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IMS High Performance Fast Path Utilities

V3R2

Agenda

- **Overview**

- **Objectives**

- **Fast Path Advanced Tool**

- **Fast Path Basic Tools**

- **Fast Path Online Tools**

- **Integrated Solution**

- **Q&A**

Overview

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IMS Tools
Product Portfolio

Database
Database Repair Facility
•HALDB Conversion and Maintenance Aid
•HD Compression- Extended
•Library Integrity Utilities
•Sequential Randomizer
•Generator
•IMS Tools Knowledge Base
System
•Parameter Manager
•Sysplex Manager

High Performance Fast Path Utilities
High Performance Load
High Performance Pointer Checker
High Performance Prefix Resolution
High Performance Unload
Index Builder
Parallel Reorganization
Online Reorganization Facility
Database Control Suite

Database Recovery Facility
DEDB Fast Recovery
High Perf Image Copy
High Perf Change Accumulation
IMS Recovery Expert

Batch Terminal Simulator
Batch Backout Manager
IMS Connect Extensions
MFS Reversal Utilities
Program Restart Facility

End to End Management

Data Base Administration	Utility Management	Recovery Management	Application Management

IMS DATA BASE TOOLS

Performance Management	TM Management	Regulatory Compliance	Information Integration

Buffer Pool Analyzer
Network Compression Facility
Performance Analyzer
Problem Investigator
OMEGAMON XE for IMS

Command Control Facility
ETO Support
HP Sysgen Tools
Queue Control Facility

IBM Encryptions for IMS and DB2 Databases
IMS Audit Management Expert

IMS Data Propagator
Websphere Replication Server
Websphere Data Event Publisher for z/OS
Websphere Classic Data Event Publisher
Websphere Classic Federation Server
Websphere Replication Server

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IMS High Performance Fast Path Utilities

- **Version 2 Release 1, 5655-K94**
  - GA: September 2004

- **Version 2 Release 2, 5655-K94**
  - GA: October 2005

- **Version 3 Release 1, 5655-R05**
  - GA: December 2006

- **Version 3 Release 2, 5655-R05**
  - GA: December 2007
  - IMS V8, V9, V10
  - z/OS V1.7 or later

- **User's guide**
  - http://www-306.ibm.com/software/data/db2imstools/imstools-library.html#imshpfputils-lib

IMS High Performance Fast Path Utilities

- **Fast Path Advanced Tool (FPA)**
  - Unload/Reload
  - Analyze
  - Change
  - Extract
  - DMAC print
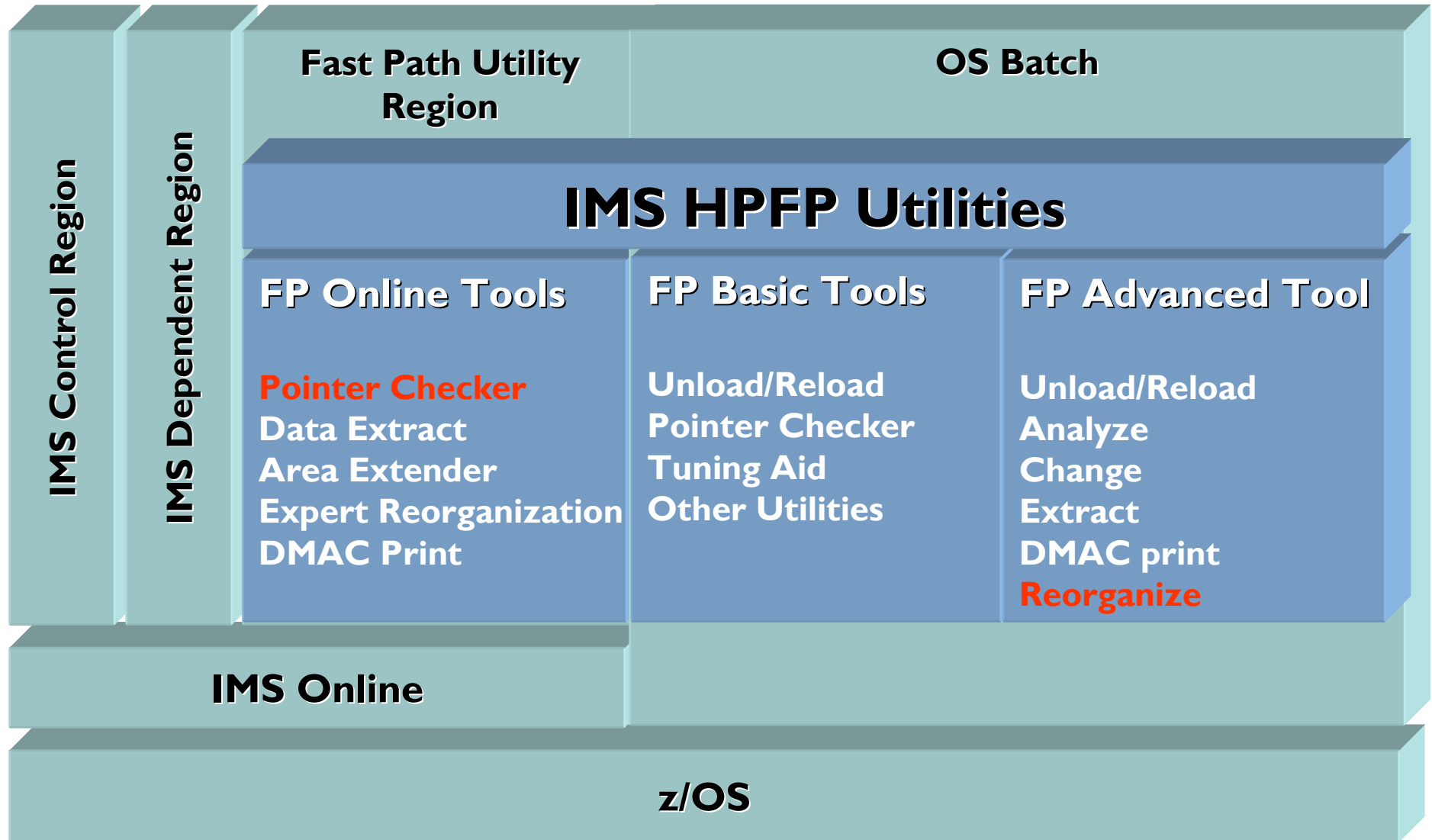 - Reorganize
- **Fast Path Online Tools (FPO)**
  - Online Pointer Checker (enhanced)
  - Online Data Extract
  - Online Area Extender
  - Online Expert Reorganization
  - Online DMAC Print
- **Fast Path Basic Tools (FPB)**
  - DEDB Unload/Reload
  - DEDB Pointer Checker
  - DEDB Tuning Aid
  - Other unload/reload utilities

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IMS High Performance Fast Path Utilities

IMS Control Region

IMS Dependent Region

Fast Path Utility Region

OS Batch

IMS HPFP Utilities

FP Online Tools	FP Basic Tools	FP Advanced Tool
Pointer Checker Data Extract Area Extender Expert Reorganization DMAC Print	Unload/Reload Pointer Checker Tuning Aid Other Utilities	Unload/Reload Analyze Change Extract DMAC print **Reorganize**

IMS Online

z/OS

Objectives

Objectives/Solutions of HPFP Utilities

- **Reorganizing DEDB**
  - FPA
    - Unload/Reload/Change/Reorganize
  - FPB
    - Unload/Reload
  - FPO
    - Online Data Extract
    - Online Area Extender
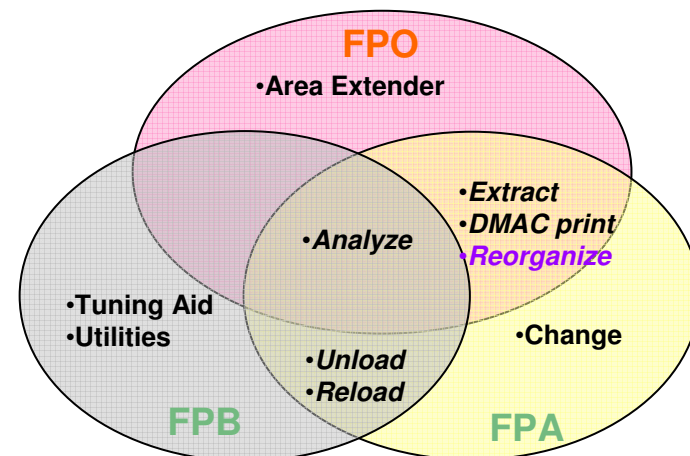   - Online Expert Reorganization

- **Analyzing DEDB**
  - FPA
    - Analyze
    - Dmac print
  - FPB
    - Pointer Checker
  - FPO
    - Online Pointer Checker
    - Online Dmac print

- **Extracting Data from DEDB**
  - FPA
    - Extract
  - FPO
    - Online Data Extract

- **Other utilities**
  - FPB
    - Tuning Aid
    - Other utilities

FPO
- Area Extender

- Extract
- DMAC print
- Reorganize

- Analyze

- Tuning Aid
- Utilities

- Unload
- Reload

- Change

FPB

FPA

Reorganizing DEDB

- **When**

  – Changing database structure

  – Preventing performance degradation

  – Better free space usage

- **Solution**

  – Reclaiming fragmented free space

  – Enlarging space

  – Changing database structure

  – Adding/deleting areas

Reorganize mode and Restructure mode

- **Reorganize mode**
  - Used for reclaiming fragmented free space, and physically storing associated segments close together
  - Only change allowed is size of SDEP Part
  - if SDEPs are unloaded/reloaded, SDEP part can not be made smaller
  - Mostly no SORT needed
  - No calls to randomizer
  - No new ACBLIB
- **Restructure mode**
  - Used to change DBD name, number of Areas, Randomizer, Area geography, CI size or pointer options
  - Can move (or add) segments within the hierarchy
  - Segment names, segment levels and segments' parents must stay same
  - Required new ACBLIB

DEDB Analysis

- **Provides two ways of verification**
  - Fast scan of database integrity
  - In-depth pointer verification

- **DEDB integrity verification of:**
  - IMS pointer values
  - Free space element chains
  - VSAM control fields
  - Space utilization

- **Reports that contain statistical information about the database**
  - Free space analysis
  - Database record and segment occurrence profiles
  - Database record and segment placement analysis
  - Overflow usage analysis of both DOVF and IOVF
  - Physical I/O statistics
  - Root distribution and synonym chain analysis

- **Second CI analysis**
  - Global/Local section in DMAC
  - Second CI dump, EQE lists, CUSN and RBA

Data Extract

- **Extracts segment data from a DEDB area and writes the output to a sequential file in the user specified format**

- **Multiple areas can be processed in a single run**

- **Writes certain parts of a segment**
  - Selection by
    - Segment name
    - Segment name and key/data comparator
    - Segment name and offset/length/data comparator
  - Selection is hierarchical
    - Lower level segments can only be selected when higher level segments satisfy selection criteria

- **Selects SDEP segments hierarchically or physically**

- **Gives you control over the amount of data you select**

- **Skips a specified number of segment occurrences**

- **Stops selection after a specified number of segment occurrences**

- **Selects every Nth occurrence**

- **Populates a test database**

Extract API for Accessing Files Generated

- **Application programs can retrieve segments from an unload file created in standard format**

- **Application I/O Interface Routine FPXGXDR0**

  – Isolates application programs from knowledge of extracted file format and future changes

  – Supports up to 9 extracted files in parallel

  – DL/I-like interface

    • INIT, GET, EOJ when reading single extracted file
    • INIx, GETx, EOJx when reading up to 9 extracted files (x identifies input file)

Fast Path Advanced Tool
(FPA)

Highlights of Fast Path Advanced Tool

- **JCL ease of use**
  - Increase the productivity of database administrator
  - Minimize steps for completing functions
  - Minimize DD statements
  - Single driver program with command language

- **High performance**
  - Reduce the time consumption of the database maintenance and database conversion
  - Internal sort
  - Media Manager call
  - Data space
  - Multi-processing
  - Integrated functions

FPA JCL ease of use - Minimize JCL DD

- **Allocates dynamically**
  - DEDB area data sets for
    - Input of the analyze, change, unload, extract and dmac print processes
    - Output of the reload and change process (with space allocation)
  - ACB libraries
  - DBRC RECON data sets
  - Data sets of unloaded and extracted segment records for
  - Output of the unload and extracted process
  - Input of the reload process
  - Image copy data sets
  - HFPPRINT data set
  - HFPRPTS data set
- **Supports the site default options**
  - Site default table
  - Site default module

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FPA JCL ease of use - Command language

- **Single driver program with unified command language for all functions**

```
//HFP        EXEC PGM=HFPMAIN0
//HFPSYSIN DD *
 GLOBAL DBRC=YES
 Command
       DBD=DEDBJN22
 /*
```

Command

UNLOAD
RELOAD
CHANGE
ANALYZE
EXTRACT
DMACPRNT
REORG

- **Advanced data set name specification**

  – Masks can be used for data set names

    • e.g.) IMSVS.USERFILE.&AREA

  – Generation data set groups (GDG)

- **Command syntax check without run**
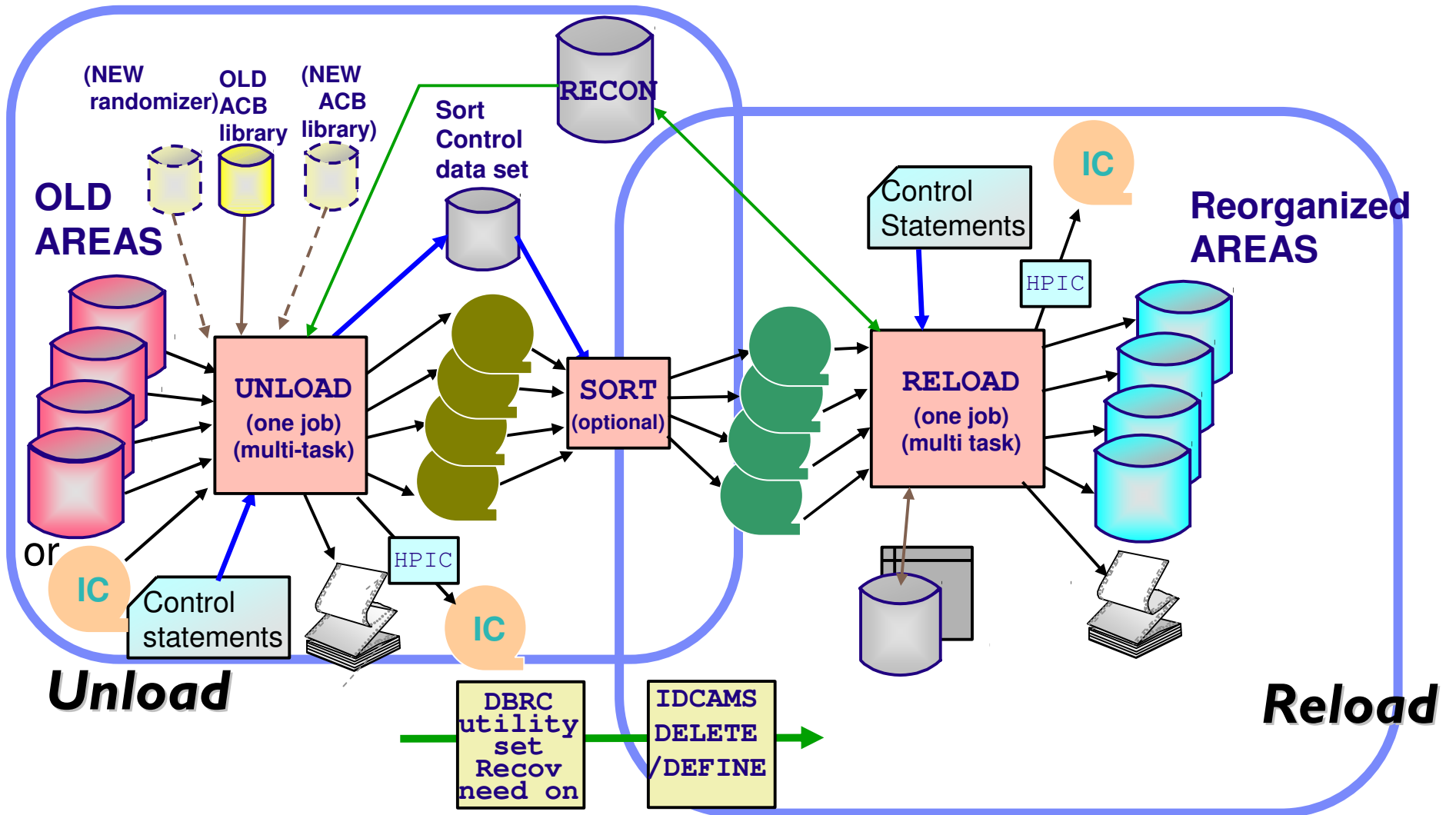
  – GLOBAL SCAN=YES

FPA Unload function

- **Writes unload record to the appropriate single or dual unload data set**

- **Two unloaded file formats**
  - DBT or TFMT

- **Compressed segments can be expanded**

- **User Exit can be used to edit &/or select segments**

- **Randomizer can be changed**

- **Supports internal SORT**

- **Processes image copy data sets as input**
  - IMS standard Image Copy and High Performance Image Copy (HPIC) V4

- **Generates image copy data sets**
  - High Performance Image Copy (HPIC) V4
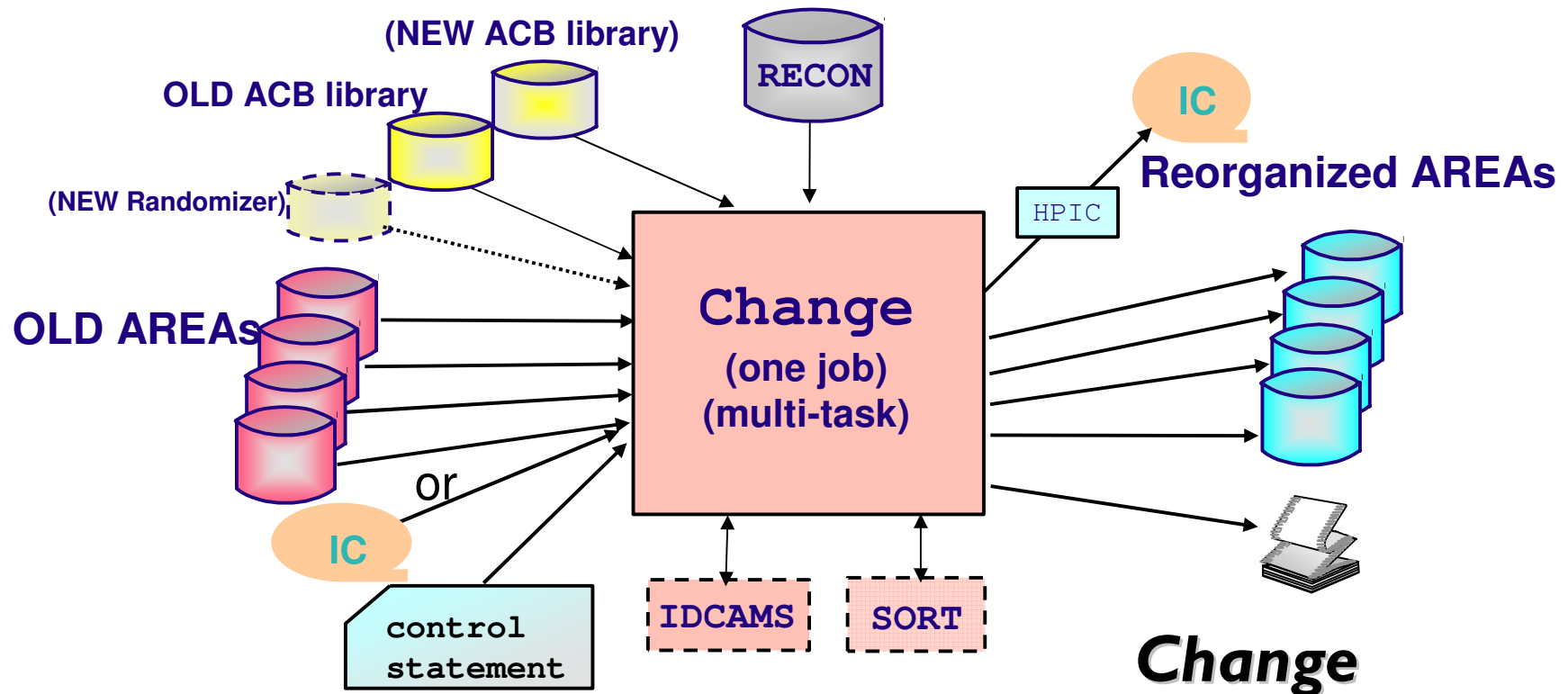
FPA Reload function

- **Reloads Area Data Sets from unload data set**

- **Supports MADS (reloads all copies of an area)**

- **User Exit can edit segments being loaded**

- **Handling Long Twin Chains ("Segment placement")**
  - Control maximum number of segments to insert in base section by segment type
  - These "additional twins" will be inserted after all other data for a RAP has been inserted, and may use base section.

- **Supports internal SORT**

- **Allocates Area Data Sets**

- **Generates image copy data sets**
  - High Performance Image Copy (HPIC) V4
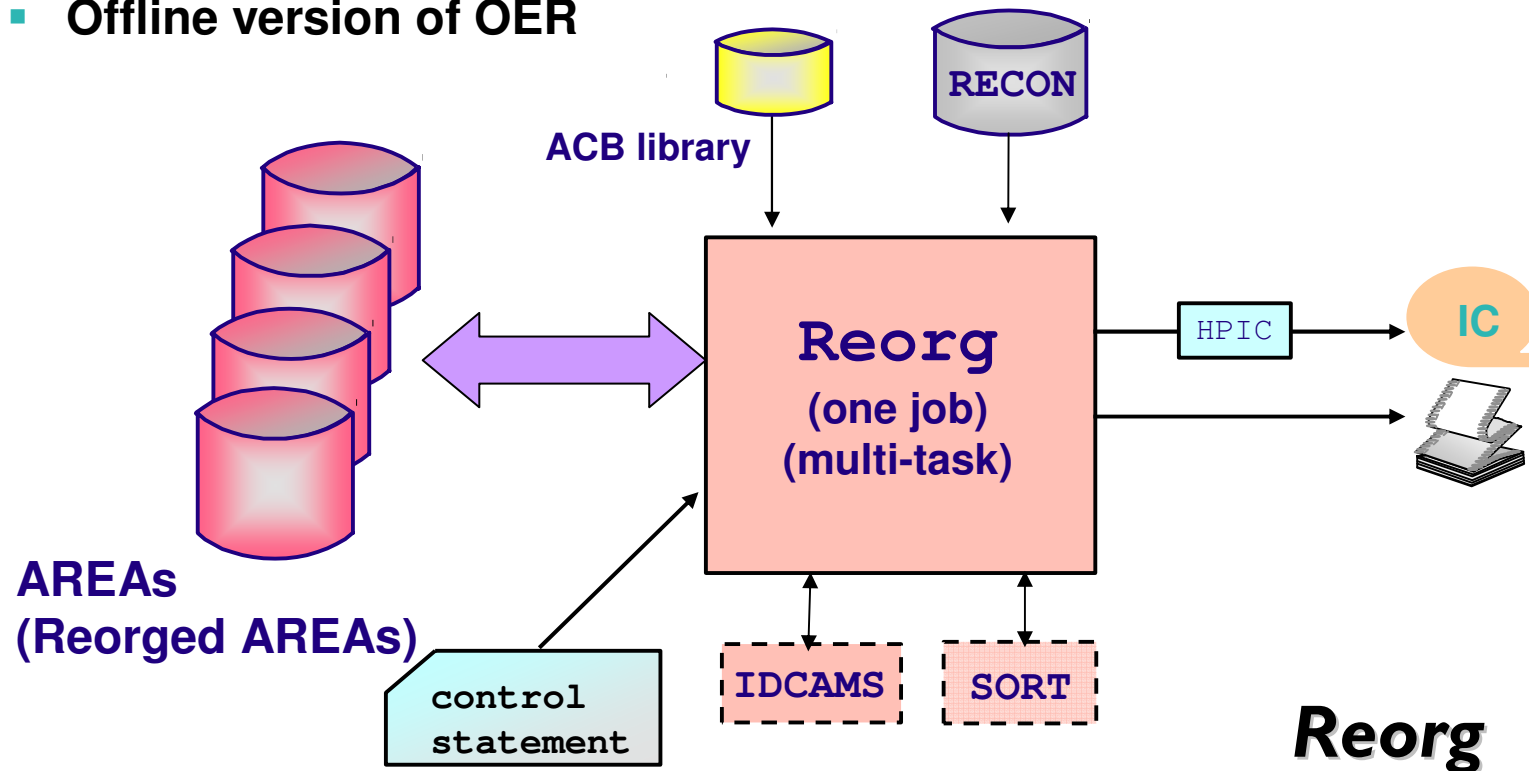
FPA Unload/Reload functions system flow

(NEW randomizer)   OLD ACB library   (NEW ACB library)

Sort Control data set

RECON

Control Statements

IC

OLD AREAS

Reorganized AREAS

UNLOAD (one job) (multi-task)

SORT (optional)

RELOAD (one job) (multi task)

HPIC

IC

or

IC

Control statements

HPIC

IC

DBRC utility set Recov need on

IDCAMS DELETE /DEFINE

Unload

Reload

FPA Change function system flow

- **Reorganizes or restructures a single or multiple DEDB areas with single job step using a shadow data set and name swap technique**
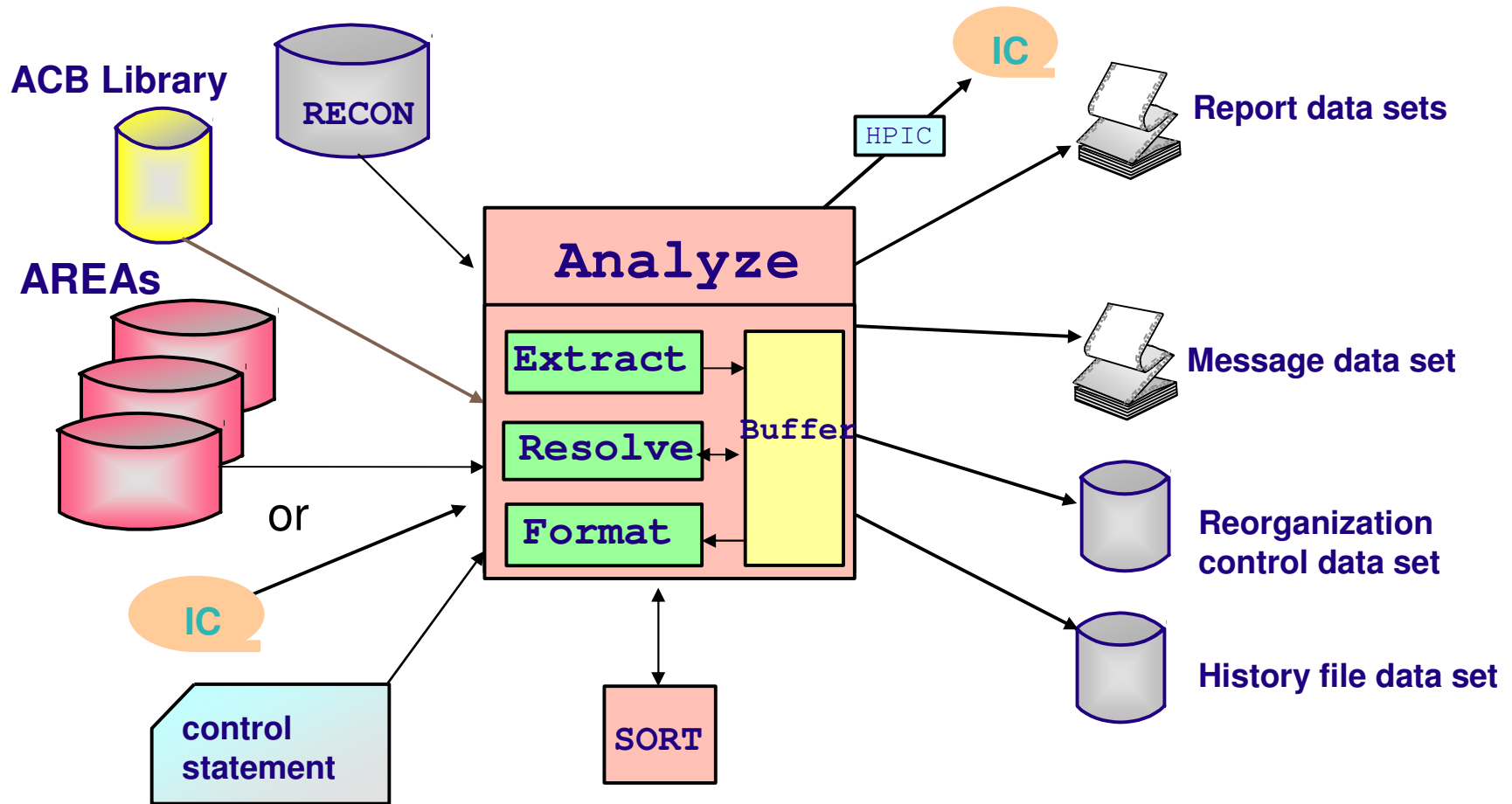

(NEW ACB library)

OLD ACB library

RECON

IC

Reorganized AREAs

(NEW Randomizer)

HPIC

OLD AREAs

Change
(one job)
(multi-task)

or

IC

control statement

IDCAMS

SORT

Change

FPA Reorganize function system flow

- **Reorganizes a single or multiple DEDB areas with single job step without a shadow data set**

- **Reorganizes a set of UOWs in a DEDB area on the basis of a ranked set of UOWs**

- **Offline version of OER**

ACB library

RECON

Reorg
(one job)
(multi-task)

HPIC

IC

AREAs
(Reorged AREAs)

control
statement

IDCAMS

SORT

Reorg

FPA Analyze function

- **Integration with the other functions (like reload, change)**

- **Processes input image copy data sets or source area datasts as input**

  - IMS standard Image Copy and High Performance Image Copy (HPIC) V4

- **Generates image copy data sets**

  - High Performance Image Copy (HPIC) V4

FPA Analyze function system flow

ACB Library

RECON

AREAs

IC

Analyze

HPIC

IC

Extract

Resolve

Buffer

Format

Report data sets

Message data set

Reorganization
control data set

History file data set

or

control
statement

SORT

FPA DMAC print function

- **Reports DMAC information of the area data set**

- **Maps Global section and Local section with offset, label, values.**

- **Provides dump specified by the DMAC length**

- **Processes input image copy data sets as input**
  - IMS standard Image Copy and High Performance Image Copy (HPIC) V4

FPA Sample Reports for DMAC print

- ## **Mapping**

```
-AREA NO:  nnnn   AREANAME: areaname   DDNAME: ddname     DSNAME: dsname
-DMAC INFORMATION :   DMAC GLOBAL SECTION
      OFFSET     LABEL         VALUE                    COMMENT
      ------   ---------   ----------------------   --------------------------------------------
      000000   DMACVNO     910                      VERSION NUMBER
      000003   DMACLKID    8                        AREA LOCK ID FOR AREA
      000004   DMACDBNM    DEDBJN30                 DATA BASE NAME
```

```
-AREA NO:  nnnn   AREANAME: areaname   DDNAME: ddname     DSNAME: dsname
- 2ND CI DUMP
  - CI-RBA: 1024  (X'0400')
  000000   F9F1F0F8 C4C5C4C2 D1D5F3F0 C4C2F3F0   C1D9F040 0004069F 0017217F 00000000   *9108DEDBJN
  000020   00000000 00000004 00068800 000001EF   00000000 00000001 0000B000 00000001   *""""""""""
  000040   00008000 00000000 00000000 00000000   00000000 00000000 00000000 00000000   *""  """"""""
  000060   00000000 00000000 00000020 00000000   01C10004 00010005 00780002 00000400   *""""""""""
  000080   00000016 0000001B 00000001 00000000   00000000 00018000 00000000 27000103   *""""""""""
.....
.....
  0003E0 ......

 - EQE INFORMATION                (START RBA: X'03C7')
    - EQE COUNTER             : 0
    0003C0                    00 00000000 00000000   00000000 00000000 00000000 00000000*        ....
    0003E0  00000000 00000000 00000000 00000000   000000                                  *...........
 - CI SUFFIX INFORMATION
    - CUSN                    : X'0006'
    - RBA                     : X'00000400'
    0003E0                                         00 06000004 00
```
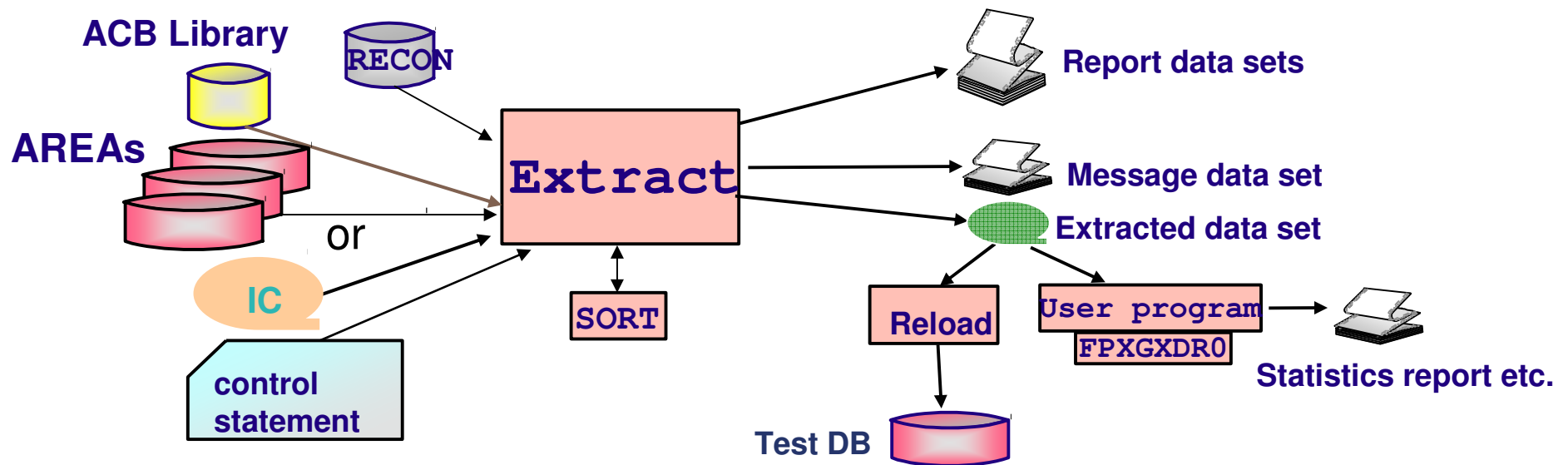
FPA Extract function

- **Provides an easy-to-use, flexible method to extract segment data from one or more offline DEDB areas and to write the output to a sequential file.**

- **Can be in one of the following formats:**

  – Standard format

  – FPB Unload/Reload format

  – FPB Unload/Reload TFMT format

  – TRIMAR Unload/Reload format

  – HD Unload format

FPA Extract function system flow and sample JCL

ACB Library

AREAs

RECON

or

IC

control statement

Extract

SORT

Report data sets

Message data set

Extracted data set

Reload

User program
FPXGXDR0

Statistics report etc.

Test DB

```
//HFPSYSIN  DD *
  GLOBAL DBRC=YES
  EXTRACT DBD=dbdname,
    IAREA=(areaname),
    ODSNMASK=user.extract.&area#,
    EFORMAT=STD,SORT=YES,COMPRESS=NO,
    SELECT SEG=CUSTOMER,FIELD=(KEY GT C'000999' AND 12:1 EQ C'A'),
    OUTPUT SEG=CUSTOMER,FIELDS=(1:20,25:5),
    OUTPUT SEG=ACCOUNT
/*
```

Fast Path Basic Tools

(FPB)

Fast Path Basic Tools

- **Fast Path Basic Tools (FPB)**

  - DEDB Unload/Reload

  - DEDB Pointer Checker

  - DEDB Tuning Aid

  - Other unload/reload utilities

Historical Toolset: Commitment to maintain support. Greater functional value in using the FP Advanced Tools instead of Fast Path Basic Tools

FPB Other unload/reload Utilities

- **Database Definition Record Create utility (FABCUR5)**
  - Reports the DB Definition Record

- **DEDB Reload Segment Data Set Create utility (FABCUR6)**
  - Enables a user application program to create a DEDB reload segment data set

- **DEDB Unload Segment Data Set Retrieve utility (FABCUR7)**
  - Enables a user application program to retrieve unloaded DEDB database segments from the DEDB reload segment data set in hierarchical order

- **HD to DEDB Unloaded data set conversion utility (FABCUR8)**
  - Converts a HD unload data set to a DEDB Unloaded segment data set

- **DEDB Unload Conversion utility (FABCUR9)**
  - ISRTs data from various formats of unload files onto an IMS Full Function or Fast Path DEDB database

- **DEDB Randomizing module (FABARMIF)**
  - Enables an application program to invoke a DEDB randomizer
    - Application specifies DBD name and rootkey
    - FABARMIF returns AREA number and RAP CI address (and UOW number)

Fast Path Online Tools

(FPO)

Highlights of Fast Path Online Tools

- **Runs various functions as a FP Utility without stopping a DEDB area**

- **Security validation using RACF**

- **Supports site default options**

  – Tools except for OAE

  – Three kinds of site default options

  • Global site default options

  • A DB member in the parameter library

  • An AREA member in the parameter library

OAE - Online Area Extender

- **Enables increasing size while allowing online access to the area to be extended**
  - SDEP Part
  - IOVF Part
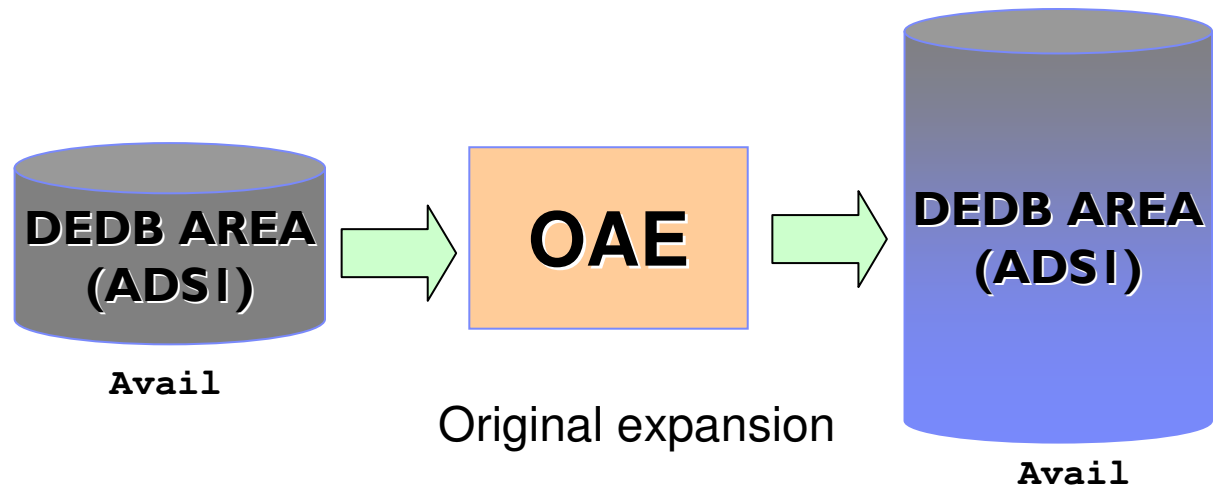
- **Two types expansion**
  - Shadow expansion
    - Specifies the target area data sets
  - Original expansion
    - Copy
      - Recreates new larger ADS
    - Rename
      - Renames the ADS

DEDB AREA (ADS1)

Avail

OAE

Original expansion

DEDB AREA (ADS1)

Avail

OAE Shadow and Original expansion

	Shadow	Original
Allocates a larger area data set reflecting your changes		
Registers the new ADS with DBRC		
For IOVF extension only: Changes the ROOT parm in DBD for the area(s) to be extended Runs DBDGEN Runs ACBGEN		
Runs the SDEP SCAN/DLET utilities		
Removes the area from VSO		
Runs Online Area Extender		
Switches to the ACBLIB containing the new DEDB member		
Reloads the area into VSO		

OAE Shadow and Original expansion..

- **Shadow expansion**

ADS1 → copy → ADS2

Avail
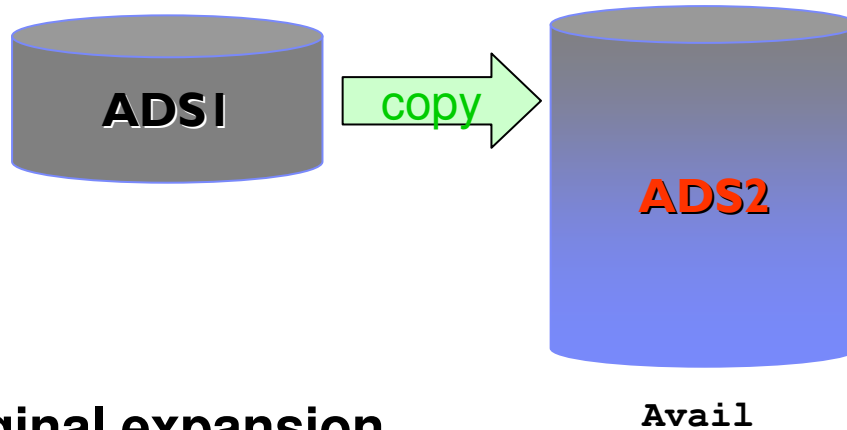
- **Original expansion**

  – Copy type

    • Processed copy phase twice
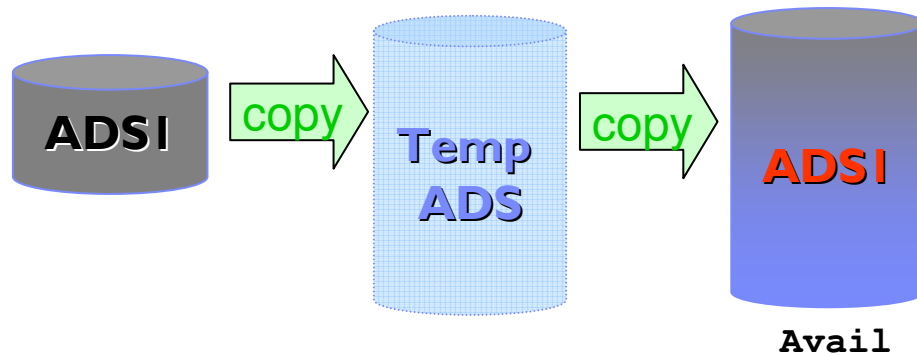
  – Rename type

    • Area is stopped temporarily

ADS1 → copy → Temp ADS → copy → ADS1

Avail

ADS1 → copy → Temp ADS => ADS1   Rename

Avail
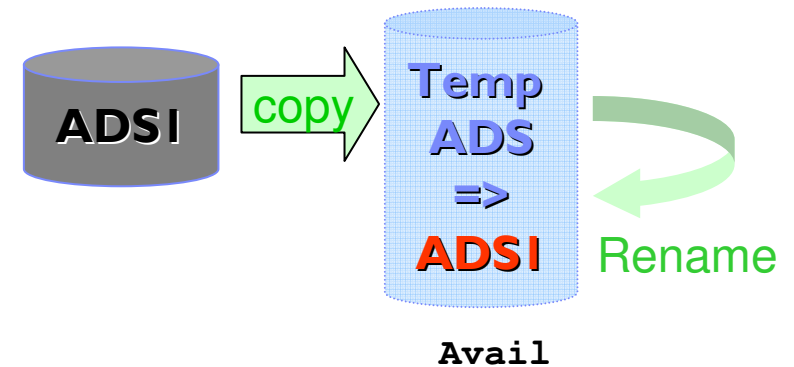
OER - Online Expert Reorganization

- **Single step execution**

  - Generating SYSIN commands for High-Speed DEDB Direct
    Reorganization (HSReorg)

  - A set of UOWs in a DEDB area based on RBASEFS and RDOVFFS
    criteria

- **Performs OPC for whole area or only reorganized UOWs**

- **Generates image copy (IMS IC, HPIC) for the new area data set**

```
//REORG     EXEC FPUTIL,DBD=dbdname
//STEPLIB   DD DISP=SHR,DSN=user.PGMLIB
//SYSOUT    DD SYSOUT=*
//SYSPRINT  DD SYSOUT=*
//FPXIN     DD *
REORG
 AREA=areaname,RDOVFFS=20,PTRCHK=YES
 PTRCHK CHKUOW=REORGED,IC=YES
/*
```
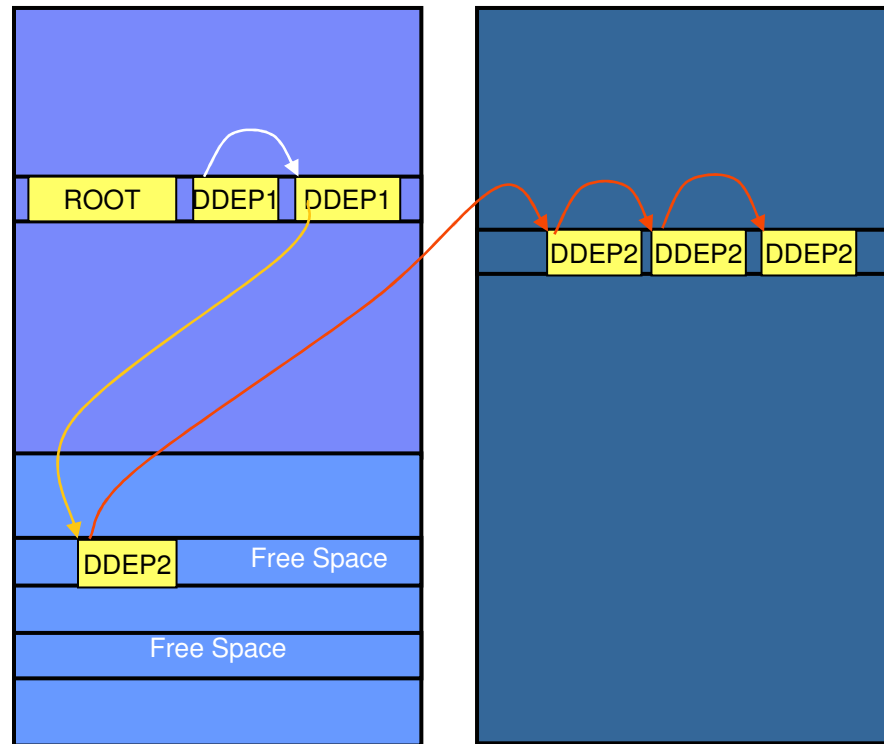
OER RBASEFS and RDOVFFS

RBASEFS criteria

RAP Base

ROOT   Free Space

DOVF

DDEP1   DDEP1
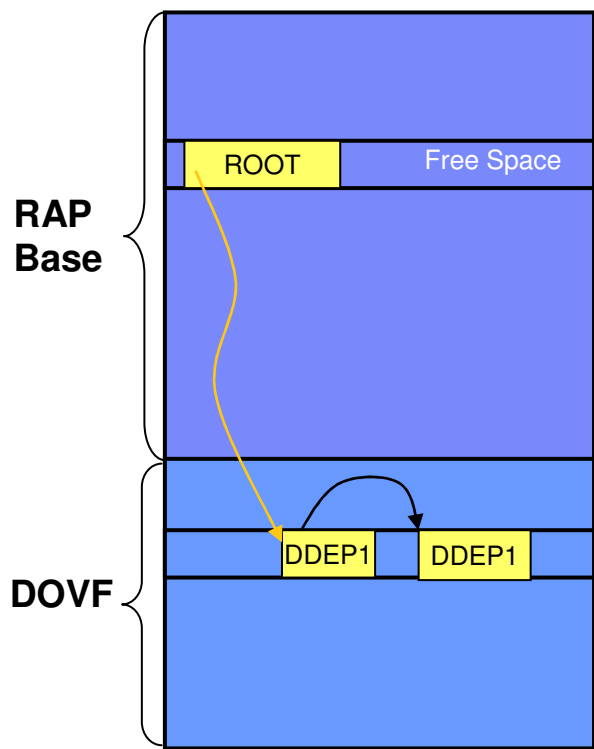
A UOW in RAA

UOW contains at least 1 RAP CI that contains free space
that is > the % that is specified, and the RAP CI also
uses a DOVF CI or an IOVF CI

RDOVFFS criteria

ROOT   DDEP1   DDEP1

DDEP2   DDEP2   DDEP2

DDEP2   Free Space

Free Space

A UOW in RAA   **IOVF**

If the free space percentage in the DOVF section in a UOW is greater than the
percentage that is specified, and the UOW also uses IOVF CIs

UOW Reorganization Threshold

- **The UOW Reorganization component reorganizes a subset of the ranked set of UOWs.**

- **The subset of UOWs is determined by the ranking order of the ranked set of UOWs.**

- **The reorganization threshold can be supplied as a number (quantity) of the ranked UOWs or as a percentage of the ranked UOWs.**

Pointer Check and Image Copy during reorganization

- **OER produces a UOW Space Statistics report showing the status of the UOW's chosen for reorganization**

- **OER can optionally also invoke OPC after the selected UOWs have been reorganized.**

- **OPC is invoked when PTRCHK=YES**

  – CHKUOW=REORGED   default

  – CHKUOW=ALL

    • Optional CIC Image Copy

Online Expert Reorganization

```
//REORG    EXEC FPUTIL,DBD=DEDBJN23,IMSID=IMS1
//STEPLIB  DD DISP=SHR,DSN=TOOLS.SHFPLMD0
//         DD DISP=SHR,DSN=IMS.SDFSRESL
//FPXIN    DD *
  REORG       AREA=DB23AR0,
              RDOVFFS=20,
              RBASEFS=20,
              REORGLIM=20,
              PTRCHK=YES

/*
```

OPC - Online Pointer Checker

- **Uses an online database as input; the DEDB area can be updated by others while OPC is running**

- **Detects pointer integrity errors in a fast and efficient manner**
  - UOW lock

- **Gets image copies (IMS IC, HPIC) during Pointer Checking**

- **Provides to collect pointer verification data, run in-depth pointer check, and produce complete analysis reports in one step, similar to the analyze function of FPA**

- **Supports one input DD**
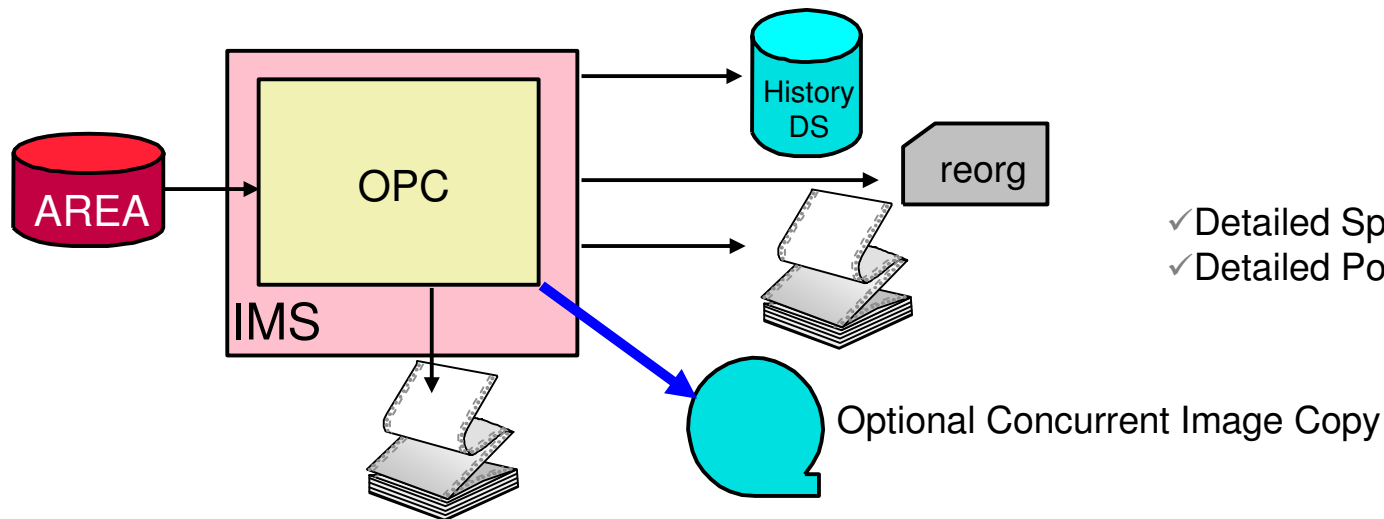
OPC Integrity verification mode

- High Speed Scan (TYPRUN=PTRSCAN)

  AREA → OPC → (report)
  IMS
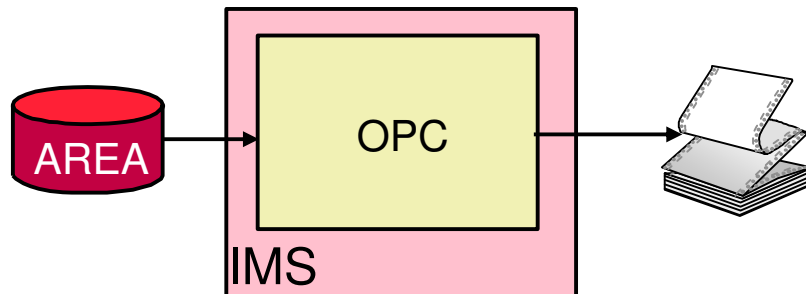
  - Reports invalid elements -
    - CIs, segments, FSEs, FSE chains, DMAC, SDEP pointers, VSAM RDF and CIDF
  - Performs pointer check-sums and reports any discrepancies
  - Prints CIs in error

- Full Analysis (TYPRUN=RPT)

  - Need not run DEDB PC program after OPC.

  AREA → OPC → History DS, reorg, (report)
  IMS

  ✓ Detailed Space Analysis Report
  ✓ Detailed Pointer Analysis Report

  Optional Concurrent Image Copy

OPC Sample JCL

```
//ANALYZE   EXEC PGM=FPUTIL,DBD=dbdname
//STEPLIB   DD DISP=SHR,DSN=HPFP.SHFPLMD0
//SYSOUT    DD SYSOUT=*
//SYSPRINT DD SYSOUT=*
//FPXIN     DD *
  ANALYZE
    AREA=areaname,
    TYPRUN=RPT,
    FULLSTEP=YES,
    SDEP=YES
  REPORT   REPORTDD=FPXRPTS
/*
//FPXRPTS DD SYSOUT=*
```
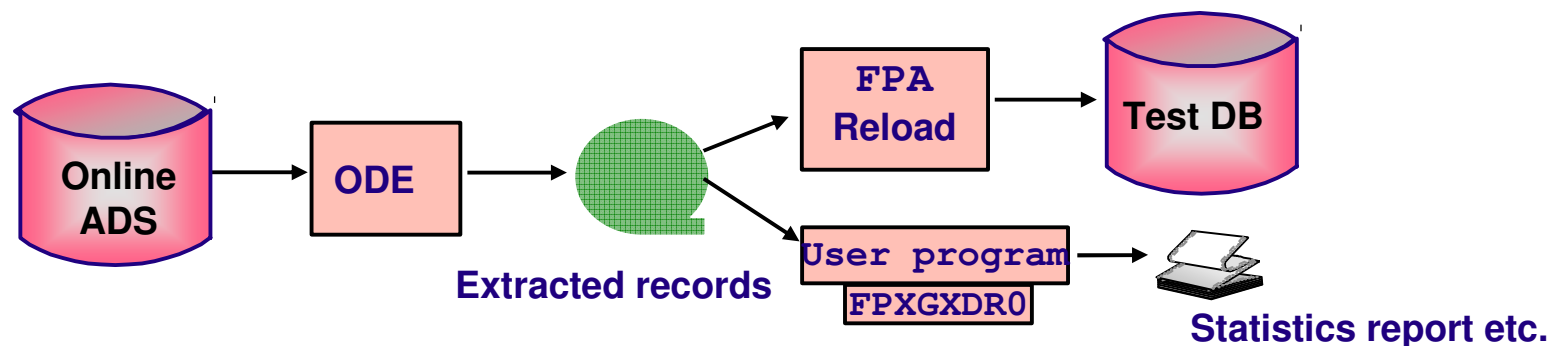
ODM - Online Dmac Print

- **Uses online multiple DEDB areas as input**

- **Reports two kinds of DMAC information**
  - DMAC that is used by the IMS control region in storage
  - DMAC of available area data sets (physical)

- **Reports Global section and Local section with offset, label, values**

- **Provides dump specified by the DMAC length**

```
//ODM       EXEC PGM=FPUTIL,DBD=dbdname
//STEPLIB  DD DISP=SHR,DSN=HPFP.SHFPLMD0
//SYSPRINT DD SYSOUT=*
//FPXIN    DD *
  DMACPRNT
    AREA=ALL or AREA=areaname or AREA=(area1,area2)
/*
```

ODE - Online Data Extract

- **Extracts segment data with various format without stopping a DEDB area**
  - Standard format (STD)
  - DBT Unload/Reload format (DBT)
  - DEDB High Performance Unload/Reload format (TFMT)
  - Trimar Unload/Reload format (UR)

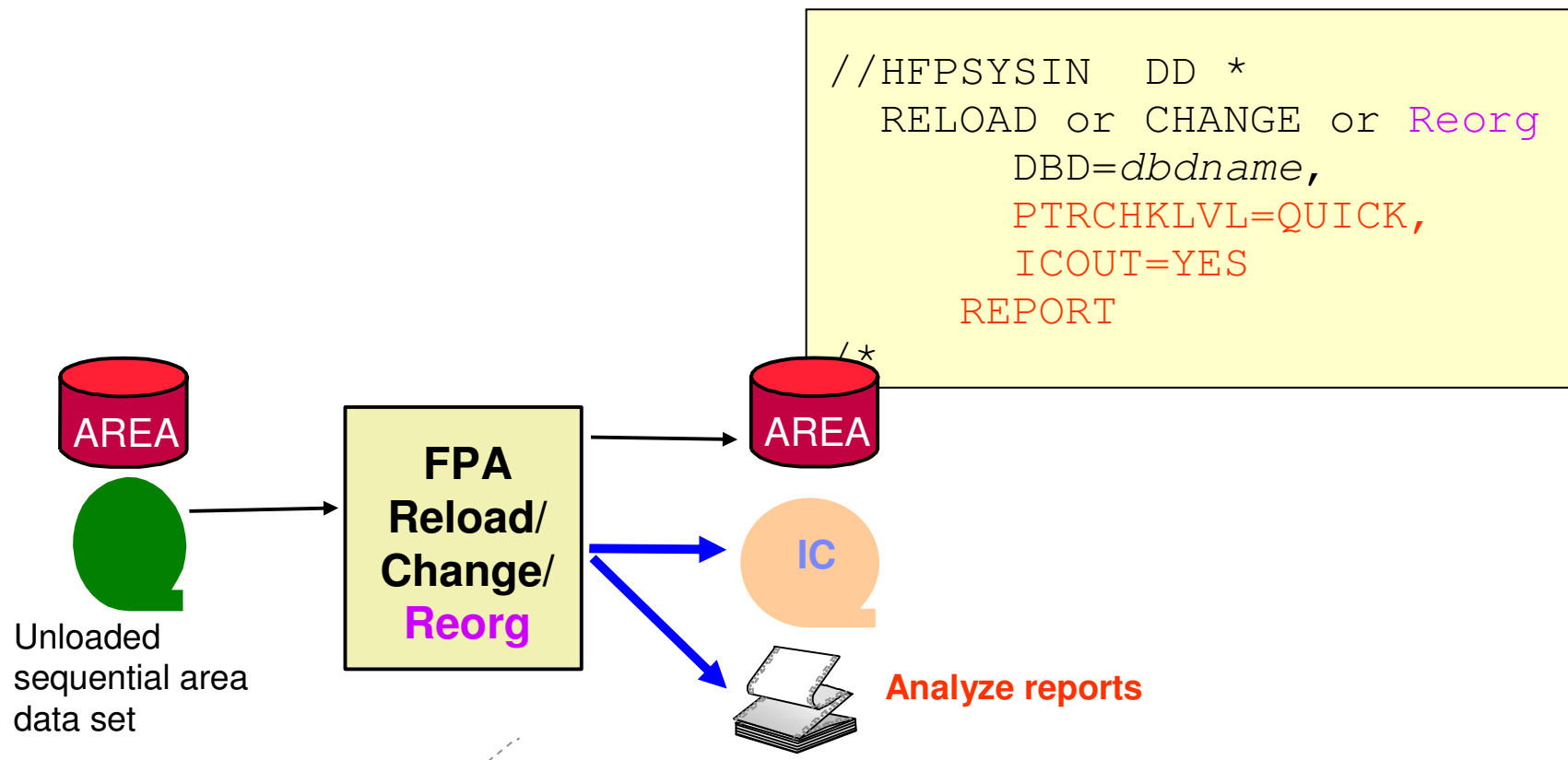- **Writes a reloadable output file for FPA Reload function**

Online ADS → **ODE** → **Extracted records** → **FPA Reload** → **Test DB**

User program **FPXGXDR0** → **Statistics report etc.**

- **UOW Locks held while pointer chains followed**
- **Internal sort**

Integrated Solution

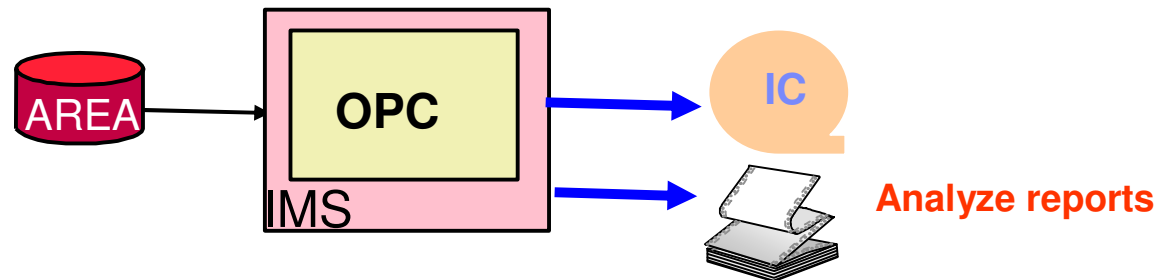# FPA Analyzing Area and Taking Image Copy Whenever Possible

- **FPA Reload/Change/Reorganize functions with Analyze and Image Copy**

```
//HFPSYSIN  DD *
  RELOAD or CHANGE or Reorg
      DBD=dbdname,
      PTRCHKLVL=QUICK,
      ICOUT=YES
      REPORT
/*
```

AREA

FPA Reload/ Change/ Reorg

AREA

IC

Unloaded sequential area data set

Analyze reports

FPO Analyzing Area and Taking Image Copy Whenever Possible

- **OPC with Concurrent Image copy**

AREA → OPC (IMS) → IC / Analyze reports

- **Online Reorganize if necessary with Analyzing and Concurrent Image copy**

AREA → OER (IMS) → AREA / IC / Analyze reports

IBM
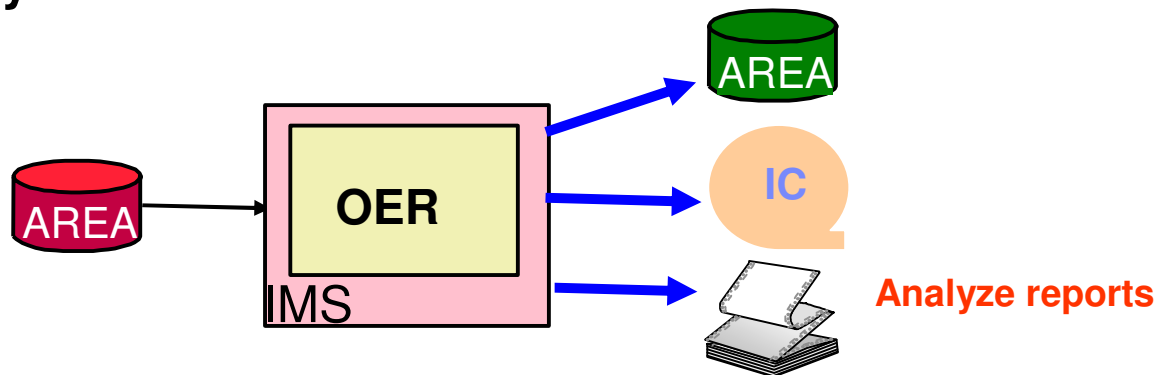
Q&A

Product Information

DB2 and IMS Tools

http://www.ibm.com/software/data/db2imstools/

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