IMT-2000 and Future Mobile Communications

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ITC-CSCC

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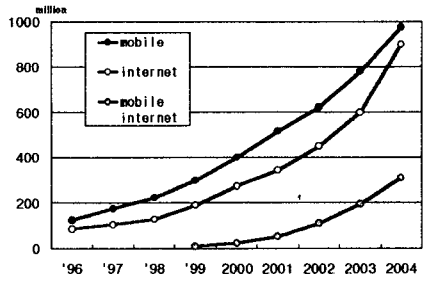
Trends of Mobile and Internet Users (worldwide)

Turning Points: '94 Mosaic Browser, '99 Micro Browser

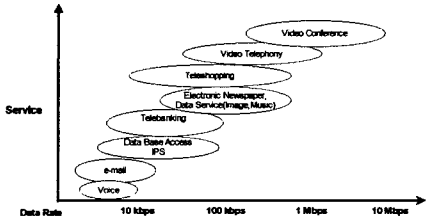


Contents

- 3-G IMT-2000 Services and Standardization
- IMT-2000 Standardization and Development in Korea
- Trends and Requirements of Future Mobile Communication
- Concluding Remarks

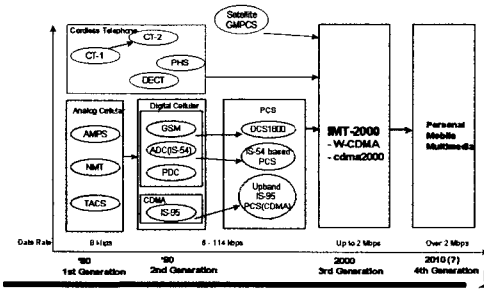
IMT-2000 Services

- Services : Voice, Data, Video,& Multimedia converge to **Mobile Internet**

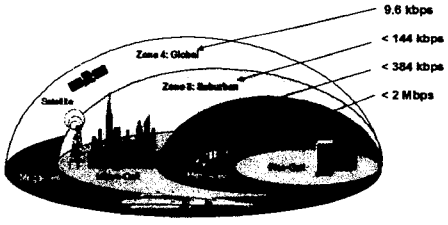


3G IMT-2000 Services and Standardization

- Evolution of Mobile communications



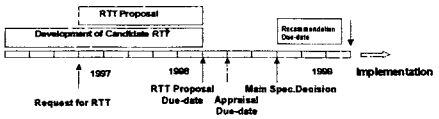
IMT-2000 Service Coverage



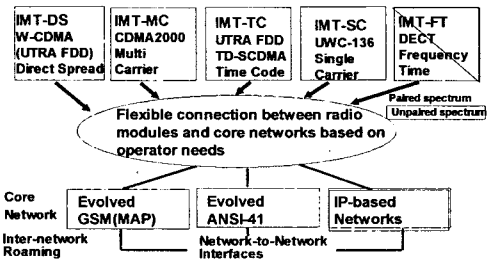
MSS vehicular speed pedestrian indoor

ITU-R Standardization Process

- FPLMTS Task Group formed in '86
- Schedule of Radio Access Standard



ITU-R Final Harmonization



Terrestrial RTT Proposals (June, '98)

Grouped into Three Family Members

- cdma2000 : US TR-45.5, Korea TTA-I
- W-CDMA : Europe, Japan, US T1P1/TR-46, China, Korea TTA-II
- UWC-136 : US TR-45.3

Convergence/Harmonization Works

- 3GPP for W-CDMA
- 3GPP-2 for cdma2000

IMT-2000 Standardization and Development Activities in Korea

Domestic R&D Consortium formed and led by ETRI

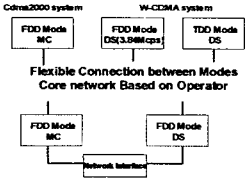
Phase I (1997-1999): Standardization Activities and System Prototyping

Phase II (1999-2002): Commercial System Development and Service Deployment

OHG Initiatives

Movement of Operator Harmonization Group ('99.4.)

- Task Force to urge standards harmonization for IMT-2000 by major mobile operators in world
- Suggest some unified scheme combining W-CDMA & cdma2000
  -> W-CDMA got more weights



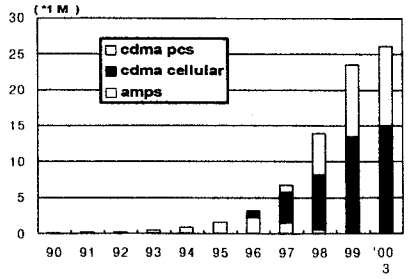
Status of Telecommunications in Korea

Population : 46 Millions / 99,300 sq. km
Seoul : 11.0 Millions / 605 sq. km
Pusan : 4.0 Millions / 436 sq. km

Status of Telecommunications
- Wireline Operators :
  KT (Korea Telecom) : *Major PTT*
  DACOM : *PSDN, International & Long Distance*
  Hanaro : *Local Loops, WLL*
  Onse Telecom : *International & Long Distance*
- Wireless Operators :
  SK Telecom (formerly KMT) : *Cellular & Pager*
  Shinsegi Telecom : *Cellular(Digital)*
  KT Freetel, Hansol PCS & LG Telecom : *PCS*
  11 Regional Pager Operators : *Pager*
  TRS Operators (2 national, and 9 regional) : TRS
  3 Mobile Data Operators : *Wireless Data*

Regulator :
MIC (Ministry of Information & Communication)

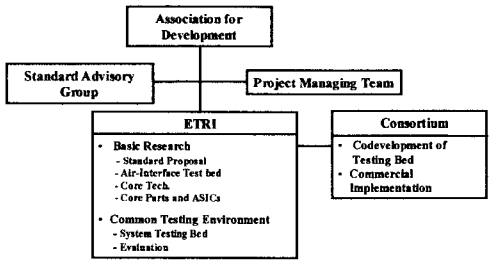
Cellular & PCS Subscribers in Korea



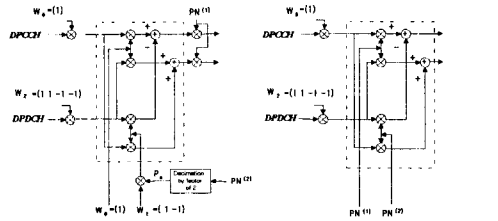
Orthogonal Complex QPSK

- General
  - Reverse Link Spreading and Modulation
  - Currently, IMT-2000 reverse link modulation and spreading scheme in Global CDMA I & II (TTA), cdma2000 & IS-95C (TIA), ETSI W-CDMA, and ARIB W-CDMA systems
  - Handling both modulation and spreading part
  - Also called HPSK (hybrid PSK) jointly with Motorola
- Advantages
  - to reduce Peak/Average Power ratio
  - to reduce Out-of-band Emission
  - to reduce the cost of Power Amplifier
  - to increase Battery Life for Hand-held terminal

R&D Structure for IMT-2000 Phase 1



Voice and Low data rate service



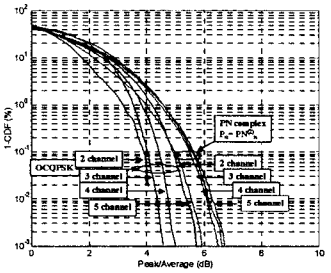
PN(1) PN(2) : Pseudo Noise Sequence
DPCCH: control channel (ETSI or ARIB notation for convenience)
DPDCH: data channel

Some Korean Contributions to IMT-2000 Standards

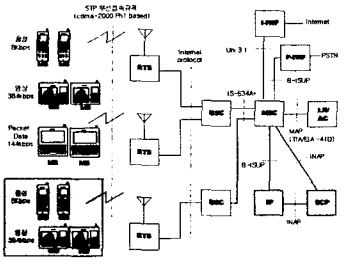
- **OCQPSK (Orthogonal Complex QPSK, HPSK) :**
  - low power modulation scheme for mobile phone
- **AiSMA (Acquisition indication Sense multiple Access) :**
  - Collision avoiding scheme for packet transmission
- **RSTS (Reverse Link Synchronous Transmission) :**
  - Interference reduction scheme with orthogonal codes in reverse direction
- **Pilot Pattern :**
  - re-confirmation scheme for frame sync. With known symbols in Pilot
- **TFCI (Transport Format Control Indicators) :**
  - Efficient coding and allocation for 15 slots in 3.84 Mcps
- **Frame Segmentation :**
  - Efficient segmentation scheme for data before sending to physical layer

Performance Comparison

(OCQPSK vs.. PN Complex QPSK)



System Test Bed for IMT-2000
implemented (cdma 2000)



Prospects for the Future Mobile Communications

- ☐ As voice is concerned, "anywhere access" is fully realized with 2-G mobiles and cordless telephones.
- ☐ As knowledge-based information society is becoming mature, main focus on communication is shifted towards ubiquitous high speed wireless multimedia/internet. "Anywhere access for data" will be the most required one for the next generation telecomm. systems.
- ☐ But, nobody is sure how much high speed data services will be utilized when one is on move. While it is easy to predict the ever-growing needs for high speed data, wherever one is located. Mobility on fixed network is as important as that on mobile network.

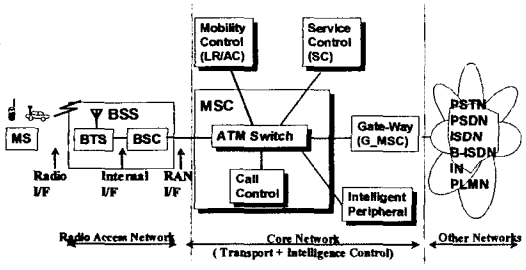
R&D Structure for IMT-2000 Phase 2 (ETRI)

- ☐ R&D Strategy
  - ○ Joint Commercial W-CDMA Model Development with Manufacturers and Operators
  - ○ Core Technology and Parts Development driven by Government with participation of Industry
- ☐ Duration : Mid. '99 - 2001
- ☐ Co-development Partners
  - ○ Mobile Phones : Samsung, Hyundai, Pantech
  - ○ Base Station : Samsung, Hyundai
  - ○ Core Network : Samsung, Hyundai, LGIC

Wireless Access as Last Mile Access

- ☐ Public Land Mobile Systems like 2-G and 3-G :
  - ○ Advantage : "wherever service" possible
  - ○ Disadvantage : limited data speed and capacity, and ***relatively high tariffs***
- ☐ Alternative 1 : ***No tariffs*** and high data speed
  - ○ Broadband Wireless LAN : within campus or large premise, and offices
  - ○ Home R.F. or Personal LAN like Bluetooth : at home or on personal move
  - ○ SRD (Short Range Communication Device)
- ☐ Alternative 2 : Low Tariffs and high data speed, where the fixed system is not conveniently accessible
  - ○ Broadband Fixed Wireless Access
  - ○ *Broadband Satellite Internet Service*
- ☐ Alternative 3 : Low tariffs and very high data speed
  - ○ SCS (Stratospheric Communication System) ???

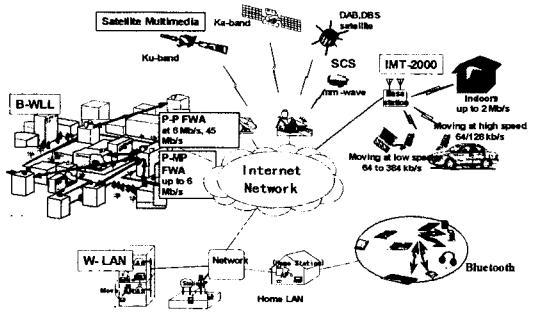
IMT-2000 Network System in Target



Most Promising Scenario

- ☐ "Wherever Wireless Internet/Multimedia Service" will be realized with 2- and 3-G mobile systems, and wireless LAN including Home R.F. and/or Bluetooth.
- ☐ Variety of user terminals:
  - ○ Mobile Phone with Microbrowser
  - ○ Smartphone
  - ○ PDA or Hand-held/Notebook computer with wireless module (2-G or 3-G mobile or Wireless LAN)
  - ○ *PDA or Hand-held/Notebook computer connectable to mobile phone with wire or wireless*

Future Wireless Internet Service



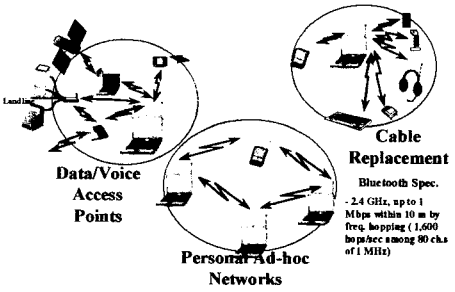
Status of Wireless LAN

- ☐ **900 MHz ISM Band : proprietary about 1 Mbps**
- ☐ **2.4 GHz ISM Band :**
  - ○ Proprietary : mainly using Frequency Hopping, about 1 Mbps
  - ○ IEEE 802.11 : standardized in June '97, about 2 Mbps
  - ○ IEEE 802.11 TGb : up to 11 Mbps
- ☐ **5 GHz :**
  - ○ Proprietary : 5.7 GHz, about 10 Mbps
  - ○ IEEE 802.11 TGa : OFDM, 6 ~ 54 Mbps
  - ○ Wireless ATM LAN : Hiper LAN, up tp 25 Mbps
- ☐ **17 GHz, 60 GHz Band Wireless ATM LAN : 155 Mbps Wireless ATM**

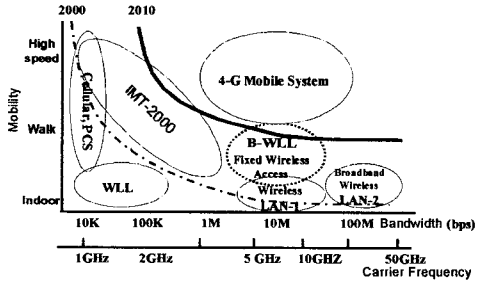
What is to be done to promote Mobile Internet?

- ☐ **Contents : Killer Applications**
  - ○ SMS, e-mail, chatting, news, weather forecasting, location info.,...
  - ○ e-commerce : stock trade, shopping, ticketing,....
  - ○ Entertainment: on-line game, MP-3,....
- ☐ **Tariffs :**
  - ○ Based on transmitted packets
  - ○ Fixed rate plan
- ☐ **Good Micro-Browser : WAP, micro-HTML for small display**
- ☐ **Voice Activated Input Tech.**
- ☐ **Innovative Display Tech.: Folding Display**
- ☐ **Personal or Home Networking :**
  - ○ Smart-phone, PDA, Hand-held computer
  - ○ Bluetooth or Home R.F.
  - ○ Wireless LAN

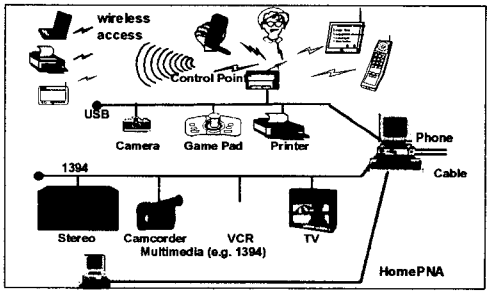
What does Bluetooth for you ?



Evolution of Wireless Access



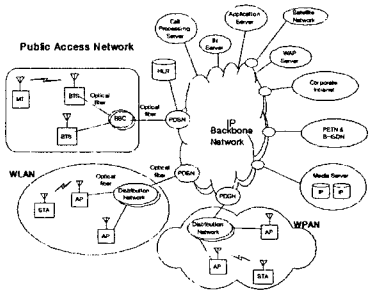
Home RF and Home PNA



Next Generation (4G) Mobile System ?

- ☐ **Do we really need to consider 4G at present ?**
- ☐ **ITU-R begin to set up a WP8F for 4G in 2000.**
- ☐ **4G should be, if there is any existence,**
  - ○ Service oriented
  - ○ Personal, multimedia, and universal
  - ○ User Driven rather than Technology Driven
  - ○ 4G will encompass all kinds of systems, interoperable with 2G & 3G, and be fully IP based.
  - ○ Open Architecture
    - **fully reconfigurable for various modes----> SDR (Software Defined Radio)**
    - **effective resource management structures for varying traffic, channel conditions, and QoS**
    - **decentralized network functionality**

4-G Network Structure



Requirements for 4-G system

- ☐ **High speed data rate :**
  - ○ Vehicular : 2 Mbps
  - ○ Pedestrian/ Indoor : 20 Mbps
- ☐ **IP based network structure : QoS guaranteed**
- ☐ **Next generation Internet support : IPv6, Mobile IP**
- ☐ **High Capacity : 5 ~ 10 times to 3-G**
- ☐ **Seamless services with fixed, and private network like Wireless LAN**
- ☐ **Frequency band : 3 ~ 8 GHz**
- ☐ **Lower system cost**

Final Remarks

- ☐ **As Wireless Internet becomes very hot issue, it is important to develop new services and applications.**
- ☐ **Wireless Internet Age will be realized mainly with combination of 2- and 3-G mobile systems, and wireless/ personal LAN.**
- ☐ **Needs to develop the core technology for the next generation systems :**
  - ○ Application for Bluetooth
  - ○ Broadband Wireless LAN
  - ○ UWB (Ultra Wide Band) communication technology
  - ○ Adaptive Array Antenna
  - ○ SDR (Software Defined Radio)
  - ○ Higher Modulation Tech.
  - ○ Voice Recognition Algorithms
  - ○ Flat Panel Display Tech.

Radio Transmission Issues

- ☐ **High output power requirement : very high data rate at higher frequency band with higher propagation loss**
  - ○ Adaptive Array Antenna/ Smart Antenna for Base station and Mobiles
  - ○ Interference Reduction Technique
  - ○ OFDM application to tackle against deeper delay spread
  - ○ Higher Adaptive Digital Modulation up to 64 QAM
  - ○ Effective asymmetric data transmission scheme between up and down channel : TDD or symmetric band allocations with dynamic channel assignment scheme
- ☐ **Frequency Spectrum Requirements :**
  - ○ ITU-R recommends additional 180 MHz bands for IMT-2000 services by 2010.
  - ○ For 4-G, conservative estimates is at least 1,000 MHz by 2015