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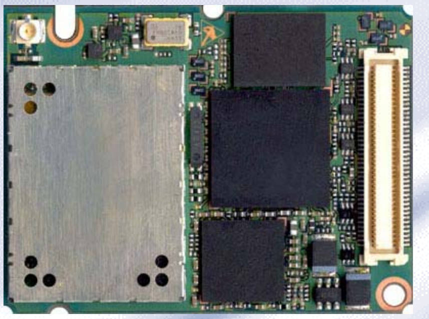

TC65 JAVA User's Guide

Siemens Cellular Engine

Version:	**01**
DocID:	**TC65 JAVA User's Guide_V01**

JAVA™ Users Guide

SIEMENS

Document Name:	**TC65 JAVA User's Guide**
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1 Preamble

As an interim solution, since the final documentation has not yet been completed, this TC65 JAVA User's Guide is supplied as a “Draft” version. Therefore modifications are likely to apply to all chapters of the document.
Paragraphs, written in “italics” are still under development.

2 Overview

The TC65 module features an ultra-low profile and low-power consumption for data (CSD and GPRS), voice, SMS and fax. With Java technology and several peripheral interfaces, the module enables easy integration of your application.
This document explains how to work with the TC65 module, the installation CD and the tools provided on the installation CD.

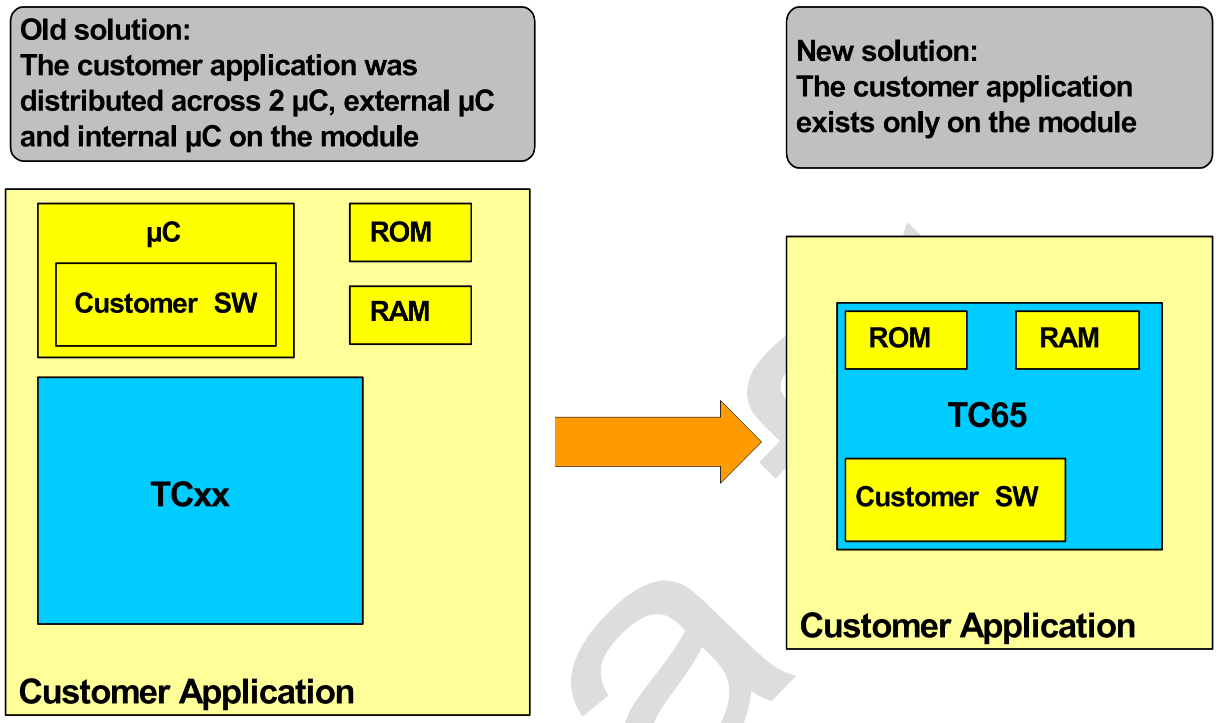

Old solution:
The customer application was distributed across 2 µC, external µC and internal µC on the module
µC
Customer SW
ROM
RAM
TCxx
Customer Application
New solution:
The customer application exists only on the module
ROM
RAM
TC65
Customer SW
Customer Application

Figure 1: Overview

2.1 Related Documents

In addition to the Java Docs for the development API (see Chapter 4), the following documents are included with the SMTK:

[1] Multiplexer Installation Guide
[2] Application Note 23: Installing TC65 Module on DSB75
[3] DSB75 Support Box - Evaluation Kit for Siemens Cellular Engines
[4] TC65 AT Command Set
[5] TC65 Hardware Interface Description
[6] Java doc \wtk\doc\html\index.html

2.2 Terms and Abbreviations

Abbreviation	Description
API	Application Program Interface
ASC	Asynchronous Serial Controller
CLDC	Connected Limited Device Configuration
CSD	Circuit-Switched Data
DAI	Digital Audio Interface
DCD	Data Carrier Detect
DSR	Data Set Ready
GPIO	General Purpose I/O
GPRS	General Packet Radio Service
GPS	Global Positioning System
HTTP	Hypertext Transfer Protocol
I/O	Input/Output
IDE	Integrated Development Environment
IP	Internet Protocol
J2ME™	Java 2 Mobile Edition
J2SE™	Java 2 Standard Edition
JAD	Java Application Description
JAR	Java Archive
JDK	Java Development Kit
JVM	Java Virtual Machine
LED	Light Emitting Diode
ME	Mobile Engine
MIDP	Mobile Information Device Protocol
OTA	Over The Air
OTAP	Over The Air Provisioning of Java Applications
PDP	Packet Data Protocol
PDU	Protocol Data Unit
SDK	Standard Development Kit
SMS	Short Message Service
SMTK	Siemens Mobile Toolkit
TCP	Transfer Control Protocol
URC	Unsolicited Result Code
URL	Universal Resource Locator
VBS	Visual Basic Script
WTK	Wireless Toolkit

3 Installation

3.1 System Requirements

The Siemens Mobility Toolkit (SMTK) TC65 requires that you have:

1. Windows 2000 or Windows XP installed
2. *40Mbytes free disk space for SMTK*
3. Administration privileges
4. Java 2 SDK, Standard Edition 1.4. To install the JDK version 1.4.2_07 provided, follow the instructions in Section 3.3.1.

If a Java IDE such as *Sun Java Studio Mobility 6 2004Q3, Eclipse 3.0, JBuilder 9, X or 2005* is installed, it can be integrated into the SMTK environment during the installation of the SMTK. To install one of the IDEs, follow the installation instructions in Section 3.3.3 and Section 3.3.4 respectively.

3.2 Installation CD

The Siemens Mobility Toolkit TC65 Installation CD includes:

- Module Exchange Suite
- *wtk*
  - bin
  - doc
  - - html
    - java docs for APIs
  - lib
  - - classes.zip
  - src
    - various examples
- AT Java Open Framework
- Network applications
  - ftp
  - mail
- JDK 1.4.2_07
  - J2sdk-1_4_2_07-windows-i586-p.exe
- Sun Java Studio Mobility 6
  - *ffj_me_win32.exe*
- Documents:
  - DSB75_HW_Description.pdf
  - TC65_AT_Command_Set.pdf
  - TC65_HW_Description.pdf
  - WM_AN_24_dev_guide.pdf
  - TC65_ReleaseNote.pdf
  - TC65_Java_UserGuide.pdf (this document)

3.2.1 Components

3.2.1.1 Module Exchange Suite

The Module Exchange Suite allows the developer to access the Flash file system on the cellular engine from the development environment over a serial interface. File transfers from PC to module are greatly facilitated by this suite.

3.2.1.2 WTK

wtk is the directory where all the necessary components for TC65 Java application creation and debugging are stored.

3.2.1.3 AT Java Open Framework (AJOF)

The AJOF allows the developer to write Java applications for the module without dealing directly with AT Commands.

3.2.1.4 Network Applications

The provided classes for ftp and mail help system integrators and developers to design their own network applications.

3.3 SMTK Installation

The SMTK comes with an installation CD. The installation program automatically installs the necessary components and IDE integrations. Software can be uninstalled and updated with the install program. The next sections cover the installation and removal of the SMTK and the installation of the SDK and the supported IDEs.

3.3.1 Installing the Standard Development Toolkit

1. The JDK version 1.4.2_07 is provided on the TC65 SMTK installation disk in the subdirectory “JDK 1.4”. To begin the installation, start the j2sdk-1_4_2_07-windows-i586-p.exe and follow the instructions of the JDK setup procedure. If there is no JDK installed on the target machine the installation of the provided JDK will be offered automatically during the SMTK installation process.
2. Once the toolkit has been installed, the environment variable “path” can be altered to comfortably use the JDK tools. This is not necessary for using the Siemens SMTK.
3. Open the Control Panel.
   a) Open **System.**
   b) Click on **Advanced.**
   c) Click on the **Environment Variables** button.
   d) Choose **path** from the list of system variables.
   e) Append the path for the bin directory of the newly installed SDK to the list of directories for the **path** variable.

3.3.2 Installing the SMTK Environment

1. *Insert CD, start setup.exe. If the dialog box appears simply press the “Next” button to continue the procedure.*
2. *You will be asked to read the license agreement. If you accept the agreement, press “Next” to continue with the installation.*
3. *You will be asked to read the license agreement for Mail4ME Java Mail Support. If you accept the agreement, press “Next” to continue with the installation.*
4. *A file including special information about the installation and use of the SMTK is shown. Press “Next” to continue.*
5. *The installation software checks for the SDK. If there is no SDK on the system the installation procedure offers the installation of the provided JDK now. If this step is denied the setup process will not continue because a properly installed JDK is mandatory for using the SMTK environment.*
6. *At this point, the installation software checks for a Java IDE to be integrated with the SMTK. A Java IDE is not necessary to use the TC65 SMTK. The IDE installation can be done at any time even if the TC65 SMTK is installed already. To integrate the SMTK into the Java IDE run the SMTK setup program in maintenance mode again. However, you can continue the setup procedure and install the IDE installation later or cancel the setup program at this stage and restart it after installing one of the supported Java IDEs. In case you wish to install a Java IDE please follow the instructions in Section 3.3.3 and the following.*
7. *If the SDK and one or more Java IDEs are found, you will be asked to choose which IDE you want integrated into the TC65 development environment. Once an IDE has been found and selected, press "Next" to continue. Ensure that your Java IDE is closed.*
8. *Select the folder where the TC65 SMTK will be installed. A folder will be suggested to you but you may browse to select a different one.*

9. *Choose the path that TC65 will appear under in the Start Menu.*
10. *A brief summary of all entries made shows up.*
11. *After step 9, all necessary files will be copied from the CD into the target folder.*
12. *This is the final step. Again, a listing of all installed components appears.*

3.3.3 Installing Sun Java Studio Mobility 6

1. *Sun Java Studio Mobility 6 is provided on the TC65 SMTK installation disk in the subdirectory "SunOne ME". To begin installation, start the ffj_me_win32.exe and follow the instructions of the Sun Studio setup procedure.*
2. *On the first use of Sun™ Studio 6 after installation, you will be prompted to specify a personal Java folder when Sun Studio is started for the first time. If more then one user uses the computer, each user may have their own Java folder.*

   Note: The integration of the SMTK into Sun™ Studio 6 is only possible if the personal user folder is set. It can only be rolled back by the user who installed the SMTK. If all users use the same Java folder, any user may roll back the integration.

3.3.4 Installing Eclipse 3.0

Eclipse can be freely downloaded from http://www.eclipse.org.

3.3.5 Installing Borland JBuilder 9, X and 2005

Borland JBuilder can be purchased from http://www.borland.com/jbuilder.

Note: The installation path name of JBuilder should not include space characters.

There are also 30 days trial versions available there. Installation instructions can be found on the web page.

3.4 SMTK Uninstall

The TC65 SMTK install package comes with an uninstall facility. The entire SMTK or parts of the package can be removed. To start the uninstall facility, open the **Control Panel**, select **Add/Remove Programs**, select **TC65** and follow the instructions.

3.5 Upgrades

The SMTK can be modified, repaired or removed by running the setup program on the Installation CD.

4 Software Platform

In this chapter, we discuss the software architecture of the SMTK and the interfaces to it.

4.1 Software Architecture

The SMTK enables a customer to develop a Java application on a PC and have it be executable on the TC65 module. The application is loaded onto the module. The platform comprises:

- Basis is the Java™ 2 Micro Edition (J2ME™)
  The J2ME™ is provided by SUN Microsystems, http://java.sun.com/j2me/. It is specifically designed for embedded systems and has a small memory footprint. TC65 uses:
  - CLDC 1.1 HI, the connected limited device configuration hot spot implementation.
  - IMP-NG, the information module profile 2nd generation, this is for the most part identical to MIDP 2.0 but without the lcdui package.

- Additional Java virtual machine interfaces:
  AT Command API
  File I/O API

  The data flow through these interfaces is shown in Figure 3 and Figure 20.

- Memory space for Java programs:

Flash File System:	around 1700k
RAM:	around 400k

  Applications code and data share the space in the flash file system and in RAM.

- Additional accessible periphery for Java applications
  - A maximum of ten shared digital I/O pins usable, for example, as:
    Output: status LEDs
  - Input: Emergency Button
  - One I2C/SPI Interface.
  - One Digital Analog Converter and two Analog Digital Converters.
  -
  - Serial interface (RS-232 API): This standard serial interface could be used, for example, with an external GPS device or a current meter.

  For detailed information see chapter 4.2.

4.2 Interfaces

4.2.1 ASC0 - Serial Device

ASC0, an Asynchronous Serial Controller, is a 9-wire serial interface. It is described in the Hardware Interface Description [5]. Without a running Java application the module can be controlled by sending AT commands via ASC0. Furthermore ASC0 is designed for transferring files from the development PC to the module and for controlling the module with AT commands. When a Java application started, ASC0 can be used as an RS-232 port, refer to Java doc [6].

4.2.2 General Purpose I/O

There are ten I/O pins that can be configured for general purpose I/O. When TC65 starts up, all 10 pins are set, by default, to high-impedance state for use as input. One pin can be configured as pulse counter. See [4] and [5] about configuring the pins.

4.2.3 DAC/ADC

TBD

4.2.4 ASC1

ASC1 is the second serial interface on the module. This is a 4-pin interface (RX, TX, RTS, CTS). It can be used as a second AT interface when a Java application is not running or by a running Java application as System.out.

4.2.5 Digital Audio Interface (DAI)

To support the DAI function, the TC65 has a five-line serial interface with one input data clock line and input/output data and frame lines. Refer to AT Command Set [4] and Hardware Interface Description document [5] for more information.

4.2.6 I2C/SPI

There is a 4 line serial interface which can be used as I2C or SPI interface. It is described in the Hardware Interface Description [5]. The at^sspi at command configures and drives this interface. For details see [5].

4.2.7 JVM Interfaces

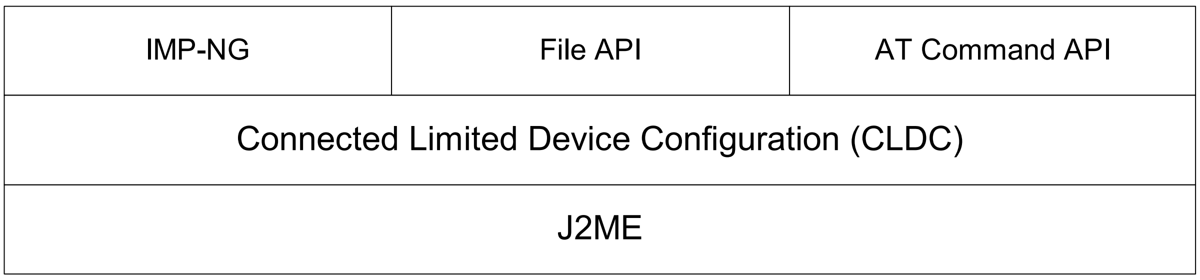


Figure 2: Interface Configuration

J2ME, CLDC and MIDP were implemented by SUN. IMP-NG is a stripped down version of MIDP 2.0 prepared by Siemens and does not include the graphical interface LCDUI. Siemens developed the File I/O API and the AT command API. Documentation for J2ME and CLDC can be found at http://java.sun.com/j2me/. Documentation for the other APIs is found in …/ Java doc [6].

4.2.7.1 IP Networking

IMP-NG provides access to TCP/IP like MIDP 2.0.

Because the used network connection, CSD or GPRS, is fully transparent to the Java interface, the CSD and GPRS parameters must be defined separately either by the AT command at^sjnet [4] or by parameters given to the connector open method, see Java doc [6].

4.2.7.2 Media

TC65 supports only a subset of the optional media package, see Java doc [6].

4.2.7.3 Others

TC65 does neither support the PushRegistry interfaces and mechanisms nor any URL schemes for the PlatformRequest method. See Java doc [6].

4.3 Data Flow of a Java Application Running on the Module

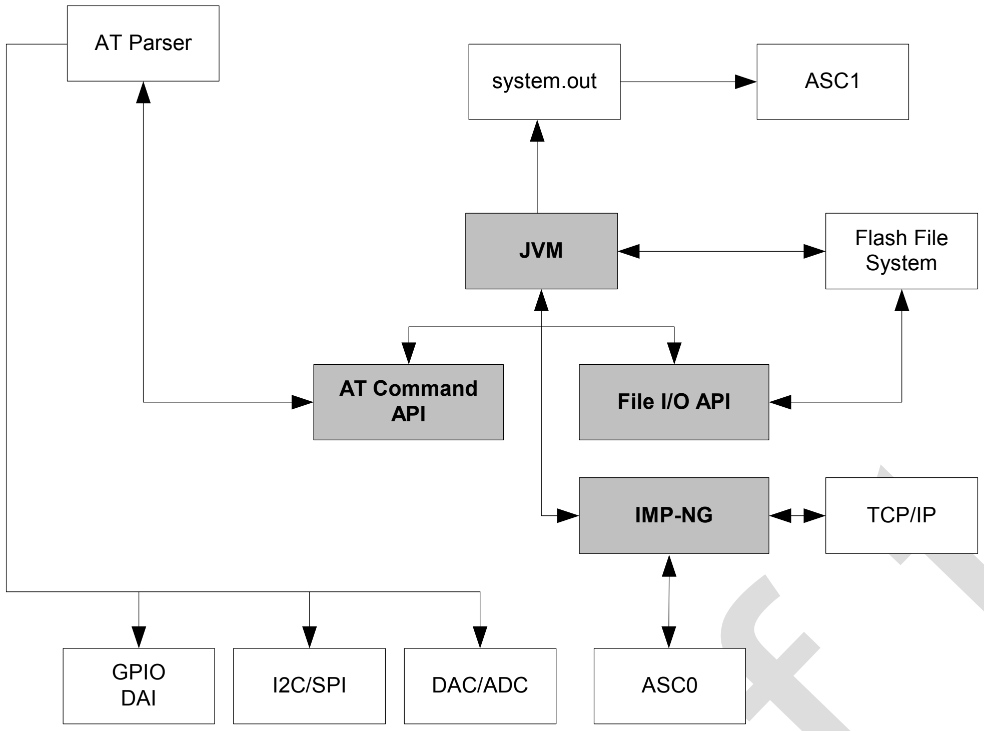


Figure 3: Data flow of a Java application running on the module.

The diagram shows the data flow of a Java application running on the module. The data flow of a Java application running in the debug environment can be found in Figure 20.

The compiled Java applications are stored as JAR files in Flash File System of module. When the application is started, the JVM interprets the JAR file and calls the interfaces to module environment.

The module environment consists of:

• Flash File System:	available memory for Java applications
• TCP/IP:	module internal TCP/IP stack
• GPIO:	general purpose I/O
• DAI:	Digital Audio Interface
• ASC0:	Asynchronous serial interface 0
• ASC1:	Asynchronous serial interface 1
• I2C:	I2C bus interface
• SPI:	Serial Peripheral Interface
• DAC:	digital analog converter
• ADC:	analog digital converter
• AT parser:	accessible AT parser

The Java environment on the module consists of:

• JVM:	Java Virtual Machine
• AT command API:	Java API to AT parser
• File API:	Java API to Flash File System
• IMP-NG:	Java API to TCP/IP [D2]and ASC0

4.4 Handling Interfaces and Data Service Resources

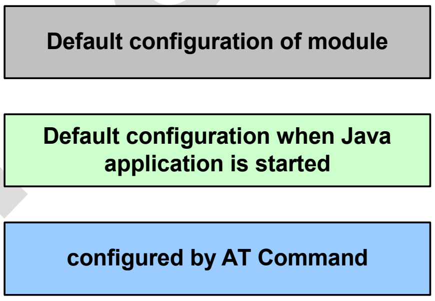
To develop Java applications the developer must know which resources, data services and hardware access are available.

- There are three AT parsers available
- There is hardware access over
  - two serial interfaces: ASC1 (System.out only) and ASC0 (fully accessible).
  - general purpose I/O. To configure the hardware access, please refer to the AT Command Set [4] and the Hardware Interface Description [5].
  - I2C/SPI
  - All restrictions of combinations are described in section 4.4.1.
  -
- A Java application has:
  - three instances of the AT command class, one with CSD and two without, each of which would, in turn, be attached to one of the three AT parsers.
  - one instance of access to a serial interface, ASC0, through the RS-232 API.
  - System.out over the serial interface, ASC1, for debugging.
  -

4.4.1 Module States

The module can exist in the following six states vis-à-vis a Java application and the four I/O pins, (pin group 0), used for ASC1 and general purpose I/O. See the AT Command Set [4] for information about any AT commands referenced. A state transition diagram is shown in Figure 10.

This section shows how Java applications must share AT parsers, GPIO pins I2C/SPI resources. DAC, ADC and DAI are not mentioned here. The USB interface is alternative to ASC1, meaning when USB is plugged in the ASC1 interface is deactivated.


Default configuration of module
Default configuration when Java application is started
configured by AT Command

Legend of colors in following figures

4.4.1.1 State 1: Default – No Java Running

This is the default state. The Java application is inactive and there is an AT interface with CSD on ASC0 as well as ASC1. All HW interface pins are configured as inputs.

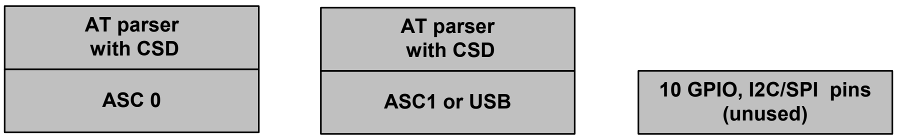


Figure 4: Module State 1

4.4.1.2 State 2: No Java Running, General Purpose I/O and I2C

The Java application is inactive. There is an AT parser with CSD on ASC0 as well as ASC1. Up to ten I/0 pins are used as general purpose I/O plus a I2C interface. The pins are configured *by at^scpin* (refer *to* AT Command Set [4]).

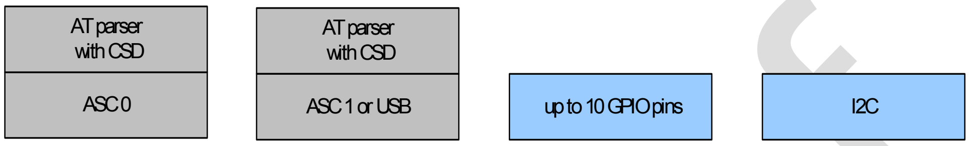


Figure 5: Module State 2

4.4.1.3 State 3: No Java Running, General Purpose I/O and SPI

The Java application is inactive and there is an AT interface with CSD on ASC0 as well as ASC1. Up to ten I/0 pins are used as general purpose I/O plus a SPI interface. The pins are configured *by at^scpin* (refer *to* AT Command Set [4]).

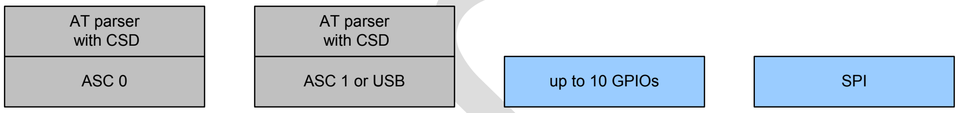


Figure 6: Module State 3

4.4.1.4 State 4: Default – Java Application Active

The Java application is active and ASC1 is used as System.out and the Java instance of the RS-232 serial interface is connected to ASC1. Java instances of AT command are connected to the available AT parsers. The Java application is activated with **at^sjra** (refer to AT Command Set [4]) or autostart.

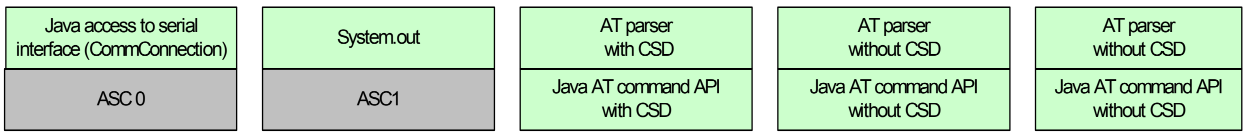

Java access to serial interface (CommConnection)
ASC0
System.out
ASC1
AT parser with CSD
Java AT command API with CSD
AT parser without CSD
Java AT command API without CSD
AT parser without CSD
Java AT command API without CSD

Figure 7: Module State 4

4.4.1.5 State 5: Java Application Active, General Purpose I/O and I2C

The Java application is active, ASC0 is used as System.out and the Java instance of the RS-232 serial interface is connected to ASC1. The Java application is activated with **at^sjra**. The I/O pins are configured *by at^scpin*. Refer to the AT Command Set [4] for AT command details.

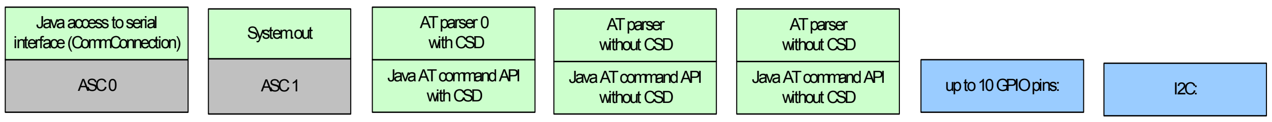

Java access to serial interface (CommConnection)
ASC 0
System.out
ASC 1
AT parser 0 with CSD
Java AT command API with CSD
AT parser without CSD
Java AT command API without CSD
AT parser without CSD
Java AT command API without CSD
up to 10 GPIO pins:
I2C:

Figure 8: Module State 5

4.4.1.6 State 6: Java Application Active, General Purpose I/O and SPI

The Java application is running, ASC0 is used as System.out and the Java instance of the RS-232 serial interface is connected to ASC1. The Java application is activated with **at^sjra** (refer *to* AT Command Set [4]).

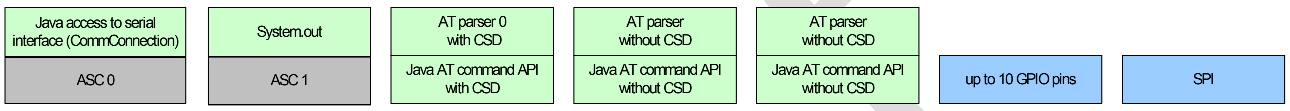

Java access to serial interface (CommConnection)
ASC 0
System.out
ASC 1
AT parser 0 with CSD
Java AT command API with CSD
AT parser without CSD
Java AT command API without CSD
AT parser without CSD
Java AT command API without CSD
up to 10 GPIO pins
SPI

Figure 9: Module State 6

4.4.2 Module State Transitions

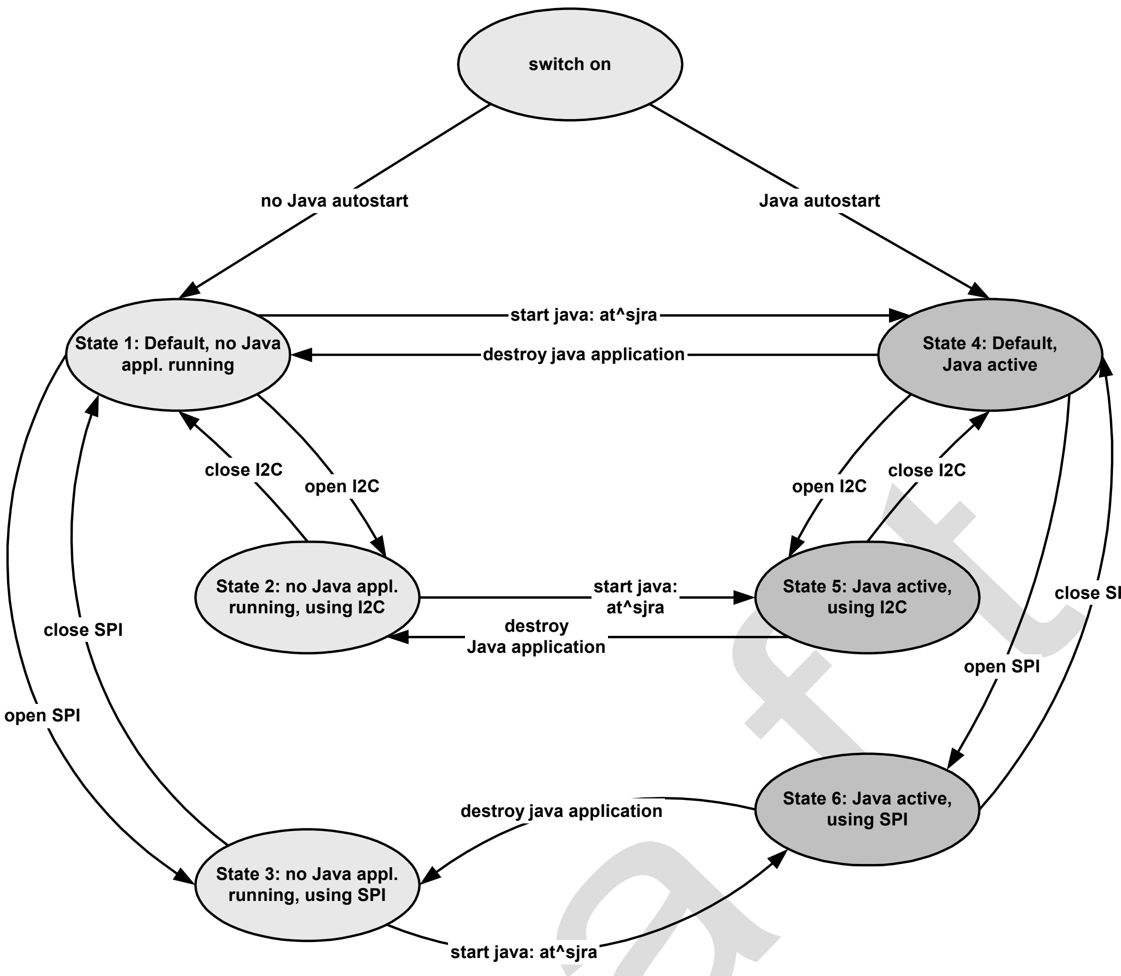


Figure 10: Module State Transition Diagram

Note: No AT parser is available over serial interface ASC0 or ASC1 while a Java application is running on the module.

- System.out is available on ASC1 for debugging while a Java application is running.
- Comparison of Java AT command APIs:

Table 1: Java AT commands

	Voice calls incoming outgoing	Data calls incoming outgoing	SMS incoming outgoing	GPRS connection	Phonebook management	AT commands
Java AT command API with CSD	●	●	●	● 2)	●	●
Java AT command API without CSD	●	-	●	● 2)	●	● 1)

●	indicates that the functionality is <u>available</u> from the Java AT command API
---	indicates that the functionality is <u>not available</u> from the Java AT command API
1)	except for AT commands related to data calls
2)	only two Java AT command APIs can be used in parallel to transmit GPRS data

5 Maintenance

Basic maintenance features of the TC65 are described below. Explicit details of these functions and modes can be found in the AT Command Set [4] and the Hardware Interface Description [5].

5.1 Power Saving

The module supports several power saving modes which can be configured by the AT command **at+cfun** [4]. Power saving affects the Java application in two ways. On the one hand it limits the access to the serial interface (RS-232-API) and the GPIO pins and on the other hand power saving efficiency is directly influenced by the way a Java application is programmed.

Java hardware access limitations:

- In NON-CYCLIC SLEEP mode (cfun=0) the serial interface cannot be accessed while in CYCLIC SLEEP mode (CFUN=7 or 9) the serial interface can be used with hardware flow control (CTS/RTS).
- *In all SLEEP modes the GPIO polling frequency is reduced, so that only signal changes which are less than 0.2Hz can be detected properly. Furthermore it should be mentioned that the signal must be constant for at least 2.12s to detect changes. For further details refer to [5].*

Java power saving efficiency:

- As long as any Java thread is active, power consumption cannot be reduced, regardless whether any SLEEP mode has been activated or not. So a Java application that wants to be power efficient should not have any unnecessarily active threads (e.g. no busy loops).

5.2 Charging

Please refer to [4] and [5] for general information about charging. Charging can be monitored by the running Java application. The JVM is active in Charge mode and when autostart is activated also in Charge-Only mode. Only a limited number of AT commands are available when the module is in Charge-Only mode. A Java application must be able to handle the Charge-Only mode and reset the module to reinstate the normal mode. See [5] for information about the Charge-Only mode.

The Charge-Only mode is indicated by URC “SYSSTART CHARGE-ONLY MODE”.

Note: When a Java application is started in Charge-Only mode only AT Command APIs without CSD are available. The indicating URC is created after issuing the very first AT command on any opened channel. To read the URC it is necessary to register a listener (see [6]) on this AT command API instance before passing the first AT command.

5.3 Airplane Mode

The main characteristic of this mode is that the RF is switched off and therefore only a limited set of AT commands is available. The mode can be entered or left using the appropriate at^scfg command. This AT command can also be used to configure the airplane mode as the standard startup mode, see [5]. The JVM is started when autostart is enabled. A Java application must be able to handle this mode. The airplane mode is indicated by URC "SYSSTART AIRPLANE MODE". Since the radio is off all classes related to networking connections, e.g. SocketConnection, UDPDatagramConnection, SocketServerConnection, HTTPConnection, will through an exception when accessed.

5.4 Alarm

The ALARM can be set by the *at+cala* AT command. Please refer to the AT Command Set [4] and Hardware Interface Description [5] for more information. One can set an alarm, switch off the module with *at^smso*, and have the module restart at the time set with *at+cala*. When the alarm triggers the module restarts in a limited functionality mode, the "airplane mode". Only a limited number of AT commands is available in this mode, though the JVM is started when autostart is enabled. A Java application must be able to handle this mode and reset the module to reinstate the normal mode.
The airplane mode is indicated by URC "SYSSTART AIRPLANE MODE".

Note: For detailed information which functionality is available in this mode see [5]. The mode indicating URC is created after issuing the very first AT command on any opened channel.

5.5 Shut Down

In the case of an unexpected shut down, data that should be written will get lost due to a buffered write access to the flash file system. However, the best and safest approach to powering down the module is to issue the AT^SMSO command. This procedure lets the engine log off from the network and allows the software to enter into a secure state and save all data. Further details can be found in [5].

5.5.1 Automatic Shutdown

The module is switched off automatically in different situations:

- under- or overtemperature
- under- or overvoltage

This will happen without a warning notification unless the appropriate URC has been activated. If the URCs are enabled, the module will deliver an alert before switching off. To activate the URCs for temperature conditions use the **at^sctm** command, to activate the undervoltage URC use the **at^sbc** command. It is recommended that these URCs be activated so that the module can be shut by the application with **at^smso** after setting an alarm, see Section 5.4. Please note that there is no URC function available for overvoltage conditions, i.e. no alert will be sent before shutdown. The commands are described in the AT Command Set [4], while a description of the shutdown procedure can be found in [5].

5.5.2 Restart after Switch Off

The module can be switched off with the AT command, **at^smso** without setting an alarm time, see the AT Command Set [4]. A power failure will also switch off the module. When the module is switched off, external hardware must restart the module with the Ignition line (IGT). The Hardware Interface Description [5] explains how to handle a switched off situation.

5.6 Special AT Command Set for Java Applications

For the full AT command set refer to [4]. There are differences in the behaviour of issuing AT commands from a Java application compared to using AT commands over a serial interface.

5.6.1 Switching from Data Mode to Command Mode

Cancelling the data flow with “+++” is not available in Java applications, see [4] for details. To break the data flow use **breakConnection(),** refer to \wtk\doc\index.html [6].

5.6.2 Mode Indication after MIDlet Startup

As on the serial interface after starting the module without autobauding on, the module sends its state (^SYSSTART, ^SYSSTART ALARM MODE etc.) to the MIDlet. This is done via URC to the AT Command API instance which executes the very first AT Command from within Java. To read this URC it is necessary to register a listener (see [6]) on this AT Command API instance before passing the first AT Command.

5.6.3 Long Responses

The AT Command API can handle responses of AT commands up to a length of 1024 bytes. Some AT commands have responses longer than 1024 bytes, for these responses the Java application will receive an Exception.

Existing workarounds:

- Instead of listing the whole phone book, read the entries one by one
- Instead of listing the entire short message memory, again list message after message
- Similarly, read the provider list piecewise
- Periods of monitoring commands have to be handled by Java, i.e. **at^moni, at^smong**. These AT commands have to be used without parameters, i.e. **at^moni** the periods have to be implemented in Java.

5.6.4 Configuration of Serial Interface

While a Java application is running on the module, only the AT Command API is able to handle AT commands. All AT commands referring to serial interface are ignored. Especially these are the following:

- AT+IPR
- AT\Q3

If Java is running, the firmware will ignore any settings from these commands. Responses to the read, write or test commands will be invalid or deliver “ERROR”.

Note:
When a Java application is running, all settings of the serial interface are done by the class CommConnection. This is fully independent of any AT commands relating a serial interface.

5.6.5 Java Commands

There is a small set of special Java AT commands:

- at^sjra, start of Java application
- at^sjnet, the configuration for Java networking connection
- at^sjotap, start and configuration of the over the air provisioning
- *at^sjsec, security configuration*

Refer to AT command set [4].

5.7 Restrictions

5.7.1 Flash File System

The maximum length of a complete path name, including the path and the filename, is limited by the Flash file system on the module to 124 characters.
It is recommended to distinguish names of classes and files not only by case sensitivity.

5.7.2 Memory

The CLDC 1.1 HI features a just in time compiler. That means that parts of the Java byte code which are frequently are translated into machine code to improve efficiency. This feature uses up RAM space. So there is always a trade off between code translation to speed up execution and RAM space available for the application.

5.8 Performance Statements

Scope of the performance study was getting comparable values that indicate the performance under certain circumstances.

5.8.1 Java

This section gives information about the Java command execution throughput ("jPS"= Java statements per second). The scope of this measurement is only the statement execution time, not the execution delay (Java command on AT interface ➔ Java instruction execution ➔ reaction on GPIO).

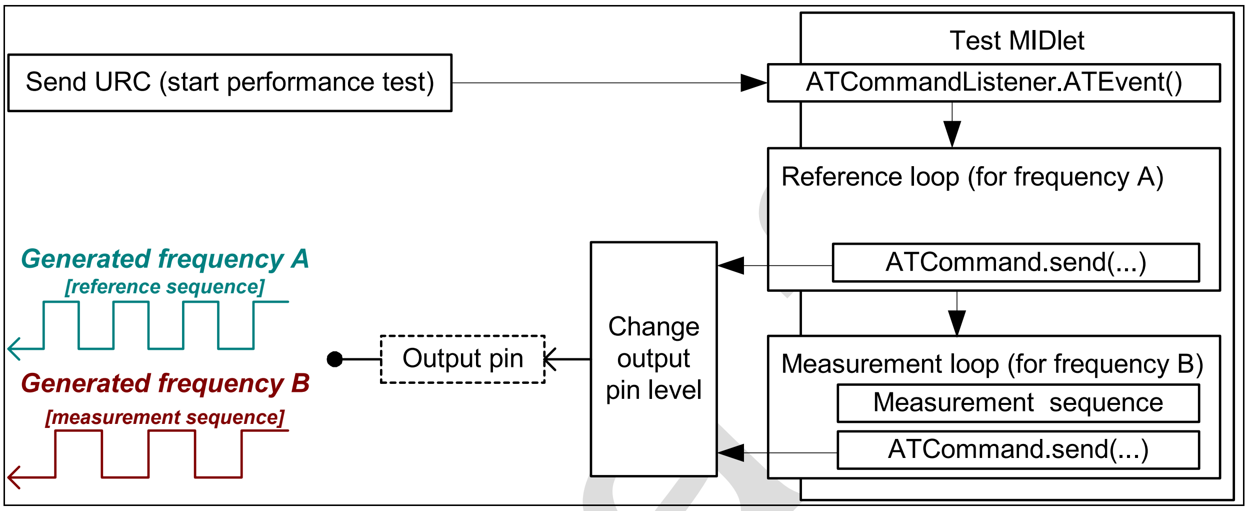


Figure 11: Test case for measuring Java command execution throughput

The following Java instruction was used for calculation of the typical jPS:

value = (2 x number of calculation statements) /
((1 / frequencyB) - (1 / frequencyA));

Measurement and calculation were done using:

- ***duration of each loop** = 600 s*
- ***number of calculation statements** = 5 "**result=(CONSTANT_VALUE/variable_value);**"-Instructions (executed twice per pin cycle)*
- ***frequencyA** as measured with universal counter*
- ***frequencyB** as measured with universal counter*

The reference loop has the same structure as the measurement loop except that the measurement sequence is moved.

State	**jPS-Value (mean)**
TC65 module in IDLE mode / Not connected	~750 jPS
CSD connection	~450 jPS

These mean values may be sporadically reduced depending on dynamic conditions.

5.8.2 Pin-IO

The pin IO test was defined to find out how fast a Java MIDlet can process URCs caused by Pin IO and react on these URCs.
The URCs are generated by feeding an input pin with an external frequency. As soon as the Java MIDlet gets informed about the URC, it tries to regenerate the feeding frequency by toggling another output pin.

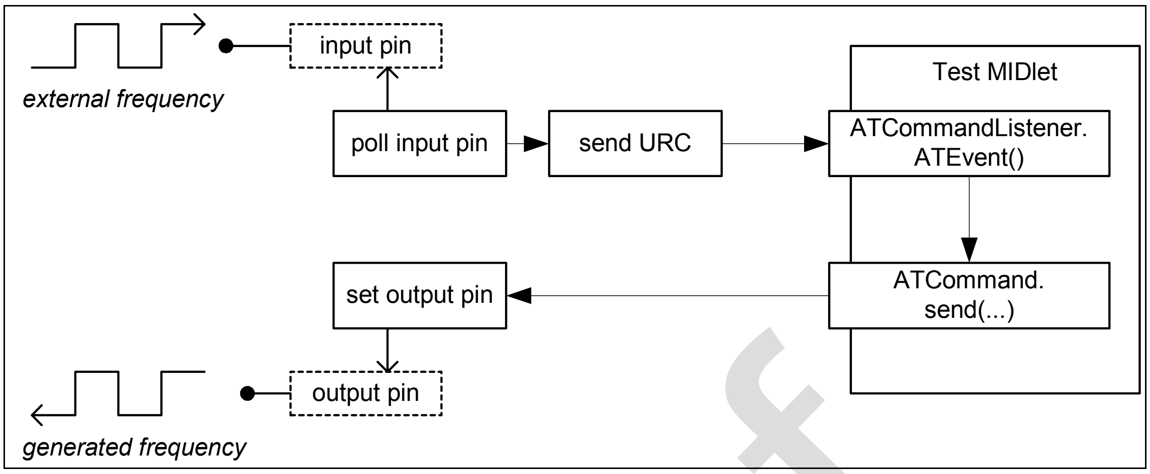


Figure 12: Test case for measuring Java MIDlet performance and handling pin-IO

The results of this test show that the delay from changing the state on the pin to processing the URC in the MIDlet is at least 20 TDMA frames, but depends mainly on the amount of garbage to collect and number of thread to serve by the virtual machine. So Pin IO is not suitable to generate or detect frequencies.

5.8.3 Data Rates on RS-232 API

For details about software platform and interfaces refer to Chapter 4, "Software Platform".
This section summarises limitations and preconditions for performance when using the interface CommConnection from package com.siemens.mp.io (refer to [6]).
The data rate on RS232 depends on the size of the buffer used for reading from and writing to the serial interface. It is recommended to use for reading from serial interface the method read (byte[ ] b). The recommended buffer size is 2kbyte.
To reach errorfree data transmission the flowcontrol on CommConnection has to be switched on: <autorts> and <autocts>, the same for connected device.

Below, different use cases are listed to give an idea of reachable data rates. All applications for measurements are working with only one thread, no more activities than those described were done in parallel.

5.8.3.1 Plain Serial Interface

Scenario: A device is connected to ASC0 (refer to 4.2.4). The Java application has to handle data input and output streams.
A simple Java application (only one thread) which is looping incoming data directly to output reaches data rates up to 140kbit/s. Test conditions: hardware flow control enabled (<autorts> and <autocts>) and baud rate on ASC0 set to 230kbit/s.

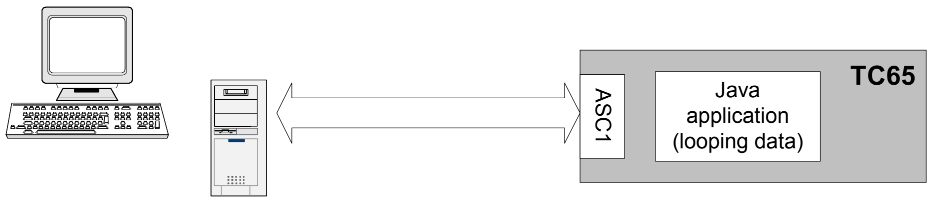


Figure 13: Scenario for testing data rates on ASC1

5.8.3.2 Voice Call in Parallel

Same scenario as in section 5.8.3.1, but a voice call added. The application is reflecting incoming data directly to output and, additionally, handles an incoming voice call. The data rates are up to 119kbit/s. Test conditions: baud rate on ASC0 set to 230kbit/s.

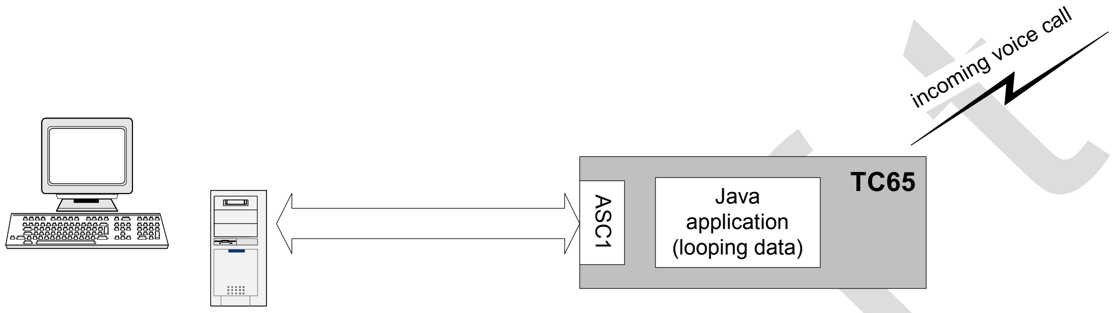


Figure 14: Scenario for testing data rates on ASC1 with a voice call in parallel

5.8.3.3 Scenarios with GPRS Connection

The biggest challenge for the module performance is setting up a GPRS connection, receiving data on interfaces of javax.microedition.io and sending or receiving the data on the RS232 API with the help of a Java application.

5.8.3.3.1 Upload

TC65 supports GPRS class 8, this means one timeslot for upload data is available. The Java application receives data over RS232 API and sends them over GPRS to a server.

Table 2: Data rate upload

	Upload data rate in [kbit/s]	
	Coding scheme 2	**Coding scheme 4**
Data rate	*11*	*18*
Theoretical value	*12*	*20*
% from theoretical value*	*91%*	*90%*

* net transmission rates for LLC layer

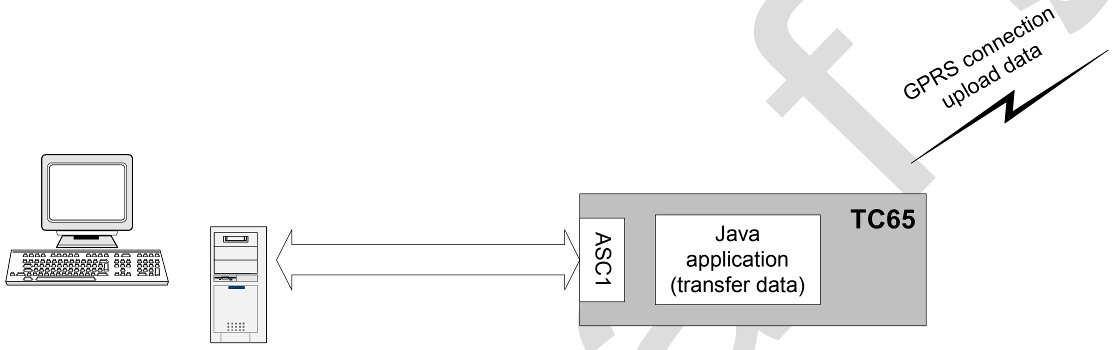


Figure 15: Scenario for testing data rates on ASC1 with GPRS data upload

5.8.3.3.2 Download

The data rate for downloading data over GPRS depends on the number of assigned timeslots and the coding schemes given by the net. TC65 supports GPRS class 8, this means the number of assigned timeslots can be up to 4.
For measurement purposes, the Java application receives data from the server over GPRS and sends them over RS232 to an external device.

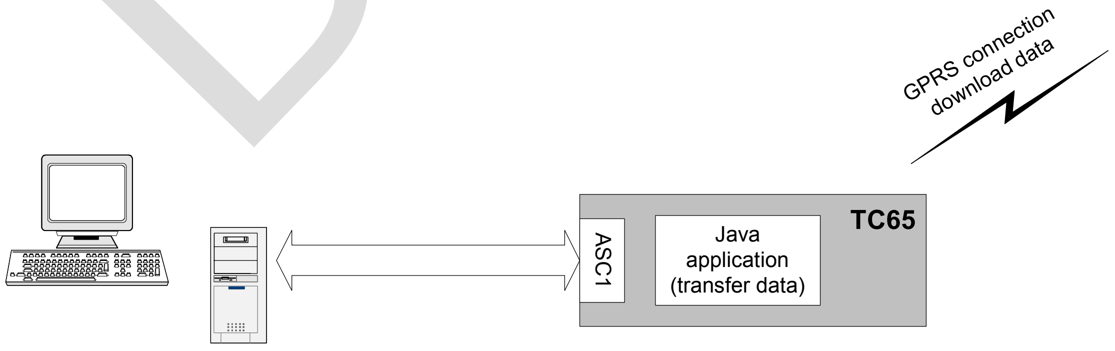


Figure 16: Scenario for testing data rates on ASC1 with GPRS data download

The tables below show the download data rates that can be achieved if hardware control is enabled on the CommConnection interface.

Table 3: Download data rate with different number of timeslots, CS2

Download data rate with x timeslots *Coding scheme 2* [kbit/s]											
1 timeslot	**theor. Value ***	**% from theor. Value**	**2 time-slots**	**theor. Value ***	**% from theor. Value**	**3 time-slots**	**theor. Value ***	**% from theor. Value**	**4 time-slots**	**theor. Value ***	**% from theor. Value**
11	*12*	*91 %*	*22*	*24*	*91 %*	*31*	*36*	*86 %*	*34*	*48*	*70 %*

* net transmission rates for LLC layer

Table 4: Download data rate with different number of timeslots, CS4

Download data rate with x timeslots *Coding scheme 4* [kbit/s]											
1 timeslot	**theor. Value ***	**% from theor. value**	**2 time-slots**	**theor. Value ***	**% from theor. value**	**3 time-slots**	**theor. Value ***	**% from theor. value**	**4 time-slots**	**theor. Value ***	**% from theor. value**
18	*20*	*90 %*	*31*	*40*	*77 %*	*34*	*60*	*56 %*	*38*	*80*	*47 %*

* net transmission rates for LLC layer

6 MIDlets

The J2ME™ Mobile Information Device Profile (MIDP) provides a targeted Java API for writing wireless applications. The MIDP runs on top of the Connected Limited Device Configuration (CLDC), which in turn, runs on top of the J2ME™. MIDP applications are referred to as MIDlets. MIDlets are controlled by the mobile device implementation that supports the CLDC and MIDP. Since IMP-NG is a subset of MIDP 2.0, IMP includes MIDlets. The MIDlet code structure is very similar to applet code. There is no main method and MIDlets always extend from the MIDlet class. The MIDlet class in the MIDlet package provides methods to manage a MIDlet's life cycle.

6.1 MIDlet Documentation

MIDP and MIDlet documentation can be found at http://wireless.java.sun.com/midp/ and in the html document directory of the wtk,
…\Siemens\SMTK\TC65wtk\doc\index.html

6.2 MIDlet Life Cycle

The MIDlet life cycle defines the protocol between a MIDlet and its environment through a simple well-defined state machine, a concise definition of the MIDlet's states and APIs to signal changes between the states. A MIDlet has three valid states:

- **Paused** – The MIDlet is initialised and is quiescent. It should not be holding or using any shared resources.
- **Active** – The MIDlet is functioning normally.
- **Destroyed** – The MIDlet has released all of its resources and terminated. This state is only entered once.

State changes are affected by the MIDlet interface, which consists of:
- **pauseApp()** – the MIDlet should release any temporary resources and become passive.
- **startApp()** – the MIDlet starts it's execution, needed resources can be acquire here or in the MIDlet constructor
- **destroyApp()** – the MIDlet should save any state and release all resources
- Note: destroyApp() is called when a MIDlet should terminate caused by device.
- **notifyDestroyed()** – the MIDlet notifies the application management software that it has cleaned up and is done
- Note: the only way to terminate a MIDlet is to call notifyDestroyed(), but destroyApp() is not automatically called by notifyDestroyed().
- **notifyPaused()** – the MIDlet notifies the application management software that it has paused

- **resumeRequest()** – the MIDlet asks application management software to be started again.

  - **getAppProperty()** – gets a named property from the MIDlet

Table 5: A typical sequence of MIDlet execution

Application Management Software	**MIDlet**
The application management software creates a new instance of a MIDlet.	The default (no argument) constructor for the MIDlet is called; it is in the Paused state.
The application management software has decided that it is an appropriate time for the MIDlet to run, so it calls the **MIDlet.startApp** method for it to enter the Active state.	The MIDlet acquires any resources it needs and begins to perform its service.
The application management software no longer needs the application be active, so it signals it to stop performing its service by calling the **MIDlet.pauseApp** method.	The MIDlet stops performing its service and might choose to release some resources it currently holds.
The application management software has determined that the MIDlet is no longer needed, or perhaps needs to make room for a higher priority application in memory, so it signals the MIDlet that it is a candidate to be destroyed by calling the **MIDlet.destroyApp** method.	If it has been designed to do so, the MIDlet saves state or user preferences and performs clean up.

6.3 Hello World MIDlet

Here is a sample HelloWorld program.

```
/**
 * HelloWorld.java
 */

package example.helloworld;
import javax.microedition.midlet.*;
import java.io.*;

public class HelloWorld extends MIDlet {

  /**
   * HelloWorld - default constructor
   */
  public HelloWorld() {
    System.out.println("HelloWorld: Constructor");
  }

  /**
   * startApp()
   */
  public void startApp() throws MIDletStateChangeException {
    System.out.println("HelloWorld: startApp");
    System.out.println("\nHello World!\n");
    destroyApp();
  }

  /**
   * pauseApp()
   */
  public void pauseApp() {
    System.out.println("HelloWorld: pauseApp()");
  }

  /**
   * destroyApp()
   */
  public void destroyApp(boolean cond) {
    System.out.println("HelloWorld: destroyApp(" + cond + ")");
    notifyDestroyed();
  }
}
```

7 AT Java Open Framework (AJOF)

7.1 AT Commands

The TC65 AT Command Set [4] contains all of the standard AT commands needed to operate a GSM/GPRS mobile. Please note that no fax commands are supported when the TC65 is operated in the Java environment. Simply issuing individual AT commands can control the TC65 module. See the “AT Command Set” to learn more about AT commands. The AT Java Open Framework allows an application to be built without dealing with individual AT commands. This framework sits on top of the AT command API.

The AT commands have been divided into six functional areas. Each area is represented as a package. Documentation for the methods of each area and the AT commands covered by these methods can be found in **…\Siemens\SMTK\TC65\AJOF\doc\index.html**, [10].

Extensions are possible to this framework. The Java tutorial in Chapter 13 gives examples on how to use this framework.

7.1.1 Mobile Engine Sstatus

This area abstracts AT commands which affect the ME status, either by setting or returning device parameters. The methods supplied in this category are mostly query methods. Most of the methods in this category can be called regardless of the ME’s current status. The values set by these methods remain valid after the method call is finished.

7.1.2 Voice Call Handling

This category provides the methods for the handling of voice calls. Some of these methods can only be executed successfully when the module is in a particular state.

7.1.3 Short Message Service

There are two formats, text and PDU, for sending short messages. The developer can create messages of both formats, however, AJOF handles SMs internally in the PDU format. With this framework, sending a short message should be as simple as writing a string to the screen. The methods provided do all the appropriate conversions for reading or preparing an SM. These conversions are transparent to the application programmer.

7.1.4 Phonebook Features

The phonebook methods provide access to the phonebook storage media. This class provides methods to select a storage medium, list the stored entries, write into, browse through, read or delete from a storage medium.

7.1.5 Pin I/O

The pin I/O class provides methods for configuring the pins, writing to and reading from the pins, configuring the pins as a port and listening to the pins/port.

8 File Transfer to Module

8.1 Module Exchange Suite

The Module Exchange Suite allows you to view the Flash file system on the module as a directory from Windows Explorer. Make sure that the module is turned on and that ASC0 of the module is connected to the configured COM port of Module Exchange Suite. The adjustment of the configured COM port can be checked by attributes on Module directory.
Please note that the Module Exchange Suite can be used only if the module is in normal mode.
While running the module with Module Exchange Suite subdirectories and files can be added in flash file system of module. Take in mind that only the maximum of 200 flash objects (files and subdirectories) per directory in flash file system of module are recommended.

8.1.1 Windows Based

The directory is called “Module” and can be found at the top level of workspace “MyComputer”. To transfer a file to the module, simply copy the file from the source directory to the target directory in the “Module -> Module Disk (A:)”.

8.1.2 Command Line Based

A suite of command line tools is available for accessing the module’s Flash file system. They are installed in the Windows System directory so that the tools are available from any directory. The module’s file system is accessed with *mod:*. The tools included in this suite are MESdel, MEScopy, MESxcopy, MESdir, MESmkdir, MESrmdir, MESport and MESformat. Entering one of these commands without arguments will describe the command’s usage. The tools mimic the standard directory and file commands. A path inside the module’s file system is identified by using “mod:” followed by the module disk which is always “A:” (e.g. “MESdir mod:a:” lists the contents of the module’s root directory).

8.2 Over the Air Provisioning

See Chapter 9 for OTA provisioning.

8.3 Security Issues

The developer should be aware of the following security issues. Security aspects in general are discussed in chapter 12.

8.3.1 Module Exchange Suite

The serial interface should be mechanically protected.

The copy protection rules for Java applications prevent opening, reading, copying, moving or renaming of JAR files. It is not recommended to use names of Java applications (for example <name>.jar) for directories, since the copy protection will deny access to open, copy or rename such directories.

8.3.2 OTAP

- A password should be used to update with OTA (SMS Authentication)
- Parameters should be set to fixed values (***at^sjotap***) whenever possible so that they cannot be changed over the air.
- The http server should be secure. (e.g. Access control via basic authentication)

9 Over The Air Provisioning (OTAP)

9.1 Introduction to OTAP

OTA (Over The Air) Provisioning of Java Applications is a common practice in the Java world. OTAP describes mechanisms to install, update and delete Java applications over the air. The TC65 product implements the Over The Air Application Provisioning as specified in the IMP-NG standard.
The OTAP mechanism described in this document does not require any physical user interaction with the device; it can be fully controlled over the air interface. Therefore it is suitable for Java devices that are not supposed to have any manual interaction like vending machines or electricity meters.

9.2 OTAP Overview

To use OTAP, the developer needs, apart from the device fitted with the TC65 module, an http server, which is reachable through a TCP/IP connection either over GPRS or CSD, and an SMS sender, which can send Class1, PID $7d short messages. This is the PID reserved for module's data download.

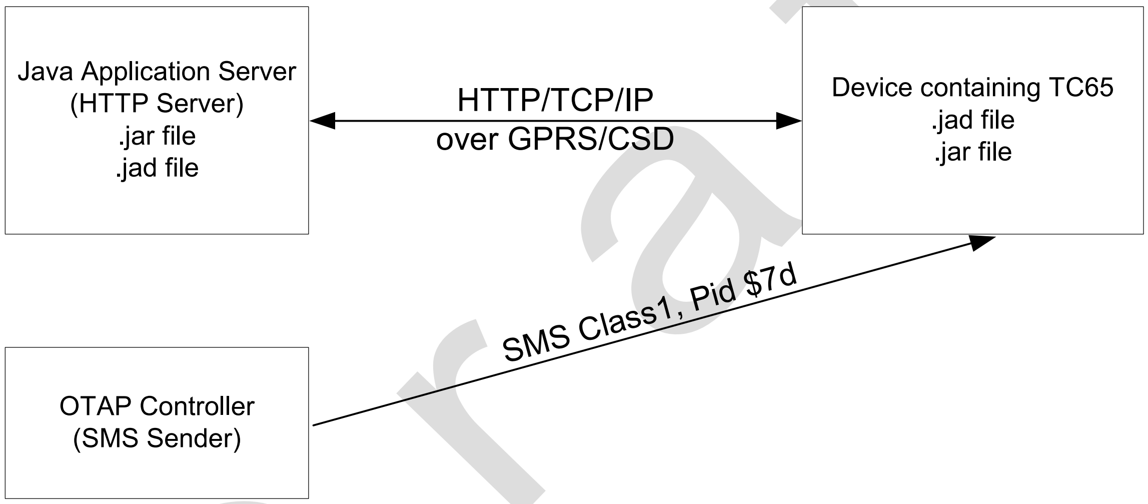


Figure 17: OTAP Overview

The Java Application Server (http Server) contains the .jar and the .jad file, which are to be loaded on the device. Access to these files can be protected by http basic authentication.
The OTAP Controller (SMS Sender) controls the OTAP operations. It sends SMs, with or without additional parameters, to the devices that are to be operated. These devices then try to contact the http server and download new application data from it. The OTAP Controller will not get any response about the result of the operation. Optionally the server might get a result response through http.

There are two types of OTAP operations:
- Install/Update: A new JAR and JAD file are downloaded and installed.
- Delete: A complete application (.jar, .jad, all application data and its directory) is deleted.

9.3 OTAP Parameters

There is a set of parameters that control the OTAP procedures. These parameters can either be set by AT command (**at^sjotap**, refer to AT Command Set [7]) presumably during the production of the device, or by SM (see Section 9.4) during operation of the device in the field. None of the parameters, which are set by AT command, can be overwritten by SM.

- JAD File URL: the location of the JAD file is used for install or update procedures. The JAD file needs to be located on the net (e.g. http://someserver.net/somefile.jad or http://192.168.1.2/somefile.jad).
- Application Directory: this is the directory where a new application (JAD and JAR file) is installed. The delete operation deletes this directory completely. When entering the application directory by **at^sjotap** or short message be sure that the path name is not terminated with a slash. For example, type "a:" or "a:/otap" rather than "a:/" or "a:/otap/". See examples provided in Chapter 9.4.
- http User: a username used for authentication with the http server.
- http Password: a password used for authentication with the http server.
- Bearer: the network bearer used to open the HTTP/TCP/IP connection, either GPRS or CSD.
- APN or Number: depending on the selected network bearer this is either an access point name for GPRS or a telephone number for CSD.
- Net User: a username used for authentication with the network.
- Net Password: a password used for authentication with the network.
- DNS: a Domain Name Server's IP address used to query hostnames.
- NotifyURL: the URL to which results are posted

There is one additional parameter that can only be set by AT command:
- SM Password: it is used to authenticate incoming OTAP SMs. Setting this password gives an extra level of security.
  Note: If there was a password set by AT command, all SMs have to include this password

Table 6: Parameters and keywords

Parameters	Max. Length AT	Keyword SM	Install/update	delete
JAD File URL	*100*	JADURL	mandatory	unused
Application Directory	*50*	APPDIR	mandatory	mandatory
HTTP User	*32*	HTTPUSER	optional	unused
HTTP Password	*32*	HTTPPWD	optional	unused
Bearer	--	BEARER	mandatory	unused
APN or Number	*65*	APNORNUM	mandatory for CSD	unused
Net User	*32*	NETUSER	optional	unused
Net Password	*32*	NETPWD	optional	unused
DNS	--	DNS	optional	unused
Notify URL	*100*	NOTIFYURL	optional	unused
SM Password	*32*	PWD	optional	optional

The length of the string parameters in the AT command is limited (see Table 6), the length in the SM is only limited by the maximum SM length.
The minimum set of required parameters depends on the intended operation (see Table 6).

9.4 Short Message Format

An OTAP control SM must be a Submit PDU with Class1, PID $7d and 8 bit encoding. As a fallback for unusual network infrastructures the SM can also be of Class0 and/or PID $00. The content of the SM consists of a set of keywords and parameter values. These parameters might be distributed over several SMs. There is one single keyword to start the OTAP procedure. For parameters that are repeated in several SMs only the last value sent is valid. For example, an SM could look like this:

Install operation:

```
First SM:    OTAP_IMPNG
             PWD:secret
             JADURL:http://www.greatcompany.com/coolapps/mega.jad
             APPDIR:a:/work/appdir
             HTTPUSER:user
             HTTPPWD:anothersecret


Second SM:   OTAP_IMPNG
             PWD:secret
             BEARER:gprs
             APNORNUM:access.to-thenet.net
             NETUSER:nobody
             NETPWD:nothing
             DNS:192.168.1.2
             START:install
```

Delete operation:

```
OTAP_IMP1.0
PWD:secret
APPDIR:a:/work/appdir
START:delete
```

The first line is required: it is used to identify an OTAP SM. All other lines are optional and their order is insignificant, each line is terminated with an LF: '\n' even the last one. The keywords, in capital letters, are case sensitive. A colon separates the keywords from their values.

The values of APPDIR, BEARER and START are used internally and have to be lower case. The password (PWD) is case sensitive. The case sensitivity of the other parameter values depends on the server application or the network. It is likely that not all parameters can be sent in one SM. They can be distributed over several SMs. Of course, every SM needs to contain the identifying first line and the PWD parameter, if necessary. The OTAP is started when the keyword START, possibly with a parameter, is contained in the SM and the parameter set is valid for the requested operation. It always ends with a reboot, either when the operation is completed, an error occurred, or the safety timer expired. This also means all parameters previously set by SM are gone.

Apart from the first and the last line in this example, these are the parameters described in the previous section. Possible parameters for the START keyword are: “install”, “delete” or nothing. In the last case, an install operation is done by default.
The network does not guarantee the order of SMs. So when using multiple SMs to start a

OTAP operation their order on the receiving side might be different from the order in which they were sent. This could lead to trouble because the OTAP operation probably starts before all parameters are received. If you discover such problems, try to wait a few seconds between sending the SMs.

9.5 Java File Format

In general, all Java files have to comply with the IMP 1.0 and TC65 specifications. There are certain components of the JAD file that the developer must pay attention to when using OTAP:

- MIDlet-Jar-URL: make sure that this parameter points to a location on the network where your latest JAR files will be located, e.g. http://192.168.1.3/datafiles/mytest.jar, not in the filesystem like file://a:/java/mytest/mytest.jar. Otherwise this JAD file is useless for OTAP.
- MIDlet-Install-Notify: this is an optional entry specifying a URL to which the result of an update/install operation is posted. That is the only way to get any feedback about the outcome of an install/update operation. The format of the posted URL complies with the MIDP OTA Provisioning specification. In contrast to the jar and jad file this URL must not be protected by basic authentication.
- MIDlet-Name, MIDlet-Version, MIDlet-Vendor: are mandatory entries in the JAD and Manifest file. Both files must contain equal values, otherwise result 905 (see 9.7) is returned.
- MIDlet-Jar-Size must contain the correct size of the jar file, otherwise result 904 (see 9.7) is returned.

Example:

```
MIDlet-Name: MyTest
MIDlet-Version: 1.0.1
MIDlet-Vendor: TLR Inc.
MIDlet-Jar-URL: http://192.168.1.3/datafiles/MyTest.jar
MIDlet-Description: My very important test
MIDlet-1: MyTest, , example.mytest.MyTest
MIDlet-Jar-Size: 1442
MicroEdition-Profile: IMP-NG
MicroEdition-Configuration: CLDC-1.1
```

A suitable Manifest file for the JAD file above might look like:

```
Manifest-Version: 1.0
MIDlet-Name: MyTest
MIDlet-Version: 1.0.1
MIDlet-Vendor: TLR Inc.
MIDlet-1: MyTest, , example.mytest.MyTest
MicroEdition-Profile: IMP-NG
MicroEdition-Configuration: CLDC-1.1
```

9.6 Procedures

9.6.1 Install/Update

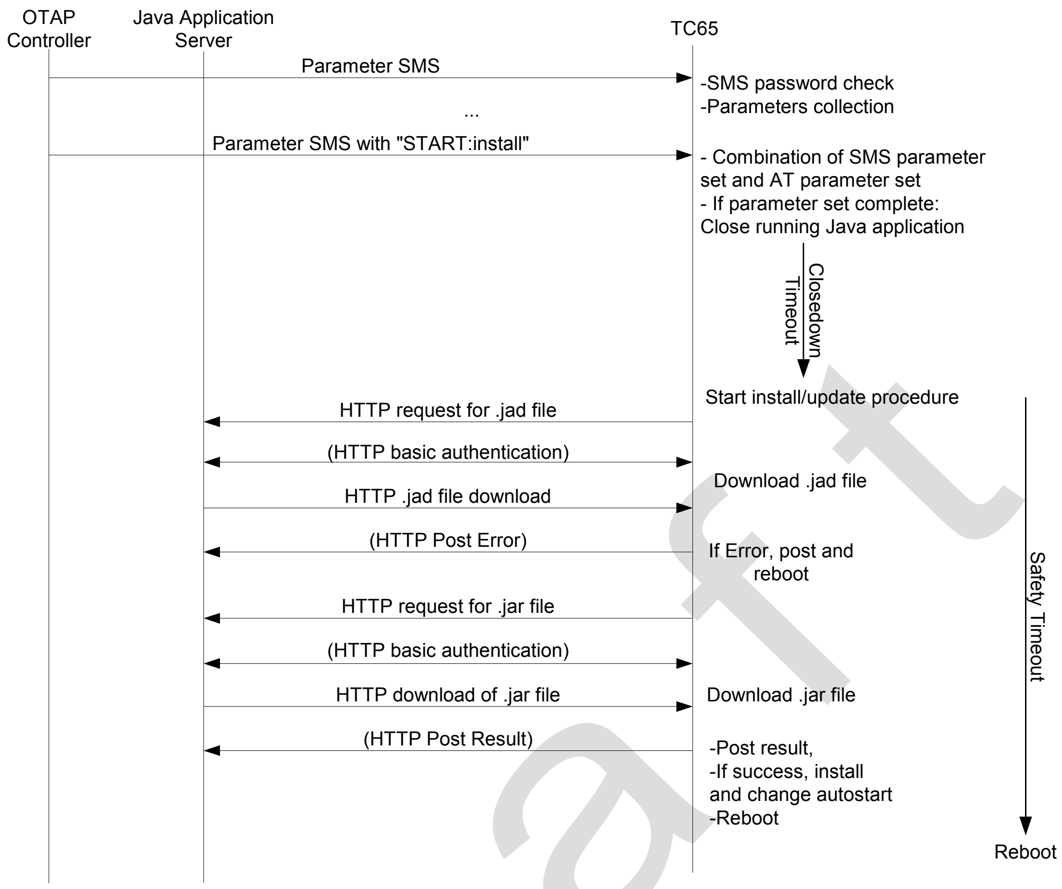

OTAP Controller
Java Application Server
TC65
Parameter SMS
-SMS password check
-Parameters collection
...
Parameter SMS with "START:install"
- Combination of SMS parameter set and AT parameter set
- If parameter set complete: Close running Java application
Closedown Timeout
Start install/update procedure
HTTP request for .jad file
(HTTP basic authentication)
Download .jad file
HTTP .jad file download
(HTTP Post Error)
If Error, post and reboot
HTTP request for .jar file
(HTTP basic authentication)
HTTP download of .jar file
Download .jar file
(HTTP Post Result)
-Post result,
-If success, install and change autostart
-Reboot
Safety Timeout
Reboot

Figure 18: OTAP: Install/Update Information Flow

(The messages in brackets are optional)

When an SM with keyword START:install is received and there is a valid parameter set for the operation, the module always reboots either when the operation completed, an error occurred or the safety timer expired. If there is any error during an update operation the old application is kept untouched, with one exception. If there is not enough space in the file system to keep the old and the new application at the same time, the old application is deleted before the download of the new one, therefore it is lost when an error occurs.
If install/update was successful the autostart is set to the new application.

9.6.2 Delete

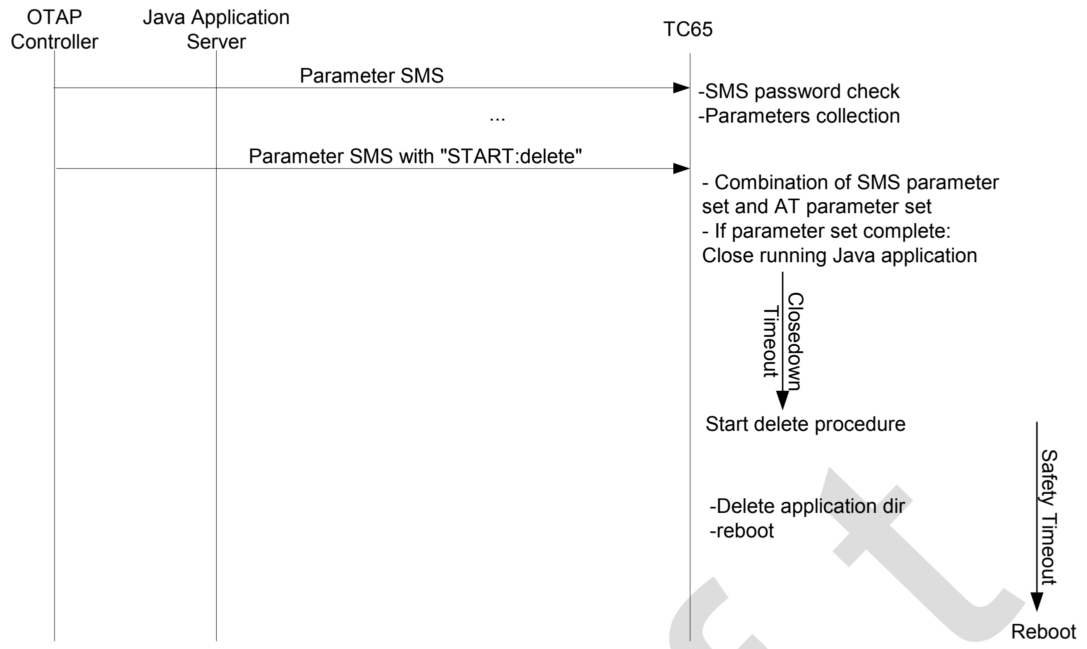


Figure 19: OTAP: Delete Information Flow

When an SM with keyword START:delete is received and there is a valid parameter set for this operation, the module reboots either when the operation completed, an error occurred or the safety timer expired. If there is any error the application is kept untouched. Autostart is not changed. No result code is passed back.

9.7 Time Out Values and Result Codes

Timeouts:

- Closedown Timeout: 10 seconds
- Safety Timeout: 5 minutes

Result Codes: Supported status codes in body of the http POST request:

- 900 Success
- 901 Insufficient memory in filesystem
- 902 -not supported-
- 903 -not supported-
- 904 JAR size mismatch, given size in JAD file does not match real size of jar file
- 905 Attribute mismatch, one of the mandatory attributes MIDlet-name, MIDlet-version, MIDlet-Vendor in the JAD file does not match those given in the JAR manifest
- 906 invalid descriptor
- 907 invalid JAR
- 908 incompatible configuration or profile
- 909 application authentication failure,
- 910 application authorization failure, tried to replace signed with unsigned version
- 911 -not supported-
- 912 -not supported-

All HTTP packets (GET, POST) send by the module contain the phone number or IMEI (if number not present) of the SIM in the User-Agent field, e.g.

```
User-Agent: TC65/+4917266666 Profile/IMP-NG Configuration/CLDC-1.1
```

This is for easy device identification at the HTTP server.

9.8 Tips and Tricks for OTAP

- For security reasons it is recommended to use an SMS password. Otherwise the "delete" operation can remove whole directories without any authentication.
- For extra security, set up a private CSD/PPP Server and set its phone number as a fixed parameter. This way, applications can only be downloaded from one special server.
- As a side effect, OTAP can be used to simply reboot the module. Just start an OTAP procedure with a parameter set which does not really do anything, like a delete operation on a nonexistent directory.
- If you don't want to start OTAP by SMS let your Java application do it by issuing the **at^sjotap** command. That triggers a install/update operation as described in chapter 9.6.1 but without the SMS part.
  Note: If a malfunctioning Java application is loaded the SM method will still be needed for another update.
- The OTAP procedure cannot be tested in the debug environment
- Be aware that the module needs to be booked into the network to do OTAP. That means that either the Java application has to enter the PIN, the PIN needs to be disabled or Autopin (see AT Command Set [4]) has to be used.
- The OTAP procedure might fail due to call collision, e.g. a incoming call when OTAP tries to start a CSD connection.

9.9 OTAP Tracer

For easy debugging of the OTAP scenario the OTAP procedure can be traced over the serial interface.

TBD

9.10 How to

This chapter is supposed to be a step-by-step guideline for using OTAP.

1. Do you need OTAP? Is there any chance that it might be necessary to update the Java application, install a new one or delete it? The reason might be that your device is in the field and you cannot or do not want to do it over the serial line. If the answer is “yes” then read through the following steps, if the answer is “no” then just consider setting the OTAP SMS password to protect your system. Then you are done with OTAP.
2. Take a look at the parameters (chapter 9.3), which control OTAP. You have to decide which of them you want to allow to be changed over the air (by SMS) and which you do not. This is mainly a question of security and what you can fit into a short message. Then set the “unchangeable” parameters with the AT command (**at^sjotap**).
3. Prepare the http server. The server must be reachable by your device over TCP/IP. That means there is a route from your device over the air interface to the http server and back. When in doubt, write a small Java application using the httpConnection Interface to test it.
4. Prepare the JAR and JAD files which are to be loaded over the air. Make sure that these files conform to the requirements named in chapter 9.5 and that they represent a valid application which can be started by **at^sjra.**
5. Put the files (JAR and JAD) on the http Server. The files can either be publicly available or protected through basic authentication. When in doubt try to download the files from the server by using a common web browser on a PC, which can reach your http server through TCP/IP.
6. Prepare the SMS sender. The sender must be able to send SMs, which conform to chapter 9.4, to your device. When in doubt try to send “normal” SMs to your device which can than be read out through the AT command interface.
7. Test with a local device. Send a suitable short message to your device, which completes the necessary parameter, set and starts the operation. The operation is finished when the device reboots. You can now check the content of the file system, if the correct jar and jad file was loaded into the correct location.
8. Analyze error. If the above test failed, looking at your devices behavior and your http servers access log can give you some hints on what went wrong:
    - If the device did not terminate the running Java application and did not reboot, not even after the safety timeout, either your SM was not understood (probably wrong format) or did not properly authenticate (probably wrong password) or your parameter set is incomplete for the requested operation.
    - If the device terminated the running Java application, but did not access your http server, and rebooted after the safety timeout, there were most likely some problems when opening the network connection. Check your network parameters.
    - If the device downloaded the jad and probably even the jar file but then rebooted without saving them in the file system, most likely one of the errors named in chapter 9.5 occurred. These are also the only error conditions, which can also be reported back. They are posted to the http server if the jad file contains the required URL.
9. Start update of remote devices. If you were able to successfully update your local device, which is hopefully a mirror of all your remote devices, you can start the update of all other devices.

10 Compiling and Running a Program without Java IDE

This chapter explains how to compile and run a Java application without a Java IDE.

10.1 Build Results

A JAR file has to be created by compiling an SMTK project. A JAR file will contain the class files and auxiliary resources associated with an application. A JAD file contains information (file name, size, version, etc.) on the actual content of the associated JAR file. It must be written by the user. The JAR file has the ".jar" extension and the JAD file has the ".jad" extension. A JAD file is always required no matter whether the module is provisioned with the Module Exchange Suite, as described in Section 8.1, or with OTA provisioning. OTA provisioning is described in Chapter 9.

In addition to class and resource files, a JAR file contains a manifest file, which describes the contents of the JAR. The manifest has the name manifest.mf and is automatically stored in the JAR file itself. An IMP manifest file for:

```
package example.mytest;
public class MyTest extends MIDlet
```

includes at least:

```
Manifest-Version: 1.0
MIDlet-Name: MyTest
MIDlet-Version: 1.0.1
MIDlet-Vendor: Siemens
MIDlet-1: MyTest, example.mytest.MyTest
MicroEdition-Profile: IMP-NG
MicroEdition-Configuration: CLDC-1.1
```

A JAD file must be written by the developer and must include at least:

```
MIDlet-Name: MyTest
MIDlet-Version: 1.0.1
MIDlet-Vendor: Siemens
MIDlet-1: MyTest, example.mytest.MyTest
MIDlet-Jar-URL: http://192.168.1.3/datafiles/MyTest.jar
MIDlet-Jar-Size: 1408
MicroEdition-Profile: IMP-NG
MicroEdition-Configuration: CLDC-1.1
```

A detailed description of these attributes and others can be found in the Java/MIDlet documentation http://java.sun.com/j2me/docs/alt-html/WTK104_UG/Ap_Attributes.html

10.2 Compile

- Launch a **Command Prompt**. This can be done from the **Programs** menu or by typing "cmd" at the **Run***…* prompt in the *Start* menu.
- Change to the directory where the code to be compiled is kept.
- Compile the program with the SDK. Examples of build batch files can be found in each sample program found in the examples directory, **…\Siemens\SMTK\TC65\wtk\src\example**.
- *If the compile was successful the program can be run from the command line. Examples of run batch files can be found in the examples directories listed above as well.*

The batch files for compiling and running the samples refer to master batch files in the **…\Siemens\SMTK\TC65\wtk\bin** directory and are using the system environment variables IMPNG_JDK_DIR that points to the root directory of the installed JDK and IMPNG_DIR which points to the root directory of the Siemens-SMTK-TC65-IMPNG installation. The installation process sets these environment variables. A modification is usually not necessary. They might be modified (e.g. for switching to a different JDK) via the advanced system properties as requested.

10.3 Run on the Module with Manual Start

- The application can be compiled at the prompt as discussed in Section 10.2 or in an IDE.
- Transfer the .jar and .jad file from the development platform to the desired directory on the module using the Module Exchange Suite or OTA provisioning. Chapter 8 explains how to download your application to the module.
- Start a terminal program and connect to ASC0.
- The command **at^sjra** is used to start the application and is sent to the module via your terminal program. Either the application can be started by .jar or by .jad file.

Example:
In your terminal program enter: **at^sjra=a:/java/jam/example/helloworld/helloworld.jar**
If you prefer to start with .jad file: **at^sjra=a:/java/jam/example/helloworld/helloworld.jad**

The Flash file system on the module is referenced by "a:".

10.4 Run on the Module with Autostart

- The application can be compiled at the prompt as discussed in Section 10.2 or in an SMTK integrated IDE.
- Transfer the .jar and .jad file from the development platform to the desired directory on the module using the Module Exchange Suite or OTA provisioning. See Chapter 8.

10.4.1 Switch on Autostart

- There is an AT command, **at^scfg**, to configure the autostart functionality. Please refer to the AT Command Set [4].
- Restart the module.

10.4.2 Switch off Autostart

To switch off autostart functionality there are two possibilities:

- AT command **at^scfg**
- *tool "autostart_off.exe" (included in the Installation CD software)*

To disable the automatic start of a user application in a module these steps have to be done:

1. *Connect the module to the PC*
2. *Make sure, that the module is switched off*
3. *Start the Autostart_Off program*
4. *Select the COM-Port*
5. Press the "Autostart Off" button

11 Debug Eenvironment

Please note that this section is not intended as a tutorial in debugging or how to use Sun Java Studio, Borland JBuilder or Eclipse. Documents for these IDEs can be found on their respective homepages. Once the proper emulator has been selected (as described in the relevant IDE sections below), your Java application can be built, debugged and executed.

11.1 Data Flow of a Java Application in the Debug Environment

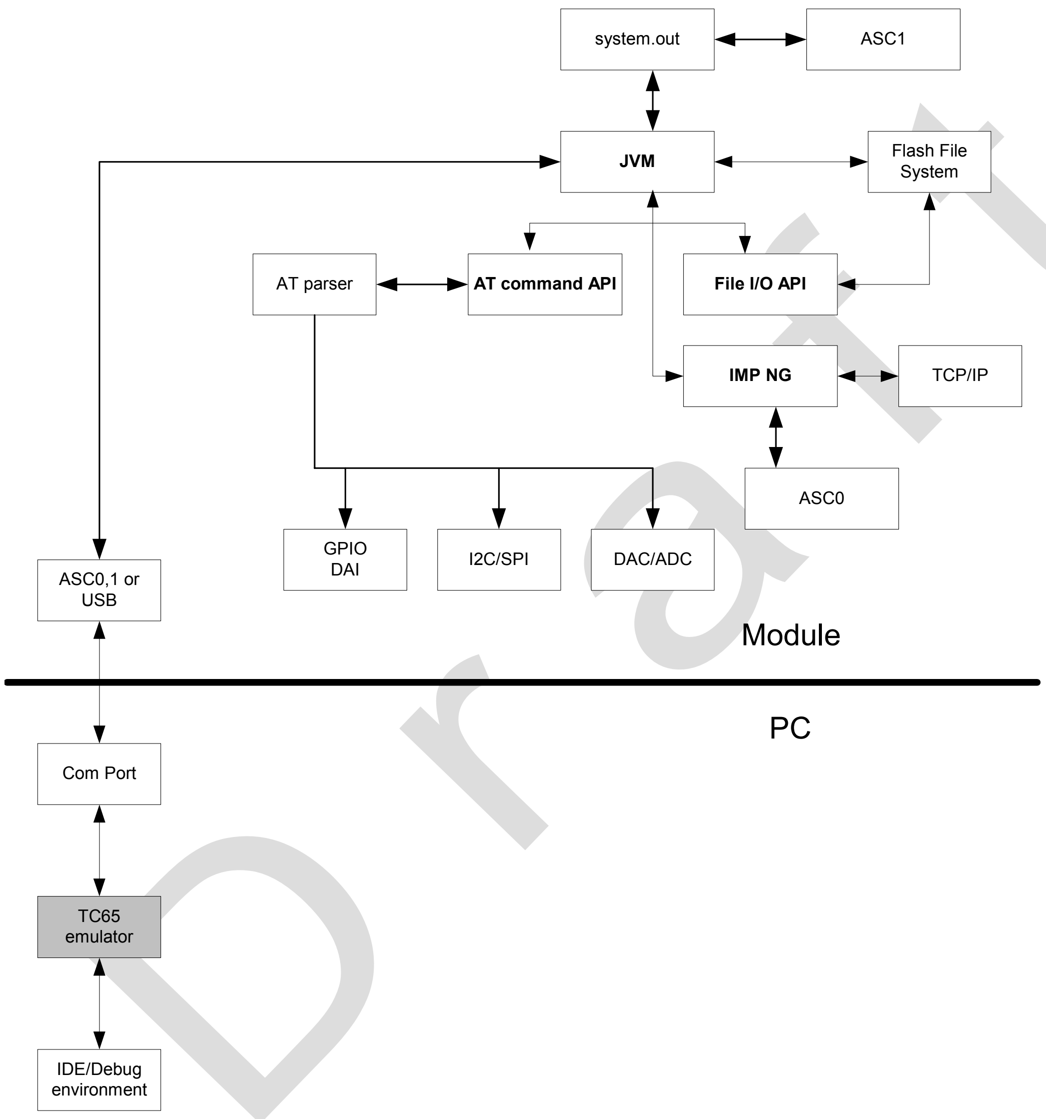


Figure 20: Data flow of a Java application in the debug environment

In the debug environment the module is connected to a PC via a serial interface. This can be USB or a RS232 line. The application can then be edited, build and debugged within an IDE on the PC. When running the MIDlet under debugger control it is executed on the module not on the PC. This ensures that all interfaces behave the same no matter if in debugging mode or not.

11.2 Emulator

TBD

11.3 Java IDE

The SMTK is integrated into your Java IDE during installation. Please note that the IDE integration is intended for debugging purposes using the PC emulator. JAR files used in the module must be configured according to the batch file examples given. If the SMTK install succeeded, one should be able to easily switch between the Siemens environment and Standard-JDK environment. This means that the special libraries/APIs are available, the emulators are available, AT commands can be sent to module. Regular function of the IDE for non-Siemens projects is unchanged.

11.3.1 Sun Java Studio Mobility 6 2004Q3

TBD

11.3.2 Borland JBuilder

TBD

11.3.3 Eclipse 3.0

TBD

11.4 Breakpoints

Breakpoints can be set as usual within the IDE. The debugger cannot step through methods or functions whose source code is not available.

12 Java Security

TBD

12.1 Secure Data Transfer

TBD

12.2 Execution Control

TBD

12.3 Application and Data Protection

TBD

13 Java Tutorial

This small tutorial includes explanations on how to use the AT Command API, suggestions for programming MIDlets and an example of using AJOF. The developer should read about MIDlets, Threads and AT commands as a complement to this tutorial.

13.1 Using the AT Command API

Perhaps the most important API for the developer is the AT command API. This is the API that lets the developer issue commands to control the module. This API consists of the **ATCommand** class and the **ATCommandListener** and **ATCommandResponseListener** interfaces. Their javadocs can be found in **…\wtk\doc\html\index.html**, [6].

13.1.1 Class ATCommand

The **ATCommand** class supports the execution of AT commands in much the same way as they would be executed over a serial interface. It provides a simple way to send strings directly to the device’s AT parsers.

13.1.1.1 Instantiation with or without CSD Support

There can be only exactly as many **ATCommand** instances as there are parsers on the device. If there are no more parsers available, the **ATCommand** constructor will throw **ATCommandFailedException**. All AT parser instances support CSD. However from a Java application point of view it may make sense to have one dedicated instance for CSD call handling. Therefore, and also for historical reasons, only one parser with CSD support may be requested through the constructor. If more then one parser with CSD support is requested, the constructor will throw **ATCommandFailedException**.

```
try {
  ATCommand atc = new ATCommand(false);
  /* An instance of ATCommand is created. CSD is not explicitly
   * requested. */
} catch (ATCommandFailedException e) {
  System.out.println(e);
}
```

The csdSupported() method returns the CSD capability of the connected instance of the device's AT parser.

```
boolean csd_support = atc.csdSupported();
```

release() releases the resources held by the instance of the ATCommand class. After calling this function the class instance cannot be used any more but the resources are free to be used by a new instance

13.1.1.2 Sending an AT Command to the Device, the send() Method

An AT command is sent to the device by using the send() method. The AT command is sent as a string which must include the finalizing line feed "\r" or the corresponding line end character.

```
String response = atc.send(“at+cpin?\r”);
/* method returns when the module returns a response */
System.out.println(response);
```

Possible response printed to System.out:

```
+CPIN: READY OK
```

This send function is a blocking call, which means that the calling thread will be interrupted until the module returns a response. The function returns the response, the result code of the AT command, as a string.

Occasionally it may be infeasible to wait for an AT command that requires some time to be processed, such as at+cops?. There is a second, non-blocking, send function which takes a second parameter in addition to the AT command. This second parameter is a callback instance, **ATCommandResponseListener**. Any response to the AT command is delivered to the callback instance when it becomes available. The method itself returns immediately. The **ATCommandResponseListener** and the non-blocking send method are described in Section 13.1.2.

Note: Using the send methods with strings with incorrect AT command syntax will cause mistakes.

13.1.1.3 Data Connections

If a data connection is created with the **ATCommand** class, for instance with **‘atd’**, an input stream is opened to receive the data from the connection. Similarly, an output stream can be opened to send data on the connection.

```
/* Please note that this example would not work unless the module had
 * been initialized and logged into a network. */

System.out.println("Dialing: ATD" + CALLED_NO);
response = atc.send("ATD" + CALLED_NO + "\r");
System.out.println("received: " + response);

if (response.indexOf("CONNECT") >= 0) {
  try {
    // We have a data connection, now we do some streaming...
    // IOException will be thrown if any of the Stream methods fail
    OutputStream dataOut = ATCmd.getDataOutputStream();
    InputStream dataIn = ATCmd.getDataInputStream();

    // out streaming...
    dataOut.write(new String("\n\rHello world\n\r").getBytes());
    dataOut.write(new String("\n\rThis data was sent by a Java " +
                             "MIDlet!\n\r").getBytes());
    dataOut.write(new String("Press 'Q' to close the " +
                             "connection\n\r").getBytes());

    // ...and in streaming
    System.out.println("Waiting for incoming data, currently " +
                       dataIn.available() + " bytes in buffer.");
    rcv = 0;
    while(((char)rcv != 'q') && ((char)rcv != 'Q') && (rcv != -1)){
      rcv = dataIn.read();
      if (rcv >= 0) {
        System.out.print((char)rcv);
      }
    }

    /* The example continues after the next block of text */
```

In **…/Siemens/SMTK/TC65/wtk/src/example** a complete data connection example, DataConnectionDemo.java, can be found.

These streams behave slightly differently than regular data streams. The streams are not closed by using the close() method. A stream remains open until the **release()** method is called. A module can be switched from the data mode to the AT command mode by calling the **breakConnection()** method.

```
    /* continue example */

    if (rcv != -1) {
      // Now break the data connection
      System.out.println("\n\n\rBreaking connection");
      try {
        strRcv = ATCmd.breakConnection();
      } catch(Exception e) {
        System.out.println(e);
      }
      System.out.println("received: " + strRcv);
    } else {
      // Received EOF, somebody else broke the connection
      System.out.println("\n\n\rSomebody else switched to " +
                         "command mode!");
    }
    System.out.println("Hanging up");
    strRcv = ATCmd.send("ATH\r");
    System.out.println("received: " + strRcv);
  } catch(IOException e) {
    System.out.println(e);
  }
} else {
  System.out.println("No data connection established,");
}
```

An IOException is thrown if any function of the I/O streams are called when the module is in AT command mode.

Data Connections are not only used for data transfer over the air but also to access external hardware. Here is a list of at commands which open a data connection:

- atd, for data calls
- at^sspi, for access to I2C/SPI
- TBD

13.1.1.4 Synchronization

For performance reasons there is no synchronization done in this class. If an instance of this class has to be accessed from different threads it has to be ensured that the **send()** functions, the **release()** function, the **cancelCommand()** function and the **breakConnection()** function are synchronized in the user implementation.

13.1.2 ATCommandResponseListener Interface

The **ATCommandResponseListener** interface defines the capabilities for receiving the response to an AT command sent to one of the module's AT parsers. When the user wants to use the non blocking version of the **ATCommand.send** function an implementation class for the **ATCommandResponseListener** interface must be created first. The single method of this class, **ATResponse()**, must contain the processing code for the possible response to the sent AT command.

```
class MyListener implements ATCommandResponseListener {

  String listen_for;

  void myListener(String awaited_response) {
    listen_for = awaited_response;
  }

  void ATResponse(String Response) {
    if (Response.indexOf(listen_for) >= 0) {
      System.out.println("received: " + strRcv);
    }
  }
}
```

13.1.2.1 Non-blocking ATCommand.send() Method

After creating an instance of the **ATCommandResponseListener** class, the class instance can be passed as the second parameter of the non-blocking ATCommand.send() method. After the AT command has been passed to the AT parser, the function returns immediately and the response to the AT command is passed to this callback class later when it becomes available

Somewhere in the application:

```
MyListener connect_list = new MyListener("CONNECT");
atc.send("ATD" + CALLED_NO + "\r", connect_list);

/* Application continues while the AT command is processed*/
/* When the module delivers its response to the AT command the callback
 * method ATResponse is called. If the response is "CONNECT", we will see
 * the printed message from ATResponse in MyListener. */
```

A running AT command sent with the non-blocking send function can be cancelled with **ATCommand.cancelCommand().** Any possible responses to the cancellation are sent to the waiting callback instance.

Note: Using the send methods with strings with incorrect AT command syntax will cause mistakes.

13.1.3 ATCommandListener Interface

The **ATCommandListener** interface implements callback functions for URCs, and changes of the serial interface signals RING, DCD and DSR. The user must create an implementation class for **ATCommandListener** to receive AT events. The **ATEvent** method of this class must contain the processing code for the different AT-Events (URCs) and the **RINGChanged, DCDChanged** and **DSRChanged** methods possible processing code for the signal state changes.

13.1.3.1 ATEvents

An ATEvent or a URC is a report message sent from the module to the application. An unsolicited result code can either be delivered automatically when an event occurs or as a result of a query the module received before. However, a URC is not issued as a *direct* response to an executed AT command. Some URCs must be activated with an AT command.

Typical URCs may be information about incoming calls, received SM, changing temperature, status of the battery etc. A summary of URCs is listed in the AT Command Set document [4].

13.1.3.2 Implementation

```
class ATListenerA implements ATCommandListener {

public void ATEvent(String Event) {
  if (Event.indexOf("+CALA: Reminder 1") >= 0) {
    /* take desired action after receiving the reminder */
  } else if (Event.indexOf("+CALA: Reminder 2") >= 0) {
    /* take desired action after receiving the reminder */
  } else if (Event.indexOf("+CALA: Reminder 3") >= 0) {
    /* take desired action after receiving the reminder */
  }

  /* No action taken for these events */
  public void RINGChanged(boolean SignalState) {}
  public void DCDChanged(boolean SignalState) {}
  public void DSRChanged(boolean SignalState) {}
}

class ATListenerB implements ATCommandListener {

  public void ATEvent(String Event) {
    if (Event.indexOf("+SCKS: 0") >= 0) {
      System.out.println("SIM Card is not inserted.");
      /* perform other actions */
    } else if (Event.indexOf("+SCKS: 1") >= 0) {
      System.out.println("SIM Card is inserted.");
     /* perform other actions */
    }
  }

  public void RINGChanged(boolean SignalState) {
    /* take some action when the RING signal changes if you want to */
  }

  public void DCDChanged(boolean SignalState) {
    /* take some action when the DCD signal changes if you want to */
  }

  public void DSRChanged(boolean SignalState {}
    /* take some action when the DSR signal changes if you want to */
  }
}
```

13.1.3.3 Registering a Listener with an ATCommand Instance

After creating an instance of the **ATCommandListener** class, this class instance has to be passed as a parameter to the **ATCommand.addListener()** method. After that, the callback methods will be called by the runtime system each time the corresponding events (URCs or signal state changes) occur on the corresponding device AT parser.

```
/* we have two ATCommands instances, atc1 and atc2 */
ATListenerA reminder_listener = new ATListenerA();
ATListenerB card_listener = new ATListenerB();

atc1.addListener(reminder_listener);
atc2.addListener(card_listener);
```

The **ATCommand.removeListener()** method removes a listener object that has been previously added to the internal list table of listener objects. After it has been removed from the list it will not be called when URCs occur. If it was not previously registered the list remains unchanged.

The same **ATCommandListener** may be added to several **ATCommand** instances and several **ATCommandListeners** may be added to the same **ATCommand.**

13.2 Programming the MIDlet

The life cycle and structure of MIDlets are described in Chapter 6. Since the MIDlets will run on J2ME™, all of J2ME™'s features, including threads, are available. Small applications, such as those without any timer functions or those used only for tests and simple examples, can be written without using threads. Longer applications should be implemented with threads.

13.2.1 Threads

Although small applications can be written without using threads longer applications should use them. The Java programming language is naturally multi-threaded which can make a substantial difference in the performance of your application. Therefore we recommend referring to Java descriptions on threads before making any choices about threading models. Threads can be created in two ways. A class can be a subclass of *Thread* or it can implement **Runnable**.

For example, threads can be launched in **startApp()** and destroyed in **destroyApp()**. Note that destroying Java threads can be tricky. It is recommended that the developer read the Java documentation on threads. It may be necessary to poll a variable within the thread to see if it is still alive.

13.2.2 Example

/* This example derives a class from Thread and creates two instances
 * of the subclass. One thread instance finishes itself, the other one
 * is stopped by the main application. */

```
package example.threaddemo;

import javax.microedition.midlet.*;

public class ThreadDemo extends MIDlet {

  /* Member variables */
  boolean    runThreads = true; // Flag for stopping threads
  DemoThread thread1;           // First instance of DemoThread
  DemoThread thread2;           // Second instance of DemoThread

  /* Private class implementing the thread to be started by the
   * main application */
  private class DemoThread extends Thread {
    int loops;

    public DemoThread(int waitTime) {
      /* Store number of loops to execute */
      loops = waitTime;
      System.out.println("Thread(" + loops + "): Created");
    }

    public void run() {
      System.out.println("Thread(" + loops + "): Started");
      for (int i = 1; i <= loops; i++) {
        /* Check if main application asked thread to die */
        if (runThreads != true) {
          System.out.println("Thread(" + loops + "): Stopped from outside");
          /* Leave thread */
          return;
        }
        /* Print loop counter and wait 1 second,
         * do something useful here instead */
        System.out.println("Thread(" + loops + "): Loop " + i);
        try {
          Thread.sleep(1000);
        } catch(InterruptedException e) {
          System.out.println(e);
        }
      }
      System.out.println("Thread(" + loops + "): Finished naturally");
    }
  }

  /**
   * ThreadDemo - constructor
   */
  public ThreadDemo() {
    System.out.println("ThreadDemo: Constructor, creating threads");
    thread1 = new DemoThread(2);
    thread2 = new DemoThread(6);
  }

  /**
   * startApp()
   */
  public void startApp() throws MIDletStateChangeException {
    System.out.println("ThreadDemo: startApp, starting threads");
    thread1.start();
    thread2.start();
    System.out.println("ThreadDemo: Waiting 4 seconds before stopping threads");
    try {
      Thread.sleep(4000);
    } catch(InterruptedException e) {
      System.out.println(e);
    }
    destroyApp(true);
    System.out.println("ThreadDemo: Closing application");
    notifyDestroyed();
  }

  /**
   * pauseApp()
   */
  public void pauseApp() {
    System.out.println("ThreadDemo: pauseApp()");
  }

  /**
   * destroyApp()
   */
  public void destroyApp(boolean cond) {
    System.out.println("ThreadDemo: destroyApp(" + cond + ")");
    System.out.println("ThreadDemo: Stopping threads from outsdide");
    runThreads = false;
    try {
      System.out.println("ThreadDemo: Waiting for threads to die");
      thread1.join();
      thread2.join();
    } catch(InterruptedException e) {
      System.out.println(e);
    }
    System.out.println("ThreadDemo: All threads died");
  }
}
```

13.3 AJOF

The following example uses AJOF. It demonstrates how the writing of an application for the module is abstracted and simplified with the framework. This example does not use threads but could be implemented in a structure similar to the one shown above.

Some comments:

- **CWmMIDlet** is the MIDlet instance wrapping the application. **CWmMIDlet** adds AT command channel management to the standard MIDlet class.
- An AT channel, **ATChannel**, consists of an ATC parser and one or more listeners waiting for URCs. The channel is distributed by the application to any class that needs access to the module via the ATC interface.

13.3.1 Example

```
/* WmTutorial.java
 * Copyright (C) Siemens AG 2003. All Rights reserved.
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 * as well as utilization of its contents and communication thereof
 * to others without express authorization are prohibited.
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 * All rights created by patent grant or registration of a utility
 * model or design patent are reserved.
 */

package example.ajoftutorial;

import com.siemens.icm.io.ATCommandFailedException;
import com.siemens.icm.ajof.WmMIDlet;
import com.siemens.icm.ajof.AtChannel;
import com.siemens.icm.ajof.AtChannel.SendTimeoutException;
import com.siemens.icm.ajof.AjofException;
import com.siemens.icm.ajof.status.WmLock;
import com.siemens.icm.ajof.status.WmLockException;
import com.siemens.icm.ajof.phonebook.SimplePhonebook;
import com.siemens.icm.ajof.phonebook.PhonebookStoreException;
import com.siemens.icm.ajof.sms.SimpleSms;
import com.siemens.icm.ajof.sms.SmsSendException;

/**
 * demonstrates how easy it is to retrieve a number from the phonebook and
send an SMS message to this destination.
 * @author SIEMENS AG
 * @version 1
 * @since AJOF 1.0
 */
public class WmTutorial extends WmMIDlet
{
    // Please, change these constants to your desired settings
    final String RECIPIENT_NAME       = "foo, bar";
    final String SERVICE_CENTRE_ADDR = "+491720000000";
    final String SIM_PIN              = "0000";
    final String MESSAGE_TXT          = "Hello, world.";

    /**
     * creates and sends an SMS message to a recipient, whose phone number
is retreived from the SIM phonebook.
     * <ol><li>get an AT channel to communicate with the module's AT
interface
     * <li>just check, if the module answers to AT commands,
     * <li>enter the <code>SIM PIN</code>, so we can access the phonebook
and send an SMS message,
     * <li>create a phonebook control and look up the recipient's phone
number,
     * <li>create an SMS control,
     * <li>set the service centre address (SCA),
     * <li>last, but not least send the SMS message.
     * <li>Please do not forget to cleanup all used resources. Each AJOF
class has a method <code>release()</code>,
     * which performs this task.
     * <li>Terminate the application by calling
<code>notifyDestroyed()</code>.</ol>
     * @see <code>AT</code>
     * @see <code>AT+CPIN</code>
     * @see <code>AT+CPBR</code>
     * @see <code>AT+CPMGF</code>
     * @see <code>AT+CPMGS</code>
     */
    public void startApp()
    {
        try
        {
            // To access the module we need an AT-channel:
            AtChannel atch = openAtChannel();

            // Test the connection
            // (this code is optional and used only for demonstration
purposes)
            System.out.println("\nTesting connection...");

            String response = atch.send("at\r");
            System.out.println("AT" + response);

            // Set elaborated error messages
            atch.send("AT+CMEE=2\r");

            // Enter the SIM PIN
            System.out.println("Entering PIN...");
            WmLock lockControl = new WmLock(atch);

            try
            {
                lockControl.sendSimPin(SIM_PIN);

                // We create a SimplePhonebook instance
                // to look into the module's phonebook.
                SimplePhonebook pbk= new SimplePhonebook(atch);

                try
                {
                    // Now let's look for the SMS's recipient.
                    // The number is stored in the phonebook.
                    System.out.println("Looking up phone number for " +
RECIPIENT_NAME + ", please wait...");
                    String destinationAddr = pbk.getNumber(RECIPIENT_NAME);

                    // create a simple SMS control
                    SimpleSms sms = new SimpleSms(atch);

                    try
                    {
                        // You need to set the SCA only once in your
application
                        sms.setServiceCentreAddr(SERVICE_CENTRE_ADDR);

                        // now send the message
                        System.out.println("Sending Short Message, please 
wait...");
                        sms.send(destinationAddr, MESSAGE_TXT);
                        System.out.println("Short Message was sent.");
                    }

                    catch (SmsSendException e)
                    {
                        System.out.println(e);
                    }

                    finally
                    {
                        // release the used resources
                        sms.release();
                        sms = null;
                    }
                }

                finally
                {
                    // release the used resources
                    pbk.release();
                    pbk = null;
                }
            }

            catch (WmLockException e)
            {
                System.out.println(e);
            }

            catch (PhonebookStoreException e)
            {
                System.out.println(e);
            }

            finally
            {
                // release the used resources
                lockControl.release();
                lockControl = null;
            }
        }

        catch (ATCommandFailedException e)
        {
            System.out.println(e);
        }

        catch (SendTimeoutException e)
        {
            System.out.println("AT_Command timeout");
        }

        finally
        {
            // Terminate the application.
            // You don't need to care about closing open AT channels.
            // WmMIDlet does this for you.
            System.out.println("Now terminating application.");
            destroyApp(true);
        }
    }

    /**
```

```
     * Your application does not necessarily need to override
<code>destroyApp()</code>, but if it does, make sure that
     * <code>super.destroyApp()</code> is called, to release the AT
channels.
     */
    public void destroyApp(boolean unconditional)
    {
        // your finalization code goes here...
        super.destroyApp(unconditional);
        notifyDestroyed();
    }
}
```

14 Network Applications

14.1 FTP Client

The package com.siemens.icm.ftp provides an FTP client and offers a simple interface for transferring files between a module and a server using the File Transfer Protocol (FTP, RFC 959). The client implements a subset of RFC 959, is able to communicate with FTP servers behind firewalls and supports binary and ASCII mode of transfer.

14.1.1 Example: FtpDemo

The MIDlet example.ftp.FtpDemo is an example for using the FTP client and exercises the main functionality of the FTP client. FtpDemo connects to an FTP server, creates a remote directory, transfers a file to the server and back, compares the copy against the original and removes the remote file and directory.

Please note that the FTP client can only access files stored in the storage folder dedicated to Java file I/O. Path names of local files are relative to the storage folder. See com.siemens.icm.io.File for more information.

Before running the MIDlet please configure ftp.jad to reflect your environment. The following properties should be set:

Property Name	Description	Example
example.ftp.remote.dir	Remote directory	incoming
example.ftp.remote.file	Remote file	test123
example.ftp.server	FTP server	ftp.siemens.de
example.ftp.user	FTP user name	ftp
example.ftp.pass	FTP password	guest
example.ftp.gprs.nameserver	Name server	193.254.160.1
example.ftp.gprs.apn	GRPS Access Point	unused
example.ftp.gprs.user	GPRS user name	unused
example.ftp.gprs.pass	GPRS password	unused
example.ftp.modem.pin	PIN for SIM card	0000

14.2 Mail Client

The package de.trantor.de is part of the Mail4Me package and provides a simple interface for sending and receiving emails through the Simple Mail Transfer Protocol (SMTP) and the Post Office Protocol (POP3). The mail client implements a subset of RFC 821, RFC 1939 and supports plain SMTP authentication (RFC 2554), enabling communication with SMTP servers hardened against spam.

See mail4me.enhydra.org for more information.

14.2.1 Example: MailDemo

The MIDlet example.mail.MailDemo is an example for using the mail client. MailDemo creates an email, sends it through SMTP, receives it through POP3, compares the checksum for sent and received email and displays the received email.

Before running the MIDlet please configure mail.jad to reflect your environment. The following properties should be set:

Property	Description	Example
example.mail.from	Sender	from@mail_provider.com
example.mail.to	Recipient	to@mail_provider.com
example.mail.hostname	Hostname of module	localhost
example.mail.smtp.server	SMTP server	smtp.mail_provider.com
example.mail.smtp.auth	Perform SMTP authentication	true/false
example.mail.smtp.user	SMTP user	mail
example.mail.smtp.pass	SMTP password	****
example.mail.pop3.server	POP3 server	pop3.mail_provider.com
example.mail.pop3.user	POP3 user name	mail
example.mail.pop3.pass	POP3 password	****
example.mail.gprs.nameserver	GPRS name server	193.254.160.1
example.mail.gprs.apn	GPRS access point	unused
example.mail.grps.user	GPRS user name	unused
example.mail.grps.pass	GPRS password	unused
example.mail.modem.pin	PIN for SIM card	0000

15 Changes to TC45

For those who are familiar with the Siemens WM TC45 product this is an overview of the main changes between TC45 and TC65.

- “real” TCP and UDP access interfaces: SocketConnection, ServerSocketConnection, UDPDatagramConnection.
  Usage of StreamConnection, StreamConnectionNotifier, DatagramConnection is now discouraged.
- Serial interfaces swapped: Standard.out is on ASC1, CommConnection on ASC0 (->open COM0 instead of COM1)
- No IO pin multiplexing: GPIOs, DAI and the serial interface for CommConnection do not share any pins, so the selection mechanism no longer exists.
- The CommConnection interface which used to be proprietary (com.siemens.icm.io) is now part of the standard package (javax.microedition.io).
- No more interface emulation on the PC: When running a MIDlet under the emulator, it is completely executed in the connected module and therefore uses the modules “real” interfaces. An emulation of interfaces such as networking, file system or serial interface on the PC side does no longer exist.
- .jad files required: A suitable descriptor file is now not only required for OTAP but in any case. An absent or invalid .jad file is an error when starting an application (at^sjra or autostart).
- Mandatory attributes: the attributes MicroEdition-Profile and MicroEdition-Configuration are now mandatory attributes in the manifest and .jad file.
- Flexible echo: When using the ATCommand class the “echo” is now switchable like in no-Java mode. Default is echo on, in TC45 the echo was always off.