

# Automatic Restart Management (ARM) with IMS

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# Abstract and Trademarks



## Abstract

Automatic Restart Management (ARM) is a function of MVS/ESA SP5.2 and OS/390. It may be used to automatically restart MVS authorized jobs and started tasks. IMS/ESA 5.1 and 6.1 include ARM support. If IMS abends, ARM can restart it without any operator intervention. If MVS fails, ARM can restart IMS on another MVS system in the sysplex. ARM can also restart any CICS and DB2 systems used with IMS. This presentation includes an overview of ARM, an explanation of IMS's support for it, and recommendations for implementing ARM with IMS systems. It explains how to increase the availability of IMS systems using data sharing, shared queues, DBCTL, or DB2.

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DB2	IBM	IMS	IMS/ESA	CICS
CICS/ESA	CICSplex SM	MVS	MVS/ESA	OS/390
Parallel Sysplex	TME 10	VTAM	NetView	

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# ARM and IMS

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## ● Agenda

- **Automatic Restart Management (ARM) Overview**
  - What is ARM?
  
- **IMS's Support for ARM**
  - What has been added to IMS for ARM?
  
- **Implementing ARM for IMS**
  - What needs to be done to use ARM with IMS?

# ARM Overview

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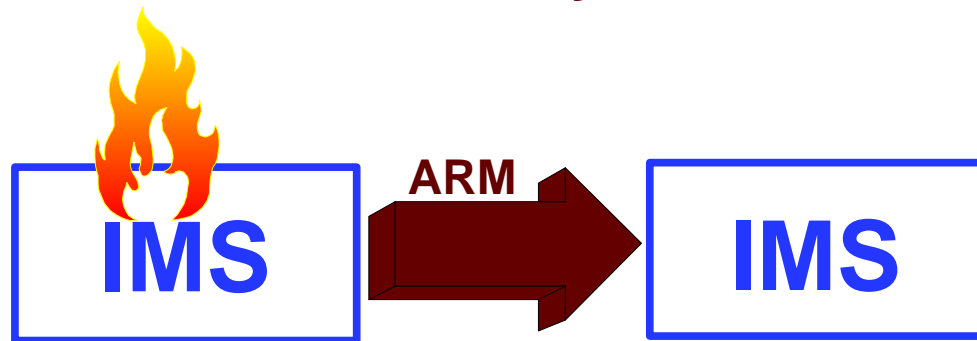
What is ARM?



# ARM Purpose

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- What ARM is:
  - Automated authorized job and started task restart
  - Managed by MVS
  - Sysplex wide
- ARM benefits:
  - Minimized outage times
  - Multiple processors exploitation
  - **Increased availability**



# Configuration Requirement

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- **MVS SP 5.2.0 or above**
  - JES2 SP 5.2.0 or JES3 5.2.1 provide full support
- **Sysplex (monoplex or multiplex)**
  - Restarts within same sysplex
- **Restarts within same JES2 MAS or JES3 complex**
- **ARM Couple Data Set (CDS)**

# Software Support

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- **Jobs/started tasks must register with ARM**
  - Software must include macros to invoke the register function
  
- **Some users of ARM:**
  - **IMS/ESA 5.1 with PN71397**
    - Includes TM, DBCTL, XRF, FDBR, and CQS
  - **DB2 4.1**
  - **CICS/ESA 4.1**
  - **CICSplex SM 1.1.1 with PN65642**
  - **VTAM 4.3**
  - **Later releases of these products**
  - **More than these!**

# Registration

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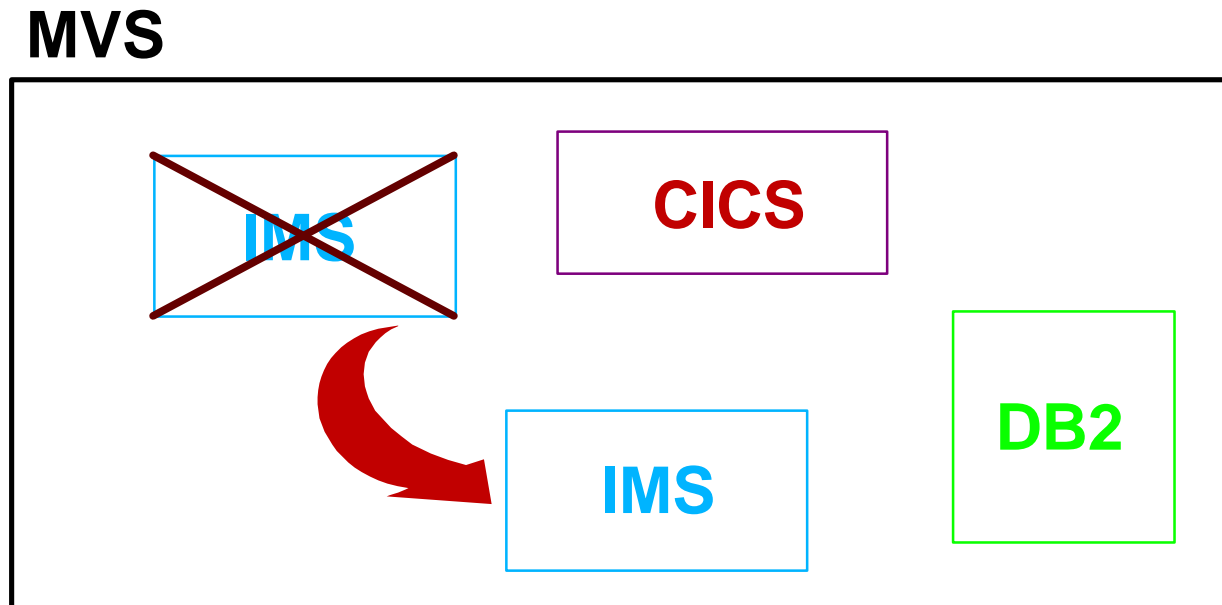
- **Job or started task requirements:**
  - **Must register with ARM as an element**
  - **May indicate dependency on other registrants**
  - **Indicates when ready to accept work**
  - **Deregisters when complete or restart not required**
- **Only registered elements are restarted**
  - **Registration is required for ARM to keep track of an element**





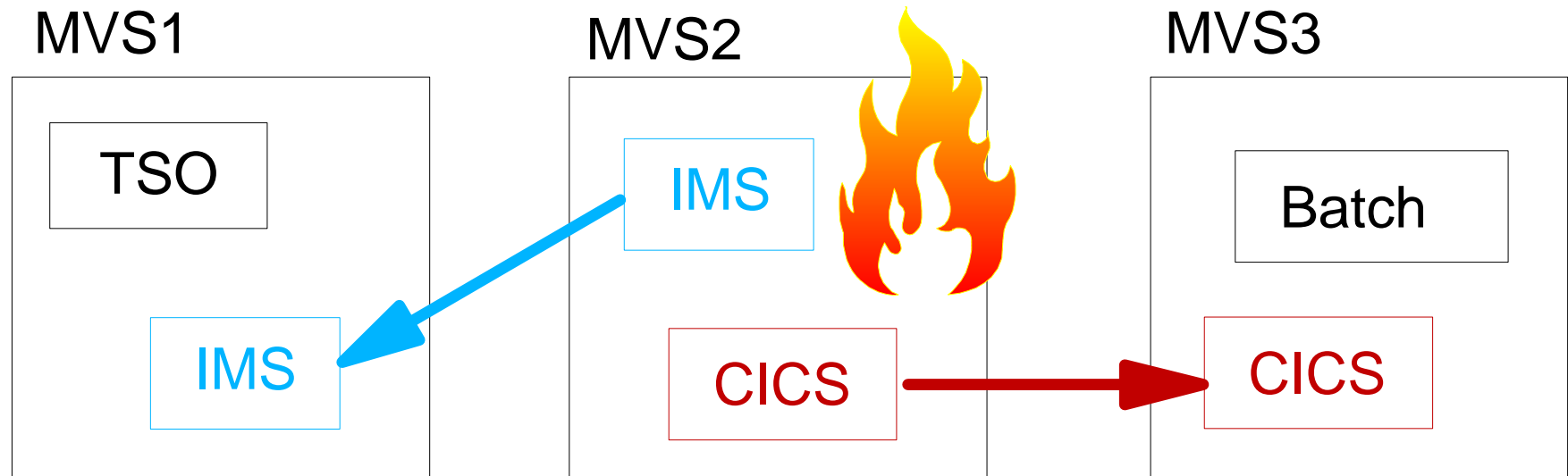
# ABENDs

- If registered element ABENDs (EOJ or EOM), ARM restarts element on same MVS



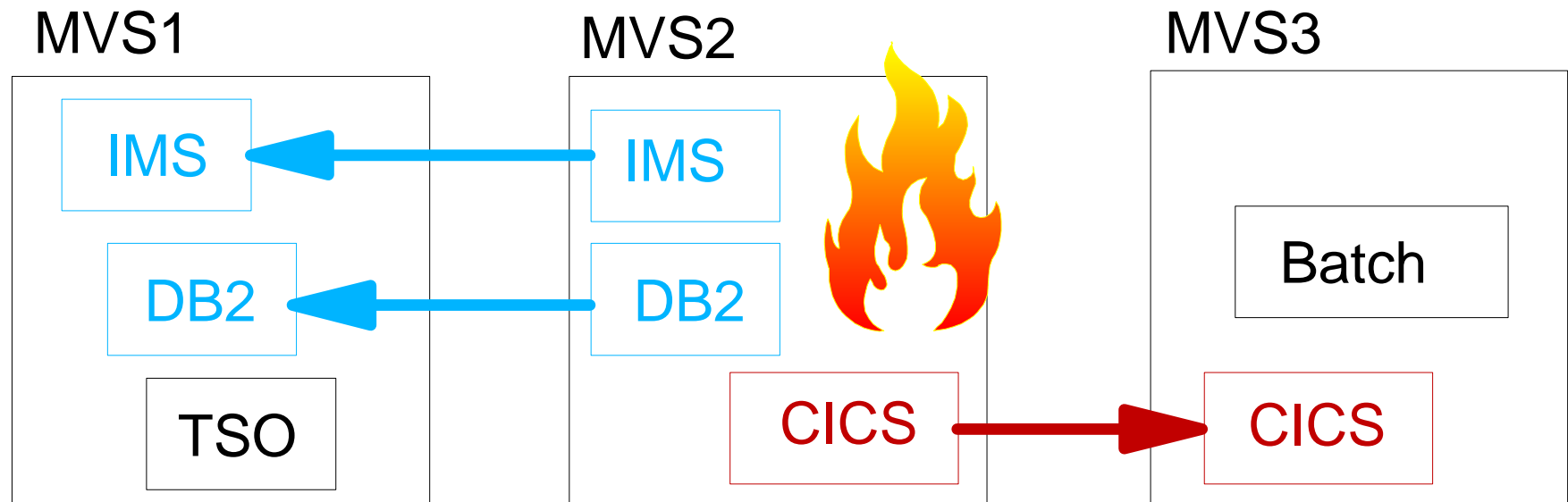
# System Failures

- If MVS fails, ARM restarts elements elsewhere in sysplex.



# Restart Groups

- Elements maybe grouped for restart on the same MVS
  - Example: IMS and DB2



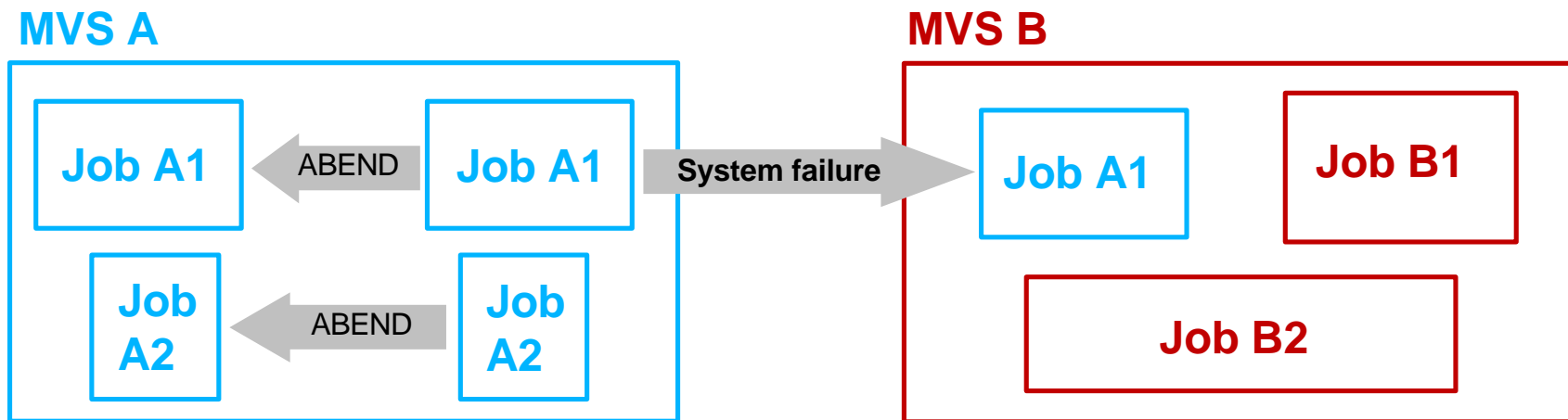
# Restart Groups

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- **Elements in group may be restarted in specified order**
  - Example: DBCTL before CICS
- **Elements in group may be restarted at pacing intervals**
  - Example: At 20 second intervals
- **Minimum CSA/ECSA may be specified for target MVS system**
- **Target MVS selected by available capacity**
  - If using WLM goal mode

# Restart Conditions

- Conditions for restart may be specified
- Restart only on ABENDS
  - Example: Application development system
- Restart on ABEND or MVS system failure
  - Example: Production system



# Restart Method

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- Three choices:
  - *Persistent*
    - Same JCL or command text as before
  - *JOB*
    - Specified data set (or member) containing JCL
  - *STC*
    - Specified command text
  
- Choice may be different for ABENDs and system failures

# ARM Policy

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- **ARM policy must be active for ARM to restart elements**
- **Policy activated by command**  
`SETXCF START,POLICY,TYPE=ARM,POLNAME=policy_name`
- **System default policy or customized policy may be used**
- **Policy defined with Administrative Data Utility**

# ARM Policy (cont.)

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For *elements* the policy defines:

- **Number of restarts in an interval**
  - Zero indicates that the element should not be restarted
  
- **Whether to restart on system failures and ABENDs**
  - Or only on ABENDs
  
- **Method of restart**
  - Persistent, JOB, or STC
  
- **Maximum wait times on restart**
  - Registration - time to register
  - Ready - time to become ready



# ARM Policy (cont.)

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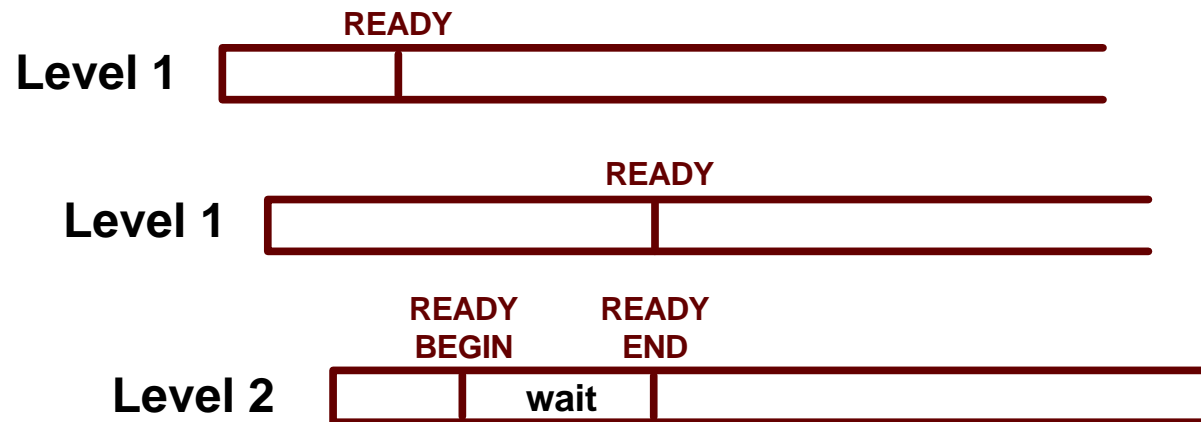
For *restart groups* the policy defines:

- Elements in group
- Candidate systems for restarts
  - Controls where the group will be restarted
- Levels for elements
  - Controls the order in which elements are restarted
- Pacing intervals between restarts of elements
- Minimum CSA/ECSA required on systems for restarts

# Levels

## Levels

- Elements are assigned a level
- Levels control order of cross-system restart activities
  - Restarts after system failures
- Elements are restarted in level order
- Elements become ready in level order



# Program Interface to ARM

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- ***Register***

- Eligible for restart

- ***Ready***

- Ready to do work
- Used to coordinate restarts of multiple elements
- Applies only to cross-system restarts

- ***Wait for Predecessor***

- Wait for other element to become ready
- Applies only to cross-system restarts
- IMS does not issue this

- ***Associate***

- Disable restart of another registrant
- IMS issues this for XRF and IMS V6 FDBR

- ***Deregister***

- Ineligible for restart

# Policy Example



```
DATA TYPE(ARM)
```

```
DEFINE POLICY NAME(MYARMPOL)
```

```
RESTART_ORDER
```

```
LEVEL(1) /* Start these elements first and */
          /* make them ready first */
          ELEMENT_TYPE(SYSIMS) /* Include elements of type SYSIMS */
          ELEMENT_NAME(DB2$DB2P) /* Include element named DB2$DB2P */

LEVEL(2) /* Start these elements second and */
          /* make them ready second */
          ELEMENT_NAME(CICSP*) /* Include element with names */
          /* beginning with CICSP */
```

# Policy Example (CONT.)



```
RESTART_GROUP(GRP1)
TARGET_SYSTEM(SYS1,SYS2,SYS3) /* Restart on these systems */
    FREE_CSA(200,1000) /* Must have 200K of CSA and */
                        /* 1000K of ECSA to restart group */
    RESTART_PACING(30) /* Delay 30 sec. between restarts */

ELEMENT(IMSP) /* For IMSP */
    RESTART_ATTEMPTS(3,300) /* Restart 3 times in 300 sec. */
    RESTART_TIMEOUT(90) /* 90 sec. to reregister after restart */
    READY_TIMEOUT(1000) /* 1000 sec. to issue READY after */
                        /* restart */
    TERMTYPE(ALLTERM) /* Restart on ABEND or system failure */
    RESTART_METHOD(ELEMTERM,PERSIST) /* Same JCL after ABEND */
    RESTART_METHOD(SYSTEM,JOB,'IMSESA.JCL(IMSPSYS)')
                        /* Special JCL for restart on another system */

ELEMENT(CICSP*) ...

ELEMENT(DB2$DB2) ...
```

# ARM Exits

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- **Workload restart exit**

- Used to prepare a system for cross-system restart
- Invoked before restarts
- Exit routine is passed which system failed and elements to be restarted
- Could cancel lower priority work on this system

- **Element restart exit**

- Used to modify restarts of elements
- Invoked for each element to be restarted on this system
- Exit routine is passed the element name, reason for restart, and restart method
- May cancel restart, change to different restart method, modify the restart method, or allow restart to proceed

# IMS's Support for ARM

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What has been added  
to IMS for ARM?



# IMS's Support for ARM

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## IMS/ESA 5.1 with PN71392

- **IMS TM, DBCTL, DCCTL, XRF are supported**
  - ARMRST=Y|N execution parameter
  - ARMRST=Y causes IMS to register if MVS 5.2 or above
  
- **Control region**
  - Registers with ARM
  - Control region starts DLI SAS and DBRC which do not register
  
- **Dependent regions, DLI and DBB batch, utilities**
  - Do not register
  - Are not restarted



# IMS Interface to ARM

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- **Element name is the IMSID**
  - May be used in `ELEMENT(imsid)` and `ELEMENT_NAME(imsid)` in ARM policy
- **Element type is SYSIMS**
  - May be used in `ELEMENT_TYPE(SYSIMS)` in ARM policy
- ***REGISTER* at initialization**
  - Eligible for restart
- ***READY* at end of restart**
  - Higher level elements in group cannot become ready until this occurs
  - Used only on cross-system restarts
- ***DEREGISTER* at normal termination**
  - Not eligible for restart

# Special Treatment

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- Restarts by ARM ignore AUTO=N
  - /ERE OVERRIDE set if not XRF alternate
  - /ERE BACKUP set for XRF alternate
- ABEND before restart completes causes *DEREGISTER*
  - Avoids restart that is likely to fail
- When XRF alternate or FDBR begins tracking, restarting of tracked IMS is disabled.
  - No need to restart IMS when an XRF alternate or FDBR is available
  - XRF alternate will be restarted if it fails
  - FDBR will be restarted if it fails

# Restarts Not Attempted

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- **IMS *DEREGISTERS* for these ABENDS:**

- U0020 - MODIFY command
- U0028 - /CHE ABDUMP
- U0604 - /SWITCH SYSTEM (XRF)
- U0758 - Message queue full
- U0759 - Message queue I/O error
- U2476 - CICS XRF takeover

- **Restart is inappropriate or would fail**

# IMS Support Summary

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- What has been added to IMS for ARM?

- ARM handling: *register, ready, deregister*

- Automatic handling of appropriate restarts
    - ◆ AUTO=Y, /ERE OVERRIDE, ...

- Deregistration when restart would fail

- Parameter to turn off ARM registration
    - ◆ ARMRST=N



# Implementing ARM for IMS

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What needs to be done  
to use ARM with IMS?



# Implementing ARM for IMS

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- **ARM restarts IMS by default if**
  - MVS 5.2
  - and
  - IMS/ESA 5.1 with PN71392
  - and
  - `SETXCF START,POLICY,TYPE=ARM`
  
- **Ways to turn off restarts:**
  - `ARMRST=N` in JCL
  - or
  - `RESTART_ATTEMPTS(0)` in ARM policy

# What to Restart

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- **Typical restart decisions**
  - **Production IMS systems**
    - ARM restart for ABENDs and system failures
  - **Development IMS systems**
    - ARM restart for ABENDs
    - Do not ARM restart for system failures
  - **Test IMS systems**
    - Never ARM restart, unless testing ARM functions



# Restart Groups with IMS

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- **DEFAULT group**

- All elements register in some group
- If not specified in policy, element is in `DEFAULT` group

- **Reasonable scheme:**

- **Do not restart any element in `DEFAULT` group**
  - `RESTART_GROUP (DEFAULT)`  
`RESTART_ATTEMPTS (0)`
  - This prevents accidental restarts of IMS, CICS, and DB2
- **Assign restartable elements to defined groups**
  - This allows intentional restarts of IMS, CICS, or DB2



# Restart Groups

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## ● CICS

- Place all CICSs using DBCTL in same restart group with IMS
  - IMS could be either DBCTL or IMS TM providing DBCTL services
  - CICS AORs using DBCTL must be in the group with IMS
  - CICS TORs and FORs do not need to be in the group with IMS and AORs
    - They do not connect to IMS

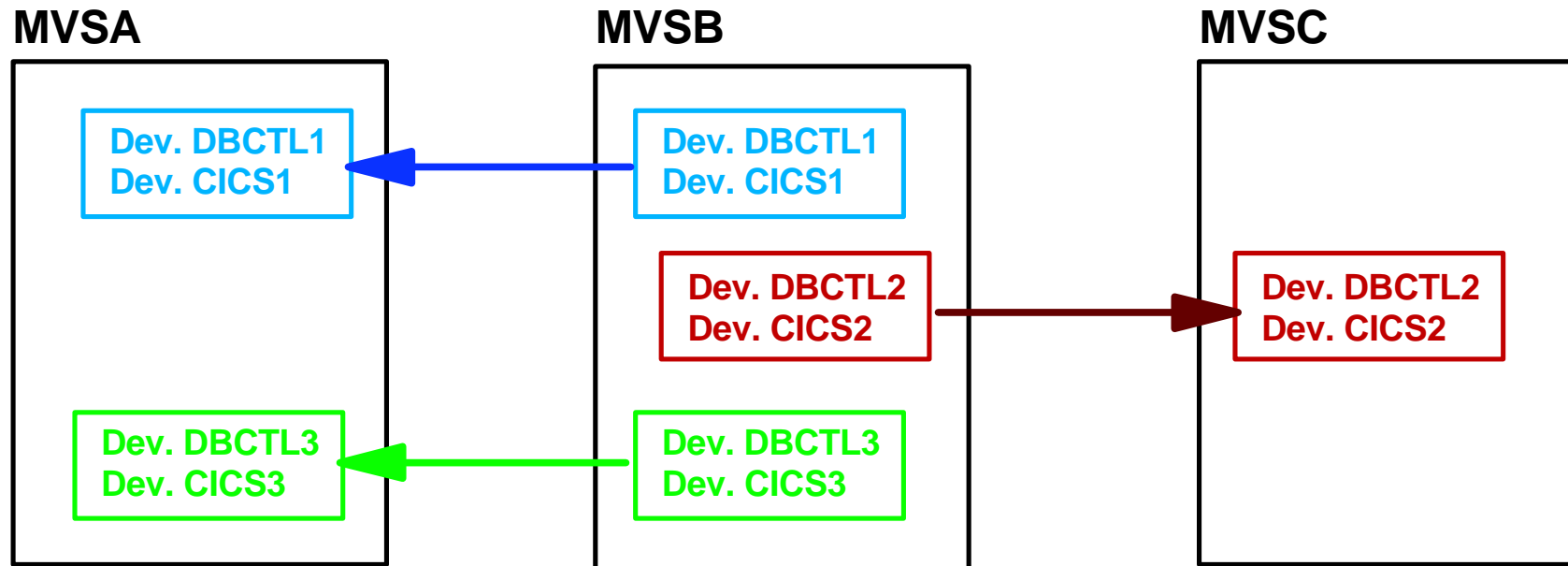
## ● DB2

- Place DB2 used by IMS in same restart group with IMS
- Place DB2 used by CICS AORs in same restart group with AORs
  - CICS TORs and FORs do not need to be in same restart group with DB2
    - They do not connect to DB2

# Restart Groups (cont.)

## ● Make groups small

- Minimize number of elements in a group
- Do not force ARM to keep multiple subsystems in one MVS unnecessarily
- If elements can run on separate MVSs, place them in separate groups
- Control candidate MVSs for restart with `TARGET_SYSTEM` parameter



# How to Restart

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## ● Restart Method

- PERSIST is usually appropriate
  - Same JCL as before
  - IMS chooses AUTO=Y and OVERRIDE (if appropriate)

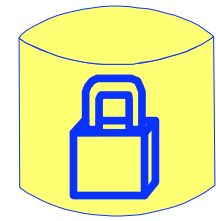
## ● Restart order and pacing

- If many CICSs are in the group, pacing may be desirable
- It is reasonable to restart DB2 and IMS concurrently

# Data Sharing

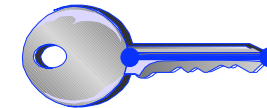
- **When block level data sharing IMS subsystem fails**

- Locks protecting in-flight updates are held
- Requests for the locks result in lock rejects
- Lock rejects generally cause application ABENDs (U3303)

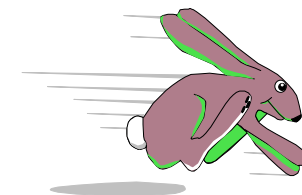


Database records and blocks

- **Held locks are released by emergency restart backout**



- **ARM should be used to automatically restart failed IMS subsystems quickly**

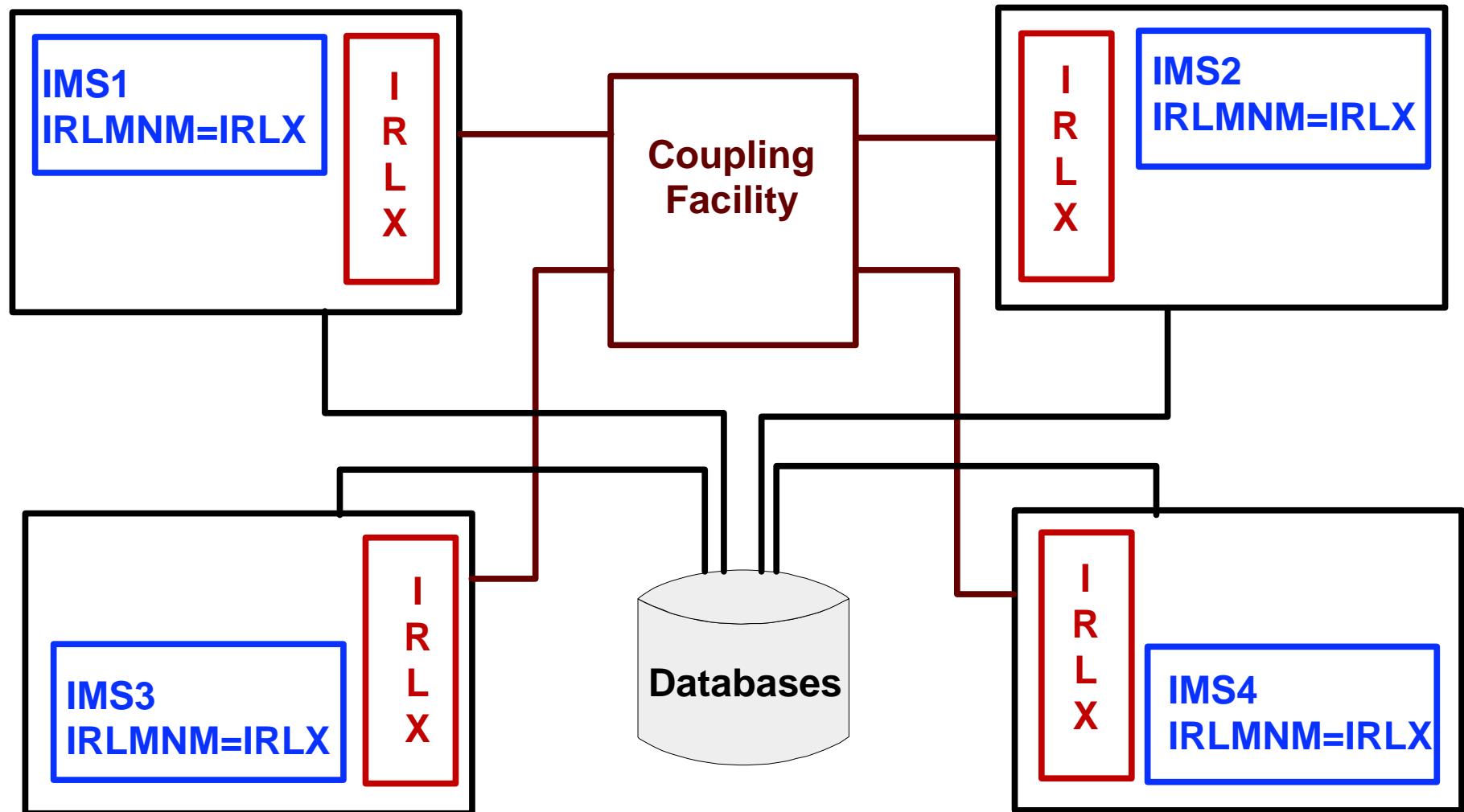


# IRLM

- **ARM support added by APAR PQ06465**
  - IRLM *registers* to ARM
  
- **IMS specifies IRLM name (IRLMNM=)**
  - This IRLM must reside on MVS where IMS runs
  - If IMS moves to another MVS
    - either
      - IRLM name must be changed (different IRLMNM=)
    - or
      - IRLM with same name must reside on new MVS
  
- **Solution!**
  - Use the same name for all IRLMs in data sharing group
  - Start an IRLM with this name on each candidate MVS system
  - Use ARM to restart IRLM only after IRLM abends

# Data Sharing Example

All IRLMNM are IRLX



# VTAM

- **VTAM applid (acbname)**

- Must be active on system
  - Cannot be active on multiple systems

OR

- Must match active **model application program definition**

- **Model Application Program Definition**

- VTAM APPL statement includes wildcard character(s) in label
  - Wildcards are \* and ?
  - ACBNAME operand cannot be coded
  - Example statement

```
IMSP*    APPL    AUTH=(PASS,ACQ,SPO),PARSESS=YES
```

- May be active on multiple systems concurrently
  - Matching application program (acbname) may be opened on any of these systems
- Recommended for use with Parallel Sysplex
  - Application (IMS, CICS, etc.) may execute on any system

# IMS/ESA 6.1 Support

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## ● Common Queue Server (CQS)

- ARM support included
- ARMRST=Y|N parameter
- Include CQS in restart group with its IMS

## ● Fast Database Recovery (FDBR)

- ARM support included
- ARMRST=Y|N parameter for FDBR region
  - Determines if FDBR will be restarted if it fails during tracking
- When FDBR is active, restarting of the tracked IMS is disabled
- Do not include FDBR in restart group with its IMS
  - IMS and FDBR will usually run on different systems



# DB2

- **When ARM is active, DB2 4.1 always *registers***
  - No parameter to turn it off
  - To avoid restarts, you must assign DB2 to a restart group with `RESTART_ATTEMPTS(0)`
  
- **DB2 element name**
  - If not data sharing,  
name is `DB2$` concatenated with member name
  - If data sharing,  
name is DB2 group name concatenated with member name
  
- **DB2 element type**
  - Element type is `SYSDB2`
  - Element type may be used to assign an element to a level
  
- **IRLM with DB2**
  - May use `ARM` or `AUTO START` to restart IRLM after system failure
  - Use `ARM` to restart IRLM after `IRLM ABEND`

# CICS

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- **When ARM is active, CICS/ESA 4.1 always registers**
  - No parameter to turn it off
  - To avoid restarts, you must assign CICS to a restart group with `RESTART_ATTEMPTS(0)`
- **CICS element name**
  - Element name is `SYSCICS_aaaaaaaa` where 'aaaaaaaa' is the applid
  - Element name may be used to assign an element to a group or level
- **CICS element type**
  - Element type is `SYSCICS`
  - Element type may be used to assign an element to a level

# Implementation Summary



## ● What needs to be done to use ARM with IMS?

- ✓ Place subsystems in restart groups



Production

Test

Development

- ✓ Decide on restart method and timings  
Persistent, JOB, or STC

Restart order, Levels, Time-outs, ...

- ✓ Create VTAM model application program definitions

IMSP\* APPL AUTH=(PASS,ACQ),...

- ✓ Create a policy

RESTART\_GROUP (GRP1)  
TARGET\_SYSTEM...

- ✓ Start the policy

SETXCF START, POLICY, TYPE=ARM, POLNAME=MYARMPOL

# Summary and Benefits

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## ● What is ARM?

- Automated restart management
- Managed by MVS
- Sysplex wide
- Works for ABENDs and MVS failures

## ● Benefits

- Increased availability
- Minimized restart times
- Simple to implement
- Supported by IMS, DB2, CICS, CPSM, VTAM



*It's automatic!*

*It's quick!*

