TEKTELIC COMMUNICATIONS INC.

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Product name:	**Kona Pico Gateway**
Product number:	**T0004471**

Revision History

Version	Date	Status	Author	Change Description
0.1	Dec 02, 2016	Preliminary	A.Naryanan	Initial Release
0.2	Dec 06, 2016	Released	A.Naryanan	Updated as per review comments
0.3	April 21, 2017	Released	A.Narayanan	Added upgrade instruction for GW prototype
0.4	April 25, 2017	Released	A.Narayanan	Added LED fault indication section
0.5	April 28, 2017	Released	A. Narayanan	Added details of lorawan_conf.json

Table of Contents

1 What's in the Box

- Pico Gateway
- AC Power adapter
- Ethernet cable
- External Antenna (for applicable models)

2 Specifications

- AC power adapter: 120V AC, 60Hz, 0.4A input, 5V DC, 2A output
- Operating temperature: 0 to 40°C
- Indoor use only, do not connect to outdoor antennas or outdoor network cables

3 System Requirements

- Requires internet access via an RJ45 cable connection or Wi-Fi connectivity (802.11 b/g/n at 2.4 GHz)
- Requires continuous access to a standard 120V, 60Hz AC power outlet

4 Connecting and Configuring your Gateway

- Connect the provided power adapter and, when applicable, the external antenna to the gateway[1]
- The gateway starts up as soon as power is applied, expect to see a solid green LED on the back RJ45 right LED

If you choose to access the internet via an RJ45 cable connection:

- Connect the Ethernet cable from your Gateway to a LAN port on your router
    - The Gateway is configured for DHCP, you should see activity indicated on the RJ45 left LED after a few moments. The System LED will flash at a high rate when trying to obtain an IP from your DHCP server
- The Gateway is ready for use

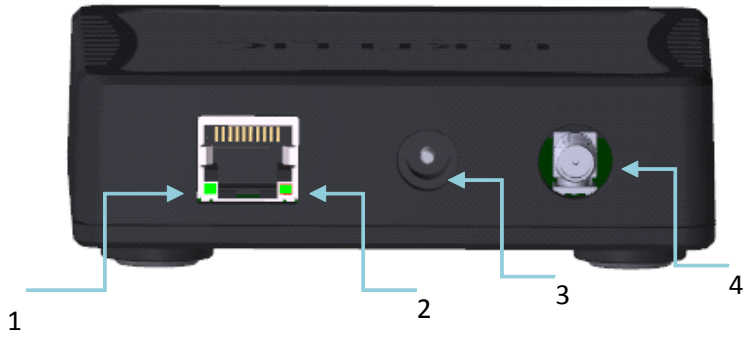
If you choose to access the internet via a Wi-Fi connection:

- Use a Wi-Fi client (eg. smart phone) and connect to the KonaPicoAP_#SN access point within the first minute of powering up the gateway (while the Wi-Fi LED is blinking)
- Browse to http://192.168.10.1 to view a webpage allowing connection to your Wi-Fi network
- Select your SSID and enter your passphrase, allowing your gateway to connect to your network as a client
    - You should see the Wi-Fi LED stop blinking and stay lit once the gateway is connected to the network
- Gateway is then ready for use

[1] Use the gateway only with the provided power supply and Antenna

If need to change the Wi-Fi network to which the gateway is connected:

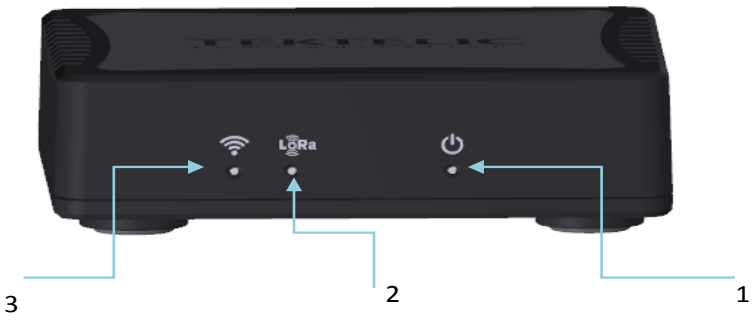
- Power cycle the gateway and use the same procedure described above to connect to a new Wi-Fi network.



5 Gateway Rear Panel

1. Ethernet activity LED – RJ45 left LED will flash when there is Ethernet activity
2. Gateway Power LED – RJ45 right LED will be solid when the gateway power supply is plugged in
3. 5V power connector
4. LoRa External Antenna connector (model dependant), use only provided antenna

6 Gateway Front Panel



1. System Status LED – as opposed to a simple power indicator, as with the RJ45 power LED on the back side:
    - LED flashes at a high rate while the gateway is obtaining an IP address via DHCP
    - LED is solid on after the gateway has obtained an IP address via DHCP, and remains solid on during normal operation

- The LED flashes at a slow rate if the gateway is unable to obtain an IP address via DHCP, the network is not connected, or some other problem prevents normal operation
- All LEDS will be ON briefly during Power On Self test (POST)

2. Wi-Fi Activity LED – indicates the state of Wi-Fi connection:

    - LED flashes when the Wi-Fi access point (KonaPicoAP_#SN) is enabled
    - LED is solid on when the gateway is connected to a Wi-Fi network

3. LoRa Activity LED – flashes with the receipt of packets:

    - The LED is lit briefly whenever an uplink packet received via the LoRaWAN is sent to the network server
    - The LED is lit briefly whenever a downlink packet received from the network server is transmitted via the LoRaWAN

Fault indication on the LEDs

1. Ethernet link down: Indicated by lack of activity on the RJ45 left LED. Ensure that the RJ45 connectors are properly inserted on both the GW and the Ethernet switch or wall jack. Also, ensure that the CAT5E cable is good.
2. Failed to obtain IP during DHCP: The System LED will continue to blink at high rate until a valid IP is allocated. Check the DHCP server logs from your network and looks for the MAC address of the GW (64:7F:DA:xx:xx:xx). If you know the IP of the GW from the logs, you can try to ping the GW to confirm that it is connected to the network.
3. Failed to connect to network server: The GW System LED will cycle through high rate (DHCP), Solid (POST) and slow rate every minute as the GW is trying to connect to server and reboots to try again. Ensure that the GW is connected to a network that has internet access. Also, see Section 9 on how to authorize GWs on Orbiwise network.

7 Software upgrading Kona Pico Gateway using TFTP[2]

1. Connect the Kona Pico gateway to the local network using Cat 5E cable.

2. Power ON the gateway and ensure that gateway gets an IP from the DHCP sever (Power led blinks few times and then stays ON when IP has been acquired)

3. Obtain the IP address assigned to the GW from the dhcp server logs.

4. Use any TFTP client to PUT the Gateway.bin file to the Pico GW as shown in Figure 1

Eg: http://tftpd32.jounin.net/

Note: The SW binary provided is named as orbiswise-vx.xx.bin or semtech-vx.xx.bin depending on which packet forwarder is required by the network server. The name used in the Remote file field should be left as Gateway.bin in either case.

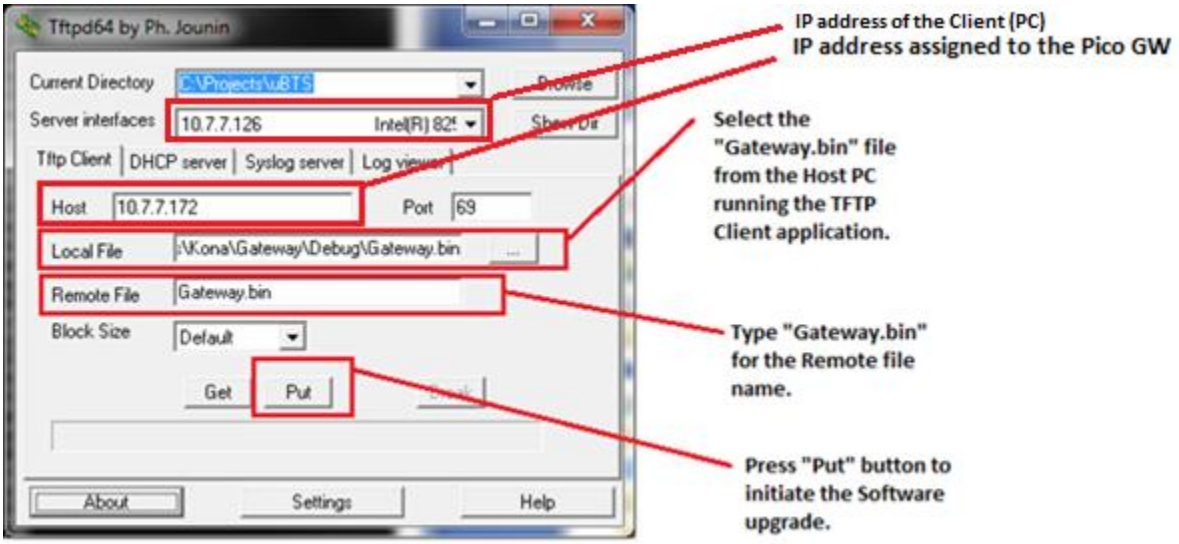


Figure 1 Tftp client settings

[2] NOTE: Upgrade through TFTP is a temporarily available for prototypes. This will be replaced with ability to upgrade the GW from a HTTPS server.

4. The LED indications during SW upgrade is shown below

[System LED]

Software update status is shown on the front panel LED intended for the purpose of showing system status. Specifically:

- The LED flashes during the TFTP transfer (i.e., while the software image is being transferred to the gateway)
- The LED turns off (briefly) while the gateway is resetting itself as a result of a successful update

Note that if the LED remains turned on instead after the transfer, then the software update failed. In a successful update, the GW would reboot itself and the System LED will behave as it would on a power up.

8 Updating customer_conf using tftp (For changing network sever)

Customer_conf.json file needs to updated when the GW needs to connect to a new network server. A sample customer_conf.json is shown in JSON 1

```
{
        "version": 1,
        "network_server": "us01-iot.semtech.com",
        "network_service_up_port": 1780,
        "network_service_down_port": 1780,
        "rest_server": "tektelic-r5.orbiwise.com",
        "rest_service_port": 1790
}
```

JSON 1: customer_conf.json

NOTE 1: The network server and rest sever urls could be replaced with a corresponding IP address. These entries are only valid for Orbiwise packet forwarder.

NOTE 2: The network server URL is only relevant when using Semtech packet forwarder

1. The instructions are same as in section 7. See Figure 2 for the settings required on the TFTP client tab to upgrade the customer_conf.json.
2. After upgrading the customer_conf.json, power cycle the board for the settings to take effect.

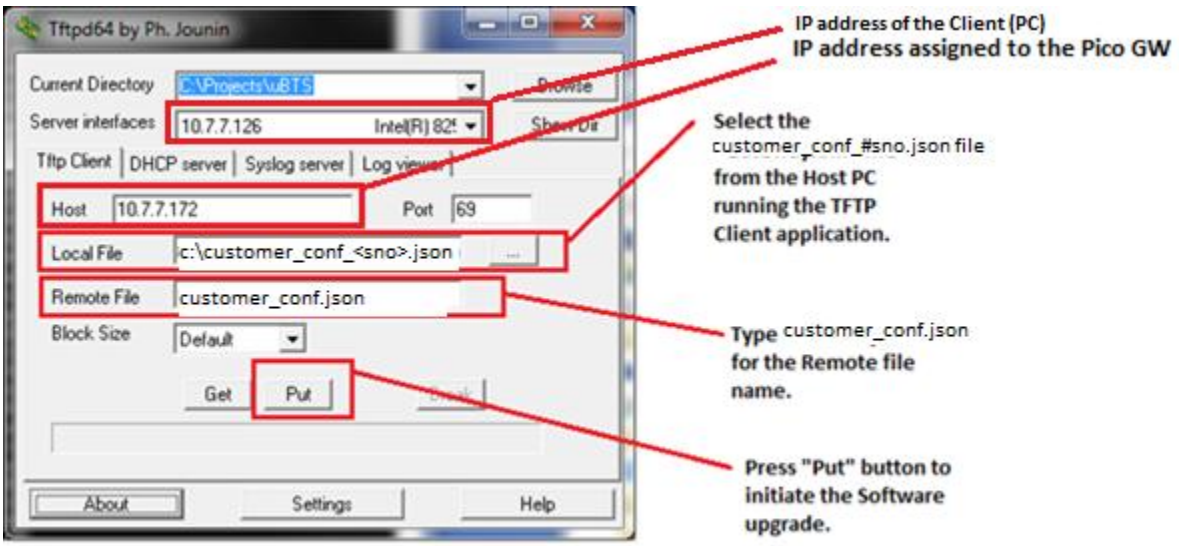


Figure 2 Tftp client settings for customer_conf.json

9 Updating lorawan_conf using tftp

The Pico GW is configured to receive on the first eight 125 KHz channels of LoRa US 902-928MHz band when using the Semtech packet forwarder. The GW can be configured to listen to different channels by changing the *lorawan_conf.json* file. The LoRa WAN (radio) configuration is delivered by means of a JSON string having the following format (see the inline comments and notes below for description of the JSON string)

```
{
    "public":true,
    "radio":    /* an array of up to two (2) entries */
        [
            {
            "enable":true/false,
            "freq":n,                /* in Hz */
            }
            /* etc. */
        ],

        "lora_multi":           /* an array of up to eight (8) entries */

        [
            {
            "enable":true/false,
            "radio":0-1,
            "offset":+/-n,
            /* an empty string denotes the default bandwidth */
            "bandwidth":""/"125kHz",
            "sf7":true/false,"sf8":true/false,"sf9":true/false,"sf10":true/false,"sf11":true/false,"sf12":true/false,
            },

            /* etc. */
        ],

    "lora_std":
            {
            "enable":true/false,
            "radio":0-1,
            "offset":+/-n,
            /* an empty string denotes the default bandwidth */
            "bandwidth":""/"125kHz"/"250kHz"/"500kHz",
            /* an empty string denotes the default spread factor */
            "spread_factor":""/"SF7"/"SF8"/"SF9"/"SF10"/"SF11"/"SF12",
        },

    "fsk":
            {
            "enable":true/false,
            "radio":0-1,
            "offset":+/-n,
            /* an empty string denotes the default bandwidth */
            "bandwidth":""/"7.8kHz"/"15.6kHz"/"31.2kHz"/"62.5kHz"/"125kHz"/"250kHz"/"500kHz",
            "datarate":0/500-250000
            }
}
```

JSON 2 lorawan_conf.json

Notes:

1. The shape of the JSON string was designed to prevent errors. That said, the values are validated only when the configuration is applied to the 8-channel gateway concentrator (SX1301) using the HAL. As a result, it is possible in some cases to specify a value that the HAL will reject (e.g., an FSK data rate of 250).
2. The shape of the JSON string does not permit the configuration of some of the parameters supported by the HAL. Such parameters are a function of the hardware. E.g., radio A (radio 0) is the clock source on the Pico Gateway, but radio B (radio 1) serves this purpose on the Semtech evaluation board.
3. Disabling all of the spread factors (sf7-sf12) for a LoRa multi-SF (spread factor) channel (IF) results in the HAL using the default set of spread factors, which (paradoxically) corresponds to enabling all of the spread factors.

A sample *lorawan_conf.json* file that configures the Pico GW to first 8 channels of Lora US band is attached below

The instructions for uploading the file to the GW are same as in section 7 except for the remote file name that needs to be changed to *lorawan_conf.json*. After updating the *lorawan_conf.json*, power cycle the GW for the settings to take effect.

10 Appendix A- Orbiwise network server primer

Orbiwise is a Carrier-grade LoraWAN™ Network Server that provides REST / JSON based interface for device applications and web-based user interface for administration of Gateways and devices.

Registering a sensor on Orbiwise network

1. The sensor/node needs to be registered on Orbiwise DASS page before it can be used
   Eg: DASS – UI: https://tektelic-r5.orbiwise.com

   Please contact Tektelic for user name and password

2. The sensor can be registered using ABP(Activation by personalization) or OTAA (over the air activation) procedure using dropdown menu *Mydevices -> List of devices -> Add device button* (See Figure 3 and Figure 4)
3. The details required for device registration are provided by the device vendor. See device packaging or device vendor webiste for instructions.

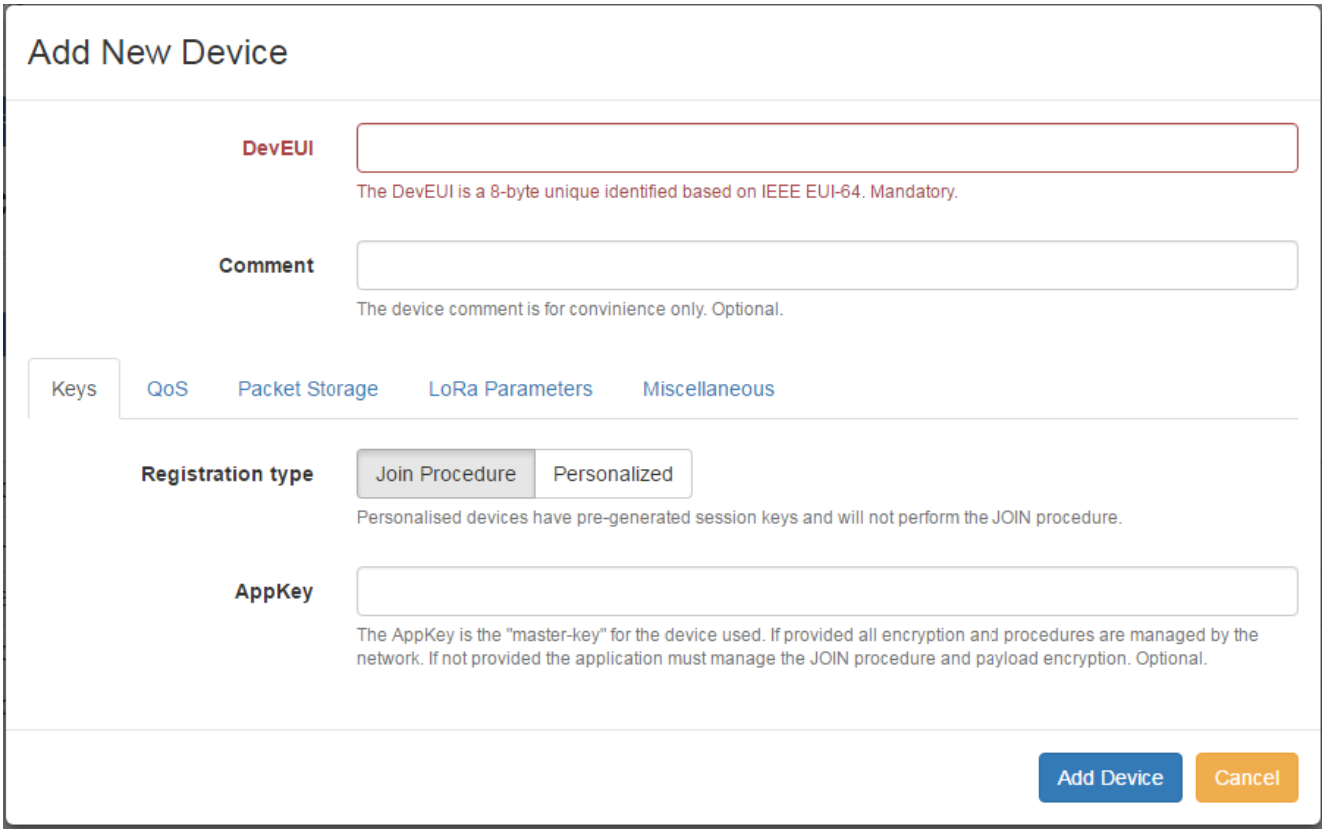


Figure 3 OTAA device registration

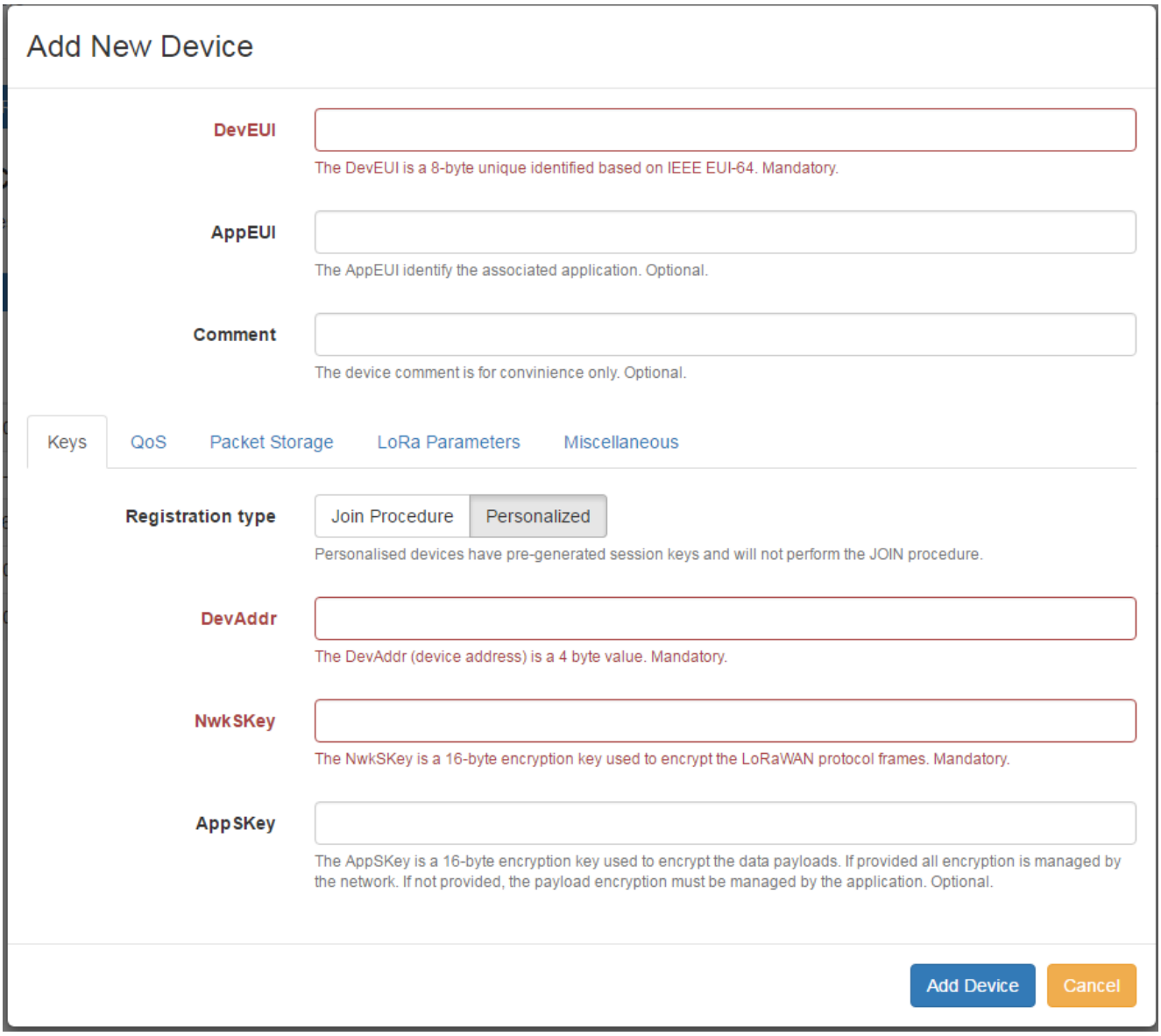


Figure 4 ABP device registration

Seeing sensor data on the DASS page

The uplink packets from the registered (and successfully joined) devices can be seen on the DASS page. If the user account has been set up to forward all the packets to an application server (For eg: cayenne.mydevices.com), then packets can only be viewed in the application and not in the DASS page.

1. You can see the sensor packets using the dropdown list : *Data -> Show packets*
2. Particular device has to be selected for the packet data to be displayed (See Figure 5)

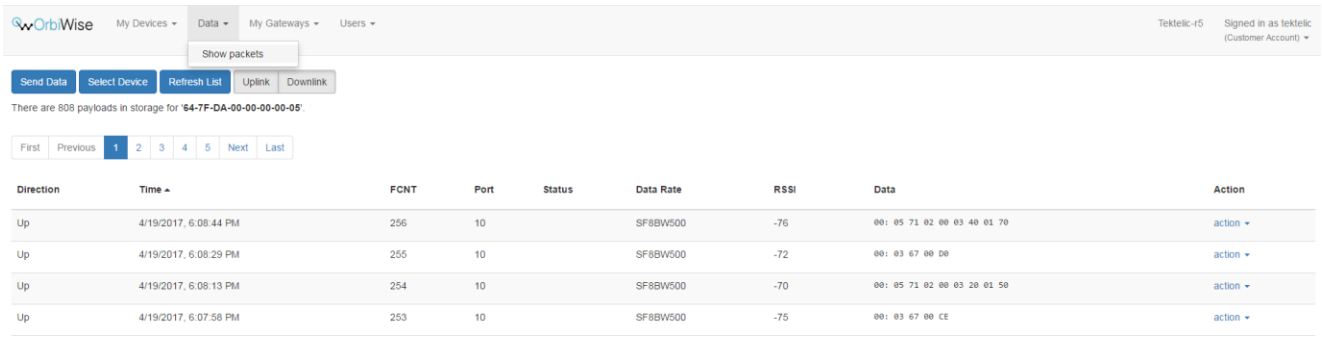


Figure 5 See device data (not forwarded)

Managing Gateways

Orbiwise server provides a management page that is available to the network operator to authorize, maintain and debug GWs. This feature is only available if you have a separate instance from Orbiwise (instead of *tektelic-r5.orbiwise.com). .*

Authorizing GWs

Each GW needs to be authorized before it can forward packets. GWs can be authorized using the drop down menu on the OMC page *Gateway->Manage Authorizations*. A list of unauthorized GWs trying to connect to the instance can be viewed using the drop down menu *Gateway->View Blocked Gateways*.

Debugging GWs using traces

When debugging issues with the GW, the logs (traces) from the server can provide valuable information. Traces can be accessed using the *Traces* button on the top right corner of the OMC page

1. Packets displayed on the screen can be narrowed down to be from a particular GW and a particular sensor using the filtering feature of the page
2. Join requests from devices and join accepts from server can be seen in the traces

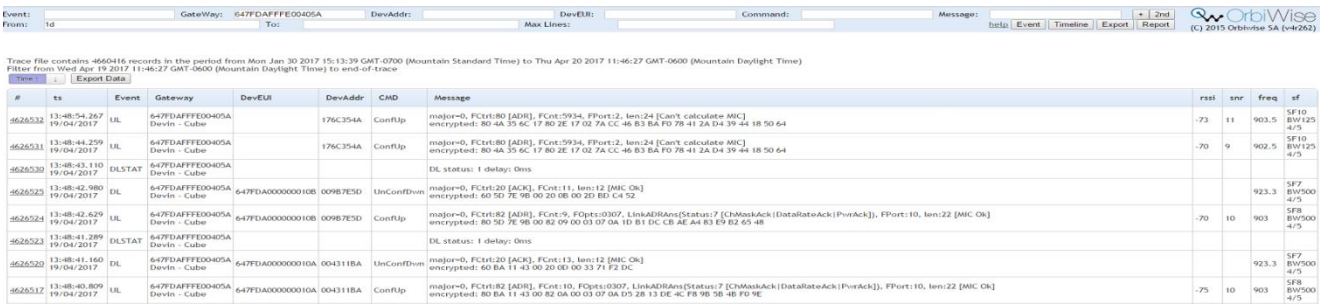


Figure 6 Server logs (Traces)