

# Instructor Guide: AD248 Red Hat JBoss Application Administration I

## Red Hat JBoss Enterprise Application Platform 7.4

### Edition 2 20240117

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## Course Timing

Total course duration: 5 ILT days / 5 VT days.

### ILT

5 (max 5) days. From 5 hours and 30 minutes to 6 hours and 30 minutes (max 6 hours and 30 minutes per day).

*Table 1. ILT Day 1*

Activity	Sections	Time
Introduction	1 sections	5 minutes
Red Hat JBoss Enterprise Application Platform: Architecture and Features	10 sections	2 hours and 50 minutes
Configuring JBoss EAP as a Standalone Server	8 sections	2 hours and 10 minutes
Scripting Configuration and Deploying Applications	2 sections	1 hour and 5 minutes

Activity	Sections	Time
Total for day	21 sections	6 hours and 10 minutes

*Table 2. ILT Day 2*

Activity	Sections	Time
Scripting Configuration and Deploying Applications	4 sections	1 hour and 10 minutes
Configuring JBoss EAP as a Managed Domain	10 sections	2 hours and 20 minutes
Configuring Servers in a Managed Domain	10 sections	2 hours and 15 minutes
Configuring Data Sources	4 sections	45 minutes
Total for day	28 sections	6 hours and 30 minutes

*Table 3. ILT Day 3*

Activity	Sections	Time
Configuring Data Sources	6 sections	1 hour and 40 minutes
Configuring the Logging Subsystem	6 sections	2 hours and 15 minutes
Configuring the Messaging Subsystem	8 sections	2 hours and 35 minutes
Total for day	20 sections	6 hours and 30 minutes

*Table 4. ILT Day 4*

Activity	Sections	Time
Securing JBoss EAP	10 sections	2 hours and 35 minutes
Configuring the Java Virtual Machine	6 sections	1 hour and 20 minutes
Configuring the Web Subsystem	6 sections	2 hours and 5 minutes
Total for day	22 sections	6 hours

*Table 5. ILT Day 5*

Activity	Sections	Time
Deploying Clustered Applications	10 sections	2 hours and 55 minutes
Compreview	2 sections	2 hours and 35 minutes
Total for day	12 sections	5 hours and 30 minutes

## VT

5 (max 5) days. From 5 hours and 30 minutes to 6 hours and 30 minutes (max 6 hours and 30 minutes per day).

*Table 6. VT Day 1*

Activity	Sections	Time
Introduction	1 sections	5 minutes
Red Hat JBoss Enterprise Application Platform: Architecture and Features	10 sections	2 hours and 50 minutes
Configuring JBoss EAP as a Standalone Server	8 sections	2 hours and 10 minutes
Scripting Configuration and Deploying Applications	2 sections	1 hour and 5 minutes
Total for day	21 sections	6 hours and 10 minutes

*Table 7. VT Day 2*

Activity	Sections	Time
Scripting Configuration and Deploying Applications	4 sections	1 hour and 10 minutes
Configuring JBoss EAP as a Managed Domain	10 sections	2 hours and 20 minutes
Configuring Servers in a Managed Domain	10 sections	2 hours and 15 minutes
Configuring Data Sources	4 sections	45 minutes
Total for day	28 sections	6 hours and 30 minutes

*Table 8. VT Day 3*

Activity	Sections	Time
Configuring Data Sources	6 sections	1 hour and 40 minutes
Configuring the Logging Subsystem	6 sections	2 hours and 15 minutes
Configuring the Messaging Subsystem	8 sections	2 hours and 35 minutes
Total for day	20 sections	6 hours and 30 minutes

*Table 9. VT Day 4*

Activity	Sections	Time
Securing JBoss EAP	10 sections	2 hours and 35 minutes
Configuring the Java Virtual Machine	6 sections	1 hour and 20 minutes
Configuring the Web Subsystem	6 sections	2 hours and 5 minutes
Total for day	22 sections	6 hours

*Table 10. VT Day 5*

Activity	Sections	Time
Deploying Clustered Applications	10 sections	2 hours and 55 minutes
Compreview	2 sections	2 hours and 35 minutes
Total for day	12 sections	5 hours and 30 minutes

# Orientation to the Classroom Network

## Orientation to the Classroom Network (10 min)

In this course, the main computer system for hands-on learning activities is `workstation`. These activities also involve two other hosts, `servera` and `serverb`.

The system called `bastion` must always be running.

These two systems are in the `lab.example.com` DNS domain.

All student computer systems have a standard user account, `student`, which has `student` as the password. The `root` password on all student systems is `redhat`.

*Table 11. Classroom Machines*

Machine name	IP addresses	Role
<code>workstation.lab.example.com</code>	172.25.250.9	Graphical workstation that the student uses. Server to install JBoss EAP
<code>bastion.lab.example.com</code>	172.25.250.254	Router to link VMs to central course servers
<code>classroom.lab.example.com</code>	172.25.252.254	Server to host the required classroom materials for the course
<code>utility.lab.example.com</code>	172.25.250.253	Server to provide supporting services.
<code>servera.lab.example.com</code>	172.25.250.10	Server to install JBoss EAP
<code>serverb.lab.example.com</code>	172.25.250.11	Server to install JBoss EAP

The `bastion` system acts as a router between the network that connects the student machines and the classroom network. If `bastion` is down, then other student machines might not function properly, or might even hang during boot.

### Guidelines to the Exercises

There are two types of hands-on learning activities: the *guided exercises* at the end of each lecture, and the *review exercises* at the end of each chapter.

You can start the exercises in any order.

All exercises have an `/opt/jboss-eap-7.4` directory for JBoss EAP binary files. This directory always contains the `admin` user with `redhat123` as the password to manage the JBoss EAP managed domains and standalone servers. You copy the resources and configurations from that source to the exercise working directory.

The exercise working directory is `/home/student/AD248/labs/exercise-name` for all the guided exercises. The review exercises use a managed domain distributed in the three machines: `workstation`, `servera`, and `serverb`. The exercise working directories for review exercises are `/opt/domain` and `/opt/standalone` in those three machines.

Both exercise types need to start each practice by using the `lab start exercise-name` command. That command ensures that you have a clean environment and all the needed resources for the exercise. Only review exercises have a `lab grade exercise-name` command to grade your work.

It is mandatory to run `lab finish exercise-name` when you finish each exercise.

**WARNING**

In the review exercises, the `lab finish exercise-name` command deletes the content of `/opt/domain` and `/opt/standalone`. Run `lab finish exercise-name` from review exercises only when you have graded your exercise. The content of `/home/student/AD248/labs/exercise-name` is never deleted.

**NOTE**

If you stops the classroom before finishing an exercise that starts JBoss EAP manually, then you need to start again all JBoss EAP standalone instances or host controllers when the classroom reboots. All other components, such as containers, or modified files in all machines, are ready at classroom restart.

## The Course Applications

Most of the applications in use in the course are from the Red Hat JBoss Enterprise Application Platform (JBoss EAP) Quickstarts repository at <https://github.com/jboss-developer/jboss-eap-quickstarts/tree/7.4.x>. Some of the quick start applications have modifications to better fit the exercise objectives. Some other applications are specific developments for this course. All applications include their source code inside the WAR or JAR files.

The following is the list of applications used in the course:

### `kitchensink.war`

From <https://github.com/jboss-developer/jboss-eap-quickstarts/tree/7.4.x/kitchensink>. The `kitchensink` quickstart demonstrates a Jakarta EE 8 web-enabled database application using JSF, CDI, EJB, JPA, and Bean Validation. In the data sources chapter the application is modified to no drop the database, and to not use the embedded data source.

### `temperature-converter.war`

From <https://github.com/jboss-developer/jboss-eap-quickstarts/tree/7.4.x/temperature-converter>. The `temperature-converter` quickstart does temperature conversion using an EJB Stateless Session Bean (SLSB), CDI, and a JSF front-end client.

### `greeter.war`

From <https://github.com/jboss-developer/jboss-eap-quickstarts/tree/7.4.x/greeter>. The `greeter` quickstart demonstrates the use of CDI, JPA, JTA, EJB and JSF in JBoss EAP.

### `logtest.war`

Red Hat Training simple web application to emit log by using a servlet. The application reads the level and the message from the user input, and write it to the log from the `com.redhat.training.view` Java package.

### `cluster.war`

Red Hat Training simple web application to inform about the numbers of visits from an HTTP session by using a Java Server Page (JSP). The application reads the number of visits from an HTTP session attribute, and increments it. The JSP also shows which JBoss EAP instance from the node is responding the request. The application has the `<distributed/>` tag in its `web.xml` file to inform the application server that the application needs session replication between cluster members.

`helloworld-mdb.war`, `mdb-client.war`, and `messaging-mdb-secure.jar`

Messaging applications. From <https://github.com/jboss-developer/jboss-eap-quickstarts/tree/7.4.x/helloworld-mdb>. The `mdb-client.war` is the web interface also coming from the `helloworld-mdb` repository. The `messaging-mdb-secure.jar` is a JMS client that access the same JMS Queue, but using `admin/admin` as credentials.

# Red Hat JBoss Enterprise Application Platform: Architecture and Features

## Chapter Information

### Overview

This chapter will introduce what Red Hat JBoss Enterprise Application Platform is, the relationship between JBoss EAP 7, the upstream Wildfly project, and Jakarta Enterprise Edition 8, and how a system administrator can install it.

### Schedule

*Table 12. ILT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Exploring the Architecture of JBoss EAP	P: Lecture	40
		A: Quiz	
2	Installing JBoss EAP	P: Lecture	45
		A: Guided Exercise	
3	Understanding Extensions, Subsystems, and Profiles	P: Lecture	25
		A: Quiz	
4	Managing JBoss EAP	P: Lecture	35
		A: Guided Exercise	
	Lab	Unguided Lab	20
Conclusion			2

*Table 13. VT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Exploring the Architecture of JBoss EAP	P: Lecture	40
		A: Quiz	
2	Installing JBoss EAP	P: Lecture	45
		A: Guided Exercise	
3	Understanding Extensions, Subsystems, and Profiles	P: Lecture	25
		A: Quiz	
4	Managing JBoss EAP	P: Lecture	35
		A: Guided Exercise	
	Lab	Unguided Lab	20
Conclusion			2

Total Time: 160 minutes

## Chapter Introduction

### Introduction (3 min)

This chapter will discuss the JBoss EAP architecture, how it addresses technical requirements (scalability and reliability), and how EAP 7 fits in. Also, we will address the various options to install EAP 7 and the different ways of managing EAP. Students will learn about the installation process, and some recommendations for production environments.

## Instructional strategies for Exploring the Architecture of JBoss EAP (35 + 5 min.)

### Objective

- Identify the architecture and features of JBoss EAP.
- Identify the relationship between JBoss EAP 7 and Jakarta Enterprise Edition 8
- Describe the relationship between JBoss EAP 7 and Wildfly
- Students learn how EAP 7 related to its upstream open source projects and formal standards.
- Students learn how EAP 7 evolved to its current form and become motivated to learn about its features.
- Students learn how EAP 7 fits typical application infrastructure scenarios.



# Presentation Notes

## Introduction (3 min)

EAP 7 updates the EAP architecture to new Jakarta EE standards, and replaces the web and messaging components with new implementations.

1. Have you worked with previous EAP releases and/or other JEE application servers?

This is an open-ended question intended to get the students talking and gauge their level of familiarity with some of the concepts presented during this lecture.

1. Do you think an application servers can be made light enough to support cloud-native applications?

This is an open-ended question intended to get the students talking.

## Lecture (35 min)

Talk lightly about EAP 7 features and benefits, and also about the relationships between EAP and Jakarta EE, and Wildfly. The real goal is to get to the topics about managed domains, hosts and servers. Beware to not spent too much time because each bullet in the first half of the lecture could lead to a long discussions by itself. Try to give students short answers and direct them to the references at the end of the section for more information.

Use the introduction to check whether the students are familiar with middleware and application server concepts. Also check their level of familiarity with Jakarta EE, EAP releases, and cloud deployments. Different parts of the lecture will need to go deeper or be treated lighter depending on students experiences and expectations. Use the opportunity to fill gaps in pre-requisite knowledge.

Use the figures to explain the EAP role as application server middleware. Notice that the second figure was left intentionally generic: it could apply equally to clustered standalone servers and to clustered server instances that are part of a managed domain. Notice that the figures illustrates only a small subset of the services and functionality provided by EAP.

If students are unfamiliar with JCP and JSRs, stress the importance of having vendor-neutral standards and that applications compliant to those standards should run unchanged in EAP and other certified JEE servers. But of course EAP is the fastest, lightest and more flexible of them all.

If someone asks, explain to students that the name change from JBoss AS to Wildfly was made to avoid confusion among the many JBoss community projects and between the open source project and the Red Hat product.

Stress the benefits of EAP, a supported, reliable distribution of an open source project, compared to Wildfly. You can make an analogy between EAP x Wildfly and RHEL x Fedora.

Highlight to sysadmins that EAP 7 is even faster and more easily manageable than EAP 6 because of the port reduction, off-line CLI, and suspended mode. Minimize the negative impact of changed components and dropped ones.

Focus more on the managed domains operating mode. Relate standalone server to the way EAP 4 and 5 operated if the students had experience with those, but do not put much emphasis on standalone server if students have no prior experience with EAP or had only with EAP 6.

Explain to students that host controllers (including domain controllers) are EAP instances that do NOT run applications. They only run management. You can navigate to the configuration files to show they are there, but do not try yet to explain the syntax and what is in other EAP installation folders.

## Quiz

Tell your students to turn to the quiz in their books. Give them approximately 5 minutes to complete it, then discuss the answers.

## Summary

EAP 7 is a fast, lightweight and open standards-compliant Jakarta EE application server designed for both traditional enterprise applications and more modern cloud applications needs.

A single server instance can be started in seconds, with the minimal components absolutely required by an application, while a managed domain can scale to hundreds of server instances, giving productivity to both the administrator and the developer.

# Instructional strategies for Installing JBoss EAP (25 + 20 min.)

## Objective

- Identify the available methods for JBoss EAP 7 installation
- Install JBoss EAP 7

## Benefits

- Students learn the different ways to install EAP appropriate to their environment
- Students learn how to install EAP 7 using the GUI installer and start EAP as an Operating System Service (RHEL)

## Presentation Notes

### Introduction (3 min)

Installing EAP 7 via the installer will allow administrators to create a Management User Account during install and allow you to customize the different subsystems of EAP 7. The zip file install method is cross-platform and can be used on multiple Operating Systems with a compatible JDK 8.

The RPM installation method is only available on RHEL. For multiple server installations, the automated install approach using the answer file along with configuration management tools like Ansible is preferred.

1. What installation options would you choose to install EAP 7 on RHEL, Any other Linux distribution and Windows Server Operating Systems?

This is an open-ended question intended to get the students talking.

## Lecture (25 min)

This topic explores in detail, the different methods available to install EAP 7. Students learn how to perform a manual installation using the GUI installer as well as patching and upgrading EAP installations. Be sure to discuss other methods for installing EAP like the RPM install (for RHEL systems), zip file install and briefly mention that EAP is also available as container images from the official Red Hat registry for OpenShift. This chapter also explores the different ways to manage EAP. Management Console, JBoss EAP CLI and Manually editing XML files. Be sure to emphasize that the web based Management Console or the JBoss EAP CLI is the preferred approach for configuring and managing EAP rather than editing the XML files manually.

## Guided Exercise

Tell your students to turn to the guided exercise in their books. Give them approximately 20 minutes to complete it, then discuss the answers.

## Summary

EAP 7 should be installed under `/opt/jboss-eap-7.4` folder and students must be able to start the server and login to the Management Console.

Note that the recommended approach in Production deployments is to run EAP using a separate user account that does not have shell access. In this Guided Exercise, the `jboss` user has ownership of the EAP 7 installation folders and EAP must be started as this user. Watch out for `Permission Denied` errors during EAP startup as well as `Address already in use` errors which indicate that another instance of EAP is already running or was not properly shutdown.

# Instructional strategies for Interpreting Extensions, Subsystems, and Profiles (20 + 5 min.)

## Objective

- Interpret the architecture of extensions, subsystems, modules, and profiles.
- Identify the relationship between JBoss EAP 7 modules, extensions, and subsystems.

- Summarize how JBoss Modules affect application classloading.

## Benefits

- Students learn how JBoss EAP 7 gets to be fast and lightweight.
- Students learn the high-level EAP configuration concepts.

## Presentation Notes

### Introduction (3 min)

The main concepts on the architecture and configuration of EAP server instances are: modules, extensions, subsystems and profiles.

1. Have you ever experienced "jar hell" ?

This is an open-ended question intended to get the students talking.

### Lecture (20 min)

The lecture follows a top-down approach from the EAP architecture to its configuration concepts. Starting with the EAP core and the modules it manages, to the extensions that provide Jakarta EE and non-Jakarta EE services, and from the subsystems that expose the management model for administrators to the profiles that provides reusable configurations tailored for common scenarios.

Do not try to explain each box in the first figure, nor each extension or subsystems that is used to illustrate the general concepts here. Just assure students most of them will be covered either in this course.

Navigate to the configuration folder for both standalone servers and managed domains, but refrain from opening and explaining all files in each folder. Just open `standalone.xml` and `domain.xml` to stress how the syntax for configuring extensions and subsystems is the same for both operating modes.

Explain the intended use for each of the out-of-the-box profiles on `domain.xml` and show that the four versions of `standalone*.xml` correspond to the same profiles. Make sure students understand the difference between a Jakarta EE profile and an EAP configuration profile.

Tell students the recommended practice is to create a new profile (or a copy of one of the `standalone*.xml` files) and customize it to an application or organization needs, instead of directly changing the provided profiles.

## Quiz

Tell your students to turn to the quiz in their books. Give them approximately 5 minutes to complete it, then discuss the answers.

## Summary

EAP has a modular architecture that allows extension modules to be activated on demand, and each of its many subsystems have its own intuitive configuration syntax. To make it easier to reuse a set of configurations for multiple subsystems, they are organized into profiles.

# Instructional strategies for Managing JBoss EAP (10 + 25 min.)

## Objective

- Describe the management options available for JBoss EAP

## Benefits

- Students learn the different ways to Manage EAP

## Presentation Notes

### Introduction (3 min)

EAP can be managed and configured in different ways. Discuss the different options that are available and the pros and cons of each.

1. What are the advantages of the JBoss EAP CLI over other options?

This is an open-ended question intended to get the students talking.

### Lecture (10 min)

Discuss both the EAP 7 Management Console and the JBoss EAP CLI. Highlight the fact that changes made from one tool are automatically reflected in the other in real-time. Highlight the ease of use features of the JBoss EAP CLI (command history, auto-complete, inbuilt documentation of attributes, scripting via bash and batch mode).

## Guided Exercise

Tell your students to turn to the guided exercise in their books. Give them approximately 25 minutes to complete it, then discuss the answers.

## Summary

Students must be able to login to the Management Console or the JBoss EAP CLI and configure the server. Changes must be persisted to `standalone.xml` and these changes must be visible across both tools immediately. Emphasize the fact that the CLI and the Management Console are the preferred

ways to configure and manage EAP and that manual editing of XML files should be avoided.

## Chapter Review (20 min.)

Have your students turn to the Unit Test in their books. Give them approximately 20 minutes to complete this exercise.

### Wrap Up (~5 min)

Final review should take approximately 5 minutes. Address any learner questions or comments and review the benefits with the students. Have students turn to the summary section in the student guide and review the summary points with them.

## Review Questions

1. What out-of-the-box EAP profile would be the simplest implementation of the Jakarta EE web profile?

The default profile is the smaller profile provided out-of-the-box by EAP 7 and it provides all APIs required by the JEE. The additions made by the other three profiles are either required only by the Jakarta EE full profile (like messaging) or provide capabilities beyond the required by Jakarta EE certification (like clustering).

1. What approach would you choose to install EAP 7 on a cluster of 8 servers that have to be configured in a similar fashion?

The automated installer approach with an answer file combined with a configuration management tool like Ansible. The JBoss EAP CLI can be used to script uniform configuration post-install.

# Configuring JBoss EAP as a Standalone Server

## Chapter Information

### Overview

This chapter discusses how to run a standalone EAP server, and how to configure that instance both with the Management Console and with the `standalone.xml` file. Students will learn about the directory structure of the standalone EAP server, and how to create separate base directories for custom configurations. Be sure to discuss the benefits of standalone mode (simple startup) and the complications (port offset for multiple instances, managing each configuration file).

# Schedule

*Table 14. ILT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Running JBoss EAP Standalone Server	P: Lecture	40
		A: Demo/Guided Exercise	
2	Configuring JBoss EAP as a Standalone Server	P: Lecture	35
		A: Demo/Quiz	
3	Configuring Interfaces and Socket Binding Groups	P: Lecture	20
		A: Demo/Quiz	
	Lab	Unguided Lab	30
Conclusion			2

*Table 15. VT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Running JBoss EAP Standalone Server	P: Lecture	40
		A: Guided Exercise	
1	Configuring JBoss EAP as a Standalone Server	P: Lecture	35
		A: Quiz	
	Configuring Interfaces and Socket Binding Groups	P: Lecture	20
		A: Quiz	
	Lab	Unguided Lab	30
Conclusion			2

Total Time: 130 minutes

## Chapter Introduction

### Introduction (3 min)

This chapter goes into specific detail about running EAP as a standalone server. Students will become familiar with the directory structure of EAP as a standalone server and will be thoroughly instructed on each part of the `standalone.xml` file. Students are also introduced to how to modify a standalone server using the Management Console. Be sure to emphasize that students should not directly edit the `standalone.xml` file and instead use either the Management Console or the EAP CLI.

# Running JBoss EAP Standalone Server (20 + 20 min.)

## Objective

- Configure an instance of JBoss EAP to run as a standalone server.
- List the characteristics of a JBoss EAP standalone server.

## Presentation Notes

### Introduction (3 min)

Standalone server allows users to run a single EAP server running in a single process. The features available for the standalone server are as robust as they are with running EAP in a Managed Domain, however there is less initial overhead. However, running concurrent instances of EAP can create some complexities such as managing port conflicts and repeating multiple directories for configuring.

1. What are the benefits of running a standalone server?

This is an open-ended question intended to get the students talking.

### Lecture (20 min)

Describe the features of the standalone server and that it is ideal for running a single instance of EAP with a single server. The server also conveniently has a single configuration file, `standalone.xml`. Be sure to emphasize which folders are required as a base directory and which directories are automatically created when the server starts. Explain the difference between the run time variables in `jboss.home.dir` and `jboss.server.base.dir`.

### Guided Exercise (20 min)

Tell your students to turn to the guided exercise in their books. Give them approximately 20 minutes to complete it, then discuss the answers.

### Summary (2 min)

Use `./standalone.sh` to run a new instance of EAP as a standalone server.

## Configuring a JBoss EAP Standalone Server (30 + 5 min.)



## Objective

- Interpret the `standalone.xml` configuration file.
- Make configuration changes and updates to JBoss EAP as a standalone server.

## Presentation Notes

### Introduction (2 min)

The `standalone.xml` file is responsible for the configuration of EAP in a standalone instance.

### Lecture (30 min)

Configuration for a standalone instance of EAP occurs in the `standalone.xml` file. The file is structured by a series of extensions that can be configured in the `<profile>` section as subsystems. Each subsystem requires a custom set of configurations that can be found in the `JBOSS_HOME/docs` directory.

Extensions are modules that extend the core capabilities of the server. The management interfaces allow remote clients to connect to the EAP instance for the purpose of managing the instance. A profile is a collection of subsystems that are used to configure the extensions.

### Quiz (5 min)

Tell your students to turn to the quiz in their books. Give them approximately 5 minutes to complete it, then discuss the answers.

### Summary

All configuration for a standalone instance of EAP is consolidated into the configuration file `standalone.xml`.

## Configuring Interfaces and Socket Binding Groups (15 + 5 min.)

### Objective

- Configure JBoss EAP network interfaces and socket binding groups

## Presentation Notes

### Introduction (1 min)

Continuing with the exploration of the `standalone.xml` file, this next section looks at the Interfaces

and Socket Binding Groups section and how they interact with each other to provide a mechanism for exposing the management and public interfaces.

1. Why would it be safer for EAP to bind to localhost out-of-the-box?

By default the server is not exposed publicly, preventing premature access while in development.

### **Lecture (15 min)**

Describe the differences between the public and the management interfaces. Explain to the students that it is useful for the management interface to have its own IP address in order to make it easier to secure the management console from public access. The socket binding groups collects all of the definitions for the ports needed for the EAP instance. New to EAP 7 is the multiplexed port facility. The multiplexed capabilities allows multiple connections to be opened on the same port instead of forcing connections onto new ports, allowing for more concurrent connections.

### **Quiz (5 min)**

Tell your students to turn to the quiz in their books. Give them approximately 5 minutes to complete it, then discuss the answers.

### **Summary (1 min)**

The interfaces element provides a single location to define physical addresses used in an environment. A socket binding group is a named collection of socket bindings used to define all of the ports needed for an EAP instance.

## **Chapter Review (30 min.)**

Have your students turn to the Unit Test in their books. Give them approximately 30 minutes to complete this exercise.

### **Wrap Up (~5 min)**

Final review should take approximately 5 minutes. Address any learner questions or comments and review the benefits with the students.

# **Scripting Configuration and Deploying Applications**

## **Chapter Information**

## Overview

This chapter discusses how to use the CLI tool and how to deploy applications using the Management console, the CLI tool and the filesystem deployer. Students will learn how to navigate into the CLI levels, understand the differences between operations and commands and how to deploy an application using the correct approach. Be sure to remember students to avoid editing XML files to configure the server unless it is required.

## Schedule

*Table 16. ILT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Configuring JBoss EAP by Using the Management Command Line Interface	P: Lecture	65
		A: Demo/Guided Exercise	
2	Deploying Applications to a Standalone Server	P: Lecture	50
		A: Demo/Guided Exercise	
	Lab	Unguided Lab	15
Conclusion			2

*Table 17. VT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Configuring JBoss EAP by Using the Management Command Line Interface	P: Lecture	65
		A: Demo/Guided Exercise	
2	Deploying Applications to a Standalone Server	P: Lecture	50
		A: Demo/Guided Exercise	
	Lab	Unguided Lab	15
Conclusion			2

Total Time: 135 minutes

## Chapter Introduction

### Introduction (3 min)

This chapter goes into specific detail about running CLI tools and how to start it an run CLI tool to explore, manage, and deploy in a EAP standalone server. Students will become familiar with the

use of the CLI tool. Students are also introduced to how to deploy and manage deploys using the Management console, the CLI tool and the filesystem deployer subsystem.

# Configuring JBoss EAP by Using the Management Command Line Interface (50 + 15 min.)

## Objective

- Connect to an instance of JBoss EAP standalone with the management CLI and execute general commands.

## Presentation Notes

### Introduction (3 min)

The CLI tool allows to configure and manage the EAP server using the command line. Most of the system administrators like to use a command line instead of an GUI application since it is possible to create scripts to automate tasks.

1. What are the benefits of running the CLI tool?

This is an open-ended question intended to get the students talking.

### Lecture (50 min)

Explain the students the three ways for configuring EAP servers. Make it clear that it is not advisable to directly edit the **XML** because these settings may be lost if the server is running.

Describe to students the benefits of using the CLI tool.

Explain the **admin-only** mode of CLI. This mode allows to start an embed server instance inside the CLI process. Teach students the benefits of using this approach.

Explain the **\_Dynamic Model Representation \_** (DMR) syntax. Explain to students that all attributes are displayed using this model.

Describe the different ways to connect to the CLI tool. Explain the difference between an operation and a command and list the most used operations and commands.

Teach students how to create script files to automate tasks.

### Guided Exercise (15 min)

Tell your students to turn to the guided exercise in their books. Give them approximately 15 minutes to complete it, then discuss the solution.

## Summary (2 min)

Using the CLI tool it is possible to configure and manage the entire server and also it is possible to create scripts to automate tasks.

# Deploying Applications to a Standalone Server (35 + 15 min.)

## Objective

- Deploy a Jakarta EE application to a JBoss EAP instance running as a standalone server.

## Presentation Notes

### Introduction (2 min)

The deployment process is responsible for installing and customizing an application in the JBoss EAP 7.

1. What type of deployments the students are supposed to deploy into their works?

This is an open-ended question intended to get the students talking.

### Lecture (35 min)

Explain the three deployment approaches to a student. Reinforce that does not matter if the students is using the management console or the CLI tool, both will synchronized changes to the XML configuration file, however, the deployment will not change the XML using the filesystem deployer.

Describe to student the process to deploy, enable, disable, and undeploy an application using the Management console.

Explain to students the `deployments` section of the `standalone.xml` configuration file.

Describe to student the process to deploy, enable, disable, and undeploy an application using the CLI tool.

Explain to students how to deploy using the filesystem deployer. Describe each of the marker files.

## Guided Exercise (15 min)

Tell your students to turn to the guided exercise in their books. Give them approximately 15 minutes to complete it, then discuss the solution.

## Summary

Prefer to deploy an application using the CLI tool or the management console. The filesystem deployer should be avoided since the file application is not managed by the EAP server.

## Chapter Review (15 min.)

Have your students turn to the Unit Test in their books. Give them approximately 15 minutes to complete this exercise.

## Wrap Up (~5 min)

Final review should take approximately 5 minutes. Address any learner questions or comments and review the benefits with the students. Review the summary points with the learners as displayed in the Student Guide.

# Configuring JBoss EAP as a Managed Domain

## Chapter Information

### Overview

### Schedule

*Table 18. ILT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Running JBoss EAP as a Managed Domain	P: Lecture	10
		A: Quiz	
2	Assigning a Domain Controller	P: Lecture	20
		A: Guided Exercise	
3	Configuring a Host Controller	P: Lecture	40
		A: Guided Exercise	
4	Configuring a Domain Controller	P: Lecture	55
		A: Quiz	
	Lab	Unguided Lab	45

Section	Title	Presentation & Engagement Methods	Time (minutes)
Conclusion			2

*Table 19. VT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Running JBoss EAP as a Managed Domain	P: Lecture	10
		A: Quiz	
2	Assigning a Domain Controller	P: Lecture	20
		A: Guided Exercise	
3	Configuring a Host Controller	P: Lecture	40
		A: Guided Exercise	
4	Configuring a Domain Controller	P: Lecture	55
		A: Quiz	
	Lab	Unguided Lab	45
Conclusion			2

Total Time: 175 minutes

## Chapter Introduction

### Introduction (3 min)

This chapter is about starting EAP in managed domain mode. To do that you need to be able to configure host controllers as either masters or slaves, and to connect slaves to their masters. This chapter also introduces the `host.xml` and `domain.xml` configuration files, shows how to start domain controllers and regular (slave) domain controllers, and how to deploy applications to a managed domain.

## Instructional strategies for Running JBoss EAP as a Managed Domain (5 + 5 min.)

### Objective

- Describe managed domain architecture.
- Students learn about managed domain main concepts.
- Students learn about the relationship between domains, hosts, sever groups and server

instances.

## Presentation Notes

### Introduction (3 min)

EAP managed domains are a set of application server instances managed from a central location, independently grouped in both physical (hosts) and logical (server groups) fashions.

1. Does your organization employ any centralized management tool for Jakarta EE and non-Jakarta EE application server instances?

This is an open-ended question intended to get the students talking.

### Lecture (5 min)

Define each managed domain term, and notice that in some contexts domain controller and master, or host controller and slave, are used interchangeably. Notice also that a domain controller is also a host controller.

Emphasize that host and server groups do not constrain server instance membership in each other, but no server instance can exist outside each of them.

### Quiz (5 min)

Tell your students to turn to the quiz in their books. Give them approximately 5 minutes to complete it, then discuss the answers.

### Summary

A managed domain organizes application server instances into hosts and server groups. One of the host controllers is the master, a.k.a. domain controller and all administrative actions are performed in and by the master.

## Instructional strategies for Assigning a Domain Controller (10 + 10 min.)

### Objective

- Assign the domain controller and start the managed domain.
- Configure secondary host controllers to an existing managed domain.



# Benefits

- Students learn about how to configure a host controller to act as a master or a slave.
- Students learn about how to start a main or secondary host controller.

## Presentation Notes

### Introduction (3 min)

To start an EAP managed domain the domain controller must be started first, and then slave host controller can register to the master and join the domain.

1. Are you familiar with the "agent" concept in centralized software management suites?

This is an open-ended question intended to get the students talking.

### Lecture (10 min)

The domain controller is the central point for administering the entire managed domain. It keeps the subsystem configurations for all server instances and determines which hosts runs what servers.

Talk about the two managed domain configuration files: host.xml and domain.xml hinting about which settings are kept in each. Make students understand that, while all host controllers have a host.xml file, only the domain controller keeps a domain.xml file.

Explain the use of the <domain-controller> element and the <local/> element to configure a host controller as a master, then remind students about management interfaces and network interfaces, to explain requirements and restrictions on both for a host controller configured as a domain controller.

Show how the <domain-controller> element changes for a slave and focus the explanation in the linking between a slave and its master, using the figure as a guide. You'll have later, in the next section, the opportunity to revisit and detail other slave configurations.

Show the many system properties and command-line options that can be provided to the domain.sh script to start a domain controller. Again don't spend too much time on slave details as you'll also revisit them in the next section.

Make sure students understand the advantages of keeping managed domain configuration files in a distinct file tree than the EAP installation files, and how to direct a host controller to the desired base folder and configuration file names.

Don't spend too much time on recovering from a failed domain controller. This is an area of heavy development for EAP 7 and new features will be added in point releases. Another area of expected improvements are discovery methods for domain controllers: specialized mechanisms already exists for Amazon and OpenShift clouds, and another one for Azure clouds is expected in early point releases.

Show students the high-level changes in the Management Console navigation in managed domain mode compared to standalone server mode.

## Guided Exercise (10 min)

Tell your students to turn to the guided exercise in their books. Give them approximately 10 minutes to complete it, then discuss the answers.

## Summary

To start EAP in managed domain mode first start a domain controller, and make sure it is accessible to slave host controllers. Use system properties and command-line options to define network parameters and paths to configuration files.

# Instructional strategies for Configuring a Host Controller (10 + 30 min.)

## Objective

- Identify the configuration options for a host controller and make configuration changes to a host controller.

## Benefits

- Students learn about the general syntax for the host controller configuration file to add server instances and JVM definitions.
- Students learn about how to add slave host controllers to a managed domain.

## Presentation Notes

### Introduction (3 min)

A host controller manages server instances running in a physical or virtual machine. The host configuration file configures things that depends on the machine running EAP such as IP addresses and file system paths. It also configures server instances running in that host.

1. Are you familiar with XML Schema files (XSD) for defining the syntax for a XML document?

This is an open-ended question intended to get the students talking.

### Lecture (10 min)

The section starts with a high-level view of the host.xml configuration file. The important elements for this section, such as <domain-controller> and <interfaces> were already explained previously,

and new elements such as <servers> will get more detailed explanations later, so take care to NOT spend too much time talking about each element.

Explain servers and JVM configurations using the sample listing. Notice that a server name is unique only inside a host controller, but JVM names are unique for the whole domain. Make sure students understand the use of port-offsets (this should not be really news to them, as it is also used for standalone servers).

Explain to students that, while most configurations are fetched by the slave from its master, a few settings depend on the physical / virtual machine the host controller runs on and are configured in the host configuration file. Those settings can be changed from the domain controller using either the Management Console or the CLI but are saved by the host controller, not the domain controller.

The review of slave host controller settings and how to start a slave host controller is the focus of this chapter. The main settings from <domain-controller> were already explained by the previous section, but the previous GE did not started any host controller other than the domain controller, so this is when students really have to understand this.

Make sure students understand the differences in network interfaces and management interfaces settings in a slave compared to a master, and remind them that administrators are not supposed to connect directly to slaves to perform administrative tasks. Administrators connect only to the domain controller, and the domain controller connects to the slaves as needed.

Review the command line parameters for starting a slave and the commonly used system properties.

The final topic about starting multiple master complements the topic about recovering from a failed domain controller from the previous section. Sometime in the EAP 7.x release cycle it is expected an automated fail-over and/or promotion mechanism will be made available but on the 7.0 release at least this is still a manual process.

## Guided Exercise (30 min)

Tell your students to turn to the guided exercise in their books. Give them approximately 30 minutes to complete it, then discuss the answers.

## Summary

A host controller acting as a slave in a managed domain register itself to the domain controller, who acts as the master, to get configuration information to give to its local server instances.

# Instructional strategies for Configuring a Domain Controller (40 + 15 min.)

## Objective

- Identify the configuration options for a domain controller and make configuration changes to the domain controller.

## Benefits

- Students learn about the general syntax for the domain configuration file.
- Students learn about how to deploy applications to an EAP managed domain.
- Students learn about how to navigate management domain managed objects using the CLI.

## Presentation Notes

### Introduction (3 min)

The domain configuration defines subsystem settings, server groups and applications made available in the managed domain.

1. How many EAP managed domains a typical medium-sized organization would require?

This is an open-ended question intended to get the students talking.

### Lecture (40 min)

Most of the settings in domain.xml were already seen in standalone server mode and the ones not seen yet will be detailed in following chapters. For now the focus is making sense of the apparent duplication of settings among profiles, server groups, and between domain.xml versus host.xml. The practical goal of this section is being able to deploy and run applications in an EAP managed domain.

Explain to students the domain controller manages a central repository of applications deployed to the management domain. Because of that, deploying applications as exploded archives is NOT a recommended option. Previous EAP releases supported exploded applications only in standalone server mode. The recommended way is deploying applications using packaged applications (Jakarta EE archives such as WAR and EAR files).

You may explain students that exploded deployments, although popular among developers, are NOT Jakarta EE-compliant. Using them risks an application assuming unsupported behaviors such as direct file system to application files (in this case, the standards-compliant way to access application files would be using classloader resources).

Explain that deploying applications to a managed domain involves three steps, even if they can be done by a single operation using the CLI: (1) uploading the contents, (2) assigning it to server groups, and (3) enabling it. Unmanaged deployments skip step (1) and the application is assumed to be available, on the same file system path, on all hosts.

When an application is deployed, its archive is uploaded to the domain controller repository and

from there it is sent to the host controllers that host server instances members of groups to which the application was assigned. Remind students that there is no way to deploy or enable an application to a single server instance: those operations (assignment and enablement) are done at the server group level.

Explain students the difference between an application "name" and "runtime name". We will see that this allows having multiple versions of the same application available in the domain controller repository. This allows faster application updates and rollbacks.

Take the time to show students now navigating management objects using the CLI differs from standalone server mode and make sure they are able to locate hosts, server groups, servers, profiles and subsystems. Be prepared for questions about the difference between "server" object and a "server-config" objects that are child of host objects. But don't spend too much time on that as servers and server groups are the subject of the next chapter.

You may also explain the students that, while older EAP releases copied all domain.xml settings and application deployments to all hosts, EAP 7 only copies settings and applications to hosts whose server instances require them (based on their membership to server groups). This makes very large domains feasible. If using the --backup option, a slave gets all settings and applications even if not requiring all them.

## Guided Exercise (15 min)

Tell your students to turn to the guided exercise in their books. Give them approximately 15 minutes to complete it, then discuss the answers.

## Summary

An EAP managed domain centralizes configuration settings in the domain.xml file, but allows some settings to be overridden at server group level (also in domain.xml) and on host or server instance levels (in host.xml). Applications are uploaded to the domain controller and from it distributed to host controllers according to the application assignment to server groups. An application can be enabled to some server groups and not to others even though assigned to them.

## Chapter Review (45 min.)

Have your students turn to the Unit Test in their books. Give them approximately 45 minutes to complete this exercise.

## Wrap Up (~5 min)

Final review should take approximately 5 minutes. Address any learner questions or comments and review the benefits with the students. Have students turn to the summary section in the student guide and review the summary points with them.

## Review Questions

1. How many active domain controllers are in a domain? Are there backup domain controllers in EAP?

Only one domain controller is active at any given time, and there is no concept of a backup domain controller. Master fail-over and slave promotions are manual processes performed by the administrator.

1. How is a host controller declared a member of a particular managed domain?

By pointing it to the domain controller native management interface IP address and TCP port.

1. How can a host controller be started using configuration files outside the EAP installation folder?

Define the `jboss.domain.master.dir` system property to point to the desired configuration folder.

1. Which is the script used to start a domain controller? And to start a slave host controller?

The same script starts both. It is the contents of `host.xml` that determines the role (master or slave) performed by the host controller.

1. How to start a host controller using the `host-slave.xml` configuration file, so it acts as slave? After all, the default `host.xml` makes it act as a master and I don't want to use it!

Use the `--host-config=host-slave.xml` command-line option.

1. Will the domain controller avoid port conflicts between server instances running in the same host?

No, the administrator has to give each server instance a different port-offset so there are no conflicts.

1. Can I deploy applications to a single server instance in an EAP managed domain?

Only if this server instance is the only server in a server group.

1. Is it possible to deploy an application to all server instances in a managed domain?

Yes, just assign and enable the application to all existing server groups.

## Configuring Servers in a Managed Domain

# Chapter Information

## Overview

This chapter will discuss the configuration and management of servers and server groups in an EAP managed domain. Students will learn about the different components that make up a managed domain and the relationship between them. Be sure to discuss the different ways to configure and manage the components and highlight the advantages of each technique.

## Schedule

*Table 20. ILT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Managed Domain Server Architecture	P: Lecture	10
		A: Quiz	
2	Configuring Server Groups	P: Lecture	30
		A: Guided Exercise	
3	Configuring Servers	P: Lecture	40
		A: Guided Exercise	
4	Deploying Applications on a Managed Domain	P: Lecture	35
		A: Guided Exercise	
	Configuring Servers in a Managed Domain	Lab	15
Conclusion			2

*Table 21. VT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Managed Domain Server Architecture	P: Lecture	10
		A: Quiz	
2	Configuring Server Groups	P: Lecture	30
		A: Guided Exercise	
3	Configuring Servers	P: Lecture	40
		A: Quiz	

Section	Title	Presentation & Engagement Methods	Time (minutes)
4	Deploying Applications on a Managed Domain	P: Lecture	35
		A: Guided Exercise	
	Configuring Servers in a Managed Domain	Lab	15
Conclusion			2

Total Time: 135 minutes

## Chapter Introduction

### Introduction (3 min)

This chapter will discuss various components like Hosts, Domain Controller, Server Groups and Servers that constitute an EAP Managed Domain and the relationship between them. Students will learn how to configure and manage these components using the EAP Management Console as well the EAP CLI. We will also take a deeper look at the structure of underlying XML configuration files (`domain.xml` and `host.xml`) and highlight the important attributes that are used for configuring Servers and Server Groups. Be sure to emphasize to the students, the usage of either the Management Console or the EAP CLI for configuration and management rather than manually editing the XML configuration files.

## Instructional strategies for Managed Domain Server Architecture (5 + 5 min.)

### Objective

- Interpret the relationship between hosts, server groups, and servers.
- Students learn about the different components that make up a Managed Domain.
- Students learn about how to design an EAP Managed Domain from the perspective of both physical layout (number of Hosts, number of Servers per Host) as well as logical grouping (number of Server Groups, number of Servers per Server Group) based on the number and type of applications that will be deployed on the Managed Domain.

## Presentation Notes

### Introduction (3 min)

An EAP Managed Domain is made up of:

- Domain Controller



- Host Controllers
- Server Groups
- Servers

1. Does an EAP Managed Domain fit into modern practices like DevOps and Microservices?

This is an open-ended question intended to get the students talking.

## Lecture (5 min)

Talk briefly about the relationship between domain controllers, hosts, server groups, and servers. Refer to the two diagrams in this section when explaining a sample EAP managed domain topology.

Use the two diagrams to explain the process of planning and designing an EAP managed domain. Explain the importance of designing both the physical layout as well as a logical layout of a managed domain.

Explain to students that the domain controller should NOT run applications. It is to be used only for managing and configuring the managed domain and should be run on a separate small server or VM which is different from the host controller machines.

## Quiz

Tell your students to turn to the quiz in their books. Give them approximately 5 minutes to complete it, then discuss the answers.

## Summary

Server groups are configured at the domain controller level and servers are configured at the host controller level.

Applications are always deployed to server groups.

A server always belongs to a single server group.

# Instructional strategies for Configuring Server Groups (15 + 15 min.)

## Objective

- Configure a server group within a managed domain.
- Identify the different options available to create and manage server groups.
- Identify the different attributes of a server group that are configured in the domain.xml file of the domain controller.

## Benefits

- Students learn about the different ways configure and manage server groups in a managed domain.
- Students learn about the different configuration attributes of a server group and how to assign profiles.
- Students learn about how applications are deployed in a managed domain.
- Students learn about deploying applications using both the management console and the EAP CLI.

## Presentation Notes

### Introduction (3 min)

The management console as well as the EAP CLI can be used to create and manage server groups and deploy applications. Server groups are assigned a unique profile which decides what subsystems and network sockets will be enabled when applications are deployed.

1. How do you decide the number of server groups in a managed domain? How do you decide which **profile** to assign to a server group?

This is an open-ended question intended to get the students talking.

### Lecture (15 min)

This topic explores in detail, the different methods available to create and manage server groups in a managed domain. Students learn how to manage server groups using the web based EAP management console as well as EAP CLI. Be sure to discuss the advantages of the EAP CLI over the other approaches in terms of ease-of-use, in-built documentation, auto complete and batch mode. Be sure to emphasize that the web based management console or the JBoss EAP CLI is the preferred approach for configuring and managing server groups rather than editing the XML files manually.

Also, this topic explores the different methods available to deploy applications to server groups in a managed domain. Students learn how to deploy and manage applications using the web based EAP Management console as well as EAP CLI. Be sure to discuss the advantages of the EAP CLI over the other approaches in terms of ease-of-use, inbuilt documentation, auto complete and batch mode. Be sure to emphasize that the web based Management Console or the JBoss EAP CLI is the **ONLY** approach for deploying applications on a Managed Domain application files should not be copied manually to any folder(s) under the EAP install directory.

## Guided Exercise

Tell your students to turn to the guided exercise in their books. Give them approximately 15 minutes to complete it, then discuss the answers.

## Summary

Students should be able to create server groups using the management console.

# Instructional strategies for Configuring Servers (20 + 20 min.)

## Objective

- Configure a server within a host controller.
- Identify the different attributes of a server configuration that are configured in the host.xml file of the host controller.
- Identify the different options available to create and manage servers in a managed domain.
- Define how to shut down servers, server groups and the entire managed domain from the management CLI.

## Benefits

- Students learn about the different ways configure and manage servers in a managed domain
- Students learn about the different configuration attributes of a server and how to assign servers to server groups.

## Presentation Notes

### Introduction (3 min)

The management console as well as the EAP CLI can be used to create and manage servers. Servers are assigned to a unique server group. If multiple servers are configured to run on the same host, then port-offsets need to be provided to avoid network port conflicts.

### Lecture (20 min)

Discuss configuring servers with both the EAP 7 management console and the JBoss EAP CLI. Highlight the fact that changes made from one tool are automatically reflected in the other in real-time. Highlight the ease of use features of the JBoss EAP CLI (command history, auto-complete, inbuilt documentation of attributes, scripting via bash and batch mode).

## Guided Exercise

Tell your students to turn to the guided exercise in their books. Give them approximately 20 minutes to complete it, then discuss the answers.

## Summary

Students must be able to configure and manage servers using the JBoss EAP CLI. Changes must be persisted to `host.xml` and these changes must be visible to the management console immediately if students wish to verify the steps using the management console. Emphasize the fact that the CLI and the management console are the preferred ways to configure and manage EAP and that manual editing of XML files should be avoided.

# Instructional strategies for Deploying Applications on a Managed Domain (15 + 20 min.)

## Objective

- Identify the different options available for application deployment on an JBoss EAP managed domain.

## Benefits

- Students learn about the different ways to deploy applications on an EAP managed domain.

## Presentation Notes

### Introduction (3 min)

The management console as well as the EAP CLI can be used to deploy applications on an EAP managed domain. Unlike deployments in standalone mode, applications are deployed to server groups in an EAP managed domain.

### Lecture (15 min)

Discuss deploying applications with both the EAP 7 management console and the JBoss EAP CLI. Highlight the fact that changes made from one tool are automatically reflected in the other in real-time.

## Guided Exercise

Tell your students to turn to the guided exercise in their books. Give them approximately 20 minutes to complete it, then discuss the answers.

## Summary

Students must be able to deploy applications on an EAP managed domain using the management

console or the JBoss EAP CLI. Applications are deployed to server groups in an EAP managed domain.

## Chapter Review (15 min.)

Have your students turn to the Unit Test in their books. Give them approximately 15 minutes to complete this exercise.

### Wrap Up (~5 min)

Final review should take approximately 5 minutes. Address any learner questions or comments and review the benefits with the students. Have students turn to the summary section in the student guide and review the summary points with them.

### Review Questions

1. How would you design an EAP managed domain (hosting multiple unique applications) to ensure high availability of server instances? Each application must be deployed on two server instances to avoid single point of failure.

Two hosts running on different servers or VMs, with each host running one server instance for an application. Create as many server groups as the number of unique applications and assign at least two servers (one each from the two hosts) to the server group.

# Configuring Datasources

## Chapter Information

### Overview

In this chapter, students will learn the process for creating datasources. The initial section goes into detail about the datasource subsystem. Later sections look at creating a driver and installing the driver in an installation of EAP and actually creating a datasource with the EAP CLI and management console. The guided exercises culminate in a final lab wherein the students install a MariaDB driver, create a datasource, and deploy the exercise application that utilizes the database.

### Schedule

*Table 22. ILT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3

Section	Title	Presentation & Engagement Methods	Time (minutes)
1	Exploring the Datasource Subsystem	P: Lecture	15
		A: Quiz	
2	Configuring JDBC Drivers	P: Lecture	30
		A: Guided Exercise	
3	Configuring Datasources	P: Lecture	45
		A: Guided Exercise	
2	Configuring an XA Datasource	P: Lecture	25
		A: Guided Exercise	
	Configuring Datasources	Lab	25
Conclusion			2

*Table 23. VT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Exploring the Datasource Subsystem	P: Lecture	15
		A: Quiz	
2	Configuring JDBC Drivers	P: Lecture	30
		A: Guided Exercise	
3	Configuring Datasources	P: Lecture	45
		A: Guided Exercise	
2	Configuring an XA Datasource	P: Lecture	25
		A: Guided Exercise	
	Configuring Datasources	Lab	25
Conclusion			2

Total Time: 145 minutes

## Chapter Introduction

### Introduction (3 min)

Most Jakarta EE applications require the capability to do basic CRUD (Create, Read, Update, Delete) operations to a database. EAP provides the capability to simply connect the server and its applications to a database. In this chapter, the students will learn how to install the JDBC driver and create a datasource to be used by an application.

# Instructional Strategies for Exploring the Datasource Subsystem (10 + 5 min.)

## Objective

- Interpret the database subsystem and connection pools.

## Benefits

- Students learn about datasources at a high level.

## Presentation Notes

### Introduction (3 min)

Jakarta EE requires that an application server must provide:

- A datasource: it will store sensitive data about how to access a database.
- A connection pool: It will open multiple database connections to minimize the time spent by an application to connect to a database.

1. Which Relational Database Management Systems are you familiar with?

This is an open-ended question intended to get the students talking.

### Lecture (10 min)

Describe that a datasource is a placeholder where the database credentials and configuration are stored in a Jakarta EE application server. When describing connection pools, try and use a real world example to help ground the concept so the student understands how they can use pools to maximize the efficiency of their datasources.

### Quiz (5 min)

Tell your students to turn to the quiz in their books. Give them approximately 5 minutes to complete it, then discuss the answers.

## Summary

Datasources allow applications and servers to access databases.

Connection pools prevent the need to manually create a connection each time one is needed, instead pulling from a pool of connections.

Validation can either occur on match with the connection or in the background at a set time.

# Instructional Strategies for Configuring JDBC Drivers (15 + 15 min.)

## Objective

- Deploy a JDBC Driver as a module.
- Configure a driver in the datasource subsystem.

## Benefits

- Students learn where to download a JDBC driver.
- Students learn how to install a JDBC driver with the EAP CLI.
- Students learn how to create a module with the EAP CLI.

## Presentation Notes

### Introduction (3 min)

Before creating a datasource that points directly to the desired database, a JDBC driver needs to first be installed in EAP for the particular type of database being used. In the final solution of the lab, students will be connecting to a MariaDB database. After installing the driver as a module, students can then define the driver in the server configuration file.

1. If a driver is required for each specific database vendor, such as MariaDB, can two databases that are both MariaDB use the same driver module?

Yes.

### Lecture (15 min)

This section explores the process for installing the JDBC module and how to define it in the `standalone.xml/domain.xml`. Be sure that students understand how the modules get created and the general process for installing the drivers. Explain that the process can be done manually, however the EAP CLI will generate the `module.xml` and create the exact directory structure needed.

### Guided Exercise (15 min)

Tell your students to turn to the guided exercise in their books. Give them approximately 15 minutes to complete it, then discuss the answers.

## Summary

JDBC drivers are installed as modules either manually or using the EAP CLI.



Drivers can be downloaded from the specific database vendor.

# Instructional Strategies for Configuring Datasources (30 + 15 min.)

## Objective

- Configure a data source.
- Configure connection validity for data sources.

## Benefits

- Students learn the general structure of a Non-XA datasource.
- Students learn how to create a datasource with the management console and with the EAP CLI.
- Students learn how to set up validity checks for datasource connections.

## Presentation Notes

### Introduction (3 min)

After installing and enabling the JDBC driver, users can create a datasource that utilizes that driver. This section introduces students to the structure of the datasource in the `standalone.xml` and `domain.xml` configuration files.

1. When is it beneficial to have larger connection pools?

This is an open-ended question intended to get the students talking.

### Lecture (30 min)

Step through the configuration file so that students understand what each tag represents and the role it plays in connecting and configuring the datasource. Describe when students may want to use specific settings, such as when to make a smaller pool or when to use certain validation.

Point out the `<drivers>` section and recall how it was configured in the previous section. The driver is referenced by name in the datasource, noting that multiple datasources can point to the same driver.

This section goes into further detail about connection validation. Be sure to describe each strategy for validating the connection and reinforce the structure for defining the different validations. Make sure students understand that multiple strategies can be defined, but only one of background and on-match can actually be enabled at a time.

The final part of this section demonstrates how to create a datasource using the management console. Students will be doing this in the next lab, but let them become familiar with the process

before proceeding.

## Guided Exercise (15 min)

Tell your students to turn to the guided exercise in their books. Give them approximately 15 minutes to complete it, then discuss the answers.

## Summary

The EAP management console provides an easy way to configure a datasource and use an already installed JDBC driver.

Users can test the datasource within the management console.

Connections can be validated either in the background or just before connection.

# Instructional Strategies for Configuring an XA Datasource (10 + 15 min.)

## Objective

- Configure an XA datasource

## Benefits

- Students learn about the structure of an XA datasource in the server XML configuration.
- Students learn how to define the XA datasource with the EAP CLI.

## Presentation Notes

### Introduction (3 min)

This section introduces XA datasources and how to configure them. While this section is brief, be sure students understand what an XA datasource is and the difference in configuring them.

1. When is it beneficial to use an XA Datasource?

This is an open-ended question intended to get the students talking.

### Lecture (10 min)

Explain that an XA datasource is a datasource that spans multiple resources, such as databases, message queues or legacy systems and can be rolled back if any of the transactions fail.

The primary difference in defining an XA datasource is that the `ServerName` and `DatabaseName`

are properties instead of a connection URL. In addition, the driver needs to provide the XA datasource class.

## Guided Exercise (15 min)

Tell your students to turn to the guided exercise in their books. Give them approximately 15 minutes to complete it, then discuss the answers.

## Summary

An XA datasource is useful for datasource connections that rely on a transaction spanning multiple resources.

## Chapter Review (25 min.)

Have your students turn to the Unit Test in their books. Give them approximately 25 minutes to complete this exercise.

## Wrap Up (~5 min)

Final review should take approximately 5 minutes. Address any learner questions or comments and review the benefits with the students. Have students turn to the summary section in the student guide and review the summary points with them.

## Review Questions

1. How do you configure a datasource that can manage lots of concurrent connections and that can roll back transactions spanning multiple resources?

Create an XA datasource with a large connection pool.

# Configuring the Logging Subsystem

## Chapter Information

### Overview

This chapter will discuss the configuration and management of the Logging subsystem of EAP. Students will learn about the different components that make up the logging subsystem and how to configure them. Be sure to discuss the different ways to configure and manage the components and highlight recommended approaches for maintaining a robust Production environment with multiple servers.

# Schedule

*Table 24. ILT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Configuring Logging Handlers	P: Lecture	75
		A: Guided Exercise	
2	Configuring Loggers	P: Lecture	30
		A: Guided Exercise	
	Configuring the Logging Subsystem	Lab	25
Conclusion			2

*Table 25. VT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Configuring Logging Handlers	P: Lecture	75
		A: Guided Exercise	
2	Configuring Loggers	P: Lecture	30
		A: Guided Exercise	
	Configuring the Logging Subsystem	Lab	25
Conclusion			2

Total Time: 135 minutes

## Chapter Introduction

### Introduction (3 min)

This chapter will discuss various components like Handlers, Loggers and the ROOT Logger that are make up the Logging subsystem and the relationship between them. Students will learn how to configure and manage these components using the EAP Management Console as well the EAP CLI. We will also take a deeper look at the structure of underlying XML configuration files and highlight the important attributes that are used for configuring the subsystem. Be sure to emphasize to the students, the usage of either the Management Console or the EAP CLI for configuration and management rather than manually editing the XML configuration files.

# Instructional strategies for Configuring Logging Handlers (40 + 35 min.)

## Objective

- Configure various types of Logging Handlers.

## Benefits

- Students learn about the different types of Logging Handlers that are available out-of-the-box with EAP and how to configure and manage them.
- Students learn how to choose the appropriate handler based on the needs of the application and the organization's policies and processes for log collection and archiving.

## Presentation Notes

### Introduction (3 min)

The EAP logging subsystem is made up of:

- Logging Handlers
- Loggers (Category Loggers)
- The ROOT Logger

1. Why do you need a logging framework? Can the applications manage their own logging? What are the advantages and disadvantages?

This is an open-ended question intended to get the students talking.

### Lecture (40 min)

Talk briefly about the relationship between Handlers, Loggers and the ROOT Logger. Explain what handlers are defined by default in a new EAP installation.

Talk briefly about the log file locations on a Standalone server and in Managed Domain mode.

Talk briefly about the 6 built-in handlers that ship with EAP.

### Guided Exercise (35 min.)

Tell your students to turn to the guided exercise in their books. Give them approximately 35 minutes to complete it, then discuss the answers.

## Summary

Handlers determine "where" and "how" an event will be logged. EAP comes with several handlers out-of-the-box that can be used to log messages from applications.

A Logger organizes events into logically related categories. A category usually maps to a certain package namespace that is running within the Java Virtual Machine.

EAP comes with 6 built-in handlers. Handlers can be configured to handle log messages at a certain default log level.

# Instructional strategies for Configuring Loggers (20 + 10 min.)

## Objective

- Configure category loggers.
- Configure the ROOT logger.

## Benefits

- Students learn about the different ways to configure and manage logger categories and how to control the amount of logging by applications.
- Students learn about the different configuration attributes of a Logger and the ROOT Logger.
- Students learn about the Logger hierarchy.
- Students learn about the log level hierarchy and how to troubleshoot issues in Production by changing log levels.

## Presentation Notes

### Introduction (3 min)

The management console as well as the EAP CLI can be used to create and manage loggers and the ROOT logger. All loggers inherit settings from the ROOT logger and they can override the log levels. Logger categories can be setup at the package or class level along with setting a default log level for fine grained control over what is logged and how much is logged.

1. Assuming your application is packaged as a set of discrete components each with their own package namespace, how would you configure the logging subsystem for efficient logging?

This is an open-ended question intended to get the students talking.

## Lecture (20 min)

This topic explores in detail, the different methods available to configure and manage loggers and the ROOT logger. Students learn how to configure and manage loggers and log levels using the web based EAP management console as well as EAP CLI. Be sure to discuss the advantages of the EAP CLI over the other approaches in terms of ease-of-use, in-built documentation, auto complete and batch mode. Be sure to emphasize that the web based management console or the JBoss EAP CLI is the preferred approach for configuring and managing server groups rather than editing the XML files manually.

Also, this topic explores the hierarchical nature of logger categories and the log levels. Students learn about the relationship between loggers and the ROOT logger and how to override settings inherited from the ROOT logger.

## Guided Exercise (10 min.)

Tell your students to turn to the guided exercise in their books. Give them approximately 10 minutes to complete it, then discuss the answers.

## Summary

Students should be able to define logger categories and configure the ROOT logger.

## Chapter Review (25 min.)

Have your students turn to the Unit Test in their books. Give them approximately 25 minutes to complete this exercise.

## Wrap Up (~5 min)

Final review should take approximately 5 minutes. Address any learner questions or comments and review the benefits with the students. Have students turn to the summary section in the student guide and review the summary points with them.

## Review Questions

1. How would you configure the logging subsystem for an application that is expected to do a lot of logging and is accessed concurrently by thousands of clients? How do you ensure that the logging does not become a bottleneck and cause the application to slow down?
  - Configure a size based rotating file handler and choose a rotate size after analyzing the rate at which log messages are generated.
  - Setup asynchronous handler for the size based handler defined above to avoid application slow down due to concurrent threads waiting for write acknowledgement from the filesystem.
  - Set the ROOT logger to **WARN** or **ERROR** level and create logger categories depending on the

package namespace of the applications and override the log levels as required.

# Configuring the Messaging Subsystem

## Chapter Information

### Overview

### Schedule

*Table 26. ILT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Exploring the Messaging Subsystem	P: Lecture	20
		A: Quiz	
2	Configuring Messaging Resources	P: Lecture	50
		A: Guided Exercise	
3	Configuring Journals and Other Settings	P: Lecture	50
		A: Guided Exercise	
	Lab	Unguided Lab	30
Conclusion			2

*Table 27. VT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Exploring the Messaging Subsystem	P: Lecture	20
		A: Quiz	
2	Configuring Messaging Resources	P: Lecture	50
		A: Guided Exercise	
3	Configuring Journals and Other Settings	P: Lecture	50
		A: Guided Exercise	
	Lab	Unguided Lab	30



Section	Title	Presentation & Engagement Methods	Time (minutes)
Conclusion			2

Total Time: 155 minutes

# Chapter Introduction

## Introduction (3 min)

This chapter presents the EAP 7 new messaging subsystem based on ActiveMQ Artemis. It shows how to configure JMS resources and Messaging Oriented Middleware (MOM) features for simple applications. Messaging is a big topic, this chapter gives only a brief overview. The essential operational procedures are shown but demanding environments will probably require a deeper discussion than provided by this course. This chapter provides enough for using the embedded MOM in a development setting but students are advised to go deeper using EAP documentation for production scenarios, using the concepts presented here and in the security and clustering chapters as starting points.

# Instructional strategies for Exploring the Messaging Subsystem (15 + 5 min.)

## Objective

- Describe the Java Messaging Service and the architecture of the messaging subsystem.
- Students learn about MOM and JMS concepts.
- Students learn about the ActiveMQ Artemis upstream project.

## Presentation Notes

### Introduction (3 min)

Messaging is again a hot topic in IT because of its relationship to cloud and IoT architectures.

1. Have you ever worked with messaging middleware? Which one?

This is an open-ended question intended to get the students talking.

### Lecture (15 min)

This section starts presenting messaging use cases. The goal is getting students without no previous exposure excited by the possibilities MOM opens to application architectures. Stress messaging is very common in financial and web applications. Then we move to JMS concepts because the administrator has to provide the resources expected by applications using the JMS API.

Two kinds of audience may be particularly demanding for this section: the first one is students with no previous messaging experience, they may require more time with concepts and discussion about use cases. The second one is students with deep knowledge of previous EAP, Red Hat or other vendor messaging solutions, they may demand deeper information about configuration and tuning. Be careful to not spend too time with any of them and direct them to other Red Hat resources and courses when appropriate. The end of this section provides many reference links.

You may tease students with little previous experience by telling that applications architected around messaging get scalability and high availability "for free".

Red Hat and EAP have a convoluted messaging product history. EAP 7 changed again (for the third time!) its embedded MOM but EAP 6 users will find most HornetQ concepts are still there, although with a different syntax. Current ActiveMQ users may find EAP 7 messages is very different because the next ActiveMQ / JBoss A-MQ product has a new core architecture. Curious instructors may want to Google all messaging products referenced in the quiz: all of them are or were part of some Red Hat offering!

The bridgehead about EAP built-in messages gives advice on product positioning, which may change after this course is released. It is important that students understand the embedded MOM is somewhat independent of other EAP subsystems: it is like the H2 embedded database, a convenience, but unlike H2 the embedded MOM follows EAP administrative conventions. The messaging-activemq subsystem includes both MOM server configurations and JMS client resources. This can be very confusing!

It was necessary to advance a few clustering concepts because in a managed domain each server instance runs a MOM instance. It does not make sense to have all those MOM instances without being part of a cluster. The GEs use standalone server mode to avoid this but the final chapter review lab requires a minimal clustered configuration. Production scenarios may use instead an external MOM (such as Red Hat JBoss A-MQ) or have a dedicated EAP instance to be used only as a MOM.

## Quiz (5 min)

Tell your students to turn to the quiz in their books. Give them approximately 5 minutes to complete it, then discuss the answers.

## Summary

EAP comes with a production-grade MOM ready to use. This sets it apart from its competition, which provides only "toy" MOMs.

# Instructional strategies for Configuring Messaging Resources (30 + 20 min.)

## Objective

- Configure JMS connection factories and destinations.
- Describe ActiveMQ connectors and acceptors.

## Benefits

- Students learn about creating JMS ConnectionFactories and Destinations
- Students learn the importance of using PooledConnectionFactories

## Presentation Notes

### Introduction (3 min)

This is the main chapter section: how to create JMS resources applications require to work. Some ActiveMQ configurations are shown to make the whole make sense but we are not really going deep into ActiveMQ administration.

1. Do you have any JMS programing experience?

This is an open-ended question intended to get the students talking.

### Lecture (30 min)

JMS ConnectionFactories provide a portable way to refer to ActiveMQ connectors, that is, they represent connections to a MOM. JMS destinations provide a portable way to refer to ActiveMQ destinations, that is, they represent a MOM queues. Terminology and semantics vary greatly from MOMs so it is important having this abstraction level in JMS, and each MOM translates those in a different way.

This section doesn't really teach how to configure remote connections to ActiveMQ servers, either standalone A-MQ or remote EAP server instances. We use only the default ActiveMQ connectors and acceptors, and how to map the application ConnectionFactory JNDI name to the default local (in-vm) connector.

Beware that ActiveMQ uses the opposite meaning for connector: for ActiveMQ it is the client-side, but for most web software a connector configures the server-side.

Besides the syntax for creating ConnectionFactories, Queues and Topics, the main takeaway of this section is using PooledConnectionFactories instead of plain ConnectionFactories. This won't affect application code, just the administrator needs to create the correct kind of object in the messagin subsystem.

Through the whole section (the whole chapter actually) making analogies to JDBC and database servers helps a lot, because most developers and administrators are familiar with relational databases. If something would not make sense for a database server or application, it probably won't make sense for JMS, MOMs and ActiveMQ either.

A potential source of confusion is the fact applications use the JMS resource JNDI name but administration uses the CLI object name for JMS resources. For example, applications see `java:/jms/queue/JB248TestQueue` but administrators see `jms-queue=TestQueue`. The names are different in purpose to highlight there are different identifiers for the same object. Be prepared for more confusion about that in the next section, because ActiveMQ uses internally a different name for destinations!

Although not used by the exercises, you can play with the CLI JNDI view object to show what applications see.

Remind students about differences between standalone server and managed domain operating modes. The first one has runtime attributes on the same CLI objects as configuration attributes. The second one has configuration attributes in the profile object, but runtime attributes in the host/server object. The guided exercises are done using standalone server mode, and students can have trouble finding the message counters in managed domain mode for the final chapter review lab.

## Guided Exercise (20 min)

Tell your students to turn to the guided exercise in their books. Give them approximately 20 minutes to complete it, then discuss the answers.

## Summary

The administrator needs to configure the JMS resources required by the application and the subjacent MOM resources. ActiveMQ makes this easy thanks to its tight integration with EAP administration.

# Instructional strategies for Configuring Journals and Other Settings (30 + 20 min.)

## Objective

- Configure Messaging journals and other messaging subsystem settings.

## Benefits

- Students learn about basic on-disk storage tuning for ActiveMQ
- Students learn about using address-settings to configure advanced MOM features

## Presentation Notes

## Introduction (3 min)

ActiveMQ administration, and general MOM administration, includes dealing with exception workflows and storage tuning. ActiveMQ manages its own storage and provides a number of facilities to optimize to different messaging use cases. This section only scratches the surface of ActiveMQ many features.

1. Which strategy would you employ for dealing with errors during message processing? Is it ok to throw away messages that fail been consumed by a client application?

This is an open-ended question intended to get the students talking.

## Lecture (30 min)

ActiveMQ uses a high-performance journal on-disk data structure and native Linux I/O capabilities to provide storage performance and reliability to match any database, with a much lower overhead. It also provides many features to deal with demanding messaging use cases, from giving guaranteed delivery to a number of exception handling approaches.

ActiveMQ provides a very sophisticated storage architecture, inherited from HornetQ. We only show one of its components, the message journal. The intent is to give a behind-the-scenes view to increase students confidence with ActiveMQ abilities to handle demanding scenarios, NOT to give tuning advice.

Most MOM message handling features are configured in ActiveMQ address-settings objects instead of in the destination resources. ActiveMQ uses a wildcard syntax which is different from Unix shell glob, regular expressions, and SQL like criteria so most students will have never seem this syntax. (The syntax is almost the same other messaging technologies such as STOMP uses)

ActiveMQ wildcards are also used for security permissions (security-settings objects). It assumes applications or business processes will adopt a consistent hierarchical naming convention for destination names that minimizes the ammount of configuration to tune MOM features to application requirements. The course labs need only the simplest wildcards: "#" for "any destination" and the full destination internal name.

Warn students the destination name for wildcards is NEITHER the JNDI name NOR the CLI resource. Remind them about the convention for generating ActiveMQ internal names from the CLI resource name, that was shown by the previous section in this chapter. And show them how to query the destination resource for its internal name (que queue-address attribute).

The security heading just makes sense of the default configurations. The security chapter will come back to ActiveMQ security-settings and ActiveMQ integration with EAP security domains.

Make sure students understand the mechanics behind dead-letter queues and its usefulness. This is the only address-setting feature to be used in the guided exercise. But warn them to review the EAP and A-MQ product documentation, and the upstream Artemis documentation, for more interesting features configured through address-settings.

## Guided Exercise (20 min)

Tell your students to turn to the guided exercise in their books. Give them approximately 20 minutes to complete it, then discuss the answers.

## Summary

ActiveMQ manages message persistence using journal files which minimize disk I/O operations and use in-memory caching for message contents. ActiveMQ is a feature-rich MOM and most its features are configured through address-settings that customize message handling for subsets of destinations.

## Chapter Review (30 min.)

Have your students turn to the Unit Test in their books. Give them approximately 30 minutes to complete this exercise.

## Wrap Up (~5 min)

Final review should take approximately 5 minutes. Address any learner questions or comments and review the benefits with the students. Have students turn to the summary section in the student guide and review the summary points with them.

## Review Questions

1. Is the embedded MOM provided by EAP 7 only a convenience for the developer?

No because it is a production-grade ActiveMQ messaging server. It does not provide the same protocol support as the full A-MQ product but, from a Java EE application point of view, it provides everything required by most demanding mission-critical messaging application.

1. What is the difference between a queue and topic destination?

A queue allows a single consumer per message. Multiple consumers may connect to the same queue, but each message is delivered on only one of them. A topic has subscribers as consumers: each message has a copy delivered to each consumer.

1. Which managed domain profiles come with the messaging-activemq subsystem enabled?

full and full-ha

1. Why is it recommended to use a PooledConnectionFactory instead of a plain ConnectionFactory?

A PooledConnectionFactory reuses and shares MOM connections among messaging clients and promotes efficient use of hardware resources. It also makes applications faster by not incurring into connection handshake overhead for each application request.

1. Which JMS resource attribute provides the name by which applications link to the resource?

The entries attribute provide one or more JNDI names to be used by applications requiring access to the resource.

1. Which EAP server instance in a server group runs the ActiveMQ embedded MOM if enabled by the server group profile?

All server instances run the MOM. So it is recommended that either the group has a single member or the MOM is configured to work as a clustered MOM.

1. Will ActiveMQ store messages in a database?

No, it manages its own journal files to store messages with higher performance than a database would provide and no compromise to reliability.

1. How can an ActiveMQ administrator configure expired and/or failed messages handling?

By configuring an address-settings object attributes.

# Securing JBoss EAP

## Chapter Information

### Overview

This chapter discusses the security features of EAP and how to configure security for applications and JMS. After this chapter, students should feel comfortable securing applications with LDAP and databases, securing JMS destinations, and securing sensitive server configuration data.

### Schedule

*Table 28. ILT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Configuring a Database Security Domain	P: Lecture	40
		A: Guided Exercise	
2	Configuring and LDAP Security Domain	P: Lecture	15
		A: Guided Exercise	
3	Securing a JMS Destination	P: Lecture	15
		A: Quiz	

Section	Title	Presentation & Engagement Methods	Time (minutes)
4	Configuring the Password Vault	P: Lecture	30
		A: Guided Exercise	
	Lab	Unguided Lab	45
Conclusion			2

*Table 29. VT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Configuring a Database Security Domain	P: Lecture	40
		A: Guided Exercise	
2	Configuring and LDAP Security Domain	P: Lecture	15
		A: Guided Exercise	
3	Securing a JMS Destination	P: Lecture	15
		A: Quiz	
4	Configuring the Password Vault	P: Lecture	30
		A: Guided Exercise	
	Lab	Unguided Lab	45
Conclusion			2

Total Time: 155 minutes

## Chapter Introduction

### Introduction (3 min)

This chapter goes into specific detail about the Security subsystem, including creating a database and LDAP security domain, protecting sensitive server configuration data, and securing JMS Queues and Topics.

## Instructional strategies for Configuring a Database Security Domain (20 + 20 min.)

### Objective

- Configure a security domain based on the database login module.



- Students learn about Security concepts in EAP.
- Students learn how to use a datasource to authorize users for an application.

## Presentation Notes

### Introduction (3 min)

EAP's security subsystem allows administrators to abstract application security without changing the application source code.

1. Why is it useful to have this level of abstraction between security and the application?

This is an open-ended question intended to get the students talking.

### Lecture (20 min)

Similar to other configurable aspects of EAP, security is managed by adjusting the subsystem settings. Security domains define how applications are authenticated and are the basis for securing application authentication and authorization in EAP.

This section looks at the basics for creating a database login module, including the adjustments that need to be made in the `web.xml` and `jboss-web.xml` in order to secure the application. A database security domain uses a datasource to validate users.

Be sure that students understand all of the parameters for creating a database security domain and where the values come from.

### Guided Exercise (20 min)

Tell your students to turn to the guided exercise in their books. Give them approximately 20 minutes to complete it, then discuss the solution.

### Summary (2 min)

The security subsystem in EAP 6 was developed under the Picketlink project. In EAP 7, Picketlink (legacy) has been replaced by the Elytron project. The course mainly teaches the usage of the legacy subsystem.

## Instructional strategies for Configuring and LDAP Security Domain (5 + 15 min.)

### Objective

- Configure a security domain based on the LDAP login module.

## Presentation Notes

### Introduction (1 min)

Login modules can be configured to use other sources of validation in addition to Datasources, such as an LDAP server.

1. Who is familiar with using LDAP? What are some advantages of LDAP?

This is an open-ended question intended to get the students talking.

### Lecture (5 min)

This lecture follows a similar structure to the previous section. Emphasize the differences in configuring for an LDAP server.

Engage the students prior to this section to understand their familiarity with LDAP. If several students are not familiar with LDAP, give a slightly more in depth overview.

### Guided Exercise (15 min)

Tell your students to turn to the guided exercise in their books. Give them approximately 15 minutes to complete it, then discuss the solution.

## Summary

Security domain login modules can be configured to use an LDAP server.

## Instructional strategies for Securing a JMS Destination (10 + 5 min.)

### Objective

- Configure role-based access control to topics and queues in the messaging subsystem.

## Presentation Notes

### Introduction (2 min)

Security domains can be used to secure other aspects of EAP, such as the messaging subsystem.

1. Why might an administrator want to create different authentication and authorization restrictions for the messaging subsystem?

This is an open-ended question intended to get the students talking.

## Lecture (10 min)

There is no guided exercise for this section, but the material is covered in the final lab. Encourage students to refer to this section in the final lab if they get stuck.

By default, the messaging subsystem utilizes the `other` security domain, which utilizes the security realm `ApplicationRealm`. The messaging subsystem, therefore, already has some security preconfigured and adding users into the application realm is a quick way to restrict access to JMS destinations.

The security domain, however, can be switched and adjusted to use other domains that are configured to use LDAP or Databases, for example. Emphasize the effective ways of targeting specific destinations to both grant and restrict access on different JMS destinations.

## Quiz (5 min)

Tell your students to turn to the Quiz in their books. Give them approximately 5 minutes to complete it, then discuss the solution.

## Summary

JMS destinations can be restricted based on role using a security domain.

# Instructional strategies for Configuring the Password Vault (10 + 20 min.)

## Objective

- Protect passwords stored in server configuration files by using the password vault.

## Presentation Notes

### Introduction (2 min)

The `standalone.xml` and `domain.xml` store lots of sensitive data openly in the XML, such as datasource passwords. The vault helps to secure this information.

1. What other information stored in the server configuration might be good to store in a vault?

This is an open-ended question intended to get the students talking.

### Lecture (8 min)

Explain to students that anyone who has read access to the server configuration files could read any passwords or sensitive data that is listed in the file. In general, it is recommended to use a password vault as this creates a level of security abstraction between the server configuration and

the credentials needed for the datasources, etc.

Be sure that students understand the steps necessary to create a vault and to reference it. Explore how this process changes when configuring a vault in domain mode. Remind students that the value that is referenced in the vault should be referenced as if it is a variable, meaning the syntax looks like: `${VARIABLE_NAME}`.

## Guided Exercise (20 min)

Tell your students to turn to the guided exercise in their books. Give them approximately 20 minutes to complete it, then discuss the solution.

## Summary

A password vault allows users to store sensitive data that can then be referenced in the server configuration files.

## Chapter Review (45 min.)

Have your students turn to the Unit Test in their books. Give them approximately 45 minutes to complete this exercise.

## Wrap Up (~5 min)

Final review should take approximately 5 minutes. Address any learner questions or comments and review the benefits with the students. Review the summary points with the learners as displayed in the Student Guide.

# Configuring the Java Virtual Machine

## Chapter Information

### Overview

This chapter will discuss the configuration of the Java Virtual Machine (JVM). Students will learn about the memory architecture of the JVM and how to configure the JVM settings for a standalone server as well a managed domain. Be sure to discuss the different levels at which the JVM settings for an EAP managed domain can be configured and highlight recommended approaches for configuring JVM's in a Production environment with multiple servers.

# Schedule

*Table 30. ILT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Configuring the JVM in a Standalone Server	P: Lecture	20
		A: Quiz	
2	Configuring the JVM in a Managed Domain	P: Lecture	40
		A: Guided Exercise	
	Configuring the Java Virtual Machine	Lab	15
Conclusion			2

*Table 31. VT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Configuring the JVM in a Standalone Server	P: Lecture	20
		A: Quiz	
2	Configuring the JVM in a Managed Domain	P: Lecture	40
		A: Guided Exercise	
	Configuring the Java Virtual Machine	Lab	15
Conclusion			2

Total Time: 80 minutes

## Chapter Introduction

### Introduction (3 min)

This chapter will discuss the configuration of the Java Virtual Machine (JVM). Students will learn how to configure the JVM for a standalone server as well as a managed domain. We will also take a deeper look at the three different levels where the JVM settings can be configured in a managed domain using the EAP management console and the EAP CLI. Be sure to emphasize to the students, the usage of either the Management Console or the EAP CLI for configuration and management rather than manually editing the XML configuration files.

# Instructional strategies for Configuring the JVM in a Standalone Server (15 + 5 min.)

## Objective

- Perform JVM configuration settings in a standalone server.

## Benefits

- Students learn about the memory architecture of the JVM, the various memory regions that make up the JVM process and how to configure them.
- Students learn how to configure JVM settings for a Standalone server.

## Presentation Notes

### Introduction (3 min)

The JVM memory is made up of: \* Heap: Consisting the young generation, survivor spaces and the old generation \* Non-Heap: Consisting the Metaspace, stack and other internal JVM metadata

1. How is the JVM different from other virtual machines of other programming languages like Perl, Python, Ruby etc?

This is an open-ended question intended to get the students talking.

### Lecture (15 min)

Talk briefly about the different memory regions in the JVM and how to configure them.

Talk briefly about the relationship between the JVM and the Operating System. Discuss the deprecation of the Permanent Generation and its replacement by the Metaspace in Java 8.

Talk briefly about how to configure the JVM settings for a standalone server.

### Quiz (5 min.)

Tell your students to turn to the Quiz in their books. Give them approximately 5 minutes to complete it, then discuss the answers.

## Summary

A JVM automatically deallocates objects by a process called Garbage Collection.

An EAP standalone server's JVM settings can be configured in the `standalone.conf` file.

The Permanent Generation has been removed in Java 8 in favor of the Metaspace.

# Instructional strategies for Configuring the JVM in a Managed Domain (20 + 20 min.)

## Objective

- Configure JVM settings in a managed domain.

## Benefits

- Students learn about the different levels at which the JVM settings can be configured in the managed domain.
- Students learn about the different configuration attributes for JVM configuration in the `host.xml` and `domain.xml` files.

## Presentation Notes

### Introduction (3 min)

The management console as well as the EAP CLI can be used to configure the JVM settings in a managed domain. The JVM settings can be configured at different levels in a managed domain and the lower levels override the settings inherited from the parent levels.

1. At what level would you choose to configure the JVM settings in a managed domain consisting of a large number of hosts, server groups and servers?

This is an open-ended question intended to get the students talking.

### Lecture (20 min)

This topic explores in detail, the different levels at which the JVM settings can be configured in a managed domain. Students learn how to configure the JVM using the web based EAP management console as well as EAP CLI. Be sure to discuss the advantages of the EAP CLI over the other approaches in terms of ease-of-use, in-built documentation, auto complete and batch mode. Be sure to emphasize that the web based management console or the JBoss EAP CLI is the preferred approach for configuring and managing server groups rather than editing the XML files manually.

Also, this topic explores how to inherit and override the JVM settings at the server group and server levels.

### Guided Exercise (20 min.)

Tell your students to turn to the guided exercise in their books. Give them approximately 20 minutes to complete it, then discuss the answers.

## Summary

Students should be able to configure the JVM settings of a standalone server as well JVM settings at the server group and server level in a managed domain.

## Chapter Review (15 min.)

Have your students turn to the Unit Test in their books. Give them approximately 15 minutes to complete this exercise.

## Wrap Up (~5 min)

Final review should take approximately 5 minutes. Address any learner questions or comments and review the benefits with the students. Have students turn to the summary section in the student guide and review the summary points with them.

## Review Questions

1. How would you configure the JVM settings in a managed domain consisting of a number of hosts, server groups and servers that is hosting a number of unique applications each requiring different garbage collection algorithms and having different memory allocation patterns and sizes? Assume the managed domain size will grow in terms of more hosts and more servers to handle future scalability.
  - Define the base set of JVM flags that all servers must be running with in the host controller level (garbage collection logging, diagnostics, profiling etc)
  - Override the heap sizes based on the application type at the `server-group` level and refer to the named JVM's in the respective servers.
  - Minimize `server` level JVM definitions if possible. Prefer to define the JVM settings at the higher levels because it is easier to maintain a uniform configuration as you scale out the managed domain by adding more hosts and defining more servers.

# Configuring the Web Subsystem

## Chapter Information

### Overview

This chapter discusses about the new web container named Undertow. Students will learn the new features provided by Undertow, understand its components and learn how to define the default web application and how to enable HTTPS for EAP instances.



# Schedule

*Table 32. ILT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Exploring the Features of the Web Subsystem	P: Lecture	20
		A: Quiz	
2	Configuring the Web Subsystem	P: Lecture	70
		A: Guided Exercise	
	Lab	Unguided Lab	30
Conclusion			2

*Table 33. VT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Exploring the Features of the Web Subsystem	P: Lecture	20
		A: Quiz	
2	Configuring the Web Subsystem	P: Lecture	70
		A: Guided Exercise	
	Lab	Unguided Lab	30
Conclusion			2

Total Time: 125 minutes

## Chapter Introduction

### Introduction (3 min)

This chapter goes into specific detail about the Undertow web container. Students will become familiar with its components learning how to define the default web application and how to enable HTTPS.

## Instructional strategies for Exploring the Features of the WebSubsystem (15 + 5 min.)

## Objective

- Identify the features of the undertow web subsystem.

## Presentation Notes

### Introduction (3 min)

The Undertow subsystems replaces the JBoss Web Server as the web container technology. Ask the following question to the students:

1. Who is familiar with the JBoss Web Server from previous version of EAP?

This is an open-ended question intended to get the students talking.

### Lecture (15 min)

Explain the students that the JBoss Web Server was replaced to Undertow to accomplish the new requirements from the Jakarta EE specification.

Teach students explaining that the Undertow is written in Java and it is fast because it is using the XNIO API.

Describe to students the new features like using Undertow as loading balancer, the port reduction, web sockets, JSON-P and HTTP/2.

Explain the five main components that can be configured under the Undertow subsystem.

### Quiz (5 min)

Tell your students to turn to the Quiz in their books. Give them approximately 5 minutes to complete it, then discuss the solution.

### Summary (2 min)

Undertow has five main components to configure the web container.

## Instructional strategies for Configuring the Web Subsystem (25 + 45 min.)

## Objective

- Configure the components of the web subsystem.

# Presentation Notes

## Introduction (2 min)

In some cases it is required to configure some items like security, enable AJP for load balancing for deployed applications.

1. Which requirements a company may need to support deployed applications?

This is an open-ended question intended to get the students talking.

## Lecture (25 min)

Explain to students that is possible to configure the default web application using two approaches:

- Changing the welcome-content file handler.
- Changing the default-web-module attribute.

Describe how to use both approaches.

Explain how to configure servers using the listeners. Describe the three available listeners and how to create virtual hosts.

Describe the process to enable SSL connections. Explain about the `keytool` command and how to enable SSL using the CLI tool.

Explain how to configure the following Undertow components:

- Buffer cache.
- Servlet container.
- Handlers.
- Filters.

Also explain about the IO subsystem and how it is related to the Undertow subsystem.

## Guided Exercise (45 min)

Tell your students to turn to the guided exercise in their books. Give them approximately 45 minutes to complete it, then discuss the solution.

## Summary

Enable the SSL only for the required scenarios. It is a better idea to enable the SSL on the load balancer instead of each EAP instance.

# Chapter Review (30 min.)

Have your students turn to the Unit Test in their books. Give them approximately 30 minutes to complete this exercise.

## Wrap Up (~5 min)

Final review should take approximately 5 minutes. Address any learner questions or comments and review the benefits with the students. Review the summary points with the learners as displayed in the Student Guide.

# Deploying Clustered Applications

## Chapter Information

### Overview

In this section, students will learn about the benefits of clustering applications and how to configure the subsystems and applications to utilize this feature. In addition, students will learn how to use EAP as a load balancer to make applications highly available. Students will also be given an overview of highly available singleton applications as well as quizzed on the material.

### Schedule

*Table 34. ILT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Exploring Clustered Applications	P: Lecture	25
		A: Quiz	
2	Configuring Subsystems that Support Clustered Applications	P: Lecture	55
		A: Guided Exercise	
3	Configuring Load Balancer	P: Lecture	35
		A: Guided Exercise	
4	Deploying HA Singleton Applications	P: Lecture	15
		A: Quiz	
	Lab	Unguided Lab	40
Conclusion			2

*Table 35. VT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Exploring Clustered Applications	P: Lecture	25
		A: Quiz	
2	Configuring Subsystems that Support Clustered Applications	P: Lecture	55
		A: Guided Exercise	
3	Configuring Load Balancer	P: Lecture	35
		A: Guided Exercise	
4	Deploying HA Singleton Applications	P: Lecture	15
		A: Quiz	
	Lab	Unguided Lab	40
Conclusion			2

Total Time: 175 minutes

## Chapter Introduction

### Introduction (3 min)

A clustered application provides many benefits to users, particularly allowing applications to persist data and maintain availability even if some of the servers no longer become available. In addition, utilizing EAP as a load balancer allows users to fine tune how to most efficiently manage the high availability of an application.

## Instructional strategies for Exploring Clustered Applications (20 + 5 min.)

### Objective

- Identify the benefits of clustering and the JBoss EAP subsystems involved in supporting clustered application deployments.
- Describe example topologies of clustered applications.

### Benefits

- Students learn about clustering benefits and concepts.
- Students learn about clustered standalone servers and a clustered managed domain.

# Presentation Notes

## Introduction (3 min)

Servers often need maintenance or repair and need to go down, or simply get overloaded with traffic. In order to keep an application online, the servers need to be clustered.

1. What are some other reasons why a server may become unavailable?

This is an open-ended question intended to get the students talking.

## Lecture (20 min)

This section covers the benefits of a clustered application. The primary benefits are high availability, scalability, failover, and fault tolerance. Be sure students understand how these types of issues can present themselves and how a cluster can work to fix these problems. The two primary obstacles for clustering are load balancing and data replication services. EAP 7 provides facilities to help with both of these, via JGroups and Infinispan.

The JGroups and Infinispan subsystems are configured by default in the **full-ha** and **ha** profiles.

Be sure that students understand the difference between a managed domain and a cluster, as they can be confusing to distinguish. A cluster can be configured either in standalone servers or in a managed domain. Use the diagrams to illustrate the point.

Students should be able to distinguish the two subsystems, Infinispan and JGroups. Infinispan facilitates caching of objects, while JGroups facilitates communication between nodes in the cluster.

In order to make a web application available for clustering, users needs to add a `<distributed>` tag in the `jboss-web.xml`.

## Quiz (5 min)

Tell your students to turn to the quiz in their books. Give them approximately 5 minutes to complete it, then discuss the answers.

## Summary

EAP provides a default configuration that makes it simple to create high availability for an application.

# Instructional strategies for Configuring Subsystems That Support Clustered Applications (35 + 20 min.)

## Objective

- Configure Infinispan and JGroups to support clusters.
- Start a cluster in standalone server or managed domain modes.

## Benefits

- Students learn about configuring JGroups and Infinispan subsystems.
- Students learn how to start clustered servers.

## Presentation Notes

### Introduction (3 min)

This section introduces students to configuring the primary subsystems involved with clustering.

1. Do any of you have experience with Infinispan or JGroups?

This is an open-ended question intended to get the students talking.

### Lecture (35 min)

JGroups communicates primarily through UDP and TCP. Be sure that students understand the difference between the two. The stacks can be modified or a new stack can be created in the management console or the EAP CLI.

The Infinispan subsystem provides the caching support for EAP. Be sure students understand the role of this subsystem in a clustered environment. Outline the four preconfigured cache containers: web, hibernate, ejb, server.

There are four types of caches: Local, Invalidation, Replication, and Distribution. There are four coordinating pages in the management console for each type of cache in the Infinispan subsystem.

To start a cluster, users start the server or domain as normal, however with the additional `jboss.node.name` parameter and referencing the full-ha or ha server configuration, if using a standalone server. Make students aware that they need to be careful of port conflicts as well as firewall rules for all of the ports required for a clustered environment. In addition, the application must be marked as distributable.

### Guided Exercise (20 min)

Tell your students to turn to the guided exercise in their books. Give them approximately 20 minutes to complete it, then discuss any questions the students have.

## Summary

JGroups creates communication between nodes over TCP or UDP. Infinispan allows caching to maintain the cluster.

# Instructional strategies for Configuring Load Balancer (15 + 20 min.)

## Objective

- Configure Undertow as a load balancer.

## Benefits

- Students learn about the benefits of a load balancer.
- Students learn how to use Undertow as a load balancer.

## Presentation Notes

### Introduction (3 min)

After configuring EAP to be clustered, EAP still needs a way to direct traffic to available servers. This requires an HTTP load balancer.

1. Which load balancer solutions have you used before?

This is an open-ended question intended to get the students talking.

### Lecture (15 min)

Configuring servers for caching and communication is only half of EAP clustering. Administrators also need a load balancer to direct HTTP requests to the available EAP servers.

Describe the need for having a server perform these load balancing tasks and how this used to require a separate server in previous versions of EAP. Now EAP provides the capability to configure a server to do load balancing. However, alternatives are still supported and can be used in conjunction with EAP 7.

Session affinity, or sticky sessions, refers to directing all requests from the same user to the same server.

Undertow has two important protocols for clustering: `mod_cluster` and AJP. AJP protocol is a binary replacement for text-based HTTP protocol. It provides long-lived persistent connections. `Mod cluster` allows a web proxy to dynamically discover back end web servers. Traditional load balancers require a static list, however `mod cluster` provides the ability to find these servers



dynamically.

In order to configure Undertow as a load balancer, users need to add a `mod_cluster` filter to the default undertow server and configure the advertise settings in both the undertow and modcluster subsystems.

Undertow can also be configured as a more traditional static load balancer by adding an outbound socket binding to point to each cluster member.

Red Hat supports other web servers as load balancers in addition to Undertow, providing support via `mod_jk` and `mod_proxy` modules.

## Guided Exercise (20 min)

Tell your students to turn to the guided exercise in their books. Give them approximately 20 minutes to complete it, then discuss the answers.

## Summary

The Undertow load balancer completes the cluster architecture and works with the Infinispan caching and JGroups node communication to provide high availability for applications.

# Instructional strategies for Deploying HA Singleton Applications (10 + 5 min.)

## Objective

- Configure and deploy a high available deployment or service.

## Benefits

- Students learn about a singleton pattern and using singleton applications and services.

## Presentation Notes

### Introduction (3 min)

A singleton is a design pattern where only a single object is created for an entire application.

1. When is a singleton useful?

This is an open-ended question intended to get the students talking.

## Lecture (10 min)

A singleton is a popular design pattern for sharing a single instance of an object across an entire application. This can prevent issues where each node in a cluster has a different data object, creating inconsistencies.

The singleton subsystem employs the Infinispan cache to register all singleton deployments and services. There are two different policies for singletons, either simple or random. Simple denotes that the first node to join the cluster run the singleton application. The random policy means that a random node is selected to run the singleton application.

Singletons can be used as a deployment or as a service in EAP. Deployments can be configured in the `/META-INF/singleton-deployment.xml` file. Alternatively, deploying it as a service in EAP allows the election policy to be defined by the application without making changes to the singleton subsystem.

## Quiz (5 min)

Tell your students to turn to the quiz in their books. Give them approximately 5 minutes to complete it, then discuss the answers.

## Summary

Singletons provide a solution to maintaining a single data object shared within a cluster.

## Chapter Review (40 min.)

Have your students turn to the Unit Test in their books. Give them approximately 40 minutes to complete this exercise.

## Wrap Up (~5 min)

Final review should take approximately 5 minutes. Address any learner questions or comments and review the benefits with the students. Have students turn to the summary section in the student guide and review the summary points with them.

# Comprehensive Review of Red Hat JBoss Application Administration I

## Chapter Information

# Overview

This chapter will exercise all the knowledge obtained throughout this course.

## Schedule

*Table 36. ILT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Comprehensive Review of Red Hat JBoss Application Administration I	P: Lecture	155
		A: Lab	
Conclusion			2

*Table 37. VT Schedule*

Section	Title	Presentation & Engagement Methods	Time (minutes)
Introduction			3
1	Comprehensive Review of Red Hat JBoss Application Administration I	P: Lecture	155
		A: Lab	
Conclusion			2

Total Time: 160 minutes

## Chapter Introduction

### Introduction (3 min)

Discuss which topics will be addressed by the comprehensive review lab.

## Instructional strategies for the Comprehensive Review of Red Hat JBoss Application Administration I(5 + 150 min.)

### Objective

- Deploy a clustered environment and a load balancer managed by a standalone server. All the passwords will be encrypted and stored in a keystore and a message queue configured for future use.

## Benefits

- Students learn how to configure an environment that resembles a real world deployment scenario used by a JBoss EAP instance.

## Presentation Notes

### Introduction (3 min)

Indicate that this is a comprehensive lab covering most of the skills learned throughout the course.

### Lecture (2 min)

Review the points that will be covered in the comprehensive lab from the Student guide.

### Guided Exercise (150 min.)

Recall students to reset their machines in order to start the lab. Also, request them to run the grading script to configure the whole set of files needed to install EAP in a production-like scenario. Most of the problems identified during the course may happen during this lab, and recall how to solve them. Additionally, the grading script can be used to check the status of the student development. Fortunately it can be executed with EAP started, which allows a simpler way to check the condition of the lab.

## Summary

In this review the student had a chance to practice most of the skills they learned in the course.

# Course and Exam Objectives Mapping

*Table 38. Course and Exam Objectives Mapping*

Course Objective	Exam Objective	Comments
Install EAP in an automated manner using a response file	Install JBoss EAP to a specific location on a system	Students can manually install EAP using the JAR installer, or use an automated process using a response file. He can also use the EAP zip file to install it. All of these are covered in detail in Chapter 1 of the course.
Describe the management options available for JBoss EAP	Configure minimal security requirements for accessing and managing JBoss EAP	Covered in Chapter 1

Course Objective	Exam Objective	Comments
Connect to an instance of JBoss EAP standalone with the CLI and execute general commands	Access and manage JBoss EAP using the provided tools	Covered in Chapter 1 and Chapter 3
Deploy a managed domain with multiple host controllers and servers	Configure and start a multi-node, multi-server JBoss EAP domain spanning at least two hosts with multiple servers per host	Covered in Chapter 4 and 5
Describe managed domain architecture  Assign the domain controller and start the managed domain  Describe how to shut down servers, server groups and the entire managed domain from the EAP CLI	Create and remove JBoss EAP domains, hosts and servers	Covered in Chapter 4 and 5
Describe the different options available for application deployment on an EAP managed domain	Start, monitor and stop individual JBoss EAP domains, hosts and servers	Covered in Chapter 4 and 5
Configure the JVM settings for the servers in the managed domain	Configure Java memory usage at the host, server group and server level	Covered in Chapter 10
Configure JBoss EAP network interfaces and socket binding groups	Configure persistent network bindings for JBoss EAP services (both addresses and ports)	Covered in Chapter 2, 4 and 5
Deploy a clustered web application on a TCP-based JGroups stack  Configure the servers for high availability	Configure high-availability clustering using TCP unicast networking	Covered in Chapter 12
Configure Infinispan and JGroups to support clusters	Secure the communications channels between clustered nodes	Covered in Chapter 12
Connect to an instance of JBoss EAP standalone with the CLI and execute general commands	Create and restore configuration snapshots	Covered in Chapter 3

Course Objective	Exam Objective	Comments
Configure the logging system with a size rotating file handler, to an NFS share so that all server logs are available centrally and are clearly identified by the server name	Configure JBoss EAP logging	Covered in Chapter 7
Configure messaging subsystem for redelivery options, dead letter queue, and expiry queue	Remove, create and configure JMS topics and queues	Covered in Chapter 8
Implement JMS messaging cluster with journals and I/O optimized and group discovery options	Secure access to JMS destinations	Covered in Chapter 8
Describe the architecture of extensions, subsystems, modules, and profiles	Select appropriate JBoss EAP server profiles based on application requirements	Covered in Chapter 2, 4 and 5
Deploy a persistent, default data source by replacing the H2 in-memory data source with a MySQL data source, and the MySQL JDBC driver deployed as a module	Configure DataSources (both XA and non-XA compliant)	Covered in Chapter 6
Describe the different options available for application deployment on an EAP managed domain  Deploy a Java EE application to a server instance running as a standalone server	Deploy and undeploy applications	Covered in Chapter 3 and 5
Deploy a JDBC Driver as a module	Deploy and undeploy additional libraries and drivers	Covered in Chapter 3, 5 and 6
Configure the components of the web subsystem	Deploy a web application to the root context	Covered in Chapter 11
Configure the components of the web subsystem	Tune and configure JBoss EAP web properties as requested	Covered in Chapter 10
Configure an HTTPS listener including a self-signed certificate	Configure an SSL encrypted connection	Covered in Chapter 11

<b>Course Objective</b>	<b>Exam Objective</b>	<b>Comments</b>
Implement a security domain backed by a database login module where the data is stored in the configured MySQL data source	Create, modify, and use security domains	Covered in Chapter 9
Implement a security domain backed by a database login module where the data is stored in the configured MySQL data source	Connect JBoss EAP to specified external security sources such as LDAP and DBMS	Covered in Chapter 9
Secure local CLI access and configure password vault for all passwords	Secure access to JBoss EAP services	Covered in Chapter 9