

Manual Lorank 8.

Ideetron b.v.

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See <https://github.com/Ideetron/Lorank> for the latest version of this manual.

1. Introduction

Welcome to the Lorank 8. This manual presents you with all the necessary information to run your Lorank 8 in a safe way. Please read this manual carefully before starting the Lorank 8 for the first time. Lora technology is a very young technology and as such constantly changing. The Lorank 8 implements the latest hardware and software as well as the most recent publicly available protocol specifications such as LoRaWAN 1R0. In order to be kept informed of future updates you can subscribe to the Github of Ideetron: <https://github.com/Ideetron/Lorank>.

2. Quick start

To quickly set up your gateway perform the steps below. For this quick start to work, the following must be fulfilled:

- On your local network a DHCP server with DNS capabilities must be operational.
- Your PC and gateway are on the same subnet.
- Your router's firewall does **not** block outgoing data traffic on higher port numbers.
- Make use of a recent browser (preferably **not** Internet Explorer).

Then we can test if the gateway works and receives and forwards packets. If your router does not have DNS capabilities, the IP number must be used, please log in to your router to obtain the number that was issued to the gateway.

- Mount the antenna (**never** operate the gateway without an antenna!)
- Connect the gateway to your local network using an Ethernet cable.
- Connect the gateway to the supplied power source, and give it a few minutes to boot.
- On a pc, surf to <http://lorank8/> or <http://lorank8.local/> or [http://\[ip-number\]/](http://[ip-number]/)

Now you should see a simple webpage with a picture of the Lorank 8 device. If this is all correct, we can see if the data gets outside, to that end:

- Switch on any LoRaWAN capable Mote [keep at least (!!) 2 meters distance between Mote and Gateway].
- Surf to <http://iot.semtech.com/gateways/> to see if the gateway is up, the first two bytes are 1D-EE.
- Surf to <http://iot.semtech.com/motes/> to see the Mote data.

Note: it may be necessary to register your mote first to the Semtech environment. First setup a personal account and register your mote using the Mote address.

If you can find your gateway in the list, and see the Mote's data, you know everything works as required. If you see the gateway but not your Mote, the latter may not be functioning. If any of these steps should not succeed a more careful start up procedure is needed, please see below. If you do not have a Mote, the gateway may not show up in the gateway list on iot.semtech.com, in that case see if it is visible on the map on their website.

Subsequently you can test if these packets are visible on The Things Network:

- Surf to <http://www.ttnstatus.org/> to see if the gateway is up.
- Surf to <http://thethingsnetwork.org/api/v0/gateways/> for additional data.
- Surf to <http://thethingsnetwork.org/api/v0/nodes/> to see the Mote data.

The Things Network is not yet fully operational and hiccups have been reported. In case that seems to be at hand, but the former step works, try again after a few days.

3. Connection to the network

The gateway should first be connected to a local network and subsequently connected to the power adapter. Do **not** connect the gateway directly to outside Internet. First, that network is very busy, and, more importantly, for the preconfigured gateway, it is relatively easy for outsiders to break in. Once that happens, a complete re-flash of the memory is needed. The router takes care of the primary protection of your gateway.

The blue LEDs should light up. If this does not happen, there is something wrong with the 5V Stabilised Power Supply. Please use the one that was delivered with the unit.

After a few minutes, the gateway starts asking for an IP number on the network using its DHCP client. It is expected that you have a DHCP server running on your network. Routers from network providers usually are configured that way. Depending on the services provided by that router you can find the gateway on its IP number or try to address it by its hostname.

Try in a recent browser (preferably not Internet Explorer!) <http://lorank8/> or <http://lorank8.local/> You should see a webpage with a picture of the Lorank 8 device. This indicates that the gateway is running.

If that does not work, the router is probably not resolving the name because no local DNS is running. In that case you need to obtain the IP number. This can only be done by logging into the router itself, and look upon the list of connected devices. Please refer to the manual of your router how this can be done. The number is usually something like 192.168.x.y or 10.x.y.z where x,y,z are numbers between 0 and 255. Then, in the browser try <http://192.168.x.y/>

If more than 10 minutes have past, and still no IP number is visible in the routers connection list, take out the power cable (from the gateway, not the mains) and reconnect. Occasionally it can happen that the DHCP server and client misunderstand each other. Do not try multiple reconnections of the power quickly in a row, this can damage the internal file system.

Apart from browsing to the webserver of the gateway, one can also login to the gateway using SSH.

4. Basic configuration

Although the gateway runs out of the box, further configuration may be required. Besides that, all gateways come with the same predefined root password, which is a potential security issue, and thus this must be changed. Furthermore, you may want to change the routers to which all data is send.

4.1 Default routers

The current version of the software allows for maximally four routers to be configured as targets for the data. Note that, in order for the service to actually start, all these routers must exist, although they do not have to accept the data. This is a shortcoming of all current packet forwarders, which we expect to be lifted in the next version. Per default we have configured the following targets in the global configuration file:

- **Semtech:** This company hosts a router that all gateways may utilise for demonstration purposes, see www.semtech.com for more information.
- **The Things Network:** This is a crowd sourced IOT network, open for anyone to use, see www.thethingsnetwork.org for more information.
- **Loralely:** The is an alternative distributed open source IOT data network, about to be launched in the coming months, see www.loralely.org for more information.

Please feel free to use one or more of the preinstalled routers or direct the data to your own private network. Note that, in the future, these URL's may change and thus this may require further attention. Consult the websites of the organisations you want to make use of first.

4.2 The Gateway ID

If the gateway is part a larger network (when not operated privately) it must identify itself using an eight byte worldwide unique identifier. The device comes with such a number preconfigured, starting with `1DEE`. This number is stored in the files gateway ID and in local_conf.json located in the directory that also contain the executables.

It is possible to change this identifier manually if needed, just by editing these files (see below how). However, if the device is to be operated on other networks such as The Things Network, we advise not to do so, or to make sure to choose an identifier that is guaranteed to be globally unique. In practice the only reliable way to ensure this is to construct it based on machine generated random numbers. In any case do not choose something based on any name, simple sequences 12345 or something alike. At this moment there are not a lot of gateway's active around the world, so it may not lead to problems immediately, but this will certainly change in the near future. Data loss or impossibility to reach your nodes may be the consequence.

4.3 Configuration parameters

Depending on the packet forwarder you run (per default, the poly forwarder is running), you can set several parameters. Below find an overview, together with their meaning and default setting. There are more, but these are beyond the scope of this manual. The relevant ones are:

```
/* Devices */
"gps"          : true    /* Indicate if you want to include (static) GPS coordinates in the stream. */
"monitor"      : false   /* If you have monitor software running, activate connection. */
"upstream"     : true    /* Set to true if you want to be able to receive data from the nodes. */
"downstream"   : true    /* Set to true if you want to be able to send data to the nodes. */
"ghoststream"  : false   /* Set to true if you have a fake packet generator running */
"radiostream"  : true    /* Set to true if you have a concentrator connected */
"statusstream" : true    /* Set to true if you want to include status updates */

/* Set a globally unique ID */
"gateway_ID"   : "1DEE000000000000" /* This number is globally unique for each device. */

/* node server for basic packet server, used by basic packet server or when no other are available */
"server_address" : "iot.semtech.com" /* domain name or IP server of network server */
"serv_port_up"   : 1680              /* port for upstream data */
"serv_port_down" : 1680              /* port for downstream data */

/* node servers for poly packet server (max 4 enabled), read by poly packet server only */
"servers":
[ {
    "server_address" : "croft.thingsnetwork.org" /* domain name or IP server of first network server */
    "serv_port_up"   : 1700                    /* port for upstream data */
    "serv_port_down" : 1701                    /* port for downstream data */
    "serv_enabled"   : true }                 /* enable this server */
{
    "server_address" : "amsterdam.loralei.org" /* domain name or IP server of second network server */
    "serv_port_up"   : 1680                    /* port for upstream data */
    "serv_port_down" : 1681                    /* port for downstream data */
    "serv_enabled"   : true } ]               /* enable this server */

/* GPS configuration */
"ref_latitude" : 0 /* Enter the latitude of the location your gateway is mounted */
"ref_longitude" : 0 /* Enter the longitude of the location your gateway is mounted */
"ref_altitude" : 0 /* Enter the altitude of the location your gateway is mounted */

/* Ghost configuration */
"ghost_address" : "127.0.0.1" /* domain name or IP server of the ghost data server */
"ghost_port"    : 1918        /* connection port for fake packets */

/* Monitor configuration */
"monitor_address" : "127.0.0.1" /* domain name or IP server of the ghost data server */
"monitor_port"    : 2008        /* connection port for machine control */
```

```

/* Informal data for status updates. */
"platform"      : ""                /* Platform definition, put * for internal, max 24 chars. */
"contact_email" : "operator@gateway.tst" /* Email of gateway operator, max 40 chars */
"description"   : "Update me"         /* Public description of this device, max 64 chars */

```

These options can be set in different manners, see the section below for the possibilities.

4.4 Configuration with built in the webserver

Planned for future versions, not available this release, please configure using SSH.

4.5 Configuration with SSH over the command line.

Per default a SSH service runs on the gateway, making is possible to login and modify the settings and software from the command line. The standard login credentials are:

```

account: root
password: LorankAdmin

```

You can login with SSH with the command `\ssh root@lorank8` or `\ssh root@[IP number]`. The first action to take is to change the root password into something personal:

```

lorank8 # passwd
(current) password: LorankAdmin
Enter new password: ***** [Type something sensible]
Retype new password: ***** [Retype your password]

```

Please make sure you remember or write down this password. If forgotten, the gateway cannot be entered again, Ideetron does not have any means of recovery. The only solution in that situation would be a complete reinstall of the Beagle Bone and subsequent installation of Lorank 8 gateway software. This is a process requiring expert skills. See <http://beagleboard.org> and <https://github.com/Ideetron> for more information.

The Lorank 8 software is located in the root directory for convenience. Usually there are three directories. One build directory, something like `'lorank-v1.0.4'`, a system directory called `'Lorank'`, and a platform dependent working directory that contains the executables and setting files for your platform. This is called `'Lorank8v1'` or something alike. The work directory contains the executables needed to run the gateway as well as its configuration files. These files are called `global_conf.json` and `local_conf.json`. Entries in the latter file supersede the ones in the former. Although the files end in `'.json'`, they are not JSON files in a strict sense. However, if you do edit these files, make sure you adhere to the format used, for otherwise the forwarder will not be able to run. Standard editing tools like **nano** and **vi** are available on the platform, for example

```
nano global_conf.json
```

Make your changes using the arrow keys (mouse does not work) and save with `^O` (control-O), exit with `^X` (control-X).

Per default, the poly forwarder is running in the background. Output is send to the system logger. If you want to experiment, it is better to test the forwarder in the foreground. In that case, the background must be stopped first. The configuration files are only read at the start of the forwarder.

The background forwarder can managed using the following commands:

```

systemctl start lorank.service
systemctl stop lorank.service
systemctl restart lorank.service
systemctl status lorank.service

```

To enable or disable the forwarder start up at boot time use the commands:

```
systemctl enable lorank.service
systemctl disable lorank.service
```

To test a forwarder in the foreground, for example after you have changed some configuration parameters, simply stop the background forwarder and start the new forwarder in the foreground like this:

```
systemctl stop lorank.service
./poly_pkt_fwd
```

The output will be put directly on screen, so you can see if the new configuration performs as expected. If so, stop it with ^C (control-C) and reactivate the background forwarder.

```
^C
systemctl start lorank.service
```

All logging of the service is written to `/var/log/syslog`, so to see what is happening under the hood, check, for example the last 200 lines in this file with:

```
tail -n 200 /var/log/syslog
```

4.6 Via SSH using PuTTY.

No version of Windows OS contains the SSH utility out of the box. So the best way to log into the gateway is making use of PuTTY, which can be found here: <http://www.putty.org/>.

5. Hardware

The gateway is built upon the Concentrator Board of IMST iC880A and a recent Beagle Bone Board Green. The latter is completely open source hardware and software, see <http://beagleboard.org> for more information. In between a connection board has been placed. The Beagle Board's USB is accessible from the outside and may not be loaded with more than 500 mA.

6. Software

6.1 Location

All software is open source and can be found on the Github of Ideetron: <https://github.com/Ideetron>. There are three main repositories that are relevant:

```
https://github.com/Ideetron/Lorank
https://github.com/Ideetron/packet\_forwarder
https://github.com/Ideetron/lora\_gateway
```

Beware however, that at the time of reading these may have different names, be moved or there may be added repositories. Please read the latest README's in the repositories.

6.2 Installation

The gateway comes preinstalled. However it can be necessary to reinstall or upgrade the software. Complete reinstallation is a delicate procedure that requires experience with embedded systems. Although the command sequence is easy, differences between platforms may cause serious trouble. Therefore we strongly discourage this procedure in general, and is given here only for completeness. The least you should do before exercising this is read the scripts called. If there is anything in there you do not understand, please do not move forward.

```
./Lorank/lorank8v1/wipe
git clone https://github.com/Ideetron/Lorank.git;
./Lorank/install lorank8v1 1.2.3
```

Note that wipe **completely removes all Lorank 8 software and settings**. Replace 1.2.3 with the software version you want to install. These can be found as releases on Github.

6.3 Upgrade

All executables are installed and build from source using git, so this can be used to upgrade as well. It is also possible, and a maybe safer if you are not comfortable with git to install a new version of the software. This does not remove your old version, so if something goes wrong, you can revert. Still, some level of expertise is needed here, should something go wrong. Basically the steps are (in the directory /root)

```
cp -r lorank8v1 lorank8v1.backup
./Lorank/lorank8v1/upgrade 1.2.3
```

If no release version is provided the most recent code is used. Usually this is not a good idea, since this code is under heavy development. Please use the latest **release version** as can be found on Github. The new version is installed in a separate directory and the executables are copied to the working directory. Since the former version stays on your system, you can revert by manually coping those back to the working directory. Another, simpler solution is to make a backup of the working directory, as is done above. When performing the upgrade, the global_conf.json is replaced, the old one saved as global_conf_old.json in the same directory. The local_conf.json is not touched because it contains your Gateway Unique Identifier. Usually some merging of the old and new global_conf file is needed. This must be performed by hand. Please first test the new software and its configuration before putting it into production. Should you be on an older version (prior to 0.1.5) that does not have the upgrade script yet, please update that first using git:

```
cd Lorank
git checkout master
git pull
cd ..
```

and then proceed as above.

7. Operation

7.1 Antenna

Warning: Never operate the gateway without a properly mounted antenna. If not mounted, the energy meant for transmission reflects back into the device and immediately destroy the input stages. The gateway will be damaged beyond repair.

7.2 Always on

The Lorank 8 is designed for 24/7 operation, provided a few precautions are taken. Do not place the device into direct sunlight (be aware of the change of sunlight during the day), near heaters or in conditions of condensing moisture. The Lorank 8 is best mounted on a high location for optimal reception, away from metal objects. Mount the device such that the antenna points upwards. The casing should at least be free on two of the sides so that the heat produced is sufficiently drained. Other transmitters such as Lora Nodes, WiFi stations and cell phones should at least be at two meters distance from the Lorank 8 to prevent damage to its highly sensitive input amplifiers.

Occasionally the server that accepts your data may stop doing so, even while the packets are send from the gateway without interruption. This can happen for instance when a crash happens server side or a firewall that is in the pathway is reinitialised. Unfortunately, the gateway is not informed of such an event, and the only option for now is to restart your gateway. See above how this can be done. We expected this problem to disappear as the software in the whole chain gets more mature over time.

7.3 Shutting down

The Lorank 8 does not have a power switch, so it seems natural to simply 'pull the plug' it when it has to be switched off. Although this is possible, and will not directly do harm it is better to login into the gateway via SSH, as described above and bring the gateway down in an orderly fashion. This can be done with the command:

```
shutdown -h now
```

The gateway will start a shutdown procedure and after approximately 30 seconds all LEDs should be off. Restarting can be done by simply disconnecting and reconnecting the power cable.

8. Specifications

Hardware:

- Frequency band : 868 MHz
- Sensitivity : -138 dBm
- Maximum power : 27 dBm (500mW)
- LoRa demodulators : 49
- Simultaneous channels : 8
- Max connected nodes : ~60 thousand (*)
- Processor : 1GHz, ARM Cortex A8
- OS : Debian / Angstrom Linux
- Wifi : Optional (via USB, not implemented yet)
- Current : 1A
- Max Current USB : 500mA
- Power Adapter : 5Volt= , 2Amp
-

(*) This is a theoretical maximum, under the assumption that nodes only send once per hour. Due to collisions, resend packets, packet loss etc., the number of nodes that can effectively be handled is lower, typically 10..20 thousand.

Software:

- Lora libraries : Semtech, with modifications from Beta Research BV
- basic packet forwarder : Semtech,
- poly packet forwarder : Beta Research BV, based on code from Semtech
- Installation scripts : Beta Research BV
- Beagle Bone : Various, see website beagle board.

9. Maintenance

The Lorank 8 does not need special maintenance. In case the device fails, and this failure cannot be attributed to incorrect handling, please contact Ideetron.

10. Disposal

This is an electronic device, and disposal should be in accordance with local environmental regulations.

11. Legal

Ideetron can in no way be held responsible for malfunctions and/or damage resulting from the information presented in this document.

12. Questions and Answers.

My gateway ID starts with 1DEE, why is that?

All gateways from Ideetron are preconfigured with an eight byte unique ID starting with '1DEE' augmented with six randomly chosen bytes. This is to make the gateway easily recognisable in the (long) list of gateways at for example Semtech. This prefix is not registered anywhere, and you are completely free to change it to your liking. If you keep the rest of the ID unchanged you can be reasonably sure the ID stays unique.

Are there any local tools to test my gateway?

The gateway comes with some precompiled tools from Semtech, which can be used for testing purposes. These can be found in the directories that match `/root/lorank8-[version_number]/lora_gateway/util_*`. Please see the `readme.md` file therein for further instructions. Ideetron cannot provide instructions for operation or guarantee for their quality of operation.

How do I setup a server within my network to catch packets?

If you want to receive packets on your own computer you need to set up a router backend yourself. Or maybe you want to simulate the existence of many node to test your setup. To that end download and compile the lora simulator tools on the github of The Things Network:
https://github.com/TheThingsNetwork/lora_simulator.