Java™ Servlet Specification

Version 3.0

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Preface

This document is the Java™ Servlet Specification, version 3.0. The standard for the Java Servlet API is described herein.

Additional Sources

The specification is intended to be a complete and clear explanation of Java Servlets, but if questions remain, the following sources may be consulted:

- A reference implementation (RI) has been made available which provides a behavioral benchmark for this specification. Where the specification leaves implementation of a particular feature open to interpretation, implementors may use the reference implementation as a model of how to carry out the intention of the specification.
- A compatibility test suite (CTS) has been provided for assessing whether implementations meet the compatibility requirements of the Java Servlet API standard. The test results have normative value for resolving questions about whether an implementation is standard.
- If further clarification is required, the working group for the Java Servlet API under the Java Community Process should be consulted, and is the final arbiter of such issues.

Comments and feedback are welcome, and will be used to improve future versions.

Who Should Read This Specification

The intended audience for this specification includes the following groups:

- Web server and application server vendors that want to provide servlet engines that conform to this standard.
- Authoring tool developers that want to support Web applications that conform to this specification
- Experienced servlet authors who want to understand the underlying mechanisms of servlet technology.

We emphasize that this specification is not a user's guide for servlet developers and is not intended to be used as such. References useful for this purpose are available from `http://java.sun.com/products/servlet`.

API Reference

The full specifications of classes, interfaces, and method signatures that define the Java Servlet API, as well as their accompanying Javadoc™ documentation, is available online.

Other Java Platform Specifications

The following Java API specifications are referenced throughout this specification:

- Java Platform, Enterprise Edition ("Java EE"), version 5
- JavaServer Pages™ ("JSP™"), version 2.1
- Java Naming and Directory Interface™ ("J.N.D.I.").

These specifications may be found at the Java Platform, Enterprise Edition Web site: `http://java.sun.com/javaee/`.

Other Important References

The following Internet specifications provide information relevant to the development and implementation of the Java Servlet API and standard servlet engines:

- RFC 1630 Uniform Resource Identifiers (URI)
- RFC 1738 Uniform Resource Locators (URL)

- RFC 2396 Uniform Resource Identifiers (URI): Generic Syntax
- RFC 1808 Relative Uniform Resource Locators
- RFC 1945 Hypertext Transfer Protocol (HTTP/1.0)
- RFC 2045 MIME Part One: Format of Internet Message Bodies
- RFC 2046 MIME Part Two: Media Types
- RFC 2047 MIME Part Three: Message Header Extensions for non-ASCII text
- RFC 2048 MIME Part Four: Registration Procedures
- RFC 2049 MIME Part Five: Conformance Criteria and Examples
- RFC 2109 HTTP State Management Mechanism
- RFC 2145 Use and Interpretation of HTTP Version Numbers
- RFC 2324 Hypertext Coffee Pot Control Protocol (HTCPCP/1.0)[1]
- RFC 2616 Hypertext Transfer Protocol (HTTP/1.1)
- RFC 2617 HTTP Authentication: Basic and Digest Authentication
- RFC 3986 Uniform Resource Identifier (URI): Generic Syntax

Online versions of these RFCs are at `http://wwww.ietf.org/rfc/`.

The World Wide Web Consortium (`http://www.w3.org/`) is a definitive source of HTTP related information affecting this specification and its implementations.

The eXtensible Markup Language (XML) is used for the specification of the Deployment Descriptors described in Chapter 13 of this specification. More information about XML can be found at the following Web sites:

`http://java.sun.com/xml`

`http://www.xml.org/`

Providing Feedback

We welcome any and all feedback about this specification. Please e-mail your comments to `jsr-315-comments@jcp.org`.

Please note that due to the volume of feedback that we receive, you will not normally receive a reply from an engineer. However, each and every comment is read, evaluated, and archived by the specification team.

1. This reference is mostly tongue-in-cheek although most of the concepts described in the HTCPCP RFC are relevant to all well-designed Web servers.

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CHAPTER 1

Overview

1.1 What is a Servlet?

A servlet is a Java™ technology-based Web component, managed by a container, that generates dynamic content. Like other Java technology-based components, servlets are platform-independent Java classes that are compiled to platform-neutral byte code that can be loaded dynamically into and run by a Java technology-enabled Web server. Containers, sometimes called servlet engines, are Web server extensions that provide servlet functionality. Servlets interact with Web clients via a request/response paradigm implemented by the servlet container.

1.2 What is a Servlet Container?

The servlet container is a part of a Web server or application server that provides the network services over which requests and responses are sent, decodes MIME-based requests, and formats MIME-based responses. A servlet container also contains and manages servlets through their lifecycle.

A servlet container can be built into a host Web server, or installed as an add-on component to a Web Server via that server's native extension API. Servlet containers can also be built into or possibly installed into Web-enabled application servers.

All servlet containers must support HTTP as a protocol for requests and responses, but additional request/response-based protocols such as HTTPS (HTTP over SSL) may be supported. The required versions of the HTTP specification that a container must implement are HTTP/1.0 and HTTP/1.1. Because the container may have a caching mechanism described in RFC2616 (HTTP/1.1), it may modify requests from the clients before delivering them to the servlet, may modify responses produced by servlets before sending them to the clients, or may respond to requests without delivering them to the servlet under the compliance with RFC2616.

A servlet container may place security restrictions on the environment in which a servlet executes. In a Java Platform, Standard Edition (J2SE, v.1.3 or above) or Java Platform, Enterprise Edition (Java EE, v.1.3 or above) environment, these restrictions should be placed using the permission architecture defined by the Java platform. For example, high-end application servers may limit the creation of a `Thread` object to insure that other components of the container are not negatively impacted.

Java SE 6 is the minimum version of the underlying Java platform with which servlet containers must be built.

1.3 An Example

The following is a typical sequence of events:

1. A client (e.g., a Web browser) accesses a Web server and makes an HTTP request.
2. The request is received by the Web server and handed off to the servlet container. The servlet container can be running in the same process as the host Web server, in a different process on the same host, or on a different host from the Web server for which it processes requests.
3. The servlet container determines which servlet to invoke based on the configuration of its servlets, and calls it with objects representing the request and response.
4. The servlet uses the request object to find out who the remote user is, what HTTP `POST` parameters may have been sent as part of this request, and other relevant data. The servlet performs whatever logic it was programmed with, and generates data to send back to the client. It sends this data back to the client via the response object.
5. Once the servlet has finished processing the request, the servlet container ensures that the response is properly flushed, and returns control back to the host Web server.

1.4 Comparing Servlets with Other Technologies

In functionality, servlets lie somewhere between Common Gateway Interface (CGI) programs and proprietary server extensions such as the Netscape Server API (NSAPI) or Apache Modules.

Servlets have the following advantages over other server extension mechanisms:

- They are generally much faster than CGI scripts because a different process model is used.
- They use a standard API that is supported by many Web servers.
- They have all the advantages of the Java programming language, including ease of development and platform independence.
- They can access the large set of APIs available for the Java platform.

1.5 Relationship to Java Platform, Enterprise Edition

The Java Servlet API v.3.0 is a required API of the Java Platform, Enterprise Edition, v.6[1]. Servlet containers and servlets deployed into them must meet additional requirements, described in the Java EE specification, for executing in a Java EE environment.

1.6 Compatibility with Java Servlet Specification Version 2.5

This section will be updated after Public Review

1. Please see the Java™ Platform, Enterprise Edition specification available at `http://java.sun.com/javaee/`

CHAPTER 2

The Servlet Interface

The `Servlet` interface is the central abstraction of the Java Servlet API. All servlets implement this interface either directly, or more commonly, by extending a class that implements the interface. The two classes in the Java Servlet API that implement the `Servlet` interface are `GenericServlet` and `HttpServlet`. For most purposes, Developers will extend `HttpServlet` to implement their servlets.

2.1 Request Handling Methods

The basic `Servlet` interface defines a `service` method for handling client requests. This method is called for each request that the servlet container routes to an instance of a servlet.

The handling of concurrent requests to a Web application generally requires that the Web Developer design servlets that can deal with multiple threads executing within the `service` method at a particular time.

Generally the Web container handles concurrent requests to the same servlet by concurrent execution of the `service` method on different threads.

2.1.1 HTTP Specific Request Handling Methods

The `HttpServlet` abstract subclass adds additional methods beyond the basic `Servlet` interface that are automatically called by the `service` method in the `HttpServlet` class to aid in processing HTTP-based requests. These methods are:

- `doGet` for handling HTTP `GET` requests
- `doPost` for handling HTTP `POST` requests
- `doPut` for handling HTTP `PUT` requests
- `doDelete` for handling HTTP `DELETE` requests

- `doHead` for handling HTTP `HEAD` requests
- `doOptions` for handling HTTP `OPTIONS` requests
- `doTrace` for handling HTTP `TRACE` requests

Typically when developing HTTP-based servlets, a Servlet Developer will only concern himself with the `doGet` and `doPost` methods. The other methods are considered to be methods for use by programmers very familiar with HTTP programming.

2.1.2 Additional Methods

The `doPut` and `doDelete` methods allow Servlet Developers to support HTTP/1.1 clients that employ these features. The `doHead` method in `HttpServlet` is a specialized form of the `doGet` method that returns only the headers produced by the `doGet` method. The `doOptions` method responds with which HTTP methods are supported by the servlet. The `doTrace` method generates a response containing all instances of the headers sent in the `TRACE` request.

2.1.3 Conditional GET Support

The `HttpServlet` interface defines the `getLastModified` method to support conditional `GET` operations. A conditional `GET` operation requests a resource be sent only if it has been modified since a specified time. In appropriate situations, implementation of this method may aid efficient utilization of network resources.

2.2 Number of Instances

The servlet declaration which is either via the annotation as described in Chapter 8 or part of the deployment descriptor of the Web application containing the servlet, as described in Chapter 14, “Deployment Descriptor”, controls how the servlet container provides instances of the servlet.

For a servlet not hosted in a distributed environment (the default), the servlet container must use only one instance per servlet declaration. However, for a servlet implementing the `SingleThreadModel` interface, the servlet container may instantiate multiple instances to handle a heavy request load and serialize requests to a particular instance.

In the case where a servlet was deployed as part of an application marked in the deployment descriptor as distributable, a container may have only one instance per servlet declaration per Java Virtual Machine (JVM™)[1]. However, if the servlet in a distributable application implements the `SingleThreadModel` interface, the container may instantiate multiple instances of that servlet in each JVM of the container.

2.2.1 Note About The Single Thread Model

The use of the `SingleThreadModel` interface guarantees that only one thread at a time will execute in a given servlet instance's `service` method. It is important to note that this guarantee only applies to each servlet instance, since the container may choose to pool such objects. Objects that are accessible to more than one servlet instance at a time, such as instances of `HttpSession`, may be available at any particular time to multiple servlets, including those that implement `SingleThreadModel`.

It is recommended that a developer take other means to resolve those issues instead of implementing this interface, such as avoiding the usage of an instance variable or synchronizing the block of the code accessing those resources. The `SingleThreadModel` Interface is deprecated in this version of the specification.

2.3 Servlet Life Cycle

A servlet is managed through a well defined life cycle that defines how it is loaded and instantiated, is initialized, handles requests from clients, and is taken out of service. This life cycle is expressed in the API by the `init`, `service`, and `destroy` methods of the `javax.servlet.Servlet` interface that all servlets must implement directly or indirectly through the `GenericServlet` or `HttpServlet` abstract classes.

2.3.1 Loading and Instantiation

The servlet container is responsible for loading and instantiating servlets. The loading and instantiation can occur when the container is started, or delayed until the container determines the servlet is needed to service a request.

1. The terms "Java virtual machine" and "JVM" mean a virtual machine for the Java(™) platform.

When the servlet engine is started, needed servlet classes must be located by the servlet container. The servlet container loads the servlet class using normal Java class loading facilities. The loading may be from a local file system, a remote file system, or other network services.

After loading the `Servlet` class, the container instantiates it for use.

2.3.2 Initialization

After the servlet object is instantiated, the container must initialize the servlet before it can handle requests from clients. Initialization is provided so that a servlet can read persistent configuration data, initialize costly resources (such as JDBC™ API-based connections), and perform other one-time activities. The container initializes the servlet instance by calling the `init` method of the `Servlet` interface with a unique (per servlet declaration) object implementing the `ServletConfig` interface. This configuration object allows the servlet to access name-value initialization parameters from the Web application's configuration information. The configuration object also gives the servlet access to an object (implementing the `ServletContext` interface) that describes the servlet's runtime environment. See Chapter 4, "Servlet Context" for more information about the `ServletContext` interface.

2.3.2.1 Error Conditions on Initialization

During initialization, the servlet instance can throw an `UnavailableException` or a `ServletException`. In this case, the servlet must not be placed into active service and must be released by the servlet container. The `destroy` method is not called as it is considered unsuccessful initialization.

A new instance may be instantiated and initialized by the container after a failed initialization. The exception to this rule is when an `UnavailableException` indicates a minimum time of unavailability, and the container must wait for the period to pass before creating and initializing a new servlet instance.

2.3.2.2 Tool Considerations

The triggering of static initialization methods when a tool loads and introspects a Web application is to be distinguished from the calling of the `init` method. Developers should not assume a servlet is in an active container runtime until the `init` method of the `Servlet` interface is called. For example, a servlet should not try to establish connections to databases or Enterprise JavaBeans™ containers when only static (class) initialization methods have been invoked.

2.3.3 Request Handling

After a servlet is properly initialized, the servlet container may use it to handle client requests. Requests are represented by request objects of type `ServletRequest`. The servlet fills out response to requests by calling methods of a provided object of type `ServletResponse`. These objects are passed as parameters to the `service` method of the `Servlet` interface.

In the case of an HTTP request, the objects provided by the container are of types `HttpServletRequest` and `HttpServletResponse`.

Note that a servlet instance placed into service by a servlet container may handle no requests during its lifetime.

2.3.3.1 Multithreading Issues

A servlet container may send concurrent requests through the `service` method of the servlet. To handle the requests, the Servlet Developer must make adequate provisions for concurrent processing with multiple threads in the `service` method.

Although it is not recommended, an alternative for the Developer is to implement the `SingleThreadModel` interface which requires the container to guarantee that there is only one request thread at a time in the `service` method. A servlet container may satisfy this requirement by serializing requests on a servlet, or by maintaining a pool of servlet instances. If the servlet is part of a Web application that has been marked as distributable, the container may maintain a pool of servlet instances in each JVM that the application is distributed across.

For servlets not implementing the `SingleThreadModel` interface, if the `service` method (or methods such as `doGet` or `doPost` which are dispatched to the `service` method of the `HttpServlet` abstract class) has been defined with the `synchronized` keyword, the servlet container cannot use the instance pool approach, but must serialize requests through it. It is strongly recommended that Developers not synchronize the `service` method (or methods dispatched to it) in these circumstances because of detrimental effects on performance.

2.3.3.2 Exceptions During Request Handling

A servlet may throw either a `ServletException` or an `UnavailableException` during the service of a request. A `ServletException` signals that some error occurred during the processing of the request and that the container should take appropriate measures to clean up the request.

An `UnavailableException` signals that the servlet is unable to handle requests either temporarily or permanently.

If a permanent unavailability is indicated by the `UnavailableException`, the servlet container must remove the servlet from service, call its `destroy` method, and release the servlet instance. Any requests refused by the container by that cause must be returned with a `SC_NOT_FOUND` (404) response.

If temporary unavailability is indicated by the `UnavailableException`, the container may choose to not route any requests through the servlet during the time period of the temporary unavailability. Any requests refused by the container during this period must be returned with a `SC_SERVICE_UNAVAILABLE` (503) response status along with a `Retry-After` header indicating when the unavailability will terminate.

The container may choose to ignore the distinction between a permanent and temporary unavailability and treat all `UnavailableExceptions` as permanent, thereby removing a servlet that throws any `UnavailableException` from service.

2.3.3.3 Asynchronous processing

Some times a filter and/or servlet is unable to complete the processing of a request without waiting for a resource or event before generating a response. For example, a servlet may need to wait for an available JDBC connection, for a response from a remote web service, for a JMS message, or for an application event, before proceeding to generate a response. Waiting within the servlet is an inefficient operation as it is a blocking operation that consumes a thread and other limited resources. Frequently a slow resource such as a database may have many threads blocked waiting for access and can cause thread starvation and poor quality of service for an entire web container.

Servlet 3.0 introduces the ability for asynchronous processing of requests so that the thread may return to the container and perform other tasks. When asynchronous processing begins on the request, another thread or callback may either generate the response and call `complete` or dispatch the request so that it may run in the context of the container using the `AsyncContext.dispatch` method. A typical sequence of events for asynchronous processing is:

1. The request is received and passed via normal filters for authentication etc. to the servlet.
2. The servlet processes the request parameters and/or content to determine the nature of the request.
3. The servlet issues requests for resources or data, for example, sends a remote web service request or joins a queue waiting for a JDBC connection.
4. The servlet returns without generating a response.
5. After some time, the requested resource becomes available, the thread handling that event continues processing either in the same thread or by dispatching to a resource in the container using the `AsyncContext`.

Java Enterprise Edition features such as a Web Application Environment (SRV14.2.2) and Propagation of Security Identity (SRV.14.3.1) are available only to threads executing the initial request or when the request is dispatched to the container via the `AsyncContext.dispatch` method. Java Enterprise Edition features may be available to other threads operating directly on the response object via the `asyncContext.start(Runnable)` method.

The `@WebServlet` and `@WebFilter` annotations described in Chapter 8 have an attribute - `asyncSupported` that is a `boolean` with a default value of `false`. When `asyncSupported` is set to true the application can start asynchronous processing in a separate thread by calling `startAsync` (see below), passing it a reference to the request and response objects, and then exit from the container on the original thread. This means that the response will traverse (in reverse order) the same filters (or filter chain) that were traversed on the way in. This will be the filters' only shot at modifying the response (e.g., by adding response headers). The response isn't committed till `complete` (see below) is called on the `AsyncContext`.

Dispatching from a servlet that has `asyncSupported=true` to one where `asyncSupported` is set to `false` is allowed. In this case, the response will be committed when the service method of the servlet that does not support async is exited, and it is the container's responsibility to call `complete` on the `AsyncContext` so that any interested `AsyncListener` instances will be notified. The `AsyncListener.onComplete` notification should also be used by filters as a mechanism to clear up resources that it has been holding on to for the async task to complete.

Dispatching from a synchronous servlet to an asynchronous servlet would be illegal. However the decision of throwing an `IllegalStateException` is differed to the point when the application calls `startAsync`. This would allow a servlet to either function as a synchronous or an asynchronous servlet.

The async task that the application is waiting for could write directly to the response, on a different thread than the one that was used for the initial request. This thread knows nothing about any filters. If a filter wanted to manipulate the response in the new thread, it would have to wrap the response when it was processing the initial request "on the way in", and passed the wrapped response to the next filter in the chain, and eventually to the servlet. So if the response was wrapped (possibly multiple times, once per filter), and the application processes the request and writes directly to the response, it is really writing to the response wrapper(s), i.e., any output added to the response will still be processed by the response wrapper(s). When an application reads from a request in a separate thread, and adds output to the response, it really reads from the request wrapper(s), and writes to the response wrapper(s), so any input and/or output manipulation intended by the wrapper(s) will continue to occur.

Alternately if the application chooses to do so it can use the `AsyncContext` to `dispatch` the request from the new thread to a resource in the container. This would enable using content generation technologies like JSP within the scope of the container.

In addition to the annotation attributes we have the following methods / classes added:

- `ServletRequest`
  - `public AsyncContext startAsync(ServletRequest req, ServletResponse res)`. This method puts the request into asynchronous mode and initializes it's `AsyncContext` with the given request and response objects and the timeout returned by `getAsyncTimeout`. The `ServletRequest` and `ServletResponse` parameters MUST be either the same objects as were passed to the calling servlet's `service`, or the filter's `doFilter` method, or be subclasses of `ServletRequestWrapper` or `ServletResponseWrapper` classes that wrap them. A call to this method ensures that the response isn't commited when the application exits out of the service method. It is committed when `AsyncContext.complete` is called on the returned `AsyncContext` or the `AsyncContext` times out and there are no listeners associated to handle the time out. The timer for async timeouts will not start until the request and it's associated response have returned from the container. The `AsyncContext` could be used to write to the response from the async thread. It can also be used to just notify that the response is not closed and committed. The `AsyncContext` returned from this can then be used for further async processing.
  - `public AsyncContext startAsync()` is provided as a convenience that uses the original request and response objects for the async processing. Please note users of this method SHOULD flush the response if they are wrapped before calling this method if you wish, to ensure that any data written to the wrapped response isn't lost.
  - `public AsyncContext getAsyncContext()` - returns the `AsyncContext` if `startAsync` was called. It is illegal to call `getAsyncContext` if the request has not been put in asynchronous mode.
  - `public boolean isAsyncSupported()` - Returns `true` if the request supports async processing, and `false` otherwise. Async support will be disabled as soon as the request has passed a filter or servlet that does not support async processing (either via the designated annotation or declaratively).
  - `public boolean isAsyncStarted()` - Returns `true` if async processing has started on this request, and `false` otherwise. If this request has been dispatched using one of the `AsyncContext.dispatch` methods since it was put in asynchronous mode, this method returns `false`.

    - `public void addAsyncListener(asyncListener, req, res)` - registers a listener for notifications of `timeout` and `complete`. The request and response objects passed in to the method are the exact same ones that are available from the `AsyncEvent` when the `AsyncListener` is notified. The request and response may or may not be wrapped.
    - `public void addAsyncListener(asyncListener)` - registers the given listener for notifications of `timeout` and `complete`. If `startAsync(req, res)` or `startAsync()` is called on the request, the exact same request and response objects are available from the `AsyncEvent` when the `AsyncListener` is notified. The request and response may or may not be wrapped.
    - `public void setAsyncTimeout(long timeoutMilliseconds)` - This is the timeout for the async processing to occur. A call to this method overrides the timeout set by the container or deployment descriptor. If the timeout is not specified either via the call to the `setAsyncTimeout` then a container default will be used.
    - `public long getAsyncTimeout()` - Gets the timeout, in milliseconds, for any asynchronous operations initiated on the request by a call to one of the `startAsync` methods. This method returns the container's default timeout, or the timeout value set via the `setAsyncTimeout` method invocation.
- `AsyncContext` - This class represents the execution context for the asynchronous operation that was started on the `ServletRequest`. The following methods are in the `AsyncContext`:
    - `public ServletRequest getRequest()` - returns the request that was used to initialize the `AsyncContext` by calling one of the `startAsync` methods.
    - `public ServletResponse getResponse()` - returns the response that was used to initialize the `AsyncContext` by calling one of the `startAsync` methods.
    - `public void dispatch(path)` - dispatches the request and response that were used to initialize the `AsyncContext` to the resource with the given path. The given path is interpreted as relative to the `ServletContext` that initialized the `AsyncContext`. All path related query methods of the request MUST reflect the dispatch target, while the original request URI, context path, path info and query string may be obtained from the request attributes as defined in Section 9.7.2, "Dispatched Request Parameters" on page 9-74. These attributes MUST always reflect the original path elements, even after multiple dispatches.
    - `public void dispatch()` - Provided as a convenience to dispatch the request and response used to initialize the `AsyncContext` to the original URI of the request. If the AsyncContext was initialized via the startAsync(ServletRequest, ServletResponse) then the dispatch is to the URI of the request passed to startAsync. If the AsyncContext was initialized with the original request and response via the startAsync(), then the disapatch is to the

URI of the request when it was last dispatched by the container. The following examples demonstrate what the target URI of dispatch would be in the different cases

CODE EXAMPLE 2-1

```
REQUEST to /url/A
AsyncContext ac = request.startAsync();
...
ac.dispatch(); does a ASYNC dispatch to /url/A
```

CODE EXAMPLE 2-2

```
REQUEST to /url/A
FORWARD to /url/B
getRequestDispatcher("/url/B").forward(request, response);
AsyncContext ac = request.startAsync();
ac.dispatch(); does a ASYNC dispatch to /url/A
```

CODE EXAMPLE 2-3

```
REQUEST to /url/A
FORWARD to /url/B
getRequestDispatcher("/url/B").forward(request, response);
AsyncContext ac = request.startAsync(request, response);
ac.dispatch(); does a ASYNC dispatch to /url/B
```

- `public void dispatch(ServletContext context, String path)` - dispatches the request and response used to initialize the `AsyncContext` to the resource with the given path in the given `ServletContext`.
- For all the 3 variations of the `dispatch` methods defined above, calls to the methods returns immediately after scheduling the dispatch to be done by the container. Control of the request and response objects of this `AsyncContext` is handed off to the target resource and the response will close when the target resource of the dispatch has completed execution and a subsequent call to `startAsync` has not been made.
- `public boolean hasOriginalRequestAndResponse()` - This method checks if the `AsyncContext` was initialized with the original request and response objects by calling `ServletRequest.startAsync()`, in which case it returns `true`. If the `AsyncContext` was initializedwith wrapped request and/or response objects using `ServletRequest.startAsync(ServletRequest, ServletResponse)`,it returns `false`. This information may be used by filters invoked in the outbound direction, after a request was put into asynchronous mode, to

  determine whether any request and/or response wrappers that they added during their inbound invocation need to be preserved for the duration of the asynchronous operation.
  - `public void start(Runnable r)` - This method allows the container to dispatches a thread to run the specified `Runnable` in the `ServletContext` that initialized the `AsyncContext`. This method allows the container to set up the appropriate contextual information for the `Runnable`. Workmanager integration will happen once the API becomes available.
  - `public void complete()` - If `request.startAsync()` then this method MUST be called to complete the async processing and close the response. The `complete` method can be invoked by the container if the request is dispatched to a servlet that does not support async processing, or the target servlet called by `AsyncContext.dispatch` does not do a subsequent call to `startAsync`. In this case, it is the container's responsibility to call `complete()` as soon as that servlet's service method is exited. An `IllegalStateException` MUST be thrown if `startAsync` was not called.
- `ServletRequestWrapper`
  - `public boolean isWrapperFor(ServletRequest req)`- Checks recursively if this wrapper wraps the given `ServletRequest` and returns `true` if it does, else it returns `false`
- `ServletResponseWrapper`
  - `public boolean isWrapperFor(ServletResponse res)`- Checks recursively if this wrapper wraps the given `ServletResponse` and returns `true` if it does, else it returns `false`.
- `AsyncListener`
  - `public void onComplete(AsyncEvent event)` - Is used to notify the listener of completion of the asynchronous operation started on the `ServletRequest`.
  - public void onTimeout(AsyncEvent event) - Is used to notify the listener of a timout of the asynchronous operation started on the `ServletRequest`.
- If there is no registered `AsyncListener` for a given request and an async timeout occurs then the container MUST do an `ERROR` dispatch to the original URI with a response code of 500 (internal server error). If there is an error page associated with the response code, the response code could potentially be reset by the error page.
- Async processing in JSP would not be supported by default as it is used for content generation and async processing would have to be done before the doing the content generation. It is upto the container how to handle this case. Once all the async activities are done, a dispatch to the JSP page using the `AsyncContext.dispatch` can be used for generating content.
- Any attempt from the async task to write to the response or read from the request blocks for as long as the original thread is still holding on to the request/response objects. This locking semantics areonly enabled when `the asyncSupported` attribute is set to `true`.

2.3.3.4 Thread Safety

Other than the `startAsync` and `complete` methods, implementations of the request and response objects are not guaranteed to be thread safe. This means that they should either only be used within the scope of the request handling thread or the application must ensure that access to the request and response objects are thread safe.

If a thread created by the application uses the container-managed objects, such as the request or response object, those objects must be accessed only within the object's life cycle as defined in sections 3.10 and 5.6. Be aware that other than the `startAsync`, and `complete` methods, the request and response objects are not thread safe. If those objects were accessed in the multiple threads, the access should be synchronized or be done through the wrapper to add the thread safety, for instance, synchronizing the call of the methods to access the request attribute, or using a local output stream for the response object within a thread.

2.3.4 End of Service

The servlet container is not required to keep a servlet loaded for any particular period of time. A servlet instance may be kept active in a servlet container for a period of milliseconds, for the lifetime of the servlet container (which could be a number of days, months, or years), or any amount of time in between.

When the servlet container determines that a servlet should be removed from service, it calls the `destroy` method of the `Servlet` interface to allow the servlet to release any resources it is using and save any persistent state. For example, the container may do this when it wants to conserve memory resources, or when it is being shut down.

Before the servlet container calls the `destroy` method, it must allow any threads that are currently running in the `service` method of the servlet to complete execution, or exceed a server-defined time limit.

Once the `destroy` method is called on a servlet instance, the container may not route other requests to that instance of the servlet. If the container needs to enable the servlet again, it must do so with a new instance of the servlet's class.

After the `destroy` method completes, the servlet container must release the servlet instance so that it is eligible for garbage collection.

CHAPTER 3

The Request

The request object encapsulates all information from the client request. In the HTTP protocol, this information is transmitted from the client to the server in the HTTP headers and the message body of the request.

3.1 HTTP Protocol Parameters

Request parameters for the servlet are the strings sent by the client to a servlet container as part of its request. When the request is an `HttpServletRequest` object, and conditions set out in "When Parameters Are Available" on page 18 are met, the container populates the parameters from the URI query string and POST-ed data.

The parameters are stored as a set of name-value pairs. Multiple parameter values can exist for any given parameter name. The following methods of the `ServletRequest` interface are available to access parameters:

- `getParameter`
- `getParameterNames`
- `getParameterValues`
- `getParameterMap`

The `getParameterValues` method returns an array of `String` objects containing all the parameter values associated with a parameter name. The value returned from the `getParameter` method must be the first value in the array of `String` objects returned by `getParameterValues`. The `getParameterMap` method returns a `java.util.Map` of the parameter of the request, which contains names as keys and parameter values as map values.

Data from the query string and the post body are aggregated into the request parameter set. Query string data is presented before post body data. For example, if a request is made with a query string of `a=hello` and a post body of `a=goodbye&a=world`, the resulting parameter set would be ordered `a=(hello, goodbye, world)`.

Path parameters that are part of a GET request (as defined by HTTP 1.1) are not exposed by these APIs. They must be parsed from the `String` values returned by the `getRequestURI` method or the `getPathInfo` method.

3.1.1 When Parameters Are Available

The following are the conditions that must be met before post form data will be populated to the parameter set:

1. The request is an HTTP or HTTPS request.
2. The HTTP method is POST.
3. The content type is `application/x-www-form-urlencoded`.
4. The servlet has made an initial call of any of the `getParameter` family of methods on the request object.

If the conditions are not met and the post form data is not included in the parameter set, the post data must still be available to the servlet via the request object's input stream. If the conditions are met, post form data will no longer be available for reading directly from the request object's input stream.

3.2 File upload

If a request is of type `multipart/form-data` and if the servlet handling the request is annotated using the `@MultipartConfig` as defined in Section 8.1.5, "@MultipartConfig" on page 8-56, the `HttpServletRequest` can make available the various parts of the multipart request via the following methods

- `public Iterable<Part> getParts()`
- `public Part getPart(String name).`

Each part provides access to the headers, content type related with it and also the content via the `getInputStream` method.

For parts with `form-data` as the `Content-Dispoisition`, but without a filename, the string value of the part will also be available via the `getParameter / getParameterValues` methods on `HttpServletRequest`, using the name of the part.

3.3 Attributes

Attributes are objects associated with a request. Attributes may be set by the container to express information that otherwise could not be expressed via the API, or may be set by a servlet to communicate information to another servlet (via the `RequestDispatcher`). Attributes are accessed with the following methods of the `ServletRequest` interface:

- `getAttribute`
- `getAttributeNames`
- `setAttribute`

Only one attribute value may be associated with an attribute name.

Attribute names beginning with the prefixes of `java.` and `javax.` are reserved for definition by this specification. Similarly, attribute names beginning with the prefixes of `sun.`, and `com.sun.` are reserved for definition by Sun Microsystems. It is suggested that all attributes placed in the attribute set be named in accordance with the reverse domain name convention suggested by the Java Programming Language Specification[1] for package naming.

3.4 Headers

A servlet can access the headers of an HTTP request through the following methods of the `HttpServletRequest` interface:

- `getHeader`
- `getHeaders`
- `getHeaderNames`

The `getHeader` method returns a header given the name of the header. There can be multiple headers with the same name, e.g. `Cache-Control` headers, in an HTTP request. If there are multiple headers with the same name, the `getHeader` method

1. The Java Programming Language Specification is available at `http://java.sun.com/docs/books/jls`

returns the first header in the request. The `getHeaders` method allows access to all the header values associated with a particular header name, returning an `Enumeration` of `String` objects.

Headers may contain `String` representations of `int` or `Date` data. The following convenience methods of the `HttpServletRequest` interface provide access to header data in a one of these formats:

- `getIntHeader`
- `getDateHeader`

If the `getIntHeader` method cannot translate the header value to an `int`, a `NumberFormatException` is thrown. If the `getDateHeader` method cannot translate the header to a `Date` object, an `IllegalArgumentException` is thrown.

3.5 Request Path Elements

The request path that leads to a servlet servicing a request is composed of many important sections. The following elements are obtained from the request URI path and exposed via the request object:

- **Context Path:** The path prefix associated with the `ServletContext` that this servlet is a part of. If this context is the "default" context rooted at the base of the Web server's URL name space, this path will be an empty string. Otherwise, if the context is not rooted at the root of the server's name space, the path starts with a / character but does not end with a / character.
- **Servlet Path:** The path section that directly corresponds to the mapping which activated this request. This path starts with a '/' character except in the case where the request is matched with the '/*' pattern, in which case it is an empty string.
- **PathInfo:** The part of the request path that is not part of the Context Path or the Servlet Path. It is either null if there is no extra path, or is a string with a leading '/'.

The following methods exist in the `HttpServletRequest` interface to access this information:

- `getContextPath`
- `getServletPath`
- `getPathInfo`

It is important to note that, except for URL encoding differences between the request URI and the path parts, the following equation is always true:

```
requestURI = contextPath + servletPath + pathInfo
```

To give a few examples to clarify the above points, consider the following:

TABLE 3-1 Example Context Set Up

`Context Path`	`/catalog`

`Servlet Mapping`	`Pattern: /lawn/*`
	`Servlet: LawnServlet`

`Servlet Mapping`	`Pattern: /garden/*`
	`Servlet: GardenServlet`

`Servlet Mapping`	`Pattern: *.jsp`
	`Servlet: JSPServlet`

The following behavior is observed:

TABLE 3-2 Observed Path Element Behavior

Request Path	Path Elements

`/catalog/lawn/index.html`	`ContextPath: /catalog`
	`ServletPath: /lawn`
	`PathInfo: /index.html`

`/catalog/garden/implements/`	`ContextPath: /catalog`
	`ServletPath: /garden`
	`PathInfo: /implements/`

`/catalog/help/feedback.jsp`	`ContextPath: /catalog`
	`ServletPath: /help/feedback.jsp`
	`PathInfo: null`

3.6 Path Translation Methods

There are two convenience methods in the API which allow the Developer to obtain the file system path equivalent to a particular path. These methods are:

- `ServletContext.getRealPath`
- `HttpServletRequest.getPathTranslated`

The `getRealPath` method takes a `String` argument and returns a `String` representation of a file on the local file system to which a path corresponds. The `getPathTranslated` method computes the real path of the `pathInfo` of the request.

In situations where the servlet container cannot determine a valid file path for these methods, such as when the Web application is executed from an archive, on a remote file system not accessible locally, or in a database, these methods must return null.

3.7 Cookies

The `HttpServletRequest` interface provides the `getCookies` method to obtain an array of cookies that are present in the request. These cookies are data sent from the client to the server on every request that the client makes. Typically, the only information that the client sends back as part of a cookie is the cookie name and the cookie value. Other cookie attributes that can be set when the cookie is sent to the browser, such as comments, are not typically returned. The specification also allows for the cookies to be `HttpOnly` cookies. `HttpOnly` cookies indicate to the client that they should not be exposed to client-side scripting code (It's not filtered out unless the client knows to look for this attribute). The use of `HttpOnly` cookies helps mitigate certain kinds of cross-site scripting attacks.

3.8 SSL Attributes

If a request has been transmitted over a secure protocol, such as HTTPS, this information must be exposed via the `isSecure` method of the `ServletRequest` interface. The Web container must expose the following attributes to the servlet programmer:

TABLE 3-3 Protocol Attributes

Attribute	Attribute Name	Java Type
cipher suite	`javax.servlet.request.cipher_suite`	`String`
bit size of the algorithm	`javax.servlet.request.key_size`	`Integer`
SSL session id	`javax.servlet.request.ssl_session_id`	`String`

If there is an SSL certificate associated with the request, it must be exposed by the servlet container to the servlet programmer as an array of objects of type `java.security.cert.X509Certificate` and accessible via a `ServletRequest` attribute of `javax.servlet.request.X509Certificate`.

The order of this array is defined as being in ascending order of trust. The first certificate in the chain is the one set by the client, the next is the one used to authenticate the first, and so on.

3.9 Internationalization

Clients may optionally indicate to a Web server what language they would prefer the response be given in. This information can be communicated from the client using the `Accept-Language` header along with other mechanisms described in the HTTP/1.1 specification. The following methods are provided in the `ServletRequest` interface to determine the preferred locale of the sender:

- `getLocale`
- `getLocales`

The `getLocale` method will return the preferred locale for which the client wants to accept content. See section 14.4 of RFC 2616 (HTTP/1.1) for more information about how the `Accept-Language` header must be interpreted to determine the preferred language of the client.

The `getLocales` method will return an `Enumeration` of `Locale` objects indicating, in decreasing order starting with the preferred locale, the locales that are acceptable to the client.

If no preferred locale is specified by the client, the locale returned by the `getLocale` method must be the default locale for the servlet container and the `getLocales` method must contain an enumeration of a single `Locale` element of the default locale.

3.10 Request data encoding

Currently, many browsers do not send a `char` encoding qualifier with the `Content-Type` header, leaving open the determination of the character encoding for reading HTTP requests. The default encoding of a request the container uses to create the request reader and parse POST data must be "ISO-8859-1" if none has been specified by the client request. However, in order to indicate to the developer, in this case, the failure of the client to send a character encoding, the container returns `null` from the `getCharacterEncoding` method.

If the client hasn't set character encoding and the request data is encoded with a different encoding than the default as described above, breakage can occur. To remedy this situation, a new method `setCharacterEncoding(String enc)` has been added to the `ServletRequest` interface. Developers can override the character encoding supplied by the container by calling this method. It must be called prior to parsing any post data or reading any input from the request. Calling this method once data has been read will not affect the encoding.

3.11 Lifetime of the Request Object

Each request object is valid only within the scope of a servlet's `service` method, or within the scope of a filter's `doFilter` method, unless the asynchronous procesing is enabled for the component and the startAsync method is invoked on the request object. In the case where asynchronous processing occurs, the request object remains valid until `complete` is invoked on the `AsyncContext`. Containers commonly recycle request objects in order to avoid the performance overhead of request object creation. The developer must be aware that maintaining references to request objects for which `startAsync` has not been called outside the scope described above is not recommended as it may have indeterminate results.

CHAPTER 4

Servlet Context

4.1 Introduction to the ServletContext Interface

The `ServletContext` interface defines a servlet's view of the Web application within which the servlet is running. The Container Provider is responsible for providing an implementation of the `ServletContext` interface in the servlet container. Using the `ServletContext` object, a servlet can log events, obtain URL references to resources, and set and store attributes that other servlets in the context can access.

A `ServletContext` is rooted at a known path within a Web server. For example, a servlet context could be located at `http://www.mycorp.com/catalog`. All requests that begin with the `/catalog` request path, known as the *context path*, are routed to the Web application associated with the `ServletContext`.

4.2 Scope of a ServletContext Interface

There is one instance object of the `ServletContext` interface associated with each Web application deployed into a container. In cases where the container is distributed over many virtual machines, a Web application will have an instance of the `ServletContext` for each JVM.

Servlets in a container that were not deployed as part of a Web application are implicitly part of a "default" Web application and have a default `ServletContext`. In a distributed container, the default `ServletContext` is non-distributable and must only exist in one JVM.

4.3 Initialization Parameters

The following methods of the `ServletContext` interface allow the servlet access to context initialization parameters associated with a Web application as specified by the Application Developer in the deployment descriptor:

- `getInitParameter`
- `getInitParameterNames`

Initialization parameters are used by an Application Developer to convey setup information. Typical examples are a Webmaster's e-mail address, or the name of a system that holds critical data.

4.4 Configuration methods

The following methods are added to `ServletContext` since Servlet 3.0 to enable programmatic definition of servlets, filters and the url pattern that they they map to. These methods can only be called during the initilization of the application either from the `contexInitialized` method of a `ServletContextListener` implementation or from the `onStartup` method of a `ServletContainerInitializer` implementation.

4.4.1 Programatically adding Servlets

The ability to programatically add a servlet to a context is useful for framework developers. For example a framework could declare a controller servlet usng this method. The return value of this method is a `ServletRegistration` object which further allows you to setup the other parameters of the servlet like init-params, url-mappings etc. There are three overloaded versions of the method as described below.

4.4.1.1 addServlet(String servletName, String className)

This method allows the application to declare a servlet programatically. It adds the servlet with the given name, and class name to the servlet context.

4.4.1.2 addServlet(String servletName, Servlet servlet)

This method allows the application to declare a servlet programatically. It adds the servlet with the given name, and servlet instance to the servlet context.

4.4.1.3 addServlet(String servletName, Class <? extends Servlet> servletClass)

This method allows the application to declare a servlet programatically. It adds the servlet with the given name, and an instance of the servlet class to the servlet context.

4.4.2 Programatically adding filters

4.4.2.1 addFilter(String filterName, String className)

This method allows the application to declare a filter programatically. It adds the filter with the given name, and class name to the web applicationt.

4.4.2.2 addFilter(String filterName, Filter filter)

This method allows the application to declare a filter programatically. It adds the filter with the given name, and filter instance to the web application.

4.4.2.3 addFilter(String filterName, Class <? extends Filter> filterClass)

This method allows the application to declare a filter programatically. It adds the filter with the given name, and an instance of the servlet class to the web application.

4.5 Context Attributes

A servlet can bind an object attribute into the context by name. Any attribute bound into a context is available to any other servlet that is part of the same Web application. The following methods of `ServletContext` interface allow access to this functionality:

- `setAttribute`
- `getAttribute`
- `getAttributeNames`
- `removeAttribute`

4.5.1 Context Attributes in a Distributed Container

Context attributes are local to the JVM in which they were created. This prevents `ServletContext` attributes from being a shared memory store in a distributed container. When information needs to be shared between servlets running in a distributed environment, the information should be placed into a session (See Chapter 7, "Sessions"), stored in a database, or set in an Enterprise JavaBeans™ component.

4.6 Resources

The `ServletContext` interface provides direct access only to the hierarchy of static content documents that are part of the Web application, including HTML, GIF, and JPEG files, via the following methods of the `ServletContext` interface:

- `getResource`
- `getResourceAsStream`

The `getResource` and `getResourceAsStream` methods take a `String` with a leading "/" as an argument that gives the path of the resource relative to the root of the context or relative to the `META-INF/resources` directory of a JAR file inside the web application's `WEB-INF/lib` directory. These methods will first search the root of the web application context for the requested resource before looking at any of the JAR files in the `WEB-INF/lib` directory. The order in which the JAR files in the `WEB-INF/lib` directory are scanned is undefined. This hierarchy of documents may exist in the server's file system, in a Web application archive file, on a remote server, or at some other location.

These methods are not used to obtain dynamic content. For example, in a container supporting the JavaServer Pages™ specification[1], a method call of the form `getResource("/index.jsp")` would return the JSP source code and not the processed output. See Chapter 9, “Dispatching Requests” for more information about accessing dynamic content.

The full listing of the resources in the Web application can be accessed using the `getResourcePaths(String path)` method. The full details on the semantics of this method may be found in the API documentation in this specification.

4.7 Multiple Hosts and Servlet Contexts

Web servers may support multiple logical hosts sharing one IP address on a server. This capability is sometimes referred to as "virtual hosting". In this case, each logical host must have its own servlet context or set of servlet contexts. Servlet contexts can not be shared across virtual hosts.

4.8 Reloading Considerations

Although a Container Provider implementation of a class reloading scheme for ease of development is not required, any such implementation must ensure that all servlets, and classes that they may use[2], are loaded in the scope of a single class loader. This requirement is needed to guarantee that the application will behave as expected by the Developer. As a development aid, the full semantics of notification to session binding listeners should be supported by containers for use in the monitoring of session termination upon class reloading.

Previous generations of containers created new class loaders to load a servlet, distinct from class loaders used to load other servlets or classes used in the servlet context. This could cause object references within a servlet context to point at unexpected classes or objects, and cause unexpected behavior. The requirement is needed to prevent problems caused by demand generation of new class loaders.

1. The JavaServer Pages™ specification can be found at `http://java.sun.com/products/jsp`
2. An exception is system classes that the servlet may use in a different class loader.

4.8.1 Temporary Working Directories

A temporary storage directory is required for each servlet context. Servlet containers must provide a private temporary directory for each servlet context, and make it available via the `javax.servlet.context.tempdir` context attribute. The objects associated with the attribute must be of type `java.io.File`.

The requirement recognizes a common convenience provided in many servlet engine implementations. The container is not required to maintain the contents of the temporary directory when the servlet container restarts, but is required to ensure that the contents of the temporary directory of one servlet context is not visible to the servlet contexts of other Web applications running on the servlet container.

CHAPTER 5

The Response

The response object encapsulates all information to be returned from the server to the client. In the HTTP protocol, this information is transmitted from the server to the client either by HTTP headers or the message body of the request.

5.1 Buffering

A servlet container is allowed, but not required, to buffer output going to the client for efficiency purposes. Typically servers that do buffering make it the default, but allow servlets to specify buffering parameters.

The following methods in the `ServletResponse` interface allow a servlet to access and set buffering information:

- `getBufferSize`
- `setBufferSize`
- `isCommitted`
- `reset`
- `resetBuffer`
- `flushBuffer`

These methods are provided on the `ServletResponse` interface to allow buffering operations to be performed whether the servlet is using a `ServletOutputStream` or a `Writer`.

The `getBufferSize` method returns the size of the underlying buffer being used. If no buffering is being used, this method must return the `int` value of `0` (zero).

The servlet can request a preferred buffer size by using the `setBufferSize` method. The buffer assigned is not required to be the size requested by the servlet, but must be at least as large as the size requested. This allows the container to reuse a set of fixed size buffers, providing a larger buffer than requested if appropriate. The method must be called before any content is written using a `ServletOutputStream` or `Writer`. If any content has been written or the response object has been committed, this method must throw an `IllegalStateException`.

The `isCommitted` method returns a boolean value indicating whether any response bytes have been returned to the client. The `flushBuffer` method forces content in the buffer to be written to the client.

The `reset` method clears data in the buffer when the response is not committed. Headers and status codes set by the servlet prior to the reset call must be cleared as well. The `resetBuffer` method clears content in the buffer if the response is not committed without clearing the headers and status code.

If the response is committed and the `reset` or `resetBuffer` method is called, an `IllegalStateException` must be thrown. The response and its associated buffer will be unchanged.

When using a buffer, the container must immediately flush the contents of a filled buffer to the client. If this is the first data that is sent to the client, the response is considered to be committed.

5.2 Headers

A servlet can set headers of an HTTP response via the following methods of the `HttpServletResponse` interface:

- `setHeader`
- `addHeader`

The `setHeader` method sets a header with a given name and value. A previous header is replaced by the new header. Where a set of header values exist for the name, the values are cleared and replaced with the new value.

The `addHeader` method adds a header value to the set with a given name. If there are no headers already associated with the name, a new set is created.

Headers may contain data that represents an `int` or a `Date` object. The following convenience methods of the `HttpServletResponse` interface allow a servlet to set a header using the correct formatting for the appropriate data type:

- `setIntHeader`
- `setDateHeader`
- `addIntHeader`
- `addDateHeader`

To be successfully transmitted back to the client, headers must be set before the response is committed. Headers set after the response is committed will be ignored by the servlet container.

Servlet programmers are responsible for ensuring that the `Content-Type` header is appropriately set in the response object for the content the servlet is generating. The HTTP 1.1 specification does not require that this header be set in an HTTP response. Servlet containers must not set a default content type when the servlet programmer does not set the type.

It is recommended that containers use the `X-Powered-By` HTTP header to publish its implementation information. The field value should consist of one or more implementation types, such as "`Servlet/3.0`". Optionally, the supplementary information of the container and the underlying Java platform can be added after the implementation type within parentheses. The container should be configurable to suppress this header.

Here's the examples of this header.

```
X-Powered-By: Servlet/3.0
```

```
X-Powered-By: Servlet/3.0 JSP/2.0 (GlassFish v3 JRE/1.6.0)
```

5.3 Convenience Methods

The following convenience methods exist in the `HttpServletResponse` interface:

- `sendRedirect`
- `sendError`

The `sendRedirect` method will set the appropriate headers and content body to redirect the client to a different URL. It is legal to call this method with a relative URL path, however the underlying container must translate the relative path to a fully qualified URL for transmission back to the client. If a partial URL is given and, for whatever reason, cannot be converted into a valid URL, then this method must throw an `IllegalArgumentException`.

The `sendError` method will set the appropriate headers and content body for an error message to return to the client. An optional `String` argument can be provided to the `sendError` method which can be used in the content body of the error.

These methods will have the side effect of committing the response, if it has not already been committed, and terminating it. No further output to the client should be made by the servlet after these methods are called. If data is written to the response after these methods are called, the data is ignored.

If data has been written to the response buffer, but not returned to the client (i.e. the response is not committed), the data in the response buffer must be cleared and replaced with the data set by these methods. If the response is committed, these methods must throw an `IllegalStateException`.

5.4 Internationalization

Servlets should set the locale and the character encoding of a response. The locale is set using the `ServletResponse.setLocale` method. The method can be called repeatedly; but calls made after the response is committed have no effect. If the servlet does not set the locale before the page is committed, the container's default locale is used to determine the response's locale, but no specification is made for the communication with a client, such as `Content-Language` header in the case of HTTP.

```
<locale-encoding-mapping-list>
    <locale-encoding-mapping>
        <locale>ja</locale>
        <encoding>Shift_JIS</encoding>
    </locale-encoding-mapping>
</locale-encoding-mapping-list>
```

If the element does not exist or does not provide a mapping, `setLocale` uses a container dependent mapping. The `setCharacterEncoding`, `setContentType`, and `setLocale` methods can be called repeatedly to change the character encoding. Calls made after the servlet response's `getWriter` method has been called or after the response is committed have no effect on the character encoding. Calls to `setContentType` set the character encoding only if the given content type string provides a value for the charset attribute. Calls to `setLocale` set the character encoding only if neither `setCharacterEncoding` nor `setContentType` has set the character encoding before.

If the servlet does not specify a character encoding before the `getWriter` method of the `ServletResponse` interface is called or the response is committed, the default `ISO-8859-1` is used.

Containers must communicate the locale and the character encoding used for the servlet response's writer to the client if the protocol in use provides a way for doing so. In the case of HTTP, the locale is communicated via the `Content-Language` header, the character encoding as part of the `Content-Type` header for text media types. Note that the character encoding cannot be communicated via HTTP headers if the servlet does not specify a content type; however, it is still used to encode text written via the servlet response's writer.

5.5 Closure of Response Object

When a response is closed, the container must immediately flush all remaining content in the response buffer to the client. The following events indicate that the servlet has satisfied the request and that the response object is to be closed:

- The termination of the `service` method of the servlet.
- The amount of content specified in the `setContentLength` method of the response has been greater than zero and has been written to the response.
- The `sendError` method is called.
- The `sendRedirect` method is called.
- The `complete` method on `AsyncContext` is called.

5.6 Lifetime of the Response Object

Each response object is valid only within the scope of a servlet's `service` method, or within the scope of a filter's `doFilter` method, unless the associated request object has asynchronous processing enabled for the component. If asynchronous processing on the associated request is sstarted, then the request object remains valid until complete method on `AsyncContext` is called. Containers commonly recycle response objects in order to avoid the performance overhead of response object creation. The developer must be aware that maintaining references to response objects for which `startAsync` on the corresponding request has not been called, outside the scope described above may lead to non-deterministic behaviour.

CHAPTER 6

Filtering

Filters are Java components that allow on the fly transformations of payload and header information in both the request into a resource and the response from a resource

This chapter describes the Java Servlet v.3.0 API classes and methods that provide a lightweight framework for filtering active and static content. It describes how filters are configured in a Web application, and conventions and semantics for their implementation.

API documentation for servlet filters is provided online. The configuration syntax for filters is given by the deployment descriptor schema in Chapter 14, "Deployment Descriptor". The reader should use these sources as references when reading this chapter.

6.1 What is a filter?

A filter is a reusable piece of code that can transform the content of HTTP requests, responses, and header information. Filters do not generally create a response or respond to a request as servlets do, rather they modify or adapt the requests for a resource, and modify or adapt responses from a resource.

Filters can act on dynamic or static content. For the purposes of this chapter, dynamic and static content are referred to as Web resources.

Among the types of functionality available to the developer needing to use filters are the following:

- The accessing of a resource before a request to it is invoked.
- The processing of the request for a resource before it is invoked.
- The modification of request headers and data by wrapping the request in customized versions of the request object.

- The modification of response headers and response data by providing customized versions of the response object.
- The interception of an invocation of a resource after its call.
- Actions on a servlet, on groups of servlets, or static content by zero, one, or more filters in a specifiable order.

6.1.1 Examples of Filtering Components

- Authentication filters
- Logging and auditing filters
- Image conversion filters
- Data compression filters
- Encryption filters
- Tokenizing filters
- Filters that trigger resource access events
- XSL/T filters that transform XML content
- MIME-type chain filters
- Caching filters

6.2 Main Concepts

The main concepts of this filtering model are described in this section.

The application developer creates a filter by implementing the `javax.servlet.Filter` interface and providing a public constructor taking no arguments. The class is packaged in the Web Archive along with the static content and servlets that make up the Web application. A filter is declared using the `<filter>` element in the deployment descriptor. A filter or collection of filters can be configured for invocation by defining `<filter-mapping>` elements in the deployment descriptor. This is done by mapping filters to a particular servlet by the servlet's logical name, or mapping to a group of servlets and static content resources by mapping a filter to a URL pattern.

6.2.1 Filter Lifecycle

After deployment of the Web application, and before a request causes the container to access a Web resource, the container must locate the list of filters that must be applied to the Web resource as described below. The container must ensure that it has instantiated a filter of the appropriate class for each filter in the list, and called its `init(FilterConfig config)` method. The filter may throw an exception to indicate that it cannot function properly. If the exception is of type `UnavailableException`, the container may examine the `isPermanent` attribute of the exception and may choose to retry the filter at some later time.

Only one instance per `<filter>` declaration in the deployment descriptor is instantiated per JVM of the container. The container provides the filter `config` as declared in the filter's deployment descriptor, the reference to the `ServletContext` for the Web application, and the set of initialization parameters.

When the container receives an incoming request, it takes the first filter instance in the list and calls its `doFilter` method, passing in the `ServletRequest` and `ServletResponse`, and a reference to the `FilterChain` object it will use.

The `doFilter` method of a filter will typically be implemented following this or some subset of the following pattern:

1. The method examines the request's headers.
2. The method may wrap the request object with a customized implementation of `ServletRequest` or `HttpServletRequest` in order to modify request headers or data.
3. The method may wrap the response object passed in to its `doFilter` method with a customized implementation of `ServletResponse` **or** `HttpServletResponse` to modify response headers or data.
4. The filter may invoke the next entity in the filter chain. The next entity may be another filter, or if the filter making the invocation is the last filter configured in the deployment descriptor for this chain, the next entity is the target Web resource. The invocation of the next entity is effected by calling the `doFilter` method on the `FilterChain` object, and passing in the request and response with which it was called or passing in wrapped versions it may have created.

   The filter chain's implementation of the `doFilter` method, provided by the container, must locate the next entity in the filter chain and invoke its `doFilter` method, passing in the appropriate request and response objects.

   Alternatively, the filter chain can block the request by not making the call to invoke the next entity, leaving the filter responsible for filling out the response object.
5. After invocation of the next filter in the chain, the filter may examine response headers.
6. Alternatively, the filter may have thrown an exception to indicate an error in processing. If the filter throws an `UnavailableException` during its `doFilter` processing, the container must not attempt continued processing down the filter chain. It may choose to retry the whole chain at a later time if the exception is not marked permanent.
7. When the last filter in the chain has been invoked, the next entity accessed is the target servlet or resource at the end of the chain.

8. Before a filter instance can be removed from service by the container, the container must first call the `destroy` method on the filter to enable the filter to release any resources and perform other cleanup operations.

6.2.2 Wrapping Requests and Responses

Central to the notion of filtering is the concept of wrapping a request or response in order that it can override behavior to perform a filtering task. In this model, the developer not only has the ability to override existing methods on the request and response objects, but to provide new API suited to a particular filtering task to a filter or target web resource down the chain. For example, the developer may wish to extend the response object with higher level output objects that the output stream or the writer, such as API that allows DOM objects to be written back to the client.

In order to support this style of filter the container must support the following requirement. When a filter invokes the `doFilter` method on the container's filter chain implementation, the container must ensure that the request and response object that it passes to the next entity in the filter chain, or to the target web resource if the filter was the last in the chain, is the same object that was passed into the `doFilter` method by the calling filter.

The same requirement of wrapper object identity applies to the calls from a servlet or a filter to `RequestDispatcher.forward` or `RequestDispatcher.include`, when the caller wraps the request or response objects. In this case, the request and response objects seen by the called servlet must be the same wrapper objects that were passed in by the calling servlet or filter.

6.2.3 Filter Environment

A set of initialization parameters can be associated with a filter using the `<init-params>` element in the deployment descriptor. The names and values of these parameters are available to the filter at runtime via the `getInitParameter` and `getInitParameterNames` methods on the filter's `FilterConfig` object. Additionally, the `FilterConfig` affords access to the `ServletContext` of the Web application for the loading of resources, for logging functionality, and for storage of state in the `ServletContext`'s attribute list. A Filter and the target servlet or resource at the end of the filter chain must execute in the same invocation thread.

6.2.4 Configuration of Filters in a Web Application

A filter is defined either via the @ServletFilter annotation as defined in Chapter 8 of the specification or in the deployment descriptor using the `<filter>` element. In this element, the programmer declares the following:

- `filter-name`: used to map the filter to a servlet or URL
- `filter-class`: used by the container to identify the filter type
- `init-params`: initialization parameters for a filter

Optionally, the programmer can specify icons, a textual description, and a display name for tool manipulation. The container must instantiate exactly one instance of the Java class defining the filter per filter declaration in the deployment descriptor. Hence, two instances of the same filter class will be instantiated by the container if the developer makes two filter declarations for the same filter class.

Here is an example of a filter declaration:

```
<filter>
    <filter-name>Image Filter</filter-name>
    <filter-class>com.acme.ImageServlet</filter-class>
</filter>
```

Once a filter has been declared in the deployment descriptor, the assembler uses the `<filter-mapping>` element to define servlets and static resources in the Web application to which the filter is to be applied. Filters can be associated with a servlet using the `<servlet-name>` element. For example, the following code example maps the Image Filter filter to the `ImageServlet` servlet:

```
<filter-mapping>
    <filter-name>Image Filter</filter-name>
    <servlet-name>ImageServlet</servlet-name>
</filter-mapping>
```

Filters can be associated with groups of servlets and static content using the `<url-pattern>` style of filter mapping:

```
<filter-mapping>
    <filter-name>Logging Filter</filter-name>
     <url-pattern>/*</url-pattern>
</filter-mapping>
```

Here the Logging Filter is applied to all the servlets and static content pages in the Web application, because every request URI matches the '`/*`' URL pattern.

When processing a `<filter-mapping>` element using the `<url-pattern>` style, the container must determine whether the `<url-pattern>` matches the request URI using the path mapping rules defined in Chapter 12, "Mapping Requests to Servlets".

The order the container uses in building the chain of filters to be applied for a particular request URI is as follows:

1. First, the `<url-pattern>` matching filter mappings in the same order that these elements appear in the deployment descriptor.
2. Next, the `<servlet-name>` matching filter mappings in the same order that these elements appear in the deployment descriptor.

If a filter mapping contains both <servlet-name> and <url-pattern>, the container must expand the filter mapping into multiple filter mappings (one for each <servlet-name> and <url-pattern>), preserving the order of the <servlet-name> and <url-pattern> elements. For example, the following filter mapping:

```
<filter-mapping>
    <filter-name>Multipe Mappings Filter</filter-name>
    <url-pattern>/foo/*</url-pattern>
    <servlet-name>Servlet1</servlet-name>
    <servlet-name>Servlet2</servlet-name>
    <url-pattern>/bar/*</url-pattern>
</filter-mapping>
```

is equivalent to:

```
<filter-mapping>
    <filter-name>Multipe Mappings Filter</filter-name>
    <url-pattern>/foo/*</url-pattern>
</filter-mapping>

<filter-mapping>
    <filter-name>Multipe Mappings Filter</filter-name>
    <servlet-name>Servlet1</servlet-name>
</filter-mapping>

<filter-mapping>
    <filter-name>Multipe Mappings Filter</filter-name>
    <servlet-name>Servlet2</servlet-name>
</filter-mapping>

<filter-mapping>
    <filter-name>Multipe Mappings Filter</filter-name>
    <url-pattern>/bar/*</url-pattern>
</filter-mapping>
```

The requirement about the order of the filter chain means that the container, when receiving an incoming request, processes the request as follows:

- Identifies the target Web resource according to the rules of "Specification of Mappings" on page 96.
- If there are filters matched by servlet name and the Web resource has a `<servlet-name>`, the container builds the chain of filters matching in the order declared in the deployment descriptor. The last filter in this chain corresponds to the last `<servlet-name>` matching filter and is the filter that invokes the target Web resource.
- If there are filters using `<url-pattern>` matching and the `<url-pattern>` matches the request URI according to the rules of Section 12.2, "Specification of Mappings", the container builds the chain of `<url-pattern>` matched filters in the same order as declared in the deployment descriptor. The last filter in this chain is the last `<url-pattern>` matching filter in the deployment descriptor for this request URI. The last filter in this chain is the filter that invokes the first filter in the `<servlet-name>` matching chain, or invokes the target Web resource if there are none.

It is expected that high performance Web containers will cache filter chains so that they do not need to compute them on a per-request basis.

6.2.5 Filters and the RequestDispatcher

New since version 2.4 of the Java Servlet specification is the ability to configure filters to be invoked under request dispatcher `forward()` and `include()` calls.

By using the new `<dispatcher>` element in the deployment descriptor, the developer can indicate for a filter-mapping whether he would like the filter to be applied to requests when:

1. The request comes directly from the client.

   This is indicated by a `<dispatcher>` element with value *REQUEST*, or by the absence of any `<dispatcher>` elements.

2. The request is being processed under a request dispatcher representing the Web component matching the `<url-pattern>` or `<servlet-name>` using a `forward()` call.

   This is indicated by a `<dispatcher>` element with value *FORWARD*.

3. The request is being processed under a request dispatcher representing the Web component matching the `<url-pattern>` or `<servlet-name>` using an `include()` call.

   This is indicated by a `<dispatcher>` element with value *INCLUDE*.

4. The request is being processed with the error page mechanism specified in ”Error Handling” on page 82 to an error resource matching the `<url-pattern>`.

   This is indicated by a `<dispatcher>` element with the value *ERROR*.

5. The request is being processed with the async context dispatch mechanism specified in ”Asynchronous processing” on page 10 to a web component using a `dispatch` call.

   This is indicated by a `<dispatcher>` element with the value *ASYNC*.

6. Or any combination of 1, 2, 3, 4 or 5 above.

For example:

```
<filter-mapping>
       <filter-name>Logging Filter</filter-name>
       <url-pattern>/products/*</url-pattern>
</filter-mapping>
```

would result in the Logging Filter being invoked by client requests starting `/products/...` but not underneath a request dispatcher call where the request dispatcher has path commencing `/products/...`. The LoggingFilter would be invoked both on the initial dispatch of the request and on resumed request. The following code:

```
<filter-mapping>
    <filter-name>Logging Filter</filter-name>
    <servlet-name>ProductServlet</servlet-name>
    <dispatcher>INCLUDE</dispatcher>
</filter-mapping>
```

would result in the Logging Filter not being invoked by client requests to the `ProductServlet`, nor underneath a request dispatcher `forward()` call to the `ProductServlet`, but would be invoked underneath a request dispatcher `include()` call where the request dispatcher has a name commencing `ProductServlet`. The following code:

```
<filter-mapping>
    <filter-name>Logging Filter</filter-name>
    <url-pattern>/products/*</url-pattern>
    <dispatcher>FORWARD</dispatcher>
    <dispatcher>REQUEST</dispatcher>
</filter-mapping>
```

would result in the Logging Filter being invoked by client requests starting `/products/...` and underneath a request dispatcher `forward()` call where the request dispatcher has path commencing `/products/...`.

Finally, the following code uses the special servlet name '*':

```
<filter-mapping>
    <filter-name>All Dispatch Filter</filter-name>
    <servlet-name>*</servlet-name>
    <dispatcher>FORWARD</dispatcher>
</filter-mapping>
```

This code would result in the All Dispatch Filter being invoked on request dispatcher forward() calls for all request dispatchers obtained by name or by path.

CHAPTER 7

Sessions

The Hypertext Transfer Protocol (HTTP) is by design a stateless protocol. To build effective Web applications, it is imperative that requests from a particular client be associated with each other. Many strategies for session tracking have evolved over time, but all are difficult or troublesome for the programmer to use directly.

This specification defines a simple `HttpSession` interface that allows a servlet container to use any of several approaches to track a user's session without involving the Application Developer in the nuances of any one approach.

7.1 Session Tracking Mechanisms

The following sections describe approaches to tracking a user's sessions

7.1.1 Cookies

Session tracking through HTTP cookies is the most used session tracking mechanism and is required to be supported by all servlet containers.

The container sends a cookie to the client. The client will then return the cookie on each subsequent request to the server, unambiguously associating the request with a session. The standard name of the session tracking cookie must be `JSESSIONID`, which must be supported by all 3.0 compliant containers. Containers may allow the name of the session tracking cookie to be customized through container specific configuration.

All servlet containers MUST provide an ability to configure whether or not the container marks the session tracking cookie as `HttpOnly`. The established configuration must apply to all contexts for which a context specific configuration has not been established (see `SessionCookieConfig`).

7.1.2 SSL Sessions

Secure Sockets Layer, the encryption technology used in the HTTPS protocol, has a built-in mechanism allowing multiple requests from a client to be unambiguously identified as being part of a session. A servlet container can easily use this data to define a session.

7.1.3 URL Rewriting

URL rewriting is the lowest common denominator of session tracking. When a client will not accept a cookie, URL rewriting may be used by the server as the basis for session tracking. URL rewriting involves adding data, a session ID, to the URL path that is interpreted by the container to associate the request with a session.

The session ID must be encoded as a path parameter in the URL string. The name of the parameter must be `jsessionid`. Here is an example of a URL containing encoded path information:

```
http://www.myserver.com/catalog/index.html;jsessionid=1234
```

URL rewriting exposes session identifiers in logs, bookmarks, referer headers, cached HTML, and the URL bar. URL rewriting should not be used as a session tracking mechanism where cookies or SSL sessions are supported and suitable.

7.1.4 Session Integrity

Web containers must be able to support the HTTP session while servicing HTTP requests from clients that do not support the use of cookies. To fulfill this requirement, Web containers commonly support the URL rewriting mechanism.

7.2 Creating a Session

A session is considered "new" when it is only a prospective session and has not been established. Because HTTP is a request-response based protocol, an HTTP session is considered to be new until a client "joins" it. A client joins a session when session tracking information has been returned to the server indicating that a session has been established. Until the client joins a session, it cannot be assumed that the next request from the client will be recognized as part of a session.

The session is considered to be "new" if either of the following is true:

- The client does not yet know about the session

- The client chooses not to join a session.

These conditions define the situation where the servlet container has no mechanism by which to associate a request with a previous request.

A Servlet Developer must design his application to handle a situation where a client has not, can not, or will not join a session.

7.3 Session Scope

`HttpSession` objects must be scoped at the application (or servlet context) level. The underlying mechanism, such as the cookie used to establish the session, can be the same for different contexts, but the object referenced, including the attributes in that object, must never be shared between contexts by the container.

To illustrate this requirement with an example: if a servlet uses the `RequestDispatcher` to call a servlet in another Web application, any sessions created for and visible to the servlet being called must be different from those visible to the calling servlet.

Additionally, sessions of a context must be resumable by requests into that context regardless of whether their associated context was being accessed directly or as the target of a request dispatch at the time the sessions were created.

7.4 Binding Attributes into a Session

A servlet can bind an object attribute into an `HttpSession` implementation by name. Any object bound into a session is available to any other servlet that belongs to the same `ServletContext` and handles a request identified as being a part of the same session.

Some objects may require notification when they are placed into, or removed from, a session. This information can be obtained by having the object implement the `HttpSessionBindingListener` interface. This interface defines the following methods that will signal an object being bound into, or being unbound from, a session.

- `valueBound`
- `valueUnbound`

The `valueBound` method must be called before the object is made available via the `getAttribute` method of the `HttpSession` interface. The `valueUnbound` method must be called after the object is no longer available via the `getAttribute` method of the `HttpSession` interface.

7.5 Session Timeouts

In the HTTP protocol, there is no explicit termination signal when a client is no longer active. This means that the only mechanism that can be used to indicate when a client is no longer active is a timeout period.

The default timeout period for sessions is defined by the servlet container and can be obtained via the `getMaxInactiveInterval` method of the `HttpSession` interface. This timeout can be changed by the Developer using the `setMaxInactiveInterval` method of the `HttpSession` interface. The timeout periods used by these methods are defined in seconds. By definition, if the timeout period for a session is set to -1, the session will never expire. The session invalidation will not take effect until all servlets using that session have exited the service method. Once the session invalidation is initiated, a new request must not be able to see that session.

7.6 Last Accessed Times

The `getLastAccessedTime` method of the `HttpSession` interface allows a servlet to determine the last time the session was accessed before the current request. The session is considered to be accessed when a request that is part of the session is first handled by the servlet container.

7.7 Important Session Semantics

7.7.1 Threading Issues

Multiple servlets executing request threads may have active access to the same session object at the same time. The container must ensure that manipulation of internal data structures representing the session attributes is performed in a thread safe manner. The Developer has the responsibility for thread safe access to the attribute objects themselves. This will protect the attribute collection inside the `HttpSession` object from concurrent access, eliminating the opportunity for an application to cause that collection to become corrupted.

7.7.2 Distributed Environments

Within an application marked as distributable, all requests that are part of a session must be handled by one JVM at a time. The container must be able to handle all objects placed into instances of the `HttpSession` class using the `setAttribute` or `putValue` methods appropriately. The following restrictions are imposed to meet these conditions:

- The container must accept objects that implement the `Serializable` interface.
- The container may choose to support storage of other designated objects in the `HttpSession`, such as references to Enterprise JavaBeans components and transactions.
- Migration of sessions will be handled by container-specific facilities.

The distributed servlet container must throw an `IllegalArgumentException` for objects where the container cannot support the mechanism necessary for migration of the session storing them.

The distributed servlet container must support the mechanism necessary for migrating objects that implement `Serializable`.

These restrictions mean that the Developer is ensured that there are no additional concurrency issues beyond those encountered in a non-distributed container.

The Container Provider can ensure scalability and quality of service features like load-balancing and failover by having the ability to move a session object, and its contents, from any active node of the distributed system to a different node of the system.

If distributed containers persist or migrate sessions to provide quality of service features, they are not restricted to using the native JVM Serialization mechanism for serializing `HttpSessions` and their attributes. Developers are not guaranteed that containers will call `readObject` and `writeObject` methods on session attributes if they implement them, but are guaranteed that the `Serializable` closure of their attributes will be preserved.

Containers must notify any session attributes implementing the `HttpSessionActivationListener` during migration of a session. They must notify listeners of passivation prior to serialization of a session, and of activation after deserialization of a session.

Application Developers writing distributed applications should be aware that since the container may run in more than one Java virtual machine, the developer cannot depend on static variables for storing an application state. They should store such states using an enterprise bean or a database.

7.7.3 Client Semantics

Due to the fact that cookies or SSL certificates are typically controlled by the Web browser process and are not associated with any particular window of the browser, requests from all windows of a client application to a servlet container might be part of the same session. For maximum portability, the Developer should always assume that all windows of a client are participating in the same session.

CHAPTER 8

Annotations and pluggability

This chapter talks about the annotations defined in Servlet 3.0 specification and the enhancements to enable pluggability of frameworks and libraries for use within a web application.

8.1 Annotations and pluggability

In a web application, classes using annotations will have their annotations processed only if they are located in the `WEB-INF/classes` directory, or if they are packaged in a jar file located in `WEB-INF/lib` within the application.

The web application deployment descriptor contains a new "`metadata-complete`" attribute on the web-app element. The "`metadata-complete`" attribute defines whether the web descriptor is complete, or whether the class files of the jar file should be examined for annotations and web fragments that specify deployment information. If "`metadata-complete`" is set to "true", the deployment tool MUST ignore any servlet annotations present in the class files of the application and web fragments. If the `metadata-complete` attribute is not specified or is set to "false", the deployment tool must examine the class files of the application for annotations, and scan for web fragments.

Following are the annotations that MUST be supported by a Servlet 3.0 compliant web container.

8.1.1 @WebServlet

This annotation is used to define a `Servlet` component in a web application. This annotation is specified on a class and contains metadata about the `Servlet` being declared. The `urlPatterns` or the `value` attribute on the annotation MUST be present. All other attributes are optional with default settings (see javadocs for more details). It is recommended to use `value` when the only attribute on the annotation is the url pattern and to use the `urlPatterns` attribute when the other attributes are also used. It is illegal to have both `value` and `urlPatterns` attribute used together on the same annotation. The default name of the `Servlet` if not specified is the fully qualified class name. The deployment descriptor elements may be used to override the name of the `Servlet`. The annotated servlet MUST specify at least one url pattern to be deployed.

Classes annotated with `@WebServlet` class MUST extend the `javax.servlet.http.HttpServlet` class.

Following is an example of how this annotation would be used.

CODE EXAMPLE 8-1 @WebServlet Annotation Example

```
@WebServlet(”/foo”)

public class CalculatorServlet extends HttpServlet{

    //...

}
```

Following is an example of how this annotation would be used with some more of the attributes specified.

CODE EXAMPLE 8-2 @WebServlet annotation example using other annotation attributes specified

```
@WebServlet(name=”MyServlet”, urlPatterns={"/foo", "/bar"})

public class SampleUsingAnnotationAttributes extends HttpServlet{

    public void doGet(HttpServletRequest req, HttpServletResponse
res) {


    }

}
```

8.1.2 @WebFilter

This annotation is used to define a `Filter` in a web application. This annotation is specified on a class and contains metadata about the filter being declared. The `urlPatterns` attribute or the `value` attribute of the annotation MUST be specified. All other attributes are optional with default settings (see javadocs for more details). It is recommended to use `value` when the only attribute on the annotation is the url pattern and to use the `urlPatterns` attribute when the other attributes are also used. It is illegal to have both `value` and `urlPatterns` attribute used together on the same annotation.

Classes annotated with `@WebFilter` MUST implement `javax.servlet.Filter`.

Following is an example of how this annotation would be used.

CODE EXAMPLE 8-3 `@WebFilter` annotation example

```
@WebFilter(“/foo”)
public class MyFilter implements Filter {
    public void doFilter(HttpServletRequest req, HttpServletResponse
res)
    {
         ...
    }
}
```

8.1.3 @WebInitParam

This annotation is used to specify any init parameters that must be passed to the `Servlet` or the `Filter`. It is an attribute of the `WebServlet` and `WebFilter` annotation.

8.1.4 @WebListener

The `WebListener` annotation is used to annotate a listener to get events for various operations on the particular web application context. Classes annotated with `@WebListener` MUST implement one of the following interfaces:

- `javax.servlet.ServletContextListener`
- `javax.servlet.ServletContextAttributeListener`
- `javax.servlet.ServletRequestListener`
- `javax.servlet.ServletRequestAttributeListener`
- `javax.servlet.http.HttpSessionListener`
- `javax.servlet.http.HttpSessionAttributeListener`

An example:

```
@WebListener
public class MyListener implements ServletContextListener{
    public void contextInitialized(ServletContextEvent sce) {
        ServletContext sc = sce.getServletContext();
        sc.addServlet("myServlet", "Sample servlet",
                      "foo.bar.MyServlet", null, -1);
        sc.addServletMapping("myServlet", new String[] {
"/urlpattern/*" });
    }
}
```

8.1.5 @MultipartConfig

This annotation, when specified on a `Servlet`, indicates that the request it expects is of type `mime/multipart`. The HttpServletRequest object of the corresponding servlet MUST make available the mime attachments via the getParts and getPart methods to iterate over the various mime attachments.

8.1.6 Other annotations / conventions

In addition to these annotations all the annotations defined in Section 15.5, "Annotations and Resource Injection" on page 15-174 will continue to work in the context of these new annotations.

By default all applications will have `index.htm(l)` and `index.jsp` in the list of `welcome-file-list`. The descriptor may to be used to override these default settings.

The order in which the Listeners, Servlets etc are loaded from the various framework jars / classes in the `WEB-INF/classes` or `WEB-INF/lib` is unspecified when using annotations. If ordering is important then look at the section for modularity of web.xml and ordering of `web.xml` and `web-fragment.xml` below. The order can be specified in the deployment descriptor only.

8.2 Pluggability

8.2.1 Modularity of web.xml

Using the annotations defined above makes the use of web.xml optional. However for upgrading or overriding either the default values or the values set via annotations, the deployment descriptor is used. As before, if the `metadata-`

complete element is set to true in the web.xml descriptor, annotations in the class files and web-fragments bundled in jars need not be processed. It implies that all the metadata for the application is specified via descriptor(s). For better pluggability and less configuration for developers, in this version (Servlet 3.0) of the specification we are introducing the notion of web module deployment descriptor fragments (web fragment). A web fragment is a part or all of the web.xml that can be specified and included in a library or framework jar's META-INF directory. The container will pick up and use the configuration as per the rules defined below.

A web fragment is a logical partitioning of the web app in such a way that the frameworks being used within the web app can define all the artifacts without asking devlopers to edit or add information in the web.xml. It can include almost all the same elements that the web.xml descriptor uses. However the top level element for the descriptor MUST be web-fragment and the corresponding descriptor file MUST be called web-fragment.xml. The ordering related elements also differ between the web-fragment.xml and web.xml See the corresponding schema for web-fragments in the deployment descriptor section in Chapter 14.

If a framework is packaged as a jar file and has metadata information in the form of deployment descriptor then the web-fragment.xml descriptor must be in the META-INF/ directory of the jar file.

If a framework wants its META-INF/web-fragment.xml honored in such a way that it augments a web application's web.xml, the framework must be bundled within the web application's WEB-INF/lib directory. In order for any other types of resources (e.g., class files) of the framework to be made available to a web application, it is sufficient for the framework to be present anywhere in the classloader delegation chain of the web application. In other words, only JAR files bundled in a web application's WEB-INF/lib directory, but not those higher up in the classloading delegation chain, need to be scanned for web-fragment.xml

During deployment the container is responsible for scanning the location specified above and discovering the web-fragment.xml and processing them. The requirements about name uniqueness that exist currently for a single web.xml also apply to the union of a web.xml and all applicable web-fragment.xml files.

An example of what a library or framework can include is shown below

```
<web-fragment>
  <servlet>
    <servlet-name>welcome</servlet-name>
    <servlet-class>
      WelcomeServlet
    </servlet-class>
  </servlet>
  <listener>
    <listener-class>
      RequestListener
   </listener-class>
  </listener>
</web-fragment>
```

The above web-fragment.xml would be included in the META-INF/ directory of the framework's jar file. The order in which configuration from web-fragment.xml and annotations should be applied is undefined. If ordering is an important aspect for a particular application please see rules defined below on how to achieve the order desired.

8.2.2 Ordering of web.xml and web-fragment.xml

Since the specification allows the application configuration resources to be composed of multiple configuration files (`web.xml` and `web-fragment.xml`), discovered and loaded from several different places in the application, the question of ordering must be addressed. This section specifies how configuration resource authors may declare the ordering requirements of their artifacts.

A deployment descriptor (`web.xml` or `web-fragment.xml`) may have a top level `<name>` element of type `javaee:java-identifierType`. If a `<name>` element is present, it must be considered for the ordering of artifacts (unless the duplicate name exception applies, as described below).

Two cases must be considered to allow application configuration resources to express their ordering preferences.

1. Absolute ordering: an `<absolute-ordering>` element in the `web.xml`.
   a. In this case, ordering preferences that would have been handled by case 2 below must be ignored.
   b. Any `<name>` element direct children of the `<absolute-ordering>` must be interpreted as indicating the absolute ordering in which those named web-fragments, which may or may not be present, must be processed.
   c. The `<absolute-ordering>` element may contain zero or one `<others />` element. The required action for this element is described below. If the `<absolute-ordering>` element does not contain an `<others/>` element, any web-fragment not specifically mentioned within `<name />` elements must be ignored.

d. Duplicate name exception: if, when traversing the children of `<absolute-ordering>`, multiple children with the same `<name>` element are encountered, only the first such occurrence must be considered.

e. If an `<ordering>` element appears in the `web.xml`, an informative message must be logged and the element must be ignored.

2. Relative ordering: an `<ordering>` element within the `web-fragment.xml`.

   a. A `web-fragment.xml` may have an `<ordering>` element. If so, this element must contain zero or one `<before>` element and zero or one `<after>` element. The meaning of these elements is explained below.

   b. Duplicate name exception: if, when traversing the web-fragments, multiple members with the same `<name>` element are encountered, the application must log an informative error message including information to help fix the problem, and must fail to deploy. For example, one way to fix this problem is for the user to use absolute ordering, in which case relative ordering is ignored.

   c. If an `<absolute-ordering>` element appears in the web-fragment, an informative message must be logged and the element must be ignored.

   d. Consider this abbreviated but illustrative example. 3 web-fragments - `web-fragment1.xml`, `web-fragment2.xml` and `web-fragment3.xml` are part of the application that also includes a `web.xml`.

```
web-fragment1.xml

<web-fragment>

  <name>MyFragment1</name>

  <ordering><after>MyFragment2</after></ordering>

  ...

</web-fragment>


web-fragment2.xml

<web-fragment>

  <name>MyFragment2</name>

  ..

</web-fragment>


web-fragment3.xml

<web-fragment>

  <name>MyFragment3</name>

  <ordering><before><others/></before></ordering>
  ..
</web-fragment>


web.xml
<web-app>
  <name>MyApp</name>
  ...
</web-app>
```

In this example the processing order will be

```
web.xml

web-fragment3.xml

web-fragment2.xml

web-fragment1.xml
```

The preceding example illustrates some, but not all, of the following principles.

- `<before>` means the document must be ordered before the document with the name matching what is specified within the nested `<name>` element.
- `<after>` means the document must be ordered after the document with the name matching what is specified within the nested `<name>` element.
- There is a special element `<others />` which may be included zero or one time within the `<before>` or `<after>` element, or zero or one time directly within the `<absolute-ordering>` element. The `<others />` element must be handled as follows.
  - If the `<before>` element contains a nested `<others />`, the document will be moved to the beginning of the list of sorted documents. If there are multiple documents stating `<before><others />`, they will all be at the beginning of the list of sorted documents, but the ordering within the group of such documents is unspecified.
  - If the `<after>` element contains a nested `<others />`, the document will be moved to the end of the list of sorted documents. If there are multiple documents requiring `<after><others />`, they will all be at the end of the list of sorted documents, but the ordering within the group of such documents is unspecified.
  - Within a `<before>` or `<after>` element, if an `<others />` element is present, but is not the only `<name>` element within its parent element, the other elements within that parent must be considered in the ordering process.

    - If the `<others />` element appears directly within the `<absolute-ordering>` element, the runtime must ensure that any web-fragments not explicitly named in the `<absolute-ordering>` section are included at that point in the processing order.
- If a `web-fragment.xml` file does not have an `<ordering>` or the `web.xml` does not have an `<absolute-ordering>` element the artifacts are assumed to not have any ordering dependency.
- If the runtime discovers circular references, an informative message must be logged, and the application must fail to deploy. Again, one course of action the user may take is to use absolute ordering in the `web.xml`.
- The previous example can be extended to illustrate the case when the `web.xml` contains an ordering section..

```
web.xml

<web-app>

  <name>MyApp</name>

  <absolute-ordering>

    <name>MyFragment3</name>

    <name>MyFragment2</name>

  </absolute-ordering>

  ...

</web-app>
```

In this example, the ordering for the various elements will be

```
web.xml

MyFragment3

MyFragment2
```

Some additional example scenarios are included below. All of these apply to relative ordering and not absolute ordering

Document A:

```
<after>

  <others/>

  <name>

    C

  </name>

</after>
```

Document B

```
<before>
  <others/>
</before>
```

Document C:

```
<after>
  <others/>
</after>
```

Document D: no ordering

Document E: no ordering

Document F:

```
<before>
  <others/>
  <name>
    B
  </name>
</before>
```

Resulting parse order:

`web.xml`, F, B, D, E, C, A.

Document <no id>:

```
<after>
  <others/>
</after>
<before>
  <name>
    C
  </name>
</before>
```

Document B:

```
<before>
  <others/>
</before>
```

Document C: no ordering

Document D:

```
<after>
  <others/>
</after>
```

Document E:

```
<before>
  <others/>
</before>
```

Document F: no ordering

Resulting parse order can be one of the following:

- B, E, F, <no id>, C, D
- B, E, F, <no id>, D, C
- E, B, F, <no id>, C, D
- E, B, F, <no id>, D, C
- E, B, F, D, <no id>, C
- E, B, F, D, <no id>, D

Document A:

```
<after>
  <name>
    B
  </name>
</after>
```

Document B: no ordering

Document C:

```
<before>
  <others/>
</before>
```

Document D: no ordering

Resulting parse order: C, B, D, A. The parse order could also be: C, D, B, A or C, B, A, D

8.2.3 Assembling the descriptor from web.xml and web-fragment.xml

If the order in which the listeners, servlets, filters, etc are invoked is important to an application then a deployment descriptor must be used. Also, if necessary, the ordering element defined above can be used. As described above, when using annotations to define the listeners, servlets and filters, the order in which they are invoked is unspecified. Below are a set of rules that apply for assembling the final deployment descriptor for the application:

1. The order for listeners, servlets, filters if relevant must be specified in either the web-fragment.xml or the web.xml.
2. The ordering will be based on the order in which they are defined in the descriptor and on the absolute-ordering element in the web.xml or an ordering element in the web-fragment, if present.
   a. Filters that match a request are chained in the order in which they are declared in the web.xml.
   b. Servlets are initialized either lazily at request processing time or eagerly during deployment. In the latter case, they are initialized in the order indicated by their load-on-startup elements.
   c. Prior to this release of the specification, context listeners were invoked in random order. As of Servlet 3.0, the listeners are invoked in the order in which they are declared in the web.xml.
3. If a servlet is disabled using the enabled element introduced in the web.xml then the servlet will not be available at the url-pattern specified for the servlet.
4. The web.xml of the web application has the highest precedence when resolving conflicts between the web.xml and web-fragment.xml.
5. If metadata-complete is not specified in the descriptors then the effective metadata for the application is derived by combining the metadata present in the annnotations and the descriptor. The rules for merging are specified below -
   a. Configuration settings in web fragments are used to augment those specified in the main web.xml in such a way as if they had been specified in the same web.xml.
   b. The order in which configuration settings of web fragments are added to those in the main web.xml is as specified above in Section 8.2.2, “Ordering of web.xml and web-fragment.xml” on page 8-58

c. The metadata-complete attribute when specified in the main web.xml, is considered complete and scanning of annotations and fragments will not occur. The absolute-ordering and ordering elements will be ignored if present. When specified on a fragment, the metadata-complete attribute applies only to scanning of annotations in that particular jar.

d. Web fragments are merged into the main web.xml unless the metadata-complete is set to true. The merging takes place before any annotation processing.

e. The following are considered configuration conflicts when augmenting a web.xml with web fragments:

   i. Multiple <init-param> elements with the same <param-name> but different <param-value>

   ii. Multiple <mime-mapping> elements with the same <extension> but different <mime-type>

f. The above configuration conflicts are resolved as follows:

   i. - Configuration conflicts within the same web.xml or web fragment are resolved such that the first configuration setting is taken and all the other instances are ignored.

   ii. Configuration conflicts between the main web.xml and a web fragment are resolved such that the configuration in the web.xml takes precedence.

   iii. Configuration conflicts between two web fragments, where the element at the center of the conflict is not present in the main web.xml, will result in an error. An informative message must be logged, and the application must fail to deploy.

g. After the above conflicts have been resolved, these additional rules areapplied

   i. Elements that may be declared any number of times are additive in the resulting web.xml. For example, <context-param> elements with different <param-name> are additive.

   ii. If an element with a minimum occurrence of zero, and a maximum occurrence of one, is present in a web fragment, and missing in the main web.xml, the main web.xml inherits the setting from the web fragment. If the element is present in both the main web.xml and the web fragment, the configuration setting in the main web.xml takes precedence. For example, if both the main web.xml and a web fragment declare the same servlet, and the servlet declaration in the web fragment specifies a <load-on-startup> element, whereas the one in the main web.xml does not, then the <load-on-startup> element from the web fragment will be used in the merged web.xml.

iii. It is considered an error if an element with a minimum occurrence of zero, and a maximum occurrence of one, is specified differently in two web fragments, while absent from the main web.xml. For example, if two web fragments declare the same servlet, but with different <load-on-startup> elements, and the same servlet is also declared in the main web.xml, but without any <load-on-startup>, then an error must be reported.

iv. <welcome-file> declarations are additive.

v. <servlet-mapping> elements with the same <servlet-name> are additive

vi. <filter-mapping> elements with the same <filter-name> are additive

vii. Multiple <listener> elements with the same <listener-class> are treated as a single <listener> declaration

viii. The web.xml resulting from the merge is considered <distributable> only if all its web fragments are marked as <distributable> as well.

ix. The top-level <icon>, <display-name>, and <description> elements of a web fragment are ignored.

8.2.4 Shared libraries / runtimes pluggability

In addition to supporting fragments and use of annotations one of the requirements is that not only we be able to plug-in things that are bundled in the `WEB-INF/lib` but also plugin shared copies of frameworks - including being able to plug-in to the web container things like JAX-WS, JAX-RS and JSF that build on top of the web container. The `ServletContainerInitializer` allows handling such a use case as described below.

An instance of the `ServletContainerInitializer` is looked up via the jar services API by the container at container / application starup time. The framework providing an implementation of the `ServletContainerInitializer` MUST bundle in the `META-INF/services` directory of the jar file a file called `javax.servlet.ServletContainerInitializer`, as per the jar services API, that points to the implementation class of the `ServletContainerInitializer`.

In addition to the `ServletContainerInitializer` we also have an annotation - `HandlesTypes`. The annotation will be applied on the implementation of `ServletContainerInitializer` to express interest in classes that are either annotated with the classes specified in the value or if a class extends / implements one of those classes. The container uses the `HandlesTypes` annotation to determine when to invoke the initializer's `onStartup` method.

If an implementation of `ServletContainerInitializer` does not have the `@HandlesTypes` annotation then it will get invoked once for every app with `null` as the value of the `Set`. This will allow for the initializer to determine based on the resources available in the app whether it needs to initialize a servet / filter or not.

The `onStartup` method of the `ServletContainerInitializer` will be invoked when the application is coming up before any of the listener's events are fired.

The `ServletContainerInitializer`'s `onStartup` method get's a `Set` of Classes that either extend / implement the classes that the initializer expressed interest in or if it is annotated with any of the classes specified via the `@HandlesTypes` annotation.

A concrete example below showcases how this would work.

Let's take the JAX-WS web services runtime.

The implementation of JAX-WS runtime isn't typically bundled in each and every war file. The implementation would bundle an implementaiton of the `ServletContainerInitializer` (shown below) and the container would look that up using the services API (the jar file will bundle in it's `META-INF/services` directory a file called `javax.servlet.ServletContainerInitializer` that will point to the `JAXWSServletContainerInitializer` shown below).

```
@HandlesTypes(WebService.class)

JAXWSServletContainerInitializer
                   implements ServletContainerInitializer

{

     public void onStartup(Set<Class<?>> c, ServletContext ctx) {

    // JAX-WS specific code here to initialize the runtime
    // and setup the mapping etc.

    ServletRegistration reg = ctx.addServlet("JAXWSServlet",
"com.sun.webservice.JAXWSServlet");

    reg.addServletMapping("/foo");

 }
```

The framework jar file can also be bundled in `WEB-INF/lib` directory of the war file.

8.3 Processing annotations and fragments

Web applications can include both annotations and the `web.xml` / `web-fragment.xml` deployment descriptors. If there is no deployment descriptor, or there is one but does not have the `metadata-complete` set to true, `web.xml`, `web-fragment.xml` and annotations if used in the application must be processed. The following table describes whether or not to process annotations and `web.xml` fragments.

TABLE 8-1 Annotations and web fragment processing requirements

Deployment descriptor	metadata-complete	process annotations and web fragments
web.xml 2.5	Yes	No
web.xml 2.5	no	yes
web.xml 3.0	yes	no
web.xml 3.0	no	yes

CHAPTER 9

Dispatching Requests

When building a Web application, it is often useful to forward processing of a request to another servlet, or to include the output of another servlet in the response. The `RequestDispatcher` interface provides a mechanism to accomplish this.

When asynchronous processing is enabled on the request, the `AsyncContext` allows a user to dispatch the request back to the servlet container.

9.1 Obtaining a RequestDispatcher

An object implementing the `RequestDispatcher` interface may be obtained from the `ServletContext` via the following methods:

- `getRequestDispatcher`
- `getNamedDispatcher`

The `getRequestDispatcher` method takes a `String` argument describing a path within the scope of the `ServletContext`. This path must be relative to the root of the `ServletContext` and begin with a '`/`'. The method uses the path to look up a servlet, using the servlet path matching rules in Chapter 12, "Mapping Requests to Servlets", wraps it with a `RequestDispatcher` object, and returns the resulting object. If no servlet can be resolved based on the given path, a `RequestDispatcher` is provided that returns the content for that path.

The `getNamedDispatcher` method takes a `String` argument indicating the name of a servlet known to the `ServletContext`. If a servlet is found, it is wrapped with a `RequestDispatcher` object and the object is returned. If no servlet is associated with the given name, the method must return `null`.

To allow `RequestDispatcher` objects to be obtained using relative paths that are relative to the path of the current request (not relative to the root of the `ServletContext`), the `getRequestDispatcher` method is provided in the `ServletRequest` interface.

The behavior of this method is similar to the method of the same name in the `ServletContext`. The servlet container uses information in the request object to transform the given relative path against the current servlet to a complete path. For example, in a context rooted at '/' and a request to `/garden/tools.html`, a request dispatcher obtained via `ServletRequest.getRequestDispatcher("header.html")` will behave exactly like a call to `ServletContext.getRequestDispatcher("/garden/header.html")`.

9.1.1 Query Strings in Request Dispatcher Paths

The `ServletContext` and `ServletRequest` methods that create `RequestDispatcher` objects using path information allow the optional attachment of query string information to the path. For example, a Developer may obtain a `RequestDispatcher` by using the following code:

```
String path = “/raisins.jsp?orderno=5”;
RequestDispatcher rd = context.getRequestDispatcher(path);
rd.include(request, response);
```

Parameters specified in the query string used to create the `RequestDispatcher` take precedence over other parameters of the same name passed to the included servlet. The parameters associated with a `RequestDispatcher` are scoped to apply only for the duration of the `include` or `forward` call.

9.2 Using a Request Dispatcher

To use a request dispatcher, a servlet calls either the `include` method or `forward` method of the `RequestDispatcher` interface. The parameters to these methods can be either the `request` and `response` arguments that were passed in via the `service` method of the `javax.servlet` interface, or instances of subclasses of the request and response wrapper classes that were introduced for version 2.3 of the specification. In the latter case, the wrapper instances must wrap the request or response objects that the container passed into the `service` method.

The Container Provider should ensure that the dispatch of the request to a target servlet occurs in the same thread of the same JVM as the original request.

9.3 The Include Method

The `include` method of the `RequestDispatcher` interface may be called at any time. The target servlet of the `include` method has access to all aspects of the request object, but its use of the response object is more limited.

It can only write information to the `ServletOutputStream` or `Writer` of the response object and commit a response by writing content past the end of the response buffer, or by explicitly calling the `flushBuffer` method of the `ServletResponse` interface. It cannot set headers or call any method that affects the headers of the response, with the exception of the `HttpServletRequest.getSession()` and `HttpServletRequest.getSession(boolean)` methods. Any attempt to set the headers must be ignored, and any call to `HttpServletRequest.getSession()` or `HttpServletRequest.getSession(boolean)` that would require adding a Cookie response header must throw an `IllegalStateException` if the response has been committed.

9.3.1 Included Request Parameters

Except for servlets obtained by using the `getNamedDispatcher` method, a servlet that has been invoked by another servlet using the `include` method of `RequestDispatcher` has access to the path by which it was invoked.

The following request attributes must be set:

```
javax.servlet.include.request_uri
javax.servlet.include.context_path
javax.servlet.include.servlet_path
javax.servlet.include.path_info
javax.servlet.include.query_string
```

These attributes are accessible from the included servlet via the `getAttribute` method on the request object and their values must be equal to the request URI, context path, servlet path, path info, and query string of the included servlet, respectively. If the request is subsequently included, these attributes are replaced for that include.

If the included servlet was obtained by using the `getNamedDispatcher` method, these attributes must not be set.

9.4 The Forward Method

The `forward` method of the `RequestDispatcher` interface may be called by the calling servlet only when no output has been committed to the client. If output data exists in the response buffer that has not been committed, the content must be cleared before the target servlet's `service` method is called. If the response has been committed, an `IllegalStateException` must be thrown.

The path elements of the request object exposed to the target servlet must reflect the path used to obtain the `RequestDispatcher`.

The only exception to this is if the `RequestDispatcher` was obtained via the `getNamedDispatcher` method. In this case, the path elements of the request object must reflect those of the original request.

Before the forward method of the RequestDispatcher interface returns without exception, the response content must be sent and committed, and closed by the servlet container. If an error occurs in the target of the RequestDispatcher.forward() the exception may be propogated back through all the calling filters and servlets and eventually back to the container

9.4.1 Query String

The request dispatching mechanism is responsible for aggregating query string parameters when forwarding or including requests.

9.4.2 Forwarded Request Parameters

Except for servlets obtained by using the `getNamedDispatcher` method, a servlet that has been invoked by another servlet using the `forward` method of `RequestDispatcher` has access to the path of the original request.

The following request attributes must be set:

```
javax.servlet.forward.request_uri
javax.servlet.forward.context_path
javax.servlet.forward.servlet_path
javax.servlet.forward.path_info
javax.servlet.forward.query_string
```

The values of these attributes must be equal to the return values of the `HttpServletRequest` methods `getRequestURI`, `getContextPath`, `getServletPath`, `getPathInfo`, `getQueryString` respectively, invoked on the request object passed to the first servlet object in the call chain that received the request from the client.

These attributes are accessible from the forwarded servlet via the `getAttribute` method on the request object. Note that these attributes must always reflect the information in the original request even under the situation that multiple forwards and subsequent includes are called.

If the forwarded servlet was obtained by using the `getNamedDispatcher` method, these attributes must not be set.

9.5 Error Handling

If the servlet that is the target of a request dispatcher throws a runtime exception or a checked exception of type `ServletException` or `IOException`, it should be propagated to the calling servlet. All other exceptions should be wrapped as `ServletExceptions` and the root cause of the exception set to the original exception, as it should not be propagated.

9.6 Obtaining an AsyncContext

An object implementing the `AsyncContext` interface may be obtained from the `ServletRequest` via one of `startAsync` methods. Once you have an `AsyncContext`, you can use it to either complete the processing of the request via the complete() method or use one of the dispatch methods described below.

9.7 The Dispatch Method

The following methods can be used to dispatch requests from the `AsyncContext`:

- `dispatch(path)`

The `dispatch` method takes a `String` argument describing a path within the scope of the `ServletContext`. This path must be relative to the root of the `ServletContext` and begin with a '`/`'. The method uses the path to look up a servlet, using the servlet path matching rules in Chapter 12, "Mapping Requests to Servlets", wraps it with a `AsyncContext` object, and returns the resulting object. If no servlet can be resolved based on the given path, an `AsyncContext` is provided that returns the content for that path.

- `dispatch(servletContext, path)`

The `dispatch` method takes a `String` argument describing a path within the scope of the `ServletContext` specified. This path must be relative to the root of the `ServletContext` specified and begin with a '`/`'. The method uses the path to look up a servlet, using the servlet path matching rules in Chapter 12, "Mapping Requests to Servlets", wraps it with a `AsyncContext` object, and returns the resulting object. If no servlet can be resolved based on the given path, an `AsyncContext` is provided that returns the content for that path.

- `dispatch()`

The `dispatch` method takes no argument. It uses the original uri as the path. The method uses the path to look up a servlet, using the servlet path matching rules in Chapter 12, "Mapping Requests to Servlets", wraps it with a `AsyncContext` object, and returns the resulting object. If no servlet can be resolved based on the given path, an `AsyncContext` is provided that returns the content for that path.

One of the `dispatch` methods of the `AsyncContext` interface may be called by the application waiting for the asynchronous event to happen. If `complete()` has been called on the `AsyncContext`, an `IllegalStateException` must be thrown. All the variations of the dispatch methods returns immediately and do not commit the response.

The path elements of the request object exposed to the target servlet must reflect the path specified in the `AsyncContext.dispatch`.

9.7.1 Query String

The request dispatching mechanism is responsible for aggregating query string parameters when dispatching requests.

9.7.2 Dispatched Request Parameters

A servlet that has been invoked by using the `dispatch` method of `AsyncContext` has access to the path of the original request.

The following request attributes must be set:

```
javax.servlet.async.request_uri
javax.servlet.async.context_path
javax.servlet.async.servlet_path
javax.servlet.async.path_info
javax.servlet.async.query_string
```

The values of these attributes must be equal to the return values of the `HttpServletRequest` methods `getRequestURI`, `getContextPath`, `getServletPath`, `getPathInfo`, `getQueryString` respectively, invoked on the request object passed to the first servlet object in the call chain that received the request from the client.

These attributes are accessible from the dispatched servlet via the `getAttribute` method on the request object. Note that these attributes must always reflect the information in the original request even under the situation that multiple dispatches are called.

CHAPTER **10**

Web Applications

A Web application is a collection of servlets, HTML pages, classes, and other resources that make up a complete application on a Web server. The Web application can be bundled and run on multiple containers from multiple vendors.

10.1 Web Applications Within Web Servers

A Web application is rooted at a specific path within a Web server. For example, a catalog application could be located at `http://www.mycorp.com/catalog`. All requests that start with this prefix will be routed to the `ServletContext` which represents the catalog application.

A servlet container can establish rules for automatic generation of Web applications. For example a `~user/` mapping could be used to map to a Web application based at `/home/user/public_html/`.

By default, an instance of a Web application must run on one VM at any one time. This behavior can be overridden if the application is marked as "distributable" via its deployment descriptor. An application marked as distributable must obey a more restrictive set of rules than is required of a normal Web application. These rules are set out throughout this specification.

10.2 Relationship to ServletContext

The servlet container must enforce a one to one correspondence between a Web application and a `ServletContext`. A `ServletContext` object provides a servlet with its view of the application.

10.3 Elements of a Web Application

A Web application may consist of the following items:

- Servlets
- JSP™ Pages[1]
- Utility Classes
- Static documents (HTML, images, sounds, etc.)
- Client side Java applets, beans, and classes
- Descriptive meta information that ties all of the above elements together

10.4 Deployment Hierarchies

This specification defines a hierarchical structure used for deployment and packaging purposes that can exist in an open file system, in an archive file, or in some other form. It is recommended, but not required, that servlet containers support this structure as a runtime representation.

10.5 Directory Structure

A Web application exists as a structured hierarchy of directories. The root of this hierarchy serves as the document root for files that are part of the application. For example, for a Web application with the context path `/catalog` in a Web container, the `index.html` file at the base of the Web application hierarchy or in a JAR file inside WEB-INF/lib that includes the `index.html` under `META-INF/resources` directory can be served to satisfy a request from `/catalog/index.html`. If an `index.html` is present both in the root context and in the `META-INF/resources` directory of a JAR file in the `WEB-INF/lib` directory of the application, then the file that is available in the root context MUST be used. The rules for matching URLs to context path are laid out in Chapter 12, "Mapping Requests to Servlets". Since the context path of an application determines the URL namespace of the contents of the Web application, Web containers must reject Web applications defining a context path that could cause potential conflicts in this URL namespace. This may occur, for example, by attempting to deploy a second Web application with the same context

1. See the JavaServer Pages specification available from `http://java.sun.com/products/jsp`.

path. Since requests are matched to resources in a case-sensitive manner, this determination of potential conflict must be performed in a case-sensitive manner as well.

A special directory exists within the application hierarchy named “WEB-INF”. This directory contains all things related to the application that aren’t in the document root of the application. Most of the WEB-INF node is not part of the public document tree of the application. Except for static resources and JSPs packaged in the META-INF/resources of a JAR file that resides in the WEB-INF/lib directory, no other files contained in the WEB-INF directory may be served directly to a client by the container. However, the contents of the WEB-INF directory are visible to servlet code using the getResource and getResourceAsStream method calls on the ServletContext, and may be exposed using the RequestDispatcher calls. Hence, if the Application Developer needs access, from servlet code, to application specific configuration information that he does not wish to be exposed directly to the Web client, he may place it under this directory. Since requests are matched to resource mappings in a case-sensitive manner, client requests for ‘/WEB-INF/foo’, ‘/WEb-iNf/foo’, for example, should not result in contents of the Web application located under /WEB-INF being returned, nor any form of directory listing thereof.

The contents of the WEB-INF directory are:

- The /WEB-INF/web.xml deployment descriptor.
- The /WEB-INF/classes/ directory for servlet and utility classes. The classes in this directory must be available to the application class loader.
- The /WEB-INF/lib/*.jar area for Java ARchive files. These files contain servlets, beans, static resources and JSPs packaged in a JAR file and other utility classes useful to the Web application. The Web application class loader must be able to load classes from any of these archive files.

The Web application class loader must load classes from the WEB-INF/classes directory first, and then from library JARs in the WEB-INF/lib directory. Also, except for the case where static resources are packaged in JAR files, any requests from the client to access the resources in WEB-INF/ directory must be returned with a SC_NOT_FOUND(404) response.

10.5.1 Example of Application Directory Structure

The following is a listing of all the files in a sample Web application:

```
/index.html
/howto.jsp
/feedback.jsp
/images/banner.gif
/images/jumping.gif
/WEB-INF/web.xml
/WEB-INF/lib/jspbean.jar
/WEB-INF/lib/catalog.jar!/META-
INF/resources/catalog/moreOffers/books.html
/WEB-INF/classes/com/mycorp/servlets/MyServlet.class
/WEB-INF/classes/com/mycorp/util/MyUtils.class
```

10.6 Web Application Archive File

Web applications can be packaged and signed into a Web ARchive format (WAR) file using the standard Java archive tools. For example, an application for issue tracking might be distributed in an archive file called `issuetrack.war`.

When packaged into such a form, a `META-INF` directory will be present which contains information useful to Java archive tools. This directory must not be directly served as content by the container in response to a Web client's request, though its contents are visible to servlet code via the `getResource` and `getResourceAsStream` calls on the `ServletContext`. Also, any requests to access the resources in `META-INF` directory must be returned with a `SC_NOT_FOUND`(404) response.

10.7 Web Application Deployment Descriptor

The Web application deployment descriptor (see Chapter 14, "Deployment Descriptor"") includes the following types of configuration and deployment information:

- `ServletContext` Init Parameters
- Session Configuration
- Servlet/JSP Definitions
- Servlet/JSP Mappings

- MIME Type Mappings
- Welcome File list
- Error Pages
- Security

10.7.1 Dependencies On Extensions

When a number of applications make use of the same code or resources, they will typically be installed as library files in the container. These files are often common or standard APIs that can be used without sacrificing portability. Files used only by one or a few applications will be made available for access as part of the Web application. The container must provide a directory for these libraries. The files placed within this directory must be available across all Web applications. The location of this directory is container-specific. The class loader the servlet container uses for loading these library files must be the same for all Web applications within the same JVM. This class loader instance must be somewhere in the chain of parent class loaders of the Web application class loader.

Application developers need to know what extensions are installed on a Web container, and containers need to know what dependencies servlets in a WAR have on such libraries in order to preserve portability.

The application developer depending on such an extension or extensions must provide a `META-INF/MANIFEST.MF` entry in the WAR file listing all extensions needed by the WAR. The format of the manifest entry should follow standard JAR manifest format. During deployment of the Web application, the Web container must make the correct versions of the extensions available to the application following the rules defined by the *Optional Package Versioning* mechanism (http://java.sun.com/j2se/1.4/docs/guide/extensions/).

Web containers must also be able to recognize declared dependencies expressed in the manifest entry of any of the library JARs under the `WEB-INF/lib` entry in a WAR.

If a Web container is not able to satisfy the dependencies declared in this manner, it should reject the application with an informative error message.

10.7.2 Web Application Class Loader

The class loader that a container uses to load a servlet in a WAR must allow the developer to load any resources contained in library JARs within the WAR following normal Java SE semantics using `getResource`. As described in the Java EE license agreement, servlet containers that are not part of a Java EE product should not allow the application to override Java SE platform classes, such as those in the java.* and javax.* namespaces, that Java SE does not allow to be modified. The container should not allow applications to override or access the container's implementation classes. It is recommended also that the application class loader be implemented so that classes and resources packaged within the WAR are loaded in preference to classes and resources residing in container-wide library JARs. An implementation MUST also guarantee that for every web application deployed in a container, a call to `Thread.currentThread.getContextClassLoader()` MUST return a `ClassLoader` instance that implements the contract specified in this section. Furthermore, the `ClassLoader` instance MUST be a separate instance for each deployed web application. The container is required to set the thread context `ClassLoader` as described above before making any callbacks (including listener callbacks) into the web application, and set it back to the original `ClassLoader`, once the callback returns.

10.8 Replacing a Web Application

A server should be able to replace an application with a new version without restarting the container. When an application is replaced, the container should provide a robust method for preserving session data within that application.

10.9 Error Handling

10.9.1 Request Attributes

A Web application must be able to specify that when errors occur, other resources in the application are used to provide the content body of the error response. The specification of these resources is done in the deployment descriptor.

If the location of the error handler is a servlet or a JSP page:

- The original unwrapped request and response objects created by the container are passed to the servlet or JSP page.
- The request path and attributes are set as if a `RequestDispatcher.forward` to the error resource had been performed.

- The request attributes in TABLE 10-1 must be set.

TABLE 10-1 Request Attributes and their types

Request Attributes	Type
`javax.servlet.error.status_code`	`java.lang.Integer`
`javax.servlet.error.exception_type`	`java.lang.Class`
`javax.servlet.error.message`	`java.lang.String`
`javax.servlet.error.exception`	`java.lang.Throwable`
`javax.servlet.error.request_uri`	`java.lang.String`
`javax.servlet.error.servlet_name`	`java.lang.String`

These attributes allow the servlet to generate specialized content depending on the status code, the exception type, the error message, the exception object propagated, and the URI of the request processed by the servlet in which the error occurred (as determined by the `getRequestURI` call), and the logical name of the servlet in which the error occurred.

With the introduction of the exception object to the attributes list for version 2.3 of this specification, the exception type and error message attributes are redundant. They are retained for backwards compatibility with earlier versions of the API.

10.9.2 Error Pages

To allow developers to customize the appearance of content returned to a Web client when a servlet generates an error, the deployment descriptor defines a list of error page descriptions. The syntax allows the configuration of resources to be returned by the container either when a servlet or filter calls `sendError` on the response for specific status codes, or if the servlet generates an exception or error that propagates to the container.

If the `sendError` method is called on the response, the container consults the list of error page declarations for the Web application that use the status-code syntax and attempts a match. If there is a match, the container returns the resource as indicated by the location entry.

A servlet or filter may throw the following exceptions during processing of a request:

- runtime exceptions or errors
- `ServletExceptions` or subclasses thereof
- `IOExceptions` or subclasses thereof

The Web application may have declared error pages using the `exception-type` element. In this case the container matches the exception type by comparing the exception thrown with the list of error-page definitions that use the `exception-type` element. A match results in the container returning the resource indicated in the location entry. The closest match in the class hierarchy wins.

If no `error-page` declaration containing an `exception-type` fits using the class-hierarchy match, and the exception thrown is a `ServletException` or subclass thereof, the container extracts the wrapped exception, as defined by the `ServletException.getRootCause` method. A second pass is made over the error page declarations, again attempting the match against the error page declarations, but using the wrapped exception instead.

Error-page declarations using the `exception-type` element in the deployment descriptor must be unique up to the class name of the exception-type. Similarly, error-page declarations using the `status-code` element must be unique in the deployment descriptor up to the status code.

The error page mechanism described does not intervene when errors occur when invoked using the `RequestDispatcher` or `filter.doFilter` method. In this way, a filter or servlet using the `RequestDispatcher` has the opportunity to handle errors generated.

If a servlet generates an error that is not handled by the error page mechanism as described above, the container must ensure to send a response with status 500.

The default servlet and container will use the `sendError` method to send 4xx and 5xx status responses, so that the error mechanism may be invoked. The default servlet and container will use the `setStatus` method for 2xx and 3xx responses and will not invoke the error page mechanism.

10.9.3 Error Filters

The error page mechanism operates on the original unwrapped/unfiltered request and response objects created by the container. The mechanism described in Section 6.2.5, "Filters and the RequestDispatcher" may be used to specify filters that are applied before an error response is generated.

10.10 Welcome Files

Web Application developers can define an ordered list of partial URIs called welcome files in the Web application deployment descriptor. The deployment descriptor syntax for the list is described in the Web application deployment descriptor schema.

The purpose of this mechanism is to allow the deployer to specify an ordered list of partial URIs for the container to use for appending to URIs when there is a request for a URI that corresponds to a directory entry in the WAR not mapped to a Web component. This kind of request is known as a valid partial request.

The use for this facility is made clear by the following common example: A welcome file of '`index.html`' can be defined so that a request to a URL like `host:port/webapp/directory/`, where '`directory`' is an entry in the WAR that is not mapped to a servlet or JSP page, is returned to the client as '`host:port/webapp/directory/index.html`'.

If a Web container receives a valid partial request, the Web container must examine the welcome file list defined in the deployment descriptor. The welcome file list is an ordered list of partial URLs with no trailing or leading /. The Web server must append each welcome file in the order specified in the deployment descriptor to the partial request and check whether a static resource in the WAR is mapped to that request URI. If no match is found, the Web server MUST again append each welcome file in the order specified in the deployment descriptor to the partial request and check if a servlet is mapped to that request URI. The Web container must send the request to the first resource in the WAR that matches. The container may send the request to the welcome resource with a forward, a redirect, or a container specific mechanism that is indistinguishable from a direct request.

If no matching welcome file is found in the manner described, the container may handle the request in a manner it finds suitable. For some configurations this may mean returning a directory listing or for others returning a `404` response.

Consider a Web application where:

- The deployment descriptor lists the following welcome files.

```
<welcome-file-list>
    <welcome-file>index.html</welcome-file>
    <welcome-file>default.jsp</welcome-file>
</welcome-file-list>
```

- The static content in the WAR is as follows

```
/foo/index.html
/foo/default.jsp
/foo/orderform.html
/foo/home.gif
/catalog/default.jsp
/catalog/products/shop.jsp
/catalog/products/register.jsp
```

- A request URI of `/foo` will be redirected to a URI of `/foo/`.
- A request URI of `/foo/` will be returned as `/foo/index.html`.
- A request URI of `/catalog` will be redirected to a URI of `/catalog/`.
- A request URI of `/catalog/` will be returned as `/catalog/default.jsp`.
- A request URI of `/catalog/index.html` will cause a `404 not found`
- A request URI of `/catalog/products` will be redirected to a URI of `/catalog/products/`.
- A request URI of `/catalog/products/` will be passed to the "default" servlet, if any. If no "default" servlet is mapped, the request may cause a `404 not found`, may cause a directory listing including `shop.jsp` and `register.jsp`, or may cause other behavior defined by the container. See Section 12.2, "Specification of Mappings" for the definition of "default" servlet.
- All of the above static content can also be packaged in a JAR file with the content listed above packaged in the `META-INF/resources` directory of the jar file. The JAR file can then be included in the `WEB-INF/lib` directory of the web application.

10.11 Web Application Environment

Servlet containers that are not part of a Java EE technology-compliant implementation are encouraged, but not required, to implement the application environment functionality described in Section 15.2.2, "Web Application Environment and the Java EE specification. If they do not implement the facilities required to support this environment, upon deploying an application that relies on them, the container should provide a warning.

10.12 Web Application Deployment

When a web application is deployed into a container, the following steps must be performed, in this order, before the web application begins processing client requests.

- Instantiate an instance of each event listener identified by a `<listener>` element in the deployment descriptor.
- For instantiated listener instances that implement `ServletContextListener`, call the `contextInitialized()` method.
- Instantiate an instance of each filter identified by a `<filter>` element in the deployment descriptor and call each filter instance's `init()` method.
- Instantiate an instance of each servlet identified by a `<servlet>` element that includes a `<load-on-startup>` element in the order defined by the load-on-startup element values, and call each servlet instance's `init()` method.

10.13 Inclusion of a web.xml Deployment Descriptor

A web application is NOT required to contain a web.xml if it does NOT contain any Servlet, Filter, or Listener components or is using annotations to declare the same. In other words an application containing only static files or JSP pages does not require a web.xml to be present.

CHAPTER 11

Application Lifecycle Events

11.1 Introduction

The application events facility gives the Web Application Developer greater control over the lifecycle of the `ServletContext` and `HttpSession` and `ServletRequest`, allows for better code factorization, and increases efficiency in managing the resources that the Web application uses.

11.2 Event Listeners

Application event listeners are classes that implement one or more of the servlet event listener interfaces. They are instantiated and registered in the Web container at the time of the deployment of the Web application. They are provided by the Developer in the WAR.

Servlet event listeners support event notifications for state changes in the `ServletContext`, `HttpSession` and `ServletRequest` objects. Servlet context listeners are used to manage resources or state held at a JVM level for the application. HTTP session listeners are used to manage state or resources associated with a series of requests made into a Web application from the same client or user. Servlet request listeners are used to manage state across the lifecycle of servlet requests. Async listeners are used to manage async events such as timeouts and completion of async processing.

There may be multiple listener classes listening to each event type, and the Developer may specify the order in which the container invokes the listener beans for each event type.

11.2.1 Event Types and Listener Interfaces

Events types and the listener interfaces used to monitor them are shown in the following tables:

TABLE 11-1 Servlet Context Events

Event Type	Description	Listener Interface
Lifecycle	The servlet context has just been created and is available to service its first request, or the servlet context is about to be shut down.	`javax.servlet. ServletContextListener`
Changes to attributes	Attributes on the servlet context have been added, removed, or replaced.	`javax.servlet. ServletContextAttributeListe ner`

TABLE 11-2 HTTP Session Events

Event Type	Description	Listener Interface
Lifecycle	An `HttpSession` has been created, invalidated, or timed out.	`javax.servlet.http. HttpSessionListener`
Changes to attributes	Attributes have been added, removed, or replaced on an `HttpSession`.	`javax.servlet.http HttpSessionAttributeListener`
Session migration	`HttpSession` has been activated or passivated.	`javax.servlet.http HttpSessionActivationListener`
Object binding	Object has been bound to or unbound from `HttpSession`	`javax.servlet.http HttpSessionBindingListener`

TABLE 11-3 Servlet Request Events

Event Type	Description	Listener Interface
Lifecycle	A servlet request has started being processed by Web components.	`javax.servlet. ServletRequestListener`
Changes to attributes	Attributes have been added, removed, or replaced on a `ServletRequest`.	`javax.servlet. ServletRequestAttributeListen er`
Async events	A timeout, connection termination or completion of async processing	`javax.servlet.AsyncListener`

For details of the API, refer to the API reference.

11.2.2 An Example of Listener Use

To illustrate a use of the event scheme, consider a simple Web application containing a number of servlets that make use of a database. The Developer has provided a servlet context listener class for management of the database connection.

1. When the application starts up, the listener class is notified. The application logs on to the database, and stores the connection in the servlet context.
2. Servlets in the application access the connection as needed during activity in the Web application.
3. When the Web server is shut down, or the application is removed from the Web server, the listener class is notified and the database connection is closed.

11.3 Listener Class Configuration

11.3.1 Provision of Listener Classes

The Developer of the Web application provides listener classes implementing one or more of the listener interfaces in the `javax.servlet` API. Each listener class must have a public constructor taking no arguments. The listener classes are packaged into the WAR, either under the `WEB-INF/classes` archive entry, or inside a JAR in the `WEB-INF/lib` directory.

11.3.2 Deployment Declarations

Listener classes are declared in the Web application deployment descriptor using the `listener` element. They are listed by class name in the order in which they are to be invoked. Unlike other listeners, listeners of type `AsyncListener` may only be registered (with a `ServletRequest`) programmatically.

11.3.3 Listener Registration

The Web container creates an instance of each listener class and registers it for event notifications prior to the processing of the first request by the application. The Web container registers the listener instances according to the interfaces they implement and the order in which they appear in the deployment descriptor. During Web application execution, listeners are invoked in the order of their registration.

11.3.4 Notifications At Shutdown

On application shutdown, listeners are notified in reverse order to their declarations with notifications to session listeners preceeding notifications to context listeners. Session listeners must be notified of session invalidations prior to context listeners being notified of application shutdown.

11.4 Deployment Descriptor Example

The following example is the deployment grammar for registering two servlet context lifecycle listeners and an `HttpSession` listener.

Suppose that `com.acme.MyConnectionManager` and `com.acme.MyLoggingModule` both implement `javax.servlet.ServletContextListener`, and that `com.acme.MyLoggingModule` additionally implements `javax.servlet.http.HttpSessionListener`. Also, the Developer wants com.acme.MyConnectionManager to be notified of servlet context lifecycle events before com.acme.MyLoggingModule. Here is the deployment descriptor for this application:

```
<web-app>
    <display-name>MyListeningApplication</display-name>
    <listener>
        <listener-class>com.acme.MyConnectionManager</listener-
class>
    </listener>
    <listener>
        <listener-class>com.acme.MyLoggingModule</listener-class>
    </listener>
    <servlet>
        <display-name>RegistrationServlet</display-name>
        ...etc
    </servlet>
</web-app>
```

11.5 Listener Instances and Threading

The container is required to complete instantiation of the listener classes in a Web application prior to the start of execution of the first request into the application. The container must maintain a reference to each listener instance until the last request is serviced for the Web application.

Attribute changes to ServletContext and HttpSession objects may occur concurrently. The container is not required to synchronize the resulting notifications to attribute listener classes. Listener classes that maintain state are responsible for the integrity of the data and should handle this case explicitly.

11.6 Listener Exceptions

Application code inside a listener may throw an exception during operation. Some listener notifications occur under the call tree of another component in the application. An example of this is a servlet that sets a session attribute, where the session listener throws an unhandled exception. The container must allow unhandled exceptions to be handled by the error page mechanism described in

Section 10.9, “Error Handling”. If there is no error page specified for those exceptions, the container must ensure to send a response back with status 500. In this case no more listeners under that event are called.

Some exceptions do not occur under the call stack of another component in the application. An example of this is a `SessionListener` that receives a notification that a session has timed out and throws an unhandled exception, or of a `ServletContextListener` that throws an unhandled exception during a notification of servlet context initialization, or of a `ServletRequestListener` that throws an unhandled exception during a notification of the initialization or the destruction of the request object. In this case, the Developer has no opportunity to handle the exception. The container may respond to all subsequent requests to the Web application with an HTTP status code 500 to indicate an application error.

Developers wishing normal processing to occur after a listener generates an exception must handle their own exceptions within the notification methods.

11.7 Distributed Containers

In distributed Web containers, `HttpSession` instances are scoped to the particular JVM servicing session requests, and the `ServletContext` object is scoped to the Web container’s JVM. Distributed containers are not required to propagate either servlet context events or `HttpSession` events to other JVMs. Listener class instances are scoped to one per deployment descriptor declaration per JVM.

11.8 Session Events

Listener classes provide the Developer with a way of tracking sessions within a Web application. It is often useful in tracking sessions to know whether a session became invalid because the container timed out the session, or because a Web component within the application called the `invalidate` method. The distinction may be determined indirectly using listeners and the `HttpSession` API methods.

CHAPTER 12

Mapping Requests to Servlets

The mapping techniques described in this chapter are required for Web containers mapping client requests to servlets.[1]

12.1 Use of URL Paths

Upon receipt of a client request, the Web container determines the Web application to which to forward it. The Web application selected must have the the longest context path that matches the start of the request URL. The matched part of the URL is the context path when mapping to servlets.

The Web container next must locate the servlet to process the request using the path mapping procedure described below.

The path used for mapping to a servlet is the request URL from the request object minus the context path and the path parameters. The URL path mapping rules below are used in order. The first successful match is used with no further matches attempted:

1. The container will try to find an exact match of the path of the request to the path of the servlet. A successful match selects the servlet.
2. The container will recursively try to match the longest path-prefix. This is done by stepping down the path tree a directory at a time, using the `'/'` character as a path separator. The longest match determines the servlet selected.
3. If the last segment in the URL path contains an extension (e.g. `.jsp`), the servlet container will try to match a servlet that handles requests for the extension. An extension is defined as the part of the last segment after the last `'.'` character.

1. Versions of this specification prior to 2.5 made use of these mapping techniques as a suggestion rather than a requirement, allowing servlet containers to each have their different schemes for mapping client requests to servlets.

4. If neither of the previous three rules result in a servlet match, the container will attempt to serve content appropriate for the resource requested. If a "default" servlet is defined for the application, it will be used. Many containers provide an implicit default servlet for serving content.

The container must use case-sensitive string comparisons for matching.

12.2 Specification of Mappings

In the Web application deployment descriptor, the following syntax is used to define mappings:

- A string beginning with a `'/'` character and ending with a `'/*'` suffix is used for path mapping.
- A string beginning with a `'*.'` prefix is used as an extension mapping.
- A string containing only the `'/'` character indicates the "default" servlet of the application. In this case the servlet path is the request URI minus the context path and the path info is null.
- All other strings are used for exact matches only.

12.2.1 Implicit Mappings

If the container has an internal JSP container, the `*.jsp` extension is mapped to it, allowing JSP pages to be executed on demand. This mapping is termed an *implicit* mapping. If a `*.jsp` mapping is defined by the Web application, its mapping takes precedence over the implicit mapping.

A servlet container is allowed to make other implicit mappings as long as explicit mappings take precedence. For example, an implicit mapping of `*.shtml` could be mapped to include functionality on the server.

12.2.2 Example Mapping Set

Consider the following set of mappings:

TABLE 12-1 Example Set of Maps

Path Pattern	Servlet
`/foo/bar/*`	`servlet1`
`/baz/*`	`servlet2`
`/catalog`	`servlet3`
`*.bop`	`servlet4`

The following behavior would result:

TABLE 12-2 Incoming Paths Applied to Example Maps

Incoming Path	Servlet Handling Request
`/foo/bar/index.html`	`servlet1`
`/foo/bar/index.bop`	`servlet1`
`/baz`	`servlet2`
`/baz/index.html`	`servlet2`
`/catalog`	`servlet3`
`/catalog/index.html`	`“default” servlet`
`/catalog/racecar.bop`	`servlet4`
`/index.bop`	`servlet4`

Note that in the case of `/catalog/index.html` and `/catalog/racecar.bop`, the servlet mapped to “`/catalog`” is not used because the match is not exact.

CHAPTER 13

Security

Web applications are created by Application Developers who give, sell, or otherwise transfer the application to a Deployer for installation into a runtime environment. Application Developers communicate the security requirements to the Deployers and the deployment system. This information may be conveyed declaratively via the application's deployment descriptor, or by using annotations within the application code.

This chapter describes the Servlet container security mechanisms and interfaces and the deployment descriptor and annotation based mechanisms for conveying the security requirements of applications.

13.1 Introduction

A web application contains resources that can be accessed by many users. These resources often traverse unprotected, open networks such as the Internet. In such an environment, a substantial number of web applications will have security requirements.

Although the quality assurances and implementation details may vary, servlet containers have mechanisms and infrastructure for meeting these requirements that share some of the following characteristics:

- **Authentication:** The means by which communicating entities prove to one another that they are acting on behalf of specific identities that are authorized for access.
- **Access control for resources:** The means by which interactions with resources are limited to collections of users or programs for the purpose of enforcing integrity, confidentiality, or availability constraints.
- **Data Integrity:** The means used to prove that information has not been modified by a third party while in transit.

- **Confidentiality or Data Privacy:** The means used to ensure that information is made available only to users who are authorized to access it.

13.2 Declarative Security

Declarative security refers to the means of expressing an application's security model or requirements, including roles, access control, and authentication requirements in a form external to the application. The deployment descriptor is the primary vehicle for declarative security in web applications.

The Deployer maps the application's logical security requirements to a representation of the security policy that is specific to the runtime environment. At runtime, the servlet container uses the security policy representation to enforce authentication and authorization.

The security model applies to the static content part of the web application and to servlets and filters within the application that are requested by the client. The security model does not apply when a servlet uses the `RequestDispatcher` to invoke a static resource or servlet using a `forward` or an `include`.

13.3 Programmatic Security

Programmatic security is used by security aware applications when declarative security alone is not sufficient to express the security model of the application. Programmatic security consists of the following methods of the `HttpServletRequest` interface:

- `authenticate`
- `login`
- `logout`
- `getRemoteUser`
- `isUserInRole`
- `getUserPrincipal`

The `authenticate` method allows an application to perform username and password collection (as an alternative to Form-Based Login). The `login` methods allow an application to instigate authentication of the request caller by the container from within an unconstrained request context.

The `logout` method is provided to allow an application to reset the caller identity of a request.

The getRemoteUser method returns the name of the remote user (that is, the caller) associated, by the container, with the request.

The isUserInRole method determines if the remote user (that is, the caller) associated with the request is in a specified security role.

The getUserPrincipal method determines the principal name of the remote user (that is, the caller) and returns a java.security.Principal object corresponding to the remote user. Calling the getName method on the Principal returned by getUserPrincipal returns the name of the remote user. These APIs allow servlets to make business logic decisions based on the information obtained.

If no user has been authenticated, the getRemoteUser method returns null, the isUserInRole method always returns false, and the getUserPrincipal method returns null.

The isUserInRole method expects a String user role-name parameter. A security-role-ref element should be declared in the deployment descriptor with a role-name sub-element containing the rolename to be passed to the method. A security-role-ref element should contain a role-link sub-element whose value is the name of the security role that the user may be mapped into. The container uses the mapping of security-role-ref to security-role when determining the return value of the call.

For example, to map the security role reference "FOO" to the security role with role-name "manager" the syntax would be:

```
<security-role-ref>
        <role-name>FOO</role-name>
        <role-link>manager</role-link>
</security-role-ref>
```

In this case if the servlet called by a user belonging to the "manager" security role made the API call isUserInRole("FOO") the result would be true.

If no security-role-ref element matching a security-role element has been declared, the container must default to checking the role-name element argument against the list of security-role elements for the web application. The isUserInRole method references the list to determine whether the caller is mapped to a security role. The developer must be aware that the use of this default mechanism may limit the flexibility in changing rolenames in the application without having to recompile the servlet making the call.

13.4 Access Control Annotations

The `@RolesAllowed`, `@DenyAll`, `@PermitAll`, and `@TransportProtected` annotations provide an alternative mechanism for defining security constraints equivalent to those that could otherwise have been expressed declaratively in the portable deployment descriptor. These annotations are defined in the Common Annotations for the Java™ Platform™ specification (JSR 250). Servlet containers MUST enforce these annotations when they are specified on(that is, targeted to) classes (and subclasses thereof) that implement the `javax.servlet.Servlet` interface and for which the Servlet container would process `security-constraints` if they were specified in the web.xml.

Within these classes, Servlet containers MUST also enforce these annotations when they are specified on (that is, targeted to) the methods of the `HttpServlet` class (defined below). At most one of `@RolesAllowed`, `@PermitAll`, or `@DenyAll` may be specified on a target. The `@TransportProtected` annotation may occur in combination with either the `@RolesAllowed` or `@PermitAll` annotations. At most one instance of each annotation type may occur on a target. When specified on a class target, the Servlet container MUST enforce these annotations for all requests processed by the public `service` method of the `Servlet` implementation class. The public service method of a Servlet that extends HttpServlet is the one which inturn calls the doXXX method.

- `public void service(ServletRequest req, ServletResponse resp);`

These annotations may also be targeted to any of the `HttpServlet` methods listed below

-
  ```
  protected void doDelete(HttpServletRequest req,
                          HttpServletResponse resp) throws
  ServletException, IOException;
  ```

-
  ```
  protected void doGet(HttpServletRequest req,
                       HttpServletResponse resp) throws
  ServletException, IOException;
  ```

-
  ```
  protected void doHead(HttpServletRequest req,
                        HttpServletResponse resp) throws
  ServletException, IOException;
  ```

-
  ```
  protected void doOptions(HttpServletRequest req,
                           HttpServletResponse resp) throws
  ServletException, IOException;
  ```

-
  ```
  protected void doPost(HttpServletRequest req,
                        HttpServletResponse resp) throws
  ServletException, IOException;
  ```

-
  ```
  protected void doPut(HttpServletRequest req,
                       HttpServletResponse resp) throws
  ServletException, IOException;
  ```

-
  ```
  protected void doTrace(HttpServletRequest req,
                         HttpServletResponse resp) throws
  ServletException, IOException;
  ```

When an annotation is specified at both the class and method level, the method targeted annotation MUST override that on the class (for the method).

When the `metadata-complete` attribute is set in the portable deployment descriptor, the annotations described in this section MUST have no effect on the access control policy enforced by the container on behalf of the corresponding web module or web fragment.

When a `security-constraint` in the portable deployment descriptor includes a `url-pattern` that matches a request URL, the security annotations described in this section MUST have no effect on the access policy enforced by the container on the request URL.

When none of these annotations have been assigned to the class and method targets corresponding to a request, the access policy that is applied by the container to the request MUST be established by the applicable security constraints, if any, in the corresponding portable deployment descriptor.

For further details on the use of these annotations refer to the Common Annotations for the Java™ Platform™ specification (JSR 250).

13.4.1 Mapping Access Control Annotations to Constraints

With the exceptions identified in the preceding section, Servlet containers MUST enforce the security constraints established as a result of the use of these annotations. This section describes a mapping of annotations to `security-constraint` elements and is provided to facilitate enforcement using the existing `security-constraint` enforcement mechanism of the container. The enforcement of these annotations by servlet containers MUST be equivalent in effect to enforcement by the container of the `security-constraint` elements resulting from the mapping defined in this section.

A @RolesAllowed annotation corresponds to a security-constraint containing an auth-constraint naming the roles named in the value of the annotation. A @DenyAll annotation corresponds to a security-constraint containing an auth-constraint naming no roles. A @PermitAll annotation corresponds to a security-constraint that does not contain an auth-constraint. A @TransportProtected annotation corresponds to a security-constraint containing a user-data-constraint with transport-guarantee corresponding to the value[1] of the annotation.

The mapping of an annotation to the corresponding security constraint is completed by converting the annotation to the corresponding web-resource-collection as defined below.

A class-targeted use of one of these annotations on a class that includes no legitimate method-targeted uses of the same or of a mutually exclusive annotation corresponds to a web-resource-collection that names the URL patterns mapped to the annotated class and that contains no http-method or http-method-omission elements.

CODE EXAMPLE 13-1 Mapping a Class-targeted annotation with no method omissions

```
@WebServlet(”/foo”)
@RolesAllowed("users");
public class CalculatorServlet extends HttpServlet{
    //...
}

<web-resource-collection>
    <web-resource-name>
        Class-targeted annotation with no method omissions
    </web-resource-name>
    <url-pattern>/foo</url-pattern>
</web-resource-collection>
```

1. true maps to “CONFIDENTIAL’, false maps to “NONE”

A class-targeted use of one of these annotations that also includes one or more legitimate method-targeted uses of the same or of a mutually exclusive annotation corresponds to a web-resource-collection that names the URL patterns mapped to the annotated class and that contains a list of http-method-omission elements corresponding to the applicable method-targeted annotations within the class.

CODE EXAMPLE 13-2 Mapping a Class-targeted annotation with method omissions

```
@WebServlet(”/foo”)
@RolesAllowed("users");
public class CalculatorServlet extends HttpServlet{

    @PermitAll
    protected void doGet(HttpServletRequest req,
            HttpServletResponse resp) {
        //...
    }
    //...
}
<!-- The class-targeted @RolesAllowed annotation maps to the
following web-resource-collection -->
<web-resource-collection>
    <web-resource-name>
        Class-targeted annotation with method omission(s)
    </web-resource-name>
    <url-pattern>/foo</url-pattern>
    <http-method-omission>GET</http-method-omission>
</web-resource-collection>
...
<!-- The web-resource collection resulting from the mapping of the
method-targeted @PermitAll annotation is shown in the code example
13.3 -->
```

A legitimate method-targeted use of one of these annotations corresponds to a web-resource-collection that names all the URL patterns mapped to the annotated class and that contains a single http-method element corresponding to the annotated method.

CODE EXAMPLE 13-3 Mapping a Method-targeted annotation

```
@WebServlet(”/foo”)
@RolesAllowed("users");
public class CalculatorServlet extends HttpServlet{

    @PermitAll
    protected void doGet(HttpServletRequest req,
```

CODE EXAMPLE 13-3 Mapping a Method-targeted annotation

```
             HttpServletResponse resp) {
         //...
     }
     //...
}
...
<!-- The method-targeted @PermitAll annotation maps to the
following web-resource-collection -->

<web-resource-collection>
    <web-resource-name>
        Method-targeted annotation
    </web-resource-name>
    <url-pattern>/foo</url-pattern>
    <http-method>GET</http-method>
</web-resource-collection>
...
<!-- The web-resource-collection resulting from the mapping of the
class-targeted @RolesAllowed annotation is shown in code example
13-2 -->
```

13.5 Roles

A security role is a logical grouping of users defined by the Application Developer or Assembler. When the application is deployed, roles are mapped by a Deployer to principals or groups in the runtime environment.

A servlet container enforces declarative or programmatic security for the principal associated with an incoming request based on the security attributes of the principal. This may happen in either of the following ways:

1. A deployer has mapped a security role to a user group in the operational environment. The user groups to which the calling principal belongs are retrieved from its security attributes. The principal is in the security role only if the principal belongs to the user group to which the security role has been mapped by the deployer.

2. A deployer has mapped a security role to a principal name in a security policy domain. In this case, the principal name of the calling principal is retrieved from its security attributes. The principal is in the security role only if the principal name is the same as a principal name to which the security role was mapped.

13.6 Authentication

A web client can authenticate a user to a web server using one of the following mechanisms:

- HTTP Basic Authentication
- HTTP Digest Authentication
- HTTPS Client Authentication
- Form Based Authentication

13.6.1 HTTP Basic Authentication

HTTP Basic Authentication, which is based on a username and password, is the authentication mechanism defined in the HTTP/1.0 specification. A web server requests a web client to authenticate the user. As part of the request, the web server passes the *realm* (a string) in which the user is to be authenticated. The web client obtains the username and the password from the user and transmits them to the web server. The web server then authenticates the user in the specified realm.

Basic Authentication is not a secure authentication protocol. User passwords are sent in simple base64 encoding, and the target server is not authenticated. Additional protection can alleviate some of these concerns: a secure transport mechanism (HTTPS), or security at the network level (such as the IPSEC protocol or VPN strategies) is applied in some deployment scenarios.

13.6.2 HTTP Digest Authentication

Like HTTP Basic Authentication, HTTP Digest Authentication authenticates a user based on a username and a password. However, unlike HTTP Basic Authentication, HTTP Digest Authentication does not send user passwords over the network. In HTTP Digest authentication the client sends a one-way cryptographic hash of the password (and additional data). Although passwords are not sent on the wire, HTTP Digest authentication requires that clear text password equivalents[2] be avaialble to the authenticating container so that it can validate received authenticators by calculating the expected digest. Servlet containers SHOULD to support HTTP_DIGEST authentication.

2. The password equivalents can be such that they can only be used to authenticate as the user at a specific realm.

13.6.3 Form Based Authentication

The look and feel of the "login screen" cannot be varied using the web browser's built-in authentication mechanisms. This specification introduces a required form based authentication mechanism which allows a Developer to control the look and feel of the login screens.

The web application deployment descriptor contains entries for a login form and error page. The login form must contain fields for entering a username and a password. These fields must be named `j_username` and `j_password`, respectively.

When a user attempts to access a protected web resource, the container checks the user's authentication. If the user is authenticated and possesses authority to access the resource, the requested web resource is activated and a reference to it is returned. If the user is not authenticated, all of the following steps occur:

1. The login form associated with the security constraint is sent to the client and the URL path triggering the authentication is stored by the container.
2. The user is asked to fill out the form, including the username and password fields.
3. The client posts the form back to the server.
4. The container attempts to authenticate the user using the information from the form.
5. If authentication fails, the error page is returned using either a forward or a redirect, and the status code of the response is set to 200.
6. If authentication succeeds, the authenticated user's principal is checked to see if it is in an authorized role for accessing the resource.
7. If the user is authorized, the client is redirected to the resource using the stored URL path.

   The error page sent to a user that is not authenticated contains information about the failure.

Form Based Authentication has the same lack of security as Basic Authentication since the user password is transmitted as plain text and the target server is not authenticated. Again additional protection can alleviate some of these concerns: a secure transport mechanism (HTTPS), or security at the network level (such as the IPSEC protocol or VPN strategies) is applied in some deployment scenarios.

13.6.3.1 Login Form Notes

Form based login and URL based session tracking can be problematic to implement. Form based login should be used only when sessions are being maintained by cookies or by SSL session information.

In order for the authentication to proceed appropriately, the action of the login form must always be `j_security_check`. This restriction is made so that the login form will work no matter which resource it is for, and to avoid requiring the server to specify the action field of the outbound form.

Here is an example showing how the form should be coded into the HTML page:

```
<form method=”POST” action=”j_security_check”>
<input type=”text” name=”j_username”>
<input type=”password” name=”j_password”>
</form>
```

If the form based login is invoked because of an HTTP request, the original request parameters must be preserved by the container for use if, on successful authentication, it redirects the call to the requested resource.

If the user is authenticated using form login and has created an HTTP session, the timeout or invalidation of that session leads to the user being logged out in the sense that subsequent requests must cause the user to be re-authenticated. The scope of the logout is the same as that of the authentication: for example, if the container supports single signon, such as Java EE technology compliant web containers, the user would need to reauthenticate with any of the web applications hosted on the web container.

13.6.4 HTTPS Client Authentication

End user authentication using HTTPS (HTTP over SSL) is a strong authentication mechanism. This mechanism requires the client to possess a Public Key Certificate (PKC). Currently, PKCs are useful in e-commerce applications and also for a single-signon from within the browser.

13.6.5 Additional Container Authentication Mechanisms

Servlet containers should provide public interfaces that may be used to integrate and configure additional HTTP message layer authentication mechanisms for use by the container on behalf of deployed applications. These interfaces should be offered for use by parties other than the container vendor (including application developers, system administrators, and system integrators).

To facilitate portable implementation and integration of additional container authentication mechanisms, it is recommended that all Servlet containers implement the Servlet Container Profile of The Java^{tm} Authentication SPI for Containers (i.e., JSR 196). The SPI is available for download at:
http://www.jcp.org/en/jsr/detail?id=196

13.7 Server Tracking of Authentication Information

As the underlying security identities (such as users and groups) to which roles are mapped in a runtime environment are environment specific rather than application specific, it is desirable to:

1. Make login mechanisms and policies a property of the environment the web application is deployed in.
2. Be able to use the same authentication information to represent a principal to all applications deployed in the same container, and
3. Require re-authentication of users only when a security policy domain boundary has been crossed.

Therefore, a servlet container is required to track authentication information at the container level (rather than at the web application level). This allows users authenticated for one web application to access other resources managed by the container permitted to the same security identity.

13.8 Specifying Security Constraints

Security constraints are a declarative way of defining the protection of web content. A security constraint associates authorization and or user data constraints with HTTP operations on web resources. A security constraint, represented as a `security-constraint` in a deployment descriptor, consists of the following elements:

- web resource collection (`web-resource-collection` in deployment descriptor)
- authorization constraint (`auth-constraint` in deployment descriptor)
- user data constraint (`user-data-constraint` in deployment descriptor)

The HTTP operations and web resources to which a security constraint applies (i.e. the constrained requests) are identified by one or more web resource collections. A web resource collection consists of the following elements:

- URL patterns (`url-pattern` in deployment descriptor)
- HTTP methods (`http-method` or `http-method-omission` elements in the deployment descriptor)

An authorization constraint establishes a requirement for authentication and names the authorization roles permitted to perform the constrained requests. A user must be a member of at least one of the named roles to be permitted to perform the constrained requests. The special role name "*" is a shorthand for all role names defined in the deployment descriptor. An authorization constraint that names no roles indicates that access to the constrained requests must not be permitted under any circumstances. An authorization constraint consists of the following element:

- role name (`role-name` in deployment descriptor)

  A user data constraint establishes a requirement that the constrained requests be received over a protected transport layer connection. The strength of the required protection is defined by the value of the transport guarantee. A transport guarantee of INTEGRAL is used to establish a requirement for content integrity and a transport guarantee of CONFIDENTIAL is used to establish a requirement for confidentiality. The transport guarantee of "NONE" indicates that the container must accept the constrained requests when received on any connection including an unprotected one. A user data constraint consists of the following element:

- transport guarantee (`transport-guarantee` in deployment descriptor)

  If no authorization constraint applies to a request, the container must accept the request without requiring user authentication. If no user data constraint applies to a request, the container must accept the request when received over any connection including an unprotected one.

13.8.1 Combining Constraints

For the purpose of combining constraints, an HTTP method is said to occur within a `web-resource-collection` when no HTTP methods are named in the collection, or the collection specifically names the HTTP method in a contained `http-method` element, or the collection contains one or more `http-method-omission` elements, none of which names the HTTP method.

When a url-pattern and HTTP method pair occurs in combination(i.e, within a `web-resource-collection`) in multiple security constraints, the constraints (on the pattern and method) are defined by combining the individual constraints. The rules for combining constraints in which the same pattern and method occur are as follows:

The combination of authorization constraints that name roles or that imply roles via the name "*" shall yield the union of the role names in the individual constraints as permitted roles. A security constraint that does not contain an authorization constraint shall combine with authorization constraints that name or imply roles to allow unauthenticated access. The special case of an authorization constraint that names no roles shall combine with any other constraints to override their affects and cause access to be precluded.

The combination of `user-data-constraints` that apply to a common `url-pattern` *and* `http-method` shall yield the union of connection types accepted by the individual constraints as acceptable connection types. A security constraint that does not contain a `user-data-constraint` shall combine with other `user-data-constraint` to cause the unprotected connection type to be an accepted connection type.

13.8.2 Example

The following example illustrates the combination of constraints and their translation into a table of applicable constraints. Suppose that a deployment descriptor contained the following security constraints.

```
<security-constraint>

    <web-resource-collection>
     <web-resource-name>precluded methods</web-resource-name>
     <url-pattern>/*</url-pattern>
     <url-pattern>/acme/wholesale/*</url-pattern>
     <url-pattern>/acme/retail/*</url-pattern>
     <http-method-exception>GET</http-method-exception>
     <http-method-exception>POST</http-method-exception>
    </web-resource-collection>

    <auth-constraint/>

</security-constraint>

<security-constraint>

    <web-resource-collection>
     <web-resource-name>wholesale</web-resource-name>
     <url-pattern>/acme/wholesale/*</url-pattern>
     <http-method>GET</http-method>
     <http-method>PUT</http-method>
    </web-resource-collection>

    <auth-constraint>
     <role-name>SALESCLERK</role-name>
    </auth-constraint>

</security-constraint>
```

```
<security-constraint>

    <web-resource-collection>
     <web-resource-name>wholesale 2</web-resource-name>
     <url-pattern>/acme/wholesale/*</url-pattern>
     <http-method>GET</http-method>
     <http-method>POST</http-method>
    </web-resource-collection>

    <auth-constraint>
     <role-name>CONTRACTOR</role-name>
    </auth-constraint>

    <user-data-constraint>
     <transport-guarantee>CONFIDENTIAL</transport-guarantee>
    </user-data-constraint>

</security-constraint>

<security-constraint>

    <web-resource-collection>
     <web-resource-name>retail</web-resource-name>
     <url-pattern>/acme/retail/*</url-pattern>
     <http-method>GET</http-method>
     <http-method>POST</http-method>
    </web-resource-collection>

    <auth-constraint>
     <role-name>CONTRACTOR</role-name>
     <role-name>HOMEOWNER</role-name>
    </auth-constraint>

</security-constraint>
```

The translation of this hypothetical deployment descriptor would yield the constraints defined in TABLE 13-1.

TABLE 13-1 Security Constraint Table

url-pattern	http-method	permitted roles	supported connection types
`/*`	`all methods except GET, POST`	access precluded	not constrained
`/acme/wholesale/*`	`all methods except GET, POST`	access precluded	not constrained
`/acme/wholesale/*`	`GET`	CONTRACTOR SALESCLERK	not constrained
`/acme/wholesale/*`	`POST`	CONTRACTOR	CONFIDENTIAL
`/acme/retail/*`	`all methods except GET, POST`	access precluded	not constrained
`/acme/retail/*`	`GET`	CONTRACTOR HOMEOWNER	not constrained
`/acme/retail/*`	`POST`	CONTRACTOR HOMEOWNER	not constrained

13.8.3 Processing Requests

When a Servlet container receives a request, it shall use the algorithm described in "Use of URL Paths" on page 95 to select the constraints (if any) defined on the `url-pattern` that is the best match to the request URI. If no constraints are selected, the container shall accept the request. Otherwise the container shall determine if the HTTP method of the request is constrained at the selected pattern. If it is not, the request shall be accepted. Otherwise, the request must satisfy the constraints that apply to the HTTP method at the `url-pattern`. Both of the following rules must be satisfied for the request to be accepted and dispatched to the associated servlet.

1. The characteristics of the connection on which the request was received must satisfy at least one of the supported connection types defined by the constraints. If this rule is not satisfied, the container shall reject the request and redirect it to the HTTPS port.[3]
2. The authentication characteristics of the request must satisfy any authentication and role requirements defined by the constraints. If this rule is not satisfied because access has been precluded (by an authorization constraint naming no roles), the request shall be rejected as forbidden and a 403 (SC_FORBIDDEN) status code shall be returned to the user. If access is restricted to permitted roles and the request has not been authenticated, the request shall be rejected as unauthorized and a 401 (SC_UNAUTHORIZED) status code shall be returned to cause authentication. If access is restricted to permitted roles and the authentication identity of the request is not a member of any of these roles, the request shall be rejected as forbidden and a 403 (SC_FORBIDDEN) status code shall be returned to the user.

13.9 Default Policies

By default, authentication is not needed to access resources. Authentication is required when the security constraints (if any) that contain the `url-pattern` that is the best match for the request URI combine to impose an `auth-constraint` (naming roles) on the HTTP method of the request. Similarly, a protected transport is not required unless the security constraints that apply to the request combine to impose a `user-data-constraint` (with a protected `transport-guarantee`) on the HTTP method of the request.

13.10 Login and Logout

The container establishes the caller identity of a request prior to dispatching the request to the servlet engine. The caller identity remains unchanged throughout the processing of the request or until the application sucessfully calls `login` or `logout` on the request. For asynchronous requests, the caller identity established at the initial dispatch remains unchanged until the processing of the overall request completes, or the application successfully calls `login` or `logout` on the request.

3. As an optimization, a container should reject the request as forbidden and return a 403 (SC_FORBIDDEN) status code if it knows that access will ultimately be precluded (by an authorization constraint naming no roles).

Being logged into an application during the processing of a request, corresponds precisely to there being a valid non-null caller identity associated with the request as may be determined by calling `getRemoteUser` or `getUserPrincipal` on the request. A `null` return value from either of these methods indicates that the caller is not logged into the application with respect to the processing of the request.

Containers may create HTTP Session objects to track login state. If a developer creates a session while a user is not authenticated, and the container then authenticates the user, the session visible to developer code after login must be the same session object that was created prior to login occurring so that there is no loss of session information.

CHAPTER **14**

Deployment Descriptor

This chapter specifies the Java™ Servlet Specification version 3.0 requirements for Web container support of deployment descriptors. The deployment descriptor conveys the elements and configuration information of a Web application between Application Developers, Application Assemblers, and Deployers.

For Java Servlets v.2.4 and greater, the deployment descriptor is defined in terms of an XML schema document.

For backwards compatibility of applications written to the 2.2 version of the API, Web containers are also required to support the 2.2 version of the deployment descriptor. For backwards compatibility of applications written to the 2.3 version of the API, Web containers are also required to support the 2.3 version of the deployment descriptor. The 2.2 and 2.3 versions are defined in the appendices.

14.1 Deployment Descriptor Elements

The following types of configuration and deployment information are required to be supported in the Web application deployment descriptor for all servlet containers:

- `ServletContext` Init Parameters
- Session Configuration
- Servlet Declaration
- Servlet Mappings
- Application Lifecyle Listener classes
- Filter Definitions and Filter Mappings
- MIME Type Mappings
- Welcome File list
- Error Pages
- Locale and Encoding Mappings
- Security configuration, including login-config, security-constraint, security-role, security-role-ref and run-as

14.2 Rules for Processing the Deployment Descriptor

This section lists some general rules that Web containers and developers must note concerning the processing of the deployment descriptor for a Web application.

- Web containers must remove all leading and trailing whitespace, which is defined as "S(white space)" in XML 1.0 (`http://www.w3.org/TR/2000/WD-xml-2e-20000814`), for the element content of the text nodes of a deployment descriptor.
- The deployment descriptor must be valid against the schema. Web containers and tools that manipulate Web applications have a wide range of options for checking the validity of a WAR. This includes checking the validity of the deployment descriptor document held within.

  Additionally, it is recommended that Web containers and tools that manipulate Web applications provide a level of semantic checking. For example, it should be checked that a role referenced in a security constraint has the same name as one of the security roles defined in the deployment descriptor.

  In cases of non-conformant Web applications, tools and containers should inform the developer with descriptive error messages. High-end application server vendors are encouraged to supply this kind of validity checking in the form of a tool separate from the container.
- The sub elements under `web-app` can be in an arbitrary order in this version of the specification. Because of the restriction of XML Schema, The multiplicity of the elements `distributable`, `session-config`, `welcome-file-list`, `jsp-config`, `login-config`, and `locale-encoding-mapping-list` was changed from "optional" to "0 or more". The containers must inform the developer with a descriptive error message when the deployment descriptor contains more than one element of `session-config`, `jsp-config`, and `login-config`. The container must concatenate the items in `welcome-file-list` and `locale-encoding-mapping-list` when there are multiple occurrences. The multiple occurrence of `distributable` must be treated exactly in the same way as the single occurrence of `distributable`.
- URI paths specified in the deployment descriptor are assumed to be in URL-decoded form. The containers must inform the developer with a descriptive error message when URL contains `CR(#xD)` or `LF(#xA)`. The containers must preserve all other characters including whitespace in URL.
- Containers must attempt to canonicalize paths in the deployment descriptor. For example, paths of the form `/a/../b` must be interpreted as `/b`. Paths beginning or resolving to paths that begin with `../` are not valid paths in the deployment descriptor.

- URI paths referring to a resource relative to the root of the WAR, or a path mapping relative to the root of the WAR, unless otherwise specified, should begin with a leading `/`.
- In elements whose value is an enumerated type, the value is case sensitive.

14.3 Deployment Descriptor

CODE EXAMPLE 14-1 The Deployment Descriptor

```
<?xml version="1.0" encoding="UTF-8"?>
<xsd:schema xmlns="http://www.w3.org/2001/XMLSchema"
        targetNamespace="http://java.sun.com/xml/ns/javaee"
        xmlns:javaee="http://java.sun.com/xml/ns/javaee"
        xmlns:xsd="http://www.w3.org/2001/XMLSchema"
        elementFormDefault="qualified"
        attributeFormDefault="unqualified"
        version="2.5">
  <xsd:annotation>
    <xsd:documentation>
      @(#)web-app_2_5.xsds1.62 05/08/06
    </xsd:documentation>
  </xsd:annotation>

  <xsd:annotation>
    <xsd:documentation>
      <![CDATA[

    This is the XML Schema for the Servlet 2.5 deployment descriptor.
    The deployment descriptor must be named "WEB-INF/web.xml" in the
    web application's war file.  All Servlet deployment descriptors
    must indicate the web application schema by using the Java EE
    namespace:

    http://java.sun.com/xml/ns/javaee

    and by indicating the version of the schema by
    using the version element as shown below:

        <web-app xmlns="http://java.sun.com/xml/ns/javaee"
          xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
          xsi:schemaLocation="..."
          version="2.5">
          ...
        </web-app>

    The instance documents may indicate the published version of
    the schema using the xsi:schemaLocation attribute for Java EE
    namespace with the following location:

    http://java.sun.com/xml/ns/javaee/web-app_2_5.xsd
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
    ]]>
    </xsd:documentation>
  </xsd:annotation>

  <xsd:annotation>
    <xsd:documentation>

      The following conventions apply to all Java EE
      deployment descriptor elements unless indicated otherwise.

      - In elements that specify a pathname to a file within the
    same JAR file, relative filenames (i.e., those not
    starting with "/") are considered relative to the root of
    the JAR file's namespace.  Absolute filenames (i.e., those
    starting with "/") also specify names in the root of the
    JAR file's namespace.  In general, relative names are
    preferred.  The exception is .war files where absolute
    names are preferred for consistency with the Servlet API.

    </xsd:documentation>
  </xsd:annotation>

  <xsd:include schemaLocation="javaee_5.xsd"/>
  <xsd:include schemaLocation="jsp_2_1.xsd"/>


<!-- **************************************************** -->


  <xsd:element name="web-app" type="javaee:web-appType">
    <xsd:annotation>
      <xsd:documentation>

    The web-app element is the root of the deployment
    descriptor for a web application.  Note that the sub-elements
    of this element can be in the arbitrary order. Because of
    that, the multiplicity of the elements of distributable,
    session-config, welcome-file-list, jsp-config, login-config,
    and locale-encoding-mapping-list was changed from "?" to "*"
    in this schema.  However, the deployment descriptor instance
    file must not contain multiple elements of session-config,
    jsp-config, and login-config. When there are multiple elements of
    welcome-file-list or locale-encoding-mapping-list, the container
    must concatenate the element contents.  The multiple occurence
    of the element distributable is redundant and the container
    treats that case exactly in the same way when there is only
    one distributable.
```

```
      </xsd:documentation>
    </xsd:annotation>

    <xsd:unique name="web-app-servlet-name-uniqueness">
      <xsd:annotation>
    <xsd:documentation>

      The servlet element contains the name of a servlet.
      The name must be unique within the web application.

    </xsd:documentation>
      </xsd:annotation>
      <xsd:selector xpath="javaee:servlet"/>
      <xsd:field    xpath="javaee:servlet-name"/>
    </xsd:unique>

    <xsd:unique name="web-app-filter-name-uniqueness">
      <xsd:annotation>
    <xsd:documentation>

      The filter element contains the name of a filter.
      The name must be unique within the web application.

    </xsd:documentation>
      </xsd:annotation>
      <xsd:selector xpath="javaee:filter"/>
      <xsd:field    xpath="javaee:filter-name"/>
    </xsd:unique>

    <xsd:unique name="web-app-ejb-local-ref-name-uniqueness">
      <xsd:annotation>
    <xsd:documentation>

      The ejb-local-ref-name element contains the name of an EJB
      reference. The EJB reference is an entry in the web
      application's environment and is relative to the
      java:comp/env context.  The name must be unique within
      the web application.

      It is recommended that name is prefixed with "ejb/".

    </xsd:documentation>
      </xsd:annotation>
      <xsd:selector xpath="javaee:ejb-local-ref"/>
      <xsd:field    xpath="javaee:ejb-ref-name"/>
    </xsd:unique>
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
    <xsd:unique name="web-app-ejb-ref-name-uniqueness">
      <xsd:annotation>
    <xsd:documentation>

      The ejb-ref-name element contains the name of an EJB
      reference. The EJB reference is an entry in the web
      application's environment and is relative to the
      java:comp/env context.  The name must be unique within
      the web application.

      It is recommended that name is prefixed with "ejb/".

    </xsd:documentation>
      </xsd:annotation>
      <xsd:selector xpath="javaee:ejb-ref"/>
      <xsd:field    xpath="javaee:ejb-ref-name"/>
    </xsd:unique>

    <xsd:unique name="web-app-resource-env-ref-uniqueness">
      <xsd:annotation>
    <xsd:documentation>

      The resource-env-ref-name element specifies the name of
      a resource environment reference; its value is the
      environment entry name used in the web application code.
      The name is a JNDI name relative to the java:comp/env
      context and must be unique within a web application.

    </xsd:documentation>
      </xsd:annotation>
      <xsd:selector xpath="javaee:resource-env-ref"/>
      <xsd:field    xpath="javaee:resource-env-ref-name"/>
    </xsd:unique>

    <xsd:unique name="web-app-message-destination-ref-uniqueness">
      <xsd:annotation>
    <xsd:documentation>

      The message-destination-ref-name element specifies the name of
      a message destination reference; its value is the
      environment entry name used in the web application code.
      The name is a JNDI name relative to the java:comp/env
      context and must be unique within a web application.

    </xsd:documentation>
      </xsd:annotation>
      <xsd:selector xpath="javaee:message-destination-ref"/>
      <xsd:field    xpath="javaee:message-destination-ref-name"/>
    </xsd:unique>

    <xsd:unique name="web-app-res-ref-name-uniqueness">
      <xsd:annotation>
    <xsd:documentation>

      The res-ref-name element specifies the name of a
      resource manager connection factory reference.  The name
      is a JNDI name relative to the java:comp/env context.
      The name must be unique within a web application.

    </xsd:documentation>
      </xsd:annotation>
      <xsd:selector xpath="javaee:resource-ref"/>
      <xsd:field    xpath="javaee:res-ref-name"/>
    </xsd:unique>

    <xsd:unique name="web-app-env-entry-name-uniqueness">
      <xsd:annotation>
    <xsd:documentation>

      The env-entry-name element contains the name of a web
      application's environment entry.  The name is a JNDI
      name relative to the java:comp/env context.  The name
      must be unique within a web application.

    </xsd:documentation>
      </xsd:annotation>

      <xsd:selector xpath="javaee:env-entry"/>
      <xsd:field    xpath="javaee:env-entry-name"/>
    </xsd:unique>

    <xsd:key name="web-app-role-name-key">
      <xsd:annotation>
    <xsd:documentation>

      A role-name-key is specified to allow the references
      from the security-role-refs.

    </xsd:documentation>
      </xsd:annotation>
      <xsd:selector xpath="javaee:security-role"/>
      <xsd:field    xpath="javaee:role-name"/>
    </xsd:key>
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
    <xsd:keyref name="web-app-role-name-references"
    refer="javaee:web-app-role-name-key">
      <xsd:annotation>
    <xsd:documentation>

      The keyref indicates the references from
      security-role-ref to a specified role-name.

    </xsd:documentation>
      </xsd:annotation>
      <xsd:selector xpath="javaee:servlet/javaee:security-role-ref"/>
      <xsd:field    xpath="javaee:role-link"/>
    </xsd:keyref>
  </xsd:element>


<!-- **************************************************** -->

  <xsd:complexType name="auth-constraintType">
    <xsd:annotation>
      <xsd:documentation>

    The auth-constraintType indicates the user roles that
    should be permitted access to this resource
    collection. The role-name used here must either correspond
    to the role-name of one of the security-role elements
    defined for this web application, or be the specially
    reserved role-name "*" that is a compact syntax for
    indicating all roles in the web application. If both "*"
    and rolenames appear, the container interprets this as all
    roles.  If no roles are defined, no user is allowed access
    to the portion of the web application described by the
    containing security-constraint.  The container matches
    role names case sensitively when determining access.

      </xsd:documentation>
    </xsd:annotation>

    <xsd:sequence>
      <xsd:element name="description"
       type="javaee:descriptionType"
       minOccurs="0" maxOccurs="unbounded"/>
      <xsd:element name="role-name"
       type="javaee:role-nameType"
       minOccurs="0" maxOccurs="unbounded"/>
    </xsd:sequence>
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
    <xsd:attribute name="id" type="xsd:ID"/>
  </xsd:complexType>

<!-- **************************************************** -->

  <xsd:complexType name="auth-methodType">
    <xsd:annotation>
      <xsd:documentation>

    The auth-methodType is used to configure the authentication
    mechanism for the web application. As a prerequisite to
    gaining access to any web resources which are protected by
    an authorization constraint, a user must have authenticated
    using the configured mechanism. Legal values are "BASIC",
    "DIGEST", "FORM", "CLIENT-CERT", or a vendor-specific
    authentication scheme.

    Used in: login-config

      </xsd:documentation>
    </xsd:annotation>

    <xsd:simpleContent>
      <xsd:restriction base="javaee:string"/>
    </xsd:simpleContent>
  </xsd:complexType>

<!-- **************************************************** -->

  <xsd:complexType name="dispatcherType">
    <xsd:annotation>
      <xsd:documentation>

    The dispatcher has four legal values: FORWARD, REQUEST, INCLUDE,
    and ERROR. A value of FORWARD means the Filter will be applied
    under RequestDispatcher.forward() calls.  A value of REQUEST
    means the Filter will be applied under ordinary client calls to
    the path or servlet. A value of INCLUDE means the Filter will be
    applied under RequestDispatcher.include() calls.  A value of
    ERROR means the Filter will be applied under the error page
    mechanism.  The absence of any dispatcher elements in a
    filter-mapping indicates a default of applying filters only under
    ordinary client calls to the path or servlet.

      </xsd:documentation>
    </xsd:annotation>
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
    <xsd:simpleContent>
      <xsd:restriction base="javaee:string">
    <xsd:enumeration value="FORWARD"/>
    <xsd:enumeration value="INCLUDE"/>
    <xsd:enumeration value="REQUEST"/>
    <xsd:enumeration value="ERROR"/>
      </xsd:restriction>
    </xsd:simpleContent>
  </xsd:complexType>

<!-- **************************************************** -->

  <xsd:simpleType name="encodingType">
    <xsd:annotation>
      <xsd:documentation>

    The encodingType defines IANA character sets.

      </xsd:documentation>
    </xsd:annotation>

    <xsd:restriction base="xsd:string">
      <xsd:pattern value="[^\s]+"/>
    </xsd:restriction>
  </xsd:simpleType>

<!-- **************************************************** -->

  <xsd:complexType name="error-codeType">
    <xsd:annotation>
      <xsd:documentation>

    The error-code contains an HTTP error code, ex: 404

    Used in: error-page

      </xsd:documentation>
    </xsd:annotation>

    <xsd:simpleContent>
      <xsd:restriction base="javaee:xsdPositiveIntegerType">
    <xsd:pattern value="\d{3}"/>
    <xsd:attribute name="id" type="xsd:ID"/>
      </xsd:restriction>
    </xsd:simpleContent>
  </xsd:complexType>
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
<!-- **************************************************** -->

  <xsd:complexType name="error-pageType">
    <xsd:annotation>
      <xsd:documentation>

    The error-pageType contains a mapping between an error code
    or exception type to the path of a resource in the web
    application.

    Used in: web-app

      </xsd:documentation>
    </xsd:annotation>

    <xsd:sequence>
      <xsd:choice>
    <xsd:element name="error-code"
         type="javaee:error-codeType"/>

    <xsd:element name="exception-type"
         type="javaee:fully-qualified-classType">
      <xsd:annotation>
        <xsd:documentation>

          The exception-type contains a fully qualified class
          name of a Java exception type.

        </xsd:documentation>
      </xsd:annotation>
    </xsd:element>
      </xsd:choice>

      <xsd:element name="location"
       type="javaee:war-pathType">
    <xsd:annotation>
      <xsd:documentation>

        The location element contains the location of the
        resource in the web application relative to the root of
        the web application. The value of the location must have
        a leading `/'.

      </xsd:documentation>
    </xsd:annotation>
      </xsd:element>
    </xsd:sequence>
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
    <xsd:attribute name="id" type="xsd:ID"/>
  </xsd:complexType>

<!-- **************************************************** -->

  <xsd:complexType name="filter-mappingType">
    <xsd:annotation>
      <xsd:documentation>

    Declaration of the filter mappings in this web
    application is done by using filter-mappingType.
    The container uses the filter-mapping
    declarations to decide which filters to apply to a request,
    and in what order. The container matches the request URI to
    a Servlet in the normal way. To determine which filters to
    apply it matches filter-mapping declarations either on
    servlet-name, or on url-pattern for each filter-mapping
    element, depending on which style is used. The order in
    which filters are invoked is the order in which
    filter-mapping declarations that match a request URI for a
    servlet appear in the list of filter-mapping elements.The
    filter-name value must be the value of the filter-name
    sub-elements of one of the filter declarations in the
    deployment descriptor.

      </xsd:documentation>
    </xsd:annotation>

    <xsd:sequence>
      <xsd:element name="filter-name"
       type="javaee:filter-nameType"/>
      <xsd:choice minOccurs="1" maxOccurs="unbounded">
    <xsd:element name="url-pattern"
         type="javaee:url-patternType"/>
    <xsd:element name="servlet-name"
         type="javaee:servlet-nameType"/>
      </xsd:choice>
      <xsd:element name="dispatcher"
       type="javaee:dispatcherType"
       minOccurs="0" maxOccurs="4"/>
    </xsd:sequence>
    <xsd:attribute name="id" type="xsd:ID"/>
  </xsd:complexType>

<!-- **************************************************** -->

  <xsd:complexType name="filter-nameType">
```

```
     <xsd:annotation>
       <xsd:documentation>

    The logical name of the filter is declare
    by using filter-nameType. This name is used to map the
    filter.  Each filter name is unique within the web
    application.

    Used in: filter, filter-mapping

       </xsd:documentation>
     </xsd:annotation>

     <xsd:simpleContent>
       <xsd:extension base="javaee:nonEmptyStringType"/>
     </xsd:simpleContent>
   </xsd:complexType>

<!-- **************************************************** -->

   <xsd:complexType name="filterType">
     <xsd:annotation>
       <xsd:documentation>

    The filterType is used to declare a filter in the web
    application. The filter is mapped to either a servlet or a
    URL pattern in the filter-mapping element, using the
    filter-name value to reference. Filters can access the
    initialization parameters declared in the deployment
    descriptor at runtime via the FilterConfig interface.

    Used in: web-app

       </xsd:documentation>
     </xsd:annotation>

     <xsd:sequence>
       <xsd:group ref="javaee:descriptionGroup"/>
       <xsd:element name="filter-name"
        type="javaee:filter-nameType"/>
       <xsd:element name="filter-class"
        type="javaee:fully-qualified-classType">
    <xsd:annotation>
      <xsd:documentation>

        The fully qualified classname of the filter.
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
      </xsd:documentation>
    </xsd:annotation>
      </xsd:element>

      <xsd:element name="init-param"
       type="javaee:param-valueType"
       minOccurs="0" maxOccurs="unbounded">
    <xsd:annotation>
      <xsd:documentation>

        The init-param element contains a name/value pair as
        an initialization param of a servlet filter

      </xsd:documentation>
    </xsd:annotation>
      </xsd:element>
    </xsd:sequence>
    <xsd:attribute name="id" type="xsd:ID"/>
  </xsd:complexType>

<!-- **************************************************** -->

  <xsd:complexType name="form-login-configType">
    <xsd:annotation>
      <xsd:documentation>

    The form-login-configType specifies the login and error
    pages that should be used in form based login. If form based
    authentication is not used, these elements are ignored.

    Used in: login-config

      </xsd:documentation>
    </xsd:annotation>

    <xsd:sequence>

      <xsd:element name="form-login-page"
       type="javaee:war-pathType">
    <xsd:annotation>
      <xsd:documentation>

        The form-login-page element defines the location in the web
        app where the page that can be used for login can be
        found.  The path begins with a leading / and is interpreted
        relative to the root of the WAR.
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
      </xsd:documentation>
    </xsd:annotation>
      </xsd:element>

      <xsd:element name="form-error-page"
       type="javaee:war-pathType">
    <xsd:annotation>
      <xsd:documentation>

        The form-error-page element defines the location in
        the web app where the error page that is displayed
        when login is not successful can be found.
        The path begins with a leading / and is interpreted
        relative to the root of the WAR.

      </xsd:documentation>
    </xsd:annotation>
      </xsd:element>

    </xsd:sequence>
    <xsd:attribute name="id" type="xsd:ID"/>
  </xsd:complexType>

<!-- **************************************************** -->

  <xsd:simpleType name=”http-methodType”>
    <xsd:annotation>
      <xsd:documentation>
    A HTTP method type as defined in HTTP 1.1 section 2.2.
      </xsd:documentation>
    </xsd:annotation>
     <xsd:restriction base=”xsd:token”>
     <xsd:pattern value="[&#33;-&#126;-[\(\
)&#60;&#62;@,;:&#34;/                         \[\]?=\{\}\\\p{Z}]]+"/>
     </xsd:restriction>

  </xsd:simpleType>

<!-- **************************************************** -->

  <xsd:simpleType name="load-on-startupType">
    <xsd:union memberTypes="javaee:null-charType xsd:integer"/>
  </xsd:simpleType>

<!-- **************************************************** -->

  <xsd:complexType name="locale-encoding-mapping-listType">
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
    <xsd:annotation>
      <xsd:documentation>

    The locale-encoding-mapping-list contains one or more
    locale-encoding-mapping(s).

      </xsd:documentation>
    </xsd:annotation>

    <xsd:sequence>
      <xsd:element name="locale-encoding-mapping"
       type="javaee:locale-encoding-mappingType"
       maxOccurs="unbounded"/>
    </xsd:sequence>
    <xsd:attribute name="id" type="xsd:ID"/>
  </xsd:complexType>

<!-- **************************************************** -->

  <xsd:complexType name="locale-encoding-mappingType">
    <xsd:annotation>
      <xsd:documentation>

    The locale-encoding-mapping contains locale name and
    encoding name. The locale name must be either "Language-code",
    such as "ja", defined by ISO-639 or "Language-code_Country-code",
    such as "ja_JP".  "Country code" is defined by ISO-3166.

      </xsd:documentation>
    </xsd:annotation>

    <xsd:sequence>
      <xsd:element name="locale"
       type="javaee:localeType"/>
      <xsd:element name="encoding"
       type="javaee:encodingType"/>
    </xsd:sequence>
    <xsd:attribute name="id" type="xsd:ID"/>
  </xsd:complexType>

<!-- **************************************************** -->

  <xsd:simpleType name="localeType">
    <xsd:annotation>
      <xsd:documentation>

    The localeType defines valid locale defined by ISO-639-1
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
    and ISO-3166.

      </xsd:documentation>
    </xsd:annotation>

    <xsd:restriction base="xsd:string">
      <xsd:pattern value="[a-z]{2}(_|-)?([\p{L}\-\p{Nd}]{2})?"/>
    </xsd:restriction>
  </xsd:simpleType>

<!-- **************************************************** -->

  <xsd:complexType name="login-configType">
    <xsd:annotation>
      <xsd:documentation>

    The login-configType is used to configure the authentication
    method that should be used, the realm name that should be
    used for this application, and the attributes that are
    needed by the form login mechanism.

    Used in: web-app

      </xsd:documentation>
    </xsd:annotation>

    <xsd:sequence>
      <xsd:element name="auth-method"
       type="javaee:auth-methodType"
       minOccurs="0"/>
      <xsd:element name="realm-name"
       type="javaee:string" minOccurs="0">
    <xsd:annotation>
      <xsd:documentation>

        The realm name element specifies the realm name to
        use in HTTP Basic authorization.

      </xsd:documentation>
    </xsd:annotation>
      </xsd:element>
      <xsd:element name="form-login-config"
       type="javaee:form-login-configType"
       minOccurs="0"/>
    </xsd:sequence>
    <xsd:attribute name="id" type="xsd:ID"/>
  </xsd:complexType>
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
<!-- ************************************************** -->

  <xsd:complexType name="mime-mappingType">
    <xsd:annotation>
      <xsd:documentation>

    The mime-mappingType defines a mapping between an extension
    and a mime type.

    Used in: web-app

      </xsd:documentation>
    </xsd:annotation>

    <xsd:sequence>
      <xsd:annotation>
    <xsd:documentation>

      The extension element contains a string describing an
      extension. example: "txt"

    </xsd:documentation>
      </xsd:annotation>

      <xsd:element name="extension"
       type="javaee:string"/>
      <xsd:element name="mime-type"
       type="javaee:mime-typeType"/>
    </xsd:sequence>
    <xsd:attribute name="id" type="xsd:ID"/>
  </xsd:complexType>

<!-- ************************************************** -->

  <xsd:complexType name="mime-typeType">
    <xsd:annotation>
      <xsd:documentation>

    The mime-typeType is used to indicate a defined mime type.

    Example:
    "text/plain"

    Used in: mime-mapping

      </xsd:documentation>
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
    </xsd:annotation>

    <xsd:simpleContent>
      <xsd:restriction base="javaee:string">
    <xsd:pattern value="[^\p{Cc}^\s]+/[^\p{Cc}^\s]+"/>
      </xsd:restriction>
    </xsd:simpleContent>
  </xsd:complexType>

<!-- **************************************************** -->

  <xsd:complexType name="nonEmptyStringType">
    <xsd:annotation>
      <xsd:documentation>
    This type defines a string which contains at least one
    character.
      </xsd:documentation>
    </xsd:annotation>
    <xsd:simpleContent>
      <xsd:restriction base="javaee:string">
    <xsd:minLength value="1"/>
      </xsd:restriction>
    </xsd:simpleContent>
  </xsd:complexType>

<!-- **************************************************** -->

  <xsd:simpleType name="null-charType">
    <xsd:restriction base="xsd:string">
      <xsd:enumeration value=""/>
    </xsd:restriction>
  </xsd:simpleType>

<!-- **************************************************** -->

  <xsd:complexType name="security-constraintType">
    <xsd:annotation>
      <xsd:documentation>

    The security-constraintType is used to associate
    security constraints with one or more web resource
    collections

    Used in: web-app

      </xsd:documentation>
    </xsd:annotation>
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
    <xsd:sequence>
      <xsd:element name="display-name"
       type="javaee:display-nameType"
       minOccurs="0"
       maxOccurs="unbounded"/>
      <xsd:element name="web-resource-collection"
       type="javaee:web-resource-collectionType"
       maxOccurs="unbounded"/>
      <xsd:element name="auth-constraint"
       type="javaee:auth-constraintType"
       minOccurs="0"/>
      <xsd:element name="user-data-constraint"
       type="javaee:user-data-constraintType"
       minOccurs="0"/>
    </xsd:sequence>
    <xsd:attribute name="id" type="xsd:ID"/>
  </xsd:complexType>

<!-- **************************************************** -->

  <xsd:complexType name="servlet-mappingType">
    <xsd:annotation>
      <xsd:documentation>

    The servlet-mappingType defines a mapping between a
    servlet and a url pattern.

    Used in: web-app

      </xsd:documentation>
    </xsd:annotation>

    <xsd:sequence>
      <xsd:element name="servlet-name"
       type="javaee:servlet-nameType"/>
      <xsd:element name="url-pattern"
       type="javaee:url-patternType"
           minOccurs="1" maxOccurs="unbounded"/>
    </xsd:sequence>
    <xsd:attribute name="id" type="xsd:ID"/>
  </xsd:complexType>

<!-- **************************************************** -->

  <xsd:complexType name="servlet-nameType">
    <xsd:annotation>
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
      <xsd:documentation>

    The servlet-name element contains the canonical name of the
    servlet. Each servlet name is unique within the web
    application.

      </xsd:documentation>
    </xsd:annotation>

    <xsd:simpleContent>
      <xsd:extension base="javaee:nonEmptyStringType"/>
    </xsd:simpleContent>
  </xsd:complexType>

<!-- **************************************************** -->

  <xsd:complexType name="servletType">
    <xsd:annotation>
      <xsd:documentation>

    The servletType is used to declare a servlet.
    It contains the declarative data of a
    servlet. If a jsp-file is specified and the load-on-startup
    element is present, then the JSP should be precompiled and
    loaded.

    Used in: web-app

      </xsd:documentation>
    </xsd:annotation>

    <xsd:sequence>
      <xsd:group ref="javaee:descriptionGroup"/>
      <xsd:element name="servlet-name"
       type="javaee:servlet-nameType"/>
      <xsd:choice>
    <xsd:element name="servlet-class"
         type="javaee:fully-qualified-classType">
      <xsd:annotation>
        <xsd:documentation>

          The servlet-class element contains the fully
          qualified class name of the servlet.

        </xsd:documentation>
      </xsd:annotation>
    </xsd:element>
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
    <xsd:element name="jsp-file"
         type="javaee:jsp-fileType"/>

      </xsd:choice>

      <xsd:element name="init-param"
       type="javaee:param-valueType"
       minOccurs="0" maxOccurs="unbounded"/>
      <xsd:element name="load-on-startup"
       type="javaee:load-on-startupType"
       minOccurs="0">
    <xsd:annotation>
      <xsd:documentation>

        The load-on-startup element indicates that this
        servlet should be loaded (instantiated and have
        its init() called) on the startup of the web
        application. The optional contents of these
        element must be an integer indicating the order in
        which the servlet should be loaded. If the value
        is a negative integer, or the element is not
        present, the container is free to load the servlet
        whenever it chooses. If the value is a positive
        integer or 0, the container must load and
        initialize the servlet as the application is
        deployed. The container must guarantee that
        servlets marked with lower integers are loaded
        before servlets marked with higher integers. The
        container may choose the order of loading of
        servlets with the same load-on-start-up value.

      </xsd:documentation>
    </xsd:annotation>
      </xsd:element>
      <xsd:element name="run-as"
       type="javaee:run-asType"
       minOccurs="0"/>
      <xsd:element name="security-role-ref"
       type="javaee:security-role-refType"
       minOccurs="0" maxOccurs="unbounded"/>
    </xsd:sequence>
    <xsd:attribute name="id" type="xsd:ID"/>
  </xsd:complexType>

<!-- **************************************************** -->
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
  <xsd:complexType name="session-configType">
    <xsd:annotation>
      <xsd:documentation>

    The session-configType defines the session parameters
    for this web application.

    Used in: web-app

      </xsd:documentation>
    </xsd:annotation>

    <xsd:sequence>
      <xsd:element name="session-timeout"
       type="javaee:xsdIntegerType"
       minOccurs="0">
    <xsd:annotation>
      <xsd:documentation>

        The session-timeout element defines the default
        session timeout interval for all sessions created
        in this web application. The specified timeout
        must be expressed in a whole number of minutes.
        If the timeout is 0 or less, the container ensures
        the default behaviour of sessions is never to time
        out. If this element is not specified, the container
        must set its default timeout period.

      </xsd:documentation>
    </xsd:annotation>
      </xsd:element>
    </xsd:sequence>
    <xsd:attribute name="id" type="xsd:ID"/>
  </xsd:complexType>

<!-- **************************************************** -->

  <xsd:complexType name="transport-guaranteeType">
    <xsd:annotation>
      <xsd:documentation>

    The transport-guaranteeType specifies that the communication
    between client and server should be NONE, INTEGRAL, or
    CONFIDENTIAL. NONE means that the application does not
    require any transport guarantees. A value of INTEGRAL means
    that the application requires that the data sent between the
    client and server be sent in such a way that it can't be
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
    changed in transit. CONFIDENTIAL means that the application
    requires that the data be transmitted in a fashion that
    prevents other entities from observing the contents of the
    transmission. In most cases, the presence of the INTEGRAL or
    CONFIDENTIAL flag will indicate that the use of SSL is
    required.

    Used in: user-data-constraint

      </xsd:documentation>
    </xsd:annotation>

    <xsd:simpleContent>
      <xsd:restriction base="javaee:string">
    <xsd:enumeration value="NONE"/>
    <xsd:enumeration value="INTEGRAL"/>
    <xsd:enumeration value="CONFIDENTIAL"/>
      </xsd:restriction>
    </xsd:simpleContent>
  </xsd:complexType>

<!-- **************************************************** -->

  <xsd:complexType name="user-data-constraintType">
    <xsd:annotation>
      <xsd:documentation>

    The user-data-constraintType is used to indicate how
    data communicated between the client and container should be
    protected.

    Used in: security-constraint

      </xsd:documentation>
    </xsd:annotation>

    <xsd:sequence>
      <xsd:element name="description"
       type="javaee:descriptionType"
       minOccurs="0"
       maxOccurs="unbounded"/>
      <xsd:element name="transport-guarantee"
       type="javaee:transport-guaranteeType"/>
    </xsd:sequence>
    <xsd:attribute name="id" type="xsd:ID"/>
  </xsd:complexType>
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
<!-- ***************************************************** -->

  <xsd:complexType name="war-pathType">
    <xsd:annotation>
      <xsd:documentation>

    The elements that use this type designate a path starting
    with a "/" and interpreted relative to the root of a WAR
    file.

      </xsd:documentation>
    </xsd:annotation>
    <xsd:simpleContent>
      <xsd:restriction base="javaee:string">
    <xsd:pattern value="/.*"/>
      </xsd:restriction>
    </xsd:simpleContent>
  </xsd:complexType>

<!-- ***************************************************** -->

  <xsd:simpleType name="web-app-versionType">
    <xsd:annotation>
      <xsd:documentation>

    This type contains the recognized versions of
    web-application supported. It is used to designate the
    version of the web application.

      </xsd:documentation>
    </xsd:annotation>
    <xsd:restriction base="xsd:token">
      <xsd:enumeration value="2.5"/>
    </xsd:restriction>
  </xsd:simpleType>

<!-- ***************************************************** -->

  <xsd:complexType name="web-appType">

    <xsd:choice minOccurs="0" maxOccurs="unbounded">
      <xsd:group ref="javaee:descriptionGroup"/>
      <xsd:element name="distributable"
       type="javaee:emptyType"/>
      <xsd:element name="context-param"
       type="javaee:param-valueType">
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
     <xsd:annotation>
       <xsd:documentation>

         The context-param element contains the declaration
         of a web application's servlet context
         initialization parameters.

       </xsd:documentation>
     </xsd:annotation>
       </xsd:element>

       <xsd:element name="filter"
        type="javaee:filterType"/>
       <xsd:element name="filter-mapping"
        type="javaee:filter-mappingType"/>
       <xsd:element name="listener"
        type="javaee:listenerType"/>
       <xsd:element name="servlet"
        type="javaee:servletType"/>
       <xsd:element name="servlet-mapping"
        type="javaee:servlet-mappingType"/>
       <xsd:element name="session-config"
        type="javaee:session-configType"/>
       <xsd:element name="mime-mapping"
        type="javaee:mime-mappingType"/>
       <xsd:element name="welcome-file-list"
        type="javaee:welcome-file-listType"/>
       <xsd:element name="error-page"
        type="javaee:error-pageType"/>
       <xsd:element name="jsp-config"
        type="javaee:jsp-configType"/>
       <xsd:element name="security-constraint"
        type="javaee:security-constraintType"/>
       <xsd:element name="login-config"
        type="javaee:login-configType"/>
       <xsd:element name="security-role"
        type="javaee:security-roleType"/>
       <xsd:group ref="javaee:jndiEnvironmentRefsGroup"/>
       <xsd:element name="message-destination"
        type="javaee:message-destinationType"/>
       <xsd:element name="locale-encoding-mapping-list"
        type="javaee:locale-encoding-mapping-listType"/>
     </xsd:choice>

     <xsd:attribute name="version"
        type="javaee:web-app-versionType"
        use="required"/>
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
    <xsd:attribute name="id" type="xsd:ID"/>

     xsd:attribute name="metadata-complete" type="xsd:boolean">
      <xsd:annotation>
       <xsd:documentation>

      The metadata-complete attribute defines whether this deployment
      descriptor is complete, or whether the class files
      of the jar file should be examined for annotations
      that specify deployment information.

      If metadata-complete is set to "true", the deployment tool
      must ignore any Servlet annotations present in the
      class files of the application.

      If metadata-complete is not specified or is set to "false", the
      deployment tool must examine the class files of the
      application for annotations, as specified by the Servlet
      specifications.

       </xsd:documentation>
      </xsd:annotation>
    </xsd:attribute>

  </xsd:complexType>

<!-- **************************************************** -->

  <xsd:complexType name="web-resource-collectionType">
    <xsd:annotation>
      <xsd:documentation>

    The web-resource-collectionType is used to identify a subset
    of the resources and HTTP methods on those resources within
    a web application to which a security constraint applies. If
    no HTTP methods are specified, then the security constraint
    applies to all HTTP methods.

    Used in: security-constraint

      </xsd:documentation>
    </xsd:annotation>

    <xsd:sequence>
      <xsd:element name="web-resource-name"
       type="javaee:string">
    <xsd:annotation>
```

CODE EXAMPLE 14-1 The Deployment Descriptor

```
      <xsd:documentation>

        The web-resource-name contains the name of this web
        resource collection.

      </xsd:documentation>
    </xsd:annotation>
      </xsd:element>
      <xsd:element name="description"
       type="javaee:descriptionType"
       minOccurs="0"
       maxOccurs="unbounded"/>
      <xsd:element name="url-pattern"
       type="javaee:url-patternType"
       maxOccurs="unbounded"/>
      <xsd:element name="http-method"
       type="javaee:http-methodType"
       minOccurs="0" maxOccurs="unbounded"/>
    </xsd:sequence>
    <xsd:attribute name="id" type="xsd:ID"/>
  </xsd:complexType>

<!-- **************************************************** -->

  <xsd:complexType name="welcome-file-listType">
    <xsd:annotation>
      <xsd:documentation>

    The welcome-file-list contains an ordered list of welcome
    files elements.

    Used in: web-app

      </xsd:documentation>
    </xsd:annotation>

    <xsd:sequence>
      <xsd:element name="welcome-file"
       type="xsd:string"
       maxOccurs="unbounded">
    <xsd:annotation>
      <xsd:documentation>

        The welcome-file element contains file name to use
        as a default welcome file, such as index.html

      </xsd:documentation>
```

CODE EXAMPLE 14-1 The Deployment Descriptor

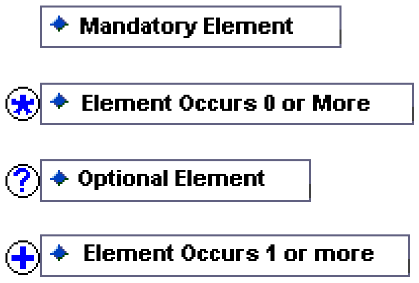
```
     </xsd:annotation>
       </xsd:element>
     </xsd:sequence>
     <xsd:attribute name="id" type="xsd:ID"/>
   </xsd:complexType>

 </xsd:schema>
```

14.4 Deployment Descriptor Diagram

This section illustrates the elements in deployment descriptor. All diagrams follow the convention displayed in FIGURE 14-1. Attributes are not shown in the diagrams. See Deployment Descriptor Schema for the detailed information.

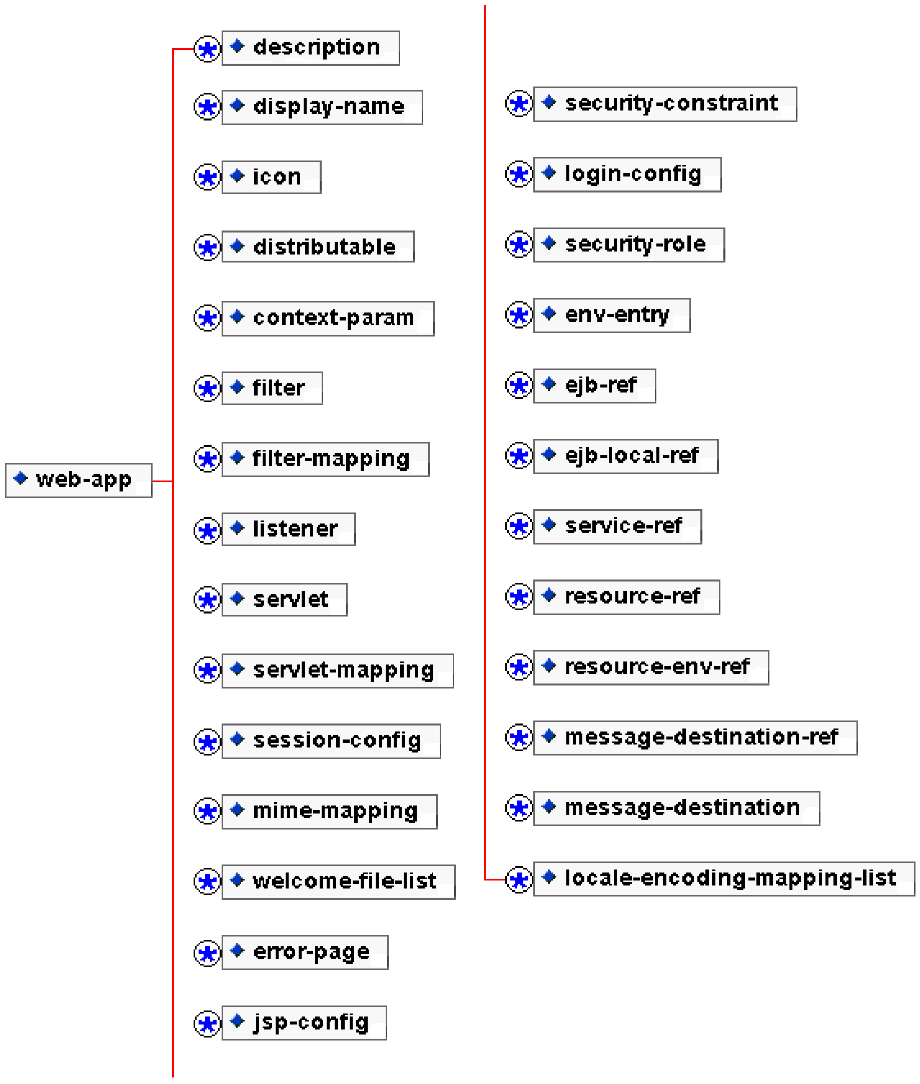
FIGURE 14-1 Convention of the Diagram of Deployment Descriptor Element



1. web-app Element

The web-app element is the root deployment descriptor for a Web application. This element contains the following elements.This element has a required attribute version to specify to which version of the schema the deployment descriptor conforms. All sub elements under this element can be in an arbitrary order.

FIGURE 14-2 web-app Element Structure



2. description Element

The `description` element is to provide a text describing the parent element. This element occurs not only under the `web-app` element but also under other multiple elements. It has an optional attribute `xml:lang` to indicate which language is used in the description. The default value of this attribute is English ("en").

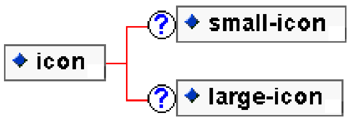
3. display-name Element

   The `display-name` contains a short name that is intended to be displayed by tools. The display name need not to be unique. This element has an optional attribute `xml:lang` to specify the language.

4. icon Element

   The `icon` contains small-icon and large-icon elements that specify the file names for small and large GIF or JPEG icon images used to represent the parent element in a GUI tool.

FIGURE 14-3 icon Element Structure



5. distributable Element

   The `distributable` indicates that this Web application is programmed appropriately to be deployed into a distributed servlet container.

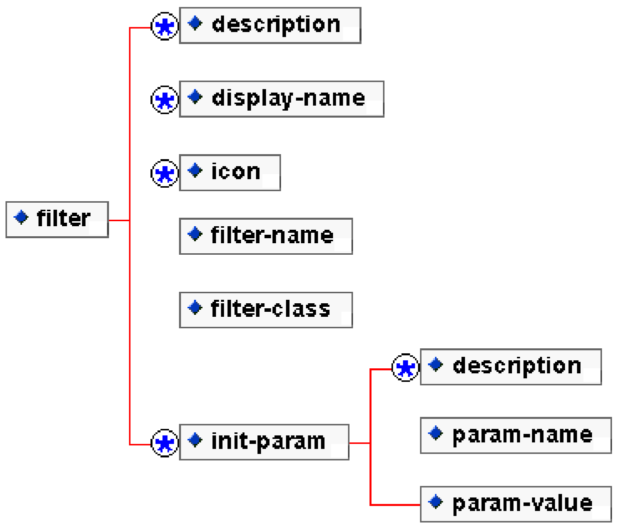
6. context-param Element

   The `context-param` contains the declaration of a Web application's servlet context initialization parameters.

7. filter Element

   The `filter` declares a filter in the Web application. The filter is mapped to either a servlet or a URL pattern in the `filter-mapping` element, using the `filter-name` value to reference. Filters can access the initialization parameters declared in the deployment descriptor at runtime via the FilterConfig interface. The `filter-name` element is the logical name of the filter. It must be unique within the Web application. The element content of `filter-name` element must not be empty. The `filter-class` is the fully qualified class name of the filter. The `init-param` element contains name-value pair as an initialization parameter of this filter.

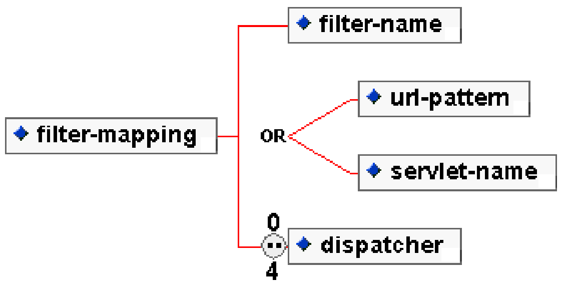
FIGURE 14-4 filter Element Structure



8. filter-mapping Element

The `filter-mapping` is used by the container to decide which filters to apply to a request in what order. The value of the `filter-name` must be one of the filter declarations in the deployment descriptor. The maching request can be specified either `url-pattern` or `servlet-name`.

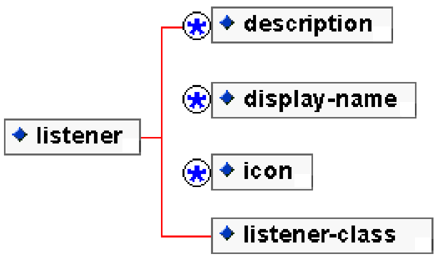
FIGURE 14-5 filter-mapping Element Structure



9. listener Element

The `listener` indicates the deployment properties for an application listener bean. The sub-element `listener-class` declares that a class in the application must be registered as a Web application listener bean. The value is the fully qualified classname of the listener class.

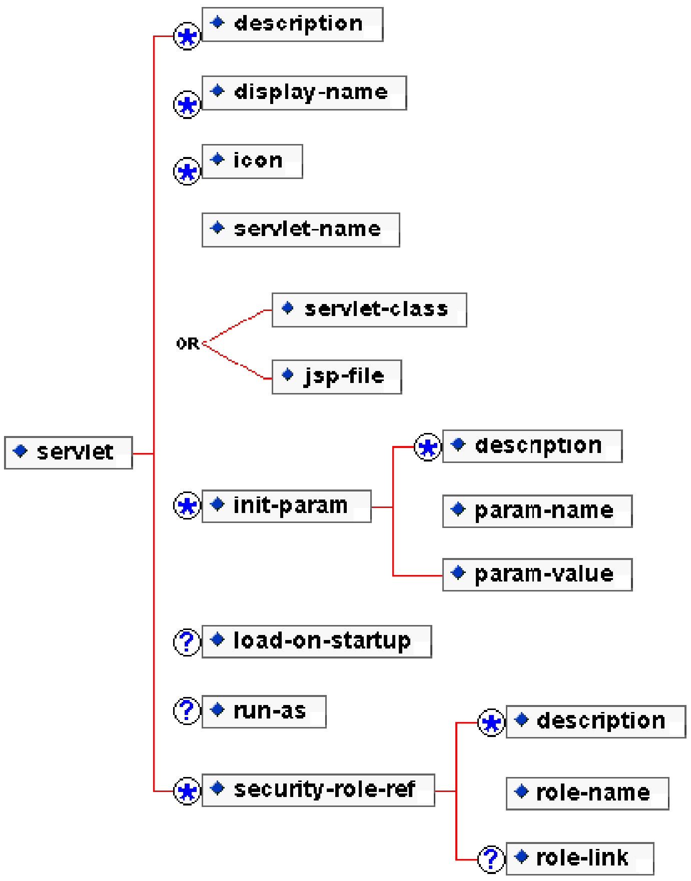
FIGURE 14-6 listener Element Structure



10. servlet Element

The `servlet` is used to declare a servlet. It contains the declarative data of a servlet. The `jsp-file` element contains the full path to a JSP file within the web application beginning with a "/". If a `jsp-file` is specified and the `load-on-startup` element is present, then the JSP should be precompiled and loaded. The `servlet-name` element contains the canonical name of the servlet. Each servlet name is unique within the web application. The element content of `servlet-name` must not be empty. The `servlet-class` contains the fully qualified class name of the servlet. The `run-as` element specifies the identity to be used for the execution of a component. It contains an optional `description`, and the name of a security role specified by the `role-name` element. The element `load-on-startup` indicates that this servlet should be loaded (instantiated and have its init() called) on the startup of the Web application. The element content of this element must be an integer indicating the order in which the servlet should be loaded. If the value is a negative integer, or the element is not present, the container is free to load the servlet whenever it chooses. If the value is a positive integer or 0, the container must load and initialize the servlet as the application is deployed. The container must guarantee that servlets marked with lower integers are loaded before servlets marked with higher integers. The container may choose the order of loading of servlets with the same `load-on-startup` value. The `security-role-ref` element declares the security role reference in a component's or in a deployment component's code. It consists of an optional `description`, the security role name used in the code(`role-name`), and an optional link to a security role(`role-link`). If the security role is not specified, the deployer must choose an appropriate security role.

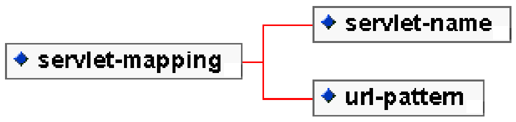
FIGURE 14-7 servlet Element Structure



11. servlet-mapping Element

The `servlet-mapping` defines a mapping between a servlet and a URL pattern.

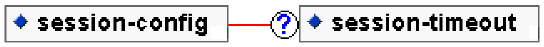
FIGURE 14-8 servlet-mapping Element Structure



12. session-config Element

The `session-config` defines the session parameters for this Web application. The sub-element `session-timeout` defines the default session timeout interval for all sessions created in this Web application. The specified timeout must be expressed in a whole number of minutes. If the timeout is 0 or less, the container ensures the default behaviour of sessions is never to time out. If this element is not specified, the container must set its default timeout period.

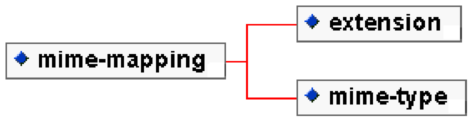
FIGURE 14-9 session-config Element Structure



13. mime-mapping Element

The `mime-mapping` defines a mapping between an extension and a mime type. The `extension` element contains a string describing an extension, such as “txt”.

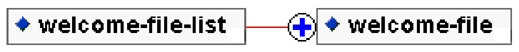
FIGURE 14-10 mime-mapping Element Structure



14. welcome-file-list Element

The `welcome-file-list` contains an ordered list of welcome files. The sub-element `welcome-file` contains a file name to use as a default welcome file, such as index.html

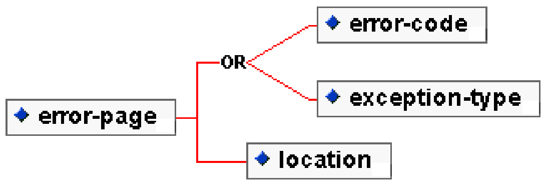
FIGURE 14-11 welcome-file-list Element Structure



15. error-page Element

The `error-page` contains a mapping between an error code or an exception type to the path of a resource in the Web application. The sub-element `exception-type` contains a fully qualified class name of a Java exception type. The sub-element `location` element contains the location of the resource in the web application relative to the root of the web application. The value of the location must have a leading '/'.

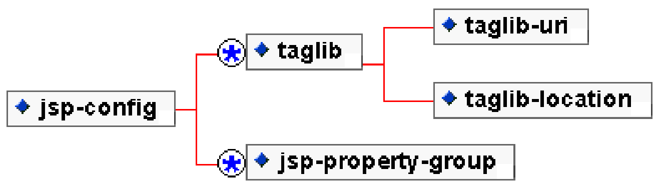
FIGURE 14-12 error-page Element Structure



16. jsp-config Element

The `jsp-config` is used to provide global configuration information for the JSP files in a web application. It has two sub-elements, `taglib` and `jsp-property-group`. The `taglib` element can be used to provide information on a tag library that is used by a JSP page within the Web application. See JavaServer Pages specification version 2.1 for detail.

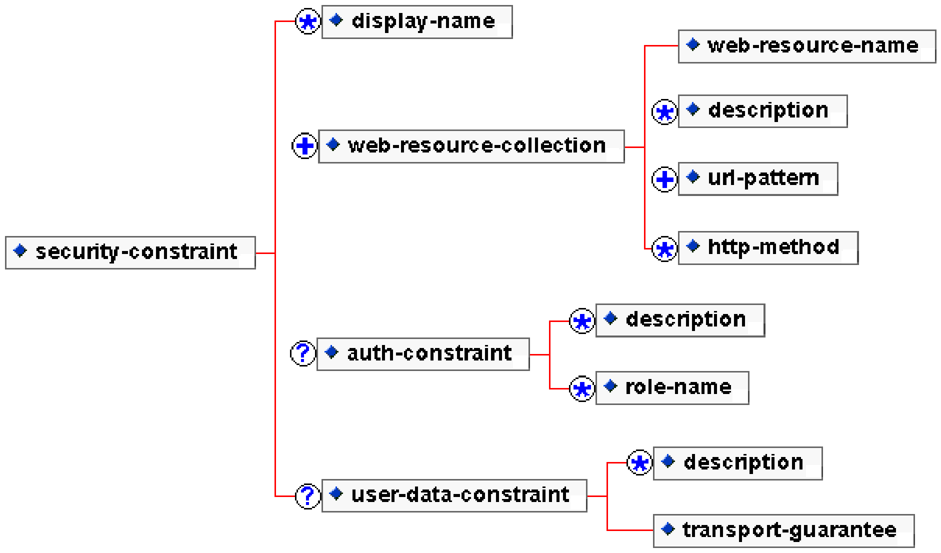
FIGURE 14-13 jsp-config Element Structure



17. security-constraint Element

The `security-constraint` is used to associate security constraints with one or more web resource collections. The sub-element `web-resource-collection` indentifies a subset of the resources and HTTP methods on those resources within a Web application to which a security constraint applies. The `auth-constraint` indicates the user roles that should be permitted access to this resource collection. The `role-name` used here must either correspond to the `role-name` of one of the `security-role` elements defined for this Web application, or be the specially reserved role-name "*" that is a compact syntax for indicating all roles in the web application. If both "*" and rolenames appear, the container interprets this as all roles. If no roles are defined, no user is allowed access to the portion of the Web application described by the containing `security-constraint`. The container matches role names case sensitively when determining access. The `user-data-constraint` indicates how data communicated between the client and container should be protected by the sub-element `transport-guarantee`. The legal values of the `transport-guarantee` is either one of `NONE`, `INTEGRAL`, or `CONFIDENTIAL`.

FIGURE 14-14 security-constraint Element Structure

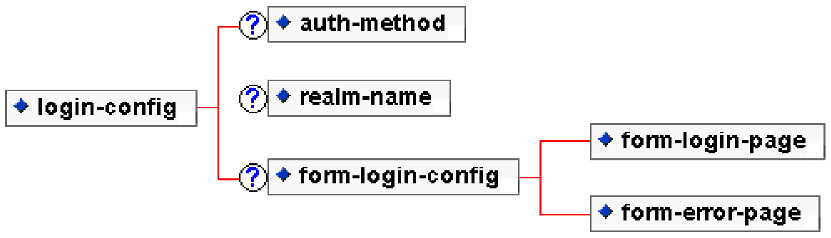


18. login-config Element

The `login-config` is used to configure the authentication method that should be used, the realm name that should be used for this application, and the attributes that are needed by the form login mechanism. The sub-element `auth-`

method configures the authentication mechanism for the Web application. The element content must be either BASIC, DIGEST, FORM, CLIENT-CERT, or a vendor-specific authentication scheme. The realm-name indicates the realm name to use for the authentication scheme chosen for the Web application. The form-login-config specifies the login and error pages that should be used in FORM based login. If FORM based login is not used, these elements are ignored.

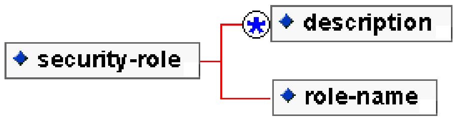
FIGURE 14-15 login-config Element Structure



19. security-role Element

The security-role defines a security role. The sub-element role-name designates the name of the security role. The name must conform to the lexical rules for NMTOKEN.

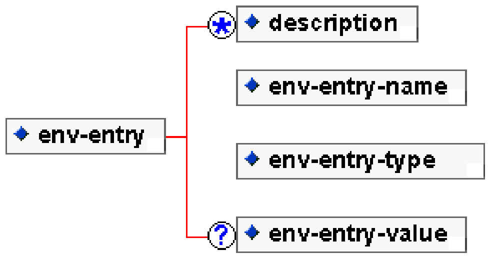
FIGURE 14-16 security-role Element Structure



20. env-entry Element

The env-entry declares an application's environment entry. The sub-element env-entry-name contains the name of a deployment component's environment entry. The name is a JNDI name relative to the java:comp/env context. The name must be unique within a deployment component. The env-entry-type contains the fully-qualified Java type of the environment entry value that is expected by the application's code. The sub-element env-entry-value designates the value of a deployment component's environment entry. The value must be a String that is valid for the constructor of the specified type that takes a single String as a parameter, or a single character for java.lang.Character.

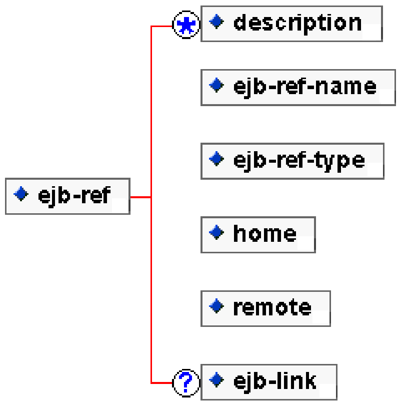
FIGURE 14-17 env-entry Element Structure



21. ejb-ref Element

The `ejb-ref` declares the reference to an enterprise bean's home. The `ejb-ref-name` specifies the name used in the code of the deployment component that is referencing the enterprise bean. The `ejb-ref-type` is the expected type of the referenced enterprise bean, which is either `Entity` or `Session`. The `home` defines the fully qualified name of the the referenced enterprise bean's home interface. The `remote` defines the fully qualified name of the referenced enterprise bean's remote interface. The `ejb-link` specifies that an EJB reference is linked to the enterprise bean. See Java Platform, Enterprise Edition, version 5.0 for more detail.

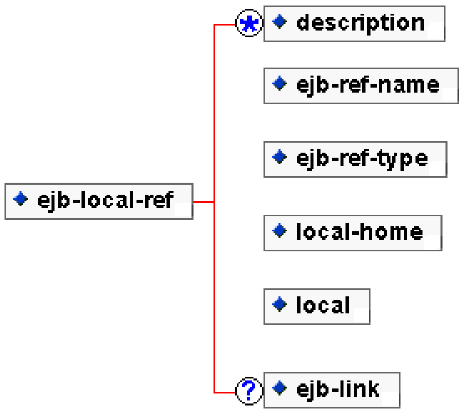
FIGURE 14-18 ejb-ref Element Structure



22. ejb-local-ref Element

The `ejb-local-ref` declares the reference to the enterprise bean's local home. The `local-home` defines the fully qualified name of the enterprise bean's local home interface. The `local` defines the fully qualified name of the enterprise bean's local interface.

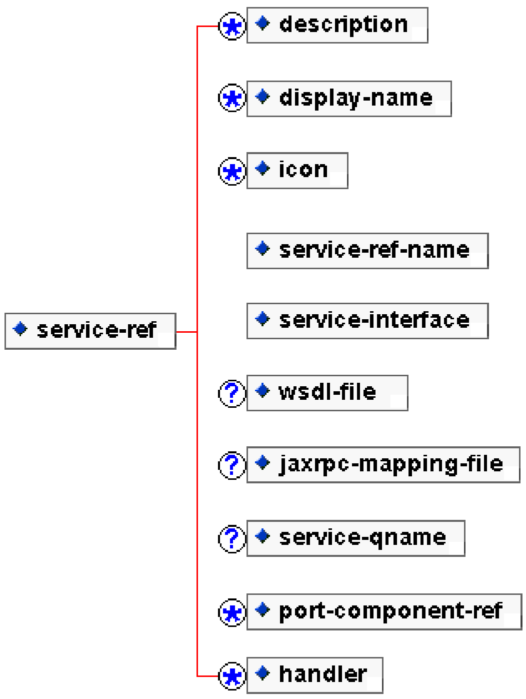
FIGURE 14-19 ejb-local-ref Element Structure



23. service-ref Element

The `service-ref` declares the reference to a Web service. The `service-ref-name` declares the logical name that the components in the module use to look up the Web service. It is recommended that all service reference names start with `/service/`. The `service-interface` defines the fully qualified class name of the JAX-WS Service interface that the client depends on. In most cases, the value will be javax.xml.rpc.Service. A JAX-WS generated Service Interface class may also be specified. The `wsdl-file` element contains the URI location of a WSDL file. The location is relative to the root of the module. The `jaxrpc-mapping-file` contains the name of a file that describes the JAX-WS mapping between the Java interaces used by the application and the WSDL description in the `wsdl-file`. The file name is a relative path within the module file. The `service-qname` element declares the specific WSDL service element that is being refered to. It is not specified if no `wsdl-file` is declared. The `port-component-ref` element declares a client dependency on the container for resolving a Service Endpoint Interface to a WSDL port. It optionally associates the Service Endpoint Interface with a particular port-component. This is only used by the container for a Service.getPort(Class) method call. The `handler` element declares the handler for a port-component. Handlers can access the `init-param` name-value pairs using the HandlerInfo interface. If port-name is not specified, the handler is assumed to be associated with all ports of the service. See JSR-109 Specification [http://www.jcp.org/en/jsr/detail?id=921] for detail. The container that is not a part of a Java EE implementation is not required to support this element.

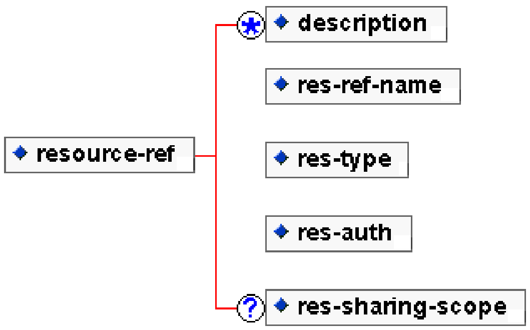
FIGURE 14-20 service-ref Element Structure



24. resource-ref Element

The `resource-ref` contains the declaration of a deployment component's reference to the external resource. The `res-ref-name` specifies the name of a resource manager connection factory reference. The name is a JNDI name relative to the java:comp/env context. The name must be unique within a deployment file. The `res-type` element specifies the type of the data source.The type is the fully qualified Java language class or the interface expected to be implemented by the data source. The `res-auth` specifies whether the deployment component code signs on programmatically to the resource manager, or whether the container will sign on to the resource manager on behalf of the deployment component. In the latter case, the container uses the information supplied by the deployer. The `res-sharing-scope` specifies whether connections obtained through the given resource manager connection factory reference can be shared. The value, if specified, must be either `Shareable` or `Unshareable`.

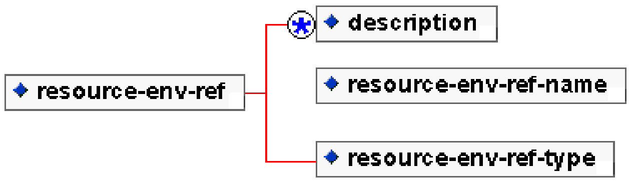
FIGURE 14-21 resource-ref Element Structure



25. resource-env-ref Element

The `resource-env-ref` contains the deployment component's reference to the administered object associated with a resource in the deployment component's environment. The `resource-env-ref-name` specifies the name of the resource environment reference. The value is the environment entry name used in the deployment component code and is a JNDI name relative to the java:comp/env context and must be unique within the deployment component. The `resource-env-ref-type` specifies the type of the resource environment reference. It is the fully qualified name of a Java language class or the interface.

FIGURE 14-22 resource-env-ref Element Structure



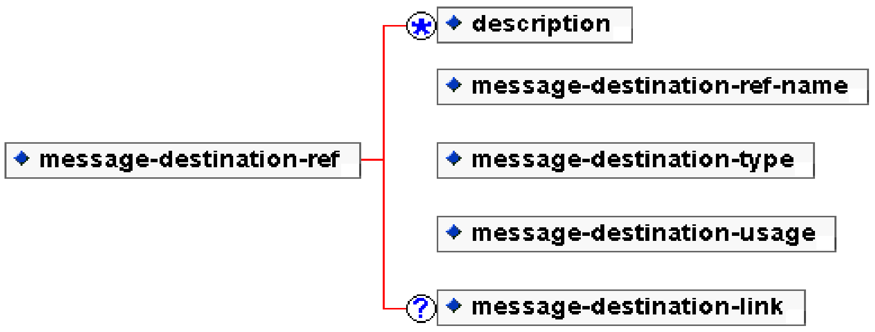
26. message-destination-ref Element

The `message-destination-ref` element contains a declaration of deployment component's reference to a message destination associated with a resource in deployment component's environment. The `message-destination-ref-name` element specifies the name of a message destination reference; its value is the environment entry name used in deployment component code. The name is a JNDI name relative to the java:comp/env context and must be unique within an ejb-jar for enterprise beans or a deployment file for others. The `message-destination-type` specifies the type of the destination. The type is specified by the Java interface expected to be implemented by the destination. The `message-destination-usage` specifies the use of the message destination indicated by the reference. The value indicates whether messages are consumed from the message destination, produced for the destination, or both. The Assembler makes use of this information in linking producers of a destination with its consumers. The `message-destination-link` links a message destination reference or message-driven bean to a message destination. The Assembler sets the value to reflect the flow of messages between producers and consumers in the application. The value must be the `message-destination-name` of a message destination in the same deployment file or in another deployment file in the same Java EE application unit. Alternatively, the value may be composed of a path name specifying a deployment file containing the referenced message destination with the `message-destination-name` of the destination appended and separated from the path name by "#". The path name is relative to the deployment file containing deployment component that is referencing the message destination. This allows multiple message destinations with the same name to be uniquely identified.

Example:

```
<message-destination-ref>
  <message-destination-ref-name>
    jms/StockQueue
  </message-destination-ref-name>
  <message-destination-type>
    javax.jms.Queue
  </message-destination-type>
  <message-destination-usage>
     Consumes
  </message-destination-usage>
  <message-destination-link>
    CorporateStocks
  </message-destination-link>
</message-destination-ref>
```

FIGURE 14-23 message-destination-ref Element Structure



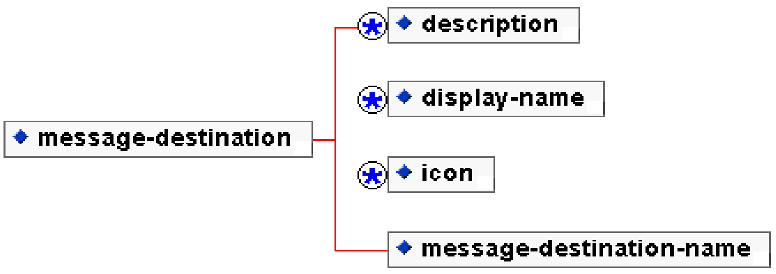
27. message-destination Element

The message-destination specifies a message destination. The logical destination described by this element is mapped to a physical destination by the deployer. The message-destination-name element specifies a name for a message destination. This name must be unique among the names of message destinations within the deployment file.

Example:

```
<message-destination>
  <message-destination-name>
    CorporateStocks
  </message-destination-name>
</message-destination>
```

FIGURE 14-24 message-destination Element Structure



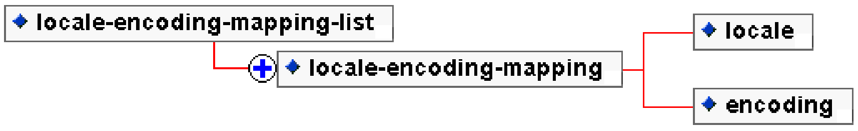
28. locale-encoding-mapping-list Element

The `locale-encoding-mapping-list` contains the mapping between the locale and the encoding. specified by the sub-element `locale-encoding-mapping`.

Example:

```
<locale-encoding-mapping-list>
    <locale-encoding-mapping>
        <locale>ja</locale>
        <encoding>Shift_JIS</encoding>
    </locale-encoding-mapping>
</locale-encoding-mapping-list>
```

FIGURE 14-25 locale-encoding-mapping-list Element Structure



14.5 Examples

The following examples illustrate the usage of the definitions listed in the deployment descriptor schema.

14.5.1 A Basic Example

CODE EXAMPLE 14-2 Basic Deployment Descriptor Example

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<web-app xmlns="http://java.sun.com/xml/ns/j2ee"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://java.sun.com/xml/ns/j2ee
    http://java.sun.com/xml/ns/j2ee/web-app_2_5.xsd”
    version=”2.5”>

    <display-name>A Simple Application</display-name>
    <context-param>
        <param-name>Webmaster</param-name>
        <param-value>webmaster@mycorp.com</param-value>
    </context-param>
    <servlet>
        <servlet-name>catalog</servlet-name>
        <servlet-class>com.mycorp.CatalogServlet
            </servlet-class>
        <init-param>
            <param-name>catalog</param-name>
            <param-value>Spring</param-value>
        </init-param>
    </servlet>
    <servlet-mapping>
        <servlet-name>catalog</servlet-name>
        <url-pattern>/catalog/*</url-pattern>
    </servlet-mapping>
    <session-config>
        <session-timeout>30</session-timeout>
    </session-config>
    <mime-mapping>
        <extension>pdf</extension>
        <mime-type>application/pdf</mime-type>
    </mime-mapping>
    <welcome-file-list>
        <welcome-file>index.jsp</welcome-file>
        <welcome-file>index.html</welcome-file>
        <welcome-file>index.htm</welcome-file>
    </welcome-file-list>
    <error-page>
        <error-code>404</error-code>
        <location>/404.html</location>
    </error-page>
    </web-app>
```

14.5.2 An Example of Security

CODE EXAMPLE 14-3 Deployment Descriptor Example Using Security

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<web-app xmlns="http://java.sun.com/xml/ns/j2ee"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://java.sun.com/xml/ns/j2ee
    http://java.sun.com/xml/ns/j2ee/web-app_2_5.xsd"
    version=”2.5”>

    <display-name>A Secure Application</display-name>
    <servlet>
    <servlet-name>catalog</servlet-name>
        <servlet-class>com.mycorp.CatalogServlet
        </servlet-class>
    <init-param>
        <param-name>catalog</param-name>
        <param-value>Spring</param-value>
    </init-param>
    <security-role-ref>
        <role-name>MGR</role-name>
        <!-- role name used in code -->
        <role-link>manager</role-link>
    </security-role-ref>
    </servlet>
    <security-role>
    <role-name>manager</role-name>
    </security-role>
    <servlet-mapping>
    <servlet-name>catalog</servlet-name>
    <url-pattern>/catalog/*</url-pattern>
    </servlet-mapping>
    <security-constraint>
    <web-resource-collection>
        <web-resource-name>SalesInfo
        </web-resource-name>
        <url-pattern>/salesinfo/*</url-pattern>
        <http-method>GET</http-method>
        <http-method>POST</http-method>
    </web-resource-collection>
    <auth-constraint>
        <role-name>manager</role-name>
    </auth-constraint>
    <user-data-constraint>
        <transport-guarantee>CONFIDENTIAL
        </transport-guarantee>
```

CODE EXAMPLE 14-3 Deployment Descriptor Example Using Security

```
    </user-data-constraint>
    </security-constraint>
</web-app>
```

CHAPTER 15

Java Enterprise Edition 6 Containers

This chapter details the requirements for Java™ Enterprise Edition (Java EE) [1] version 5 technology compliant web containers.

15.1 Sessions

Distributed servlet containers that are part of a Java EE implementation must support the mechanism necessary for migrating other Java EE objects from one JVM to another.

15.2 Web Applications

Java EE technology-compliant containers are required to provide a mechanism by which a deployer can learn what JAR files containing resources and code are available for the Web application. Providing such the mechanism is recommended, but not required for the containers that are not part of Java EE technology-compliant implementation. The containers should provide a convenient procedure for editing and configuring library files or extensions.

1. The Java EE Specification is available at `http://java.sun.com/javaee`

15.2.1 Web Application Class Loader

Servlet containers that are part of a Java EE product should not allow the application to override Java SE or Java EE platform classes, such as those in `java.*` and `javax.*` namespaces, that either Java SE or Java EE do not allow to be modified.

15.2.2 Web Application Environment

Java EE defines a naming environment that allows applications to easily access resources and external information without explicit knowledge of how the external information is named or organized.

As servlets are an integral component type of Java EE technology, provision has been made in the Web application deployment descriptor for specifying information allowing a servlet to obtain references to resources and enterprise beans. The deployment elements that contain this information are:

- `env-entry`
- `ejb-ref`
- `ejb-local-ref`
- `resource-ref`
- `resource-env-ref`
- `service-ref`

The developer uses these elements to describe certain objects that the Web application requires to be registered in the JNDI namespace in the Web container at runtime.

The requirements of the Java EE environment with regard to setting up the environment are described in Chapter 5 of the Java EE Specification.

Servlet containers that are part of a Java EE technology-compliant implementation are required to support this syntax. Consult the Java EE 5 Specification for more details. This type of servlet container must support lookups of such objects and calls made to those objects when performed on a thread managed by the servlet container. This type of servlet container should support this behavior when performed on threads created by the developer, but are not currently required to do so. Such a requirement will be added in the next version of this specification. Developers are cautioned that depending on this capability for application-created threads is not recommended, as it is non-portable.

15.3 Security

This section details the additional security requirements of a Java EE technology compliant web container.

15.3.1 Propagation of Security Identity in EJB™ Calls

A security identity, or principal, must always be provided for use in a call to an enterprise bean. The default mode in calls to enterprise beans from web applications is for the security identity of a web user to be propagated to the EJB container.

In other scenarios, web containers are required to allow web users that are not known to the web container or to the EJB container to make calls:

- Web containers are required to support access to web resources by clients that have not authenticated themselves to the container. This is the common mode of access to web resources on the Internet.
- Application code may be the sole processor of signon and customization of data based on caller identity.

In these scenarios, a web application deployment descriptor may specify a `run-as` element. When it is specified, the container must propagate the security identity for any call from a servlet to the EJB layer in terms of the security role name defined in the `run-as` element. The security role name must be one of the security role names defined for the web application.

For web containers running as part of a Java EE platform, the use of run-as elements must be supported both for calls to EJB components within the same Java EE application, and for calls to EJB components deployed in other Java EE applications.

15.3.2 Container Authorization Requirements

In a full Java EE product all Servlet containers MUST implement the Java Authorization Contracts for Containers (i.e, JSR 115). The JACC Specification is available for download at http://www.jcp.org/en/jsr/detail?id=115

15.3.3 Container Authentication Requirements

In a full Java EE product, all Servlet container MUST implement the Servlet Container Profile of The Java Authentication SPI for Containers (i.e, JSR 196). The JSAPI Specification is available for download at http://www.jcp.org/en/jsr/detail?id=196

15.4 Deployment

This section details the deployment descriptor, packaging and deployment descriptor processing requirements of a Java EE technology compliant container.

15.4.1 Deployment Descriptor Elements

The following additional elements exist in the Web application deployment descriptor to meet the requirements of Web containers that are JSP pages enabled or part of a Java EE application server. They are not required to be supported by containers wishing to support only the servlet specification:

- `jsp-config`
- Syntax for looking up JNDI objects (`env-entry`, `ejb-ref`, `ejb-local-ref`, `resource-ref`, `resource-env-ref`)
- Syntax for specifying the message destination (`message-destination`, `message-destination-ref`)
- Reference to a Web service (`service-ref`)

The syntax for these elements is now held in the JavaServer Pages specification version 2.1, and the Java EE specification version 5.0.

15.4.2 Packaging and Deployment of JAX-WS Components

Web containers may choose to support running components written to implement a Web service endpoint as defined by the JAX-RPC and/or JAX-WS specifications. Web containers embedded in a JavaEE conformant implementation are required to support JAX-RPC and JAX-WS web service components. This section describes the packaging and deployment model for such JAX-RPC and JAX-WS Web component implementations.

JSR-109 [`http://jcp.org/jsr/detail/109.jsp`] defines the model for packaging a Web service interface with its associated WSDL description and associated classes. It defines a mechanism for JAX-WS and JAX-RPC enabled Web containers to link to a component that implements this Web service. A JAX-WS or JAX-RPC Web service implementation component uses the APIs defined by the JAX-WS and/or JAX-RPC specifications, which defines its contract with the JAX-WS and/or JAX-WS enabled Web containers. It is packaged into the WAR file. The Web service developer makes a declaration of this component using the usual `<servlet>` declaration.

JAX-WS and JAX-RPC enabled Web containers must support the developer in using the Web deployment descriptor to define the following information for the endpoint implementation component, using the same syntax as for HTTP Servlet components using the `servlet` element. The child elements are used to specify endpoint information in the following way:

- the `servlet-name` element defines a logical name which may be used to locate this endpoint description among the other Web components in the WAR
- the `servlet-class` element provides the fully qualified Java class name of this endpoint implementation
- the `description` element(s) may be used to describe the component and may be displayed in a tool
- the `load-on-startup` element specifies the order in which the component is initialized relative to other Web components in the Web container
- the `security-role-ref` element may be used to test whether the authenticated user is in a logical security role
- the `run-as` element may be used to override the identity propagated to EJBs called by this component

Any servlet initialization parameters defined by the developer for this Web component may be ignored by the container. Additionally, the JAX-WS and JAX-RPC enabled Web component inherits the traditional Web component mechanisms for defining the following information:

- mapping of the component to the Web container's URL namespace using the servlet mapping technique
- authorization constraints on Web components using security constraints
- the ability to use servlet filters to provide low-level byte stream support for manipulating JAX-WS and/or JAX-RPC messages using the filter mapping technique
- the timeout characteristics of any HTTP sessions that are associated with the component
- links to Java EE objects stored in the JNDI namespace

15.4.3 Rules for Processing the Deployment Descriptor

The containers and tools that are part of Java EE technology-compliant implementation are required to validate the deployment descriptor against the XML schema for structural correctness. The validation is recommended, but not required for the web containers and tools that are not part of a Java EE technology compliant implementation.

15.5 Annotations and Resource Injection

The Java Metadata specification (JSR-175), which is part of J2SE 5.0 and greater, provides a means of specifying configuration data in Java code. Metadata in Java code is also referred to as annotations. In Java EE annotations are used to declare dependencies on external resources and configuration data in Java code without the need to define that data in a configuration file.

This section describes the behavior of annotations and resource injection in a Java EE technology compliant Servlet containers. This section expands on the Java EE 5 specification section 5 titled "Resources, Naming, and Injection."

Annotations must be supported on the following container managed classes that implement the following interfaces and are declared in the web application deployment descriptor.

TABLE 15-1 Components and Interfaces supporting Annotations and Dependency Injection

Component Type	Classes implementing the following interfaces
Servlets	`javax.servlet.Servlet`
Filters	`javax.servlet.Filter`

Listeners	`javax.servlet.ServletContextListener`
	`javax.servlet.ServletContextAttributeListener`
	`javax.servlet.ServletRequestListener`
	`javax.servlet.ServletRequestAttributeListener`
	`javax.servlet.http.HttpSessionListener`
	`javax.servlet.http.HttpSessionAttributeListener`

Web containers are not required to perform resource injection for annotations occuring in classes other than those listed above in TABLE 15-1.

References must be injected prior to any lifecycle methods being called and the component instance being made available the application.

In a web application, classes using resource injection will have their annotations processed only if they are located in the `WEB-INF/classes` directory, or if they are packaged in a jar file located in `WEB-INF/lib`. Containers may optionally process resource injection annotations for classes found elsewhere in the application's classpath.

The web application deployment descriptor contains a new "metadata-complete" attribute on the web-app element. The "metadata-complete" attribute defines whether the web descriptor is complete, or whether the class files of the jar file should be examined for annotations that specify deployment information. If "metadata-complete" is set to "true", the deployment tool must ignore any Servlet annotations present in the class files of the application. If the full attribute is not specified or is set to "false", the deployment tool must examine the class files of the application for annotations, as previously specified.

Following are the annotations that are required by a Java EE technology compliant web container.

15.5.1 @DeclareRoles

This annotation is used to define the security roles that comprise the security model of the application. This annotation is specified on a class, and it is used to define roles that could be tested (i.e., by calling `isUserInRole`) from within the methods of the annotated class. Roles that are implicitly declared as a result of their use in a `@RolesAllowed` need not be explicitly declared using the `@DeclareRoles` annotaion. The `@DeclareRoles` annotation may only be defined in classes implementing the `javax.servlet.Servlet` interface or a subclass thereof.

Following is an example of how this annotation would be used.

CODE EXAMPLE 15-1 `@DeclareRoles` Annotation Example

```
@DeclareRoles("BusinessAdmin")
 public class CalculatorServlet {
       //...
  }
```

Declaring `@DeclareRoles` ("BusinessAdmin") is equivalent to defining the following in the web.xml.

CODE EXAMPLE 15-2 @DeclareRoles web.xml

```
<web-app>
    <security-role>
```

CODE EXAMPLE 15-2 @DeclareRoles web.xml

```
      <role-name>BusinessAdmin</role-name>
    </security-role>
  </web-app>
```

This annotation is not used to relink application roles to other roles. When such linking is necessary, it is accomplished by defining an appropriate security-role-ref in the associated deployment descriptor.

When a call is made to `isUserInRole` from the annotated class, the caller identity associated with the invocation of the class is tested for membership in the role with the same name as the argument to `isCallerInRole`. If a `security-role-ref` has been defined for the argument role-name the caller is tested for membership in the role mapped to the `role-name`.

For further details on the `@DeclareRoles` annotation refer to the Common Annotations for the Java™ Platform™ specification (JSR 250) section 2.10.

15.5.2 @EJB Annotation

Enterprise JavaBeans™ 3.0 (EJB) components may referenced from a web component using the `@EJB` annotation. The `@EJB` annotation provides the equivalent functionality of declaring the `ejb-ref` or `ejb-local-ref` elements in the deployment descriptor. Fields that have a corresponding `@EJB` annotation are injected with the a reference to the corresponding EJB component.

An example:

```
@EJB private ShoppingCart myCart;
```

In the case above a reference to the EJB component “`myCart`” is injected as the value of the private field “`myCart`” prior to the classs declaring the injection being made available.

The behavior the `@EJB` annotation is further detailed in section 15.5 of the EJB 3.0 specification (JSR220).

15.5.3 @EJBs Annotation

The `@EJBs` annotation allows more than one `@EJB` annotations to be declared on a single resource.

An example:

CODE EXAMPLE 15-3 @EJBs Annotation Example

```
@EJBs({@EJB(Calculator), @EJB(ShoppingCart)})
public class ShoppingCartServlet {
//...
}
```

The example above the EJB components `ShoppingCart` and `Calculator` are made available to `ShoppingCartServlet`. The `ShoppingCartServlet` must still look up the references using JNDI but the EJBs do not need to declared in the web.xml file.

The @EJBs annotation is discussed in further detailed in section 15.5 of the EJB 3.0 specification (JSR220).

15.5.4 @Resource Annotation

The `@Resource` annotation is used to declare a reference to a resource such as a data source, Java Messaging Service (JMS) destination, or environment entry. This annotation is equivalent to declaring a `resource-ref`, `message-destination-ref` or `env-ref`, or `resource-env-ref` element in the deployment descriptor.

The `@Resource` annotation is specified on a class, method or field. The container is responsible injecting references to resources declared by the `@Resource` annotation and mapping it to the proper JNDI resources. See the Java EE Specification Chapter 5 for further details.

An example of a @Resource annotation follows:

CODE EXAMPLE 15-4 @Resource Example

```
@Resource private javax.sql.DataSource catalogDS;
public getProductsByCategory() {
    // get a connection and execute the query
    Connection conn = catalogDS.getConnection();
..
}
```

In the example code above, a servlet, filter, or listener declares a field `catalogDS` of type `javax.sql.DataSource` for which the reference to the data source is injected by the container prior to the component being made available to the application. The data source JNDI mapping is inferred from the field name “`catalogDS`” and type (`javax.sql.DataSource`). Moreover, the `catalogDS` resource no longer needs to be defined in the deployment descriptor.

The semantics of the `@Resource` annotation are further detailed in the Common Annotations for the Java™ Platform™ specification (JSR 250) Section 2.3 and Java EE Specification specification 5.2.3.

15.5.5 @PersistenceContext Annotation

This annotation specifies the container managed entity manager for referenced persistence units.

An example:

CODE EXAMPLE 15-5 @PersistenceContext Example

```
@PersistenceContext (type=EXTENDED)
EntityManager em;
```

The behavior the `@PersistenceContext` annotation is further detailed in section 8.4.1 of the Java Persistence document which is part of the EJB 3.0 specification (JSR220) and in section 15.11 of the EJB 3.0 specification.

15.5.6 @PersistenceContexts Annotation

The PersistenceContexts annotation allows more than one @PersistenceContext to be declared on a resource. The behavior the `@PersistenceContext` annotation is further detailed in section 8.4.1 of the Java Persistence document which is part of the EJB 3.0 specification (JSR220) and in section 15.11 of the EJB 3.0 specification.

15.5.7 @PersistenceUnit Annotation

The `@PersistenceUnit` annotation provides Enterprise Java Beans components declared in a servlet a reference to a entity manager factory. The entity manager factory is bound to a separate persistence.xml configuration file as described in section 5.10 of the EJB 3.0 specification (JSR220).

An example:

CODE EXAMPLE 15-6 @PersistenceUnit Example

```
@PersistenceUnit
EntityManagerFactory emf;
```

The behavior the `@PersistenceUnit` annotation is further detailed in section 8.4.2 of the Java Persistence document which is part of the EJB 3.0 specification (JSR220) and in section 15.10 of the EJB 3.0 specification.

15.5.8 @PersistenceUnits Annotation

This annotation allows for more than one `@PersistentUnit` annotations to be declared on a resource. The behavior the `@PersistenceUnits` annotation is further detailed in section 8.4.2 of the Java Persistence document which is part of the EJB 3.0 specification (JSR220) and in section 15.10 of the EJB 3.0 specification.

15.5.9 @PostConstruct Annotation

The `@PostConstruct` annotation is declared on a method that does not take any arguments, and must not throw any checked expections. The return value must be void. The method MUST be called after the resources injections have been completed and before any lifecycle methods on the component are called.

An example:

CODE EXAMPLE 15-7 @PostConstruct Example

```
@PostConstruct
public void postConstruct() {
    ...
}
```

The example above shows a method using the `@PostConstruct` annotation.

The `@PostConstruct` annnotation MUST be supported by all classes that support dependency injection and called even if the class does not request any reources to be injected. If the method throws an unchecked exception the class MUST not be put into service and no method on that instance can be called.

Refer to the Java EE specification section 2.5 and the Common Annotations for the Java™ Platform™ specifcation section 2.5 for more details.

15.5.10 @PreDestroy Annotation

The @PreDestroy annotation is declared on a method of a container managed component. The method is called prior to component being reomvoed by the container.

An example:

CODE EXAMPLE 15-8 @PreDestroy Example

```
@PreDestroy
public void cleanup() {
    // clean up any open resources
    ...
}
```

The method annotated with `@PreDestroy` must return void and must not throw a checked exception. The method may be public, protected, package private or private. The method must not be static however it may be final.

Refer to the JSR 250 section 2.6 for more details.

15.5.11 @Resources Annotation

The `@Resources` annotation acts as a container for multiple `@Resource` annotations because the Java MetaData specification does not allow for multiple annotations with the same name on the same annotation target.

An example:

CODE EXAMPLE 15-9 @Resources Example

```
@Resources ({
@Resource(name=”myDB” type=javax.sql.DataSource),
@Resource(name=”myMQ” type=javax.jms.ConnectionFactory)
})
public class CalculatorServlet {
//...
}
```

In the example above a JMS connection factory and a data source are made available to the `CalculatorServlet` by means of an `@Resources` annotation.

The semantics of the `@Resources` annotation are further detailed in the Common Annotations for the Java™ Platform™ specification (JSR 250) section 2.4.

15.5.12 @RunAs Annotation

The `@RunAs` annotation is equivalent to the `run-as` element in the deployment descriptor. The `@RunAs` annotation may only be defined in classes implementing the `javax.servlet.Servlet` interface or a subclass thereof.

An example:

CODE EXAMPLE 15-10 @RunAs Example

```
@RunAs("Admin")
public class CalculatorServlet {

@EJB private ShoppingCart myCart;

    public void doGet(HttpServletRequest, req, HttpServletResponse
res) {
    //....
    myCart.getTotal();
    //....
    }
}
    //....
}
```

The `@RunAs("Admin")` statement would be equivalent to defining the following in the web.xml.

CODE EXAMPLE 15-11 @RunAs web.xml Example

```
<servlet>
    <servlet-name>CalculatorServlet</servlet-name>
    <run-as>Admin</run-as>
</servlet>
```

The example above shows how a servlet uses the @RunAs annotation to propagate the security identity "`Admin`" to an EJB component when the `myCart.getTotal()` method is called. For further details on propagating identities see Section 15.3.1, "Propagation of Security Identity in EJB™ Calls" on page 15-171.

For further details on the `@RunAs` annotation refer to the Common Annotations for the Java™ Platform™ specification (JSR 250) section 2.6.

15.5.13 @WebServiceRef Annotation

The @WebServiceRef annotation provides a reference to a web service in a web component in same way as a `resource-ref` element would in the deployment descriptor.

An example:

```
@WebServiceRef private MyService service;
```

In this example a reference to the web service “`MyService`” will be injected to the class declaring the annotation.

This annotation and behavior are further detailed in the JAX-WS Specification (JSR 224) section 7.

15.5.14 @WebServiceRefs Annotation

This annotation allows for more than one `@WebServiceRef` annotations to be declared on a single resource. The behavior of this annotation is further detailed in the JAX-WS Specification (JSR 224) section 7.

APPENDIX **A**

Change Log

This document is the proposed final draft of the Java Servlet 3.0 Servlet specification developed under the Java Community Process^{SM} (JCP).

A.1 Changes since Servlet 3.0 Public Review

1. Updated isAsyncStarted to return false once a dispatch to the container or a call to complete is done from the async handler
2. Added ordering support for fragments
3. Added support for file upload
4. Added support for loading static resources and JSPs from JAR files that are included in the META-INF/resources directory of the JAR file which is then bundled in the WEB-INF/lib directory
5. Changed annotation names based on feedback on Public Review of the specification
6. Added programmatic login / logout support
7. Added support for securit related common annotations - @RolesAllowed, @PermitAll, @DenyAll
8. Clarified welcome files

A.2 Changes since Servlet 3.0 EDR

1. The suspend / resume APIs are no longer present in the specification. They have been replaced by startAsync and AsyncContext which now has forward and complete methods.
2. Annotation names have changed and there are only top level annotations. The method level annotations for declaring the servlet methods are no longer being used.
3. The rules for assembling web.xml from fragments and annotations is described.

A.3 Changes since Servlet 2.5 MR6

1. Added support for annotations and web fragments
2. Added support for suspend / resume to allow async support in servlets.
3. Added support for initializing servlets and filters from the ServletContext at initialization time.
4. Added support for HttpOnly cookies and allow configuring cookies.
5. Added convenience methods to ServletRequest to get Response and ServletContext

A.4 Changes since Servlet 2.5 MR 5

A.4.1 Clarify SRV 8.4 "The Forward Method"

Change the last sentence of the section which currently is:

> "Before the forward method of the `RequestDispatcher` interface returns, the response content must be sent and committed, and closed by the servlet container."

to read:

"Before the forward method of the `RequestDispatcher` interface returns without exception, the response content must be sent and committed, and closed by the servlet container. If an error occurs in the target of the `RequestDispatcher.forward()` the exception may be propogated back through all the calling filters and servlets and eventually back to the container."

A.4.2 Update Deployment descriptor "http-method values allowed"

The facet for `http-method` element in the deployment descriptor is currently more restrictive than the http specification. The following change is being made to the descriptor to allow the set of method names as defined by the http specification. The pattern value of `http-methodType` is being changed from

```
<xsd:pattern value="[\p{L}-[\p{Cc}\p{Z}]]+"/>
```

to closely match what the HTTP specification lists as allowable HTTP methods names.

```
<xsd:pattern value="[&#33;-&#126;-[\(\)&#60;&#62;@,;:&#34;/\[\]?=\
{\}\\\p{Z}]]+"/>
```

A.4.3 Clarify SRV 7.7.1 "Threading Issues"

Change the paragraph which currently is:

"Multiple servlets executing request threads may have active access to a single session object at the same time. The Developer has the responsibility for synchronizing access to session resources as appropriate."

to read:

"Multiple servlets executing request threads may have active access to the same session object at the same time. The container must ensure that manipulation of internal data structures representing the session attributes is performed in a threadsafe manner. The Developer has the responsibility for threadsafe access to the attribute objects themselves. This will protect the attribute collection inside the HttpSession object from concurrent access, eliminating the opportunity for an application to cause that collection to become corrupted."

A.5 Changes Since Servlet 2.5 MR 2

A.5.1 Updated Annotation Requirements for Java EE containers

Added EJBs, PreDestroy, PeristenceContext, PersistenceContexts, PersistenceUnit, and PersistenceUnits with descriptions to the list of required Java EE cdontainer annotations in Section 15.5, "Annotations and Resource Injection".

A.5.2 Updated Java Enterprise Edition Requirements

Updated the Annotations to the final Java EE annotation names. Also updated the "full" attribute in the `web.xml` to be "metadata-complete".

A.5.3 Clarified HttpServletRequest.getRequestURL()

The API documentation for `javax.servlet.http.HttpServletRequest.getRequestURL()` was clarified.

The text in italics was added:

If this request has been forwarded using `RequestDispatcher.forward(ServletRequest, ServletResponse)`, the server path in the reconstructed URL must reflect the path used to obtain the RequestDispatcher, and not the server path specified by the client. Because this method returns a `StringBuffer`, not a string, you can modify the URL easily, for example, to append query parameters.

A.5.4 Removal of IllegalStateException from HttpSession.getId()

The HttpSessionBindingListener calls the valueUnbound event after the session has been expired, unfortunately, the HttpSession.getId() method is often used in this scenario and is supposed to throw an IllegalStateException. The servlet EG agreed to remove the exception from the API to prevent these types of exceptions.

A.5.5 ServletContext.getContextPath()

The method `getContextPath()` was added to the `ServletContext` in the API. The description is as follows:

```
public java.lang.String getContextPath()
```

Returns the context path of the web application. The context path is the portion of the request URI that is used to select the context of the request. The context path always comes first in a request URI. The path starts with a "/" character but does not end with a "/" character. For servlets in the default (root) context, this method returns "".

It is possible that a servlet container may match a context by more than one context path. In such cases getContextPath() will return the actual context path used by the request and it may differ from the path returned by this method. The context path returned by this method should be considered as the prime or preferred context path of the application.

Returns: The context path of the web application.

HttpServletRequest.getContextPath() was updated to clarify its relationship with the ServletContext.getContextPath() method. The clarification is as follows.

It is possible that a servlet container may match a context by more than one context path. In such cases this method will return the actual context path used by the request and it may differ from the path returned by the ServletContext.getContextPath() method. The context path returned by ServletContext.getContextPath() should be considered as the prime or preferred context path of the application.

A.5.6 Requirement for web.xml in web applications

Section 10.13, "Inclusion of a web.xml Deployment Descriptor" was added which removes requirement for Java EE compliant web applications. The section is as follows:

A web application is NOT required to contain a web.xml if it does NOT contain any Servlet, Filter, or Listener components. In other words an application containing only static files or JSP pages does not require a web.xml to be present.

A.6 Changes Since Servlet 2.4

A.6.1 Session Clarification

Clarified Section 7.3, “Session Scope” to allow for better support of session ids being used in more than one context. This was done to support the Portlet specification (JSR 168). Added the following paragraph at the end of Section 7.3:

> “Additionally, sessions of a context must be resumable by requests into that context regardless of whether their associated context was being accessed directly or as the target of a request dispatch at the time the sessions were created."

Made the changes in Section 9.3, “The Include Method” by replacing the following text:

> "It cannot set headers or call any method that affects the headers of the response. Any attempt to do so must be ignored."

with the following:

> "It cannot set headers or call any method that affects the headers of the response, with the exception of the HttpServletRequest.getSession() and HttpServletRequest.getSession(boolean) methods. Any attempt to set the headers must be ignored, and any call to HttpServletRequest.getSession() or HttpServletRequest.getSession(boolean) that would require adding a Cookie response header must throw an IllegalStateException if the response has been committed."

A.6.2 Filter All Dispatches

Modified Section 6.2.5, “Filters and the RequestDispatcher” to clarify a way to map a filter to all servlet dispatches by appending the following text to the end of the section:

Finally, the following code uses the special servlet name '*':

CODE EXAMPLE A-1 Example of special servlet name ‘*’

```
<filter-mapping>
    <filter-name>All Dispatch Filter</filter-name>
    <servlet-name>*</servlet-name>
    <dispatcher>FORWARD</dispatcher>
</filter-mapping>
```

This code would result in the All Dispatch Filter being invoked on request dispatcher forward() calls for all request dispatchers obtained by name or by path.

A.6.3 Multiple Occurrences of Servlet Mappings

Previous versions of the servlet schema allows only a single url-pattern or servlet name per servlet mapping. For servlets mapped to multiple URLs this results in needless repetition of whole mapping clauses.

The deployment descriptor `servlet-mappingType` was updated to:

CODE EXAMPLE A-2 `servlet-mappingType` descriptor

```
<xsd:complexType name="servlet-mappingType">
    <xsd:sequence>
    <xsd:element name="servlet-name" type="j2ee:servlet-
nameType"/>
    <xsd:element name="url-pattern" type="j2ee:url-patternType"
minOccurs="1"
maxOccurs="unbounded"/>
    </xsd:sequence>
    <xsd:attribute name="id" type="xsd:ID"/>
</xsd:complexType>
```

A.6.4 Multiple Occurrences Filter Mappings

Previous versions of the servlet schema allows only a single url-pattern in a filter mapping. For filters mapped to multiple URLs this results in needless repetition of whole mapping clauses.

The deployment descriptor schema the `filter-mappingType` was updated to:

CODE EXAMPLE A-3 Updated `filter-mappingType` schema

```
<xsd:complexType name="filter-mappingType">
    <xsd:sequence>
    <xsd:element name="filter-name" type="j2ee:filter-nameType"/>
    <xsd:choice minOccurs="1" maxOccurs="unbounded">
        <xsd:element name="url-pattern" type="j2ee:url-
patternType"/>
        <xsd:element name="servlet-name" type="j2ee:servlet-
nameType"/>
    </xsd:choice>
```

CODE EXAMPLE A-3 Updated `filter-mappingType` schema

```
    <xsd:element name="dispatcher" type="j2ee:dispatcherType"
minOccurs="0"
maxOccurs="4"/>
    </xsd:sequence>
    <xsd:attribute name="id" type="xsd:ID"/>
</xsd:complexType>
```

This change allows multiple patterns and servlet names to be defined in a single mapping as can be seen in the following example:

CODE EXAMPLE A-4 Filter mapping example

```
<filter-mapping>
    <filter-name>Demo Filter</filter-name>
    <url-pattern>/foo/*</url-pattern>
    <url-pattern>/bar/*</url-pattern>
    <servlet-name>Logger</servlet-name>
    <dispatcher>REQUEST</dispatcher>
    <dispatcher>ERROR</dispatcher>
</filter-mapping>
```

Section 6.2.4, “Configuration of Filters in a Web Application” was updated to clarify the cases where there are multiple mappings with the following text:

"If a filter mapping contains both <servlet-name> and <url-pattern>, the container must expand the filter mapping into multiple filter mappings (one for each <servlet-name> and <url-pattern>), preserving the order of the <servlet-name> and <url-pattern> elements."

An examples was also provided to clarify cases when there are multiple mappings.

A.6.5 Support Alternative HTTP Methods with Authorization Constraints

The previous Servlet 2.4 schema restricted HTTP methods to GET, POST, PUT, DELETE, HEAD, OPTIONS, and TRACE. The schema http-methodType was changed from:

CODE EXAMPLE A-5 Servlet 2.4 `http-methodType` schema

```
<xsd:complexType name="http-methodType">
...
    <xsd:simpleContent>
```

CODE EXAMPLE A-5 Servlet 2.4 `http-methodType` schema

```
    <xsd:restriction base="j2ee:string">
        <xsd:enumeration value="GET"/>
        <xsd:enumeration value="POST"/>
        <xsd:enumeration value="PUT"/>
        <xsd:enumeration value="DELETE"/>
        <xsd:enumeration value="HEAD"/>
        <xsd:enumeration value="OPTIONS"/>
        <xsd:enumeration value="TRACE"/>
    </xsd:restriction>
    </xsd:simpleContent>
</xsd:complexType>
```

To the following:

CODE EXAMPLE A-6 Servlet 2.5 `http-methodType` schema

```
<xsd:simpleType name="http-methodType">
    <xsd:annotation>
    <xsd:documentation>
        A HTTP method type as defined in HTTP 1.1 section 2.2.
    </xsd:documentation>
    </xsd:annotation>

    <xsd:restriction base="xsd:token">
    <xsd:pattern value="[\p{L}-[\p{Cc}\p{Z}]]+"/>
    </xsd:restriction>
</xsd:simpleType>
```

The http-method elements now need to be a token as described in HTTP 1.1 specification section 2.2.

A.6.6 Minimum J2SE Requirement

Servlet 2.5 Containers now require J2SE 5.0 as the minimum Java version. Section 1.2, “What is a Servlet Container?” was updated to reflect this requirement.

A.6.7 Annotations and Resource Injection

Java EE technology compliant containers require annotations and resource injection on servlets, filters, and listeners. Section 15.5, “Annotations and Resource Injection” describes the annotations and resource injection in further detail.

A.6.8 SRV.9.9 ("Error Handling") Requirement Removed

Section 10.9.1, “Request Attributes” defines the following requirement:

> If the location of the error handler is a servlet or a JSP page:
>
> [...]
>
> The response setStatus method is disabled and ignored if called.
>
> [...]

The JSP 2.1 EG has asked that this requirement above be removed to allow JSP error pages to update the response status.

A.6.9 HttpServletRequest.isRequestedSessionIdValid() Clarification

The API clarification better describes what happens when a client did not specify a session id. The API documentation was updated to specify when false is returned. The API documentation now states:

> Returns **false** if the client did not specify any session ID.

A.6.10 SRV.5.5 ("Closure of Response Object") Clarification

The behavior in Section 5.5, “Closure of Response Object” the response's content length is set to 0 via response.setHeader("Content-Length", "0") and any subsequently setHeader() calls are ignored.

Section 5.5, “Closure of Response Object” was updated to allow all headers to be set by changing:

"The amount of content specified in the setContentLength method of the response and has been written to the response"

To the following:

"The amount of content specified in the setContentLength method of the response has been greater than zero and has been written to the response"

A.6.11 ServletRequest.setCharacterEncoding() Clarified

The API was updated to described the behavior if the method is called after the getReader() was called. If the getReader() is called there will be no effect.

A.6.12 Java Enterprise Edition Requirements

Chapter 15, “Java Enterprise Edition 6 Containers details all requirements of a Java EE container. Previously the requirements were mixed into each chapter.

A.6.13 Servlet 2.4 MR Change Log Updates Added

Added the changes from the Servlet 2.4 Maintenance Review. These changes include grammar and typographical fixes.

A.6.14 Synchronized Access Session Object Clarified

Section 7.7.1, “Threading Issues” was updated to clarify that access to the session object should be synchronized.

A.7 Changes Since Servlet 2.3

- Optional “X-Powered-By” header is added in the response (5.2)
- Clarification of “overlapping constraint” (12.8.1, 12.8.2)
- Add the section to clarify the process order at the time of web application deployment (9.12)
- Clarification that the security model is also applied to filter (12.2)
- Change the status code from 401 to 200 when FORM authentication is failed as there is no appropriate error status code in HTTP/1.1 (12.5.3)
- Clarification of the wrapper objects (6.2.2)
- Clarification of overriding the platform classes (9.7.2)
- Clarification of welcome file (9.10)
- Clarification of internationalization - the relationship among setLocale, setContentType, and setCharacterEncoding (5.4, 14.2.22)
- Clarification of ServletRequestListener and ServletRequestAttributeListener description (14.2.18, 14.2.20)

- Add HttpSessionActivationListener and HttpSessionBindingListener into the Table 10-1.
- Change the word "auth constraint" to "authorization constraint" (12.8)
- Add “Since” tag in the newly added methods in javadoc(14.2.16, 14.2.22)
- Fix the data type of `<session-timeout>` to `xsdIntegerType` in schema(13.3)
- Clarification when the listener throws the unhandled exception(10.6)
- Clarification of the “shared library”(9.7.1)
- Clarification of the container’s mechanism for the extension(9.7.1, third paragraph)
- `HttpSession.logout` method was removed. The portable authentication mechanism will be addressed in the next version of this specification and logout will also be discussed in that scope.(12.10)
- It is now a recommendation, instead of a requirement, that the reference to the request and response object should not be given to the object in other threads - based on the requirement from JSR-168. Warnings are added when the thread created by the application uses the objects managed by the container.(2.3.3.3)
- It is now a recommendation, that the dispatch should occur in the same thread of the same JVM as the original request - based on the requirement from JSR-168(8.2)
- Clarification of “wrap” (6.2.2)
- Clarification of handling the path parameter for the mapping(11.1)
- Add the description about the “HTTP chunk” in `HttpServlet.doGet` method(15.1.2)
- J2SE 1.3 is the minimum version of the underlying Java platform with which servlet containers must be built (1.2)
- Clarification of ServletResponse.setBufferSize method (5.1)
- Clarification of ServletRequest.getServerName and getServerPort (14.2.16.1)
- Clarification of Internationalization (5.4, 14.2.22)
- Clarification of the redirection of the welcome file (9.10)
- Clarification of ServletContextListener.contextInitialized (14.2.12.1)
- Clarification of HttpServletRequest.getRequestedSessionId - making it clear that it returns the session ID specified by the client (15.1.3.2)
- Clarification of the class loader for the extensions - the class loader must be the same for all web applications within the same JVM (9.7.1)
- Clarification of the case when ServletRequestListener throws an unhandled exception (10.6, 14.2.20)
- Clarification of the scope of ServletRequestListener (14.2.20)
- Add the description about the case when the container has a caching mechanism (1.2)
- Validating deployment descriptor against the schema is required for Java EE containers (13.2)
- Sub elements under `<web-app>` can be in an arbitrary order (13.2)
- One example of the container’s rejecting the web application was removed due to the contradiction with SRV.11.1 (9.5)
- url-patternType is changed from j2ee:string to xsd:string (13)
- The sub-elements under `<web-app>` in deployment descriptor can be in the arbitrary order (13)

- The container must inform a developer with a descriptive error message when deployment descriptor file contains an illegal character or multiple elements of `<session-config>`, `<jsp-config>`, or `<login-config>` (13)
- Extensibility of deployment descriptor was removed (13)
- Section SRV.1.6 added - describing the compatibility issue with the previous version of this specification (1.6)
- New attributes are added in RequestDispatcher.forward method (8.4.2)
- New methods in ServletRequest interface and ServletRequestWrapper (14.2.16.1)
- The interface SingleThreadModel was deprecated ((2.2.1, 2.3.3.1, 14.2.24)
- Change the name of the method ServletRequestEvent.getRequest to ServletRequestEvent.getServletRequest (14.2.19.2)
- Clarification of the “request” to access to WEB-INF directory (9.5)
- Clarification of the behavior of ServletRequest.setAttribute - change “value” to “object” in “If the value passed in is null,” (14.2.16.1)
- Fix the inconsistency between this specification and HttpServletRequest, getServletPath - the return value starts with “/” (15.1.3.2)
- Fix the inconsistency between this specification and HttpServletRequest.getPathInfo - the return value starts with “/” (15.1.3.2)
- Fix the inconsistency between this specification and HttpServletRequest.getPathTranslated - add the case when the container cannot translate the path (15.1.3.2)
- Allow HttpServletRequest.getAuthType to return not only pre-defined four authentication scheme but also the container-specific scheme (15.1.3.2)
- Change the behavior of ttpSessionListener.sessionDestroyed to notify before the session is invalidated (15.1.14.1)
- Fix the wrong status code of 403 to 404 (9.5, 9.6)
- Element “taglib” should be “jsp-config” (13.2)
- Fix the version number of JSP specification to 2.0
- Fix the wrong formats (5.5, 6.2.5, 12.8.3, 12.9)
- HTTP/1.1 is now required (1.2)
- <url-pattern> in <web-resource-collection> is mandatory (13.4)
- Clarification of IllegalArgumentException in the distributed environments (7.7.2)
- Clarification of error page handling (9.9.1, 9.9.2, 9.9.3, 6.2.5)
- Clarification of Security Constraints, especially in the case of overlapping constraints (12.8)
- Clarification of the case when <session-timeout> element is not specified (13.4)
- Clarification of the case when the resource is permanently unavailable (2.3.3.2)
- Add missing getParameterMap() in the enumerated list (4.1)
- Clarification of the status code when /WEB-INF/ resource is accessed (9.5)
- Clarification of the status code when /META-INF/ resource is accessed (9.6)
- Change xsd:string to j2ee:string in deployment descriptor (13.4)
- Extensibility of deployment descriptors (SRV.13)
- XML Schema definition of deployment descriptor (SRV.13)
- Request listeners (SRV.10 and API change)
  New API: ServletRequestListener, ServletRequestAttributeListener and associated event classes
- Ability to use Filters under the Request Dispatcher (6.2.5)

- Required class loader extension mechanism (9.7.1)
- Listener exception handling (10.6)
- Listener order vs. servlet init()/destroy() clarification (ServletContextListener javadoc change)
- Servlets mapped to WEB-INF / response handling (9.5)
- Request dispatcher / path matching rules (8.1)
- Welcome files can be servlets (9.10)
- Internationalization enhancements (5.4, 14,2,22, 15.1.5)
- SC_FOUND(302) addition (15.1.5)
- "Relative path" in getRequestDispatcher() must be relative against the current servlet (8.1)
- Bug fix in the example of XML (13.7.2)
- Clarification of access by getResource "only to the resource" (3.5)
- Clarification of SERVER_NAME and SERVER_PORT in getServerName() and getServerPort() (14.2.16)
- Clarification: "run-as" identity must apply to all calls from a servlet including init() and destroy() (12.7)
- Login/logout description and methods added (12.10, 15.1.7)

APPENDIX **B**

Deployment Descriptor Version 2.2

This appendix defines the deployment descriptor for version 2.2. All web containers are required to support web applications using the 2.2 deployment descriptor.

B.1 Deployment Descriptor DOCTYPE

All valid web application deployment descriptors must contain the following DOCTYPE declaration:

```
<!DOCTYPE web-app PUBLIC "-//Sun Microsystems, Inc.//DTD Web
Application 2.2//EN" "http://java.sun.com/j2ee/dtds/web-
app_2_2.dtd">
```

B.2 DTD

The DTD that follows defines the XML grammar for a web application deployment descriptor.

CODE EXAMPLE B-1 Version 2.2 DTD

```
<!--
The web-app element is the root of the deployment descriptor for a web
application
-->
<!ELEMENT web-app (icon?, display-name?, description?, distributable?, context-
param*, servlet*, servlet-mapping*, session-config?, mime-mapping*, welcome-
file-list?, error-page*, taglib*, resource-ref*, security-constraint*, login-
config?, security-role*, env-entry*, ejb-ref*)>
```

CODE EXAMPLE B-1 Version 2.2 DTD

```
<!--
The icon element contains a small-icon and a large-icon element
which specify the location within the web application for a small and
large image used to represent the web application in a GUI tool. At a
minimum, tools must accept GIF and JPEG format images.
-->
<!ELEMENT icon (small-icon?, large-icon?)>
<!--
The small-icon element contains the location within the web
application of a file containing a small (16x16 pixel) icon image.
-->
<!ELEMENT small-icon (#PCDATA)>
<!--
The large-icon element contains the location within the web
application of a file containing a large (32x32 pixel) icon image.
-->
<!ELEMENT large-icon (#PCDATA)>
<!--
The display-name element contains a short name that is intended
to be displayed by GUI tools
-->
<!ELEMENT display-name (#PCDATA)>
<!--
The description element is used to provide descriptive text about
the parent element.
-->
<!ELEMENT description (#PCDATA)>
<!--
The distributable element, by its presence in a web application
deployment descriptor, indicates that this web application is
programmed appropriately to be deployed into a distributed servlet
container
-->
<!ELEMENT distributable EMPTY>
<!--
The context-param element contains the declaration of a web
application's servlet context initialization parameters.
-->
<!ELEMENT context-param (param-name, param-value, description?)>
<!--
The param-name element contains the name of a parameter.
-->
<!ELEMENT param-name (#PCDATA)>
<!--
The param-value element contains the value of a parameter.
-->
<!ELEMENT param-value (#PCDATA)>
```

CODE EXAMPLE B-1 Version 2.2 DTD

```
<!--
The servlet element contains the declarative data of a
servlet.
If a jsp-file is specified and the load-on-startup element is present, then the
JSP should be precompiled and loaded.
-->
<!ELEMENT servlet (icon?, servlet-name, display-name?, description?, (servlet-
class|jsp-file), init-param*, load-on-startup?, security-role-ref*)>
<!--
The servlet-name element contains the canonical name of the
servlet.
-->
<!ELEMENT servlet-name (#PCDATA)>
<!--
The servlet-class element contains the fully qualified class name
of the servlet.
-->
<!ELEMENT servlet-class (#PCDATA)>
<!--
The jsp-file element contains the full path to a JSP file within
the web application.
-->
<!ELEMENT jsp-file (#PCDATA)>
<!--
The init-param element contains a name/value pair as an initialization param of
the servlet
-->
<!ELEMENT init-param (param-name, param-value, description?)>
<!--
The load-on-startup element indicates that this servlet should be
loaded on the startup of the web application.
The optional contents of these element must be a positive integer indicating the
order in which the servlet should be loaded.
Lower integers are loaded before higher integers.
If no value is specified, or if the value specified is not a positive integer,
the container is free to load it at any time in the startup sequence.
-->
<!ELEMENT load-on-startup (#PCDATA)>
<!--
The servlet-mapping element defines a mapping between a servlet and a url pattern
-->
<!ELEMENT servlet-mapping (servlet-name, url-pattern)>
<!--
The url-pattern element contains the url pattern of the
mapping. Must follow the rules specified in Section 10 of the Servlet
API Specification.
-->
```

CODE EXAMPLE B-1 Version 2.2 DTD

```
<!ELEMENT url-pattern (#PCDATA)>
<!--
The session-config element defines the session parameters for this web
application.
-->
<!ELEMENT session-config (session-timeout?)>
<!--
The session-timeout element defines the default session timeout interval for all
sessions created in this web application.
The specified timeout must be expressed in a whole number of minutes.
-->
<!ELEMENT session-timeout (#PCDATA)>
<!--
The mime-mapping element defines a mapping between an extension and a mime type.
-->
<!ELEMENT mime-mapping (extension, mime-type)>
<!--
The extension element contains a string describing an
extension. example: "txt"
-->
<!ELEMENT extension (#PCDATA)>
<!--
The mime-type element contains a defined mime type. example: "text/plain"
-->
<!ELEMENT mime-type (#PCDATA)>
<!--
The welcome-file-list contains an ordered list of welcome files elements.
-->
<!ELEMENT welcome-file-list (welcome-file+)>
<!--
The welcome-file element contains file name to use as a default welcome file,
such as index.html
-->
<!ELEMENT welcome-file (#PCDATA)>
<!--
The taglib element is used to describe a JSP tag library.
-->
<!ELEMENT taglib (taglib-uri, taglib-location)>
<!--
The taglib-uri element describes a URI, relative to the location of the web.xml
document, identifying a Tag Library used in the Web Application.
-->
<!ELEMENT taglib-uri (#PCDATA)>
<!--
the taglib-location element contains the location (as a resource
relative to the root of the web application) where to find the Tag
Libary Description file for the tag library.
```

CODE EXAMPLE B-1 Version 2.2 DTD

```
-->
<!ELEMENT taglib-location (#PCDATA)>
<!--
The error-page element contains a mapping between an error code or exception
type to the path of a resource in the web application
-->
<!ELEMENT error-page ((error-code | exception-type), location)>
<!--
The error-code contains an HTTP error code, ex: 404
-->
<!ELEMENT error-code (#PCDATA)>
<!--
The exception type contains a fully qualified class name of a Java exception
type.
-->
<!ELEMENT exception-type (#PCDATA)>
<!--
The location element contains the location of the resource in the web application
-->
<!ELEMENT location (#PCDATA)>
<!--
The resource-ref element contains a declaration of a Web Application’s reference
to an external resource.
-->
<!ELEMENT resource-ref (description?, res-ref-name, res-type, res-auth)>
<!--
The res-ref-name element specifies the name of the resource factory reference
name.
-->
<!ELEMENT res-ref-name (#PCDATA)>
<!--
The res-type element specifies the (Java class) type of the data source.
-->
<!ELEMENT res-type (#PCDATA)>
<!--
The res-auth element indicates whether the application component code performs
resource signon programmatically or whether the container signs onto the
resource based on the principle mapping information supplied by the deployer.

Must be CONTAINER or SERVLET
-->
<!ELEMENT res-auth (#PCDATA)>
<!--
The security-constraint element is used to associate security constraints with
one or more web resource collections
-->
```

CODE EXAMPLE B-1 Version 2.2 DTD

```
<!ELEMENT security-constraint (web-resource-collection+, auth-constraint?,
user-data-constraint?)>
<!--
The web-resource-collection element is used to identify a subset of the resources
and HTTP methods on those resources within a web application to which a security
constraint applies.
If no HTTP methods are specified, then the security constraint applies to all
HTTP methods.
-->
<!ELEMENT web-resource-collection (web-resource-name, description?, url-
pattern*, http-method*)>
<!--
The web-resource-name contains the name of this web resource collection
-->
<!ELEMENT web-resource-name (#PCDATA)>
<!--
The http-method contains an HTTP method (GET | POST |...)
-->
<!ELEMENT http-method (#PCDATA)>
<!--
The user-data-constraint element is used to indicate how data communicated
between the client and container should be protected
-->
<!ELEMENT user-data-constraint (description?, transport-guarantee)>
<!--
The transport-guarantee element specifies that the communication between client
and server should be NONE, INTEGRAL, or CONFIDENTIAL.
NONE means that the application does not require any transport guarantees.
A value of INTEGRAL means that the application requires that the data sent
between the client and server be sent in such a way that it can’t be changed in
transit.
CONFIDENTIAL means that the application requires that the data be transmitted
in a fashion that prevents other entities from observing the contents of the
transmission.
In most cases, the presence of the INTEGRAL or CONFIDENTIAL flag will indicate
that the use of SSL is required.
-->
<!ELEMENT transport-guarantee (#PCDATA)>
<!--
The auth-constraint element indicates the user roles that should be permitted
access to this resource collection.
The role used here must appear in a security-role-ref element.
-->
<!ELEMENT auth-constraint (description?, role-name*)>
<!--
The role-name element contains the name of a security role.
-->
```

CODE EXAMPLE B-1 Version 2.2 DTD

```
<!ELEMENT role-name (#PCDATA)>
<!--
The login-config element is used to configure the authentication method that
should be used, the realm name that should be used for this application, and the
attributes that are needed by the form login mechanism.
-->
<!ELEMENT login-config (auth-method?, realm-name?, form-login-config?)>
<!--
The realm name element specifies the realm name to use in HTTP Basic
authorization
-->
<!ELEMENT realm-name (#PCDATA)>
<!--
The form-login-config element specifies the login and error pages that should
be used in form based login.
If form based authentication is not used, these elements are ignored.
-->
<!ELEMENT form-login-config (form-login-page, form-error-page)>
<!--
The form-login-page element defines the location in the web app where the page
that can be used for login can be found
-->
<!ELEMENT form-login-page (#PCDATA)>
<!--
The form-error-page element defines the location in the web app where the error
page that is displayed when login is not successful can be found
-->
<!ELEMENT form-error-page (#PCDATA)>
<!--
The auth-method element is used to configure the authentication mechanism for
the web application.
As a prerequisite to gaining access to any web resources which are protected by
an authorization constraint, a user must have  mechanism.
Legal values for this element are "BASIC", "DIGEST", "FORM", or "CLIENT-CERT".
-->
<!ELEMENT auth-method (#PCDATA)>
<!--
The security-role element contains the declaration of a security role which is
used in the security-constraints placed on the web application.
-->
<!ELEMENT security-role (description?, role-name)>
<!--
The role-name element contains the name of a role. This element must contain a
non-empty string.
-->
<!ELEMENT security-role-ref (description?, role-name, role-link)>
<!--
```

CODE EXAMPLE B-1 Version 2.2 DTD

```
The role-link element is used to link a security role reference to a defined
security role.
The role-link element must contain the name of one of the security roles defined
in the security-role elements.
-->
<!ELEMENT role-link (#PCDATA)>
<!--
The env-entry element contains the declaration of an application’s environment
entry.
This element is required to be honored on in J2EE compliant servlet containers.
-->
<!ELEMENT env-entry (description?, env-entry-name, env-entry-value?, env-entry-
type)>
<!--
The env-entry-name contains the name of an application’s environment entry
-->
<!ELEMENT env-entry-name (#PCDATA)>
<!--
The env-entry-value element contains the value of an application’s environment
entry
-->
<!ELEMENT env-entry-value (#PCDATA)>
<!--
The env-entry-type element contains the fully qualified Java type of the
environment entry value that is expected by the application
code.
The following are the legal values of env-entry-type: java.lang.Boolean,
java.lang.String, java.lang.Integer, java.lang.Double, java.lang.Float.
-->
<!ELEMENT env-entry-type (#PCDATA)>
<!--
The ejb-ref element is used to declare a reference to an enterprise bean.
-->
<!ELEMENT ejb-ref (description?, ejb-ref-name, ejb-ref-type, home, remote, ejb-
link?)>
<!--
The ejb-ref-name element contains the name of an EJB
reference. This is the JNDI name that the servlet code uses to get a
reference to the enterprise bean.
-->
<!ELEMENT ejb-ref-name (#PCDATA)>
<!--
The ejb-ref-type element contains the expected java class type of the referenced
EJB.
-->
<!ELEMENT ejb-ref-type (#PCDATA)>
<!--
```

CODE EXAMPLE B-1 Version 2.2 DTD

```
The ejb-home element contains the fully qualified name of the EJB’s home
interface
-->
<!ELEMENT home (#PCDATA)>
<!--
The ejb-remote element contains the fully qualified name of the EJB’s remote
interface
-->
<!ELEMENT remote (#PCDATA)>
<!--
The ejb-link element is used in the ejb-ref element to specify that an EJB
reference is linked to an EJB in an encompassing Java2 Enterprise Edition (J2EE)
application package.
The value of the ejb-link element must be the ejb-name of and EJB in the J2EE
application package.
-->
<!ELEMENT ejb-link (#PCDATA)>
<!--
The ID mechanism is to allow tools to easily make tool-specific references to
the elements of the deployment descriptor.
This allows tools that produce additional deployment information (i.e
information beyond the standard deployment descriptor information) to store the
non-standard information in a separate file, and easily refer from these tools-
specific files to the information in the standard web-app deployment descriptor.
-->
<!ATTLIST web-app id ID #IMPLIED>
<!ATTLIST icon id ID #IMPLIED>
<!ATTLIST small-icon id ID #IMPLIED>
<!ATTLIST large-icon id ID #IMPLIED>
<!ATTLIST display-name id ID #IMPLIED>
<!ATTLIST description id ID #IMPLIED>
<!ATTLIST distributable id ID #IMPLIED>
<!ATTLIST context-param id ID #IMPLIED>
<!ATTLIST param-name id ID #IMPLIED>
<!ATTLIST param-value id ID #IMPLIED>
<!ATTLIST servlet id ID #IMPLIED>
<!ATTLIST servlet-name id ID #IMPLIED>
<!ATTLIST servlet-class id ID #IMPLIED>
<!ATTLIST jsp-file id ID #IMPLIED>
<!ATTLIST init-param id ID #IMPLIED>
<!ATTLIST load-on-startup id ID #IMPLIED>
<!ATTLIST servlet-mapping id ID #IMPLIED>
<!ATTLIST url-pattern id ID #IMPLIED>
<!ATTLIST session-config id ID #IMPLIED>
<!ATTLIST session-timeout id ID #IMPLIED>
<!ATTLIST mime-mapping id ID #IMPLIED>
<!ATTLIST extension id ID #IMPLIED>
```

CODE EXAMPLE B-1 Version 2.2 DTD

```
<!ATTLIST mime-type id ID #IMPLIED>
<!ATTLIST welcome-file-list id ID #IMPLIED>
<!ATTLIST welcome-file id ID #IMPLIED>
<!ATTLIST taglib id ID #IMPLIED>
<!ATTLIST taglib-uri id ID #IMPLIED>
<!ATTLIST taglib-location id ID #IMPLIED>
<!ATTLIST error-page id ID #IMPLIED>
<!ATTLIST error-code id ID #IMPLIED>
<!ATTLIST exception-type id ID #IMPLIED>
<!ATTLIST location id ID #IMPLIED>
<!ATTLIST resource-ref id ID #IMPLIED>
<!ATTLIST res-ref-name id ID #IMPLIED>
<!ATTLIST res-type id ID #IMPLIED>
<!ATTLIST res-auth id ID #IMPLIED>
<!ATTLIST security-constraint id ID #IMPLIED>
<!ATTLIST web-resource-collection id ID #IMPLIED>
<!ATTLIST web-resource-name id ID #IMPLIED>
<!ATTLIST http-method id ID #IMPLIED>
<!ATTLIST user-data-constraint id ID #IMPLIED>
<!ATTLIST transport-guarantee id ID #IMPLIED>
<!ATTLIST auth-constraint id ID #IMPLIED>
<!ATTLIST role-name id ID #IMPLIED>
<!ATTLIST login-config id ID #IMPLIED>
<!ATTLIST realm-name id ID #IMPLIED>
<!ATTLIST form-login-config id ID #IMPLIED>
<!ATTLIST form-login-page id ID #IMPLIED>
<!ATTLIST form-error-page id ID #IMPLIED>
<!ATTLIST auth-method id ID #IMPLIED>
<!ATTLIST security-role id ID #IMPLIED>
<!ATTLIST security-role-ref id ID #IMPLIED>
<!ATTLIST role-link id ID #IMPLIED>
<!ATTLIST env-entry id ID #IMPLIED>
<!ATTLIST env-entry-name id ID #IMPLIED>
<!ATTLIST env-entry-value id ID #IMPLIED>
<!ATTLIST env-entry-type id ID #IMPLIED>
<!ATTLIST ejb-ref id ID #IMPLIED>
<!ATTLIST ejb-ref-name id ID #IMPLIED>
<!ATTLIST ejb-ref-type id ID #IMPLIED>
<!ATTLIST home id ID #IMPLIED>
<!ATTLIST remote id ID #IMPLIED>
<!ATTLIST ejb-link id ID #IMPLIED>
```

APPENDIX **C**

Version 2.3 Deployment Descriptor

This appendix defines the deployment descriptor for version 2.3. All web containers are required to support web applications using the 2.3 deployment descriptor.

C.1 Deployment Descriptor DOCTYPE

All valid web application deployment descriptors for version 2.3 of this specification must contain the following `DOCTYPE` declaration:

```
<!DOCTYPE web-app PUBLIC "-//Sun Microsystems, Inc.//DTD Web
Application 2.3//EN" "http://java.sun.com/dtd/web-app_2_3.dtd">
```

C.2 DTD

The DTD that follows defines the XML grammar for a web application deployment descriptor.

CODE EXAMPLE C-1 Version 2.3 DTD

```
<!--
The web-app element is the root of the deployment descriptor for
a web application.
-->
<!ELEMENT web-app (icon?, display-name?, description?, distributable?, context-
param*, filter*, filter-mapping*, listener*, servlet*, servlet-mapping*,
session-config?, mime-mapping*, welcome-file-list?, error-page*, taglib*,
resource-env-ref*, resource-ref*, security-constraint*, login-config?,
security-role*, env-entry*, ejb-ref*,  ejb-local-ref*)>
```

CODE EXAMPLE C-1 Version 2.3 DTD

```
<!--
The auth-constraint element indicates the user roles that should
be permitted access to this resource collection. The role-name
used here must either correspond to the role-name of one of the
security-role elements defined for this web application, or be
the specially reserved role-name "*" that is a compact syntax for
indicating all roles in the web application. If both "*" and
rolenames appear, the container interprets this as all roles.
If no roles are defined, no user is allowed access to the portion of
the web application described by the containing security-constraint.
The container matches role names case sensitively when determining
access.

Used in: security-constraint
-->
<!ELEMENT auth-constraint (description?, role-name*)>
<!--
The auth-method element is used to configure the authentication
mechanism for the web application. As a prerequisite to gaining access to any
web resources which are protected by an authorization
constraint, a user must have authenticated using the configured
mechanism. Legal values for this element are "BASIC", "DIGEST",
"FORM", or "CLIENT-CERT".

Used in: login-config
-->
<!ELEMENT auth-method (#PCDATA)>
<!--
The context-param element contains the declaration of a web
application’s servlet context initialization parameters.

Used in: web-app
-->
<!ELEMENT context-param (param-name, param-value, description?)>
<!--
The description element is used to provide text describing the parent
element.  The description element should include any information that
the web application war file producer wants to provide to the consumer of the
web application war file (i.e., to the Deployer). Typically, the tools used by
the web application war file consumer will display the description when
processing the parent element that contains the description.

Used in: auth-constraint, context-param, ejb-local-ref, ejb-ref,
env-entry, filter, init-param, resource-env-ref, resource-ref, run-as,
security-role, security-role-ref, servlet, user-data-constraint, web-app, web-
resource-collection
-->
```

CODE EXAMPLE C-1 Version 2.3 DTD

```
<!ELEMENT description (#PCDATA)>
<!--
The display-name element contains a short name that is intended to be
displayed by tools.  The display name need not be unique.

Used in: filter, security-constraint, servlet, web-app

Example:

<display-name>Employee Self Service</display-name>
-->
<!ELEMENT display-name (#PCDATA)>
<!--
The distributable element, by its presence in a web application
deployment descriptor, indicates that this web application is
programmed appropriately to be deployed into a distributed servlet
container

Used in: web-app
-->
<!ELEMENT distributable EMPTY>
<!--
The ejb-link element is used in the ejb-ref or ejb-local-ref
elements to specify that an EJB reference is linked to an
enterprise bean.

The name in the ejb-link element is composed of a
path name specifying the ejb-jar containing the referenced enterprise bean with
the ejb-name of the target bean appended and separated from the path name by
"#".  The path name is relative to the war file containing the web application
that is referencing the enterprise bean.
This allows multiple enterprise beans with the same ejb-name to be
uniquely identified.

Used in: ejb-local-ref, ejb-ref

Examples:

    <ejb-link>EmployeeRecord</ejb-link>

    <ejb-link>../products/product.jar#ProductEJB</ejb-link>

-->
<!ELEMENT ejb-link (#PCDATA)>
<!--
The ejb-local-ref element is used for the declaration of a reference to an
enterprise bean's local home. The declaration consists of:
```

CODE EXAMPLE C-1 Version 2.3 DTD

```
    - an optional description
    - the EJB reference name used in the code of the web application
      that's referencing the enterprise bean
    - the expected type of the referenced enterprise bean
    - the expected local home and local interfaces of the referenced
      enterprise bean
    - optional ejb-link information, used to specify the referenced
      enterprise bean

Used in: web-app
-->
<!ELEMENT ejb-local-ref (description?, ejb-ref-name, ejb-ref-type, local-home,
local, ejb-link?)>
<!--
The ejb-ref element is used for the declaration of a reference to
an enterprise bean's home. The declaration consists of:

    - an optional description
    - the EJB reference name used in the code of
      the web application that's referencing the enterprise bean
    - the expected type of the referenced enterprise bean
    - the expected home and remote interfaces of the referenced
      enterprise bean
    - optional ejb-link information, used to specify the referenced
      enterprise bean

Used in: web-app
-->
<!ELEMENT ejb-ref (description?, ejb-ref-name, ejb-ref-type, home, remote, ejb-
link?)>
<!--
The ejb-ref-name element contains the name of an EJB reference. The
EJB reference is an entry in the web application's environment and is
relative to the java:comp/env context.  The name must be unique
within the web application.

It is recommended that name is prefixed with "ejb/".

Used in: ejb-local-ref, ejb-ref

Example:

<ejb-ref-name>ejb/Payroll</ejb-ref-name>
-->
<!ELEMENT ejb-ref-name (#PCDATA)>
<!--
```

CODE EXAMPLE C-1 Version 2.3 DTD

```
The ejb-ref-type element contains the expected type of the
referenced enterprise bean.

The ejb-ref-type element must be one of the following:

    <ejb-ref-type>Entity</ejb-ref-type>
    <ejb-ref-type>Session</ejb-ref-type>

Used in: ejb-local-ref, ejb-ref
-->
<!ELEMENT ejb-ref-type (#PCDATA)>
<!--
The env-entry element contains the declaration of a web application’s
environment entry. The declaration consists of an optional
description, the name of the environment entry, and an optional
value.  If a value is not specified, one must be supplied
during deployment.
-->
<!ELEMENT env-entry (description?, env-entry-name, env-entry-value?, env-entry-
type)>
<!--
The env-entry-name element contains the name of a web applications’s
environment entry.  The name is a JNDI name relative to the
java:comp/env context.  The name must be unique within a web application.

Example:

<env-entry-name>minAmount</env-entry-name>

Used in: env-entry
-->
<!ELEMENT env-entry-name (#PCDATA)>
<!--
The env-entry-type element contains the fully-qualified Java type of
the environment entry value that is expected by the web application’s
code.

The following are the legal values of env-entry-type:

    java.lang.Boolean
    java.lang.Byte
    java.lang.Character
    java.lang.String
    java.lang.Short
    java.lang.Integer
    java.lang.Long
    java.lang.Float
```

CODE EXAMPLE C-1 Version 2.3 DTD

```
    java.lang.Double

Used in: env-entry
-->
<!ELEMENT env-entry-type (#PCDATA)>
<!--
The env-entry-value element contains the value of a web application’s
environment entry. The value must be a String that is valid for the
constructor of the specified type that takes a single String
parameter, or for java.lang.Character, a single character.

Example:

<env-entry-value>100.00</env-entry-value>

Used in: env-entry
-->
<!ELEMENT env-entry-value (#PCDATA)>
<!--
The error-code contains an HTTP error code, ex: 404

Used in: error-page
-->
<!ELEMENT error-code (#PCDATA)>
<!--
The error-page element contains a mapping between an error code
or exception type to the path of a resource in the web application

Used in: web-app
-->
<!ELEMENT error-page ((error-code | exception-type), location)>
<!--
The exception type contains a fully qualified class name of a
Java exception type.

Used in: error-page
-->
<!ELEMENT exception-type (#PCDATA)>
<!--
The extension element contains a string describing an
extension. example: "txt"

Used in: mime-mapping
-->
<!ELEMENT extension (#PCDATA)>
<!--
Declares a filter in the web application. The filter is mapped to
```

CODE EXAMPLE C-1 Version 2.3 DTD

```
either a servlet or a URL pattern in the filter-mapping element, using the
filter-name value to reference. Filters can access the
initialization parameters declared in the deployment descriptor at
runtime via the FilterConfig interface.

Used in: web-app
-->
<!ELEMENT filter (icon?, filter-name, display-name?, description?, filter-
class, init-param*)>
<!--
The fully qualified classname of the filter.

Used in: filter
-->
<!ELEMENT filter-class (#PCDATA)>
<!--
Declaration of the filter mappings in this web application. The
container uses the filter-mapping declarations to decide which filters to apply
to a request, and in what order. The container matches the request URI to a
Servlet in the normal way. To determine which filters to apply it matches filter-
mapping declarations either on servlet-name, or on url-pattern for each filter-
mapping element, depending on which style is used. The order in which filters
are invoked is the order in which filter-mapping declarations that match a
request URI for a servlet appear in the list of filter-mapping elements.The
filter-name value must be the value of the <filter-name> sub-elements of one of
the <filter> declarations in the deployment descriptor.

Used in: web-app
-->
<!ELEMENT filter-mapping (filter-name, (url-pattern | servlet-name))>
<!--
The logical name of the filter. This name is used to map the filter.
Each filter name is unique within the web application.

Used in: filter, filter-mapping
-->
<!ELEMENT filter-name (#PCDATA)>
<!--
The form-error-page element defines the location in the web app
where the error page that is displayed when login is not successful
can be found. The path begins with a leading / and is interpreted
relative to the root of the WAR.

Used in: form-login-config
-->
<!ELEMENT form-error-page (#PCDATA)>
<!--
```

CODE EXAMPLE C-1 Version 2.3 DTD

```
The form-login-config element specifies the login and error pages
that should be used in form based login. If form based authentication
is not used, these elements are ignored.

Used in: login-config
-->
<!ELEMENT form-login-config (form-login-page, form-error-page)>
<!--
The form-login-page element defines the location in the web app
where the page that can be used for login can be found. The path
begins with a leading / and is interpreted relative to the root of the WAR.

Used in: form-login-config
-->
<!ELEMENT form-login-page (#PCDATA)>
<!--
The home element contains the fully-qualified name of the enterprise
bean's home interface.

Used in: ejb-ref

Example:

<home>com.aardvark.payroll.PayrollHome</home>
-->
<!ELEMENT home (#PCDATA)>
<!--
The http-method contains an HTTP method (GET | POST |...).

Used in: web-resource-collection
-->
<!ELEMENT http-method (#PCDATA)>
<!--
The icon element contains small-icon and large-icon elements that
specify the file names for small and a large GIF or JPEG icon images
used to represent the parent element in a GUI tool.

Used in: filter, servlet, web-app
-->
<!ELEMENT icon (small-icon?, large-icon?)>
<!--
The init-param element contains a name/value pair as an
initialization param of the servlet

Used in: filter, servlet
-->
<!ELEMENT init-param (param-name, param-value, description?)>
```

CODE EXAMPLE C-1 Version 2.3 DTD

```
<!--
The jsp-file element contains the full path to a JSP file within
the web application beginning with a '/'.

Used in: servlet
-->
<!ELEMENT jsp-file (#PCDATA)>
<!--
The large-icon element contains the name of a file
containing a large (32 x 32) icon image. The file
name is a relative path within the web application's
war file.

The image may be either in the JPEG or GIF format.
The icon can be used by tools.

Used in: icon

Example:

<large-icon>employee-service-icon32x32.jpg</large-icon>
-->
<!ELEMENT large-icon (#PCDATA)>
<!--
The listener element indicates the deployment properties for a web
application listener bean.

Used in: web-app
-->
<!ELEMENT listener (listener-class)>
<!--
The listener-class element declares a class in the application must be registered
as a web application listener bean. The value is the fully qualified classname
of the listener class.

Used in: listener
-->
<!ELEMENT listener-class (#PCDATA)>
<!--
The load-on-startup element indicates that this servlet should be
loaded (instantiated and have its init() called) on the startup
of the web application. The optional contents of
these element must be an integer indicating the order in which
the servlet should be loaded. If the value is a negative integer,
or the element is not present, the container is free to load the
servlet whenever it chooses. If the value is a positive integer
or 0, the container must load and initialize the servlet as the
```

CODE EXAMPLE C-1 Version 2.3 DTD

```
application is deployed. The container must guarantee that
servlets marked with lower integers are loaded before servlets
marked with higher integers. The container may choose the order
of loading of servlets with the same load-on-start-up value.

Used in: servlet
-->
<!ELEMENT load-on-startup (#PCDATA)>
<!--

The local element contains the fully-qualified name of the
enterprise bean's local interface.

Used in: ejb-local-ref
-->
<!ELEMENT local (#PCDATA)>
<!--
The local-home element contains the fully-qualified name of the
enterprise bean's local home interface.

Used in: ejb-local-ref
-->
<!ELEMENT local-home (#PCDATA)>
<!--
The location element contains the location of the resource in the web
application relative to the root of the web application. The value of
the location must have a leading '/'.

Used in: error-page
-->
<!ELEMENT location (#PCDATA)>
<!--
The login-config element is used to configure the authentication
method that should be used, the realm name that should be used for
this application, and the attributes that are needed by the form login mechanism.

Used in: web-app
-->
<!ELEMENT login-config (auth-method?, realm-name?, form-login-config?)>
<!--
The mime-mapping element defines a mapping between an extension
and a mime type.

Used in: web-app
-->
<!ELEMENT mime-mapping (extension, mime-type)>
<!--
```

CODE EXAMPLE C-1 Version 2.3 DTD

```
The mime-type element contains a defined mime type. example:
"text/plain"

Used in: mime-mapping
-->
<!ELEMENT mime-type (#PCDATA)>
<!--
The param-name element contains the name of a parameter. Each parameter name
must be unique in the web application.

Used in: context-param, init-param
-->
<!ELEMENT param-name (#PCDATA)>
<!--
The param-value element contains the value of a parameter.

Used in: context-param, init-param
-->
<!ELEMENT param-value (#PCDATA)>

<!--
The realm name element specifies the realm name to use in HTTP
Basic authorization.

Used in: login-config
-->
<!ELEMENT realm-name (#PCDATA)>
<!--
The remote element contains the fully-qualified name of the enterprise bean's
remote interface.

Used in: ejb-ref

Example:

<remote>com.wombat.empl.EmployeeService</remote>
-->
<!ELEMENT remote (#PCDATA)>
<!--
The res-auth element specifies whether the web application code signs
on programmatically to the resource manager, or whether the Container
will sign on to the resource manager on behalf of the web application. In the
latter case, the Container uses information that is supplied by the Deployer.

The value of this element must be one of the two following:

    <res-auth>Application</res-auth>
```

CODE EXAMPLE C-1 Version 2.3 DTD

```
    <res-auth>Container</res-auth>

Used in: resource-ref
-->
<!ELEMENT res-auth (#PCDATA)>
<!--
The res-ref-name element specifies the name of a resource manager
connection factory reference.  The name is a JNDI name relative to the
java:comp/env context.  The name must be unique within a web application.

Used in: resource-ref
-->
<!ELEMENT res-ref-name (#PCDATA)>

<!--
The res-sharing-scope element specifies whether connections obtained
through the given resource manager connection factory reference can be
shared. The value of this element, if specified, must be one of the
two following:

    <res-sharing-scope>Shareable</res-sharing-scope>
    <res-sharing-scope>Unshareable</res-sharing-scope>

The default value is Shareable.

Used in: resource-ref
-->
<!ELEMENT res-sharing-scope (#PCDATA)>
<!--
The res-type element specifies the type of the data source. The type
is specified by the fully qualified Java language class or interface
expected to be implemented by the data source.

Used in: resource-ref
-->
<!ELEMENT res-type (#PCDATA)>
<!--
The resource-env-ref element contains a declaration of a web application's
reference to an administered object associated with a resource in the web
application's environment.  It consists of an optional description, the resource
environment reference name, and an indication of the resource environment
reference type expected by
the web application code.

Used in: web-app

Example:
```

CODE EXAMPLE C-1 Version 2.3 DTD

```
<resource-env-ref>
    <resource-env-ref-name>jms/StockQueue</resource-env-ref-name>
    <resource-env-ref-type>javax.jms.Queue</resource-env-ref-type>
</resource-env-ref>
-->
<!ELEMENT resource-env-ref (description?, resource-env-ref-name,
    resource-env-ref-type)>
<!--
The resource-env-ref-name element specifies the name of a resource
environment reference; its value is the environment entry name used in the web
application code.  The name is a JNDI name relative to the
java:comp/env context and must be unique within a web application.

Used in: resource-env-ref
-->
<!ELEMENT resource-env-ref-name (#PCDATA)>
<!--
The resource-env-ref-type element specifies the type of a resource
environment reference.  It is the fully qualified name of a Java
language class or interface.

Used in: resource-env-ref
-->
<!ELEMENT resource-env-ref-type (#PCDATA)>
<!--
The resource-ref element contains a declaration of a web application's reference
to an external resource. It consists of an optional description, the resource
manager connection factory reference name, the indication of the resource
manager connection factory type expected by the web application code, the type
of authentication (Application or Container), and an optional specification of
the shareability of connections obtained from the resource (Shareable or
Unshareable).

Used in: web-app

Example:

    <resource-ref>
    <res-ref-name>jdbc/EmployeeAppDB</res-ref-name>
    <res-type>javax.sql.DataSource</res-type>
    <res-auth>Container</res-auth>
    <res-sharing-scope>Shareable</res-sharing-scope>
    </resource-ref>
-->
<!ELEMENT resource-ref (description?, res-ref-name, res-type, res-auth, res-
sharing-scope?)>
```

CODE EXAMPLE C-1 Version 2.3 DTD

```
<!--
The role-link element is a reference to a defined security role. The
role-link element must contain the name of one of the security roles
defined in the security-role elements.

Used in: security-role-ref
-->
<!ELEMENT role-link (#PCDATA)>
<!--
The role-name element contains the name of a security role.
The name must conform to the lexical rules for an NMTOKEN.

Used in: auth-constraint, run-as, security-role, security-role-ref
-->
<!ELEMENT role-name (#PCDATA)>
<!--
The run-as element specifies the run-as identity to be used for the
execution of the web application. It contains an optional description, and
the name of a security role.

Used in: servlet
-->
<!ELEMENT run-as (description?, role-name)>
<!--
The security-constraint element is used to associate security
constraints with one or more web resource collections

Used in: web-app
-->
<!ELEMENT security-constraint (display-name?, web-resource-collection+, auth-
constraint?, user-data-constraint?)>
<!--
The security-role element contains the definition of a security
role. The definition consists of an optional description of the
security role, and the security role name.

Used in: web-app

Example:

    <security-role>
    <description>
        This role includes all employees who are authorized
        to access the employee service application.
    </description>
    <role-name>employee</role-name>
    </security-role>
```

CODE EXAMPLE C-1 Version 2.3 DTD

```
-->
<!ELEMENT security-role (description?, role-name)>
<!--
The security-role-ref element contains the declaration of a security
role reference in the web application's code. The declaration consists
of an optional description, the security role name used in the code,
and an optional link to a security role. If the security role is not
specified, the Deployer must choose an appropriate security role.

The value of the role-name element must be the String used as the
parameter to the EJBContext.isCallerInRole(String roleName) method
or the HttpServletRequest.isUserInRole(String role) method.

Used in: servlet

-->
<!ELEMENT security-role-ref (description?, role-name, role-link?)>
<!--
The servlet element contains the declarative data of a
servlet. If a jsp-file is specified and the load-on-startup element is present,
then the JSP should be precompiled and loaded.

Used in: web-app
-->
<!ELEMENT servlet (icon?, servlet-name, display-name?, description?, (servlet-
class|jsp-file), init-param*, load-on-startup?, run-as?, security-role-ref*)>
<!--
The servlet-class element contains the fully qualified class name
of the servlet.

Used in: servlet
-->
<!ELEMENT servlet-class (#PCDATA)>
<!--
The servlet-mapping element defines a mapping between a servlet
and a url pattern

Used in: web-app
-->
<!ELEMENT servlet-mapping (servlet-name, url-pattern)>
<!--
The servlet-name element contains the canonical name of the
servlet. Each servlet name is unique within the web application.

Used in: filter-mapping, servlet, servlet-mapping
-->
<!ELEMENT servlet-name (#PCDATA)>
```

CODE EXAMPLE C-1 Version 2.3 DTD

```
<!--
The session-config element defines the session parameters for
this web application.

Used in: web-app
-->
<!ELEMENT session-config (session-timeout?)>
<!--
The session-timeout element defines the default session timeout
interval for all sessions created in this web application. The
specified timeout must be expressed in a whole number of minutes.
If the timeout is 0 or less, the container ensures the default
behaviour of sessions is never to time out.

Used in: session-config
-->
<!ELEMENT session-timeout (#PCDATA)>
<!--
The small-icon element contains the name of a file
containing a small (16 x 16) icon image. The file
name is a relative path within the web application's
war file.

The image may be either in the JPEG or GIF format.
The icon can be used by tools.

Used in: icon

Example:

<small-icon>employee-service-icon16x16.jpg</small-icon>
-->
<!ELEMENT small-icon (#PCDATA)>
<!--
The taglib element is used to describe a JSP tag library.

Used in: web-app
-->
<!ELEMENT taglib (taglib-uri, taglib-location)>

<!--
the taglib-location element contains the location (as a resource
relative to the root of the web application) where to find the Tag
Libary Description file for the tag library.

Used in: taglib
-->
```

CODE EXAMPLE C-1 Version 2.3 DTD

```
<!ELEMENT taglib-location (#PCDATA)>
<!--
The taglib-uri element describes a URI, relative to the location
of the web.xml document, identifying a Tag Library used in the Web
Application.

Used in: taglib
-->
<!ELEMENT taglib-uri (#PCDATA)>
<!--
The transport-guarantee element specifies that the communication
between client and server should be NONE, INTEGRAL, or
CONFIDENTIAL. NONE means that the application does not require any
transport guarantees. A value of INTEGRAL means that the application
requires that the data sent between the client and server be sent in
such a way that it can't be changed in transit. CONFIDENTIAL means
that the application requires that the data be transmitted in a
fashion that prevents other entities from observing the contents of
the transmission. In most cases, the presence of the INTEGRAL or
CONFIDENTIAL flag will indicate that the use of SSL is required.

Used in: user-data-constraint
-->
<!ELEMENT transport-guarantee (#PCDATA)>
<!--
The url-pattern element contains the url pattern of the mapping. Must
follow the rules specified in Section 11.2 of the Servlet API
Specification.

Used in: filter-mapping, servlet-mapping, web-resource-collection
-->
<!ELEMENT url-pattern (#PCDATA)>
<!--
The user-data-constraint element is used to indicate how data
communicated between the client and container should be protected.

Used in: security-constraint
-->
<!ELEMENT user-data-constraint (description?, transport-guarantee)>

<!--
The web-resource-collection element is used to identify a subset
of the resources and HTTP methods on those resources within a web
application to which a security constraint applies. If no HTTP methods are
specified, then the security constraint applies to all HTTP methods.

Used in: security-constraint
```

CODE EXAMPLE C-1 Version 2.3 DTD

```
-->
<!ELEMENT web-resource-collection (web-resource-name, description?, url-
pattern*, http-method*)>

<!--
The web-resource-name contains the name of this web resource
collection.

Used in: web-resource-collection
-->
<!ELEMENT web-resource-name (#PCDATA)>
<!--
The welcome-file element contains file name to use as a default
welcome file, such as index.html

Used in: welcome-file-list
-->
<!ELEMENT welcome-file (#PCDATA)>
<!--
The welcome-file-list contains an ordered list of welcome files
elements.

Used in: web-app
-->
<!ELEMENT welcome-file-list (welcome-file+)>
<!--
The ID mechanism is to allow tools that produce additional deployment
information (i.e., information beyond the standard deployment
descriptor information) to store the non-standard information in a
separate file, and easily refer from these tool-specific files to the
information in the standard deployment descriptor.

Tools are not allowed to add the non-standard information into the
standard deployment descriptor.
-->

<!ATTLIST auth-constraint id ID #IMPLIED>
<!ATTLIST auth-method id ID #IMPLIED>
<!ATTLIST context-param id ID #IMPLIED>
<!ATTLIST description id ID #IMPLIED>
<!ATTLIST display-name id ID #IMPLIED>
<!ATTLIST distributable id ID #IMPLIED>
<!ATTLIST ejb-link id ID #IMPLIED>
<!ATTLIST ejb-local-ref id ID #IMPLIED>
<!ATTLIST ejb-ref id ID #IMPLIED>
<!ATTLIST ejb-ref-name id ID #IMPLIED>
<!ATTLIST ejb-ref-type id ID #IMPLIED>
```

CODE EXAMPLE C-1 Version 2.3 DTD

```
<!ATTLIST env-entry id ID #IMPLIED>
<!ATTLIST env-entry-name id ID #IMPLIED>
<!ATTLIST env-entry-type id ID #IMPLIED>
<!ATTLIST env-entry-value id ID #IMPLIED>
<!ATTLIST error-code id ID #IMPLIED>
<!ATTLIST error-page id ID #IMPLIED>
<!ATTLIST exception-type id ID #IMPLIED>
<!ATTLIST extension id ID #IMPLIED>
<!ATTLIST filter id ID #IMPLIED>
<!ATTLIST filter-class id ID #IMPLIED>
<!ATTLIST filter-mapping id ID #IMPLIED>
<!ATTLIST filter-name id ID #IMPLIED>
<!ATTLIST form-error-page id ID #IMPLIED>
<!ATTLIST form-login-config id ID #IMPLIED>
<!ATTLIST form-login-page id ID #IMPLIED>
<!ATTLIST home id ID #IMPLIED>
<!ATTLIST http-method id ID #IMPLIED>
<!ATTLIST icon id ID #IMPLIED>
<!ATTLIST init-param id ID #IMPLIED>
<!ATTLIST jsp-file id ID #IMPLIED>
<!ATTLIST large-icon id ID #IMPLIED>
<!ATTLIST listener id ID #IMPLIED>
<!ATTLIST listener-class id ID #IMPLIED>
<!ATTLIST load-on-startup id ID #IMPLIED>
<!ATTLIST local id ID #IMPLIED>
<!ATTLIST local-home id ID #IMPLIED>
<!ATTLIST location id ID #IMPLIED>
<!ATTLIST login-config id ID #IMPLIED>
<!ATTLIST mime-mapping id ID #IMPLIED>
<!ATTLIST mime-type id ID #IMPLIED>
<!ATTLIST param-name id ID #IMPLIED>
<!ATTLIST param-value id ID #IMPLIED>
<!ATTLIST realm-name id ID #IMPLIED>
<!ATTLIST remote id ID #IMPLIED>
<!ATTLIST res-auth id ID #IMPLIED>
<!ATTLIST res-ref-name id ID #IMPLIED>
<!ATTLIST res-sharing-scope id ID #IMPLIED>
<!ATTLIST res-type id ID #IMPLIED>
<!ATTLIST resource-env-ref id ID #IMPLIED>
<!ATTLIST resource-env-ref-name id ID #IMPLIED>
<!ATTLIST resource-env-ref-type id ID #IMPLIED>
<!ATTLIST resource-ref id ID #IMPLIED>
<!ATTLIST role-link id ID #IMPLIED>
<!ATTLIST role-name id ID #IMPLIED>
<!ATTLIST run-as id ID #IMPLIED>
<!ATTLIST security-constraint id ID #IMPLIED>
<!ATTLIST security-role id ID #IMPLIED>
```

CODE EXAMPLE C-1 Version 2.3 DTD

```
<!ATTLIST security-role-ref id ID #IMPLIED>
<!ATTLIST servlet id ID #IMPLIED>
<!ATTLIST servlet-class id ID #IMPLIED>
<!ATTLIST servlet-mapping id ID #IMPLIED>
<!ATTLIST servlet-name id ID #IMPLIED>
<!ATTLIST session-config id ID #IMPLIED>
<!ATTLIST session-timeout id ID #IMPLIED>
<!ATTLIST small-icon id ID #IMPLIED>
<!ATTLIST taglib id ID #IMPLIED>
<!ATTLIST taglib-location id ID #IMPLIED>
<!ATTLIST taglib-uri id ID #IMPLIED>
<!ATTLIST transport-guarantee id ID #IMPLIED>
<!ATTLIST url-pattern id ID #IMPLIED>
<!ATTLIST user-data-constraint id ID #IMPLIED>
<!ATTLIST web-app id ID #IMPLIED>
<!ATTLIST web-resource-collection id ID #IMPLIED>
<!ATTLIST web-resource-name id ID #IMPLIED>
<!ATTLIST welcome-file id ID #IMPLIED>
<!ATTLIST welcome-file-list id ID #IMPLIED>
```

Glossary

A

Application Developer	The producer of a web application. The output of an Application Developer is a set of servlet classes, JSP pages, HTML pages, and supporting libraries and files (such as images, compressed archive files, etc.) for the web application. The Application Developer is typically an application domain expert. The developer is required to be aware of the servlet environment and its consequences when programming, including concurrency considerations, and create the web application accordingly.
Application Assembler	Takes the output of the Application Developer and ensures that it is a deployable unit. Thus, the input of the Application Assembler is the servlet classes, JSP pages, HTML pages, and other supporting libraries and files for the web application. The output of the Application Assembler is a web application archive or a web application in an open directory structure.

D

Deployer	The Deployer takes one or more web application archive files or other directory structures provided by an Application Developer and deploys the application into a specific operational environment. The operational environment includes

a specific servlet container and web server. The Deployer must resolve all the external dependencies declared by the developer. To perform his role, the deployer uses tools provided by the Servlet Container Provider.

The Deployer is an expert in a specific operational environment. For example, the Deployer is responsible for mapping the security roles defined by the Application Developer to the user groups and accounts that exist in the operational environment where the web application is deployed.

P

principal	A principal is an entity that can be authenticated by an authentication protocol. A principal is identified by a *principal name* and authenticated by using *authentication data*. The content and format of the principal name and the authentication data depend on the authentication protocol.

R

role (development)	The actions and responsibilities taken by various parties during the development, deployment, and running of a web application. In some scenarios, a single party may perform several roles; in others, each role may be performed by a different party.
role (security)	An abstract notion used by an Application Developer in an application that can be mapped by the Deployer to a user, or group of users, in a security policy domain.

S

security policy domain	The scope over which security policies are defined and enforced by a security administrator of the security service. A security policy domain is also sometimes referred to as a *realm*.
security technology domain	The scope over which the same security mechanism, such as Kerberos, is used to enforce a security policy. Multiple security policy domains can exist within a single technology domain.

Servlet Container Provider	A vendor that provides the runtime environment, namely the servlet container and possibly the web server, in which a web application runs as well as the tools necessary to deploy web applications. The expertise of the Container Provider is in HTTP-level programming. Since this specification does not specify the interface between the web server and the servlet container, it is left to the Container Provider to split the implementation of the required functionality between the container and the server.
servlet definition	A unique name associated with a fully qualified class name of a class implementing the Servlet interface. A set of initialization parameters can be associated with a servlet definition.
servlet mapping	A servlet definition that is associated by a servlet container with a URL path pattern. All requests to that path pattern are handled by the servlet associated with the servlet definition.
System Administrator	The person responsible for the configuration and administration of the servlet container and web server. The administrator is also responsible for overseeing the well-being of the deployed web applications at run time. This specification does not define the contracts for system management and administration. The administrator typically uses runtime monitoring and management tools provided by the Container Provider and server vendors to accomplish these tasks.

U

uniform resource locator (URL) A compact string representation of resources available via the network. Once the resource represented by a URL has been accessed, various operations may be performed on that resource.[1] A URL is a type of uniform resource identifier (URI). URLs are typically of the form:

```
<protocol>//<servername>/<resource>
```

For the purposes of this specification, we are primarily interested in HTT-based URLs which are of the form:

```
http[s]://<servername>[:port]/<url-path>[?<query-string>]
```

For example:

```
http://java.sun.com/products/servlet/index.html
```

```
https://javashop.sun.com/purchase
```

In HTTP-based URLs, the '/' character is reserved to separate a hierarchical path structure in the URL-path portion of the URL. The server is responsible for determining the meaning of the hierarchical structure. There is no correspondence between a URL-path and a given file system path.

W

web application A collection of servlets, JSP pages , HTML documents, and other web resources which might include image files, compressed archives, and other data. A web application may be packaged into an archive or exist in an open directory structure.

All compatible servlet containers must accept a web application and perform a deployment of its contents into their runtime. This may mean that a container can run the application directly from a web application archive file or it may mean that it will move the contents of a web application into the appropriate locations for that particular container.

1. See RFC 1738

web application archive A single file that contains all of the components of a web application. This archive file is created by using standard JAR tools which allow any or all of the web components to be signed.

Web application archive files are identified by the `.war` extension. A new extension is used instead of `.jar` because that extension is reserved for files which contain a set of class files and that can be placed in the classpath or double clicked using a GUI to launch an application. As the contents of a web application archive are not suitable for such use, a new extension was in order.

web application, distributable A web application that is written so that it can be deployed in a web container distributed across multiple Java virtual machines running on the same host or different hosts. The deployment descriptor for such an application uses the `distributable` element.