Next Generation Mobile and Wireless Standards, "LTE and IMT-Advanced"

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Income and Resources

SAMSUNG

Approximately 138,000 Employees
(124 Offices in 56 Countries)

World wide
As of 2006

	Revenues	Net Income
US$ (billion)	$ 63.4	$8.5
KR¥ (trillion)	¥58.98	¥7.9

2006 Parent Company Income
Exchange rate : KR¥/US$: 932 / 1
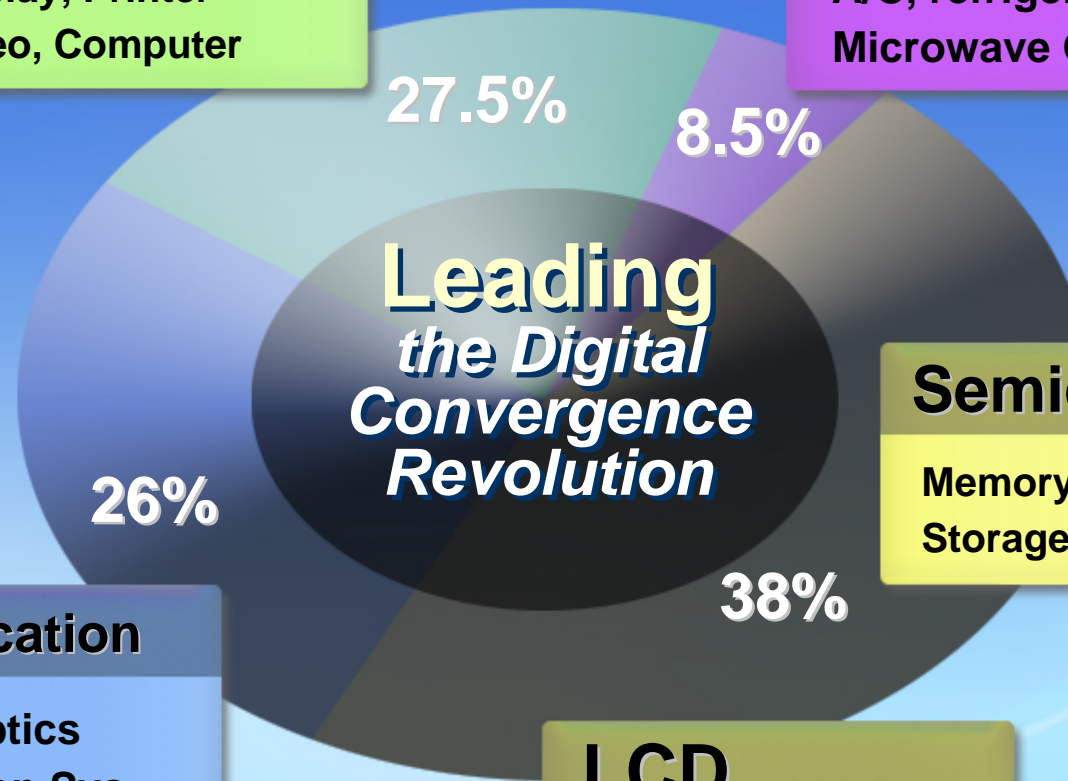
IT Mega-trends

Being Digital

Being Networked

Being Mobile/Wireless

* **"Being Digital" since 1965**
  * Your computing power and memory size kept growing
    since "Moore's law" was announced in 1965.

    Transistor was invented in 1947, the first IC was developed in 1958.
    and the first micro-processor were introduced in 1971.

  * "Moore's law": The # of transistors per a chipset doubles in every 18 months.

  = "5 years later," the price of a processor will drop to "1/10" of today's price, or
    you can buy the "10 times powerful" device at the price you paid today.
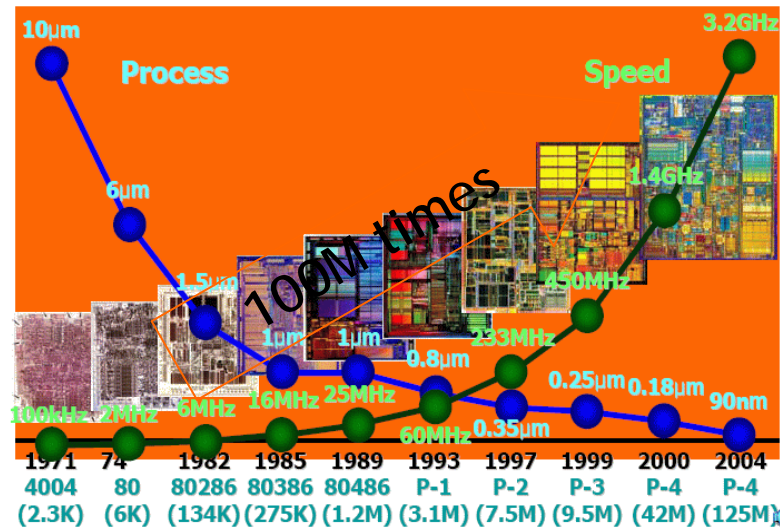
☞ Your computing power and memory size have been growing more than 10 million times since 1970s.

☞ Enterprise equipment (e.g. Mainframe) was replace by Home device (e.g. Desktop PC), then by Personal device (e.g. Laptop PC).

☞ Your device has become smaller and more intelligent.

Example

1st Micro-processor
(Intel 4004)
2300 transistors
@ 100 KHz (1971)

Pentium-4
42 M transistors
@ 1.4 GHz (2000)
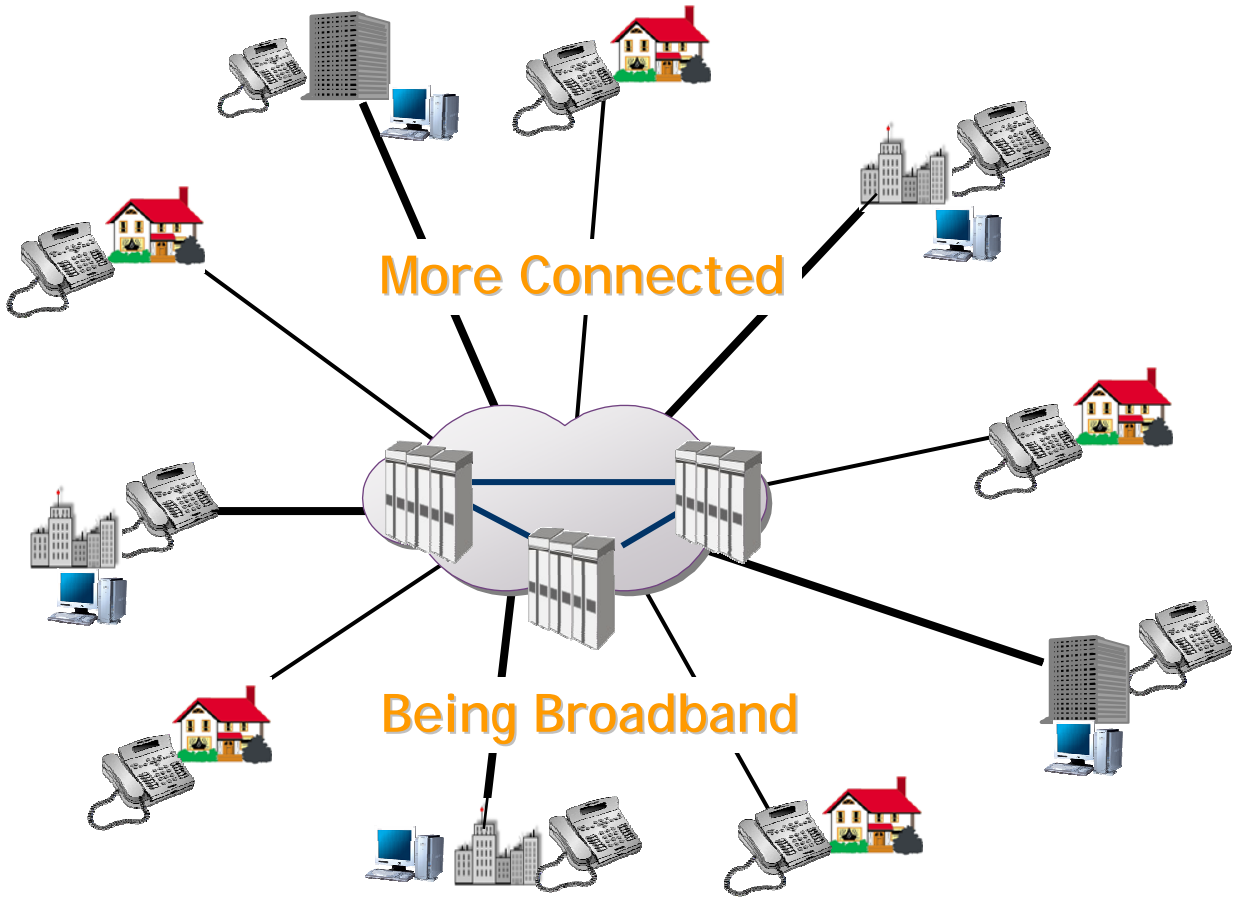
Being Networked

- **"Being Networked" since 1989**
  - More devices are getting more connected with other devices since "World Wide Web" was invented in 1989.

    - Desktop PCs could generate tons of contents as a result of "Being digital", convenient GUI accelerated the communication of multimedia contents, then it was realized that "network is the bottleneck".

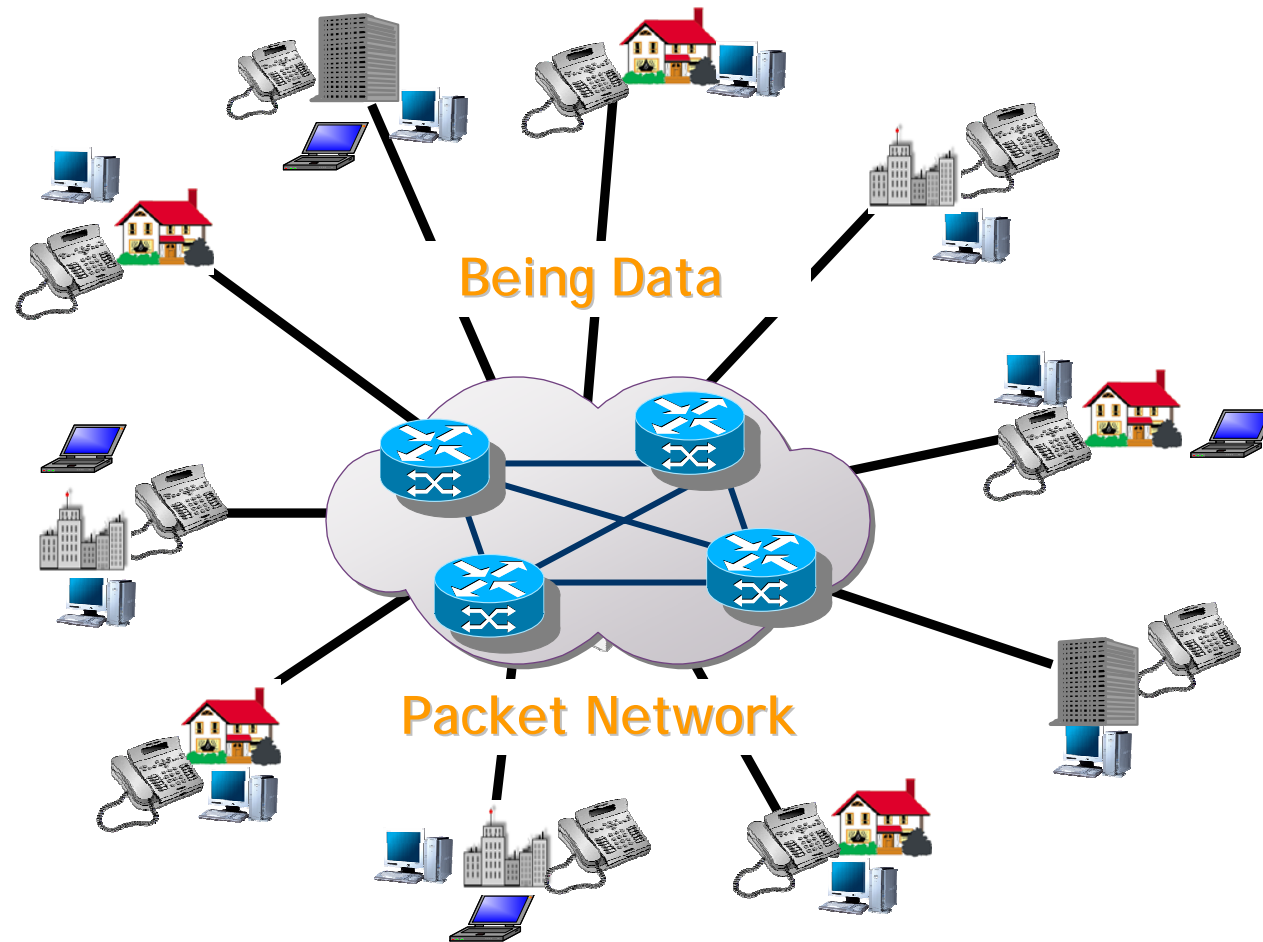   - "Information Superhighway Initiative" was started in 1993 and "Internet Revolution" followed in 1996.

  - Access networks are getting broadband (e.g. xDSL and Cable modem)
  - Packaged media (e.g. CD) are being replaced by Networked media (e.g. MP3).
  - Circuit-switched voice networks are being replaced by Packet-switched data networks.

More Connected

Being Broadband
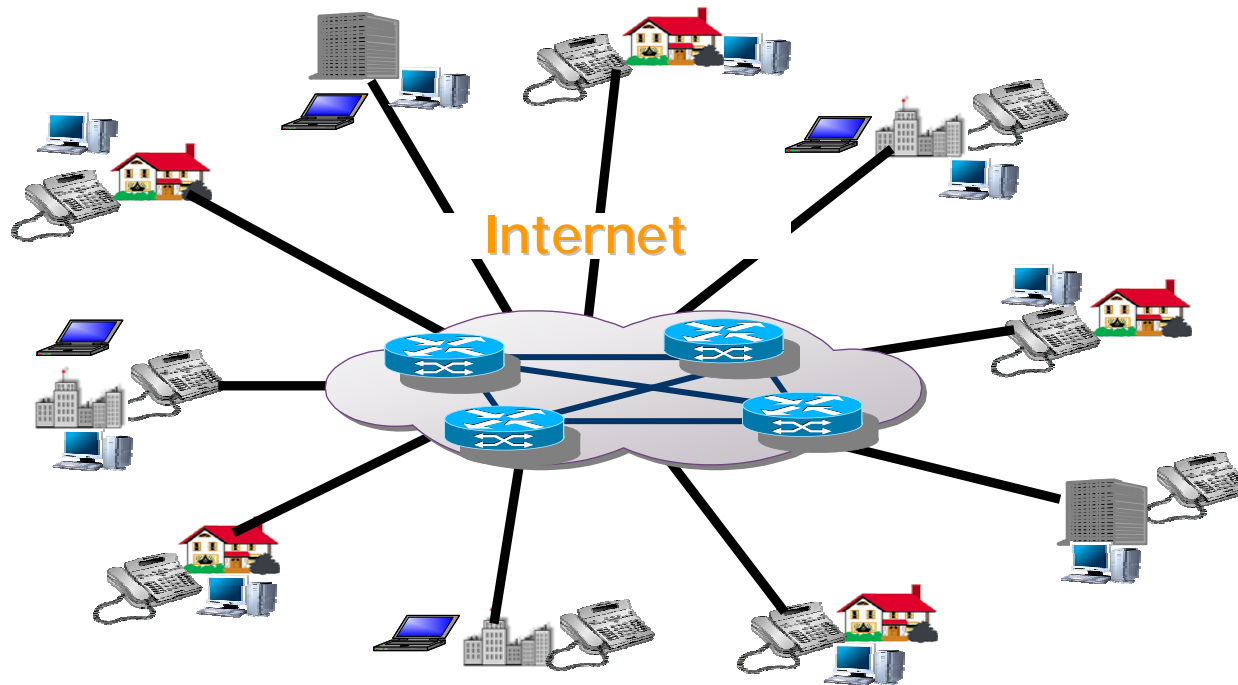
- ☞ "Internet" became an utility enabling us "distance-free" life.
- ☞ Centralized, client-server networks are being combined with Distributed, peer-to-peer networks.
- ☞ Network control power moved from "Big Brothers" to "You".

Internet

Being Mobile and Wireless

❋ **"Being Mobile and Wireless" since 1991**

- ■ Access networks are getting wireless, mobile and tetherless since "GSM" started its commercial services in 1991.

   ⛿ The mobility is the killer applications.

- ■ By "Being digital", your handset could include everything you can imagine such as MP3 player, Digital Camera, Camcorder and Mobile TV.

Example

1977

Being Networked

Being Digital

- 12 KB
- 1 MHz
- No Network

2005

Being Mobile

Being Digital

- 40 GB
- 2 GHz
- ADSL 2 Mbps

2010

- 80 GB
- 4 GHz
- Mobile WiMAX 34 Mbps
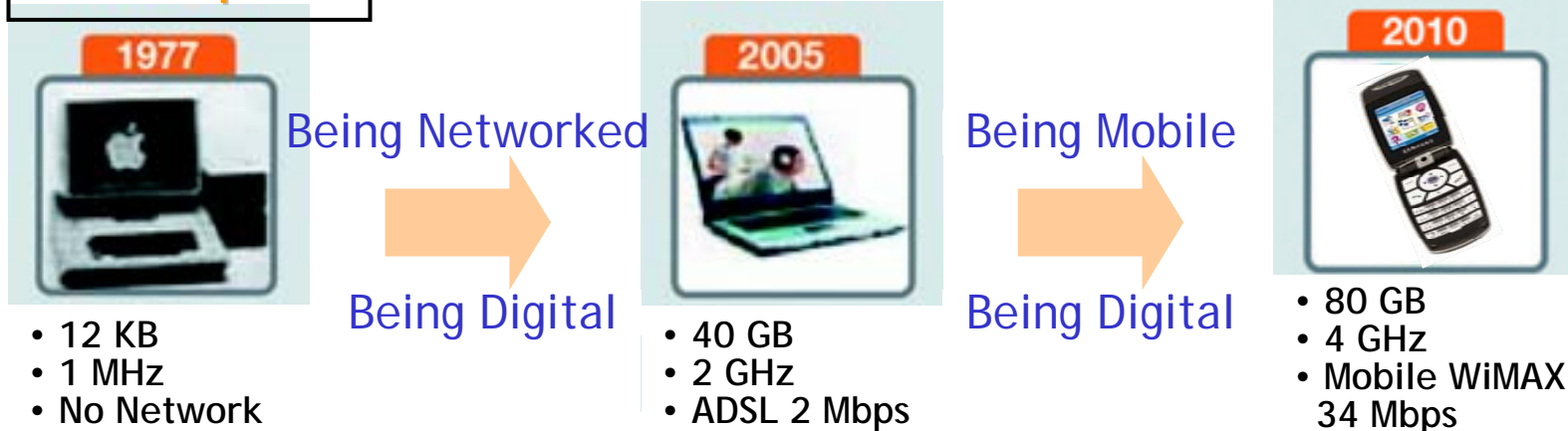
☞ "Handset" became the primary device and enables "you" to produce the contents easily and distribute them at very low cost.

- Production: You can create your own UCC using your handset or you can add your opinion on a book you read in Amazon.
- Distribution: You can download Headline news using your handset or you can upload your Open House picture on your Blog immediately.

- ENG had enabled reporters to collect news anywhere and SNG had enabled reporters real time broadcasting.
- HNG (Handset News Gathering) is just around the corner.

☞ "Mobile Devices" is not only going to change the world and but also going to change the way the world changes (Mobile Web 2.0).

IT Mega-trends

Next Generation Mobile

Next Generation Services

IMT-Advanced

- **Observation-1**: DSL performance defines the user expectations.
  - 4G services need Mbps per user to satisfy the customers.
- **Observation-2**: Consumers are unlikely to pay more on Mobile broadband services which is comparable to DSL performance.
  - Price per Mbps should be close to DSL service.
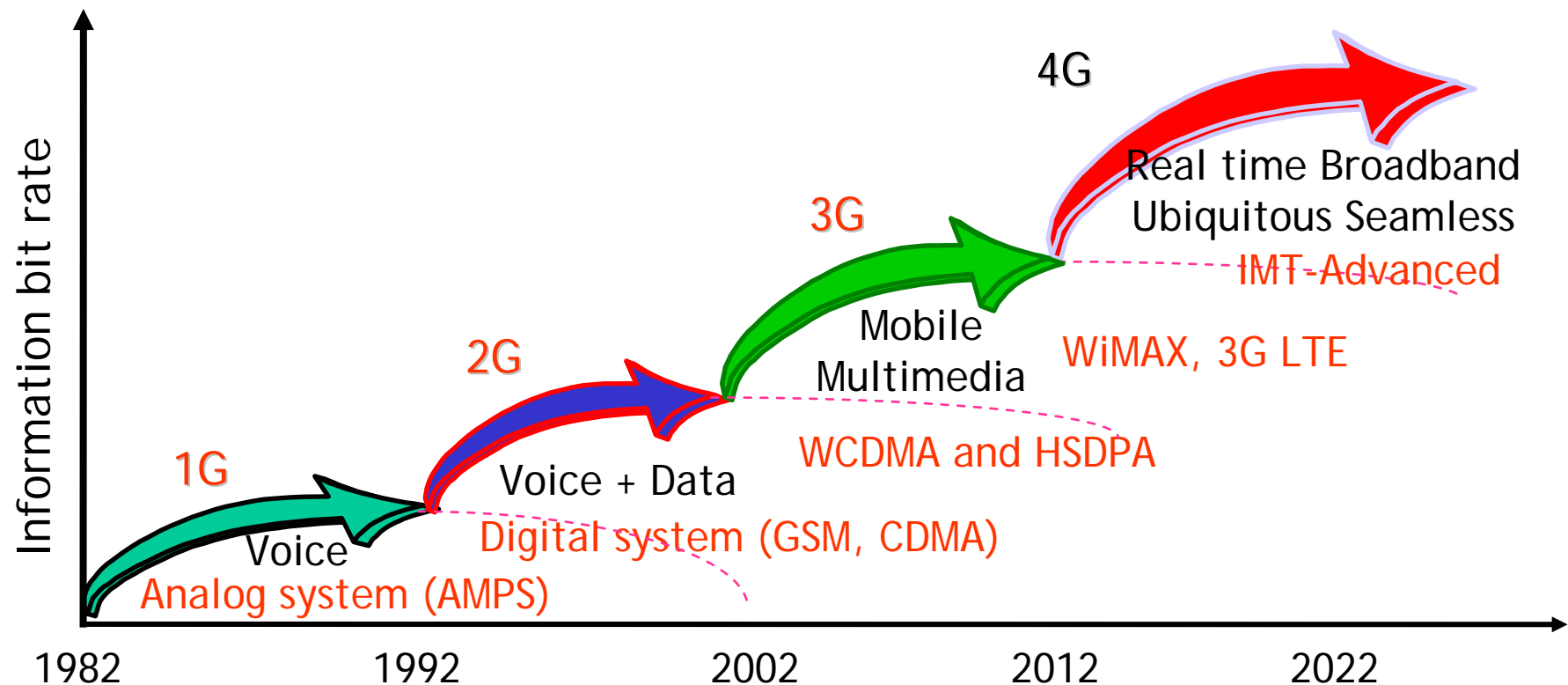
Market Observations

● **Korean Wireless Internet Research**

(Source: Merrill Lynch Research, 2003)

- Strong needs in Broadcasting as well as in Broadband applications
- Interests in business applications and m-commerce
- More coverage in mobile (e.g. subway) and indoor environments

● **Sprint Nextel Trial Findings**

(Source: NGMN Conference, June 2006)

- Market needs in Business applications; "Office anywhere"
- Interests in Visually rich, real time applications

● **"Video" and "User production and Distribution"**

(Source: Wired - "Six trends driving the global economy", July 2006)

- Peer production: Blogs, user reviews and photo-sharing
- Video unlimited: Samsung Mobile TV handset and Apple Video iPod
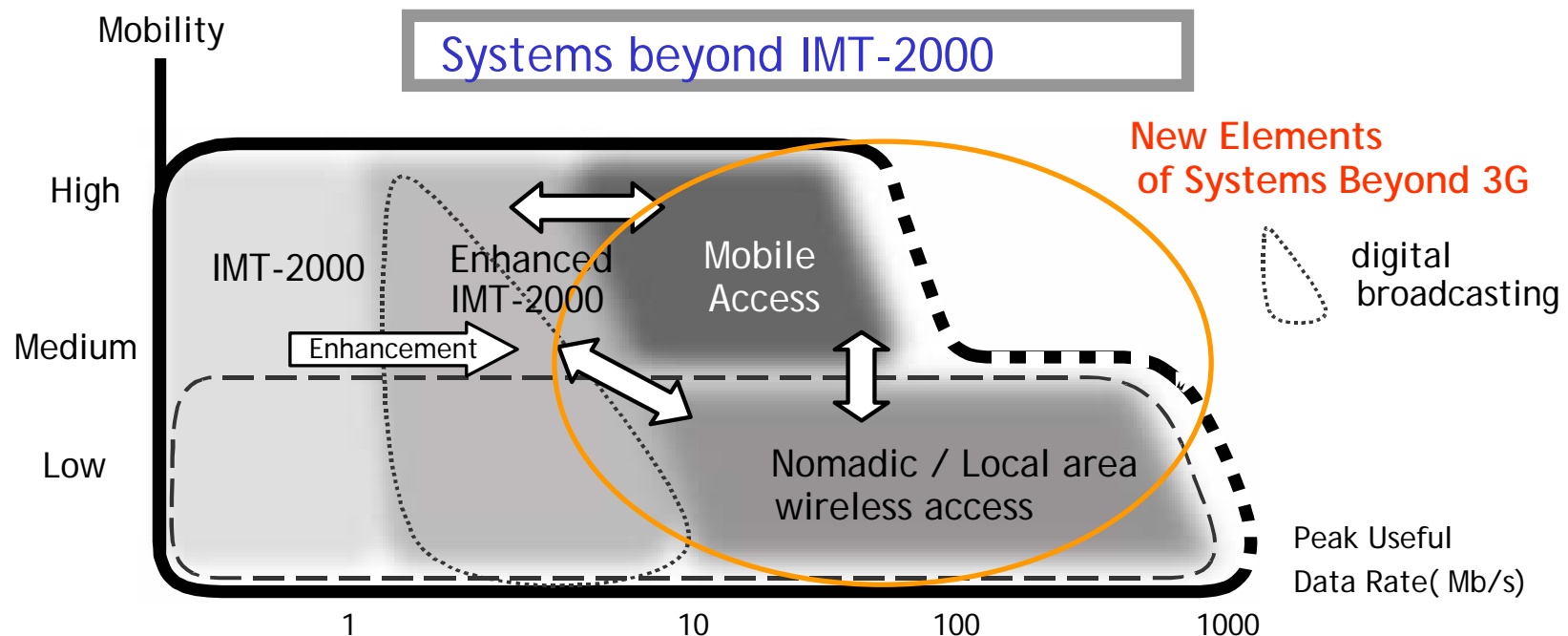
Standard Activities in ITU-R

- **Systems Beyond IMT-2000**
  - ITU-R Working Party 8F (WP8F) established in November 1999
  - Recommendation M.1645: drafted in 2003
- New Mobile Access: 100Mbps at High mobility

  New Nomadic/Local area Access: 1Gbps at Low mobility
- New Elements are named as IMT-Advanced in 2005

IMT-Advanced Roadmap

| 2003 Vision Rec. M.1645 | 2004-5 Services Technology Spectrum view |
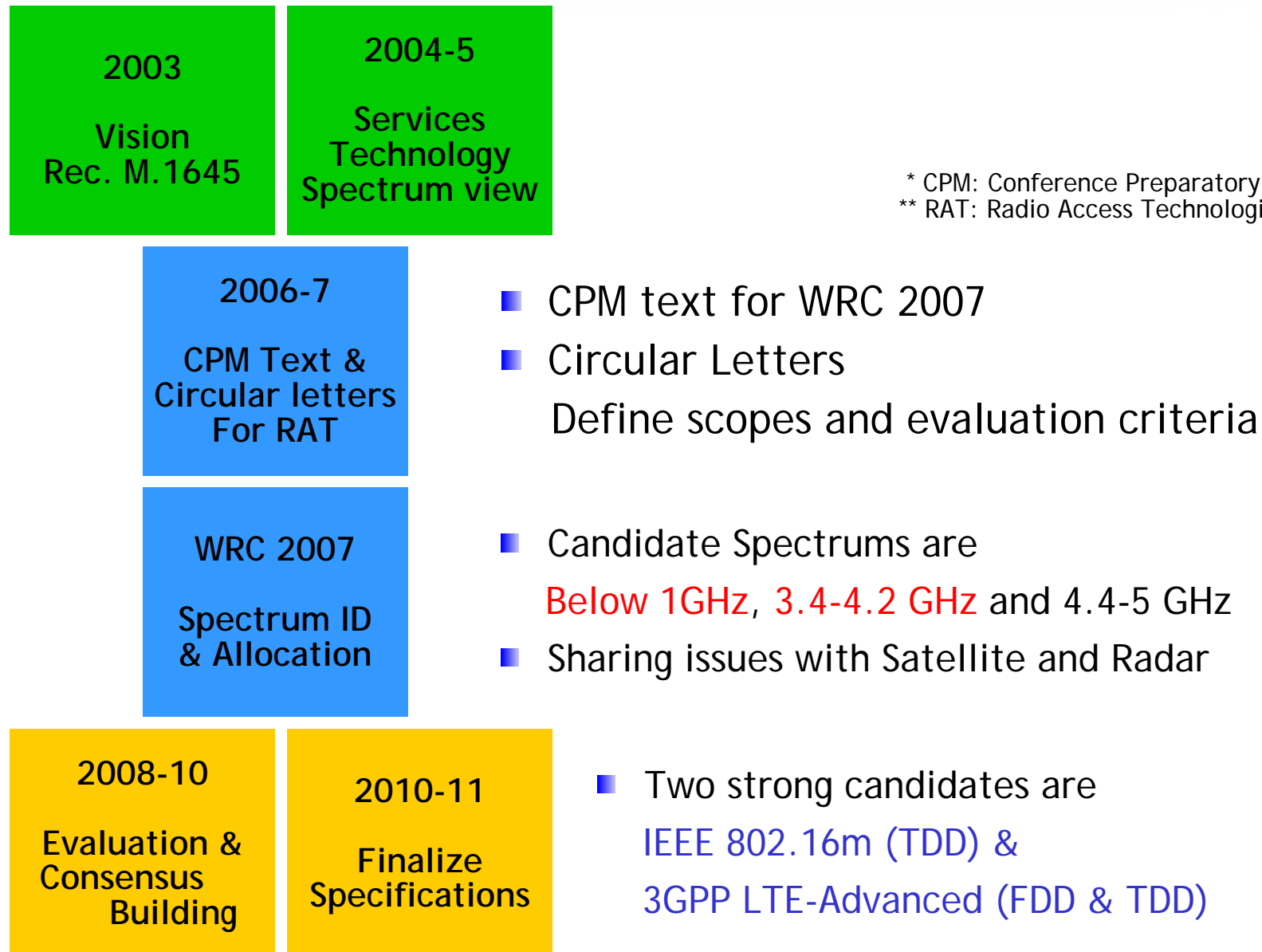
* CPM: Conference Preparatory Meeting
** RAT: Radio Access Technologies

2006-7

CPM Text & Circular letters For RAT

- CPM text for WRC 2007
- Circular Letters

  Define scopes and evaluation criteria

WRC 2007

Spectrum ID & Allocation

- Candidate Spectrums are

  Below 1GHz, 3.4-4.2 GHz and 4.4-5 GHz
- Sharing issues with Satellite and Radar

2008-10

Evaluation & Consensus Building

2010-11

Finalize Specifications

- Two strong candidates are

  IEEE 802.16m (TDD) &

  3GPP LTE-Advanced (FDD & TDD)
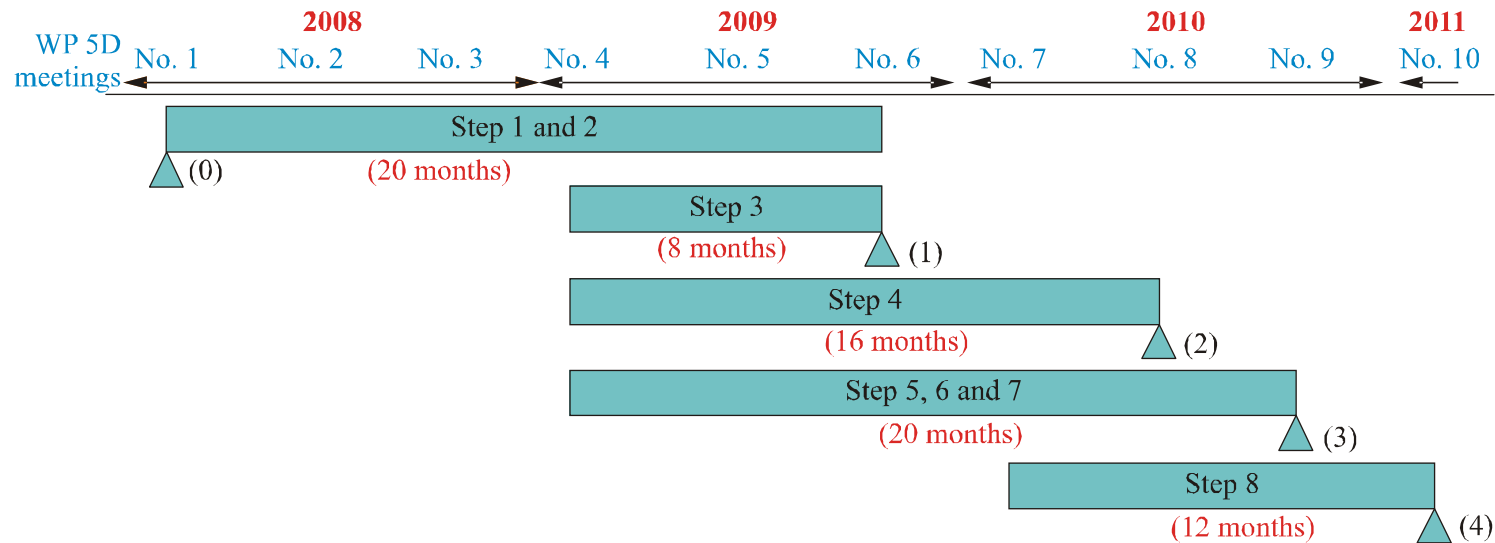
Steps in radio interface development process:

Step 1: Issuance of the circular letter
Step 2: Developement of candidate RITs and SRITs
Step 3: Reception of the RIT and SRIT submissions and acknowledgement of receipt
Step 4: Evaluation of candidate RITs and SRITs by evaluation groups

Step 5: Review and coordination of outside evaluation activities
Step 6: Review to assess compliance with minimum requirements
Step 7: Consideration of evaluation results, consensus building and decision
Step 8: Development of radio interface Recommendation(s)

Critical milestones in radio interface development process:

(0): issue an invitation to propose RITs — March 2008
(1): ITU proposed cut off for submission of candidate RIT proposals — October 2009

(2): Cut off for evaluation report to ITU — June 2010
(3): WP 5D decides framework and key characteristics of IMT-Advanced RITs and SRITs — October 2010
(4): WP 5D completes development of radio interface specification Recommendations — February 2011

IMT-Advanced A2-01

IT Mega-trends

Next Generation Mobile

Next Generation Enablers

Broadband Mobile

Enabling technologies

Summary

Is Broadband Mobile Coming ?

* **Mobile users** and **Mobile data** increase rapidly !!!
  - ▪ 3 billion mobile users worldwide and 25% growth rate in 2006
  - ▪ Mobile data service revenues (in 4Q/2006) increased up to 12-14%
    - ● Credit goes to more flat-rate pricing on data
    - ● Data ARPU takes a bigger share of total ARPU (increased up to 20%)
* **Current infrastructures** (3G and Wi-Fi) isn't good enough !!!
  - ▪ 3G Mobile Internet Service
    - ● Expensive: Billion dollars spent to buy 3G Spectrum
    - ● HSPA (launched in 2006) supports 14.4Mbps DL and 5.76Mbps UL
  - ▪ Wireless LAN Service
    - ● Coverage is limited and W-LAN cannot support the mobility
    - ● Interference due to excessive un-coordinated AP installation
* Will **Mobile WiMAX** and **3G LTE** solve the problem ?
  - ▪ Mobile WiMAX commercialized in Korea and upcoming in USA.
  - ▪ The first 3GPP LTE commercial service is expected in 2010.

OFDM and MIMO are almost ready !

* OFDM
  * Modem performance already approached theoretical limit, so the simple way to increase the capacity is to increase the bandwidth.
  * OFDM is the best technology in terms of the receiver complexity as the bandwidth increases.

* MIMO
  * As the number of antenna in Tx and Rx increases, channel capacity increases linearly.

☞ OFDM and MIMO are already proven technologies in Mobile TV, WLAN and Mobile WiMAX (and 3G LTE) radio interfaces.

☞ Samsung has shown that OFDM and MIMO are the cost effective enabling technologies for 4G broadband mobile through Mobile WiMAX commercialization and Samsung 4G Forum Demo.

All IP flat architecture Determined !

✱ Low Cost is the killer application !!!

■ 4G network architecture should guarantee low TCO (total cost of ownership) and reasonable service cost.

■ It should provide seamless mobility, low-latency (e.g. real time game), higher-throughput (e.g. video), support for QoS and security.

■ It should ensure integration with legacy infrastructures as well as smooth evolution to 4G network architecture.

▷ All IP flat network architecture is the 4G architecture that Mobile WiMAX and 3GPP SAE (System Architecture Evolution) already adopted.

■ Less CAPEX (e.g. Backhaul cost)

● Simple IP flat architecture enables operator less CAPEX by reducing # of equipments and by supporting "infra sharing and leasing"

■ Less OPEX (e.g. Staff cost)

● Self-configuration and self-optimization will reduce OPEX.

Lessons from 3G

- Mobile operators formed NGMN to provide a vision for NG

  - China Mobile, KPN, NTT-DoCoMo, Orange, SK Telecom.,
    Sprint-Nextel, T-Mobile & Vodafone etc.

- Lessons learned from 3G summarized in NGMN WP version 2.1

  - The wide range of interests of the participants in Standard has led to development delay, compromises in design, the need to support redundant options, and missed opportunities for interoperability.

  - A very undesired and unexpected experience when introducing 3G systems has been the very poor support of operational tasks by O&M systems, mostly network element managers which are rarely addressed in the standardization forums.

  - Some technology companies are beginning to use IPR license fees in a manner that violates the spirit of those earlier agreements (FRAND) and threatens the health of the mobile industry ecosystem.

  - In order to avoid the experience of 3G where fully-functional UEs were unavailable for testing and early deployment, a portfolio of device shall be made available well in advance of the commercial launch.

Summary

Customers

- Multimedia Handset
- Broadband and Broadcasting
- Prosumers: Mobile Web 2.0

⚑ Broadband Mobile

Operators

- Broadband (video) Market
- Business Applications
- Integration and Evolution

⚑ All IP flat Architecture

Enabling Technologies
OFDM, MIMO, FSU

⚑ Customers are getting ready with Broadband Mobile !!!

⚑ Enabling technologies are being proven and almost ready !!!

⚑ Only Early adopters will enjoy the upcoming 4G market !!!

So Radical Today, So Obvious Tomorrow

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Photograph by Jim Richardson

Celtic Realm
National Geographic magazine, March 2006
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