Rapid Fire Wireless 101

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Data Communication + Wireless Telecomm = Huge Opportunity!

- The wired computing world has long existed separately from the wireless telecommunications world
- Each has unique issues and heritage
- They are mixing now, and this talk introduces the technologies at their intersection

Learning Objectives

- As a result of this presentation, you will:
  - Understand the basics of cellular, wireless development, and related technologies
  - Know where to go to learn more about particular wireless technologies of interest
  - Be able to specify the components necessary to design, implement, and deploy wireless-enabled services

Presentation Agenda

- Cellular Technologies
- Markup Languages
- Programming on the Client
- WLANs, Proximity Networking, and RFID
- Related Technologies and Initiatives
- Summary and Resources

All Those G's: 1G, 2G, 3G...

- " 1G" = first generation analog cellular deployed in 1980s (example: AMPS)
- " 2G" = second generation digital voice centric technologies deployed in 1990s (TDMA, then GSM and CDMA)
  - " 2.5G" = upgrades for speed, packet focus, deploying widely now (GPRS layered on top of GSM, for instance)
- " 3G" = third generation, data-centric, packet based technologies optimized for high bandwidth (WCDMA and cdma2000, both part of the IMT-2000 standards)
- More: wireless.java.sun.com/getstart/articles/radio

Worldwide Mobile Usage

Cellular Technology	*Subscribers, Dec 2002 (in millions)*	*Market Share (%)*
GSM	787.5	69.7
CDMA	142.7	12.6
TDMA	109.2	9.7
Japan PDC	60.1	5.3
Analog (1G)	30	2.7
TOTAL	1129.8	--

Source: EMC's World Cellular Review and GSM Association
www.gsmworld.com/news/statistics/substats.shtml

- Worldwide growth of 379.1 million subscribers (+50.5%) from Feb 2001 to Dec 2002
- GSM's usage (including WCDMA) increased from 63.3% share in Feb 2001 to 69.7% share in Dec 2002

Global System for Mobile (GSM)

- Specifies family of standards for digitally encoding and transmitting voice and data over mobile telephony systems
- 2G circuit switched data throughput of approximately 9.6Kbps
- Differentiators vs. TDMA and CDMA:
  - Subscriber Identity Module (SIM)
  - International roaming in 179+ countries
- For more information, visit the GSM Association at: www.gsmworld.com
- GSM adoption around the world: www.gsmworld.com/news/statistics

GSM Radio Frequencies

GSM Band (Mhz)	*Geographic Usage of Band*	*Handset Transmit (Tx)*	*Handset Receive (Rx)*
900	Outside US	880-915 Mhz	925-960 Mhz
1800	Outside US	1710-1785 Mhz	1805-1865 Mhz
1900	Within US	1850-1910 Mhz	1930-1990 Mhz

Source: Nokia 7210 User Guide

- GSM 900 MHz networks were built out earlier in most places outside the US, with 1800 MHz later
- PCS systems based upon both GSM and CDMA operate in the 1900 MHz band in the United States

Short Message Service (SMS)

- Enables GSM-based mobile phones to send and receive short text messages
  - Email-like messages, 160 characters or less
  - SMS email centers interface SMS with Internet email
- Widely available in existing GSM networks, with many text-based services deployed
- Next gen multimedia messaging: MMS
- Learn more about SMS from the GSM Association: www.gsmworld.com/technology/sms/intro.shtml

General Packet Radio Service (GPRS)

- Provides end-to-end, packet based, “always on” upgrade for GSM
- Real world data throughput comparable to 28-56Kbps wireline dial-up connections
- Requires new GPRS-aware handsets for subscribers, but all-software upgrades exist for GSM network infrastructure
- Further data speed boosts promised by Enhanced Data rates for GSM Evolution (EDGE) technology
- More about GPRS from the GSM Association: www.gsmworld.com/technology/gprs/intro.shtml

Third Generation Mobile (3G)

- Build upon the core 2G (second generation) and 2.5G (second generation plus GPRS, etc.) GSM and CDMA technologies
- Data speeds of approximately 144Kbps (moving user, outdoors) up to 2Mbps+ (stationary indoor environments)
- Requires new infrastructure and handsets
- Driven by Third Generation Partnership Project (3GPP) www.3gpp.org and 3GPP2 www.3gpp2.org
- GSM Association page on 3G: www.gsmworld.com/technology/3g/intro.shtml

Carrier Technology Choices

Carrier	*System*	*Upgrade path*
Verizon Wireless	CDMA	CDMA 1X, then CDMA 1xEV
Cingular Wireless	GSM	GSM overlay in TDMA markets, GPRS upgrade
AT&T Wireless	GSM	GSM overlay on TDMA, GPRS upgrade
Sprint PCS	CDMA	CDMA 1X, then CDMA 1xEV-DO
Nextel Communications	IDEN	IDEN upgrades
T-Mobile	GSM	GPRS upgrade

Source: Wireless Week

November 2001

Wireless Application Protocol (WAP)

- A set of specifications for implementing primarily text-based services for wireless devices including mobile phones
  - Requires connection to server to work
- Specifies entire protocol stack, including XML based Wireless Markup Language (WML)
- Issues with security during protocol conversions from WAP 1.0 stack to HTTP/IP
- After WAP Forum merged into the OMA, specs are at: www.wapforum.org/what/technical.htm
- Tip: Use a transcoding portal to WAP, i-mode, and SMS enable your services

i-Mode

- NTT DoCoMo's "Internet Mode" service for mobile phone users in Japan
  - Java™ technology-enabled ("iAppli") in Jan 2001
  - 36.7 Million+ users, including 16.2 Million+ iAppli
- Uses HTML-based Compact HTML (C-HTML) rather than WML
- Uses HTTP/HTTPS (TLS/SSL) rather than WAP stack
- For more information, visit NTT DoCoMo at: www.nttdocomo.com
- I-Mode technical FAQ: www.mobilemediajapan.com/imodefaq

Extensible Hypertext Markup Language (XHTML)

- Re-crafting of HTML 4 as a modularized, XML-based markup language
- WML, C-HTML, and HTML have converged into XHTML
  - XHTML Basic is renderable in any XHTML compliant browser
- WAP 2.0 adopted XHTML, HTTP/TCP/IP, and TLS/SSL, merging WAP technologies with standard Internet Java+XML+IP technologies
- W3C Recommendation for XHTML 1.0: www.w3.org/TR/xhtml1

Java™ 2 Platform, Micro Edition (J2ME™)

- The J2ME platform specifies Java technology for consumer and embedded devices including mobile phones, PDAs, and digital TV settop boxes
- Enables portable client side logic which can work while connected (networked) or disconnected (often the case with wireless)
- The J2ME platform specifies virtual machine features and core APIs in Configurations, plus application- or market-specific APIs in Profiles
- Homepage for the J2ME platform (links to APIs, tools, etc.): java.sun.com/j2me

J2ME Platform, Connected, Limited Device Configuration (CLDC)

- Specifies core VM features and APIs for devices with limited power, limited and intermittent network connectivity, and extremely constrained UIs
- Implemented in mobile phones, two way pagers and handhelds, and PDAs from many vendors and carriers worldwide
- Manufacturer may use any CLDC compliant VM that they like
- CLDC homepage: java.sun.com/products/cldc

J2ME Platform, Mobile Information Device Profile (MIDP)

- Targets two-way communication devices implementing J2ME CLDC
- Addresses display and UI, data persistence, and HTTP-based networking
- 3GPP has chosen J2ME MIDP for 3G standards worldwide
- MIDP homepage: java.sun.com/products/midp
- J2ME™ Wireless Toolkit: java.sun.com/products/j2mewtoolkit

Wireless Ethernet (IEEE 802.11)

- Optimized for data transmission up to 100 meters in office, campus LANs, and “hot spots”
- Waits, retransmits in response to interference (like wired Ethernet; good for data, bad for voice)
- Widely deployed 802.11b (“Wi-Fi”): up to 11Mbps in congested 2.4GHz ISM RF band
- Newer 802.11a: 5.2GHz band, up to 54Mbps
- 802.11g deploying now: 54Mbps in same 2.4GHz band as 802.11b
- Wi-Fi interoperability and technical info: www.wi-fi.org
- Overview of 802.11 security issues: www.oreillynet.com/pub/a/wireless/2002/04/19/security.h

Bluetooth

- Set of hardware and software standards specifying how devices can communicate wirelessly in same unlicensed 2.4GHz RF band as Wi-Fi
- Optimized for 30 meters or less, Personal Area Networks (PANs)
- Based upon master-slave relationships in networks of up to eight devices, piconets
- Bluetooth Special Interest Group homepage at: www.bluetooth.com
- Java™ APIs for Bluetooth (targets devices implementing J2ME CLDC): jcp.org/jsr/detail/82.jsp

HomeRF

- Combination of IEEE 802.11b and Digital Enhanced Cordless Telecommunication (DECT) standards
- Same 2.4GHz RF band as Bluetooth and Wi-Fi
- Optimized for voice transmission up to approximately 50 meters within high RF interference (“noisy”) home environments
- Similar to Bluetooth, frequency hops to avoid interference
- More on HomeRF: www.homerf.org

Ultra Wideband (UWB)

- UWB radio technology spreads RF signal over a wide range of frequencies (mostly above 3.1GHz in US, pending ongoing FCC review)
- Minimizes interference by operating at very low power levels (order of nanowatts, i.e., background noise)
- Could compete with WLAN technologies in addition to providing various sensing capabilities including ground penetrating radar (GPR), through-wall imaging, vehicular radar, and more
- Learn more from the UWB Working Group: www.uwb.org

Radio Frequency ID (RFID)

- RFID uses RF waves in one of several different frequency ranges between 125KHz and 5.8GHz to transfer data between a moveable item and reader
- RFID tags can be passive backscatter devices or active transmitters
- Learn more about identifying, categorizing, or tracking RFID tagged items from: www.autoid.org/presentations/presentations.htm
- The Auto-ID Center is developing standards for inexpensive RFID as a replacement for the UPC barcode. Learn more and download their Savant reference server to try it out yourself: www.autoidcenter.org

Mobile IP

- Mobile Internet Protocol (Mobile IP) enables data communication as a device moves through different IP subnets
- Delivers data via device's home address (fixed) and care-of address (changes as device moves)
- Works at network layer, across various data link and physical layers (GPRS, WLAN, etc.)
- Mobile IPv4 deployment underway
- Mobile IPv6 in progress at IETF
- More information on Mobile IP: www.ietf.org
- Example implementation: www.sun.com/software/solaris/ds/ds-mobile_ip

Global Positioning System (GPS)

- Satellite based navigation system funded and operated by the US Department of Defense
- Satellites transmit 1575.42 Mhz carrier signals available for civilian usage
- GPS receiver requires signals from at least four satellites to compute its position in three dimensional space at any given time
- Receivers embedded in increasing numbers of cell phones, cars, and other devices, enable new kinds of location based services (LBS)
- For more details, see: www.colorado.edu/geography/gcraft/notes/gps/gps.html

SyncML

- Specifies a common protocol for use in synchronizing data from mobile information devices to other devices and services
- XML-based markup language for content of synchronization messages
- For more information: www.syncml.org

Voice eXtensible Markup Language (VoiceXML)

- Specifies XML-based markup language for speech recognition and synthesis applications using landline and mobile phone systems
- Also enables markup-based approaches to recognizing DTMF key input and recording spoken input
- For more information, visit the VoiceXML Forum at: www.voicexml.org
- VoiceXML 2.0 W3C candidate draft: www.w3.org/TR/2003/CR-voicexml20-20030128/

Open Mobile Alliance (OMA)

- Formed to promote interoperability of services across geographies, operators, and handsets
  - Groups merged or merging into the OMA include the WAP Forum, MMS Interoperability Group, SyncML Initiative, Location Interoperability Forum, and more
- Working with 3GPP, IETF, W3C, and the Java Community Process℠ initiative (JCP℠) to ensure:
  - Products and services are based upon open, global standards not locked to proprietary technologies
  - Application layer is bearer agnostic
  - Architecture and service enablers are OS independent
- For more information, visit: www.openmobilealliance.org

Tech Trends to Watch

- Migration to standard Web technologies
  - Telecom and enterprise convergence breeds use of Java™ technology+XML+IP everywhere
- Interoperability across networks and geographies
  - Enablers including tri-band GSM, the OMA, combined 3G+WLAN devices
- Location awareness
  - Devices know where they are (and so, network services know where you are)
  - Tagged things can communicate as they move through physical space

Recommendations

- Design for markup and bearer neutrality
  - Support SMS, XHTML, WAP, and i-mode using transcoding portal capabilities
- Factor your code carefully
  - Use J2ME technology for computation and graphics intensive client side coding
  - Use a Java 2 Platform, Enterprise Edition (J2EE™) application server for server side work
- Use open standards wisely
  - Java technology + XML + IP protocols give you portability and flexibility in hardware and software choices, and choice saves you money!

What You Should Do

- Build your services using open Internet standards (Java technology, XML, IP)
- Think vendor neutral as you design your architecture
- Start developing and deploying your wireless services today!

Resources

- Sun's Wireless Developer portal:
  java.sun.com/wireless
- J2ME code camps and wireless resources:
  www.sun.com/developers/evangcentral
- End-to-end Blueprints for Wireless:
  java.sun.com/blueprints/wireless
- J2ME™ Archive:
  billday.com/j2me

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Copyright Statement

Speaker Bio

Bill Day is a Staff Engineer and Technology Evangelist at Sun Microsystems.

Bill created the *J2ME Archive* to help developers build and deploy wireless applications. He writes about software development for numerous publications speaks frequently on wireless technology, grid computing, and system security. Bill also teaches Java and Wireless development as an extension instructor for the University of California Berkeley.

More information is available from Bill's site:
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