IBM Storage

Transparent Cloud Tiering Performance (DSS Dump and Restore)

Khanh Ly, Albert Vreeland, Don Denning

April 02, 2024

Agenda

- Hardware Configuration
- TCT Test Data for Full Volume Dump and Restore
- DS8K Compression vs. TS7770 Compression Comparison
- DSS Dump / Restore Performance (with/without DS8K Compression Turned on)
- TCT Performance Workload and Copy Modes
- TCT Grid Performance

Hardware Configuration

TS7770 (Release 5.4)	Drawer Counts	Grid Links	FICON Channels	IBM System Z Host
TS7770 VED-O 3956/3957 CSB/XSB (Active Cluster)	10	4x10Gb	8x16Gb	z15
TS7770 VED-O 3956/3948 CFC/XFC (DR Cluster)	10	4x10Gb	8x16Gb	z15

DS8000 (Release 9.4)	Cache	HA	TeraPack Array (Flash)	Links to TS7770	FICON Channels	IBM System Z Host
DS8950F	1TB	2x32 GFC 2x16 GFC	2 pairs 4x100GB	2x10Gb (SSL enabled)	16x16Gb	z15

Test Data Sets

Dataset Name	Description	DSORG	RECFM	LRECL	BLKSIZE	SIZE (tracks)
DATA.BLUEPAGE	Dense text, max lrecl=371+4	PS	VB	8192	27998	48
DATA.DUMP	System dump of an address space	PS	FBS	4160	24960	4528
DATA.HISMAP	HIS data, max lrecl=115+4	PS	VB	255	27998	515
DATA.IADUMP	Some kind of binary data	PS-L	FB	64	27968	36907
DATA.JAVA	Java byte code(?) in printable hex, most records lrecl=64+4	PS	VB	1024	27998	6366
DATA.LINKLIB	LINKLIB from a system	PO	U	0	27998	3191
DATA.LPALIB	LPALIB from a system	PO	U	0	27998	1026
DATA.MACLIB	MACLIB from a system	PO	FB	80	27920	3497
DATA.PARMLIB	PARMLIB from a system	PO	FB	80	19040	201
DATA.PROCLIB	PROCLIB from a system	PO	FB	80	19040	63
DATA.SADUMP	A standalone dump	PS-L	FS	4160	4160	67940
DATA.SMFMIX	SMF records from a running system	PS	VBS	32760	27998	1469
DATA.SVCDUMP	WLM dump	PS-L	FBS	4160	24960	41359
DATA.XMLETM	XML from a performance monitor	PS	VB	4096	27998	3134
OPTIMZ	11 byte fields starting with X'0B0000000000000001FF00' and incrementing by X'10000' (=65536)	PS	FSA	8906	8906	5617
SMF.CICS	CICS TS SMF type 110 records (99.996%)	PS	VBS	32767	32760	13404
SMF.DB2	DB2 SMF type 101 (99.69%) and 102 records (0.26%)	PS	VBS	32760	27966	14905
SMF.OTHER	Mostly SMF type 14 (15.06%), type 30 (11.76%) and type 42 (24.38%) records	PS	VBS	32760	27998	10175

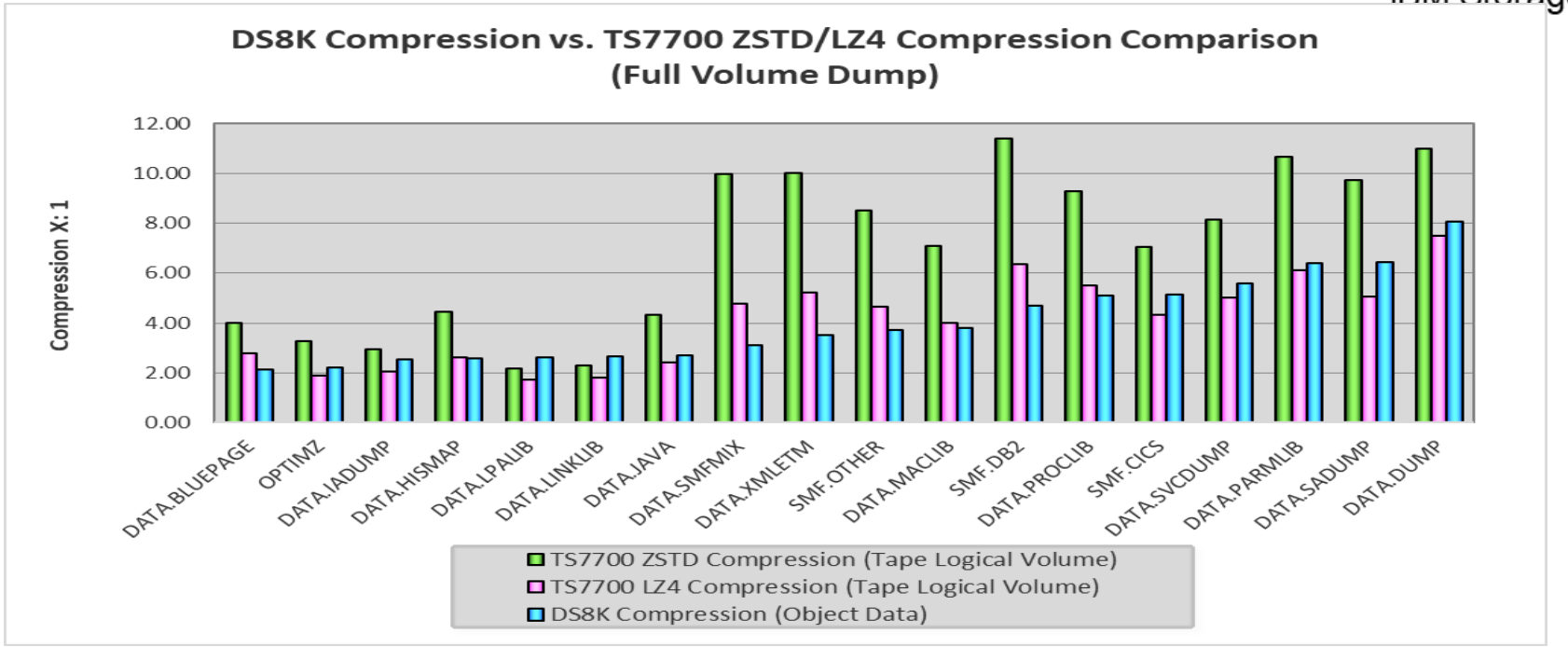
There are 18 different test data sets used to create the test volume for Dss Dump and Dss Restore.

Test Volumes

(65520 cylinders / 982,800 tracks)

Volume Name	Content	% Full
DATA.BLUEPAGE	20438 copies of the DATA.BLUEPAGE datasets	99
DATA.DUMP	216 DATA.DUMP copies of the DATA.DUMP datasets	99
DATA.HISMAP	1904 copies of the DATA.HISMAP datasets	99
DATA.IADUMP	26 copies of the DATA.IADUMP datasets	97
DATA.JAVA	154 copies of the DATA.JAVA datasets	99
DATA.LINKLIB	307 copies of the DATA.LINKLIB datasets	99
DATA.LPALIB	956 DATA.LPALIB datasets	99
DATA.MACLIB	280 copies of the DATA.MACLIB datasets	99
DATA.PARMLIB	4880 copies of the DATA.PARMLIB datasets	99
DATA.PROCLIB	15572 copies of the DATA.PROCLIB datasets	99
DATA.SADUMP	14 copies of the DATA.SADUMP datasets	96
DATA.SMFMIX	667 copies of the DATA.SMFMIX datasets	99
DATA.SVCDUMP	23 copies of the DATA.SVCDUMP datasets	96
DATA.XMLETM	313 copies of the DATA.XMLETM datasets	99
OPTIMZ	174 copies of the OPTIMZ datasets	99
SMF.CICS	73 copies of the SMF.CICS datasets	99
SMF.DB2	65 copies of the SMF.DB2 datasets	98
SMF.OTHER	96 copies of the SMF.OTHER datasets	99
COMBO	4 copies from each of the 18 datasets above	87

To test DSS dump and restore, we created 18 test volumes using the 18 test data sets. Each volume has 65520 cylinders / 982,800 tracks and is filled with the same data set until it is full. We also create one special volume (COMBO), which has 4 copies from each of the 18 data sets.

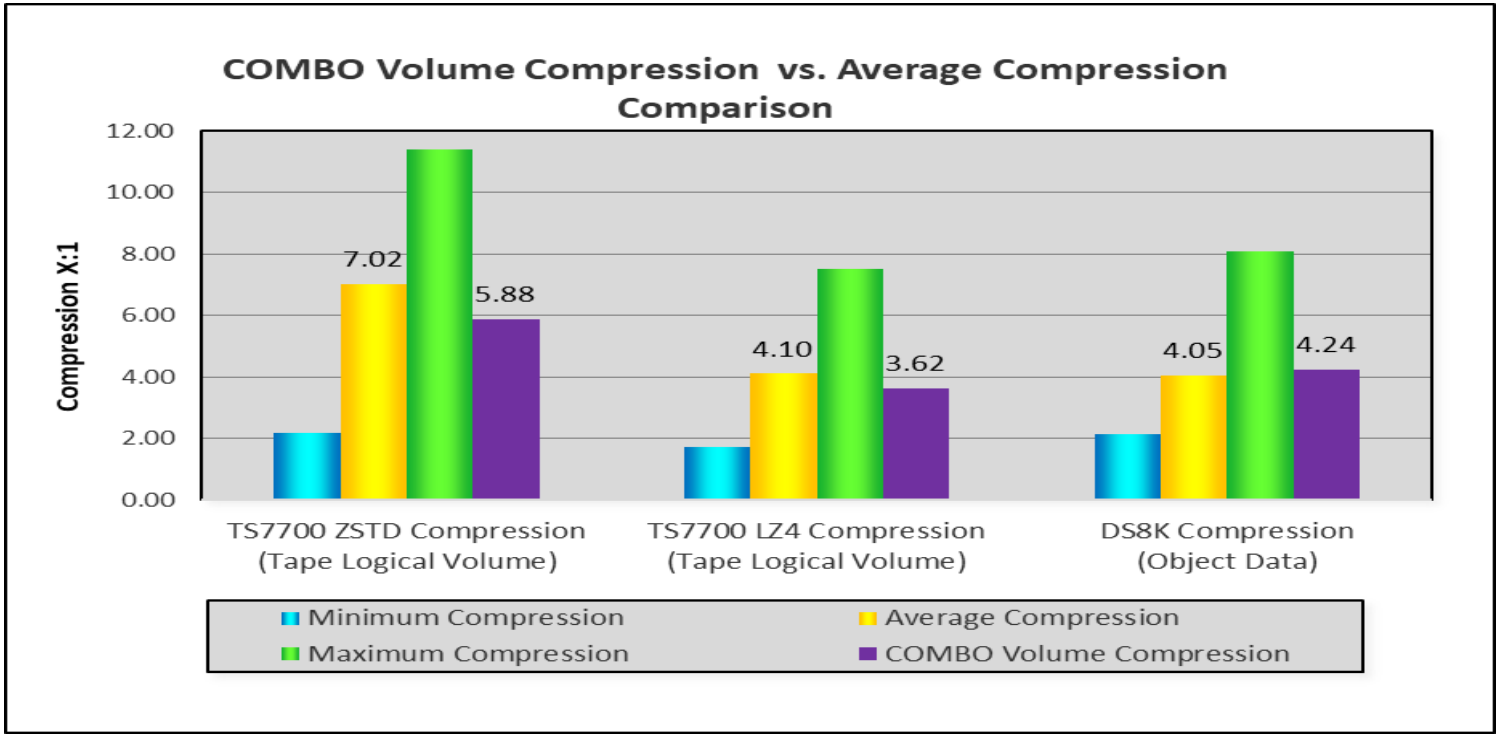


These are 54 full volume dump tests using 18 different test volumes with 3 different compression schemes:

- DS8K Compression: data were compressed at DS8K and transferred to TS7770 as object data (TCT)
- TS7770 ZSTD/LZ4 Compression: data were transferred to TS7770 via FICON channel as tape logical volume and compressed at TS7770 using ZSTD/LZ4 compression

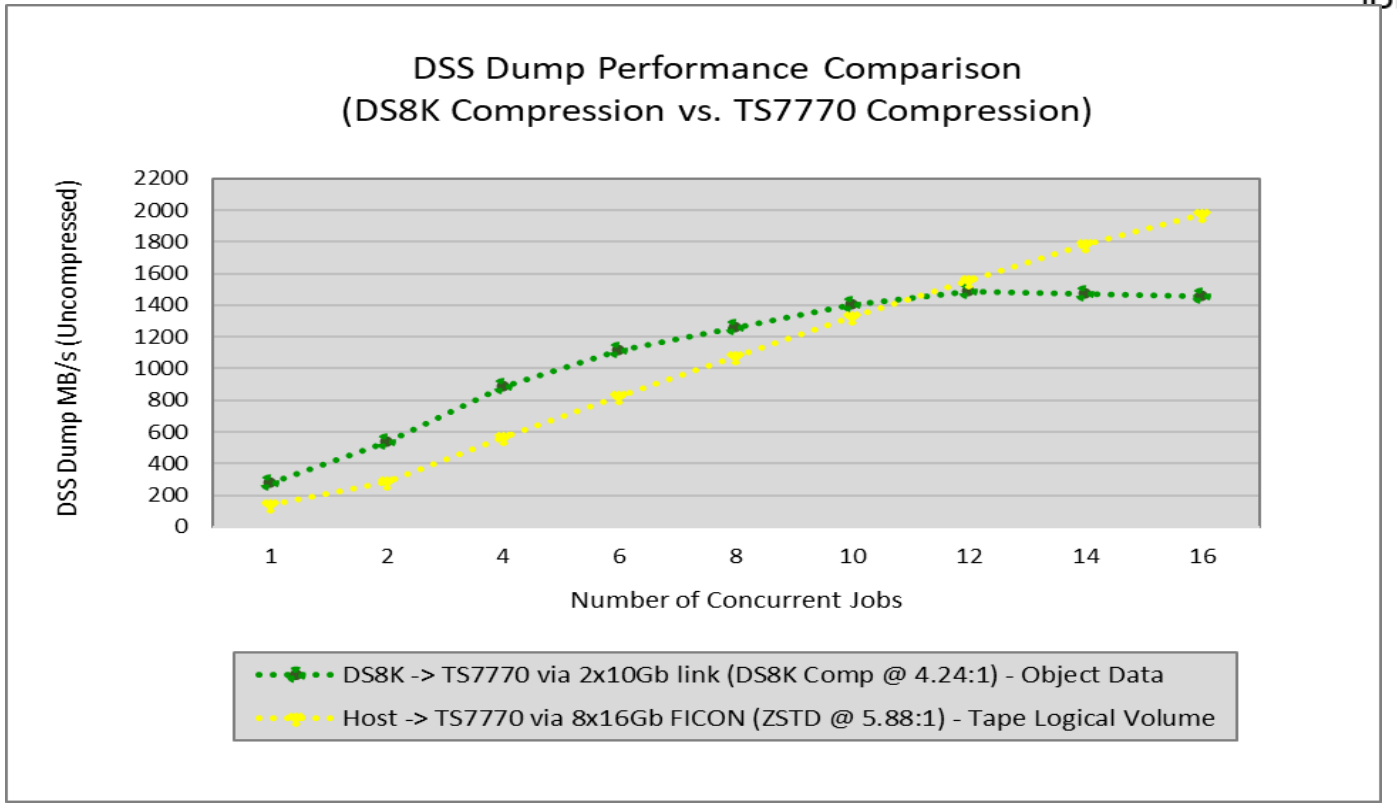
Compression ratio for each test was collected. The first goal is to compare the compression ratio using different compression schemes. The second goal is to collect the minimum, maximum and average compression ratio for each compression method.

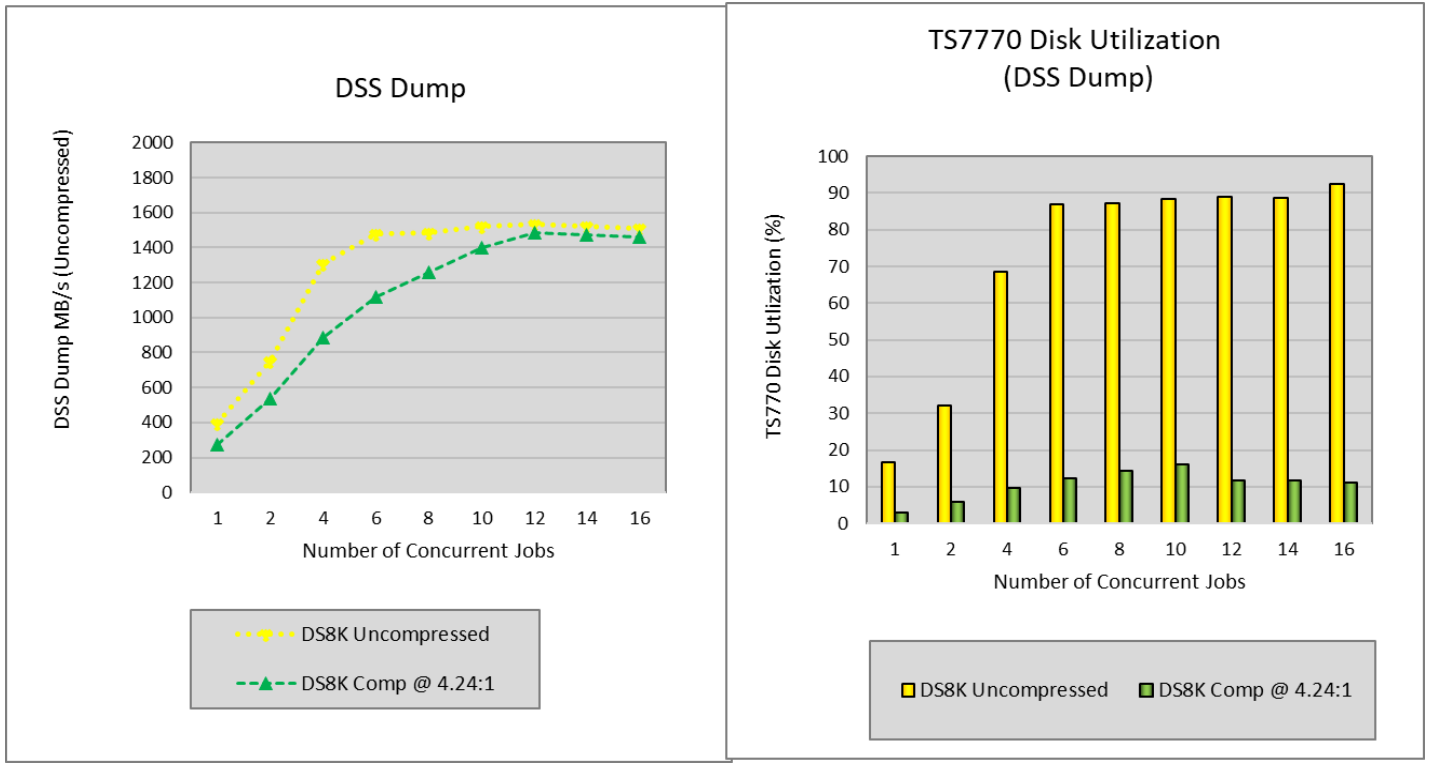
COMBO volume consists of 4 copies of the above datasets.
COMBO volume size is 65520 cylinders (982,800 tracks). Space remaining is 123,680 tracks.



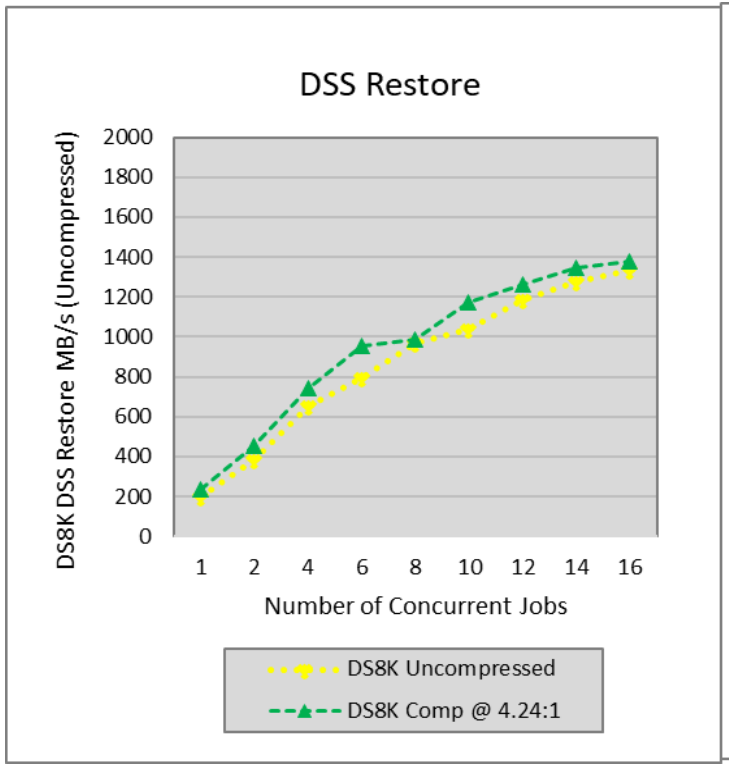
In this chart, we compare the average compression ratio for each compression scheme against the compression ratio for the COMBO volume using the corresponding compression method. Result shows the compression ratio using the COMBO test volume is very close to the average compression ratio.

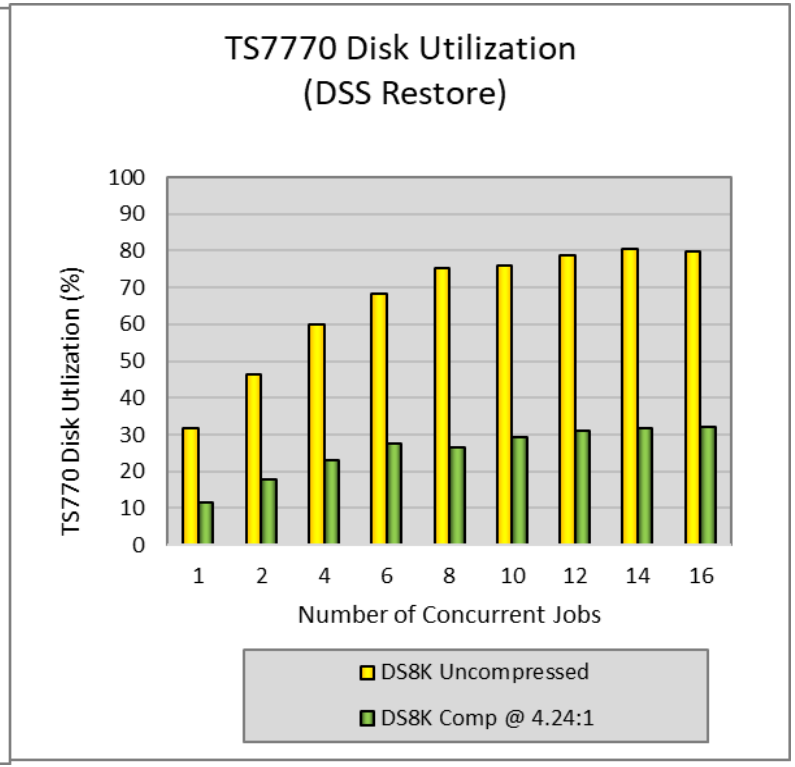
-> COMBO volume will be used as test volume for TCT Performance benchmark workload.


DSS Dump Performance Comparison
(DS8K Compression vs. TS7770 Compression)
DSS Dump MB/s (Uncompressed)
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
1
2
4
6
8
10
12
14
16
Number of Concurrent Jobs
DS8K -> TS7770 via 2x10Gb link (DS8K Comp @ 4.24:1) - Object Data
Host -> TS7770 via 8x16Gb FICON (ZSTD @ 5.88:1) - Tape Logical Volume



With 16 concurrent jobs, DSS Dump with DS8K compression turned on is about 4% lower than DSS dump with DS8K compression turned off. The advantage for turning on DS8K compression is that TS7770 disk utilization is cut as much as 88% because much less data are draining to the TS7770



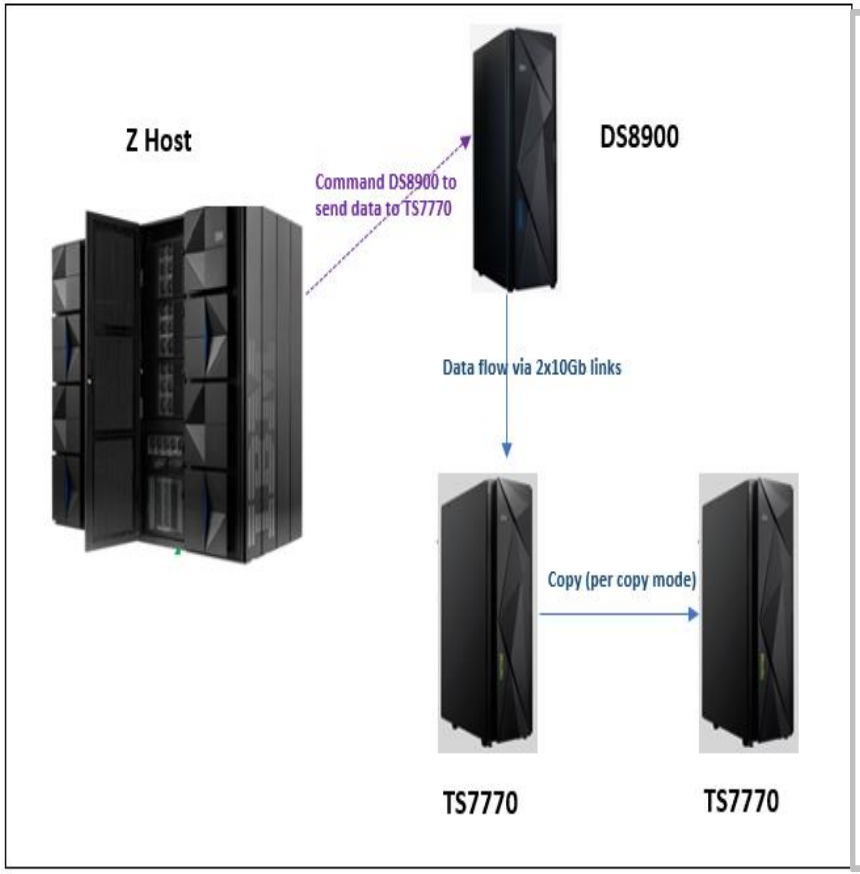


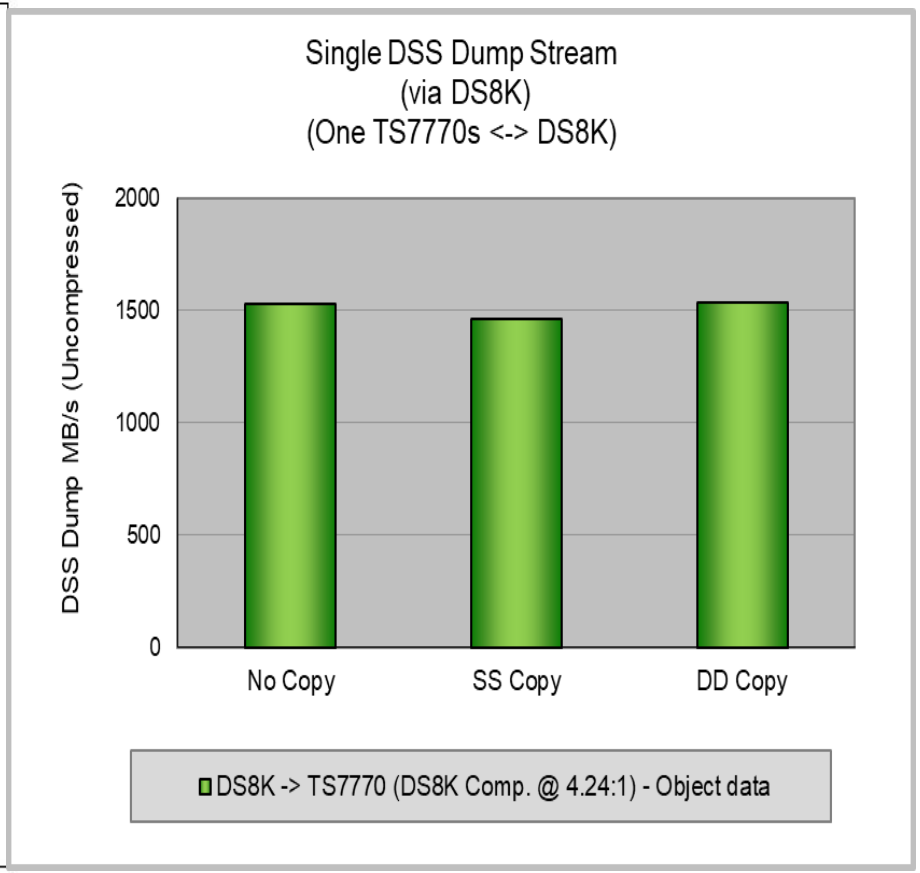
With 16 concurrent jobs, DSS restore with DS8K compression turned on is about 4% lower than DSS restore with DS8K compression turned off. The advantage for turning on DS8K compression is that TS7770 disk utilization is cut as much as 60% because much less data are recalled from the TS7770

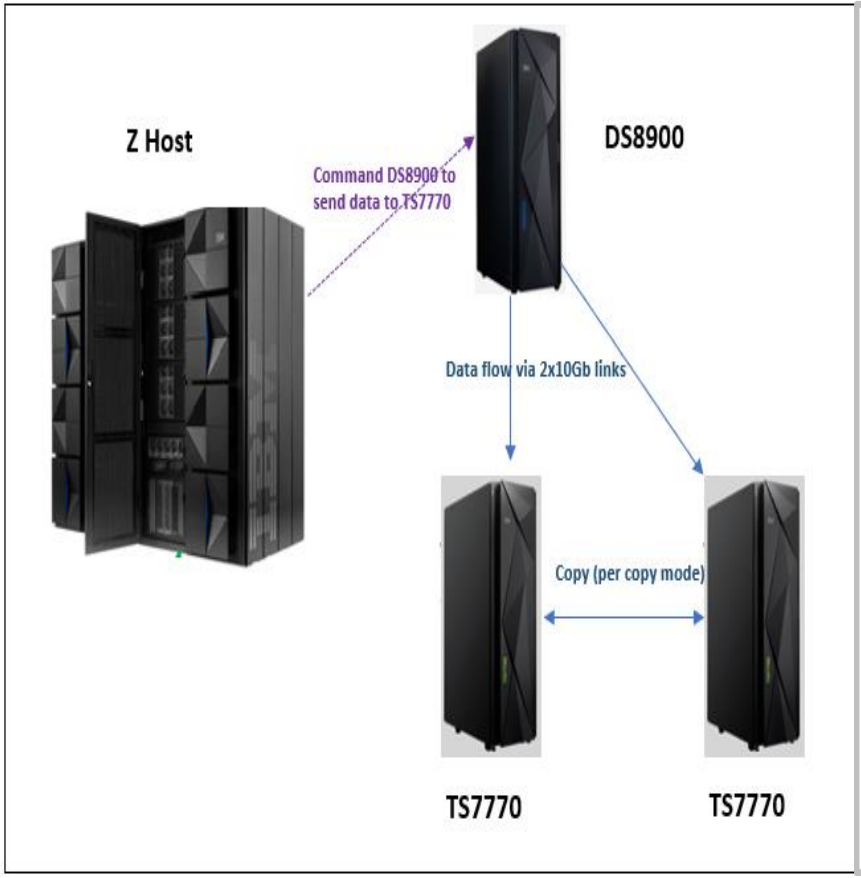
TCT Performance Workloads

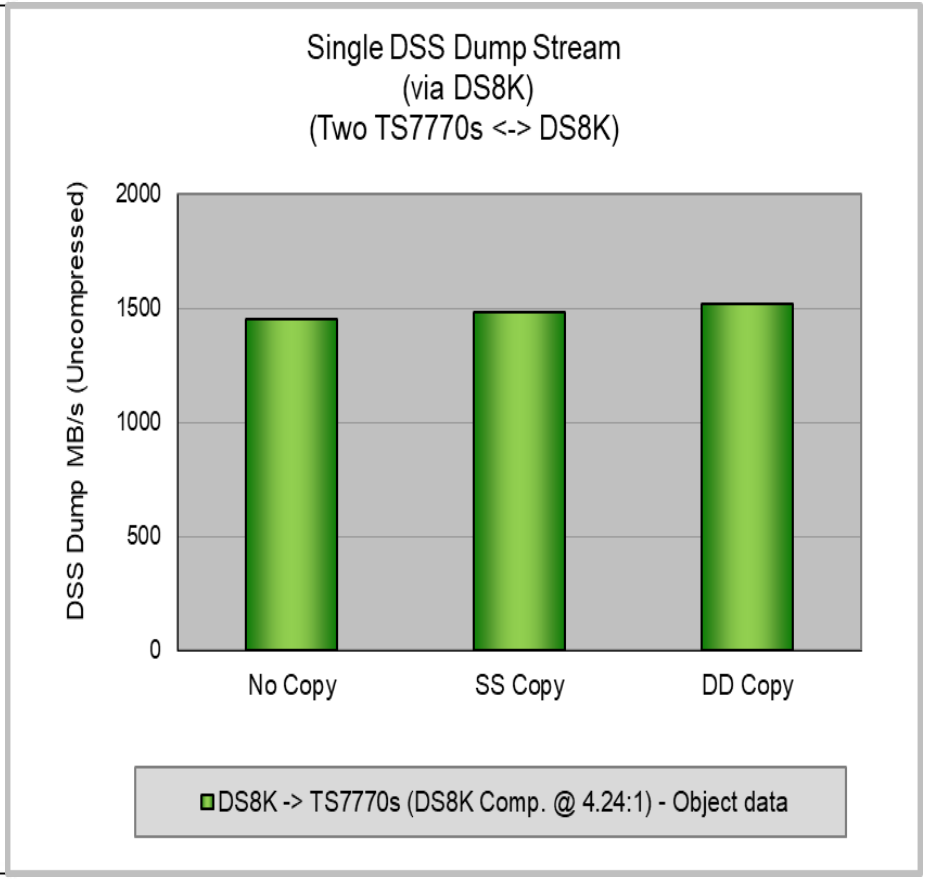
TCT Performance Workloads and Copy Modes

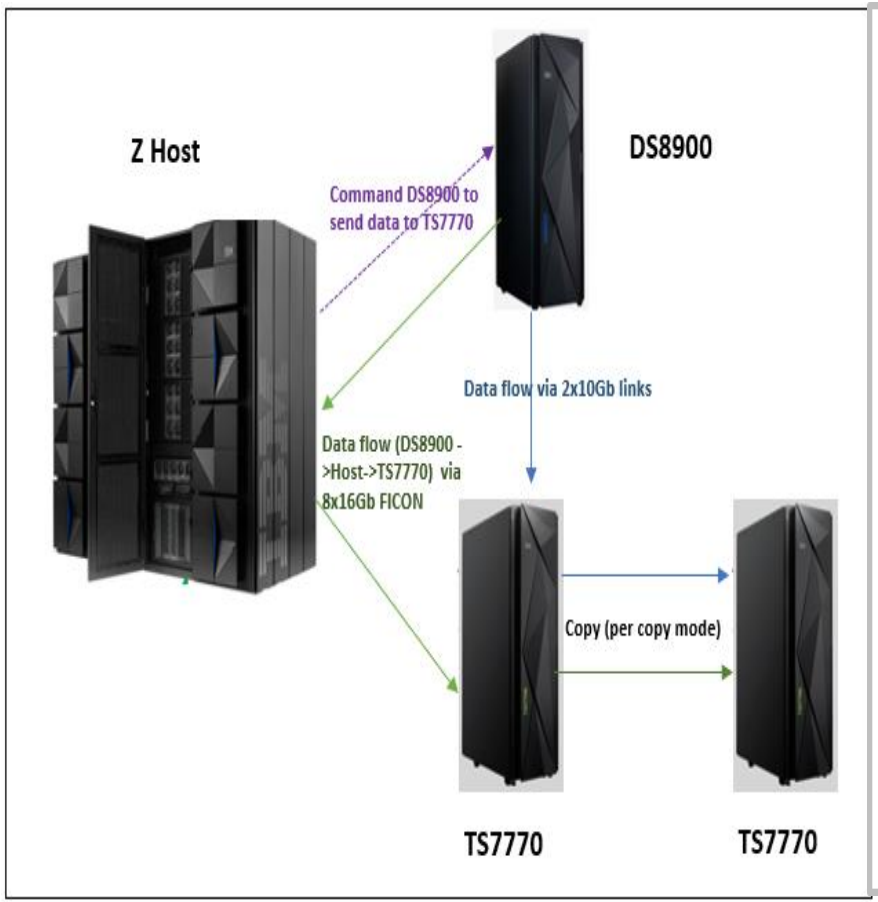
- Unless otherwise stated, all runs were made with 16 concurrent DSS Dump jobs per active cluster, which receives data from DS8K (or host). Each job dumps a COMBO volume via 2x10Gb link (or 8x16Gb FICON channels).
- Clusters are located at zero or nearly zero distance to each other in laboratory setup.
- All runs were made using TS7770 DCT=125 (default setting).
- Based on the object copy mode (or tape volume copy mode), data will be copied to the other TS7770. Copy modes include:
  - No Copy – No copy operation to the other TS7770.
  - SS Copy (Sync Mode Copy) – Data is forked at the adapter level across two cluster within the same grid. Sync copy and DSS Dump operations are running concurrently.
  - DD Copy (Deferred Copy Mode) – Data is written to the local disk cache, read out from the local disk cache, and put in the copy queue to be copied to the remote TS7770. In DS8K offload, copy will start after it arrives in the copy queue. In FICON workload, copy will be delayed until end of the batch window (because of the DCT=125 setting used).

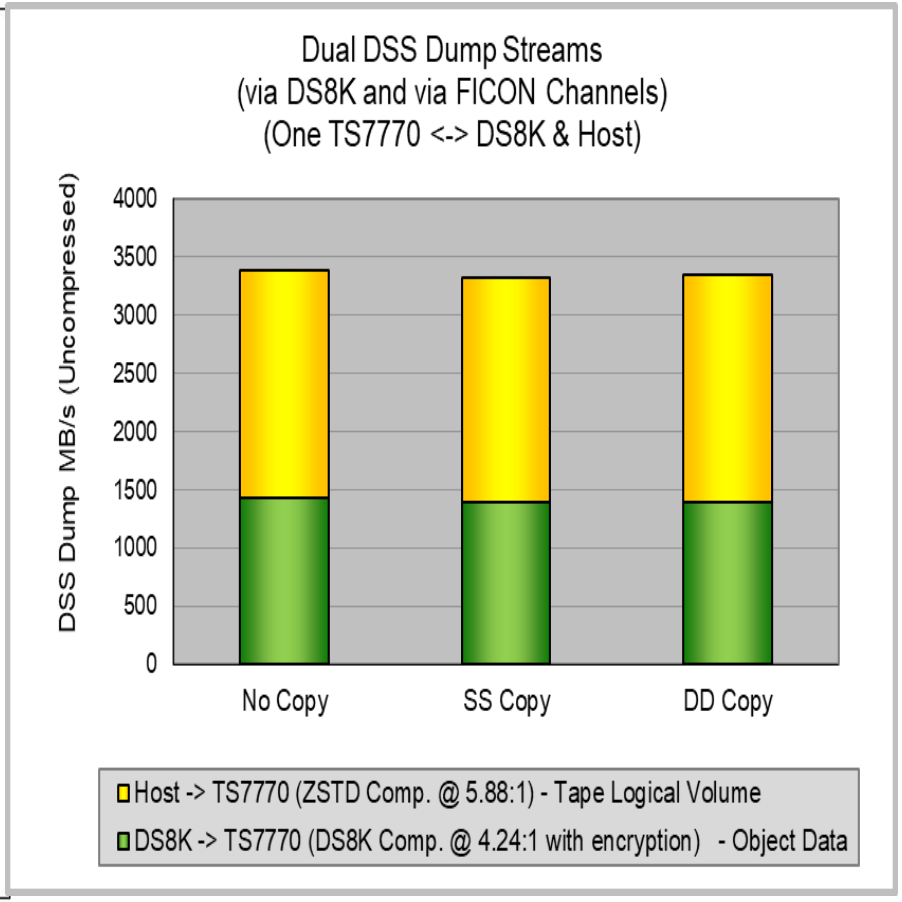

Z Host
DS8900
Command DS8900 to send data to TS7770
Data flow via 2x10Gb links
Copy (per copy mode)
TS7770
TS7770

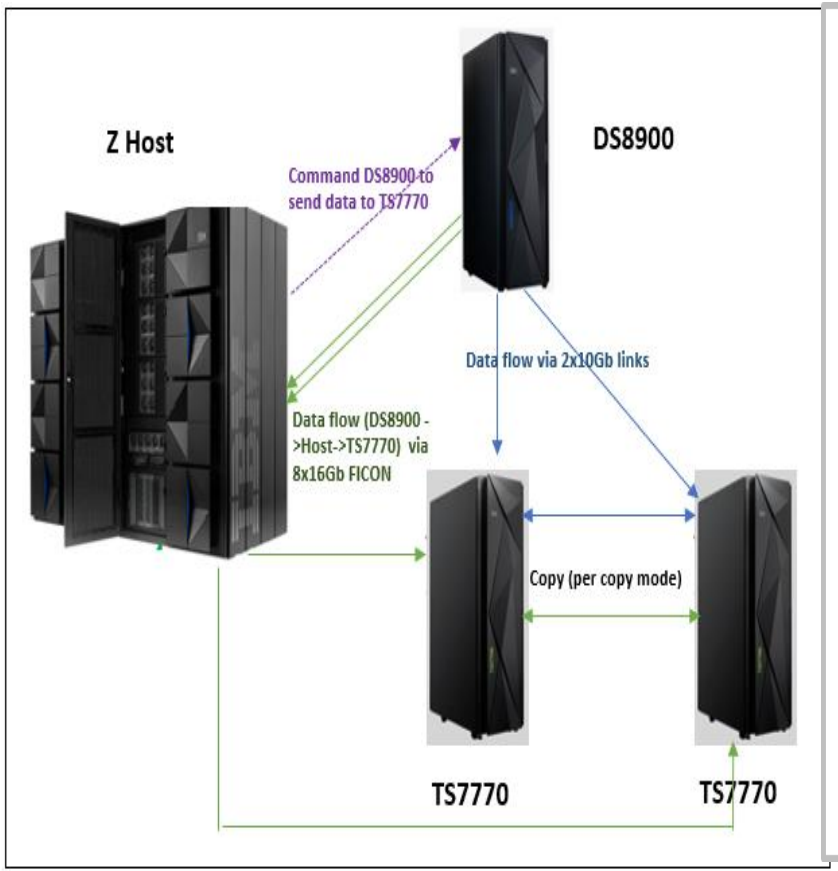

Single DSS Dump Stream
(via DS8K)
(One TS7770s <-> DS8K)
DSS Dump MB/s (Uncompressed)
2000
1500
1000
500
0
No Copy
SS Copy
DD Copy
DS8K -> TS7770 (DS8K Comp. @ 4.24:1) - Object data

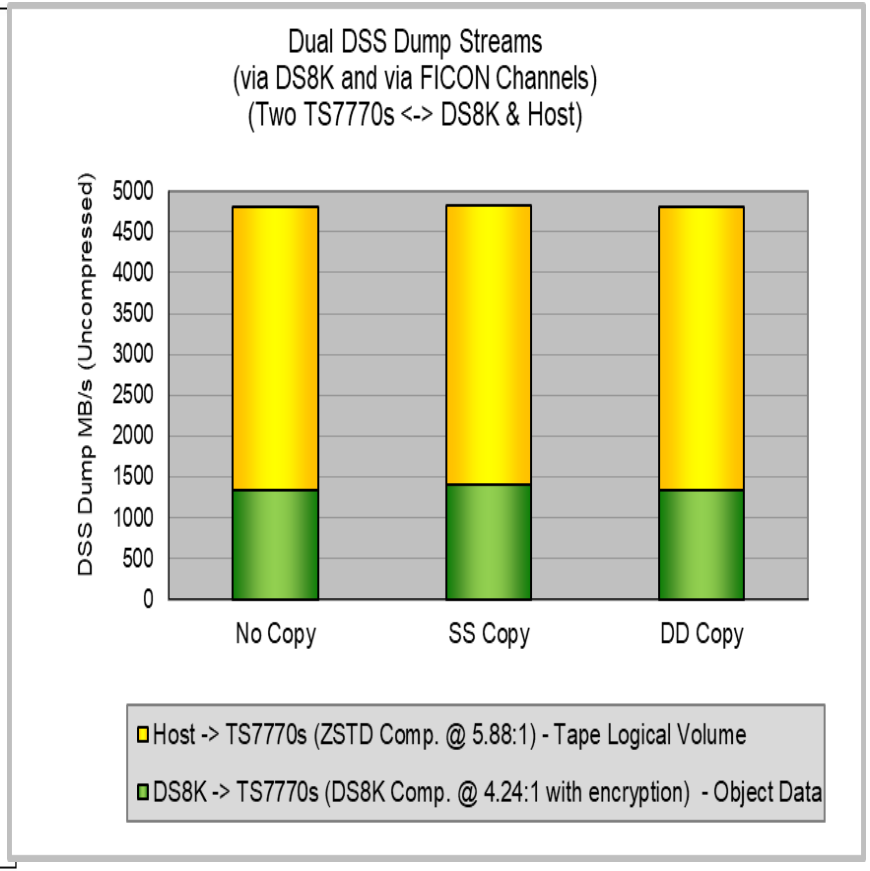

Z Host
DS8900
Command DS8900 to send data to TS7770
Data flow via 2x10Gb links
Copy (per copy mode)
TS7770
TS7770


Single DSS Dump Stream
(via DS8K)
(Two TS7770s <-> DS8K)
DSS Dump MB/s (Uncompressed)
2000
1500
1000
500
0
No Copy
SS Copy
DD Copy
DS8K -> TS7770s (DS8K Comp. @ 4.24:1) - Object data


Z Host
DS8900
Command DS8900 to send data to TS7770
Data flow via 2x10Gb links
Data flow (DS8900 ->Host->TS7770) via 8x16Gb FICON
Copy (per copy mode)
TS7770
TS7770


Dual DSS Dump Streams
(via DS8K and via FICON Channels)
(One TS7770 <-> DS8K & Host)
DSS Dump MB/s (Uncompressed)
4000
3500
3000
2500
2000
1500
1000
500
0
No Copy
SS Copy
DD Copy
Host -> TS7770 (ZSTD Comp. @ 5.88:1) - Tape Logical Volume
DS8K -> TS7770 (DS8K Comp. @ 4.24:1 with encryption) - Object Data


Z Host
DS8900
Command DS8900 to send data to TS7770
Data flow via 2x10Gb links
Data flow (DS8900 ->Host->TS7770) via 8x16Gb FICON
Copy (per copy mode)
TS7770
TS7770


Dual DSS Dump Streams
(via DS8K and via FICON Channels)
(Two TS7770s <-> DS8K & Host)
DSS Dump MB/s (Uncompressed)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
No Copy
SS Copy
DD Copy
Host -> TS7770s (ZSTD Comp. @ 5.88:1) - Tape Logical Volume
DS8K -> TS7770s (DS8K Comp. @ 4.24:1 with encryption) - Object Data

Thank You.

IBM Storage