Hms 5G Starterkit and Testing Solution User Guide

5G Starterkit
User Guide

5G Starterkit with IO-Link Sensors

The 5G Starterkit with IO-Link sensors can be used to illustrate a couple of industrial production use cases.

5G Use Cases and 3GPP Standard

3GPP is a consortium that has defined the 5G communication standard. Within the 3GPP TR 22.804 specification, there are (among other things) several use cases that are defined for 5G networks. Below is a list of these use cases:

- Motion control
- Control-to-control
- Massive wireless sensor networks
- Mobile worker
- Closed-loop process control
- Mobile control panels with safety
- Mobile robots
- Remote access and maintenance
- Augmented reality
- Process monitoring
- Plant asset management

The Starterkit has been prepared to simulate three of these use cases: massive wireless sensor networks, mobile workers,s and closed-loop process control.

Massive Wireless Sensor Networks

The key objective of this use case is to collect data from the factory floor and provide this to IT systems for further data processing. The data is used for several purposes:

- Collection of KPIs in order to improve operational efficiency
- Collection of process data for product level production quality traceability
- Predictive maintenance
- And more …

The Starterkit does not come with an IT system. Instead, data from the sensors is transmitted through the cellular network to a dashboard on a tablet.
It is envisioned that as the SG technology matures the 5G interface will eventually be integrated directly into the sensors.
Please see 3GPP TR 22.804 for a full description of these use cases.

Contents

Mobile Worker

The mobile worker use case is part of the digitalization of the factory. In this demo, the mobile worker will be provided sensor data through a dashboard on a tablet. In a real factory setting, the mobile worker would be able to use the tablet for several different tasks:

- Monitoring of processes and production flow
- Step-by-step instructions for specific tasks, for example in manual assembly workplaces
- Ad-hoc support from a remote expert, for example for maintenance or service tasks

As described in 3GPP TR 22.804 use case “Augmented Reality, head-mounted AR devices could also be a suitable device for the mobile worker.

Closed-Loop Process Control
With closed-loop process control, a PLC or controller receives information about the state of a process from several sensors. Based on the information received from the sensors, it calculates new data to be sent to the actuators of the process. This cycle is repeated continuously.

This use case is supported as an extension to the demo and is described in a later chapter, see “PLC Integration”.

Connecting the Hardware

To connect the 5G Starterkit with IO-Link sensors you will need:

- A 5G Wireless Router
- Two SIMs for the Industry Connect private cellular network (not included in the kit)
  – The two SIMs should belong to the same APN
  – Each SIM should have a static IP address
  – The SIMs should be allowed to send IP packets to each other
- A tablet that can connect to the Industry Connect private cellular network (not included in the kit)

In addition, you will need the following during configuration:

- A laptop with an Ethernet cable
- PH2 screwdriver for mounting the SIM

Inserting the SIM in the Wireless Router

The Wireless Router uses a 4FF nano-SIM. Please ensure that the PIN is disabled before inserting the SIM.

The SIM holder is located behind a metal cover. Unscrew the two screws and remove the cover.
Take out the top SIM tray (SIM 1) and insert the SIM. Insert the SIM tray into the Wireless Router again.

Mount the cover again and insert the screws.

inserting the SIM into the Tablet

Follow the instructions of the tablet and insert the SIM.

Mounting the Wireless Router on the Starterkit

Unpack the Starterkit from the transport case.

Mount the Wireless Router on the DIN rail of the Starterkit (on the left side of the Starterkit). Make sure that the antenna connectors are on the top and the power connector is on the bottom.

Power Supply

A power supply is included with the Starterkit.

- Mount the appropriate mains power adaptor for your region
- Mount the M12 connector of the power cable to the X31 port of the orange IO-Link master
- Mount the orange power connector to the small gateway between the Wireless Router and the IO-Link master
- Mount the white power connector to the Wireless Router
- Connect the power supply to a mains outlet (230 VAC or 110 VAC)

Antennas

Antennas are connected to the SMA connectors of the device.
Mount two stub antennas on the Wireless Router. These two antennas should be connected to the ports marked

Cellular 1 and Cellular 2.
For the 5G Wireless Router, 4 antennas are needed to achieve 3GPP compliance. In this case, the additional two antennas should be connected to the ports marked GNSS and Cellular 3.

Connecting Ethernet

Two Ethernet cables are supplied with the Starterkit.
One Ethernet cable has an M12 connector. The M12 connector should be connected to the X22 port on the orange IO-Link master. The other end is connected to port 1 on the Wireless Router.
The other Ethernet cable is connected to Eth1 of the small gateway next to the IO-Link master (Eth1 is the top one). The other end of the cable is connected to port 2 of the Wireless Router.

Test the Sensors

At this stage, it is possible to test the sensors.
When idle, the stack light should be displaying different “standby” patterns.
If an object is put in front of the laser distance sensor the stack light will switch mode and instead show an indication of the distance.
When the push button is pressed, the stack light will show the signal strength of the Wireless Router. If there is no connection to the Wireless Router, the stack light will show red.

Software Configuration

Web GUI

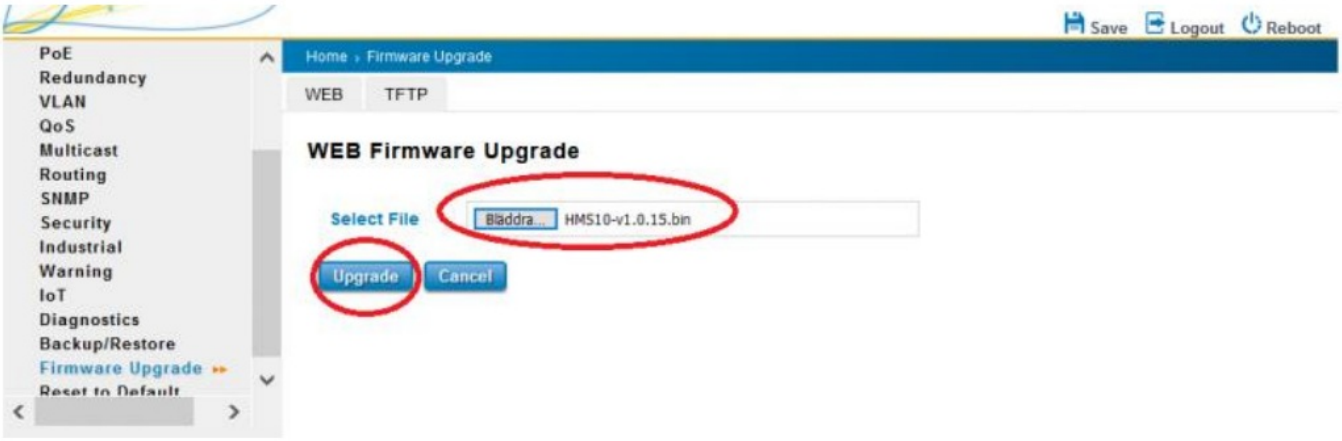
The web GUI of the Wireless Router can be accessed from a PC connected to the Ethernet port. The default IP address of the Wireless Router is 192.168.10.1/24.
The configuration of the Ethernet interface of the PC should be:
IP address: 192.168.10.100
Netmask: 255.255.255.0
GW: 192.168.10.1
The web GUI can be reached from the PC by entering 192.168.10.1 into a web browser. The default credentials are:
Username: admin
Password: admin

Optional: Factory Reset

Factory reset of the device can be performed by inserting a paper clip or similar into the small hole on the front of the Wireless Router marked “Reset” and pressing the button for at least 7 seconds.

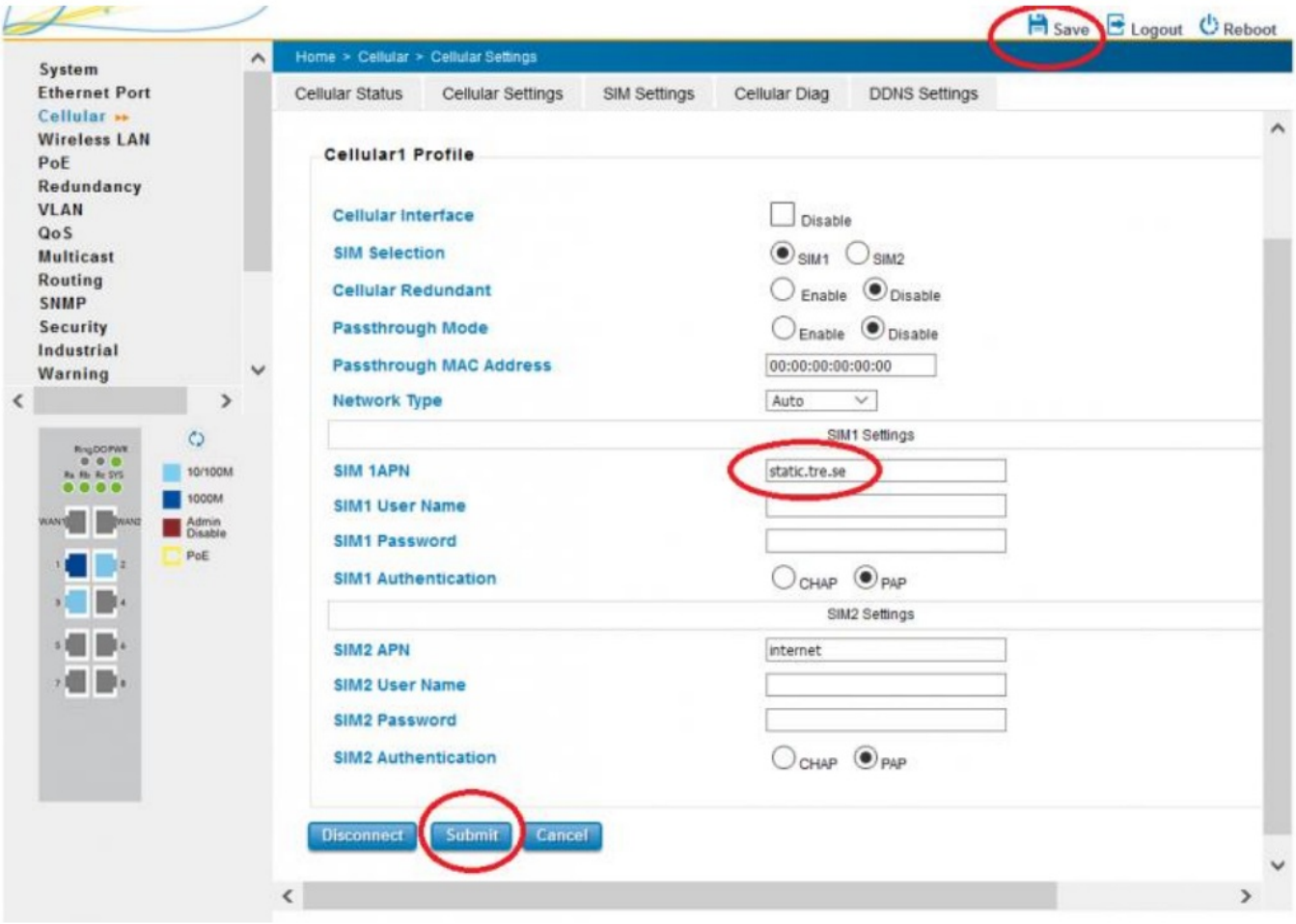
Optional: Firmware Upgrade

The 5G Wireless Router firmware can be found on **https://www.hmsnetworks.com/technologies/5G/5G-solutions-starterkits**.
Go to “Home > Firmware Upgrade” to upgrade the 5G Wireless Router.



Cellular Configuration

Go to “Home > Cellular > Cellular Settings” to configure the cellular settings:

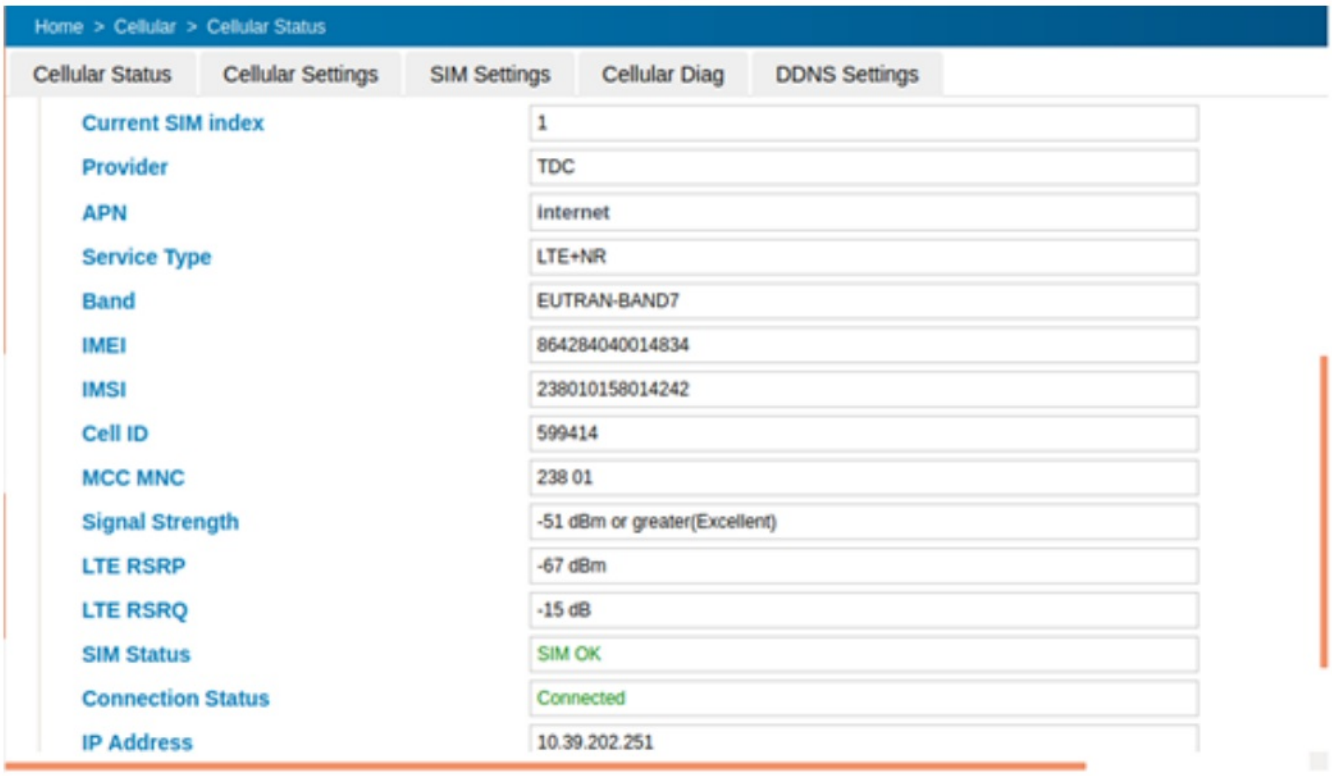


- **APN**
  – For some networks, this can be left empty
  – For other networks, the APN needs to be configured manually
- **User Name**
  – Can normally be left empty
- **Password**
  – Can normally be left empty
- **Network type**
  – This setting can usually be left on “Auto”

– Alternatively, a specific technology can be chosen. E.g. LTE+NR5G which indicates a 5G non-standalone system

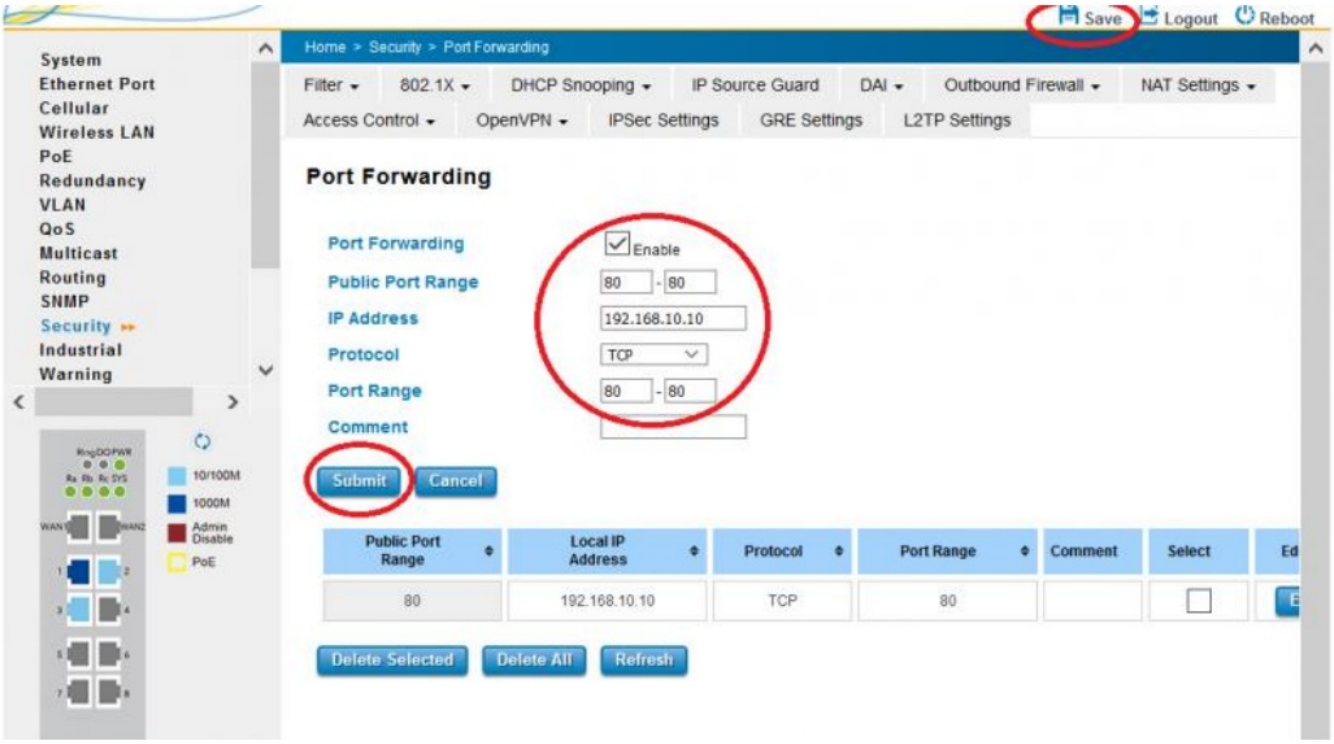
After the parameters have been changed, the “Submit” button should be pressed. To connect to the network, the “Connect” button is pressed and in order to make the changes permanent, the “Save” button should be pressed.

After connecting, the status can be seen on “Home > Cellular > Cellular Status”:



Please note the Cellular IP address allocated to the device.

Port Forwarding
To access the dashboard from the tablet, port forwarding must be configured in the Wireless Router.
Go to “Home > Security > Port Forwarding” to configure port forwarding.



Please configure forwarding of port 80 TCP to LAN IP address 192.168.10.10 port 80. Press “Submit” and then “Save” to make the changes permanent.

Test the Dashboard

At this stage it should be possible to reach the dashboard from the tablet.
Start a web browser on the tablet and type in the IP address of the Cellular IP of the Wireless Router.

Optional: Dashboard Application Software Update

The Starterkit dashboard and other functionality is implemented in the small gateway next to the orange IO-Link master.

First, turn off the power to the Starterkit by unplugging the power supply from the main outlet.
To upgrade this gateway, the SD card inserted at the top of the gateway should be removed (the SD card is located close to the power connector).

The Dashboard Application Software can be found on https://www.hmsnetworks.com/technologies/5G/5G-solutions-starterkits.

Insert the SD card into a laptop with a micro-SD card slot.
Download the new software. After downloading the new software, the name needs to be changed to:

sc145update.tar.gz
After changing the name, the software should be copied to the directory: lrupdate
Remove the SD card from the laptop and place it into the gateway again.
Power on the Starterkit again by connecting the power supply to the main outlet.
After power is applied, the gateway will be upgraded. The upgrade takes around 8 minutes. After the upgrade is completed, the stack light will start flashing again.

Extending the Starterkit

The Starterkit can be extended in a number of ways.

Large Screen Dashboard
As an alternative to the tablet, it is possible to display the dashboard on a larger stationary screen. This screen could be mounted above the Starterkit or somewhere else.

The large screen needs to have a web browser to access the dashboard and should be connected to the 5G network either through the wired N interface or through a 5G cellular connection.

Custom Dashboard
It is possible to modify the dashboard interface supplied with the Starterkit. In this case, the dashboard web page is placed on a customer-supplied web server whereas the sensor data is collected from the gateway on the Starterkit.

The sensor data is made available through two JSON files:

- http://<IPaddress>/starter-data.json Distance sensor and other sensor data
- http://<IPaddress>/snmp.json Signal strength

PLC Integration

Normally the10-Link devices are controlled by the small gateway next to the orange 10-Link master. As an alternative to this gateway, it is possible to connect the 10-Link devices to a PLC instead. This PLC can be connected directly to the 10-Link master or through the 5G network.

- Start by disconnecting the Ethernet cable from the small gateway next to the orange 10-Link master.
- 10-Link device data is available as Modbus/TCP from the 10-Link master. Please see the IFM support web pages regarding the information on how to configure the 10-Link master and how to access the data through Modbus.
- To enable Modbus/TCP connectivity through the SG network, the SG Wireless Router needs to be Please see the user manual provided on
  https://www.hmsnetworks.com/technologies/5G/5G-solutions-starterkits

IT Integration
Data from the 10-Link devices can be exported to an IT system by several different means.

JSON Files
The JSON files mentioned in the previous section “Custom Dashboard” can also be used for IT integration. In this case, the IT system simply reads the JSON files periodically to get the data from the sensors.

Modbus/TCP
It is also possible to read the sensor data directly from the orange IO-Link master. This is done in a similar way as for “PLC Integration” described above.

If Modbus data is only read by the IT system, it is not necessary to disconnect the small gateway next to the orange IO-Link master.

MQTT or REST API
The orange IO-Link master has a dedicated Ethernet port for IT connectivity. To connect to this port, an extra M12/RJ-45 Ethernet cable is needed. This cable can be ordered from IFM with article number E12490.

- Connect an M12/RJ-45 Ethernet cable between the IO-Link master port X23 and the Wireless Router port 3.
- IO-Link device data is available as MQTT and REST API from the IO-Link master. Please see the IFM support web pages regarding the information on how to configure the IO-Link master and how to access the data through MQTT and REST API.
- To enable MQTT and REST API connectivity through the 5G network, the 5G Wireless Router needs to be configured. Please see the user manual provided on **https://www.hmsnetworks.com/technologies/5G/5G-solutions-starterkits**

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Documents / Resources

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