Overview of CICS Integration Options

CICS Integration Wildfire Workshop

IBM Washington Systems Center

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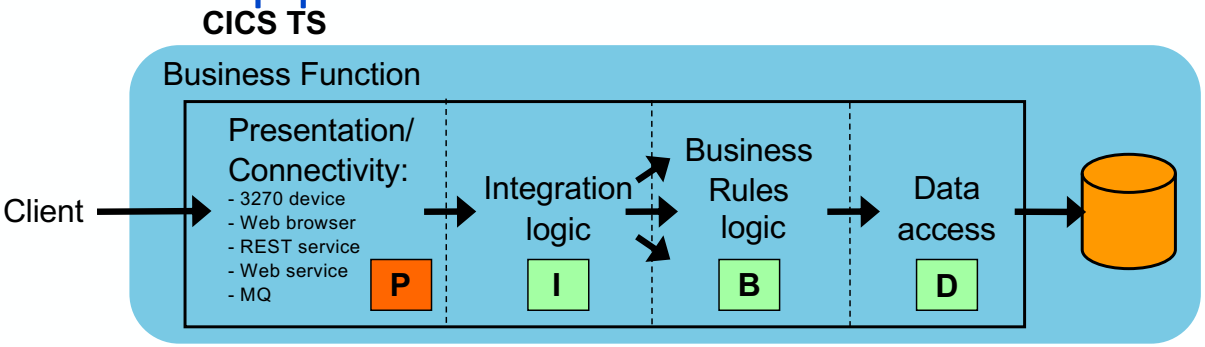
Topic Abstract

- This topic is an overview of all CICS integration technologies. While all connectivity options will be surveyed, emphasis will be placed on the newer connectivity options that enable Web services, REST services, Atom feeds, Event processing, Servlets and JSPs, and SCA.

Agenda

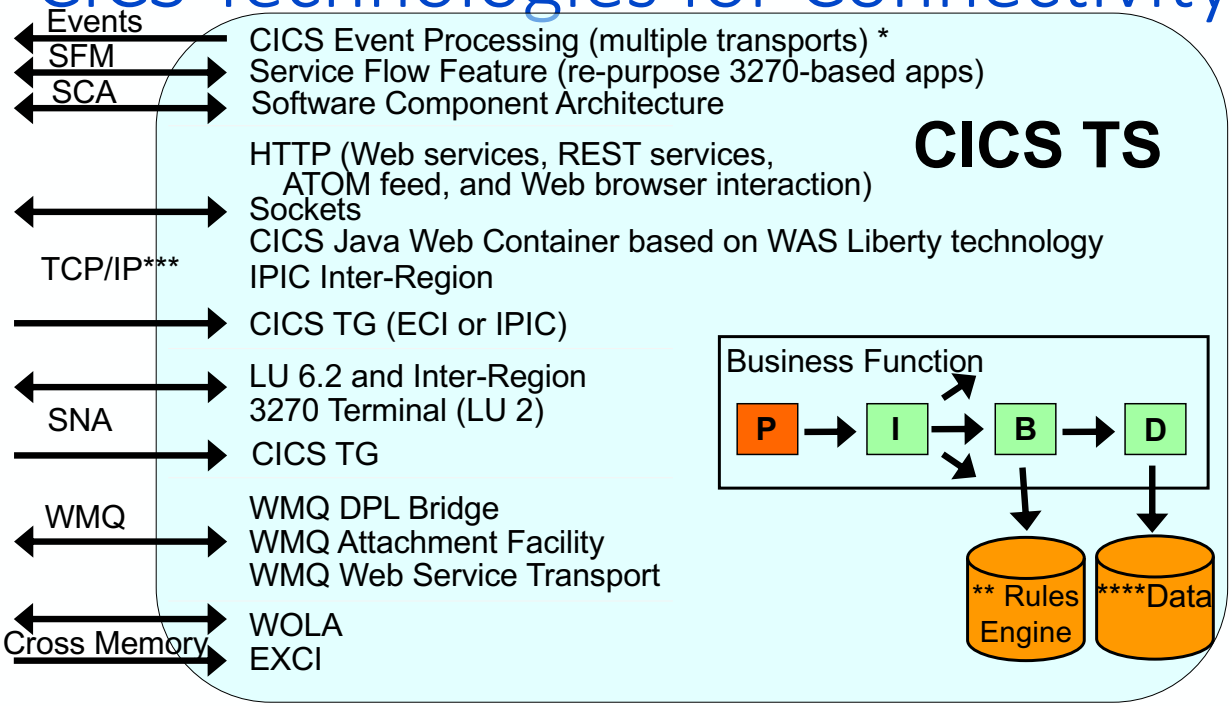
- CICS in the Server Role
- TCP/IP
  - HTTP
    - Web Support
    - Web Services
    - REST Services
    - ATOM Support
    - Servlets and JSPs
  - IPIC
- SNA
- WMQ
- Cross Memory: EXCI and WOLA
- Event Processing
- Java

CICS Application Architecture



- **Best practice in CICS application design is to separate key elements of the application, in particular:**
  - Presentation logic - 3270, HTML, XML, JSON, Servlets
  - Integration or Aggregation logic - Menu, router, tooling
  - Business Rules logic - Reusable component
  - Data access logic - VSAM, DB2, IMS, …
- **Provides a framework for reuse and facilitates separation of concerns, clear interfaces, ownership, and optimization**

CICS Technologies for Connectivity



* Events can have different transports or CICS can process its own events
** IBM Operational Decision Manager
*** IBM Worklight – can access CICS Data using REST, Web Services, and ATOM feeds
**** VSAM, DB2, and IMS

CICS TCPIP Connectivity Options

- HTTP
  - Web browser interfaces
  - Web services
  - REST services
  - ATOM feeds
  - Servlets and JSPs
- Sockets
  - Provided by Communications Server
- IPIC
  - Region-to-Region Communications
  - Protocol option with CICS TG
- ECI
  - Protocol option with CICS TG

CICS TCP/IP Connectivity Options

HTTP

The URL - Directing Requests using HTTP

- Scheme – http or https
- Host name or address
- Port (optional)
- Path
- queryString (may or may not see these on URL)
  - Name=value pairs separated by an '&'

```
http://demomvs.demopkg.ibm.com:8091/account?name=Dennis&state=
TX

scheme://host:port/path?queryString
```

HTTP Request

- **Request Line: method absolute_path http_version**

```
post /account/lookup HTTP/1.1
```

- **Headers: name:value;name:value;etc:etc**

```
Accept: */*;Accept: image/jpeg;Content-length: 44
```

- **Blank Line : Carriage return Line feed twice**

- **Body : URL encoded forms data : name=value pairs**

```
field1=stringa&field2=stringb&field3=stringc
```

HTTP Response

- **Status Line:** HTTP_version status_code response_phrase

```
HTTP/1.1 200 ok
```

- **Headers:** name:value;name:value;etc:etc

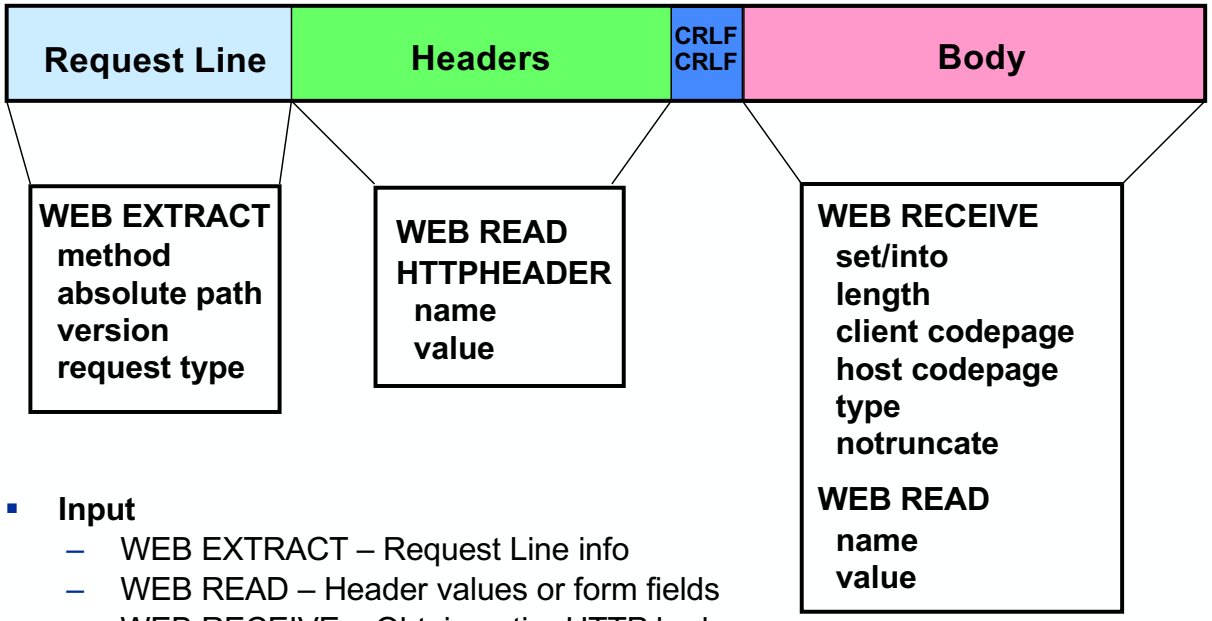
```
Content-type: text/html;Content-length: 54
```

- **Blank Line :** Carriage return Line feed twice

- **Body :** HTML tags and text

```
<html><title>A Sample</title><h1>Sample 1</h1>...
```

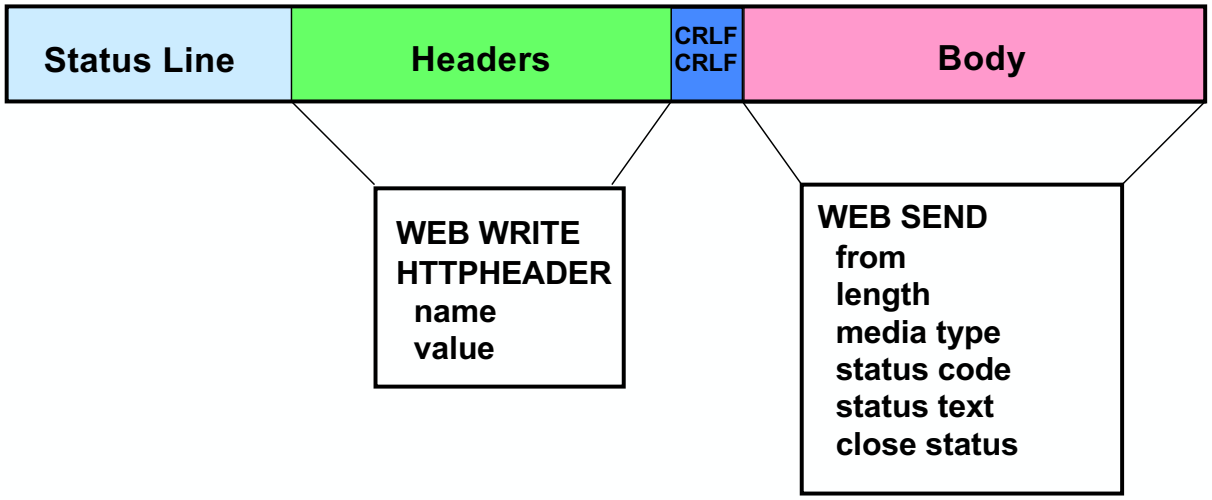
CICS APIs for HTTP Interaction



- **Input**
  - WEB EXTRACT – Request Line info
  - WEB READ – Header values or form fields
  - WEB RECEIVE – Obtain entire HTTP body

- **CICS can also be an HTTP Requester**
  - Send/receive, or converse

CICS APIs for HTTP Interaction



- **Output**
  - –Document API – compose dynamic content
  - –WEB SEND – Send return data

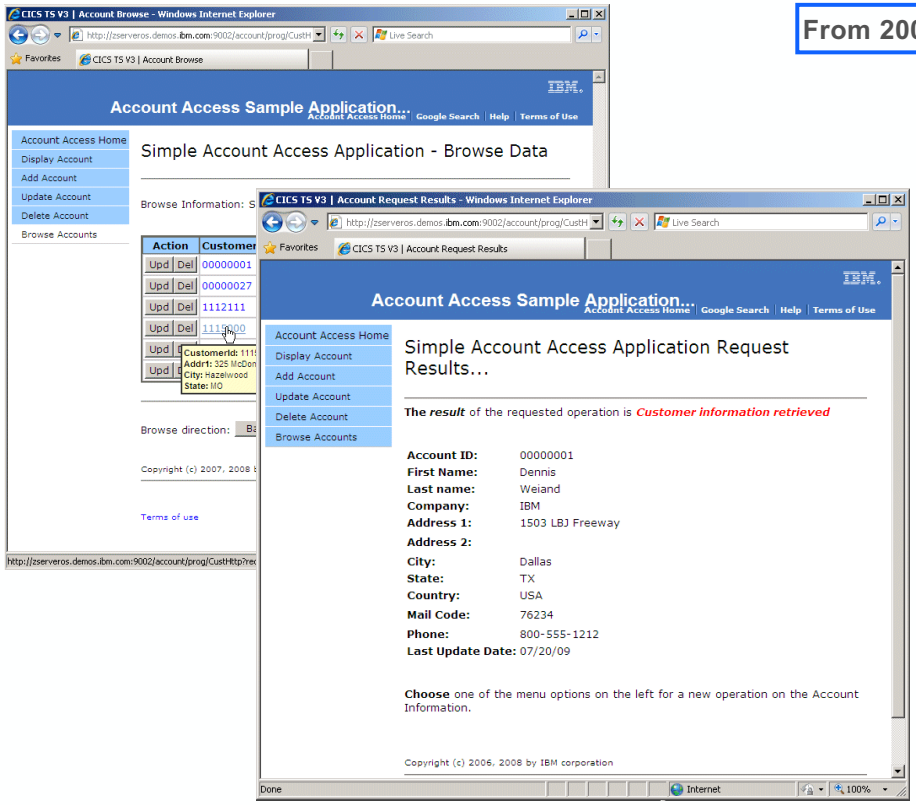
URIMAP

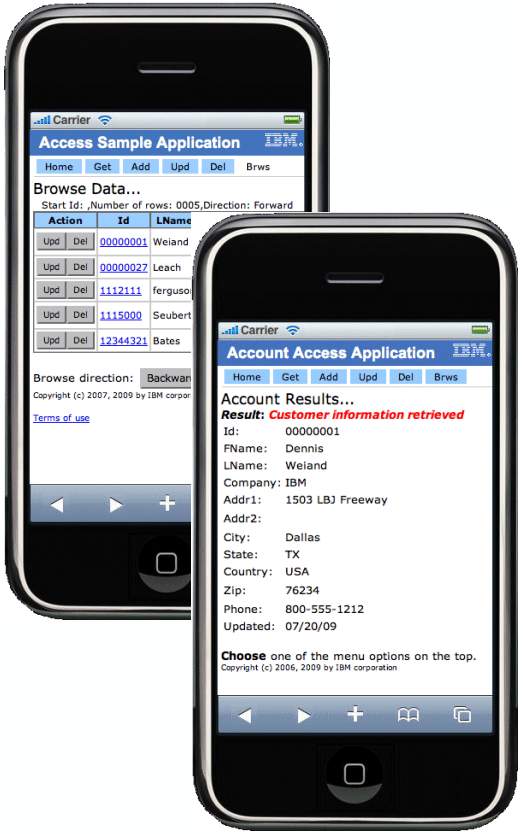
- For CICS as an HTTP server
  - Replaces and simplifies the function provided by the CICS Web support analyzer exit
  - Static response, such as a DOCTEMPLATE or HFS file
    - Static HTML
    - Cascading Style Sheets
    - Javascript
    - Graphics
  - Dynamic response – Request is directed to an application program or a PIPELINE
  - Redirection to another server
- For a CICS application as an HTTP client
  - Applications should use a URIMAP name to avoid hard coding URLs of HTTP servers

```
 Urimap       : CUSTURI1
 Group        : DDWCUST
 Description  :
 STatus       : Enabled
 USAge        : Server
UNIVERSAL RESOURCE IDENTIFIER
 Scheme       :HTTP
 HOST         : *
 Path         : account/*
...
 TCpipservice :
 Analyzer     : No
 Converter    :
 Transaction  :
 Program      :
...
 Mediatype    : text/html
 CHaracterset : iso-8859-1
 HOSTCodepage : 1047
 TEmplatename :
 HFsfile      : /u/dweiand/html/*
```

Simple Browser-based Application Interface

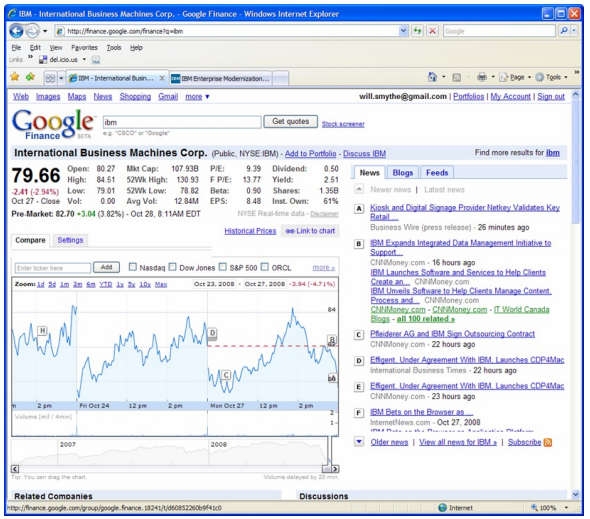
From 2005





Modern Browser-based Application Characteristics

- Rich user experience with minimal page transitions
- Dynamic content
- Data asynchronously retrieved via REST or SOAP service calls
- Client-side validation
- User encouraged to add value
- Simplified user interface
- Integration of relevant data from multiple sources
- Commonly referred to as Web 2.0

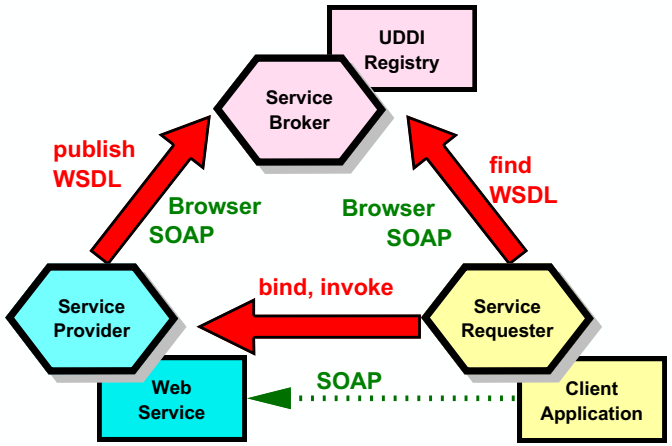


CICS TCP/IP Connectivity Options

Web Services

Web Services: Terminology

- Architecture for
  - Application to application
    - Communication
    - Interoperation
- Definition:
  - Web Services are software components described via **WSDL** that are capable of being accessed via standard network protocols such as **SOAP** over **HTTP**
- WS-I.org (Web Services Interoperability Organization):
  - An organization to ensure interoperability



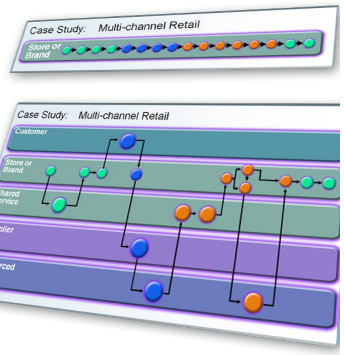
The entire industry is agreeing on one set of standards !!

Associated technology: Service Oriented Architecture

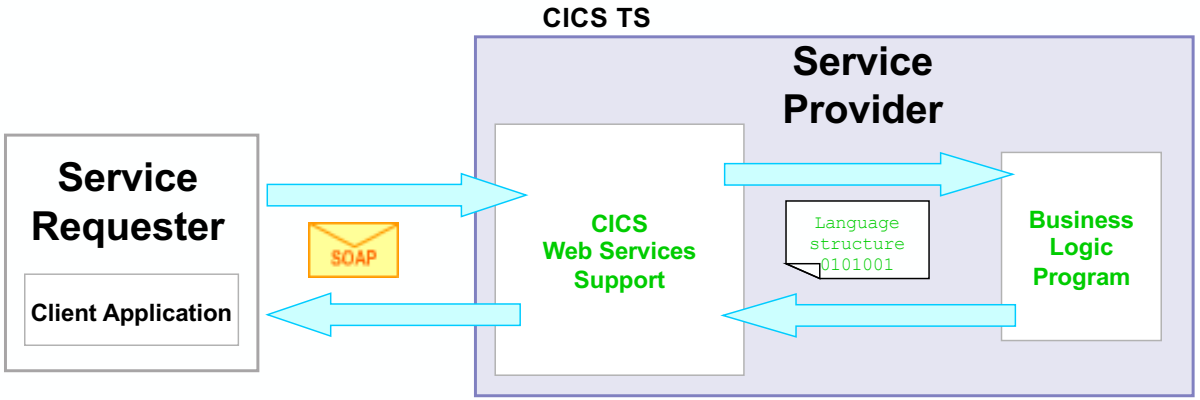
- Reuse of Services (encapsulated Business functions)
- Align with Business process to respond faster to Business needs
- Compose new applications by combining Services

SOA Levels

- Service Enablement - Transform existing applications to services
- Service Integration –Align with business, abstract integration layer, look into ESB
- Process Integration – Composite applications with process choreography and service aggregation



CICS as a Web Service Provider



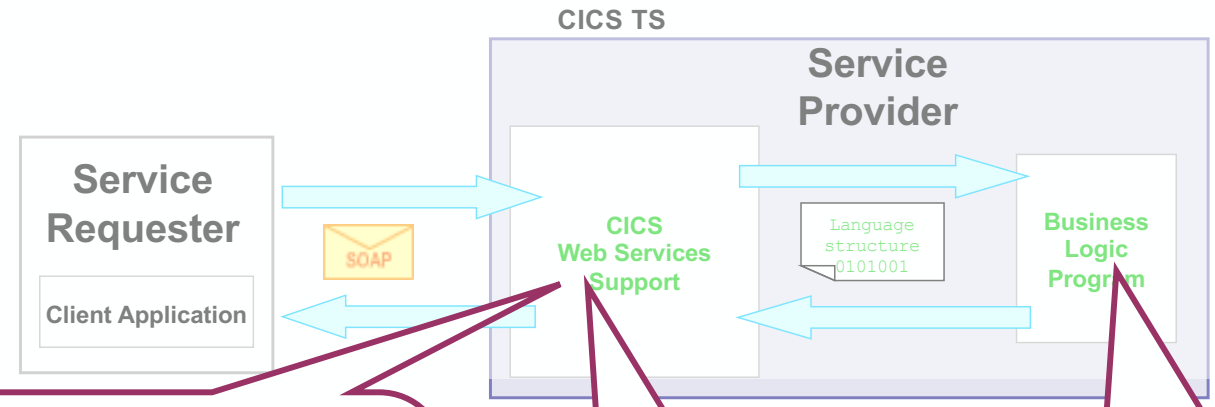
SOAP Message - XML, tag delimited data, one body, zero or more headers

zero or more headers | **body containing application data**

Languages Structure – e.g. COBOL copybook

```
01 DFHCOMMAREA.
      03  CUSTOMER-FIRST-NAME  PIC X(30).
      03  CUSTOMER-LAST-NAME   PIC X(30).
      ...
```

CICS as a Web Service Provider



Since CICS TS V3.1
- CICS parses SOAP request into a COMMAREA or Channel and Containers
- Since V4.1, Initial general parse is zAAP eligible
- Field level parse can be zAAP eligible if using RDz

Batch utilities provided with CICS (or use RDz) to generate or start with either a copybook or WSDL

Any CICS-supported programming language

Web services: Tooling

- CICS Web Services Assistant
  - Batch utilities
- IBM Developer for System z (IDz)
  - Eclipse-based
  - Additional language constructs supported
  - Can generate COBOL converter program with PARSE verb
    - Can be zAAP eligible
- Both allow for the various development styles
  - Top down
  - Bottom up
  - Meet in the middle
- Can also invoke web services and can also return faults
  - EXEC CICS INVOKE SERVICE, and EXEC SOAPFAULT CREATE

Web services: CICS TS Web Service Standards Support

- Both HTTP and WebSphere MQ network layers supported
  - HTTP 1.0 and 1.1 supported
  - CICS applications acting as providers or requesters are agnostic to transport mechanism used
- XML Encryption Syntax and Processing — interoperability with entities using XML
- XML Signature Syntax and Processing — interoperability with entities using XML
- SOAP 1.1 and 1.2 — to send and receive Web services messages
- WSDL 1.1 and 2.0 — to describe Web service interfaces (WSDL 2.0 in TS 3.2)
- WSDL 1.1 Binding Extension for SOAP 1.2 for Interoperability with interfaces
- WS-I Basic Profile 1.1 — for interoperability between providers and requesters using SOAP
- WS-I Simple SOAP Binding Profile 1.0 — for interoperability using SOAP
- WS-AtomicTransaction — for propagating transactional context
- WS-Coordination — for coordinating transaction outcome
- WS-Security — for authentication and encryption of all or part of a message *(PK22736)* username token profile 1.0, X.509 Certificate Token
- WS-Trust — for establish trust relationships (in TS 3.2)
- MTOM / XOP — for efficient handling of large messages (in TS 3.2)
- SOAP 1.1 Binding for MTOM 1.0 — to describe the use of MTOM (in TS 3.2)
- WS-Addressing — to indicate request and response routing (in TS 4.1)

CICS TCP/IP Connectivity Options

REST Services

REST Services

- Similar in concept to hyperlinked data
- Lightweight data transfer
- Representational State Transfer
  - Nouns (URLs) indicate what is being worked on
  - Verbs (GET, PUT, POST, DELETE) indicate the action to be performed (List, Create, Read, Update, Delete)
- Format of results is not defined
  - Popular formats of returned data are XML and JSON
- Can use EXEC CICS TRANSFORM for XML parse/create
- Recent CICS feature for creating JSON
- Approaches in CICS
  - CICS WEB API
  - ATOM Feed
  - Servlet and JSP (Liberty Profile)
  - JAX-RS (Liberty Profile)

REST Service Requests

Request URI	HTTP Method	Event
Collection URI, e.g.: `http://xyz.com/prefix/myResource`	**GET**	**List**
	POST	**Create**
	PUT	
	DELETE	
Member URI, e.g.: `http://xyz.com/prefix/myResource/resourceID`	**GET**	**Retrieve**
	POST	
	PUT	**update**
	DELETE	**delete**

REST Simple Sample

- Request

```
GET /mortgage/231677 HTTP/1.1
  Host: www.example.com
  Accept-Language: en
  Charset: UTF-8
```

- Response

or

```
HTTP/1.1 200 OK
  Language: en_us
  Charset: UTF-8
  Content-Type: text/json
{“principal”:”238000”,”rate”:”3.5”, “type”:”5/1 ARM”}
```

```
HTTP/1.1 200 OK
  Language: en_us
  Charset: UTF-8
  Content-Type: text/xml
<mortgage><principal>238000</principal><rate>3.5</rate><type>5/1 ARM</type></mortgage>
```

CICS TCP/IP Connectivity Options

JSON Support

JSON (JavaScript Object Notation)…

- JavaScript Object Notation
  - Data in attribute-value pairs
  - Used primarily to transmit data between a server and web application
  - Alternative to XML
- Originally based on JavaScript –
  - Most commonly used in web browsers
  - Dynamic computer programming language
- JSON MIME type
  - Official: “application/json”
  - Unofficial: “text/json” or “text/javascript”

JSON (JavaScript Object Notation)…

- Attribute-value pairs (example of JSON)

```
{
  "id": 1,
  "name": "Foo",
  "price": 123,
  "tags": [ "Bar", "Eek" ],
  "stock": {
       "warehouse": 300,
       "retail": 20
     }
}
```

- **Info about JSON schema: `http://json-schema.org/`**
- **Info about JSON schema core definitions and terminolgy: `http://tools.ietf.org/html/draft-zyp-json-schema-04`**
- **Info about JSON schema interactive and non-interactive validation: `http://tools.ieft.org/html/draft-fge-json-schema-validation-00`**

JSON (JavaScript Object Notation)…

- Can be requested from a web browser using AJAX (Asynchronous JavaScript And XML)

```
var my_JSON_object;
var http_request = new XMLHttpRequest(); http_request.open("GET", url,
true); http_request.onreadystatechange = function () {
   var done = 4, ok = 200;
   if (http_request.readyState === done &&
         http_request.status === ok) {
   my_JSON_object =
         JSON.parse('''http_request.responseText''');
 }
};
http_request.send(null);
```

JSON with CICS TS

- CICS native support for JSON—delivered in V5.2; use Feature Pack for CICS TS V4.2 and V5.1. (all languages supported in CICS)
- JAX-RS and JSON4J (in the Liberty Profile) (Java)
- CICS Transaction Gateway (inbound only)
- zOS Connect
  - Running in a stand-alone server (WOLA or IPIC to CICS)
  - Build toolkit, API toolkit

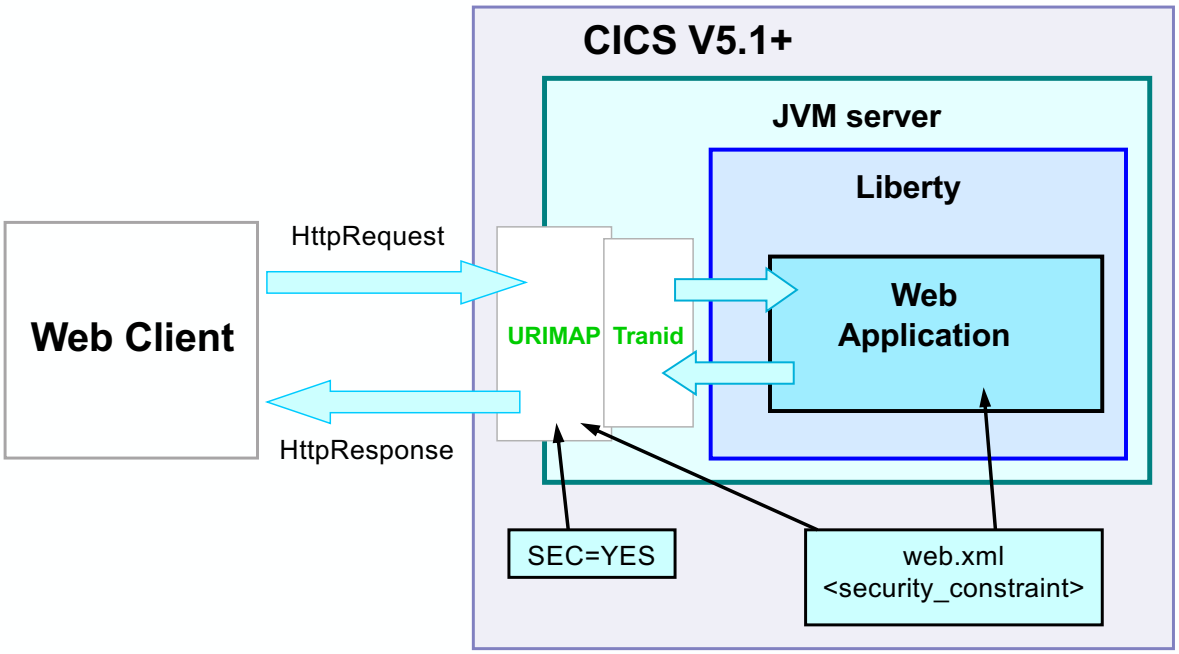
JSON in CICS TS

- JSON support in CICS:
  - JSON web services
    - Bottom-up – start with a copybook
      - Request-response (aka RPC) style service only
    - Top down – start with a JSON schema
      - Request-response style service
      - RESTful style service
  - JSON Transformer Linkable Interface (callable)
    - Bottom up – start with a copybook description and generate the ‘transforms’ to have a JSON string in a program converted into a copybook (and vice versa)
    - Top down – start with a JSON schema and generated the ‘transforms’ to have a JSON string in a program converted into a copybook (and vice versa
- In the Liberty profile (JAX-RS and JSON4J) (Java)

CICS TCP/IP Options – Related Technology

Java Servlets and JSPs

JV Servlets and JSP support…



- Standard Java APIs (Servlet, JSP, JDBC)
- Supports much of the Liberty Profile
- Can use the JCICS API or EXEC CICS LINK to a program in any language

Java Servlets and JSP support…

- Supports Java servlets and JavaServer Pages (JSPs) and RESTful clients, connectivity to DB2 (type 2 driver)
- CICS TS also supports distributed transactions, a type 4 JDBC driver, and Liberty security
- CICS's support built on the WAS Liberty profile technology
- Highly configurable
- Can use the JCICS and JCICSX classes along with JEE 8 and 9 and Spring Boot framework.
- Can use Eclipse, Rational Application Developer (RAD), and IBM Developer for System z (Idz) as well as other IDEs to develop servlets and JSPs
- Define BUNDLE resource for your application
- Several samples

CICS Servlets and JSP support

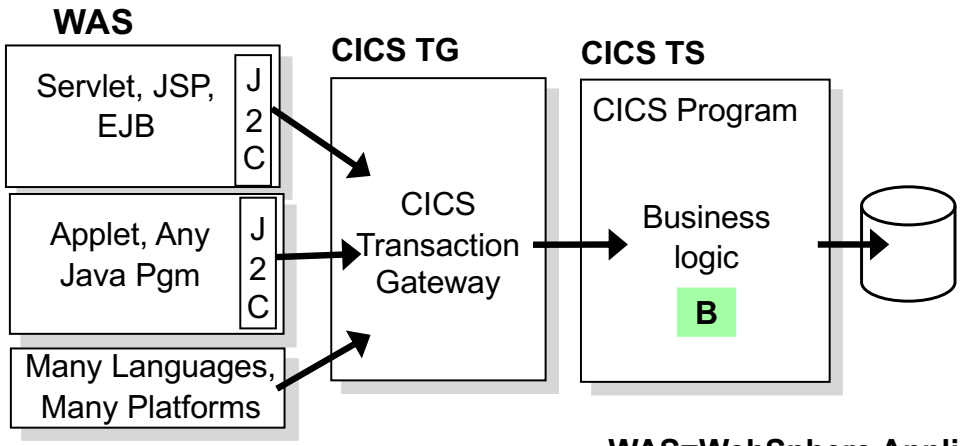
- Uses Java 8+ (64-bit)
- Can use CICS basic authentication
- Can run under Liberty security
- By default, task runs under the CJSA transaction
- Can add a URIMAP and TRANSACTION resource to a CICS bundle if you want to run under a specific transaction

CICS TCP/IP Connectivity Options

CICS Transaction Gateway, Sockets, and IPIC

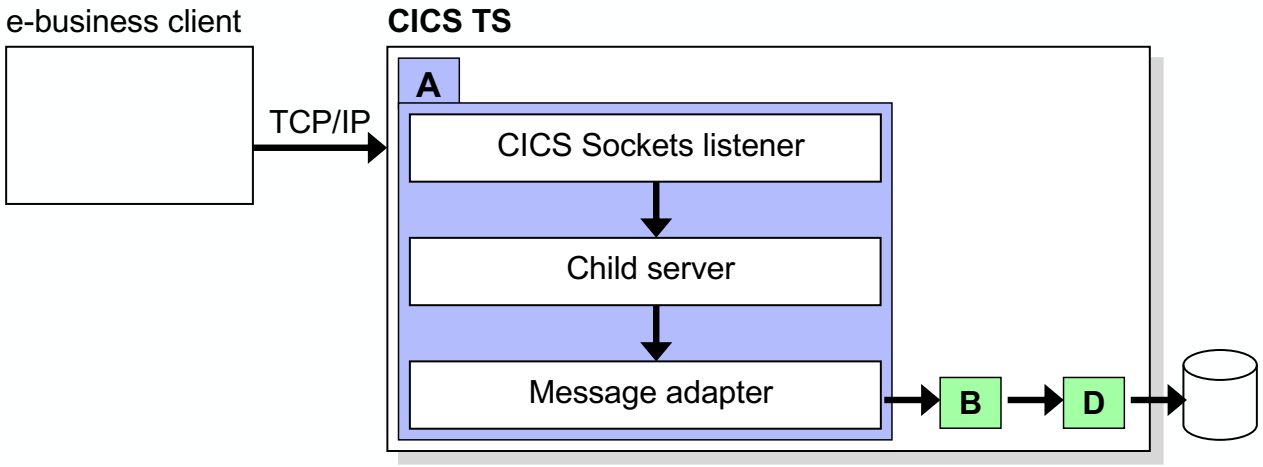
CICS Transaction Gateway

- Enabler for the Java Connector Architecture (J2C)
- Using C, C++, C#, VB, COBOL on workstation
- COMMAREA or channel and containers
- Supported with any JEE 1.4 or higher compliant application server
- SNA or TCP/IP (ECI, IPIC) to CICS



WAS=WebSphere Application Server

TCP/IP Sockets

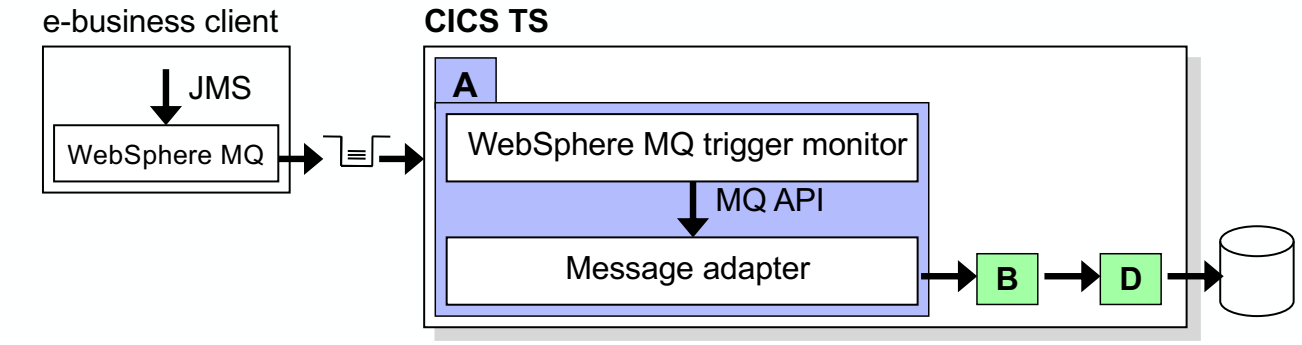


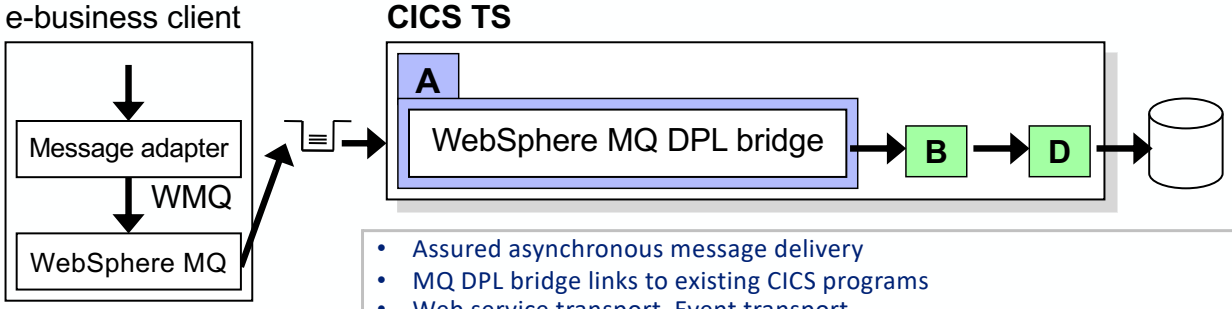
- *CICS Sockets provides a completely programmable solution where other access options are not suitable*
- *Support for sockets is provided by Communications Server*

CICS & MQ Connectivity Options

- The messaging Interface to CICS
  - MQ Attachment Facility
  - MQ DPL Bridge
  - MQ as a Web service transport
  - Can be a transport for CICS Events

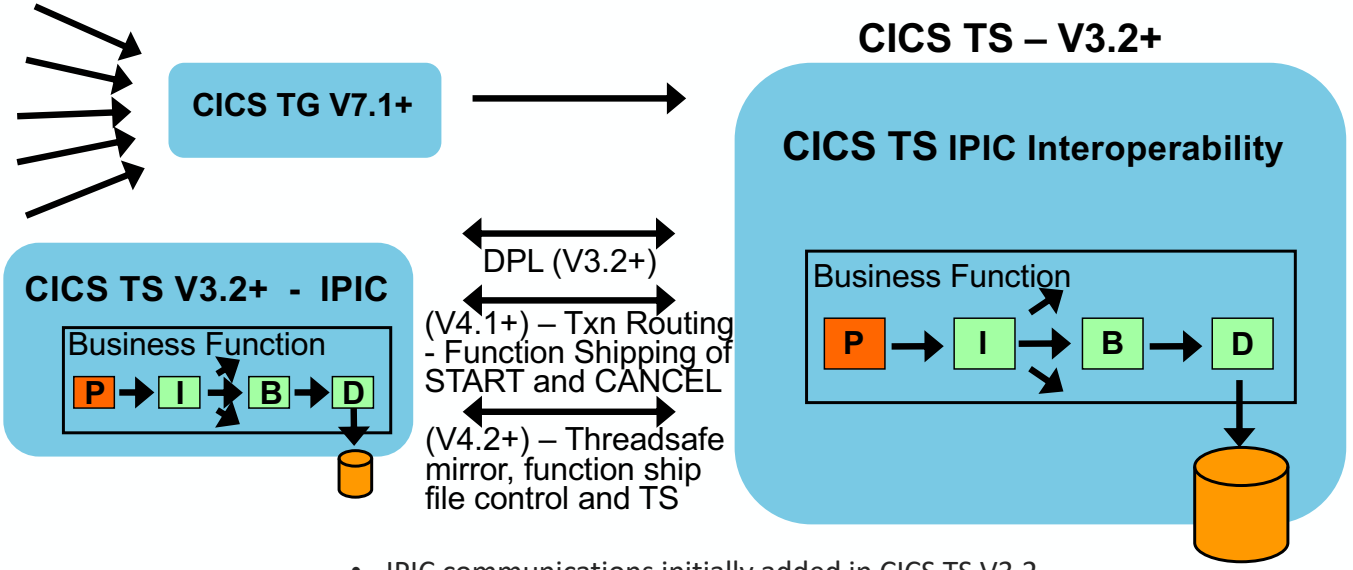
WMQ Interoperability Options





- Assured asynchronous message delivery
- MQ DPL bridge links to existing CICS programs
- Web service transport, Event transport
- MQ calls are threadsafe
- Group Attach and Group unit of recovery

IPIC Interoperability

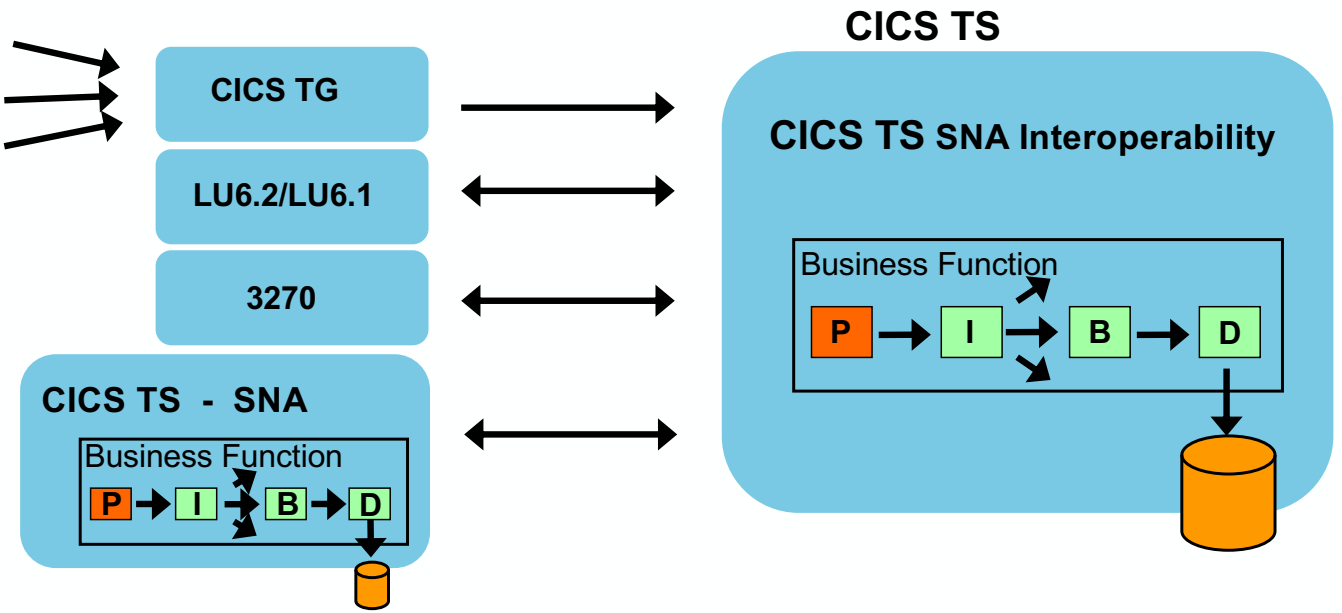


- IPIC communications initially added in CICS TS V3.2
- Provides DPL between CICS regions (V3.2 or higher)
- Provides transaction routing and Function Shipping of START and CANCEL requests between CICS regions (V4.1 or higher)
- CICS TS V4.2: Threadsafe mirror, function shipping of file control and TS
- Can be used with CICS Transaction Gateway V7.1 or higher
- Allows for channels and containers communications between CICS TG and CICS

CICS SNA Options

- SNA (Systems Network Architecture) has been available in CICS for several releases
- SNA is mature and stable
- CICS will enhance IPIC where it makes sense.

SNA Interoperability Options



- SNA (Systems Network Architecture has been around a long time, is very mature, and very stable). can be used for…
  - Region-to-region communications
  - CICS Transaction Gateway
  - LU6.2 and LU6.1
  - SNA-based 3270 devices

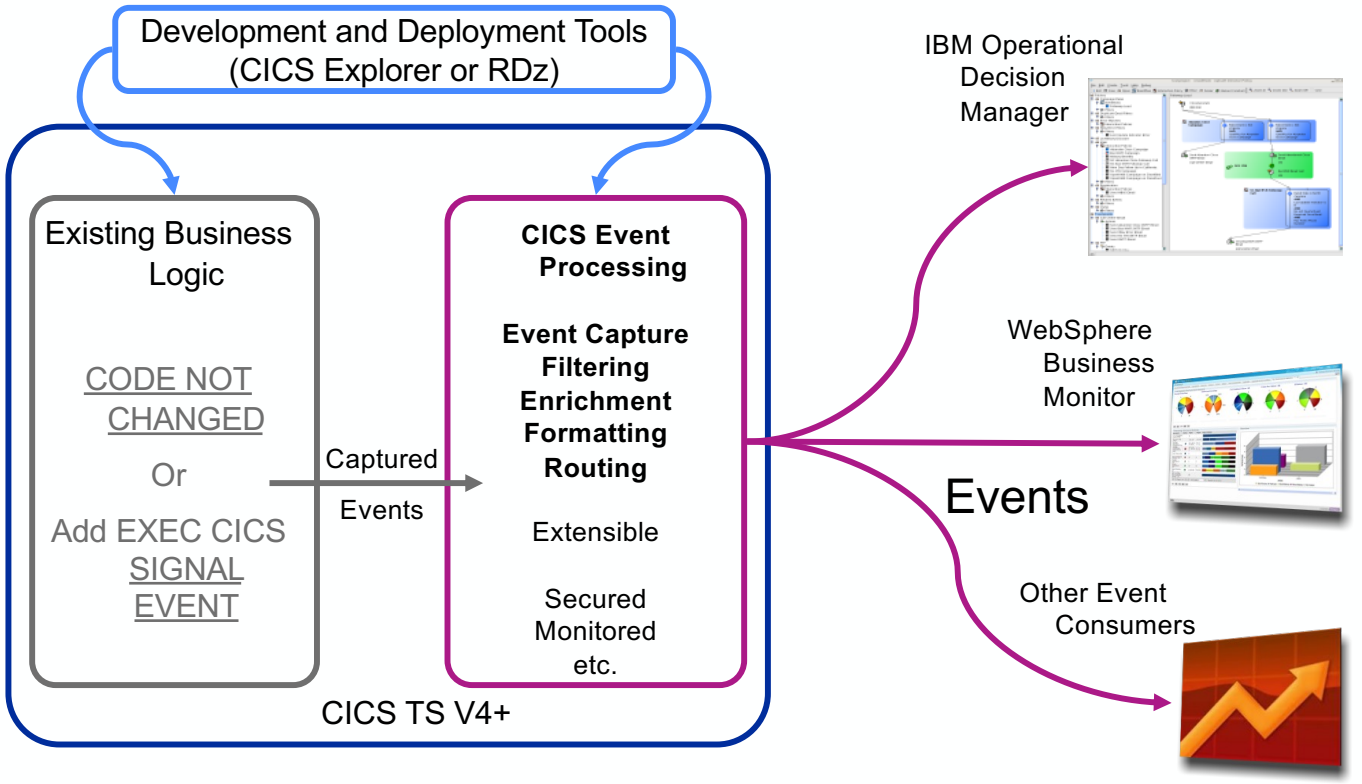
CICS Event Processing

- Provide information relevant to your business processes to a variety of systems
  - IBM Operational Decision Manager
  - WebSphere Business Monitor
  - Emit to WMQ queues or via HTTP
  - CICS-based transactions and programs
  - User-written programs
- Receiving system analyzes business information from one or more sources and takes appropriate action

Event Processing…

- An event is something that happens that is relevant to the business
  - "**simple**" event: meaningful in itself (not an aggregation of information)
    - Order placement, stock trade
  - "**complex** event processing": detect and respond to patterns of events
    - 3 orders from a customer in 2 days, suspicious pattern of ATM activity
  - "Business Event Processing" extends event processing capabilities to business users
- CICS can be significant source of events
  - Focus is on events relevant to the Line-of-Business
  - ***CICS emits single events***
  - Events emitted by CICS could
    - Drive another CICS transaction
    - Be written to a temporary storage queue
    - Be input to a monitor or business manager's dashboard
    - Be sent to a "complex event processing" engine such as IBM Operational Decision Manager
- Can be business events (CICS TS V4.1+)
- System events (CICS TS V4.2+)

Event Processing…

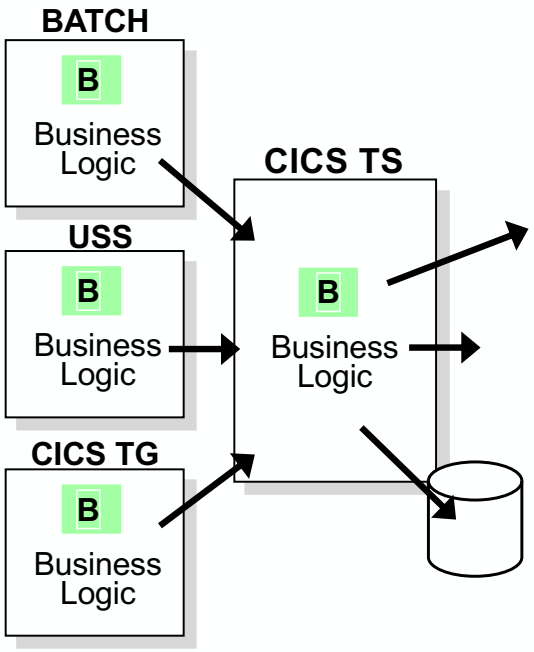


CICS Cross Memory Communications

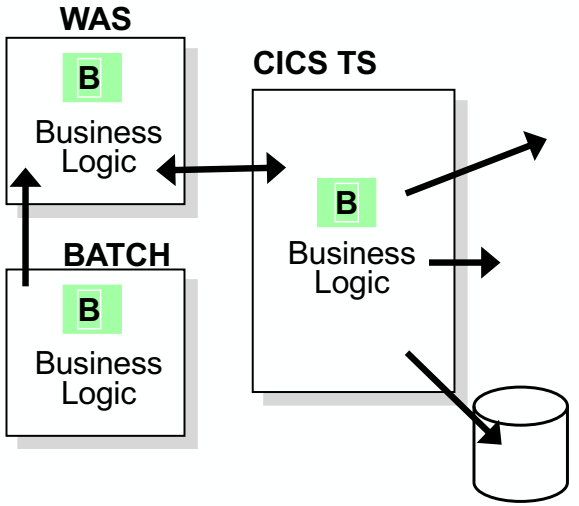
- EXCI (External Communications Interface)
- WOLA (WebSphere Optimized Local Adapter)

CICS Cross Memory

EXCI



WOLA



WAS=WebSphere Application Server

Summary

- CICS in the Server Role
- The TCP/IP Transport
  - HTTP
    - Web Support
    - Web Services
    - REST Services
    - ATOM Support
    - Java Servlets and JSPs
  - Sockets
  - IPIC
- SNA
- WMQ
- Cross Memory: EXCI and WOLA
- Event Processing
- Not discussed, but supported by CICS
  - SCA
  - Service Flow Feature
  - Business Rules