

Application Programming in the IMS World

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#16398 - Cedar



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IMS 13 APAR PM78158 MPP,JMP,IFP regions PARDLI capability

■ Current

- For BMPs, PARDLI=1 means all DL/I processing is to be performed in the IMS control region to prevent control region system 113 abends resulting from system X22 abends in the BMP region

■ Change

- APAR PM78158 provides the ability to specify the PARDLI parameter for JMP, MPP, and IFP regions.
 - Note using PARDLI=1 for MPP, JMP, or IFP regions can seriously degrade performance. Use of PARDLI=1 for MPP, JMP, or IFP regions is intended only for application debugging purposes if needed.

IMS 13 APAR PM86872 IMS Timing Services and connecting to External Subsystems.

■ Current

- Application programs running in IMS dependent regions using STIMER= may not be terminated with ABENDU240 while in a long running call to an External Subsystem.
- ABENDU240 was delayed until after the External Subsystem returned to IMS.

■ Change

- ABENDU240 will now be enforced in IMS dependent regions that are running in an External Subsystem (ESS) when time expires using IMS Timing Services.

ICAL Enhancements

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Support for Truncated Messages

- **New “RECEIVE” subfunction code**
 - With an expanded response area
 - Retrieves the response message after an ICAL “SENDRECV” is issued with an inadequate response area specification and gets partial data (AIB RC X’100’, AIB RS X’00C’)
 - IMS 13 keeps a copy of the entire response message in the control region private storage
 - Until a subsequent ICAL “SENDRECV”, syncpoint, or application termination
- **Addresses**
 - Partial response message due to inadequate application specification
- **Benefit**
 - Provides the ability to complete the retrieval of a reply message
 - Without having to re-issue a complete ICAL “SENDRECV” and associated network transmission costs

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ICAL subfunction RECEIVE

■ Format:

- >>-ICAL--*aib--response area*-----><

■ **AIB**

- **AIBSFUNC** value “**RECEIVE**”
- **AIBOAUSE** is used as an input and output parameter based on AIBSFUNC
 - For the “RECEIVE” call
 - Contains the length of the response area
- **AIBOALEN** = request area length
 - Used as an **output parameter for “RECEIVE”**
 - When complete response is returned in *response area*, this field is 0
 - If partial data is returned (AIB RC X'100', RS X'00C'), this field contains the actual length of the response message

ICAL sub-function *RECEIVE* ...

■ Usage example:

❖ ICAL --aib—request area, response area

- ⇒ AIBSFUNC (**SENDRECV**)
- ⇒ AIBOAUSE – Response area length
- CALL is issued → AIBRETRN=x'100', AIBREASN='00C'
 - × Specified length of the output response area is too small
 - × AIBOAUSE= length of the data that was returned in the response area
 - × **AIBOALEN** = the actual length of the entire response message
- Using the value in the previous **AIBOALEN** and leveraging the new support which keeps the message in IMS CTL region private, retrieve the entire response:

❖ ICAL --aib— **response area**

- ⇒ Where *response area* has been expanded to contain the entire message
- ⇒ AIBSFUNC (**RECEIVE**)
- ⇒ AIBOAUSE – new response area length
- CALL is issued successfully
 - ✓ AIBOAUSE – length of the response in the response area
 - ✓ AIBOALEN – set to 0 because the call successfully returned the entire response

ICAL sub-function RECEIVE ...

- **ICAL “RECEIVE” is only valid if previous ICAL “SENDRECV” failed**

- **Response data is available for retrieval until:**
 - A new ICAL call with sub-function code SENDRECV is issued
 - When the IMS application reaches a syncpoint
 - Checkpoint for an BMP application
 - Abnormal termination

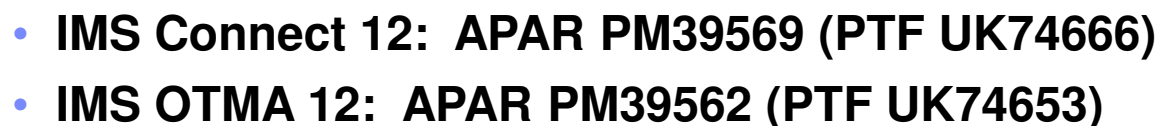
AIBUTKN

- **New AIB field - AIBUTKN**

- Provides optional specification of a 1-8 byte map name
- Included in the OTMA state data prefix to be sent to the callout destination
- IMS 12: PM73135/UK82636

- **Benefit**

- Ability to send a name to a remote ICAL destination that can be used for message formatting or service identification purposes



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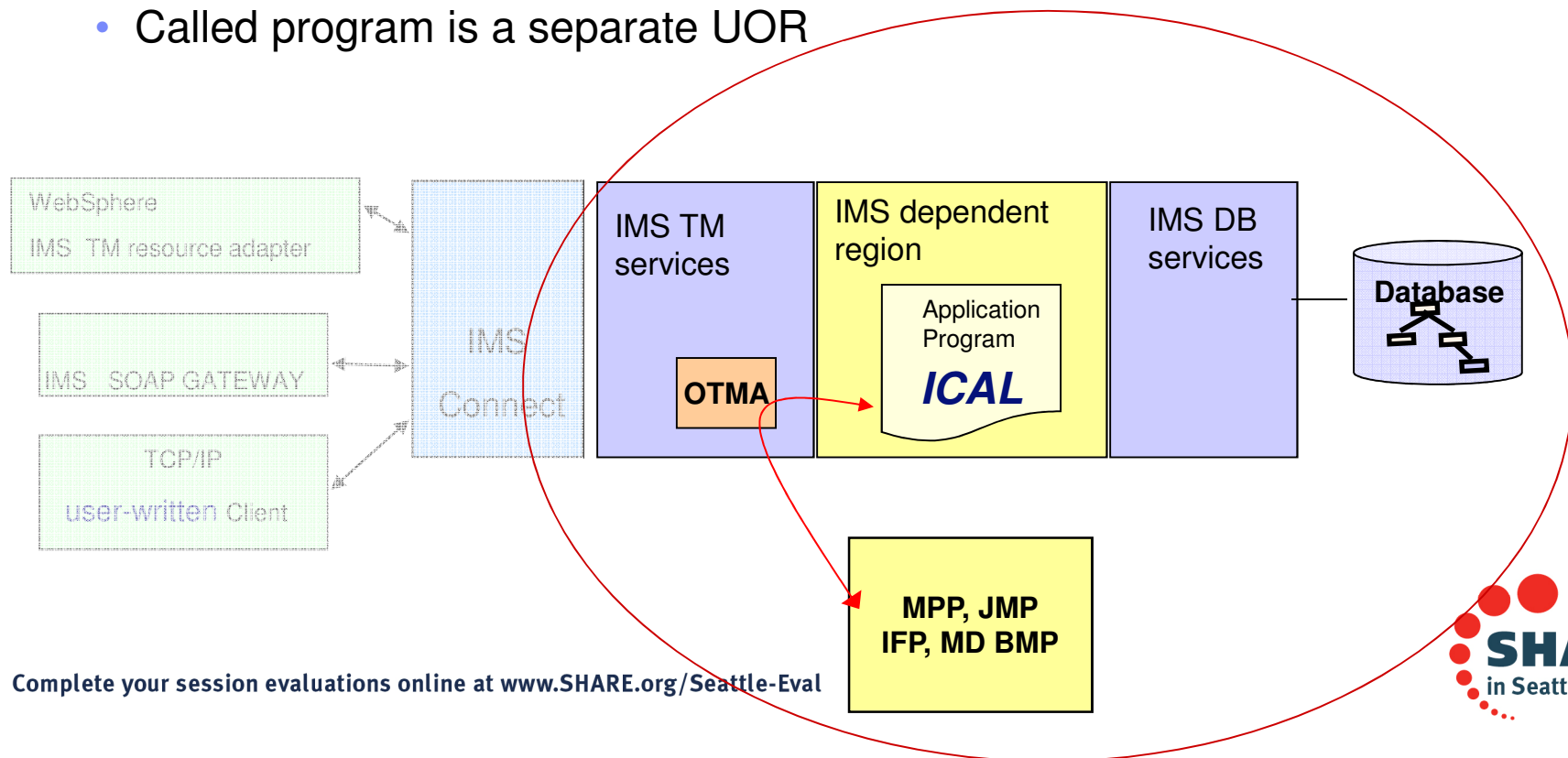
IMS 12 Synchronous Callout SendOnly Ack SPE

■ IMS 13 APAR for Callout Send-Only ACK SPE

- The ACKs were sent back with the complete response message text
 - This could be very large
- IMS 13 APAR PM90943 allows the OTMA Client to request that the request message text not be send back with the ACK
- IMS Connect 13 APAR PI10653 adds flag IRM_F1_SOARSP to allow the IMS Connect Client to request that the request message text not be returned with the ACK

Synchronous Program Switch

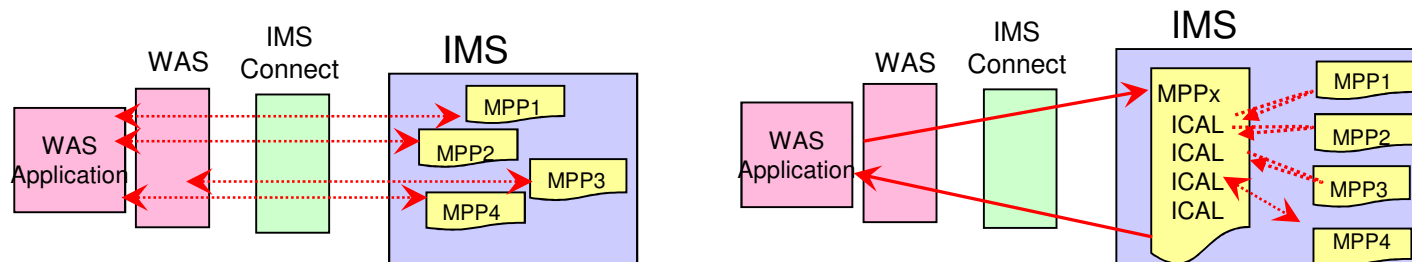
- **New** capability that enhances the DL/I ICAL support
 - Allows an IMS application program to synchronously call and wait for a reply from another IMS application program
 - Within the calling program's UOR
 - Called program is a separate UOR



Synchronous Program Switch...

■ Benefits

- Modernization of the IMS application infrastructure
 - Provides an internal service flow of IMS transactions to complete a business process
 - In the same IMS or a different IMS
- Implementation of a Process Server or Broker inside IMS
 - Reduces unnecessary network traffic when accessing multiple applications in the same IMS or IMSplex



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The DL/I ICAL call

Same Format

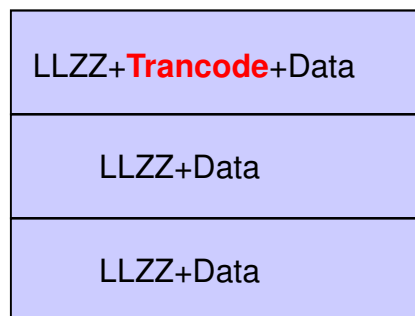
>>-ICAL--aib--request_area--response_area-----><

Call Name	DB/DC	DBCTL	DCCTL	DB Batch	TM Batch
-----------	-------	-------	-------	----------	----------

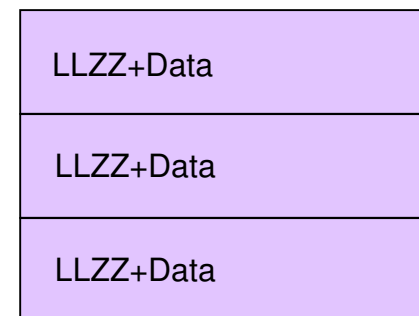
ICAL	X		X		
------	---	--	---	--	--

```
01 AIB.
02 AIBRID PIC x(8) VALUE 'DFS AIB '.
02 AIBLEN PIC 9(9) USAGE BINARY.
02 AIBSFUNC PIC x(8) VALUE 'SENDRECV'.
02 AIBRSNM1 PIC x(8) VALUE 'OTMDEST1'.
02 AIBRSNM2 PIC x(8).
02 AIBRESV1 PIC x(8).
02 AIBOALEN PIC 9(9) USAGE BINARY VALUE 28.
02 AIBOAUSE PIC 9(9) USAGE BINARY VALUE 30.
02 AIBRSFLD PIC 9(9) USAGE BINARY VALUE 5000.
02 AIBRESV2 PIC x(8).
02 AIBRETRN PIC 9(9) USAGE BINARY.
02 AIBREASN PIC 9(9) USAGE BINARY.
02 AIBERRXT PIC 9(9) USAGE BINARY.
```

Request Data (example of multi-segment):



Response Data in multi-segment:

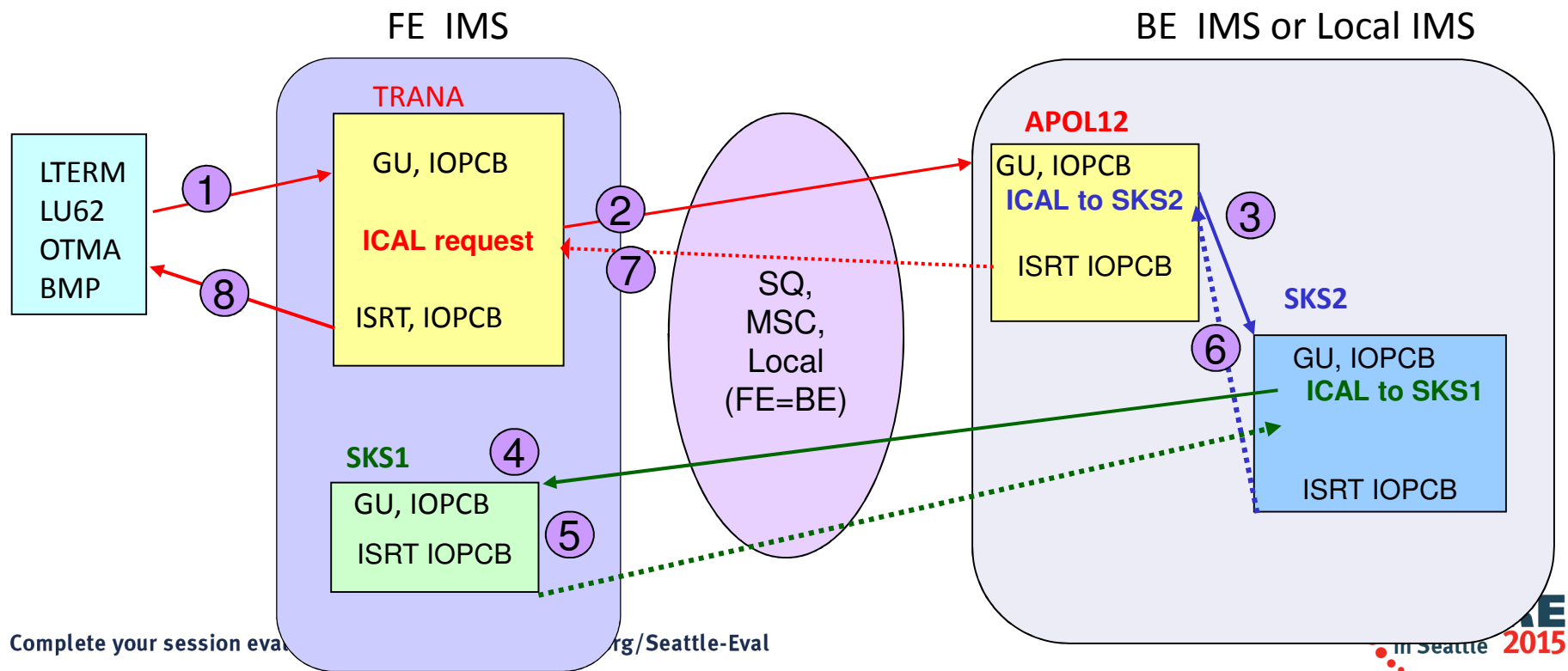


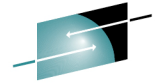
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Application Examples...

- The IMS application environment supports recursive requests
 - ICAL to ICAL
 - Across a single or multiple IMS systems





OTMA Transaction Expiration and Shared Queues SPE

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■ **SPE: APAR/PTFs**

- **IMS 10: PM05985 (UK75413/UK75414)**
- **IMS 11: PM05984 (UK74312/UK74313)**
- **IMS 12: PM46829 (UK75415/UK75416)**

■ **Enhancements**

- **Options when transaction expiration occurs at application GU time**
 - **Option to suppress or display symptom dumps and DFS554A messages**
 - **Option to return input message instead of DFS3688I**
- **Improved routing capability of Shared Queues back-end ALTPCB output**
- **Improved usability of /DIS TMEMBER TPIPE command**

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OTMA Descriptors

- **OTMA destination descriptor enhancements**
 - TYPE={MQSERIES}
 - Provides asynchronous callout and messaging support (ISRT ALTPCB)
 - EXIT={YES | NO}
 - Specifies whether or not the OTMA exits are to be called
- **Corresponding enhancement to IMS Type-2 OTMADESC commands**
 - [CREATE | UPDATE | DELETE | QUERY] OTMADESC
 - Recovered across warm and emergency restarts
- **New/changed member control cards in DFSYDTx requires an IMS COLD start to take effect (not new to IMS 13)**
- **Benefits**
 - Simplifies asynchronous messaging to WMQ
 - Removes the need to code the OTMA exits, DFSYPRX0 and DFSYDRU0
 - Provides dynamic change capability with the Type-2 commands

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IMS 12 SPE Enhancement

SSA Qualify By Position and Length

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SSA Enhancement - Qualify by Position

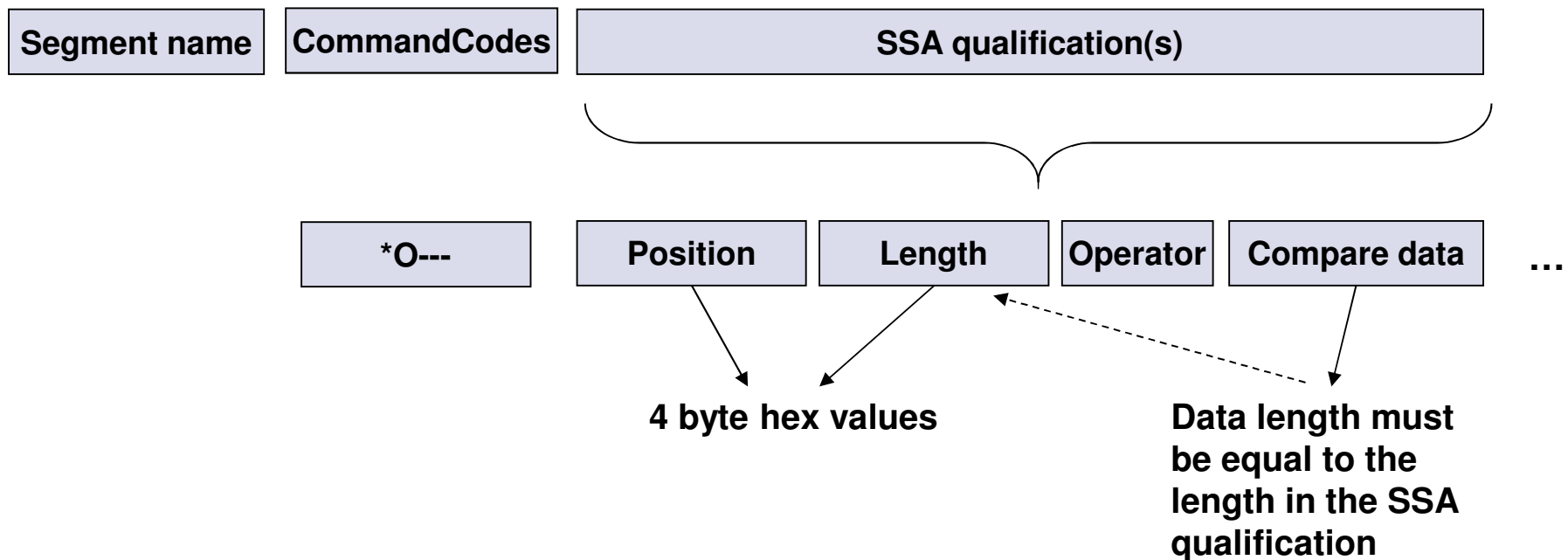
- **IMS 12 APAR PM65139 / PTF UK81837 & UK81838**
 - New SSA command code “O”
 - Enhanced database SSA processing with ability to search for data in a segment by specifying a field position and length instead of a field name
 - Contains core IMS database code

- **IMS 12 APAR PM69378 / PTF UK81917**
 - Enhanced IMS Universal Drivers to allow SQL predicates containing ‘columns’ not defined in the DBD by internally converting ‘columns’ to position and length for SSA qualification
 - Contains IMS universal driver code

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SSA Enhancement - Qualify by Position

- New SSA using “O” command code with position/length



SSA Enhancement - Qualify by Position

- New SSA with “O” command code, position and length

DBD

Field	Offset	Len
Labname	1	5
Street	10	20
State	30	2

Database

0	1	2	3
12345678901234567901235678901			
SVL	DEV	555	BAILEY AVE
ARC	RSC	650	HARRY RD
			CA

COBOL Copybook

Field	Offset	Len
Labname	1	5
Type	6	3
Street	10	20
State	30	2

```

GU IBMLABS *O(0000000100000005EQSVL  )
GU IBMLABS *O(0000000100000005EQARC  )
GU IBMLABS *O(0000001E00000002EQCA)
GU IBMLABS *O(0000000600000003EQDEV)
  
```

Position Length

‘bb’ Status Code: all segments returned successfully

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SSA Enhancement - Performance Consideration

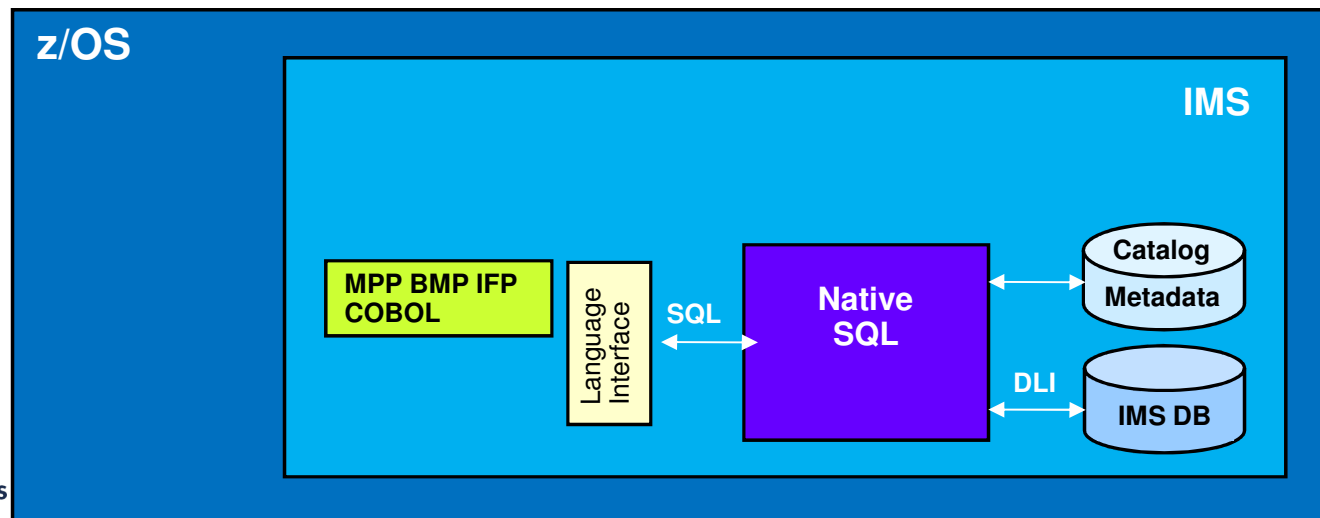
- Performance will be similar to a search on a non-key field
- IMS will scan the database looking for field match(es)
- Qualification of the root key will help reduce the impact
- If business need requires searching on a non-key field
 - Consider defining the non-key field as a searchable field in the DBD

IMS Native SQL Support for COBOL

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IMS 13 SQL Support

- Native SQL COBOL
- Provides standard SQL keywords to easily access IMS data
 - ✓ SELECT, INSERT, UPDATE, DELETE
 - ✓ Uses Dynamic SQL programming model
 - ✓ Converts SQL statements to DL/I calls
 - ✓ Supports a subset of SQL keywords that are currently supported by IMS Universal JDBC driver
- Uses database metadata in IMS Catalog
 - ✓ No need to generate metadata for use in applications



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IMS 13 SQL support for COBOL Solution Highlights

- **SQL support for COBOL**

- Use Dynamic SQL as a query language for COBOL programs to access IMS database
- EXEC SQLIMS is the interface to execute IMS SQL calls

- **Native SQL in IMS**

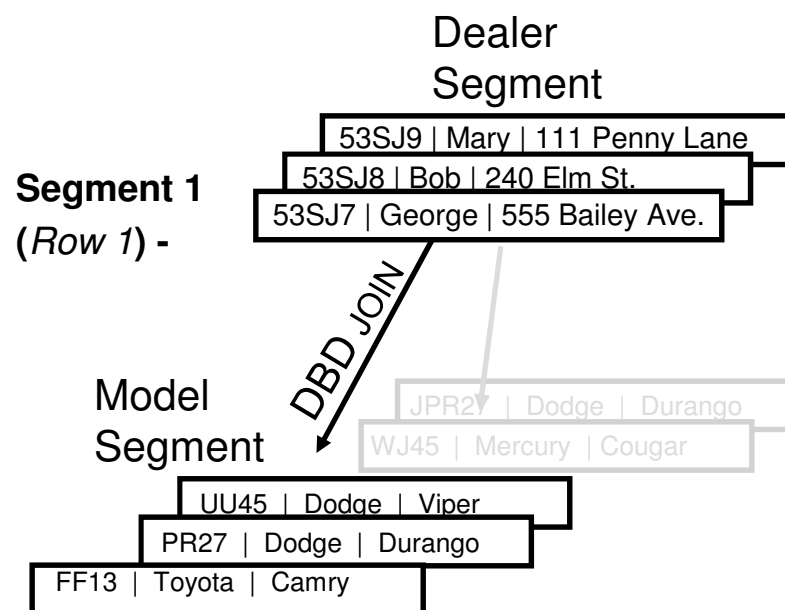
- Process SQL calls natively by the IMS subsystem
- Still perform DL/I database call processing to IMS DB
- Provide a consolidated way for SQL processing
- Uses database metadata in IMS Catalog

- **Support IMS TM/DB (MPP, IFP, BMP) and DBCTL BMP**

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Hierarchical to Relational Terminology Mapping

Hierarchical Design



Relational Design

Dealer Table

	DealerID	DealerName	DealerAddress
Row 1 -	0	53SJ7	George 555 Bailey Ave.
	1	53SJ8	Bob 240 Elm St.
	2	53SJ9	Mary 111 Penny Ln.
Row N -

Model Table

	ID	Make	Model	Dealer	
Row 1 -	UU45	Dodge	Viper	53SJ7	0
	PR27	Dodge	Durango	53SJ7	0
	FF13	Toyota	Camry	53SJ7	0
	JR27	Dodge	Durango	53SJ8	1
	WJ45	Mercury	Cougar	53SJ8	1
Row N -

Note: Segment Names ~ Table Names

Segment Instances ~ Table Rows

Segment Field Names ~ Column Names

Segment unique key ~ Table primary key

IMS foreign key field ~ Table foreign key

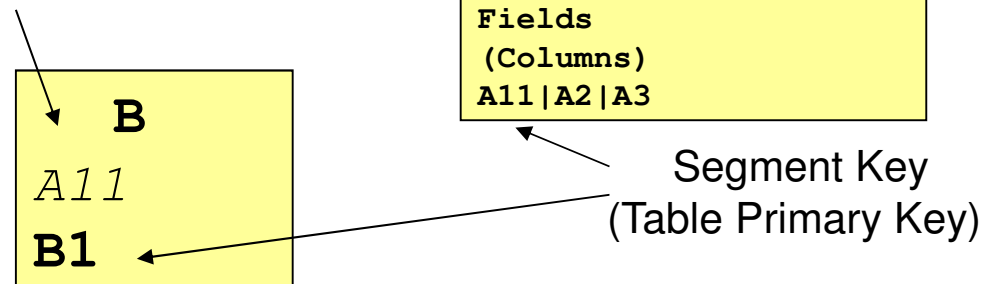
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PCB ~ Schema

Solution highlights - IMS foreign keys Referential constraint

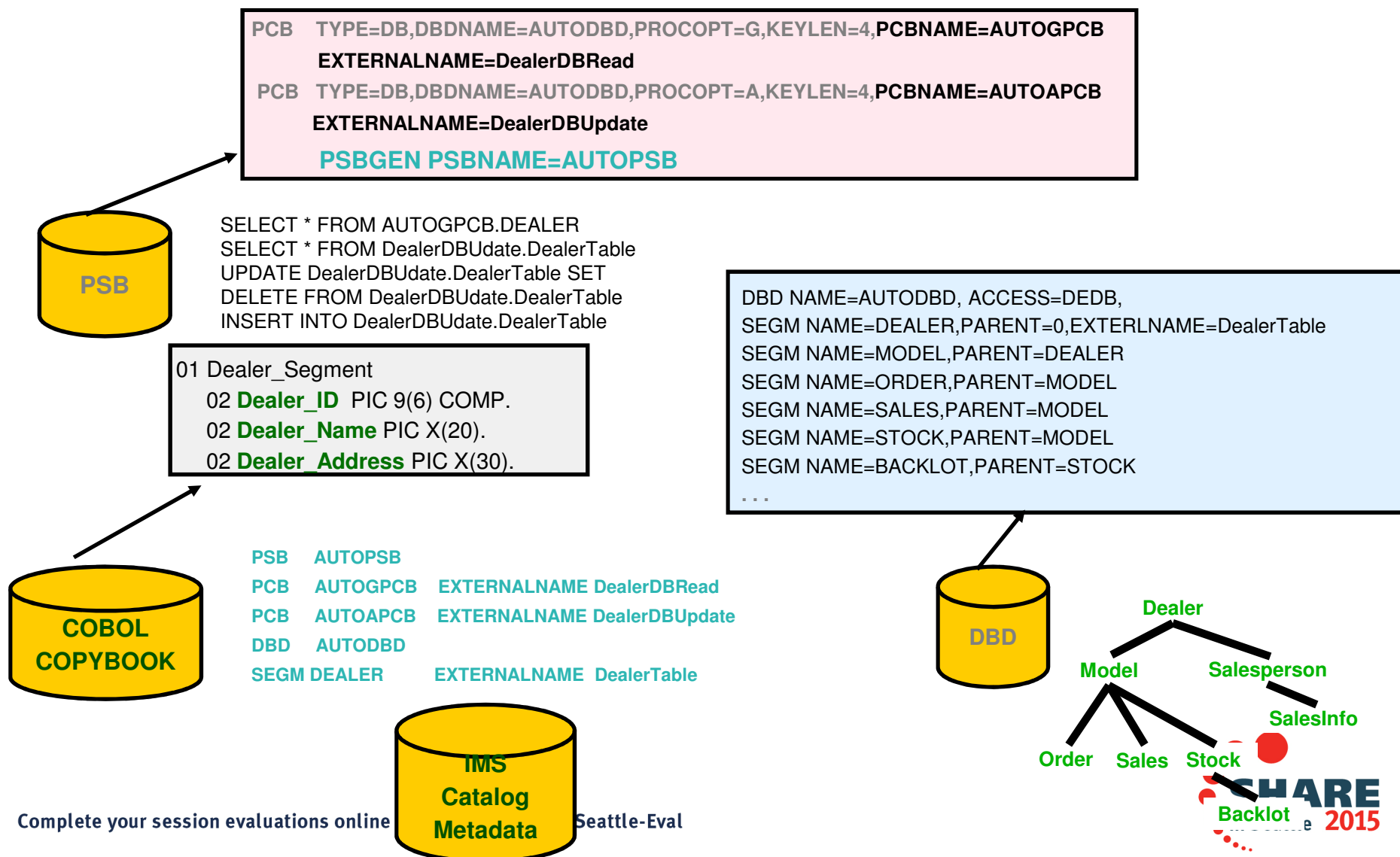
- IMS cannot insert a dependent segment unless the parent segment exists
 - IMS has built-in foreign keys in each segment which are comprised of keys of each parent segment
 - Exist in the key feedback area not physically stored in the IMS database
 - For INSERT operations the Foreign Keys are used to establish the correct position in the hierarchy
 - Values aren't actually inserted as they already exist in the database

IMS Foreign Key - *maintain referential integrity.*
(Segment Parent Key
Table Foreign Key)



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IMS Catalog Metadata and SQL



Solution Details – Dynamic SQL

- Enable SQL statement to be constructed at runtime
 - No need to hard code SQL statement in the application
 - Segment and field names associated with the SQL calls are not known at compile time
 - SQL accepts input in the form of a character string
- Use Prepare call to process SQL statement
 - Parse SQL statement for syntax and semantics validation at runtime. No bind process.
 - Convert SQL artifacts to DLI
 - Statement can be prepared once and then execute many times

SQL Statements

■ Data Access

- SELECT... FROM... to retrieve data
- INSERT INTO... VALUES... to insert data
- UPDATE... SET... to update data
- DELETE FROM... to delete data
- WHERE... AND... OR... to perform conditional selection of data

■ Pre-compiler directives

- DECLARE CURSOR, STATEMENT... to declare cursor, statement
- INCLUDE SQLIMSCA, SQLIMSDA... to generate SQLIMSCA and SQLIMSDA structures
- WHENEVER... to handle errors and warnings

Solution Details – Key application elements

- Delimit SQL statement using EXEC SQLIMS ... END-EXEC
- Dynamic SQL programming model
 - Must call PREPARE to process SQL statement
- Host variables
 - Use for both send and receive data processed by IMS
- SQL communication area (SQLIMSCA)
 - Structure used by IMS to provide status feedback
 - SQLIMSCODE (error code), SQLIMSSTATE (state), SQLIMSERRM (error message)
- SQL description area (SQLIMSDA)
 - DESCRIBE statement IMS provides information to an application program about a prepared statement
 - FETCH statement application program describes a host variable or buffer that is to be used to contain an output value from a row of the result.

Handling errors

- SQL communication area (SQLIMSCA)
 - Structure used by IMS to provide status feedback
 - The SQL INCLUDE statement is used in the COBOL application to provide the declaration of the SQLIMSCA

```
EXEC SQLIMS INCLUDE SQLIMSCA
```

- The main elements in the SQLIMSCA are:
 - SQLIMSCODE – A return code represents a successful or failed SQL operation
 - Example -8004
 - SQLIMSSTATE – Common codes for error conditions which conform to the SQL standard
 - Example 58030
 - SQLIMSERRM – Error message text

– Example IMS returned the PCB status code

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SQL descriptor area (SQLIMSDA)

- SQLIMSDA stores information about prepared SQL statements or host variables.
 - SQLIMSDA header
 - SQLIMSVAR entry
 - each column or host variable is described

```
EXEC SQLIMS INCLUDE SQLIMSDA
```

- Can be read by IMS or the application program
 - Read by application program after a DESCRIBE statement
 - Read by IMS for the host variables set by the application program

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IMS Native SQL Support for COBOL solution

- Compile IMS program using COBOL compiler with the SQL(IMS) option
 - Create an executable program to be run in IMS.
 - IMS co-processor knows when a particular SQL statement begins and ends by the following delimits for SQL statements:

```
— EXEC SQLIMS  
    SQL-STATEMENT  
— END-EXEC .
```

- Translate SQL statement to a COBOL CALL statement

```
*EXEC SQLIMS FETCH . . .  
CALL SQLTDLI USING SQL-PARMLIST
```

- SQLTDLI
 - non-language-specific interface added to DFSLI000

IMS coprocessor

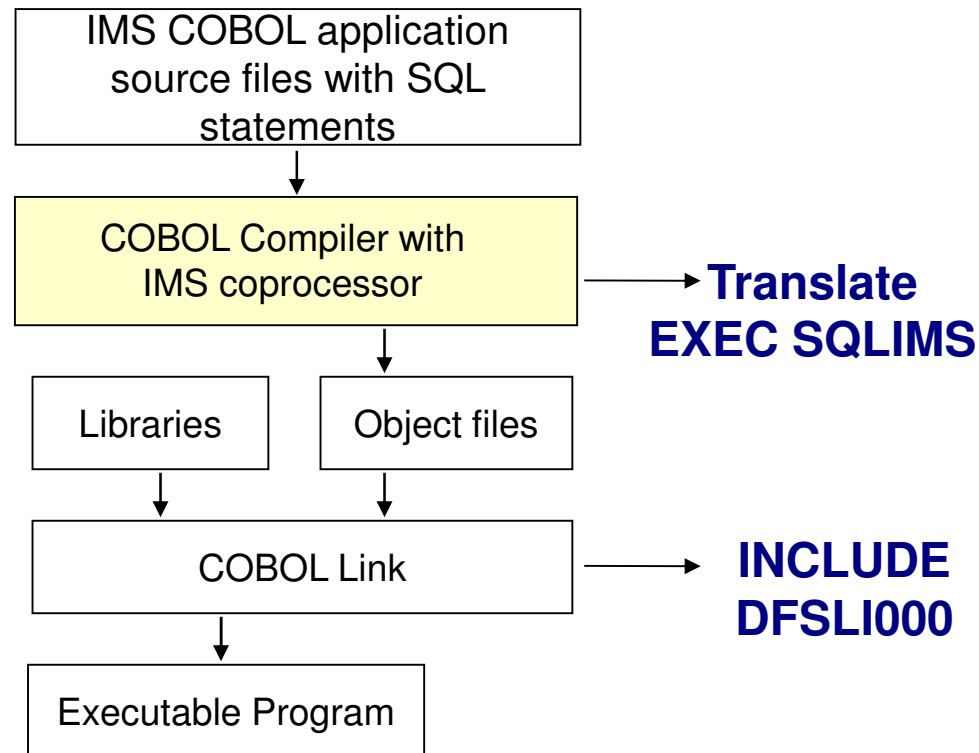
- Compile IMS SQL COBOL application with IMS coprocessor
- Pre-process EXEC SQLIMS statements in COBOL source
- Integrated with Enterprise COBOL V5.1
- Specify 'SQLIMS' compiler option to compile COBOL program with IMS SQL calls

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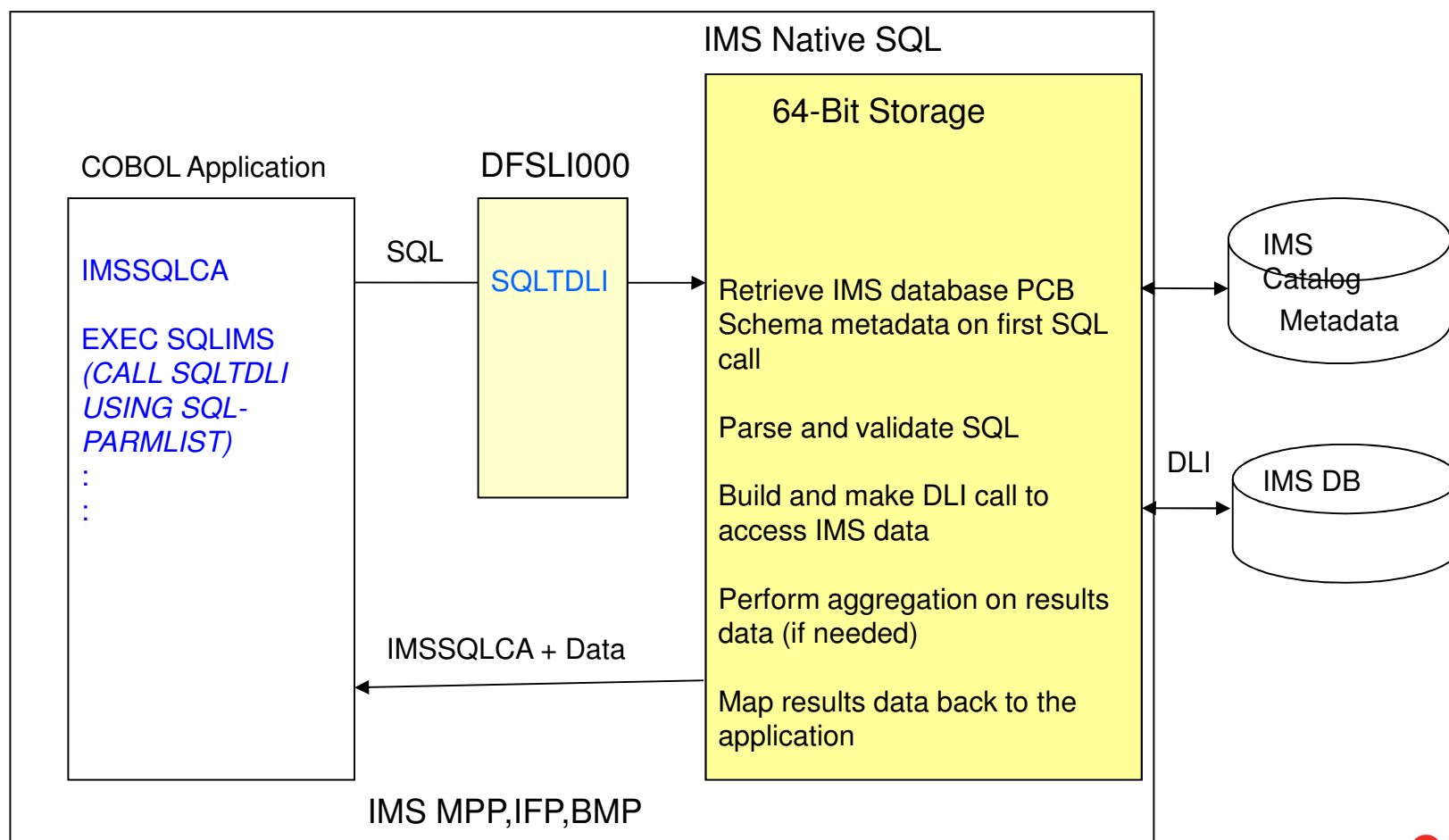
Sample JCL for compile

```
//*****  
//* COMPILING IMS COBOL SQL PROGRAM  
//*****  
//COBOL1 EXEC PGM=IGYCRCTL,  
// PARM='LIST,XREF,CP(37),SQLIMS("APOSTSQL"),DUMP,LIB,DYNAM'  
//STEPLIB DD DSN=IGYV5R10.TRIAL.SIGYCOMP,DISP=SHR  
// DD DSN=IGYV5R10.TRIAL.SIGYMAC,DISP=SHR  
// DD DSN=IMSBLD.IMSTS%.CRESLIB,DISP=SHR  
//SYSLIB DD DSN=IGYV5R10.TRIAL.CEEZ1D0.SCEERUN,DISP=SHR  
// DD DSN=USER.PRIVATE.PROCLIB,DISP=SHR  
//SYSPRINT DD SYSOUT=A  
//SYSLIN DD DSN=&&LOADSET,DISP=(MOD,PASS),  
// UNIT=SYSDA,SPACE=(80,(500,200))
```

IMS COBOL SQL application compiled and linked



IMS SQL Call Request Handler



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SQL considerations and restrictions for COBOL

- A subset of SQL keywords is supported.
 - Aggregate functions and XML are not supported by COBOL SQL in SELECT statements.
 - SQL COMMIT and ROLLBACK keywords are not supported.
 - use IMS DB system services call to commit or roll back your database changes
- Batch and DB Batch are not supported.
- IBM® CICS® Transaction Server for z/OS® and DB2® for z/OS stored procedures to IMS are not supported..
- The IMS catalog must be enabled to use SQL support for COBOL..
- Specify at least 12M for your IMS dependent region size for running a COBOL SQL application.
- Only one cursor and SQL statement can be active at a time in the application.
- For IMS database services, GSAM, IMS TM, and message processing services, continue to use DL/I API.
- Dynamic SQL statement is supported. Static SQL is not supported
- Only EBCDIC CCSID 37 and 1140 codepages for the COBOL CODEPAGE option are supported.
- Note The IMS Universal Database resource adapter and IMS Universal JDBC driver internally manage the LL field on behalf of the application
 - For SQL support for COBOL, COBOL applications are responsible for managing the LL field

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Performance

■ Recommendations

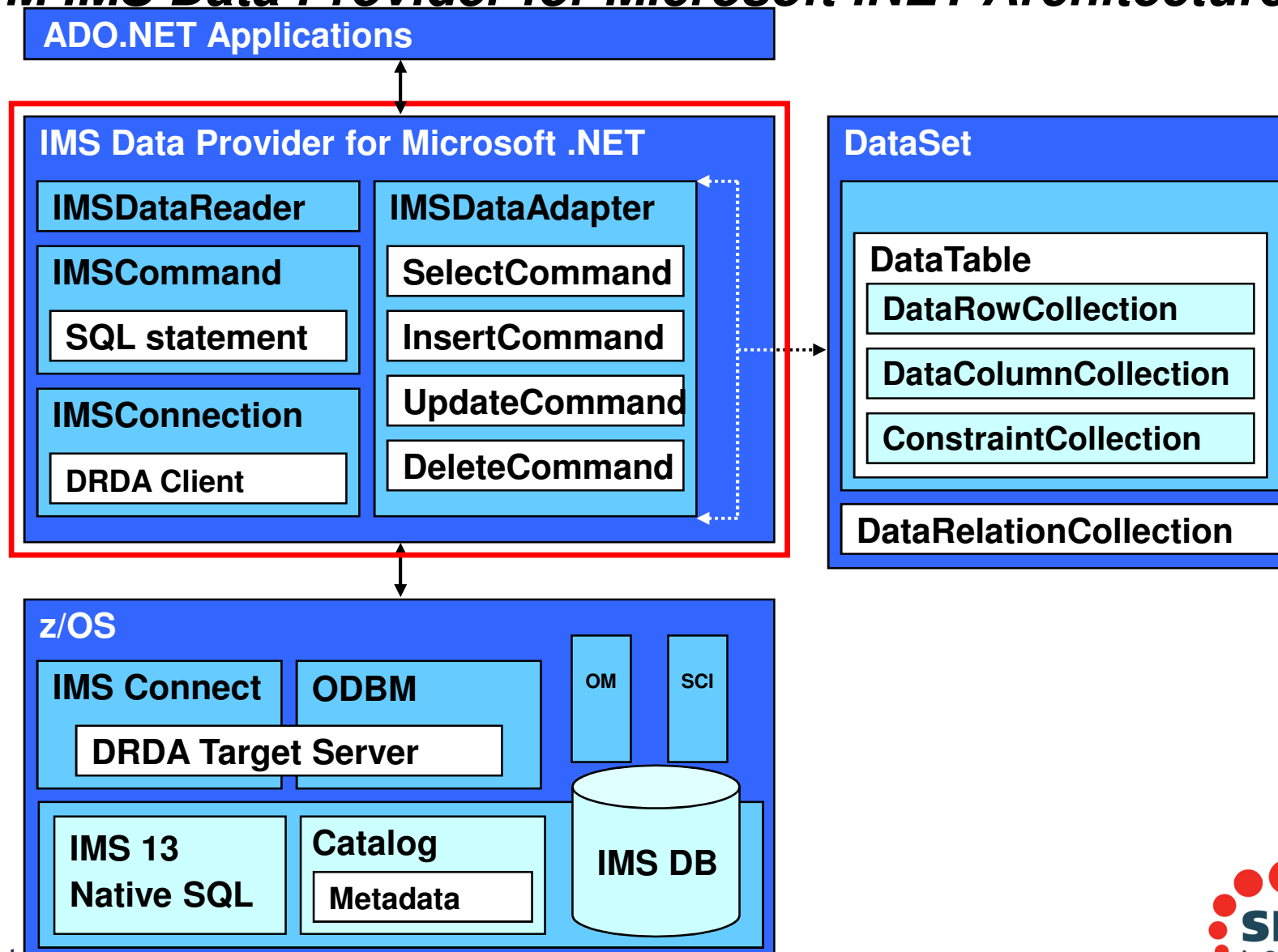
- Fully qualify all tables (segments) and columns (fields) in SQL statements
 - Specify the schema (PCB) name
- Always use PREPARE call for SQL statement that is going to be executed multiple times
- Consider using FETCH or cursors to select a set of rows and then process the set either one row at a time or one rowset at a time

IMS Enterprise Suite V3.1

IBM IMS Data Provider for Microsoft .NET

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IBM IMS Data Provider for Microsoft .NET Architecture



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IMS Universal Driver Enhancements

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ESAF support in Java Dependent Regions (JDR)

- With IMS 13, the ESAF interface can be used in JMP/JBP regions to access any ESAF defined to the IMS control region
 - WebSphere MQ, DB2, WOLA (WebSphere Optimized Local Adapter)
- Support for the SSM= parameter on the JMP/JBP dependent region startup JCL
- Only one ESS connection method allowed per JMP/JBP
 - Default ESS connection method is DB2 RRSAF
 - No impact to existing users
 - Need to specify ESAF as the connection method by specifying SSM= in the JMP/JBP dependent region JCL
- Provides support for all types of ESAF interfaces
- WebSphere MQ and WOLA can now be accessed via JMP/JBP regions

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IMS 13 APAR PM90041: All users of the IMS V13 Universal Drivers

- This APAR contains various performance enhancements
- Connection Properties:
 - Property Name: signedCompare
 - Behavior:
 - Set to true ranged queries over signed data types.
 - Set to false, standard binary comparisons are performed based on the binary representation of the data type value.
 - Setting the value to false can increase performance but might result in incorrect results.
 - The signedCompare property applies to all environments.
 - PropertyName: t2OutputBufferSize
 - Behavior:
 - Sets the size of the output buffer in bytes for the results from a SELECT operation
 - The t2OutputBufferSize property applies only to Type-2 connections

IMS 12 APAR PI30300 : *All users of the IMS Universal Drivers and* CSL ODBM Input user exit

- service allows users of the CSL ODBM Input user exit the capability to alter the PSB and/or alias names before an APSB call
 - The IMS Universal Drivers code has been modified to support a new DRDA codepoint, sent via the ACCRDBRM response, that allows ODBM to change the PSB and/or alias name via the ODBM Input user exit.
 - The IMS Universal Drivers will receive any altered PSB and/or alias names via the ACCRDBRM response from ODBM.

Highlights

- **RACF password phrases (“passphrases”) can now optionally be used within TM Resource Adapter messages to IMS Connect and when signing on to IMS**
- **Security checking**
 - Passphrase sent to RACF at authentication time
- **Benefit**
 - Passphrases are
 - **More robust**
 - 9 to 100 bytes
 - Can contain mixed-case letters, numbers and special characters
 - **Easier to remember**

Enhancements to Existing Function – TMRA & ICON

■ IMS TM Resource Adapter (TMRA)

- Will use new functionality to build a message including password phrase and send it to IMS Connect

■ IMS Connect

- Will be able to accept messages from IMS TM Resource Adapter that contain a passphrase
 - Users will be able to change their password phrase in the application data section of the message received from TMRA
 - Format: 'oldphrase' 'newphrase' 'newphrase'
 - To preserve single quotes that are part of the passphrase, add another single quote next to each
 - Layout of TMRA message:

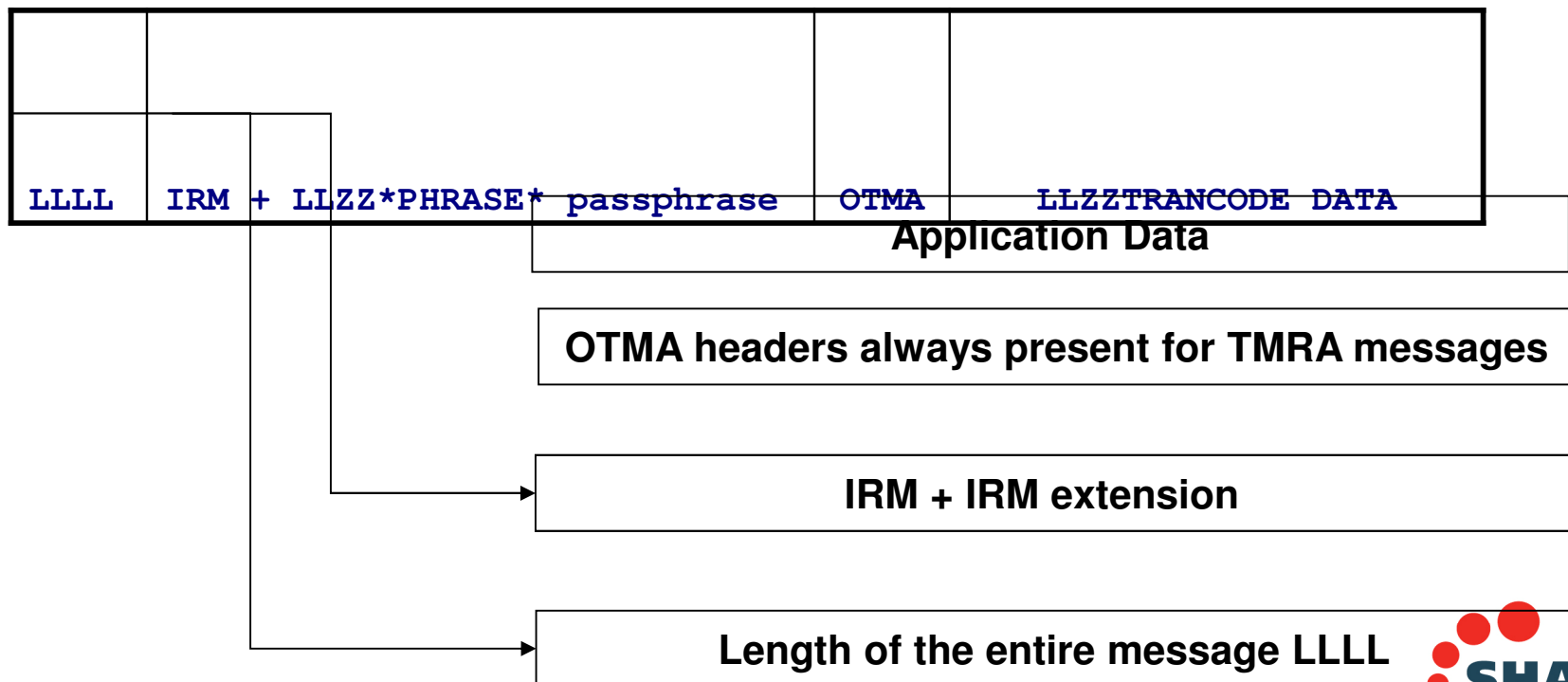
LLLL	IRM	OTMA	LLZZApplication_Data

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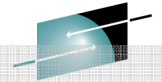
Enhancements to Existing Function – TMRA & ICON

■ Usage

- IMS TMRA externalizes the password/passphrase specification as a connection property
- Passphrase is passed in an IRM extension to IMS Connect
- IMS Connect uses the passphrase for authentication of the request



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Enhancements to Existing Function – TMRA & ICON

LLLL	IRM	OTMA	LLZZApplication_Data
------	-----	------	----------------------

LLZZHWSPWCH 'THE NIGHT IS 'YOUNG'' 'TODAY IS A NEW DAY' 'TODAY IS A NEW DAY'

Old passphrase

New passphrase x 2

Password and passphrase change request eyecatcher