



# z/OS zEnterprise Data Compression Usage and Configuration - BSAM/QSAM Exploitation

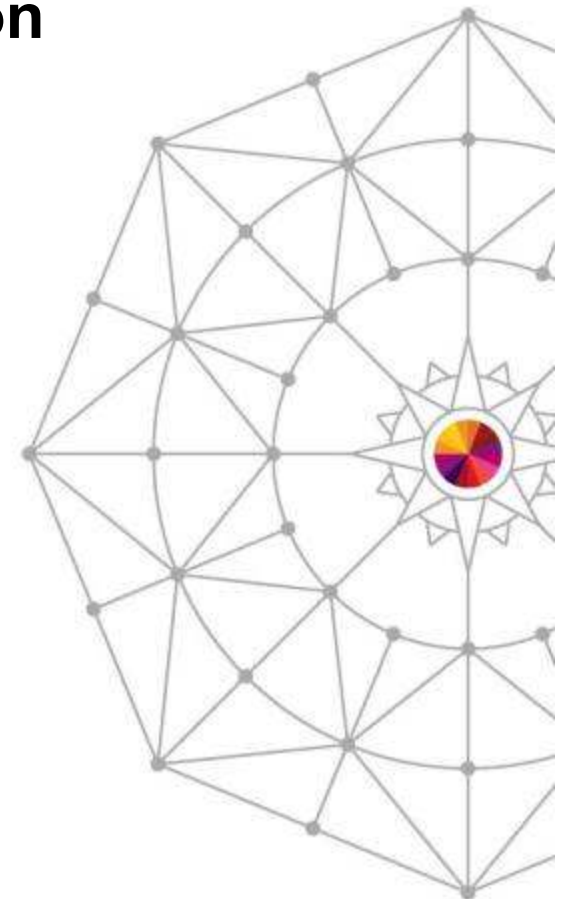
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March 13, 2014  
Session 15080



3/17/14: Includes minor updates post SHARE>



# Agenda

- BSAM/QSAM Compression
  - zEDC Value
  - Configuration
  - Setup and Use
  - Coexistence
  - Identifying Candidates
  - Performance data shows value!

# IBM z Enterprise Data Compression

## *New data compression offering*



### What is it?

- ✓ *zEDC Express is an IO adapter that does high performance industry standard compression*
- ✓ *Used by z/OS Operating System components, IBM Middleware and ISV products*
- ✓ *Applications can use zEDC via industry standard APIs (zlib and Java)*
- ✓ *Each zEDC Express sharable across 15 LPARs, up to 8 devices per CEC.*
- ✓ *Raw throughput up to **1 GB/s** per zEDC Express Hardware Adapter*

### What Changes?

It is time to revisit your decisions about compression.

- **Disk Savings:** Many people are already getting value from CMPSC compression and software compression today
- **Performance:** High throughput alternative to existing System Z compression for large or active files.
- **Industry Standard:** Low cost compressed data exchange across all platforms
- **Pervasive:** Standard APIs allow quick adoption by middleware products running on System Z

### What is the Value?

#### **New sources of customer value**

- **QSAM/BSAM** compression can save disk cost
- **Business Partner Data Exchange** can have higher throughput with lower CPU cost
- **Sterling Connect:Direct** saves additional link bandwidth, elapsed time.
- **ISV Products** delivery expanded customer value
- **Java** transparently accelerates java.util.zip
- **IBM Encryption Facility** for standard compliant data exchange
- **Improved availability** with SMF compression

# QSAM/BSAM zEDC – Value



**z/OS DFSMS (BSAM/QSAM) introduces a new type of compression (zEDC) for non-VSAM extended format data sets.**

- **Value: For customers who don't use BSAM/QSAM compression today**

Customers who don't currently compress their BSAM/QSAM data can take advantage of the disk space savings available through zEDC compression with minimal CPU overhead.

- **Value: For customers who currently do use BSAM/QSAM compression**

The CPU cost of compressing BSAM/QSAM data can be reduced when using zEDC compression compared to existing BSAM/QSAM compression options. Note that the disk space savings may vary depending on the type of compression used.

# zEDC Configuration

## ▪ Operating system requirements

- Requires z/OS 2.1
  - PTFs for new zEDC Express for z/OS feature\*
  - PTFs for BSAM/QSAM zEDC exploitation\*
    - APAR OA42195
- Coexistence PTFs for z/OS V1.13 and V1.12\*
  - offer software decompression support only

## ▪ Server requirements

- Exclusive to zEC12 and zBC12
- New zEDC Express feature for PCIe I/O drawer (FC#0420)
  - With the March 31, 2014 Firmware MCL release
  - Note: Each feature can be shared across up to 15 LPARs; Up to 8 features available on zEC12 or zBC12
- zEDC Express for z/OS feature must be enabled in an IFAPRDxx PARMLIB member.

(\*) Planned availability 1Q2014

# zEDC Configuration cont

## Considerations for allocating a *non-VSAM compressed format data set*

- DFSMS does not require the zEDC Express feature to be available in order to allocate a zEDC compressed format data set
  - DFSMS cannot differentiate between a system where the feature is not configured and a system where the feature is configured but not available.
- If not on a zEC12/zBC12, there are times where DFSMS may still allocate a zEDC compressed format data set.
- *In these cases,*
  - *BSAM/QSAM will write data non-compressed;*
  - *BSAM/QSAM will continue to invoke zEDC to decompress existing compressed data, however, zEDC will use software decompression.*
- ***For best performance, zEDC Express is needed on all systems accessing the compressed data***

# QSAM/BSAM zEDC – Setup

DFSMS (BSAM/QSAM) introduces a new type of compression for non-VSAM extended format data sets: **zEDC compression**.

- The customer can request new zEDC compression for new data sets in a similar manner to how the existing types of compression (generic and tailored compression) are requested.
  - It can be selected at either or both the data set level or system level.
    - **Data set level**
      - In addition to existing Tailored (T) and Generic (G) values, new **zEDC Required (ZR)** and **zEDC Preferred (ZP)** values will be available on the COMPACTION option in data class.
      - When COMPACTION=Y in data class, the system level is used
    - **System level**
      - In addition to existing TAILORED and GENERIC values, new **zEDC Required (ZEDC\_R)** and **zEDC Preferred (ZEDC\_P)** values will be available on the COMPRESS parameter found in IGDSMSxx member of SYS1.PARMLIB.
- Can be activated using **SET SMS=xx** or at IPL
  - Data class continues to take precedence over system level. The default continues to be **GENERIC**.



# QSAM/BSAM zEDC – Setup cont.

## Use of Extended Format Version 2

zEDC Compressed Format data sets are created as Version 2 data sets ...regardless of the user's specification in DataClass, JCL or SYS1.PARMLIB.

- Extended format V2 data sets are new in V2.1.
  - *Created to allow DFSMSdss support for FlashCopy® when copying sequential, non-striped, multivolume EF V2 data sets*
- Minor incompatibility between V1 and V2: FEOV is not supported on output for V2 data sets; results in an abend 737-48.



# Request via SMS Data Class



Panel Utilities Scroll Help		
DGTD CDC9	DATA CLASS DEFINE/ALTER	Page 3 of 6
Command ==>		
SCDS Name . . . : USER6.MYSCDS		
Data Class Name : DC93		
To DEFINE/ALTER Data Class, Specify:		
Compaction . . . . .	—	(Y, N, T, G, ZR, ZP or blank)
Spanned / <u>Nonspanned</u> . . . . .		(S, N or blank)
System Determined <u>Blocksize</u> . . . . .	N	(Y or N)
EATTR . . . . .		(O, N or blank)
Use ENTER to Perform Verification; Use UP/DOWN Command to View other Panels; Use HELP Command for Help; Use END Command to Save and Exit; CANCEL to Exit.		

## New Compaction values

**ZP: Prefer zEDC compression.** The system will not fail the allocation request but rather create either a tailored compressed data set if the zEDC function is not supported by the system or create a non-compressed extended format data set if the minimum allocation amount requirement (5MB, or 8MB Primary if no Secondary) is not met.

**ZR: Require zEDC compression.** The system will fail the allocation request if the zEDC function is not supported by the system or the minimum allocation amount requirement (5MB, or 8MB Primary if no Secondary) is not met.



# Request via SMS Parmlib

- To request the use of zEDC compression at the system level (COMPACTION=Y in Data Class) when creating new compressed format data sets, new values are defined for the COMPRESS parameter found in IGDSMSxx member of SYS1.PARMLIB.

**COMPRESS(TAILORED|GENERIC|zEDC\_R|zEDC\_P)**

- **zEDC\_R** tells the system to fail the allocation request if the zEDC function is not supported by the system or the minimum allocation amount requirement (5MB, or 8MB Primary if no Secondary) is not met.
- **zEDC\_P** tells the system to not fail the allocation request but rather create either a tailored compressed data set if the zEDC function is not supported by the system or create a non-compressed extended format data set if the minimum allocation amount requirement (5MB, or 8MB Primary if no Secondary) is not met.

*Therefore, when the default system level is modified to specify zEDC\_R or zEDC\_P, all new allocation requests using a data class with COMPACTION=Y will request zEDC compression.*

# DFA -

## New fields to indicate DFSMS zEDC SW installed

60 (3C)	Bit string	4	DFAFEAT9	Features byte 9
	1... ..		DFAJ3AA	JES3_ALLOC_ASSIST ENABLED
	.1.. ..		DFAMEMUX	Reserved
	...1. ....		DFAPDSEG	PDSE Generation support is installed
	...1 ....		DFAZEDCCMP	zEDC Compression support is installed
	.... xxxx			Reserved
...				
...				
80 (50)	Unsigned	1	DFACMPTYPEDEF	Default compression type (found in IGDSMSxx COMPRESS)
		0	DFACMPTYPEGEN	Generic compression
		1	DFACMPTYPETLRD	Tailored compression
		2	DFACMPTYPEzEDCR	zEDC compression required
		3	DFACMPTYPEzEDCP	zEDC compression preferred
81 (51)	Character	31		Reserved

# DFSMS allocation determines compressed format

- DFSMS allocation processing determines if a data set can be allocated as compressed format. The type of compression to be used for the data set is not determined until the first OPEN for output of the data set.
- The following table summarizes the system behavior during SMS allocation processing for a new data set based on system levels and the user's allocation request.

z/OS Level	z/OS V2.1			
Processor Level	zEC12/zBC12		Pre-zEC12/zBC12	
Meets minimum compression space requirements <sup>1</sup>	Meet space requirements	Does not meet space requirements	Meet space requirements	Does not meet space requirements
Request: zEDC Required	<ul style="list-style-type: none"> <li>•Allocation successful</li> <li>•Create as compressed format (V2)</li> </ul>	<ul style="list-style-type: none"> <li>•Allocation fails with IGD17168I message</li> </ul>	<ul style="list-style-type: none"> <li>•Allocation fails with IGD17168I message</li> </ul>	<ul style="list-style-type: none"> <li>•Allocation fails with IGD17168I message</li> </ul>
Request: zEDC Preferred	<ul style="list-style-type: none"> <li>•Allocation successful</li> <li>•Create as compressed format (V2)</li> </ul>	<ul style="list-style-type: none"> <li>•Allocation successful</li> <li>•Create as non-compressed extended format</li> </ul>	<ul style="list-style-type: none"> <li>•Allocation successful</li> <li>•Create as compressed format (V2)</li> </ul>	<ul style="list-style-type: none"> <li>•Allocation successful</li> <li>•Create as non-compressed extended format</li> </ul>

1 - Minimum compression space requirements are 5MB, or 8MB Primary if no Secondary

# SMS Scheduling System Selection for JES3 Environment

- In a JES3 environment, SMS identifies a list of one or more target systems where the job should be scheduled.
  - The table below identifies how SMS would select systems (based on priority) when the data set is to be allocated with zEDC compression (Required or Preferred)
- A system is capable of BSAM/QSAM zEDC Compression:
  - *zEC12 or zBC12*

Priority	System Description Based on zEDC Capability
1	<p>System capable of BSAM/QSAM zEDC compression.</p> <p>Devices are available on the system</p>
2	<p>System capable of BSAM/QSAM zEDC compression.</p> <p>No devices currently available on the system, however devices were available during this IPL</p>
3	<p>System capable of BSAM/QSAM zEDC compression.</p> <p>No devices currently available on the system, and none have been available during this IPL</p>
4	System not capable of BSAM/QSAM zEDC compression.

# DFSMS OPEN Processing Determines Type of Compression

- The first OPEN of the data set for output determines the compression type for the data set based on data class and PARMLIB specifications. For a zEDC request, it must also determine level of the system. When running on a multi-system sysplex, it is possible for the data set to be allocated on one system but opened on a different system.
- The following table summarizes the system behavior during OPEN processing for a new data set based on system levels and the zEDC compression request.

z/OS Level	z/OS V2.1			
Processor Level	zEC12/zBC12		Pre-zEC12/zBC12	
DS1COMPR Flag set during allocation	DS1COMPR=on	DS1COMPR=off	DS1COMPR=on	DS1COMPR=off
Request: zEDC Required	•Create as zEDC compressed format (V2)	•N/A (Note 1)	•Create as zEDC compressed format (V2) (Note 2)	•N/A (Note 1)
Request: zEDC Preferred	•Create as zEDC compressed format (V2)	•Create as non-compressed extended format	•Create as Tailored compressed format (V2)	•Create as non-compressed extended format

Notes:

- Since the allocation determined that the minimum compression space was not met, OPEN will not check the data class for a compression type.
- Since the allocation was successful for this data set (DS1COMPR=on), the system will avoid failing OPEN but instead create the data set in zEDC compressed format. In this situation, all data will be written non-compressed.

## DFSMS Allocation Determines Compressed Format (Coexistence)



- DFSMS allocation processing determines if a data set can be allocated as compressed format. The type of compression to be used for the data set is not determined until the first OPEN for output of the data set.
- The following table summarizes the system behavior during SMS allocation processing for a new data set based on system levels and the user's allocation request.

z/OS Level	z/OS V1R12 or V1R13	
Meets minimum compression space requirements: 5MB Primary if no Secondary	Meets space requirement	Does not meet space requirement
DataClass specifies <b>COMPACTION other than 'N'</b> (See Note1)	Allocation successful. Create as compressed format (DS1COMPR=on)	Allocation successful. Create as non-compressed extended format (DS1COMPR=off)
DataClass specifies <b>COMPACTION = N or not specified</b>	Allocation successful. Create as non-compressed extended format (DS1COMPR=off)	Allocation successful. Create as non-compressed extended format (DS1COMPR=off)

**Note1:** On downlevel systems, SMS allocation does not differentiate between the different COMPACTION options.



## DFSMS Open Processing Determines Type of Compression (Coexistence)

- The first OPEN of the data set for output determines the compression type for the data set based on data class and PARMLIB specifications. For a zEDC request, it must also determine level of the system. When running on a multi-system sysplex, it is possible for the data set to be allocated on one system but opened on a different system.
- The following table summarizes the system behavior during OPEN processing for a new data set based on system levels and the zEDC compression request.

z/OS Level	z/OS V1R12 or V1R13	
	DS1COMPR=on	DS1COMPR=off
<b>zEDC Request (see Note 3)</b>		
<b>zEDC Required</b>	Create as zEDC compressed format (EF V2) (See Note2)	n/a (See Note1)
<b>zEDC Preferred</b>	Create as tailored compressed format	n/a
<b>N/A</b>	N/A	Create as non-compressed extended format

- Note1: Since the allocation set DS1COMPR=off, OPEN will not check the data class for a compression type.
- Note2: Since the allocation was successful for this data set, the system will avoid failing OPEN but instead create the data set in zEDC compressed format (which causes the data set to be V2). In this situation, all data will be written non-compressed on a V1R12 or V1R13 system. However, if written from a V2.1 system capable of zEDC compression, the data will be written compressed. (Also, for this case, the EF V2 specification is set by the system during the first OPEN for output instead of SMS allocation time and only for zEDC compressed format. Note that the restriction that a user cannot request a to create a new EF V2 data set on downlevel systems continues to exist).
- Note3: Since new values for zEDC compression are not available for the COMPRESS parameter found in IGDSMSxx member of SYS1.PARMLIB on downlevel systems, only DataClass will be used to determine if zEDC compressed format is requested.

# Identifying zEDC Compressed Format Data Set

## Dictionary token identifies type of compression

- **First two bytes of token**

– Generic Token	.10.	.000	....	0000	X' 4000'
– Tailored Token	.11.	.xxx	....	0000	X' 6x00'
– <b>zEDC Token</b>	<b>.11.</b>	<b>.000</b>	<b>....</b>	<b>0001</b>	<b>X' 6001'</b>
– Rejection Token 1...			....	....	X' 8000'

*Note: The above is not an API....but we'll let you know if this changes*

- **Dictionary token displayed in**

- LISTCAT
- DCOLLECT

- **New one-byte Compression Type found in**

- SMF 14/15 records
- *\*May also be available via additional APIs...stay tuned\**

# SMF



## Use SMF records to determine compression ratio and type

- SMF Type 14/15 contains existing compressed/uncompressed bytes to calculate compression ratio.
- SMF Type 14/15 defines new bits to identify zEDC compressed format data set, as well as indicate if zEDC Express is not available for compression/decompression during this OPEN.

# SMF cont.

## Compressed Format Data Set Section (Type 1)

This describes the information acquired for compressed format data sets.

### Record Type 14

Offsets	Name	Length	Format Description
4 (4)	SMF14XF1	1 binary	Bit Meaning When Set  0 Compressed format data set size values invalid. 1 Compression of the data set has been rejected. 2 SMF14zEDCNAC. At times, zEDC hardware not available for compression thus data written uncompressed. 3 SMF14zEDCNAD. At times, zEDC hardware not available for decompression thus data decompressed using software
4-7 Reserved...			
6 (6)	SMF14CDL	8 binary	Number of bytes of compressed data read or written since this open.
14 (E)	SMF14UDL	8 binary	Number of bytes of data read or written since this open (data length prior to compression).
22 (16)	SMF14CDS	8 binary	Size of the compressed format data set (number of compressed user data bytes).
30 (1E)	SMF14UDS	8 binary	Size of the compressed format data set (number of uncompressed user data bytes).

# SMF cont.

## Compressed Format Data Set Section (Type 1)

This describes the information acquired for compressed format data sets.

### Record Type 14

Offsets	Name	Length	Format Description
---------	------	--------	--------------------

80 x'50'	SMF14CMPTYPE	1 binary	Compression Type
----------	--------------	----------	------------------

#### Meaning When Set

0	SMF14CMPTYPENA	Not compressed format or Unknown
1	SMF14CMPTYPEGEN	Generic Compression
2	SMF14CMPTYPETLRD	Tailored Compression
3	SMF14CMPTYPEZEDC	zEDC Compression

# Compatible with Existing Compression Types



**zEDC Compressed format data sets are *essentially* compatible with other compressed format data sets**

- DFSMSDfp
  - *Supports BSAM and QSAM access for zEDC compressed format data sets*
  - *zEDC compressed format data sets will be defined as extended format V2 (EF V2) data sets, regardless of the user's specification in DataClass, JCL or SYS1.PARMLIB.*
    - *Note: FEOV is not supported on output for V2 data sets. When FEOV is issued on output to a V2 data set, abend 737-48 is issued.*
- DFSMSDss
  - *Supports DUMP, RESTORE, COPY, DEFrag, CONSOLIDATE, and PRINT of zEDC compressed format data sets*
  - *REBLOCK keyword is not supported on COPY for zEDC compressed format data sets*
  - *Note: As today, when copying or restoring compressed format data sets the type of compression used is carried along from the source. This is true whether the preallocated target was usable, or had to be scratched and reallocated. Also, DFSMSDss does not support copying a compressed format data set to a non-compressed format data set or vice versa.*
- DFSMSHsm
  - *Supports Migrate/Recall of zEDC compressed format data sets (DSS is the DataMover)*

# Converting Existing Data Sets to zEDC Compression



**To take advantage of zEDC compression, existing data sets (whether compressed or not) must be copied to a new target data set allocated with zEDC compression.**

- **No utility available to perform a conversion without de-compressing source and re-compressing target**



# DFSMSdfp Coexistence

**Coexistence PTFs for DFSMS components to support access to zEDC compressed format data sets.**

DFSMS coexistence PTFs will allow a user on V1R12 and V1R13 to read/write zEDC compressed format data sets

- *Writes will write user data non-compressed*
- *Reads of compressed data will use software decompression*

# DFSMSdss Coexistence

## Coexistence PTFs for DFSMSdss (COPY/DUMP/RESTORE)

- ▶ DFSMSdss will allow a user on V1R12 and V1R13 to RESTORE a compressed format sequential data set when the form of compression used was zEDC compression. Information indicating the data set is a compressed format data set will be preserved during the RESTORE.
- ▶ DFSMSdss will fail logical data set COPY and DUMP operations of extended format data sets in the zEDC compressed format.
  - *A new reason code will be added to the existing ADR778E indicating a compressed format data set compressed with the zEDC form of compression is not supported on this release.*
- ▶ DFSMSdss will fail logical data set COPY and RESTORE operations when a pre-allocated output data set is compressed format with the zEDC form of compression.
  - *A new reason code will be added to the existing ADR285E indicating a pre-allocated compressed format data set compressed with the zEDC form of compression is not supported on this release.*

# IBM System z Batch Network Analyzer

Helping determine if you have files that are candidates for zEDC: the IBM System z Batch Network Analyzer



- A free, Microsoft Windows-based “as is” tool to analyze batch windows using SMF data
- Available to Customers, Business Partners and IBMers
- Replaces the old BWATOOL
- PC based, graphical and text reports
  - *Including Gantt charts and support for Alternate Processors*



Available from NA Advanced Technical Support

<http://w3.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/PRS5126>

## zBNA can help identify zEDC Compression Candidates

Identify zEDC compression candidates across specified time spans, like batch windows

Help estimate utilization of a zEDC feature and help size number of features needed

Generate a list of data sets by job which already do hardware compression and may be candidates for zEDC

Generate lists of data sets by job which might be zEDC candidates but are not in extended format

Initial support was December 2013—updates made in January and February 2014



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# Improved Compression Ratios and Performance\*

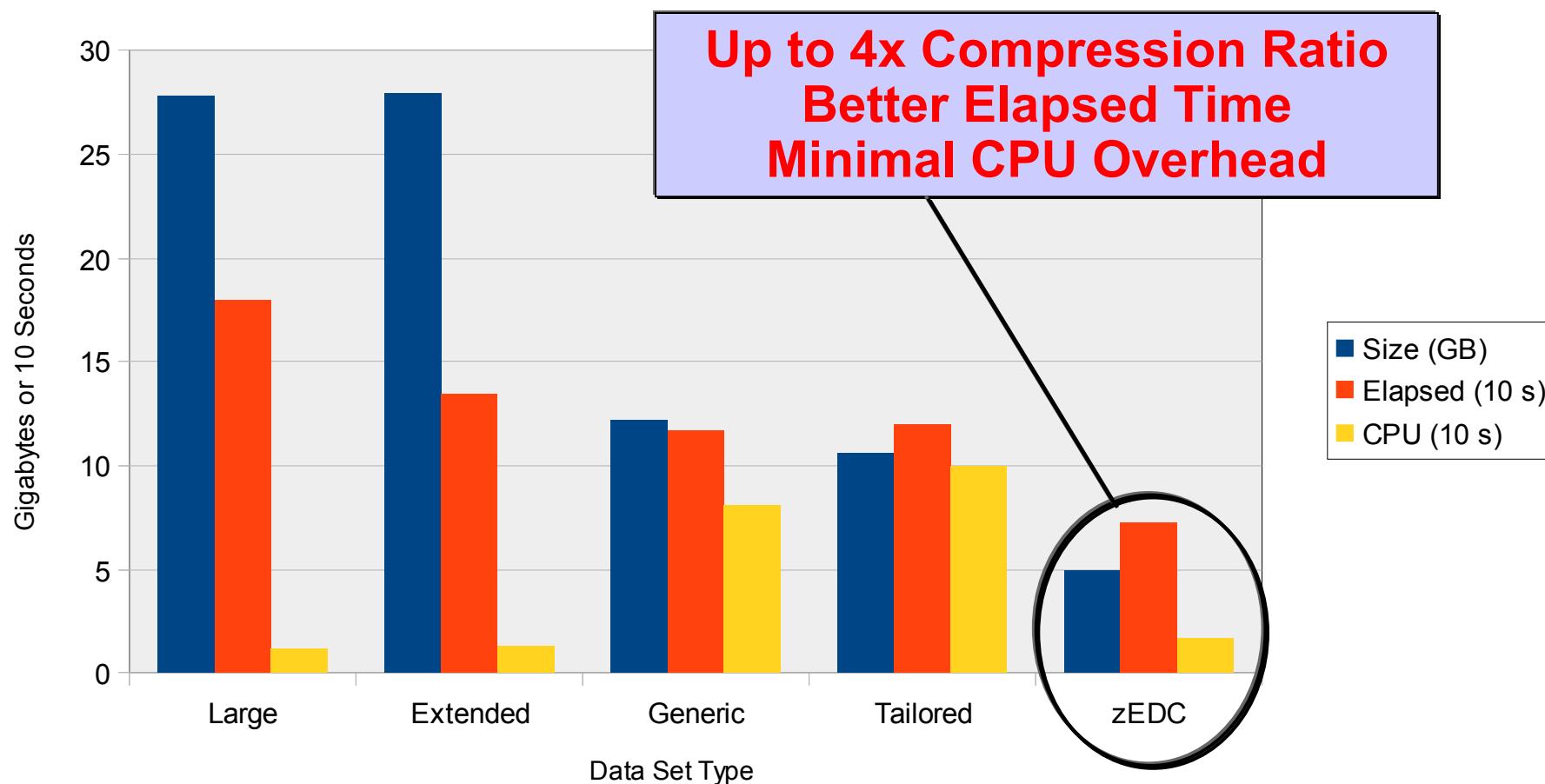


Compression rates will vary with the data...

- For BSAM/QSAM we see up to 4X compression for zEDC
  - That's as much as 2X better than generic or tailored compression
- Also, for BSAM/QSAM we see 80% or more CPU time reduction compared to tailored and generic compression
  - CPU cost for zEDC is ~0.1sec/GB in testing on a zEC12

\* Based on projections and/or measurements completed in a controlled environment. Results may vary by customer based on individual workload, configuration and software levels.

# BSAM/QSAM zEDC Compression – Value!



\*Measurements completed in a controlled environment. Results may vary by customer based on individual workload, configuration and software levels.

# ***Referenced Sessions***



- **Session 15099: zEnterprise Data Compression: What is it and How Do I Use it?**
- **Session 15207: System z Batch Network Analyzer – Because Batch is Back!**

Complete your session evaluations online at [www.SHARE.org/Anaheim-Eval](http://www.SHARE.org/Anaheim-Eval)



## ***New Function available soon.....***



- *BSAM/QSAM zEDC exploitation PTFs for z/OS V2.1 and z/OS V1R12 and V1R13*
  - *Track master APAR OA42195*
  - *Publication Updates available with z/OS 1Q14 Refresh*
    - *z/OS DFSMS Using the New Functions*
    - *etc*



# Thank You!

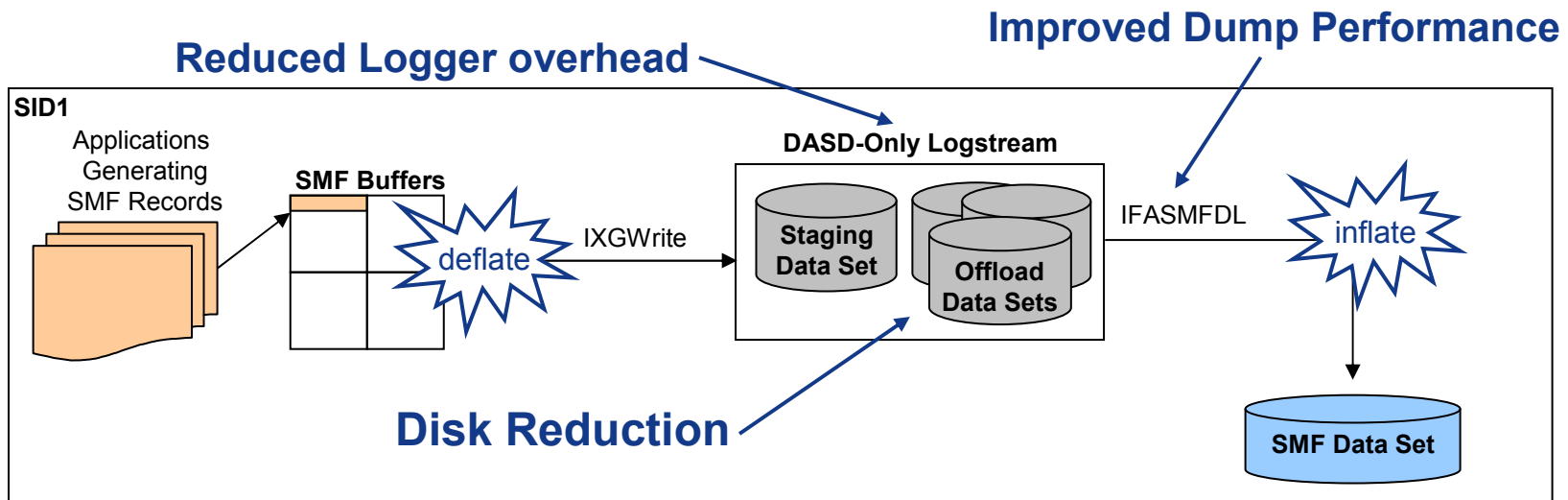


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# SMF with zEDC



This example shows a DASD-Only logstream used for SMF recording



- Compression SMF logstreams reduce the amount of data in System Logger up to **4x** and reduce the elapsed time to extract IFASMFDL data up to **15%**
- zEDC compression must be available on all systems that will access zEDC compressed SMF logstreams
- Setup from SMFPRMxx either globally or per Logstream

## SMFPRMxx in SYS1.PARMLIB

DEFAULTLSNAME(DEFAULT,...,**COMPRESS**)

LSNAME(SMF30,TYPE(30),...,**COMPRESS(PERMFIX(10M))**)

LSNAME(RMF,TYPE(70:79)...,**COMPRESS**)





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#### Notes:

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