GATEWAY

VEGA BS

User Manual

Vega BS gateway designed to deploy LoRaWAN network within 863-870 MHz frequency band.

Vega BS operates with Linux operating system and supplied with pre-installed Packet forwarder software.

Document Information	
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This document applies to the following products:

Product name	Type number
Gateways	Vega BS-1
	Vega BS-2
	Vega BS-1.2
	Vega BS-2.2

Revision History

Revision	Date	Name	Comments
01	27.04.2017	KEV	Document creation date
02	15.05.2017	PKP	Minor edits
03	18.05.2017	KEV	Общее руководство на БС-1 и БС-2
04	13.06.2017	KEV	Edits in the content of the package
05	14.06.2017	KEV	Part «Configuration» was edit, A5 format
06	14.08.2017	KEV	Antenna mounting recommendation was added
07	16.08.2017	KEV	Part «Operation» was edit
08	28.08.2017	KEV	Minor edits in the «Configuration of a static IP-adress»
09	27.09.2017	KEV	«SIM card installation» was added
10	02.11.2017	KEV	Parts «Gateway setting up for 3G operation», «Recommendations» were added, new format

11	29.06.2018	KEV	Vega BS-1.2 and Vega BS-2.2 description is added, content of the package is changed, working temperatures are changed
12	23.08.2018	KEV	Minor changes
13	18.09.2018	KEV	Minor changes
14	24.10.2018	KEV	Ethernet type added in specification
15	20.11.2018	KEV	Changes in part «Configuration of a static IP-adress», adds to part «Start of work»
16	29.04.2019	KEV	Operating position of DIP-switches changed (fig. 3.3)

CONTENT

INTRODUCTION

This manual is designed for Vega BS-1, Vega BS-2, Vega BS-1.2 and Vega BS-2.2 gateways (hereinafter – the gateway) manufactured by Vega-Absolute LLC and provides information on powering and activation procedure, control commands and functions of the gateway.

This manual is targeted at specialists familiar with installation work fundamentals for electronic and electrical equipment.

The gateway shall be installed and adjusted by qualified specialists in order to ensure proper operation of the device.

1 DESCRIPTION AND OPERATION PRINCIPLES

Vega BS gateway is designed to deploy LoRaWAN network within 863-870 MHz frequency band.

The gateway operates with Linux operating system and is supplied with pre-installed Packet forwarder software.

IP65

IP67

The gateway is powered and communicates with the server via the Ethernet channel.

The device is configured through Ethernet via SSH protocol with any terminal program (e.g. PuTTY).

Vega BS-2 and Vega BS-2.2 have an additional 3G-module for communication channel and GPS/GLONASS-module for gateway positioning, and internal clock synchronizing with navigation-satellites signals.

2 SPECIFICATION

	BS-1	BS-1.2	BS-2	BS-2.2
Main				
GPS/GLONASS module	no		yes	
3G modem	no		yes	
Server communication link	Ethernet 10/100 Base-T		Ethernet 10/100 Base-T, GSM 3G	
Operating system	Linux			
USB-port	yes			
Operating	-40...+70 °C			
LoRaWAN				
Number of LoRa channels	8			
Frequency band	863-870 MHz			
Power output	up to 500 mW			
Antenna connector	SMA	N-Type female	SMA	N-Type
Radio coverage in restrained urban conditions	up to 5 km			
Radio coverage within line of sight	up to 15 km			
Power				
Power consumption	3 W		4 W	
Power supply	Passive POE 4,5(+) 7,8(-) 15 W			
Case				
Housing dimensions	165 x 110 x 40	190 x 183 x 75	165 x 110 x 40	190 x 183 x 75
Ingress protection	IP65	IP67	IP65	IP67
Mounting	mast supports			

3 OPERATION

The gateway terminal board has control and indication instruments, input and output interfaces. Detailed information see below.

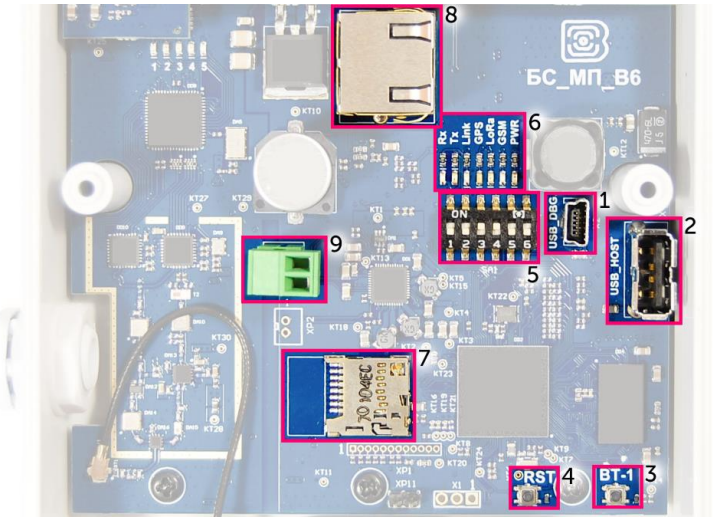


Fig. 3.1. Control and indication instruments, input and output interfaces.

1 – mini USB-port for connection to a computer

2 – USB-host for connection of external devices

3 – */Spare/*

4 – gateway reset button

5 – service DIP-switches

6 – performance indicators of various systems

7 – micro SD-card connector

8 – Ethernet-cable connector

9 – additional power connector (optional)

CONTACTS

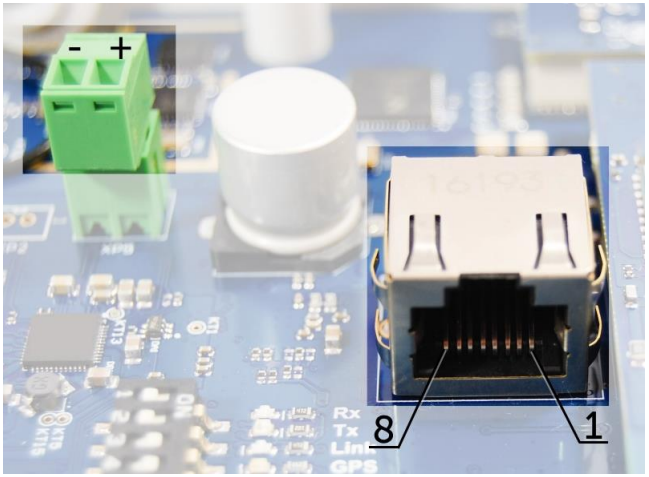


Fig. 3.2. Contacts in the connectors.

The gateway is connected to the network with 8-core network cable (twisted pair) through connector on the terminal board (fig. 3.1 (8)). Cable shall be crimped in compliance with T568A and T568B standards. Contacts shall be numerated 1-8 right-to-left.

Colors are shown for cable T568B:

Contact no.	Color	Designation
1	Orange-and-white	TD+ signal
2	Orange	TD- signal
3	Green-and-white	RD+ signal
4	Blue	Power
5	Blue-and-white	Power
6	Green	RD- signal
7	Brown-and-white	Ground
8	Brown	Ground

There is an additional power connector on the board (fig. 3.1 (9)). It can be connectable only when power contacts 4, 5 and 7, 8 in the network cable are disabled. Permissible power voltage is 12-48 V. Minimum power is 20 W.

INPUT AND OUTPUT INTERFACES

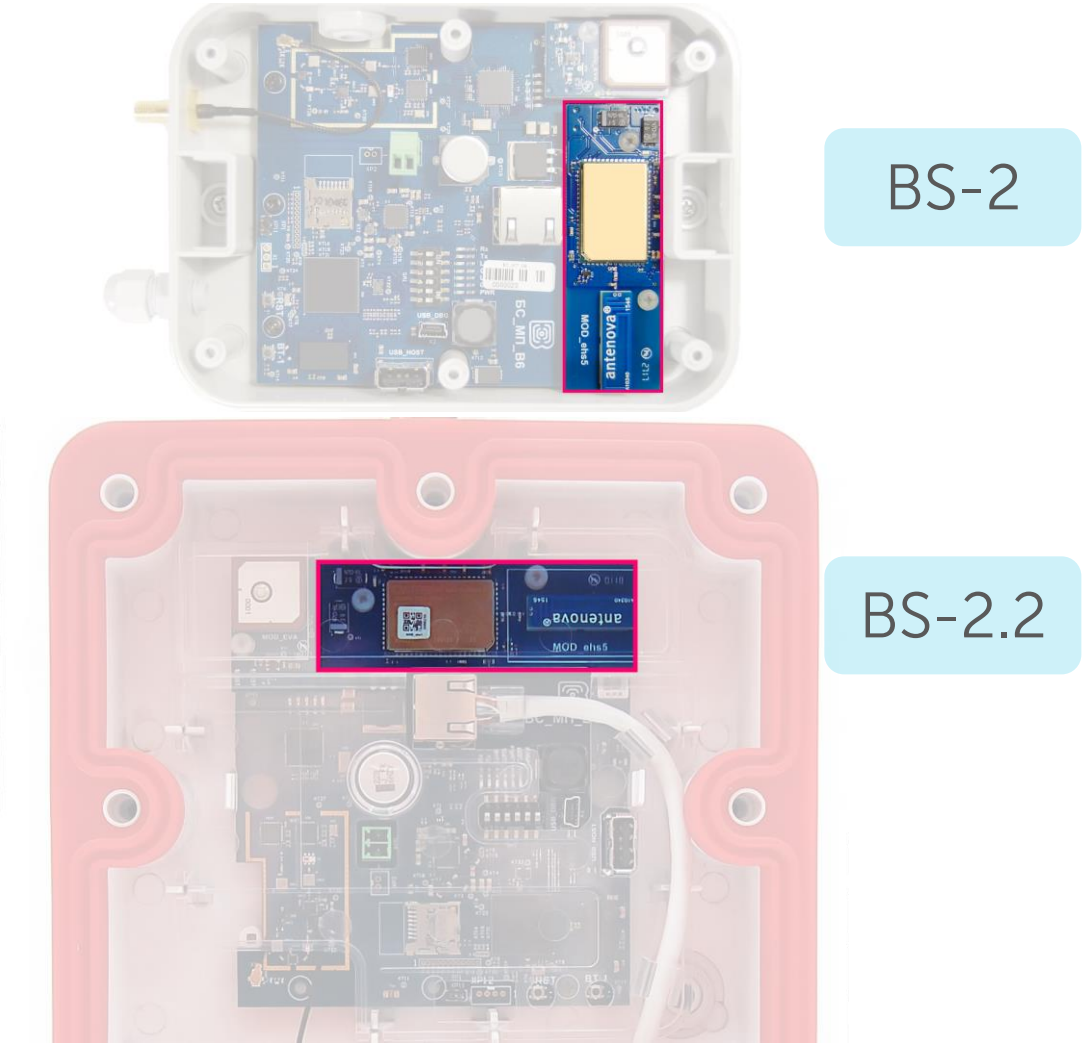
The gateway has a mini-USB-port for connecting to a computer and working via the SSH protocol (Fig. 3.1 (1)), and a USB-host for connecting of external devices via a USB cable (Fig. 3.1 (2)). There is a slot on the board for a SD card (fig. 3.1 (7)).

In addition, there is a connector on the gateway housing for connecting of the antenna supplied with the device: SMA or N-connector.

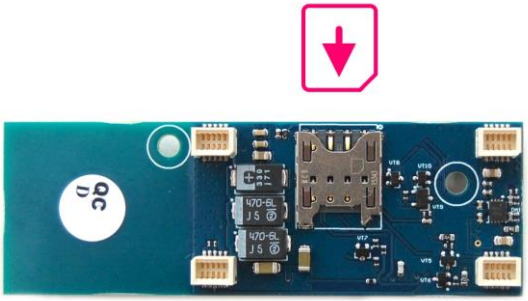
For high-quality signal reception, it is important to place the gateway antenna properly. For antenna installing recommendations, see the Appendix.

SIM CARD INSTALLATION AT THE BS-2 AND BS-2.2

Vega BS-2 and Vega BS-2.2 gateways include a GSM module, installing on the main board.



The SIM slot is located on the back of the module. To install the SIM card, you must disconnect the GSM module from the main board and turn it over.



You need to insert the SIM card of the micro-SIM format into the slot, and then return the GSM module on its own place.

CONTROL INSTRUMENTS – PUSHBUTTONS AND SWITCHES

There are two buttons on the gateway board. One button is spare for further developments (Fig. 3.1 (3)). Push the other button (Fig. 3.1 (4)) for the gateway instantaneous rebooting.

In addition, there are DIP-switches (Fig. 3.1 (5)) on the board used to select the download option of the firmware image: from internal memory, from the SD card or via mini-USB from the computer. The switches are only for service conditions. In operating mode, only switches 3 and 4 shall be enable, see fig. 3.3.

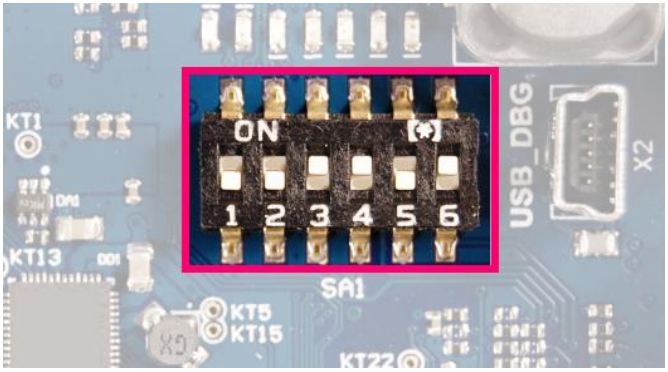


Fig. 3.3. Operating position of DIP-switches

INDICATION

There are several LEDs (fig. 3.1 (6)) on the terminal board; its signals showing in the table below. They indicate operation of particular systems: power (on / off), visibility of GPS satellites, GSM modem (on / off), operation of the LoRa signals processing program (Packet forwarder on/off), Ethernet activity, the data exchange via mini USB port.

LED	Color	Indication
Rx	Green	*Flashes* – data exchange via USB_DBG port
Tx	Red	
Link	Green	*Flashes* – activity via Ethernet
GPS[1]	Blue	*Doesn't light* – no data from GPS-receiver *Flashes*– there data exist, but are not valid for use by Packet forwarder *Lights* – location identified
LoRa	Yellow	*Lights* – Packet forwarder is started *Doesn't light* – Packet forwarder is stopped
GSM	Green	*Lights* – GSM-modem is enabled *Doesn't light* – GSM-modem is disabled
PWR	Red	*Lights* – gateway is powered *Doesn't light* – gateway is not powered

[1] GPS LED indicates the GPS system functioning only while Packet forwarder processing (LoRa LED lights).

4 GATEWAY CONFIGURATION

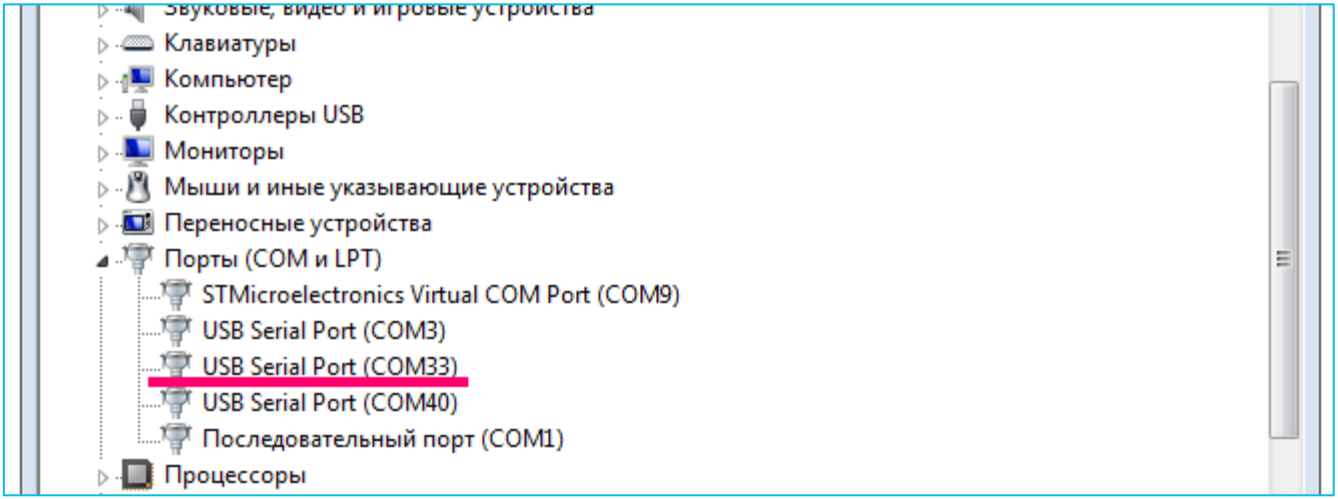
CONNECTION TO THE COMPUTER – START OF WORK

The gateway is configuring while connects to a computer using a terminal program. Connection is possible, for example, with a mass-market PuTTY program. There are two ways of connection to the gateway – via a serial port or SSH.

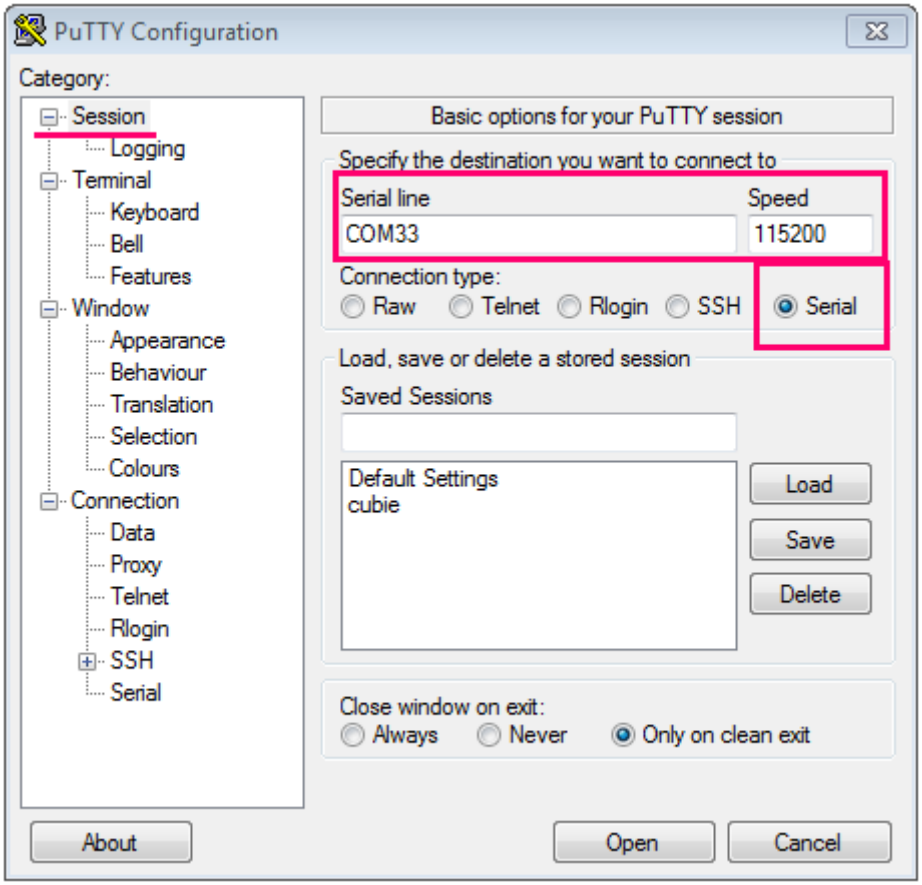
1. Connection via a serial port

In case of a serial port, connect the gateway to a personal computer with a mini-USB connector by a cable. On the board, the required port designating as USB_DBG (Fig. 3.1 (1)). Next, connect to a virtual COM port by installing the driver for MCP2200. **"Ports (COM and LPT)"** menu appears at the device manager.

Search **"USB Serial Port"** in the "Ports" menu and see its number.



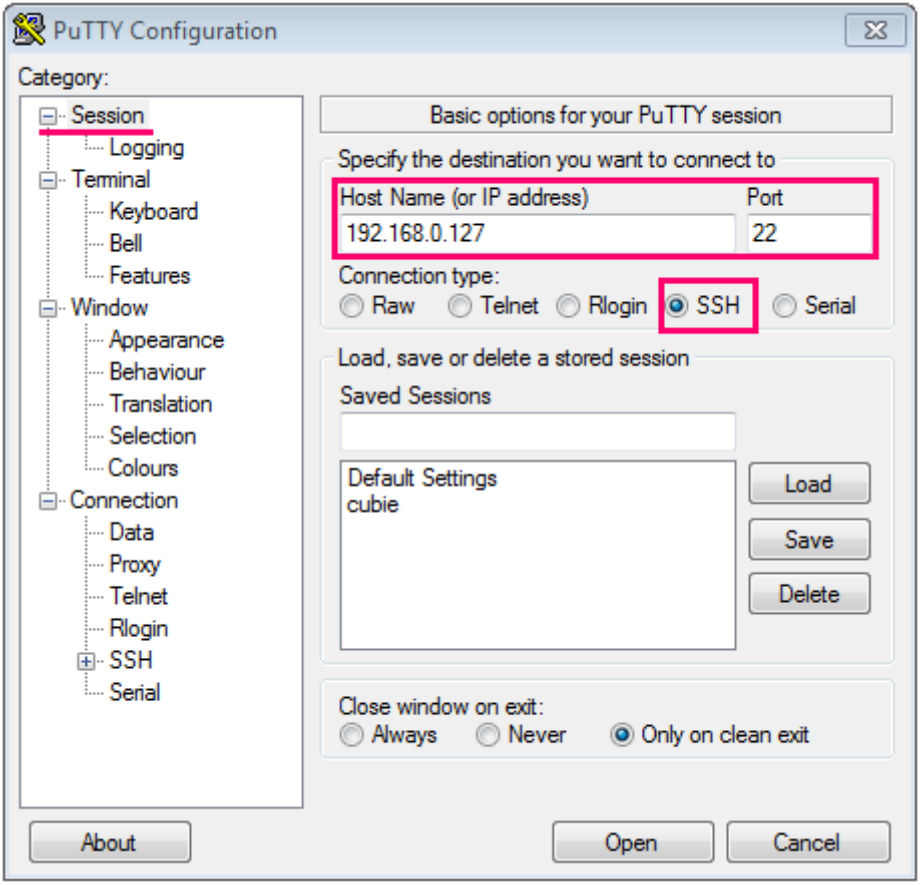
Open PuTTY, select **Serial**, enter number of the gateway virtual COM-port and speed (115200) in the corresponding fields.



Push "**Open**" button.

2. Connection via SSH

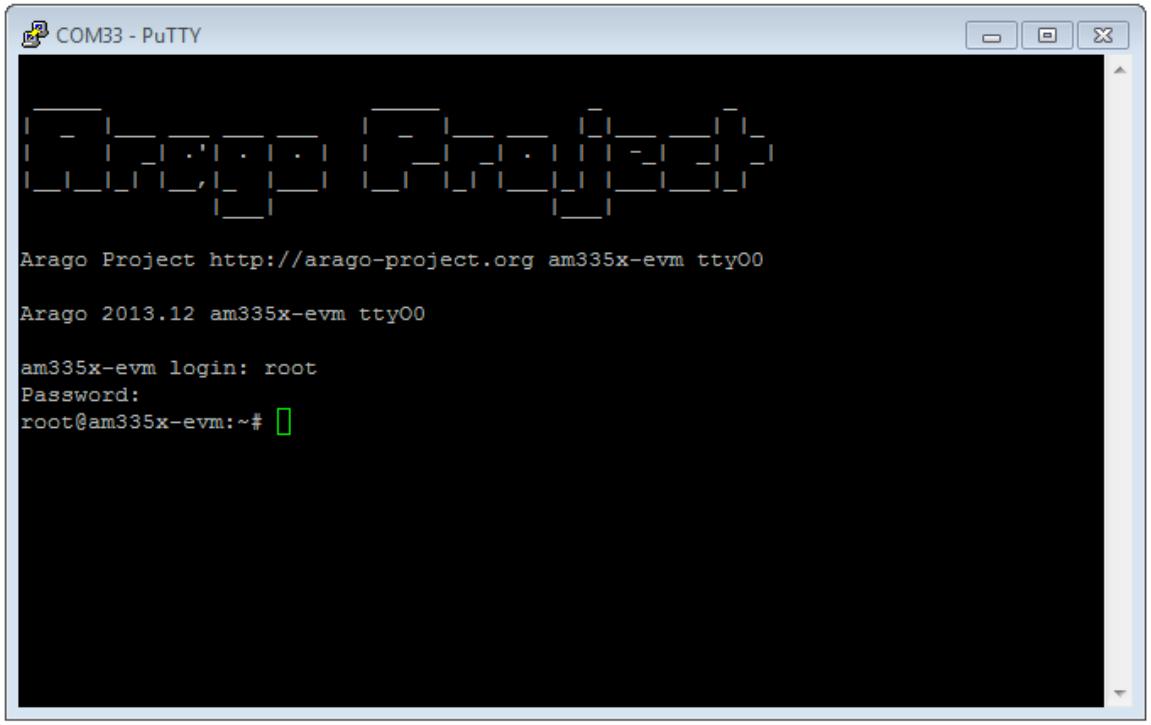
In case of SSH, select SSH connection in the PuTTY dialog box, enter the device's IP-address and port 22. By default, the device obtains an IP-address via DHCP when connected via Ethernet.



Push "**Open**" button.

After connecting to the gateway by one of the methods, PuTTY terminal window appears where you should to enter login and password. By default, login **root** and password **temppwd** (symbols not displaying while entering the password) are used for connection to

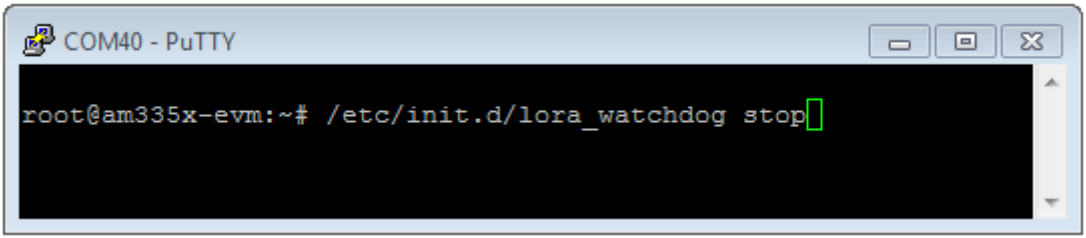
the gateway. At the first connection, it is recommend to change the password for individual access.



Now the configuration can be carrying out.

Packet forwarder starts automatically when the system starts. Before the gateway configuring, stop Packet forwarder by entering command:

/etc/init.d/lora_watchdog stop



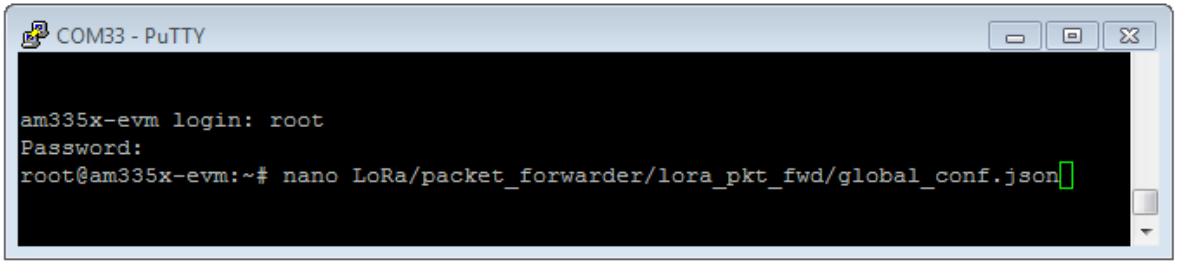
Configuration files are in the directory **LoRa/packet_forwarder/lora_pkt_fwd** – it may contain frequency band, the gateway ID, IP-address and server ports settings.

global_conf.json – global configuration file;

local_conf.json – local configuration file.

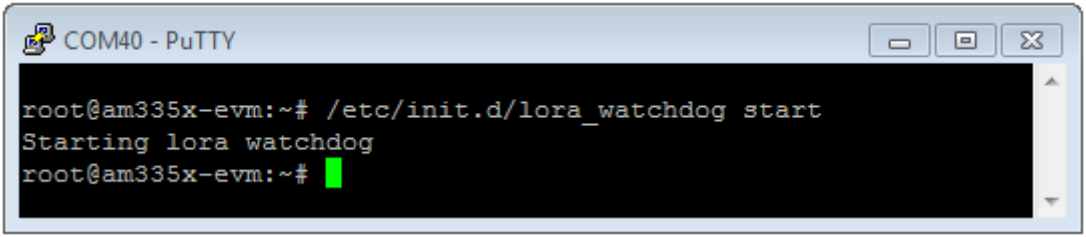
Settings contained in local_conf.json file take priority over global_conf.json

Enter the command, containing the required configuration file in order to change the settings, for example:



After all changes completed enter the command:

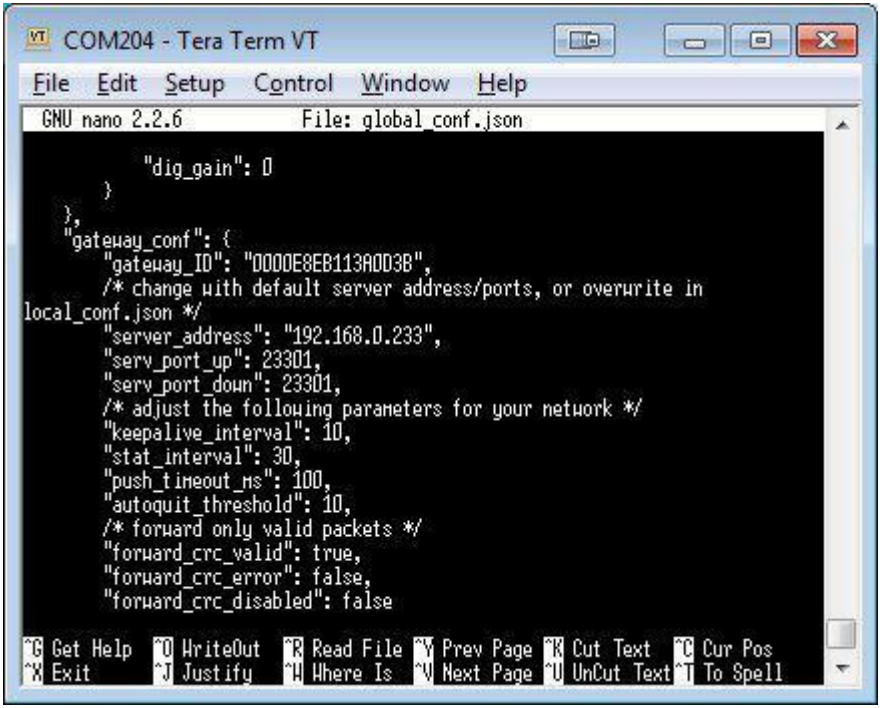
/etc/init.d/lora_watchdog start



Packet forwarder will automatically start with new settings.

To connect the gateway to the server, you must use the UDP port specified in the server configuration file. On the gateway, the port configuration is in the global_conf.json file

In the global_conf.json file, the UDP port settings are in the gateway_conf section, there are server_port_up and server_port_down parameters.



In order to communicate with the server correctly, you should make sure that these UDP port parameters correspond to those specified in the server configuration file (see details in the «IOT Vega Server Manual»).

To replace configuration file (for example, for change frequency plan) you need to make the following steps:

1. Go to Packet forwarder directory by the command:
   cd LoRa/packet_forwarder/lora_pkt_fwd/
2. Download file with needful settings. For example, from iotvega.com the EU868 frequency plan file (following command is exactly for that file):
   wget http://iotvega.com/content/ru/bs/bs01/EU868_global_conf.json
3. Open the old file global_conf.json by the command:
   nano LoRa/packet_forwarder/lora_pkt_fwd/global_conf.json
   and make a copy of the next parameters - gateway_ID, server address and port, and then close the file.
4. Delete old file global_conf.json by the command:
   rm global_conf.json
5. Make a copy of downloaded file (EU868_global_conf.json in our example) with a new name global_conf.json by the command:
   cp EU868_global_conf.json global_conf.json
6. Open file global_conf.json by the command:
   nano LoRa/packet_forwarder/lora_pkt_fwd/global_conf.json
   and specify saved in step 3 parameters, - gateway_ID, server address and port, and then save and close the file.
7. Restart gateway by the command: **reboot**

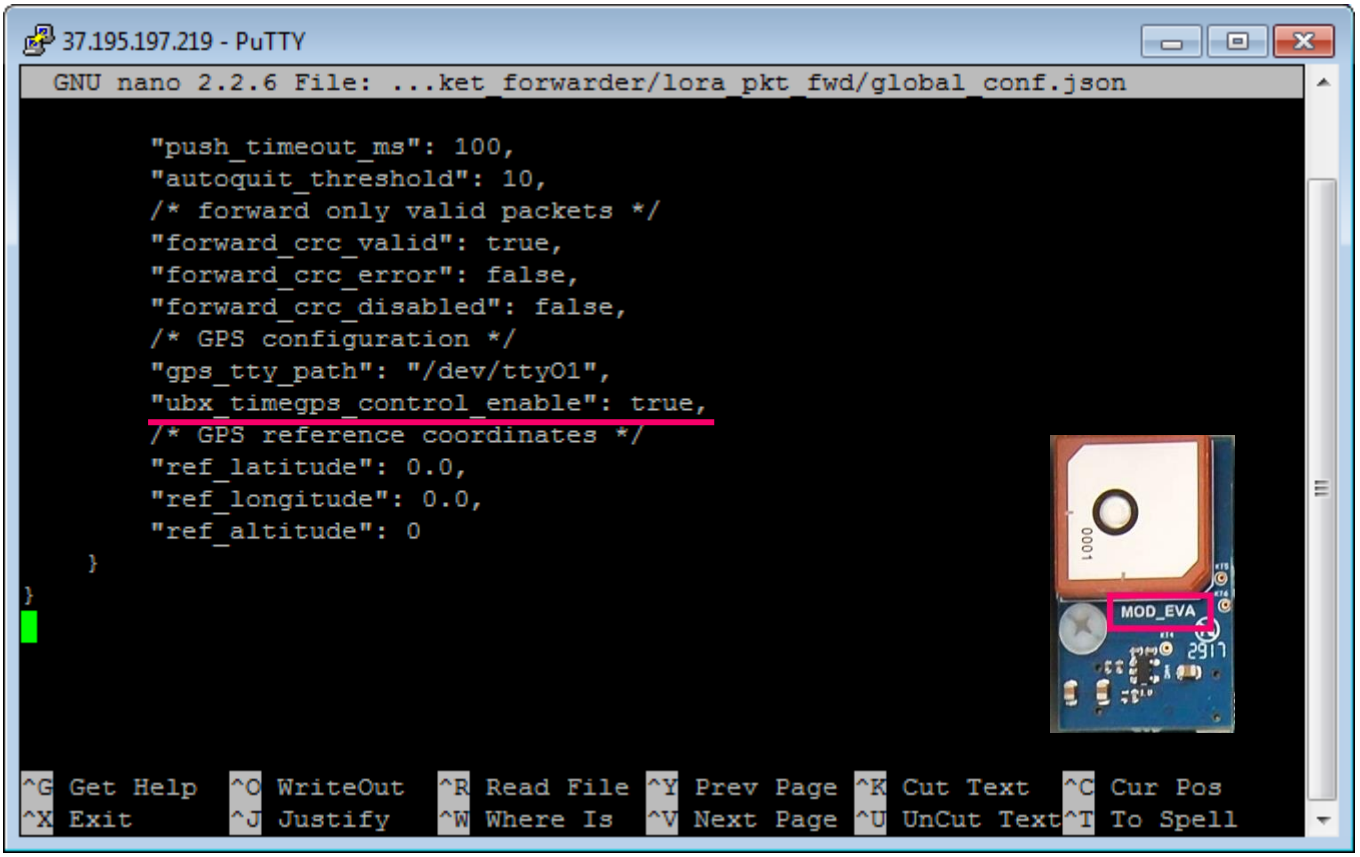
PACKET FORWARDER UPDATING TO 4.0.1 VERSION

Packet forwarder updating through computer connection using the terminal program in the following way:

1. After connecting to gateway, enter login and password in the PuTTY terminal window.
2. Enter a command **/etc/init.d/lora_watchdog stop** – command to turn off the internal timer.
3. Go to the root directory with the command **cd ~/**

Before upgrading Packet forwarder, save the settings from the files local_conf.json and global_conf.json located in ~/LoRa/packet_forwarder /lora_pkt_fwd/ for later restoration of the settings after the update

4. Delete files of the previous version of Packet forwarder by sequential introduction of commands:
   rm -r LoRa
   rm LoRa.tar.gz
5. Download files of the new version of the Packet forwarder by typing at the command line:
   wget ftp://89.189.183.233:14104/3.12.10-ti2013.12.01/LoRa_v4.0.1.tar.gz
6. Unzip the downloaded files with the command **tar xf LoRa_v4.0.1.tar.gz -C ~/**
7. Move downloaded files to the working directory **mv ~/LoRa_v4.0.1 ~/LoRa**
8. Restore settings in files **local_conf.json** и **global_conf.json**
9. If the GPS module in BS-2 has a label "MOD_EVA", then in the file global_conf.json the option "ubx_timegps_control_enable" should be enabled, i.e. "Ubx_timegps_control_enable": true. In other cases, when the GPS-module has other labels, that option should be disabled, i.e. "Ubx_timegps_control_enable": false.



10. Restart the Packet forwarder process with the command
    /etc/init.d/lora_watchdog start

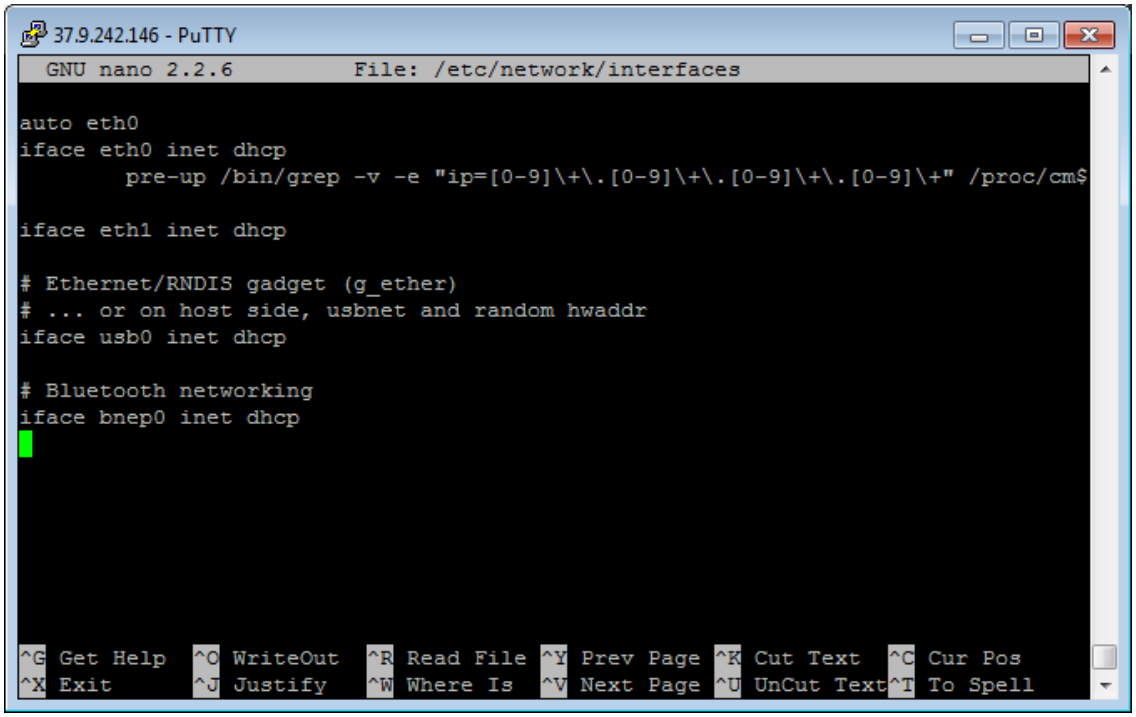
Update complete.

CONFIGURATION OF A STATIC IP-ADRESS FOR THE GATEWAY

Configuration of a static IP is different for first generation gateways and second.

For the first generation (BS-1 and BS-2) configuration carrying out with the terminal program in the following way:

1. After connecting to the gateway, enter login and password in the PuTTY terminal window.
2. Open file **nano /etc/network/interfaces.** Search authorization settings in this file:

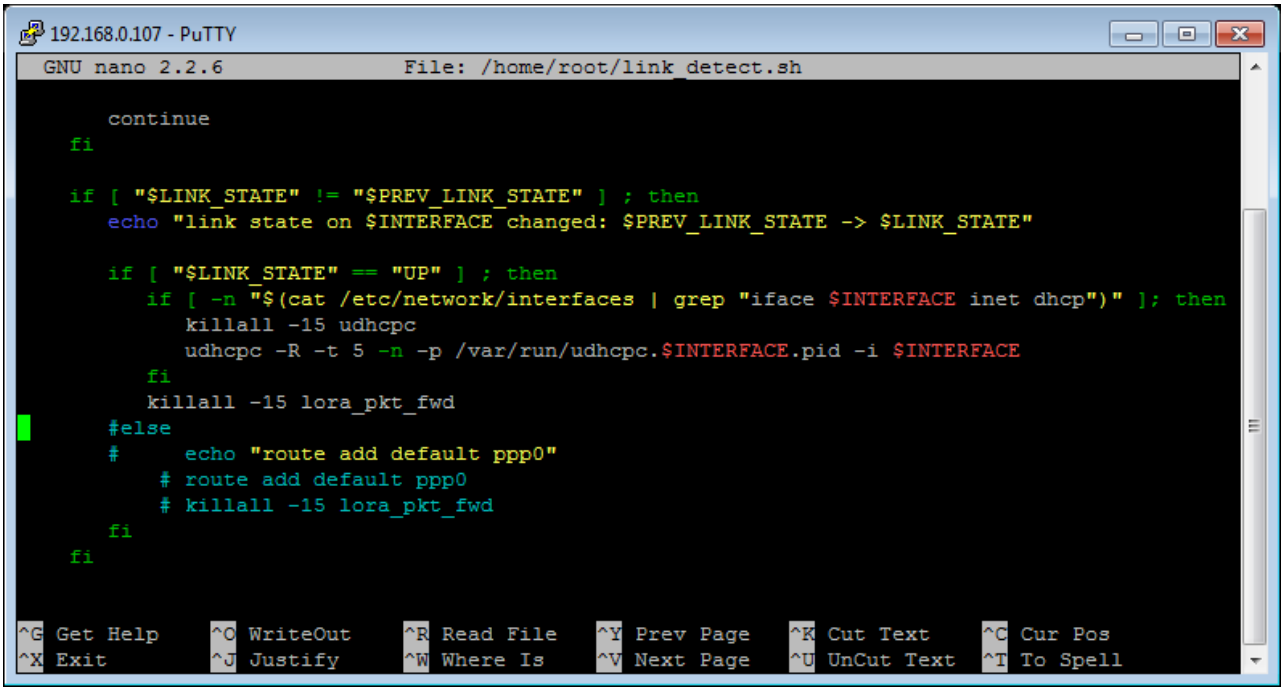


3. Enter changes highlighted in red:

```
auto eth0
iface eth0 inet static
pre-up /bin/grep -v -e "ip=[0-9]\+\.[0-9]\+\.[0-9]\+\.[0-9]\+" /proc/cmdline > /dev/null
address 192.168.240.252
netmask 255.255.255.0
gateway 192.168.240.1
```

In that example shown setting of the static IP-address 192.168.240.252 and gateway 192.168.240.1
You need to change those values to others, which are necessary to your own case

4. Open file **nano link_detect.sh -** then search string
   if ["$LINK_STATE" == "UP"] ; then
   Check after this string the following string is entered
   if [-n "$(cat /etc/network/interfaces | grep "iface $INTERFACE inet dhcp")"]; then
   Check before string
   killall -15 lora_pkt_fwd
   the following string is entered
   fi
   (see figure below)



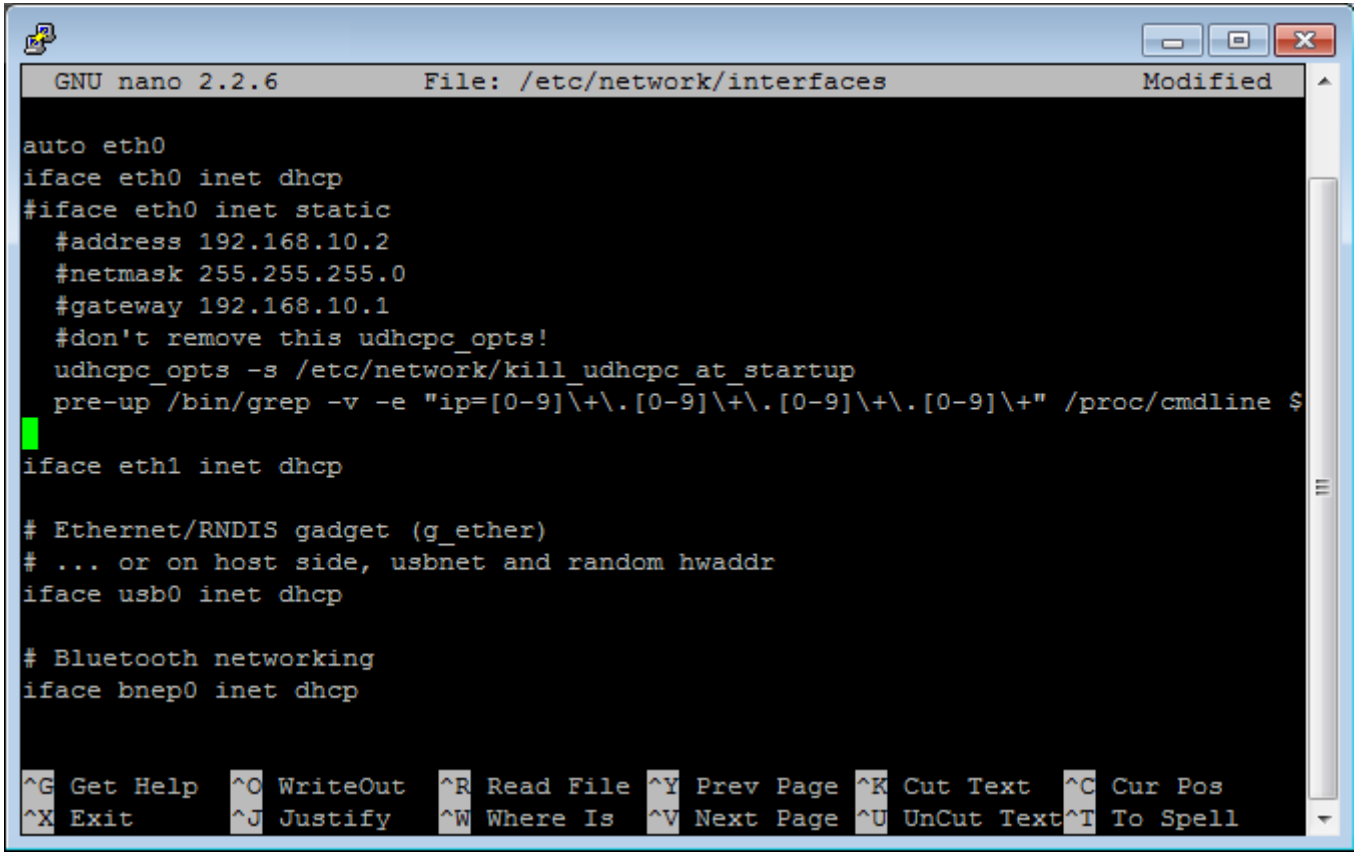
5. If the strings correspond to the figure above, do not change anything. If these strings are absent, enter them – changes are highlighted in red:

```
if [ "$LINK_STATE" == "UP" ] ; then
if [ -n "$(cat /etc/network/interfaces | grep "iface $INTERFACE inet dhcp")" ]; then
killall -15 udhcpc
udhcpc –R –t 5 –n –p /var/run/udhcpc.$INTERFACE.pid –i $INTERFACE
fi
killall -15 lora_pkt_fwd
```

6. Enter **reboot** at the command line to reboot the gateway with new settings.

For the second generation (BS-1.2 and BS-2.2) configuration carrying out with the terminal program in the following way:

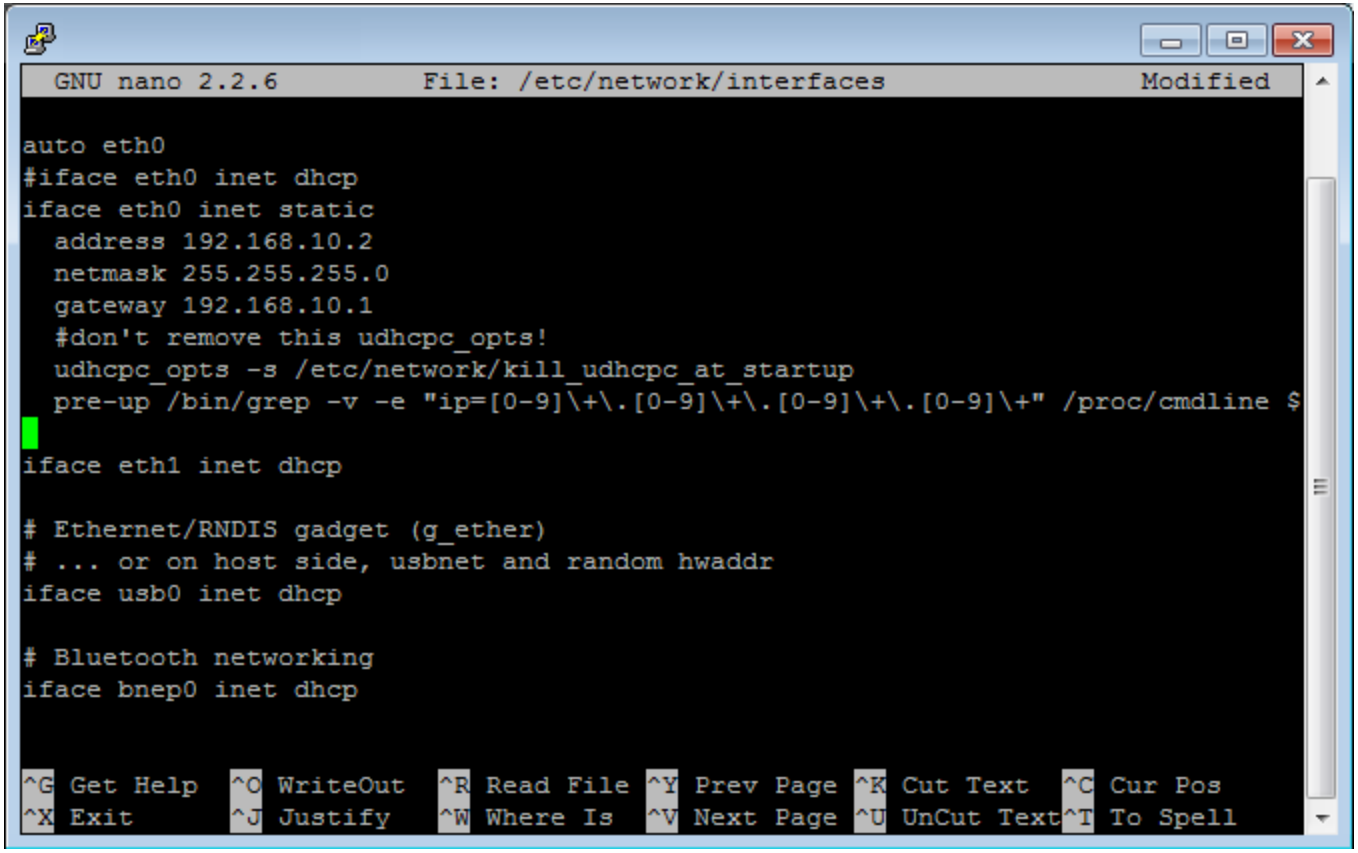
1. After connecting to the gateway, enter login and password in the PuTTY terminal window.
2. Open file **nano /etc/network/interfaces.** Search authorization settings in this file:



3. That are strings exactly:

```
auto eth0
iface eth0 inet dhcp
#iface eth0 inet static
  #address 192.168.10.2
  #netmask 255.255.255.0
  #gateway 192.168.10.1
  #don't remove this udhcpc_opts!
```

4. For static IP mode, you should to remove # symbol from the 3rd to 6th strings and specify your parameters are address, netmask and gateway.
5. Comment the 2nd string, there is result on the following screenshot (but another addresses value):



In that example shown setting of the static IP-address 192.168.10.2 and gateway 192.168.10.1
You need to change those values to others, which are necessary to your own case

6. Type **reboot** in command line for gateway restarting with new settings.
7. Going back is similar.

GATEWAY SETTING UP FOR 3G OPERATION

Gateway BS-2.2 does not required a special setting up for 3G operation, except the paragraph 3, namely – specifying a cellular operator's APN

Gateway BS-2 setting up for 3G operation using the terminal program is in the following order:

1. After connecting to the gateway enter login and password in the PuTTY terminal window.
2. Check, that in file **nano /etc/ppp/peers/wvdial** entered strings highlighted in red:

```
noauth
name wvdial
usepeerdns
defaultroute
replacedefaultroute
```

If these strings are not present, then you should to add them.

3. Check, that in file **nano /etc/wvdial.conf** entered strings highlighted in red:

```
; Init1 = ATZ
; Init2=ATQO V1 E1 &C1 &D2 +FCLASS=0
Init1 = AT+CPIN?
Init2 = AT+CGDCONT=1,"IP","internet.beeline.ru"
Modem Type = USB Modem
Baud = 460800
New PPPD = yes
Auto Reconnect = off
Modem = /dev/ttyACM0
ISDN = 0
```

```
Phone = *99#
Password = beeline
Username = beeline
```

where "internet.beeline.ru" is APN cellular operator. Change APN value according to APN cellular operator using by the gateway.

In that example shown 3G setting for Beeline cellular operator
You need to change those values to others, which are necessary to your own case

If the strings correspond to the figure above, you do not need to change anything, except the APN. If these strings are not present, then you should to add them. At that, strings

```
Init1 = AT+CPIN?
Init2 = AT+CGDCONT=1,"IP","internet.beeline.ru"
```

are entering instead string

```
Init = AT+CGDCONT=1,"IP","internet.beeline.ru"
```

The last three strings of the file specify the required dial-up phone, user name and password (different for each cellular operator):

```
Phone = *99#
Password = beeline
Username = beeline
```

Password and Username fields could not be are empty, if those parameters are not used by the cellular operator, then you may to enter 'internet' word at both fields for example

4. Create a script to update the DNS data received from the operator

nano /etc/ppp/ip-up.d/resolv_conf_update

```
#!/bin/sh -e
cat /etc/ppp/resolv.conf > /etc/resolv.conf
exit 0
```

Give him the right to run by typing at the command line:

chmod +x /etc/ppp/ip-up.d/resolv_conf_update

5. Add parameters to startup by typing at the command line:

update-rc.d gsm_init defaults

6. Type **reboot** at the command line to reboot the gateway with new settings.

To stop using the 3G modem for communicate with server for BS-2, type at the command line **update-rc.d -f gsm_init remove** and restart the gateway to apply new settings.

To start using the 3G modem to communicate with the server again for BS-2, type **update-rc.d gsm_init defaults** at the command line and restart the gateway to apply new settings.

BS-2.2 gateways are switching between Ethernet and 3G automatically

For recommendations for gateways using white IP, see Appendix.

If you use such two communication channels as Ethernet and 3G at the same time you should to remember that Ethernet has a priority for communication and 3G used as a backup option if gateway cannot communicate with the server via Ethernet

5 STORAGE AND TRANSPORTATION REQUIREMENTS

Vega BS gateways shall be stored in the original packaging in heated room at temperatures +5 °C to +40 °C and relative humidity less than 85 %.

The gateway transportation is permissible in covered freight compartments of all types at any distance at temperatures -40 °C to +85 °C.

6 CONTENT OF THE PACKAGE

The gateway delivered complete with:

Vega BS gateway – 1 pc.

POE-adapter– 1 pc.

Factory certificate – 1 pc.

7 WARRANTY

The manufacturer guarantees normal operation of the gateway and its elements within 36 months from the date of sale.

The manufacturer undertakes to repair or replace the failed device within 36 months from the date of sale.

The consumer undertakes to comply with the terms and conditions of transportation, storage and operation, specified in this manual.

Warranty does not apply to:

- the device with mechanical, electrical and / or other damages and defects caused by violation of the transportation, storage and operation requirements;

- the device lacking any part of the kit;

- the device with traces of repair performed not by the manufacturer's service center;

- the device with traces of oxidation or other signs of liquids leaking inside the device.

In the event of a warranty claim, contact the service center:

113/1, Kirova Str., Novosibirsk, 630008, Russia.

Tel.: +7 (383) 206-41-35.

APPENDIX – RECOMMENDATIONS FOR WORKING WITH GATEWAY

ANTENNA MOUNTING RECOMMENDATIONS

The Antenna included in the scope of supply has fasteners for installation on a mast support. To ensure maximum communication range, follow the installation guidelines for the antenna:

1. Install the antenna outside, preferably on the roof of the building (the higher - the better, depending on the surrounding buildings). Installing the antenna in the room significantly weakens the sensitivity of the antenna.

2. The installation site shall be as far as possible from the cellular antennas. Antenna tuning requires the maximum distance from other antennas. After tuning and testing, antenna can be brought back closer to the cellular antennas, if the quality of the communication is satisfactory.

3. The antenna shall not stand in the close proximity to obstacles (about 2 meters from railing, walls, etc.). The sensitivity towards the obstacle weakens.

4. The gateway shall be installed in the close proximity to the antenna – at the length of the antenna coaxial conductor. Increase of the cable length between the antenna and the gateway will result in a loss of antenna sensitivity.

For example, 25 meters of RG-58 cable attenuate the signal by 14 dBm, i.e. if transmission power is 14 dBm (25mW), the power on the antenna will be 1mW

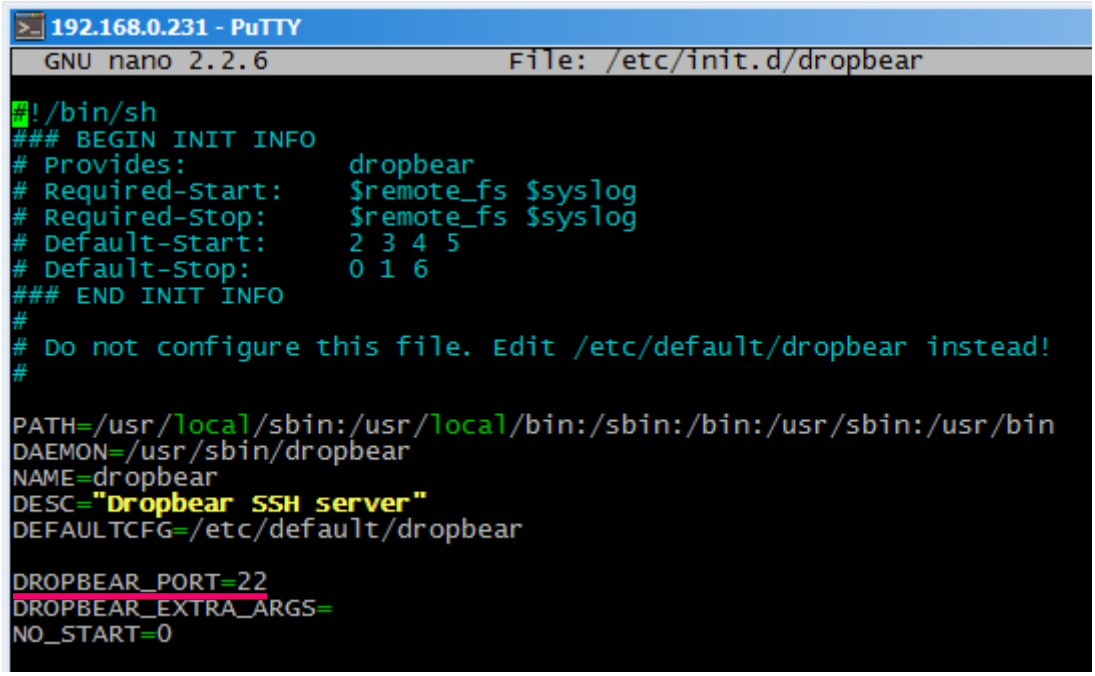
5. The antenna directional pattern shall be taken into account. In the horizontal plane, the antenna has a circular direction, but no vertical direction. Therefore, the quality of communication directly under the antenna will be worse than at some distance from the antenna.

RECOMMENDATIONS FOR GATEWAY USING IN WHITE IP NET

In case the BS is used in network with white IP, it is recommended to change the standard port numbers of ssh and telnet to anothers. This should be taken into account while port forwarding. The steps sequence for changing BS dropbear and telnetd ports is described below.

To change ssh port:

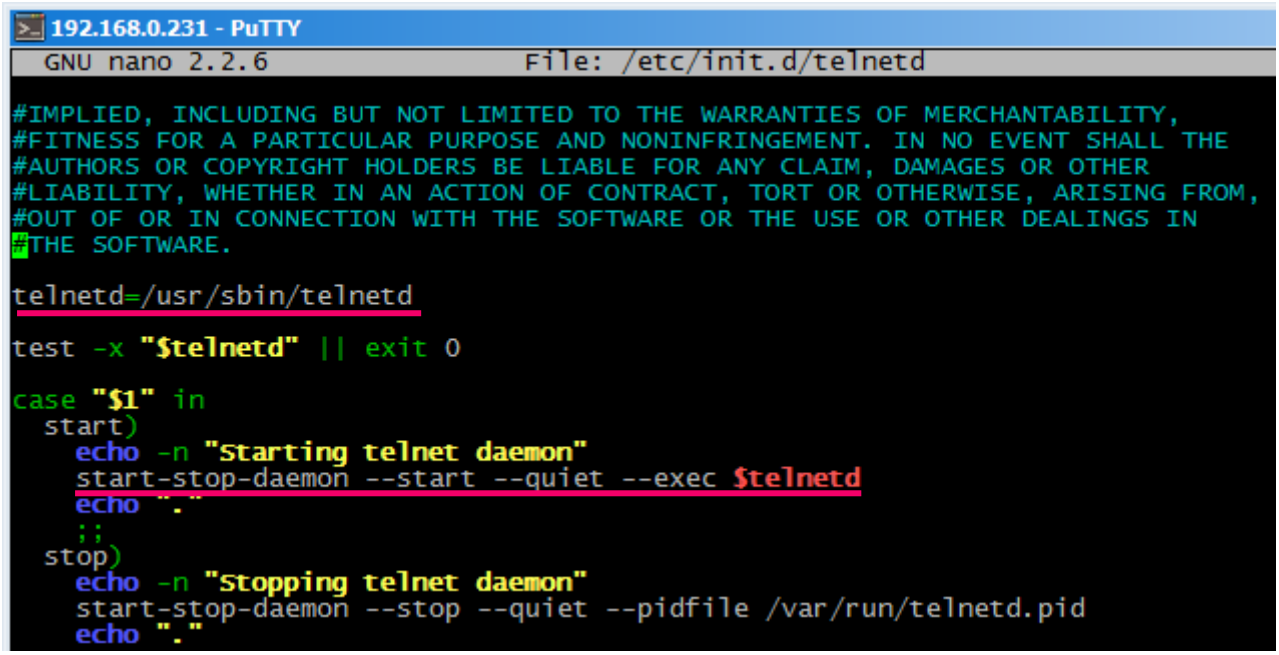
1. Enter at the command line of the terminal program **/etc/init.d/dropbear stop**
2. Open file **nano /etc/init.d/dropbear**



3. Find string DROPBEAR_PORT=22 and change standard port «22» to another, then save the file.
4. Enter at the command line of the terminal program **/etc/init.d/dropbear start**

To change telnet port:

1. Enter at the command line of the terminal program **/etc/init.d/telnetd stop**
2. Enter at the command line **killall -15 telnetd**
3. Open file **nano /etc/init.d/telnetd** - and find strings:



4. Enter strings highlighted in red (instead of "2224" enter the desired port number):

```
telnetd=/usr/sbin/telnetd
port="-p 2224"
...
start-stop-daemon --start --quiet --exec $telnetd -- $port
```

5. Save file and enter at the command line **/etc/init.d/telnetd start**

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