Beyond 3G: from 3G to Seamless Intertechology Wireless Networks

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Outline

- Lessons from 3G
- What we need: Killer Applications
- 4G Mobile Networks: why, what, how
- 4G Imperatives: RAN, IP Network, and Service Ubiquity
- Conclusion
Lessons from 3G

- UMTS deployments in Europe is slow so far.
  - may be 2.5G/GPRS + WLAN/802.11
    Will 802.11 work in small devices? → No.
    Issues: Power consumption, no high speed mobility. → Primarily a laptop medium.

- Heavy standardization
  cost, optimality, etc..

- DoCoMo’s 3G Network
  - High bandwidth, lots of capacity
  - It has been said that no significant eye- or ear-catching services yet.
  But …
Application Plan in 3G

- Image-clipping with i-mode
- i-motion
- Possible to use FOMA and 2G phones with a single phone number
- Dual network service
- PDA type
- 2G/3G dual phone
- Smaller, lighter handsets with longer battery time
- Video Delivery
- Music Delivery
- Visual mail
- Send visual images instantly as mail
- International roaming
- Mobile EC
- Location information
- New service deployment
- Handset enhancement

Upon service launch
Current Picture Mail Services

NTT DoCoMo’s Multimedia Mail Service
0.3 M pels CMOS/CCD

1. URL notification
2. Retrieve image by URL

30KB JPEG
in 2G

100KB MPEG
in 3G

i-shot Server
i-motion Server
Ubiquitous Computing World enabled by

APIs for IrDA, Bluetooth and Non-contact IC, 100KB footprint, 10MB Memory Space. Authorized download XML-protocol, etc.

DoCoMo’s Java Phone is now comparable to i-PAQ, and more than Palm.
Two approaches to creating Killer Applications

- to follow what successfully happened in the legacy Internet.
  
  Example: E-mail and web browsing in i-mode

- to recognize what value 'mobile' adds.
  That is “ubiquity”, in other words, service availability.

Example in Consumer Electronics: Sony’s Walkman

Multimedia mail and Java Applications (e-commerce) are now taking-off.
4G Imperatives: RAN

Spectrum will remain the vital resource.

New capabilities of Systems Beyond IMT-2000

ITU-R Vision

- Peak Useful Data Rate (Mb/s)
- Mobility
  - High
  - Low
- IMT-2000
- Enhanced IMT-2000
- New Mobile Access
- New Nomadic / Local Area Wireless Access

Dashed line indicates that the exact data rates associated with Systems Beyond are not yet determined.
DoCoMo’s 4G Broadband Packet Wireless Access Test-bed

**Purpose**

- Demonstrate maximum throughput of more than 100Mbps and 20Mbps in the forward and reverse links
- Clarify key technologies for broadband packet wireless access
- Evaluate real broadband channel conditions
- Evaluate IP packet transmission via real wireless channel

**Schedule**

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- Development (Manufacturing)
- Connection test and experiments

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4G: ITU-R view

Seamless Intertechology Wireless Networks

Source: ITU-R
WP8F Vision

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4G Imperatives:  
IP Network

- True convergence with the Internet is critical
  - IP must be supported efficiently
    - Not primarily to decrease costs but to enable services
  - Remove discontinuities at the wired/wireless interface and the data/voice interface
  - The Internet must also evolve to support wireless mobility and ubiquity efficiently.
Ubiquity as Service Availability

- **Ubiquity**
  - number of terminals/distribution density/real time/total information volume,

- **Mobility**
  - High-speed
  - High-capacity
  - Low bit cost
  - IP-based

- **Ubiquitous NW**
  - Nomadic Wireless Access
  - Millimeter wave

- **Information Speed (Mbit/s)**
  - 2G
  - 3G
  - 3.5G
  - 4G

- Low-speed & capacity
- Intermittent & scattered
- Very large number
- IP-based / non IP-based?
4G Imperatives:
Ubiquitous Service Platform

Functional Leap with the second waist

3.5G

Service Ubiquity

connectivity

Heterogeneous Radio Access Network

Heterogeneous Radio Access Network

Applications

Web services middleware
Summary

- Lessons from 3G → We need Killer Applications
  Candidates: Enhanced Web Access, Multimedia Mail, Java applications
- 4G Imperatives: RAN, IP Network, and Ubiquitous Service Platform.
- 4G should be defined in terms of applications, services & markets
  - Not purely by air interface protocol, (IP) backbone or bandwidth
- ‘Ubiquity ‘is the key word to go further beyond 3G.
Definition of 4G Network

4G Network =
Heterogeneous RAN +
Advanced IP Network +
Service Ubiquity +
Business Model - COST
Appendix
DoCoMo’s Approaches to 4G System Infrastructure Development

**Backgrounds**
- Deployment of Wireless LAN
- User needs for broadband, fixed amount tariff
- Universalized IP technologies
- Network operators and services independent of infrastructure (MVNO)

**Requirements**
- Efficient area coverage
- Integration of diversified access systems
- Development of IP applications in wireless network
- Always-on connections
- Lower cost
- Enhancement of service competitiveness

**Approaches**
- Affirmative deployment of the system into indoor area
- Support of multiple access systems and seamless connections between them
- Efficient and high quality transmission of multimedia traffic
- Earlier deployment of All-IP network
- Network platform to enable new services facilely
- International standardizations

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These approaches aim to enhance network coverage, support diverse access systems, and enable efficient and high-quality multimedia traffic transmission, while also facilitating the deployment of All-IP networks and the development of new services through international standardizations.
Mobile Network Generations

- **1st Generation**
  - Analog Cellular
  - Voice
  - Low speed data (64kbps)
  - 1980s

- **2nd Generation**
  - Digital Cellular
  - Voice
  - High speed data (384kbps, 2Mbps)
  - Growing stage
  - 1990s

- **3rd Generation**
  - IMT-2000
  - Voice
  - Multimedia communications
  - Expansion stage
  - 2000s

- **4th Generation**
  - Super high speed
  - Mature stage
  - 2000s

- **AMPS**
- **TACS**
- **NMT**
- **NTT High Cap**
- **GSM**
- **IS-95**
- **PDC**
- **PHS**

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4G Ubiquitous Architecture: The Basic Model of DoCoMo US Labs

DoCoMo Applications

Voice

3rd-party Applications

DoCoMo Middleware (Seamless Support)

3rd-party Middleware

IP-Based Core Network:
DoCoMo-owned and operated (AAA, Mobility Support)

3G / FOMA Access
3G / 3rd-party Access
DoCoMo WLAN Hotspot
3rd-party WLAN Hotspot
PAN, CAN, AAN etc.

DoCoMo 4G Access Network

Emerging Access

DoCoMo API
OPEN API
PROPRIETARY API
OPEN API
OPEN API

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4G Imperatives: IP Network

- True convergence with the Internet is critical
  - IP must be supported efficiently
    - Not primarily to decrease costs but to enable services
  - Remove discontinuities at the wired/wireless interface and the data/voice interface
  - The Internet must also evolve to support wireless mobility and ubiquity efficiently. Examples:
    - IP is in the RAN
    - VoIP is in the core and backbone
    - Data handoff occurring between heterogeneous radio technologies
4G Imperatives: Ubiquitous Service Platform

Innovative applications, not voice, will be the key revenue generator

⇒ Programmability and Open APIs
   AAA, mobility and ‘plug and access’
   (Note: programmability does not equal “active networks” a la DARPA)

⇒ Foster a 3rd-party app developer community
   Build on work centered on fixed networks (Parlay, JAIN, OSA)

⇒ The search for the killer app should never end
   Any static portfolio of applications and services will eventually become a commodity

⇒ Radical personalization and niche applications

*Applications with a market size of 1*