

LEAP USER GUIDE

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The LEAP add-on, when combined with JADE, provides a modified run-time environment for enabling FIPA agents to execute on lightweight devices running Java.

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1 Introduction

This document describes how to use the LEAP add-on to obtain JADE-LEAP (“JADE powered by LEAP”), a runtime environment for enabling FIPA agents to execute on lightweight devices running Java.

The LEAP software was mainly developed within the scope of the LEAP IST project (<http://leap.crm-paris.com>) and has been made available as a JADE add-on since the release of JADE3.0.

1.1 Target audience

This document is intended for JADE users who are interested in developing multi-agent applications that have to be deployed on lightweight devices such as mobile phones and PDAs.

The reader is therefore assumed to be already familiar with

- JADE. For people new to JADE we recommend to read the JADE Administrators Guide and Programmers Guide first available on the JADE web site (<http://jade.cselt.it>).
- The Micro Edition version of the Java 2 platform (J2ME) and in particular (for the sections of this document dealing with MIDP) with the Java Wireless Toolkit. For people new to J2ME we recommend to visit <http://java.sun.com> first.

1.2 Rationale

As a consequence of the introduction of always-connected wireless networks (GPRS, UMTS, WLAN) and of the continuous growth in power and resources of handheld devices such as PDAs and cell phones, the wireless and wire-line environments are progressively integrating together. In this scenario the need of deploying applications distributed partly in the fixed network and partly on handheld devices is becoming more and more important.

JADE, unfortunately, cannot run, as it is, on small devices for the following reasons:

1. The complete JADE runtime environment has a memory footprint of some Mbytes that cannot fit the (often strong) limitations of handheld devices.
2. JADE requires JDK1.2 (or later) while the majority of handheld devices only support PersonalJava or MIDP.
3. Wireless links have different characteristics with respect to fixed network such as high latency, low bandwidth, intermittent connectivity and dynamic IP address assignment that must be taken into account properly.

The LEAP add-on was created to solve these problems and allows deploying JADE agents on handheld devices as described in the followings.

1.3 The JADE-LEAP runtime environment

The LEAP add-on, when combined with JADE, replaces some parts of the JADE kernel forming a modified runtime environment that we will identify as JADE-LEAP (“JADE powered by LEAP”) and that can be deployed on a wide range of devices varying from servers to Java enabled cell phones. In order to achieve this, JADE-LEAP can be shaped

in three different ways corresponding to the three types of Java environments that can be found on the considered devices:

- **j2se**: to execute JADE-LEAP on PC and servers in the fixed network running JDK1.2 or later.
- **pjava**: to execute JADE-LEAP on handheld devices supporting PersonalJava such as most of today PDAs.
- **midp**: to execute JADE-LEAP on handheld devices supporting MIDP1.0 only such as the great majority of Java enabled cell phones.

Though different internally, the three versions of JADE-LEAP provide the same set of API to developers thus offering a homogeneous layer over a diversity of devices and types of network as depicted in Figure 1.

Only a few features that are available in JADE-LEAP for *j2se* and *pjava* are not supported in JADE-LEAP for *midp* as they are intrinsically related to Java classes that are not supported in MIDP (see 5 for a summary of MIDP unsupported features).

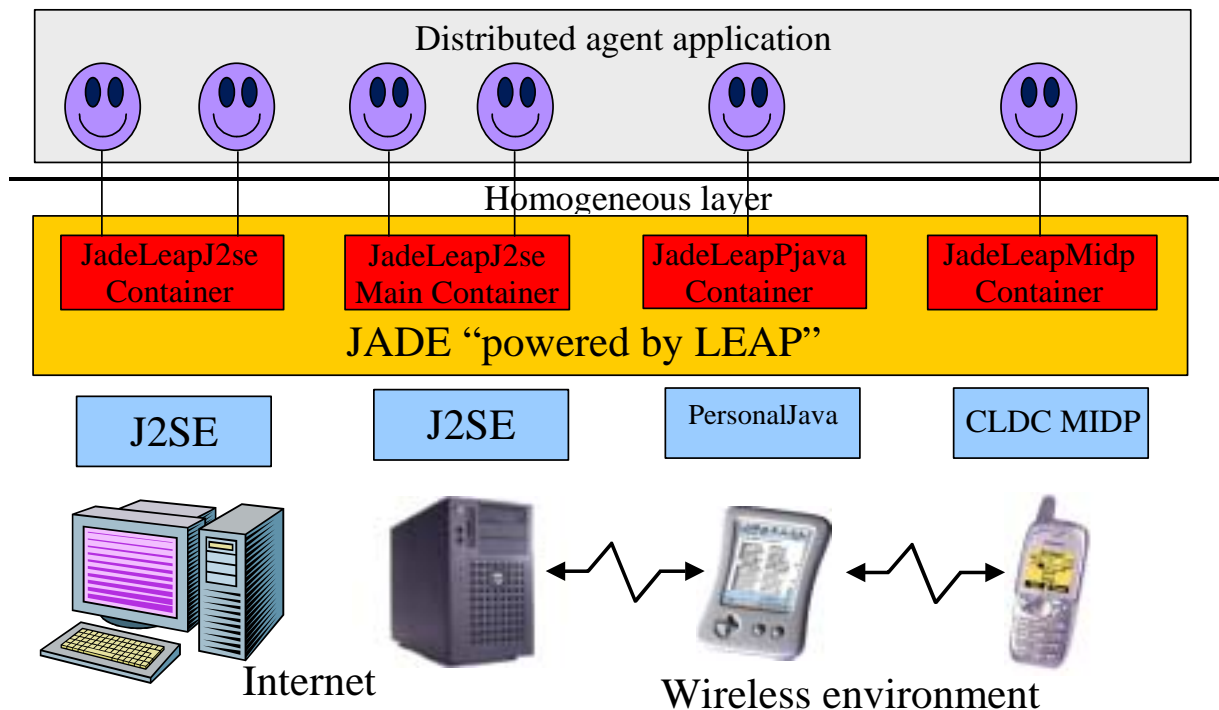


Figure 1. The JADE-LEAP runtime environment

1.4 JADE and JADE-LEAP

From the point of view of application developers and users JADE-LEAP for *j2se* is almost identical to JADE both in terms of APIs and runtime administration (see 4 for a summary of the differences). Therefore in general developers can deploy their JADE agents on JADE-LEAP and vice versa without changing a single line of code. Moreover there is no need for a JADE-LEAP programmers guide or API documentation as those provided with JADE apply to JADE-LEAP too.

On the other hand it should be kept in mind that JADE containers and JADE-LEAP containers cannot be mixed within a single platform!

1.5 Downloading

JADE-LEAP for *j2se*, *pjava* and *midp* can be directly downloaded in binary form from the “Download” area of the JADE web site (<http://jade.cselt.it>).

People interested in modifying JADE-LEAP have to download (besides the JADE sources) the LEAP add-on from the “Add-ons and 3rd Party software” area of the JADE web site and follow the instructions included in 3

2 Using JADE-LEAP

2.1 Executing JADE-LEAP on PCs and Servers

When working on PCs and Servers running JDK1.2 or later, the *j2se* version of JADE-LEAP must be used. As mentioned in 1.4, JADE-LEAP for *j2se* is almost identical (from the users point of view) to pure JADE. As a consequence starting a JADE-LEAP main container or normal container is done, like in JADE, by typing (assuming JADE-LEAP classes are in the classpath):

```
java jade.Boot [options] [agents specification]
```

where valid options are listed in 2.1.1 (same options valid for JADE except for the differences listed in 4) and agents specification is a list of semicolon-separated (‘;’) specifiers of the following form

```
<local-name>:<agent-class>[( <arg1> , <arg2>... )]
```

Note the difference with respect to JADE where agent specifiers are separated by spaces. Moreover, unlike in JADE, there must be no spaces between agent arguments.

As an example typing

```
java jade.Boot -gui -nomtp
```

```
    Peter:myPackage.MyClass1;John:myPackage.MyClass2(anarg)
```

would launch a Main container with no MTP and activate the RMA GUI plus an agent called Peter of class `myPackage.MyClass1` (with no argument) and an agent called John of class `myPackage.MyClass2` (with an argument whose value is “anarg”).

Similarly, typing

```
java jade.Boot -container -host myHost
```

would launch a normal container (with no agent on it) that will register to a main container running on host `myHost`.

In addition, in order to maintain backward compatibility with previous versions of JADE-LEAP, the old style command line

```
java jade.Boot <bootstrap properties file name>
```

is still valid and is equivalent to

```
java jade.Boot -conf <bootstrap properties file name>
```

2.1.1 Options

Command line options can have two different forms:

-<key> <value>
-<switch>

Each option expresses a configuration property. Unless explicitly mentioned options of the first form express configuration properties that can equivalently be set within the bootstrap properties file as

<key> = <value>

On the other hand options of the second form do not have any equivalent in the bootstrap properties file.

The following command line options can be used to configure JADE-LEAP for *j2se*.

-main <true|false> Indicates whether or not this is a main container (Default = true).

-container Shortcut for -main false.

-host <host-name/address> Indicates the host where the Main container is running (Default = localhost); ignored if this is the Main container.

-port <port-number> Indicates the port where the Main container is listening for commands (Default = 1099); ignored if this is the Main container.

-local-port <port-number> Indicates the port where this container will listen for commands (Default = 1099).

-gui¹ Activates the RMA GUI.

-name <name> Indicates the name to be assigned to the platform (Default = <main-host>:<main-port>/JADE); ignored if this is a normal container.

-container-name <name> Indicates the name to be assigned to this container (Default = Container-n); ignored if this is the Main container whose name is always "Main-Container".

-mtps <semicolon-separated list of MTP specifiers> Activates the specified MTPs, where each MTP specifier has the form

[<mtp-address>:]<mtp-class>[(<arg1><arg2>...)]

By default the IIOP MTP is activated on a Main container while no MTP is activated on a normal container.

-mtp² <semicolon-separated list of MTP specifiers> Same as -mtps.

-nomtp Indicate that no MTP has to be activated on this container (typically used to avoid starting the IIOP MTP on a main container).

-agents <semicolon-separated list of agent specifiers> Activates the specified agents.

-conf <filename> Reads the configuration properties specified in the indicated properties file.

¹ This option can be specified in a properties file as -gui <true|false> (Default = false).

² This option cannot be specified in a properties file.

2.2 Executing JADE-LEAP on handheld devices

2.2.1 Execution modes

The JADE-LEAP runtime environment can be executed on a handheld device in two different ways.

The “**Stand-alone**” execution mode where a complete container is executed on the handheld device.

The “**Split**” execution mode where the container is split into a FrontEnd (actually running on the handheld device) and a BackEnd (running on a J2SE host) linked together through a permanent connection (see Figure 2). This execution mode is particularly suited for resource-constrained and wireless devices since:

- The FrontEnd is definitely more lightweight than a complete container.
- The bootstrap phase is faster.
- Less bytes are transmitted over the wireless link.

It is important to remark that the developer does not have to care in anyway about the fact that an agent will run on a stand-alone container or on the FrontEnd of a split container as the APIs they provide are exactly the same.

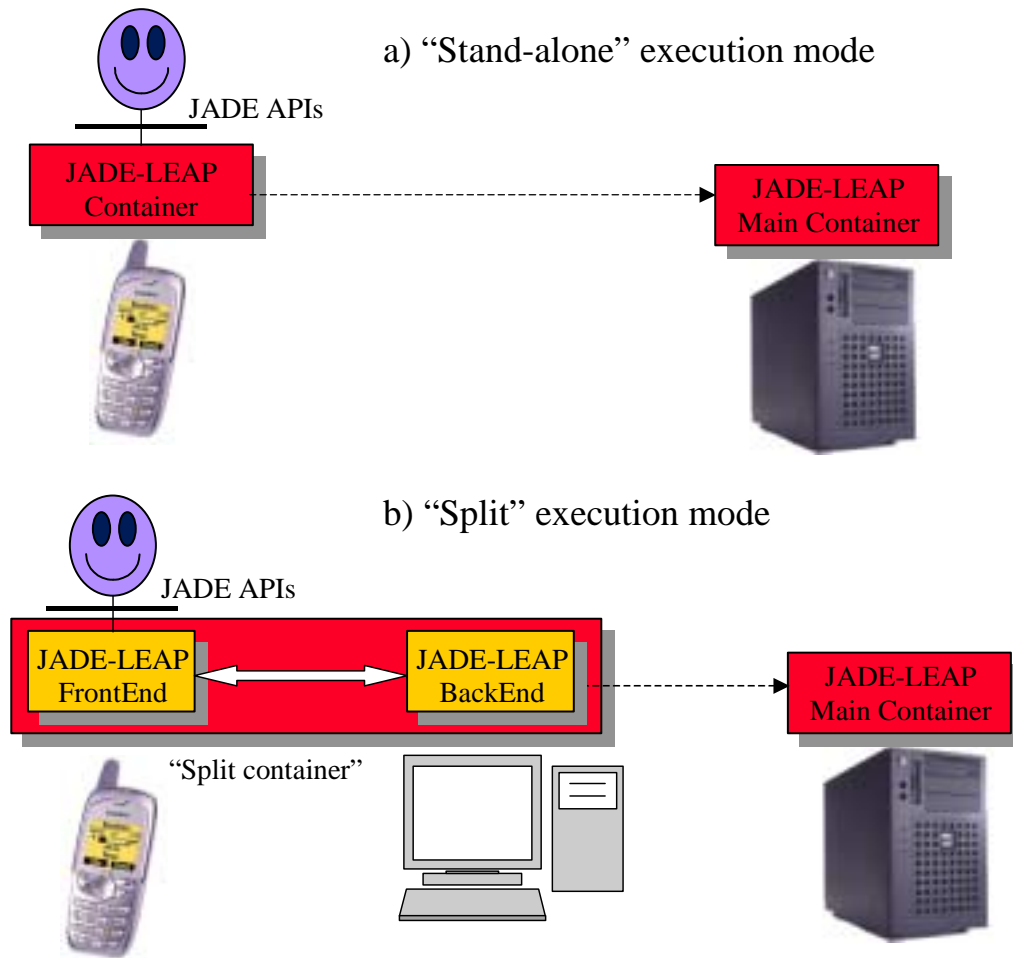


Figure 2. Execution modes

The following issues must be taken into account:

- When launching a split container, a *j2se* container (possibly, but NOT necessarily the Main Container) must already be active on the host where the BackEnd has to be created.
- A Main Container cannot be split.
- Agent mobility and cloning is never supported on a split container.

2.2.2 PDAs and smart-phones running PersonalJava

When working on PDAs and smart-phones running PersonalJava, the *pjava* version of JADE-LEAP must be used.

Stand-alone execution

A *pjava* stand-alone container is started, exactly as for a *j2se* container, by typing (assuming JADE-LEAP classes are in the classpath):

```
java jade.Boot [options] [agents specification]
```

where the same options and agents specification valid for *j2se* apply (see 2.1) except for the `-gui` option as the JADE tools (including the RMA) require JDK1.2 or later to run.

In addition, in order to maintain backward compatibility with previous versions of JADE-LEAP, the old style command line

```
java jade.Boot <properties file name>
```

is still valid and is equivalent to

```
java jade.Boot -conf <properties file name>
```

Split execution

A *pjava* split container is started by typing (assuming JADE-LEAP classes are in the classpath):

```
java jade.MicroBoot [options] [agents specification]
```

where the agents specification has the same format as in *pjava* stand-alone execution and in *j2se* and the following options are available.

`-host <host-name/address>` Indicates the host where the BackEnd has to be created (Default = localhost).

`-port <port-number>` Indicates the port where the *j2se* container active on “host” is listening for commands (Default = 1099).

`-agents <semicolon-separated list of agent specifiers>` Activates the specified agents.

`-exitwhenempty <true|false>` When this option is set to `true` the container automatically exits as soon as there are no more agents living on it.

`-conf <filename>` Read the configuration properties from the specified file

2.2.3 Cell phones running MIDP1.0

When working on cell-phones running MIDP1.0 (or higher), the *midp* version of JADE-LEAP must be used.

In order to be deployed on MIDP devices, JADE-LEAP for *midp* is configured as a MIDlet Suite including the following MIDlets:

`jade.Boot`. Load this MIDlet to start a stand-alone container.

`jade.MicroBoot`. Load this MIDlet to start a split container.

`jade.util.leap.Config`. Load this MIDlet to manually edit configuration properties

`jade.util.leap.OutputViewer`. Load this MIDlet to view the output printed out during the previous JADE-LEAP execution session.

Since neither starting a Main container nor activating MTPs is supported in MIDP, only the `host`, `port`, `agents` and `exitwhenempty` (only for split execution) configuration options can be specified when starting JADE-LEAP for *midp*. It has to be noticed that, as for *pjava*, the `-host` and `-port` options indicate different things depending on the execution mode:

- the host and port of the Main container when a stand-alone container is activated;
- the host where the BackEnd must be started and the port of the *j2se* container that must already be active on that host when a split container is activated.

Configuration options can be set in two ways:

- As properties set in the JAD or MANIFEST.
- By means of the `jade.util.leap.Config` MIDlet.

2.2.3.1 Setting configuration options as properties in the JAD or MANIFEST

In order to make JADE-LEAP read configuration properties from the JAD or MANIFEST set the `MIDlet-LEAP-conf` key in the JAD or MANIFEST to "jad" (default) and specify configuration options as `MIDlet-LEAP-<key>: <value>`

As an example the following lines in the JAD or MANIFEST would start (when `JADEsplit` is selected) a FrontEnd that tries to create its BackEnd on host `host1` and launches agents `Peter` of class `MyClass1` and `John` of class `MyClass2`.

```
MIDlet-1: JADEsplit, , jade.MicroBoot
...
MIDlet-LEAP-conf: jad
MIDlet-LEAP-host: host1
MIDlet-LEAP-agents: Peter:MyClass1;John:MyClass2
```

This way of setting configuration options is quite simple, but must be done before uploading JADE-LEAP on the cell phone and cannot be changed unless JADE-LEAP is uploaded again.

2.2.3.2 Setting configuration options using the Config MIDlet

In order to make JADE-LEAP read the configuration properties previously set through the `Config` MIDlet set the `MIDlet-LEAP-conf` key in the JAD or MANIFEST to "config". Follow the process depicted in Figure 3 to specify configuration properties through the `Config` MIDlet.



Load the JADE MIDlet suite and select the Config MIDlet.

Press the Set button to activate the Set property form and set a new property specifying its key and value.

Press the Exit button to leave the Config MIDlet and save the configuration.

Figure 3. Setting properties through the Config MIDlet

This way of setting configuration options is more flexible as configuration options can be changed without the need of uploading JADE-LEAP again.

In order to reset a configuration property, set its value to an empty string (“”).

2.2.3.3 The OutputViewer

Since a MIDP device in general does not allow you to view logging printouts produced by calls to `System.out.println`, in case of problems during JADE-LEAP execution, it is possible to review JADE-LEAP logging printouts by launching the `jade.util.leap.OutputViewer` MIDlet.

See 6.3 and the documentation of the `jade.util.Logger` class to know how to use this facility from your code too.

2.2.4 An example

Figure 4 depicts, as an example, a scenario including, among others, a stand-alone container running on a Personal Java PDA and a split container running on a MIDP phone and shows the configuration properties to execute each container.

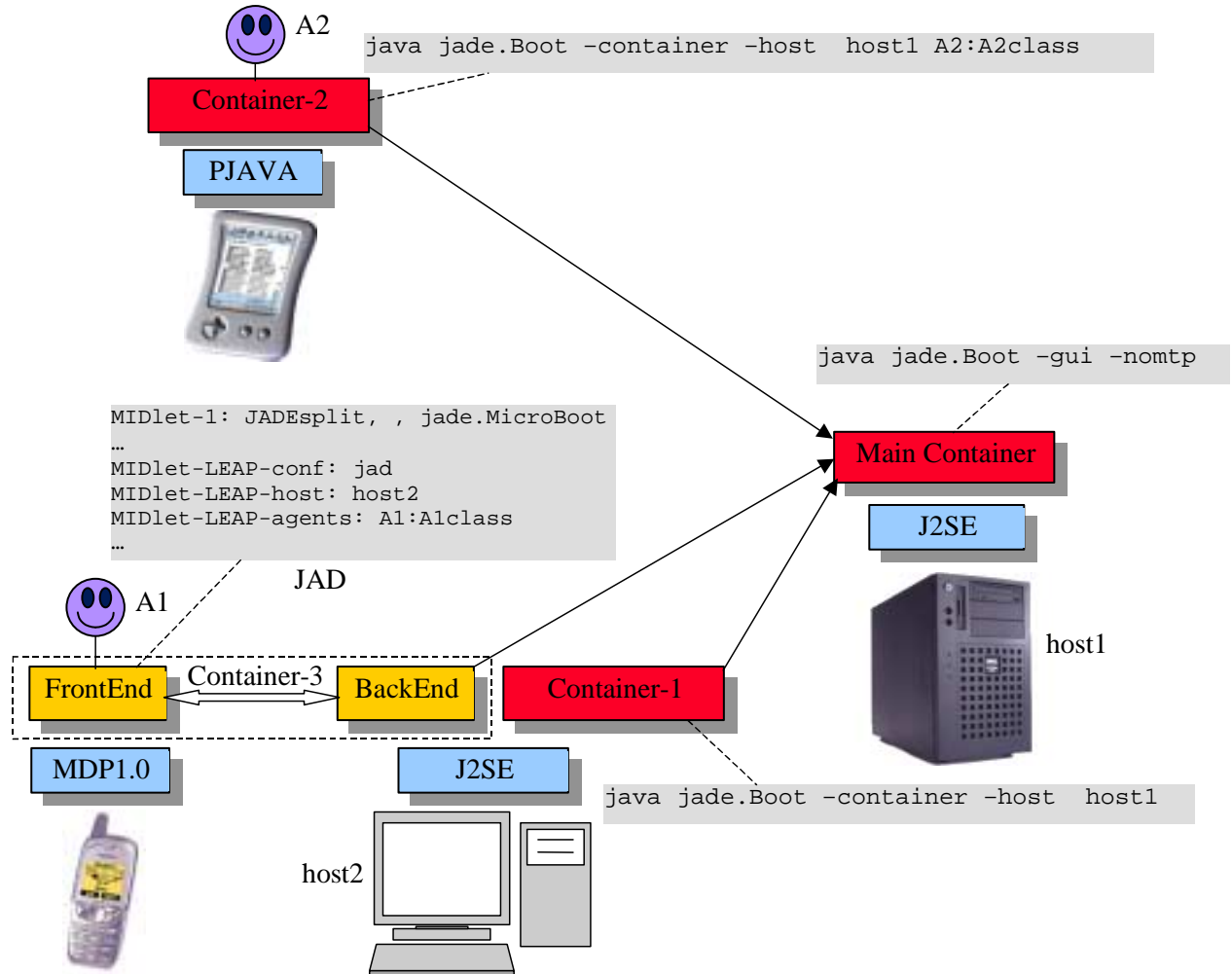


Figure 4. An example

3 Compiling JADE-LEAP

3.1 Getting the software

In order to compile JADE-LEAP for a given environment (see 1.3) it is necessary to download the JADE sources from the “Download” area of the JADE web site and the LEAP add-on from the “Add-ons & third party SW” area of the JADE web site. The LEAP add-on must be unzipped **in the JADE root directory**. Once this has been done your JADE directory structure should look like:

```

jade/
|
| -add-ons/
|   | - ...
|   | -leap/
|     | - ...
|     | -demo/ includes a simple demo application
|     | -resources/ includes build resuorces
|     | -src/ includes the leap add-on source files
| - ...
|-src/ includes the JADE source files

```

We will refer to the `jade/add-ons/leap` directory as the “LEAP root directory” and we will indicate it simply as `leap/`.

3.2 Preliminary steps

As for JADE, building JADE-LEAP can be done using the program ‘**ant**’ (version **1.5.1** or later), a platform-independent version of make. ‘ant’ uses the file ‘`build.xml`’, which contains all the information about the files that have to be compiled, and that is located into the LEAP root directory . The ‘ant’ program must be installed on your computer, and can be freely downloaded from the Jakarta Project at the Apache web site: <http://ant.apache.org>.

Using ant requires you to set the following environment variables (see the ant documentation for details).

- `JAVA_HOME` must point to your JDK1.2 or later.
- `ANT_HOME` must point to where you installed ant.

Before you can build JADE-LEAP you still need to edit the `buildLEAP.properties` file included in the LEAP root directory and set the `java-1.1-home` and `j2me-wtk-home` properties to point to the directory where JDK 1.1.8 is installed (required only to compile JADE-LEAP for *pjava*) and the directory where the Sun J2ME Wireless Toolkit is installed (required only to compile JADE-LEAP for *midp*).

3.3 Building JADE-LEAP

To build JADE-LEAP for a given environment (*j2se*, *pjava* or *midp*) go in the LEAP root directory and type

```
ant <env> rebuild
```

where `<env>` indicates the environment you are compiling JADE-LEAP for.

For instance

```
ant midp rebuild
```

will build JADE-LEAP for *midp*.

Typing

```
ant all rebuild
```

will build JADE-LEAP for all environments.

As a result of the build process three new directories (one per environment) are created under the LEAP root directory. The produced JADE-LEAP jar files are named

```
leap/j2se/lib/JadeLeap.jar
leap/pjava/lib/JadeLeap.jar
leap/midp/lib/JadeLeap.jar
```

3.3.1 Build process details

This informative section provides some details about the build process. You are not required to be aware of these details to build and run JADE-LEAP.

Building JADE-LEAP for a given environment goes through the following steps.

1) Initialization. In this step the directory for the selected environment is deleted and re-created to ensure the build process starts from a clean situation. In particular the following directory structure is created:

```
leap/
|
| -<env>/
|   |
|   | -classes/
|   | -doc/
|   | -lib/
|   | -src/
```

2) Setup. In this step the proper source files are copied from the JADE sources (directory `jade/src`) and the LEAP add-on sources (directory `leap/src`) into the `leap/<env>/src` directory. Then all copied files are preprocessed by means of the LEAP preprocessor. In order to adapt to different Java, hardware and network environments in fact, some JADE-LEAP source files need to be modified “on the fly” before compilation. In order to achieve this we adopted an approach similar to the `#ifdef` directives of the C language. More in details the JADE-LEAP source files that require on-the-fly modifications include special Java comments that can be interpreted by the LEAP preprocessor. The piece of code below provides an example for this.

```
//#MIDP_EXCLUDE_BEGIN
// For some reason the local address or port may be in use
while (true) {
    try {
        sc = new Socket(ta.getHost(), Integer.parseInt(ta.getPort()));
        break;
    }
    catch (BindException be) {
        // Do nothing and try again
    }
}
//#MIDP_EXCLUDE_END

/*#MIDP_INCLUDE_BEGIN
String url = "socket://" + ta.getHost() + ":" + ta.getPort();
sc = (StreamConnection) Connector.open(url, Connector.READ_WRITE,
false);
#MIDP_INCLUDE_END*/
```

The lines such as `//#MIDP_EXCLUDE_BEGIN` and `/*MIDP_INCLUDE_BEGIN` are just comments for the Java compiler, but are well defined directives for the LEAP preprocessor. Therefore, with reference to the example above, the same code after *midp* preprocessing would look like

```
String url = "socket://" + ta.getHost() + ":" + ta.getPort();
sc = (StreamConnection) Connector.open(url, Connector.READ_WRITE,
false);
```

Similar directives exist for *pjava*

3) Compilation. In this step the preprocessed files are compiled to produce class files. When building JADE-LEAP for *midp*, compiled files are also pre-verified.

4) Jar. In this step all compiled/pre-verified files are packaged into a single jar file called `JadeLeap.jar` and stored into the `leap/<env>/lib` directory.

3.4 The demo

The LEAP add-on also includes a simple demonstrative application that allows you to try JADE-LEAP and that is located in the `leap/demo` directory. This demo is a simplified chat application by means of which a group of participants exchange textual messages. Each message sent by a member of the group is received by all participants.

3.4.1 Building the demo

In order to compile the demo go to the LEAP root directory and type

```
ant <env> demo
```

where `<env>`, as usual, indicates the environment you want to compile the demo for (*j2se*, *pjava*, *midp*). Note that the only part of the demo that depends on the environment is the GUI that is based on AWT for *j2se* and *pjava* and on the `javax.microedition.lcdui` package for *midp*.

Typing

```
ant all demo
```

compiles the demo for all environments.

As a result of the compilation three files are created (one per environment) into the `leap/demo` directory called

```
demoJ2se.jar
```

```
demoPjava.jar
```

```
demoMidp.jar
```

Note that, unlike `demoJ2se.jar` that only includes the demo classes, `demoPjava.jar` and `demoMidp.jar` include both the demo classes and the JADE-LEAP classes so that they are ready to be uploaded on a handheld device.

3.4.2 Running the demo

In order to run the demo the following utility files are provided.

`startPlatform.bat` - Batch file to execute the platform plus the

`ChatManagerAgent`, i.e. the agent that acts as a presence server informing each participant when other participants join/leave the chat.

`startParticipant.bat` - Batch file to start a `ChatClientAgent` (i.e. the agent that allows a user to take part to the chat) on the PC. You can activate as many of these agents as you like.

`demo.jad` - JAD descriptor file to execute the demo on a MIDP device (refer to your MIDP device documentation to see how to upload this file plus the `demoMidp.jar` file to your MIDP device). Providing the Java Wireless Toolkit is correctly installed on your PC, double-clicking on this file should activate the wireless device emulator and load the demo MIDlet suite as shown in Figure 5.



Figure 5. Starting the demo on the wireless emulator

Selecting `Start` activates a `ChatClientAgent` on the wireless emulator.

Selecting `Configure` starts the `Config` MIDlet that allows you to set configuration options as described in 2.2.3.2. As the wireless emulator should be running on the same host as the main container you should not need to configure anything and keep default options.

Selecting `View-output` allows you to review logs (see 2.2.3.3) in case of problems.

4 APPENDIX 1 - Summary of the differences between JADE and JADE-LEAP for j2se

This appendix provides a summary of the differences between JADE and JADE-LEAP for `j2se` from both the administrator and programmer point of view.

Jar files. The `JadeLeap.jar` jar file that is produced when building JADE-LEAP for `j2se` includes also the classes related to the administration tools (that in JADE are included in the `jadeTools.jar` file) and to the default IIOP MTP (that in JADE are included in the `iiop.jar` file).

Command line. In JADE-LEAP agent specification (as already highlighted in 2.1) the semicolon (;) character is used as separator instead of a space (). Moreover, unlike in JADE, there must be no spaces between agent arguments. As for command line options the following differences should be taken into account.

- In JADE, when launching a main container, the `-host` and `-port` options indicate the local host (only meaningful in case the local machine has more than one network interface) and local port for the main container. In JADE-LEAP on the other hand these options are ignored (they are considered only when launching a peripheral container). The `-local-host` and `-local-port` should be used instead. The `-local-host` and `-local-port` options are valid also in the case of a peripheral container.
- If only agents specification must be put in the command line (without any option), the `-agents` option must be used instead since, when using JADE-LEAP, a command line like

```
java jade.Boot xxxx
```

is interpreted as if `xxxx` represented the name of a configuration file. Therefore e.g.

```
java jade.Boot john:MyClass
```

will not work and

```
java jade.Boot -agents john:MyClass
```

must be typed instead.
- The `-dump` option is not available in JADE-LEAP

In-process interface. The `ProfileImpl` class available in JADE-LEAP is different with respect to that provided in JADE. More in details it provides a constructor that gets a `jade.util.leap.Properties` object as parameter, while in JADE it gets a `jade.util.BasicProperties`.

Security. The JADE-S security add-on does not work on JADE-LEAP at present.

5 APPENDIX 2 - Summary of the limitations in JADE-LEAP for *pjava* and *midp*

This appendix provides a summary of JADE-LEAP limitations that you have to take into account when working in *pjava* and *midp* with respect to a *j2se* environment.

5.1 PJAVA

- All JADE administration tools have GUIs based on Swing. As a consequence they cannot be executed on a *pjava* container. The same applies for the `jade.gui` package.
- It is not possible to “sniff” (by means of the Sniffer agent) or “introspect” (by means of the Introspector agent) an agent running on a *pjava* stand-alone container. Note that, on the other hand, it is possible to sniff an agent running on a *pjava* split container.

5.2 MIDP

- The limitations described for *pjava* in the previous section also apply to *midp*.
- Agent mobility and cloning is not supported.

- The reflective introspectors (`jade.content.onto.ReflectiveIntrospector` and `jade.content.onto.BCReflectiveIntrospector`) are not supported in *midp* as they make use of Java reflection. The JADE support for content languages and ontologies can still be used by either working with abstract descriptors or using the `jade.content.onto.MicroIntrospector`.
- The `jade.wrapper` package and the methods of the `jade.core.Runtime` class that refer to classes in that package are not available in *midp*. A simplified in-process interface is still available through the `startUp()` and `shutDown()` methods of the `jade.core.Runtime` class (when executing a standalone container) and the `jade.core.MicroRuntime` class (when executing a split container).

6 APPENDIX 3. Hints for programmers

As already mentioned in 1.4, JADE-LEAP provides the same APIs to applications developers with respect to JADE (except for the differences described in 4 and 5). As a consequence there is no need for a specific JADE-LEAP programmers guide or API documentation since those provided with JADE are still valid. When working on MIDP devices however there are issues that should be taken into account that are not covered in JADE documentation. This appendix provides proper hints to address these issues properly.

6.1 Ad-hoc startup

In some cases programmers might need to perform specific operations before starting up the JADE-LEAP runtime or, more in general, they might need to start the JADE-LEAP runtime from within another MIDlet. This can be done by means of the `jade.core.Runtime` (standalone execution) and `jade.core.MicroRuntime` (split execution) classes that provide a minimal “in-process interface”. In particular a useful approach is to create an ad-hoc startup class by extending `jade.Boot` (for standalone execution) or `jade.MicroBoot` (for split execution) and redefining the `startApp()` method as needed. The MIDP part of the `chat.client.Start` class included in the chat demo provided with the LEAP add-on shows an example for this.

6.2 Agent GUI

Agents typically have GUIs to interact with a user. The base element for all MIDP GUIs is the `javax.microedition.lcdui.Displayable` class. In order to show whatever `Displayable` object it is necessary to have a reference to the current MIDlet.

When starting JADE-LEAP for *midp* using the built-in startup classes `jade.Boot` (standalone execution) and `jade.MicroBoot` (split execution) a pointer to the current MIDlet is made available by means of the public static variable `midlet` of the `jade.core.Agent` class.

A code similar to that below can therefore be used (e.g. within the `setup()` method of an agent) to show a `Form` that acts as a GUI.

```
Form f = new Form("My Gui");
// Append proper items to the form
Display.getDisplay(Agent.midlet).setCurrent(f);
```

When starting JADE-LEAP by means of an ad-hoc startup class, as described in 6.1, programmers should take care that the `Agent.midlet` variable is properly set or make available to agents a pointer to the current MIDlet in a different way.

6.3 Printouts

In general a MIDP device does not show logging printouts produced by calls to `System.out.println()`. Especially during the development phase this can be quite inconvenient. To partially overcome this limitation the `println()` static method of the `jade.util.Logger` class can be used. When running on a *j2se* or *pjava* environment this method just calls `System.out.println()`. When running on a *midp* environment, on the other hand, logging printouts written by means of this method are redirected so that they can later be viewed by means of the `jade.util.leap.OutputViewer` MIDlet.