Oracle RAC Architecture

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Objectives

In this lecture, you should learn how to describe the following:

- Oracle RAC hardware requirements
- Shared storage configuration options
- Oracle Grid Infrastructure components
- Oracle Clusterware network configuration
- Oracle RAC connectivity cycle
- Oracle RAC database files locations

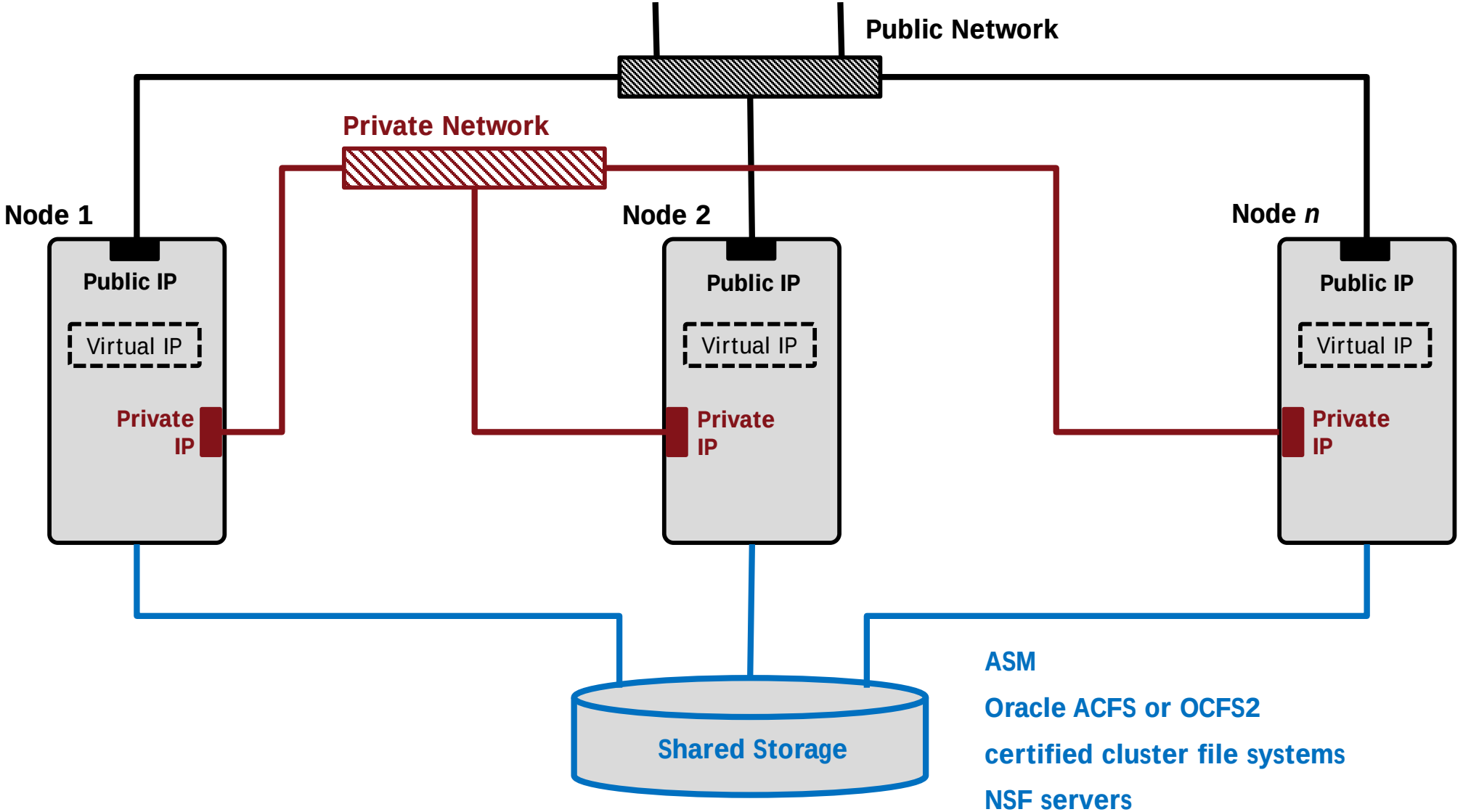
Oracle RAC History

- Oracle Parallel Server (OPS)
  - Oracle 6.2 on VAX/VMS.
- Oracle Real Application Cluster (RAC)
  - Oracle 9i

Oracle RAC: Software Stack

- Oracle Grid Infrastructure
  - Clusterware
    - Manage the whole cluster
    - Monitor the availability of the resources
    - Controls the resources startup order
    - Can be programmed for user applications
  - ASM
- Oracle Database

Oracle RAC Basic Architecture



ASM

Oracle ACFS or OCFS2

certified cluster file systems

NSF servers

~~Raw disks~~

Oracle RAC Architecture Overview

- Every server that is part of the RAC is called node.
- Clients connect to the database through public network.
- Nodes connect to each other via private network (called interconnect)
- Database datafiles are stored in shared storage.
- A RAC database has multiple instances. Every instance is running in a single node.
- For a database to be available to the clients, at least one instance should be up and running.

Oracle RAC: Hardware Requirements

- Two or more servers
  - Similar hardware architecture and same OS
- Two Network cards installed into every node:
  - Public network: connected to the clients
  - Private network: interconnect network among the nodes
  - Redundant private interconnect configuration is highly recommended
- Shared storage
  - High speed storage network required, such as 16GbE FC
  - Redundant connections to the storage with multipathing configuration

Oracle RAC: Memory Requirements

- If the same workload is kept on an instance, when migrating a single-instance database to RAC, more memory is need:
  - 10% more buffer cache
  - 15% more shared pool
  - Memory used by ASM and Clusterware processes
- Memory consumed by client sessions will be distributed among the instances

Shared Storage Options

- ASM (the recommended option)
  - Volume manager and file system for Oracle Databases
  - More efficient for Oracle Databases
  - The only supported option with Oracle Standard Edition
- Oracle ACFS
  - Extends ASM functionality to support all files.
  - Provides: dynamic FS resizing, direct access to ASM DG, I/O parallelism
- OCFS2 (Oracle Cluster File System 2)
  - Open source general-purpose file system developed by Oracle

Shared Storage Options (cont)

- Third-party Certified cluster file systems
  - Examples: Veritas Storage Foundation Cluster File System (SFCFS) for Oracle RAC
- NFS Server
  - Only NFS protocol version 3 (NFSv3) is currently supported

Oracle RAC: Engineered Systems

- Oracle Database Appliance (ODA)
  - Pros: tested for maximum performance, easy management
  - Cons: only two nodes
- Oracle Exadata Database Machine

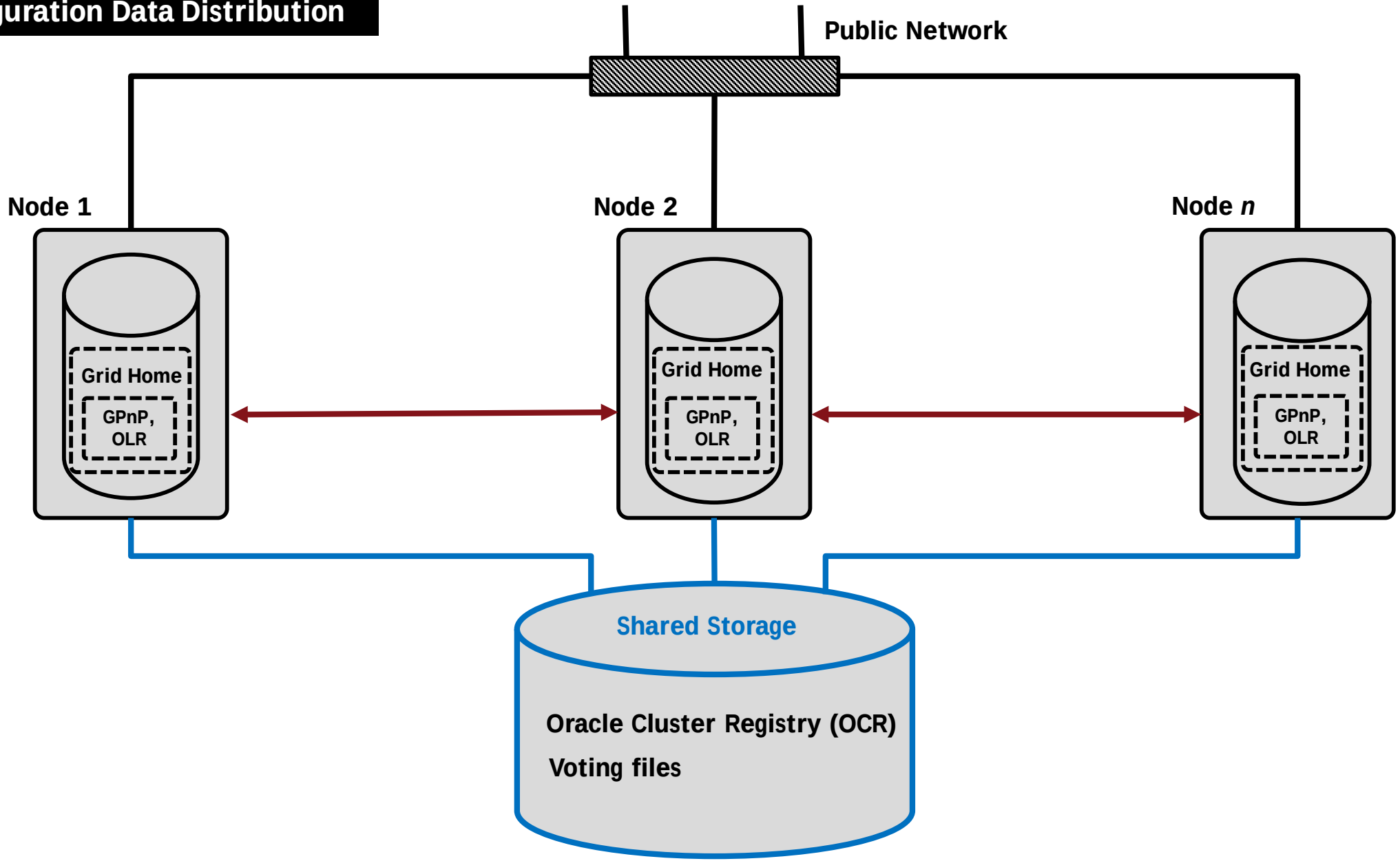
About Oracle Grid Infrastructure

- Provide clustering features (clusterware) plus ASM
- It must be installed in its own, local home
- Usually owned by a dedicated OS user “`grid`”
- Cluster Ready Service (CRS) resources:
  - ASM instances
  - ASM Diskgroup
  - Virtual IP (VIP) services
  - Single Client Access Name (SCAN)
  - SCAN listener
  - database services
  - Oracle Net listener
  - Oracle Notification Service (ONS)

About Oracle Clusterware

- Requires shared storage to store:
  - Voting files for node membership
  - Oracle Clusterware Registry (OCR) for cluster configuration information
  - They must be saved in a high-redundant storage
- Further configuration data stored in two local files:
  - Oracle Local Registry (OLR): metadata for the local node
  - Grid Plug and Play (GPnP) profile: network profile and VD
- It used private interconnect network to carry the heartbeat communication

Oracle Clusterware Configuration Data Distribution



Clusterware: CRS Daemons and Services

Daemon/Service	Process Name	Description
CRS	**CRSD**	Start, stop, monitor, and failover operations on resources
CSS Service	**ocssd.bin**	Monitors the node membership in the cluster and updates the node status information in VD
CSS Agent	**cssdagent**	Monitors, starts, and stops the CSS.
CSS Monitor	**cssdmonitor**	It works with the CSS agent to provide data integrity in the clusterware. Base on the CPU startvation or OS status, it may reboot the node.
CTSS	**octssd.bin**	Maintains time synchronization among all the nodes in the cluster
EVM	**evmd.bin**	Publishes events to all the cluster nodes
ONS	**ons**	Manages the Fast Application Notification (FAN) events

Clusterware: CRS Daemons and Services (cont)

Daemon/Service	Process Name	Description
Oracle Agent	**`oraagent`**	Managing ohasd resources owned by `oracle`
Oracle Root Agent	**`orarootagen`**	Managing ohasd resources owned by `root`
Oracle ASM		Managing the shared storage and disk volumes

Note: this list is not all the Clusterware processes.

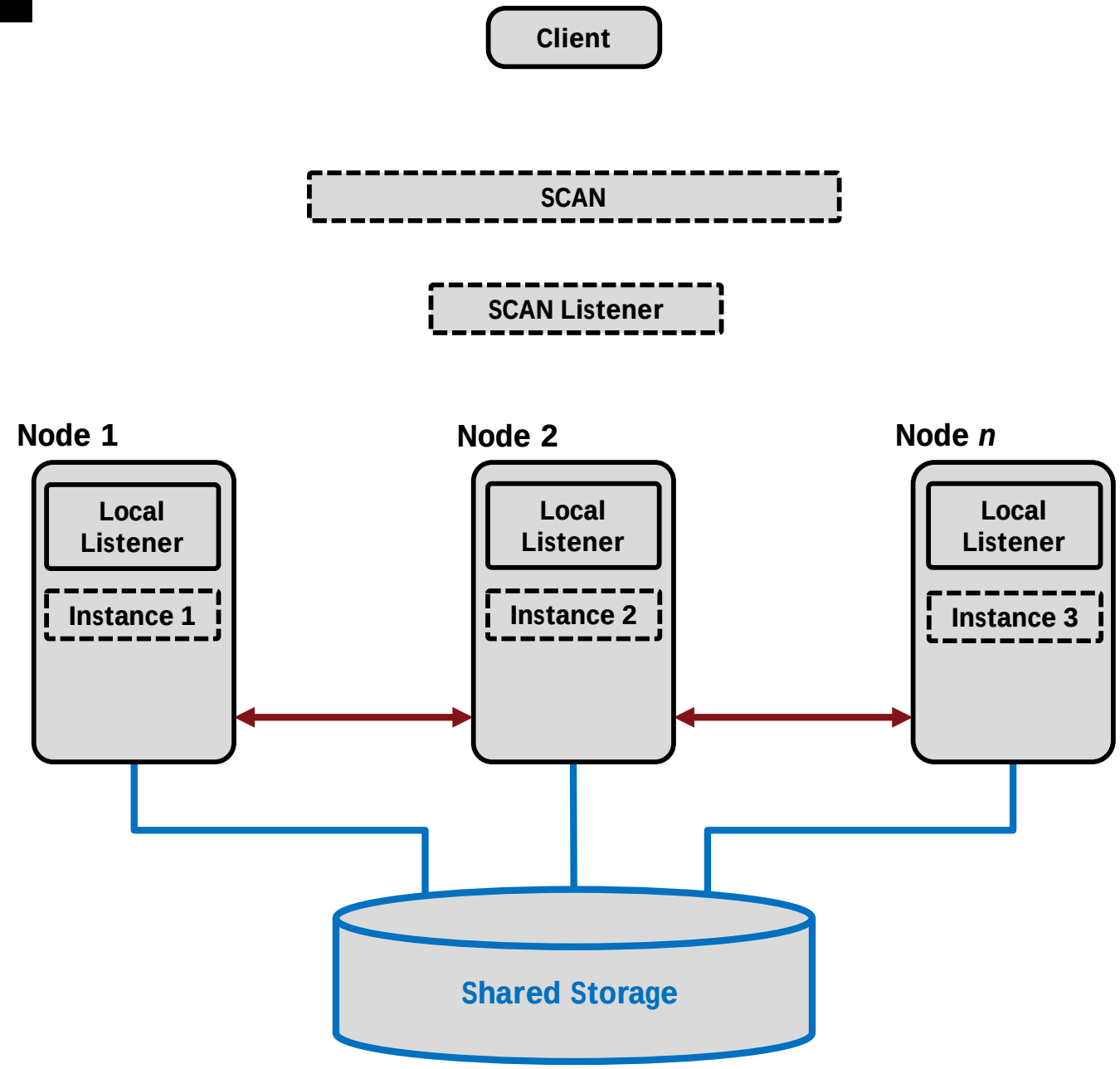
Oracle Clusterware Network Configuration

- Oracle Grid Naming Service (GNS)
  - A subdomain is delegated in the DNS server for the cluster
  - You only define the GNS server VIP in the DNS
  - DHCP is supported only in Linux systems
- Static Configuration:
  - No subdomain is delegated in the DNS server
  - All names and addresses are resolved by DNS:
    - A SCAN name to resolve to three static IP addresses for the cluster
    - A public and virtual IP names and addresses for each node
    - A virtual IP name and address for each node

Oracle Clusterware Network Configuration (cont)

- Single Client Access Name (SCAN)
  - A domain name registered to at least one and up to three IP addresses, either in DNS or GNS.
  - Must be used by the clients when connecting to the RAC database
- Node Virtual IP (VIP) is managed by the Clusterware:
  - Must be assigned to each node
  - Must be on the same subnet as the public IP address
  - Provides rapid failure notification and failover

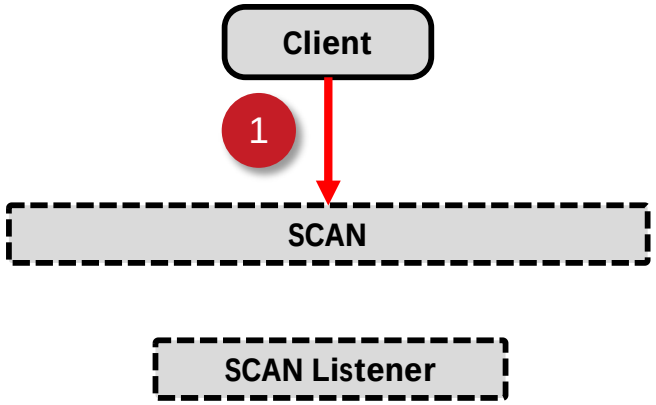
Oracle RAC Connectivity Cycle

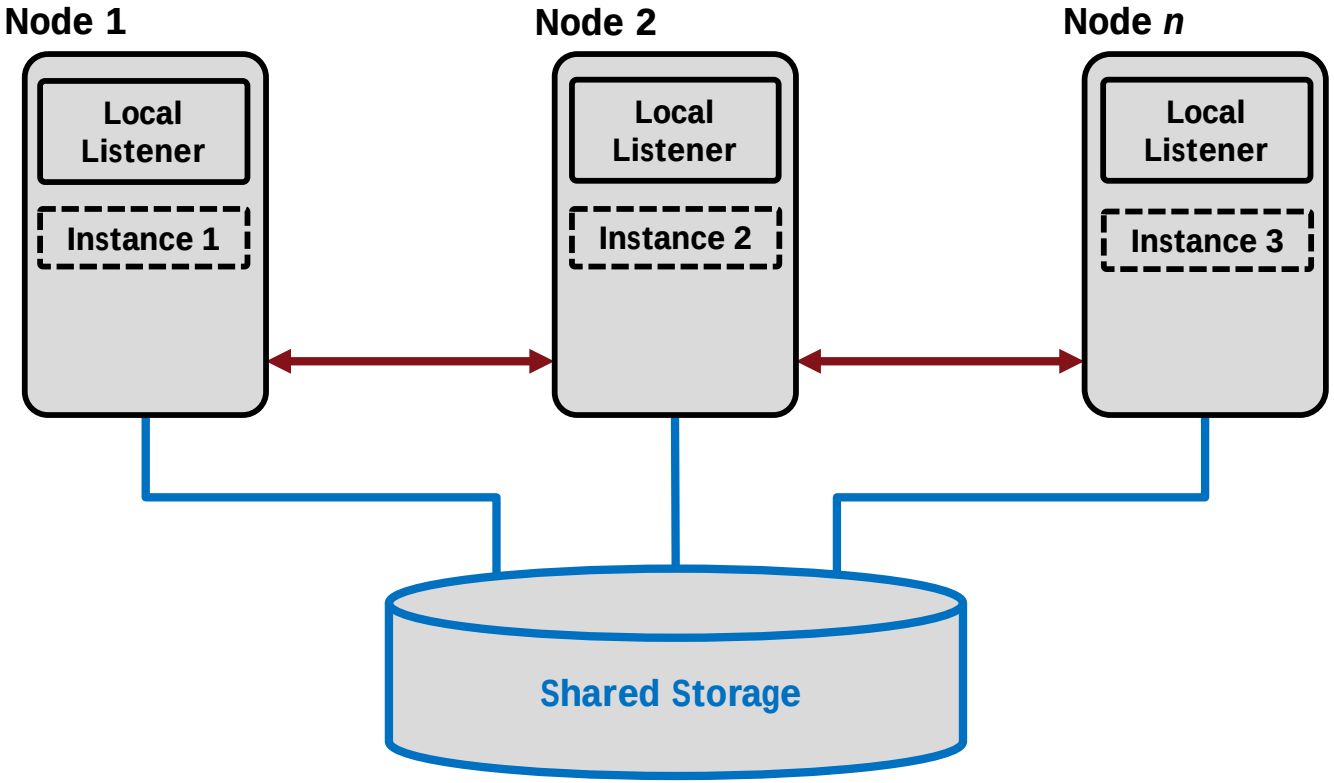


Oracle RAC Connectivity Cycle

Steps:

1. Client requests connection using a **SCAN** name and a **service name**. The DNS or GNS returns to the client on of the SCNA IP addresses

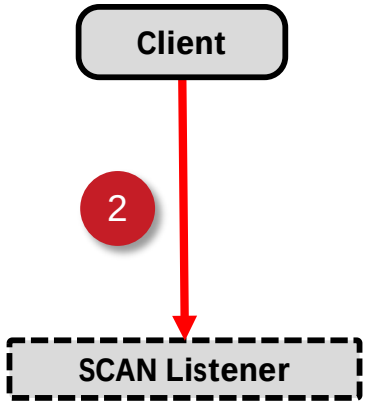


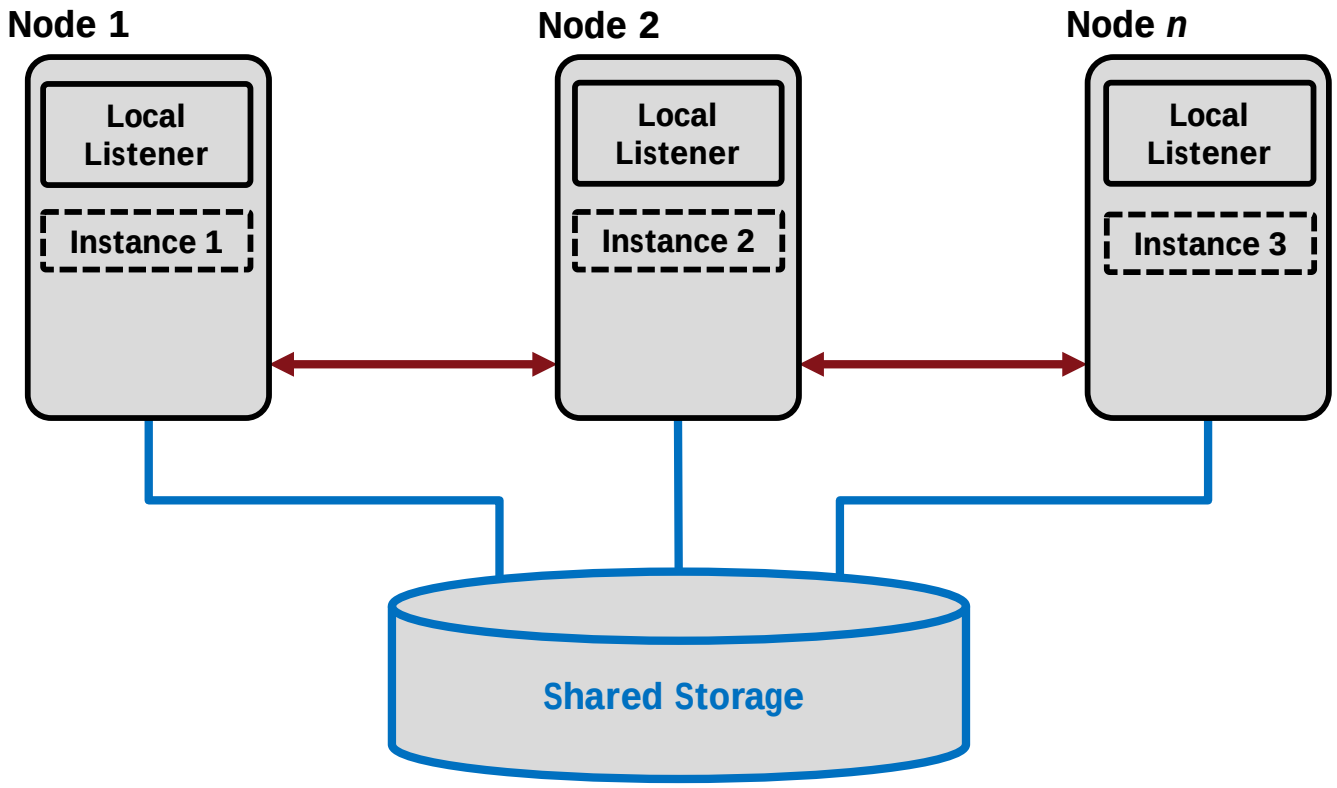


Oracle RAC Connectivity Cycle

Steps:

2 Using a SCAN IP, the client connects to a SCAN Listener providing it with a service name.

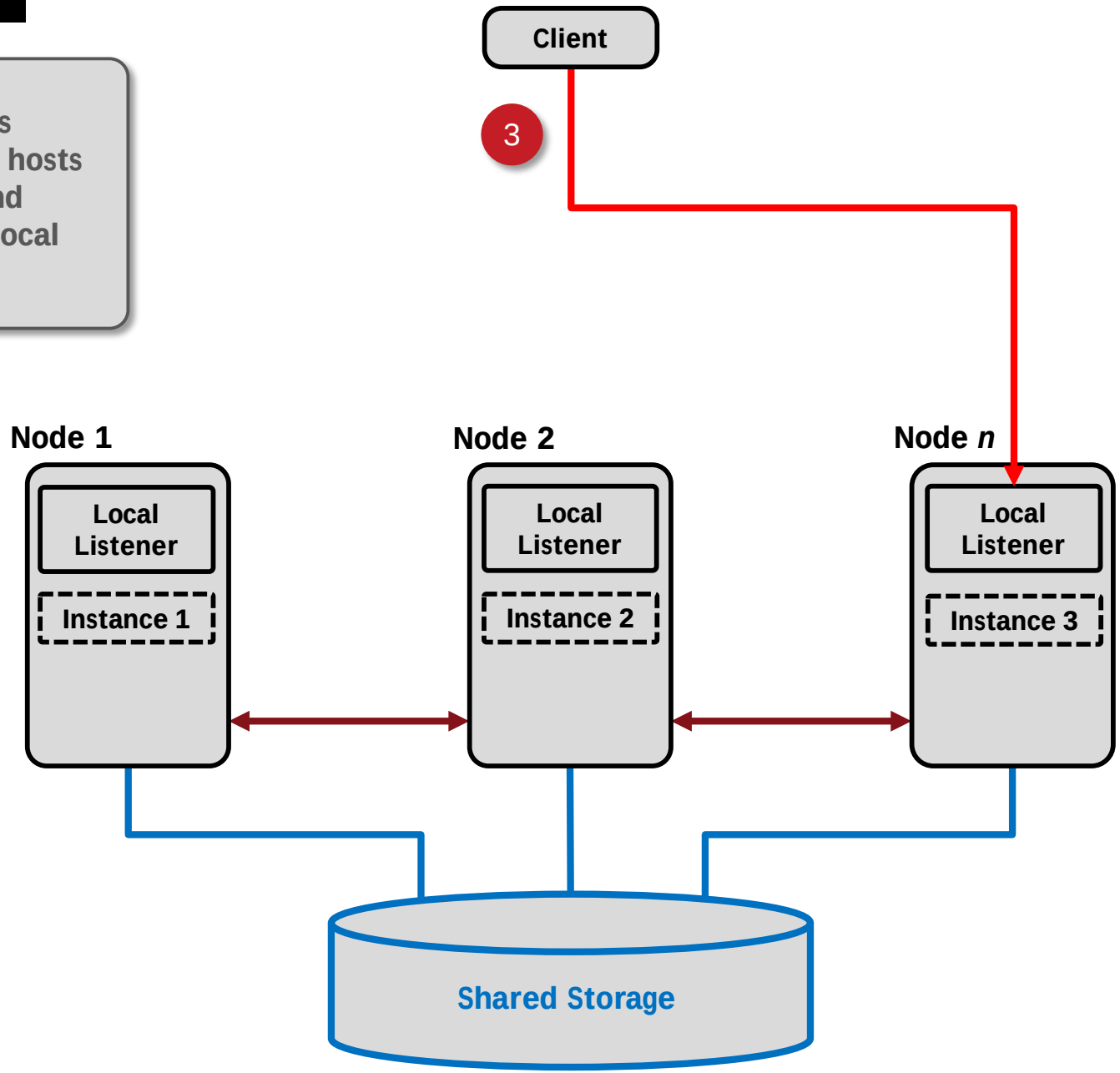




Oracle RAC Connectivity Cycle

Steps:

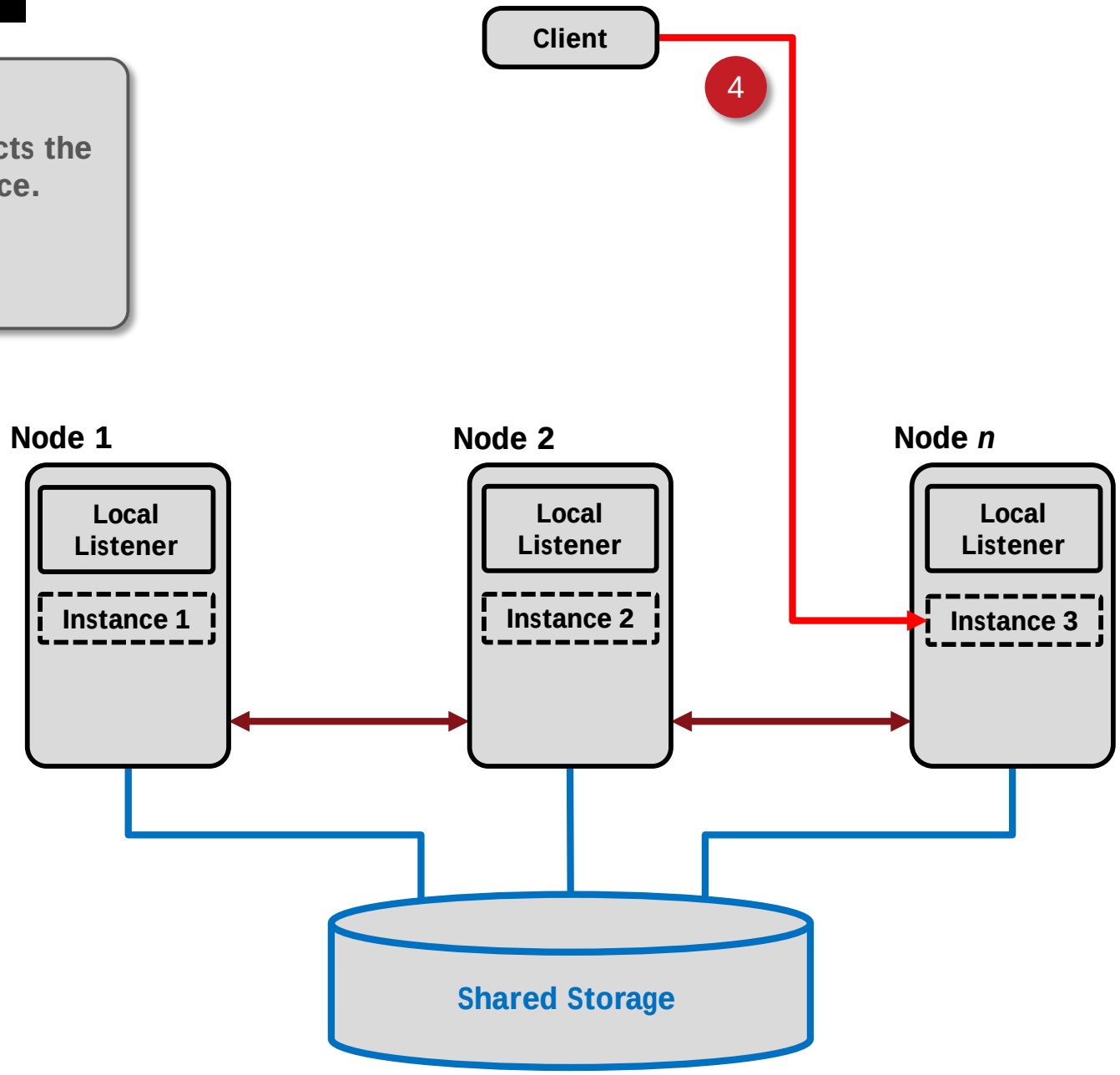
3 SCAN listener determines which database instance hosts the requested service and routes the client to the local listener on the node.



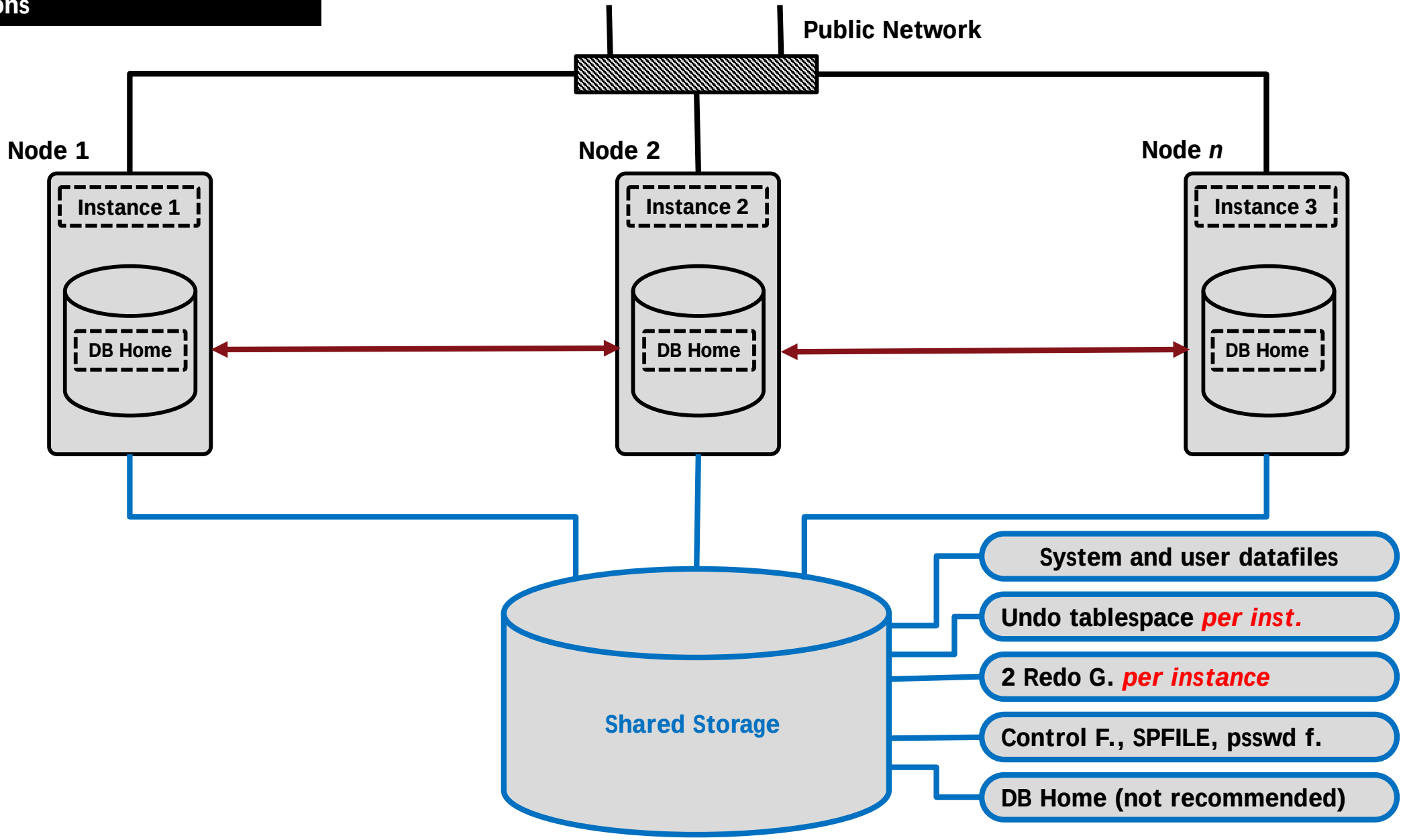
Oracle RAC Connectivity Cycle

Steps:

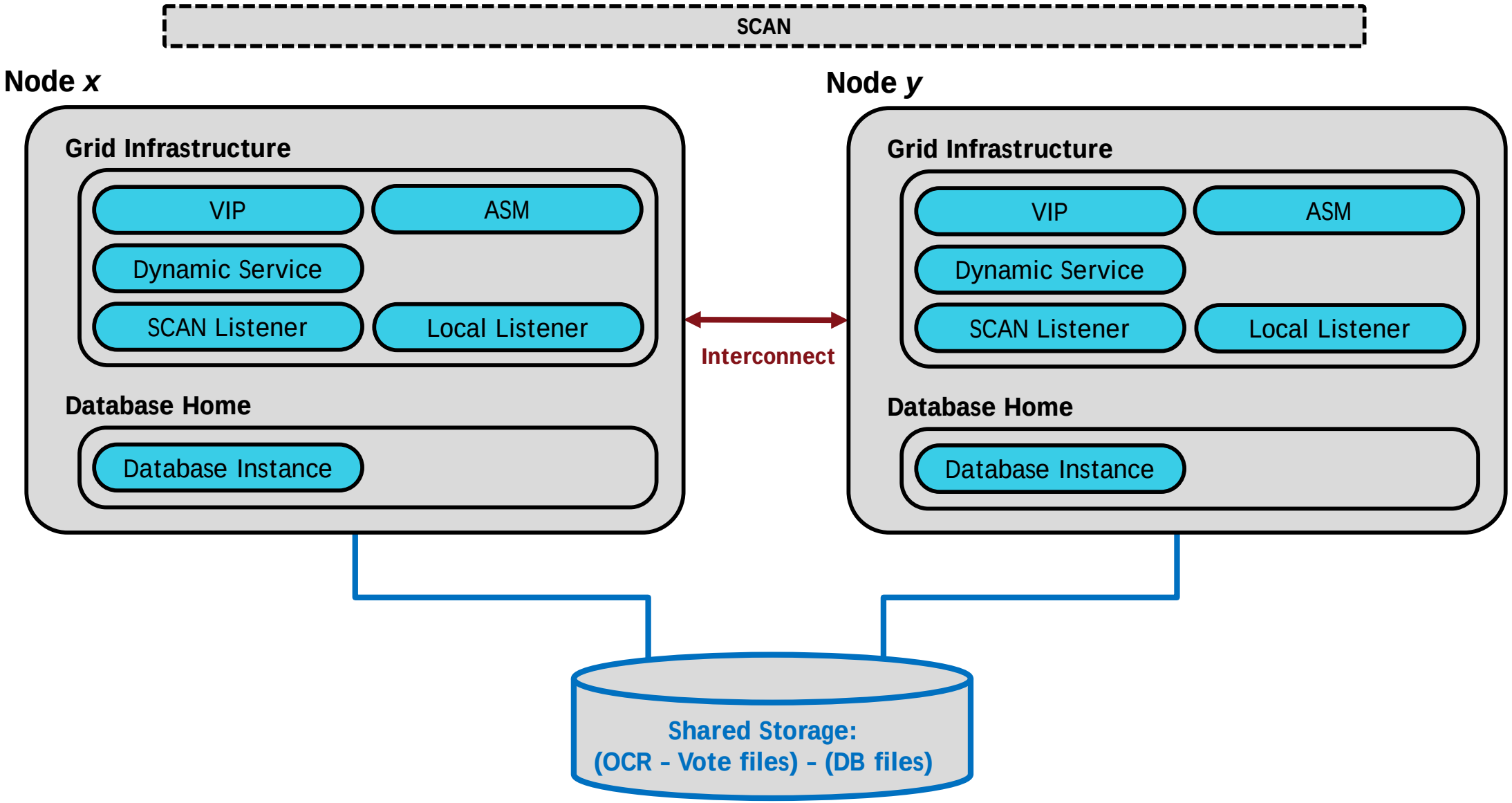
4 The local listener connects the client to the local instance.



Oracle RAC Database File Locations



Oracle RAC Clusterware and Database Stack Components



Summary

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