TECNIDRO®

# HYDRONET

Remote Reading and Control Radio System
for water distribution networks

# HYDRONET Radio System

Saving water resources is now a priority objective in the management of distribution networks, but remains difficult to achieve without the support of specific and reliable automation technologies.

With over 30 years of experience in the production of hydraulic equipment, **TECNIDRO** introduces to the market an innovative solution proposing **HYDRONET** system, based on the latest LPWAN radio transmission technologies.

**HYDRONET** has been specifically designed for public water management networks on geographical areas as well as for plants with a more limited extension belonging to farm and private companies.


The system operates on a near real-time basis allowing the remote acquisition of water flows and volumes, the opening / closing of valves at the network distribution nodes, the monitoring of the operating parameters (pressure, temperature, humidity, etc.), the notification of alarms and the processing of the data collected for the subsequent historical analysis and the possible invoicing of the fees.

The **HYDRONET** radio system guarantees a reliable, safe and protected from fraud and vandalism, taking into account the peculiar characteristics of agricultural irrigation networks, usually characterized by a high number of water delivery points, grouped or installed individually in large perimeters, subject to critical environmental conditions and typically without any electricity sources.

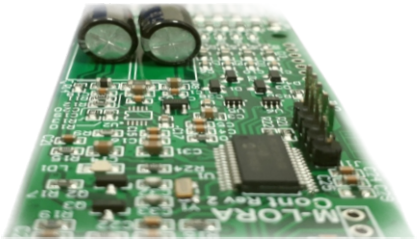
# IoT - Internet of Things

The HYDRONET radio system has been designed by TECNIDRO by adopting the innovative LoRa® (Long Range) point-to-point wireless communication technology, developed to create networks with low-power and wide-range devices (LPWAN - Low Power Wide Area Network), key-issue for the application of the Internet of Things (IoT).

The open communication protocol LoRaWAN™, developed by LoRa Alliance ™ and based on LoRa® technology, ensures that all devices (End Nodes), servers and software components of the system are interoperable with each other, ensuring a high standard of security for the IoT communications. The HYDRONET solution can integrate a variety of other third party devices provided with the same LoRaWAN™ technology, such as meteorological station, field sensors/transducers etc.

LoRaWAN™

LoRa® Alliance



LoRa® is a trademark owned by Semtech
LoRaWAN ™ ia a trademark owned by LoRa Alliance

The **HYDRONET** radio system developped by **TECNIDRO** offers a solution that is:

***Specific*** Coverage up to 15 km and over in open field, designed for irrigation networks, even of large size, installed in remote areas or isolated and permanently exposed to critical weather conditions.

***Autonomous*** Local radio transmission in 868 Mhz (or 915 Mhz according to country frequenly plan), frequency band, licence-free, independent from the operators of mobile communication networks.

***Self-sufficient*** Peripheral units powered by a replaceable lithium battery (6 to 10 years depending on the type of service), without the need for solar panels, accumulators or connection to electrical power supply panels.

***Modular*** Available in the "smart" version only for Remote Reading operation (reading meters / sensors / alarms) or in the "extended" version for the Remote control operation (Remote Reading + Valve control) and expandable to new irrigation perimeters for future implementation.

***Protected*** Compact cylindrical peripheral unit (RTU - Remote Terminal Unit) for installation in Ø2" (50mm) tube, IP67 waterproofs, with cable cut/ intrusion detection alarm. Data transmission protected by cryptography algorithm.

***Innovative*** LoRaWAN™ standard two-way communication protocol, long range and low power with adaptive bandwidth management (ADR).

***Low Cost*** Not significant communication costs and drastic reduction of maintenance costs.

***Open*** Possibility to integrate third party sensors and devices adopting the same LoRaWAN™ communication tecnology.




# Remote Reading and Control

The management of an irrigation network may involve different needs:

- a) limited only to the periodic reading of the volumes of water supplied in different nodes of the plant and to the monitoring of the network operating parameters (for example the pressure in the pipeline or the level of a reservoir);
- b) extended to the scheduling of irrigation shifts with the activation of valves in the field or to the occasional/seasonal interruption of irrigation at different network levels (sector or an entire perimeter).

In some cases, irrigation networks may have mixed needs, requiring the control and monitoring of the main distribution network and the acquisition of secondary network volumes/parameters.

The **HYDRONET** system satisfies all the possible needs being able to manage different configurations (Fig.1):

**Remote reading**: the system allows the remote reading of the flow rates and volumes measured by the water meters, the detection and management of the alarms (cable cut and/or intrusion) and the acquisition of an analogue signal acquired at the managed point, (pressure, temperature, level, etc.). This configuration is typical in public distribution networks (Fig.2), where the Water Administrator operates just to collect information (water flow/volumes) to properly invoice the consumptions of the users and/or to keep under control the main nodes of the water network.

Remote control: the system maintains all the functions of acquisition of the remote reading and integrates those with the remote control of hydraulic valves (through solenoid valve), also allowing to program their cyclic opening / closing or to execute immediate commands. This configuration is suitable for both the public service (Fig.3), which needs to manage the users shifting and the scheduled maintenance interventions, and for the automation of private systems (Fig.4), where capability to program the openings/closures at sector level and the control of the main network are key points for the management.

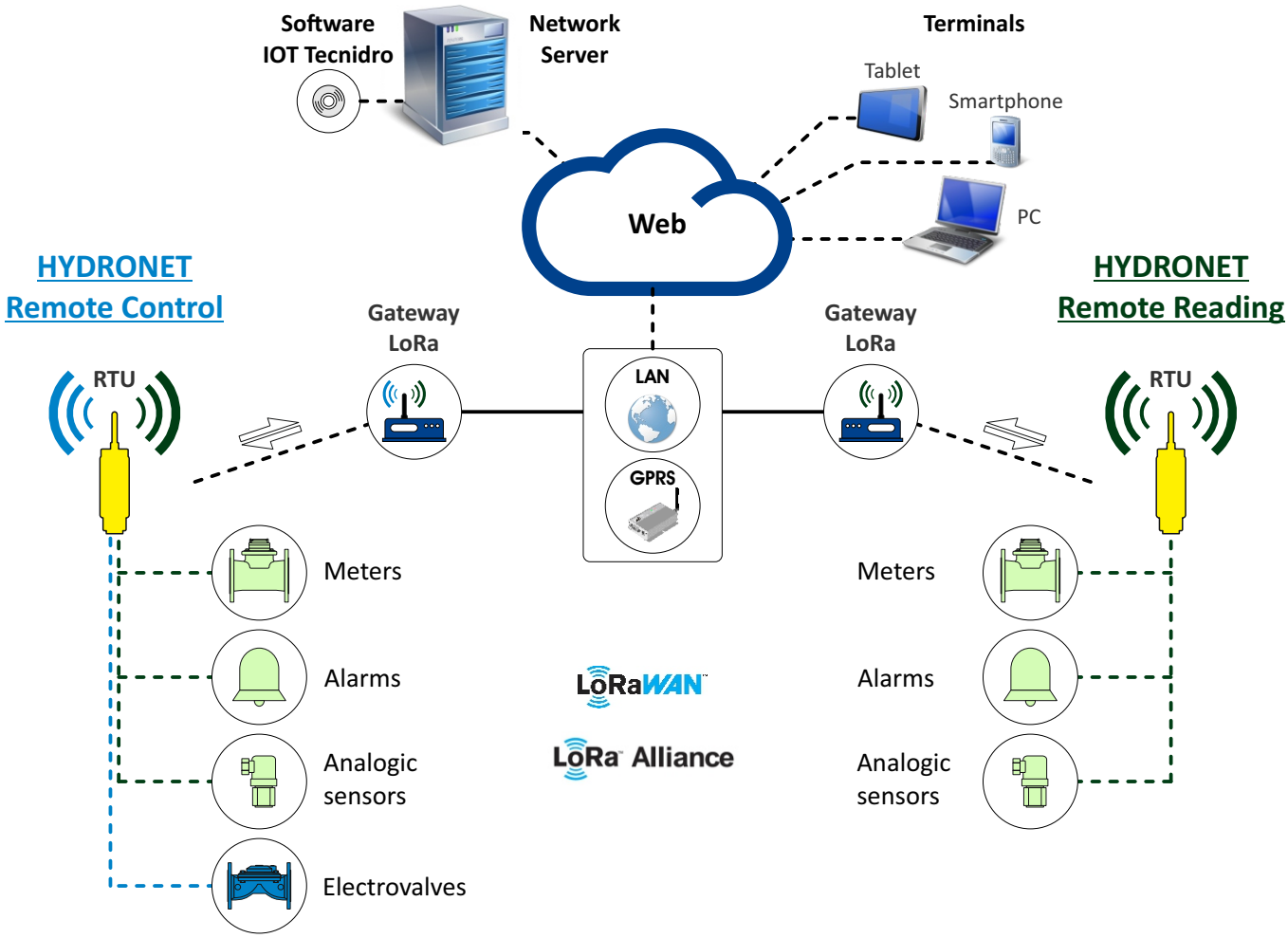



*Fig.1 - Remote Reading and Remote Control systems configuration*

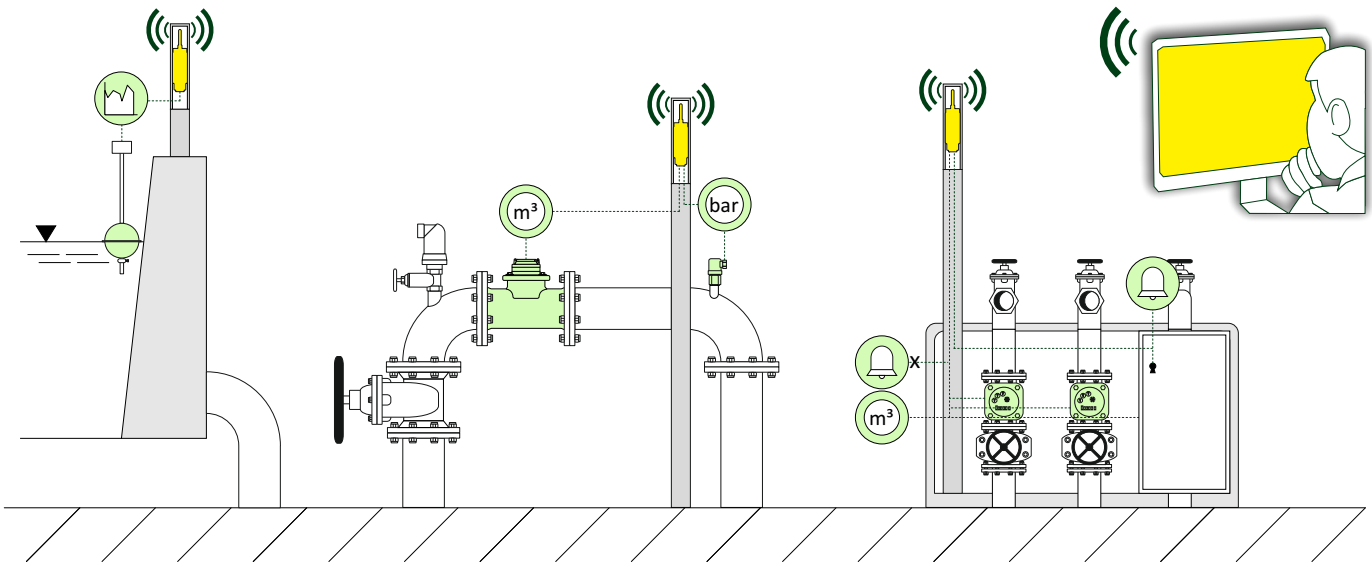



*Fig.2 - Example of data acquisition with HYDRONET remote reading system for public irrigation networks*

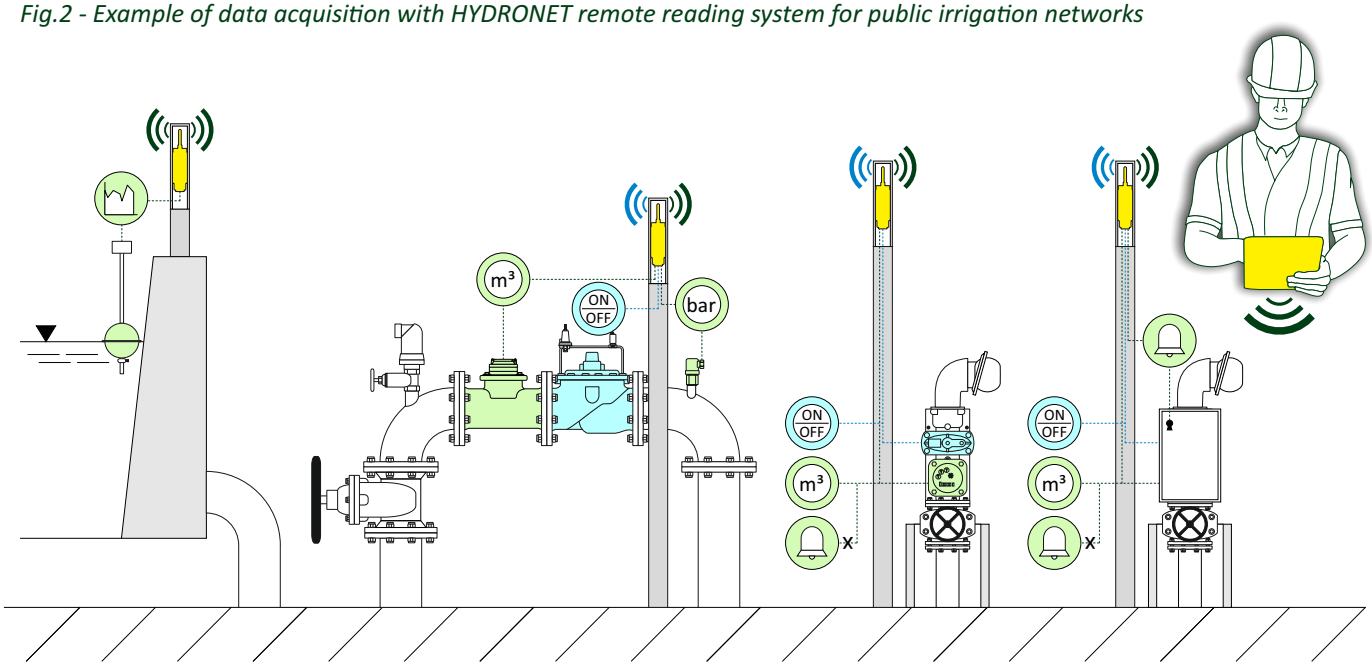



*Fig.3 - Example of data acquisition and commands with HYDRONET remote control system for public irrigation networks*

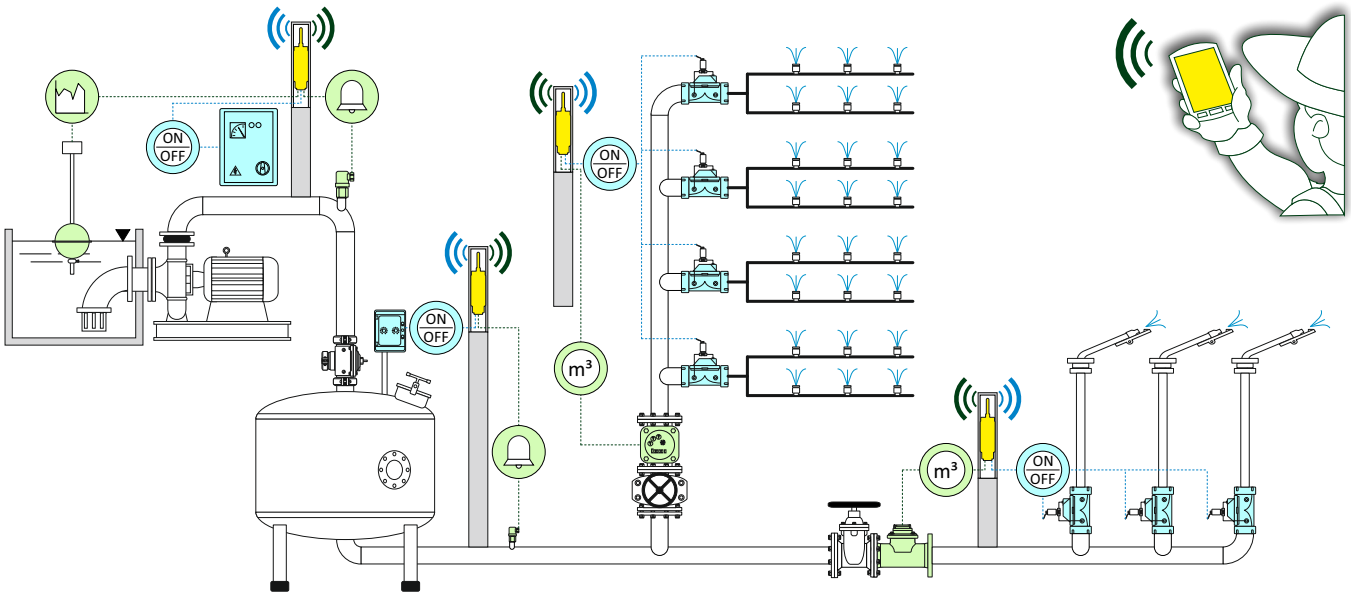



*Fig.4 - Example of HYDRONET remote control system with commands and acquisitions for private systems*

# HYDRONET System Structure

The **HYDRONET** system is based on a large-scale autonomous radio network that operates with the LoRaWan ™ communication protocol on the 868 Mhz multichannel frequency band, licence free in Europe and in many other countries.

The system consists of RTU (Remote Terminal Units) peripheral units that are independent of each other, powered by a long-life lithium battery and suitable for installation in the open field (Fig.5) near the hydraulic equipment to be monitored or controlled. The RTUs are self-sufficient and have a very low visual impact, not requiring any solar panel that would make them more exposed to theft and vandalism.

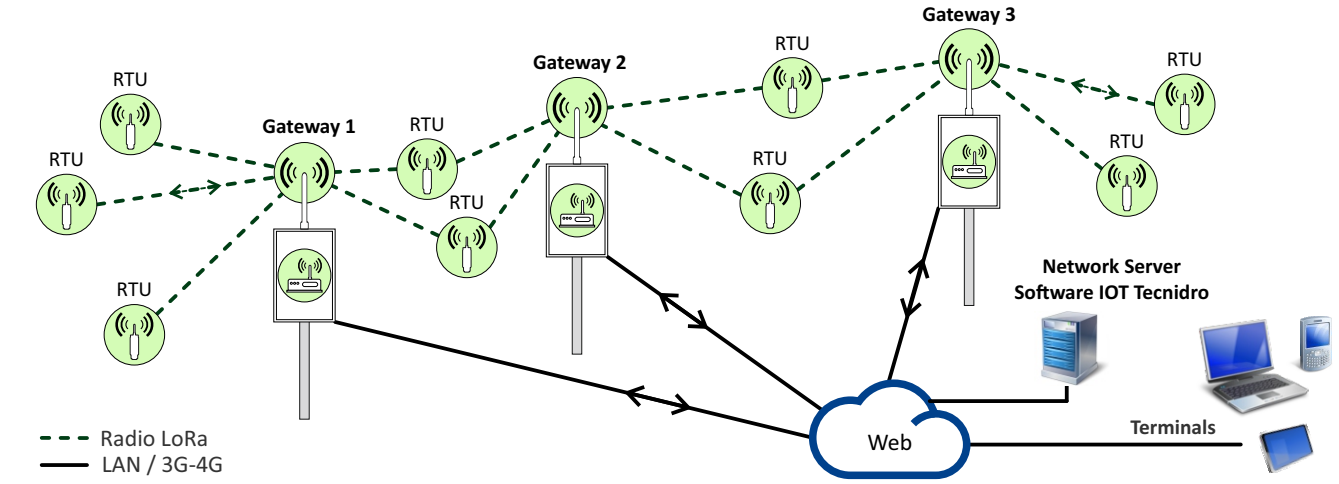
*Fig.5 RTU*

Communication with the RTUs is ensured by one or more concentrator devices (Gateway), with local or autonomous power supply, generally installed on top of the existing structures chosen for the management of the service (Fig.6 - warehouses, technical rooms, piezometric towers etc.), to be easily accessible and at the same time offer optimal network coverage.

The radio network is characterized by a star-like configuration (Fig.7) that does not require any routing, i.e. the RTUs communicate each directly and bidirectionally with the nearest Gateway or that guarantee the best radio signal quality.
Gateway points are equipped with an Ethernet / LAN port for direct connection to the Internet (or alternatively a 3G / 4G module) for transferring information to and from a dedicated Network Server or an in Cloud remote service, which manages the database and makes it available on the WEB platform for system management.

*Fig.6 - Gateway*

The user interface of the **HYDRONET** system is represented by the **Tecnidro IOT** software, accessible from any point at any time from fixed or mobile PC, smartphone and tablet. The interface is organized on several hierarchical levels to allow an easy consultation of information, the display of the status of the geolocalized field equipment, sending commands, notification of alarms and data extraction for their subsequent processing.



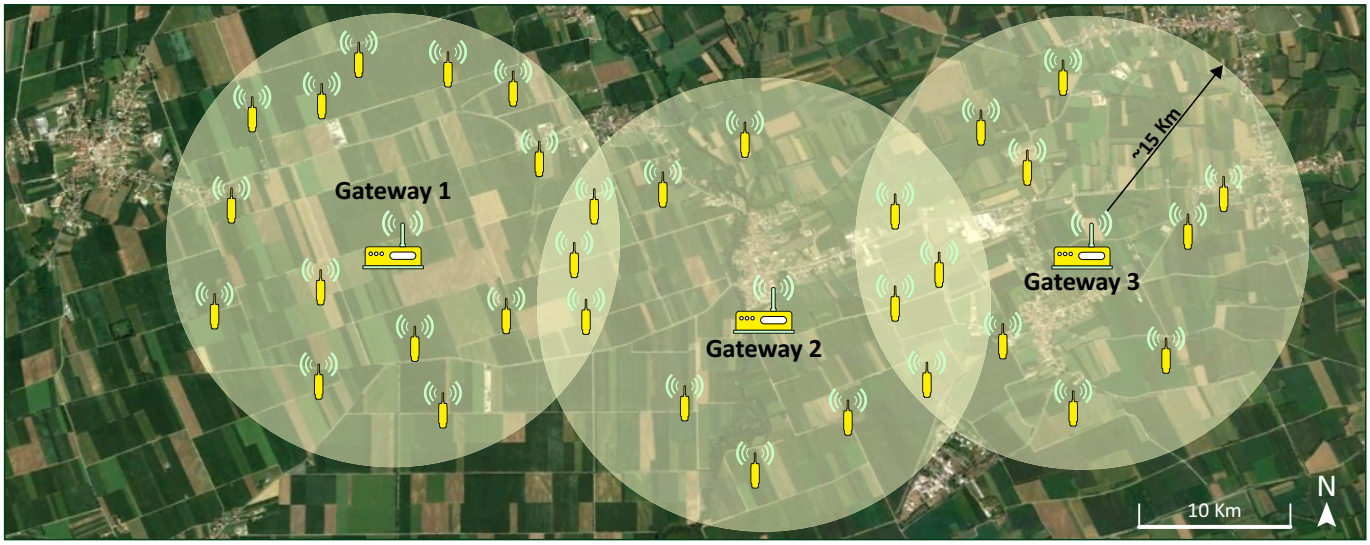




*Fig.7 - Coverage of the star-like radio communication network*

In addition to the large radio coverage capability, the HYDRONET system offers further advantages, easily managing in almost real time (Near Real Time) a very large number of remote devices.
Communication between the RTUs and the Gateway is completed in a very short time (up to 2 minutes for 1,000 managed points) and the transmission interval can be programmed at the most suitable value for the system, preserving the battery life.

Each Gateway is designed to manage up to a maximum recommended of 256 uniquely coded RTU units, thus concentrating the communication of a network composed of over 1,000 devices including meters, valves, sensors and more.

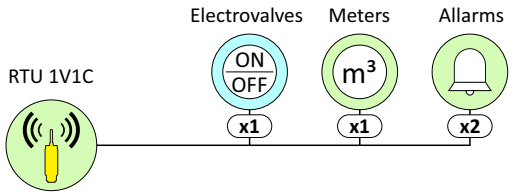
The total number of field devices that can be connected to the peripherals depends on the number of outputs and inputs used by the RTUs, which are available in different standard models (Fig.8) to adapt to the specific needs of each type of system.
The electronics of the RTU is designed to manage up to:

- n. 4 digital outputs for solenoid valve control
- n. 4 impulsive inputs for water meter reading
- n. 5 digital status / alarm inputs (valve status, cable cut, intrusion, etc.)
- n. 1 analogue input for sensor acquisition (pressure, level, temperature, etc.)

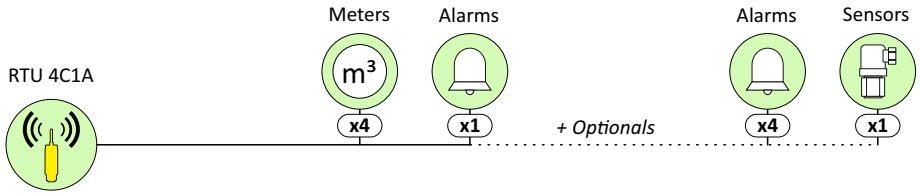
The availability of electronic inputs and outputs can be fully exploited in relation to the type of RTU adopted (R-Tube or R-Box version).

*Fig.8 - RTU standard models*

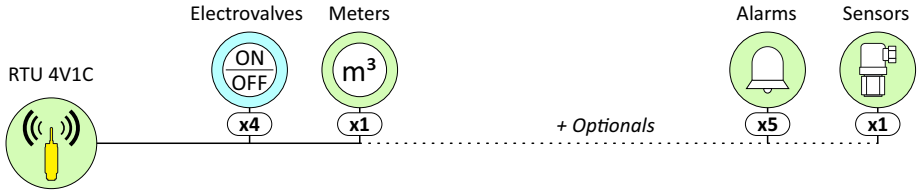
**RTU 1V1C**



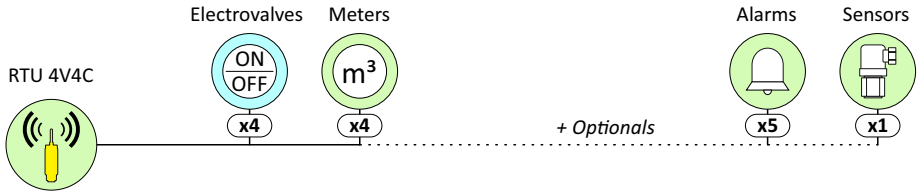

**RTU 4C1A**




**RTU 4V1C**




**RTU 4V4C**



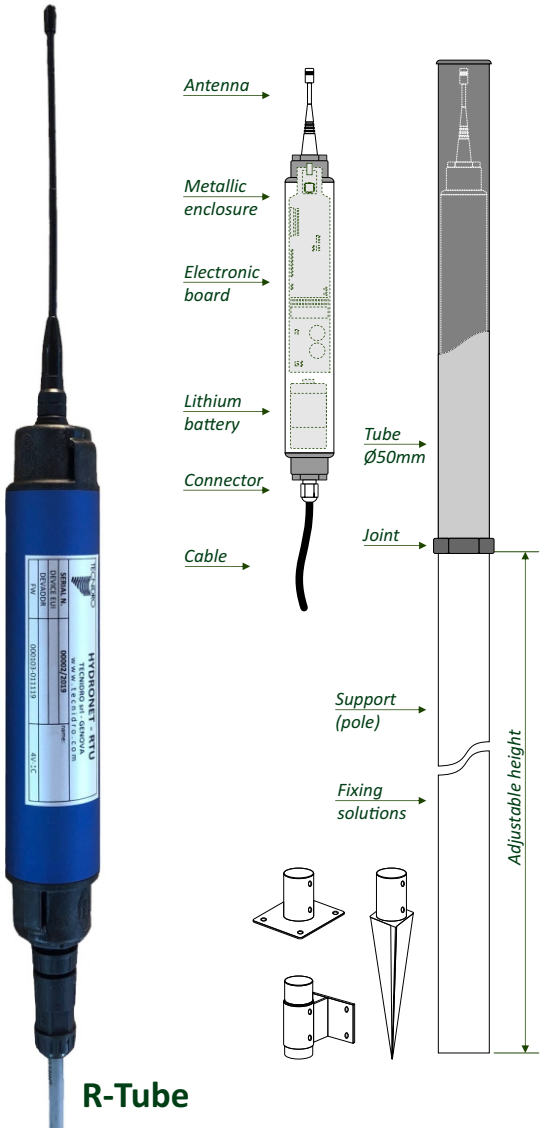
# Radio Peripheral Units - RTU

The RTU (Remote Terminal Unit) radio peripheral unit is the most exposed element of the **HYDRONET** system, as it is intended for installation near the field equipment to be monitored or controlled, normally positioned in open spaces and often without any type of protection (i.e. fences, box etc.).
Specific measures have therefore been adopted to eliminate any element of vulnerability, and in particular:

- the standard **R-Tube** version of the RTU unit is protected by a waterproof metal enclosure to allow installation in open places exposed to atmospheric agents or subject to high humidity;

- the cylindrical shape of the case has been designed to be inserted inside a standard Ø50 mm plastic tube, making it even more protected and hidden from view;

- the protection tube is housed on a robust self-supporting galvanized steel pole, of variable height to reach the optimal elevation of the RTU and available with bracket at the bottom in different executions for anchoring to the ground, or fixing to the floor or wall.




**R-Tube**

**R-Box**

The RTU unit can be also supplied in an **R-Box** version, with a waterproof case designed for wall mounting or for housing inside chambers or protective covers.

**LR** **XR**

**Antennas**

The transmission is entrusted to different models of high-performance omnidirectional antennas that can be combined with the RTU depending on the extension of the system and equipped with an SMA connector for the possible quick replacement.
For special applications, solutions with directional antennas are also available.

The **R-Tube** and **R-Box** units are powered by an internal lithium battery, long lasting and replaceable at the end of its life, avoiding the use of solar panels and traditional accumulators.

***Without solar panel***

*Subject to rapid deterioration of performance, damage and susceptible to theft and vandalism*

***Without traditional batteries***

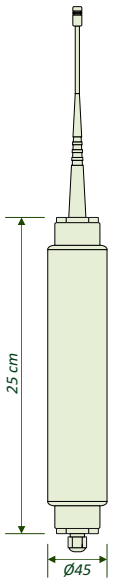
*Voluminous, short useful life, sensitive to low temperatures, dangerous and polluting*

## RTU Common Technical Characteristics

| | |
|---|---|
| **Communication protocol** | Lora Alliance™ LoRaWan™ certified |
| **Radio frequency band LoRa** | 868 MHz, (EU 863-870) multi-channels, license free<br>or 915 Mhz, (US902-928, AU912-928) according to country frequency plan |
| **Distance range** | up to 15 km on open spaces, in-sight antennas,<br>(coverage expandable with additional Gateways) |
| **Power supply** | Lithium Battery, replaceable |
| **Battery life** | 6-10 years according to operation conditions |
| **Standard inputs** | n°4 impulsive inputs (from water meters)<br>n°1 immediate alarm input (cable cut / intrusion / tampering)<br>n°4 configurable digital inputs (i.e. valve status)<br>n°1 analogue input (pressure, level sensor, etc..) |
| **Standard outputs** | n°4 solenoid valves (Latching) |
| **Working temperature** | from -30°C to +70°C |

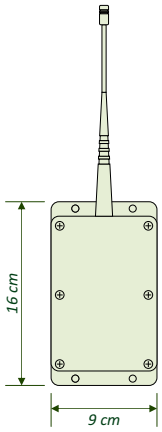
## RTU mod. R-TUBE - Dimensional characteristics

| | |
|---|---|
| **Enclosure** | Anodized aluminium tube with tecnopolymer caps<br>and anti-condensing vent |
| **Protection degree** | IP 67 |
| **Connectors** | n°1 SMA antenna connector<br>n°1 Multi-pin for devices connections |
| **Dimensions** | Ø45 mm x 250 mm (excluding antenna and connector) |
| **Weight** | Approx. 0,50 kg |



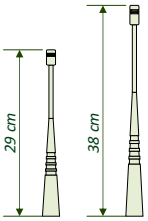

## RTU mod. R-BOX - Dimensional characteristics

| | |
|---|---|
| **Enclosure** | Polycarbonate box with cover and fixing wings<br>for wall mounting |
| **Protection degree** | IP 67 |
| **Connectors** | n°1 SMA antenna connector<br>n°1 Multi-pin for devices connection |
| **Dimensions** | 90 x 160 x 50 mm (excluding antenna and connector) |
| **Weight** | Approx. 0,50 kg |




## Antennas characteristics

| | |
|---|---|
| **Mod. LR** | Omnidirectional antenna Long Range |
| **Mod. XR** | Omnidirectional antenna Extended Range |
| **Directional** | On request |




*All technical data may be subject to change at any time and without notice.*

# Central Unit - GATEWAY

The Gateway concentrator for LoRaWAN ™ networks manages the data acquisition and the command sending via a bi-directional radio communication with the RTUs and communicates via Internet with the Network Server, by an Ethernet port connection (LAN) or through 3G/4G/LTE module. Each Gateway is suitable to monitor and control RTU units, potentially without a limit on the maximum number of managed units. To contain the read/command time within 2 minutes, the RTUs managed by a single Gateway must not exceed 256 units.

Gateway central units are available in two versions:
**Gateway GBA**: basic version for mounting on DIN rail, suitable for indoor installation or for outdoor use with IP67 protective cabinet, requires the availability of electric power and internet line (or additional 3G/4G/LTE module).

**Gateway GEX**: extended version designed for wall or support pole mounting, protected by an IP67 housing for outdoor use, receives power supply with PoE (Power over Ethernet) technology and is available with optional 3G/4G/LTE module.

For installation sites without power supply availability a solar panel kit with charger/regulator and battery is also available.

**Gateway GBA**

**Gateway GEX**

| ***Technical characteristics*** | **Gateway GBA** | **Gateway GEX** |
|---|---|---|
| ***Communication protocol*** | Lora Alliance™ LoRaWan™ certified | Lora Alliance™ LoRaWan™ certified |
| ***Radio frequency band*** | 868MHz Multi-SF 8 channels (or 915 MHz based on country freq. plan) | 868 MHz Multi-SF 8, 16 or 24 channels (or 915 MHz based oncountry freq. plan) |
| ***Operating system*** | Linux 4.1.15 (Yocto) | Linux 4.1.15 (Yocto) |
| ***Working temperature*** | from -40°C to +85°C | from -40°C to +85°C |
| ***Power supply*** | 12V, 1A | PoE 42-60 VDC, DC 12-24 V, |
| ***Enclosure material*** | Aluminium and polycarbonate | Aluminium |
| ***Dimensions*** | 114 x 99 x 70 mm (without antenna) | 258 x 228 x 90 mm (without antenna) |
| ***Protection degree*** | for indoor use or in IP67 cabinet | enclosure for outdoor use IP67 |
| ***Connectors*** | Ethernet 1 RJ-45 10/100<br>1 x SMA LoRa antenna<br>1 x USB Host, 1 x Micro USB Device | Ethernet 1 RJ-45 10/100 (PoE)<br>1 x “N” type LoRa antenna<br>1 x “N” type GPS/GNNS |

# Analogue and Digital Sensors

The analog and digital inputs of the RTUs make it possible to detect a wide variety of sensors, such as pressure transducers, level transducers, soil humidity sensors, tensiometers, proximity contacts, digital thermometers, anemometers, flow switches, etc.

The **HYDRONET** system also allows the detection of any device compatible with the LoRaWan® protocol.

*Examples of sensors that can be acquired from the RTUs*

**Pressure transmitter**

**Temperature sensor**

**Tensiometer soil humidity**

*All technical data may be subject to change at any time and without notice.*

# Network Server

The Network Server is the heart of the HYDRONET system, which ensures performance and keeps under control the operation of the entire infrastructure 24 hours a day.

Network Server

The Network Server manages the LoRaWAN ™ network carrying out all system functions, including:
- registration of RTU codes and authorized devices
- authentication of RTUs and connected devices
- GPS position of the RTUs
- management of transmissions from the RTU to the center (uplink)
- management of transmissions from the center to the RTU (downlink)
- Gateway management
- configuration of communication and stand-by times
- monitoring of communication parameters
- generation of network alarms

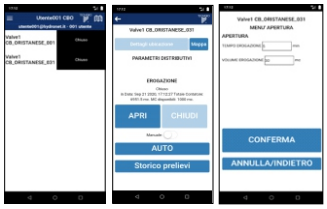
In addition, the Network Server is equipped with memory and back-up disks for maintaining the historical database of each individual communication made to and from the RTUs.

For medium-large size systems, the Network Server is normally dedicated (**On-premises**), supplied and installed at the customer's facility specifically for the this system, while for medium-small extension systems, a remote **In-Cloud** Network Server service is offered. This solution avoid the need to manage a local IT infrastructure with relevant cost for its implementation and maintenace.
The technical characteristics and performance of the Network Server workstations are defined according to the network extension and number of managed RTUs, guaranteeing at the same time the expansion capability of the system.

# Software IOT Tecnidro

The user interface is provided by the Tecnidro IOT software, a **WEB** based platform accessible both from the fixed terminal (Desktop) for the operations of start-up, programming, configuration, analysis and data processing, and from remote terminals (Notebook, Tablet, Smartphone, etc.) for the consultation and remote control of the RTUs.

**Software IOT Tecnidro**




A specific HYDRONET **APP** that can operate on Android and iOS mobile devices is also available

The Tecnidro IOT application for network monitoring and remote control includes several basic and detailed functions, including:

- assignment of the RTU identification name
- management of the communication quality of between RTU and Gateway
- display of the last communication intervened between RTU and Gateway
- display of the residual charge of the RTU battery
- display of the flow rates and volumes totalizers of the water meters
- display of the historical graphs of the digital sensors connected to the RTUs
- define a program of solenoid valve opening/closing commands schedeuled on the base of time and/or volume
- sending immediate commands to open/close the solenoid valves
- alarming on cable cutting, intrusion detection and other configured sensor thresholds
- display on geolocalized dynamic maps of the RTU activity status

For more details on the Tecnidro IOT software features and operating functions please refer to the "Installation, Use and Maintenance Instructions - Hydronet" in the latest version.

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