Single Points of Failure in a Computer
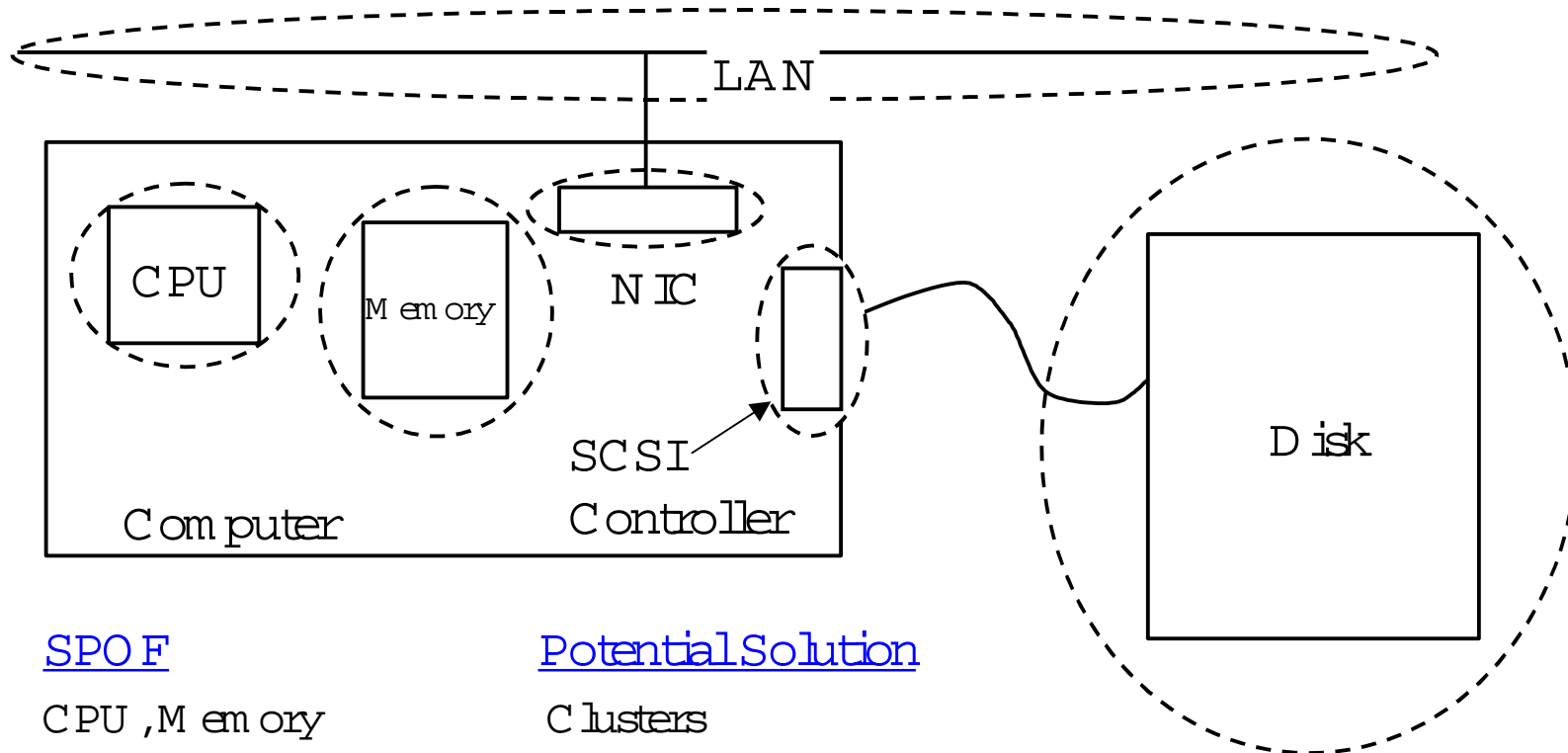
SPOF	Potential Solution
CPU, Memory	Clusters
Disks	Mirroring and RAID
Interface Cards	Mirroring and PV Links
LAN, NICs	Redundant LANs and LANIC
Power	UPS, Diesel generator

What is ServiceGuard?

Craig T. Williams

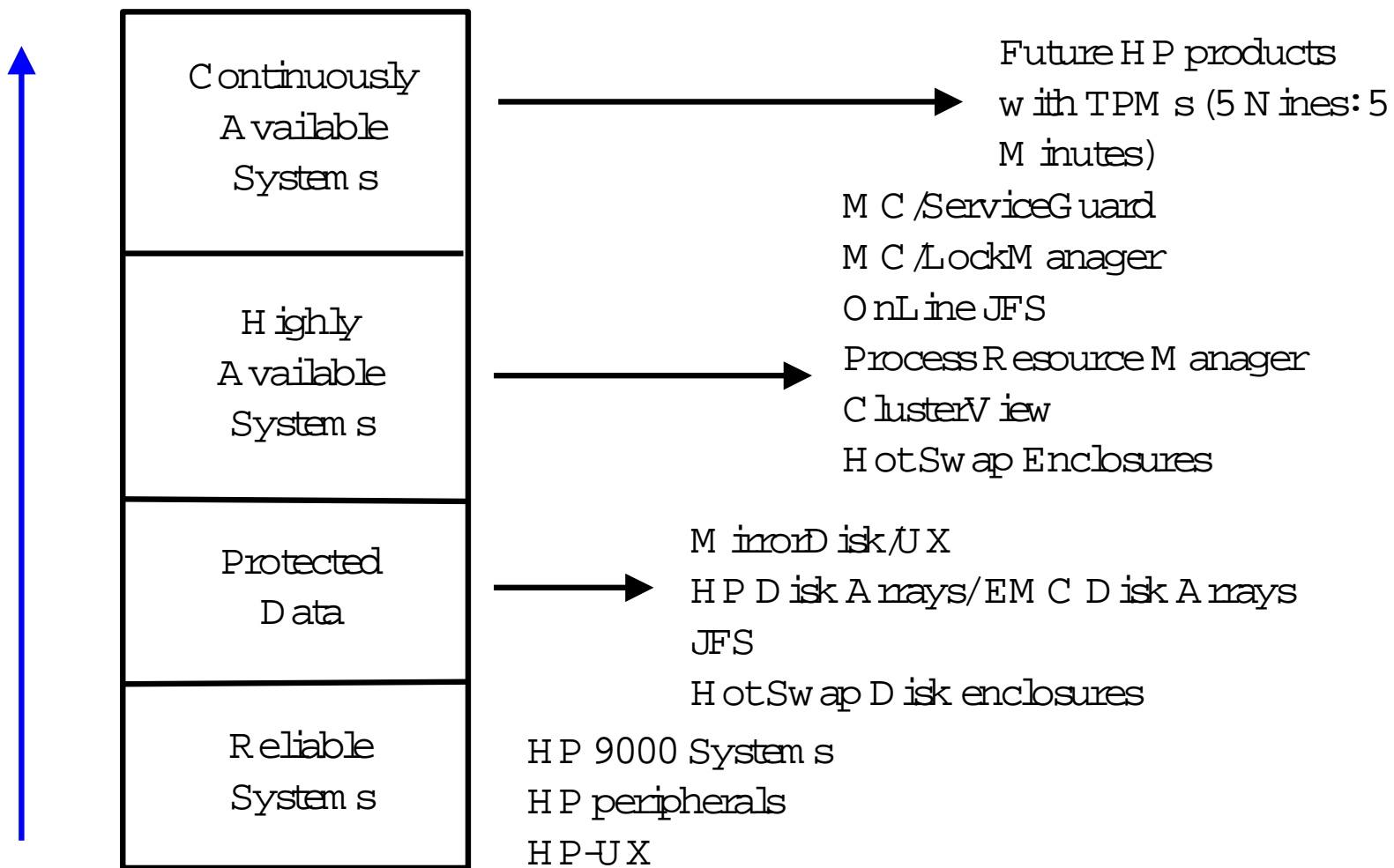Hewlett-Packard Company

351 East Evelyn Ave

MS: D40

Mountain View, CA 94041

650-694-3665 / 650-694-3331 (fax)

craig_t_williams@hp.com

High Availability Solutions

Continuously Available Systems	Future HP products with TPMs (5 Nines: 5 Minutes)
Highly Available Systems	MC/ServiceGuard MC/LockManager OnLine JFS Process Resource Manager ClusterView HotSwap Enclosures
Protected Data	MirrorDisk/UX HP Disk Arrays/EMC Disk Arrays JFS HotSwap Disk enclosures
Reliable Systems	HP 9000 Systems HP peripherals HP-UX

Steps to Install and Implement a High Availability Solution

1. Define High Availability Requirements

2. Perform Environmental Audit and Configuration Planning

3. Plan Installation

4. Plan Implementation

5. Install and Configure Systems

6. Install and Configure Applications

7. Develop Operational Procedures

8. Test High Availability Implementation
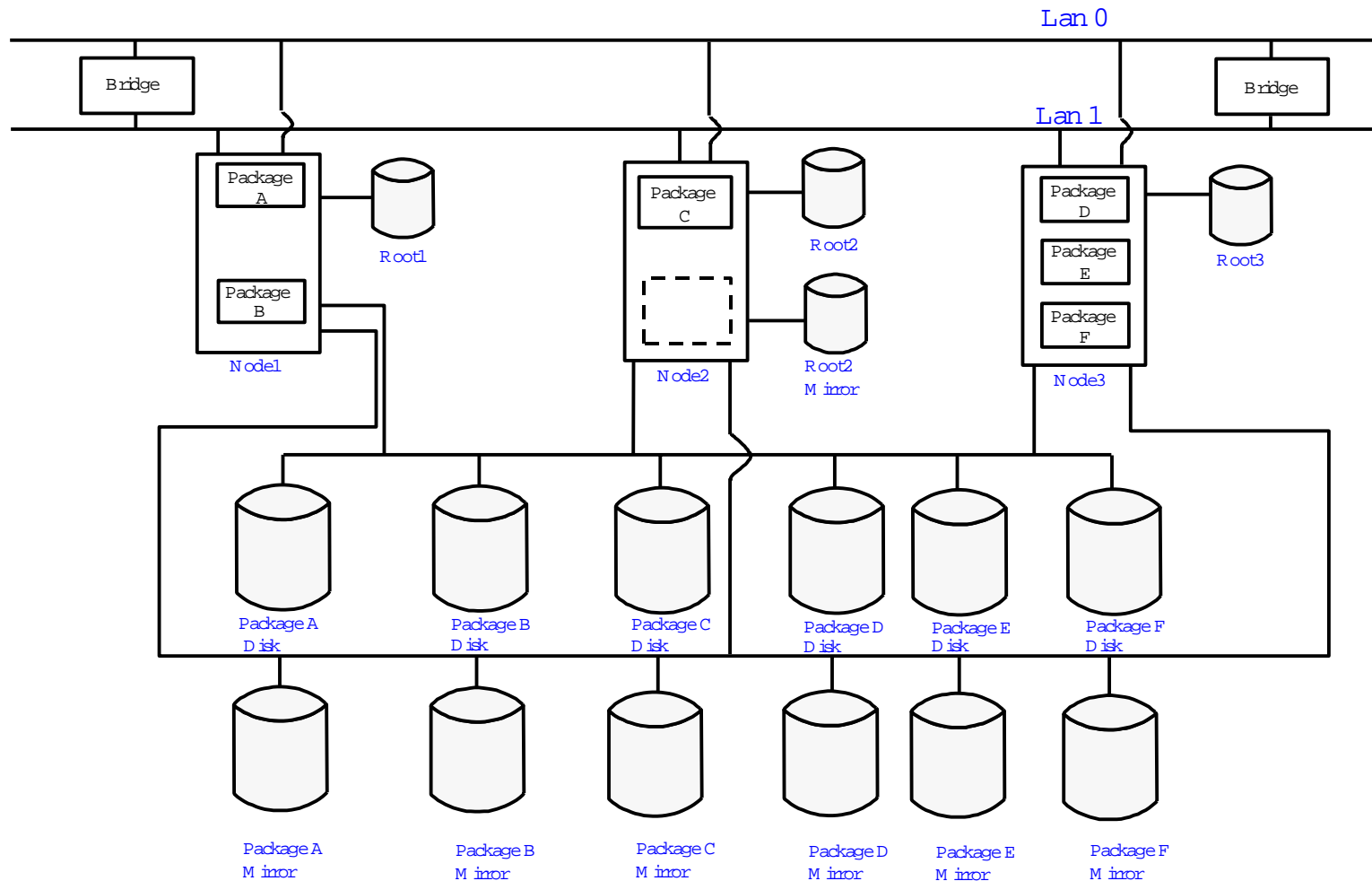
9. Complete System Acceptance.

Features/Benefits of MC/ServiceGuard

- Completely transparent to applications
- Intelligent cluster reconfiguration after node failure
    - Data Integrity: No 'split-brain' syndrome
    - Dynamic formation of new, viable cluster
- Flexible load balancing
- Mixed Series 800 class nodes
- Facilitates online hardware and software updates

- Highly available Enterprise Cluster
    - Fast switching of applications to alternate node (<60 seconds for basic system resources with JFS)
    - LAN failure protection (very fast local switch to standby LAN adapter inside same node)
- Application Packages
    - Easy application management
    - Flexible recovery options
- No idle resources
    - All systems run mission-critical applications

MC/ServiceGuard History

- Initial release of MC/SG
  - 4 nodes
  - packages & relocatable IP

- New Features of 10.03 SG (HP-UX 10.01)
  - service restart option
  - **cmmigrate** command
    (SwitchOver to MC/SG)

- New Features of 10.04 SG (HP-UX 10.10)
  - SAM GUI for MC/SG
  - 8 node support
  - RS-232C link for 2-node heartbeat
  - security enhancements (.rhosts)

- New features of 10.05 SG (hp-UX 10.10)
  - Support for ClusterView

- New features of 10.10 SG (hp-UX 10.20)
  - Online node and package configuration
  - Support for event monitoring services (EMS)
  - New MC/SG commands: **cmscancl,
    cmgetconf, cmdeleteconf**

- New Features of 11.00 SG (HP-UX 11.00
  - 16 nodes
  - New Failover and Failback Policies
  - Support for V-Class
  - Support for HP-UX 11.00

How MC/ServiceGuard Works

Lan 0

Lan 1

Bridge

Bridge

| Package A |
| Package B |

Node1

Root1

| Package C |

Node2

Root2

Root2
Mirror

| Package D |
| Package E |
| Package F |

Node3

Root3

Package A
Disk

Package B
Disk

Package C
Disk

Package D
Disk

Package E
Disk

Package F
Disk

Package A
Mirror

Package B
Mirror

Package C
Mirror

Package D
Mirror

Package E
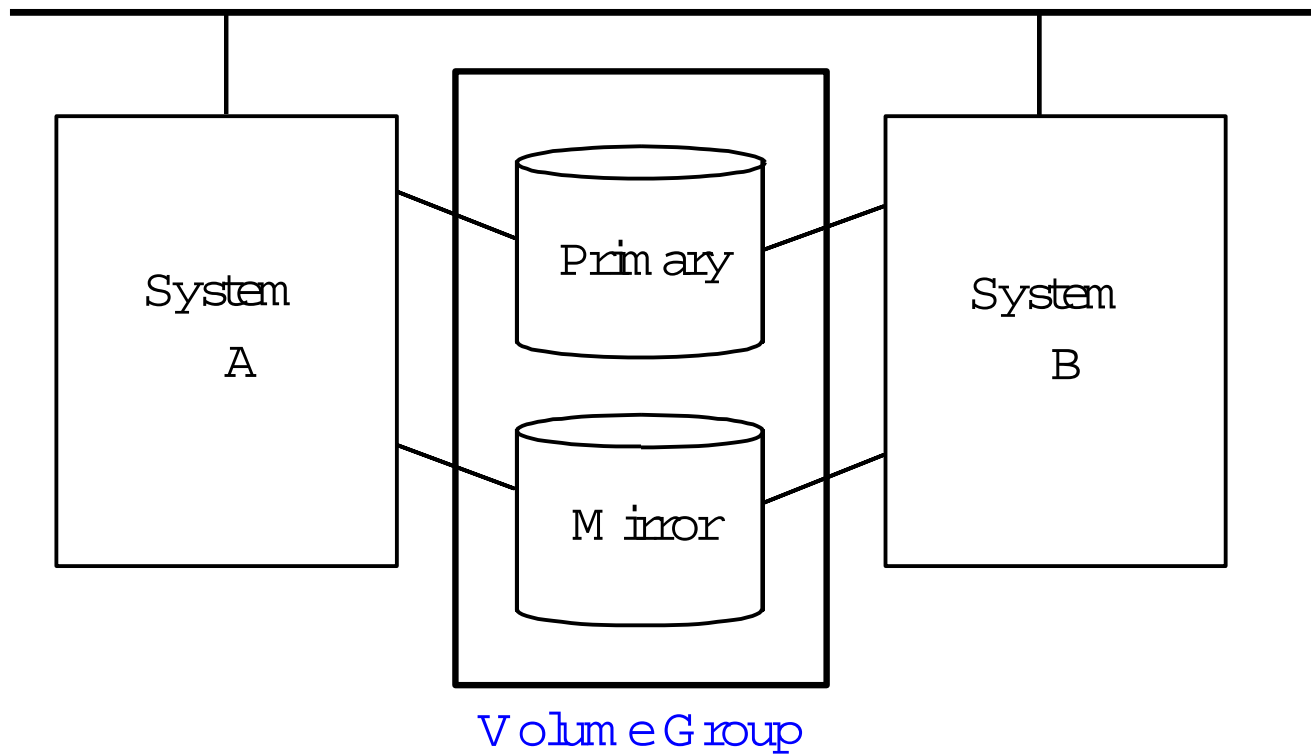Mirror

Package F
Mirror

Volume Groups and Mirrors

Disk Drive Technology

- Standalone drives with LVM mirroring

- High Availability Disk Arrays

- Disk Arrays with AutoRAID

- HP SureStore XP256 Disk Arrays

# MC/ServiceGuard Configuration Using Mirrored Disks

System A

Primary

System B

Mirror

Volume Group

Recommended SCSI Addressing for 4-Node Cluster

System or Disk	Host Interface or Device SCSI Address
System A	7
System B	6
System C	5
System D	4
Disk 1	3
Disk 2	2
Disk 3	1
Disk 4	0
Disk 5	15
Disk 6	14
etc.	13-8

sg0301

MC/ServiceGuard Volume Groups

This belongs to a
MC/ServiceGuard cluster

cmlvmd

cmlvmd

Volume Group

sg1706

11
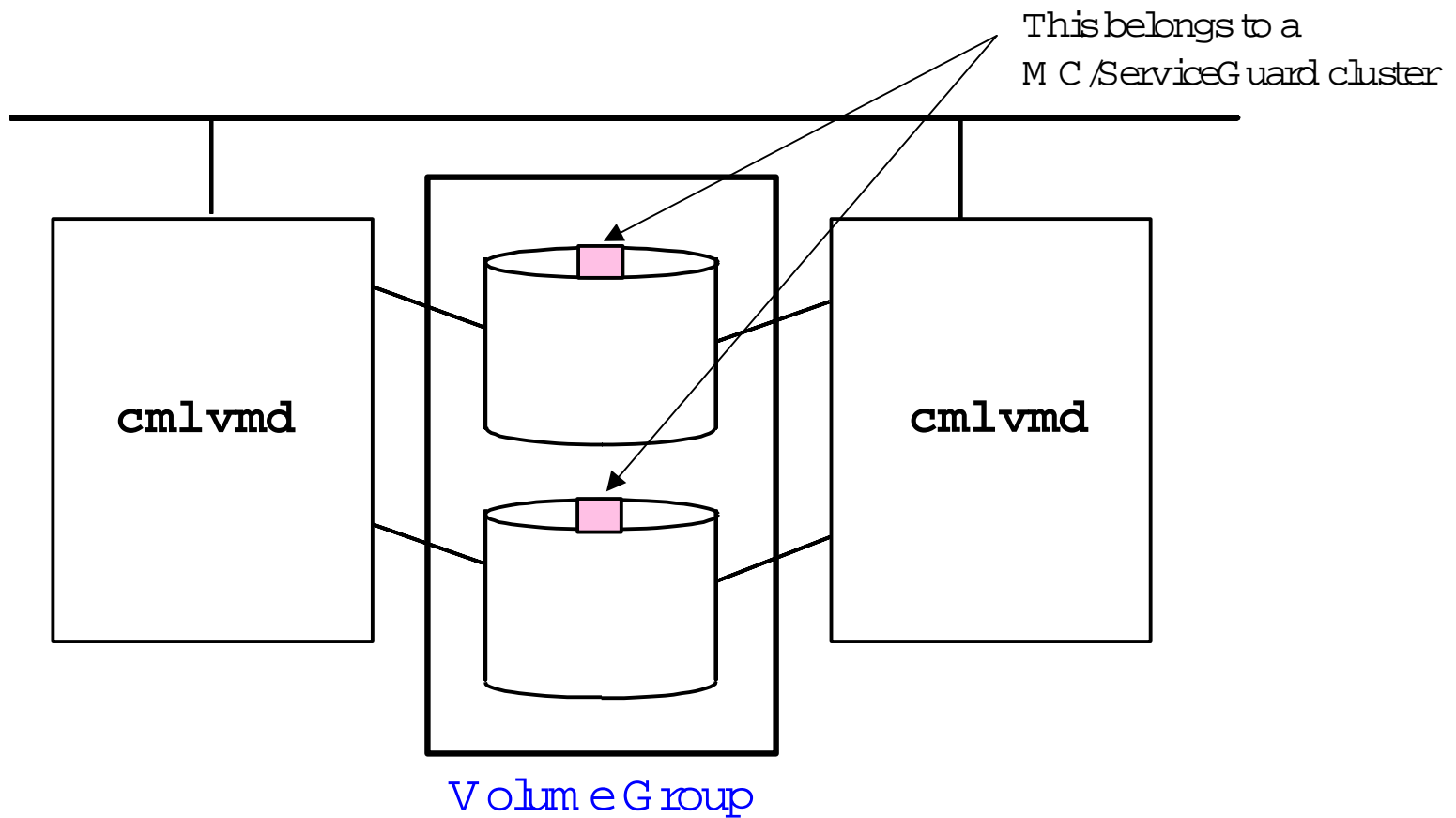
Marking Volume Groups as
MC/ServiceGuard Volume Groups

Marking Volume Group   `vgchange -c y VGName`
for MC/ServiceGuard

Marking Volume Group   `vgchange -c n VGName`
as non-MC/ServiceGuard

Standard Volume Group   `vgchange -a y VGName`
Activation

Exclusive Volume Group   `vgchange -a e VGName`
Activation

Standby LAN Cards

Data and

Heartbeat LAN

Heartbeat
Packet

192.20.45.120

Data
Packet

192.20.45.121

lan0

lan0

Bridge

lan1

lan1

Standby LAN

Dedicated Heartbeat LANs

Data LAN

(Redundant) Heartbeat Packet

Data Packet

192.20.45.120

lan0

lan1

15.19.83.120

192.20.45.121

lan0

lan1

15.19.83.121

Heartbeat Packet

Data Packet
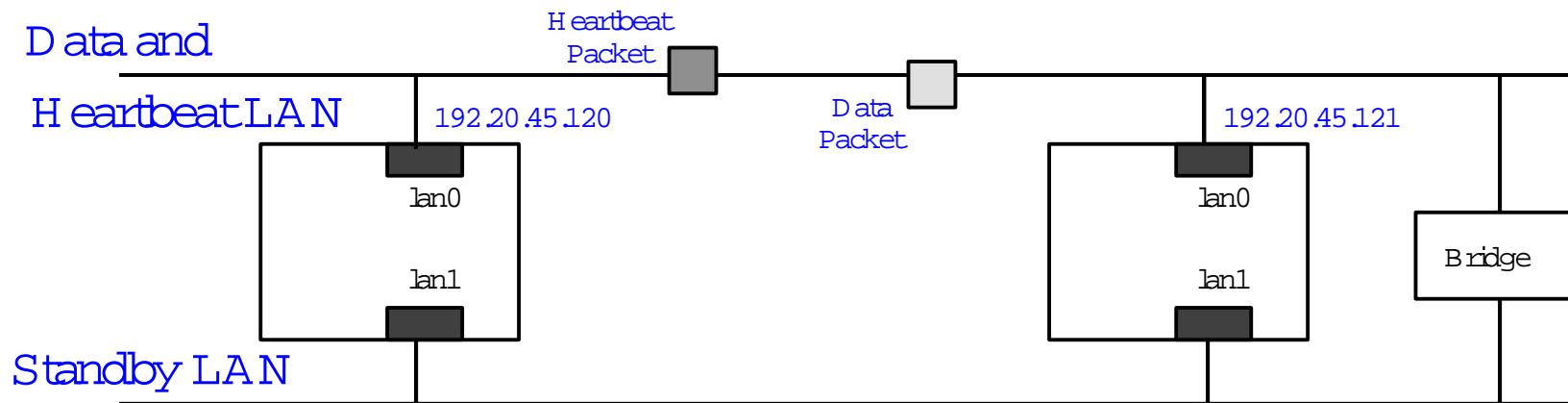
Dedicated Heartbeat LAN
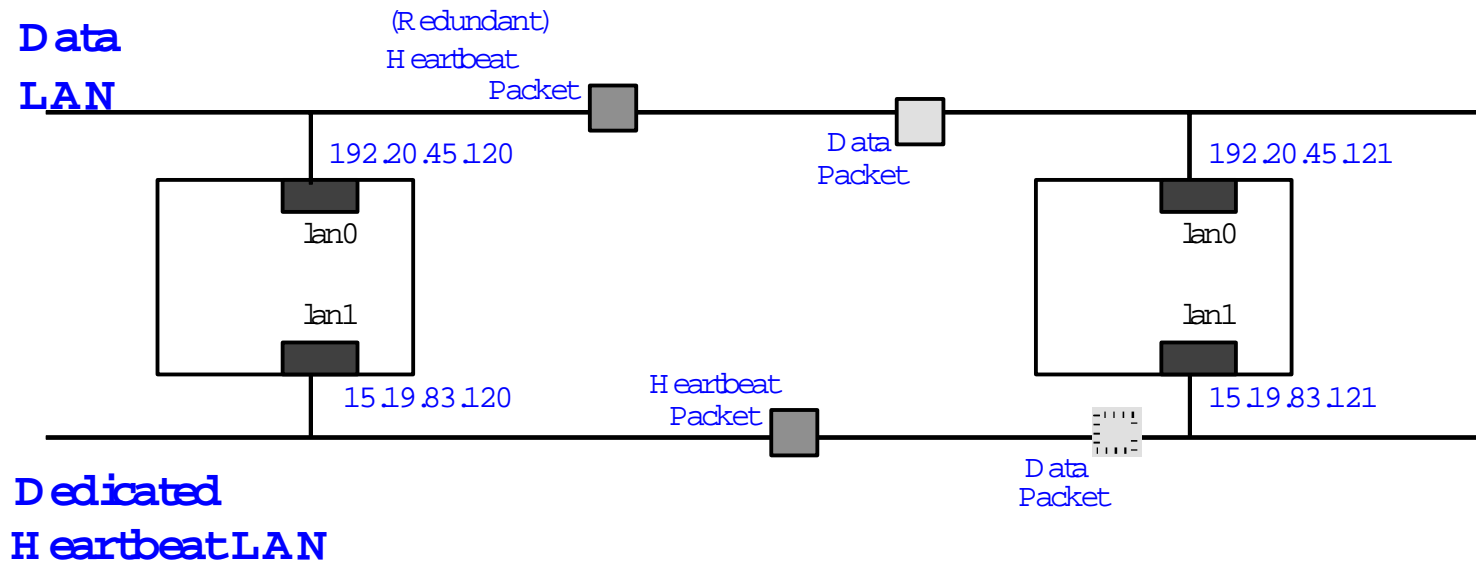
Dedicated Heartbeat LAN and Standby LAN Cards

Data LAN

(Redundant)
Heartbeat
Packet

192.20.45.120

lan2   lan0

lan1

Data
Packet

192.20.45.121

lan2   lan0

lan1

15.19.83.122

Bridge

Heartbeat
Packet

15.19.83.120

15.19.83.121

Dedicated Heartbeat LAN

Sample Cluster

Heartbeat
Packet

lan0   lan1
cmcld
process

Root   Mirror
        Root

lan2

System
A

Primary

Cluster
Lock

Mirror

VG0
1

Primary

Mirror

VG0
2

lan0   lan1
cmcld
process

Root   Mirror
        Root

lan2
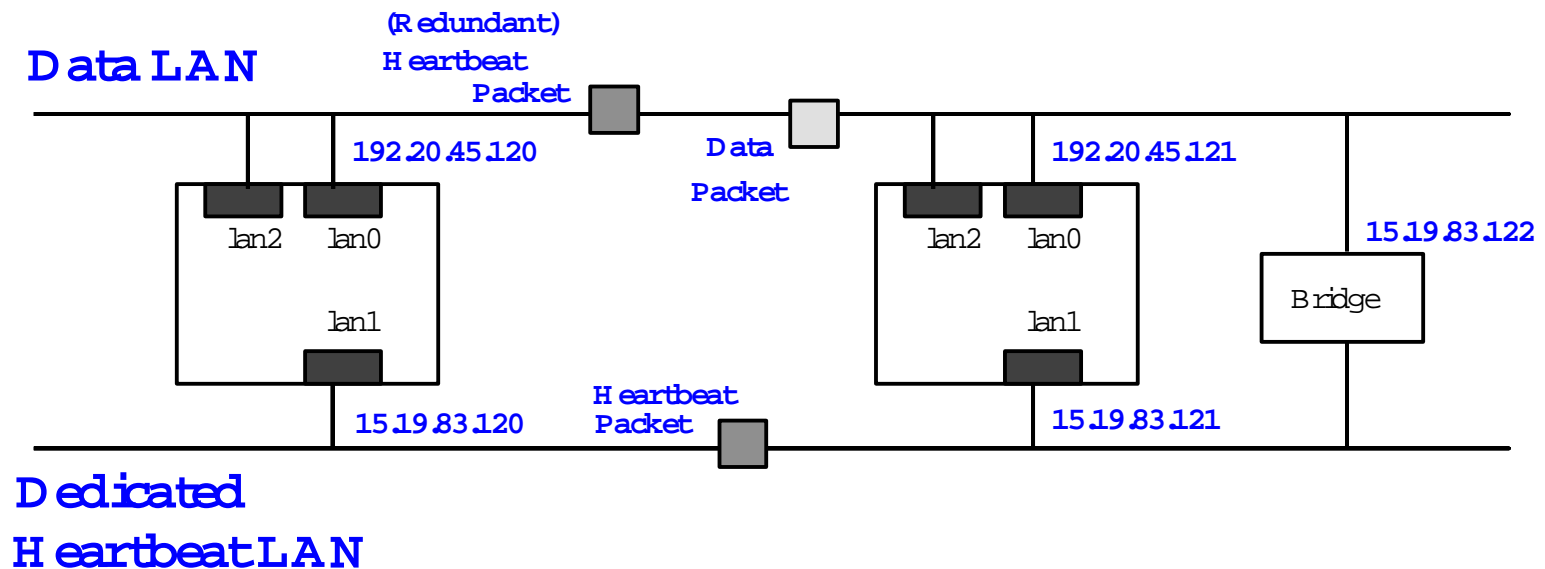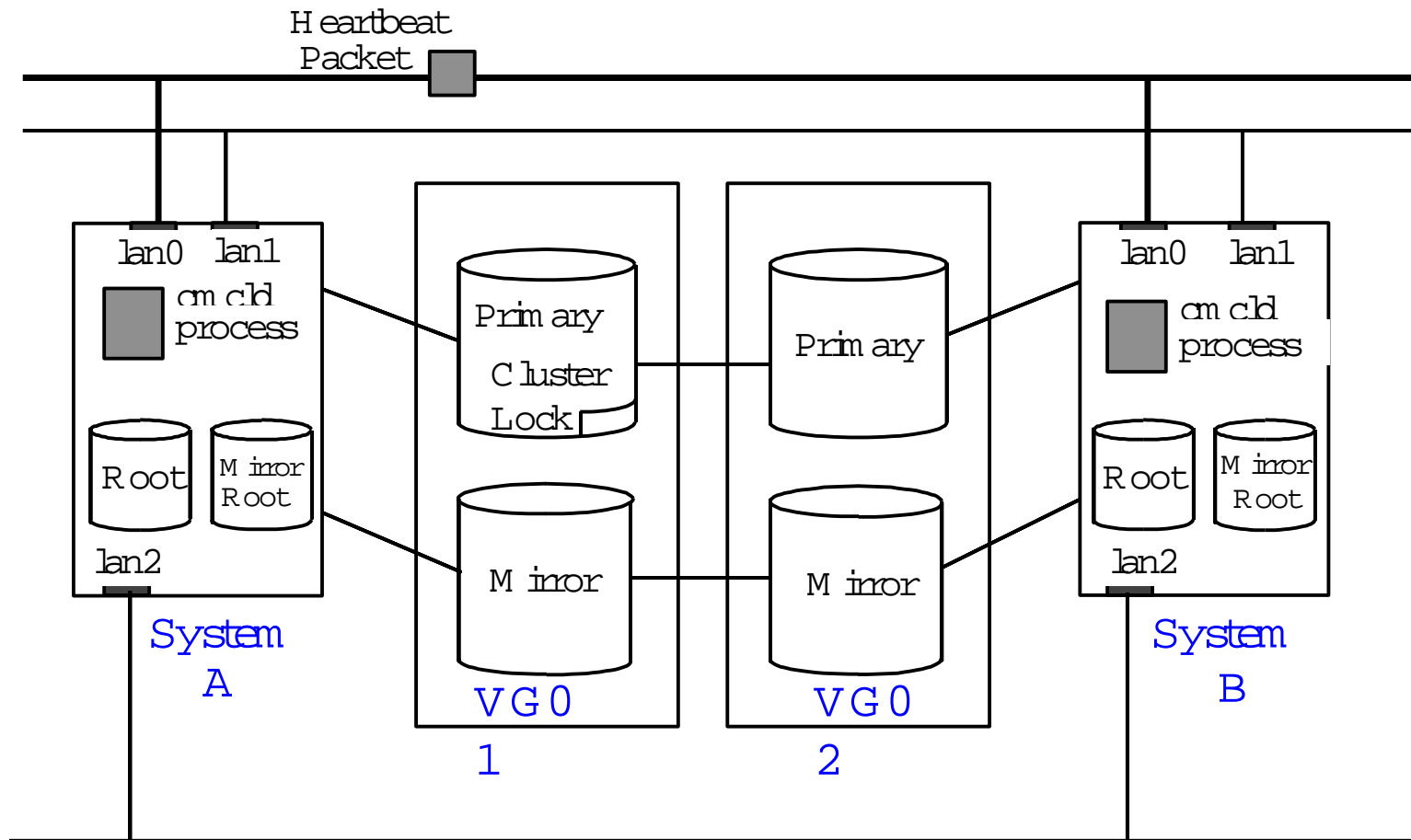
System
B

Cluster Formation Requirements

Cluster Lock Disk
- Required for 2 nodes
- Optional for 3 or 4 nodes
- Not supported for 5 or more nodes
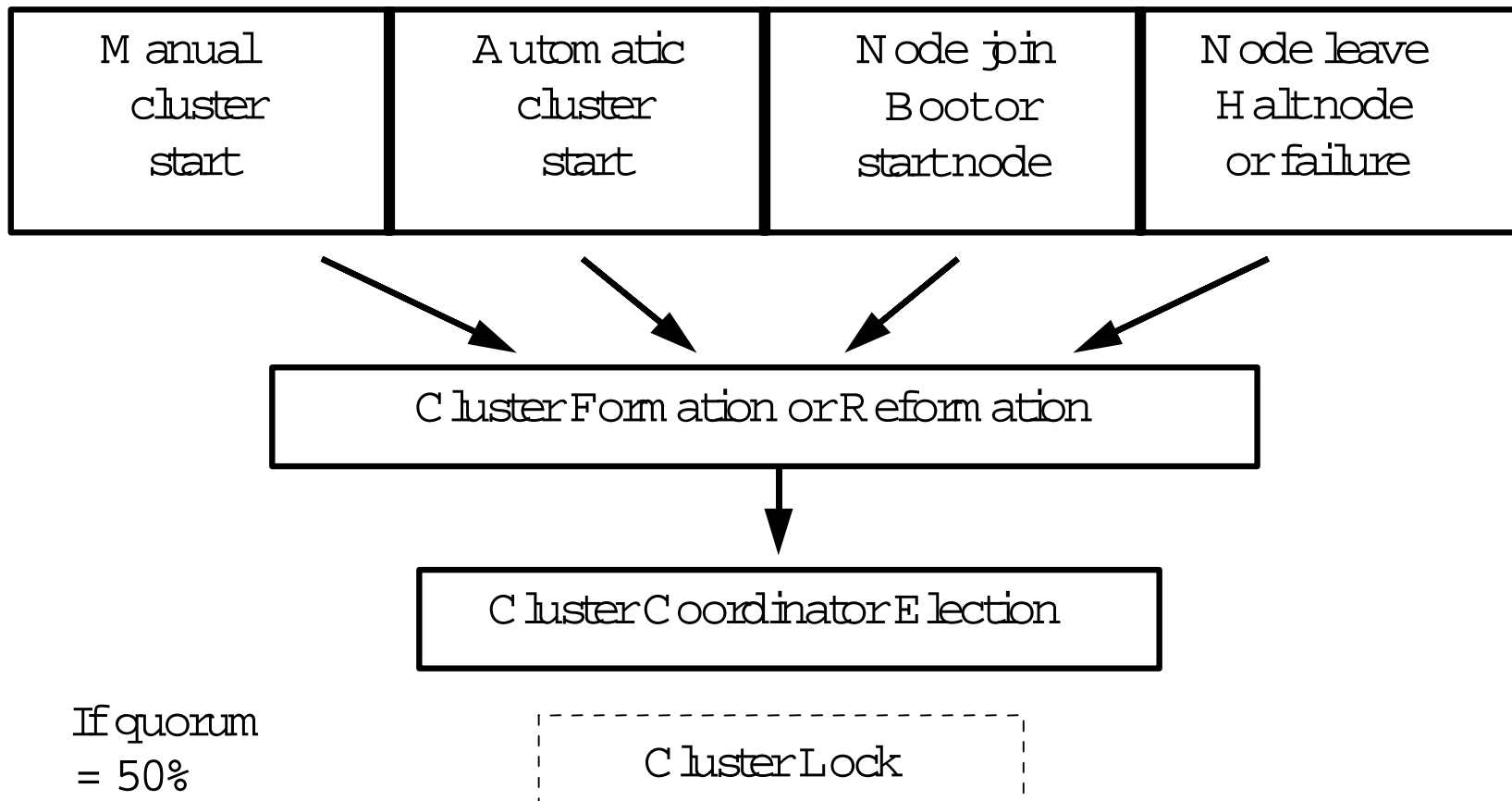- Should be on separate power sources from other systems in cluster

Node Attendance
- 100% node attendance is required for initial cluster formation
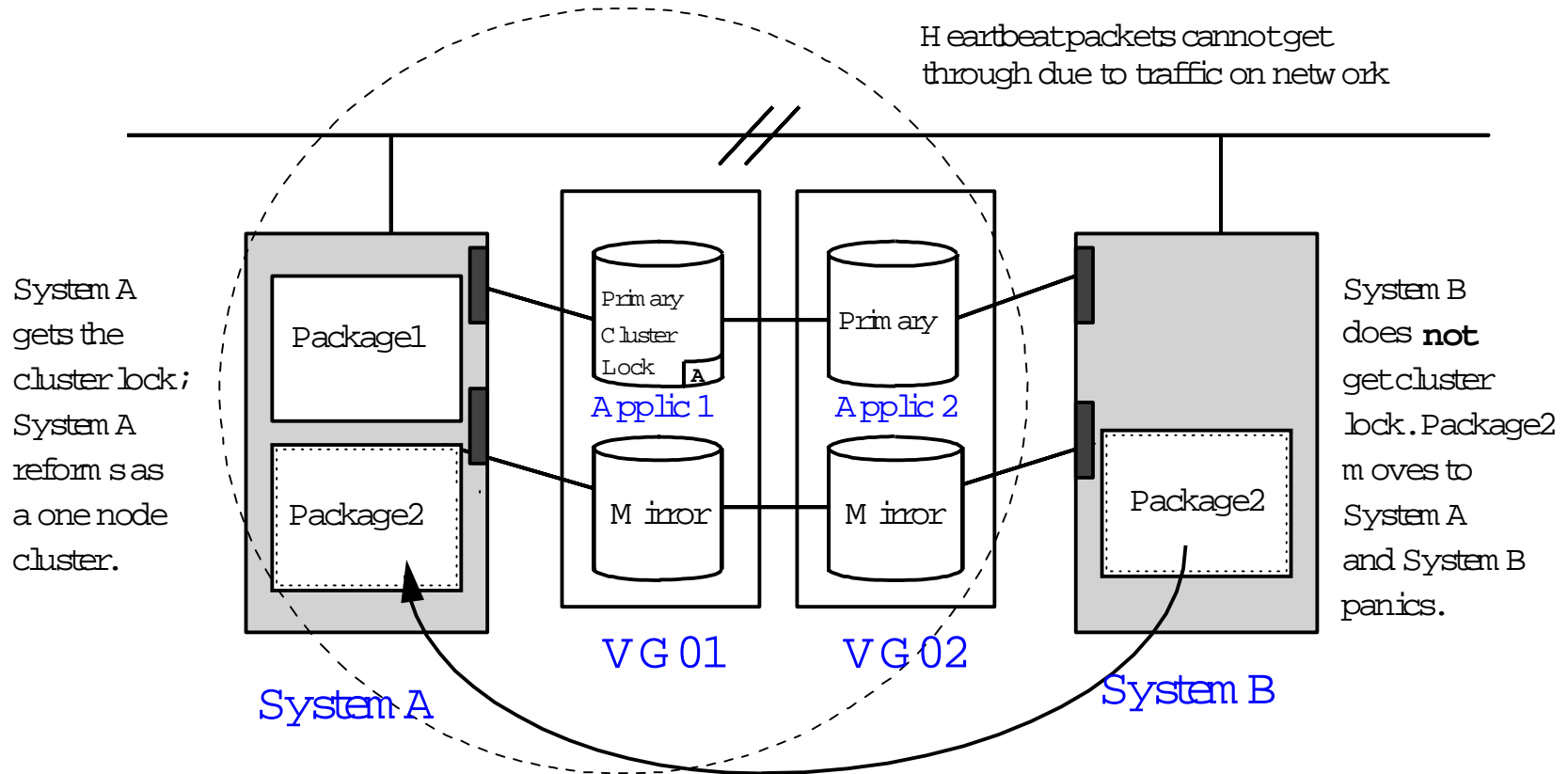
Network Requirements
- All nodes in the cluster must be on same subnet
- LAN cards in the same system <u>MUST</u> be on separate subnets
- At least one HEARTBEAT_IP network is configured

When Is the Election Protocol Used?

This protocol is used during 4 events:

Manual cluster start	Automatic cluster start	Node join Boot or start node	Node leave Halt node or failure

Cluster Formation or Reformation

Cluster Coordinator Election

If quorum = 50%

Cluster Lock

Cluster Reformation Example

Heartbeat packets cannot get
through due to traffic on network

System A
gets the
cluster lock;
System A
reforms as
a one node
cluster.

Package1

Package2

Primary
Cluster
Lock **A**

Applic 1

Mirror

Primary

Applic 2

Mirror

System B
does **not**
get cluster
lock. Package2
moves to
System A
and System B
panics.

Package2

VG 01

VG 02

System A

System B

Procedure for Configuring a Packageless Cluster

1 Setup trusted hosts within cluster systems:
  vi $HOME/.rhosts

  OR **/etc/cmcluster/cmclnodelist**

2. **cd /etc/cmcluster**

3. **cmquerycl -C cmclconf.ascii -n nodel -n node2**

4. **Vi cmclconf.ascii**

    Modify CLUSTER_NAME field

5. **cmcheckconf -C /etc/cmcluster/cmclconf.ascii**

6. **cmapplyconf -C /etc/cmcluster/cmclconf.ascii**

7. **cmruncl**

Viewing the Cluster – **cmviewcl** Command

```
# cmviewcl -v
                     STATU
CLUSTER              S
  cluster1            up
  NODE               STATUS           STATE
  System A            up              running

  Network_Parameters:                    NAM
  INTERFACE   STATUS    PATH          E
  PRIMARY          up      56/36.1     lan0
  STANDBY          up      60/6        lan1

  Serial Heartbeat:
  DEVICE FILE NAME   CONNECTED TO:
  /dev/tty0p3          /dev/tty0p3
```
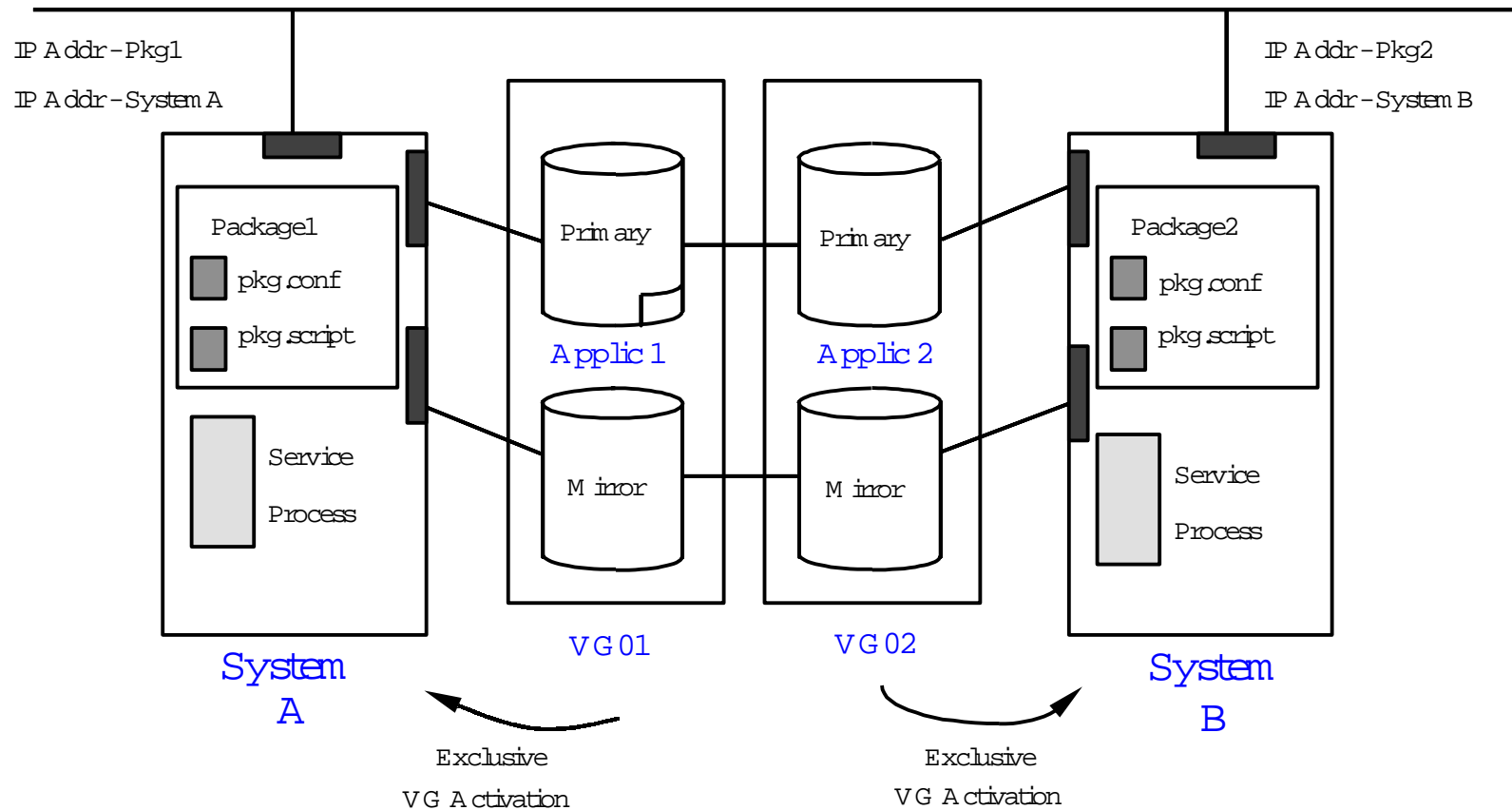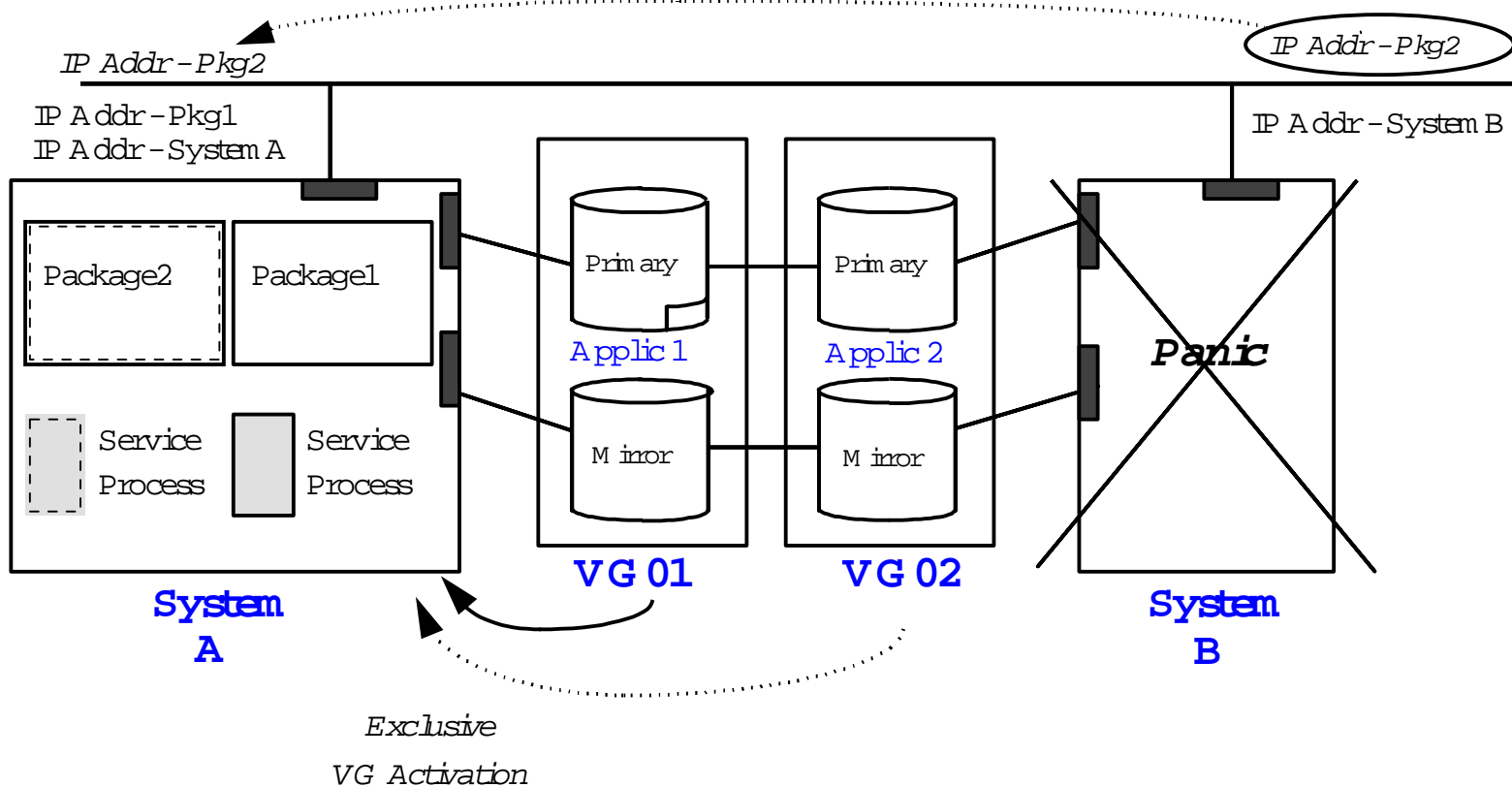
Introduction to MC/ServiceGuard

Sample Package Configuration

IP Addr - Pkg1

IP Addr - System A

IP Addr - Pkg2

IP Addr - System B

Package1

pkg.conf

pkg.script

Service

Process

Primary

Applic 1

Primary

Applic 2

Mirror

Mirror

Package2

pkg.conf

pkg.script

Service

Process

System A

VG01

VG02

System B

Exclusive

VG Activation

Exclusive

VG Activation

Sample Configuration after Node Failure

IP Addr-Pkg2

IP Addr-Pkg2

IP Addr-Pkg1
IP Addr-System A

IP Addr-System B

Package2

Package1

Primary

Primary

Applic 1

Applic 2

Panic

Mirror

Mirror

Service
Process

Service
Process

VG 01

VG 02

System
A

System
B

Exclusive

VG Activation

Procedure for Configuring a Package

1. `mkdir   /etc/cmcluster/package_name`

    (Create directory for package specific files)

2. `cd /etc/cmcluster/package_name`

    (Change to the directory)

3. `cmmakepkg -p pkg.conf` (Create package configuration template)

4. `vi pkg.conf`   (Modify package parameters)

5. `cmmakepkg -s pkg.cntl` (Create package control script template)

6. `vi pkg.cntl`   (Modify script variables)

7. `ftp pkg.cntl to other systems in the cluster`

    (Distribute the control script to all nodes)

8. `cmcheckconf -P /etc/cmcluster/package_name/pkg.conf`

    (Verify the package configuration file)

9. `cmapplyconf -P /etc/cmcluster/package_name/pkg.conf`

    (Compile the package into the config file)

Mc/ServiceGuard Online Reconfiguration

- Ability to change cluster configuration while cluster is running
- Online node functionality
  - Add a new node
  - Remove an existing node
- Online package functionality
  - Add a package
  - Delete a package
  - Modify some package attributes while package is running
  - Modify entire package while cluster and other packages continue
    To run but modified package is down

High Availability Cluster SAM

Enhance HA Cluster SAM

- All ServiceGuard functionality available in SAM :
  - Cluster Configuration
  - Cluster Administration
  - Package Configuration
  - Package Administration

- Concurrent monitoring of "syslog.log" output

- Concurrent monitoring of "pkg.ctl.log" output

- Monitoring cluster status and events