Development of PLC in Sumitomo Electric

March, 2004

Sumitomo Electric Industries, Ltd.

Application of PLC ① (Distribution Line)

Backbone IP NW

PLC System

20kV Line

HE — Repeater

Apartment
- CPE
- CPE
- CPE

Home Gateway | Home Gateway

220V Line

Apartment
- CPE
- CPE
- CPE
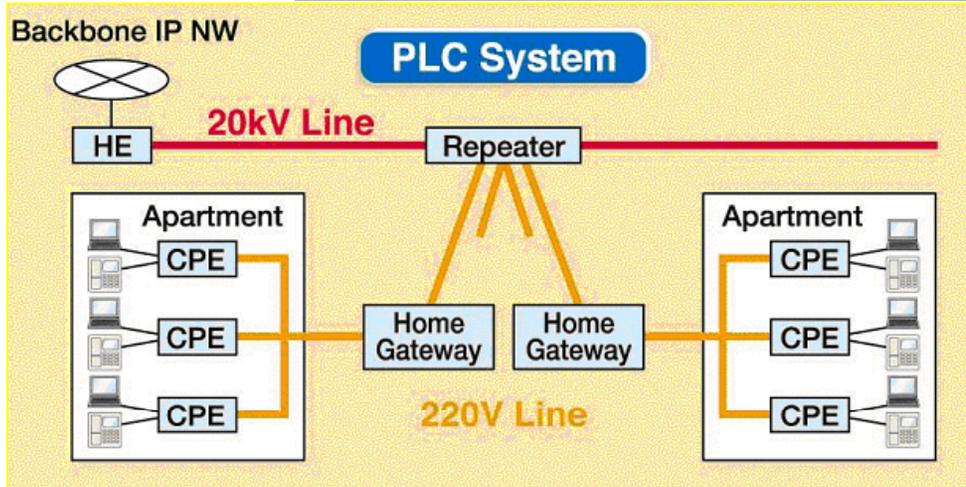
Internet

VoIP

(Video streaming)

Installation example

MAN/ Internet

Apartment House

10/100 Base-TX

Router

GbE Backbone

GbE Switch

10/100 Base-TX

MV (20kV)

WHM

Meter Room

LV (220V)

CPE

HV

Repeater

Home Gateway

HE

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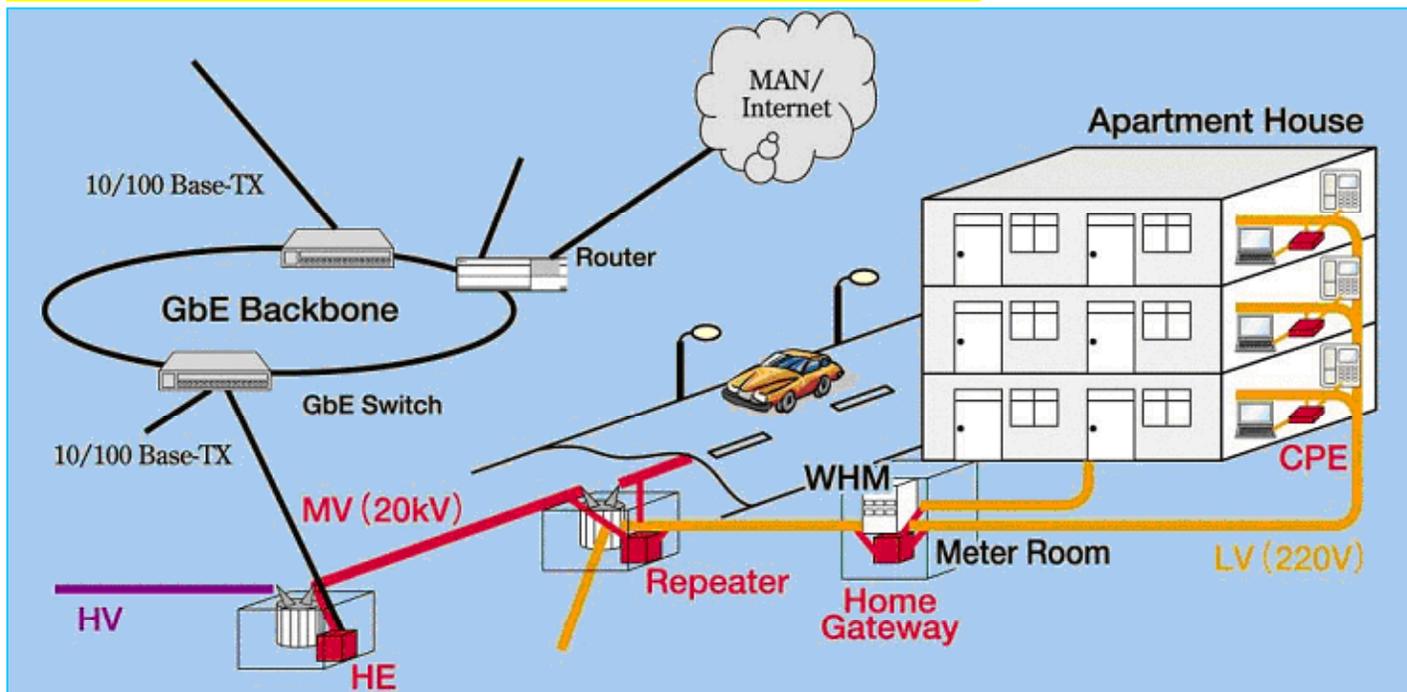
Application of PLC ② (In Building)

Apartment Houses / Hotel

Microwave

CPE

Power line

Internet

VoIP

(Video streaming)

WHM

Meter Room

Headend

Optical Fiber/DSL

PLC

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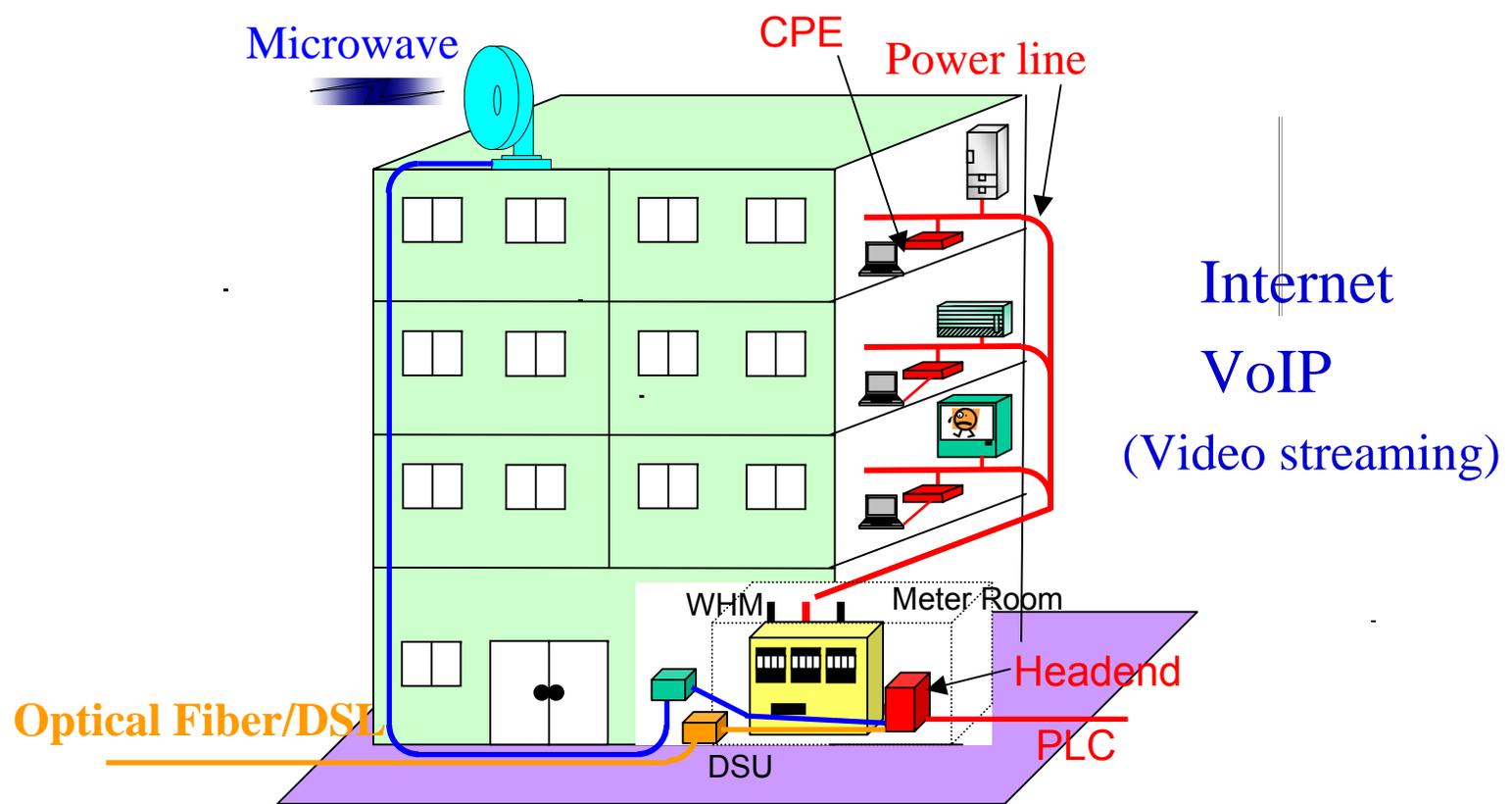
PLC transmits the data from the PLC, optical fiber or microwave to each room, each plug

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Application of PLC ③
(In House)

Individual House

HE

Access line
(ADSL, CATV, Fiber)

CB

CPE

CPE
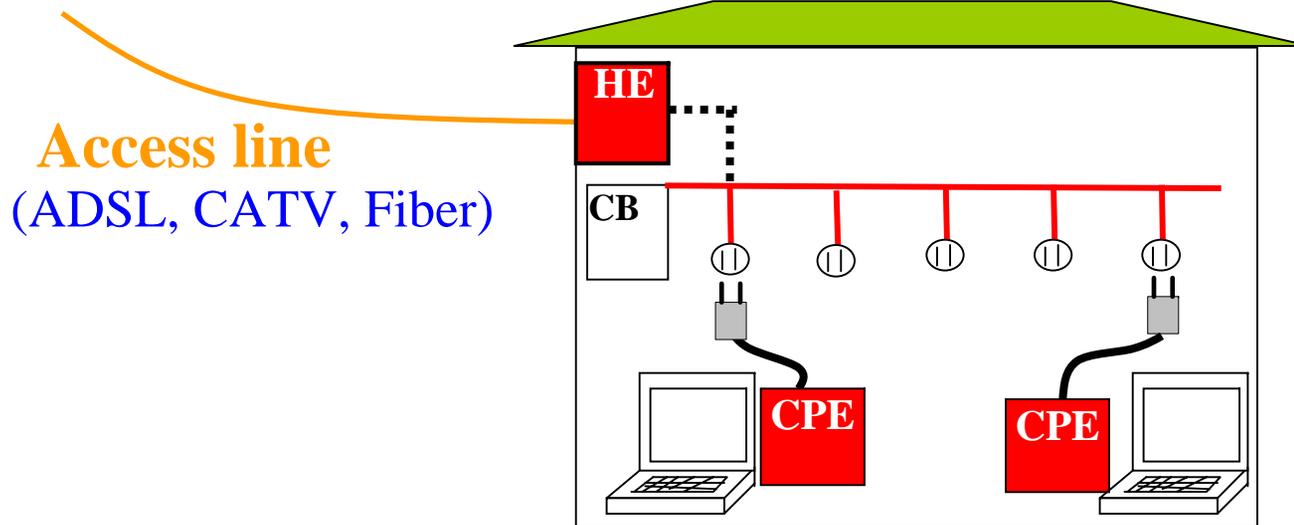
No need of wiring

Home LAN **formed by PLC through ADSL or FTTH**
Home automation is available

Application of PLC ④ (Rural Area)

Long distant overhead line needs several Repeaters

Optical Fiber

HE

Repeater

RE

Distribution Line (4 – 12kV)

Substation
138/4-12kV

Pole Tr

**RE** **Repeater**

**240/120V (Low Voltage)**

CPE   CPE

CPE
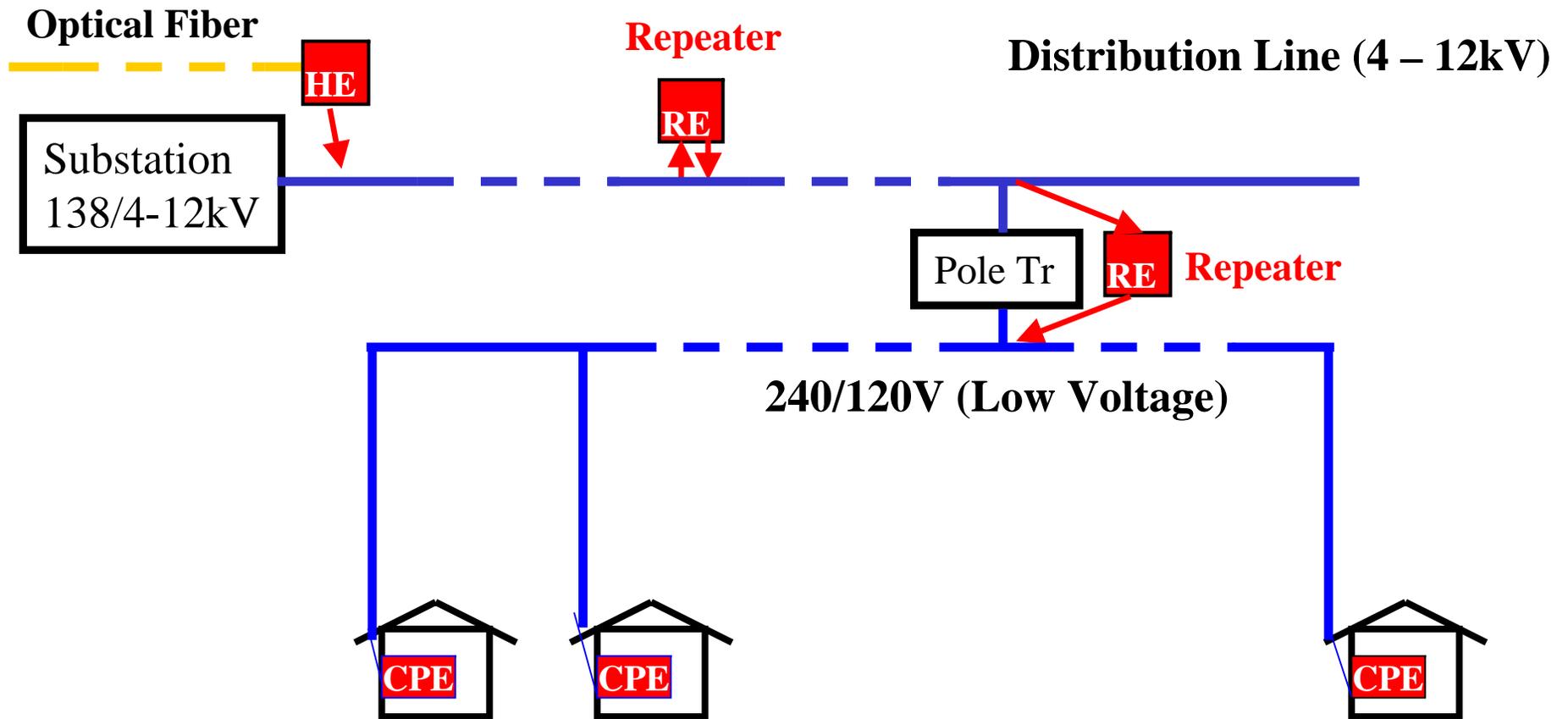
Avoidance of Interference due to Radiation

Power lines could be an antenna → electric field radiation

Possible interference with other wireless equipment

Radio-Amateur, Short-wave radio bands

450k 535k 1605k 1.7M 30M 50M (Hz)

Low frequency PLC

AM radio

PLC

OFDM Easy to avoid the Radio-Amateur and the Short-wave radio bands

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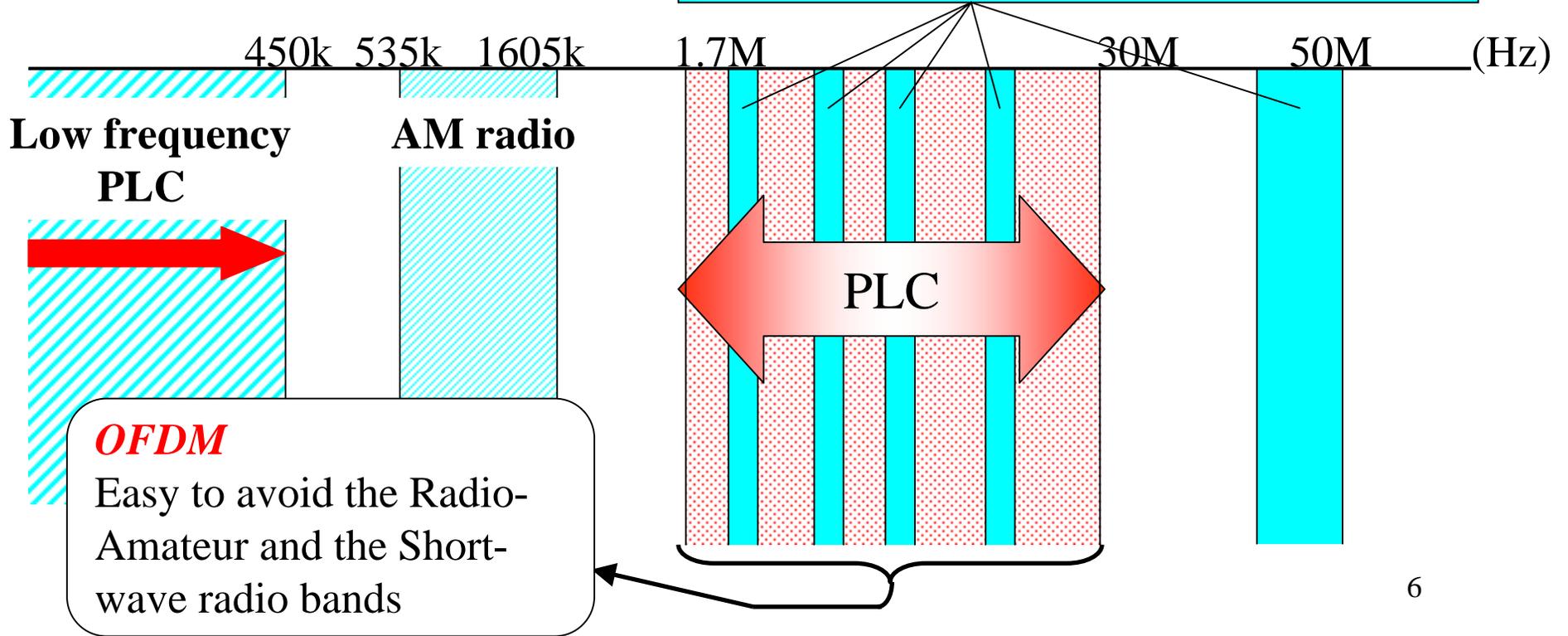
Power Masking with OFDM Technology

	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 Signal**
Avoidance of existing RF band	○ *(Spectrum mask)*	✕ **(Need filters)**
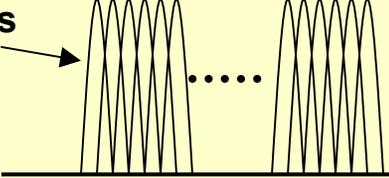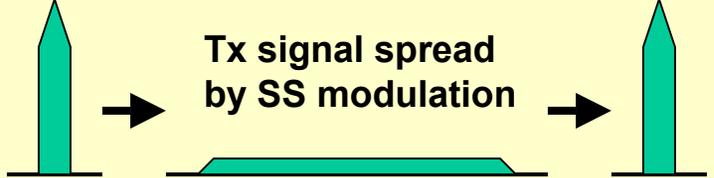
How to avoid interference with the existing RF band

No use of these carriers

Existing RF band (radio amateurs etc.)

frequency f

OFDM spectrum f

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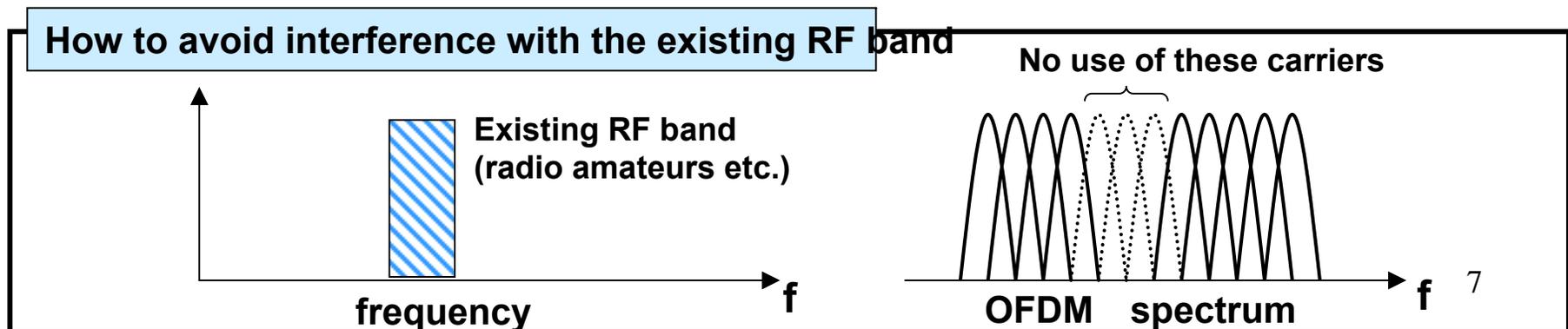
PLC Products Lineup (45Mbps)

Sample HE/Repeater Specification

Item	Specification
Modulation	OFDM
Number of Carriers	1280 (Programmable)
Frequency Band	2.5MHz〜11.8MHz（LINK1） 13.8MHz〜22.8MHz（LINK2）
Bandwidth	6.3MHz（Upstream : 2.5MHz Downstream : 3.8MHz）
Data Rate	45MbpsMax.（Upstream : 18Mbps Downstream : 27Mbps）
Multi-Access Method	TDMA—FDD
Transmission Power	−40dBm/Hz Max.

Sample VoIP CPE Specification

Item	Specification
Modulation	OFDM
Number of Carriers	1280 (Programmable)
Frequency Band	13.8MHz〜22.8MHz（LINK2）
Bandwidth	6.3MHz（Upstream : 2.5MHz Downstream : 3.8MHz）
Data Rate	45MbpsMax.（Upstream : 18Mbps Downstream : 27Mbps）
Multi-Access Method	TDMA—FDD
Transmission Power	−40dBm/Hz Max.

Sample 200Mbps PLC Modem Spec

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/Hz Max.	

Desired Features of 200Mbps PLC Modem

- ## Performance:
  - – Maximum speed up to 200 Mbps, thanks to:
    - High-density, high-efficiency OFDM modulation.
    - > 100 Mbps FTP transfer
    - > 25 simultaneous VoIP calls per LV transformer
  - – 100% coverage in each house

- ## Plug-and-Play:
  - – Ready to use out of the box (no configuration needed by end-user for normal usage).

- ## Compact size/Low cost:
  - – Additional parts around a chip reduced
  - – No CPU board and fan needed

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- Flexibility:
  - Suited for **home-networking** and **access**
  - Programmable frequency bands (10, 20 or 30 MHz, from 1 to 34 MHz)
  - Supports master/slave and peer-to-peer architectures
  - Support time-division and frequency-division coexistence between access & in-home
  - Designed to work in multi-dwelling units, hotels, office buildings, airports, etc.
  - Programmable QoS architecture and strict bandwidth/latency reservation