

IEICE Lecture Meeting in Bandung

Advances in Wireless Networks Towards a Ubiquitous World

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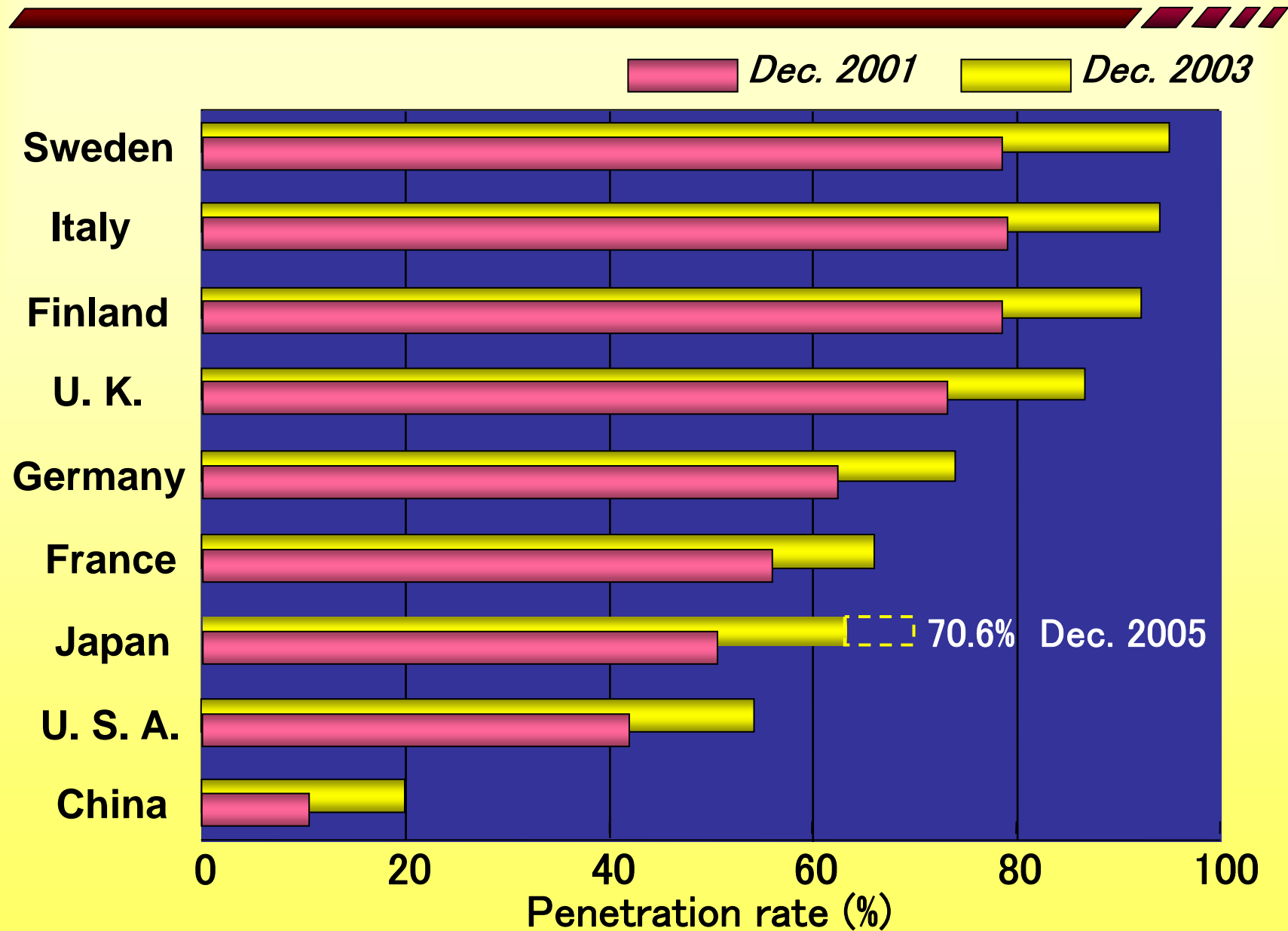
先端ワイヤレスコミュニケーション研究センター

Advanced Wireless Communication research Center

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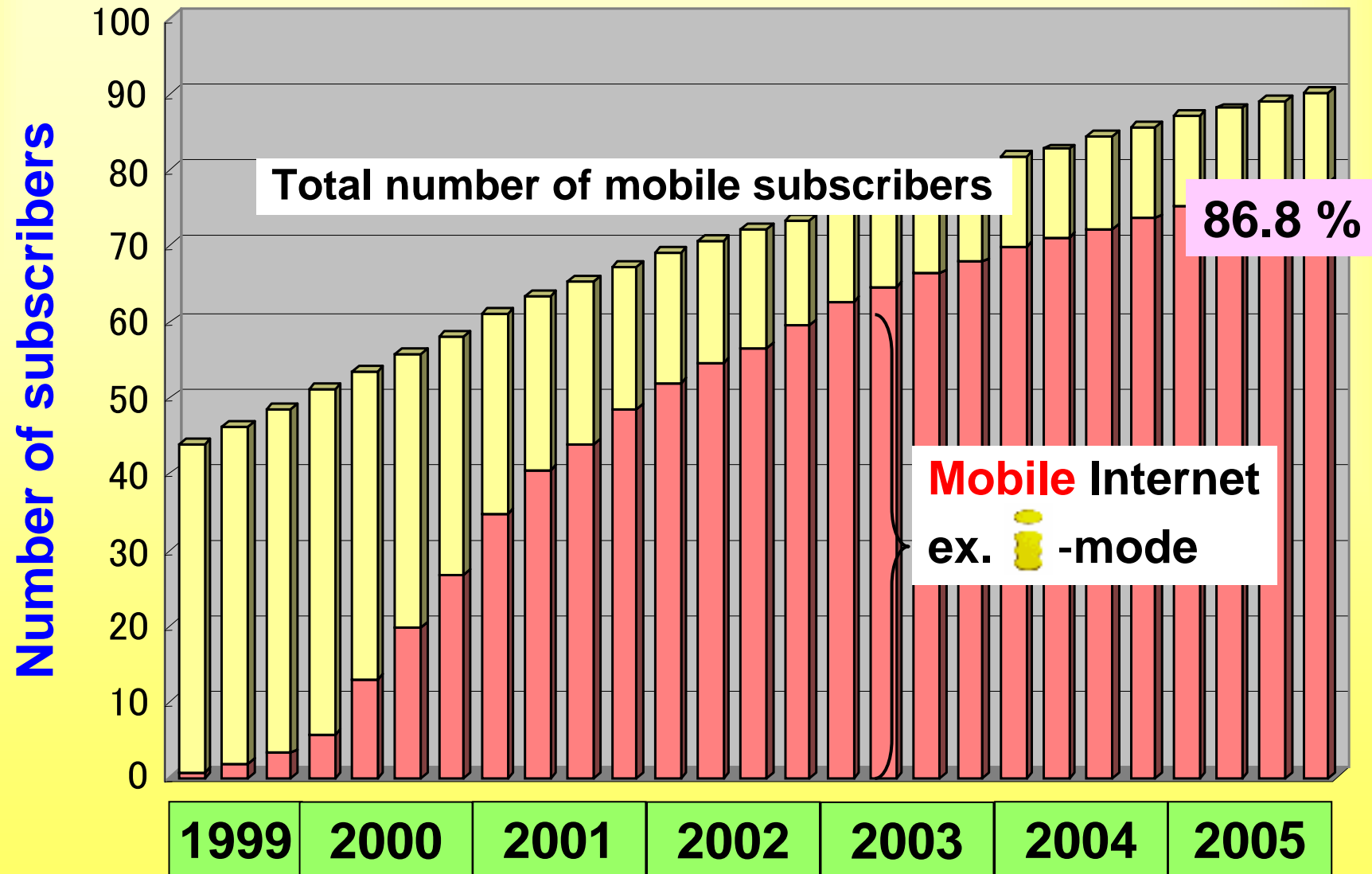
- Current market trends
- Evolution scenario from 3G to 4G
- “Mobile Ubiquitous”
A synergistic combination of mobile communication systems and a ubiquitous environment.

Mobile Phone Penetration Rate

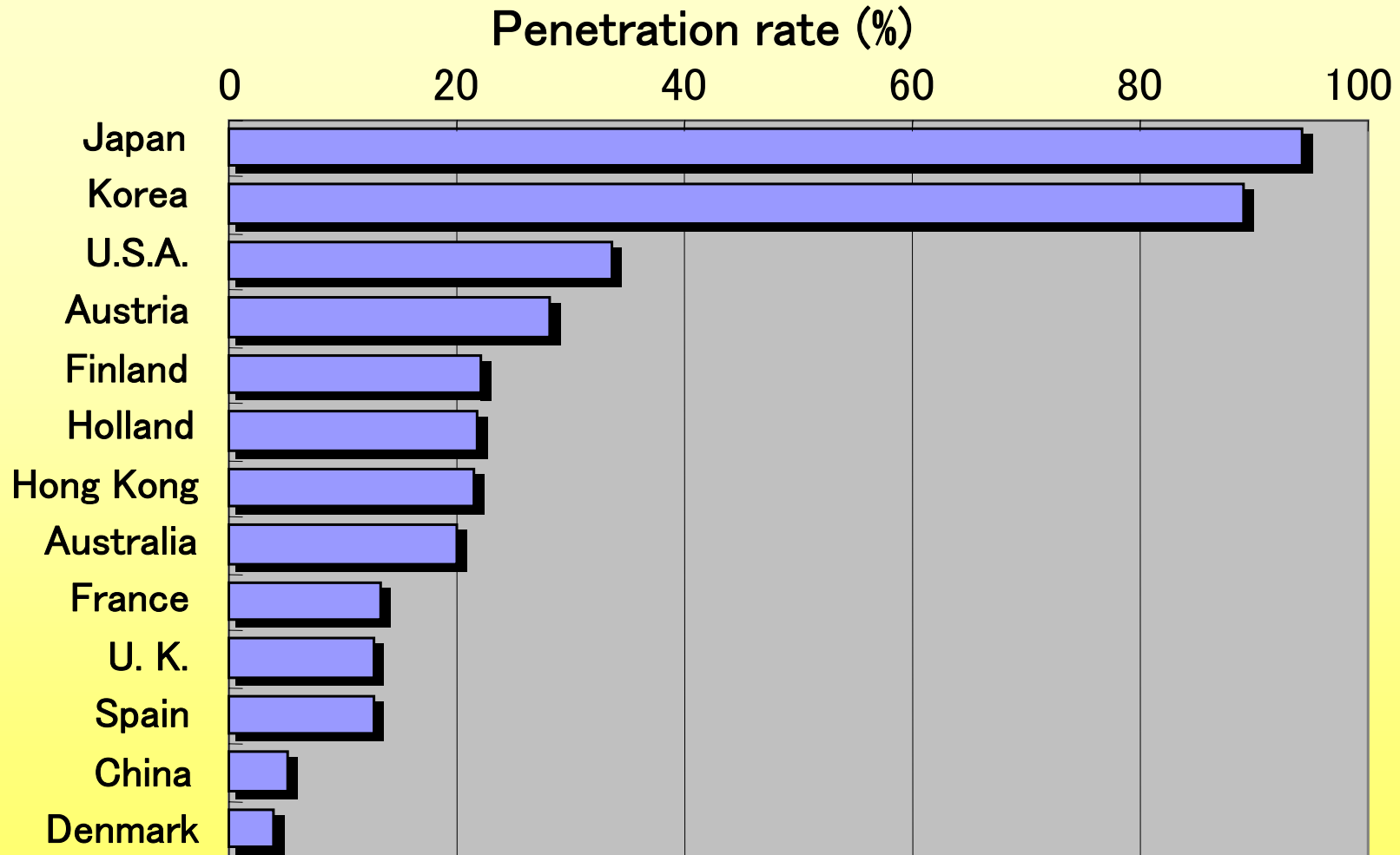


Mobile Internet Migration in Japan

(Millions)



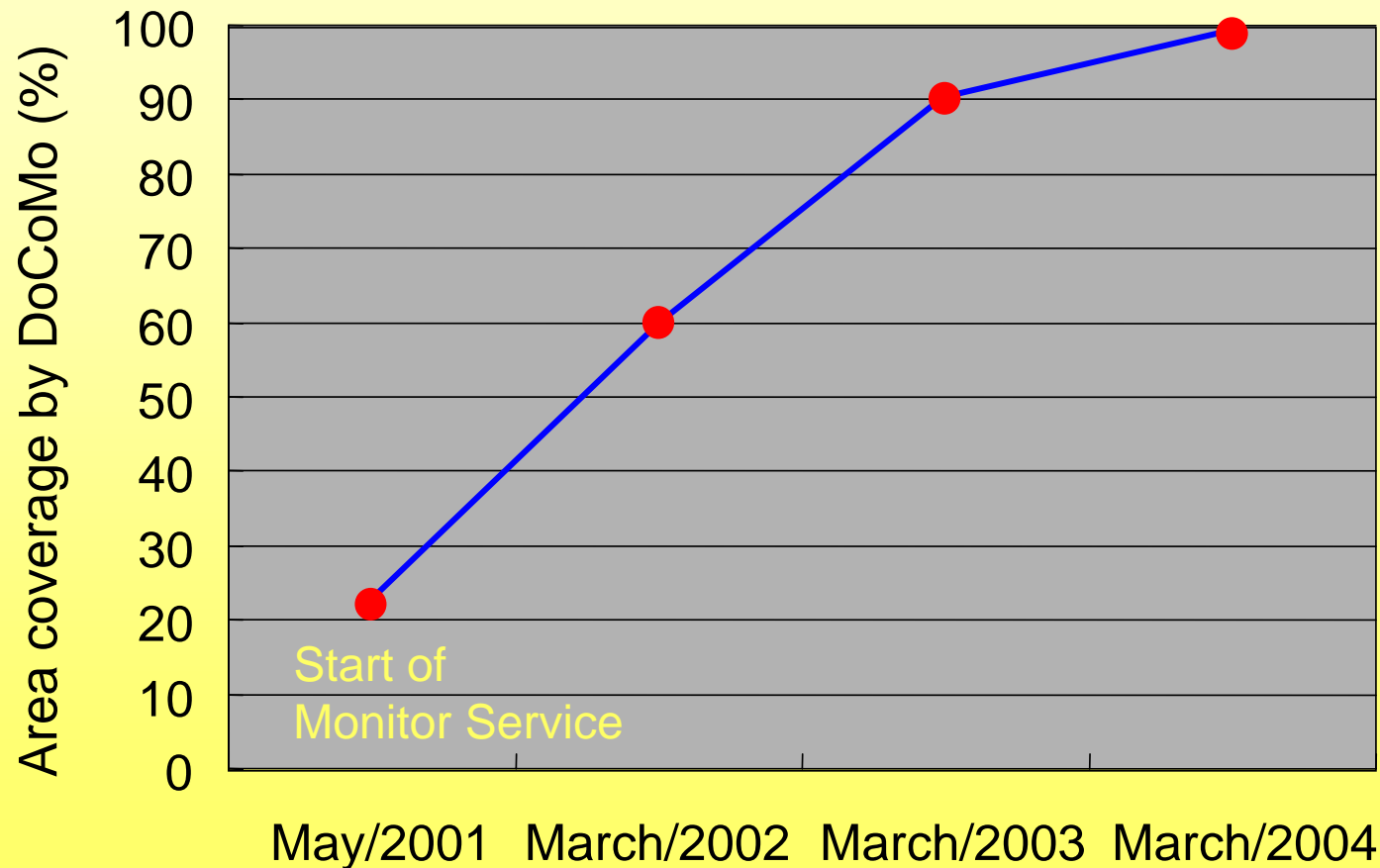
Mobile Internet Migration in the World



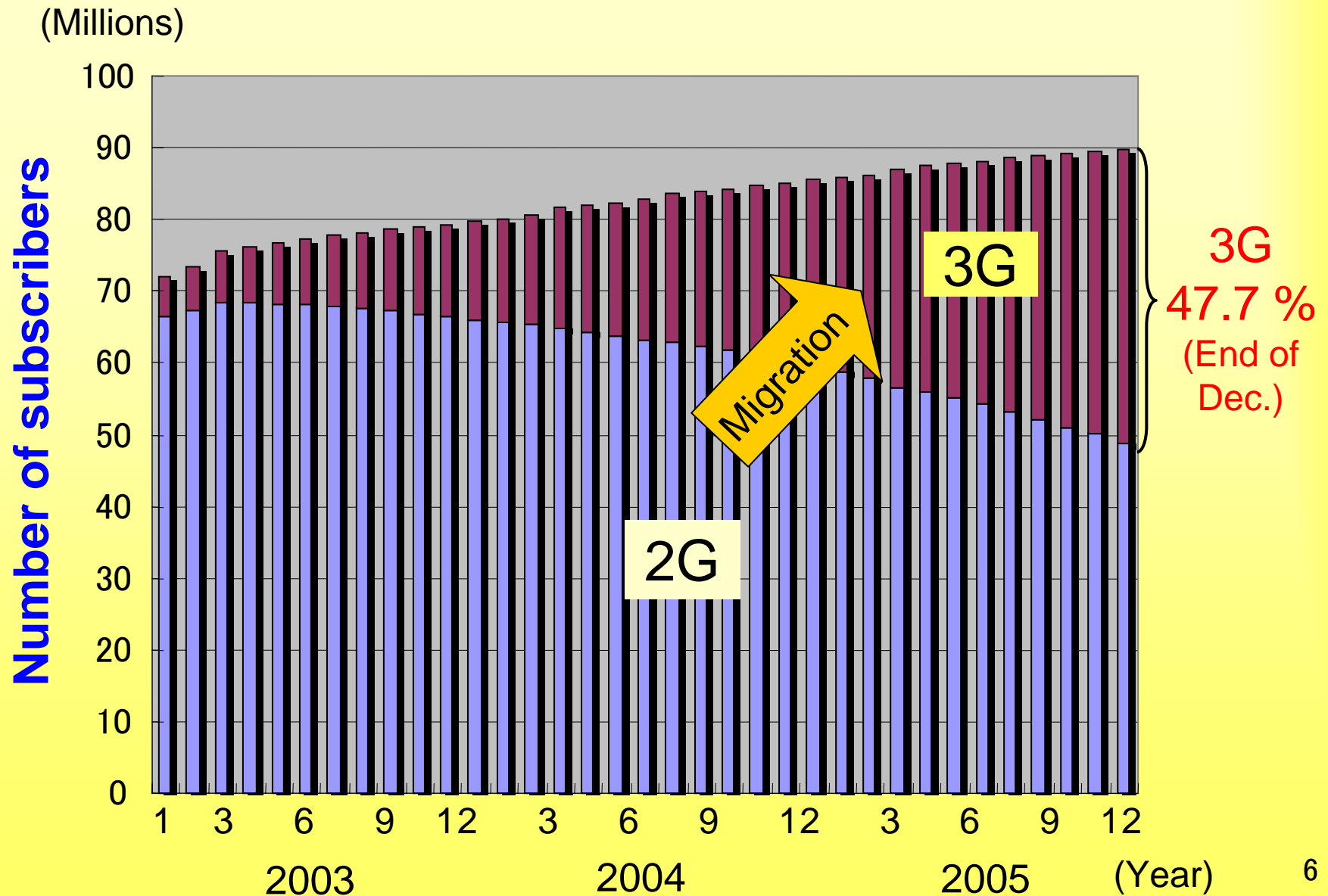
From "2005 White Paper: Information and Communications in Japan"
by the Japanese government.

3G Deployment in Japan

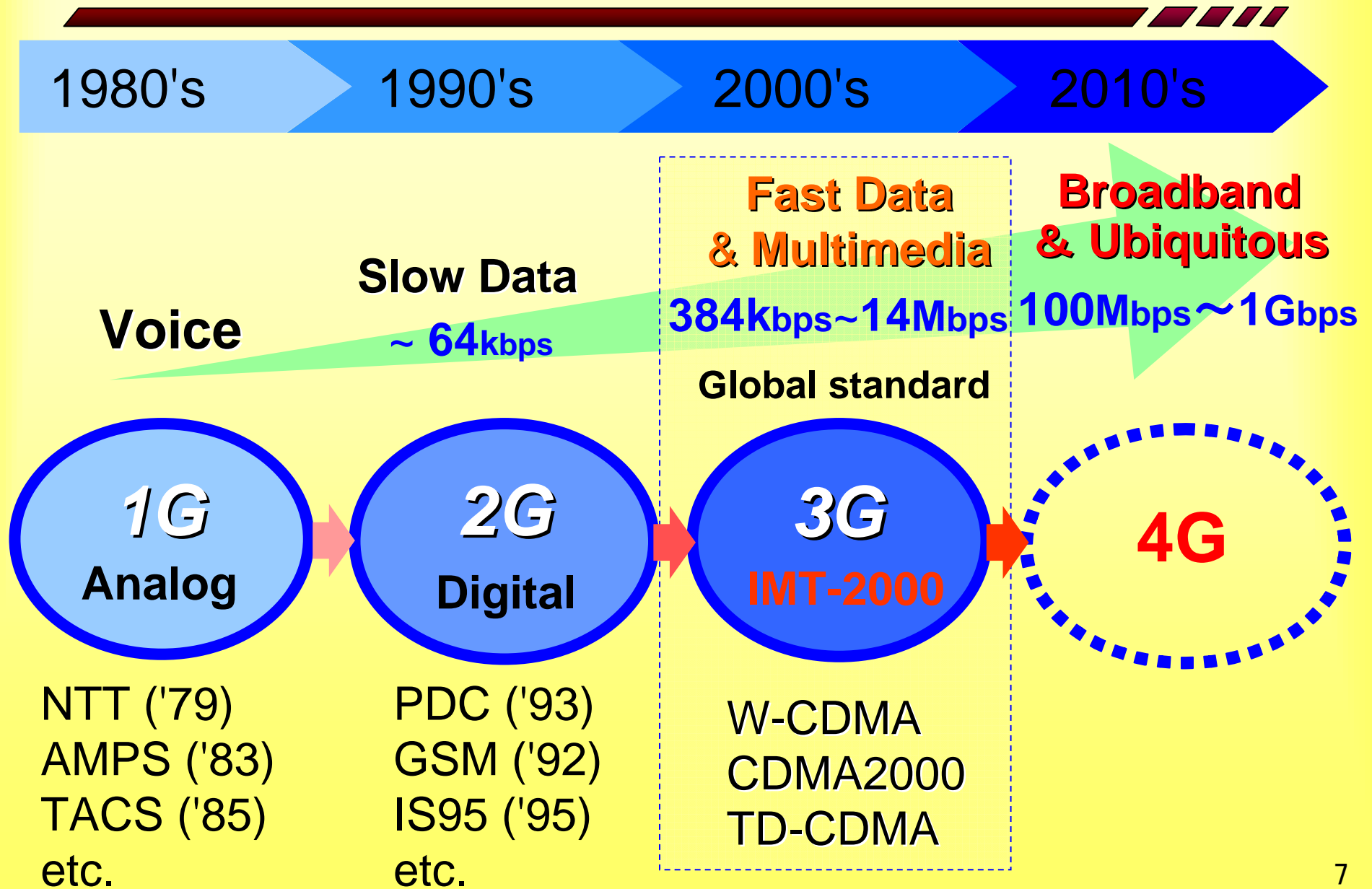
- **Nationwide deployment** (Population coverage of **99%**) was achieved at the end of March 2004.



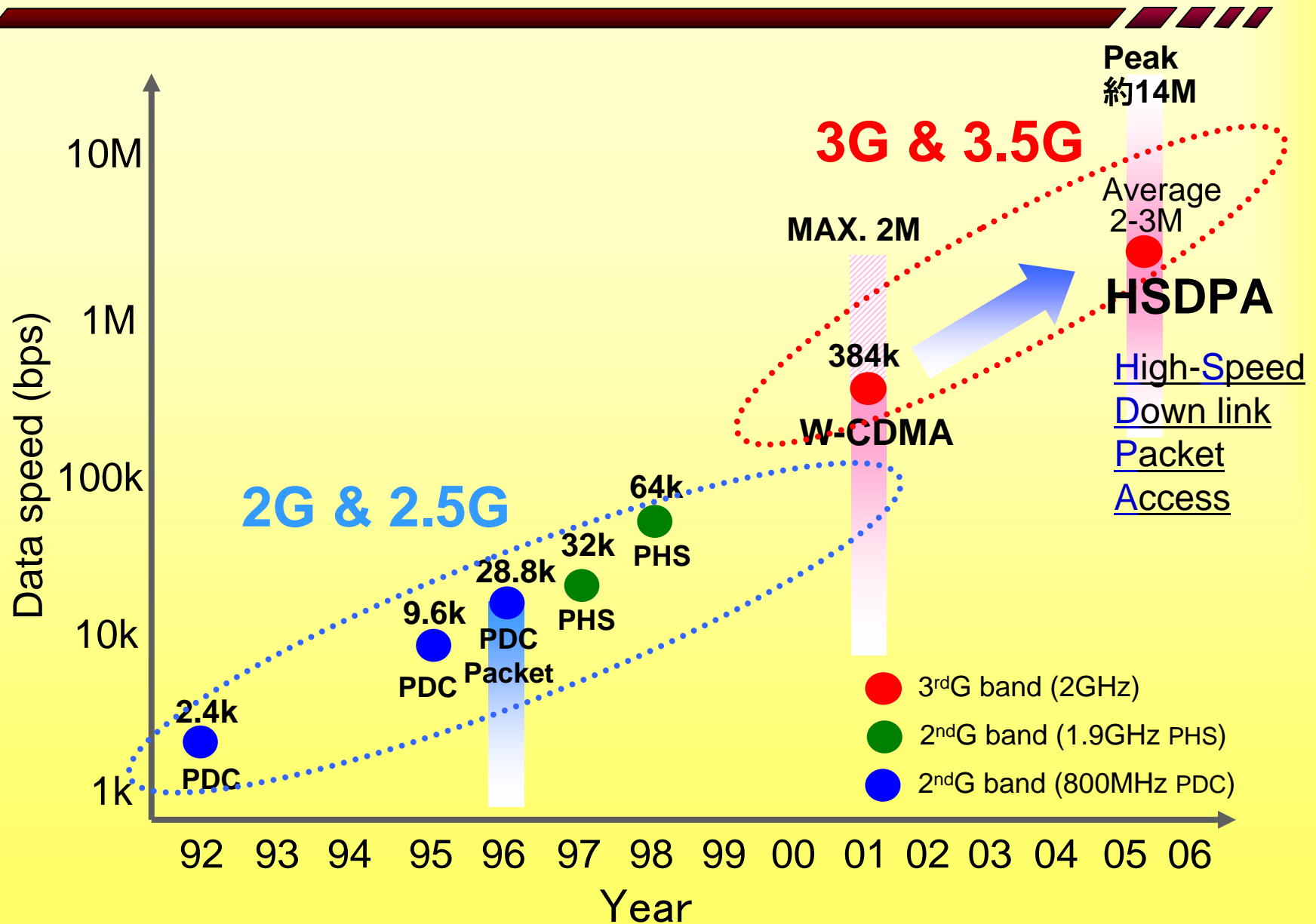
Increase of 3G Subscribers in Japan



Advances in Mobile Communication



Enhancement of Data Speed

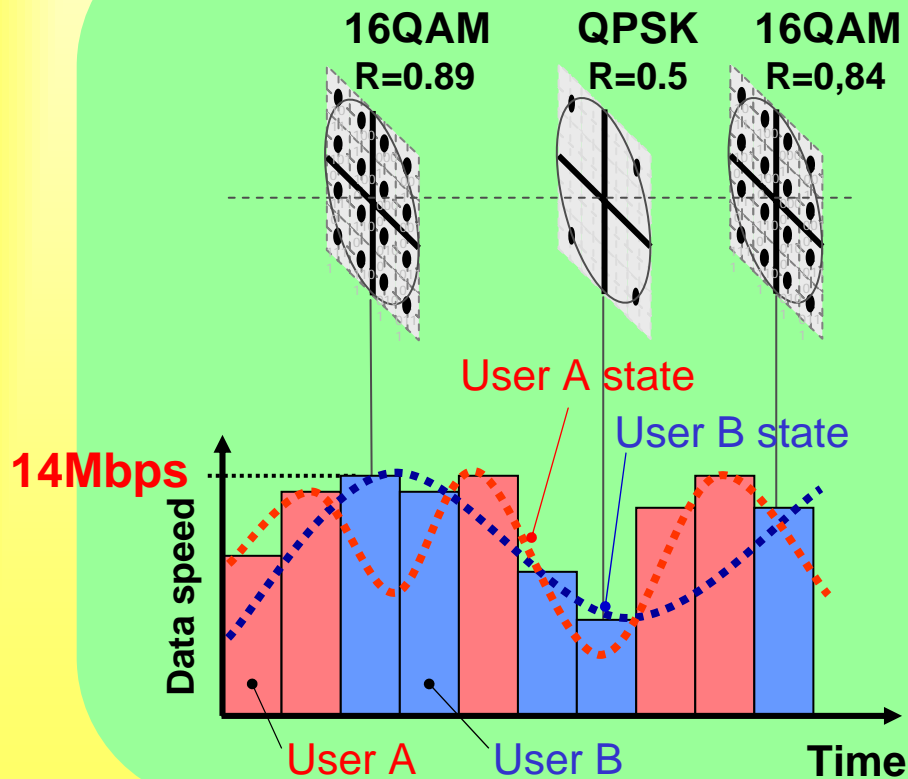


HADPA (High-Speed Downlink Packet Access)

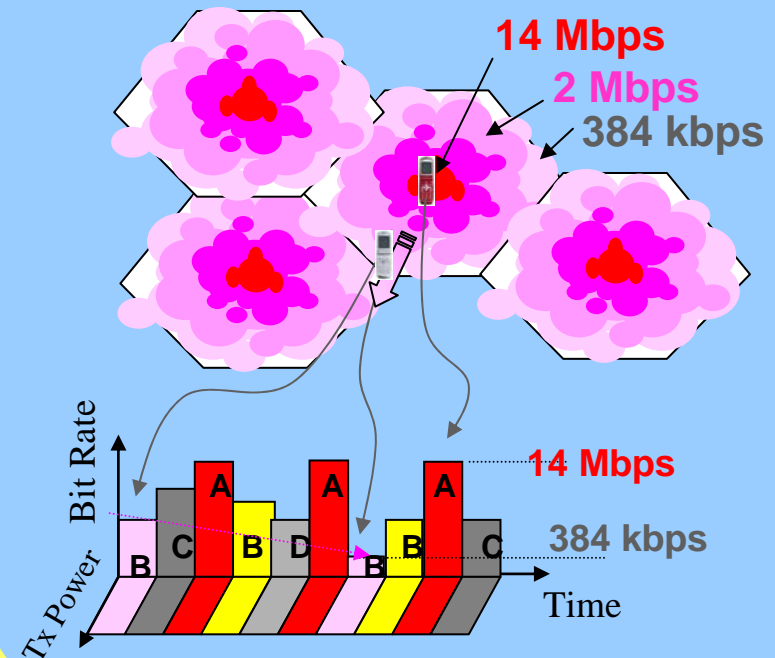
- Goal;**
- Low bit-cost by more efficient use of down link radio resource.
 - Increase peak and average user throughput.

- Technologies;**
- Adaptive modulation and encoding, Hybrid-ARQ

Adaptive modulation and encoding



Packet speed changes from 384 kbps to 14 Mbps for each user.



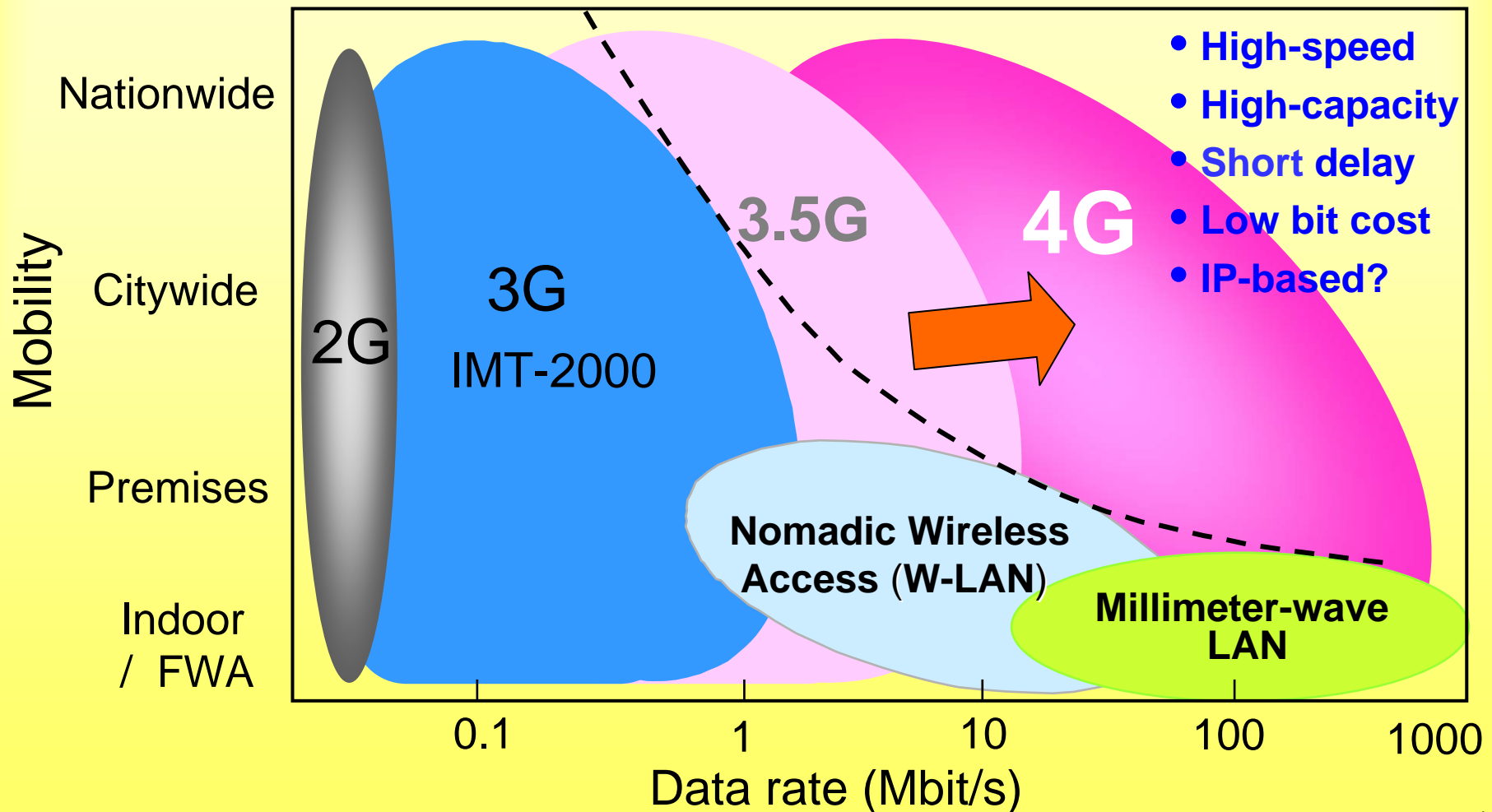
HSDPA Terminals (Prototype)

- DoCoMo developed prototype terminals with maximum down link speed of 3.6 Mbps.



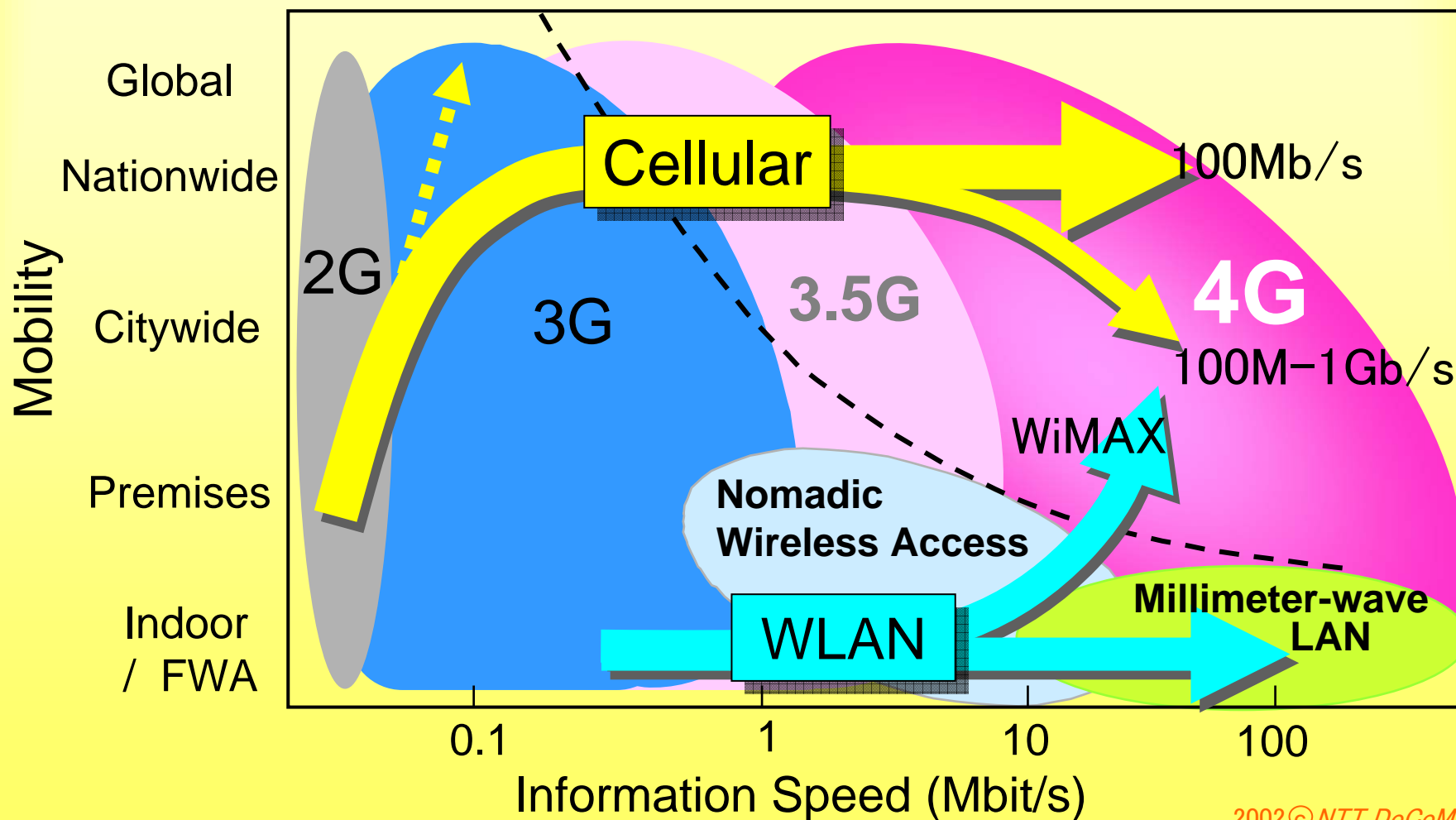
4G Enhancement in Transmission

- New **Broadband Packet Wireless Access Technology** will remarkably enhance system performance.



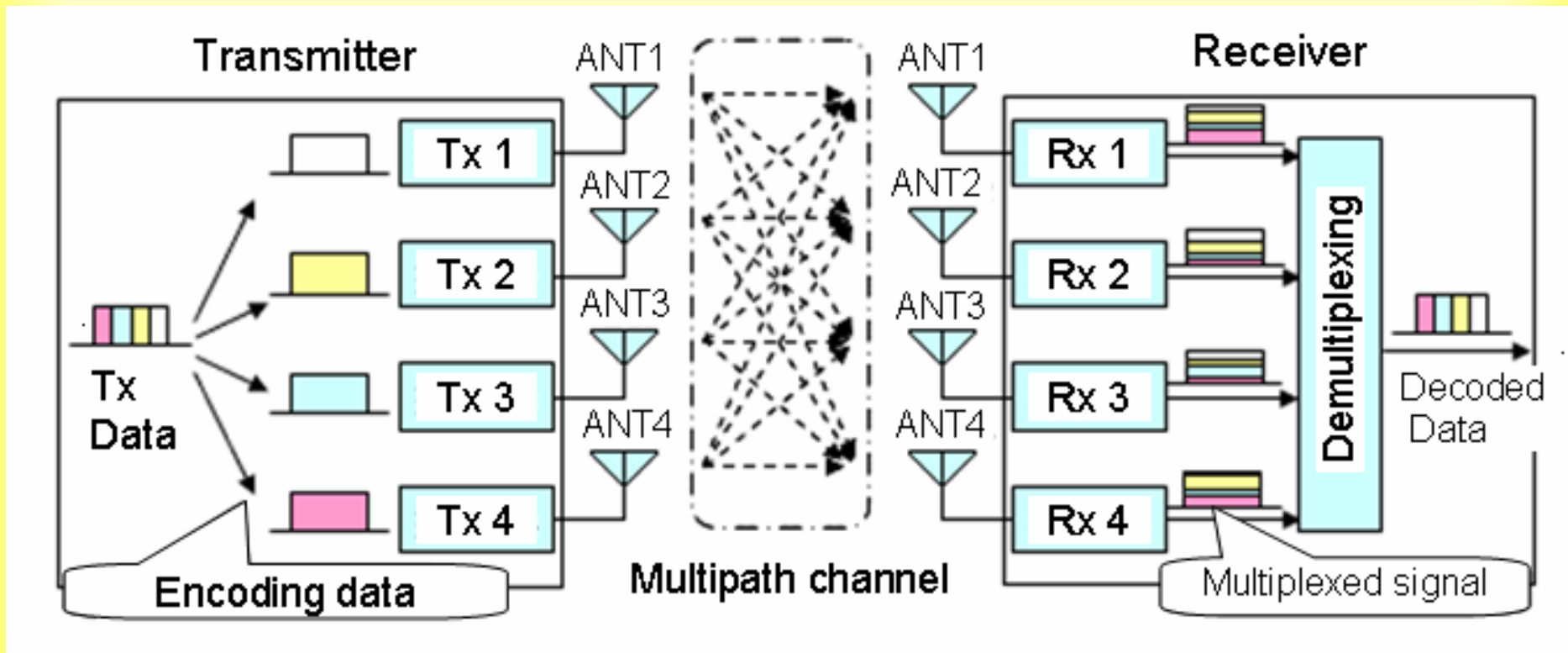
Two Streams with Overlapping Goal

- Cellular and Wireless LAN technologies will target a similar field.



1Gbps Wireless Access

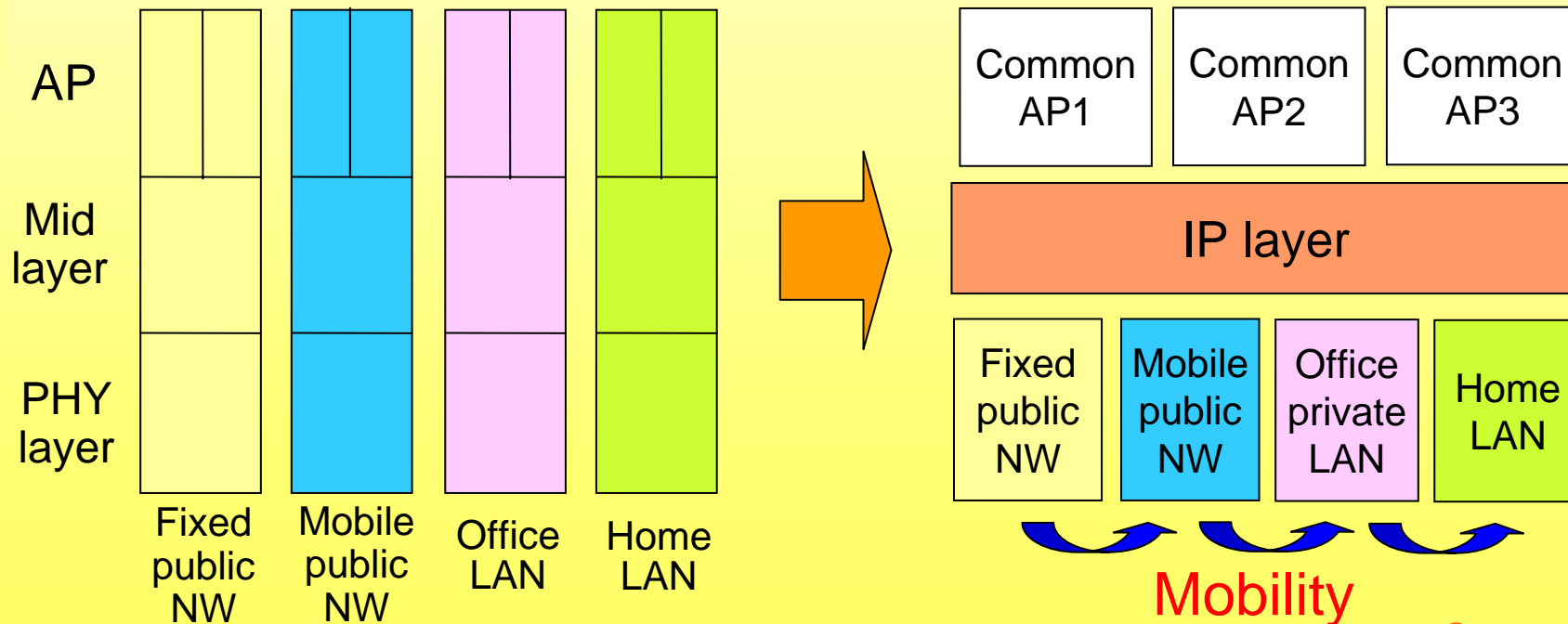
● MIMO (Multiple-Input Multiple-Output)



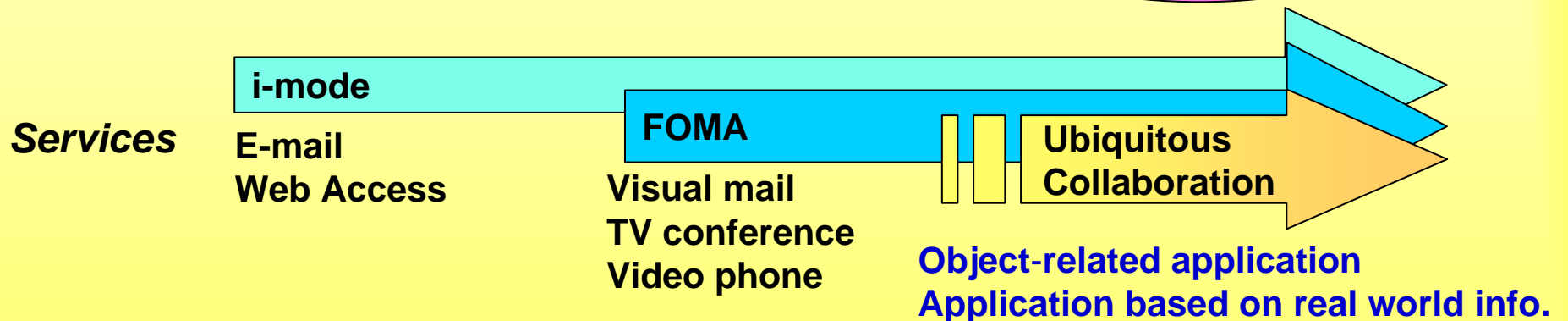
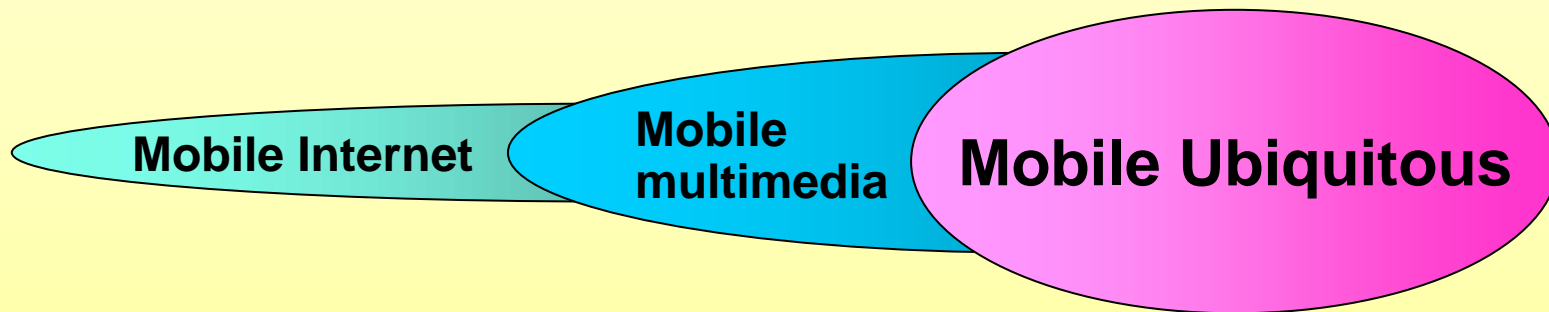
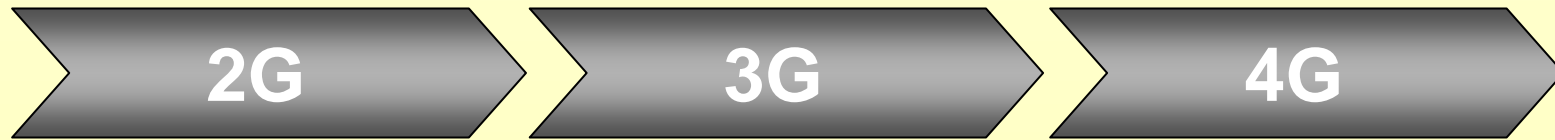
Spectrum efficiency target: 10bit/Hz
Demultiplexing method is the key.

IP Network Technology Impact

- **IP Convergence in Layer 3** may enable **Seamless Service** among heterogeneous NWs.
 - **Unified Mobility Management** (Both macro- and micro-mobility) is key technology.
 - **Security Measures** will be more important considering connection to private NWs.



4G Evolution Scenario



Vision of Future Wireless Communication

● MultiSphere Model (Ref. WWRF report)

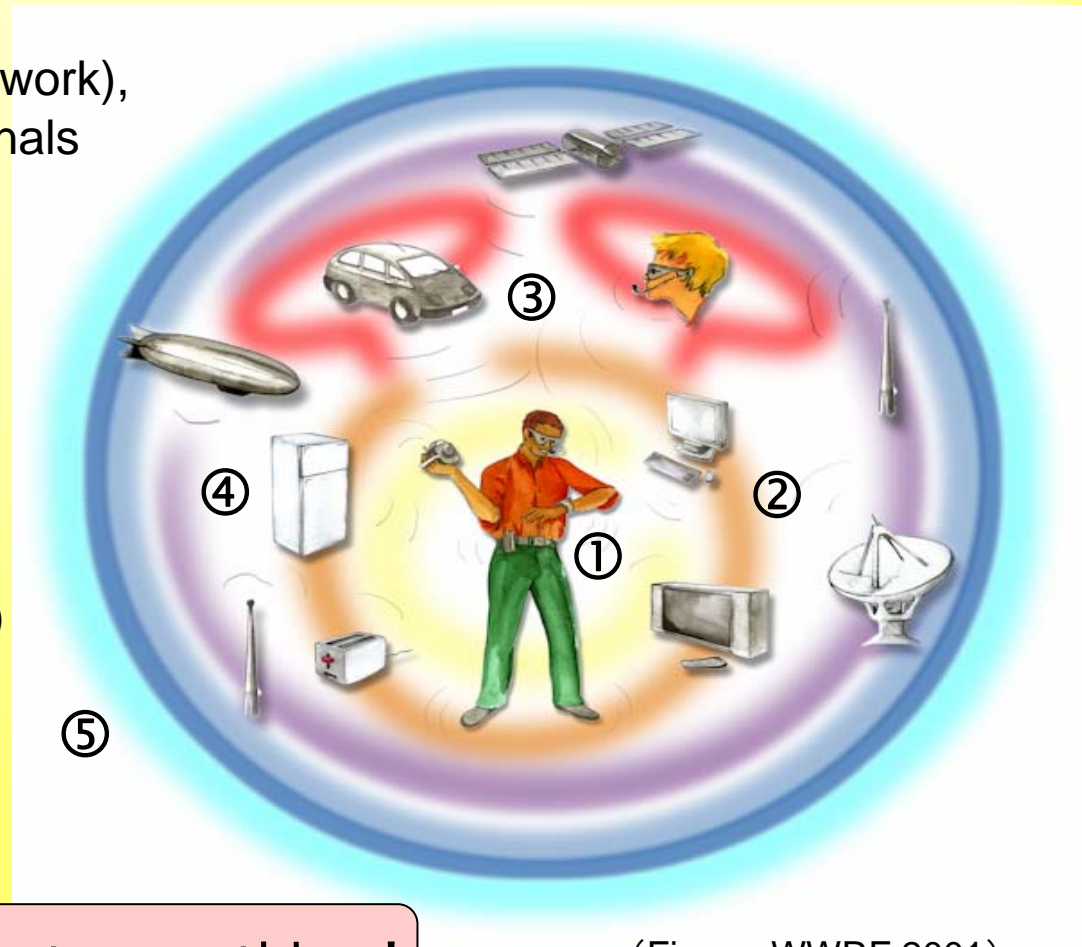
Level ①: **PAN** (Personal Area Network),
Wearable Devices Terminals

Level ②: Immediate Environment
(**Ubiquitous**)

Level ③: Instant Partners
(**Ad hoc** Networking)

Level ④: Radio Accesses (Global)
3G, 4G **Mobile Network**

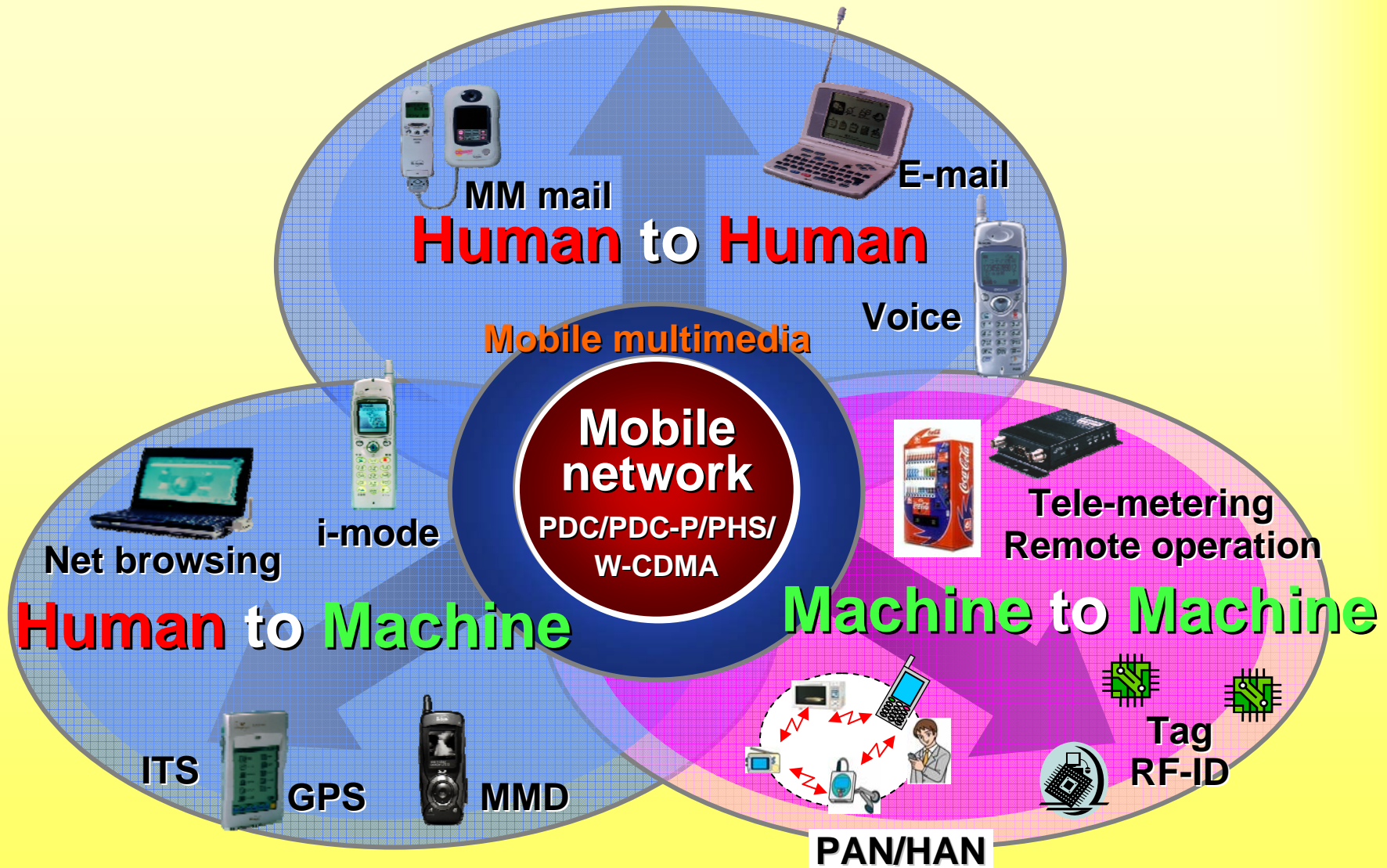
Level ⑤: CyberWorld (**Internet**)



Wireless technologies connect everything !

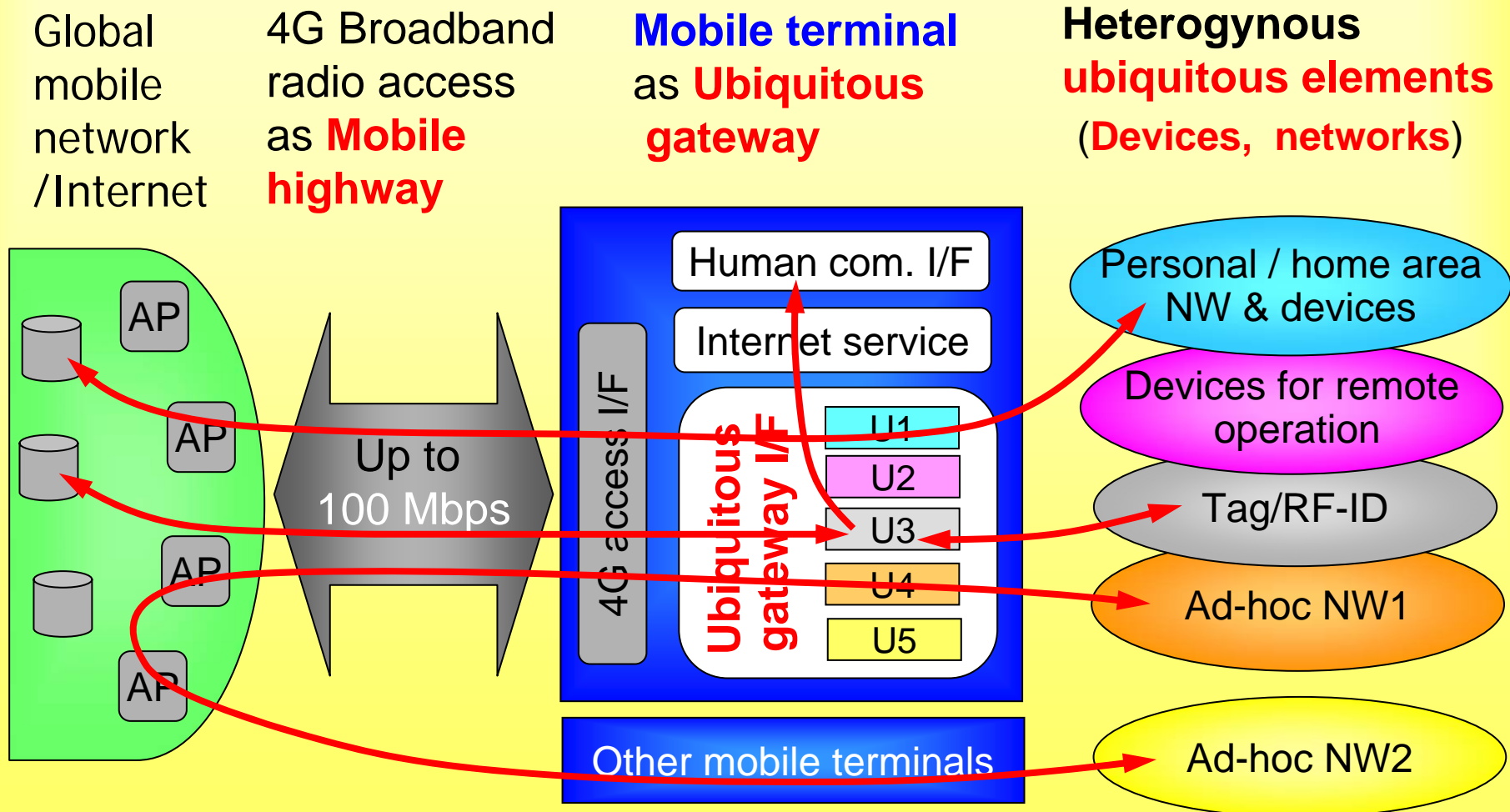
(Figure: WWRF 2001)

Ubiquitous: Non-Human Communications



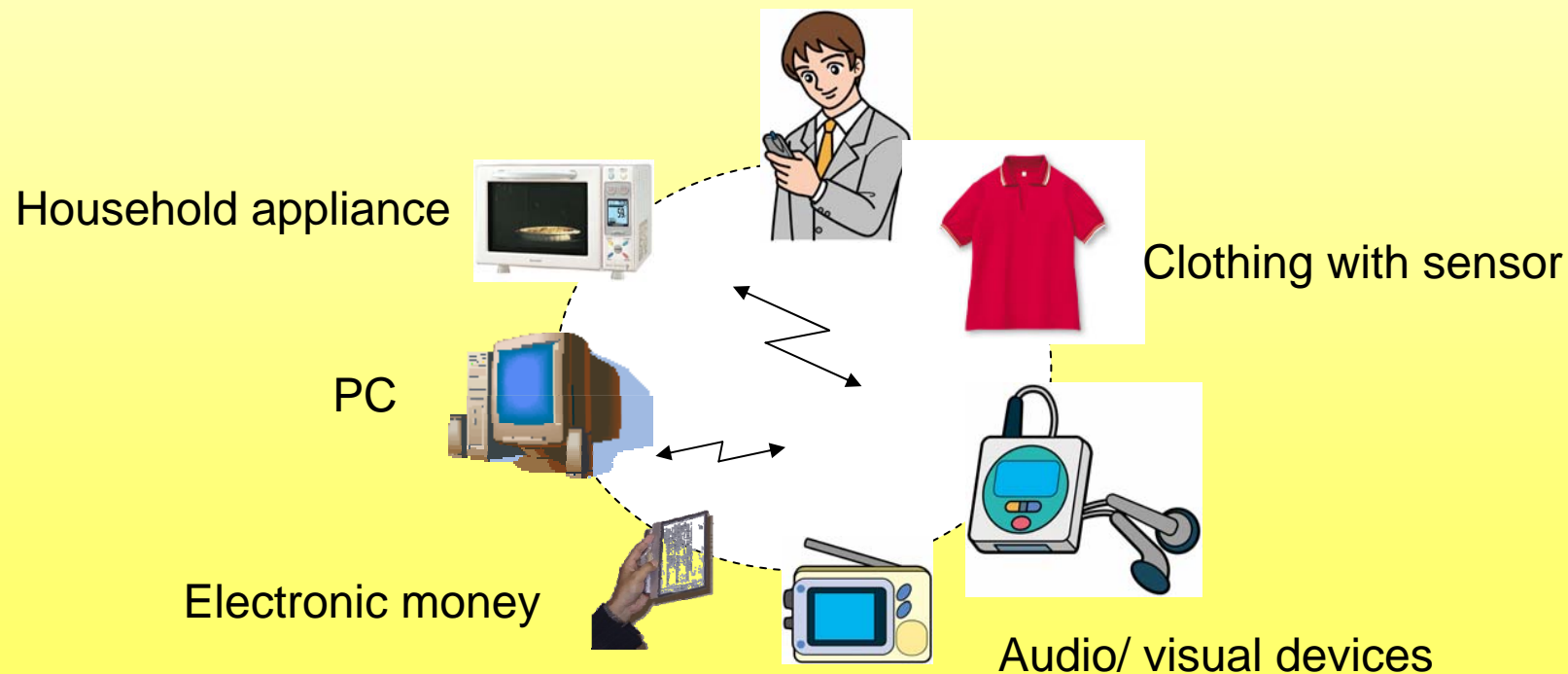
Mobile Ubiquitous Model

- Mobile terminal can "network" with various ubiquitous elements.



Ubiquitous Element (1) -PAN/HAN-

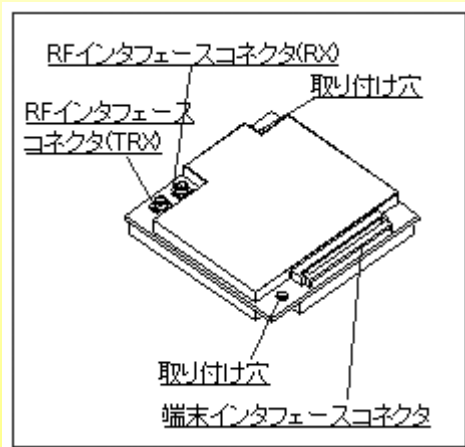
- Personal Area Network (**PAN**)
Home (or Room) Area Network (**HAN**)
- **Logically reconfigurable terminal** – enhancing its function with surrounding devices available at that time.



Ubiquitous Element (2) -Device for Remote Operation-

- **Dopa* ubiquitous module** can be installed in any machine or product and adds a packet communication function.

* DoCoMo Packet service by PDC-P system



Size: 37 x 35.7 x 5 mm
Weight: 13 g



Vending machines



Video monitors



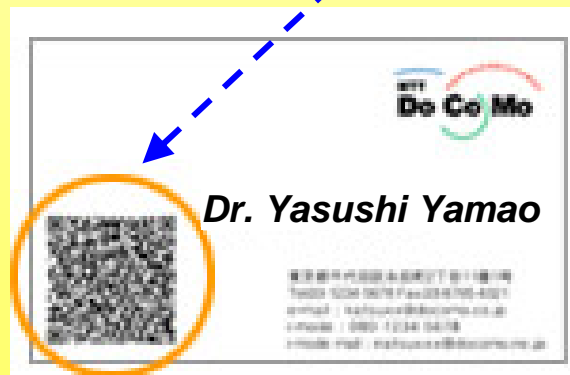
Delivery vehicles

Ubiquitous Element (3) -Barcode-

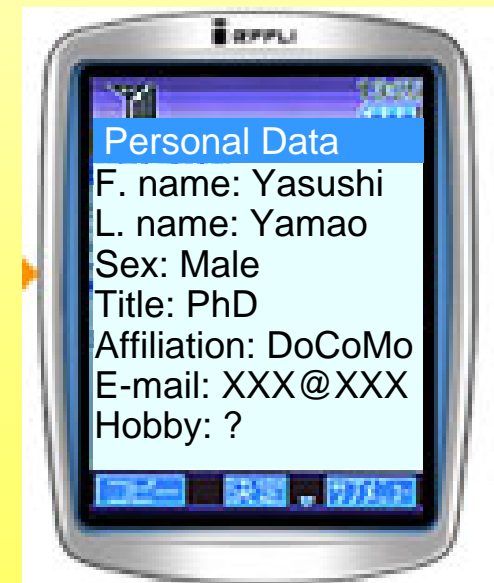
- New mobile phones can capture and decode **two-dimensional (2D) barcodes**. If necessary, they access the URL indicated in the code and obtain detailed information.



2D Barcode



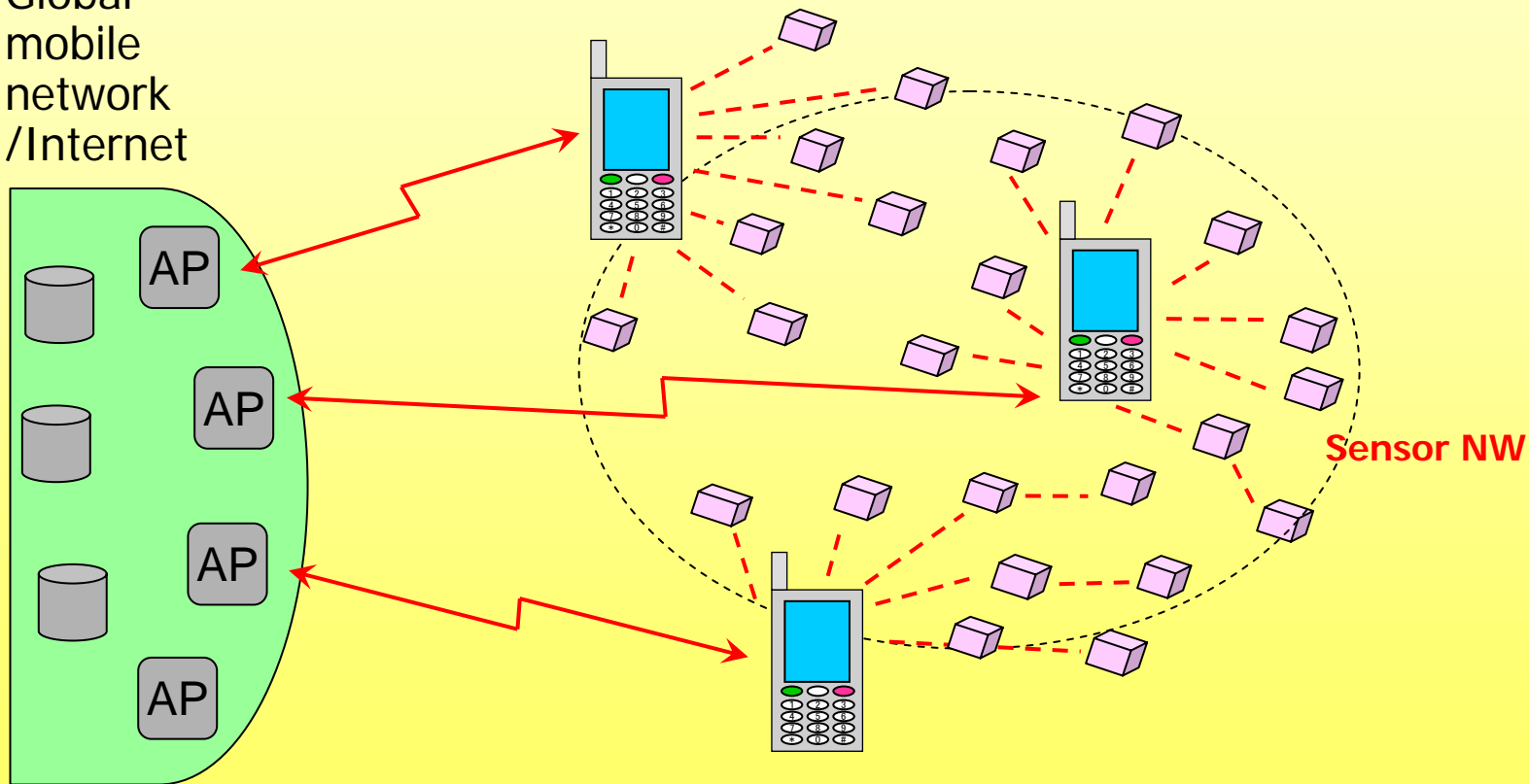
ex. Business card,
Goods,



Ubiquitous Element (4) -Sensor NW-

- Sensor networks (Weather, earthquake, environmental change, etc.)

Global mobile network /Internet



Summary

- Survey current market trends and present an evolution scenario from 3G to 4G
- Proposed “**Mobile Ubiquitous**” and described its value.

Thank you for your attention!

