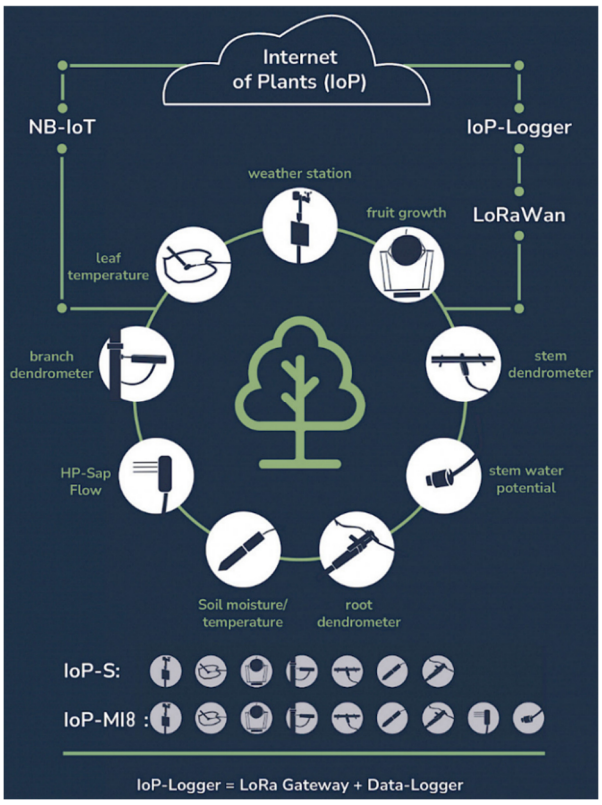
Internet of Plants (IoP) Solutions

- A Modular & Scalable Monitoring System -

Overview

ECOMATIK's Internet of Plants (IoP) integrates advanced technologies for continuous monitoring of a wide range of plant and environmental parameters — effectively making plants "internet-enabled." Designed for flexibility, the IoP system is a versatile tool ideal for a wide range of scientific and agricultural applications.



The modular IoP system combines low-power measurement and transmission nodes (LoRaWAN, NB-IoT/LTE-M) with a comprehensive range of sensors:

- **IoP-S:** Compact nodes for specific low-power sensors
- **IoP-MI8:** Multi-Sensor Stations for advanced monitoring applications, with direct transmission or with local data storage capacity (+ Logger).
- **IoP-Logger:** Special LoRa gateway with embedded LoRa stack server and local data logging function

Flexible cloud-based data hosting and online visualization provide seamless access to all collected data and insights:

0) Hardware Only: You manage server, payload decoding, integration, and database independently.

1) Basic Hosting (optional but recommended): Secure cloud storage with CSV download via browser – no visualization; ideal for users doing their own analysis (Excel, R, Python); low-cost, storage-based pricing.

2) Online Visualization (optional add-on): Web dashboard with live/historical data, charts, exports, and optional alerts. Perfect for teams needing a ready-to-use monitoring interface without internal IT setup.

IoP-S series:
Small measurement nodes, limited number of specific sensor types.

IoP-MI8 / Ydoc-x-MI8:
Multi-sensor stations with Ecomatik Multi-Interface (MI8) for advanced monitoring applications.
Custom-built products available on request: IoP-MI8 integrated with a fully featured data logger (+ Logger), e.g. YDOC or CR350.

Analog	RS485	Available types:	IoP-MI8	IoP-MI8 + Logger
IoP-S-LA	IoP-S-LR	**LoRaWAN** [1]	IoP-MI8-L	
IoP-S-NA	IoP-S-NR	**Cellular**[2] **(i.a. NB-IoT, LTE-M)**	IoP-MI8-N	IoP-MI8-LOG-N

[1] **LoRa transmission:** Local wide-area network, centralized topology, requires gateway. Payload limit 51 bytes, max. 16 data values!

[2] **Cellular transmission:** Cellular network, decentralized topology, network coverage required. Payload large, max. 33 data values!

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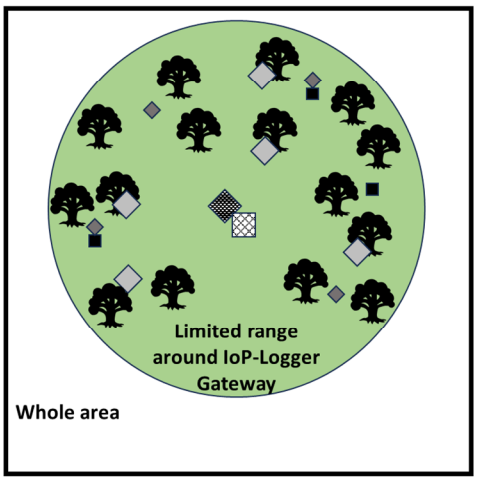
Application examples

LoRa-WAN based IoP network + IoP-Logger Gateway with internet connection

- intensive monitoring, large number of measurement positions in a limited area -



Measurement tree

IoP-Logger, range: depending on local conditions, 150 m to several km
→ Receives & stores data from sensor nodes, transmits data (e-mail, MQTT)
→ Requires power (grid or solar) + internet (Ethernet, WiFi, Cellular)

Solar Power Station: requires full sun light

IoP-MI8-L, Multi-Sensor Node for advanced monitoring applications:
→ Direct transmission to gateway (real-time possible), no local data storage
→ Payload limit 51 bytes, max. 16 data values!

MI8 connectivity:

Analog inputs (8x 16-bit SE or 4x DIFF) e.g.:	**Digital inputs** (SDI-12, I²C) for e.g.:
○ Sap flow sensors (SF-HP N3D2 or N3D1)	○ Soil SMT100, TEROS 11 or TEROS 21
○ Dendrometers/fruit growth (all types)	○ Air temperature & humidity
○ Leaf & air temperature sensor (LAT-B3)	○ Compact weather stations
○ FloraPulse stem water potential	○ etc…

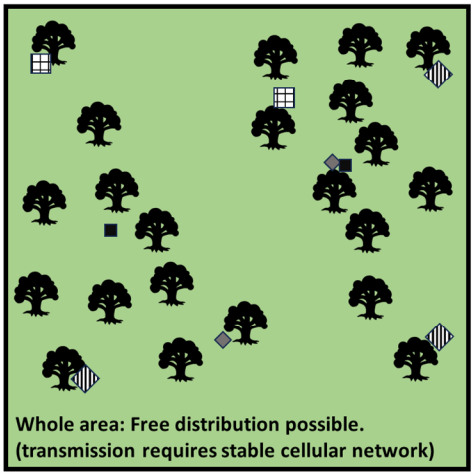
IoP-S, Small Measurement Node, limited number of specific sensor types:
→ Transmission to local gateway, no local data storage

IoP-S-LA, 3x analog:
e.g. 3x Dendrometer OR 1x LAT-B3 + 1x Dendrometer

IoP-S-LR, digital RS485
e.g. 3x SMT100 soil VWC and temperature, etc.

NB-IoT based IoP system with data transmission directly via cellular Network

- large area, measurement positions scattered individually or in small, spaced clusters -



Measurement tree

IoP-MI8-N, Multi-Sensor node for advanced monitoring applications
→ Direct transmission to server (real-time possible), no local data storage
→ Requires stable cellular NB-IoT / LTE-M signal
→ Payload large, max. 33 data values!

IoP-MI8 + Logger, Multi-Sensor Logger for advanced monitoring applications
→ Fully featured data logger, with local data storage
→ Option: periodic data transmission to server via cellular NB-IoT

MI8 connectivity:

Analog inputs (8x 16-bit SE or 4x DIFF) e.g.:	**Digital inputs** (SDI-12, I²C) for e.g.:
○ Sap flow sensors (SF-HP N3D2 or N3D1)	○ Soil SMT100, TEROS 11 or TEROS 21
○ Dendrometers/fruit growth (all types)	○ Air temperature & humidity
○ Leaf & air temperature sensor (LAT-B3)	○ Compact weather stations
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IoP-S, Small Measurement Node, limited number of specific sensor types:
→ Direct transmission to server (real-time possible), no local data storage
→ Requires stable cellular NB-IoT / LTE-M signal

IoP-S-NA, 3x analog:
e.g. 3x Dendrometer OR 1x LAT-B3 + 1x Dendrometer

IoP-S-NR, digital RS485
e.g. 3x SMT100 soil VWC and temperature, etc.

Technical specifications of IoP-S (analog) and IoP-MI8

Device name	IoP-S analog (-LA and -NA)	IoP-MI8
Channel	3x analog Or 2x analog+1x I2C	8 Singe ended/ 4 differential 1x UART (3.3V) 1x I2C (3.3V) 1x SDI-12
Compatible Sensors	Analog sensors e.g.: - Dendrometer (all models) - Temperature probes (e.g. LAT-B3) Digital sensors: - I2C: Air T/RH sensors - Pulse: Rain	Analog sensors e.g.: - Dendrometer (all models) - Temperature probes (e.g.LAT-B3) - Sap-Flow, Heat-Pulse (N3D1, N3D2) - FloraPulse water potential sensor - Digital sensors (SDI-12 & I2C), e.g.: SMT100, TEROS 21, TEROS 11, etc. **NOTE** Customized setups available on request, with configuration options depending on sensor type, quantity, and transmission technology.
Resolution of Analog Channels	12 Bit (analog noise-free) Resolution & measurement range: - 11 mm (e.g. DD-L1): 3 µm - 25 mm (e.g. DD-L2): 6 µm - 50 mm (e.g. DD-L3): 13 µm - 120 mm (e.g. DF4): 37 µm Temperature sensors - if <50°C: 0.1 °C	16 Bit (real noise-free) Resolution & measurement range: - 11 mm (e.g. DD-L1): 0.2 µm - 25 mm (e.g. DD-L2): 0.4 µm - 50 mm (e.g. DD-L3): 0.8 µm - 120 mm (e.g. DF4): 2.3 µm Temperature sensors - if <50 °C: 0.003 °C
Power output	3.3 V (not regulated) and 5V (regulated)	3.3 V and 5.3 V (both switched, regulated)
Configuration	All nodes are pre-programmed according to customer specifications, ready for use	
Battery and Life time	8500 mAh Li-SOCI2 battery (replaceable) > 1 year, depends on configuration.	8500 mAh Li-SOCI2 battery (replaceable) External 30 Ah rechargeable LiFePO4 battery (IoP BAT) for high power sensors.