KT
"The value networking company"

The Final Destination of Broadband, WiBro Service Plan

2005.11

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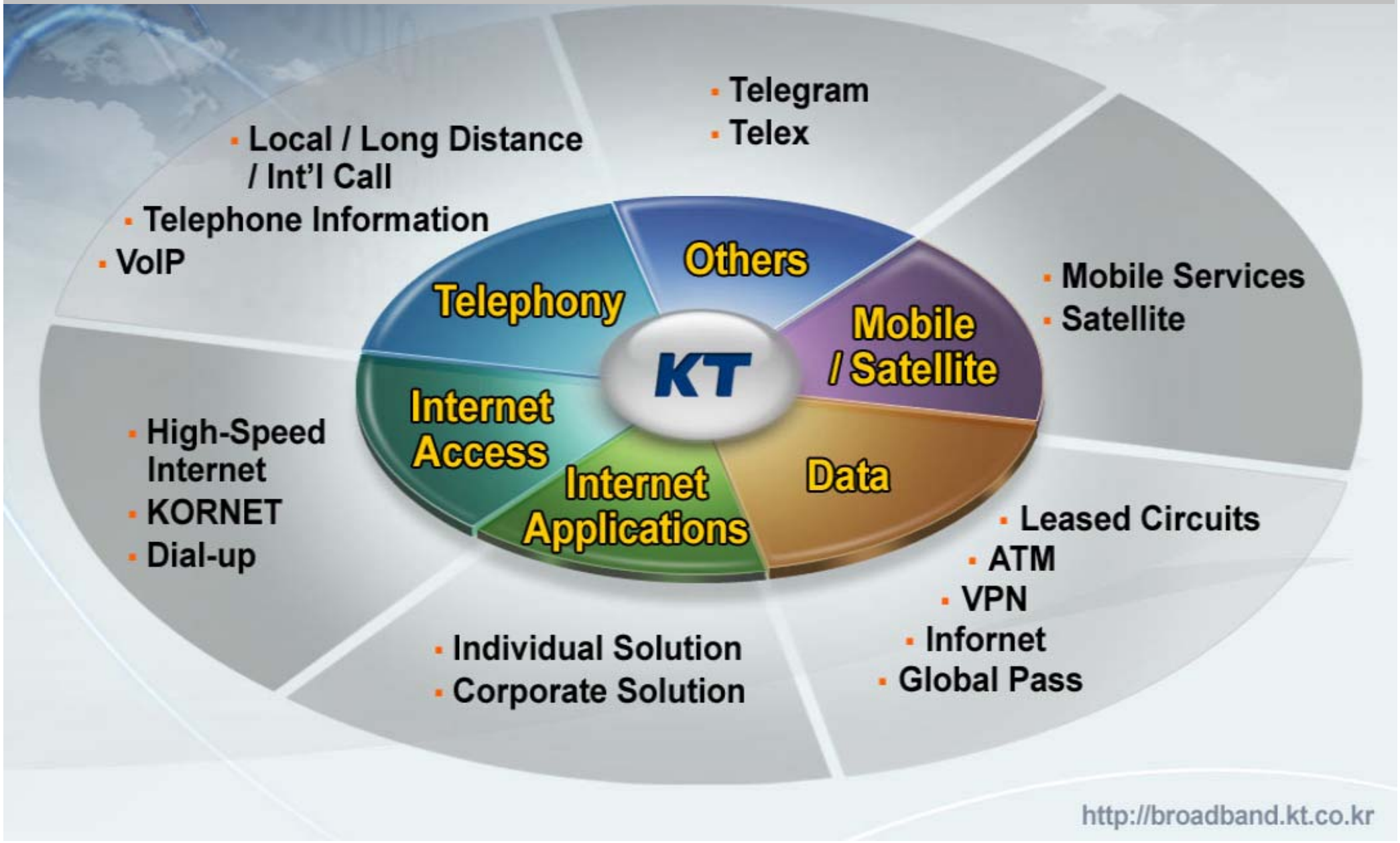
KT SI BU ITS Team

Contents

I. Brief Introduction Of KT (1/3)

– Business Domain

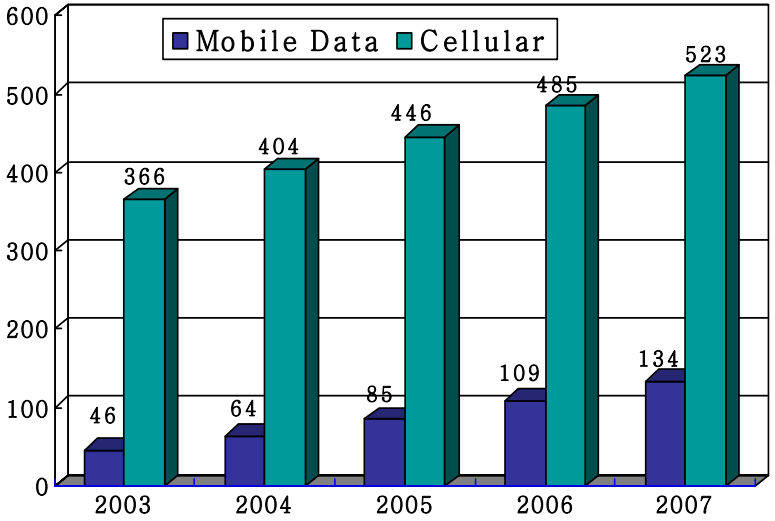


I. Brief Introduction Of KT (2/3) – Mobile Data Market Trend

Prospect of worldwide mobile data

Average 31% growth per year

Revenue (Unit: Billion, USD)

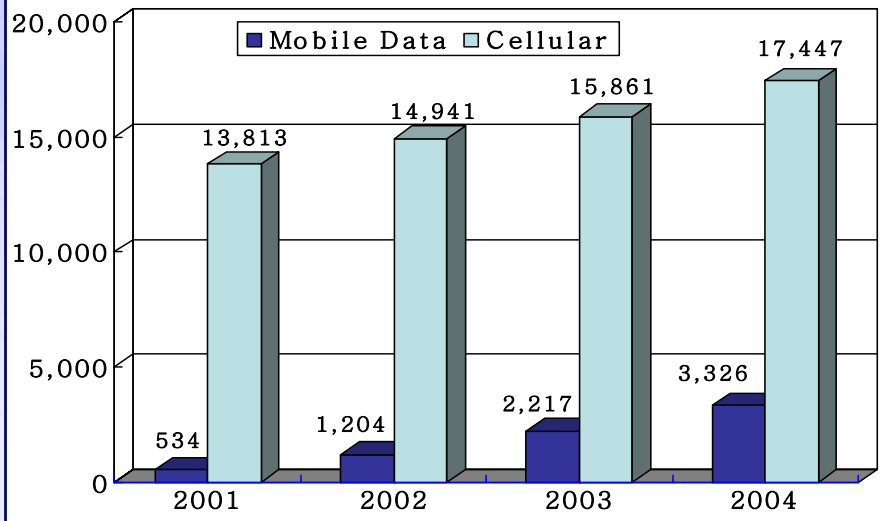


Source: IDC

Prospect of domestic mobile data

Growing-up of mobile data

Revenue (Unit: Million, USD)

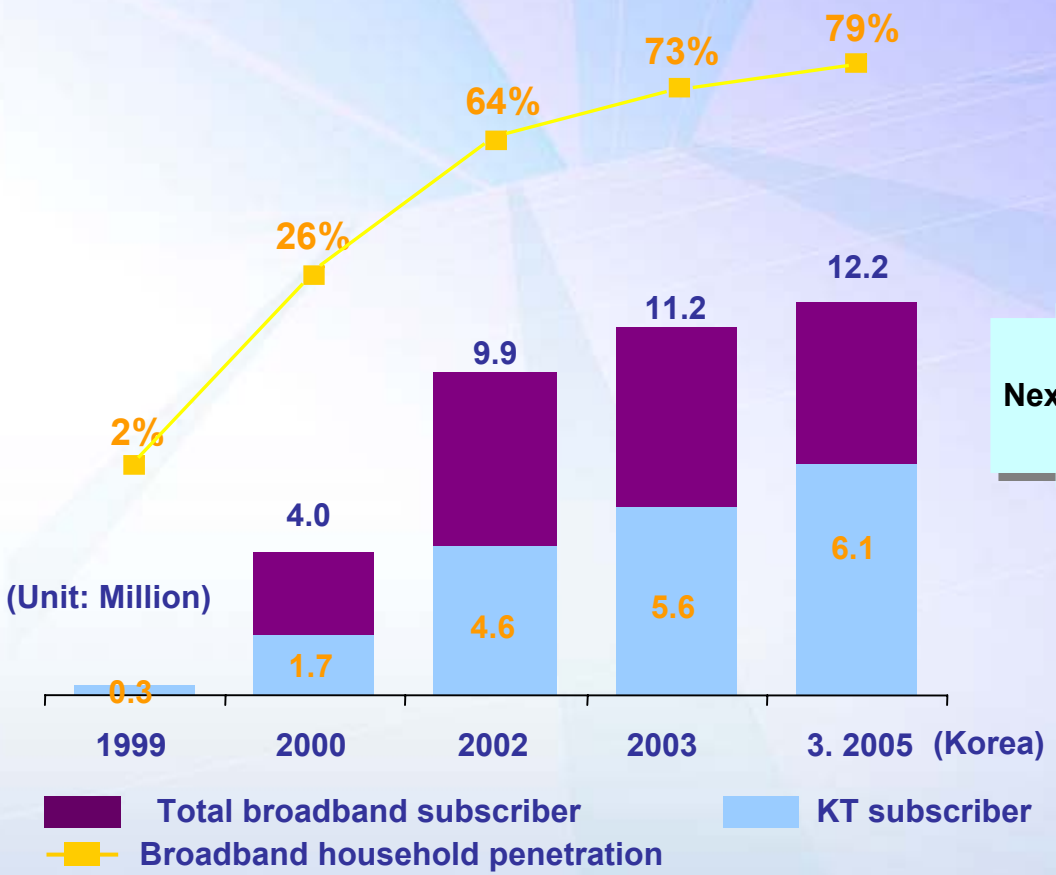


Source: KISDI

- Growth of mobile data usage worldwide
- More bandwidth per user

I. Brief Introduction Of KT (3/3) – Broadband Market Trand

Broadband market



Next

Wireless broadband market

What's the next big thing ?

Continue to grow in residential broadband and expand into wireless broadband

II. Overview Of WiBro (1/6)

– Definition

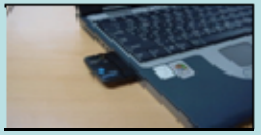
"WiBro service means high speed wireless internet service which is available anytime, anywhere using portable terminal in stationary or even in mobile environment."

☞ **WiBro: Wireless Broadband**

"Stationary or Mobile Environment"	"Any time, Any where"	"High Data Rate"	"Low Tariff"
■ Nomadic ■ Vehicular Mobility	■ Seamless Service even in outdoor such as street, park and etc.	■ 1+ Mbps User Data Rate (Day 1) ■ Higher Data Rate (Future)	■ Low CAPEX ■ Roaming with WLAN and CDMA

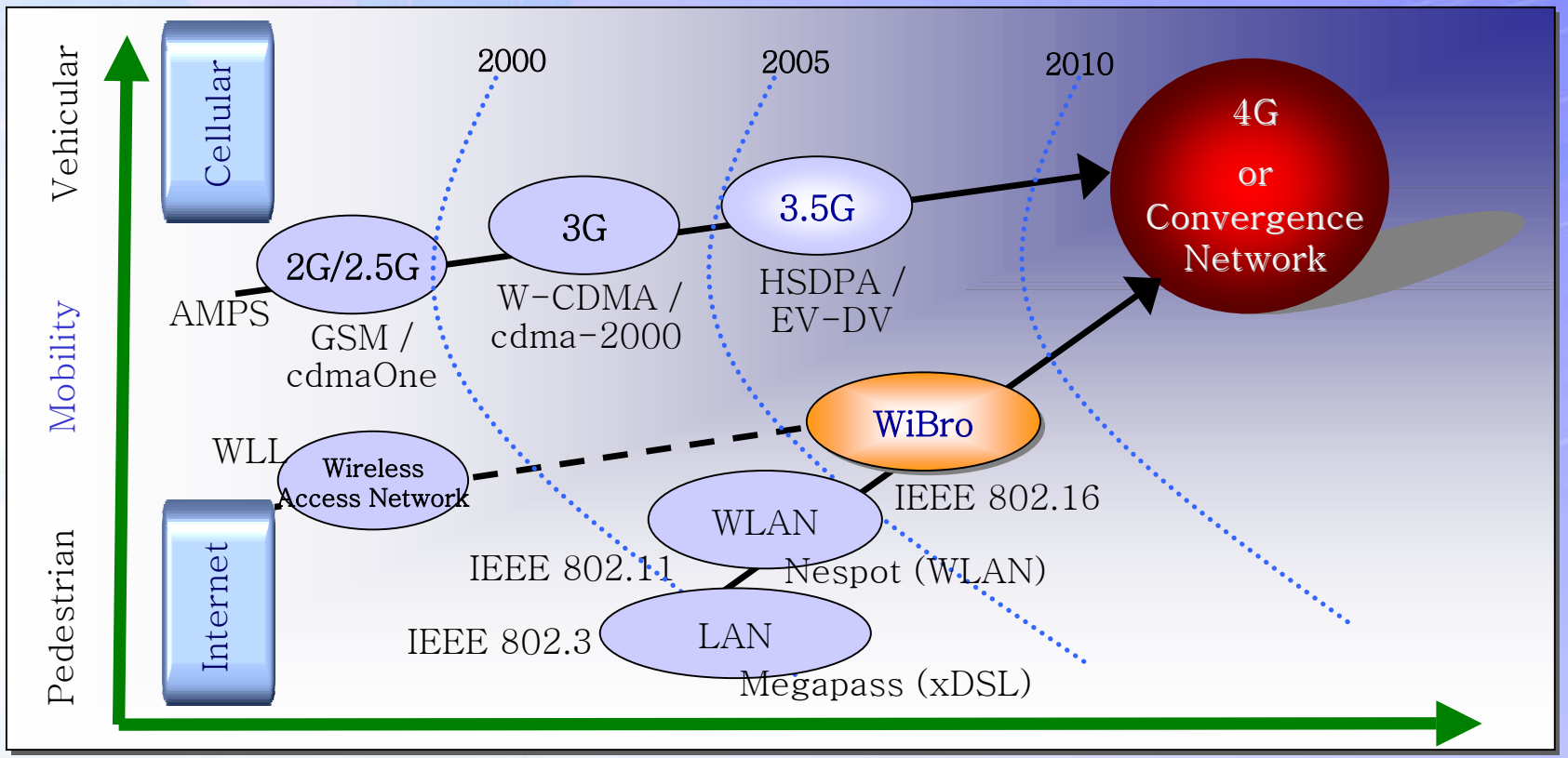




II. Overview Of WiBro (2/6)

– Evolutionary Path

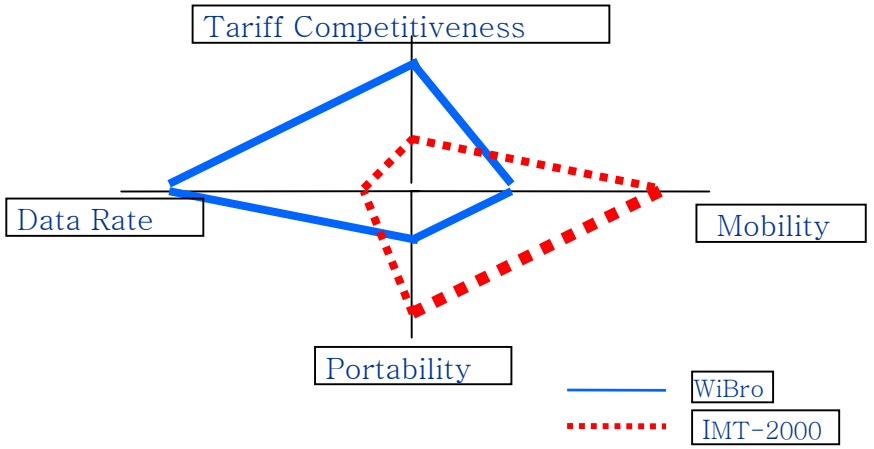


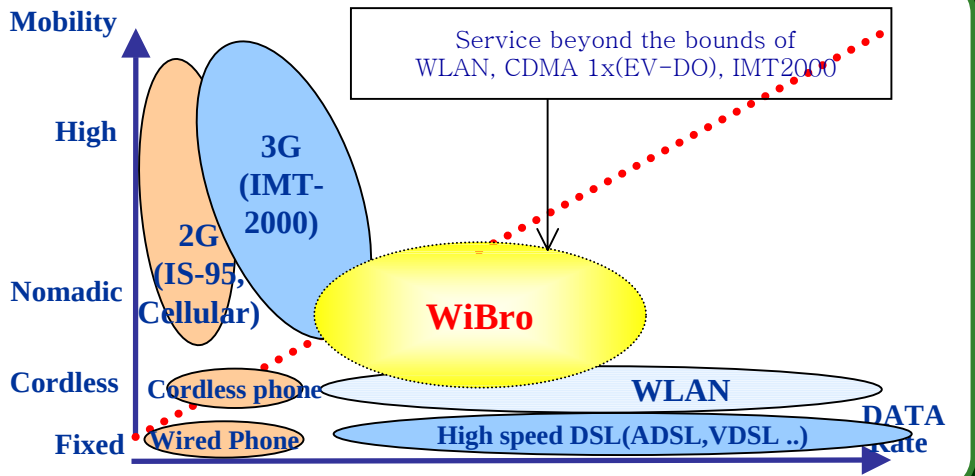
- Evolution of the Technology
  - Wired Internet: IEEE802.3(LAN) → IEEE802.11(WLAN) → IEEE802.16(WiBro)
  - Cellular Network: 1G (Analog) → 2G (Digital) → 3G (IMT-2000) → 3.5G (HSDPA)
- WiBro is a 'last mile' extension of the wired Internet.

II. Overview Of WiBro (3/6)

– Positioning

Service Positioning





Service Comparison

Item	WiBro	High Speed DSL	WLAN	Mobile Com.
Service Area	Outdoor/Indoor	Indoor	Indoor (Hotspot)	Outdoor / Indoor
Data Rate	High Speed	Ultra High Speed	Very High Speed	Med / Low speed
Mobility	High	No	Low	Very high
Contents	Wired/Wireless Contents	Wired	Wired / Wireless	Wireless
Tariff	Relatively Low	Relatively Low	Low	High
Terminal	Smart phone, PDA, Notebook etc.	Desktop, Notebook	PDA, Notebook	Cellular phone, PDA

II. Overview of WiBro (4/6)

– Performance

Item		WiBro	W-CDMA		CDMA 2000	
			R4	R5 (HSDPA)	1x EV-DO	1x EV-DO Rev.A (*)
Duplex		TDD	FDD	FDD	FDD	FDD
Multiple Access		OFDMA	CDMA	CDMA	CDMA	CDMA
Bandwidth (FA)		10MHz	5MHz x 2	5MHz x 2	1.25MHz x 2	1.25MHz x 2
Frequency		2.3~2.4GHz	UL:1.94~1.98/DL:2.13~2.17GHz		800MHz/1.8GHz	800MHz/1.8GHz
Max. Data Rate (1FA 1sector)	DL	18.432 Mbps	2 Mbps	13.976 Mbps	2.4576 Mbps	3.072 Mbps
	UL	6.144 Mbps/User	2 Mbps/User	2 Mbps/User	153.6 kbps/User	1.2288 Mbps/User
Average Throughput (1FA 1sector)	DL	5.95 Mbps	1.04 Mbps	5 Mbps	850 kbps	825 kbps
	UL	1.53 Mbps	1.21 Mbps	1.5 Mbps	266.1 kbps	465.4 kbps
Standardization		802.16-2004/Cor1, 802.16e (2005.9)	2001.3	2002.6	2000.10	2004.2
Network Deployment		yr. 2006	Seoul Area	yr. 2006	Operating	yr. 2005

(*) In Revision A, the performance of 1x EV-DO is increased to that of 1x EV-DV.

II. Overview of WiBro (5/6)

– Application Services

Mobile

Automobile Service

Office

Seamless, Ubiquitous Experience

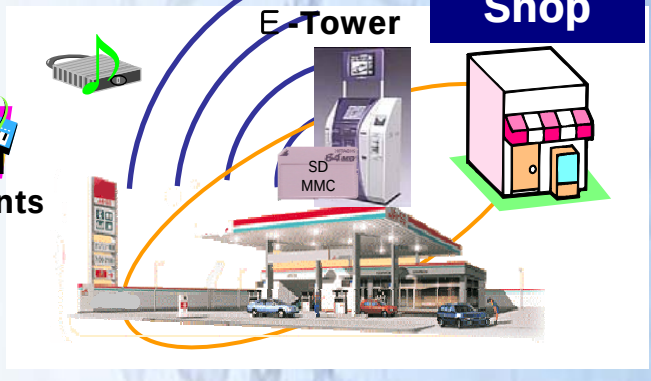
Home

Map Info

Outdoor

Digital Contents

Shop



II. Overview of WiBro (6/6)

– Service Requirement

Service Class

- Interactive Service (Best-efforts)
  - Web Browsing, Interactive Game, etc.
- Streaming Service (rtPS: Real Time Polling Service)
  - VoD, MPEG, etc.
- Background service (nrtPS: Non Real Time Polling Service)
  - FTP, E-MAIL, SMS, multicast/broadcast, MMS, Push etc.
- Real Time Service (UGS: Unsolicited Grant Service)
  - VoIP

Requirements for Service

- Provide high speed internet access for outdoor users with xDSL data rate
- Maximize the usage over the allocated spectrum
- Maximize the spectral efficiency
- Extend service coverage
- Reduce the cost per bit
- Low power consumption of MS
- Faster handoff

III. Standardization (1/6)

– TTA Standard

- **TTA has begun WiBro Standardization since June 2003.**
  - Establishment of 2 Working Groups and 2 Ad Hoc
  - WiBro Standardization Activities & Timeline is as follows.
  - ☞ TTA : Telecommunications Technology Association in Korea

Phase I Standardization for WiBro has been completed.

3Q 2003	**Definition of Service/System Requirements**
4Q 2003	**Preparation of the Draft Standard** - Definition of major system parameters - Definition of items/criteria/conditions for Evaluation - Collection and Evaluation of Baseline Proposals - Selection of Baseline Proposals
1Q 2004	**Completion of Draft Standard**
2Q 2004	**Approval and Notification of Standard**

Phase II Standardization for advanced WiBro is in progress.

3Q 2004 ~2Q 2005	**Harmonization with IEEE 802.16e** **Approval and Notification of New Standard including performance enhanced technologies such as MIMO, smart antenna etc.**

III. Standardization (2/6)

– TTA Standard

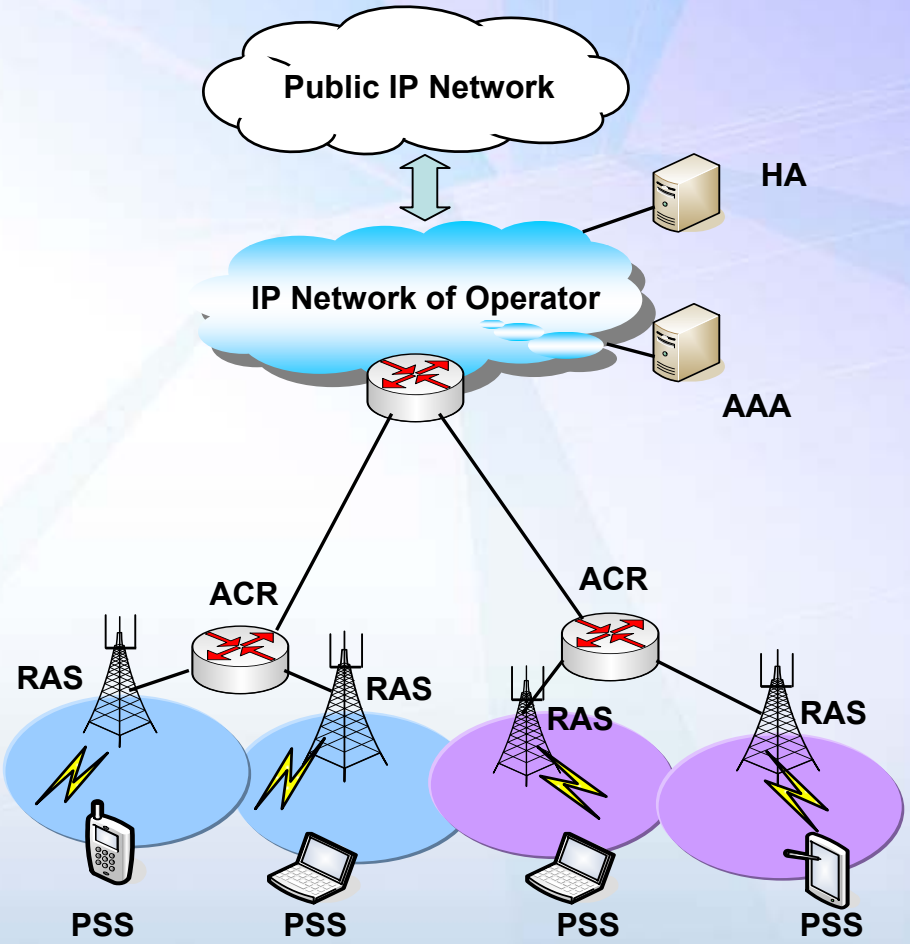
Major System Requirement	
Duplexing	TDD
Multiple Access	OFDMA
Channel BW	10 [MHz]

Radio Access Requirement	
Frequency Reuse Factor	**1**
Mobility	**≤ 60 [Km/h]**
Service Coverage	**≤ 1 [Km]**
Spectral Efficiency [bps/Hz/cell(sector)]	**Max. DL / UL = 6 / 2** **Aver. DL / UL = 2 / 1**
Handoff	**≤ 150 [ms]**
Throughput (per user)	**Max. DL / UL = 3 / 1 [Mbps]** **Min. DL / UL = 512 / 128 [Kbps]**

III. Standardization (3/6)

– TTA Standard

Reference Model



■ **PSS (Portable Subscriber Station)**
- Wireless access
- IP mobility, Terminal/User authentication
- Multicast service, Other network interworking

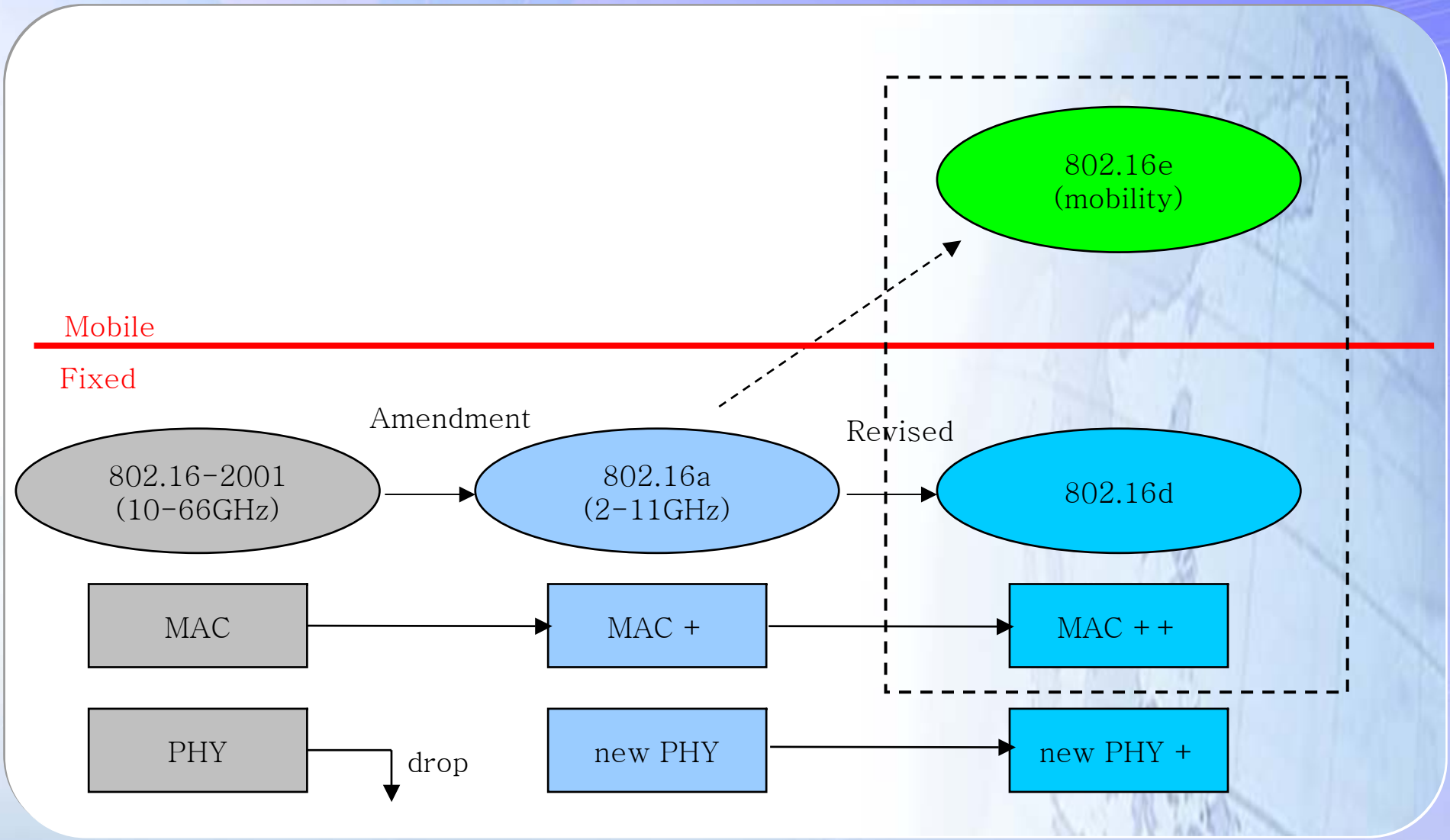
■ **RAS (Radio Access Station)**
- Wireless Access
- Radio resource management/Control
- Handoff support
- QoS support, Downlink Multicast

■ **ACR (Access Control Router)**
- IP routing and Mobility management
- Authentication/Security
- QoS, IP Multicast, Billing support
- Handoff control between RASs

■ **Core Network**
- Authentication, Billing
- IP Mobility support
- Other network interworking

III. Standardization (4/6)

- IEEE 802.16 Evolution



III. Standardization (5/6)

– IEEE 802.16 Evolution

IEEE 802.16d

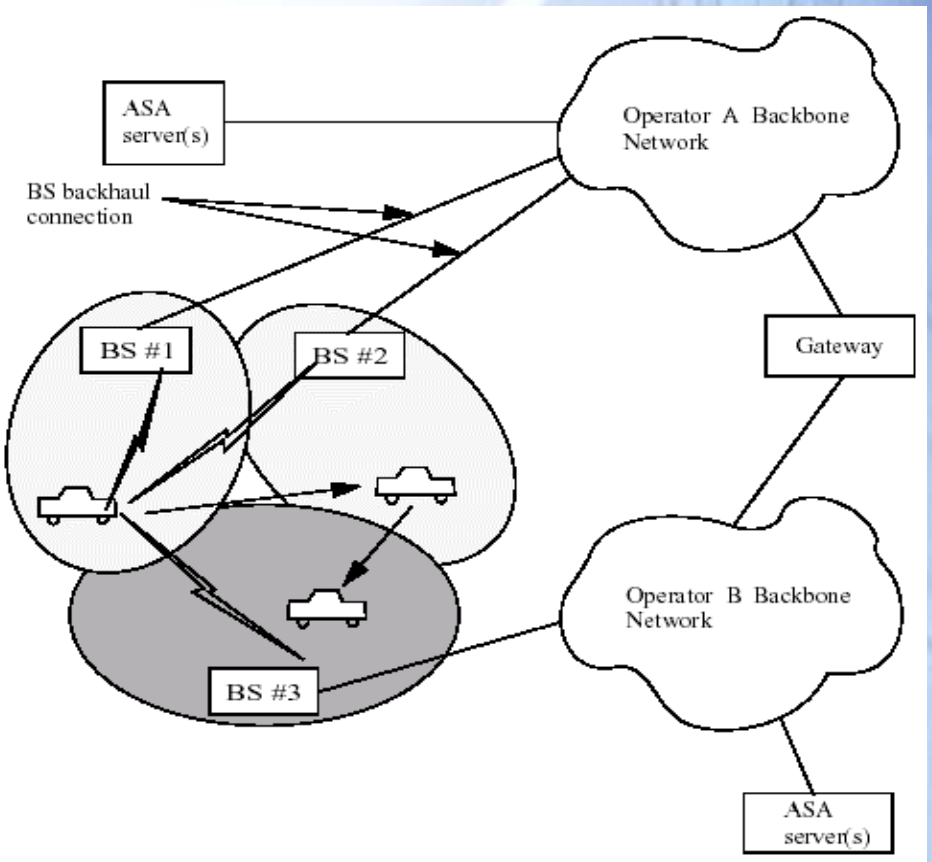
- Revision to 802.16, 802.16a, 802.16c
- Licensed bands, 2~11GHz
- Non line of sight (Practical)
- Lower component cost
  - Good for residential and small-business
- 30Mbps in 10MHz BW

IEEE 802.16e

- Amendment to 802.16a/c/d
- Licensed bands, 2~6GHz
- Non line of sight
- Support vehicular mobility
- Main concern on handoff and sleeping mode

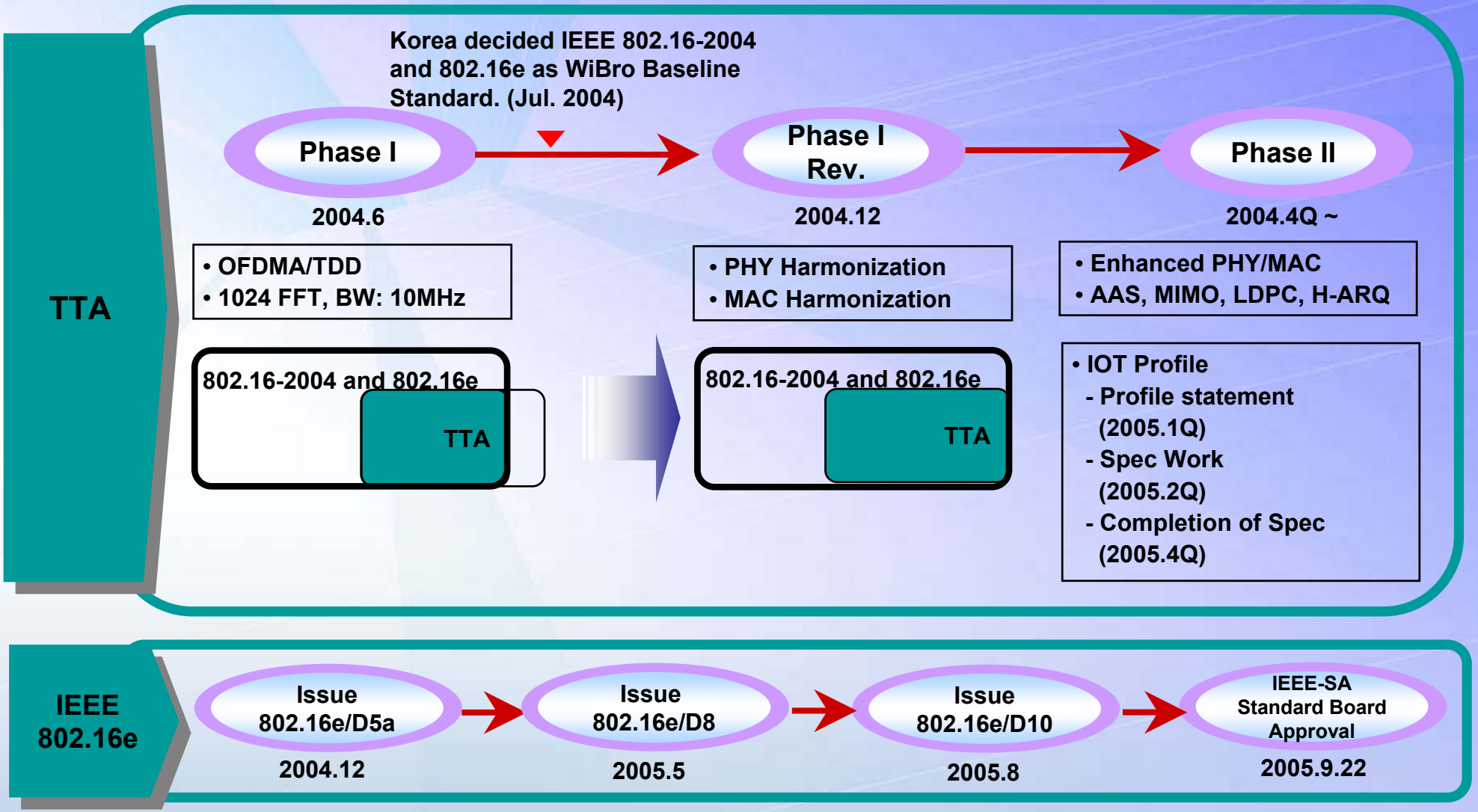
IEEE 802.16-2004/Cor1 and 802.16e are scheduled to approve Sep. 22. 2005.

IEEE 802.16e Network Model



III. Standardization (6/6)

– Harmonization

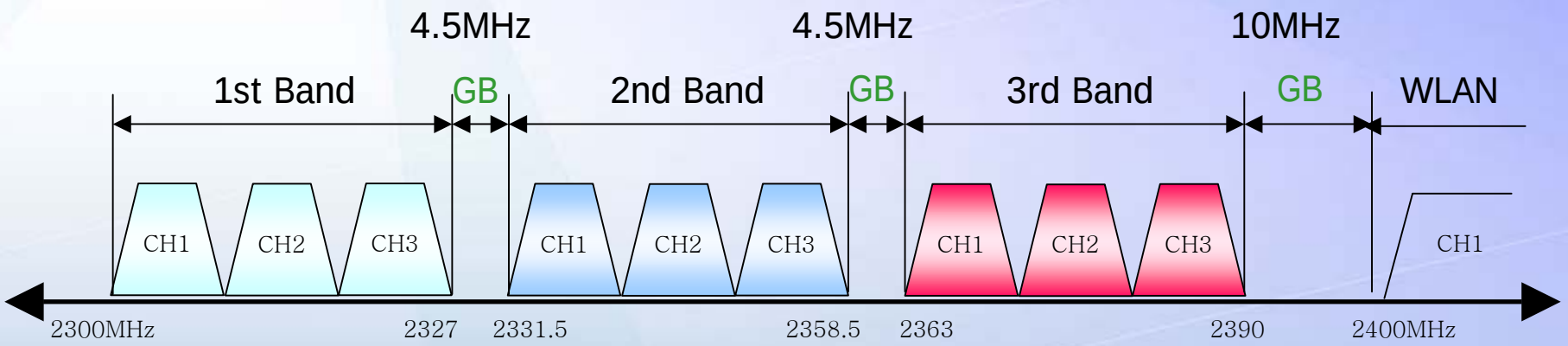


IV. WiBro Technology (1/6)

– Requirements & Spectrum

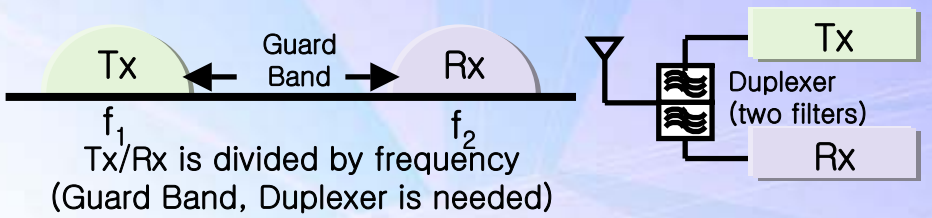
- **WiBro system should satisfy IEEE 802.16-2004, IEEE 802.16e D3 above standard and 5 performance criteria**
  - Min data rate under 60km/h condition in cell edge: 512kbps (DL), 128kbps (UL)
  - Bandwidth: above 9MHz
  - Roaming between WiBro operators
  - Frequency reuse factor: 1
  - Duplex: TDD including Tx/Rx time slot synchronization between WiBro operators

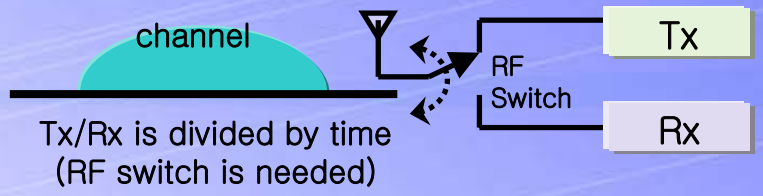
- **Spectrum allocation for WiBro service**



IV. WiBro Technology (2/6)

– TDD/OFDM in detail



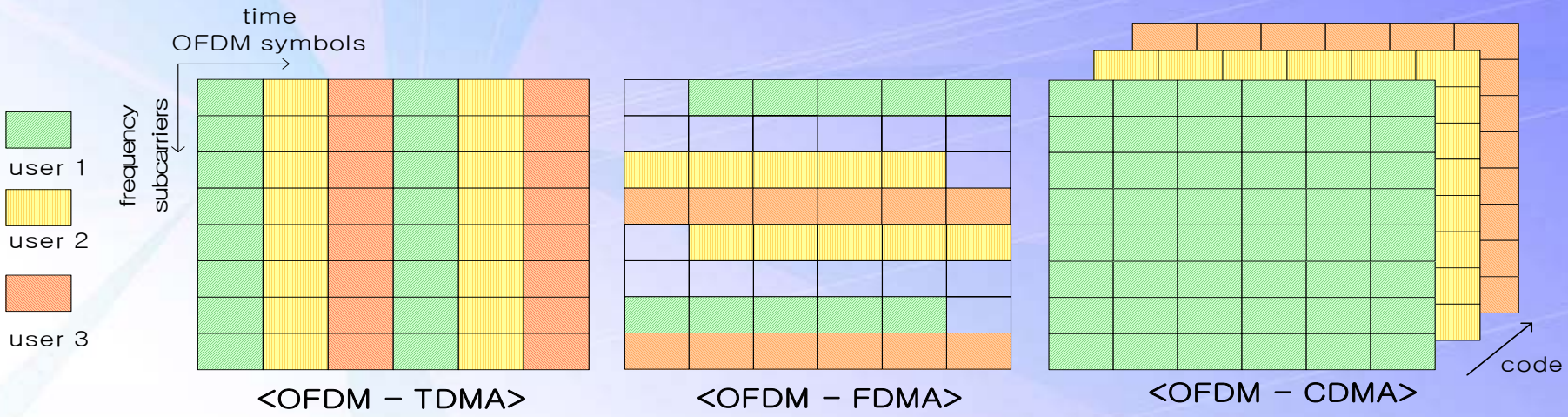


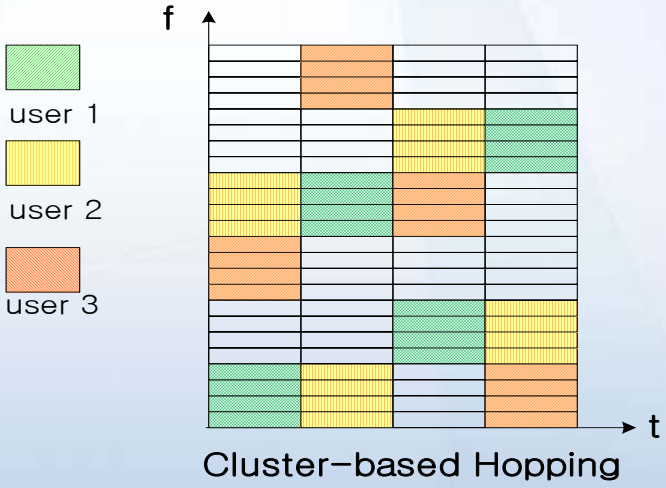
Item	FDD	TDD
Guard Band	Min 20~30MHz is needed	Not Required
Symbol Rate	R_s	2 R_s
Power Amplifier	-	Max 3dB additional power is needed for the same coverage as FDD system
Composition of channel	Paired band	Non paired band
Tx/Rx timing	Not Required	Tx/Rx timing synchronization Inter-cell synchronization should be required for the prevention of TDD inherent interference
Cell radius	Tx power Macro cell available	Tx power + Guard Time + PA ramp-up Micro cell and Pico cell
Channel reciprocity	Low	High

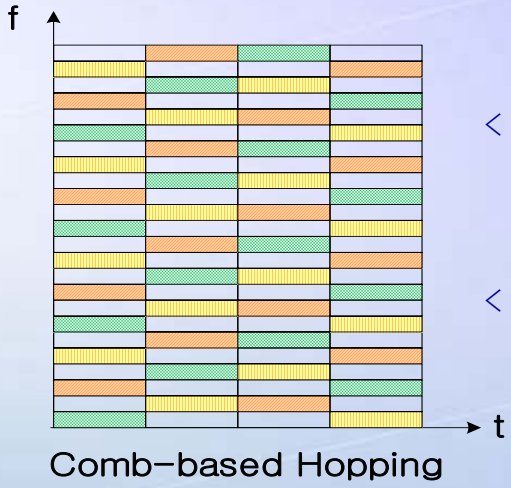
IV. WiBro Technology (3/6)

– TDD/OFDM in detail

- OFDM-TDMA/FDMA/CDMA, Frequency hopping OFDMA







< Pros >

- Frequency Diversity Gain
- Inter-cell Interference Reduction

< Cons >

- Difficulty in finding good hopping pattern for channel condition

IV. WiBro Technology (4/6)

– Key Features

- RF Frequency: 2.3GHz
- Multiple Access/Duplexing: OFDMA/TDD
- Frame length: 5 msec
- Bandwidth: scalable from 1.25MHz to 20MHz
- Flexible subchannelization for band selection and diversity
- Fast AMC (Adaptive Modulation and Coding) subchannel based on uplink CQI (Channel Quality Indicator)
- Full diversity subchannel by multiple symbol grouping
- Cell differentiation with different PN sequences
- Pilot tone based downlink and uplink
- Separate ranging channel time slot
- More efficient channel code: convolutional (or block) turbo code
- H-ARQ in the downlink and uplink
- Modulation level: QPSK, 16QAM, 64QAM
- Optional AAS (Adaptive Antenna System) support

IV. WiBro Technology (5/6)

– System Parameters

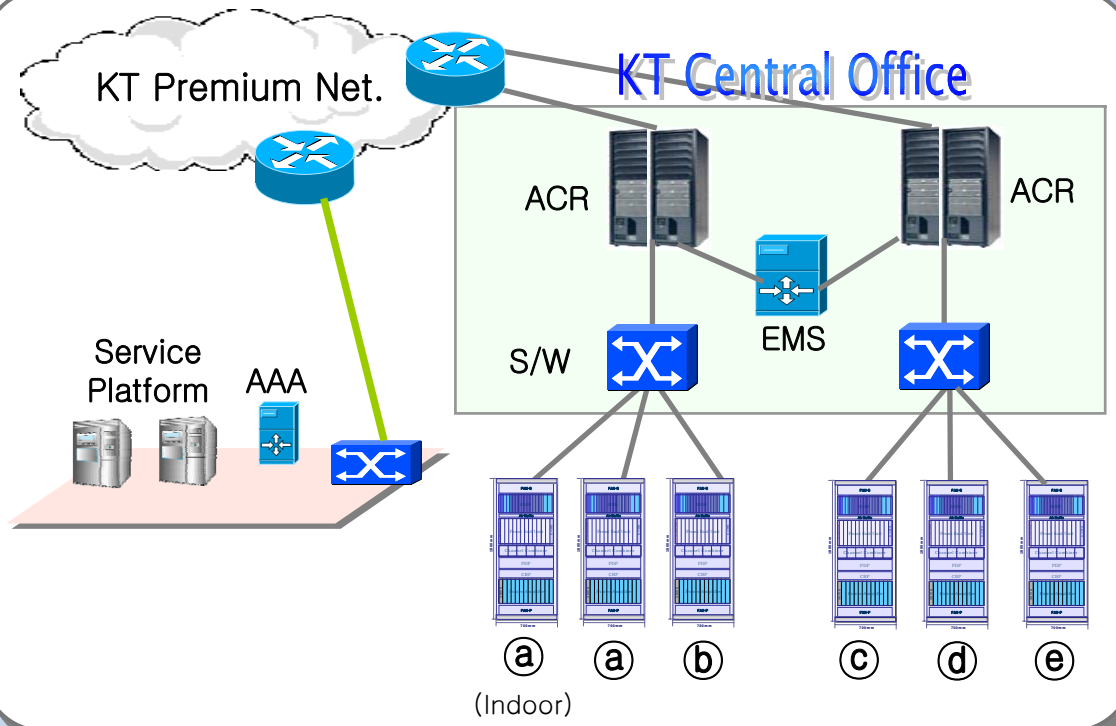
Parameter	Value
Channel spacing	9 MHz
Effective bandwidth	8.75 MHz
Number of used tones	864 out of 1,024
Number of data tones	768
Number of pilot tones	96
Tone spacing	9.765625 kHz
Ratio of cyclic prefix time to basic OFDM symbol time	1/8
Basic OFDMA symbol time	102.4 μs
Cyclic prefix time	12.8 μs
OFDMA symbol time	115.2 μs
TDD frame length	5 ms
Number of symbols in a frame	42
TTG+RTG	161.6 μs

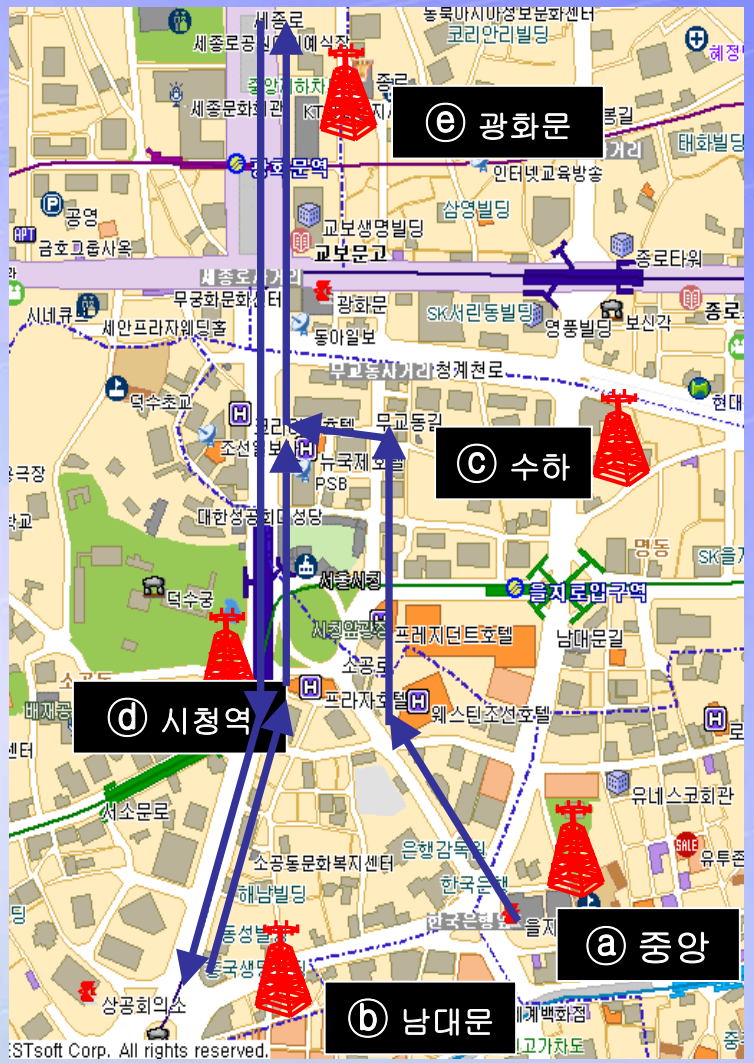
IV. WiBro Technology (6/6)

– KT WiBro Testbed

❒ **WiBro Testbed**

- **RAS: ⓐCentral(중앙), ⓑNam-Dae-Moon(남대문)**
  ⓒSu-Ha(수하), ⓓCity-Hall Station(시청역)
  ⓔGwang-Wha-Moon(광화문)
- **ACR: ⓐ Central(중앙)**

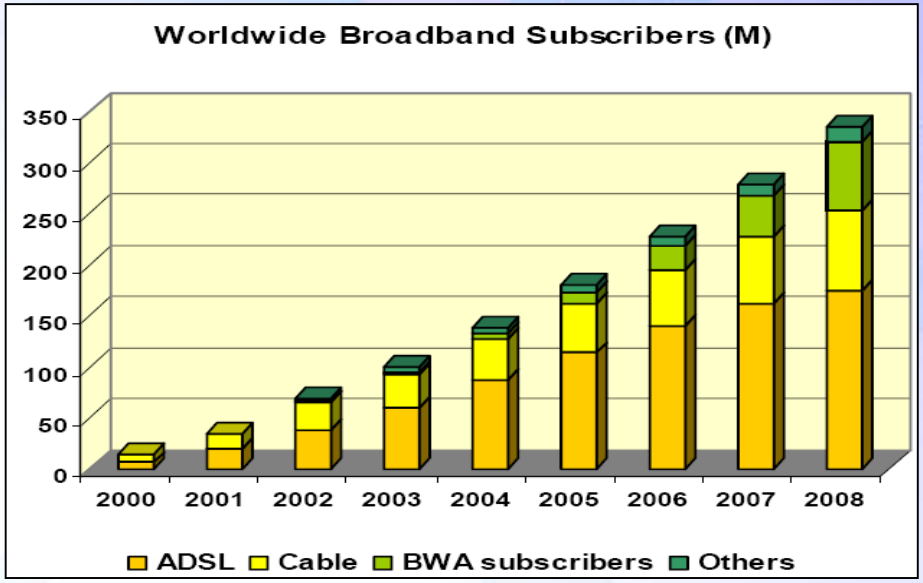




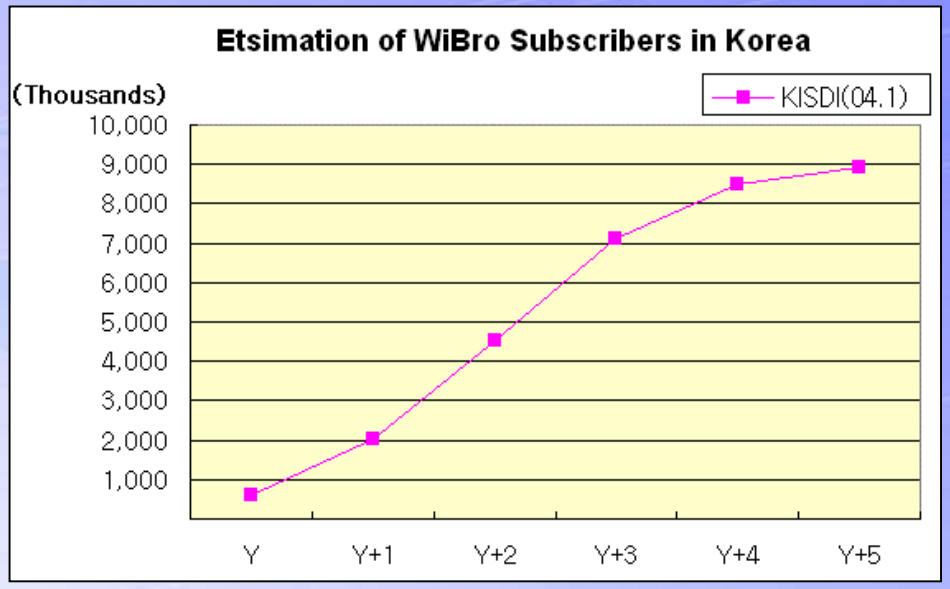
<Downtown Seoul>

V. Business Plan (1/10)

– Market Estimation



• source: Maravedis (2004)



• source: Korea Information Strategy Development Institute (2004)

- **Wireless broadband market will keep growing**
  - ❖ **Domestic: In 2011, about 9 million users (KISDI)**
  - ❖ **Overseas: In 2008, mobile broadband market will be the 40% of broadband market**

V. Business Plan (2/10)

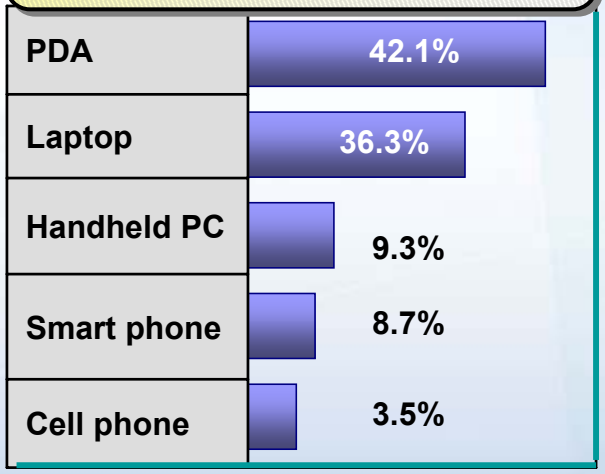
– Market Analysis

User's needs

- Potential target users: Young generation (age 10-40), business professionals, students, etc.
- Internet usage pattern: Web surfing & download (40%), email (20%), game (17%), etc.
- Preferred services: email > game > web surfing > messenger
- Preferred user devices: PDA (42%), laptop (36%), and other devices (<10%).

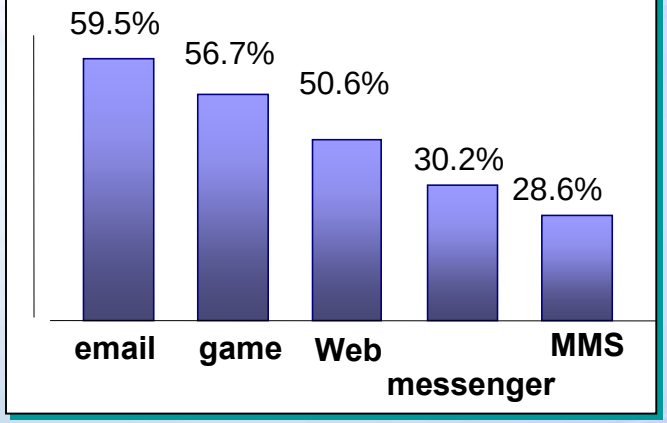
Preferred device →

PDA, laptop



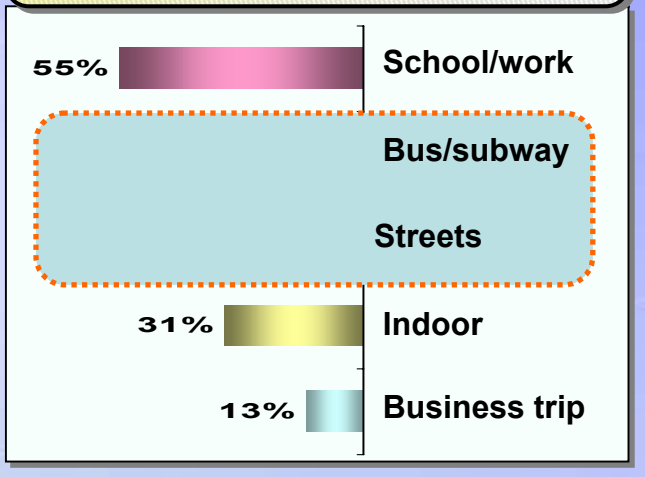
Preferred service →

email > game …



Preferred location →

On move

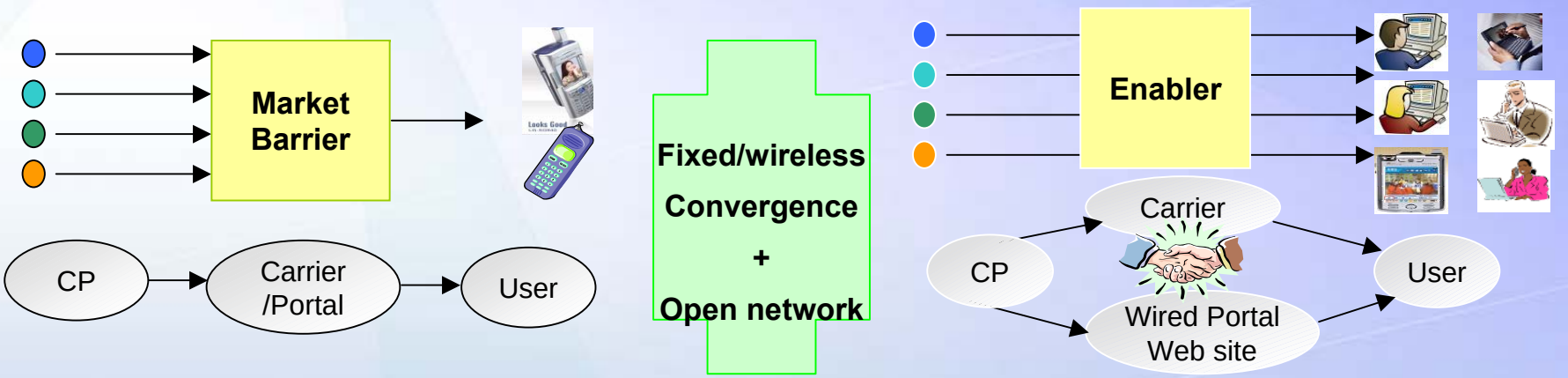


V. Business Plan (3/10)

– Business Model

BM strategy

- **Creating a strong value-chain with an open IP transport architecture.**
  - **Creating synergy with the conventional services by optimizing the service positioning (Win-Win)**
- **Aside from the individual users, create business models for enterprises and public sectors.**
  - **Networking of the individual, enterprise, and public sector will create synergy.**



Current mobile Internet service architecture

Future high-speed mobile Internet service architecture

V. Business Plan (4/10)

– Service Model

Develop killer application model for multimedia/convergence
- **Emphasizing the strong points for high speed internet**
- **Combining with existing service to expand customer's feasibility and maximize revenue generation**

Existing Service		WiBro Killer App.	
Fixed Service	▪ **Information**: Information search, e-mail, etc. ▪ **Entertainment**: Movie VOD, etc. ▪ **Other usage**: e-Stock, e-Banking, e-Learning	Core Service	• **MMS (Multimedia Messaging Service)** • **Push-type service** - Group video chat, Ad & coupon service • **Game**: IP based various network games • **LBS** (Location Based Service) • **IP Multicasting service** - High-Quality VOD, broadcasting, movie
Wireless Service	▪ **Short Message Service** (SMS) ▪ **Entertainment**: VOD, games ▪ **m-Commerce**: e-Banking, etc.	Combination Service	• **WiFi combined service** • **CDMA combined service** • **DMB combined service**

Evolution
- Multimedia
- Fixed/wireless convergence

- Application of core technology of KT's existing infrastructure
- Fixed (demand mobility) + Wireless (demand broadband)
  → Combined Service

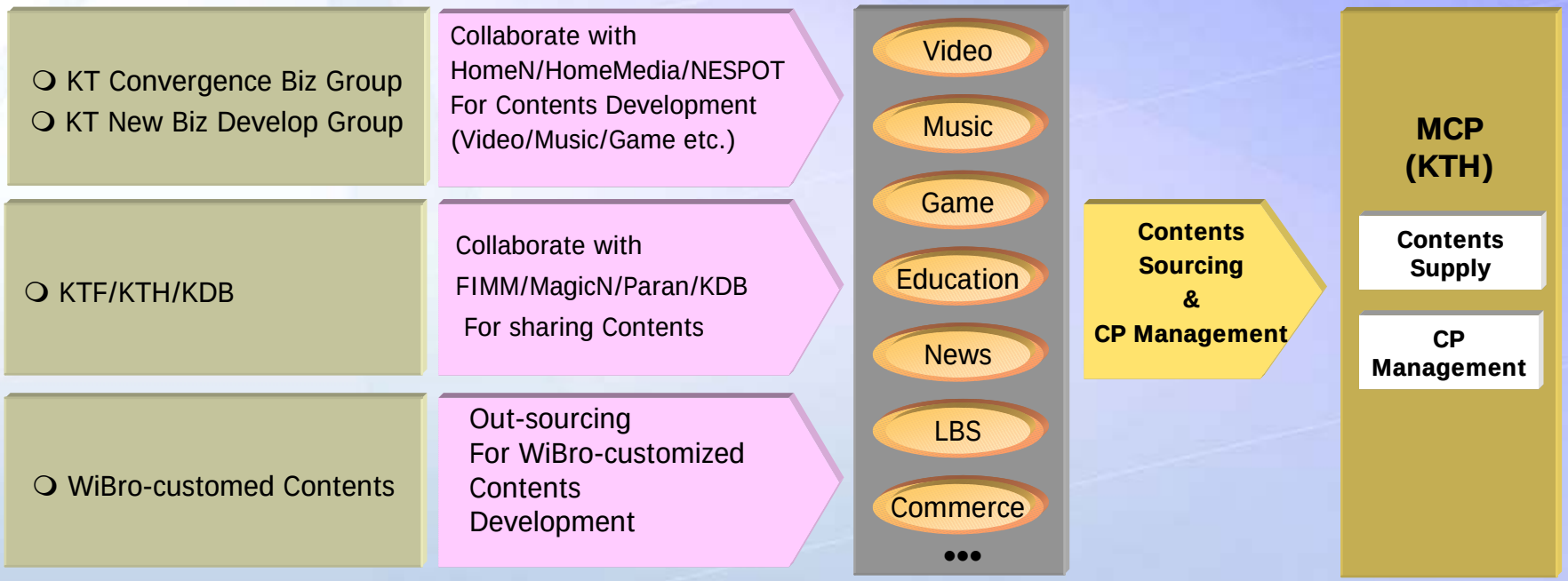
- Existing fixed/wireless contents + various internet services
  → Multimedia, 3D, upgrade by solution-combined production

V. Business Plan (5/10)

– Contents Development

Contents Development and Management Strategy

- **Utilize KT's conventional portal services to develop Multi-Purpose Portals**
- **Utilize KT Group's contents: KTF(Fimm / MagicN), KTH(Paran), KDB**
- **Utilize KTH's MCP: Strengthen CP Relations**
- **Develop CP Management System: CP Selection, Support, Evaluation**

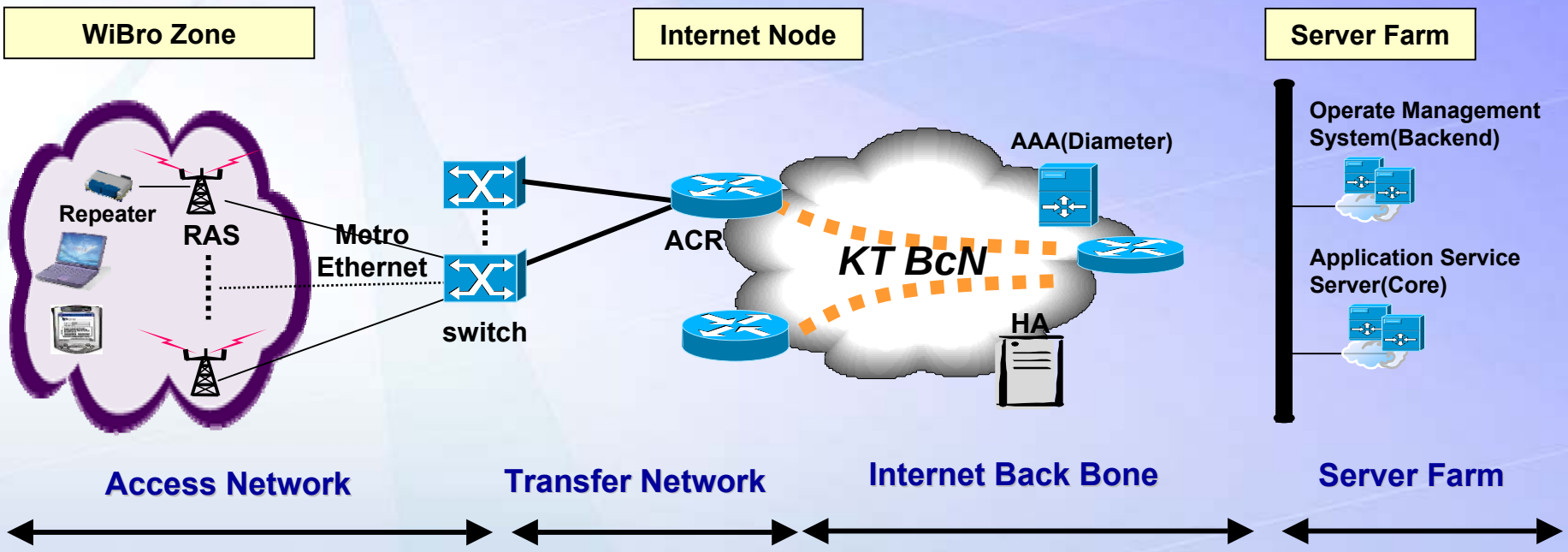


V. Business Plan (6/10)

– Network Planning

❖ Utilize KT's state of art premium back bone and optical access network
❖ Low cost and efficient network

WiBro Network Architecture



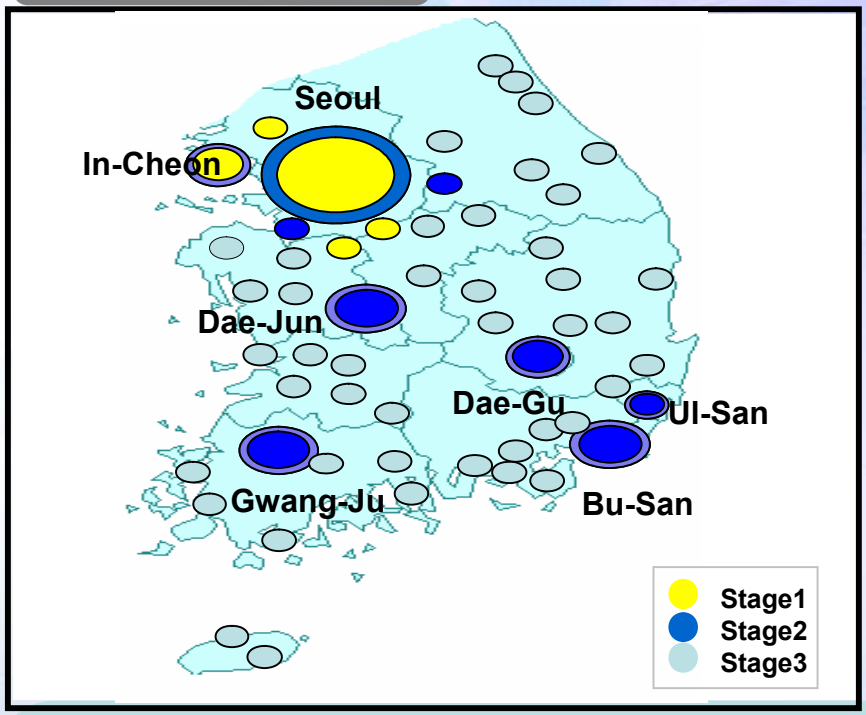
※ RAS: Radio Access Station, ACR: Access Control Router, BcN: Broadband Convergence Network,
HA: Home Agent

V. Business Plan (7/10)

– Network Deployment

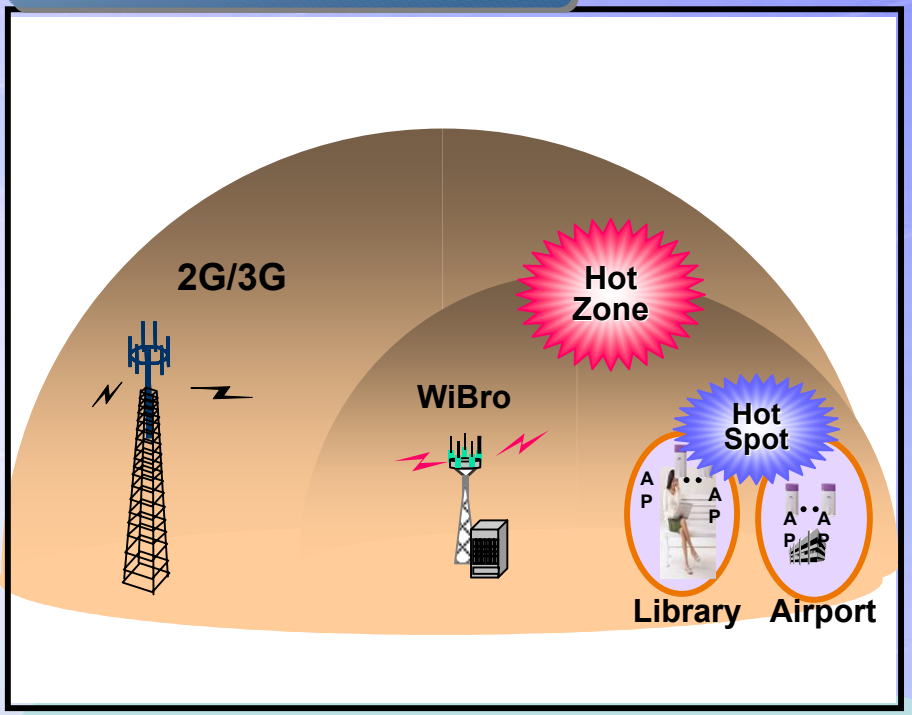
- **February 2006, KT WiBro Service starts in Seoul.**

Network Deployment



- Stage1 : Seoul, metropolitan (10)
- Stage2 : Metro, major cities (20)
- Stage3 : Minor cities (54)

Wireless Network Integration



- 2G/3G: Voice-oriented, wide-area, narrow-band
- WiBro: Urban cities
- WiFi: Hot-Spot

V. Business Plan (8/10)

– WiBro Systems

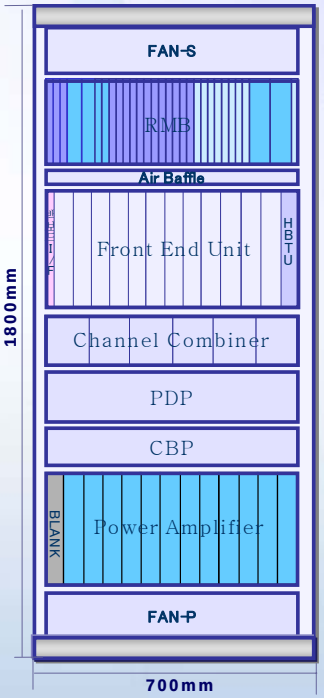
Production Schedule

	RAS (Base Station)	PSS (Mobile Station)
Vendor	Samsung, LG, POSDATA	Samsung, POSDATA, Orthotron, RunCom
Schedule	End of 2005	End of 2005 ~2006

☞ **2005.11 Busan APEC : City-wide WiBro Demonstration**

Mini-RAS

Standard RAS



V. Business Plan (9/10)

– User Equipments

Terminal roadmap

DBDM

- ✓ WiBro + Wi-FI
- ✓ WiBro + CDMA
- ✓ WiBro + DMB

WiBro only

- ✓PCMCIA's
- ✓Embeded modem's
- ✓PDA's

TBTM

- ✓ WiBro + Wi-FI + DMB
- ✓ WiBro + CDMA + DMB

Customized one chip

- ✓ Personal/business
- ✓ Convergence
- ✓ Application specific

Early stage → Growing stage → Matured stage

V. Business Plan (10/10)

– APEC Demo

- WiBro demonstration during Busan APEC Summit
  - ❖Date: 2005. 11.12~20
  - ❖Guest: APEC participants (15,000 VIPs: Political leaders, CEOs, Press, etc.)
  - ❖Service Area: Bexco convention center, Dong-bak Island, Hae-Woon-Dae Hotel
  - ❖Demo Services
    - ✓High-speed Wireless Internet Access, World News, APEC News
    - ✓Real-time Mobile Multimedia, Messaging, Chatting and Internet Broadcast

<Deployed Systems>

Item		Quantity*
System	ACR	2
	RAS	10
	Repeater	9
	EMS	1
User Terminal	PDA	200
	Tablet PC	100
	Laptop	100
	PCMCIA	600

* Subject to change

VI. Emerging Technology in ITS(1/3)

– Current ITS Communication Technologies in Korea

In order to communicate probe data or information between Bus and Traffic Management Center, Wireless & Mobile Technology must be applied.

Fixed Line
- PSTN Modem, ADSL
- Coaxial cable
- Optical Fiber Cable

Wireless
- RF Beacon [Unlicensed Radio, UHF Band, 4800 bps]
- Wireless Data Network [Band Width 2Mhz, 9600 bps]
- DSRC (Dedicated Short Range Communications)
- Wireless LAN
- WiBro (Wireless Broadband) : Coming on Febuary 2006

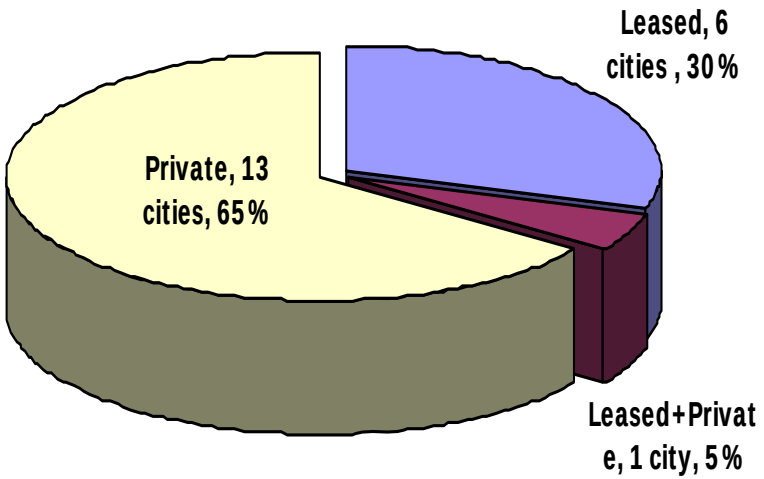
Mobile
- TRS (Trunked Radio System) : Not Applied yet
- CDMA
- HSDPA (High Speed Downlink Packet Access) : Coming on April 2006

VI. Emerging Technology in ITS(2/3)

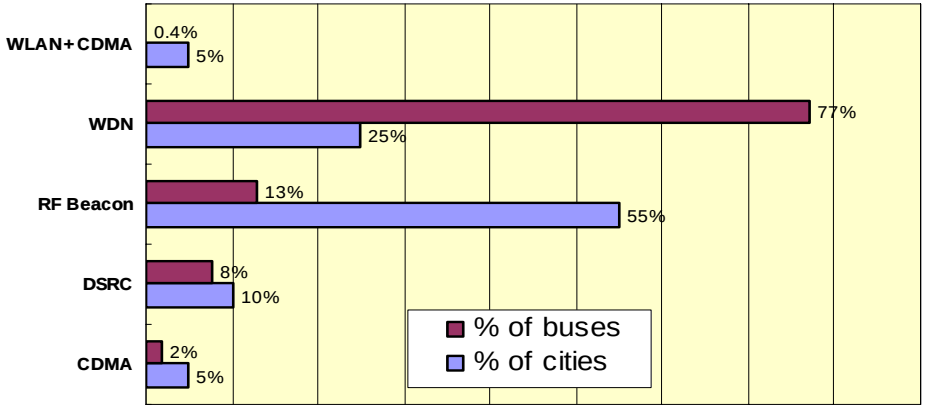
– Current Status in Korea

- **Wireless Communication Technologies Applied to BIS/BMS**
  - **Leasing wireless network costs more than building a private wireless network in long term. There fore many cities prefer building a private wireless network in BIS/BMS**
  - **Most of leased networks are wireless data network since it cost less to build other type of wireless network**

The Operation Type of Wireless Network in Korea



The Ratio of Wireless Technologies applied to ATPS(BIS/BMS)



Type of Wireless	No. of cities	No. of buses
CDMA	1	231
DSRC	2	967
RF Beacon	11	1,614
Wireless Data Network	5	9,716
WLAN+CDMA	1	50
Total	20	12,578

VI. Emerging Technology in ITS(3/3)

– *Future Basics* of Wireless Communication Technology in BIS/BMS

- **Major Requests from local autonomous entities for BIS/BMS in Korea**
  - **Service Coverage : Limited area → Wide area (nation-wide) & All area**
  - **2-way Communication (download, upload)**
  - **Data Rate : Limited data Speed (under 10 Kbps) → High Speed (over 1 Mbps)**
  - **Real Time Response : Minimize Time Lag & Time Delay**
  - **Ensuring stability in BIS/BMS Services**
  - **Low Costs of Construction & Operating BMS/BIS**
  - **Availability for additional ITS Service (ATIS, etc) & Other Personal Service (Telematics, etc)**

Expected Outcome from WiBro

- **portability & mobility**
- **nation-wide coverage**
- **high speed**
- **inter-activity**
- **price competitiveness**

Thank you !


Worldwide Scale Economy
Investment
WiBro
WiMAX
Technology
Manufacturing & operating
Extensive network & terminal expertise
Policy
Partnership
Relaxed regulation
Mutual cooperative partnership