z/VM Dynamic Memory Management

For the latest version see https://www.vm.ibm.com/library/presentations/

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IBM

First

What is Dynamic Memory Management, and why do we care?

Then

Planning for Dynamic Memory Management: requirements, tools, and helpful hints.

Followed by

The Nitty-Gritty: Commands and Configuration Statements

And finally

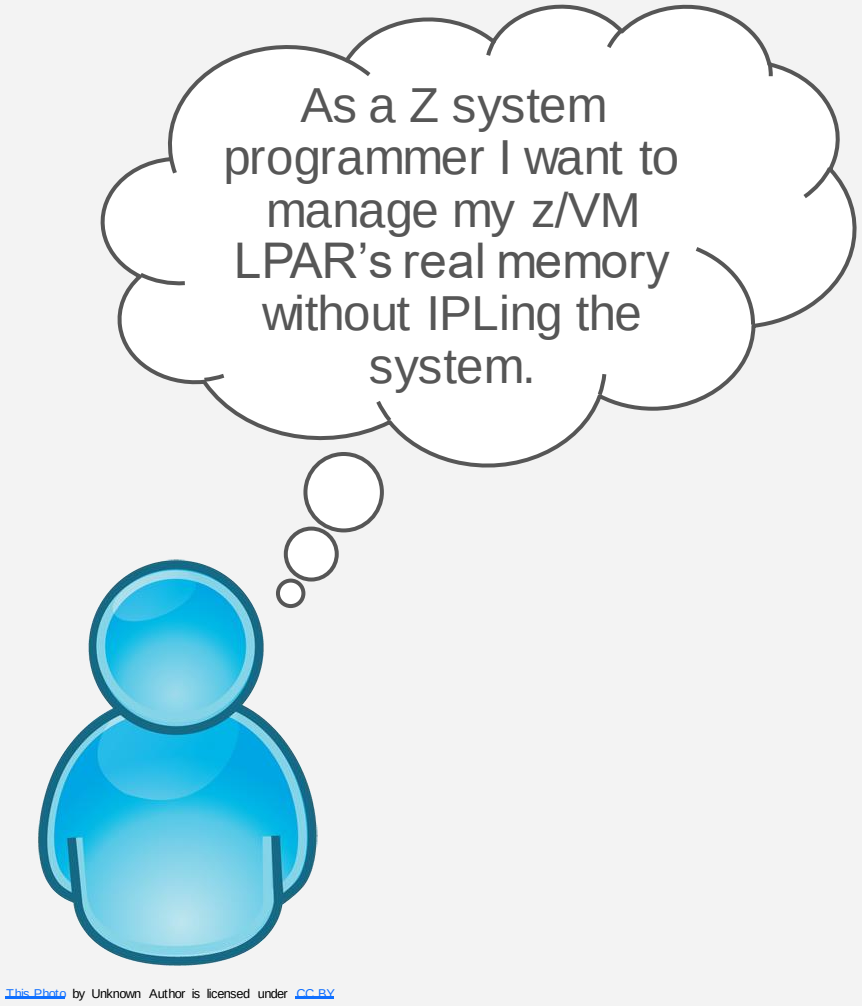
Paging implications, interactions with other commands, & conclusion

Problem statement

The **flexibility to reassign** (add and remove) system resources is critical to customers. Today's **workloads are not static**. Having to tolerate a re-IPL to modify the memory configuration is burdensome to customers and contrary to the goal of **continuous operations**.

With Memory Reclamation, a system administrator can **take real memory offline** from a z/VM partition, **making it available** to other partitions on the CPC. The removal will be **dynamic**; no re-IPL of the z/VM image is required to accomplish the change in the memory configuration.

This session will describe these new capabilities, give some guidance on use, and walk through some examples.

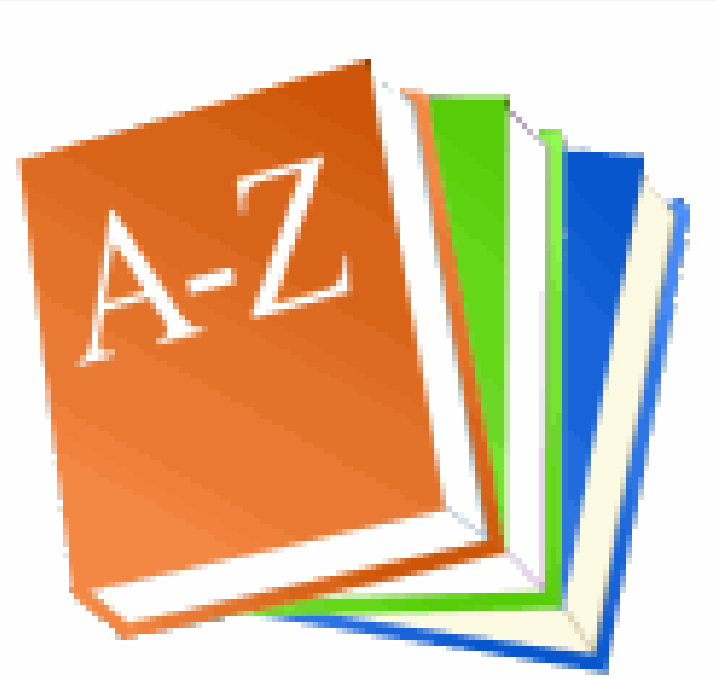


Definition of Terms

Storage is also called memory on IBM Z hardware.

Storage must be added or removed in multiples of the **storage increment size** (this is referred to by PR/SM as “storage granularity”). This is determined by the hardware, and mimicked by z/VM second level.

Memory reclamation is the process of removing some storage from your z/VM partition’s configured storage and putting it back into standby storage.



Today: z/VM 7.2 – and APAR VM66173

z/VM 7.2 + APAR VM66173, PTF UM35834

- 4 TB real memory support
- `SET STORAGE` command allows a new `RECONFIGURABLE` keyword
  - Added in anticipation of Dynamic Memory Downgrade (DMD) enablement
  - Any specified reconfigurable value will generate an error message
- Improvements to real memory management
- Enhancements to paging threshold settings
- New & improved commands and statements

Dynamic Memory Downgrade

- Will pre-req VM66173 (+ VM66508 - https://www.vm.ibm.com/service/redalert/)
- Reconfigurable storage can be removed from a running z/VM system
- `RECONFIGURABLE` storage to be added up to 50% of total online storage

What?

APAR VM66271

When?

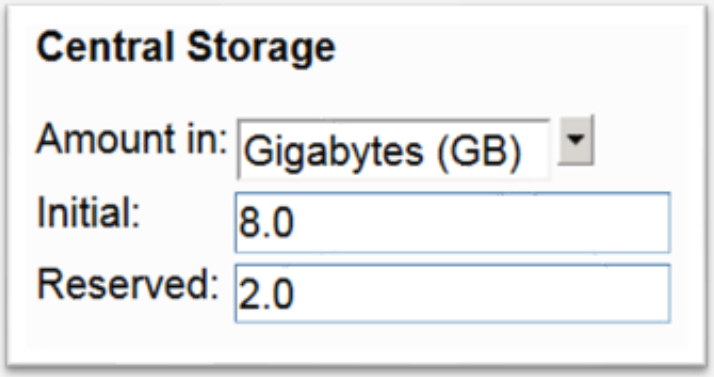
3Q21

Dynamic Memory Downgrade, AKA Memory Reclamation, will extend the real memory dynamic management characteristics of z/VM to include removing real memory from a running z/VM system. Previously z/VM allowed adding memory, but not removing it.

What is Dynamic Memory Management, and why do we care?

PR/SM's view of your storage

Via the Activation Profile



z/VM's view of your storage

```
query store
16:20:24 STORAGE = 8G CONFIGURED = 8G INC = 128M STANDBY = 2G RESERVED = 0
16:20:24 Permanent = 4G Reconfigurable = 4G Maximum STORAGE = 10G
Ready;
```

```
query store
16:20:24 STORAGE = 8G CONFIGURED = 8G INC = 128M STANDBY = 2G RESERVED = 0
16:20:24 Permanent = 4G Reconfigurable = 4G Maximum STORAGE = 10G
Ready;
```

What are those new fields in the **QUERY STORAGE** response?

Permanent

The amount of real storage that cannot be decreased, only increased. It contains important CP control structures and long term locked pages.

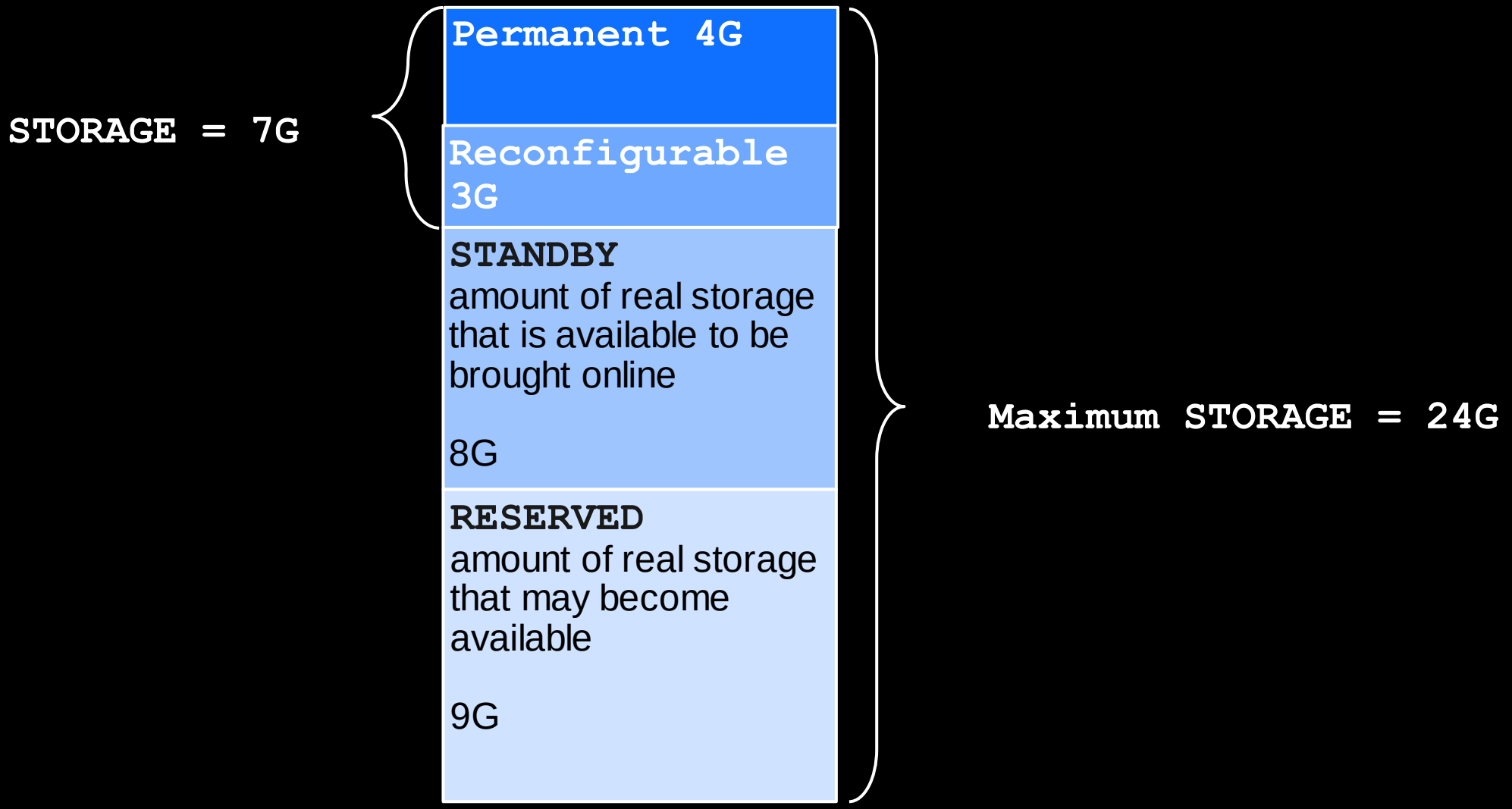
Reconfigurable

The amount of real storage that can be decreased or increased.

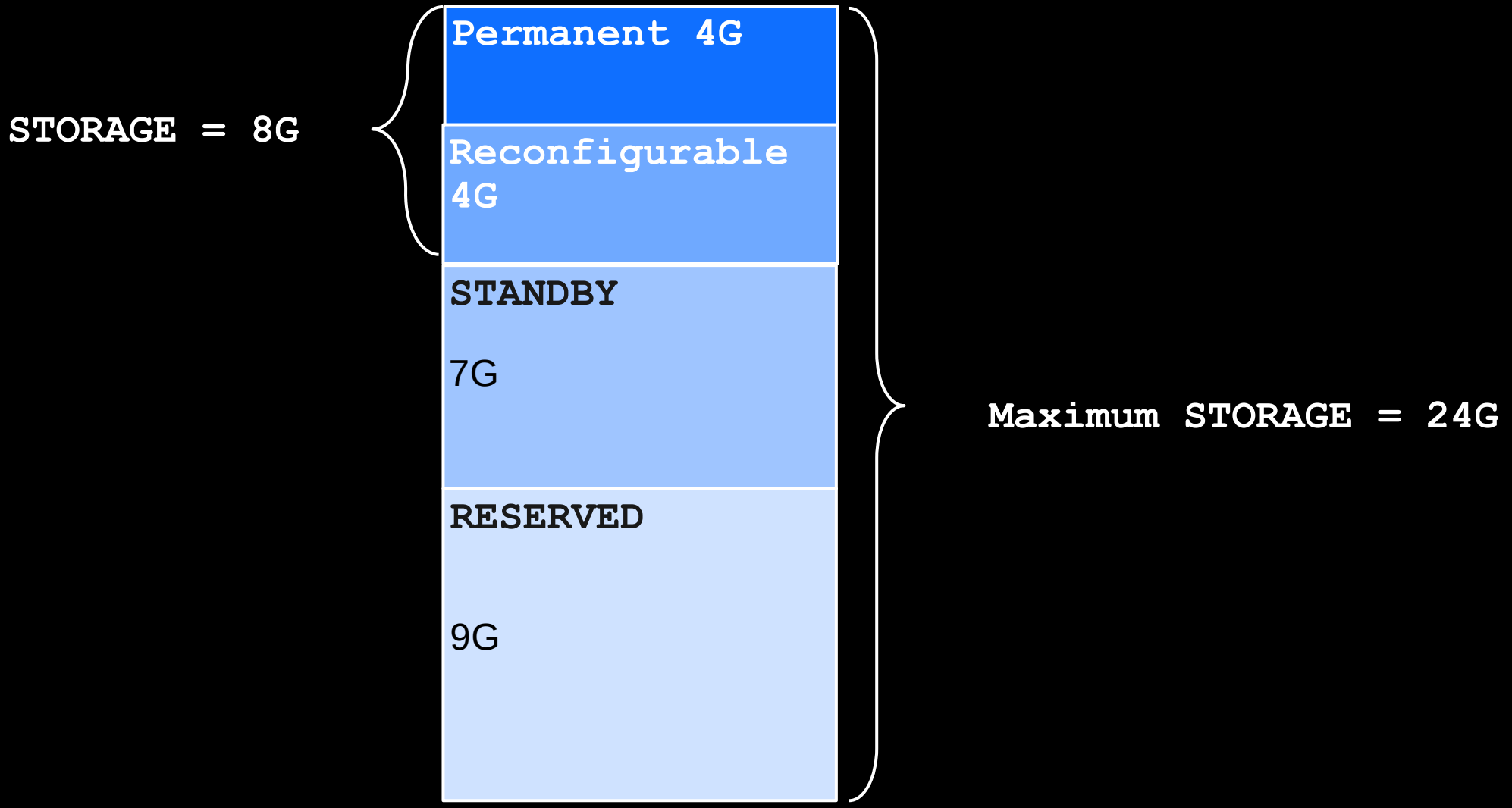
Total reconfigurable storage cannot exceed 50% of configured storage.

Maximum STORAGE

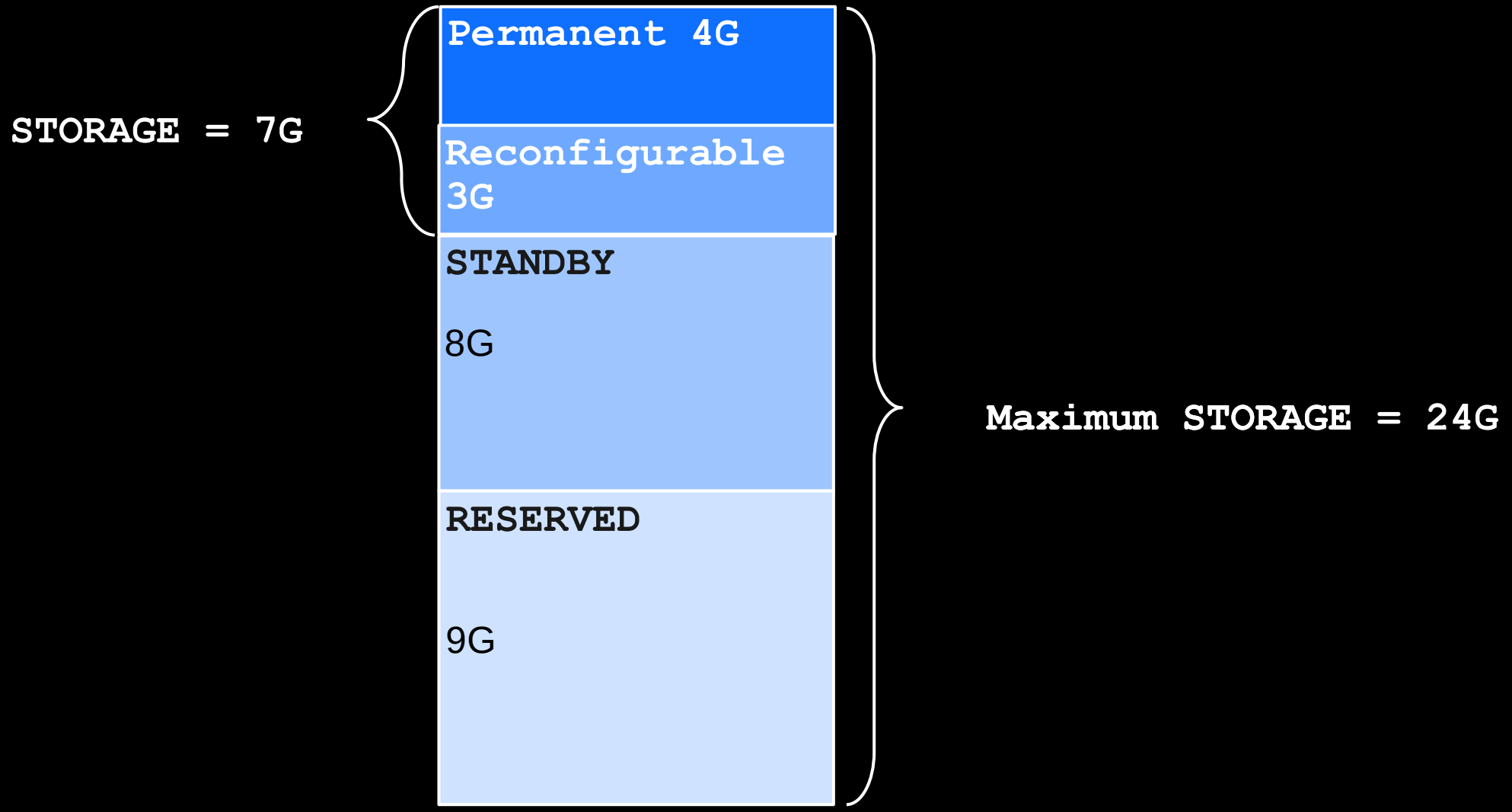
The largest amount of storage that can be brought online to z/VM. Maximum = Initial + Reserved in your LPAR definition, up to 4T.



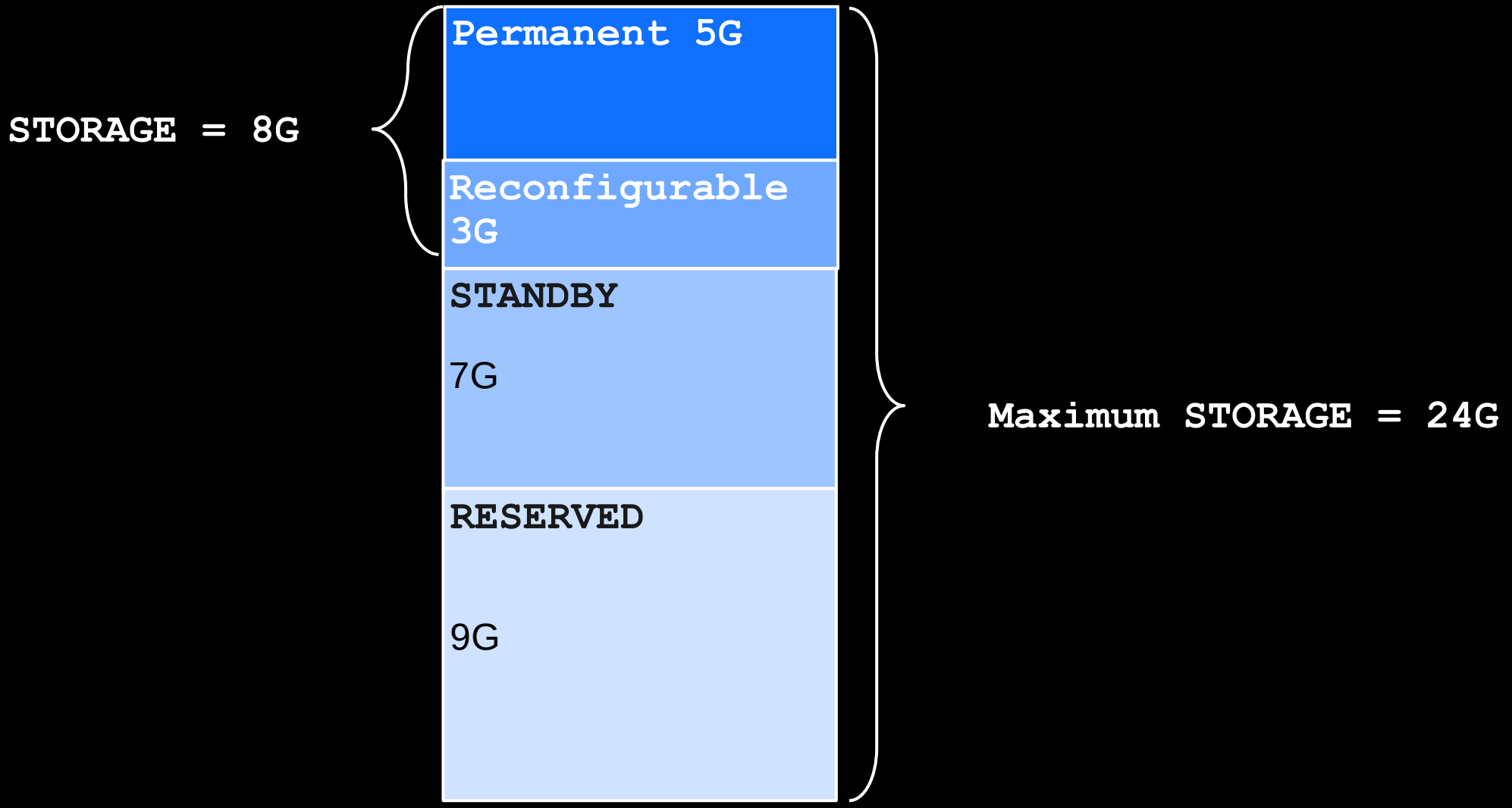
SET STOR RECONF +1G



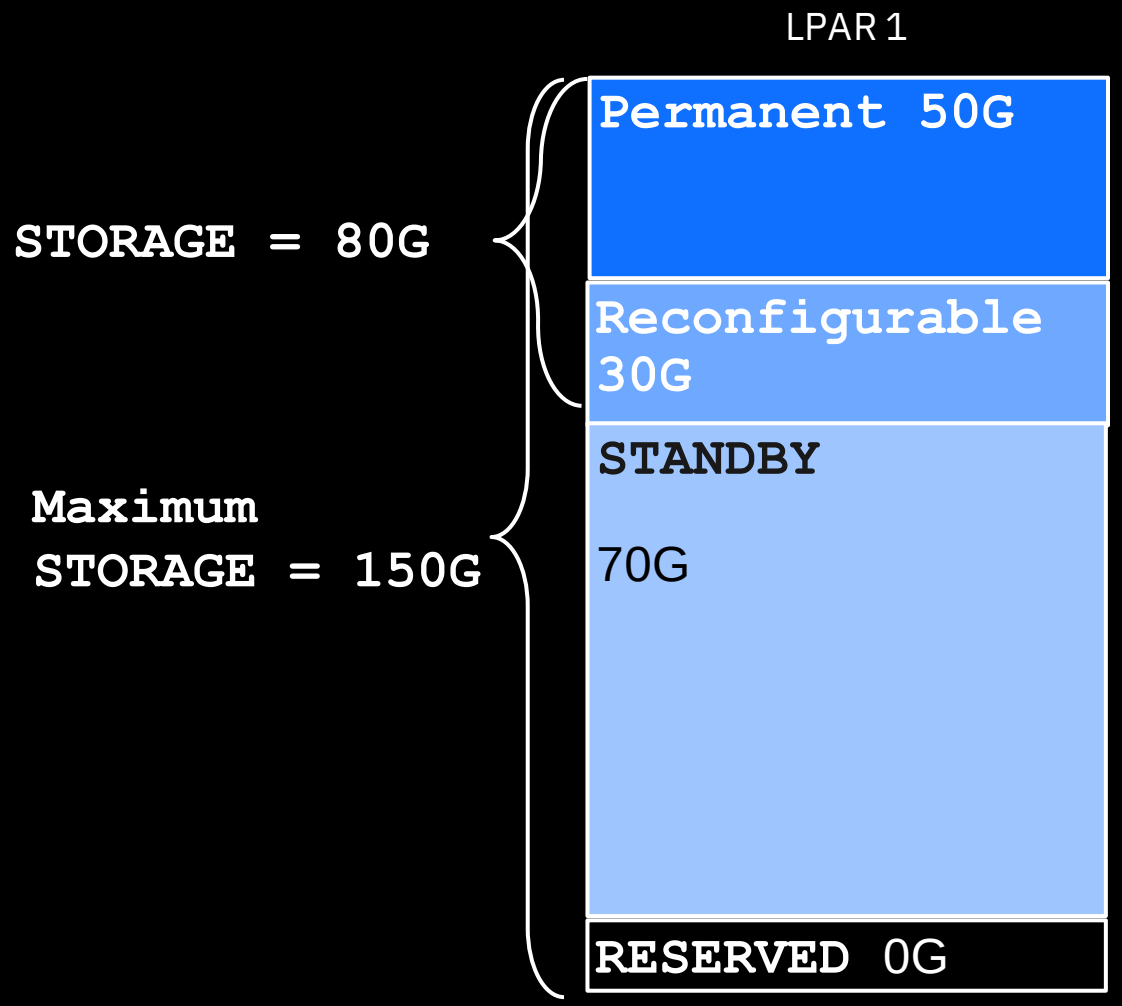
SET STOR RECONF -1G



SET STOR PERM +1G



One LPAR is lonely, but has lots of **STANDBY** memory

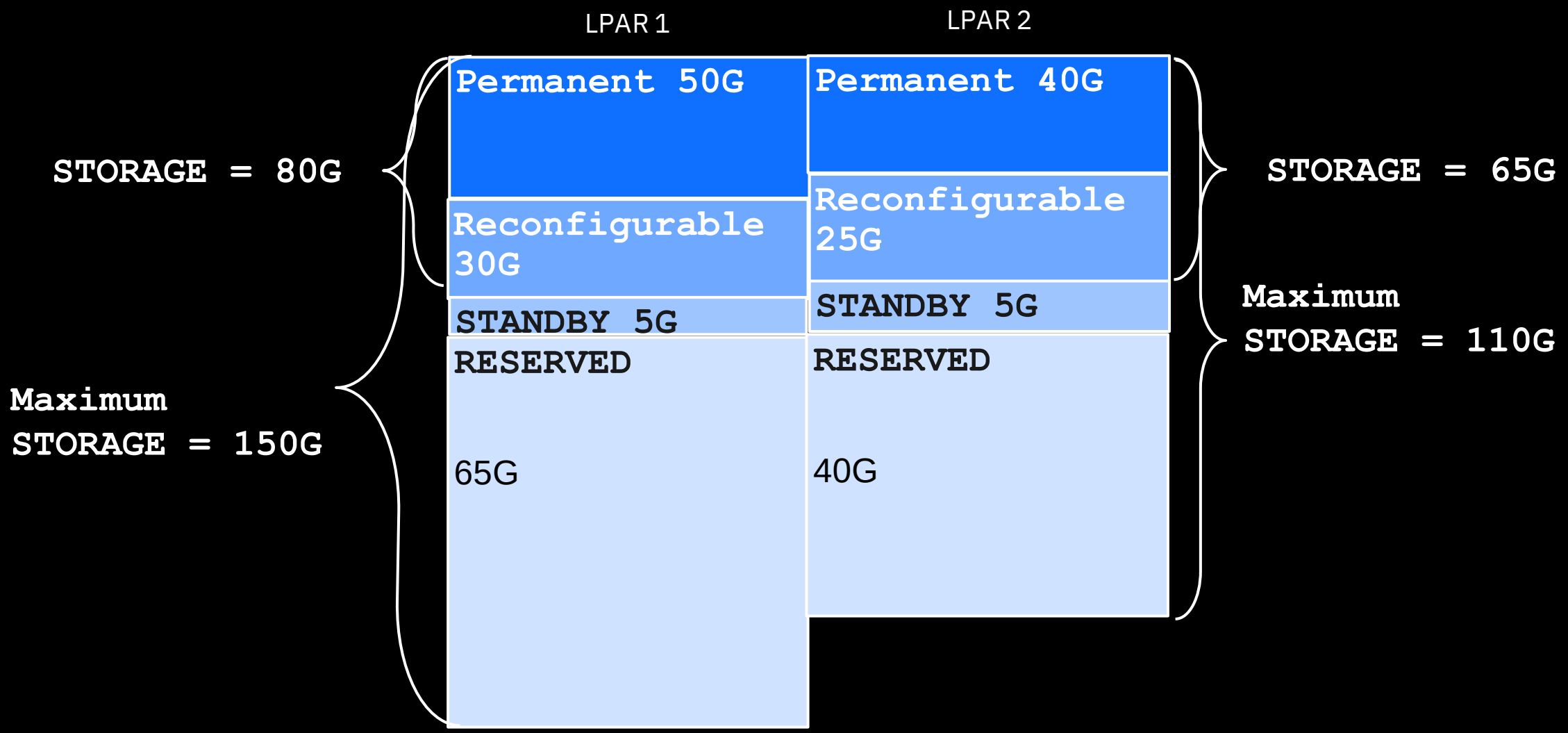


Total storage on the CPC 150G

A new partition is activated! I gain a friend but lose some **STANDBY** memory.

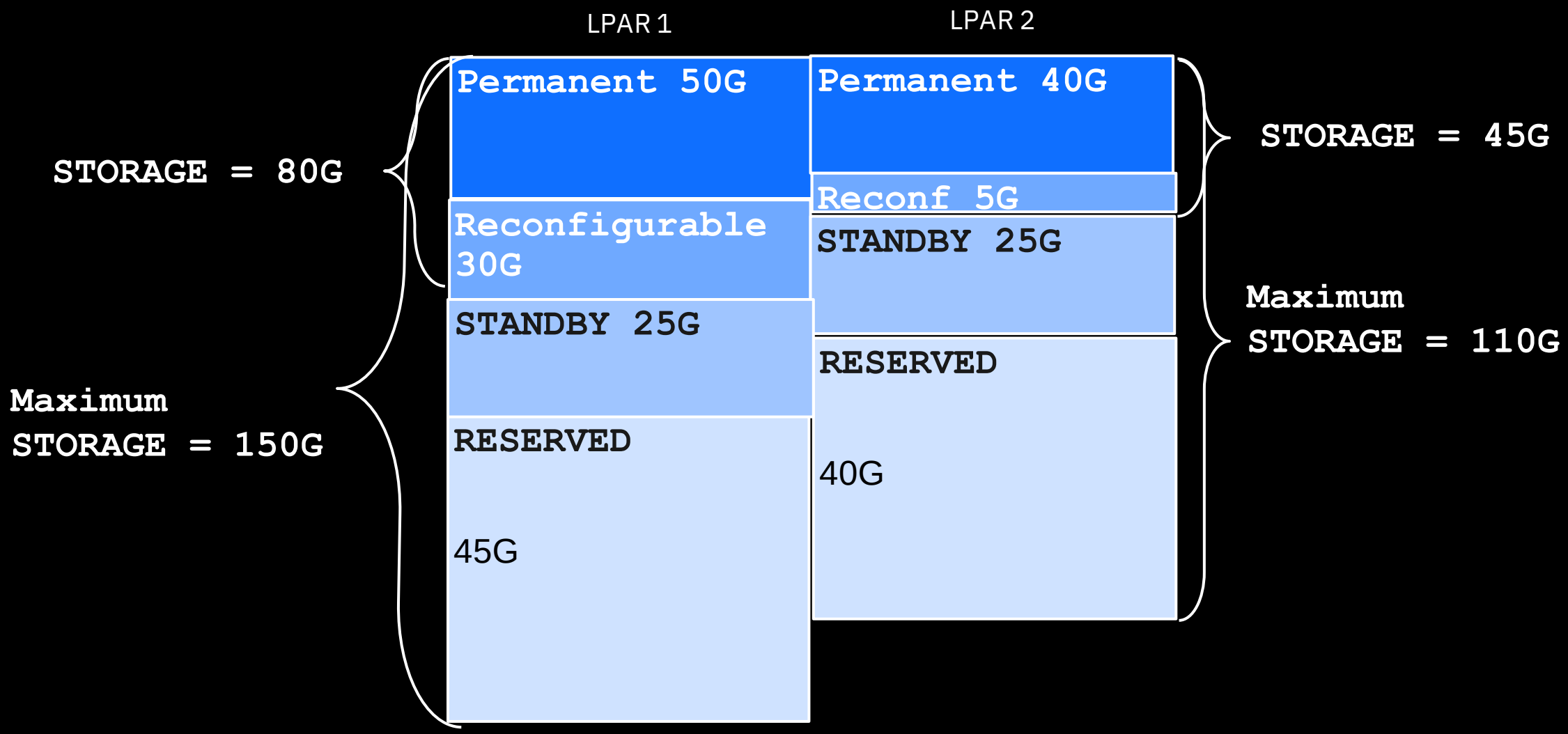
Total storage on the CPC = 150G = 80G + 60G + 10G (STANDBY)

Partition 2 adds 5G of memory, I now have less STANDBY



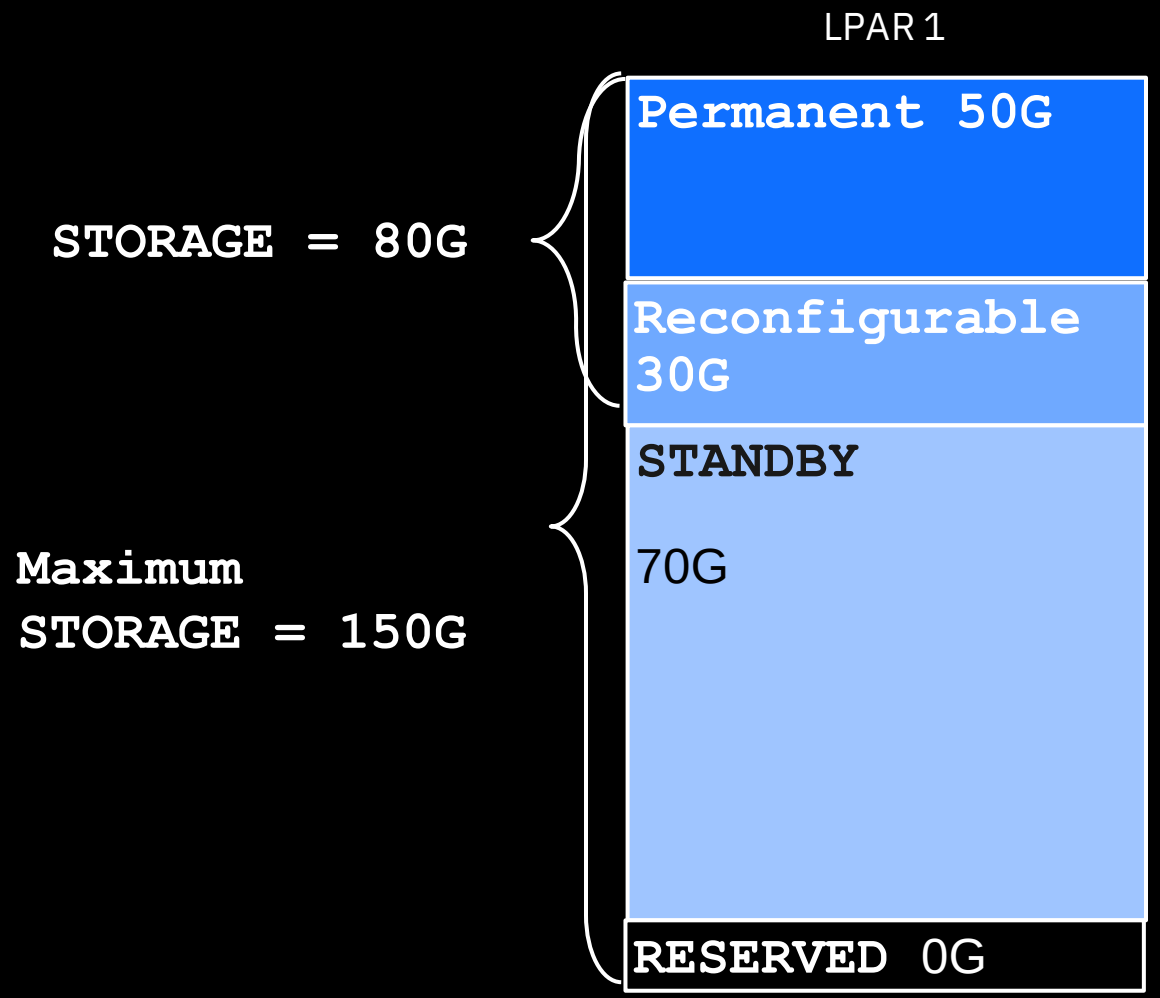
Total storage on the CPC = 150G = 80G + 65G + 5G (STANDBY)

Partition 2 subtracts 20G of memory, I now have more STANDBY



Total storage on the CPC = 150G = 80G + 45G + 25G (STANDBY)

The other LPAR is deactivated. More **STANDBY** for me!



Total storage on the CPC 150G

Planning for Dynamic Memory Management on z/VM

Requirements and Restrictions

- z/VM LPAR on z14, Emperor II, Rockhopper II (or newer hardware) is necessary for first level real storage reclamations.
  - Dependency on z14 firmware enhancements in QDIO and HPMA2
- Other improvements are available on all supported hardware.
  - New **`STORAGE`** configuration statement to preserve or reset the storage configuration across IPLs
  - Ability to set a paging warning threshold customized to your system
- Not more than 50% of all online storage may be defined as reconfigurable
- 4G of permanent storage is an enforced *minimum* and thereafter no more than 50% of storage can be reconfigurable.
- Storage additions (and reclamations) must be done in multiples of the storage increment size (QUERY STORAGE will show the increment size).

How much permanent storage should I have?

It depends

- Consider what is running today and how it runs (e.g. overcommit, V:R ratio, etc.).
- Consider loads that require permanent storage (e.g. QDIO workloads – large amounts of long term pins)
- Monitor to see if the system performs to expectations.

Permanent storage can be added later, but it cannot be removed dynamically!

If possible, use **`VIR2REAL EXEC`** or **`MONITOR`** data to look at your system workload before you add the variable workload. Think about

- Storage originally defined for the LPAR
- The virtual to real ratio for your core workload
- Storage instantiated on a typical day

Add a little extra to your permanent storage to cover the parts of your variable workload that must be in permanent storage.

- CP control blocks
- I/O and MONITOR pages

How much reconfigurable storage should I have?

The following situations lend themselves to reconfigurable storage (variable workloads)

- Work that happens during special events or at certain periods of time
- Guests that don't always run in the LPAR
- An application that is growing and needs more storage temporarily
- Test LPARs on a storage rich CPC (which would normally be set up to over-commit storage)

These workloads are perfect for reconfigurable storage; you can have storage when you need it and give storage back for use by another LPAR when you don't

Think about the amount of storage you would use for the variable workload and the new virtual to real ratio for your system after the new workload and storage are added

Remember, a decrease in reconfigurable storage will result in a higher V:R ratio

Not more than 50% of all online storage may be defined as reconfigurable.

VIR2REAL EXEC

- Gathers information about the system and the users currently running on it
- Differentiates between users running CMS (by looking at which NSSes or devices they IPL) and those not running CMS
- Looks at both their total virtual storage and instantiated storage
  - Shows what the system looks like at this moment in time
  - Total virtual shows you the highest potential utilization
- Compares these numbers to the real storage available to the system
- Gives information on the storage available to the system as well as the increments in which it may be increased
- Looks at the paging space available, current utilization and what the paging space utilization would be **if the guests used all their available virtual storage**

VIR2REAL EXEC

```
vir2real
Storage information for VM system GDLLCPX2
CMS users IPL NSSes "CMS GCS" or devices "0190".

Total Virtual storage (only ids not running CMS):          0 MB (   0.0 GB)
Total Virtual storage (only ids running CMS):           9252 MB (   9.0 GB)
Total Virtual storage (all logged on userids):          9252 MB (   9.0 GB)
Total of all Instantiated pages:                         373 MB (   0.4 GB)
Usable real storage (pageable) for this system:      2599481 MB (2538.6 GB)
Total LPAR Real storage:                             2621440 MB (2560.0 GB)
Permanent storage:                                   2097152 MB (2048.0 GB)
Reconfigurable storage: (Increment size 4G)           524288 MB ( 512.0 GB)
Maximum possible storage:                            4194304 MB (4096.0 GB)

Total Virtual disk (VDISK) space defined:               1200 MB (   1.2 GB)
Average Virtual disk size:                               200 MB

Virtual to (usable) Real storage ratio:      0.0 : 1
Virtual + VDISK to Real storage ratio:       0.0 : 1
Virtual to Real ratio (non CMS work only):   0.0 : 1
Total Instantiated to Real storage ratio:    0.0 : 1

Paging:  33 volumes active, usable space is:         2244608 MB (2192.0 GB)
Total Paging space in use at  1% utilization:            118 MB (   0.1 GB)
Note:  Agelist KeepSlot is DISABLED
```

CHKRECLM EXEC

- Collects all the same information as **VIR2REAL** and calculates the same ratios, but then models taking away the specified amount of storage from your system and recalculates the same information
- Allows you to compare how your system would look after a reclamation
- Will warn you if a reclamation isn't possible because of lack of reconfigurable storage, or if the value specified is not a multiple of the increment size
- Virtual to real overcommit ratio is a guideline many customers use
- Shows a range of paging space utilization, because there could be multiple copies of a page

CHKRECLM EXEC

```
chkreclm 12G
Storage reclamation information for VM system GDLLCPX2 on 2021-04-11 at 12:47:46
CMS users IPL NSSes "CMS GCS" or devices "0190".

Your system has:
Total Virtual storage (only ids not running CMS):          0 MB (   0.0 GB)
Total Virtual storage (only ids running CMS):           9252 MB (   9.0 GB)
Total Virtual storage (all logged on userids):          9252 MB (   9.0 GB)
Total of all Instantiated pages:                         372 MB (   0.4 GB)
Paging usable space:                                  2140625 MB (2090.5 GB)
Total Paging space in use:                               118 MB (   0.1 GB)
Paging warning setting:                                              90%

Projected real and virtual storage ratios:
                                                  Current     Post-Reclaim
Total LPAR Real storage:                       2560.0 GB      2548.0 GB
Virtual to (usable) Real storage ratio:            0.0 : 1     0.0 : 1
Virtual to Real ratio (non CMS work only):         0.0 : 1     0.0 : 1
Total Instantiated to Real storage ratio:          0.0 : 1     0.0 : 1
Virtual + VDISK to Real storage ratio:             0.0 : 1    0.0 : 1
```

CHKRECLM EXEC

```
Estimated paging space utilization after reclamation:
                                                  Low          High
Percent of paging in use:                          0.6 %        0.6 %
Paging in use:                                    12.2 GB      12.2 GB
Paging usable space:                            2090.5 GB    2090.5 GB
Note:  AGELIST KEEPSLOT NO is in effect.  Therefore, more paging will result in more page space usage.
Consult the CP Planning and Admin book chapter on Allocating DASD space for more info.
```

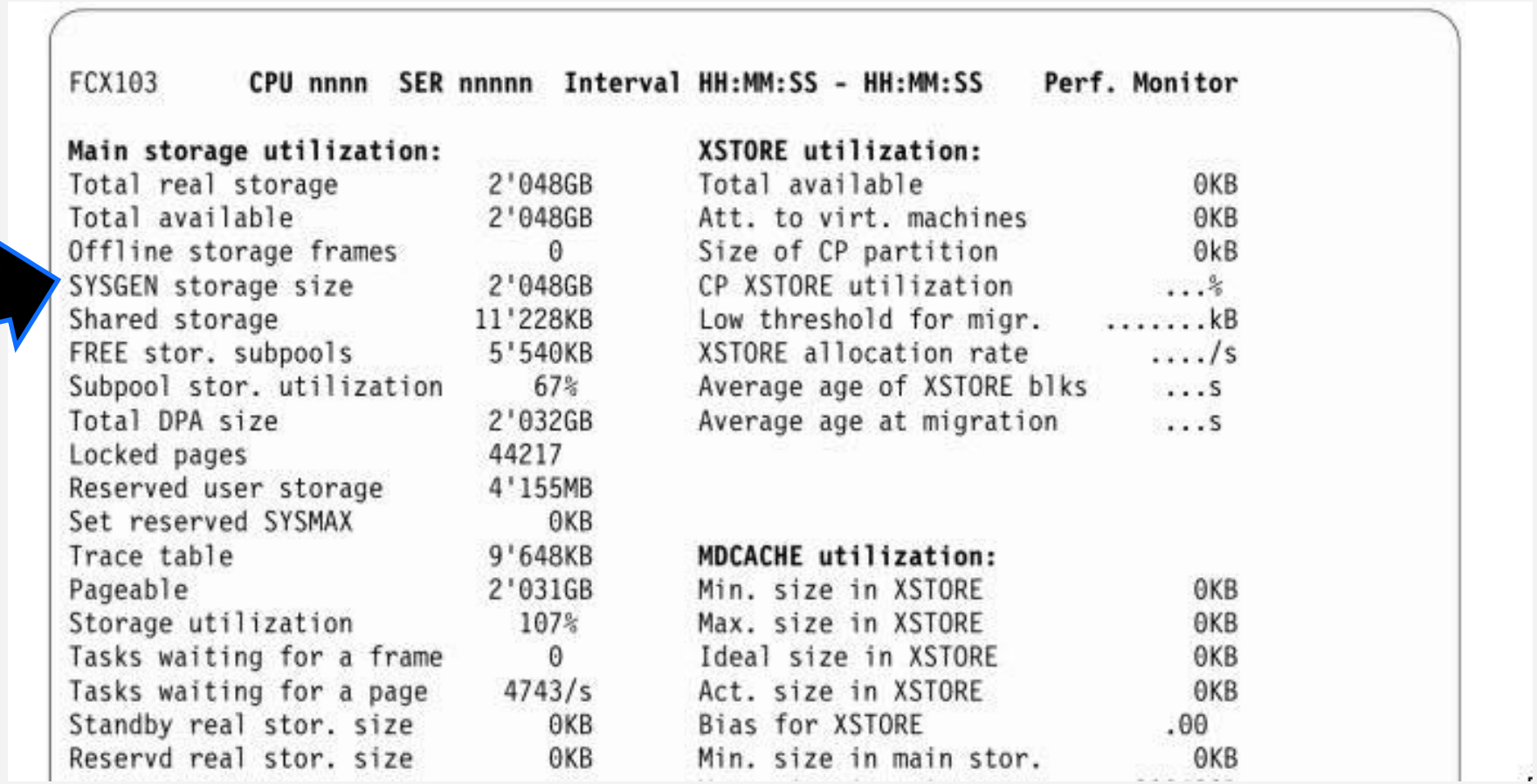
VIR2REAL EXEC and **CHKRECLM EXEC**

- **VIR2REAL** is an existing EXEC available on the z /VM downloads page: https://www.vm.ibm.com/download/packages/descript.cgi?VIR2REAL
  - The updated EXEC now uses CP commands/responses available with 4 TB real memory support (APAR VM66713) to display the amount of Permanent, Reconfigurable, and Maximum memory sizes
- **CHKRECLM** is a new EXEC that will be made available on the downloads page after the DMD APAR is available

Performance Toolkit can help too!

- Performance Toolkit for z/VM reports can also help with determining your workload's size
- FCX103, Storage Utilization – STORAGE – provides information about the real storage available on the system

SYSGEN storage size shows the amount of storage online to the z/VM system



```
FCX103      CPU nnnn  SER nnnnn  Interval HH:MM:SS - HH:MM:SS    Perf. Monitor

Main storage utilization:                 XSTORE utilization:
Total real storage          2'048GB       Total available                0KB
Total available             2'048GB       Att. to virt. machines         0KB
Offline storage frames           0        Size of CP partition           0kB
SYSGEN storage size         2'048GB       CP XSTORE utilization        ...%
Shared storage             11'228KB       Low threshold for migr.    .......kB
FREE stor. subpools         5'540KB       XSTORE allocation rate       ..../s
Subpool stor. utilization       67%       Average age of XSTORE blks    ...s
Total DPA size              2'032GB       Average age at migration      ...s
Locked pages                44217
Reserved user storage       4'155MB
Set reserved SYSMAX             0KB
Trace table                 9'648KB       MDCACHE utilization:
Pageable                    2'031GB       Min. size in XSTORE            0KB
Storage utilization             107%      Max. size in XSTORE            0KB
Tasks waiting for a frame         0       Ideal size in XSTORE           0KB
Tasks waiting for a page       4743/s     Act. size in XSTORE            0KB
Standby real stor. size         0KB       Bias for XSTORE              .00
Reservd real stor. size         0KB       Min. size in main stor.        0KB
```

Performance Toolkit can help too! (continued)

- FCX292, User Page Utilization Data – UPGUTL – gives you information about how much storage your guests are using

```
FCX292      CPU nnnn  SER nnnnn  Interval HH:MM:SS - HH:MM:SS    Perf. Monitor

               <------------------------------------------- Storage -------------------------------------------->
                                   <------------------------ Resident --------------------------->
           Data                                                <----- Invalid But Resident ------>              Base
         Spaces                    <---- Total ----> <-Locked--> <-- UFO --> <-- PNR --> <-AgeList->            Space Nr of
Userid    Owned   WSS  Inst Resvd T_All   T<2G  T>2G  L<2G  L>2G  U<2G  U>2G  P<2G  P>2G  A<2G  A>2G XSTOR   AUX  Size Users
>>Mean>>   10.6 5645M 6113M  256M 5391M    34M 5356M 585.1 41472    .0 2743K 292.6   46M  73.1 6008K    .0 3305M 6341M    56
User Class Data:
PERF         .0   16M   35M    .0   16M     .0   16M    .0    .0    .0  512K    .0   15M    .0 24576    .0   34M 3072M     1
Service      .0 1972K 5196K 2048K 2048K   4096 2044K    .0 77824    .0 1204K    .0    .0    .0  376K    .0 3640K 32768K    1

User Data:
APCSCIF       0  952K  972K     0    4K      0    4K     0     0     0     0     0     0     0     0     0  968K   64M
BK200001      0 3318M 3074M     0 3072M      0 3072M     0     0     0     0     0     0     0     0     0 2160K 3328M
BK200007      0 3318M 3074M     0 3072M    12M 3060M     0     0     0     0     0     0     0     0     0 3074M 3328M
BK200008      0 3318M 3074M     0 3072M    76K 3072M     0     0     0     0     0     0     0     0     0 3074M 3328M
BK300012      0 4194M   16G     0 6814M   164K 6814M     0     0     0 8728K    4K  265M    4K  273M     0   16G 16640M
BK400015      0  100G  100G     0   86G   760M   85G     0     0     0   47M     0 1085M     0   50M     0   60G  100G

Command ===> _
F1=Help  F4=Top  F5=Bot  F    F8=Fwd  F12=Return
```

Shows number of instantiated pages, add up the numbers in this column for User Data: to get the sum of all instantiated pages over all users

The Nitty-Gritty: Configuration Statements and Commands

CP Variables

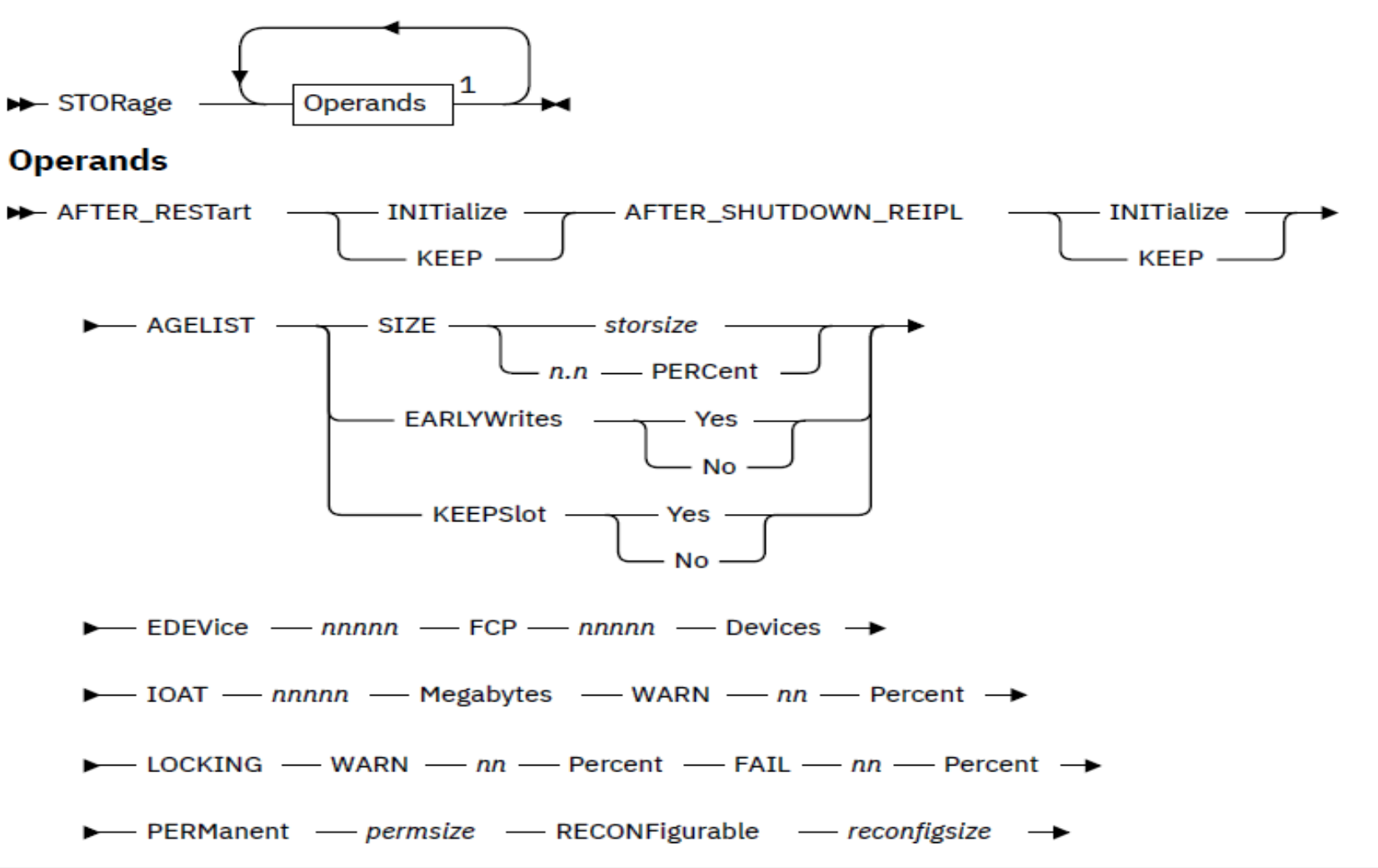
- z/VM New Function Variable List page:
  https://www.vm.ibm.com/newfunction/varlist.html
- Issue QUERY VARIABLE to find out what function your z/VM system has

APAR	CP Variable	Value	Meaning
VM66173	CP.FUNCTION.MEMORY.RECLAIM	1	Value indicates that dynamic removal of reconfigurable memory is supported.
VM66173	CP.LIMIT.MEMORY.RECONFIG	0	Value indicates that 0% of a system's real memory can be designated as reconfigurable. However, all the functions needed for DMD are available and functional (like system configuration options for PERM and RECONFIG).
VM66173	CP.LIMIT.MEMORY.REAL_TOTAL	4	Value indicates that 4 TB of real memory is supported.
VM66271	CP.LIMIT.MEMORY.RECONFIG	50	Value indicates that 50% of a system's real memory can be designated as reconfigurable.

How do I define reconfigurable storage?

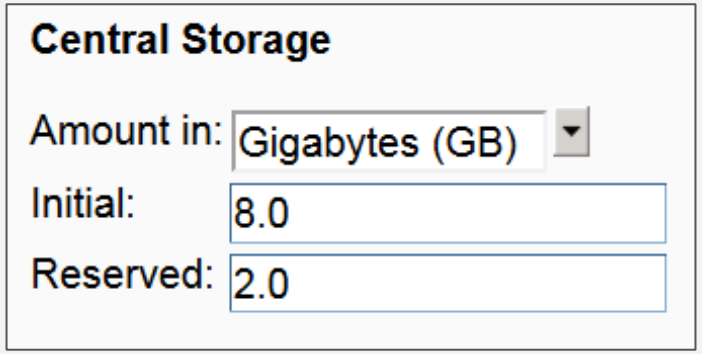
- To bring reconfigurable storage online
  - 4G of permanent storage must be available
  - **`QUERY STORE`** shows some standby storage
  - A z/VM partition on a z14, Emperor II, or Rockhopper II if you are using it 1st level (or newer hardware)
- Define using the system configuration file **`STORAGE`** statement
- Define (redefine) storage dynamically using the **`SET STORAGE`** command

STORAGE System Configuration Statements



STORAGE System Configuration Statements (continued)

- Let's say your LPAR activation profile has **`INITIAL = 8G`** and **`RESERVED = 2G`**

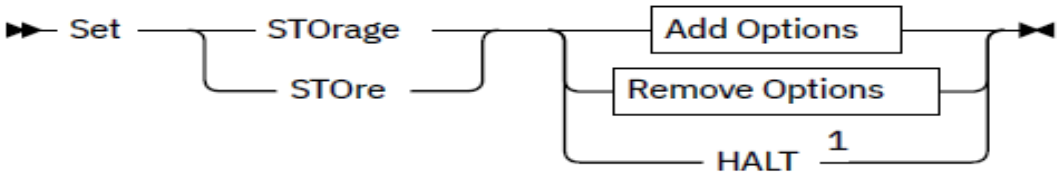


- You can specify the storage available to your LPAR with the **`STORAGE`** statements
  - **`STORAGE PERManent 8G`**
  - **`STORAGE RECONFigurable 2G`**

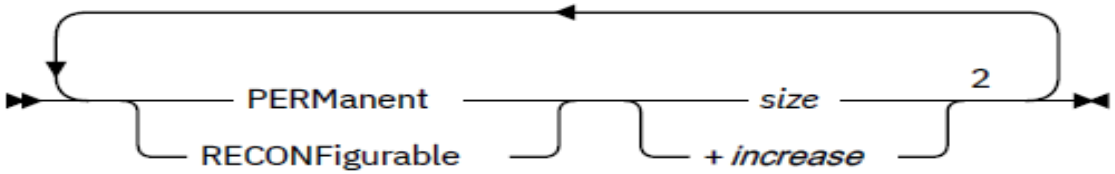
    … Or maybe

  - **`STORAGE PERM 4G RECONF 4G`**

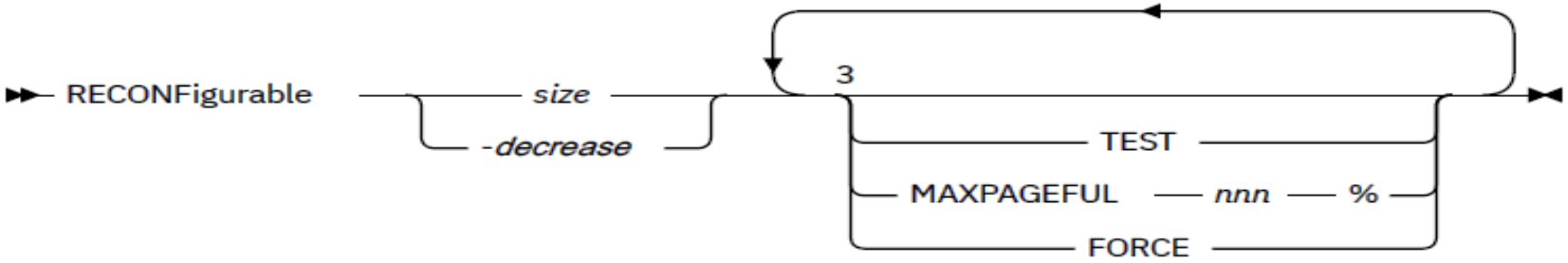
Dynamic Storage Reconfiguration



Add Options



Remove Options



Notes:

[1] HALT is valid only when a storage reconfiguration add or the vacate part of the storage reconfiguration remove operation is in progress.

[2] You can specify the operands in any order, but you can specify an operand only once per SET STORAGE command.

[3] You can specify the operands in any order, but you can specify an operand only once per SET STORAGE command.

Dynamically Adding Storage

- Add `PERManent` and `RECONFigurable` storage in one command

```
SET STOR PERM +32G RECONF +32G
```

  - When adding both `PERManent` and `RECONFigurable` storage in one command, `PERManent` storage is always processed first

- Storage initialization changes made in APAR VM66173 (4 TB real memory support)

  - Storage initialization may still be taking place after a `SET STORE` add command has completed. Another `SET STORE` command may be issued as soon as this process has completed, even if frame initialization is ongoing

  - `QUERY FRAMES` will show a non-zero value for `NotInitialized=` if frames are still being initialized

- A `SET STORE` command will be rejected if storage reconfiguration is currently in progress

- A `QUERY STORE` command will indicate if a storage reconfiguration is in progress.

Dynamically Removing Storage

```
SET STOR RECONF -1G
HCPPCC2593I Storage reclamation viability test passed with MAXPAGEFULL
 value of 90%. 19% of paging space could be required for the current
 workload.
HCPPCC2581I Storage reconfiguration to remove 1G of reconfigurable
 initiated by OPERATOR.
HCPPCC2582I Storage reconfiguration by OPERATOR is complete. Permanent
 = 4G Reconfigurable = 1G
```

Use `TEST` to determine the viability

```
SET STOR RECONF -200G TEST
HCPPCC2650E Storage reclamation viability test failed with MAXPAGEFULL
 value of 90%. 150% of paging space could be required for the current
 workload.
```

Dynamically Removing Storage (continued)

- Use `MAXPAGEFULL` to set maximum paging percent

```
SET STOR RECONF 0 MAXPAGEFULL 95%
HCP2650E Storage reclamation viability test failed with MAXPAGEFULL value of
 95%. 150% of paging space could be required for the current workload.
```

- Use `FORCE` to skip any viability checks (use at your own risk!)

```
SET STOR RECONF 0 FORCE
HCP2581I Storage reconfiguration to remove 2G of reconfigurable initiated by
 OPERATOR.
HCP2582I Storage reconfiguration by OPERATOR is complete. Permanent = 4G
 Reconfigurable = 0
```

Using FORCE is very risky. It can cause a PGT004 abend if the system runs out of paging space!

Monitoring a Storage Reconfiguration

- Use new `RECONFiguration` option of `Q STOR` to check status of an in-progress storage addition

```
Query STorage RECONFiguration
STORAGE = 5G CONFIGURED = 5G INC = 128M STANDBY = 9G RESERVED = 0
Permanent = 4G Reconfigurable = 1G Maximum STORAGE = 14G
Storage increase in progress. Elapsed time = 00:00:01
Target:  Permanent =   13312M
Total to add:     Permanent =    9216M
Remainder to add: Permanent =    9216M
Storage reconfiguration is active.
```

Monitoring a Storage Reconfiguration (continued)

- Use new `RECONFiguration` option of `Q STOR` to check status of an in-progress storage reclamation

```
Query STore RECONFiguration
STORAGE = 12544M CONFIGURED = 12544M INC = 128M STANDBY = 1792M RESERVED = 0
Permanent = 7G Reconfigurable = 5376M Maximum STORAGE = 14G
Storage decrease in progress. Elapsed time = 00:00:01
Target Reconfigurable =    2048M
Total to remove       =    5120M
Remainder to remove   =    3328M
MAXPAGEFULL           = Forced to no limit
Storage reconfiguration is active.
```

Halting a Storage Reconfiguration in Progress

```
SET STOR HALT
```

- Terminate a storage reconfiguration in progress
- Any portion of the reconfiguration already completed will not be undone

```
HCP2650E Storage reclamation viability test failed...
```

- As a reclamation progresses, the system will periodically check viability so…
- The system will halt an in-progress reclamation if the viability test fails

Memory Reclamation on Guest Systems

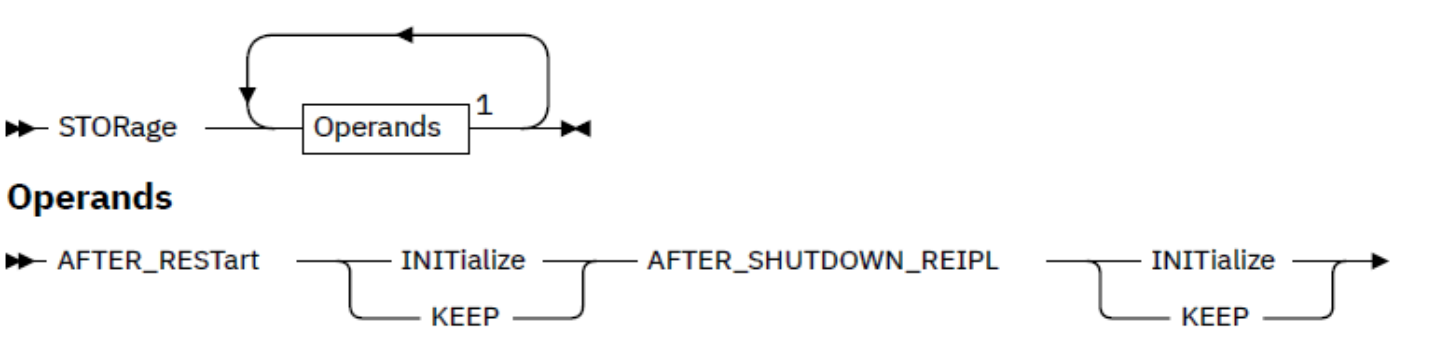
- z/VM second-level will support memory reclamation on z13
- Useful for testing out reclamations
  - Use `INCrement` operand of `DEFINE STORAGE` command to see how increment size affects adding and removing storage
  - Second level guest must specify `DEFINE STORAGE` command with STANDBY and/or RESERVED storage
- When your second level z/VM system has no STANDBY or RESERVED storage defined, the increment size will be 1M and you cannot use `SET STORAGE` to add or remove storage.

Storage and Initialization

- If you leave your system how it is today (with no changes to the SYSTEM CONFIG) your storage will come up as `Permanent`.
  - If you have `STANDBY` or `RESERVED` storage available, you may be able to add `RECONFIGURABLE` storage later
- `STORE=` IPL parameter overrides SYSTEM CONFIG specifications for `Permanent` and `Reconfigurable` storage
  - The amount of storage specified will be `Permanent`
- If you have 4G storage or less, it will always be initialized as `Permanent` storage. `Reconfigurable` is only available after you have 4G of `Permanent` storage
- Use system configuration statements to change storage handling after a restart
- If there are multiple STORAGE entries, the last one “wins”

Reminder: Always use CPSYNTAX to check your configuration file for errors! Find problems BEFORE your system restarts!

System Configuration Restart Options



Use new `AFTER_RESTart` and `AFTER_SHUTDOWN_REIPL` options to specify how storage is initialized

- `AFTER_RESTart` specifies how to initialize storage after an abend
- `AFTER_SHUTDOWN_REIPL` specifies how to initialize storage after a `SHUTDOWN REIPL` command

In both cases:

- `INITialize` will initialize storage in the “usual” way using system config options (if available)
- `KEEP` will initialize storage based on the storage configuration at the time of the restart/reIPL

System Configuration Restart Options (continued)

- Want to ignore any dynamic storage changes made prior to reIPLing? Use `INITialize`
  - Specify behavior after a SHUTDOWN REIPL:
    - `STORage AFTER_SHUTDOWN_REIPL INITialize`
- Want to keep storage the way it was before the restart? Use `KEEP`
  - Specify behavior after a CP Abend or PSW RESTART
    - `STORage AFTER_RESTart KEEP`
- `KEEP` uses the amount of permanent and reconfigurable storage online at system termination.
  - As long as both the CP nucleus being IPLed and the CP nucleus being SHUTDOWN are DMD capable. This behavior can only be changed in the system configuration file

Storage After a Restart

If your storage does not match what you would expect, check `QUERY STORE IPL`

```
 q store ipl
STORAGE = 256G CONFIGURED = 256G INC = 1G STANDBY = 0 RESERVED = 0
Permanent = 200G Reconfigurable = 56G Maximum STORAGE = 256G
IPL actual:    Permanent = 200G Reconfigurable = 56G
IPL requested: Permanent = 200G Reconfigurable = 200G
IPL requested data source: STORAGE system configuration statement(s)
Last start was a system restart from SHUTDOWN REIPL
```

Keep in mind…

- Time it takes to complete a reclamation depends on size and system workload
- Try to avoid simultaneous storage reconfigurations on other partitions
- Specified storage values must be a multiple of the increment size (`INCrement`)
- Limit reconfigurable memory to the amount expected to be reclaimed (there is some overhead associated with managing reconfigurable storage)
- CP manages reconfigurable and permanent storage differently
- Ensure workload is stabilized before initiating a reclamation
- A storage reconfiguration may halt, but will not be automatically undone
- Update your system configuration file to match dynamic storage changes if you want to keep them going forward

Paging implications, interactions with other commands, and conclusion

Paging considerations

- How much paging space do I need?
  - Consider the total amount of potential memory your guests will use
  - How much is instantiated in aggregate on a given day?
  - Consult *CP Planning and Administration* Chapter 23, *Paging Space* for guidance
- Be prepared for spikes in virtual storage use – this translates to real storage use
  - z/VM will warn you when paging space is 90% full (always)
- Set your own warning level!
  - SYSTEM CONFIG statement `PAGING WARNING nnn%`
  - Dynamic command `SET PAGING WARNING nnn%`
  - This value will be used to send an alert to the system operator whenever the paging space exceeds the specified threshold (as well as when you go over 90%)
- If set, the `PAGING WARNING` percentage will be the default MAXPAGEFULL value used in reclamation viability checks

Storage reclamation and paging

- Removing storage can cause more paging
  - We will have less main storage to work with!
  - The act of removing storage uses some storage temporarily
- Is it okay to exceed your normal paging space utilization during a storage reclamation?
  - Maybe, if you're removing storage so you can move workload to a new system
  - Maybe not, the storage being removed should be excess so you wouldn't expect to see a large increase in utilization

- CP will not do a storage reclamation if it will cause paging utilization to go above the warning threshold you've set
- Using the `SET PAGING` command to reset the warning threshold will not affect any current reclamations running.
- As previously mentioned, you can override the paging warning threshold for a particular memory reclamation
  - Using the `MAXPAGEFULL` operand on `SET STORAGE`
  - Decimal integer in the range of 0 to 100

QUERY command updates

`QUERY STORE IPL`

- Storage configuration specification at the last start of the system
- Could be used for new automated bring-up procedures

`QUERY FRAMES`

- Now shows permanent, reconfigurable, and vacating frames (number of frames being taken offline):

```
Permanent=52428800 Reconfigurable=14680064 Vacating=0
```

- Also shows frames not yet initialized:

```
NotInitialized=0
```

`QUERY PAGING`

- Shows the new WARNING nnn%

`QUERY SXSSTORE`

- Frame Table Active Range
  - Shows you the range of addressable frames for the System eXecution Space, some of the frames within that range might be offline
- Always shows the host logical storage address ranges, which do not necessarily correspond with actual sizes

Conclusion

An exciting new capability, memory reclamation, is coming soon to z/VM 7.2 systems near you

Available via APAR VM66271

Memory reclamation is available only for the IBM z14 (or newer) family of servers (or equivalent)

It introduces a new type of memory, reconfigurable, which requires some planning to use

It includes other enhancements like the ability to set another paging warning threshold and the ability to keep or reset dynamic storage changes on restart

Thank you!