

Ecofriendly, Energy Saving, Healthy Life

# Communication Technologies for Smart Grid

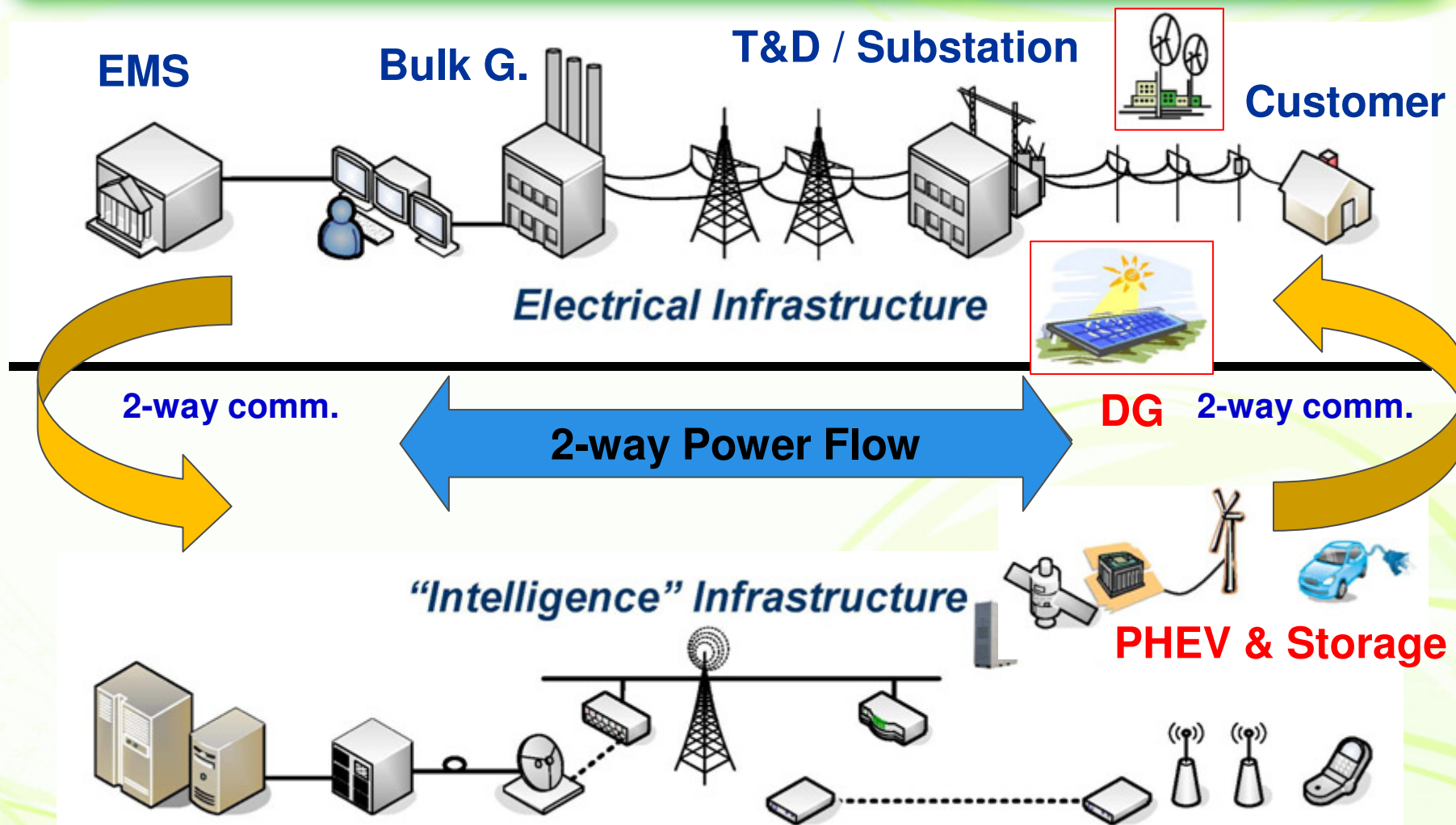


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**New Energy BU, TATUNG CO.**

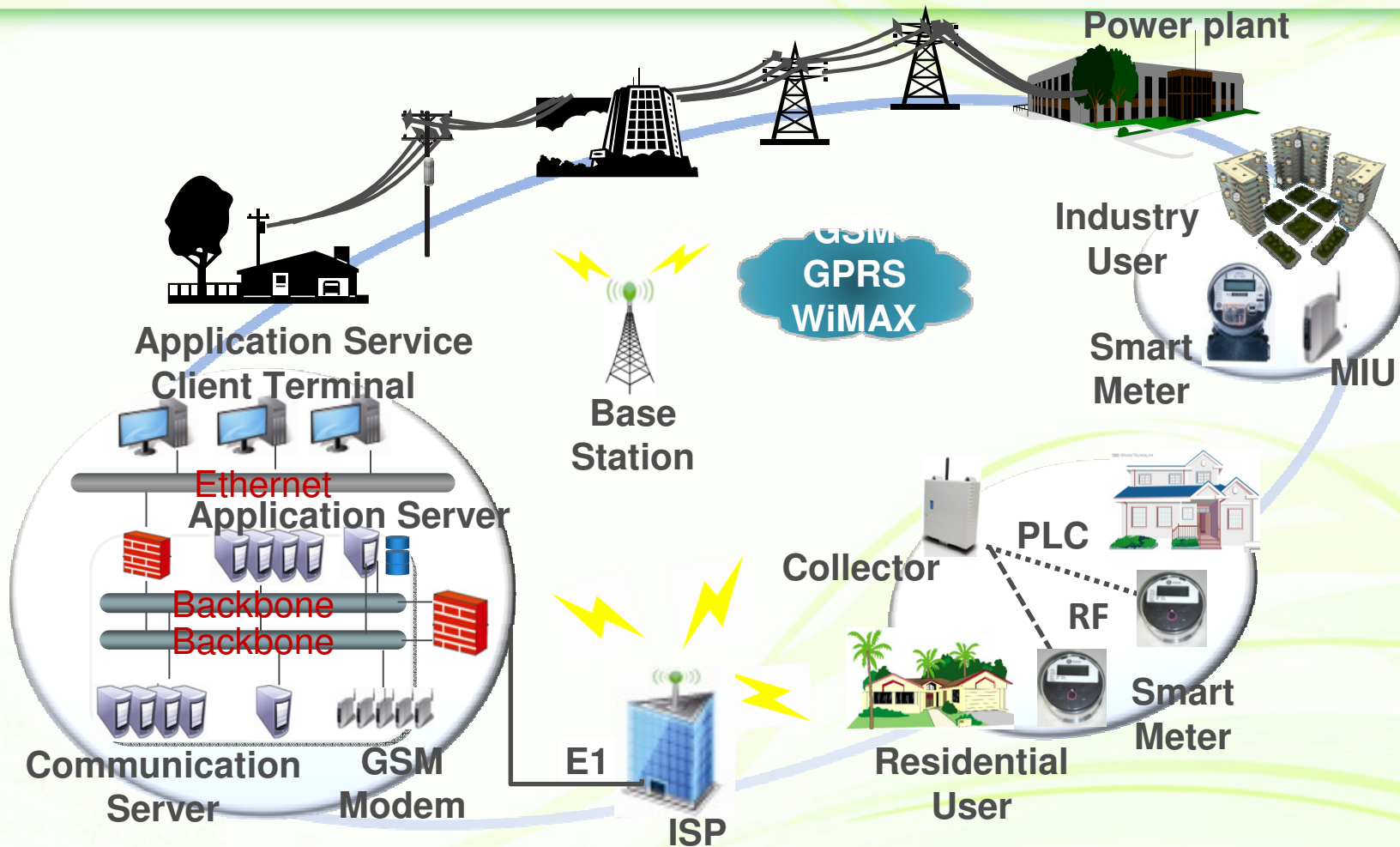


# Smart Grid – Grid Modernization



Source: NIST

# TPC AMI Architecture



# Communication Technologies (1/2)

## ■ Wired technologies

- Ethernet (with optic fiber)
- Power line communications (PLC)
  - Broadband PLC (BPL)
  - Narrowband PLC (NPL)

## ■ Wireless technologies

- IEEE 802.15.4 (ZigBee) → 802.15.4g
- IEEE 802.11x (Wi-Fi)
- RF 800 MHz / 900 MHz



# Communication Technologies (2/2)

## ■ Networking

- Concentrator or Mesh network (ad hoc network)
- How about hybrid...
- IPv6 needed

## ■ Standards compliance

## ■ Robust and reliability

## ■ Cyber security



# Ex. of Key Technology: PLC

$$H(f) = \sum_{i=1}^N g_i e^{-\underbrace{(a_0 + a_1 f^k)}_{\text{Attenuation}} d_i} e^{-j2\pi f \underbrace{\tau_i}_{\text{Delay}}}$$

Weights

It is accurate in the range of 500 kHz ~ 20 MHz.

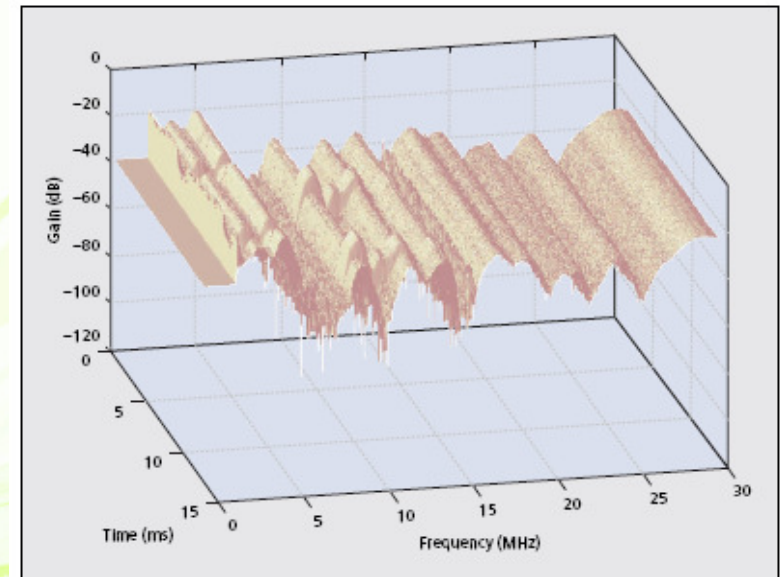
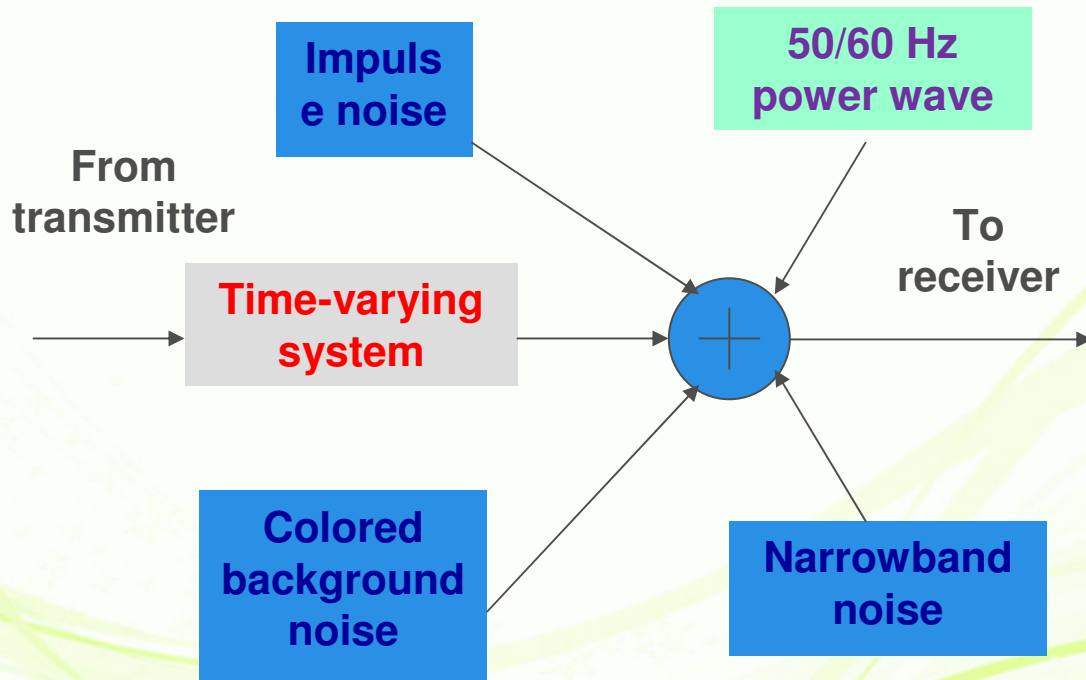
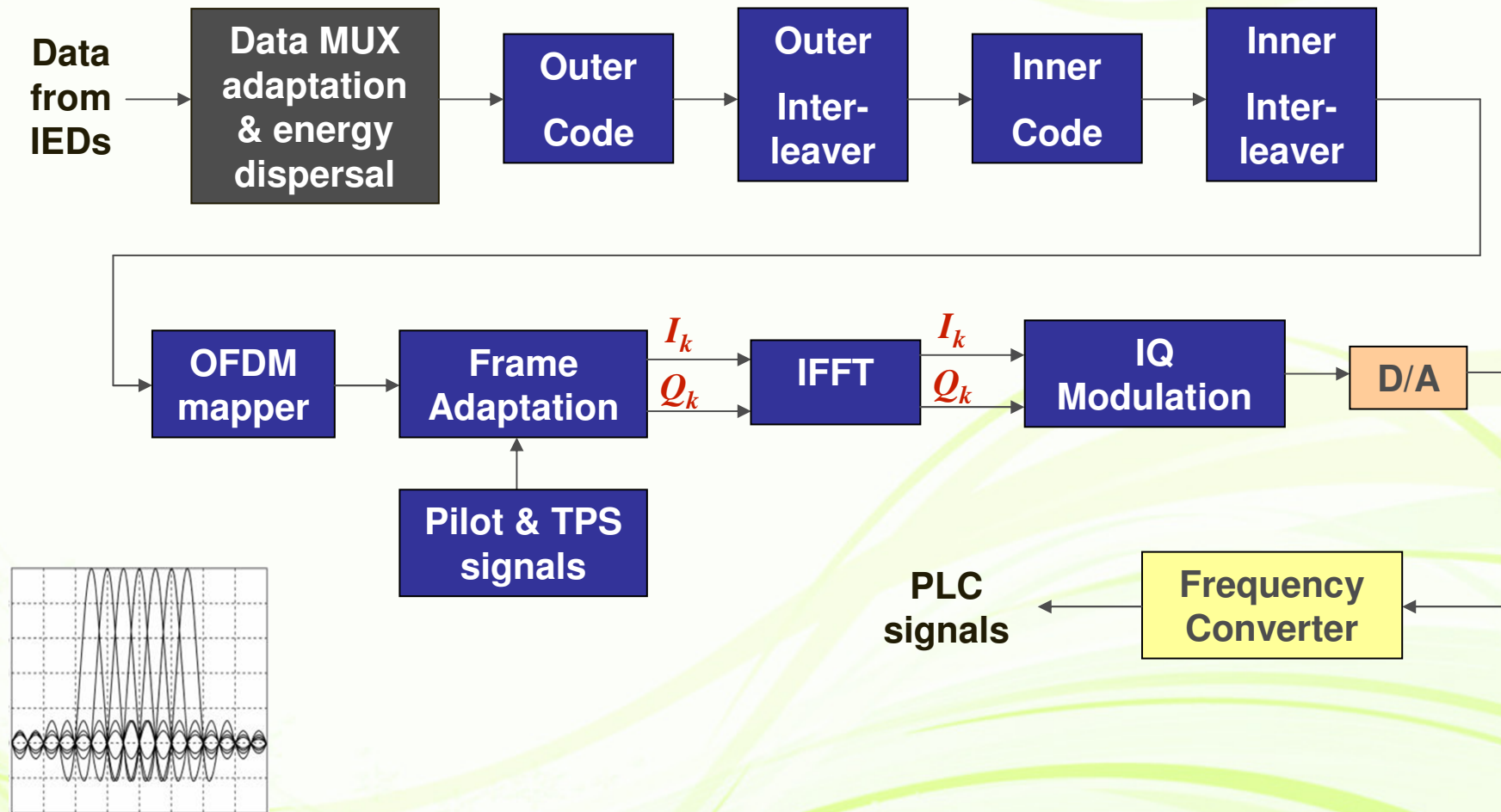


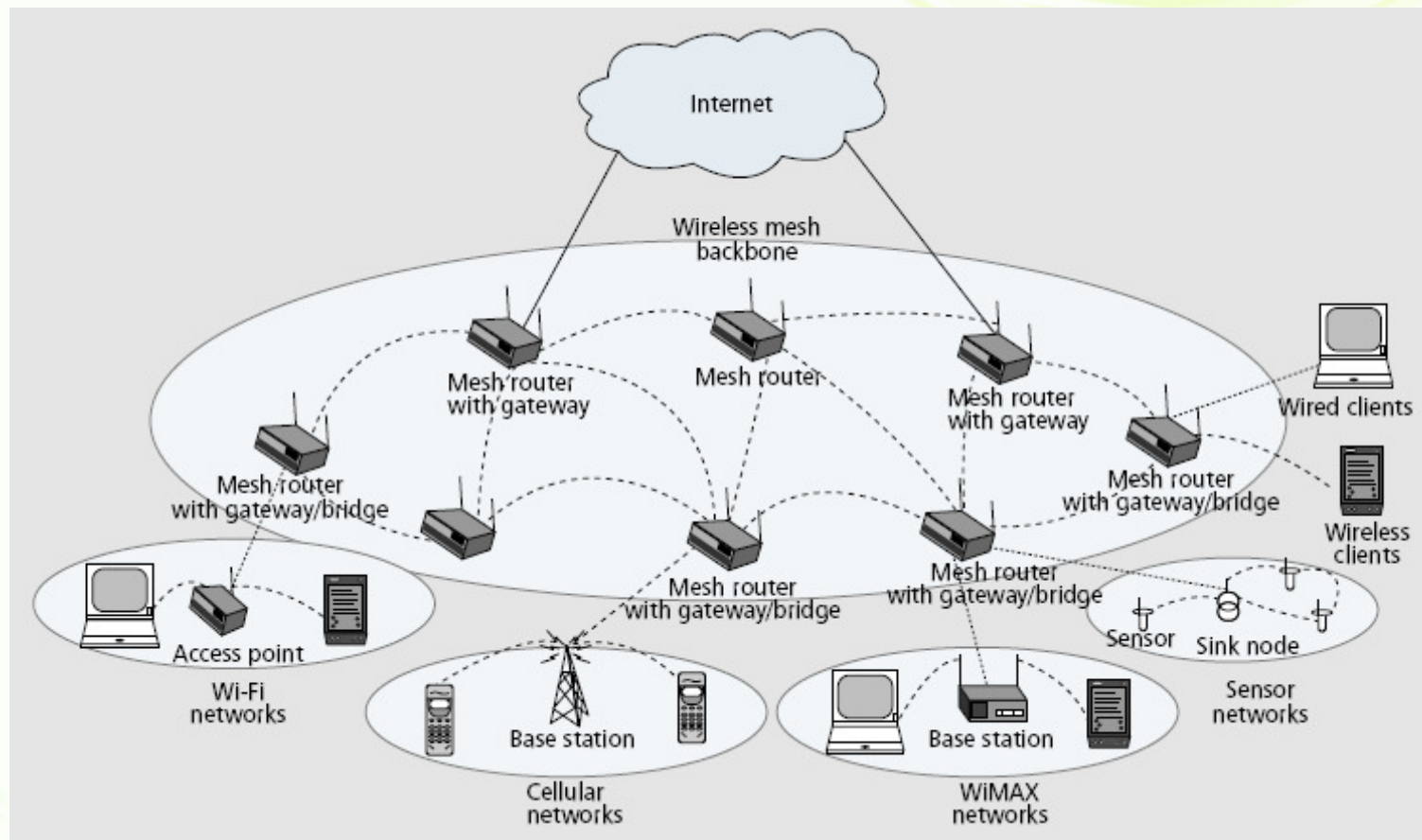
Figure 1. Measured time variation of an indoor power line channel.

# Ex. of Key Technology: OFDM-based PLC



C. P. Lin (Member of the IEEE)

# Ex. of Key Technology: WMN



## Source:

Akyildiz, I. F. and Xudong Wang, "A Survey on Wireless Mesh Networks," IEEE Comm. Magazine, pp. 23-30, Sep. 2005.



# Ex. of Smart Meters with Comm. Module



ANSI 1P Meter



IEC 1P Meter

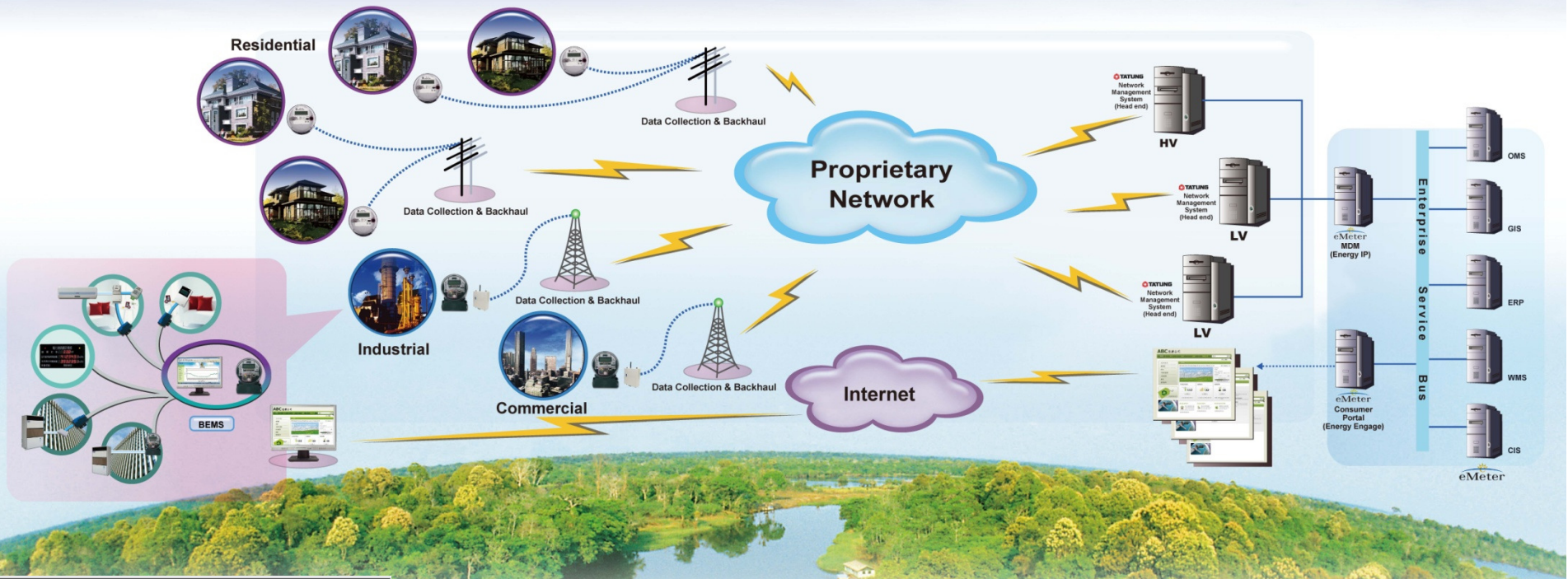
- Bi-directional Communication with disconnect switch
- ANSI C12.20, Class 0.5
- ANSI C12.18 type II Optical port
- TOU (4-tier, 4-season with critical-tire pricing)
- LCD Display, Event Log, RTC
- Comm. Module : ZigBee / BPL / NPL / Wi-Fi / RF 900 MHz



Smart meter  
with ZigBee module



Smart meter  
with BPL module



**SmartGrid**

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Smart Grid Management

配電自動化  
Distribution Automation

先進電表  
基礎建設  
Advanced Metering Infrastructure

住商能源管理  
Residential & Commercial Energy Management

**Thank you for listening.**