Smart Computer Concentrators for interfacing and aggregating energy meter data (SIA)

What is SIA?

Super small, high end embedded Linux machine used to interface multiple energy meters in real time

To the meters:

Protocols

- IEC 1107
- Modbus

Interfaces

- Current Loop (CL)
- RS-485

To high level MDMS systems:

Protocols

- Multispeak 3.0j

Interfaces

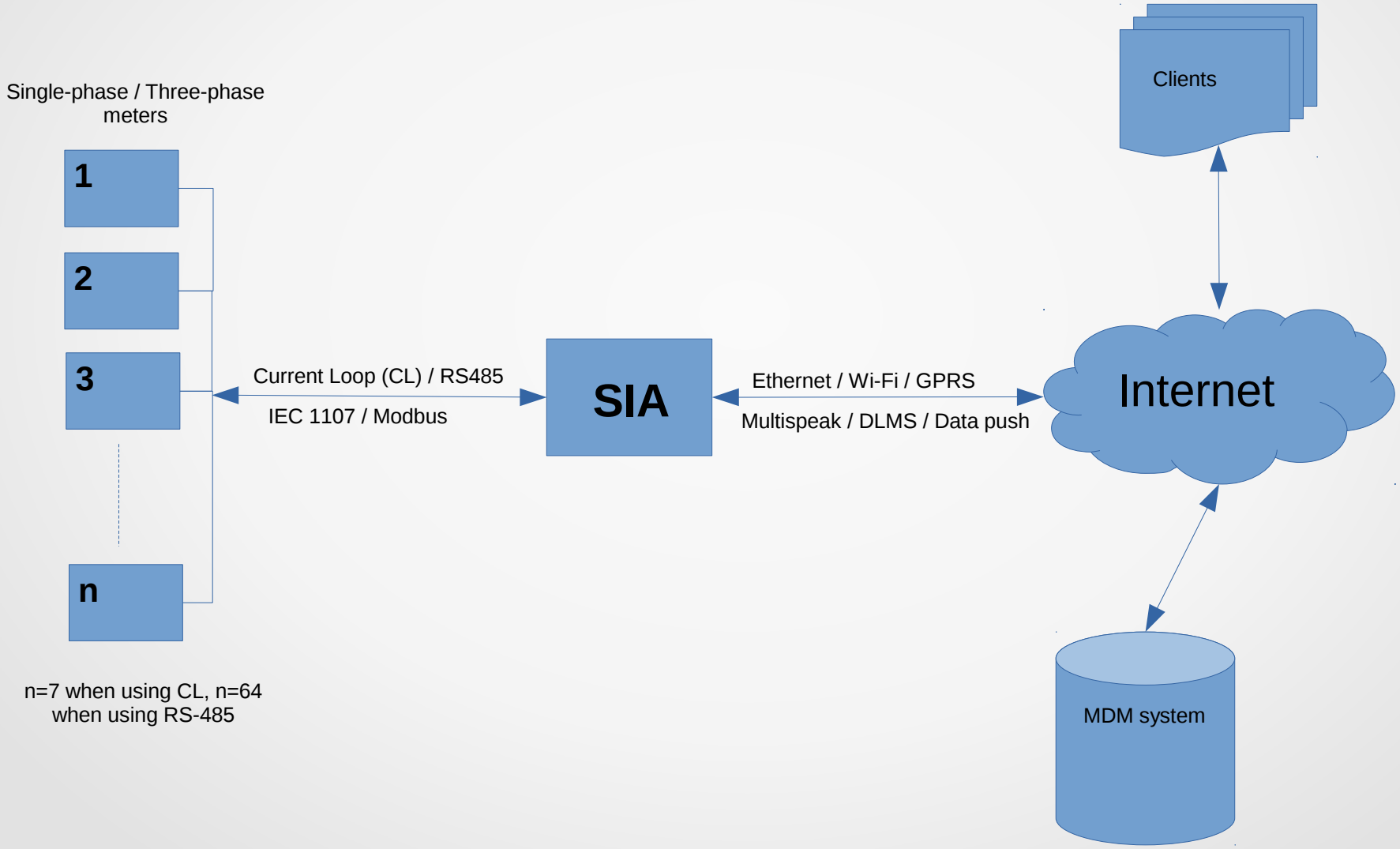
- Ethernet
- Wi-Fi
- GPRS
- RF

Features and benefits

DIN Rail mount	Easy mounting in any industrial environment
Very small size	Eases the installation in space constrained environment.
Low price	Create feature rich “Smart Grid” systems without spending a fortune.
Low power consumption	< 1.5 W consumption
AMR	All meter data (readout, load profiles and events) are automatically read by SIA on a predefined period of time and stored in local Sqlite database. Since the connection to the meters is wired and local, this approach avoids the problems of the existing AMR systems where remote connection to the meter can not be established, which leads to cost increase and data loss.
Automatic clock correction	SIA automatically synchronizes its clock using NTP (Network Time Protocol) and monitors whether the clocks of the meters accurate. If a time correction is needed SIA performs it automatically taking that burden off the AMR/AMI system.
One device serves multiple meters	Aggregates multiple meters, thus avoiding the need to have a separate communication module for each meter
VPN	Communication between the device and the MDMS system is secured using OpenVPN, making it virtually unbreakable.
Encrypted local storage	The file system on the local SD card is encrypted, so nobody can look or manipulate the data on it even if the card gets stolen.
Watchdog	Internal mechanism keeps track if the firmware is working properly and automatically reboots the device if it crashes for some reason. Ensures high reliability of the device.

Local data analysis	Stores and analyzes the meter data locally and this way distributes the computational and storage load for MDMS systems.
Reduces meter complexity	Reduces meter complexity, thus its price, by doing the communication and real-time data analysis instead of the meter.
User notification	SIA can track in real time for any selected parameter of the measurement (like consumed power in terms of money or value) and when a certain threshold is reached to automatically notify the user for this event via SMS or Email.
Interface convert	• RS 485 to LAN, Wi-Fi • CL to LAN, Wi-Fi
Remote firmware update	Device firmware can be remotely updated. No need to have physical access to the device.
Easy monitoring and configuration	Uses embedded Web interface for configuration, meter data presentation, monitoring and manipulation.
Flexibility	The embedded Linux OS makes the device very flexible and scalable by allowing it to add complex functionality, according to particular use cases and customer requirements, thus eliminating the need to modify the meter.

Architecture



We use a “modular” concept meaning that we are keeping the meters as simple as possible, so they can be cheap and deal with “metering” tasks only. When those meters need to be part of a bigger MDMS system we add a small and cheap computer/concentrator module, generally called SIA, with the appropriate interface to the outside world (currently SIA supports Ethernet, Wi-Fi, GPRS, RF Radio). SIA is not a transparent communication modem, but a complex embedded machine that, apart from many other features, supports reading multiple meters at the same time and storing those data locally, thus eliminating the need to have a separate communication module for each meter. SIA talks to the meters using IEC1107 or Modbus protocol and then Multispeak or DLMS (in development) to the MDM system.

The single phase meters support IEC1107 only, while the 3 phase meters support Modbus also. When the meter is connected to a SIA module, SIA uses one of these protocols to talk to the meter. From that point on SIA can talk different high level protocols to interface those data to external data centers. Currently SIA implements Multispeak and we plan to add support for DLMS, by implementing it inside the SIA module and inside the 3 phase meters

Specification

CPU	ARM9/400MHz
Flash	128MB mSD card (expandable 4GB)
RAM	32MB DDR
OS	Embedded Linux, kernel 2.6.28
Ethernet *	10 Mb, 10BASE-T; Build in 1.5kV magnetic isolation; RJ45 port
Wi-Fi *	**Mesh or client topology** Compliance for IEEE802.11 b/g; Encryption algorithm - 128-bit AES, 128-bit TKIP, 128-bit WEP, 64-bit WEP; Authentication algorithm - WPA, WPA2; Line modulation type - 16QAM, 64QAM, BPSK, CCK, DBPSK, DQPSK, OFDM, PBCC, QPSK, DSSS; Max range indoors – 100m; Max range open space - 300m;
RF *	Operates in license-free ISM 433, 868, and 915 MHz frequency bands ETS300-220 / FCC15.247 sertified & compliant 4.8 – 100 kbps throughput (typical usage around 10 kbps) Frequency Hopping Spread Spectrum (FHSS) Line-of-sight range up to 1km (25 mW) Line-of-sight range up to 4km (500 mW) Up to +15dBm & +27dBm output power Sensitivity: -110dBm @ 9.6 kbps Frame

GPRS *	Quad-band support: GSM 850 MHz, EGSM 900 MHz, DCS 1800 MHz and PCS 1900 MHz; Power Class 4 (33 dBm nominal maximum output power) for GSM/EGSM bands; Power Class 1 (30 dBm nominal maximum output power) for DCS/PCS bands; GPRS multislot class 10; All GPRS coding schemes from CS1 to CS4 are supported; GPRS bit rate: 85.6 kb/s (max.), 53.6 kb/s (typ.) in down-link; 42.8 kb/s (max.), 26.8 kb/s (typ.) in up-link; Encryption algorithms A5/1 for GSM and GPRS are supported;
Токов кръг (CL) **	Single-channel Up to 7 devices (meters)
RS-485 **	Up to 64 devices (meters)
Size	9cm x 1.75cm x 5.64cm (Height x Width x Depth)
Power supply	External 16-30V VDC, 100mA
Work temperature	-5 to 40°C
Humidity	0 – 90% Non-Condensing

***** Ethernet, Wi-Fi, RF and GPRS interfaces are self excluding. The device can have either one of them, but not all of them at the same time.

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SIA Wi-Fi/CL photos

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