

S H A R E

Technology • Connections • Results

Reduce Costs: Getting the Most out of zIIPs and zAAPs with DB2 for z/OS

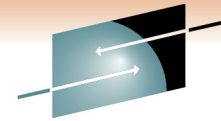
Session Number: 8415
February 28, 2011

Greg Dyck
DB2 for z/OS Development
IBM Silicon Valley Lab,
San Jose, CA

SHARE
in Anaheim
2011



Disclaimer



S H A R E

Technology • Connections • Results

© Copyright IBM Corporation 2010, 2011. All rights reserved.

U.S. Government Users Restricted Rights - Use, duplication or disclosure restricted by GSA ADP Schedule Contract with IBM Corp.

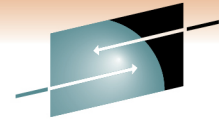
THE INFORMATION CONTAINED IN THIS PRESENTATION IS PROVIDED FOR INFORMATIONAL PURPOSES ONLY. WHILE EFFORTS WERE MADE TO VERIFY THE COMPLETENESS AND ACCURACY OF THE INFORMATION CONTAINED IN THIS PRESENTATION, IT IS PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED. IN ADDITION, THIS INFORMATION IS BASED ON IBM'S CURRENT PRODUCT PLANS AND STRATEGY, WHICH ARE SUBJECT TO CHANGE BY IBM WITHOUT NOTICE. IBM SHALL NOT BE RESPONSIBLE FOR ANY DAMAGES ARISING OUT OF THE USE OF, OR OTHERWISE RELATED TO, THIS PRESENTATION OR ANY OTHER DOCUMENTATION. NOTHING CONTAINED IN THIS PRESENTATION IS INTENDED TO, NOR SHALL HAVE THE EFFECT OF, CREATING ANY WARRANTIES OR REPRESENTATIONS FROM IBM (OR ITS SUPPLIERS OR LICENSORS), OR ALTERING THE TERMS AND CONDITIONS OF ANY AGREEMENT OR LICENSE GOVERNING THE USE OF IBM PRODUCTS AND/OR SOFTWARE.

Information regarding potential future products is intended to outline our general product direction and it should not be relied on in making a purchasing decision. The information mentioned regarding potential future products is not a commitment, promise, or legal obligation to deliver any material, code or functionality. Information about potential future products may not be incorporated into any contract. The development, release, and timing of any future features or functionality described for our products remains at our sole discretion.

IBM, the IBM logo, ibm.com, DB2 , DRDA, Hipersockets, Tivoli, Omegamon, z9, z10 and zEnterprise are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both. If these and other IBM trademarked terms are marked on their first occurrence in this information with a trademark symbol (® or ™), these symbols indicate U.S. registered or common law trademarks owned by IBM at the time this information was published. Such trademarks may also be registered or common law trademarks in other countries. A current list of IBM trademarks is available on the Web at "Copyright and trademark information" at www.ibm.com/legal/copytrade.shtml

TOPICS

- **zIIP & zAAP Overview**
- **DB2 workloads that leverage zIIP & zAAP**
- **What is new ?**
- **Estimation & Monitoring of zIIP & zAAP redirect**

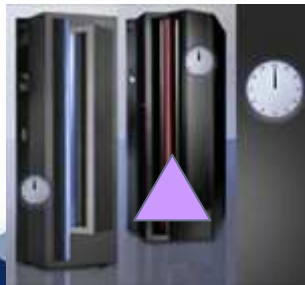


SHARE
Technology • Connections • Results

zIIP & zAAP

Overview

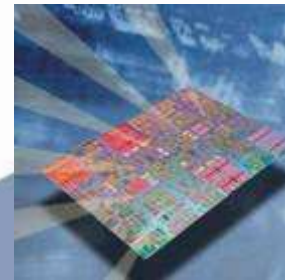
Mainframe Innovation: Specialty Engines



**Internal Coupling
Facility (ICF) 1997**



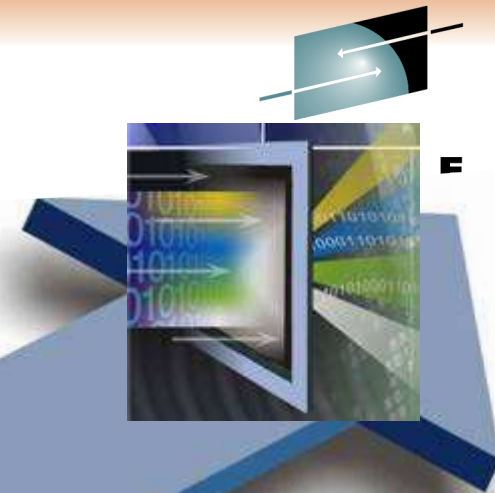
**Integrated Facility
for Linux® (IFL)
2000**



**System z Application
Assist Processor (zAAP)
2004**

Eligible for zAAP:

- Java execution environment
- z/OS XML System Services



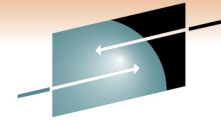
**IBM System z Integrated
Information Processor
(zIIP) 2006**

Eligible for zIIP:

- DB2 remote access , BI/DW, Utilities Build Index and Sort processing, XML Parsing, **RUNSTATS, BP Prefetch, Deferred Write**
- z/OS XML System Services
- HiperSockets for large messages
- IPsec encryption
- z/OS Global Mirror (XRC)
- IBM GBS Scalable Architecture for Financial Reporting
- z/OS CIM Server
- ISVs

SHARE
in Anaheim
2011

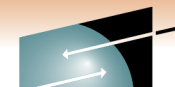
How zIIP and zAAP are similar ?



SHARE
Technology • Connections • Results

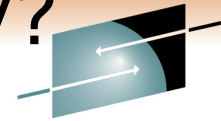
- Both run asynchronously to general purpose processors and receive eligible work from z/OS
- Neither can run z/OS or be IPLed with z/OS (or any other operating system)
- IBM has no intention of imposing IBM software charges on zIIP and zAAP capacity used for the workloads designated by IBM
- Both have the same price
- PROJECTCPU option can measure the eligible workload for both
- RMF™ monitors both zAAP and zIIP activity
- WLM manages both zAAP and zIIP workloads

How zIIP and zAAP are different ?



zAAP	zIIP
<p>Introduced in 2004.</p>	<p>Introduced in 2006.</p> <p style="text-align: right;">SHARE Technology • Connections • Results</p>
<p>System z Application Assist Processor (originally the zSeries Application Assist Processor). Available on IBM zEnterprise 196 (z196), IBM System z10™, and IBM System z9® servers, and IBM eServer™ zSeries® 990 and 890 (z990, z890).</p>	<p>System z Integrated Information Processor Available on IBM zEnterprise, System z10, and System z9 servers.</p>
<p>Intended to help implement new application technologies on System z, such as Java and XML.</p>	<p>Intended to help integrate data and transaction processing across the enterprise</p>
<p>Exploiters include:</p> <ul style="list-style-type: none"> • Java via the IBM SDK (IBM Java Virtual Machine (JVM)), such as portions of: <ul style="list-style-type: none"> • WebSphere Application Server • IMS™ • DB2 • CICS® • Java batch • CIM Client applications • z/OS XML System Services, such as portions of: <ul style="list-style-type: none"> • DB2 9 (New Function Mode), and later • Enterprise COBOL V4.1, and later • Enterprise PL/I V3.8, and later • IBM XML Toolkit for z/OS, V1.9 and later • CICS TS V4.1 	<p>Exploiters include, portions of:</p> <ul style="list-style-type: none"> • DB2 V8, DB2 9, DB2 10 for z/OS <ul style="list-style-type: none"> • Data serving • Data Warehousing • Select utilities • z/OS Communications Server <ul style="list-style-type: none"> • Network encryption • HiperSockets for large messages • z/OS XML System Services <ul style="list-style-type: none"> • DB2 9 New Function Mode • z/OS Global Mirror (XRC), System Data Mover (SDM) • IBM GBS Scalable Architecture for Financial Reporting • z/OS CIM server <div style="position: absolute; top: 50%; left: 70%; transform: translate(-50%, -50%);"> <p>New zAAP on zIIP capability</p> </div> <p style="text-align: right;">SHARE In Anaheim 2011</p>

What is the zAAP on zIIP capability?



SHARE
Technology • Connections • Results

- A new capability that can enable System z Application Assist Processor (zAAP) eligible workloads to run on System z Integrated Information Processors (zIIPs).
 - **For customers with no zAAPs and zIIPs**
 - The combined eligible workloads may make the acquisition of a single zIIP cost effective.
 - **For customers with only zIIP processors**
 - Makes Java and z/OS XML System Services -based workloads eligible to run on existing zIIPs – maximizes zIIP investment.
 - **Available on z/OS V1.9, V1.10 and V1.11**
 - This new capability is not available for z/OS LPARS if zAAPs are installed on the server.

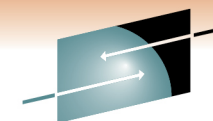
SHARE
in Anaheim
2011

How to enable the zAAP on zIIP capability?



- The capability ships default enabled with z/OS V1.11.
 - **Parameter in SYS1.PARMLIB(IEASYSxx) : ZAAPZIIP = YES (default in z/OS V1.11)**
 - **If you wish to disable the function for any reason, you must IPL with ZAAPZIIP=NO in the IEASYSxx Parmlib member.**
- Also available with z/OS V1.9 and V1.10
 - **With PTF for APAR OA27495, and**
 - **Enabled with ZAAPZIIP=YES in the IEASYSxx Parmlib (the default is NO)**
- This new capability does not remove the requirement to purchase and maintain one or more general purpose processors for every zIIP processor on the server.

DB2 Workloads that leverage zIIP



SHARE
Technology • Connections • Results

Usage of zIIP is transparent to applications - No changes to applications
Basic support in DB2 V8 & DB2 9, 10 Conversion & New Function Modes

Portions of the following DB2 for z/OS workloads will benefit from zIIP

1. ERP, CRM, Business Intelligence or other enterprise applications

- Via DRDA over a TCP/IP connection (enclave SRBs)
 - *Workloads using DB2 Connect, T4 JCC Universal driver, Data Server Client and CLI/ODBC, JDBC, SQLJ, .NET, pureQuery APIs*
- Remote native SQL procedures (DB2 9 for z/OS NFM)
- XML Schema validation & non-validation parsing (DB2 9 for z/OS NFM)
- New method to control the portion of SQL requests that are eligible to be diverted to zIIP engines
 - *Improved performance via reduced processor switching*
 - *Also increases portion of DRDA processing (see above) that is eligible to run on zIIPs to up to 60%*
 - *APAR PM12256 for DB2 V8, DB2 9, included in DB2 10 base*
 - *APAR PM28626 + OA35146 will improve processor utilization balance*

2. Data warehousing / Business Intelligence applications

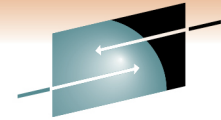
- CPU intensive parallel queries, including star schema queries

3. DB2 for z/OS utility functions used to maintain index structures and portions of RUNSTATS processing on DB2 10

4. DB2 10 Buffer Pool Prefetch and Deferred Write processing

SHARE
in Anaheim
2011

How does zIIP work ?



A program can work with z/OS to have a portion of its enclave Service Request Block (SRB) work directed to a zIIP. Portions of the types of work listed below that are executed in enclave SRBs can be redirected to a zIIP.

SHARE
Technology • Connections • Results

Example 1 = Distributed SQL requests (DRDA)

- Workload that access DB2 for z/OS V8 via DRDA over a TCP/IP connection are dispatched within z/OS in enclave SRBs. z/OS directs a portion of this work to the zIIP.
- **Includes DRDA DB2 9 Native (non-WLM) SQL Stored Procedures and XML Schema validation & non-validation parsing.**

Example 2 = CPU intensive parallel queries

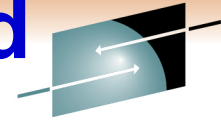
CPU intensive parallel queries will now use enclave SRBs. z/OS directs a portion of this work to the zIIP.

Example 3 = DB2 utilities for index maintenance and **RUNSTATS**

DB2 Utilities LOAD, REORG, and REBUILD use enclave SRBs for the portion of the processing that is related to index maintenance. Portions of DFSORT, **DB2SORT and RUNSTATS (DB2 10)** processing also will use enclave SRBs. z/OS directs a portion of this work to the zIIP.

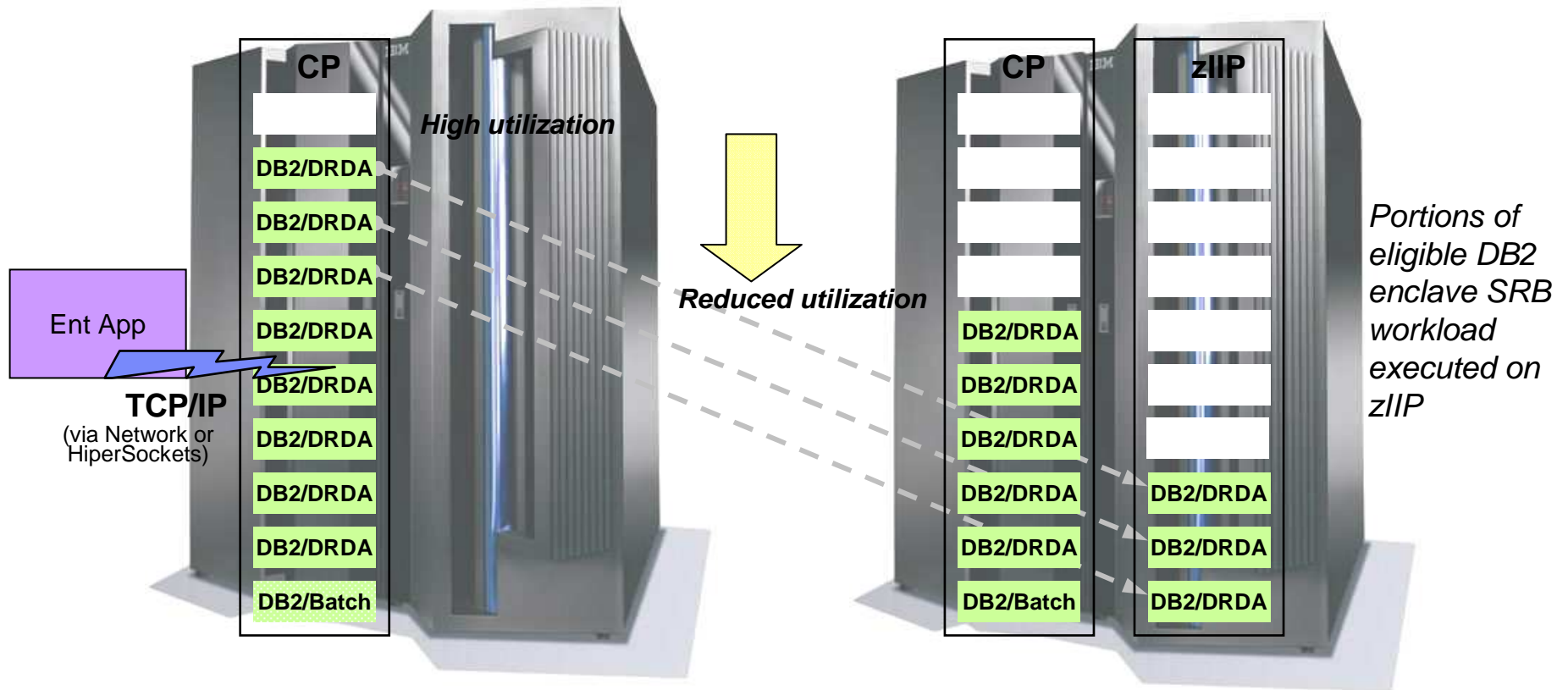
SHARE
in Anaheim
2011

Example 1: Enterprise Distributed Applications



Enterprise Applications that access DB2 for z/OS V8 via DRDA, including DB2 9 Native SQL Stored Procedures and XML parsing, over a TCP/IP connection will have portions of these SQL requests directed to the zIIP.

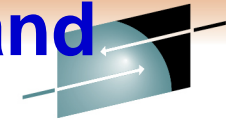
SHARE
Technology • Connections • Results



For illustrative purposes only

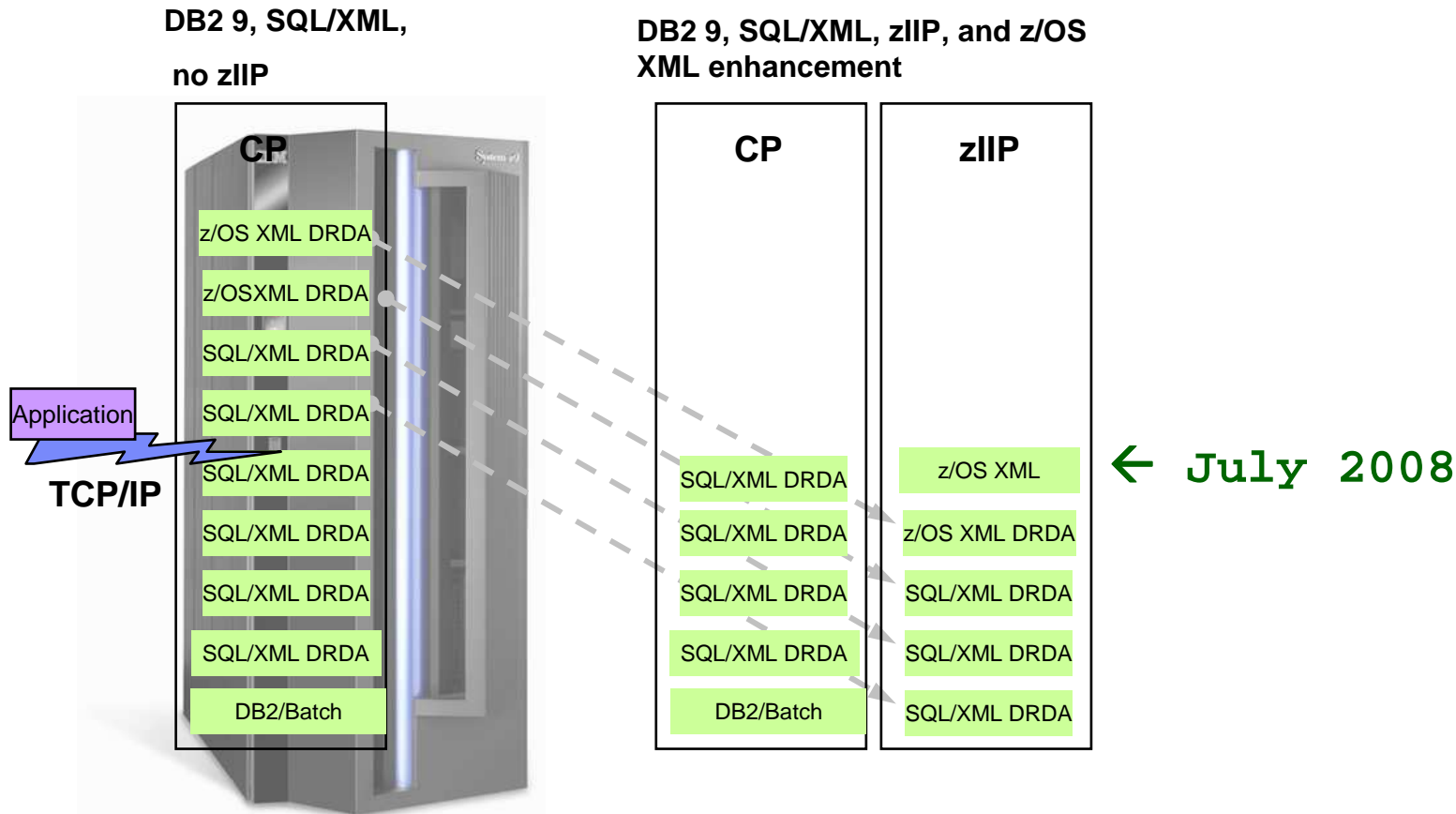
Actual workload redirects may vary

Example 1A: z/OS XML and DB2 9 DRDA and zIIP



SHARE
Technology • Connections • Results

Enterprise Applications that access DB2 9 for z/OS via DRDA over a TCP/IP connection can have all of enclave SRB SQL/XML System Services requests directed to the zIIP



For illustrative purposes only. Single application only. Actual workload redirects may vary

DB2 9 for z/OS XML enclave SRB processing eligible to run on zIIP

DB2 9 all z/OS XML System Services processing eligible for zIIP (July 2008 – OA23828 z/OS 1.8, 1.9)

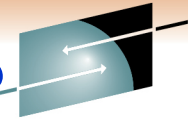
DB2 V8 DRDA zIIP Redirect processing



SHARE
Technology • Connections • Results

- Applicable to DRDA workload over TCP/IP connection
 - Only work done under enclave SRB is eligible.
 - Portion of the eligible work will be redirected.
- WLM managed Stored Procedure & UDF (User Defined Function) SQL processing under TCB, are not eligible for zIIP redirect
 - **Stored Procedure Call, Results set and Commit processing that run under enclave SRB, are eligible for zIIP redirect.**
- DB2 to DB2 TCP/IP DRDA Server processing is eligible for zIIP redirect
 - Requester DB2 local processing is not eligible.
 - Processing under TCB
- Available in CM (Compatibility Mode) and NFM (New Function Mode)

What is new with DRDA zIIP Redirect processing ?



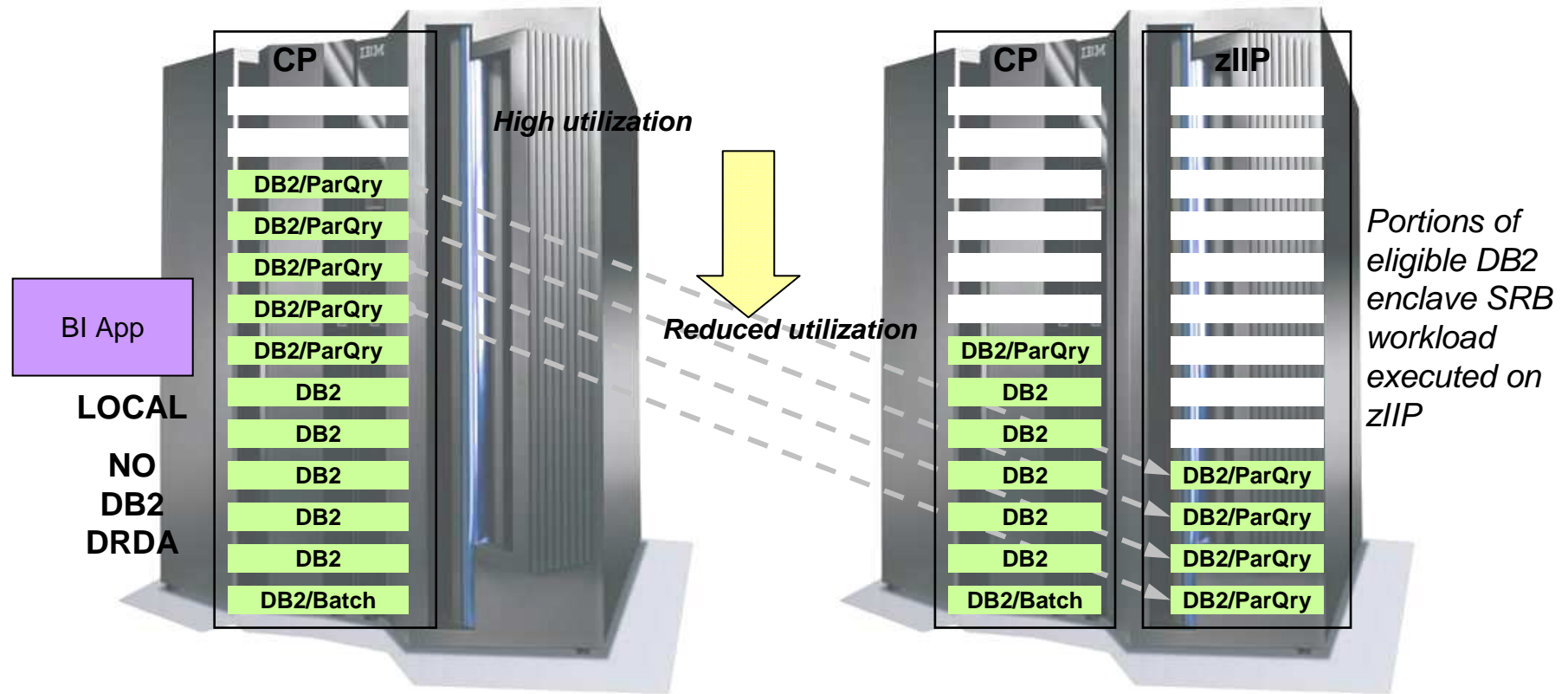
SHARE
Technology • Connections • Results

- **Remote native SQL procedures (DB2 9 for z/OS NFM)**
- **XML Schema validation parsing (DB2 9 for z/OS NFM)**
- **New method to control the portion of SQL requests that are eligible to be redirected to zIIP engines**
 - **Improved performance via reduced processor switching**
 - **Also increases portion of DRDA work that is eligible to run on zIIPs to up to 60%**
 - **APAR PM12256 for V8, DB2 9, included in DB2 10 base**
 - **APAR PM28626 + OA35146 will improve processor utilization balance**

Example 2.5 : Business Intelligence Applications – No DRDA



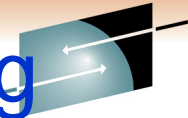
Parallel queries via LOCAL connection will have portions of this work directed to the zIIP



For illustrative purposes only

Actual workload redirects may vary depending on how long the queries run and how much parallelism is used

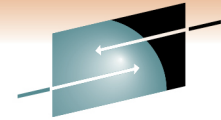
Parallel Query zIIP Redirect Processing



- Applicable to CPU intensive parallel queries using Star Schema and non Star Schema
 - Portion of the child task processing will be redirected after certain CPU usage threshold has exceeded for each parallel group.
 - Main tasks coming in via DRDA via TCP/IP will benefit from the DRDA zIIP redirect as well.
- The combined child & main tasks coming in through DRDA via TCP/IP is expected to yield additional zIIP redirect.
- Increased zIIP redirect potential with Star Join dynamic Index ANDing enhancement in DB2 9..
- Query parallelism is enabled for the following cases in DB2 10 :
 - For parallel group that contains workfile from materialized view and table expression
 - For the last parallel group top query block multi row fetch with read only cursor
 - For table access for query block containing OLAP functions
- Buffer Pool Prefetch processing redirected to zIIP in DB2 10

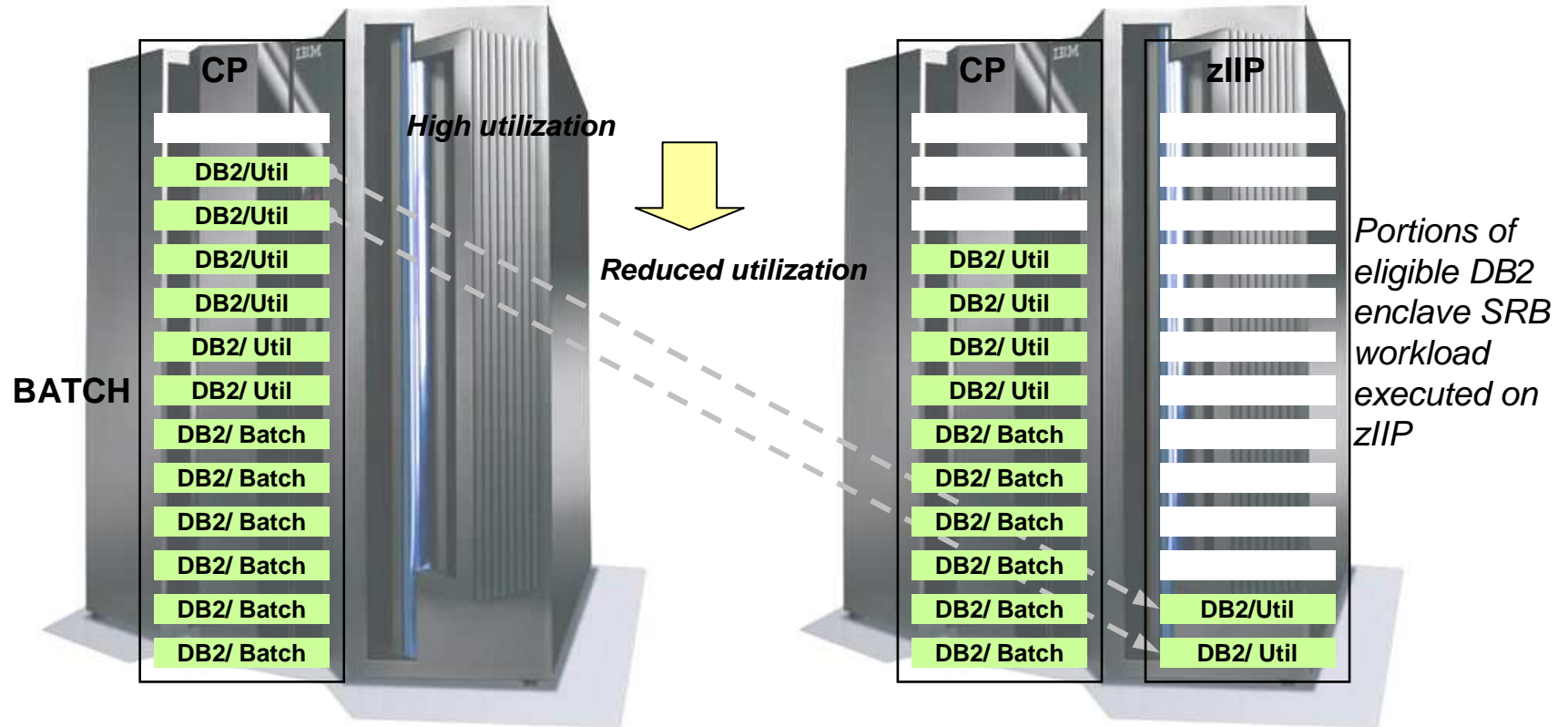
SHARE
Technology • Connections • Results

Example 3: DB2 for z/OS Utilities



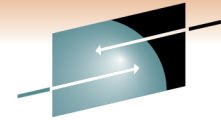
SHARE
Technology • Connections • Results

Portion of the DB2 utilities used to maintain index structures (within LOAD, REORG, and REBUILD) and portions of DFSORT, DB2SORT and **RUNSTATS** processing are redirected to zIIP.



For illustrative purposes only, actual workload redirects may vary.

DB2 Utilities zIIP Redirect processing



SHARE
Technology • Connections • Results

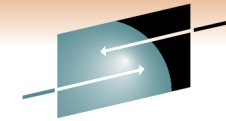
- **Portions of DB2 Utility (LOAD, REORG, & REBUILD) processing related to Index maintenance are eligible to be redirected**
- **Redirect benefit depends on:**
 - How many Indices are defined on the Table
 - How many Partitions are in the Table for Partition Utility
 - Number of Columns, Column data type etc.
- **Higher end of range is expected with:**
 - Tables with many Indices or many partitions for Partition Utility
- **Lower end of range is expected with:**
 - Tables with fewer Indices
 - Fewer partitions for Partition Utility
 - Compression used
- **Portions of RUNSTATS processing redirected to zIIP in DB2 10**

DB2 Utilities DFSORT & DB2SORT zIIP redirect

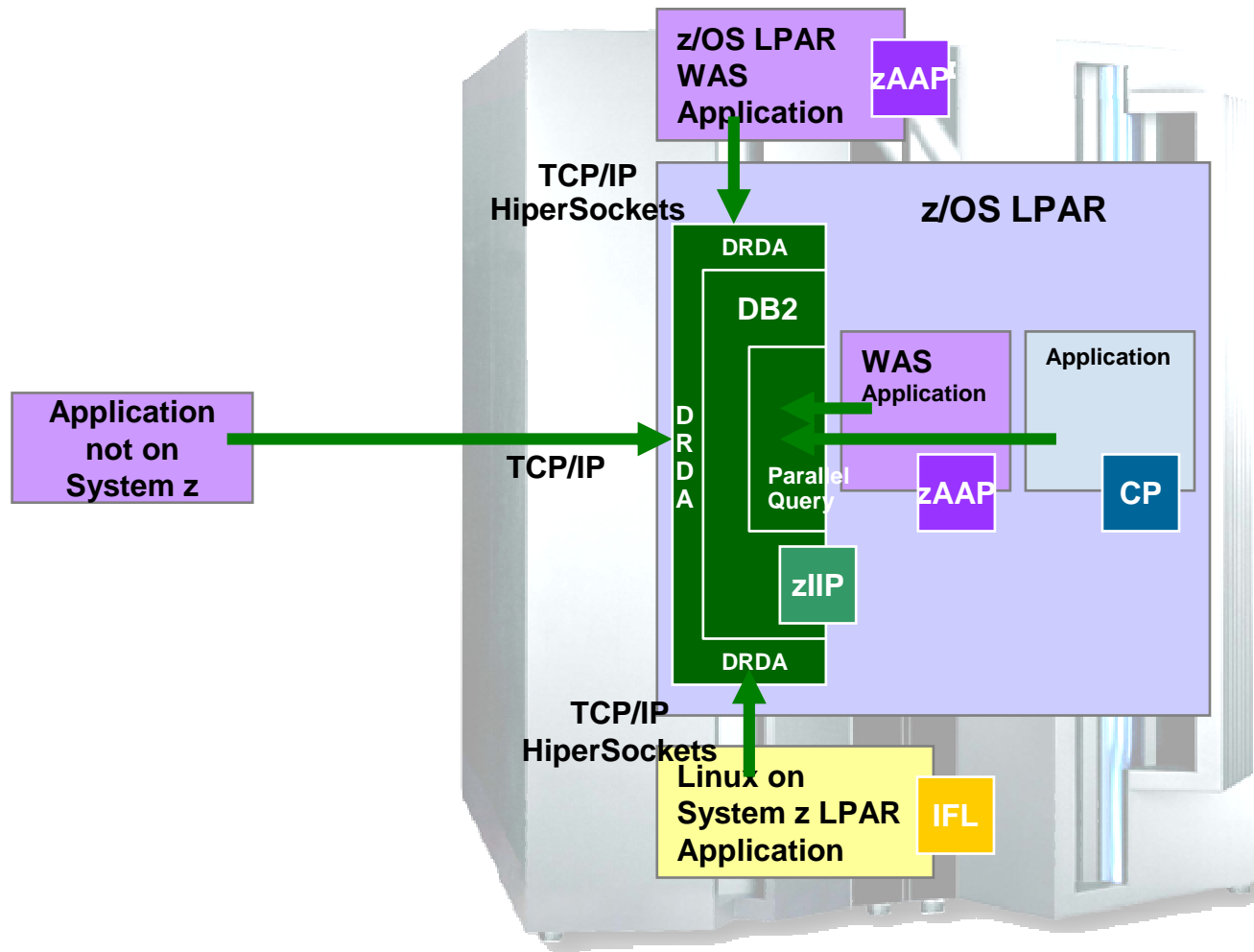


- DFSORT :
 - Introduced in August 2009
 - Applicable to in-memory fixed length record sort processing
 - Pre-requisites :
 - z/OS 1.10, DB2 APAR PK85889 (V8, DB2 9), DFSORT APAR PK85856
- **DB2SORT**
 - **Introduced in September 2010**
 - **Applicable to in-memory fixed and variable length record sort processing**
 - **Pre-requisites :**
 - **DB2 APAR PK12819 (V8, DB2 9), Zparm DB2SORT= ENABLE**
- Utilities that benefit :
 - LOAD, REORG, REBUILD INDEX and CHECK INDEX for Index key Sort processing
 - CHECK DATA for Foreign key Sort processing
 - RUNSTATS for COLGROUP processing

Co-existence of zIIP with other Specialty Engines



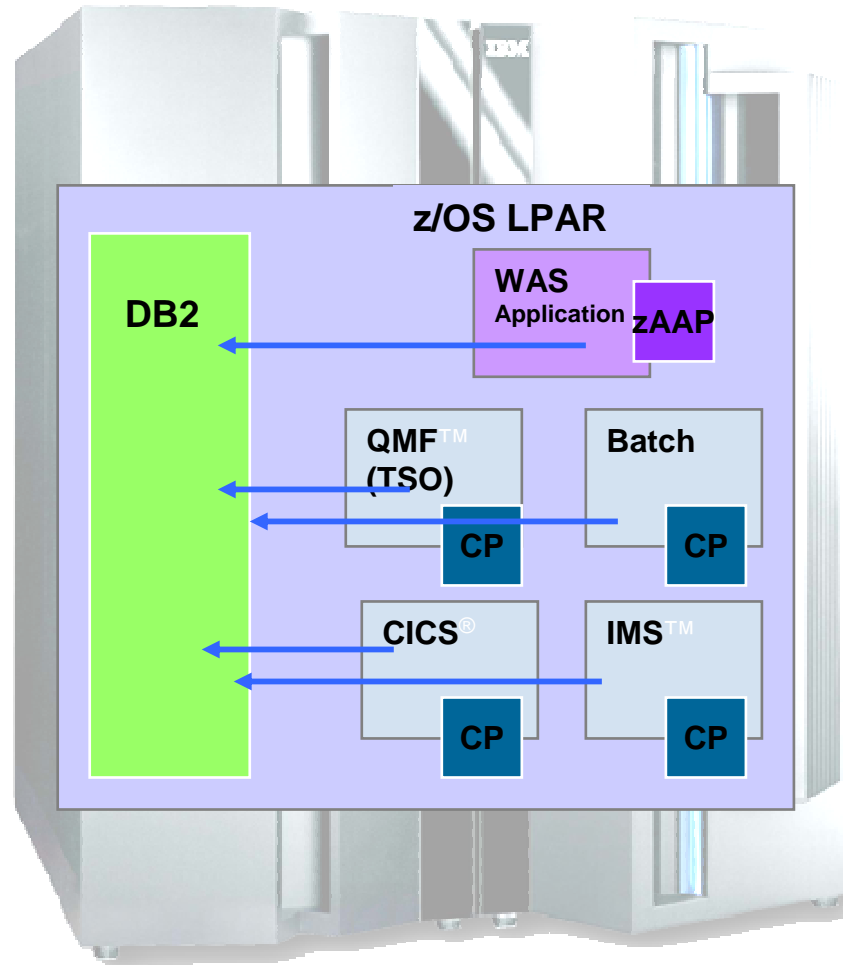
SHARE
Technology • Connections • Results



Some instances where zIIP would not be exploited



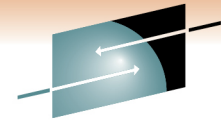
SHARE
Technology • Connections • Results



Exceptions: DB2 parallel queries (zIIP) and XML parsing (zAAP) are eligible.

DB2 Workloads that leverage zAAP

- SQLJ & JDBC applications using IBM JCC Type 2 Universal driver on a z/OS LPAR
 - Connects to DB2 via RRS Attach
- Java based (SQLJ, JDBC) DB2 External Stored Procedures running in a z/OS WLM Application Environment
- z/OS XML System Services called via TCB for XML **Schema validation** & non-validation parsing for z/OS XML documents by Batch applications & Utilities



SHARE
Technology • Connections • Results

zIIP & zAAP Enablement Process

zIIP & zAAP Software Enablement Process

SHARE
Technology • Connections • Results

- **Install z/OS zIIP & zAAP support maintenance**
- **Install DB2 for z/OS support maintenance**
- **Set up SYS1.PARMLIB(IEAOPTxx) member**
 - **When zIIP or zAAP hardware is not installed, set PROJECTCPU=YES for projecting zIIP or zAAP redirect**
 - **No need to be on z9, z10 or zEnterprise Processor for projection**
 - **zIIP / zAAP redirect projection / estimation is shown under APPL% IIPCP / AAPCP in the RMF Workload Activity Report**
 - **Recommend taking default values for the following parameters related scheduling algorithms :**
 - **IIPHONORPRIORITY, ZIIPAWMT for zIIP**
 - **IFAHONORPRIORITY, ZAAPAWMT for zAAP**

zIIP & zAAP Hardware Enablement Using System z Hardware Management Console



SHARE
Technology • Connections • Results

Customize Image Profiles: P66ADI14 : LP01 : Processor

P66ADI14
LP01
General
Processor
Security
Storage
Options
Load
Crypto

Logical Processor Assignments

Dedicated processors

Select	Processor Type	Initial	Reserved
<input checked="" type="checkbox"/>	Central processors (CPs)	3	2
<input checked="" type="checkbox"/>	Integrated facility for applications (IFAs)	2	0
<input checked="" type="checkbox"/>	System z9 integrated information processor (zIIPs)	3	0

Not Dedicated Processor Details for :

CPs IFAs zIIPs

zIIPs

zIIP Details

Initial processing weight: 25 1 to 999 Initial capping

Enable workload manager

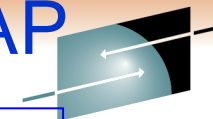
Minimum processing weight: 0

Maximum processing weight: 0

Save Copy Notebook Paste Profile Cancel Help

Done

Display CPU information with zIIP & zAAP



SHARE

Technology • Connections • Results

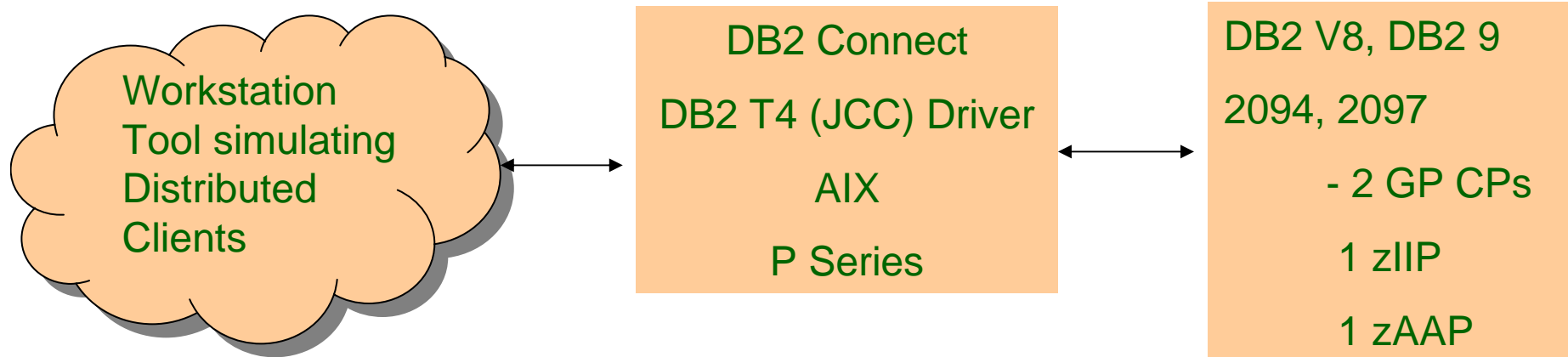
```
D M=CPU
IEE174I 10.37.03 DISPLAY
PROCESSOR STATUS
ID  CPU              SERIAL
00  +                02B29E2094
01  +                02B29E2094
02  +A              02B29E2094
03  +I              02B29E2094

CPC ND = 002094.S28.IBM.02.00000004B29E
CPC SI = 2094.724.IBM.02.000000000004B29E
CPC ID = 00
CPC NAME = SYSS01
LP NAME = STLABH2      LP ID = 2
CSS ID = 0
MIF ID = 2

+ ONLINE      - OFFLINE      . DOES NOT EXIST      W WLM-MANAGED
N NOT AVAILABLE

A      APPLICATION ASSIST PROCESSOR (zAAP)
I      INTEGRATED INFORMATION PROCESSOR (zIIP)
```

DRDA Workload Measurement Configuration



Workloads :

- ODBC/CLI SQL
- ODBC/CLI calling Stored Procedures
- IBM JCC T4 Driver for JDBC Parallel Queries
- DB2 Utilities
- XML LOAD and INSERT workload

Monitoring System level zIIP & zAAP Redirect with zIIP & zAAP installed



RMF CPU Report for CLI DRDA Workload :

C P U A C T I V I T Y				z/OS V1R7		SYSTEM ID H2	
				RPT VERSION V1R7 RMF			
CPU	2094	MODEL	724	H/W MODEL	S28		
---	CPU---	ONLINE	TIME	LPAR	BUSY	MVS	BUSY
NUM	TYPE	PERCENTAGE	TIME	PERC	TIME	PERC	
0	CP	100.00	22.49		22.49		
1	CP	100.00	21.72		21.72		
CP	TOTAL/AVERAGE		22.11		22.11	←	CP CPU %
2	AAP	100.00	0.10		0.10		
AAP	AVERAGE		0.10		0.10	←	zAAP CPU %
3	IIP	100.00	32.47		32.47		
IIP	AVERAGE		32.47		32.47	←	zIIP CPU %

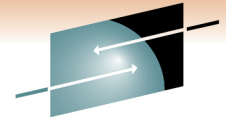
zIIP Redirect % at the LPAR level = 42%

RMF report SYSIN :

REPORTS(CPU) for CPU Activity Report

SYSRPTS(WLMGL(SCLASS,RCLASS,POLICY,SYSNAM(XXXX))) for Workload Activity Report





S H A R E

Technology • Connections • Results

Estimation & Monitoring of zIIP Redirect for **DRDA Workload**

RMF Workload Activity Report Showing CLI SQL DRDA zIIP Estimate

REPORT BY: POLICY=DRDAIC1 ORKLOAD=DB2 **SERVICE CLASS=DDFWORK** RESOURCE GROUP=*NONE PERIOD=1 IMPORTANCE=2
 CRITICAL =NONE **INTERVAL: 55 Sec**

TRANSACTIONS	TRANS-TIME	HHH.MM.SS.TTT	--DASD I/O--	---SERVICE---	SERVICE TIMES	---APPL %---	PAGE-IN RATES	---STORAGE---
AVG	2.89	ACTUAL	14	SSCHRT 494.1	IOC 0	CPU 30.2	SINGLE 0.0	AVG 0.00
MPL	2.89	EXECUTION	14	RESP 0.3	CPU 857374	CP 54.33	BLOCK 0.0	TOT 0.00
ENDED	11137	QUEUED	0	CONN 0.2	MSO 0	IIPCP 29.79	SHARED 0.0	CEN 0.00
END/S	200.22	R/S AFFIN	0	DISC 0.0	SRB 0		HSP 0.0	EXP 0.00
#SWAPS	0	INELIGIBLE	0	Q+PEND 0.1	TOT 857374	AAP 0.00	HSP MISS 0.0	SHR 0.00
EXCTD	0	CONVERSION	0	IOSQ 0.0	/SEC 15413	IIP 0.00	EXP SNGL 0.0	
AVG ENC	2.89	STD DEV	16				EXP BLK 0.0	
REM ENC	0.00				ABSRPTN 5326		EXP SHR 0.0	
MS ENC	0.00				TRX SERV 5326			

Service Times : CPU time includes IIP and AAP time

APPL % is % of a single engine.
 $APPL\% IIP = \text{Service Time IIP} / \text{Report Interval}$
 $APPL\% CP = (\text{Service Time CPU} + \text{SRB} + \text{RCT} + \text{IIT} - \text{AAP} - \text{IIP}) / \text{Report Interval}$

Using WLM Subsystem DDF, Service Class **DDFWORK**

IIPCP shows the zIIP estimate when zIIP hardware is not installed and PROJECTCPU=YES or when zIIP processor configured but offline

Estimated Redirect % = 55% (APPL% IIPCP / APPL% CP)



Tivoli Omegamon DB2PE Accounting Report with CLI SQL DRDA zIIP Redirect Estimate

CONNTYPE: DRDA		
AVERAGE	APPL(CL.1)	DB2 (CL.2)
-----	-----	-----
CP CPU TIME	0.002754	0.001726
AGENT	0.002754	0.001726
NONNESTED	0.002754	0.001726
STORED PRC	0.000000	0.000000
UDF	0.000000	0.000000
TRIGGER	0.000000	0.000000
PAR.TASKS	0.000000	0.000000
SECP CPU	0.001534	N/A
SE CPU TIME	0.000000	0.000000

← Includes SECP CPU time.
Does not include SE CPU time.

← zIIP eligible work run on CP

← CPU time on zIIP

SECP shows the zIIP estimate when zIIP hardware is not installed and PROJECTCPU=YES or when zIIP processor is configured but offline

Estimated Redirect % = 55% (Class 1 SECP / CP)

Note: 'IIP' changed to 'SE' (Specialty Engine) with Omegamon DB2PE APAR PK51045
SE CPU TIME could include zIIP and zAAP CPU time.





RMF Workload Activity Report Showing CLI SQL DRDA zIIP Redirect

REPORT BY: POLICY=DRDAIC1 WORKLOAD=DB2 **SERVICE CLASS=DDFWORK** RESOURCE GROUP=ANR1
INTERVAL: 54 Sec Technology · Connections · Results

TRANSACTIONS	TRANS-TIME	HHH.MM.SS.TTT	--DASD	I/O--	---SERVICE----	SERVICE TIMES	---APPL %---
AVG	2.90	ACTUAL	14	SSCHRT 507.2	IOC	0	CP 24.02
MPL	2.90	EXECUTION	13	RESP 0.3	CPU 831425	SRB 0.0	AAPCP 0.00
ENDED	11384	QUEUED	0	CONN 0.2	MSO 0	RCT 0.0	IIPCP 0.00
END/S	207.84	R/S AFFIN	0	DISC 0.0	SRB 0	IIT 0.0	AAP 0.00
#SWAPS	0	INELIGIBLE	0	Q+PEND 0.1	TOT 831425	HST 0.0	IIP 29.49
EXCTD	0	CONVERSION	0	IOSQ 0.0	/SEC 15179	AAP 0.0	
AVG ENC	2.90	STD DEV	15			IIP 16.2	
REM ENC	0.00				ABSRPTN 5243		
MS ENC	0.00				TRX SERV 5243		

Service Times : CPU time includes IIP and AAP time

APPL % is % of a single engine.
 APPL% IIP = Service Time IIP / Report Interval
 APPL% CP = (Service Time CPU+SRB+RCT+IIT-AAP-IIP) / Report Interval

Using WLM Subsystem DDF, Service Class **DDFWORK**
 Redirect % = Service Time IIP / Service Time CPU
 = APPL% IIP / (APPL% CP+APPL% IIP)
 = 55% for this DRDA workload
 zIIP Redirect % at the LPAR level = 42%



Tivoli Omegamon DB2PE Accounting Report with CLI SQL DRDA zIIP Redirect



CONNTYPE: DRDA		
AVERAGE	APPL(CL.1)	DB2 (CL.2)
-----	-----	-----
CP CPU TIME	0.001197	0.000751
AGENT	0.001197	0.000751
NONNESTED	0.001197	0.000751
STORED PRC	0.000000	0.000000
UDF	0.000000	0.000000
TRIGGER	0.000000	0.000000
PAR.TASKS	0.000000	0.000000
SECP CPU	0.000000	N/A
SE CPU TIME	0.001480	0.000911

- ← **Chargeable CPU time.
Includes SECP CPU time.
Does not include SE CPU time.**
- ← **zIIP eligible work run on CP**
- ← **CPU time on zIIP**

SECP value of zero indicates that 100% of the zIIP eligible work ran on zIIP

$$\begin{aligned}
 \text{Redirect \%} &= \text{Class 1 SE CPU} / (\text{CP CPU} + \text{SE CPU}) \\
 &= 55 \% \text{ for this workload}
 \end{aligned}$$



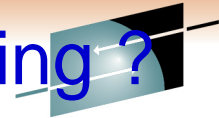
DRDA zIIP Redirect Measurement Summary



SHARE
Technology • Connections • Results

- Measured with CLI SQL, JDBC and Stored Procedure distributed workloads.
 - CLI workload achieved expected redirect %
 - WLM Managed Stored Procedure achieved 10% redirect
 - Stored Procedure Call, Results set and Commit processing eligible for zIIP redirect.
- Parallel Query workload achieved expected redirect %
- DB2 9 DRDA Native SQL Procedure Language Stored Procedure SQL processing and XML Schema validation and non-validation parsing are eligible for zIIP redirect
- DRDA zIIP redirect up to 60% with APAR PM12256 with improved performance

What is new with zIIP, zAAP OMPE reporting?



SHARE
Technology • Connection • Results

- Tivoli Omegamon DB2PE Accounting report changes with APARs PK51045 & PK50575 :
 - IIP changed to SE to indicate that the value may include CPU usage from either or both Specialty Engines (zIIP & zAAP)
 - Example :
 - **SE CP CPU** will include zIIP CPU and zAAP CPU for a DRDA SQLJ Java External Stored Procedure workload
- SECP (projection / overflow) does not include zAAP overflow or zAAP projection
 - Applicable only to zIIP in DB2 V8 and DB2 9
- SECP (projection / overflow) is not reported in DB2 10.
 - Need to use RMF Workload Activity Report Service / Reporting Class information

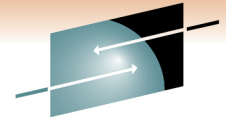


What's new with DB2 address space CPU reporting?

- **OMPE Statistics Report CPU section shows the zIIP redirect for DB2 10 DBM1 Prefetch and Deferred Write processing :**

CPU TIMES	TCB TIME	PREEMPT SRB	NONPREEMPT SRB	TOTAL TIME	PREEMPT IIP SRB	/COMMIT
SYSTEM SERVICES ADDRESS SPACE	0.012387	0.000777	0.003326	0.016490	N/A	0.008245
DATABASE SERVICES ADDRESS SPACE	0.375790	24.036392	0.002450	24.414632	1:03.304060	12.207316
IRLM	0.000018	0.000000	0.078741	0.078759	N/A	0.039379
DDF ADDRESS SPACE	0.000267	0.000018	0.000133	0.000418	0.000000	0.000209
TOTAL	0.388461	24.037188	0.084651	24.510300	1:03.304060	12.255150

- **PREEMPT IIP SRB time shows the CPU time redirected to zIIP**
- **/COMMIT shows the chargeable (non-zIIP) CP CPU time**



S H A R E

Technology • Connections • Results

Estimation & Monitoring of zIIP Redirect for Parallel Query Workload

RMF Workload Activity Report

Showing Local Parallel Query zIIP Redirect Estimate



REPORT BY: POLICY=DRDAIC1

REPORT CLASS=SSPQ1
HOMOGENEOUS: GOAL DERIVED FROM SERVICE CLASS BATCH_M

TRANSACTIONS	TRANS-TIME	HHH.MM.SS.TTT	--DASD I/O--	---SERVICE---	-- SERVICE TIMES--	APPL %---
AVG	0.20	ACTUAL	3.57.786	SSCHRT 0.4	IOC 94	CPU 129.2 CP 10.75
MPL	0.20	EXECUTION	3.56.910	RESP 8.1	CPU 3559K	SRB 0.0 AAPCP 0.00
ENDED	1	QUEUED	875	CONN 2.9	MSO 0	RCT 0.0 IIPCP 8.46
END/S	0.00	R/S AFFIN	0	DISC 1.0	SRB 23	IIT 0.0
#SWAPS	1	INELIGIBLE	0	Q+PEND 0.2	TOT 3559K	HST 0.0 AAP 0.00
EXCTD	0	CONVERSION	0	IOSQ 4.0	/SEC 2961	AAP 0.0 IIP 0.00
AVG ENC	0.00	STD DEV	0			IIP 0.0
REM ENC	0.00				ABSRPTN 15K	
MS ENC	0.00				TRX SERV 15K	

Using WLM Subsystem JES, Service Class BATCH_M , Reporting Class SSPQ1
With Classification Qualifier TN for Job Name

IIPCP shows the zIIP estimate when zIIP hardware is not installed
and PROJECTCPU=YES or when zIIP processor configured but offline

Estimated Redirect % = 79% (APPL% IIPCP / APPL% CP)

Tivoli Omegamon DB2PE Accounting Report with Local Parallel Query zIIP Estimate



PLANNAME: DSNTEP2		
AVERAGE	APPL(CL.1)	DB2 (CL.2)
-----	-----	-----
CP CPU TIME	54.689704	54.681809
AGENT	6.774643	6.766781
NONNESTED	6.774643	6.766781
STORED PRC	0.000000	0.000000
UDF	0.000000	0.000000
TRIGGER	0.000000	0.000000
PAR.TASKS	47.915061	47.915027
SECP CPU	38.242719	N/A
SE CPU TIME	0.000000	0.000000

← **Chargeable CPU time.
Includes SECP CPU time.
Does not include SE CPU time.**

← **zIIP eligible work run on CP**

← **CP time on zIIP**

SECP shows the zIIP estimate when zIIP hardware is not installed and PROJECTCPU=YES or when zIIP processor is configured but offline

Estimated Redirect % = 70% (SECP / CP)

41 Note: 'IIP' changed to 'SE'(Specialty Engine) with Omegamon DB2PE APAR PK51045
SE CPU TIME could include zIIP and zAAP CPU time

RMF Workload Activity Report

Showing Local Parallel Query zIIP Redirect



REPORT BY: POLICY=DRDAIC1

REPORT CLASS=SSPQ1

HOMOGENEOUS: GOAL DERIVED FROM SERVICE CLASS BATCH_M

TRANSACTIONS	TRANS-TIME	HHH.MM.SS.TTT	--DASD	I/O--	---SERVICE---	SERVICE TIMES	---APPL	%---		
AVG	0.19	ACTUAL	3.52.930	SSCHRT	0.4	IOC 94	CPU	129.1	CP	2.23
MPL	0.19	EXECUTION	3.52.074	RESP	8.9	CPU 3556K	SRB	0.0	AAPCP	0.00
ENDED	1	QUEUED	856	CONN	3.1	MSO 0	RCT	0.0	IIPCP	0.01
END/S	0.00	R/S AFFIN	0	DISC	1.5	SRB 28	IIT	0.0		
#SWAPS	1	INELIGIBLE	0	Q+PEND	0.1	TOT 3556K	HST	0.0	AAP	0.00
EXCTD	0	CONVERSION	0	IOSQ	4.2	/SEC 2845	AAP	0.0	IIP	8.11
AVG ENC	0.00	STD DEV	0				IIP	101.3		
REM ENC	0.00					ABSRPTN		15K		
MS ENC	0.00					TRX SERV		15K		

Using WLM Subsystem JES, Service Class BATCH_M , Reporting Class SSPQ1
With Classification Qualifier TN for Job Name

Redirect % = Service Time IIP / Service Time CPU (more accurate)
= APPL% IIP / (APPL% CP+APPL%IIP)
= 78 % for this Query

Tivoli Omegamon DB2PE Accounting Report with Local Parallel Query zIIP Redirect



PLANNAME: DSNTEP2		
AVERAGE	APPL(CL.1)	DB2 (CL.2)
-----	-----	-----
CP CPU TIME	19.373768	19.365788
AGENT	6.779348	6.771411
NONNESTED	6.779348	6.771411
STORED PRC	0.000000	0.000000
UDF	0.000000	0.000000
TRIGGER	0.000000	0.000000
PAR.TASKS	12.594420	12.594377
SECP CPU	2.813831	N/A
SE CPU TIME	35.886951	35.886951

← Chargeable CPU time.
Includes IIPCP CPU time.
Does not include IIP CPU time.

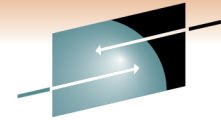
← zIIP eligible but ran on CP

← CPU time on zIIP

Total zIIP eligible work % = 70% ((SE +SECP) / (CP+SE))
zIIP Redirect % = 65% ((SE / (CP+SE))
zIIP eligible but ran on CP = 5% ((SECP / (CP+SE))

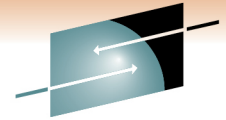


Parallel Query zIIP Redirect Measurement Summary



SHARE
Technology Community Results

- Measurement done with local and distributed Star Schema and non Star Schema parallel queries.
 - Distributed parallel queries benefit from the DRDA zIIP redirect for the Main task as well.
- No significant increase in Total CPU (CP + zIIP) and elapsed time.
- IFCID 231 has been enhanced to provide zIIP related CPU information.
- Increased zIIP redirect potential with Star Join dynamic Index ANDing enhancement in DB2 9.
- More queries enabled for parallelism in DB2 10.
- Buffer Pool Prefetch processing redirected to zIIP in DB2 10.



S H A R E

Technology • Connections • Results

Estimation & Monitoring of zIIP Redirect for Utility Workload

RMF Workload Activity Report

Showing Rebuild Index Utility zIIP Redirect Estimate



REPORT BY: POLICY=DRDAIC1

REPORT CLASS=RBLDINDX

DESCRIPTION =DB2 REBUILD INDEX

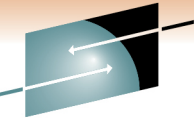
TRANSACTIONS	TRANS-TIME	HHH.MM.SS.TTT	--DASD	I/O--	---SERVICE---	SERVICE	TIMES	---APPL	%---		
AVG	0.17	ACTUAL	3.29.961	SSCHRT	312.3	IOC	176	CPU	82.3	CP	17.44
MPL	0.17	EXECUTION	1.18.230	RESP	0.3	CPU	2267K	SRB	0.0	AAPCP	0.00
ENDED	1	QUEUED	2.11.731	CONN	0.2	MSO	0	RCT	0.0	IIPCP	4.56
END/S	0.00	R/S AFFIN	0	DISC	0.0	SRB	50	IIT	0.0		
#SWAPS	1	INELIGIBLE	0	Q+PEND	0.1	TOT	2267K	HST	0.0	AAP	0.00
EXCTD	0	CONVERSION	0	IOSQ	0.0	/SEC	4804	AAP	0.0	IIP	0.00
AVG ENC	0.00	STD DEV	0					IIP	0.0		
REM ENC	0.00					ABSRPTN	29K				
MS ENC	0.00					TRX SERV	29K				

Using WLM Subsystem JES, Service Class BATCH_M , Reporting Class RBLDINDX
With Classification Qualifier TN for Job Name

IIPCP shows the zIIP estimate when zIIP hardware is not installed
and PROJECTCPU=YES or when zIIP processor configured but offline

Estimated Redirect % = $\text{APPL\% IIPCP} / \text{APPL\% CP}$
= 26%

Tivoli Omegamon DB2PE Accounting Report with Utility Workload zIIP Estimate



SHARE
Technology • Connections • Results

PLANNAME:DSNUTIL or CONNTYPE:UTILITY		
AVERAGE	APPL(CL.1)	DB2 (CL.2)
-----	-----	-----
CP CPU TIME	1:03.92512	31.245707
AGENT	14.005918	11.460791
NONNESTED	14.005918	11.460791
STORED PRC	0.000000	0.000000
UDF	0.000000	0.000000
TRIGGER	0.000000	0.000000
PAR.TASKS	49.919203	19.784917
SECP CPU	16.045606	N/A
SE CPU TIME	0.000000	0.000000

← **Chargeable CPU time.
Includes SECP CPU time.
Does not include SE CPU time.**

← **zIIP eligible work run on CP**

← **CPU time on zIIP**

**SECP shows the zIIP estimate when zIIP hardware is not installed
and PROJECTCPU=YES or when zIIP processor is configured but offline**

Estimated Redirect % = 25% (SECP / CP)

SHARE
in Anaheim
2011

47 Note: 'IIP' changed to 'SE' (Specialty Engine) with Omegamon DB2PE APAR PK51045011
SE CPU TIME could include zIIP and zAAP CPU time

RMF Workload Activity Report

Showing Rebuild Index Utility zIIP Redirect



REPORT BY: POLICY=DRDAIC1

REPORT CLASS=RBLDINDX

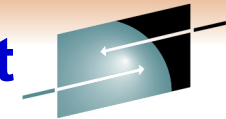
HOMOGENEOUS: GOAL DERIVED FROM SERVICE CLASS BATCH_M

TRANSACTIONS	TRANS-TIME	HHH.MM.SS.TTT	--DASD	I/O--	---	SERVICE---	SERVICE	TIMES	---	APPL	%---
AVG	0.17	ACTUAL	3.01.033	SSCHRT	357.0	IOC	178	CPU	81.5	CP	15.84
MPL	0.17	EXECUTION	1.08.519	RESP	0.3	CPU	2313K	SRB	0.0	AAPCP	0.00
ENDED	1	QUEUED	1.52.514	CONN	0.2	MSO	0	RCT	0.0	IIPCP	1.47
END/S	0.00	R/S AFFIN	0	DISC	0.0	SRB	51	IIT	0.0		
#SWAPS	1	INELIGIBLE	0	Q+PEND	0.1	TOT	2313K	HST	0.0	AAP	0.00
EXCTD	0	CONVERSION	0	IOSQ	0.0	/SEC	5603	AAP	0.0	IIP	3.91
AVG ENC	0.00	STD DEV	0					IIP	16.1		
REM ENC	0.00					ABSRPTN	34K				
MS ENC	0.00					TRX SERV	34K				

Using WLM Subsystem JES, Service Class BATCH_M , Reporting Class RBLDINDX
With Classification Qualifier TN for Job Name

Redirect % = Service Time IIP / Service Time CPU (Accurate)
= APPL% IIP / (APPL% CP+APPL%IIP)
= 20 % for this Rebuild Index Utility

Tivoli Omegamon DB2PE Accounting Report for Utility Workload zIIP Redirect



SHARE
Technology • Connections • Results

PLANNAME: DSNUTIL or CONNTYPE: UTILITY

AVERAGE	APPL(CL.1)	DB2 (CL.2)
-----	-----	-----
CP CPU TIME	52.070150	19.363503
AGENT	13.315781	10.777834
NONNESTED	13.315781	10.777834
STORED PRC	0.000000	0.000000
UDF	0.000000	0.000000
TRIGGER	0.000000	0.000000
PAR.TASKS	38.754370	8.585669
SECP CPU	3.808629	N/A
SE CPU TIME	12.759936	12.759936

← **Chargeable CPU time.
Includes IIPCP CPU time.
Does not include IIP CPU time.**

← **zIIP eligible but ran on CP**

← **CPU time on zIIP**

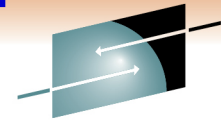
Total zIIP eligible work % = 26% ((SE +SECP) / (CP+SE))

zIIP Redirect % = 20% ((SE / (CP+SE))

zIIP eligible but ran on CP = 6% ((SECP / (CP+SE))

Note: 'IIP' changed to 'SE' (Specialty Engine) with Omegamon DB2PE APAR PK51045
SE CPU TIME could include zIIP and zAAP CPU time

Utility zIIP Redirect with DFSORT

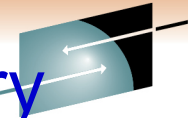


S H A R E

Technology • Connections • People

- Introduced in Aug 2009 for zIIP redirect for DFSORT processing for some DB2 Utilities
 - Applicable to in-memory fixed length record sort processing in DFSORT
- Utilities that benefit :
 - LOAD, REORG, REBUILD INDEX and CHECK INDEX for Index key Sort processing
 - CHECK DATA for Foreign key Sort processing
 - RUNSTATS for COLGROUP processing
- Measured zIIP redirect benefit
 - 30% to 60% of DFSORT CPU
 - 10% to 40% of total Utility CPU
 - Varies with number of Indices
 - More benefit with more Indices
 - Measurement with up to 6 Indices

Utility zIIP Redirect Measurement Summary



SHARE
Technology • Connections • Results

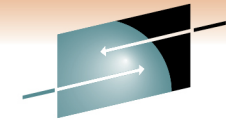
- Measured LOAD, REBUILD INDEX and REORG Utilities.
- zIIP redirect % depends on % CPU consumed by the Build Index phase of the Utility.
- Observed Class 1 CPU reduction for configuration with 4 CPs and 2 zIIPs with fixed length Index key :
 - 5 to 20% for Rebuild Index
 - 10 to 20% for Load or Reorg of a Partition with one Index only, or Load of entire Table, or Reorg of entire Tablespace
 - 40% for Rebuild Index of logical Partition of Non Partitioning Index
 - 40 to 50% for Reorg Index
 - 30 to 60% for Load or Reorg of a Partition with more than one Index
- CPU overhead incurred during execution unit switch from TCB to enclave SRB during Index Rebuild phase
 - Typically less than 10%
 - Eligible for zIIP redirect
- Additional zIIP redirect for portions of DFSORT, DB2SORT and RUNSTATS COLGROUP processing
- DB2 10 zIIP redirect for portions of RUNSTATS processing

DB2 XML related zIIP,zAAP enhancements



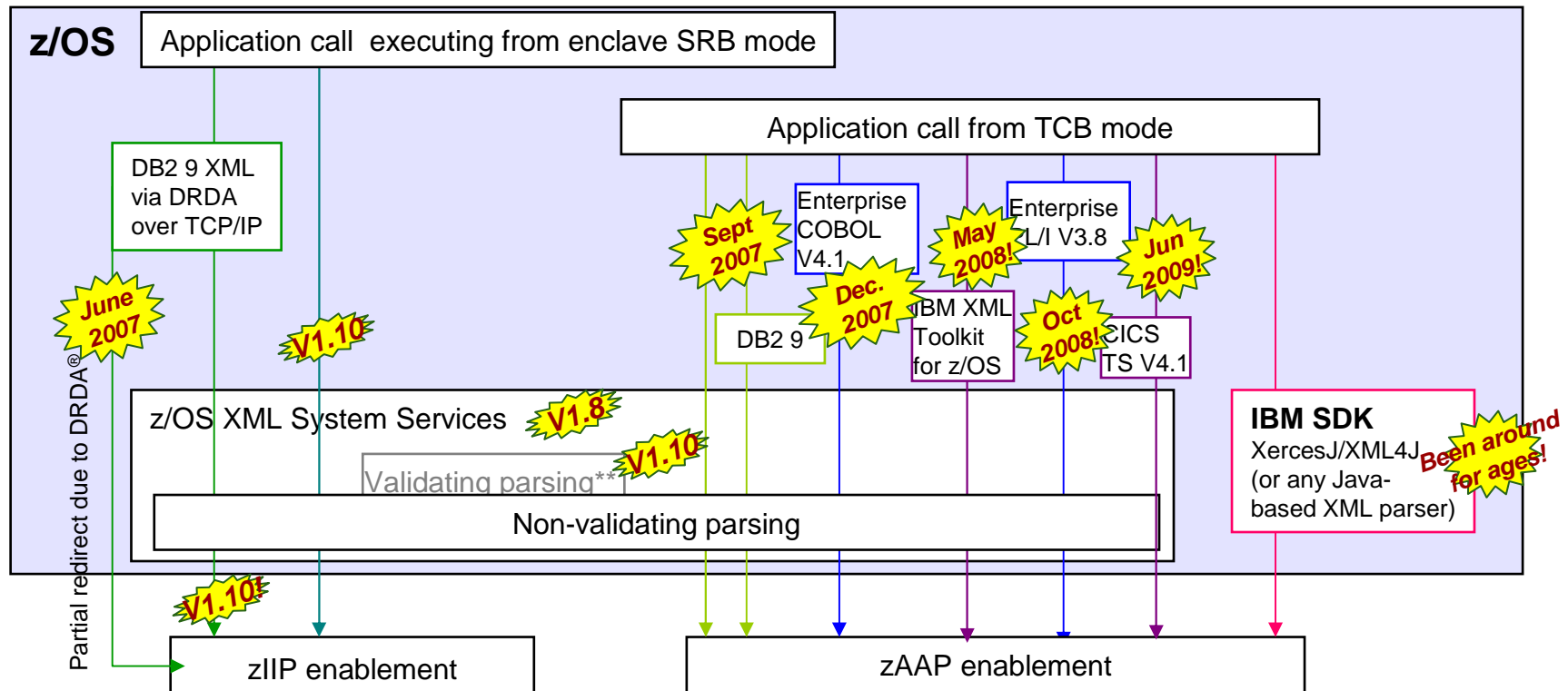
- z/OS XML System Services using zAAP (Sep 2007- OA20308)
 - **Benefits DB2 9 NFM XML Schema non-validation Parsing**
 - XML Applications (Insert, Update)
 - XML LOAD Utility
 - **zAAP redirect for TCB processing**
- z/OS XML System Services zIIP redirect for enclave SRB processing (July 2008 – OA23828)
- **DB2 10 XML Schema validation parsing eligible for zIIP or zAAP redirect**
 - Available in z/OS 1.9. Performance improvement with APAR OA32251 on z/OS 1.10
 - Enabled in DB2 9 via APARs PK90032, PK90040
 - UDF call avoided
- **Whitepaper on DB2 9 use of XML System Services :**
<http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101088>

z/OS XML System Services zIIP or zAAP eligibility summary



SHARE
Technology • Connections • Results

ALL validating and non validating parsing performed by z/OS XML System Services is eligible for zAAP or zIIP!



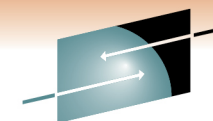
→ How much work is eligible for the zIIP or zAAP will depend on amount of XML data being processed

XML System Services Parsing Measurements Summary



- **zAAP** redirect for XML LOAD Utility
 - 17 to 36% of XML System Services Parsing processing was redirected to **zAAP**
 - Higher **zAAP** redirect with
 - *Larger doc size, # of nodes*
 - *Fewer indices*
- **zIIP** redirect for DRDA TCP/IP XML Insert, Update applications
 - Depends on the degree of XML parsing
 - Redirect is in addition to the base DRDA redirect
 - 63% **zIIP** redirect for Lab XML INSERT workload

New Tivoli Omegamon DB2 PE Accounting Report Layout Showing XML LOAD zAAP Redirect



SHARE

Technology • Connections • Results

AVERAGE	APPL (CL.1)	DB2 (CL.2)
-----	-----	-----
ELAPSED TIME	11:36.6837	11:27.1818
NONNESTED	11:36.6837	11:27.1818
STORED PROC	0.000000	0.000000
UDF	0.000000	0.000000
TRIGGER	0.000000	0.000000
CP CPU TIME	3:29.67361	3:23.08585
AGENT	3:29.53441	3:23.08558
NONNESTED	3:29.53441	3:23.08558
STORED PRC	0.000000	0.000000
UDF	0.000000	0.000000
TRIGGER	0.000000	0.000000
PAR.TASKS	0.139205	0.000270
SECP CPU	0.000079	N/A
SE CPU TIME	57.497246	57.497246
NONNESTED	57.497246	57.497246
STORED PROC	0.000000	0.000000
UDF	0.000000	0.000000
TRIGGER	0.000000	0.000000
PAR.TASKS	0.000000	0.000000
SUSPEND TIME	0.000000	5:43.35838
AGENT	N/A	5:43.35838
PAR.TASKS	N/A	0.000000
STORED PROC	0.000000	N/A
UDF	0.000000	N/A
NOT ACCOUNT.	N/A	1:23.24058

Changes introduced by APARs :

DB2 9 : PK50575

Omegamon DB2PE : PK51045

<-- New - Replaces IIPCP CPU

<-- New - Replaces IIP CPU Time

New report fields :

SE CPU : Includes both zIIP & zAAP CPU usage

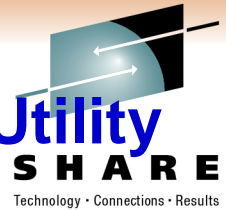
SECP : zIIP eligible work that ran on CP due zIIP overflow or with PROJECTCPU=YES

Does not show similar zAAP information - use to RMF report AAPCP info.

SHARE
in Anaheim

2011

RMF Workload Activity Report for XML LOAD Utility



REPORT BY: POLICY=POL_XML WORKLOAD=BATCH SERVICE CLASS=BATCHMED RESOURCE GROUP=*NONE PERIOD=1 IMPORTANCE=3
 CRITICAL =NONE

-TRANSACTIONS-	TRANS-TIME	HHH.MM.SS.TTT	--DASD I/O--	---SERVICE----	--SERVICE TIMES--	---APPL %---	-----STORAGE-----	
AVG	6.50	ACTUAL	9.50.231	SSCHRT 665.2	IOC 884057	CPU 1448.496	CP 188.65	AVG 3751.48
MPL	6.50	EXECUTION	8.46.172	RESP 0.3	CPU 398897K	SRB 0.862	AAPCP 0.04	TOTAL 24368.79
ENDED	4	QUEUED	1.04.059	CONN 0.2	MSO 0	RCT 0.000	IIPCP 0.00	SHARED 0.00
END/S	0.01	R/S AFFIN	0	DISC 0.0	SRB 237449	IIT 0.155		
#SWAPS	0	INELIGIBLE	0	Q+PEND 0.1	TOT 400019K	HST 0.000	AAP 53.16	--PAGE-IN RATES--
EXCTD	0	CONVERSION	0	IOSQ 0.0	/SEC 667455	AAP 318.578	IIP 0.05	SINGLE 0.0
AVG ENC	0.00	STD DEV	0			IIP 0.329		BLOCK 0.0
REM ENC	0.00				ABSRPTN 103K			SHARED 0.0
MS ENC	0.00				TRX SERV 103K	PROMOTED 0.000		HSP 0.0

GOAL: EXECUTION VELOCITY 40.0% VELOCITY MIGRATION: I/O MGMT 73.9% INIT MGMT 73.9%

XML LOAD job was run under Service Class BATCHMED.

zAAP redirection is 22% (= 53.16/(188.65+53.16)*100), (APPL% AAP / (CP + AAP))

Similar to the Omegamon DB2PE redirection % (SE CPU / (CP CPU + SE CPU))

AAPCP of 0.04 is showing that there was a small overflow from zAAP

Summary



- Easy implementation
 - No DB2 application change or tuning options
- Additional DB2 9 zIIP redirect capabilities with :
 - DRDA Native SQL Procedure workload
 - DRDA **SQL/XML Schema validation** and non-validation parsing
 - Enhancements to Star Join parallel queries using dynamic Index ANDing
- Additional DB2 9 zAAP redirect with **XML Schema validation** and non-validation parsing
- DRDA zIIP redirect up to 60% and improved performance with APAR PM12256
- DB2 10 : zIIP redirect for Buffer Pool Prefetch , Deferred Write processing, and portions of RUNSTATS processing
- DB2 10 : Additional queries enabled for parallelism
- **zIIP & zAAP can be leveraged to grow or develop or port new distributed and business intelligence and XML applications on DB2 for z/OS in a cost effective way.**
 - Frees up general purpose CP cycles for other workload processing
- **Reference Information: <http://www.ibm.com/systems/z/specialtyengines/>**