



Hidden Gems of IBM i

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Database – Constraints



Gems you've owned for decades...

- Data-Centric technologies save you time and money

Pre-2010

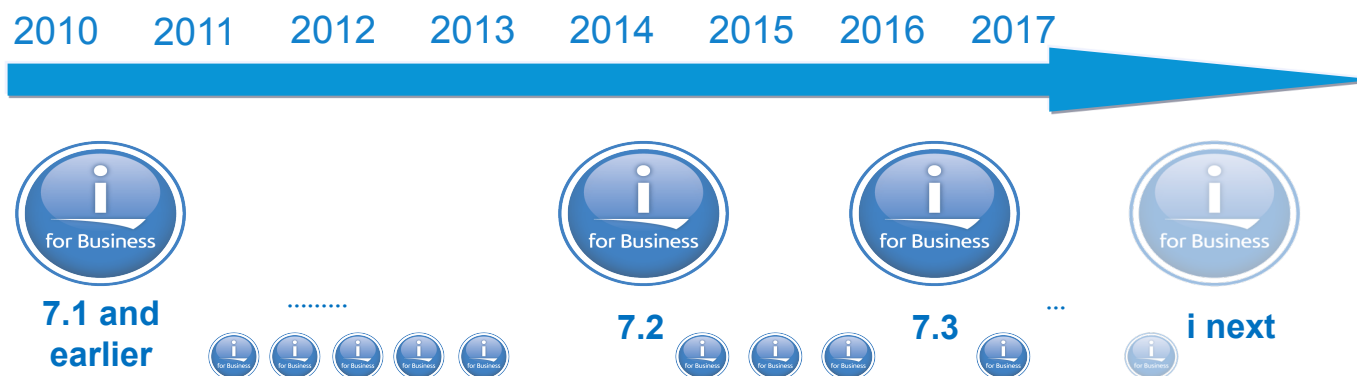


Long Time Gems

- SQL Views → Dawn of time
- Primary Keys → V3R1M0
- Foreign Keys → V3R1M0
- Native Triggers → V3R1M0
- Check Constraints → V3R6M0
- SQL Triggers → V5R1M0

More Recently Added...

- Data-Centric technologies save you time and money



- Field Procedures
- Implicitly hidden columns
- Range and Hash Partitioning
- Row Change Timestamp
- And more...

- Row Permissions
- Column Masks
- Media Preference
- Memory Preference
- EVI Only Access

- Temporal Tables
- Generated Columns for Auditing
- New OLAP Specifications

Constraints

- **Constraints** enforce the business rules defined by the data model

There are three types of constraints:

1. A **unique constraint** is a rule that forbids duplicate values in one or more columns within a table.
Two forms:
 - a) **Unique Key(s)** – a unique index is used
 - b) **Primary Key** – a single column with a unique, non-NULL value (sometimes an Identity value is used)
2. A **referential constraint** is a logical rule about values in one or more columns in one or more tables
3. A **check constraint** sets restrictions on data added to a specific table



Constraints Enforce the Rules

- Physical Data Model (PDM) of reengineered Employee Master table and Department legacy file

EMP_MAST
EMP_MAST PK
EMPNO
FIRSTNME
MIDINIT
LASTNAME
WORKDEPT [FK]
PHONENO
HIREDATE
JOB
EDLEVEL
SEX
BIRTHDATE
SALARY
BONUS
COMM
EM_ROW_CHANGE_TS

DEPARTMENT
DEPTNO
DEPTNAME
MGRNO [FK]
ADMRDEPT [FK]
LOCATION

Unique Keys
Provide Single
Row Retrieval

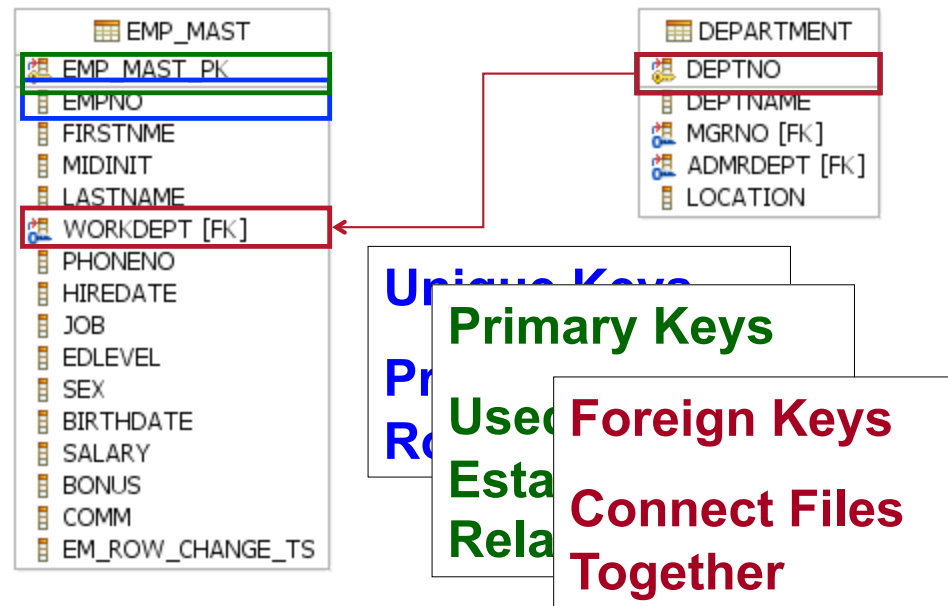
Constraints Enforce the Rules

EMP_MAST	
	EMP_MAST_PK
	EMPNO
	FIRSTNME
	MIDINIT
	LASTNAME
	WORKDEPT [FK]
	PHONENO
	HIREDATE
	JOB
	EDLEVEL
	SEX
	BIRTHDATE
	SALARY
	BONUS
	COMM
	EM_ROW_CHANGE_TS

DEPARTMENT	
	DEPTNO
	DEPTNAME
	MGRNO [FK]
	ADMRDEPT [FK]
	LOCATION

Unique Keys
 Primary Keys
 Foreign Keys
Primary Keys
Used to
Establish
Relationships

Constraints Enforce the Rules



Constraints Enforce the Rules

Check
Must be
'M' or 'F'

EMP_MAST	
EMP_MAST PK	Primary Key
EMPNO	Primary Key
FIRSTNME	
MIDINIT	
LASTNAME	
WORKDEPT [FK]	Foreign Key
PHONENO	
HIREDATE	
JOB	
EDLEVEL	
SEX	Check Constraint
BIRTHDATE	
SALARY	
BONUS	
COMM	
EM_ROW_CHANGE_TS	

DEPARTMENT	
DEPTNO	Primary Key
DEPTNAME	
MGRNO [FK]	Foreign Key
ADMRDEPT [FK]	Foreign Key
LOCATION	

Unique Keys
Primary Keys
Used to Establish Relationships
Foreign Keys
Check Constraint Enforces business rules

Database – Client Special Registers





Client Special Registers – truly are special

- Client Special registers were added to IBM i 6.1, are you using them?
- DB2 for i tooling includes these registers both as output (identification of workload) and filter (find something specific)
- 5 Special registers

Register Name	SQL Special Register Name	Datatype	Database Monitor Column (where QQRID=1000)
Client Application Name	CURRENT CLIENT_APPLNAME	VARCHAR(255)	QVC3001
Client Accounting	CURRENT CLIENT_ACCTNG	VARCHAR(255)	QVC3005
Client Program ID	CURRENT CLIENT_PROGRAMID	VARCHAR(255)	QVC3006
Client User ID	CURRENT CLIENT_USERID	VARCHAR(255)	QVC3002
Client Workstation	CURRENT CLIENT_WRKSTNNAME	VARCHAR(255)	QVC3003

- Client Special register values are inherited across SQL Server Mode and DRDA connections

Client Special Registers – truly are special

Brand your applications and workloads using:

1. Set Client Information (SQLESETI) API
2. SQL Call Level Interface (SQL CLI) – SQLSetConnectAttr()
3. ODBC – SQLSetConnectAttr()
4. JDBC - setClientInfo() connection method
5. SYSPROC.WLM_SET_CLIENT_INFO procedure

Database Monitor includes pre-filters



The screenshot shows a configuration window titled "Client registers" with the following fields and options:

- Accounting string: []
- Application name: []
- Program name: [STRSQL]
- Client user: []
- Workstation: []

Database – Create or Replace Tables



Create OR REPLACE Table

Data Definition Language (DDL) SQL statements that support the optional 'OR REPLACE' clause:

- ❑ CREATE OR REPLACE ALIAS
- ❑ CREATE OR REPLACE FUNCTION
- ❑ CREATE OR REPLACE MASK
- ❑ CREATE OR REPLACE PERMISSION
- ❑ CREATE OR REPLACE PROCEDURE
- ❑ CREATE OR REPLACE SEQUENCE
- ❑ **CREATE OR REPLACE TABLE**
- ❑ CREATE OR REPLACE TRIGGER
- ❑ CREATE OR REPLACE VARIABLE
- ❑ CREATE OR REPLACE VIEW



Replacing a table:

- ✓ Data-Centric
- ✓ **Dependent Views & MQTs preserved**
- ✓ **Triggers preserved**
- ✓ RCAC controls preserved
- ✓ Auditing preserved
- ✓ Authorizations preserved
- ✓ Comments and Labels preserved
- ✓ Rows optionally deleted

Knowledge Center

http://www-01.ibm.com/support/knowledgecenter/ssw_ibm_i_72/db2/rbafzhctabl.htm?lang=en

Article for previous OR REPLACE statements

<http://iprodeveloper.com/database/use-sql-create-or-replace-improve-db2-i-object-management>



Create OR REPLACE Table

Alternative is using ALTER TABLE, BUT....

- 1) **Complex** to continually build the perfect set of changes
- 2) Change management products find it **difficult** to handle ALTER TABLE

CREATE OR REPLACE TABLE allows users to manage the master table source.

- The attributes specified on the CREATE OR REPLACE TABLE will be compared to the existing attributes and the corresponding alters are performed.

Before

```
ALTER TABLE corpdata.employee  
  
ALTER COLUMN firstnme  
    SET DATA TYPE VARCHAR(20) NOT NULL  
  
ALTER COLUMN lastname  
    SET DATA TYPE VARCHAR(30) NOT NULL  
  
ALTER COLUMN phoneno  
    SET DATA TYPE VARCHAR(13)  
  
ADD COLUMN level INT BEFORE edlevel
```

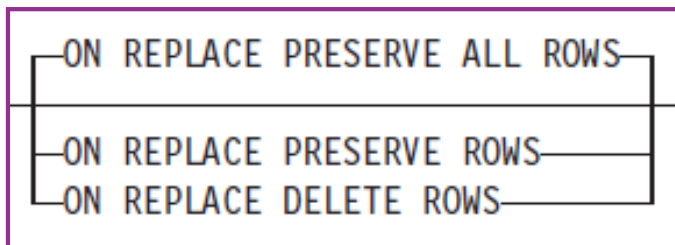
After

```
CREATE OR REPLACE TABLE corpdata.employee(  
    empno CHAR(6) NOT NULL,  
    firstnme VARCHAR(20) NOT NULL,  
    midinit CHAR(1) NOT NULL,  
    lastname VARCHAR(30) NOT NULL,  
    workdept CHAR(3) DEFAULT NULL,  
    phoneno VARCHAR(13) DEFAULT NULL,  
    hiredate DATE DEFAULT NULL,  
    job CHAR(8) DEFAULT NULL,  
    level INT,  
    edlevel SMALLINT NOT NULL,  
    sex CHAR(1) DEFAULT NULL,  
    birthdate DATE DEFAULT NULL,  
    salary DECIMAL(9, 2) DEFAULT NULL,  
    bonus DECIMAL(9, 2) DEFAULT NULL,  
    comm DECIMAL(9, 2) DEFAULT NULL,  
    PRIMARY KEY( empno ) )
```

Create OR REPLACE Table

DB2 for i implements table replacement using the necessary set of **ALTER** operations. If alter doesn't support the action, neither will create or replace table.

Do you want to preserve the data?



PRESERVE ALL ROWS (default)

- Rows are always preserved
- Columns can be dropped or altered

PRESERVE ROWS

- Rows are preserved, unless a range is eliminated from a partitioned table
- If a specified range or partition name matches, the partition is preserved
- Columns can be dropped or altered

DELETE ROWS

- All rows are deleted
- No delete triggers are fired

Create OR REPLACE Table

What about **CREATE TABLE AS** or **CREATE TABLE LIKE**?

```
CREATE OR REPLACE TABLE EMPLOYEE AS
(SELECT * FROM MASTER_TABLES.EMPLOYEE)
WITH NO DATA
INCLUDING IDENTITY COLUMN ATTRIBUTES
INCLUDING COLUMN DEFAULTS
INCLUDING IMPLICITLY HIDDEN COLUMN ATTRIBUTES
INCLUDING ROW CHANGE TIMESTAMP COLUMN ATTRIBUTES
ON REPLACE PRESERVE ROWS
```

Using **CREATE TABLE AS**

- Copy-options can be used to retain columns and attributes
- Constraints are not included
- Must use WITH NO DATA

```
CREATE OR REPLACE TABLE EMPLOYEE LIKE
MASTER_TABLES.EMPLOYEE
INCLUDING IDENTITY COLUMN ATTRIBUTES
INCLUDING COLUMN DEFAULTS
INCLUDING IMPLICITLY HIDDEN COLUMN ATTRIBUTES
INCLUDING ROW CHANGE TIMESTAMP COLUMN ATTRIBUTES
ON REPLACE PRESERVE ROWS
```

Using **CREATE TABLE LIKE**

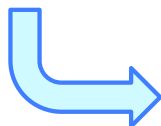
- Copy-options can be used to retain columns and attributes
- Constraints are not included

Create OR REPLACE Table

Generating DDL for existing tables will normally produce separate statements for the table and its constraints.

Use the **GENERATE_SQL()** procedure to produce master table source.

```
CALL qsys2.generate_sql (
  'EMPLOYEE',
  'TOYSTORE_MINNESOTA_1',
  'TABLE',
  CREATE_OR_REPLACE_OPTION => '1',
  CONSTRAINT_OPTION => '2')
```



Constraints

```
CREATE OR REPLACE TABLE TOYSTORE_MINNESOTA_1.EMPLOYEE (
EMPNO CHAR(6) CCSID 37 NOT NULL ,
FIRSTNME VARCHAR(12) CCSID 37 NOT NULL ,
MIDINIT CHAR(1) CCSID 37 NOT NULL ,
LASTNAME VARCHAR(15) CCSID 37 NOT NULL ,
WORKDEPT CHAR(3) CCSID 37 DEFAULT NULL ,
PHONENO CHAR(4) CCSID 37 DEFAULT NULL ,
HIREDATE DATE DEFAULT NULL ,
JOB CHAR(8) CCSID 37 DEFAULT NULL ,
EDLEVEL SMALLINT NOT NULL ,
SEX CHAR(1) CCSID 37 DEFAULT NULL ,
BIRTHDATE DATE DEFAULT NULL ,
SALARY DECIMAL(9, 2) DEFAULT NULL ,
BONUS DECIMAL(9, 2) DEFAULT NULL ,
COMM DECIMAL(9, 2) DEFAULT NULL ,
CONSTRAINT TOYSTORE_MINNESOTA_1.Q_TOYST00001_EMPLOYEE_EMPNO_00001 PRIMARY KEY(
EMPNO ) ,
CONSTRAINT TOYSTORE_MINNESOTA_1.RED
FOREIGN KEY( WORKDEPT )
REFERENCES TOYSTORE_MINNESOTA_1.DEPARTMENT ( DEPTNO )
ON DELETE SET NULL
ON UPDATE NO ACTION ,
CONSTRAINT TOYSTORE_MINNESOTA_1.NUMBER
CHECK( PHONENO >= '0000' AND PHONENO <= '9999' ) )
```

Systems Management - Watches



Watches

- Watches can be used to automate the actions taken when the following occur:
 - Message
 - Licensed Internal Code Log (LIC Log)
 - Problem Activity Log Entry (PAL entry)
- Start Watch (STRWCH) command or API ([QSCSWCH](#))
- End Watch (ENDWCH) command or API ([QSCEWCH](#))
- Work with Watches (WRKWCH) command to display watches
- When the condition being watched occurs, your program gets control and you can take any action you want



Watches

- Low Overhead
 - Watches are an exit program
 - Minimal overhead until the watched condition occurs
- Your program gets control to determine what action to take
- Your program runs *out-of-band*
- For message watches
 - Can watch for messages sent to any message queue, including
 - QSYSOPR, History Log
 - Can watch for messages sent to any job log
 - Can specify generic job name
 - Can specify *ALL to watch for a message to all job logs

Navigator for i – Application Administration





Application Administration for Navigator for i

Control who can access what tasks in Navigator for i

Welcome x Dashboard x Application Administration x

Application Administration (Local Settings) - localhost

Select the functions or applications available to users.

Select	Function	Default Access	All Object Access	Customized Access
<input type="radio"/>	localhost	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="radio"/>	System	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="radio"/>	Monitors	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="radio"/>	Basic Operations	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="radio"/>	Work Management	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="radio"/>	Configuration and Service	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="radio"/>	Network	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="radio"/>	Integrated Server Administration	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="radio"/>	Security	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="radio"/>	Users and Groups	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="radio"/>	Databases	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="radio"/>	Journal Management	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="radio"/>	Performance	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="radio"/>	File Systems	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="radio"/>	AFP Manager	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Page 1 of 1 | 1 Go | Rows 15 | Total: 15 Selected: 0

Remove Customization

Applications ...

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IBM i Management

- Target Systems and Groups
- Favorites
- System
 - System Status
 - System Operator Messages
 - History Log
 - Search
 - Disk Status
 - Run Command
- Emulation
 - Application Administration

Systems Management – Jobs in Memory Pools



Display Jobs Running in a Memory Pool

- Work Management → Active Memory Pools
- Select the desired memory pool and you can see the jobs running in that memory pool

Welcome x Dashboard x Active Memory Pools x Base x

Active Jobs - Dmi1.rchland.ibm.com

Refresh Memory pool: Base Elapsed time: 00:00:23

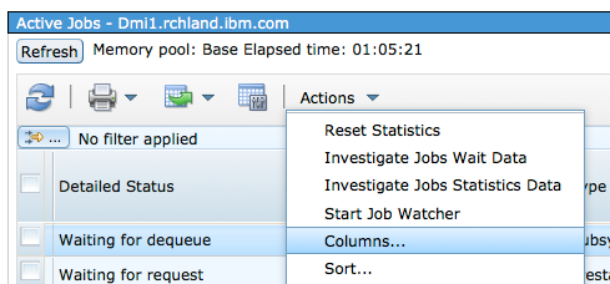
Search

No filter applied

Job Name	Detailed Status	Current User	Type	CPU %	Run Priority	Thread Count	Tempor Storage Used(M
Admin2	Waiting for thread	Qlwisvr	Batch immediate	0.9	25	127	1,001
Qzrcsrsvs	Running	Dmmay	Prestart batch - Server	0.3	20	1	284
Qbase	Waiting for dequeue	Qsys	Subsystem	0	0	2	2

Display Jobs Running in a Memory Pool... Customize Columns

- Customize columns to add/omit additional information
- Customization is remembered



The screenshot shows the 'Active Jobs - Dmi1.rchland.ibm.com' window with a table of jobs. The table has 14 columns: Job Name, Detailed Status, Current User, CPU %, Run Priority, Thread Count, Temporary Storage Used(MB), Page Fault Rate, Disk I/O Rate, Disk I/O Count, Synchronous Disk I/O Rate, Total Disk I/O Count, and Type. The table contains 4 rows of job data.

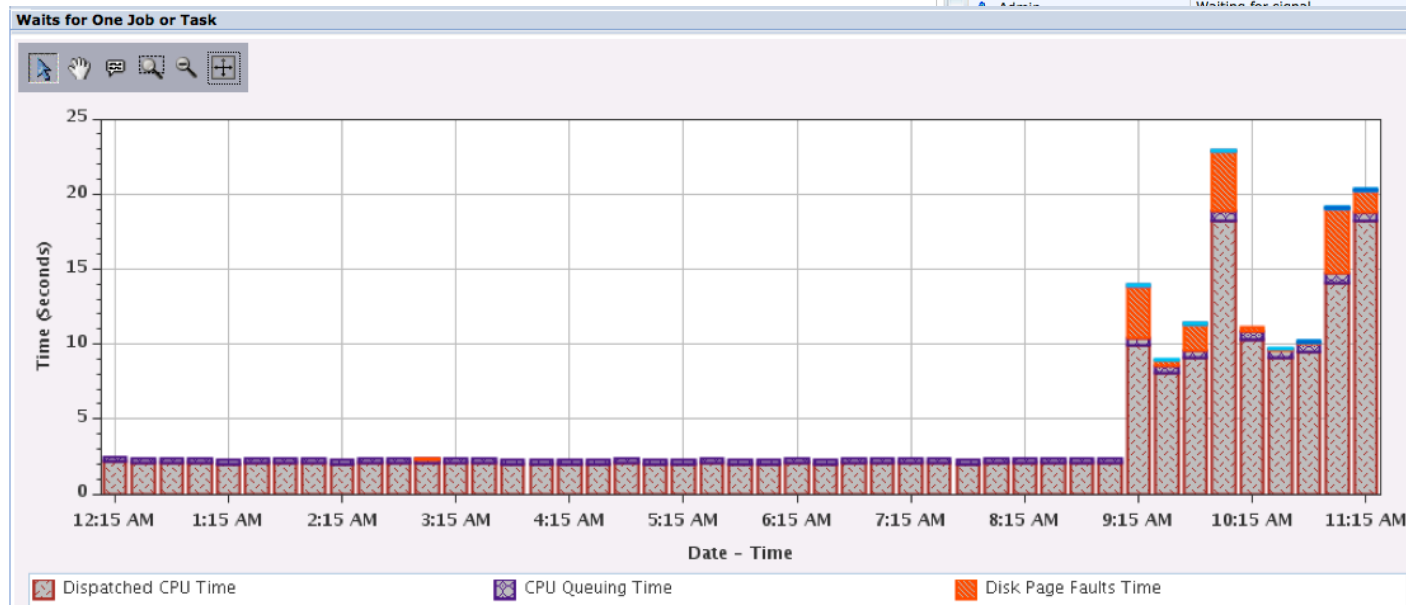
Job Name	Detailed Status	Current User	CPU %	Run Priority	Thread Count	Temporary Storage Used(MB)	Page Fault Rate	Disk I/O Rate	Disk I/O Count	Synchronous Disk I/O Rate	Total Disk I/O Count	Type
Qzcrsrvs	Running	Dmmay	0.3	20	1	473	4.6	8.9	37,402	5.7	75,916	Prestart bat
Crtprfda2	Waiting for dequeue	Qsys	0	50	1	31	0.1	4.2	17,748	2.1	176,909	Batch - Ser
Qpwfservso	Waiting for time interval	Dmmay	0	20	1	3	0.2	3.9	16,718	0.2	17,721	Prestart bat
Crtprfda	Waiting for dequeue	Qsys	0	50	1	32	0	0.5	2,110	0.1	23,560	Batch - Ser

Look Backward in Time for a Job

- If you discover a job with a potential performance issue, you can easily launch the Performance Data Investigator to see what the job has been doing in the past



The screenshot shows the 'Active Jobs' window from the IBM Performance Center. The title bar reads 'Active Jobs - Dmi1.rchland.ibm.com'. Below the title bar, there are icons for Refresh, Memory pool, Base Elapsed time (00:00:23), and an Actions dropdown menu. A table lists various jobs with columns for Job Name and Detailed Status. The 'Admin2' job is selected, and a context menu is open over it, showing options like 'Reset Statistics', 'Printer Output', 'Job Log', 'Details', 'Reply...', 'Hold...', 'Release', 'Move...', 'Delete/End...', 'Performance', and 'Properties'. The 'Performance' option is expanded, showing 'Elapsed Performance Statistics' and 'Investigate Job Wait Data'.

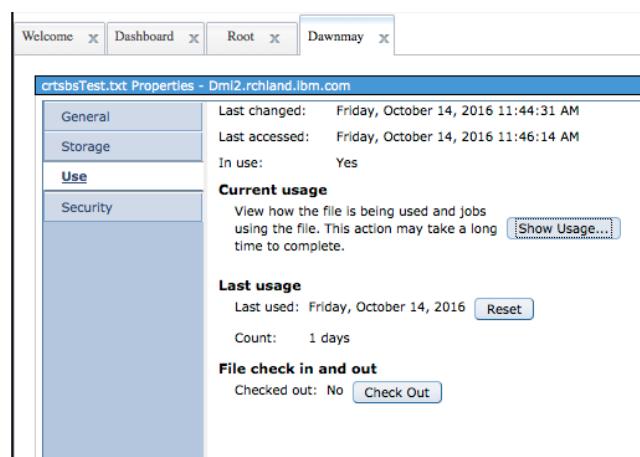


Systems Management – Holder of Files in IFS



Display File Usage Information – find holders of files in the IFS

- Locate the file in the IFS, view Properties
- Select Use tab, then click on the “Show Usage” button



Display File Usage Information – find holders of files in the IFS ...

- Select the entry to review details which will display the job(s)

crtsbsTest.txt Properties - Dmi2.rchland.ibm.com

General	Last changed: Friday, October 14, 2016 11:44:31 AM
Storage	Last accessed: Friday, October 14, 2016 11:55:31 AM
Use	In use: Yes
Security	

Current usage as of 10/14/16 11:56 AM

Select	Usage Type	Job Count
<input checked="" type="radio"/>	Shared (All) - Read only	1

Jobs Using /dawnmay/crtsbsTest.txt - Dmi2

|
 |
 |
 |
 Actions ▾

... No filter applied

<input type="checkbox"/>	Job Name	User	Status	Type	Entered System
<input type="checkbox"/>	Dawnmayb	Dmmay	Running	Interactive	10/14/16 10:01:38 AM

Systems Management – Security Wizard



Security Wizard

- Security → All Tasks → Configure

The screenshot displays the Security Wizard application interface. At the top, there are three tabs: 'Welcome', 'Dashboard', and 'Configure'. The 'Configure' tab is active. Below the tabs, the main content area is titled 'Security Wizard - localhost'. The 'Welcome' section features a graphic of a server rack and a key with binary code, and text explaining the wizard's purpose: to create security recommendations, reports, and apply them to the system. Navigation buttons include '< Back', 'Next >', 'Finish', and 'Cancel'. On the right side, a navigation pane shows a tree view with 'Security' expanded to show sub-items like 'Authorization Lists' and 'Intrusion Detection', and 'All Tasks' expanded to show 'Configure' and 'Permissions'. The 'Configure' option is highlighted. Below this, a 'Security Policy' dialog box is open, asking 'How would you characterize the general security policy for your system?' with radio button options for 'Strict', 'Average' (which is selected), and 'Relaxed'. A server rack icon is also present in this dialog.



Security Wizard - Recommendations

Summary of Recommendations

To accept a recommended setting for a security control, leave its checkbox checked.
 To keep the current setting for a security control, click its checkbox to remove the check.

--- Select Action ---

Select	System Value	Security Control	Current Setting	Recommended Setting
<input checked="" type="checkbox"/>	DDMACC	DDM request access	Check object authorizations	No remote access allowed
<input checked="" type="checkbox"/>	QSCANFCTL	Scan file system control	*NONE	If there are errors when calling the exit program, the system will fail the request which triggered the exit program callThe system will not attempt to upgrade the access for the scan descriptor passed to the exit program to include write access
<input checked="" type="checkbox"/>	JOBACN	Job action	File for user	Reject network jobs
<input checked="" type="checkbox"/>	QDSCJOBTV	Time interval before disconnected jobs end	240	60
<input checked="" type="checkbox"/>	QSCANFS	Scan file system	Objects of type *STMF that are in *TYPE2 directories in the Root(/), QOpensys, and User-defined file systems will be scanned	Objects of type *STMF that are in *TYPE2 directories in the Root(/), QOpensys, and User-defined file systems will be scanned
<input checked="" type="checkbox"/>	QDPSGNINF	Sign-on display information control	Do not display	Display
<input checked="" type="checkbox"/>	QINACTMSGQ	Inactive job message queue	End job	End job
<input checked="" type="checkbox"/>	QLMTSECOFR	Limit security officer device access	No	Yes
<input checked="" type="checkbox"/>	QALWBJRST	Allow object restore option	Restore all objects	Does not allow objects with security-sensitive attributes to be restored.
<input checked="" type="checkbox"/>	QMAXSGNACN	Action to take for failed signon attempts	Disable profile	Disable device and profile
<input checked="" type="checkbox"/>	QLMTDEVSSN	Limit device sessions	No	Yes
<input checked="" type="checkbox"/>	QVFOBJRST	Verify object on restore	Verify: Restore unsigned objects; Do not restore objects with failed signatures	Verify: Do not restore unsigned objects; Do not restore objects with failed signatures

Page 1 of 2 | 1 Go | Rows 12 | Total: 21

OK Cancel



Access Client Solutions – Integrated File System

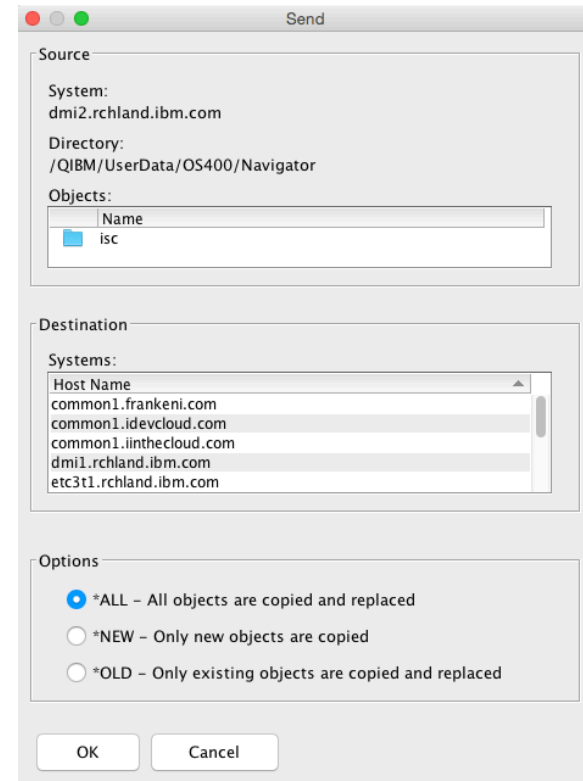
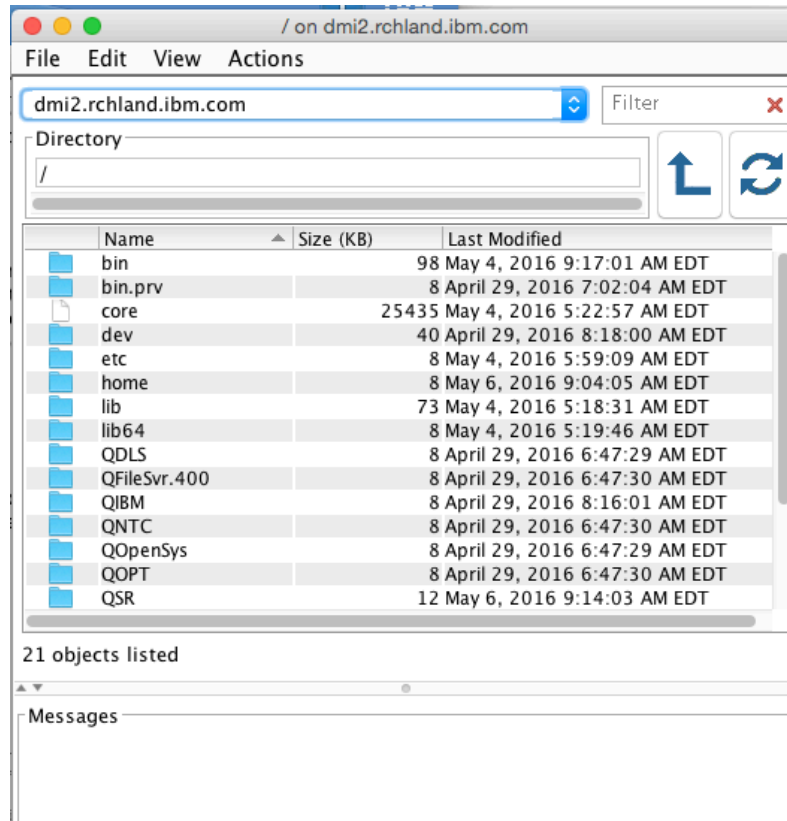


IBM i Access Client Solutions – Integrated File System

The screenshot displays the IBM i Access Client Solutions web interface. At the top, there is a blue header with the text "IBM i Access Client Solutions" and an IBM logo. Below the header is a menu bar with "File", "Edit", "Actions", "Tools", and "Help". The main content area is divided into two sections. On the left is a navigation pane with a "Welcome" link and a "System:" dropdown menu set to "dmi2.rchland.ibm.com". Below this are three expandable sections: "General" (containing "Data Transfer", "S250 Emulator", "Integrated File System", "Navigator for i", and "Printer Output"), "Database" (containing "Run SQL Scripts" and "SQL Performance Center"), and "Console" (containing "S250 Console"). The "Integrated File System" item is highlighted. On the right is a main content area with a heading "Integrated File System" and a paragraph: "Integrated File System provides an interface for browsing the integrated file system of your IBM i and working with objects in the integrated file system in the following ways:". This is followed by a bulleted list of actions: "Create new folders (directories, libraries, and folders)", "Delete objects", "Rename objects", "Copy objects between your client system and your IBM i", "Copy objects within the integrated file system on an IBM i or to the integrated file system on another IBM i", "Send objects to another IBM i (or to several)", and "View properties of objects". Below the list is a note: "Note: Copying or sending objects from one IBM i to another uses the QFileSvr.400 file system." and a final paragraph: "This task requires a system configuration. To add or change a system configuration, select **System Configurations** from the **Management** tasks."



IBM i Access Client Solutions – Integrated File System



A couple of command line gems....





Analyze Command Performance (ANZCMDPFR)

- Simple utility that reports wall-clock time spent on the specified command and provides other performance-related information

```
                Analyze Command Performance (ANZCMDPFR)

Type choices, press Enter.

Command . . . . . wrkactjob
_____
_____
_____
_____
_____

Command file . . . . . _____ Name
  Library . . . . . *LIBL      Name, *LIBL, *CURLIB
Command member . . . . . *FIRST  Name, *FIRST
Output . . . . . *MSG        *MSG, *OUTFILE
```



Analyze Command Performance – CPCC711

- CPCC711 logged to the job log of the job that ran the ANZCMDPFR
- Contains the detailed analysis information

Additional Message Information

```
Message ID . . . . . : CPCC711
Date sent . . . . . : 10/14/16      Time sent . . . . . : 12:48:34
```

```
Message . . . . . : ANZCMDPFR command completed successfully.
```

```
Cause . . . . . : The request to measure the performance of a single CL
                  command or a set of CL commands has completed.
```

```
Total Time Used . . . . . : 2.038
Total CPU time Used . . . . . : .003
Synchronous Database Reads . . . . . : 0
Synchronous Non Database Reads . . . : 19
Synchronous Database Writes . . . . . : 0
Synchronous Non Database Writes . . . : 0
Asynchronous Database Reads . . . . . : 0
Asynchronous Non Database Reads . . . : 0
Asynchronous Database Writes . . . . . : 0
```

More...

Press Enter to continue.



Display Service Tools User IDs Without Going into SST

- Display Services Tools User ID
 - DSPSSTUSR
- Will also show if the SST ID is linked to an IBM i user profile
 - Associating an SST User ID with an IBM i user profile is done in SST

```
Display Service Tools User IDs                               System:  DMI1
Type options, press Enter.
  5=Display

Opt  DST/SST ID  Status  Linked  Description
  █  DMMAY      *ENABLED  DMMAY   DAWN MAY
  -  GIBBONS    *ENABLED           JOE GIBBONS
  -  QSECOFR    *ENABLED  QSECOFR QSECOFR
  -  QSRV      *ENABLED           QSRV
  -  11111111  *ENABLED           11111111
  -  22222222  *ENABLED           22222222
```


Navigator for i Dashboards



Navigator for i Dashboards

The screenshot displays the IBM Navigator for i interface. On the left is a navigation tree under 'IBM i Management' with categories like Target Systems and Groups, Favorites, System, Monitors, Basic Operations, Work Management, Configuration and Service, Network, Integrated Server Administration, Security, Users and Groups, Database, Journal Management, Performance, File Systems, and Internet Configurations. The main dashboard area is titled 'Dashboard' and contains six panels:

- CPU Utilization:** A line graph showing 1% utilization over time (16:15:29 to 16:15:36).
- Page Faults:** A line graph showing 84 page faults over time.
- Disk Utilization:** A line graph showing 1% disk utilization for Disk Pool 1, Unit 6 over time.
- Disk Pool Usage:** A line graph showing 7% disk pool usage for Disk Pool 1 over time.
- Jobs:** A list of jobs with columns for Name, User, Status, and Subsystem. The list includes ADMIN (0%), ADMIN1 (0%), ADMIN2 (0.8%), ADMIN3 (0%), ADMIN4 (0%), ADMIN5 (0%), and CRTPFRDTA (0%). The filter matches 270 jobs.
- Operator Messages:** A list of messages showing 0 Inquiry and 14 Critical messages.

- Easy to understand **real time** information
- **Green=good**, **Amber=warning**, **Red=Problem**
- Simply “click” to drill down to find details
- Perfect for new or none IBMi SysAdmins

Navigator for i Dashboards

< **Operator Messages**

✖ Operator Messages

? 0 Inquiry

✖ 14 Critical

➡

Critical Messages

IBM i grace period expires in 51 days on 21/07/16. >

IBM i grace period expires in 51 days on 21/07/16. >

IBM i grace period expires in 51 days on 21/07/16. >

IBM i grace period expires in 52 days on 21/07/16. >

IBM i grace period expires in 52 days on 21/07/16. >

IBM i grace period expires in 52 days on 21/07/16. >

I >

CPF2103 received by SETCLASSCL at 1100. (C D I R) >

IBM i grace period expires in 52 days on 21/07/16. >

IBM i grace period expires in 52 days on 21/07/16. >

IBM i grace period expires in 50 days on 21/07/16. >

IBM i grace period expires in 51 days on 21/07/16. >

IBM i grace period expires in 51 days on 21/07/16. >

IBM i grace period expires in 51 days on 21/07/16. >

- In this case we can see
 - someone forgot to apply their licenses

Generated Columns for Auditing



Generated Columns for Auditing

- **How can you see who last updated a record?**
 - **Journaling – Painful and slow**
 - **Application Logs – Not available for every file**
- **What we need is**
 - **System maintained audit**
 - **That is easy to enable**
 - **Simple to interrogate**
 - **Acceptable to auditors**
 - **Cost effective to install and activate**

In 7.3 IBM gave us Generated Columns

Navigator for i Dashboards



```
1 select * from cascade3.gc2pf|
```

ODDTL	AUDIT_TYPE_CHANGE	AUDIT_USER	AUDIT_CLIENT_IP	AUDIT_JOB_NAME	AUDIT_TIME
*BASIC	U	QSECOFR	192.168.2.88	015267/QUSER/QZDASOINIT	2016-06-02 19:39:27.830448
*BASIC	U	QSECOFR	192.168.2.88	015267/QUSER/QZDASOINIT	2016-06-02 19:39:27.857975
*BASIC	U	QSECOFR	192.168.2.88	015267/QUSER/QZDASOINIT	2016-06-02 19:39:27.885889
*BASIC	U	QSECOFR	192.168.2.88	015267/QUSER/QZDASOINIT	2016-06-02 19:39:27.913217
*BASIC	U	QSECOFR	192.168.2.88	015267/QUSER/QZDASOINIT	2016-06-02 19:39:27.941536
*BASIC	I	PAUL	-	015315/PAUL/QPADEV0005	2016-06-02 19:44:55.277099

- **Notice that there is no IP address for the last entry**
 - This was added via DFU
 - I hope to see this limitation removed
- **Note if you want to see deleted records**
Then you need to enable Temporal Support

RPG “Sort Arrays”



RPG: Sort and search a data structure array

- Sort a data structure array using one subfield as a key

```
// sort by name  
SORTA info(*).name;
```

```
// sort by due date  
SORTA info(*).dueDate;
```

- Search a data structure array using one subfield as a key

```
// search for a name  
pos = %LOOKUP('Jack' : info(*).name);
```

```
// search for today's date  
pos = %LOOKUP(%date() : info(*).dueDate);
```


RPG: Sort ascending or descending

- Non-sequenced arrays can be sorted either ascending or descending.

```
D meetings      S      D DIM(100)
/free
// sort descending with the most recent date first
sorta(d) meetings;
```

- (D) extender indicates a descending sort.
- (A) Extender indicates ascending (default).

Example: The "family" array

```

D child          ds          qualified template
D  name          25a        varying
D  age           5i 0
D family         ds          qualified dim(5)
D  name          25a        varying
D  numChild      5i 0
D  child         likeds(child) dim(10)
  
```

name	numChild	child	
		name	age
Smith	2	Sally	12
		Jimmy	2
Jones	3	Polly	9
		Andy	5
		Mary	11

The "family" array sorted ascending by oldest child

```
// sort the family array by age of first child
SORTA family(*).child(1).age;
```

name	numChild	child	
		name	age
Smith	2	Sally	12
		Jimmy	2
Jones	3	Polly	9
		Andy	5
		Mary	11



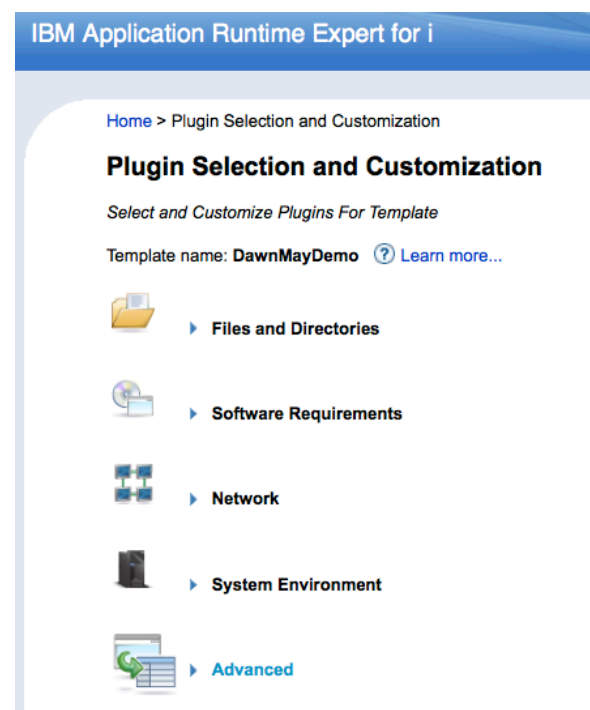
Systems Management – Administration Runtime Expert



Administration Runtime Expert – 5733-ARE

<http://www-03.ibm.com/systems/power/software/i/are/index.html>

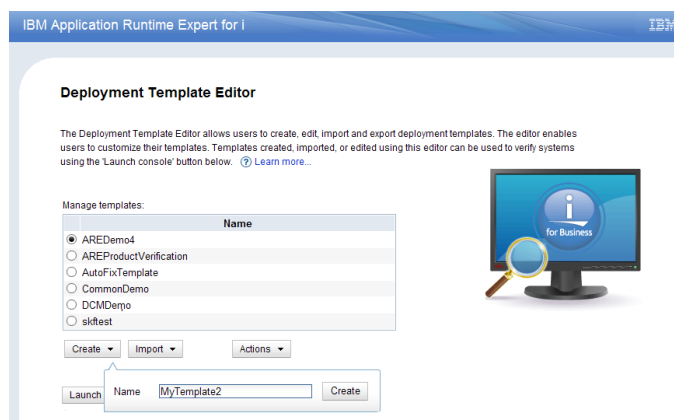
- **Automated** tool to verify the physical condition and runtime attributes of:
 - Applications
 - Systems
 - Environments
- Ability to **fix detected problems**
 - Fix user profiles to known values
 - Fix authorities on files and directories
- Verify **multiple systems**
- **Schedule** verifications
 - Select system
 - Timeframe



Administration Runtime Expert – Manage PTF's

<http://www.ibmssystemsmag.com/Blogs/i-Can/September-2015/IBM-Application-Runtime-Expert-for-i--Managing-PTF/>

- Compare PTF levels across systems
- Compare PTF levels against IBM cloud
- Send PTF's from one system to another via *SAVF
- Load PTF's from image catalogs
- Scheduled PTF verifications
- Send an email when something is wrong
- Compare an endless number of other system attributes





Useful ARE utilities

IBM i includes a handful of ready made templates

Network checking

- Run the network plugin
- Verify DNS servers

Damaged Object checking

- Run the network plugin
- Identify objects with *data checks*

Pre-Checker

- Verify the Java environment
- Verify the condition of PASE

Host Servers

- Verify the Host Servers are active

Basic IAS Server Verify

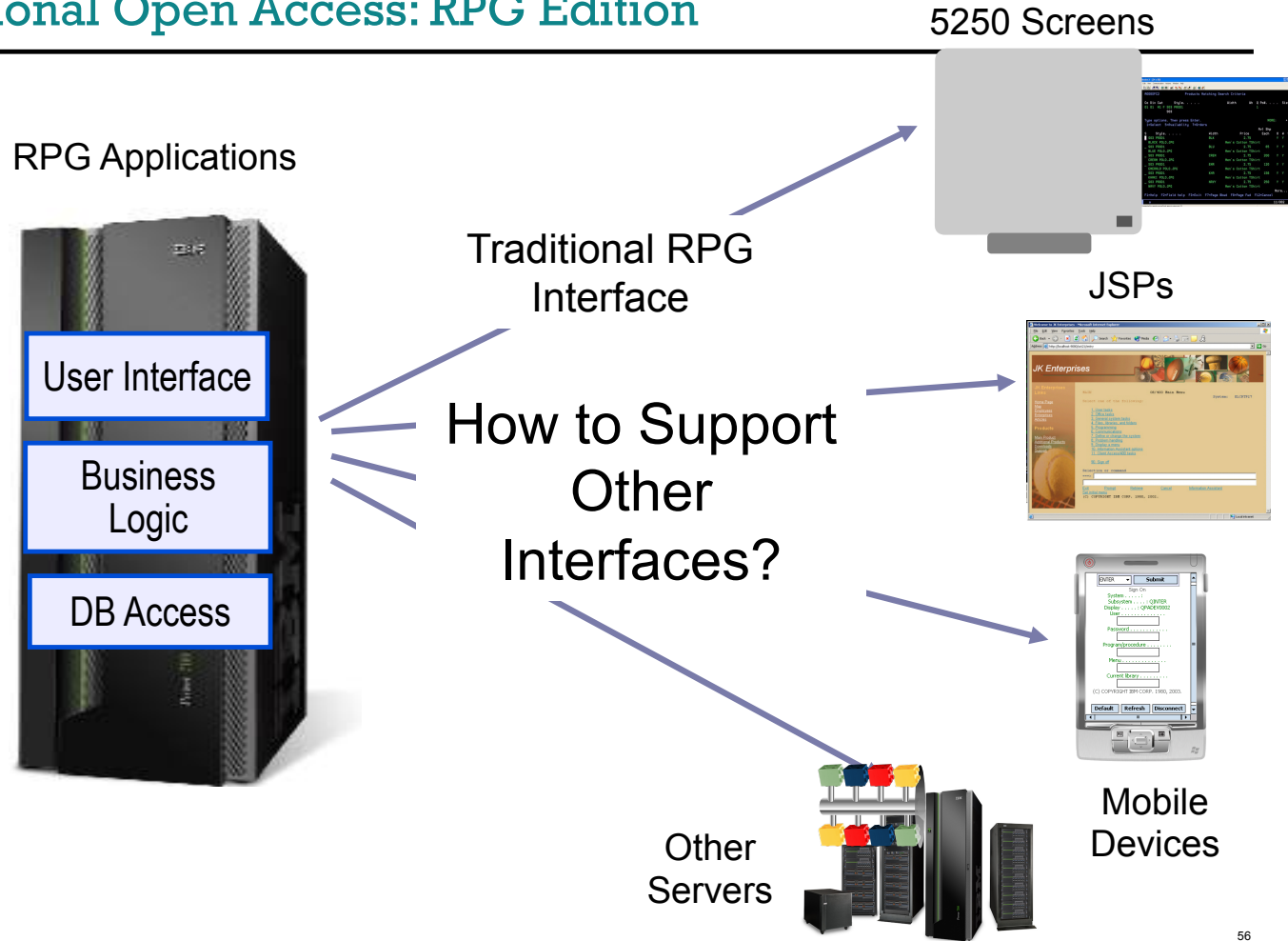
- Specify IAS server name
- Basic IAS server infrastructure

RPG Open Access

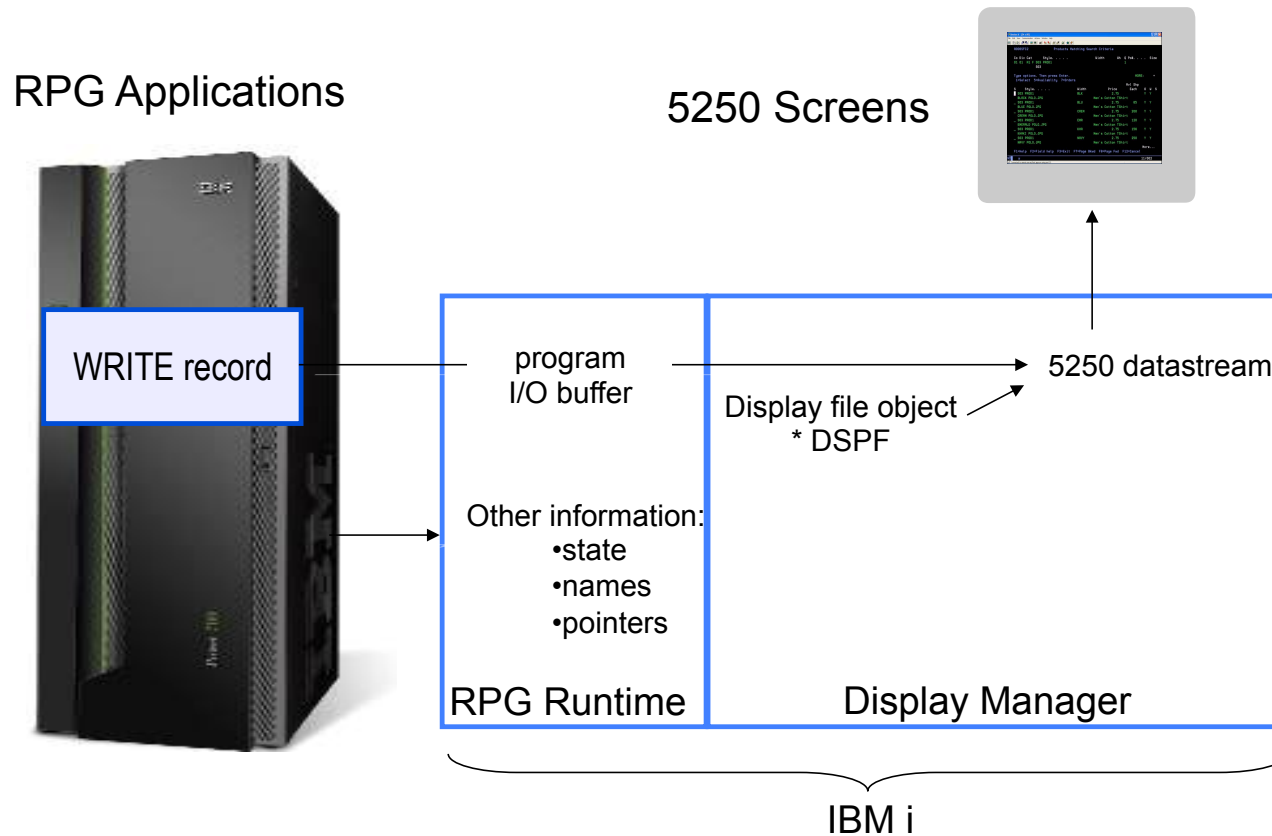




Rational Open Access: RPG Edition



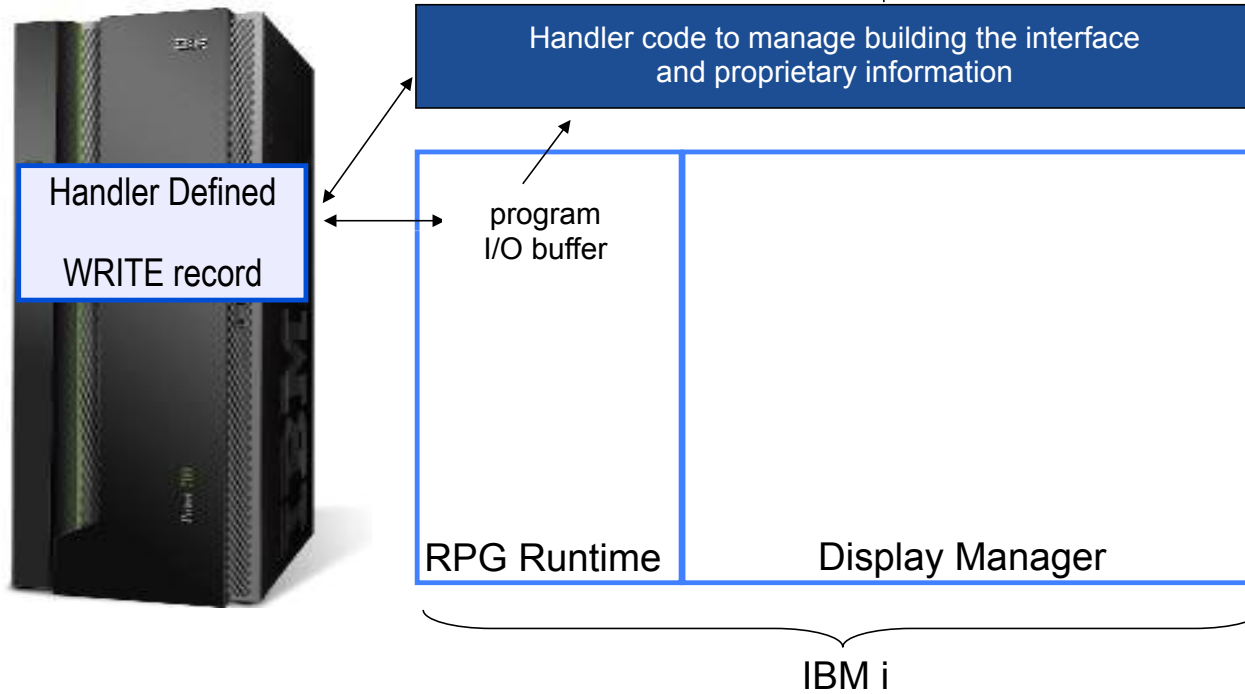
Rational Open Access: RPG Edition



Rational Open Access: RPG Edition



RPG Applications





Any RPG device type

Any RPG device type can be defined as an Open Access file: DISK, PRINTER, or WORKSTN.

The provider of the handling procedure can choose the RPG device-type that best fits the function that the handler provides.

Examples

- User interface: WORKSTN file
- Creating an Excel document: PRINTER file
- Accessing a Web service: keyed DISK file

The RPG coding to define an Open Access file

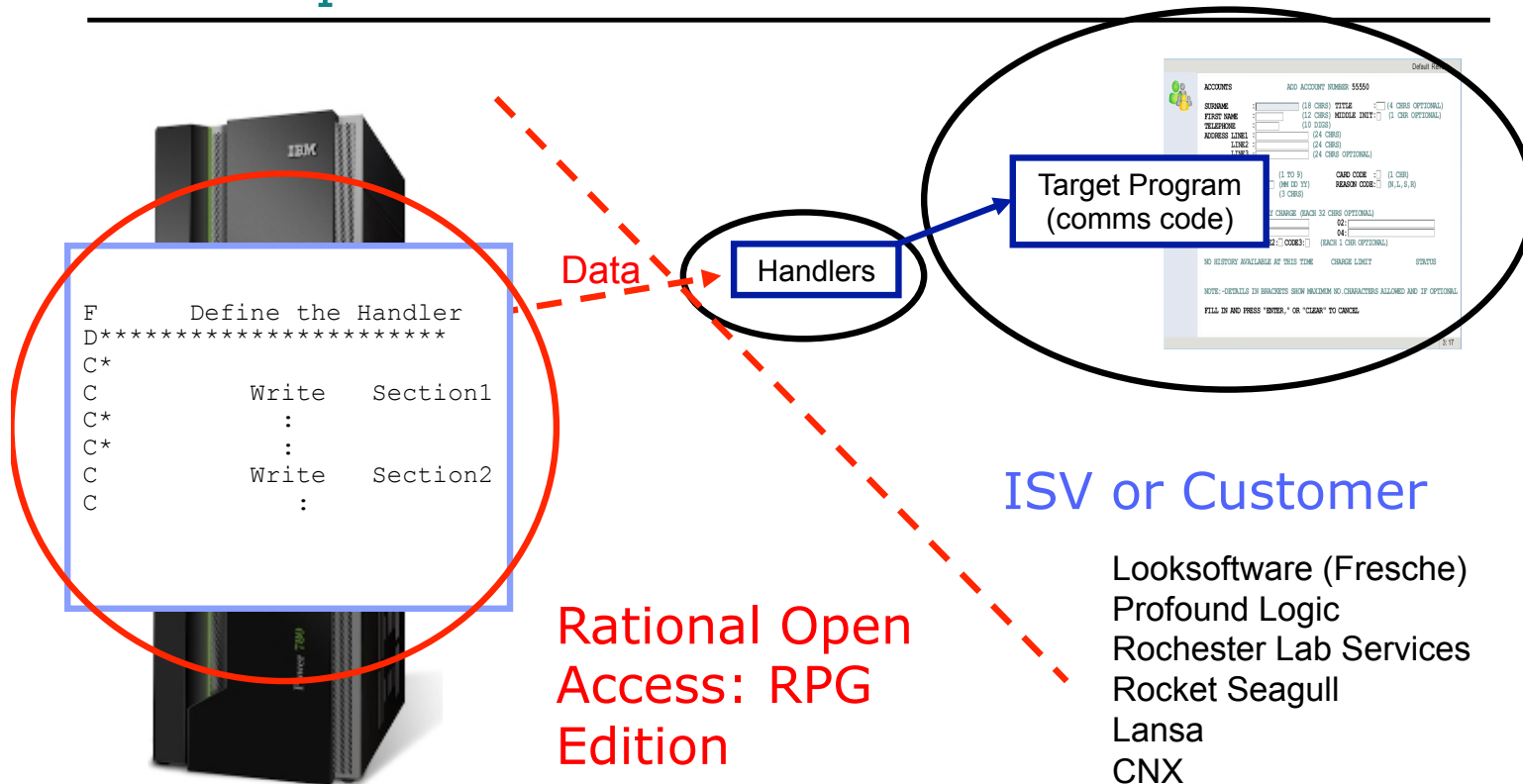
The HANDLER keyword identifies the location of the handler. The handler can be a program or a procedure.

```
Fmyfile    cf    e    workstn  extdesc('MYLIB/MYFILE')
F                                     handler('MYLIB/MYSRVPGM(hdlMyfile)')
F                                     usropn
```

Other examples of the HANDLER keyword

- handler('MYLIB/MYPGM')
- handler(charVariable)
 - where charVariable = 'MYLIB/MYPGM' or 'MYSRVPGM(proc)'
- handler(rpgPrototype)
- handler(procptrVariable)

Rational Open Access: RPG Edition

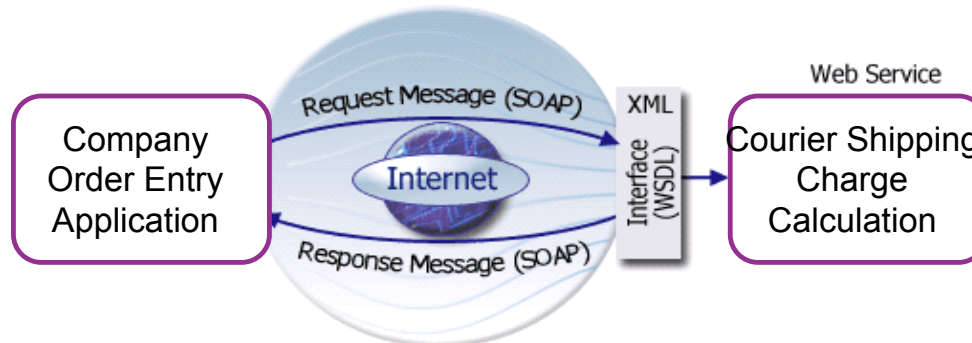


Consuming Web Services



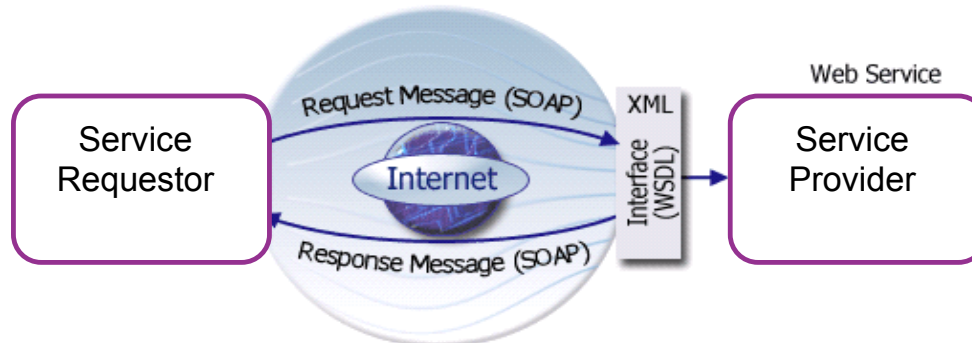
Web Services Made Easy

- Software Application requiring some additional components
- Exposed Services; published and available
- Web Service = Self-Contained function with well-defined interfaces that provide functionality that is accessible over the Internet/Intranet
- Industry Standard Connection protocol
- SOAP or REST



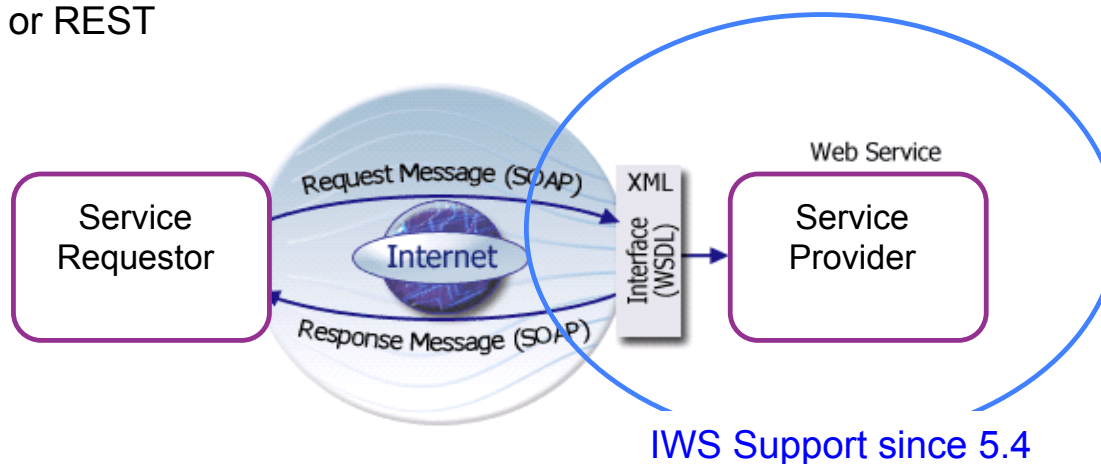
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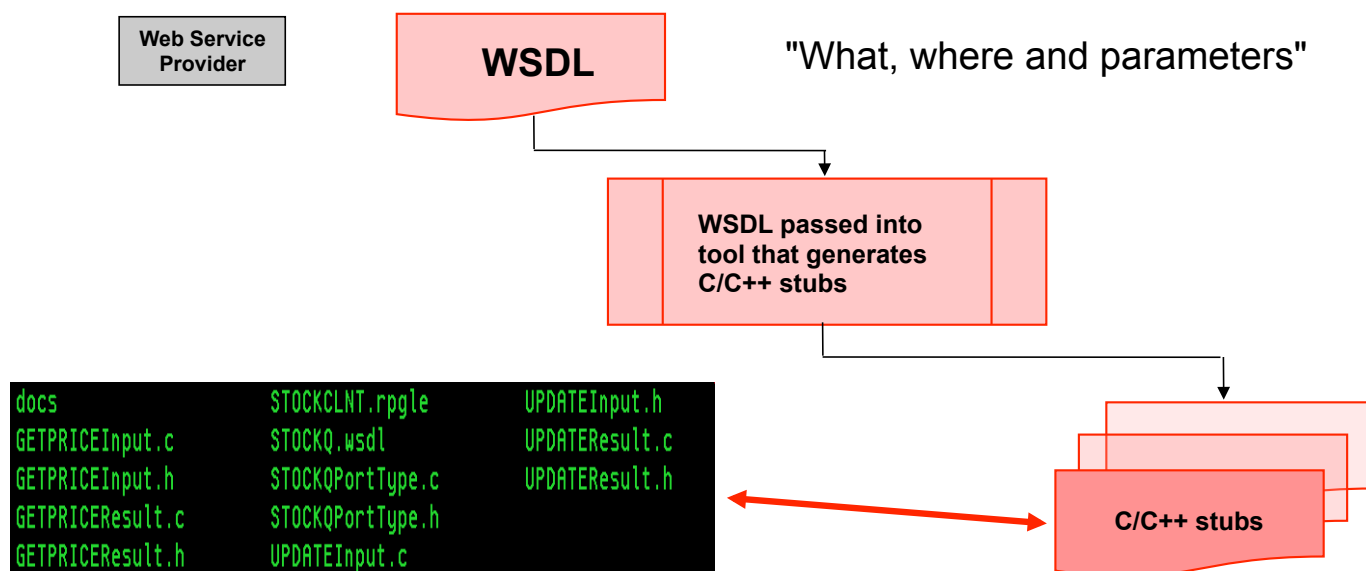
Solving the RPG Issue

- Provide an easier path for ILE RPG programs to consume a Web service
- Use WSDL2RPG tool
 - Generate RPG stub code directly from a WSDL file
- Allow RPG programmers to decide whether or not they want to work with C stub code

Web Services Client for ILE

Step 1: Stub Generation – Creating a Web Services Proxy

- Developer generates stubs using:
 - Java tools (wsdl2ws.jar)
 - Qshell script - `wsdl2ws.sh -lc STOCKQ.wsdl`



RPG Client Application using StockQuote.c stub

Business application can reference the "stubs" using procedure names

```

H DFTNAME(GETQUOTERP)
DgetStub          PR          *   ExtProc('get_StockQuote_stub')
D pEndpoint       *          *   Value
*
DgetQuote         PR          4F   ExtProc('getQuote')
D pStockQuoteWS  *          *   Value
D pStockName     *          *   Value
*
DdestroyStub      PR          ExtProc('destroy_StockQuote_stub')
D pStockQuoteWS  *          *   Value
D StockQuoteWS   S          *
D Endpoint       S          100A
D StockName      S          10A
D fQuoteDollars  S          4F
D QuoteDollars   S          6P 3
D Output         S          50A
C                eval      Endpoint = 'http://cobolpv:9080' +
C                                '/StockQuote/services' +
C                                '/StockQuote' + X'00'

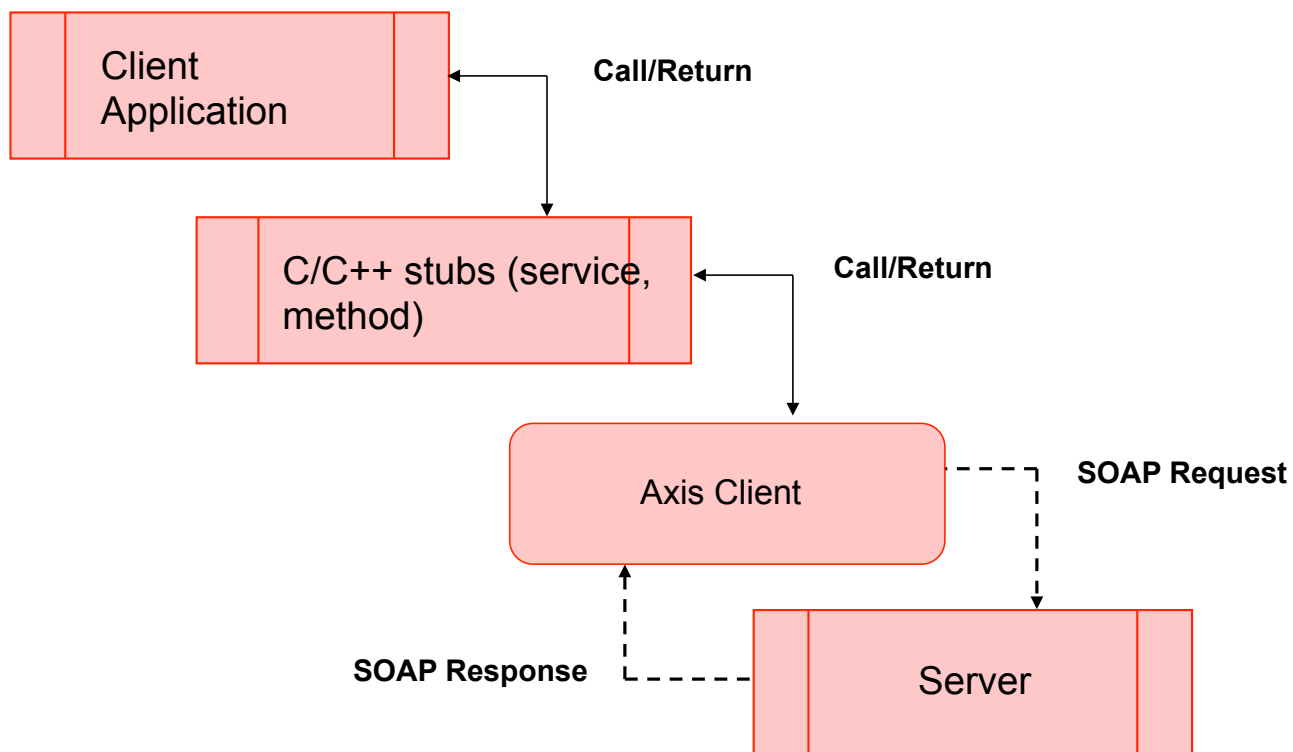
```

NOT ALL CODE SHOWN IN THIS EXAMPLE

Web Services Client for ILE

Step 2: Compile/Bind and Invocation

- Create the application that uses the stubs to invoke the Web service



WSDL2RPG Tool

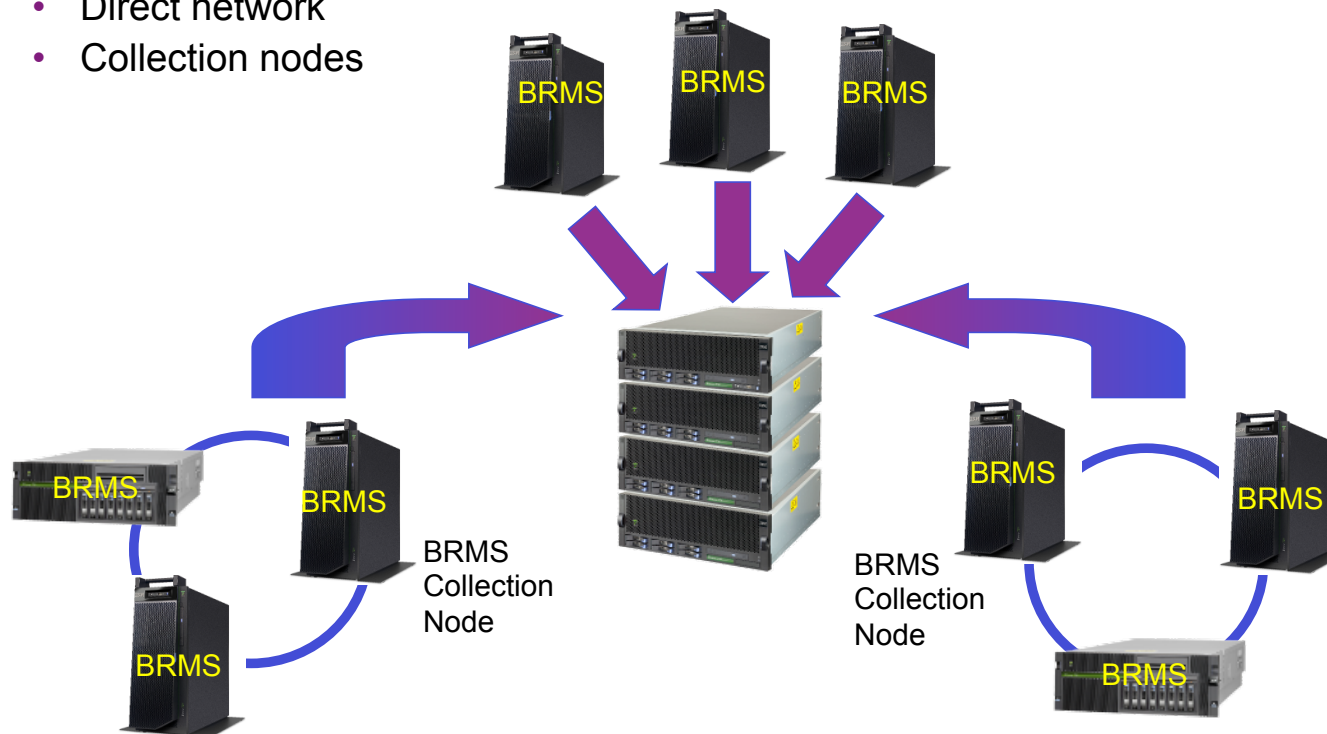
- WSDL2RPG generates RPG stub code directly from WSDL files
 - C stub code no longer needs to be called by user
 - Pure ILE RPG solution at their disposal
- RPG Stub code is less error prone
 - Parameters are clearly defined as RPG data structures instead of pointers
 - No need to map RPG prototypes to C procedures names
 - Overly complex WSDL files can still cause problem
 - No more memory management issues
- RPG programmers can stay in RPG and avoid C altogether

A Lot of Little Things



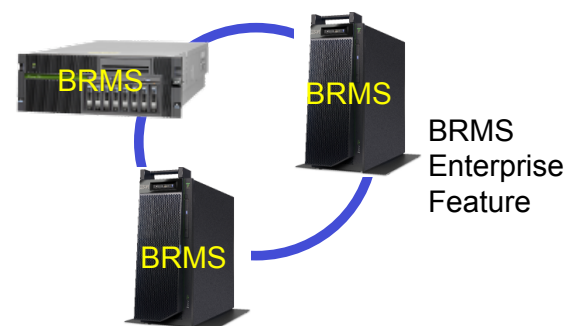
BRMS Enterprise Function

- For environments where there are multiple sites running BRMS
- Centralized site in enterprise for collection of BRMS data
 - Direct network
 - Collection nodes



BRMS Enterprise Function

- Central “Enterprise System” (HUB) pulls important information from systems (NODES) defined in its “Enterprise” network.
- Automates tasks to assist in managing health of BRMS backup/recovery
 - May generate
 - specific notifications
 - verifications
 - other functions
- Navigator for i GUI interface only
- Enterprise Capability being added to Advanced Feature of BRMS

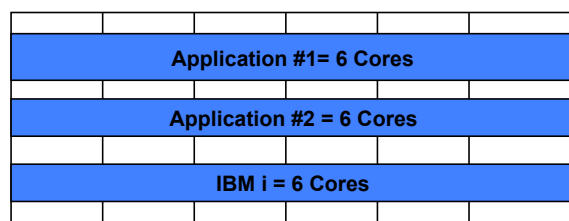


IBM i Workload Groups

Enhanced Management & Licensing

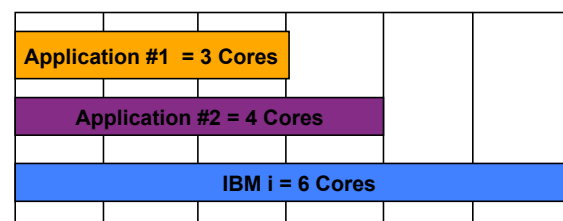
- Workload Groups new capabilities to manage/license workloads on IBM i
 - Limit the number of cores that are used by specific applications within single system/partition/subsystem
 - Limits placed at the whole processor-core level
 - Applications licensed for the number of capped cores
 - Can cap a single job or all jobs/threads in a subsystem

IBM i Today



IBM i System / Partition / Subsystem

IBM i with Workload Groups



IBM i System / Partition / Subsystem

<https://www.ibm.com/developerworks/mydeveloperworks/wikis/home?lang=en#/wiki/IBM%20i%20Technology%20Updates/page/IBM%20i%20workload%20groups>

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- Minimize risk
- Maximize ROI



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