Mobile Development & Runtime Challenges for Today and Tomorrow

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IBM Research: A Culture of Innovation

Inventing the building blocks

- Relational Database
- DRAM
- Copper chips
- Mark I
- FORTRAN
- Blue Gene
- Watson
- Blue Gene

Diffusion of IT

- Social Analytics
- Cloud
- Mobile
- Big Data Analytics
- Smarter Planet

68 years of innovation

- 5 Nobel Laureates
- 9 Medals of Technology
- 5 National Medals of Science
- 1 Turing Award
A New Era of Smart

IBM Research: Open and Collaborative

The Eras of IBM Research: “The World Is Now Our Lab”
Outline

The challenges of mobile development, runtime and management

Adhoc Computing – Wearable meets Cognitive

Mobile Analytics - Making Sense of all this Data

Advanced Runtime and Development Services for Mobile 2.0
Our new reality ... changed by Mobile
Mobile is a Transformational change for all Industries

Healthcare

Insurance
Mobile apps go deeper than front-end UI

Front-end

Short time to market
Web? Hybrid? Native?

Teamwork
Industrialize app dev
Integrate with SDLC

Back-end

30% of the value and effort is visible (mobile UI)
70% of the value and effort lies under the surface

User engagement
Connect to back-end
Efficient and flexible push notifications
Track and leverage location
Offline availability
B2E app distribution

Security

Operations

Manage and enforce app versions
Track problems that affect UX
Ensuring continued support in a quick-changing landscape

Push upgrades
User authentication
Malware detection
Data protection
A new Mobile Era, We Have Moved From...

- **Single** transactions to **personalized engagement**
- **Millions** of PCs to **billions** of mobile devices
- **Structured** data to **massive amounts of unstructured data**
- **Static** applications to **dynamic composable services**
- **Rigid infrastructure to** an **elastic cloud infrastructure**
- **Reactive security** to **Intelligent, proactive protection**
Processes businesses need to address

- Transform strategy and operations (e.g., multi roles)
- Build and deploy multi-platform mobile applications
- Optimize mobile experience to build loyalty
- Leverage analytics to turn information into insights
- Continuously update your mobile application
- Deliver exceptional performance leveraging the new scalable 3 tier architectures
- Support BYOD and a mobile workforce
- Oversee security, risk and compliance
IBM MobileFirst acquisitions

Secure B2C mobile transactions

Mobile device management

Enable service providers to analyze their mobile data

Cross platform mobile apps

Continuous delivery for mobile

Transform

Optimize

Engage

Build

Mobile customer engagement

Improve the mobile customer experience

High speed content delivery

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The IBM Worklight Platform supports the complete mobile application lifecycle

**Application Scanning**
Detect code vulnerabilities at the time of development

**Quality Assurance**
Collect beta test feedback, crashes and analyze user sentiment

**Foundation**
Development, Runtime, Operations
Console & Private Store

### Development
- Studio
- Server
- Console

### Continuous Delivery
- Runtime
- Application Center
IBM Bluemix Mobile Cloud Services
Scalable Backend Services to Accelerate & Enrich Apps

**Integration**
Connect with APIs & Systems of Record

**Analytics**
for reporting and insight

**Workflow**
to automate next actions

**Cloud Storage**
for mobile data management

**Security**
to prevent unauthorized access to data

Cloud Integration
Embeddable Analytics
Rules
Mobile Data
Mobile Application Security

Mobile Quality Assurance
Workflow
Cloudant NoSQL DB
Supporting hybrid Mobile application backend connecting Cloud APIs to the Worklight Platform

IBM Worklight Foundation

IBM Codename: BlueMix

Extend your enterprise mobile app platform investment through Cloud APIs:
• Worklight ready SDK that can be plugged into your project
• Lifecycle management controls API access for BlueMix services
• Worklight security framework integrates with BlueMix mobile application and services
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Advanced Runtime and Development Services for Mobile 2.0
The next computing platform is a plethora of Wearable, IoT and Mobile devices
People will use multiple devices that seamlessly work together to accomplish their goals

Activity tracking
Heart rate
Oxygen saturation
Body temperature
Calories burned

Camera Augmentation
Voice Call
Music
Checking Time
Alarm
News & Alerts
GPS

Browsing
Messaging
Calendar
Wearable enables new business opportunities
Not supported by smart phones driven by always on, hands free, new sensors

**B2E - Transforming Professions**
- Field worker safety
- Emergency response
- Smart conference
- Customer service
- Smart law enforcement
- Field worker effectiveness
- Smart doctor

**B2C - Engaging Customers**
- Payments
- Elderly Monitoring
- Amusement parks
- Customer loyalty
- Pay as you live insurance
- Banking
- Healthcare
- Shopper analytics
- Home caring

Customer service
B2C - Engaging Customers
Field worker safety
B2E - Transforming Professions
Not supported by smart phones driven by always on, hands free, new sensors
New computation and data capture is growing on Wearable and Mobile devices

Four tier architecture

- Distributed application deployment topologies – from Single App to Multi App Multi Device
- Diverse SDKs and device APIs
- Dynamicity - application logic is context sensitive

E2E privacy & security

- Need to maintain Data consistency across tires
- We need a simple programming model to overcome the complex distributed topologies
A New Era of Smart As Seen By You
As Seen By Stranger 1
As Seen By Stranger 2
Wearables are the new I/O for cognitive and analytics. We need Cognitive systems to make sense of all this data.

- Activity
- Emotion
- Stress
- Pulse
- Sleep quality
- Sight
- Excitement
- Identity

Cognitive Services:
- NLP
- Vision
- Affective Computing
- Augmented Reality
- Biometric authentication
- Context

Augmentation:
- Audio Visual Guidance
- Recommendation
- Correction of errors

System of Records:
- App
- Serv
- Storage

Cloud 3.0 / SoftLayer
The Guardian Angel mobile application works as your personal protective application. It allows intuitive specification of “shields” that govern the personal wellness and safety of their owner, detect hazard and notify employees and emergency centers.

**Hazards Detection**
- Excessive lifting, pushing, carrying
- Fatigue
- Alertness
- Dehydration
- Fall / Injury
- Use of safety equip

**BLE/ANT+ / CPU**
- Accelerometer:
  - Speed-X
  - Speed-Y
  - Speed-Z

**Environmental-sensing:**
- Temperature
- Light
- Noise
- Oxygen deficiency
- Carbon monoxide

**GPS Sensor:**
- Location

**Bio-sensing:**
- Heart-rate
- Body temperature

**Alert Employee**

**Inform Emergency Center**

**Broadcast message to nearby employees**

**IBM WorkRight**

**Federated Analytics**
Detective (real-time) / Predictive
The IBM WorkRight Cloud - it's not about the hat

Versatile Connectivity

WorkRight Client Services

Local Rules /flow engine

Wear Hub

Apps

local time/geo Situation

Site Coverage

WorkRight Services

Ad-hoc interoperability

WorkRight Client Services

Device connectivity Hub

Analytics/ Temporal/ Situation Storage

Rules/events /flow engine

Time/geo/ Situation Storage

WorkRight Services

Back-end Analytics / Anytime Compliance

Federated Front-end Analytics
Demo Workright
Technologies Overview

- **Multi-Objects Recognition System**
  - Uses advanced computer vision techniques for multi objects detection
  - Robust for perspective capture
  - Able to distinguish between products from the same brand and even in sub-brand
  - Multi-objects segmentation

- **Visualization**
  - Uses augmented reality for natural augmentation in context
  - Accurate Pose estimation for 3D Warping
Augmented Reality for Maintenance - Challenges

- Vision Challenge
  - Non planar objects
    - various faces look different
  - 2D/3D mapping capabilities
    - Working with 3D objects
    - Natural Augmentation
  - Realtime considerations
    - Fast yet accurate pose estimation
  - Various lighting conditions
    - Outdoor/indoor noise/saturation
Demo AR
Sleep Well, Live Well Demo
IBM and EarlySense Use Cognitive Models to Help Improve Sleep Patterns and Promote Good Health

1. EarlySense Sensor under the pillow
   - Generates KPI’s
     • Heart Ratio (HR)
     • Respiration Rate (RR)
     • Movement

2. Personal Monitor
   - You can see your performance in terms of HR, RR and movement

3. Emergency Monitor
   - Shows people with problematic KPI’s
   - Authorized staff can take actions in real time

4. BI Monitor for at rest analysis of accumulated data
   - More details on Youtube
Demo Mobile IoT Convergence
Outline

The challenges of mobile development, runtime and management

Adhoc Computing – Wearable meets Cognitive

Mobile Analytics - Making Sense of all this Data

Advanced Runtime and Development Services for Mobile 2.0
A comprehensive, standards-based, spatiotemporal support for the IBM platform, middleware and solutions

Collect & Store data

Collect Business and operational spatiotemporal events from heterogeneous sensor environment
Collect GPS traces and filter out noisy data.
Integrate and enrich with GIS data
Index & Store location information

Operational Decision Management

Trigger actuators and business processes upon rules and detected situations
Push alerts to mobile devices and operators
Refine & Create business rules in visual context

Visualization and Analytics

Track location of mobile devices and moving assets
Detect space-time aware situations and incorporate into business decisions and events
Interactive discovery and analysis on historical data

Proactive Event-Driven Computing

Forecast and respond to future events and situations ahead of time
A New Era of Smart

Smarter Systems Need to Respond to Space and Time Situations

Risk Management
Enhance maritime risk management done by customs agencies with analysis of vessel route and movement patterns

Fleet Management
Allow operators to track and trace their fleet, assist to drivers and monitor dangerous driving behavior

Retail
Offer coupons to customers who drove near a store 3 times in the past week

Safety and Security
Alert when detecting inadvertent entrance to restricted zones or dangerous patterns, e.g. vehicles approaching each other
Analytics Explained

- **Hindsight:** What happened?
- **Diagnostic Analytics:** Why did it happen?
- **Predictive Analytics:** What will happen?
- **Prescriptive Analytics:** How can we make it happen?

- **Descriptive Analytics:** What happened?
Innovative In-Store Customer Presence Detection

Taking digital traffic analysis to the store

<table>
<thead>
<tr>
<th>Web metrics</th>
<th>Store metrics</th>
<th>Web metrics</th>
<th>Store metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session / First session</td>
<td>Store visit / first store visit</td>
<td>Avg time per page</td>
<td>Time spent in each zone</td>
</tr>
<tr>
<td>Unique/Repeat visitor</td>
<td>Unique/rep store visitor</td>
<td>Traffic volume</td>
<td>Total visitors to store</td>
</tr>
<tr>
<td>Session duration</td>
<td>Store entry/exit duration</td>
<td>Bounce rate</td>
<td>Short durations, no zones visited</td>
</tr>
<tr>
<td>Page views per session</td>
<td>Number of zones visited</td>
<td>Frequency per unique visitor</td>
<td>Number of zones visited</td>
</tr>
<tr>
<td>Avg new/repeat session len</td>
<td>Avg time spent in store; new/rep</td>
<td>Unique visitor per store / time</td>
<td>Recurring store entries</td>
</tr>
</tbody>
</table>
Marketing manager gets trends analysis
IBM Spatiotemporal Analytical Workbench
Combining Advanced ST Analysis + Advanced Visualization + User Interaction

Movement analysis and pattern detection in public transportation

Understanding temporal distribution of event data

Movement analysis, clustering and pattern detection in maritime transportation

Spatiotemporal clustering of events and locations
Demo VA
Basic backend location-based services (LBS)

**Spatiotemporal Context Management**
Create/Read/Update/Delete Context, Geo-Fences, Entities.

**Order tracking**

<table>
<thead>
<tr>
<th>Status</th>
<th>On route</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimated arrival in 1 day</td>
<td>In flight from Chicago to Paris</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Route</th>
<th>Status</th>
<th>Estimated arrival</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Packing your order</td>
<td>February 18, 2006, 11:32 AM</td>
</tr>
<tr>
<td>02</td>
<td>Pickup by FedEx</td>
<td>February 18, 2006, 3:02 PM</td>
</tr>
<tr>
<td>03</td>
<td>FedEx hub, Chicago</td>
<td>February 18, 2006, 8:27 PM</td>
</tr>
<tr>
<td>04</td>
<td>FedEx hub, Paris</td>
<td>Est. arrival: February 19, 2006, 7:25 AM</td>
</tr>
<tr>
<td>05</td>
<td>European customs check</td>
<td></td>
</tr>
<tr>
<td>06</td>
<td>FedEx hub, Bordeaux (FR)</td>
<td>Est. arrival in 1 day</td>
</tr>
<tr>
<td>07</td>
<td>Delivered to you</td>
<td>Est. arrival in 1 day</td>
</tr>
</tbody>
</table>

**Geospatial queries**

- **Range queries**: e.g., find all UPS/FedEx locations within 1-mile radius
- **Proximity searches**: e.g., find 10 nearest UPS/FedEx locations

**Geospatial triggers**

- Invoke listener’s code to e.g., send a coupon whenever a VIP customer enters / exits one of the electric shops.
- Remotely lock tablet application when logged-in person’s Smartphone is outside 20m range for more than 1 min.
Advanced triggering capabilities

Notify listener if a certain spatiotemporal condition had occurred

- Entity entering/exiting/dwelling inside/outside geofence
- Groups entering/exiting/dwelling inside/outside geofence
- Entity left the group (distance more than 100 m for more than 1 min)
- Deviation from route by more than 200 m for longer than 5 min
- Not all employees are inside/outside the facility within 5 min
- The entity speed is above the threshold
Demo Location
Technologies implementing S/T Solutions

IBM Interactive Maps Technology
Embed interactive map-based visualizations for data-in-motion in web apps

IBM Map Authoring Toolkit
Create maps and spatial objects. Assign business meaning to locations

IBM Spatiotemporal Analytics Workbench
Create insight from spatiotemporal big data

IBM Location Intelligence Toolkit
Standards-based libraries and tools for developing location-aware applications

Prescriptive ST Mobile Analytics
Automatically suggest behavioral policies for mobile entities and systems

Predictive ST Mobile Analytics
Provide actionable insight in the context of mobile platform and its data

Scalable Geo-fence Technology
Highly scalable dynamically adjusting grid-based spatial indexing

IBM Proactive Technology Online
Scalable engine for complex event processing
Outline

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Advanced Runtime and Development Services for Mobile 2.0
Secure Multi-Modal Context Based Authentication

<table>
<thead>
<tr>
<th>Business Concern</th>
<th>Solution Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>New risks associated with mobile device accessing the enterprise / services</td>
<td>Use context and strong authentication to reduce unauthorized access risk</td>
</tr>
<tr>
<td>“Compliant” userid / password entry on mobile devices has low user satisfaction</td>
<td>Use mobile device built-in sensors -- alternative authentication modalities, including biometrics. Eliminate traditional 2 factor hardware tokens.</td>
</tr>
<tr>
<td>Mobile devices have become security tokens (credential caching) that are easily lost or stolen</td>
<td></td>
</tr>
<tr>
<td>User interaction with mobile devices is brief, dominated by authentication</td>
<td>Balance security requirements with improved usability</td>
</tr>
<tr>
<td>Situational Impairments</td>
<td>Multi-factor authentication allows selection of authentication modality appropriate for the context</td>
</tr>
</tbody>
</table>

Reduce security risk through context aware usable strong authentication and risk-based access
Demo Biometric Auth.
Rapid mobile application development
IBM Worklight App Framework

- Wizard-based enterprise and public API discovery
- Extensibility of app logic and UI components
- Out-of-the-box app architecture takes care of "plumbing"
- Controlled look and feel, compliant with target mobile OS
- Fast screen generation, screen flow control
- Integrated with Worklight Studio
Mobile applications analysis – Anti-Patterns

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Exec Summary

• Automatically identify and fix **syntactic**, **semantic** and global **anti-patterns** in mobile applications

• Identify and collect semantic and syntactic anti-patterns and best practices for improving the application **UX and Performance**.

• Dynamically optimize applications according to the user specific behavior or common behavior of many users

Customer Value and Business Impacts

• Extremely reduce the time spent by developers and experts that manually inspect customers applications, in order to provide code fixes. Provide the developers in line automated support suggesting transformations from the anti-patterns to the best practices

• Enable easy fixing and creation of highly performing, efficient apps, with superior UX

Technical Challenge – Open Problems:

• Data flow analysis for JavaScript
• Extracting state machine from apps
• Refactoring of anti-pattern for JavaScript
• Refactoring of anti-pattern for the mobile application
• point-to analysis or other well known analysis for JavaScript
• Semantic anti-patterns identification – No best practices available
• On the top of the formal representation further code analysis and transformation algorithms to be explored.
Web legacy, mobile enablement

A New Era of Smart

Executive Summary

- Enable customers to easily extend their existing Web1.0 (JSP) application to mobile while leveraging existing technology (code & skills) with the UI and the UX expected from a mobile app.

- Provide mobile JSP tag libraries for enriching Web1.0 applications as well as native WL client containers, for calling the remote web1.0 application while exposing the application to device capabilities and hosting static content inside the container to minimize access to server

Customer Value and Business Impacts

- A real need coming from WebSphere clients who want to maintain their Web1.0 applications while mobile enabling them (WAS/ WebSphere portal/ WebSphere Commerce customers)

- Bring every WAS customer into the world of Mobile, while addressing common adoption inhibitors (such as large code bases in place, lack of skills..) and leveraging existing investments

- Provides a rapid method for mobilizing the volume of web sites and portals, entry point without new skills

Technical Challenges

- Define and develop a custom JSP tag library for declaration of mobile web applications utilizing the device capabilities (what is the natural declarative method for defining mobile web?)

- Develop native client side containers (android/iOS) that would enable loading of pages from a remote server while accessing static web content hosted on the device to minimize networking and server accesses (requires a sophisticated solution to deal with same origin policy and security issues)
**Business Value**

- A cost-effective, drop-dead simple solution for secure cloud-to-enterprise connectivity
  - A simple mobile app project no longer has to become a complex and costly security project which takes ages to be approved by CISO
  - Makes a strong case for IBM cloud offering
  - Allows to switch from backend-powered Worklight adaptors to cloud-based solutions (which is something that customers and partners are already looking for)

**Exec Summary**

- A framework for secure and controlled delivery of enterprise data to the cloud, which
  - Encapsulates an end-to-end security solution that protects the data on its way to and inside the cloud
    - Incorporates a secure tunnel between the enterprise and the cloud
  - Seamlessly integrates with the enterprise data-sources
  - Allows a fine-grained control over the data items that leave the enterprise boundaries, which is realized via access rules and censorship transformations
  - Supports in-enterprise processing of data
    - The only way to handle classified data that must not be shipped to the cloud
    - Also helps reducing the amount of data to be transmitted
    - Is a vehicle for complex censorship transformations and access checks