

SOAP/ REST and IBM i & Watson

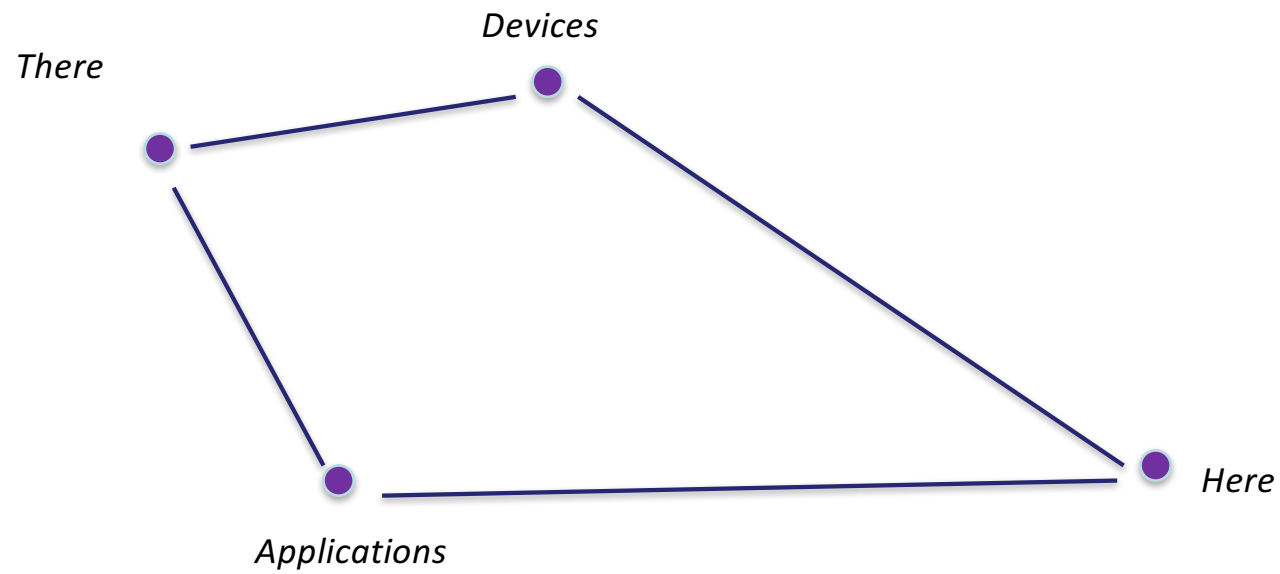
Tim Rowe- timmr@us.ibm.com
Business Architect Application Development

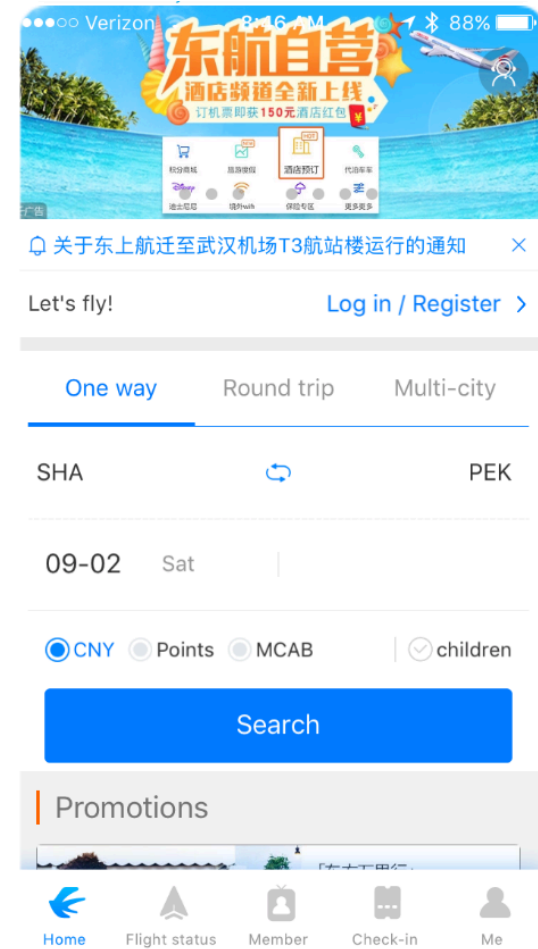
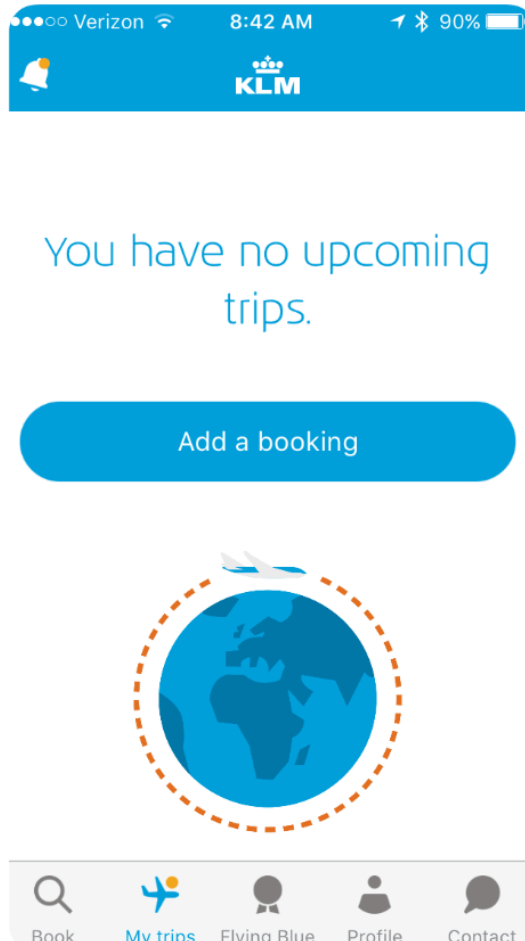
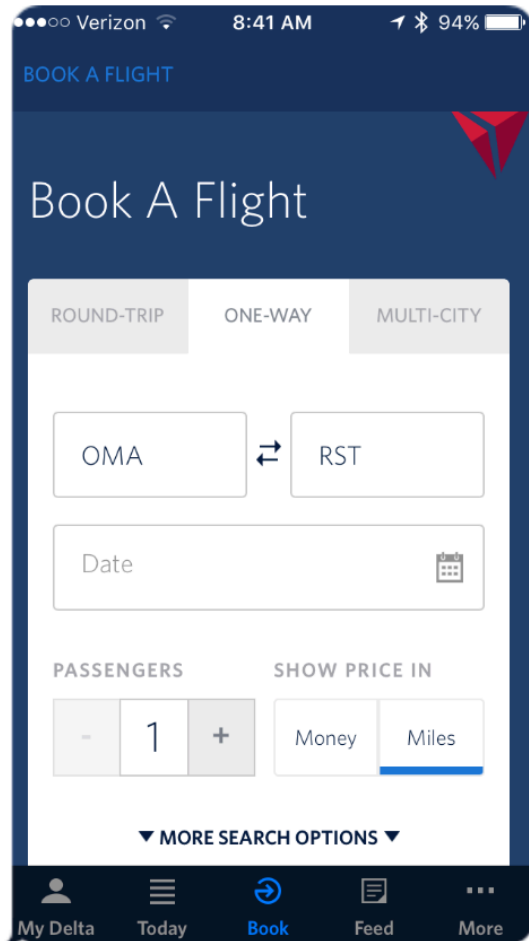


What is an API - Agenda

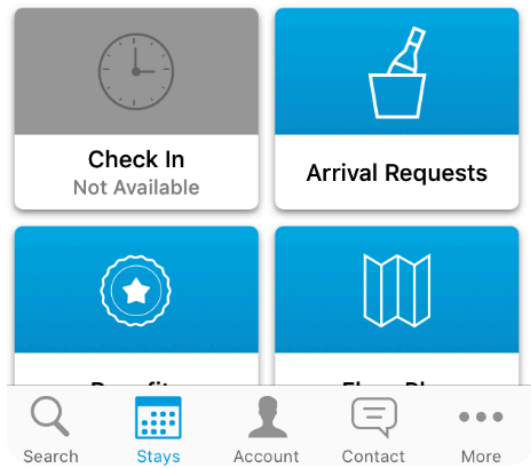
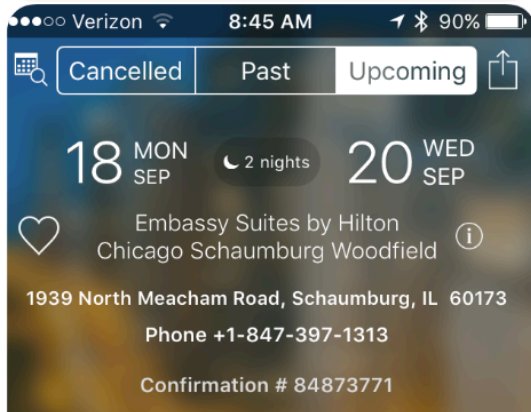
- What is an API
- What is a Web Service
- SOAP vs REST
 - What is SOAP
 - What is REST
 - Benefits
 - Drawbacks

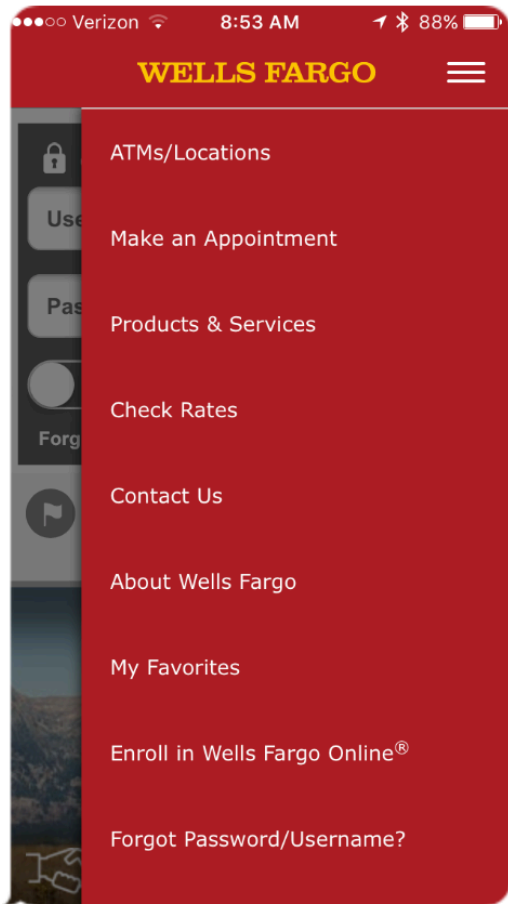
Connections













API Definition

A pplication

P rogramming

I nterface



API Definition

Application programming interface

From Wikipedia, the free encyclopedia



WIKIPEDIA
The Free Encyclopedia

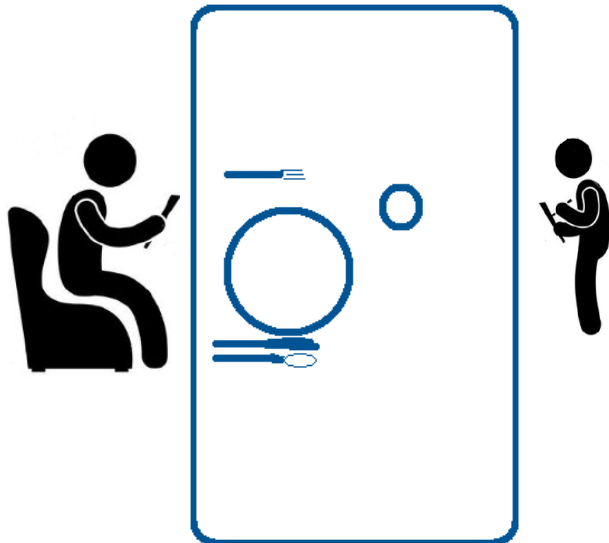
"API" redirects here. For other uses, see [API \(disambiguation\)](#).

In [computer programming](#), an **Application Programming Interface (API)** is a set of [subroutine](#) definitions, protocols, and tools for building [application software](#). In general terms, it is a set of clearly defined methods of communication between various software components. A good API makes it easier to develop a [computer program](#) by providing all the building blocks, which are then put together by the [programmer](#). An API may be for a web-based system, [operating system](#), [database system](#), [computer hardware](#) or [software library](#). An API specification can take many forms, but often includes specifications for [routines](#), [data structures](#), [object classes](#), [variables](#) or [remote calls](#). [POSIX](#), [Microsoft Windows API](#), the [C++ Standard Template Library](#) and [Java APIs](#) are examples of different forms of APIs. Documentation for the API is usually provided to facilitate usage.

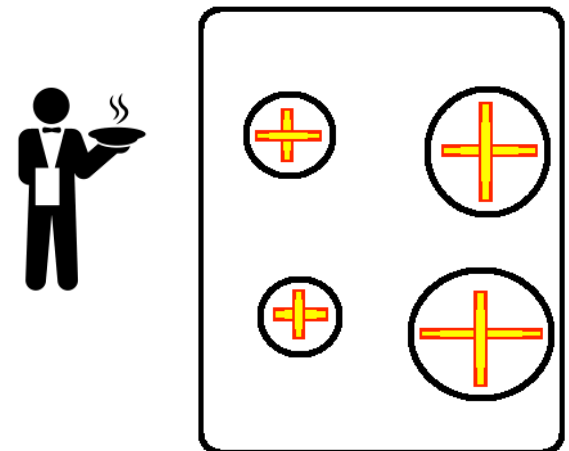
APIs - Simple

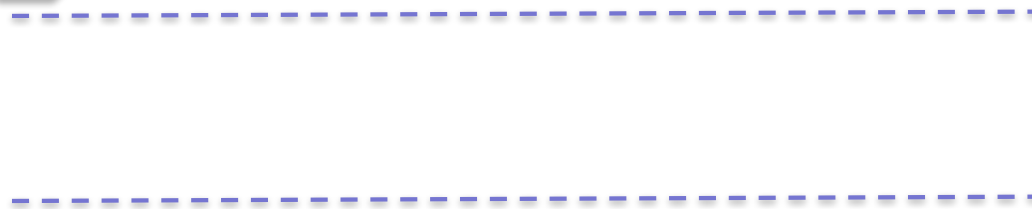
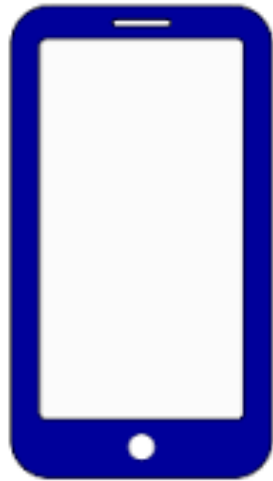
Simple way to connect endpoints. Send a request and receive a response.

Example



Kitchen







The API Economy

Not just a buzz-word, but rather the evolution of services-oriented IT. Allows users, businesses & partners the ability to interact in new and different ways resulting in the growth (in some cases the revolution) of business.

What is the API economy?

- Cloud, mobile and social - business as-a-service economies
- Data has considerable value and can be monetized given an easy-to-consume API
- APIs standard building block for doing development
 - Mobile
 - Web
- Easy integration with other apps and services
- APIs provide consumability for 3rd Parties – broaden your reach





What is the API Economy



Creating value by offering APIs that others want



Using APIs to help your developers innovate freely



Supporting your mobile development team with APIs



What is the API Economy



Making APIs the
common
language in a
hybrid world



Linking devices to
data on the
Internet of Things
(IoT)



What is a Web Service ?

... a service?

**A repeatable
business task –**
e.g., check
customer credit;
open new account



Available on the Web



SOAP

vs

REST





Simple

Object



Access

Protocol



What is SOAP

- Exposes **operations** that implement logic
- Designed for distributed computing
- Standardized
- Aligns with Enterprise Application needs
 - Support multi transport
 - Enterprise security – WS.Security
 - Governance with strong typing
 - Broad Development tooling support
- XML Based message protocol
- Uses WSDL as a contract between consumer and provider



REpresntational

Sate

Tansfer



What is REST

- Architectural Style as described by Roy Fielding
- Resource focused
- Every request is via hyperlink ie http request
- Easily consumed by any client, especially web clients
- Light weight
 - Uses JSON vs XML
 - No required header for each message
- Resources are driven by HTTP Specification
 - GET, PUT, DELETE, POST



Why one vs the other ? Philosophical Difference

SOAP

- Enterprise Driven
- Contract based
- Robust Infrastructure
- More Security Options

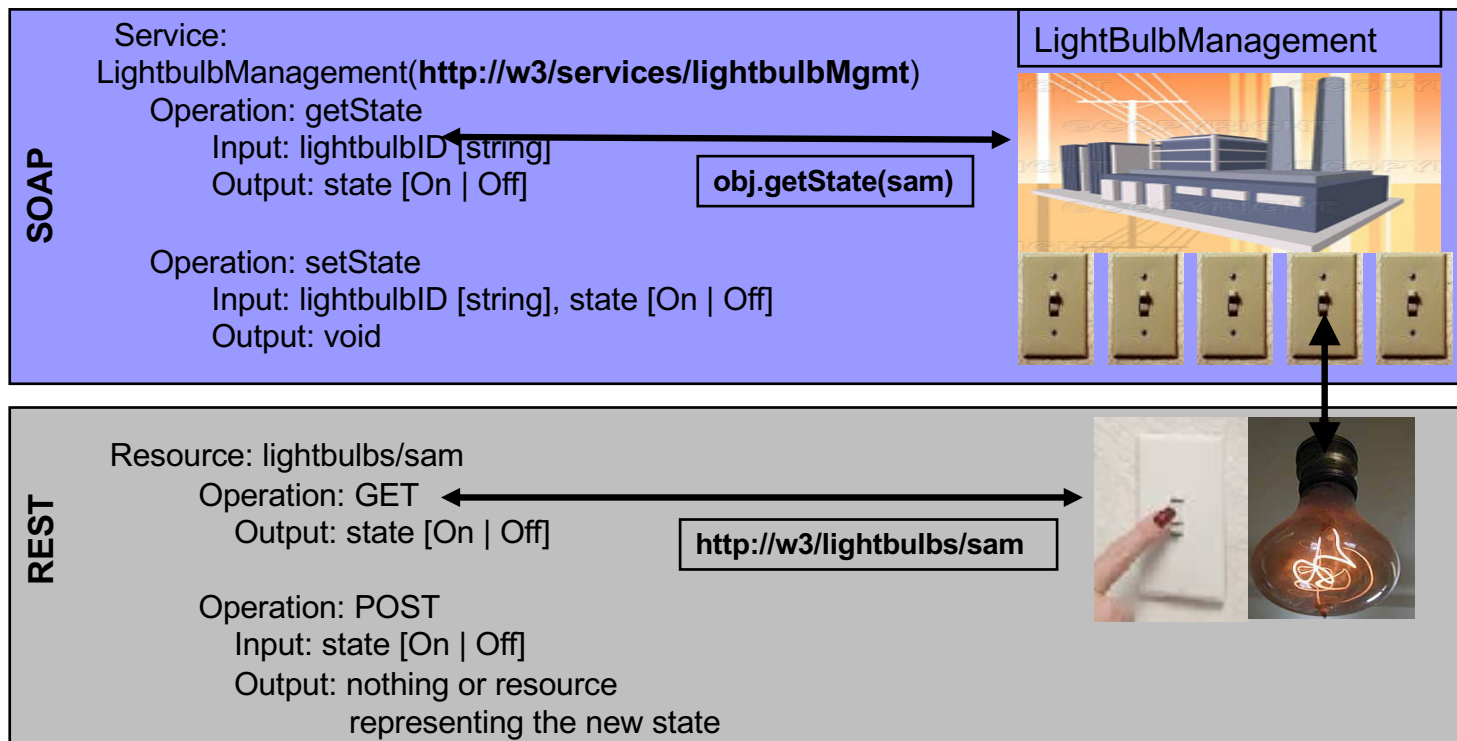


Rest

- Simplicity
- Small packet size
- HTTP focused
- Easy to call from JavaScript

SOAP vs. REST example

Is the light bulb currently on?



SOAP vs. REST example data flows

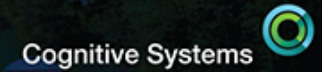
SOAP request

```
POST /services/LightBulbManager HTTP/1.1
Host: example.com
Content-Type: text/xml; charset=UTF-8
SOAPAction: "LightBulbManager#getState"
```

```
<?xml version='1.0' ?>
<env:Envelope xmlns:env="...">
<env:Body>
  <ns1:getState xmlns:ns1="...">
    <in0 xsi:type="xsd:string">SAM</in0>
  </ns1:add>
</SOAPenv:Body>
</env:Envelope>
```

REST request

```
GET http://w3/lightbulbs/SAM HTTP/1.1
Host: example.com
Accept: application/xml
```

Creating Web Services on IBM i

Tim Rowe - Business Architect for Application Development

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Using a REST API with Watson

Search flights

From → To:

DALLAS to BOSTON

09/07/2017



For example: Flight from houston to CHICAGO

<https://ibm-i-watson-test.mybluemix.net/>

What are the characteristics of a web service?

Web Service

- Encapsulated
 - Access through interface
- Reusable
 - Write once – use everywhere
- Stateless
 - Information not retained
- Event driven
 - No required order
- Loosely coupled
 - Callable from anywhere

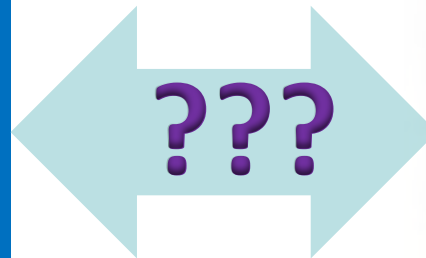
Traditional subroutine

- Global data
 - Access directly
- Reuse by copy
 - Maintain everywhere
- Stateful
 - Information retained in job
- Application driven
 - Fixed order
- Tightly coupled
 - Tied to application

Simple View

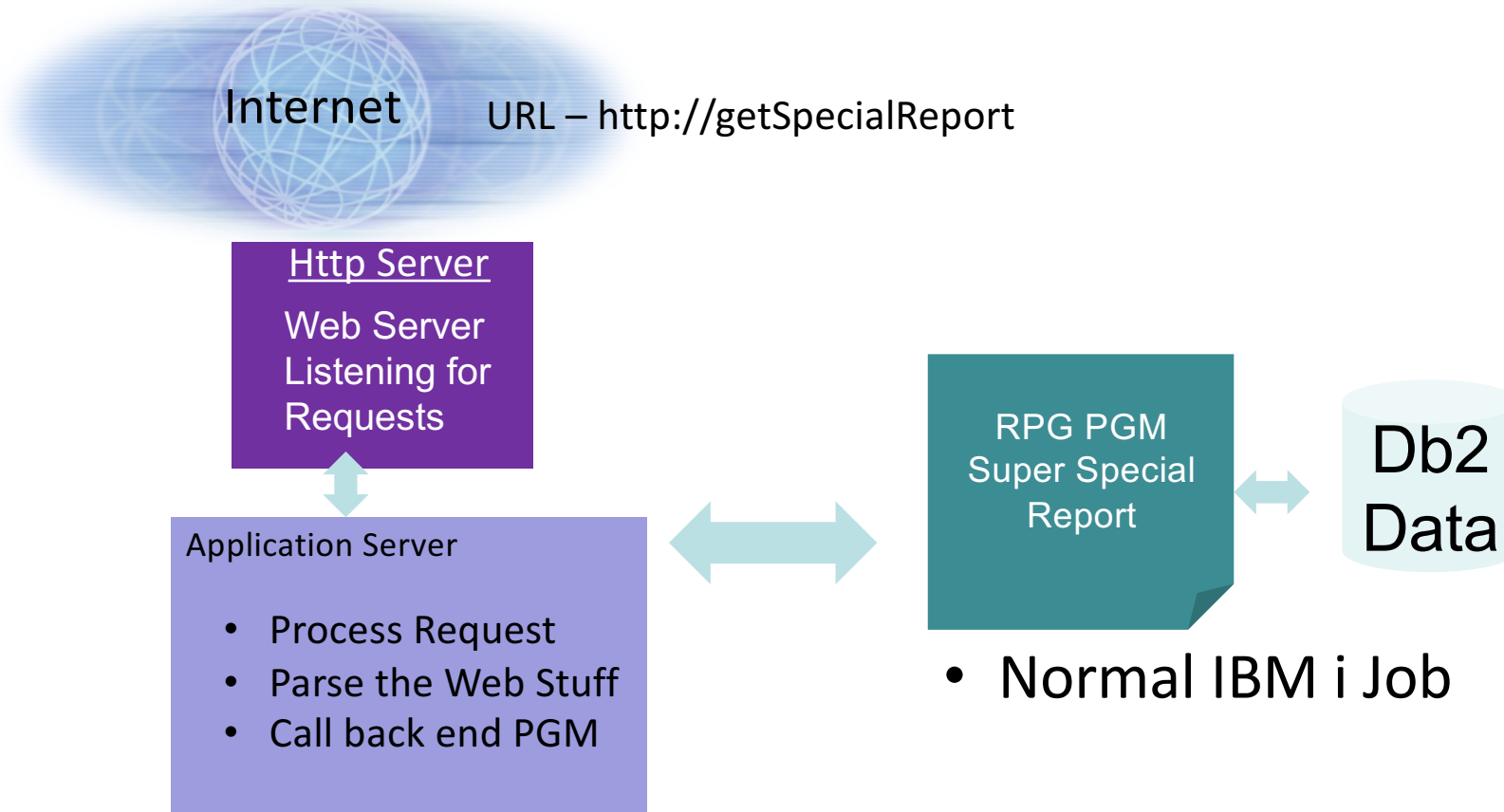
IBM i

RPG PGM
Super Special
Report



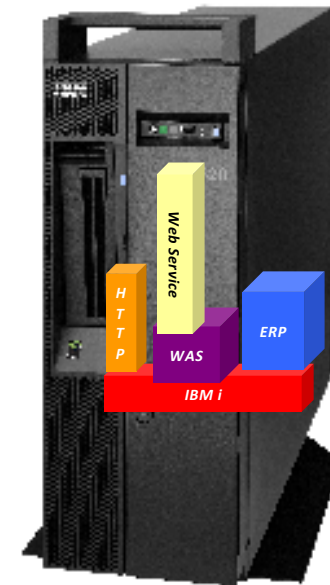
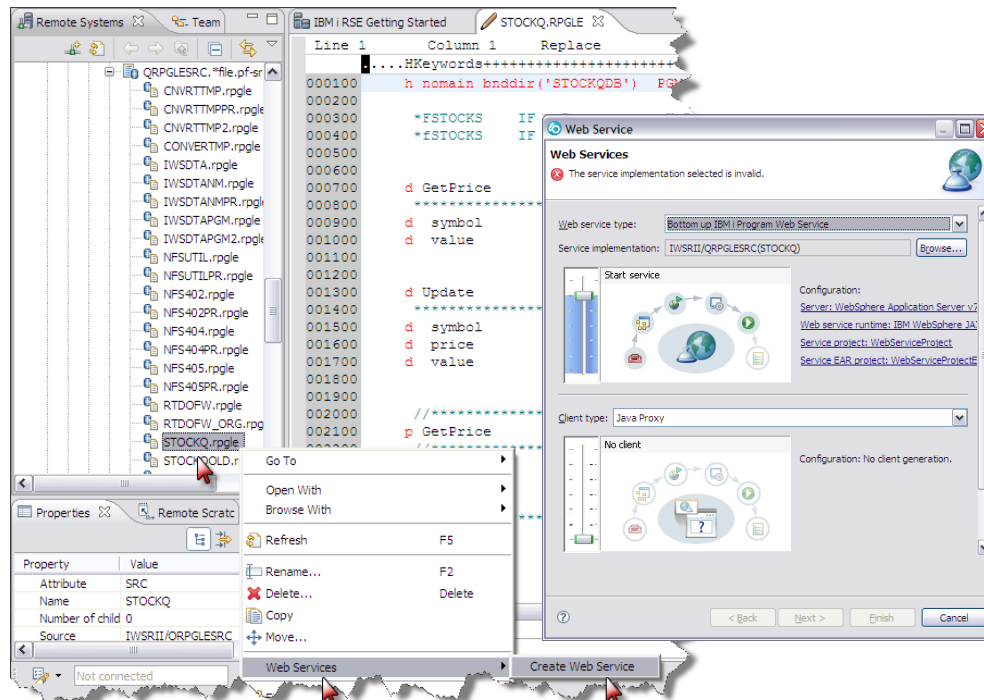
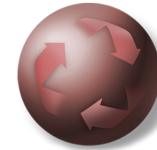
How do you connect your IBM i to the outside world ?

Logistics



Rational Developer for i

RDi & Modernization Tools: Web Services Wizard

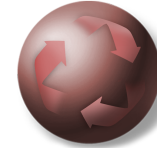


More Information:

<http://www-01.ibm.com/software/awdtools/developer/rdiso/>

Host Access Transformation Services

IBM Rational HATS Toolkit



1. Create a macro that steps through your application.

2. Create an Integration Object.

3. Create web service support files.

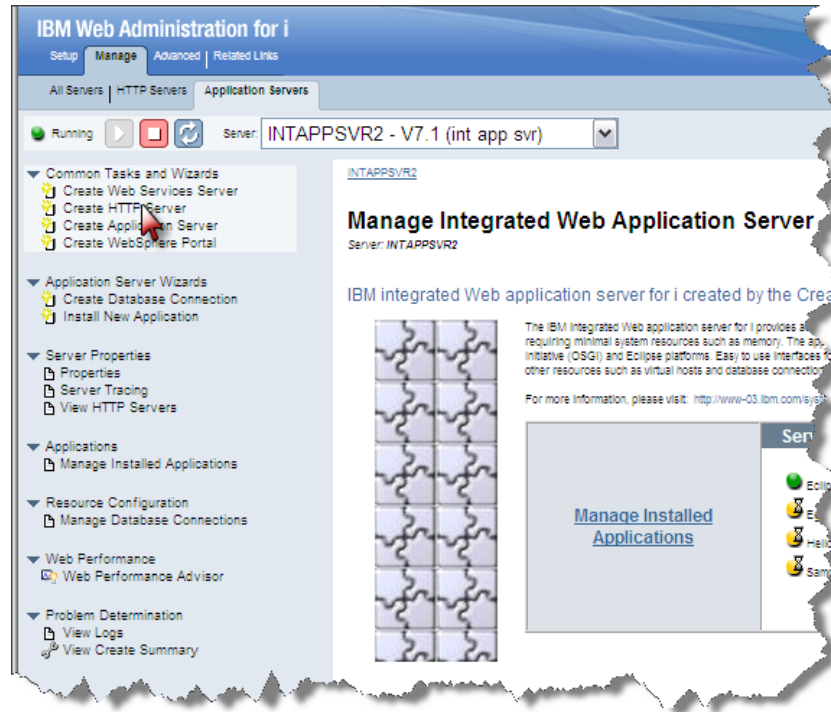
4. Create the web service and WSDL.

More Information:

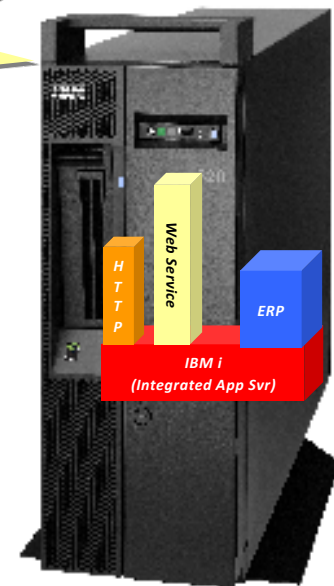
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IBM i Integrated Web Services Environment

IBM i: Integrated Web Services Server SOAP & REST



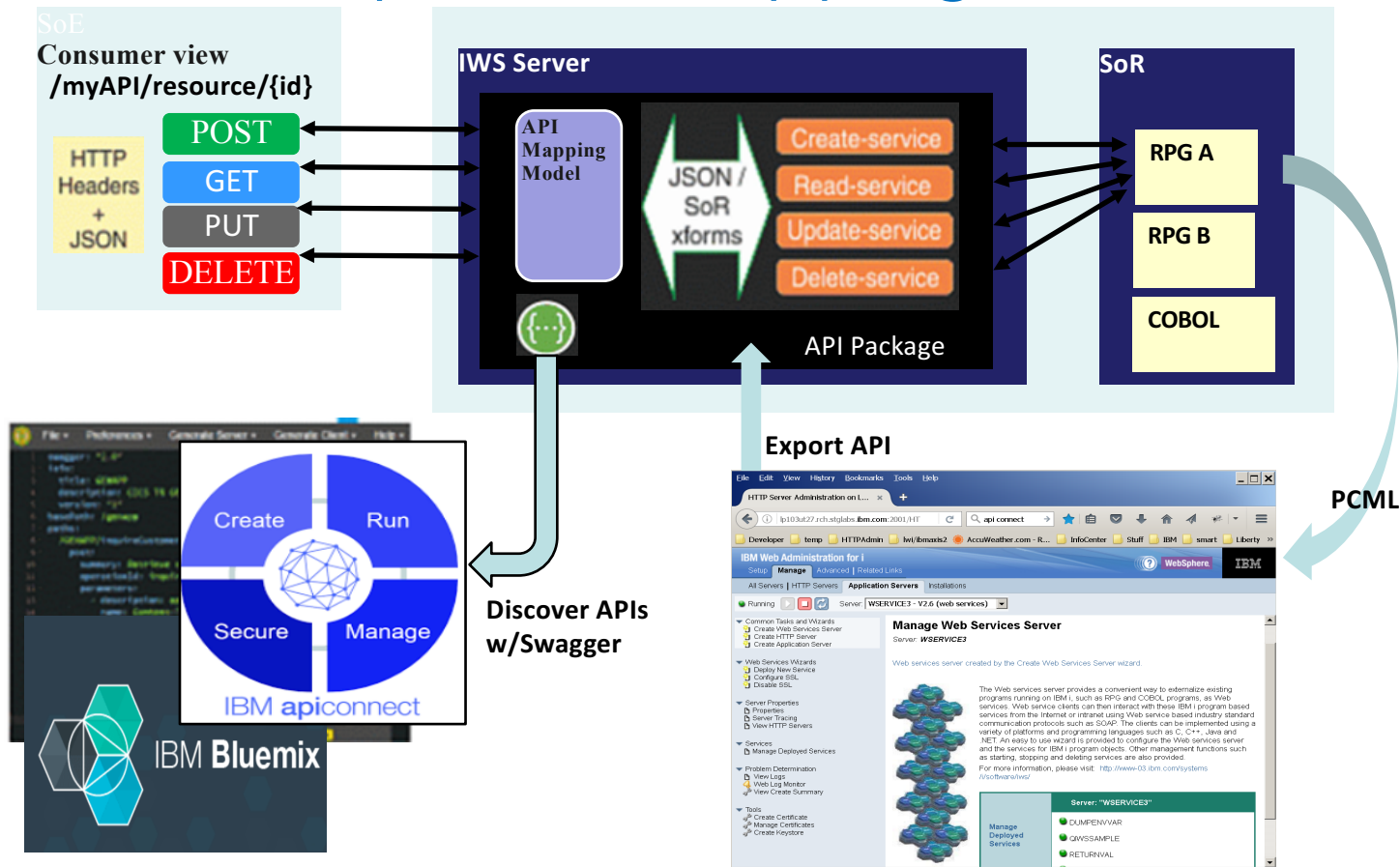
Included with
IBM i



About integrated web services

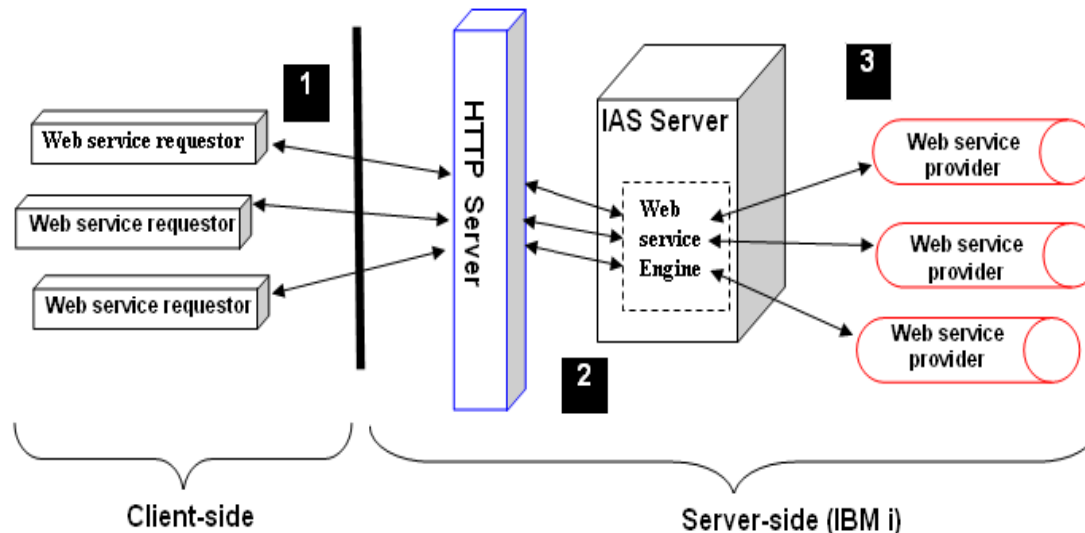
- Released December of 2007 on IBM i 5.4, 6.1, and 7.1
 - Installed as part of base operating system option 3
 - Always load latest HTTP Group PTF for latest fixes and enhancements
- Consists of two separate entities
 - Integrated web services client for ILE
 - Integrated web services server
- Latest information, including product prerequisites, can be found at <http://www.ibm.com/systems/i/software/iws/>
- Continues to be re-invented and enhanced on 7.2 & 7.3

IWS server API requests – mapping & transformation





Web service client/server flow does not change



- When a web services server is created, an associated HTTP server is also created
 - You can go straight to the web services server, but if you need SSL or basic authentication, you need to do it via the HTTP server
- The web service provider implementation code (i.e. RPG or COBOL programs or service programs) are run in separate jobs



What are all the parts...

- HTTP Apache Server
 - Connector to the IAS server
- IAS Server (Liberty)
 - JAX-RS (REST)
 - JAX-WS (SOAP)
 - Java program
 - Handles Inputs
 - Calls the backend ILE Program
 - Converts Output back to Web format



About integrated web services server REST support

- Supported in IBM i 7.1 and 7.2 and 7.3
 - On version 2.6 of integrated web services server
 - Server will handle both SOAP and REST services
- Uses JAX-RS
 - Java API for RESTful Web Services
- Two ways to deploy a REST service
 - IBM Web Administration GUI updated
 - Deploying a REST service will require more user input than when deploying a SOAP service
 - QShell script `installWebService.sh` updated to support REST



How to Get Started - Rest

- Identify the RPG / Cobol / Java pgm
- Figure out the HTTP methods
 - GET - read activities
 - POST - create entries
 - PUT - update an entry
 - DELETE – remove
- Determine the URI - Identifiers
 - Use Nouns vs Verbs
 - Keep it simple



Getting Started

Examples

Examples

- GET /defects: list all bugs.
- GET /defects/123: Retrieve bug 123.
- POST /defects/123: Create a new defect 123 with the POST request body.
- PUT /defects/123: Update defect 123 with the PUT request body.
- DELETE /defects/123: delete defect 123



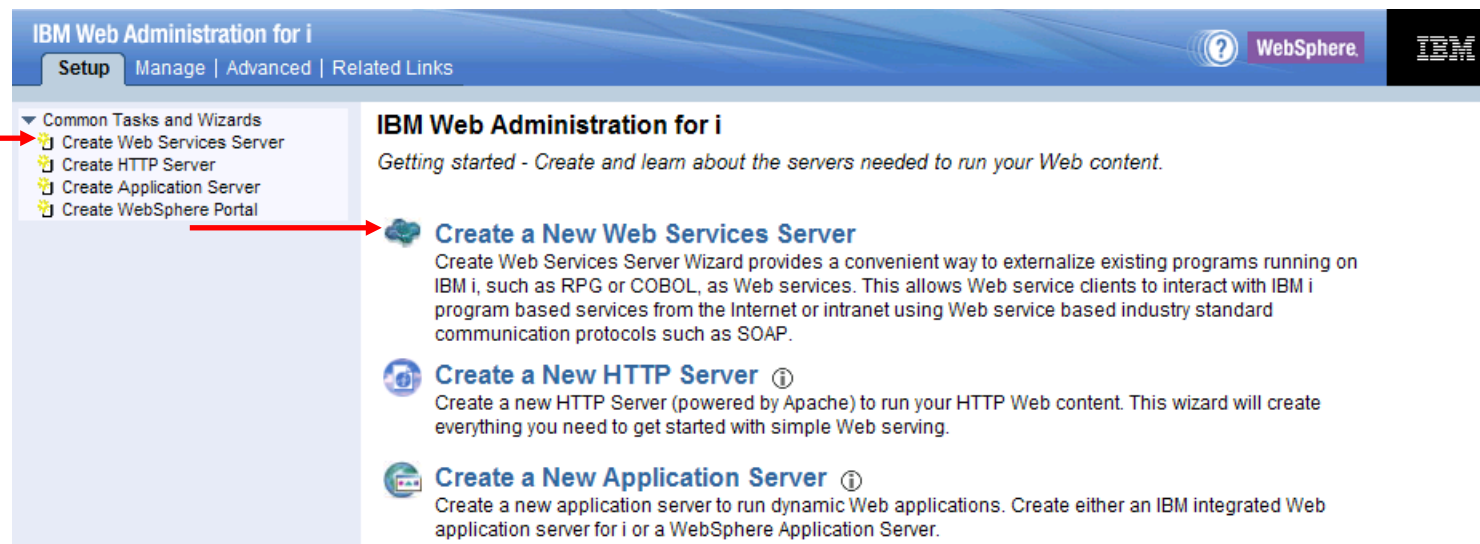
Getting Started

Planning

- Specify media types (e.g. XML, JSON, etc.) the procedure will accept
- Specify media types the procedure will return
- Optionally specify what values to inject in procedure input parameters
 - Path segment (e.g. `/accounts/{id}`)
 - Matrix parameters (e.g. `/cars;color=blue`)
 - Query parameters (e.g. `/cars?color=blue`)
 - Form data
 - HTTP headers
 - HTTP Cookies
- Optionally designate response code and HTTP header output parameters

Create web services server

Access Web Admin <http://hostname:2001/HTTPAdmin>



The screenshot shows the IBM Web Administration for i interface. The top navigation bar includes 'Setup', 'Manage', 'Advanced', and 'Related Links'. The left sidebar lists 'Common Tasks and Wizards' with sub-items: 'Create Web Services Server', 'Create HTTP Server', 'Create Application Server', and 'Create WebSphere Portal'. A red arrow points to the 'Create Web Services Server' link in the sidebar. The main content area is titled 'IBM Web Administration for i' and contains a 'Getting started' section with three links: 'Create a New Web Services Server', 'Create a New HTTP Server', and 'Create a New Application Server'. A red arrow points to the 'Create a New Web Services Server' link in the main content area.

IBM Web Administration for i

Setup | Manage | Advanced | Related Links

WebSphere. IBM

Common Tasks and Wizards

- Create Web Services Server
- Create HTTP Server
- Create Application Server
- Create WebSphere Portal

IBM Web Administration for i

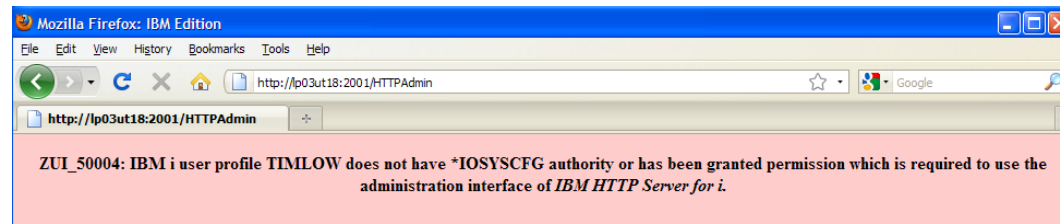
Getting started - Create and learn about the servers needed to run your Web content.

- Create a New Web Services Server**
Create Web Services Server Wizard provides a convenient way to externalize existing programs running on IBM i, such as RPG or COBOL, as Web services. This allows Web service clients to interact with IBM i program based services from the Internet or intranet using Web service based industry standard communication protocols such as SOAP.
- Create a New HTTP Server** ⓘ
Create a new HTTP Server (powered by Apache) to run your HTTP Web content. This wizard will create everything you need to get started with simple Web serving.
- Create a New Application Server** ⓘ
Create a new application server to run dynamic Web applications. Create either an IBM integrated Web application server for i or a WebSphere Application Server.

Click on the Create New Web Services Server link

Web Integration Permissions

In the past, any user wanting to use Web Admin they were required to have ***ALLOBJ** and ***IOSYSCFG** special authority!

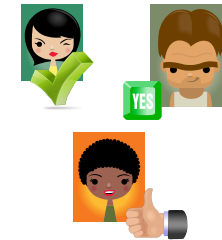


System Security policy just does not allow this!



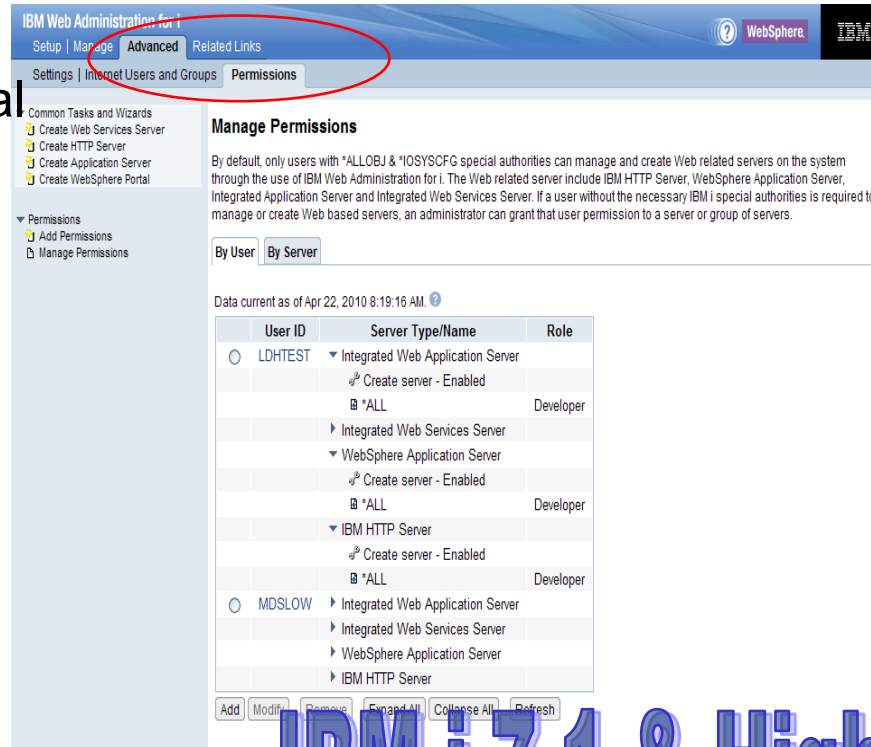
'Permissions' Support

- Now a ***USER** granted 'permission' can use the GUI
- Group profiles are now supported



Web Integration Permissions

- **Developers can use Web Admin**
 - No longer need *ALLOBJ special authority
 - Administrators can grant users 'Permission'
 - Empowering the User
 - Group Profile support
- **Two Permissions Available**
 - Operator – Start & Stop servers
 - Developer – All functions



IBM Web Administration for i
Setup | Manage | **Advanced** | Related Links

Settings | Internet Users and Groups | **Permissions**

Common Tasks and Wizards
 Create Web Services Server
 Create HTTP Server
 Create Application Server
 Create WebSphere Portal

Permissions
 Add Permissions
 Manage Permissions

Manage Permissions

By default, only users with *ALLOBJ & *IOSYSCFG special authorities can manage and create Web related servers on the system through the use of IBM Web Administration for i. The Web related server include IBM HTTP Server, WebSphere Application Server, Integrated Application Server and Integrated Web Services Server. If a user without the necessary IBM i special authorities is required to manage or create Web based servers, an administrator can grant that user permission to a server or group of servers.

By User | By Server

Data current as of Apr 22, 2010 8:19:16 AM.

User ID	Server Type/Name	Role
LDHTEST	Integrated Web Application Server	
	Create server - Enabled	
	*ALL	Developer
	Integrated Web Services Server	
	WebSphere Application Server	
	Create server - Enabled	
MDSL0W	*ALL	Developer
	IBM HTTP Server	
	Create server - Enabled	
	*ALL	Developer
	Integrated Web Application Server	
	Integrated Web Services Server	
	WebSphere Application Server	
	IBM HTTP Server	

Add | Modify | Remove | Expand All | Collapse All | Refresh

Integrated GUI interface now available to Developers and Operators without compromising your system security

IBM i 7.1 & Higher

How do you test things ?



Why SoapUI Blog

Download Getting Started

SoapUI users unite at SmartBear Connect! Learn more [→](#)

Build Better | Test Smarter

The Most Advanced REST & SOAP Testing Tool in the World

Download SoapUI NG Pro



Free Download

<https://www.soapui.org>

Create web services server (cont.)

Step 1: Specify server name.



The screenshot shows the IBM Web Administration for i console. The top navigation bar includes 'Setup', 'Manage', 'Advanced', and 'Related Links'. The left sidebar lists 'Common Tasks and Wizards' with options: 'Create Web Services Server', 'Create HTTP Server', 'Create Application Server', and 'Create WebSphere Portal'. The main content area is titled 'Create Web Services Server' and 'Specify Web services server name - Step 1 of 3'. It contains a welcome message and a form to specify the server name and description.

IBM Web Administration for i WebSphere 

Setup | Manage | Advanced | Related Links

▼ Common Tasks and Wizards

- 📁 Create Web Services Server
- 📁 Create HTTP Server
- 📁 Create Application Server
- 📁 Create WebSphere Portal

Create Web Services Server

Specify Web services server name - Step 1 of 3

Welcome to the Create Web Services Server wizard. A Web services server provides a convenient way to externalize existing programs running on IBM i, such as RPG and COBOL programs, as Web services. Web service clients can then interact with these IBM i program based services from the Internet or intranet via Web service based industry standard communication protocols such as SOAP. The clients can be implemented using a variety of platforms and programming languages such as C, C++, Java and .NET. This wizard creates everything needed to run Web services.

For more information, please visit: <http://www-03.ibm.com/systems/i/software/iws/>

Specify a unique name for this server 

Server name:

Server description:

Create web services server (cont.)

Step 2: User Profile for web container.

The screenshot shows the IBM Web Administration for i console. The top navigation bar includes 'Setup', 'Manage', 'Advanced', and 'Related Links'. The left sidebar lists 'Common Tasks and Wizards' with options: 'Create Web Services Server', 'Create HTTP Server', 'Create Application Server', and 'Create WebSphere Portal'. The main content area is titled 'Create Web Services Server' and 'Specify User ID for Server - Step 2 of 3'. It contains a paragraph explaining the need for an IBM i user ID and a section for 'Specify user ID for this server' with three radio button options: 'Use default user ID' (selected), 'Specify an existing user ID', and 'Create a new user ID'. A note specifies that the default user ID is QWSERVICE.

IBM Web Administration for i

Setup | Manage | Advanced | Related Links

WebSphere IBM

▼ Common Tasks and Wizards

- 📁 Create Web Services Server
- 📁 Create HTTP Server
- 📁 Create Application Server
- 📁 Create WebSphere Portal

Create Web Services Server

Specify User ID for Server - Step 2 of 3

The server requires an IBM i user ID to run the server's jobs. It is recommended that a special user ID is specified to run the server's jobs since this user ID is given authority to all of the server's objects, such as files and directories.

Specify user ID for this server: ?

- Use **default** user ID
- Specify an **existing** user ID
- Create a **new** user ID

Note: The default server user ID is QWSERVICE.

Create web services server (cont.)

Step 3: Create the server

The screenshot shows the IBM Web Administration for i console. The top navigation bar includes 'Setup', 'Manage', 'Advanced', and 'Related Links'. The left sidebar lists 'Common Tasks and Wizards' with options: 'Create Web Services Server', 'Create HTTP Server', 'Create Application Server', and 'Create WebSphere Portal'. The main content area is titled 'Create Web Services Server' and shows 'Summary - Step 3 of 3'. There are tabs for 'Servers' and 'Services'. The 'Web Services Server Information' section lists: Server name: WSERVICE3, Server description: Web services server created by the Create Web Services Server wizard, Internal port range: 10076 - 10085, Server root: /www/WSERVICE3, Server URL: http://p28ut24.rchland.ibm.com:10086, User ID for server: QWSERVICE, Context root: /web. The 'HTTP Server Information' section lists: HTTP server name: WSERVICE3, HTTP server description: Web services server created by the Create Web Services Server wizard, Port: 10086, Document root: /www/WSERVICE3/htdocs, Server root: /www/WSERVICE3, Server association: WSERVICE3.

IBM Web Administration for i

Setup Manage | Advanced | Related Links

WebSphere IBM

Common Tasks and Wizards

- Create Web Services Server
- Create HTTP Server
- Create Application Server
- Create WebSphere Portal

Create Web Services Server

Summary - Step 3 of 3

Servers Services

Web Services Server Information

Server name: WSERVICE3
Server description: Web services server created by the Create Web Services Server wizard.
Internal port range: 10076 - 10085
Server root: /www/WSERVICE3
Server URL: http://p28ut24.rchland.ibm.com:10086
User ID for server: QWSERVICE
Context root: /web

HTTP Server Information

HTTP server name: WSERVICE3
HTTP server description: Web services server created by the Create Web Services Server wizard.
Port: 10086
Document root: /www/WSERVICE3/htdocs
Server root: /www/WSERVICE3
Server association: WSERVICE3

Create web services server (cont.)

Once created, the server is started and deployed sample service started

The screenshot shows the IBM Web Administration for i console. The 'Manage' tab is active, and the 'Application Servers' section is selected. A server named 'WSERVICE3 - V1.5 (web services)' is shown as 'Running'. The left sidebar contains a navigation menu with categories like 'Common Tasks and Wizards', 'Web Services Wizards', 'Server Properties', 'Services', 'Web Performance', and 'Problem Determination'. The main content area displays 'Manage Web Services Server' for 'WSERVICE3', including a description of the server's purpose and a link to the 'ConvertTemp' service under 'Manage Deployed Services'.

Install web service

Select "Deploy New Service" to install a new web service



The screenshot shows the IBM Web Administration for i console. The left sidebar contains a tree view of navigation options. The 'Web Services Wizards' folder is expanded, and 'Deploy New Service' is highlighted with a blue circle. The main content area displays the 'Manage Web Services Server' page for 'WSERVICE3'. It includes a description of the server, a list of services, and a 'Manage Deployed Services' button.

IBM Web Administration for i

Setup **Manage** Advanced | Related Links

All Servers | HTTP Servers **Application Servers**

Running Server: WSERVICE3 - V1.5 (web services)

WSERVICE3

Manage Web Services Server

Server: **WSERVICE3**

Web services server created by the Create Web Services Server wizard.

The Web services server provides a convenient way to externalize existing programs running on IBM i, such as RPG and COBOL programs, as Web services. Web service clients can then interact with these IBM i program based services from the Internet or intranet using Web service based industry standard communication protocols such as SOAP. The clients can be implemented using a variety of platforms and programming languages such as C, C++, Java and .NET. An easy to use wizard is provided to configure the Web services server and the services for IBM i program objects. Other management functions such as starting, stopping and deleting services are also provided.

For more information, please visit: <http://www-03.ibm.com/systems/i/software/iws/>

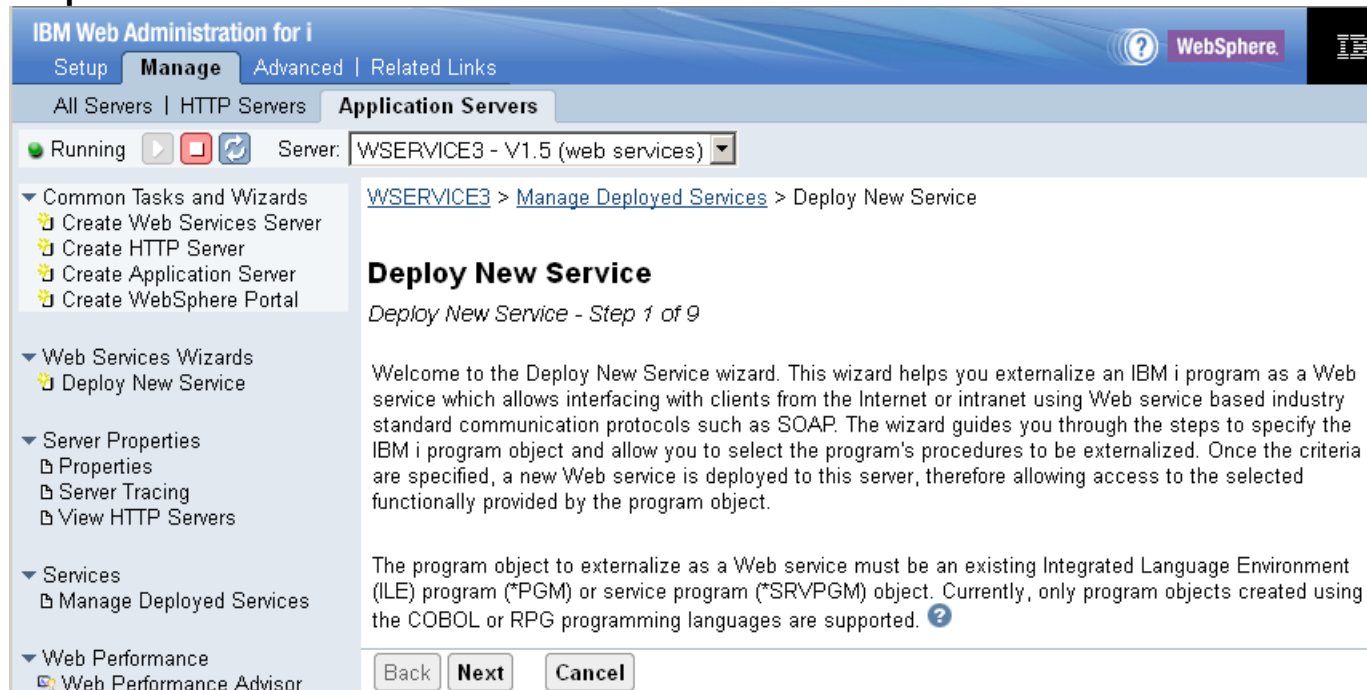
Manage Deployed Services

Server: "WSERVICE3"

- ConvertTemp

Install web service (cont.)

Step 1: Select Next to install a new web service



The screenshot shows the IBM Web Administration for i console. The top navigation bar includes 'Setup', 'Manage' (selected), 'Advanced', and 'Related Links'. The 'WebSphere' logo is visible on the right. Below the navigation bar, the 'Application Servers' tab is active, and the server 'WSERVICE3 - V1.5 (web services)' is selected. The left sidebar contains a tree view with categories: 'Common Tasks and Wizards', 'Web Services Wizards', 'Server Properties', 'Services', and 'Web Performance'. The 'Deploy New Service' option is highlighted under 'Web Services Wizards'. The main content area displays the 'Deploy New Service' wizard, which is 'Step 1 of 9'. The wizard text explains that it helps externalize an IBM i program as a Web service using protocols like SOAP. It also notes that only COBOL or RPG programming languages are supported. At the bottom of the wizard, there are 'Back', 'Next', and 'Cancel' buttons.

IBM Web Administration for i
Setup **Manage** Advanced | Related Links WebSphere

All Servers | HTTP Servers **Application Servers**

Running Server: WSERVICE3 - V1.5 (web services)

WSERVICE3 > Manage Deployed Services > Deploy New Service

Deploy New Service

Deploy New Service - Step 1 of 9

Welcome to the Deploy New Service wizard. This wizard helps you externalize an IBM i program as a Web service which allows interfacing with clients from the Internet or intranet using Web service based industry standard communication protocols such as SOAP. The wizard guides you through the steps to specify the IBM i program object and allow you to select the program's procedures to be externalized. Once the criteria are specified, a new Web service is deployed to this server, therefore allowing access to the selected functionally provided by the program object.

The program object to externalize as a Web service must be an existing Integrated Language Environment (ILE) program (*PGM) or service program (*SRVPGM) object. Currently, only program objects created using the COBOL or RPG programming languages are supported. ?

Back **Next** Cancel

Install web service (cont.)

Step 2: What program or service program contains the web service?

IBM Web Administration for i
Setup **Manage** Advanced | Related Links

All Servers | HTTP Servers **Application Servers**

Running Server: WSERVICE3 - V1.5 (web services)

Common Tasks and Wizards
Create Web Services Server
Create HTTP Server
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Web Performance Advisor

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View Logs
Web Log Monitor

WSERVICE3 > Manage Deployed Services > Deploy New Service

Deploy New Service

Deploy New Service: Specify Location of IBM i Program Object - Step 2 of 9

The IBM i object to be externalized as a Web service must be an existing ILE program (*PGM) or service program (*SRVPGM) located on the system. Currently, only program objects written using the COBOL or RPG programming languages are supported.

Specify the library and program object for the Web service.

Specify IBM i library and ILE program object name **(Recommended)**

You can specify the program object location by entering the name of the library that contains the program object, as well as the name of the program object. This is the fastest and recommended way to locate the program object.

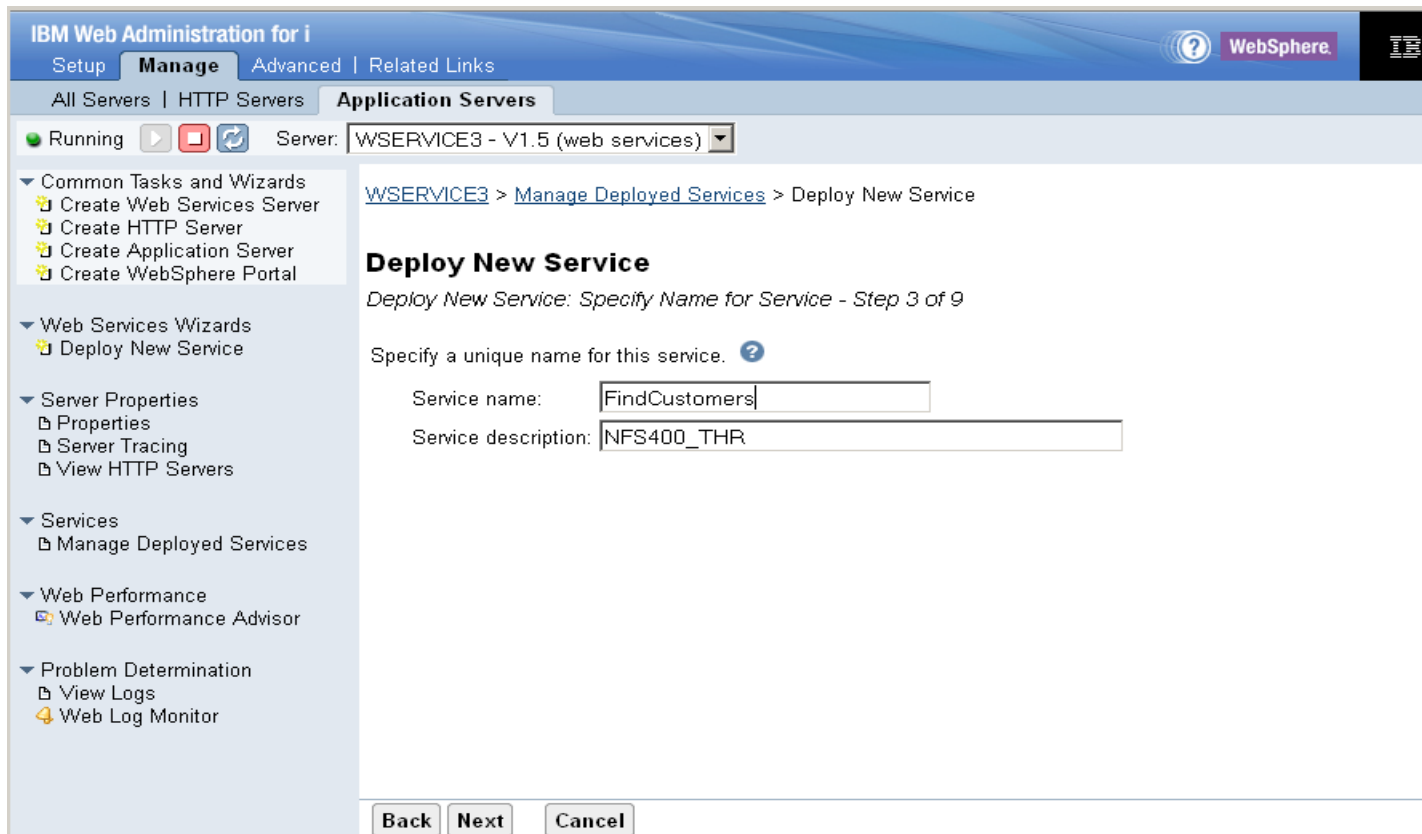
Library name: IWSRIL
ILE Object name: NFS400_THR
ILE Object type: *SRVPGM *PGM

Browse the integrated file system for the IBM i program object

Back **Next** **Cancel**

Install web service (cont.)




Step 3: What should we call this new web service?



IBM Web Administration for i

Setup **Manage** Advanced | Related Links

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Running    Server: WSERVICE3 - V1.5 (web services)

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WSERVICE3 > Manage Deployed Services > Deploy New Service

Deploy New Service

Deploy New Service: Specify Name for Service - Step 3 of 9

Specify a unique name for this service. 

Service name:

Service description:

Back **Next** **Cancel**

Install web service (cont.)

Step 4: What procedures should be externalized as web service operations?

IBM Web Administration for i
 Setup **Manage** Advanced | Related Links
 All Servers | HTTP Servers **Application Servers**
 Running Server: WSERVICE3 - V1.5 (web services)

Common Tasks and Wizards
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Export procedures:

Select	Procedure name/Parameter name	Usage	Data type	Count
<input type="checkbox"/>	▶ GETCITYNAME			
<input type="checkbox"/>	▶ FINDTOCITIES			
<input type="checkbox"/>	▶ FINDFROMCITIES			
<input type="checkbox"/>	▶ GETFLIGHTINFO			
<input type="checkbox"/>	▶ FINDFLIGHTS			
<input type="checkbox"/>	▶ FINDFLIGHTSDOW			
<input type="checkbox"/>	▶ GETCUSTNAME			
<input type="checkbox"/>	▶ GETCUSTNUMBER			
<input checked="" type="checkbox"/>	▼ FINDCUSTOMERS			
	<input type="checkbox"/> POSITION	input	char	
	<input type="checkbox"/> LISTTYPE	input	char	
	<input type="checkbox"/> COUNTREQ	input	int	
	<input type="checkbox"/> COUNTRET	output	int	
	<input type="checkbox"/> CUSTLIST	output	struct	

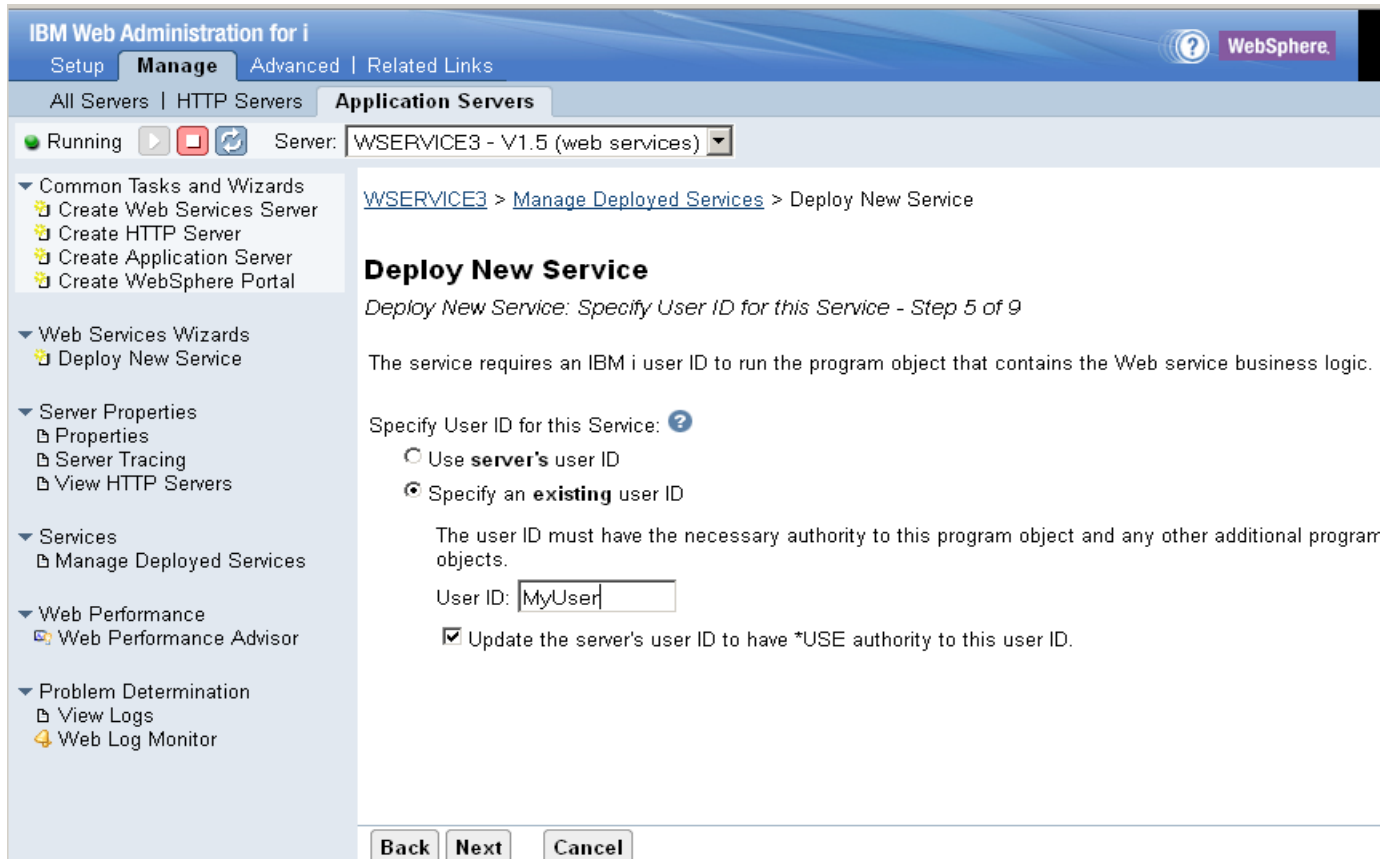
Select All Deselect All Expand All Collapse All

Back Next Cancel

Count dropdown menu:
 COUNTRET
 100
 COUNTREQ
 COUNTRET

Install web service (cont.)



Step 5: Specify user profile for the web service



IBM Web Administration for i

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WSERVICE3 > Manage Deployed Services > Deploy New Service

Deploy New Service

Deploy New Service: Specify User ID for this Service - Step 5 of 9

The service requires an IBM i user ID to run the program object that contains the Web service business logic.

Specify User ID for this Service: 

Use **server's** user ID

Specify an **existing** user ID

The user ID must have the necessary authority to this program object and any other additional program objects.

User ID:

Update the server's user ID to have *USE authority to this user ID.

Back **Next** **Cancel**

Install web service (cont.)


Step 6: Specify library list for the web service




IBM Web Administration for i
Setup **Manage** Advanced | Related Links WebSphere IBM

All Servers | HTTP Servers **Application Servers**

Running   Server: WSERVICE3 - V1.5 (web services) ▼


▼ Common Tasks and Wizards
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WSERVICE3 > [Manage Deployed Services](#) > Deploy New Service

Deploy New Service

Deploy New Service: Specify Library List - Step 6 of 9

The functionality of the IBM i program you want to externalize as a Web service may depend upon other IBM i programs in the system. Specify all libraries in which programs exist that the Web service programs depend on. If no library is specified, a default library list is used.

Specify library list position for this Web service:

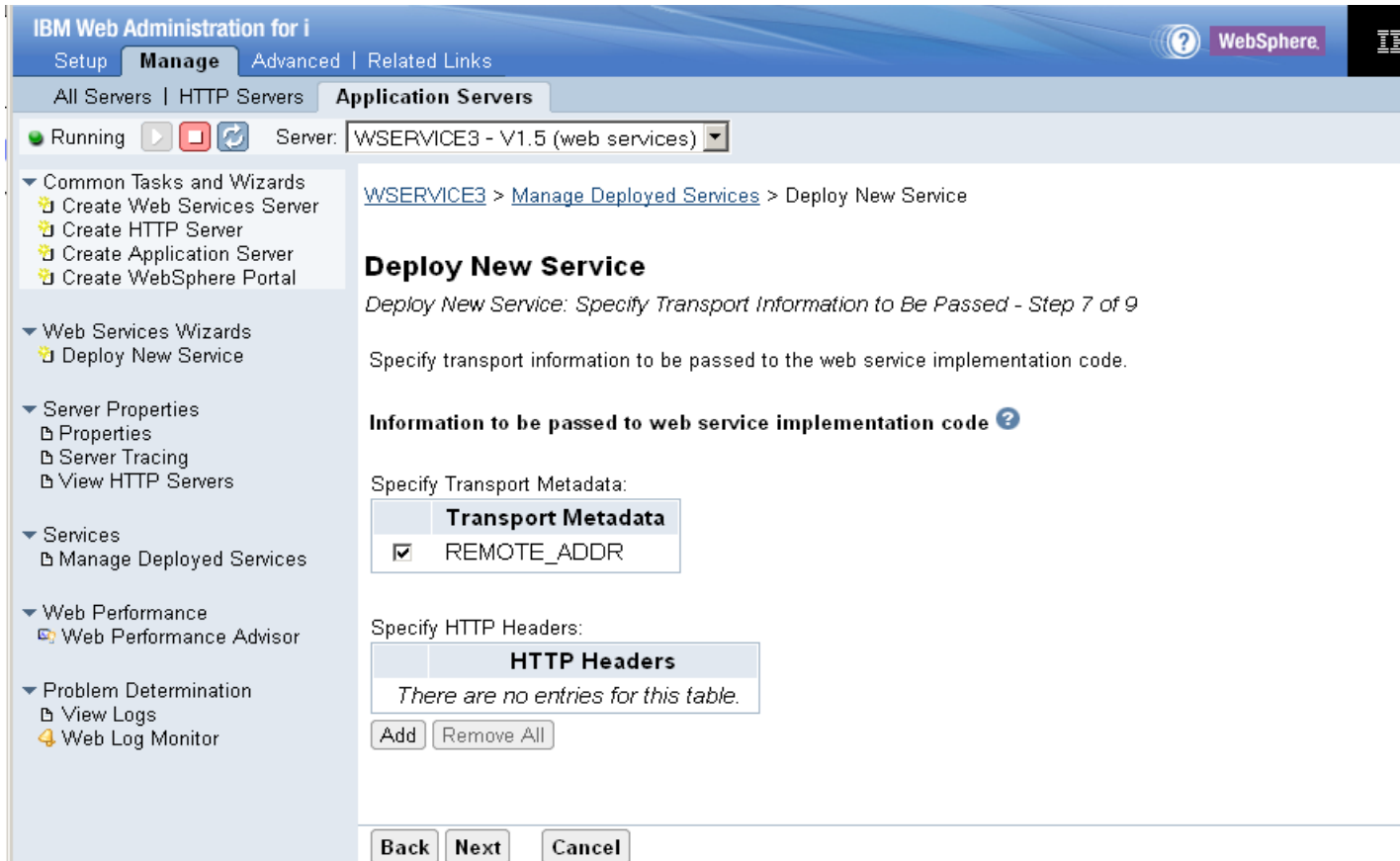
- Insert libraries in front of user library portion of the library list
- Insert libraries at the end of user library portion of the library list

Library list entries: 

Library name	
<input type="radio"/>	IWSR11
<input checked="" type="radio"/>	flight400

Install web service (cont.)



Step 7: Specify what request information should be passed to web service



IBM Web Administration for i

Setup **Manage** Advanced | Related Links

All Servers | HTTP Servers **Application Servers**


Running   Server: WSERVICE3 - V1.5 (web services)

WSERVICE3 > [Manage Deployed Services](#) > Deploy New Service

Deploy New Service

Deploy New Service: Specify Transport Information to Be Passed - Step 7 of 9

Specify transport information to be passed to the web service implementation code.

Information to be passed to web service implementation code 

Specify Transport Metadata:

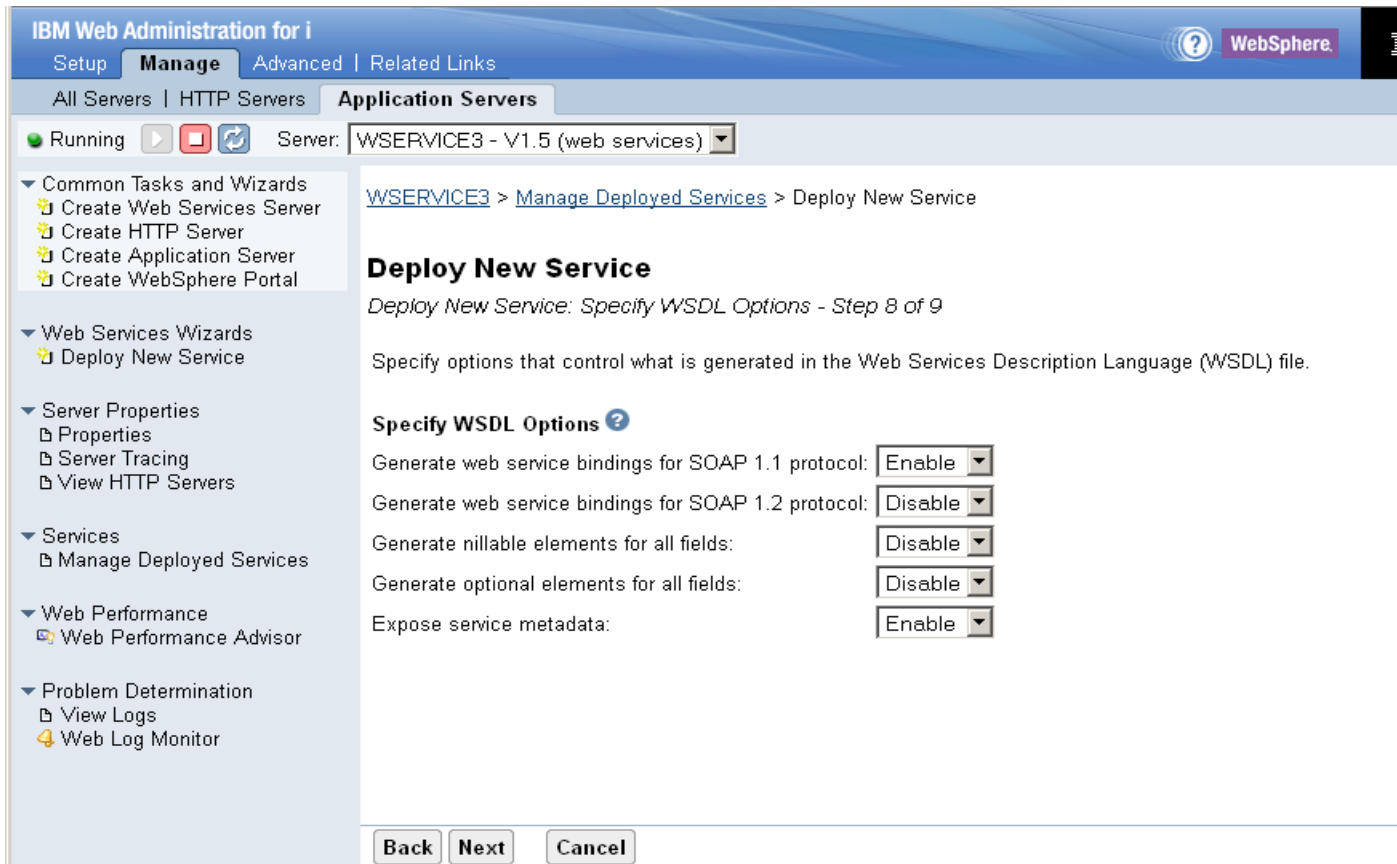
Transport Metadata	
<input checked="" type="checkbox"/>	REMOTE_ADDR

Specify HTTP Headers:

HTTP Headers	
There are no entries for this table.	

Install web service (cont.)




Step 8: Specify WSDL options for web service



IBM Web Administration for i

Setup **Manage** Advanced | Related Links

All Servers | HTTP Servers **Application Servers**

Running    Server: WSERVICE3 - V1.5 (web services) ▼

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▼ Server Properties

- ▢ Properties
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- ▶ Web Performance Advisor

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- ▶ Web Log Monitor

WSERVICE3 > Manage Deployed Services > Deploy New Service

Deploy New Service

Deploy New Service: Specify WSDL Options - Step 8 of 9

Specify options that control what is generated in the Web Services Description Language (WSDL) file.

Specify WSDL Options ?

Generate web service bindings for SOAP 1.1 protocol: ▼

Generate web service bindings for SOAP 1.2 protocol: ▼

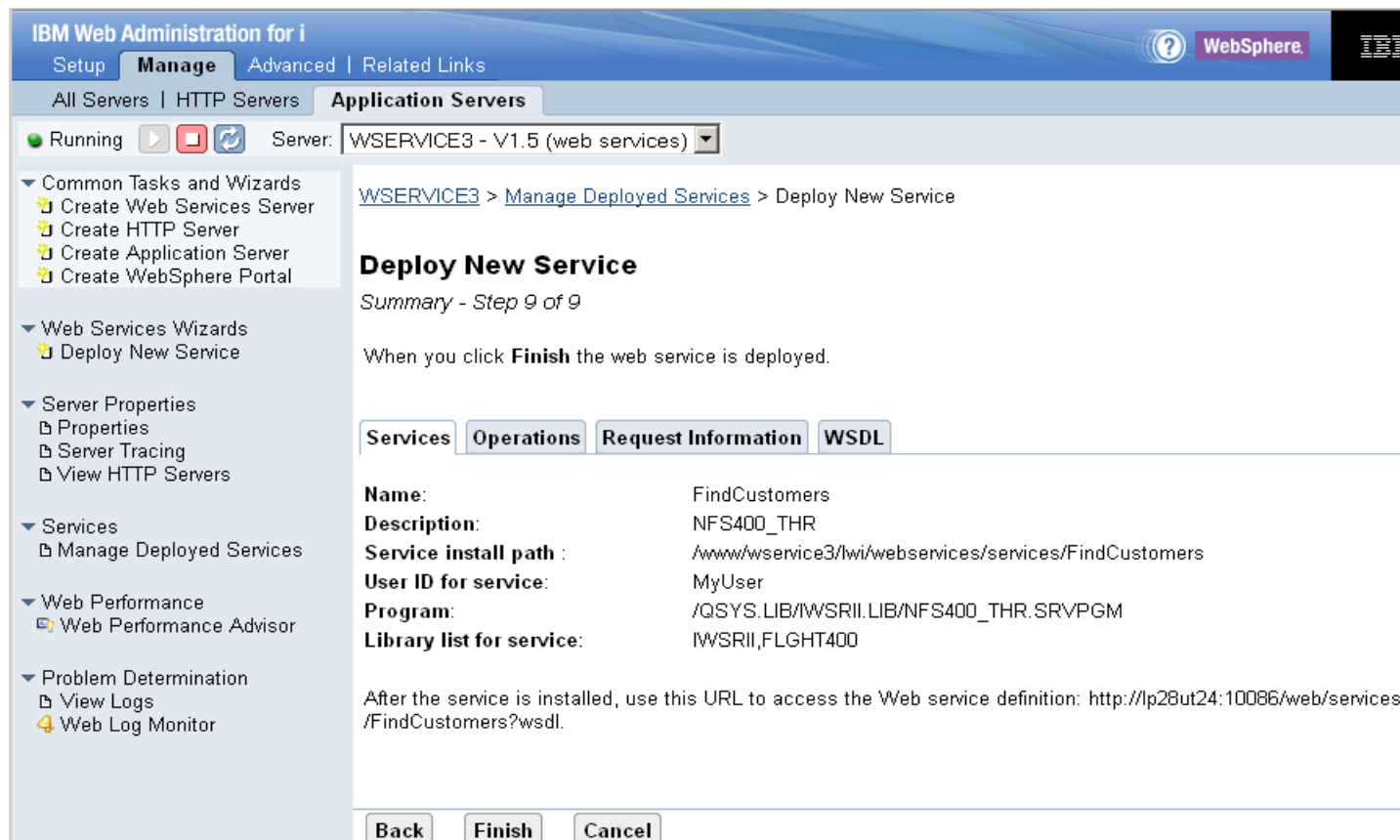
Generate nillable elements for all fields: ▼

Generate optional elements for all fields: ▼

Expose service metadata: ▼

Install web service (cont.)




Step 9: Ready to deploy the new web service – Services tab



IBM Web Administration for i

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WSERVICE3 > Manage Deployed Services > Deploy New Service

Deploy New Service

Summary - Step 9 of 9

When you click **Finish** the web service is deployed.

Services **Operations** **Request Information** **WSDL**

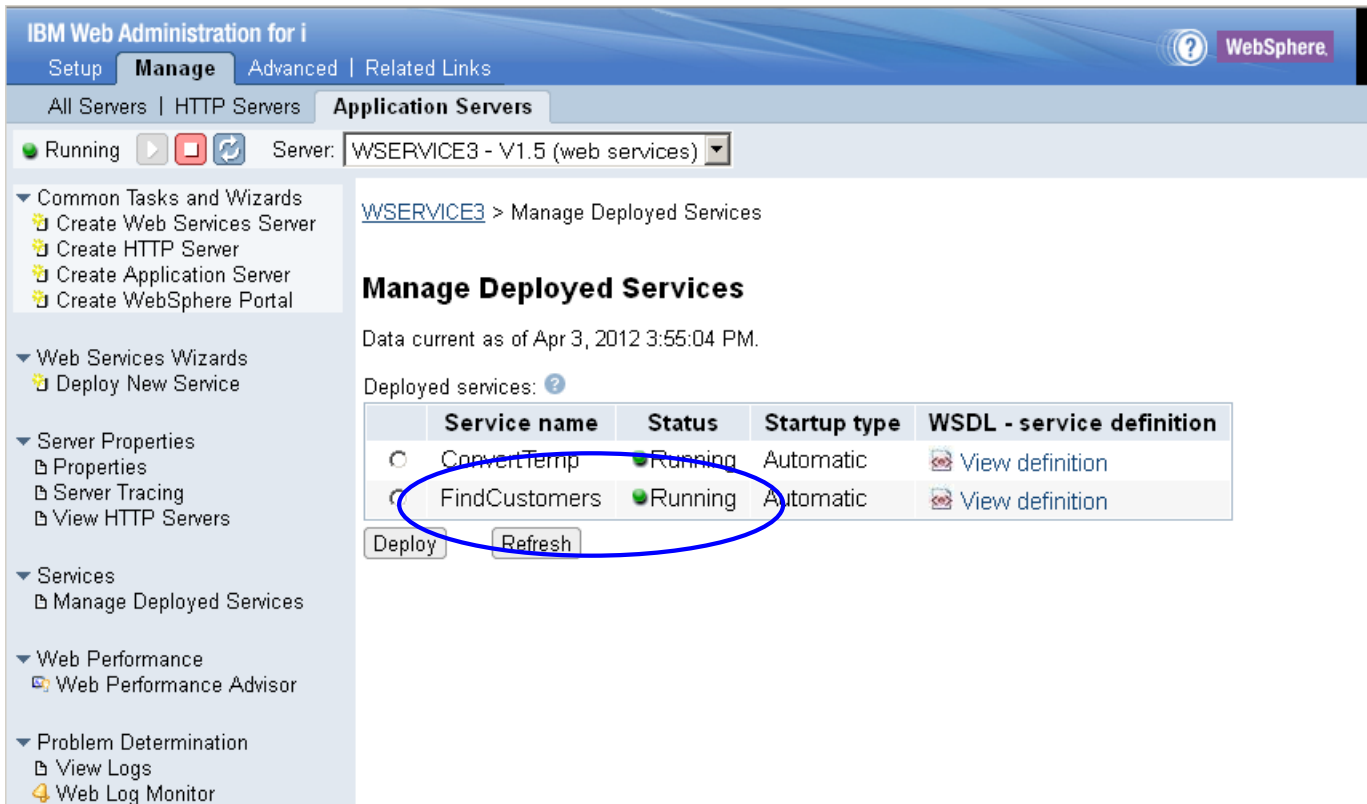
Name:	FindCustomers
Description:	NFS400_THR
Service install path :	/www/wservice3/!wi/webservices/services/FindCustomers
User ID for service:	MyUser
Program:	/QSYS.LIB/WSRII.LIB/NFS400_THR.SRVPGM
Library list for service:	IWSRII,FLGHT400

After the service is installed, use this URL to access the Web service definition: <http://lp28ut24:10086/web/services/FindCustomers?wsdl>.

Back **Finish** **Cancel**

Install web service (cont.)



After a few seconds, service is installed and started



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- View Logs
- Web Log Monitor

WSERVICE3 > Manage Deployed Services

Manage Deployed Services

Data current as of Apr 3, 2012 3:55:04 PM.

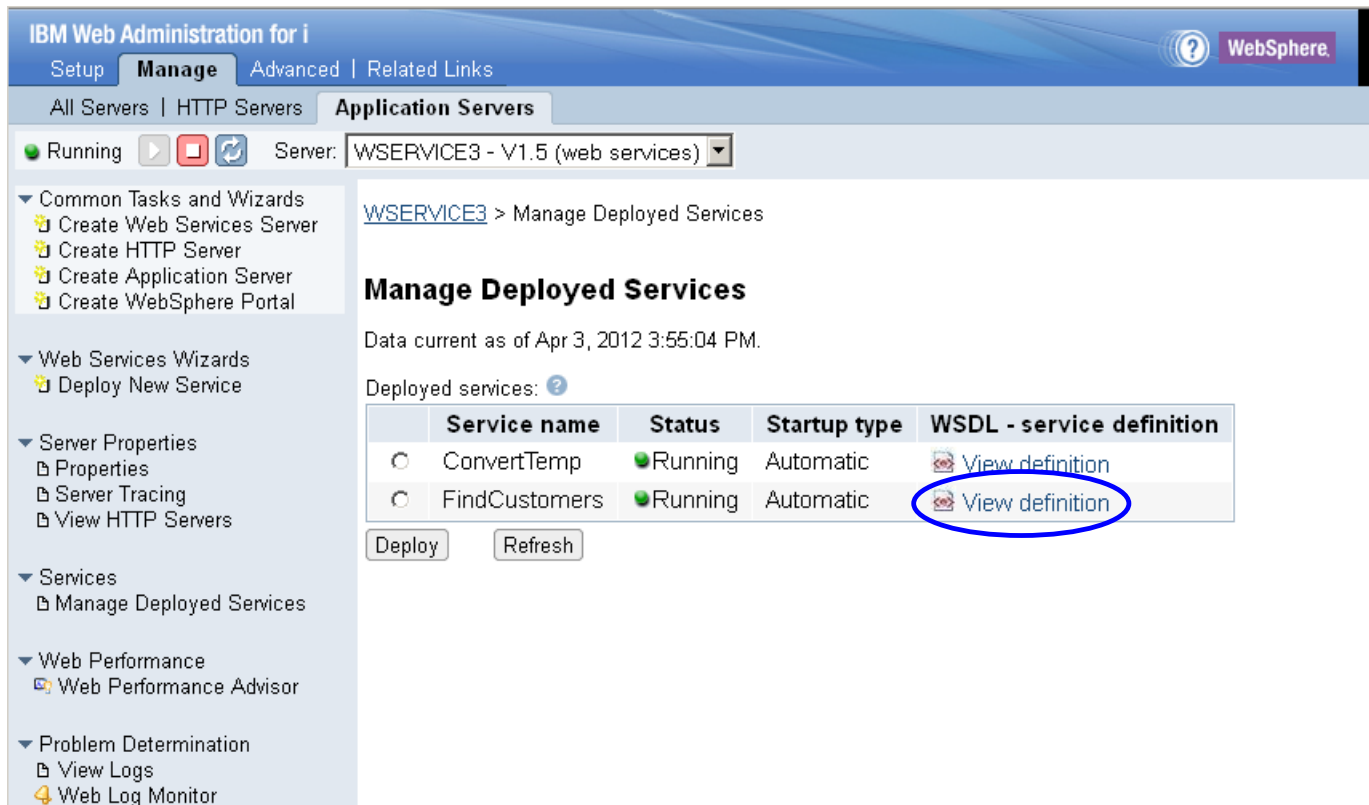
Deployed services: ?

	Service name	Status	Startup type	WSDL - service definition
<input type="radio"/>	ConvertTemp	 Running	Automatic	 View definition
<input type="radio"/>	FindCustomers	 Running	Automatic	 View definition

Deploy Refresh

Manage the web service



You can view WSDL as long as server is active



IBM Web Administration for i


Setup **Manage** Advanced | Related Links





All Servers | HTTP Servers **Application Servers**

Running   Server: WSERVICE3 - V1.5 (web services)

Manage Deployed Services

Data current as of Apr 3, 2012 3:55:04 PM.

Deployed services: 

	Service name	Status	Startup type	WSDL - service definition
<input type="radio"/>	ConvertTemp	 Running	Automatic	 View definition
<input type="radio"/>	FindCustomers	 Running	Automatic	 View definition

Left sidebar menu:

- Common Tasks and Wizards
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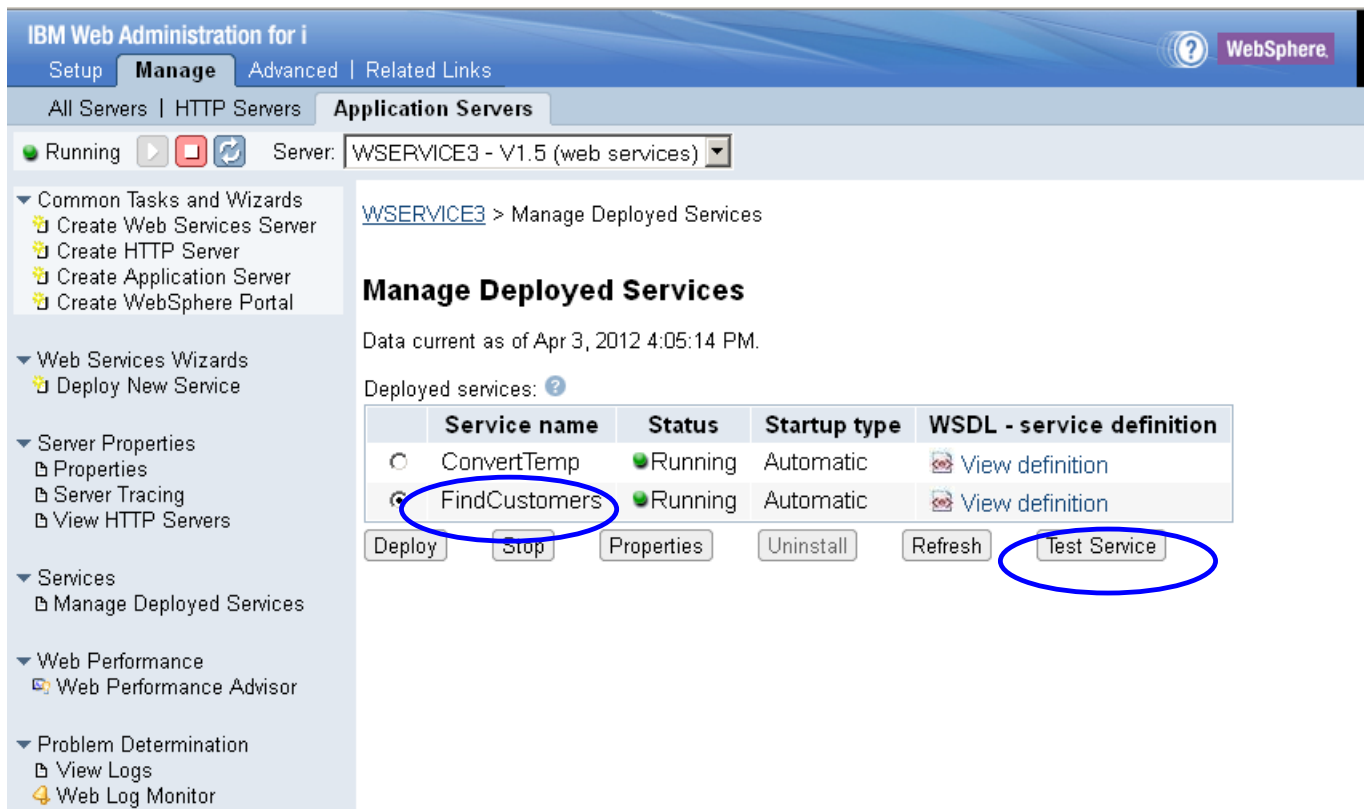
Manage the web service (cont.)

View the WSDL file (partial listing below)

```
<?xml version="1.0" encoding="UTF-8"?>
<wsdl:definitions xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/"
  xmlns:wsaw="http://www.w3.org/2006/05/addressing/wsdl" xmlns:mime="http://schemas.xmlsoap.org/wsdl/mime/"
  xmlns:ns="http://findcustomers.wsbeans.iseries/xsd" xmlns:http="http://schemas.xmlsoap.org/wsdl/http/"
  xmlns:tns="http://findcustomers.wsbeans.iseries" xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/" xmlns:ns1="http://org.apache.axis2/xsd"
  xmlns:soap12="http://schemas.xmlsoap.org/wsdl/soap12/" targetNamespace="http://findcustomers.wsbeans.iseries">
  <wsdl:documentation>FindCustomers</wsdl:documentation>
  <wsdl:types>
    <xs:schema attributeFormDefault="qualified" elementFormDefault="qualified"
      targetNamespace="http://findcustomers.wsbeans.iseries/xsd">
      <xs:element name="findcustomers_XML">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="args0" type="ns:FINDCUSTOMERSInput"/>
          </xs:sequence>
        </xs:complexType>
      </xs:element>
      <xs:complexType name="FINDCUSTOMERSInput">
        <xs:sequence>
          <xs:element name="COUNTREQ" type="xs:int"/>
          <xs:element name="LISTTYPE" type="xs:string"/>
          <xs:element name="POSITION" type="xs:string"/>
        </xs:sequence>
      </xs:complexType>
      <xs:element name="findcustomers_XMLResponse">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="return" type="xs:string"/>
          </xs:sequence>
        </xs:complexType>
      </xs:element>
      <xs:element name="findcustomers">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="args0" type="ns:FINDCUSTOMERSInput"/>
            .....
```

Manage the web service (cont.)




You can test the web service (but not over SSL and only for SOAP 1.1)



IBM Web Administration for i

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- View Logs
- Web Log Monitor

WSERVICE3 > Manage Deployed Services

Manage Deployed Services

Data current as of Apr 3, 2012 4:05:14 PM.

Deployed services: ?

	Service name	Status	Startup type	WSDL - service definition
<input type="radio"/>	ConvertTemp	Running	Automatic	 View definition
<input checked="" type="radio"/>	FindCustomers	Running	Automatic	 View definition

Deploy Stop Properties Uninstall Refresh **Test Service**

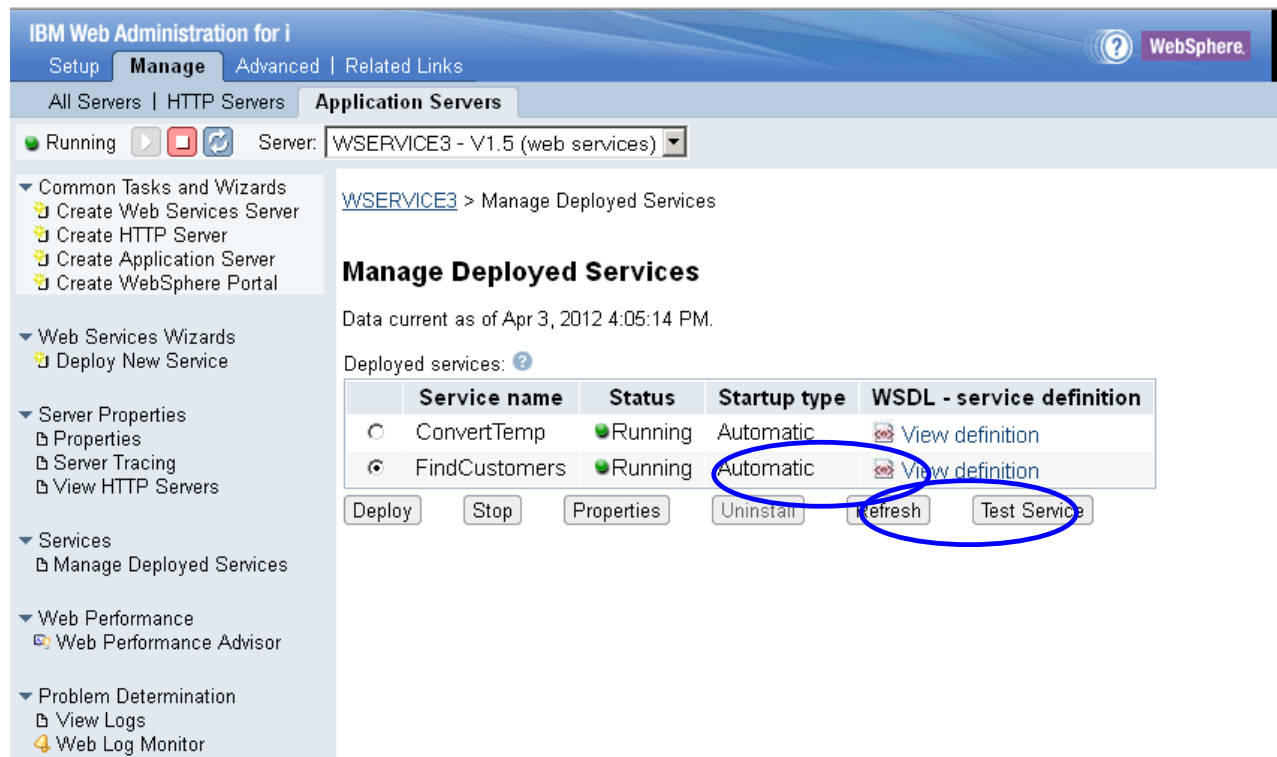
Manage the web service (cont.)

The screenshot displays the **i5/OS Web Services Test Client** interface. On the left, the **Navigator** pane shows a tree view of the WSDL structure:

- WSDL Main
 - http://lp28ut24:10086/web/services/F
 - FindCustomers
 - FindCustomersSoap11Binding
 - findcustomers
 - findcustomers_XML

Manage the web service (cont.)



You can view and modify web service properties



IBM Web Administration for i

Setup **Manage** Advanced | Related Links WebSphere

All Servers | HTTP Servers **Application Servers**

Running   Server: WSERVICE3 - V1.5 (web services)

Common Tasks and Wizards

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Problem Determination



- View Logs
- Web Log Monitor

WSERVICE3 > Manage Deployed Services

Manage Deployed Services

Data current as of Apr 3, 2012 4:05:14 PM.

Deployed services: 

	Service name	Status	Startup type	WSDL - service definition
<input type="radio"/>	ConvertTemp	Running	Automatic	 View definition
<input checked="" type="radio"/>	FindCustomers	Running	Automatic	 View definition

Deploy Stop Properties Uninstall **Refresh** Test Service

Manage the web service (cont.)

Web service properties – General tab

The screenshot shows the IBM Web Administration for i console. The top navigation bar includes 'Setup', 'Manage', 'Advanced', and 'Related Links'. The 'Manage' tab is active. Below the navigation, there are tabs for 'All Servers', 'HTTP Servers', and 'Application Servers'. The 'Application Servers' tab is selected, and the server 'WSERVICE3 - V1.5 (web services)' is chosen. The left sidebar contains a tree view with categories like 'Common Tasks and Wizards', 'Web Services Wizards', 'Server Properties', 'Services', 'Web Performance', and 'Problem Determination'. The main content area shows the 'Service Properties' for 'FindCustomers' under the 'General' tab. The service information is as follows:

Service information	
Name:	FindCustomers
Description:	NFS400_THR
Startup type:	Automatic
Service install path:	/www/WSERVICE3/webservices/services/FindCustomers
Program:	/QSYS.LIB/WSRILIB/NFS400_THR.SRVPGM
Web service definition URL:	http://lp28ut24:10086/web/services/FindCustomers?wsdl
WSDL target namespace URI:	http://findcustomers.wsbeans.iseries
User ID for this service:	MYUSER
<input checked="" type="checkbox"/> Update the server's user ID to have *USE authority to this user ID.	

About integrated web services server REST support

- Supported in IBM i 7.1, 7.2, & 7.3
 - On version 2.6 of integrated web services server
 - Server will handle both SOAP and REST services
- Uses JAX-RS
 - Java API for RESTful Web Services
- Two ways to deploy a REST service
 - IBM Web Administration GUI updated
 - Deploying a REST service will require more user input than when deploying a SOAP service
 - QShell script `installWebService.sh` updated to support REST

Best practices for REST services

- Use HTTP methods as CRUD (create/read/update/delete) operations: POST (create), GET (read), PUT (update), DELETE (delete)
- URI design matters
 - Use nouns, not verbs (/accounts/{id} not /getaccount?id=nn)
 - Predictable
 - Learn from popular APIs (Google, Facebook, Twitter, etc.)
- Keep them stateless (independent)
- Don't send data that is not needed
- Think about cacheability
 - To improve network efficiency, scalability and user-perceived performance of your API
- Think about pagination, querying, sorting



New things to set when deploying a REST web service

- Specify the URI path to the resource (e.g. /accounts)
- For each procedure (resource method)
 - a) Specify the HTTP method the procedure will handle
 - b) Optionally specify URI segment path for the procedure
 - c) Specify media types (e.g. XML, JSON, etc.) the procedure will accept
 - d) Specify media types the procedure will return
 - e) Optionally specify what values to inject in procedure input parameters
 - Path segment (e.g. /accounts/{id})
 - Matrix parameters (e.g. /cars;color=blue)
 - Query parameters (e.g. /cars?color=blue)
 - Form data
 - HTTP headers
 - HTTP Cookies
 - f) Optionally designate response code and HTTP header output parameters

Procedure and program parameter rules

- No injection to input parameters will be allowed if:
 - There is more than one input parameter that is a structure
 - There is an input parameter that is an array
 - The data type of an input parameter is something other than byte, integer, char, float, packed, or zoned
- If you want to accept JSON or XML as an input parameter, then specify an input parameter that is a structure
 - A resource request method (i.e. procedure) can accept JSON, XML, or both, assuming you indicate what media types the procedure accepts
 - A resource request method can return both types of media types, based on what the client sends on the Accept request header. For example, following example indicates that client only accepts XML responses:

```
Accept: application/xml
```

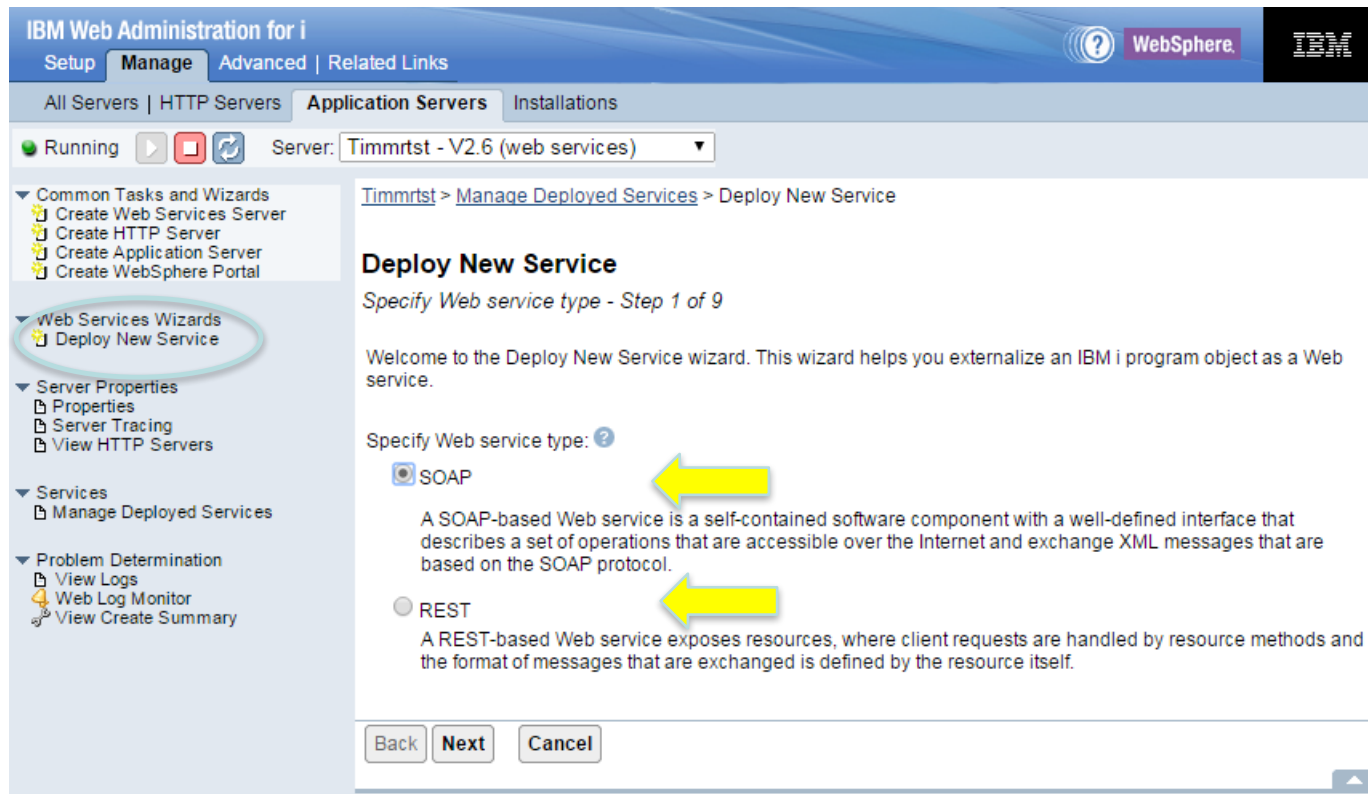
HTTP response code and headers

- A procedure output parameter with type integer can be designated as the HTTP response code parameter
 - Allows you to control what response code to return (e.g. 405 – not allowed)
- A procedure output parameter that is an array of type char can be designated as the HTTP header parameter
 - Mainly for specifying HTTP caching headers





Demo of REST based Methodology

Deploy new Service – SOAP or REST



IBM Web Administration for i
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Timmrst > Manage Deployed Services > Deploy New Service

Deploy New Service

Specify Web service type - Step 1 of 9

Welcome to the Deploy New Service wizard. This wizard helps you externalize an IBM i program object as a Web service.

Specify Web service type: ?

SOAP

A SOAP-based Web service is a self-contained software component with a well-defined interface that describes a set of operations that are accessible over the Internet and exchange XML messages that are based on the SOAP protocol.

REST

A REST-based Web service exposes resources, where client requests are handled by resource methods and the format of messages that are exchanged is defined by the resource itself.

Back Next Cancel

REST Service – Specify *PGM or *SRVPGM

IBM Web Administration for i
Setup **Manage** Advanced | Related Links

All Servers | HTTP Servers **Application Servers** Installations

Running Server: Timmrtst - V2.6 (web services) ▼

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Timmrtst > [Manage Deployed Services](#) > Deploy New Service

Deploy New Service

Specify Location of IBM i Program Object - Step 2 of 9

The IBM i object to be externalized as a Web service must be an existing ILE program (*PGM) or service program (*SRVPGM) located on the system.

Specify the program object for the Web service.

Specify IBM i library and ILE program object name **(Recommended)**

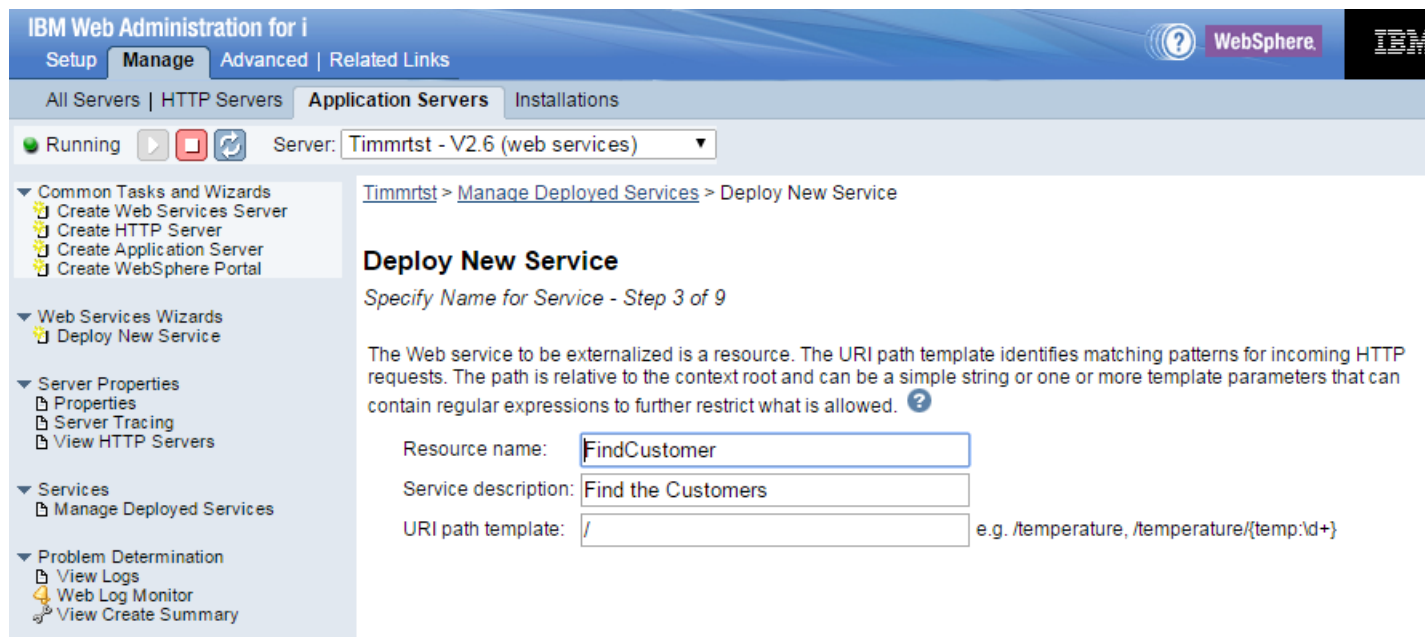
Browse the integrated file system for the IBM i program object

Alternatively, you can search for the program object in the integrated file system, which could take a while if a directory is specified that contains a lot of objects, such as /QSYS.LIB.

Path of program object: e.g. /QSYS.LIB/MYLIB.LIB



Note: Specify a *PGM or *SRVPGM object.

REST – Specify Service Name



IBM Web Administration for i
Setup | **Manage** | Advanced | Related Links

All Servers | HTTP Servers | **Application Servers** | Installations

Running   Server: Timmrtst - V2.6 (web services) ▼

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Timmrtst > [Manage Deployed Services](#) > Deploy New Service

Deploy New Service

Specify Name for Service - Step 3 of 9

The Web service to be externalized is a resource. The URI path template identifies matching patterns for incoming HTTP requests. The path is relative to the context root and can be a simple string or one or more template parameters that can contain regular expressions to further restrict what is allowed. 

Resource name:

Service description:

URI path template: e.g. /temperature, /temperature/{temp:d+}

REST – Select the Export Procedures

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Running Server: Timmrtst - V2.6 (web services)

- Common Tasks and Wizards
 - Create Web Services Server
 - Create HTTP Server
 - Create Application Server
 - Create WebSphere Portal
- Web Services Wizards
 - Deploy New Service
- Server Properties
 - Properties
 - Server Tracing
 - View HTTP Servers
- Services
 - Manage Deployed Services
- Problem Determination
 - View Logs
 - Web Log Monitor
 - View Create Summary

<input type="checkbox"/>	▶ GETCITYNAME			
<input type="checkbox"/>	▶ FINDTOCITIES			
<input type="checkbox"/>	▶ FINDFROMCITIES			
<input type="checkbox"/>	▶ GETFLIGHTINFO			
<input type="checkbox"/>	▶ FINDFLIGHTS			
<input type="checkbox"/>	▶ FINDFLIGHTSDOW			
<input type="checkbox"/>	▶ GETCUSTNAME			
<input type="checkbox"/>	▶ GETCUSTNUMBER			
<input checked="" type="checkbox"/>	▼ FINDCUSTOMERS			
	POSITION	input ▼	char	
	LISTTYPE	input ▼	char	
	COUNTREQ	input ▼	int	
	COUNTRET	output ▼	int	
	CUSTLIST	output ▼	struct	

Select All Deselect All Expand All Collapse All

Back Next Cancel

COUNTRET ▼
100
COUNTREQ
COUNTRET


COUNTRET

REST – Define the Parameters

Deploy New Service

Specify Resource Method Information - Step 5 of 9

Procedures are mapped to resource methods. Each resource method needs to be defined to handle client requests by mapping an HTTP request method to a resource method.

Specify resource method information. 

Procedure name: FINDCUSTOMERS

URI path template for resource: /

HTTP request method: GET

URI path template for method: *NONE

Allowed input media types: *ALL

Returned output media types: *XML_AND_JSON

HTTP response code output parameter: *NONE

HTTP header array output parameter: *NONE

Whether to wrap input parameters:

Wrap input parameters

Do not wrap input parameters

Input parameter mappings:

Parameter name	Data type	Input source	Identifier	Default Value
POSITION	char	*QUERY_PARAM <input type="text"/>	position <input type="text"/>	*NONE <input type="text"/>
LISTTYPE	char	*QUERY_PARAM <input type="text"/>	listtype <input type="text"/>	*NONE <input type="text"/>
COUNTREQ	int	*QUERY_PARAM <input type="text"/>	countreq <input type="text"/>	*NONE <input type="text"/>


REST – Specify User Profile for the Service

[Timmrst](#) > [Manage Deployed Services](#) > Deploy New Service

Deploy New Service

Specify User ID for this Service - Step 6 of 9

The service requires an IBM i user ID to run the program object that contains the Web service business logic.

Specify User ID for this Service: 

Use **server's** user ID

The server's user ID must have the necessary authority to this program object and any other additional program objects.

Specify an **existing** user ID

REST – Update the Library List

IBM Web Administration for i
 Setup **Manage** Advanced | Related Links
 All Servers | HTTP Servers **Application Servers** Installations

Running Server: Timmrtst - V2.6 (web services)

[Timmrtst](#) > [Manage Deployed Services](#) > Deploy New Service

Deploy New Service

Specify Library List - Step 7 of 9

The functionality of the IBM i program you want to externalize as a Web service may depend upon that the Web service programs depend on. If no library is specified, a default library list is used.

Specify library list position for this Web service:

Insert libraries in front of user library portion of the library list
 Insert libraries at the end of user library portion of the library list

Library list entries:

	Library name
<input type="radio"/>	IWSRII
<input checked="" type="radio"/>	flight400

REST – Transport Information

IBM Web Administration for i

Setup **Manage** Advanced | Related Links

All Servers | HTTP Servers **Application Servers** Installations

Running Server: Timmrst - V2.6 (web services)

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Timmrst > [Manage Deployed Services](#) > Deploy New Service

Deploy New Service

Specify Transport Information to Be Passed - Step 8 of 9

Specify transport information to be passed to the web service implementation code.

Information to be passed to web service implementation code ?

Specify Transport Metadata:

Transport Metadata
<input type="checkbox"/> REMOTE_ADDR

Specify HTTP Headers:

HTTP Headers
<i>There are no entries for this table.</i>

Add Remove All

REST - Finish

IBM Web Administration for i

Setup **Manage** Advanced | Related Links

All Servers | HTTP Servers **Application Servers** Installations

Running Server: Timmrtst - V2.6 (web services)

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 - View Create Summary

Timmrtst > Manage Deployed Services > Deploy New Service

Deploy New Service

Summary - Step 9 of 9

When you click **Finish** the web service is deployed.

Service	Method	Request Information
Resource name:	FindCustomer	
Resource description:	Find the Customers	
Service install path :	/www/timmrtst/webservices/services/FindCustomer	
URI path template:	/	
User ID for service:	*SERVER (QWSERVICE)	
Program:	/QSYS.LIB/IWSRILIB/NFS400_THR.SRVPGM	
Library list for service:	IWSRII,FLGHT400	

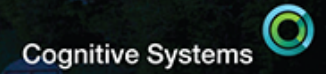
Back Finish Cancel



What have we done lately....

- 3 node support
 - HTTP on one node
 - Application Server on a node
 - Backend RPG on a node
- Use Authenticated User
- Services re-deploy
- Connection pool pre-initialization
- Variable length fields
- Many other updates as requested by the community

<https://www.ibm.com/developerworks/community/wikis/home?lang=en#!/wiki/dW%20IBM%20Integrated%20Web%20Services%20for%20i>



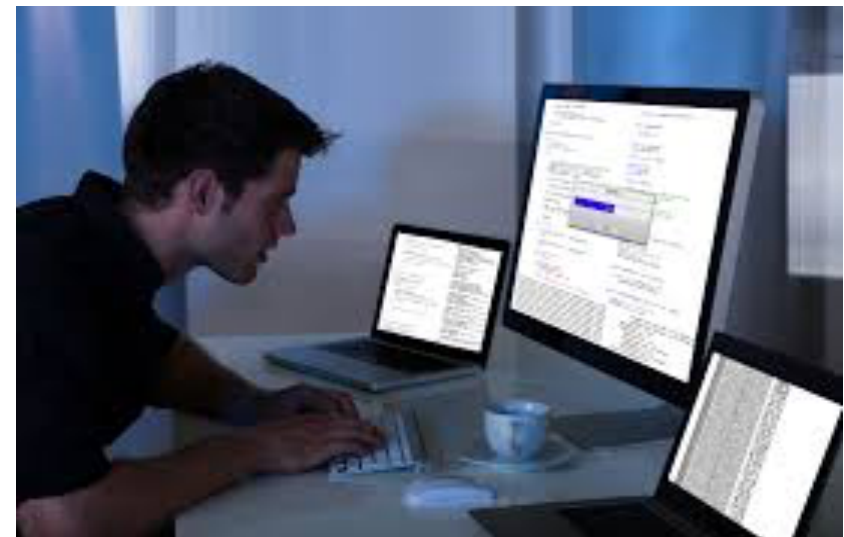
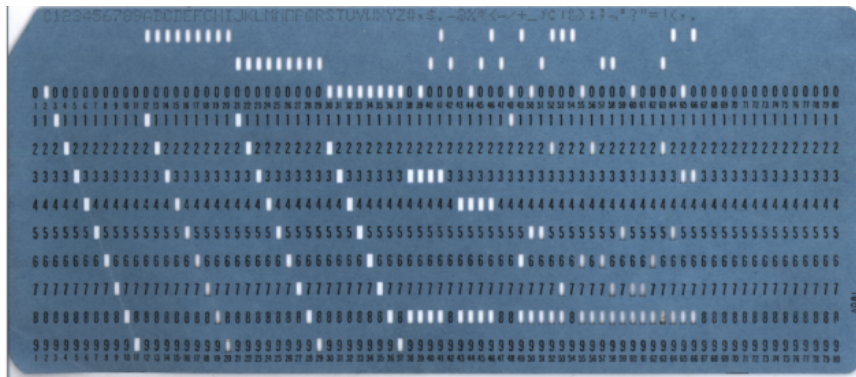
Calling Web Services from IBM i

Tim Rowe - Business Architect for Application Development

timmr@us.ibm.com



RPG - Where to we start....





RPG - A Modern Business Language

- Interoperability
 - o Java
 - o XML
 - o SQL
- Readability
 - o Free form
 - o Blank lines
 - o Comments
- Functionality
 - o Procedures
 - o Data areas
 - o Data structures
 - o More data types
 - o Extended file support
- Modern Tools
 - o RD i, RTC, ARCAD Power Pack

```
read file;           // Get next record
dow not %eof(file);  // Keep looping with record
  if %error;
    dsply 'The read failed';
    leave;
  else;
    chain(n) name database data;
    time = hours * num_employees
           + overtime_saved;
    pos = %scan (',' : name);
    name = %xlate(upper : lower : name);
    exsr handle_record;
    read file;
  endif;
enddo;
begsr handle_record;
eval(h) time = time + total_hours_array (empno);
temp_hours = total_hours - excess_hours;
record_transaction();
endsr;
```

Rational Developer for i

- Modern
- Integrated
- Analysis
- Debugger
- Visual
- Supports RPG, COBOL, CL, C, C++, SQL, DDM



```

// Gets information about a file.
// [in] filepath : Path to the file.
// [out] infoptr : Structure containing the file information.
// Return : On success 1 is returned. 0 is returned if there was an
// error accessing the file or the file does not exist.

int CFSUtils::GetFileStats(char *filepath, fsutilsFileInfo_t *infoptr)
(
    int len, flagslashend = 0;

    if (filepath == NULL || infoptr == NULL)
        return(0);

    //remove any trailing slashes if necessary
    len = strlen(filepath);
    if (len > 0) {
        if (*(filepath+len-1) == '\\') || *(filepath+len-1) == '/' {
            //only remove the trailing slash if it is not the only slash
            if (strchr(filepath, '\\') != (filepath+len-1) && strchr(filepath, '/')
                *(filepath+len-1) == '\\')
                flagslashend = 1;
        }
    }
    else {
        return(0); //the filepath is empty
    }
}

#ifdef WIN32

```

```

cd ftps
/home2/yantzi/demos/ftps>
ls -la
total 136
drwxr-xr-x  5 yantzi  staff      4096 Dec 03 15:09 .
drwxr-xr-x  5 yantzi  staff      256 Dec 08 11:10 ..
-rw-r--r--  1 yantzi  staff     10018 Dec 03 15:09 .cproject
-rw-r--r--  1 yantzi  staff     2972 Dec 03 15:09 .project

```



How do you connect RPG to Watson

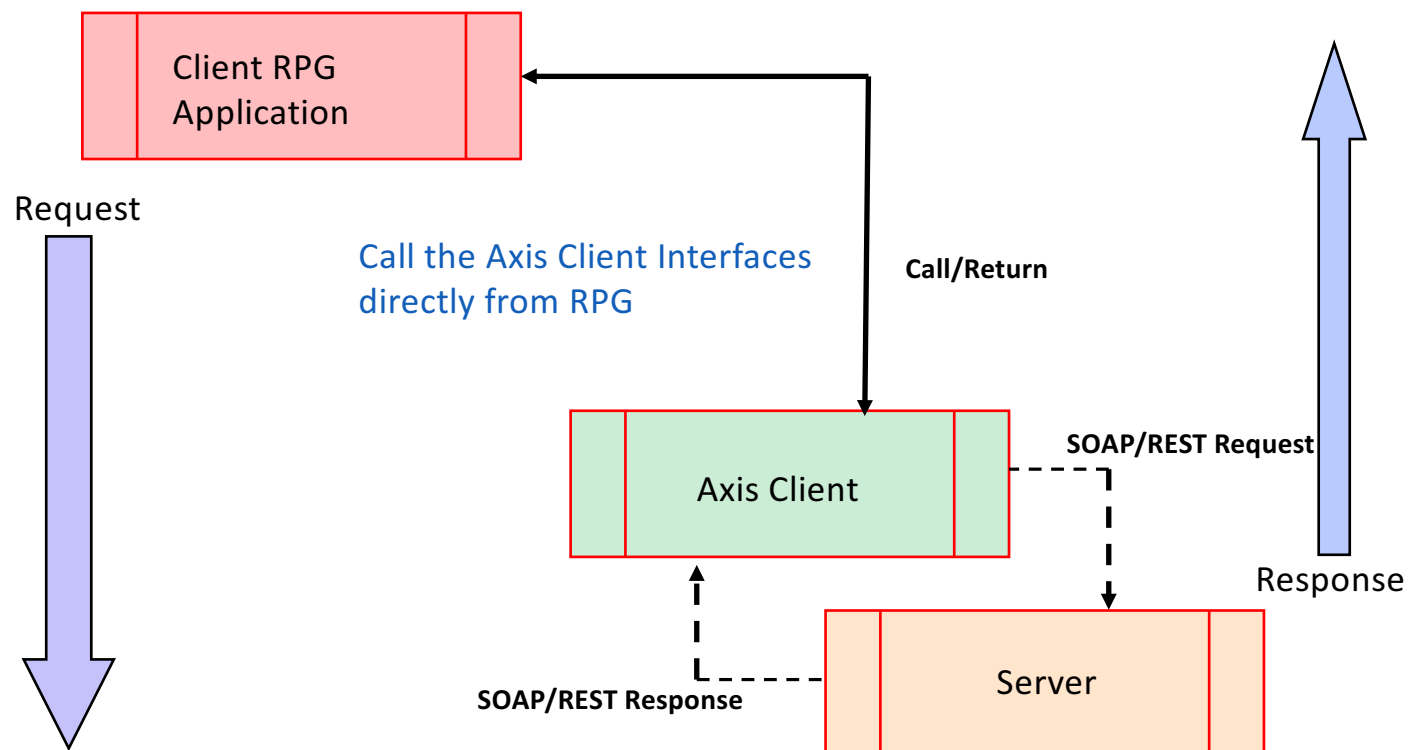
- Many different ways.....
 - SQL
 - Integrated Web Services Client
 - Call another language that speaks ‘REST’
 - Java
 - Node.js
 - Python



Integrated Web Services Client

- Overview
 - Based on Apache AXIS C++
 - Consists
 - Tool to convert WSDL to RPG/C/C++ stubs (SOAP only support)
 - SOAP Client
 - REST Client
 - Availability
 - IBM i SS1 Option 3
 - **Latest HTTP group PTF**
- Supports
 - C, C++, RPG, COBOL

Integrated Web Services Client





RPG Calling Axis Client

```
str1 = 'https://watson-api-explorer.mybluemix.net/' +  
      'language-translator/api/v2/translate?model_id=' +  
      fromLang + '-' + toLang + '&text=' + str1 + X'00';  
  
// Create HTTP transport handle.  
tHandle = axiscTransportCreate(str1:AXISC_PROTOCOL_HTTP11);  
  
// Set SSL information - turn off SSLv2, SSLv3, TLSv1 and tolerate  
// certificate not being in key store  
NONE = 'NONE' + X'00';  
propBuf1 = '/QIBM/USERDATA/ICSS/CERT/SERVER/DEFAULT.KDB' + X'00';  
propBuf2 = 'true' + X'00';  
  
axiscTransportSetProperty(tHandle: AXISC_PROPERTY_HTTP_SSL:  
    %addr(propBuf1):  
    %addr(NULLSTR): %addr(NULLSTR):  
    %addr(NONE) : %addr(NONE):  
    %addr(NONE) : %addr(NULLSTR): %addr(NULLSTR):  
    %addr(propBuf2));
```



RPG Calling Axis Client

```
// Indicate that the payload in response should stay in UTF-8
propBuf2 = 'false' + X'00';
axiscTransportSetProperty(tHandle: AXISC_PROPERTY_CONVERT_PAYLOAD:
    %addr(propBuf2));

// Flush transport so request is sent and receive response.
rc = axiscTransportFlush(tHandle);
if (rc = 0);
    rc = axiscTransportReceive(tHandle:
        %ADDR(response): %SIZE(response): 0);

        dow rc > 0 AND bytesRead < %SIZE(response);
        bytesRead = bytesRead + rc;
        rc = axiscTransportReceive(tHandle:
            %ADDR(response)+bytesRead:
            %SIZE(response)-bytesRead: 0);
        enddo;
endif;
```



Some Additional Light Reading

Developer Works – 3 Part Series on Rest for IBM i

- <https://www.ibm.com/developerworks/ibmi/library/i-rest-web-services-server1/>
- <http://www.ibm.com/developerworks/ibmi/library/i-rest-web-services-server2/>
- <https://www.ibm.com/developerworks/ibmi/library/i-rest-web-services-server3/>

Questions and Answers



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