The Future of Mobile Communications

April 2, 2003
Keiji Tachikawa
President & CEO
NTT DoCoMo, Inc.
Historical Growth of Mobile Communications
Worldwide Subscriber Growth

In millions

<table>
<thead>
<tr>
<th>Year</th>
<th>Africa</th>
<th>South/Central America</th>
<th>North America</th>
<th>Europe</th>
<th>Asia/Oceania</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>91</td>
<td>8</td>
<td>170</td>
<td>179</td>
<td>170</td>
<td>57</td>
</tr>
<tr>
<td>1999</td>
<td>41</td>
<td>93</td>
<td>170</td>
<td>292</td>
<td>63</td>
<td>67</td>
</tr>
<tr>
<td>2000</td>
<td>83</td>
<td>137</td>
<td>350</td>
<td>350</td>
<td>137</td>
<td>347</td>
</tr>
<tr>
<td>2001</td>
<td>23</td>
<td>118</td>
<td>347</td>
<td>740</td>
<td>83</td>
<td>74.8</td>
</tr>
</tbody>
</table>

*1: 1995~1999 Averaged growth rate

Source: International Telecommunication Union

* Including Japan
Subscribers & Penetration Rate by Nation

(As of December 2002 / Source: EMC World Cellular Database and TCA)
The Telecom Market in Japan

Subscribers (millions)

- Fixed-line Telephone
- Mobile Phone
- Wireless Internet
- Fixed-line Internet
- Mobile Phone
- Wireless Internet

<table>
<thead>
<tr>
<th>Year</th>
<th>Fixed-line Telephone</th>
<th>Mobile Phone</th>
<th>Wireless Internet</th>
<th>Fixed-line Internet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994.3</td>
<td>2.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995.3</td>
<td>4.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996.3</td>
<td>11.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1997.3</td>
<td>26.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1998.3</td>
<td>38.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1999.3</td>
<td>47.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000.3</td>
<td>56.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001.3</td>
<td>66.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002.3</td>
<td>76.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003.2</td>
<td>79.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Mobile Communications for the 21st Century
Directions of Mobile Communications

From Voice to Non-Voice

Multimedia

i-mode

Ubiquitous

Globalization

Core Businesses

2G

3G

To Anything Mobile

From Domestic to International
# Mobile Communications Services

| Person-Person | Cellular phone (voice communications)  
|               | Mail  
|               | Videophone  
| Person-Machine | Browsing (i-mode)  
|               | Location information distribution (GPS)  
|               | E-newspaper/advertisement, video distribution (ex.Cinema Pre-view)  
|               | Music distribution/Games  
|               | Mobile e-Commerce (ex.C-mode)  
| Machine-Machine | Environment monitoring  
|               | Remote monitoring/control (vehicle, POS of vending machine, home appliances)  
|               | Car multimedia (ITS)  

Projected Growth of MM Traffic

Challenging the Mobile multimedia

Non-voice image data)

2000 2010

Traffic

2001

2000 2010

Voice

Projected Growth of MM Traffic
3rd Generation Mobile Communication System
Evolution of Mobile Networks

1st Generation
- Analog Cellular
  - AMPS ('83)
  - TACS ('85)
  - NTT ('79)
  - etc.

2nd Generation
- Digital Cellular
  - PDC ('93)
  - GSM ('92)
  - IS95 ('95)
  - etc.

3rd Generation
- High speed Data Transmission
  - IMT-2000
  - W-CDMA '01
  - cdma2000

4th Generation

1980s 1990s 2000s 2010s
Main Issues for 3G Introduction

- Network
- Handsets
- Services
## FOMA Network Construction

<table>
<thead>
<tr>
<th>Year</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outdoor</strong></td>
<td></td>
</tr>
<tr>
<td>Oct.2001</td>
<td></td>
</tr>
<tr>
<td>March.2003</td>
<td>91</td>
</tr>
<tr>
<td>March.2004</td>
<td>97</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indoor</strong></td>
<td></td>
</tr>
<tr>
<td>March.2003</td>
<td>140</td>
</tr>
<tr>
<td>March.2004</td>
<td>1600</td>
</tr>
<tr>
<td>March.2005</td>
<td>3000</td>
</tr>
</tbody>
</table>
Variety of FOMA Handsets

**Standard type**
- Previous model
- Latest model

- Smaller & lighter
- Longer battery life
- Compatible with video mail service
- Enhanced i-motion service
- Built-in camera

Released '03.1

**Card type**

**Visual type**
- Previous model
- Latest model

- Smaller & lighter
- Longer battery life
- Compatible with video mail service
- Enhanced i-motion service

**PDA type**

- Smaller & lighter
- Longer battery life
- Compatible with video mail service
- Enhanced i-motion service
# FOMA Handset -Future Development Plan-

<table>
<thead>
<tr>
<th></th>
<th>2002 New Model</th>
<th>2003 Spring Model</th>
<th>2004 Fall Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Max. standby time</strong></td>
<td>Approx. 180 hours</td>
<td>To be further enhanced in 2002 Models</td>
<td>300 hours or more</td>
</tr>
<tr>
<td></td>
<td>Approx. 250 hrs in static standby)</td>
<td></td>
<td>To be further enhanced</td>
</tr>
<tr>
<td><strong>Weight/Size</strong></td>
<td>Approx. 130g/120cc</td>
<td>110g/110cc</td>
<td>100g or less/100g or less</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>To be smaller &amp; lighter</td>
</tr>
<tr>
<td><strong>Camera features</strong></td>
<td>Built-in camera in all models</td>
<td>Higher resolution and quality to be supported</td>
<td>Cameras to be installed as standard feature</td>
</tr>
<tr>
<td></td>
<td>100,000-300,000 pixels</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Videophone</strong></td>
<td>Visual type handset limited to 1 model</td>
<td>Videophone capability to be installed as standard feature</td>
<td>Including “simple videophone” capability)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Service offerings</strong></td>
<td>“Video mail” (&quot;i-motion mail&quot;) (100KB)</td>
<td>“V-Live” “e-authentication”</td>
<td>“e-commerce” “Location information”</td>
</tr>
<tr>
<td></td>
<td>“High-quality photo” transmit to PCs (100KB)</td>
<td>“Global roaming” with chip-embedded card</td>
<td>Expand variety of handsets/devices</td>
</tr>
<tr>
<td></td>
<td>“Enhanced i-motion” (300KB)</td>
<td>“PDC/FOMA dual mode handsets”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>“Enhanced i-appli” (200KB)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3G Services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet</td>
<td>i-mode, i-motion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual com</td>
<td>Videophone, Visual mail</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Content Distribution</td>
<td>M-stage Music, Cinema, Games</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positioning</td>
<td>Location, Navigation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remote sensing &amp; control</td>
<td>Video monitoring/control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Settlement</td>
<td>Mobile e-commerce</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**i-mode Service**

**i-mode’s success factors**
1. Packet NW  (Constant connection, Low tariff)
2. IP protocol (HTML)
3. Handset  
   (Small size, Light weight, Color display)
4. Win-Win relationship  
   (Between operator and content providers)

---

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Subscribers</th>
<th>No. of Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(As of January 31, 2003)

- No. of Subscribers: 36.6 million
- No. of Sites: 63,200
**i-motion Service**

**i Motion Service**

-Launched in November 2001-

News
(News highlights or pictures, etc.)

Movie/Music Promotion Videos
(Music video or movie trailers)

Playback sport highlights or news with video + sound

XX Newspaper
1. General news
2. City news
3. Politics
4. International
5. Economy
6. Sport
7. Mobile Information
8. Video news(iMotion)

Today’s video news
Oct. 22, 2001
>Live net broadcast service for investors “MiD LIVE” starts from November...

Press conference scene

Playing iMotion

To maximize the benefits for individual investors…
Launch of Video Mail -- “i-motion mail”

“i-motion”-compatible FOMA handset

- Video file taken by a FOMA handset
- “i-motion” video file downloaded from web site

Send as an attachment file

Video of max. 100 Kbytes (approx. 15 sec, max. 15 frames/sec)

i-mode mail with URL for video downloading

Transmission of large-volume, high-resolution photos (VGA)

Compatible FOMA handset

- VGA (640×480)

Send VGA file to a PC

Still picture of up to 100 Kbytes

Send as an attachment file
Certain things cannot be communicated just by voice and mail.
Video Phone Service

Business Applications facilitate the adoption of 3G Service

Videoconference

Virtual Conference Room

Communications between Building construction site and Headquarters etc.
**Information Distribution**  
* M-stage visual/music/book

---

**Content Server**

**Distribution Server**

**FOMA PHS Network**

**Information Provider**

**DoCoMo**

**User**

---

**Visual**

- News
- Sports
- Movies
- Cooking
- Shopping

---

**Music**

- Search
- Listen to Sample
- Download

**Book**

- Read a business publication in the train on your way to work.
- Read a book on English conversation at lunchtime.
- Read in bed the book that bothered you during the day.
- Read a mystery novel while you are waiting for someone.
Navigation Service

Easy-to-follow navigation for first-time visitors to Shinjuku Gyoen Park

When visitors arrive at a particular spot in the Park, guidance pertaining to the spot begins automatically in video or voice.
## Mobile e-commerce

### “i-mode” combined with infrared data transfer

- **On a street corner**
  - “Club Cmode”
  - Drink purchase
  - Earn points

- **At a video shop**
  - “Mobile GEO”
  - Member-ship certificate
  - Earn points

### “e-value” field trials using contactless IC cards

- **CAFIS* Center**
  - Mobile info.
  - Device + contactless IC

  **Subway e-ticket**
  **Drink purchase using e-money**
  **E-ticket for event, concert, etc.**

### e-billing service based on two-dimensional codes

- **Convenience store**
  - Lawson
  - “iLAWSON”
  - Convenience store
  - Coupon
  - Coupon (external use)

- **DAM**
  - Karaoke
  - “clubDAM.com”
  - Request input
  - My song list
  - New release list

- **Subscriber**
  - Pay by two-dimensional code
  - Download two-dimensional code to cellular handset

- **Billing company**
  - Money transfer
  - Receipt notice

- **Billing information**
  - Receipt notice and money transfer

---

*e Credit And Finance Information System*
Mobile Systems beyond 3G (IMT-2000)

Ubiquity
- Number of terminals/distribution density/real time/information volumes

Speed (Mbits/s)
- Low-speed & capacity
- Intermittent & scattered
- Very large number
- IP-based/non IP-based?

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

- Nomadic Wireless Access
- Millimeter wave LAN

2G, 3G, 3.5G, G

Beyond 3G (IMT-2000)
## Service Evolution from 3G to 4G

<table>
<thead>
<tr>
<th></th>
<th>3G (IMT-2000)</th>
<th>4G</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>File</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Download Time</td>
<td>about 200 sec.</td>
<td>about 1 sec.</td>
</tr>
<tr>
<td><strong>Image</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Image (Resolution)</td>
<td>352 x 288 pixels (CIF)</td>
<td>1024 x 1920 pixels (Hi-Vision)</td>
</tr>
<tr>
<td>Bit rate</td>
<td>384 kbps</td>
<td>24 Mbps x 2 (Stereo)</td>
</tr>
<tr>
<td><strong>Awareness</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kinds of Information</td>
<td>Voice</td>
<td>3-D Audio-Visual-Air pressure</td>
</tr>
<tr>
<td>Bit rate</td>
<td>3.4 kbps</td>
<td>50 Mbps</td>
</tr>
</tbody>
</table>

3-D Audio-Visual-Air pressure

---

Kinds of Information

- Voice
- 3-D Audio-Visual-Air pressure

Bit rate

- 3.4 kbps
- 50 Mbps

Image (Resolution)

- 352 x 288 pixels (CIF)
- 1024 x 1920 pixels (Hi-Vision)

Bit rate

- 384 kbps
- 24 Mbps x 2 (Stereo)
**Major System Capability/Performance Targets**

**New capabilities**
- Rapid deployment of new services
- Facile development of new services

**Seamless connections**
- Handover between heterogeneous access systems
- 100 Mbps (peak)
- 20 Mbps (average)
- 10 folds than 3G
- Information bit-rate: 384 kbps
- 1/10-1/100 per bit

**Mobility**
- Unified control
- Connection delay (5-8s)
- Transmission delay
- Less than 500 ms
- Less than 50 ms

**Performance enhancements**
- Enhanced control based on characteristics of user movement

**Open up new markets**
- Enhancements of profitability

**Major System Capability/Performance Targets**
- Connection delay (5-8s)
- Transmission delay
- 500 ms
Human Interface for 4G System

Biological Interface
Silent voice: Talk without vocalization
- Recognition of nerve signals around mouth
- Recognition of nerve signals relating to limb control and sensation
- Real-time biological signal recognition technologies

Avatar Interface
As if you are actually there
- Mobile controller
- Expression control technologies
- Humanoid robot

Pervasive Interface
Chaser Phone: Talk over a mobile without holding anything
- Array microphone and speakers

Analysis of Biological Signals

Magnetic Shield Room

High-speed, Large-capacity File Server

High-speed Analysis CPU Server

Biological Information Analysis Technologies
Everything is based on the understanding of humans

Sensor Network
- Ubiquitous I/O technologies
- Personal identification technologies
- Sensor network

Wear-at-all-times Interface
Implanted devices and human body communications

Red Text: Technology
Black Text: Service Image
Tele-Communication with Alter-ego-robots Using BUI

BUI: Biological signals User Interface

Affordance
Entrainment

EEG
EMG

Voice
Mental
Condition

Motion
Force
Body Image

Touch
Smell
Breath

Network

EMG : Electromyogram
EEG : Electroencephalogram
### Human Factor
In addition to audio+visual, senses of touch, smell, and taste. Higher quality/security.

- Intelligent communications
- Research on five senses
- Authentication using biotechnology

### Assist Human Ability
Intelligence, Robots, Wearability

- Alter-ego communications
- Motor neuron research
- Wearable devices
- Intelligence/recognition modeling

### Expand Human Space
From real environment to cyber space

- Environment reproduction (nature, artificial objects)
- Super reality communications
- Knowledge processing

<table>
<thead>
<tr>
<th>Directions of Research</th>
<th>Service Image</th>
<th>Research Themes</th>
</tr>
</thead>
</table>
| **Human Factor**       | Net museum (3D exhibits) | - Intelligent communications  
   - Research on five senses  
   - Authentication using biotechnology |
| **Assist Human Ability** | Active travel navigators  
   Electronic cars  
   Interactive navigation | - Alter-ego communications  
   - Motor neuron research  
   - Wearable devices  
   - Intelligence/recognition modeling |
| **Expand Human Space**  | Virtual tour | - Environment reproduction (nature, artificial objects)  
   - Super reality communications  
   - Knowledge processing |
Analysis of Mobile Communications in Social Terms
Social Impact

Mobile Communications

Bright side  Creation of New Culture
- Personalization of communications
  - My own customized handset
  - Always with you, 24 hours a day
- Multimedia communications
  - Text mail
  - Mail with still-picture/video attachments

Dark side  New Problems
- Concerns of electromagnetic impact
- Improper usage manner
- Abuse of communication means
  - Spam
  - Mail
  - Pornography
Roles of Mobile Services

Social Trends

- Aging society
- Lower birth rate
- Personalization
- Globalization

Roles of Mobile Services

- Safety
- Individuality
- Convenience
- Value-added society
- Environmental Conservation

Individuals
- Mobile
- Added value
- Environmental problem
- Crime

Business

Society