ITU/ ICTP Workshop on New Radiocommunication Technologies for ICT in Developing Countries (Africa Region)
Trieste, Italy May 17 – 21, 2004

New Technologies: PLC & HAPS part 1

Prof. R. Struzak, PhD, DSc
Former Vice-Chairman, Radio Regulations Board, ITU
r.struzak@ieee.org

Note: These are preliminary notes, intended only for distribution among the participants. Beware of misprints!

We will talk about…

- Emerging technologies, complementing the “old” radio, terrestrial and satellite …
- Predicted to operate soon…
- But some predictions have proved to be wrong
- Even those made by experts with impeccable credentials…

My preferred prediction …

“Radio has no future”

- (***Lord Kelvin,*** famous physicists, 1897)
  - 1896: Marconi - 1st transmission at 1.6 km distance

- “Prediction is difficult - especially of the future”
  - (***Storm Petersen***, Danish humorist)

New TV receivers

Source: Electronic Design, Jan 25/99p.34

R Struzak

MT2000 + MT2500 chips + new displays create new TV sets/ set-top boxes terrestrial, satellite, cable

~US$20/chip (large quantities) available 1999

Source: MicroTune Inc.

Body multimedia terminal

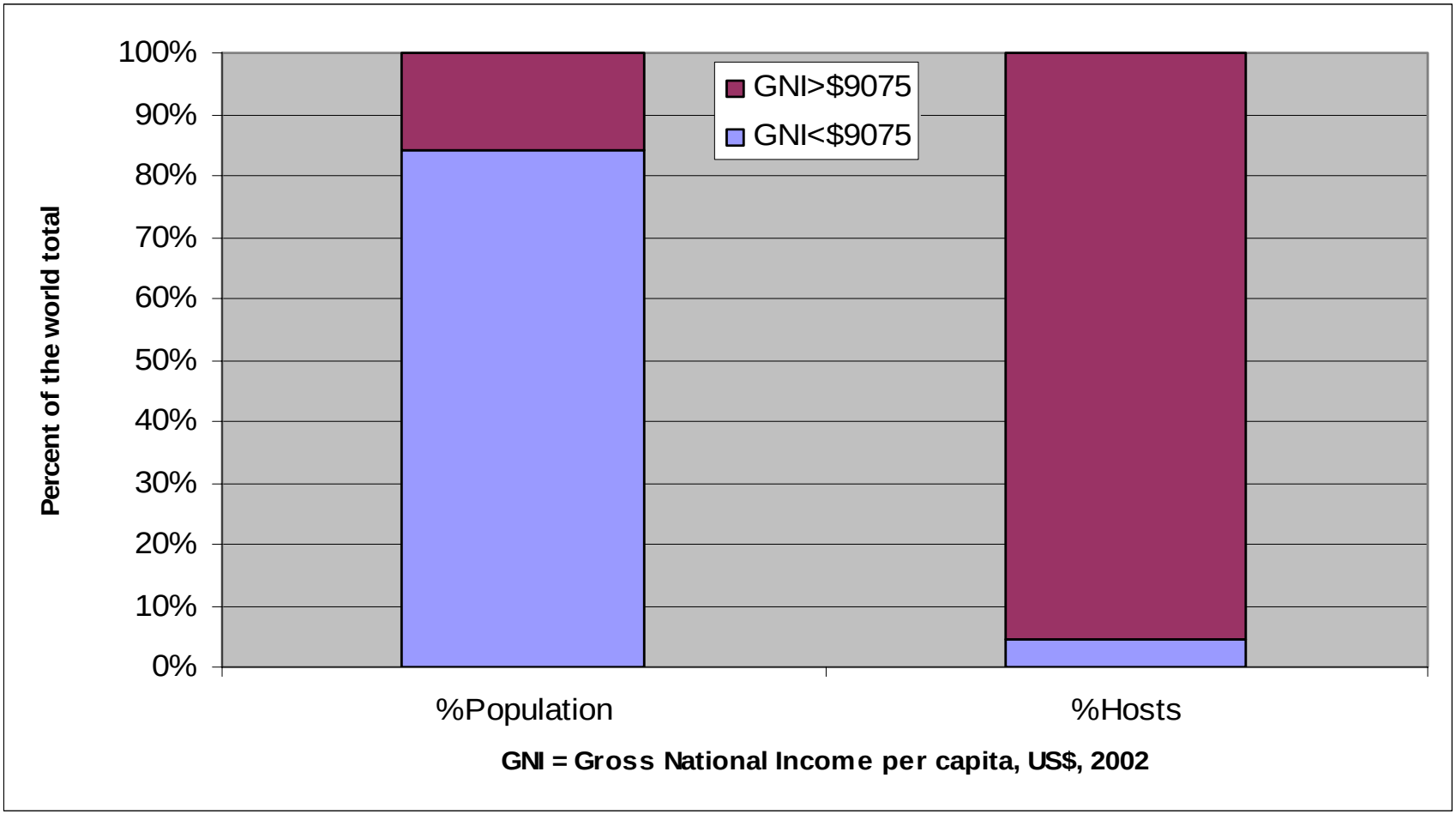
GPS receiver prototype

- Source: IBM Research Journal

Why quest for new technologies?

- The modern technologies are available only to the richest part of the world's population
  - 15% of the population use 96% of Internet hosts
  - 85% of the population use 5% of Internet hosts

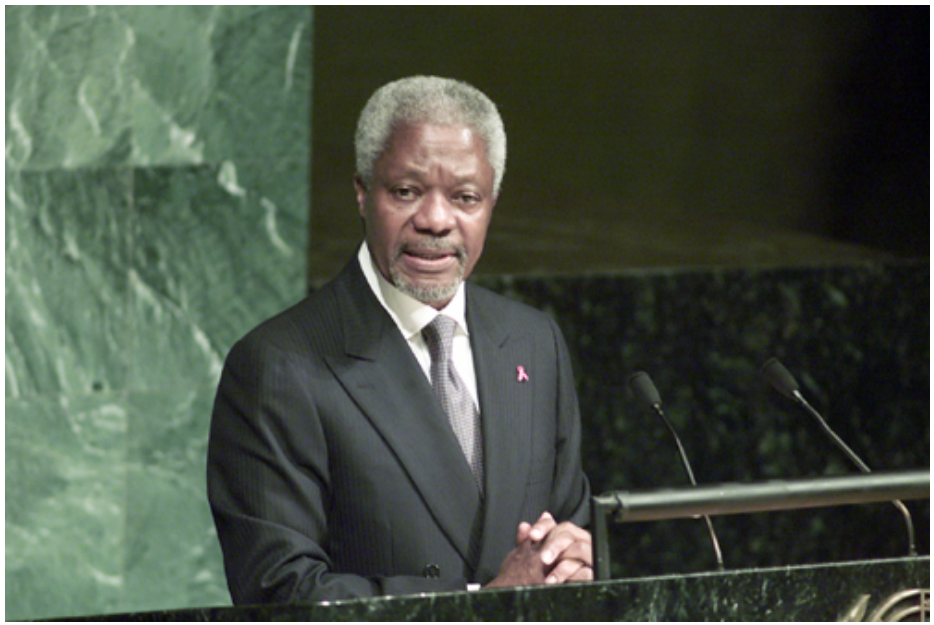
World Population & Internet Hosts



Source: World Telecommunication Development Report, ITU, 2003

Access to Information

= A Key Problem of Humanity



- Report Of The UN Secretary General, 2000
- G8 Okinawa Charter on Global Information Society, 2000
- World Summit on Information Society (WSIS) 2003, 2005

http://www.un.org/millennium/sg/report/full.htm
http://www.itu.int/wsis

Digital divide

- Hope in new technologies
- We will discuss here only 2: PLC and HAPS

PLC: Power line communication

- Known also as
  - PLT: Power Line Telecommunications
- Use of existing wires of electric utility network to transmit information and create communication networks for data, voice, and video applications
- Supports narrow-band and wide-band applications; the latter known also as BPL or Broadband over Power Lines

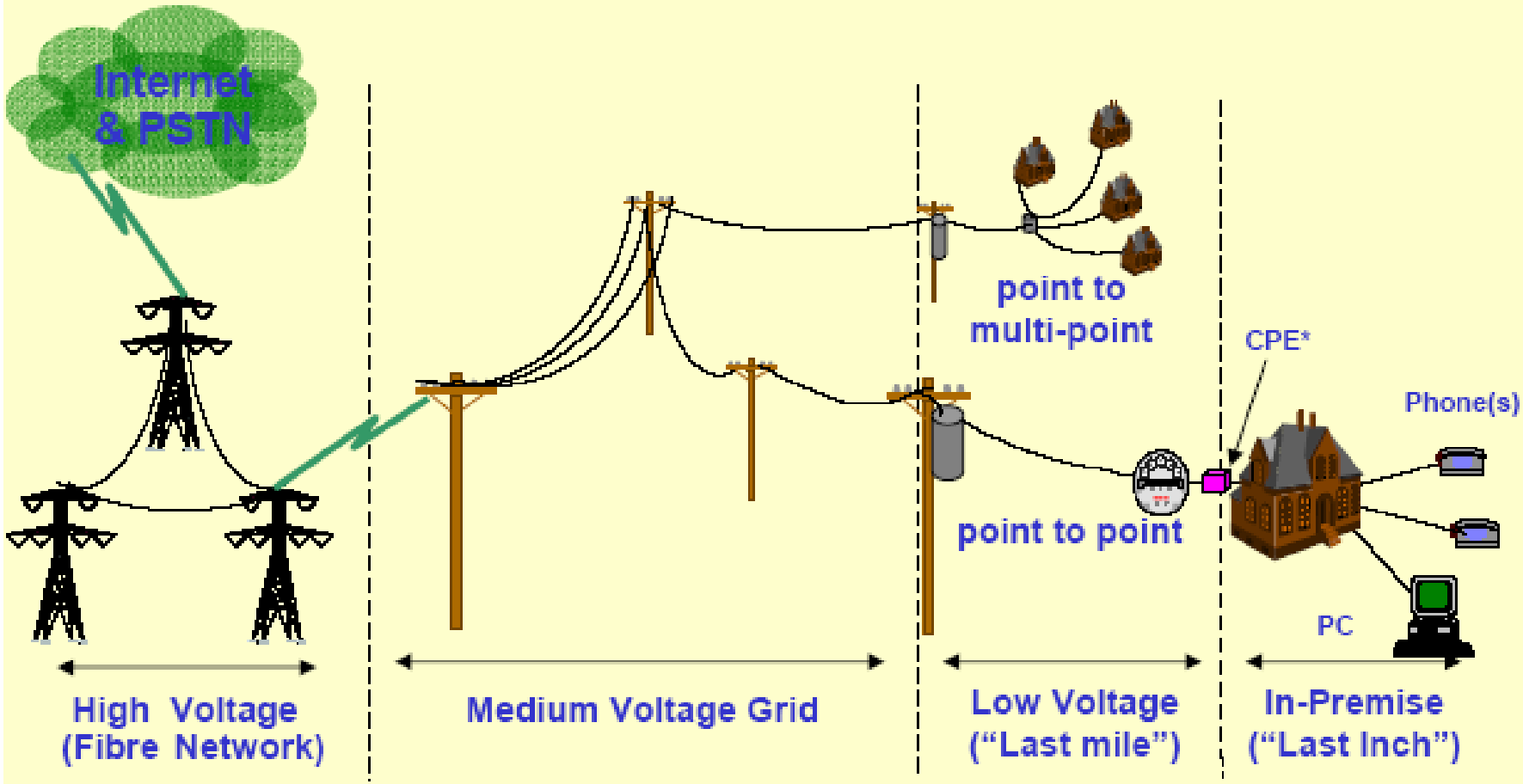
Typical Applications

- Internet Access and High-Speed Networking
- IP Telephony (VoIP Digital Telephone Service)

- Infrastructure surveillance and Video Security
- Utility Network and System Applications
  - Automatic Meter Reading (AMR)
  - SCADA (Supervisory Control and Data Acquisition) Applications
  - Power network management and monitoring, etc.

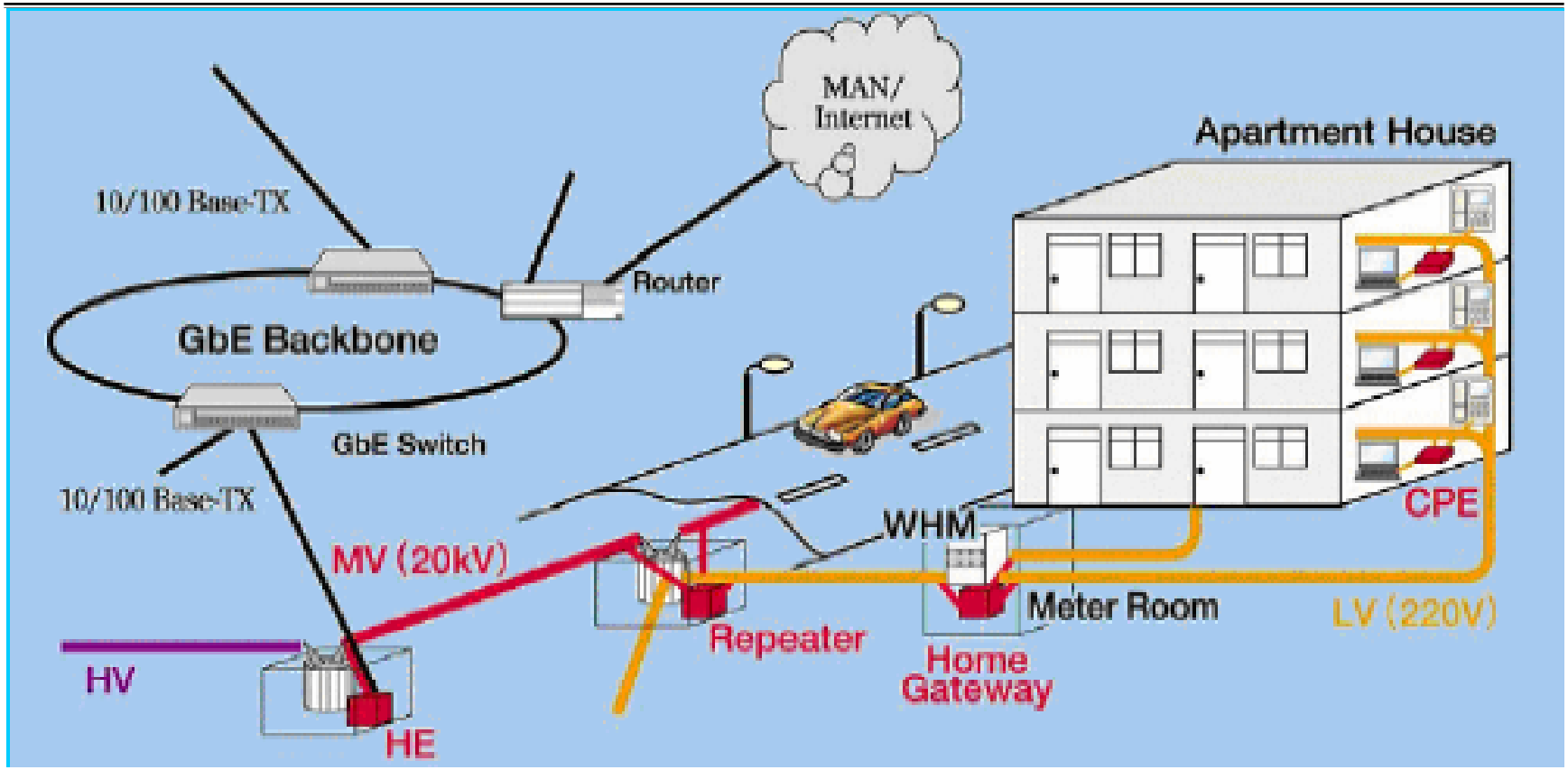
Generic Integrated Model

plcforum



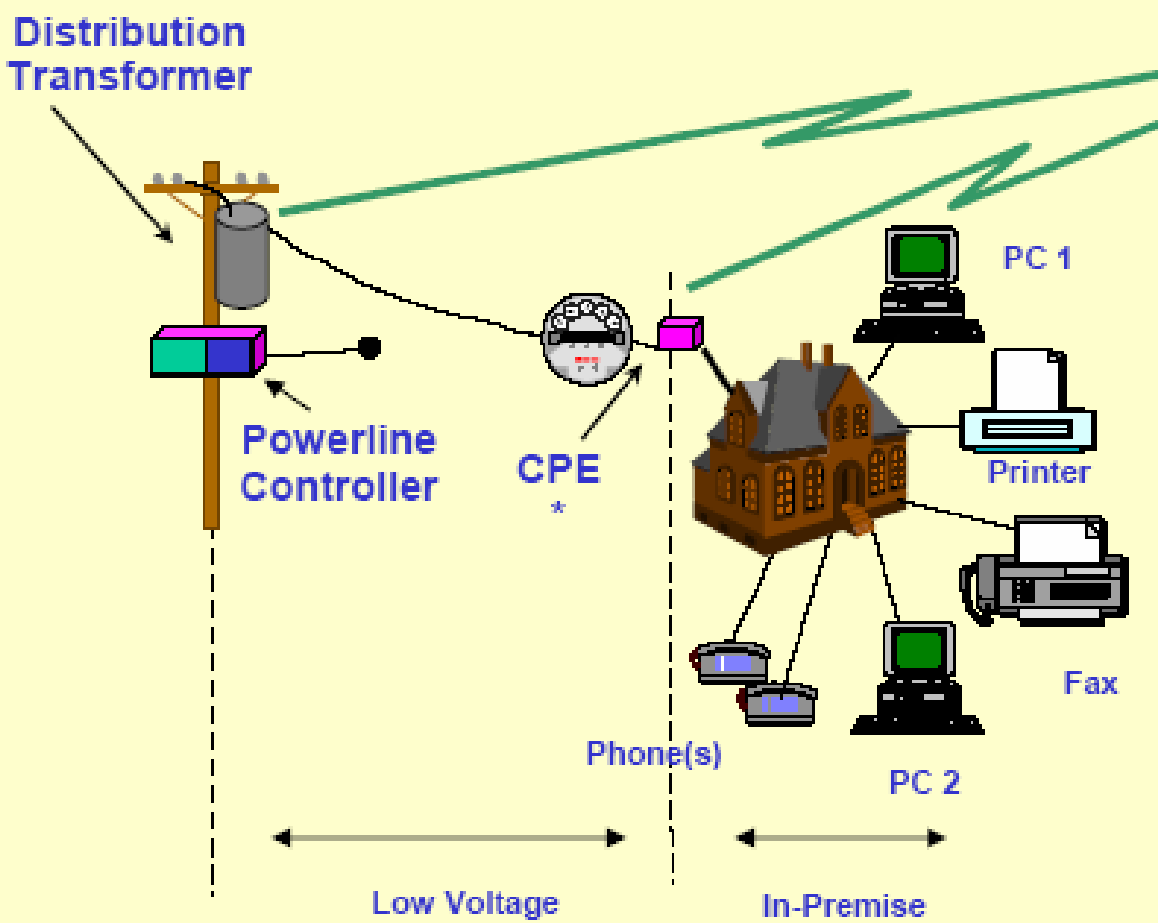
PSTN - Public Service Telephone Network

* CPE - Customer Premise Equipment


MAN/
Internet
Apartment House
10/100 Base-TX
Router
GbE Backbone
GbE Switch
10/100 Base-TX
CPE
WHM
MV (20kV)
Meter Room
LV (220V)
Repeater
Home
Gateway
HV
HE

LV Access/In-premise Model

plcforum

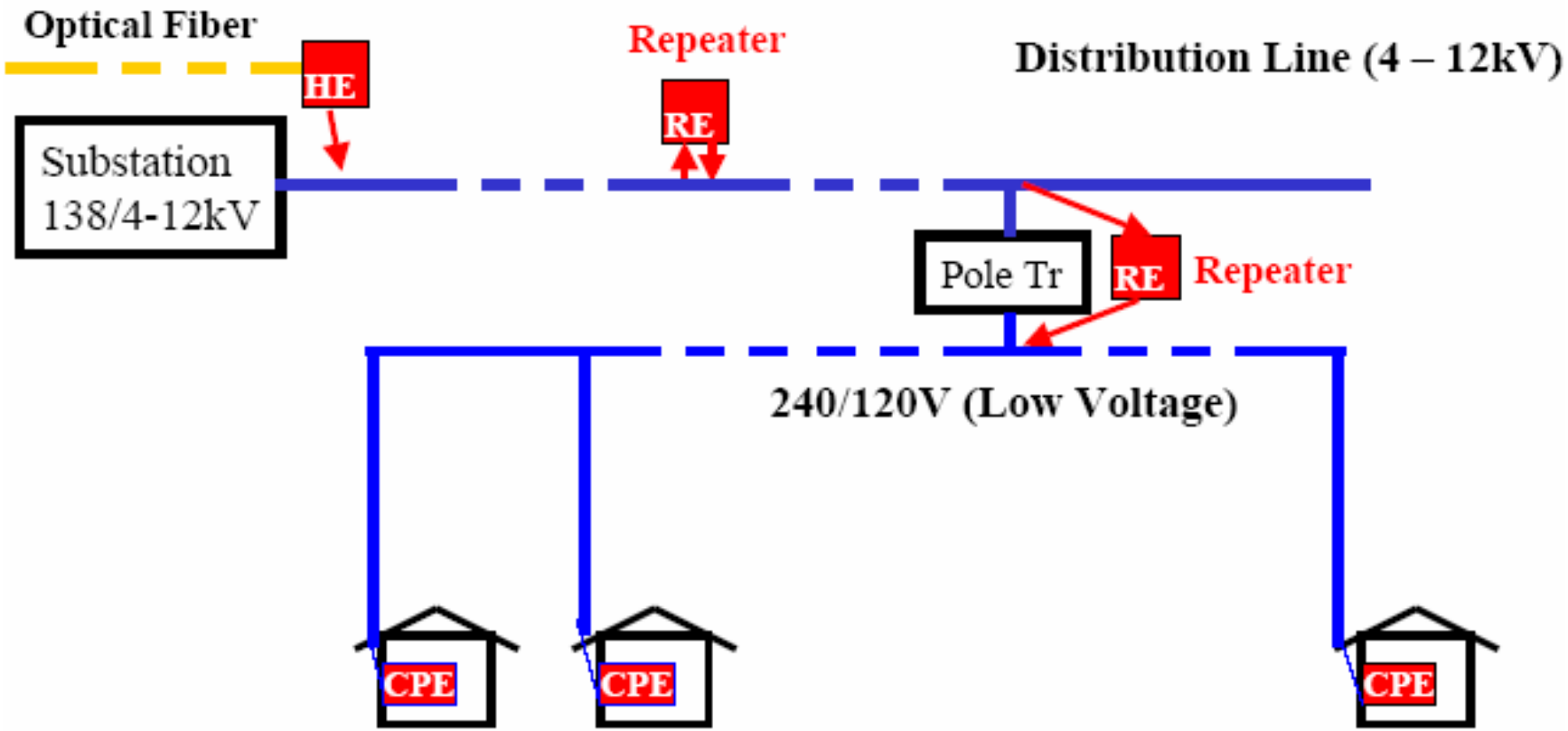


Telecom connection through:

- Microwave links
- Copper cable
- Fibre
- Satellite

* CPE - Customer Premise Equipment
* PSTN - Public Service Telephone Network

Rural applications



Typical performance (2002)

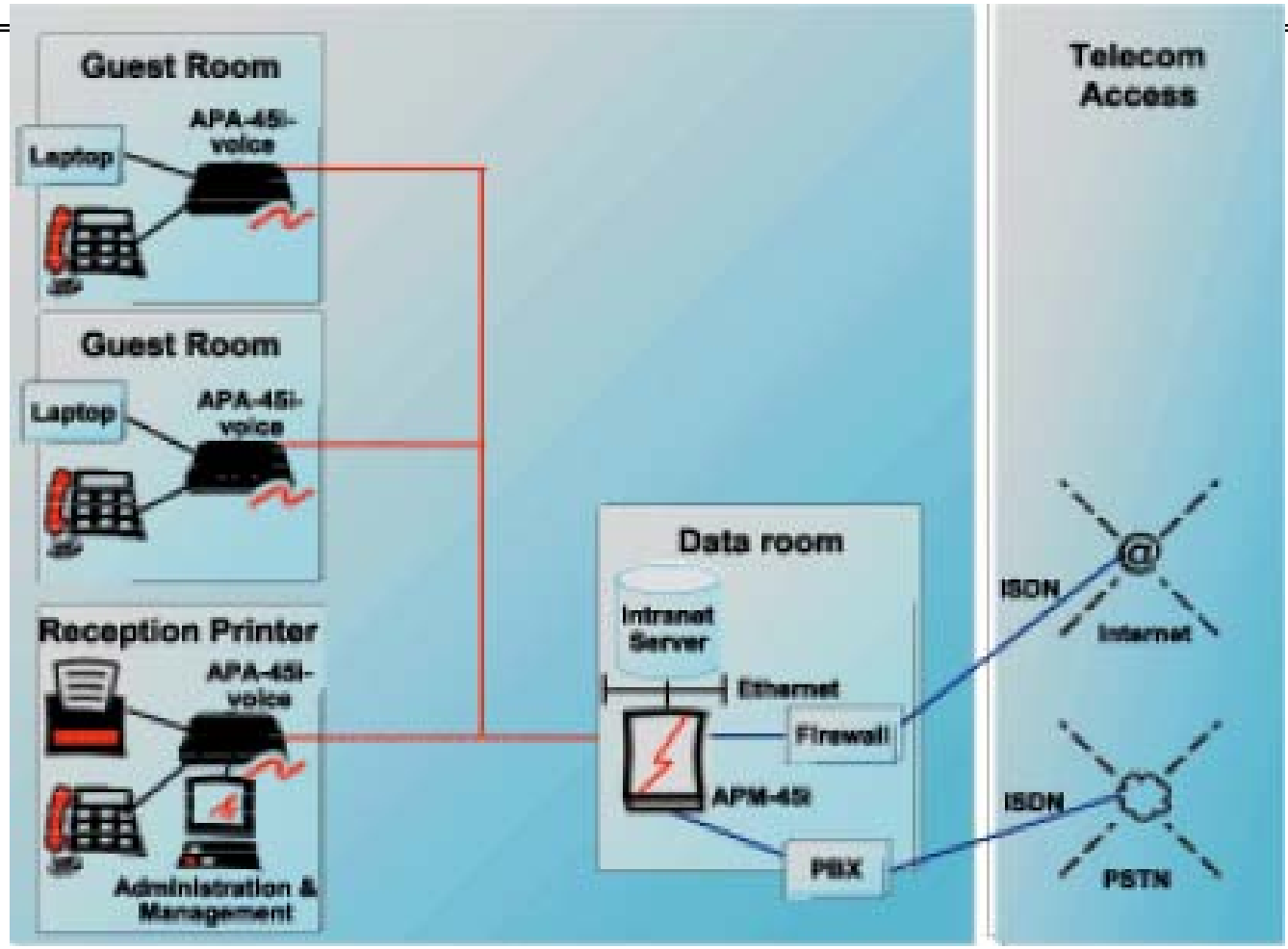
System	Bandwidth (now)	Reach	Bandwidth (2003/2004)
In House	1-10Mbps	100m	50-100Mbps
Access (LV)	2-20Mbps	250-500m	50-100Mbps
Access (MV)	2-20Mbps	1 - 3km	50-100Mbps

Example 2004

Item	Specification	
	HE, RE, HG	CPE
Modulation Method	OFDM	
Frequency Band	2 - 30MHz (Selective)	
Bandwidth	Approx. 30MH z	
Data Rate (Physical layer rate)	200Mbps Max..	
Multi-Access Method	Master Slave or CSMA	
Transmission Power	-50dBm	

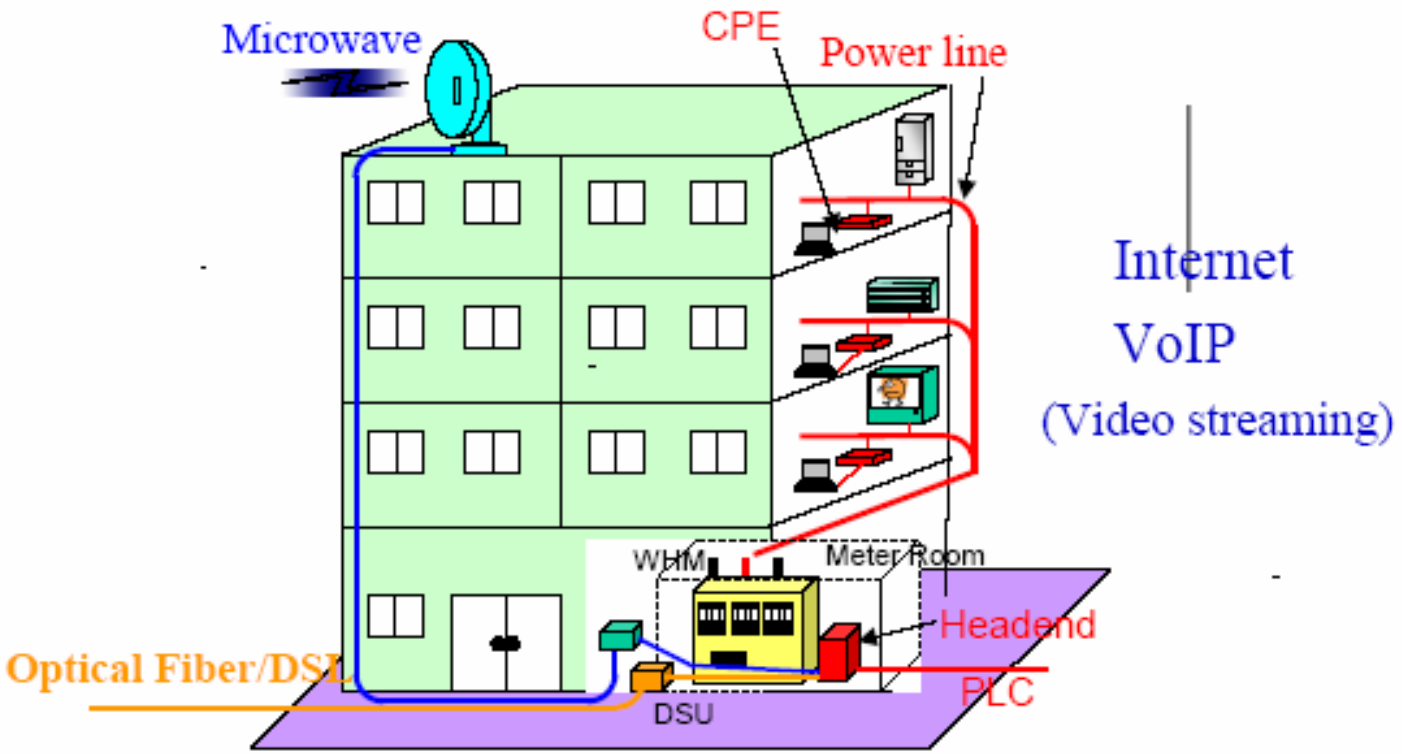
Source: Sumimoto Electric

Hotel



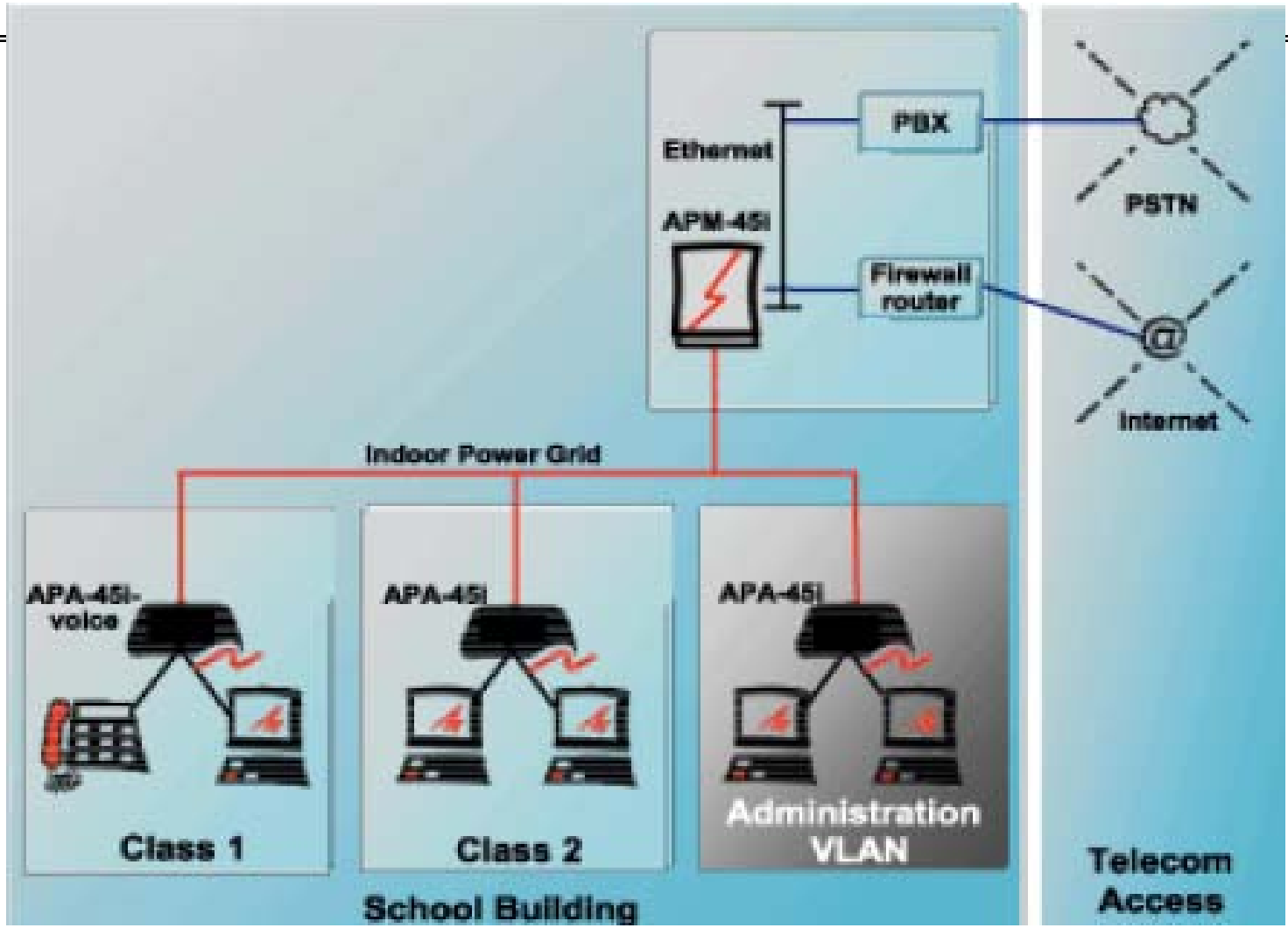
Source: ASCOM

Apartment Houses / Hotel



- PLC transmits the data from the PLC, optical fiber or microwave to each room, each plug

School



Source: ASCOM

Video surveillance

High-Voltage Power Line

Video Backhaul

Power Substation

Medium-Voltage Power Distribution Lines

(IP Broadband Local Loop)

Data Signals Coupled Onto Power Network at Substation Via Capacitive Coupler

BPL Modem Prepares Signals for Transmission To Utility Nodes and Customers

Regional Communications Center

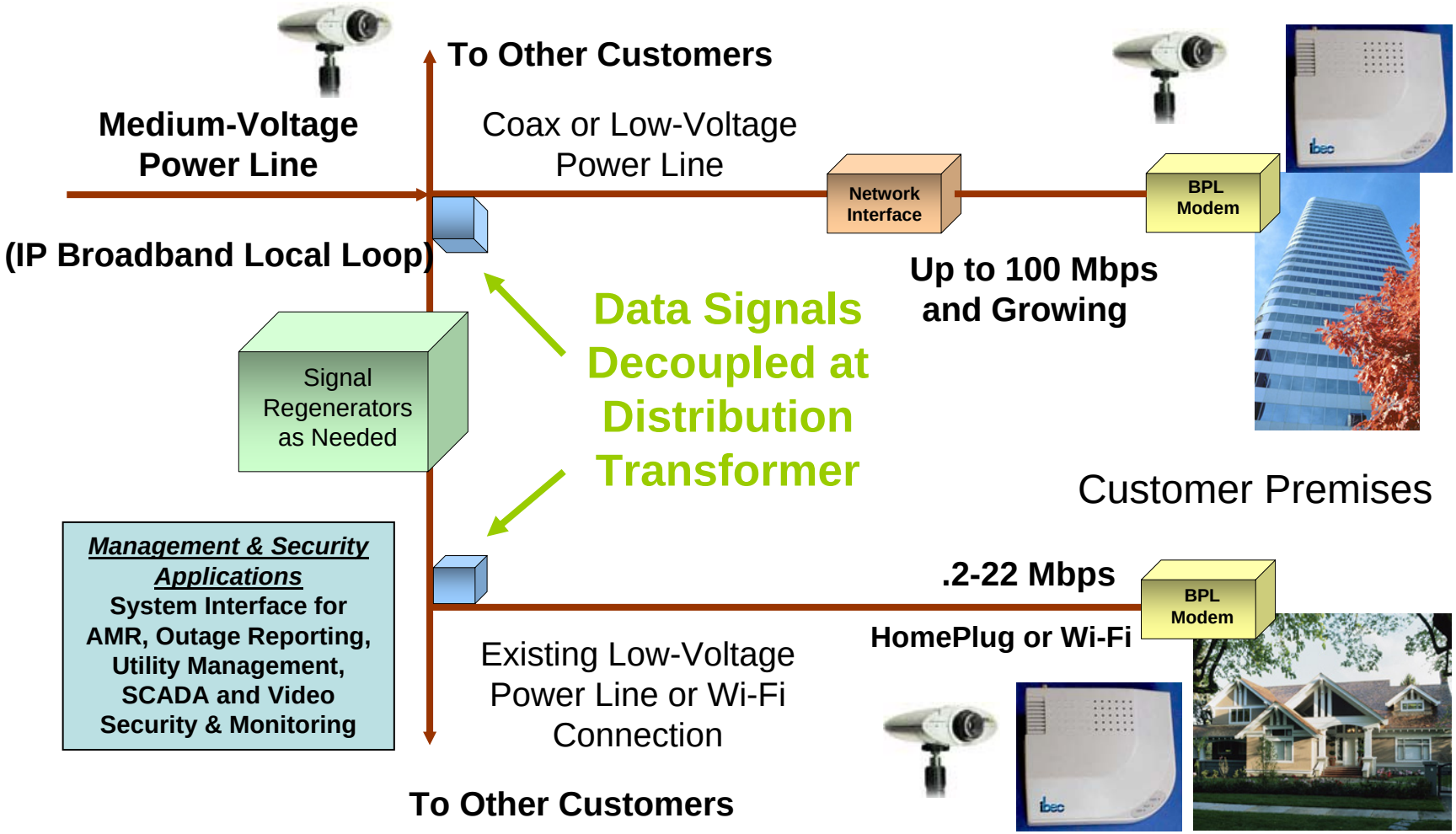
Utility or IBEC Back Office

IBEC Internet Interface

Public/IBEC Telephone Network

R Struzak

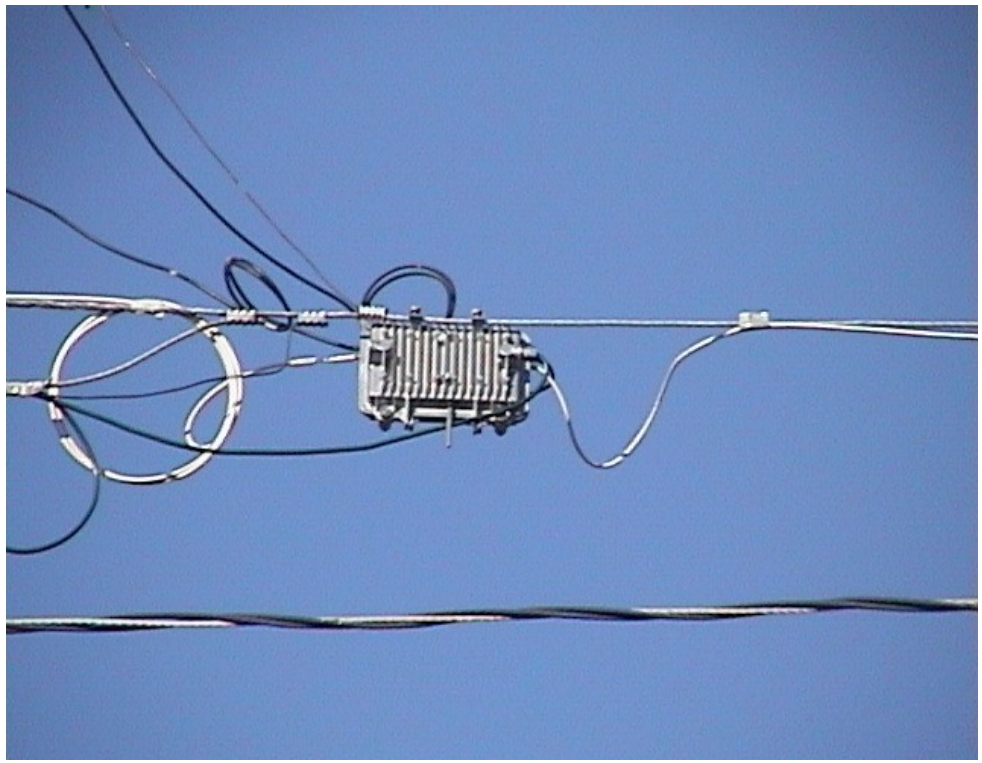
Video surveillance



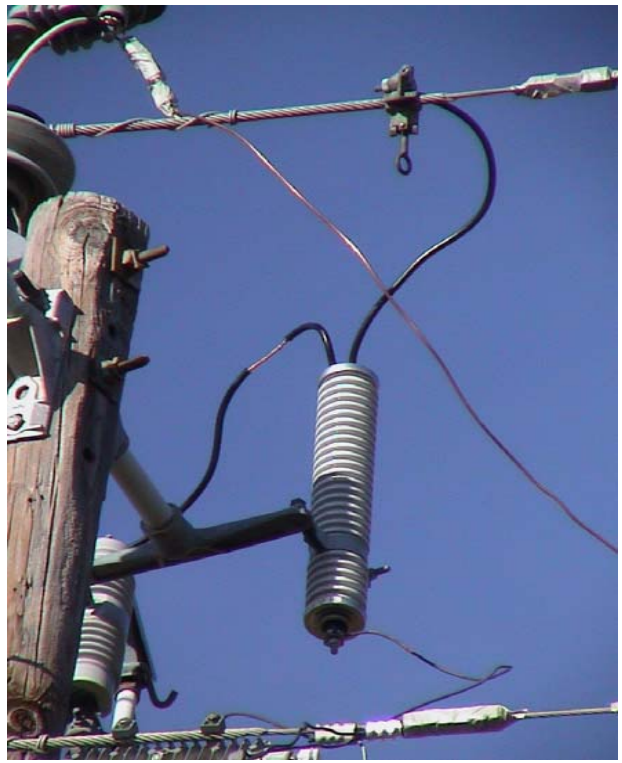
Video surveillance

- Fully Internet-Protocol Based Solutions
  - Fully “Open” Broadband Network on Power Line
  - Maximum Flexibility in Adding New Features
  - Security Provided Via Encryption and Passwords
  - Makes Future Upgrades Quick and Easy
  - Solution Fits Almost Any Existing Power Network
  - Provides Lowest-Cost Surveillance Solution Available

Cullman Electric Co-op Pilot Program



Single-Unit BPL Regenerator On MV Distribution Line



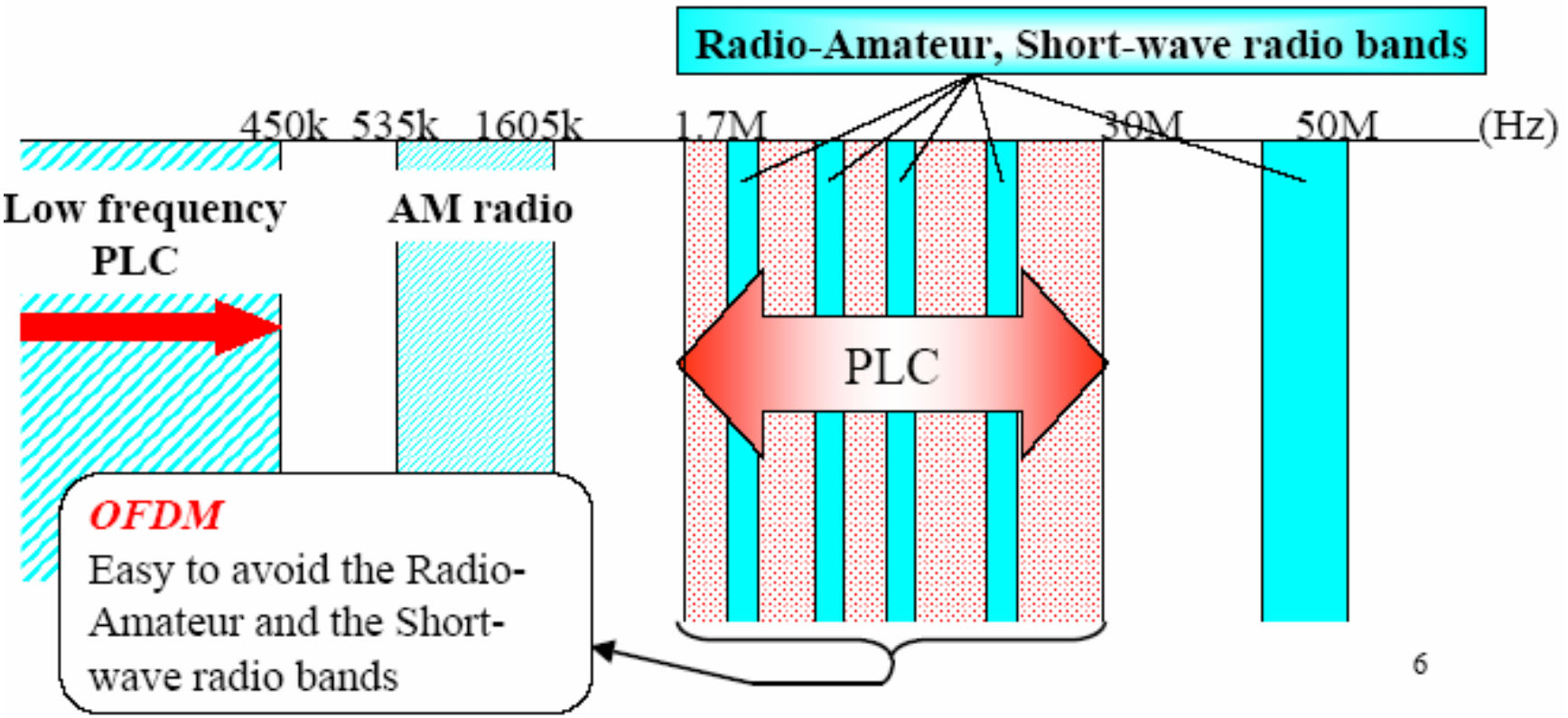
BPL Coupling Through Lightning Arrestor

Cullman Electric Co-op Pilot Program

Video Surveillance and Homeland Security Applications Directly Over the Existing Electric Power Lines *www.ibec.net/cam*

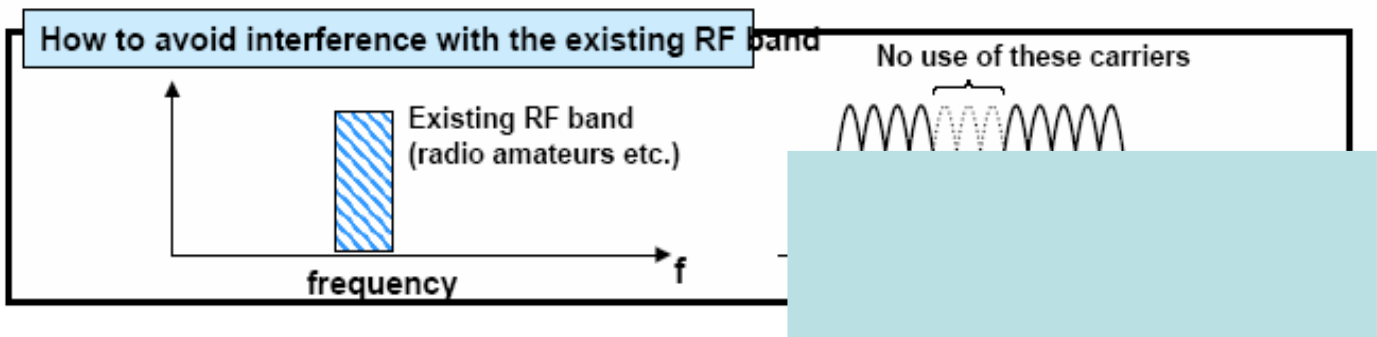
R Struzak

Frequencies used



Modulation

	OFDM (Orthogonal Frequency Division	S S (Spread Spectrum)
Principle of Modulation	Carriers Data stream divided in a lot of orthogonal carriers. Efficient use of frequency band →high speed transmission	Tx signal spread by SS modulation Tx Signal Signal on power line Rx Signa
Avoidance of existing RF band	○ (Spectrum mask)	× (Need filters)



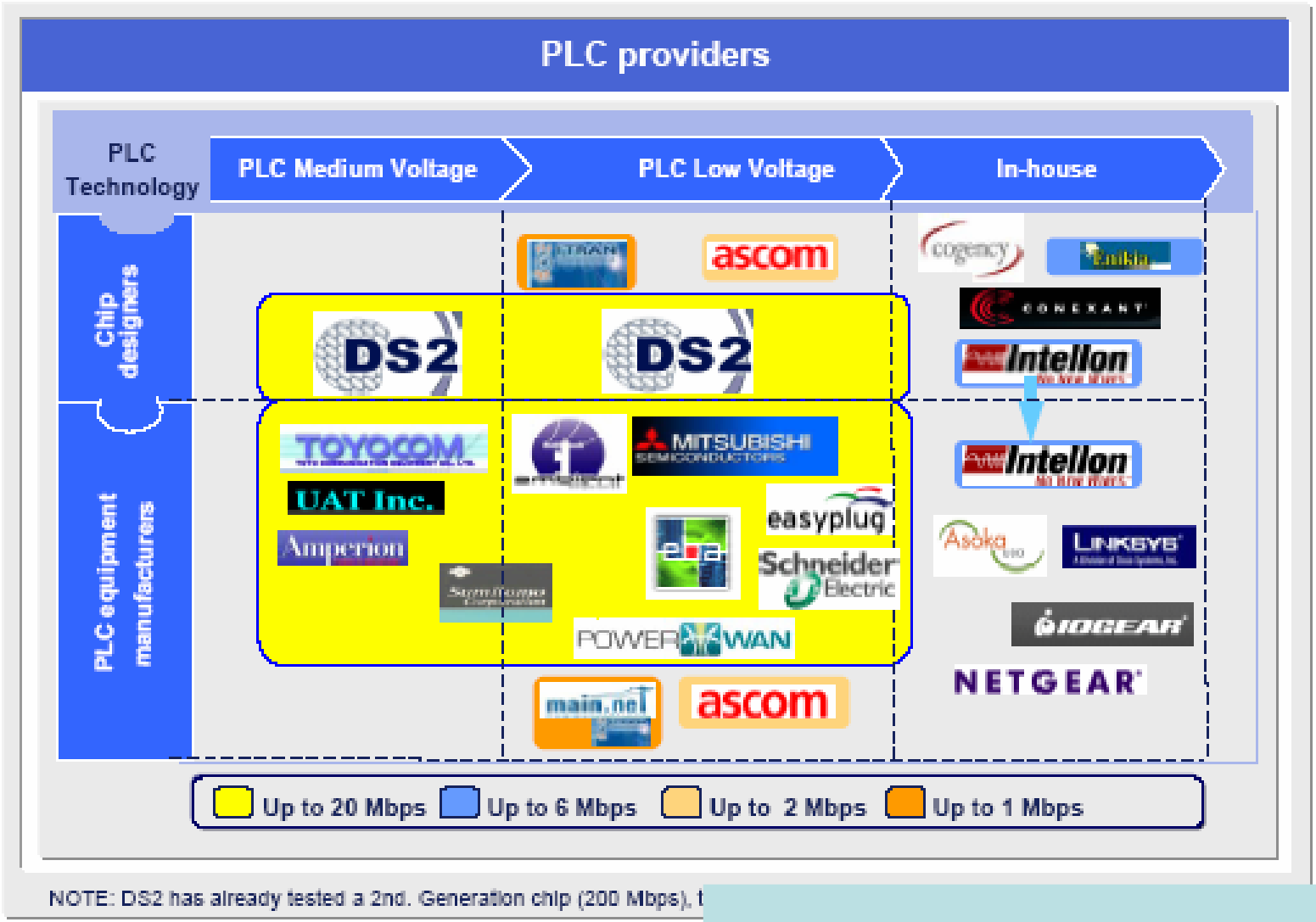
Benefits

- Cost efficiency
  - No additional cabling infrastructure (access via standard power plug)
  - Easy & fast installation
- Standard interfaces
  - Ethernet, USB, TV(?), telephone (POT, ADSL, ISDN)

Benefits

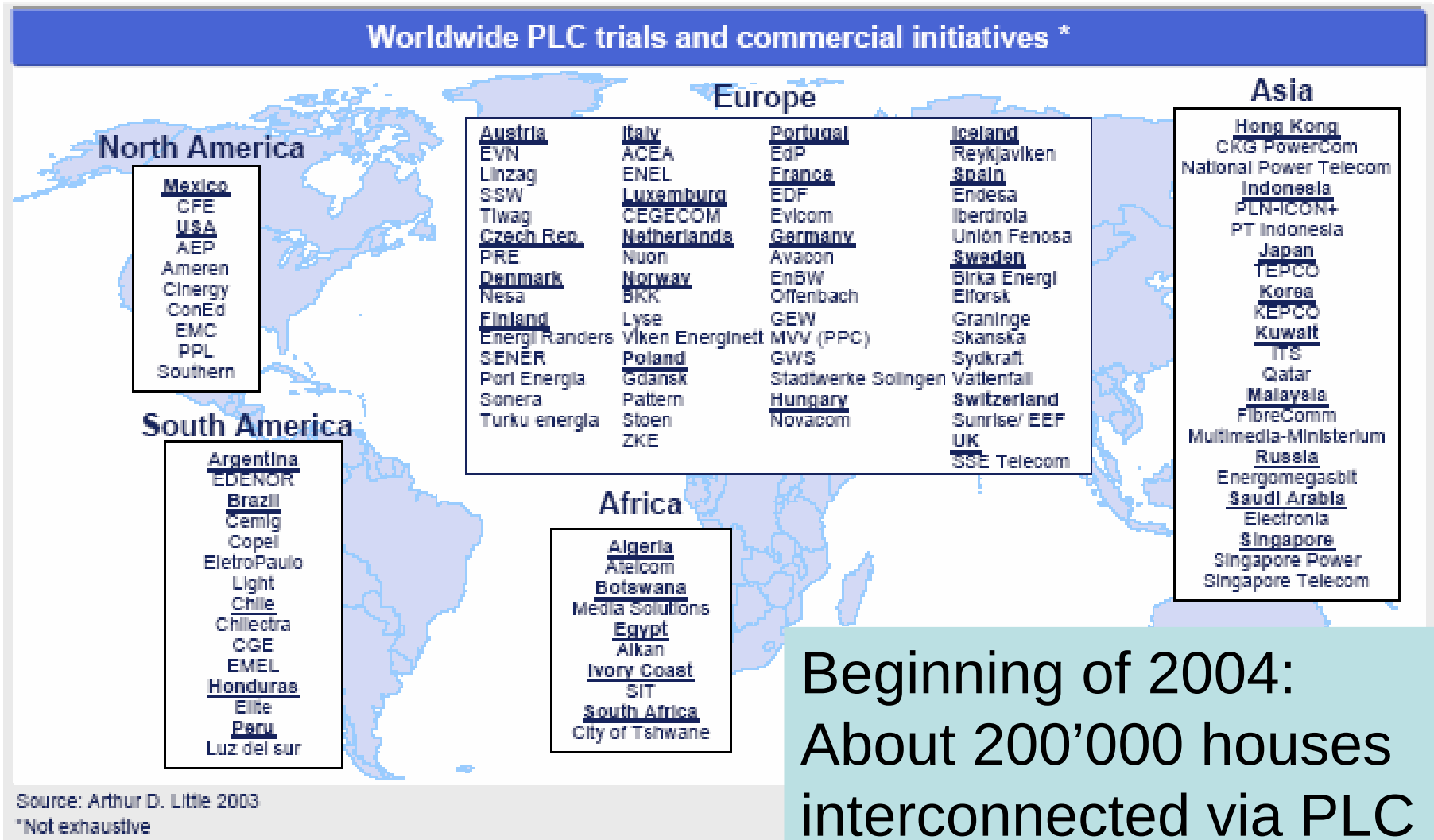
- As power lines exist in most houses, the technology is applicable not only in wealthy areas but also in socially disadvantageous areas and rural communities
- It offers an alternative way
  - To solve “last mile” problem
  - To bridge “digital divide”

Leading manufacturers ensure the availability and development of PLC equipment. 2nd generation chipset will increase performance and competitiveness



NOTE: DS2 has already tested a 2nd. Generation chip (200 Mbps), t

More than 80 PLC initiatives in more than 40 countries show a high interest in PLC technology among worldwide utilities



Beginning of 2004:
About 200'000 houses interconnected via PLC

Some PLC companies & sites

- ASCOM, Sumimoto Electric, Cullman Electric Coop, Xilingx
- www.PLCforum.com, www.plca.net, www.ipcf.org, www.ascom.ch, www.broadband.ch