Mobile Web Services: Challenges, Issues and Case Study

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About Me

- Practicing Software Engineer for 17+ years
- Work with Web Services on mobile devices
- Recently deployed Proof of Concept mobile project for an IBM customer
- Also focus on high performance Web Services
- IBM Representative to W3C XML Binary Characterization Working Group
- Please email me with any questions about this presentation
Agenda

- Challenges and Issues
  - Functionality
  - Development Tools/Environment
  - Devices
  - Wireless Security
  - Security and Devices
  - Wireless Networks
  - Integration

- Hospital Case Study

- References
Functionality

- What functionality do you present on a mobile device?
  - Depends on requirements AND on device capabilities
- Quickest road to failure is to not be honest about inherent device limitations
- Web Services and mobile devices does not have to mean invoking web services from the device
Functionality

- Extending an existing solution to mobile
  - What function(s) do you provide?
    - Subset of existing function
    - All existing function
  - Device functionality must be easy to use
  - Map to existing solution
    - “Keep the same deficiencies”
- Be careful if you provide function on device that is easier to do on laptop/desktop
Functionality

- Device functionality is best left to “read-only”
  - Data entry is tedious for most users
    - You and I are not most users
- Understand your user base
  - Can get frustrated very easily
  - Your device can become a paperweight very quickly
Development Tools/Environment

- Java?
  - J2SE
  - J2ME
    - Profiles?
- C, C++, C#, VB?
- Development tools
  - Free or $$
- Following are some I’ve used:
Development Tools/Environment

- RIM Blackberry
  - Java
  - Supports J2ME plus RIM extensions
  - Free JDE
    - [http://www.blackberry.net/developers/na/java/start/index.shtml](http://www.blackberry.net/developers/na/java/start/index.shtml)

- Sharp SL-6000
  - Java
  - Supports J2SE
    - Download .class files you build on desktop to run on device
Development Tools/Environment

- **Palm**
  - C
    - Metrowerks CodeWarrior
  - Java
    - IBM WebSphere Studio Device Developer
Development Tools/Environment

- PocketPC
  - Java
    - IBM WebSphere Studio Device Developer
  - C#, C++, Visual Basic
    - Microsoft tools
Devices

- Non-connected
- Bluetooth
- 802.11b
- Cellular

For any serious application
  - 802.11b
  - Cellular
Devices

- **802.11b**
  - Palm Tungsten C (integrated)
  - Sharp SL-6000 (integrated)
  - PocketPC (various) (integrated or card)

- **Cellular**
  - RIM Blackberry (integrated)
  - Sharp SL-6000 (requires cellular card)
  - PocketPC (various) – requires cellular card
  - Palm Tungsten W (integrated)
Devices

- Don’t just choose a device due to its characteristics
  - Take into account:
    - Development environment
    - Development language
    - Usability and capability
    - Available accessories
    - Available expansion hardware and software
    - Wireless Security model supported
Devices

- Dual mode devices are starting to emerge
  - 802.11 and Cellular
- You can do this today with an 802.11b integrated device and add a cellular CF card
  - Need WECM for seamless roaming
Devices – Pros/Cons

- Palm Powered Devices
  - OS is still single-threaded
  - Lots of aftermarket apps and accessories
  - Large user base

- PocketPC
  - Multithreaded OS
  - Lots of aftermarket apps and accessories
  - Large user base
  - Familiar look and feel to Windows
Devices

- **Sharp SL-6000**
  - Runs embedded Linux – Multithreaded
  - Full VGA screen
  - Currently not a lot of aftermarket apps and accessories
  - Currently small user base

- **RIM Blackberry**
  - Java only device
  - Niche market with good penetration
  - Screens are weakness (not even ½ VGA)
Wireless Security

- Depending on the application, different aspects need to be considered
- For 802.11b
  - For an enterprise, WEP doesn’t cut it
  - LEAP is solid enough for most applications
  - There are other wireless security protocols
    - 802.11i
      - Recently approved and provides solid security
    - Many are not yet provided for handhelds
Wireless Security

- For Cellular
  - Some devices provide no security by default
    - Palm Tungsten W
      - However, can use VPN software
  - RIM Blackberry has good security story
    - Everything is Triple DES encrypted from device to BES server

- For 802.11b and Cellular
  - IBM’s WebSphere Everyplace Connection Manager (WECM)
Wireless Security

- WECM
  - Provides excellent security
  - Provides seamless roaming between LAN and WAN networks
    - Roam between 802.11b to Cellular
  - Picks up lost connections... where you left off
Security and Devices

- Palm Tungsten C
  - WEP – out of the box
  - LEAP – 3rd party add-on
    - http://www.mtghouse.com
  - WECM – IBM add-on

- Sharp SL-6000
  - WEP – out of the box
  - LEAP – 3rd party add-on
    - http://www.mtghouse.com
  - WECM – IBM add-on
Security and Devices

- PocketPC devices with Windows Mobile 2003
  - WEP – out of the box
  - LEAP – out of the box
  - WECM – IBM add-on

- RIM Blackberry
  - Triple DES encryption from device to BES server – out of the box
Security and Devices – Sharp SL-6000

- Does not support alphanumeric power-on passwords
- Opera Browser
  - Good HTML and JavaScript support
  - Very configurable
  - Can control browser cache
  - Supports separate browser password
Security and Devices – PocketPC

- Supports alphanumeric power-on passwords
- PocketIE Browser
  - Good HTML and Javascript support
  - Browser has almost no configuration options
    - Very weak
    - No options to clear cache
    - No separate browser password
Security and Devices – Palm

- Supports alphanumeric power-on passwords
- Browser issues
  - Not as robust as Opera or as versatile as PocketIE
Wireless Networks

- Cellular
  - GSM, CDMA, TDMA, iDEN, etc.
  - Pros: Wide coverage area
  - Cons: Slow and expensive

- 802.11
  - 802.11, 802.11a, 802.11b, 802.11g
  - b very pervasive... g getting there
  - Pros: Fast and cheap
  - Cons: Narrow coverage area
Wireless Networks

- Broadband cellular networks are emerging
- Verizon
  - 300 - 500kbps
    - Currently – Washington DC and San Diego areas only
Integration

- Often you want to integrate with existing enterprise solution
  - Accomplished easiest with standards-based approach
    - Web Services
  - "Yes, but I thought web services were fat and slow... how can I do that on a handheld?"
Integration

- Two approaches
  - Invoke web services from handheld
  - Leave the web services on the server
- Web Services from handheld
  - IBM’s Web Services Toolkit for Mobile devices
  - Provides ability to invoke web services from variety of handhelds
Integration

- Performance is acceptable on 802.11 LANs
  - Can be sluggish on cellular WANs
  - However, this is due to the network, not the Web Services

- Also consider how much code you want on the device
  - Put Web Services on server and provide a browser based solution
    - No device coding
    - More portable
    - Limited to browser UI, however
Case Study

- Hospital with an existing clinical information system
  - J2EE web application
  - WebSphere on IBM 390 backed up by DB2
- Browser based application used by physicians to
  - View/update patient information
  - Write prescriptions, track problems, *etc.*
  - 99% originally written by IBM
  - In use for 2.5 years
Case Study

- Allows physicians to query and update various information:
  - Demographics
  - General Problems
  - Labs
  - Medications
  - Insurance
  - Schedules
    - Physician and Clinic
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<th>Diagnosis Code</th>
<th>Date</th>
<th>Status</th>
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<td>FIBROADENOMA</td>
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<td>AZOTEMIA</td>
<td>7906</td>
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<td>V420</td>
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<td>UNCODED</td>
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<td>V4589</td>
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<td>Active</td>
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<td>S/P CHOLECYSTECECOMY</td>
<td>V4589</td>
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<td>Active</td>
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<tr>
<td>STEROID INDUCED DIABETES</td>
<td>25000</td>
<td>07/31/2003</td>
<td>Active</td>
</tr>
</tbody>
</table>
### Outpatient Medications

#### Display Converted Medications

- **Description**: PREDNISONE 2.5MG TABLET, PROGRAF 1MG CAPSULE, VITAMIN, ZETIA 10MG TABLET
- **Route**: ORAL
- **Dosage**: 2.5MG, 1MG, 10MG
- **Frequency**: QD, BID
- **Qty RXD**: 0
- **Refills**: 0
- **Rx Date**: 07/06/2004, 07/06/2004, 07/22/2004, 05/06/2004
- **Status**: Active

**Buttons**:
- Add
- Inactivate
- Inactivate with reason
- Prescription
Existing Architecture

Locked Down Station

Desktop

Laptop

Wired

802.11b via Cisco LEAP

Wireless

IBM 390

WebSphere

Stored Procedure Manager

DB2
History

- Hospital wants a mobile solution for physicians
- Have tried:
  - Wireless Toshiba Tablets
  - Were considering Thinkpads on a cart
- Perfect opportunity to prove Web Services utilization and handhelds
History

- November 2003
  - First meeting with key hospital decision makers
    - Director of Medical Infomatics, CIO, IT Director, and staff
  - Showed demo of what was possible using various devices
    - Collected initial requirements
- December 2003
  - Proposed Architecture to meet requirements
  - Received the go-ahead to build solution
History

- January 2004
  - Proof of Concept (POC) requirements review meeting
- February 2004
  - Begin POC implementation
- June 2004
  - POC Launch (6/11)
  - POC to run for period of 2-3 weeks for each participant
Device Functionality
Requirements for POC

- Log in and authentication
- Query patient data
  - Demographics
  - General Problems
  - Medications
- General queries
  - Personal patient list
  - Physician Schedule (current day)
  - Clinic Schedule (current day)
  - Hospital Census
- Prescribe medications and Print prescriptions
- Asynchronous Lab Result notification
General Requirements

- No client code
  - Unrealistic based on one requirement
- Use any device
  - Unrealistic
- No horizontal scroll bars
- Read-only device interface
  - Data input is very tedious
Challenges

- Solution must be easy to use
  - Follow existing web application usage model but presentable on handheld
- HIPAA
- Wireless security
  - Was no LEAP client for Sharp Zaurus device
- Device security
  - Passwords and browser cache
- Device battery life
- Manage expectations
- Hospital Cisco network configuration
- Printing
Cisco Network Configuration

- Cisco APs are set by default to only allow Cisco hardware to authenticate
- We used non-Cisco LEAP clients
- Had to change authentication type on all APs to
  - Accept Open Authentication
**PH078 AP Radio: Internal Data Encryption**

Cisco 1200 Series AP 12.02T1

If VLANs are **not** enabled, set Radio Data Encryption on this page. If VLANs are enabled, Radio Data Encryption is set independently for each enabled VLAN through VLAN Setup.

Use of Data Encryption by Stations is: [Full Encryption]

Accept Authentication Type: [Open] [Shared] [Network-EAP]  
Require EAP: [✓] [ ] [ ]

<table>
<thead>
<tr>
<th>Transmit With Key</th>
<th>Encryption Key</th>
<th>Key Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>WEP Key 1:</td>
<td></td>
<td>128 bit</td>
</tr>
<tr>
<td>WEP Key 2:</td>
<td></td>
<td>not set</td>
</tr>
<tr>
<td>WEP Key 3:</td>
<td></td>
<td>not set</td>
</tr>
<tr>
<td>WEP Key 4:</td>
<td></td>
<td>not set</td>
</tr>
</tbody>
</table>

Enter 40-bit WEP keys as 10 hexadecimal digits (0-9, a-f, or A-F). Enter 128-bit WEP keys as 26 hexadecimal digits (0-9, a-f, or A-F). This radio supports Encryption for all Data Rates.

Apply  OK  Cancel  Restore Defaults
Deployed Architecture

- **Blended Architecture**
  - Use a thin client on device only for functional requirements that can’t be met with the browser
  - Use the browser for all other functional requirements
- This puts the most code on the server and the least code on the device
  - Meets all functional requirements
Deployed Architecture

- Code on device to support asynchronous Lab Result notification only
- No code on the device for everything else
  - Browser based access for all other functionality
  - All other UI provided by server JSPs and Portlets
Deployed Architecture

- Utilize Web Services
- Web Services Front End (WSFE)
  - Future integration point for any other entities
    - Key point
  - Can be expanded to be the front end to clinical information system or other systems they want to expose services from
- Utilize WebSphere Everyplace Access (WEA) on server only
  - WebSphere Portal
- Existing hospital architecture and components do not change
Deployed Architecture with Portal and Web Services Front End

Locked Down Station
Desktop
Laptop

802.11b via Cisco LEAP

Wired

IBM 390

WebSphere

Stored Procedure Manager

Mobile Devices – Browser and custom client code

WEA/WebSphere Portal
Mobile Portlets
Mobile Portlets
Mobile Portlets

Web Services Front End

getDbDemographics
getGeneralProblems
getMedications
getCensus
printPrescription
etc.

DB2
Web Services Front End

- Allows you to expose services in a non-proprietary manner
- Can expose clinical information system or other system functionality
- Allows integration with business partners, present and future
Architecture Advantages

- Best of both worlds
  - Minimal client code
  - Maximum functionality

- Utilizes Web Services
  - Device does not invoke web services
  - Portlets invoke web services in WSFE
  - Code on device is invoked with web services
Architecture Advantages

- POC can be accomplished with no disruption to the existing system
  - Installation
  - Development
  - Testing
  - Pilot
Architecture Advantages

- Solution is an add-on, not a replacement
- All POC components are on a separate machine
  - WebSphere Everyplace Access (WEA)
    - Which contains Portal Server
  - WSFE

- This machine queries the production database
Devices Used

- New Sharp Zaurus SL-6000
  - Embedix OS (Linux)
  - Intel 400 Mhz XScale processor
  - 64 meg or RAM
  - Integrated 802.11b wireless radio
  - Full VGA screen (Portrait and Landscape)
  - Voice recorder
  - CFII, IrDA, SD, USB
  - Opera browser
  - Jeode JVM
  - QWERTY keyboard
Devices Used

- HP IPAQ h4355 PocketPC
  - Intel 400 MHz XScale processor
  - 64 meg RAM
  - Integrated 802.11b, Bluetooth, IrDA
  - SD Slot
  - Voice Recorder
  - ½ VGA screen
  - QWERTY keyboard
Architecture Advantages

- Solution tested with Sharp SL-6000, PocketPC H4355, and Palm Tungsten C
  - Palm eliminated due to browser issues
- Device portability because:
  - Mostly browser based
  - Java for piece that is not
Proof of Concept

- Began 6/11/04
- 4 Physicians took part
  - Each loaned a Sharp device (two also got the PocketPC)
  - We met with each one for training
- Device is “out of the box” except:
  - Web Services Toolkit for Mobile Devices component
  - Our custom notification client
  - LEAP client from MeetingHouse for Sharp device
Demo
Products/Technologies Used

- WebSphere Everyplace Access 4.3 (WEA)
  - Integrated Portal Server
- Web Services Toolkit for Mobile Devices
- Device notification technology
  - Client and Server components
Future Possibilities

- Use WSFE to expose interfaces to other systems
- Deploy other devices
  - Palm Tungsten C
  - Others...
- Use Portlets for full solution
  - Not just mobile piece
Follow-On Architecture

Locked Down Station
Desktop
Laptop

Wired
802.11b via Cisco LEAP

Wireless

Web Services Front End

WEA/WebSphere Portal
Mobile Portlets
Portlets
Mobile Portlets
Portlets
Mobile Portlets
Portlets

Pharmacy
Other Health Care Facilities

IBM 390
WebSphere
Stored Procedure Manager

Mobile Devices – Browser and custom client code

DB2
Issues and Concerns

- Device Battery life
- Device Browser anomalies
- Hospital network issues

- We don’t control any
References

- [http://www.blackberry.net/developers/na/java/start/index.shtml](http://www.blackberry.net/developers/na/java/start/index.shtml) – Blackberry JDE
- [http://www.microsoft.com/windowsmobile/developers/default.mspx](http://www.microsoft.com/windowsmobile/developers/default.mspx) – Microsoft page for mobile developers
- [http://www-1.ibm.com/industries/wireless/doc/content/solution/278603104.html](http://www-1.ibm.com/industries/wireless/doc/content/solution/278603104.html) – IBM’s WebSphere Everyplace Connection Manager
- [http://www.mtghouse.com](http://www.mtghouse.com) – LEAP clients from Meeting House