Software



OrionNetworkServer

ADMINISTRATOR'S GUIGE

FUNCTION AND PURPOSE

STRUCTURE AND OPERATION PRINCIPLES

CONNECTION TO THE SERVER AND OPERATION

TROUBLESHOOTING



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Contents

INTRO	DUCTION	3
1.	FUNCTION AND PURPOSE OF SOFTWARE	4
2.	ADVANTAGES AND FUNCTIONALITY OF THE NETWORK SERVER	5
3.	BASIC SPECIFICATIONS	б
4.	COMPOSITION AND STRUCTURE OF THE NETWORK SERVER	7
5.	INTERFACE AND PROTOCOL	9
6.	CONNECTION AND OPERATION	10
6.1.	Dashboard	12
6.2.	Profiles	13
6.3.	Coverage	16
6.4.	Gateways	17
6.4.1.	Gateways monitoring and changing	18
6.4.2.	Adding a new gateway and changes in gateways	21
6.5.	Applications	23
6.5.1.	Add new and change applications	24
6.5.2.	Transfer of configuration / commands from the Server to nodes	26
6.6.	Nodes	27
6.6.1.	Node monitoring	28
6.6.2.	Add a new and change Node	33
6.6.3.	Certification by testing the Node	35
7.	ROUTINE MAINTANCE	36
8.	TROUBLESHOOTING	37
8.1.	Join Accept is not delivered to Node	38
8.2.	No data from Node	40
8.3.	No connection to the network	41
8.4.	Data from Node discontinue to be displayed in the system	42
9.	REVISION SHEET	43



INTRODUCTION

This manual describes the software designed to operate with the full-featured OrionNetworkServer, its capabilities and ways of interacting with it, and also contains a description of possible troubles arising during operation and methods of solving them.

This Manual is intended for professionals who operate and maintain the OrionNetworkServer software.



1. FUNCTION AND PURPOSE OF SOFTWARE

The OrionNetworkServer software is a set of software tools (services, applications, programs) of a full-featured carrier-class LoRaWAN network Server. The software allows implementing a fail-safe, totally distributed, easily scalable and secure network infrastructure management system.

The built-in redundancy of the Server, as well as its distributed system with a high level of fail safety ensures guaranteed operation of the system without data loss: collection, processing and storing all received data through a variety of heterogeneous LoRa gateways from terminal devices, adapting data transmission rates, storing, and processing received and sent data through multiple gateways in the LoRaWAN network.



2. ADVANTAGES AND FUNCTIONALITY OF THE NETWORK SERVER

Building an easily scalable, distributed, high security system ensures a high level of fail safety, since the individual Server software components can be located both on one server and on geographically remote Servers. LoRaWAN network architecture is built on a "multi-star" topology and has the best balance between the service life of autonomous power supplies and the provision of communication range. The increased reliability of the system is achieved due to its adaptability to independent recovery of the data processing interrupted by the incorrect shutdown of the Server. The Server structure allows storing, without data loss, messages in the queue in an unlimited number.

In LoRaWAN networks, nodes are not associated with a specific gateway and the data transmitted by a node is received by multiple gateways (broadcast). Each gateway forwards the received packet from the end node to the OrionNetworkServer over the Internet. Networks of cellular operators, MetroEthernet, Wi-Fi or satellite networks can be used as the transit channel.

All information from terminal devices through gateways goes to the network server, which performs network management, filters redundantly received data packets, performs security checks, schedules acknowledgments through the optimal gateway, and identifies the adaptive data transfer rate.

If a node is mobile and moving, then there is no need for handover from gateway to gateway (handover) that allows applications to continuously operate with mobile IoT devices.

Factors affecting network bandwidth:

- the number of gateway channels that simultaneously support the data reception and transmission to terminal devices;
- data transfer rate (air time);
- the forward packet size;
- packets transmission frequency.

High network bandwidth is achieved through the use of Adaptive Data Rate (ADR) and a multi-channel gateway transceiver, which allows messages to be received simultaneously on multiple channels.

The network server ensures organizing LoRaWAN networks and is easily scalable by increasing the number of gateways, the network also allows switching the data transfer rate and reducing the broadcast time – this enables optimizing and increasing the autonomy of each terminal device and increasing the total network capacity.

Also, the functionality of the network Server ensures connecting any LoRa WAN terminal devices of class A, B or C, the logging function (recording of all actions) provides archiving of all information received from gateways and devices, supports uploading data as needed and upon request.



3. BASIC SPECIFICATIONS

The OrionNetworkServer software is fully LoRaWAN 1.0.3 compliant. The Network Server has a distributed structure, and its geographic distribution allows for the maximum level of fail safety. In addition, the Network Server ensures:

- Connection of an unlimited number of gateways;
- Connection of up to 240 terminal devices;
- Flexible selection system of settings for connected terminal devices;
- Device activation by personalization (ABP);
- Over the air activation (OTAA);
- Gateways control;
- Support for arbitrary frequency plans;
- Interaction between the Server and the API is implemented via Websocket;
- System monitoring and diagnostics (optional routers);
- Online viewing of packets from each terminal device;
- Provide concise statistics for each device and gateway on the network.

In addition, the Network Server has a built-in network planning (simulation) tool.

The NetworkServer database should contain information of newly connected devices: **DevEUI**,

AppEUI and AppKey.

To implement a Network Server, any operating system with 64-bit Linux operating system and NTP time synchronization system can be used.

The Network Server is capable of running in a container, on a virtual machine, or on a target computer.



4. COMPOSITION AND STRUCTURE OF THE NETWORK SERVER

The structure of the OrionNetworkServer software consists of certain software components, service solutions, and open-source software modules ensuring the several network managements functions: setting the schedule and frequency plan, controlling the operation speed, processing and storing data.

Implementation of the Server modular architecture provides a high level of fail safety and ensures integration into existing infrastructures. Software components can be located both in a separate container (Operating-system-level virtualization) and on a separate server. Together, they form a turnkey solution including a user-friendly web interface for device management and APIs for integration.

Information is transferred from gateways to the server through the TCP/IP protocol stack using SSL encryption. Parallelization at the message level allows tasks to be distributed across multiple queues. If the result of task processing does not meet certain requirements, then the same task can be re-queued.

OrionNetworkServer interacts with Application Servers via the WEBSOCKET API protocol.

The network is monitored and controlled from the operator's workplace. Synchronization of the Client and Server operation is based on the implementation of remote procedure calls through the REST API.

Various composite modules of software components allow interaction with various external applications through a standard interfaces set. The interaction between the Network Server elements is performed using the AMQP protocol focused on processing messages from LoRa WAN devices.



The structure of the OrionNetworkServer network Server:



The Network Server has a modular architecture and consists of the main components:

- LWServer;
- LWAuthorizator;
- LWCollector;
- WSOutput (Middleware).

Data from devices come through various LoRa gateways, which redirect the received data from devices to the Network Server to the LWServer service responsible for interaction of the network gateways with the rest of system components and dispatching the UDP socket, and also receiving and transmitting LoRaWAN messages from / to the network gateways. The LWServer service operates in a non-blocking mode and stores all received messages in a queue until the services receive them. The service is capable of processing tens of thousands of messages per second.

The **LWAuthorizator** service deals with authorization and authentication of subscriber devices, processing requests for subscriber devices authorization from LWServer, and also searches for subscriber devices in the database. When performing the OTAA/ABP network connection procedure, the service is responsible for authorization through external systems, as well as for updating the AppSKEY and NwkSKEY with the ability to export cryptographic terminal keys and other information.

LWAuthorizator transmits all the settings of the subscriber (terminal) device to LWServer for entering it into the database.

LWCollector is responsible for recording confirmed or unconfirmed messages (Confirmed and Unconfirmed LoRaWan Messages) to the database from subscriber devices received through the LWServer, as well as for broadcasting messages to the **WSOutput** service.

The *Middleware* module ensures interaction with various external applications and services through a set of standard interfaces, such as the *WSOutput* service.

The **WSOutput** service with the Middleware module is responsible for interacting with external systems, for pre-preparing data, transferring this data from or / the Client's application server via the Websocket API.

The RabbitMQ **queue manager** sends the received data from the queue to the RabbitMQ message broker, which in turn converts the exchange protocols from the official one from Sender to the formal one from Receiver.

As a database management system, the OrionNetworkServer uses the open-source objectrelational database management system PostgreSQL 9.5.X.

Application Server provides a web interface for managing Users, Organizations, Applications, Gateways, or Devices.



5. INTERFACE AND PROTOCOL

Convenient and intuitive web interface of the Server and Client applications provides a simple and prompt integration of new base stations (gateways) or nodes (terminal devices) with the possibility of preliminary radio planning, as well as calculating gateway coverage areas with analysis of the span profile. In addition, the software ensures monitoring of all current information of the gateways or network nodes status on the built-in interactive map in real time. In addition, the Network Server has advantages:

- Possibility to register new LoRaWAN routers and terminals in the network by importing them into CSV or files of a similar format;
- Possibility to create groups of LoRaWAN routers and Terminal devices in the network;
- Possibility to configure and manage alarms warning about LoRaWAN router and terminal equipment failures or changes in operating parameters;
- Possibility to view analytical data of the Network operation parameters at the level of the LoRaWAN radio signal spectrum;
- Possibility to remotely configure LoRaWAN routing, change their operating parameters and connection parameters (optional); The network manager supports sending multicast commands to terminal devices (Multicast).

The graphical shell for managing the system server is a GUI (graphical user interface). The GUI is a web application that interacts with OrionNetworkServer through the REST API (the principle of organizing the app interaction with the server using the HTTP) allowing the remote administration of the platform through a web portal.

Using the WebSocket API protocol allows establishing a stable continuous connection that reduces the transmitted information volume and saves time and traffic and transferring data both from the Server to the Client and vice versa.

WebSocket server (WebSocket API). When a Client connects to the WebSocket API, the RabbitMQ queue broker sends data from the Middleware queue to the corresponding Middleware microservice acting as a Data Consumer.

Data is transmitted to the Client via the WebSocket API protocol, which contains interaction methods and tools in the form of software components of the API interface and is also a means of integrating various applications.

Various WebSocket API commands enable:

- creating, receiving or deleting applications;
- creating or removing devices from the system;
- setting or querying various parameters such as GPS coordinates, device class, communication status, and more;
- control connections to devices and check or send data to the device with confirmation of receipt;
- requests for a list of tariffs or devices;
- receiving regular data and requesting archived information from the database with e-mail notifications.



6. CONNECTION AND OPERATION

Remote access to the web server is implemented through the web client user interface, which includes launching several services over HTTPS using SSL encryption and rendering all information. The login window looks like:

LEON	
SIGN IN TO CONTINUE	
Enter username	4
This field is required	
Password	
This field is required	
Login	
©2016 - 2020-Leon LoRaWAN Network Server	

Authorization to enter the system: enter the Login and Password. After a successful login, the application window will be displayed with a title, main menu, and work area:

LEON	≡ 8	۵	English	~	•	4
🖂 Oashboard	Dashboard					
🔮 Profiles						
• Coverage						
🗣 Gateways						
🚓 Applications						
📥 Nodes						
📥 Multicast nodes						
Log3						
						+



Six main icons are displayed at the top of the window:

≡	Collapse / expand the item menu
8	User settings
4	All notifications
English Русский English	Language Russian / English
1	Full screen
•	Logout

To display the names of the main tabs in the main menu, expand the menu





After selecting any of the menu items, the work area displays properties of the corresponding items.



6.1. Dashboard

After selecting the Dashboard in the workspace, the main parameters of devices connected to the network server will be displayed:

LEON	≡ 8			Q English	× 2. 0
M. Oschbeard © Coverage	Dashboard				
🗢 Gateways	Nodes activity				C
& Applications					
ah Nodes		630			
da Multicast nodes		Total			
		34 1 0 595 Active today No connection more t No connection No connection			
		5% 0% 0% 94%			
	Signal strength indicator (RSSI)	1 2 Amount of days Signal-to-no	vise ratio (LSNR)	1 D A	rount of days
	20	RSSI (dBm)		LSNR (dBm)	
	22 25 5 5 5 5 5 5 5 5 5 5 5 5 5		127 1039 1043 1043 1043 1045 1049 1045 1043 1045 1049 1045 1049 1045 1049 1045 1049 1045 1049 1045 1049 1045 1049 1049 1049 1049 1049 1049 1049 1049	-54 -52 -50 -58 -58 -58 -54 -52	

The following diagrams are displayed in the Device panel:

- Relative Signal Strength Indicator (RSSI), total for all devices;
- Signal/noise ratio (LSNR), total for all devices;
- Relative Signal Strength Indicator (RSSI), for each transmitted packet;
- Signal/noise ratio (LSNR), for each transmitted packet;
- Spreading factor, for each transmitted packet;
- Receive frequencies (percentage of use for each of the available frequencies);
- Traffic history (number of messages per day).

All chart elements are interactive: mouseover the corresponding diagram element – and detailed information of the selected item appears.

To update the chart in manual mode, click the icon in the upper right corner of the chart:





6.2. Profiles

After selecting the Profiles menu item, a list of profiles will be displayed in the workspace.

LEON	≡ 8					🗘 English 👻 🖍 🕞
Lud Dashboard	Profiles					
Coverage	Q Search					Add profile
🗢 Gateways						
& Applications	Action ~ (0 of 16 selected				
📥 Nodes	Username	Email	Profile type	Joined	Description	
📥 Multicast nodes	s.deitzhan	s.seitzhan@ตกงก-เกมิตากอาก	Administrator	2020-11-16 10:25:37	Oricast2M developer	
Logs	V.Shyvokem	ukasenov@katel.kz	Monitoring	2020-11-09 10:34:27	Poposition dispersions.	
	www.selovakly	aesselovsky@orlon-in2m.com	Administrator	2020-11-03 12:37:33	Onon Service Desk Manager	
	voerstutie	a.lurkenov@orion-m2in.com	Administrator	2020-10-08 15:28:07	StionM2M developer	
	daasiaalatov	diraslaslator genion-m2ra.com	Dealer	2020-08-13 16:19:09	Лан спарижента QC Опоем284	

The profile types can be:

- Administrator has the right to create / edit / delete own objects;
- Dealer has the same rights as the Administrator. Can add and manage child profiles;
- Monitoring rights only to view objects.



To create a new Profile, go to the Profiles section and click on button Add profile and fill in the appropriate fields:

Username	admin
Password	
Confirm password	
Email	email@mail.com
Profile type	Administrator
Description	
	Show objects of this profile:
	□ Applications □ Nodes □ Gateways
	Grant permissions to your objects to the profile:
Applications:	View Change
Nodes:	View Change
Gateways:	□ View □ Change
	Grant permissions to all objects to the profile:
Applications:	Grant permissions to all objects to the profile:
Applications: Nodes:	Grant permissions to all objects to the profile: View Change View Change



Possible types of objects to be displayed in a newly added profile:

- Applications;
- Nodes;
- Gateways.

Assigning the rights to own profile objects: <u>modification</u> or <u>viewing</u> only by marking the appropriate actions.

Only the Super Administrator may assign the profile rights to all objects. It is possible to assign View / Modify rights. The profile will have the appropriate rights to all OrionNetworkServer objects.

To **delete a profile**, go to the Profiles section. Select the profile to be deleted. Select Delete in the actions list and click the "**OK**" button. Agree with warning message:

LEON	≡ 8	
Lashboard	Profiles	
Coverage	Q. Sea	rch
🗢 Gateways		
& Applications	Action	Gn 1 of 16 selected
A Nodes	Detete Send nobilications	Erealt
da Multicast nodes	🗹 steidean	aamichon@orion-m2m.com
O Loga	V.SkymFuet	adorence@attrika
	avrantizakiy	a.senselovskiy@orion-m2m.com
	Abuikeney)	nku/kei.ov@orioh-m2m.cots
	ditestudates	dia-sulut.wijkenn-m2m.com



6.3. Coverage

After selecting the Coverage menu item, a map is displayed in the workspace showing all the Gateways installation points and coverage areas of each of them:



Coverage is calculated using the online tool **CloudRF™**. The calculation is possible both for actually installed gateways and for projected gateways, the installation parameters of which are registered in the OrionNetworkServer. Detailed instructions for setting gateways into the system are described in the **Gateways** section.

In the map's lower left corner, the cursor coordinates and map scale are displayed. The navigation menu is located in the upper left corner.

The following items are located in the upper right corner:

Layer control button



Polyline measuring tool allowing to measure the map distance between two or more points

Active gateways are shown on the map as **blue** dots, inactive ones – as **red** dots. When clicking on a point, detailed information about the selected gateway is displayed:

EUI	00206827EB63D070
Altitude	20m
Data count per hour	1
Description	Бишкек
Last seen	2020-12-09 15:36



6.4. Gateways

After selecting the Gateways menu item, the workspace displays a table with the main gateway parameters entered into the system:

LEON	≡ 8							English 👻 🦨
🕍 Dashboard 🎙 Coverage	Gateways							
	Q 00E Search	Found: S(Total: 309)						Add gatewa
 Applications Nodes 	Action Ga							
A Multicast nodes	Title	Coverage network	Description	EUI	RTT Data count per hou	Off/On	Last seen	Ip / Port
	67 C(8/280)	Санкт Петеребург 💽		00008,0760,1290086	0	0	2019-08-16 13:18:39	89.243.255.132~
	Nega test 💌	Челябие сас	Санкт-Петербург, Синопская наб., 14	65308SEB12431955	0	•	2018-10-30 19:04:10	78.07.126.100 ~
	EGLER/OSH O	fladarient pag		3000E868114(1949	0	۰	2018-12-18 13:48:27	175.5 - 10 184+
	MPCK_Forta			007068FW11410587	0	0	2018-04-17 20:45:36	717.116.75.125-
	000005973122509C3-5H8_20B	•	0000E8EB31290002 - SP8_2011	0000F56B1129u0Cz	0	٥	2018-03-20 19:23:36	20.248 255.122 +
	Found: 5							25 Table siz

The table displays the following gateway parameters:

- Gateway name;
- Gateway description;
- EUI gateway;
- Status (ON/OFF);
- The last event (Date, Time), if the Gateway had no contact during the day, the field is highlighted in red;
- IP address and Gateway connection port.

Also, in this area, functions are available for adding, removing and searching gateways by certain parameters.



6.4.1. Gateways monitoring and changing

To monitor and change the parameters of each individual gateway, go to the gateway by selecting it in the table.

The following diagrams are displayed in the working area of the Gateway for monitoring:

• *Relative Signal Strength Indicator* (RSSI) in a gradient format with a 10 dBm step and *Signal/noise ratio* (LSNR) in a gradient format with a 2 dBm step, for the last 24 hours for all nodes working through the Gateway:



• Composite diagram of Signal Strength Indicator (RSSI) and Signal/Noise Ratio (LSNR):



• Signal Strength Indicator (RSSI), for each transmitted packet, indicating the date, time and frequency of the packet transmission:





• Signal/noise ratio (LSNR), for each transmitted packet, indicating the date, time and frequency of the packet transmission:



• Spreading factor for each transmitted packet, indicating the date, time and frequency of the packet transmission:



• Receiving frequencies (percentage of use of each frequency available for the selected period, by default for the last day), when one of the frequencies is selected on the diagram, the number of messages transmitted on this frequency for the selected period is displayed:





• Traffic history – number of messages processed by the Gateway: <u>for the selected period</u>; <u>last day or month</u>



All diagram elements are interactive: mouse over the corresponding element – and detailed information for the selected element appears.

In the table Received data:

lime	Node	Frequency, MHz	Message type	FCNT	RSSI, dBm	LSNR, dB	SF	Size	Air time, ms	Bandwidth, kHz	Mac	Direction	Data	Downlink ack	Downlink ack tim
020-12-07 23:22:28	50%369329746070	869.1	JR		-121	-7.2	12	23	1155.072	125		Uplink	SE40	N/A	
020-12-07 23:21:05	0.0476932974FC%)	869.1	JR		-120	-6.2	11	23	659.456	125		Uplink	3556	N/A	
020-12-07 23:20:28	35967503297AFC70	868.9	JR		-119	-5	10	23	329.728	125		Uplink	200A	N/A	
020-12-07 21:07:23	300659921006-153	869.1	UDU	47	-122	-11	12	27	1646.592	125		Uplink	703 67/02/2000 31/2700007 (31/00/97	N/A	
020-12-07 20:41:59	3080168014767029	869.1	JR		-120	-10.8	12	23	1155.072	125		Uplink	AA20	N/A	
020-12-07 20:40:36	0C390660147E7493	868.9	JR		-120	-5	11	23	659.456	125		Uplink	1050	N/A	
020-12-07 20:39:58	40255686167F++20	868.9	JR		-117	-6.8	10	23	329.728	125		Uplink	BP:8	N/A	
020-11-19 16:12:17	04/90/85784421042	869.1	AL				12	33	1318.912	125		Downlink	OEO/13A	N/A	
020-11-19 16:12:15	D6F6753754/6/02/2	869.1	JR		-120	-16.8	12	23	1155.072	125		Uplink	F.140	N/A	
020-11-19 16:10:54	DG + 9/7344213/2	869.1	JA				11	33	659.456	125		Downlink	993269	N/A	

the total number of messages received by the Gateway and detailed information on the last ten messages are displayed. Detailing includes the following fields:

- Message reception time;
- Dev EUI of the node transmitted the message;
- The frequency at which the message was transmitted;
- Message sequence number (FCNT);
- Relative Signal Strength Indicator (RSSI);
- Signal/noise ratio (LSNR);
- Spread Factor (SF);
- Packet size in bytes;
- Packet transmission time (Air time) in milliseconds;
- The data is in hexadecimal format.



6.4.2. Adding a new gateway and changes in gateways

To add a new gateway in the workspace of the Gateways item, click the button Add gateway

When the window opens, then enter the following parameters:

- Gateway name;
- Description (installation address and any comments required);
- Gateway IP address;
- Gateway Port;
- Gateway EUI;
- Coverage the settlement for installing the Gateway to be selected from the pop-up list. If there is no settlement in the list, you can add it by clicking on the + to the right of the Coverage field;
- Suspension height of the gateway antenna.

Add gateway		
Title		required
Description		
IP		
Port		
EUI		required
Coverage	Start typing 👻 🕇	required
Antenna	Start typing 👻	
Antenna azimuth	0	required
Antenna tilt	0	required
Altitude	0	



There are two ways to specify a location:

- Click on the interactive map;
- Enter geographic coordinates.



If there is no need to save the settings, click the button Back to gateways :he upper part of the window.

If you need to make **changes** or **adjustments** to the Gateway parameters, select the appropriate Gateway in the workspace. After that, the workspace will display the data described above. The internal data structure is completely the same as when adding a new Gateway.

Below the Latest data table there is a field Change gateway that displays the current Gateway settings and its location on the interactive map.



6.5. Applications

After selecting the Application menu item, the following application settings are displayed in the workspace:

٤	Search					Add application
ction	Go					
	Name	Nodes	App ID	App EUI	Clients count	Consumer count
	Sestapp	10	5365725178	D65FG25685054274	1	1
	October 2M - AMR (Temperature)	1	5FQ77207*	PCERAFISE707%74X3	1	1
	Bloudig, Agro	1	26633/2801	6889/962/42/10/2322	0	0
	029275	1	163154%0	380640531860348F	0	0
\square	(RU vite)	1	81065025	SPECODER/7DA1400	0	0

The table displays the following application parameters:

- Application name;
- Number of Nodes using the Application;
- App ID;
- App EUI;
- Number of WebSocket Clients;
- Number of RabbitMQ consumers.

Also, in this area, adding, changing, deleting and searching applications for any parameters are available.



6.5.1. Add new and change applications

In the workspace of the Application element, click on the button Добавить приложение

Name		required	
App ID	AB7C5888	required	
App EUI	7402BAC85191C37B	required	
Output		required	
Clients limit	2		
Consumer limit	1		
Auto consume start	0		
Accessible apps	Start typing		
+	New extra field		

In the opened window enter the following parameters:

- Application name (set arbitrarily for future identification);
- App ID automatically generated by the server;
- App EUI automatically generated by the Server;
- Exit, selected from the pop-up list of available types of interfaces for data transfer from the Server to the client application (WebSocket);
- Limiting the number of WebSocket clients. A server provides each one with automatic data retrieval from queues from a specified number of clients via the WebSocket protocol;
- Limiting the number of RabbitMQ consumers. Server, using the WebSocket protocol, allows each consumer receiving data from queues from a specified number of consumers (WebSocket users), as well as requesting or, if necessary, re-requesting archived data from the Server Database (DB);
- Autostart of the consumer provides the ability to automatically request the required data from the Server each time when a user connects to the Server;
- Available applications select from the pop-up list of available Middleware microservices with configured settings and application parameters.



After completing all the settings click the button

Add

e lower left part of the window.

To **change** the parameters of an Application, select the appropriate Application and click on it. In the Application window that opens, make changes and click

Name	OnonM2N - AH2 (Temperature)		required
App ID	FF077207		required
App EUI	FCY2AER870D5F853		required
Output	WebSocket	~	required
Clients limit	5		
Consumer limit	3		
o consume start	0		
Accessible apps	Start typing		
+	New extra field		

The structure and data are completely identical to those for adding a new application.



6.5.2. Transfer of configuration / commands from the Server to nodes

For remote transfer of configuration or commands in the **Application** tab, select from the list of WebSocket applications: /apps/lwParser?

CONTRACTOR DAN	id-SOFEEDPExtole	movine SuEi7Br	EksVZZSnia	a.	
orthographic and an and the		-papiro arriva	and the second second	· · ·	
apps/lwParser?	op id=S9EEE03E&tol	en=pxbnSvFi7	BREESVZ402	nkas	

Then click Send data

In the pop-up window on the right side, enter the following data:

- EUI Nodes;
- Fport (by default 2);

and enter the Configuration Data in the form of a **hex** string (see Terminal Exchange Protocol).

Move the toggle switch on to **ON** and press the Send button.

Back	Decode data	Send data 📘	Save			Node EUI
Filter by EUI	:	From		То		Li
		2020-12-09 16:44	#	2020-12-09 17:44	*	Fport
Node EUI	Date~	FCNT	Freq	RSSI	LSNR	2
						Payload (hex string)
						OFF
						Send
						_
						Constanting -
The con	firmati	on will be th	ne inform	nation window:		SUCCESS

Depending on the device class (A or C), the data will enter the queue and be sent during the next session with the terminal device.



Data sent

6.6. Nodes

After selecting the Nodes menu item, a table with the main parameters of nodes entered into the system is displayed in the workspace:

on V Go	Search									Add nod
							Packet los	s rate		
Device EUI	Device address	Application	Off/On	Last message	Description	Lastjoin	Actually	Daily	Weekly	Monthly
	A668D45B	testapp	0		KV6		096	0%	0%	096
5006558310CE1387	00520588	testapp	0	2020-12-07 21:07:23	KV8	2020-11-13 21:54:00	096	0%	0%	0%
64/20044F3CB0F271	(32873120	testapp	0		KV10		0%	0%	096	0%
ASEE8F7ASAS645cA	56448578	testapp	0		KV7		0%	0%	0%	0%
-	AFAICON	testapo	0		KV11	2020-11-19 16:12:15	0%	096	0%	096

The table displays the following gateway parameters:

- EUI devices;
- Device address;
- Application;
- Last message;
- Description;
- Last connection;
- Loss ratio.

Also, functions are available here for adding, deleting and searching nodes by any parameters.

To monitor and change the parameters of each individual node, select the Node in the table.



6.6.1. Node monitoring

The following diagrams are displayed in the working area of the Node:

• Signal strength indicator (RSSI) of a Node in a gradient format with a step of 10 dBm and Signal/noise ratio (LSNR) of a Node in a gradient format with a step of 2 dBm, for the last 24 hours for all nodes:



• Composite diagram of Signal Strength Indicator (RSSI) and Signal/Noise Ratio (LSNR):



• Signal Strength Indicator (RSSI), for each transmitted packet, indicating the date, time and frequency of the packet transmission:





• Signal/noise ratio (LSNR), for each transmitted packet, indicating the date, time and frequency of the packet transmission:



• Spreading factor for each transmitted packet, indicating the date, time and frequency of the packet transmission:



• Receiving frequencies (percentage of use of each frequency available for the selected period, by default for the last day), when one of the frequencies is selected on the diagram, the number of messages transmitted on this frequency for the selected period is displayed:





- C Packet loss rate Frequency 865.1 4.0 Packet loss rate 865.3 865.5 2.0 865.9 0.0 12:00 18:00 10 Dec 2020, Th 06:00
- Packet Loss rate the percentage of lost packets for the period for each frequency:

• Traffic history – number of messages transmitted by the Node for the selected period, last day or month:



• FCNT – message sequence number, which is reset every time the Node is rebooted:





- The Current data tables displaying the following information:
 - In the table Gateways in radius displays the following data for each gateway:
 - Gateway (Dev EUI);
 - RSSI (Receive Signal Strength Indication);
 - SNR (Signal/Noise Ratio);
 - Noticed (Date and time of packet transmission):

Current data				Refresh in 10
Gateways in range 👩				
Gateway	RSSI	SNR	Seen	
60C5ARFYT17R838F	-47 dBm	9.8 dB	2020-12-10 09:47:46	
0000/3827EB009E0B	-99 dBm	-5 dB	2020-12-10 09:47:46	

- The data transferred from the Network Server to the Node:

Fime	Gateway	Frequency, MHz	Message type	FCNT	RSSI, dBm	LSNR, dB	SF	Size	Air time, ms	Bandwidth, kHz	Mac	Direction	Data	Downlink ack	Downlink ack time
020-12-10 09:47:46	60CGHSFFFFF7663BF	865.7	UDU	1461	-47	9.8	7	28	61.696	125	06FE1B	Uplink	78AA203041422C8E00990000	N/A	
020-12-10 09:27:07	60ClassPEPE7663BF	865.7	UDU	1460	-46	10.5	7	28	61.696	125	06FE1C	Uplink	78A920000192278E00990000	N/A	
020-12-10 09:08:04	60CSA8FFFE7663BF	865.7	UDU	1459	-46	8.8	7	28	61.696	125	06FE1D	Uplink	78A8200001E2228/00990000	N/A	
020-12-10 08:49:13	60C5//8FFFE78638F	865.3	UDU	1458	-47	10	7	28	61.696	125	06FE1A	Uplink	78A7200001321E8E00990000	N/A	
020-12-10 08:29:41	60C528597E7863BF	865.5	UDU	1457	-45	7	7	28	61.696	125	06FE1B	Uplink	784520000182197500930000	N/A	
020-12-10 08:09:08	60C5ASFFFE7683BF	865.3	UDU	1456	-46	10.3	7	28	61.696	125	06FE1A	Uplink	78A520000102148E00990000	N/A	
020-12-10 07:48:01	60C5ASFFF07663BF	865.7	UDU	1455	-44	9.8	7	28	61.696	125	06FE1A	Uplink	784420000122103200990000	N/A	
020-12-10 07:28:14	60C5A5FFFE7663BF	865.9	UDU	1454	-45	9.3	7	28	61.696	125	06FE1B	Uplink	RA3200001720B8E00990000	N/A	
020-12-10 07:08:16	60C5AS9FFE76632F	865.3	UDU	1453	-47	9.8	7	28	61.696	125	06FE1A	Uplink	78A220002202058E00990000	N/A	
020-12-10 06:47:56	60C5A3FFFE76638F	865.9	UDU	1452	-46	9.3	7	28	61.696	125	06FE1A	Uplink	78A329500112028E00990000	N/A	

- The ADR log table showing ADR operation:
 - Transmission time;
 - The gateway through which the transmission passed;
 - Current DR (Current delivery rate);
 - Ideal DR (Ideal delivery rate);
 - Current Tx Power (Current signal strength according to LoRaWAN[™] Specification);
 - Ideal Tx Power (Reference signal strength according to LoRaWAN[™] Specification);
 - Current NB Trans (number of retransmissions, a detailed description of this field is given in the LoRaWAN ™ Specification);
 - Ideal NB Trans (number of available retransmission windows);
 - SNR Margin (Signal/Noise ratio margin to ideal value);



- Max SNR (maximum Signal/Noise ratio);
- Avg SNR (average Signal/Noise Ratio):

ime	Gateway	Current dr	Ideal dr	Current tx power	Ideal tx power	Current nbtrans	Ideal nbtrans	Snr margin	Max snr	Avg snr
020-12-07 17:47:44	6005A8FFFE76838F	DR5 - SF7	DR5 - SF7	PWR5	PWR5	2	1	6.49	10.3	8.99
020-12-06 20:27:45	60C5A8FFFE76636F	DR5 - SF7	DR5 - SF7	PWR5	PWR5	1	3	7.17	10.8	9.67
020-11-21 18:51:58	60C5A8FFFE7663BF	DR5 - SF7	DR5 - SF7	PWR5	PWR5	2	1	7.275	11.5	9.775
020-11-21 12:10:49	60C5A8FFFE7860PF	DR5 - SF7	DR5 - SF7	PWR4	PWR5	1	2	6.775	11.3	9.275
2020-11-21 02:45:51	60C%A8FFFET663BF	DR5 - SF7	DR5 - SF7	PWR2	PWR4	1	1	6.785	10.5	9.285
2020-11-20 19:51:17	60C5A8FFFE780CBF	DR2 - SF10	DR5 - SF7	PWR0	PWR2	1	1	15.89	13	10.89
2020-11-19 08:30:38	60CSAGE0FE7663BF	DR5 - SF7	DR5 - SF7	PWR2	PWR4	2	1	6.785	10.3	9.285
2020-11-19 01:30:36	60C5ASFFFF7663BF	DR2 - SF10	DR5 - SF7	PWR0	PWR2	1	2	15.01	12.8	10.01
2020-11-16 06:54:13	60C5ASFFFF7663BF	DR5 - SF7	DR5 - SF7	PWR5	PWR5	2	1	6.69	10.8	9.19
2020-11-15 23:51:18	60C5A85976 2503BF	DR5 - SF7	DR5 - SF7	PWR5	PWR5	3	2	6.77	10.3	9.27

All diagram elements are interactive: mouse over the corresponding diagram element – and the detailed information appears for the selected element.



6.6.2. Add a new and change Node

If it is necessary to add a new Node, click on the button

in the Node working field:

Back to nodes Add node						Simple	Advanced
Node settings							
Add node				LoRaWAN AES128 keys			
Activation	OTTA ASP			App key Application Key	If you want to enable over-the-sir join, add or derive the device's application key.	Ø	2
Application	required	,	~	Nwks key Network Session Key	E7181A3344797428FFE8FB36CD801544	Ø	2
Device EUI	required	⊘ ≓		Apps key Application Session Key	545F6F8DF46D630A73600FBEE7828C92	2	=
Device address	1AC\$4438	⊗ =		NOTE: When copy-pasting an AES128 key, use it as it is. It is a cryptop	graphic key without the notion of endianness.		
Tariff	repired	,	~				
Description							
Off/On							
+	New extra field						
Add							

Add node

Then, in the opened window enter the following parameters related to the Node configuration on the network Server side:

- Activation method (OTTA/ATS); •
- Application. One of the available applications is selected from the pop-up list; •
- Device EUI (assigned by the Node manufacturer); •
- Device address (automatically assigned by the server); ٠
- Tariff (the maximum number of messages processed by the server per day). Selected from • the list of available tariff plans;
- Description; •
- App key Application key; •
- Nwks key Network session key; •
- Apps key Application session key. ٠

After switching the checkbox to advanced mode Simple Advanced, the following settings are available:

Location (where the Node is installed). By entering the coordinates of the proposed installation site on the map, you can analyze the network coverage at the proposed installation point.

Possible settings of LoRaWAN Node Parameters directly related to the operation of the radio interface of the Node are:

- Node class (LoRaWAN class of node A-B-C, selected from the pop-up menu);
- Rx window (Preferred LoRaWAN receive window, selected from pop-up menu); ٠
- Region (Available frequency plans according to LoRaWAN[™] Regional Parameters);



Software | OrionNetworkServer | ADMINISTRATOR'S GUIDE

- Duty cycle;
- ADR (Adaptive delivery rate, ADR on/off);
- ADR interval (The number of messages, after the reception of which a decision is made to change the transmission rate);
- Adr min (The minimum transmission rate, selected from the pop-up list: DR0 DR7);
- Adr max (The maximum transmission rate, selected from the pop-up list: DR0 DR7);
- Adr fix (Fixed delivery rate, selected from the DR0-DR7 pop-up list).

LoRaWAN Sequence Numbers Settings:

- Seq up (Uplink sequence number);
- Seq down (Downlink sequence number);
- Down queue (default value 0);
- Sequence check (selected from the pop-up list). Strict checking requires strictly ascending sequence numbers. Poor check (Relaxed) allows resetting sequence numbers.

The LoRaWAN Node Parameters and LoRaWAN Sequence Numbers windows are:

LoRaWAN node parameters		LoRaWAN sequence numbers	
Node class LoikaWM node class	A veget	Seq up Uplink sequence number (PCnt Up)	0 regist
Rc window LoBaWAN Receive Window preference	Ril v	Seq down Downlink sequence number (FCnt Down)	0 required
Region	K2865-888 V	Down queue	0 repired
Duty cycle	0 repind	Sequence check	Solici. regional Bolici de de se ingles a delly increasing sequence numbers. Datage to state of your Solicies of section of the section of
ADR Adaptive Data Rate	Chlythe end-device can enable / disable ADR		device is sending deta, but you don't see them in the deta subput.
Adrinterval	20		
Adrmin	Dec 🗸		
Adr max	DRs V		
Adr fix	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		
Roaming support			

<u>Note</u>

If the device sends data, but it is not visible at the output, specify a poor check (Relaxed).

Required fields are marked with the comment Required field.

After completing all settings, click the button **at the bottom of the window**.

If any **changes** to the parameters of a Node are needed, select the appropriate Node in the element workspace. After that, the workspace displays the data described above. The internal structure and data are completely the same as for adding a new Node.

After changing the Node parameters, press the button



6.6.3. Certification by testing the Node

To certify the terminal devices:

- Log in to **OrionNetworkServer** and go to the Application tab;
- In the list of *WebSocket* applications, click on the link: /apps/lwNodeTesting?.....;
- Select a node for testing and click the button

2	Filter			Information about test cases	Run all test
	Device EUI	Device address	Status	Description	
	7AA897413630374	172E6C01	-		
	C3680AFEFFF9659F	78563420	-		

During the test, the status is *well be displayed with information about Progress*:

Progress		0%
Total time	0:06:30 (7 Minutes)	
Started in	2020-12-10 13:01:47	
Last message	-	

After the test, the status **Passed** or **FAD** will be displayed.



Terminal device testing allows checking the device for compliance of parameters with the LoRaWAN standard.



7. ROUTINE MAINTANCE

The operation of the OrionNetworkServer consists of preventive and maintenance performed by the maintenance personnel of the operating side. The routine performance monitoring is necessary in order to identify possible malfunctions of the network server.

During monthly (scheduled) maintenance check system updates, check the database and the libraries integrity.

During the Network Server operation and its scheduled maintenance, check the availability and quality of gateway connections, and the connection quality with terminal devices.

Monitoring of Gateways parameters is given in paragraph 6.4.1 of this Manual.

Monitoring of Nodes parameters (terminal devices) are given in paragraph 6.6.1 of this Manual.

All maintenance work shall be performed by the operating personnel; specialists from other specialized departments may be involved in the work in agreement with the operating party management.



8. TROUBLESHOOTING

During the settings or using the Network Server, some malfunctions associated with the operation of software components may occur. This section presents possible malfunctions and methods of their elimination.



8.1. Join Accept is not delivered to Node

When this problem occurs, the server does not send Join Accept in response to the Join Request from the terminal device (Node).

CAUSE	Unexpected shutdown of the lw_serv software component												
HOW TO IDENTIFY	Re Fu 2022 2022 2022 2022 2022 2022 2022 2	Look in equest att Data 5213 1 BpeMR 2020-05-14 09:15:07 2020-05-14 09:15:07 2020-05-14 09:14:43 2020-05-14 09:14:43 2020-05-14 09:14:19 2020-05-14 09:14:19 2020-05-14 09:14:19 2020-05-14 09:11:58 2020-05-14 09:11:58 2020-05-14 09:11:58 2020-05-14 09:11:26 2020-05-14 09:11:18 2020-05-14 09:11:18 2020-05-25 06:24:51.0 20-05-25 06:24:51.9 20-05-25 06:24:51.9 20-05-25 06:24:51.9 20-05-25 06:24:51.9 20, u'rxnb': 2, u' 20-05-25 06	A the Node empts are empts are estito shown Umos coverserest cover	e Monit e visible Visible Vacrora, MHz 864.9 865.1 864.7 865.3 864.5 864.7 865.3 864.7 9 864.7 865.3 864.7 865.3 864.7 864.7 865.3 864.7 864.7 865.3 864.7 864.7 865.3 864.7 9 864.7 864	Coring se Coring se	Ctic Oin FCNT	Den: in t Req RSSI, dBm -116 -120 -123 -118 -117 -124 -118 -117 -117 -124 -118 -117 -117 -124 -118 -117 -124 -118 -117 -124 -118 -117 -124 -118 -120 W_SEI t: 54, 218, 395 W_SEI t: 54, 218, 395 W_SEI t: 55, 428, 407 t; t' (18, 189 t, 55, 407 t, t' (18, 189 t, t' (18,	che Da uest LSNR, dB -14.5 -16 -18 -13 -6.8 -8 -12.8 -8 -15.8 -12.2 rv.log rv.log ######## 40d7b2273 02e302c22 0,56023) ########## 40d7b2273 02e302c22 0,56023) ####################################	SF 12 12 12 12 12 12 12 12 12 12	Pasmep 23 23 23 23 23 23 23 23 23 23 23 23 23	tion Airtime, ms 1155.072 1	Message Type Message Type Message Type PonyckHas cnoco6HocTb, kHz 125 125 125 125 125 125 125 125	- only Join
	2020-05-25 06:24:51.936 DEBUG LWServer - push_data: RX from semtech PUSH_ACK in SRV PUSH_DATA:												



	Restart lw_serv. To do this, as shown in the figure, on the command line, enter: Supervisorctl restart LW_SERV	<pre>supervisor> restart LW_SERV LW_SERV: stopped LW_SERV: started supervisor> root@app-iot-br-01:/var/log/leon#</pre>							
SOLUTION	After that, make sure that JR/JA is work In addition, join_accept messages shou reach the Authorizator component, and 2020-06-09 09:04:21.891 INF0 LWServer - join_accept: 2020-06-09 09:04:22.431 INF0 LWServer - join_accept_ 2020-06-09 09:04:22.611 INF0 LWServer - join_accept_ 2020-06-09 09:04:22.611 INF0 LWServer - join_accept_ 2020-06-09 09:04:22.611 INF0 LWServer - join_accept_ 2020-06-09 09:04:22.820 INF0 LWServer - join_accept_ 2020-06-09 09:04:22.980 INF0 LWServer - join_accept_ 2020-06-09 09:04:22.980 INF0 LWServer - join_accept_ 2020-06-09 09:04:22.980 INF0 LWServer - join_accept_ 2020-06-09 09:04:23.048 INF0 LWServer - join_accept_ 2020-06-09 09:04:23.048 INF0 LWServer - join_accept_	King and no answer messages are missing in the log. Ald appear in the log, which means that JR messages the response is returned to lw_serv: DEV_EUI: 36335325C385302 not in DB. SKIP JR. tx: Not found DevEui: 363353273385C02 from LWA. Skip request tx: Join accept TX for: 1194BF55CF2920C2 tx: Join accept sent to 1194BF55CF2920C2, via GW: 0000B827E8561387 tx: Join accept sent to ECSA25696534D864 tx: Join accept sent to ECSA25696534D864, via GW: 0000B827E89FC3A5 tx: Join accept TX for: E2344499F1F95AF4 tx: Join accept TX for: E2344499F1F95AF4 tx: Join accept sent to E2344499F1F95AF4							



8.2. No data from Node

When this problem occurs, the terminal device (Node) does not send data packets.

CAUSE	No Node AppKey on the Server.
	In the workspace of the menu items Nodes in the search box, enter the AppKey to be checked. If the searched device is not displayed in the nodes list, it means that it is not in the system: Nodes
HOW TO IDENTIFY	Q 278C64886639DA70 Search Found: 0(Total: 630) Add node Action Go
	Device EUI Device address Application Off/On Last message Description Last join
SOLUTION	This problem can be solved as follows: in the node settings tab, in the Keys block, enter the required Node AppKey.



8.3. No connection to the network

When this problem occurs, the terminal device (Node) does not send data packets.

CAUSE	HOW TO IDENTIFY	SOLUTION
Regional settings of the Node frequency plan do not match the regional settings of the network frequency plan.	In the workspace of the menu items Nodes in the list of nodes there is no display of connection attempts.	Set the correct regional frequency plan in the Node settings.
The current Node AppKey does not match the key on the server.	In the workspace of the menu Nodes in the list of nodes, in the table column Last connection having mouse over the faulty node, the text will turn red and pop-up information will be displayed: "MIC ERROR".	This problem can be solved as follows: in the node settings tab, in the Keys block, set the correct Node AppKey.



8.4. Data from Node discontinue to be displayed in the system

Data packets sent by the terminal device (Node) was no longer displayed in the system.

CAUSE	Messages with data from the Node stopped arriving on the Server.																
	da	In the vate and tin	workspa ne of the	ce of th receive	e men ed mes	u N ssag	odes ge do	in th es no	e l ot	ist co	of no	des, in o ond to t	coli :he	umn expe	Las ecte	t mess d data	ages, the
		Data 1053 Last 10	shown														
<u>ک</u>		Time	Gateway	Frequency, MHz	Message type	FCNT	RSSI, dBm	LSNR, dB	SF	Size	Air time, ms	Bandwidth, kHz	Mac	Direction	Data	Downlink ack	Downlink ack time
造		2020-12-07 18:46:11	00008827EB40565F	869.1	JR		-36	10.5	12	23	1155.072	125		Uplink	FB08	N/A	
Z		2020-12-07 18:44:48	00008527EB40565F	869.1	JR		-45	10.5	11	23	659.456	125		Uplink	B5CB	N/A	
Ĩ		2020-12-07 18:44:11	00008827F840565i-	869.1	JR		-36	11.2	10	23	329.728	125		Uplink	48DD	N/A	
0		2020-12-01 09:57:43	000008278840565F	869.1	JR		-36	9.2	12	23	1155.072	125		Uplink	CD61	N/A	
		2020-12-01 07:40:23	0000B8275640565F	868.9	JR		-45	9.2	11	23	659.456	125		Uplink	F783	N/A	
0		2020-12-01 06:38:34	0000B827EB40565F	868.9	JR		-41	13.8	10	23	329.728	125		Uplink	17AB	N/A	
Т		2020-11-30 18:38:35	00008627£040565F	869.1	JR		-37	9.5	12	23	1155.072	125		Uplink	D271	N/A	
		2020-11-30 18:37:12	000088275840555F	869.1	JR		-49	11.2	11	23	320 728	125		Uplink	3360 85DE	N/A	
		2020-11-30 11:17:09	00000827E840565F	868.9	JR		-45	9.2	10	23	1155.072	125		Uplink	43B6	N/A	
		All message types	All directions	Show1	or the period											1 2 3 4	5 6 7 > >
UTION	or wl	To solv n the requ hich BS th Nodes	ve this p ired Nod e data p search 1	roblem le and r assed t	, in the review he last	e wo in ⁻ t tin	orksp the s ne:	oace ectio	of	th Da	e mer ta and	u Node d Gatev	₂s i vay	n the /s in	e lis the	t of no radius	odes, click s through
SOLI		Device FU	Dovico	addross	anlication	Off/On	Lastm	000000		Do	cription	Lasticia		Packet	loss rate	ily Wookby	Monthly
		4EFEA049DSC	825B1 526DA4	27 Te	estMSK	0	2020-1	1-26 20:08:2	23	ligi	nting	2020-11-26 11:3	8:48	0%	., 02	6 0%	2%
			Found: 1				-			•						5	Table size

Next, make sure that the gateway is available and operational. If necessary, restore the functionality of the gateway.



9. REVISION SHEET

Version	Data	Name	Comments
01	01.06.2020	ZM	Document creation date
02	01.04.2020	ZM	Added a description of the server structure
03	10.06.2020	ZM	Added a Troubleshooting Section
04	22.06.2020	ZM	Correct a Troubleshooting Section
05	03.11.2020	ZM	Added a section Transferring configuration / commands from the Server to the terminal device
06	16.11.2020	ZM	Added a Certification Section (p. 6.2.3)
07	10.12.2020	ZM	EN translation; correction

