Comunicação via Rede Elétrica (PLC)

Tecnologia, Produtos e Aplicações da Semitech



Raphael Mehrbians
VP, Business Development
Semitech

EM INGLÊS

semitech semiconductor

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Your Brazilian Connection

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A Quadrarep é uma empresa de representação, na área de componentes eletrônicos.
Ela fornece suporte local, técnico e comercial, para essas empresas desde 2001.



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LINE CARD

aoneer

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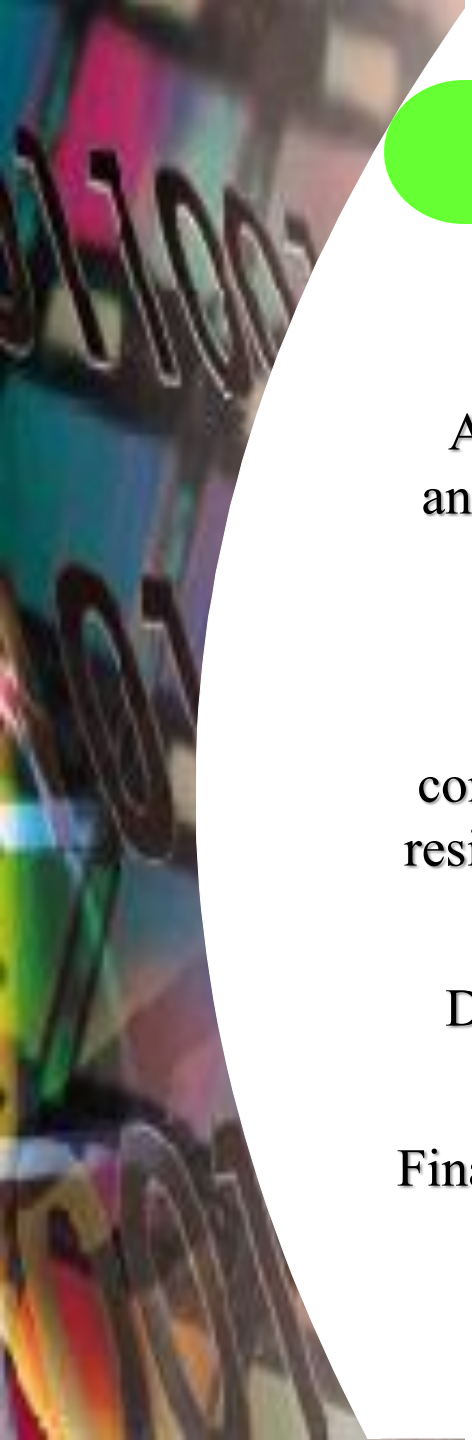
e-peas semiconductors

TE connectivity

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AISTORM

Chip HOMER



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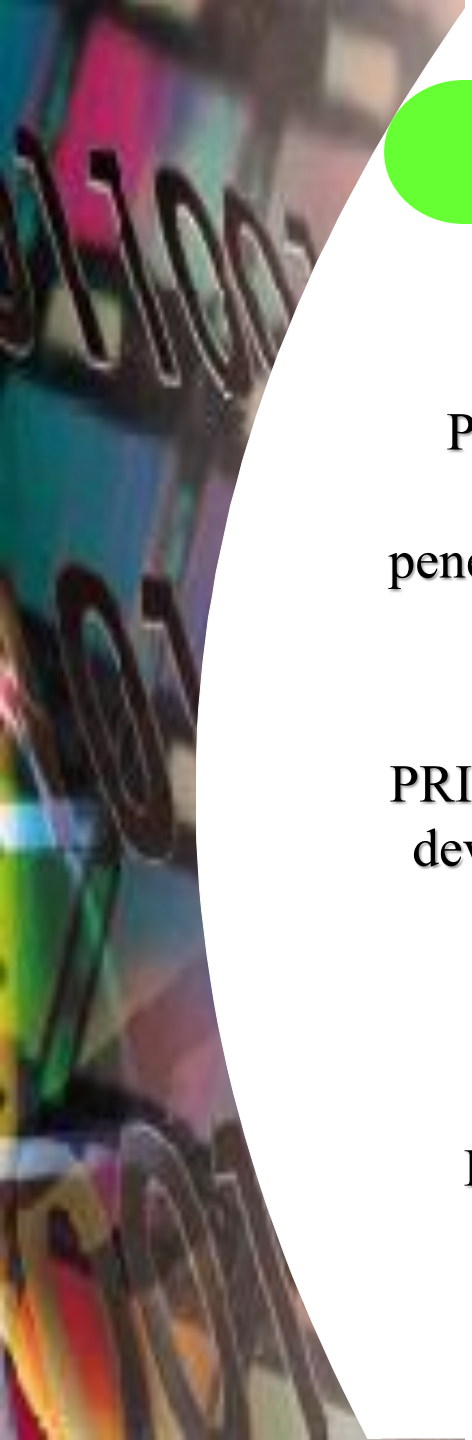
Power Line Communication - PLC

As soluções de PLC operando em AC evoluiram nos últimos 30+ anos, e podem ser divididas entre Narrowband PLC (NB-PLC) para smartrgrids / automation, e Broadband PLC (BB-PLC) para principalmente internet e multimedia dentro das residências.

Antes da década de 90 o PLC era usado principalmente para concessionárias de eletricidade, telemetria e automações simples em residências, usando tipo protocol X10 a 20bps – pulsos sincronizados no zero-crossing.

Década de 90 as velocidades já foram para 1200bps e até 10kbps, usando FSK para modulação.

Final dos 90 e começo dos 2000 já existiam Soluções que chegavam a 350kbps



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Power Line Communication - PLC

PLC em consumer otimiza maior velocidade em menor distância, enquanto PLC para industrial e smartgrid prioriza distância, penetração e resiliência grande à ruídos elétricos, e é aonde a Semitech desenvolve Soluções.

Dos padrões existentes para esse mercado a Semitech atende o PRIME, G3-PLC, IEEE 1901.2, indo até 1Mbps de velocidade, e entre devices opera entre 100m e 400m, podendo chegar a até quilometros via mesh e repetidoras.

Por filosofia é uma solução robusta, então permite seu uso em ambientes industriais ruidosos e com grandes distâncias.

Funciona em AC e DC, então desde rede elétrica pública até em veículos o NB-PLC opera com alta qualidade.



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Semitech

O porque da solução de PLC da Semitech ser a melhor do mercado é o que vamos ver agora com o Raphael….

POWER LINE COMMUNICATION FOR SMART INFRASTRUCTURE

Semitech Introduction

Turning existing power wiring into reliable communication networks

SMART GRID • SMART LIGHTING • INDUSTRIAL IoT
TRUCK & TRAILER • RAIL

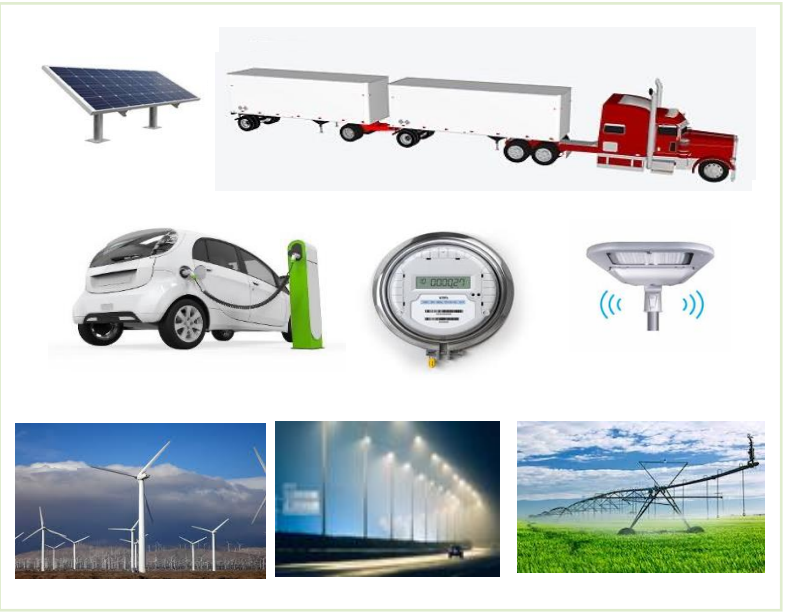


October 14, 2026

Connectivity for Existing Infrastructure

- Smart grids and electricity meters
- Smart lighting and building infrastructure
- Industrial and agricultural control
- Truck, trailer and rail communications
- Battery charging and smart energy

Cost | Reliability | Coverage | Connectivity



Smart Energy | Industry 4.0 | ADAS & EV Charging | Smart Lighting

PLC chips, modules and IP for Industrial IoT

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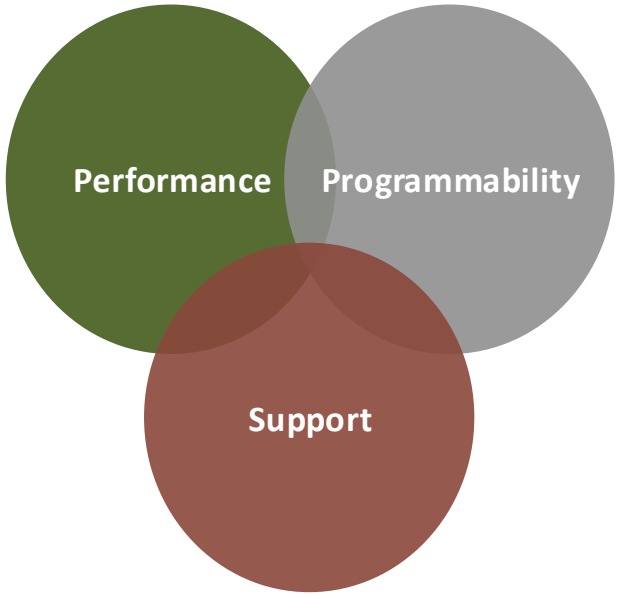
Semitech at a Glance

Company	**Headquartered in Melbourne, Australia since 2010** ▪ Australian engineering team and investors with US founders
Business Model	**Fabless semiconductor company** ▪ Globally recognized supply chain
Technology Leadership	**Multi-mode PLC platform with superior performance** ▪ World's only integrated PLC + Wireless combo deployed in volume ▪ World's only commercially available PLC4TRUCKS solution adopted by leading industry suppliers
Market Validation	**Over 20M connected devices worldwide** ▪ Deployment includes Itron's OpenWay® Riva platform
Applications	**One platform for diverse customer applications** ▪ Metering, transportation, lighting and industrial control ▪ Expanding towards data centers and edge AI

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Why Customers Choose Semitech

- **Reliable communication in challenging environments**
  - Noise-adaptive modes for industrial power lines
  - Validated by major metering and transportation customers
- **Flexible technology that fits your application**
  - Standard protocols and custom firmware on a common platform
  - Select chips or modules to suit your design
  - Rich feature set including CSMA, mesh networking and application tailored protocols
- **Direct engineering support through integration**
  - Comprehensive evaluation tools, reference designs and customer board reviews
  - Custom algorithm development and optional design services



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Narrowband versus Broadband PLC





	NB-PLC	BB-PLC
Bandwidth	1-600 kbps	10-500 Mbps
Band	10-500 kHz	1.8-86 MHz
Typical Distance	100's – 1000's meters	10's meters
Typical Applications	Metering, Lighting, Industrial monitoring & control, Fire alarms	Home networking, IPTV, Building automation
Standards/Schemes	G3-PLC, PRIME, FSK, IEEE 1901.2, PLC4Trucks	HomePlug AV2, GreenPHY, G.hn, HD-PLC

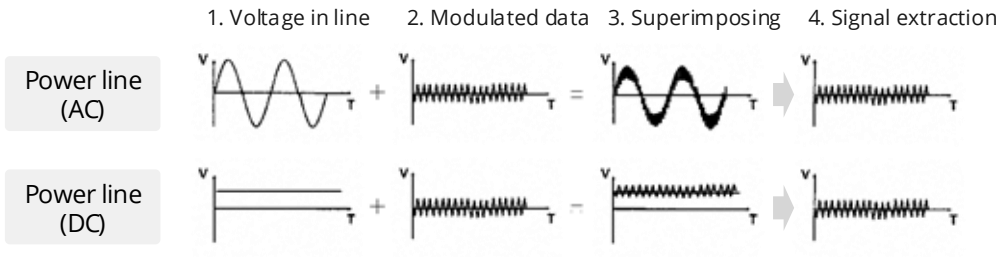


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How PLC Connects Devices

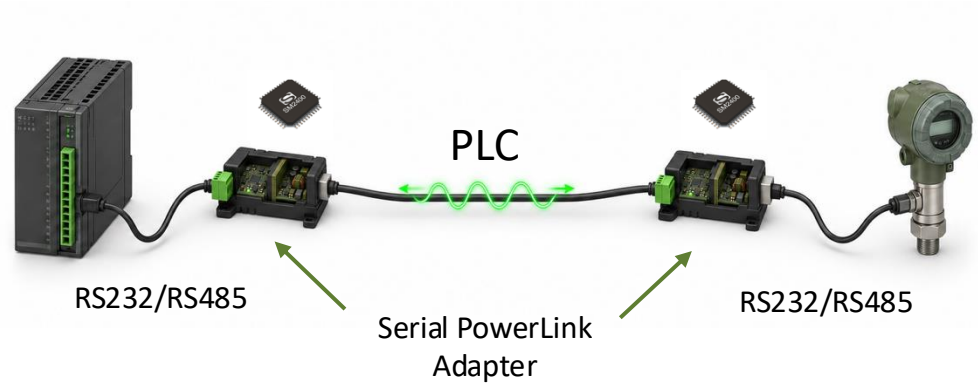
Data Over Power Wiring

- **Power Line Communication uses existing electrical wiring**
  - A modem adds a communication signal to AC or DC
  - A second modem receives the data at the other end
  - Devices exchange control commands and telemetry
- **Design depends on the electrical environment**
  - Coupling, noise and topology determine link performance
  - PLC and RF can provide complementary paths



Example: Serial Retrofit

- **Two PowerLink adapters bridge a serial connection**
  - Short serial links connect the controller and sensor
  - PLC carries their data over existing power wiring
  - The application continues using its serial protocol



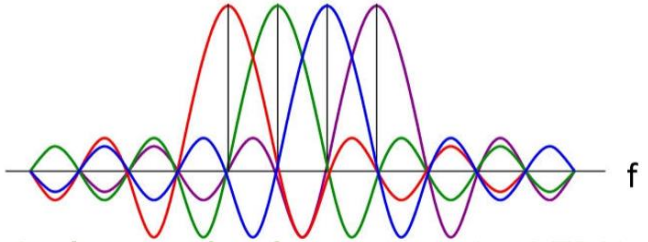
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OFDM – Orthogonal Frequency Division Multiplexing

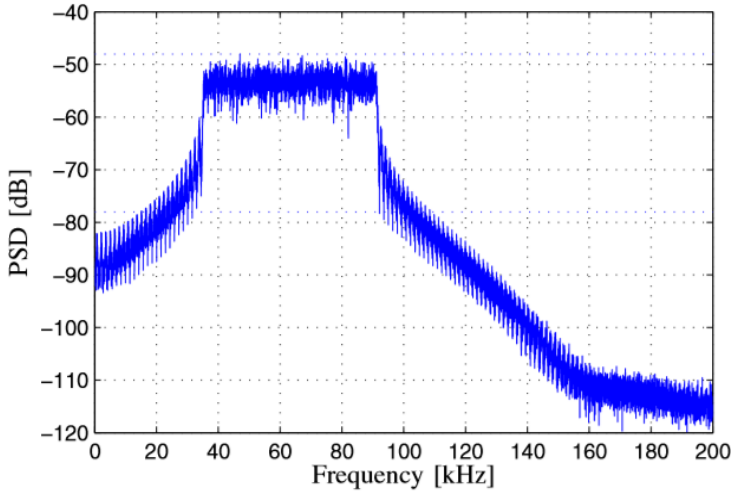
- Multiple frequencies each carrying data
- Each frequency can carry different data
- Usually closely spaced carriers
- Redundancy is when two or more carriers have the same data (ROBO mode)
- Different modulation schemes are used

OFDM is very effective in dealing with multipath

A common problem in wireless and other broadband systems



Orthogonal sub-carriers in OFDM



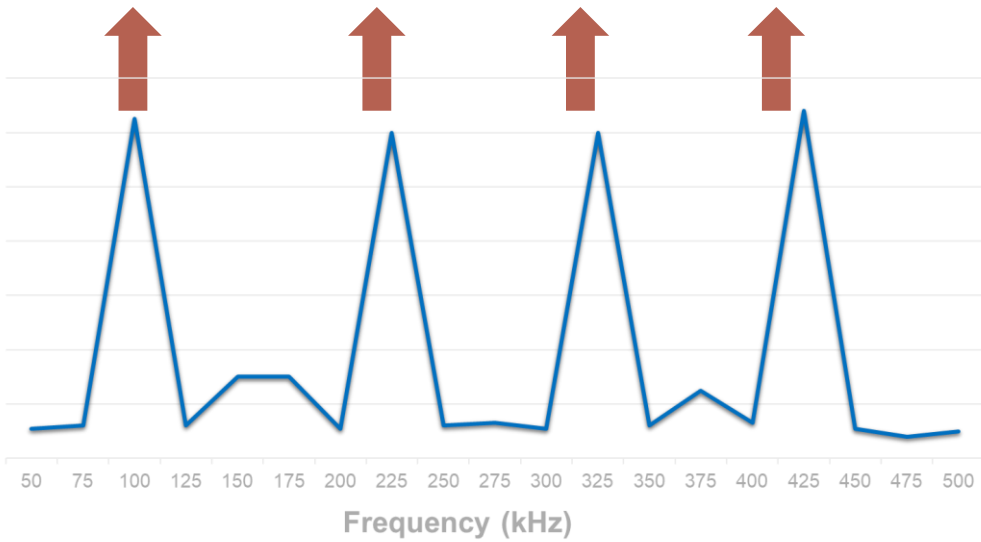
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Extremely Robust XXR Mode

- **XXR is a Semitech proprietary mode**
  - Extremely robust comm mode
  - Tailored for power line noise profile
  - Particularly suitable for P2P comm over long distances
  - Demonstrated multi-kilometer connectivity in a single hop
  - Up to ~4Kbps data rates
- **XXR Method**
  - Up to 4 independent channels (carriers) placed anywhere in the spectrum to avoid noise sources such as switching power supplies
  - Each channel is an independent BPSK modem
  - Send different data for higher combined bandwidth
  - Send same data for redundancy (diversity)

Carrier frequencies placed to avoid sources of noise on power line

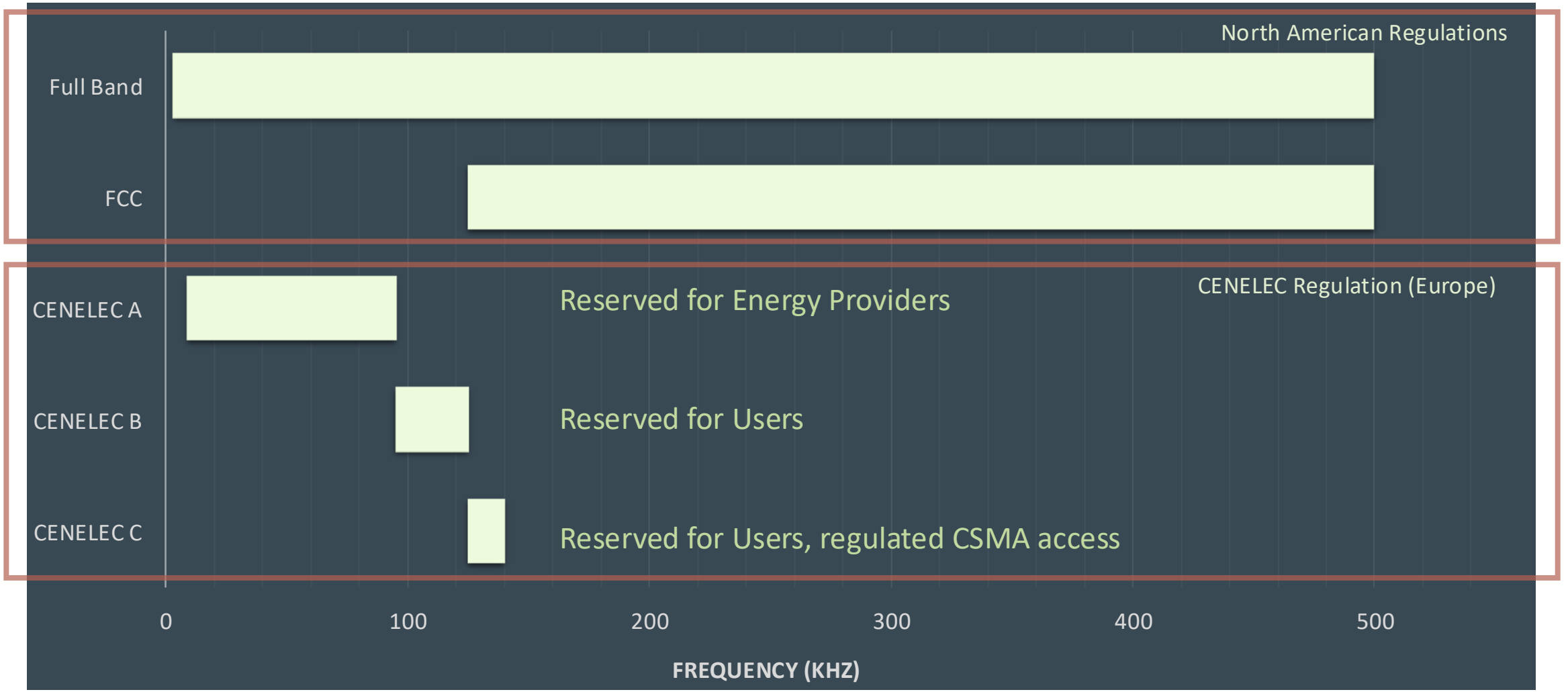
Spectrum diversity: One symbol on one channel is a success



Reliable in Noisy Industrial Environments

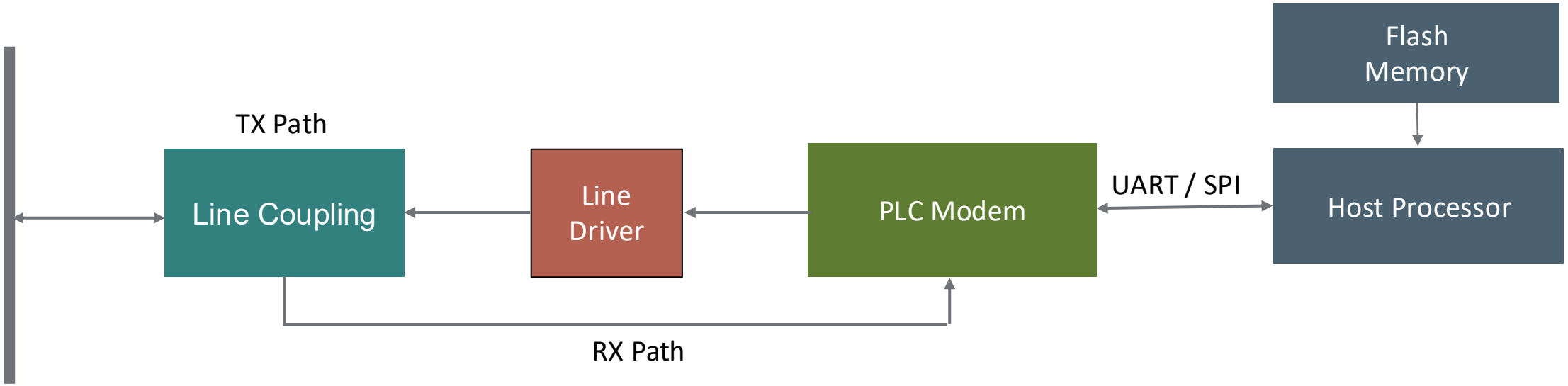
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NB-PLC Supported Operational Bands



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Typical PLC System



Line Driver: **Amplifies the transmitted signal**

Coupler: **Blocks low frequencies (50/60Hz) and passes the high frequencies for data communication – can be inductive or capacitive**

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Product Portfolio – IP, Chips, and Modules

SM2400 SoC



- Multi-mode narrowband PLC modem
- Comprehensive set of standard-based and proprietary modes
- Noise-adaptive communication
- Operates on AC and DC lines
- Evaluation tools and reference designs

Modules and Adapters



PLC Module



PLC + Wireless Module



Low Voltage DC PLC Module

- Faster evaluation and integration
- Reduced hardware design effort
- Minimized design risk
- Customization by agreement

Choose the integration level that fits your product and skills

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Applications Across AC and DC Infrastructure

Enables communications over AC / DC power lines



Monitoring and control for a wide range of industrial devices and applications

Smart Metering



- Electricity meters
- Medium-voltage links
- Home displays

Transportation



- Trailer ABS and sensor data
- Truck / trailer pairing
- Train and railroad comms

Smart Lighting



- Airfield lighting
- Venue lighting
- Street lighting
- Emergency lighting
- LED control systems

Industrial IoT



- Battery chargers
- Irrigation systems
- Production line equipment

Solar Energy



- Solar inverters
- Battery storage

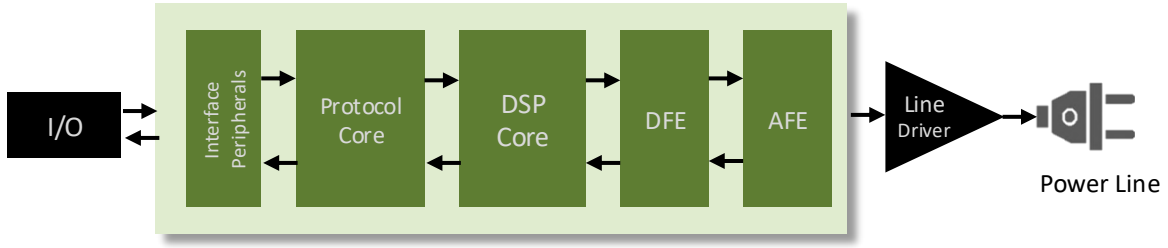
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SM2400: A Universal NB-PLC Modem

- SM2400 offers the most comprehensive set of communication modes for IoT applications
  - Metering: PRIME, G3-PLC, IEEE 1901.2
  - Automotive: PLC4TRUCKS
  - Industrial: XXR, G3-Hybrid, SNET (Semitech NET)
- Programmable architecture enables continuous improvement and performance enhancement

Superior Flexibility & Noise Immunity

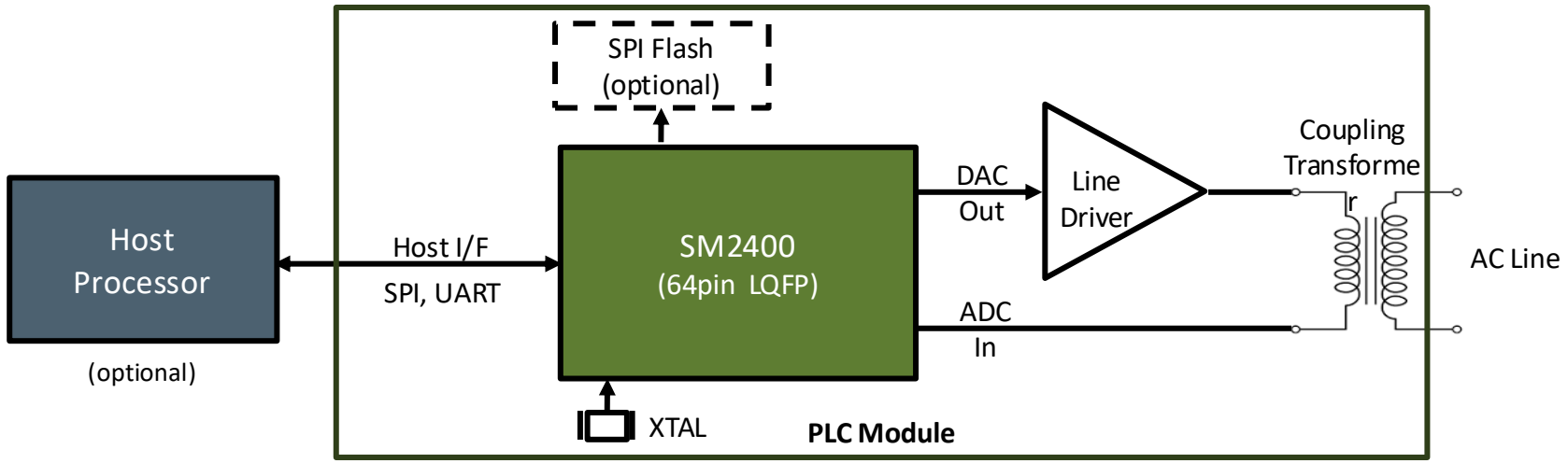
- Data Rates up to 1Mbps
- Programmable high-performance OFDM engine
- Efficient power consumption
- Operates over AC/DC lines
- Operates over multiple bands up to 490kHz: FCC, CEN-A, B, C, Full-band
- SPI / UART micro-controller interface
- 3.3V (5V) tolerant I/O
- Small footprint package: 64pin LQFP (7mm x 7mm)





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SM2400 – PLC System Architecture



Boot options:

- External Flash
- Optional Host (MCU)

Line Driver supported options:

SG Micro	SGM8423
On Semiconductor	NCS5651
Texas Instruments	THS6222/6232

SM2400:

- Dual core architecture
- Integrated Analog Front-End (AFE) with support for various Line Drivers for best Cost / Performance

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Standards-Based PLC and Hybrid Networking

G3-PLC and G3-Hybrid

- **G3-PLC**
  - Narrowband OFDM for smart metering and industrial applications
  - IPv6 / 6LoWPAN with mesh networking
  - CEN-A, CEN-B, FCC
  - Certified platform
- **G3-Hybrid**
  - PLC and RF in one unified IP network
  - Alternative paths improve coverage and resilience
  - Reference device with TI

G3-Alliance G3-Hybrid

IEEE and LON Standards

- **IEEE 1901.2**
  - Narrowband OFDM below 500 kHz
- **CEA / CTA-709.2**
  - LON power-line channel for control networks
  - Building and industrial automation
  - Fully interoperable with legacy Echelon implementation

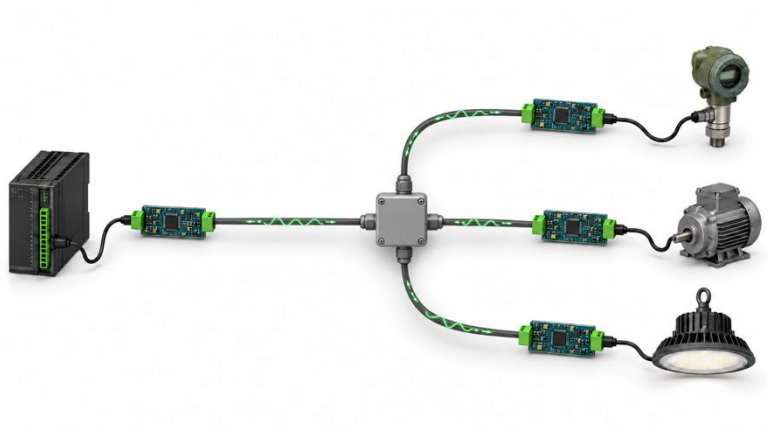
IEEE CTA™ Consumer Technology Association, producer of CES®

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Networking and Serial Retrofit

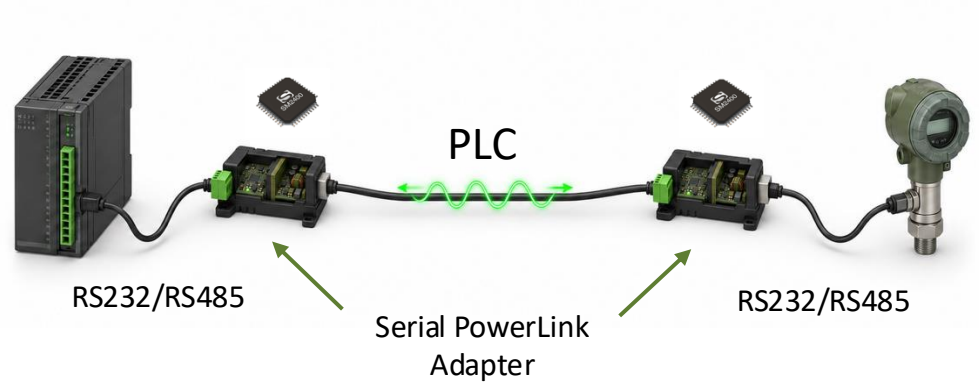
SNET Mesh

- **Lightweight MAC for reliable control and telemetry over power-line wiring**
  - Master-controlled networks with scheduled access for predictable access
  - TDMA for polling and latency-sensitive traffic
  - CSMA-CA for discovery and asynchronous data
  - Adaptive PHY and multi-hop routing
  - Configurable for low latency operation



Serial PowerLink

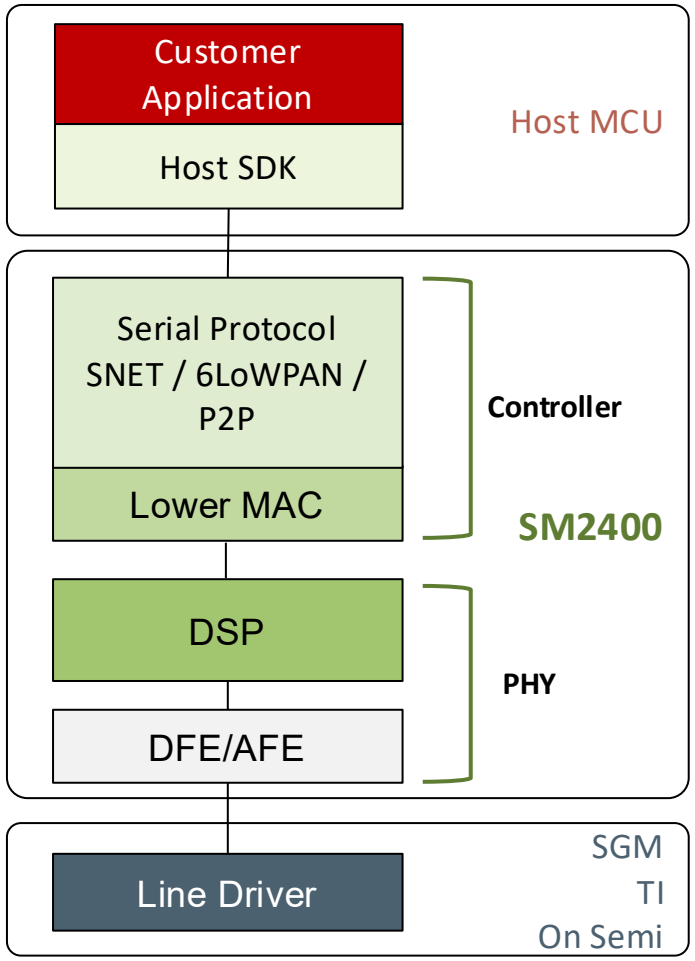
- **Extends serial communications over existing power wiring**
  - Transparent end-to-end serial transport
  - Eliminates long data cabling
  - RS232 / RS485 interfaces
  - Carries serial protocols such as Modbus
  - Ideal for retrofit retaining the controller, field device and application



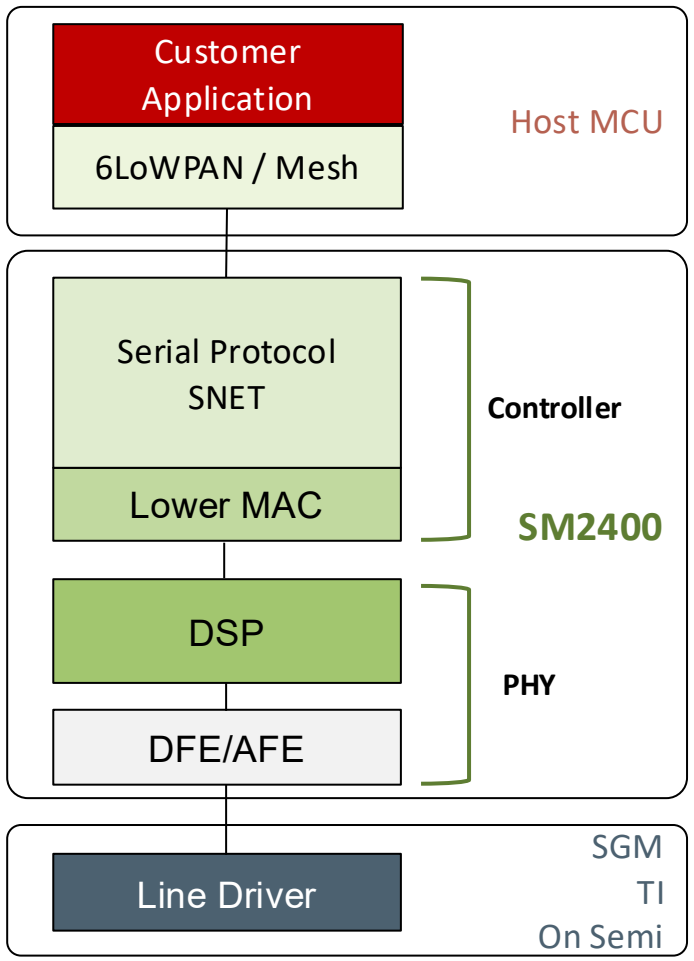
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System Software Application

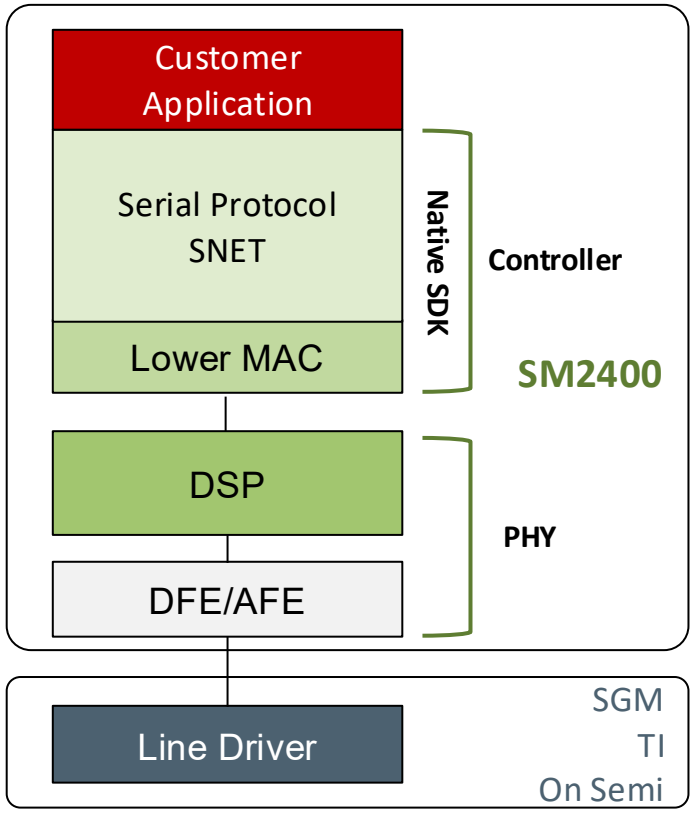
Typical Hosted Application



Hosted Networking Stack



Simple Hostless Application



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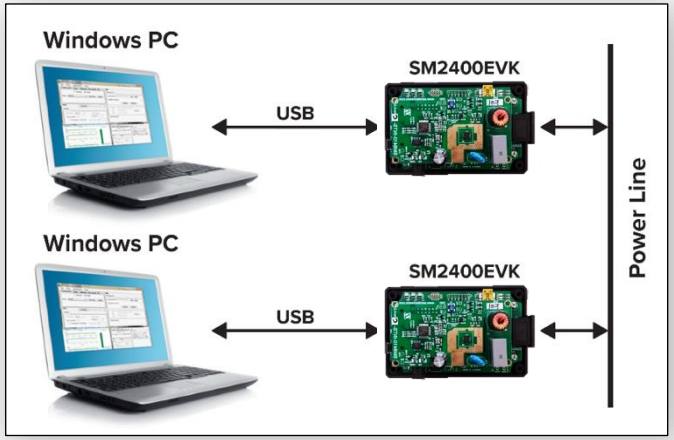
Evaluation Through Production

- **1. Evaluate communication on your power network**
  - EVKs, MikroE Click™ boards and PC evaluation GUI
  - Compare G3-PLC, SNET, XXR and application-specific modes
- **2. Integrate the technology into your product**
  - SDKs and Altium schematics, layouts and BOMs
  - Engineering support, customization, and optional design services
- **3. Validate your design**
  - Customer board reviews and performance verification
  - Staged PHY, MAC and IPv6 testing where applicable
- **4. Prepare for production**
  - Production test scripts

A supported path from evaluation to production



GUI Based Evaluation Tool



EVKs

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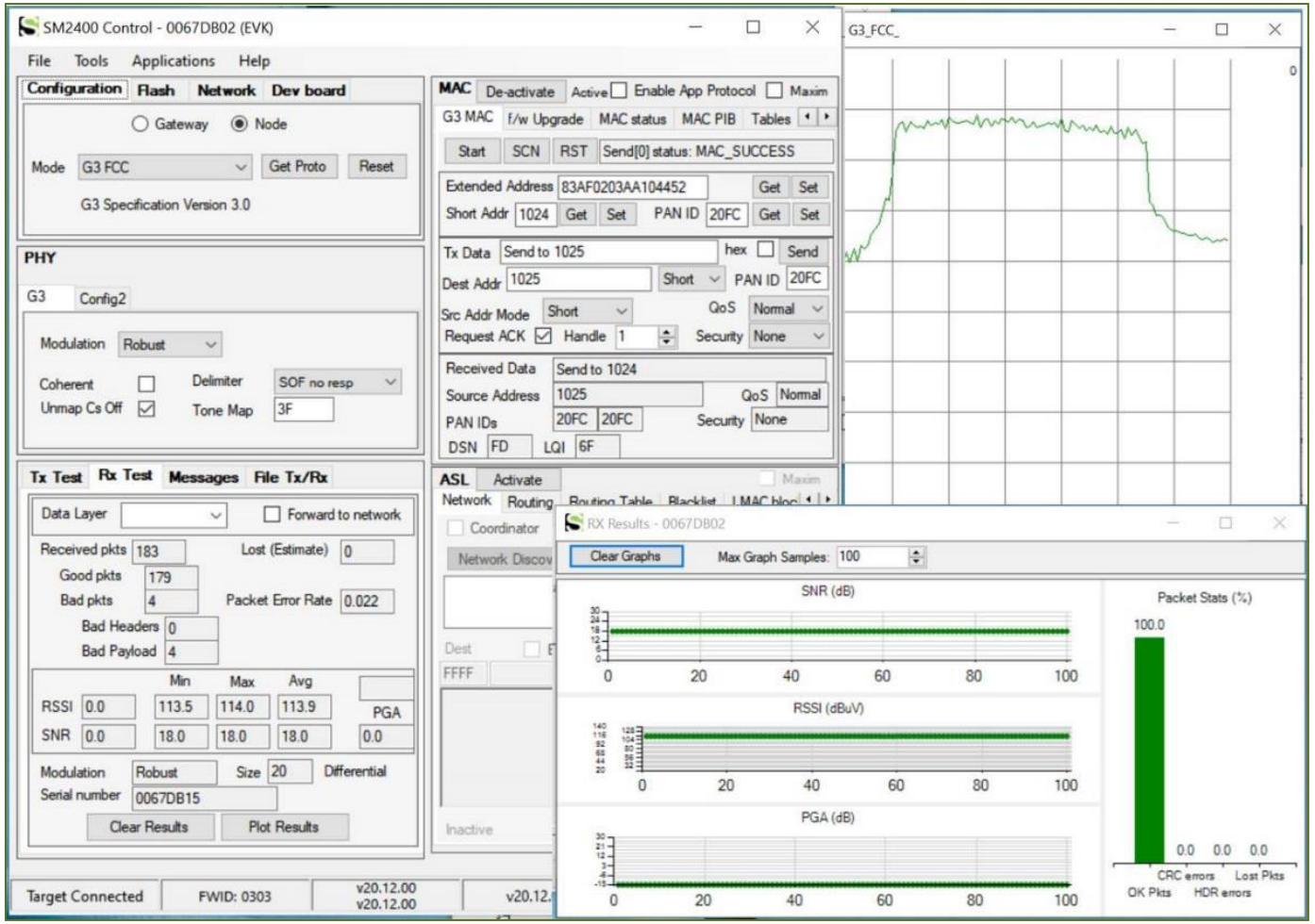
Customer Support & Testing Software

PC Based Evaluation Tool & GUI

1. Download firmware
2. Configure network
3. Control modem
4. Monitor and test performance
   - Line noise, SNR, RSSI, Packet Errors
   - Real time performance plots

Enables Staged Testing

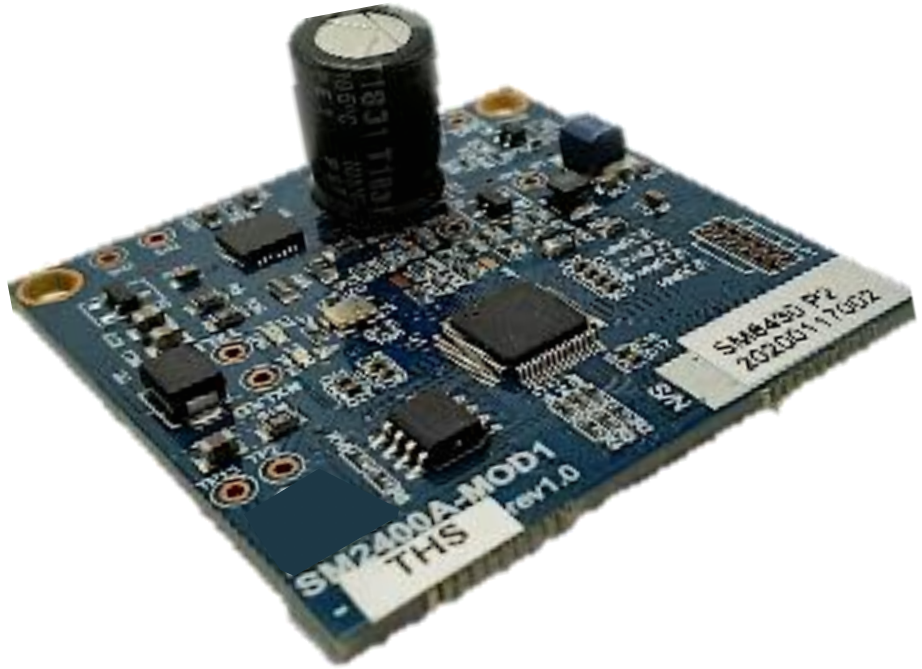
- PHY only – easiest for testing performance
- PHY + MAC – Evaluate network
- PHY + ADP – Includes adaptation layer for complete application
- All firmware configurations available
- PLC+RF support



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SM2400 NB-PLC Module

- **PLC over AC/DC wiring (275V/400V)**
- **FCC-band operation: 155-490 kHz**
- **OFDM and extreme-noise (XXR) modes**
  - Serial PowerLink passthrough
  - SNET mesh
  - G3-PLC
  - Voltage and coupling options by module



SM2400 NB-PLC Module

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G3-Hybrid Reference Design

- PLC and RF in one hybrid network
- Dynamic selection of available links
- Alternative paths improve resilience
- Integrated communication stack

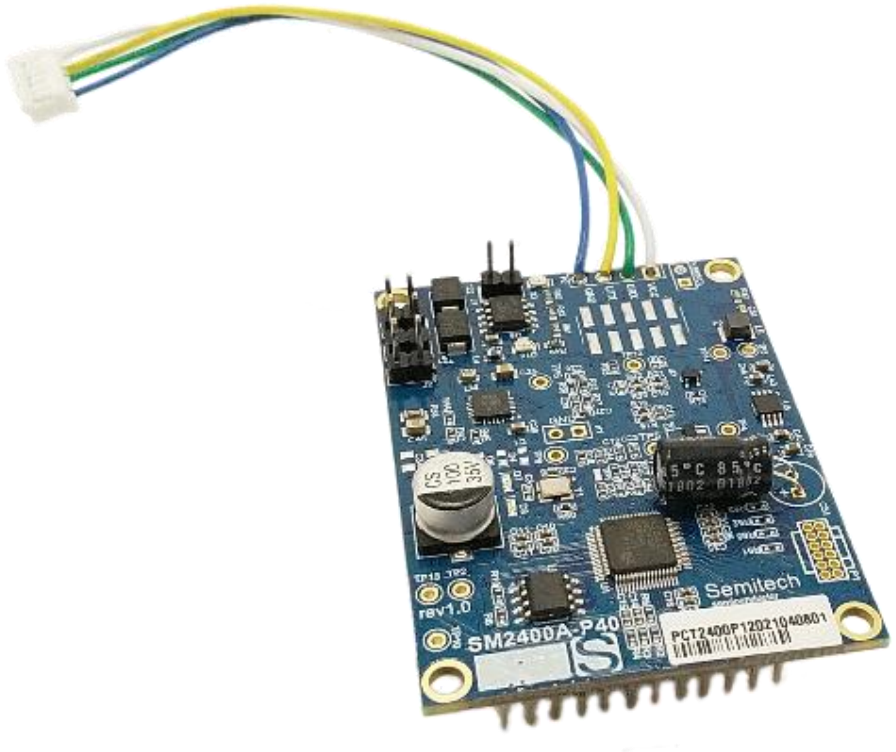


SM2400 G3-Hybrid (PLC+RF) Module

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PLC4TRUCK Module

- Turnkey truck / trailer ABS reader
- 8-32V DC lines
- J1587 / J2497 (PLC4TRUCKS) compliant
- 4-pin power and serial interface
- UART with optional RS-485



SM2400 PLC4TRUCKS Module

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Appendix – Application Examples

SUCCESS STORY

Smart Metering



- **Semitech modems connect over 20M devices worldwide**
- **Proven in Itron's OpenWay® Riva platform**
  - Licensed PLC + 802.15.4 hybrid communication IP
  - Volume deployment for several years
- **SM2400 supports Itron Distributed Intelligence**
  - Custom firmware for application requirements
  - Selected for strong technology and support reputation
- **XXR deployed on medium-voltage (MV) lines**
  - Multi-kilometer links in one hop
- **G3-PLC certified; G3-Hybrid certification ready**

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Smart Lighting

SPX AIDS TO NAVIGATION

musco Lighting



- **Customer need: distributed lighting control**
  - Individual and group color and intensity control
  - Light health monitoring and coordinated operation
- **Semitech implementation: PLC networking**
  - Deployed by Musco in venue lighting systems
  - Control over power wiring avoiding RF interference
- **Broader applications**
  - Street, emergency, airfield and pool lighting
  - Networking tailored to lighting control requirements

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Transportation – Truck / Trailer Communication





- **Customer need: data between truck and trailer**
  - ABS status, trailer identification and telematics
- **Semitech implementation: PLC4TRUCKS (J2497)**
  - Adopted by leading North American industry suppliers
  - Deployed in ABS systems and telematics gateways
  - PLC-to-BLE bridges connect mobile devices
- **Additional capabilities**
  - Trailer light control and truck / trailer pairing
  - Expansion to sensors such as TPMS and drain valves

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Industrial IoT

Omnicell



- **Customer need: connect distributed industrial assets**
  - Power-line noise and separate data cabling complicate deployment
- **Semitech implementation: multi-mode SM2400**
  - Deployed in forklift chargers, irrigation and mining
  - Other applications include smart medication cabinets, solar, etc.
- **Communication modes tailored to the application**
  - **XXR** for challenging electrical noise conditions
  - **Serial PowerLink** for point-to-point communication
  - **SNET** for networked control and telemetry

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Demo Video

How to Get Started

Collateral

- **Website information and documentation**

  http://www.semitechsemi.com/

Tier	Type	Documents	Access Requirement
1	Public	Product Briefs & brochures	Everyone
2	Technical	Datasheets and Application Notes	Email address
3	Confidential	Full access, EVKs, User Guides, Software	NDA

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Evaluation

Products #	Type	Comments
SM2400A-MQEQ-T	Modem SoC	**Quantity 1: US$15** ▪ Price varies based on volume ▪ Direct contact for volume production pricing
SM2400-EVKM4-15V-D	Complete Evaluation Kit (Includes baseboard + communication module)	**Quantity 1: US$250** ▪ Min of 2 EVKs required for testing ▪ Software updates, alternate configurations and GUI can be downloaded from website ▪ Contact Semitech directly for available variations in HW & SW for your specific application
SM2400-P40-24-T	Production Ready Low Voltage DC Module	Quantity 1: US$50 ▪ Transportation Solution (PLC4TRUCKS / J2497 compliant) ▪ Optional SNET ▪ 8 - 24VDC

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