Module 11

Introduction to Clustering

At the end of this module, you will be able to:

- ✓ Understand the uses of a cluster

- ✓ Describe the basic cluster architecture

- ✓ Describe the multi-tier cluster architecture

- ✓ Understand how clusters communicate

Road Map

1. **Cluster Architecture**
    –   Cluster definition
    –   Basic cluster architecture
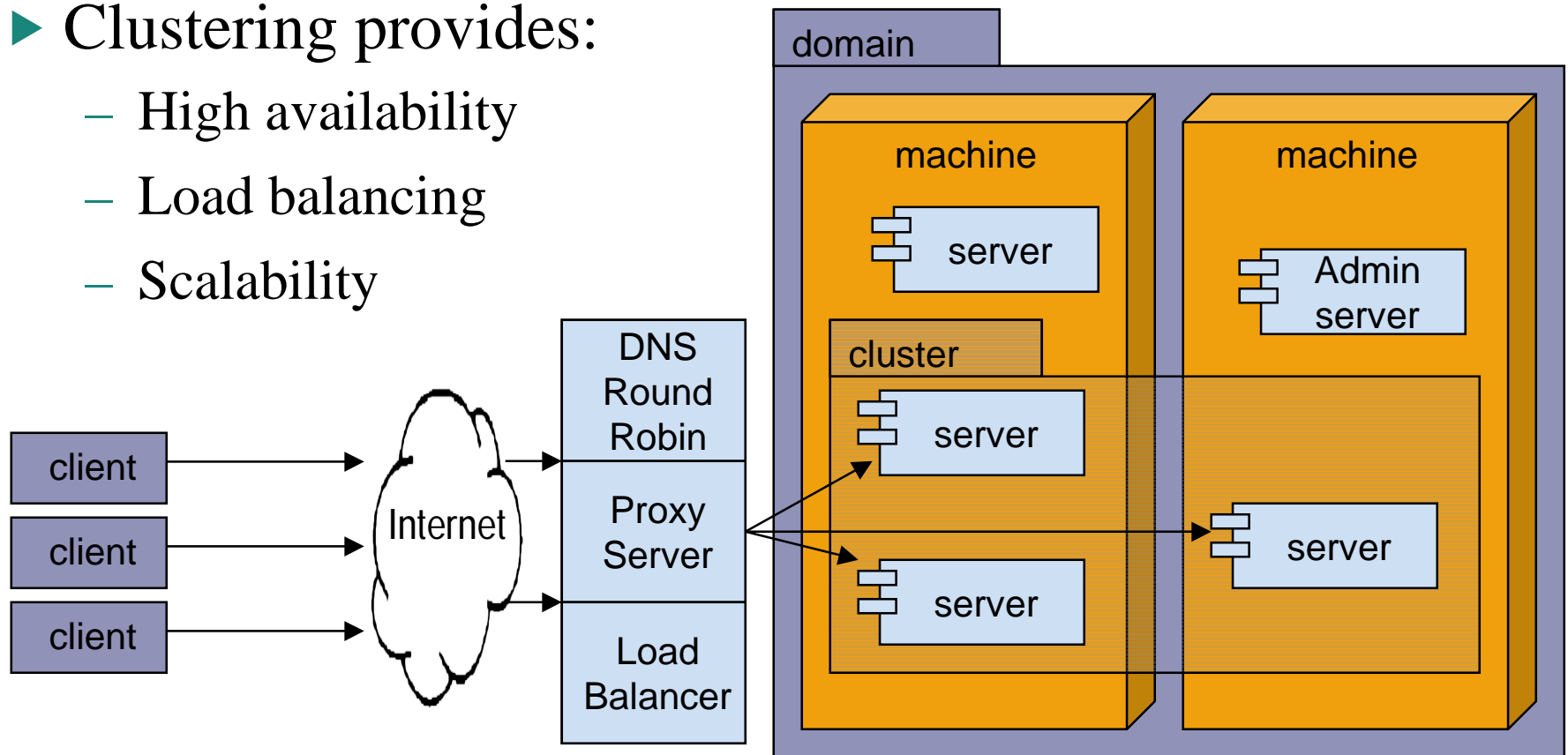   –   Multi-tier cluster architecture
    –   Proxy servers

2. Networks and Clusters

3. Cluster Communication

Definition: Clustering

▶ A *cluster* is a group of WebLogic Server instances, working in coordination.

▶ Clustering provides:
  – High availability
  – Load balancing
  – Scalability

Benefits of Clustering

▶ There are two main benefits of clustering together WebLogic servers:

- – Scalability

- – High-Availability

▶ Scalability allows you to add and remove servers without disrupting current services.

▶ High-Availability ensures that when a server (in a cluster) fails, there are other servers to take over the work so the client is not affected.

Key Capabilities

► The key capabilities of a WebLogic cluster are:

– Application Failover

When an object in an application is performing a task becomes unavailable, another object will take over and finish the job.

– Site Failover

When all the services and applications in a single site fail they can switch to a separate site and continue processing.

– Server Migration

When a server fails, pinned services can be migrated to another server in a cluster.

– Load Balancing

The even distribution of tasks and communications across multiple servers.

Cluster Architecture

▶ Applications are generally broken into multiple tiers, each representing their distinct functionality:

– Web tier

– Presentation tier

– Business or object tier

▶ WebLogic provides clustering support for all three tiers.

▶ Other services, such as JMS and JDBC, can take advantage of clusters but load-balancing and failover is a little different.

# Deciding on a Cluster Architecture

► Good architecture is somewhat subjective but there are a few global considerations:

  – Performance

  – Efficient replication

  – Optimal load balancing

  – Effective failover

  – Reliable communication

► There are two primary cluster architectures to choose from:

  – Basic Cluster architecture

  – Multi-tier architecture

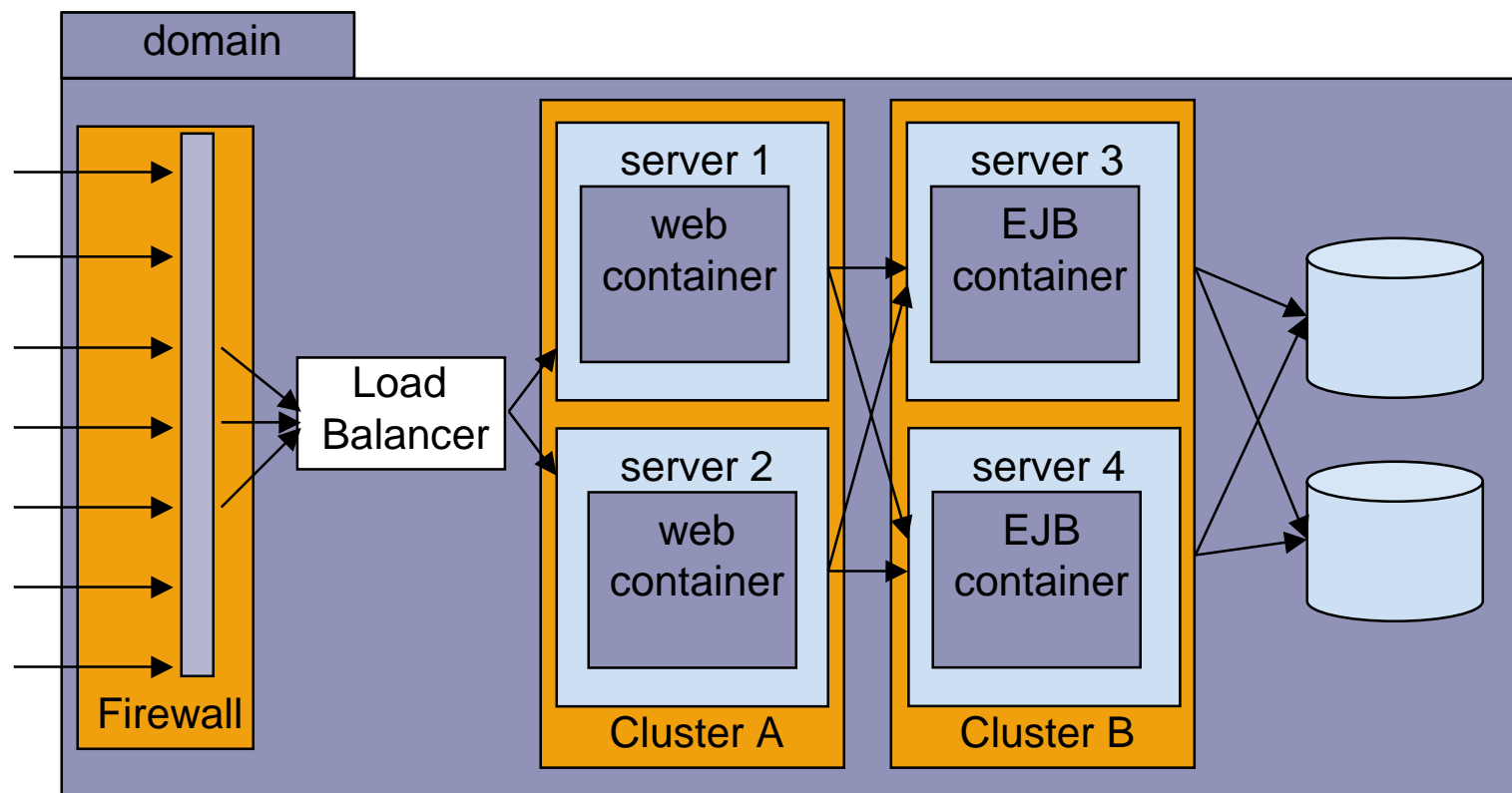© 2006 BEA Systems, Inc.

Basic Cluster Architecture

▶ A basic cluster architecture combines static HTTP, presentation logic, business logic and objects into one cluster.
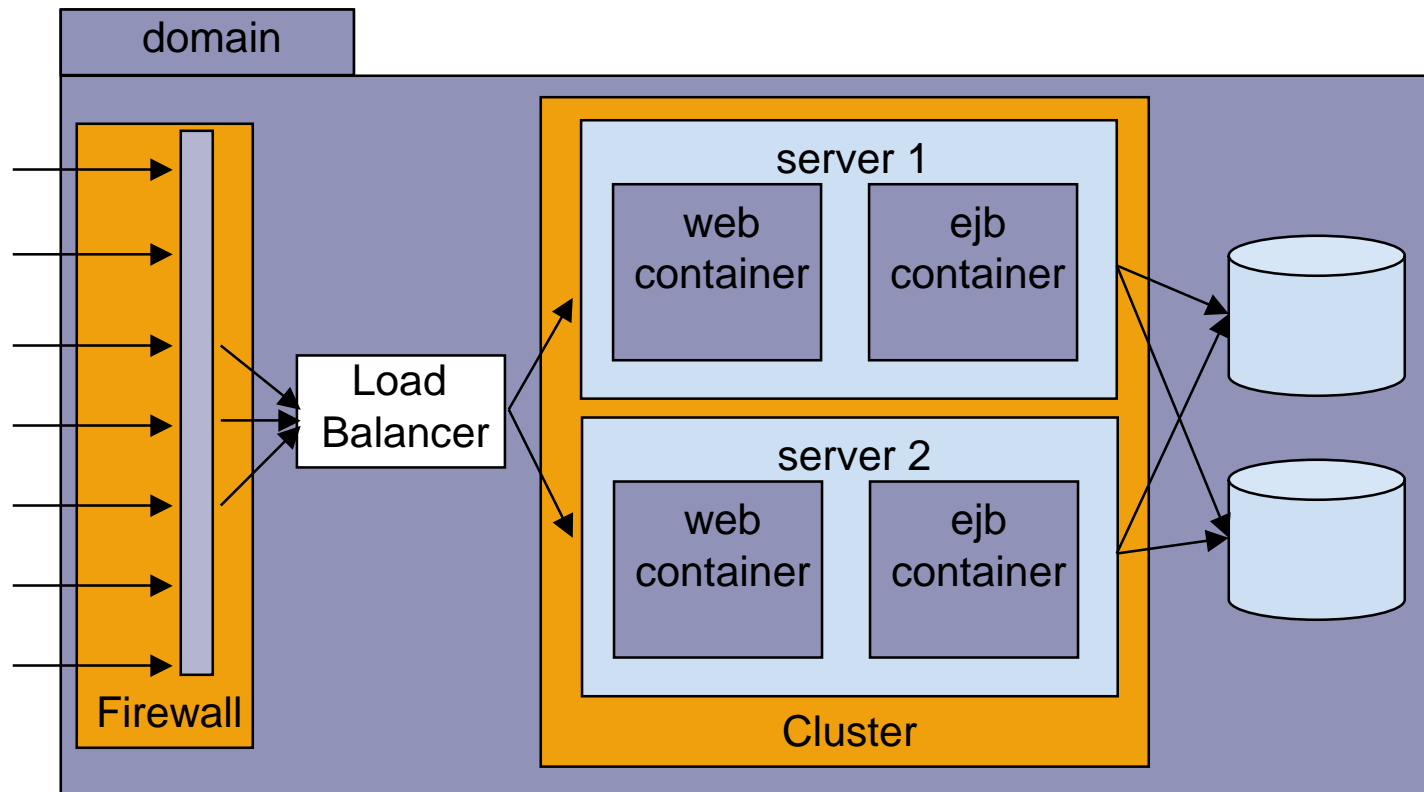
Multi-Tier Cluster Architecture

▶ The Web tier and the business logic with services can be separated into two clusters.

When to Use Multi-tier Architecture

▶ The multi-tier cluster is recommended for Web Applications that require:

- Load balancing for method calls to clustered EJBs

- Flexibility for load balancing between servers that provide HTTP content and servers that provide clustered objects

- Higher availability (fewer single points of failure)

- More flexible security

Basic Cluster Architecture Advantages and Disadvantages

▶ The basic cluster architecture has these advantages:

 – Easy administration

 – Flexible load balancing

 – Robust security

▶ The basic cluster architecture has these disadvantages:

 – Cannot load balance EJB method calls

 – Load balancing across the tiers may become unbalanced

Multi-tier Advantages and Disadvantages

▶ The multi-tier architecture has these advantages:

– Improved load balancing

– Load balancing of EJB methods

– Higher availability

– Improved security options

▶ The multi-tier architecture has these disadvantages:

– Can create a bottleneck when presentation tier makes frequent calls to the business logic

– Increased licensing cost

– Added firewall configuration complexity

Proxy Servers

▶ Proxy servers are used to provide load balancing and failover for a cluster.

– Are the client's first level of interaction with the cluster

– Give the cluster its single server appearance

▶ A proxy server can be either software-based or hardware-based.

▶ A software-based proxy server may be an internal WebLogic servlet or a 3rd party application.

▶ A hardware-based proxy server is typically a physical load balancer.
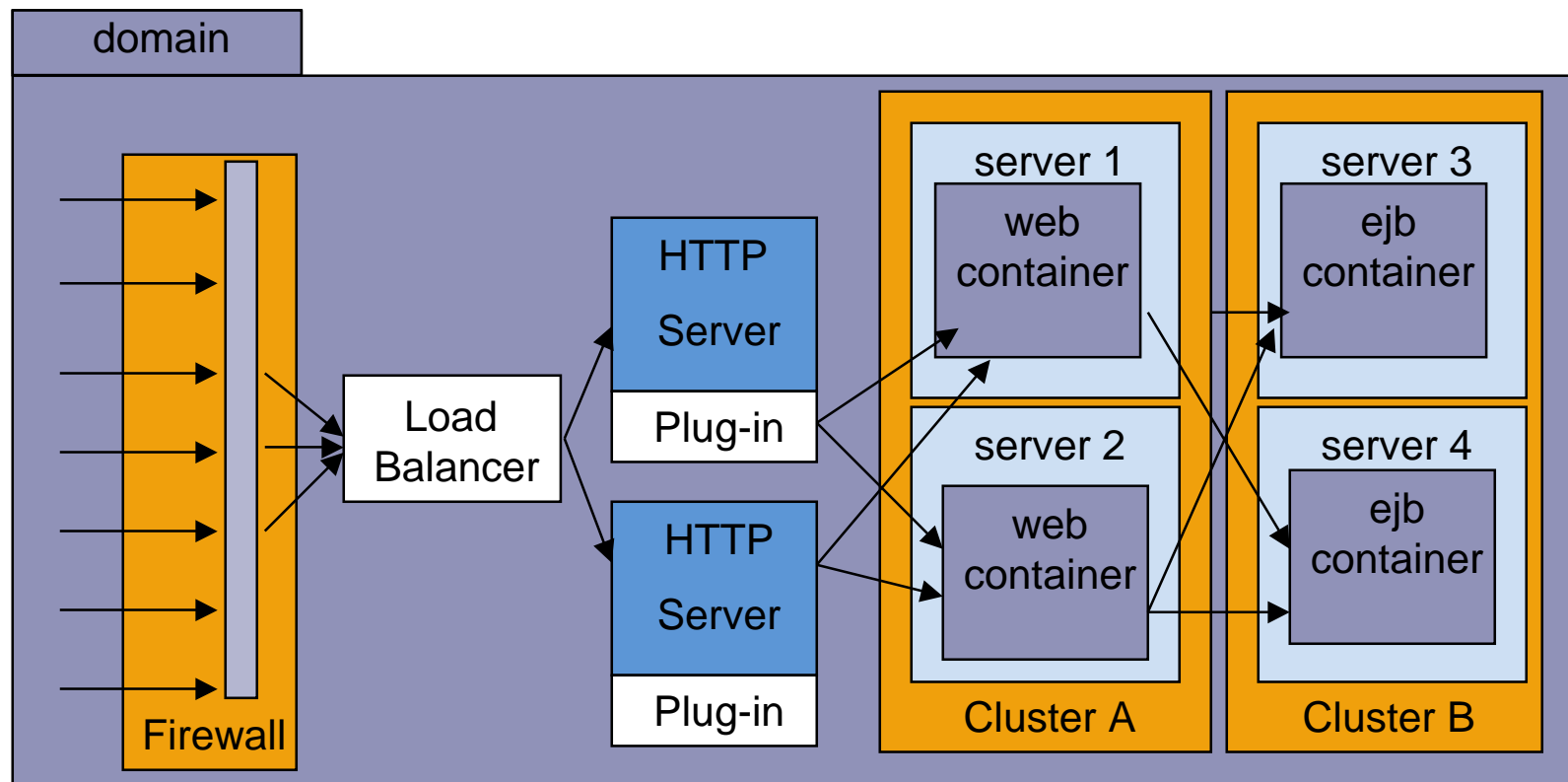
Basic Cluster Proxy Architecture

▶ Similar to the basic cluster architecture, except static content is hosted on non-clustered HTTP servers.
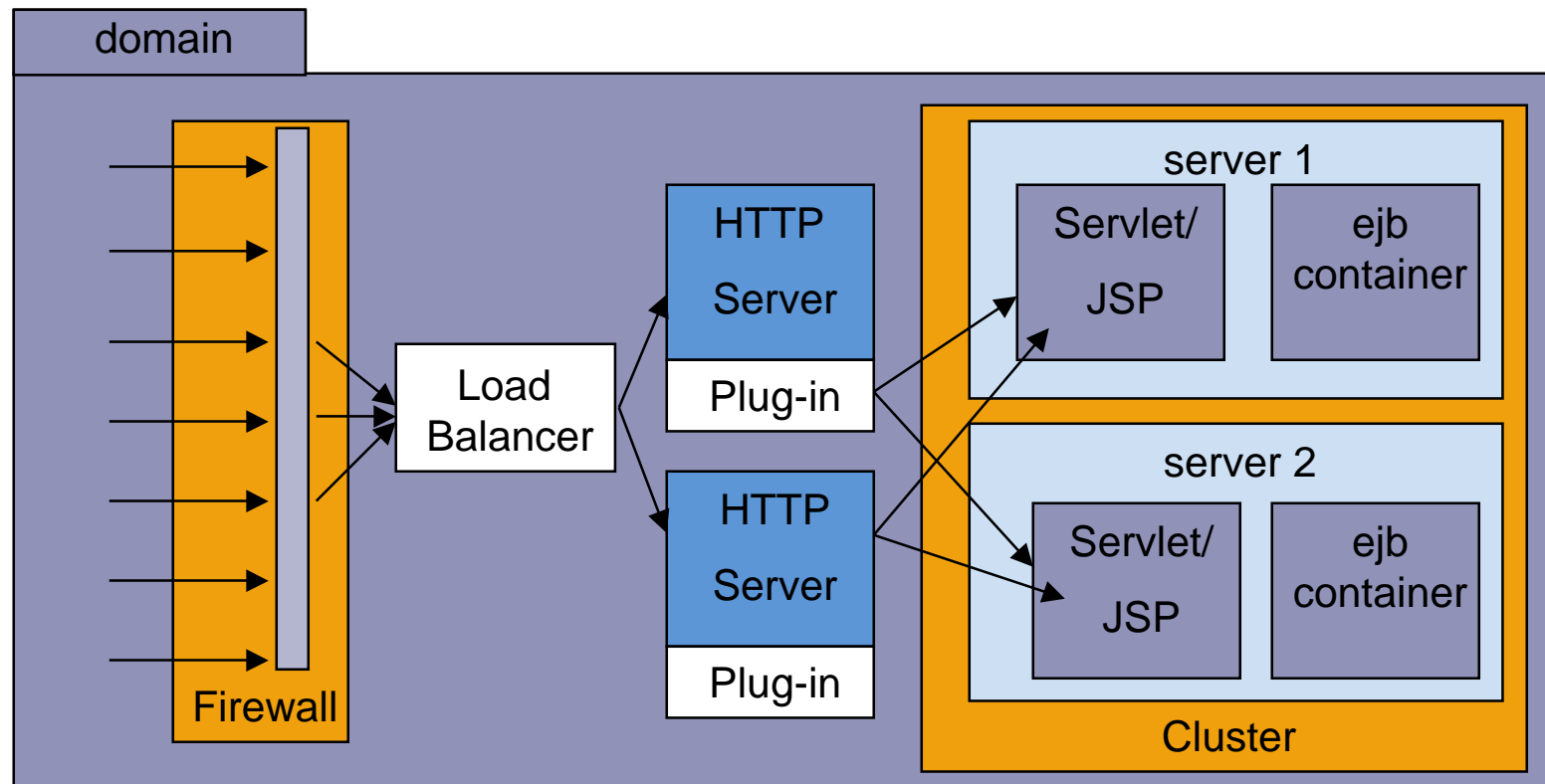
Multi-Tier Cluster Proxy Architecture

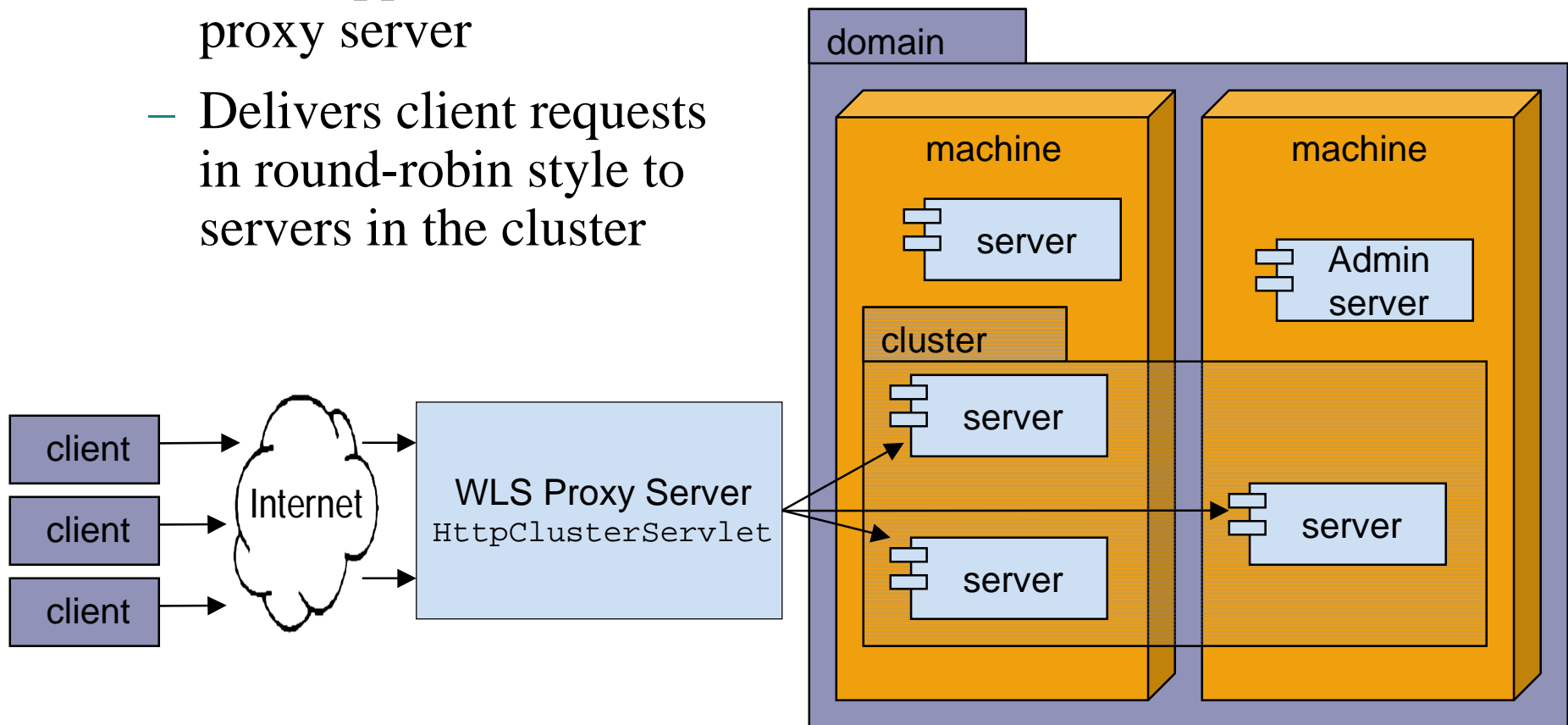▶ Similar to the multi-tier cluster architecture, except static content is hosted on non-clustered HTTP servers.

WLS HttpClusterServlet

▶ `HttpClusterServlet:`

– Is deployed in the default Web Application of the proxy server

– Delivers client requests in round-robin style to servers in the cluster

WLS Plug-Ins…

▶ WLS is compatible with major Web servers using the following plug-ins:

- Sun Java System Web Server plug-in (formerly Netscape iPlanet or Sun One Web Server)

- IIS plug-in (Microsoft IIS)

- Apache plug-in

…WLS Plug-Ins

▶ Plug-ins:

– Delegate dynamic content requests to WLS

– Round-robin across a cluster

– Support routing based on URL path or on MIME type of the requested file or both

– Route HTTP requests to back-end WLS instances based on session cookie or URL rewriting

– Avoid failed servers in the cluster

Proxy Plug-in Vs. Load Balancer

▶ There are many advantages to using a physical load balancer instead of the proxy plug-in:

- No need to configure client plug-ins

- Eliminating the proxy layer reduces the number of connections

- The availability of more sophisticated load balancing algorithms

▶ There are a number of disadvantages as well:

- Additional administration

- Explicit configuration of "sticky" sessions for stateful web applications

Architecture Recommendations

▶ If possible, place static web content on separate web servers in the DMZ.

▶ Use a combined tier architecture if your presentation and control tier makes multiple invocations of the business tier.

▶ Make sure that your architecture choice supports passing active and passive cookies between the cluster and client application.

Section Review

In this section, we learned how to:

✓ Describe the uses of a cluster

✓ Describe a basic cluster architecture

✓ Understand the use of a proxy server

✓ Use a multi-tier architecture

✓ Decide on the best cluster architecture to use

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Road Map

1. Basic Clusters

2. Multi-Tier Clusters

3. **Networks and Clusters**

   – Local Area Networks

   – Metropolitan Area Networks

   – Wide Area Networks

4. Cluster Communication

Cluster in Networks

▶ WebLogic Server clusters can be created in three different kinds of networks:

– Local Area Networks

– Metropolitan Area Networks

– Wide Area Networks

▶ When you are configuring your cluster, you will need to keep in mind the type of network you are using.
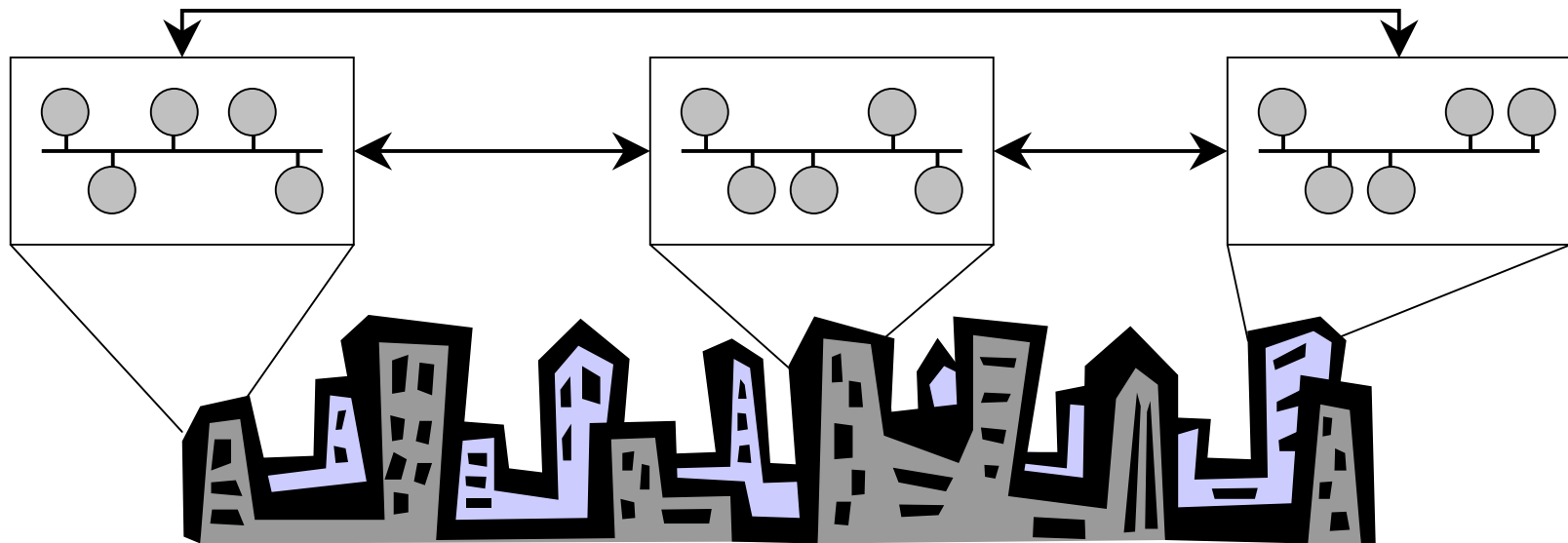
Local Area Networks

▶ A local area network (LAN) serves a local set of computers.

- They usually use high quality, high-speed communication links

- Typical data transmission speeds are 100 megabits/second

▶ Most clusters exist within a single LAN
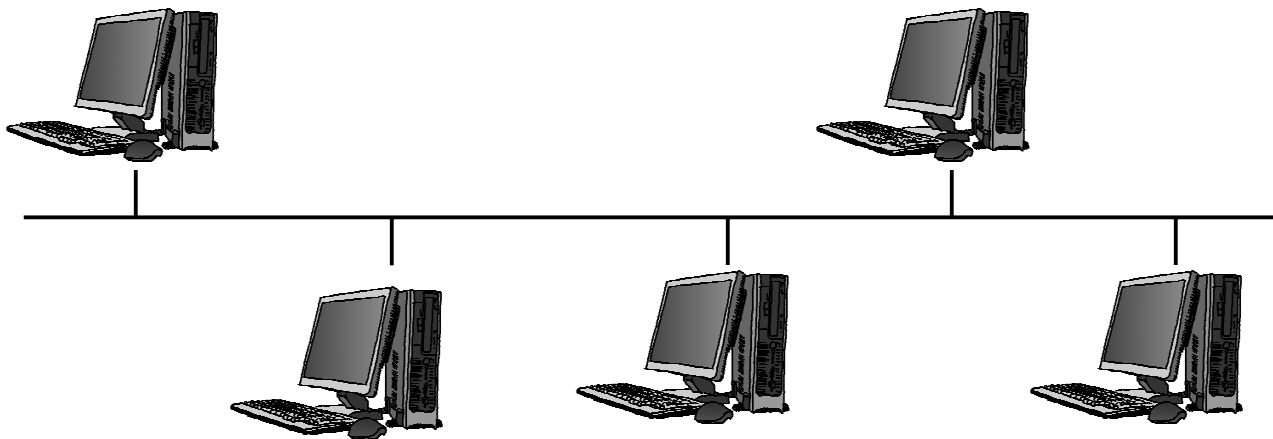
Metropolitan Area Networks

▶ A Metropolitan Area Network (MAN) is a network that usually spans a campus or a city.

▶ You can have different clusters located reasonably close to each other within a MAN.

Wide Area Networks

▶ A Wide Area Network (WAN) usually spans a wider geographical area and can be made up of smaller MANs and Local Area Networks (LAN).

▶ You can have different clusters located in different regions within a WAN.

– A cluster can be located in different LANs within a MAN or within a WAN.
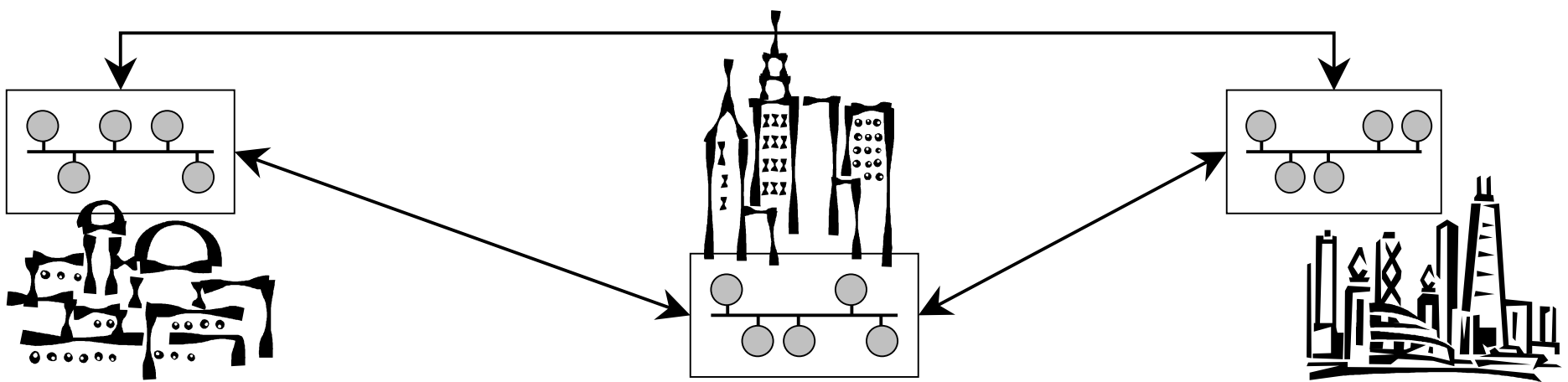
Section Review

In this section, we learned how to:

✓ Describe different types of networks that a cluster can operate in

Road Map

1. Basic Clusters

2. Multi-Tier Clusters

3. MANs and WANs

4. **Cluster Communication**

   – One-to-many communications

   – Peer-to-peer communications

   – Topic

Server Communication in a Cluster

▶ WebLogic Server instances in a cluster communicate with one another using two different techniques:

- Multicast (UDP)

- Sockets (peer-to-peer TCP)

▶ IP multicast broadcasts one-to-many communications among clustered instances.

▶ IP sockets are used for peer-to-peer communications between servers.

Detecting a Failure

- ▶ WebLogic clusters detect a failure of a server instance in the following ways:
  - – Through the use of IP sockets
  - – Through the WebLogic server heartbeat

- ▶ If a server in the cluster unexpectedly closes it's socket, it will be market as "failed" and it's services will not be used.

- ▶ Server instances use multicast to broadcast heartbeats every 10 seconds to other server instances in the cluster.
  - – If three heartbeats are missed from a peer server, the server is marked as "failed" and it's services will not be used

One-to-Many Communications

▶ WebLogic Server uses one-to-many communication for:

- Cluster-wide JNDI updates

- Cluster "heartbeats"

▶ Because all one-to-many communications occur over IP multicast,when designing a cluster, consider these factors:

- If your cluster spans multiple subnets, you network must be configured to reliably transmit messages

- A firewall can break IP multicast transmissions

- The multicast address should not be shared with other applications

- Multicast storms may occur

Peer-to-Peer Communications

▶ WebLogic Server uses peer-to-peer communications for:

– Accessing non-clustered objects that reside on a remote server instance in the cluster

– Replicating HTTP session states and stateful session EJB states between a primary and a secondary server

– Accessing clustered objects that reside on a remote server instance (typically, in a multi-tier cluster architecture)

Multi-Tier Communications

▶ Multi-tier clusters will require more IP Sockets than a combined-tier cluster:

– One socket for replicating session states

– One socket for each WebLogic Server in the EJB cluster, for accessing remote objects

▶ As an example, using a three-node cluster, the worst-case scenario would be five open sockets per server:

– One primary and secondary replicated session

– Each server simultaneously invokes a remote EJB method on each node in the cluster

Communication in a WAN

▶ In a WAN, the servers in your cluster may span multiple subnets.

▶ In order for multicast messages to reliably transmit across the WAN your network must meet the following requirements:

– Full support of IP multicast packet propagation

– A network latency that allows for multicast messages to reach their destination in 200 to 300 milliseconds

– A multicast time-to-live value high enough to ensure that routers do not discard multicast packets

Section Review

In this section, we learned how to:

✓ Describe how servers communicate in a cluster

✓ Understand how multi-tier clusters communicate

Module Review

In this module, we learned how to:

✓ Describe the differences between a basic cluster architecture and a multi-tier cluster architecture

✓ Use a proxy server to load balance requests to a cluster

✓ Describe how servers in a cluster communicate