

**Application of information and communication technologies in home telehealth system**

**Yeh-Liang Hsu, Ph.D**

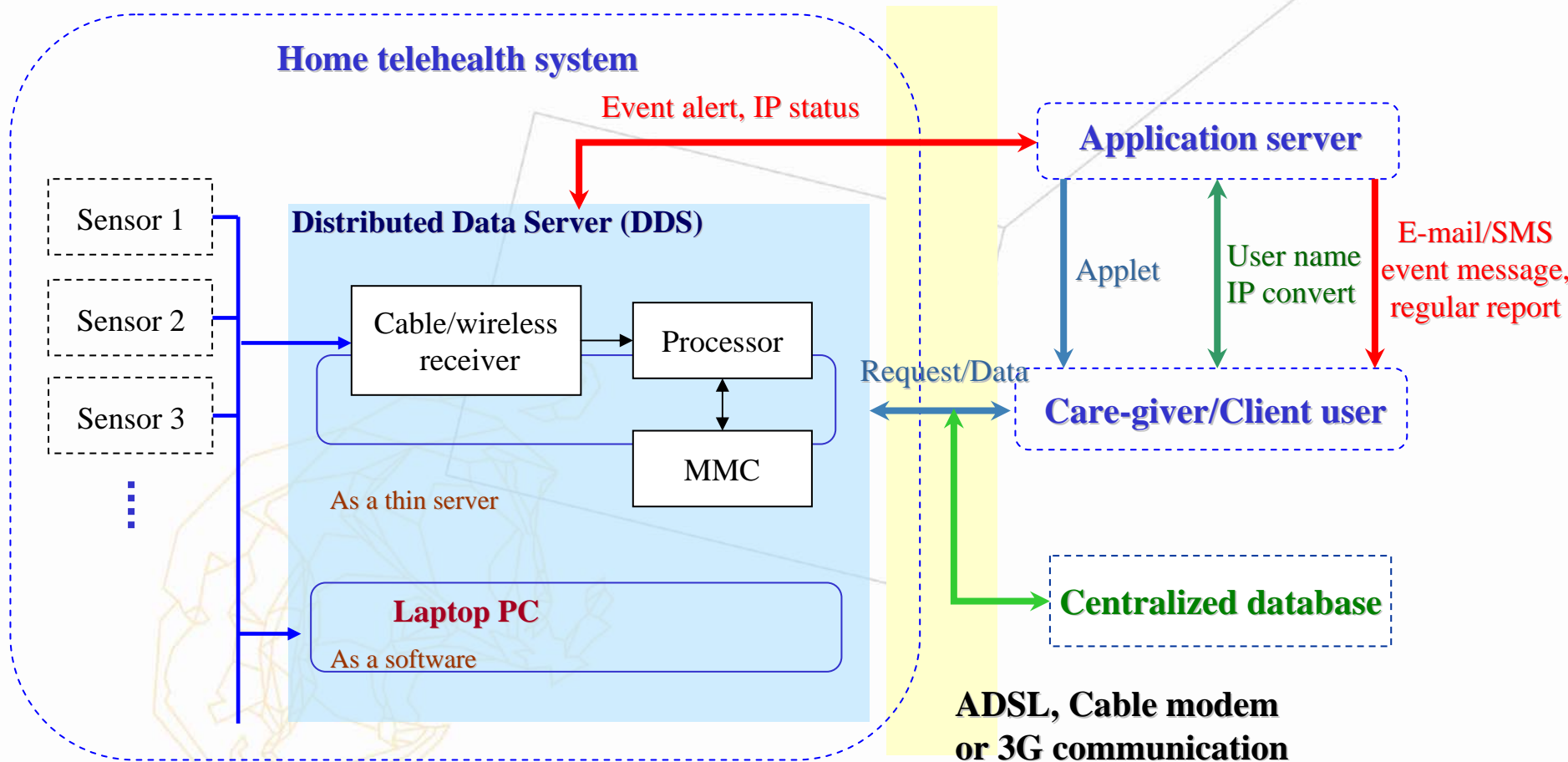
Professor, Department of Mechanical Engineering

Director, Gerontechnology Research Center

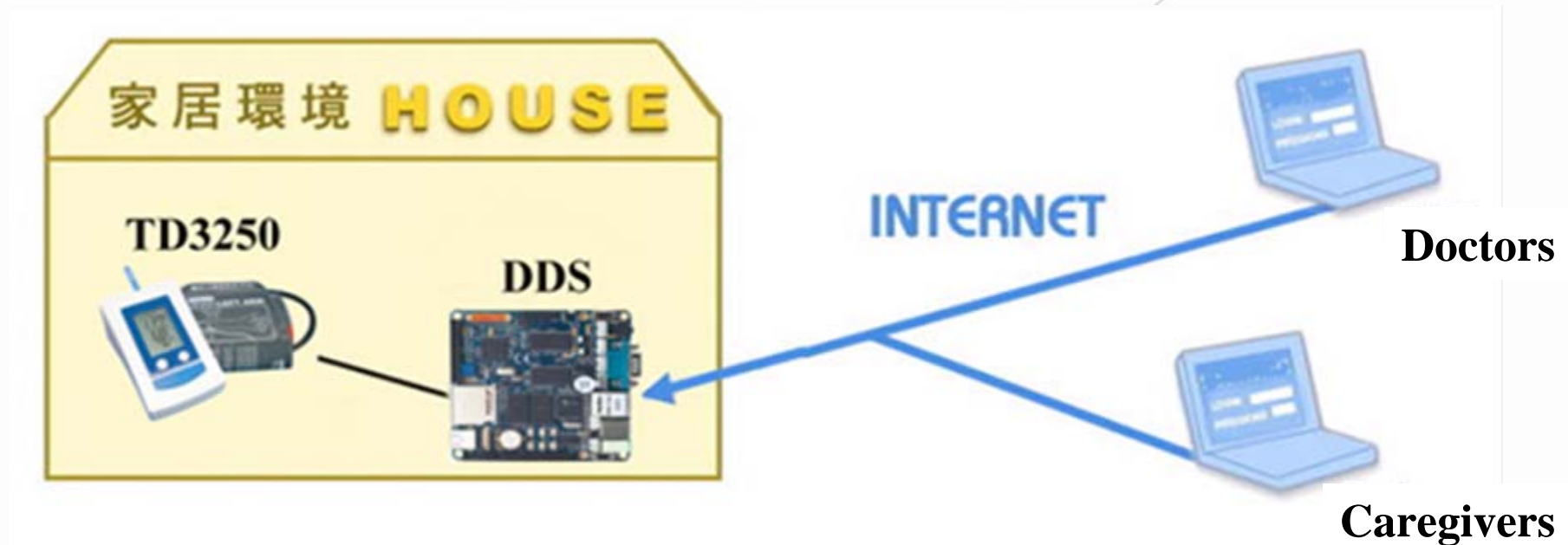
Secretary General, Yuan Ze University

05/17/2010

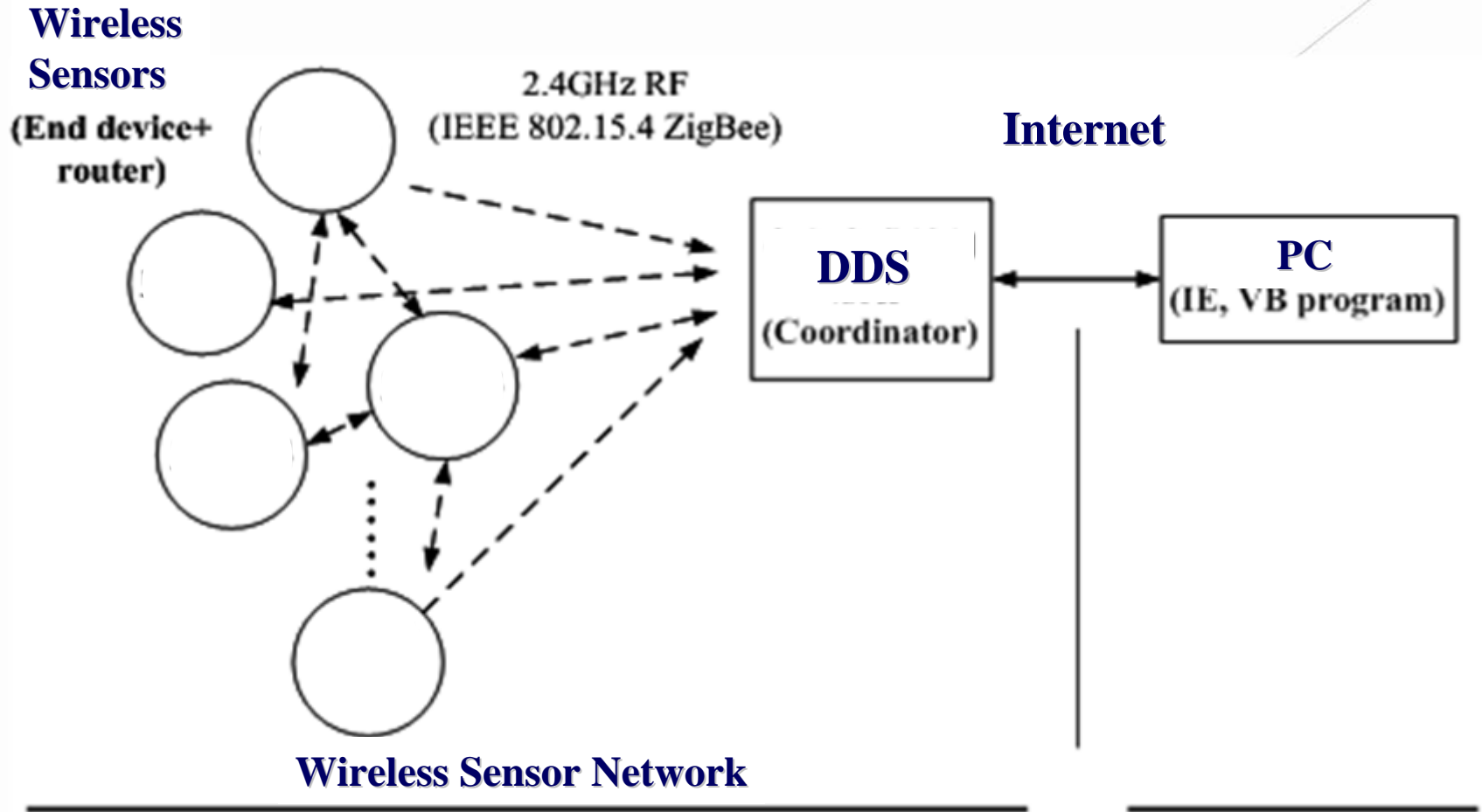
# The Decentralized Home Telehealth System



# Workshop on building a home telehealth system (I)



# Workshop on building a home telehealth system (II)



# Basic concepts of communication technologies (1/4)

- ✓ Communications: Transmitting voices, text, image and data between two remote places through certain communication media
- ✓ Communication media
  - Telephone line, TV cable, light fiber, power line
  - Wireless transmission: electromagnetic waves, light
- ✓ Two major considerations when selecting communication technologies:
  - Transmission speed: “data rate”, expressed in kbps or Mbps
  - Transmission distance

# Basic concepts of communication technologies (2/4)

## Electromagnetic waves

- ✓ Wave length  $\lambda$  and frequency  $\nu$  (Hz)

$$\lambda = c / \nu$$

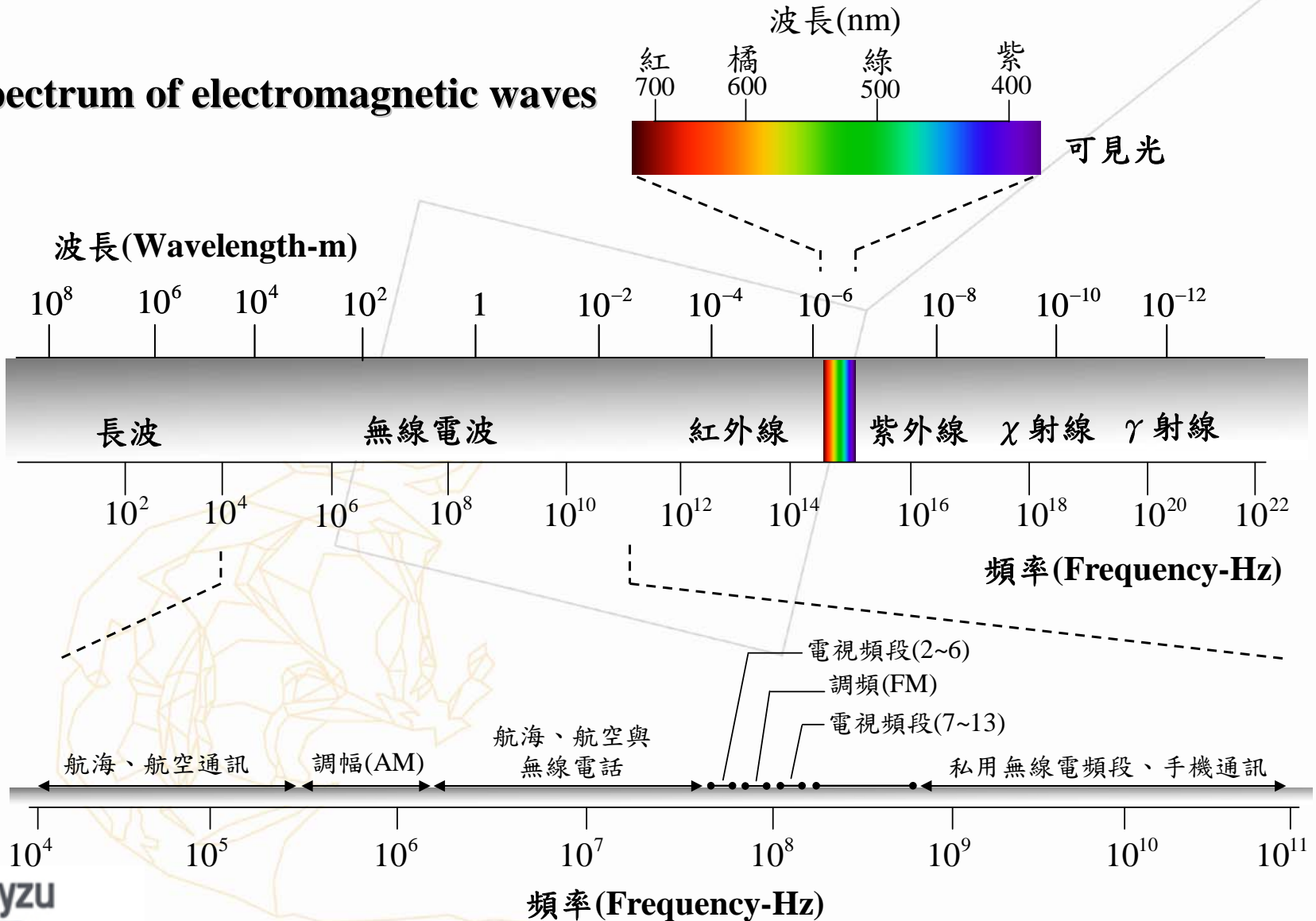
- ✓ Energy of electromagnetic waves

$$E = h\nu, \quad h = 6.626 \times 10^{-34} \text{ J} \cdot \text{sec}$$



# Basic concepts of communication technologies (3/4)

## Spectrum of electromagnetic waves

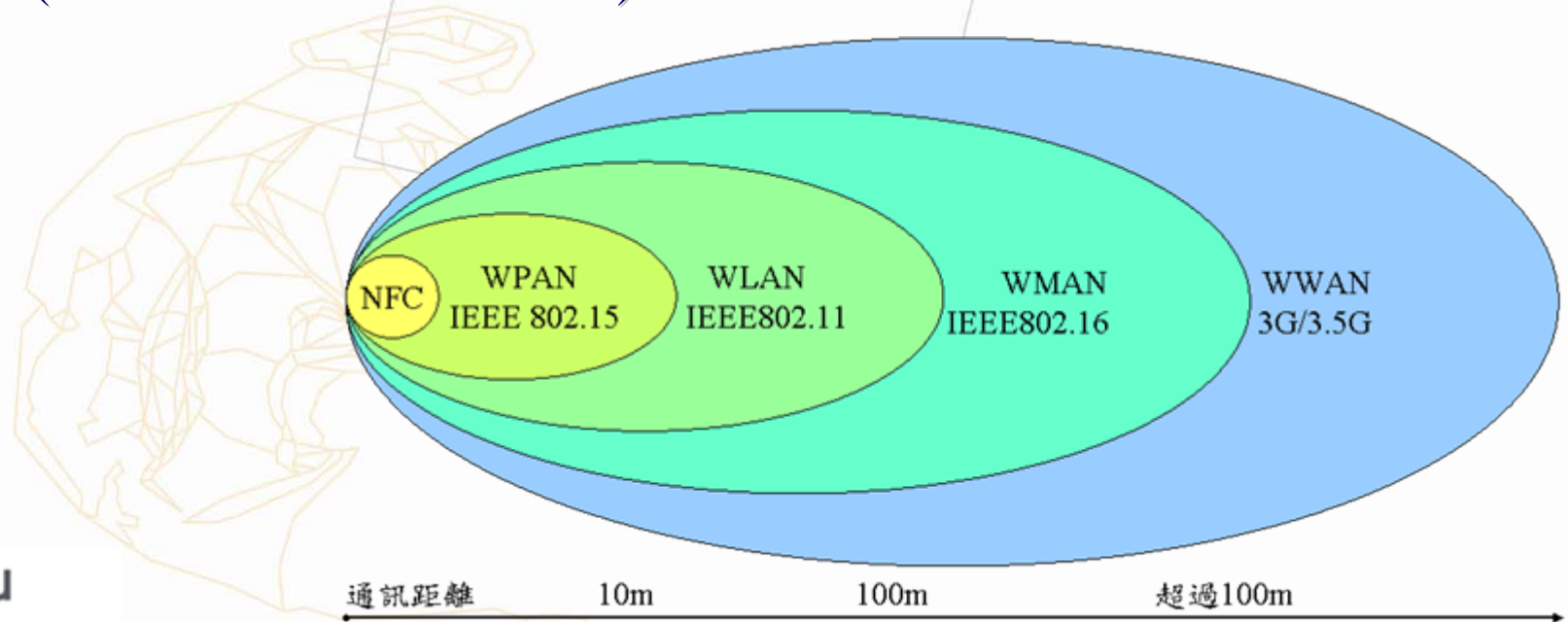




# Basic concepts of communication technologies (4/4)

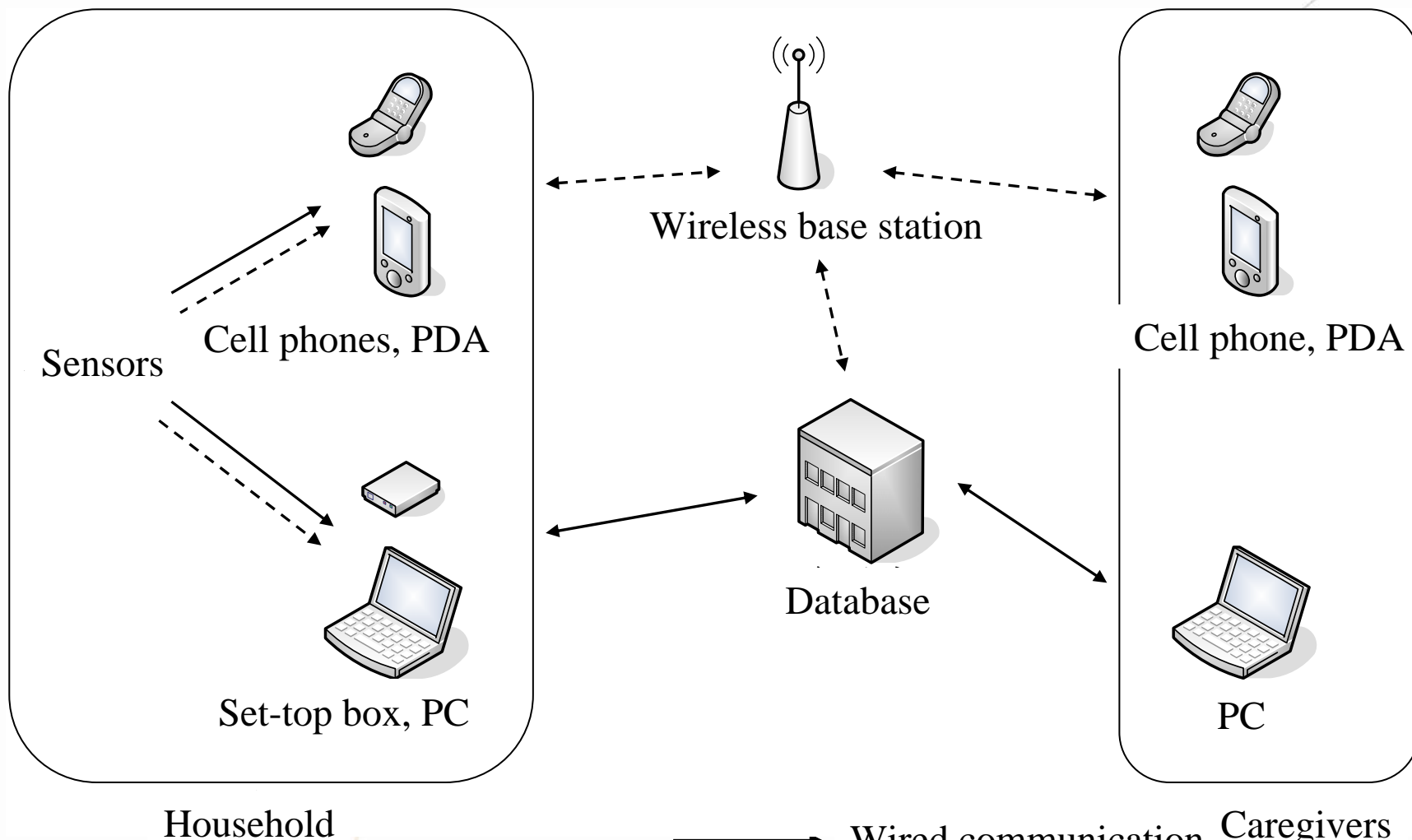
## Communication technologies classified by transmission distance

- ✓ WWAN (Wireless Wide Area Network)
- ✓ WMAN (Wireless Metropolitan Area Network)
- ✓ WLAN (Wireless Local Area Network)
- ✓ WPAN (Wireless Personal Area Network)
- ✓ NFC (Near Field Communication)





# Typical communication framework of a home telehealth system



# Vital sign data transmission at local site (1/8)

## RS-232 and USB

- ✓ Transmitting data from sensing device to home gateway
- ✓ RS-232, 115.2kbps, 60m
- ✓ USB is much faster than RS-232

	USB 1.1 host control		USB 2.0 host control	
Compatibility	USB 1.1	USB 2.0	USB 1.1	USB 2.0
Low speed	1.5Mbps	1.5Mbps	1.5Mbps	1.5Mbps
Full speed	12Mbps	12Mbps	12Mbps	12Mbps
High speed	12Mbps	12Mbps	12Mbps	480Mbps

## Let's be clear about the units...

- ✓ 1 Byte = 8 bit
- ✓ 1 KB = 1024 Byte
- ✓ 1 MB = 1024 KB
- ✓ 1 GB = 1024 MB
- ✓ 1 TB = 1024 GB
  
- ✓ 1 Bps (Byte per second) = 8 bps (bit per second)
- ✓ 512 kbps = 64 KBps
- ✓ 1.5 Mbps = 1536 kbps = 192 KBps
- ✓ 3 Mbps = 3072 kbps = 384 KBps

# Vital sign data transmission at local site (2/8)

## Near Field Communication (NFC)

- ✓ Near Field Communication or NFC, is a short-range high frequency wireless communication technology which enables the exchange of data between devices over about a 10 cm distance. (Wikipedia)
- ✓ NFC technology is an extension of Radio Frequency Identification (RFID).
- ✓ Frequency: 13.56MHz; transmission distance: up to 20cm; data rate: 106kbps, 212kbps, 424kbps, 848kbps.
- ✓ Applications:
  - Card emulation: the NFC device behaves like an existing contactless card for electronic ticketing, electronic money, electronic key
  - P2P mode: two NFC devices are communicating and exchanging information.

## Vital sign data transmission at local site (3/8)

- ✓ A personal area network (PAN) is a computer network used for communication among computer devices, including telephones and personal digital assistants, in proximity to an individual's body. (Wikipedia)
- ✓ The reach of a PAN is typically a few meters. PANs can be used for communication among the personal devices themselves, or for connecting to a higher level network and the Internet.
- ✓ A wireless personal area network (WPAN) can also be made possible with network technologies such as IrDA, Bluetooth, and ZigBee.

# Vital sign data transmission at local site (4/8)

## WPAN

- ✓ Infrared: The Infrared Data Association (IrDA) defines physical specifications communications protocol standards for the short-range exchange of data over infrared light. (Wikipedia)
  - The transmission distance of IrDA is up to 8m. Data rate is 16 Mbps.
  - IrDA interfaces are used in medical instrumentation, test and measurement equipment, mobile phones, and laptop computers, digital cameras, PDAs etc.
- ✓ IEEE 802.15 is now the main stream technology for WPAN
  - IEEE 802.15.1, Bluetooth
  - IEEE802.15.4, ZigBee



# Vital sign data transmission at local site (5/8)

## WPAN

- ✓ Bluetooth was invented by telecom vendor Ericsson in 1994. It was originally conceived as a wireless alternative to RS-232 data cables to connect mobile phone and earphone wirelessly.
  - Frequency: 2.4GHz, transmission distance: up to 100m
  - Data rate: Version 1.0 → 1Mbps, Version 2.0 + EDR (2004) → 3Mbps, Version 3.0 + HS (2009) → 24Mbps.
  - Lower power consumption, short range, safe and reliable, many extensions and applications.



# Vital sign data transmission at local site(5/7)

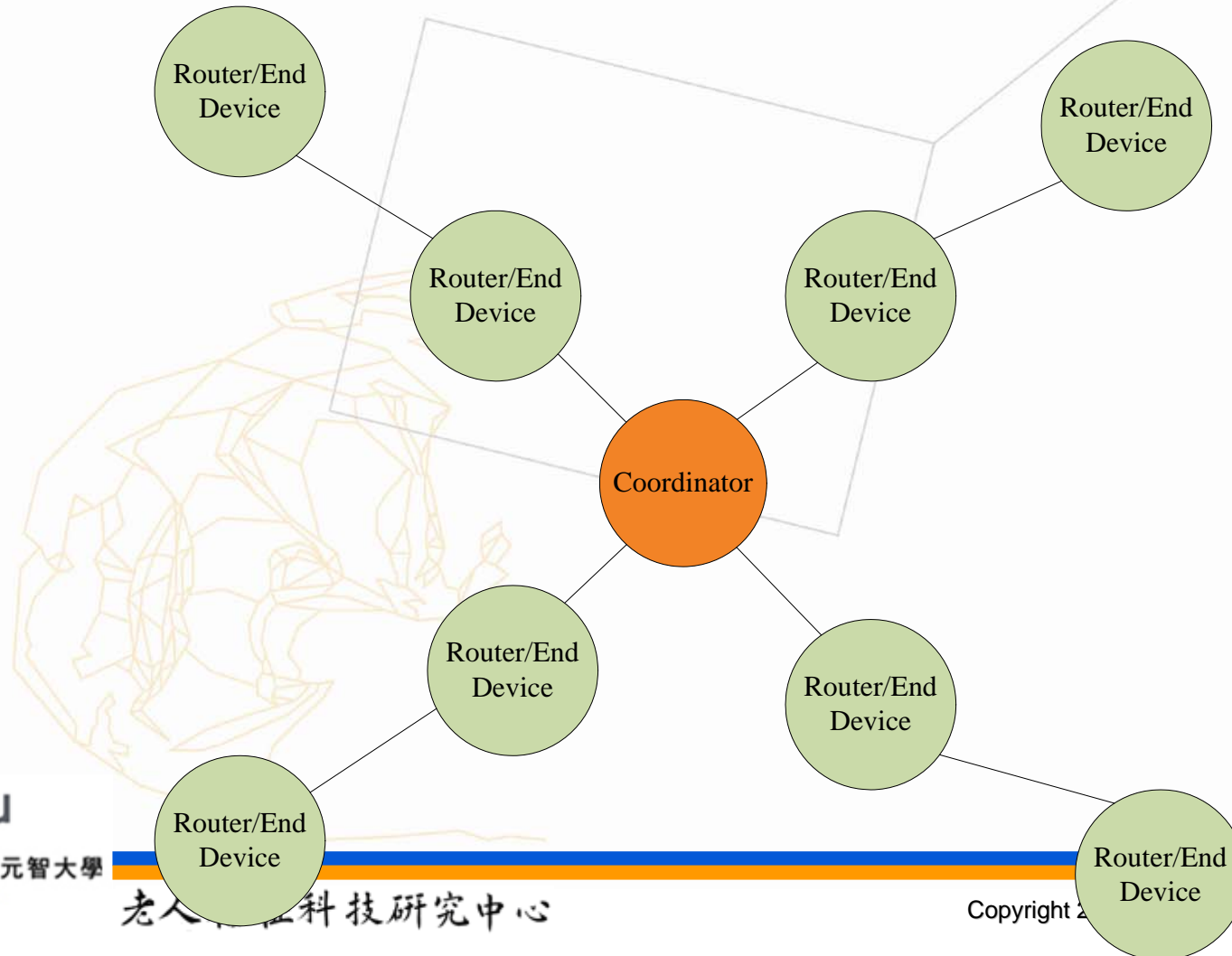
## WPAN

- ✓ Zigbee: The technology defined by the ZigBee specification (2003) is intended to be simpler and less expensive than other WPANs, such as Bluetooth.
  - ZigBee is targeted at radio-frequency (RF) applications that require a low data rate, long battery life, and secure networking.
  - Frequency: 2.4GHz; transmission distance: 10~75m, data rate: 10kps~250kbps
- ✓ Applications:
  - Home Automation, ZigBee Smart Energy, Commercial Building Automation
  - Telecommunication Applications
  - Personal, Home, and Hospital Care
  - Environmental information collecting

# Vital sign data transmission at local site (6/8)

## WPAN

- ✓ Zigbee Wireless Sensor Network (WSN): Coordinator, router and end device



# Vital sign data transmission at local site (7/8)

## Wireless Local Area Network, WLAN

✓ IEEE 802.11, indoor, low mobility, high data rate

Specification	802.11a	802.11b	802.11g
Date	1999/7	1999/7	2003/6
Frequency	5GHz	2.4GHz	2.4GHz
Data rate	54Mbps	11Mbps	54Mbps
Transmission distance	100m	>100m	>100m

## Health data transmission to the remote site (1/2)

- ✓ Plain Old Telephone Service, (POTS) or Public Switched Telephone Network, PSTN
- ✓ Integrated Services Digital Network (ISDN)
- ✓ Asymmetric Digital Subscriber Line (ADSL)
- ✓ Cable Modem

	Data Rate
POTS/PSTN	<56kbps
ISDN	~1.5Mbps
ADSL	8Mbps/640Kbps
Cable Modem	~5Mbps

# Health data transmission to the remote site (2/2)

## Wireless Metropolitan Area Network (WMAN)

✓ WiMAX: Worldwide Interoperability for Microwave Access

Specification	Frequency	Transmission distance	Data rate	
IEEE 802.16	10GHz~66GHz	1.6km ~ 4.8 km	32 Mbps ~134Mbps	Fixed
IEEE 802.16d	3.5 GHz及5.8GHz	6.4 km ~ 8.6 km	75Mbps	Fixed
IEEE 802.16e	2.5 GHz及3.5GHz	1.6 km ~ 4.8 km	15Mbps	Mobile

## Wireless Wide Area Network (WWAN)

✓ Mobile data network: GSM (8.6kbps), GPRS (64~115kbps), 3G (114kbps~2Mbps), 3.5G (384kbps~3.6Mbps)



元智大學  
Yuan Ze University



**Thank You**

**Yeh-Liang Hsu**  
**mehsu@saturn.yzu.edu.tw**

**<http://grc.yzu.edu.tw/>**  
**<http://designer.mech.yzu.edu.tw/>**