Flexible and PrecIse IrriGation PlAtform to Improve FaRm Scale Water PrOductivity

Figaro Platform Integration

D6.3 first set of models and devices integration
# Revision History

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| Author(s)     | Lior Doron  
Pedro Galvão  
Adélio Silva |
| Deliverable Lead Contractor | HIDROMOD |
| Responsible Person | Adélio Silva |
| Contact for query | adelio@hidromod.com |

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Artifact Rationale

This document provides a brief overview of the Devices and Models already linked to the FIGARO Platform. It details how data is acquired and flows within the Platform and the interaction of the software systems to integrate multiple data types using them to produce specific outputs including the optimal irrigation recommendation via the Platform interface.

According the DOW uManage is the basic client for the FIGARO Platform and it is from here that all interaction with the user is done. The FIGARO Platform collects all available data for the different farms (connecting directly to the field sensors and acquiring data from other external sources), asks AQUASAFE to run the necessary models using the acquired data and returns the appropriate information and recommendation to the farmers.

The goal is that FIGARO will enable connection with a wide variety of data sources and then run any model in order to provide the farmers with the most reliable advice possible. At this stage a relevant number of external data sources, devices collecting data in the field and calibrated models are already connected to the Figaro Platform and available for use.

The present Deliverable intends to provide a brief overview of the first version of the Figaro Platform describing the integration of data sources, devices and models.
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1. Physical sensors

uManage platform acts as the FIGARO DSS user interface and is one of the methods for the Platform to collect data from sensors and devices. uManage provides a robust and powerful tool for communicating with physical sensors. The Figaro Platform communicates with the sensor through an RF platform called rNet.

1.1 The rNet system

rNet by Netafim is the new generation of wireless control and monitoring systems. Transferring data effectively from sensors and hydraulic units in the field to the growers’ PC, tablet or mobile device. The monitoring solution includes an advanced radio system ensuring reliable and accurate communications. The four basic components of the rNet system are:

- rLink - Base unit, Router unit (if needed), rSense - Sense unit and uManage™ software.
- Typical network includes up to 150 rSense units on a wireless network and up to 15 routers.

*Figure 1: rNet: support to different communication channels*
1.1.1 rSense unit
The rSense unit transmits data from the sensors, water meters and other devices in the field. It includes the following features:

- Automatic identification of an extensive array of sensors.
- Sensor unit calculation.
- Normal water meter (1 Hz max) or Dry contact (pulse).
- Adjustable sampling of sensors and broadcast (Default setting: each sensor is sampled every 15 minutes and data is broadcasted every 30 minutes).

1.1.2 rLink unit
The rLink unit is the communication [radio] platform between the rSense Units (the router/s - if present) and the uManage platform control software. This rLink unit can:

- Communicate with multiple rSense units via radio network.
- Store the route map of the network.
- Pre-set to the system area frequency.
- manage up to 150 rSense units in a wireless network including the option of using routers.
- Communicate with the control application by cellular connection.

1.1.3 rLink as a Router Unit
The router unit serves as a relay between the base unit, remote rSense units or other router units.

Used where the distance between the base and the units in the field is greater than 3 Km (2 miles), or to overcome absence of line-of-sight or obstructions between the base and the units in the field.

The router unit Store and Forward (SAF) mode in the Radio system can be activated in any remote unit by updating the route map in the base unit. An rSense unit configured in SAF mode maintains all the remote unit features.

The router can be fed by grid electricity or by a solar panel.

1.2 Standard sensors
The system consists of a few “standard” sensors that the FIGARO Platform can communicate with in an automatic fashion. While the sensor is connected to the rSense unit, the rsense unit automatically recognize the sensor type and communicates with it. The list of the standard sensors that are integrated into the Figaro Platform is below.
<table>
<thead>
<tr>
<th>Sensor name</th>
<th>sensor type</th>
<th>vendor</th>
<th>comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensiometer</td>
<td>Soil moisture</td>
<td>Verius proivders</td>
<td>Measure soil tension</td>
</tr>
<tr>
<td>NetaSense</td>
<td>Soil moisture</td>
<td>Netafim</td>
<td>TDR</td>
</tr>
<tr>
<td>ECH2O</td>
<td>Soil moisture</td>
<td>Netafim</td>
<td>Capacitance</td>
</tr>
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<td>Temperature</td>
<td>Netafim</td>
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<td>Pressure</td>
<td>Pressure</td>
<td>Netafim</td>
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<tr>
<td>General 4-20 mA</td>
<td>Standard 4-20 mA</td>
<td>Verius proivders</td>
<td>Standard 4-20 mA or 0-5 V</td>
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<tr>
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<td>Water meter</td>
<td>Verius proivders</td>
<td>Dry contact output is required</td>
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<tr>
<td>Fertilizer</td>
<td>NPK level</td>
<td>C-Thech</td>
<td>Developed as part of the FIGARO</td>
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<tr>
<td>Relative humidity</td>
<td>Relative humidity</td>
<td>Part of Netafim’s weather station</td>
<td></td>
</tr>
<tr>
<td>Radiation</td>
<td>Radiation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precipitation</td>
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<td></td>
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<tr>
<td>DFM</td>
<td>Soil moisture</td>
<td>Netafim</td>
<td>Capacitance</td>
</tr>
</tbody>
</table>

1.3 Non-standard sensors

uManage as part of the FIGARO Platform enables the user to connect some non-standard sensors as well. In order to connect a non-standard physical sensor the user can define in the rNet system a non-standard physical sensor and then complete all required parameters manually and thus easily enabling communication and reading data from the sensor. This type of sensor is limited in the data manipulation activities that the FIGARO Platform can perform on the sensor data because for this purpose, the sensor is treated by the Figaro Platform as a general sensor.
2. Virtual sensors

The FIGARO Platform enables the user to define some types of virtual sensors. The term “virtual sensor” relates to the fact that the system is not connected physically through hardware to a physical sensor but rather it reads data through an electronic communication and on the sensing end a physical sensor does not necessarily exist – it could be any data source.

The virtual sensors that the FIGARO system supports today through the uManage application include:

- any kind of manual data serial. This could be a single value data serial (value + date) or a 3D data including the sampling location. This sensor however is limited regarding the data manipulation activities the FIGARO Platform can perform on the sensor data since, according to the Platform, the sensor is a general sensor.

- Receiving data from an FTP server – the system is equipped to connect to different FTP servers, map the data fields to virtual sensors and automatically download data periodically into the virtual sensors. At a later stage, the system can use this data for any calculation manipulation and decision-making needs.

- Receiving data via web service - the system can connect to specific web server providers, map the data points to virtual sensors and automatically download data periodically into the virtual sensors. At a later stage, the system can use this data for any calculation, manipulation and decision-making needs.

- Unlike FTP servers, where the communication method is more or less the same, web services can be very variable and thus development of a specialized interface is required in most cases.
3. Controllers

The current version of the FIGARO DSS can communicate with controllers for controlling purposes through a web service.

Up till now the system connected to the control line of Netafim called NMC and the communication done through a property protocol.

As there is no standard in this field, in order to connect to other vendors’ controllers, a different communication interface should be developed for each different controller brand.
4. Models

In the FIGARO Platform, models are managed through the AQUASAFE Platform. In the first phase AQUACROP has been implemented as the standard crop model but three additional models are also available (although still in a limited way): MOHID LAND, SWAT and DAISY.

In the case of AQUACROP, for the standard user, all operations are accessible through the main FIGARO client (uManage). In this case, as long as the user has a calibrated version of AQUACROP for his farm, there is an option on the FIGARO Platform to upload this model and start to receive the model outputs such as irrigation advice (see FIGARO Platform manual for details).

For the other cases although the models are already running in AQUASAFE there is not yet a suitable connection from the FIGARO Platform and their use is possible directly from AQUASAFE.
5. Meteorology

Meteorological forecasts are a basic need for a system such as FIGARO. In this sense, although it is recommended that the users make use of high resolution local meteorological forecasts, global meteorological forecasts are always available from GFS. Although this forecast has a low spatial resolution (0.5 degrees) it have the advantage of being available for any point in the globe.

Presently this GFS data is being routed through the HYDRONET Platform which is adding to the data provided by NOAA the computation of the potential evapotranspiration.

This data is collected by AQUASAFE together with all other meteorological forecast data available and the data from local meteorological stations if available. Using all these data sets AQUASAFE then builds a “best time series” following provided user options regarding the relevance of each data set.

In standard conditions this time series will start to be filled with the collected meteorological data (until now), followed by the high resolution model forecasts and then by the GFS forecasts (for the periods when the high resolution forecasts are not available). As mentioned if neither meteorological data or high resolution models forecasts area available the time series will be fully filled with GFS data.

This time series is then returned to the FIGARO Platform as a data set and used within AQUASAFE to provide boundaries data to the models.