQTT key
- power supply unit, 12 V
- outdoor LTE USB modem with antenna, USB cable and assembly accessories (figure 2.1)
- SIM card of the provider 1NCE with 10 years operation time and 500 MB flat rate, already integrated in the LTE USB modem
- software CD-ROM containing MQTT key for the installation on a PC

Figure 2.1: Outdoor LTE modem with accesories

2.2 Installation site

The *Aranea* basic appliance is suitable for indoor operation in a dry and low-dust environment. The ambient temperature of 50 °C should not be exceeded. Direct sunlight should be avoided.

The housing allows easy mounting on a top-hat rail; the installation position does not matter.

The outdoor LTE USB modem from *Aranea Outdoor* is suitable for outdoor use and comes with accessories for waterproof sealing and pole mounting. Please refer to the separate operating instructions in the modem packaging.

2.3 Local network requirements

Aranea LAN always requires an Ethernet-based wired local area network (LAN) with an internet connection for proper use.

The LAN must meet the following requirements:

1. There is a DHCP and DNS server and a gateway to the internet.
2. An NTP server on the internet is accessible from the LAN.
3. *ZeroConf* (mDNS) is not blocked by restrictions.
4. The port of the REST API configured in the configuration file `config.toml` (default setting `8008`) is accessible from the computers in the LAN on which the SARAD application software is running.

If the *SARAD MQTT Broker* for data transmission via the internet, which can be used optionally with *Aranea LAN* is to be used, access to the *SARAD MQTT Broker* must not be blocked by restrictions.

2.4 Connection of measuring devices and Ethernet or LTE USB modem

Aranea LAN is connected to the LAN via its Ethernet socket on the front right side of the unit. *Aranea LTE* and *Aranea Outdoor* are connected to their modem via one of the four USB sockets on the front right side of the device (Figure 2.2). These devices can also be connected to a LAN via the Ethernet socket. The Ethernet connection is then prioritised over the modem so that no mobile data is consumed as long as the internet connection is established via the Ethernet.

All free USB Type-A sockets on the front of the device are available for connecting SARAD measuring devices.

Hint

Always connect all peripheral devices before connecting the power supply.

Figure 2.2: *Aranea LTE* with LTE modem connected via the USB extension. The USB extension may differ from the one shown in the photo.

2.5 Power supply

Power is supplied via the supplied mains adapter.

To switch off the device, it is sufficient to disconnect the power supply. If the UPS battery is charged, short power interruptions of up to 10 seconds are bridged. The operating system is then shut down and the UPS is switched off after a total of 30 seconds so that the device is completely switched off.

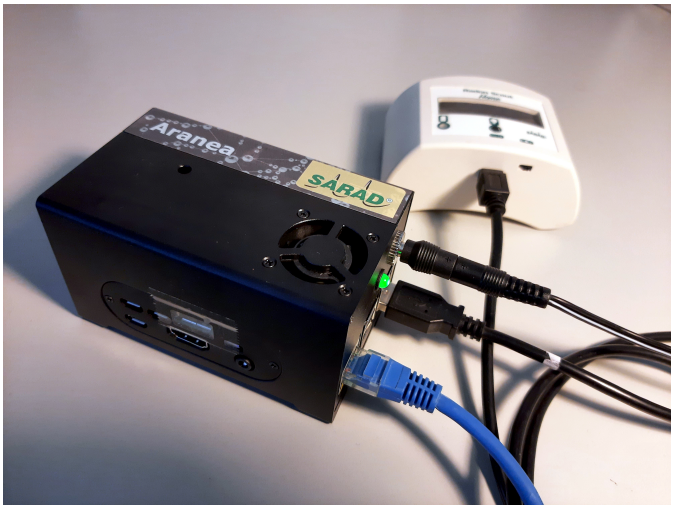

Figure 2.3: *Aranea LAN* with connected power supply unit The blue Ethernet cable establishes the connection to the LAN.

Hint

Avoid frequently connecting and disconnecting the operating voltage as long as the battery is not charged.

Warning

If the external power is restored in the 20 seconds between the start of the shutdown and the UPS switching off, the Raspberry Pi will remain off. In this case, the power must be disconnected again for at least 30 seconds before it will start up again.

2.6 Operating statuses

When the power is connected, the UPS is charged and the operating system starts. During this phase the green LED on the front right of the unit is off. The temperature dependent fan control is also not yet active. The fan therefore runs at full power.

Once the boot process is complete, the LED will start flashing. This indicates that the unit is searching for a network connection to the internet in order to set its internal clock. Once this process is complete, the *SARAD Registration Server Service* will be started, attempting to connect to the pre-configured *SARAD MQTT Broker*. During this normally very short phase, phase, the LED will flash with a shorter dark phase. When the LED is steady, the system is ready.

The *Aranea* will revert to the flashing state if the connection to the *SARAD MQTT Broker* is lost, or if no functioning meter is connected.

Table 2.1 gives an overview of the operating states.

Table 2.1: Operating states

Condition	Operating state
LED off, fan running	UPS is on, operating system is booting or is shut down
LED flashing (1:0.6)	operating system active, search for network connection
LED off, fan off	network connected, system time set, *SARAD Registration Server Service* is starting
LED flashing (1:0.3)	*SARAD Registration Server Service* running, not ready for operation
LED on	ready for operation
LED on, fan running	rare; in hot environments

When the operating system is shut down, the green LED will turn off first, then the fan will turn on. 30 seconds after disconnecting the power supply, the fan switches off. The unit is now completely shut down. The red LED on the Raspberry Pi inside the case will remain on for a few seconds.

2.7 Installation of the application software

The included CD-ROM contains setup programmes for the key files needed to connect to the *SARAD MQTT Broker*, the *SARAD Registration Server Service*, and the current version of *Radon Vision 8* or *dVision 4*. This software has to be installed on the Windows PC that shall be used to read measuring data from the SARAD meters connected via *Aranea*.

First install the MQTT keys with `setup_SARAD-MQTT-Login_<mqtt group>_0001.exe`, then install the *SARAD Registration Server Service* and finally the application software.

Important

Keep the setup file for the MQTT keys confidential! This file installs the keys that give you access to the *SARAD MQTT Broker*. Treat it like any other important key!

If all steps were successful, you will see a device list in *Radon Vision 8* or *dVision 4* an instrument list in which the SARAD meter connected to *Aranea* will appear, regardless of where on earth it is currently located (Figure 2.4). You can use the remote instrument in the same way as the locally connected instruments.

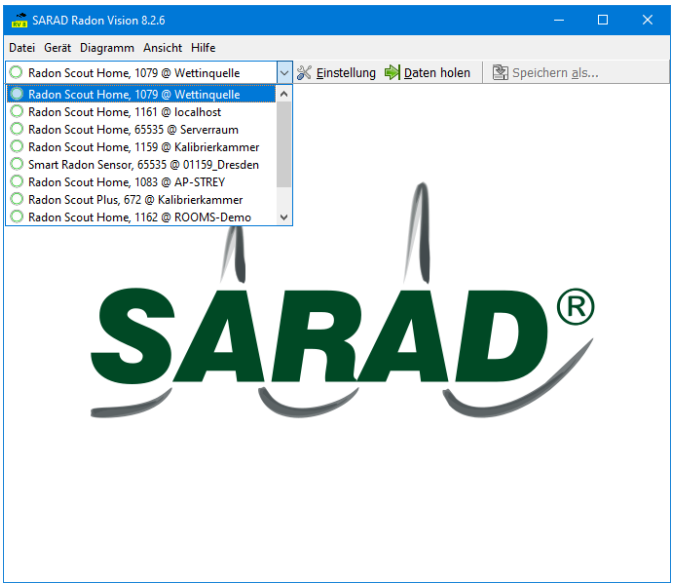

Figure 2.4: Instrument list with one local and several remote meters in *Radon Vision 8*

3 Maintenance and configuration

3.1 Security

During the development of the *Aranea* components, great emphasis was placed on information technology security. In particular, *Aranea LTE* and *Aranea Outdoor*, when operating over the mobile network, offer little in the way of attack surface to potential attackers.

However, all *Aranea* systems are powerful mini-computers which, when connected to your LAN and even more so to the internet, have just as much potential for abuse as any PC.

Please follow these basic rules:

1. Change the default password (section 3.3) that came with your *Aranea* system as soon as you connect an Ethernet cable to it for the first time!
2. Keep the MQTT keys secret! Apart from the software CD, they are located on your Windows PC in a system directory accessible only by the administrator. On the *Aranea* base unit, they are stored in folder `/etc/regserver/` (see 3.8).
3. Use strong passwords for the administrator account of your PC and for the *Aranea* default user!
4. Notify SARAD GmbH immediately if you suspect that a key has fallen into the wrong hands! We will deactivate the key and send you a replacement free of charge (section 3.8).
5. Update your operating system regularly to close newly discovered security holes (section 3.5)!

3.2 User interface

3.2.1 General information

A minimal Raspberry Pi OS without a graphical user interface is installed on the *Aranea* system (see [7] and [3]).

The default credentials for the default user are

user pi

password raspberry

Once you have gained access to the system via SSH or the web interface, you should change the password using the `passwd` command.

The prerequisite for accessing to your *Aranea* system described in the following two sections is that the unit is connected to your LAN with an Ethernet cable. The host name is made up of the word 'aranea' and the numerical part of the serial number as follows `aranea<serial number>` (e. g. `aranea0007`).

The SD card containing the *Aranea* system firmware is configured using an overlay file system so that no data is written to the SC card during operation. In addition to the uninterruptible power supply, this provides protection against damage to the file system. This overlay file system must always be deactivated before any permanent changes can be made.

3.2.2 SSH

Requirements:

- command prompt (`cmd.exe`) or Powershell on Windows or
- terminal on Linux or Mac OS.
- The PC must be on the same LAN as the *Aranea* system connected by Ethernet cable

Type `ssh pi@aranea<series_no>`. Then enter the password.

3.2.3 Web interface

For more convenient system administration, your *Aranea* is equipped with the *Cockpit* web interface [1]. You can access this in your web browser at the address `https://aranea<series_no>:9090`.

> **Hint**
>
> In the past, *Firefox* has occasionally had problems displaying the terminal in *Cockpit*. Use another browser if necessary.

In this case, the browser will display a warning that a self-signed certificate has been used for SSL encryption. You can ignore this warning ('Accept risk and continue'). If you are uncomfortable with this, the following method works:

1. Open a command prompt on your PC: Win + r, `cmd`, Enter
2. Type:

   ```
   ssh pi@araneaxxxx -L 9090:araneaxxxx:9090
   ```

   `xxxx` is the numeric part of the serial number of your *Aranea* system.
3. Open your web browser. Type `localhost:9090` into the address bar.

3.3 Changing your password

3.3.1 Work environment

- PC (Windows or Linux) with web browser
- Ethernet cable for connecting *Aranea*

3.3.2 Steps

1. Connect the *Aranea* to Ethernet and power it up using the power supply.
2. Wait for the status LED flash or light steadily.
3. Login to the web interface (see section 3.2.3)

   user pi

   password raspberry

   see figure 3.1

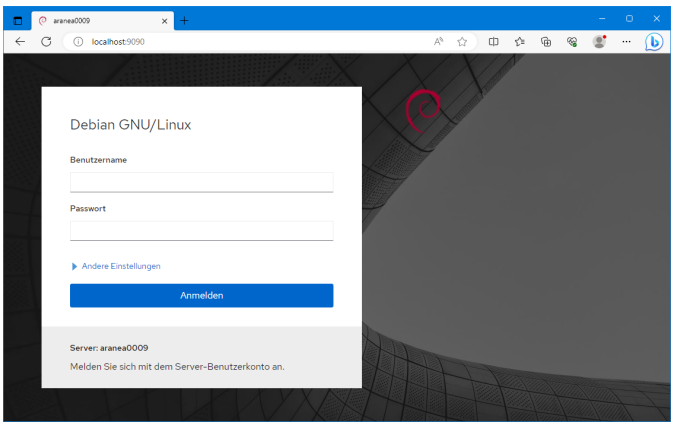

Figure 3.1: Login to *Aranea LAN* with *Cockpit*

4. Type:

   ```
   sudo raspi-config
   ```

5. Select `4 Performance Options`, then `P3 Overlay File System`, then `No` and `OK`. When the question 'Would you like the boot partition to be write-protected?' appears, select `No` again.
6. `Finish`, reboot.
7. After rebooting, login to the web interface again, then type:

   ```
   passwd
   ```

When prompted, enter the current password and the new password twice.

8. Repeat step 4
9. Select `4 Performance Options`, then `P3 Overlay File System`, then `Yes` and `OK`. If the question 'Would you like the boot partition to be write-protected?' appears, select `Yes` again.
10. `Finish`, reboot.

3.4 Backup copy of the SD card

3.4.1 Work environment

- PC (Windows or Linux) with web browser
- Ethernet cable for connecting *Aranea*
- USB microSD card adapter with 8 GB microSD card inserted

3.4.2 Steps

1. Connect the *Aranea* to Ethernet, power it up with the power supply and connect the SD card adapter to one of the blue USB ports.
2. Login to the web interface (see section 3.2.3)
3. Clone the card:
   - `ls /dev/sd*` provides the name of the new SD card.
   - `sudo ~/piclone_cmd/piclone_cmd /dev/sda`. Where 'sda' is the designation of the new SD card.

3.5 Update of operating system

3.5.1 Work environment

- PC (Windows or Linux) with web browser
- Ethernet cable for connecting *Aranea*
- access to the internet

3.5.2 Steps

1. Steps for deactivating the overlay file system as in section 3.3.2 steps 1 to 6
2. Login to the web interface
3. Update the operating system
   a) Open 'Software Updates'
   b) Click 'Install security updates' or 'Install all updates' button if updates are available.

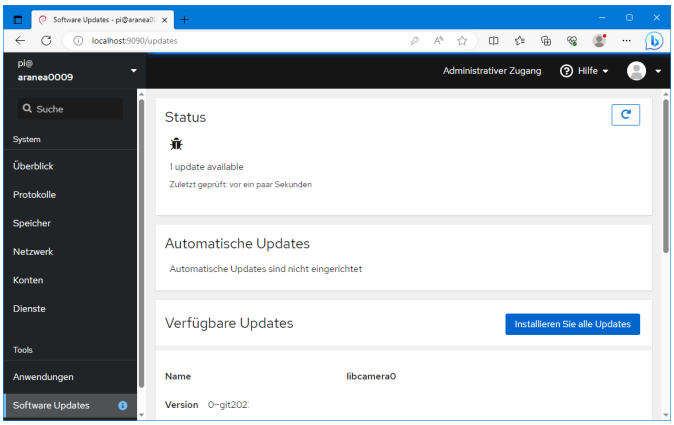

Figure 3.2: Install updates

   c) Restart if necessary
4. Steps for activating the overlay file system as in section 3.3.2 steps 8 to 10

3.6 Configuration of the SARAD Registration Server Service

The configuration of the *SARAD Registration Server Service* on the *Aranea* system is done by means of the `config.toml` text file in the `/etc/regserver/` folder. Your *Aranea* system is configured at the factory so you do not need to change anything here unless you have special requirements, e. g. using your own MQTT broker. More details about the configurable parameters can be found in the *SARAD Registration Server Service* manual [5]. You can make your changes using the *Vim* or *Nano* editors.

3.7 Update of the SARAD Registration Server Service

3.7.1 Scenario

As part of SARAD's support, you have been asked to update the *SARAD Registration Server Service*. The software is available in the form of a public Git repository (see [2]) on Github [4].

3.7.2 Work environment

- PC (Windows or Linux) with web browser
- Ethernet cable for connecting *Aranea*
- access to internet

3.7.3 Steps

1. Steps for deactivating the overlay file system as in section 3.3.2 steps 1 to 6
2. Login to the web interface and go to terminal
3. Update the *SARAD Registration Server Service*:

```
sudo -H PIPX_HOME=/opt/pipx PIPX_BIN_DIR=/usr/local/bin pipx reinstall regserver
sudo systemctl restart regserver
```

4. Steps for activating the overlay file system as in section 3.3.2 steps 8 to 10

3.8 Substitute the MQTT key

3.8.1 Scenario

You have discovered that your authentication key the *SARAD MQTT Broker* may have fallen into the wrong hands and have submitted a request to SARAD to withdraw the key and issue a new one. The old key was then deactivated by SARAD and you received a new key consisting of three files.

3.8.2 Work environment

- PC (Windows or Linux) with web browser
- On the PC you have copied the three key files (`tls_cert_personal.crt`, `tls_key_personal.pem`, `tls_cert_sarad.pem`) to your home directory. This is the directory you are in when you start the command prompt (`cmd.exe`).
- Ethernet cable for connecting *Aranea*

3.8.3 Steps

1. Steps for deactivating the overlay file system as in section 3.3.2 steps 1 to 6
2. Login to the web interface and go to the terminal
3. Give users write permissions:

```
sudo chmod -R o+w /etc/regserver
```

4. Delete the old key:

   ```
   rm /etc/regserver/tls*
   ```

5. Copy the new key from your PC to *Aranea*. To do this, type the following at the command prompt on your PC

   ```
   scp tls* pi@<araneaxxxx>:/etc/regserver
   ```

6. On *Aranea*:
   - Check, if the key files are there:

     ```
     ls -lah /etc/regserver
     ```

   - Withdraw write permission from the user:

     ```
     sudo chmod -R o-w /etc/regserver
     ```

7. Steps for activating the overlay file system as in section 3.3.2 steps 8 to 10

3.9 Using an internal NTP server

3.9.1 Scenario

You want to operate the system in a secure area that is completely disconnected from the internet. This means that you cannot use the factory-configured NTP server to set the system time. However, you have your own NTP server in the LAN that you can use instead.

3.9.2 Work environment

- PC (Windows or Linux) with web browser
- Ethernet cable for connecting *Aranea*

3.9.3 Steps

1. Steps for deactivating the overlay file system as in section 3.3.2 steps 1 to 6
2. Login to the web interface and go to the terminal
3. Enter your own NTP server in the file `/etc/systemd/timesyncd.conf`
4. Steps for activating the overlay file system as in section 3.3.2 steps 8 to 10

3.10 Maintenance work in the field

3.10.1 Scenario

You are using *Aranea LTE* or *Aranea Outdoor* somewhere outdoors and want to carry out one of the maintenance tasks described above on site using the most common means possible.

3.10.2 Work environment

- Notebook PC with Windows 11, WLAN and Ethernet interface
- The user has administrator rights on the notebook, or the notebook has been preconfigured by the administrator before use.
- Smartphone
- Ethernet cable for connecting *Aranea*

3.10.3 Procedure

You use your smartphone as a mobile hotspot to provide your notebook with an internet connection via Wi-Fi. *Aranea* is connected directly to the notebook with an Ethernet cable.

On the notebook, under *Network Connections*, share the Wi-Fi interface via Properties » Sharing » Allow other users to connect... and select the Ethernet interface to which your *Aranea* is connected under Home networking connection.

Still in *Network Connections*, switch to the Ethernet interface. Under Properties » Internet Protocol Version 4 (TCP/IPv4) » Properties, set the static IP address to `10.74.21.1`.

You can now access your *Aranea* at the IP address `10.74.21.11` with `ssh pi@10.74.21.11` and the notebook serves as a gateway to the internet for *Aranea*. This allows all maintenance work to be carried out without restriction.

4 Troubleshooting

After switching on, the fan runs, the LED remains off. The power supply works, but the operating system does not boot. The most likely cause is that the SD card is damaged. If you have a backup of the SD card, you can replace the SD card:

1. Disconnect the power supply.
2. Open the front of the unit opposite the plug connectors.
3. Carefully remove the SD card with a small pair of pliers and insert the new SD card with the contacts facing up.

After switching on, the LED flashes with 0.6 s dark phase. If the LED does not start flashing with 0.3 s dark phase, then *Aranea* is not connected to the internet and cannot set its system time. Possible causes:

- Your LAN is not connected to the internet.
- For *Aranea LTE*, the LTE USB modem is not connected.
- With *Aranea LTE*, the network coverage is not sufficient.
- Your firewall is blocking the outgoing connection to the NTP server on UDP port 123.

After switching on, the LED flashes with 0.3 s dark phase. As long as the LED is flashing, the *Aranea* system is not fully operational, i. e. there is either no contact to the *SARAD MQTT Broker* or there is no SARAD meter connected. Possible causes for the lack of contact with the *SARAD MQTT Broker*:

- Your firewall is blocking outgoing connections to the *SARAD MQTT Broker* on TCP port 8883.

You will find the unit with the fan running and the LED dark. We assume that the unit was working perfectly before. Then this condition was caused by a power failure where the power was restored after the operating system was shut down before the UPS was turned off after 30 s. Disconnect the power supply for at least 30 s and then reconnect it.

You can reach the support team of SARAD GmbH at `support@sarad.de`.

5 FAQ

Is any data stored on the SARAD MQTT Broker? No, at least not permanently. The *SARAD MQTT Broker* is more like a relay station, acting as an intermediary for data transmission. It caches the transmitted data for a certain period of time and is not comparable to a cloud database.

How do you ensure that my data does not fall into the wrong hands? The data is transferred encrypted (TLS) and the data transfer via the *SARAD MQTT Broker* is only possible with authentication.

Can we run the MQTT broker ourselves? Yes, with the appropriate knowledge, this is easily possible. More information can be found in the manual of the *SARAD Registration Server Service* [6].

6 Technical data

6.1 Power supply

Voltage input wide range 6 V to 61 V; inner conductor is plus, outer conductor is minus

Voltage output 5 V, 3 A on lateral USB Type-A socket

6.2 Uninterruptible power supply

Capacity of the battery 2000 mA h

Battery type lithium iron phosphate (LiFePO4)

6.3 Raspberry Pi 4 B

Prozessor 1.5 GHz ARM Cortex-A72 quad core CPU

RAM 2 GiB LPDDR4 SDRAM

Ethernet Gigabit LAN RJ45 (up to 1000 Mbit)

USB 2× USB 2.0 / 2× USB 3.0

SD card 8 GiB

6.4 Mechanical characteristics

Dimensions $59 \times 64 \times 105\,\mathrm{mm}^3$

Options for connection top-hat rail (can be fixed with grub screw); four M4 threaded holes on the bottom of the case

6.5 Environmental conditions

Range of operating temperature $-20\,^\circ\mathrm{C}$ to $60\,^\circ\mathrm{C}$

Protection class IP20

Cooling active

6.6 LTE modem (only for Aranea LTE and Aranea Outdoor)

SIM M2M SIM card from 1NCE with 500 MiB data volume over 10 years

Standards LTE/UMTS/HSDPA/GPRS/EDGE/GSM

Type ZTE MF79U (*Aranea LTE*), ALFA Tube-U4G Global (*Aranea Outdoor*)

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