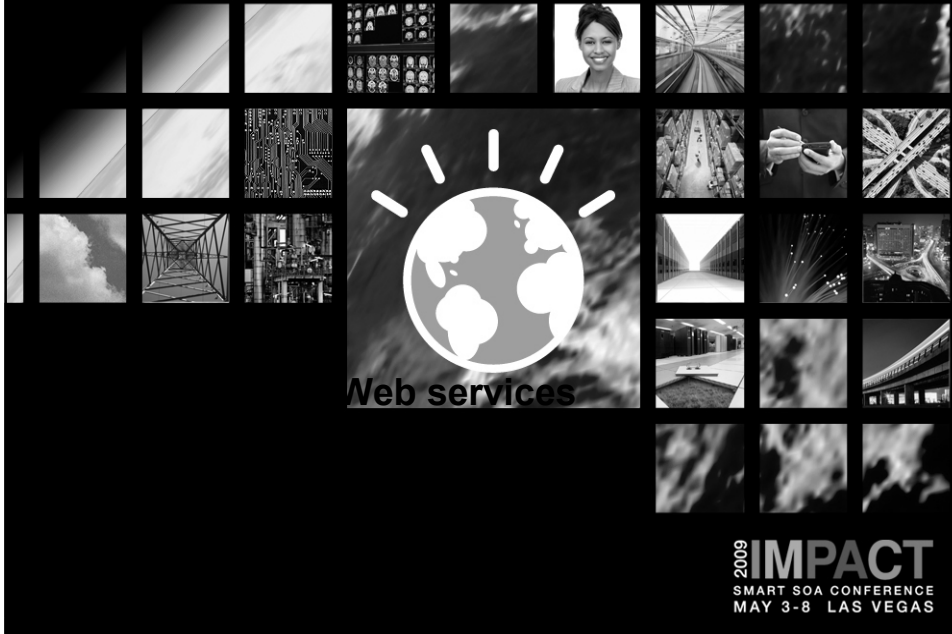


A smart conference for a smarter planet



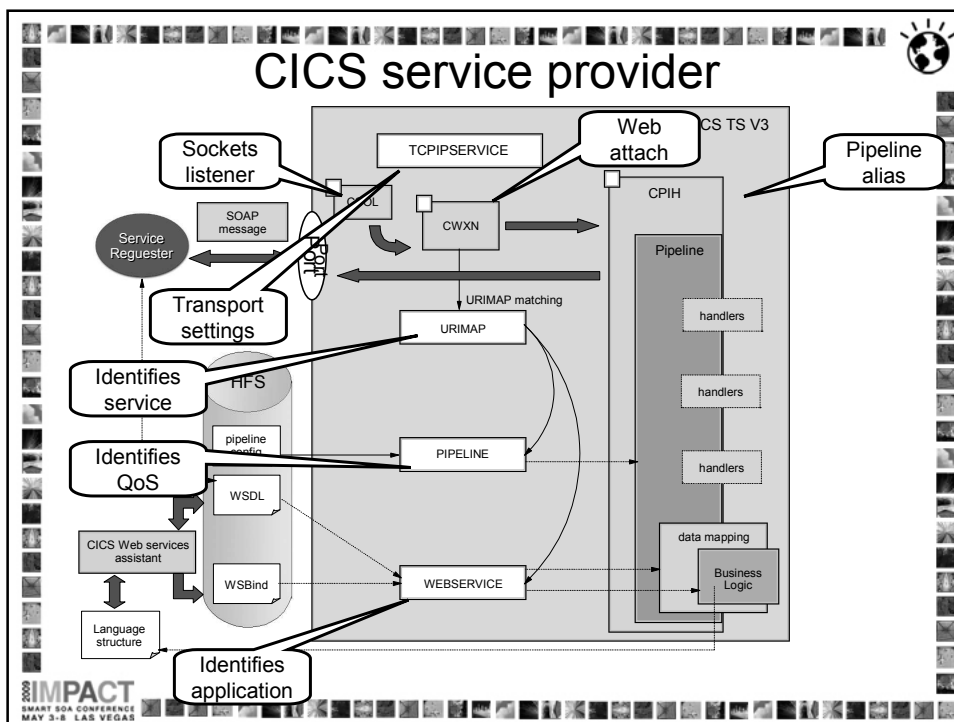
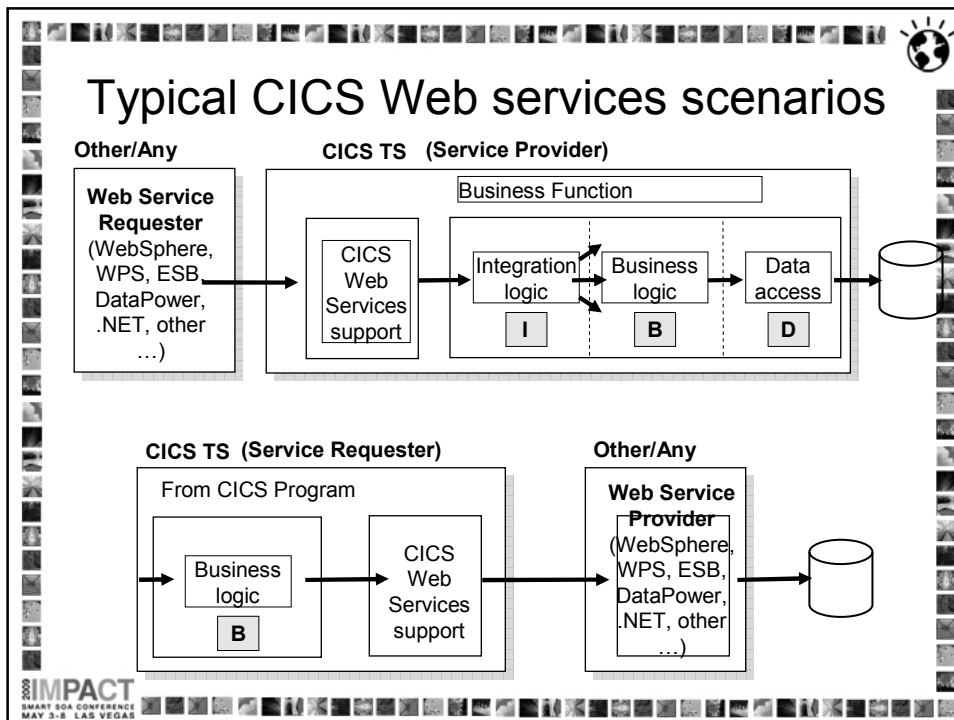
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## Agenda

- - Main considerations for CICS Web services workload management and availability:
    - Load balancing techniques
    - CICSplex considerations
  - Customer example:
    1. Project requirements
    2. Tested infrastructure
    3. Workload management configuration
    4. Availability tests
    5. Scalability tests



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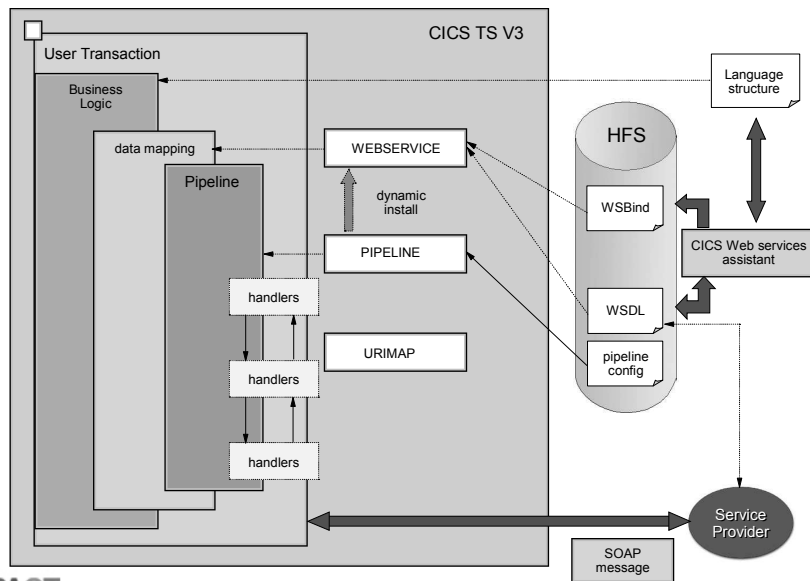


## Pipeline Containers

- Many Containers exist on the pipeline Channel
  - Containers you may find useful include:
    - DFHWS-URI (the URI for the service)
    - DFHWS-WEBSERVICE (the resource name)
    - DFHWS-SOAPLEVEL (the SOAP version)
    - DFHREQUEST/DFHRESPONSE
    - DFHWS-TRANID (the pipeline alias transaction id)
    - DFHWS-USERID (the pipeline alias user id)
- **Important:** if you change either DFHWS-TRANID or DFHWS-USERID CICS starts a new pipeline alias task

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## CICS service requester



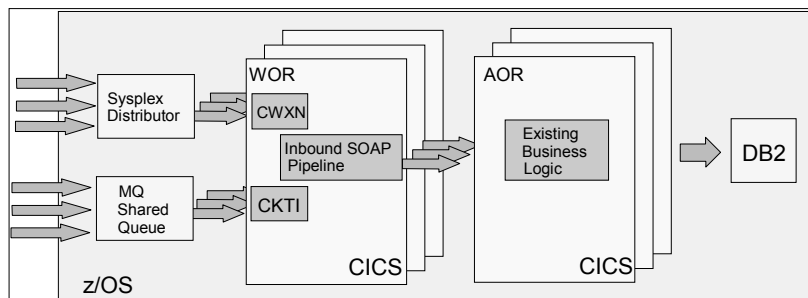
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## Workload management planning considerations

- **How to's**
  - How to workload manage service requests
  - How to set the pipeline transaction id
  - How to process Web service requests across a CICSplex
  - How to ensure service availability
  - How to view service requests
  - How to monitor against performance goals
  - How to configure for scalability
- **Tools for the job**
  - TCP/IP workload balancing techniques
  - MQ message routing/sharing
  - Dynamic workload management with CICSplex SM
  - Operations with CICS Explorer
  - Tivoli Monitoring

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## Workload balancing of inbound service requests

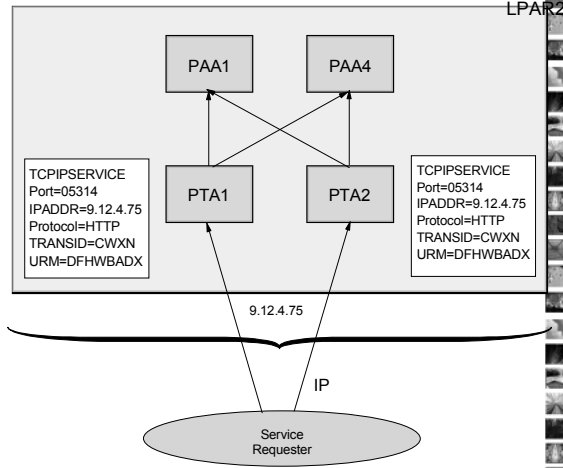


- As the service hit rate increases or because of availability demands, it becomes necessary to balance a Web services workload across multiple CICS regions
  - For HTTP, this can be achieved by using port sharing or the Sysplex Distributor
  - For WebSphere MQ, a queue sharing group can be set up to allow multiple CICS regions to service messages on the same queue
- Once within CICS, the existing business logic application that is linked from the message adapter can be on an application owning region (AOR) and workload managed, for example, by CICSplex SM

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# TCP/IP port sharing

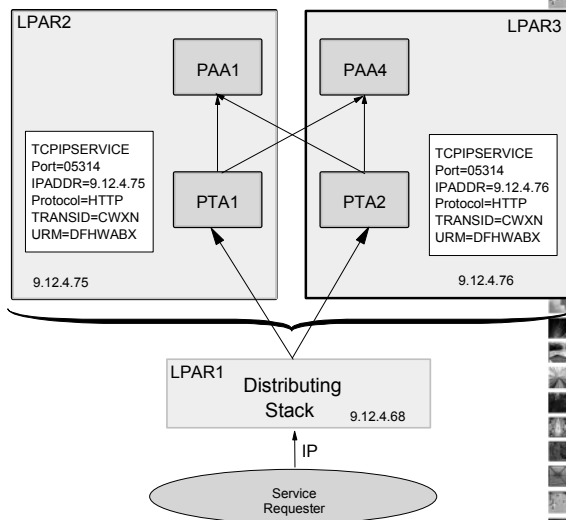
- Simple way to spread HTTP requests across group of CICS router regions running in same z/OS LPAR
- CICS TCPIP SERVICES configured with same port
- Port in TCP/IP profile configured with the **SHAREPORT** or **SHAREPORTWLM** options
- When **SHAREPORT** is specified, TCP/IP evenly balances the number of active connections across the servers based on the number of active and backlog socket connections
- **SHAREPORTWLM** causes incoming connections to be balanced based on WLM server-specific recommendations



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# Sysplex Distributor

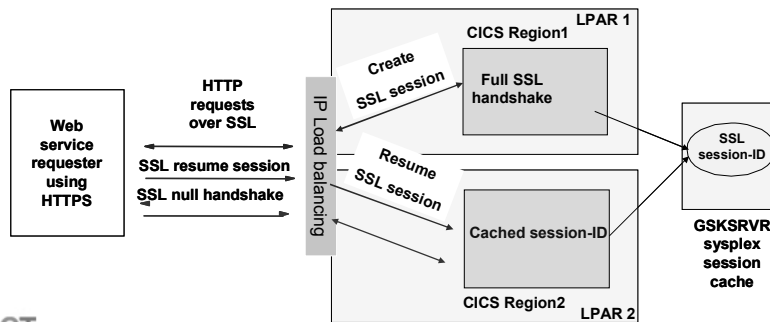
- Single network-visible IP address for the sysplex cluster
- CICS TCPIP SERVICES configured with same port but different IP addresses
- URL used by service requester contains **VIPA** (Virtual IP address)
- VIPA address resolved to one of specific IP addresses by **distributing stack**
- Distribution of connection requests is based on how well CICS regions are meeting WLM goals if **SERVERWLM** is specified on TCP/IP **VIPADISTRIBUTE** statement for shared port



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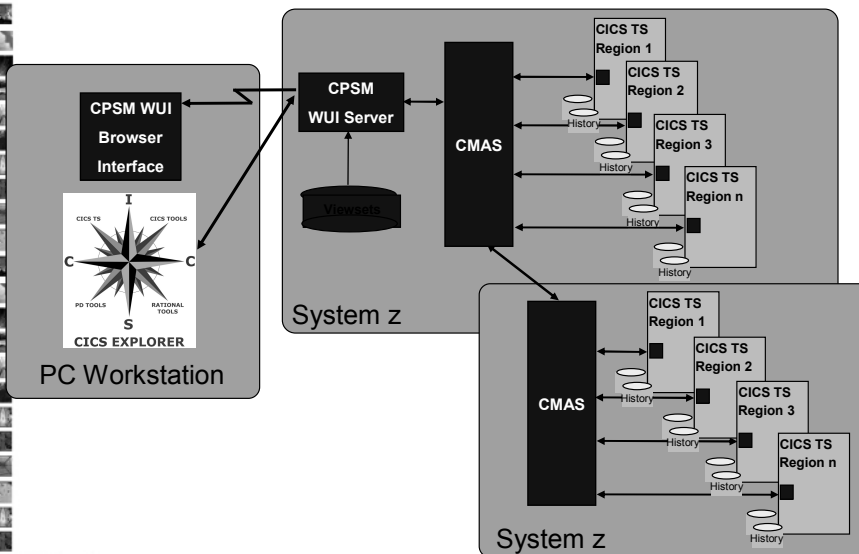
# SSL considerations

- Enable persistent TCP/IP connections when using SSL in order to minimise cost of SSL handshaking (set **SOCKETCLOSE** attribute of TCP/IPSERVICE)
- When connections timeout, it is still possible to avoid impact of **full handshake** by reusing SSL session id (**SSLDELAY** and **SSLCACHE** SIT parameters)
- SSL session ID may be retained by CICS in a **local SSL cache** or can be shared across multiple CICS regions using the sysplex session cache support provided by System SSL



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# CICSplex SM Architecture



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## Setting the pipeline alias transaction id

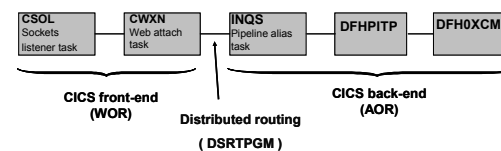
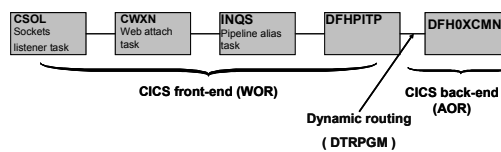
- Default pipeline alias transaction is **CPIH**
- Good practice to use private alias transactions to provide for:
  - Accounting
  - Security
  - WLM goals
- How to set
  - Specify transaction ID on the **URIMAP** resource definition and (optionally) use same mirror transaction ID in the AOR
  - Alternative is to change the transaction ID of the target business logic program by modifying the contents of the context container **DFHWS-TRANID** in a message handler program
    - Data mapping and business logic program runs in a **separate task** using the specified transaction ID
    - More costly than setting in the URIMAP
    - Use only if you need to inspect the contents of the message before setting the transaction

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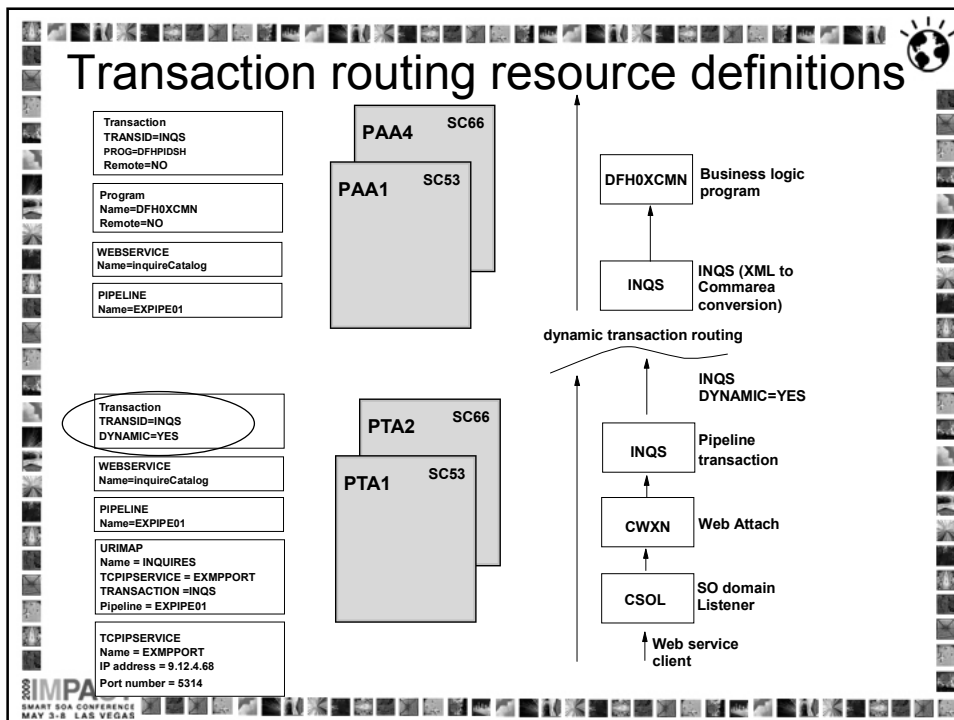
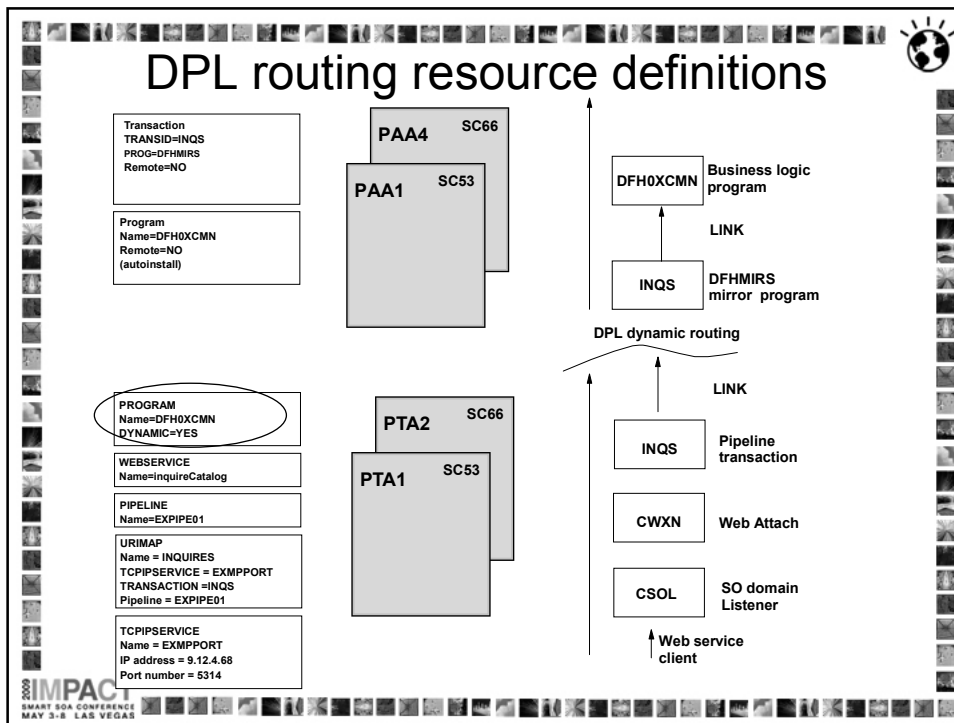
## Dynamic routing

### Two choices for dynamic routing

- **DPL routing**
  - Use distributed program link (DPL) to invoke the business logic program
  - All pipeline processing is done in the front-end (router) region and the link to the business logic program is routed to an AOR
- **Transaction Routing**
  - Route the entire pipeline and business logic processing to an AOR
  - This is done by setting the transaction ID in the URIMAP and then dynamically routing this transaction.



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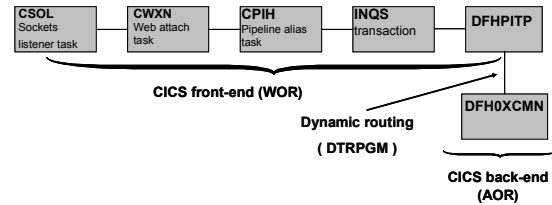


# Dynamic routing variations

When set DFHWS-TRANID in message handler

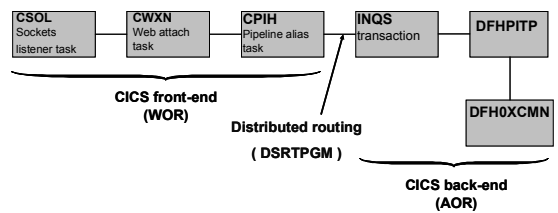
## DPL routing

- Additional task in WOR



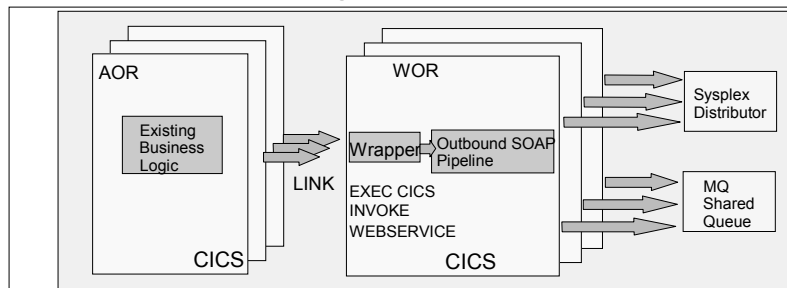
## Transaction Routing

- CPIH runs in WOR
- INQS is transaction routed to AOR



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# Workload balancing of outbound service requests



- You might want to run Web service requester applications in a number of dedicated CICS systems
  - Back level CICS regions can make (indirect) Web service calls
  - No need to define Web services resources in all AORs
  - Workload manage DPL calls to CICS service requester programs

**Important:** CICS does not support persistent connections (through connection pooling) for outbound Web service calls over HTTP(S). But SSL session id reuse is supported.

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# Customer background and project scope

## Business....

- Very large financial services group
- Retail banking, insurance, mortgages etc...
- 20+ million accounts
- Services large percentage of country ATM payments
- Large car insurer (8+ million policies)
- **Service availability is paramount**

## Project scope....

- Determine the best infrastructure bearing in mind the **security, workload management** and **scalability** requirements
- Understand the management and monitoring aspects of the solution, and monitoring tool capabilities



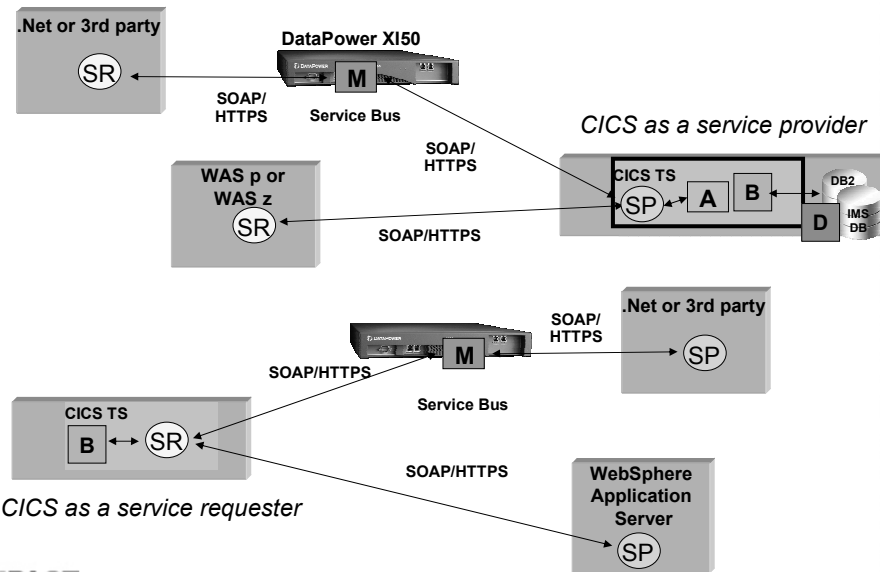
Deploying CICS Web services to preserve IT investments in the banking industry.

<http://www.ibm.com/software/hsp/cics/tserver/v32/library/index.html>

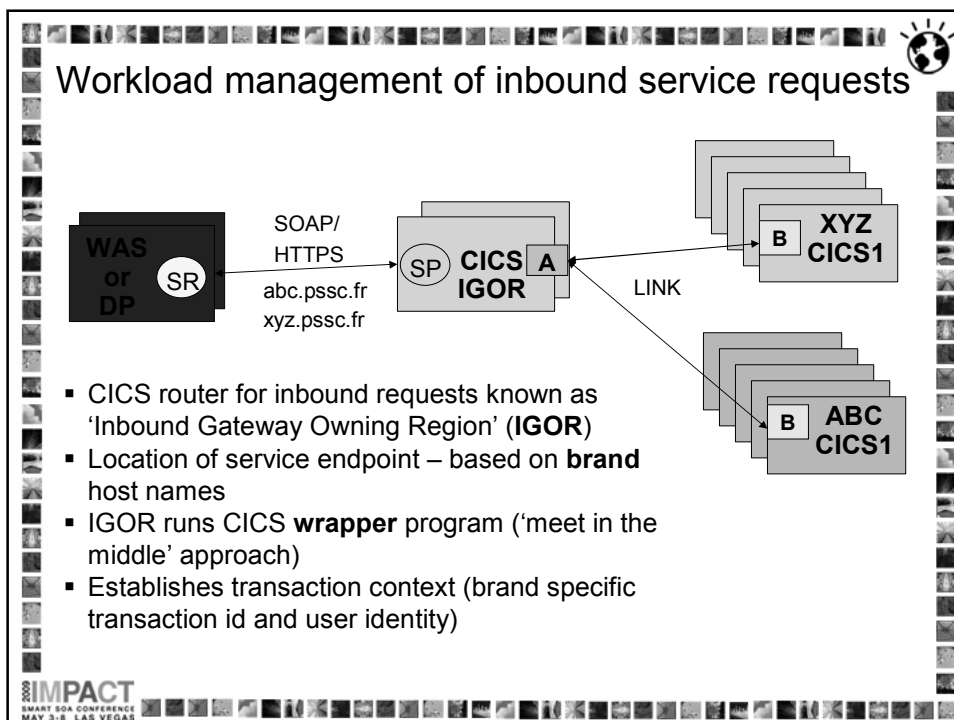
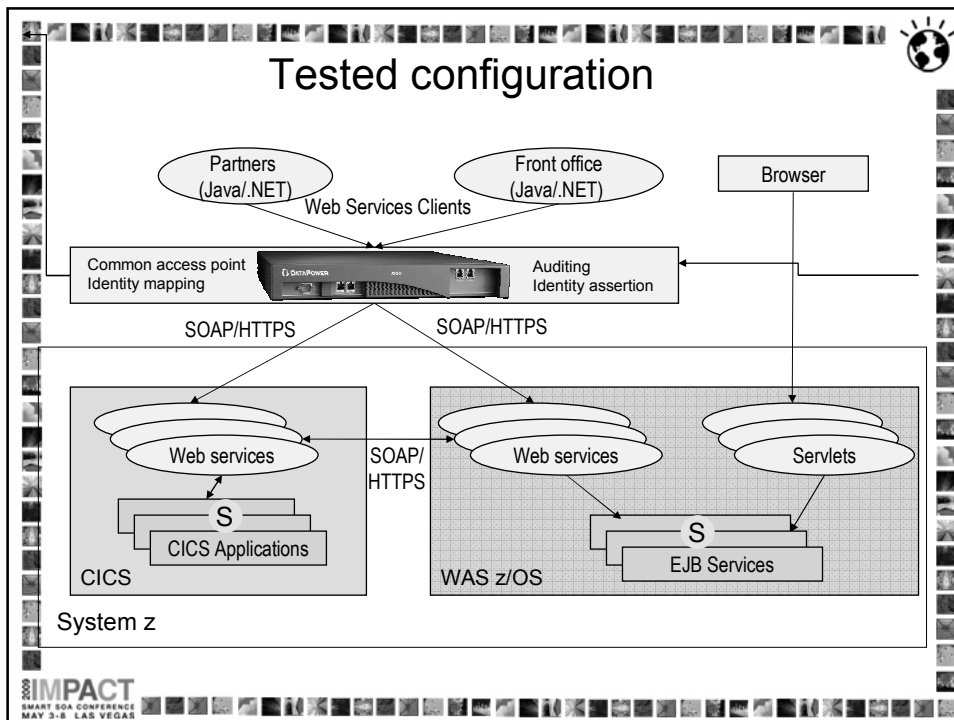
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# Usage scenarios

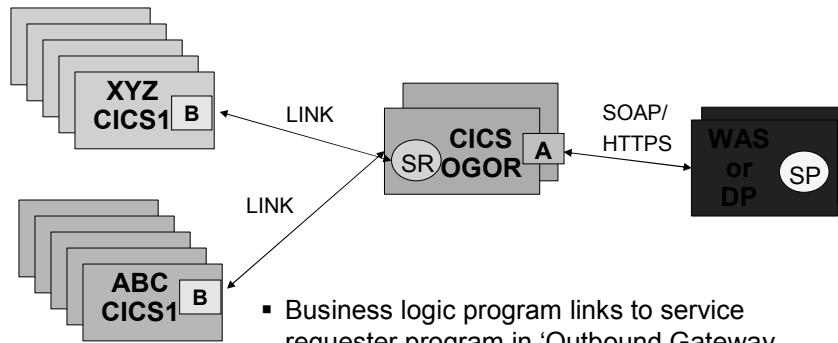
M Mediation



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## Workload management of outbound service requests

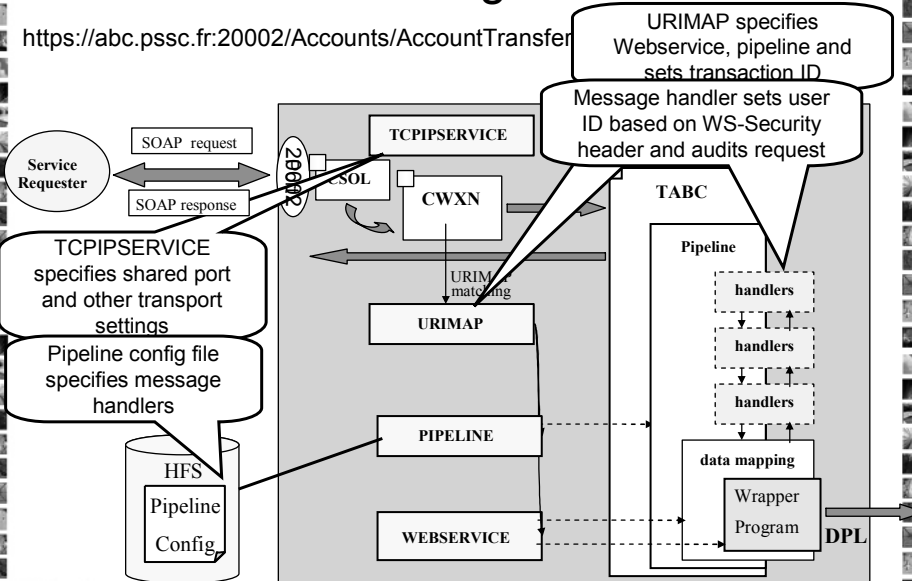


- Business logic program links to service requester program in 'Outbound Gateway Owning Region' (**OGOR**)
- Runs CICS Web service requester program which uses EXEC CICS INVOKE WEBSERVICE API to call service provider

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## CICS configuration

<https://abc.pssc.fr:20002/Accounts/AccountTransfer>



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## TCPIPService definition

```
CEDA DEFINE TCPIPService( TCPIPABC )
TCPIPService : TCPIPABC
GRoup       : WSIGOR
DEscription ==> TCPIPService FOR BRAND ABC
Urm         ==> DFHWBADX
Portnumber  ==> 20002           1-65535
Status      ==> Open           Open ! Closed
PRotocol    ==> Http           Iiop ! Http ! Eci ! User
TRansaction ==> CWXN
Backlog     ==> 00005         0-32767
TSqprefix   ==>
Ippaddress  ==>
SOcketclose ==> 000030       No ! 0-240000 (HHMSS)
Maxdatalen  ==> 000032       3-524288
SECURITY
SSL         ==> Clientauth   Yes ! No ! Clientauth
```

- PORTNUMBER is set to **20002**, the shared port
- SOCKETCLOSE to **30** so that connections persist but that an idle connection is timed out after 30 seconds

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## Distributed VIPA (example)

```
;DISTRIBUTE CICS WEB SERVICES
;Add serverwlm -
VIPADISTRIBUTE DEFINE DISTM SERVERWLM
10.10.1.100 PORT 20002
DESTIP 10.20.1.11 10.20.1.12 10.20.1.13
```

- Host **abc.pssc.fr** is mapped to address **10.10.1.100** by DNS
- Port **2002** is defined as a distributed port with destination addresses 10.20.1.11, 10.20.1.12 and 10.20.1.13 (TCP/IP stacks on 3 LPARs)

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## URIMAP definition

```
CEDA DEFine Urimap(AcntTABC )
Urimap      : AcntTABC
Group       : WSIGOR
Description ==> URIMAP for brand ABC Account Transfer service
STatus      ==> Enabled           Enabled | Disabled
USAge       ==> Pipeline         Server | Client | Pipeline
UNIVERSAL RESOURCE IDENTIFIER
Scheme      ==> HTTPS           HTTP | HTTPS
HOST        ==> abc.pssc.fr
(Lower Case) ==>
Path        ==> /Accounts/AccountTransfer

ASSOCIATED CICS RESOURCES
TCpipservice ==> TCPIPABC
TTransaction ==> TABC
PIipeline    ==> PIPEHIGH
Webservice   ==> AcntTrn
```

- Transaction **TABC** (Transfer for brand **ABC**) is name of the transaction id to be used for pipeline transaction
- Host **abc.pssc.fr** specifies the host component of the URI to which the URIMAP definition applies

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## Pipeline definition

- **CEDA View PIPeline( PIPEHIGH )**
  - Pipeline : **PIPEHIGH**
  - Group : WSIGOR
  - Description : Pipeline for high value transactions
  - STatus : Enabled Enabled !  
Disabled
  - Configfile : **/group/config/highvalueprovider.xml**
  - (Mixed Case) :
  - :
  - :

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# Program definition

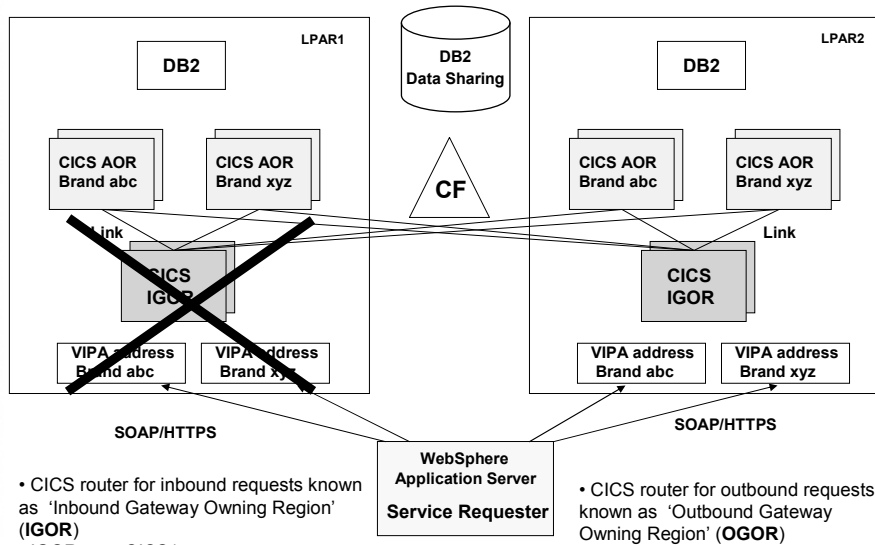
```

CEDA View PROGRAM( SPS7TABC )
  Status      : Enabled           Enabled ! Disabled
  RSl         : 00                0-24 ! Public
  CEdf        : Yes               Yes ! No
  DAtalocation : Any             Below ! Any
  EXECKey     : User             User ! Cics
  Concurrency : Threadsafe       Quasirent ! Threadsafe
  Api         : Cicsapi          Cicsapi ! Openapi

REMOTE ATTRIBUTES
  Dynamic     : Yes             No ! Yes
  REMOTESystem :
  REMOTENAME  : SPS7TABC
  Transid     : TABC
  XECutionset : Fullapi         Fullapi ! Dplsubset
  
```

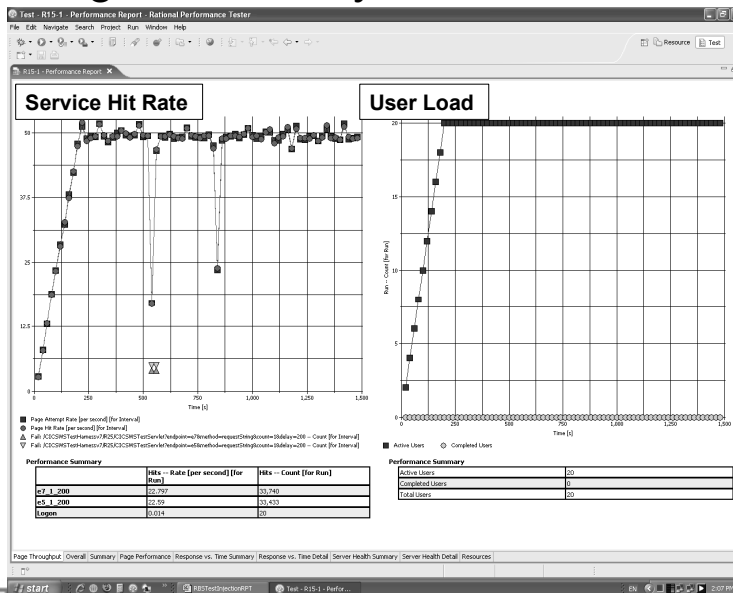
- When the wrapper program running in the IGOR links to a business logic program, the program link is dynamically routed to a set of brand AORs using **CICSplex SM workload management**
- The remote program definitions for business logic programs in the IGORs include a Transid so that the same transaction ids are also used in the AORs for the mirror transactions

# High availability configuration





# High availability test scenario



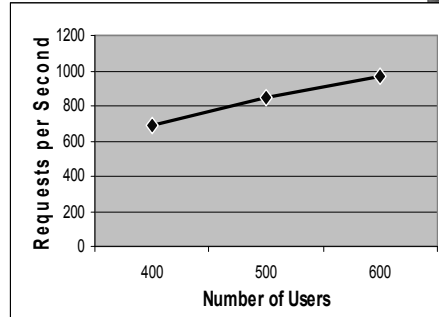
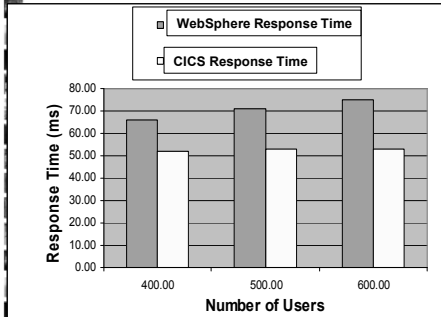
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# Other tested failure scenarios

Failure scenario	Circumvention
IGOR failure	Sysplex distributor and TCP/IP port sharing
Slow response in AOR	<p><b>In CICS:</b></p> <ul style="list-style-type: none"> <li>• Ensure that IGOR max tasks is set high enough</li> <li>• Ensure that there are enough SSL and Open TCBS</li> <li>• Ensure that there are enough <b>MRO sessions</b> between the IGORs and AORs</li> <li>• Consider use of <b>TRANCLASS</b> for IGOR transactions to protect services against specific poorly performing service</li> </ul> <p><b>In WebSphere:</b></p> <ul style="list-style-type: none"> <li>• Ensure that enough <b>threads</b> are available in WebSphere</li> </ul>
No response in AOR	<ul style="list-style-type: none"> <li>• Use <b>RTIMOUT</b> to timeout pipeline transactions</li> <li>• Use HTTP pool connection timeout setting (<code>com.ibm.websphere.webservices.http.connectionTimeout</code>) to timeout suspended CICS Web service requests.</li> </ul>
Slow response in IGOR	Use <b>SERVERWLM</b> as the distribution method for the IGOR TCP/IP ports
No response in IGOR	<p>Implement an automated procedure</p> <ul style="list-style-type: none"> <li>• To raise an alert when an IGOR is stalled</li> <li>• Close the TCP/IPSERVICE of the stalled IGOR</li> </ul>

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## Scalability tests



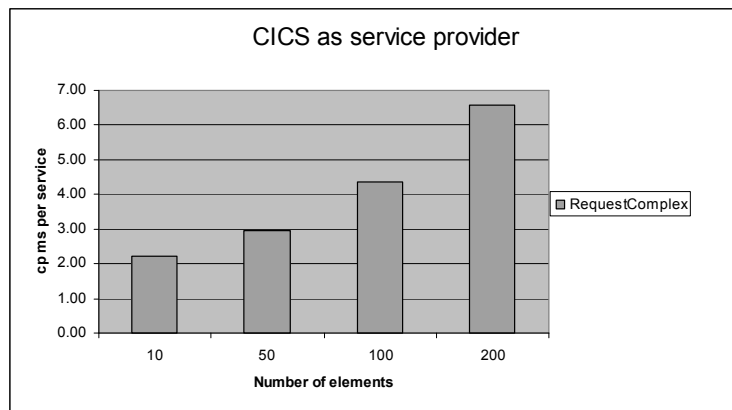
These tests were performed with service requester application deployed in WebSphere Application Server for z/OS and service provider application deployed in CICS

- Delay of 50 ms coded in CICS business logic program
- Short messages
  - Request <1K
  - Response 3.3K

Note: these tests performed with CICS TS V3.1 on a z9

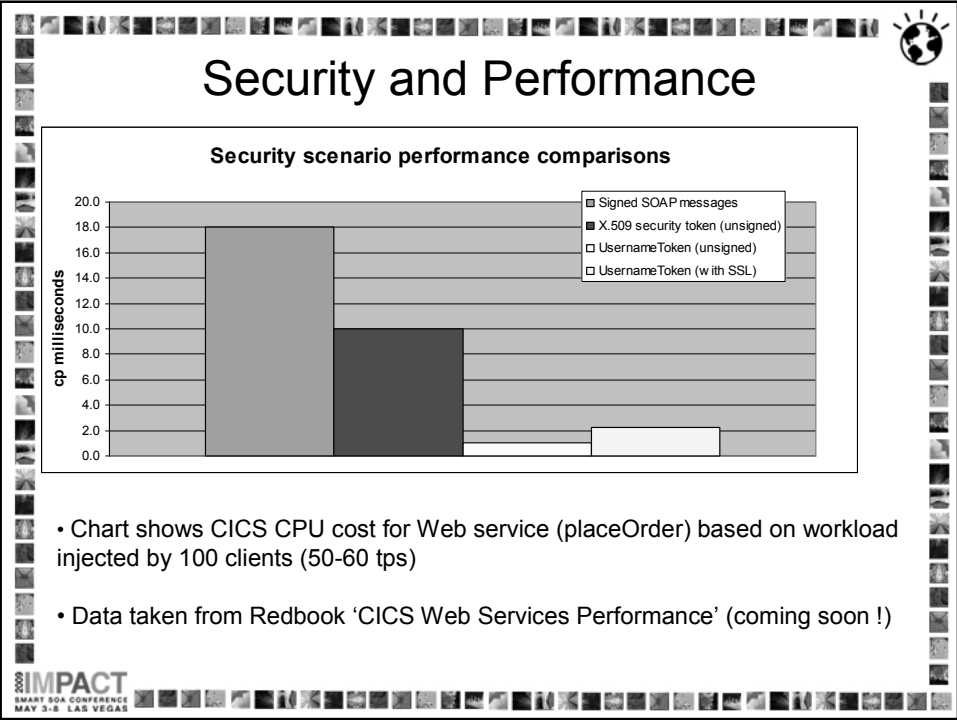
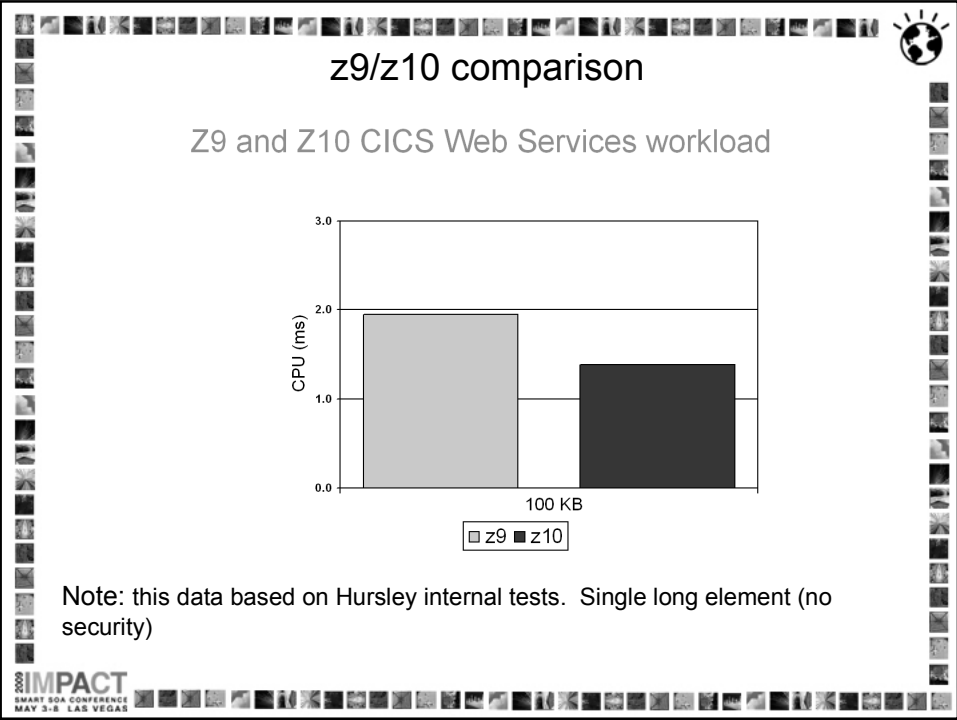
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## Changing the number of elements (inbound)

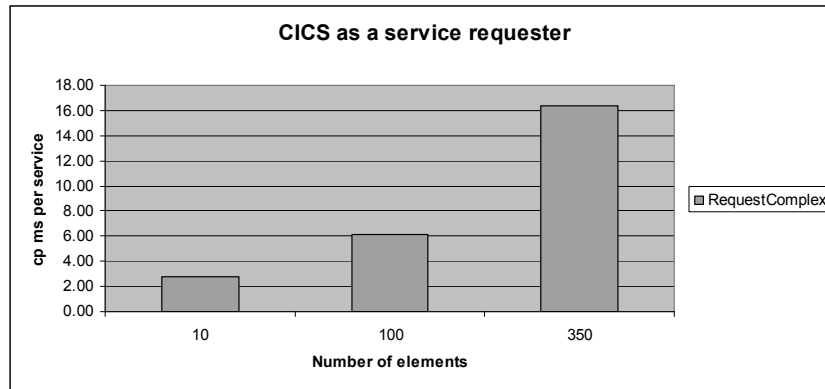


- Web service performance depends on the length and complexity of the message
- Each element (customer record) in this test contains 10 sub-elements
- Total length of the 10 element message is 3.3K
- Total length of 200 element message is 68K    20 x Msg Size → 3 x CPU

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## Changing number of elements (outbound)



- CICS has to parse response message
- Total length of the 10 element (customer record) message is 3.3K
- Total length of 350 element message is 102K

35 x Msg Size → 6 x CPU

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## Using CICSplex SM Web User Interface

**Web service**  
EYUVC12801 3 records collected at 10/21/08 15:30:10.

Context: WSPLEX  
Scope: WSPLEX

**Which CICS regions are running services**

Record name	CICS system name	Web service name	Web service status	Number of times web service used
1	CICSIGO1	AcntTrn	Inservice	154263
2	CICSIGO2	AcntTrn	Inservice	173805
3	CICSIGO3	AcntTrn	Inservice	233910

**How many services**

**Local or dynamic transaction**  
EYUVC12801 12 records collected at 10/21/08 15:31:13

Context: WSPLEX  
Scope: WSPLEX  
Transaction ID: [T\*] [Aa]  
Enabled status: [ ] [ ]

Record	CICS system name	Transaction ID	Enabled status	Number of times transaction used
1	CICSABC1	TABC	Enabled	91605
2	CICSABC2	TABC	Enabled	102445
3	CICSABC3	TABC	Enabled	127310
4	CICSIGO1	TABC	Enabled	181980
5	CICSIGO1	TXYZ	Enabled	179253
6	CICSIGO1	TABC	Enabled	202737
7	CICSIGO2	TXYZ	Enabled	199904
8	CICSIGO3	TABC	Enabled	258013
9	CICSIGO3	TXYZ	Enabled	256594
10	CICSXYZ1	TXYZ	Enabled	91800
11	CICSXYZ2	TXYZ	Enabled	99018
12	CICSXYZ3	TXYZ	Enabled	127055

**Where are transactions running**

**How many transactions**

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# CICS Explorer

The top screenshot shows a table of CICS regions:

Region	Name	Status	Usage Counter	Pipeline	URI Map
CICSGO1	AcntTrn	INSERVICE	42679	PIPEHIGH	
CICSGO2	AcntTrn	INSERVICE	53892	PIPEHIGH	
CICSGO3	AcntTrn	INSERVICE	62304	PIPEHIGH	

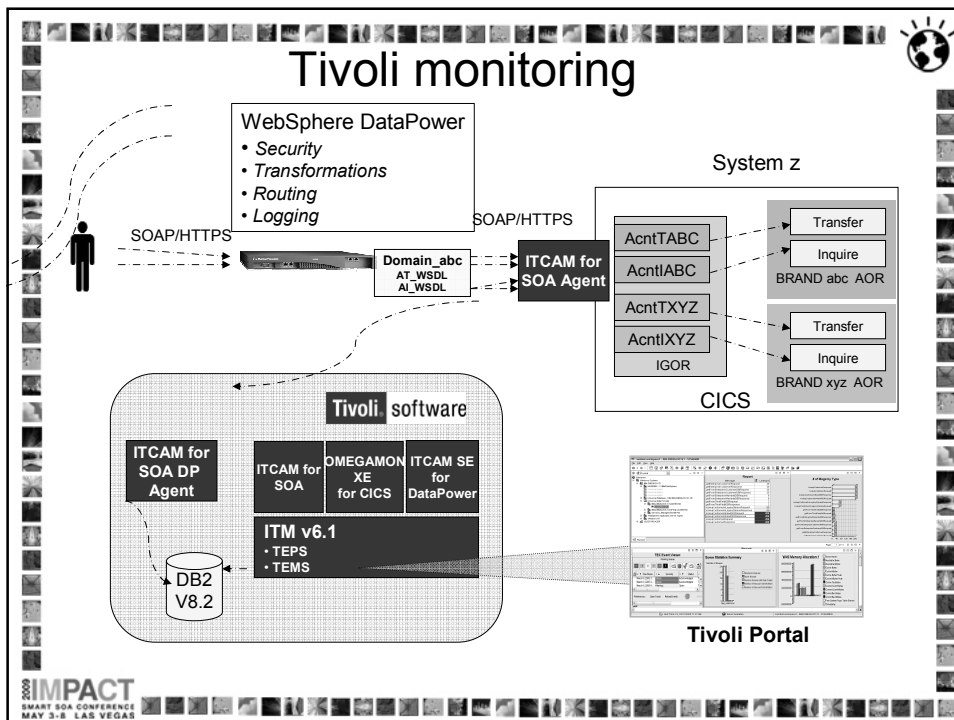
The bottom screenshot shows a detailed task table:

Region	System	Tasks	Maxs	CICS Status	CPU	Openctcbs	Maxopenctcbs	Actstcbs	Maxstcbs
CICSABC1	TR01	3	120	ACTIVE	0000:00:20...	0	50	0	8
CICSABC2	TR02	3	120	ACTIVE	0000:00:21...	0	50	0	8
CICSABC3	TR03	3	120	ACTIVE	0000:00:23...	0	50	0	8
CICSGO1	TR01	38	240	ACTIVE	0000:02:55...	30	100	0	50
CICSGO2	TR02	38	240	ACTIVE	0000:02:43...	30	100	0	50
CICSGO3	TR03	37	240	ACTIVE	0000:03:14...	30	100	0	50
CICSVZ1	TR01	19	120	ACTIVE	0000:00:01...	15	50	0	8
CICSVZ2	TR02	18	120	ACTIVE	0000:00:01...	14	50	0	8
CICSVZ3	TR03	18	120	ACTIVE	0000:00:01...	14	50	0	8

Annotations with callouts point to specific data points in the tables:

- "Which CICS regions are running services" points to the Region column in the top table.
- "How many services" points to the Name column in the top table.
- "Number of active tasks" points to the Tasks column in the bottom table.
- "CPU time" points to the CPU column in the bottom table.

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# OMEGAMON XE for CICS



URIMAP Analysis - GAR6-PC002 - SYSADMIN

View: Group Services

System ID	CICS Region Name	URIMAP Name	Enable status	TCPIP Service	Usage	Scheme	Reference count
MVR4	CICSIG02	AcntTABC	Enabled	TCPIPABC	Pipeline	HTTPS	33021
MVR4	CICSIG02	AcntKXYZ	Enabled	TCPIPXYZ	Pipeline	HTTPS	54
MVR4	CICSIG02	AcntTABC	Enabled	TCPIPABC	Pipeline	HTTPS	0
MVR4	CICSIG02	AcntTXYZ	Enabled	TCPIPXYZ	Pipeline	HTTPS	25266

URIMAP Global

System ID	CICS Region Name	Reference count	Disabled count	Unmatched count	Matched count	Redirect count	Analyzer count	Static count delivered	Dynamic count delivered
MVR4	CICSIG02	59044	0	0	59044	0	0	0	0

URIMAP Global Counts

URIMAP Summary Reference Co...

Hub Time: Thu, 03/29/2007 03:16 PM Server Available URIMAP Analysis - GAR6-PC002 - SYSADMIN

Gives service counts

# OMEGAMON XE for CICS



Service Level Analysis - GAR6-PC002 - SYSADMIN

View: Group Services

Service Level Analysis

- Service Level Analysis
- Service Task Details
- Storage Analysis
- Subpool Details
- System Initialization Table
- Task Class Analysis
- TCPIP Statistics
- Temporary Storage Queues
- Temporary Storage Summary
- Terminal Storage Violations
- Transaction Analysis
- Transaction Storage Violations

OCS Service Class Response Time

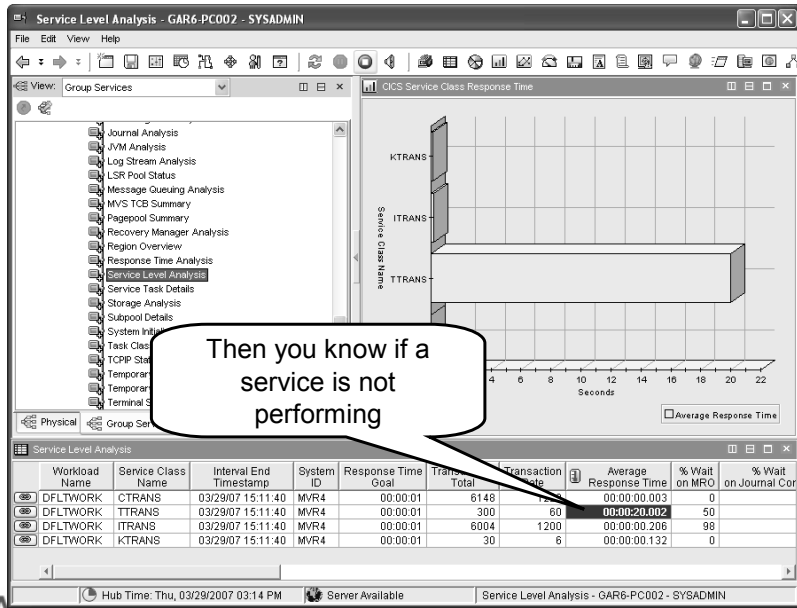
Service Level Analysis

Workload Name	Service Class Name	Interval End Timestamp	System ID	Response Time Goal	Transactions Total	Transaction Rate	Average Response Time	% Wait on MRO	% Wait on Journal Control
DFLTWORK	CTTRANS	03/29/07 15:16:40	MVR4	00:00:01	11411	2282	00:00:00.004	0	0
DFLTWORK	TTRANS	03/29/07 15:16:40	MVR4	00:00:01	10996	2199	00:00:00.35	49	0
DFLTWORK	ITTRANS	03/29/07 15:16:40	MVR4	00:00:01	5911	1182	00:00:00.206	98	0
DFLTWORK	KTRANS	03/29/07 15:16:40	MVR4	00:00:01	29	5	00:00:00.127	0	0

Hub Time: Thu, 03/29/2007 03:17 PM Server Available Service Level Analysis - GAR6-PC002 - SYSADMIN

Response time goals can be set for transaction groups

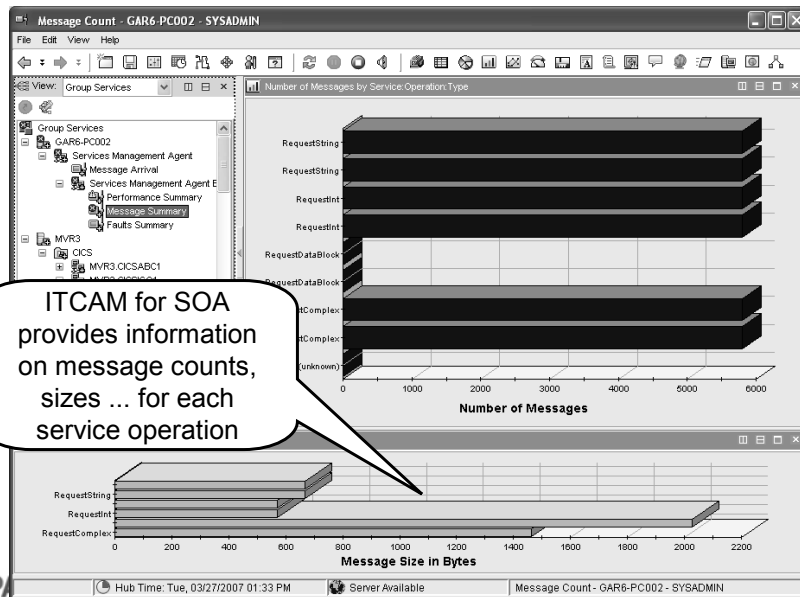
# OMEGAMON XE for CICS



Then you know if a service is not performing

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# ITCAM for SOA



ITCAM for SOA provides information on message counts, sizes ... for each service operation

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## Summary

- Build a highly available robust CICS Web services infrastructure using
  - **Sysplex Distributor** and **TCP/IP port sharing** (or shared WMQ queues) to workload manage service requests across different CICS regions
  - **CICSplex SM** to dynamically route program link requests
  - **CICS Explorer** for friendly operations
  - Monitoring tools like **OMEGAMON XE for CICS** for tracking against service response-time goals
- Perform your own tests to validate that the infrastructure meets the availability goals and to test recovery procedures
- Customer benchmarks have proved the linear scalability of CICS Web services workloads up to transaction rates in excess of **1500 services per second**
- Scalability and performance depend on a number of factors, including
  - Number of elements, message length and complexity
  - Persistence of connections (especially if SSL is used)
  - Security options
- Take advantage of further performance improvements with **CICS TS V4.1** and system **z10**

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## Further information

- ITSO Redbooks
  - “CICS Web Services Workload Management and Availability” (SG24-7144)
  - “Implementing CICS Web Services” (SG24-7657)



- Information Centers
  - CICS

<http://publib.boulder.ibm.com/infocenter/cicsts/v3r2/index.jsp>

- WebSphere

<http://publib.boulder.ibm.com/infocenter/wasinfo/v6r1/index.jsp>

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