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*Extending the Enterprise to Cloud and Mobile with*  
**IBM z/OS Connect**

*Systems Magazine Webcast*

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## *The API Economy – the bigger picture*

- What are the drivers and how will z/OS integrate?

## *z/OS Connect*

- Overview / Problem statement
- Perspectives –
  - The ‘front end’ – users of z/OS Connect ‘systems of engagement’
  - What’s happening inside z/OS Connect?
    - Service providers
    - Interceptors
    - Data transformers
  - The ‘back-end’ – interacting with business assets ‘systems of record’

# The API Economy

A view from on high

# APIs - the building blocks for apps

Application Programming Interface



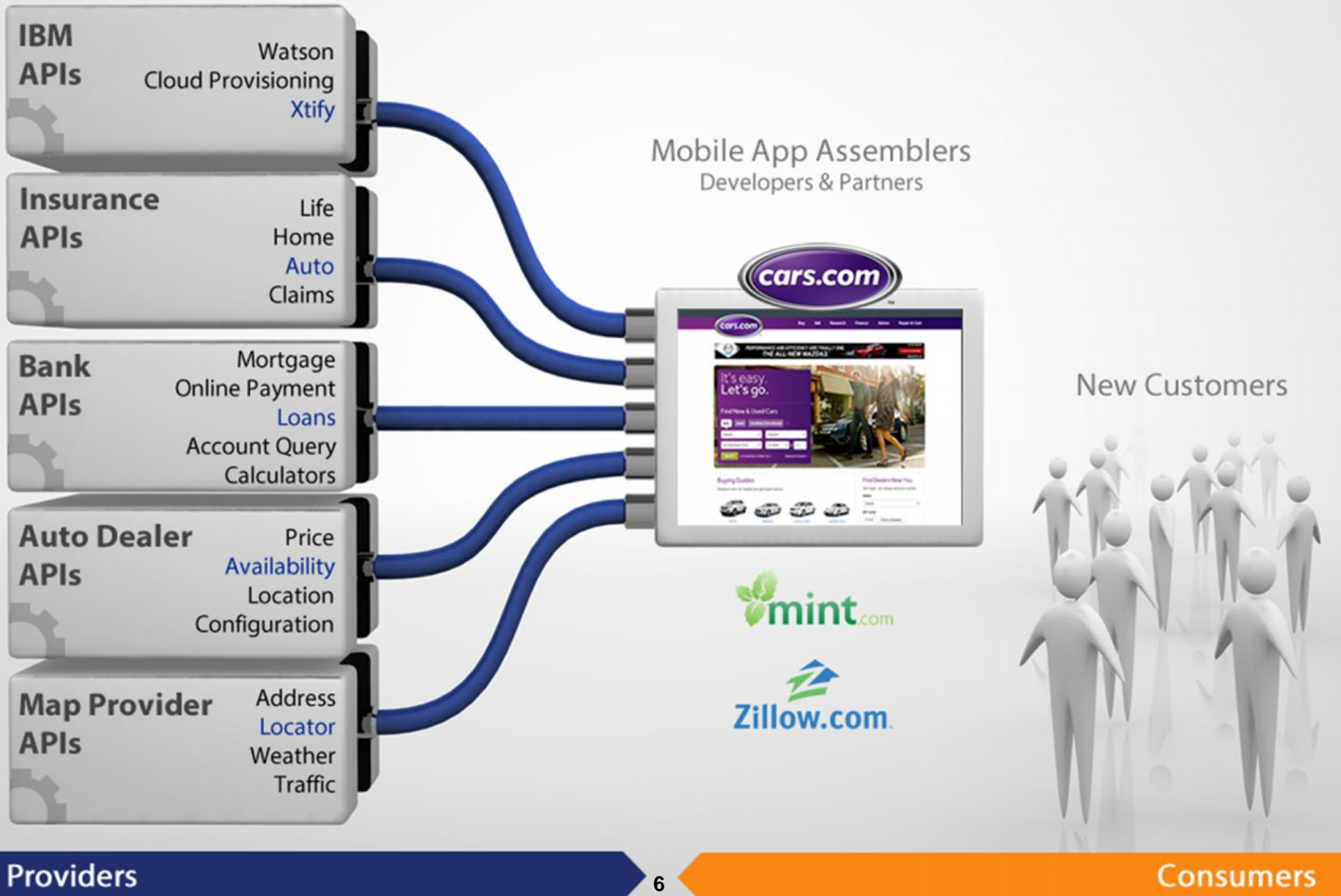
The **“API economy”** has changed how developers think about building apps, and how organizations deploy software in the cloud

## Bank Externalized Services



# API Economy

Mobile App Assembly



Mobile App Assemblers  
Developers & Partners

New Customers

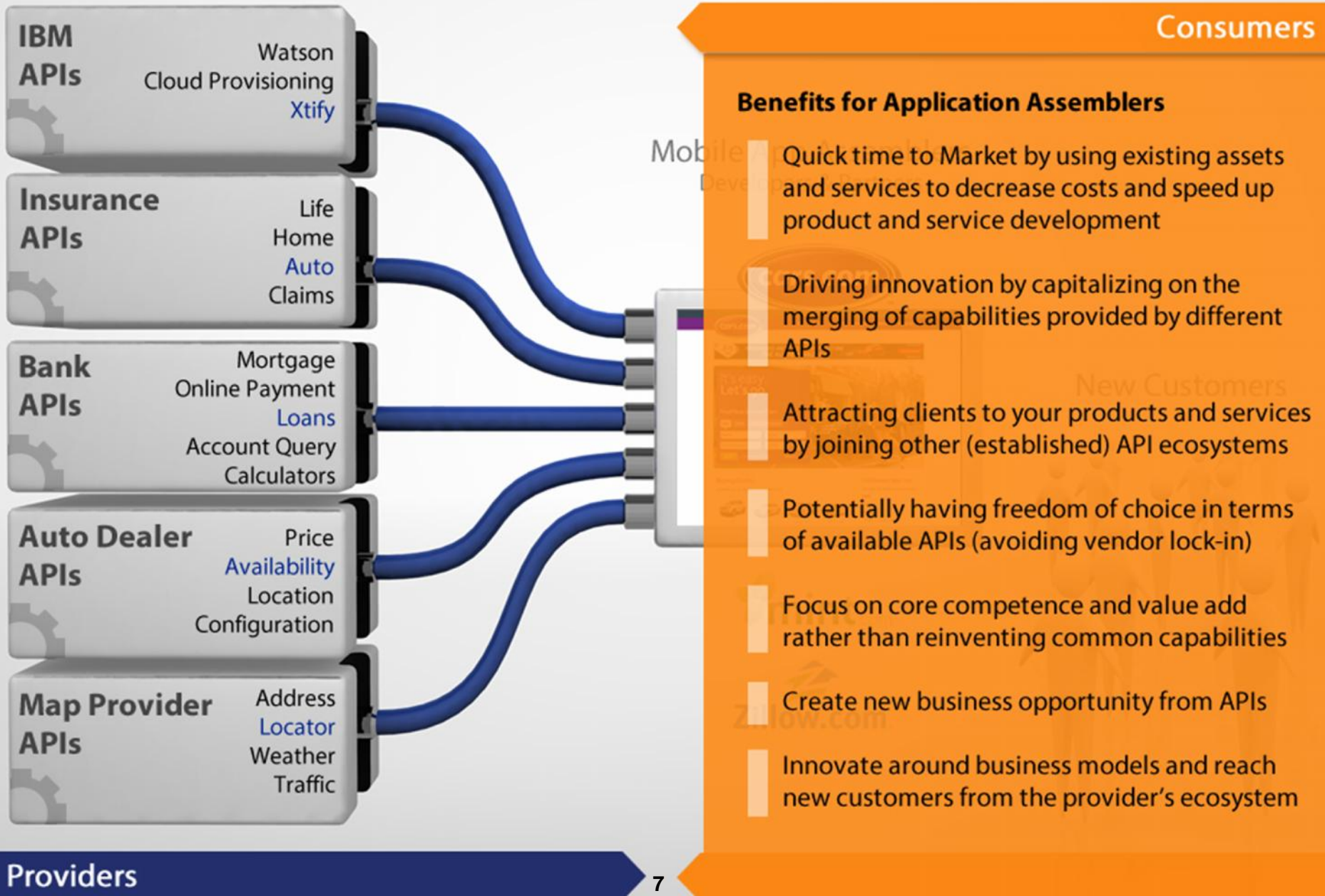
Providers

6

Consumers

# API Economy

Mobile App Assembly



# API Economy

Provider Perspective

## Mobile App Assemblers Developers & Partners



New Customers



Providers

Consumers



# API Economy

Provider Perspective

## Mobile App Assemblers

Developers & Partners



### Providers

#### Benefits

- Expanding into new customer bases and niches that you normally wouldn't be able to reach on your own
- Focusing on your core value
- Expanding your brand and brand loyalty
- Easier possibilities in establishing new partnerships and capitalizing on them
- Benefitting from open innovations of crowdsourcing and expert sourcing, which are implicitly unlocked through the opening of APIs
- Realize profit from new business models
- Decreased development costs and time through software (e.g., mobile apps) produced by third parties
- Keeping up with application demands (e.g. new apps, new features)
- Wider and quicker coverage of different platforms and devices



New Customers



# API Economy

Lifecycle



## Business Assets

Exposable Enterprise Services

## Web APIs

APIs providing commercial access to the Business Assets

## Developers

Use APIs to create Apps

## Apps

Use backend services through Web APIs

## End Users

Increase revenue by using Apps with Business Assets



## The API Economy

Where companies [providers] expose their (internal) digital business assets or services in the form of (Web) APIs to third parties [consumers] with the goal of unlocking additional business value through the creation of new assets

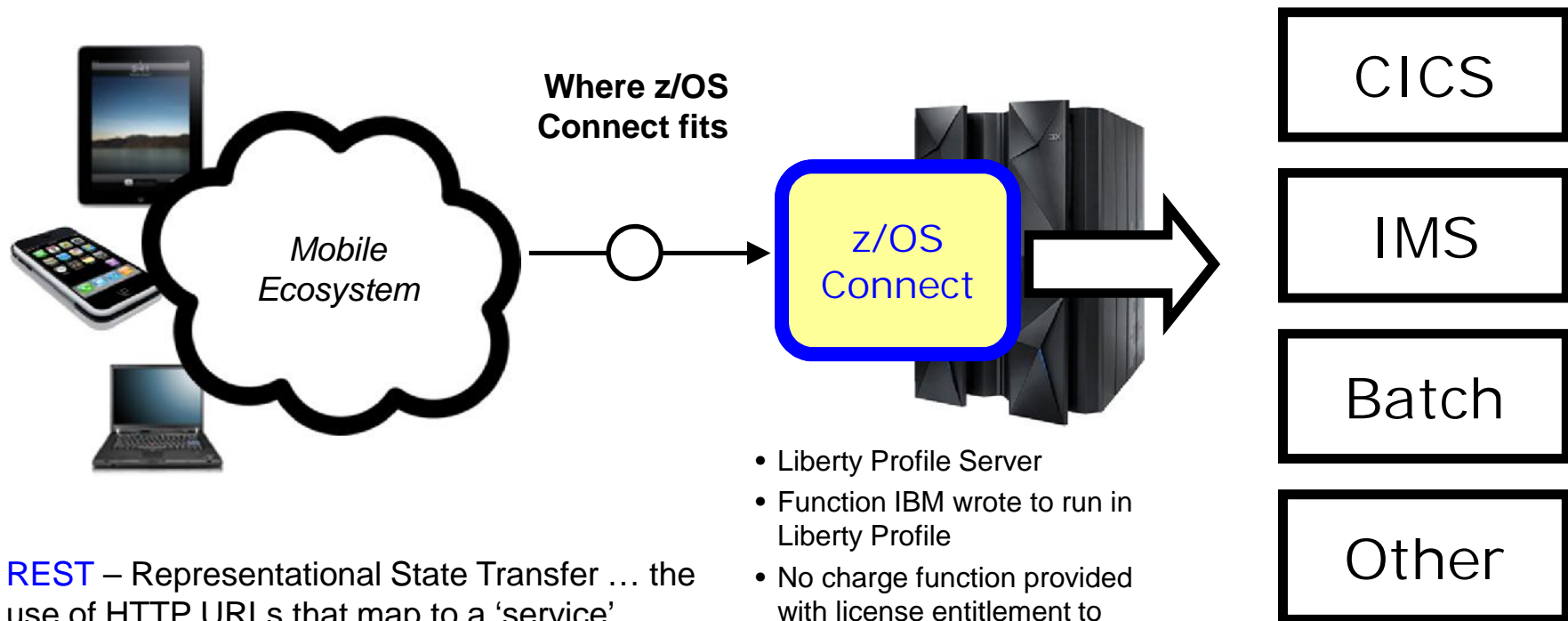
# Overview

Setting Context Before Going into Details

# z/OS Connect – What is it?



It's about getting REST and JSON into your mainframe environment in a way that enables you to best take advantage of the assets that exist there:



**REST** – Representational State Transfer ... the use of HTTP URLs that map to a 'service', such as 'query account' or 'update data'

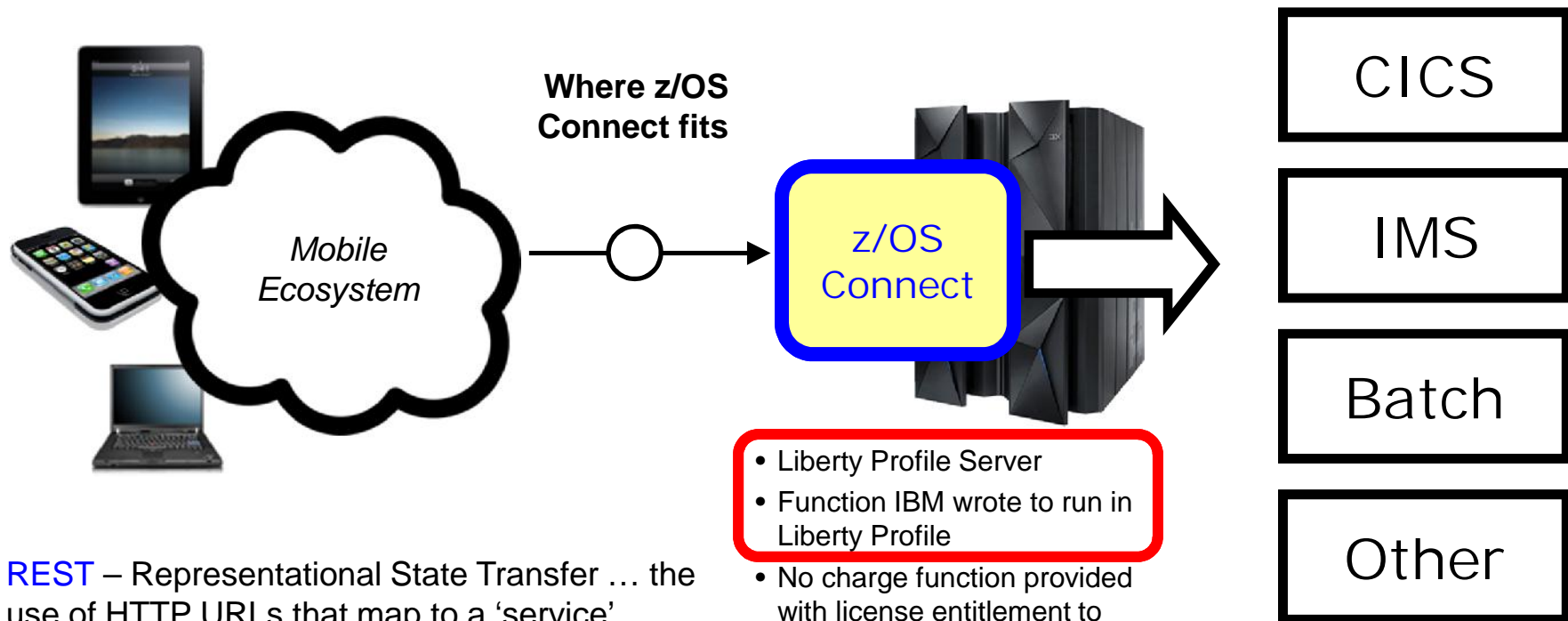
- Liberty Profile Server
- Function IBM wrote to run in Liberty Profile
- No charge function provided with license entitlement to WAS z/OS, CICS or IMS

**JSON** – JavaScript Object Notation ... a standard of representing data as a set of name/value pairs. This is passed back and forth along with REST request/responses

# z/OS Connect – What is it?



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# Websphere Application Server - in the beginning ...



Java EE Compliant

Secure

Scalable

Java COMPATIBLE ENTERPRISE EDITION

WebSphere  
Your Business Platform for SOA

Robust

Well-tooled

Fast

... but customers wanted something more ...

---



*Lightweight*  
*Composable*  
*Simple*  
*Flexible*  
*Dynamic*  
*Extensible*  
*Cloud-ready*



WebSphere Application Server  
**Liberty Profile**

WAS 8.5, June 2012

... but customers wanted something more ...

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*Lightweight*

3 second server start

*Composable*

user-selectable features on a tiny kernel

*Simple*

all server config in a single server.xml file

*Flexible*

jar file installs, zip file deployments

*Dynamic*

all config updates applied with no server start

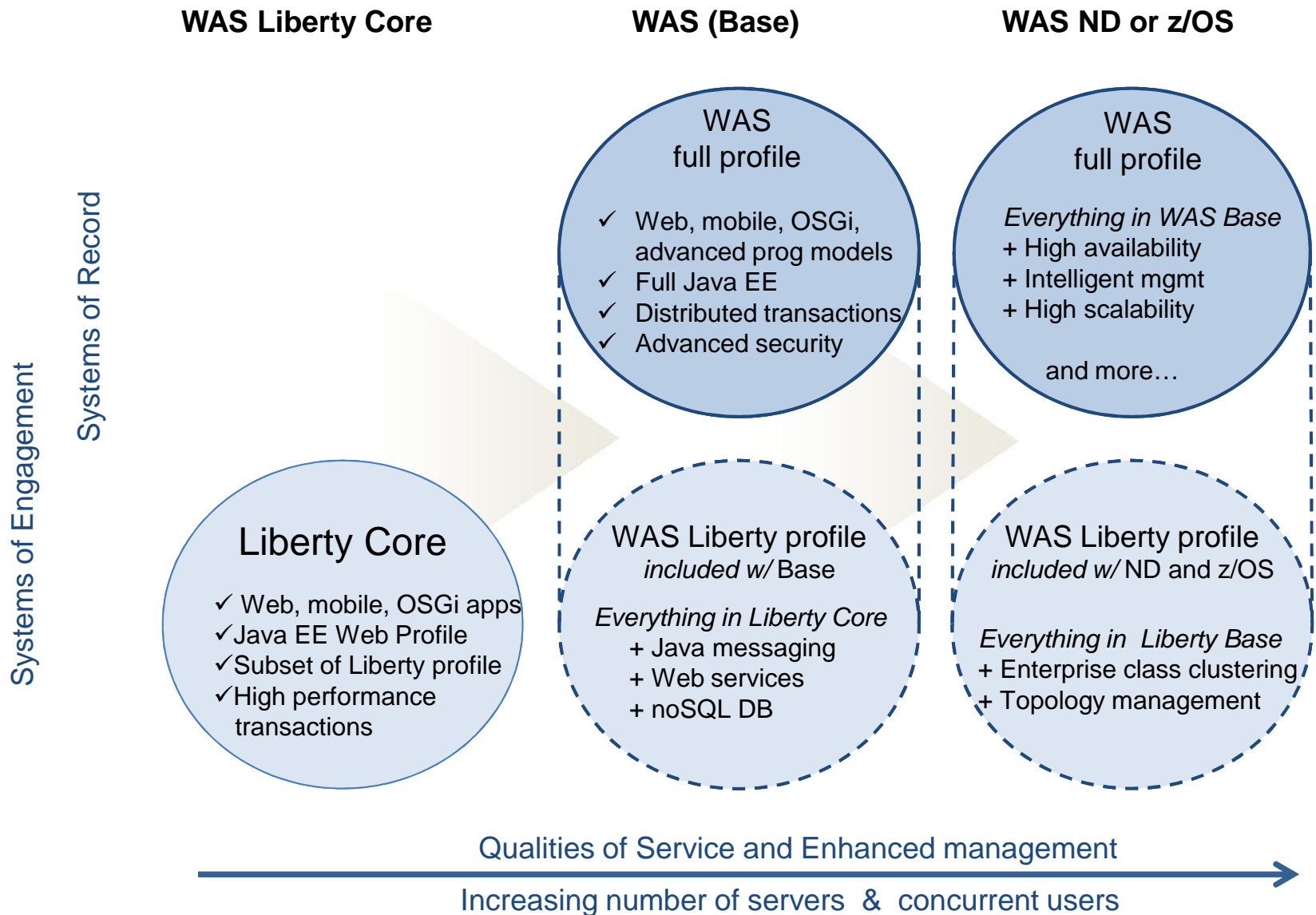
*Extensible*

write your own user features

*Cloud-ready*

in BlueMix, Pure App, SoftLayer

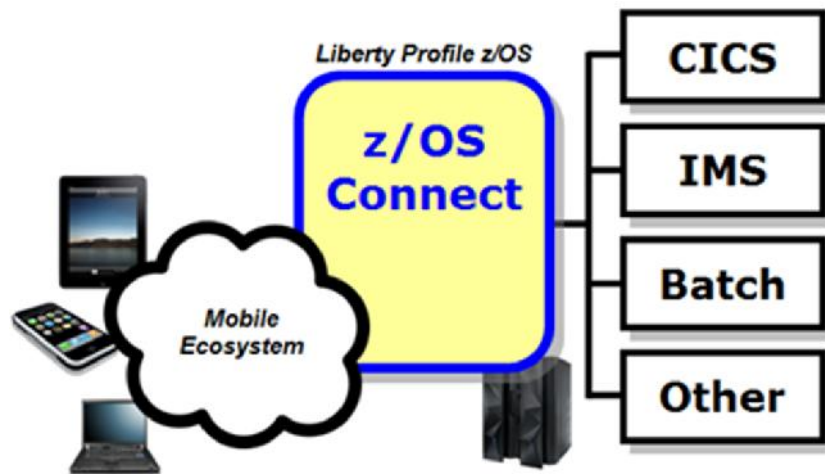




# Why z/OS Connect?



This represents another component to configure and maintain in your environment. So what value does it bring?



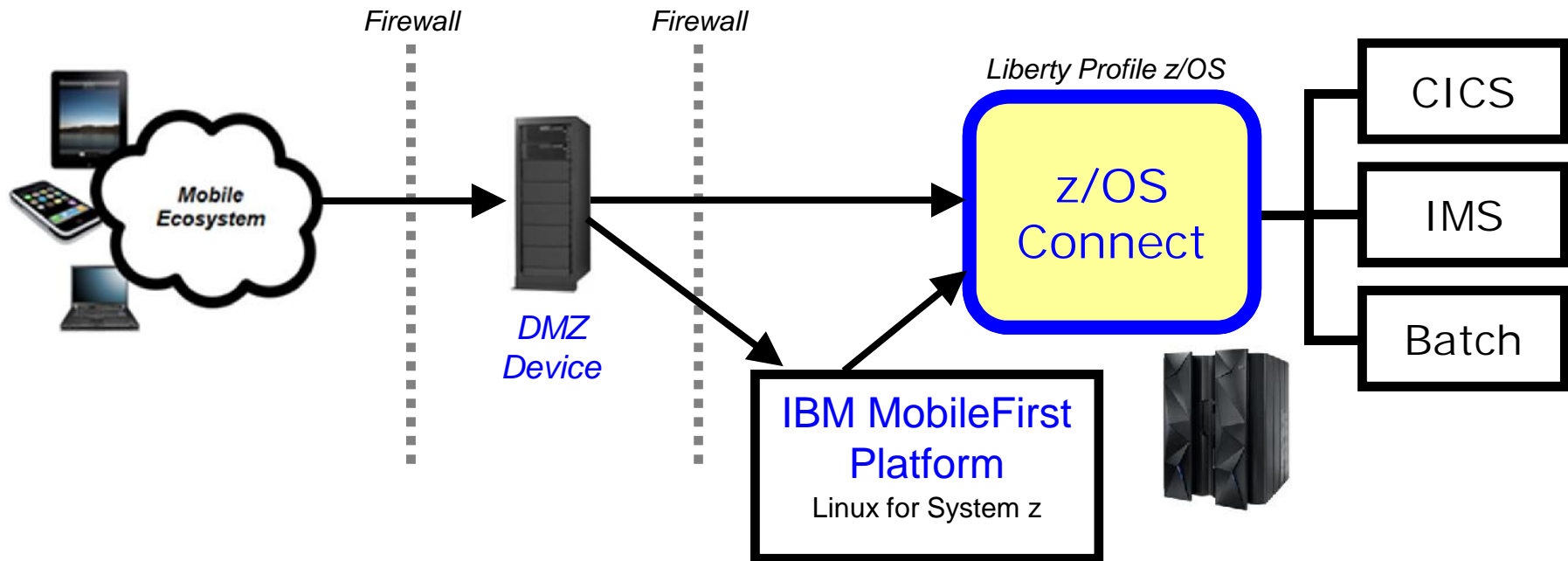
You *could* enable Mobile access without z/OS Connect  
z/OS Connect simplifies and makes the environment more consistent and manageable

- Provides a common and consistent entry point for mobile access to one or many backend systems
- Java, so runs on specialty engines
- Shields backend systems from requiring awareness of RESTful URIs and JSON data formatting
- Provides point for authorization of user to invoke backend service
- Provides point for capturing usage information using SMF
- Simplifies front-end functions by allowing them to pass RESTful and JSON rather than be aware of or involved in data transformation
- Extensible Framework!

# Context Within Overall Mobile Architecture



The message here is that z/OS Connect is a *piece* of the Mobile architecture, but in most cases will not be the only component:

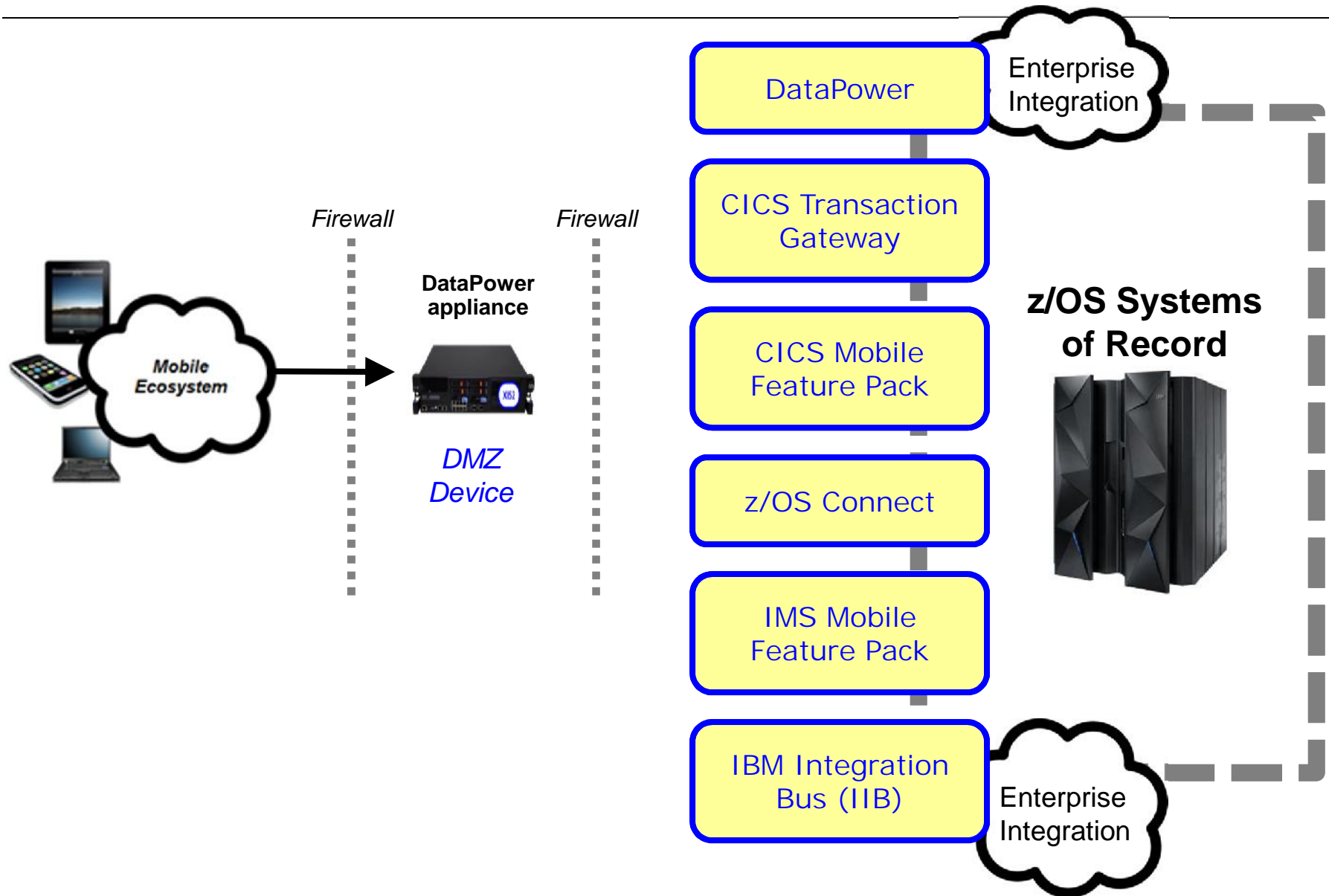


Users of z/OS Connect would access through normal corporate firewall infrastructure

IBM Worklight to provide application management, security and operational governance for mobile applications

z/OS Connect would be behind the secure firewall, and on LPARs along with backend systems

# Positioning IBM solutions: accessing z Systems of Record



# Different *Delivery* Approaches



This is delivered with WAS z/OS, CICS and IMS ... objective is to provide different approach paths depending on what you have:

## WAS z/OS

Delivered as function that runs inside Liberty Profile z/OS. Initially will use WOLA (WebSphere Optimized Local Adapters) to access backend.

## CICS

Delivered as part of Liberty Profile that runs inside of CICS region. Will use JCICS interface to access CICS functions

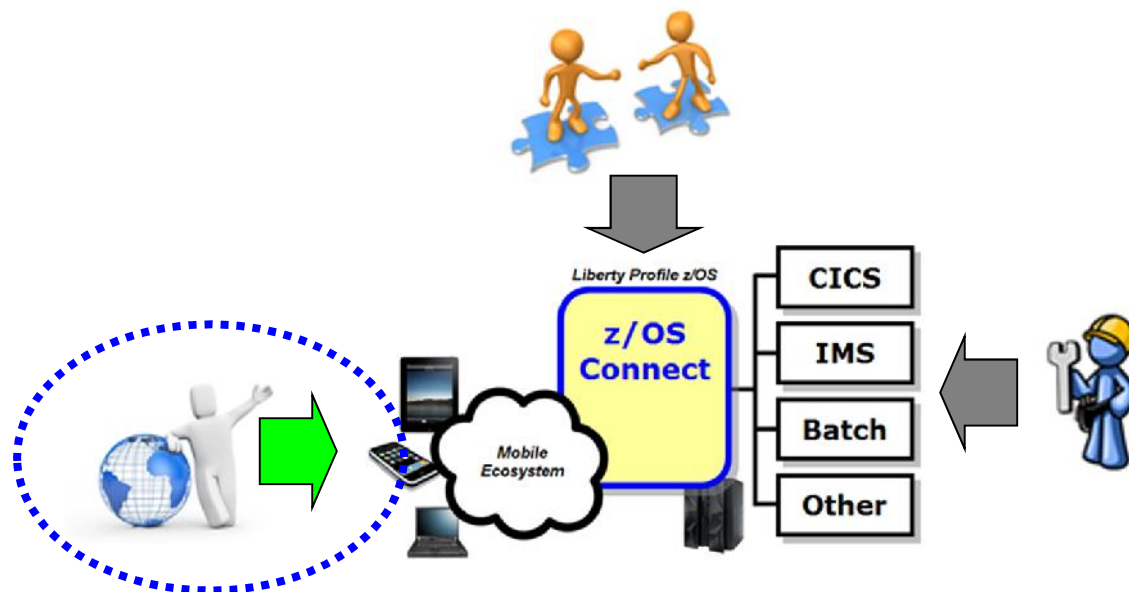
## IMS

Delivered as part of IMS Enterprise Suite (v3.1.1), or downloadable from the Liberty repository, it also has an Eclipse-based tooling platform for service creation and administration (IMS Explorer)

These different delivery mechanisms tend to obscure the main story of what it is and how it works, so for now let's stipulate IBM offers several ways to get this and now focus on some details

# Front-End Perspective

Looking at z/OS Connect from a perspective of users of the function



# RESTful Services



Stands for Representational State Transfer ... this is a protocol built on HTTP, using HTTP verbs\*, where the URI indicates the service requested:



*URI = Uniform resource identifier*

```
https://mysite.com/CustomApp/getCustomer?cn=1234
```

There's no magic to this ... if the URI is understood by the receiving server, then the implied action is taken. What that action is depends on how the server is configured.

Knowing what URIs the server supports is important, which is why z/OS Connect has a discovery function that can be used to query for the configured services and details on those services.

RESTful services are growing in popularity because it's easier to implement than other web service protocols such as SOAP, which involves XML and WSDL and parsing ...

\* For example, GET, PUT, POST, DELETE

# JSON – JavaScript Object Notation



It is a way of passing data back and forth as a series of name/value pairs.



*URI = Uniform resource identifier*

`https://mysite.com/CustomerApp/update?cn=1234`

```
{
  "firstName": "John",
  "lastName": "Smith",
  "age": 25,
  "address": {
    "streetAddress": "1234 Main Street",
    "city": "Anytown",
    "state": "NY",
    "postalCode": "10021-1234"
  },
}
```

The data being passed in is appended to the URL and passed in to the server

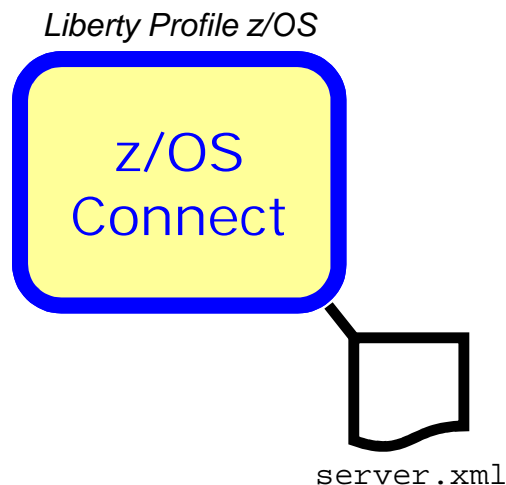
JSON can be passed back to the client as well.



# A Peek Inside z/OS Connect Configuration



We're about to show you the discovery function, which returns a list of configured services. Let's first look inside z/OS Connect ...



```
<feature>zosConnect-1.0</feature>

<zosConnectService serviceName="serv1" ... />
<zosConnectService serviceName="serv2" ... />
<zosConnectService serviceName="serv3" ... />
<zosConnectService serviceName="serv4" ... />
```

- For z/OS Connect to understand what URIs to handle and how to handle them, you need to configure that information into `server.xml`  
[More information on server.xml configuration coming up](#)
- The sample above is a simplified representation of the configuration for multiple services
- z/OS Connect understands its environment based on this configuration data ...  
*and it can provide information back using a discovery function*

# z/OS Connect Discovery Function

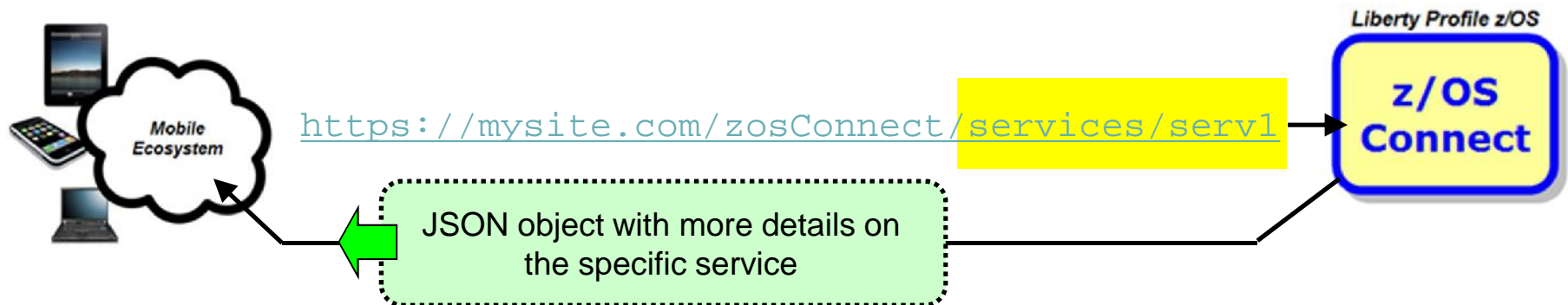


A discovery function is provided to allow developers to query for a list of configured services, and drill down for details on a given configured service:

## Query for configured services



## Query for details on a given configured service

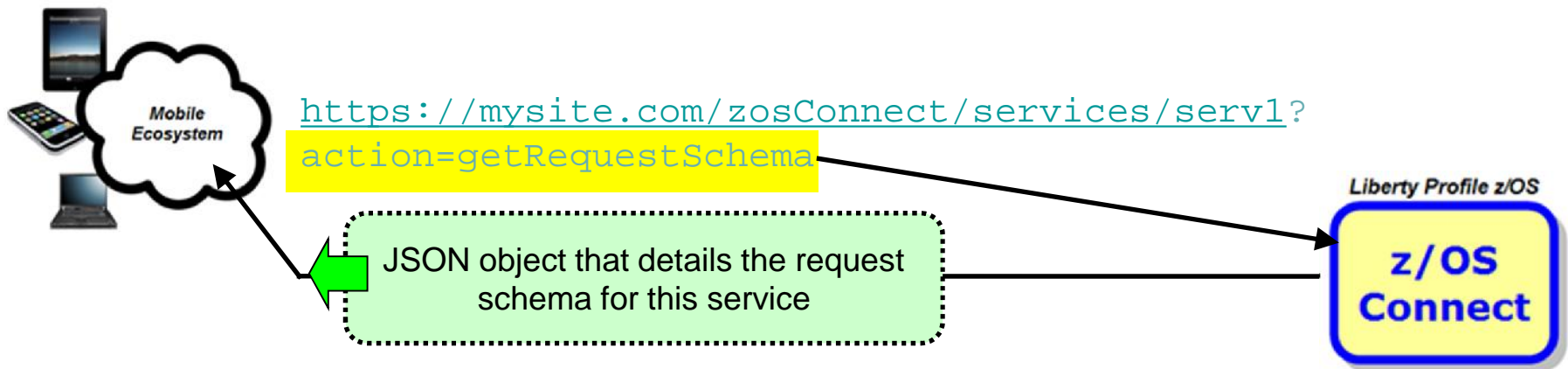


# z/OS Connect for Service Invocation

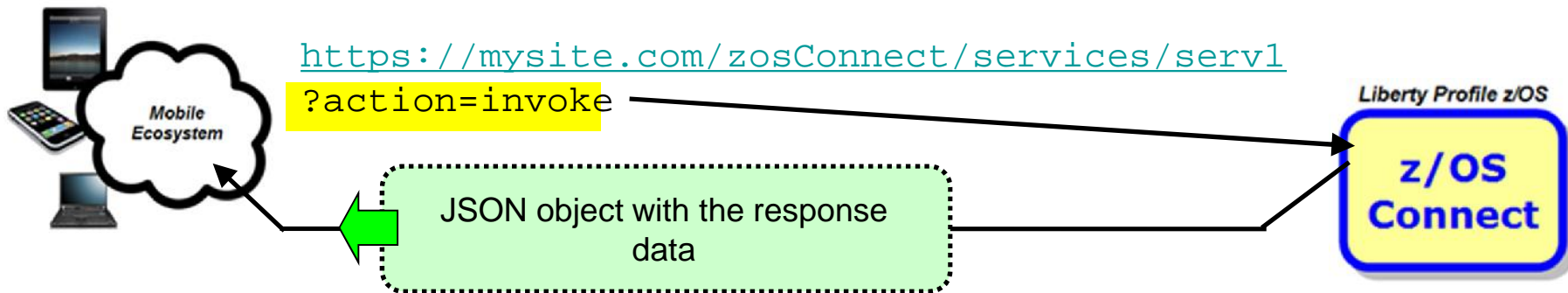


Once you have discovered a service that you would like to invoke, you can use z/OS Connect to get the request schema and then invoke the service:

## Get the request schema

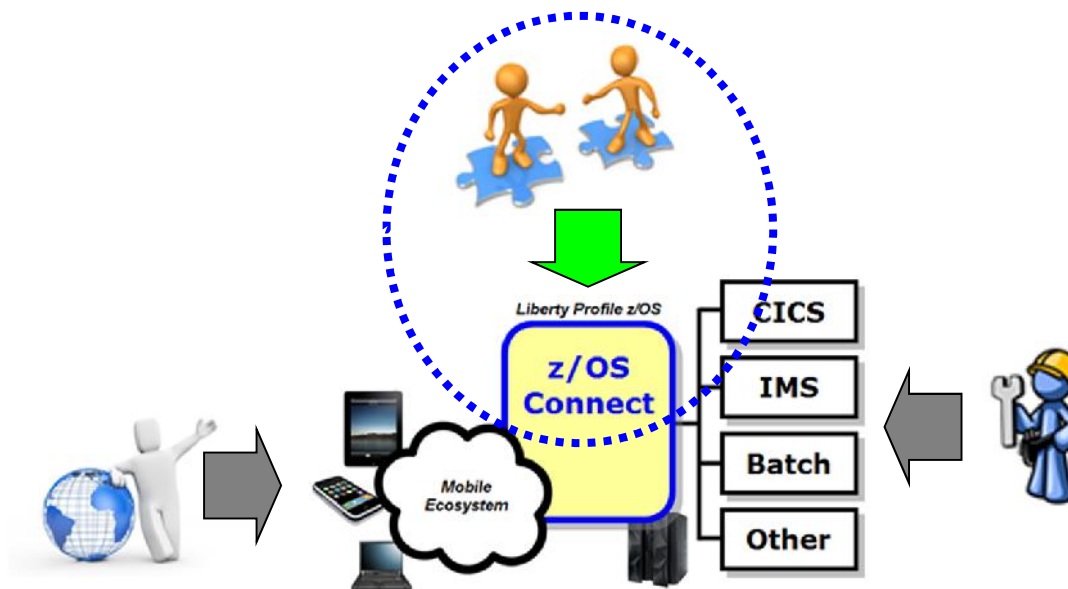


## Invoke the service



# Inside Perspective

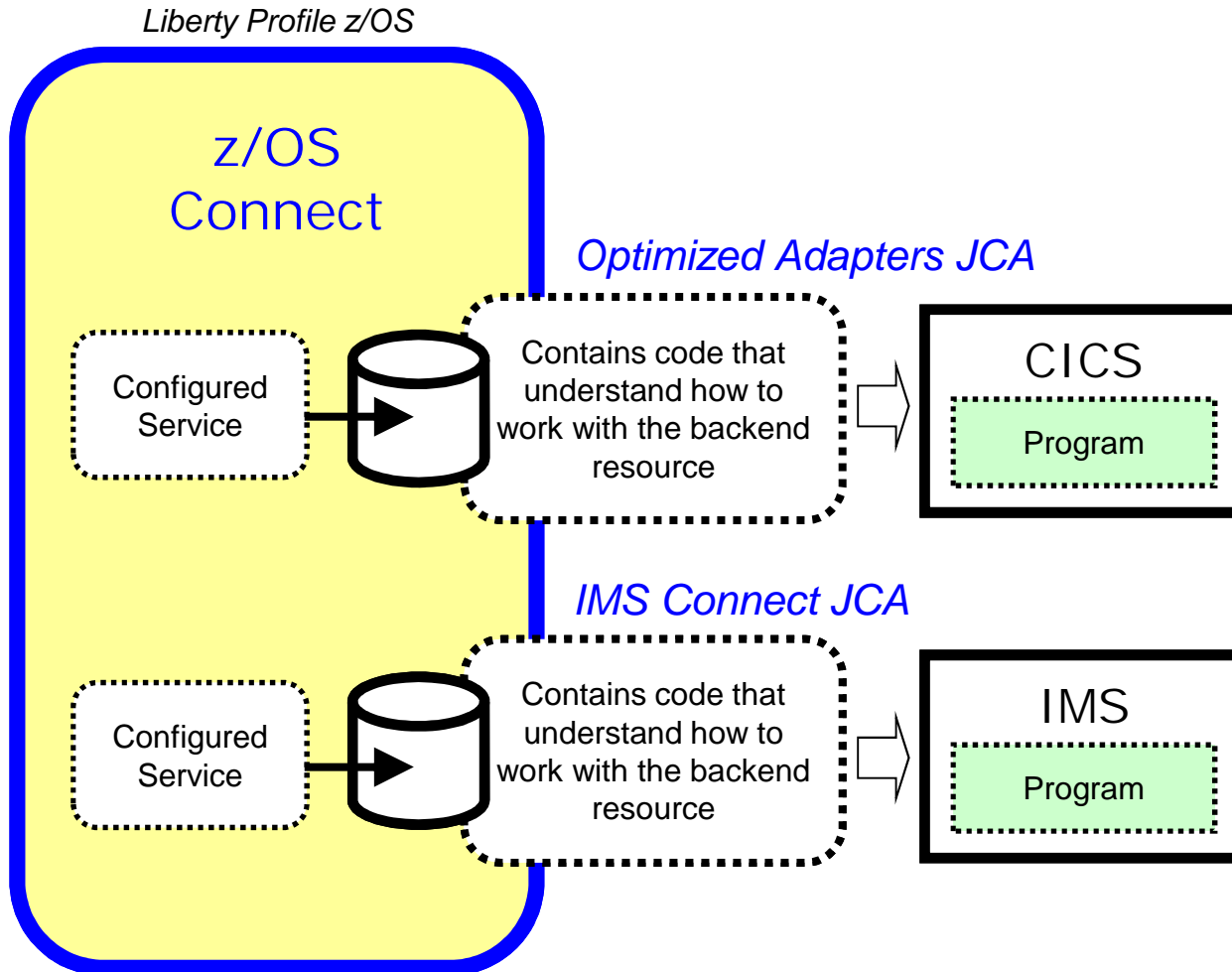
Looking at how z/OS Connect works inside the function itself



# z/OS Connect Service Providers



A 'service provider' is what provides connectivity to a specific backend resource. You may have one or more service providers configured:



To connect to a backend CICS region, for example, you need to specify which CICS region and what mechanism is to be used to connect

A 'service provider' definition provides that information to z/OS Connect

Configured services are tied to service provider definitions to complete the circuit

Multiple service providers are supported, as illustrated here

# Overview of server.xml Updates for z/OS Connect



z/OS Connect behavior is defined by updates to the server.xml of the Liberty Profile in which z/OS Connect operates:

Liberty Profile z/OS



<https://myhost.com/zosConnect/services/HelloWorld>

z/OS Connect is defined as a feature in the Feature Manager section, along with WOLA used to get to the backend

```
<featureManager>
  <feature>zosConnect-1.0</feature>
  <feature>zosLocalAdapters-1.0</feature>
</featureManager>
```

```
<zosConnectService id="serv1"
  serviceName="HelloWorld"
  serviceRef="wolaHelloService"
</zosConnectService>
```

This defines a service – HelloWorld – that will be exposed to Mobile users. It maps to a service provider that defines how the backend CICS will be accessed.

```
<authData id="cauth1" user="user1" password="{xor}LDo8Ki02KyY=" />
<connectionFactory id="wolaCF" jndiName="eis/ola" containerAuthDataRef="cauth1" >
  <properties.ola/>
</connectionFactory>
```

```
<localAdaptersConnectService id="wolaHelloService"
  wolaRegisterName="CICSREGA"
  wolaServiceName="PROGRAM1"
  connectionFactoryRef="wolaCF"
</localAdaptersConnectService>
```

This defines the service provider – WOLA in this case – that provides the connectivity to the backend CICS region

# Multiple Configured Services



You provide definitions for each service you wish to expose using z/OS Connect. For example, this shows Update, Create and Delete:

<https://myhost.com/zosConnect/services/ContactCreate>

<https://myhost.com/zosConnect/services/ContactUpdate>

<https://myhost.com/zosConnect/services/ContactDelete>

```
<zosConnectService id="zcs3" serviceName="ContactCreate"
  serviceDescription="Create"
  serviceRef="wolaKIXPHONE"
  dataXformRef="xformJSON2Byte">
</zosConnectService>
```

Pointer to section in XML that defines the "Service Provider," which provides connectivity to the backend system

```
<zosConnectService id="zcs4" serviceName="ContactUpdate"
  serviceDescription="Update"
  serviceRef="wolaKIXPHONE"
  dataXformRef="xformJSON2Byte">
</zosConnectService>
```

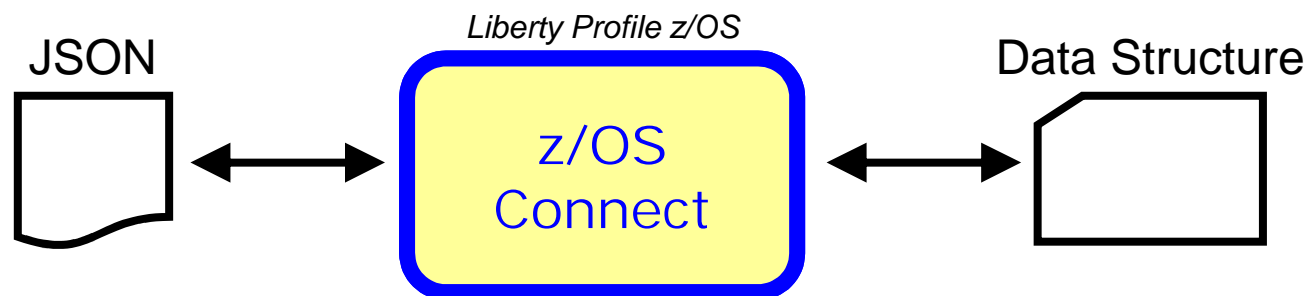
Pointer to section in XML that provides information on how to do data transformation

```
<zosConnectService id="zcs5" serviceName="ContactDelete"
  serviceDescription="Delete"
  serviceRef="wolaKIXPHONE"
  dataXformRef="xformJSON2Byte">
</zosConnectService>
```

# Data Transformation



z/OS Connect accepts JSON data, but then needs to convert that to the data format required by the backend program. Data conversion provides that:



```
<zosConnectDataXform id="xformJSON2Byte"  
  bindFileLoc="/u/user1/bindfiles"  
  bindFileSuffix=".bnd"  
  requestSchemaLoc="/u/user1/schema"  
  responseSchemaLoc="/u/user1/schema"  
  requestSchemaSuffix=".json"  
  responseSchemaSuffix=".json">  
</zosConnectDataXform>
```

ID of transform section that was referenced in the service definition

XML that tells z/OS Connect where the bind file is located and the file suffix that is used

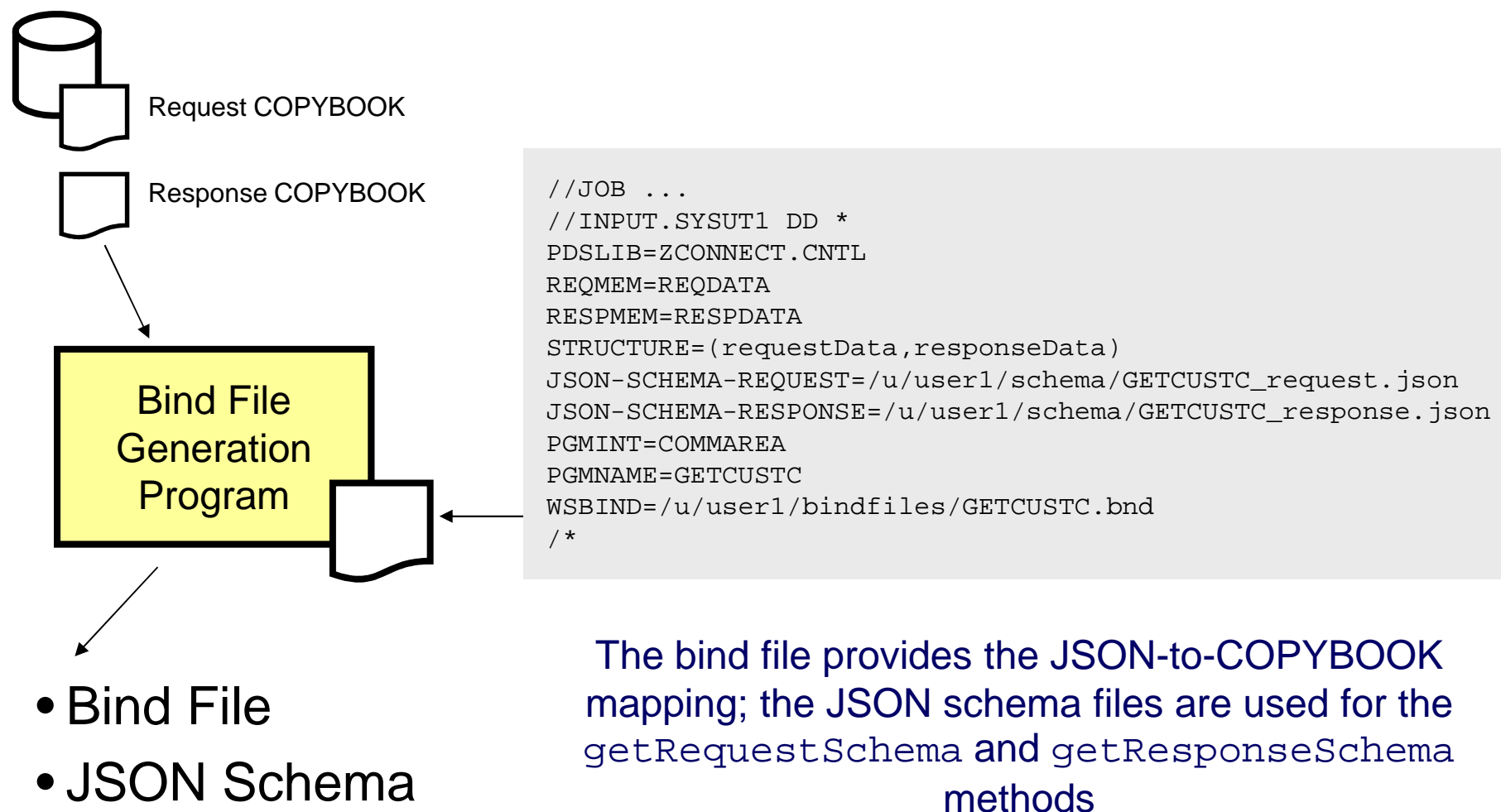
XML that tells z/OS Connect where the JSON schema information is located



# Bind Files



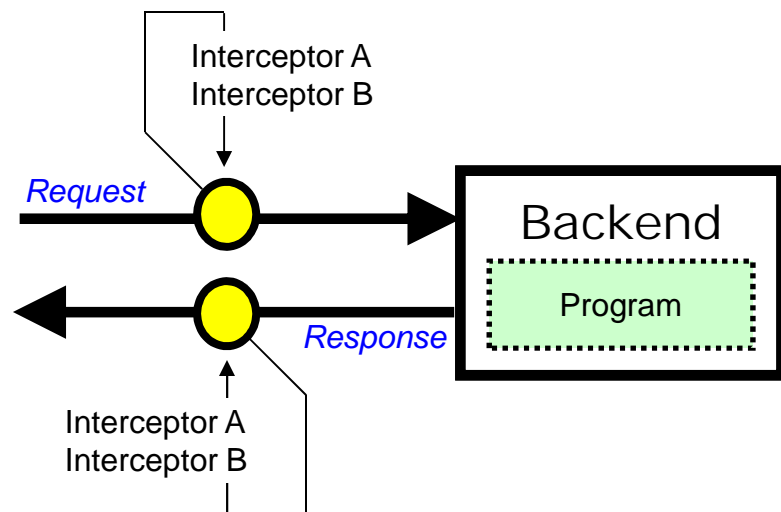
Bind files are generated with a supplied utility. Bind files provide z/OS Connect with knowledge of how JSON maps to the target data structure



# Overview of Interceptors



The interceptor framework provides a way to call code to do pre-invoke work and then again to do post-invoke work:



In `server.xml` you can:

- Define 'global interceptors,' which apply to all configured services
- Define interceptors specific to a given configured service
- Have services 'opt out' of global interceptors

z/OS Connect comes with a security interceptor (for authorization) and an audit interceptor (for SMF recording)

It is also possible to write your own interceptor and have it called as part of request/response processing

# Audit (SMF) Interceptor



The audit interceptor writes SMF 120.11 records with the following information captured:

*Liberty Profile z/OS*



- System Name
- Sysplex Name
- Jobname
- Job Prefix
- Address Space Stoken

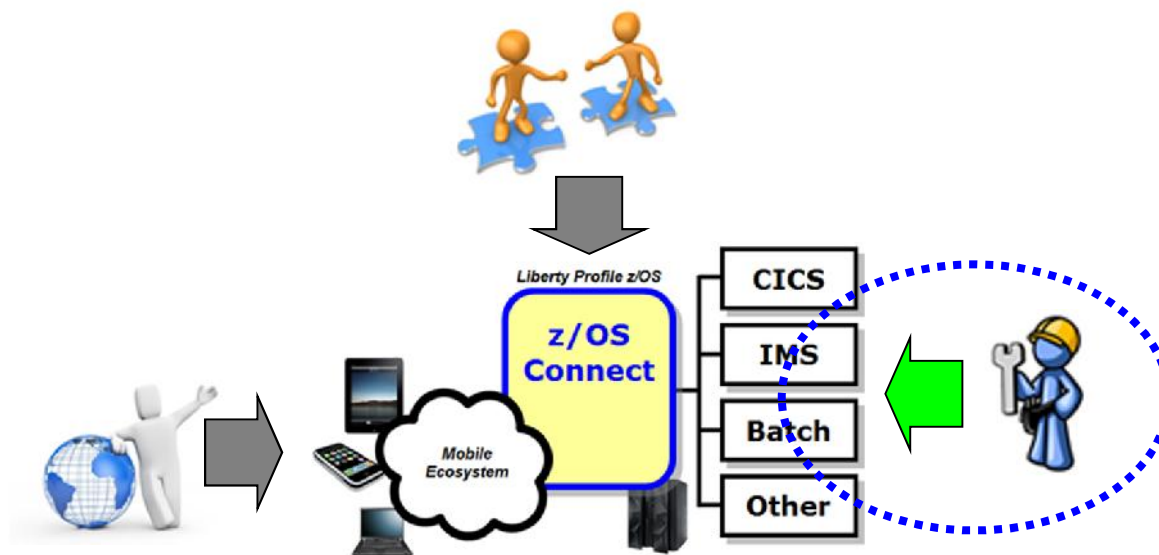
*Server Identification  
Section*

- Arrival Time
- Completion Time
- Target URI
- Input JSON Length
- Response JSON Length
- Method Name
- Service Name
- Userid

*z/OS Connect  
User Data Section*

# Backend Perspective

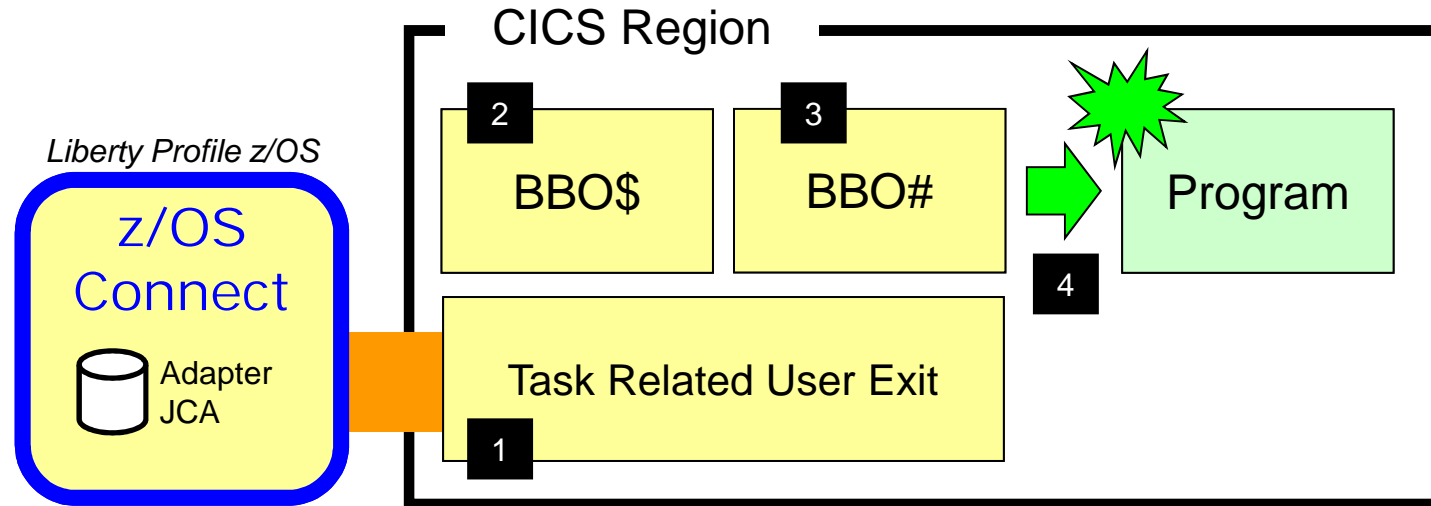
Looking at z/OS Connect from perspective of CICS, Batch and IMS



# Optimized Adapters Support in CICS



To support WOLA in CICS the following code must be installed. JCL samples provided to do the installation:

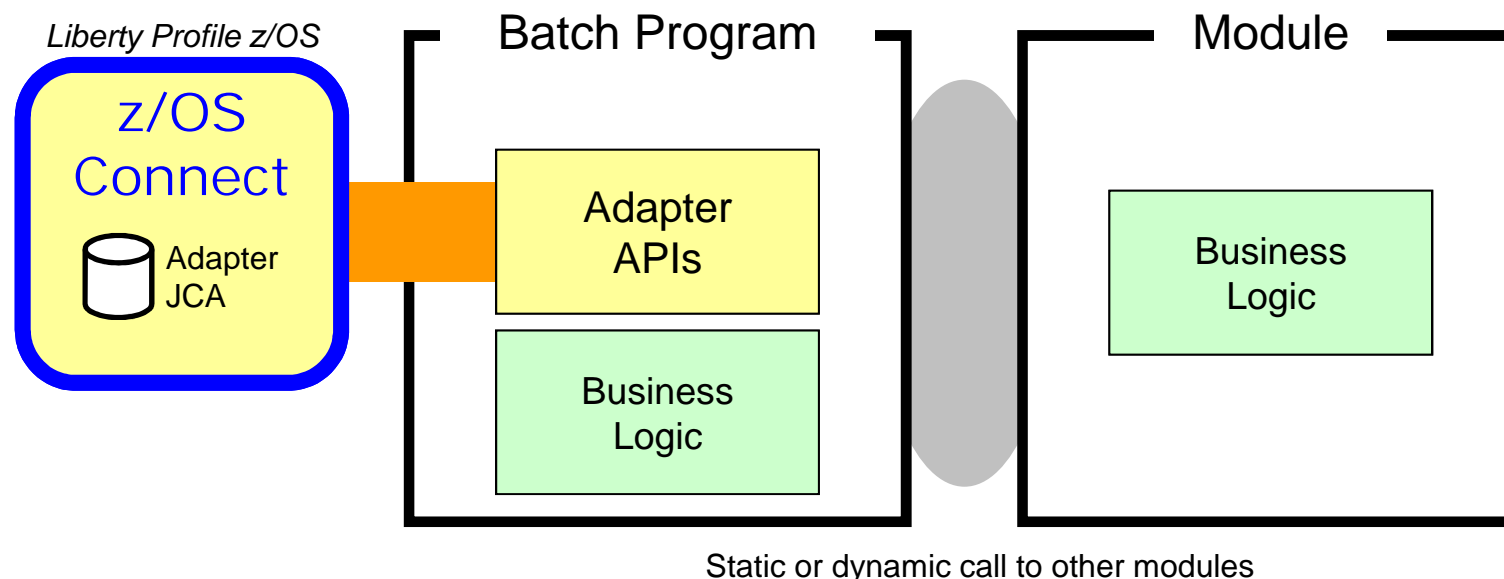


- 1 The WOLA TRUE provides the low-level connectivity for cross-memory communications using Optimized Adapters.
- 2 The BBO\$ long running task handles the calls coming from z/OS Connect. The BBO\$/BBO# combination shields the target program from any awareness of Optimized Adapters.
- 3 The BBO# invocation task is used to perform the EXEC CICS LINK to the target service.
- 4 Finally, an EXEC CICS LINK is performed and the target service invoked with the data from z/OS Connect passed in. The target CICS program has no knowledge of Optimized Adapters.

# Optimized Adapters and Batch Programs



The Batch Program would use the APIs to “Host a Service” and wait for call from z/OS Connect:



When the target of the z/OS Connect call is a Batch Program, that program will need to use WOLA APIs to “Host a Service”

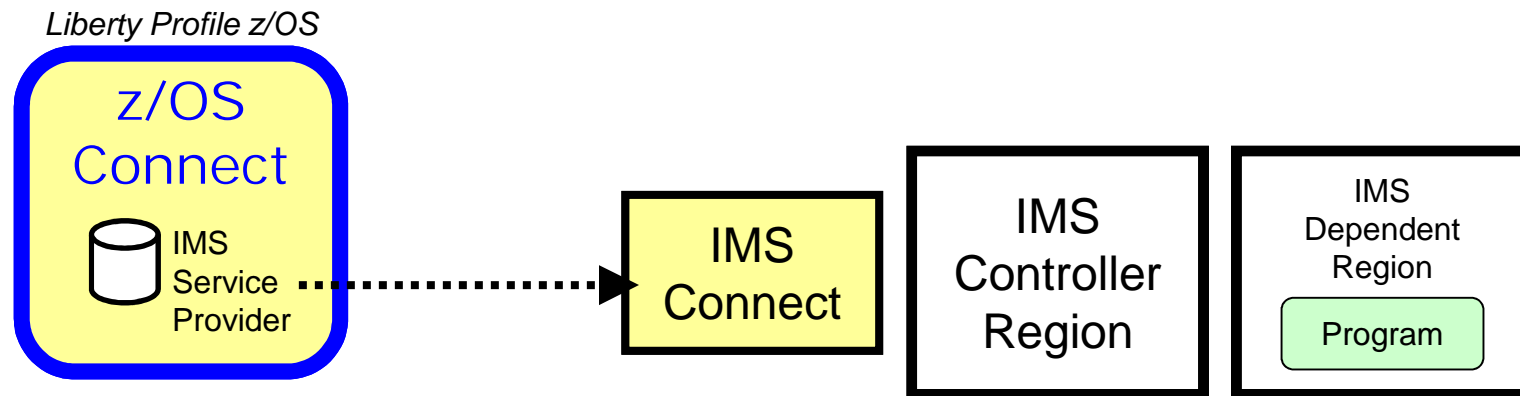
BBOA1SRV, BBOA1RCA or BBOA1RCS

Business logic being called may reside in the hosting batch program, or that program may perform static or dynamic calls to another module where business logic resides

# z/OS Connect and IMS



z/OS Connect interacts with IMS using function provided by IMS and announced in letter ENUS214-220:

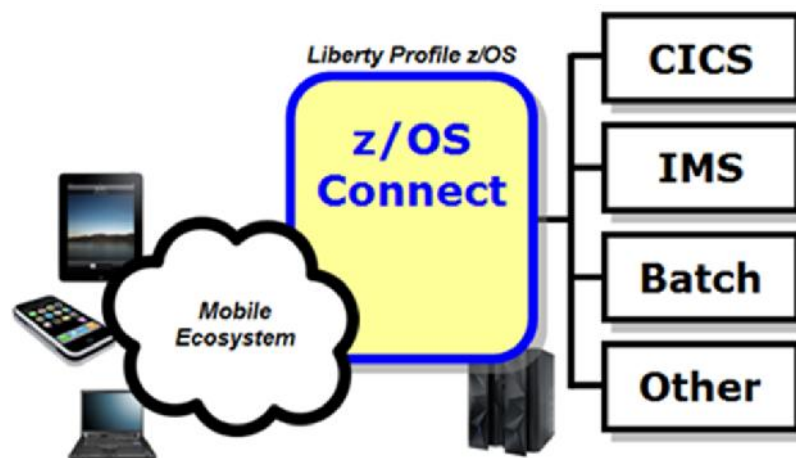


From a z/OS Connect perspective the concepts are the same as what we've shown so far. The syntax for the service provider would be different (IMS Connect vs. Optimized Adapters). And the pointer to the JCA resource adapter would specify the IMS JCA.

It is possible to use the Liberty Optimized Adapters with IMS, but only if the program uses the optimized adapter APIs to 'host a service' like described for Batch programs

# Summary

Wrap-up of Presentation

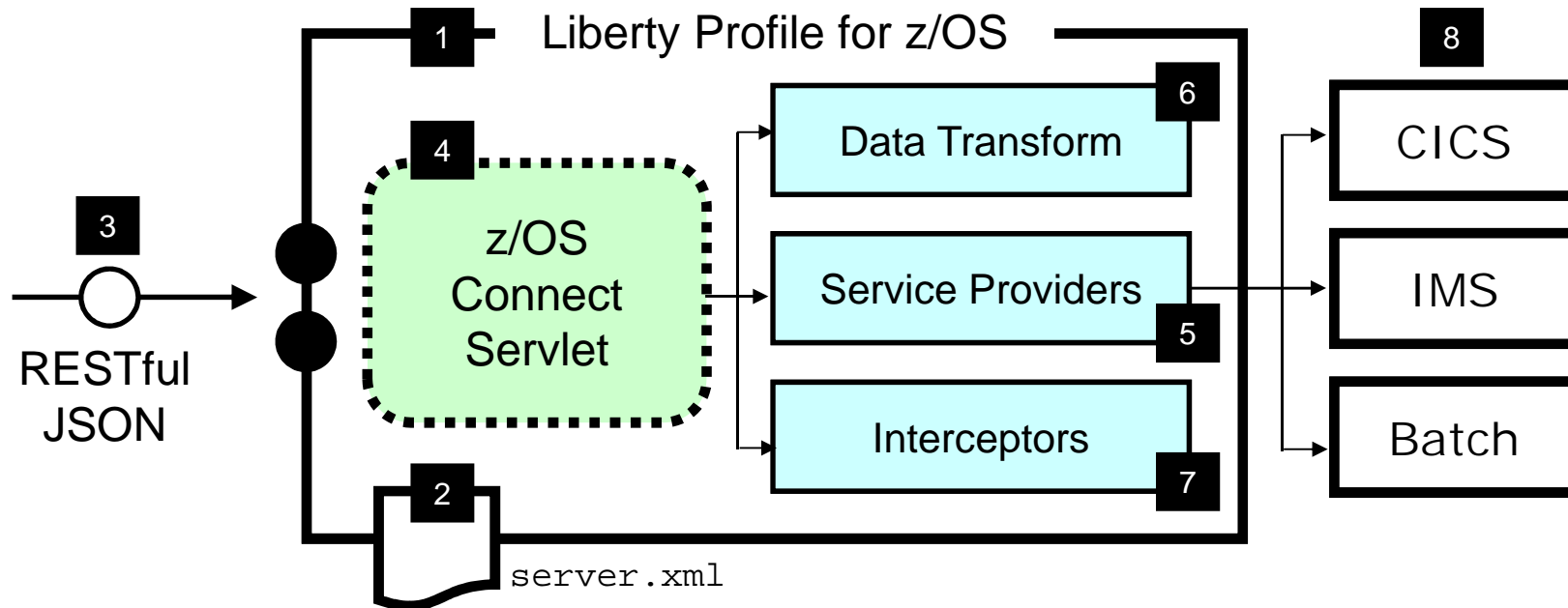




# Summary in One Picture



A summary of what we covered:



- 1 z/OS Connect is software function that runs in Liberty Profile for z/OS.
- 2 z/OS Connect is described and configured in the Liberty `server.xml` file
- 3 z/OS Connect is designed to accept RESTful URIs with JSON data payloads

- 4 One part of z/OS Connect is a servlet that runs in Liberty Profile z/OS.
- 5 A 'Service Provider' is software that provides the connectivity to the backend system
- 6 z/OS Connect provides the ability to transform JSON to the layout required by backend

- 7 'Interceptors' are callout points where software can be invoked to do things such as SAF authorization and SMF activity recording
- 8 Initially the backend systems supported will be CICS, IMS and Batch

Topic	Link
<b>Guide to WebSphere on z/OS Collateral</b> –Updated master list of links to collateral	<a href="http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102205">http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102205</a>
<b>Liberty z/OS Connect</b> –Overview, whitepapers, videos –Executive Brochure	<a href="http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102439">http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102439</a>
<b>Why WAS for z/OS</b> –Executive Brochure –History of release enhancements –Technical Presentation, videos	<a href="http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101532">http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101532</a>
<b>WAS for z/OS Liberty Profile</b> –Executive Brochure –Quick Start Guide and Samples	<a href="http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102110">http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102110</a>
<b>WebSphere Optimized Local Adapters (WOLA)</b> –Overview, whitepapers, videos –History of WOLA updates	<a href="http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101490">http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101490</a>
<b>Training – z/OS Wildfire Workshops</b> –WAS for z/OS v8.5 –WebSphere Compute Grid (Batch)	<a href="http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/PRS1778">http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/PRS1778</a>
<b>WebSphere on z Virtual User Group</b> –Join the User Group –Download previous webcasts	<a href="http://www.websphereusergroup.org/zos">http://www.websphereusergroup.org/zos</a>