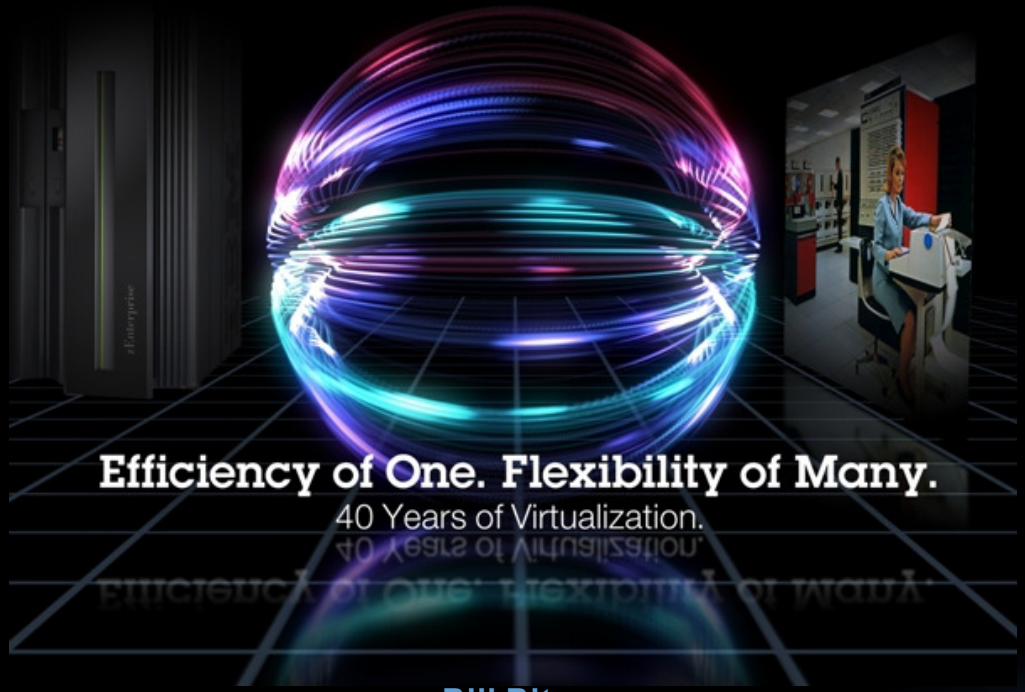
The Merits of z/VM
Increasing the Endless Possibilities of Virtualization



Bill Bitner

IBM Endicott – The Birthplace of IBM

z/VM Customer Focus and Care Leader
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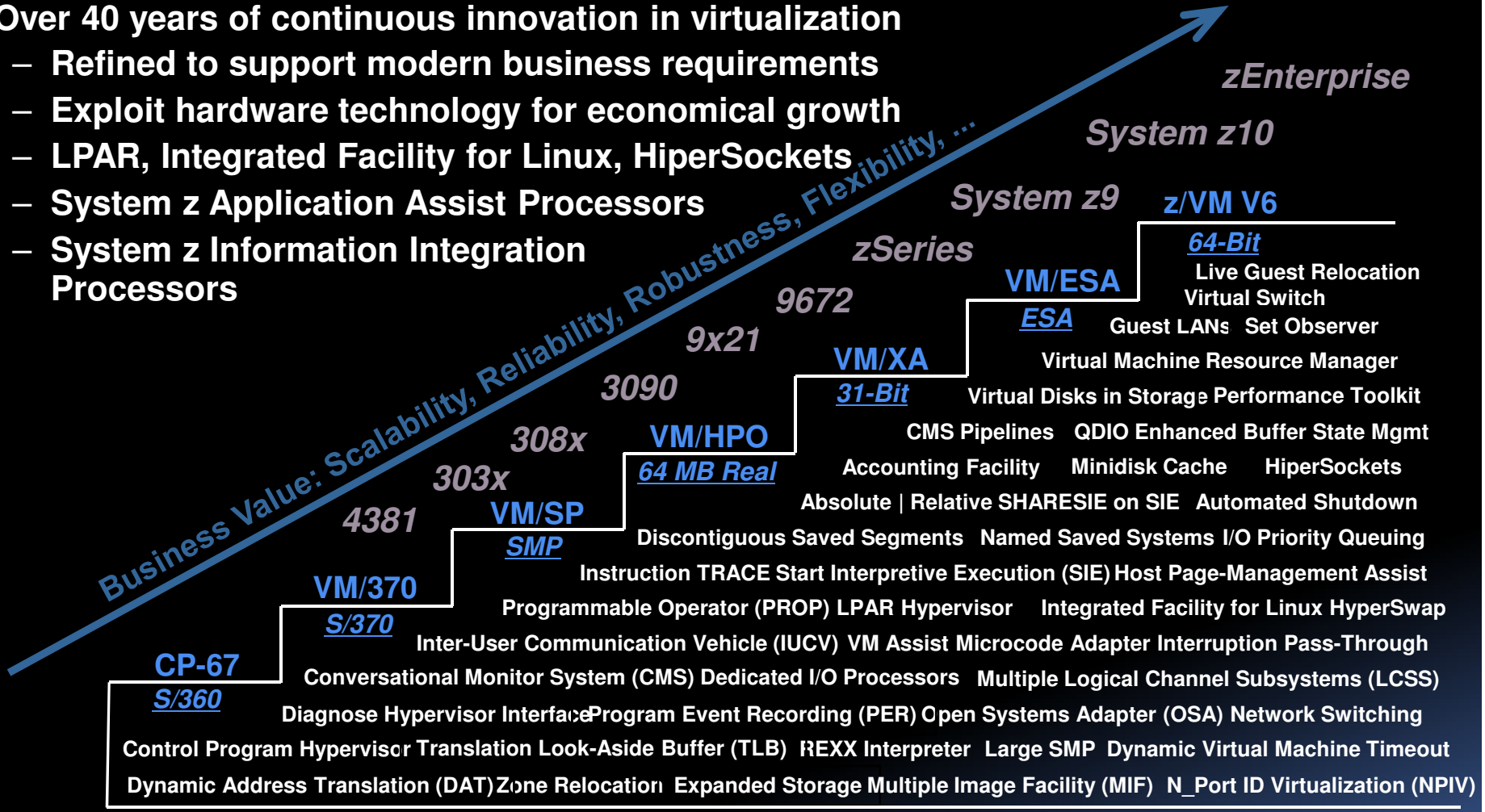
Agenda

z/VM Timeline	• Heritage and History • Constantly Expanding Function
z/VM Attributes	• Core Design Principles • Strengths
What Makes Live Guest Relocation Special?	• Making it safe • Making it manageable
New Possibilities	• Availability • Flexibility in Testing

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

z/VM Attributes

Replication of the Architecture

- z/VM creates virtual machines with a high degree of architecture fidelity.
  - Obeys the rules of the z/Architecture Principle of Operations
  - Allows for a high level of trust that the virtualization provided by z/VM does not skew or contaminate or disrupt from functionality compared to running without z/VM.
- Test programs used to validate System z Servers are also run against z/VM
- New processor features often implemented early in an internal z/VM version to aid in other software development
- This faithful replication of architecture gives ISVs a higher confidence that z/VM virtualization is a platform that can be supported.

All Under One Corporation

- IBM has the entire stack
  - Hardware / FirmwareFirmware
  - Hypervisor
  - Operating Systems
  - Middleware
- Facilitates advances and interaction
  - Hardware assists
    - HPMA – Host Page Management Assist
  - Handshaking between Hypervisor and Operating Systems
    - Asynchronous Page Fault Processing
  - Multiple levels
    - QEBSM – QDIO Enhanced Buffer State Management
  - Testing advantages
- IBM Support

z/VM Community

- Long term connections, communication, and collaboration
  - VMSHARE electronic conference started in 1976
- z/VM customers and ISVs increase the level of help available
- z/VM Community tends to be friendlier, less flames, than other groups
- Long history of providing additional function and tools
  - Modifications to z/VM
  - Various tools and download packages
    - E.g. TRACK
- Long history of influencing and steering IBM
- z/VM Community – you're never alone

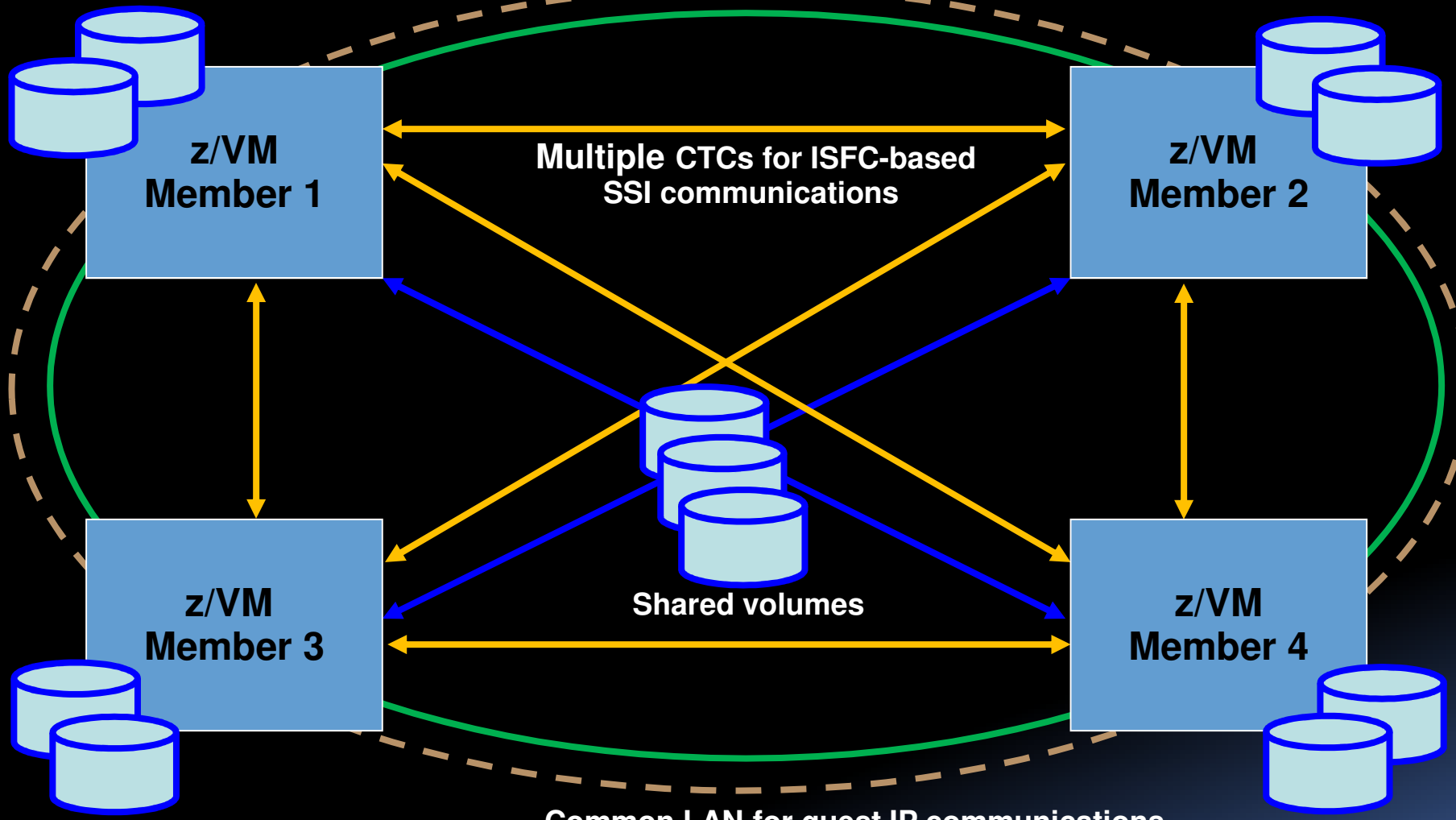
The Original Cloud

- 1970s Earliest Virtual Machines provided to software and hardware developers.
  - Infrastructure as a Service
- 1980s CMS Development environments
  - Platform as a Service
- 1990s OV/VM Virtual Machines
  - Software as a Service
- 2012 Linux + Middleware + Management Software
  - Whatever you need as a Service

Adaptability to Varying Workloads

- The breadth and depth of z/VM systems is impressive
- z/VM Customers may span…
  - Memory >100 x's
  - System Processors 32 x's
  - Virtual Machine Size >800 x's
  - I/O Devices >500 x's
- z/VM supports them all and continues to adjust to changes in customer demographics
- Historically things have changed significantly, on the same code base
  - 1992: Over 20,000 OVVM CMS virtual machines
  - 2010: Over 500 Linux virtual machines

What Makes SSI & LGR Special?



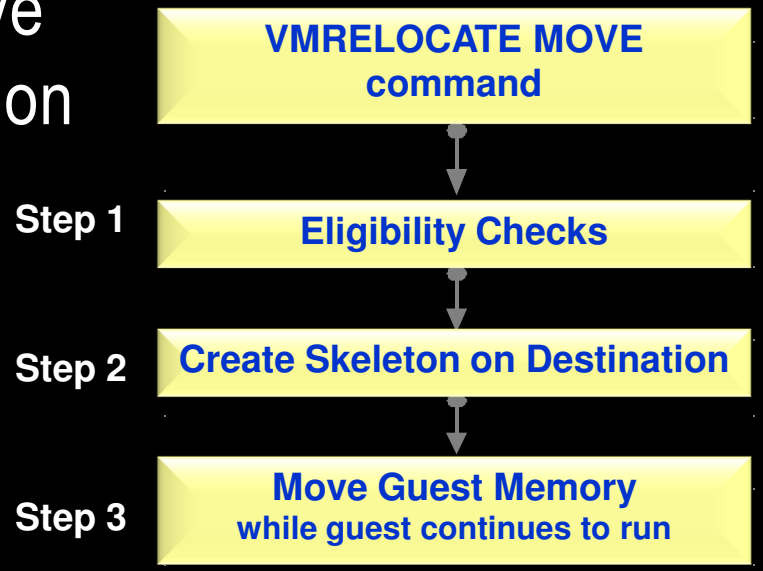
SSI Cluster Management: Features for Greater Reliability

- 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.

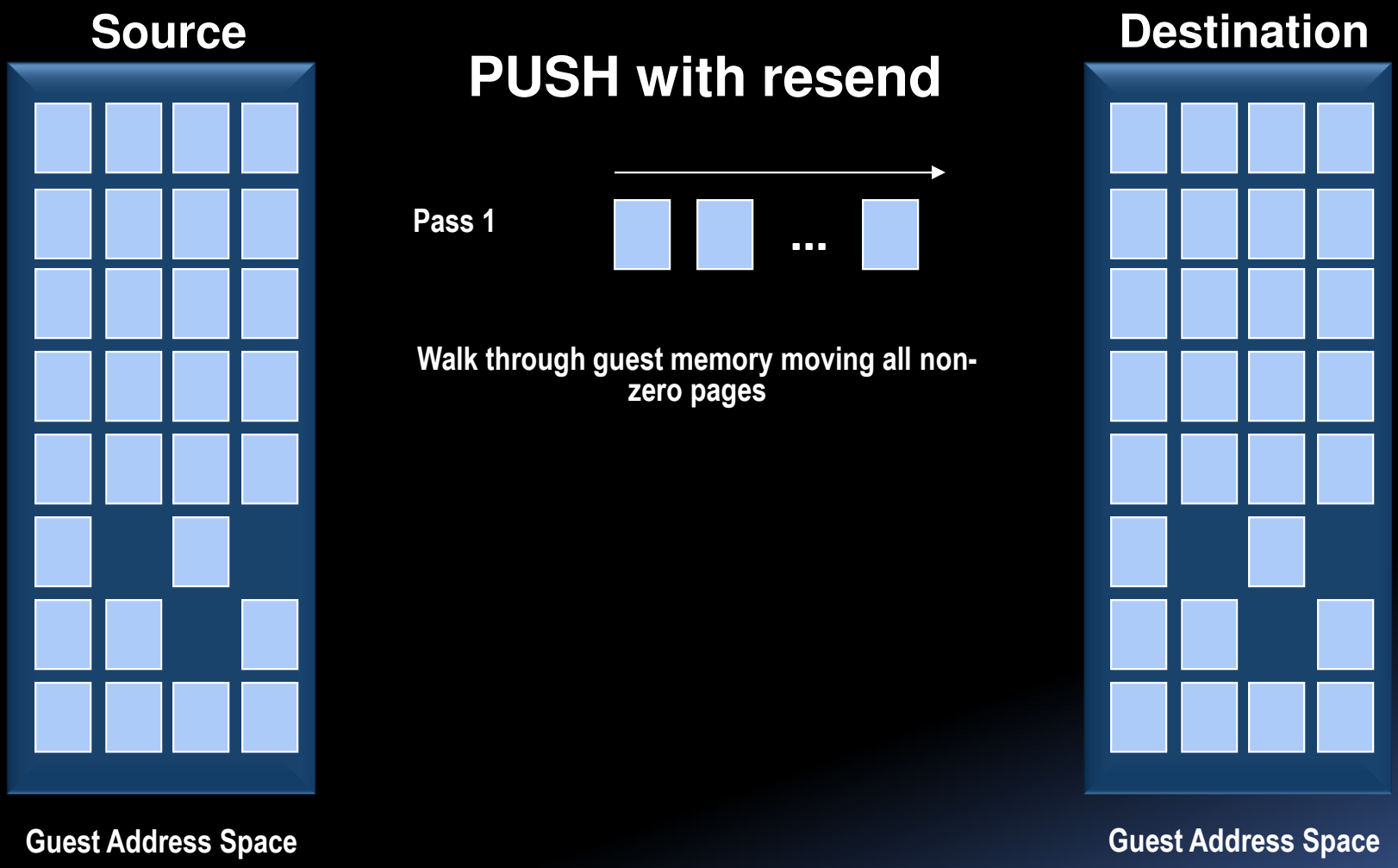
SSI Cluster Management: Addressing Problems

- 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



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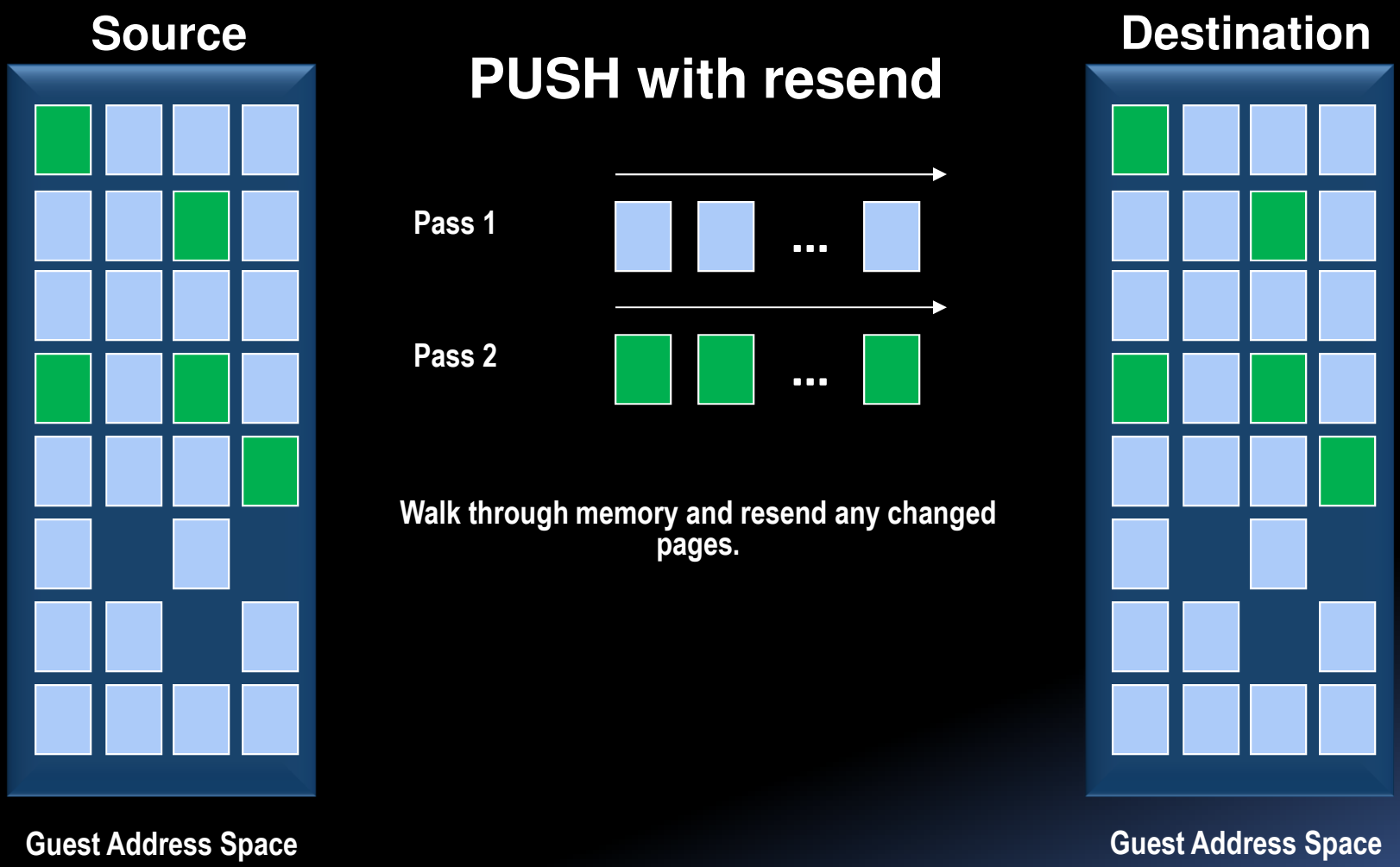

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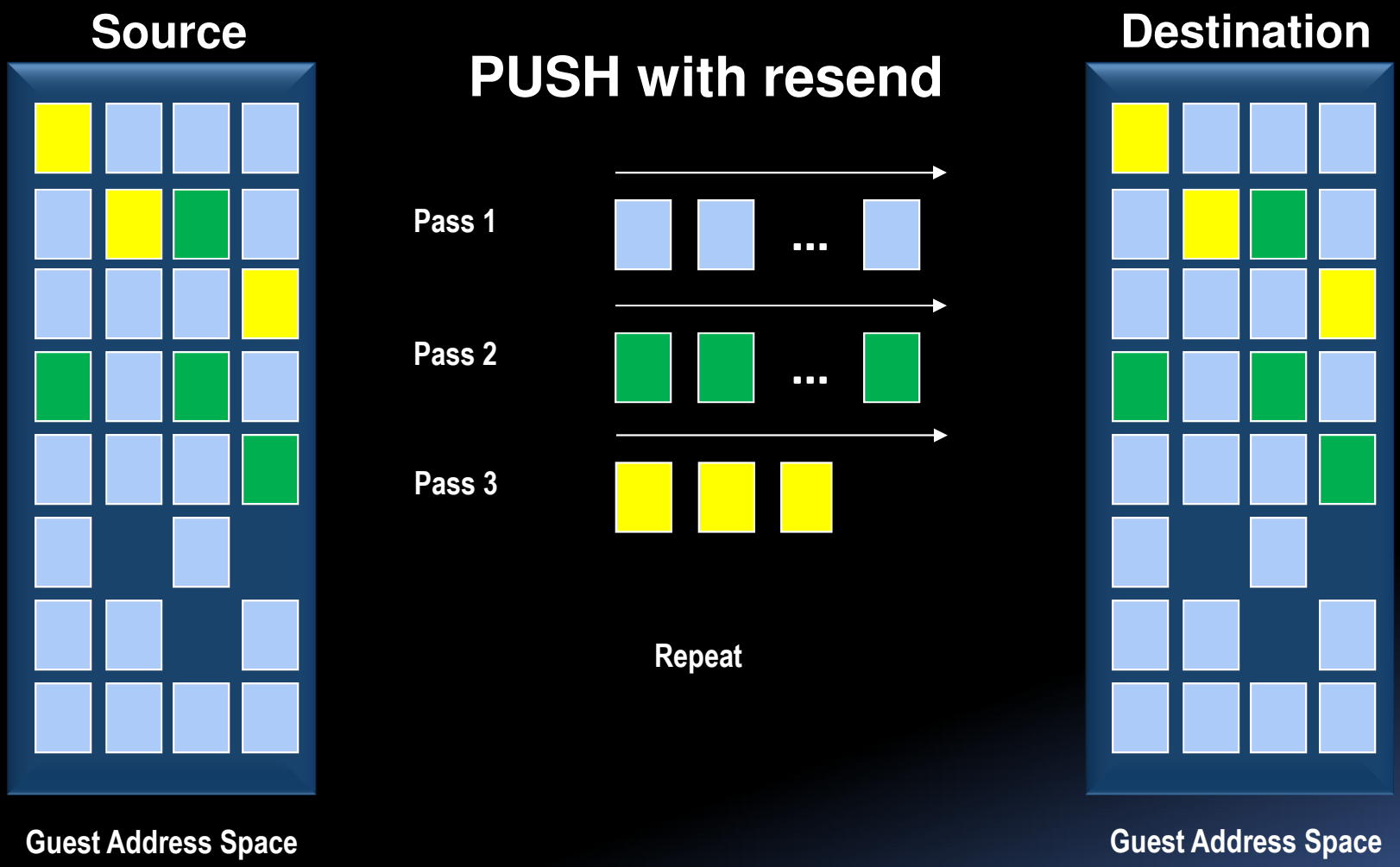

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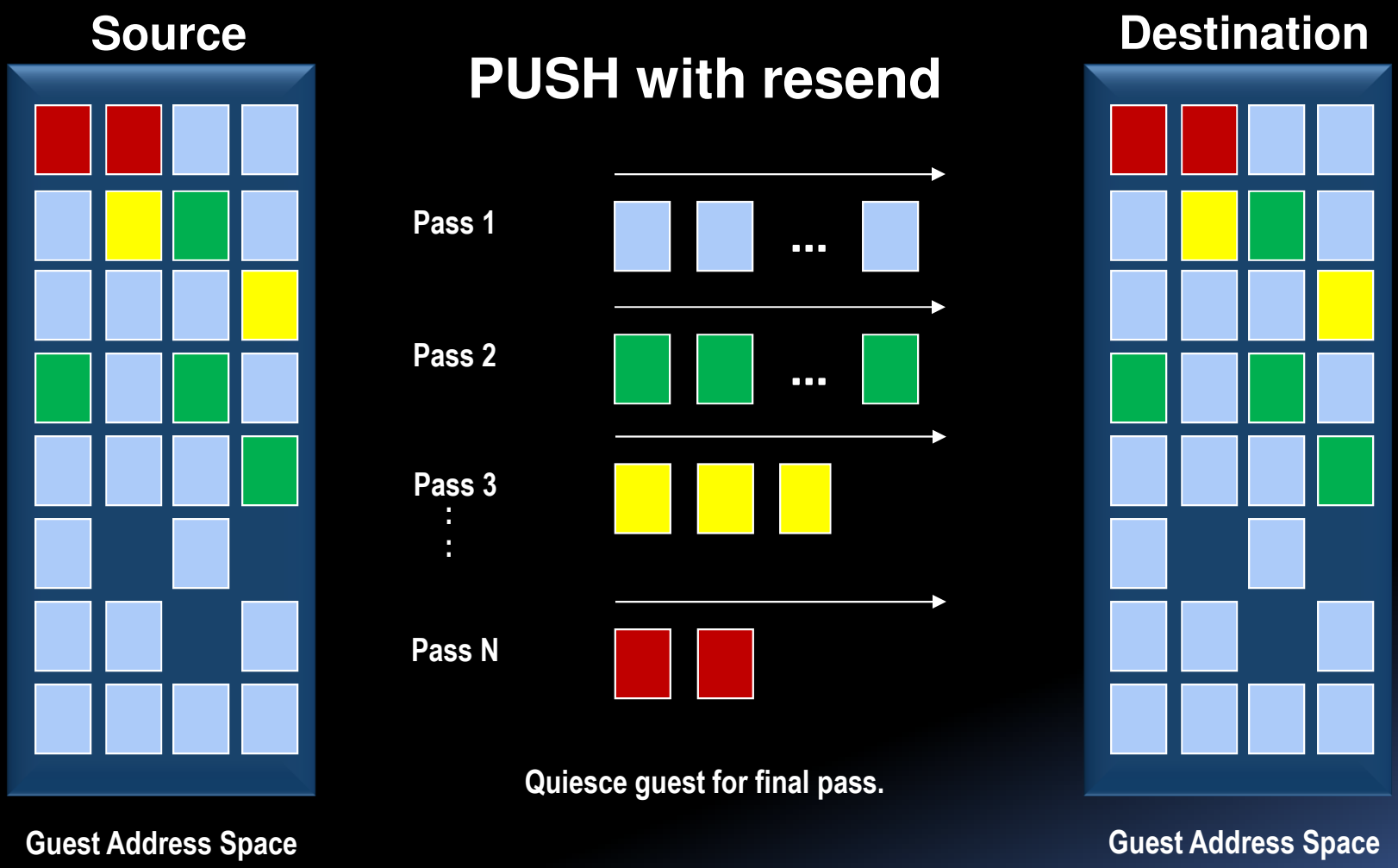
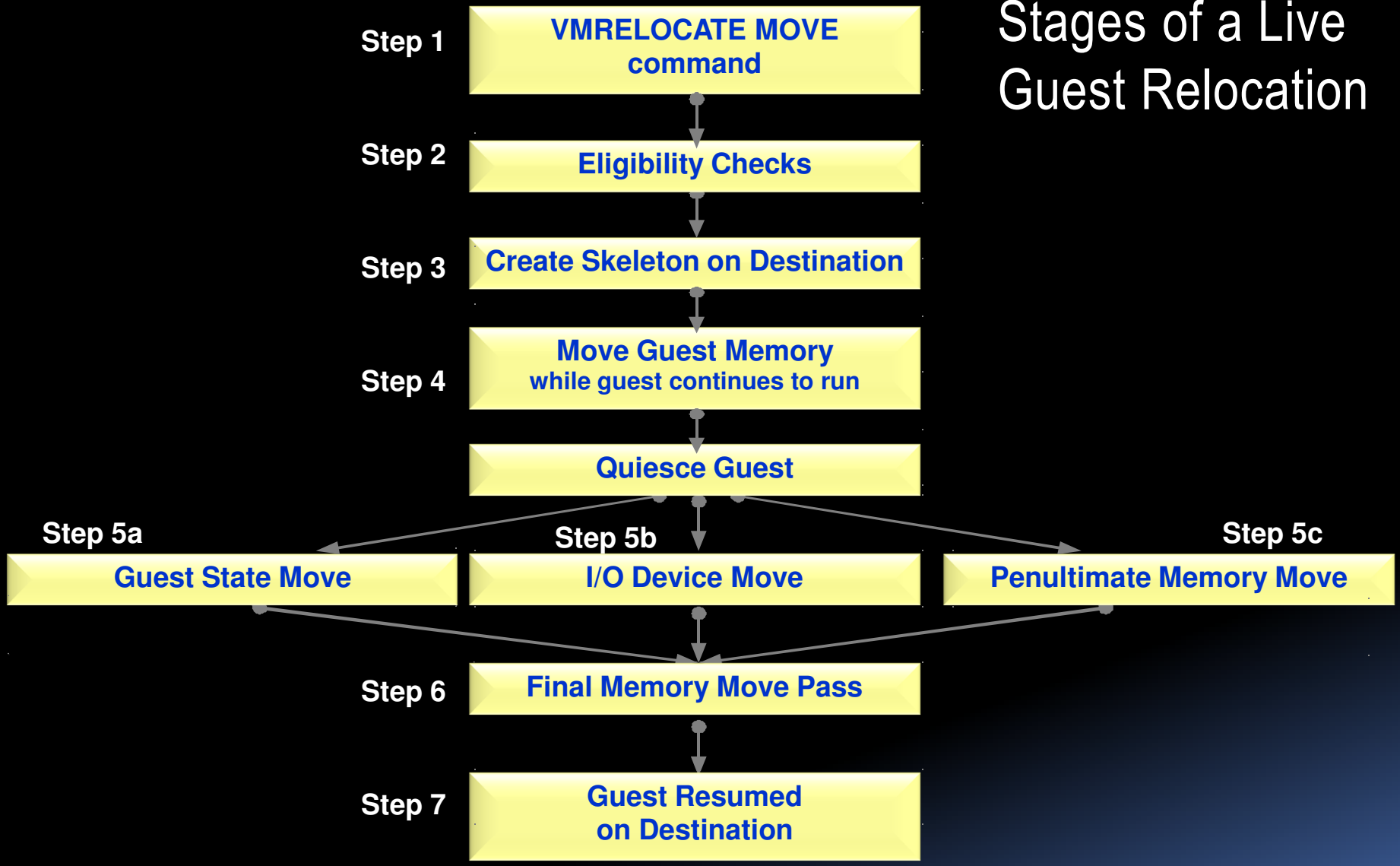


Stages of a Live Guest Relocation



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

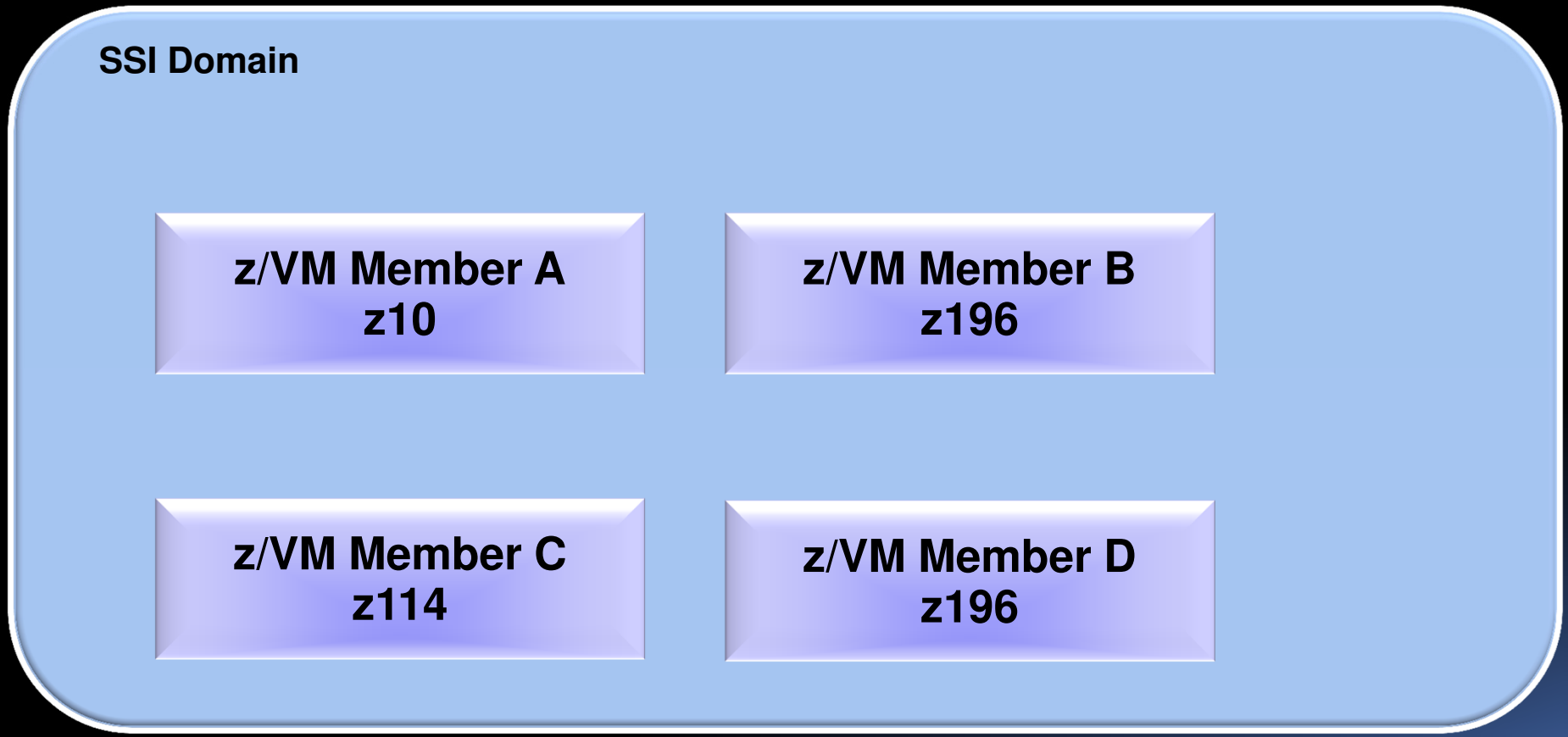
z/VM Member B
z196

z/VM Member C
z114

z/VM Member D
z196

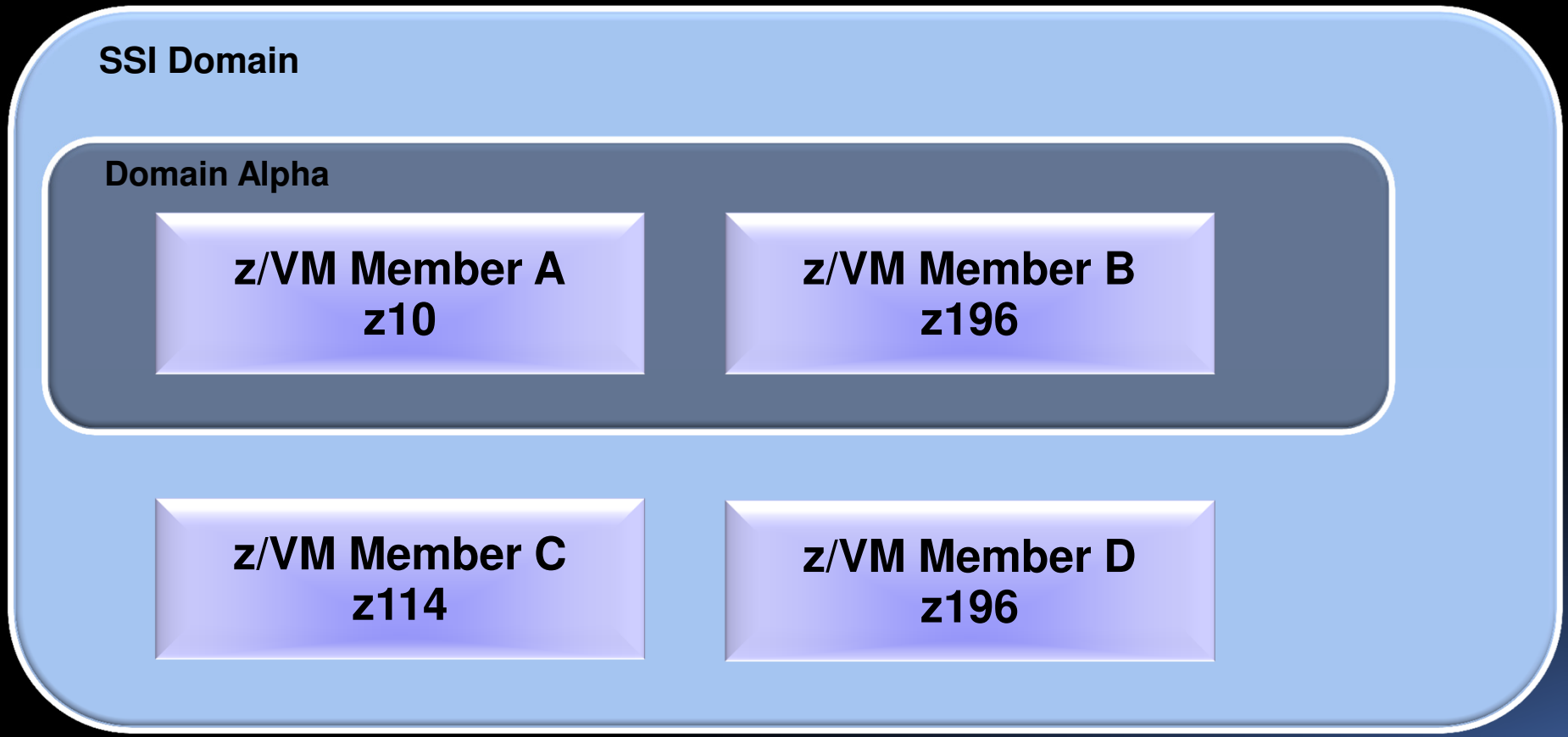
Relocation Domains

- 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.



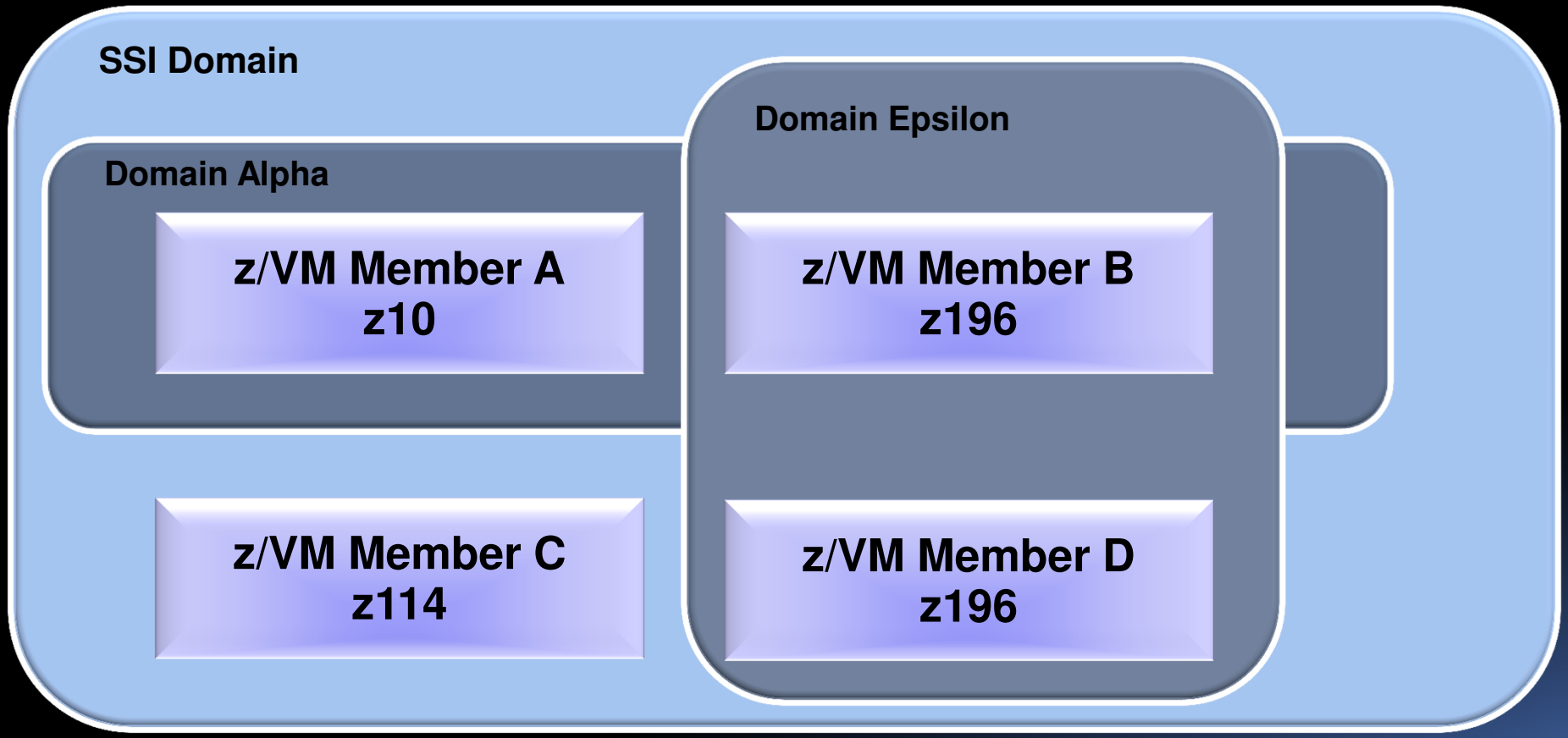
Relocation Domains

- 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.



Relocation Domains

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



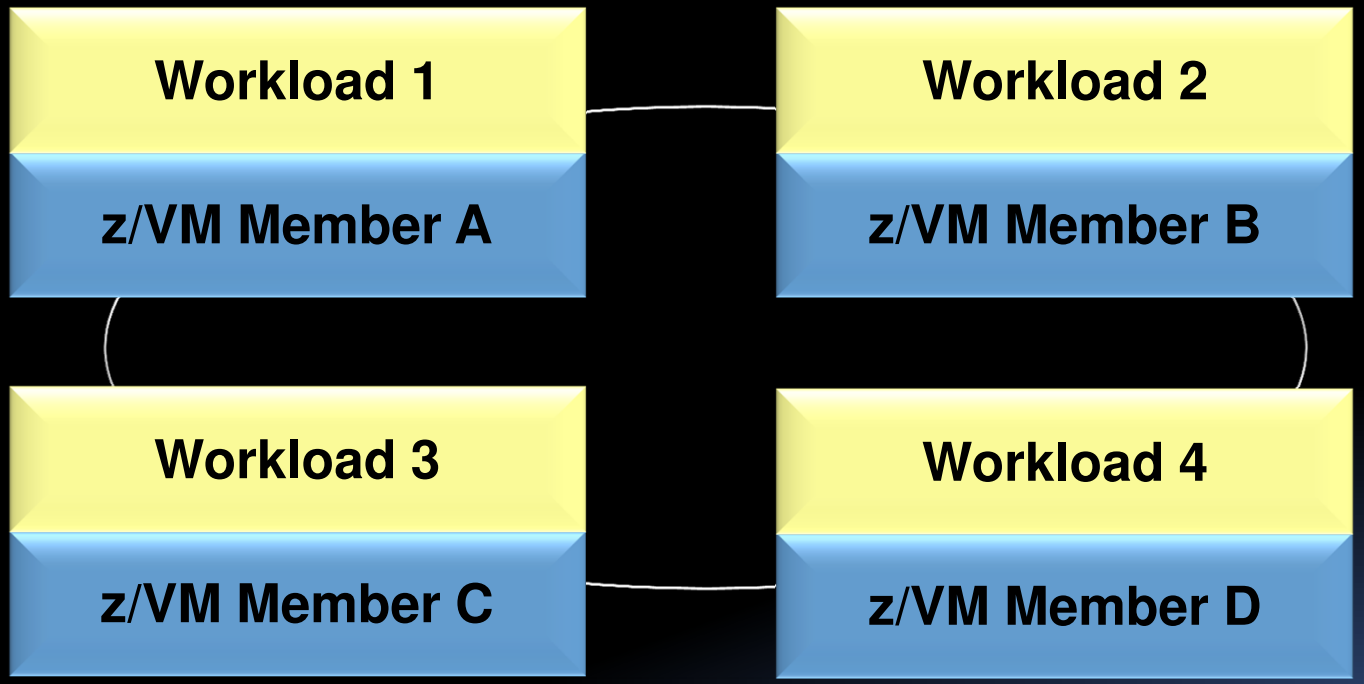
New Possibilities

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. Local Disaster Recover (Business Continuity)
9. Migrate to New Processor

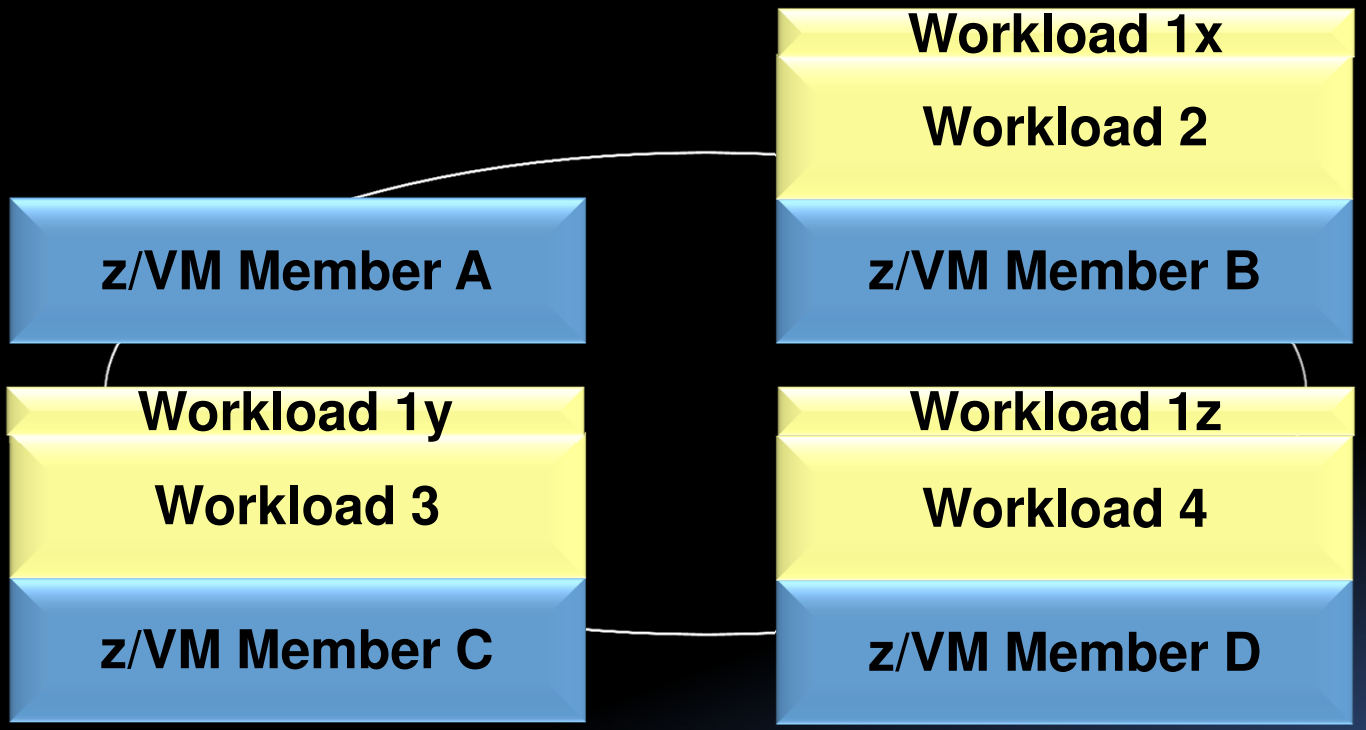
Flexibility for Planned Outages

- 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...



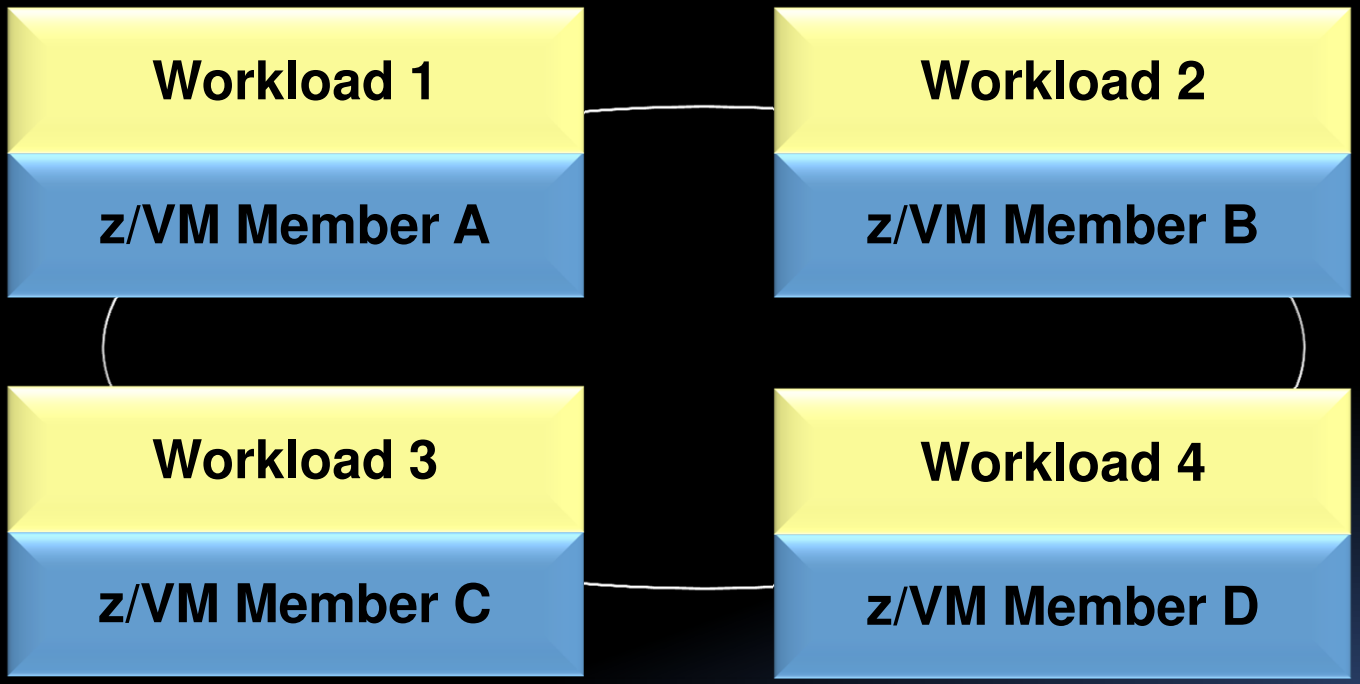
Flexibility for Planned Outages

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.



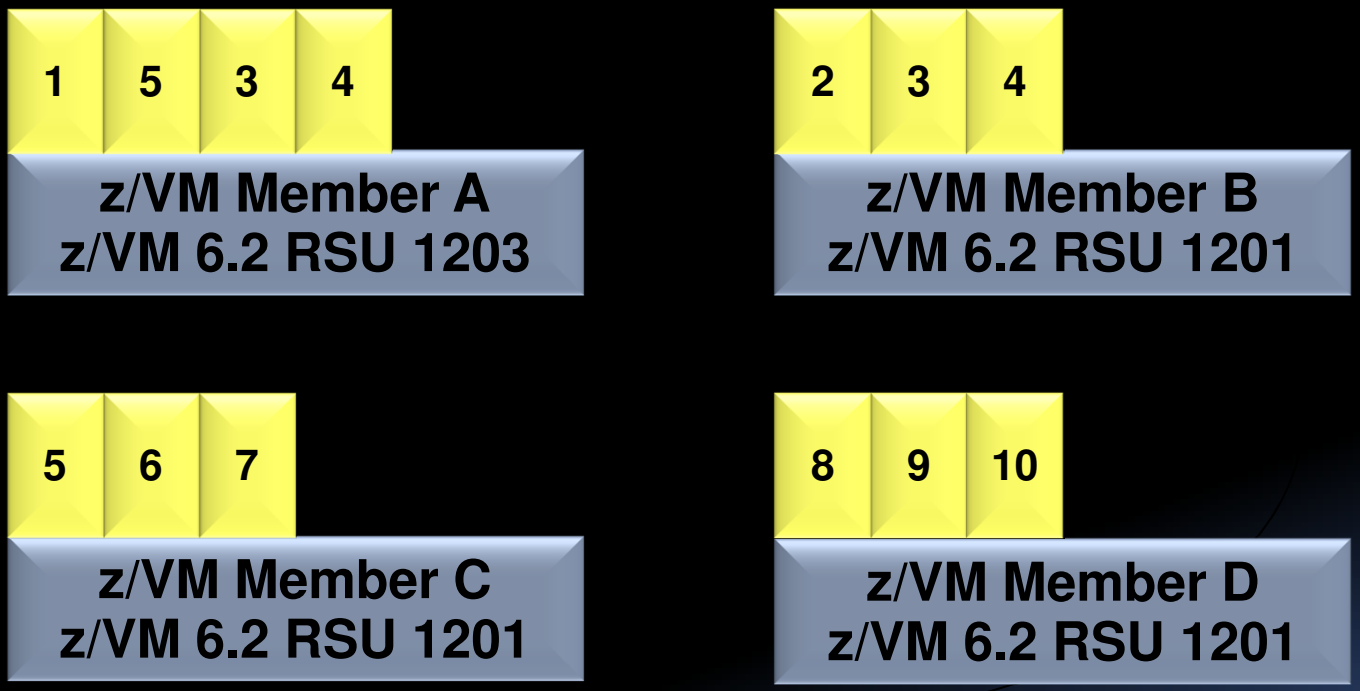
Flexibility for Planned Outages

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.

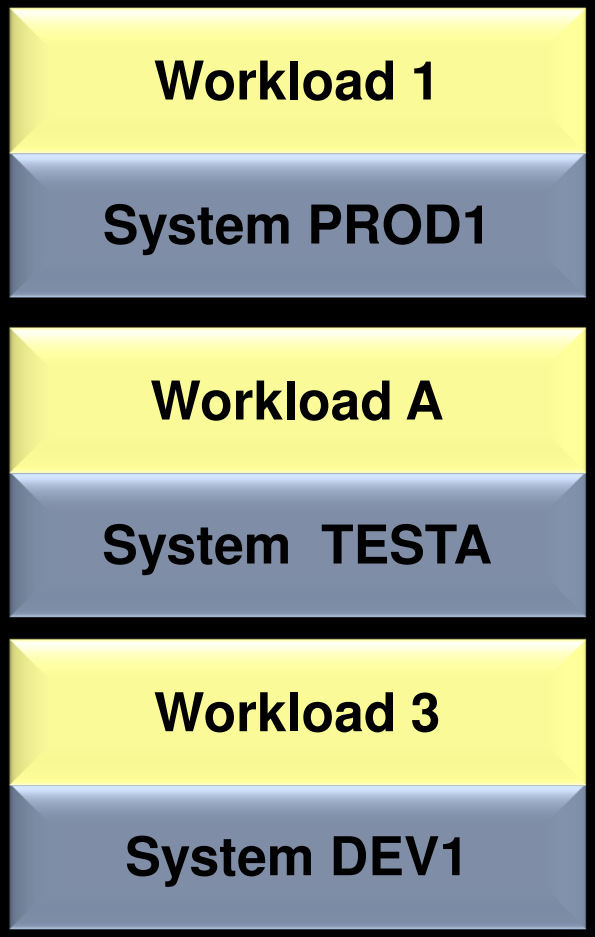


Increased Control Over Server Sprawl

- 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 with 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.

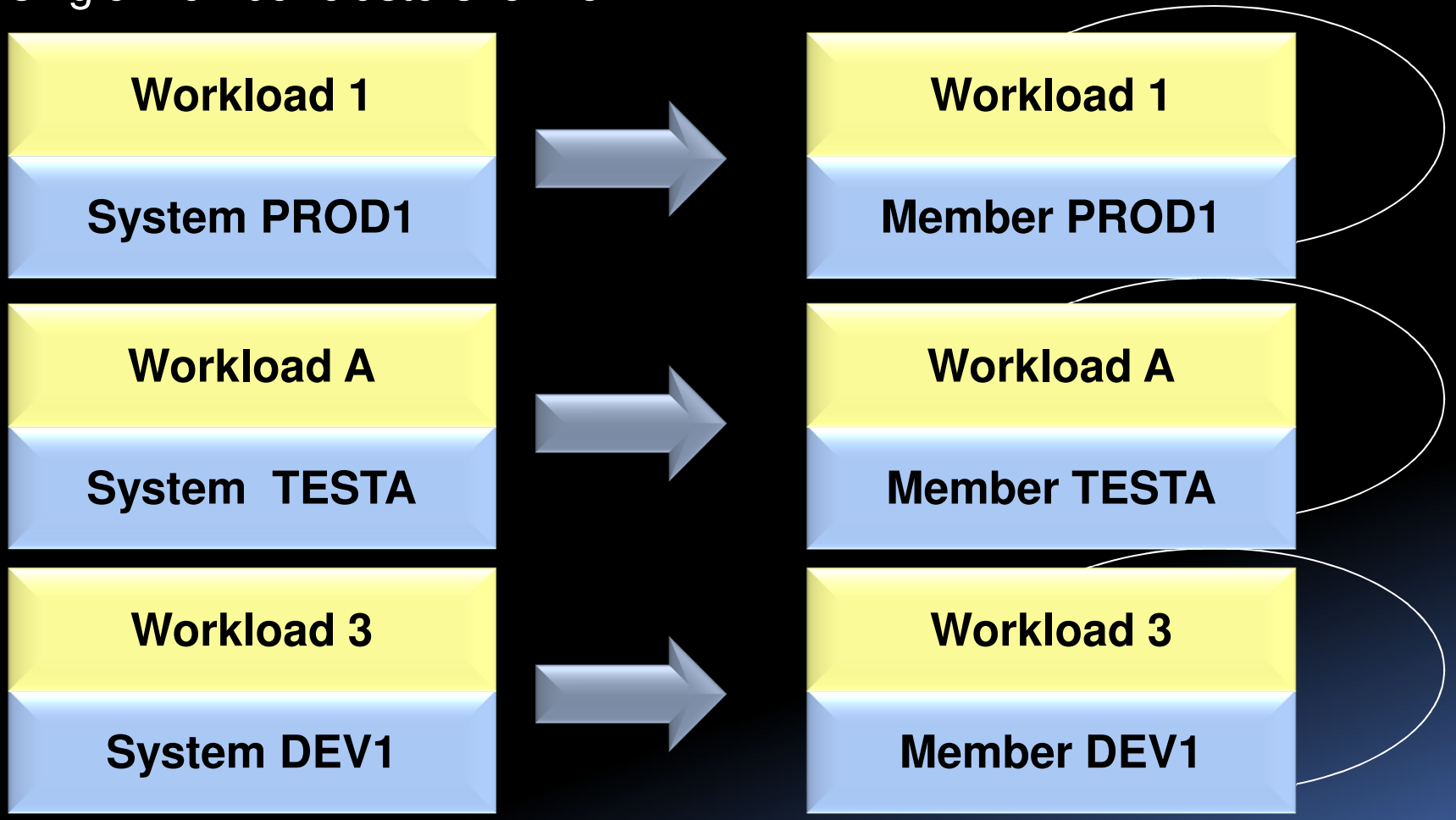
Increased Control Over Server Sprawl

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



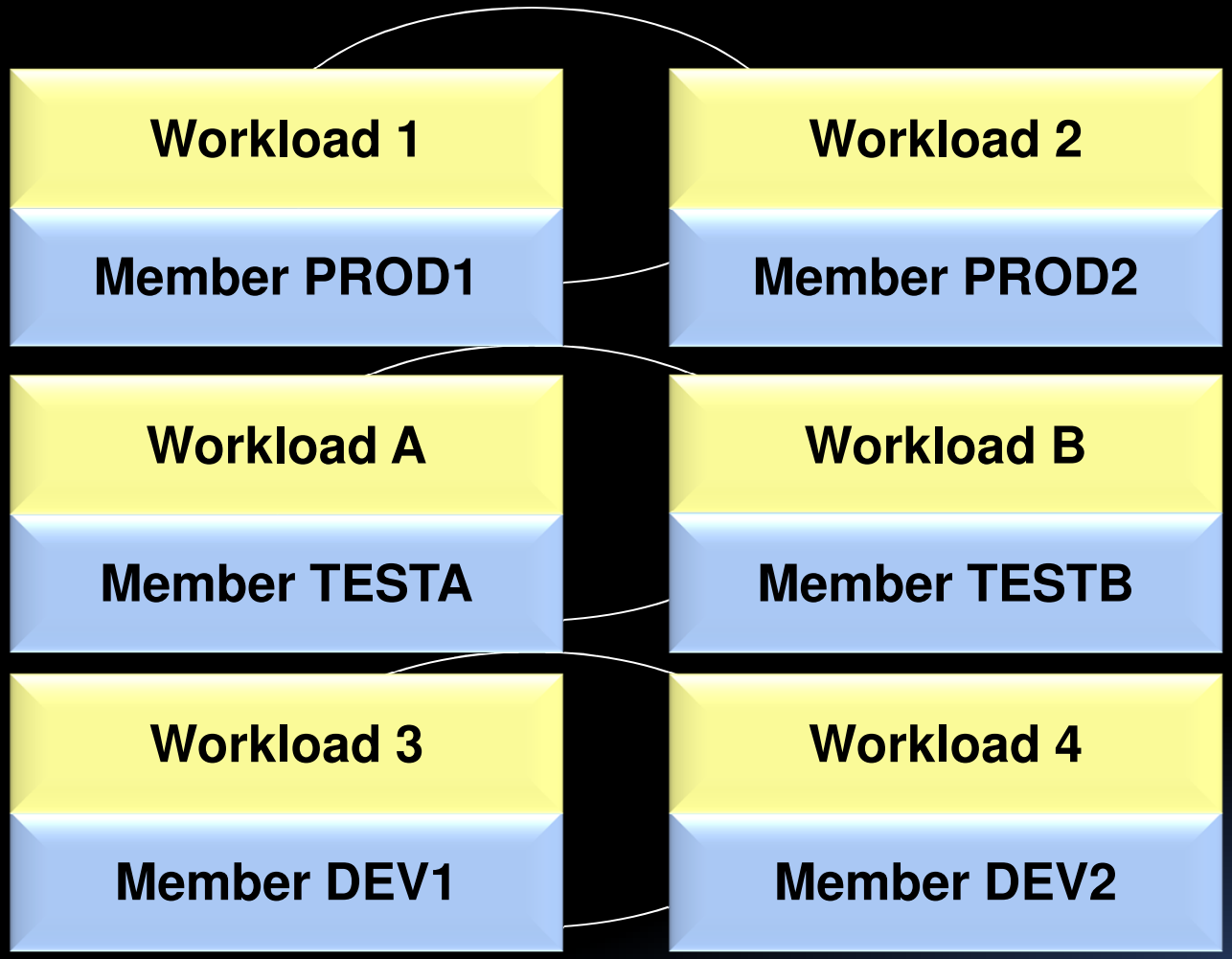
Increased Control Over Server Sprawl

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.

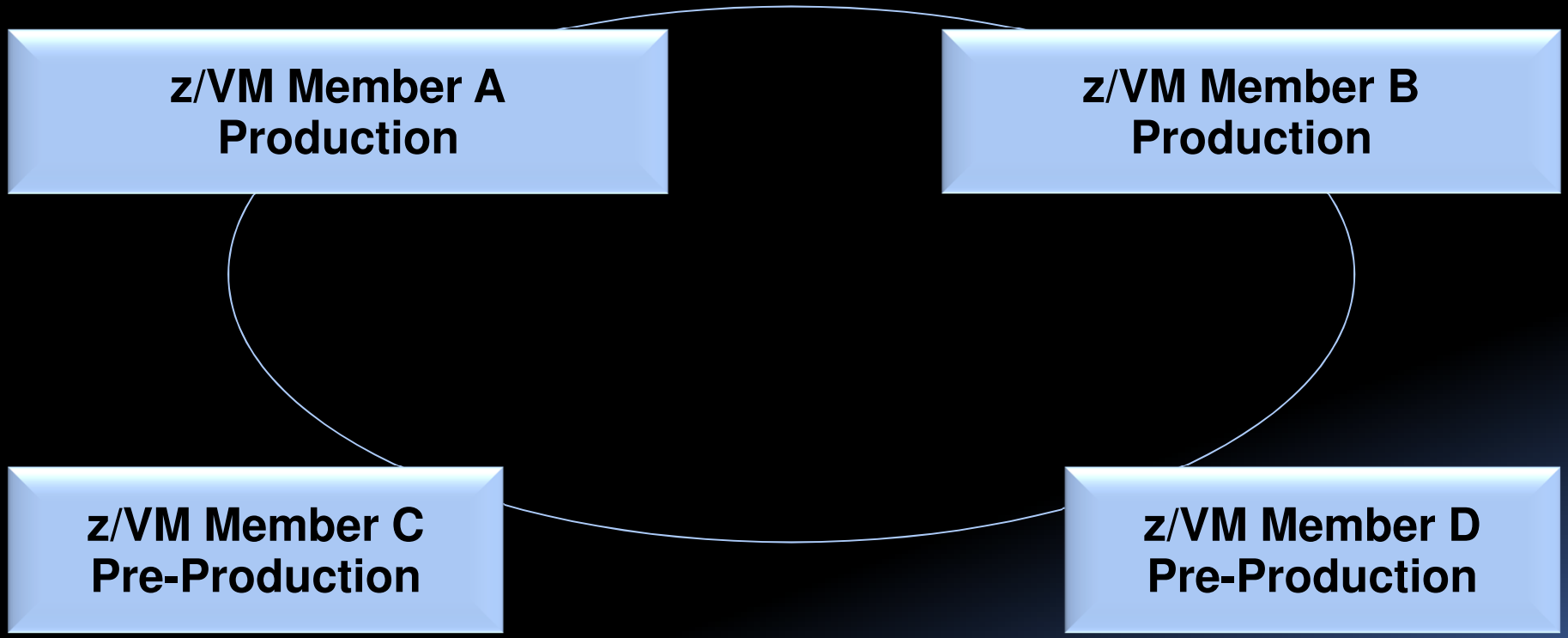


Production with Protection

- 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

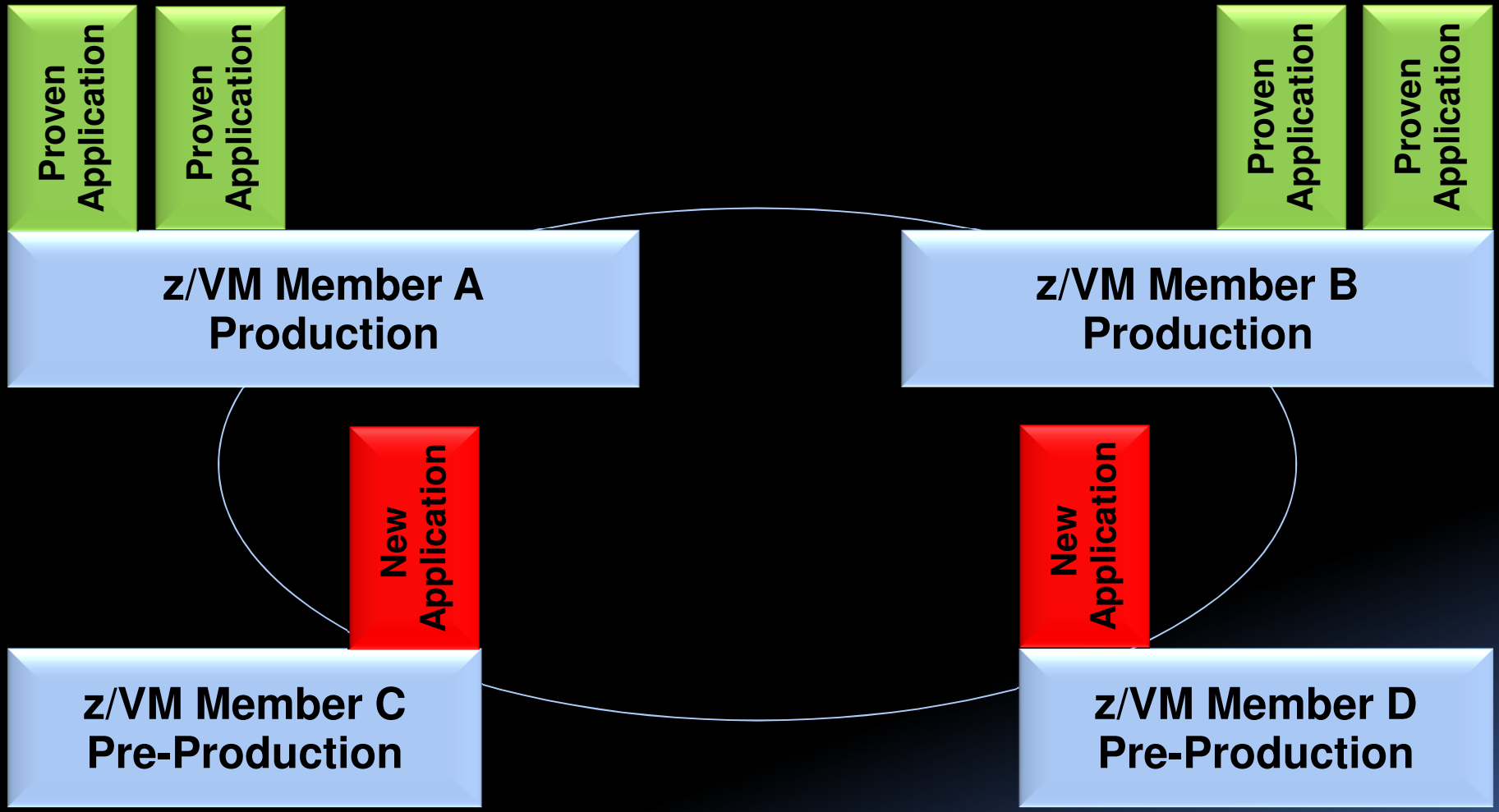
Production with Protection

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



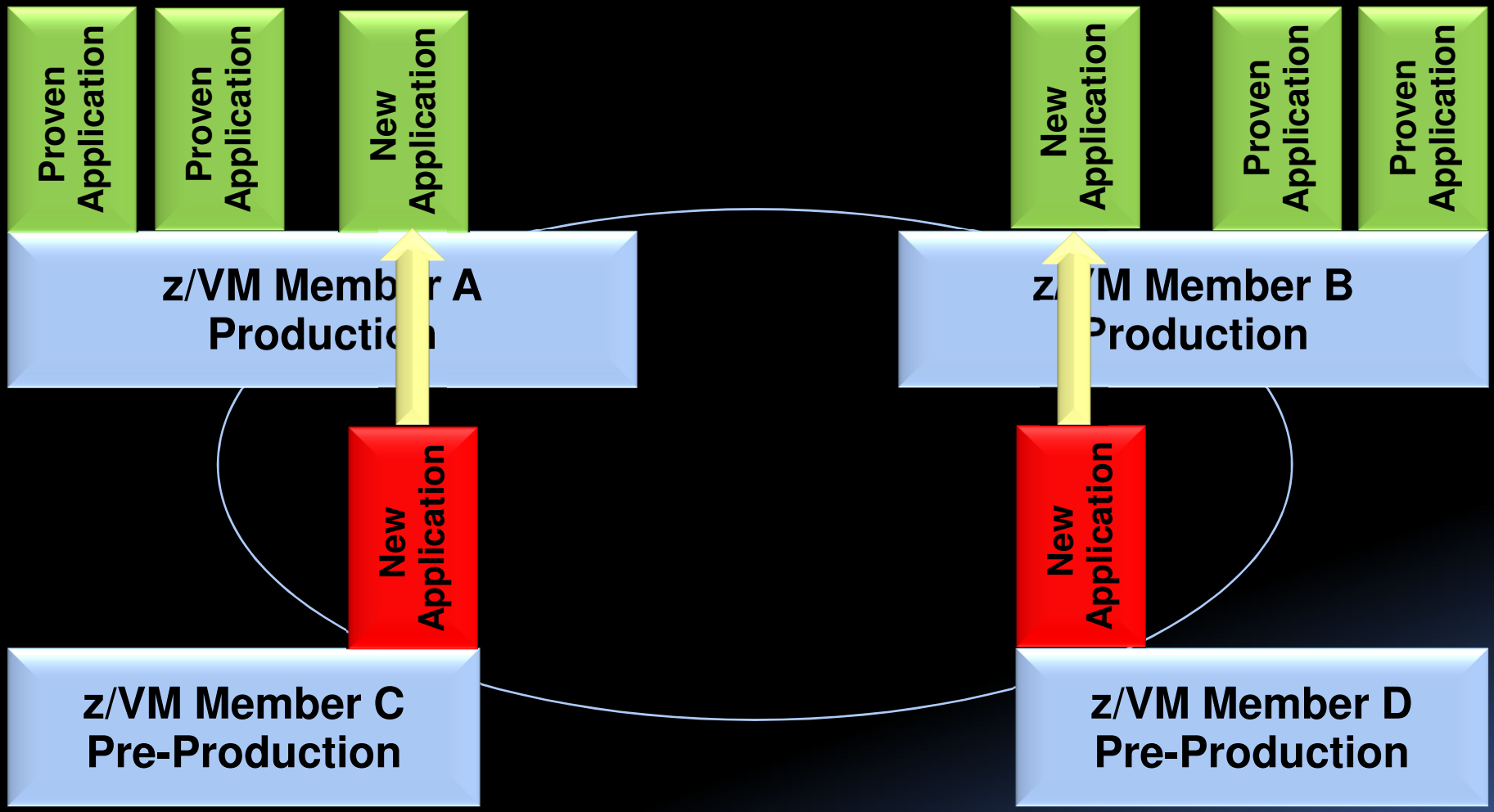
Production with Protection

- Allow new application to run in pre-production LPARs



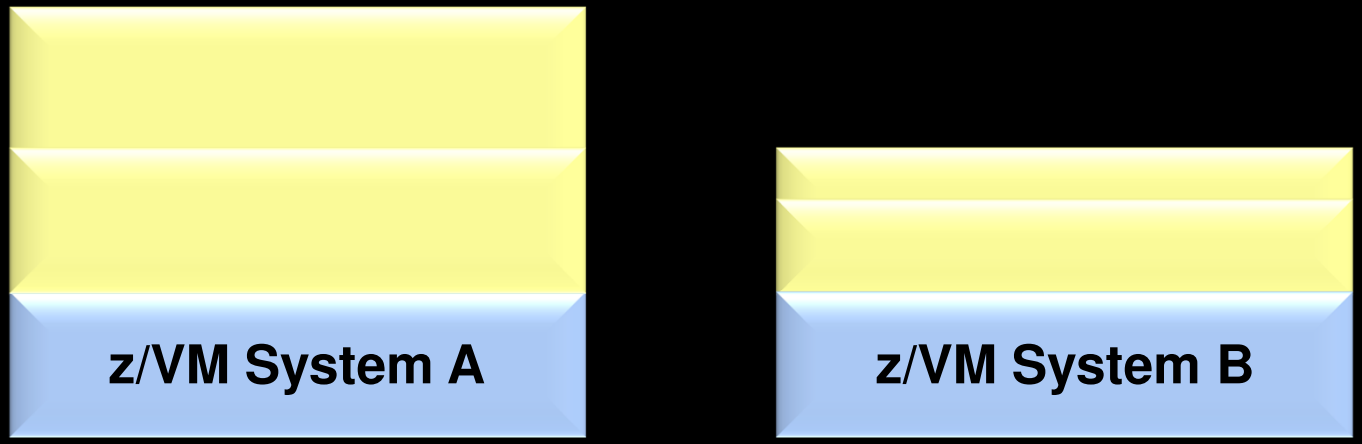
Production with Protection

- 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...



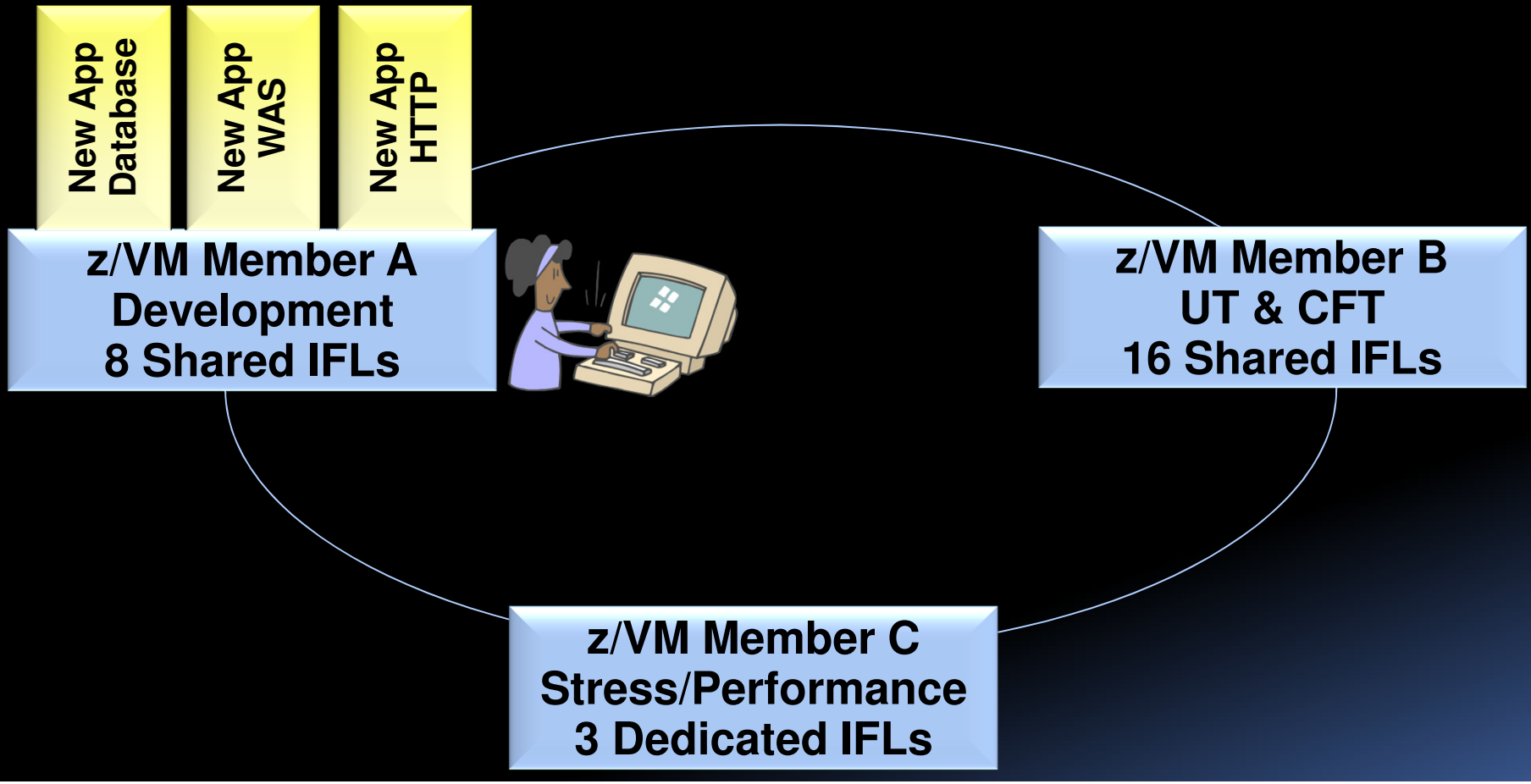
- With individual z/VM systems, one would need to define new virtual machines on B and remove the definitions on A
  - Responsibility of ensuring integrity during process is on shoulders of system programmer.
- With an SSI cluster, one can more easily redistribute the load through logoff/logon or in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

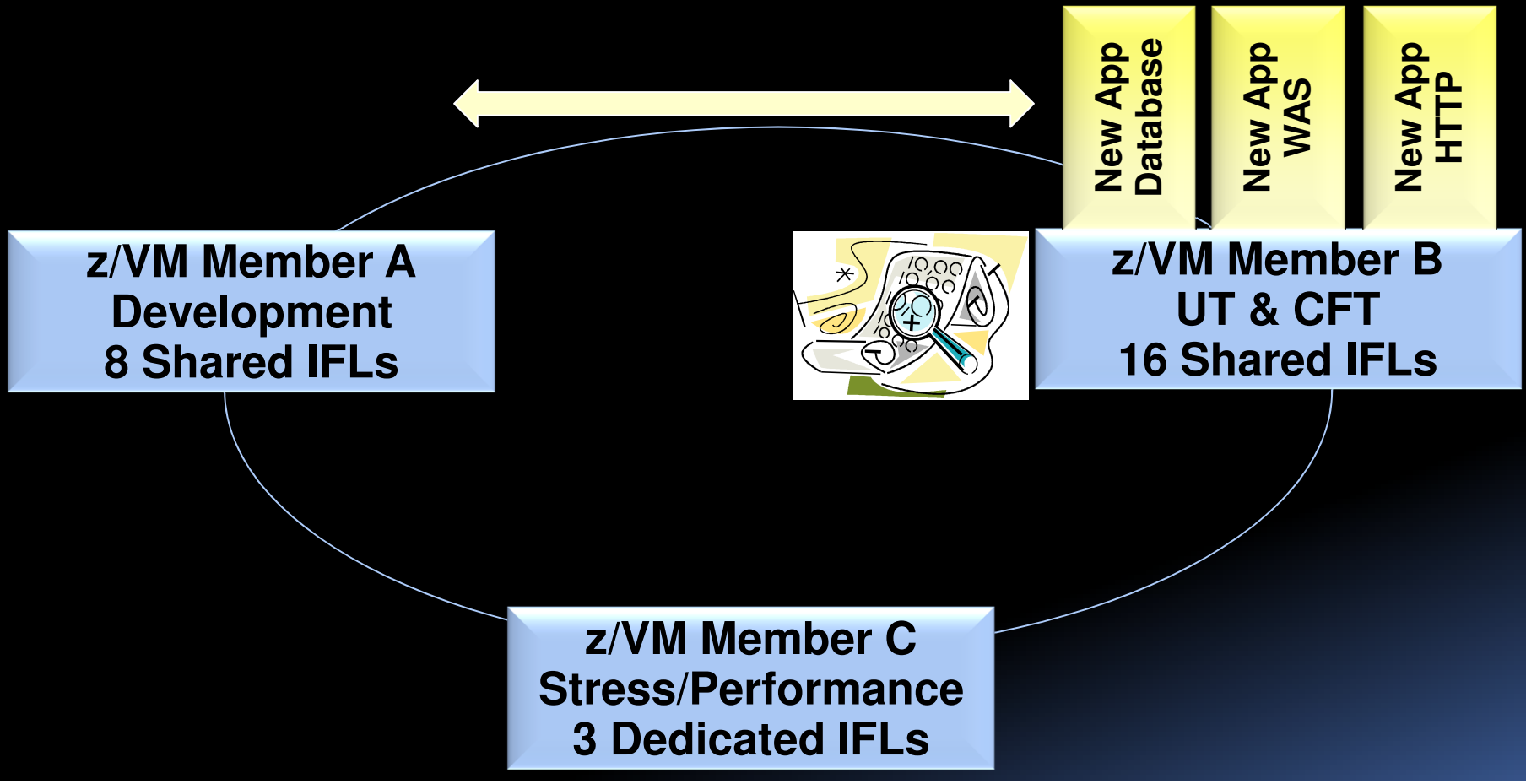
Consistent Test Bed for Stress Tests

- Consider this example with development, unit test, component function test, performance test, and stress tests.
- Build it all in the development member.



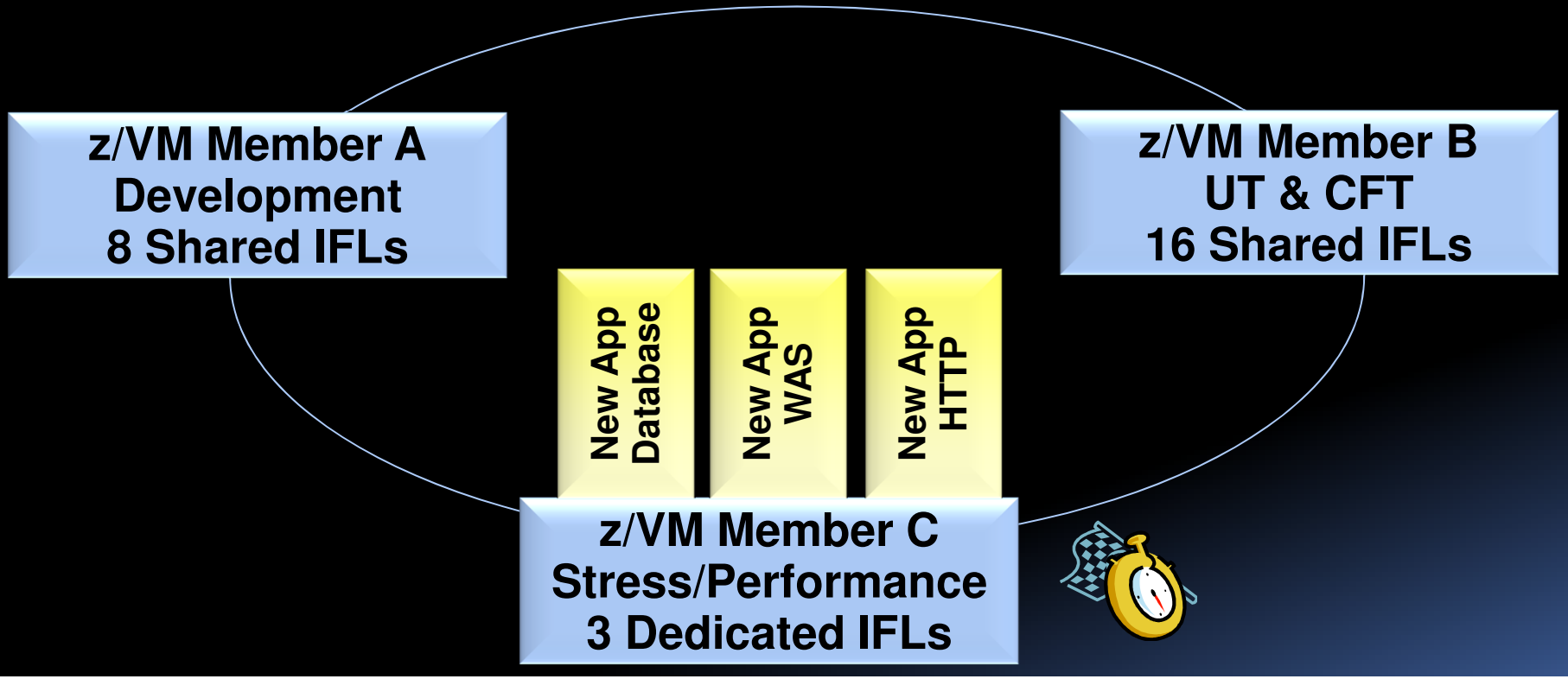
Consistent Test Bed for Stress Tests

- Development and Test could share the virtual machines involved, passing them back and forth between the systems as needed.

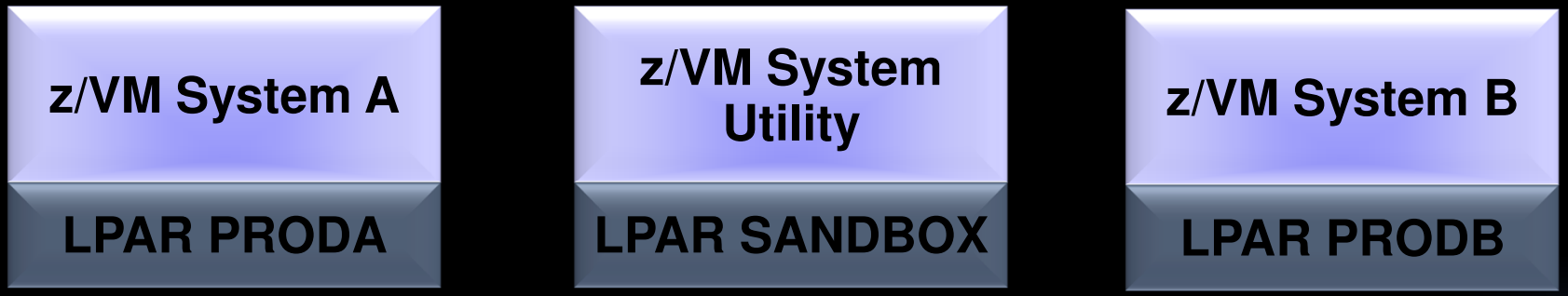


Consistent Test Bed for Stress Tests

- When ready for performance or stress test, move to Member C with Dedicated resources
- More control over what has changed

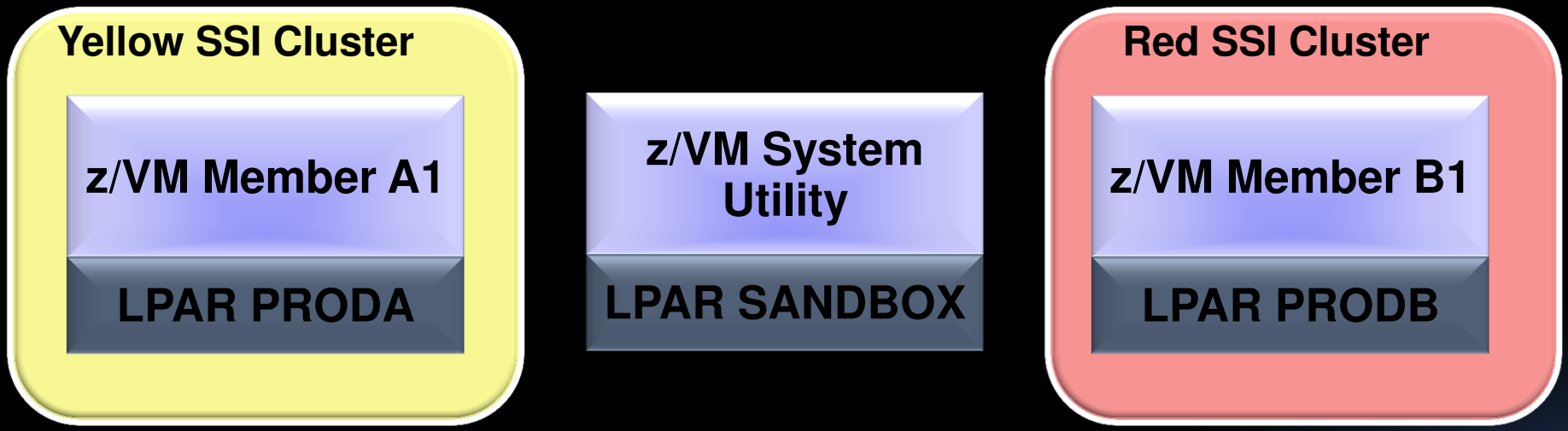


One From the Customers – Utility Migration LPAR



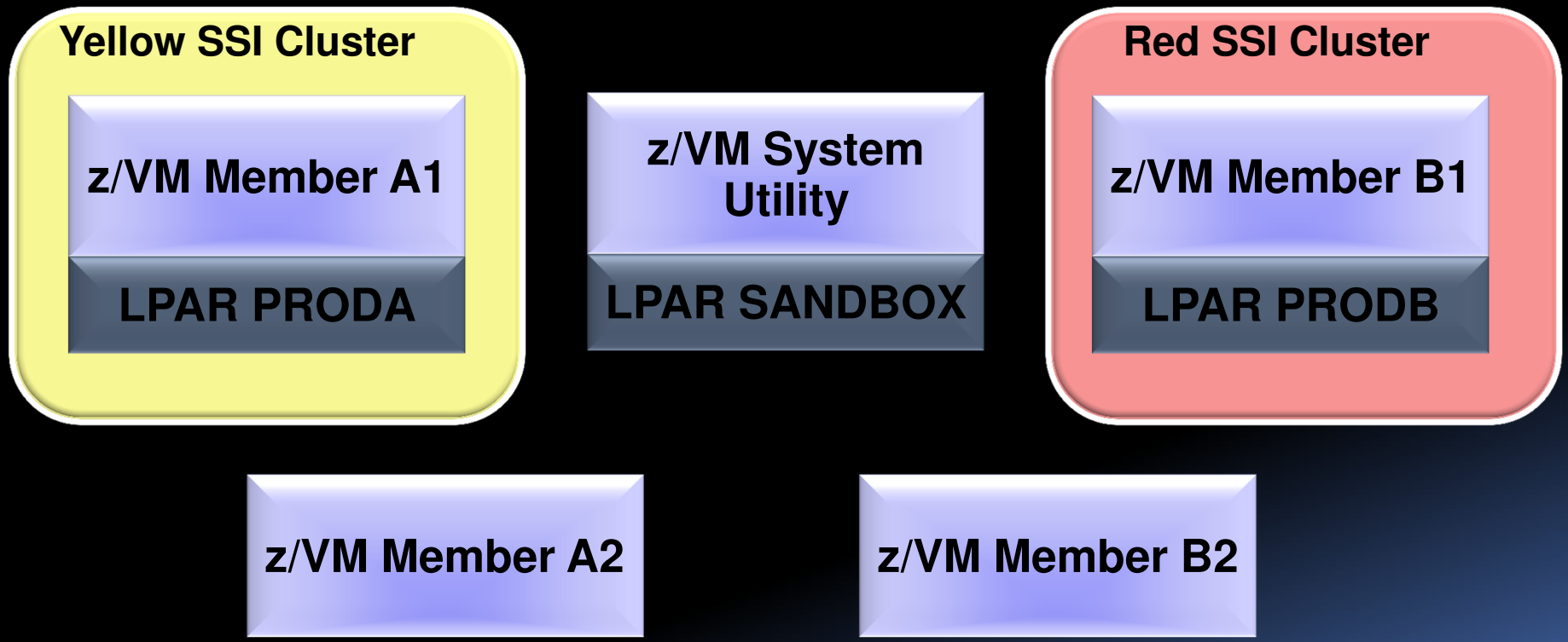
One From the Customers – Utility Migration LPAR

- 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



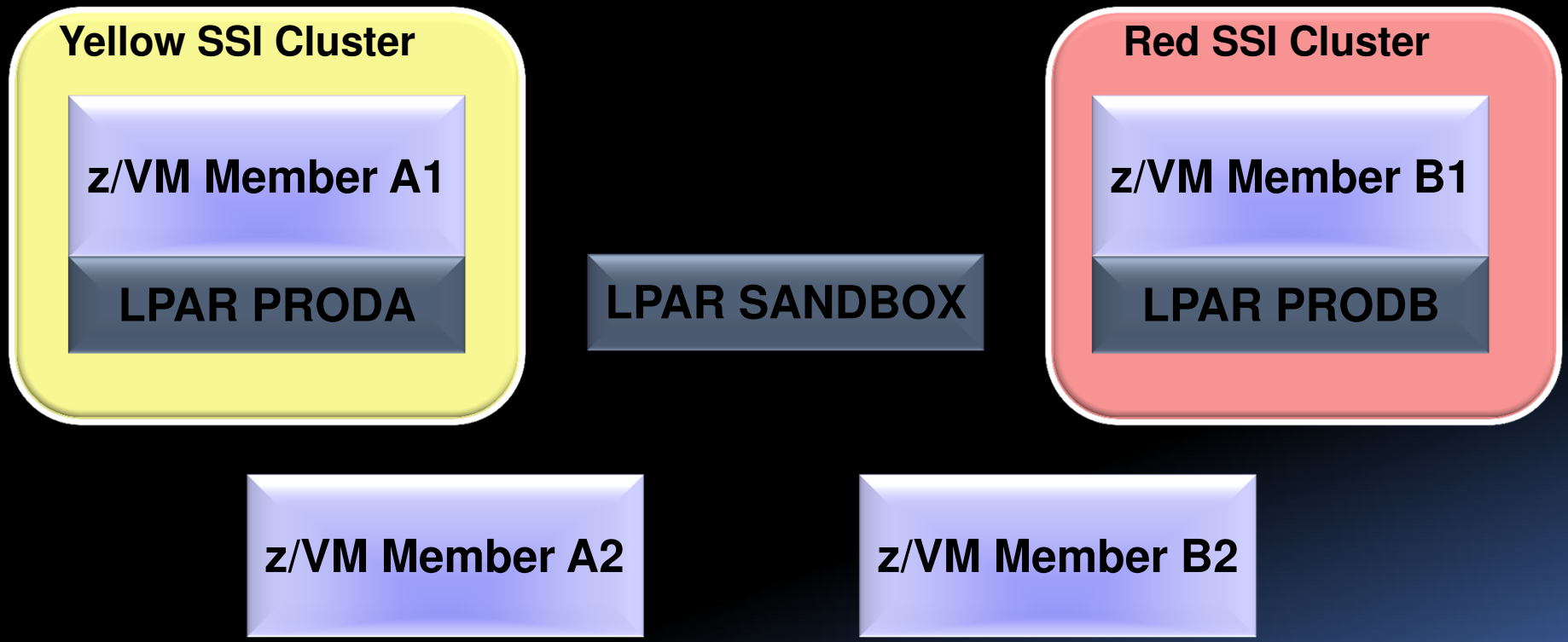
One From the Customers – Utility Migration LPAR

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



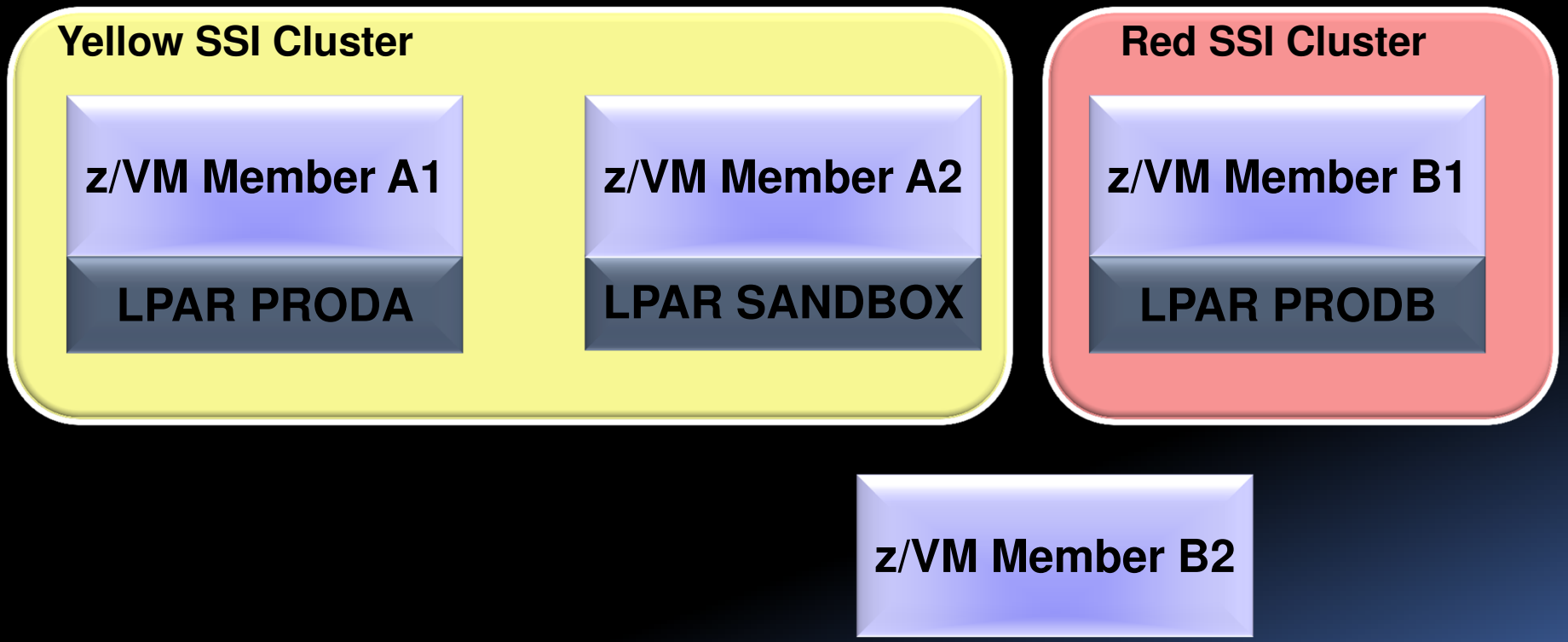
One From the Customers – Utility Migration LPAR

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



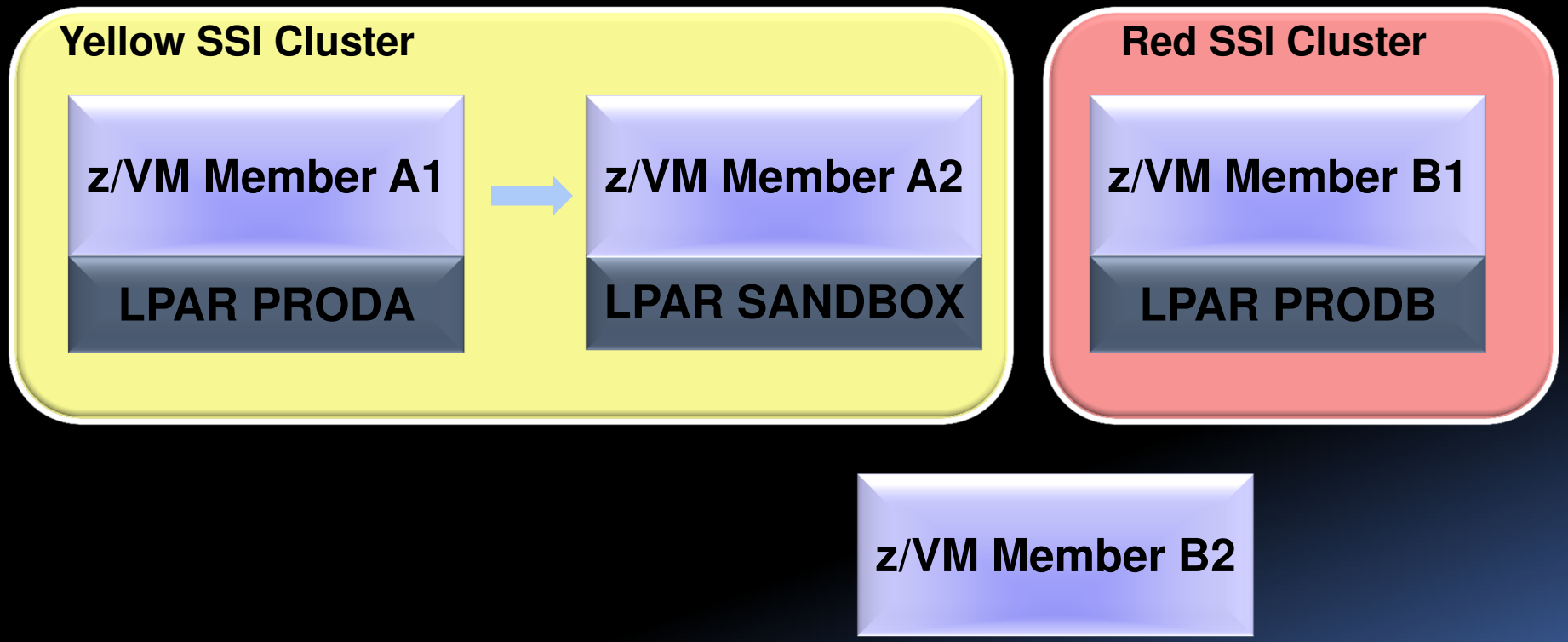
One From the Customers – Utility Migration LPAR

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



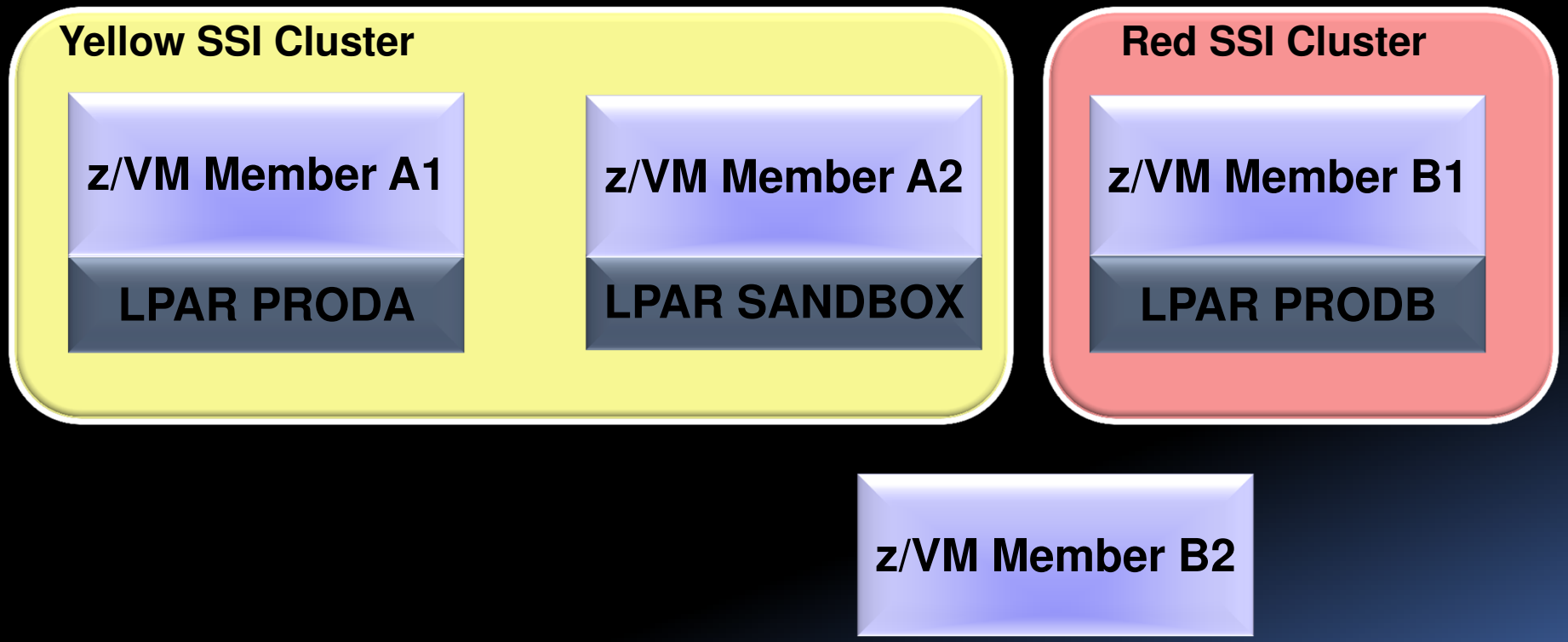
One From the Customers – Utility Migration LPAR

- 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



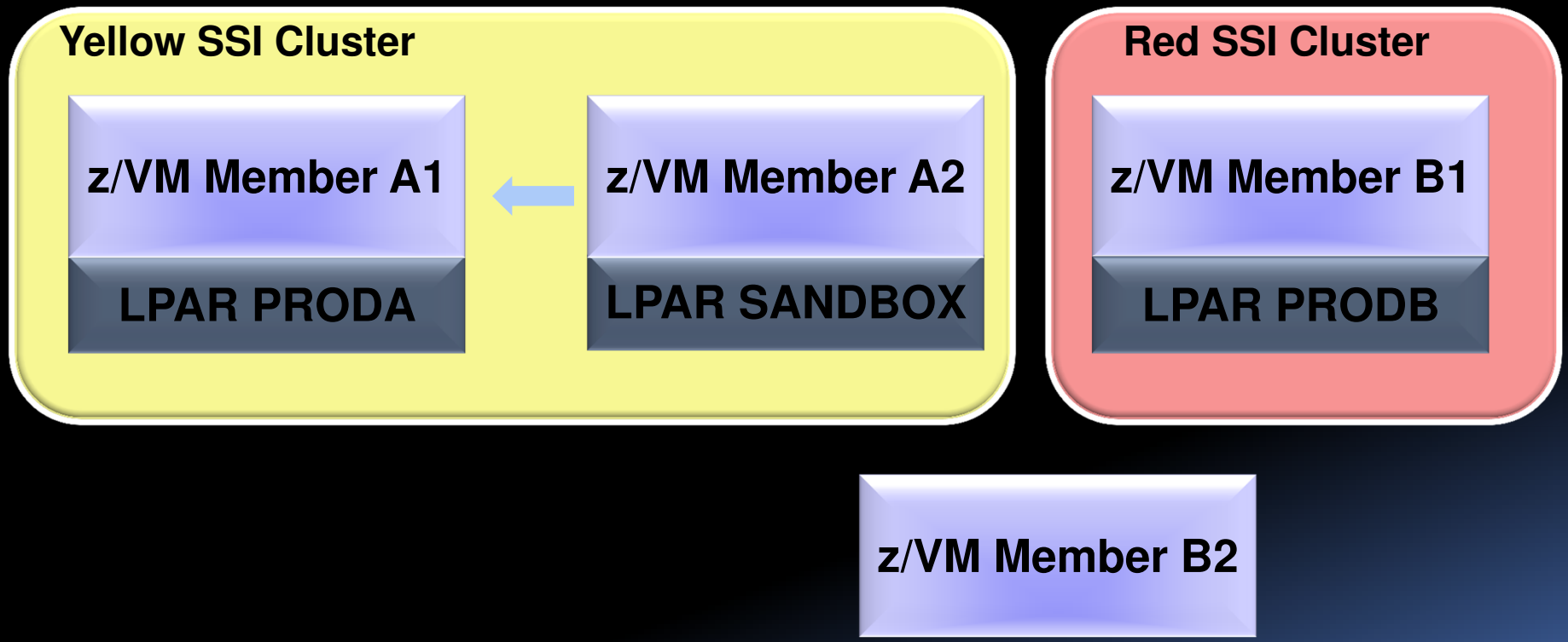
One From the Customers – Utility Migration LPAR

- 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



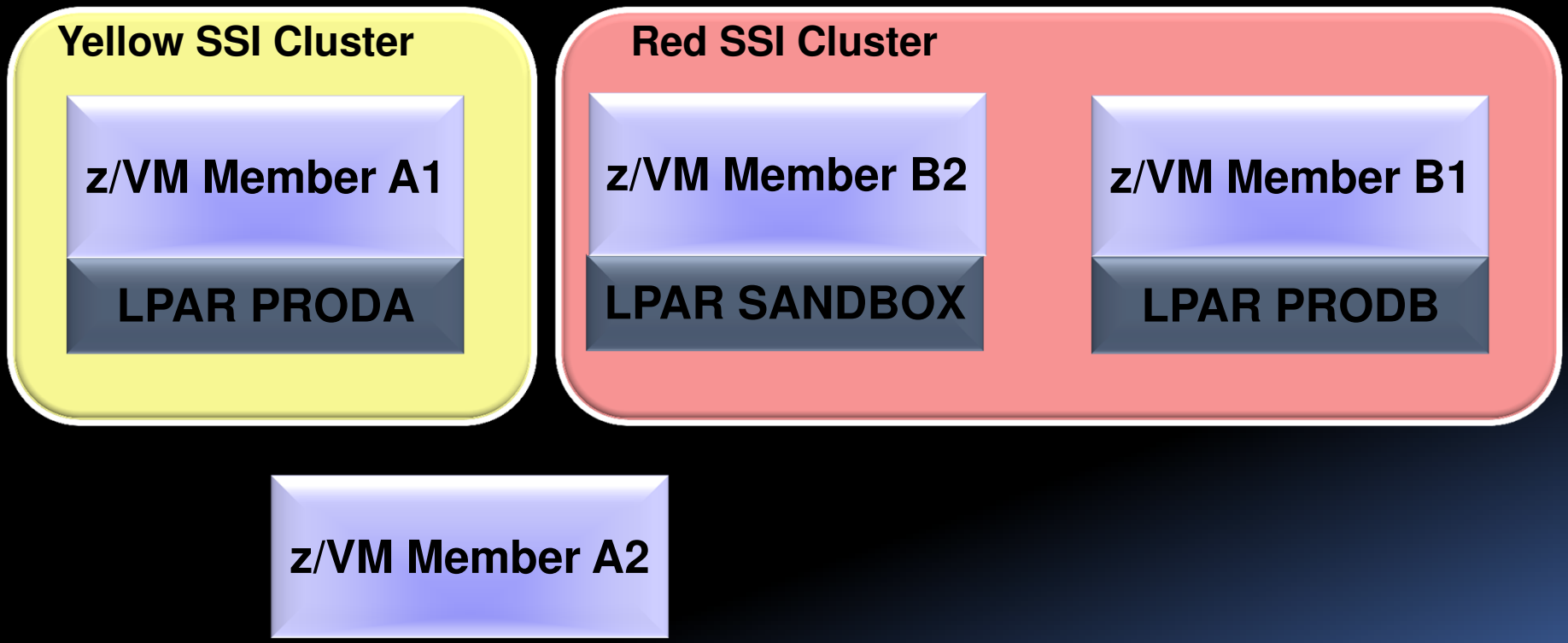
One From the Customers – Utility Migration LPAR

- 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



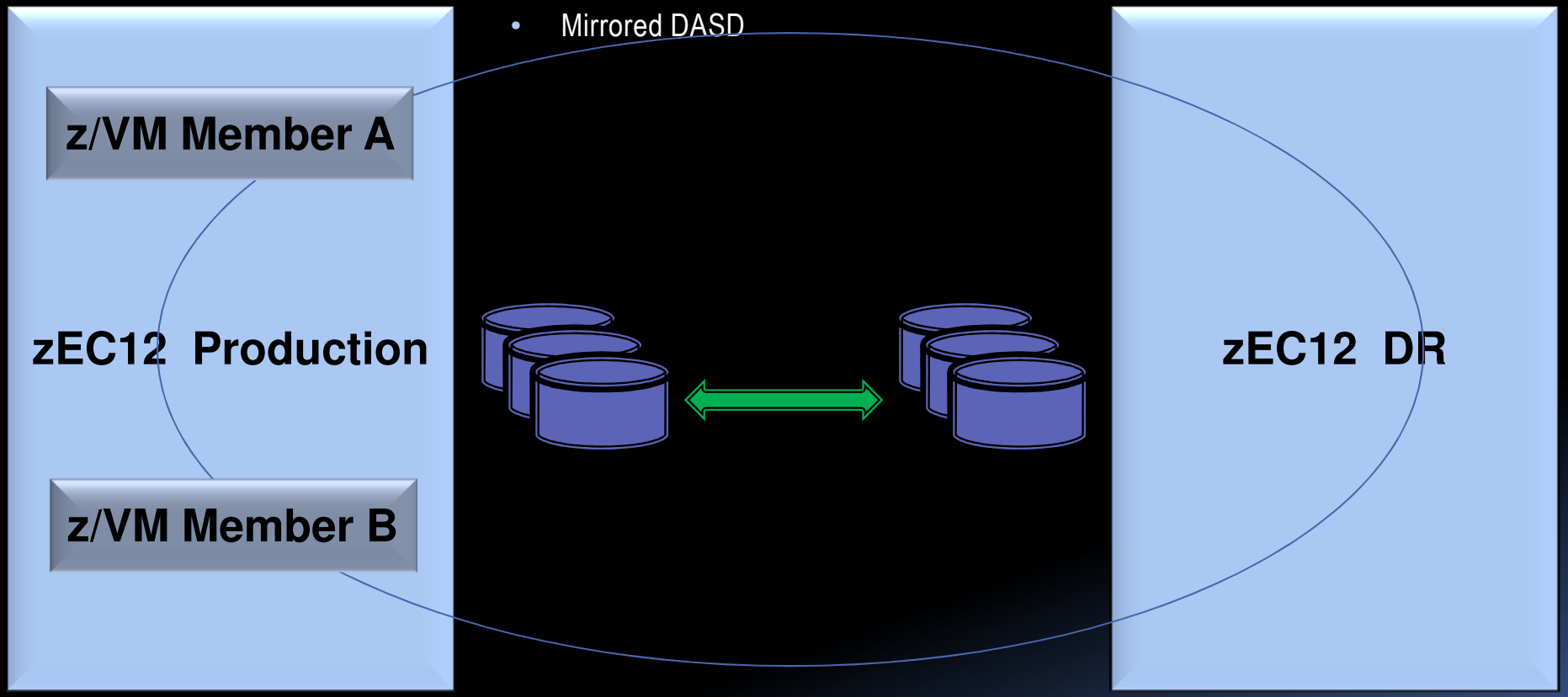
One From the Customers – Utility Migration LPAR

- Repeat on Red SSI Cluster



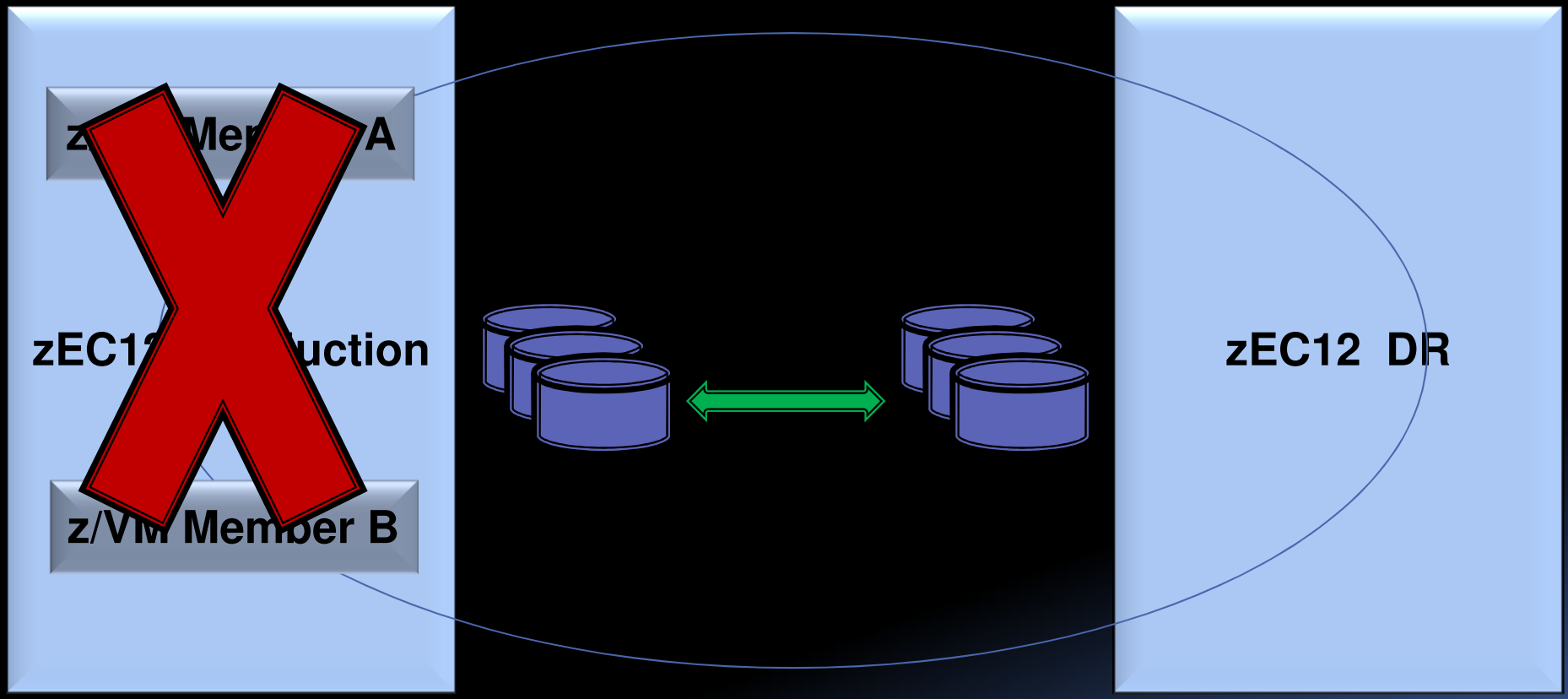
Local Disaster Recovery (Business Continuity)

- Four Members Defined:
  - 2 Members active in production (A & B)
  - 2 Members standby in DR (C & D)
  - Mirrored DASD



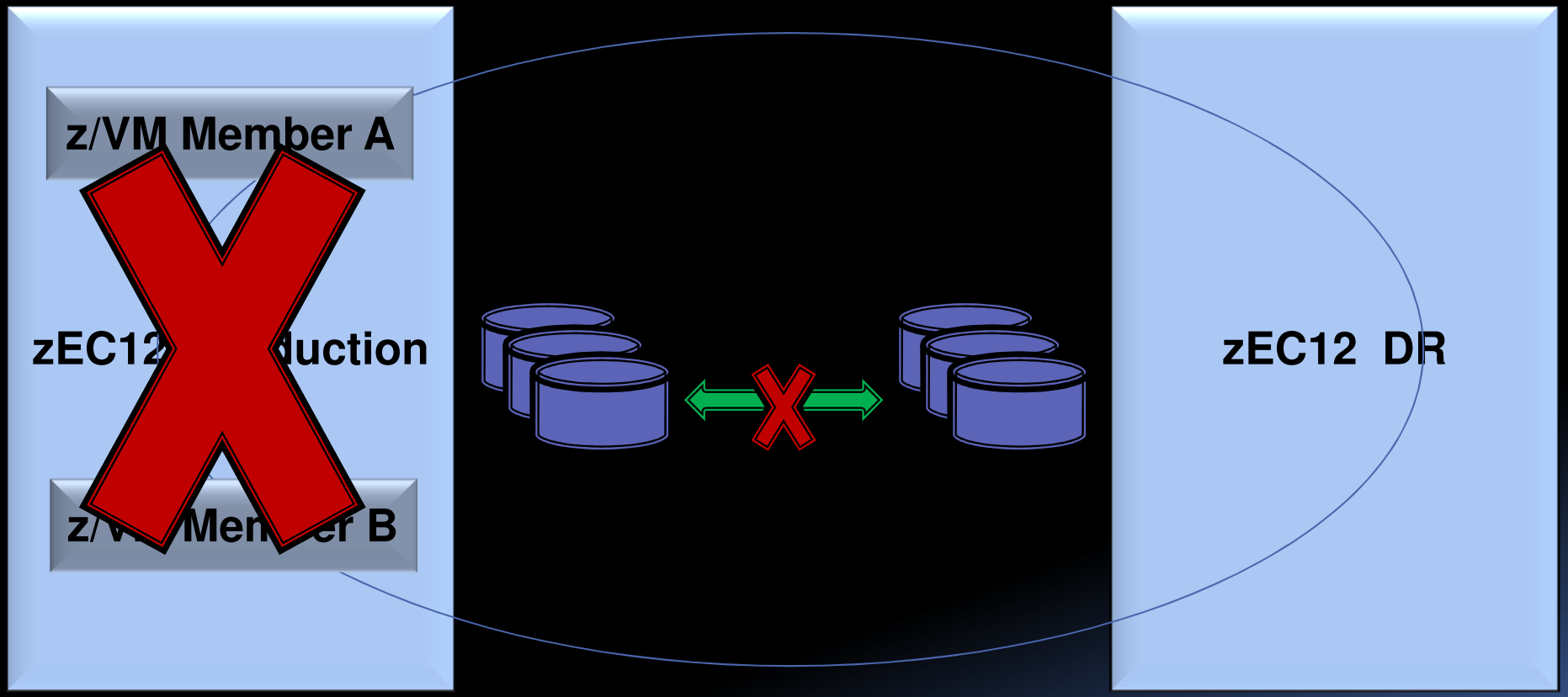
Local Disaster Recovery (Business Continuity)

- Assume Production Side goes down



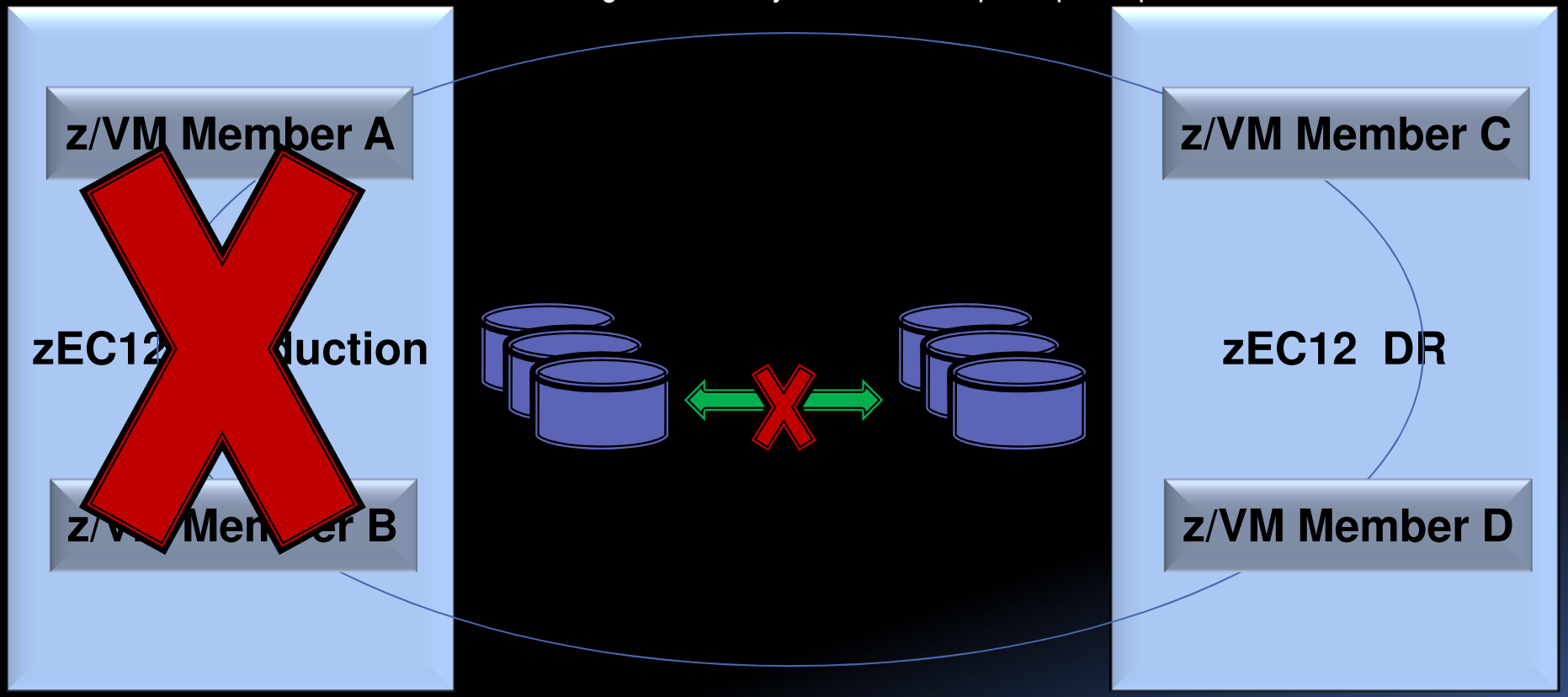
Local Disaster Recovery (Business Continuity)

- Assume Production Side goes down
- Sever mirroring of DASD



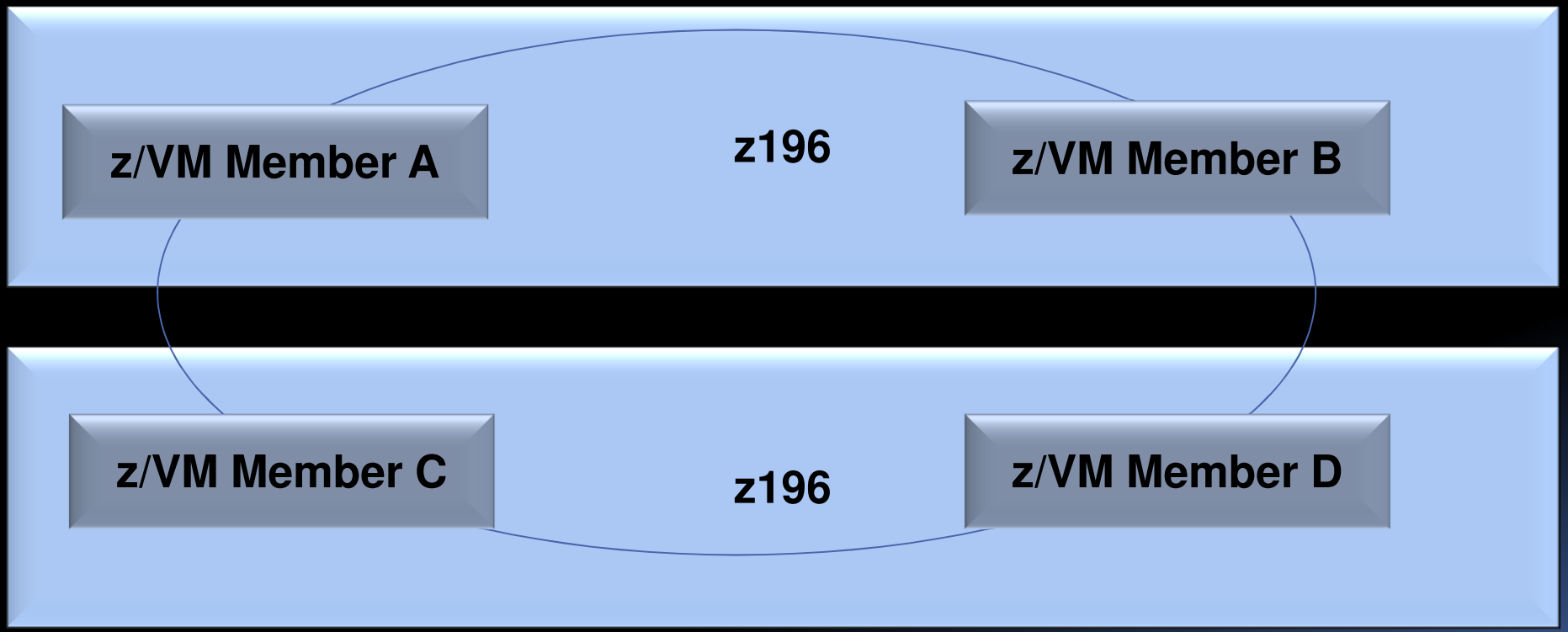
Local Disaster Recovery (Business Continuity)

- Bring up Member C & D
- Logon virtual machines (shared directory)
- Not a High Availability Solution, but perhaps helpful.



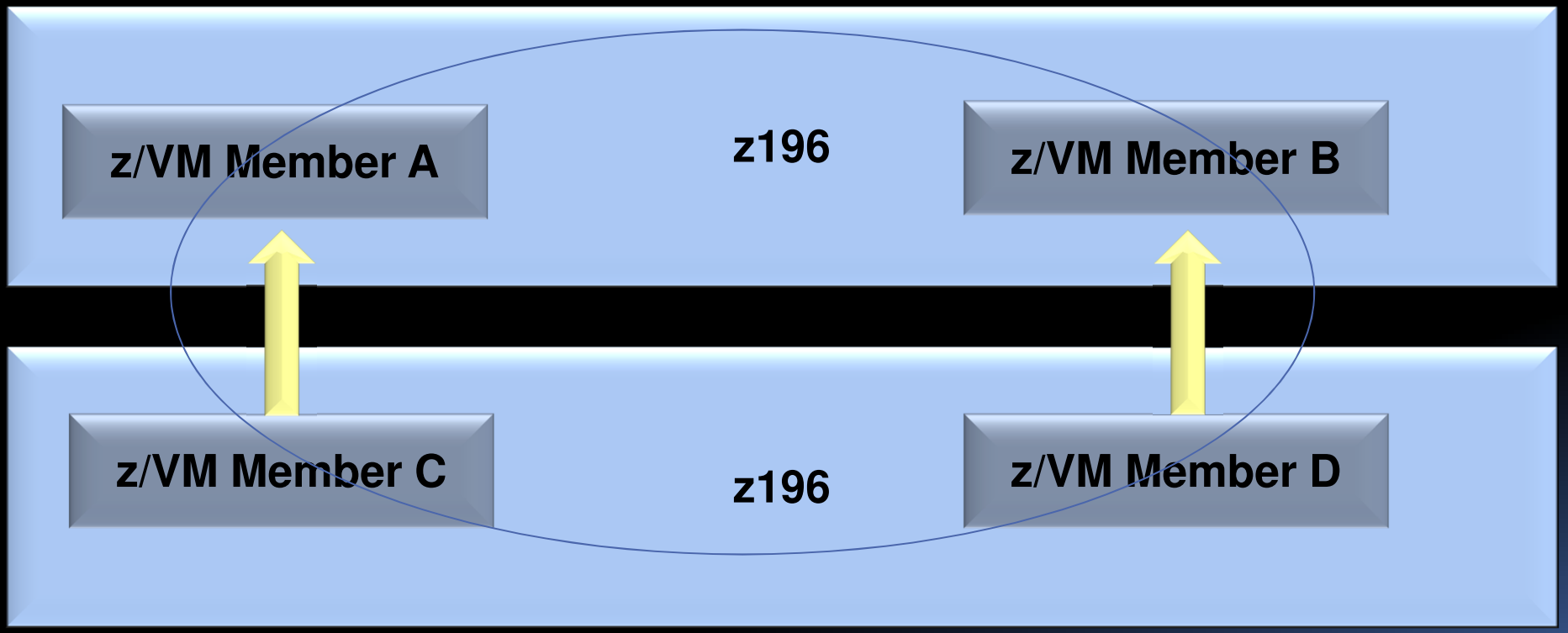
Migrate to New Processors

- Four Members Defined:
  - 2 Members on each of 2 CECs



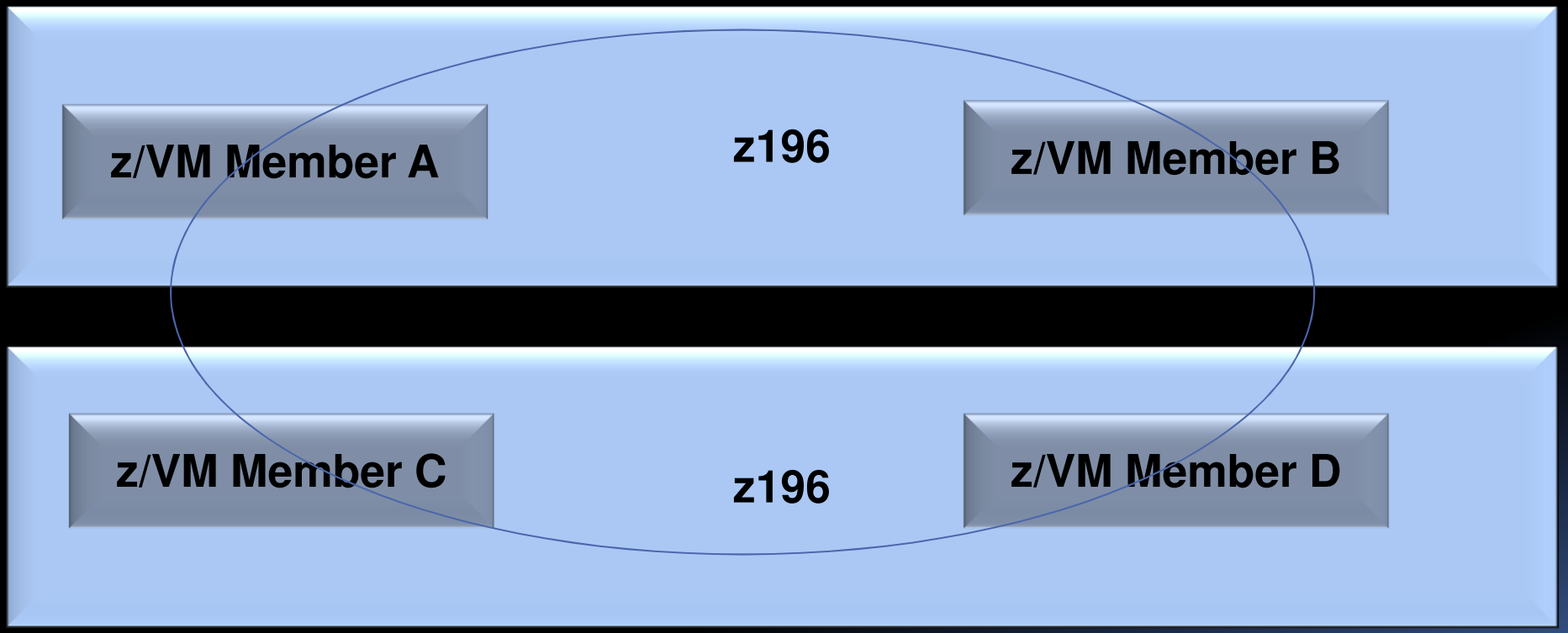
Migrate to New Processors

- Move work off of second z196 to first z196, unto just Members A & B



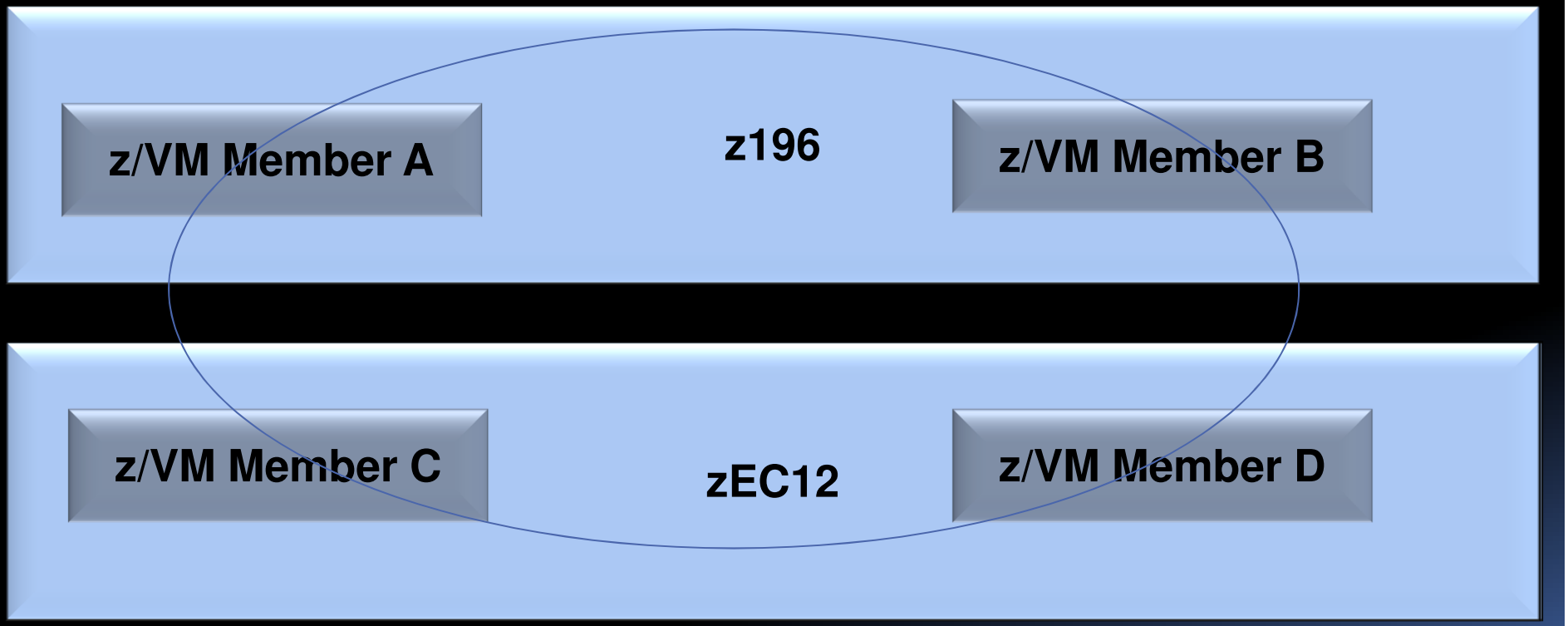
Migrate to New Processors

- Move work off of second z10 to first z196, unto just Members A & B
- Shutdown Members C & D



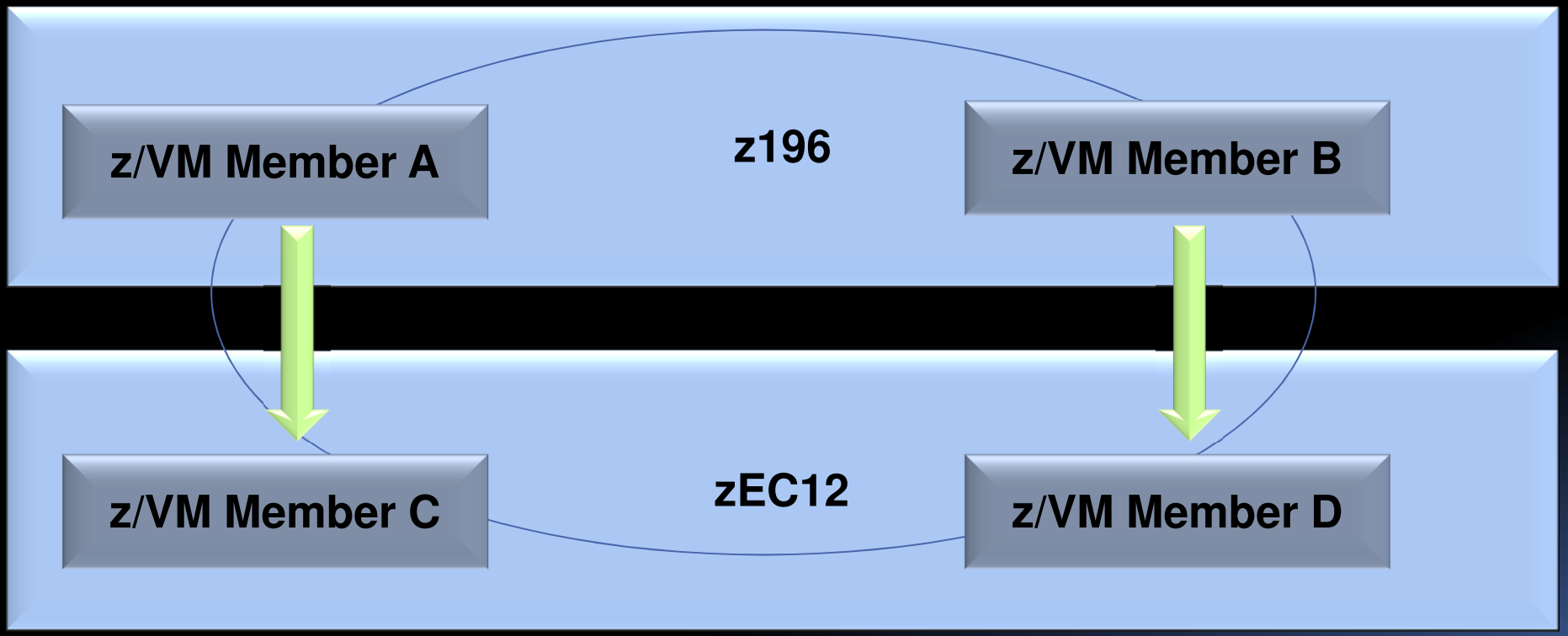
Migrate to New Processors

- Push out z196 and pull in the new zEC12
- Start up Members C & D on the new zEC12



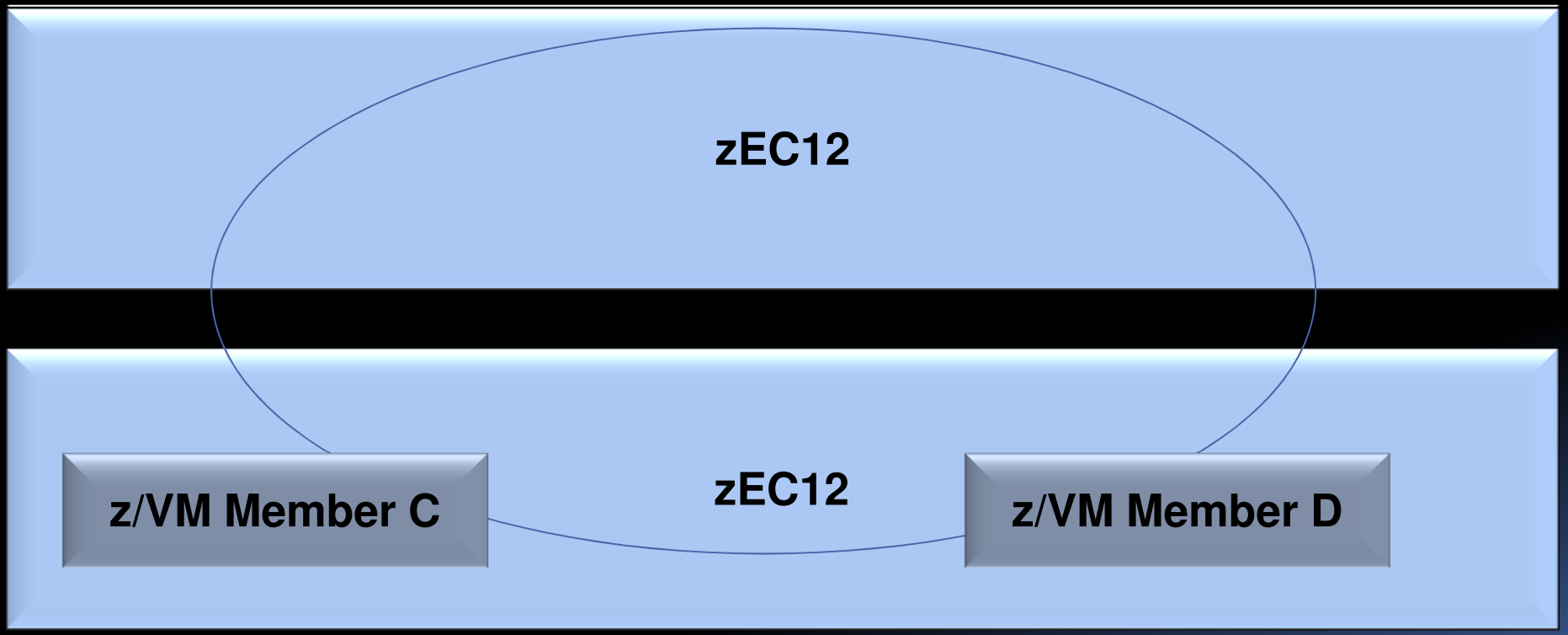
Migrate to New Processor

- Now, move Member A and B workloads to the Members C and D.



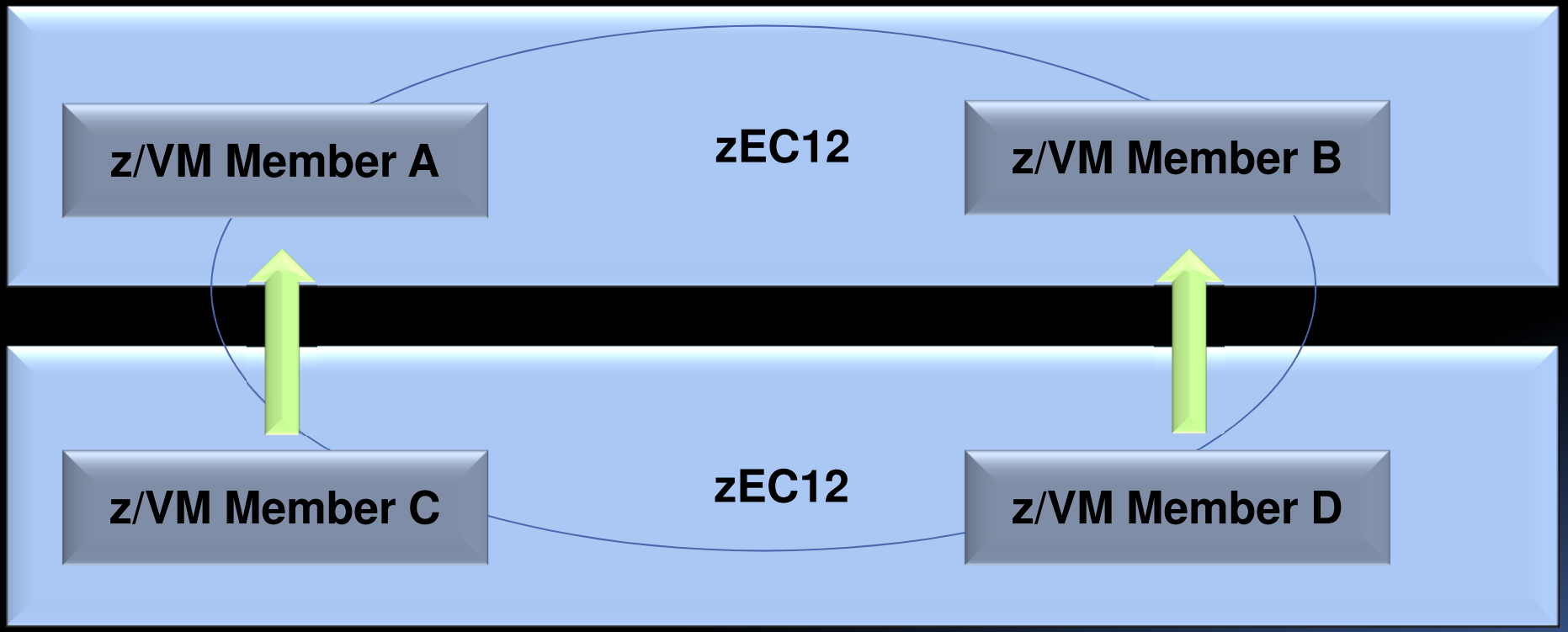
Migrate to New Processor

- Shutdown Members A and B
- Pull out old z196
- Push in new zEC12



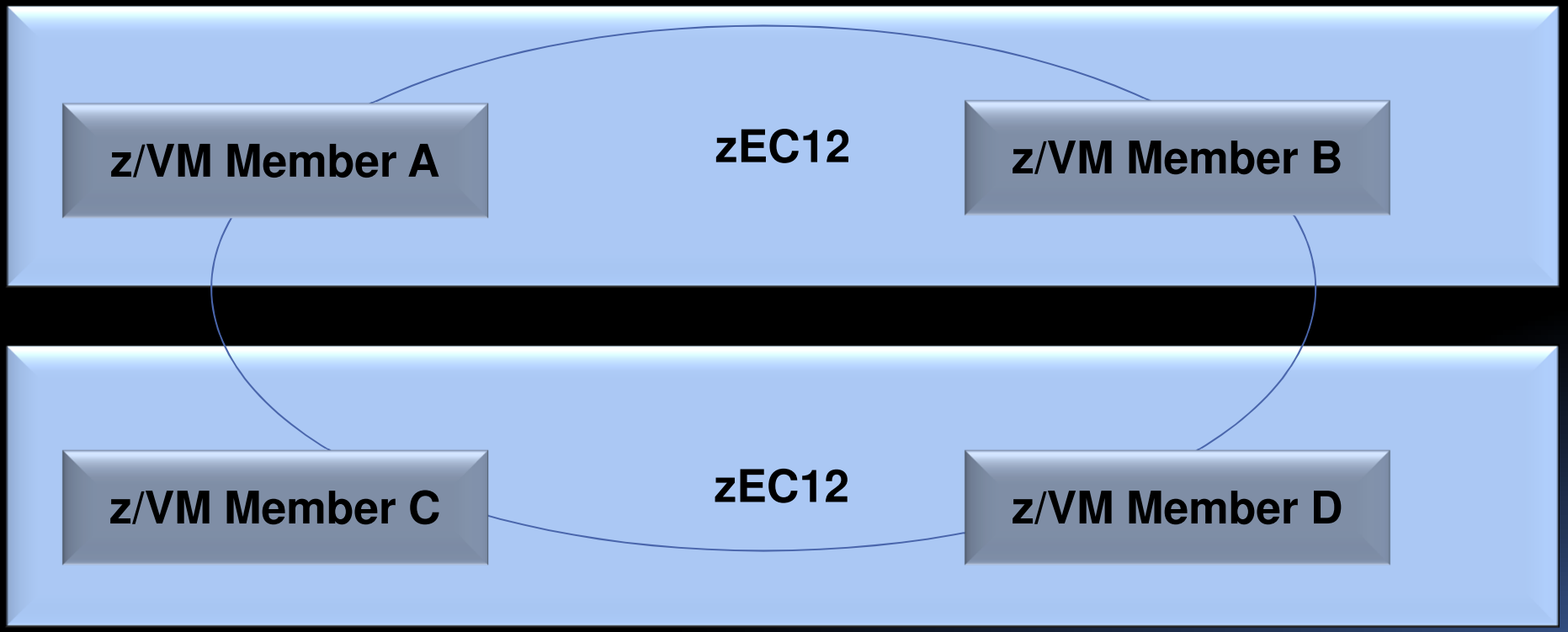
Migrate to New Processor

- Bring back up Members A and B
- Move workloads back to Members A & B



Migrate to New Processor

- Running on new processors without shutting down servers!!
- Would need to re-boot Linux to pick up new zEC12 hardware facilities.



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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