

Session 4 Innovation: Broadband access technologies

**ITU-MIC Forum on Wireless Broadband
Networks for Asia-Pacific Region**

Tokyo, Japan. Mar 24.2010

ROOT INC. Hiroshi Mano

<http://www.root-hq.com>

Today's Wireless Technologies 1

IEEE802.11x

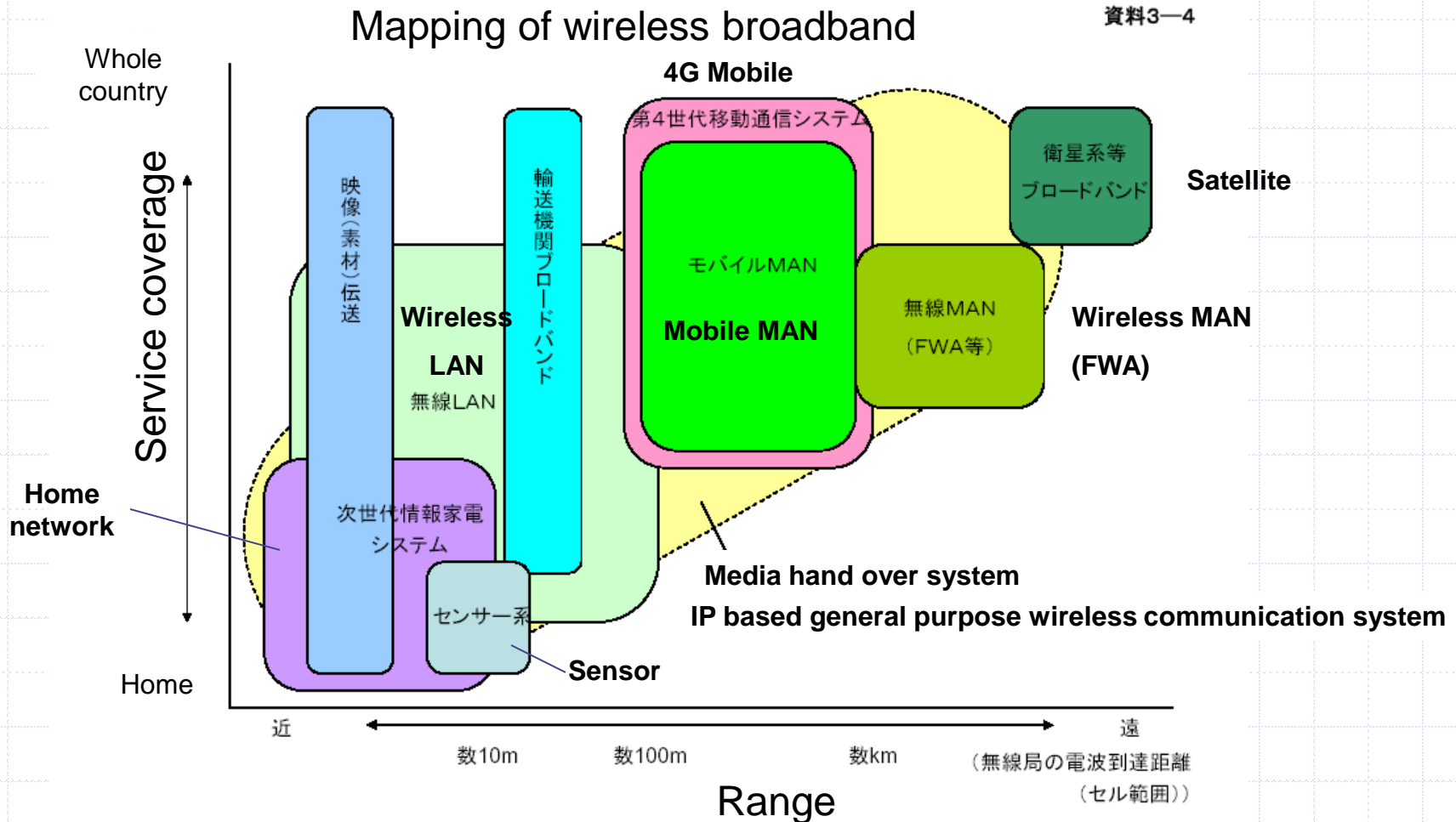
- ◆ 802.11a: 5 GHz, 54 Mbps
- ◆ 802.11b: 2.4 GHz, 11 Mbps
- ◆ 802.11e: Quality of Service (QoS)
- ◆ 802.11g: 2.4 GHz, 54 Mbps
- ◆ 802.11i: Security
- ◆ 802.11j: Japan 5 GHz Channels (4.9-5.1 GHz)
- ◆ 802.11n: High-Speed
- ◆ 802.11r: Roaming hand over
- ◆ 802.11aa: Video streaming
- ◆ 802.11ac: Under 6GHz very high throughput
- ◆ 802.11ad: 60GHz very high throughput
- ◆ 802.11af: TV white space

Today's Wireless Technologies 2

- 802.15 WPAN (Wireless Personal Area Network)
 - ◆ UWB
 - 110-480Mbps~Gbps??
 - ◆ Blue tooth/ZigBee
 - 2.4GHz
- Wi-MAX
 - ◆ 802.16 WMAN
 - 75Mbps long distance,
 - ◆ 802.16e Mobile WMAN
 - 30Mbps mobility
- IEEE802.20
 - ◆ High speed IP mobile
 - ◆ Down link 3Mbps、Up Link 900Kbps
- IEEE802.21
 - ◆ Media hand over between 3GPP-Wireless LAN
- IEEE802.22
 - ◆ Cognitive radio
 - ◆ Sharing frequency with digital broadcasting

Future of Wireless broadband

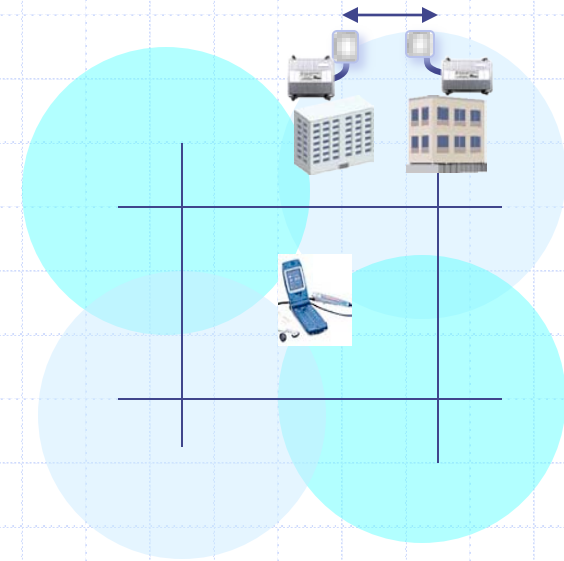
- ◆ Ministry of Internal Affairs and Communications (MIC)
- ◆ Set up Study Group for Wireless Broadband Promotion(2008)



A change in the role of the radio communication

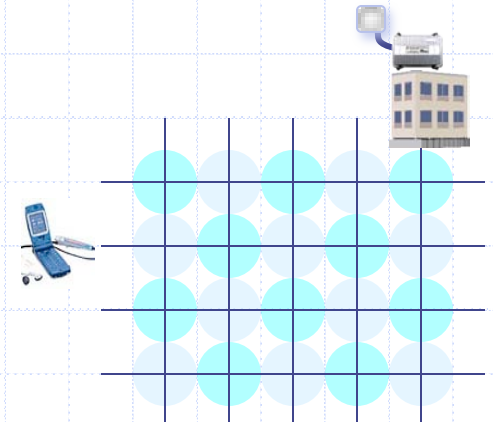
◆ Before the Internet

- Low density of network
 - ◆ Long distance for fixed wireless access
 - ◆ Large cell for mobile
 - Base stations are connected by expensive network
- Limited application
 - ◆ Narrow band applications.
 - ◆ Application specific communication



◆ After the internet

- High density of network
 - ◆ Fixed access are covered by FTTH,xDSL,CATV
 - ◆ Small cell for mobile
 - Connect mobile terminal to neighbor network
 - Base stations are connected by inexpensive network
- Un limited application
 - ◆ Wide band application
 - ◆ General purpose communication



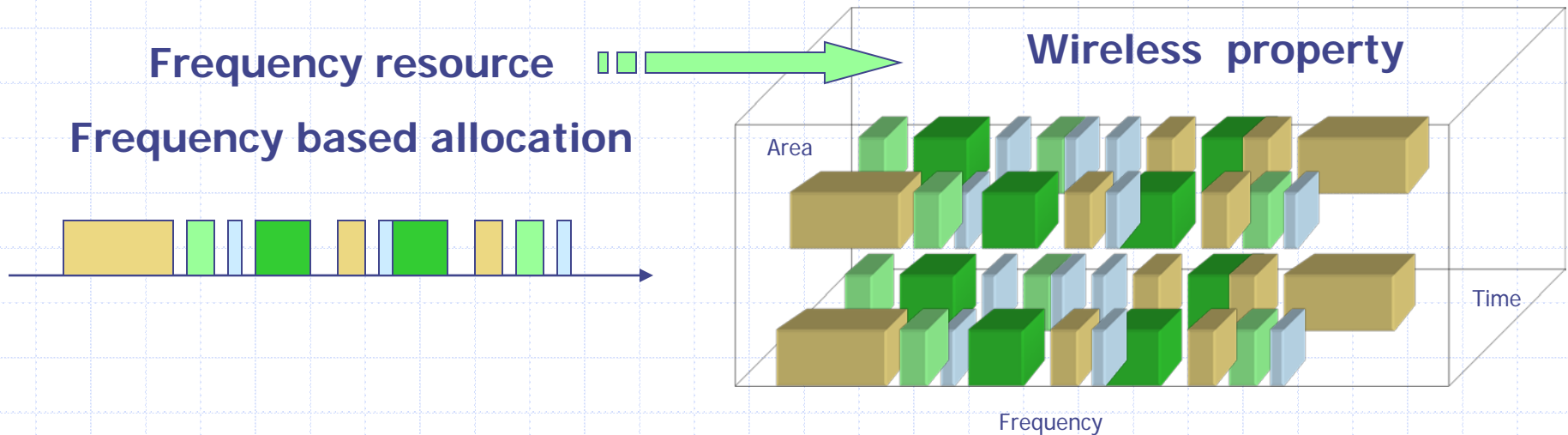
A change of wireless property

◆ Before

- Development speed > Consumption speed
- Narrow band application (Voice)
- Enough clear band on frequency based allocation

◆ Now

- Development speed < Consumption speed
- Wide band application
- Frequency, Space, Time based allocation



Change of the technology

◆ Before the Internet

- Analog communication
- Digital communication
- Continuous communication
 - ◆ Error = Information Lost
 - ◆ 99.999999.....% BER is required
 - ◆ Liner feed back
- Circuit switch
 - ◆ Connection best effort
 - Limited capacity for connection
 - ◆ Guaranteed band width
 - After connection established

Good for telephone

◆ After the Internet

- Digital packet communication
- Store & Forward
 - ◆ Error ≠ Information Lost
 - ◆ Retry can recover the information lost.
 - ◆ Delay and quality are trade-off.
 - ◆ Packet base feed back
- Packet exchange
 - ◆ Guaranteed connection
 - ◆ Best effort for band width

Good for general purpose

New wireless topics in last 10years

- ◆ Spread spectrum
 - Low spreading, no process gain
- ◆ Bluetooth
 - Low speed
- ◆ V-OFDM
 - No advantage to ADSL
- ◆ Wi-MAX
 - No line of site required
 - High speed,
 - Long distance
- ◆ UWB
 - Data rate > process gain
 - Dedicated frequency is required ?
- ◆ SFDR
 - General coverage
-> Limited coverage

- ◆ Technical advantage / condition
 - Robustness for noise
 - ◆ If enough process gain is high...
 - Very low cost
 - ◆ Huge mass-produces...
 - Non line of site
 - ◆ If the link margin is enough...
 - High speed
 - ◆ If the band width is enough...
 - Long distance
 - ◆ If the power is enough
 - No need clear band
 - If enough band width is allocated...
 - 1chip solution cover everything
 - ◆ If huge dynamic range is given...

Nobody can exceed the principle

$$C = W \cdot \log_2 (1 + S / N)$$

Key word's and essential technologies for next generation

- ◆ Digital Packet base
 - Not continuous communications base
- ◆ Modulated architecture
 - Technology neutral frequency management
- ◆ Under / Over / Cognitive / Commons
 - Reuse technologies
- ◆ Restructuring low frequency band
 - VHF/UHF
- ◆ Host base demodulation/ modulation
 - Minimize analog part ⇒ autonomous base station

Conclusion

- ◆ The innovation of wireless technology never stop.
- ◆ There is no super technology that can take over the primitive theory.
- ◆ Don't use cutting edge technologies.
- ◆ Most demands can be settled by COTS (Commercial off-the-shelf) technologies.
- ◆ Wireless and the Wire (fiber) can not replace each other. Both technology is complimentary each other.