SK Telecom's Technology Evolution

SKT 2nd Analyst Seminar

September 2003

SK Telecom

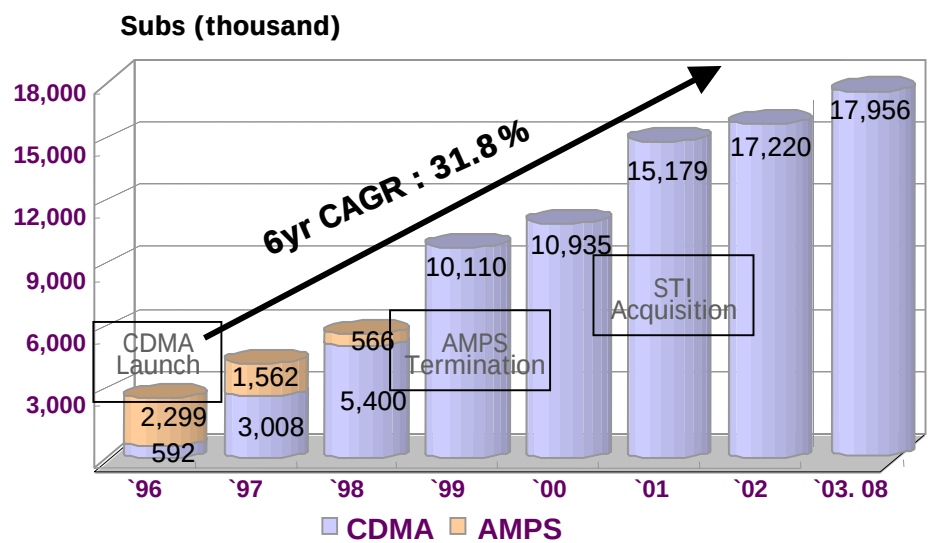
- **SK Telecom Overview**
- New Technologies and Services
  - Technology Roadmap
  - Cellular Network
  - Wireless Data & Broadcasting Network
    - Wireless LAN
    - High-speed Portable Internet
    - Satellite Digital Multimedia Broadcasting
  - Network Evolution
    - Beyond 3G
    - Broadband convergence Network
  - Advanced System Technologies
    - Software Defined Radio
    - Capacity Enhancement Technology
  - New Business Applications
- Conclusion

Pioneering CDMA Leader

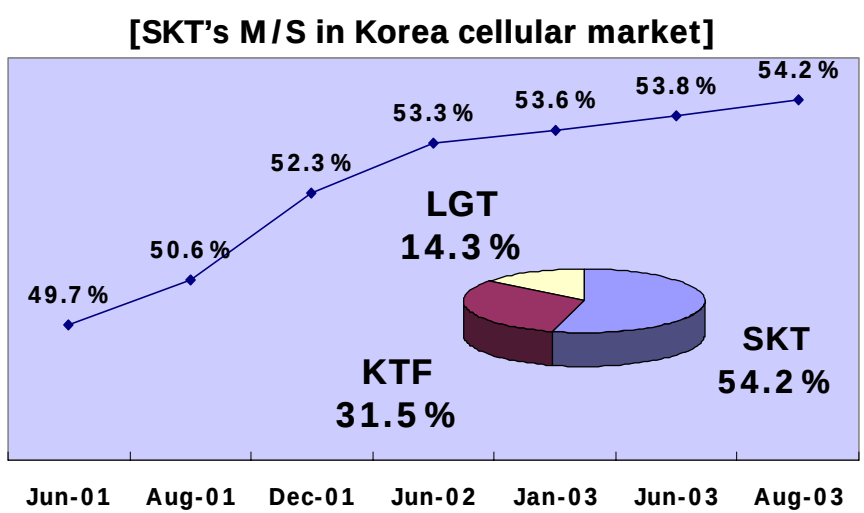
Pioneering History

Mar 1984	Established
Jan 1996	Commercial CDMA cellular service launched
Oct 1999	Handset based wireless Internet service (n.Top) launched
Oct 2000	Commercial CDMA2000 1X service launched
Dec 2000	3G (W-CDMA) license acquired
Oct 2001	Integrated multi-access Internet portal (NATE) launched
Jan 2002	World's first CDMA 1xEV-DO service launched

Rapid Subscriber Growth



Strong Market Leadership



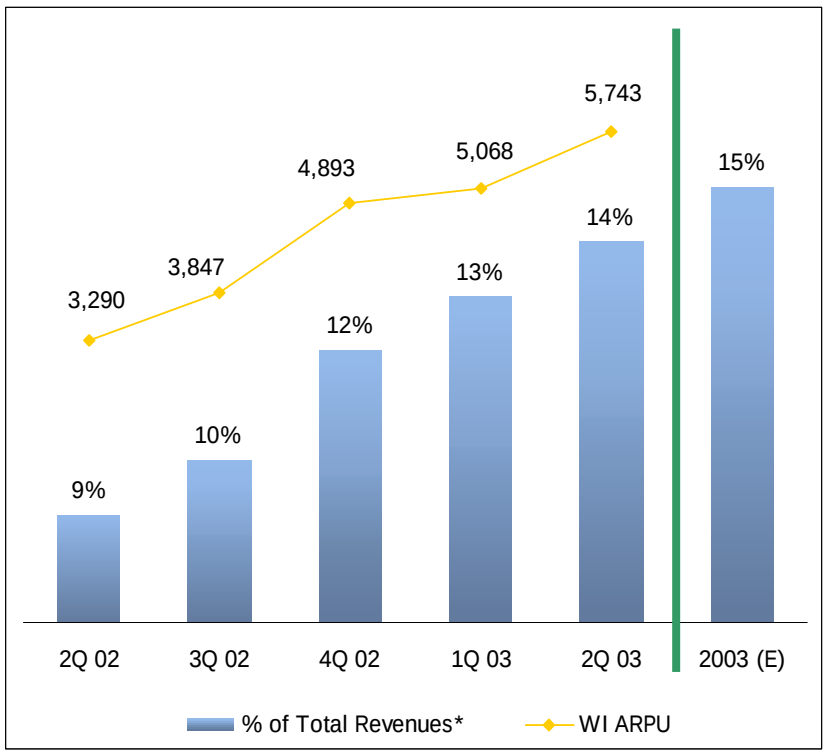
SK Telecom

Market Growth

Increasing usage of data services and products has been boosting our ARPU.

Data ARPU & % of Total Revenues*

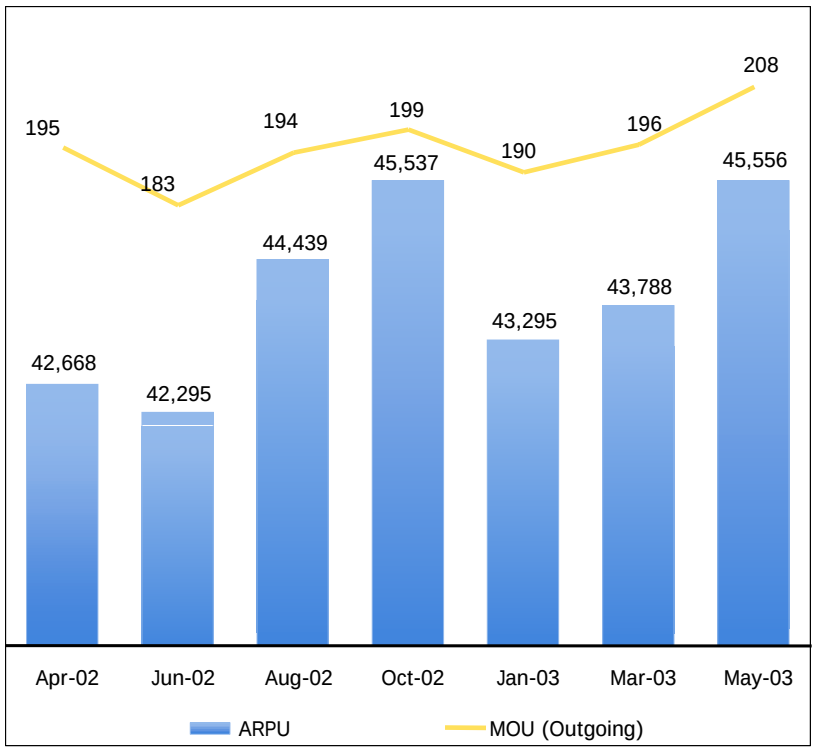
(Data ARPU in Won)



*% of Total Revenues excluding interconnection revenues

ARPU & MOU

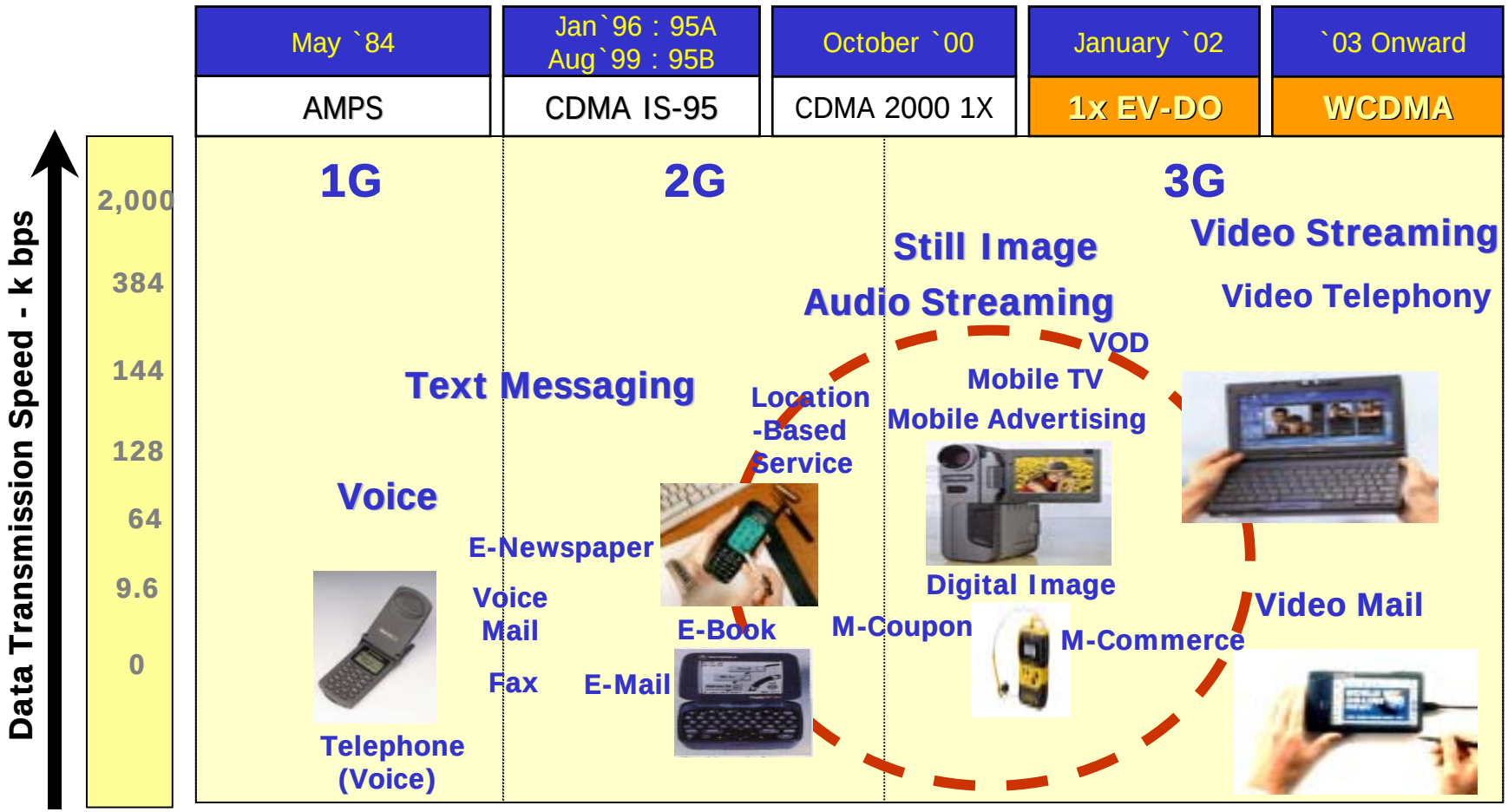
(ARPU in Won)



- ARPU : Average Revenue Per User
- MOU : Minute of Usage

Network & Service Evolution

SKTelecom offers variety of multi-media services through the most advanced network and plans to enhance service offerings in line with further network evolution



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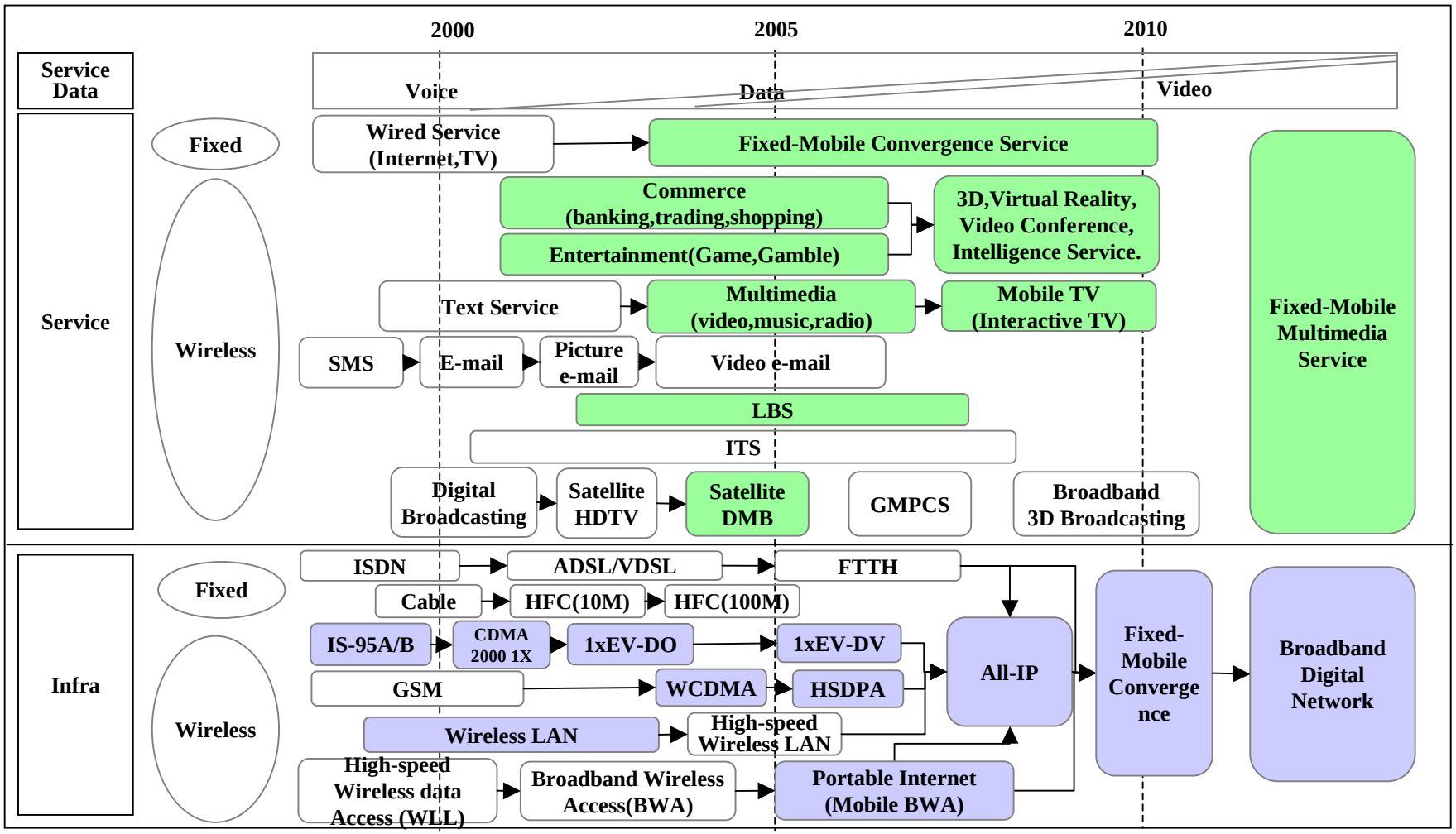
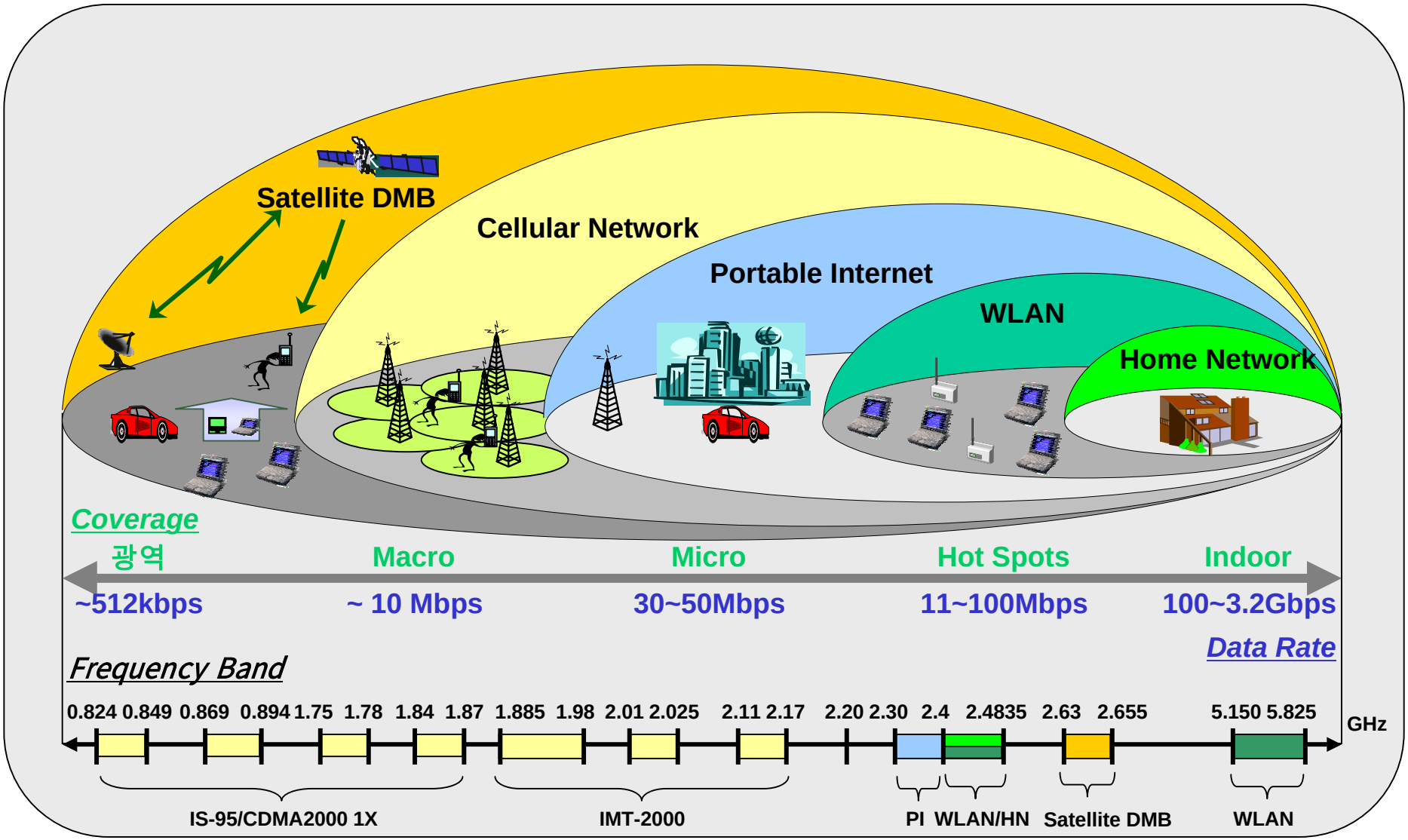
Technology Roadmap

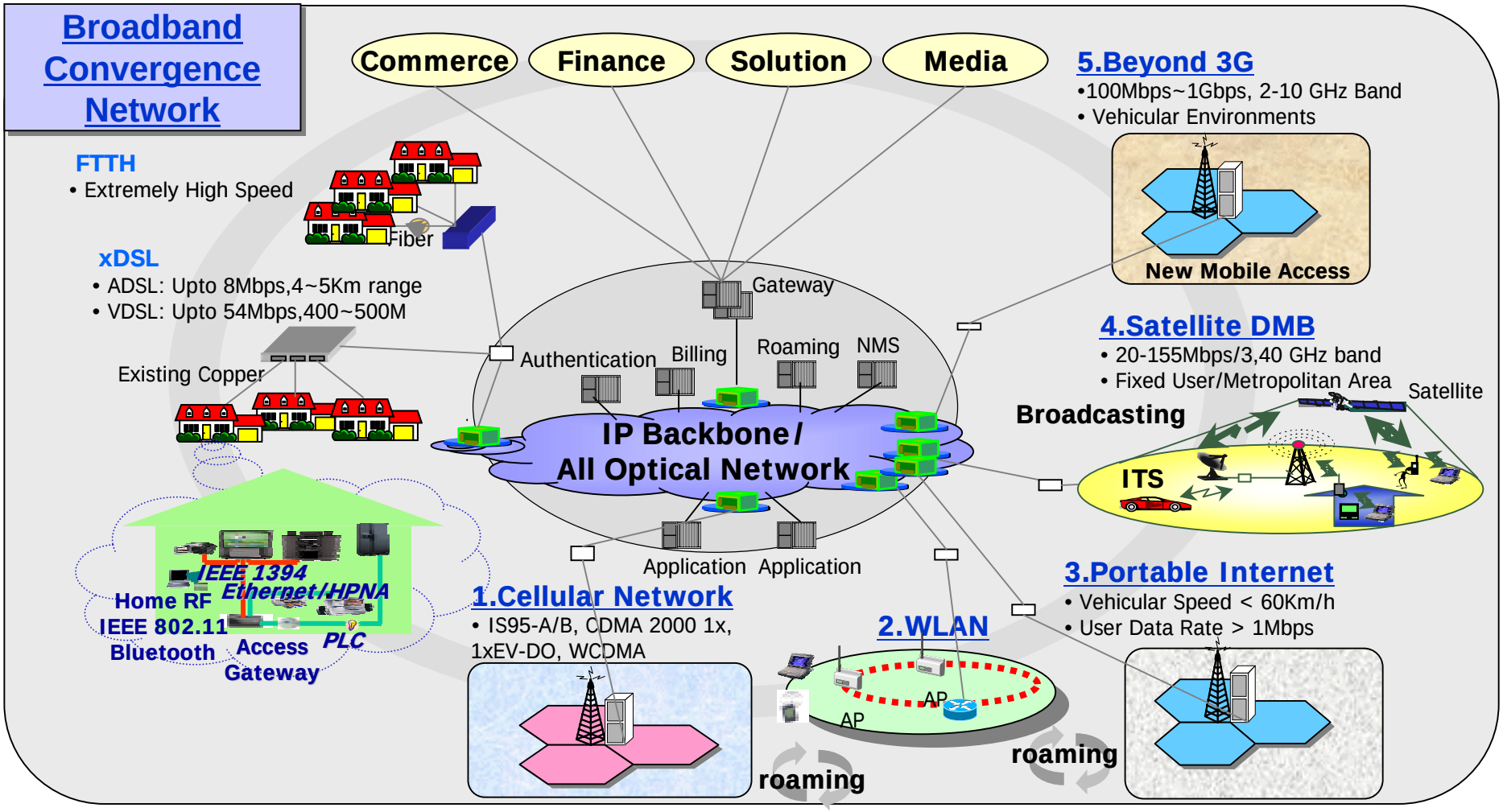


- ITS : Intelligent Transport System
- ISDB : Integrated Services Digital Broadcasting
- ADSL : Asynchronous Digital Subscriber Line
- BWA : Broadband Wireless Access
- VDSL : Very high speed Digital Subscriber Line
- HFC : Hybrid Fiber Coaxial Cable
- FTTH : Fiber To The Home
- GMPCS : Global Mobile Personal Communications by Satellite
- LAN : Local Area Network
- DMB : Digital Multimedia Broadcasting
- HSDPA : High Speed Downlink Packet Access
- WLL : Wireless Local Loop

Technology Roadmap



Technology Roadmap



- ITS : Intelligent Transport System
- ADSL : Asynchronous Digital Subscriber Line
- VDSL : Very high speed Digital Subscriber Line
- FTTH : Fiber To The Home
- HPNA : Home Phone-line Networking Alliance
- PLC : Power Line Communication
- NMS : Network Management System
- DMB : Digital Multimedia Broadcasting

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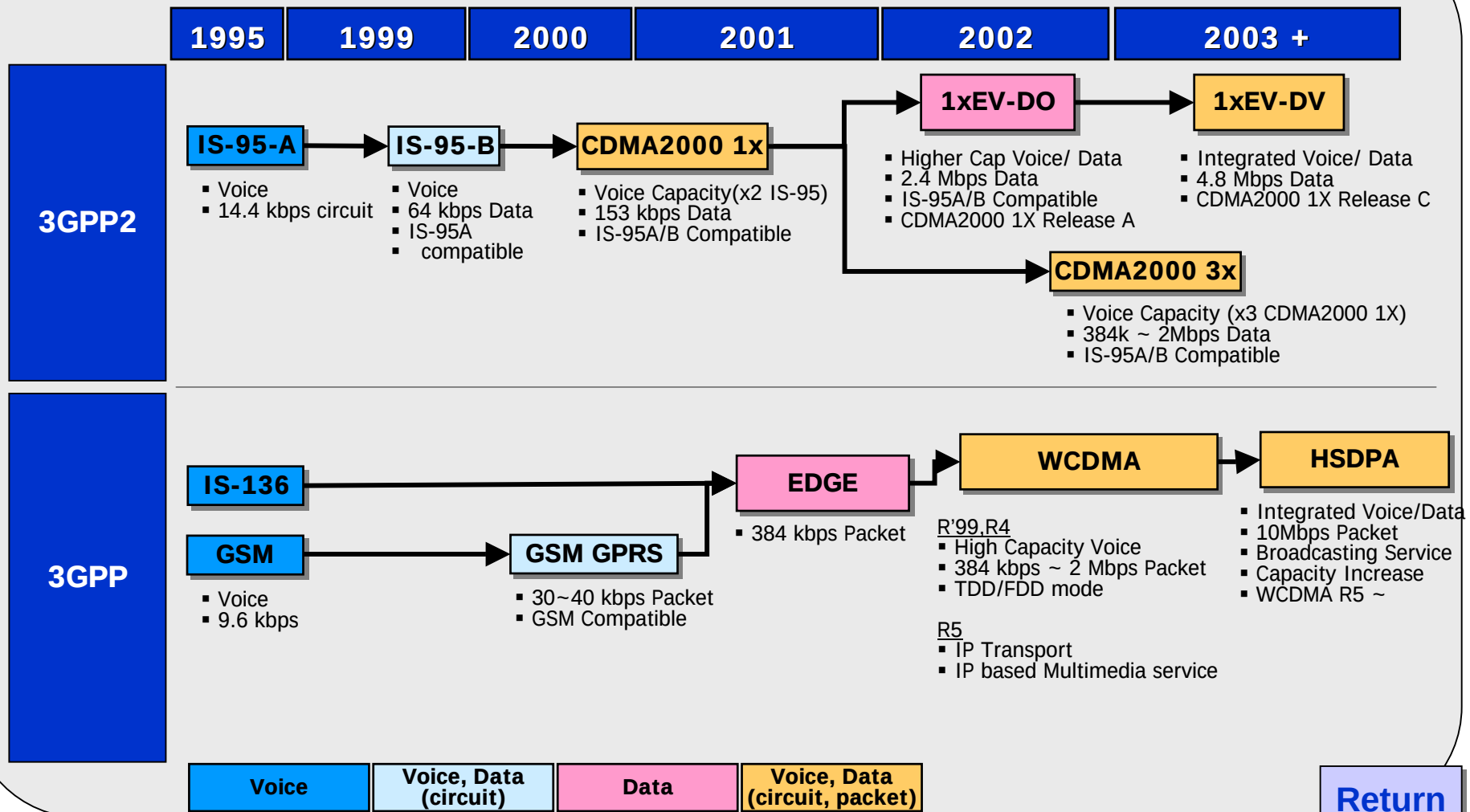
Cellular Network

Cellular Network Evolution Path



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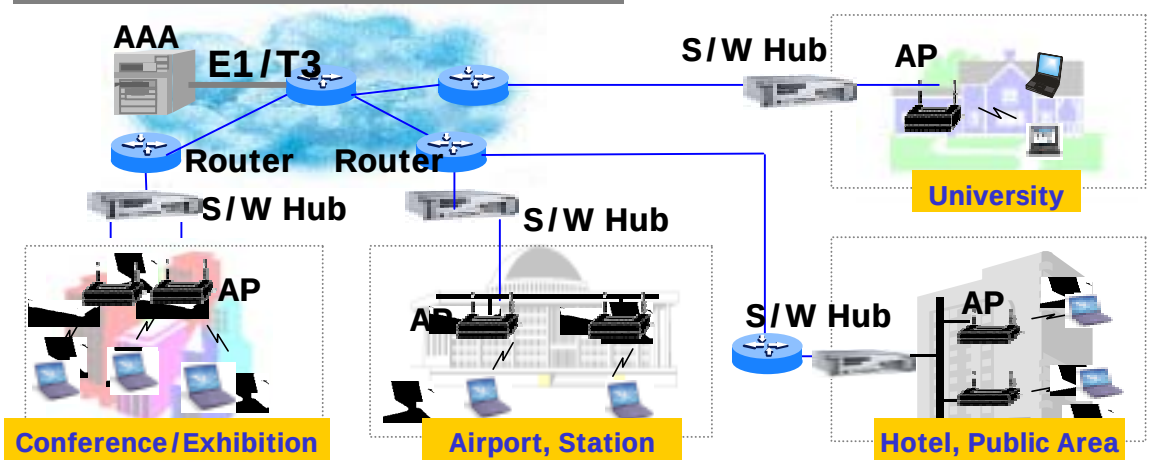
Wireless LAN

WLAN Concept



WLAN Charateristics			
Specification	802.11b	802.11a	802.11g
Data Rate	11Mbps	54Mbps	54Mbps
Bandwidth	22MHz	20MHz	22MHz
Freq. Band	2.4MHz	5MHz	2.4GHz
Coverage	100m	50m	100m
Modulation	DSSS	OFDM	OFDM
Commercialize	'00	'03	'03
speed	pedestrian		

WLAN Business Status

- ❑ Timely deployment of network through correlation of marketing and establishment of Hotspots
- ❑ Maximize investment through optimized network design
- ❑ Development of subscriber line solution to minimize circuit operational cost

	대학	Zone	Core Network
Network Status	▪ NATE Campus: 7 - AP: 600	▪ 2 Locations(Kangnam, Shinchon subway station) - Hotspots : 57 - AP: 200	▪ Core Equipments - AAA, Billing, NMS

▪ AAA : Authentication, Authorization, and Accounting ▪ AP : Access Point ▪ NMS : Network Management System ▪ WLAN : Wireless Local Area Network

Wireless LAN

Wireless LAN Technology Issue

Security	▪ WEP data encryption method used in WLAN is vulnerable to hacking. ▪ AES(Advanced Encryption Standard), TKIP(Temporal Key Integrity Protocol) ▪ TKIP : TTLS(Tunneled Transport Layer Security), PEAP(Protected Extensible Authentication Protocol)
Roaming	▪ Cellular Roaming, Portable Internet Roaming ▪ No Standard, inter-system handover delay, other technology issue ▪ AP Sharing, Charging, Security issue
5GHz WLAN	▪ 455MHz in 5GHz band has been allocated for WLAN use at WRC2003. ▪ 5GHz Feasibility and Field Test

SK Telecom		
	Completed	▪ Connection Manager Development : Authentication/Security(TTLS), CDMA2000 1X/WLAN Roaming ▪ BASN(Broadband Access Serving Node) Development: Mobile IP, Access control, Radius Proxy
	In Progress	▪ Connection Manager Enhancement : 1xEV-DO/WLAN Roaming, PI/WLAN Roaming ▪ BASN Performance Enhancement ▪ WLAN/Cellular Roaming Application Service ▪ WLAN AAA : PEAP ▪ 5GHz WLAN System Performance Test

Return

▪ PI : Portable Internet
▪ WEP : Wired Equivalent Privacy
▪ AAA : Authentication, Authorization, and Accounting

Portable Internet

Portable Internet Concept

Cellular
- High Mobility
- Low Data rate

Enhancing Data rate

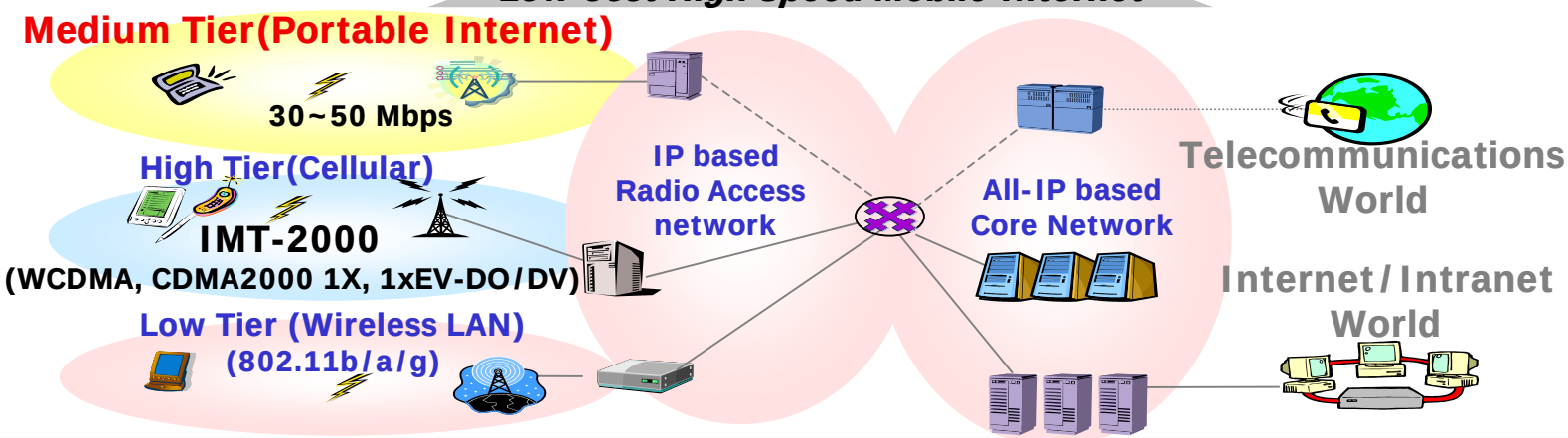
Portable Internet
- Mobility Enhanced
- High Data Rate

Enhancing Mobility

WLAN
- Low Mobility
- High Data rate

Multi Access

Low Cost High Speed Mobile Internet



Development Status

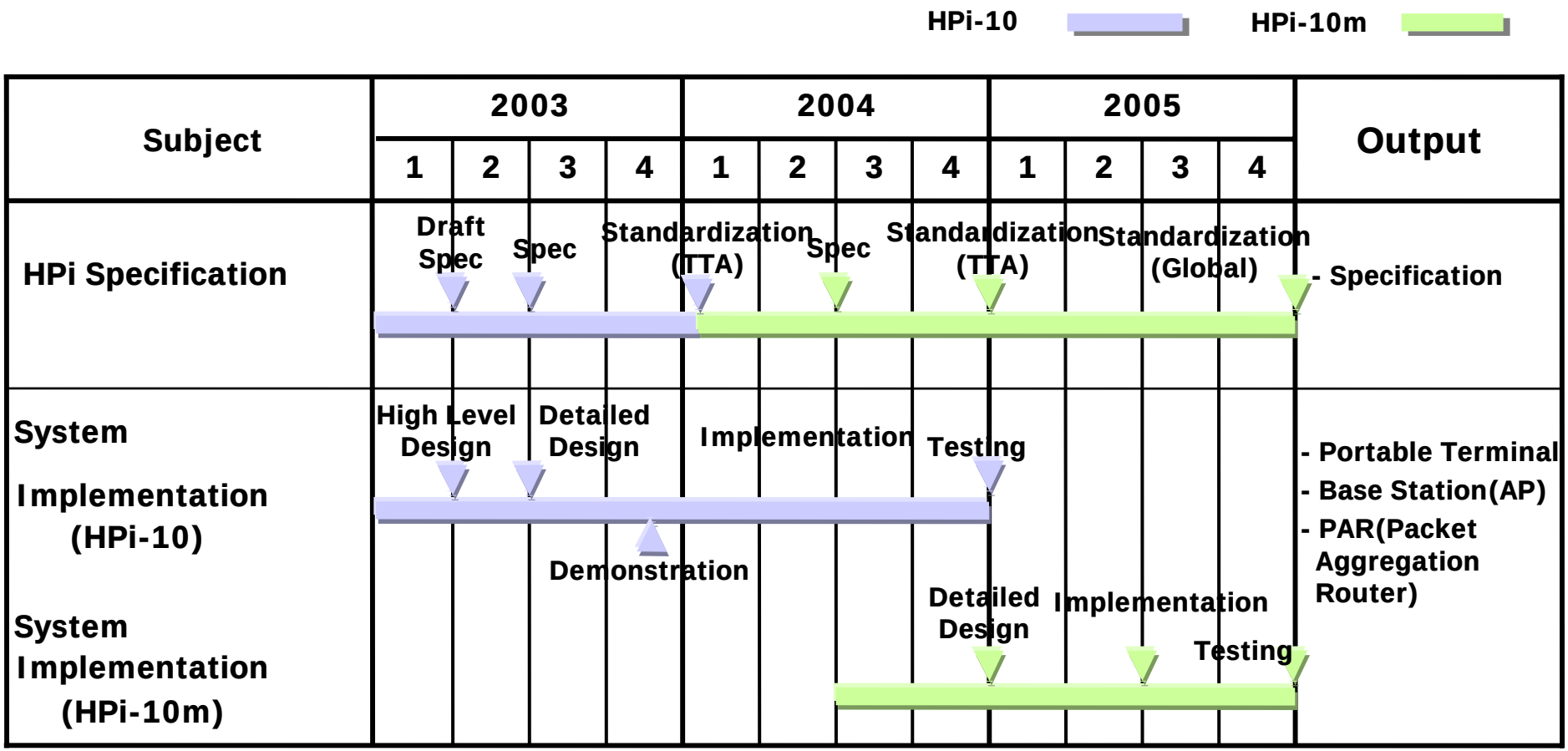
- ❑ Oct. 2002: Government changing 2.3GHz frequency allocation from WLL to Portable Internet
- ❑ 1Q 2003: HPi Project launched (ETRI, SEC, SKT, KT, KTF, Hanaro)
- ❑ 3Q 2003: Start Standardization for 2.3GHz Portable Internet Service at TTA

PI Technology Characteristics Comparison

		ETRI HPi	Flarion f-OFDM	BroadStorm Broad@ir	Navini Ripwave	ArrayComm i-BURST
Duplex		TDD	FDD	TDD	TDD	TDD
Bandwidth		10MHz	1.25MHz x 2	5MHz	5MHz	5MHz
Multiple Access		OFDMA	FH-OFDMA	OFDMA	MC-SCDMA	TDMA/SDMA
Single User Downlink Data Rate at Cell Edge		1Mbps	634Kbps	800Kbps	1Mbps	384Kbps
Maximum Data Rate	DL	24.8 Mbps	3.2 Mbps	8 Mbps	8 Mbps	14.4 Mbps
	UL	5.2 Mbps	950 Kbps	512 Kbps	4 Mbps	1.6 Mbps
Maximum Vehicular Speed Supported		60Km/h	250Km/h	100Km/h Future 250Km/h	40Km/h(NLOS) 80Km/h(LOS)	25Km/h
Maximum User/Sector		not defined	125	500	1000	2000
Coverage	Urban	0.6Km	0.6Km	1.5Km	6Km	1.3Km
	Suburban	1.3Km	1.6Km	3Km	8Km	3Km
	Rural	5Km	5.7Km	10Km	13Km	11Km
Antenna Technology		'05 MIMO	3-sector Tx/Rx Diversity	4Q, '04 Smart Antenna	Smart Antenna Joint detection	Smart Antenna
Commercialization		'05, 2Q	'03, 1Q	-	'03, 1Q	'04, 3Q

- OFDM : Orthogonal Frequency Division Multiplexing
- MC : Multicarrier
- FH : Frequency Hopping
- SDMA : Space Division Multiple Access
- TDMA : Time Division Multiple Access
- MIMO : Multiple-Input Multiple-Output

Implementation Roadmap of HPi



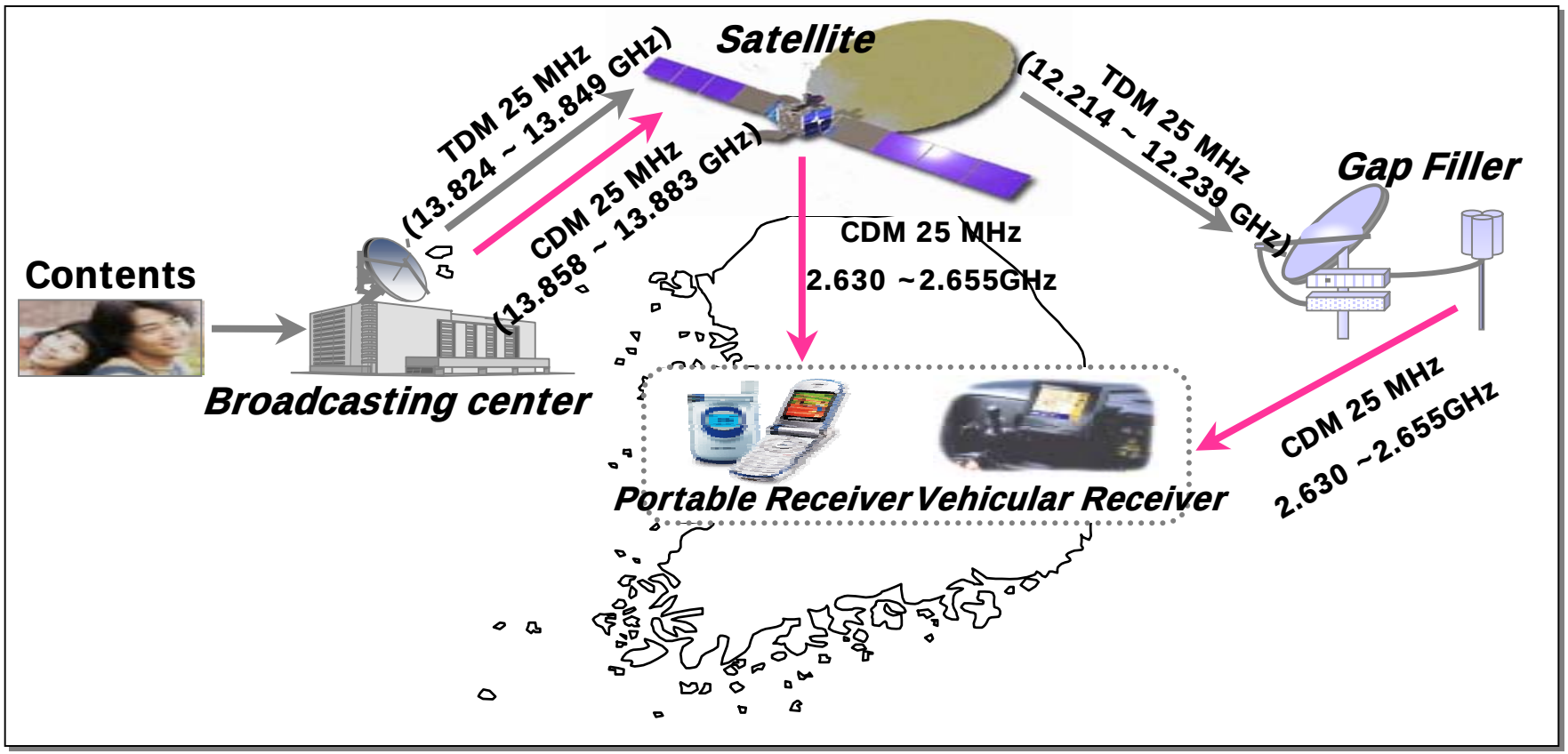
- HPi-10m : MIMO applied system(DL : 50Mbps)
- MIMO : Multi-Input Multi-Output

Return

Satellite DMB

Satellite DMB Concept

S-DMB is designed to provide satellite and complementary terrestrial Gap-Filler services for high quality audio and multimedia data for vehicular, portable and fixed reception



- CDM : Code Division Multiplex
- TDM : Time Division Multiplex
- DMB : Digital Multimedia Broadcasting

Satellite DMB

Satellite DMB Development Status

❑ Satellite

Manufactured by SS Loral, to be launched in Jan. 2004

❑ Gap Filler

Frequency conversion gap filler has already been developed (3Q, ’03)

❑ Terminal

- Mobile Phone Receiver, Vehicular Receiver, PDA Receiver etc.
- Developed by 21 manufactures including Samsung, LG, Toshiba
- Commercial Type(1Q, ’04)

❑ CellPLAN™

Terrestrial network planning tool for PMSB has already been developed (3Q,’03)

❑ DM(Diagnostic Monitor)

Has already been developed (4Q, ’02)

Satellite DMB

Service Features

- Nationwide coverage direct from Satellite and Gap Fillers
- Variety of combinational 9 video and 11 CD-quality audio channels within bandwidth
- Stable reception with High mobility adopting CDM technology
- Variable data rate 32~512Kbps

Service Schedule

- 2003. 12 Roll-out for Terrestrial Network
- 2004. 1 Satellite launch and Establishment of Broadcasting center
- 2004. 5 Commencement of Service

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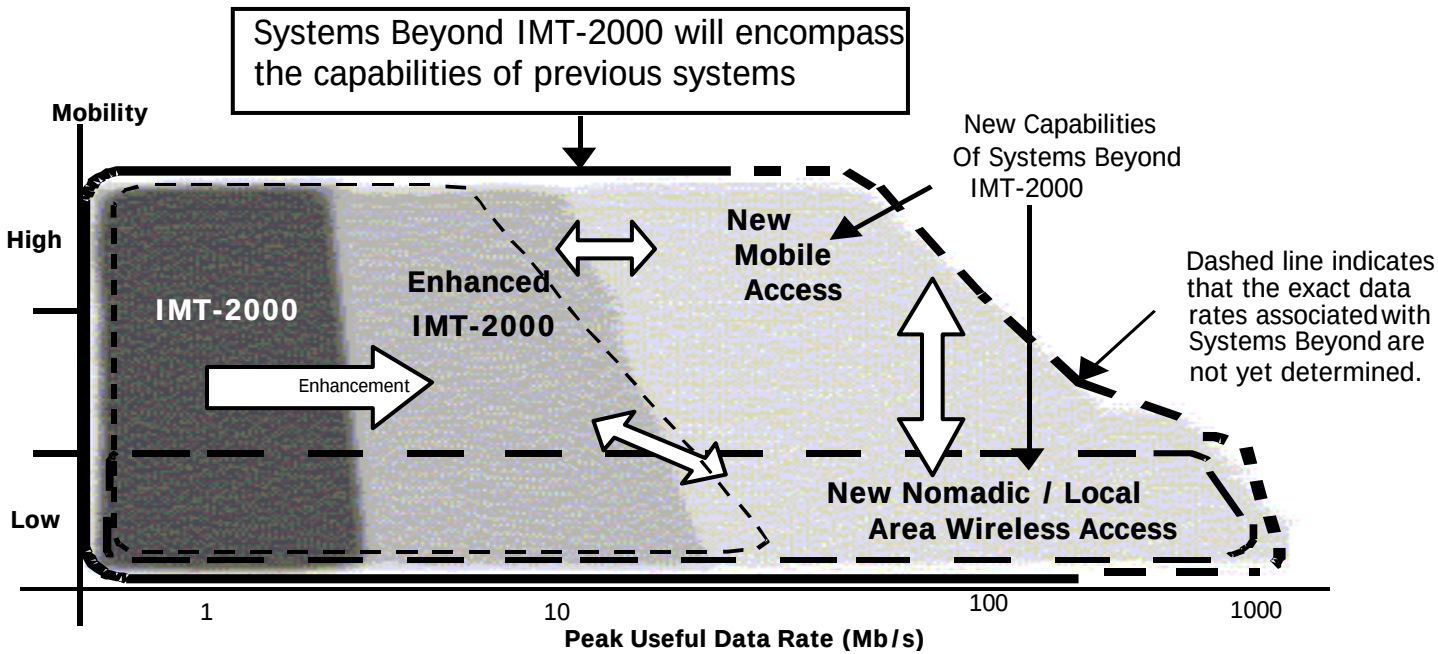
Beyond 3G

Beyond 3G Concept

Provide data rates up to 100Mbps in high mobility, and 1Gbps in low mobility environment and provide seamless service by system interworking of cellular, WLAN, broadcasting network and etc.



(ITU-R WP8F Vision Doc.)

Beyond 3G

Beyond 3G Requirements

Ubiquitous Mobile Access

- ❑ Seamless multi access services via different networks
- ❑ The most suitable network according to place, time, cost.
- ❑ Adaptive terminal(SDR)

High Capacity

- ❑ Higher Spectral Efficiency
- ❑ Multiple Antenna : Smart Antenna, Diversity Techniques
- ❑ Adaptive/multi carrier modulation, New multiple access schemes, powerful code

Low Cost Service

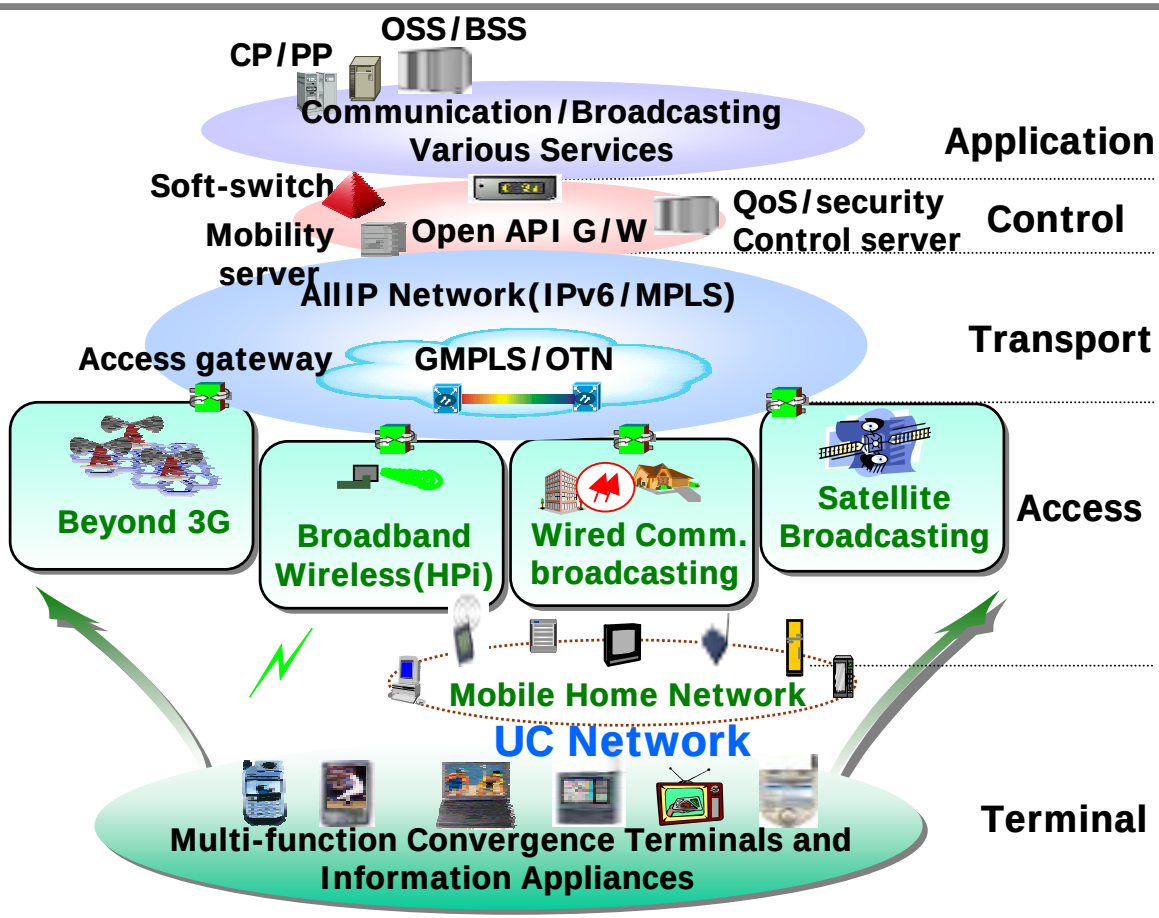
- ❑ All IP network
- ❑ End-to-End QoS to support various services and application class
- ❑ separation of service, control, transport

Return

Broadband convergence Network

BcN Concept

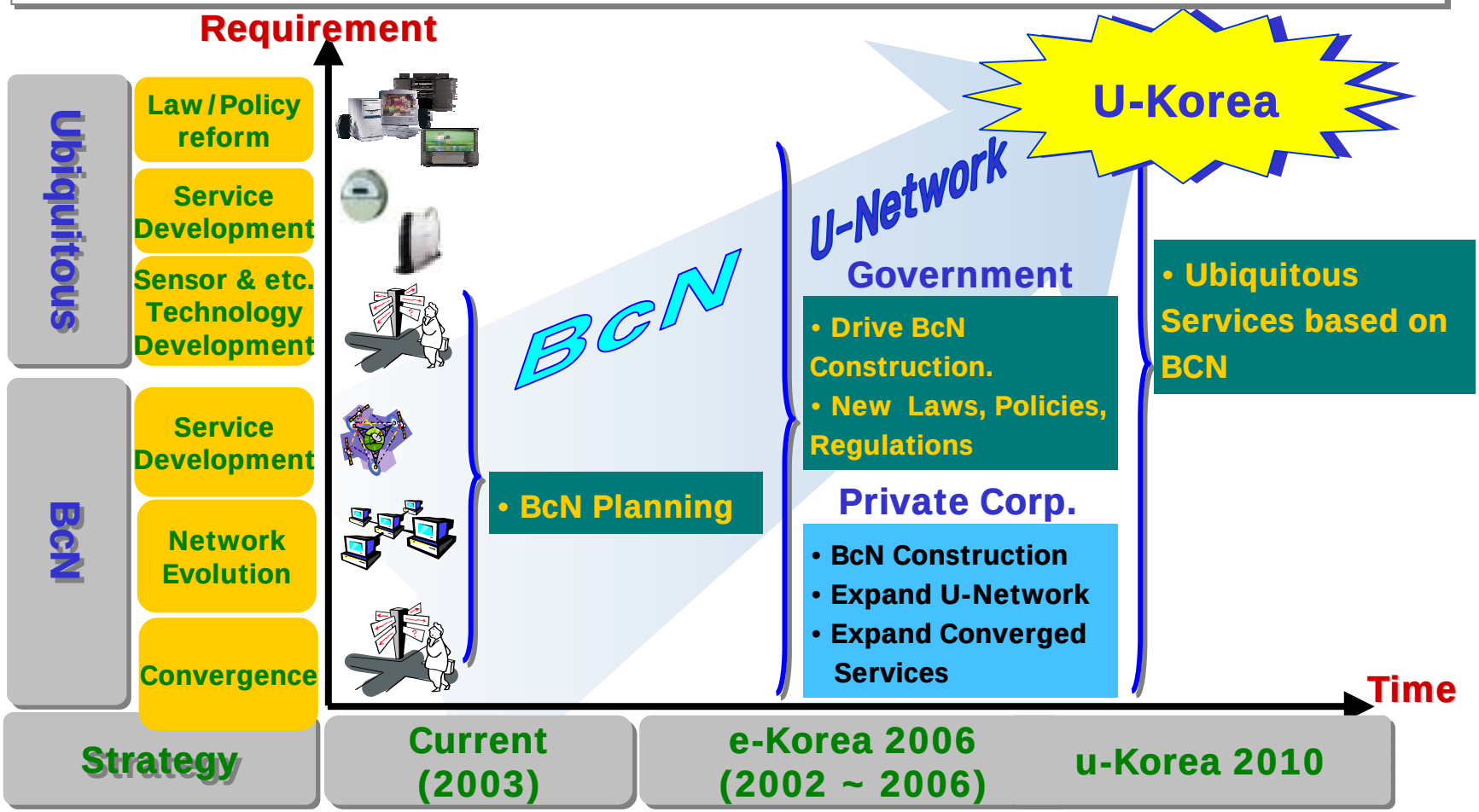
NGcN is a convergence network which can provide high quality broadband multimedia services, consisting of *voice, data, and broadcasting services in a converged form*, through various mobile and fixed network access environment on integrated terminals and information appliances.



- BcN : Broadband convergence Network
- UC : Ubiquitous Computing
- CP : Content Provider
- PP : Program Provider
- OSS : Operating Support System
- BSS : Business Support System
- MPLS : Multi-protocol Label Switch

Broadband convergence Network

Government : Law/Policy Reform and Technology Development Support
Private Corp.: Construct BcN Infra and Develop U-Environment Services



(MIC BcN Presentation)

Broadband convergence Network

3 stage plan to create world class Broadband convergence Network Infrastructure by 2010 and provide high quality converged services.

Factors	1st Stage (2004 ~ 2005)		2nd Stage (2006 ~ 2007)		3rd Stage (2008 ~ 2010)	
Network	▪ Independent Evolution of IP based Services ▪ High Quality and Security		▪ Integration of Mobile and Fixed Network ▪ Introduction of FTTH		▪ Integrated IP based Network ▪ Spread of FTTH	
Speed (bps)	Fixed 50M	Mobile 2M	Fixed 50M ~ 1G	Mobile 2M ~ 50M	Fixed 50M ~ 1G	Mobile 10M ~ 100M
NGcN (diffusion ratio)	5,000,000 House Hold (31%)	35,000,000 Subscribers (73%)	11,200,000 House Hold (70%)	37,440,000 Subscribers (90%)	14,400,000 House Hold (90%)	39,840,000 Subscribers (93%)
Services (examples)	Mobile/Fixed Video Phone Home Networking		Network Based High Quality Broadcasting Service		Broadband MMoIP	

(MIC BcN Report)

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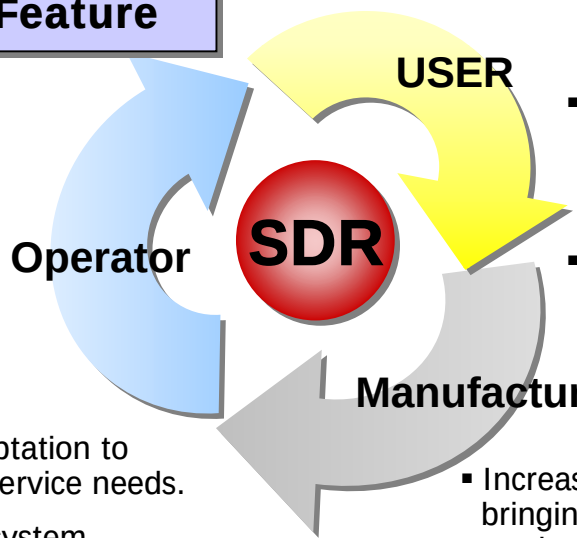
Software Defined Radio

SDR Concept

SDR enables system reconstruction or system upgrade just by changing system software without replacing any hardware components. It enables efficient implementation and operation of multi-mode/multi-band wireless systems.

SDR Feature



- Global Roaming through software download
- Enables selection of supported service and increases service quality.
- No need to replace terminals in applying new technology.

- Fast adaptation to various service needs.
- Reduce system deployment cost by eliminating overlapping system investment
- Increase spectral efficiency
- Faster Time-to-market

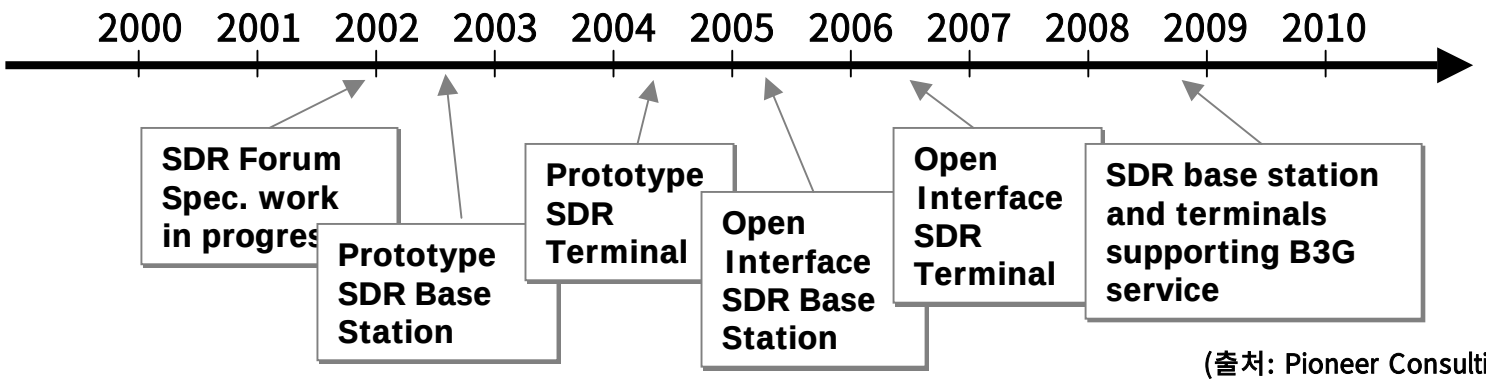
- Increase of margin by bringing down the cost of production
- Easier to apply new system functionality and performance enhancement technology
- Decrease market lead time

Product Development

- ❑ Base station oriented development.
- ❑ Commercial GSM products and prototype CDMA products are available.
- ❑ Main Systems
  - AirNet: AdaptCell
  - SDRT: SpectruCell
  - Harris: FALCON II
- ❑ Terminal products expected by 2004 due to issues concerning terminal size, power consumption, and price.

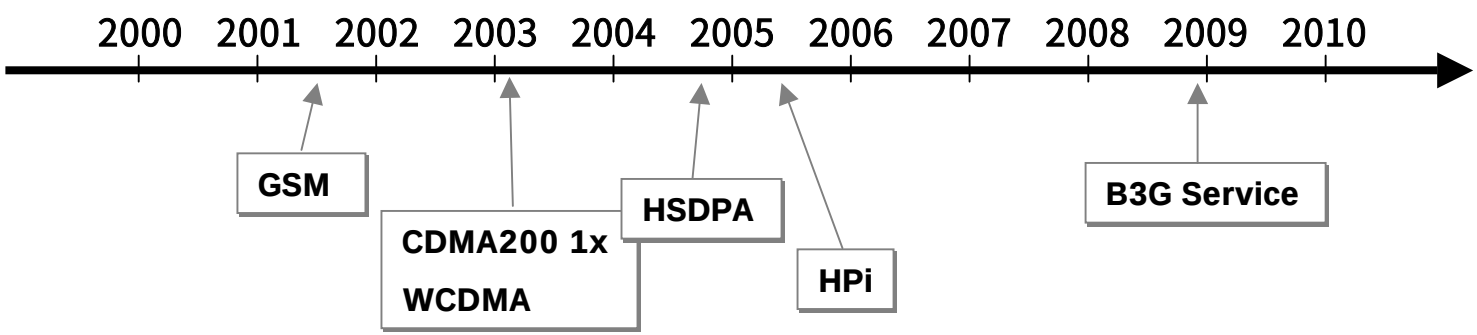
Software Defined Radio

SDR Technology Evolution Roadmap



(출처: Pioneer Consulting)

SDR Application on Mobile Service



Performance Enhancement Technology

Performance Enhancement Issue

- **Radio Access Technology Enhancement**
- **System Engineering Technology Enhancement**

Performance Enhancement Technology

- Diversity Antenna
- Embedded Antenna
- Radio Network Planning – CellPLAN
- Radio Network Optimization – RANO(Radio Network Optimizer)

Diversity Antenna

Diversity Antenna Concept

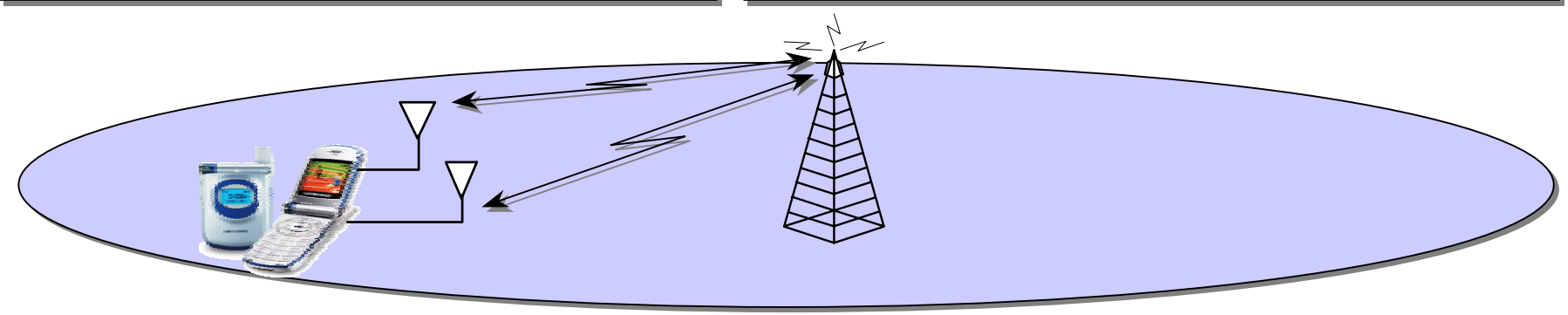
Enables mobile terminal to improve its received signal quality by intelligently combining signals received through multiple antennas.

Features

- More user on the same network
- Coverage improvement
- High signal quality
- Higher data rate at cell edge
- Longer use of battery
- Lower SAR

Development Status

- 2002. 10 Performance Test - Simulation
- 2003. 7~9 Field Trial(on SKT and Sprint Network)
- 2004. 2Q Commercial Diversity Chip
- 2005. 2Q Commercial Terminal



▪ SAR : Specific Absorption Rate

Embedded Antenna

Embedded Antenna Concept

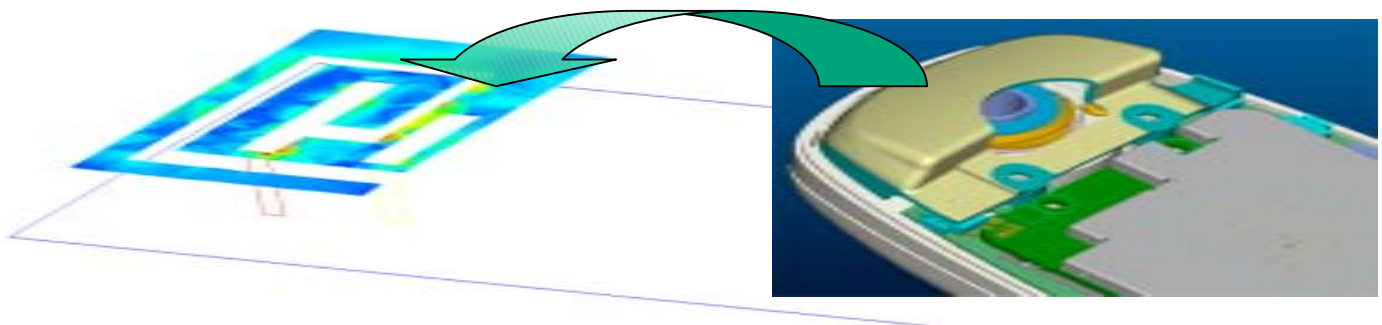
Uses different geometric structure of the antenna. It can be embedded in terminals and has superior multi-band performance.

Features

- **Reduction of terminal power consumption**
- **Reduction of SAR**
- **Superior design and portability**
- **Multi-band capability for SDR based terminals**
- **Can be used as diversity antenna**

Development Status

- **2002. 6~8 Drive test**
- **2002. 10 Compact MLA**
- **2003. 1 License Agreement**
- **2003. 3Q Production and Marketing**



CellPLAN

CellPLAN Concept

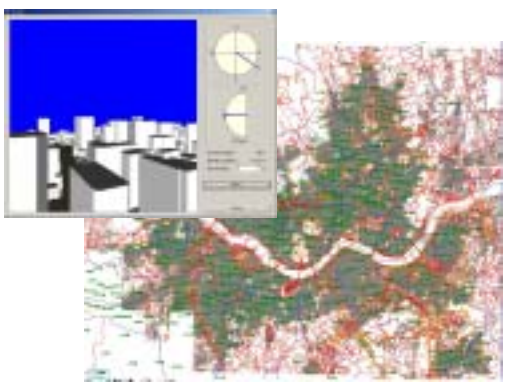
Creates suitable Cellular Network Configuration for various service scenarios by using GIS and air environment analysis.

Features

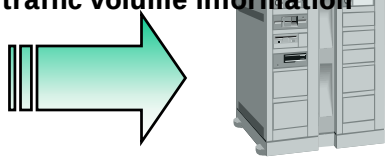
- **High capacity by optimized cell planning**
- **Effectively cope with changing service and network environment**
- **Cell Configuration and Planning Consulting**

Development Status

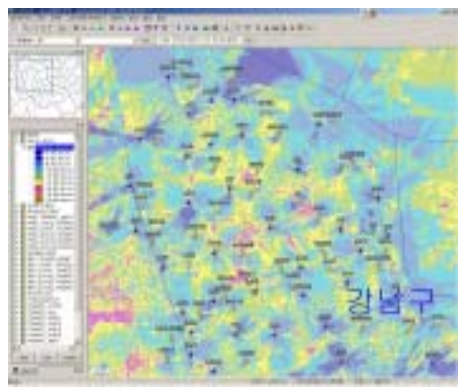
- **1998. CDMA CellPLAN**
- **2001. CDMA2000 1X CellPLAN**
- **2001. 1xEV-DO CellPLAN**
- **2001. WCDMA CellPLAN**



- **3D GIS DB**
- **Signal fading prediction**
- **traffic volume information**



- **Call quality**
- **capacity**



CellPLAN
(*Cell*ular Radio Network *Plan*ning System)

Radio Network Optimizer

RANO Concept

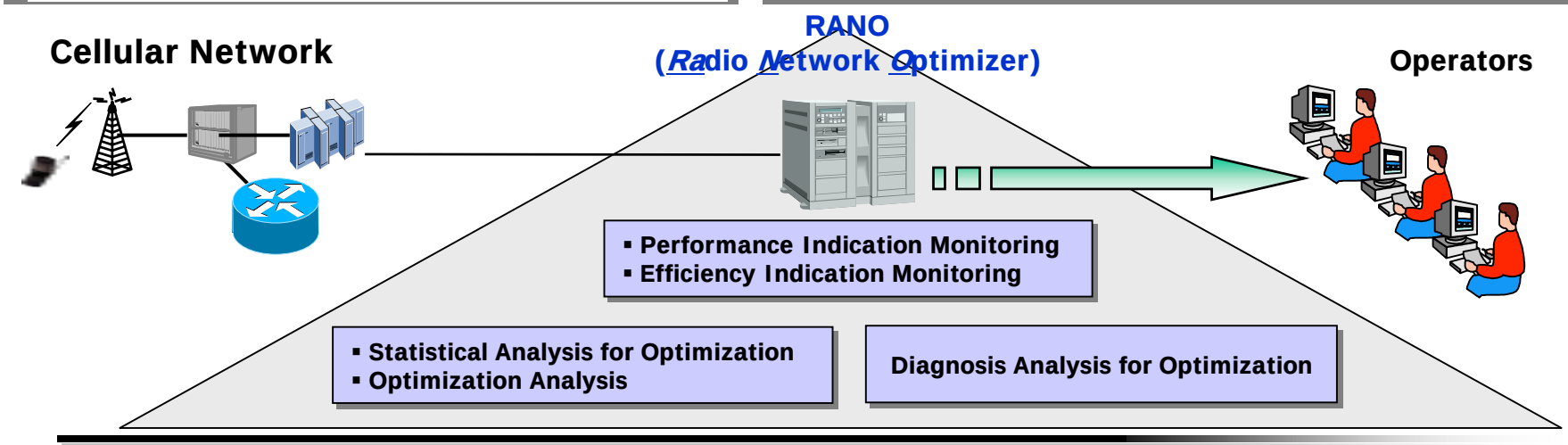
Keeps network in its optimized state through real-time monitoring and network analysis of the operating cellular network.

Features

- Increase network performance
- Better service quality
- Higher network efficiency
- Network Engineering Consulting

Development Status

- 2002. CDMA2000 1X RANO
- 2003. 1xEV-DO RANO
- 2004. WCDMA RANO



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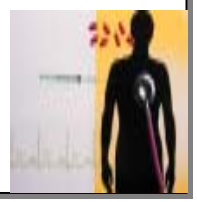
New Business Applications

Medical, Welfare

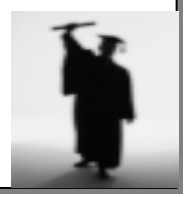
- Mobile Health Checker
- Medical Data Provision Service
- Nursing Care Information Service





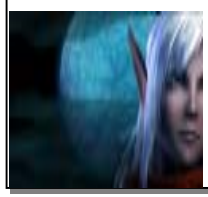
Education

- Active Knowledge Management
- Knowledge Discovery Tool
- On-Demand Knowledge Center

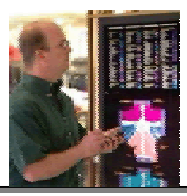
Entertainment

- Mobile Game Service
- High-Quality Multimedia Service
- Interactive Multimedia Service



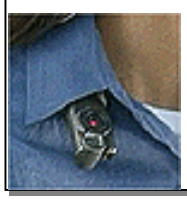
Business

- Shopper's Eye
- Autonomous Purchasing Object
- Virtual Collaborative Design

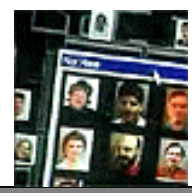
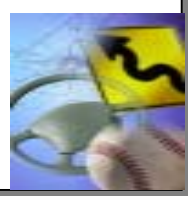

Daily Life

- Mobile Decision Support
- Personal Awareness Assistant
- Augmented Reality



Location Based Service

- Mobile Guard
- Virtual Location Awareness
- Disaster Prevention, Countermeasure

- SKT Overview
- New Technologies and Services
  - Technology Roadmap
  - Cellular Network
  - Wireless Data & Broadcasting Network
    - Wireless LAN
    - High-speed Portable Internet
    - Satellite Digital Multimedia Broadcasting
  - Network Evolution
    - Beyond 3G
    - Broadband convergence Network
  - Advanced System Technologies
    - Software Defined Radio
    - Capacity Enhancement Technology
  - New Business Applications
- **Conclusion**

Conclusion

Key Technologies of Mobile Communications

Portable Internet	Wireless LAN
Satellite Digital Multimedia Broadcasting	Software Defined Radio
	Performance Enhancement Technology
Beyond 3G	Broadband convergence Network

R&D Investment, Technology Development

Cope with Changing Future Environment

- Global Leader in Wireless Technology & Product Innovation
- Technology Evolution to 3G and next ...
- Leading Position in Wireless Internet Market
- Service Evolution to Multimedia




Thank you

September 2003