Making database maintenance tasks simpler and easier than ever with the IBM IMS Fast Path Solution Pack

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Agenda

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- IMS Fast Path Solution Pack overview
- Make space management simpler and easier
- Make database tuning simpler and easier
- Make FP secondary index maintenance simpler and easier
- Other useful functions to make DBA tasks simpler and easier

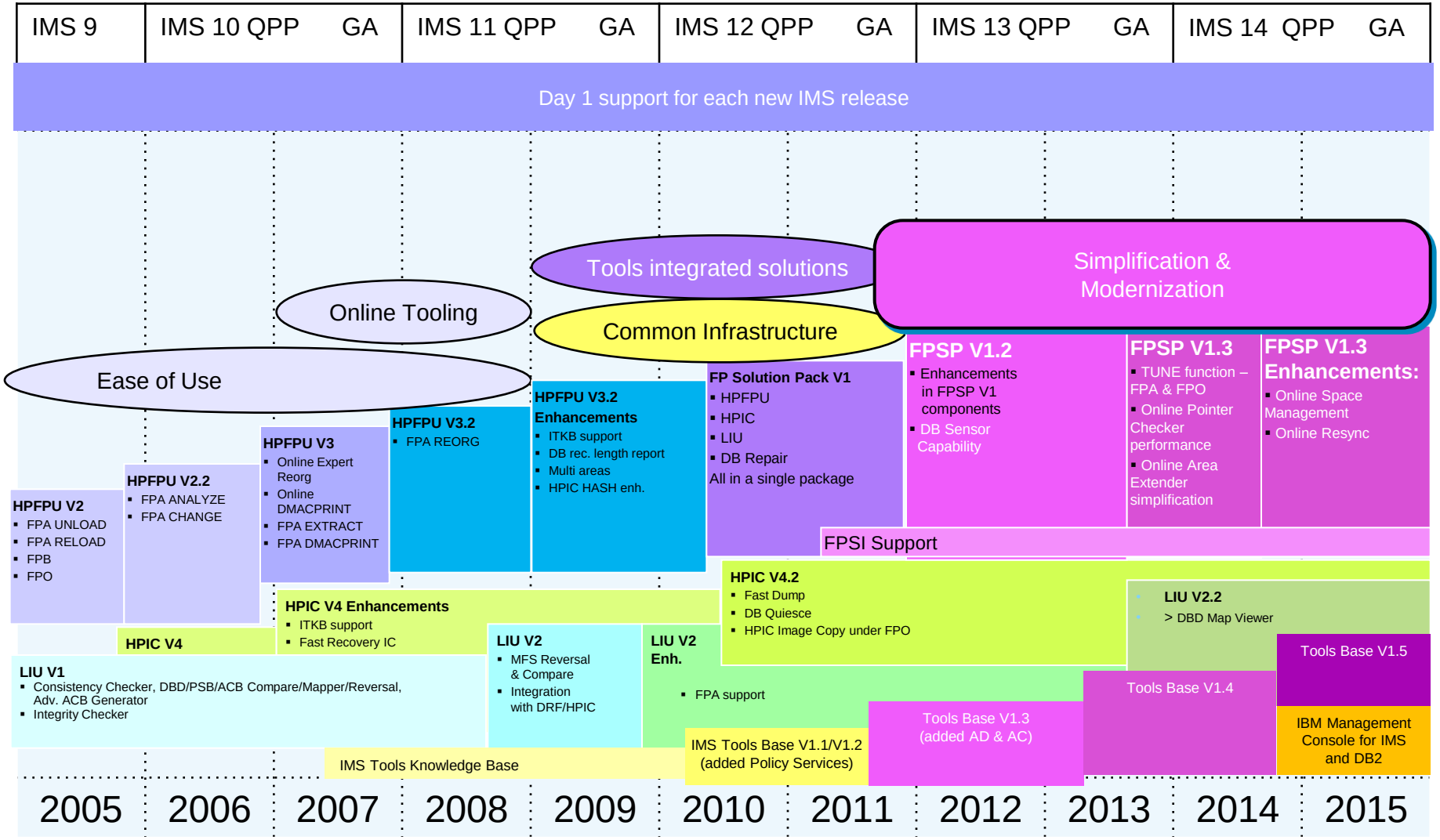
IMS Fast Path Solution Pack overview

Product overview

- **IMS Fast Path Solution Pack for z/OS (FP Solution Pack)**
  - Provides high performance batch utilities and efficient online utilities for IMS DEDB
    - Accelerating DEDB area maintenance tasks
  - Simplifies DEDB monitoring, analysis, and tuning
    - Providing statistics, symptoms, and recommendation for Management Console GUI
    - Automating some space maintenance tasks
  - Provides IMS FP Secondary Index maintenance functions

- **Latest release:**
  - Version 1.3 (GA: November 2013)

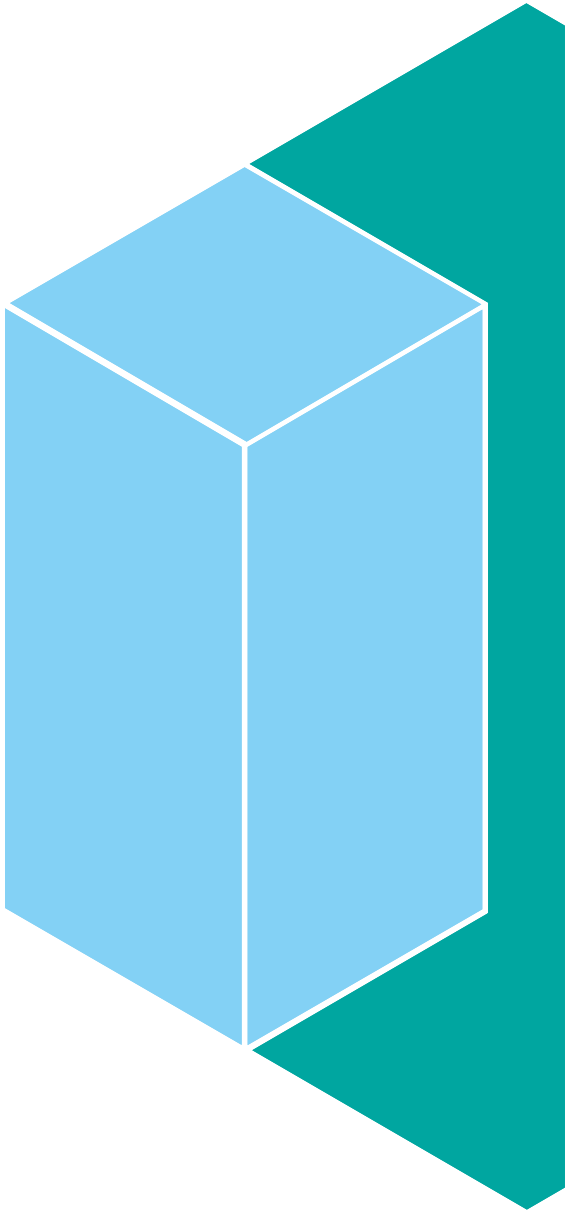
History of IMS FP Tooling



FP Solution Pack utility functions

DEDB Maintenance Task	Solution Function	Fast Path Online (FPO) utility	Online Space Management (OSM) utility	Fast Path Advanced (FPA) function	Fast Path Basic (FPB) utility
Managing space	**Unload**	Online Data Extract (ODE)		Unload	DEDB Unload
	Reload			Reload	DEDB Reload
	Shadow area reorganization	* This function is provided by IMS DEDB Alter		Change	
	In-place area reorganization	Online Expert Reorg (OER)	Combines OER, OAE, and OPC functions, and supports **Active Autonomics**	Reorganization	
	IOVF/SDEP expansion	Online Area Extender (OAE)		Reload or Change	
Analyzing space utilization	**Integrity verification and space analysis**	Online Pointer Checker (OPC)		Analyze	DEDB Pointer Checker
	Print DMAC	Online DMAC Print (ODM)		DMAC Print	
Tuning space & randomizer	**Area tuning aid**	Combination of OPC and FPA Tune		Tune	DEDB Tuning Aid
Extracting segment data	**Extract specific segments**	Online Data Extract (ODE)		Extract	* User exits for DEDB Unload or DEDB Reload
Managing Index	**DEDB Index building**			Build Index	
	DEDB Index Synchronization			Online Resync	
Misc.	**Area initialization**			Initialize	

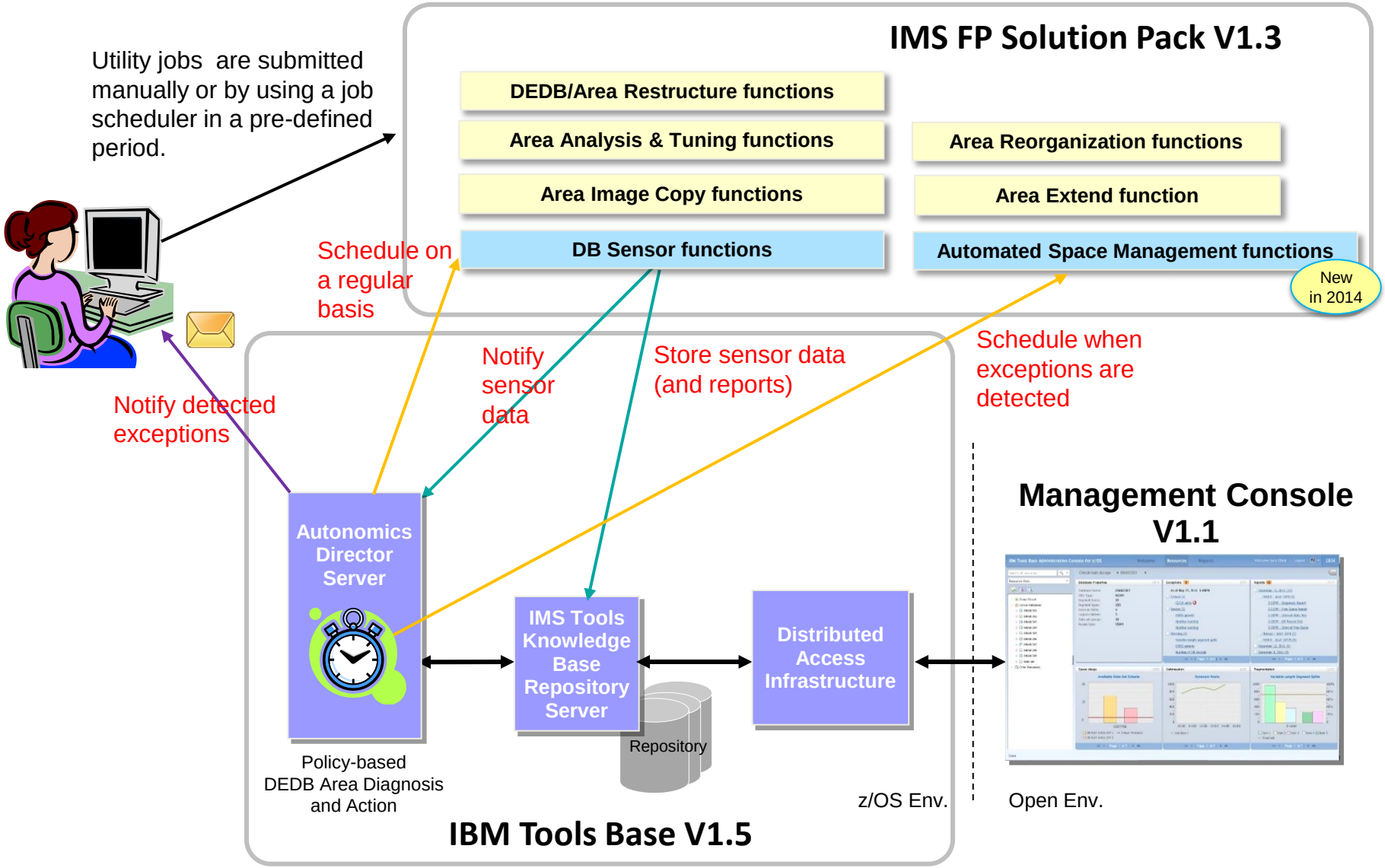
Make space management simpler and easier



Background and challenge of space management

- DEDB space utilization must be monitored on a regular basis for the following reasons:
  - To avoid application failures that might be caused by out-of-space conditions
  - To determine the optimal timing for reorganization or expansion
- DBA needs deep IMS skill and experiences for database space analysis, it takes a lot of time to check a large number of reports that IMS tools generates
- In operating environments that cannot be stopped, unload/reload cannot be used to increase free space in areas, and ineffective reorganization causes unnecessary impact upon online performance

Enhanced capabilities with IBM Tools Base



Database Sensor function

- Database Sensor collects and stores DEDB area statistics data in the Sensor Data repository of IMS Tools Knowledge Base
- The stored data can be used by Policy Services, Autonomics Director, and Management Console for database analysis and tuning purposes

- Database Sensor function (**SENSOR=YES** option) is provided by the following tools:
  - **Integrated DB Sensor**, which runs inside the following utilities
    - Fast Path Advance Tool (FPA)
    - Fast Path Online Tools (FPO)
    - IMS High Performance Image Copy (HPIC)
  - **Stand-alone DB Sensor**
    - Fast Path Stand-alone DB Sensor (FP Stand-alone DB Sensor)

- Sensor data can be printed by the following tool:
  - **Fast Path DB Sensor Printing utility**

Sensor data for DEDB area

- These categories of sensor data can be collected and stored for a DEDB area

- A complete list of the data elements supported by the DB Sensor can be found in the Reference section of the IBM Tools Base Policy Services User's Guide.

- **Area level statistics**
  - Area definition
  - Free space percentages
    - RAA Base, DOVF, IOVF, and SDEP
  - Usage of overflow (DOVF and IOVF)
  - Number of segment occurrences
  - Database record stats (optional)
  - Randomizing synonym stats (optional)
  - Physical I/O stats (optional)
  - Uow stats
- **UOW or UOW Group level statistics (optional)**
  - Free space percentages
  - Overflow usage
  - Number of segment occurrences
  - Database record stats
  - Randomizing synonym stats
  - Physical I/O stats

FP integrated DB Sensor – Sensor function running inside utilities

FPA commands that support the integrated DB Sensor

- UNLOAD
- **RELOAD**
- **CHANGE**
- **REORG**
- **ANALYZE**
- TUNE
- EXTRACT
- DMACPRT
- INDEXBLD
- INITIALIZE

A Sample JCL Stream for FPA

```
//HFP      EXEC PGM=HFPMAIN0
//STEPLIB  DD DISP=SHR,DSN=HPFP.SHFPLMD0
//         DD DISP=SHR,DSN=IMSVS.SDFSRESL
//         DD DISP=SHR,DSN=ITB.SHKTLOAD
//IMSACB   DD DISP=SHR,DSN=IMSVS.ACBLIB
//IMSDALIB DD DISP=SHR,DSN=IMSVS.MDALIB
//HFPRPTS  DD SYSOUT=*
//HFPPRINT DD SYSOUT=*
//HFPSRPT  DD SYSOUT=*
//HFPSYSIN DD *
  GLOBAL  DBRC=YES,
          ITKBSRVR=FPQSRV01,
          ADXCFGRP=ADSRV01
  ANALYZE DBD=DEDBJN22,
          IAREA=(DB22AR0),
          PTRCHKLVL=FULL,
          SENSOR=YES,
          SENSOR_DBREC=YES,
          SENSOR_UOW=YES,
          SENSOR_UOW_REPORT=YES
  REPORT
/*
```

FPO utilities (commands) that support the integrated DB Sensor

- **OPC (ANALYZE)**
- ODE
- OAE
- **OER (REORG with PTRCHK=YES)**
- ODM

A Sample JCL Stream for FPO

```
//HFP     EXEC FPUTIL,DBD=DEDBJN23,IMSID=IMS1
//FPU.STEPLIB DD DISP=SHR,DSN=HPFP.SHFPLMD0
//            DD DISP=SHR,DSN=IMSVS.SDFSRESL
//            DD DISP=SHR,DSN=ITB.SHKTLOAD
//            DD DISP=SHR,DSN=IMSVS.MDALIB
//FPXMFILE    DD SYSOUT=*
//FPXRPTS     DD SYSOUT=*
//FPXSPRT     DD SYSOUT=*
//FPXIN DD *
  GLOBAL  DBRC=YES,
          ITKBSRVR=FPQSVR01,
          ADXCFGRP=ADSVR01
  ANALYZE AREA=ALL,
          TYPRUN=RPT,
          FULLSTEP=YES,
          SENSOR=YES,
          SENSOR_DBREC=YES,
          SENSOR_UOW=YES,
          SENSOR_UOW_REPORT=YES
/*
```

- The ADXCFGRP option is needed so that Tools Base Autonomics Director can be notified of a new sensor data for evaluation.

FP Stand-alone DB Sensor

- Can processes both offline and online DEDB areas
- Can processes multiple areas of a DEDB in a job

- FP Stand-alone DB Sensor does not verify segment pointer integrity
- If you want to collect and store sensor data only when database integrity is verified, use a FPA or FPO, or HPIC job with SENSOR=YES option specified

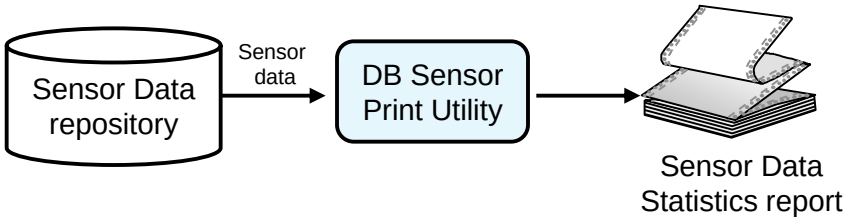
- Considerations on online area processing
  - If FP Stand-alone DB Sensor runs against an online area, the data element values might be collected while the area is being updated
  - For sensor data integrity, use either of the following methods:
    - Quiesce the area or take the area offline before running the Sensor job
    - Use OPC's DB Sensor function

A Sample JCL Stream

```
//HFP       EXEC PGM=HFPSENSR
//STEPLIB   DD DISP=SHR,DSN=HPFP.SHFPLMD0
//          DD DISP=SHR,DSN=IMSVS.SDFSRESL
//          DD DISP=SHR,DSN=IMSVS.PGMLIB
//          DD DISP=SHR,DSN=ITB.SHKTLOAD
//IMSACB    DD DISP=SHR,DSN=IMSVS.ACBLIB
//IMSDALIB  DD DISP=SHR,DSN=IMSVS.MDALIB1
//HFPSPRT   DD SYSOUT=*
//HFPPRINT  DD SYSOUT=*
//HFPSYSIN  DD *
  GLOBAL    DBRC=YES,
            ITKBSRVR=FPQSRV01,
            ADXCFGRP=ADSRV01
  DATABASE  DBD=DEDBJN23,
            IAREA=*ALL
/*
```

FP DB Sensor Printing Utility

- DB Sensor Printing utility
  - Reads the latest sensor data for the specified DEDB area from the IMS Tools KB Sensor Data repository, and print a Sensor Data Statistics report in the HFPSPRT data set
  - Can print the sensor data that is related to UOW in the Sensor Data Statistics report when the UOW_REPORT=YES is specified



- Current restrictions
  - Only one area can be processed in a job step
  - Only the latest sensor data for an area can be printed

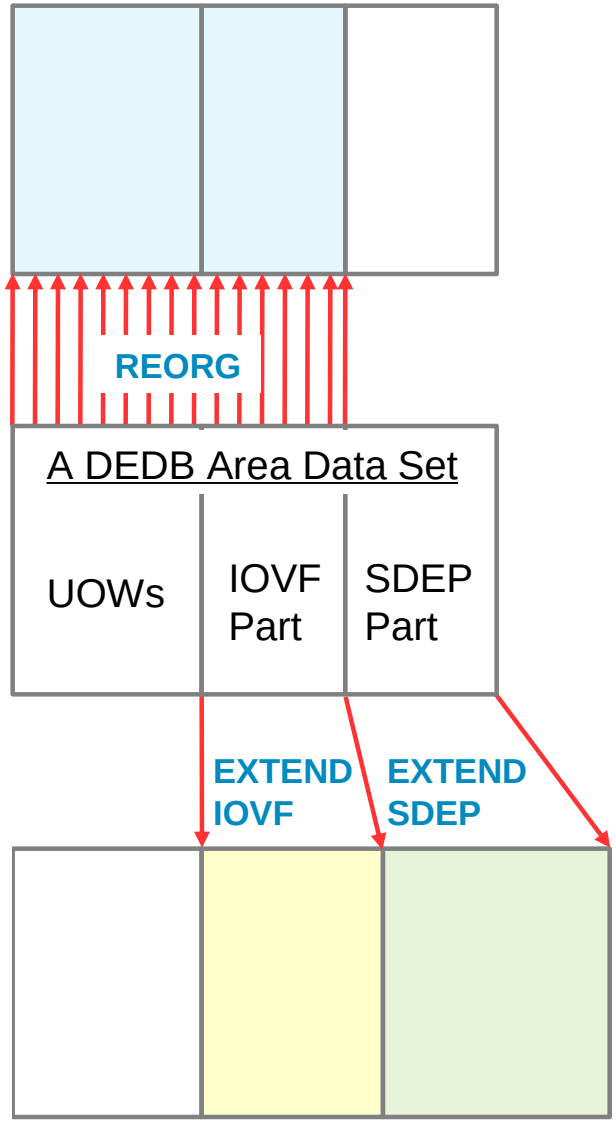
A Sample JCL Stream

```
//HFPSPRNT EXEC PGM=HFPSPRNT
//STEPLIB  DD DISP=SHR,DSN=HPFP.SHFPLMD0
//         DD DISP=SHR,DSN=ITB.SHKTLOAD
//RECON1 DD DISP=SHR,DSN=HPFP.RECON1
//HFPSPRT DD SYSOUT=*
//HFPSOUT DD SYSOUT=*
//HFPSPRIN DD *
  GLOBAL   ITKBSRVR=FPQSVR01
  DATABASE DBD=DEDBJN23,
           AREA=DB23AR1
/*
```

Requirement: Area space management automation

- Provides a new Policy Services rules and policy for Fast Path DEDB to enable "active" actions for the following recommendations for a DEDB area:
  - REORG is needed
  - EXTEND is needed
- Uses the policy to determine when a DEDB area needs online reorganization or online area extender to be run and actually initiate the run

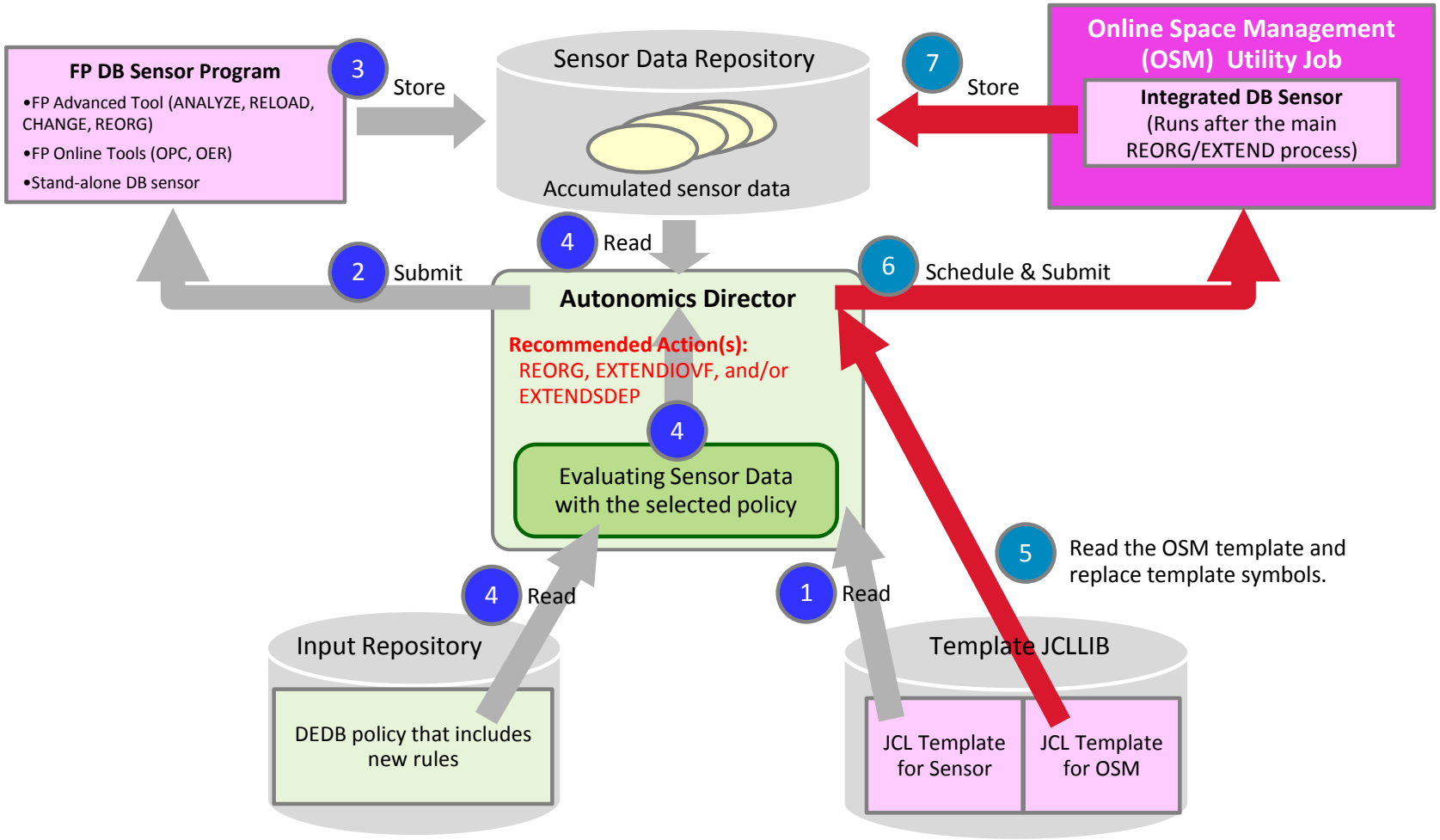
Free spaces and segments in UOWs and IOVF are reorganized and relocated within the same data set.



A new area data set is allocated in a new space and segments are copied to the new ADS with the size of IOVF part and/or SDEP part extended to avoid space run-out in these portions of the area.

Our solution: FP Active Autonomics

- An area is reorganized or expanded only when Autonomics Director (AD) detects exceptions by automated sensor data evaluation
- (Possibly) multiple area space management actions can be taken in one OSM job step automatically based on the exceptions and associated action recommendations by AD



Online Space Management utility (OSM)

- OSM integrates the following FPO functions for a DEDB area into one job step:
  - **Online free space reorganization**
    - Reorganizes a set of UOWs in the area based on the ranked set of UOWs
  - **Online area expansion**
    - Extends IOVF portion, SDEP portion, or both of the area
  - **Online pointer checking and sensor data collection**
    - Verifies the DEDB integrity, generating Area Analysis reports, and collect and store sensor data for the area after the area is reorganized or expanded

- These functions are provided internally by the following utility functions:
  - Reorganization – Online Expert Reorganization (OER)
  - Area expansion – Online Area Extender (OAE)
  - Pointer checking and sensor data collection – Online Pointer Checker (OPC)

Policy Services rules used to evaluate sensor data

- Sensor data evaluation for an area is done by using IBM Tools Base Policy Services
- Policy Services runs automatically non-peak hours, which is defined in AD, and based on an AD Monitor List definition for the area
- The Monitor List definition includes the evaluation policy to be used and the timing of evaluation
  - The following sensor data evaluation rules can be used:
    - **IBM.DEDB_RFS.11** and **IBM.DEDB_RFS.21**

      … used to detect a need for free space reorganization
    - **IBM.DEDB_FS.31**

      … used to detect a need for IOVF expansion
    - **IBM.DEDB_FS.81**

      … used to detect a need for SDEP expansion
- A policy evaluation can detect exceptional states of the area space usage and can recommend REORG, EXTENDIOVF, or EXTENDSDEP action to be taken by OSM for the area
- AD can be configured to schedule an OSM job in a database maintenance window when a REORG or EXTENDxxxx action is recommended

OSM skeleton JCL for Autonomics Director

- A sample JCL stream (HFPOSM0J) is provided in the SHFPSAMP data set
- It needs to be customized and be stored in the JCLLIB library to be used by Autonomics Director
- Symbolic variables $DBNAME$, $ARNAME$, $IMSSYS$, and $ACTION$ will be replaced by Autonomics Director at run time with the database name, area name, IMS ID, and a list of recommended actions

```
//HFPOSM0J JOB
//OSM      EXEC PGM=HFPMAIN0
//STEPLIB  DD DISP=SHR,DSN=FPS.SHFPLMD0
//         DD DISP=SHR,DSN=IMS.SDFSRESL
//         DD DISP=SHR,DSN=ITB.SHKTLOAD
//IMSDALIB DD DISP=SHR,DSN=IMS.MDALIB
//PROCLIB  DD DISP=SHR,DSN=IMS.PROCLIB
//SYSPRINT DD SYSOUT=*
//SYSOUT   DD SYSOUT=*
//HFPSYSIN DD *
  GLOBAL
       ADXCFGRP=ADSERVER,
       ITKBSRVR=ITKBSRVR,
       IMSID=$IMSSYS$
  MANAGE
       DBD=$DBNAME$,
       IAREA=$ARNAME$,
       ACTION=$ACTION$,
       REORGATIOVFEXT=NO,
       SCANDELT=YES
  SETREORGPARM
       REORGLIM=25%
  SETEXTENDPARM
       ACBLIB=IMSVS.ACBLIB,
       DATACLAS=DATA,
       MGMTCLAS=MGMT,
       STORCLAS=STOR,
       DDNAME=$ARNAME$T,
       DSNAME=TEMP.OAE.$ARNAME$.ADS,
       IOVF_UOW=30%,
       SDEP_CI=300
/*
```

An example scenario of FP Active Autonomics (1/3)

1. Everyday after 8:00 p.m., Autonomics Director initiates an OPC utility job for each of the 5 areas. The OPC utility stores the sensor data and notifies Autonomics Director.
2. Autonomics Director evaluates sensor data that is collected from each area, and detected the following conditions:

```
  Menu   View   Help
                    Autonomics Director Monitor List Entries        Row 1 to 5 of 5

Locale  . . :  RECON6AC          Group type  :  DATABASE
Status  . :

Actions:   S - View the database attributes
           V - View recommendations
           X - Select a database, partition, area for schedul
           H - View evaluation history

   Action
Act Needed  Sev  DBDName   PartName  Eval-Date    Eval-Time   Snsr-Date    Snsr-Time
__  N            DEDB0006  DBAR005   Jun 05,'14   14:33:52    Jun 05,'14   14:33:52
__  N            DEDB0006  DBAR004   Jun 05,'14   14:34:01    Jun 05,'14   14:34:01
__  N            DEDB0006  DBAR003   Jun 05,'14   14:34:11    Jun 05,'14   14:34:10
__  Y        C   DEDB0006  DBAR002   Jun 05,'14   14:33:22    Jun 05,'14   14:33:22
__  Y        C   DEDB0006  DBAR001   Jun 05,'14   14:32:34    Jun 05,'14   14:32:34
*** ************************** Bottom of data ***************************** ****
Command ===>
 F3=Exit    F5=RFIND    F7=Up      F8=Down    F12=Cancel
                        英数 半角
```

DBAR003, DBAR004 and DBAR005 have no exception

DBAR001 and DBAR002 need action

```
Reorganization needed  . . . . . . . : Y
SDEP extension needed  . . . . . . . : N
IOVF extension needed  . . . . . . . : N
Severity . . . . . . . . . . . . . . : C
```

Action REORG is recommended for DBAR002

Actions REORG and EXTENDIOVF are recommended for DBAR001

```
Reorganization needed  . . . . . . . : Y
SDEP extension needed  . . . . . . . : N
IOVF extension needed  . . . . . . . : Y
Severity . . . . . . . . . . . . . . : C
```

An example scenario of FP Active Autonomics (2/3)

3. On Sunday after 3:00 a.m., during the defined database maintenance window, Autonomics Director submits the OSM utility job for each area to which some actions were recommended by the last policy evaluation.

A case where all OSM jobs succeeded

```
 Menu  View  Help
 ------------------------------------------------------------------------------
                      Autonomics Director Reorg Job Status        Row 1 to 2 of 2

Locale  . . :  RECON6AC        Group type  :  USERGRP
Group name  . . . . . :   FP6AC
Group description . . :   FOR TEST
Reorg-Date  . . . . . :   Jun 05,'14       Reorg-Time  . . . . . :   15:33:43


Row Actions:   S - View the job details

Act   Job type  Job name  Job num    Job status            End status    Completed
__    REORG     DBAR001R  JOB01024   Ended                 RC00          Successful
__    REORG     DBAR002R  JOB01025   Ended                 RC00          Successful
******************************** Bottom of data ********************************
```

DBAR001 and DBAR002 are expanded or reorganized successfully

A case where an OSM job failed

```
Row Actions:   S - View the job details

Act   Job type  Job name  Job num    Job status            End status    Completed
__    REORG     DBAR001R  JOB01001   Ended                 RC08(OAE)     Failed
__    REORG     DBAR002R  JOB01002   Ended                 RC00          Successful
******************************** Bottom of data ********************************
```

The OSM job for DBAR001 failed in OAE process, and the OSM job for DBAR002 succeeded

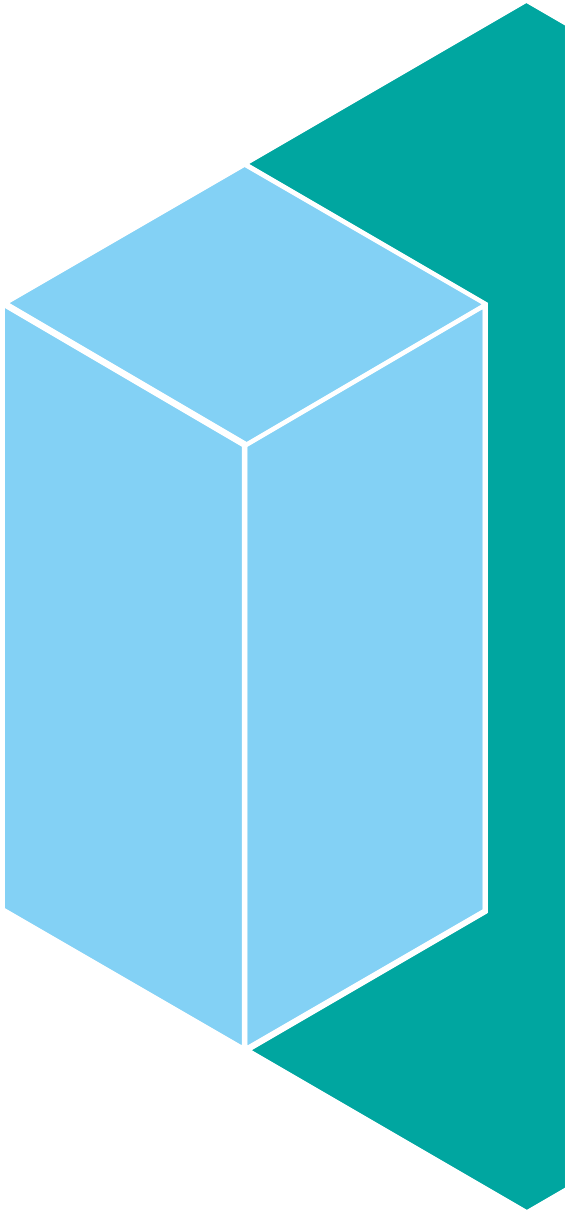
An example scenario of FP Active Autonomics (3/3)

4. Autonomics Director evaluates the sensor data that was notified by the OSM utility job. As result of policy evaluation, Autonomics Director did not detect exceptional state in the two reorganized or expanded areas. Autonomics Director recommends no action for those areas.

The exceptional states of DBAR001 and DBAR002 have been resolved after OSM jobs completed

```
 Menu   View   Help
                    Autonomics Director Monitor List Entries        Row 1 to 5 of 5

Locale . . :  RECON6AC          Group type  :  DATABASE
Areas . . :

Actions:   S - View the database attributes
           V - View recommendations
           X - Select a database, partition, area for scheduling on demand
           H - View evaluation history

   Action
   Needed  Sev  DBDName   PartName  Eval-Date    Eval-Time   Snsr-Date    Snsr-Time
__ N            DEDB0006  DBAR005   Jun 05,'14   15:28:45    Jun 05,'14   15:28:44
__ N            DEDB0006  DBAR004   Jun 05,'14   15:28:55    Jun 05,'14   15:28:55
__ N            DEDB0006  DBAR003   Jun 05,'14   15:29:03    Jun 05,'14   15:29:03
__ N            DEDB0006  DBAR002   Jun 05,'14   15:33:42    Jun 05,'14   15:33:42
__ N            DEDB0006  DBAR001   Jun 05,'14   15:33:42    Jun 05,'14   15:33:42
******************************** Bottom of data ********************************

Command ===>                                                   Scroll ===>  PAGE
 F1=Help    F3=Exit    F5=RFIND   F7=Up      F8=Down    F12=Cancel
                                                                        22/015
                                 英数 半角
ﾎﾟｰﾄ 1023 を使用して ﾘﾓｰﾄ･ｻｰﾊﾞｰ/ﾎｽﾄ ysivm7.toyosu.japan.ibm.com に接続しました
```

Make database tuning simpler and easier



Background and challenge of database tuning

- When an exceptional state of an area is detected by space monitoring
  - Tuning these areas to obtain the optimal database definition parameters, then reorganize or restructure them based on the tuning results, might resolve the exception
- Tuning a database often involves significant and time-consuming database administration tasks
  - DBDLIB and ACBLIB need to be generated for each iterative if DBD structure change is required
  - Unloading and reloading the area to determine if the changes are effective is time-consuming

FPA TUNE function

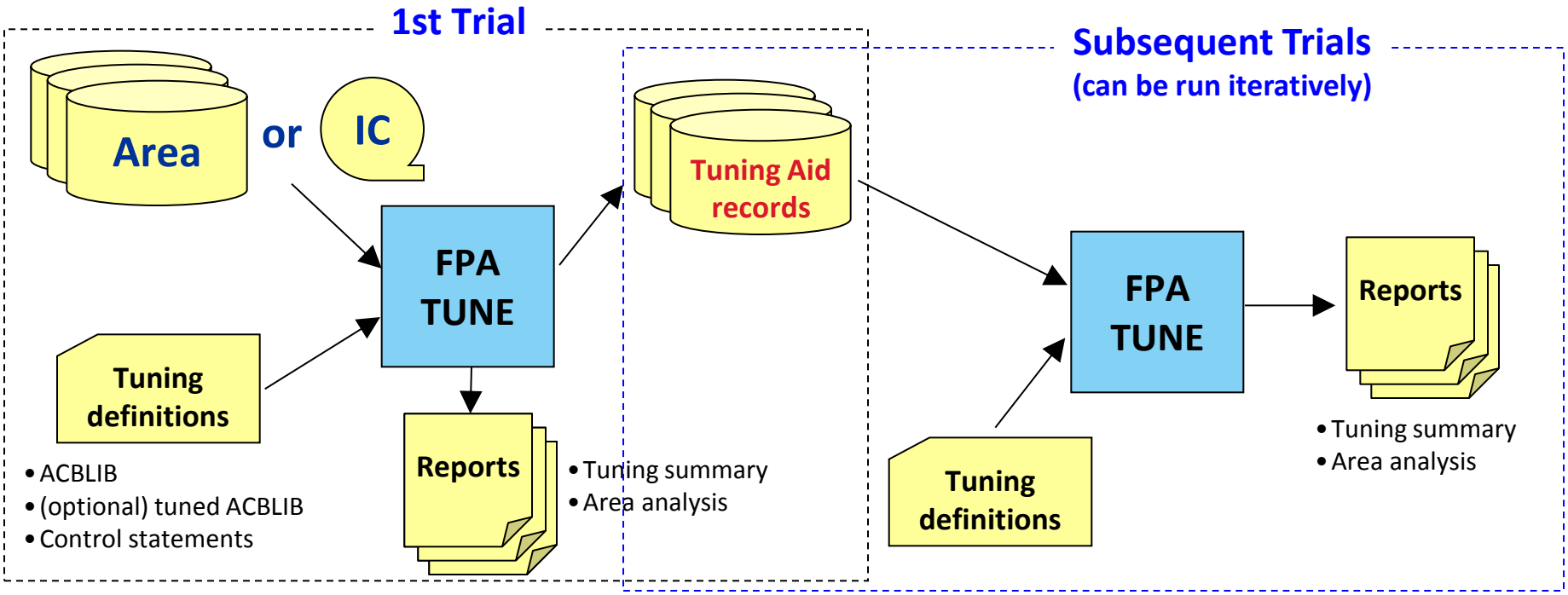
- Simulate changes of the DBD parameters and the randomizing routine
  - Without loading the segments
  - Helps user to select the physical database attributes that satisfy the performance and space utilization requirements
  - Allows user to specify new DBD parameters and new randomizing routine with keywords, instead of new ACBLIB
    - Randomizing module
    - UOW parameter values
    - ROOT parameter values
    - Number of database areas
    - CI sizes
  - Tunes multiple areas in parallel
  - Provides a set of complete reports to verify effects of changes

A sample JCL stream for FPA TUNE

```
//FPATUNE EXEC PGM=HFPMAIN0
//STEPLIB DD DISP=SHR,DSN=HFP.SHFPLMD0
//        DD DISP=SHR,DSN=IMSVS.SDFSRESL
//IMSACB   DD DISP=SHR,DSN=user.ACBLIB
//IMSDALIB DD DISP=SHR,DSN=user.MDALIB
//HFPSYSIN DD *
  GLOBAL DBRC=NO
  TUNE
    DBD=DEDBJN30,
    IAREA=DB30AR0,
    TARDSNMASK='HPFP.DB30AR0.TAR',
    AREASCAN=YES
  SIMULATE
    OAREA=DB30AR0
  AREADEF
    OAREA=DB30AR0,
    UOW=(28,8)
  THRESHOLD
    DOVFFS_PCT=30,
    IOVFFS_PCT=50
/*
```

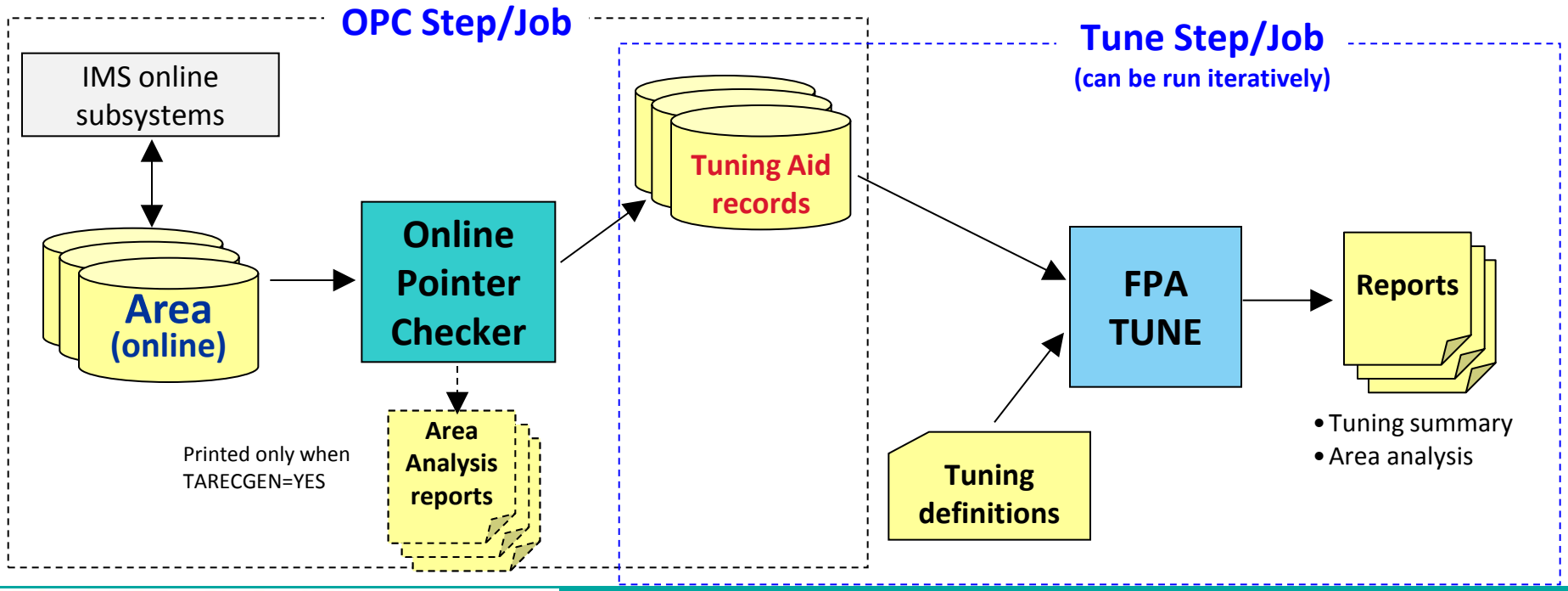
FPA TUNE with offline areas or image copies

- The Tune function scans the database and simulates the tuned areas using input area and tuning definitions
- The Tune function generates reports of the tuning summary and area analysis for current areas and simulated areas.
- The Tune function also generates **Tuning Aid records (TARs)**, that enable to run the Tune function iteratively without scanning the database (AREASCAN=NO).



FPA TUNE using online areas as input

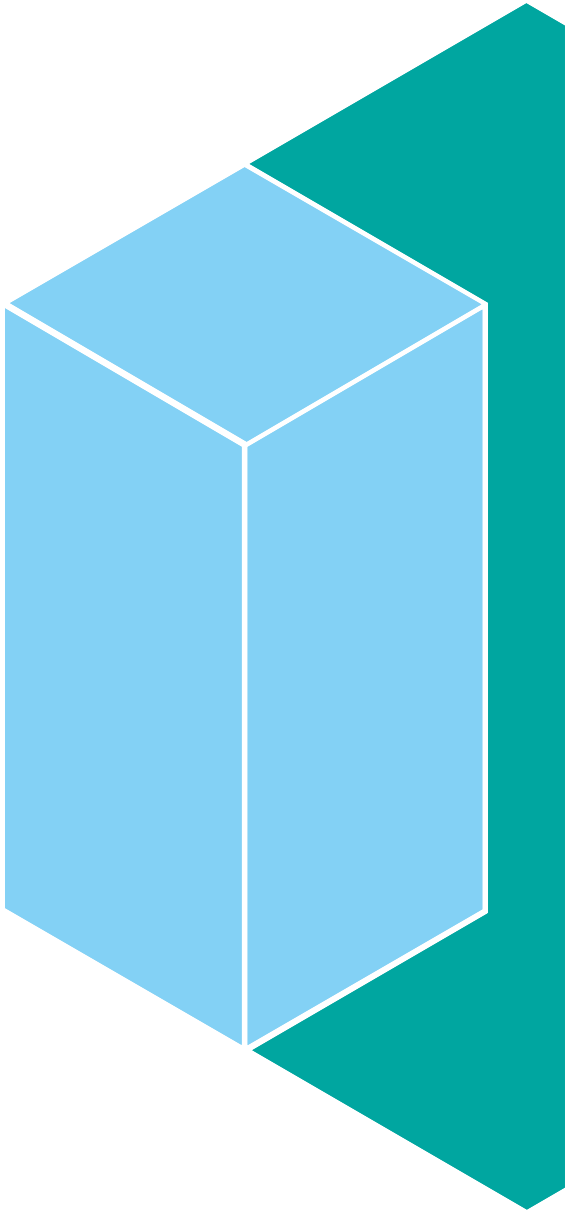
- By using OPC, you can simulate DEDB tuning without making areas offline
- OPC with TARECGEN=YES or TARECGEN=ONLY can be used to scan the online areas and generates the Tuning Aid records (TARs)
- Use TARECGEN=YES if you want to generate the complete analysis reports in the OPC job
- Use TARECGEN=ONLY to suppresses generating the complete analysis reports in the OPC job, which is recommended if you want to reduce CPU time and shorten the elapsed time of the OPC job
  - The FPA TUNE function in another job (or in another jobstep) can simulate tunings and generate reports with multiple different DBD parameters using the TARECs



Area Tuning Summary report

```
IMS HPFP UTILITIES - FPA TUNE                    "Area Tuning Summary Report"                    PAGE:       1
5655-W14 V1R3                                                                              2013-09-13 16:22:48

DBD NAME: DEDBJN30
SIMULATION MODE: RESTRUCTURE (AREADEF subcommands are specified)
CURRENT RESOURCES:
 - ACBLIB DDNAME: IMSACB
 - RANDMIZER    : DBFHDC44
SIMULATED RESOURCES:
 - ACBLIB DSNAME: IMS.ACBLIB
 - RANDMIZER    : DBFHDC44

Threshold Exceptions:

    Exceptions from current areas
    ------------------------------------------------------------------------------------------------------------
    Area     Threshold        Description of Threshold Exception
    -------- ---------------  ---------------------------------------------------------------------------------
    DB30AR0  DOVFFS_PCT       The percentage of free space in DOVF fell below the threshold.
             IOVFFS_PCT       The percentage of free space in IOVF fell below the threshold.
    ------------------------------------------------------------------------------------------------------------

    Exceptions from simulated areas
    ------------------------------------------------------------------------------------------------------------
    Area     Threshold        Description of Threshold Exception
    -------- ---------------  ---------------------------------------------------------------------------------
                              *** No exception was detected ***
    ------------------------------------------------------------------------------------------------------------

Area Statistics:

  *: Shows the point of threshold exception.

  AREA NAME: DB30AR0
  ---------------------------------------------------------------------------------------------
  Keyword                   Threshold Value    Current Value   Simulated Value          Difference
  ------------------------ ---------------- ----------------  ----------------  ------------------
  DOVFFS_PCT                            30%              26%*              57%                 +31
  IOVFFS_PCT                            50%              47%*              98%                 +51

Database Definition and Database Record Distribution:

  Upper row for each area shows the definition and number of database records of current areas
  Lower row for each area shows the definition and number of database records of simulated areas
  * shows the difference

                                                                   TOTAL CI'S                      SDEP START
    AREA     AREA  CI-SIZE  UOW=           ROOT=          ---------------------------------------  ------------------  NUMBER OF
    NAME      NO.                                           BASE      DOVF      IOVF      TOTAL      BLOCK#  RBA(HEX)  DB RECORDS
  --------  -----  -------  -------------  -------------  --------- --------- --------- ---------  --------- --------  -----------
  DB30AR0       1    2,048         (24,4)     (6500,500)    120,000    24,000    11,900   155,900          -        -      109,900
  DB30AR0       1    2,048         (28,8)*    (6500,500)    120,000    48,000    13,883   181,883          -        -      109,900
  --------  -----  -------  -------------  -------------  --------- --------- --------- ---------  --------- --------  -----------
```

Make FP secondary index maintenance simpler and easier



Solutions provided by FP Solution Pack

- FP Advanced (FPA) tool provides the capability of
  1. Building the secondary indexes (**offline Build Index function**)
  2. Synchronizing out-of-sync secondary index databases with their primary DEDB database (**online Resync function**)
  3. Verifying integrity of index pointer segments in secondary indexes (the **INDEXDBD** option of the ANALYZE function)
  4. Supporting the **IB(BLD_SECONDARY(…))** capability of DRF for the recovery of indexed DEDB areas
     - FP secondary indexes can be rebuilt during DEDB area recovery

Customer's Business Benefits

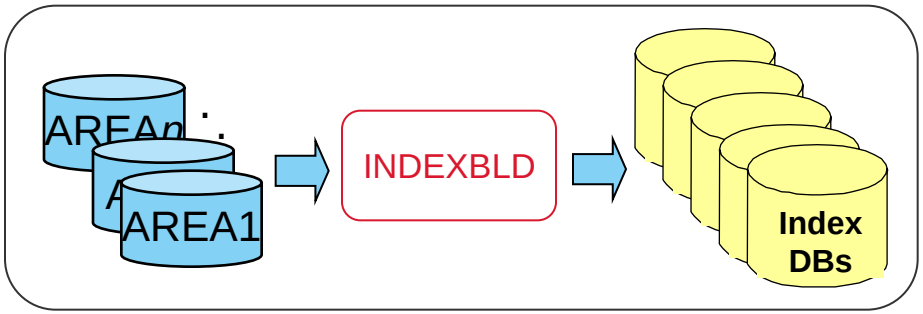
- Improved productivity by high performance index building/rebuilding
- Protection from loss of business caused by corrupted or inconsistent indexes
- Faster recovery from a failure in an indexed DEDB

Offline Build Index function

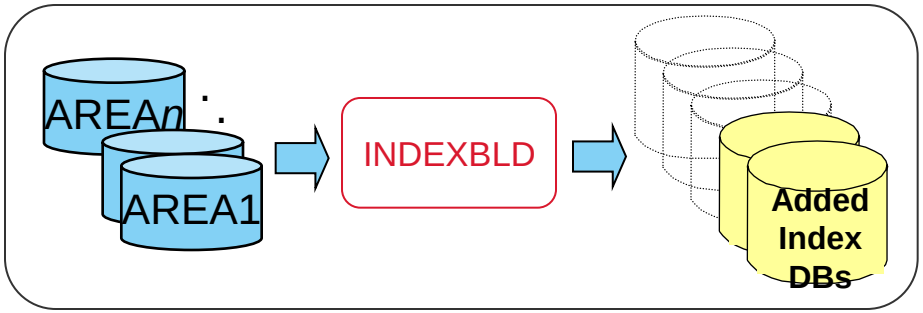
- Provides a keyword BUILDMODE to specify a run mode of the Build Index function
  - SCANLOAD
  - SCAN
  - LOAD
- Builds all secondary indexes for a DEDB when the secondary indexes are defined against the existing DEDB
- Builds only the added or broken secondary indexes
  - Builds secondary index databases faster than initially loading data to a DEDB
- Stores pointer segments that have duplicate keys in data sets

```
//HFPSYSIN DD *
  GLOBAL DBRC=YES
  INDEXBLD DBD=DEDBJN22,ITASKCTL=4,
  IAREA=[ALL|(area1,area2,...)],
  INDEXDBD=[ALL|(indexdbd1,indexdbd2,…)]
/*
```

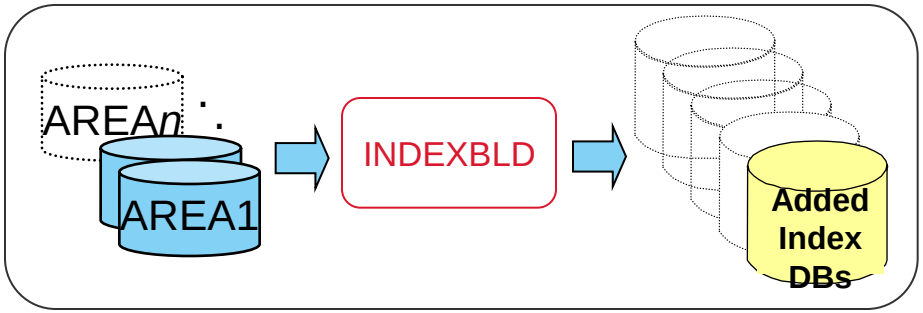
Build all indexes for a DEDB



Build selected indexes of a DEDB



Build indexes for specific areas



Three phases of Build Index process

Phase 1: Area Scan processing

1-a. Scans the offline DEDB AREAs and generates pointer segments in parallel

1-b. Writes Build pointer segment records into Build Pointer Segment record date sets in parallel

Phase 2: SORT processing

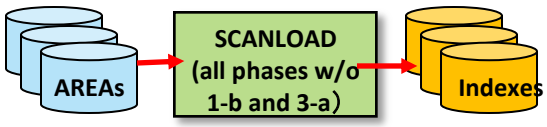
2-a. Sorts pointer segments generated from the offline DEDB AREAs in parallel

Phase 3: Load processing

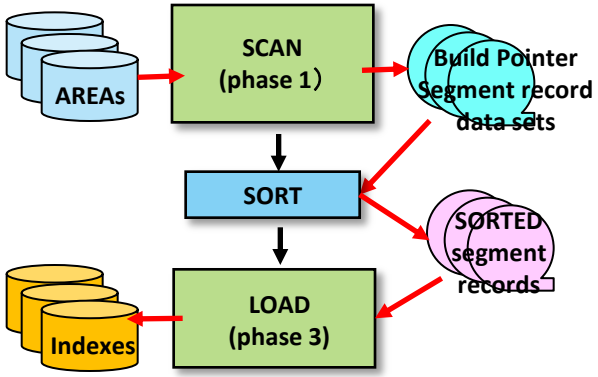
3-a. Reads pointer segments from Build Pointer Segment record date sets in parallel

3-b. Builds the indexes in parallel

scan load method (one job)



Two-step method (three jobs)



Build Index function JCL examples

SCAN mode

```
//HFPSYSIN DD *
  GLOBAL DBRC=YES
  INDEXBLD DBD=DEDBJN21,
    IAREA=(1-5),
    INDEXDBD=ALL,
    IDXPROC=BUILD,
    BUILDMODE=SCAN
  BLDMFILECTL
    DSNAME='HFP.BUILD.SCAN1.&INDEX',
    SPACE=(CYL,10,10),
    UNIT=SYSDA
/*
```

External Sort & Merge

LOAD mode

```
//HFPSYSIN DD *
  GLOBAL DBRC=YES
  INDEXBLD DBD=DEDBJN21,
    INDEXDBD=INDEX1,
    IDXPROC=BUILD,
    BUILDMODE=LOAD,
    BUILDDSNMASK='HFP.BUILD.&INDEX.SORT',
    SORT=NO
/*
```

SCANLOAD mode

```
//HFPSYSIN DD *
  GLOBAL DBRC=YES
  INDEXBLD DBD=DEDBJN21,
    IAREA=ALL,
    INDEXDBD=ALL,
    IDXPROC=BUILD,
    RESYNCMODE=SCANLOAD
/*
```

Secondary Index Processing report

- Provides the following information:
  - The number of index pointer segments that were loaded into each secondary index, or the number of build pointer segment records for BUILDMODE=SCAN
  - The Build Pointer Segment record data sets that were created or used
  - Sort control statement cards for each Build Pointer Segment record data set

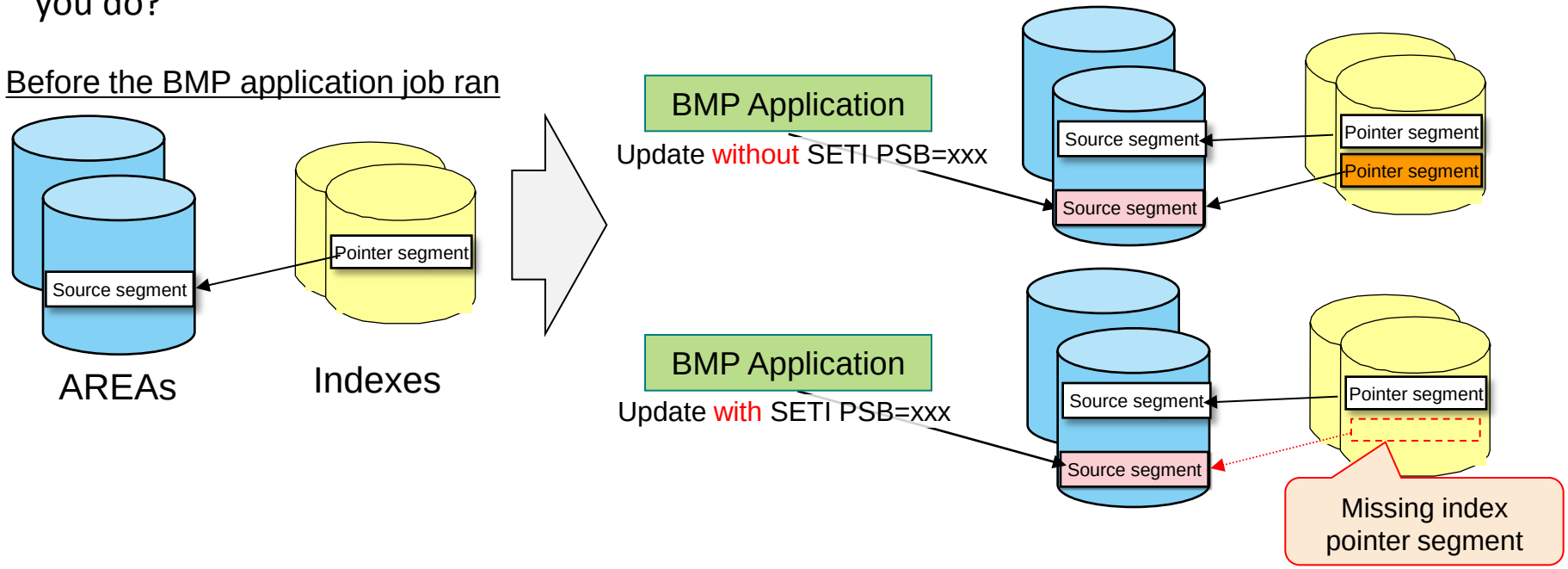
```
IMS HPFP UTILITIES - FPA INDEXBLD                    "Secondary Index Processing Report"                    PAGE:       1
5655-W14 V1R3                                                                                       2015-02-13 23:04:09
  - PRIMARY DEDB NAME            : DEDBJN21
  - NUMBER OF SEC. INDEX DATABASE:      3(PARTITION INCLUDED)

SEC. INDEX DATABASE INFORMATION:

    PARTITION                      ALLOC                                                LOADED         SUPPRESSED     TOTAL
    GROUP      DBDNAME   DDNAME    TYPE   DSNAME                                        SEGMENTS       SEGMENTS       SEGMENTS
    ---------  --------  --------  -----  ---------------------------------------------  -------------  -------------  -------------
    INDEX1     INDEX1    INDEX1DD   DYN   HPFP.KSDS.INDEX1
                                                                              (TOTAL)        441,312
    ---------  --------  --------  -----  ---------------------------------------------  -------------  -------------  -------------
    INDEX1     INDEX2    INDEX2DD   DYN   HPFP.KSDS.INDEX2
                                                                              (TOTAL)        184,434
    ---------  --------  --------  -----  ---------------------------------------------  -------------  -------------  -------------
    INDEX1     INDEX3    INDEX3DD   DYN   HPFP.KSDS.INDEX3
                                                                              (TOTAL)        166,363
    ---------  --------  --------  -----  ---------------------------------------------  -------------  -------------  -------------
    INDEX1                                                                (GROUP TOTAL)        792,109              0        792,109

BUILD POINTER SEGMENT RECORD DATA SET INFORMATION:

  INDEX
  DBDNAME  DDNAME   DSNAME                                                   ALLOCATION
  -------- -------- -------------------------------------------------------  -----------
  INDEX1   S0000010 HPFP.BUILD.INDEX1                                        DYNALLOC
  INDEX2   S0000020 HPFP.BUILD.INDEX2                                        DYNALLOC
  INDEX3   S0000030 HPFP.BUILD.INDEX3                                        DYNALLOC

SORT CONTROL STATEMENT INFORMATION:

INDEX DBDNAME: INDEX1     DSNAME: HPFP.BUILD.INDEX1
SORT CONTROL STATEMENT:
   SORT FIELDS=(1,00031,CH,A)
   RECORD TYPE=F,LENGTH=00100
   OPTION FILSZ=E0000441312
…
```

SCAN
LOAD

SCAN

Challenges in FPSI index synchronization

- For fast updates of areas, you may use the FPSI option SETI PSB=xxx
  - This option allows the suppression of index maintenance in a BMP region while a DEDB area is being updated.
- The result is that the secondary indexes no longer accurately reflects changes in the DEDB areas
- So, re-synchronization of the DEDB areas and the secondary indexes is required in the next maintenance window
- But, for the case that areas cannot be made offline to build the secondary indexes, how should you do?



Online Resync function

- Synchronizes index pointer segments in secondary index databases with the pointers in the primary DEDB database without bringing the DEDB database offline
- Provides a keyword RESYNCMODE to specify a run mode of the Online Resync function
  - VERIFYUPDATE
  - DIRECTUPDATE
  - AREASCAN
  - VERIFY
  - UPDATE

Note: For a secondary index database that contains non-unique keys, RESYNCMODE=DIRECTUPDATE must be used.

- Online Resync function is activated by the combination of the following options for the INDEXBLD command:
  - IDXPROC=RESYNC
  - TOICTL=NONE
- Invokes FPUTIL region internally and issues DL/I calls to update secondary indexes to resynchronize them with the online DEDB areas
  - You do not need to generate a PSB to access secondary indexes
  - Use the SYNC keyword to specify the interval between the synchronization points for updating secondary index databases with DL/I calls

Four phases of Online Resync process

Phase 1: Area Scan processing

1-a. Scans the online DEDB AREAs and generates pointer segment records in parallel

1-b. Writes unverified Resync pointer segment records into Unverified Resync Pointer Segment record date sets in parallel

Phase 2: SORT processing

2-a. Sorts pointer segments generated from the online DEDB AREAs in parallel

Phase 3: Compare processing

3-a. Reads pointer segments from the indexes or Unverified Resync Pointer Segment record date sets in parallel

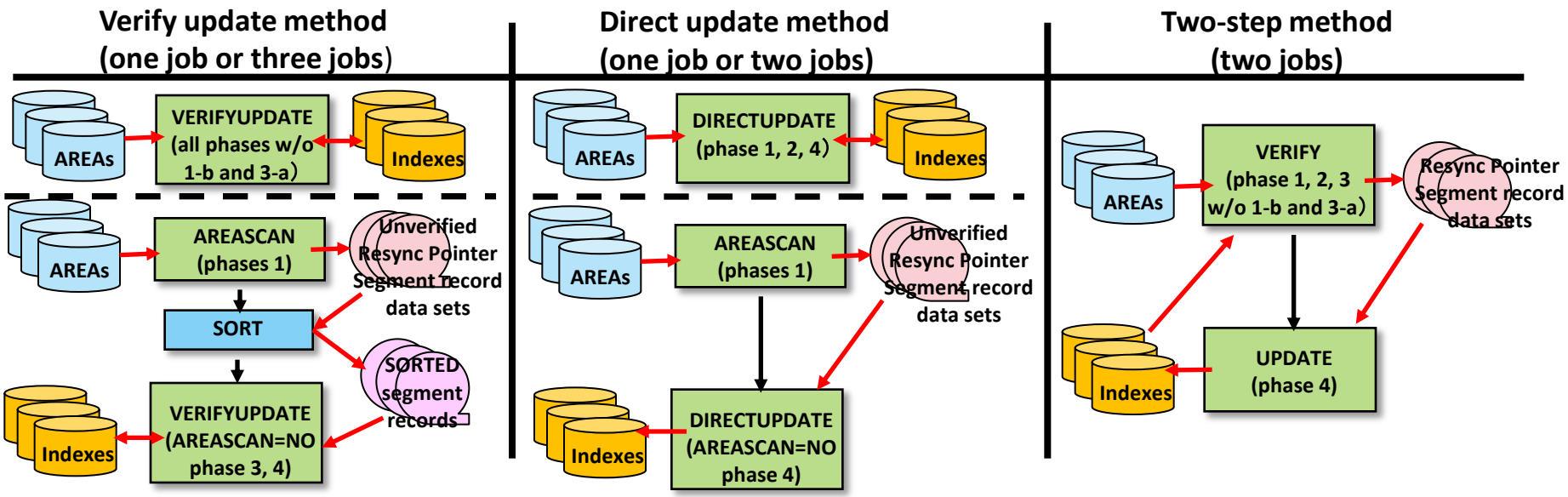
3-b. Compares the two sets of pointer segments, then generates Resync Pointer Segment records only for those have differences, in parallel

3-c. Writes Resync pointer segment records into Resync Pointer Segment record date sets in parallel

Phase 4: Update processing

4-a. Reads pointer segments from (Unverified) Resync Pointer Segment record date sets in parallel

4-b. Updates the indexes serially



Online Resync function JCL examples

DIRECTUPDATE mode

```
//HFPSYSIN DD *
  GLOBAL DBRC=YES,IMSID=IMS1
  INDEXBLD DBD=DEDBJN22,
    IAREA=(AREA1,AREA2,AREA3),
    INDEXDBD=ALL,
    IDXPROC=RESYNC,
    RESYNCMODE=DIRECTUPDATE,
    TOICTL=NONE
/*
```

VERIFY mode

```
//HFPSYSIN DD *
  GLOBAL DBRC=YES
  INDEXBLD DBD=DEDBJN22,
    IAREA=ALL,
    INDEXDBD=(INDEX1,INDEX2,INDEX3),
    IDXPROC=RESYNC,
    RESYNCMODE=VERIFY,
    TOICTL=NONE
  FILECTL
    DSNAME='HFP.&INDEX',
    STORCLAS=STRCLS
/*
```

These statements specify Resync Pointer Segment record data sets

VERIFYUPDATE mode

```
//HFPSYSIN DD *
  GLOBAL DBRC=YES,IMSID=IMS1
  INDEXBLD DBD=DEDBJN22,
    IAREA=ALL,
    INDEXDBD=ALL,
    IDXPROC=RESYNC,
    RESYNCMODE=VERIFYUPDATE,
    TOICTL=NONE
/*
```

UPDATE mode

```
//HFPSYSIN DD *
  GLOBAL DBRC=YES,IMSID=IMS1
  INDEXBLD DBD=DEDBJN22,
    INDEXDBD=(INDEX1,INDEX2,INDEX3),
    IDXPROC=RESYNC,
    RESYNCMODE=UPDATE,
    TOICTL=NONE
    RESYNCDSNMASK='HFP.&INDEX'
/*
```

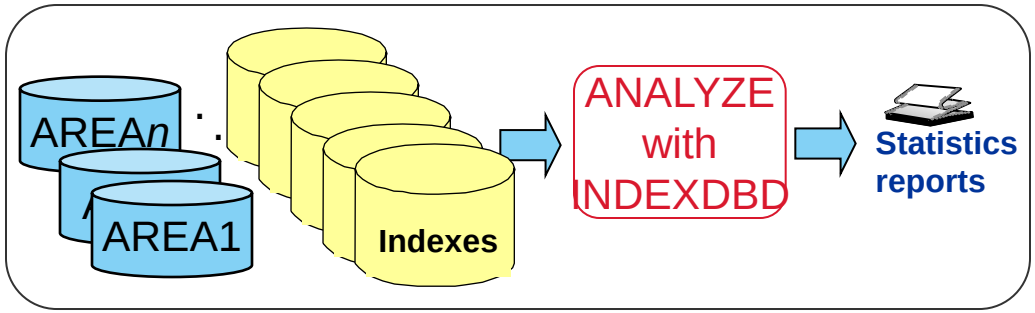
Secondary Index Resync report

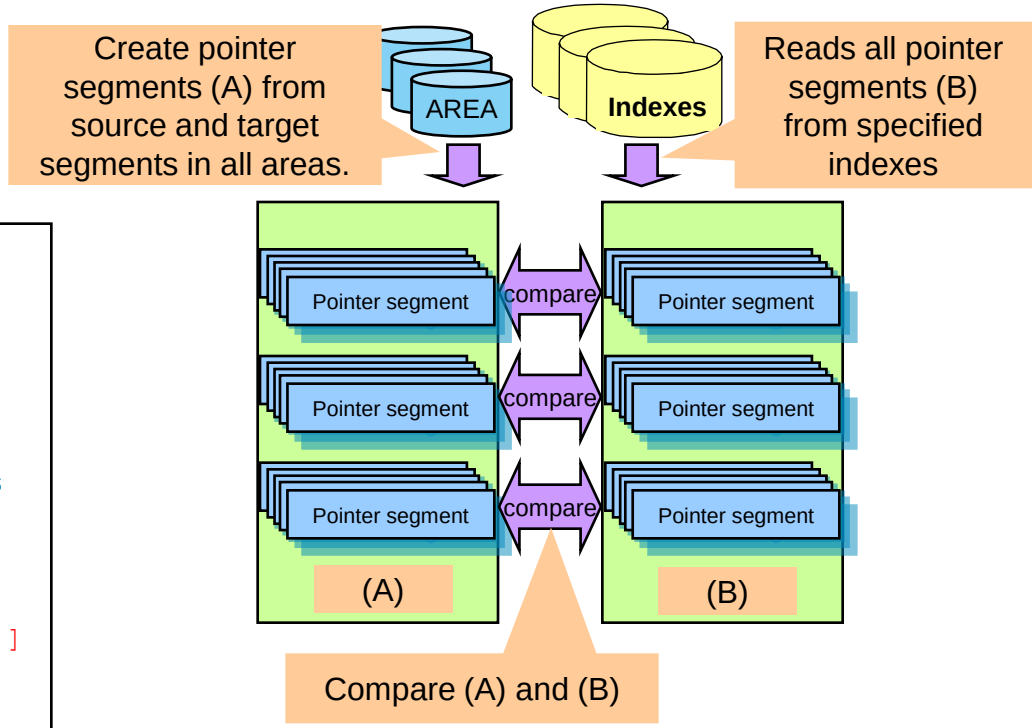
- Provides the following information:
  - The number of index pointer segments that were inserted to or deleted from each secondary index databases
  - The Resync Pointer Segment record data sets that were created or used
  - Sort control statement cards for each Unverified Resync Pointer Segment record data set when RESYNCMODE=AREASCAN

```
IMS HPFP UTILITIES - FPA INDEXBLD                        "Secondary Index Resync Report"                                PAGE:       1
5655-W14 V1R3                                                                                                     2014-05-02 10:29:17

  - PRIMARY DEDB NAME            : DEDBJN23
  - NUMBER OF SEC. INDEX DATABASE:      3(PARTITION INCLUDED)
  - RESYNC MODE                  : VERIFY
  - TOICTL                       : NONE

SEC. INDEX DATABASE INFORMATION:

  *: RESYNC PERFORMED #: ISRT/DLET FAILED

                                                                                                  POINTER SEGMENT
  PARTITION                                                                                 ----------------------------------------------------
  GROUP     DBDNAME  DDNAME   DSNAME                                                       BEFORE RESYNC AFTER RESYNC  INSERTED      DELETED
  --------- -------- -------- ------------------------------------------                  ------------- ------------- ------------- -------------
           *DEDBGS22 GS22KSDS HPFP.GS22KSDS
                                                                                  (TOTAL)      1,500,000     2,000,000       500,000             0
  --------- -------- -------- ------------------------------------------                  ------------- ------------- ------------- -------------
  DEDBGS25 *DEDBGS25 GS25KSDS HPFP.GS25KSDS
                                                                                  (TOTAL)      1,000,000       900,000       200,000       300,000
  --------- -------- -------- ------------------------------------------                  ------------- ------------- ------------- -------------
  DEDBGS25  DEDBGS26 GS26KSDS HPFP.GS26KSDS
                                                                                  (TOTAL)        400,000       400,000             0             0
  -------- -------- -------- ------------------------------------------                   ------------- ------------- ------------- -------------
  DEDBGS25                                                                  (GROUP TOTAL)      1,400,000     1,300,000       200,000       300,000

RESYNC POINTER SEGMENT RECORD DATA SET INFORMATION:

  INDEX
  DBDNAME  DDNAME   DSNAME                                                        ALLOCATION
  -------- -------- -------------------------------------------------------       -----------
  DEDBGS22 S000001R HPFP.RSNC.DEDBGS22                                            DYNALLOC
  DEDBGS25 S000002R HPFP.RSNC.DEDBGS25                                            DYNALLOC
  DEDBGS26 S000003R HPFP.RSNC.DEDBGS26                                            DYNALLOC
```

Analyzing one or multiple secondary indexes

- FPA ANALYZE function with INDEXDBD option
  - Verifies the integrity of the index pointer segments in secondary index specified in the option, in addition to verifying the integrity of all IMS physical pointers in DEDB areas

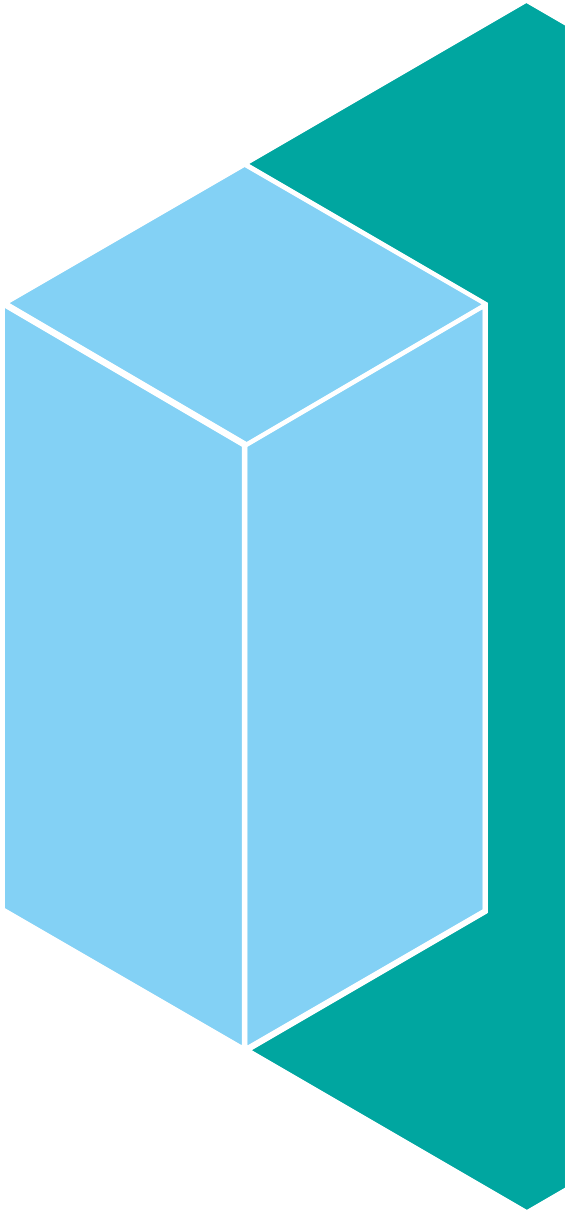





```
//HFP       EXEC PGM=HFPMAIN0
//STEPLIB   DD DISP=SHR,DSN=FPSP.SHFPLMD0
//          DD DISP=SHR,DSN=IMSVS.SDFSRESL
//          DD DISP=SHR,DSN=IMSVS.PGMLIB
//IMSACB    DD DISP=SHR,DSN=IMSVS.ACBLIB
//IMSDALIB  DD DISP=SHR,DSN=IMSVS.MDALIB
//HFPSYSIN DD *
  GLOBAL DBRC=YES
  ANALYZE
    DBD=DEDBJN22,PTRCHKLVL=FULL,
    IAREA=ALL,
    INDEXDBD=[ALL|(indexdbd1,indexdbd2,...)]
  REPORT
/*
```

Mandatory option for index analysis

Other useful functions to make DBA tasks simpler and easier



OER segment shunting (FPO)

- OER provides segment shunting capability
  - Reorganizes specified segments directly into DOVF or IOVF, bypassing the RAP CI even though space might currently exist in the RAP CI
  - The only segments that can be shunted are direct dependent segments
- Allows you to retain space in the RAP CI for new inserts
- **INDD DD** can be used to specify which segments to shunt
  - Similar to the INDD data set for the IMS DEDB High-Speed Direct reorganization utility (HSR)

An example JCL stream

```
//OER     EXEC FPUTIL,DBD=DEDBJN23,IMSID=IMS1
//STEPLIB DD DISP=SHR,DSN=HPFP.SHFPLMD0
//        DD DISP=SHR,DSN=IMSVS.SDFSRESL
//        DD DISP=SHR,DSN=IMSVS.PGMLIB
//FPXIN DD *
    REORG  AREA=(DB23AR1,DB23AR2)
           PTRCHK=YES
    PTRCHK TYPRUN=RPT
           FULLSTEP=YES
           CHKUOW=ALL
/*
//INDD DD *
AREA=DB23AR1
DD1
DD11
AREA=DB23AR2
DD1
DD11
DD12
DD2
/*
```

SORT FILSZ estimation (FPA)

- In order to prevent jobs from failing due to lack of sort work space, FPA functions
  - Automatically estimates the number of intermediate records
  - Calculates the value of the FILSZ parameter of DFSORT
- **SORTOPT_FILSZ=AUTO** enables FILSZ estimation
  - Supported by
    - ANALYZE
    - CHANGE
    - EXTRACT
    - RELOAD
    - REORG
    - TUNE
    - UNLOAD
  - Even SORTOPT_FILSZ=NONE is specified, if FPA can calculate the actual number of records to sort before invoking DFSORT, FPA adds the FILSZ parameter to the SORT control statement

An example JCL

```
//HFPANA   EXEC PGM=HFPMAIN0
//STEPLIB  DD DISP=SHR,DSN=HPFP.SHFPLMD0
//         DD DISP=SHR,DSN=IMS.SDFSRESL
//         DD DISP=SHR,DSN=IMS.PGMLIB
//IMSACB   DD DISP=SHR,DSN=IMS.ACBLIB
//HFPRPTS  DD SYSOUT=*
//HFPPRINT DD SYSOUT=*
//HFPSYSIN DD *
  ANALYZE
    DBD=DEDBJN23,
    ATASKCTL=1,
    SORTOPT_FILSZ=AUTO,
    PTRCHKLVL=FULL,
    SDEPCHKLVL=FULL
  REPORT
/*
```

Segment edit/compression routine call skip (FPA)

- FPA Unload function and FPA Change function allow to skip the segment edit/compression exit routine process in order to avoid unnecessary impact on performance
- **EDITCOMP_SKIP=YES** is effective when the COMPRTN keyword parameters are the same between
  - For the Unload function, IMSACB and NEWACB
  - For the Change function, OLDACB and IMSACB

※ Warning: If the segment edit/compression exit routines have the same name but different contents, running the job with the EDITCOMP_SKIP=YES option might destroy the database.

An example JCL

```
//HFP EXEC PGM=HFPMAIN0
//STEPLIB  DD DISP=SHR,DSN=HPFP.SHFPLMD0
//         DD DISP=SHR,DSN=IMSVS.SDFSRESL
//         DD DISP=SHR,DSN=IMSVS.PGMLIB
//IMSACB   DD DISP=SHR,DSN=IMSVS.ACBLIB
//NEWACB   DD DISP=SHR,DSN=IMSVS.ACBLIB.NEW
//IMSDALIB DD DISP=SHR,DSN=IMSVS.MDALIB
//OAREA001 DD DISP=OLD,DSN=HPFP.USRFILE
//HFPRPTS  DD SYSOUT=*
//HFPPRINT DD SYSOUT=*
//HFPSYSIN DD *
  GLOBAL
    DBRC=YES
  UNLOAD
    DBD=DEDBJN22,
    COMPRESS=YES,
    EDITCOMP_SKIP=SKIP,
    IAREA=(DB22AR0),
    OAREA=(DB22AR0)
/*
```

ADS name from RECON without authorization (FPA)

- A new option **AREADSN=RECON** with DBRC=NO
  - FPA does sign-on/off to DBRC to obtain the area data set names from the RECON, but does not issue area authorization call to DBRC
  - The AREADSN parameter is valid only for ANALYZE and TUNE functions
- Provides ease of use JCL, avoids affecting the operation of business applications

```
//HFP       EXEC PGM=HFPMAIN0
//STEPLIB   DD DISP=SHR,DSN=HPFP.SHFPLMD0
//          DD DISP=SHR,DSN=IMSVS.SDFSRESL
//IMSACB    DD DISP=SHR,DSN=IMSVS.ACBLIB
//RECON1    DD DISP=SHR,DSN=IMSVS.RECON1
//RECON2    DD DISP=SHR,DSN=IMSVS.RECON2
//RECON3    DD DISP=SHR,DSN=IMSVS.RECON3
//HFPRPTS   DD SYSOUT=*
//HFPPRINT  DD SYSOUT=*
//HFPSYSIN  DD *
  GLOBAL
      DBRC=NO,
      AREADSN=RECON
  ANALYZE
      DBD=DEDBJN22,
      IAREA=ALL,
      PTRCHKLVL=FULL
/*
```

Another option of AREADSN

- **AREADSN=NORECON** (specified with DBRC=NO) suppresses access to RECON
- With this option, FPA obtains area data set names from *areaname* DD statements or from the utility control statements.

New DB Record Length Distribution report (FPA/FPO)

- This report is produced when DBRLDIST=YES is specified (default: DBRLDIST=NO)
  - Visualizes database record length distribution to allow you to recognize the skewness of distribution at a glance

```
IMS HPFP UTILITIES - FPA ANALYZE                    "DB Record Length Distribution Report"                PAGE:       1
5655-W14 V1R3                                                                                   2014-04-15 14:45:46

0DBDNAME: DEDB000F   AREA NAME  : DB23AR1     DDNAME: DB23AR11    DSNAME   :  IMSVS.DB23.DB23AR1.ADS1
                     AREA NUMBER:     1       DSTYPE: ADS


  BASIC FIGURES
  ---------------------------------------------------------------------------------------------
   CI SIZE:                          2,048
   DB RECORD LENGTH:  AVG:           1,340  MAX:           9,376  MIN:            282

 DB RECORD LENGTH (INCLUDING THE LENGTH OF SEGMENT PREFIX):

 DB RECORD LENGTH  NUMBER OF                 CUM      DISTRIBUTION OF DB RECORD LENGTHS (PCT)            LENGTH RANGES IN
 RANGE (RANGE      DB RECORDS       PCT OF   PCT                                                  1  WHICH AVG, MIN, MAX,
 SIZE APPROX.      THAT FIT IN      NBR OF   FROM        1    2    3    4    5    6    7    8    9    0  MED, AND 1ST/3RD
 1/ 20 OF CI SIZE) THE RANGE        DB RECS  SHORTEST    0    0    0    0    0    0    0    0    0    0  QUARTILES EXISTED
 ---------------- ---------------  -------- -------- ---------------------------------------------------  ----------------------
       1 -     102               0     0.0 %     0.0 %
     103 -     204               0     0.0 %     0.0 %
     205 -     307               4     6.5 %     6.5 % ***                                               MIN
     308 -     409               8    12.9 %    19.4 % ******
     410 -     512               6     9.7 %    29.0 % ****                                              1ST
     513 -     614               0     0.0 %    29.0 %
     615 -     716               0     0.0 %    29.0 %
     717 -     819               0     0.0 %    29.0 %
     820 -     921               0     0.0 %    29.0 %
     922 -   1,024              16    25.8 %    54.8 % ************                                     MED
   1,025 -   1,126               2     3.2 %    58.1 % *
   1,127 -   1,228               4     6.5 %    64.5 % ***
   1,229 -   1,331               2     3.2 %    67.7 % *
   1,332 -   1,433               4     6.5 %    74.2 % ***                                               AVG
   1,434 -   1,536               0     0.0 %    74.2 %
   1,537 -   1,638               1     1.6 %    75.8 %                                                   3RD
   1,639 -   1,740               2     3.2 %    79.0 % *
   1,741 -   1,843               4     6.5 %    85.5 % ***
   1,844 -   1,945               2     3.2 %    88.7 % *
   1,946 -   2,048               0     0.0 %    88.7 %
  MORE THAN  2,048               7    11.3 %   100.0 % *****                                             MAX
 ---------------- ---------------  -------- -------- ---------------------------------------------------  ----------------------
   TOTAL                        62   100.0 %
```

APAR Information

APAR/PTF numbers for FP Solution Pack V1.3 new functions (1)

- **FP Active Autonomics**
  - Fast Path Solution Pack V1.3 - PI06716/UI17205
  - IBM Tools Base V1.4 - PI09140 and PI09270/UI16631
  - IBM Tools Base V1.5 - FP Active Autonomics function is included in the base level

- **FPA TUNE function's must-have APAR/PTF**
  - PI06424/UI14684: Enhancement for Area Tuning Summary report and TARECGEN

- **FPA INDEXBLD function enhancements for FP Secondary Index**
  - PI17756/UI23683: Online RESYNC for FP Secondary Index
  - PI17756/UI23683: Better handling of duplicate keys (DUPKEYMAX and DUPKEYACT)
  - PI34189/UI28095: Providing SCAN mode and LOAD mode for Build Index function, and skipping the scan for the empty area for Build Index function and Online RESYNC (BUILDMODE)
  - PI44783/UI31515: Providing AREASCAN mode for Online RESYNC
  - PI49799/UI35100: Stopping job when specified duplicate keys detected for Build Index function and Online RESYNC (PROC_AFT_DUPKEY)

APAR/PTF numbers for FP Solution Pack V1.3 new functions (2)

- **IMS V14 support**
  - PI22667/UI23956: This also includes the support for 64-bit buffers in OER

- **Other new functions**
  - PI05155/UI12771: OPC performance improvement
  - PI16431/UI18578: Retrieving ADS name from RECON without authorization (AREADSN)
  - PI14356/UI18137: DB Record Length Distribution report (DBRLDIST)
  - PI16740/UI19724: OAE multi volume support (MAXVOLS and VOLUME_EXT)
  - PI18225/UI20175: Duplicate keyword check enhancement (KEYWORD_DUPCHK)
  - PI18788/UI19156: Setting the “empty flag” in 2nd CI when an area is initialized (to conform to the IMS V12/V13 enhancement)
  - PI22426/PI27786: Storing reorganization timestamp in the ITKB repository (ITKBDATA)
  - PI24263/UI20801: Providing a sample JCL for stand-alone DB Sensor
  - PI33076/UI28552: OER segment shunting support
  - PI38789/UI28364: Dynamic allocation of RECON data sets using DFSMDA members for OPC and OER
  - PI44783/UI31515: Skipping the segment edit/compression routine call for FPA Unload function and FPA Change function (EDITCOMP_SKIP)
  - PI50655/UI34002: Adding FILSZ parameter to SORT control statements automatically (SORTOPT_FILSZ)

Documentation

Product page, user's guides, and documentation changes

- Product home page
  - **IMS Fast Path Solution Pack for z/OS**
    http://www.ibm.com/software/products/en/imsfastpathsolupackforzos
  - **IMS Tools**
    http://www.ibm.com/software/data/db2imstools/products/ims-tools.html

- User's Guides on IBM Knowledge Center
  - **IMS Fast Path Solution Pack for z/OS, V1.3**
    http://www.ibm.com/support/knowledgecenter/SSS8RM_1.3.0/com.ibm.imstools.fpx13.doc/fpxhome.htm

- Documentation changes
  - http://www-304.ibm.com/support/docview.wss?uid=swg27047491