Wired vs Wireless meters

Wireless open standards

Comparison

Protocol	Frequency	Range	Data Rate	Topology	Power Usage
Zigbee	2.4 GHz, 915/868 MHz	Short	Up to 250 kbps	Mesh, Star	Very Low
LoRaWAN	868/915 MHz	Long	0.3–50 kbps	Star	Extremely Low
Wi-SUN	868/915 MHz	Medium to Long	50–300 kbps	Mesh	Low to Medium
Bluetooth LE	2.4 GHz	Short	125 kbps–2 Mbps	Star, Mesh	Very Low
IEEE 802.11ah	Sub-GHz (~900 MHz)	Medium	Up to Mbps	Star, Tree	Low
IEEE 802.15.4	Various	Short–Medium	20–250 kbps	Mesh, Star	Very Low
Thread	2.4 GHz	Short	250 kbps	Mesh	Very Low

Recommended for Residential Microgrid Applications in Uganda:

- **LoRaWAN**: If covering a large geographical area (kilometers), due to its excellent range, penetration, and low power use.
- **Wi-SUN**: For robust, medium-to-large-scale smart metering networks, especially if a mesh topology is desirable.
- **Zigbee/Thread**: Ideal for dense residential areas where devices (meters) are closer together, benefiting from low power and reliable mesh networking.

Wired Open standards

Comparison

Protocol	Standard	OSI Layers	Medium	Topology	Range	Data Rate	Typical Application Areas	Remarks

G3-PLC	ITU-T G.9903	Layers 1-2	Power Lines	Mesh, Star	Up to several km	2.4–35 kbps	Smart grids, AMI, smart meters	Robust, designed for noisy environments; supports IPv6, strong security
PRIME	ITU-T G.9904	Layers 1-2	Power Lines	Mesh, Star	Up to several km	21–128 kbps	Smart metering, distribution automation	Optimized for higher-speed PLC, widely used in European smart meter rollouts
IEEE 1901.2 PLC	IEEE 1901.2	Layers 1-2	Power Lines	Mesh, Star	Up to several km	2.4–500 kbps	Smart grids, smart cities	High interoperability, IPv6 support; ideal for utility and smart city deployments
M-Bus (Meter-Bus)	EN 13757	Layers 1-2	Twisted pair cable	Bus	Up to ~1 km	0.3–38.4 kbps	Meter reading (water, heat, gas)	Widely used in Europe; reliable, low-cost wired solution
KNX	ISO/IEC 14543-3	Layers 1-2	Twisted pair cable	Bus, Star, Tree	Up to ~1 km	9.6 kbps	Building automation, home control	Open standard for building automation, popular in Europe
BACnet MS/TP	ASHRAE 135	Layers 1-2	RS-485 twisted pair	Bus	Up to ~1.2 km	9.6–115.2 kbps	Building automation, HVAC controls	Common in building and industrial automation; robust, scalable

Ethernet	IEEE 802.3	Layers 1-2	CAT5/CAT 6 cable	Star, Tree	Up to ~100 m	10 Mbps–100 Gbps	Networking backbone, smart buildings	High-speed, standard networking; widely supported across industries
RS-485 (EIA-485)	EIA-485	Layers 1-2	Twisted pair cable	Bus	Up to ~1.2 km	Up to 10 Mbps	Metering, industrial control systems	Simple, robust, widely used for serial data transmission
CAN Bus	ISO 11898	Layers 1-2	Twisted pair cable	Bus	Up to ~1 km	Up to 1 Mbps	Automotive, industrial automation	High reliability, robust error detection, common in harsh environments

Recommended Wired Protocols for Residential Microgrid Metering (Uganda)

- **PLC-based (e.g., G3-PLC or IEEE 1901.2)**:
  - Ideal due to existing infrastructure (power lines).
  - Good for scalable, reliable deployments.
- **RS-485**:
  - Robust, simple wiring suitable for smaller clusters.
  - Common for direct-wired connections (local clusters).
- **M-Bus**:
  - Suitable if integrating gas, water, or heat metering alongside electricity

Comparison between wired and wireless

Aspect	Wireless Option (Wi-SUN/LoRaWAN)	Wired Option (G3-PLC, RS-485)	Recommendation
Installation Cost	□□ Lower	□□ Higher (cabling, labor)	Wireless □
Maintenance Cost	□□ Moderate (battery replacements)	□□ Low (no batteries required)	Wired □
Reliability	□□ Medium (environment dependent)	□□ High (consistent, stable)	Wired □

Aspect	Wireless Option (Wi-SUN/LoRaWAN)	Wired Option (G3-PLC, RS-485)	Recommendation
Scalability	□□ High (easy additions)	□□ Moderate to low (harder additions)	Wireless □
Range/ Coverage	□□ Good (with repeaters)	□□ Excellent (using PLC)	Wired (PLC) □
Security	□□ Good (depends on setup)	□□ Very Good	Wired □
Installation Time	□□ Short	□□ Longer	Wireless □
Physical disruption	□□ Minimal	□□ High (trenching, wiring)	Wireless □

? Recommended Choice: Hybrid or G3-PLC

? Primary Recommendation: G3-PLC (Wired)

Given your scenario (dense apartment blocks with existing electrical infrastructure and meters located closely on the ground floor), **G3-PLC** offers significant advantages:

- **Low Ongoing Maintenance:** No batteries to manage.
- **High Reliability:** Stable signal leveraging existing wiring.
- **Cost-effective (long-term):** Minimal ongoing costs after initial installation.
- **Robust & secure**: Highly suited for apartment complexes.

? Alternate Recommendation: Hybrid (PLC Backbone + Wireless Endpoints)

If flexibility or future expansions matter, consider a hybrid setup:

- Use **G3-PLC** within each block to connect meters reliably to a local gateway.
- Connect block gateways to a central system via wireless (**Wi-SUN or LoRaWAN**). This reduces physical disruption between buildings while maintaining the reliability within each block.

This hybrid method provides the best of both worlds—flexibility and low maintenance.

Links

[Chatgpt detailed thread]

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