EMOG Protocol: Application notes

April 2026

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Overview

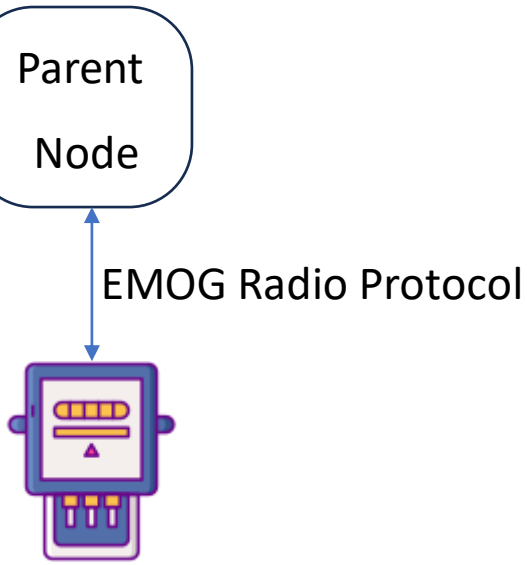
In the EMOG metering solution, wireless communication modules are fitted in or on smart/prepaid meters. Communication modules communicate with the meters on the manufacture's protocol (DLMS, DL/T 645, etc.), and with parent devices on the EMOG protocol. The EMOG protocol is a thin layer on top of the manufacturer's protocol to enable a secure, self configurating radio mesh with gateways to the Internet.
The protocol provides for normal bidirectional messages to meters, as well as special messages of own generation devices (solar panels, diesel generators, mass energy storage etc.) for the switching of meter registers under different supply conditions to the grid.

Abbreviations and Definitions

CIU	Customer Interface Units
DLMS	Device Language Message System
DL/T 645	Multi-function Watt-hour Meter Communication Protocol
TOU	Time of Use
DSM	Demand Side Management
EMOG	Encrypted, Mesh, Own Generation

Section 1: Use cases

1.1 Single meter, Single parent configuration.

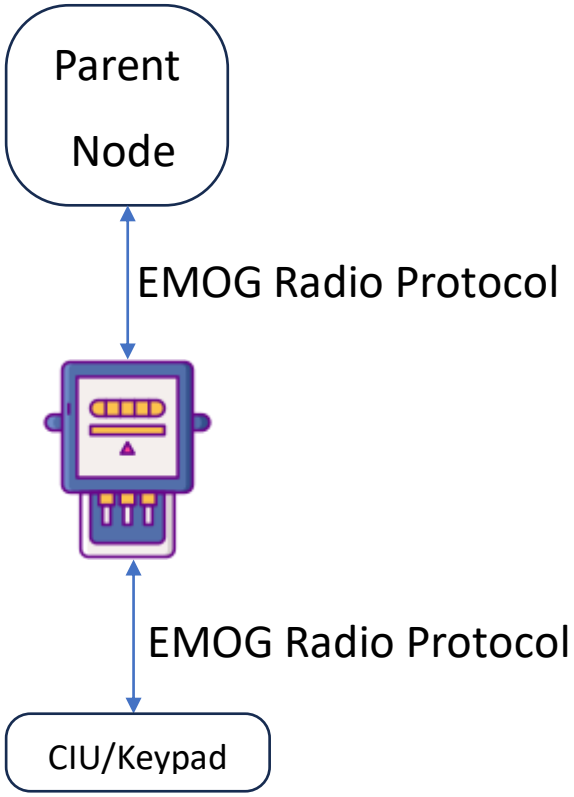


The simplest application of the EMOG protocol is shown above. It is an electricity meter equipped with an EMOG communication module connected via a radio link to a Parent Node.

In this setup, the EMOG communication module attached to the meter must be configured as a “Normal Electricity meter”. (Other modes of communication modules of devices is listed in Section 3).
Any smart or pre-paid electricity meter with an EMOG communication module can be used. (Veryco meters can be ordered with an EMOG Communication module pre-installed, while communication modules for other meter types can be developed – see section 3.)

The Single Meter Web Server Node can be used as parent node in this configuration. (See Section 4 for Node details):

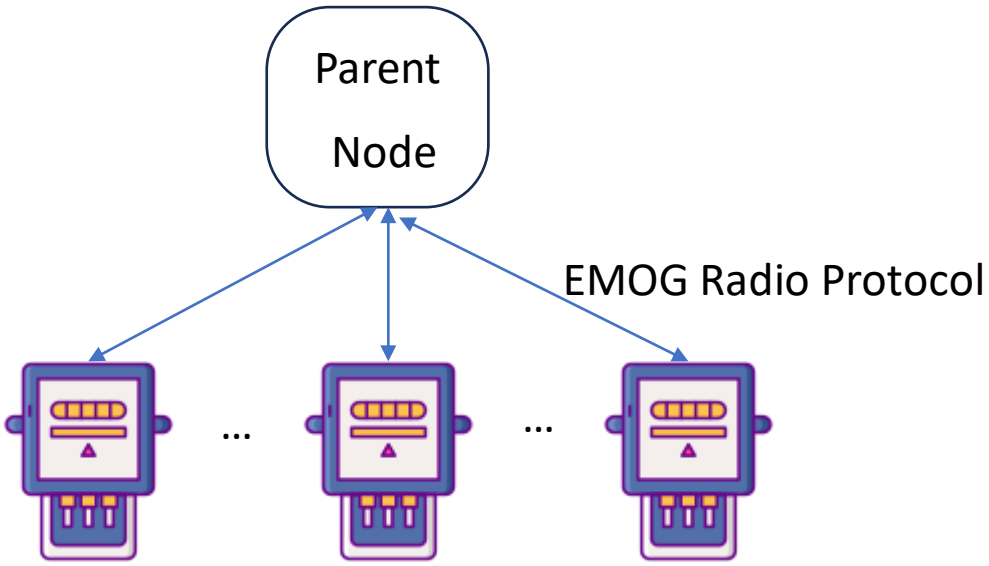
1.2 Single Meter with CIU/keypad, Single parent configuration.



This configuration is identical to the single meter setup above, but with a keypad added. If the parent node is configured as a gateway, or if no parent node is configured, a keypad can be installed for entering of STS tokens and display of remaining credit.

The keypad is an USB-powered device with local display and EMOG keypad firmware loaded. See section 5 for details.

1.3 Multiple meters, Single parent configuration



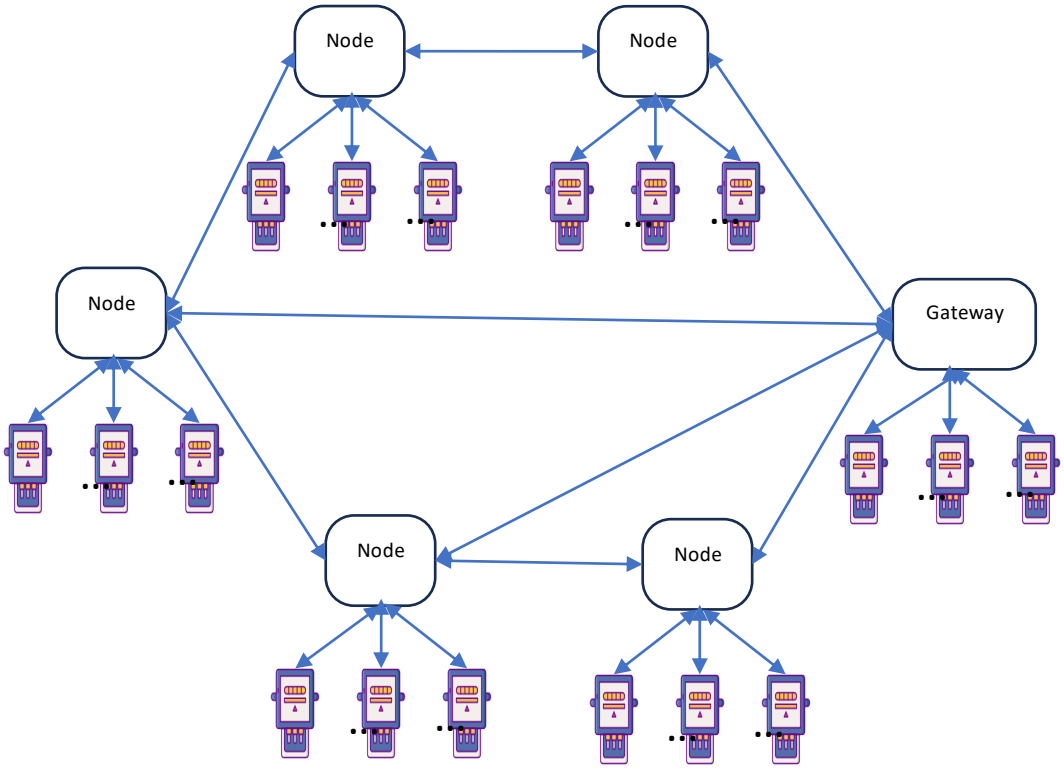
This configuration is typically used by a utility company with multiple electricity meters installed in a single meter kiosk or metering room. Up to 100 meters can be connected to a single parent node if they are within radio range (±50m) of the parent node.

In this setup, the EMOG communication module attached to each meter must be configured as a "Normal Electricity meter". (Other modes of communication modules of devices is listed in Section 3).
Any smart or pre-paid electricity meter with an EMOG communication module can be used. (Veryco meters can be ordered with an EMOG Communication module pre-installed, while communication modules for other meter types can be developed – see section 3.)

The Parent Node is a node device with EMOG Parent-Node firmware loaded. Depending on the hardware installed to the node device, the parent node can be configured as one of the following types (See Section 4 for details):

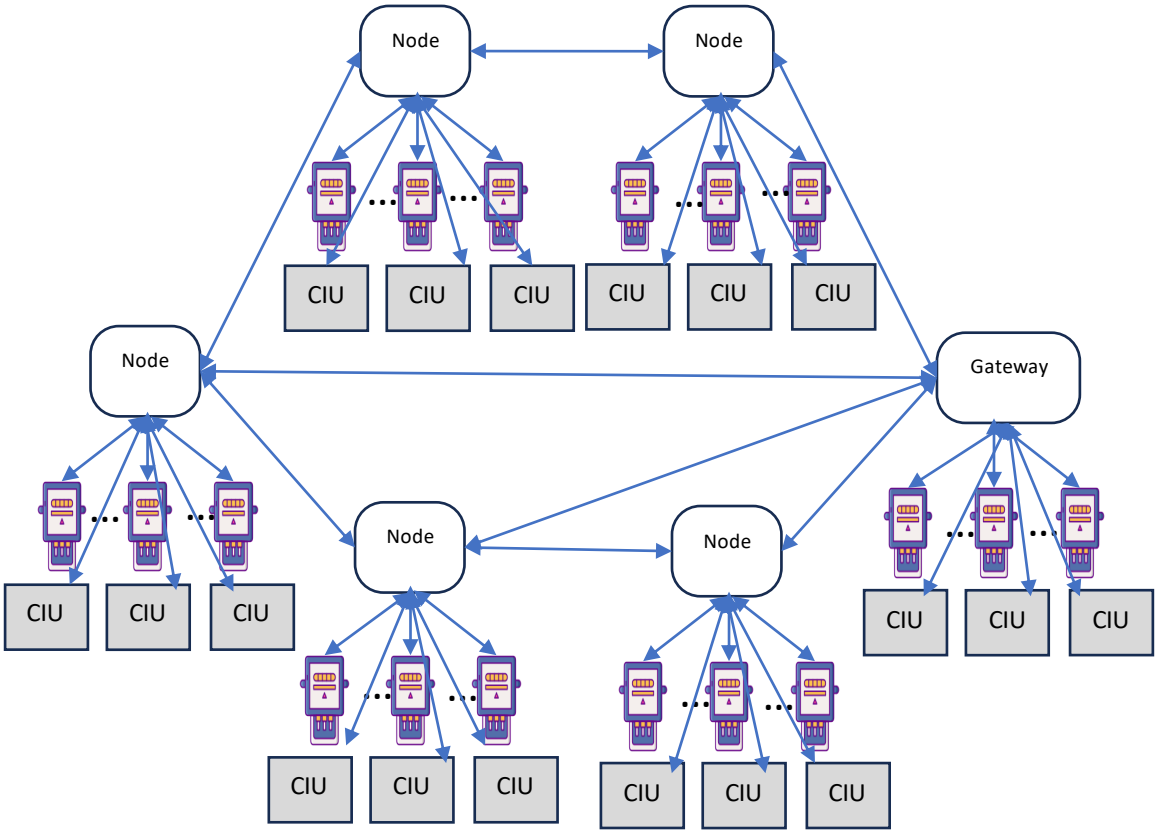
- Multi-meter node with local AP (Universal node)
- Gateway via Wi-Fi to the utility Internet portal.
- Gateway via Ethernet cable to the utility Internet portal.
- Gateway via GSM (LTE) to the utility Internet portal.
- Gateway via serial port to an external modem.

1.4 Multiple Meters, Mesh Configuration.



This configuration is typically used on a site or suburb by a utility company where parent nodes are within radio range (±100m) of each other. At least one of the nodes must be configured as a gateway, while other nodes will be auto configured to connect to the utility Internet portal via the mesh.

1.5 Multiple meters, Mesh configuration with CIU / Keypads



Customer Interface Units are touch-screen devices with displays and EMOG CIU firmware loaded. They can be installed in the homes of electricity users within range (±100 meters) of any node connected to the mesh.

For prepaid meters, the CIU displays remaining credit, and enables the upload of STS tokens.

2 Section 2: Own Generation

The EMOG communication module of an electricity meter has the following registers (amongst others):

- 1.8.0 Active Energy Import when the grid is powered from the main infeed.
- 2.8.0 Active Energy Export when the grid is powered from the main infeed.
- 81.8.0 Active Energy Import when the grid is powered from own generation.
- 82.8.0 Active Energy Export when the grid is powered from own generation.

There are also TOU and reactive power registers for each category above. The

2.1 Complex with Own Generation switchover

A complex or suburb with own generation is defined as a grid with a single (main) infeed point, plus a diesel generator or mass energy storage device connected to the internal grid in such a manner that the power is supplied to the grid by either the main infeed point, or by own generation. The generator (or mass energy storage) can supply energy to users on the grid only if the main infeed to the grid is switched off.

This configuration is like the mesh-configuration of section 1.4 or 1.5 above, except that the EMOG communication module of one meter in the mesh must be configured as "Own Generation Sensor". There are two options:

- Main infeed-type Own Generation sensor.
- Generator-type Own Generation sensor.

If the Own Generation sensor is connected to the voltage output of the generator, it sends a message to all devices on the grid that the generator is online when a sensor device is powered up.

Similarly, if the Own Generation sensor is connected to the voltage supply-side of the main infeed, it sends a message to all devices on the grid that the generator is not online when a sensor device is powered up.

Energy imported and exported by the user will be reflected on registers 1.8.0 and 2.8.0 when Own generation is off.

Energy imported and exported by the user will be reflected on registers 81.8.0 and 82.8.0 when Own generation is on.

2.2 Rooftop Solar panel installations with no-limit export energy

If energy export from the solar installation on the house to the grid is not limited by the utility, the EMOG communication module attached to the meter must be configured as a "Normal Electricity meter". All energy exported to the grid will be reflected in register 2.8.0.

2.3 Rooftop Solar panel installations with limited export energy

If energy export from the solar installation on the house to the grid is limited by the utility to restrict the user to be a nett importer, the EMOG communication module attached to the meter must be configured as a "Nett Import Electricity meter". Only the energy exported to the grid will be reflected in register 2.8.0 during periods when energy imported for the month exceeds energy exported for the month to date.

Energy export to the grid during periods when energy exported for the month exceeds energy imported for the month to date, will reflect on meter register 82.8.0.

2.4 Utility Solar panel installations on rooftops.

This model can be used by utilities where solar panels on rooftops are part of the infrastructure of the utility (i.e. the solar panels are not owned by the user).

Two meters with EMOG communication devices (both configured as “Normal Electricity meter”) must be installed on each house. The first meter must be installed in the metering kiosk on the grid that feeds the house, and a second meter must be installed on the inverter output of the solar panel.

The energy consumption of the user must be configured on the billing system of the utility as the sum of the import register values of the two meters minus the value of the export register of meter 1.

2.5 Complex with Own Generation and rooftop solar panels.

The EMOG communication modules on meters for houses with rooftop solar panels can be configured as “Normal Electricity meter” or “Nett Import Electricity meter” whether or not own generation is implemented for the complex. The interpretation of register 82.8.0 is however different for the two use-cases.

A normal electricity meter will reflect energy export on register 2.8.0 when the generator is off, and on register 82.8.0 when the generator is on.

A nett-import electricity meter will reflect capped energy export on register 2.8.0 when the generator is off, and a summation of surplus export energy and own generation export energy on register 82.8.0. This means that register 82.8.0 cannot be used for billing for a nett-import meter in a complex with own generation.

2.6 Demand side management (Geyser control).

DSM is typically used at complexes where the bulk supply is on a Time-of-Use (TOU) tariff, while the consumers in the complex are billed on a block tariff. DSM can also be used for Demand management where the bulk tariff has a KVA component. The principle of DSM is to switch selected loads off during peak periods.

Consumer-load meters must be installed in the geyser (or non-essential load) circuit inside the premises of consumers. This is a meter with a comms module configured as a “consumer load meter”.

If a suitable CIU is installed in the house where geyser control is implemented, the consumption and status of the geyser will be displayed on the CIU screen. Furthermore, if the CIU is connected to the Wi-Fi of the consumer, Shelly devices can be used as consumer load meters.

Shelly 1PM

3 Section 3: Communication modules

"Comms Modules" are devices connected to a meter that enables the meter to become part of the EMOG communication network. A comms module has "down" and "up" protocol. The down protocol is the protocol of the meter (e.g. DLMS), and the up protocol is EMOG.

The comms module keeps register information of the meter and operates with a sending stack. The sending stack is a list of messages that will be sent to the parent node on the next poll by the parent node. The behaviour of the comms module depends on the comms module type. The following types can be configured.

1. Normal Electricity meter
2. Own Generation-ON sensor
3. Own Generation-Off sensor
4. Nett Import Electricity meter
5. Consumer load meter

4 Section 4: Parent Nodes

There are two main categories of Nodes:

- Non-Gateway Nodes
- Gateway Nodes

4.1 Non-Gateway Nodes

1. Single meter web server node with local AP

This simple parent node shows a meter dashboard via web-browser on a smart phone, tablet or PC. The meter (with comms module), node and user device must be within Wi-Fi range of each other.

The Single Meter Web Server Node can only be used where the meter is not connected to a parent node of the utility company. If the meter is connected to utility node, the user must use a CIU for a dashboard to the meter.

2. Multi-meter mesh node (Universal Node)

The Universal node is typically used by utility companies to connect multiple meters (100 maximum) to the mesh communication ecosystem. The universal node can be configured with a smart phone via a local access point.

Universal nodes communicate with the local meters and with the gateway via other nodes.

3. Multi-meter mesh node with CIU coordinator (Coordinator Node)

The coordinator node is a special version of the Universal node. It is used by utility companies at complexes where customers are equipped with CIUs.

Coordinator nodes communicate with the local meters, local CIUs, and with the gateway via other nodes.

4.2 Gateway Nodes

Gateway Nodes connect to the MQTT Broker of the utility company via the Internet. Configuration is done with a smart phone via a local access point. The following types of Gateway Nodes can be installed on the mesh communication ecosystem:

1. Wi-Fi Gateway
2. Ethernet Gateway
3. GSM (LTE) Gateway
4. Wi-Fi CIU Gateway

5 Section 5: Customer Interface Units

The following CIUs can be deployed:

1. Stand-alone Prepaid CIU
2. Smart meter CIU
3. Wi-Fi CIU Gateway