Whither the Mobile Internet: Storage and Mobile Internets

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Whither the Mobile Internet: Storage and Mobile Terminals

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Disclaimer

• My *personal* opinions, *not* official Nokia position!
Outline

- The Mobile Internet
- Gadget Heaven
- Storage: What are we capable of?
- Storage: What shall we do with it?
- Conclusions
The Mobile Internet
Internet Users: Wired and Wireless

- end of 2001, according to “Info Please”
- US: 149M total, 6.7M (4.5%) wireless
- Asia-Pacific: 115M total, 40M (35%) wireless
- Western Europe: 126M total, 17.5M (14%) wireless
- Worldwide: 533M total, 85M (16%) wireless
- Just a year earlier, 80% of wireless Internet users were reported to be in Asia, mostly DoCoMo i-mode
i-Mode Users

imo mode subscribers in Japan

Jan '99 Jul '99 Jan '00 Jul '00 Jan '01 Jul '01 Jan '02 Jul '02

5 million
10 million
15 million
25 million
30 million

JAVA enabled imode handsets

@2002 Eurotechnology Japan K.K.
Today

- 5/10 of AT&T Wireless' models are “wireless Internet ready” (5/5 GSM phones; rest are TDMA)
- 14% of South Koreans have used wireless Internet (56% have used wired Internet)
- 60 million wireless Internet users in Japan (80% of cell phones)
  - In some reports, 50% of DoCoMo i-mode users in Japan do not have a PC at home
- Wireless Internet users will exceed wired sometime in the next few years
Gadget Heaven
Which One Is The Future?
Features

- Cameras! Still & limited video, VGA (640x480) res
  - In Japan, more than half of new phones are camera phones
  - Megapixel cameras on their way
- Audio: MP3, AAC, etc.
- Games: multi-player over Bluetooth or GPRS (IP packet-based cellular for data)
- Multimedia Messaging (MMS): send & receive all the above
- GPS
- Megapixel displays on their way?
Samsung SPH-V3000

- Can view streaming television/video over Internet connection
- 110K pixel CMOS camera
- 176x192 pixel 256K color display
- 2.4Mbps network
- Camcorder mode can store up to 30 minutes of video
  - No details yet on format, quality, etc.
  - Storage technology: ???
  - 64Kbps video would be < 16MB
- Samsung predicting 10-15% of market will be “camcorder” phones this year
PalmOS & Microsoft-Powered Devices
Storage: What Are We Capable Of?
In the Devices: Mobile Storage

- Flash
  - lots of form factors
  - 1GB today
- Microdrives
  - standard mechanical & magnetic technologies
  - 4GB this year
With the Devices: Toshiba Hopbit

- Bluetooth device
- 5GB, 1.8” hard drive
  - 1,000 MP3s, or
  - 3,000 digital pictures, or
  - 37 hours of MPEG video, 320x240 @ 15fps
- 200 hours battery life
Across the Network: What's a “G”? 

- 1G: First generation, analog mobile phones
- 2G: TDMA, CDMA, GSM -- digital, what you’re using now
- 2.5G: GPRS (GSM), CDMA-2000 1xRTT, NTT DoCoMo i-Mode
  - always on packet-switched
  - 10-100Kbps, realistically
- 3G: W-CDMA (UMTS), EDGE, CDMA-2000 1xEV-DO
  - theoretically 2Mbps downlink
  - practically, 100-400Kbps
  - asymmetric
  - single world-wide standard was original goal
- 4G: 100Mbps in 2006-2010?
  - NTT DoCoMo & other Japanese companies working on it
Local Connectivity

- Bluetooth
- WLAN: 11Mbps -> 100Mbps
- Can gateway from there to the Internet
Where Should the Storage Reside?

- At the device: fast, always present, hard to share, expensive, power-hungry, prone to failure or loss
- Storage Service Provider: separate provider, no QoS or security
- Wireless Operator's network: controlled net (security & QoS), integrated authentication & billing, good caching
- Your home or office
What is the Computation Model?

- Computation at the server
  - e.g., web map databases such as Mapquest
  - heavily read oriented, weakly consistent

- Computation at the terminal/client
  - e.g., every PC app using NFS or CIFS

- Consistency semantics, security (inc. AAA), naming, performance (round trips), APIs, disconnected operation
Storage: What Shall We Do With It?
Usage Models Will Expand

- **Doing (alone)**
- **Talking & Messaging (person-to-person)**
- **Sharing (one-to-some)**
- **Publishing (one-to-many)**
- **Automating (machine-to-machine[s])**
Consuming, sharing, editing, storing, mixing all types of content

Types of content:
- user created (images, videoclips, music, etc.)
- personal (music, movies, movieclips, games, applications, etc.)
- group (family, friends, daughter's soccer team, etc.)
- community (greyhound owners' image album, etc.)
- subscribed (Manchester United Multimedia news service, etc.)
- network provided (location-based weather info, etc.)
Video Bandwidths

- 64 Kbps: video call
- 1.5 Mbps: MPEG-1
- 9.8 Mbps: DVD MPEG-2 MP@ML (max sustained)
- 36 Mbps (4.5 MB/s): HDTV
Video Bandwidths * 20 Million

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- 160 GB
- 3.75 TB
- 24.5 TB
- 90 TB
End Game

- Record everything a user sees and hears
- 20M seconds awake/year
- 160GB – 90TB/year/customer
- One low-res customer-year fits in a disk drive today; HDTV in 2015
  - Assuming 60% CAGR, LOTS of technical hurdles are cleared
- Fits in matchbook-size drive in 2013 (lo-res) or 2025 (HDTV)
- This should excite and frighten you
(Geek Reality)
Macro System Issues

• 64 Kbps * 1B customers = 8 TB/sec planet-wide
  • Oh, maybe a decade from now, maybe two...
  • And you wondered where all that storage we build is going to go...
  • That's a LOT of wireless network bandwidth
Conclusions
Cambrian Explosion, 543M Years Ago
Conclusions

- The mobile Internet will be a driving force in the tech industry as a whole in the next decade
  - It will be very different from the wired Internet
  - Multimedia will be important
  - Nobody really knows what it will look like
- Device-local and server-based storage will both be important
  - Form factor, power, price very important
  - Individual devices limited, but aggregate is huge