IMS Connect: Much More than a TCP/IP Gateway !

Session A06

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Topics

- **IMS Connect Architecture – continuously evolving**
  - Included in IMS Version 9 as part of System Services
  - TCP/IP server foundation for
    - Transaction access and commands
    - Type-2 commands for IMS resources
      - *Enhanced Type-2 commands for IMS Connect resources (IMS 12)*
    - DB access (IMS 11)
  - IMS Connect API (IMS Enterprise Suite)
- **Along with Support for IMS-IMS Interaction**
  - Asynchronous Program Switching (IMS 12)
  - MSC (IMS 12)
  - ISC (IMS 13)
- **And Support for Calling out to distributed environments**
  - Along with ICAL enhancements for control data (IMS 14)
- **In a high availability environment**
  - VIPA, DVIPA, and Sysplex distribution
  - Super member support
  - TPIPE Parallelism (IMS 14)

A Continuously Evolving Architecture

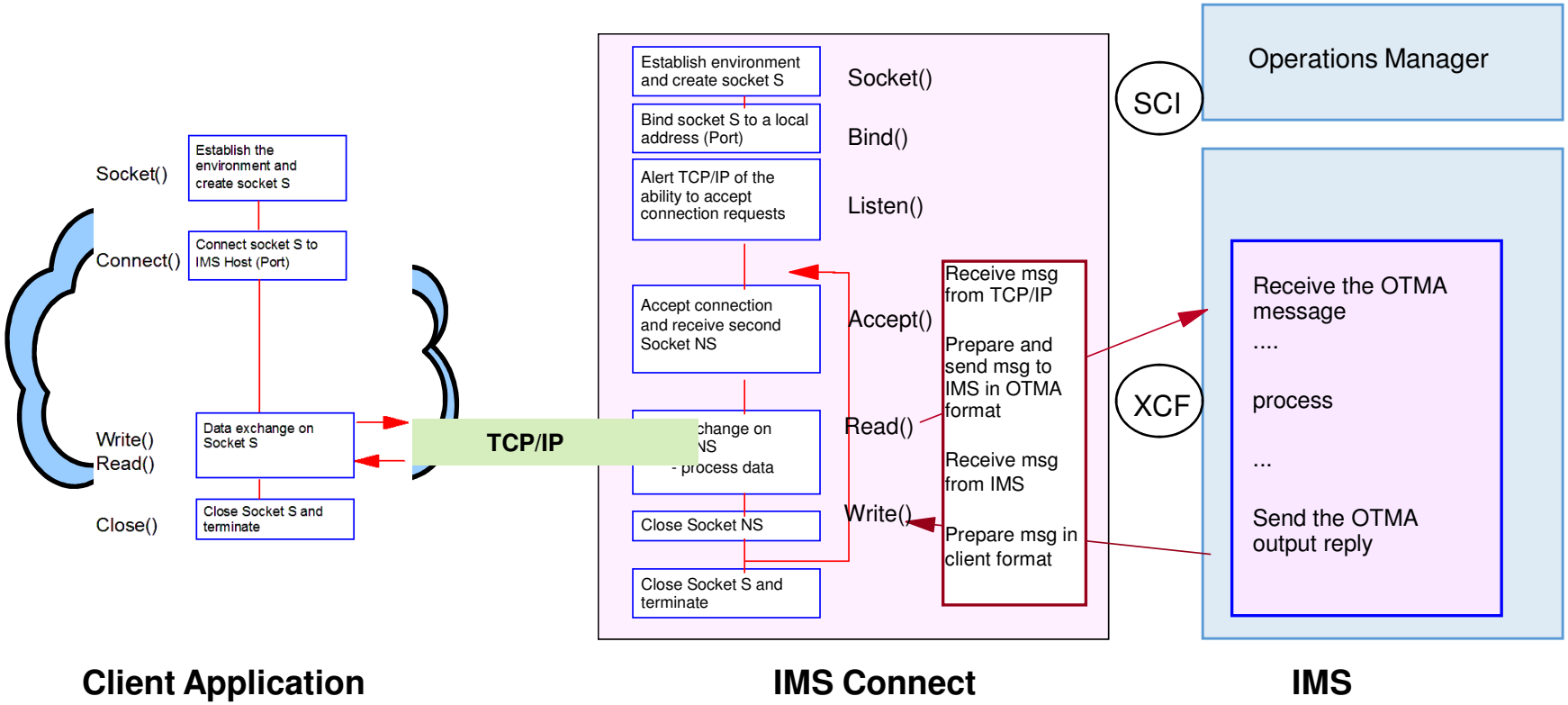
IMS Connect Architecture – Continuously Evolving

- **Provides the IMS capability to integrate with TCP/IP environments**
  - Delivered as part of IMS – part of System services
    - Supports TM/DB, DCCTL, and DBCTL environments
  - Configured on a z/OS server

- ***Benefits and Value***
  - Supports TCP/IP sockets access to:
    - IMS transactions and commands
    - IMS databases
  - Supports
  - Provides a general purpose and structured interface
  - Provides a strategic base for new connection technologies
  - Supports migration for existing environments to TCP/IP
  - …

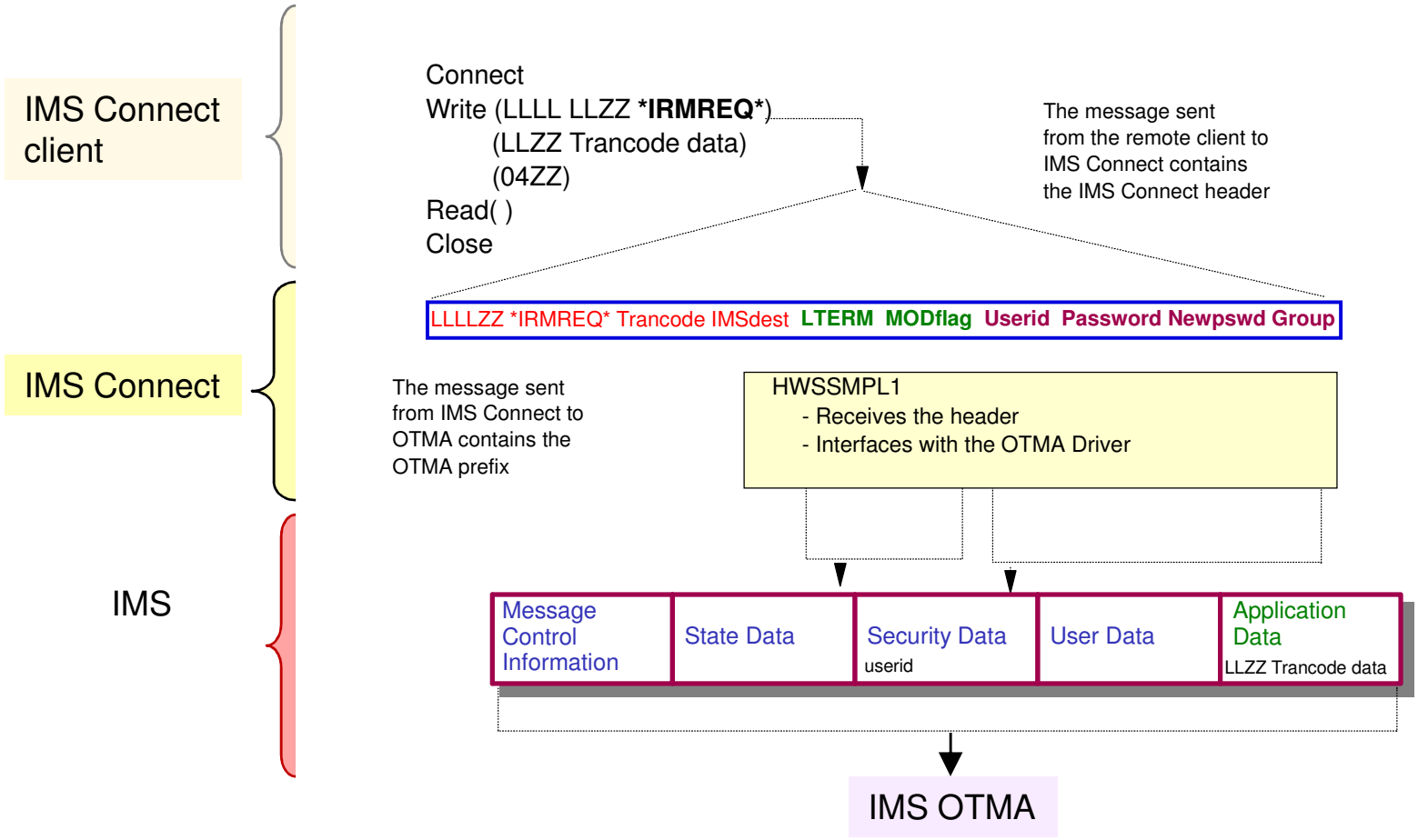
In the Beginning

- **IMS Connect provided a way for TCP/IP access to transactions and commands**



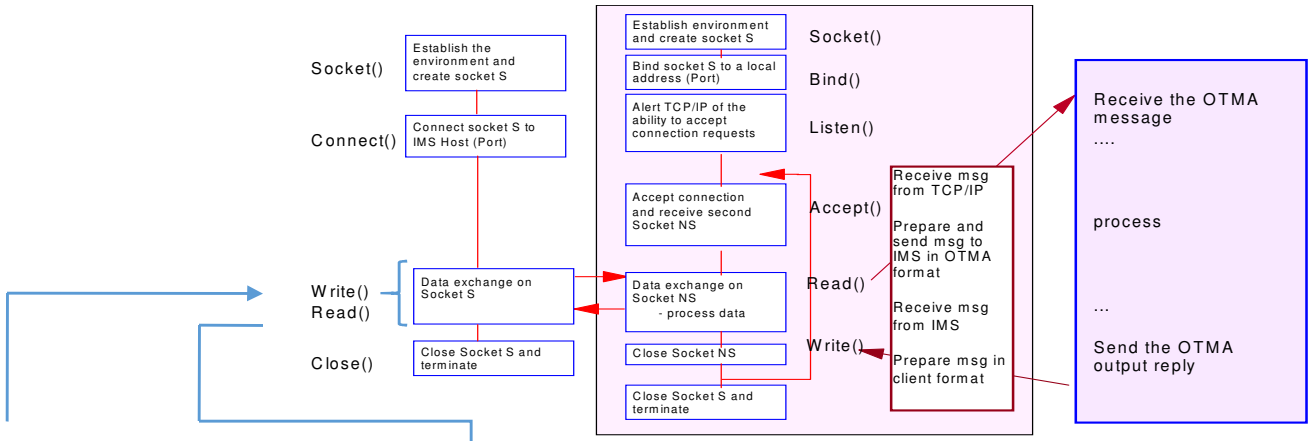
IMS Connect – OTMA Message Protocol

- With access to IMS using the OTMA interface



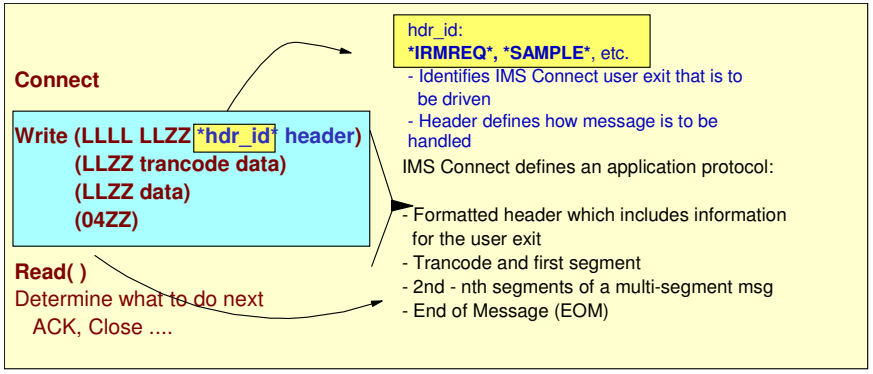
And a Defined Application Protocol

- **IMS Connect application program interface**



- **Input Messages**

LLLL = length of entire msg including all data segments and the EOM
LL = length of the header data



Note: hdr_id + header are often generically referred to as the IRM (IMS request message)

- **Output messages**

– CSMOKY (Complete Status Message)
  - Sent by IMS Connect upon successful interaction with IMS

LLLL	LL	ZZ	*CSMOKY*

– RMM (Request Mod Message)
  - Returned as the first structure of an output message if the MFS mod name was requested

LLLL	LL	ZZ	*REQMOD*	MFS mod name

– RSM (Request Status Message)
  - Sent by IMS Connect upon rejection of an inbound request
  - Return and reason codes are documented in the IMS Connect manuals

LLLL	LL	ZZ	*REQSTS*	Return code	Reason code

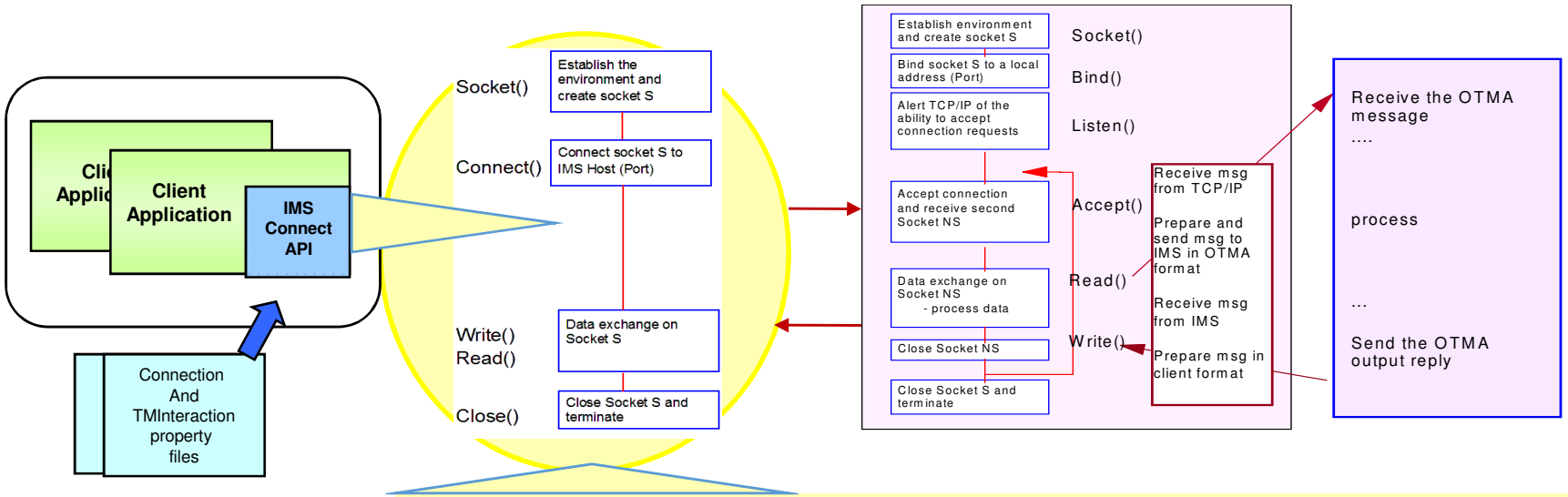
– Outbound application reply message

LLLL	LL	ZZ	data ...

– COR (Synchronous Callout Correlator Token)
  - Provides the necessary token for IMS to tie the request and reply together

LLLL	LL	ZZ	*CORTKN*	

Simplification of the API interface



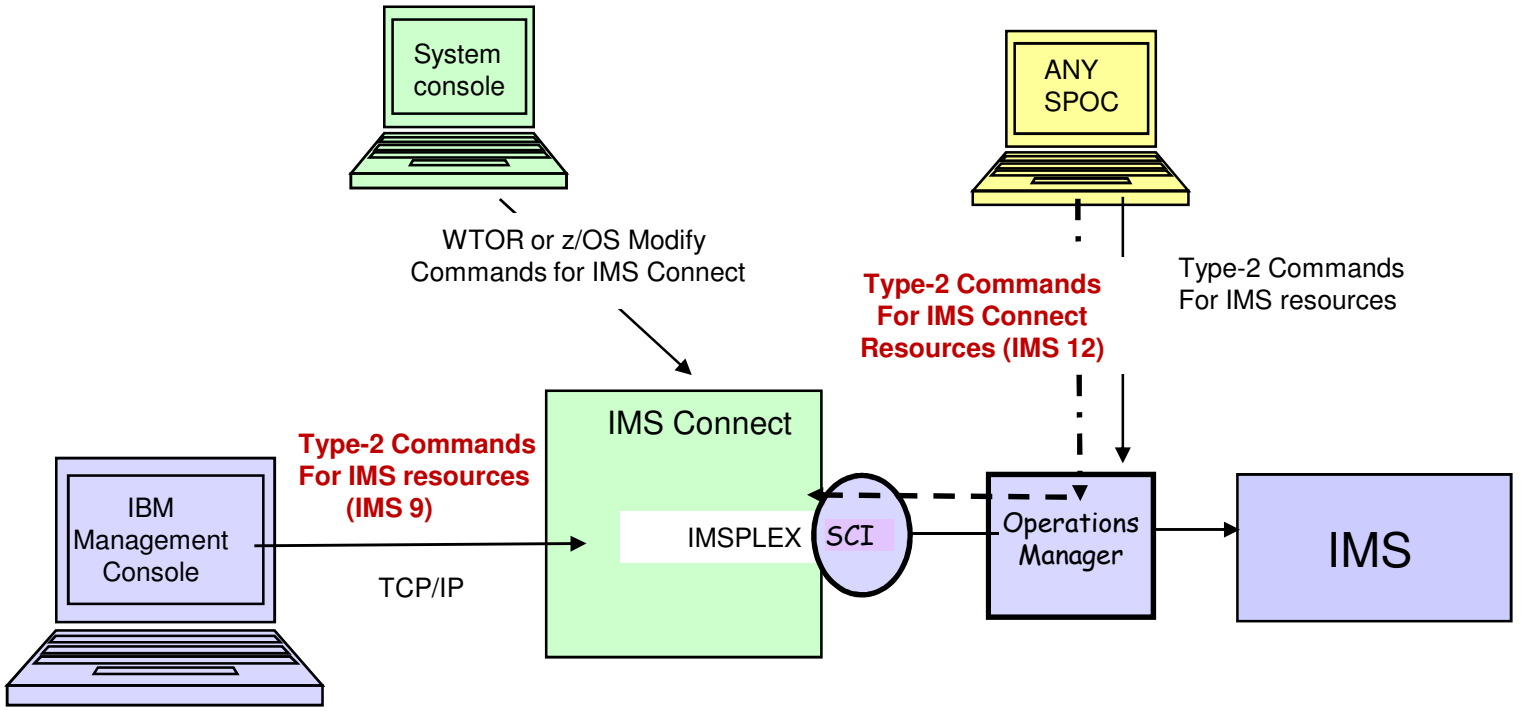
Com.ibm.ims.connect package
(IMS Connect API)

✓Opens connections to IMS connect on behalf of the client application
✓Provides client applications with programmatic control of connections
✓Assembles messages to send to IMS Connect, including the (IRM) header
✓Manages the IMS Connect message protocol by sending and receiving the appropriate messages for interactions with IMS Connect

- ***IMS Enterprise Suite*** **IMS Connect API for Java (initially introduced for support with IMS 10/11)**
  - Streamlined interface for interacting with IMS Connect (com.ibm.ims.connect package)
    - Simplifies Java client applications with easy methods for managing socket connections and the IMS Connect interaction protocols
      - Addresses the complexities of RYO programs
      - Hides the intricacies of both sockets programming and the application protocol
  - **Supports**
    - Single and multi-segment message
    - Commands (both type-1 and type-2)
    - Synchronous callout

With Enhanced Command Support

- **Support for Type-2 commands for IMS resources and for IMS Connect resources**



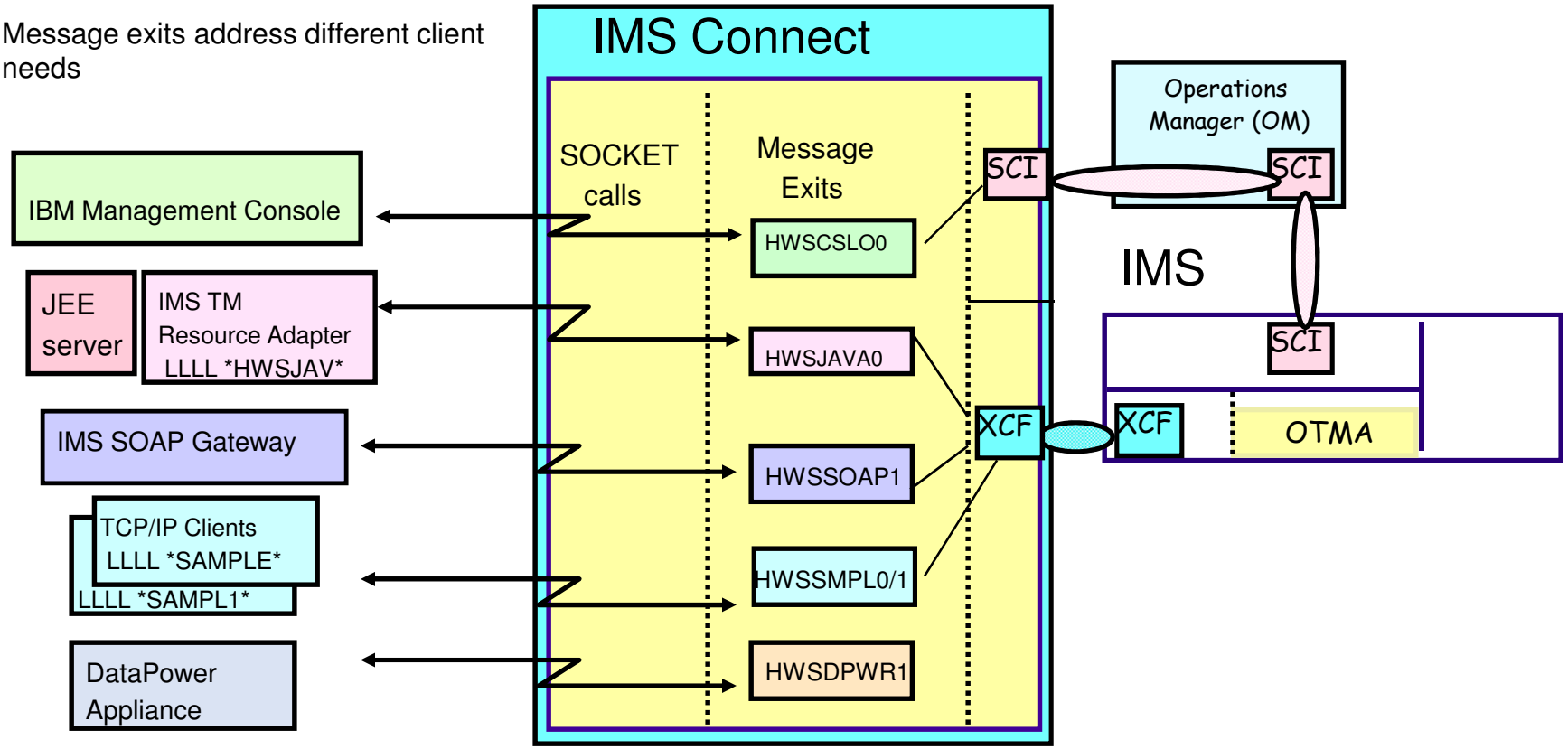
And Modification using Exit Routines

- **Mechanism to modify IMS Connect behavior**

  - HWSUINIT – Initialization/Termination
    - Has access to a user-defined table
  - Message Exits – affect each message
    - Depending on the environment: HWSSMPL0/1, HWSSOAP1, HWSJAVA0, HWSDPWR1
  - HWSCSLO0/O1 – For support of clients entering type-2 commands
    - Used by IBM Management Console for IMS and DB2
  - HWSTECL0 – for event recording (performance and data analysis)
    - Used by IMS Connect Extensions
  - HWSPCH0 – Password change
  - IMSLSECX – Security
  - ODBM support
    - HWSAUTH0 – DB security exit
    - HWSROUT0 – DB routing exit
  - HWSEXPIO - Port Message Edit Exit
    - Allows modification of Input messages before IMS Connect processing and output messages before being sent to the TCP/IP client
      - *Addresses the need when a remote program cannot conform to the IMS Connect standard header requirements but needs the functionality of IMS Connect*

Exit Routines …

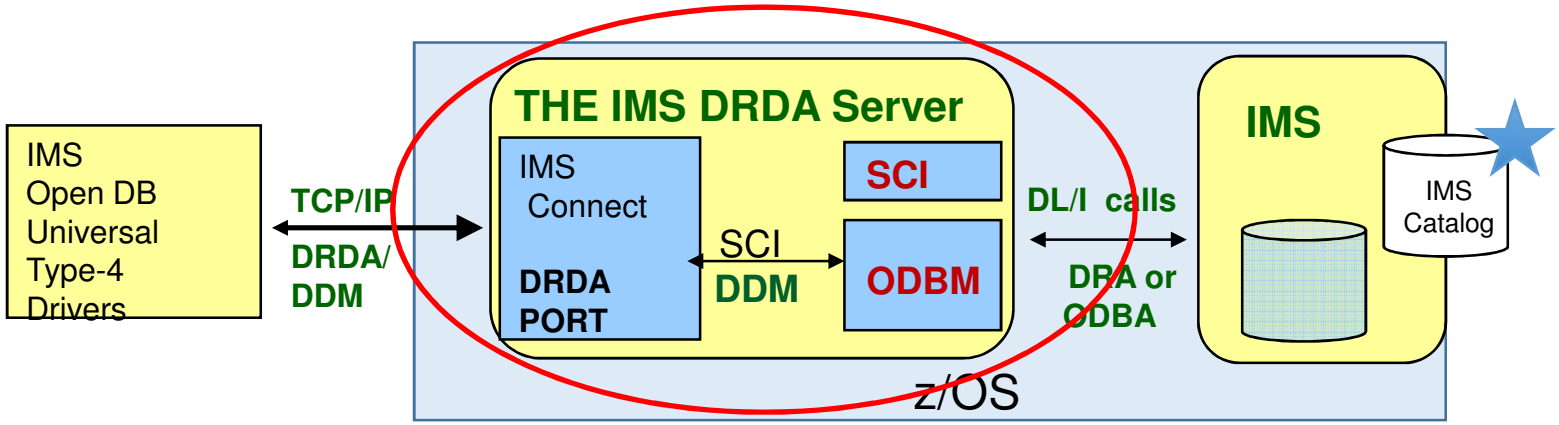
Message exits address different client needs



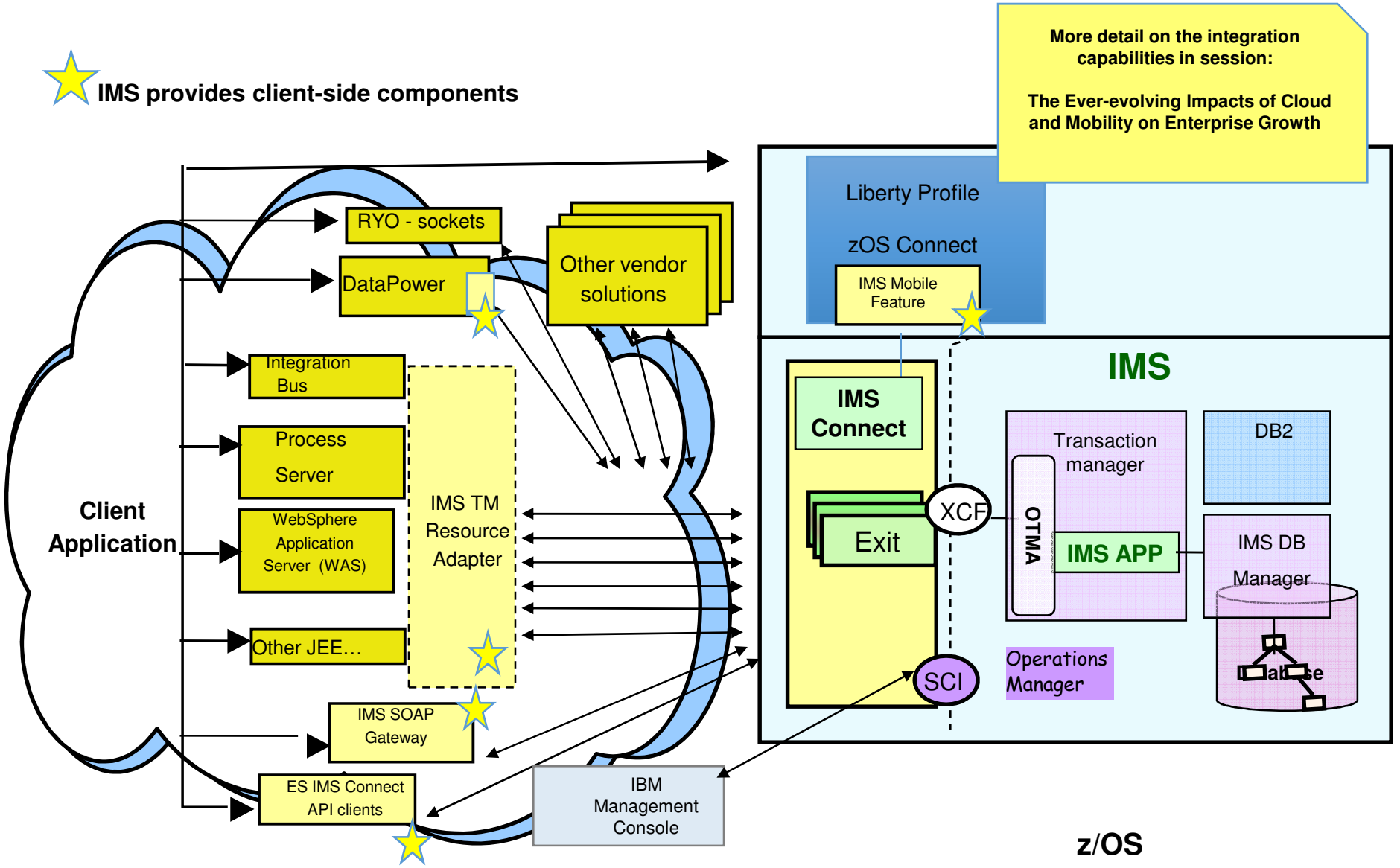
Each exit places its identifier (ascii/ebcdic versions) in an IMS Connect table
E.g.:
HWSJAV
IRMREQ *IRMRE1* …
SAMPL0 *SAMPLE1" …
…

As well as Database Support

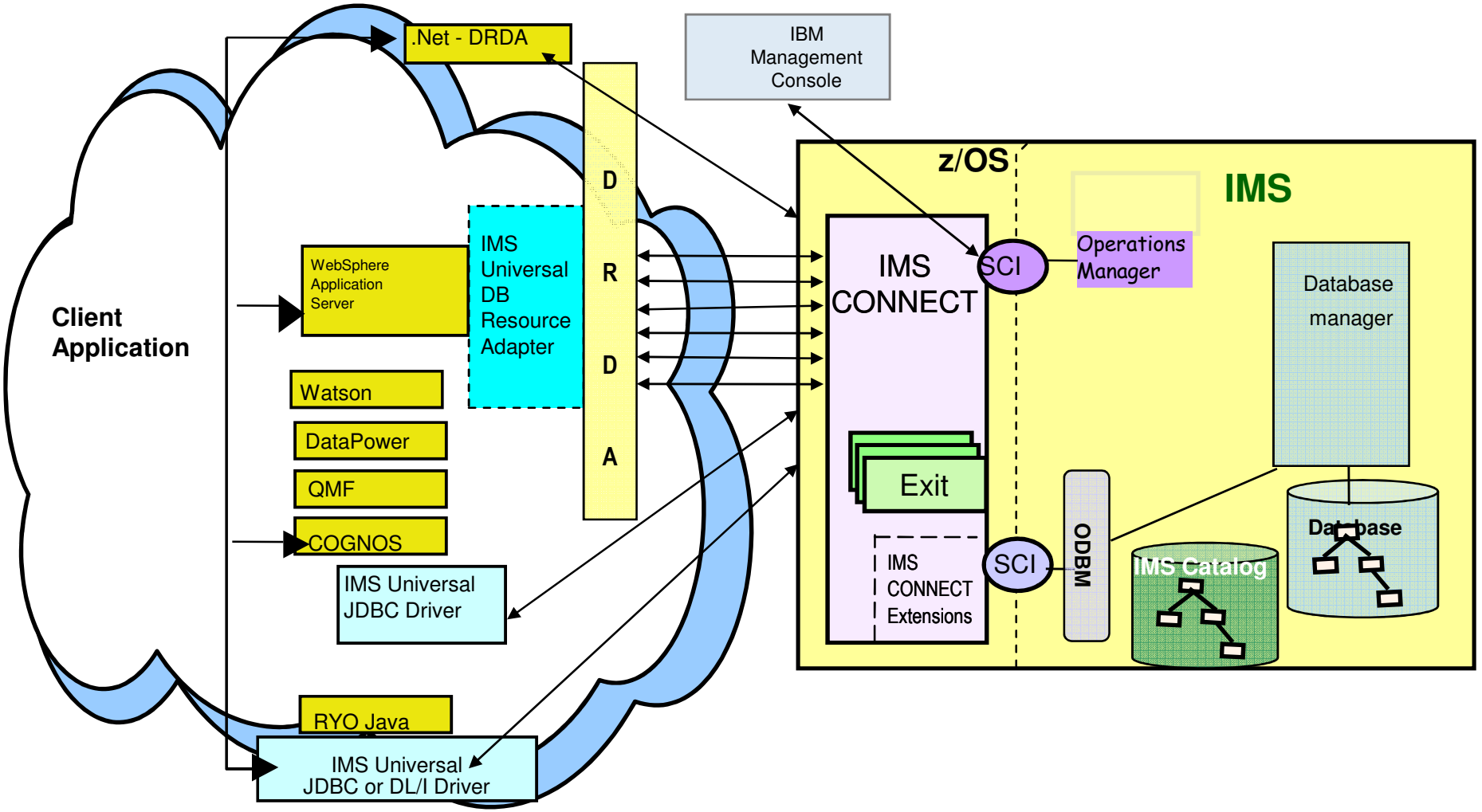
- **DRDA (Distributed Relational Database Architecture) implementation via TCP/IP, IMS Connect and ODBM**
  - Open Data Base Manager (ODBM) – a CSL address space (Common Service Layer)
    - Works with IMS Connect to provide distributed access to IMS databases
    - IMS Connect
      - Accesses ODBM via SCI (Structured Call Interface which is implemented by another CSL address space also called the SCI)
      - Can be used in a DBCTL environment



IMS Connect – Provides Integration to Transactions and Commands



IMS Connect –Integration to Databases

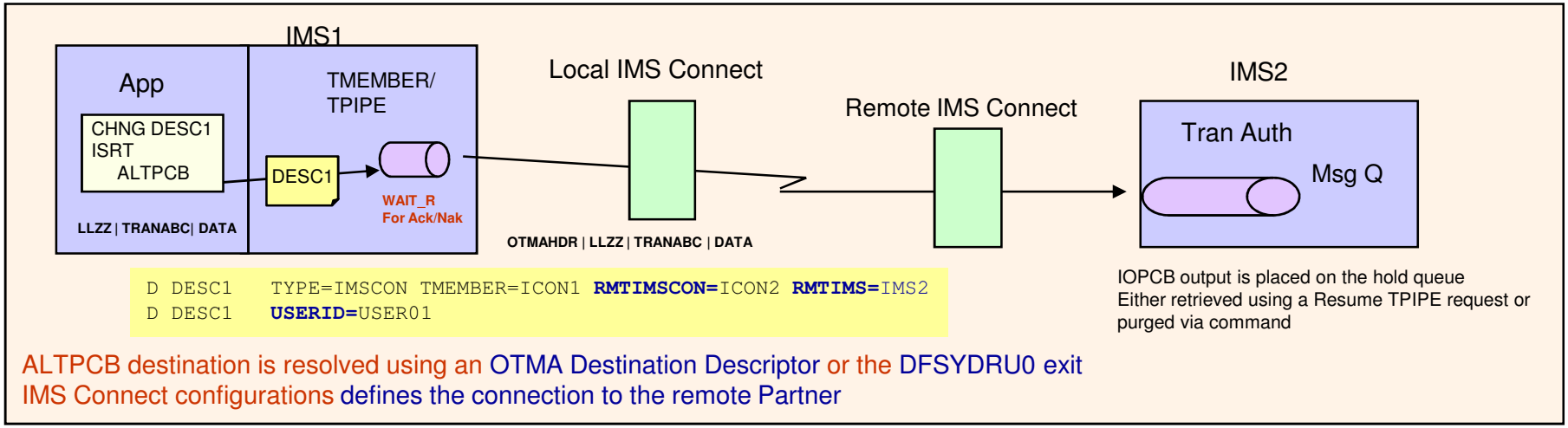


Along with Support for IMS-IMS Interaction

(enhancing traditional protocols)

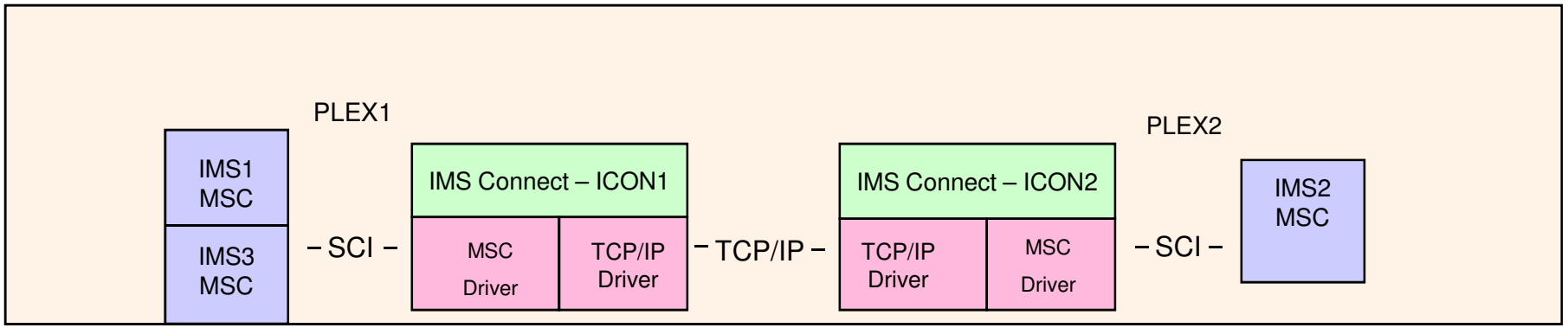
IMS Connect – Also enhances traditional protocols

- ***Asynchronous IMS - IMS TCP/IP Support (IMS 12)***
  - TCP/IP connections between the local and remote IMS systems
    - Managed by IMS Connect to IMS Connect communications
      - *Without having to write client code or invoke additional gateways*
  - OTMA
    - Sends OTMA remote ALTPCB messages to IMS Connect using new destination information (OTMA destination descriptors or DFSYDRU0 exit Routine)
  - IMS Connect
    - Receives OTMA ALTPCB messages from a local IMS and sends them to the remote IMS Connect for processing in the remote IMS
      - *Enhanced IMS Connect configuration specifications*



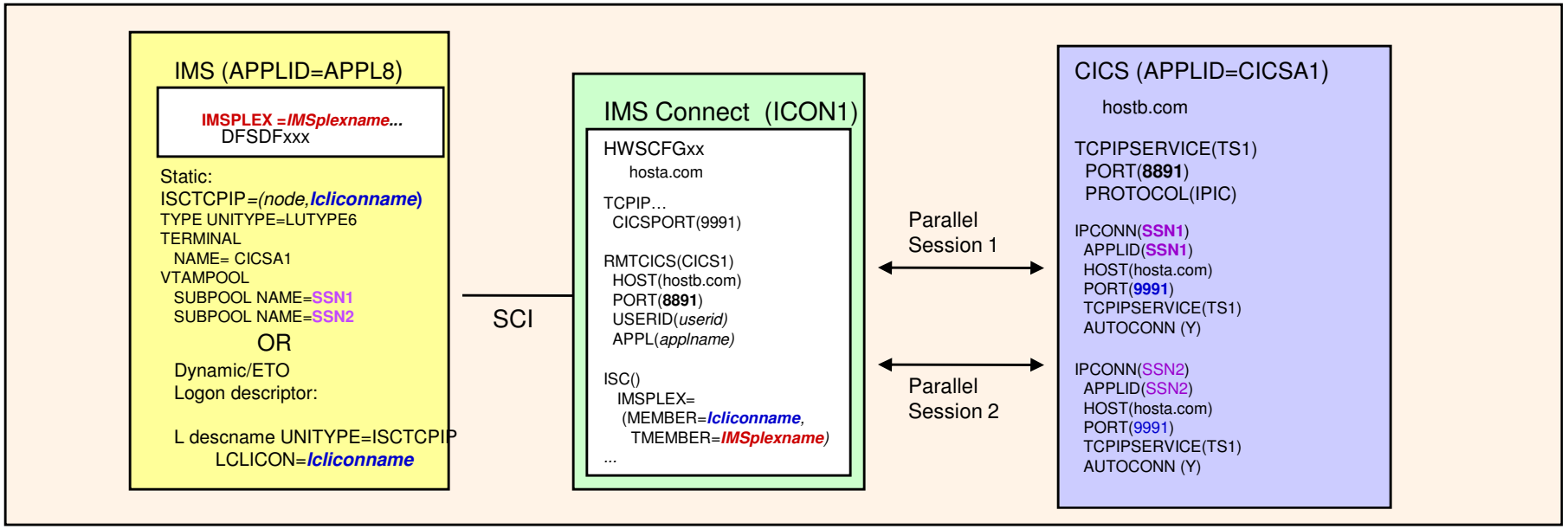
IMS Connect – Also enhances traditional protocols …

- ***Support for MSC communications (IMS – IMS) across a TCP/IP link (IMS12)***
  - Physical link MSPLINK TYPE=TCPIP
    - Provides a mechanism to complement or backup existing SNA/VTAM links
      - *Take advantage of potentially higher bandwidths*
    - Supports operational compatibility with other link types (CTC, MTM, VTAM)
    - Leverages IMS Connect and the Common Service Layer
      - *IMS Connect sends/receives messages via the TCP/IP network*
      - *IMS MSC manages the message processing*
      - *CSL provides the Structured Call Interface (SCI) for communications between IMS components including IMS Connect*



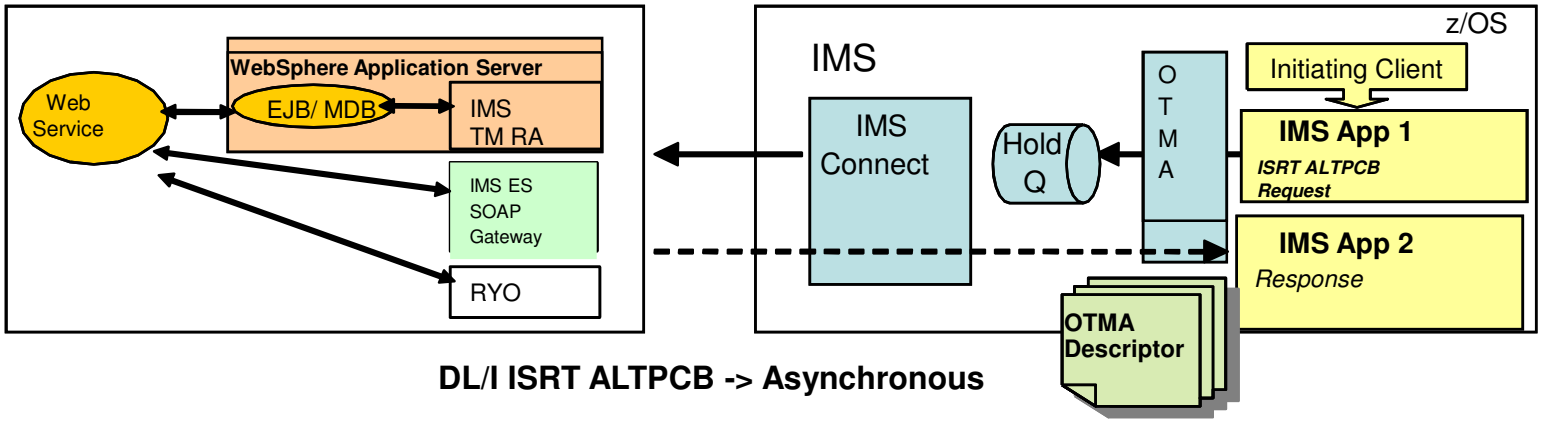
IMS Connect – Also enhances traditional protocols …

- ***Support for ISC communications (IMS – CICS) across a TCP/IP link (IMS13)***
  - – Leverages existing static/dynamic terminal definitions
    - New keyword: ISCTCPIP in DFSDCxxx
      - – *Specifies that an ISC-defined terminal is to use the TCP/IP support*
    - The Common Service Layer (CSL) provides the Structured Call Interface (SCI) for communications between IMS and IMS Connect
  - – Minimum CICS 5.1 - leverages existing IPIC connectivity capability



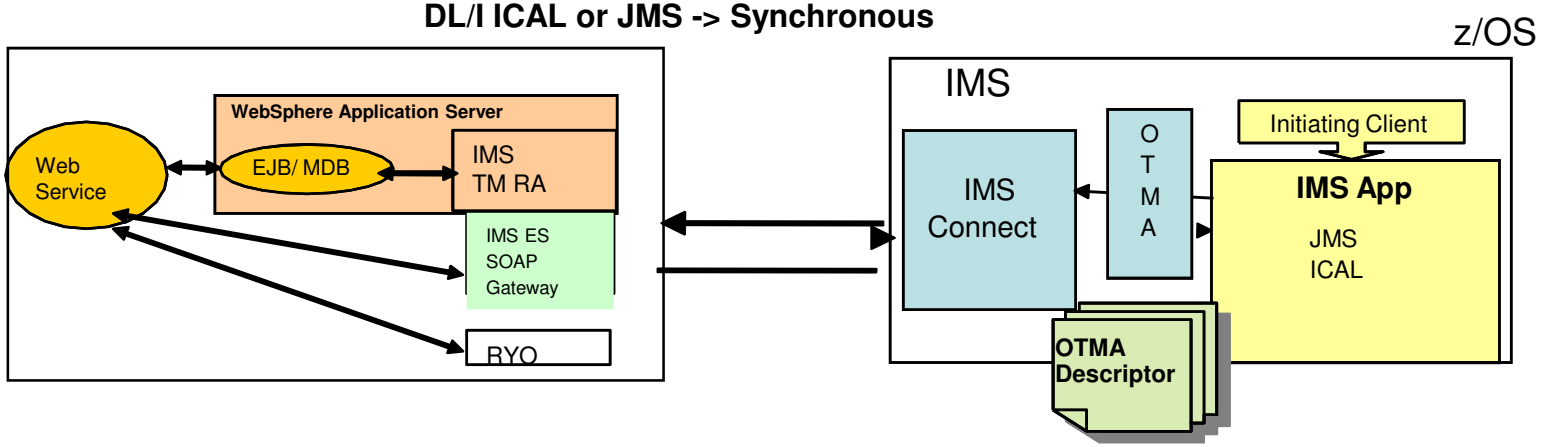
With Support for Calling out to distributed environments

IMS Application Callout



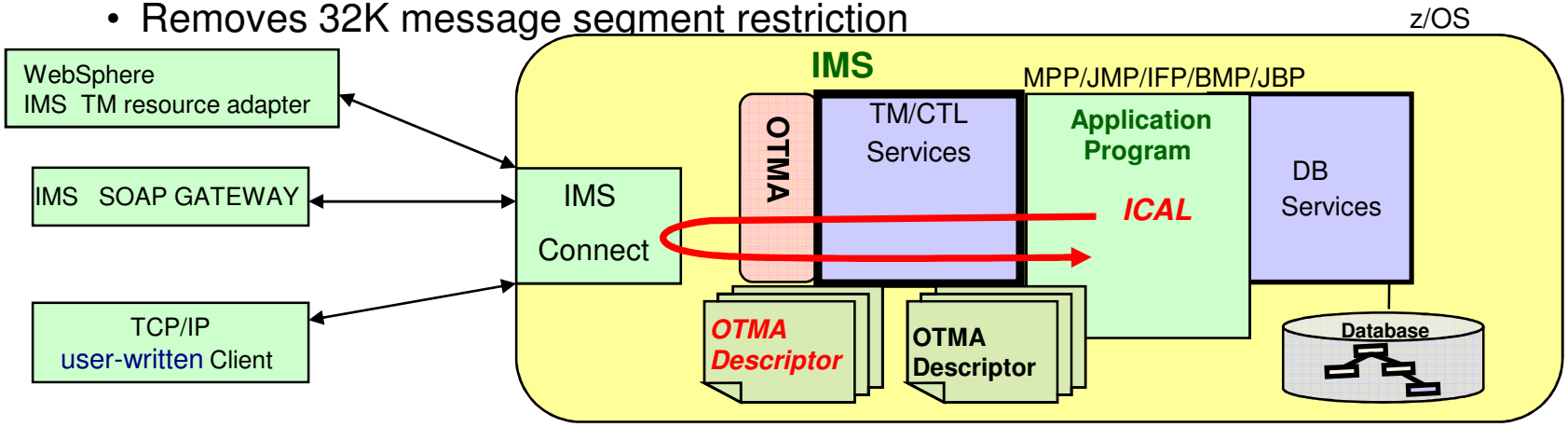
DL/I ISRT ALTPCB -> Asynchronous

DL/I ICAL or JMS -> Synchronous



IMS Synchronous Callout

- **DL/I ICAL**
  - Allows IMS transactions to access a service outside IMS and wait for a reply within the same unit of work
    - Positions IMS as both a client and a server - integrates IMS with other server and applications
    - Removes application managed message correlation
    - Removes 32K message segment restriction



>>---ICAL---aib---request_area---response_area-----><

- aib: specifies the application interface block (AIB) that is used for the call.
- request_area: specifies the request area to use for this call.
  - Contains request message data that is sent from the IMS application program to the application that is specified in the OTMA destination descriptor
- response_area: specifies the response area to use for this call.

Synchronous Callout Enhancement

- **IMS 14 introduces an ICAL enhancement to support an optional control data area**
  - Well-formed for content and context: LLLL<TAGn> data </TAGn>
    - Any type of control data can be specified and passed to IMS Connect and its external applications
  - Consisting of 1 to many control data items
    - Any number of “services” or “operations” can be specified on the same call

- **Benefits**
  - Provides a simple method to pass metadata, XML converter override, security credentials, endpoint information, etc., with the callout message
    - Increases the flexibility of callout applications
    - Allows more efficient usage of OTMA destination descriptors with overrides
      - *Fewer descriptors saves ECSA*

Synchronous Callout Enhancement

▪ ICAL – Control data

```
>>---ICAL---aib---request_area---response_area-----><
```

- aib: specifies the application interface block (AIB) that is used for the call.
- request_area: specifies the request area to use for this call.
  - Contains request message data that is sent from the IMS application program to the application that is specified in the OTMA destination descriptor
- response_area: specifies the response area to use for this call.

```
>>--ICAL--aib---request_area---response_area---control_area><
```

- The parameter aib specifies the application interface block (AIB) that is used for the call
  - AIBOPLEN - length of the total control area
- The request_area specifies the request area to use for this call.
- The response_area specifies the response area to use for this call.
- The control_area specifies the optional control data to use for this call

  The control data can consist of 1 to many control data items:

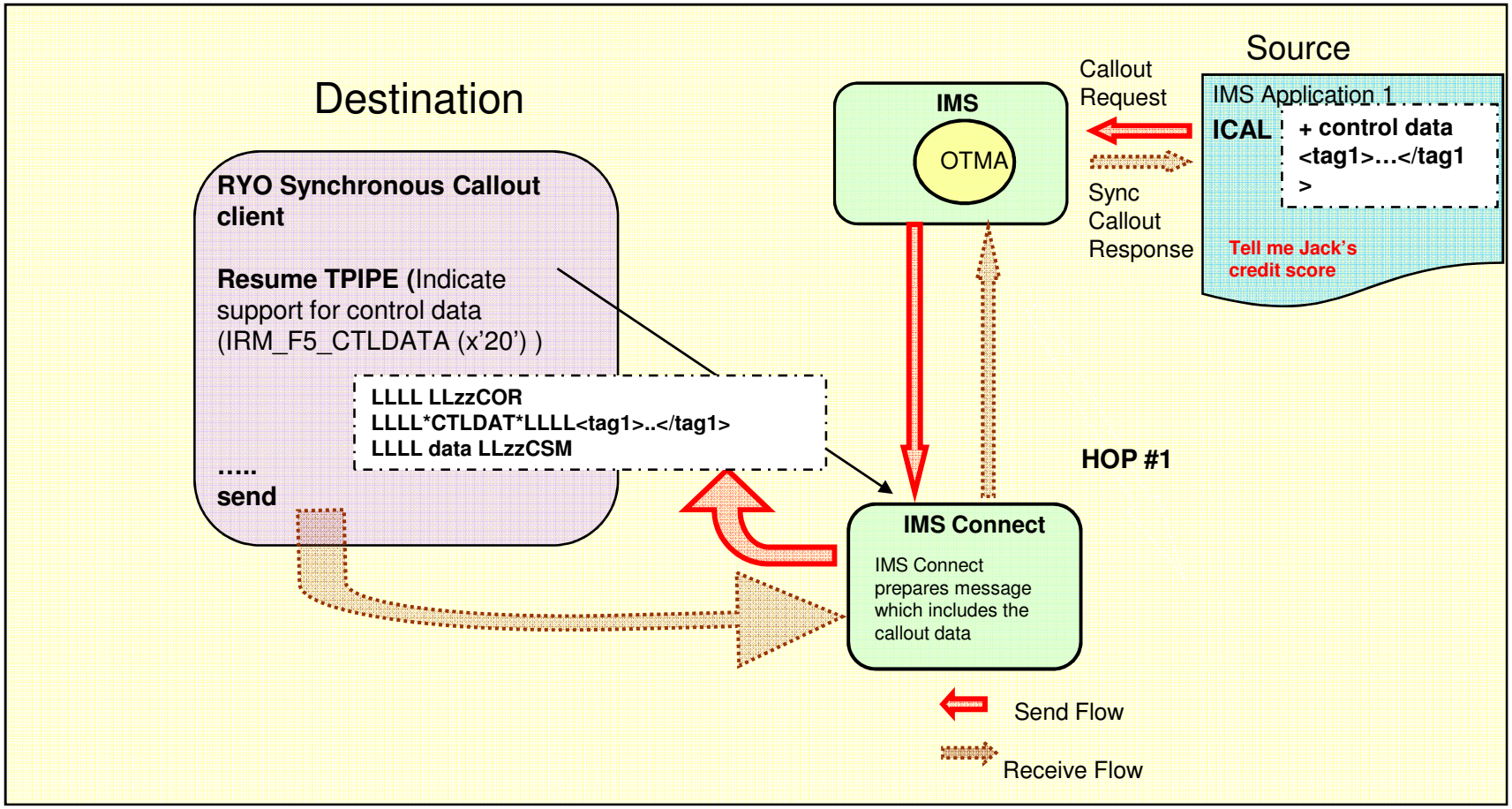
  The format of control data item(s) in the ICAL control data are as follows:

  LLLL | <tag1> | data | </tag1> {LLLL | <tagn> | data | </tagn>…}

  The tag name and data contents will be treated as binary and passed "as is" to the target client

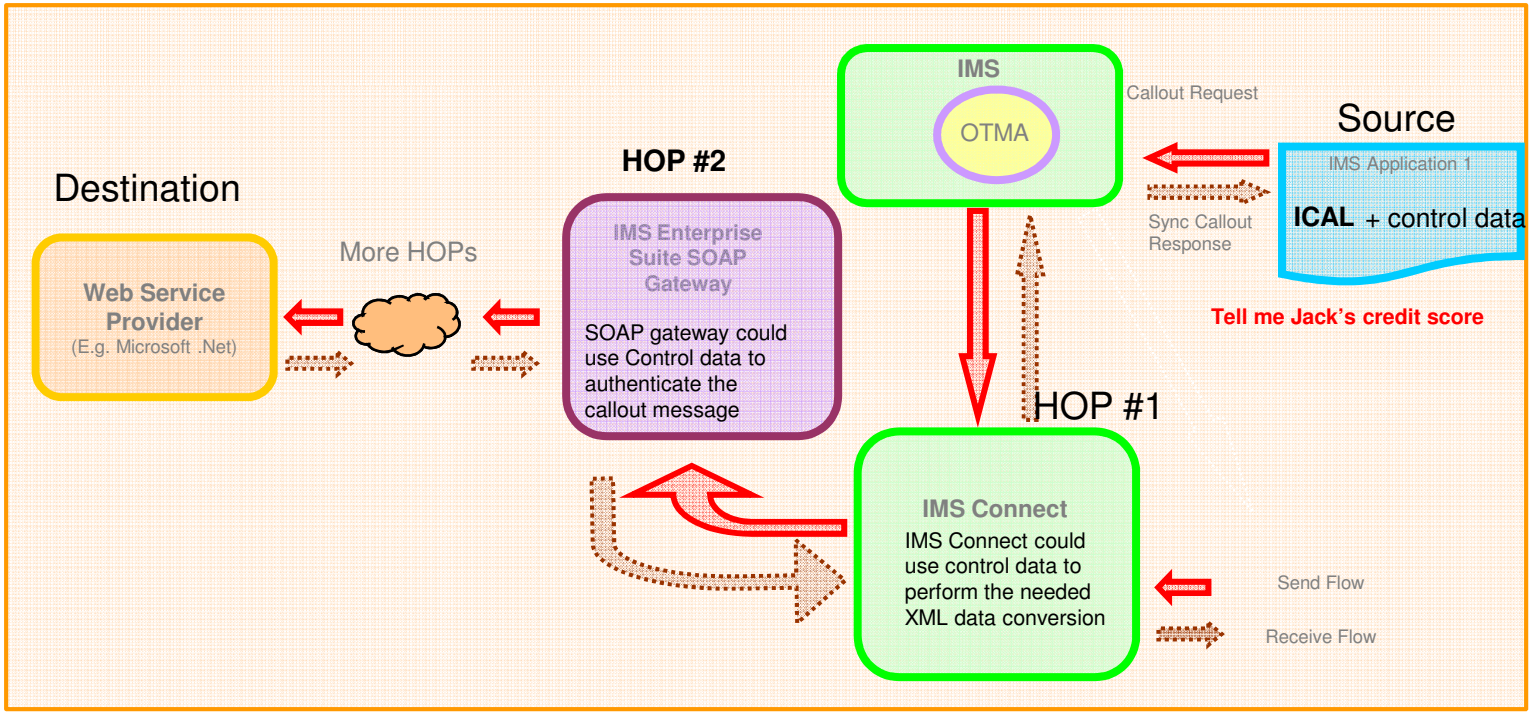
Synchronous Callout Enhancement …

- **EXAMPLE 1: ICAL Control data contains "data about the data"**
  - Provides information to the hops for special processing



Synchronous Callout Enhancement …

- **EXAMPLE 2**
  - Specialized IMS-defined control data items start with **DFS** in the Tag **DFSCNVTR**
    - *Identifies that an XML converter name follows in the associated control data field*
    - ***The converter name and the tags should be in uppercase EBCDIC***
  - For IMS Soap Gateway messages
    - *Minimizes the number of destination descriptors that have to be specified*
      - » Previously, one was needed for each unique converter name

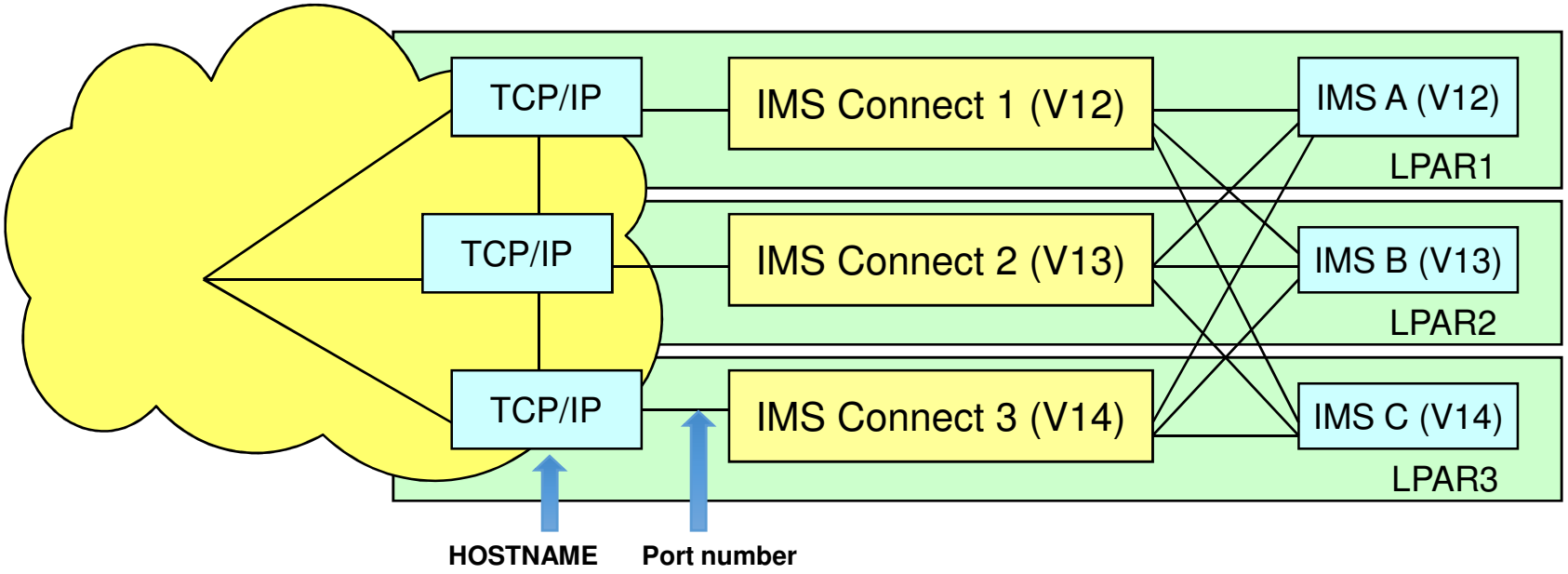


And support for
a High Availability Environment

(workload balancing, sysplex distribution, failover, etc…)

Architecting for Availability

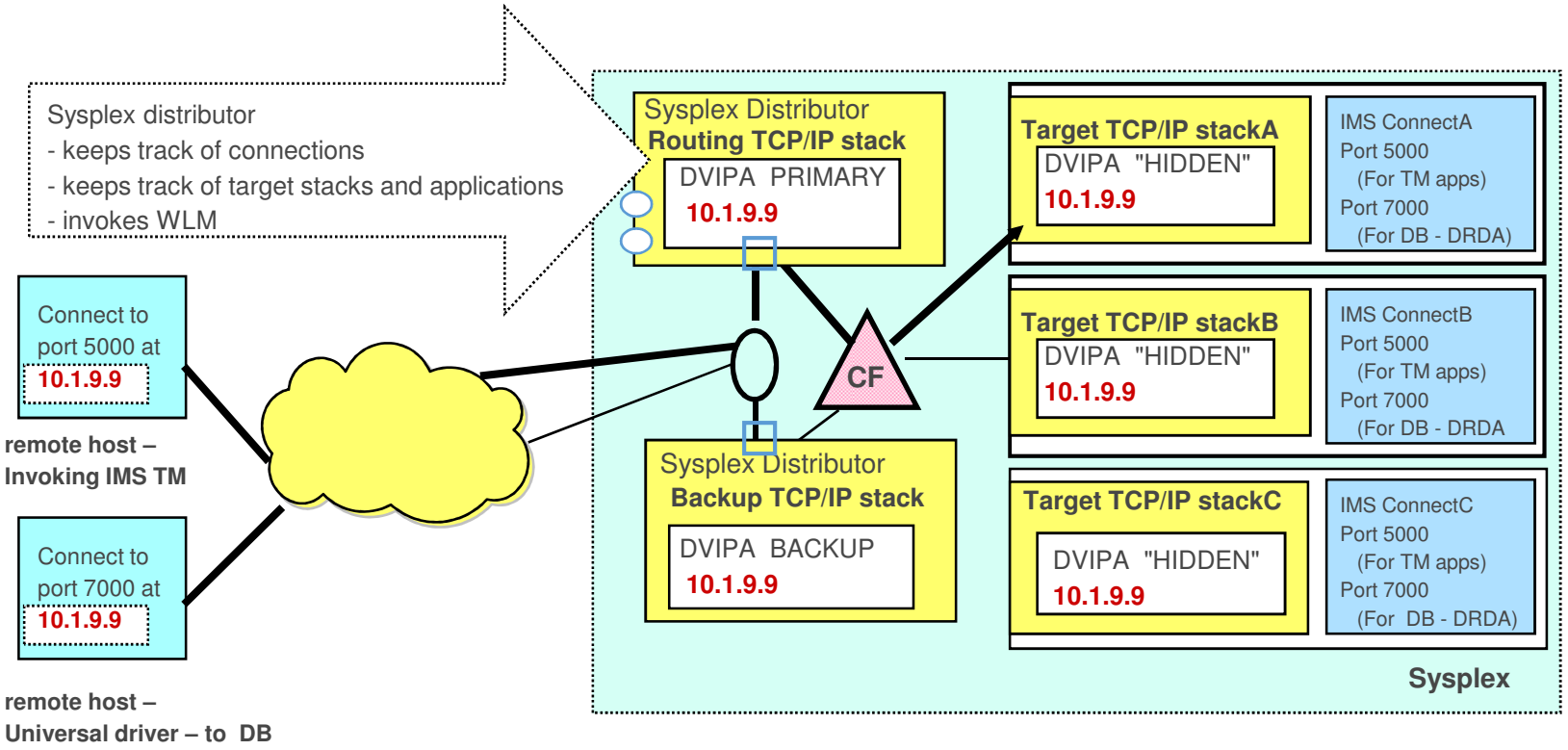
- **The use of mechanisms such as IP spraying, workload balancing and sysplex distribution**
  - Allow a connection request to be routed to any of the available IMS Connect instances
    - Different versions of IMS Connect and IMS can coexist
      - *Mixed versions of IMS Connect and IMS are limited to the functionality of the lower release level*



Port Sharing

- **A method to distribute workload for IP applications *within* a z/OS LPAR**
  - Multiple instances of an application can listen on the same PORT number
    - Allows the workload to be distributed among the server applications listening on the same port
    - Simplifies the request for the remote client that does not know there might be multiple server application instances that can accept the message
  - Can be implemented using round-robin distribution or with the workload manager
- **IMS Connect Ports - Provide the mechanism to access different IMS resources**
  - Examples:
    - PORTID - defines the PORT numbers for access to IMS TM applications and commands
    - PORT - defines the PORT numbers, distinct from those defined in PORTID
      - *Also for access to IMS TM applications and commands but allow an IMS Connect override of the TCP/IP Keepalive specification*
    - SSLPORT – defines the Secure Socket Layer port ***(use AT/TLS instead)***
    - DRDAPORT - used specifically for access to IMS DB.

In a Sysplex Distributor Environment

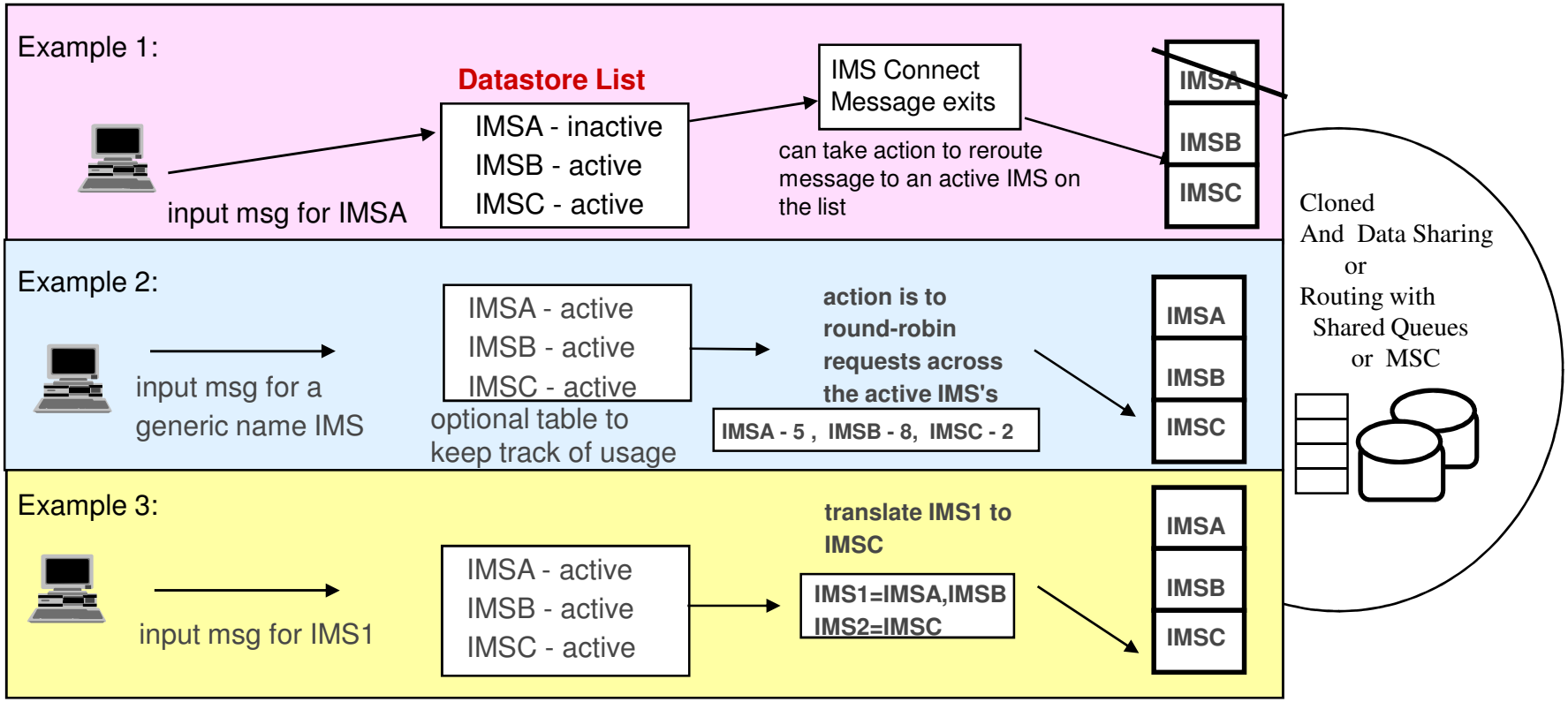


VIPA (Static Virtual IP Addressing)
Eliminates an application's dependence on a particular network interface (IP address)
- Non-disruptive rerouting of traffic in the event of failure
- A defined VIPA does not relate to any physical network attachment
  > There could be multiple network interfaces on a single TCP/IP stack
  (e.g., 10.1.9.7 and 10.1.9.8 are the physical interfaces in front of virtual 10. 1.9.9

Dynamic VIPA
Support for other TCP/IP stacks to be backup VIPA address
- Allows an active stack to assume the load of a failing stack
  >Stacks share information using z/OS XCF messaging

IMS Connect Workload Balancing and Failover

- **Once a message destination is resolved to a particular z/OS host and IMS Connect system**
  - IMS Connect can access multiple IMS Systems (datastores)
  - Message exits can reroute a message to a different target IMS
    - The Datastore table provides information as to which systems are active



Routing - Transactions

- **Two tables available to IMS Connect Message exits**
  - INIT TABLE
    - Points to the datastore table
    - Allows user data to be stored
  - DATASTORE TABLE (datastore = an IMS system)
    - Contains datastore id's, status (active or inactive) and optional user data
- **User Initialization Exit Routine (HWSUINIT)**
  - USAGE
    - Driven during initialization and termination
    - Load user table(s) and obtain any needed storage
    - Add user data to INIT and DATASTORE tables
    - e.g., define alternate IMS systems
- **IMS Connect provides the interface**
  - IMS Connect message exits that are provided do not take advantage of the capability but can be enhanced to do so
  - Plug-ins such as **IMS Connect Extensions (CEX)** provide routing support

Routing - Databases

- **IMS Connect has an internal table**
  - Keeps track of ODBMS and the IMS datastores and aliases

- **IMS Connect DB Routing Exit routine (HWSROUT0)**
  - Can determine or change the destination of a database access request
    - Select an ODBM by its name
    - Allow IMS Connect to select an ODBM instance
      - *By alias name*
        - » If only one ODBM has specified the alias, the request is routed to that ODBM
        - » If the alias is associated with multiple ODBMs then IMS Connect uses a round-robin technique to route the request across those resources.
      - *If the alias is blanks then IMS Connect round-robins the request across all the ODBM resources in the IMSplex.*
    - Override the alias provided in the incoming request

Note

- **Although the Sysplex Distributor is an efficient mechanism for workload balancing**
  - Balancing only occurs when a new connection is being established
  - If an IMS Connect region fails
    - New connection requests are automatically routed to the remaining active IMS Connect regions and workload balancing occurs among the active regions
  - When the failed IMS Connect is restarted
    - Connections that are already active with other IMS Connect regions are NOT re-balanced
      - *Only NEW connections are routed to the restarted region*
  - Implication:
    - Because many of the connections with IMS Connect are persistent
      - *The environment after an IMS Connect has failed and been restarted, might be unbalanced until enough new connections have been requested.*

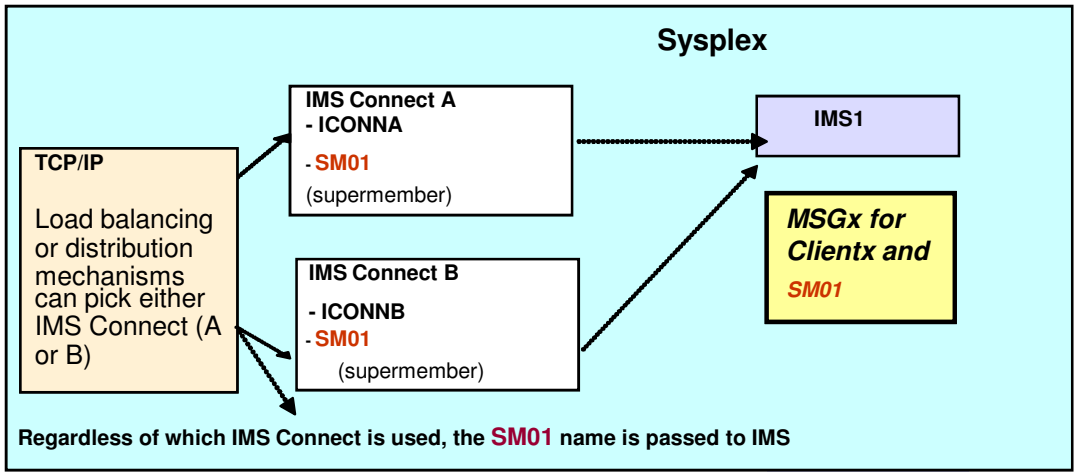
And also in support of Sysplex

- **Super member Support (OPTIONAL)**
  - Allows retrieval (Resume TPIPE requests) of any queued asynchronous messages regardless of the connection path
    - Includes undelivered IOPCB messages along with all unsolicited ALTPCB messages
  - A **group name** given to a set of IMS Connect instances
    - *Any IMS Connect can retrieve the message*
  - Generic structure name in IMS on which the messages are queued
    - *IMS Connect systems are recognized by IMS by both their specific name and supermember name*
    - *For Shared Queues, no affinity to an IMS system*
      - » Any IMS can deliver the message

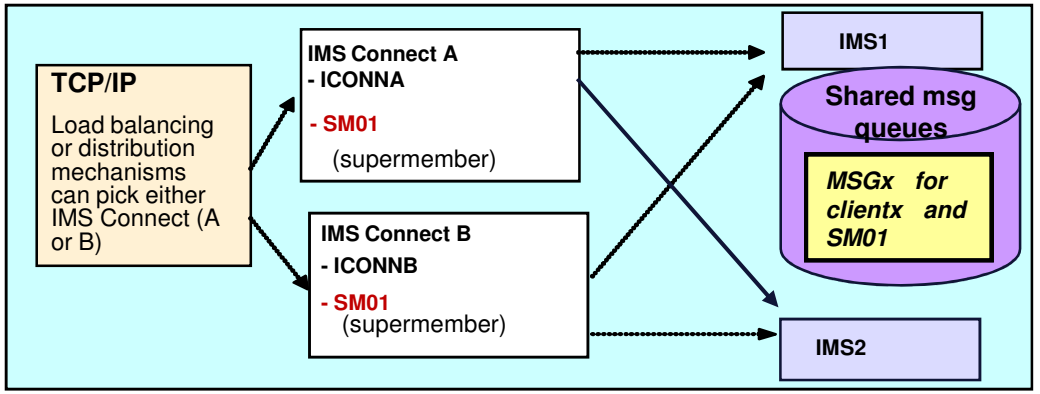
And also in support of Sysplex …

Resume TPIPE for clientx through IMS Connect for a message in IMS

Clientx

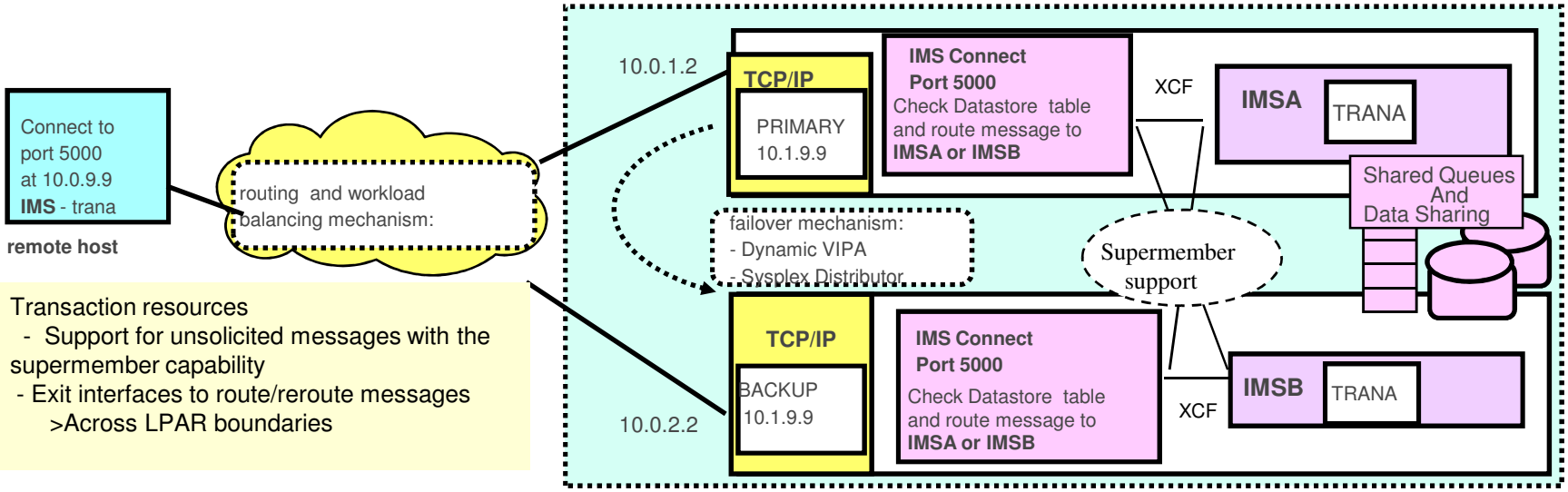


Resume TPIPE for clientx through IMS Connect for a message in IMS



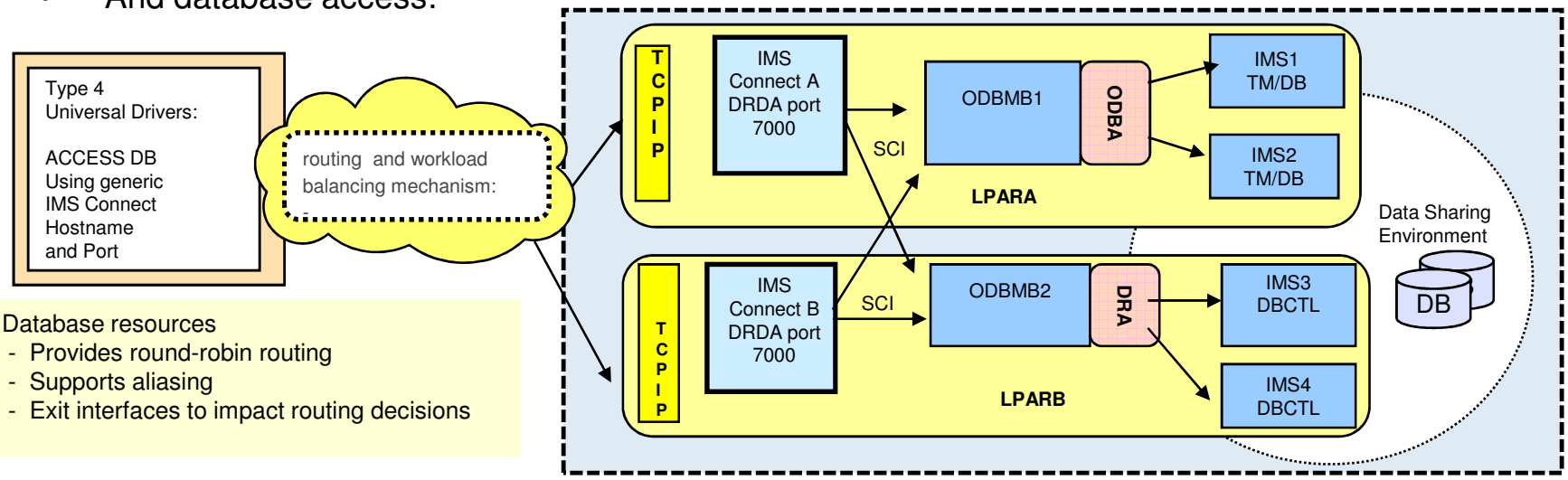
And also in support of Sysplex …

- **Transaction access through sysplex distribution and supermember support :**



Transaction resources
- Support for unsolicited messages with the supermember capability
- Exit interfaces to route/reroute messages
  >Across LPAR boundaries

- And database access:



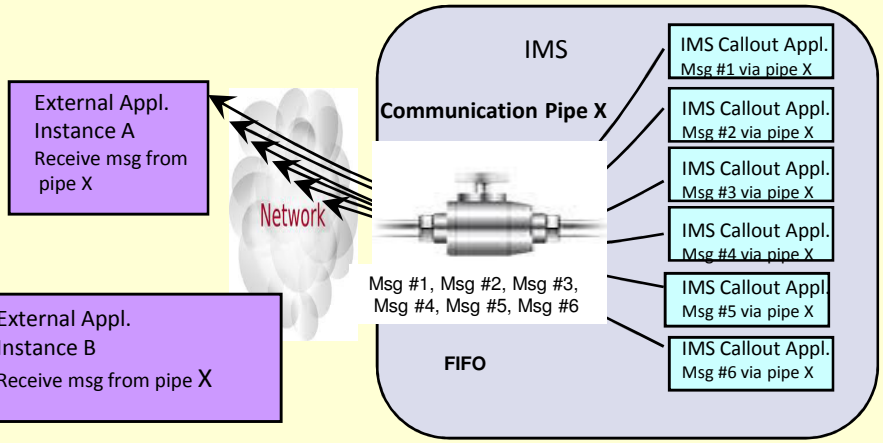
Database resources
- Provides round-robin routing
- Supports aliasing
- Exit interfaces to impact routing decisions

TPIPE Parallelism

- **New in IMS14: ability for multiple Resume TPIPE client requests to be concurrently active on a single TPIPE**
  - Alleviates potential throughput bottlenecks for callout

- **Potential problems in pre-IMS14 systems:**

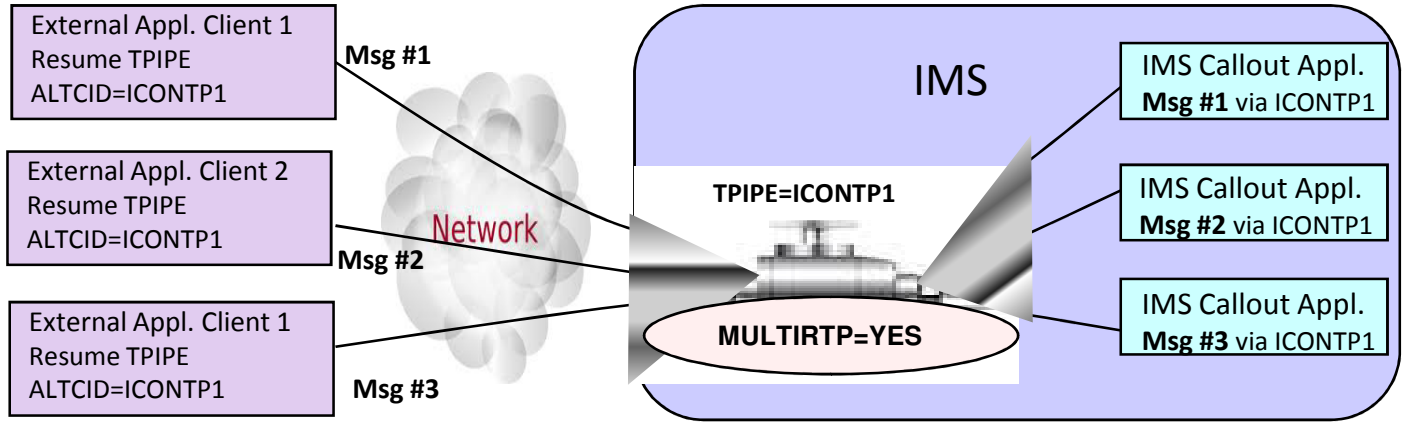
- Restriction: For each TPIPE, only a single active ***Resume TPIPE*** can be active
  - One message at a time in FIFO order for the same tpipe
  - If one is blocked the others cannot be delivered



Even if another Resume TPIPE is issues again the tpipe name, this second request will be queued and have to wait for the active RT to terminate
- provides for failover but not throughput or workload balancing

TPIPE Parallelism …

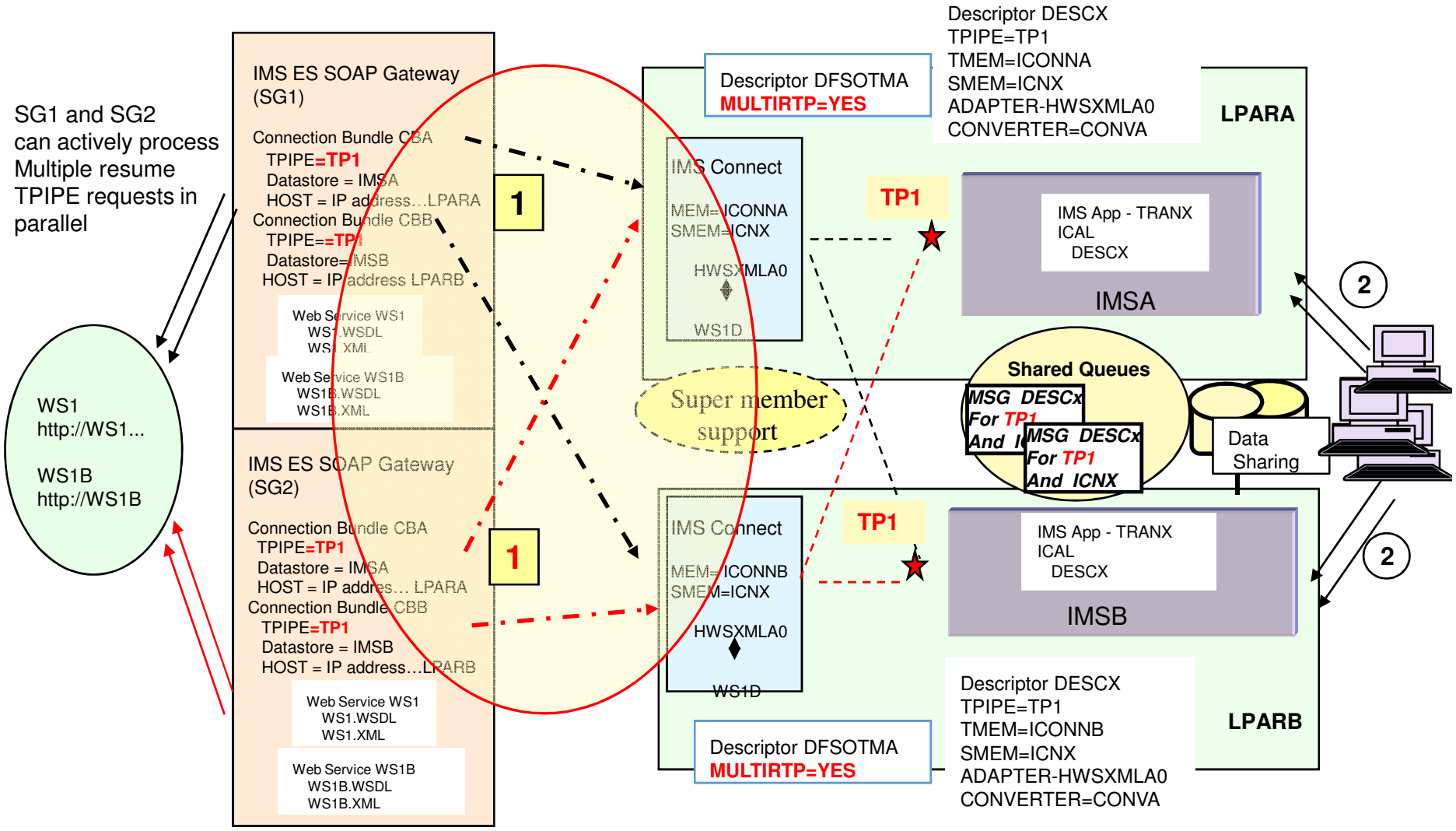
- **MULTIRTP=Y: Enables multiple active Resume TPIPE requests to pull messages from a single TPIPE**
  - Creates additional control blocks up to the LIMITRTP value to support concurrency and to minimize queuing



- Benefit
  - *Supports multiple callout applications to the same TPIPE for best performance and parallelism*
    - » No need to implement circumventions or re-design applications
  - *Resume TPIPE protocol for client requestors remains unchanged*
    - » No new architecture or option required on Resume TPIPE
    - » Still must wait for ACK from each message sent

An Enhanced Environment

- Enhances sysplex environment – parallelism with the same TPIPE name



So… In Review

IMS Connect is more than a TCP/IP Gateway

It is the interface for evolving integration capabilities

And… is the springboard to new connection technologies