



**Apache Log4j 2**  
v. 2.0-beta4  
User's Guide

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# Introduction

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## 1.1 Welcome to Log4j 2!

### 1.1.1 Introduction

Almost every large application includes its own logging or tracing API. In conformance with this rule, the E.U. **SEMPER** project decided to write its own tracing API. This was in early 1996. After countless enhancements, several incarnations and much work that API has evolved to become log4j, a popular logging package for Java. The package is distributed under the [Apache Software License](#), a fully-fledged open source license certified by the [open source](#) initiative. The latest log4j version, including full-source code, class files and documentation can be found at <http://logging.apache.org/log4j/2.0/index.html>.

Inserting log statements into code is a low-tech method for debugging it. It may also be the only way because debuggers are not always available or applicable. This is usually the case for multithreaded applications and distributed applications at large.

Experience indicates that logging was an important component of the development cycle. It offers several advantages. It provides precise *context* about a run of the application. Once inserted into the code, the generation of logging output requires no human intervention. Moreover, log output can be saved in persistent medium to be studied at a later time. In addition to its use in the development cycle, a sufficiently rich logging package can also be viewed as an auditing tool.

As Brian W. Kernighan and Rob Pike put it in their truly excellent book *"The Practice of Programming"*:

As personal choice, we tend not to use debuggers beyond getting a stack trace or the value of a variable or two. One reason is that it is easy to get lost in details of complicated data structures and control flow; we find stepping through a program less productive than thinking harder and adding output statements and self-checking code at critical places. Clicking over statements takes longer than scanning the output of judiciously-placed displays. It takes less time to decide where to put print statements than to single-step to the critical section of code, even assuming we know where that is. More important, debugging statements stay with the program; debugging sessions are transient.

Logging does have its drawbacks. It can slow down an application. If too verbose, it can cause scrolling blindness. To alleviate these concerns, log4j is designed to be reliable, fast and extensible. Since logging is rarely the main focus of an application, the log4j API strives to be simple to understand and to use.

### 1.1.2 Log4j 2

Log4j 1.x has been widely adopted and used in many applications. However, through the years development on it has slowed down. It has become more difficult to maintain due to its need to be compliant with very old versions of Java. Its alternative, SLF4J/Logback made many needed improvements to the framework. So why bother with Log4j 2? Here are a few of the reasons.

1. Log4j 2 is designed to be usable as an audit logging framework. Both Log4j 1.x and Logback will lose events while reconfiguring. Log4j 2 will not. In Logback exceptions in Appenders are never visible to the application. In Log4j 2 Appenders can be configured to allow the exception to percolate to the application
2. Log4j 2 uses a Plugin system that makes it extremely easy to extend the framework by adding new Appenders, Filters, Layouts, Lookups, and Pattern Converters without requiring any changes to Log4j.

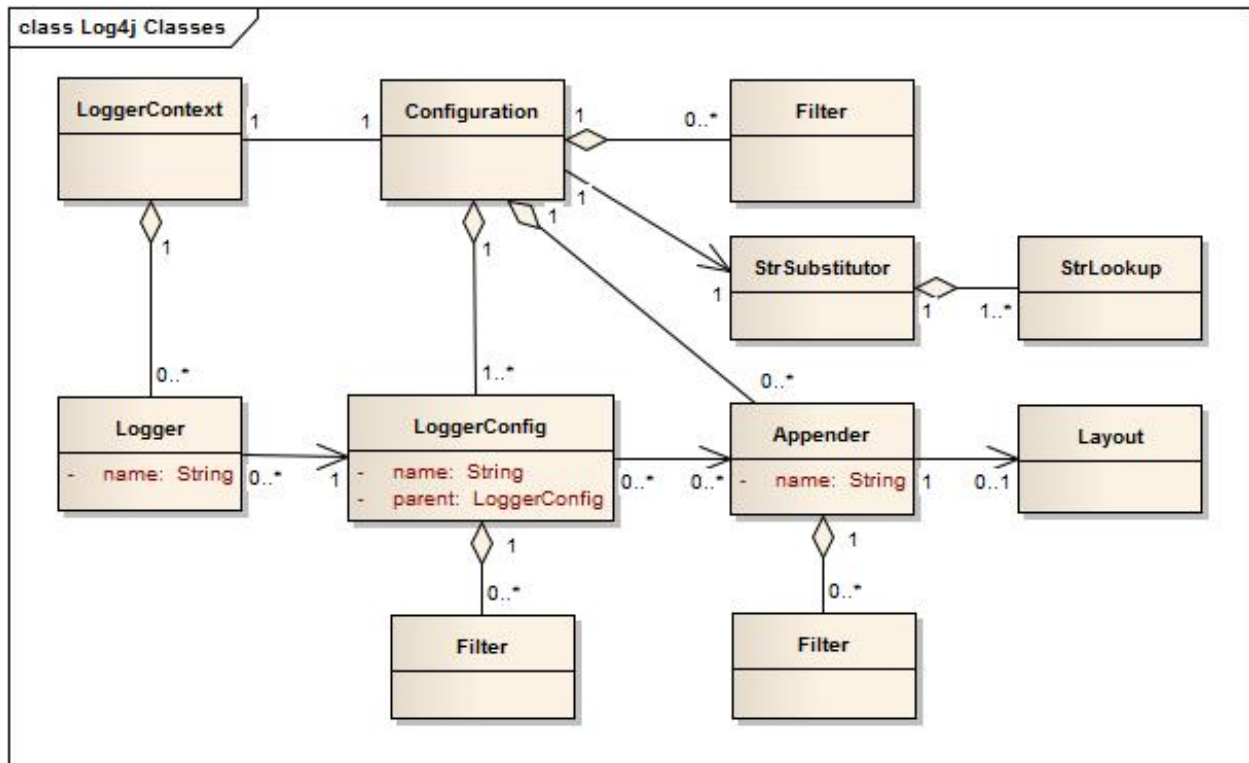
3. The performance of Log4j 2 is similar to that of Logback. It is slightly slower in some tests and faster in others.
4. Due to the Plugin system configuration is simpler. Entries in the configuration do not require a class name to be specified.
5. Support for Message objects. Messages allow support for interesting and complex constructs to be passed through the logging system and be efficiently manipulated. Users are free to create their own Message types and write custom Layouts, Filters and Lookups to manipulate them.
6. Log4j 1.x supports Filters on Appenders. Logback added TurboFilters to allow filtering of events before they are processed by a Logger. Log4j 2 supports Filters that can be configured to process events before they are handled by a Logger, as they are processed by a Logger or on an Appender.
7. Many Logback Appenders do not accept a Layout and will only send data in a fixed format. Most Log4j 2 Appenders accept a Layout, allowing the data to be transported in any format desired.
8. Layouts in Log4j 1.x and Logback return a String. This resulted in the problems discussed at [Logback Encoders](#). Log4j 2 takes the simpler approach that Layouts always return a byte array. This has the advantage that it means they can be used in virtually any Appender, not just the ones that write to an OutputStream.
9. The Syslog Appender supports both TCP and UDP as well as support for the BSD syslog and the [RFC 5424](#) formats.
- 10 Log4j 2 takes advantage of Java 5 concurrency support and performs locking at the lowest level possible. Log4j 1.x has known deadlock issues. Many of these are fixed in Logback but many Logback classes still require synchronization at a fairly high level.
- 11 It is an Apache Software Foundation project following the community and support model used by all ASF projects. If you want to contribute or gain the right to commit changes just follow the path outlined at [Contributing](#)

# Architecture

## 2.1 Architecture

### 2.1.1 Main Components

Log4j uses the classes shown in the diagram below.



Applications using the Log4j 2 API will request a `Logger` with a specific name from the `LogManager`. The `LogManager` will locate the appropriate `LoggerContext` and then obtain the `Logger` from it. If the `Logger` must be created it will be associated with the `LoggerConfig` that contains either a) the same name as the `Logger`, b) the name of a parent package, or c) the root `LoggerConfig`. `LoggerConfig` objects are created from `Logger` declarations in the configuration. The `LoggerConfig` is associated with the `Appenders` that actually deliver the `LogEvents`.

#### 2.1.1.1 Logger Hierarchy

The first and foremost advantage of any logging API over plain `System.out.println` resides in its ability to disable certain log statements while allowing others to print unhindered. This capability assumes that the logging space, that is, the space of all possible logging statements, is categorized according to some developer-chosen criteria.

In Log4j 1.x the `Logger Hierarchy` was maintained through a relationship between `Loggers`. In Log4j 2 this relationship no longer exists. Instead, the hierarchy is maintained in the relationship between `LoggerConfig` objects.

Loggers and LoggerConfigs are named entities. Logger names are case-sensitive and they follow the hierarchical naming rule:

### Named Hierarchy

A LoggerConfig is said to be an *ancestor* of another LoggerConfig if its name followed by a dot is a prefix of the *descendant* logger name. A LoggerConfig is said to be a *parent* of a *child* LoggerConfig if there are no ancestors between itself and the descendant LoggerConfig.

For example, the LoggerConfig named "com.foo" is a parent of the LoggerConfig named "com.foo.Bar". Similarly, "java" is a parent of "java.util" and an ancestor of "java.util.Vector". This naming scheme should be familiar to most developers.

The root LoggerConfig resides at the top of the LoggerConfig hierarchy. It is exceptional in that it always exists and it is part of every hierarchy. A Logger that is directly linked to the root LoggerConfig can be obtained as follows:

```
Logger logger = LogManager.getLogger(LogManager.ROOT_LOGGER_NAME);
```

All other Loggers can be retrieved using the [LogManager.getLogger](#) static method and passing the name of the desired Logger. Further information on the Logging API can be found at [Log4j 2 API](#).

#### 2.1.1.2 LoggerContext

The [LoggerContext](#) acts as the anchor point for the Logging system. However, it is possible to have multiple active LoggerContexts in an application depending on the circumstances. More details on the LoggerContext are at [Log Separation](#).

#### 2.1.1.3 Configuration

Every LoggerContext has an active [Configuration](#). The Configuration contains all the Appenders, context-wide Filters, LoggerConfigs and contains the reference to the StrSubstitutor. During reconfiguration two Configuration objects will exist. Once all Loggers have been redirected to the new Configuration, the old Configuration will be stopped and discarded.

#### 2.1.1.4 Logger

As stated previously, Loggers are created by calling [LogManager.getLogger](#). The Logger itself performs no direct actions. It simply has a name and is associated with a LoggerConfig. It extends [AbstractLogger](#) and implements the required methods. As the configuration is modified Loggers may become associated with a different LoggerConfig, thus causing their behavior to be modified.

### 2.Retrieving Loggers

Calling the `getLogger` method with the same name will always return a reference to the exact same Logger object.

For example, in

```
Logger x = Logger.getLogger("wombat");
Logger y = Logger.getLogger("wombat");
```

`x` and `y` refer to *exactly* the same Logger object.

Configuration of the log4j environment is typically done at application initialization. The preferred way is by reading a configuration file. This is discussed in [Configuration](#).



Log4j makes it easy to name Loggers by *software component*. This can be accomplished by instantiating a Logger in each class, with the logger name equal to the fully qualified name of the class. This is a useful and straightforward method of defining loggers. As the log output bears the name of the generating Logger, this naming strategy makes it easy to identify the origin of a log message. However, this is only one possible, albeit common, strategy for naming loggers. Log4j does not restrict the possible set of loggers. The developer is free to name the loggers as desired.

Nevertheless, naming loggers after the class where they are located seems to be the best strategy known so far.

#### 2.1.1.5 LoggerConfig

[LoggerConfig](#) objects are created when Loggers are declared in the logging configuration. The LoggerConfig contains a set of Filters that must allow the LogEvent to pass before it will be passed to any Appenders. It contains references to the set of Appenders that should be used to process the event.

#### 2. Log Levels

LoggerConfigs will be assigned a Log [Level](#). The set of possible levels includes (TRACE, DEBUG, INFO, WARN, ERROR and FATAL). Note that in Log4j 2, the Level is an Enum and cannot be subclassed. Users who desire more granularity are encouraged to use [Markers](#) instead.

[Log4j 1.x](#) and [Logback](#) both have the concept of "Level Inheritance". In Log4j 2, Loggers and LoggerConfigs are two different objects so this concept is implemented differently. Each Logger references the appropriate LoggerConfig which in turn can reference its parent, thus achieving the same effect.

Below are five tables with various assigned level values and the resulting levels that will be associated with each Logger. Note that in all these cases if the root LoggerConfig is not configured a default Level will be assigned to it.

Logger Name	Assigned LoggerConfig	Level
root	root	DEBUG
X	root	DEBUG
X.Y	root	DEBUG
X.Y.Z	root	DEBUG

#### Example 1

In example 1 above, only the root logger is configured and has a Log Level. All the other Loggers reference the root LoggerConfig and use its Level.

Logger Name	Assigned LoggerConfig	Level
root	root	DEBUG
X	X	ERROR
X.Y	X.Y	INFO
X.Y.Z	X.Y.Z	WARN

### Example 2

In example 2, all loggers have a configured `LoggerConfig` and obtain their `Level` from it.

Logger Name	Assigned LoggerConfig	Level
root	root	DEBUG
X	X	ERROR
X.Y	X	ERROR
X.Y.Z	X.Y.Z	WARN

### Example 3

In example 3, the loggers `root`, `x` and `x.y.z` each have a configured `LoggerConfig` with the same name. The Logger `x.y` does not have a configured `LoggerConfig` with a matching name so uses the configuration of `LoggerConfig x` since that is the `LoggerConfig` whose name has the longest match to the start of the Logger's name.

Logger Name	Assigned LoggerConfig	level
root	root	DEBUG
X	X	ERROR
X.Y	X	ERROR
X.Y.Z	X	ERROR

### Example 4

In example 4, the loggers `root` and `x` each have a Configured `LoggerConfig` with the same name. The loggers `x.y` and `x.y.z` do not have configured `LoggerConfigs` and so get their `Level` from the `LoggerConfig` assigned to them, `x`, since it is the `LoggerCofnig` whose name has the longest match to the start of the Logger's name.

Logger Name	Assigned LoggerConfig	level
root	root	DEBUG
X	X	ERROR
X.Y	X.Y	INFO
X.YZ	X	ERROR

### Example 5

In example 5, the loggers `root`, `x`, and `x.y` each have a Configured `LoggerConfig` with the same name. The logger `x.yz` does not have configured `LoggerConfig` and so gets its `Level` from the `LoggerConfig` assigned to it, `x`, since it is the `LoggerCofnig` whose name has the longest match to the start of the Logger's name. It is not associated with `LoggerConfig x.y` since tokens after periods must match exactly.

The table below provides illustrates how Level filtering works. In the table, the vertical header shows the Level of the LogEvent, while the horizontal header shows the Level associated with the appropriate LoggerConfig. The intersection identifies whether the LogEvent would be allowed to pass for further processing (Yes) or discarded (No).

Event Level	LoggerConfig Level					
	TRACE	DEBUG	INFO	WARN	ERROR	FATAL
ALL	NO	NO	NO	NO	NO	NO
TRACE	YES	NO	NO	NO	NO	NO
DEBUG	YES	YES	NO	NO	NO	NO
INFO	YES	YES	YES	NO	NO	NO
WARN	YES	YES	YES	YES	NO	NO
ERROR	YES	YES	YES	YES	YES	NO
FATAL	YES	YES	YES	YES	YES	YES
OFF	YES	YES	YES	YES	YES	YES

#### 2.1.1.6 Filter

In addition to the automatic log Level filtering that takes place as described in the previous section, Log4j provides [Filters](#) that can be applied before control is passed to any LoggerConfig, after control is passed to a LoggerConfig but before calling any Appenders, after control is passed to a LoggerConfig but before calling a specific Appender, and on each Appender. In a manner very similar to firewall filters, each Filter can return one of three results, Accept, Deny or Neutral. A response of Accept means that no other Filters should be called and the event should progress. A response of Deny means the event should be immediately ignored and control should be returned to the caller. A response of Neutral indicates the event should be passed to other Filters. If there are no other Filters the event will be processed.

Although an event may be accepted by a Filter the event still might not be logged. This can happen when the event is accepted by the pre-LoggerConfig Filter but is then denied by a LoggerConfig filter or is denied by all Appenders.

#### 2.1.1.7 Appender

The ability to selectively enable or disable logging requests based on their logger is only part of the picture. Log4j allows logging requests to print to multiple destinations. In log4j speak, an output destination is called an [Appender](#). Currently, appenders exist for the console, files, remote socket servers, Apache Flume, JMS, and remote UNIX Syslog daemons. More than one Appender can be attached to a Logger.

An Appender can be added to a Logger by calling the [addLoggerAppender](#) method of the current Configuration. If a LoggerConfig matching the name of the Logger does not exist, one will be created, the Appender will be attached to it and then all Loggers will be notified to update their LoggerConfig references.

**Each enabled logging request for a given logger will be forwarded to all the appenders in that Logger's LoggerConfig as well as the Appenders of the LoggerConfig's parents.** In other words, Appenders are inherited additively from the LoggerConfig hierarchy. For example, if a console appender is added to the root logger, then all enabled logging requests will at least print on the console. If in addition a file appender is added to a LoggerConfig, say *C*, then enabled logging requests for *C* and *C*'s children will print in a file *and* on the console. It is possible to override this default behavior so that Appender accumulation is no longer additive by setting `additivity="false"` on the Logger declaration in the configuration file.

The rules governing appender additivity are summarized below.

### Appender Additivity

The output of a log statement of Logger *L* will go to all the Appenders in the LoggerConfig associated with *L* and the ancestors of that LoggerConfig. This is the meaning of the term "appender additivity".

However, if an ancestor of the LoggerConfig associated with Logger *L*, say *P*, has the additivity flag set to `false`, then *L*'s output will be directed to all the appenders in *L*'s LoggerConfig and it's ancestors up to and including *P* but not the Appenders in any of the ancestors of *P*.

Loggers have their additivity flag set to `true` by default.

The table below shows an example:

Logger Name	Added Appenders	Additivity Flag	Output Targets	Comment
root	A1	not applicable	A1	The root logger has no parent so additivity does not apply to it.
x	A-x1, A-x2	true	A1, A-x1, A-x2	Appenders of "x" and root.
x.y	none	true	A1, A-x1, A-x2	Appenders of "x" and root. It would not be typical to configure a Logger with no Appenders.
x.y.z	A-xyz1	true	A1, A-x1, A-x2, A-xyz1	Appenders in "x.y.z", "x" and root.
security	A-sec	false	A-sec	No appender accumulation since the additivity flag is set to <code>false</code> .
security.access	none	true	A-sec	Only appenders of "security" because the additivity flag in "security" is set to <code>false</code> .

### 2.1.1.8 Layout

More often than not, users wish to customize not only the output destination but also the output format. This is accomplished by associating a [Layout](#) with an Appender. The Layout is responsible for formatting the LogEvent according to the user's wishes, whereas an appender takes care of sending the formatted output to its destination. The [PatternLayout](#), part of the standard log4j distribution, lets the user specify the output format according to conversion patterns similar to the C language `printf` function.

For example, the PatternLayout with the conversion pattern "%r [%t] %-5p %c - %m%n" will output something akin to:

```
176 [main] INFO org.foo.Bar - Located nearest gas station.
```

The first field is the number of milliseconds elapsed since the start of the program. The second field is the thread making the log request. The third field is the level of the log statement. The fourth field is the name of the logger associated with the log request. The text after the '-' is the message of the statement.

Just as importantly, log4j will render the content of the log message according to user specified criteria. For example, if you frequently need to log `Oranges`, an object type used in your current project, then you can create an `OrangeMessage` that accepts an `Orange` instance and pass that to Log4J so that the `Orange` object can be formatted into an appropriate byte array when required.

### 2.1.1.9 StrSubstitutor and StrLookup

The [StrSubstitutor](#) class and [StrLookup](#) interface were borrowed from Apache Commons Lang and then modified to support evaluating LogEvents. In addition the [Interpolator](#) class was borrowed from Apache Commons Configuration to allow the StrSubstitutor to evaluate variables that from multiple StrLookups. It too was modified to support evaluating LogEvents. Together these provide a mechanism to allow the configuration to reference variables coming from System Properties, the configuration file, the ThreadContext Map, StructuredData in the LogEvent. The variables can either be resolved when the configuration is processed or as each event is processed, if the component is capable of handling it. See [Lookups](#) for more information.

## Bog4j 1.x Migration

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### 3.1 Migration from Log4j 1.x

#### 3.1.1 The Log4j 1.x bridge

Perhaps the simplest way to convert to using Log4j 2 is to replace the log4j 1.x jar file with Log4j 2's log4j-1.2-api jar. However, to use this successfully applications must meet the following requirements:

1. They must not access methods and classes internal to the Log4j 1.x implementation such as Appenders, LoggerRepository or Logger's callAppenders method.
2. They must not programmatically configure Log4j.
3. They must not be configuring by calling DomConfigurator or the PropertiesConfigurator.

#### 3.1.2 Converting to the Log4j 2 API

For the most part, converting from the Log4j 1.x API to Log4j 2.0 should be fairly simple. Many of the log statements will require no modification. However, where necessary the following changes must be made.

1. Calls to `Logger.getLogger` must be modified to `LogManager.getLogger`.
2. Calls to `Logger.getRootLogger` or `LogManager.getRootLogger` must be replaced with `LogManager.getLogger("")`.
3. Calls to `LogManager.getLogger` that accept a `LoggerFactory` must remove the `LoggerFactory` and use one of Log4j 2's other extension mechanisms.
4. Calls to `logger.setLevel` or similar methods are not supported in the API. Applications should remove these. Equivalent functionality is provided in the Log4j 2 implementation classes but may leave the application susceptible to changes in Log4j 2 internals.
5. The Log4j 2 API methods accept String messages instead of Objects. Applications that wish to log Objects should either wrap the Object in an `ObjectMessage` or create a custom `Message` for the Object.
6. Where appropriate, applications should convert to use parameterized messages instead of String concatenation.

#### 3.1.3 Configuration

Although the Log4j 2 configuration syntax is different than that of Log4j 1.x, most, if not all, of the same functionality is available. Below are the example configurations for Log4j 1.x and their counterparts in Log4j 2.

##### 3.1.3.1 Sample 1 - Simple configuration using a Console Appender

Log4j 1.x XML configuration

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE log4j:configuration PUBLIC "-//APACHE//DTD LOG4J 1.2//EN" "log4j.dtd">
<log4j:configuration xmlns:log4j='http://jakarta.apache.org/log4j/'>
  <appender name="STDOUT" class="org.apache.log4j.ConsoleAppender">
    <layout class="org.apache.log4j.PatternLayout">
      <param name="ConversionPattern" value="%d %-5p [%t] %C{2} (%F:%L) - %m%n"/>
    </layout>
  </appender>
  <category name="org.apache.log4j.xml">
    <priority value="info" />
  </category>
  <root>
    <priority value="debug" />
    <appender-ref ref="STDOUT" />
  </root>
</log4j:configuration>
```

### Log4j 2 XML configuration

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration>
  <appenders>
    <Console name="STDOUT" target="SYSTEM_OUT">
      <PatternLayout pattern="%d %-5p [%t] %C{2} (%F:%L) - %m%n"/>
    </Console>
  </appenders>
  <loggers>
    <logger name="org.apache.log4j.xml" level="info"/>
    <root level="debug">
      <appender-ref ref="STDOUT"/>
    </root>
  </loggers>
</configuration>
```

#### 3.1.3.2 Sample 2 - Simple configuration using a File Appender

##### Log4j 1.x XML configuration

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE log4j:configuration PUBLIC "-//APACHE//DTD LOG4J 1.2//EN" "log4j.dtd">
<log4j:configuration xmlns:log4j="http://jakarta.apache.org/log4j/">
  <appender name="A1" class="org.apache.log4j.FileAppender">
    <param name="File" value="A1.log" />
    <param name="Append" value="false" />
    <layout class="org.apache.log4j.PatternLayout">
      <param name="ConversionPattern" value="%t %-5p %c{2} - %m%n"/>
    </layout>
  </appender>
  <appender name="STDOUT" class="org.apache.log4j.ConsoleAppender">
    <layout class="org.apache.log4j.PatternLayout">
      <param name="ConversionPattern" value="%d %-5p [%t] %C{2} (%F:%L) - %m%n"/>
    </layout>
  </appender>
  <category name="org.apache.log4j.xml">
    <priority value="debug" />
    <appender-ref ref="A1" />
  </category>
  <root>
    <priority value="debug" />
    <appender-ref ref="STDOUT" />
  </root>
</log4j:configuration>
```

### Log4j 2 XML configuration

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration>
  <appenders>
    <File name="A1" fileName="A1.log" append="false">
      <PatternLayout pattern="%t %-5p %c{2} - %m%n"/>
    </File>
    <Console name="STDOUT" target="SYSTEM_OUT">
      <PatternLayout pattern="%d %-5p [%t] %C{2} (%F:%L) - %m%n"/>
    </Console>
  </appenders>
  <loggers>
    <logger name="org.apache.log4j.xml" level="debug">
      <appender-ref ref="A1"/>
    </logger>
    <root level="debug">
      <appender-ref ref="STDOUT"/>
    </root>
  </loggers>
</configuration>
```

#### 3.1.3.3 Sample 3 - SocketAppender

Log4j 1.x XML configuration. This example from Log4j 1.x is misleading. The SocketAppender does not actually use a Layout. Configuring one will have no effect.



```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE log4j:configuration PUBLIC "-//APACHE//DTD LOG4J 1.2//EN" "log4j.dtd">
<log4j:configuration xmlns:log4j="http://jakarta.apache.org/log4j/">
  <appender name="A1" class="org.apache.log4j.net.SocketAppender">
    <param name="RemoteHost" value="localhost"/>
    <param name="Port" value="5000"/>
    <param name="LocationInfo" value="true"/>
    <layout class="org.apache.log4j.PatternLayout">
      <param name="ConversionPattern" value="%t %-5p %c{2} - %m%n"/>
    </layout>
  </appender>
  <appender name="STDOUT" class="org.apache.log4j.ConsoleAppender">
    <layout class="org.apache.log4j.PatternLayout">
      <param name="ConversionPattern" value="%d %-5p [%t] %C{2} (%F:%L) - %m%n"/>
    </layout>
  </appender>
  <category name="org.apache.log4j.xml">
    <priority value="debug"/>
    <appender-ref ref="A1"/>
  </category>
  <root>
    <priority value="debug"/>
    <appender-ref ref="STDOUT"/>
  </root>
</log4j:configuration>
```

### Log4j 2 XML configuration

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration>
  <appenders>
    <Socket name="A1" host="localhost" port="5000">
      <SerializedLayout/>
    </Socket>
    <Console name="STDOUT" target="SYSTEM_OUT">
      <PatternLayout pattern="%d %-5p [%t] %C{2} (%F:%L) - %m%n"/>
    </Console>
  </appenders>
  <loggers>
    <logger name="org.apache.log4j.xml" level="debug">
      <appender-ref ref="A1"/>
    </logger>
    <root level="debug">
      <appender-ref ref="STDOUT"/>
    </root>
  </loggers>
</configuration>
```

#### 3.1.3.4 Sample 4 - AsyncAppender

Log4j 1.x XML configuration using the AsyncAppender.

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE log4j:configuration PUBLIC "-//APACHE//DTD LOG4J 1.2//EN" "log4j.dtd">
<log4j:configuration xmlns:log4j="http://jakarta.apache.org/log4j/" configDebug="true">
  <appender name="ASYNC" class="org.apache.log4j.AsyncAppender">
    <appender-ref ref="TEMP"/>
  </appender>
  <appender name="TEMP" class="org.apache.log4j.FileAppender">
    <param name="File" value="temp"/>
    <layout class="org.apache.log4j.PatternLayout">
      <param name="ConversionPattern" value="%d %-5p [%t] %C{2} (%F:%L) - %m%n"/>
    </layout>
  </appender>
  <root>
    <priority value="debug"/>
    <appender-ref ref="ASYNC"/>
  </root>
</log4j:configuration>
```

### Log4j 2 XML configuration.

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="debug">
  <appenders>
    <File name="TEMP" fileName="temp">
      <PatternLayout pattern="%d %-5p [%t] %C{2} (%F:%L) - %m%n"/>
    </File>
    <Asynch name="ASYNC">
      <appender-ref ref="TEMP"/>
    </Asynch>
  </appenders>
  <loggers>
    <root level="debug">
      <appender-ref ref="ASYNC"/>
    </root>
  </loggers>
</configuration>
```

#### 3.1.3.5 Sample 5 - AsyncAppender with Console and File Log4j 1.x XML configuration using the AsyncAppender.

```

<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE log4j:configuration PUBLIC "-//APACHE//DTD LOG4J 1.2//EN" "log4j.dtd">
<log4j:configuration xmlns:log4j="http://jakarta.apache.org/log4j/" configDebug="true">
  <appender name="ASYNC" class="org.apache.log4j.AsyncAppender">
    <appender-ref ref="TEMP"/>
    <appender-ref ref="CONSOLE"/>
  </appender>
  <appender name="CONSOLE" class="org.apache.log4j.ConsoleAppender">
    <layout class="org.apache.log4j.PatternLayout">
      <param name="ConversionPattern" value="%d %-5p [%t] %C{2} (%F:%L) - %m%n"/>
    </layout>
  </appender>
  <appender name="TEMP" class="org.apache.log4j.FileAppender">
    <param name="File" value="temp"/>
    <layout class="org.apache.log4j.PatternLayout">
      <param name="ConversionPattern" value="%d %-5p [%t] %C{2} (%F:%L) - %m%n"/>
    </layout>
  </appender>
  <root>
    <priority value="debug"/>
    <appender-ref ref="ASYNC"/>
  </root>
</log4j:configuration>

```

Log4j 2 XML configuration. Note that the Async Appender should be configured after the appenders it references. This will allow it to shutdown properly.

```

<?xml version="1.0" encoding="UTF-8"?>
<configuration status="debug">
  <appenders>
    <Console name="CONSOLE" target="SYSTEM_OUT">
      <PatternLayout pattern="%d %-5p [%t] %C{2} (%F:%L) - %m%n"/>
    </Console>
    <File name="TEMP" fileName="temp">
      <PatternLayout pattern="%d %-5p [%t] %C{2} (%F:%L) - %m%n"/>
    </File>
    <Asynch name="ASYNC">
      <appender-ref ref="TEMP"/>
      <appender-ref ref="CONSOLE"/>
    </Asynch>
  </appenders>
  <loggers>
    <root level="debug">
      <appender-ref ref="ASYNC"/>
    </root>
  </loggers>
</configuration>

```

# API

---

## 4.1 Log4j 2 API

### 4.1.1 Overview

The Log4J 2 API provides the interface that applications should code to and provides the adapter components required for implementers to create a logging implementation. Although Log4j 2 is broken up between an API and an implementation, the primary purpose of doing so was not to allow multiple implementations, although that is certainly possible, but to clearly define what classes and methods are safe to use in "normal" application code.

#### 4.1.1.1 Hello World!

No introduction would be complete without the customary Hello, World example. Here is ours. First, a `Logger` with the name "HelloWorld" is obtained from the [LogManager](#). Next, the logger is used to write the "Hello, World!" message, however the message will be written only if the `Logger` is configured to allow informational messages.

```
import org.apache.logging.log4j.LogManager;
import org.apache.logging.log4j.Logger;

public class HelloWorld {
    private static Logger logger = LogManager.getLogger("HelloWorld");
    public static void main(String[] args) {
        logger.info("Hello, World!");
    }
}
```

The output from the call to `logger.info()` will vary significantly depending on the configuration used. See the [Configuration](#) section for more details.

#### 4.1.1.2 Substituting Parameters

Frequently the purpose of logging is to provide information about what is happening in the system, which requires including information about the objects being manipulated. In Log4j 1.x this could be accomplished by doing:

```
if (logger.isDebugEnabled()) {
    logger.debug("Logging in user " + user.getName() + " with birthday " + user.getBirthDayCalendar());
}
```

Doing this repeatedly has the effect of making the code feel like it is more about logging than the actual task at hand. In addition, it results in the logging level being checked twice; once on the call to `isDebugEnabled` and once on the debug method. A better alternative would be:

```
logger.debug("Logging in user {} with birthday {}", user.getName(), user.getBirthDayCalendar());
```

With the code above the logging level will only be checked once and the String construction will only occur when debug logging is enabled.

### 4.1.1.3 Formatting Parameters

Substituting parameters leaves formatting up to you if `toString()` is not what you want. To facilitate formatting, you can use the same format strings as Java's [Formatter](#). For example:

```
public static Logger logger = LogManager.getFormatterLogger("Foo");

logger.debug("Logging in user %s with birthday %s", user.getName(), user.getBirthdayCalendar());
logger.debug("Logging in user %1$s with birthday %2$tm %2$te,%2$tY", user.getName(), user.getBirthdayCalendar());
logger.debug("Integer.MAX_VALUE = %,d", Integer.MAX_VALUE);
logger.debug("Long.MAX_VALUE = %,d", Long.MAX_VALUE);
```

To use a formatter Logger, you must call one of the `LogManager` [getFormatterLogger](#) method. The output for this example shows that `Calendar toString()` is verbose compared to custom formatting:

```
2012-12-12 11:56:19,633 [main] DEBUG: User John Smith with birthday java.util.GregorianCalendar[time=?,areFieldsSet=
2012-12-12 11:56:19,643 [main] DEBUG: User John Smith with birthday 05 23, 1995
2012-12-12 11:56:19,643 [main] DEBUG: Integer.MAX_VALUE = 2,147,483,647
2012-12-12 11:56:19,643 [main] DEBUG: Long.MAX_VALUE = 9,223,372,036,854,775,807
```

# Configuration

---

## 5.1 Configuration

Inserting log requests into the application code requires a fair amount of planning and effort. Observation shows that approximately 4 percent of code is dedicated to logging. Consequently, even moderately sized applications will have thousands of logging statements embedded within their code. Given their number, it becomes imperative to manage these log statements without the need to modify them manually.

Configuration of Log4j 2 can be accomplished in 1 of 4 ways:

1. Through a configuration file written in XML or JSON.
2. Programmatically, by creating a `ConfigurationFactory` and `Configuration` implementation.
3. Programmatically, by calling the APIs exposed in the `Configuration` interface to add components to the default configuration.
4. Programmatically, by calling methods on the internal `Logger` class.

This page focuses primarily on configuring Log4j through a configuration file. Information on programmatically configuring Log4j can be found at [Extending Log4j 2](#).

Note that unlike Log4j 1.x, the public Log4j 2 API does not expose methods to add, modify or remove appenders and filters or manipulate the configuration in any way.

### 5.1.1 Automatic Configuration

Log4j has the ability to automatically configure itself during initialization. When Log4j starts it will locate all the `ConfigurationFactory` plugins and arrange them in weighted order from highest to lowest. As delivered, Log4j contains two `ConfigurationFactory` implementations, one for JSON and one for XML.

1. Log4j will inspect the "log4j.configurationFile" system property and, if set, will attempt to load the configuration using the `ConfigurationFactory` that matches the file extension.
2. If no system property is set the JSON `ConfigurationFactory` will look for `log4j2-test.json` or `log4j2-test.jsn` in the classpath.
3. If no such file is found the XML `ConfigurationFactory` will look for `log4j2-test.xml` in the classpath.
4. If a test file cannot be located the JSON `ConfigurationFactory` will look for `log4j2.json` or `log4j2.jsn` on the classpath.
5. If a JSON file cannot be located the XML `ConfigurationFactory` will try to locate `log4j2.xml` on the classpath.
6. If no configuration file could be located the `DefaultConfiguration` will be used. This will cause logging output to go to the console.

An example application named `MyApp` that uses log4j can be used to illustrate how this is done.

```
import com.foo.Bar;

// Import log4j classes.
import org.apache.logging.log4j.Logger;

public class MyApp {

// Define a static logger variable so that it references the
// Logger instance named "MyApp".
Logger logger = LogManager.getLogger(MyApp.class.getName());

public static void main(String[] args) {

// Set up a simple configuration that logs on the console.

logger.trace("Entering application.");
Bar bar = new Bar();
if (!bar.doIt() {
    logger.error("Didn't do it.");
}
logger.trace("Exiting application.");
}
}
```

MyApp begins by importing log4j related classes. It then defines a static logger variable with the name MyApp which happens to be the fully qualified name of the class.

MyApp uses the Bar class defined in the package com.foo.

```
package com.foo;
import org.apache.logging.log4j.Logger;

public class Bar {
    static Logger logger = LogManager.getLogger(Bar.class.getName());

    public boolean doIt() {
        logger.entry();
        logger.error("Did it again!");
        return logger.exit(false);
    }
}
```

If no configuration files are present logback will default to the DefaultConfiguration which will set up a minimal logging environment consisting of a [ConsoleAppender](#) attached to the root logger. The output will be formatted using a [PatternLayout](#) set to the pattern "%d{HH:mm:ss.SSS} [%t] %-5level %logger{36} - %msg%n".

Note that by default, the root logger is assigned to Level.ERROR.

The output of MyApp would be similar to:

```
17:13:01.540 [main] ERROR com.foo.Bar - Did it again!
17:13:01.540 [main] ERROR MyApp - Didn't do it.
```

As was described previously, Log4j will first attempt to configure itself from configuration files. A configuration equivalent to the default would look like:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="OFF">
  <appenders>
    <Console name="Console" target="SYSTEM_OUT">
      <PatternLayout pattern="%d{HH:mm:ss.SSS} [%t] %-5level %logger{36} - %msg%n"/>
    </Console>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="Console"/>
    </root>
  </loggers>
</configuration>
```

Once the file above is placed into the classpath as `log4j2.xml` you will get results identical to those listed above. Changing the root level to trace will result in results similar to:

```
17:13:01.540 [main] TRACE MyApp - Entering application.
17:13:01.540 [main] TRACE com.foo.Bar - entry
17:13:01.540 [main] ERROR com.foo.Bar - Did it again!
17:13:01.540 [main] TRACE com.foo.Bar - exit with (false)
17:13:01.540 [main] ERROR MyApp - Didn't do it.
17:13:01.540 [main] TRACE MyApp - Exiting application.
```

Note that status logging is disabled when the default configuration is used.

Perhaps it is desired to eliminate all the TRACE output from everything except `com.foo.Bar`. Simply changing the log level would not accomplish the task. Instead, the solution is to add a new logger definition to the configuration:

```
<logger name="com.foo.Bar" level="TRACE"/>
<root level="ERROR">
  <appender-ref ref="STDOUT"/>
</root>
```

With this configuration all log events from `com.foo.Bar` will be recorded while only error events will be recorded from all other components.

### 5.1.2 Additivity

In the previous example all the events from `com.foo.Bar` were still written to the Console. This is because the logger for `com.foo.Bar` did not have any appenders configured while its parent did. In fact, the following configuration



```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="OFF">
  <appenders>
    <Console name="Console" target="SYSTEM_OUT">
      <PatternLayout pattern="%d{HH:mm:ss.SSS} [%t] %-5level %logger{36} - %msg%n"/>
    </Console>
  </appenders>
  <loggers>
    <logger name="com.foo.Bar" level="trace">
      <appender-ref ref="Console"/>
    </logger>
    <root level="error">
      <appender-ref ref="Console"/>
    </root>
  </loggers>
</configuration>
```

would result in

```
17:13:01.540 [main] TRACE com.foo.Bar - entry
17:13:01.540 [main] TRACE com.foo.Bar - entry
17:13:01.540 [main] ERROR com.foo.Bar - Did it again!
17:13:01.540 [main] TRACE com.foo.Bar - exit (false)
17:13:01.540 [main] TRACE com.foo.Bar - exit (false)
17:13:01.540 [main] ERROR MyApp - Didn't do it.
```

Notice that the trace messages from `com.foo.Bar` appear twice. This is because the appender associated with logger `com.foo.Bar` is first used, which writes the first instance to the Console. Next, the parent of `com.foo.Bar`, which in this case is the root logger, is referenced. The event is then passed to its appender, which is also writes to the Console, resulting in the second instance. This is known as additivity. While additivity can be quite a convenient feature (as in the first previous example where no appender reference needed to be configured), in many cases this behavior is considered undesirable and so it is possible to disable it by setting the additivity attribute on the logger to false:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="OFF">
  <appenders>
    <Console name="Console" target="SYSTEM_OUT">
      <PatternLayout pattern="%d{HH:mm:ss.SSS} [%t] %-5level %logger{36} - %msg%n"/>
    </Console>
  </appenders>
  <loggers>
    <logger name="com.foo.Bar" level="trace" additivity="false">
      <appender-ref ref="Console"/>
    </logger>
    <root level="error">
      <appender-ref ref="Console"/>
    </root>
  </loggers>
</configuration>
```

Once an event reaches a logger with its additivity set to false the event will not be passed to any of its parent loggers, regardless of their additivity setting.

### 5.1.3 Automatic Reconfiguration

When configured from a File, Log4j has the ability to automatically detect changes to the configuration file and reconfigure itself. If the `monitorInterval` attribute is specified on the configuration element and is set to a non-zero value then the file will be checked the next time a log event is evaluated and/or logged and the `monitorInterval` has elapsed since the last check. The example below shows how to configure the attribute so that the configuration file will be checked for changes only after at least 30 seconds have elapsed. The minimum interval is 5 seconds.

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration monitorInterval="30">
...
</configuration>
```

### 5.1.4 Configuration Syntax

As the previous examples have shown as well as those to follow, Log4j allows you to easily redefine logging behavior without needing to modify your application. It is possible to disable logging for certain parts of the application, log only when specific criteria are met such as the action being performed for a specific user, route output to Flume or a log reporting system, etc. Being able to do this requires understanding the syntax of the configuration files.

#### 5.1.4.1 Configuration with XML

The configuration element in the XML file accepts several attributes:

Attribute Name	Description
<code>dest</code>	Either "err", which will send output to stderr, or a file path or URL.
<code>monitorInterval</code>	The minimum amount of time, in seconds, that must elapse before the file configuration is checked for changes.
<code>name</code>	The name of the configuration.
<code>packages</code>	A comma separated list of package names to search for plugins. Plugins are only loaded once per classloader so changing this value may not have any effect upon reconfiguration.
<code>schema</code>	Identifies the location for the classloader to locate the XML Schema to use to validate the configuration. Only valid when <code>strict</code> is set to true. If not set no schema validation will take place.

<code>status</code>	The level of internal Log4j events that should be logged to the console.
<code>strict</code>	Enables the use of the strict XML format. Not supported in JSON configurations.
<code>verbose</code>	Enables diagnostic information while loading plugins.

Log4j can be configured using two XML flavors; concise and strict. The concise format makes configuration very easy as the element names match the components they represent however it cannot be validated with an XML schema. For example, the ConsoleAppender is configured by declaring an XML element named Console under its parent appenders element. However, element and attribute names are not case sensitive. In addition, attributes can either be specified as an XML attribute or as an XML element that has no attributes and has a text value. So

```
<patternLayout pattern="%m%n"/>
```

and

```
<PatternLayout>  
  <pattern>%m%n</pattern>  
</PatternLayout>
```

are equivalent.

The file below represents the structure of an XML configuration, but note that the elements in italics below represent the concise element names that would appear in their place.

```

<?xml version="1.0" encoding="UTF-8"?>
<configuration>
  <properties>
    <property name="name1">value</property>
    <property name="name2" value="value2"/>
  </properties>
  <
  filter ... />
  <appenders>
    <
  appender ... >
    <
  filter ... />
  </
  appender>
  ...
  </appenders>
  <loggers>
    <logger name="name1">
    <
  filter ... />
  </logger>
  ...
  <root level="level">
    <appender-ref ref="name"/>
  </root>
  </loggers>
</configuration>

```

See the many examples on this page for sample appender, filter and logger declarations.

### 5.Strict XML

In addition to the concise XML format above, Log4j allows configurations to be specified in a more "normal" XML manner that can be validated using an XML Schema. This is accomplished by replacing the friendly element names above with their object type as shown below. For example, instead of the ConsoleAppender being configured using an element named Console it is instead configured as an appender element with a type attribute containing "Console".

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration>
  <properties>
    <property name="name1">value</property>
    <property name="name2" value="value2"/>
  </properties>
  <filter type="type" ... />
  <appenders>
    <appender type="type" name="name">
      <filter type="type" ... />
    </appender>
    ...
  </appenders>
  <loggers>
    <logger name="name1">
      <filter type="type" ... />
    </logger>
    ...
    <root level="level">
      <appender-ref ref="name"/>
    </root>
  </loggers>
</configuration>
```

Below is a sample configuration using the strict format.

```

<?xml version="1.0" encoding="UTF-8"?>
<configuration status="debug" strict="true" name="XMLConfigTest"
    packages="org.apache.logging.log4j.test">
  <properties>
    <property name="filename">target/test.log</property>
  </properties>
  <filter type="ThresholdFilter" level="trace"/>

  <appenders>
    <appender type="Console" name="STDOUT">
      <layout type="PatternLayout" pattern="%m MDC%X%n"/>
      <filters>
        <filter type="MarkerFilter" marker="FLOW" onMatch="DENY" onMismatch="NEUTRAL"/>
        <filter type="MarkerFilter" marker="EXCEPTION" onMatch="DENY" onMismatch="ACCEPT"/>
      </filters>
    </appender>
    <appender type="Console" name="FLOW">
      <layout type="PatternLayout" pattern="%C{1}.%M %m %ex%n"/>
      <filters>
        <filter type="MarkerFilter" marker="FLOW" onMatch="ACCEPT" onMismatch="NEUTRAL"/>
        <filter type="MarkerFilter" marker="EXCEPTION" onMatch="ACCEPT" onMismatch="DENY"/>
      </filters>
    </appender>
    <appender type="File" name="File" fileName="${filename}">
      <layout type="PatternLayout">
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </layout>
    </appender>
    <appender type="List" name="List">
  </appender>
</appenders>

  <loggers>
    <logger name="org.apache.logging.log4j.test1" level="debug" additivity="false">
      <filter type="ThreadContextMapFilter">
        <KeyValuePair key="test" value="123"/>
      </filter>
      <appender-ref ref="STDOUT"/>
    </logger>>

    <logger name="org.apache.logging.log4j.test2" level="debug" additivity="false">
      <appender-ref ref="File"/>
    </logger>>

    <root level="trace">
      <appender-ref ref="List"/>
    </root>
  </loggers>

</configuration>

```

### 5.1.4.2 Configuration with JSON

In addition to XML, Log4j can be configured using JSON. The JSON format is very similar to the concise XML format. Each key represents the name of a plugin and the key/value pairs associated with it are its attributes. Where a key contains more than a simple value it itself will be a subordinate plugin. In the example below, ThresholdFilter, Console, and PatternLayout are all plugins while the Console plugin will be assigned a value of STDOUT for its name attribute and the ThresholdFilter will be assigned a level of debug.

```
{ "configuration": { "status": "error", "name": "RoutingTest",
                    "packages": "org.apache.logging.log4j.test",
                    "properties": {
                        "property": { "name": "filename",
                                      "value": "target/rolling1/rollingtest-$$${sd:type}.log" }
                    },
                    "ThresholdFilter": { "level": "debug" },
                    "appenders": {
                        "Console": { "name": "STDOUT",
                                     "PatternLayout": { "pattern": "%m%n" }
                        },
                        "List": { "name": "List",
                                  "ThresholdFilter": { "level": "debug" }
                        },
                        "Routing": { "name": "Routing",
                                    "Routes": { "pattern": "$${sd:type}" },
                                    "Route": [
                                        {
                                            "RollingFile": {
                                                "name": "Rolling-$$${sd:type}", "fileName": "${filename}",
                                                "filePattern": "target/rolling1/test1-$$${sd:type}.%i.log.gz",
                                                "PatternLayout": { "pattern": "%d %p %C{1} [%t] %m%n" },
                                                "SizeBasedTriggeringPolicy": { "size": "500" }
                                            }
                                        },
                                        { "appender-ref": "STDOUT", "key": "Audit" },
                                        { "appender-ref": "List", "key": "Service" }
                                    ]
                                }
                    },
                    "loggers": {
                        "logger": { "name": "EventLogger", "level": "info", "additivity": "false",
                                    "appender-ref": { "ref": "Routing" } },
                        "root": { "level": "error", "appender-ref": { "ref": "STDOUT" } }
                    }
                }
}
```

Note that in the RoutingAppender the Route element has been declared as an array. This is valid because each array element will be a Route component. This won't work for elements such as appenders and

filters, where each element has a different name in the concise format. Appenders and filters can be defined as array elements if each appender or filter declares an attribute named "type" that contains the type of the appender. The following example illustrates this as well as how to declare multiple loggers as an array.

```
{ "configuration": { "status": "debug", "name": "RoutingTest",
                    "packages": "org.apache.logging.log4j.test",
                    "properties": {
                        "property": { "name": "filename",
                                      "value": "target/rolling1/rollingtest-$$${sd:type}.log" }
                    },
                    "ThresholdFilter": { "level": "debug" },
                    "appenders": {
                        "appender": [
                            { "type": "Console", "name": "STDOUT", "PatternLayout": { "pattern": "%m%n" }},
                            { "type": "List", "name": "List", "ThresholdFilter": { "level": "debug" }},
                            { "type": "Routing", "name": "Routing",
                              "Routes": { "pattern": "$${sd:type}"},
                              "Route": [
                                  {
                                      "RollingFile": {
                                          "name": "Rolling-${sd:type}", "fileName": "${filename}",
                                          "filePattern": "target/rolling1/test1-${sd:type}.%i.log.gz",
                                          "PatternLayout": { "pattern": "%d %p %C{1.} [%t] %m%n"},
                                          "SizeBasedTriggeringPolicy": { "size": "500" }
                                      }
                                  },
                                  { "appender-ref": "STDOUT", "key": "Audit"},
                                  { "appender-ref": "List", "key": "Service" }
                              ]
                            }
                        ]
                    },
                    "loggers": {
                        "logger": [
                            { "name": "EventLogger", "level": "info", "additivity": "false",
                              "appender-ref": { "ref": "Routing" }},
                            { "name": "com.foo.bar", "level": "error", "additivity": "false",
                              "appender-ref": { "ref": "Console" } }
                        ],
                        "root": { "level": "error", "appender-ref": { "ref": "STDOUT" } }
                    }
                }
}
```

The JSON support uses Jackson to parse the JSON files. These dependencies must be added to a project that wants to use JSON for configuration:



```
<dependency>
  <groupId>org.codehaus.jackson</groupId>
  <artifactId>jackson-core-asl</artifactId>
  <version>1.9.2</version>
</dependency>

<dependency>
  <groupId>org.codehaus.jackson</groupId>
  <artifactId>jackson-mapper-asl</artifactId>
  <version>1.9.2</version>
</dependency>
```

#### 5.1.4.3 Configuring loggers

An understanding of how loggers work in Log4j is critical before trying to configure them. Please reference the Log4j [architecture](#) if more information is required. Trying to configure Log4j without understanding those concepts will lead to frustration.

A `LoggerConfig` is configured using the `logger` element. The `logger` element must have a `name` attribute specified, will usually have a `level` attribute specified and may also have an `additivity` attribute specified. The level may be configured with one of TRACE, DEBUG, INFO, WARN, ERROR, ALL or OFF. If no level is specified it will default to ERROR. The `additivity` attribute may be assigned a value of true or false. If the attribute is omitted the default value of false will be used.

A `LoggerConfig` (including the root `LoggerConfig`) can be configured with properties that will be added to the properties copied from the `ThreadContextMap`. These properties can be referenced from Appenders, Filters, Layouts, etc just as if they were part of the `ThreadContext Map`. The properties can contain variables that will be resolved either when the configuration is parsed or dynamically when each event is logged. See [Property Substitution](#) for more information on using variables.

The `LoggerConfig` may also be configured with one or more `appender-ref` elements. Each appender referenced will become associated with the specified `LoggerConfig`. If multiple appenders are configured on the `LoggerConfig` each of them be called when processing logging events.

Every configuration must have a root logger. If one is not configured the default root `LoggerConfig`, which has a level of ERROR but with no appenders attached, will be used. The main differences between the root logger and other loggers are

1. The root logger does not have a `name` attribute.
2. The root logger does not support the `additivity` attribute since it has no parent.

#### 5.1.4.4 Configuring Appenders

An appender is configured either using the specific appender plugin's name or with an `appender` element and the `type` attribute containing the appender plugin's name. In addition each appender must have a `name` attribute specified with a value that is unique within the set of appenders. The name will be used by loggers to reference the appender as described in the previous section.

Most appenders also support a layout to be configured (which again may be specified either using the specific `Layout` plugin's name as the element or with "layout" as the element name along with a `type` attribute that contains the layout plugin's name. The various appenders will contain other attributes or elements that are required for them to function properly.

#### 5.1.4.5 Configuring Filters

Log4j allows a filter to be specified in any of 4 places:

1. At the same level as the appenders, loggers and properties elements. These filters can accept or reject events before they have been passed to a `LoggerConfig`.
2. In a logger element. These filters can accept or reject events for specific loggers.
3. In an appender element. These filters can prevent or cause events to be processed by the appender.
4. In an appender reference element. These filters are used to determine if a `Logger` should route the event to an appender.

Although only a single `filter` element can be configured, that element may be the `filters` element which represents the `CompositeFilter`. The `filters` element allows any number of `filter` elements to be configured within it. The following example shows how multiple filters can be configured on the `ConsoleAppender`.

```

<?xml version="1.0" encoding="UTF-8"?>
<configuration status="debug" name="XMLConfigTest" packages="org.apache.logging.log4j.test">
  <properties>
    <property name="filename">target/test.log</property>
  </properties>
  <ThresholdFilter level="trace"/>

  <appenders>
    <Console name="STDOUT">
      <PatternLayout pattern="%m MDC%X%n"/>
    </Console>
    <Console name="FLOW">
      <PatternLayout pattern="%C{1}.%M %m %ex%n"/>
      <filters>
        <MarkerFilter marker="FLOW" onMatch="ACCEPT" onMismatch="NEUTRAL"/>
        <MarkerFilter marker="EXCEPTION" onMatch="ACCEPT" onMismatch="DENY"/>
      </filters>
    </Console>
    <File name="File" fileName="${filename}">
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
    </File>
    <List name="List">
    </List>
  </appenders>

  <loggers>
    <logger name="org.apache.logging.log4j.test1" level="debug" additivity="false">
      <ThreadContextMapFilter>
        <KeyValuePair key="test" value="123"/>
      </ThreadContextMapFilter>
      <appender-ref ref="STDOUT"/>
    </logger>>

    <logger name="org.apache.logging.log4j.test2" level="debug" additivity="false">
      <property name="user">${sys:user.name}</property>
      <appender-ref ref="File">
        <ThreadContextMapFilter>
          <KeyValuePair key="test" value="123"/>
        </ThreadContextMapFilter>
      </appender-ref>
      <appender-ref ref="STDOUT" level="error"/>
    </logger>>

    <root level="trace">
      <appender-ref ref="List"/>
    </root>
  </loggers>

</configuration>

```

### 5.1.5 Property Substitution

Log4j 2 supports the ability to specify tokens in the configuration as references to properties defined elsewhere. Some of these properties will be resolved when the configuration file is interpreted while others may be passed to components where they will be evaluated at runtime. To accomplish this, Log4j uses variations of Apache Commons Lang's [StrSubstitutor](#) and [StrLookup](#) classes. In a manner similar to Ant or Maven, this allows variables declared as `${name}` to be resolved using properties declared in the configuration itself. For example, the following example shows the filename for the rolling file appender being declared as a property.

```

<?xml version="1.0" encoding="UTF-8"?>
<configuration status="debug" name="RoutingTest" packages="org.apache.logging.log4j.test">
  <properties>
    <property name="filename">target/rolling1/rollingtest-$$${sd:type}.log</property>
  </properties>
  <ThresholdFilter level="debug" />

  <appenders>
    <Console name="STDOUT">
      <PatternLayout pattern="%m%n" />
    </Console>
    <List name="List">
      <ThresholdFilter level="debug" />
    </List>
    <Routing name="Routing">
      <Routes pattern="$$${sd:type}">
        <Route>
          <RollingFile name="Rolling-$$${sd:type}" fileName="$$${filename}"
            filePattern="target/rolling1/test1-$$${sd:type}.*i.log.gz">
            <PatternLayout>
              <pattern>%d %p %C{1.} [%t] %m%n</pattern>
            </PatternLayout>
            <SizeBasedTriggeringPolicy size="500" />
          </RollingFile>
        </Route>
        <Route appender-ref="STDOUT" key="Audit" />
        <Route appender-ref="List" key="Service" />
      </Routes>
    </Routing>
  </appenders>

  <loggers>
    <logger name="EventLogger" level="info" additivity="false">
      <appender-ref ref="Routing" />
    </logger>

    <root level="error">
      <appender-ref ref="STDOUT" />
    </root>
  </loggers>

</configuration>

```

While this is useful, there are many more places properties can originate from. To accommodate this, Log4j also supports the syntax `$$${prefix:name}` where the prefix identifies tells Log4j that variable name should be evaluated in a specific context. The contexts that are built in to Logj4 are:

Prefix	Context
ctx	Thread Context Map (MDC)

date	Inserts the current date and/or time using the specified format
env	System environment variables
map	A value from a MapMessage
sd	A value from a StructuredDataMessage. The key "id" will return the name of the StructuredDataId without the enterprise number. The key "type" will return the message type. Other keys will retrieve individual elements from the Map.
sys	System properties

A default property map can be declared in the configuration file. If the value cannot be located in the specified lookup the value in the default property map will be used. The default map is pre-populated with a value for "hostName" that is the current system's host name or ip address and the "contextName" with is the value of the current logging context.

An interesting feature of StrLookup processing is that when a variable reference is declared with multiple leading '\$' characters each time the variable is resolved the leading '\$' is simply removed. In the previous example the "Routes" element is capable of resolving the variable at runtime. To allow this the prefix value is specified as a variable with two leading '\$' characters. When the configuration file is first processed the first variable is simply removed. Thus, when the Routes element is evaluated at runtime it is the variable declaration "\${sd:type}" which causes the event to be inspected for a StructuredDataMessage and if one is present the value of its type attribute to be used as the routing key. Not all elements support resolving variables at runtime. Components that do will specifically call that out in their documentation.

If no value is found for the key in the Lookup associated with the prefix then the value associated with the key in the properties declaration in the configuration file will be used. If no value is found the variable declaration will be returned as the value. Default values may be declared in the configuration by doing:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration>
  <properties>
    <property name="type">Audit</property>
  </properties>
  ...
</configuration>
```

*As a footnote, it is worth pointing out that the variables in the RollingFile appender declaration will also not be evaluated when the configuration is processed. This is simply because the resolution of the whole RollingFile element is deferred until a match occurs. See [RoutingAppender](#) for more information.*

### 5.1.6 Status Messages

Just as it is desirable to be able to diagnose problems in applications, it is frequently necessary to be able to diagnose problems in the logging configuration or in the configured components. Since logging has not been configured, "normal" logging cannot be used during initialization. In addition, normal logging within appenders could create infinite recursion which Log4j will detect and cause the recursive events to

be ignored. To accommodate this need, the Log4j 2 API includes a [StatusLogger](#). Components declare an instance of the StatusLogger similar to:

```
protected final static Logger logger = StatusLogger.getLogger();
```

Since StatusLogger implements the Log4j 2 API's Logger interface, all the normal Logger methods may be used.

When configuring Log4j it is sometimes necessary to view the generated status events. This can be accomplished by adding the status attribute to the configuration element. The following configuration has the status attribute set to debug.

```

<?xml version="1.0" encoding="UTF-8"?>
<configuration status="debug" name="RoutingTest"
    packages="org.apache.logging.log4j.test">
  <properties>
    <property name="filename">target/rolling1/rollingtest-$$${sd:type}.log</property>
  </properties>
  <ThresholdFilter level="debug"/>

  <appenders>
    <Console name="STDOUT">
      <PatternLayout pattern="%m%n"/>
    </Console>
    <List name="List">
      <ThresholdFilter level="debug"/>
    </List>
    <Routing name="Routing">
      <Routes pattern="$$${sd:type}">
        <Route>
          <RollingFile name="Rolling-$$${sd:type}" fileName="${filename}"
            filePattern="target/rolling1/test1-$$${sd:type}.*i.log.gz">
            <PatternLayout>
              <pattern>%d %p %C{1.} [%t] %m%n</pattern>
            </PatternLayout>
            <SizeBasedTriggeringPolicy size="500" />
          </RollingFile>
        </Route>
        <Route appender-ref="STDOUT" key="Audit"/>
        <Route appender-ref="List" key="Service"/>
      </Routes>
    </Routing>
  </appenders>

  <loggers>
    <logger name="EventLogger" level="info" additivity="false">
      <appender-ref ref="Routing"/>
    </logger>

    <root level="error">
      <appender-ref ref="STDOUT"/>
    </root>
  </loggers>

</configuration>

```

During startup this configuration produces:



```
2011-11-23 17:08:00,769 DEBUG Generated plugins in 0.003374000 seconds
2011-11-23 17:08:00,789 DEBUG Calling createProperty on class org.apache.logging.log4j.core.
    config.Property for element property with params(name="filename",
    value="target/rolling1/rollingtest-${sd:type}.log")
2011-11-23 17:08:00,792 DEBUG Calling configureSubstitutor on class org.apache.logging.log4j.
    core.config.plugins.PropertiesPlugin for element properties with
    params(properties={filename=target/rolling1/rollingtest-${sd:type}.log})
2011-11-23 17:08:00,794 DEBUG Generated plugins in 0.001362000 seconds
2011-11-23 17:08:00,797 DEBUG Calling createFilter on class org.apache.logging.log4j.core.
    filter.ThresholdFilter for element ThresholdFilter with params(level="debug",
    onMatch="null", onMismatch="null")
2011-11-23 17:08:00,800 DEBUG Calling createLayout on class org.apache.logging.log4j.core.
    layout.PatternLayout for element PatternLayout with params(pattern="%m%n",
    Configuration(RoutingTest), null, charset="null")
2011-11-23 17:08:00,802 DEBUG Generated plugins in 0.001349000 seconds
2011-11-23 17:08:00,804 DEBUG Calling createAppender on class org.apache.logging.log4j.core.
    appender.ConsoleAppender for element Console with params(PatternLayout(%m%n), null,
    target="null", name="STDOUT", suppressExceptions="null")
2011-11-23 17:08:00,804 DEBUG Calling createFilter on class org.apache.logging.log4j.core.
    filter.ThresholdFilter for element ThresholdFilter with params(level="debug",
    onMatch="null", onMismatch="null")
2011-11-23 17:08:00,806 DEBUG Calling createAppender on class org.apache.logging.log4j.test.
    appender.ListAppender for element List with params(name="List", entryPerNewLine="null",
    raw="null", null, ThresholdFilter(DEBUG))
2011-11-23 17:08:00,813 DEBUG Calling createRoute on class org.apache.logging.log4j.core.appender.
    routing.Route for element Route with params(appender-ref="null", key="null", Node=Route)
2011-11-23 17:08:00,823 DEBUG Calling createRoute on class org.apache.logging.log4j.core.appender.
    routing.Route for element Route with params(appender-ref="STDOUT", key="Audit", Node=Route)
2011-11-23 17:08:00,824 DEBUG Calling createRoute on class org.apache.logging.log4j.core.appender.
    routing.Route for element Route with params(appender-ref="List", key="Service", Node=Route)
2011-11-23 17:08:00,825 DEBUG Calling createRoutes on class org.apache.logging.log4j.core.appender.
    routing.Routes for element Routes with params(pattern="${sd:type}",
    routes={Route(type=dynamic default), Route(type=static Reference=STDOUT key='Audit'),
    Route(type=static Reference=List key='Service')}})
2011-11-23 17:08:00,827 DEBUG Calling createAppender on class org.apache.logging.log4j.core.appender.
    routing.RoutingAppender for element Routing with params(name="Routing",
    suppressExceptions="null", Routes({Route(type=dynamic default),Route(type=static
    Reference=STDOUT key='Audit'),
    Route(type=static Reference=List key='Service')}), Configuration(RoutingTest), null, null)
2011-11-23 17:08:00,827 DEBUG Calling createAppenders on class org.apache.logging.log4j.core.config.
    plugins.AppendersPlugin for element appenders with params(appenders={STDOUT, List, Routing})
2011-11-23 17:08:00,828 DEBUG Calling createAppenderRef on class org.apache.logging.log4j.core.
    config.plugins.AppenderRefPlugin for element appender-ref with params(ref="Routing")
2011-11-23 17:08:00,829 DEBUG Calling createLogger on class org.apache.logging.log4j.core.config.
    LoggerConfig for element logger with params(additivity="false", level="info", name="EventLogger",
    appender-ref={Routing}, null)
2011-11-23 17:08:00,830 DEBUG Calling createAppenderRef on class org.apache.logging.log4j.core.
    config.plugins.AppenderRefPlugin for element appender-ref with params(ref="STDOUT")
```

```

2011-11-23 17:08:00,831 DEBUG Calling createLogger on class org.apache.logging.log4j.core.config.
    LoggerConfig$RootLogger for element root with params(additivity="null", level="error",
    appender-ref={STDOUT}, null)
2011-11-23 17:08:00,833 DEBUG Calling createLoggers on class org.apache.logging.log4j.core.
    config.plugins.LoggersPlugin for element loggers with params(loggers={EventLogger, root})
2011-11-23 17:08:00,834 DEBUG Reconfiguration completed
2011-11-23 17:08:00,846 DEBUG Calling createLayout on class org.apache.logging.log4j.core.
    layout.PatternLayout for element PatternLayout with params(pattern="%d %p %C{1.} [%t] %m%n",
    Configuration(RoutingTest), null, charset="null")
2011-11-23 17:08:00,849 DEBUG Calling createPolicy on class org.apache.logging.log4j.core.
    appender.rolling.SizeBasedTriggeringPolicy for element SizeBasedTriggeringPolicy with
    params(size="500")
2011-11-23 17:08:00,851 DEBUG Calling createAppender on class org.apache.logging.log4j.core.
    appender.RollingFileAppender for element RollingFile with
    params(fileName="target/rolling1/rollingtest-Unknown.log",
    filePattern="target/rolling1/test1-Unknown.%i.log.gz", append="null", name="Rolling-Unknown",
    bufferedIO="null", immediateFlush="null",
    SizeBasedTriggeringPolicy(SizeBasedTriggeringPolicy(size=500)), null,
    PatternLayout(%d %p %C{1.} [%t] %m%n), null, suppressExceptions="null")
2011-11-23 17:08:00,858 DEBUG Generated plugins in 0.002014000 seconds
2011-11-23 17:08:00,889 DEBUG Reconfiguration started for context sun.misc.
    Launcher$AppClassLoader@37b90b39
2011-11-23 17:08:00,890 DEBUG Generated plugins in 0.001355000 seconds
2011-11-23 17:08:00,959 DEBUG Generated plugins in 0.001239000 seconds
2011-11-23 17:08:00,961 DEBUG Generated plugins in 0.001197000 seconds
2011-11-23 17:08:00,965 WARN No Loggers were configured, using default
2011-11-23 17:08:00,976 DEBUG Reconfiguration completed

```

If the status attribute is set to error than only error messages will be written to the console. This makes troubleshooting configuration errors possible. As an example, if the configuration above is changed to have the status set to error and the logger declaration is:

```

<logger name="EventLogger" level="info" additivity="false">
  <appender-ref ref="Routng"/>
</logger>

```

the following error message will be produced.

```

2011-11-24 23:21:25,517 ERROR Unable to locate appender Routng for logger EventLogger

```

Applications may wish to direct the status output to some other destination. This can be accomplished by setting the dest attribute to either "err" to send the output to stderr or to a file location or URL. This can also be done by insuring the configured status is set to OFF and then configuring the application programmatically such as:

```

StatusConsoleListener listener = new StatusConsoleListener(Level.ERROR);
((StatusLogger) logger).registerListener(listener);

```

### 5.1.7 Testing in Maven

Maven can run unit and functional tests during the build cycle. By default, any files placed in `src/test/resources` are automatically copied to `target/test-classes` and are included in the classpath during execution of any tests. As such, placing a `log4j2-test.xml` into this directory will cause it to be used instead of a `log4j2.xml` or `log4j2.json` that might be present. Thus a different log configuration can be used during testing than what is used in production.

A second approach, which is extensively used by Log4j 2, is to set the `log4j.configurationFile` property in the method annotated with `@BeforeClass` in the junit test class. This will allow an arbitrarily named file to be used during the test.

# Plugins

---

## 6.1 Plugins

### 6.1.1 Introduction

Log4j 1.x allowed for extension by requiring class attributes on most of the configuration declarations. In the case of some elements, notably the `PatternLayout`, the only way to add new pattern converters was to extend the `PatternLayout` class and add them via code. One of goals of Log4j 2 is to make extending it extremely easy through the use of plugins.

In Log4j 2 a plugin is declared by adding a `Plugin` annotation to the class declaration. During initialization the `Configuration` will invoke the `PluginManager` to locate all the Log4j plugins that are located in the declared `packages`. As the configuration is processed the appropriate plugins will be automatically configured and initialized. Log4j 2 utilizes a few different types of plugins which are described in the following sections.

### 6.1.2 Core

Core plugins are those that are directly represented by an element in a configuration file, such as an `Appender`, `Logger` or `Filter`. Custom plugins that conform to the rules laid out in the next paragraph may simply be referenced in the configuration, provided they are appropriately configured to be loaded by the `PluginManager`.

Every Core plugin must declare a static method that is marked with a `PluginFactory` annotation. To allow the `Configuration` to pass the correct parameters to the method, every parameter to the method must be annotated as one of the following attribute types. Each attribute or element annotation must include the name that must be present in the configuration in order to match the configuration item to its respective parameter.

#### 6.1.2.1 Attribute Types

##### **PluginAttr**

The parameter must resolve to a `String`, although it can be the `String` representation of a `boolean`, `numeric` value, or any other `Object` that can be created from a `String` value.

##### **PluginElement**

The parameter may represent a complex object that itself has parameters that can be configured.

##### **PluginConfiguration**

The current `Configuration` object will be passed to the plugin as a parameter.

### 6.1.3 Converters

Converters are used by [PatternLayout](#) to render the elements identified by the conversion pattern. Every converter must specify its type as "Converter" on the Plugin attribute, have a static newInstance method that accepts an array of Strings as its only parameter and returns an instance of the Converter, and must have a ConverterKeys annotation present that contains the array of converter patterns that will cause the Converter to be selected. Converters that are meant to handle LogEvents must extend the LogEventPatternConverter class and must implement a format method that accepts a LogEvent and a StringBuilder as arguments. The Converter should append the result of its operation to the StringBuilder.

A second type of Converter is the FileConverter - which must have "FileConverter" specified in the type attribute of the Plugin annotation. While similar to a LogEventPatternConverter, instead of a single format method these Converters will have two variations; one that takes an Object and one that takes an array of Objects instead of the LogEvent. Both append to the provided StringBuilder in the same fashion as a LogEventPatternConverter. These Converters are typically used by the RollingFileAppender to construct the name of the file to log to.

### 6.1.4 Lookups

Lookups are perhaps the simplest plugins of all. They must declare their type as "Lookup" on the plugin annotation and must implement the StrLookup interface. They will have two methods; a lookup method that accepts a String key and returns a String value and a second lookup method that accepts both a LogEvent and a String key and returns a String. Lookups may be referenced by specifying `${ name:key }` where *name* is the name specified in the Plugin annotation and key is the name of the item to locate.

### 6.1.5 Plugin Preloading

Scanning for annotated classes dynamically takes a bit of time during application initialization. Log4j avoids this by scanning its classes during the build. In the Maven build, the PluginManager is invoked as shown below and then the resulting Map is stored in a file in the jar being constructed. Log4j will locate all the files created this way and preload them, which shortens startup time considerably. Adding the following plugin definition to your project's pom.xml will cause the plugin manager to be called during the build. It will store the resulting file in the correct location under the directory specified in the first argument after scanning all the components located under the package specified in the second argument.

```
<plugin>
  <groupId>org.codehaus.mojo</groupId>
  <artifactId>exec-maven-plugin</artifactId>
  <version>1.2.1</version>
  <executions>
    <execution>
      <phase>process-classes</phase>
      <goals>
        <goal>java</goal>
      </goals>
    </execution>
  </executions>
  <configuration>
    <mainClass>org.apache.logging.log4j.core.config.plugins.PluginManager</mainClass>
    <arguments>
      <argument>${project.build.outputDirectory}</argument>
      <argument>org.myorg.myproject.log4j</argument>
    </arguments>
  </configuration>
</plugin>
```

# Lookups

---

## 7.1 Lookups

Lookups provide a way to add values to the Log4j configuration at arbitrary places. They are a particular type of Plugin that implements the [StrLookup](#) interface. Information on how to use Lookups in configuration files can be found in the [Property Substitution](#) section of the [Configuration](#) page.

### 7.1.1 ContextMapLookup

The ContextMapLookup allows applications to store data in the Log4j ThreadContext Map and then retrieve the values in the Log4j configuration. In the example below, the application would store the current user's login id in the ThreadContext Map with the key "loginId". During initial configuration processing the first '\$' will be removed. The PatternLayout supports interpolation with Lookups and will then resolve the variable for each event. Note that the pattern "%X{loginId}" would achieve the same result.

```
<File name="Application" fileName="application.log">
  <PatternLayout>
    <pattern>%d %p %C{1.} [%t] ${ctx:loginId} %m%n</pattern>
  </PatternLayout>
</File>
```

### 7.1.2 DateLookup

The DateLookup is somewhat unusual from the other lookups as it doesn't use the key to locate an item. Instead, the key can be used to specify a date format string that is valid for [SimpleDateFormat](#). The current date, or the date associated with the current log event will be formatted as specified.

```
<RollingFile name="Rolling-${map:type}" fileName="${filename}" filePattern="target/rolling1/test1-${date:MM-dd-yy}">
  <PatternLayout>
    <pattern>%d %p %C{1.} [%t] %m%n</pattern>
  </PatternLayout>
  <SizeBasedTriggeringPolicy size="500" />
</RollingFile>
```

### 7.1.3 EnvironmentLookup

The EnvironmentLookup allows systems to configure environment variables, either in global files such as /etc/profile or in the startup scripts for applications, and then retrieve those variables from within the logging configuration. The example below includes the name of the currently logged in user in the application log.

```
<File name="Application" fileName="application.log">
  <PatternLayout>
    <pattern>%d %p %C{1.} [%t] ${env:USER} %m%n</pattern>
  </PatternLayout>
</File>
```

### 7.1.4 MapLookup

The MapLookup serves two purposes.

1. Provide the base for Properties declared in the configuration file.
2. Retrieve values from MapMessages in LogEvents.

The first item simply means that the MapLookup is used to substitute properties that are defined in the configuration file. These variables are specified without a prefix - e.g. `${name}`. The second usage allows a value from the current [MapMessage](#), if one is part of the current log event, to be substituted. In the example below the RoutingAppender will use a different RollingFileAppender for each unique value of the key named "type" in the MapMessage. Note that when used this way a value for "type" should be declared in the properties declaration to provide a default value in case the message is not a MapMessage or the MapMessage does not contain the key. See the [Property Substitution](#) section of the [Configuration](#) page for information on how to set the default values.

```
<Routing name="Routing">
  <Routes pattern="${map:type}">
    <Route>
      <RollingFile name="Rolling-${map:type}" fileName="${filename}"
        filePattern="target/rolling1/test1-${map:type}.*i.log.gz">
        <PatternLayout>
          <pattern>%d %p %C{1.} [%t] %m%n</pattern>
        </PatternLayout>
        <SizeBasedTriggeringPolicy size="500" />
      </RollingFile>
    </Route>
  </Routes>
</Routing>
```

### 7.1.5 StructuredDataLookup

The StructuredDataLookup is very similar to the MapLookup in that it will retrieve values from StructuredDataMessages. In addition to the Map values it will also return the name portion of the id (not including the enterprise number) and the type field. The main difference between the example below and the example for MapMessage is that the "type" is an attribute of the [StructuredDataMessage](#) while "type" would have to be an item in the Map in a MapMessage.



```
<Routing name="Routing">
  <Routes pattern="${sd:type}">
    <Route>
      <RollingFile name="Rolling-${sd:type}" fileName="${filename}"
        filePattern="target/rolling1/test1-${sd:type}.%i.log.gz">
        <PatternLayout>
          <pattern>%d %p %C{1.} [%t] %m%n</pattern>
        </PatternLayout>
        <SizeBasedTriggeringPolicy size="500" />
      </RollingFile>
    </Route>
  </Routes>
</Routing>
```

### 7.1.6 SystemPropertiesLookup

As it is quite common to define values inside and outside the application by using System Properties, it is only natural that they should be accessible via a Lookup. As system properties are often defined outside the application it would be quite common to see something like:

```
<appenders>
  <File name="ApplicationLog" fileName="${sys:logPath}/app.log"/>
</appenders>
```

# Appenders

---

## 8.1 Appenders

Appenders are responsible for delivering LogEvents to their destination. Every Appender must implement the [Appender](#) interface. Most Appenders will extend [AbstractAppender](#) which adds [Lifecycle](#) and [Filterable](#) support. Lifecycle allows components to finish initialization after configuration has completed and to perform cleanup during shutdown. Filterable allows the component to have Filters attached to it which are evaluated during event processing.

Appenders usually are only responsible for writing the event data to the target destination. In most cases they delegate responsibility for formatting the event to a [layout](#). Some appenders wrap other appenders so that they can modify the LogEvent, handle a failure in an Appender, route the event to a subordinate Appender based on advanced Filter criteria or provide similar functionality that does not directly format the event for viewing.

Appenders always have a name so that they can be referenced from Loggers.

### 8.1.1 AsynchAppender

The AsynchAppender accepts references to other Appenders and causes LogEvents to be written to them on a separate Thread. Note that exceptions while writing to those Appenders will be hidden from the application. The AsynchAppender should be configured after the appenders it references to allow it to shut down properly.

Parameter Name	Type	Description
appender-ref	String	The name of the Appenders to invoke asynchronously. Multiple appender-ref elements can be configured.
blocking	boolean	If true, the appender will wait until there are free slots in the queue. If false, the event will be written to the error appender if the queue is full.
bufferSize	integer	Specifies the maximum number of events that can be queued. The default is 128.
error-ref	String	The name of the Appender to invoke if none of the appenders can be called, either due to errors in the appenders or because the queue is full. If not specified then errors will be ignored.
filter	Filter	A Filter to determine if the event should be handled by this Appender. More than one Filter may be used by using a CompositeFilter.

name	String	The name of the Appender.
suppressExceptions	boolean	The default is true, causing exceptions to be internally logged and then ignored. When set to false exceptions will be percolated to the caller.

### AsynchAppender Parameters

A typical AsynchAppender configuration might look like:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <File name="MyFile" fileName="logs/app.log">
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
    </File>
    <Asynch name="Asynch">
      <appender-ref ref="MyFile"/>
    </Asynch>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="Asynch"/>
    </root>
  </loggers>
</configuration>
```

#### 8.1.2 ConsoleAppender

As one might expect, the ConsoleAppender writes its output to either System.err or System.out with System.err being the default target. A Layout must be provided to format the LogEvent.

Parameter Name	Type	Description
filter	Filter	A Filter to determine if the event should be handled by this Appender. More than one Filter may be used by using a CompositeFilter.
layout	Layout	The Layout to use to format the LogEvent. If no layout is supplied the default pattern layout of "%m%n" will be used.

follow	boolean	Identifies whether the appender honors reassignments of System.out or System.err via System.setOut or System.setErr made after configuration. Note that the follow attribute cannot be used with Jansi on Windows.
name	String	The name of the Appender.
suppressExceptions	boolean	The default is true, causing exceptions to be internally logged and then ignored. When set to false exceptions will be percolated to the caller.
target	String	Either "SYSTEM_OUT" or "SYSTEM_ERR". The default is "SYSTEM_ERR".

### ConsoleAppender Parameters

A typical Console configuration might look like:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <Console name="STDOUT" target="SYSTEM_OUT">
      <PatternLayout pattern="%m%n"/>
    </Console>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="STDOUT"/>
    </root>
  </loggers>
</configuration>
```

#### 8.1.3 FailoverAppender

The FailoverAppender wraps a set of appenders. If the primary Appender fails the secondary appenders will be tried in order until one succeeds or there are no more secondaries to try.

Parameter Name	Type	Description
filter	Filter	A Filter to determine if the event should be handled by this Appender. More than one Filter may be used by using a CompositeFilter.
primary	String	The name of the primary Appender to use.

failovers	String[]	The names of the secondary Appenders to use.
name	String	The name of the Appender.
retryInterval	integer	The number of seconds that should pass before retrying the primary Appender. The default is 60.
suppressExceptions	boolean	The default is true, causing exceptions to be internally logged and then ignored. When set to false exceptions will be percolated to the caller.
target	String	Either "SYSTEM_OUT" or "SYSTEM_ERR". The default is "SYSTEM_ERR".

### FailoverAppender Parameters

A Failover configuration might look like:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <RollingFile name="RollingFile" fileName="logs/app.log"
      filePattern="logs/app-%d{MM-dd-yyyy}.log.gz">
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
      <TimeBasedTriggeringPolicy />
    </RollingFile>
    <Console name="STDOUT" target="SYSTEM_OUT">
      <PatternLayout pattern="%m%n"/>
    </Console>
    <Failover name="Failover" primary="RollingFile" suppressExceptions="false">
      <Failovers>
        <appender-ref ref="Console"/>
      </Failovers>
    </Failover>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="Failover"/>
    </root>
  </loggers>
</configuration>
```

### 8.1.4 FileAppender

The FileAppender is an OutputStreamAppender that writes to the File named in the fileName parameter. The FileAppender uses a FileManager (which extends OutputStreamManager) to actually perform the file I/O. While FileAppenders from different Configurations cannot be shared, the FileManagers can be if the Manager is accessible. For example, two webapps in a servlet container can have their own configuration and safely write to the same file if Log4J is in a ClassLoader that is common to both of them.

Parameter Name	Type	Description
append	boolean	When true - the default, records will be appended to the end of the file. When set to false, the file will be cleared before new records are written.
bufferedIO	boolean	When true - the default, records will be written to a buffer and the data will be written to disk when the buffer is full or, if immediateFlush is set, when the record is written. File locking cannot be used with bufferedIO. Performance tests have shown that using buffered I/O significantly improves performance, even if immediateFlush is enabled.
filter	Filter	A Filter to determine if the event should be handled by this Appender. More than one Filter may be used by using a CompositeFilter.
fileName	String	The name of the file to write to. If the file, or any of its parent directories, do not exist, they will be created.
immediateFlush	boolean	When set to true, each write will be followed by a flush. This will guarantee the data is written to disk but could impact performance.
layout	Layout	The Layout to use to format the LogEvent
locking	boolean	When set to true, I/O operations will occur only while the file lock is held allowing FileAppenders in multiple JVMs and potentially multiple hosts to write to the same file simultaneously. This will significantly impact performance so should be used carefully. Furthermore, on many systems the file lock is "advisory" meaning that other applications can perform operations on the file without acquiring a lock. The default value is false.

name	String	The name of the Appender.
suppressExceptions	boolean	The default is true, causing exceptions to be internally logged and then ignored. When set to false exceptions will be percolated to the caller.

### FileAppender Parameters

Here is a sample File configuration:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <File name="MyFile" fileName="logs/app.log">
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
    </File>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="MyFile"/>
    </root>
  </loggers>
</configuration>
```

#### 8.1.5 FlumeAppender

*This is an optional component supplied in a separate jar.*

**Apache Flume** is a distributed, reliable, and available system for efficiently collecting, aggregating, and moving large amounts of log data from many different sources to a centralized data store. The `FlumeAppender` takes `LogEvents` and sends them to a Flume agent as serialized Avro events for consumption.

The Flume Appender supports two modes of operation.

1. It can act as a remote Flume client which sends Flume events via Avro to a Flume Agent configured with an Avro Source.
2. It can act as an embedded Flume Agent where Flume events pass directly into Flume for processing.

Usage as an embedded agent will cause the messages to be directly passed to the Flume Channel and then control will be immediately returned to the application. All interaction with remote agents will occur asynchronously. Setting the "embedded" attribute to "true" will force the use of the embedded agent. In addition, configuring agent properties in the appender configuration will also cause the embedded agent to be used.

Parameter Name	Type	Description
----------------	------	-------------

agents	Agent[]	An array of Agents to which the logging events should be sent. If more than one agent is specified the first Agent will be the primary and subsequent Agents will be used in the order specified as secondaries should the primary Agent fail. Each Agent definition supplies the Agents host and port. The specification of agents and properties are mutually exclusive. If both are configured an error will result.
agentRetries	integer	The number of times the agent should be retried before failing to a secondary.
batchSize	integer	Specifies the number of events that should be sent as a batch. The default is 1. <i>This parameter only applies to the Flume NG Appender.</i>
compress	boolean	When set to true the message body will be compressed using gzip
dataDir	String	Directory where the Flume write ahead log should be written. Valid only when embedded is set to true and Agent elements are used instead of Property elements.
embedded	boolean	When set to true the embedded Flume agent will be used. When Agent elements are used the events will be sent to a file channel and then routed to a FailoverSinkProcessor which will use each configured agent in the order they are declared.
filter	Filter	A Filter to determine if the event should be handled by this Appender. More than one Filter may be used by using a CompositeFilter.
eventPrefix	String	The character string to prepend to each event attribute in order to distinguish it from MDC attributes. The default is an empty string.
flumeEventFactory	FlumeEventFactory	Factory that generates the Flume events from Log4j events. The default factory is the FlumeAvroAppender itself.
layout	Layout	The Layout to use to format the LogEvent. If no layout is specified RFC5424Layout will be used.



mdcExcludes	String	A comma separated list of mdc keys that should be excluded from the FlumeEvent. This is mutually exclusive with the mdcIncludes attribute.
mdcIncludes	String	A comma separated list of mdc keys that should be included in the FlumeEvent. Any keys in the MDC not found in the list will be excluded. This option is mutually exclusive with the mdcExcludes attribute.
mdcRequired	String	A comma separated list of mdc keys that must be present in the MDC. If a key is not present a LoggingException will be thrown.
mdcPrefix	String	A string that should be prepended to each MDC key in order to distinguish it from event attributes. The default string is "mdc:".
name	String	The name of the Appender.
properties	Property[]	One or more Property elements that are used to configure the Flume Agent. The properties must be configured without the agent name (the appender name is used for this) and no sources can be configured. All other Flume configuration properties are allowed. Specifying both Agent and Property elements will result in an error.
reconnectionDelay	integer	The number of milliseconds the application should wait before trying again to connect to the agent.
suppressExceptions	boolean	The default is true, causing exceptions to be internally logged and then ignored. When set to false exceptions will be percolated to the caller.

### FlumeAvroAppender Parameters

A sample FlumeAppender configuration that is configured with a primary and a secondary agent, compresses the body, and formats the body using the RFC5424Layout:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <Flume name="eventLogger" suppressExceptions="false" compress="true">
      <Agent host="192.168.10.101" port="8800"/>
      <Agent host="192.168.10.102" port="8800"/>
      <RFC5424Layout enterpriseNumber="18060" includeMDC="true" appName="MyApp"/>
    </Flume>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="eventLogger"/>
    </root>
  </loggers>
</configuration>
```

A sample FlumeAppender configuration that is configured with a primary and a secondary agent, compresses the body, formats the body using RFC5424Layout and passes the events to an embedded Flume Agent.

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <Flume name="eventLogger" suppressExceptions="false" compress="true" embedded="true">
      <Agent host="192.168.10.101" port="8800"/>
      <Agent host="192.168.10.102" port="8800"/>
      <RFC5424Layout enterpriseNumber="18060" includeMDC="true" appName="MyApp"/>
    </Flume>
    <Console name="STDOUT">
      <PatternLayout pattern="%d [%p] %c %m%n"/>
    </Console>
  </appenders>
  <loggers>
    <logger name="EventLogger" level="info">
      <appender-ref ref="eventLogger"/>
    </logger>
    <root level="warn">
      <appender-ref ref="STDOUT"/>
    </root>
  </loggers>
</configuration>
```

A sample FlumeAppender configuration that is configured with a primary and a secondary agent using Flume configuration properties, compresses the body, formats the body using RFC5424Layout and passes the events to an embedded Flume Agent.

```

<?xml version="1.0" encoding="UTF-8"?>
<configuration status="error" name="MyApp" packages="">
  <appenders>
    <Flume name="eventLogger" suppressExceptions="false" compress="true" embedded="true">
      <Property name="channels">file</Property>
      <Property name="channels.file.type">file</Property>
      <Property name="channels.file.checkpointDir">target/file-channel/checkpoint</Property>
      <Property name="channels.file.dataDirs">target/file-channel/data</Property>
      <Property name="sinks">agent1 agent2</Property>
      <Property name="sinks.agent1.channel">file</Property>
      <Property name="sinks.agent1.type">avro</Property>
      <Property name="sinks.agent1.hostname">192.168.10.101</Property>
      <Property name="sinks.agent1.port">8800</Property>
      <Property name="sinks.agent1.batch-size">100</Property>
      <Property name="sinks.agent2.channel">file</Property>
      <Property name="sinks.agent2.type">avro</Property>
      <Property name="sinks.agent2.hostname">192.168.10.102</Property>
      <Property name="sinks.agent2.port">8800</Property>
      <Property name="sinks.agent2.batch-size">100</Property>
      <Property name="sinkgroups">group1</Property>
      <Property name="sinkgroups.group1.sinks">agent1 agent2</Property>
      <Property name="sinkgroups.group1.processor.type">failover</Property>
      <Property name="sinkgroups.group1.processor.priority.agent1">10</Property>
      <Property name="sinkgroups.group1.processor.priority.agent2">5</Property>
      <RFC5424Layout enterpriseNumber="18060" includeMDC="true" appName="MyApp" />
    </Flume>
    <Console name="STDOUT">
      <PatternLayout pattern="%d [%p] %c %m%n" />
    </Console>
  </appenders>
  <loggers>
    <logger name="EventLogger" level="info">
      <appender-ref ref="eventLogger" />
    </logger>
    <root level="warn">
      <appender-ref ref="STDOUT" />
    </root>
  </loggers>
</configuration>

```

### 8.1.6 JMSQueueAppender

The JMSQueueAppender sends the formatted log event to a JMS Queue.

Parameter Name	Type	Description
----------------	------	-------------

factoryBindingName	String	The name to locate in the Context that provides the <a href="#">QueueConnectionFactory</a> .
factoryName	String	The fully qualified class name that should be used to define the Initial Context Factory as defined in <a href="#">INITIAL_CONTEXT_FACTORY</a> . If no value is provided the default InitialContextFactory will be used. If a factoryName is specified without a providerURL a warning message will be logged as this is likely to cause problems.
filter	Filter	A Filter to determine if the event should be handled by this Appender. More than one Filter may be used by using a CompositeFilter.
layout	Layout	The Layout to use to format the LogEvent. If no layout is specified SerializedLayout will be used.
name	String	The name of the Appender.
password	String	The password to use to create the queue connection.
providerURL	String	The URL of the provider to use as defined by <a href="#">PROVIDER_URL</a> . If this value is null the default system provider will be used.
queueBindingName	String	The name to use to locate the <a href="#">Queue</a> .
securityPrincipalName	String	The name of the identity of the Principal as specified by <a href="#">SECURITY_PRINCIPAL</a> . If a securityPrincipalName is specified without securityCredentials a warning message will be logged as this is likely to cause problems.
securityCredentials	String	The security credentials for the principal as specified by <a href="#">SECURITY_CREDENTIALS</a> .
suppressExceptions	boolean	The default is true, causing exceptions to be internally logged and then ignored. When set to false exceptions will be percolated to the caller.
urlPkgPrefixes	String	A colon-separated list of package prefixes for the class name of the factory class that will create a URL context factory as defined by <a href="#">URL_PKG_PREFIXES</a> .

userName	String	The user id used to create the queue connection.
----------	--------	--

### JMSQueueAppender Parameters

Here is a sample JMSQueueAppender configuration:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <JMSQueue name="jmsQueue" queueBindingName="MyQueue"
      factoryBindingName="MyQueueConnectionFactory"/>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="jmsQueue"/>
    </root>
  </loggers>
</configuration>
```

#### 8.1.7 JMSTopicAppender

The JMSTopicAppender sends the formatted log event to a JMS Topic.

Parameter Name	Type	Description
factoryBindingName	String	The name to locate in the Context that provides the <a href="#">TopicConnectionFactory</a> .
factoryName	String	The fully qualified class name that should be used to define the Initial Context Factory as defined in <a href="#">INITIAL_CONTEXT_FACTORY</a> . If no value is provided the default InitialContextFactory will be used. If a factoryName is specified without a providerURL a warning message will be logged as this is likely to cause problems.
filter	Filter	A Filter to determine if the event should be handled by this Appender. More than one Filter may be used by using a CompositeFilter.
layout	Layout	The Layout to use to format the LogEvent. If no layout is specified SerializedLayout will be used.
name	String	The name of the Appender.

password	String	The password to use to create the queue connection.
providerURL	String	The URL of the provider to use as defined by <code>PROVIDER_URL</code> . If this value is null the default system provider will be used.
topicBindingName	String	The name to use to locate the <code>Topic</code> .
securityPrincipalName	String	The name of the identity of the Principal as specified by <code>SECURITY_PRINCIPAL</code> . If a securityPrincipalName is specified without securityCredentials a warning message will be logged as this is likely to cause problems.
securityCredentials	String	The security credentials for the principal as specified by <code>SECURITY_CREDENTIALS</code> .
suppressExceptions	boolean	The default is true, causing exceptions to be internally logged and then ignored. When set to false exceptions will be percolated to the caller.
urlPkgPrefixes	String	A colon-separated list of package prefixes for the class name of the factory class that will create a URL context factory as defined by <code>URL_PKG_PREFIXES</code> .
userName	String	The user id used to create the queue connection.

### JMSTopicAppender Parameters

Here is a sample JMSTopicAppender configuration:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <JMSTopic name="jmsTopic" topicBindingName="MyTopic"
      factoryBindingName="MyTopicConnectionFactory"/>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="jmsQueue"/>
    </root>
  </loggers>
</configuration>
```

### 8.1.8 OutputStreamAppender

The OutputStreamAppender provides the base for many of the other Appenders such as the File and Socket appenders that write the event to an Output Stream. It cannot be directly configured. Support for immediateFlush and buffering is provided by the OutputStreamAppender. The OutputStreamAppender uses an OutputStreamManager to handle the actual I/O, allowing the stream to be shared by Appenders in multiple configurations.

### 8.1.9 RewriteAppender

The RewriteAppender allows the LogEvent to be manipulated before it is processed by another Appender. This can be used to mask sensitive information such as passwords or to inject information into each event. The RewriteAppender must be configured with a [RewritePolicy](#). The RewriteAppender should be configured after any Appenders it references to allow it to shut down properly.

Parameter Name	Type	Description
appender-ref	String	The name of the Appenders to call after the LogEvent has been manipulated. Multiple appender-ref elements can be configured.
filter	Filter	A Filter to determine if the event should be handled by this Appender. More than one Filter may be used by using a CompositeFilter.
name	String	The name of the Appender.
rewritePolicy	RewritePolicy	The RewritePolicy that will manipulate the LogEvent.
suppressExceptions	boolean	The default is true, causing exceptions to be internally logged and then ignored. When set to false exceptions will be percolated to the caller.

#### RewriteAppender Parameters

##### 8.1.9.1 RewritePolicy

RewritePolicy is an interface that allows implementations to inspect and possibly modify LogEvents before they are passed to Appender. RewritePolicy declares a single method named rewrite that must be implemented. The method is passed the LogEvent and can return the same event or create a new one.

##### 8.MapRewritePolicy

MapRewritePolicy will evaluate LogEvents that contain a MapMessage and will add or update elements of the Map.

Parameter Name	Type	Description
----------------	------	-------------

mode	String	"Add" or "Update"
keyValuePair	KeyValuePair[]	An array of keys and their values.

The following configuration shows a RewriteAppender configured to add a product key and its value to the MapMessage.:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <Console name="STDOUT" target="SYSTEM_OUT">
      <PatternLayout pattern="%m%n"/>
    </Console>
    <Rewrite name="rewrite">
      <appender-ref ref="STDOUT"/>
      <MapRewritePolicy mode="Add">
        <KeyValuePair key="product" value="TestProduct"/>
      </MapRewritePolicy>
    </Rewrite>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="Rewrite"/>
    </root>
  </loggers>
</configuration>
```

### 8.PropertiesRewritePolicy

PropertiesRewritePolicy will add properties configured on the policy to the ThreadContext Map being logged. The properties will not be added to the actual ThreadContext Map. The property values may contain variables that will be evaluated when the configuration is processed as well as when the event is logged.

Parameter Name	Type	Description
properties	Property[]	One or more Property elements to define the keys and values to be added to the ThreadContext Map.

The following configuration shows a RewriteAppender configured to add a product key and its value to the MapMessage.:



```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <Console name="STDOUT" target="SYSTEM_OUT">
      <PatternLayout pattern="%m%n"/>
    </Console>
    <Rewrite name="rewrite">
      <appender-ref ref="STDOUT"/>
      <PropertiesRewritePolicy>
        <Property key="user">${sys:user.name}</Property>
        <Property key="env">${sys:environment}</Property>
      </PropertiesRewritePolicy>
    </Rewrite>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="Rewrite"/>
    </root>
  </loggers>
</configuration>
```

### 8.1.10 RollingFileAppender

The `RollingFileAppender` is an `OutputStreamAppender` that writes to the File named in the `fileName` parameter and rolls the file over according the `TriggeringPolicy` and the `RolloverPolicy`. The `RollingFileAppender` uses a `RollingFileManager` (which extends `OutputStreamManager`) to actually perform the file I/O and perform the rollover. While `RolloverFileAppenders` from different Configurations cannot be shared, the `RollingFileManagers` can be if the Manager is accessible. For example, two webapps in a servlet container can have their own configuration and safely write to the same file if `Log4J` is in a `ClassLoader` that is common to both of them.

A `RollingFileAppender` requires a [TriggeringPolicy](#) and a [RolloverStrategy](#). The triggering policy determines if a rollover should be performed while the `RolloverStrategy` defines how the rollover should be done. If no `RolloverStrategy` is configured, `RollingFileAppender` will use the [DefaultRolloverStrategy](#).

File locking is not supported by the `RollingFileAppender`.

Parameter Name	Type	Description
append	boolean	When true - the default, records will be appended to the end of the file. When set to false, the file will be cleared before new records are written.

bufferedIO	boolean	When true - the default, records will be written to a buffer and the data will be written to disk when the buffer is full or, if immediateFlush is set, when the record is written. File locking cannot be used with bufferedIO. Performance tests have shown that using buffered I/O significantly improves performance, even if immediateFlush is enabled.
filter	Filter	A Filter to determine if the event should be handled by this Appender. More than one Filter may be used by using a CompositeFilter.
fileName	String	The name of the file to write to. If the file, or any of its parent directories, do not exist, they will be created.
filePattern	String	The pattern of the file name of the archived log file. The format of the pattern should be dependent on the RolloverPolicy that is used. The DefaultRolloverPolicy will accept both a date/time pattern compatible with <code>SimpleDateFormat</code> and and/or a <code>%i</code> which represents an integer counter. The pattern also supports interpolation at runtime so any of the Lookups (such as the <code>DateLookup</code> ) can be included in the pattern.
immediateFlush	boolean	When set to true, each write will be followed by a flush. This will guarantee the data is written to disk but could impact performance.
layout	Layout	The Layout to use to format the LogEvent
name	String	The name of the Appender.
policy	TriggeringPolicy	The policy to use to determine if a rollover should occur.
strategy	RolloverStrategy	The strategy to use to determine the name and location of the archive file.
suppressExceptions	boolean	The default is true, causing exceptions to be internally logged and then ignored. When set to false exceptions will be percolated to the caller.

### RollingFileAppender Parameters

### 8.1.10.1 Triggering Policies

#### 8.Composite Triggering Policy

The `CompositeTriggeringPolicy` combines multiple triggering policies and returns true if any of the configured policies return true. The `CompositeTriggeringPolicy` is configured simply by wrapping other policies in a "Policies" element.

#### 8.OnStartup Triggering Policy

The `OnStartup` policy takes no parameters and causes a rollover if the log file is older than the current JVM's start time.

#### 8.SizeBased Triggering Policy

Causes a rollover once the file has reached the specified size. The size can be specified in bytes, KB, MB or GB.

#### 8.TimeBased Triggering Policy

Causes a rollover once the date/time pattern no longer applies to the active file. This policy accepts an "increment" attribute which indicates how frequently the rollover should occur based on the time pattern and a "modulate" boolean attribute.

Parameter Name	Type	Description
interval	integer	How often a rollover should occur based on the most specific time unit in the date pattern. For example, with a date pattern with hours as the most specific item and an increment of 4 rollovers would occur every 4 hours. The default value is 1.
modulate	boolean	Indicates whether the interval should be adjusted to cause the next rollover to occur on the interval boundary. For example, if the item is hours, the current hour is 3 am and the interval is 4 then the first rollover will occur at 4 am and then next ones will occur at 8 am, noon, 4pm, etc.

### TimeBasedTriggeringPolicy Parameters

### 8.1.10.2 Rollover Strategies

#### 8.Default Rollover Strategy

The default rollover strategy accepts both a date/time pattern and an integer from the `filePattern` attribute specified on the `RollingFileAppender` itself. If the date/time pattern is present it will be replaced with the current date and time values. If the pattern contains an integer it will be incremented on each rollover. If

the pattern contains both a date/time and integer in the pattern the integer will be incremented until the result of the date/time pattern changes. If the file pattern ends with ".gz" or ".zip" the resulting archive will be compressed using the compression scheme that matches the suffix. The pattern may also contain lookup references that can be resolved at runtime such as is shown in the example below.

The default rollover strategy supports two variations for incrementing the counter. The first is the "fixed window" strategy. To illustrate how it works, suppose that the min attribute is set to 1, the max attribute is set to 3, the file name is "foo.log", and the file name pattern is "foo-%i.log".

Number of rollovers	Active output target	Archived log files	Description
0	foo.log	-	All logging is going to the initial file.
1	foo.log	foo-1.log	During the first rollover foo.log is renamed to foo-1.log. A new foo.log file is created and starts being written to.
2	foo.log	foo-1.log, foo-2.log	During the second rollover foo-1.log is renamed to foo-2.log and foo.log is renamed to foo-1.log. A new foo.log file is created and starts being written to.
3	foo.log	foo-1.log, foo-2.log, foo-3.log	During the third rollover foo-2.log is renamed to foo-3.log, foo-1.log is renamed to foo-2.log and foo.log is renamed to foo-1.log. A new foo.log file is created and starts being written to.
4	foo.log	foo-1.log, foo-2.log, foo-3.log	In the fourth and subsequent rollovers, foo-3.log is deleted, foo-2.log is renamed to foo-3.log, foo-1.log is renamed to foo-2.log and foo.log is renamed to foo-1.log. A new foo.log file is created and starts being written to.

By way of contrast, when the the fileIndex attribute is set to "max" but all the other settings are the same the following actions will be performed.

Number of rollovers	Active output target	Archived log files	Description
0	foo.log	-	All logging is going to the initial file.

1	foo.log	foo-1.log	During the first rollover foo.log is renamed to foo-1.log. A new foo.log file is created and starts being written to.
2	foo.log	foo-1.log, foo-2.log	During the second rollover foo.log is renamed to foo-2.log. A new foo.log file is created and starts being written to.
3	foo.log	foo-1.log, foo-2.log, foo-3.log	During the third rollover foo.log is renamed to foo-3.log. A new foo.log file is created and starts being written to.
4	foo.log	foo-1.log, foo-2.log, foo-3.log	In the fourth and subsequent rollovers, foo-1.log is deleted, foo-2.log is renamed to foo-1.log, foo-3.log is renamed to foo-2.log and foo.log is renamed to foo-3.log. A new foo.log file is created and starts being written to.

Parameter Name	Type	Description
fileIndex	String	If set to "max" (the default), files with a higher index will be newer than files with a smaller index. If set to "min", file renaming and the counter will follow the Fixed Window strategy described above.
min	integer	The minimum value of the counter. The default value is 1.
max	integer	The maximum value of the counter. Once this values is reached older archives will be deleted on subsequent rollovers.

### DefaultRolloverStrategy Parameters

Below is a sample configuration that uses a RollingFileAppender with both the time and size based triggering policies, will create up to 7 archives on the same day (1-7) that are stored in a directory based on the current year and month, and will compress each archive using gzip:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <RollingFile name="RollingFile" fileName="logs/app.log"
      filePattern="logs/${date:yyyy-MM}/app-%d{MM-dd-yyyy}-%i.log.gz">
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
      <Policies>
        <TimeBasedTriggeringPolicy />
        <SizeBasedTriggeringPolicy size="250 MB"/>
      </Policies>
    </RollingFile>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="RollingFile"/>
    </root>
  </loggers>
</configuration>
```

This second example shows a rollover strategy that will keep up to 20 files before removing them.

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <RollingFile name="RollingFile" fileName="logs/app.log"
      filePattern="logs/${date:yyyy-MM}/app-%d{MM-dd-yyyy}-%i.log.gz">
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
      <Policies>
        <TimeBasedTriggeringPolicy />
        <SizeBasedTriggeringPolicy size="250 MB"/>
      </Policies>
      <DefaultRolloverStrategy max="20"/>
    </RollingFile>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="RollingFile"/>
    </root>
  </loggers>
</configuration>
```

Below is a sample configuration that uses a RollingFileAppender with both the time and size based triggering policies, will create up to 7 archives on the same day (1-7) that are stored in a directory based on the current year and month, and will compress each archive using gzip and will roll every 6 hours when the hour is divisible by 6:

```

<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <RollingFile name="RollingFile" fileName="logs/app.log"
      filePattern="logs/${date:yyyy-MM}/app-%d{yyyy-MM-dd-HH}-%i.log.gz">
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
      <Policies>
        <TimeBasedTriggeringPolicy interval="6" modulate="true"/>
        <SizeBasedTriggeringPolicy size="250 MB"/>
      </Policies>
    </RollingFile>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="RollingFile"/>
    </root>
  </loggers>
</configuration>

```

### 8.1.11 RoutingAppender

The RoutingAppender evaluates LogEvents and then routes them to a subordinate Appender. The target Appender may be an appender previously configured and may be referenced by its name or the Appender can be dynamically created as needed. The RoutingAppender should be configured after any Appenders it references to allow it to shut down properly.

Parameter Name	Type	Description
filter	Filter	A Filter to determine if the event should be handled by this Appender. More than one Filter may be used by using a CompositeFilter.
name	String	The name of the Appender.
rewritePolicy	RewritePolicy	The RewritePolicy that will manipulate the LogEvent.
routes	Routes	Contains one or more Route declarations to identify the criteria for choosing Appenders.
suppressExceptions	boolean	The default is true, causing exceptions to be internally logged and then ignored. When set to false exceptions will be percolated to the caller.

#### RoutingAppender Parameters

### 8.1.11.1 Routes

The Routes element accepts a single, required attribute named "pattern". The pattern is evaluated against all the registered Lookups and the result is used to select a Route. Each Route may be configured with a key. If the key matches the result of evaluating the pattern then that Route will be selected. If no key is specified on a Route then that Route is the default. Only one Route can be configured as the default.

Each Route must reference an Appender. If the Route contains an appender-ref attribute then the Route will reference an Appender that was defined in the configuration. If the Route contains an Appender definition then an Appender will be created within the context of the RoutingAppender and will be reused each time a matching Appender name is referenced through a Route.

Below is a sample configuration that uses a RoutingAppender to route all Audit events to a FlumeAppender and all other events will be routed to a RollingFileAppender that captures only the specific event type. Note that the AuditAppender was predefined while the RollingFileAppenders are created as needed.

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <Flume name="AuditLogger" suppressExceptions="false" compress="true">
      <Agent host="192.168.10.101" port="8800"/>
      <Agent host="192.168.10.102" port="8800"/>
      <RFC5424Layout enterpriseNumber="18060" includeMDC="true" appName="MyApp"/>
    </Flume>
    <Routing name="Routing">
      <Routes pattern="$$${sd:type}">
        <Route>
          <RollingFile name="Rolling-${sd:type}" fileName="${sd:type}.log"
            filePattern="${sd:type}.*i.log.gz">
            <PatternLayout>
              <pattern>%d %p %C{1.} [%t] %m%n</pattern>
            </PatternLayout>
            <SizeBasedTriggeringPolicy size="500" />
          </RollingFile>
        </Route>
        <Route appender-ref="AuditLogger" key="Audit"/>
      </Routes>
    </Routing>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="Routing"/>
    </root>
  </loggers>
</configuration>
```

### 8.1.12 SMTPAppender

Sends an e-mail when a specific logging event occurs, typically on errors or fatal errors.



The number of logging events delivered in this e-mail depend on the value of **BufferSize** option. The `SMTPAppender` keeps only the last `BufferSize` logging events in its cyclic buffer. This keeps memory requirements at a reasonable level while still delivering useful application context.

The default behavior is to trigger sending an email whenever an `ERROR` or higher severity event is logged and to format it as `HTML`. The circumstances on when the email is sent can be controlled by setting one or more filters on the Appender. As with other Appenders, the formatting can be controlled by specifying a `Layout` for the Appender.

Parameter Name	Type	Description
<code>bcc</code>	String	The comma-separated list of BCC email addresses.
<code>cc</code>	String	The comma-separated list of CC email addresses.
<code>bufferSize</code>	integer	The maximum number of log events to be buffered for inclusion in the message. Defaults to 512.
<code>filter</code>	Filter	A Filter to determine if the event should be handled by this Appender. More than one Filter may be used by using a <code>CompositeFilter</code> .
<code>from</code>	String	The email address of the sender.
<code>layout</code>	Layout	The <code>Layout</code> to use to format the <code>LogEvent</code> . The default is <code>SerializedLayout</code> .
<code>name</code>	String	The name of the Appender.
<code>replyTo</code>	String	The comma-separated list of reply-to email addresses.
<code>smtpDebug</code>	boolean	When set to true enables session debugging on <code>STDOUT</code> . Defaults to false.
<code>smtpHost</code>	String	The SMTP hostname to send to. This parameter is required.
<code>smtpPassword</code>	String	The password required to authenticate against the SMTP server.
<code>smtpPort</code>	integer	The SMTP port to send to.
<code>smtpProtocol</code>	String	The SMTP transport protocol (such as "smtps", defaults to "smtp").
<code>smtpUsername</code>	String	The username required to authenticate against the SMTP server.

suppressExceptions	boolean	The default is true, causing exceptions to be internally logged and then ignored. When set to false exceptions will be percolated to the caller.
to	String	The comma-separated list of recipient email addresses.

### SMTPAppender Parameters

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <SMTP name="Mail" suppressExceptions="false" subject="Error Log" to="errors@logging.apache.org"
      from="test@logging.apache.org" smtpHost="localhost" smtpPort="25" bufferSize="50">
    </SMTP>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="Mail"/>
    </root>
  </loggers>
</configuration>
```

#### 8.1.13 SocketAppender

The `SocketAppender` is an `OutputStreamAppender` that writes its output to a remote destination specified by a host and port. The data can be sent over either TCP or UDP and can be sent in any format. The default format is to send a `Serialized LogEvent`. `Log4j 2` contains a `SocketServer` which is capable of receiving serialized `LogEvents` and routing them through the logging system on the server.

Parameter Name	Type	Description
filter	Filter	A Filter to determine if the event should be handled by this Appender. More than one Filter may be used by using a <code>CompositeFilter</code> .
host	String	The name or address of the system that is listening for log events. This parameter is required.
immediateFlush	boolean	When set to true, each write will be followed by a flush. This will guarantee the data is written to disk but could impact performance.
layout	Layout	The Layout to use to format the <code>LogEvent</code> . The default is <code>SerializedLayout</code> .
name	String	The name of the Appender.

port	integer	The port on the host that is listening for log events. This parameter must be specified.
protocol	String	"TCP" or "UDP". This parameter is required.
reconnectionDelay	integer	If set to a value greater than 0, after an error the SocketManager will attempt to reconnect to the server after waiting the specified number of milliseconds. If the reconnect fails then an exception will be thrown (which can be caught by the application if suppressExceptions is set to false).
suppressExceptions	boolean	The default is true, causing exceptions to be internally logged and then ignored. When set to false exceptions will be percolated to the caller.

### SocketAppender Parameters

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <Socket name="socket" host="localhost" port="9500">
      <SerializedLayout />
    </Socket>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="socket"/>
    </root>
  </loggers>
</configuration>
```

#### 8.1.14 SyslogAppender

The SyslogAppender is a SocketAppender that writes its output to a remote destination specified by a host and port in a format that conforms with either the BSD Syslog format or the RFC 5424 format. The data can be sent over either TCP or UDP.

Parameter Name	Type	Description
appName	String	The value to use as the APP-NAME in the RFC 5424 syslog record.

charset	String	The character set to use when converting the syslog String to a byte array. The String must be a valid <a href="#">Charset</a> . If not specified, the default system Charset will be used.
enterpriseNumber	integer	The IANA enterprise number as described in <a href="#">RFC 5424</a>
filter	Filter	A Filter to determine if the event should be handled by this Appender. More than one Filter may be used by using a CompositeFilter.
facility	String	The facility is used to try to classify the message. The facility option must be set to one of "KERN", "USER", "MAIL", "DAEMON", "AUTH", "SYSLOG", "LPR", "NEWS", "UUCP", "CRON", "AUTHPRIV", "FTP", "NTP", "AUDIT", "ALERT", "CLOCK", "LOCAL0", "LOCAL1", "LOCAL2", "LOCAL3", "LOCAL4", "LOCAL5", "LOCAL6", or "LOCAL7". These values may be specified as upper or lower case characters.
format	String	If set to "RFC5424" the data will be formatted in accordance with RFC 5424. Otherwise, it will be formatted as a BSD Syslog record. Note that although BSD Syslog records are required to be 1024 bytes or shorter the SyslogLayout does not truncate them. The RFC5424Layout also does not truncate records since the receiver must accept records of up to 2048 bytes and may accept records that are longer.
host	String	The name or address of the system that is listening for log events. This parameter is required.
id	String	The default structured data id to use when formatting according to RFC 5424. If the LogEvent contains a StructuredDataMessage the id from the Message will be used instead of this value.
immediateFlush	boolean	When set to true, each write will be followed by a flush. This will guarantee the data is written to disk but could impact performance.

includeMDC	boolean	Indicates whether data from the ThreadContextMap will be included in the RFC 5424 Syslog record. Defaults to true.
mdcExcludes	String	A comma separated list of mdc keys that should be excluded from the LogEvent. This is mutually exclusive with the mdcIncludes attribute. This attribute only applies to RFC 5424 syslog records.
mdcIncludes	String	A comma separated list of mdc keys that should be included in the FlumeEvent. Any keys in the MDC not found in the list will be excluded. This option is mutually exclusive with the mdcExcludes attribute. This attribute only applies to RFC 5424 syslog records.
mdcRequired	String	A comma separated list of mdc keys that must be present in the MDC. If a key is not present a LoggingException will be thrown. This attribute only applies to RFC 5424 syslog records.
mdcPrefix	String	A string that should be prepended to each MDC key in order to distinguish it from event attributes. The default string is "mdc:". This attribute only applies to RFC 5424 syslog records.
messageld	String	The default value to be used in the MSGID field of RFC 5424 syslog records.
name	String	The name of the Appender.
newLine	boolean	If true, a newline will be appended to the end of the syslog record. The default is false.
port	integer	The port on the host that is listening for log events. This parameter must be specified.
protocol	String	"TCP" or "UDP". This parameter is required.

reconnectionDelay	integer	If set to a value greater than 0, after an error the SocketManager will attempt to reconnect to the server after waiting the specified number of milliseconds. If the reconnect fails then an exception will be thrown (which can be caught by the application if suppressExceptions is set to false).
suppressExceptions	boolean	The default is true, causing exceptions to be internally logged and then ignored. When set to false exceptions will be percolated to the caller.

### SyslogAppender Parameters

A sample syslogAppender configuration that is configured with two SyslogAppenders, one using the BSD format and one using RFC 5424.

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <Syslog name="bsd" host="localhost" port="514" protocol="TCP"/>
    <Syslog name="RFC5424" format="RFC5424" host="localhost" port="8514"
      protocol="TCP" appName="MyApp" includeMDC="true"
      facility="LOCAL0" enterpriseNumber="18060" newLine="true"
      messageId="Audit" id="App"/>
  </appenders>
  <loggers>
    <logger name="com.mycorp" level="error">
      <appender-ref ref="RFC5424"/>
    </logger>
    <root level="error">
      <appender-ref ref="bsd"/>
    </root>
  </loggers>
</configuration>
```

## Layouts

---

### 9.1 Layouts

An Appender uses a Layout to format a LogEvent into a form that meets the needs of whatever will be consuming the log event. In Log4j 1.x and Logback Layouts were expected to transform an event into a String. In Log4j 2 Layouts return a byte array. This allows the result of the Layout to be useful in many more types of Appenders. However, this means you need to configure most Layouts with a `Charset` to insure the byte array contains correct values.

#### 9.1.1 HTMLLayout

The HTMLLayout generates an HTML page and adds each LogEvent to a row in a table.

Parameter Name	Type	Description
charset	String	The character set to use when converting the HTML String to a byte array. The value must be a valid <code>Charset</code> . If not specified, the default system Charset will be used.
contentType	String	The value to assign to the Content-Type header. The default is "text/html".
locationInfo	boolean	If true, the filename and line number will be included in the HTML output. The default value is false.
title	String	A String that will appear as the HTML title.

HTML Layout Parameters

#### 9.1.2 PatternLayout

A flexible layout configurable with pattern string. The goal of this class is to format a LogEvent and return the results. The format of the result depends on the *conversion pattern*.

The conversion pattern is closely related to the conversion pattern of the printf function in C. A conversion pattern is composed of literal text and format control expressions called *conversion specifiers*.

*Note that any literal text may be included in the conversion pattern.*

Each conversion specifier starts with a percent sign (%) and is followed by optional *format modifiers* and a *conversion character*. The conversion character specifies the type of data, e.g. category, priority, date, thread name. The format modifiers control such things as field width, padding, left and right justification. The following is a simple example.

Let the conversion pattern be `"%-5p [%t]: %m%n"` and assume that the log4j environment was set to use a `PatternLayout`. Then the statements

```
Logger logger = LogManager.getLogger("MyLogger");
logger.debug("Message 1");
logger.warn("Message 2");
```

would yield the output

```
DEBUG [main]: Message 1
WARN [main]: Message 2
```

Note that there is no explicit separator between text and conversion specifiers. The pattern parser knows when it has reached the end of a conversion specifier when it reads a conversion character. In the example above the conversion specifier `%-5p` means the priority of the logging event should be left justified to a width of five characters.

If the pattern string does not contain a specifier to handle a `Throwable` being logged, parsing of the pattern will act as if the `%xEx` specifier had been added to the end of the string. To suppress formatting of the `Throwable` completely simply add `%ex{0}` as a specifier in the pattern string.

Parameter Name	Type	Description
charset	String	The character set to use when converting the syslog String to a byte array. The String must be a valid <code>Charset</code> . If not specified, the default system <code>Charset</code> will be used.
pattern	String	
replace	RegexReplacement	Allows portions of the resulting String to be replaced. If configured, the replace element must specify the regular expression to match and the substitution. This performs a function similar to the <code>RegexReplacement</code> converter but applies to the whole message while the converter only applies to the String its pattern generates.

### Pattern Layout Parameters

#### 9.1.2.1 Patterns

The conversions that are provided with Log4j are:

Conversion Pattern	Description
--------------------	-------------



**c**{precision}  
**logger**{precision}

Outputs the name of the logger that published the logging event. The logger conversion specifier can be optionally followed by *precision specifier*, which consists of a decimal integer, or a pattern starting with a decimal integer.

If a precision specifier is given and it is an integer value, then only the corresponding number of right most components of the logger name will be printed. If the precision contains other non-integer characters then the name will be abbreviated based on the pattern. If the precision integer is less than one the right-most token will still be printed in full. By default the logger name is printed in full.

Conversion Pattern	Logger Name	Result
%c{1}	org.apache. commons.Foo	Foo
%c{2}	org.apache. commons.Foo	commons.Foo
%c{1.}	org.apache. commons.Foo	o.a.c.Foo
%c{1.1.~.~}	org.apache. commons.test. Foo	o.a.~.~.Foo
%c{.}	org.apache. commons.test. Foo	...Foo

**C**{precision}  
**class**{precision}

Outputs the fully qualified class name of the caller issuing the logging request. This conversion specifier can be optionally followed by *precision specifier*, that follows the same rules as the logger name converter.

**d**{pattern}  
**date**{pattern}

Outputs the date of the logging event. The date conversion specifier may be followed by a set of braces containing a date and time pattern string per [SimpleDateFormat](#).

The predefined formats are ABSOLUTE, COMPACT, DATE, ISO8601, and ISO8601\_BASIC.

You can also use a set of braces containing a time zone id per [java.util.TimeZone.getTimeZone](#). If no date format specifier is given then ISO8601 format is assumed.

Pattern	Example
%d{ISO8601}	2012-11-02 14:34:02,781
%d{ISO8601_BASIC}	20121102 143402,781
%d{ABSOLUTE}	14:34:02,781
%d{DATE}	02 Nov 2012 14:34:02,781
%d{COMPACT}	20121102143402781
%d{HH:mm:ss,SSS}	14:34:02,781
%d{dd MMM yyyy HH:mm:ss,SSS}	02 Nov 2012 14:34:02,781
%d{HH:mm:ss}{GMT+0}	18:34:02,781

**ex**{["none"|"short"|"full"|depth]}  
**exception**{["none"|"short"|"full"|depth]}  
**throwable**{["none"|"short"|"full"|depth]}

Outputs the Throwable trace that has been bound to the LoggingEvent, by default this will output the full trace as one would normally find by a call to Throwable.printStackTrace(). The throwable conversion word can be followed by an option in the form **%throwable{short}** which will only output the first line of the Throwable or **%throwable{n}** where the first n lines of the stacktrace will be printed. Specifying **%throwable{none}** or **%throwable{0}** will suppress printing of the exception.

**F**  
**file**

Outputs the file name where the logging request was issued.

**highlight**{pattern}{style}

Adds ANSI colors to the result of the enclosed pattern based on the current event's logging level.

The default colors for each level are:

Level	ANSI color
FATAL	Bright red
ERROR	Bright red
WARN	Yellow
INFO	Green
DEBUG	Cyan
TRACE	Black (looks dark grey)

The color names are ANSI names defined in the [AnsiEscape](#) class.

The color and attribute names and are standard, but the exact shade, hue, or value.

Inten	Code	0	1	2	3	4	5	6	7
Norm		Black	Red	Greer	Yellow	Blue	Mage	Cyan	White
Bright		Black	Red	Greer	Yellow	Blue	Mage	Cyan	White

Color table

You can use the default colors with:

```
%highlight{%d [%t] %-5level: %msg%n%throwable}
```

You can override the default colors in the optional {style} option. For example:

```
%highlight{%d [%t] %-5level: %msg%n%throwable}
  {FATAL=white, ERROR=red, WARN=blue, INFO=black,
   DEBUG=green, TRACE=blue}
```

You can highlight only the a portion of the log event:

```
%d [%t] %highlight{%-5level: %msg%n%throwable}
```

You can style one part of the message and highlight the rest the log event:

```
%style{%d [%t]}{black} %highlight{%-5level:
  %msg%n%throwable}
```

You can also use the STYLE key to use a predefined group of colors:

```
%highlight{%d [%t] %-5level: %msg%n%throwable}
{STYLE=Logback}
```

The STYLE value can be one of:

Style	Description														
Default	See above														
Logback	<table border="1"> <thead> <tr> <th>Level</th> <th>ANSI color</th> </tr> </thead> <tbody> <tr> <td>FATAL</td> <td>Blinking bright red</td> </tr> <tr> <td>ERROR</td> <td>Bright red</td> </tr> <tr> <td>WARN</td> <td>Red</td> </tr> <tr> <td>INFO</td> <td>Blue</td> </tr> <tr> <td>DEBUG</td> <td>Normal</td> </tr> <tr> <td>TRACE</td> <td>Normal</td> </tr> </tbody> </table>	Level	ANSI color	FATAL	Blinking bright red	ERROR	Bright red	WARN	Red	INFO	Blue	DEBUG	Normal	TRACE	Normal
Level	ANSI color														
FATAL	Blinking bright red														
ERROR	Bright red														
WARN	Red														
INFO	Blue														
DEBUG	Normal														
TRACE	Normal														

**K**{key}  
**map**{key}  
**MAP**{key}

Outputs the entries in a [MapMessage](#), if one is present in the event. The **K** conversion character can be followed by the key for the map placed between braces, as in **%K{clientNumber}** where `clientNumber` is the key. The value in the Map corresponding to the key will be output. If no additional sub-option is specified, then the entire contents of the Map key value pair set is output using a format `{{key1,val1},{key2,val2}}`

**I**  
**location**

Outputs location information of the caller which generated the logging event.

The location information depends on the JVM implementation but usually consists of the fully qualified name of the calling method followed by the callers source the file name and line number between parentheses.

**L**  
**line**

Outputs the line number from where the logging request was issued.

**m**  
**msg**  
**message**

Outputs the application supplied message associated with the logging event.

**M**  
**method**

Outputs the method name where the logging request was issued.

<p><b>marker</b></p> <p><b>n</b></p> <p><b>p{level name mapping}</b> <b>level{level name mapping}</b></p> <p><b>r</b> <b>relative</b></p> <p><b>replace{pattern}{regex}{substitution}</b></p> <p><b>rEx</b>["none" "short" "full" depth],[filters(packages)] <b>rException</b>["none" "short" "full" depth],[filters(packages)] <b>rThrowable</b>["none" "short" "full"  depth],[filters(packages)]</p> <p><b>sn</b> <b>sequenceNumber</b></p>	<p>The name of the marker, if one is present.</p> <p>Outputs the platform dependent line separator character or characters.</p> <p>This conversion character offers practically the same performance as using non-portable line separator strings such as "\n", or "\r\n". Thus, it is the preferred way of specifying a line separator.</p> <p>Outputs the level of the logging event. A level name mapping map be provided in the form "level=value, level=value" where level is the name of the Level and value is the value that should be displayed instead of the name of the Level.</p> <p>Outputs the number of milliseconds elapsed since the JVM was started until the creation of the logging event.</p> <p>Replaces occurrences of 'regex', a regular expression, with its replacement 'substitution' in the string resulting from evaluation of the pattern. For example, "%replace(%msg){\s}{\s}" will remove all spaces contained in the event message.</p> <p>The pattern can be arbitrarily complex and in particular can contain multiple conversion keywords. For instance, "%replace{%logger %msg}{\.\.}{/}" will replace all dots in the logger or the message of the event with a forward slash.</p> <p>The same as the %throwable conversion word but the stack trace is printed starting with the first exception that was thrown followed by each subsequent wrapping exception.</p> <p>The throwable conversion word can be followed by an option in the form %rEx{short} which will only output the first line of the Throwable or %rEx{n} where the first n lines of the stacktrace will be printed. The conversion word can also be followed by "filters(packages)" where packages is a list of package names that should be suppressed from stack traces. Specifying %rEx{none} or %rEx{0} will suppress printing of the exception.</p> <p>Includes a sequence number that will be incremented in every event. The counter is a static variable so will only be unique within applications that share the same converter Class object.</p>
--	--

**style**{pattern}{ANSI style}

Uses ANSI escape sequences to style the result of the enclosed pattern. The style can consist of a comma separated list of style names from the following table.

Style Name	Description
Normal	Normal display
Bright	Bold
Dim	Dimmed or faint characters
Underline	Underlined characters
Blink	Blinking characters
Reverse	Reverse video
Hidden	
Black or FG_Black	Set foreground color to black
Red or FG_Red	Set foreground color to red
Green or FG_Green	Set foreground color to green
Yellow or FG_Yellow	Set foreground color to yellow
Blue or FG_Blue	Set foreground color to blue
Magenta or FG_Magenta	Set foreground color to magenta
Cyan or FG_Cyan	Set foreground color to cyan
White or FG_White	Set foreground color to white
Default or FG_Default	Set foreground color to default (white)
BG_Black	Set background color to black
BG_Red	Set background color to red
BG_Green	Set background color to green
BG_Yellow	Set background color to yellow
BG_Blue	Set background color to blue
BG_Magenta	Set background color to magenta
BG_Cyan	Set background color to cyan
BG_White	Set background color to white

For example:

<p><b>t</b> <b>thread</b></p>	<p>Outputs the name of the thread that generated the logging event.</p>
<p><b>x</b> <b>NDC</b></p>	<p>Outputs the Thread Context Stack (also known as the Nested Diagnostic Context or NDC) associated with the thread that generated the logging event.</p>
<p><b>X</b>{key} <b>mdc</b>{key} <b>MDC</b>{key}</p>	<p>Outputs the Thread Context Map (also known as the Mapped Diagnostic Context or MDC) associated with the thread that generated the logging event. The <b>X</b> conversion character can be followed by the key for the map placed between braces, as in <b>%X{clientNumber}</b> where <code>clientNumber</code> is the key. The value in the MDC corresponding to the key will be output. If no additional sub-option is specified, then the entire contents of the MDC key value pair set is output using a format <code>{key1,val1},{key2,val2}</code></p> <p>See the <a href="#">ThreadContext</a> class for more details.</p>
<p><b>u</b>{"RANDOM"   "TIME"} <b>uuid</b></p>	<p>Includes either a random or a time-based UUID. The time-based UUID is a Type 1 UUID that can generate up to 10,000 unique ids per millisecond, will use the MAC address of each host, and to try to insure uniqueness across multiple JVMs and/or ClassLoaders on the same host a random number between 0 and 16,384 will be associated with each instance of the UUID generator Class and included in each time-based UUID generated. Because time-based UUIDs contain the MAC address and timestamp they should be used with care as they can cause a security vulnerability.</p>
<p><b>xEx</b>{"none" "short" "full" depth],[filters(packages)] <b>xException</b>["none" "short" "full" depth],[filters(packages)] <b>xThrowable</b>["none" "short" "full" depth],[filters(packages)]</p>	<p>The same as the <code>%throwable</code> conversion word but also includes class packaging information.</p> <p>At the end of each stack element of the exception, a string containing the name of the jar file that contains the class or the directory the class is located in and the "Implementation-Version" as found in that jar's manifest will be added. If the information is uncertain, then the class packaging data will be preceded by a tilde, i.e. the '~' character.</p> <p>The throwable conversion word can be followed by an option in the form <b>%xEx{short}</b> which will only output the first line of the Throwable or <b>%xEx{n}</b> where the first n lines of the stacktrace will be printed. The conversion word can also be followed by "filters(packages)" where packages is a list of package names that should be suppressed from stack traces. Specifying <b>%xEx{none}</b> or <b>%xEx{0}</b> will suppress printing of the exception.</p>

%	The sequence %% outputs a single percent sign.
---	--

By default the relevant information is output as is. However, with the aid of format modifiers it is possible to change the minimum field width, the maximum field width and justification.

The optional format modifier is placed between the percent sign and the conversion character.

The first optional format modifier is the *left justification flag* which is just the minus (-) character. Then comes the optional *minimum field width* modifier. This is a decimal constant that represents the minimum number of characters to output. If the data item requires fewer characters, it is padded on either the left or the right until the minimum width is reached. The default is to pad on the left (right justify) but you can specify right padding with the left justification flag. The padding character is space. If the data item is larger than the minimum field width, the field is expanded to accommodate the data. The value is never truncated.

This behavior can be changed using the *maximum field width* modifier which is designated by a period followed by a decimal constant. If the data item is longer than the maximum field, then the extra characters are removed from the *beginning* of the data item and not from the end. For example, if the maximum field width is eight and the data item is ten characters long, then the first two characters of the data item are dropped. This behavior deviates from the `printf` function in C where truncation is done from the end.

Below are various format modifier examples for the category conversion specifier.

Format modifier	left justify	minimum width	maximum width	comment
%20c	false	20	none	Left pad with spaces if the category name is less than 20 characters long.
%-20c	true	20	none	Right pad with spaces if the category name is less than 20 characters long.
%.30c	NA	none	30	Truncate from the beginning if the category name is longer than 30 characters.
%20.30c	false	20	30	Left pad with spaces if the category name is shorter than 20 characters. However, if category name is longer than 30 characters, then truncate from the beginning.



<code>%-20.30c</code>	<code>true</code>	<code>20</code>	<code>30</code>	Right pad with spaces if the category name is shorter than 20 characters. However, if category name is longer than 30 characters, then truncate from the beginning.
-----------------------	-------------------	-----------------	-----------------	---

## Pattern Converters

### 9.1.2.2 ANSI Styling on Windows

ANSI escape sequences are supported natively on many platforms but are not by default on Windows. To enable ANSI support simply add the [Jansi](#) jar to your application and Log4j will automatically make use of it when writing to the console.

### 9.1.2.3 Example Patterns

#### 9.Filtered Throwables

This example shows how to filter out classes from unimportant packages in stack traces.

```
<properties>
  <property name="filters">org.junit,org.apache.maven,sun.reflect,java.lang.reflect</property>
</properties>
...
<PatternLayout pattern="%m%xEx{filters(${filters})}%n"/>
```

The result printed to the console will appear similar to:

```
Exception java.lang.IllegalArgumentException: IllegalArgument
    at org.apache.logging.log4j.core.pattern.ExtendedThrowableTest.
        testException(ExtendedThrowableTest.java:72) [test-classes/?:?]
    ... suppressed 26 lines
    at $Proxy0.invoke(Unknown Source) [?:?]
    ... suppressed 3 lines
Caused by: java.lang.NullPointerException: null pointer
    at org.apache.logging.log4j.core.pattern.ExtendedThrowableTest.
        testException(ExtendedThrowableTest.java:71) ~[test-classes/?:?]
    ... 30 more
```

#### 9.ANSI Styled

The log level will be highlighted according to the event's log level. All the content that follows the level will be bright green.

```
<PatternLayout>
  <pattern>%d %highlight{%p} %style{%C{1.} [%t] %m}{bold,green}%n</pattern>
</PatternLayout>
```

### 9.1.3 RFC5424Layout

As the name implies, the RFC5424Layout formats LogEvents in accordance with [RFC 5424](#), the enhanced Syslog specification. Although the specification is primarily directed at sending messages via Syslog, this format is quite useful for other purposes since items are passed in the message as self-describing key/value pairs.

Parameter Name	Type	Description
appName	String	The value to use as the APP-NAME in the RFC 5424 syslog record.
charset	String	The character set to use when converting the syslog String to a byte array. The String must be a valid <a href="#">Charset</a> . If not specified, the default system Charset will be used.
enterpriseNumber	integer	The IANA enterprise number as described in <a href="#">RFC 5424</a>
exceptionPattern	String	One of the conversion specifiers from <a href="#">PatternLayout</a> that defines which <a href="#">ThrowablePatternConverter</a> to use to format exceptions. Any of the options that are valid for those specifiers may be included. The default is to not include the Throwable from the event, if any, in the output.
facility	String	The facility is used to try to classify the message. The facility option must be set to one of "KERN", "USER", "MAIL", "DAEMON", "AUTH", "SYSLOG", "LPR", "NEWS", "UUCP", "CRON", "AUTHPRIV", "FTP", "NTP", "AUDIT", "ALERT", "CLOCK", "LOCAL0", "LOCAL1", "LOCAL2", "LOCAL3", "LOCAL4", "LOCAL5", "LOCAL6", or "LOCAL7". These values may be specified as upper or lower case characters.

format	String	If set to "RFC5424" the data will be formatted in accordance with RFC 5424. Otherwise, it will be formatted as a BSD Syslog record. Note that although BSD Syslog records are required to be 1024 bytes or shorter the SyslogLayout does not truncate them. The RFC5424Layout also does not truncate records since the receiver must accept records of up to 2048 bytes and may accept records that are longer.
id	String	The default structured data id to use when formatting according to RFC 5424. If the LogEvent contains a StructuredDataMessage the id from the Message will be used instead of this value.
immediateFlush	boolean	When set to true, each write will be followed by a flush. This will guarantee the data is written to disk but could impact performance.
includeMDC	boolean	Indicates whether data from the ThreadContextMap will be included in the RFC 5424 Syslog record. Defaults to true.
mdcExcludes	String	A comma separated list of mdc keys that should be excluded from the LogEvent. This is mutually exclusive with the mdcIncludes attribute. This attribute only applies to RFC 5424 syslog records.
mdcIncludes	String	A comma separated list of mdc keys that should be included in the FlumeEvent. Any keys in the MDC not found in the list will be excluded. This option is mutually exclusive with the mdcExcludes attribute. This attribute only applies to RFC 5424 syslog records.
mdcRequired	String	A comma separated list of mdc keys that must be present in the MDC. If a key is not present a LoggingException will be thrown. This attribute only applies to RFC 5424 syslog records.
mdcPrefix	String	A string that should be prepended to each MDC key in order to distinguish it from event attributes. The default string is "mdc:". This attribute only applies to RFC 5424 syslog records.

messageId	String	The default value to be used in the MSGID field of RFC 5424 syslog records.
newLine	boolean	If true, a newline will be appended to the end of the syslog record. The default is false.
newLineEscape	String	String that should be used to replace newlines within the message text.

### RFC5424Layout Parameters

#### 9.1.4 SerializedLayout

The SerializedLayout simply serializes the LogEvent into a byte array. This is useful when sending messages via JMS or via a Socket connection. The SerializedLayout accepts no parameters.

#### 9.1.5 SyslogLayout

The SyslogLayout formats the LogEvent as BSD Syslog records matching the same format used by Log4j 1.2.

Parameter Name	Type	Description
charset	String	The character set to use when converting the syslog String to a byte array. The String must be a valid <a href="#">Charset</a> . If not specified, the default system Charset will be used.
facility	String	The facility is used to try to classify the message. The facility option must be set to one of "KERN", "USER", "MAIL", "DAEMON", "AUTH", "SYSLOG", "LPR", "NEWS", "UUCP", "CRON", "AUTHPRIV", "FTP", "NTP", "AUDIT", "ALERT", "CLOCK", "LOCAL0", "LOCAL1", "LOCAL2", "LOCAL3", "LOCAL4", "LOCAL5", "LOCAL6", or "LOCAL7". These values may be specified as upper or lower case characters.
newLine	boolean	If true, a newline will be appended to the end of the syslog record. The default is false.

<code>newLineEscape</code>	String	String that should be used to replace newlines within the message text.
----------------------------	--------	---

## SyslogLayout Parameters

### 9.1.6 XMMLLayout

The output of the XMMLLayout consists of a series of `log4j:event` elements as defined in the [log4j.dtd](#). If configured to do so it will output a complete well-formed XML file. The output is designed to be included as an *external entity* in a separate file to form a correct XML file.

For example, if `abc` is the name of the file where the XMMLLayout output goes, then a well-formed XML file would be:

```
<?xml version="1.0" ?>
<!DOCTYPE log4j:eventSet SYSTEM "log4j.dtd" [<!ENTITY data SYSTEM "abc">]>
<log4j:eventSet version="2.0" xmlns:log4j="http://logging.apache.org/log4j/">

</log4j:eventSet>
```

This approach enforces the independence of the XMMLLayout and the appender where it is embedded.

The `version` attribute helps components to correctly interpret output generated by XMMLLayout. The value of this attribute should be "2.0".

Appenders using this layout should have their encoding set to UTF-8 or UTF-16, otherwise events containing non ASCII characters could result in corrupted log files.

# 10 Filters

---

## 10.1 Filters

Filters allow Log Events to be evaluated to determine if or how they should be published. A Filter will be called on one if its filter methods and will return a Result, which is an Enum that has one of 3 values - ACCEPT, DENY or NEUTRAL.

Filters may be configured in one of four locations;

1. Context-wide Filters are configured directly in the configuration. Events that are rejected by these filters will not be passed to loggers for further processing. Once an event has been accepted by a Context-wide filter it will not be evaluated by any other Context-wide Filters nor will the Logger's Level be used to filter the event. The event will be evaluated by Logger and Appender Filters however.
2. Logger Filters are configured on a specified Logger. These are evaluated after the Context-wide Filters and the Log Level for the Logger. Events that are rejected by these filters will be discarded and the event will not be passed to a parent Logger regardless of the additivity setting.
3. Appender Filters are used to determine if a specific Appender should handle the formatting and publication of the event.
4. Appender Reference Filters are used to determine if a Logger should route the event to an appender.

### 10.1.1 BurstFilter

The BurstFilter provides a mechanism to control the rate at which LogEvents are processed by silently discarding events after the maximum limit has been reached.

Parameter Name	Type	Description
level	String	Level of messages to be filtered. Anything at or below this level will be filtered out if <code>maxBurst</code> has been exceeded. The default is WARN meaning any messages that are higher than warn will be logged regardless of the size of a burst.
rate	float	The average number of events per second to allow.
maxBurst	integer	The maximum number of events that can occur before events are filtered for exceeding the average rate. The default is 10 times the rate.
onMatch	String	Action to take when the filter matches. May be ACCEPT, DENY or NEUTRAL. The default value is NEUTRAL.

onMismatch	String	Action to take when the filter does not match. May be ACCEPT, DENY or NEUTRAL. The default value is DENY.
------------	--------	---

### Burst Filter Parameters

A configuration containing the `BurstFilter` might look like:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <RollingFile name="RollingFile" fileName="logs/app.log"
      filePattern="logs/app-%d{MM-dd-yyyy}.log.gz">
      <BurstFilter level="INFO" rate="16" maxBurst="100"/>
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
      <TimeBasedTriggeringPolicy />
    </RollingFile>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="RollingFile"/>
    </root>
  </loggers>
</configuration>
```

#### 10.1.2 CompositeFilter

The `CompositeFilter` provides a way to specify more than one filter. It is added to the configuration as a `filters` element and contains other filters to be evaluated. The `filters` element accepts no parameters.

A configuration containing the `CompositeFilter` might look like:

```

<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <filters>
    <Marker marker="EVENT" onMatch="ACCEPT" onMismatch="NETURAL"/>
    <DynamicThresholdFilter key="loginId" defaultThreshold="ERROR"
      onMatch="ACCEPT" onMismatch="NEUTRAL">
      <KeyValuePair key="User1" value="DEBUG"/>
    </DynamicThresholdFilter>
  </filters>
  <appenders>
    <File name="Audit" fileName="logs/audit.log">
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
    </File>
    <RollingFile name="RollingFile" fileName="logs/app.log"
      filePattern="logs/app-%d{MM-dd-yyyy}.log.gz">
      <BurstFilter level="INFO" rate="16" maxBurst="100"/>
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
      <TimeBasedTriggeringPolicy />
    </RollingFile>
  </appenders>
  <loggers>
    <logger name="EventLogger" level="info">
      <appender-ref ref="Audit"/>
    </logger>
    <root level="error">
      <appender-ref ref="RollingFile"/>
    </root>
  </loggers>
</configuration>

```

### 10.1.3 DynamicThresholdFilter

The `DynamicThresholdFilter` allows filtering by log level based on specific attributes. For example, if the user's loginid is being captured in the `ThreadContext Map` then it is possible to enable debug logging for only that user.

Parameter Name	Type	Description
defaultThreshold	String	Level of messages to be filtered. If there is no matching key in the key/value pairs then this level will be compared against the event's level.



keyValuePair	KeyValuePair[]	One or more KeyValuePair elements that define the matching value for the key and the Level to evaluate when the key matches.
onMatch	String	Action to take when the filter matches. May be ACCEPT, DENY or NEUTRAL. The default value is NEUTRAL.
onMismatch	String	Action to take when the filter does not match. May be ACCEPT, DENY or NEUTRAL. The default value is DENY.

### Dynamic Threshold Filter Parameters

Here is a sample configuration containing the DynamicThresholdFilter:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <DynamicThresholdFilter key="loginId" defaultThreshold="ERROR"
    onMatch="ACCEPT" onMismatch="NEUTRAL">
    <KeyValuePair key="User1" value="DEBUG"/>
  </DynamicThresholdFilter>
</configuration>
<appenders>
  <RollingFile name="RollingFile" fileName="logs/app.log"
    filePattern="logs/app-%d{MM-dd-yyyy}.log.gz">
    <BurstFilter level="INFO" rate="16" maxBurst="100"/>
    <PatternLayout>
      <pattern>%d %p %C{1.} [%t] %m%n</pattern>
    </PatternLayout>
    <TimeBasedTriggeringPolicy />
  </RollingFile>
</appenders>
<loggers>
  <root level="error">
    <appender-ref ref="RollingFile"/>
  </root>
</loggers>
</configuration>
```

#### 10.1.4 MapFilter

The MapFilter allows filtering against data elements that are in a MapMessage.

Parameter Name	Type	Description
----------------	------	-------------

keyValuePair	KeyValuePair[]	One or more KeyValuePair elements that define the key in the map and the value to match on. If the same key is specified more than once then the check for that key will automatically be an "or" since a Map can only contain a single value.
operator	String	If the operator is "or" then a match by any one of the key/value pairs will be considered to be a match, otherwise all the key/value pairs must match.
onMatch	String	Action to take when the filter matches. May be ACCEPT, DENY or NEUTRAL. The default value is NEUTRAL.
onMismatch	String	Action to take when the filter does not match. May be ACCEPT, DENY or NEUTRAL. The default value is DENY.

### Map Filter Parameters

As in this configuration, the MapFilter can be used to log particular events:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <MapFilter onMatch="ACCEPT" onMismatch="NEUTRAL" operator="or">
    <KeyValuePair key="eventId" value="Login"/>
    <KeyValuePair key="eventId" value="Logout"/>
  </MapFilter>
  <appenders>
    <RollingFile name="RollingFile" fileName="logs/app.log"
      filePattern="logs/app-%d{MM-dd-yyyy}.log.gz">
      <BurstFilter level="INFO" rate="16" maxBurst="100"/>
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
      <TimeBasedTriggeringPolicy />
    </RollingFile>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="RollingFile"/>
    </root>
  </loggers>
</configuration>
```

This sample configuration will exhibit the same behavior as the preceding example since the only logger configured is the root.

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <RollingFile name="RollingFile" fileName="logs/app.log"
      filePattern="logs/app-%d{MM-dd-yyyy}.log.gz">
      <BurstFilter level="INFO" rate="16" maxBurst="100"/>
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
      <TimeBasedTriggeringPolicy />
    </RollingFile>
  </appenders>
  <loggers>
    <root level="error">
      <MapFilter onMatch="ACCEPT" onMismatch="NEUTRAL" operator="or">
        <KeyValuePair key="eventId" value="Login"/>
        <KeyValuePari key="eventId" value="Logout"/>
      </MapFilter>
      <appender-ref ref="RollingFile">
      </appender-ref>
    </root>
  </loggers>
</configuration>
```

This third sample configuration will exhibit the same behavior as the preceding examples since the only logger configured is the root and the root is only configured with a single appender reference.

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <RollingFile name="RollingFile" fileName="logs/app.log"
      filePattern="logs/app-%d{MM-dd-yyyy}.log.gz">
      <BurstFilter level="INFO" rate="16" maxBurst="100"/>
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
      <TimeBasedTriggeringPolicy />
    </RollingFile>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="RollingFile">
        <MapFilter onMatch="ACCEPT" onMismatch="NEUTRAL" operator="or">
          <KeyValuePair key="eventId" value="Login"/>
          <KeyValuePari key="eventId" value="Logout"/>
        </MapFilter>
      </appender-ref>
    </root>
  </loggers>
</configuration>
```

### 10.1.5 MarkerFilter

The MarkerFilter compares the configured Marker value against the Marker that is included in the LogEvent. A match occurs when the Marker name matches either the Log Event's Marker or one of its parents.

Parameter Name	Type	Description
marker	String	The name of the Marker to compare.
onMatch	String	Action to take when the filter matches. May be ACCEPT, DENY or NEUTRAL. The default value is NEUTRAL.
onMismatch	String	Action to take when the filter does not match. May be ACCEPT, DENY or NEUTRAL. The default value is DENY.

#### Marker Filter Parameters

A sample configuration that only allows the event to be written by the appender if the Marker matches:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <RollingFile name="RollingFile" fileName="logs/app.log"
      filePattern="logs/app-%d{MM-dd-yyyy}.log.gz">
      <MarkerFilter marker="FLOW" onMatch="ACCEPT" onMismatch="DENY"/>
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
      <TimeBasedTriggeringPolicy />
    </RollingFile>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="RollingFile"/>
    </root>
  </loggers>
</configuration>
```

### 10.1.6 RegexFilter

The RegexFilter allows the formatted or unformatted message to be compared against a regular expression.

Parameter Name	Type	Description
regex	String	The regular expression.
useRawMsg	boolean	If true the unformatted message will be used, otherwise the formatted message will be used. The default value is false.
onMatch	String	Action to take when the filter matches. May be ACCEPT, DENY or NEUTRAL. The default value is NEUTRAL.
onMismatch	String	Action to take when the filter does not match. May be ACCEPT, DENY or NEUTRAL. The default value is DENY.

### Regex Filter Parameters

A sample configuration that only allows the event to be written by the appender if it contains the word "test":

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <RollingFile name="RollingFile" fileName="logs/app.log"
      filePattern="logs/app-%d{MM-dd-yyyy}.log.gz">
      <RegexFilter regex=".* test .*" onMatch="ACCEPT" onMismatch="DENY"/>
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
      <TimeBasedTriggeringPolicy />
    </RollingFile>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="RollingFile"/>
    </root>
  </loggers>
</configuration>
```

#### 10.1.7 StructuredDataFilter

The StructuredDataFilter is a MapFilter that also allows filtering on the event id, type and message.

Parameter Name	Type	Description
----------------	------	-------------

keyValuePair	KeyValuePair[]	One or more KeyValuePair elements that define the key in the map and the value to match on. "id", "id.name", "type", and "message" should be used to match on the StructuredDataId, the name portion of the StructuredDataId, the type, and the formatted message respectively. If the same key is specified more than once then the check for that key will automatically be an "or" since a Map can only contain a single value.
operator	String	If the operator is "or" then a match by any one of the key/value pairs will be considered to be a match, otherwise all the key/value pairs must match.
onMatch	String	Action to take when the filter matches. May be ACCEPT, DENY or NEUTRAL. The default value is NEUTRAL.
onMismatch	String	Action to take when the filter does not match. May be ACCEPT, DENY or NEUTRAL. The default value is DENY.

### StructuredData Filter Parameters

As in this configuration, the StructuredDataFilter can be used to log particular events:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <StructuredDataFilter onMatch="ACCEPT" onMismatch="NEUTRAL" operator="or">
    <KeyValuePair key="id" value="Login"/>
    <KeyValuePair key="id" value="Logout"/>
  </StructuredDataFilter>
  <appenders>
    <RollingFile name="RollingFile" fileName="logs/app.log"
      filePattern="logs/app-%d{MM-dd-yyyy}.log.gz">
      <BurstFilter level="INFO" rate="16" maxBurst="100"/>
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
      <TimeBasedTriggeringPolicy />
    </RollingFile>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="RollingFile"/>
    </root>
  </loggers>
</configuration>
```

### 10.1.8 ThreadContextMapFilter

The ThreadContextMapFilter allows filtering against data elements that are in the ThreadContext Map.

Parameter Name	Type	Description
keyValuePair	KeyValuePair[]	One or more KeyValuePair elements that define the key in the map and the value to match on. If the same key is specified more than once then the check for that key will automatically be an "or" since a Map can only contain a single value.
operator	String	If the operator is "or" then a match by any one of the key/value pairs will be considered to be a match, otherwise all the key/value pairs must match.
onMatch	String	Action to take when the filter matches. May be ACCEPT, DENY or NEUTRAL. The default value is NEUTRAL.

onMismatch	String	Action to take when the filter does not match. May be ACCEPT, DENY or NEUTRAL. The default value is DENY.
------------	--------	---

### ThreadContext Map Filter Parameters

A configuration containing the ThreadContextMapFilter might look like:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <ThreadContextMapFilter onMatch="ACCEPT" onMismatch="NEUTRAL" operator="or">
    <KeyValuePair key="User1" value="DEBUG" />
    <KeyValuePair key="User2" value="WARN" />
  </ThreadContextMapFilter>
  <appenders>
    <RollingFile name="RollingFile" fileName="logs/app.log"
      filePattern="logs/app-%d{MM-dd-yyyy}.log.gz">
      <BurstFilter level="INFO" rate="16" maxBurst="100" />
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
      <TimeBasedTriggeringPolicy />
    </RollingFile>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="RollingFile" />
    </root>
  </loggers>
</configuration>
```

The ThreadContextMapFilter can also be applied to a logger for filtering:



```

<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <RollingFile name="RollingFile" fileName="logs/app.log"
      filePattern="logs/app-%d{MM-dd-yyyy}.log.gz">
      <BurstFilter level="INFO" rate="16" maxBurst="100"/>
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
      <TimeBasedTriggeringPolicy />
    </RollingFile>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="RollingFile"/>
      <ThreadContextMapFilter onMatch="ACCEPT" onMismatch="NEUTRAL" operator="or">
        <KeyValuePair key="foo" value="bar"/>
        <KeyValuePair key="User2" value="WARN"/>
      </ThreadContextMapFilter>
    </root>
  </loggers>
</configuration>

```

### 10.1.9 ThresholdFilter

This filter returns the onMatch result if the level in the LogEvent is the same or more specific than the configured level and the onMismatch value otherwise. For example, if the ThresholdFilter is configured with Level ERROR and the LogEvent contains Level DEBUG then the onMismatch value will be returned since ERROR events are more specific than DEBUG.

Parameter Name	Type	Description
level	String	A valid Level name to match on.
onMatch	String	Action to take when the filter matches. May be ACCEPT, DENY or NEUTRAL. The default value is NEUTRAL.
onMismatch	String	Action to take when the filter does not match. May be ACCEPT, DENY or NEUTRAL. The default value is DENY.

#### Threshold Filter Parameters

A sample configuration that only allows the event to be written by the appender if the level matches:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <RollingFile name="RollingFile" fileName="logs/app.log"
      filePattern="logs/app-%d{MM-dd-yyyy}.log.gz">
      <ThresholdFilter level="TRACE" onMatch="ACCEPT" onMismatch="DENY"/>
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
      <TimeBasedTriggeringPolicy />
    </RollingFile>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="RollingFile"/>
    </root>
  </loggers>
</configuration>
```

### 10.1.10 TimeFilter

The time filter can be used to restrict filter to only a certain portion of the day.

Parameter Name	Type	Description
start	String	A time in HH:mm:ss format.
end	String	A time in HH:mm:ss format. Specifying an end time less than the start time will result in no log entries being written.
timezone	String	The timezone to use when comparing to the event timestamp.
onMatch	String	Action to take when the filter matches. May be ACCEPT, DENY or NEUTRAL. The default value is NEUTRAL.
onMismatch	String	Action to take when the filter does not match. May be ACCEPT, DENY or NEUTRAL. The default value is DENY.

#### Time Filter Parameters

A sample configuration that only allows the event to be written by the appender from 5:00 to 5:30 am each day using the default timezone:

```
<?xml version="1.0" encoding="UTF-8"?>
<configuration status="warn" name="MyApp" packages="">
  <appenders>
    <RollingFile name="RollingFile" fileName="logs/app.log"
      filePattern="logs/app-%d{MM-dd-yyyy}.log.gz">
      <TimeBasedTriggeringPolicy />
      <PatternLayout>
        <pattern>%d %p %C{1.} [%t] %m%n</pattern>
      </PatternLayout>
    </RollingFile>
  </appenders>
  <loggers>
    <root level="error">
      <appender-ref ref="RollingFile"/>
    </root>
  </loggers>
</configuration>
```

## 11 JMX

---

### 11.1 JMX

JMX support is incomplete at this time. Patches are welcome!

# Logging Separation

---

## 12.1 Logging Separation

There are many well known use cases where applications may share an environment with other applications and each has a need to have its own, separate logging environment. This purpose of this section is to discuss some of these cases and ways to accomplish this.

### 12.1.1 Use Cases

This section describes some of the use cases where Log4j could be used and what its desired behavior might be.

#### 12.1.1.1 Standalone Application

Standalone applications are usually relatively simple. They typically have one bundled executable that requires only a single logging configuration.

#### 12.1.1.2 Web Applications

A typical web application will be packaged as a WAR file and will include all of its dependencies in WEB-INF/lib and will have its configuration file located in the class path or in a location configured in the web.xml.

#### 12.1.1.3 Java EE Applications

A Java EE application will consist of one or more WAR files and possibly some EJBs, typically all packaged in an EAR file. Usually, it is desirable to have a single configuration that applies to all the components in the EAR. The logging classes will generally be placed in a location shared across all the components and the configuration needs to also be shareable.

#### 12.1.1.4 "Shared" Web Applications and REST Service Containers

In this scenario there are multiple WAR files deployed into a single container. Each of the applications should use the same logging configuration and share the same logging implementation across each of the web applications. When writing to files and streams each of the applications should share them to avoid the issues that can occur when multiple components try to write to the same file(s) through different File objects, channels, etc.

### 12.1.2 Approaches

#### 12.1.2.1 The Simple Approach

The simplest approach for separating logging within applications is to package each application with its own copy of Log4j and to use the BasicContextSelector. While this works for standalone applications and may work for web applications and possibly Java EE applications, it does not work at all in the last

case. However, when this approach does work it should be used as it is ultimately the simplest and most straightforward way of implementing logging.

#### 12.1.2.2 Using Context Selectors

There are a few patterns for achieving the desired state of logging separation using ContextSelectors:

1. Place the logging jars in the container's classpath and set the system property "Log4jContextSelector" to "org.apache.logging.log4j.core.selector.BasicContextSelector". This will create a single LoggerContext using a single configuration that will be shared across all applications.
2. Place the logging jars in the container's classpath and use the default ClassLoaderContextSelector. Include the Log4jContextListener in each web application. Each ContextListener can be configured to share the same configuration used at the container or they can be individually configured. If status logging is set to debug in the configuration there will be output from when logging is initialized in the container and then again in each web application.
3. Use the JNDIContextFilter and set the system property "Log4jContextSelector" to "org.apache.logging.log4j.core.selector.JNDIContextSelector". This will cause the container to use JNDI to locate each's web application's LoggerContext.

# 1 Extending Log4j

---

## 13.1 Extending Log4j

Log4j 2 provides numerous ways that it can be manipulated and extended. This section includes an overview of the various ways that are directly supported by the Log4j 2 implementation.

### 13.1.1 LoggerContextFactory

The `LoggerContextFactory` binds the Log4j API to its implementation. The Log4j `LogManager` locates a `LoggerContextFactory` by locating all instances of `META-INF/log4j-provider.xml`, a file that conforms to the `java.util.Properties` DTD, and then inspecting each to verify that it specifies a value for the `"Log4jAPIVersion"` property that conforms to the version required by the `LogManager`. If more than one valid implementation is located the value for `"FactoryPriority"` will be used to identify the factory with the highest priority. Finally, the value of the `"LoggerContextFactory"` property will be used to locate the `LoggerContextFactory`. In Log4j 2 this is provided by `Log4jContextFactory`.

Applications may change the `LoggerContextFactory` that will be used by

1. Implementing a new `LoggerContextFactory` and creating a `log4j-provider.xml` to reference it making sure that it has the highest priority.
2. Create a new `log4j-provider.xml` and configure it with the desired `LoggerContextFactory` making sure that it has the highest priority.
3. Setting the system property `"log4j2.LoggerContextFactory"` to the name of the `LoggerContextFactory` class to use.
4. Setting the property `"log4j2.LoggerContextFactory"` in a properties file named `"log4j2.LogManager.properties"` to the name of the `LoggerContextFactory` class to use. The properties file must be on the classpath.

### 13.1.2 ContextSelector

`ContextSelectors` are called by the Log4j `LoggerContext` factory. They perform the actual work of locating or creating a `LoggerContext`, which is the anchor for `Loggers` and their configuration. `ContextSelectors` are free to implement any mechanism they desire to manage `LoggerContexts`. The default `Log4jContextFactory` checks for the presence of a System Property named `"Log4jContextSelector"`. If found, the property is expected to contain the name of the Class that implements the `ContextSelector` to be used.

Log4j provides three `ContextSelectors`:

#### **BasicContextSelector**

Uses either a `LoggerContext` that has been stored in a `ThreadLocal` or a common `LoggerContext`.

#### **ClassLoaderContextSelector**

Associates `LoggerContexts` with the `ClassLoader` that created the caller of the `getLogger` call.

#### **JNDIContextSelector**

Locates the `LoggerContext` by querying JNDI.

### 13.1.3 ConfigurationFactory

Modifying the way in which logging can be configured is usually one of the areas with the most interest. The primary method for doing that is by implementing or extending a ConfigurationFactory. Log4j provides two ways of adding new ConfigurationFactories. The first is by defining the system property named "log4j.configurationFactory" to the name of the class that should be searched first for a configuration. The second method is by defining the ConfigurationFactory as a Plugin.

All the ConfigurationFactories are then processed in order. Each factory is called on its getSupportedTypes method to determine the file extensions it supports. If a configuration file is located with one of the specified file extensions then control is passed to that ConfigurationFactory to load the configuration and create the Configuration object.

Most Configuration extend the BaseConfiguration class. This class expects that the subclass will process the configuration file and create a hierarchy of Node objects. Each Node is fairly simple in that it consists of the name of the node, the name/value pairs associated with the node, The PluginType of the node and a List of all of its child Nodes. BaseConfiguration will then be passed the Node tree and instantiate the configuration objects from that.

```
@Plugin(name = "XMLConfigurationFactory", type = "ConfigurationFactory")
@Order(5)
public class XMLConfigurationFactory extends ConfigurationFactory {

    /**
     * Valid file extensions for XML files.
     */
    public static final String[] SUFFIXES = new String[] { ".xml", "" };

    /**
     * Return the Configuration.
     * @param source The InputSource.
     * @return The Configuration.
     */
    public Configuration getConfiguration(InputSource source) {
        return new XMLConfiguration(source, configFile);
    }

    /**
     * Returns the file suffixes for XML files.
     * @return An array of File extensions.
     */
    public String[] getSupportedTypes() {
        return SUFFIXES;
    }
}
```

### 13.1.4 LoggerConfig

LoggerConfig objects are where Loggers created by applications tie into the configuration. The Log4j implementation requires that all LoggerConfigs be based on the LoggerConfig class, so applications



wishing to make changes must do so by extending the `LoggerConfig` class. To declare the new `LoggerConfig`, declare it as a `Plugin` of type "Core" and providing the name that applications should specify as the element name in the configuration. The `LoggerConfig` should also define a `PluginFactory` that will create an instance of the `LoggerConfig`.

The following example shows how the root `LoggerConfig` simply extends a generic `LoggerConfig`.

```
@Plugin(name = "root", type = "Core", printObject = true)
public static class RootLogger extends LoggerConfig {

    @PluginFactory
    public static LoggerConfig createLogger(@PluginAttr("additivity") String additivity,
                                           @PluginAttr("level") String loggerLevel,
                                           @PluginElement("appender-ref") AppenderRef[] refs,
                                           @PluginElement("filters") Filter filter) {

        List<AppenderRef> appenderRefs = Arrays.asList(refs);
        Level level;
        try {
            level = loggerLevel == null ? Level.ERROR : Level.valueOf(loggerLevel.toUpperCase());
        } catch (Exception ex) {
            LOGGER.error("Invalid Log level specified: {}. Defaulting to Error", loggerLevel);
            level = Level.ERROR;
        }
        boolean additive = additivity == null ? true : Boolean.parseBoolean(additivity);

        return new LoggerConfig(LogManager.ROOT_LOGGER_NAME, appenderRefs, filter, level, additive);
    }
}
```

### 13.1.5 Lookups

Lookups are the means in which parameter substitution is performed. During Configuration initialization an "Interpolator" is created that locates all the Lookups and registers them for use when a variable needs to be resolved. The interpolator matches the "prefix" portion of the variable name to a registered Lookup and passes control to it to resolve the variable.

A Lookup must be declared using a `Plugin` annotation with a type of "Lookup". The name specified on the `Plugin` annotation will be used to match the prefix. Unlike other `Plugins`, `Lookups` do not use a `PluginFactory`. Instead, they are required to provide a constructor that accepts no arguments. The example below shows a `Lookup` that will return the value of a `System Property`.

```

@Plugin(name = "sys", type = "Lookup")
public class SystemPropertiesLookup implements StrLookup {

    /**
     * Lookup the value for the key.
     * @param key the key to be looked up, may be null
     * @return The value for the key.
     */
    public String lookup(String key) {
        return System.getProperty(key);
    }

    /**
     * Lookup the value for the key using the data in the LogEvent.
     * @param event The current LogEvent.
     * @param key the key to be looked up, may be null
     * @return The value associated with the key.
     */
    public String lookup(LogEvent event, String key) {
        return System.getProperty(key);
    }
}

```

### 13.1.6 Filters

As might be expected, Filters are used to reject or accept log events as they pass through the logging system. A Filter is declared using a Plugin annotation of type "Core" and an elementType of "filter". The name attribute on the Plugin annotation is used to specify the name of the element users should use to enable the Filter. Specifying the printObject attribute with a value of "true" indicates that a call to toString will format the arguments to the filter as the configuration is being processed. The Filter must also specify a PluginFactory method that will be called to create the Filter.

The example below shows a Filter used to reject LogEvents based upon their logging level. Notice the typical pattern where all the filter methods resolve to a single filter method.

```

@Plugin(name = "ThresholdFilter", type = "Core", elementType = "filter", printObject = true)
public final class ThresholdFilter extends AbstractFilter {

    private final Level level;

    private ThresholdFilter(Level level, Result onMatch, Result onMismatch) {
        super(onMatch, onMismatch);
        this.level = level;
    }

    public Result filter(Logger logger, Level level, Marker marker, String msg, Object[] params) {
        return filter(level);
    }

    public Result filter(Logger logger, Level level, Marker marker, Object msg, Throwable t) {
        return filter(level);
    }

    public Result filter(Logger logger, Level level, Marker marker, Message msg, Throwable t) {
        return filter(level);
    }

    @Override
    public Result filter(LogEvent event) {
        return filter(event.getLevel());
    }

    private Result filter(Level level) {
        return level.isAtLeastAsSpecificAs(this.level) ? onMatch : onMismatch;
    }

    @Override
    public String toString() {
        return level.toString();
    }

    /**
     * Create a ThresholdFilter.
     * @param loggerLevel The log Level.
     * @param match The action to take on a match.
     * @param mismatch The action to take on a mismatch.
     * @return The created ThresholdFilter.
     */
    @PluginFactory
    public static ThresholdFilter createFilter(@PluginAttr("level") String loggerLevel,
                                              @PluginAttr("onMatch") String match,
                                              @PluginAttr("onMismatch") String mismatch) {
        Level level = loggerLevel == null ? Level.ERROR : Level.toLevel(loggerLevel.toUpperCase());
        Result onMatch = match == null ? Result.NEUTRAL : Result.valueOf(match.toUpperCase());
        Result onMismatch = mismatch == null ? Result.DENY : Result.valueOf(mismatch.toUpperCase());

        return new ThresholdFilter(level, onMatch, onMismatch);
    }
}

```

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### 13.1.7 Appenders

Appenders are passed an event, (usually) invoke a Layout to format the event, and then "publish" the event in whatever manner is desired. Appenders are declared as Plugins with a type of "Core" and an elementType of "appender". The name attribute on the Plugin annotation specifies the name of the element users must provide in their configuration to use the Appender. Appender's should specify printObject as "true" if the toString method renders the values of the attributes passed to the Appender.

Appenders must also declare a PluginFactory method that will create the appender. The example below shows an Appender named "Stub" that can be used as an initial template.

Most Appenders use Managers. A manager actually "owns" the resources, such as an OutputStream or socket. When a reconfiguration occurs a new Appender will be created. However, if nothing significant in the previous Manager has change the new Appender will simply reference it instead of creating a new one. This insures that events are not lost while a reconfiguration is taking place without requiring that logging pause while the reconfiguration takes place.

```
@Plugin(name = "Stub", type = "Core", elementType = "appender", printObject = true)
public final class StubAppender extends OutputStreamAppender {

    private StubAppender(String name, Layout layout, Filter filter, StubManager manager,
        boolean handleExceptions) {

    }

    @PluginFactory
    public static StubAppender createAppender(@PluginAttr("name") String name,
        @PluginAttr("suppressExceptions") String suppress,
        @PluginElement("layout") Layout layout,
        @PluginElement("filters") Filter filter) {

        boolean handleExceptions = suppress == null ? true : Boolean.valueOf(suppress);

        if (name == null) {
            LOGGER.error("No name provided for StubAppender");
            return null;
        }

        StubManager manager = StubManager.getStubManager(name);
        if (manager == null) {
            return null;
        }
        if (layout == null) {
            layout = PatternLayout.createLayout(null, null, null, null);
        }
        return new StubAppender(name, layout, filter, manager, handleExceptions);
    }
}
```

### 13.1.8 Layouts

Layouts perform the formatting of events into the printable text that is written by Appenders to some destination. All Layouts must implement the Layout interface. Layouts that format the event into a String should extend AbstractStringLayout, which will take care of converting the String into the required byte array.

Every Layout must declare itself as a plugin using the Plugin annotation. The type must be "Core", and the elementType must be "Layout". printObject should be set to true if the plugin's toString method will provide a representation of the object and its parameters. The name of the plugin must match the value users should use to specify it as an element in their Appender configuration. The plugin also must provide a static method annotated as a PluginFactory and with each of the methods parameters annotated with PluginAttr or PluginElement as appropriate.

```
@Plugin(name = "SampleLayout", type = "Core", elementType = "layout", printObject = true)
public class SampleLayout extends AbstractStringLayout {

    protected SampleLayout(boolean locationInfo, boolean properties, boolean complete,
                           Charset charset) {

    }

    @PluginFactory
    public static SampleLayout createLayout(@PluginAttr("locationInfo") String locationInfo,
                                           @PluginAttr("properties") String properties,
                                           @PluginAttr("complete") String complete,
                                           @PluginAttr("charset") String charset) {

        Charset c = Charset.isSupported("UTF-8") ?
            Charset.forName("UTF-8") : Charset.defaultCharset();
        if (charset != null) {
            if (Charset.isSupported(charset)) {
                c = Charset.forName(charset);
            } else {
                LOGGER.error("Charset " + charset + " is not supported for layout, using " +
                    c.displayName());
            }
        }
        boolean info = locationInfo == null ? false : Boolean.valueOf(locationInfo);
        boolean props = properties == null ? false : Boolean.valueOf(properties);
        boolean comp = complete == null ? false : Boolean.valueOf(complete);
        return new SampleLayout(info, props, comp, c);
    }
}
```

### 13.1.9 PatternConverters

PatternConverters are used by the PatternLayout to format the log event into a printable String. Each Converter is responsible for a single kind of manipulation, however Converters are free to format the event in complex ways. For example, there are several converters that manipulate Throwables and format them in various ways.

A `PatternConverter` must first declare itself as a `Plugin` using the standard `Plugin` annotation but must specify value of "Converter" on the `type` attribute. Furthermore, the `Converter` must also specify the `ConverterKeys` attribute to define the tokens that can be specified in the pattern (preceded by a '%' character) to identify the `Converter`.

Unlike most other `Plugins`, `Converters` do not use a `PluginFactory`. Instead, each `Converter` is required to provide a static `newInstance` method that accepts an array of `Strings` as the only parameter. The `String` array are the values that are specified within the curly braces that can follow the converter key.

The following shows the skeleton of a `Converter` plugin.

```
@Plugin(name = "query", type = "Converter")
@ConverterKeys({"q", "query"})
public final class QueryConverter extends LogEventPatternConverter {

    public QueryConverter(String[] options) {
    }

    public static QueryConverter newInstance(final String[] options) {
        return new QueryConverter(options);
    }
}
```

### 13.1.10 Custom Plugins