z/VM Live Guest Relocation Planning and Use

Session 12482

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Agenda

- Planning for Live Guest Relocation (LGR)
- Relocation Domains
- Relocating a Guest
- Demo
- Helpful Hints

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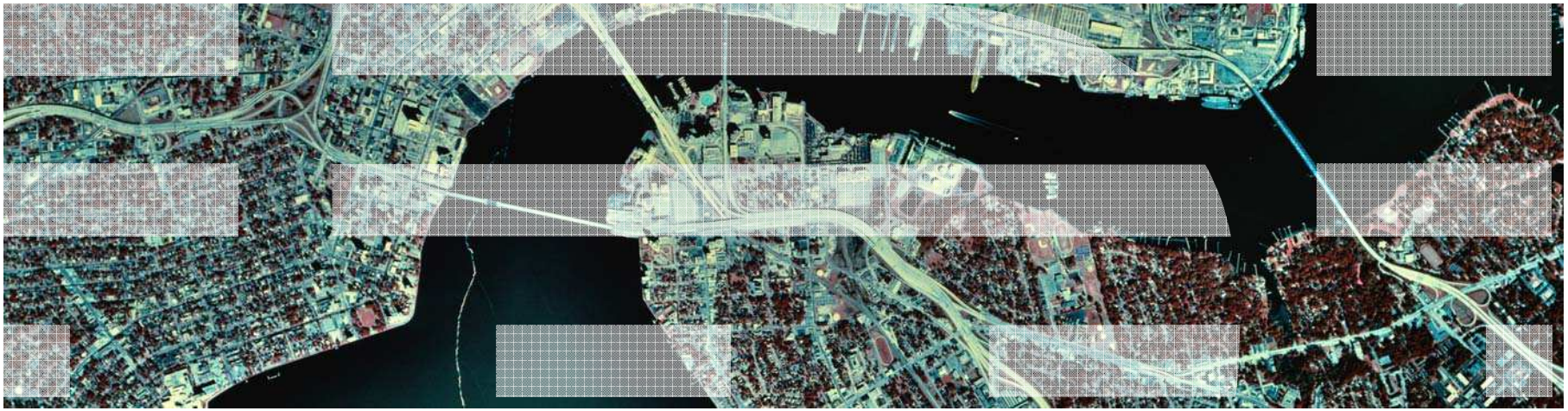

Planning
for
Live Guest Relocation

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General Guidelines for Relocating a Guest

Make sure all resources used by the virtual machine are available on the destination member

- Facilities (will be handled automatically within a relocation domain)
- Crypto cards
- Capacity for the virtual machine's memory and processor requirements
- Devices
  - –Make sure that there really is an equivalent device on the destination
    - ♦OSAs should be connected to the same LAN segment
    - ♦FCPs should have access to the same SAN fabric
    - ♦WWPNs and LUNs
    - •If possible, use the same device numbers to refer to equivalent devices
  - –Equivalency ids (**EQID**s) are defined for devices that need them
    - •OSAs and FCPs
  - –If connected to a VSWITCH, make sure the same VSWITCH is defined on the destination and the OSAs have been assigned EQIDs.
  - –If the virtual machine has an FCP, make sure the “queue_if_no_path” option is specified in Linux

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Guest Configuration for Live Guest Relocation

- In order to be eligible to relocate, a guest must be:
  - Defined as a single configuration virtual machine
  - Running in an ESA or XA virtual machine in ESA/390 or z/Architecture mode
  - Logged on and disconnected
  - Running only type CP or type IFL virtual processors
- **OPTION CHPIDVIRTUALIZATION ONE** should be specified in guest's directory entry
- If a guest is using a DCSS or NSS:
  - Identical NSS or DCSS must be available on the destination member
  - It cannot have the following types of page ranges
    - SW (shared write)
    - SC (shared with CP)
    - SN (shared with no data)

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Guest Configuration for Live Guest Relocation (cont.)

- A guest can relocate if it has any of the following:
  - Private virtual disks in storage (created with DEFINE VFB-512 command)
  - An open console file
- A relocating guest can be using any of the following facilities:
  - Virtual machine time bomb (Diag x'288')
  - IUCV connections to *MSG and *MSGALL CP system services
  - Application monitor record (APPLDATA) collection
    - If guest buffer is not in a shared DCSS
  - Single Console Image Facility (SCIF)
  - Collaborative Memory Management Assist (CMMA)
- There are conditions that will prevent a guest from relocating
  - Documented in CP Planning and Administration, Chapter 27 - "Preparing for Live Guest Relocation in a z/VM SSI Cluster"

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Memory Requirements for Live Guest Relocation

- A relocating guest's current memory size ***must*** fit in available space on the destination member

Guest's Current Memory Size

Virtual memory fully populated, including
- Private Vdisks
- Estimated size of supporting CP structures

<

Available space
- sum of available memory

Paging disk

Expanded storage

Central storage

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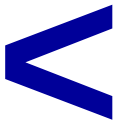
Memory Requirements for Live Guest Relocation…

- Additional checks

1. Does the guest's current memory size exceed paging capacity on the destination?

Guest's Current Memory Size

Virtual memory fully populated, including
- Private Vdisks
- Estimated size of supporting CP structures



Paging disk capacity

May be overridden if you are certain that this is not applicable to your environment

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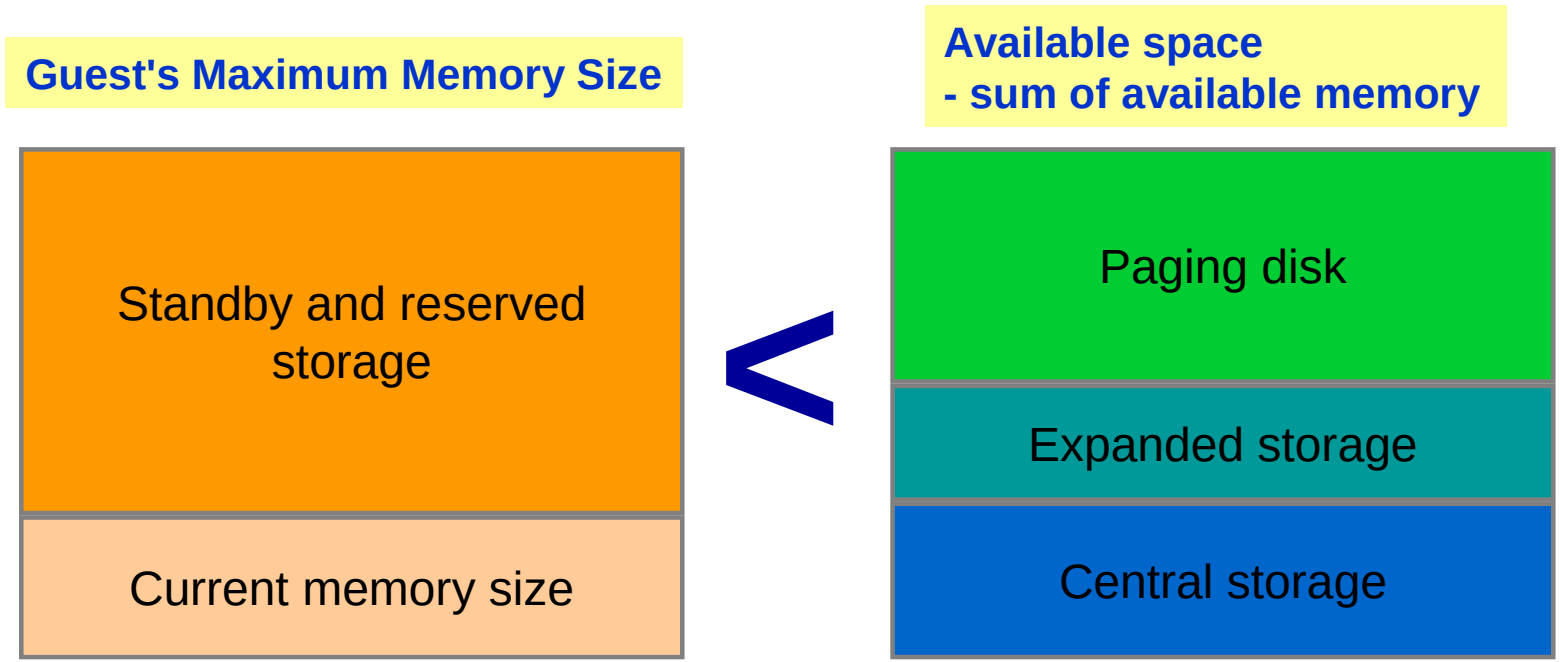
Memory Requirements for Live Guest Relocation…

- Additional checks

2. Does the guest's maximum memory size exceed available space on the destination?



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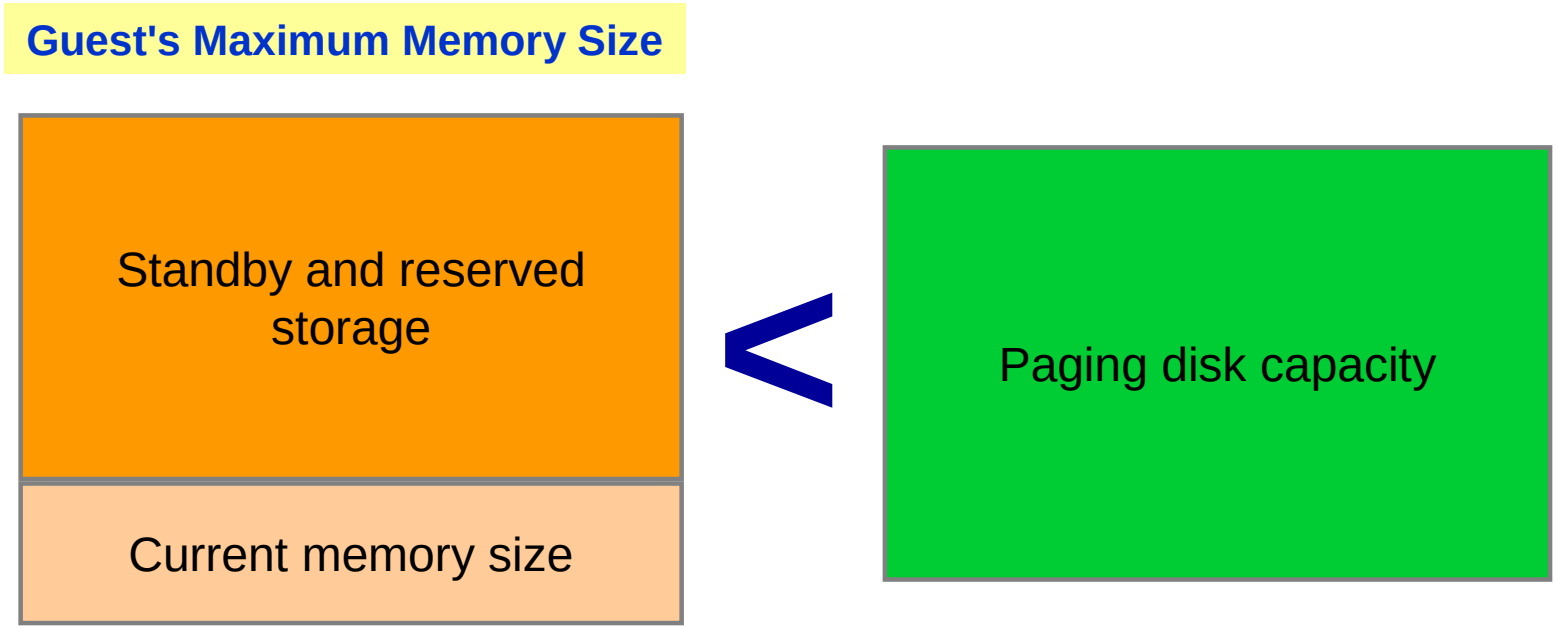
Memory Requirements for Live Guest Relocation…

- Additional checks

3. Does the guest's maximum memory size exceed paging capacity on the destination?



May be overridden if you are certain that this is not applicable to your environment

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Memory Requirements for Live Guest Relocation…

- Include standby and reserved storage settings when calculating maximum memory size for a guest

- Relocations may increase paging demand

  – Available paging space should be at least 2x total virtual memory of all guests
    - Including guests to be relocated to this member

  – Avoid allocating more than 50% of available paging space
    - If size of guests to be relocated increase in-use amount to > 50%, system performance could be affected

```
q alloc page

                EXTENT     EXTENT  TOTAL  PAGES   HIGH    %
VOLID  RDEV      START        END  PAGES IN USE   PAGE USED
------ ---- ---------- ---------- ------ ------ ------ ----
L24B66 4B66          0       3338 601020 252428 252428   42%
```


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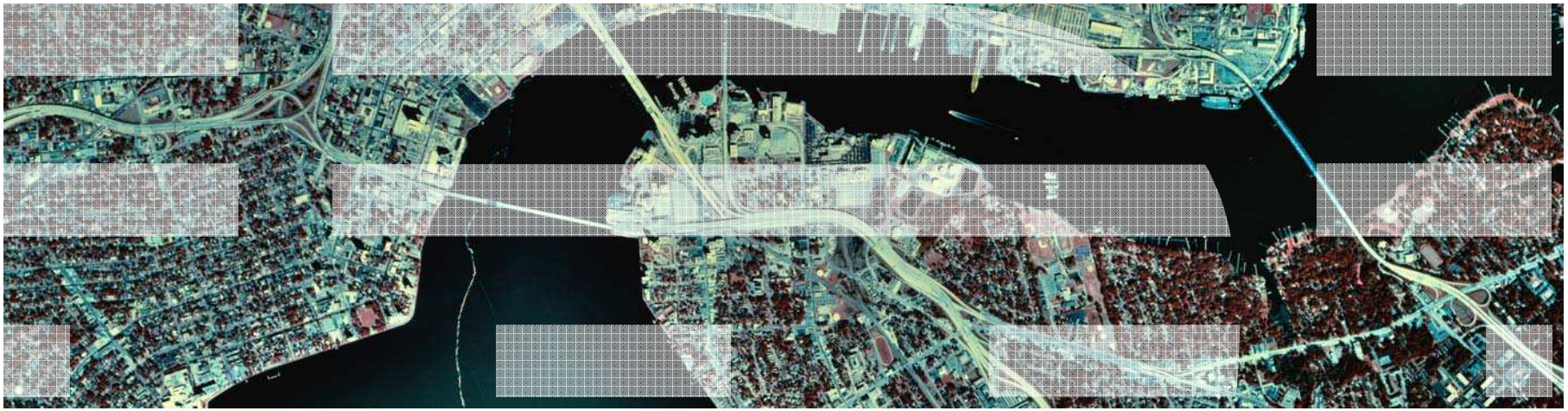

Relocation Domains

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What is a Relocation Domain?

- A relocation domain defines a set of members of an SSI cluster among which virtual machines can relocate freely

- Relocation domains can be defined for business or technical reasons

- Regardless of differences in the facilities of the individual members, a domain has a common architectural level
  - –This is the maximal common subset of all the members' facilities

- Several default domains are automatically defined by CP
  - –Single member domains for each member in the SSI
  - –An SSI domain that will have the features and facilities common to all members

- Defining your own domains is useful in a 3+ member cluster
  - –In a 1 or 2 member cluster, all possible domains are defined by default
  - –Defined via a SYSTEM CONFIG statement or dynamically by command

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Architecture Fencing in Domains

- Guests cannot use facilities or features not included in the domain even if the member they are on has access to those features
  - We call this “fencing”

- Examples of commands/instructions with “fenced” responses:
  - **Q CPUID** -the model number will always reflect the virtual architecture level, the processor number is set at logon and not affected by relocation or relocation domain changes
  - **Diagnose x'00'** – will reflect the virtual CPLEVEL
  - **STFLE**

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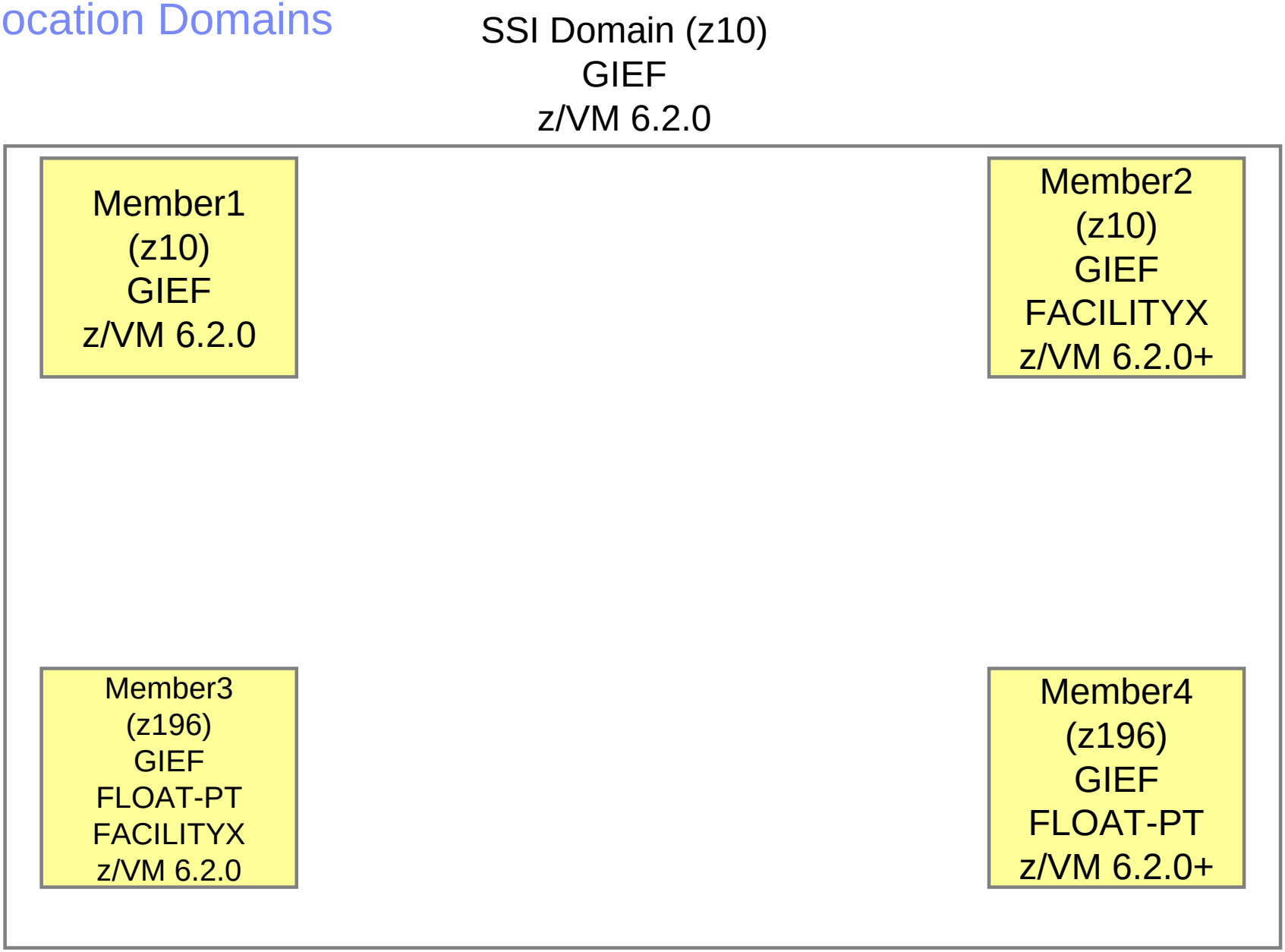
Relocation Domains



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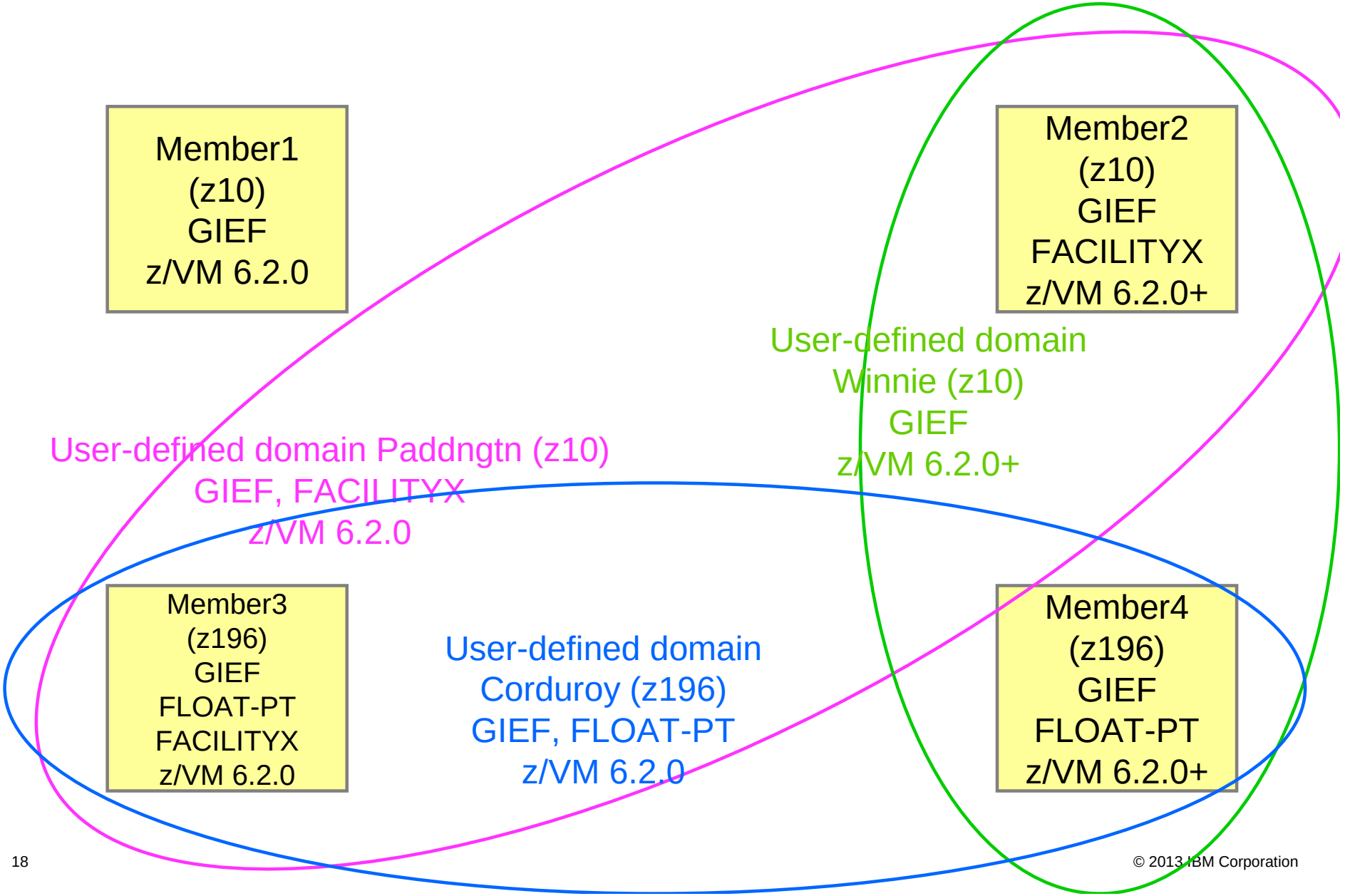
Relocation Domains



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Assigning Relocation Domains

- Virtual machines may be assigned to a domain in their directory entry
  - Default for single configuration virtual machines is the SSI domain
  - Default for multiconfiguration virtual machines is their single member domain, which cannot be changed

- Virtual machines are assigned a virtual architecture level when they log on, according to what domain they are in

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Assigning Relocation Domains - Directory

```
dirm for lgrrh56 vmrelocate on domain winnie
DVHXMT1191I Your VMRELOCATE request has been sent for processing to
DVHXMT1191I DIRMAINT at MEMBER1 via DIRMSAT2.
Ready; T=0.01/0.02 11:32:46
DVHREQ2288I Your VMRELOCATE request for LGRRH56
DVHREQ2288I at * has been accepted.
DVHBIU3450I The source for directory e
DVHBIU3450I LGRRH56 has been updated.
DVHBIU3424I The next ONLINE will take
DVHBIU3424I immediately.
DVHRLA3891I Your DSATCTL request has b
DVHRLA3891I for processing.
DVHRLA3891I Your DSATCTL request has b
DVHRLA3891I for processing.
DVHRLA3891I Your DSATCTL request has been relayed
DVHRLA3891I for processing.
DVHRLA3891I Your DMVCTL request has been relayed
DVHRLA3891I for processing.
DVHRLA3891I Your DMVCTL request has been relayed
DVHRLA3891I for processing.
DVHRLA3891I Your DMVCTL request has been relayed
DVHRLA3891I for processing.
DVHBIU3428I Changes made to directory entry LGRRH56
DVHBIU3428I have been placed online.
DVHREQ2289I Your VMRELOCATE request for LGRRH56
DVHREQ2289I at * has completed; with RC = 0.
```

```
USER LGRRH56 E 2G 3G ABCDEFG
   INCLUDE LGRDFLT
   IPL 150
   VMRELOCATE ON DOMAIN WINNIE
   LINK PMAINT 0193 0F93 RR
   MDISK 0150 3390 1 END FL4BC8 MR ALL WRITE MULTI
   MDISK 0151 3390 1 END FL4BC9 MR ALL WRITE MULTI
   MDISK 0152 3390 1 END FL4BCA MR ALL WRITE MULTI
```


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Assigning Relocation Domains - Dynamic

- A guest may be dynamically reassigned to a domain with the same or greater facilities
  - –as long as the member it is currently on has access to those facilities
- Example: before relocating a guest in the SSI domain to a member with more facilities, you may want to reassign it to a domain that includes those facilities

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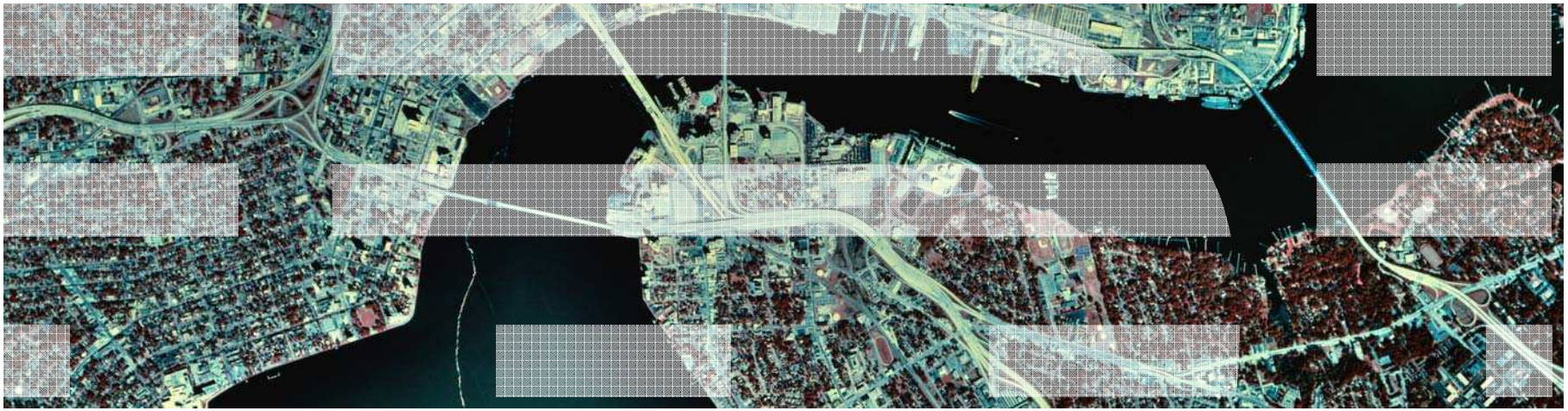

Live Guest Relocation

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Starting and Managing a Live Guest Relocation

- New **VMRELOCATE** command

  – Several operands to start and monitor relocations, including:

    - **TEST** – determine if guest is eligible for specified relocation
    - **MOVE** – relocates guest
      - **MAXQUIESCE** – maximum quiesce time (relocation is cancelled if exceeded)
      - **MAXTOTAL** – maximum total time (relocation is cancelled if exceeded)
    - **STATUS** – display information about relocations that are in progress
    - **CANCEL** – stop a relocation

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What to Know Before Starting Relocations

- Guests are relocated in several stages

- A relocation can be canceled at any time until after the guest's final state is moved
  - **VMRELOCATE CANCEL** command from the source or destination
  - **CPHX** will cancel a **VMRELOCATE SYNC** command

- If there are any eligibility failures at any point until after the guest's final state is moved, the relocation cancels

- The guest continues to run on originating member if a relocation fails or is cancelled

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What to Know Before Starting Relocations…

- Use the **VMRELOCATE TEST** command before you try a **VMRELOCATE MOVE**

- Choose one class A user to always issue your **VMRELOCATE** commands
  - Only issue one **VMRELOCATE** command at a time
    - Default **SYNCHRONOUS** option to enforce one-at-a-time relocations

- Use the **AT** command to issue **VMRELOCATE**s on another member in your SSI cluster

- Know how long your Linux machine can be quiesced, look at applications and when they will timeout (30 seconds? 5 seconds?)
  - Use the **MAXQUIESCE** option to tell CP how long quiesce time can be
  - If this is exceeded, the relocation will be cancelled and the virtual machine resumed on the source member

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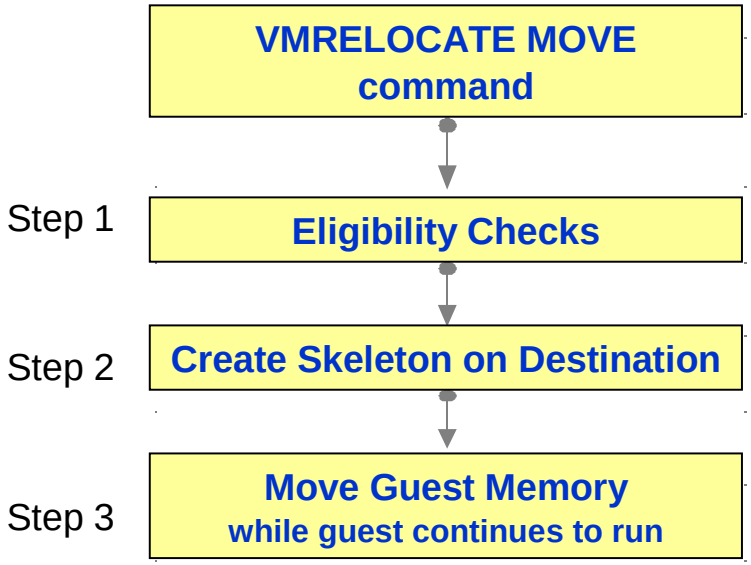
Stages of a Live Guest Relocation



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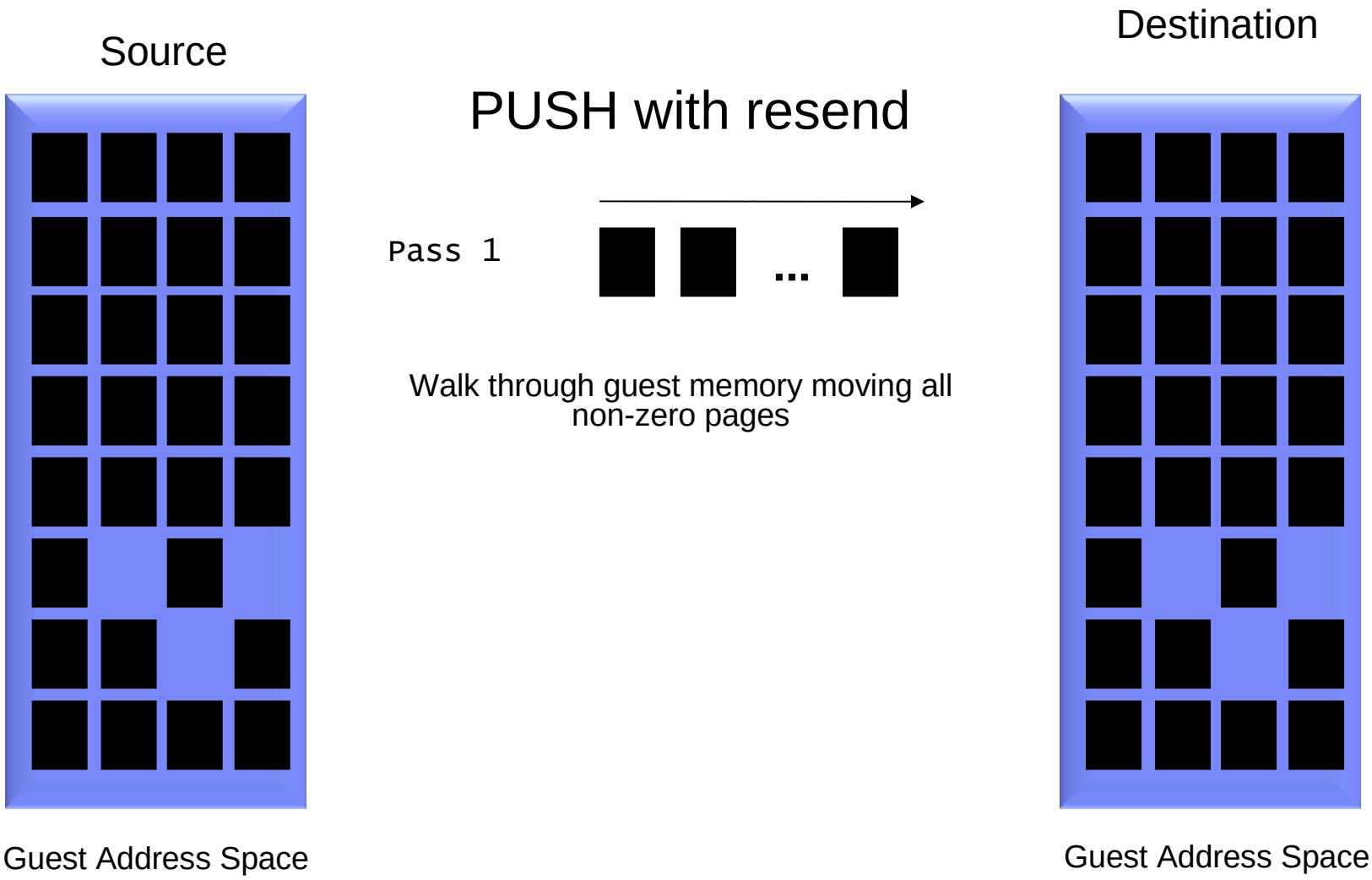
LGR, High-Level View of Memory Move



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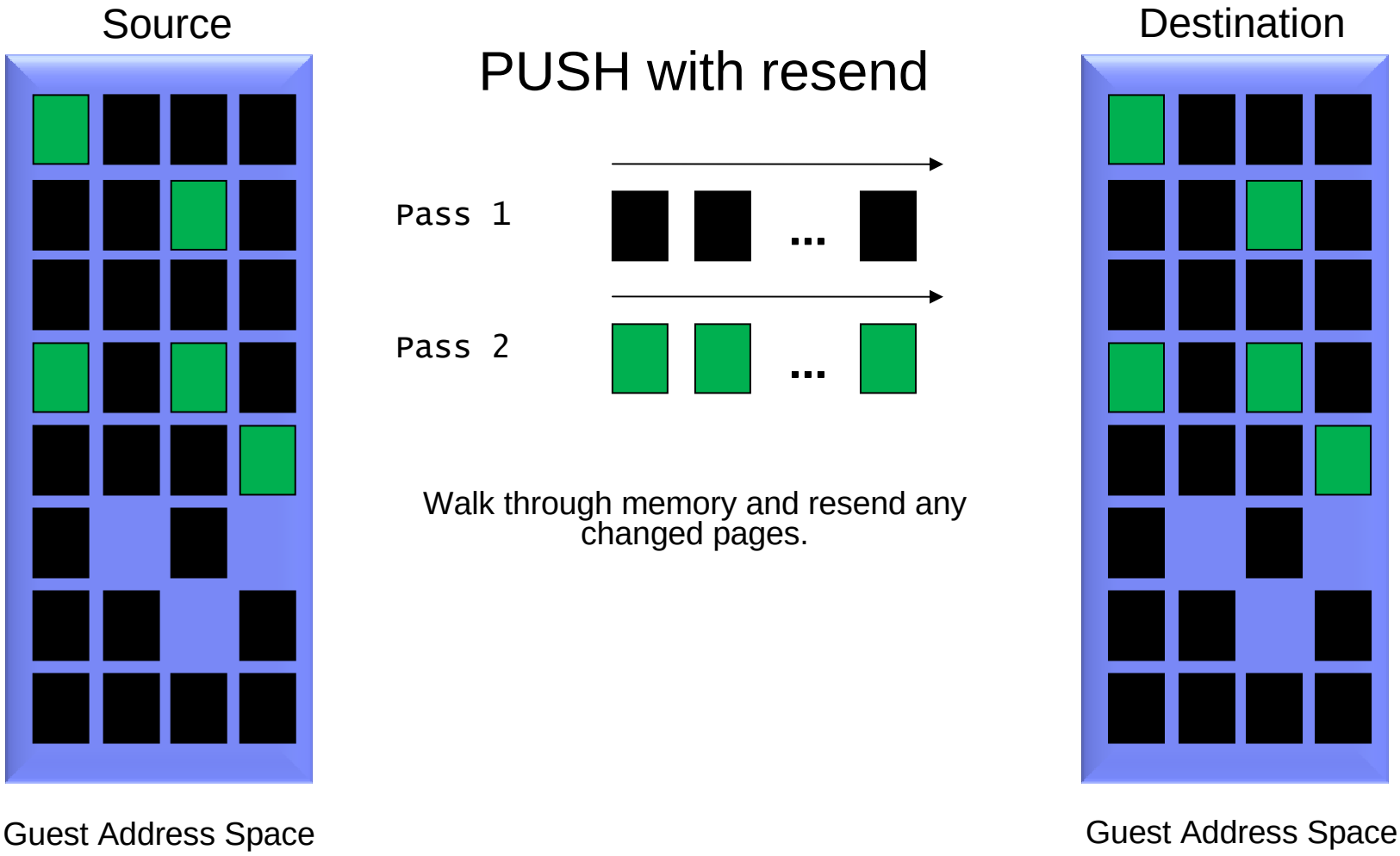
LGR, High-Level View of Memory Move



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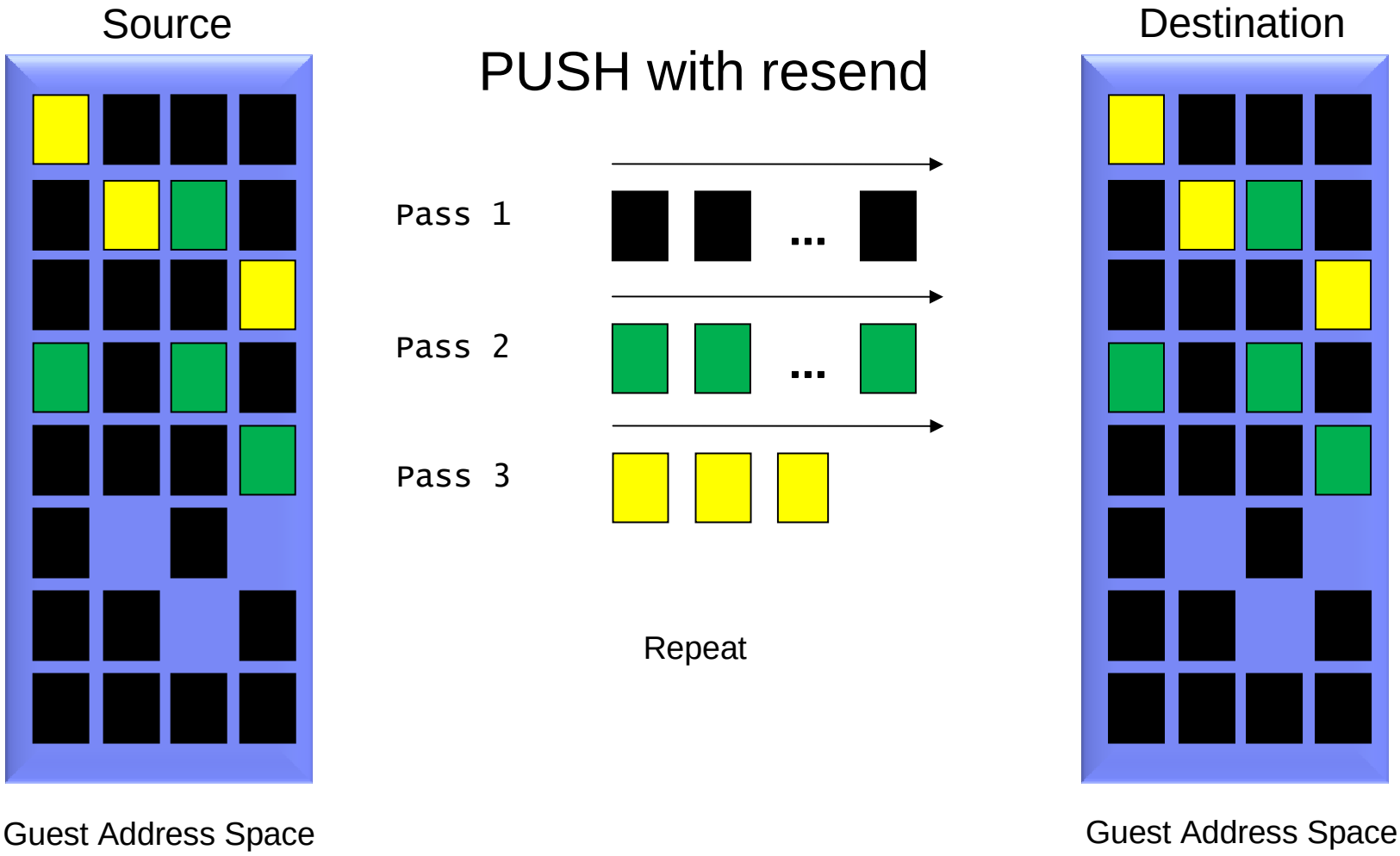

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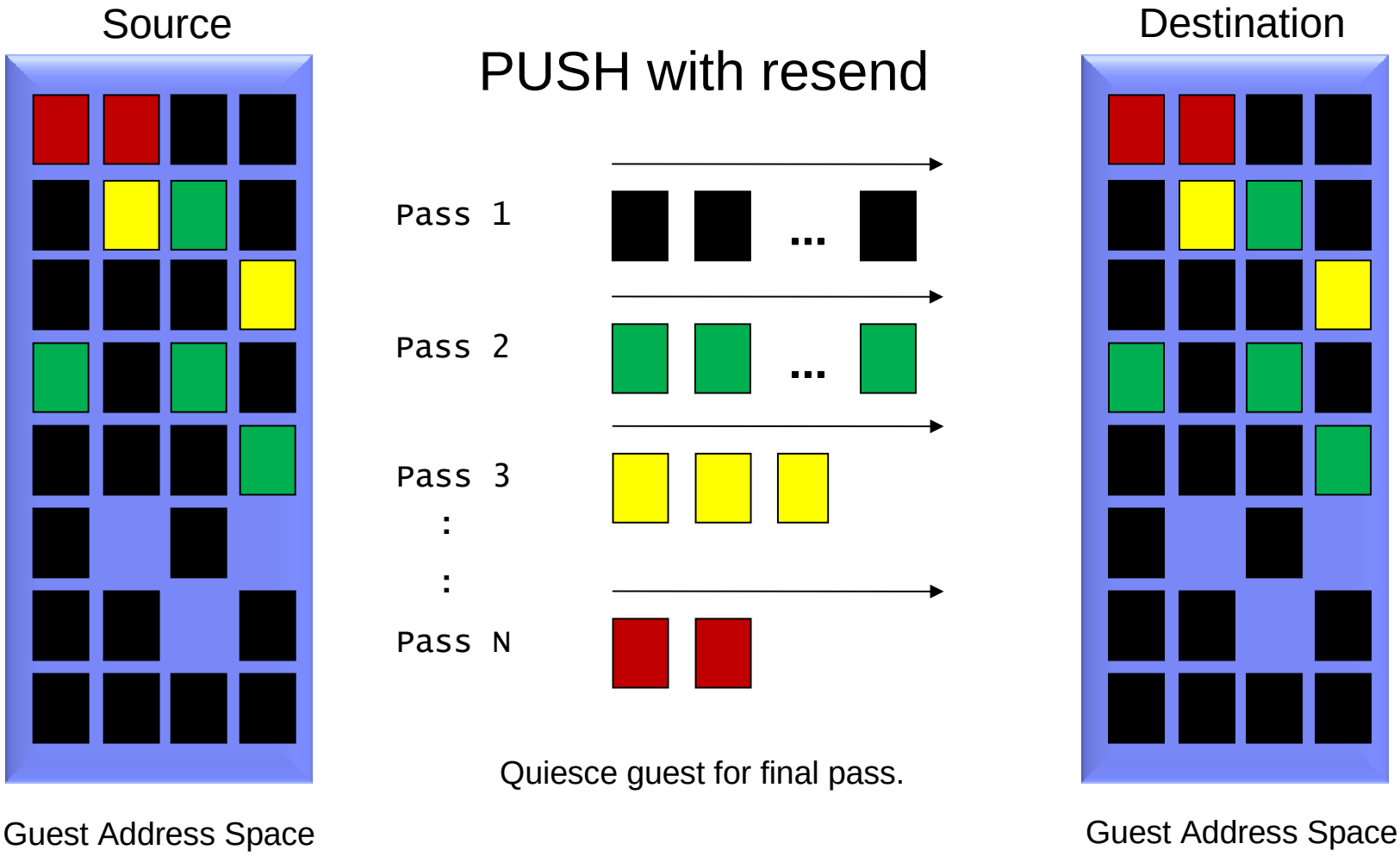

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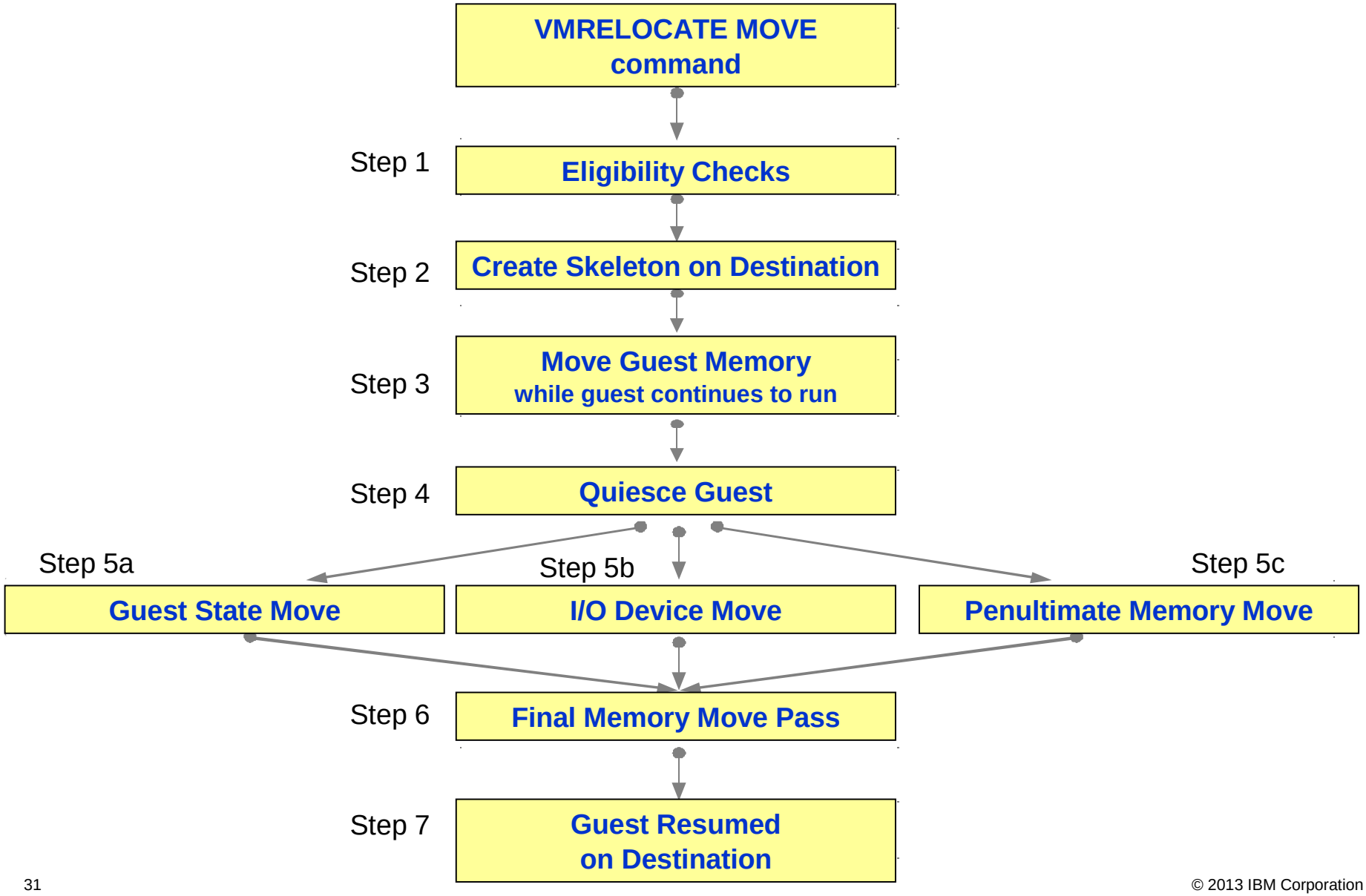

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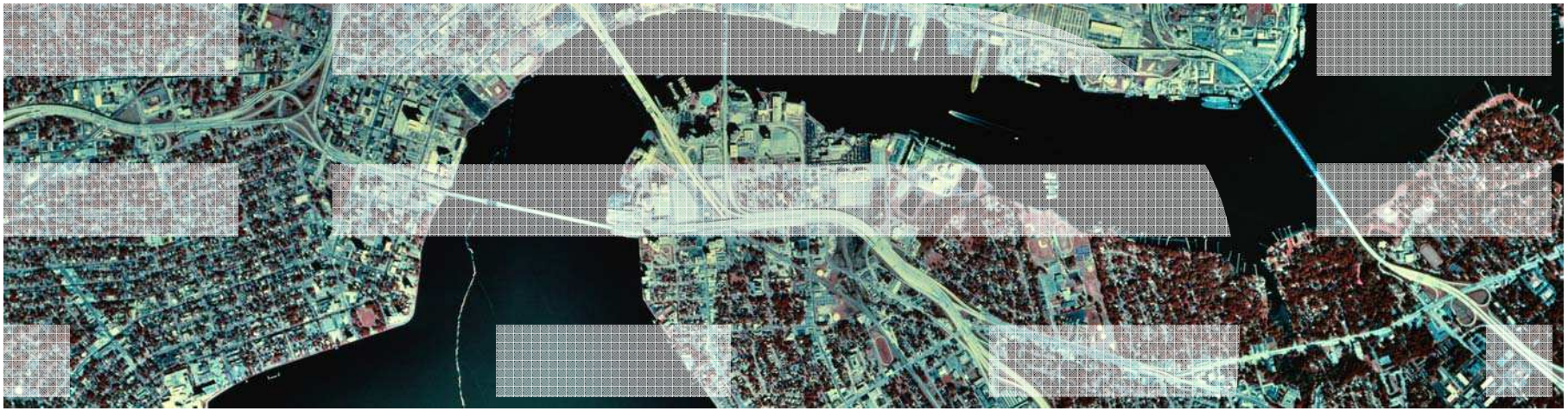

Demo

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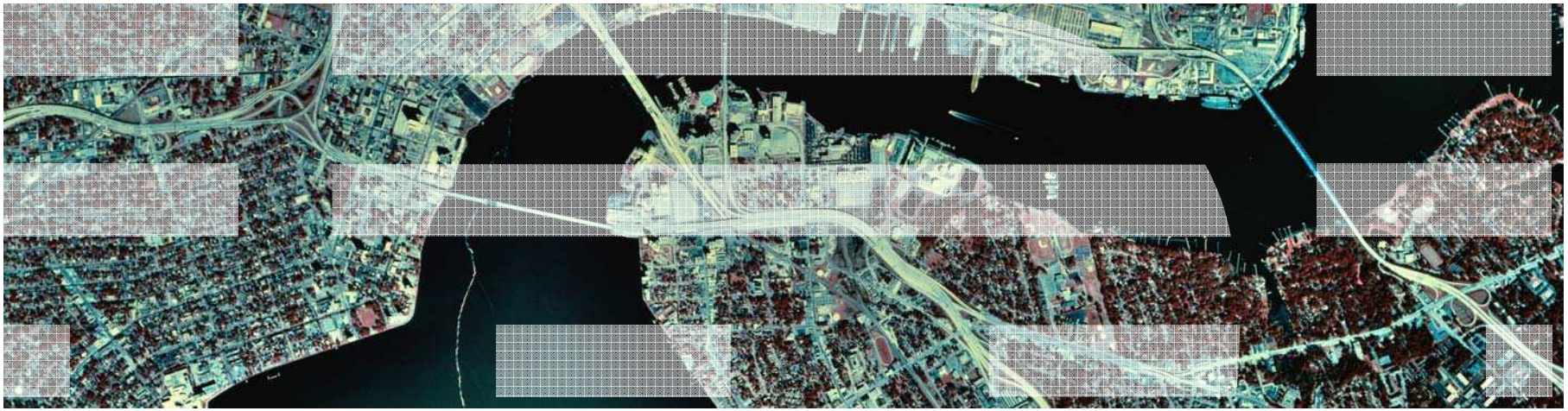

Helpful Hints

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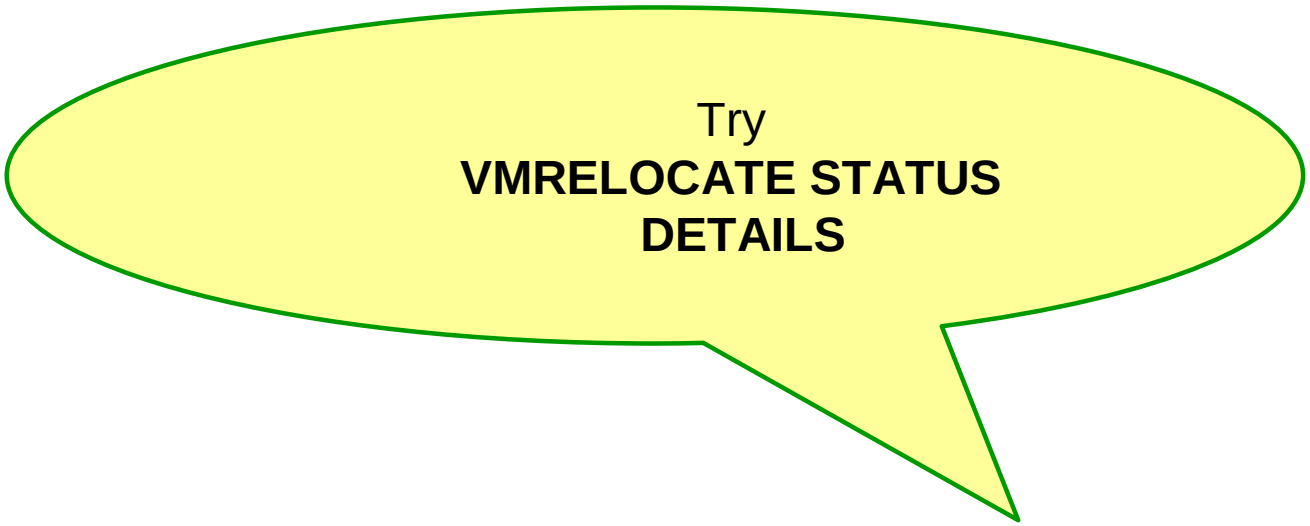
Helpful Hints



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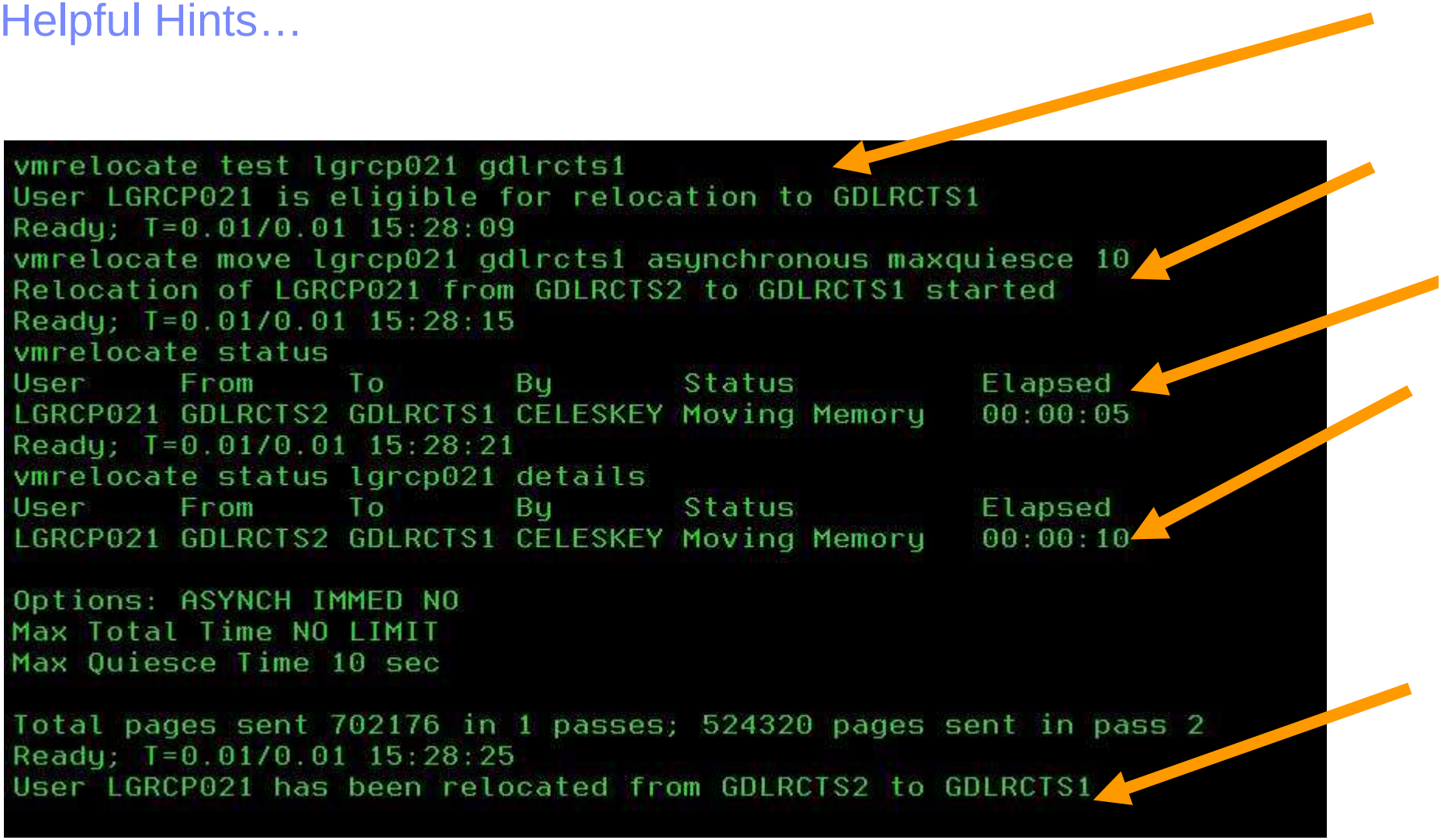
Helpful Hints…



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Helpful Hints…

Help! My relocation always exceeds my quiesce time!

Are you issuing relocations one at a time?

Check system constraints, are you trying to relocate to a member that really can't handle another user?

How many CTCs do you have between your members? How fast are they? How many devices do you have on each CHPID?

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Helpful Hints…

I don't trust that you're really leaving the guest running, I want to see what my guest is doing as he relocates!

Use SCIF from another single configuration virtual machine -
SET OBSERVER LINUX01 *

Have the virtual machine spool his console
SPOOL CONS * START

Connect to Linux via SSH or VNC

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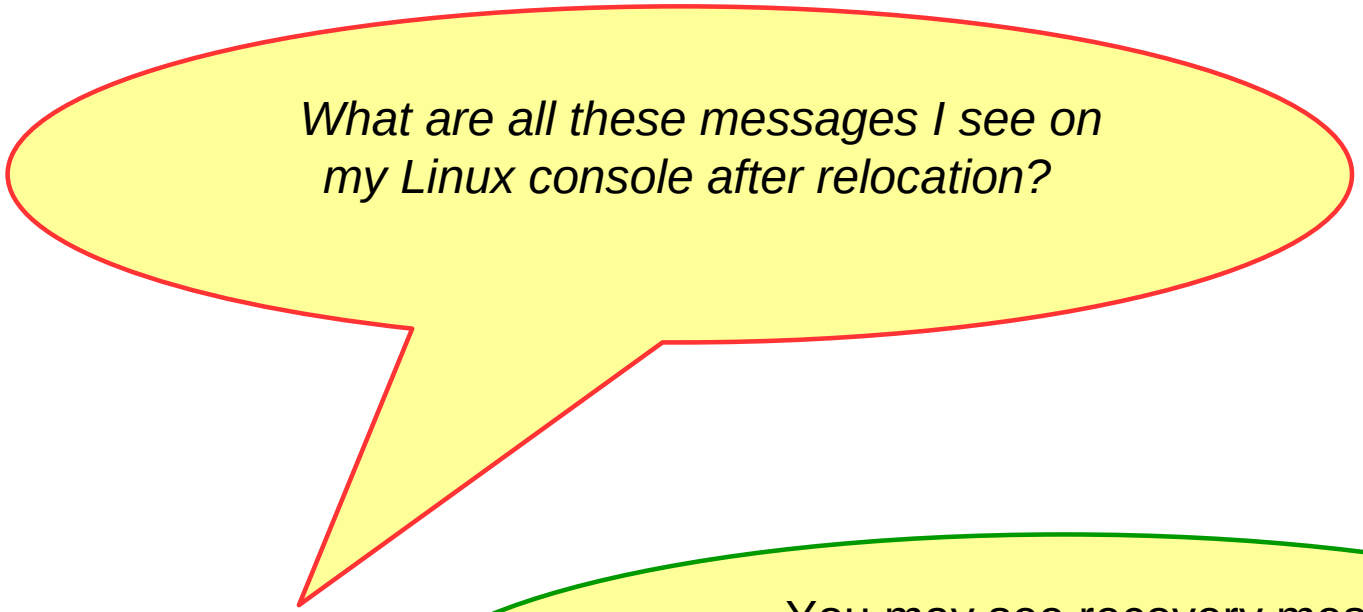
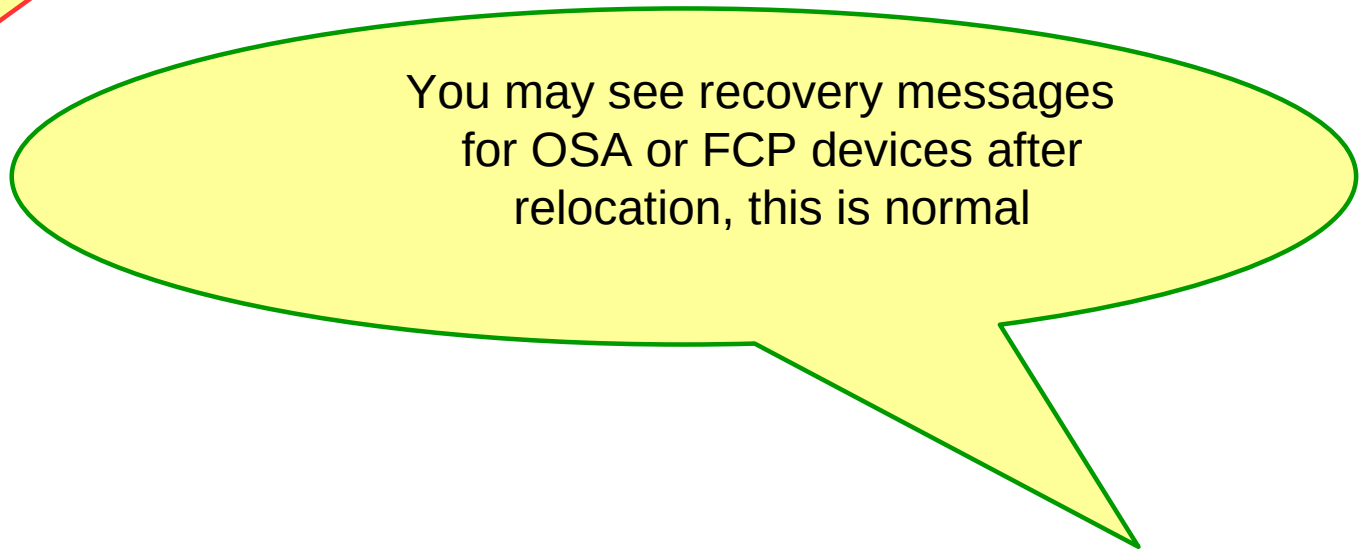
Helpful Hints…





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Summary

- z/VM Live Guest Relocation is supported for Linux on System z guests
  - Read requirements and restrictions before attempting!

- Guests can be using a variety of devices and services while they relocate

- Set up relocation domains before logging on your guests
  - If you have more than 2 members in your SSI cluster
  - If your cluster spans different hardware or software levels

- Relocation is "safe"
  - A relocation will not be allowed if the relocating guest would overwhelm the destination member's memory
  - "Throttling" is used to mitigate the impact of a relocation on running workloads
  - Relocations can be queried and cancelled manually
  - Relocations might automatically be cancelled to prevent harm to the guest or system
  - If a relocation is cancelled or terminated, the guest continues to run on the source member

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More Information

z/VM 6.2 resources
http://www.vm.ibm.com/zvm620/

http://www.vm.ibm.com/events/

z/VM Single System Image Overview
http://www.vm.ibm.com/ssi/

Live Virtual Classes for z/VM and Linux
http://www.vm.ibm.com/education/lvc/

z/VM 6.2 Workshops
http://www.redbooks.ibm.com/cgi-bin/searchsite.cgi?query=Using+z/VM+v6.2+and+Linux

Redbooks
- An Introduction to z/VM SSI and LGR
  http://publib-b.boulder.ibm.com/redpieces/abstracts/sg248006.html?Open
- Using z/VM v 6.2 Single System Image (SSI) and Live Guest Relocation (LGR)
  http://publib-b.boulder.ibm.com/abstracts/sg248039.html?Open
- DB2 10 for Linux on System z Using z/VM v6.2, Single System Image Clusters and Live Guest Relocation
  http://www.redbooks.ibm.com/abstracts/sg248036.html?Open

Whitepaper
- z/VM Migration: Migrating the User Directory and RACF Environment
  http://public.dhe.ibm.com/common/ssi/ecm/en/zsw03246usen/ZSW03246USEN.PDF

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Live Guest Relocation – Example

```
q ssi
SSI Name: SSITEST
SSI Mode: Stable
Cross-System Timeouts: Enabled
SSI Persistent Data Record (PDR) device: FL4B84 on 4B84
SLOT SYSTEMID STATE      PDR HEARTBEAT        RECEIVED HEARTBEAT
   1 GDLLCPX1 Joined     2011-10-13 15:10:18 2011-10-13 15:10:18
   2 GDLLCPX2 Joined     2011-10-13 15:10:12 2011-10-13 15:10:12
   3 GDLLCPX3 Joined     2011-10-13 15:10:26 2011-10-13 15:10:26
   4 GDLMCPX4 Joined     2011-10-13 15:10:35 2011-10-13 15:10:35
Ready; T=0.01/0.01 15:10:41
```


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Live Guest Relocation – Example

```
formssi display 141
HCPPDF6618I Persistent Data Record on device 0141 (label FL4B84) is for
HCPPDF6619I PDR                    state: Unlocked
HCPPDF6619I                   time stamp: 10/13/11 15:10:42
HCPPDF6619I      cross-system timeouts: Enabled
HCPPDF6619I PDR slot  1           system: GDLLCPX1
HCPPDF6619I                        state: Joined
HCPPDF6619I                   time stamp: 10/13/11 15:10:18
HCPPDF6619I                  last change: GDLLCPX1
HCPPDF6619I PDR slot  2           system: GDLLCPX2
HCPPDF6619I                        state: Joined
HCPPDF6619I                   time stamp: 10/13/11 15:10:42
HCPPDF6619I                  last change: GDLLCPX2
HCPPDF6619I PDR slot  3           system: GDLLCPX3
HCPPDF6619I                        state: Joined
HCPPDF6619I                   time stamp: 10/13/11 15:10:26
HCPPDF6619I                  last change: GDLLCPX3
HCPPDF6619I PDR slot  4           system: GDLMCPX4
HCPPDF6619I                        state: Joined
HCPPDF6619I                   time stamp: 10/13/11 15:10:35
HCPPDF6619I                  last change: GDLMCPX4
Ready; T=0.01/0.01 15:10:48
```


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Live Guest Relocation – Example

```
xautolog lgrlin21
Command accepted
Ready; T=0.01/0.01 15:11:44
AUTO LOGON  ***       LGRLIN21 USERS = 21
HCPCLS6056I XAUTOLOG information for LGRLIN21: The IPL command is verifi
set secuser lgrlin21 *
HCPCFX6768I SECUSER of LGRLIN21 initiated.
Ready; T=0.01/0.01 15:11:50
LGRLIN21: Booting default (ipl)...
LGRLIN21: Linux version 2.6.16.60-0.21-default (geeko@buildhost) (gcc ve
 UTC 2008
```

▪ ▪ ▪

```
Welcome to SUSE Linux Enterprise Server 10 SP2 (s390x) - Kernel 2.6.16.6
"
"
linux-nxpt login:
```


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Live Guest Relocation – Example

```
q lgrlin21 at all
GDLLCPX2  : LGRLIN21  - DSC
Ready;  T=0.01/0.01  15:44:52
```

```
vmrelocate test lgrlin21 to gdllcpx1
User LGRLIN21 is eligible for relocation to GDLLCPX1
Ready;  T=0.01/0.01  15:45:21
```

```
VMRELOCATE MOVE LGRLIN21 TO GDLLCPX1 MAXQ 5 SEC
Relocation of LGRLIN21 from GDLLCPX2 to GDLLCPX1 started
User LGRLIN21 has been relocated from GDLLCPX2 to GDLLCPX1
LGRLIN21:  User LGRLIN21 has been relocated from GDLLCPX2 to GDLLCPX1
```


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Live Guest Relocation – Example

```
LGRLIN21: qeth: check on device 0.0.0700, dstat=x0, cstat=x2 <4>qeth: ir
qeth: irb: 00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00
qeth: irb: 00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00
qeth: irb: 00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00
qdio : received check condition on activate queues on device 0.0.0702 (c
qeth: Recovery of device 0.0.0700 started ...
qeth: Device 0.0.0700/0.0.0701/0.0.0702 is a OSD Express card (level: 03
with link type OSD_100 (portname: whatever)
qeth: Hardware IP fragmentation not supported on eth0
qeth: VLAN enabled
qeth: Multicast enabled
qeth: IPV6 enabled
qeth: Broadcast enabled
qeth: Using SW checksumming on eth0.
qeth: Outbound TSO enabled
USER DSC    LOGOFF AS   LGRLIN21 USERS = 20     FORCED BY SYSTEM
Ready; T=0.01/0.01 15:45:52
LGRLIN21: qeth: Device 0.0.0700 successfully recovered!
Oct 13 15:45:51 linux-nxpt kernel: qeth: check on device 0.0.0700, dstat
00 00  00 80 e0 80"
Oct 13 15:45:51 linux-nxpt kernel: qeth: irb: 00 00 00 00  00 00 00 00
Oct 13 15:45:51 linux-nxpt kernel: qeth: irb: 00 00 00 00  00 00 00 00
Oct 13 15:45:51 linux-nxpt kernel: qeth: irb: 00 00 00 00  00 00 00 00
LGRLIN21: Oct 13 15:45:51 linux-nxpt kernel: qdio : received check condi
Oct 13 15:45:51 linux-nxpt kernel: qeth: Recovery of device 0.0.0700 sta
Oct 13 15:45:56 linux-nxpt kernel: qeth: Device 0.0.0700/0.0.0701/0.0.07
Oct 13 15:45:56 linux-nxpt kernel: with link type OSD_100 (portname: wha
Oct 13 15:45:56 linux-nxpt kernel: qeth: Using SW checksumming on eth0."
```


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Live Guest Relocation – Example

```
q lgrlin21 at all
GDLLCPX1 : LGRLIN21 - DSC
Ready; T=0.01/0.01 15:46:35
```

```
AT GDLLCPX1 CMD VMRELOCATE MOVE LGRLIN21 TO GDLLCPX2 MAXQ 5 SEC
Relocation of LGRLIN21 from GDLLCPX1 to GDLLCPX2 started
LGRLIN21: User LGRLIN21 has been relocated from GDLLCPX1 to GDLLCPX2
User LGRLIN21 has been relocated from GDLLCPX1 to GDLLCPX2
LGRLIN21: qeth: check on device 0.0.0700, dstat=x0, cstat=x2 <4>qeth: ir
qeth: irb: 00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00
qeth: irb: 00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00
qeth: irb: 00 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00
qdio : received check condition on activate queues on device 0.0.0702 (c
qeth: Recovery of device 0.0.0700 started ...
qeth: Device 0.0.0700/0.0.0701/0.0.0702 is a OSD Express card (level: 03
with link type OSD_100 (portname: whatever)
qeth: Hardware IP fragmentation not supported on eth0
qeth: VLAN enabled
qeth: Multicast enabled
qeth: IPV6 enabled
qeth: Broadcast enabled
qeth: Using SW checksumming on eth0.
qeth: Outbound TSO enabled
Ready; T=0.01/0.01 15:47:10
LGRLIN21: qeth: Device 0.0.0700 successfully recovered!
```


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Live Guest Relocation – Example

```
q LGRLIN21 AT ALL
GDLLCPX2 : LGRLIN21 - DSC
Ready; T=0.01/0.01 15:47:41
```


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