



Efficiency of one. Flexibility of Many. 40 years of virtualization.



z/VM 6.2: Increasing the Endless Possibilities of Virtualization

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Efficiency of One. Flexibility of Many.

40 Years of Virtualization.

Bill Bitner

IBM Endicott – The Birthplace of IBM

z/VM Customer Focus and Care Leader
bitnerb@us.ibm.com



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z/VM Timeline

- Heritage and History
- Constantly Expanding Function

Reflecting on the z/VM 6.2 Design

- Challenges
- Speeds and Feeds

What Makes Live Guest Relocation Special?

- Making it safe
- Making it manageable

New Possibilities

- Availability
- Flexibility in Testing



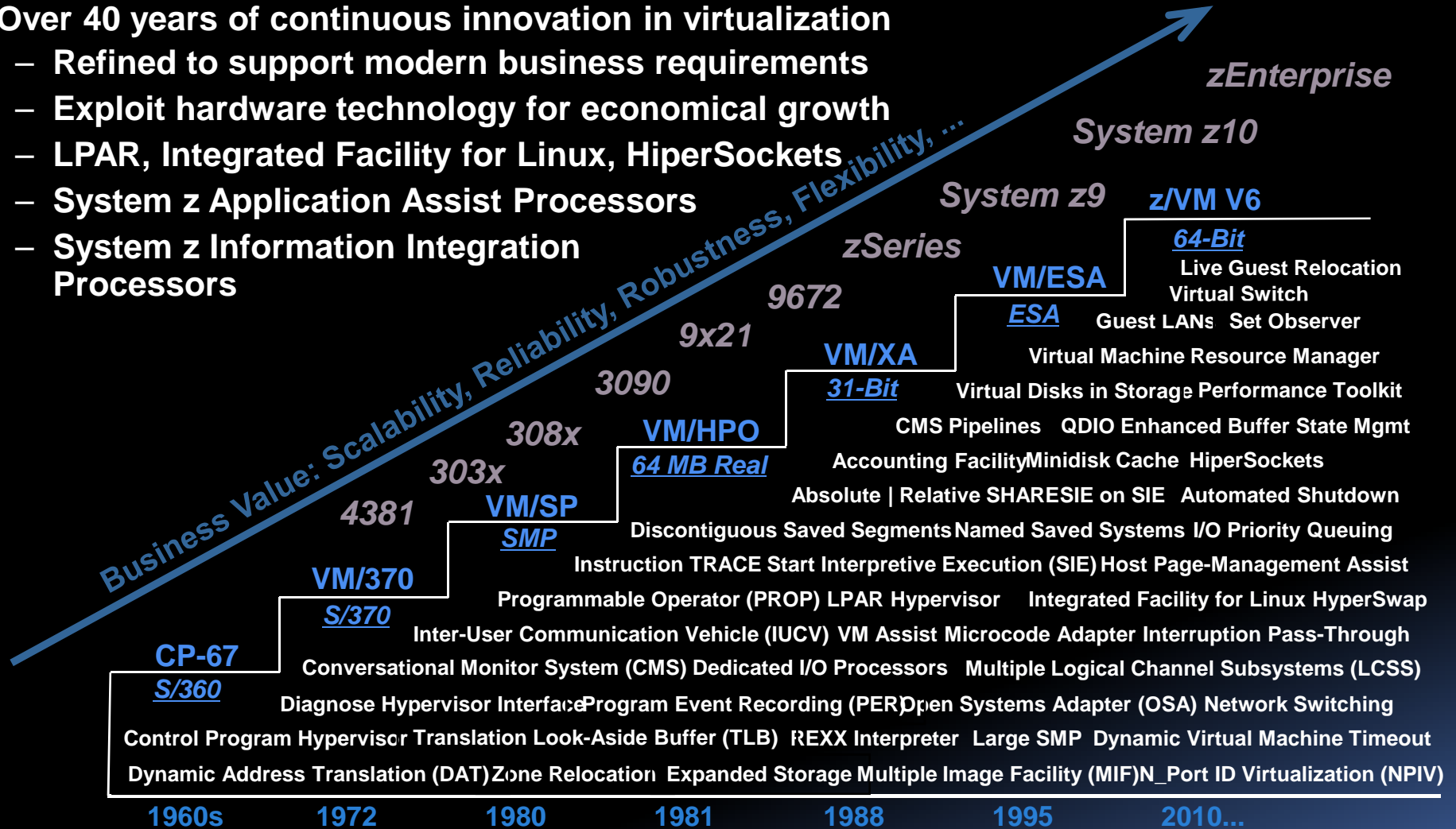
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IBM System z Virtualization Genetics

Over 40 years of continuous innovation in virtualization

- Refined to support modern business requirements
- Exploit hardware technology for economical growth
- LPAR, Integrated Facility for Linux, HiperSockets
- System z Application Assist Processors
- System z Information Integration Processors



IBM System z – a comprehensive and sophisticated suite of virtualization function



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Reflecting on the z/VM 6.2 Design



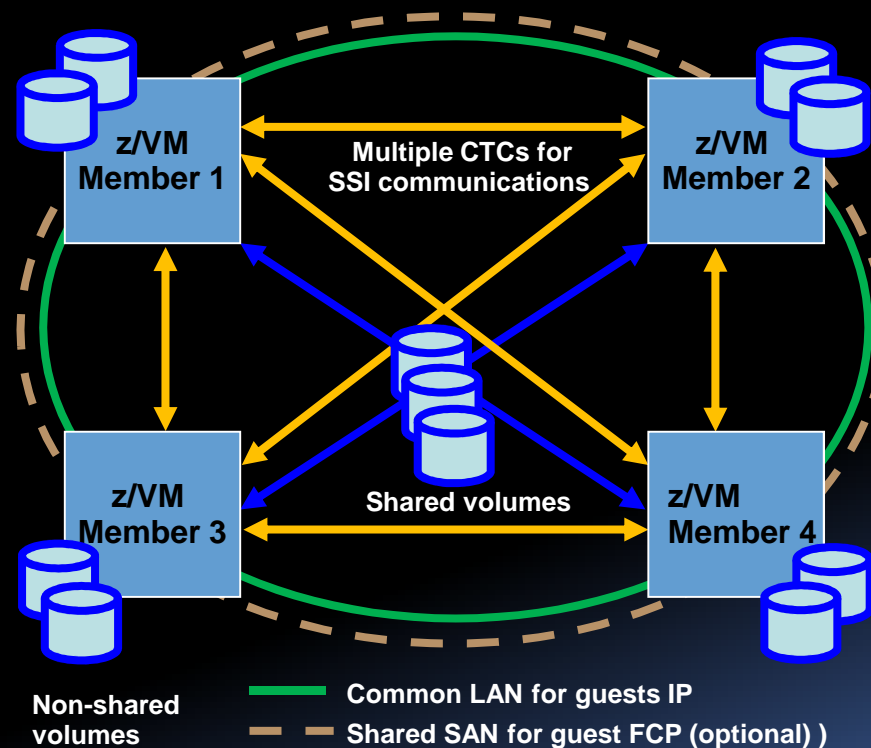
z/VM Version 6 Release 2

- Highlights
 - Announced **October 12, 2011**
 - Made generally available on **December 2, 2011**
 - Planned end of service is **April 30, 2015**
- New Priced Feature VM Single System Image:
 - Single System Image (SSI) Clustering
 - Live Guest Relocation (LGR)
- References
 - z/VM Home Page: www.ibm.com/vm/
 - z/VM 6.2 Info: www.ibm.com/vm/zvm620/
 - z/VM SSI Info: www.ibm.com/vm/ssi/



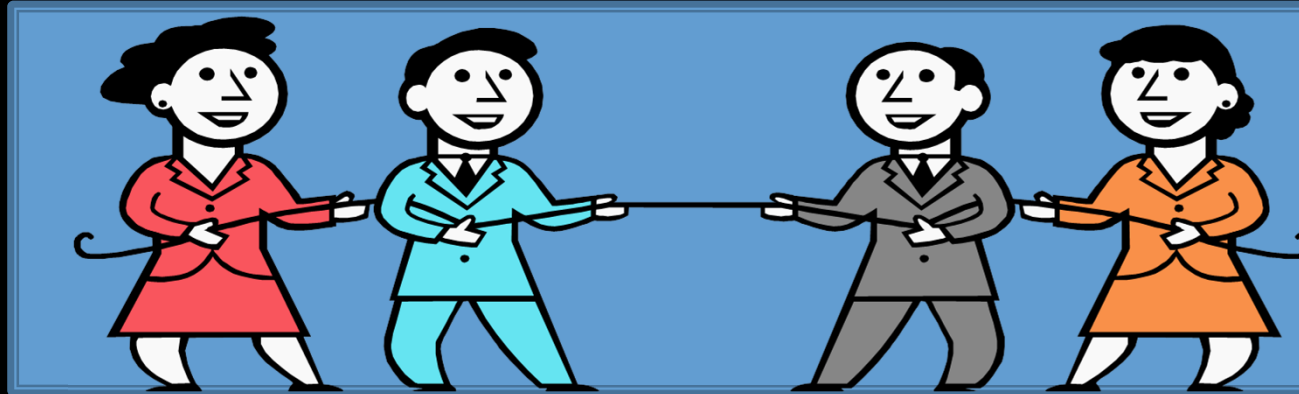
SSI Feature: Clustered Hypervisor with LGR Support

- Connect up to four z/VM systems as members of a Single System Image (SSI) cluster
- Provides a set of shared resources for member systems and their hosted virtual machines
- Cluster members can be run on the same or different System z servers
- Simplifies systems management of a multi-z/VM environment
 - Single user directory
 - Cluster management from any member
 - Apply maintenance to all members in the cluster from one location
 - Issue commands from one member to operate on another
 - Built-in cross-member capabilities
 - Resource coordination and protection of network and disks





Key Early Design Struggle



- Shorter Schedule
- Less Features
- Build off of early prototypes
 - Based on a Server Virtual Machine
- More Restrictions
- Longer Schedule
- Do it right
 - Various features
 - RAS
- Different design basics than other platforms
- Less Restrictions

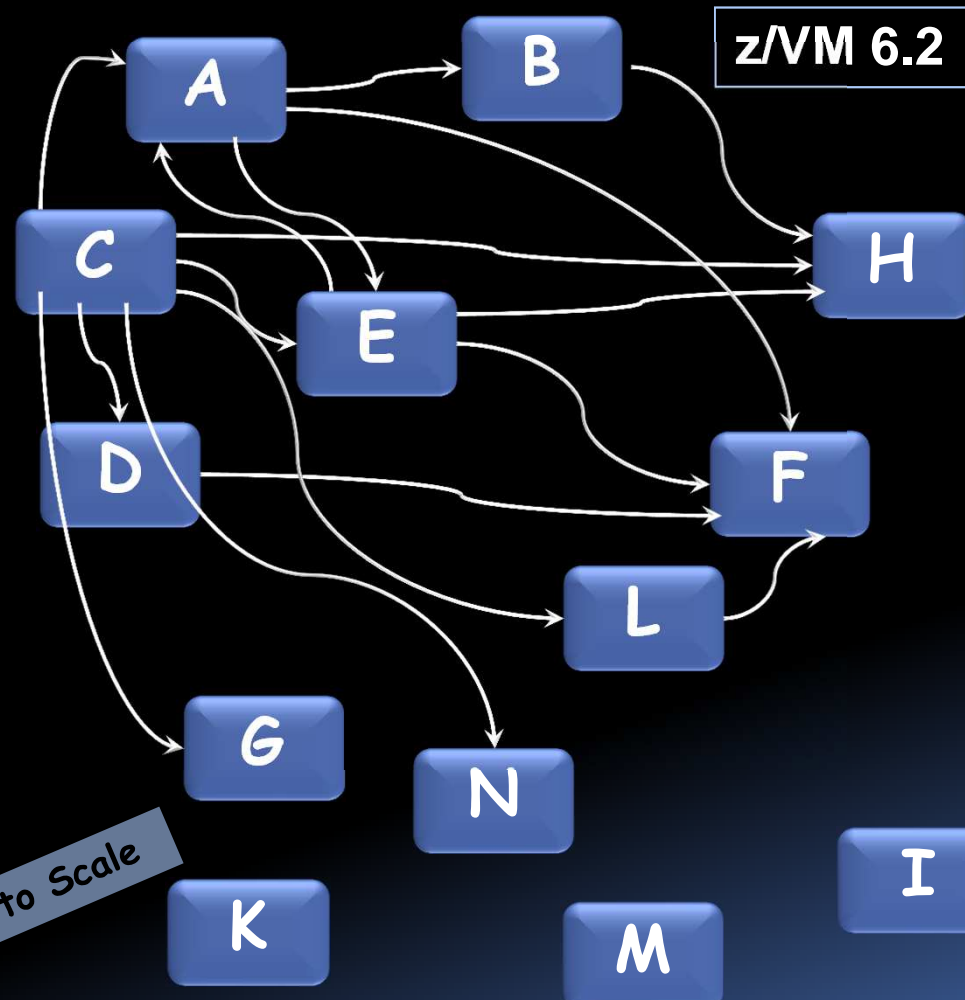
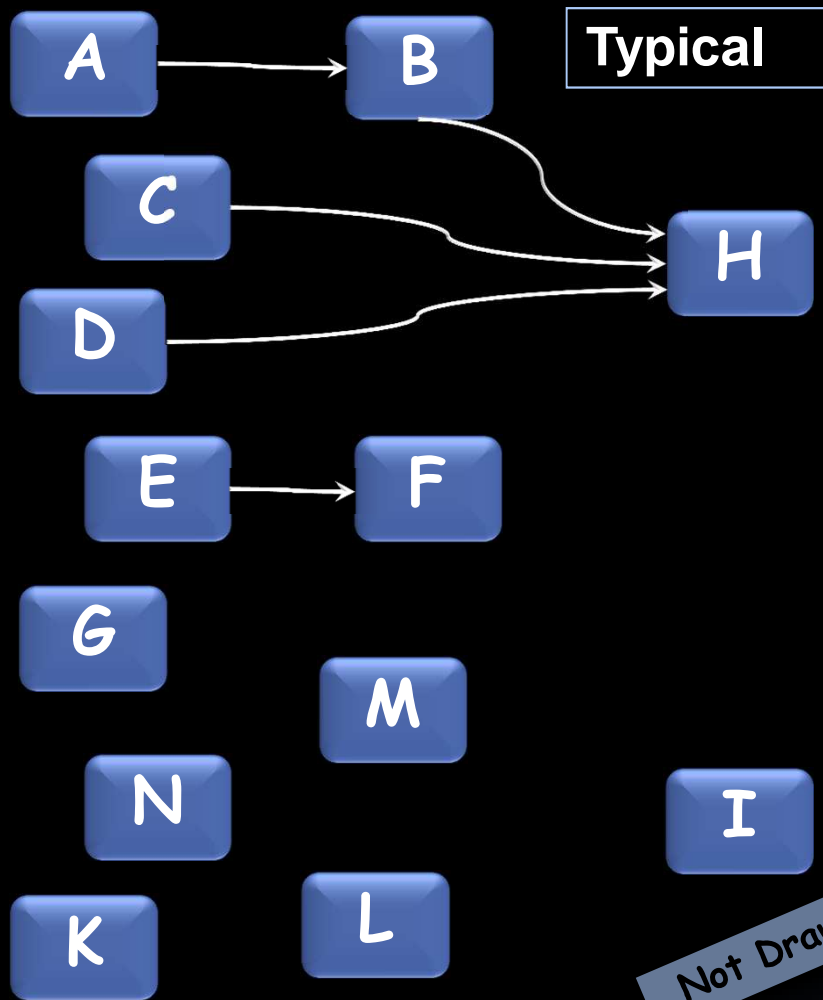


Why So Difficult to do LGR?

- Maintaining accurate representation of the architecture
 - A z/VM Strength
- Flexibility of the architecture
 - Different I/O devices
 - Crypto devices
 - Dynamic Resources
- Flexibility of z/VM
 - Tuning Options
 - CP System Services
 - Shared Memory
- Making it Worthy of the “System z” Brand



Typical Release vs. z/VM 6.2 Line Item Relations

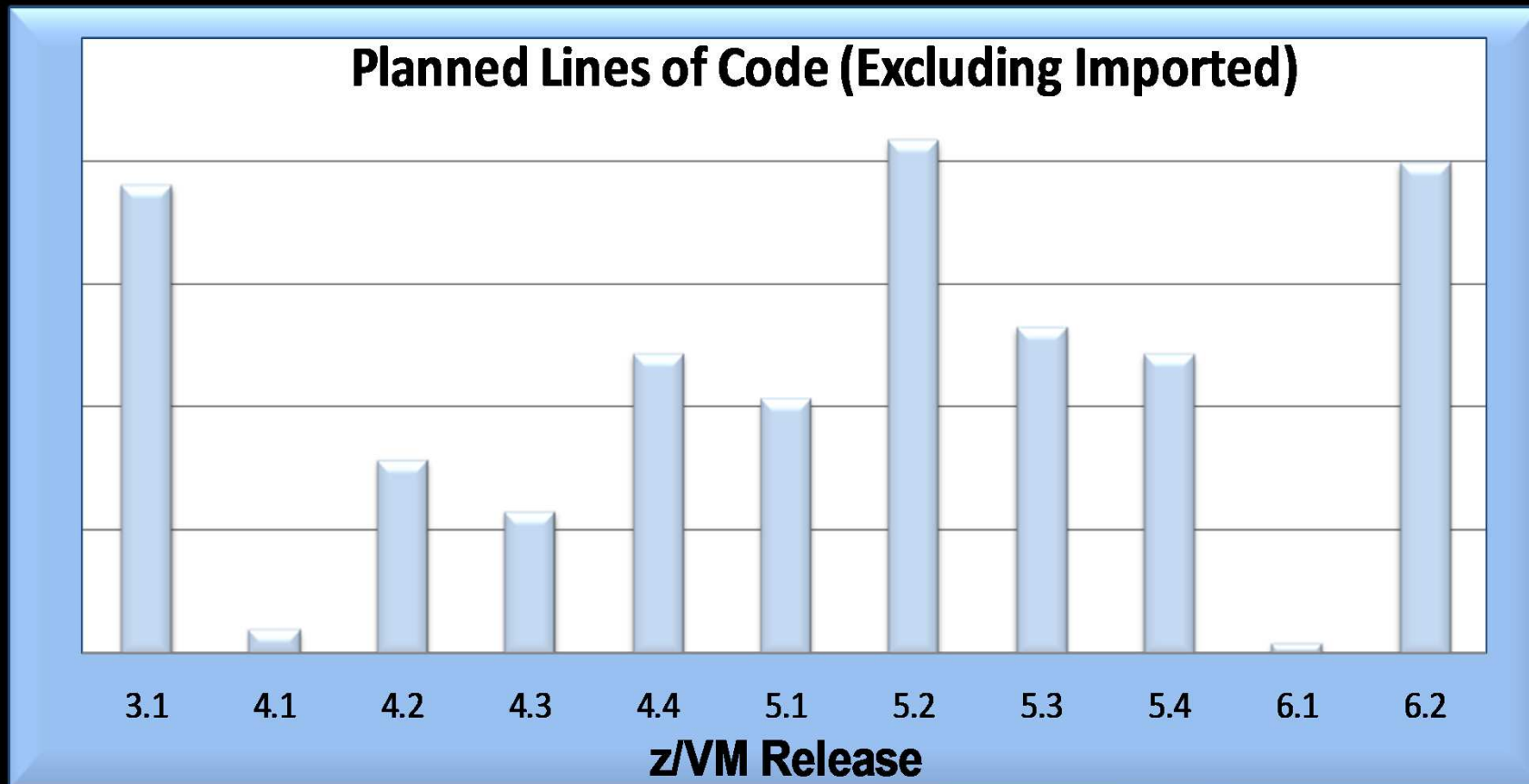


Not Drawn to Scale



Speeds and Feeds

- Start of regular weekly team meetings: Feb 5, 2008

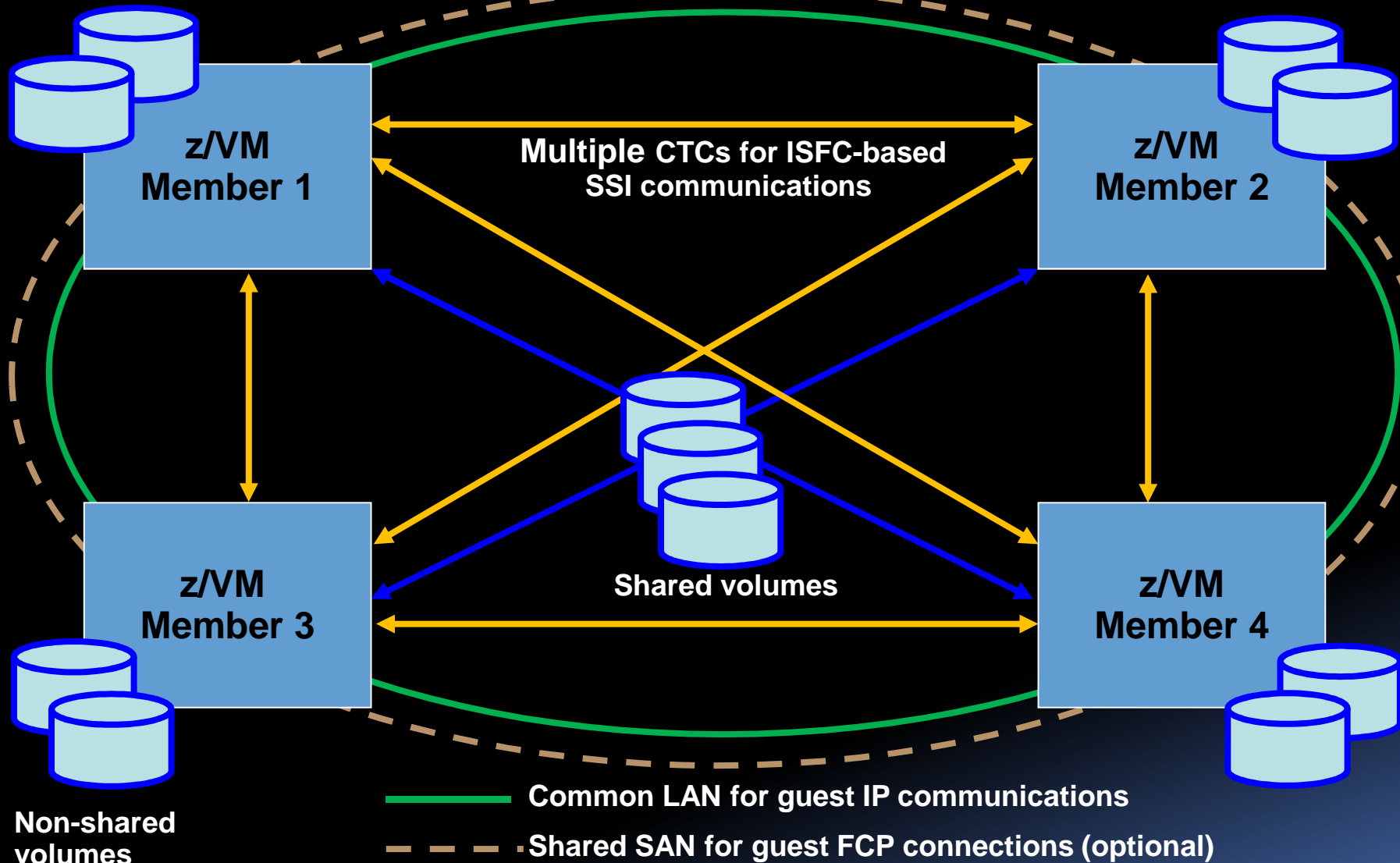




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**What Makes SSI &
LGR Special?**





SSI Cluster Management: Features for Greater Reliability

- Cross-checking of configuration details as members join cluster and as resources are used:
 - SSI membership definition and identity
 - Consistent definition of shared spool volumes
 - Compatible virtual network configurations (MAC address ranges, VSwitch definitions)
- Cluster-wide policing of resource access:
 - Volume ownership marking to prevent dual use
 - Coordinated minidisk link checking
 - Autonomic minidisk cache management
 - Single logon enforcement
- DirMaint
 - Main DirMaint virtual machine which can run on any of the members
 - Main DirMaint coordinates with satellite virtual machines on other members
 - A member that is down will be brought “up to speed” when re-started.

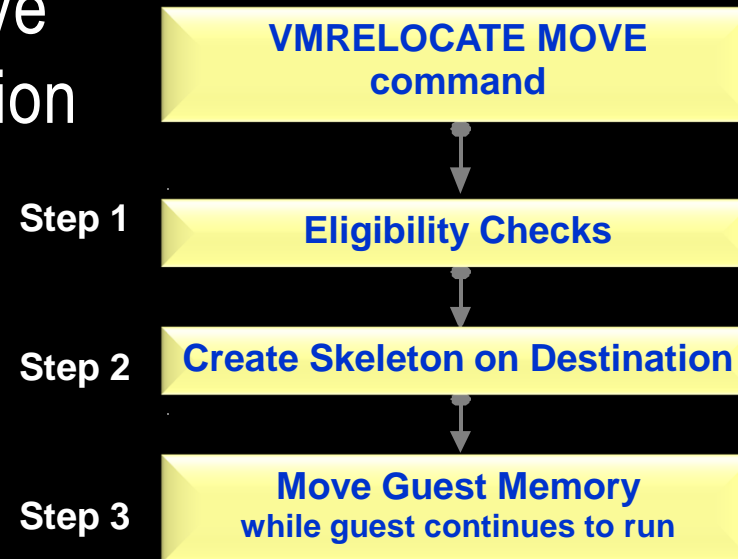


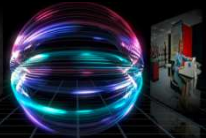
SSI Cluster Management: Addressing Problems

- Communications failure “locks down” future resource allocations until resolved
 - Existing running workloads continue to run
 - Prevents new accesses to resources
 - Cluster could temporarily be split and workloads continue to run
- Added the new “REPAIR” option to IPL for severe problem resolution
 - Meant for use with a single member cluster to repair
 - Allows correcting various problems that aren’t addressable in standard cluster.

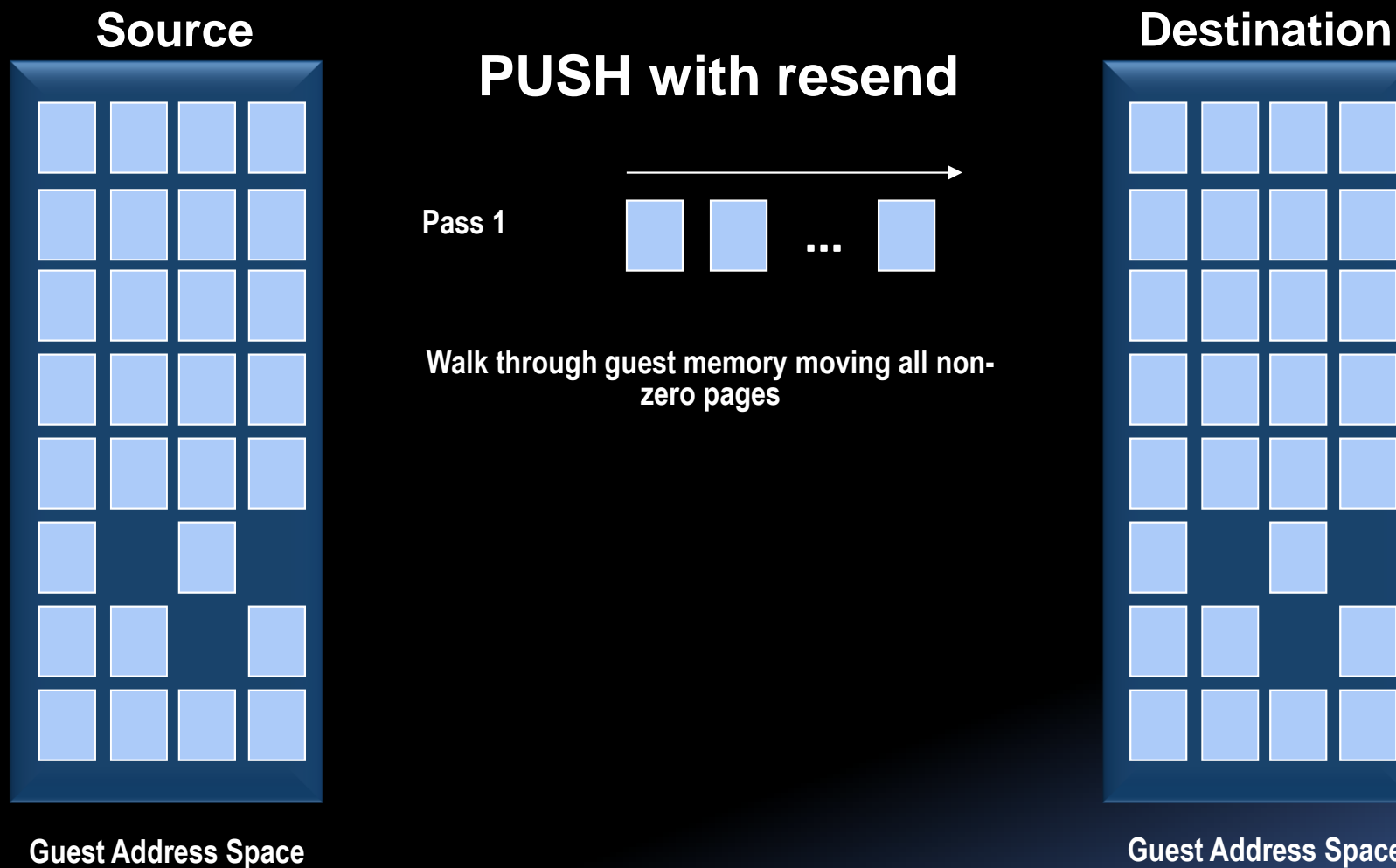


Stages of a Live Guest Relocation



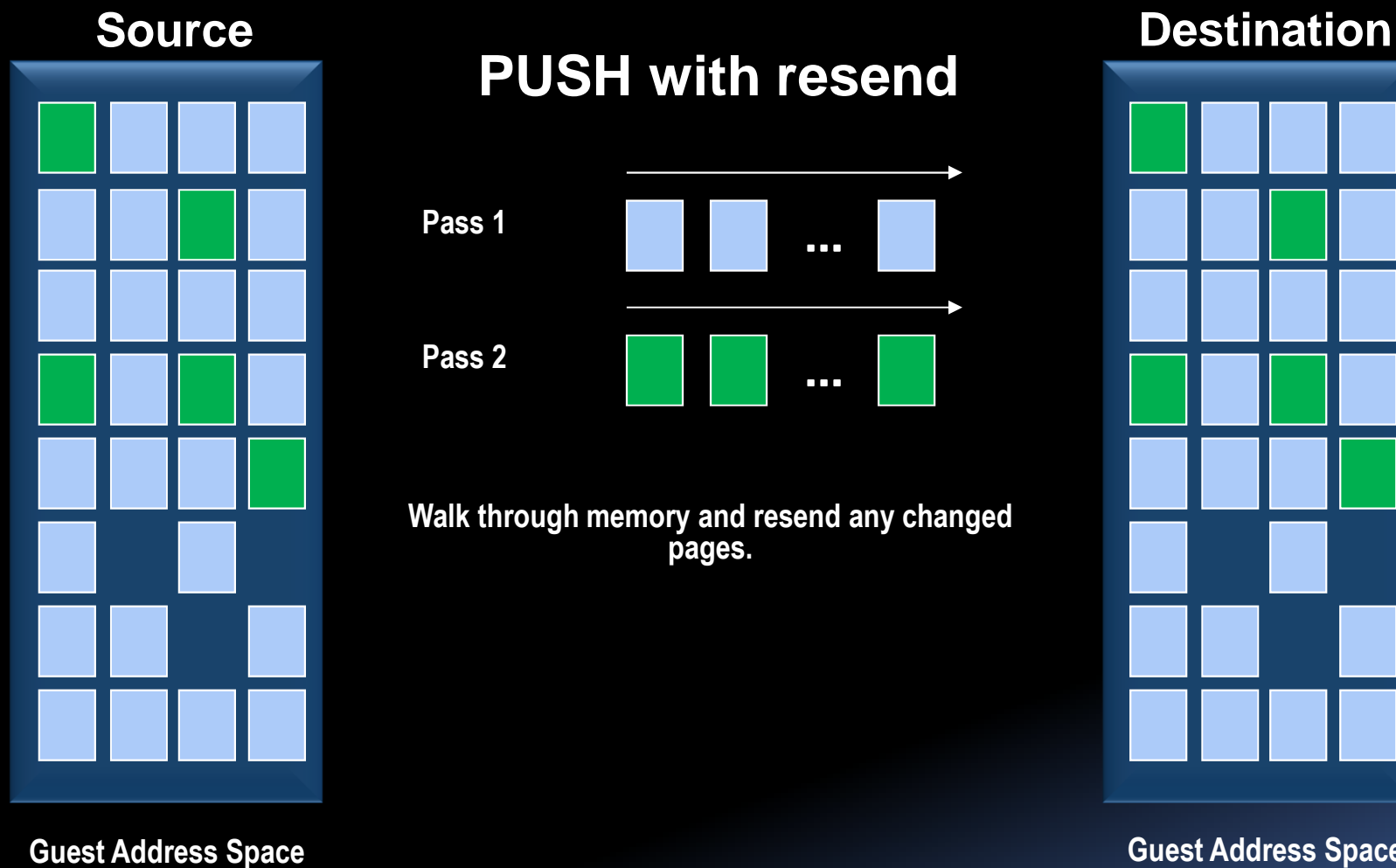


LGR, High-Level View of Memory Move



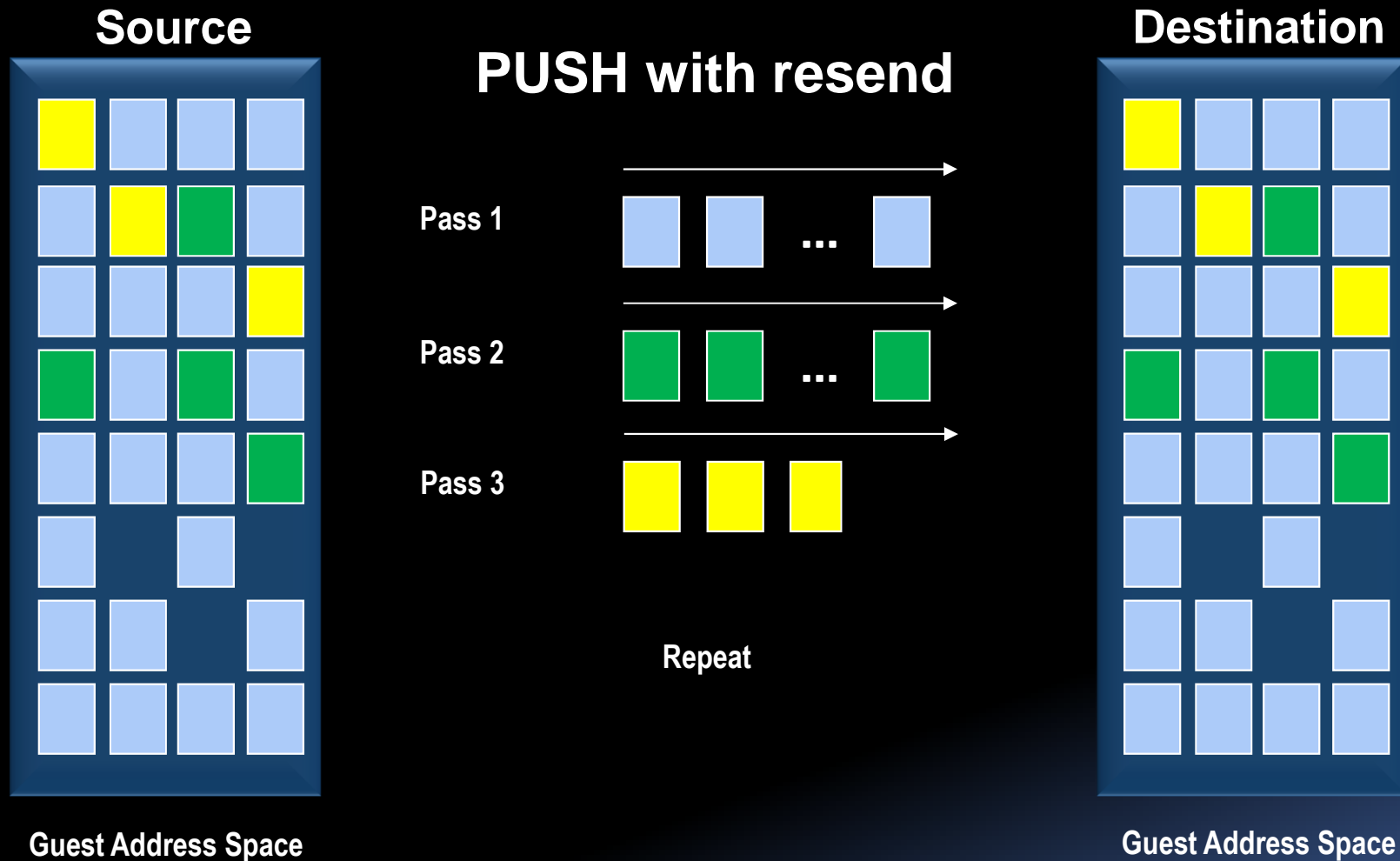


LGR, High-Level View of Memory Move



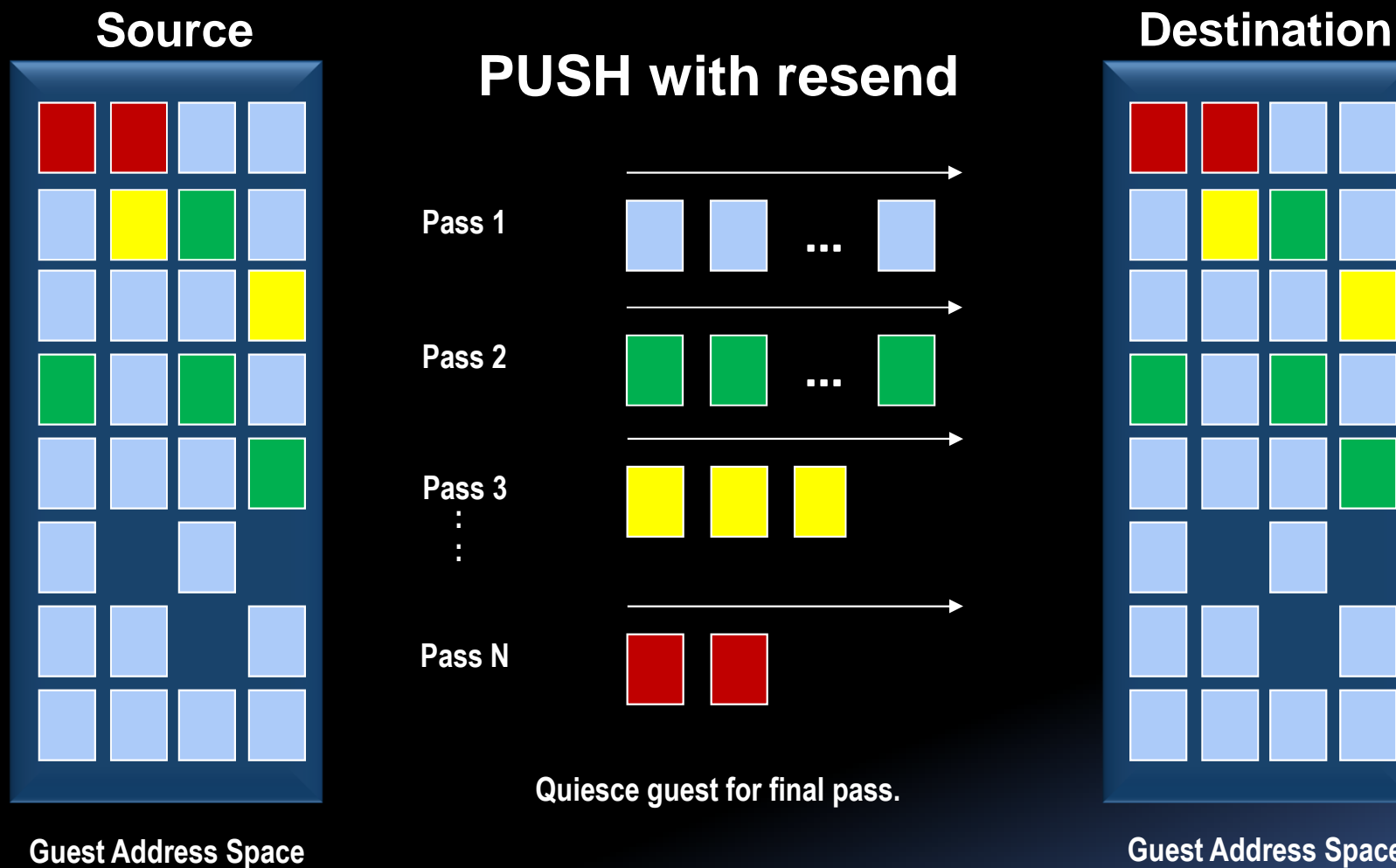


LGR, High-Level View of Memory Move



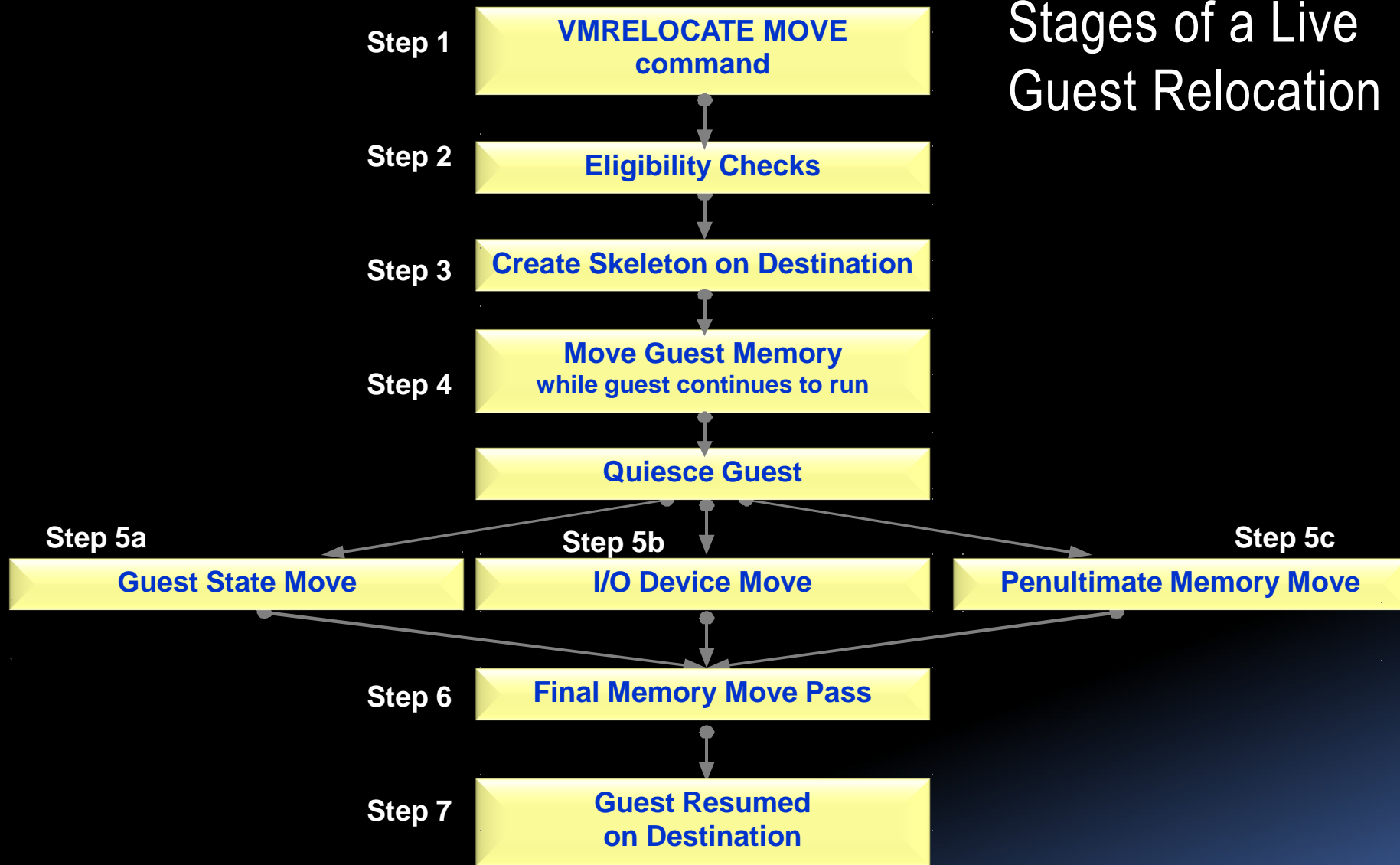


LGR, High-Level View of Memory Move





Stages of a Live Guest Relocation





Live Guest Relocation

- New CP Planning and Administration Chapter: Preparing for Live Guest Relocations in a z/VM SSI Cluster
- New CP `VMRELOCATE` command
 - `VMRELOCATE` command starts, cancels, or tests a Live Guest Relocation
 - CP Commands & Utilities Reference: 14 pages (6 pages messages)
 - Options to control behavior:
 - `MAXQUIESCE` – maximum quiesce time
 - `MAXTOTAL` – maximum total relocation time
 - `TEST` – test it first (what a concept!)
 - `STATUS` – find out status



Live Guest Relocation

- New SMAPI interfaces
 - VMRELOCATE
 - VMRELOCATE_Image_Attributes
 - VMRELOCATE_Modify
- Other Interfaces of note:
 - *VMEVENT
 - *MONITOR
 - *ACCOUNT
- New CP Exit Points



Safe Guest Relocation

- Eligibility checks done multiple times throughout the relocation process.
- Check more than just eligibility to move the virtual machine, but also check is it “safe” to move.
 - Overrides are available via *force* options
- Checks for:
 - Does virtual machine really have access to all the same resources and functions?
 - Will moving the virtual machine over commit resources to the point of jeopardizing other workload on the destination system?
- Pacing logic to minimize impact to other work in more memory constrained environments



Relocation Domains

- Greater control over where virtual machines can relocate and what architecture features they will have.
- Architecture available to a virtual machine within a relocation domain is the maximal common subset.

z/VM Member A
z10

z/VM Member B
z196

z/VM Member C
z114

z/VM Member D
z196



Relocation Domains

- By default, the SSI domain is a relocation domain that includes all members of an SSI Cluster.
- Additionally, there is a domain for each member which includes only that member.

SSI Domain

z/VM Member A
z10

z/VM Member B
z196

z/VM Member C
z114

z/VM Member D
z196



Relocation Domains

- Domain Alpha is created to span a z10 and a z196, this restricts the architecture exposed to the virtual machine assigned to Alpha to only the maximal common instructions and features. In this case, most likely a subset of the z196.

SSI Domain

Domain Alpha

z/VM Member A
z10

z/VM Member B
z196

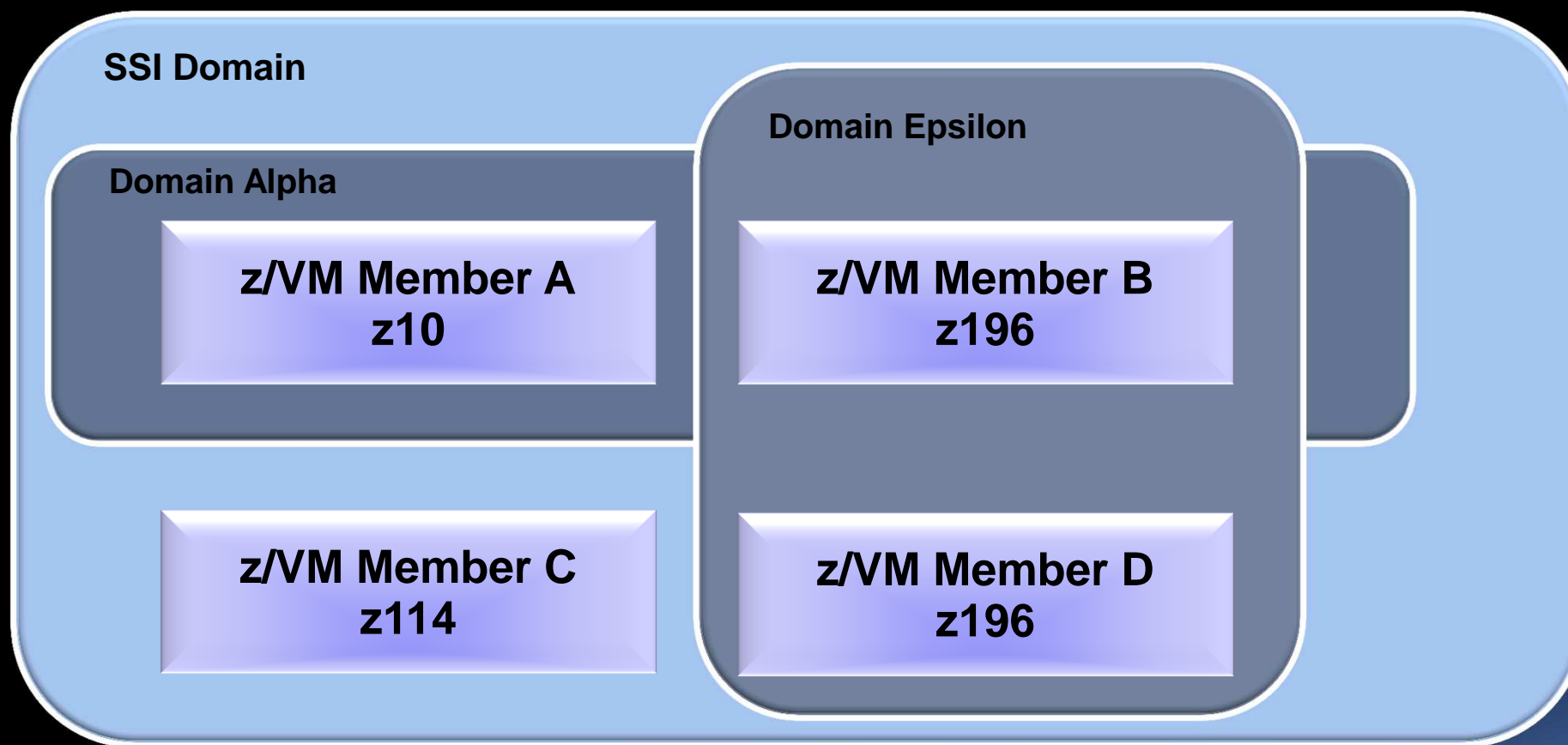
z/VM Member C
z114

z/VM Member D
z196



Relocation Domains

- Virtual machines in domain Epsilon are afforded the full z196 architecture.





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New Possibilities



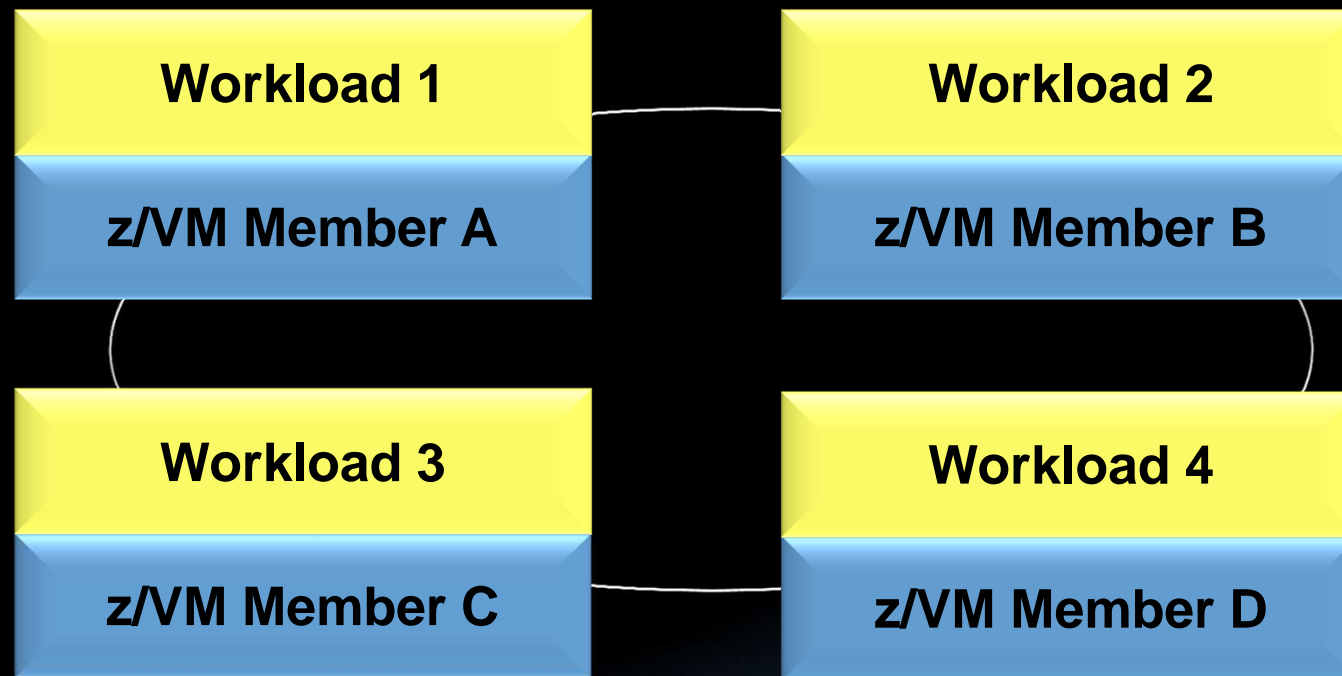
What Can You Do with SSI Clusters and LGR?

1. Flexibility for Planned Outages
2. Methodically Testing at Current Levels
3. Increased Control Over Server Sprawl
4. Production with Protection
5. Managing Resource Distribution
6. Consistent Test Bed for Stress Tests
7. One From the Customers – Utility Migration LPAR
8. Migrate to New Processor



Flexibility for Planned Outages

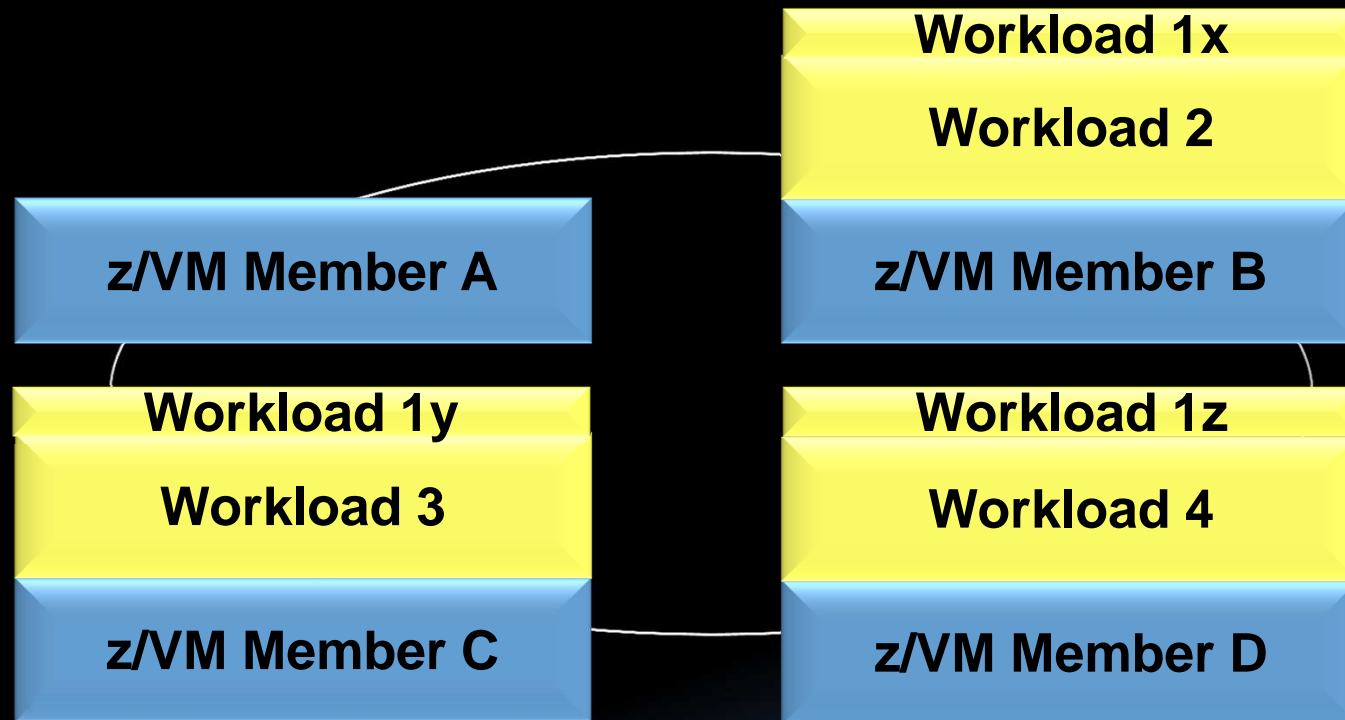
- The good news is workload running on z/VM is becoming more and more critical; the bad news is that brings greater availability challenges.
 - Maintenance windows for down time get smaller
- SSI and LGR allow moving work and rolling out service...





Flexibility for Planned Outages

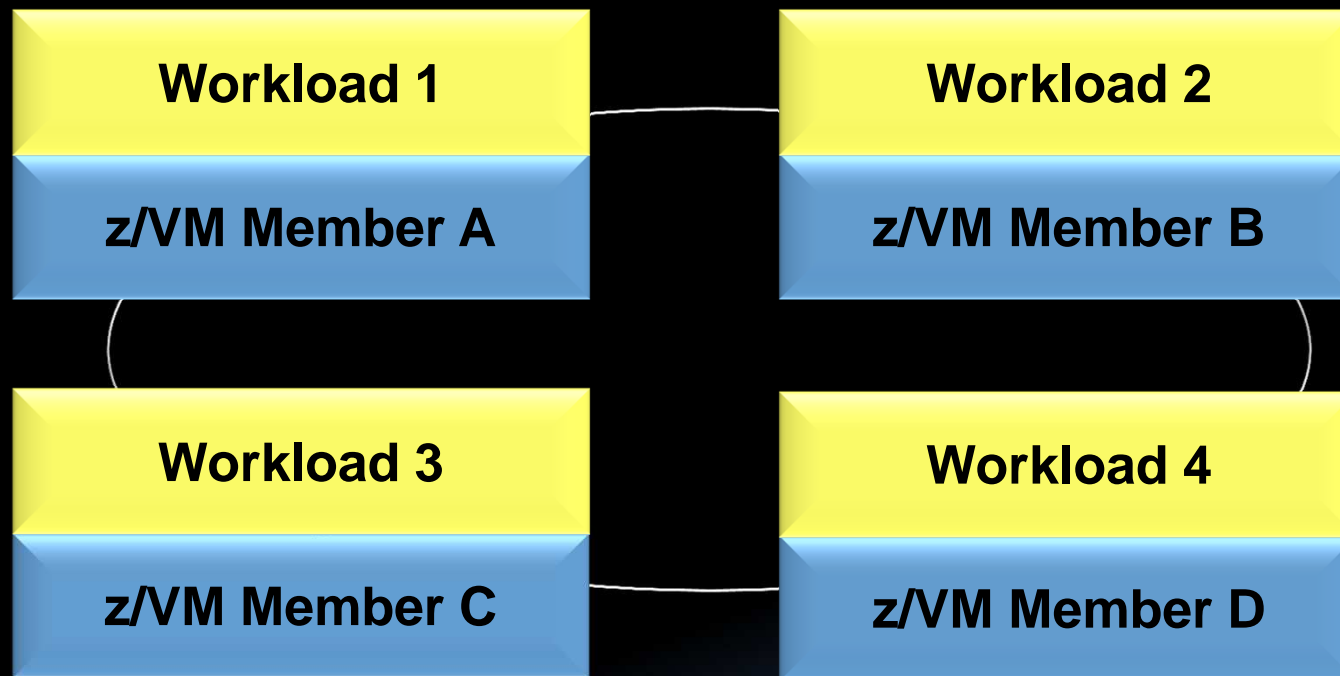
1. Apply maintenance to Member A, having new CP load module ready for IPL.
2. Move critical work from Member A to the other 3 members in the cluster.
3. Shutdown Member A and bring back up with new CP load module.





Flexibility for Planned Outages

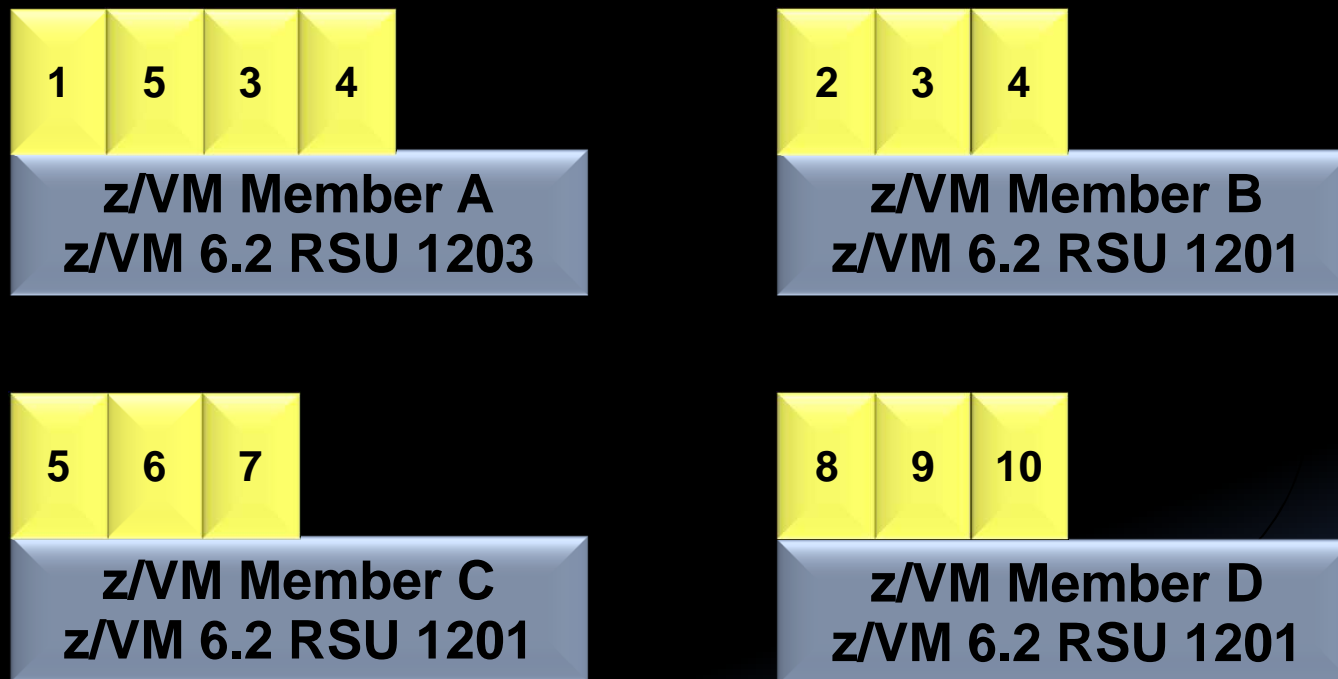
1. Move workloads back to member A
2. Rejoice





Methodically Testing at Current Levels

- Testing for new levels of z/VM in the past often required use of second level systems and trade-offs between matching production environment.
- z/VM SSI clusters can be used to help test and migrate throughout the members.
- Perhaps start with System A at new service level and slowly move work there to test.





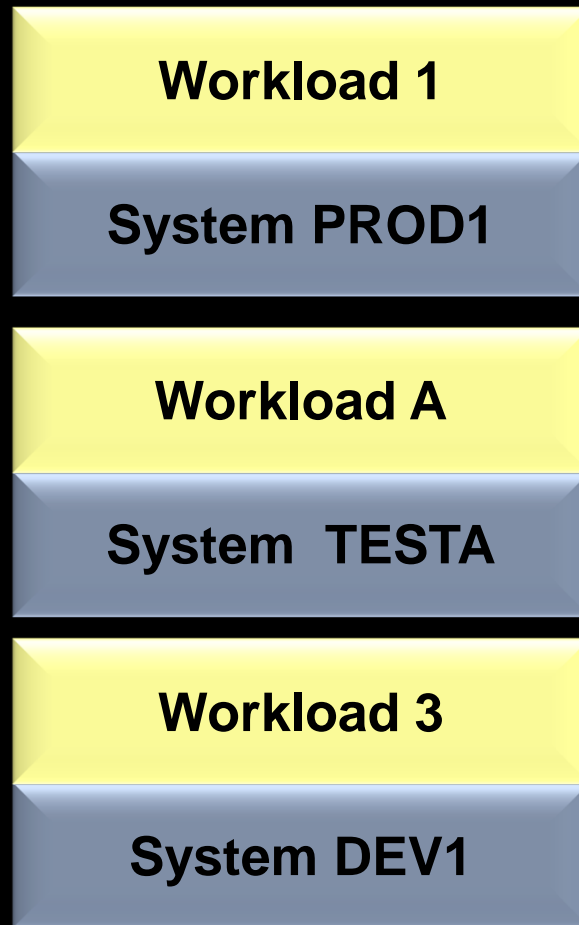
Increased Control Over Server Sprawl

- Server sprawl and the success of virtualization have led to virtual server sprawl, z/VM SSI Clusters improve the management characteristics for these environments.
- Consider customer where a single LPAR for production is sufficient today, but they are growing at a significant rate.
- Various reasons to expand past a single LPAR:
 - Out growing single LPAR capacity
 - Risk management: avoiding all eggs in one basket and diversification.
 - Flexibility for software licensing
- Move to z/VM 6.2 keeping your individual system, but prepare them to run as multi-member SSI in the future.
 - Bring in another LPAR and bring up an additional SSI member.



Increased Control Over Server Sprawl

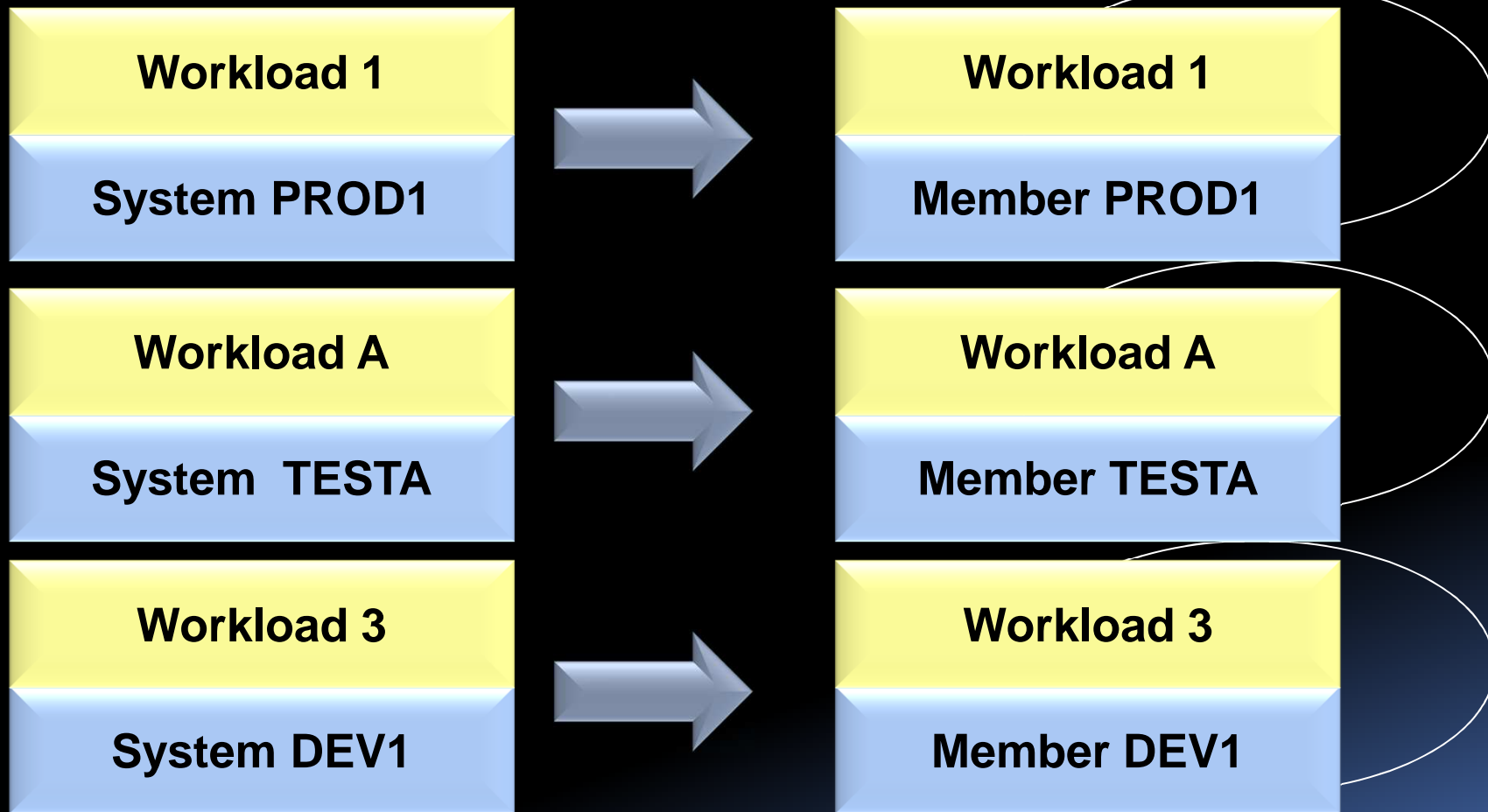
Today, you may have 3 separate systems, but may not have compelling reason to combine them into a cluster.





Increased Control Over Server Sprawl

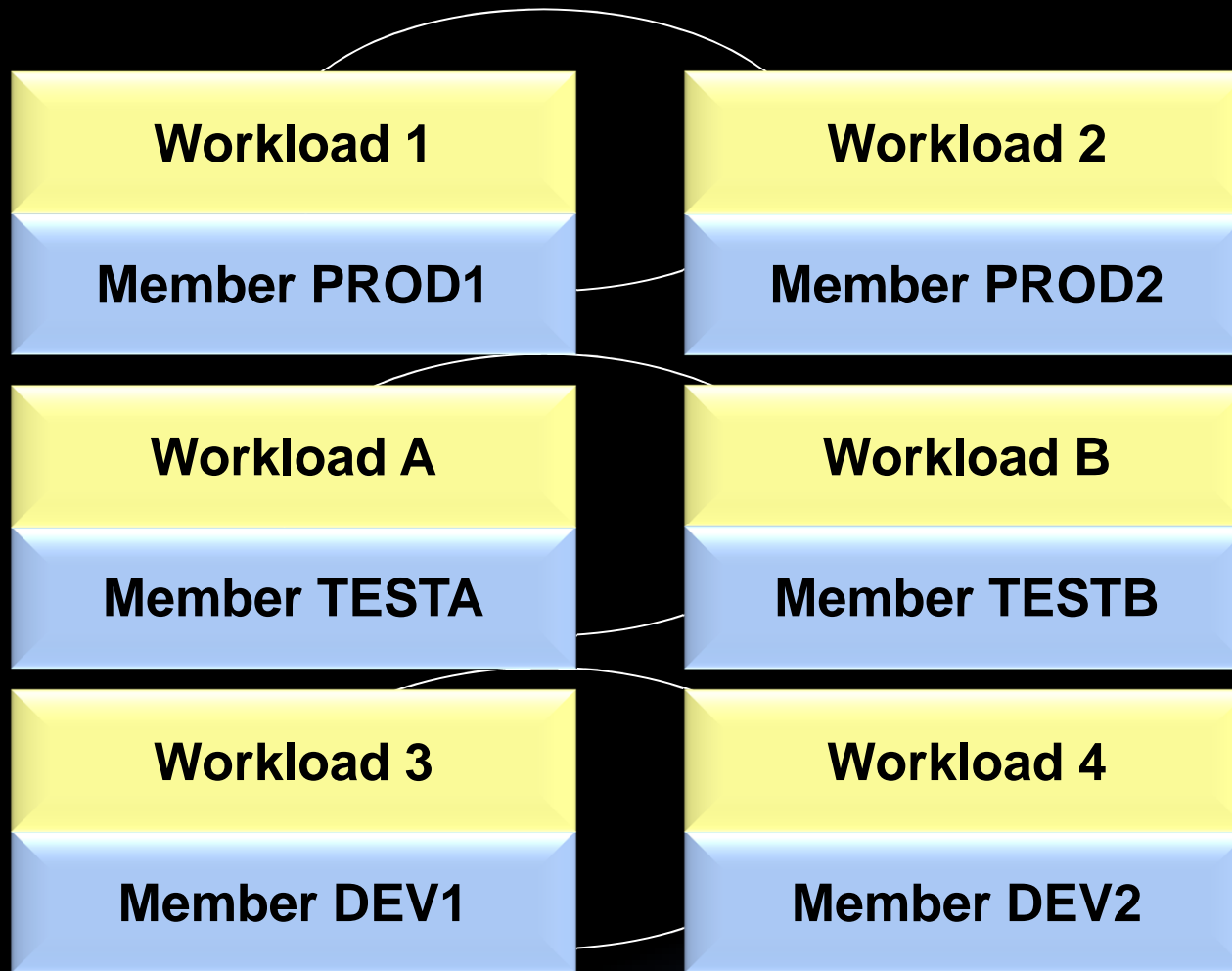
Move to z/VM 6.2 and create clusters that just happen to be single member clusters for now.





Increased Control Over Server Sprawl

As workloads increase, create additional members in each cluster.





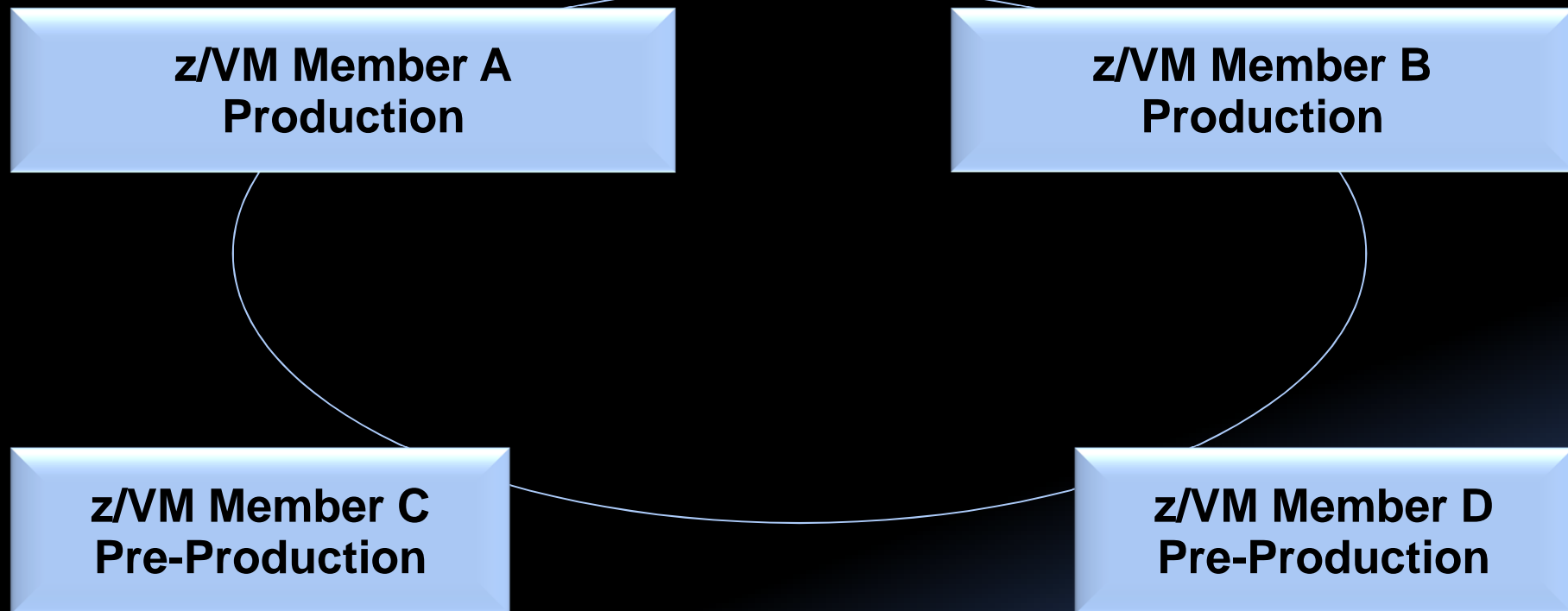
Production with Protection

- When adding a new application or upgrading an application in production, what is your confidence that you know how it will
 - Perform?
 - Impact other production workload?
 - Meet expectations?
- Single System Image provides a way to allow workload to be part of the production environment, and yet be isolated



Production with Protection

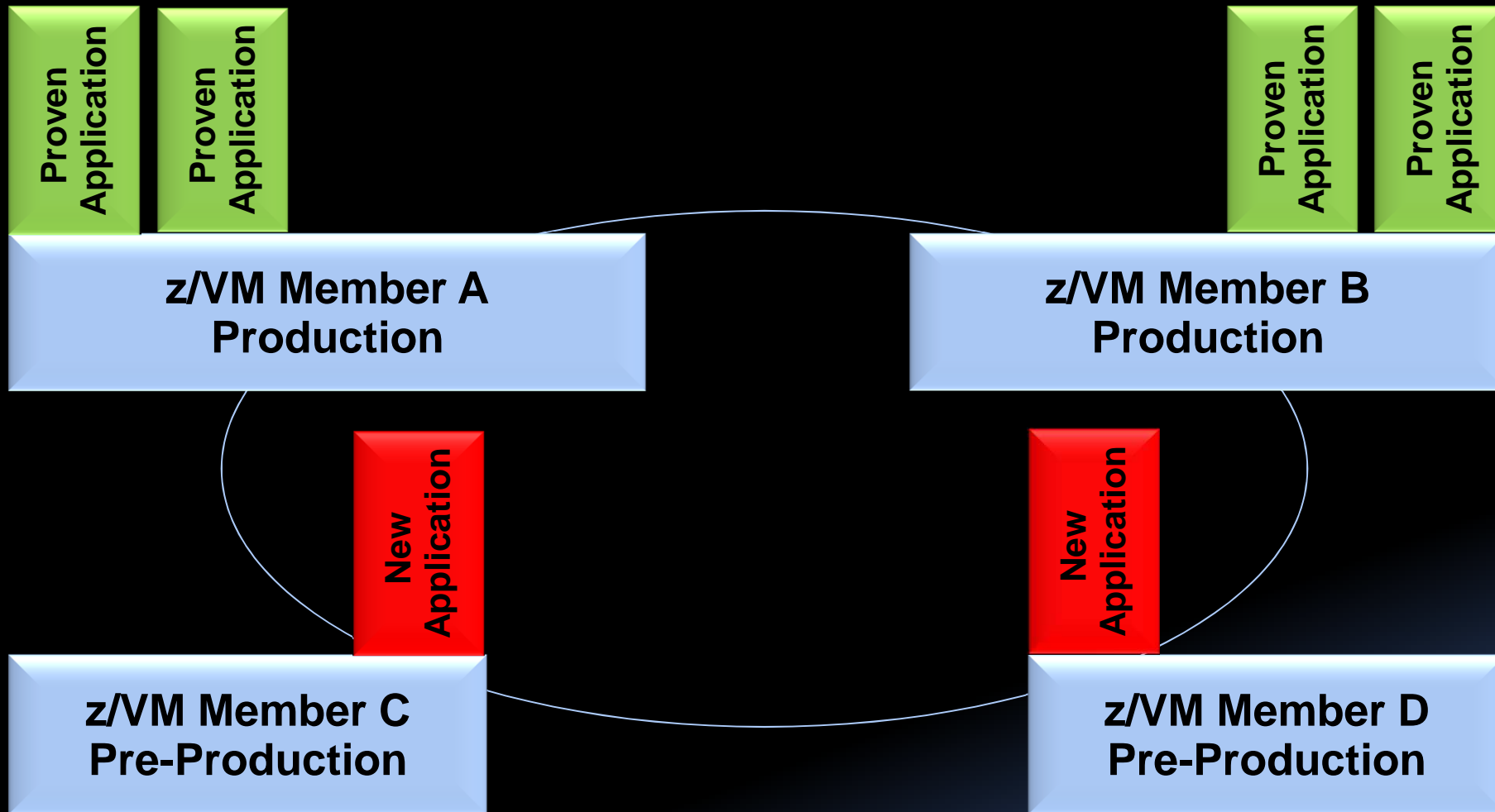
- Four Members
 - True Production – two for redundancy
 - Full amount of resources.
 - Pre-Production: proving grounds
 - Limited resources.





Production with Protection

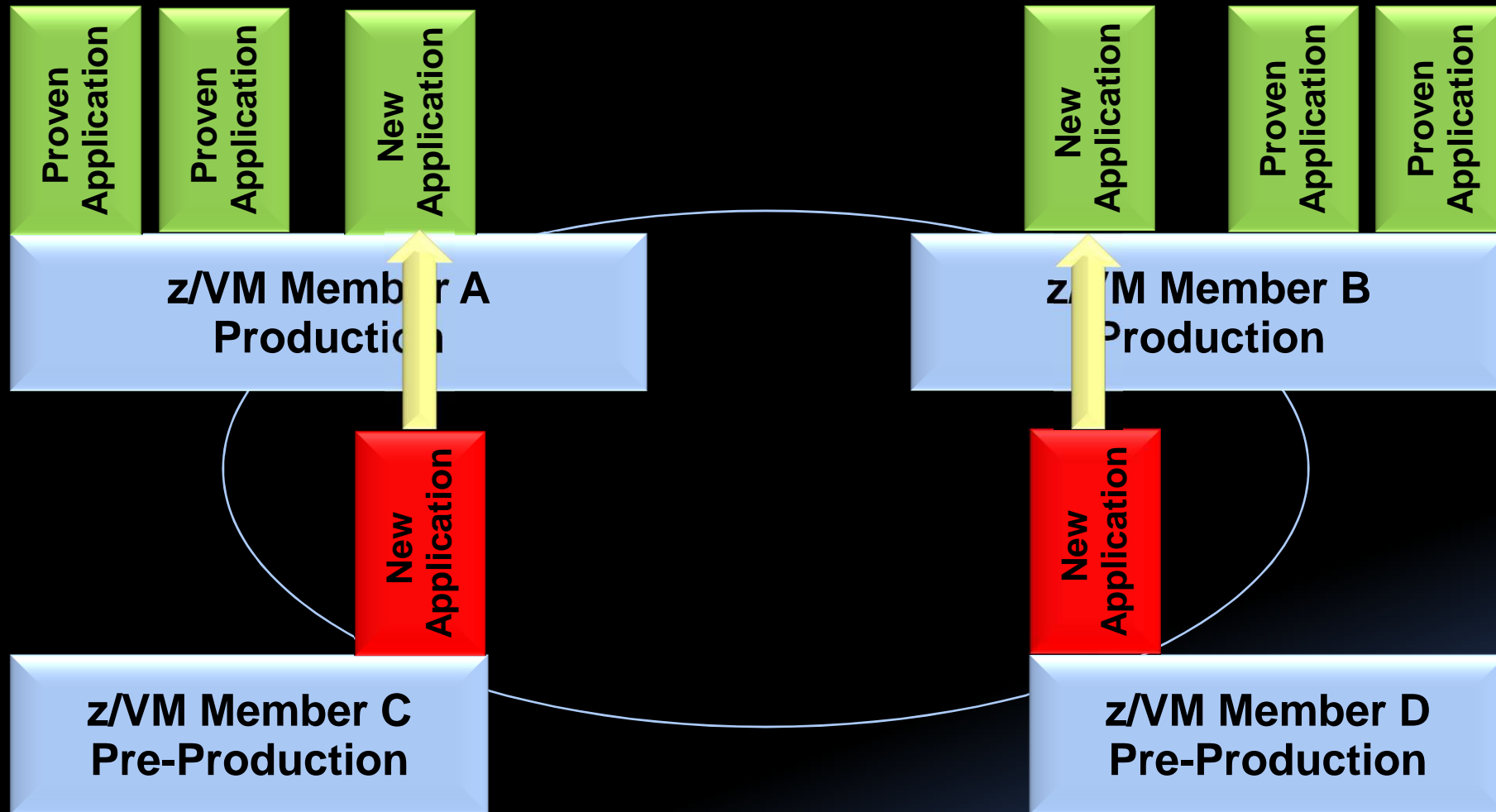
- Allow new application to run in pre-production LPARs





Production with Protection

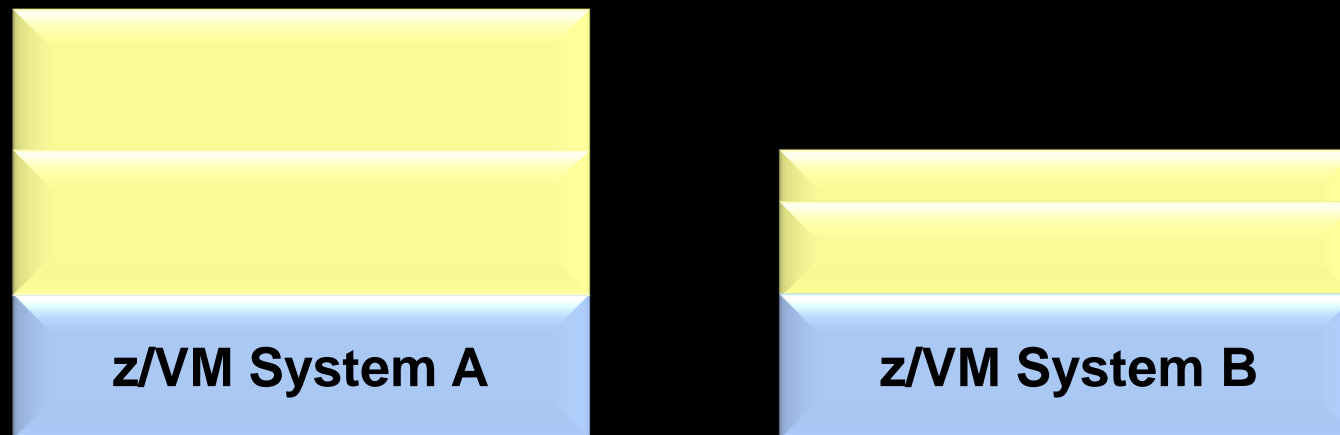
- If all goes well, move into true production





Managing Resource Distribution

- Some customers have or are in processing of exceeding the capacity of a single z/VM system and split work across LPARs
- Determining how to divide the workloads across LPARs is a challenge, particularly in a dynamic world...



- With individual z/VM systems, one would need to define new virtual machines on B and remove the definitions on A
 - Responsibility of ensuring integrity during process is on shoulders of system programmer.
- With an SSI cluster, one can more easily redistribute the load through logoff/logon or in many cases with LGR.

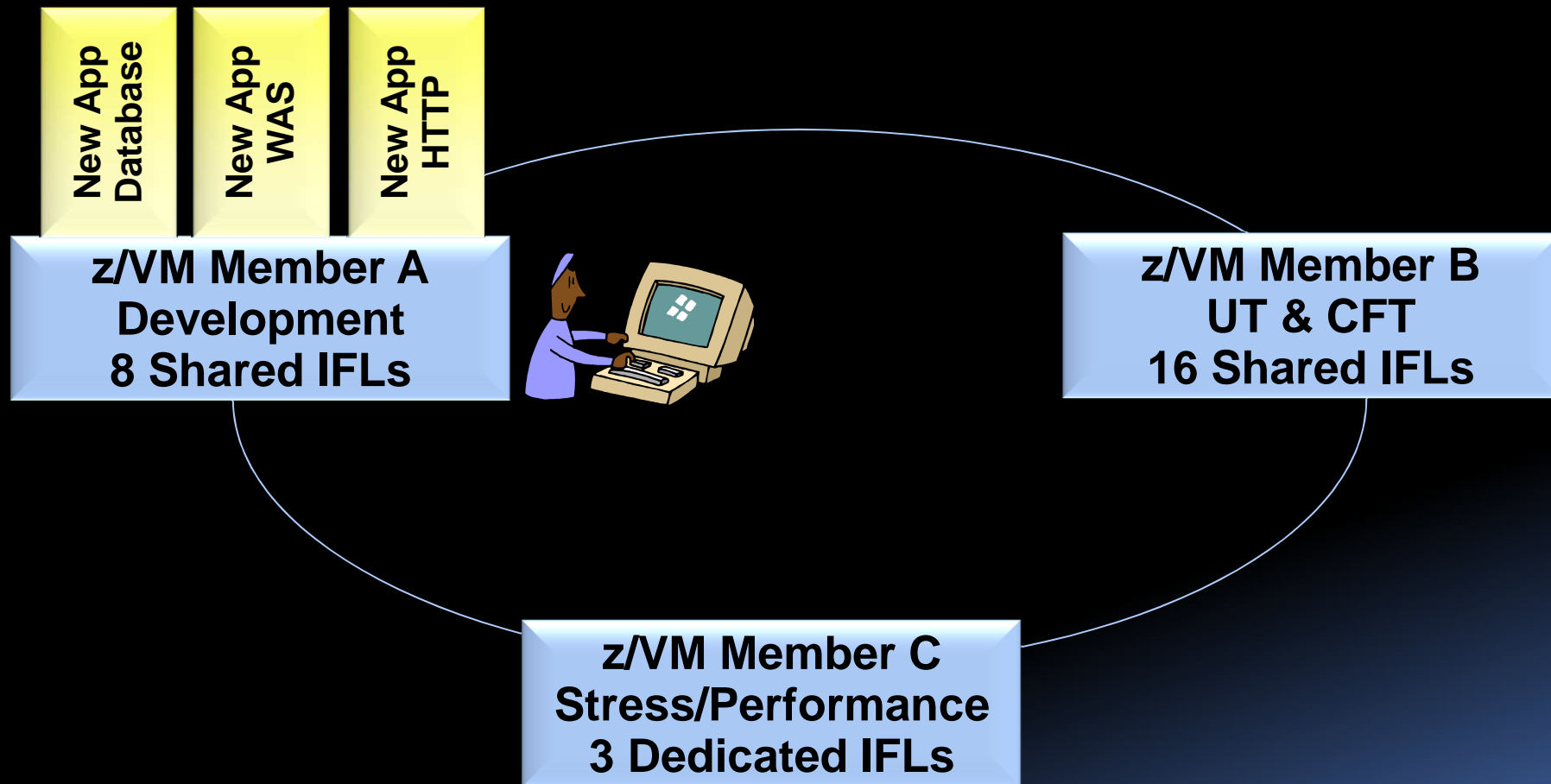


Consistent Test Bed for Stress Tests

- Testing Challenges:
 - Controlling test environments, testing in **consistent** manner
 - Functional and QA testing of various test programs
 - Stress testing in a controlled environment
- Having an SSI cluster environment allows:
 - Virtual server with same resources, run in different members of cluster based on needs
 - Load in development probably not as heavy, run that in a smaller shared environment
 - Various testing in UT & CFT could create a heavier load for various testing
 - An isolated LPAR (member) for stress testing or establishing performance characteristics of workload.

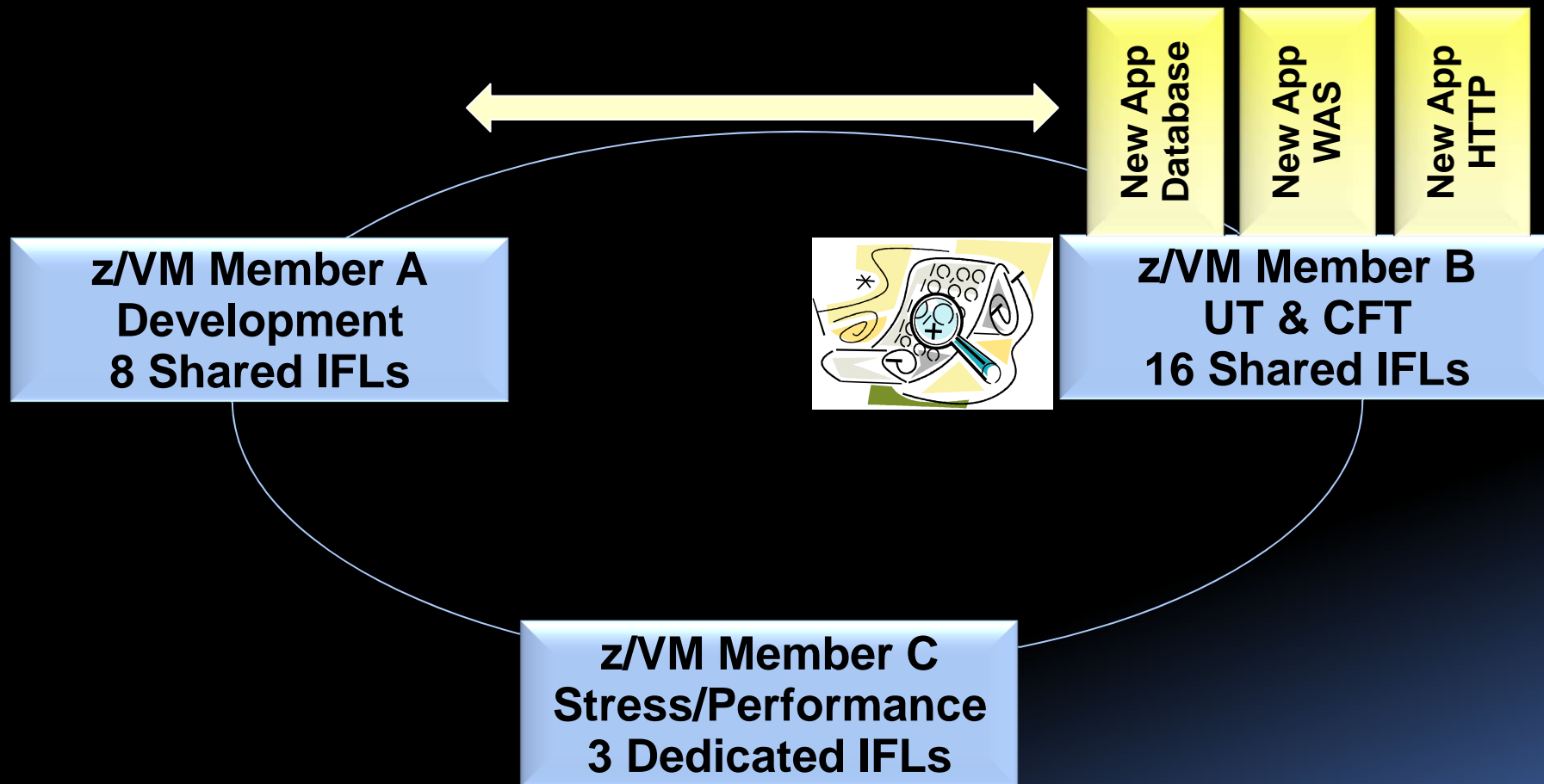


Consistent Test Bed for Stress Tests



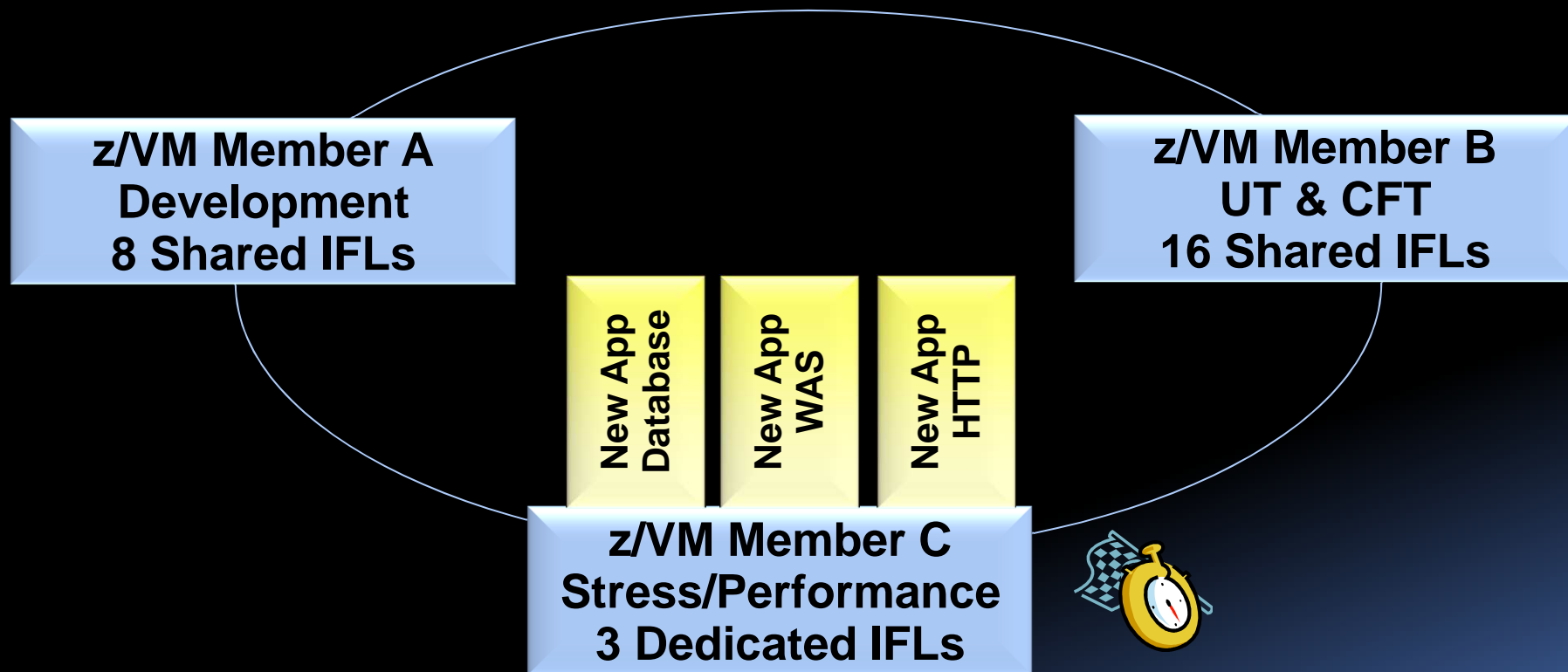


Consistent Test Bed for Stress Tests





Consistent Test Bed for Stress Tests

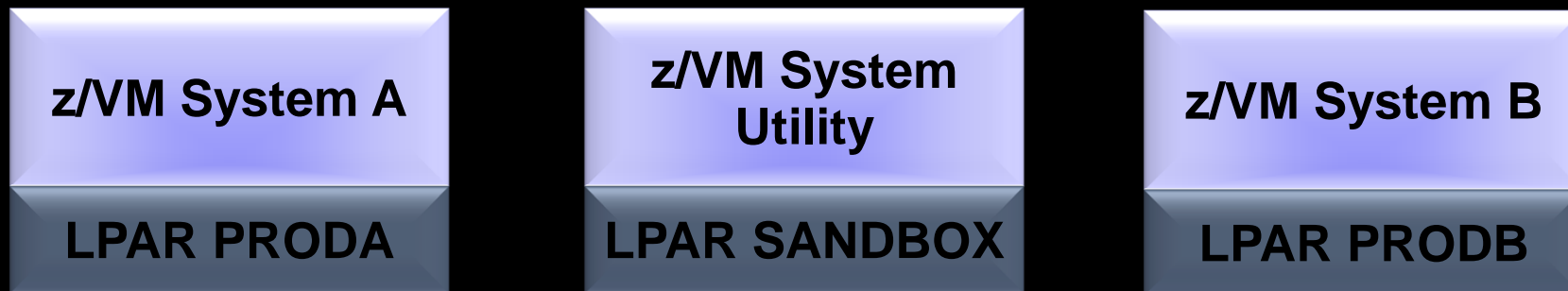




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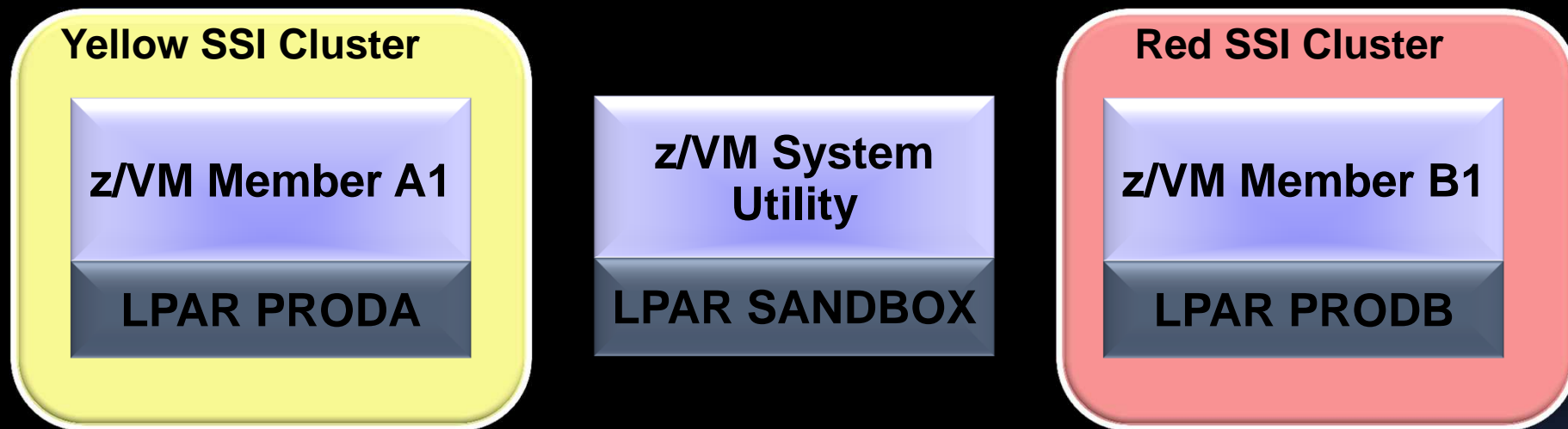
One From the Customers – Utility Migration LPAR





One From the Customers – Utility Migration LPAR

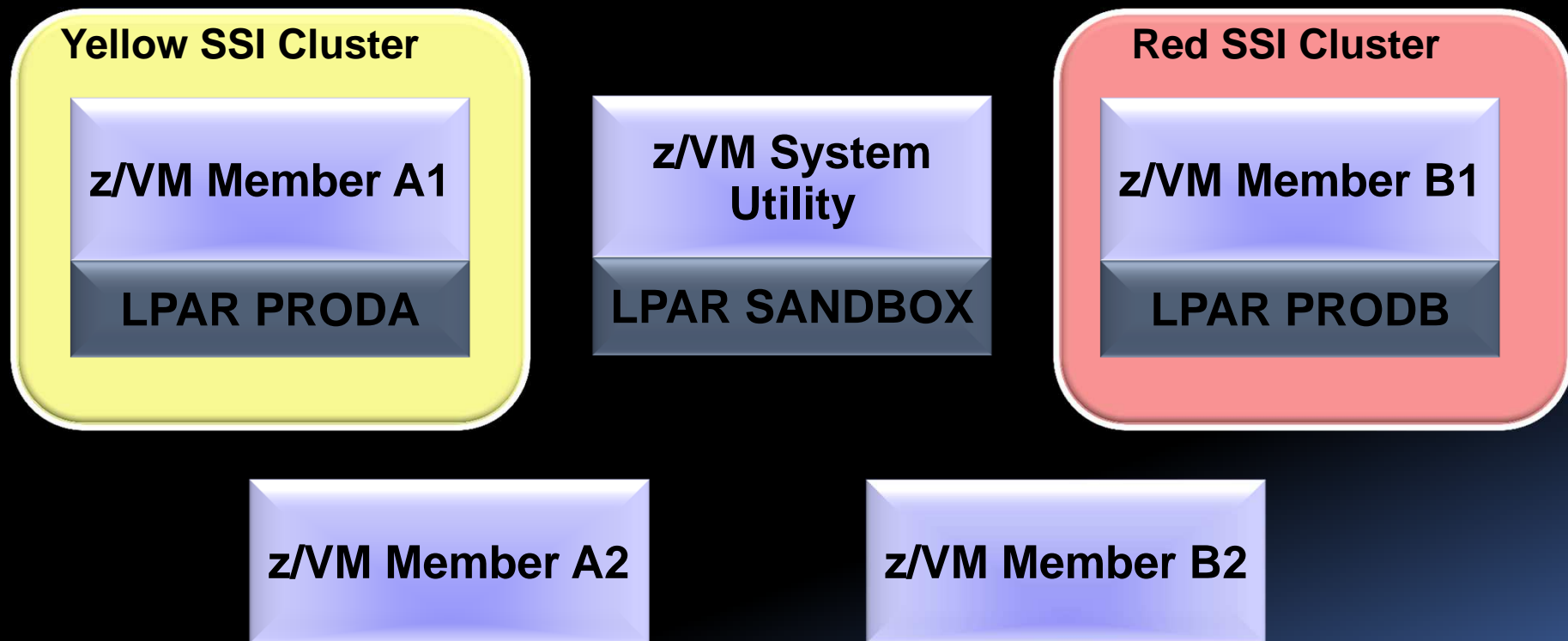
- Create SSI Cluster for each production System
 - Two Two-Member Clusters
 - But only include one of the production LPARs in each
- Utility System can stay a singleton or even a non-SSI system





One From the Customers – Utility Migration LPAR

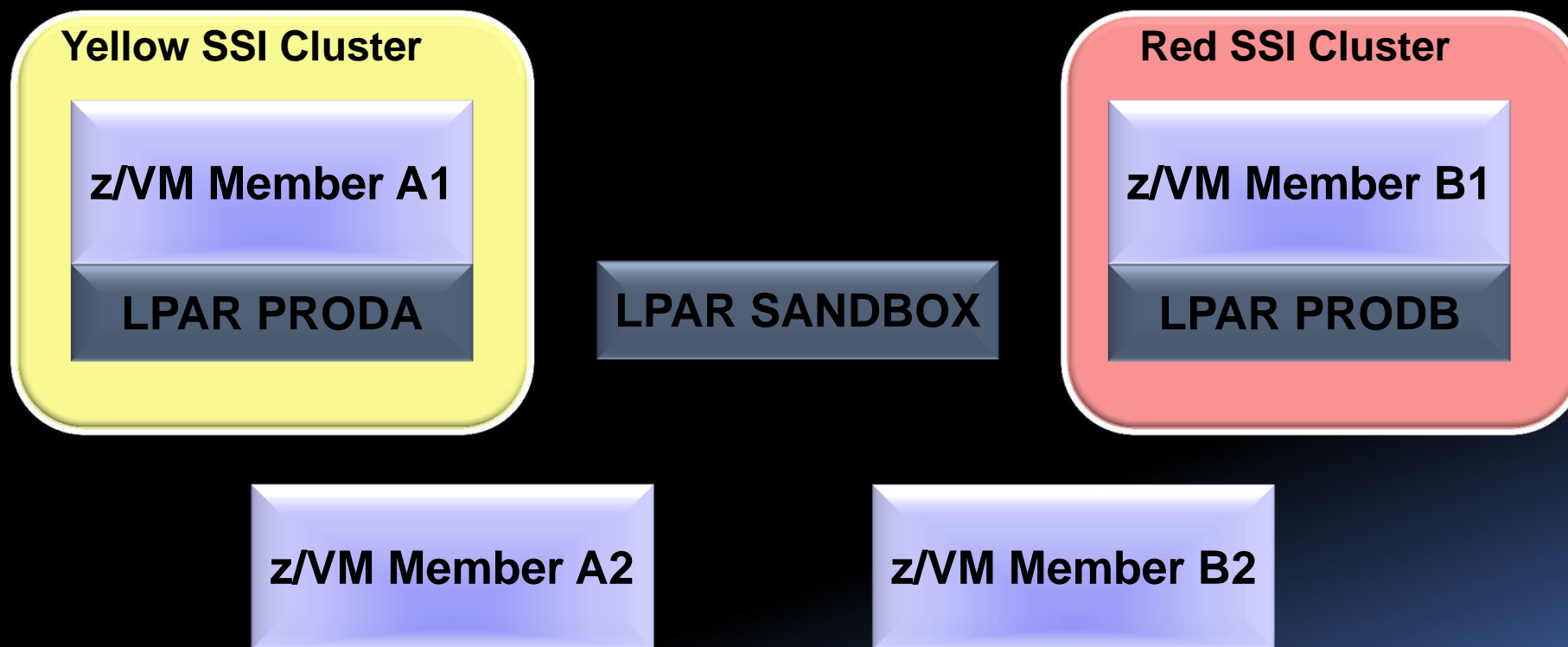
- Clone the production members so there is a second system (member) for each of the production LPARs.





One From the Customers – Utility Migration LPAR

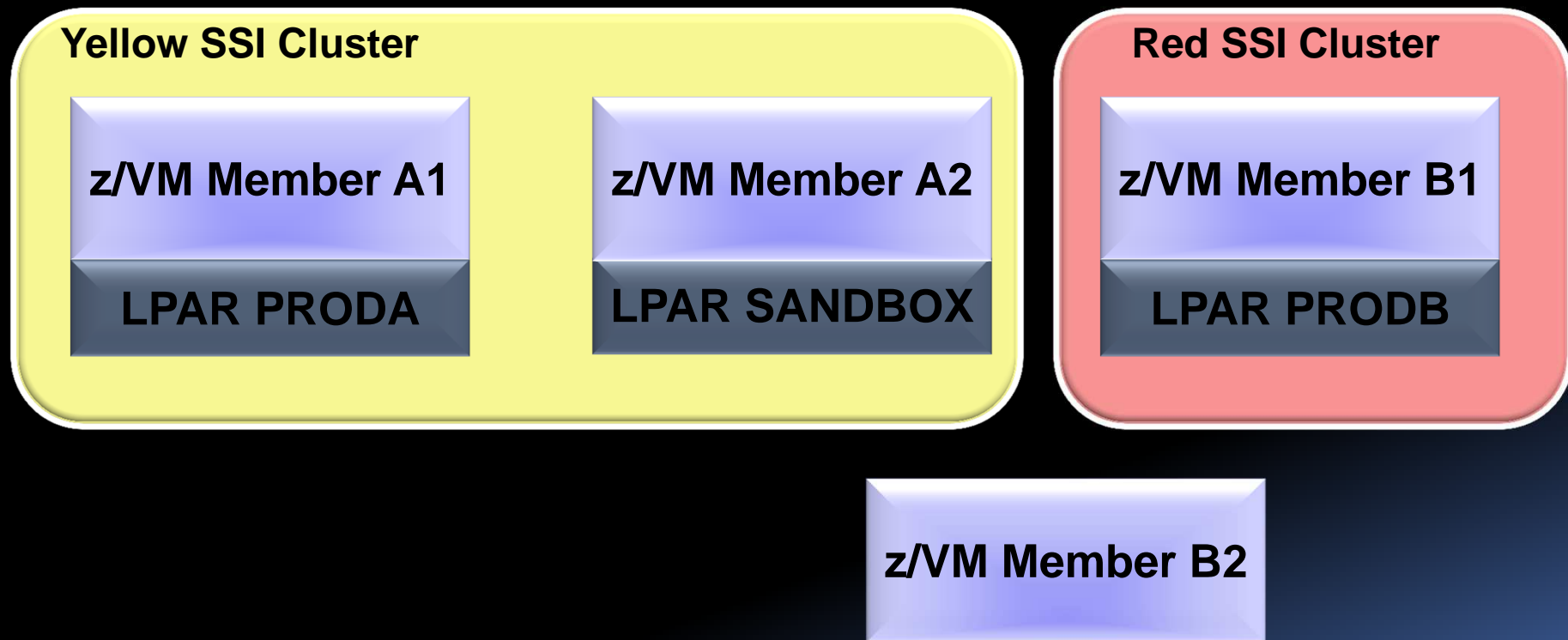
- To update CP on production LPAR PRODA
 1. Shutdown Utility System





One From the Customers – Utility Migration LPAR

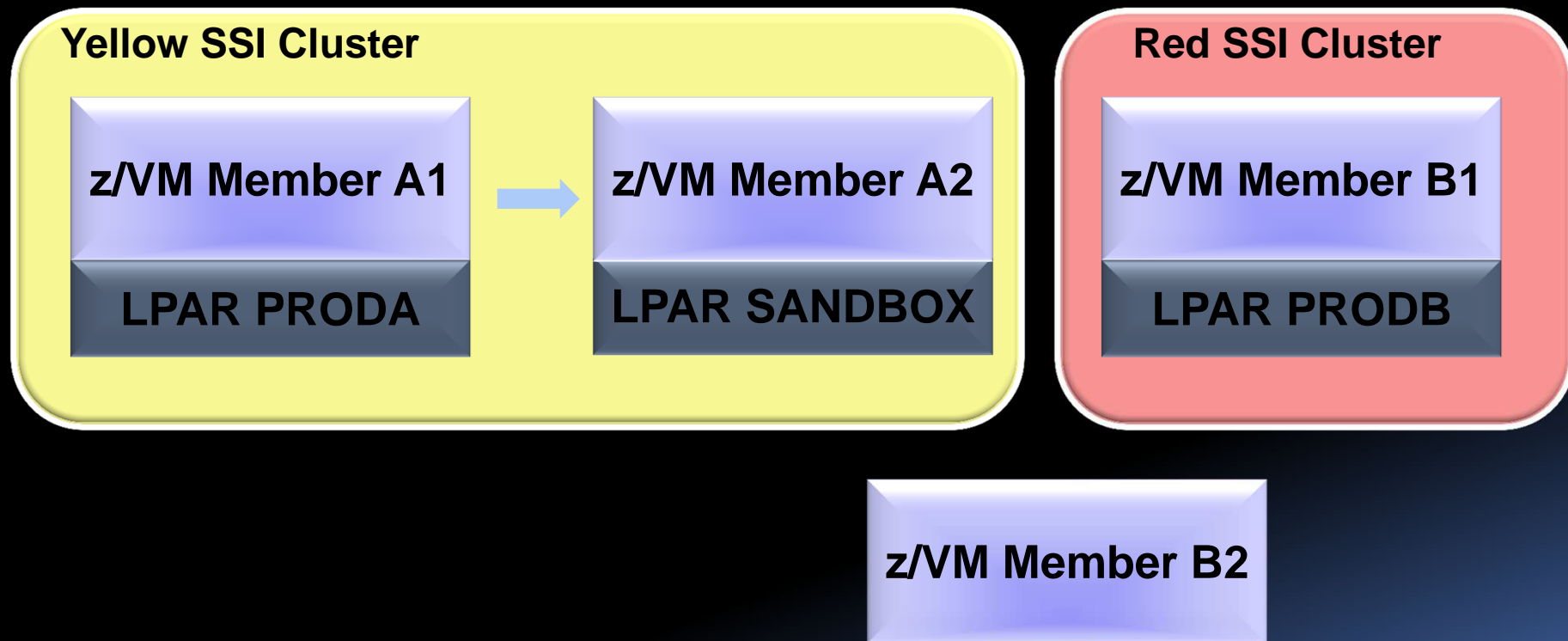
- To update CP on production LPAR PRODA
 1. Shutdown Utility System
 2. Bring up the other Member in SANDBOX LPAR





One From the Customers – Utility Migration LPAR

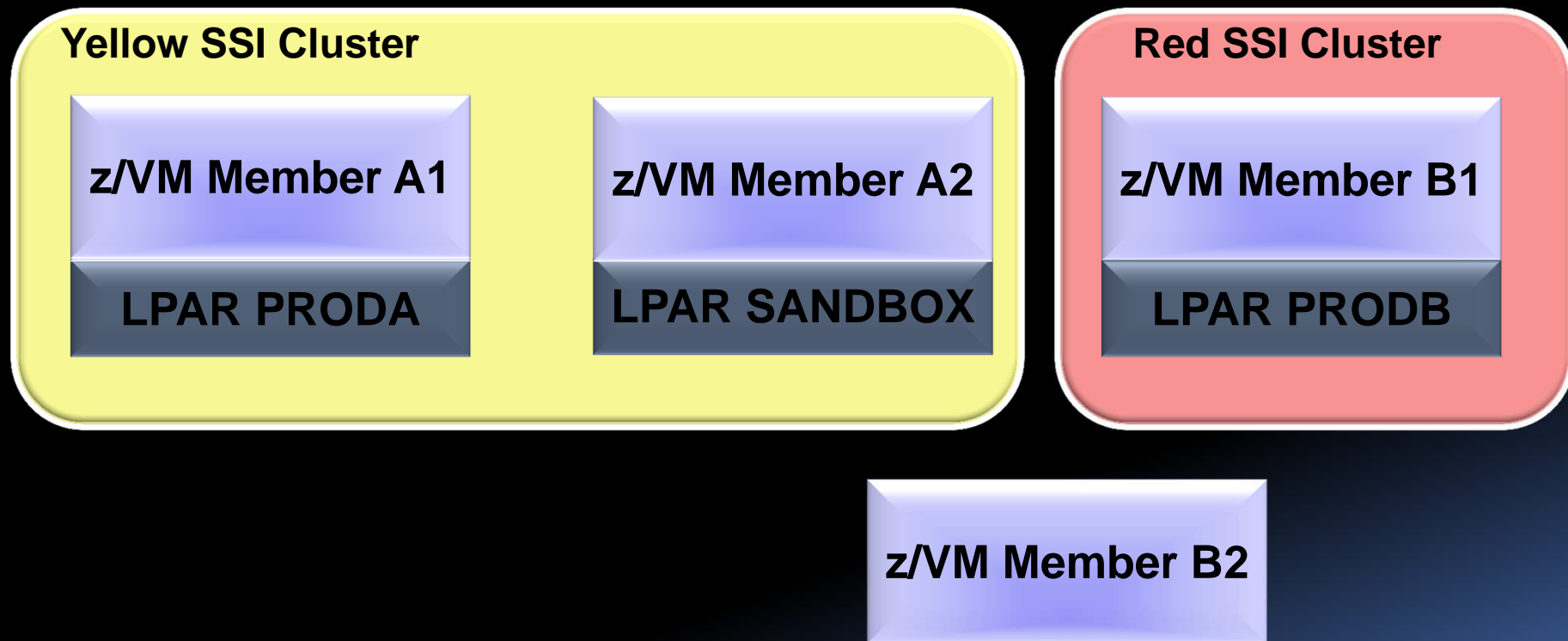
- To update CP on production LPAR PRODA
 1. Shutdown Utility System
 2. Bring up the other Member in SANDBOX LPAR
 3. Move work from A1 to A2





One From the Customers – Utility Migration LPAR

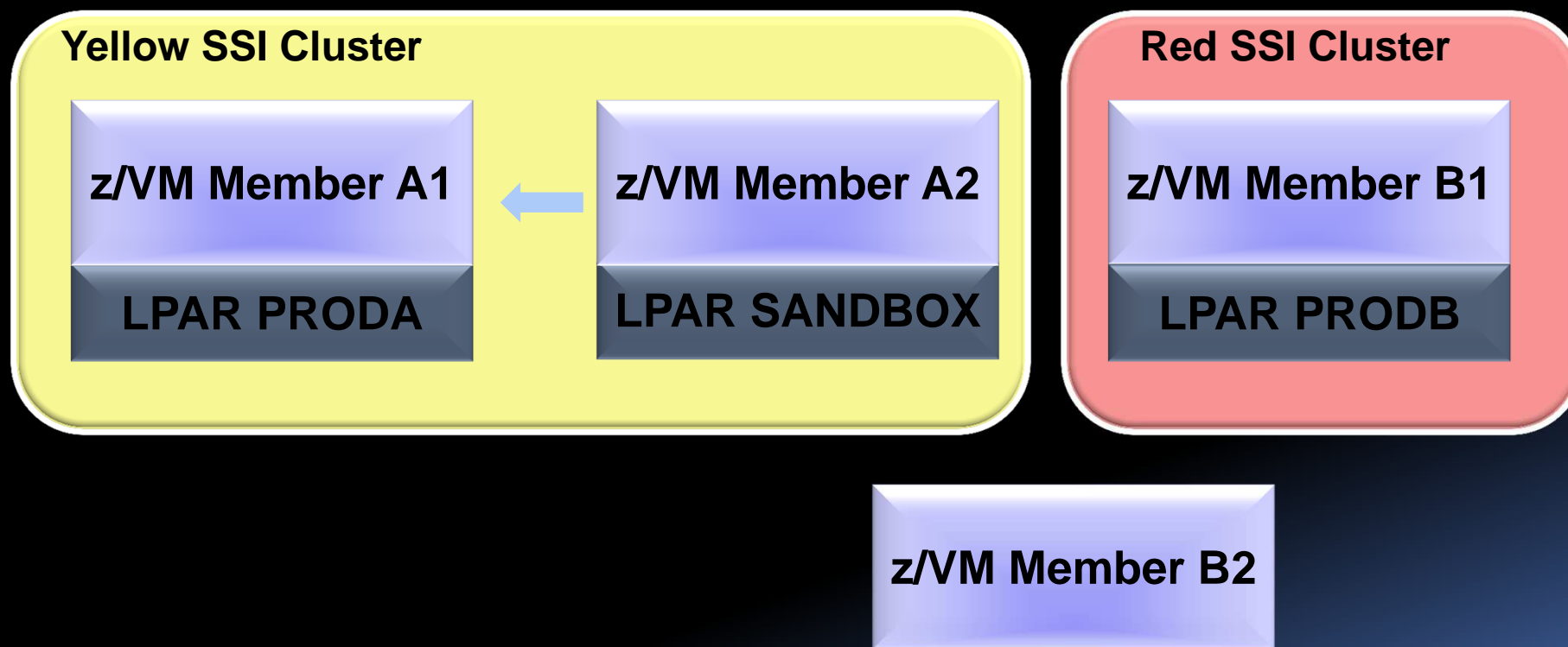
- To update CP on production LPAR PRODA
 1. Shutdown Utility System
 2. Bring up the other Member in SANDBOX LPAR
 3. Move work from A1 to A2
 4. Bounce A1 to pick up service





One From the Customers – Utility Migration LPAR

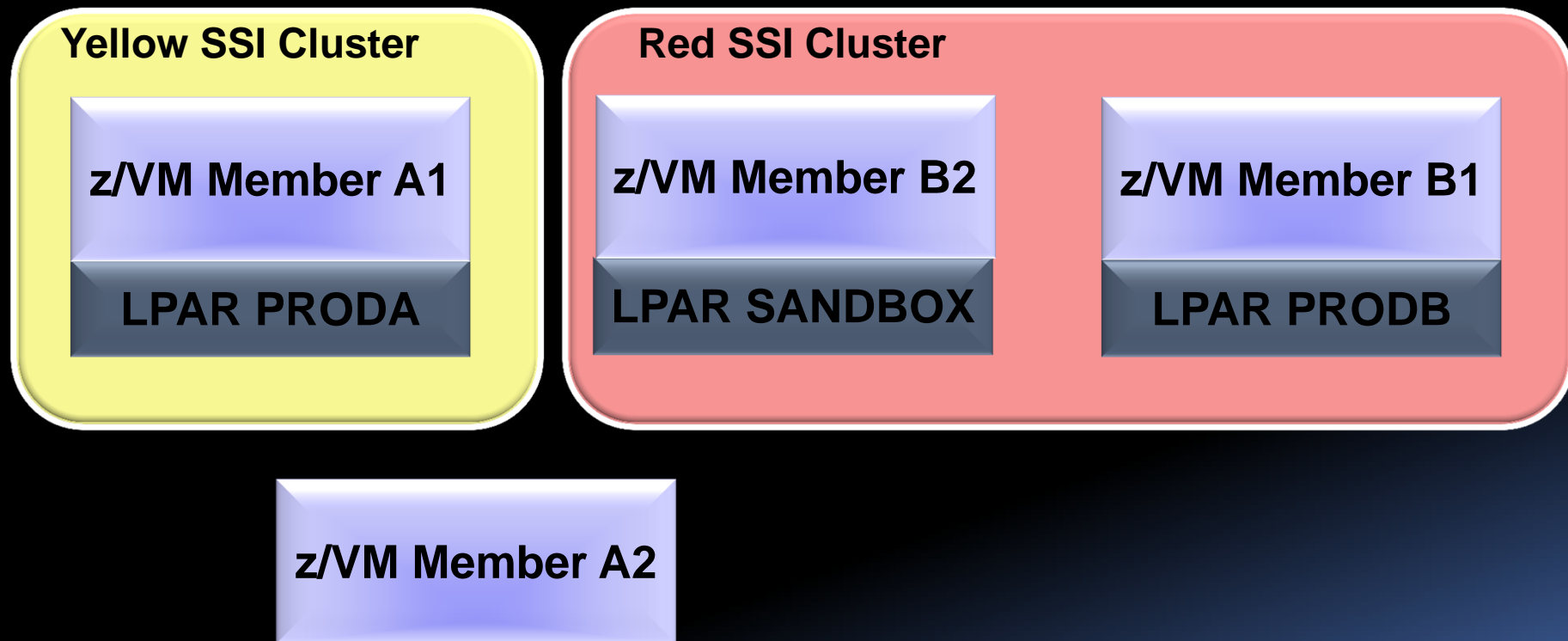
- To update CP on production LPAR PRODA
 1. Shutdown Utility System
 2. Bring up the other Member in SANDBOX LPAR
 3. Move work from A1 to A2
 4. Bounce A1 to pick up service
 5. Move work back to A1 from A2





One From the Customers – Utility Migration LPAR

- Repeat on Red SSI Cluster



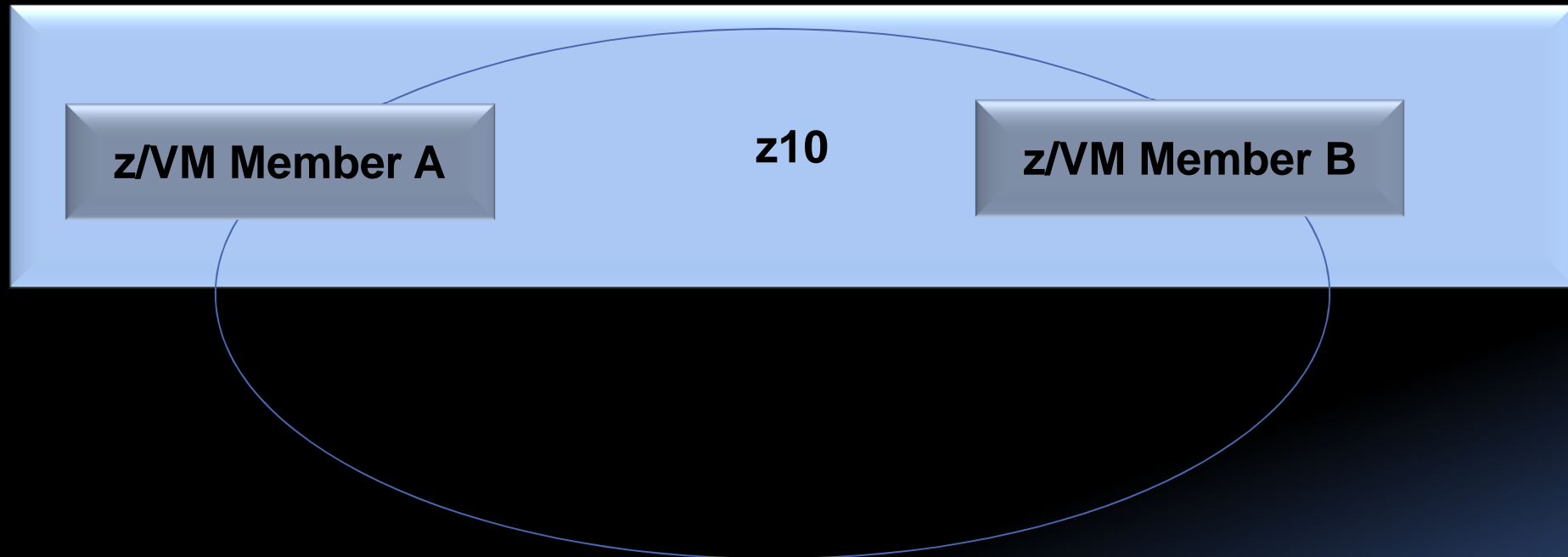


Migrate to New Processor

- Four Members Defined:
 - 2 Members: Active on existing CEC
 - 2 Members: Defined, but inactive

z/VM Member C

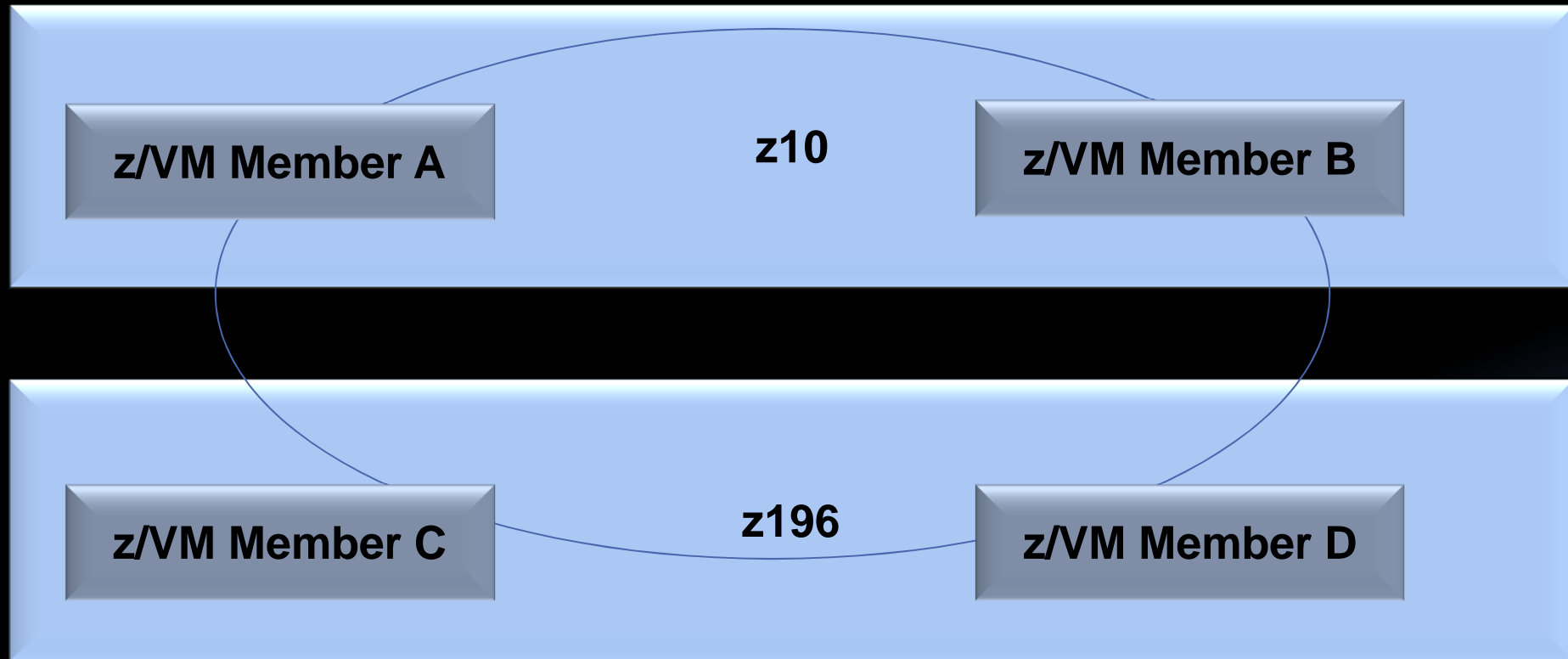
z/VM Member D

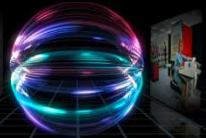




Migrate to New Processor

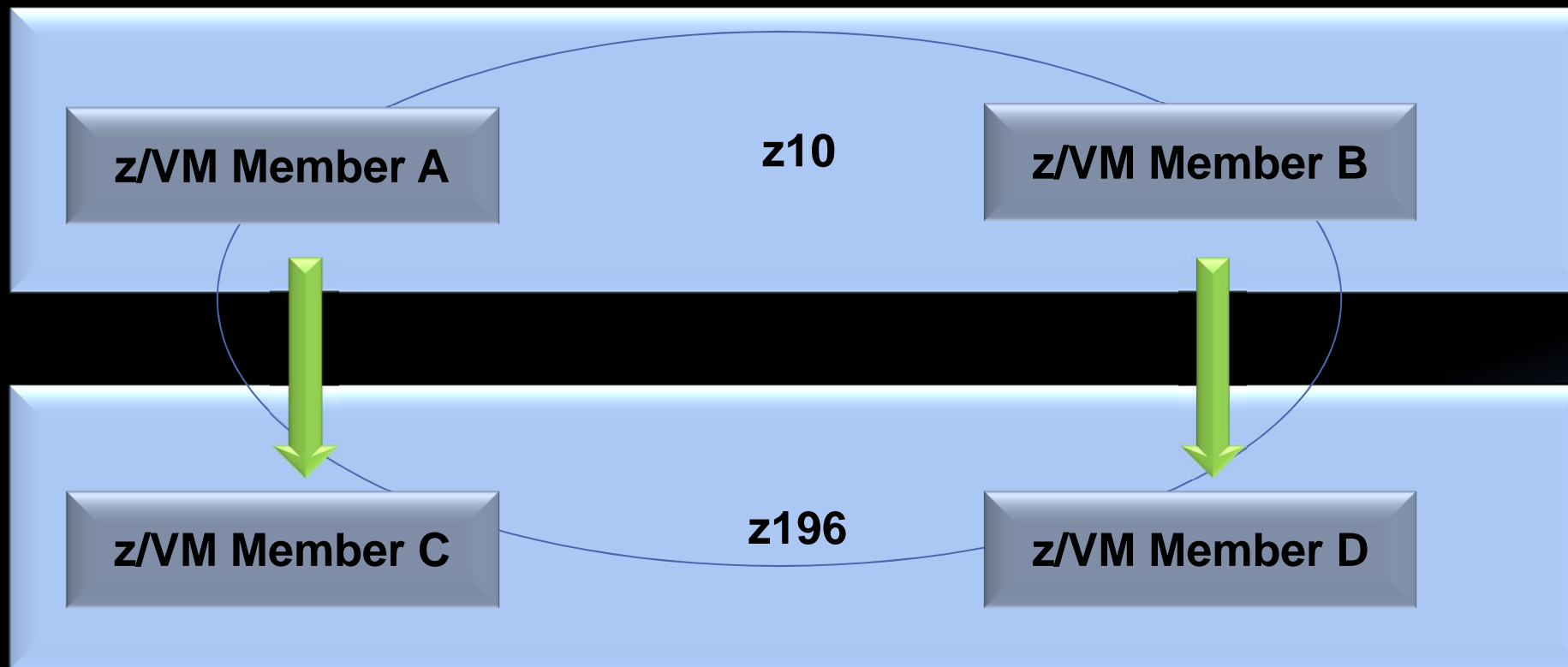
- Bring in New z196
- Start up Members C & D on the z196





Migrate to New Processor

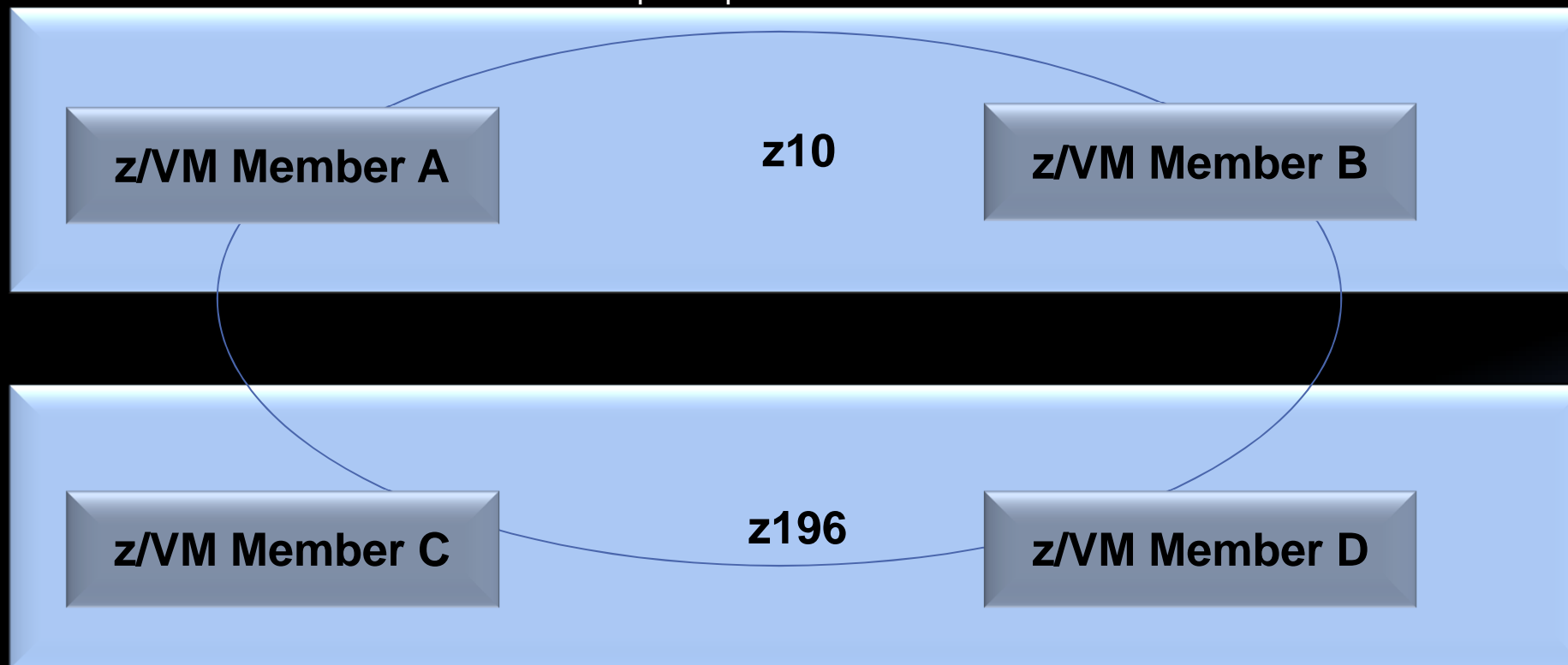
- Bring in New z196
- Start up Members C & D on the z196
- Move workload to z196





Migrate to New Processor

- Shutdown Members A and B
- Remove z10 from the Floor
- Now running on new hardware with Members C & D
- Would need to re-boot Linux to pick up new z196 hw facilities





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Summary



Summary: z/VM 6.2 – Another Milestone for Virtualization

Manage Resources & Workloads

- For decades, System z has shown the strength of moving resources to the work that needed it. SSI and LGR add more value by allowing work to move to the resources in a non-disruptive manner.

Optimize Success

- The SSI clustering takes advantage of hardware and software technology to optimize success by minimizing the complex system programmer steps required for clustering technology, with low overhead and without specialized hardware.

Protect the Advantage

- Guest mobility in general is remarkable technology. z/VM Live Guest Relocation takes it to the next level. Exploiting LGR doesn't mean giving up the rich resource control and management features customers have come to love with z/VM.



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Session Handout and
Evaluation





Efficiency of one. Flexibility of Many. 40 years of virtualization.



Contact Info:

Bill Bitner
z/VM Customer Focus and Care
z/VM Development Lab – Endicott, NY
bitnerb@us.ibm.com
+1 607-429-3286

