



IBM System *i*™

## Moving RPG to an SOA Framework; A Step by Step Overview

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i want control.  
i want an *i*.*

Simplify IT

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## Why SOA?

### *Does this sound like applications in your shop?*

- Have difficulty in adapting applications for business changes
- Functionality within applications is not modularized to support reusability
- High costs, time consuming and lacks integration across business units
- Application portfolio misaligned to business strategy
- Proprietary applications are fragmented and unable to “talk to one another”
- Lack enterprise-wide, cross-data sharing capabilities
- IT resources are tied up with no bandwidth for new projects
- Uncertainty about the long-term role of the existing portfolio
- Difficulty linking applications to modern technologies

Does Implementing SOA Help?

## Why Modernize?

### The interface is changing.

- The preference is for GUI as opposed to green screen.
- Integration with new architectures requires modular code

### The Choices

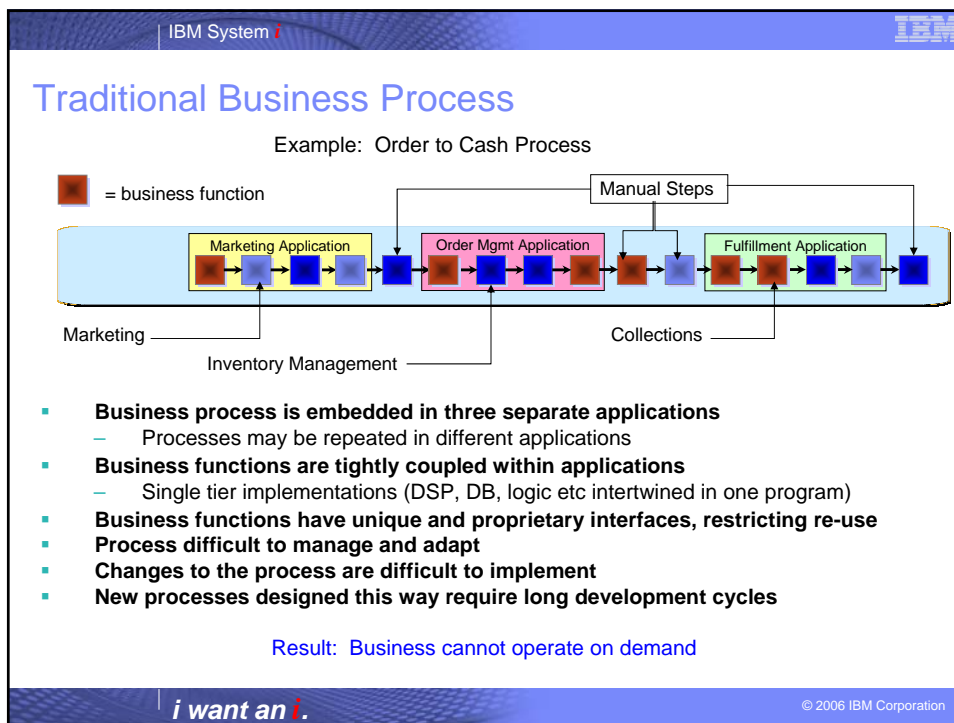
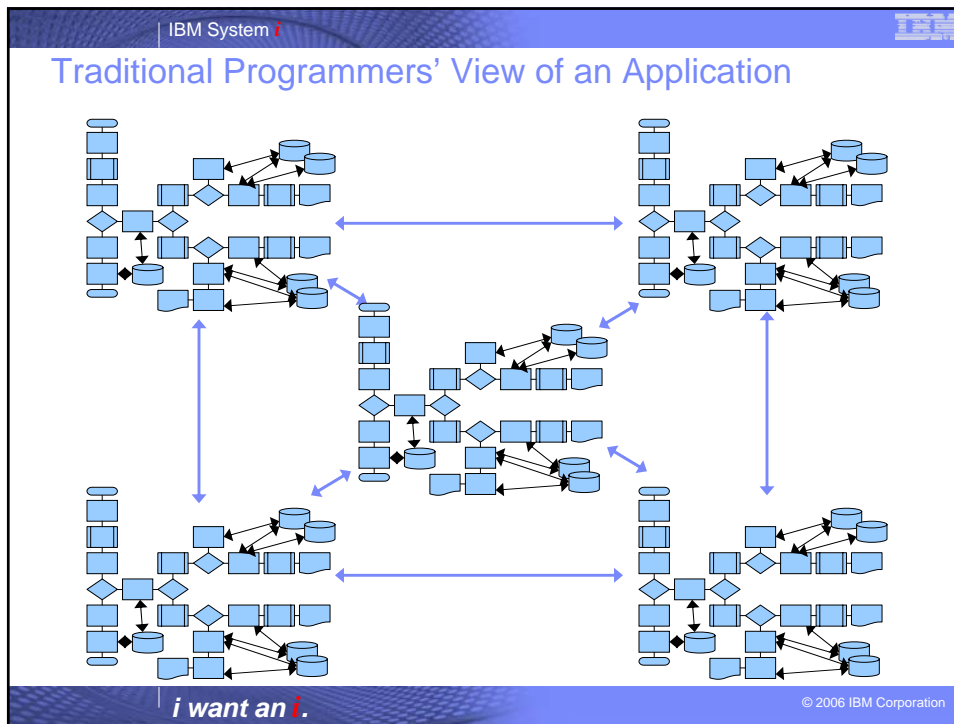
- Get new applications.
- Modernize current applications.

### Considerations

- Protect investment in current working code.
- Protect investment is staff who understand the *business* application.
- Protect investment in staff who understand the code.
- Reduce the maintenance overhead.

Does Implementing SOA Help?





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## Step 1: Customer Self Service

- Customers now order online using a web browser and the Internet
- Business partners can order using a web service call from their own process
- Customers are better served
- Reduces requirement for additional staff to take more orders


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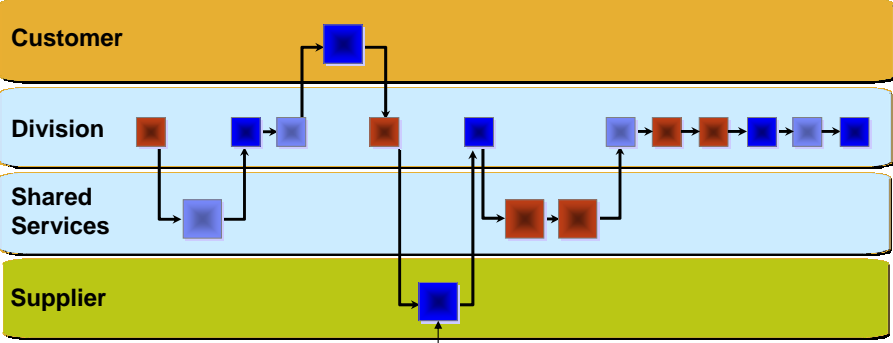
## Step 2: Remove Redundant Code

- Common business functions are shared across the enterprise
- Marketing, Billing, and Receivables are handled uniformly
- Enterprise can scale across divisions and lower costs

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### Step 3: "Just in Time" Inventory

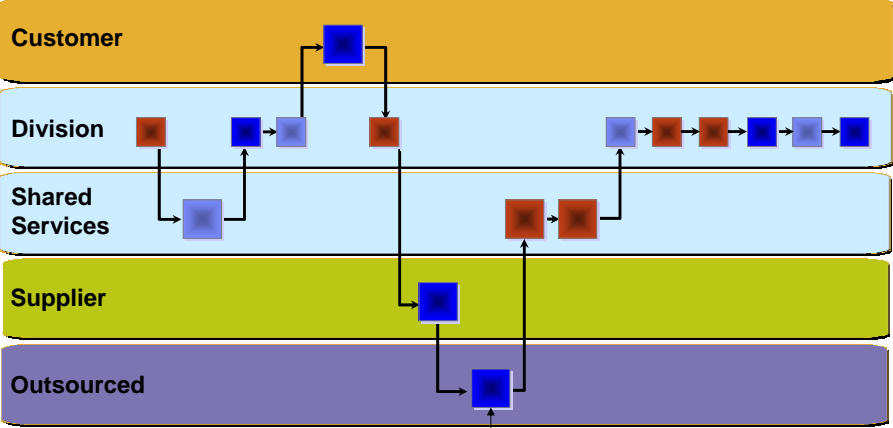


- Minimize or eliminate inventory management function
  - Suppliers responsibility to ship when inventory gets low
- Costs are reduced because less inventory is needed
- Inventory servicing is better because of supplier integration with the process

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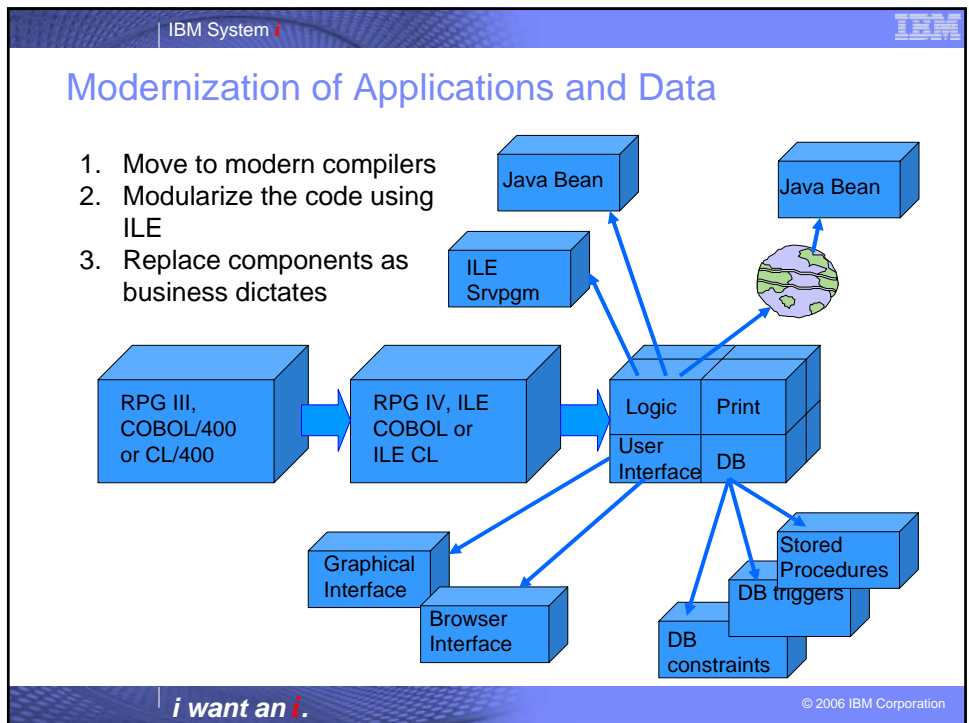
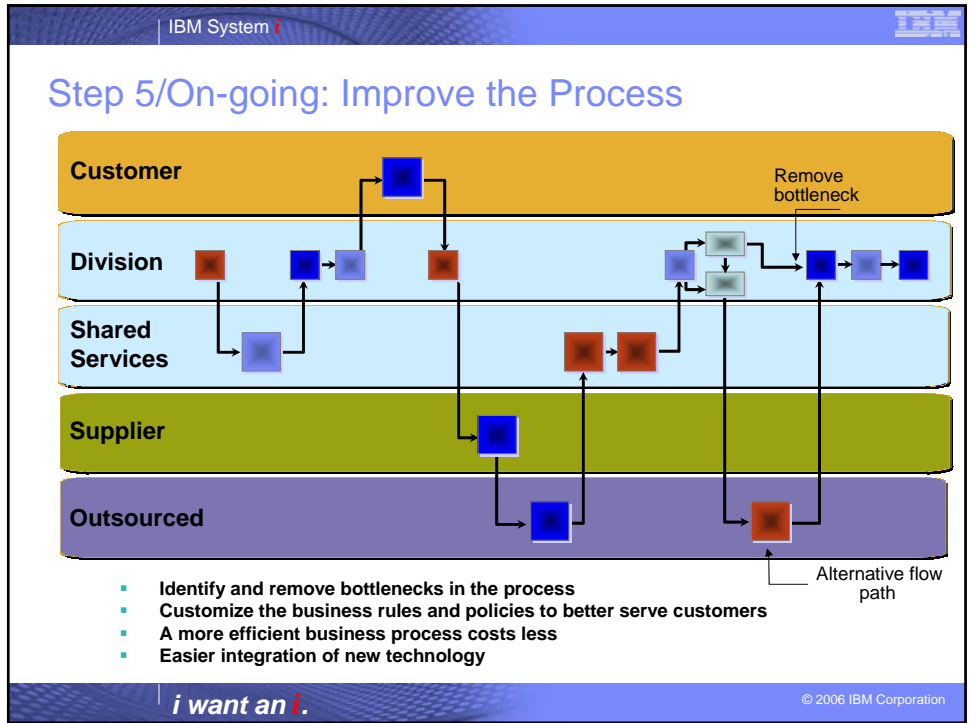
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### Step 4: Examine Viability and Off-Load as Required



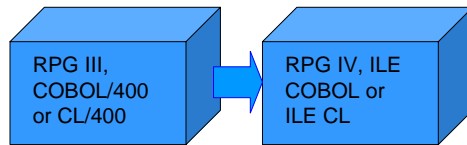
- Shipping is not a core competency
- Shipping companies (e.g. FedEx, DHL, UPS) have more capabilities
- Reduce shipping infrastructure and overhead costs
- Improve customer satisfaction - shipping/handling costs more accurate, maybe reduced

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## Modernization of Applications and Data

1. Move to modern compilers
2. Modularize the code using ILE
3. Replace components as business dictates



### RPG

- Procedures
- Local variables
- Integration with Java
- Extended names, expanded limits
- Ability to work with XML files

### COBOL

- Call to procedures
- Expanded limits
- Ability to work with XML files
- Current language standards

### CL

- New logic control commands
- Expanded number of files supported
- Variables

## Conversion to Modern Compilers

- **CVTRPGSRC – RPG III syntax to RPG IV syntax**
  - Converts to new specification layout
  - One conditioning indicator per line
  - Arrays converted to D-Specs
  - CODE/400 has the CVTRPGSRC option
    - Can view converted source prior to “saving” to the server
- **COBOL/400 to ILE COBOL**
  - Recompile as ILE COBOL
- **CL to ILE CL**
  - Recompile as ILE CL

## A Word on Conversion

- **CVTRPGSRC only does a *syntax* conversion**
  - It will work – almost 100%
  - No logic flow changed
- **COBOL and CL re-compiles**
  - No logic flow changed
- **Third party conversion tools offer re-engineering:**
  - Redefine data structures' fields by reordering them naturally, converting from/to positions to actual lengths, and indenting subfields.
  - Redefine \*LIKE DEFN-defined fields in the D-specs.
  - Redefine C-spec-defined fields in the D-specs.
  - Redefine any of the ADD, SUB, MULT, DIV, Z-ADD, Z-SUB, MOVE, MOVE, etc. operations as free-form EVAL operations.
  - Convert Operation Codes to their free form equivalent.
  - Perform case conversion to either lower case or mixed case.
- **Third party and local conversion GREATLY increase the likelihood of testing requirements.**
- **Important to understand the tool and its conversion process**

## Conversion – Vendor Tools

- **The programs have already been converted to RPG IV.**
- **Using the RPGWIZ conversion command in the RPG Toolbox from Linoma Software.**
  - Converted to Mixed Case.
  - Converted to Extended Factor 2.
    - Beware! You may not get the same results.
  - Field definitions moved to D Specs.
- **Using a local conversion program.**
  - Added a copy directive for a standard H SPEC.

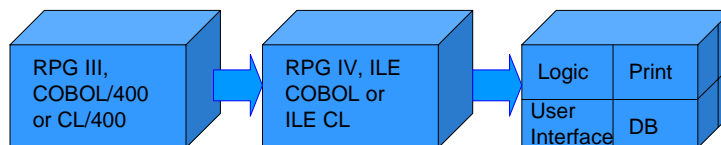
```
H Debug DatEdit(*MDY/) Option(*SrcStmt:*NoDebugIO)
```

## After Conversion - The Next Step

- **Start using BIFs.**
  - BIFs offer powerful coding methods.
  - Prepare you for later techniques
    - Subprocedures – writing your own BIFs.
- **Get rid of conditioning RPG Indicators (left and right)**
  - No longer required.
  - Take the opportunity to make indicators self explanatory.
- **Use Prototyped Calls.**
  - Have the compiler validate your parameters.
  - Get rid of parameter lists.
  - Make calls self documenting.
- **What about Free Form RPG?**

## Modernization of Applications and Data

1. Move to modern compilers
2. Modularize the code using ILE
3. Replace components as business dictates



### Modular Design

- Code reuse
- Improved quality of code

### Maintenance

- Less maintenance repetition
- Easier to determine location of required changes
- Compiles are faster?

### Distribution of business function

- Can distribute code as required

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## Integrated Language Environment

OS/400

ILE

JOB

OPM

- Dynamic or static binding
- One environment integrates all ILE languages
  - both traditional and procedure based
- Environment provides run-time behaviour
- OPM still available

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## Binding: By Copy and By Reference

\*PGM A

\*MODULE A \*MODULE B

CALLB B CALLPRC P2

RPG CL

Bind by Copy

Bind by Reference

\*SRVPGM S

\*MODULE X PRC X

\*MODULE Y PRC Y

\*MODULE Z PRC P1 PRC P2

Multiple Call Entry Points

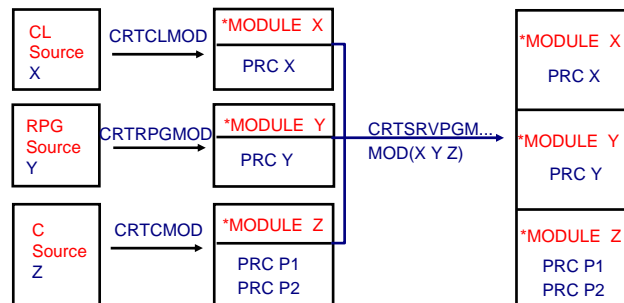
- Both are static (bound) calls
  - static calls are significantly faster than dynamic
- Completion of reference bind on 1st call to \*PGM A
  - dynamic bind to \*SRVPGM S
  - then, all bound calls to 'S' are static

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## Service Programs

- \*SRVPGM object type
- A collection of commonly used modules packaged together
- A kind of "subroutine library"
- Uses fast static call - static bind by reference
- Cannot be called dynamically
- Multiple entry points



## RPG IV Subprocedures

- This is the RPG IV name for a User-Defined Procedure or BIF
- Subprocedures can:
  - Define their own local variables
    - This provides for "safer" development since only the code associated with the variable can change its content
  - Access Global variables
    - Those defined in the main body of the source
    - This includes access to any files defined in the program
  - Be called recursively
- The Compilation Unit can have any number of subprocedures
  - Each must have its own prototype
- By "Compilation Unit" we mean those source lines processed by the compiler in a single compilation
  - This includes any /COPY members

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## Taking Inventory

**DATABOROUGH**  
legacy enhancement solutions

- Impact Analysis
- Structure Charts
- Data Flows
- Data Modelling
- Pseudo Code
- Word & Visio Export
- Business Rules
- Drill-down Inquiry

REDP4046 - Modernizing and Improving the Maintainability of RPG Applications Using X-Analysis Version 5.6

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## Modernization of Applications and Data

1. Move to modern compilers
2. Modularize the code using ILE
3. Replace components as business dictates
  - User interface – Web GUI, Rich client

ReFacing

- Translation of data stream

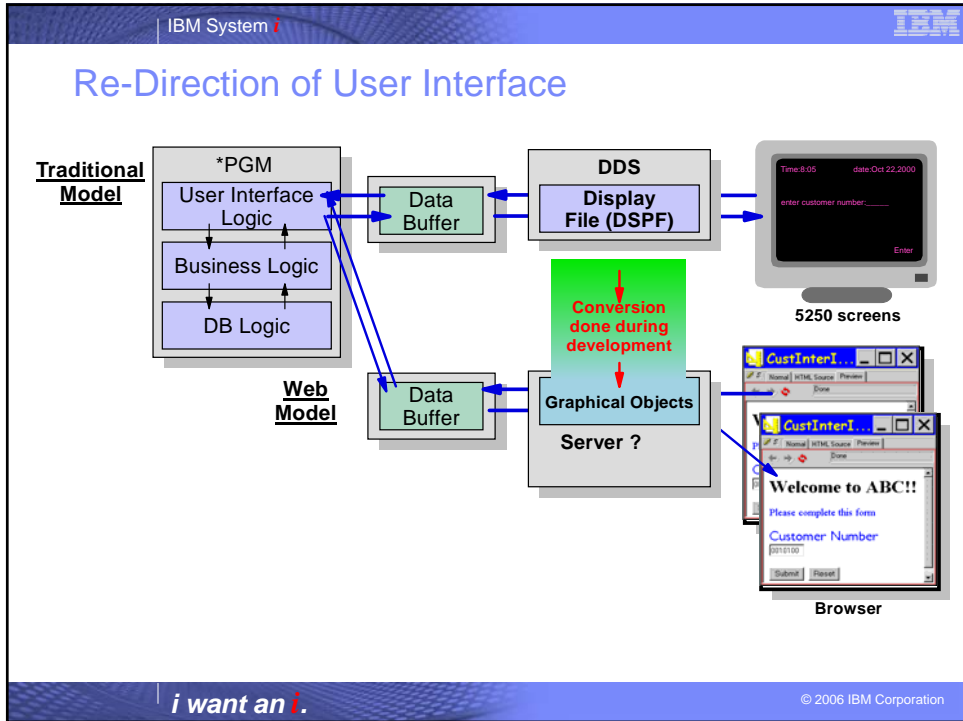
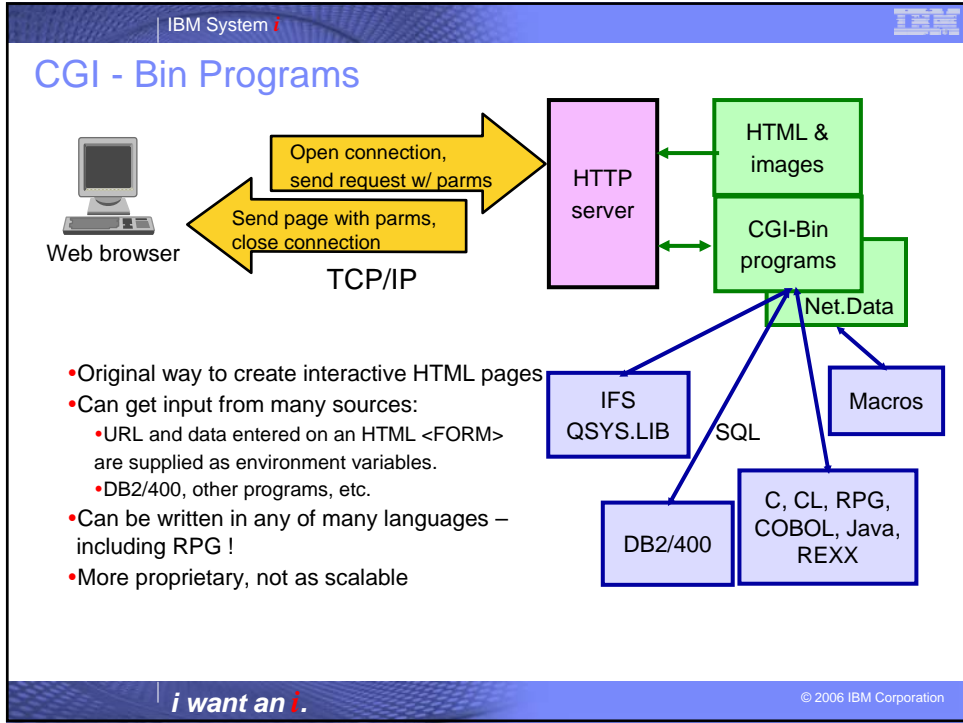
Re-direction

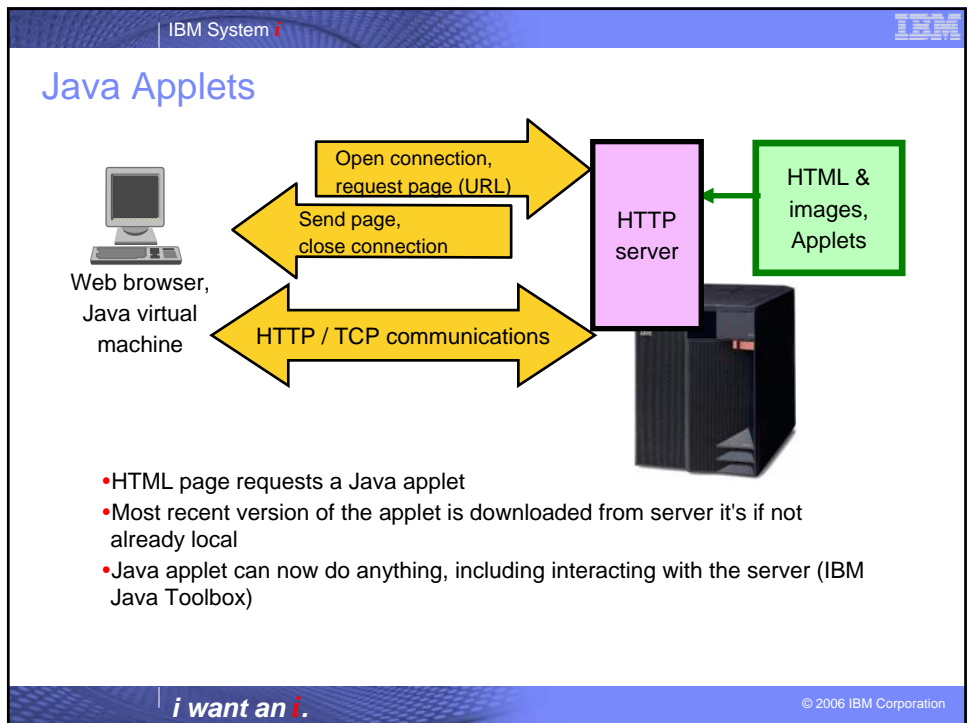
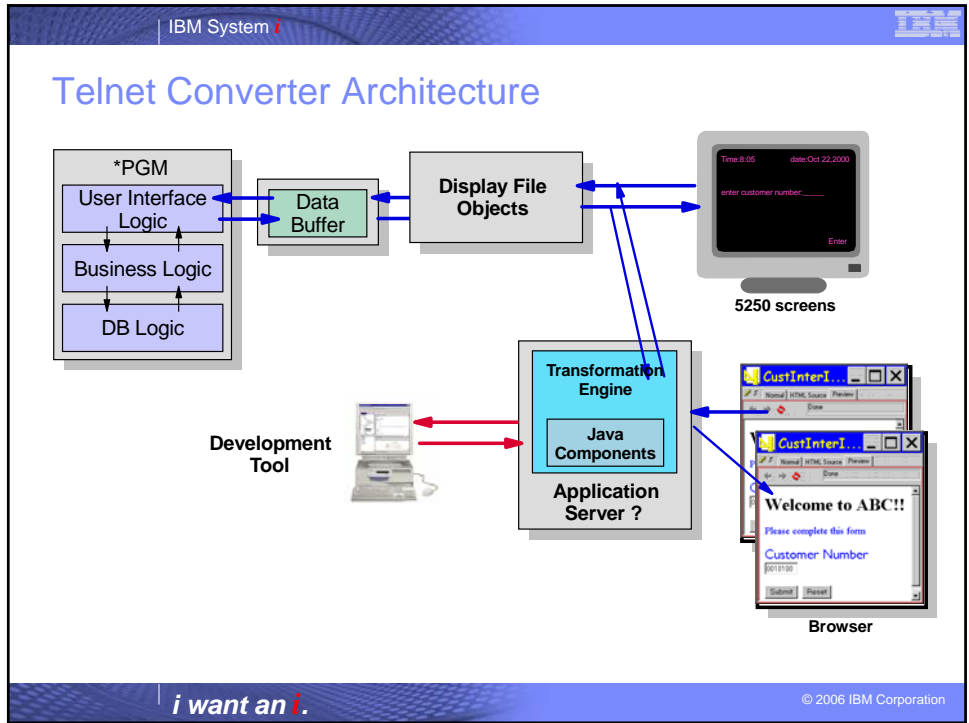
- Alternate interface with re-direct intercept

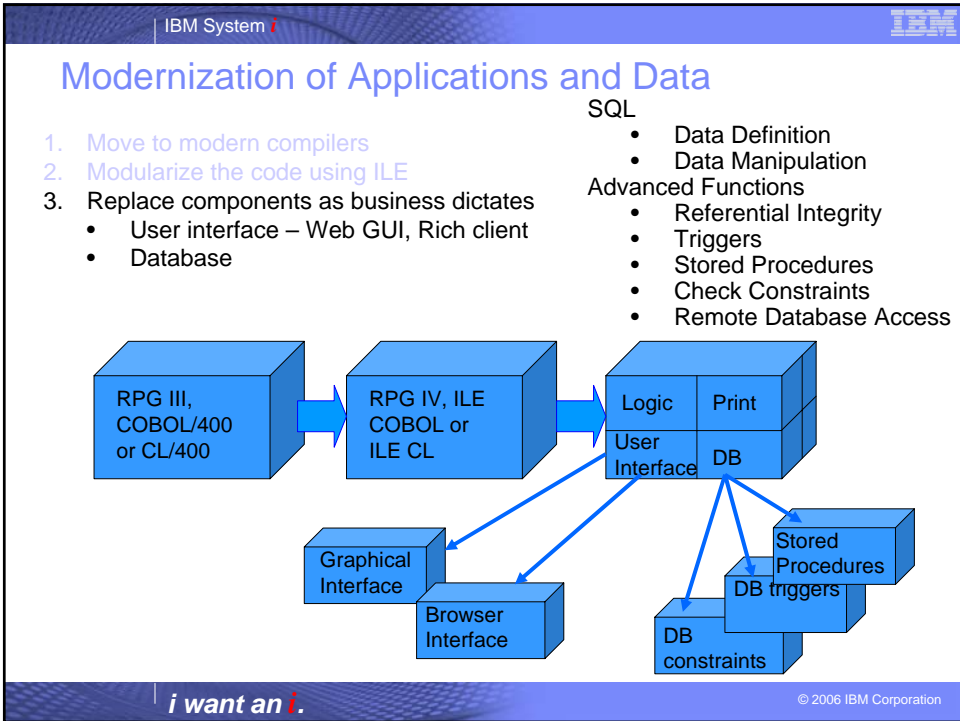
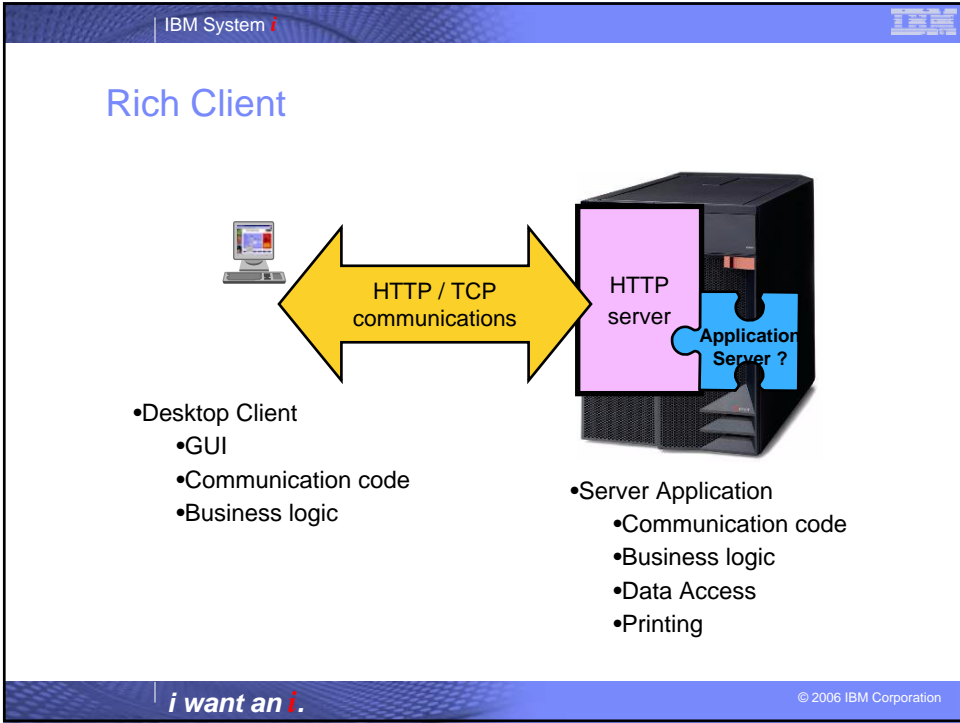
Crafting of new

- CGI-bin
- Java – JSP, JSP, rich client

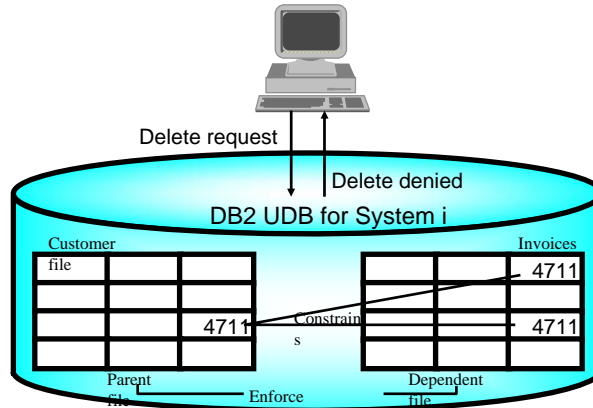
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## What is Referential Integrity?



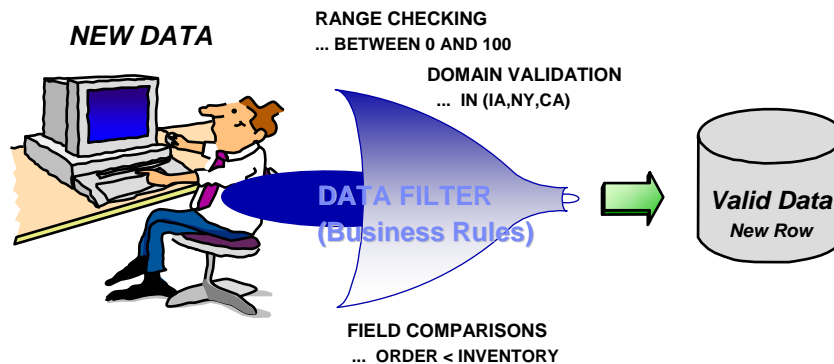
- A capability provided by the database management system to ensure
  - logical consistency of data values between files
  - validity of data relationships
  - robust enforcement of integrity constraints

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## Check Constraints

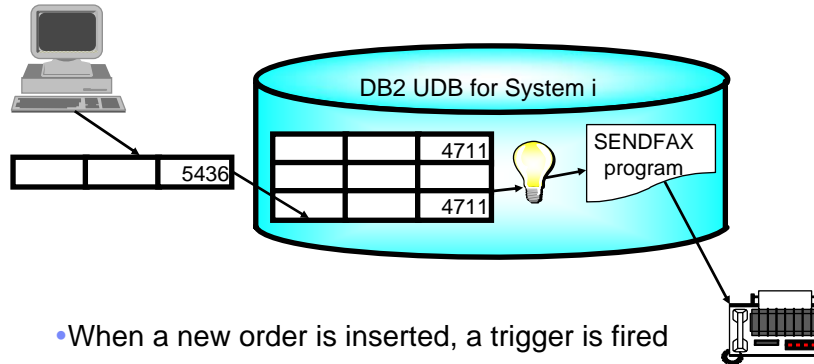
What are they?



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## Triggers: An Example



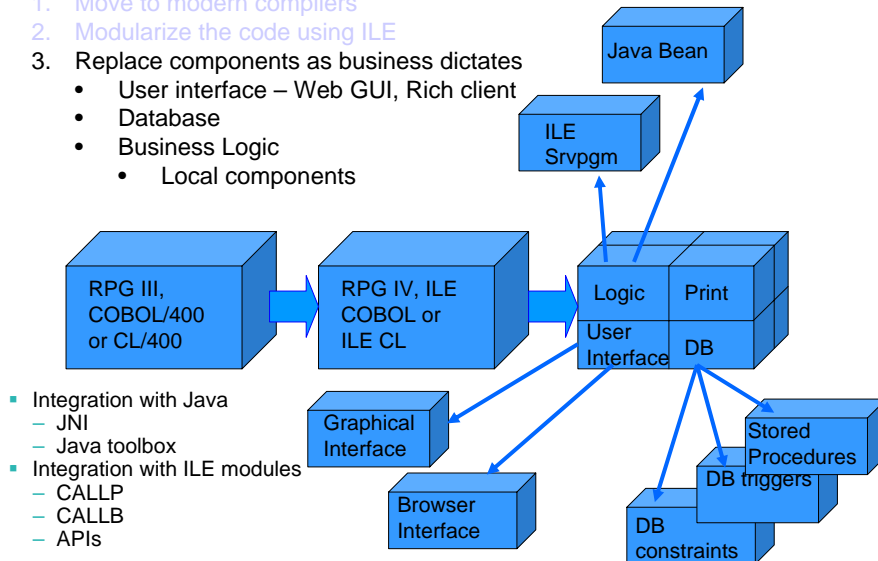
- When a new order is inserted, a trigger is fired
- Trigger retrieves information about order and customer
- A confirmation fax is automatically sent

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## Modernization of Applications and Data

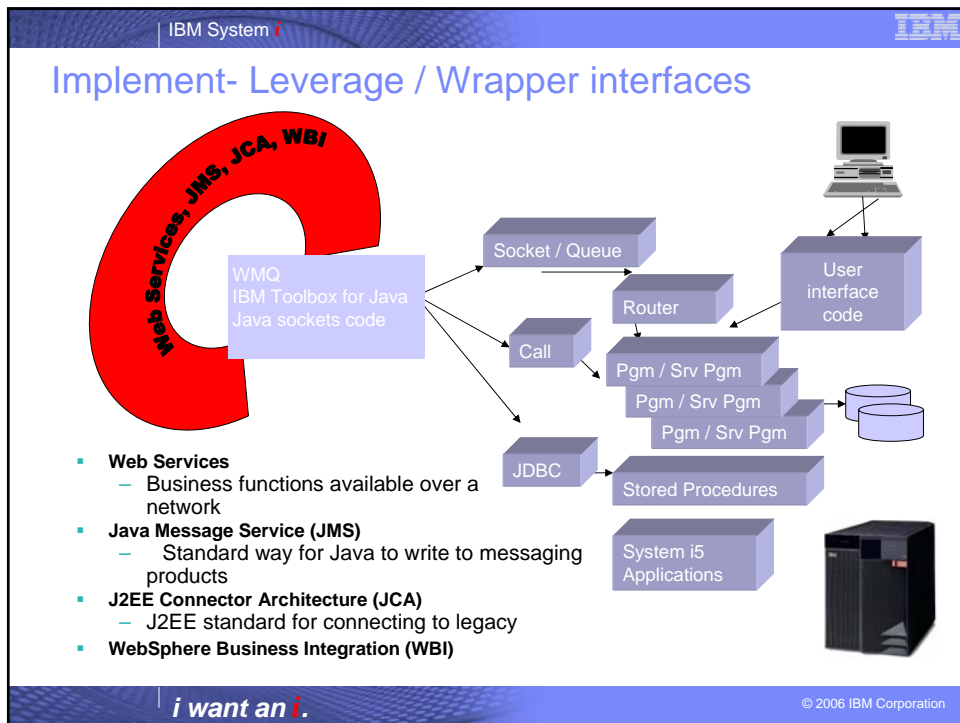
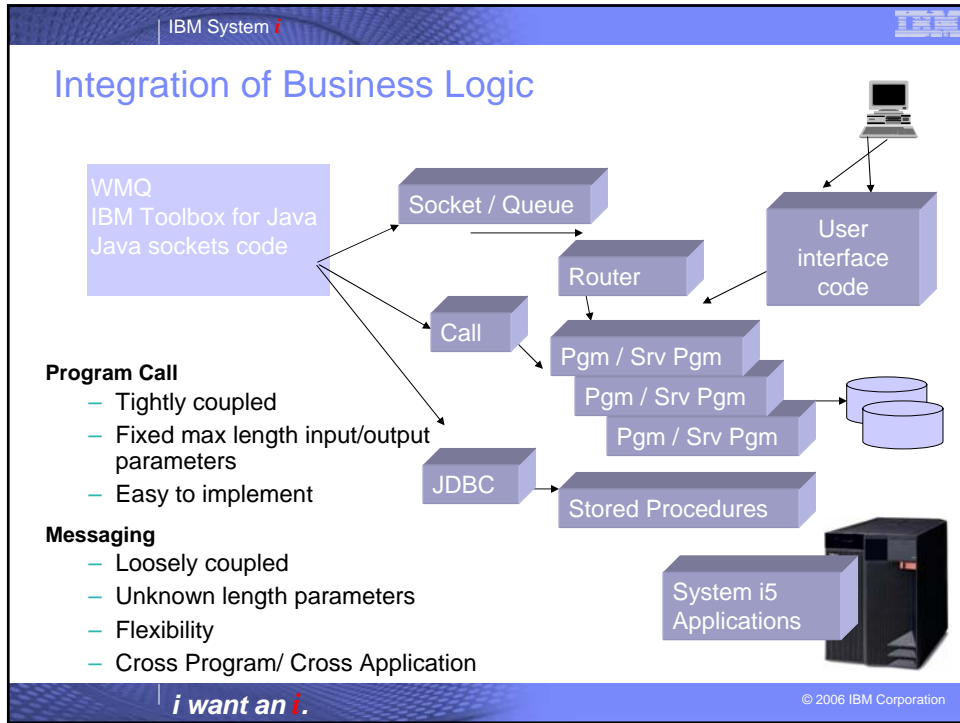
1. Move to modern compilers
2. Modularize the code using ILE
3. Replace components as business dictates
  - User interface – Web GUI, Rich client
  - Database
  - Business Logic
    - Local components



- Integration with Java
  - JNI
  - Java toolbox
- Integration with ILE modules
  - CALLP
  - CALLB
  - APIs

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## Modernization of Applications and Data

1. Move to modern compilers
2. Modularize the code using ILE
3. Replace components as business dictates
  - User interface – Web GUI, Rich client
  - Database
  - Business Logic
    - Local components
    - Remote components

Web Services

- Java
- RPG, COBOL
- Other

XML

- Transfer of data

Transaction Processing

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## Integration of Applications

**Problem:**

- Integrating software applications across multiple operating systems, programming languages, and hardware platforms is
  - Difficult
  - Not something that can be solved by any one particular proprietary environment
- Traditionally, the problem has been one of tight-coupling
  - One application that calls a remote network is tied strongly to it by the function call it makes and the parameters it requests
  - Fixed interface to access remote programs or data, with little flexibility or adaptability to changing environments or needs
- Web services technology allows applications to communicate in a platform, and programming language independent manner

**Solutions:**

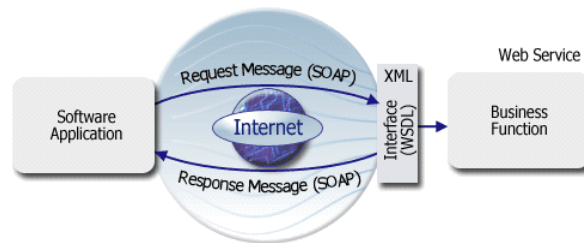
- Web Services
- Other XML
- Other Solutions

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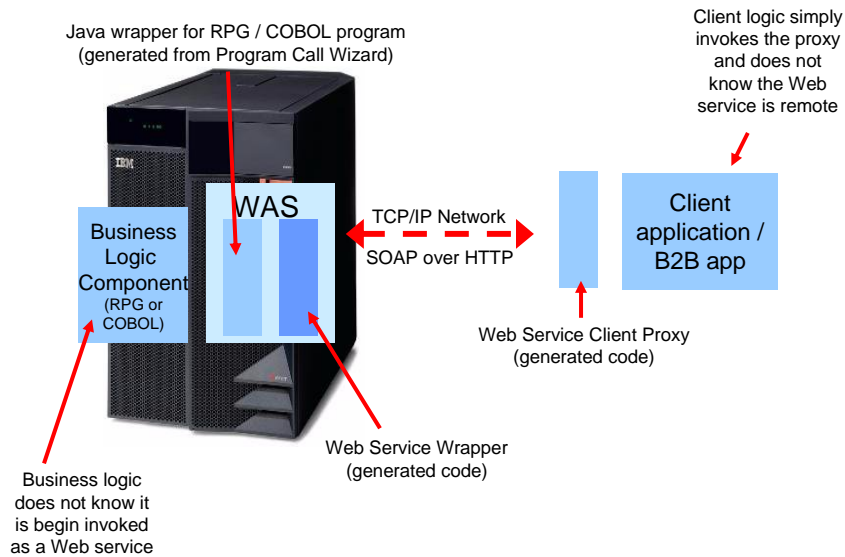
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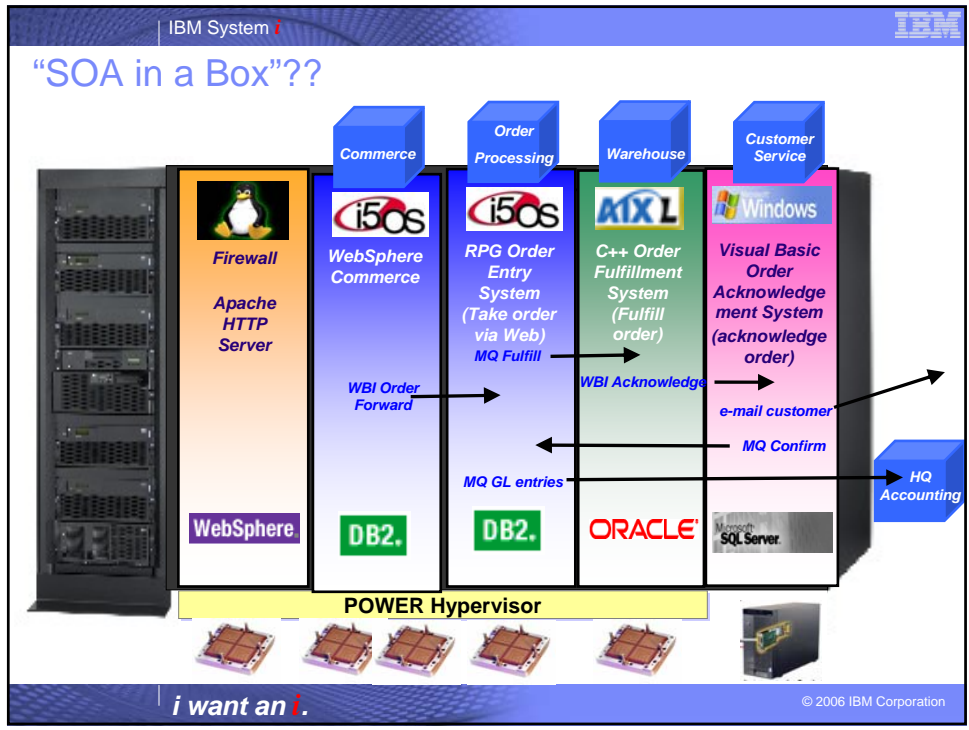
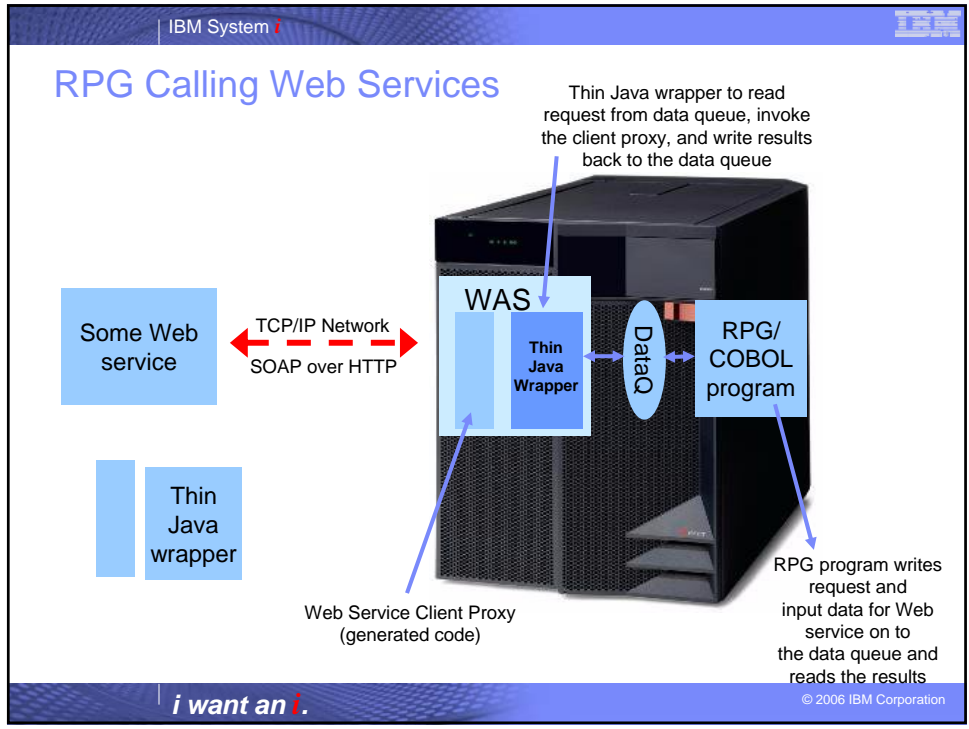
## What are Web Services?

- Web services are self-contained software components, with a well-defined interface
- Extensible Markup Language (XML) is a standardized language used for interface description
- Web services use protocols based on XML to describe
  - operations that can be executed
  - data that can be exchanged with other programs or web services



## Overview With System i





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## Summary

1. Move to modern compilers
2. Modularize the code using ILE
3. Replace components as business dictates

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