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BIG Connectivity with WebSphere MQ and WebSphere Message Broker [z/OS & Distributed]

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IBM

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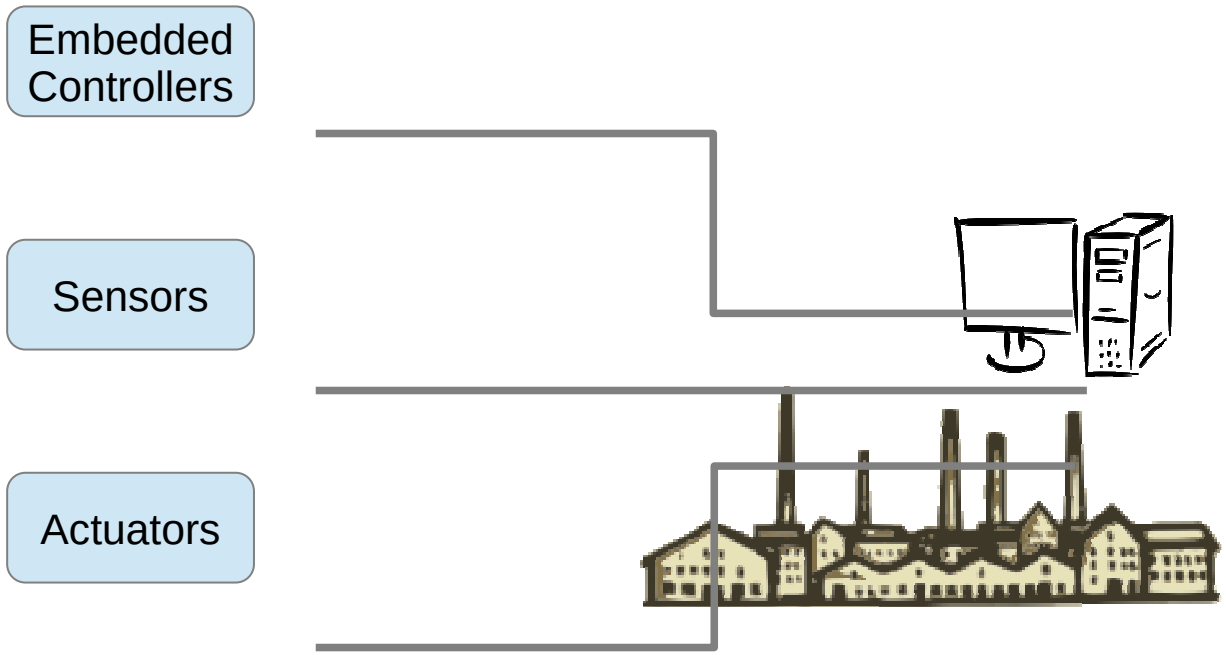
Agenda

- MQ
  - **WebSphere MQ Extended Reach (MQXR)**
  - WebSphere MQ HTTP Bridge
- Message Broker
  - Introduction to Worklight
  - Worklight Adapters
  - Message Broker Mobile Patterns
    - *Mobile enablement for Microsoft .NET applications*
    - *Create flexible mobile services on top of Message Broker*
    - *Outbound push notifications for asynchronous data delivery*
    - *Resource handler including security and caching*

Tightly Coupled Systems

Digital devices have now been embedded into systems for over 40 years.

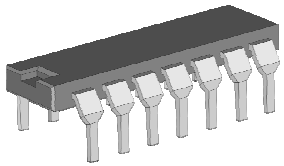
Typically they have used propriety interfaces, tightly coupling the devices to their data capture systems.

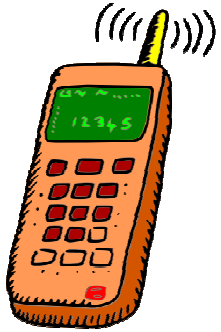


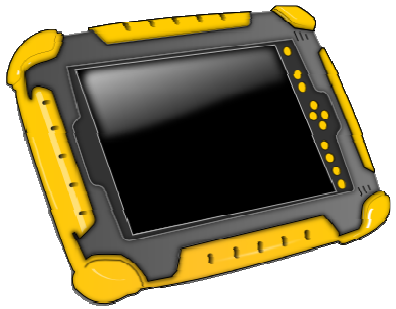
Embedded and Mobile Devices

The proliferation of devices has risen dramatically in recent times:

- Popularisation of custom embedded circuitry







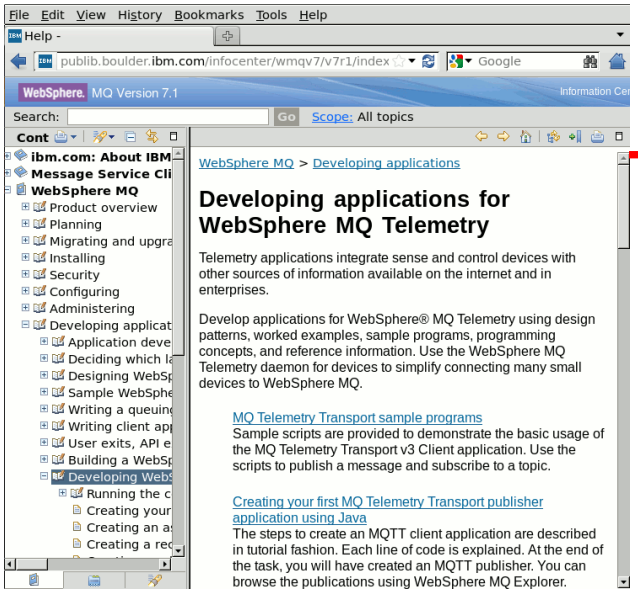
- Mobile Phones / Tablets

- Appreciation by industry as to the possibilities of making data available to the user

The Internet of Things

Billions of smart devices **instrument** our world today

Internet Communication



HTTP → WWW

HTTP serves as the de-facto protocol for communication between browsers and the internet

What protocol should machines use to communicate with each other?

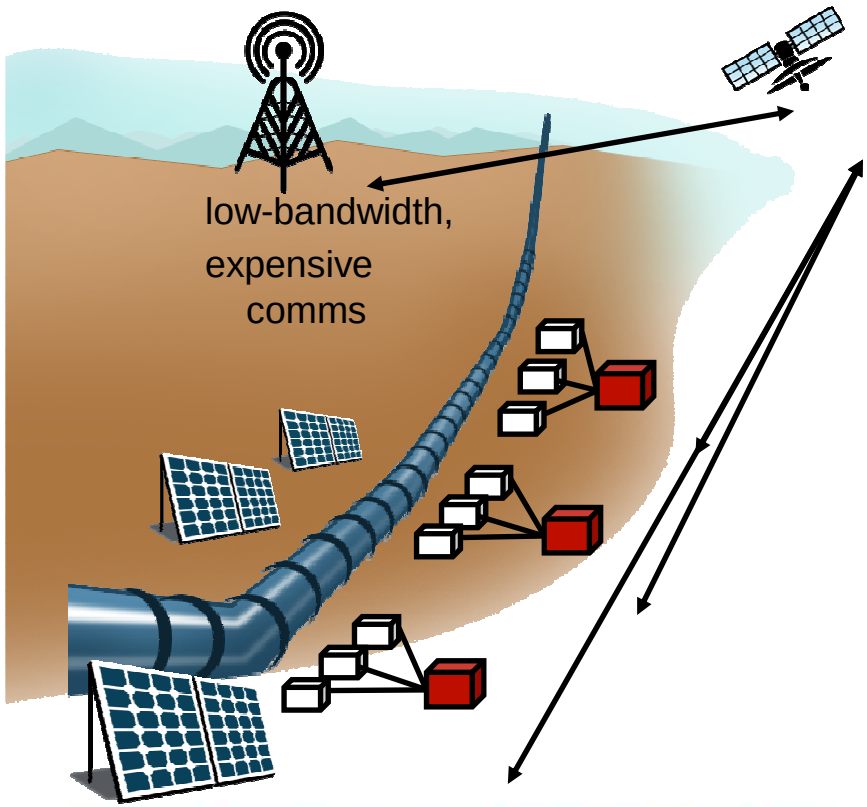
A common Machine to Machine (M2M) protocol

? → Internet of Things

MQ Telemetry Transport (MQTT)

To save inventing a new protocol every time a new embedded device came along, a common protocol is needed.

MQTT is that protocol. It traces its roots back to 1999, where Dr Andy Stanford-Clark of IBM, and Arlen Nipper of Arcom (now Eurotech) devised the protocol.



Design goals of MQTT:

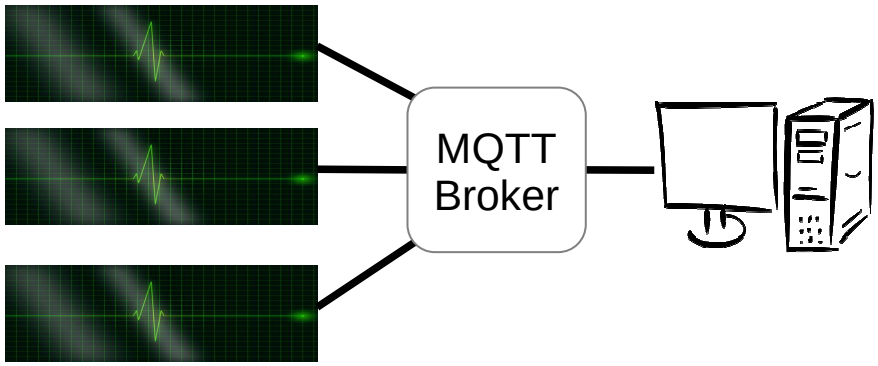
- Works over unreliable communication networks
- Minimal data overhead (low bandwidth)
- Capable of supporting large numbers of devices
- Simple to interface the data with the traditional IT world
- Simple to developers to write applications to use

MQ Telemetry Transport (MQTT)

- Expect and cater for frequent network disruption – built for ***low bandwidth***, ***high latency***, ***unreliable***, ***high cost*** networks
- Expect that client applications may have very ***limited resources*** available.
- ***Publish/subscribe*** messaging paradigm as required by the majority of SCADA and sensor applications.
- Provide traditional messaging ***qualities of service*** where the environment allows.
- ***Published protocol*** for ease of adoption by device vendors and third-party client software.

MQTT Sample Usage Applications

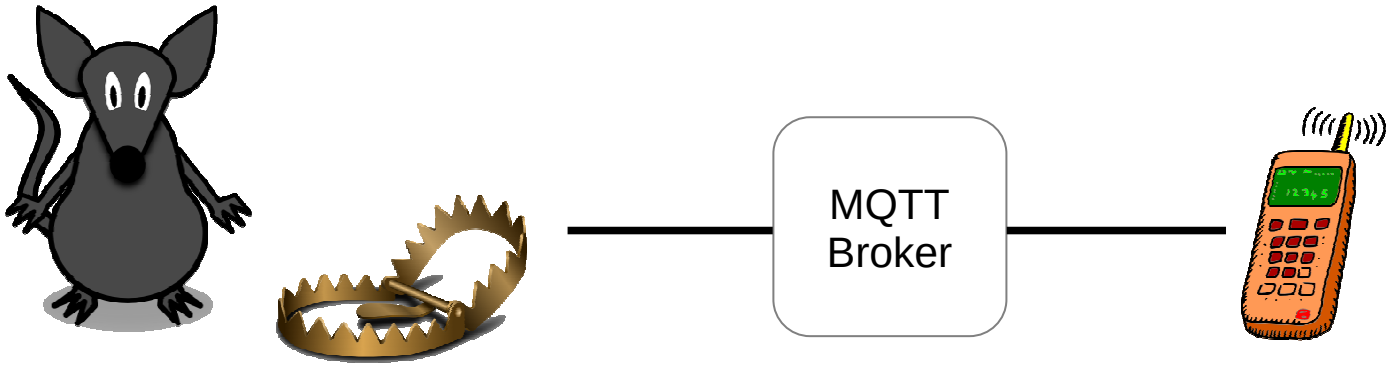
Medical devices in hospital equipment



Facebook Messenger

Low latency (milliseconds)
Low battery usage
Uses data sparingly
Implemented within weeks

The Andy Stanford-Clark Mouse Trap State Advisor



MQTT Qualities of Service

QoS 0: At most once delivery (non-persistent)

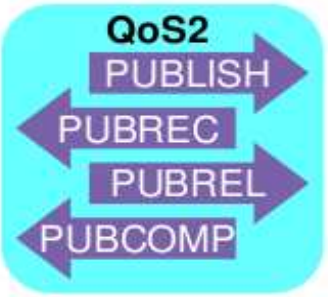
– No retry semantics are defined in the protocol.
– The message arrives either once or not at all.

QoS 1: At least once delivery (persistent, dups possible)

– Client sends message with Message ID in the message header
– Server acknowledges with a PUBACK control message
– Message resent with a DUP bit set If the PUBACK message is not seen

QoS 2: Exactly once delivery (persistent)

– Uses additional flows to ensure that message is not duplicated
– Server acknowledges with a PUBREC control message
– Client releases message with a PUBREL control message
– Server acknowledges completion with a PUBCOMP control message



MQTT Power Usage

How does MQTT use power?

- HTC Android mobile phone

	% Battery / Hour	
Keep Alive (Seconds)	3G	Wifi
60	0.77641278	0.0119021
120	0.38884457	0.0062861
240	0.15568461	0.00283991
480	0.07792208	0.00134018

Protocol allows tuning to suit devices

MQTT Data Usage

How does MQTT compare to HTTP for data usage?

Scenario	HTTP	MQTT n3
1. Getting a single piece of data from the server	126 bytes	69 bytes
2. Putting a single piece of data to the serve	141 bytes	47 bytes
3. Getting 100 pieces of data from the server	12600 bytes	2445 bytes
4. Putting 100 pieces of data to the server	14100 bytes	2126 bytes

Very favourably – of the order of a 5x saving!

WebSphere MQ Telemetry

Supplied as a component WebSphere MQ V7.1 and v7.5, under the component name "**WebSphere MQ Extended Reach**" (or MQXR).

MQXR brings MQTT protocol functionality to WebSphere MQ!

WebSphere. software

- Highly scaleable : 100,000+ clients
- Security : SSL channels, JAAS authentication, WMQ OAM
- Ships with reference Java and C clients
  - Small footprint clients
  - other APIs and implementations of MQTT available via 3rd parties

WebSphere MQ Telemetry – Further Reading

MQTT homepage:
http://mqtt.org

MQTT Specification
http://www.ibm.com/developerworks/webservices/library/ws-mqtt/index.html

WebSphere MQ and MQ Telemetry
http://www-01.ibm.com/software/integration/wmq/

MQTT: the Smarter Planet Protocol
http://andypiper.co.uk/2010/08/05/mqtt-the-smarter-planet-protocol/

Lotus Expeditor (micro broker)
http://www.ibm.com/software/lotus/products/expeditor/

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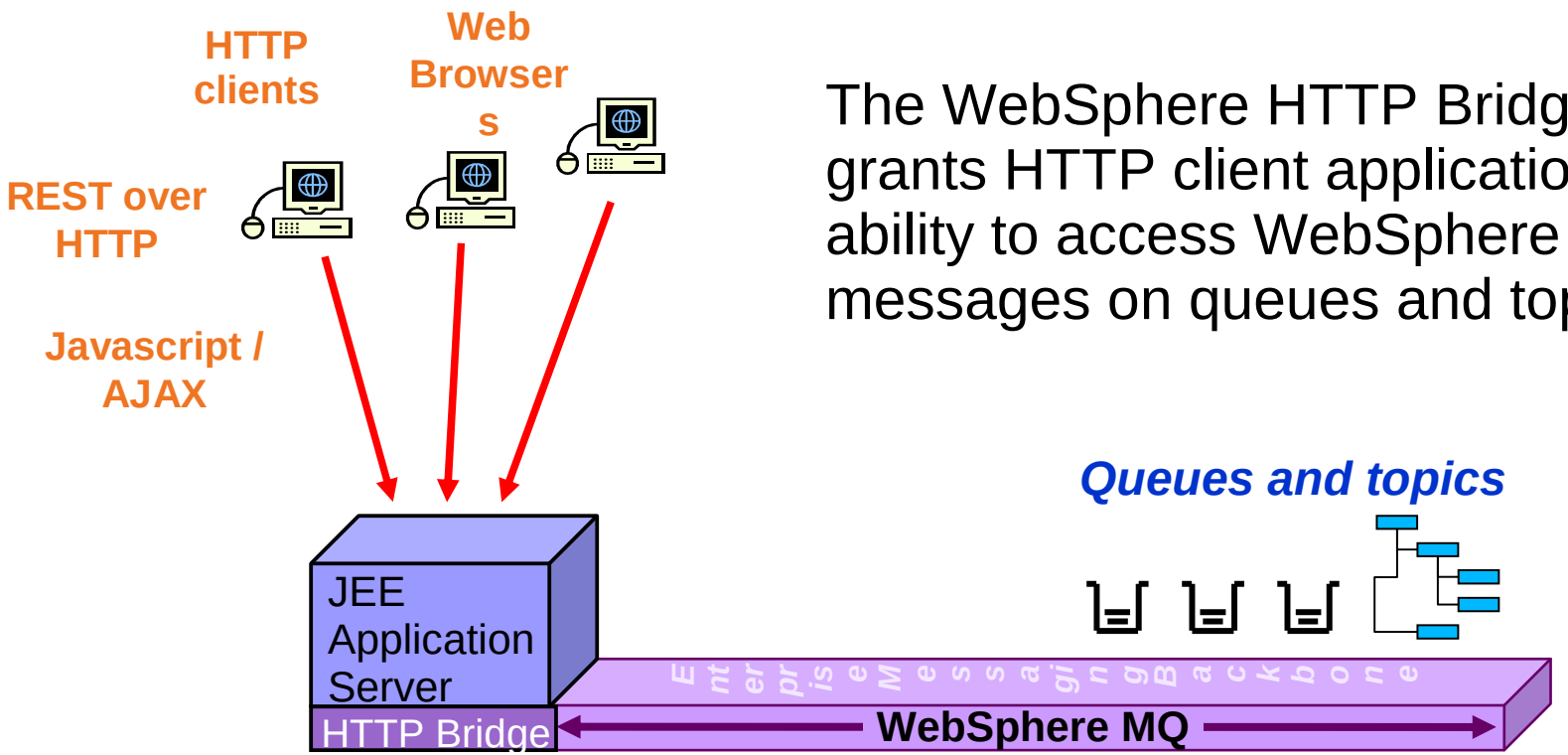
WebSphere MQ HTTP Bridge



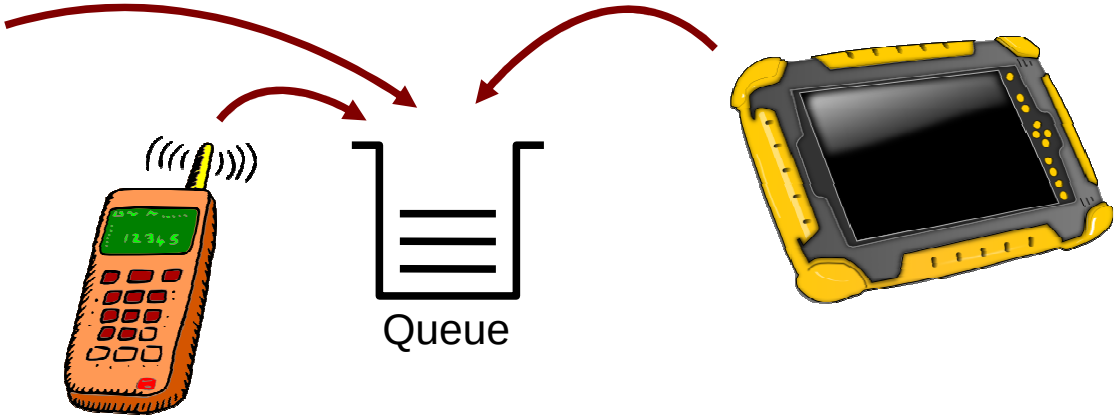
The WebSphere HTTP Bridge grants HTTP client applications the ability to access WebSphere MQ messages on queues and topics.

The HTTP Bridge comprises of a JEE Web application (servlet), which is to be installed into a JEE Application server in order to be used.

WebSphere MQ HTTP Bridge

The WebSphere MQ HTTP Bridge provides two key benefits:

1) **Zero Client Footprint**.
   No WebSphere MQ MQI client libraries are required on the application host.
   In addition, ***any*** platform which supports HTTP can access WebSphere MQ data.



2) **Simplifies access to WebSphere MQ messages** from browser based internet applications.
   No WebSphere MQ programming knowledge is required to program the client applications

WebSphere MQ HTTP Bridge

How does data access work from HTTP?

HTTP Request	Result
POST	Puts a message to a queue or topic (MQPUT)
GET	Browses the first message on the queue (MQGET with browse)
DELETE	Receives a message from the queue (destructive MQGET), or creates a non-durable subscription from a topic
PUT	Not used

The HTTP request defines the location and name of the the queue or topic access point:

POST /msg/queue/myQueue/ HTTP/1.1
Host: myhost.mydomain

WebSphere MQ HTTP Bridge

Example 1: **MQPUT**
Put a messsage to a queue, with message body containing a string message:

```
POST /msg/queue/myQueue/ HTTP/1.1
Host: myhost.mydomain
Content-Type: text/plain
x-msg-correlID: 1234567890
Content-Length: 60

Here is my message body that is posted on the queue.
```

This HTTP POST response is of the form:

```
HTTP/1.1 200 OK
Date: Wed, 2 Jan 2007 22:38:34 GMT
Server: Apache-Coyote/1.1 WMQ-HTTP/1.1 JEE-Bridge/1.1
Content-Length: 0
```

WebSphere MQ HTTP Bridge

Example 2: **MQGET**
Destructively receive a message from a queue, waiting a maximum of 10 seconds:

```
DELETE /msg/queue/myQueue/ HTTP/1.1
Host: myhost.mydomain
x-msg-wait: 10
x-msg-require-headers: correlID
```

This HTTP DELETE response is of the form:

```
HTTP/1.1 200 OK
Date: Wed, 2 Jan 2007 22:38:34 GMT
Server: Apache-Coyote/1.1 WMQ-HTTP/1.1 JEE-Bridge/1.1
Content-Length: 60
Content-Type: text/plain; charset=utf-8
x-msg-correlId: 1234567890

Here is my message body from the queue.
```

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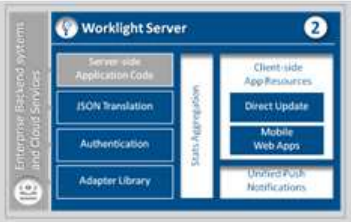
Worklight Overview

Worklight Studio

The most complete, extensible environment with maximum code reuse and per-device optimization



Worklight Server

Unified notifications, runtime skinning, version management, security, integration and delivery

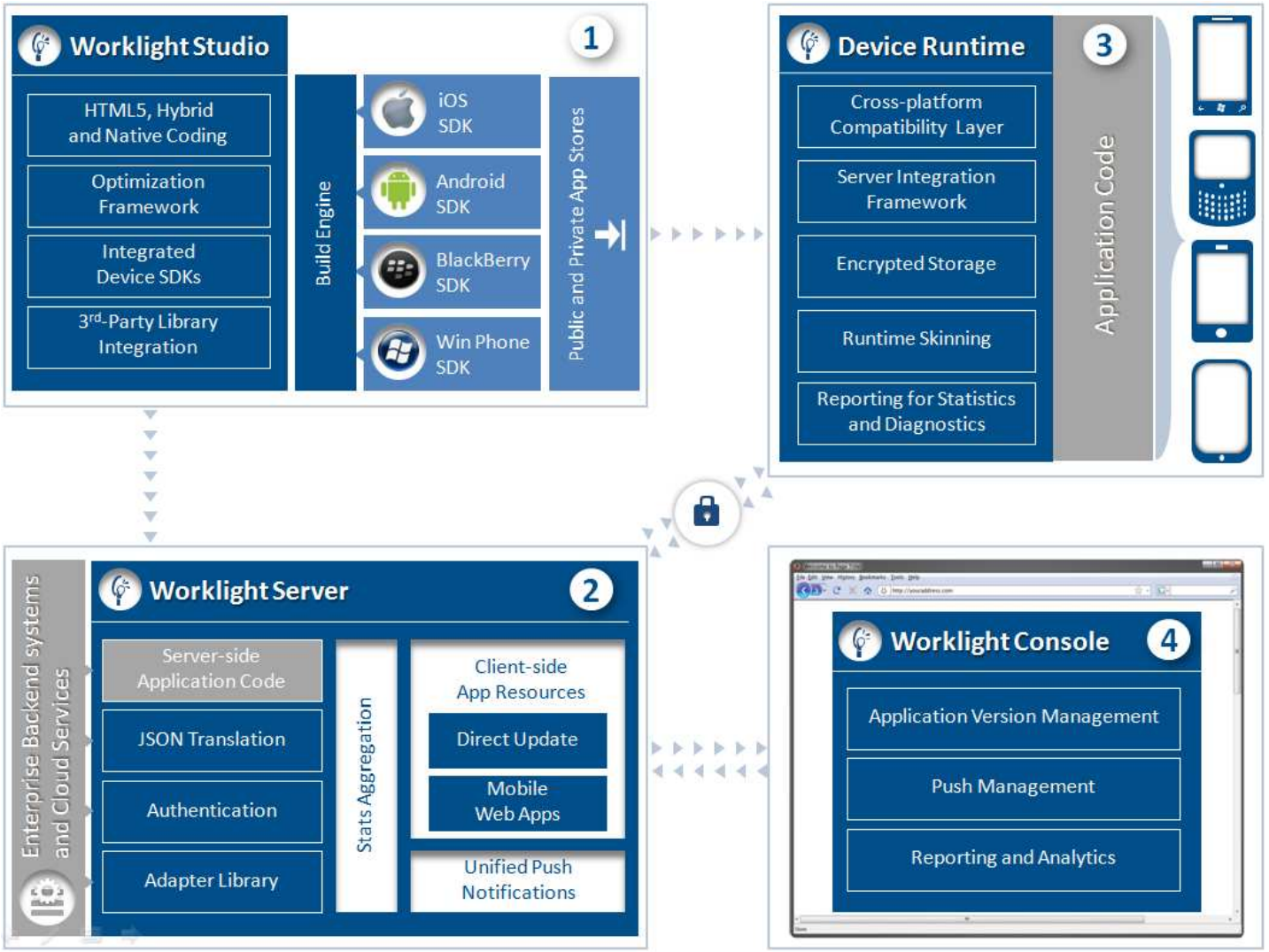
Worklight Runtime Components

Extensive libraries and client APIs that expose and interface with native device functionality

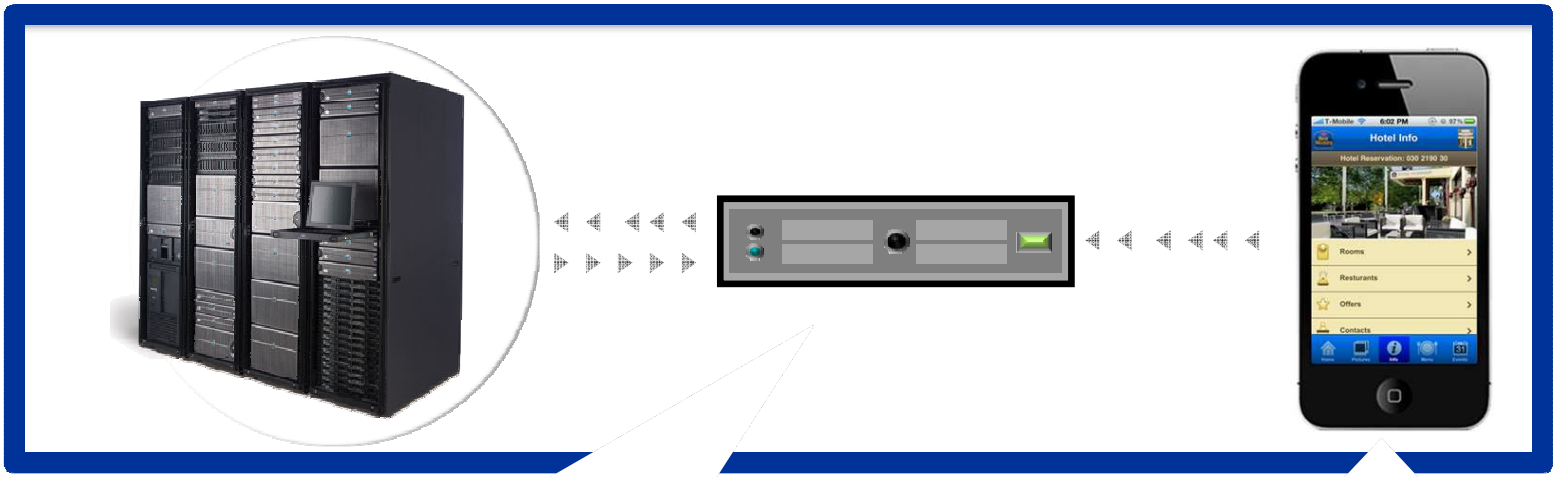
Worklight Console

A web-based console for real-time analytics and control of your mobile apps and infrastructure

Worklight Architecture



Worklight Overview



Worklight Server

- Server-side Application Code
- JSON Translation
- Authentication
- Adapter Library
- Stats Aggregation
- Client-side App Resources
- Direct Update
- Mobile Web Apps
- Unified Push Notifications

Device Runtime

- PhoneGap
  - Cross Platform Technology
- Worklight
  - Security and Authentication
  - Back-end Data Integration
  - Post-deployment control and Diagnostics

Application Code

Types of Mobile Application

Worklight An IBM company

SHARE Technology · Connections · Results

Browser Access

Written in HTML5 JavaScript and CSS3. Quick and cheap to develop, but less powerful than native.

Browser Access

Hybrid Apps - Web

HTML5 code and Worklight runtime libraries packaged within the app and executed in a native shell.

Downloadable

Hybrid Apps - Mixed

User augments web code with native language for unique needs and maximized user experience.

Downloadable

Native Apps

Platform-specific. Requires unique expertise, pricy and long to develop. Can deliver higher user experience.

Downloadable

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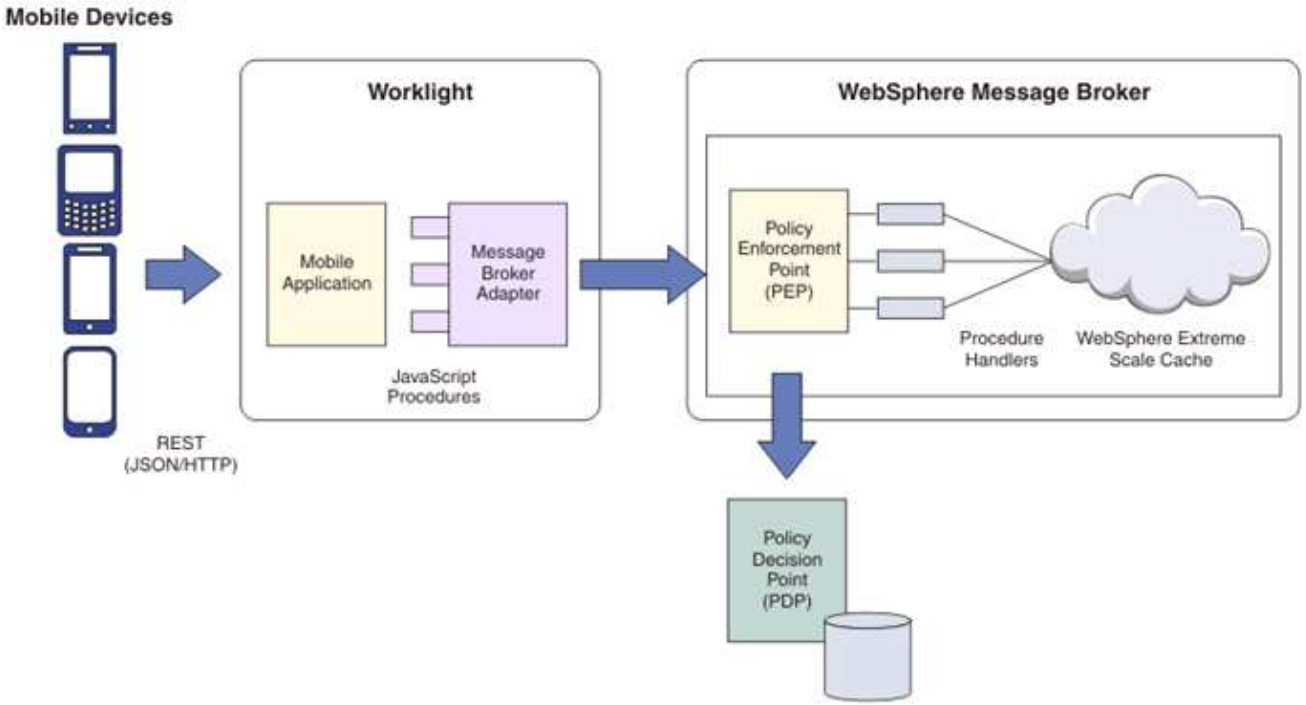
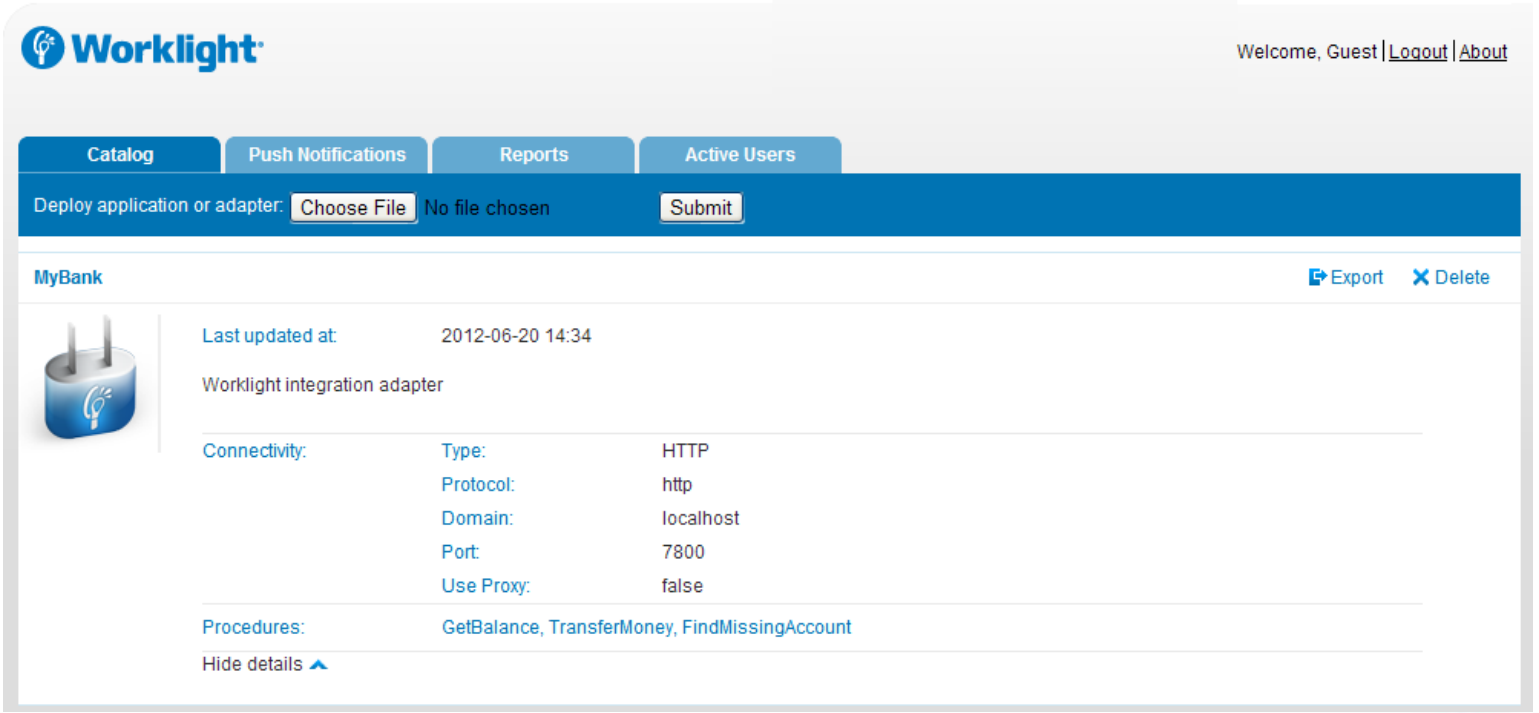
Worklight Adapters

- Adapters provide the glue between Worklight and back-end applications
  - Provides the extensibility mechanism for Worklight to call out to back-end systems
- Worklight has two built-in interfaces that adapters can use (HTTP and SQL)
  - Worklight has client-side JavaScript APIs so that applications can invoke services
  - Likewise, server-side JavaScript APIs are available to implement procedures (adapters)



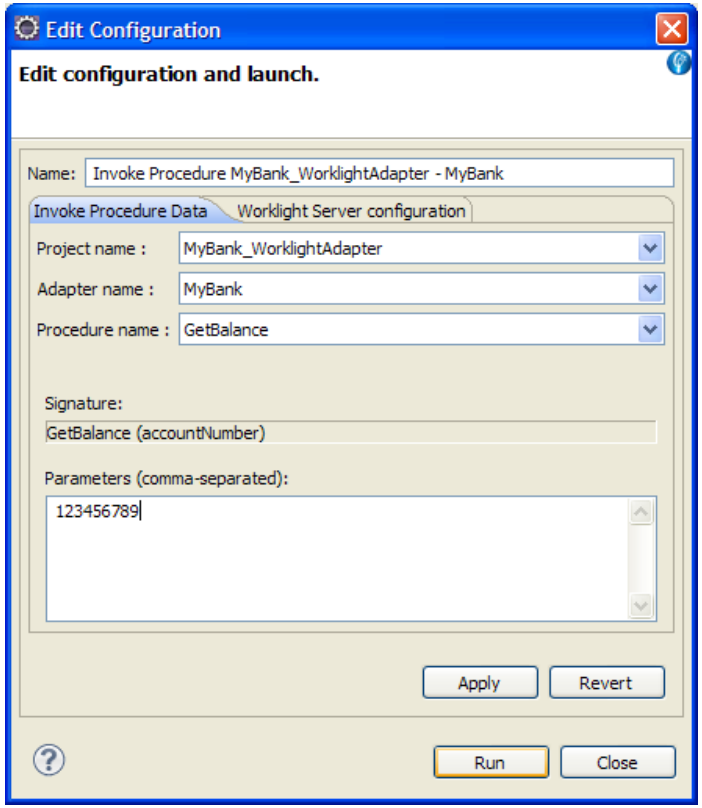
Worklight Adapters

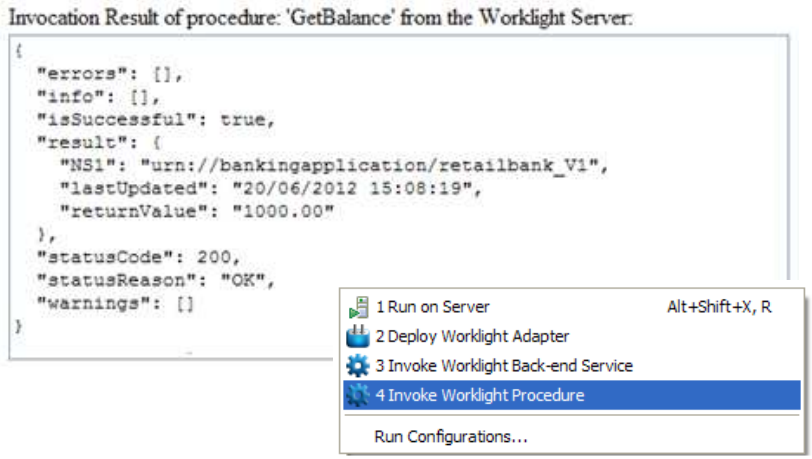
- An adapter contains two files for configuration and implementation
  - The first file is XML and contains the overall metadata (procedure names, protocol etc)
  - Second file is JavaScript and contains one function (procedure) for each entry point
- Adapters are uploaded to Worklight Server ready for mobile applications
  - Once deployed, adapters are managed through the Worklight Console



Invoking Worklight adapters

- Adapters are invoked from mobile applications using HTTP/JSON
  - This convention makes Worklight adapters easy to test using web browsers
  - Client side applications use the XMLHttpRequest object for asynchronous calls
  - Mobile toolkits (JQuery, Dojo and Sencha) wrap this in a device independent layer





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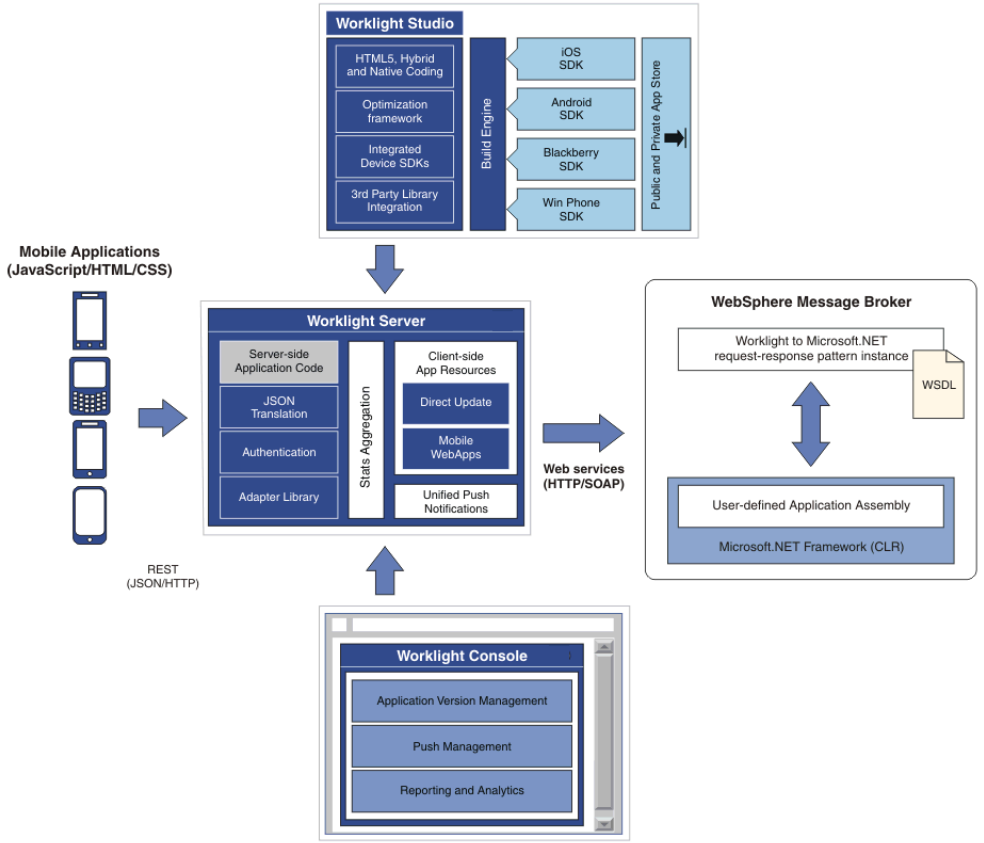
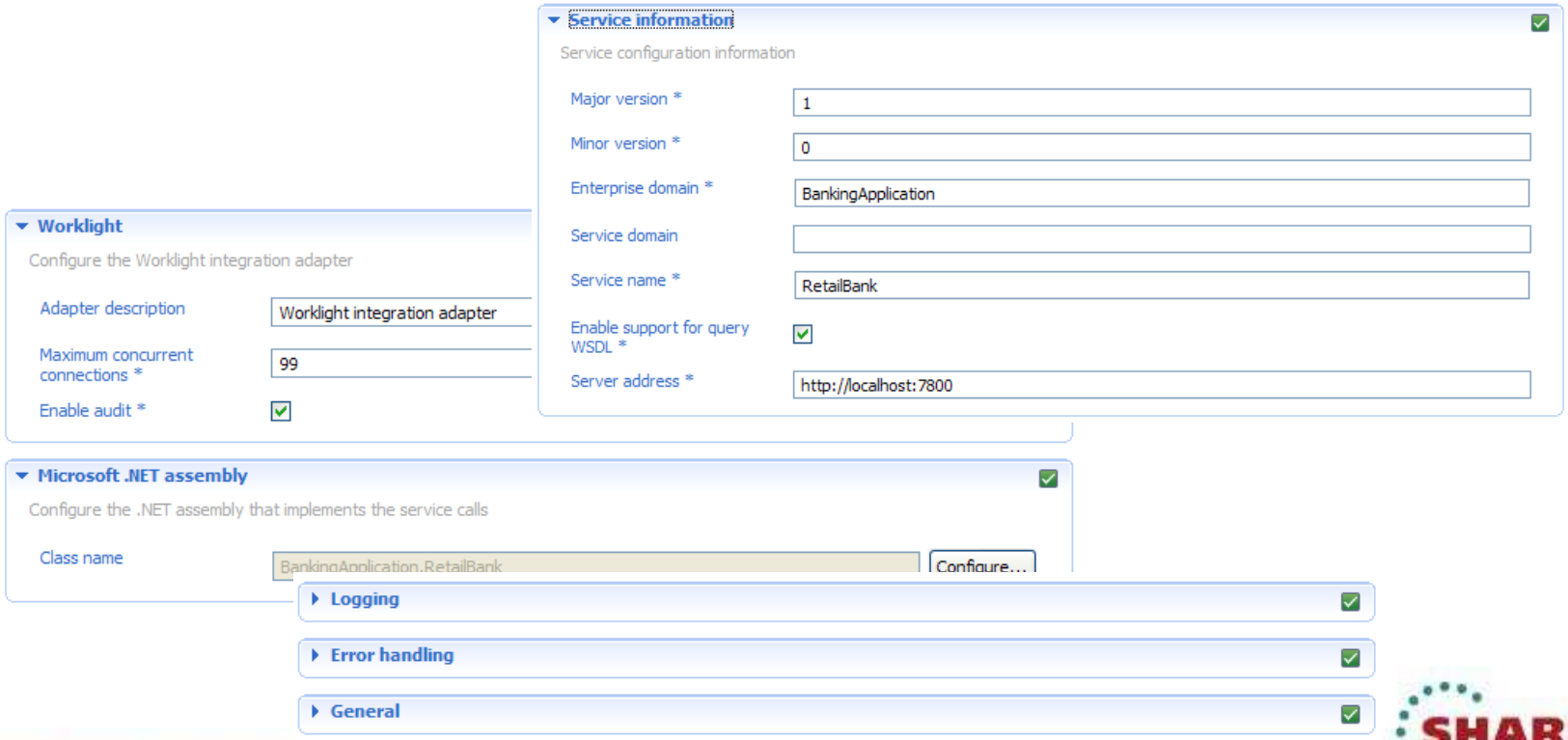
Worklight to Microsoft .NET Service Enablement

- Creates a mobile-ready service around a Microsoft .NET application
  - Generates a web service implementation which is deployed to Message Broker
  - Builds a Worklight integration adapter and a sample mobile application
  - Inbound data from the mobile application is sent to Worklight as JSON/HTTP
  - The adapter converts the JSON data into/from SOAP/HTTP for the .NET web service



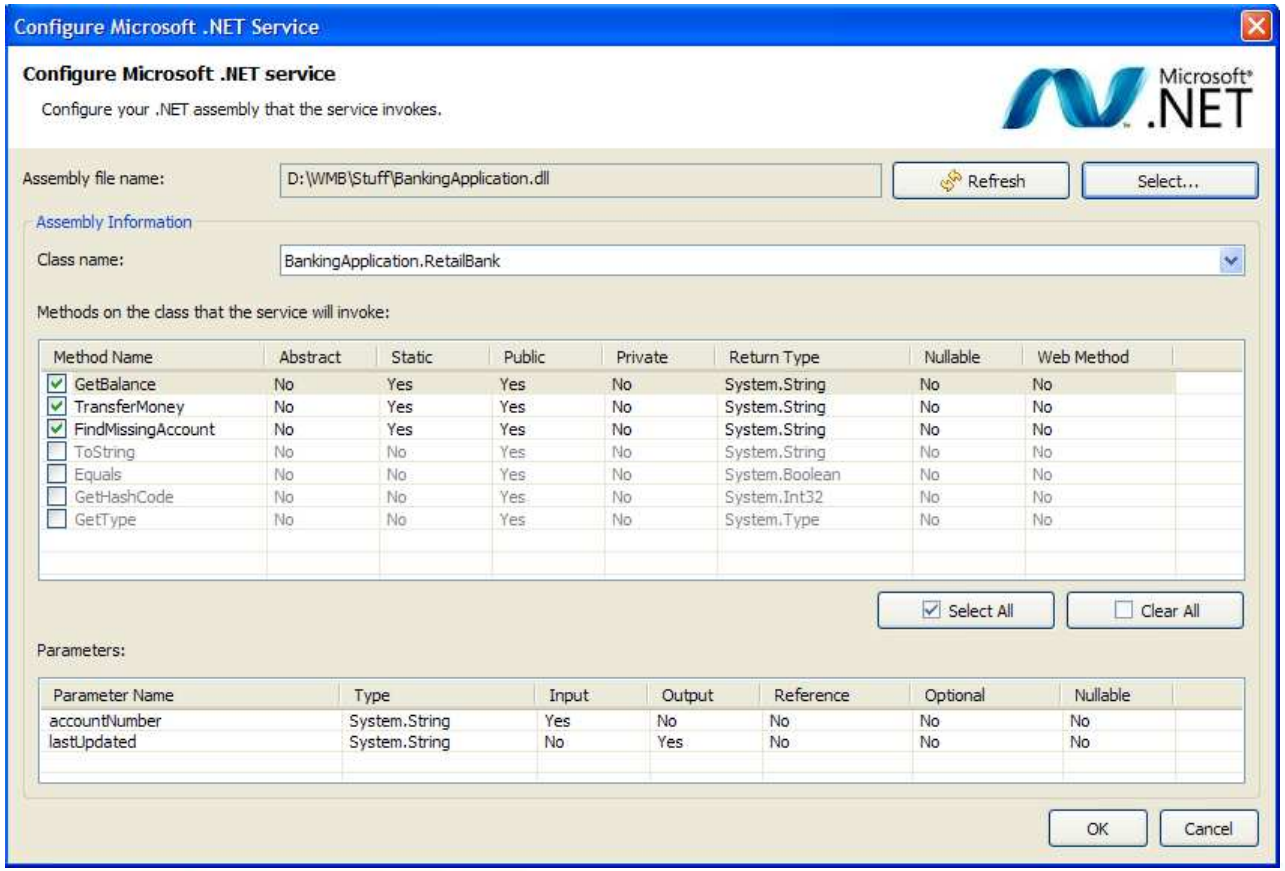
Configuring the Pattern Instance

- Pattern is configured with Microsoft .NET and Worklight information
  - Server address is a key field as it is used to configure both ends of the connection!
  - Standard set of error handling and logging options are provided by the pattern
  - Adapter configured with the maximum number of concurrent (HTTP) connections
  - Once this limit is reached, Worklight will queue inbound requests from applications



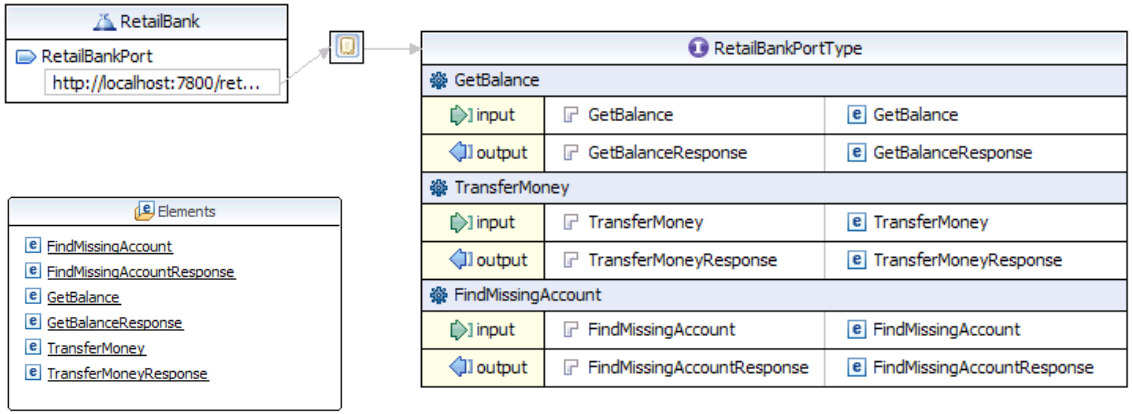
Configuring the Microsoft .NET Assembly

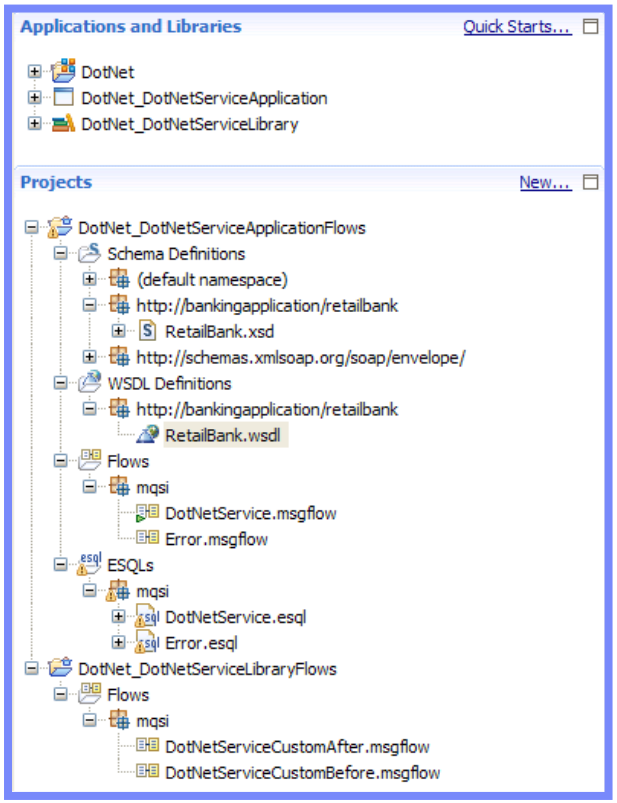
- User-defined editor allows the pattern user to select their .NET assembly
  - Selection proceeds to a class and the (static) methods available in that class
  - Assembly can be developed in any .NET language (for example, VB.NET or C#)
  - Return value and parameters are reflected on and displayed by the user-defined editor

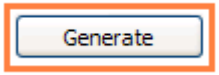


Generated Message Broker Projects

- The pattern generates an application and a library
  - Application contains the mechanics of the pattern instance
  - Library contains subflows for user customizations
  - Customizations are never deleted on re-generation!
- WSDL represents the selected .NET methods
  - One WSDL operation for each .NET (static) method
  - Likewise one message part defined per operation
  - WSDL types are defined in a separate XML schema file
  - WSDL and XSD are deployed directly to Message Broker

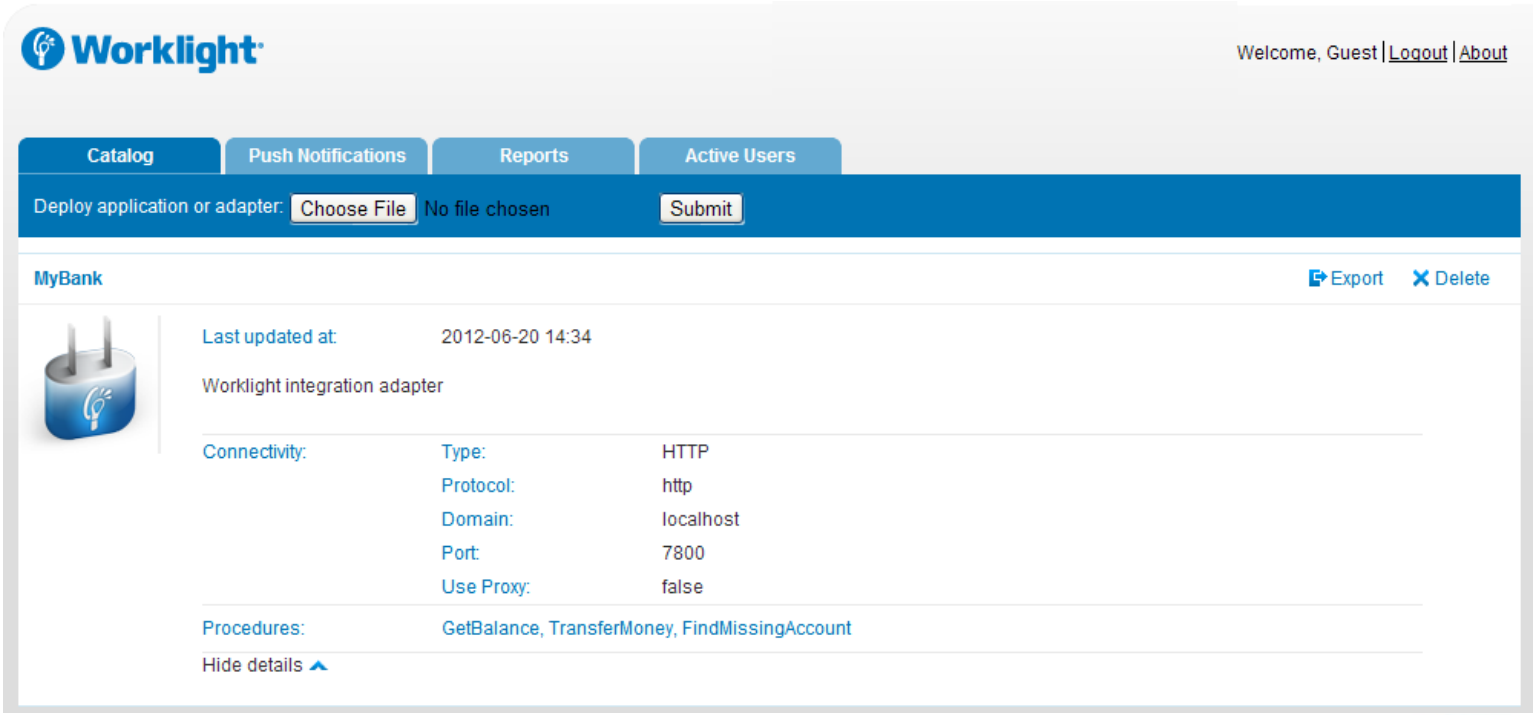






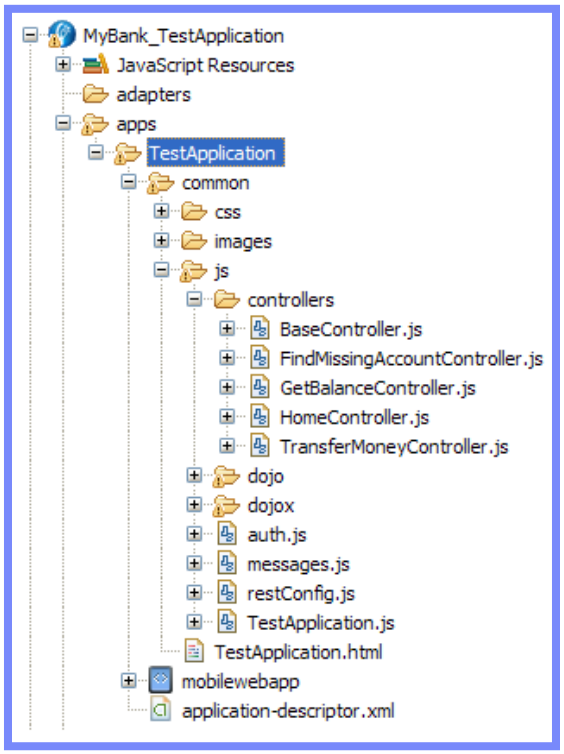
Worklight Adapter

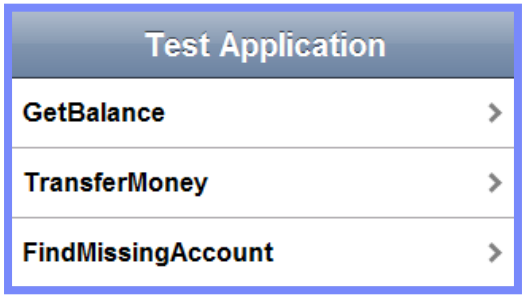
- Worklight adapter generated which reflects the web service methods
  - Integrates the mobile application with the Message Broker .NET web service
  - One procedure is generated for each operation (method) on the web service
  - Adapter manages the conversion between JSON and SOAP/XML data formats
  - Adapter generated in a separate project so it can be deployed to Worklight Server

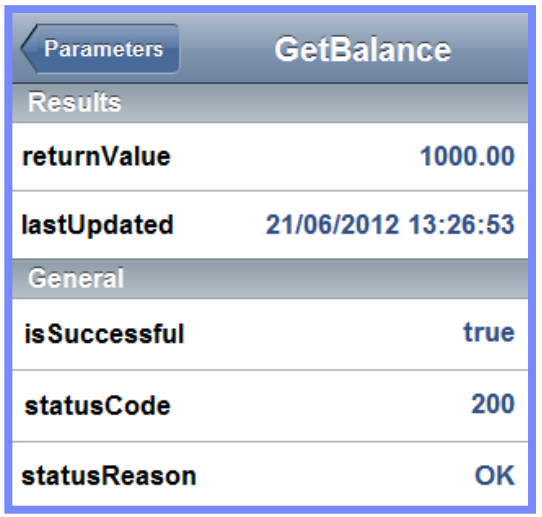


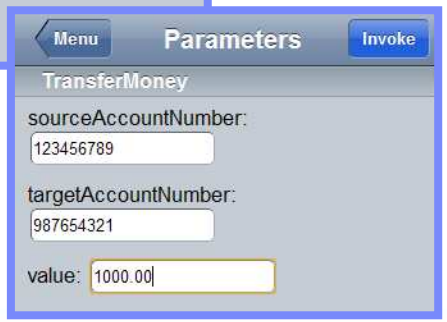
Mobile Application

- Pattern also creates a mobile application to test the Worklight adapter
  - Each operation has views (pages) to configure and invoke the back-end service
  - Application is built using Dojo Mobile (ensures it is device independent)
  - More information on the Dojo mobile toolkit here: http://dojotoolkit.org/features/mobile



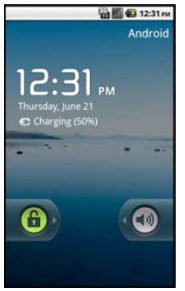


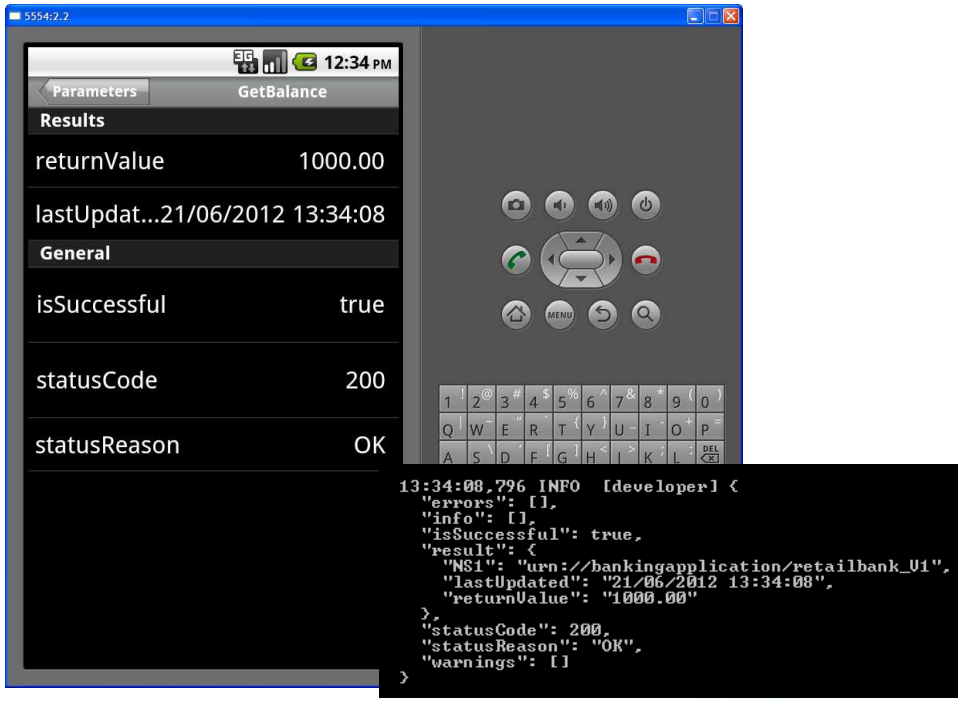




Mobile Application

- The mobile application has a single mobile web environment
  - Application is best suited for browsers on small screen mobile devices
  - Easy to add extra environments for iOS, Android and many more!
- Android development requires a separate download (Android SDK)
  - Pick and choose your target Android versions from Android SDK Manager





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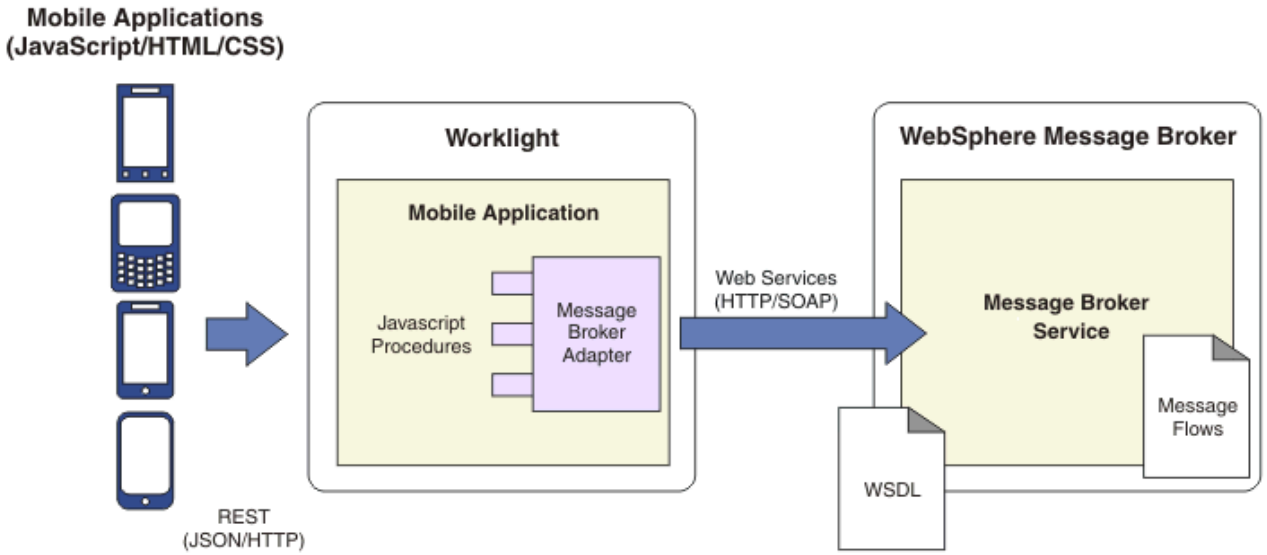
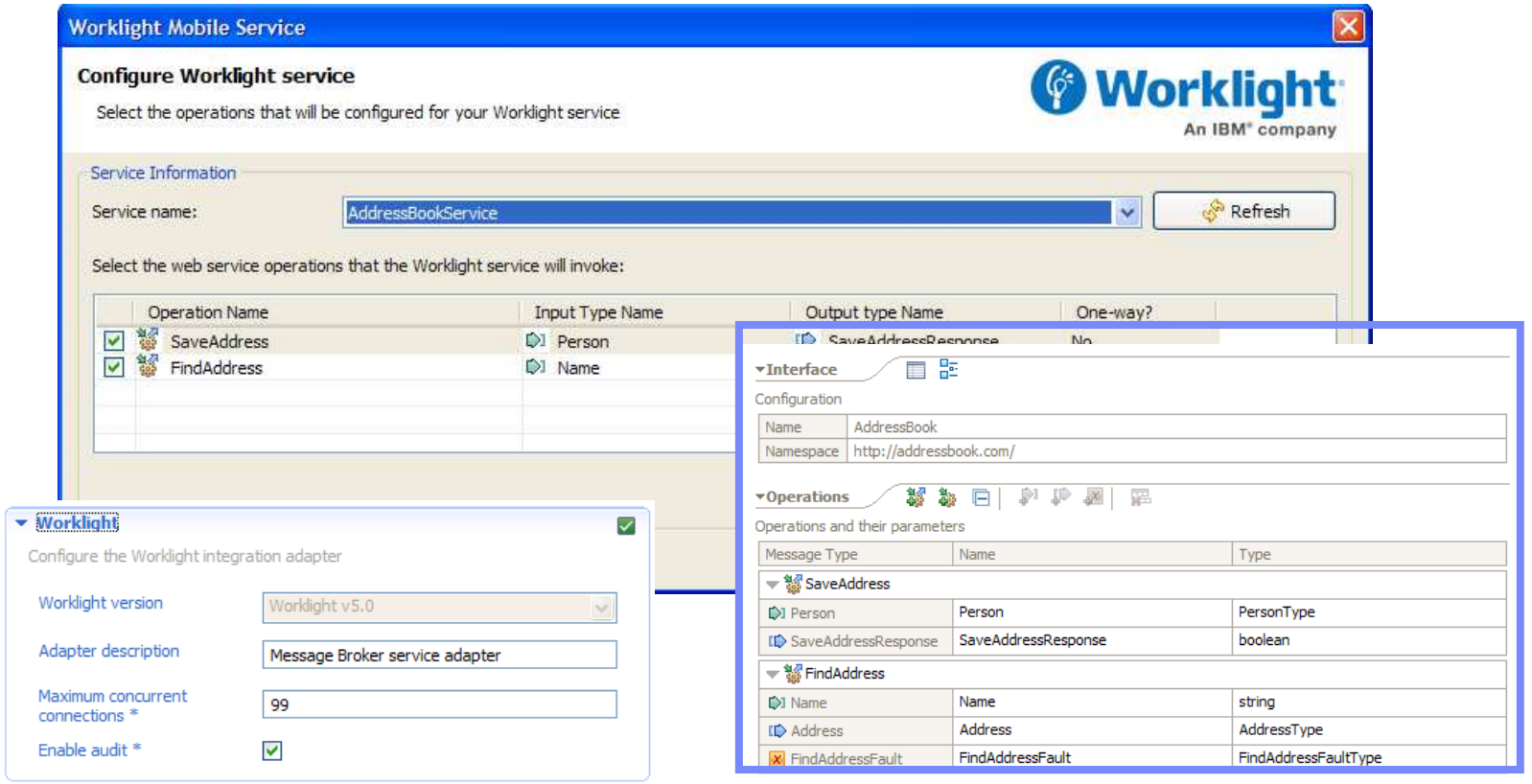
Worklight Mobile Services

- Creates a mobile-ready interface around a Message Broker service
  - Services are a first class artifact in Message Broker alongside applications and libraries
  - Builds an adapter to integrate Worklight and Message Broker services
  - Inbound data from the mobile application is sent to Worklight as JSON/HTTP
- Makes it very simple to mobile enable a Message Broker service!
  - The adapter passes the inbound request straight through to the service
  - Pattern adds an HTTP/JSON message flow (binding) to the service project



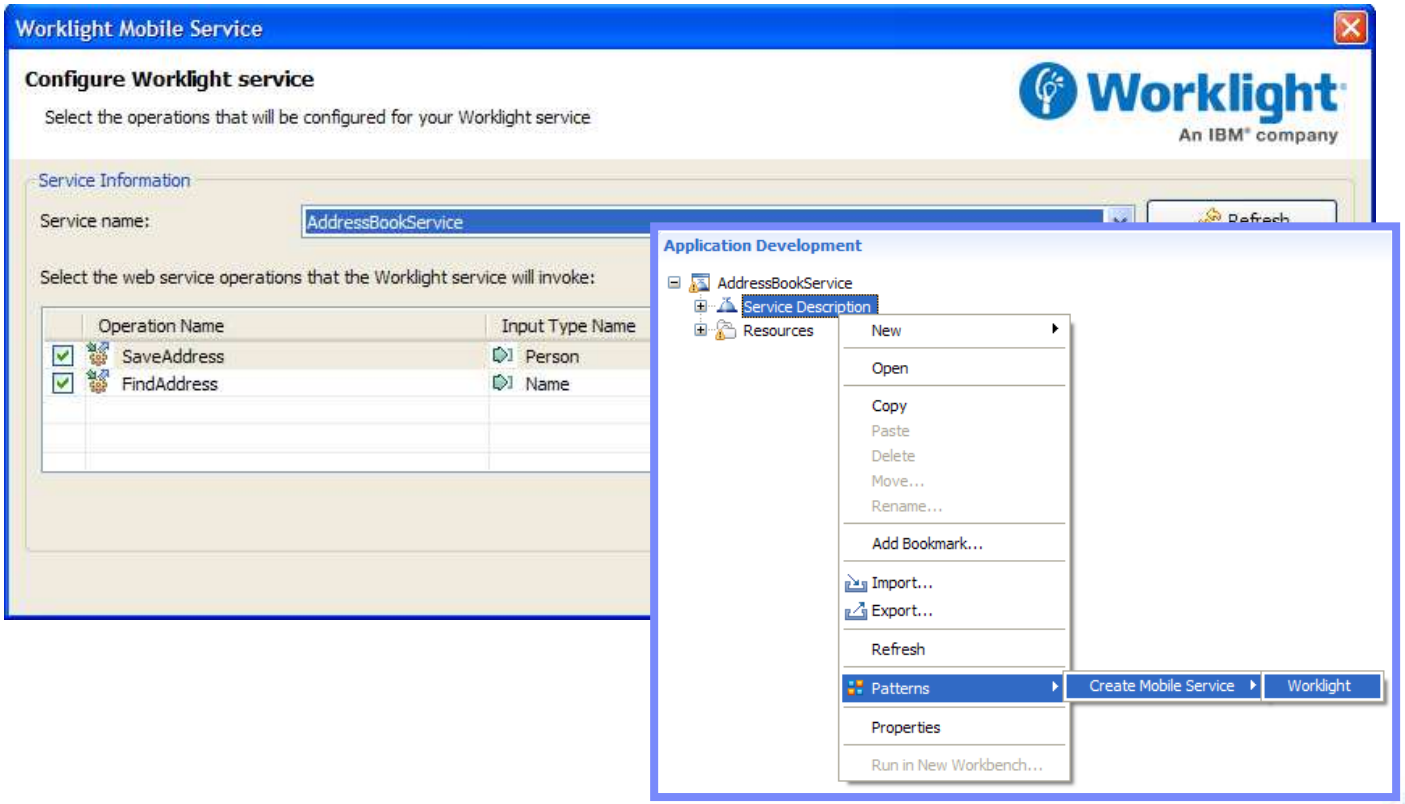
Configuring the Pattern Instance

- Create a Message Broker service and then instantiate the pattern
  - You choose which operations in the service are available to mobile applications
  - Standard set of Worklight pattern parameters provided to configure the adapter



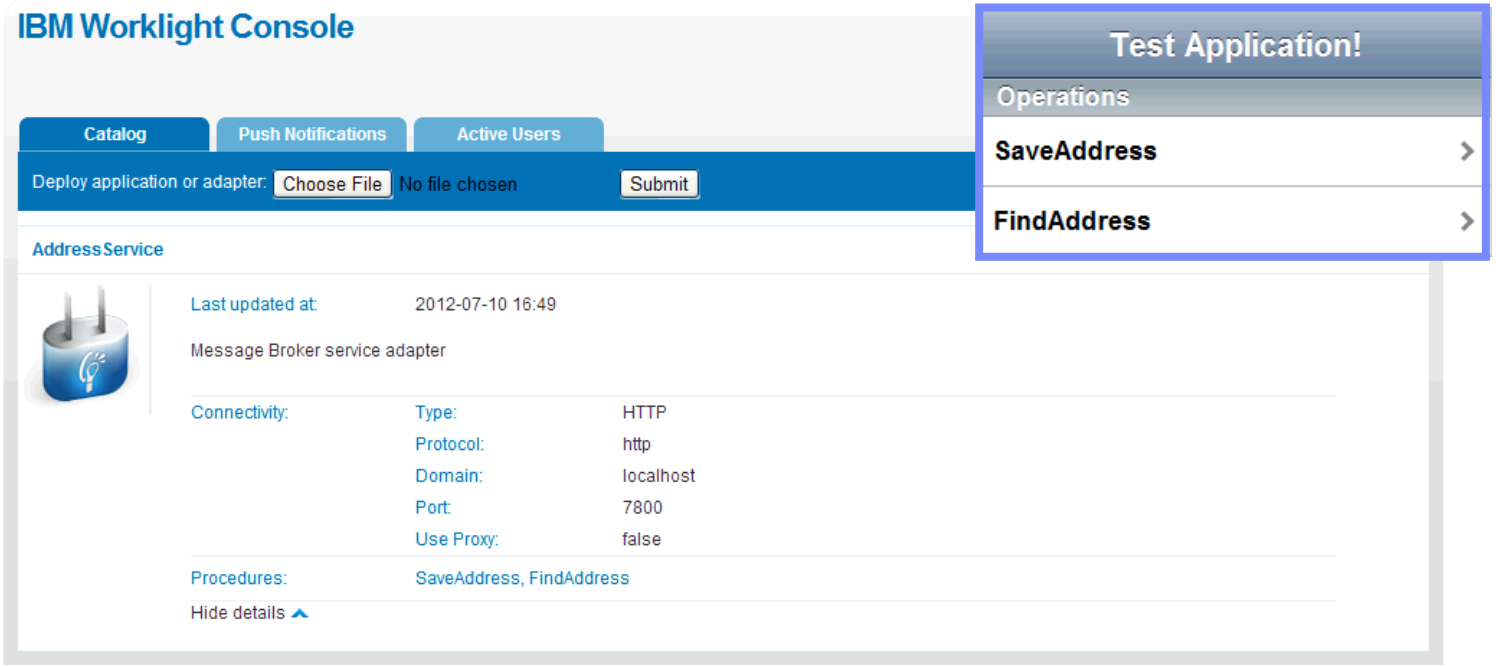
Configuring the Pattern Instance

- The mobile service pattern can also be launched from the Navigator
  - Intuitive user experience for mobile enablement of Message Broker services
  - The selected service name is passed to the pattern as the launch configuration
  - Pattern instance is configured automatically and can be immediately generated



Worklight Adapter

- Generates a Worklight adapter which reflects the web service methods
  - Integrates the mobile application with the Message Broker web service
  - One procedure is generated for each selected operation in the service
  - Request-response and one-way interactions for the service are supported



Agenda

- MQ
  - WebSphere MQ Extended Reach (MQXR)
  - WebSphere MQ HTTP Bridge
- Message Broker
  - Introduction to Worklight
  - Worklight Adapters
  - **Message Broker Mobile Patterns**
    - Mobile enablement for Microsoft .NET applications
    - Create flexible mobile services on top of Message Broker
    - **Outbound push notifications for asynchronous data delivery**
    - Resource handler including security and caching

Worklight Push Notification Services

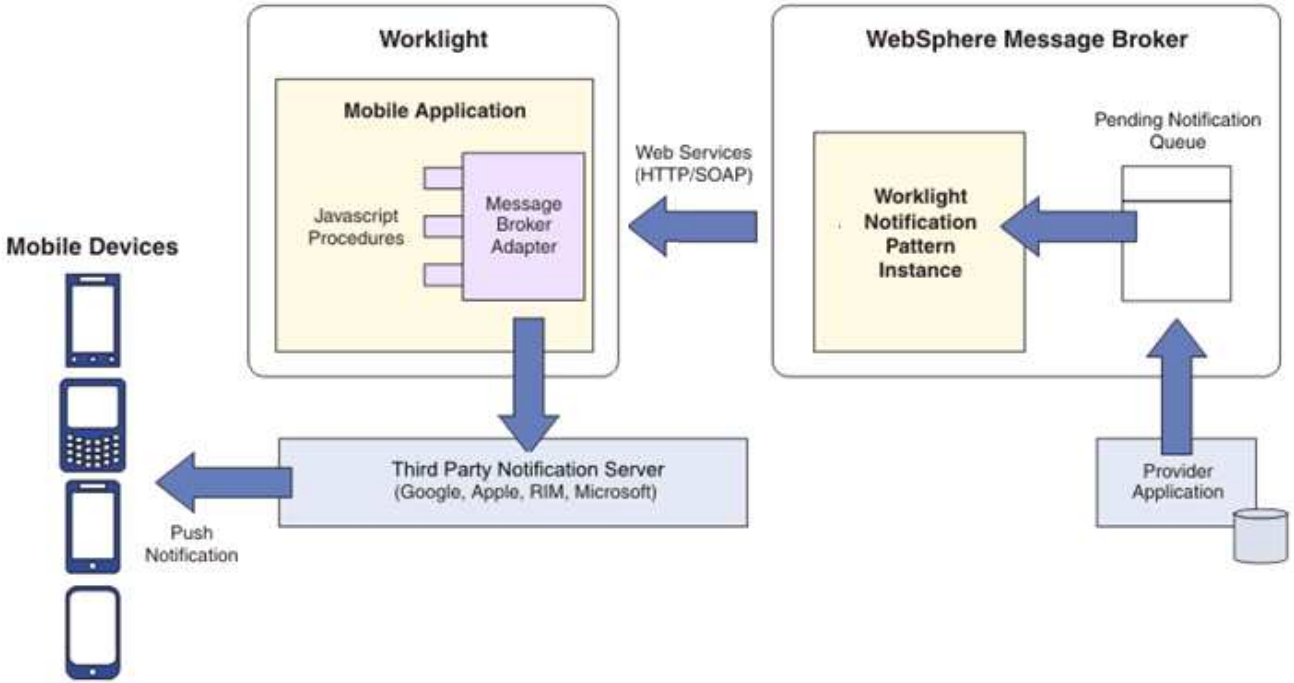
- Worklight supports asynchronous push notifications to mobile applications
  - Push notifications have a measurable impact on the success of mobile applications
  - There are many IT challenges in supporting push notifications (devices, delivery etc)
- Push notifications are applicable across many industry verticals
  - Healthcare, retail, travel, transportation, government, insurance and more!
- All the major mobile platforms support push notification services
  - Apple iOS 3, Google Android 2.2, RIM Blackberry 5 and Windows Phone 7

Worklight Push Notification Services

- Users receive notifications when the mobile application is not active
  - Efficiency gain as application does not need to issue constant queries
  - Saves battery life and also reduces network bandwidth (communication fees)
- Notifications are not always appropriate and have disadvantages
  - Users need to subscribe on their device to receive push notifications
  - Notifications are limited in the size of their payload (for example, 256 bytes on iOS)
  - No quality of service is guaranteed and there is no delivery notification
  - No guarantee either that the end-to-end delivery chain is secure

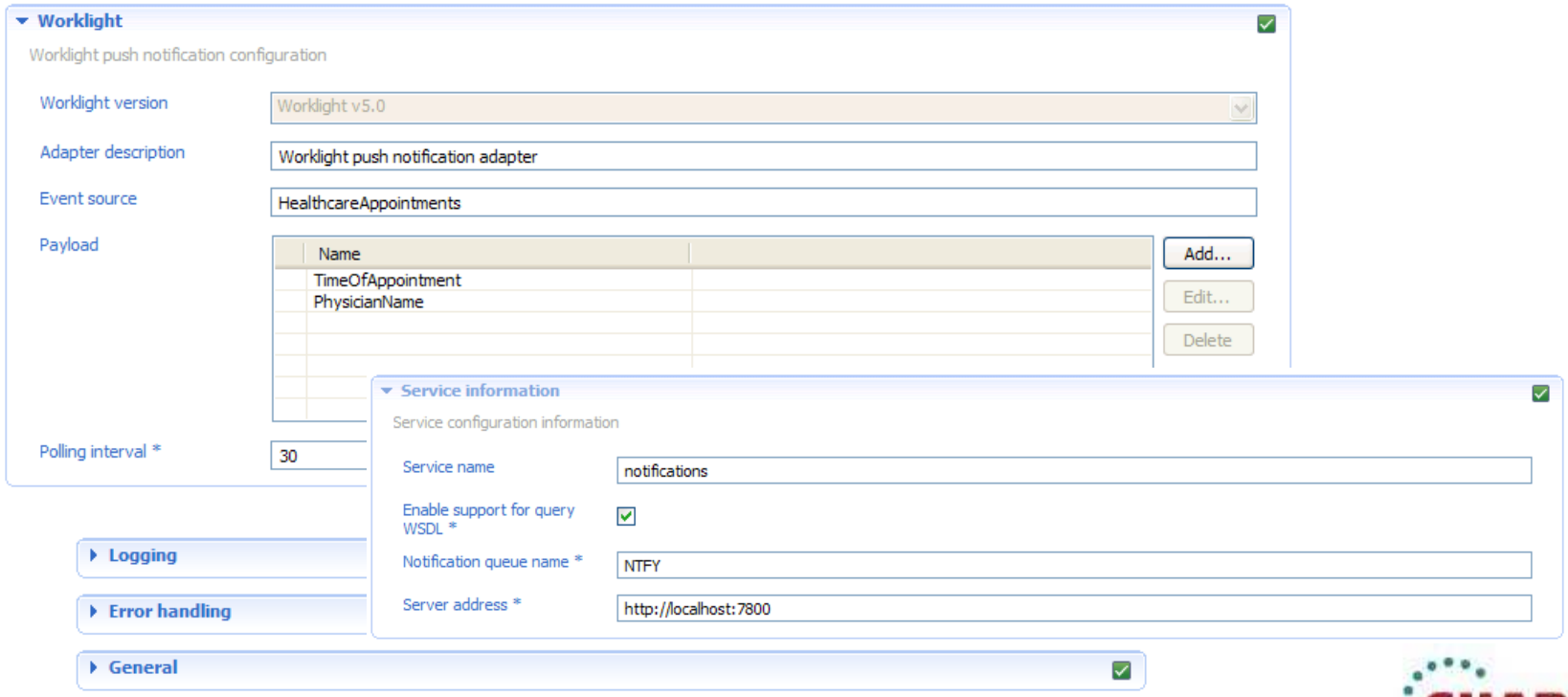
Worklight Push Notification from WebSphere MQ

- Creates a push notification adapter from a WebSphere MQ queue
  - Generates a web service implementation which is deployed to Message Broker
  - Builds a Worklight integration adapter which polls for pending notifications
  - Pending notifications are written to a WebSphere MQ queue by a provider application
  - The adapter converts the notifications into JSON and arranges delivery to the mobile



Configuring the Pattern Instance

- Pattern is configured with Worklight and Message Broker information
  - Server address is a key field as it is used to configure both ends of the connection!
  - Standard set of error handling and logging options are provided by the pattern
- Application specific fields can be delivered in the push notification
  - Configured as part of the pattern instance so that an accurate schema can be created



Worklight Adapter

- Worklight adapter generated which periodically checks for notifications
  - Integrates Worklight with a queue of notifications managed by Message Broker
  - Generated pattern instance project includes a schema for the notification messages
  - Adapter manages the conversion from XML to JSON for the Worklight server-side calls
- Polling interval for pending notifications is configurable in the pattern
  - Adapter greedily processes all pending notifications each time it wakes up

```
<xsd:complexType name="Payload">
    <xsd:annotation>
        <xsd:documentation xml:lang="en">Application specific data in the notification messages.</xsd:documentation>
    </xsd:annotation>
    <xsd:sequence>
        <xsd:element minOccurs="0" name="TimeOfAppointment" type="xsd:string"/>
        <xsd:element minOccurs="0" name="PhysicianName" type="xsd:string"/>
    </xsd:sequence>
</xsd:complexType>

<xsd:element name="Notification">
    <xsd:annotation>
        <xsd:documentation xml:lang="en">Response message for notification messages.</xsd:documentation>
    </xsd:annotation>
    <xsd:complexType>
        <xsd:sequence>
           <xsd:element name="UserId" type="xsd:string"/>
           <xsd:element minOccurs="0" name="Badge" type="xsd:string"/>
           <xsd:element minOccurs="0" name="Sound" type="xsd:string"/>
           <xsd:element minOccurs="0" name="ActivateButtonLabel" type="xsd:string"/>
           <xsd:element minOccurs="0" name="NotificationText" type="xsd:string"/>
           <xsd:element name="Payload" type="tns:Payload"/>
        </xsd:sequence>
    </xsd:complexType>
</xsd:element>
```

NotificationPortType		
GetNotification		
input	GetNotification	GetNotification
output	GetNotificationResponse	GetNotificationResponse
PutNotification		
input	PutNotification	PutNotification
output	PutNotificationResponse	PutNotificationResponse

Agenda

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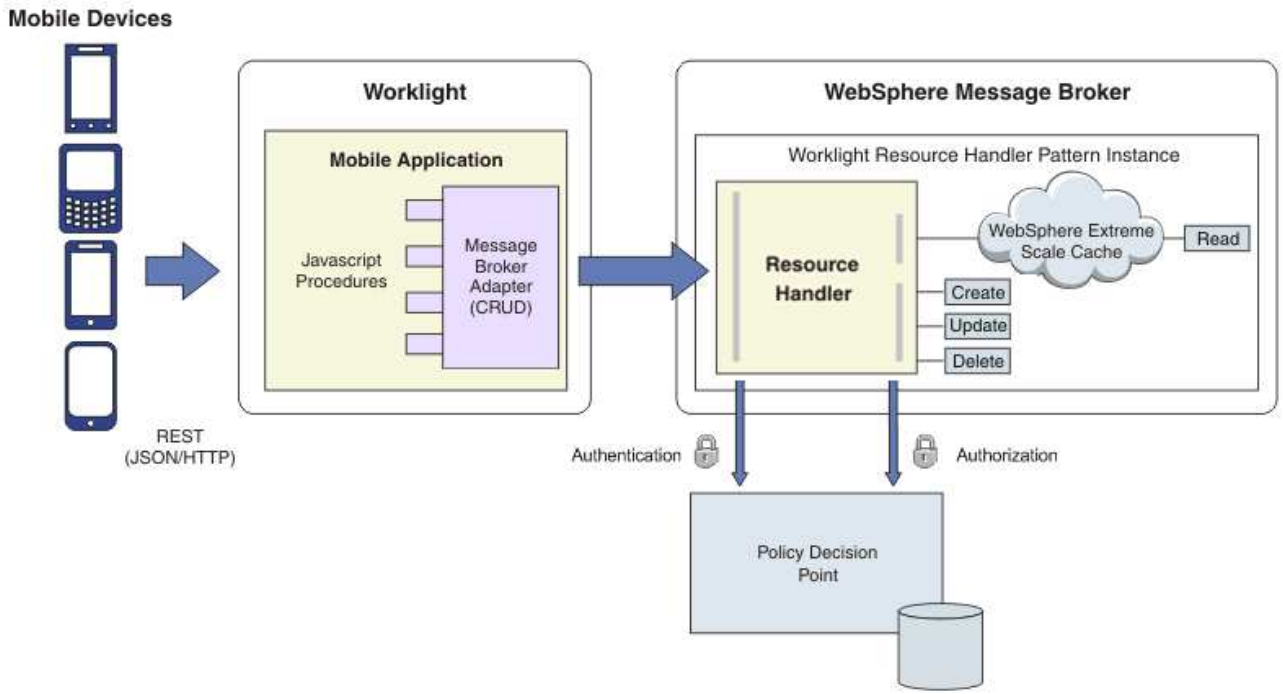
    - **Resource handler including security and caching**

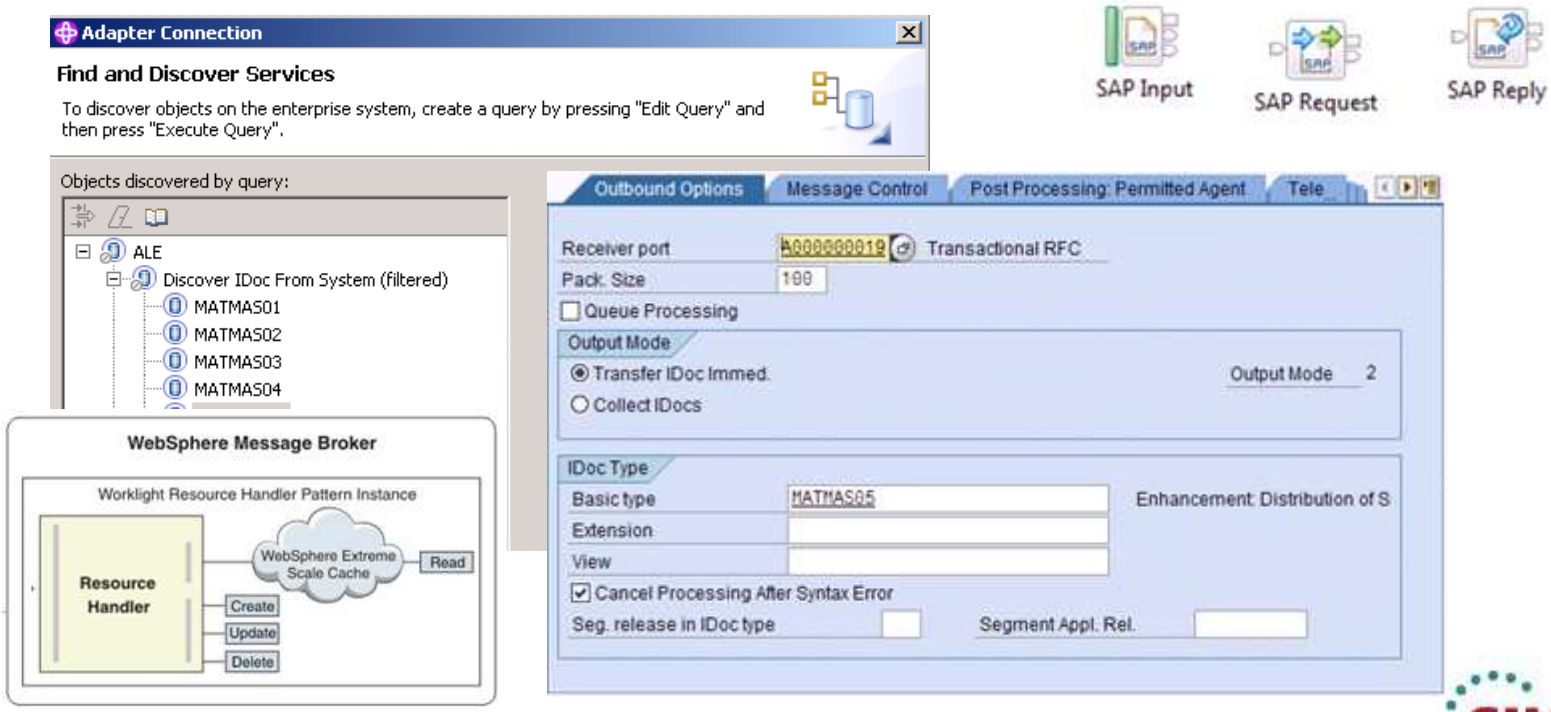
Worklight Resource Handler

- Resource oriented architecture is a well known implementation pattern
  - Provides a common set of functions (CRUD – Create Read Update and Delete)
  - This pattern provides an adapter which implements CRUD operations
  - A Message Broker service is generated with subflows for each operation
  - The service integrates security authorization and authentication (LDAP)
  - Operations optionally integrate with the Message Broker Global Cache (WXS)



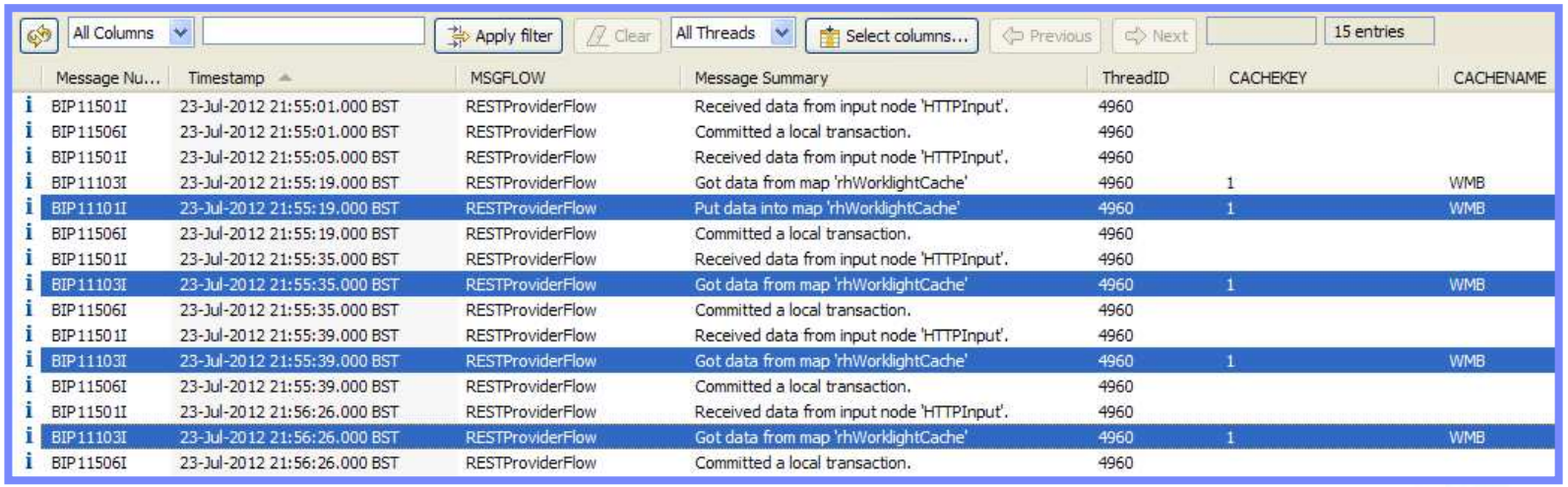
Implementing Resource Handlers

- Complete the pattern instance by implementing the resource handlers
  - Subflows are generated for each CRUD operation in a customization project
  - Pattern generates a reference implementation of a back end system in ESQL
- Message Broker has excellent support for enterprise applications
  - Common design pattern to integrate with SAP, Siebel, JDEdwards and PeopleSoft
  - Wizards makes it easy to discover the application content (for example, SAP iDocs)
  - Rich SAP support includes iDocs, ALE, BAPI and query SAP tables (QISS)



WebSphere Extreme Scale (WXS)

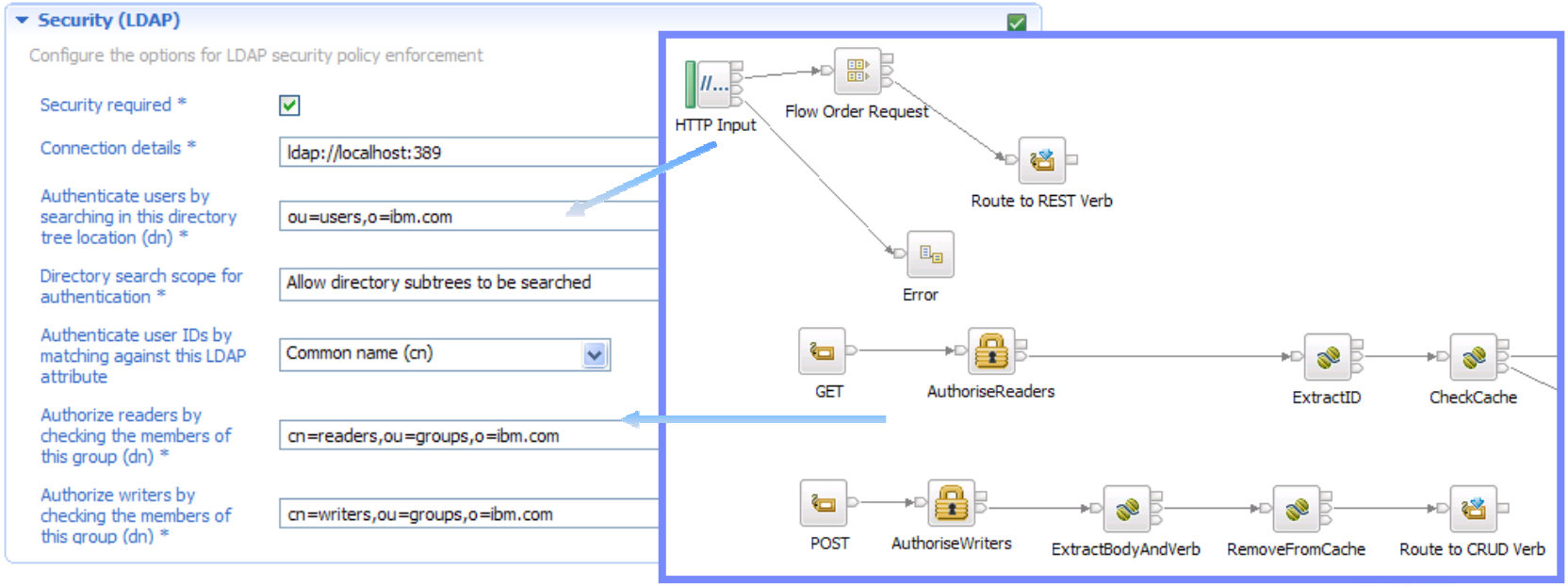
- WebSphere Extreme Scale is tightly integrated with Message Broker
  - Provides a highly scalable, fault tolerant, elastic in-memory data grid
  - One or more execution groups manage a single logical cache of key-value data
  - WXS components are hosted within the execution group processes
  - Default scope is one cache per broker but this can be extended to multiple brokers
- Vital for mobile applications where the number of devices can be huge
  - Caching fits perfectly with a CRUD model of many readers and (generally) few writers
  - Message Broker activity log shows the cache activity as CRUD operations complete



Message Nu...	Timestamp	MSGFLOW	Message Summary	ThreadID	CACHEKEY	CACHENAME
BIP11501I	23-Jul-2012 21:55:01.000 BST	RESTProviderFlow	Received data from input node 'HTTPInput'.	4960		
BIP11506I	23-Jul-2012 21:55:01.000 BST	RESTProviderFlow	Committed a local transaction.	4960		
BIP11501I	23-Jul-2012 21:55:05.000 BST	RESTProviderFlow	Received data from input node 'HTTPInput'.	4960		
BIP11103I	23-Jul-2012 21:55:19.000 BST	RESTProviderFlow	Got data from map 'rhWorklightCache'	4960	1	WMB
BIP11101I	23-Jul-2012 21:55:19.000 BST	RESTProviderFlow	Put data into map 'rhWorklightCache'	4960	1	WMB
BIP11506I	23-Jul-2012 21:55:19.000 BST	RESTProviderFlow	Committed a local transaction.	4960		
BIP11501I	23-Jul-2012 21:55:35.000 BST	RESTProviderFlow	Received data from input node 'HTTPInput'.	4960		
BIP11103I	23-Jul-2012 21:55:35.000 BST	RESTProviderFlow	Got data from map 'rhWorklightCache'	4960	1	WMB
BIP11506I	23-Jul-2012 21:55:35.000 BST	RESTProviderFlow	Committed a local transaction.	4960		
BIP11501I	23-Jul-2012 21:55:39.000 BST	RESTProviderFlow	Received data from input node 'HTTPInput'.	4960		
BIP11103I	23-Jul-2012 21:55:39.000 BST	RESTProviderFlow	Got data from map 'rhWorklightCache'	4960	1	WMB
BIP11506I	23-Jul-2012 21:55:39.000 BST	RESTProviderFlow	Committed a local transaction.	4960		
BIP11501I	23-Jul-2012 21:56:26.000 BST	RESTProviderFlow	Received data from input node 'HTTPInput'.	4960		
BIP11103I	23-Jul-2012 21:56:26.000 BST	RESTProviderFlow	Got data from map 'rhWorklightCache'	4960	1	WMB
BIP11506I	23-Jul-2012 21:56:26.000 BST	RESTProviderFlow	Committed a local transaction.	4960		

Authorization and Authentication

- Patterns provides a security model based around LDAP
  - Caching fits perfectly with a CRUD model of many readers and (generally) few writers
  - Users are authenticated using HTTP basic authentication by the HTTP Input node
  - Authorization is then done by splitting the users into two groups (readers/writers)
  - A user is authorized if they are a member of the group in the LDAP directory
  - The LDAP queries are issued by the message flow using the Security PEP node
  - Caching changes are made through WXS after the user has cleared security



This was session 12626 - The rest of the week ……

	Monday	Tuesday	Wednesday	Thursday	Friday	
08:00					Are you running too many queue managers or brokers?	
09:30		What's New in WebSphere Message Broker			Diagnosing Problems for MQ	CICS and WMQ - The Resurrection of Useful
11:00		Extending IBM WebSphere MQ and WebSphere Message Broker to the Cloud	WMQ - Introduction to Dump Reading and SMF Analysis - Hands-on Lab	BIG Data Sharing with the cloud - WebSphere eXtreme Scale and WebSphere Message Broker integration	Getting the best availability from MQ on z/OS by using Shared Queues	
12:15						
01:30	Introduction to MQ	MQ on z/OS – Vivisection	Migration and maintenance, the necessary evil	The Dark Side of Monitoring MQ - SMF 115 and 116 Record Reading and Interpretation		
03:00	First Steps With WebSphere Message Broker: Application Integration for the Messy	BIG Connectivity with WebSphere MQ and WebSphere Message Broker	WebSphere MQ CHINIT Internals	Using IBM WebSphere Application Server and IBM WebSphere MQ Together		
04:30	WebSphere MQ application design, the good, the bad and the ugly	What's New in the WebSphere MQ Product Family	MQ & DB2 – MQ Verbs in DB2 & Q-Replication	WebSphere MQ Channel Authentication Records		
06:00			Clustering - The Easier Way to Connect Your Queue Managers			