SS7 Stack User Guide

The guide to the JBoss Communications SS7 Stack

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1. Document Conventions

This manual uses several conventions to highlight certain words and phrases and draw attention to specific pieces of information.

In PDF and paper editions, this manual uses typefaces drawn from the *Liberation Fonts* [https://fedorahosted.org/liberation-fonts/] set. The Liberation Fonts set is also used in HTML editions if the set is installed on your system. If not, alternative but equivalent typefaces are displayed. Note: Red Hat Enterprise Linux 5 and later includes the Liberation Fonts set by default.

1.1. Typographic Conventions

Four typographic conventions are used to call attention to specific words and phrases. These conventions, and the circumstances they apply to, are as follows.

`Mono-spaced Bold`

Used to highlight system input, including shell commands, file names and paths. Also used to highlight key caps and key-combinations. For example:

> To see the contents of the file `my_next_bestselling_novel` in your current working directory, enter the `cat my_next_bestselling_novel` command at the shell prompt and press **Enter** to execute the command.

The above includes a file name, a shell command and a key cap, all presented in Mono-spaced Bold and all distinguishable thanks to context.

Key-combinations can be distinguished from key caps by the hyphen connecting each part of a key-combination. For example:

> Press **Enter** to execute the command.
>
> Press **Ctrl**+**Alt**+**F1** to switch to the first virtual terminal. Press **Ctrl**+**Alt**+**F7** to return to your X-Windows session.

The first sentence highlights the particular key cap to press. The second highlights two sets of three key caps, each set pressed simultaneously.

If source code is discussed, class names, methods, functions, variable names and returned values mentioned within a paragraph will be presented as above, in `Mono-spaced Bold`. For example:

> File-related classes include `filesystem` for file systems, `file` for files, and `dir` for directories. Each class has its own associated set of permissions.

Proportional Bold

This denotes words or phrases encountered on a system, including application names; dialogue box text; labelled buttons; check-box and radio button labels; menu titles and sub-menu titles. For example:

> Choose **System > Preferences > Mouse** from the main menu bar to launch **Mouse Preferences**. In the **Buttons** tab, click the **Left-handed mouse** check box and click **Close** to switch the primary mouse button from the left to the right (making the mouse suitable for use in the left hand).
>
> To insert a special character into a **gedit** file, choose **Applications > Accessories > Character Map** from the main menu bar. Next, choose **Search > Find** from the **Character Map** menu bar, type the name of the character in the **Search** field and click **Next**. The character you sought will be highlighted in the **Character Table**. Double-click this highlighted character to place it in the **Text to copy** field and then click the **Copy** button. Now switch back to your document and choose **Edit > Paste** from the **gedit** menu bar.

The above text includes application names; system-wide menu names and items; application-specific menu names; and buttons and text found within a GUI interface, all presented in Proportional Bold and all distinguishable by context.

Note the **>** shorthand used to indicate traversal through a menu and its sub-menus. This is to avoid the difficult-to-follow 'Select **Mouse** from the **Preferences** sub-menu in the **System** menu of the main menu bar' approach.

`Mono-spaced Bold Italic` or ***`Proportional Bold Italic`***

Whether Mono-spaced Bold or Proportional Bold, the addition of Italics indicates replaceable or variable text. Italics denotes text you do not input literally or displayed text that changes depending on circumstance. For example:

> To connect to a remote machine using ssh, type `ssh` *`username@domain.name`* at a shell prompt. If the remote machine is `example.com` and your username on that machine is john, type `ssh john@example.com`.
>
> The `mount -o remount` *`file-system`* command remounts the named file system. For example, to remount the `/home` file system, the command is `mount -o remount /home`.
>
> To see the version of a currently installed package, use the `rpm -q` *`package`* command. It will return a result as follows: *`package-version-release`*.

Note the words in bold italics above username, domain.name, file-system, package, version and release. Each word is a placeholder, either for text you enter when issuing a command or for text displayed by the system.

Aside from standard usage for presenting the title of a work, italics denotes the first use of a new and important term. For example:

> When the Apache HTTP Server accepts requests, it dispatches child processes or threads to handle them. This group of child processes or threads is known as

a *server-pool*. Under Apache HTTP Server 2.0, the responsibility for creating and maintaining these server-pools has been abstracted to a group of modules called *Multi-Processing Modules* (*MPMs*). Unlike other modules, only one module from the MPM group can be loaded by the Apache HTTP Server.

1.2. Pull-quote Conventions

Two, commonly multi-line, data types are set off visually from the surrounding text.

Output sent to a terminal is set in `Mono-spaced Roman` and presented thus:

```
books        Desktop   documentation  drafts  mss    photos   stuff  svn
books_tests  Desktop1  downloads      images  notes  scripts  svgs
```

Source-code listings are also set in `Mono-spaced Roman` but are presented and highlighted as follows:

```
package org.jboss.book.jca.ex1;

import javax.naming.InitialContext;

public class ExClient
{
   public static void main(String args[])
       throws Exception
   {
      InitialContext iniCtx = new InitialContext();
      Object         ref    = iniCtx.lookup("EchoBean");
      EchoHome       home   = (EchoHome) ref;
      Echo           echo   = home.create();

      System.out.println("Created Echo");

      System.out.println("Echo.echo('Hello') = " + echo.echo("Hello"));
   }

}
```

1.3. Notes and Warnings

Finally, we use three visual styles to draw attention to information that might otherwise be overlooked.

Note

A note is a tip or shortcut or alternative approach to the task at hand. Ignoring a note should have no negative consequences, but you might miss out on a trick that makes your life easier.

Important

Important boxes detail things that are easily missed: configuration changes that only apply to the current session, or services that need restarting before an update will apply. Ignoring Important boxes won't cause data loss but may cause irritation and frustration.

Warning

A Warning should not be ignored. Ignoring warnings will most likely cause data loss.

2. Provide feedback to the authors!

If you find a typographical error in this manual, or if you have thought of a way to make this manual better, we would love to hear from you! Please submit a report in the the *Issue Tracker* [http://bugzilla.redhat.com/bugzilla/], against the product **JBoss Communications SS7 Stack** , or contact the authors.

When submitting a bug report, be sure to mention the manual's identifier: SS7Stack_User_Guide

If you have a suggestion for improving the documentation, try to be as specific as possible when describing it. If you have found an error, please include the section number and some of the surrounding text so we can find it easily.

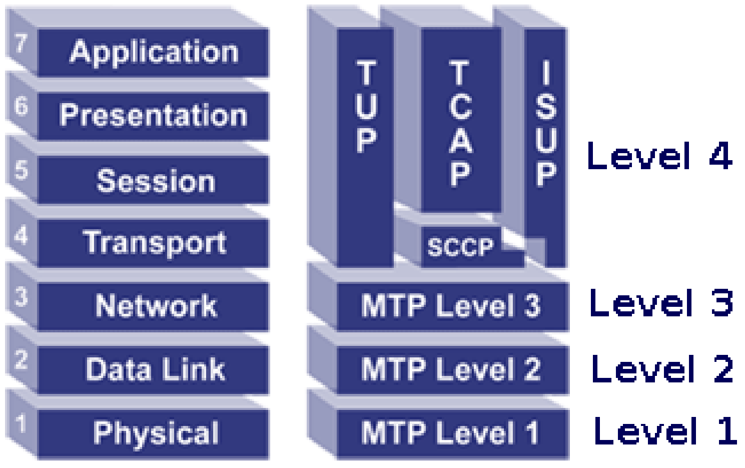
Introduction to JBoss Communications SS7 Stack

Important

Spaces where introduced in in some tables and code listings to ensure proper page render.

Common Channel Signaling System No. 7 (i.e., SS7 or C7) is a global standard for telecommunications defined by the *International Telecommunication Union (ITU) Telecommunication Standardization Sector (ITU-T)* [http://www.voip-info.org/wiki/view/ITU] . The standard defines the procedures and protocol by which network elements in the public switched telephone network (PSTN)) exchange information over a digital signaling network to effect wireless (cellular) and wireline call setup, routing and control. The ITU definition of SS7 allows for national variants such as the American National Standards Institute (ANSI) and Bell Communications Research (Telcordia Technologies) standards used in North America and the European Telecommunications Standards Institute (*ETSI* [http://www.voip-info.org/wiki/view/ETSI]) standard used in Europe.

The hardware and software functions of the SS7 protocol are divided into functional abstractions called "levels". These levels map loosely to the Open Systems Interconnect (OSI) 7-layer model defined by the *International Standards Organization (ISO)* [http://www.iso.ch/] .



SS7 Stack overview

JBoss Communications SS7 Stack is software based SS7 protocol implementation providing Level 2 and above. The JBoss Communications SS7 Stack is a platform in the sense that it does not provide the application itself but rather allows users to build the application

1.1. Time Division Multiplexing

In circuit switched networks such as the Public Switched Telephone Network (PSTN) there exists the need to transmit multiple subscribers’ calls along the same transmission medium. To accomplish this, network designers make use of TDM. TDM allows switches to create channels, also known as tributaries, within a transmission stream. A standard DS0 voice signal has a data bit rate of 64 kbit/s, determined using Nyquist’s sampling criterion. TDM takes frames of the voice signals and multiplexes them into a TDM frame which runs at a higher bandwidth. So if the TDM frame consists of n voice frames, the bandwidth will be n*64 kbit/s. Each voice sample timeslot in the TDM frame is called a channel . In European systems, TDM frames contain 30 digital voice channels, and in American systems, they contain 24 channels. Both standards also contain extra bits (or bit timeslots) for signalling (SS7) and synchronisation bits. Multiplexing more than 24 or 30 digital voice channels is called higher order multiplexing. Higher order multiplexing is accomplished by multiplexing the standard TDM frames.For example, a European 120 channel TDM frame is formed by multiplexing four standard 30 channel TDM frames.At each higher order multiplex, four TDM frames from the immediate lower order are combined, creating multiplexes with a bandwidth of n x 64 kbit/s, where n = 120, 480, 1920, etc.

Chapter 2.

The Basics

Important

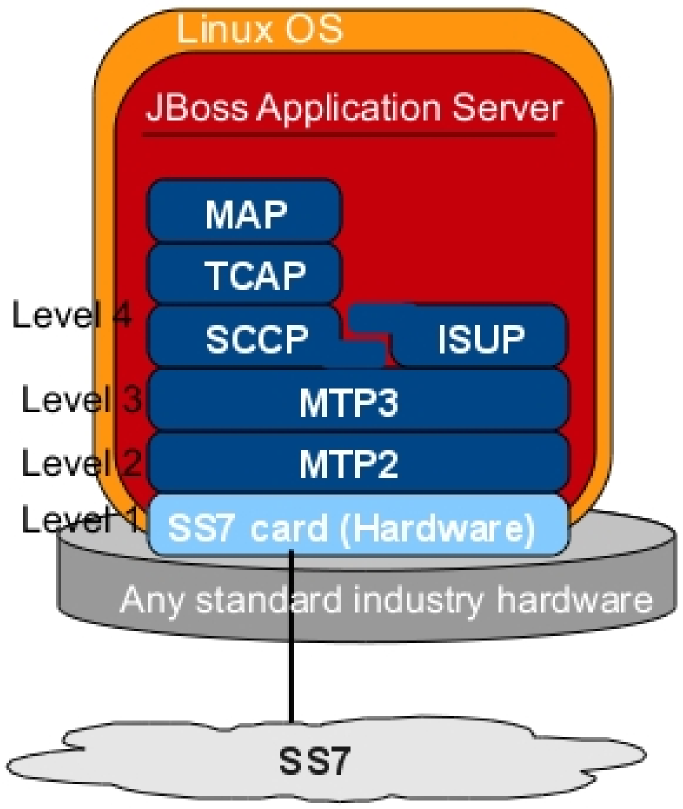
Be aware, JBoss Communications SS7 Stack is subject to changes as it is under active development!

The JBoss Communications SS7 Stack is logically divided into two sections. The lower section includes SS7 Level 3 and below. The lower section is influenced by type of SS7 hardware (Level 1) used.

The upper section includes SS7 Level 4 and above. This logical division is widely based on flexibility of JBoss Communications SS7 Stack to allow usage of any SS7 hardware available in the market and yet JBoss Communications SS7 Stack Level 4 and above remains the same.

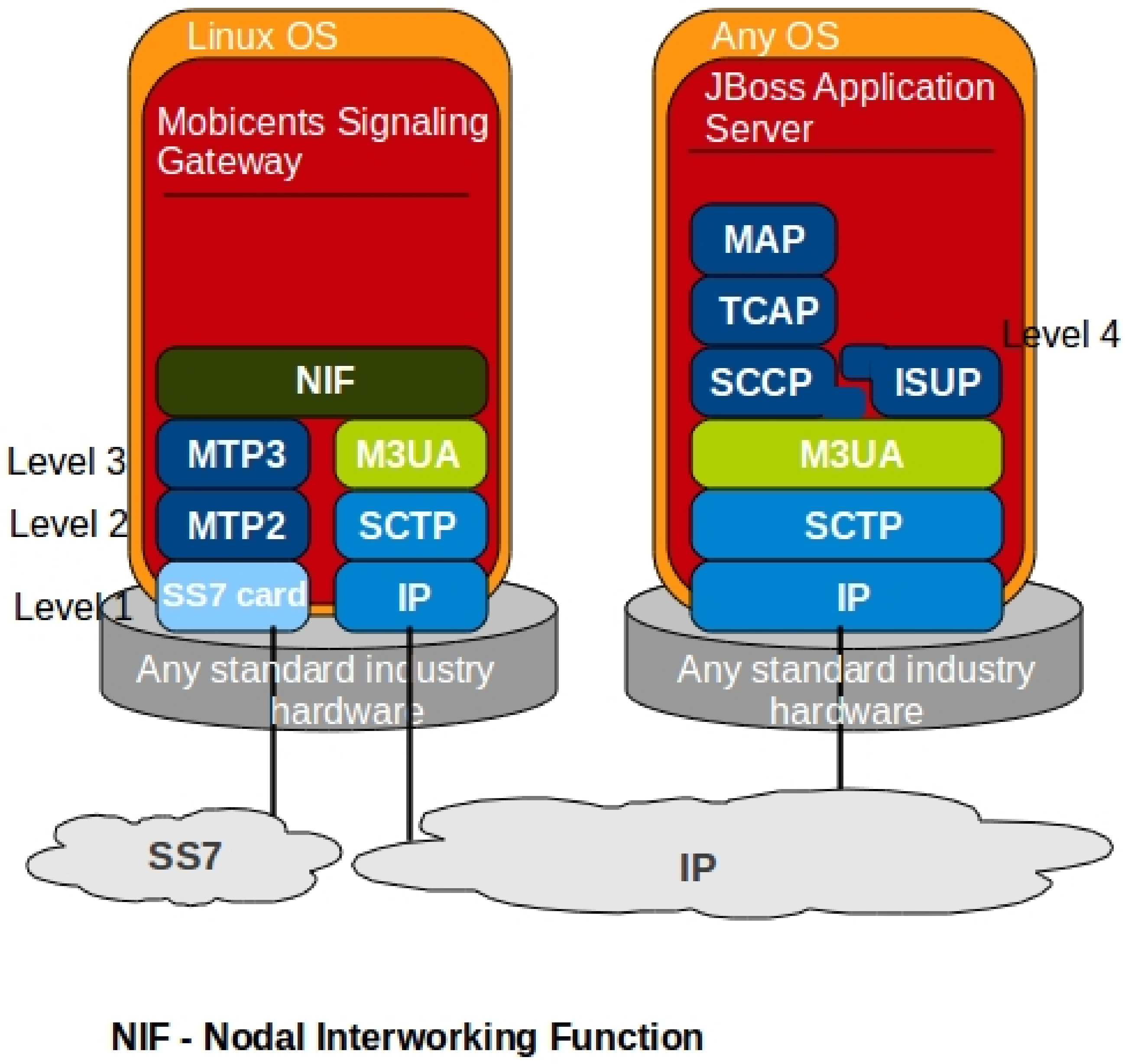
Further JBoss Communications SS7 Stack provides flexibility to use the Level 2,3 and Level 4 in same JVM and in same machine where SS7 Hardware (Level 1) is installed. Or its also possible to have Level 1,2,3 to be installed on separate machine and Level 4 on separate machine. In latter case `M3UA` over SCTP is leveraged for communication between Level 4 and Level 3 and is called JBoss Communications Signaling Gateway.

Bellow diagram shows complete JBoss Communications SS7 Stack in same machine



JBoss Communications SS7 Stack

Bellow diagram shows JBoss Communications Signaling Gateway



JBoss Communications Signaling Gateway

Important

If you use JBoss Communications M3UA stack, you have to use JDK 7 to run the stack as well as to compile source code. M3UA leverages Java SCTP which is available only from JDK 7.

Apart from advantages mentioned in

JBoss Communications SS7 Stack consists of following functional blocks:

2.1. Linkset

`Linkset` is logical group of links between two Signaling Points. This term hides `MTP` layer, ie. it abstracts whether hardware `MTP` is used or M3UA.

Three type of `Linkset` are defined

- `DahdiLinkset` : As the name suggests, this linkset is for `dahdi` based hardware. `dahdi` boards only provides SS7 MTP1 layer and usually depends on external software to provide MTP2/ MTP3 support.

  Well known `dahdi` based SS7 cards are `Diguim` and `Sangoma`

- `DialogicLinkset` : Linkset for `dialogic` based hardware. `dialogic` boards have MTP2 and MTP3 support on board.

- `M3UALinkset` : M3UA stands for MTP Level 3 (MTP3) User Adaptation Layer as defined by the IETF SIGTRAN working group in RFC 4666. `M3UALinkset` enables the JBoss Communications SS7 Stack Level 4 (e.g. ISUP, SCCP) to run over IP instead of instead of SS7 network

Each type of linkset has coresponding factory. Configuration of linkset factories is exaplained in subsections of *Section 3.4, “ Configuring JBoss Communications SS7 Service ”*.

2.2. Shell Management client

`Shell` is Command Line Interface (CLI) tool which allows to manage different aspects of JBoss Communications SS7 Stack in interactive manner. It connects to different instances of JBoss Communications SS7 Stack which manage `Linksets`, `SCCP` routing and `M3UA`. For detailed information please refer to: *Chapter 5, Shell Command Line*. Usually `Shell` will be invoked from remote machine(remote to `Linksets` and application protocols).

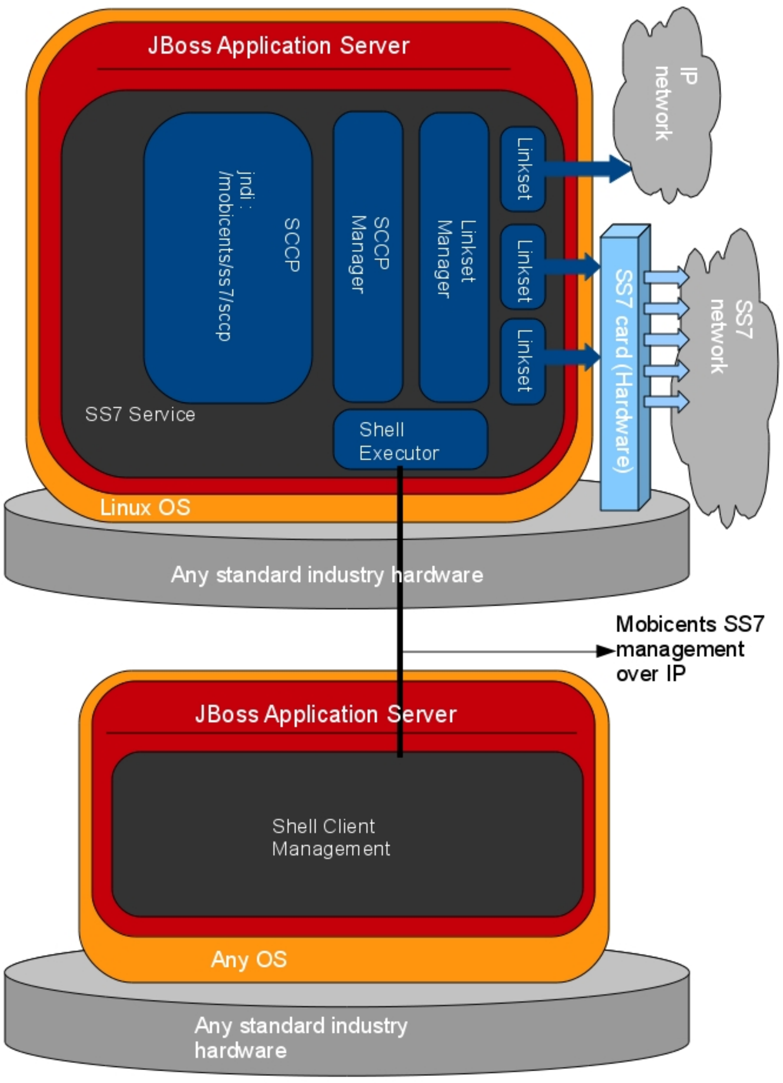
2.3. SS7 Service

Service is element which is used to manage `LinkSets` and protocols like `SCCP`. SS7 service creates instance of JBoss Communications SCCP Stack and bind's it to JNDI name java:/ mobicents/ss7/sccp

SS7 Service is JMX based service deployed in JBoss Application Server

SS7 Service hides the details like whether Level 4 and above connects to JBoss Communications Signaling Gateway via M3UA or SS7 Hardware is installed in same machine as Level 4

Diagram below depicts elements which are deployed as part of `SS7 Service`:



JBoss Communications SS7 Stack SS7Service elements.

Service serves following purposes:

Expose protocol access points
: Access points allows user to access lower layer protocols, like `SCCP` and interact through such protocols with `SS7` network.

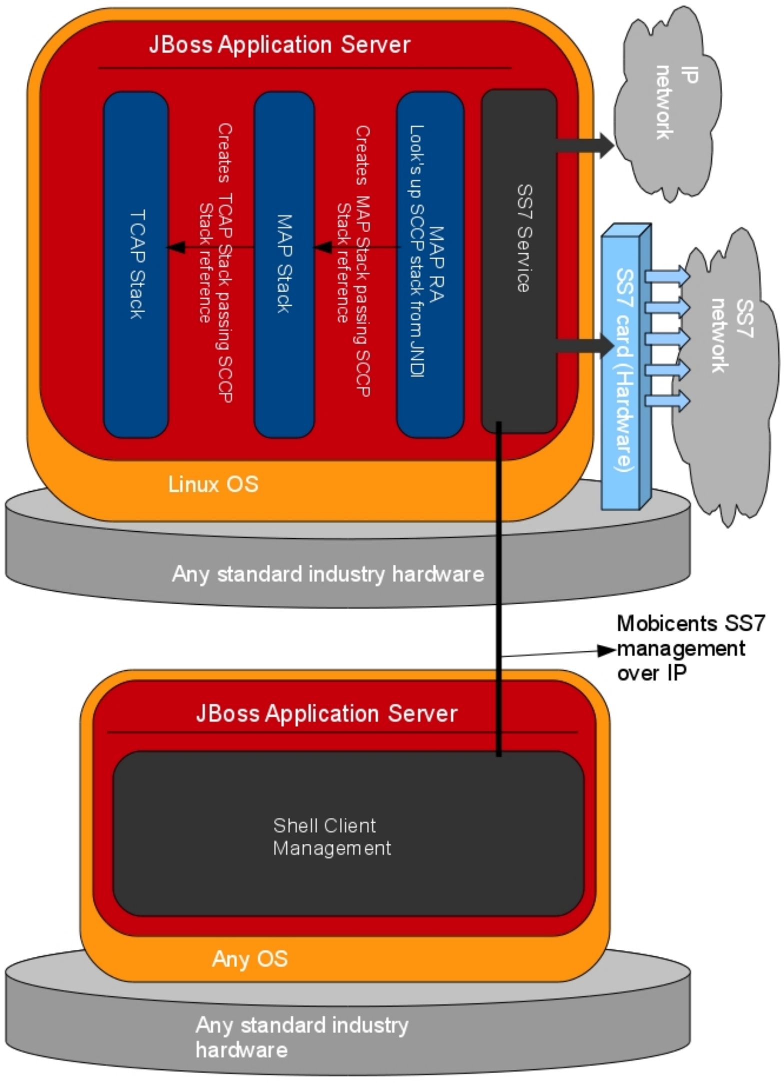
Expose management interface
: `Shell Executor` allows `Shell` client to connect and issue commands.

Manage Linksets and their lifecycle
: `Linkset Manager` persists linksets information and manages their lifecycle, ie. it creates, activates them(also after restart).

Configuration of SS7 Service is exaplained in section *Section 3.4, “ Configuring JBoss Communications SS7 Service ”*

2.4. JBoss Communications SS7 Stack Usage

Diagram below depicts how JBoss Communications SS7 Stack is used:

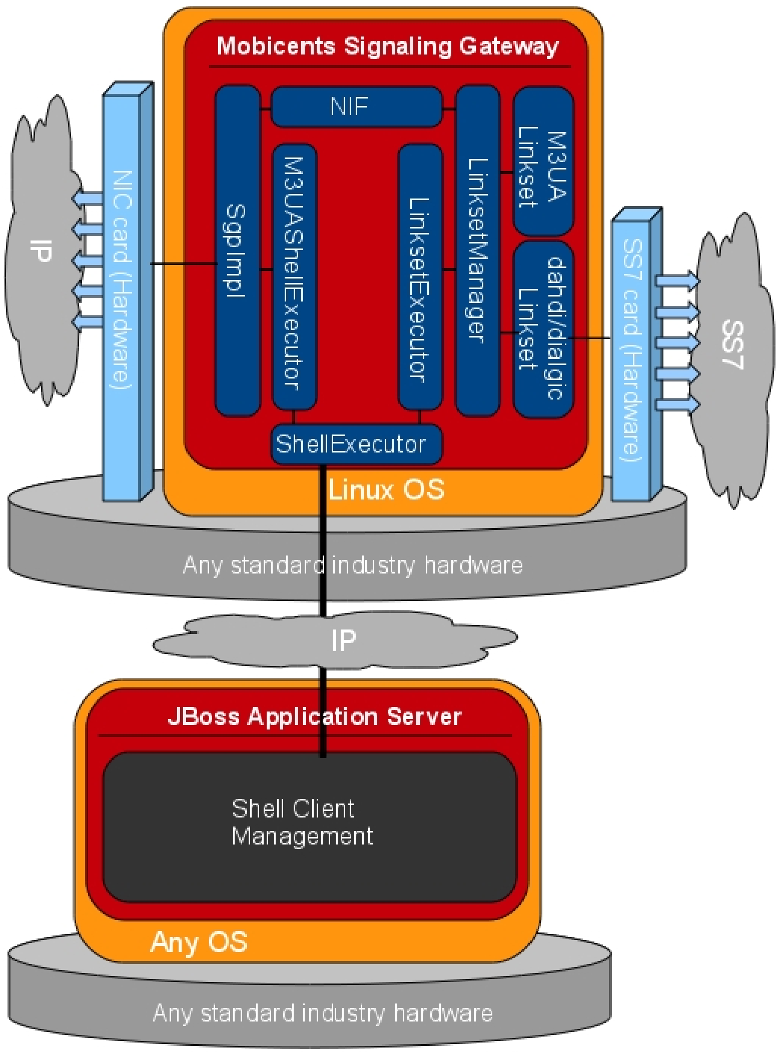

JBoss Application Server
TCAP Stack
Creates TCAP Stack passing SCCP Stack reference
MAP Stack
Creates MAP Stack passing SCCP Stack reference
MAP RA
Look's up SCCP stack from JNDI
SS7 Service
IP network
SS7 card (Hardware)
SS7 network
Linux OS
Any standard industry hardware
Mobicents SS7 management over IP
JBoss Application Server
Shell Client Management
Any OS
Any standard industry hardware

JBoss Communications SS7 Stack general design

2.5. JBoss Communications Signaling Gateway

JBoss Communications Signaling Gateway (SG) is a signaling agent that receives/sends Switched Circuit Network (SCN) native signaling at the edge of the IP network. JBoss Communications Signaling Gateway leverages JBoss Communications M3UA Stack explained in *Section 2.5.1, “JBoss Communications M3UA Stack”* and Linkset explained in *Section 2.1, “Linkset”*

Diagram below shows the components which are included in JBoss Communications SG. Configuration of SG is explained in *Section 3.7, “ Configuring JBoss Communications Signaling Gateway ”*



JBoss Communications Signaling Gateway components

2.5.1. JBoss Communications M3UA Stack

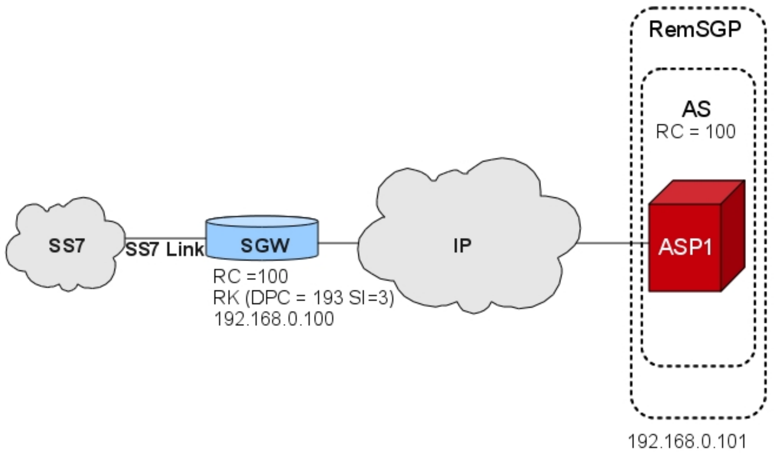
M3UA is client-server protocol supporting the transport of any SS7 MTP3-User signalling (e.g., ISUP and SCCP messages) over IP. M3UA is defined by the IETF SIGTRAN working group in RFC 4666. JBoss Communications M3UA Stack can be used on Application Server side or can be used on Signaling Gateway side.

Note

JBoss Communications M3UA Stack uses Java SCTP layer which is available from JDK 7 onwards

2.5.1.1. JBoss Communications M3UA Stack on AS side

Diagram below demonstrates the JBoss Communications M3UA Stack used on Application Server (AS) side. The information below explains the basic functionality of the JBoss Communications M3UA Stack when used as an Application Server which will communicate with an External Signaling Gateway

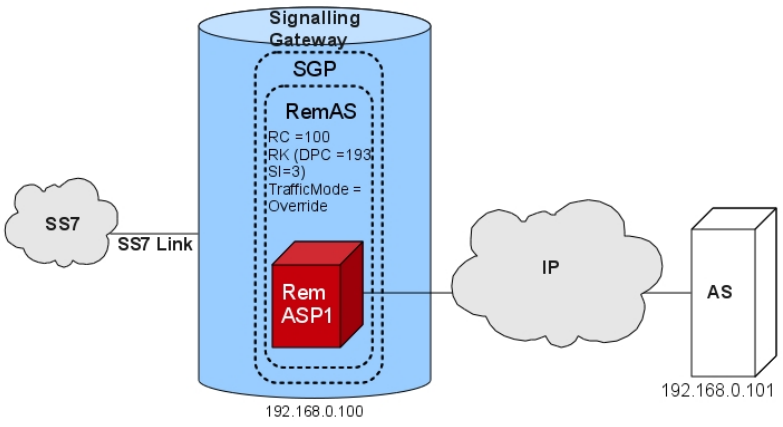


JBoss Communications M3UA Stack configured on AS side

If configured as an AS, does not support configuring conventional SS7 links etc on that same stack. To use M3UA Stack as AS, the Routing Context (RC) must be known. See Section *Section 3.4.1, "Configuring Remote Signaling Gateway"* for configuring M3UA Stack as AS. The Remote Signaling Gateway Process (RemSGP) object is created under the M3UA Stack.

2.5.1.2. JBoss Communications M3UA Stack on SG side

Diagram below demonstrates the JBoss Communications M3UA Stack used on Signaling Gateway (SG) side. The JBoss Communications Signaling Gateway provides the Nodal Interworking Function (NIF) that allows SS7 Signaling (SCCP/ISUP) to be inter-worked into the M3UA/IP Network as shown in *???*



JBoss Communications M3UA Stack configured on SG side

JBoss Communications M3UA Stack used on SG side will share common point code with a set of M3UA Application Server. M3UA stack on SG side can be configured as Loadbalance or Override traffic mode. It doesn't support Broadcast traffic mode. See Section *Section 3.7, " Configuring JBoss Communications Signaling Gateway "* for configuring M3UA Stack as SG. JBoss Communications M3UA Stack used on SG side doesn't support routing key management messages. The Routing Key should be provisioned statically using the management console.

Installation and Running

3.1. Installing

JBoss Communications SS7 stack at its core requires only Java if you are using only `M3UALinkset`. However if you plan to use `DahdiLinkset` or `DialogicLinkset`, respective SS7 cards needs to be installed on the server along with native libraries.

A simple way to get started is to download and install binary. This will provide you with all the dependencies you need to get going. You can obtain binary release from NOT AVAILABLE

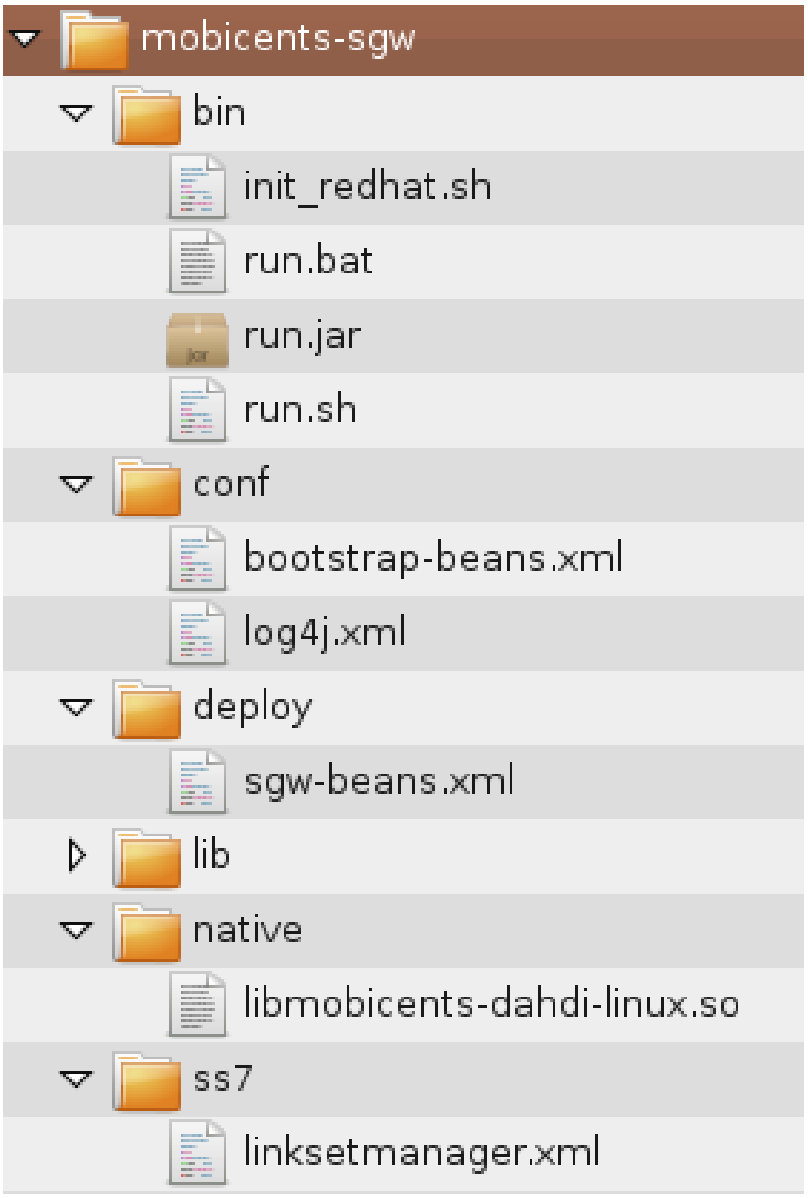
3.1.1. Binary

The JBoss Communications SS7 Stack binary is broken down into a few modules.

The following is a description of the important services and libraries that make up JBoss Communications SS7 Stack

- `asn` : Abstract Syntax Notation One (ASN.1) library is used by various JBoss Communications SS7 Stack protocols to encode/decode the structured data exchanged between Signaling Point over networks. To know more about asn library refer to document included with asn. Applications using any of the JBoss Communications SS7 Stack User Protocols may never need to call asn API directly, however it must be in classpath as JBoss Communications SS7 Stack User Protocols refers this library.
- `ss7` : ss7 contains the service that is deployed in JBoss AS and libraries that end applications refers to. It also includes JBoss Communications Signaling Gateway. The sub-modules included in ss7 are
  - `docs` : User guide for JBoss Communications SS7 Stack
  - `mobicents-sgw` : Standalone Signaling Gateway as explained in section *Section 2.5, “JBoss Communications Signaling Gateway”*

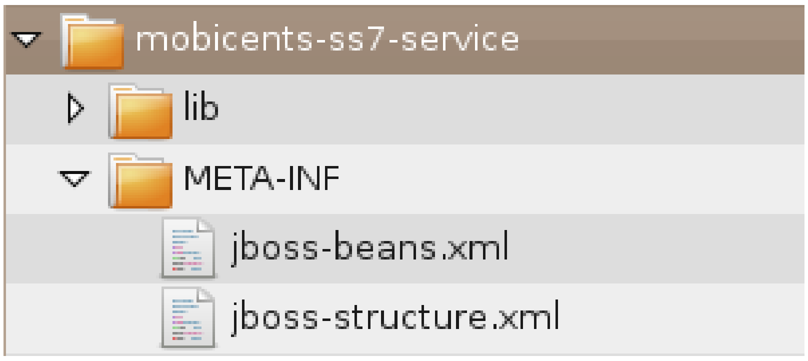
    mobicents-sgw binary has following layout:



```
mobicents-sgw
    bin
        init_redhat.sh
        run.bat
        run.jar
        run.sh
    conf
        bootstrap-beans.xml
        log4j.xml
    deploy
        sgw-beans.xml
    lib
    native
        libmobicents-dahdi-linux.so
    ss7
        linksetmanager.xml
```

- `mobicents-ss7-service` : SS7 service is the core engine as explained in section *Section 2.3, "SS7 Service"*

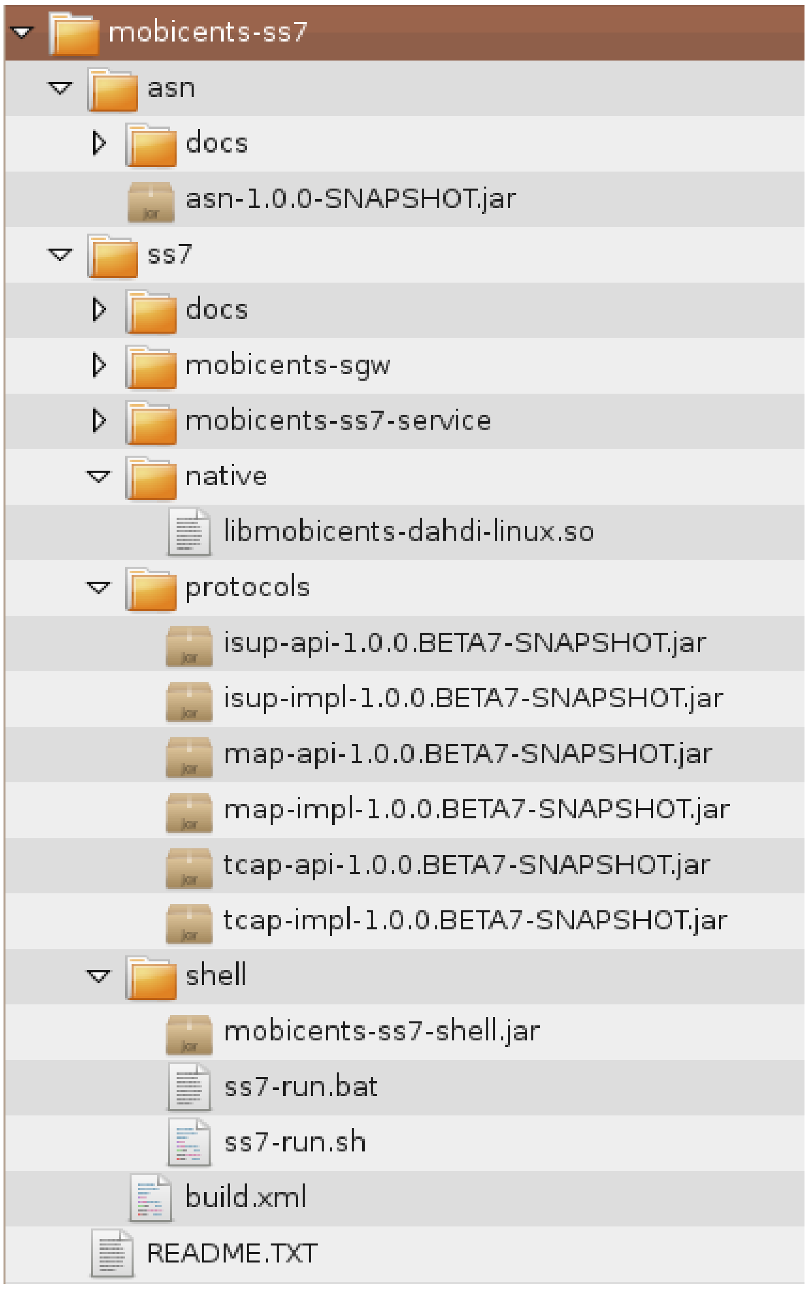
  mobicents-ss7-service binary has following layout:



```
mobicents-ss7-service
    lib
    META-INF
        jboss-beans.xml
        jboss-structure.xml
```

- `native` : native libraries component to interact with SS7 Card installed on server, runtime component. As of now native libraries are compiled only for linux OS. However if you plan to use `M3UALinkset` there is no dependency on OS as everything is 100% java.
- `protocols` : The JBoss Communications SS7 Stack User Protocols libraries. Your application would directly call the API's exposed by these libraries. Depending on application you may be either interested in `TCAP`, `MAP` or both or `ISUP` libraries
- `shell` : the Command Line Interface (CLI) module to manage the JBoss Communications SS7 Stack. Refer *Chapter 5, Shell Command Line* to understand how to use shell

Binary release has following layout:



```
mobicents-ss7
    asn
        docs
        asn-1.0.0-SNAPSHOT.jar
    ss7
        docs
        mobicents-sgw
        mobicents-ss7-service
        native
            libmobicents-dahdi-linux.so
        protocols
            isup-api-1.0.0.BETA7-SNAPSHOT.jar
            isup-impl-1.0.0.BETA7-SNAPSHOT.jar
            map-api-1.0.0.BETA7-SNAPSHOT.jar
            map-impl-1.0.0.BETA7-SNAPSHOT.jar
            tcap-api-1.0.0.BETA7-SNAPSHOT.jar
            tcap-impl-1.0.0.BETA7-SNAPSHOT.jar
        shell
            mobicents-ss7-shell.jar
            ss7-run.bat
            ss7-run.sh
        build.xml
    README.TXT
```

JBoss Communications SS7 Stack binary layout.

3.2. Installing JBoss Communications SS7 Service Binary

The upper layers of Mobicents SS7 viz., TCAP, MAP depends on JBoss Communications SS7 Service and JBoss Communications SS7 Service must be installed before upper layers can be used. The JBoss Communications SS7 Service binary requires that you have JBoss Application Server installed and JBOSS_HOME system property set. To know further details on setting JBOSS_HOME look *Appendix B, Setting the JBOSS_HOME Environment Variable*

Once JBOSS_HOME is properly set, use ant to deploy the mobicents-ss7-service, shell scripts and shell library.

Important

Ant 1.6 (or higher) is used to install the binary. Instructions for using Ant, including install, can be found at *http://ant.apache.org/*

```
[usr]$ cd ss7-1.0.0.BETA8/ss7
[usr]$ ant deploy
```

To undeploy these services

```
[usr]$ cd ss7-1.0.0.BETA8/ss7
[usr]$ ant undeploy
```

While above steps will deploy the necessary ss7 service and shell components, the `java.library.path` should be set to point the directory containing native component or should be copied to JBoss native library path manually. This step is only required if you are using the SS7 board on server.

3.3. Running JBoss Communications SS7 Service

Starting or stopping JBoss Communications SS7 Service is no different than starting or stopping JBoss Application Server

3.3.1. Starting

Once installed, you can run server by executing the run.sh (Unix) or run.bat (Microsoft Windows) startup scripts in the `<install_directory>/bin` directory (on Unix or Windows). If the service started properly you should see following lines in the Unix terminal or Command Prompt depending on your environment:

```
23:22:26,079 INFO  [LinksetManager] SS7 configuration file path /
home/abhayani/workarea/mobicents/jboss-5.1.0.GA/server/default/data/
linksetmanager.xml
23:22:26,141 INFO  [LinksetManager] Started LinksetManager
23:22:26,199 INFO  [SS7Service] Starting SCCP stack...
23:22:26,229 INFO  [SccpStackImpl] Starting ...
23:22:26,230 INFO  [RouterImpl] SCCP Router configuration file: /home/
abhayani/workarea/mobicents/jboss-5.1.0.GA/server/default/deploy/mobicents-
ss7-service/sccp-routing.txt
23:22:26,261 INFO  [SS7Service] SCCP stack Started. SccpProvider bound to
 java:/mobicents/ss7/sccp
23:22:26,261 INFO  [ShellExecutor] Starting SS7 management shell environment
23:22:26,270 INFO  [ShellExecutor] ShellExecutor listening
 at /127.0.0.1:3435
23:22:26,270 INFO  [SS7Service] [[[[[[[[[ Mobicents SS7 service
 started ]]]]]]]]]
```

If you have started ss7-1.0.0.BETA8 for the first time, there are no `Linkset` defined. You need to use Shell Client to connect to ss7-1.0.0.BETA8 as defined in *Chapter 5, Shell Command Line* and create `Linkset` as per your need and SS7 card installed

Once the `Linkset` are defined, the state and configuration of `Linkset` and `Link` is persisted by `LinksetManager` which stands server re-start.

3.3.2. Stopping

You can shut down the server(s) you can run server(s) by executing the `shutdown.sh -s` (Unix) or `shutdown.bat -s` (Microsoft Windows) scripts in the `<install_directory>/bin` directory (on Unix or Windows). Note that if you properly stop the server, you will see the following three lines as the last output in the Unix terminal or Command Prompt:

```
[Server] Shutdown complete
Shutdown complete
Halting VM
```

3.4. Configuring JBoss Communications SS7 Service

Configuration is done through an XML descriptor named `jboss-beans.xml` and is located at `$JBOSS_HOME/server/profile_name/deploy/mobicents-ss7-service/META-INF`, where **profile_name** is the server profile name.

3.4.1. Configuring Remote Signaling Gateway

Remote Signaling Gateway is only needed if the underlying SS7 service will leverage `M3UALinkset`. `RemSgpImpl` acts as remote Signaling Gateway Process that contains the list of Application Server (AS) (and list of Application Server Process (ASP) within each AS) connecting to external Signaling Gateway (SG). `M3UAShellExecutor` accepts the `M3UA` commands and executes necessary operations. `RemSignalingGateway` manages the remote SGP.

```
<!-- ================================================== -->
<!-- Remote Signalling Gateway Service                   -->
<!-- ================================================== -->
<!--
         | Beans RemSgpImpl, M3UAShellExecutor and RemSignalingGateway defined bellow
 are only
         | needed if M3UALinkset will be used to connect to external Signaling Gateway. Delete/
Comment
         | out these beans if hardware is installed in same machine where
         | mobicents-ss7-service is running.
-->
<bean name="RemSgpImpl"
    class="org.mobicents.protocols.ss7.m3ua.impl.as.RemSgpImpl">
</bean>

<bean name="M3UAShellExecutor"
    class="org.mobicents.protocols.ss7.m3ua.impl.oam.M3UAShellExecutor">
    <property name="sgp">
        <inject bean="RemSgpImpl" />
    </property>
</bean>

<!-- Define Remote Signalling Gateway-->
<bean name="RemSignalingGateway"
    class="org.mobicents.ss7.RemSignalingGateway">
    <property name="remSgpImpl">
        <inject bean="RemSgpImpl" />
    </property>
</bean>
```

3.4.2. Configuring LinksetFactory

Concrete implementation of `LinksetFactory` is responsible to create new instances of corresponding `Linkset` when instructed by `LinksetManager`. JBoss Communications SS7 Stack defined three linkset factories :

- `DahdiLinksetFactory`

```
<bean name="DahdiLinksetFactory"
    class="org.mobicents.ss7.hardware.dahdi.oam.DahdiLinksetFactory">
</bean>
```

- `DialogicLinksetFactory`

```
<bean name="DialogicLinksetFactory"
    class="org.mobicents.ss7.hardware.dialogic.oam.DialogicLinksetFactory">
</bean>
```

- `M3UALinksetFactory`

```
<bean name="M3UALinksetFactory"
    class="org.mobicents.protocols.ss7.m3ua.impl.oam.M3UALinksetFactory">
    <property name="remSgp">
        <inject bean="RemSgpImpl" />
    </property>
</bean>
```

Its highly unlikely that you would require all three factories on same server. If you have `dahdi` based SS7 card installed, keep `DahdiLinksetFactory` and remove other two. If you have `dialogic` based SS7 card installed, keep `DialogicLinksetFactory` and remove other two. If you don't have any hardware installed and depend on M3UA, keep `M3UALinksetFactory` and remove other two. Nevertheless you can still use above factories in any combinations.

`LinksetFactoryFactory` is just a call-back class listening for new factories deployed and maintains Map of available factory name vs factory. You should never touch this bean.

3.4.3. Configuring LinksetManager

`LinksetManager` is responsible for managing `Linkset` and `Link`.

```
<!-- ================================================== -->
    <!-- Linkset manager Service                                -->
    <!-- ================================================== -->
    <bean name="LinksetManager"
        class="org.mobicents.ss7.linkset.oam.LinksetManager">

        <property name="linksetFactoryFactory">
            <inject bean="LinksetFactoryFactory" />
        </property>
        <property name="persistDir">${jboss.server.data.dir}</property>
    </bean>

    <bean name="LinksetExecutor"
        class="org.mobicents.ss7.linkset.oam.LinksetExecutor">
        <property name="linksetManager">
            <inject bean="LinksetManager" />
        </property>
    </bean>
```

LinksetManager when started looks for file `linksetmanager.xml` containing serialized information of underlying linksets and links. The directory path is configurable by changing value of `persistDir` property.

Warning

`linksetmanager.xml` should never be edited by hand. Always use Shell Client to connect to JBoss Communications SS7 Stack and execute commands.

`LinksetExecutor` accepts the `M3UA` commands and executes necessary operations.

3.4.4. Configuring ShellExecutor

`ShellExecutor` is responsible for listening to incoming command. Received commands are executed on local resources to perform actions like creation and management of `SCCP` routing rule, creation and management of `Linkset`, management of `M3UA` stack.

```
<!-- ================================================== -->
    <!-- Shell Service                                    -->
    <!-- ================================================== -->
    <!-- Define Shell Executor -->
    <bean name="ShellExecutor"
        class="org.mobicents.ss7.ShellExecutor">
        <property name="address">${jboss.bind.address}</property>
        <property name="port">3435</property>
        <property name="linksetExecutor">
            <inject bean="LinksetExecutor" />
        </property>
        <!-- M3UAShellExecutor required only if M3UALinkset will be created. -->
        <property name="m3UAShellExecutor">
            <inject bean="M3UAShellExecutor" />
        </property>
        <property name="ruleExecutor">
            <inject bean="RuleExecutor" />
        </property>
    </bean>
```

By default ShellExecutor listens at `jboss.bind.address` and port `3435`. You may set the `address` property to any valid IP address that your host is assigned. The shell commands are exchanged over TCP/IP.

Note

To understand JBoss bind options look at *Installation_And_Getting_Started_Guide* [http://docs.jboss.org/jbossas/docs/Installation_And_Getting_Started_Guide/5/html_single/index.html]

3.4.5. Configuring SS7Service

`SS7Service` acts as core engine binding all the components together. To get holistic view of SS7 Service look at *Section 2.3, "SS7 Service"*

```
        <!-- ================================================== -->
    <!-- Mobicents SS7 Service                            -->
    <!-- ================================================== -->
    <bean name="SS7Service" class="org.mobicents.ss7.SS7Service">

ectly=true)</

annotation>
```

```
        <property name="jndiName">java:/mobicents/ss7/sccp</property>
        <property name="routerImpl"><inject bean="RouterImpl" /></property>
        <property name="linksetManager"><inject bean="LinksetManager" /></property>
        <property name="shellExecutor"><inject bean="ShellExecutor" /></property>
         <!-- remSignalingGateway required only if M3UALinkset will be used to connect to remote
 Signalling Gateway -->
            <property name="remSignalingGateway"><inject bean="RemSignalingGateway" /></
property>
    </bean>
```

SS7 service creates new instance of SCCP stack and binds it to JNDI address `java:/mobicents/ss7/sccp`. The JNDI name can be configured to any valid JNDI name specific to your application.

3.5. Installing JBoss Communications Signaling Gateway Binary

JBoss Communications Signaling Gateway Binary doesn't require any additional steps. You may copy `mobicents-sgw` to any folder of your choice.

3.6. Running JBoss Communications Signaling Gateway

In the Linux terminal or Windows command prompt, the JBoss Communications Signaling Gateway has started successfully if the last line of output is similar to the following

```
15:51:18,247 INFO [MainDeployer] [[[[[[[[ Mobicents Signaling Gateway:
 release.version=1.0.0.BETA8 Started ]]]]]]]]
```

3.6.1. Starting JBoss Communications Signaling Gateway

Procedure 3.1. Running the JBoss Communications Signaling Gateway on Linux

1. Change the working directory to installation directory (the one in which the zip file's contents was extracted to)

   ```
   downloads]$ cd "mobicents-ss7-<version>/ss7/mobicents-sgw"
   ```

2. (Optional) Ensure that the `bin/run.sh` start script is executable.

   ```
   mobicents-sgw$ chmod +x bin/run.sh
   ```

3. Execute the `run.sh` Bourne shell script.

```
mobicents-sgw$ ./bin/run.sh
```

Procedure 3.2. Running the JBoss Communications Signaling Gateway on Windows

1. Using Windows Explorer, navigate to the `bin` subfolder in the installation directory.

2. The preferred way to start the JBoss Communications Signaling Gateway is from the Command Prompt. The command line interface displays details of the startup process, including any problems encountered during the startup process.

   Open the Command Prompt via the **Start** menu and navigate to the correct folder:

   ```
   C:\Users\<user>\My Downloads>cd "mobicents-ss7-<version>\ss7\mobicents-
   sgw"
   ```

3. Start the Gateway by executing one of the following files:

   • `run.bat` batch file:

     ```
     C:\Users\<user>\My Downloads\mms-standalone<version>>bin\run.bat
     ```

3.6.2. Start the Gateway With Alternate Configuration

Using `run.sh` without any arguments binds the gateway at `127.0.0.1`. To bind gateway to different ip, pass the ip address as value to `-b` command line option. For example to bind the server to `115.252.103.220`

```
mobicents-sgw$ ./bin/run.sh -b 115.252.103.220
```

3.6.3. Stopping

The only option to stop the gateway is by pressing `Ctrl c` and bringing down the JVM or kill the process.

3.7. Configuring JBoss Communications Signaling Gateway

Configuration is done through an XML descriptor named `sgw-beans.xml` and is located at `mobicents-sgw/deploy`,

3.7.1. Configuring Signaling Gateway Process

Signaling Gateway Process that contains the list of Remote Application Server (Rem AS) (and list of Remote Application Server Process (Rem ASP) within each rem AS) connecting to external Application Server (AS). `M3UAShellExecutor` accepts the `M3UA` commands and executes necessary operations.

```
<!-- ================================================== -->
<!-- Signalling Gateway Process Service                 -->
<!-- ================================================== -->
<bean name="SgpImpl"
    class="org.mobicents.protocols.ss7.m3ua.impl.sg.SgpImpl">
    <constructor>
        <parameter>${sgw.bind.address}</parameter>
        <parameter>3434</parameter>
    </constructor>
</bean>

<bean name="M3UAShellExecutor"
    class="org.mobicents.protocols.ss7.m3ua.impl.oam.M3UAShellExecutor">
    <property name="sgp">
        <inject bean="SgpImpl" />
    </property>
</bean>
```

`SgpImpl` listens at ip `${sgw.bind.address}` and port `3434` for incoming request from ASP.

3.7.2. Configuring LinksetFactory

Concrete implementation of `LinksetFactory` is responsible to create new instances of corresponding `Linkset` when instructed by `LinksetManager`. JBoss Communications Signaling Gateway defines two linkset factories :

- `DahdiLinksetFactory`

```
<bean name="DahdiLinksetFactory"
    class="org.mobicents.ss7.hardware.dahdi.oam.DahdiLinksetFactory">
</bean>
```

- `DialogicLinksetFactory`

```
<bean name="DialogicLinksetFactory"
    class="org.mobicents.ss7.hardware.dialogic.oam.DialogicLinksetFactory">
</bean>
```

Its highly unlikely that you would require both the factories on same gateway. If you have `dahdi` based SS7 card installed, keep `DahdiLinksetFactory` and remove other. If you have `dialogic` based SS7 card installed, keep `DialogicLinksetFactory` and remove other.

`LinksetFactoryFactory` is just a call-back class listening for new factories deployed and maintains Map of available factory name vs factory. You should never touch this bean.

3.7.3. Configuring LinksetManager

`LinksetManager` is responsible for managing `Linkset` and `Link`.

```
<!-- ================================================ -->
    <!-- Linkset manager Service                                    -->
    <!-- ================================================ -->
    <bean name="LinksetManager"
        class="org.mobicents.ss7.linkset.oam.LinksetManager">

        <property name="linksetFactoryFactory">
            <inject bean="LinksetFactoryFactory" />
        </property>
        <property name="persistDir">${linkset.persist.dir}</property>
    </bean>

    <bean name="LinksetExecutor"
        class="org.mobicents.ss7.linkset.oam.LinksetExecutor">
        <property name="linksetManager">
            <inject bean="LinksetManager" />
        </property>
    </bean>
```

LinksetManager when started looks for file `linksetmanager.xml` containing serialized information of underlying linksets and links. The directory path is configurable by changing value of `persistDir` property.

Warning

`linksetmanager.xml` should never be edited by hand. Always use Shell Client to connect to JBoss Communications Signaling Gateway and execute commands.

`LinksetExecutor` accepts the `linkset` commands and executes necessary operations.

3.7.4. Configuring ShellExecutor

`ShellExecutor` is responsible for listening to incoming command. Received commands are executed on local resources to perform actions like creation and management of `Linkset`, management of `M3UA` stack.

```
<!-- ================================================== -->
    <!-- Shell Service                                         -->
    <!-- ================================================== -->
    <bean name="ShellExecutor"
        class="org.mobicents.ss7.sgw.ShellExecutor">
        <property name="address">${sgw.bind.address}</property>
        <property name="port">3436</property>
        <property name="linksetExecutor">
            <inject bean="LinksetExecutor" />
        </property>
        <property name="m3UAShellExecutor">
            <inject bean="M3UAShellExecutor" />
        </property>
    </bean>
```

By default ShellExecutor listens at `sgw.bind.address` and port `3436`. You may set the `address` property to any valid IP address that your host is assigned. The shell commands are exchanged over TCP/IP.

3.7.5. Configuring SignalingGateway

`SignalingGateway` acts as core engine binding all the components together.

```
        <!-- ================================================== -->
    <!-- Mobicents Signaling Gateway                           -->
    <!-- ================================================== -->
    <bean name="SignalingGateway"
        class="org.mobicents.ss7.sgw.SignalingGateway">
        <property name="shellExecutor">
            <inject bean="ShellExecutor" />
        </property>

        <property name="nodalInterworkingFunction">
            <inject bean="NodalInterworkingFunction" />
        </property>

    </bean>
```

The `NodalInterworkingFunction` sits between the SS7 netwrok and IP network and routes messages to/from both the MTP3 and the M3UA layer, based on the SS7 DPC or DPC/SI address information

3.8. Setup from source

JBoss Communications SS7 Stack is an open source project, instructions for building from source are part of the manual! Building from source means you can stay on top with the latest features. Whilst aspects of JBoss Communications SS7 Stack are quite complicated, you may find ways to become contributors.

JBoss Communications SS7 Stack works with JDK1.5 and above (If using M3UA, JDK1.7 and above). you will need also need to have the following tools installed. Minimum requirement version numbers provided.

- `Subversion Client 1.4` : Instructions for using SVN, including install, can be found at *http://subversion.tigris.org*
- `Maven 2.0.9` : Instructions for using Maven, including install, can be found at *http://maven.apache.org/*
- `Ant 1.7.0` : Instructions for using Ant, including install, can be found at *http://ant.apache.org*

3.8.1. Release Source Code Building

1. **Downloading the source code**

   Use SVN to checkout a specific release source, the base URL is ?, then add the specific release version, lets consider 1.0.0.BETA8.

   ```
   [usr]$ svn co ?/ss7-1.0.0.BETA8
   ```

2. **Building the source code**

   Now that we have the source the next step is to build and install the source. JBoss Communications SS7 Stack uses Maven 2 to build the system. There are three profiles.

Default one builds only java source. The other two profiles available "dahdilinux" and "dialogiclinux" additionaly compile native modules.

Note

Native modules are supported only for linux OS for now.

Use "dahdilinux" profile if linux server on which this code is built already has dahdi module installed. Make sure you pass "include.zap" system property pointing to correct directory where dahdi is installed

```
[usr]$ cd ss7-1.0.0.BETA8
[usr]$ mvn install -Pdahdilinux -Dinclude.zap=/usr/include/dahdi
```

Use "dialogiclinux" profile if linux server on which this code is built already has dialogic module installed. Make sure you pass "include.dialogic" system property pointing to correct directory where dialogic libraries are installed

```
[usr]$ cd ss7-1.0.0.BETA8
[usr]$ mvn install -Pdialogclinux -Dinclude.dialogic=/usr/include/dialogic
```

To build JBoss Communications SS7 Stack without building any native libraries use

```
[usr]$ cd ss7-1.0.0.BETA8
[usr]$ mvn install
```

Note

If you are using JBoss Communications SS7 Stack without any native dependencies, JBoss Communications SS7 Stack can run on any OS.

Use Ant to build the binary .

```
[usr]$ cd ss7-1.0.0.BETA8/release
[usr]$ ant
```

3.8.2. Development Trunk Source Building

Similar process as for *Section 3.8.1, “Release Source Code Building”*, the only change is the SVN source code URL, which is NOT AVAILABLE.

Hardware Setup

This chapter contains reference to configure hardware drivers for different types of `SS7` cards.

JBoss Communications SS7 Stack supports `dahdi` based SS7 cards like `diguim` and `sangoma`. Generally `dahdi` based SS7 crads doesn't have MTP2/MTP3 support on board and relies on external software to provide these services.

JBoss Communications SS7 Stack also supports `dialogic` based SS7 cards which has on board support for MTP2/MTP3

4.1. Sangoma

To install Sangoma cards visit the Sangoma wiki at *http://wiki.sangoma.com/*

4.2. Diguim

To install Diguim cards visit the Diguim site at *http://www.digium.com/en/products/digital/*

4.3. Dialogic

To install Dialogic cards visit the Dialogic site at *http://www.dialogic.com/*

Shell Command Line

5.1. Introduction

JBoss Communications SS7 Stack provides Shell client to manage configuration of SS7 Stack Services. This chapter describes how to install and start client. Also it describes available commands and provides examples. To see examples of specific flow, to perform certain tasks, please refer to sections in chapter devoted to `Linksets`, `SCCP` or `M3UA` .

5.2. Starting

Shell client can be started with following command from `$JBOSS_HOME/bin` :

```
[$] ./ss7-run.sh
```

Once console starts, it will print following information:

```
=========================================================================

Mobicents SS7: release.version=1.0.0-SNAPSHOT
This is free software, with components licensed under the GNU General Public
 License
version 2 and other licenses. For further details visit http://mobicents.org
=========================================================================

mobicents>
```

The `ss7-run` script supports following options

```
Usage: SS7 [OPTIONS]
Valid Options
-v           Display version number and exit
-h           This help screen
```

Shell needs to connect to managed instance. Command to connect has following structure:

```
ss7 connect <IP> <PORT>
```

Example 5.1. Connec to remote machine

```
mobicents>ss7 connect 10.65.208.215 3435

mobicents(10.65.208.215:3435)>
```

> **Note**
>
> Host IP and port are optional, if not specified, shell will try to connect to `127.0.0.1:3435`

Command to disconnect has following structure:

```
ss7 discconnect
```

Example 5.2. Disconnect

```
mobicents(10.65.208.215:3435)>ss7 disconnect

Bye
mobicents>
```

5.3. Linkset Management

Linksets are managed by `linkset` command. It allows to perform following:

- create linkset
- delete linkset
- activate linkset
- deactivate linkset
- create link
- delete link
- activate link
- deactivate link

- list state of linksets and present links

5.3.1. Create Linkset

Linkset can be create by issuing command with following structure:

```
linkset create <linkset-type> opc <point-code> apc <point-code> ni <network-id> <linkset-name>
```

or in case of dialogic:

```
linkset create dialogic opc <point-code> apc <point-code> ni <network-id> srcmod <src-mode>
 destmod <dest-mode> <linkset-name>
```

or in case of M3UA:

```
linkset create m3ua opc <point-code> apc <point-code> ni <network-id> as <as-name> <linkset-
name>
```

Where:

linkset-type
: refers to type of linkset to be created, ie. `dahdi` , `dialogic` or `m3ua` . Correct values depend on which linkset factories have been deployed.

point-code
: is simply `MTP` point - either local(`opc`) or remote(`dpc`)

ni
: is simply network identifier. It can have following values:

  0
  : International network

  1
  : Spare (for international use only)

  2
  : National network

  3
  : Reserved for national use

linkset-name
: simple string name, which identifies linkset

as-name
: Name of AS that M3UALinkset wrapps. Make sure that AS is already created as explained in *Section 5.5.2.1, “Create AS”*

Example 5.3. Linkset creation

```
mobicents(10.65.208.215:3435)>linkset create dahdi opc 1 apc 2 ni 0 linkset1
LinkSet successfully added
mobicents(10.65.208.215:3435)>linkset create dialogic opc 3 apc 4 ni 3
 srcmod 1 destmod 2 linkset2
LinkSet successfully added
```

5.3.2. Remove Linkset

Linkset can be deleted by issuing command with following structure:

```
linkset delete  <linkset-name>
```

Where:

linkset-name
: is name set during link creation

Example 5.4. Linkset Removal

```
mobicents(10.65.208.215:3435)>linkset delete linkset1
LinkSet successfully deleted
```

5.3.3. Activate Linkset

Linkset can be activated by issuing command with following structure:

```
linkset activate  <linkset-name>
```

Where:

linkset-name
: is name set during link creation

Example 5.5. Linkset Activation

```
mobicents(10.65.208.215)>linkset activate linkset1
LinkSet activated successfully
```

5.3.4. Deactivate Linkset

Linkset can be deactivated by issuing command with following structure:

```
linkset deactivate  <linkset-name>
```

Where:

linkset-name
: is name set during link creation

Example 5.6. Linkset Deactivateion

```
mobicents(10.65.208.215)>linkset deactivate linkset1
LinkSet deactivated successfully
```

5.3.5. Create Link

`Link` can be created in `Linkset` by issuing command with following structure:

```
linkset link create span <span-num> code <code-num> channel <channel-num> <linkset-name>
 <link-name>
```

Where:

span-num
: integer number. It represents port number in card(indexed from 0).

code-num
: link code(sls assigned to this link).

channel-num
: integer number indicating time slot number(TDM time slot).

linkset-name
: is name set during link creation.

link-name
: name which identifies link in linkset.

Example 5.7.

```
mobicents(10.65.208.215:3435)>linkset link create span 1 code 1 channel 1
 linkset1 link1
Link successfully added
```

5.3.6. Remove Link

`Link` can be removed from in `Linkset` by issuing command with following structure:

```
linkset link delete <linkset-name> <link-name>
```

Where:

linkset-name
: is name set during link creation

link-name
: name which identifies link in linkset

Example 5.8. Link Removal

```
mobicents(10.65.208.215:3435)>linkset link delete linkset1 link1
Link successfully deleted
```

5.3.7. Activate Link

Link can be activated by issuing command with following structure:

```
linkset link activate <linkset-name> <link-name>
```

Where:

linkset-name
: is name set during link creation

link-name
: name which identifies link in linkset

Example 5.9. Link Activation

```
mobicents(10.65.208.215:3435)>linkset link activate linkset1 link1
Link activated successfully
```

5.3.8. Deactivate Link

Link can be deactivated by issuing command with following structure:

```
linkset link deactivate <linkset-name> <link-name>
```

Where:

linkset-name
: is name set during link creation

link-name
: name which identifies link in linkset

Example 5.10. Link Deactivateion

```
mobicents(10.65.208.215:3435)>linkset link deactivate linkset1 link1
Link deactivated successfully
```

5.3.9. Show status

Linkset and Link's status can be viewed by issuing command with following structure:

```
linkset show
```

Example 5.11. Linkset Status

```
mobicents(10.65.208.215:3435)>linkset show
linkset1      dahdi     opc=1           apc=2           ni=0
 state=UNAVAILABLE
    link1        span=1    channelId=1    code=1   state=UNAVAILABLE
```

The possible state of Linkset are

- UNAVAILABLE : Indicates the linkset does not have any “available” links and cannot transport traffic
- SHUTDOWN : Indicates the linkset has been shutdown in the configuration
- AVAILABLE : Indicates the linkset has at least one available link and can carry traffic

The possible state of Link are

- UNAVAILABLE : Indicates the link is not available to carry traffic. This can occur if the link is remotely or locally inhibited by a user. It can also be unavailable if MTP2 has not been able to successfully activate the link connection.
- SHUTDOWN : Indicates the link has been shutdown in the configuration.
- AVAILABLE : Indicates the link is active and able to transport traffic
- FAILED : A link is FAILED when the link is not shutdown but is unavailable at layer2 for some reason. For example Initial Alignment failed or the link test messages sent by MTP3 are not being acknowledged.

5.4. SCCP Management

SCCP provides connectionless and connection-oriented network services. This includes address(GTT) translation and routing, flow control segmentation and reassembly.

A global title is an address (e.g., a dialed 800 number, calling card number, or mobile subscriber identification number) which is translated by SCCP into a destination point code and subsystem number. A subsystem number uniquely identifies an application at the destination signaling point. SCCP is used as the transport layer for TCAP -based services

As SCCP acts as message router, it requires means to configure routing information. CLI provides way to easly manage routing rules information in JBoss Communications SCCP implementation.

5.4.1. Rule

SCCP routing mechanism makes routing decisions based on `rules`. Routing can be based on Global Title (GTT) or Destination Point Code and Sub-System Number (DPC + SSN)

Rule for routing on GTT
: Each rule consits of three elements:

  pattern
  : determines pattern to which destiantion address is compared. It has complex structure which looks as follows:

    translation type (tt)
    : integer numer which is used in a network to indicate the preferred method of global title analysis

    numbering plan (np)
    : integer value which indicates which numbering plan will be used for the global title. Its value aids the routing system in determining the correct network system to route message to.

    nature of address (noa)
    : integer value which indicates address type., Specificaly it indicates the scope of the address value, such as whether it is an international number (i.e. including the country code), a "national" or domestic number (i.e. without country code), and other formats such as "local" format.

    digits
    : actual address

    sub-system number (ssn)
    : identifies application in SCCP routing network.

  translation
  : determines target for messages which destination address matches pattern. It has exactly the same structure as `pattern` .

  mtp info
  : determines mtp layer information. If `translation` does not indicate local address(subsystem number), this information is used to send message through MTP layer. It has following structure:

    name
    : name identifing one of Linkset used by SCCP

originating point code (opc)
: local point code used as originating MTP address

destination point code (dpc)
: remote point code used as destination MTP address

signaling link selection (sls)
: identifies link in linkset

Rule for routing on DPC + SSN
: Each rule consits of three elements:

  DPC
  : Destination point Code

  SSN
  : Sub System Number

  mtp info
  : same as mtp info used in GTT

5.4.2. Rule Management

SCCP routing rules are managed by `sccprule` command. It allows to perform following:

- sccprule create
- sccprule delete
- sccprule show

5.4.2.1. Create Rule

Rule can be create by issuing command with following structure:

```
sccprule create <name> pattern tt <translation type> np <numbering plan> noa <nature of address> digits <digits> ssn <ssn>
                    translation tt <translation type> np <numbering plan> noa <nature of address> digits <digits> ssn <ssn>
                        mtpinfo name <name> opc <originating point code> dpc <destination point code> sls <signaling link selection>
```

```
sccprule create <name> dpc <destination point code> ssn <sub-system number> mtpinfo name <name> opc <originating point code> dpc <destination point code> sls <signaling link selection>
```

```
```

- `pattern` option is mandatory can be followed by following options:

  tt
  : Value indicating type of translation. It is not mandatory, if absent "-1" should be passed. It requires integer argument.

  np
  : Specifies numberingplan to be used by SCCP to aid it in determinig correct network system. It is not mandatory, if absent -1 should be passed. It requires integer argument. It can have following values

0	UNKNOWN
1	ISDN_TELEPHONY
3	DATA
4	TELEX
5	MERITIME_MOBILE
6	LAND_MOBILE
7	ISDN_MOBILE

  noa
  : Specifies nature of address to indicate scope of address. It is not mandatory, if absent -1 should be passed. It requires integer argument. It can have following values

0	SPARE
1	SUBSCRIBER
2	UNKNOWN

3
: NATIONAL

4
: INTERNATIONAL

digits
: Specifies string representation of number(digits). It is mandatory and requires argument.

ssn
: Specifies subsystem number. It is not mandatory, if absent -1 should be passed. It requires integer argument.

- `translation` is optional. If present it supports exactly the same options as `parameter`
- `mtpinfo` is optional. If present it must be followed by following options:

name
: Specifies name of mtp linkset. It is mandatory, requires string argument.

opc
: Specifies originating point code. It is mandatory, requires integer argument.

apc
: Specifies adjacent point code. It is mandatory, requires integer argument.

sls
: Specifies signal link selector. It is mandatory, requires integer argument.

Example 5.12. SCCP Rule creation

```
mobicents(10.65.208.215:3435)>sccprule create Rule1 pattern tt -1 np -1 noa
 3 digits 99604 ssn -1 translation tt -1 np 3 noa 4 digits 77865 ssn -1
Rule successfully added
mobicents(10.65.208.215:3435)>sccprule create Rule2 pattern tt -1 np 3 noa 4
 digits 99605 ssn -1 mtpinfo name name1 opc 12 apc 56 sls 1
Rule successfully added
mobicents(10.65.208.215:3435)>sccprule create Rule3 pattern tt -1 np 3 noa
 4 digits 99606 ssn -1 translation tt -1 np 3 noa 4 digits 77865 ssn -1
 mtpinfo name name1 opc 12 apc 56 sls 1
Rule successfully added
mobicents(10.65.208.215:3435)>sccprule create Rule4 dpc 1 ssn 8 mtpinfo name
 name1 opc 2 apc 1 sls 16
Rule successfully added
```

5.4.2.2. Delete SCCP Rule

SCCP Rule can be deleted by issuing command with following structure:

```
sccprule delete  <rule-name>
```

Where:

rule-name
: is name set during rule creation

Example 5.13. SCCP Rule Removal

```
mobicents(10.65.208.215:3435)>sccprule delete Rule1
Rule successfully removed
```

5.4.2.3. Show SCCP Rule

Rule's can be viewed by issuing command with following structure:

```
sccprule show
```

It will show all the rules created

5.5. M3UA Management

Commands to manage JBoss Communications M3UA Stack used on Application Server (AS) side differs from commands to manage JBoss Communications M3UA Stack used on Signaling Gateway side (SGW).

5.5.1. M3UA Management - SGW side

M3UA - SGW side is managed by `m3ua` command. It allows to perform following:

- m3ua ras create
- m3ua rasp create
- m3ua ras add

5.5.1.1. Create Remote AS

Remote Application Server (AS) can be created by issuing command with following structure:

```
m3ua ras create rc <routing-context> rk dpc <destination point code> opc <originating point code>
            si <service indicator> traffic-mode <traffic mode> <ras-name>
```

Where:

routing-context
: refers to Routing Context. Make sure its unique for each Remote AS created. The same Routing Context should be used while creating AS on M3UA Stack used on AS side.

routing key
: Routing Key describes a set of SS7 parameters and parameter values that uniquely define the range of signaling traffic to be handled by a particular Application Server. Routing Key includes

    destination point code
    : The Destination Point Code parameter is mandatory, and it identifies the Destination Point Code of incoming SS7 traffic. dpc is integer number

    originating point code
    : The Originating Point Code parameter contains one or more (comma separated) SS7 OPC entries, and its format is the same as for the Destination Point Code parameter. OPC is optional and absence of the OPC parameter in the Routing Key indicates the use of any OPC value.

    service indicator
    : The optional service indicator field contains one or more (comma separated) Service Indicators from the values described bellow. The absence of the SI parameter in the Routing Key indicates the use of any SI value, excluding of course MTP management.

3	SCCP
4	TUP
5	ISUP
9	Broadband ISUP
10	Satellite ISUP

12
: AAL type 2 Signalling

13
: Bearer Independent Call Control (BICC)

14
: Gateway Control Protocol

traffic-mode
: The optional Traffic Mode Type parameter identifies the traffic mode. If not specified Override is used as default. It can take either of loadshare or override.

ras-name
: Rem AS name

Example 5.14. Rem AS creation

```
mobicents(127.0.0.1:3436)>m3ua ras create rc 100 rk dpc 123 RAS1
Successfully created AS name=RAS1
mobicents(127.0.0.1:3436)>m3ua ras create rc 101 rk dpc 456 opc 987 si 3
 traffic-mode loadshare RAS2
Successfully created AS name=RAS2
```

5.5.1.2. Create Remote ASP

Remote Application Server Process (ASP) can be create by issuing command with following structure:

```
m3ua rasp create ip <ip> port <port> <rasp-name>
```

Where:

ip
: ip address of Application Server Process from AS side trying to connect to this Rem ASP

port
: port of Application Server Process from AS side trying to connect to this Rem ASP

Example 5.15. Rem ASP creation

```
mobicents(127.0.0.1:3436)>m3ua rasp create ip 127.0.0.1 port 2345 RASP1
Successfully created ASP name=RASP1
```

5.5.1.3. Assign Remote ASP to Remote AS

Remote Application Server Process (ASP) can be assigned to Remote Application Server (AS) with following structure

```
m3ua ras add <ras-name> <rasp-name>
```

Where:

ras name
: name of Remote AS created earlier

rasp name
: name of Remote ASP created earlier

Example 5.16. Add Rem ASP to Rem AS

```
mobicents(127.0.0.1:3436)>m3ua ras add RAS1 RASP1
Successfully added ASP name=RASP1 to AS name=RAS1
```

5.5.2. M3UA Management - AS side

M3UA - AS side is managed by `m3ua` command. It allows to perform following:

- m3ua as create
- m3ua asp create
- m3ua as add
- m3ua asp start
- m3ua asp stop

5.5.2.1. Create AS

Application Server (AS) can be created by issuing command with following structure:

```
m3ua as create rc <routing-context> <as-name>
```

Where:

routing-context
: refers to Routing Context already configured on M3UA stack on SGW side.

name
: simple string name, which identifies AS. Make sure this is unique

Example 5.17. AS creation

```
mobicents(127.0.0.1:3435)>m3ua as create rc 100 AS1
Successfully created AS name=AS1
```

5.5.2.2. Create ASP

Application Server Process (ASP) can be created by issuing command with following structure:

```
m3ua asp create ip <ip> port <port> remip <rem-ip> remport <rem-port> <asp-name>
```

Where:

ip
: local ip address of Application Server Process. This ip address should match with ip address configured when Remote ASP was created.

port
: local port of Application Server Process. This port should match with port configured when Remote ASP was created.

remip
: The ip address of Mobicents Signaling Gateway listening for incoming connection requests

remport
: The port of Mobicents Signaling Gateway listening for incoming connection requests

asp-name
: Name of this ASP. It should be unique

Example 5.18. ASP creation

```
mobicents(127.0.0.1:3435)>m3ua asp create ip 127.0.0.1 port 2345 remip
 127.0.0.1 remport 3434 ASP1
```

```
Successfully created AS name=ASP1
```

5.5.2.3. Assign ASP to AS

Application Server Process (ASP) can be assigned to Application Server (AS) with following structure

```
m3ua as add <as-name> <asp-name>
```

Where:

as name
: name of AS created earlier

asp name
: name of ASP created earlier

Example 5.19. Add ASP to AS

```
mobicents(127.0.0.1:3435)>m3ua as add AS1 ASP1
Successfully added ASP name=ASP1 to AS name=AS1
```

5.5.2.4. Start ASP

Application Server Process (ASP) can be started with following structure

```
m3ua asp start <asp-name>
```

Where:

asp name
: name of ASP created earlier. Make sure ASP you are trying to start is assigned to at least one AS

Example 5.20. Start ASP

```
mobicents(127.0.0.1:3435)>m3ua asp start ASP1
Successfully started ASP name=ASP1
```

5.5.2.5. Stop ASP

Application Server Process (ASP) can be stopped with following structure

```
m3ua asp stop <asp-name>
```

Where:

asp name
: name of ASP started earlier.

Example 5.21. Stop ASP

```
mobicents(127.0.0.1:3435)>m3ua asp stop ASP1
Successfully stopped ASP name=ASP1
```

SCCP

The Signaling Connection Control Part (SCCP) is defined in ITU-T Recommendations Q.711-Q.716. SCCP sits on top of Message Transfer Part 3 (MTP3) in the SS7 protocol stack. The SCCP provides additional network layer functions to provide transfer of noncircuit-related (NCR) signaling information, application management procedures and alternative and more flexible methods of routing.

6.1. Routing Management

Routing rules are configured using the Command Line Interface as explained *Section 5.4, “SCCP Management”*

6.2. SCCP Usage

The `org.mobicents.protocols.ss7.sccp.SccpStack` is responsible for taking the config file and turning it into `org.mobicents.protocols.ss7.sccp.Router`. All the sccp messages sent by SCCP User Part are routed as per the rule configured in Router

Note

The term SCCP User Part refers to the applications that use SCCP's services.

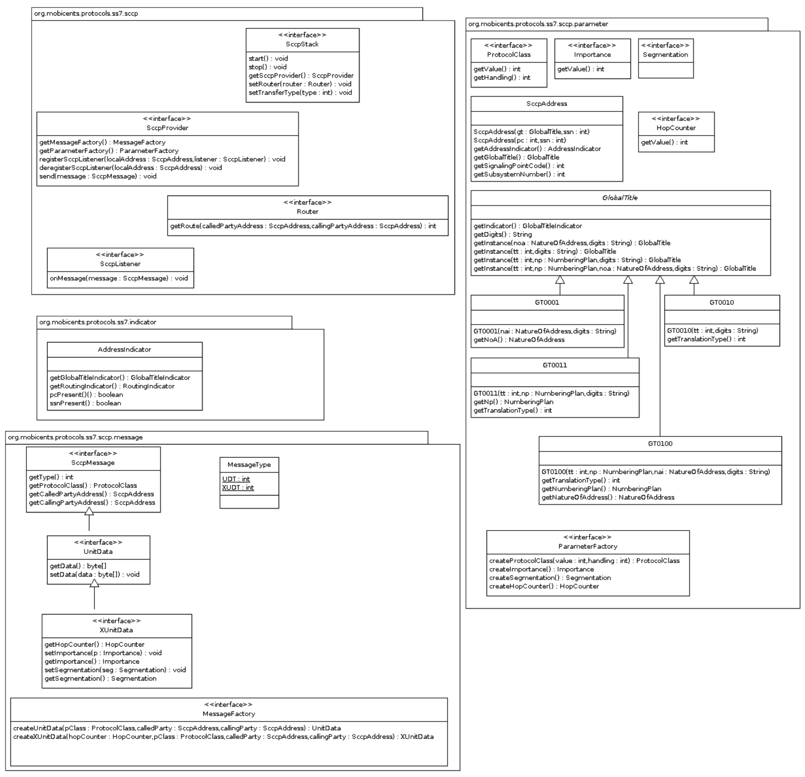
The SCCP User Part gets handle to `SccpStack` by doing JNDI look-up as explained in *Section 6.3, “Access Point”*

`SccpStack` exposes `org.mobicents.protocols.ss7.sccp.SccpProvider` that interacts directly with SccpStack. This interface defines the methods that will be used by SCCP User Part to send `org.mobicents.protocols.ss7.sccp.message.SccpMessage` and register `org.mobicents.protocols.ss7.sccp.SccpListener`'s to listen for incoming SCCP messages.

SCCP User Part registers SccpListener for specific local `org.mobicents.protocols.ss7.sccp.parameter.SccpAddress`. For every incoming SccpMessage, if the called party address matches with this local SccpAddress, the corresponding SccpListner is called.

SccpProvider also exposes `org.mobicents.protocols.ss7.sccp.message.MessageFactory` and `org.mobicents.protocols.ss7.sccp.parameter.ParameterFactory` to create new concrete SccpMessage viz., `org.mobicents.protocols.ss7.sccp.message.UnitData` or `org.mobicents.protocols.ss7.sccp.message.XUnitData` passing the corresponding parameters created by leveraging ParameterFactory.

The UML class diagram looks like


org.mobicents.protocols.ss7.sccp
<<interface>>
SccpStack
start() : void
stop() : void
getSccpProvider() : SccpProvider
setRouter(router : Router) : void
setTransferType(type : int) : void
<<interface>>
SccpProvider
getMessageFactory() : MessageFactory
getParameterFactory() : ParameterFactory
registerSccpListener(localAddress : SccpAddress,listener : SccpListener) : void
deregisterSccpListener(localAddress : SccpAddress) : void
send(message : SccpMessage) : void
<<interface>>
Router
getRoute(calledPartyAddress : SccpAddress,callingPartyAddress : SccpAddress) : int
<<interface>>
SccpListener
onMessage(message : SccpMessage) : void
org.mobicents.protocols.ss7.indicator
AddressIndicator
getGlobalTitleIndicator() : GlobalTitleIndicator
getRoutingIndicator() : RoutingIndicator
pcPresent()() : boolean
ssnPresent() : boolean
org.mobicents.protocols.ss7.sccp.message
<<interface>>
SccpMessage
getType() : int
getProtocolClass() : ProtocolClass
getCalledPartyAddress() : SccpAddress
getCallingPartyAddress() : SccpAddress
MessageType
UDT : int
XUDT : int
<<interface>>
UnitData
getData() : byte[]
setData(data : byte[]) : void
<<interface>>
XUnitData
getHopCounter() : HopCounter
setImportance(p : Importance) : void
getImportance() : Importance
setSegmentation(seg : Segmentation) : void
getSegmentation() : Segmentation
<<interface>>
MessageFactory
createUnitData(pClass : ProtocolClass,calledParty : SccpAddress,callingParty : SccpAddress) : UnitData
createXUnitData(hopCounter : HopCounter,pClass : ProtocolClass,calledParty : SccpAddress,callingParty : SccpAddress) : XUnitData
org.mobicents.protocols.ss7.sccp.parameter
<<interface>>
ProtocolClass
getValue() : int
getHandling() : int
<<interface>>
Importance
getValue() : int
<<interface>>
Segmentation
SccpAddress
SccpAddress(gt : GlobalTitle,ssn : int)
SccpAddress(pc : int,ssn : int)
getAddressIndicator() : AddressIndicator
getGlobalTitle() : GlobalTitle
getSignalingPointCode() : int
getSubsystemNumber() : int
<<interface>>
HopCounter
getValue() : int
GlobalTitle
getIndicator() : GlobalTitleIndicator
getDigits() : String
getInstance(noa : NatureOfAddress,digits : String) : GlobalTitle
getInstance(tt : int,digits : String) : GlobalTitle
getInstance(tt : int,np : NumberingPlan,digits : String) : GlobalTitle
getInstance(tt : int,np : NumberingPlan,noa : NatureOfAddress,digits : String) : GlobalTitle
GT0001
GT0001(nai : NatureOfAddress,digits : String)
getNoA() : NatureOfAddress
GT0010
GT0010(tt : int,digits : String)
getTranslationType() : int
GT0011
GT0011(tt : int,np : NumberingPlan,digits : String)
getNp() : NumberingPlan
getTranslationType() : int
GT0100
GT0100(tt : int,np : NumberingPlan,nai : NatureOfAddress,digits : String)
getTranslationType() : int
getNumberingPlan() : NumberingPlan
getNatureOfAddress() : NatureOfAddress
<<interface>>
ParameterFactory
createProtocolClass(value : int,handling : int) : ProtocolClass
createImportance() : Importance
createSegmentation() : Segmentation
createHopCounter() : HopCounter

JBoss Communications SS7 Stack SCCP Class Diagram

6.3. Access Point

`SS7 Service` provides user with access point to `SCCP` protocol/stack.

To get handle to `SccpStack` do the JNDI look-up passing the JNDI name configured in SS7 service as explained in *Section 3.4.5, “Configuring SS7Service”*

```
private static SccpProvider getSccpProvider() throws NamingException {

    // no arg is ok, if we run in JBoss
    InitialContext ctx = new InitialContext();
    try {
        String providerJndiName = "/mobicents/ss7/sccp";
        return ((SccpStack) ctx.lookup(providerJndiName)).getSccpProvider();

    } finally {
        ctx.close();
    }
}
```

6.4. SCCP User Part Example

Below is SCCP User Part example listening for incoming SCCP message and sending back new message

```
public class Test implements SccpListener {

    private SccpProvider sccpProvider;
    private SccpAddress localAddress;

    private static SccpProvider getSccpProvider() throws NamingException {

        // no arg is ok, if we run in JBoss
        InitialContext ctx = new InitialContext();
        try {
            String providerJndiName = "/mobicents/ss7/sccp";
            return ((SccpStack) ctx.lookup(providerJndiName)).getSccpProvider();
        } finally {
            ctx.close();
        }
    }

    public void start() throws Excetpion {

        this.sccpProvider = getSccpProvider();

        int translationType = 0;
        int subSystemNumber = 0;

        GlobalTitle gt = GlobalTitle.getInstance(translationType,
                NumberingPlan.ISDN_MOBILE, NatureOfAddress.NATIONAL, "1234");

        localAddress = new SccpAddress(gt, 0);

        this.sccpProvider.registerSccpListener(localAddress, this);
    }

    public void stop() {
        this.sccpProvider.deregisterSccpListener(localAddress);
    }
    public void onMessage(SccpMessage message) {

        if (message.getType() == MessageType.UDT) {
            throw new IlleagalArgumentException("Dont like UDT");
        } else if (message.getType() == MessageType.XUDT) {
            XUnitData xudt = (XUnitData) message;
            localAddress = ((XUnitData) message).getCalledPartyAddress();
            SccpAddress remoteAddress = ((XUnitData) message)
                    .getCallingPartyAddress();

            // now decode content

            byte[] data = xudt.getData();

            // some data encoded in
            CallRequest cr = new CallRequest(data);

            byte[] answerData;

            if (cr.getCallee().equals(this.localAddress)) {
                EstablihsCallAnswer eca = new EstablihsCallAnswer(cr);
                answerData = eca.encode();

            } else {
                TearDownCallAnswer tdca = new TearDownCallAnswer(cr);
                answerData = tdca.encode();
            }

            HopCounter hc = this.sccpProvider.getParameterFactory()
                    .createHopCounter(5);

            XUnitData sccpAnswer = this.sccpProvider
                    .getMessageFactory()
                    .createXUnitData(hc, xudt.getProtocolClass(),
                            message.getCallingPartyAddress(), this.localAddress);

            this.sccpProvider.send(sccpAnswer);

        }

    }

}
```

TCAP

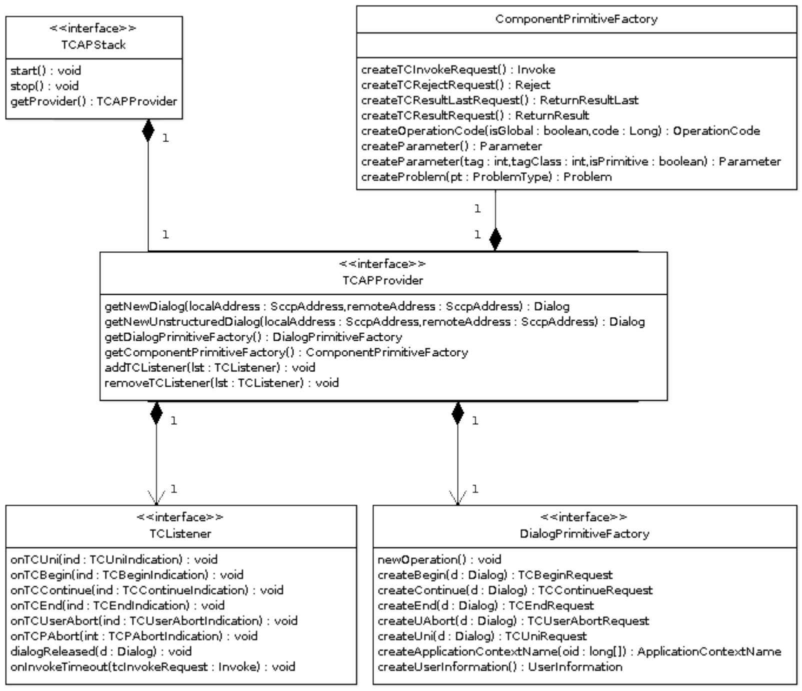
The Transaction Capabilities Application Part (TCAP) is defined in ITU-T Recommendations Q.771-Q.775. TCAP allows services at network nodes to communicate with each other using an agreed-upon set of data elements. Its primary purpose is to facilitate multiple concurrent dialogs between the same sub-systems on the same machines, using Transaction IDs to differentiate these, similar to the way TCP ports facilitate multiplexing connections between the same IP addresses on the Internet.

7.1. JBoss Communications SS7 Stack TCAP Usage

`org.mobicents.protocols.ss7.tcap.api.TCAPStack` interface defines the methods required to represent TCAP Protocol Stack. TCAPStack exposes `org.mobicents.protocols.ss7.tcap.api.TCAPProvider` that interacts directly with TCAPStack. TCAPProvider defines methods that will be used by TCAP User Part to create new `org.mobicents.protocols.ss7.tcap.api.tc.dialog.Dialog` to be sent across network. TCAP User Part also registers `org.mobicents.protocols.ss7.tcap.api.TCListener` to listen TCAP messages.

TCAPProvider also exposes `org.mobicents.protocols.ss7.tcap.api.DialogPrimitiveFactory` to create dialog primitives and `org.mobicents.protocols.ss7.tcap.api.ComponentPrimitiveFactory` to create components. Components are a means of invoking an operation at a remote node

The UML Class Diagram looks like


<<interface>>
TCAPStack
start() : void
stop() : void
getProvider() : TCAPProvider
ComponentPrimitiveFactory
createTCInvokeRequest() : Invoke
createTCRejectRequest() : Reject
createTCResultLastRequest() : ReturnResultLast
createTCResultRequest() : ReturnResult
createOperationCode(isGlobal : boolean,code : Long) : OperationCode
createParameter() : Parameter
createParameter(tag : int,tagClass : int,isPrimitive : boolean) : Parameter
createProblem(pt : ProblemType) : Problem
1
1
1
1
<<interface>>
TCAPProvider
getNewDialog(localAddress : SccpAddress,remoteAddress : SccpAddress) : Dialog
getNewUnstructuredDialog(localAddress : SccpAddress,remoteAddress : SccpAddress) : Dialog
getDialogPrimitiveFactory() : DialogPrimitiveFactory
getComponentPrimitiveFactory() : ComponentPrimitiveFactory
addTCListener(lst : TCListener) : void
removeTCListener(lst : TCListener) : void
1
1
1
1
<<interface>>
TCListener
onTCUni(ind : TCUniIndication) : void
onTCBegin(ind : TCBeginIndication) : void
onTCContinue(ind : TCContinueIndication) : void
onTCEnd(ind : TCEndIndication) : void
onTCUserAbort(ind : TCUserAbortIndication) : void
onTCPAbort(int : TCPAbortIndication) : void
dialogReleased(d : Dialog) : void
onInvokeTimeout(tcInvokeRequest : Invoke) : void
<<interface>>
DialogPrimitiveFactory
newOperation() : void
createBegin(d : Dialog) : TCBeginRequest
createContinue(d : Dialog) : TCContinueRequest
createEnd(d : Dialog) : TCEndRequest
createUAbort(d : Dialog) : TCUserAbortRequest
createUni(d : Dialog) : TCUniRequest
createApplicationContextName(oid : long[]) : ApplicationContextName
createUserInformation() : UserInformation

JBoss Communications SS7 Stack TCAP Class Diagram `org.mobicents.protocols.ss7.tcap.TCAPStackImpl` is concrete implementation of `TCAPStack`. The TCAP User Part creates instance of `TCAPStackImpl` passing the reference of `SccpProvider` and new instance of `SccpAddress` representing address to which bind listenr. `TCAP` stack creates internaly JBoss Communications `MAP` Stack implementation. Passed `SccpAddress` is used to match against incoming messages destination address.

```
            SccpProvider sccpProvider = getSccpProvider(); //JNDI lookup of SCCP Stack and get
Provider
           SccpAddress localAddress createLocalAddress();

           TCAPStack tcapStack = new TCAPStackImpl(sccpPprovider, localAddress);



           ...

           private SccpAddress createLocalAddress()
           {
              int translationType = 0;

              int subSystemNumber = 0;


              GlobalTitle gt = GlobalTitle.getInstance(translationType,

              NumberingPlan.ISDN_MOBILE, NatureOfAddress.NATIONAL, "1234");

              SccpAddress localAddress = new SccpAddress(gt, 0);
              return localAddress;
           }
```

The reference to `SccpProvider` is received from `SccpStack`. To get handle to `SccpStack` do the JNDI look-up passing the JNDI name configured in SS7 service as explained in *Section 6.3, "Access Point"*

The TCAP User Part should register the concrete implementation of `TCListener` with `TCAPProvider` to listen for incoming TCAP messages.

```
   public class Client implements TCListener{
        .....
        tcapProvider = tcapStack.getProvider();
        tcapProvider.addTCListener(this);
        ....
    }
```

The TCAP User Part leverages TCAPProvider to create new Dialog. The component's between the nodes are exchanged within this Dialog

```
        clientDialog = this.tcapProvider.getNewDialog(thisAddress, remoteAddress);
```

The TCAP User Part leverages ComponentPrimitiveFactory to create new components. These components are sent usig the dialog

```
        //create some INVOKE
        Invoke invoke = cpFactory.createTCInvokeRequest();
        invoke.setInvokeId(this.clientDialog.getNewInvokeId());
        invoke.setOperationCode(cpFactory.createOperationCode(true,new Long(12)));
        //no parameter
        this.clientDialog.sendComponent(invoke);
```

7.2. JBoss Communications SS7 Stack TCAP User Part Example

Below is TCAP User Part example. This example creates dialog and exchanges messages withing structured dialog. Refer to source for function calls:

```
public class Client implements TCListener{
    //encoded Application Context Name
    public static final long[] _ACN_ = new long[] { 0, 4, 0, 0, 1, 0, 19, 2 };
    private TCAPStack stack;
    private SccpAddress thisAddress;
    private SccpAddress remoteAddress;

    private TCAPProvider tcapProvider;
    private Dialog clientDialog;

    Client(SccpProvider sccpPprovider, SccpAddress thisAddress,SccpAddress remoteAddress) {
        super();
        this.stack = new TCAPStackImpl(sccpPprovider,thisAddress); //pass address, so stack can
register in SCCP
        this.runningTestCase = runningTestCase;
        this.thisAddress = thisAddress;
        this.remoteAddress = remoteAddress;
        this.tcapProvider = this.stack.getProvider();
        this.tcapProvider.addTCListener(this);
    }

    private static SccpProvider getSccpProvider() throws NamingException {

        // no arg is ok, if we run in JBoss
        InitialContext ctx = new InitialContext();
        try {
            String providerJndiName = "/mobicents/ss7/sccp";
            return ((SccpStack) ctx.lookup(providerJndiName)).getSccpProvider();
        } finally {
            ctx.close();
        }
    }

    public void start() throws TCAPException, TCAPSendException {
        clientDialog = this.tcapProvider.getNewDialog(thisAddress, remoteAddress);
       ComponentPrimitiveFactory cpFactory = this.tcapProvider.getComponentPrimitiveFactory();

        //create some INVOKE
        Invoke invoke = cpFactory.createTCInvokeRequest();
        invoke.setInvokeId(this.clientDialog.getNewInvokeId());

        invoke.setOperationCode(cpFactory.createOperationCode(true,new Long(12)));
        //no parameter
        this.clientDialog.sendComponent(invoke);

        ApplicationContextName acn = this.tcapProvider.getDialogPrimitiveFactory()
```

```
            .createApplicationContextName(_ACN_);
        //UI is optional!
        TCBeginRequest tcbr = this.tcapProvider.getDialogPrimitiveFactory().createBegin(this.clientDialog);
        tcbr.setApplicationContextName(acn);
        this.clientDialog.send(tcbr);
    }

    public void dialogReleased(Dialog d) {



    }

    public void onInvokeTimeout(Invoke tcInvokeRequest) {

    }

    public void onTCBegin(TCBeginIndication ind) {



    }

    public void onTCContinue(TCContinueIndication ind) {

        //send end
        TCEndRequest end = this.tcapProvider.getDialogPrimitiveFactory().createEnd(ind.getDialog());
        end.setTermination(TerminationType.Basic);
        try {
            ind.getDialog().send(end);

        } catch (TCAPSendException e) {
            throw new RuntimeException(e);
        }
    }

    public void onTCEnd(TCEndIndication ind) {
        //should not happen, in this scenario, we send data.
    }

    public void onTCUni(TCUniIndication ind) {
        //not going to happen

    }
    public void onTCPAbort(TCPAbortIndication ind) {
        // TODO Auto-generated method stub

    }

    public void onTCUserAbort(TCUserAbortIndication ind) {
        // TODO Auto-generated method stub

    }


    public static void main(String[] args)
    {

        int translationType = 0;
        int subSystemNumber = 0;
        GlobalTitle gt = GlobalTitle.getInstance(translationType,NumberingPlan.ISDN_MOBILE,NatureOfAddress.NAT
        SccpAddress localAddress = new SccpAddress(gt,0);

        gt = GlobalTitle.getInstance(translationType,NumberingPlan.ISDN_MOBILE,NatureOfAddress.NATIONAL, "15
        SccpAddress remoteAddress = new SccpAddress(gt,0);
        Client c = new Client(getSccpProvider(),localAddress,remoteAddress);
    }

}
```

MAP

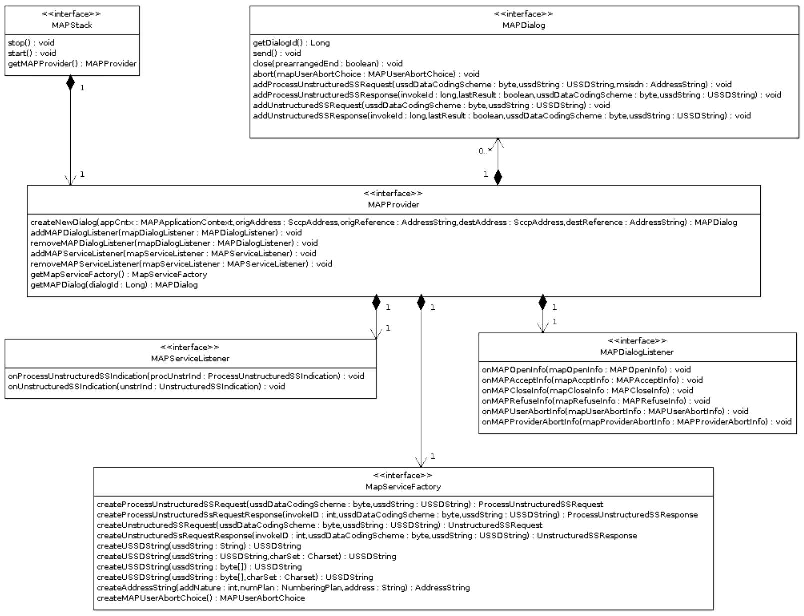
Mobile application part (MAP) is the protocol that is used to allow the GSM network nodes within the Network Switching Subsystem (NSS) to communicate with each other to provide services, such as roaming capability, text messaging (SMS), Unstructured Supplementary Service Data (USSD) and subscriber authentication. MAP provides an application layer on which to build the services that support a GSM network. This application layer provides a standardized set of services. MAP uses the services of the SS7 network, specifically the Signaling Connection Control Part (SCCP) and the Transaction Capabilities Application Part (TCAP)

Important

For better understanding of this chapter please read GSM 09.02.

8.1. SS7 Stack MAP Usage

`org.mobicents.protocols.ss7.map.api.MAPStack` interface defines the methods required to represent MAP Protocol Stack. MAPStack exposes `org.mobicents.protocols.ss7.map.api.MAPProvider` that interacts directly with MAPStack. This interface defines the methods that will be used by any registered MAP User application implementing the `org.mobicents.protocols.ss7.map.api.MAPDialogListener` and `org.mobicents.protocols.ss7.map.api.MAPServiceListener` interface to listen MAP messages and dialogue handling primitives. The class diagram looks like


<<interface>>
MAPStack
stop() : void
start() : void
getMAPProvider() : MAPProvider
<<interface>>
MAPDialog
getDialogId() : Long
send() : void
close(prearrangedEnd : boolean) : void
abort(mapUserAbortChoice : MAPUserAbortChoice) : void
addProcessUnstructuredSSRequest(ussdDataCodingScheme : byte,ussdString : USSDString,msisdn : AddressString) : void
addProcessUnstructuredSSResponse(invokeId : long,lastResult : boolean,ussdDataCodingScheme : byte,ussdString : USSDString) : void
addUnstructuredSSRequest(ussdDataCodingScheme : byte,ussdString : USSDString) : void
addUnstructuredSSResponse(invokeId : long,lastResult : boolean,ussdDataCodingScheme : byte,ussdString : USSDString) : void
1
1
0..*
1
<<interface>>
MAPProvider
createNewDialog(appCntx : MAPApplicationContext,origAddress : SccpAddress,origReference : AddressString,destAddress : SccpAddress,destReference : AddressString) : MAPDialog
addMAPDialogListener(mapDialogListener : MAPDialogListener) : void
removeMAPDialogListener(mapDialogListener : MAPDialogListener) : void
addMAPServiceListener(mapServiceListener : MAPServiceListener) : void
removeMAPServiceListener(mapServiceListener : MAPServiceListener) : void
getMapServiceFactory() : MapServiceFactory
getMAPDialog(dialogId : Long) : MAPDialog
1
1
1
1
1
<<interface>>
MAPServiceListener
onProcessUnstructuredSSIndication(procUnstrInd : ProcessUnstructuredSSIndication) : void
onUnstructuredSSIndication(unstrInd : UnstructuredSSIndication) : void
<<interface>>
MAPDialogListener
onMAPOpenInfo(mapOpenInfo : MAPOpenInfo) : void
onMAPAcceptInfo(mapAccptInfo : MAPAcceptInfo) : void
onMAPCloseInfo(mapCloseInfo : MAPCloseInfo) : void
onMAPRefuseInfo(mapRefuseInfo : MAPRefuseInfo) : void
onMAPUserAbortInfo(mapUserAbortInfo : MAPUserAbortInfo) : void
onMAPProviderAbortInfo(mapProviderAbortInfo : MAPProviderAbortInfo) : void
1
<<interface>>
MapServiceFactory
createProcessUnstructuredSSRequest(ussdDataCodingScheme : byte,ussdString : USSDString) : ProcessUnstructuredSSRequest
createProcessUnstructuredSsRequestResponse(invokeID : int,ussdDataCodingScheme : byte,ussdString : USSDString) : ProcessUnstructuredSSResponse
createUnstructuredSSRequest(ussdDataCodingScheme : byte,ussdString : USSDString) : UnstructuredSSRequest
createUnstructuredSsRequestResponse(invokeID : int,ussdDataCodingScheme : byte,ussdString : USSDString) : UnstructuredSSResponse
createUSSDString(ussdString : String) : USSDString
createUSSDString(ussdString : USSDString,charSet : Charset) : USSDString
createUSSDString(ussdString : byte[]) : USSDString
createUSSDString(ussdString : byte[],charSet : Charset) : USSDString
createAddressString(addNature : int,numPlan : NumberingPlan,address : String) : AddressString
createMAPUserAbortChoice() : MAPUserAbortChoice

JBoss Communications SS7 Stack MAP Class Diagram

Note

JBoss Communications SS7 Stack MAP has implementation for USSD Message only. Any contribution to implement message specific to SMS or other are welcome. We will provide you all the help that you may need initially.

`org.mobicents.protocols.ss7.map.MAPStackImpl` is concrete implementation of `MAPStack` . The MAP User application creates instance of `MAPStackImpl` passing the reference of `SccpProvider` and new instance of `SccpAddress` representing address to which bind listener. This addess will be used to match against destination address in `SCCP` messages.

```
        SccpProvider sccpProvider = getSccpProvider(); //JNDI lookup of SCCP Stack and get
Provider
        SccpAddress localAddress createLocalAddress();

        MAPStackImpl mapStack = new MAPStackImpl(sccpPprovider, localAddress);


        ...

        private SccpAddress createLocalAddress()
        {
            int translationType = 0;

            int subSystemNumber = 0;


            GlobalTitle gt = GlobalTitle.getInstance(translationType,

            NumberingPlan.ISDN_MOBILE, NatureOfAddress.NATIONAL, "1234");

            SccpAddress localAddress = new SccpAddress(gt, 0);
            return localAddress;
        }
```

The reference to `SccpProvider` is received from `SccpStack` . To get handle to `SccpStack` do the JNDI look-up passing the JNDI name configured in SS7 service as explained in *Section 6.3, “Access Point”*

The MAP User application should register the concrete implementation of `MAPDialogListener` and `MAPServiceListener` with `MAPProvider` to listen for incoming MAP Dialog and MAP Primitive messages.

```
public class MAPExample implements MAPDialogListener, MAPServiceListener {
        .....
        mapProvider = mapStack.getMAPProvider();
        mapProvider.addMAPDialogListener(this);
        mapProvider.addMAPServiceListener(this);
        ....
}
```

The MAP User Application leverages `MapServiceFactory` to create instance of `USSDString` and `AddressString`

```
        MapServiceFactory servFact = mapProvider.getMapServiceFactory();
        USSDString ussdString = servFact.createUSSDString("*125*+31628839999#",
                null);

        AddressString msisdn = this.servFact.createAddressString(
                AddressNature.international_number, NumberingPlan.ISDN,
                "31628838002");
```

The MAP User Application leverages `MAPProvider` to create new `MAPDialog` and send USSD message

```
        // First create Dialog
        MAPDialog mapDialog = mapProvider.createNewDialog(
                MAPApplicationContext.networkUnstructuredSsContextV2,
                destAddress, destReference, origAddress, origReference);

        byte ussdDataCodingScheme = 0x0f;

        // USSD String: *125*+31628839999#
```

```
    // The Charset is null, here we let system use default Charset (UTF-7 as
    // explained in GSM 03.38. However if MAP User wants, it can set its own
    // impl of Charset
    USSDString ussdString = servFact.createUSSDString("*125*+31628839999#",
            null);

    AddressString msisdn = this.servFact.createAddressString(
            AddressNature.international_number, NumberingPlan.ISDN,
            "31628838002");

    mapDialog.addProcessUnstructuredSSRequest(ussdDataCodingScheme,
            ussdString, msisdn);

    // This will initiate the TC-BEGIN with INVOKE component
    mapDialog.send();
```

8.2. SS7 Stack MAP Usage

The complete example looks like

```
public class MAPExample implements MAPDialogListener, MAPServiceListener {

    private MAPStack mapStack;
    private MAPProvider mapProvider;

    MapServiceFactory servFact;

    SccpAddress destAddress = null;

    // The address created by passing the AddressNature, NumberingPlan and
    // actual address
    AddressString destReference = servFact.createAddressString(
            AddressNature.international_number, NumberingPlan.land_mobile,
            "204208300008002");

    SccpAddress origAddress = null;

    AddressString origReference = servFact.createAddressString(
            AddressNature.international_number, NumberingPlan.ISDN,
            "31628968300");
```

```
MAPExample(SccpProvider sccpPprovider, SccpAddress address,
        SccpAddress remoteAddress) {
    origAddress = address;
    destAddress = remoteAddress;

    mapStack = new MAPStackImpl(sccpPprovider, origAddress);
    mapProvider = mapStack.getMAPProvider();
    servFact = mapProvider.getMapServiceFactory();

    mapProvider.addMAPDialogListener(this);
    mapProvider.addMAPServiceListener(this);
}

private static SccpProvider getSccpProvider() throws NamingException {

    // no arg is ok, if we run in JBoss
    InitialContext ctx = new InitialContext();
    try {
        String providerJndiName = "/mobicents/ss7/sccp";
        return ((SccpStack) ctx.lookup(providerJndiName)).getSccpProvider();

    } finally {
        ctx.close();
    }
}

private static SccpAddress createLocalAddress() {
    GlobalTitle gt = GlobalTitle
            .getInstance(
                    NatureOfAddress.NATIONAL.getValue(),
                    org.mobicents.protocols.ss7.indicator.NumberingPlan.ISDN_MOBILE,
                    NatureOfAddress.NATIONAL, "1234");

    return new SccpAddress(gt, 0); // 0 is Sub-System number
}

private static SccpAddress createRemoteAddress() {
    GlobalTitle gt = GlobalTitle
            .getInstance(
                    NatureOfAddress.NATIONAL.getValue(),
                    org.mobicents.protocols.ss7.indicator.NumberingPlan.ISDN_MOBILE,
                    NatureOfAddress.NATIONAL, "1572582");
        return new SccpAddress(gt, 0); // 0 is Sub-System number
    }

    public void run() throws Exception {

        // First create Dialog
        MAPDialog mapDialog = mapProvider.createNewDialog(
                MAPApplicationContext.networkUnstructuredSsContextV2,
                destAddress, destReference, origAddress, origReference);

        // The dataCodingScheme is still byte, as I am not exactly getting how
        // to encode/decode this.
        byte ussdDataCodingScheme = 0x0f;

        // USSD String: *125*+31628839999#
        // The Charset is null, here we let system use default Charset (UTF-7 as
        // explained in GSM 03.38. However if MAP User wants, it can set its own
        // impl of Charset
        USSDString ussdString = servFact.createUSSDString("*125*+31628839999#",
                null);

        AddressString msisdn = this.servFact.createAddressString(
                AddressNature.international_number, NumberingPlan.ISDN,
                "31628838002");

        mapDialog.addProcessUnstructuredSSRequest(ussdDataCodingScheme,
                ussdString, msisdn);

        // This will initiate the TC-BEGIN with INVOKE component
        mapDialog.send();
    }

    public void onMAPAcceptInfo(MAPAcceptInfo mapAccptInfo) {
        // TODO Auto-generated method stub

    }

    public void onMAPCloseInfo(MAPCloseInfo mapCloseInfo) {
        // TODO Auto-generated method stub

    }

    public void onMAPOpenInfo(MAPOpenInfo mapOpenInfo) {
        // TODO Auto-generated method stub
    }

    public void onMAPProviderAbortInfo(MAPProviderAbortInfo mapProviderAbortInfo) {
        // TODO Auto-generated method stub

    }

    public void onMAPRefuseInfo(MAPRefuseInfo mapRefuseInfo) {
        // TODO Auto-generated method stub

    }

    public void onMAPUserAbortInfo(MAPUserAbortInfo mapUserAbortInfo) {
        // TODO Auto-generated method stub

    }

    public void onProcessUnstructuredSSIndication(
            ProcessUnstructuredSSIndication procUnstrInd) {
        // TODO Auto-generated method stub

    }

    public void onUnstructuredSSIndication(UnstructuredSSIndication unstrInd) {
        // TODO Auto-generated method stub

    }

    public static void main(String[] args) throws Exception {
        SccpProvider sccpProvider = getSccpProvider(); // JNDI lookup of SCCP

        SccpAddress localAddress = createLocalAddress();
        SccpAddress remoteAddress = createRemoteAddress();

        MAPExample example = new MAPExample(sccpProvider, localAddress,
                remoteAddress);

        example.run();

    }

}
```

Appendix A. Java Development Kit (JDK): Installing, Configuring and Running

The **JBoss Communications Platform** is written in Java; therefore, before running any **JBoss Communications** server, you must have a working Java Runtime Environment (JRE) or Java Development Kit (JDK) installed on your system. In addition, the JRE or JDK you are using to run **JBoss Communications** must be version 5 or higher[1].

Should I Install the JRE or JDK? Although you can run **JBoss Communications** servers using the Java Runtime Environment, we assume that most users are developers interested in developing Java-based, **JBoss Communications**-driven solutions. Therefore, in this guide we take the tact of showing how to install the full Java Development Kit.

Should I Install the 32-Bit or the 64-Bit JDK, and Does It Matter? Briefly stated: if you are running on a 64-Bit Linux or Windows platform, you should consider installing and running the 64-bit JDK over the 32-bit one. Here are some heuristics for determining whether you would rather run the 64-bit Java Virtual Machine (JVM) over its 32-bit cousin for your application:

- Wider datapath: the pipe between RAM and CPU is doubled, which improves the performance of memory-bound applications when using a 64-bit JVM.
- 64-bit memory addressing gives virtually unlimited (1 exabyte) heap allocation. However large heaps affect garbage collection.
- Applications that run with more than 1.5 GB of RAM (including free space for garbage collection optimization) should utilize the 64-bit JVM.
- Applications that run on a 32-bit JVM and do not require more than minimal heap sizes will gain nothing from a 64-bit JVM. Barring memory issues, 64-bit hardware with the same relative clock speed and architecture is not likely to run Java applications faster than their 32-bit cousin.

Note that the following instructions detail how to download and install the 32-bit JDK, although the steps are nearly identical for installing the 64-bit version.

Downloading. You can download the Sun JDK 5.0 (Java 2 Development Kit) from Sun's website: *http://java.sun.com/javase/downloads/index_jdk5.jsp*. Click on the **Download** link next to "JDK 5.0 Update <*x*>" (where <*x*> is the latest minor version release number). On the next page, select your language and platform (both architecture—whether 32- or 64-bit—and operating

[1] At this point in time, it is possible to run most **JBoss Communications** servers, such as the JAIN SLEE, using a Java 6 JRE or JDK. Be aware, however, that presently the XML Document Management Server does not run on Java 6. We suggest checking the JBoss Communications web site, forums or discussion pages if you need to inquire about the status of running the XML Document Management Server with Java 6.

system), read and agree to the `Java Development Kit 5.0 License Agreement`, and proceed to the download page.

The Sun website will present two download alternatives to you: one is an RPM inside a self-extracting file (for example, `jdk-1_5_0_16-linux-i586-rpm.bin`), and the other is merely a self-extracting file (e.g. `jdk-1_5_0_16-linux-i586.bin`). If you are installing the JDK on Red Hat Enterprise Linux, Fedora, or another RPM-based Linux system, we suggest that you download the self-extracting file containing the RPM package, which will set up and use the SysV service scripts in addition to installing the JDK. We also suggest installing the self-extracting RPM file if you will be running **JBoss Communications** in a production environment.

Installing. The following procedures detail how to install the Java Development Kit on both Linux and Windows.

Procedure A.1. Installing the JDK on Linux

- Regardless of which file you downloaded, you can install it on Linux by simply making sure the file is executable and then running it:

```
~]$ chmod +x "jdk-1_5_0_<minor_version>-linux-<architecture>-rpm.bin"
~]$ ./"jdk-1_5_0_<minor_version>-linux-<architecture>-rpm.bin"
```

You Installed Using the Non-RPM Installer, but Want the SysV Service Scripts

If you download the non-RPM self-extracting file (and installed it), and you are running on an RPM-based system, you can still set up the SysV service scripts by downloading and installing one of the `-compat` packages from the JPackage project. Remember to download the `-compat` package which corresponds correctly to the minor release number of the JDK you installed. The compat packages are available from *ftp://jpackage.hmdc.harvard.edu/JPackage/1.7/generic/RPMS.non-free/*.

Important

You do not need to install a `-compat` package in addition to the JDK if you installed the self-extracting RPM file! The `-compat` package merely performs the same SysV service script set up that the RPM version of the JDK installer does.

Procedure A.2. Installing the JDK on Windows

- Using Explorer, simply double-click the downloaded self-extracting installer and follow the instructions to install the JDK.

Configuring. Configuring your system for the JDK consists in two tasks: setting the `JAVA_HOME` environment variable, and ensuring that the system is using the proper JDK (or JRE) using the `alternatives` command. Setting `JAVA_HOME` usually overrides the values for `java`, `javac` and `java_sdk_1.5.0` in `alternatives`, but we will set them all just to be safe and consistent.

Setting the `JAVA_HOME` Environment Variable on Generic Linux

After installing the JDK, you must ensure that the `JAVA_HOME` environment variable exists and points to the location of your JDK installation.

Setting the `JAVA_HOME` Environment Variable on Linux. You can determine whether `JAVA_HOME` is set on your system by `echo`ing it on the command line:

```
~]$ echo $JAVA_HOME
```

If `JAVA_HOME` is not set already, then you must set its value to the location of the JDK installation on your system. You can do this by adding two lines to your personal `~/.bashrc` configuration file. Open `~/.bashrc` (or create it if it doesn't exist) and add a line similar to the following one anywhere inside the file:

```
export JAVA_HOME="/usr/lib/jvm/jdk1.5.0_<version>"
```

You should also set this environment variable for any other users who will be running **JBoss Communications** (any environment variables `export`ed from `~/.bashrc` files are local to that user).

Setting `java`, `javac` and `java_sdk_1.5.0` Using the `alternatives` command

Selecting the Correct System JVM on Linux using `alternatives`. On systems with the `alternatives` command, including Red Hat Enterprise Linux and Fedora, you can easily choose which JDK (or JRE) installation you wish to use, as well as which `java` and `javac` executables should be run when called.

As the root user, call `/usr/sbin/alternatives` with the `--config java` option to select between JDKs and JREs installed on your system:

```
root@localhost ~]$ /usr/sbin/alternatives --config java

There are 3 programs which provide 'java'.

  Selection    Command
-----------------------------------------------
   1           /usr/lib/jvm/jre-1.5.0-gcj/bin/java
   2           /usr/lib/jvm/jre-1.6.0-sun/bin/java
*+ 3          /usr/lib/jvm/jre-1.5.0-sun/bin/java
```

```
Enter to keep the current selection[+], or type selection number:
```

In our case, we want to use the Sun JDK, version 5, that we downloaded and installed, to run the `java` executable. In the `alternatives` information printout above, a plus (+) next to a number indicates the one currently being used. As per `alternatives`' instructions, pressing **Enter** will simply keep the current JVM, or you can enter the number corresponding to the JVM you would prefer to use.

Repeat the procedure above for the `javac` command and the `java_sdk_1.5.0` environment variable, *as the root user*:

```
~]$ /usr/sbin/alternatives --config javac
```

```
~]$ /usr/sbin/alternatives --config java_sdk_1.5.0
```

Setting the `JAVA_HOME` Environment Variable on Windows

For information on how to set environment variables in Windows, refer to *http://support.microsoft.com/kb/931715*.

Testing. Finally, to make sure that you are using the correct JDK or Java version (5 or higher), and that the java executable is in your `PATH`, run the `java -version` command in the terminal from your home directory:

```
~]$ java -version
java version "1.5.0_16"
Java(TM) 2 Runtime Environment, Standard Edition (build 1.5.0_16-b03)
Java HotSpot(TM) Client VM (build 1.5.0_16-b03, mixed mode, sharing)
```

Uninstalling. There is usually no reason (other than space concerns) to remove a particular JDK from your system, given that you can switch between JDKs and JREs easily using `alternatives`, and/or by setting `JAVA_HOME`.

Uninstalling the JDK on Linux. On RPM-based systems, you can uninstall the JDK using the `yum remove <jdk_rpm_name>` command.

Uninstalling the JDK on Windows. On Windows systems, check the JDK entry in the `Start` menu for an uninstall command, or use `Add/Remove Programs`.

Appendix B. Setting the JBOSS_HOME Environment Variable

The **JBoss Communications Platform** (**JBoss Communications**) is built on top of the **JBoss Enterprise Application Platform**. You do not need to set the `JBOSS_HOME` environment variable to run any of the **JBoss Communications Platform** servers *unless* `JBOSS_HOME` is *already* set.

The best way to know for sure whether `JBOSS_HOME` was set previously or not is to perform a simple check which may save you time and frustration.

Checking to See If JBOSS_HOME is Set on Unix. At the command line, `echo` **`$JBOSS_HOME`** to see if it is currently defined in your environment:

```
~]$ echo $JBOSS_HOME
```

The **JBoss Communications Platform** and most JBoss Communications servers are built on top of the **JBoss Enterprise Application Platform** (**JBoss Enterprise Application Platform**). When the **JBoss Communications Platform** or JBoss Communications servers are built *from source*, then `JBOSS_HOME` *must* be set, because the JBoss Communications files are installed into (or "over top of" if you prefer) a clean **JBoss Enterprise Application Platform** installation, and the build process assumes that the location pointed to by the `JBOSS_HOME` environment variable at the time of building is the **JBoss Enterprise Application Platform** installation into which you want it to install the JBoss Communications files.

This guide does not detail building the **JBoss Communications Platform** or any JBoss Communications servers from source. It is nevertheless useful to understand the role played by **JBoss AS** and `JBOSS_HOME` in the JBoss Communications ecosystem.

The immediately-following section considers whether you need to set `JBOSS_HOME` at all and, if so, when. The subsequent sections detail how to set `JBOSS_HOME` on Unix and Windows

Important

Even if you fall into the category below of *not needing* to set `JBOSS_HOME`, you may want to for various reasons anyway. Also, even if you are instructed that you do *not need* to set `JBOSS_HOME`, it is good practice nonetheless to check and make sure that `JBOSS_HOME` actually *isn't* set or defined on your system for some reason. This can save you both time and frustration.

You *DO NOT NEED* to set `JBOSS_HOME` if...

- ...you have installed the **JBoss Communications Platform** binary distribution.

- ...you have installed a JBoss Communications server binary distribution *which bundles **JBoss Enterprise Application Platform***.

You *MUST* set JBOSS_HOME if...

- ...you are installing the **JBoss Communications Platform** or any of the JBoss Communications servers *from source*.
- ...you are installing the **JBoss Communications Platform** binary distribution, or one of the JBoss Communications server binary distributions, which *do not* bundle **JBoss Enterprise Application Platform**.

Naturally, if you installed the **JBoss Communications Platform** or one of the JBoss Communications server binary releases which *do not* bundle **JBoss Enterprise Application Platform**, yet requires it to run, then you should install before setting `JBOSS_HOME` or proceeding with anything else.

Setting the JBOSS_HOME Environment Variable on Unix. The `JBOSS_HOME` environment variable must point to the directory which contains all of the files for the **JBoss Communications Platform** or individual JBoss Communications server that you installed. As another hint, this topmost directory contains a `bin` subdirectory.

Setting `JBOSS_HOME` in your personal `~/.bashrc` startup script carries the advantage of retaining effect over reboots. Each time you log in, the environment variable is sure to be set for you, as a user. On Unix, it is possible to set `JBOSS_HOME` as a system-wide environment variable, by defining it in `/etc/bashrc`, but this method is neither recommended nor detailed in these instructions.

Procedure B.1. To Set JBOSS_HOME on Unix...

1. Open the `~/.bashrc` startup script, which is a hidden file in your home directory, in a text editor, and insert the following line on its own line while substituting for the actual install location on your system:

```
export JBOSS_HOME="/home/<username>/<path>/<to>/<install_directory>"
```

2. Save and close the `.bashrc` startup script.

3. You should `source` the `.bashrc` script to force your change to take effect, so that `JBOSS_HOME` becomes set for the current session[1].

```
~]$ source ~/.bashrc
```

4. Finally, ensure that `JBOSS_HOME` is set in the current session, and actually points to the correct location:

[1] Note that any other terminals which were opened prior to your having altered `.bashrc` will need to `source ~/.bashrc` as well should they require access to `JBOSS_HOME`.

> **Note**
>
> The command line usage below is based upon a binary installation of the **JBoss Communications Platform**. In this sample output, `JBOSS_HOME` has been set correctly to the *`topmost_directory`* of the **JBoss Communications** installation. Note that if you are installing one of the standalone **JBoss Communications** servers (with **JBoss AS** bundled!), then `JBOSS_HOME` would point to the *`topmost_directory`* of your server installation.

```
~]$ echo $JBOSS_HOME
/home/silas/<path>/<to>/<install_directory>
```

Setting the JBOSS_HOME Environment Variable on Windows. The `JBOSS_HOME` environment variable must point to the directory which contains all of the files for the JBoss Communications Platform or individual JBoss Communications server that you installed. As another hint, this topmost directory contains a `bin` subdirectory.

For information on how to set environment variables in recent versions of Windows, refer to *http://support.microsoft.com/kb/931715*.

Appendix C. Revision History

Revision History

Revision 1.0	Wed June 2 2010	BartoszBaranowski
Creation of the JBoss Communications SS7 Stack User Guide.		
Revision 1.1	Tue Dec 21 2010	AmitBhayani
Creation of the JBoss Communications SS7 Stack User Guide.		

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