A Basic Roadmap for IMS High Availability and Resiliency

Session IMS-05

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Abstract

- **Is your business to move towards a 24x7x365 online environment for your IMS resources? Where are you on this road? Are you aware of your options and how to get there? This session outlines the technology enhancements that IMS has provided to answer these requirements, describes the intrinsic capabilities in the environment, and details the different options you have to answer the issues you may be facing.**

- Availability – ability to readily obtain/access a resource

- Resiliency – ability to recover from or adjust easily to misfortune or change
  – elasticity

  - Recoverability – ability to bring back to a normal condition or state

Topics

- **Availability and Resiliency**
    - Strategies to address failures
    - Strategies to support day-to-day operations, change, and growth

(Note: Assumption for this presentation
- Some familiarity with existing IMS capabilities
    - As mentioned in the abstract, the goal is to put what IMS provides into a basic roadmap **)**

IMS Functionality

(Service) Availability and Resiliency (Data)

Recoverability

- **Emergency restart**
- **Logging** – IMS records all significant changes to persistent data (e.g. messages and database updates) in a recovery log. Dual logging offers protection against data loss.
- **Archiving** – Logs automatically archived to secondary storage (tape or DASD)
- **DBRC** multicopy RECON data sets
- **Repository Server** multicopy repository data sets for DRD

- **Transaction recovery** - State of all transactions stored in recovery log.

- **DB Change Accumulation** – Extract DB updates from logs to reduce recovery time
- **Image Copies (IC) –** Manually backup DB data periodically to reduce recovery time
- **DEDB Multiple Area Data Sets (MADS**) – provides multiple copies of DEDB Areas

All IMS systems

\+ All IMS TM systems

\+ All IMS DB systems

- **IMS CSL – common Service Layer components** provide an infrastructure base for many new functions
- **Dynamic Resource Definition (DRD)** Eliminates need for Online Change outages for MODBLKs (sysgen) changes
- **Refreshable User Exits** – Eliminates needs to recycle IMS to update many user exits.
- **Multiple PSTs (Dependent Regions)** – provides redundancy for applications
- **Member Online Change (OLC)** – reduces application data outage by limiting impact of OLC to specific entities.
- **Cloned IMS Connect, ODBM, OM, RM -** Allows for messages to be re-routed through an alternate instance in the event of an outage
- **IMS Connect connectivity -** connects to multiple IMS copies and can reroute messages to healthy IMS systems.
- **Sysplex Distributor** for re-routing to an alternate IMS Connect
- **z /OS WLM integration** - WLM health reporting integrates region health with Sysplex Distributor
- **ARM** – In place region restart to outages
- **Resource Recovery** – Definitions and

- **PWFI Refresh –** application updates into running systems
- **VTAM Generic Resources** for terminals

- **Duplexed** IMS Coupling Facility (CF) structures
- **Db2 Data Sharing** – IMS systems can connect to Db2 which can use data sharing

- **Shared Message Queues** – IMS message queues are shared via CF structures to allow any IMS to process any message regardless of availability of the original IMS. Cloned systems to allow any transaction to be processed on any system which allows work to continue during planned or unplanned outages.
- **MQ Shared Queues** – allows redundancy of MQ messages into IMS TM

- **Single System data sharing** – allows multiple applications to share data owned by a single IMS
- **Multi-system Database data sharing -** allows the database to be accessed by more than one IMS system. Cloned systems allow all IMS systems to access all databases.
- **HALDB** - reduces planned data outage by isolating impact when need to take a partition offline
- **HALDB Online Reorganization -** to reduce data outage
- **HALDB Alter / DEDB Alter** - dynamic database structure changes
- **Database quiesce** – limits or eliminates transaction failures to set recovery points or take fast Image Copies
- **64-FastPath** – reduces potential outages due to storage constraints
- **Fast DataBase Recovery (FDBR)** – Automatic resolution of in-flight data base changes and release of locks to allow immediate access to the data from another IMS.
- **IMS Catalog, IMS Managed ACBs, DDL**

Disaster Recovery

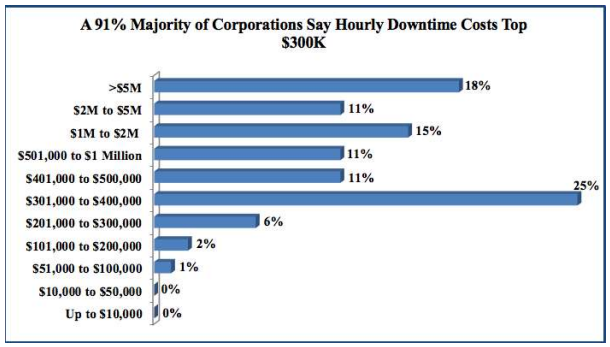
- **Data replication** – IMS active log datasets, DB data sets, RECONs and ICs can be mirrored to a secondary storage subsystem using data replication. zHyperwrite support improves performance of logs.

- **Software Replication** (e.g. IIDR)) used to improve failover time at stand-by site with manual intervention
- **Software Replication integrated with GDPS CA -** Provide near continuous availability when the need to switch one or more workloads to another site.

Processes and Tooling

How Much Disruption Can Your Systems Tolerate?

- **The reality**
  - Database, hardware, software, and application interruptions happen
    - Planned (occur at optimal times for minimal disruption and cost)
      - To introduce change, apply maintenance, address growth
    - Unplanned (occur anytime and can be very costly)
      - Outages and component failures
  - To mitigate the risk – have the procedures, tools, and right technology in place to monitor, restore, and restart



Hourly cost of server downtime tops $1 million for 44% of enterprises
Source: ITIC 2021 Hourly Cost of Downtime Survey

- **Ensure business continuity by planning for:**
  - Data and Disaster recovery
    - Restore business after an unplanned outage
  - High availability
    - Meet service availability objective, e.g., 99.9% availability or 8.8 hours of downtime per year
  - Continuous availability
    - No downtime (planned or unplanned)

Containing Risk → Greater Availability

High Risk and Impact

Resilient/Reliable

Availability and Resiliency (Data)

Availability and Resiliency (Service)

Disaster Recovery

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Containing Risk → Greater Availability

	High Risk and Impact	*Medium Risk and Impact*
	Resilient/Reliable	**Failover Capable**
Availability and Resiliency (Data)		
Availability and Resiliency (Service)		
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Containing Risk → Greater Availability

	High Risk and Impact	*Medium Risk and Impact*	*Low Risk and Impact*
	Resilient/Reliable	**Failover Capable**	**Fault Tolerant**
Availability and Resiliency (Data)			
Availability and Resiliency (Service)			• **Cloned Data sharing systems** – Allows any transaction or DB work to be processed by any IMS which allows work to continue during planned or unplanned outages of an IMS. • **Cloned ICON, ODBM, OM, RM -** Allows for work to be re-routed through an alternate instance in the event of an outage • **Duplexed** IMS CF structures • **VTAM Generic Resources** for terminals • **Sysplex Distributor** for IMS Connect routing
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Containing Risk → Greater Availability

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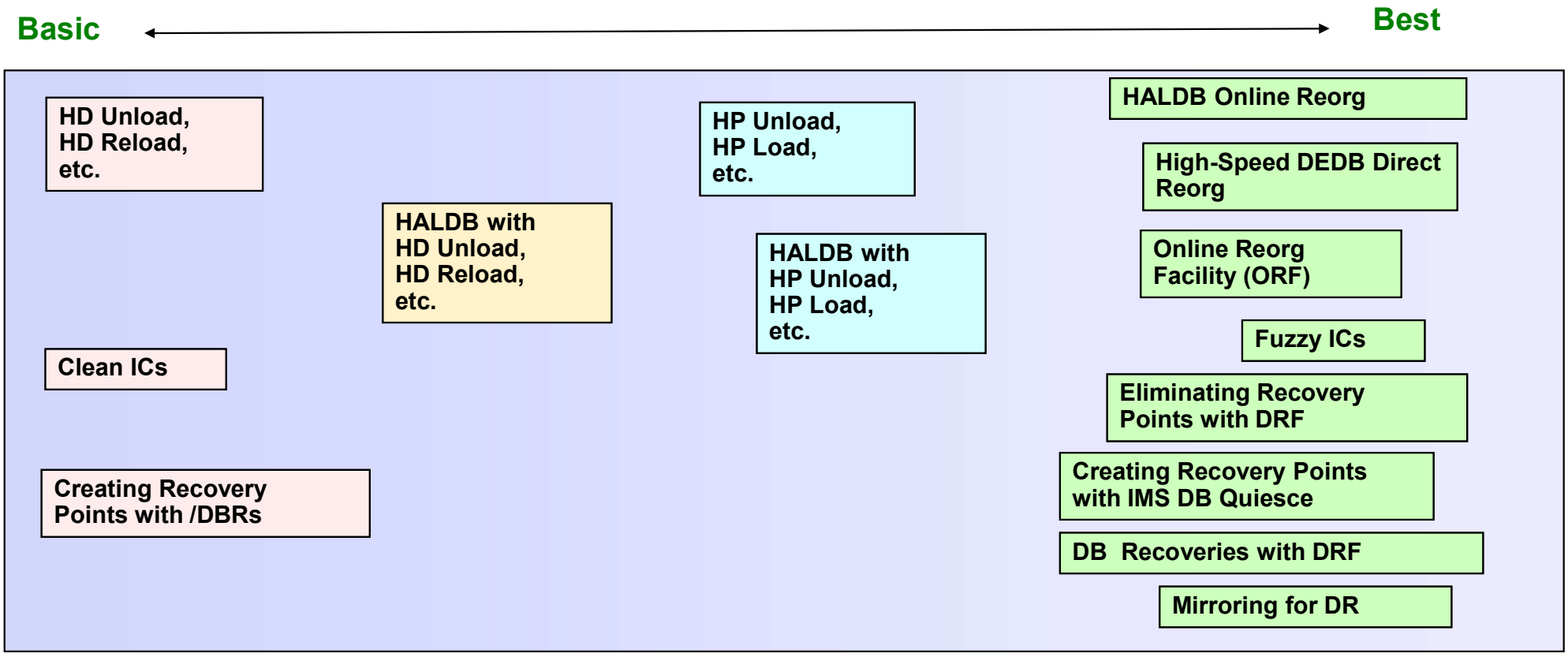
And to Maximize Database Availability



Establish Objectives and Procedures

Establish Objectives for each type of outage:
- *Recovery Time* Objective (RTO) = How much time is needed to restore business operations?
- *Recovery Point* Objective (RPO) = How much data could we afford to *lose*?

- **Planned Maintenance**
  - System and software upgrades or reconfiguration, application changes, database administration
    - ***Consider:*** leveraging any downtime windows, determining if a rolling maintenance strategy can be implemented, documenting how long an application environment can be unavailable while changes are being made, …
- **Component Failure**
  - Operator errors, software defects, disk failure, subsystems, hardware, power grid, …
  - Data is recoverable but changes might be stranded until component is restored
    - ***Consider:*** determining if a restart can be done versus requirement to continue ASAP – e.g., in a data sharing environment, FDBR provides improvement over simply restarting IMS. IMS Shared Queues provides availability for messages when a single IMS fails…
      - Tooling: IMS DEDB Fast Recovery (DFR), can provide some of the functionality FDBR provides
- **Disaster**
  - Flood, earthquake, fire, hurricane, …, loss of a site
  - Data is not recoverable
    - ***Consider:*** implementing a disaster recovery plan-- e.g., data replication, …

Additional Considerations

- **And has your environment accounted for:**
  - **Redundancy**
    - With spare components to avoid Single Points of Failure
  - **Isolation**
    - To minimize disturbances of critical applications/ systems from other workload in the environment
  - **Concurrency**
    - That allows performance of maintenance while concurrently supporting ongoing operations
  - **Automation**
    - Of operations to minimize, as much as possible, human error
  - **Scope**
    - Which determines the availability needs for single IMS, multiple sites and/or parallel sysplex

So for Failures, IMS Provides:

- **Resiliency**
  - Isolation, toleration and recovery from component failures to minimize the impact to applications and business processes
    - Automatic restart and recoverability solutions
      - Error toleration
        - Internal (e.g., PST abend)
        - External (e.g., I/O errors on DB)
      - Ability to manage errors without intervention (e.g., deadlock abends and reschedules)
    - Ability to prevent or limit scope of error (e.g., message flood protection)

- **Ability to address and mask single points of failure**
  - Planned outages
    - Dynamic capabilities (using IMS function such as Alter, DRD, OLR for HALDB…)
    - Redundancy (using IMS environments such as Sysplex, Data sharing, Shared Queues, …)
    - Tooling, e.g., Online Reorg Facility which can also implement ‘structure’ type changes dynamically
  - Unplanned outages
    - Limit scope/impact of error (EEQEs, DB level failure, …)
    - Redundancy (Sysplex, Shared Queues, FDBR, …)

So for Failures, IMS Provides:

- **Redundancy**
  - Parallel Sysplex solutions
    - To address single points of failure by providing redundancy in order to mask failures of single components
      - Data Sharing and Shared Queues
    - Dynamic workload balancing
    - Single system image view of the IMS systems
    - Platform for continuous availability applications
      - Fewer planned outages
      - Unplanned outages

  - Reference the following for details on concepts, planning, implementation, backup, and recovery refer to the following:
    - IMS in the parallel sysplex - Volume I: Reviewing the IMSplex Technology
      - http://www.redbooks.ibm.com/redbooks/pdfs/sg246908.pdf
    - IMS in the parallel sysplex - Volume II: Planning the IMSplex
      - http://www.redbooks.ibm.com/redbooks/pdfs/sg246928.pdf
    - IMS in the parallel sysplex - Volume III: IMSplex Implementation and Operations
      - http://www.redbooks.ibm.com/redbooks/pdfs/sg246929.pdf

And with Parallel Sysplex

- **Your environment has the ability to provide**
  - Redundant HW components
  - Redundant SW components
  - Dynamic routing for all workload
    - Facilitated with tooling such as IMS Connect Extensions
  - Data sharing for all critical data
  - Sufficient failover capacity for recovery

- **Review**
  - Operational processes and procedures for sysplex problem determination & recovery
    - “System z Parallel Sysplex Best Practices
      - http://www.redbooks.ibm.com/redbooks/pdfs/sg247817.pdf
    - “System z Parallel Sysplex Recovery”
      - https://publibz.boulder.ibm.com/epubs/pdf/e0s1p702.pdf
  - Application considerations
    - Ability to run in a sysplex
      - Recovery in the case of a component failure
      - Recovery in the case of an application problem
    - Tooling, e.g., IMS Recovery Expert which can analyze recovery assets/ establish optimal recovery procedures to minimize recovery time and recovery point objectives

Along With

- **Procedures for Automated recovery / restart**
  - Automatic Restart Manager (ARM)
    - Ability to restart a job or task without operator intervention based on a pre-configured policy
    - https://www.ibm.com/support/knowledgecenter/en/SSEPH2_15.1.0/com.ibm.ims15.doc.sag/system_intro/ims_zosarm.htm
  - IBM System Automation for z/OS
    - Subsystem/component, product and workload automatic restarts/recovery upon failure
    - https://www.ibm.com/support/knowledgecenter/SSWRCJ_4.1.0/com.ibm.safos.doc_4.1/kc_welcome-444.html
  - Sysplex Failure Management (SFM)
    - Ability to define a sysplex-wide policy that specifies the actions to take when certain failures occur
    - https://ibm.biz/BdyZYY
  - Db2 Restart Light
    - To resolve in doubt units of work and complete member crash recovery
    - https://www.ibm.com/docs/en/db2-for-zos/13?topic=environment-restart-light-in-data-sharing

Beyond failure and just as important, the environment should support:

Resiliency and Availability for

day-to-day operations, change, and growth

Resiliency and Availability

- **Intrinsic resiliency – the IMS architecture**
- **In a single IMS environment – vertical growth**
  - Applications and Data
    - IMS message region environment and database changes
    - Dynamic enhancements to support performance and growth
    - Shrinking batch cycle – migration to BMPs and/or data sharing
  - Infrastructure
    - Open Connectivity
      - Transaction accessibility through OTMA and IMS Connect
      - Database accessibility through, IMS Connect, Open Database
    - Common service layer (CSL) and Dynamic Resource Definition (DRD)
- **In a multi-IMS environment – horizontal growth**
  - MSC – workload distribution
    - Dynamic MSC
  - Parallel Sysplex
    - Data sharing
    - Shared queues
    - Dynamic routing and sysplex distribution
- **Enhancements with Continuous Delivery with minimal disruption**

Intrinsic Resiliency

Intrinsic resiliency = belonging to IMS by the nature of its architecture

- ***Application compatibility***
  - Programs written decades ago still work - IMS does not require recompiles for new IMS releases
- ***Database compatibility***
  - Databases do not require upgrades for new IMS releases
  - Database definitions outside of programs
- ***Programming interface***
  - DL/I calls used for database access - program not aware of data sets and physical characteristics of data
  - DL/I calls used for input/output messages - program independent of communication protocols
  - Additional support for relational JDBC/SQL access which hides the DI/I interface
- ***Multi-region online system***
  - Isolates failure

IMS has allowed users to grow their application/environment in lieu of forcing major conversions

Intrinsic Resiliency …

Intrinsic resiliency = belonging to IMS by the nature of its architecture …

- ***Data integrity with DBRC***
  - Provides an additional level of database protection, simplified recovery, and controlled access
    - ***Use of DBRC (level of protection) is a choice* … but remember, "you can run, but you can't hide"**
  - RECON data set holds info about recovery-related events and data sets used by the IMS recovery utilities
    - To control database recovery, register the databases in the RECON data set
  - Possible environments:
    - Log control – controls IMS logging -- databases do not have to be registered
    - Recovery control – includes log control and records information about data sets related to db recovery
      - GENJCL function for creating recovery related JCL is available
      - But.. does not protect the databases from use outside of DBRC control
    - Share control – full DBRC environment
      - Required for data sharing
      - Ensures that only valid sharing combinations run concurrently.
      - Validates that the correct job/utility is run at the right time ensuring database integrity.
      - Non-data sharing environments can specify this environment and register all databases with a share level of 0 (no sharing)

Higher availability environments with Integrity + recoverability = DBRC

Intrinsic Resiliency …

Intrinsic resiliency = belonging to IMS by the nature of its architecture …

- **Online Change functionality**
  - Ability to add, delete, and replace IMS databases, programs, transactions, and MFS formats online, without the necessity to bring down your IMS system
    - Local OLC, Member OLC, Global OLC
- **Dynamic specification**
  - **ETO (Extended Terminal Option)** which supports dynamic definition of VTAM terminals to an IMS system
    - Automatic creation of required runtime structures when needed
      - E.g., during logon, signon, when output is queued, when assigning or changing destinations. etc
    - Automatic deletion of the runtime structures when no longer needed
    - Tooling, e.g., IMS™ ETO Support
  - **Dynamic Resource Definition (DRD)** which supports changes to a running system
  - **DDL** which supports modifying program and database views in the IMS Catalog

- **Fast Database Recovery**
  - Reduces the impact of a failed subsystem
    - Quick DB backout/DEDB redo and release of retained locks when an IMS online System fails

- **Architected structure for change and growth (discussed in later pages)**
  - BPE (Base Primitive Environment)
  - CSL (Common Service Layer)
    - DRD (Dynamic Resource Definition) …

If you have Single IMS systems

Application and Data Growth

The flexibility to address change, performance, and workload growth on a running system

- **Dynamic growth of threads (ODBA, DBCTL, and message regions) to 4,095**
  - Supports greater concurrency
- **Optimization of the scheduling process with Quick Reschedule, Wait for Input (WFI), and Pseudo WFI**
  - Eliminates unnecessary application program termination and rescheduling improving performance and reducing CPU usage
- **Enhanced operational process to implement program changes in WFI, PWFI regions where the program is not preloaded**
  - UPDATE PGM …. START(REFRESH)
  - Enables faster rollout of application changes for all affected dependent regions

Application and Data Growth …

The flexibility to address change, performance, and workload growth on a running system…

- **With implementation or migration to HALDB (High Availability Large Data Base)**
  - Ability to increase database capacity without application changes
  - Increase in database availability
    - Partitions, not databases, are removed from system
    - Shortened reorganization process
    - Batch window is shortened with concurrent processing
  - Improved manageability. E.g., data sets may be smaller

- **Dynamic buffer pool management – Full function and Fast Path databases**
  - Provides a mechanism for timely response to resolve performance issues
  - Full Function dynamic buffer pool management
    - Change number of buffers in a pool, add or delete a buffer pool, assign database data set to a pool …
      - Eliminates system down time for modifications to buffer pool definitions
  - Fast Path dynamic pool management
    - Supports expansion of pools before buffers are needed and compression when applicable
      - Smarter use of subpools …
  - Tooling assistance to determine optimal values – e.g., IMS Buffer Pool Analyzer

Application and Data Growth…

The flexibility to address change, performance, and workload growth on a running system…

- **Additional Dynamic modifications**
  - **HALDB Alter** – allows dynamic addition of information to your database
  - **DEDB Alter** – allows adjustment to data growth by allowing dynamic resizing of Fast Path Areas
  - **DB Versioning** – allows quick deployment of database changes without impacting existing applications
  - **Member Online Change** – minimizes impact to end users when deploying changes

- **Continuing Innovation**
  - **IMS Catalog -** stores trusted metadata and definitions about your databases (DBDs) and application program specification blocks (PSBs) that are defined to IMS.
  - **IMS Managed ACBs –** eases management of *application control blocks* (ACBs) for databases and program views
  - **DDL** (Data Definition Language)/ Load from Catalog – Minimizes and/or eliminates impact for certain changes
  - …

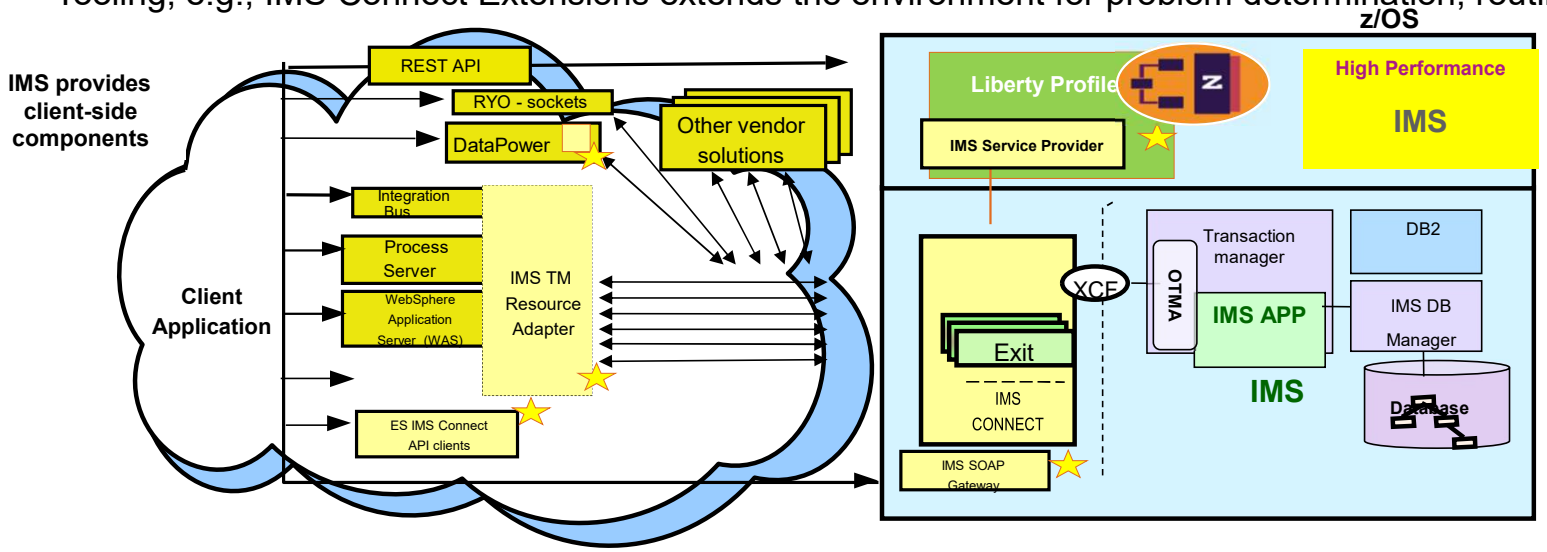
- **Ability to address the shrinking batch window**
  - Data Sharing
  - Conversion to BMP
  - Assistance with tooling such as IMS Program Restart Facility

Infrastructure

Components that enable support for the growth of evolving technologies while still leveraging investment in existing environment and business processes

- **OTMA (Open Transaction Manager Access)**
  - Provides standardization of access to IMS transactions
    - Clients: IMS Connect, IMQ, WAS, IMS SP with z/OS Connect, etc.

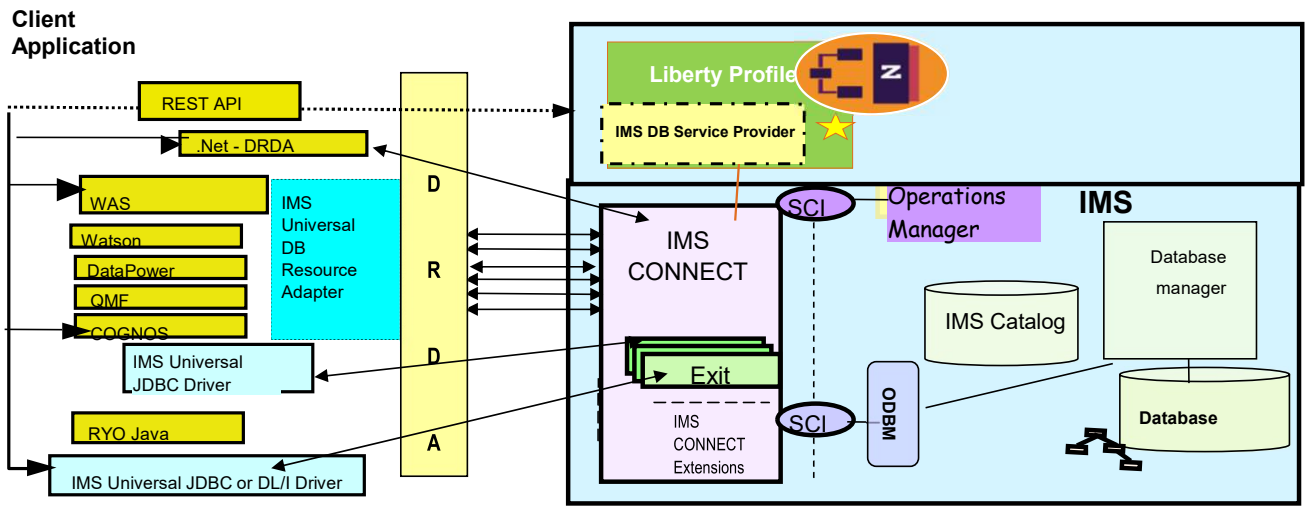
- **IMS Connect (IMS TCP/IP Socket server)**
  - Supports resiliency by providing standard TCP/IP client access to the IMS Control Regions without changing IMS
  - Tooling, e.g., IMS Connect Extensions extends the environment for problem determination, routing, etc.



Infrastructure

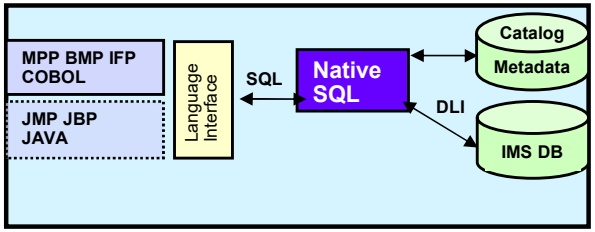
Components that enable support for the growth …

- **Open Database**
  - **Supports DRDA standards = resiliency for application developers to use relational interfaces without changing the IMS database**
    - IMS Connect
    - ODBM (Open Database Manager) - enables open access to IMS databases
    - IMS Universal Drivers – provide Java applications and with connectivity and access to IMS databases
    - IMS Catalog
  - Provides the foundation for Data Definition Language (DDL)



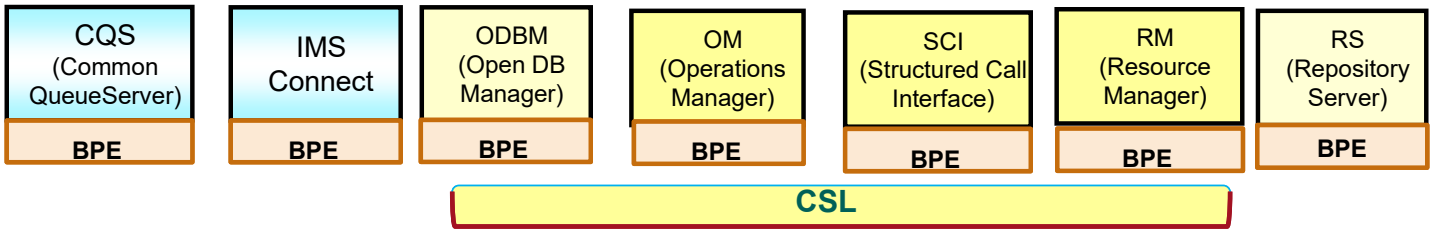
Including Cobol Native SQL support

- Allows application developers with relational SQL expertise to code programs that can access IMS hierarchical structures
  - Developers do not need to understand the IMS structures
  - IMS databases are unchanged and DBA proceses continue to run as is



Infrastructure - CSL

- **Extending the Infrastructure with common services**
  - **Base Primitive Environment (BPE)**
    - A common system service base
      - Provides services such as tracing, message formatting, parsing, storage management, sub-dispatching, and serialization
        - » Hidden layer in the address spaces but externalized through traces, commands, exits, messages/abends

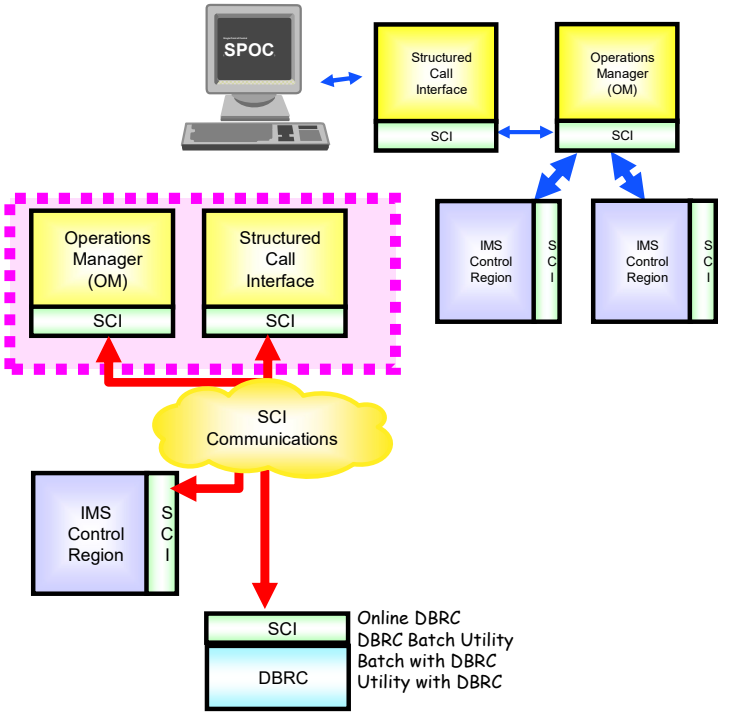


- And … **a Common Service Layer (CSL)**
  - **Optional** (but again…. 'you can run but you can't hide' --- CSL provides a base for new functions)
  - a collection of IMS ***manager*** address spaces that simplifies systems management tasks in an ***IMSplex***
    - A single system image (IMSplex)
    - Ease of use through a single point of control
    - Coordination of shared resources across all IMS systems

Infrastructure – CSL …

- **CSL**

  - Structured Call Interface ***(SCI)*** **-** *s*tandardizes intra-communications between IMSplex members
    - Required in every z/OS image where CSL is active
  - Operations manager ***(OM)*** **-** ***p***rovides an enhanced interface (type-2 commands) to control resources
    - Supports a SPOC (single point of control) for operations management and automation
      - TSO, Batch, TCP/IP client through IMS Connect
  - Resource manager ***(RM)*** **-** ***p***rovides the infrastructure for managing global resources and coordinating IMSplex-wide processes
    - IMS is the exploiter of these services
  - Open Database Manager ***(ODBM)*** **-** *s*upports open standards for distributed and local Java application program connectivity to IMS databases



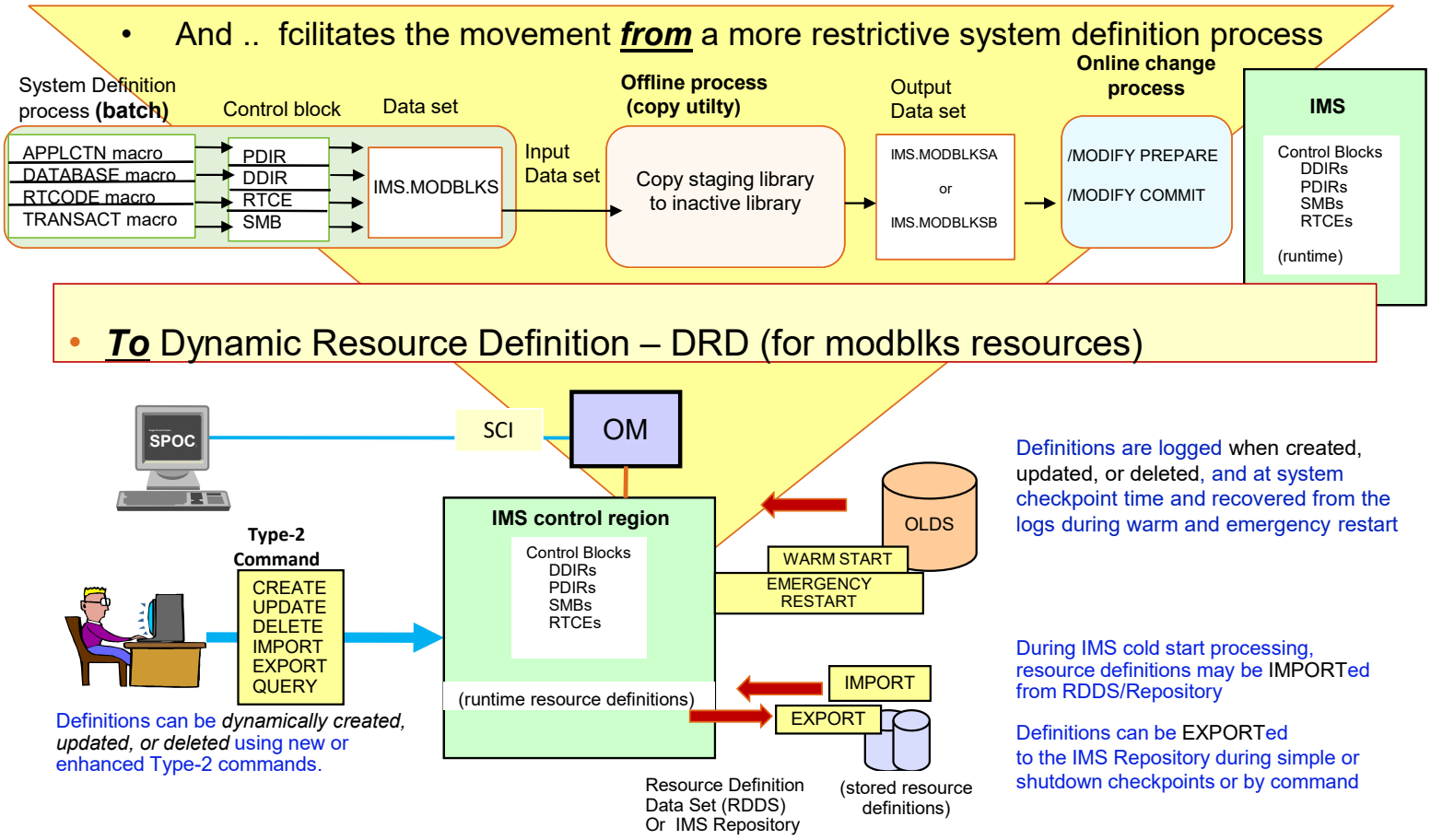
Tooling: **IMS Sysplex Manager** can display real-time data related to the CSL components that are associated with the IMSplex environment, data from the Coupling Facility (CF) structures used by IMS, or data that is generated by IMS systems that are running in a sysplex or IMSplex.

- At minimum, implement the ***'enhanced command environment'*** (OM and SCI)
  - To support OM type-2 commands for new functions

  - INIT (INITiate Process)
  - TERM (TERMinate Process)
  - UPD (UPDate Resource,Quiesce , FF Buffer Pools)
  - UPD (UPDate IMSCON)
  - DEL (DELete Resource)
  - CRE (CREate Resource)
  - EXP (EXPort Resource)
  - IMP (IMPort Resource)
  - QRY (QueRY Resource)
  - QRY (QueRy IMSCON)
  - QUE (QUEue Message)
  - REFRESH (REFRESH USEREXIT)
  - …
  - … and additional resources continue to be added

Infrastructure – Dynamic Resource Definition (DRD)

DRD – allows resource definition changes while the system continues to be available



Infrastructure - DRD…

Improves the availability of the online environment

- No requirement for MODBLKS SYSGEN
- No requirement for IMS restart/MODBLKS online change
  - Limitations associated with these methods eliminated

- **DRD**
  - Dynamic definition of MODBLKS resource using Type-2 commands
  - Databases, programs, transaction, Fast Path Routing codes, and associated descriptors that are part of DRD
    - Additionally, transactions can also be defined dynamically with the DFSINSX0 user exit
- **IMS Repository**
  - Provides an optional single centralized store for resource definitions for an IMSplex
    - Across multiple IMSs or for a single standalone IMS
    - Supports changes even when an IMS is down
      - Definitions are providen when IMS cold start is required

Additionally, for horizontal growth …

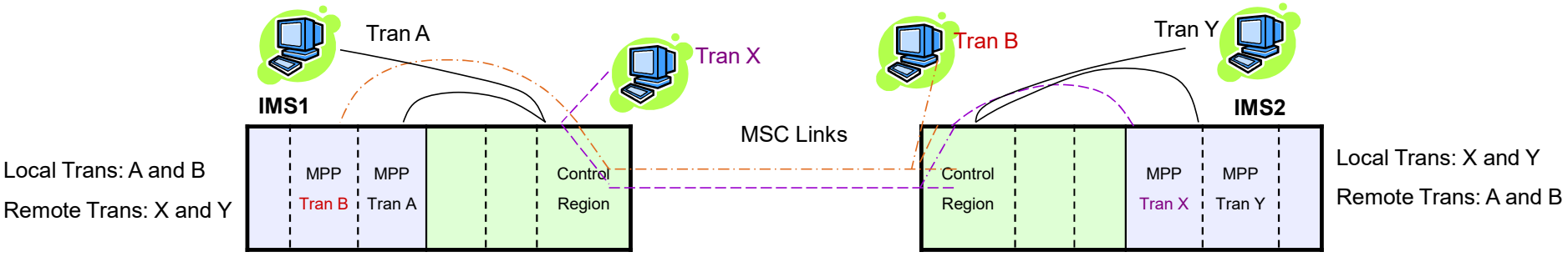
Multi-IMS Environments

- Support pent-up demand or answer the need to add or remove systems as business requirements fluctuate

Multiple Systems Coupling (MSC)

Supports growth by connecting IMS systems in the same or different locations

- **Allows transparent end-user access to transactions in any of the systems in the MSC network**



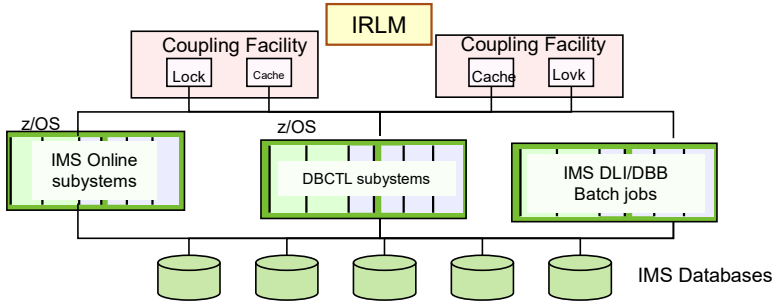
- Through seamless workload routing – no changes to the application programs
  - Based on definitions, IMS routes and controls message traffic between connected IMS systems
  - Transactions may be defined as remote (processed by another IMS) with responses sent back to the sending IMS/terminal
- Communication between 2 or more (up to 2036) IMS systems can run on any combination of supported operating systems
  - Supported link types: channel-to-channel (CTC), memory-to-memory (MTM), VTAM, TCP/IP
    - No restriction on VTAM or TCP/IP link distances
- With DRD - dynamic MSC definitions can be enabled in an online system

Tooling: **IMS Workload Router** provides flexibility in how the workload is routed and balanced, along with the ability to dynamically change routing destinations without having to design and code MSC user exits.

Parallel Sysplex – Data Sharing

Allows sharing of databases by different IMS subsystems

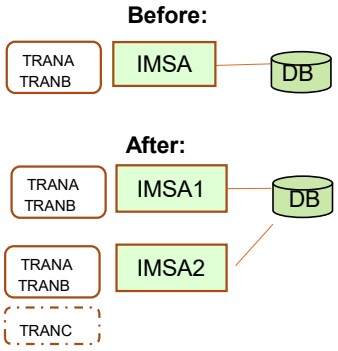
- IMS subsystems (IMS online, DBCTL, DLI/DBB batch)
  - Without changes to the application programs
- Approaches for online environments (may be combined)
  - Cloning – making multiple copies of a system
  - Joining unlike systems to access each other's data



- Data Sharing Group ***Infrastructure***
-

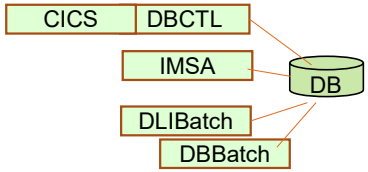
Increases capacity

- When a single system is no longer adequate



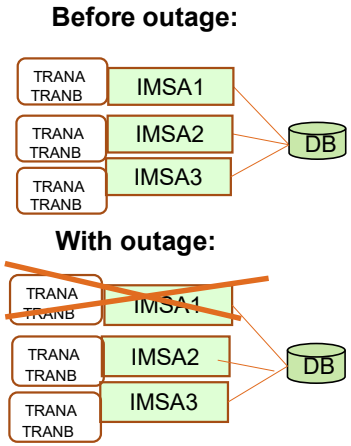
Increases concurrency

- Multiple subsystems



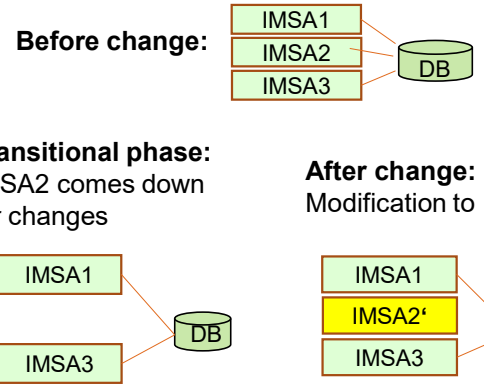
- Addresses the shrinking batch window

Increases availability (unplanned outage)



Increases availability and flexibility (planned outage)

- Maintenance, sysgen, parameter changes, etc



Parallel Sysplex – Data Sharing…

A few things to review in your environment

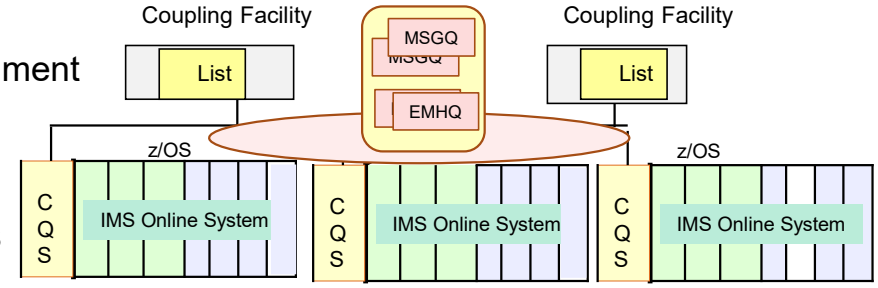
- IMS Databases can be Single Points Of Failure
  - Setup healthy database maintenance processes – Reorgs, IC, CA, Backout, Recovery
  - Establish DR backup database environment – local mirroring, global mirroring, GDPS
- Use FDBR for Quick DB Backout and release of retained Locks if an IMS Online System Fails
- Review data sharing environment with respect to application design
  - *Application designs with possible DB locking problems*
    - Small Databases with few records and frequent updates
    - DBs with ascending or descending keys
  - *Application designs with Least Possible DB Locking Problems*
    - Do DB reads with “Read” PCB and do DB updates at end of program with an “Update” PCB
    - Minimize the number of DB calls in a unit of work
    - Identify, examine and resolve DB deadlocks – U777 Abends
    - Use 2 PCBs for one database – 1 for read and 1 for update processing
  - *Use PROCOPT Effectively* - Determine if any “Exclusive” database access in PSBs / PCBs (PROCOPT=E)
  - *Minimize Database “Hot Spots”* - with Good DB and Application Design
  - *Use “Read Only”, PROCOPT=GO*, when possible*
    - Avoids DB locking BUT is Read without integrity
  - *Review checkpoint frequency in BMP/batch* - Especially in update intensive BMPs and Batch DLI JOBS
- **With DB2 data sharing -** Use DB2 Group Attach feature for IMS Dependent Region connection to DB2 group

Parallel Sysplex – Shared Queues

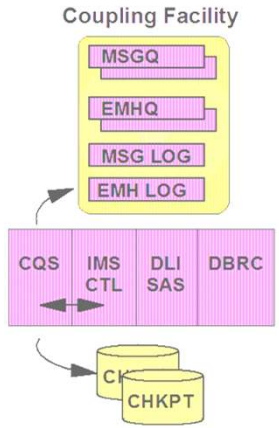
Single system image to end users

Allows a transaction to be sent to any IMS in the shared queues group

- Although not required, data sharing enhances the environment



- **Supports automatic balancing/ routing of messages among multiple IMS systems**
  - A message placed on the Shared Queues can be processed by any IMS with ***interest*** in the message
  - Optimizes throughput up to the full capacity of the parallel sysplex
    - No single IMS can remain underutilized while others overloaded
- **Allows for incremental growth**
  - New IMS subsystems can be added as workload increases
    - Up to 256 IMS systems on 32 z/OS images can be combined to process a single workload
  - New IMSs can be for processing only systems (no network) during periods of heavy activity
- **Improves availability and reliability**
  - If an IMS fails, the workload may be assumed by the surviving IMSs
  - Contents of shared queues are not affected if one or more IMSs are cold started



Parallel Sysplex – Shared Queues…

A few things to review in your environment

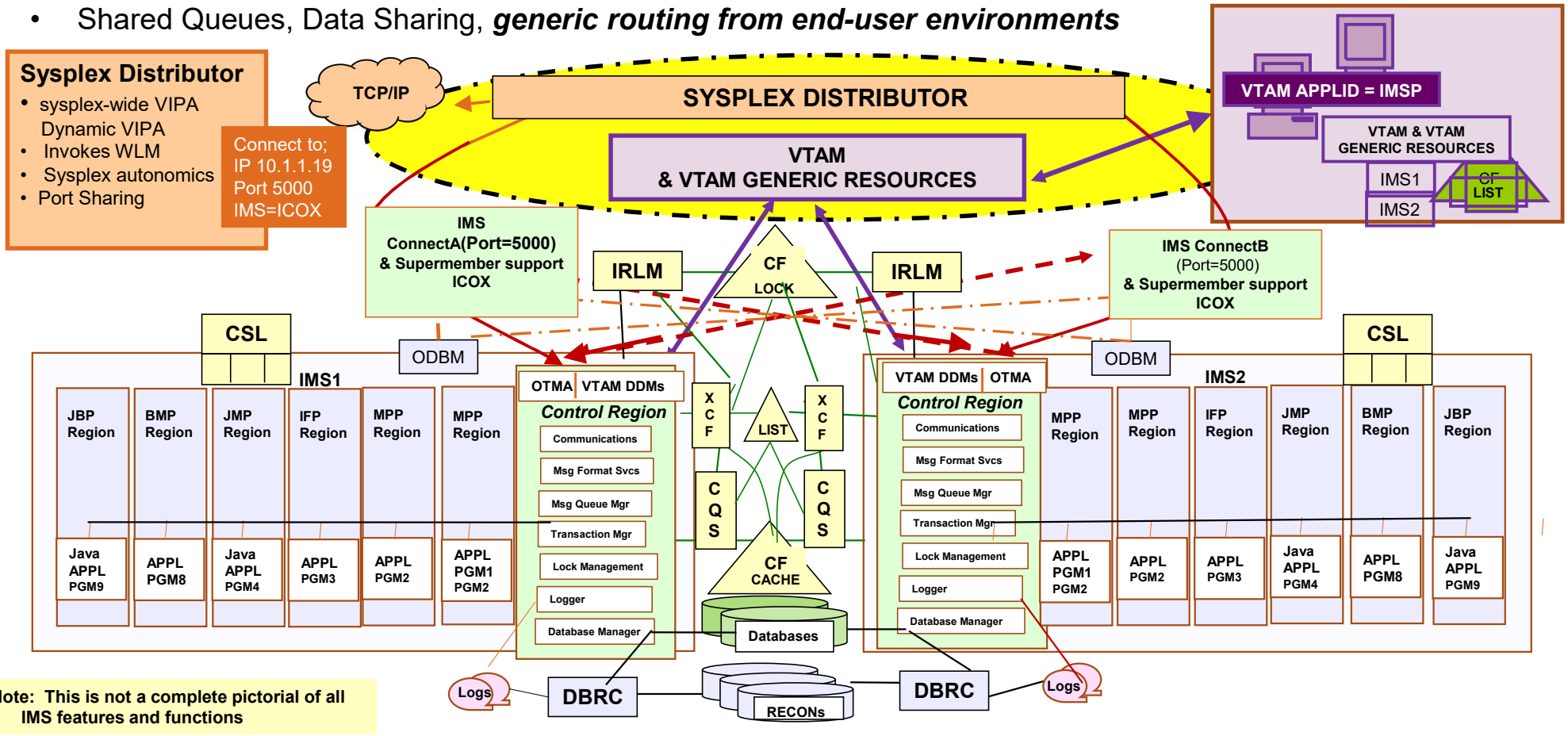
- **Consider IMS Shared Message Queues implementation after IMS data sharing implementation**
  - Allows cloning of application environments

- **Transaction considerations**
  - Determine if there are any serialized TRANs
    - Review TRANSACT macros for SERIAL=YES or MAXRGN=1
    - Review APPLCTN macros for SCHDTYP=SERIAL
    - Try to remove serialization constraint
  - Reduce the Number of Transaction Manager Calls
    - Use single segment input messages
    - Send output in a single insert to the message queue
  - Use ROLB vs ROLL Call for Application Problem Processing
    - Gives control back to application program after backout vs. backout and U778 Abend

All of which provides…. A Redundant Environment

Which addresses growth, pent-up demand, and fluctuating business demands

- Shared Queues, Data Sharing, ***generic routing from end-user environments***

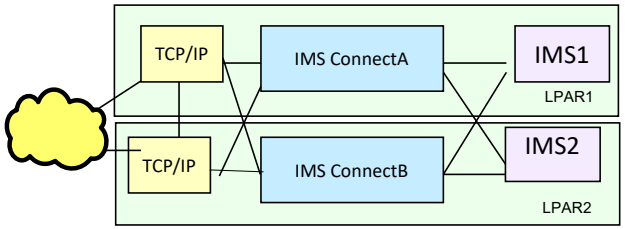


Note: This is not a complete pictorial of all IMS features and functions

And… With Evolving TCP/IP Connections

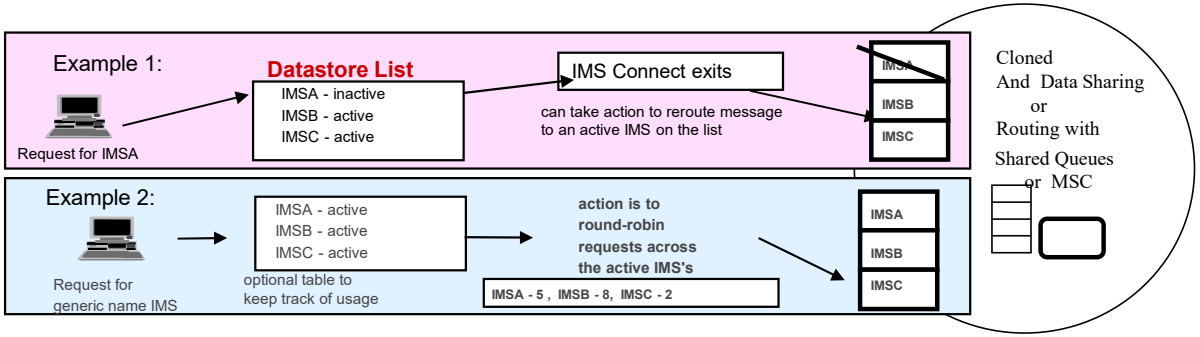
IMS Connect is a gateway for evolving technology requirements

- Provides standard interfaces for access to IMS from environments that use
  - Rest APIs, Open DB access, analytics, etc…
- Provides IMS-IMS TCP/IP connections underlying MSC, ISC, asynch pgm switches
- Interfaces with Sysplex Distributor (SD) and Workload Manager (WLM) for workload balancing and failover
  - Allows WLM to know when resources are constrained or available
    - Minimizes the possibility that that SD assigning work that an IMS Connect cannot handle



Note:
- Reconnection after a failure does not rebalance the existing connections

- **Note: Balancing network connections does not always mean balancing workload for IMS**
  - So Additionally, IMS Connect provides mechanisms (exit routines) for rerouting of a request for load balancing or if an IMS is unavailable
    - Assumes the other IMS can handle the request



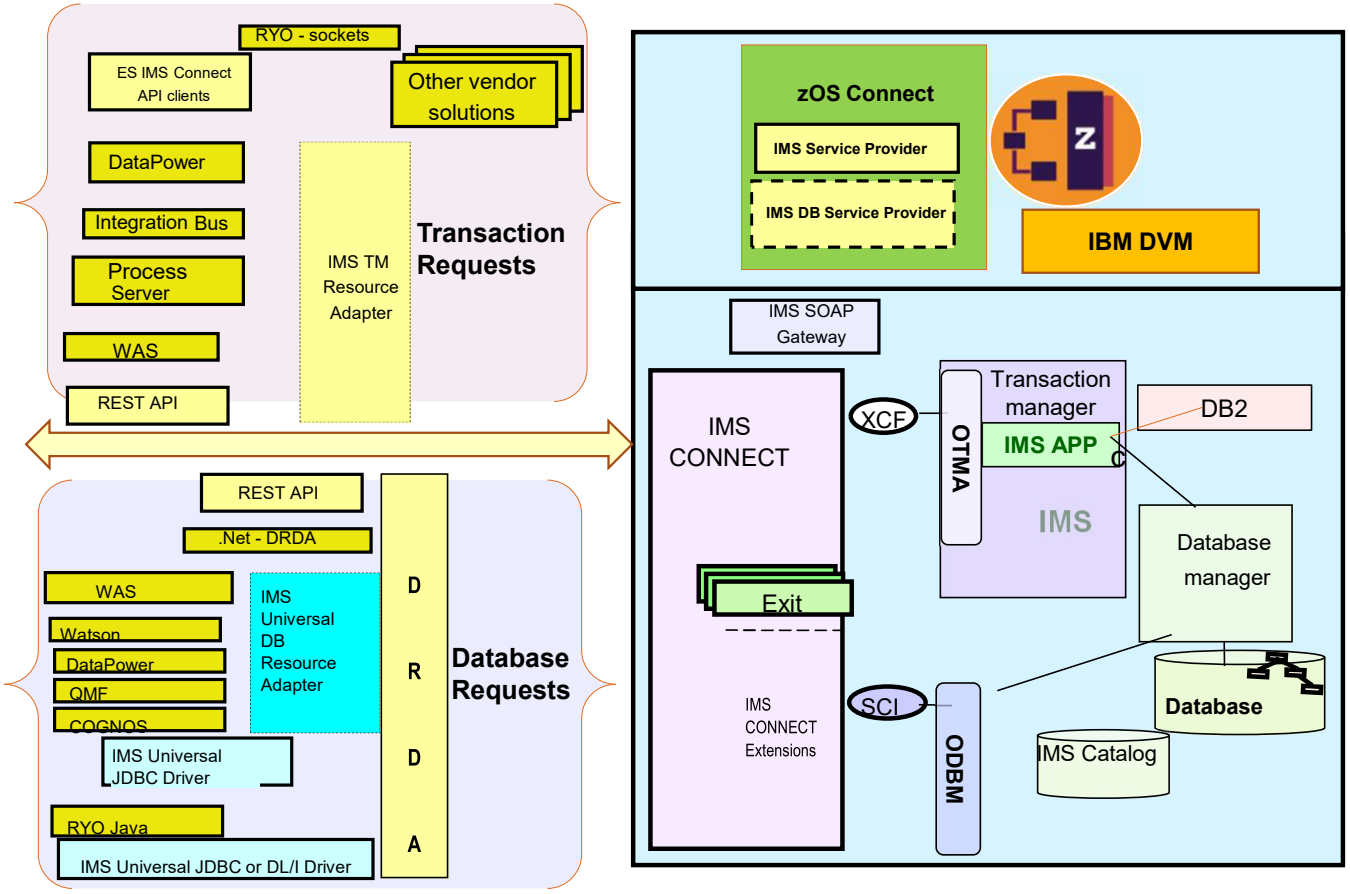
Tooling, e.g. IMS Connect Extensions (IMS CEX) enhances the functionality of IMS Connect for load balancing and rebalancing after a failure, routing, problem determination, etc.
- **Without having to write exit routines**

…For Growth

IMS Connect is a gateway for evolving technology requirements …

Resilient support for strategic solutions:

- **Cloud**
  - Quickly deploy new services
  - Facilitate on premise provisioning of IMS resources w/o an outage
- **Analytics**
  - Easily add analytics solutions for IMS data
- **Mobile**
  - Scale due to increase loads
  - Enhance information
  - Maintain availability for 24x7 access
- **Bottom line: Ability to deploy strategic initiatives in IMS without impacting your existing availability**



Along with Continuous Delivery

- **Model for releasing enhancements which began with IMS 15.1**
  - Without having to wait for a new version of IMS and associated disruption of migrations
    - Previous versions were released on an approximate 2- year boundary

- **Continuous delivery of IMS functionality and support for new technology**
  - Through the PTF process
    - Although a new function becomes available, it does not have to be enabled or implemented unless needed
  - Dynamically enablement or disablement of new IMS functions
    - Type-2 command or IMS parameter
    - Without causing an IMS system outage

Functional resiliency with minimal disruption for continuous availability!

So, now that you have seen all that can be done…

Do you know what the acronym **IMS** means?

- **I**nformation **M**anagement **S**ystem

AND

- **I**ntegrity, **M**anageability, **S**erviceability
- **I**ntegration to **M**ainframe **S**ystems
- **I M**ust **S**ay …. *Best in Class*