



SIM Toolkit Device Requirements - User Experience Enhancements

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1 Introduction

1.1 Overview

This document is driven by the need within the Mobile Connect initiative of an improved user experience with regards to the SIM Toolkit. This has been requested within different groups and often asked by Mobile Network Operators (MNOs), therefore the goal of this document is to describe these user experience upgrades in a generic manner and not necessarily linked to Mobile Connect.

One of the Mobile Connect implementations is based on a SIM applet which is embedded in the user's SIM card. In this implementation, the interaction with the end user to display or collect information from the user is based on the SIM Toolkit (STK) functionality defined in ETSI TS 102 223 [1]. This ETSI Technical Specification details the STK commands and events, however it does not describe in detail the expected behaviour of the device when handling those user interactions. This results in a slightly different user experience from device to device. In addition, some of the information displayed cannot be modified.

The existing user experience and inconsistency between devices often has a negative impact on the SIM based authentication solutions by MNOs. A balance between security and user experience is made and other, less secure, but more user friendly solutions are chosen.

The purpose of this document is to describe some enhancements to the current SIM Toolkit user experience. These enhancements will be beneficial within the Mobile Connect framework, however, these can be used by any other application making use of the user interface of the SIM Toolkit.

1.2 Scope

This document provides device requirements for the STK proactive commands used by SIM applications.

1.3 Recommendations for improvement

- Add configuration to briefly display numbers when they are typed before they turn into asterisks.
- Be able to display PIN in clear or with asterisks.
- View password feature.
Configure the background and font colour, (black over white or white over black, or other colours).
- Change the font type + size
- Display an image with coordinates on the screen.
- Display icons
- Biometric sensor. SIM Toolkit to talk to OS biometric module.
- Configure the buttons visible on keyboard (no Symbol, *, #, etc.)

1.4 Abbreviations

Term	Description
STK	SIM Toolkit
MSSP	Managed Security Service Provider
MNO	Mobile Network Operator
OS	Operating System

1.5 References

Ref	Doc Number	Title
[1]	ETSI TS 102 223	Smart Cards; Card Application Toolkit (CAT) Available at http://www.etsi.org/deliver/etsi_ts/102200_102299/102223/12.01.00_60/ts_102223v120100p.pdf
[2]	RFC 2119	“Key words for use in RFCs to Indicate Requirement Levels”, S. Bradner, March 1997. Available at http://www.ietf.org/rfc/rfc2119.txt
[3]	ETSI TS 102 225	Smart Cards; Secured packet structure for UICC based applications (Release 9) http://www.etsi.org/deliver/etsi_ts/102200_102299/102225/09.00.00_60/ts_102225v090000p.pdf

1.6 Conventions

“The key words “must”, “must not”, “required”, “shall”, “shall not”, “should”, “should not”, “recommended”, “may”, and “optional” in this document are to be interpreted as described in RFC2119 [2].”

2 Requirements

2.1 STK Proactive Commands Used

In order to provide an enriched User Experience, the support of the following STK proactive commands is required:

- DISPLAY TEXT
- GET INPUT
- SEND SHORT MESSAGE
- SELECT ITEM
- SEND USSD

2.2 STK Events used

Typically the SIM applet is triggered by a Secured Packet Command as defined in ETSI TS 102 225 [3] (i.e. binary SMS 03.48), thanks to the EVENT_FORMATTED_SMS_PP_ENV STK event.

2.3 Expected Device Behaviour and User Experience

In this section the different device behaviour is described for the different SIM Toolkit commands used.

2.4 DISPLAY TEXT Command

The device shall be compliant with the DISPLAY TEXT proactive command as described in ETSI TS 102 223 [1] regarding the parameters and the text format.

The device must handle the 3 text encoding:

- Data Coding Scheme 00 → GSM default alphabet 7 bits packed
- Data Coding Scheme 04 → GSM default alphabet 8 bits
- Data Coding Scheme 08 → 16 bits UCS2 alphabet

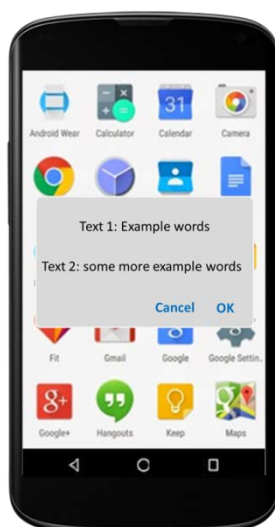


Figure 1: DISPLAY TEXT User Interface

Pressing home or back buttons on the device should not make the pop up window disappear. The pop up window should remain on top and only exit with ok/cancel.

2.4.1 Buttons Handling

On reception of the DISPLAY TEXT SIM Toolkit proactive command, the device must display on its screen the text contained and the two options which are "OK" and "Cancel".

In addition to the text and the OK/Cancel buttons, most of the devices offer the possibility to do different actions with other buttons (virtual, tactile or physical). The table below describes the device behaviour expected and the return code associated in the TERMINAL RESPONSE.



Figure 2: Main device User Interface definition

It would be desirable to be able to display a window title (Text 1) in a similar to the way to the GET INPUT command.

It should be possible to provide the title (Text 1) within the display text command. If the title is not provided then no title is displayed.

The URL displayed within the text 2 content should be automatically detected as hyperlinks. By clicking on the link the default phone browser should be triggered to open the URL.

The device must return the result of the user's action to the applet in the TERMINAL RESPONSE.

The returned code and the device behaviour must follow the principle detailed below:

User's action	Mobile Connect Result	STK Result	Returned code (hex)	Device behaviour
OK pressed (1)	Validation	Command performed successfully	00	Window closing
Cancel pressed (2)	Cancellation	Proactive UICC session terminated by the user	10	Window closing
Home pressed (if present) (3)	Cancellation	Proactive UICC session terminated by the user	10	Window closing
Back pressed (if present) (4)	Cancellation	Backward move in the proactive UICC session requested by the user	11	Window closing
Multi task button (if present) (5)	None	None	None	No action, The user is able to reactivate the window using the Multi-task button (if no action is taken by the user before the timeout the device must close the STK channel including in the TERMINAL RESPONSE the returned code 12)
User clicks beside the displayed window (if possible) (6)	None	None	None	No action (window still displayed)
No user action (timeout)	Cancellation	No response from user	12	Window closing after the timeout

Table 1: DISPLAY TEXT result code according to user's action

NOTE: Certain buttons presented in the above table may be not implemented according to the device's OS, manufacturer, etc.

2.4.2 Timeout Handling

The DISPLAY TEXT STK command could contain a value in the "Duration" tag as defined in ETSI TS 102 223 [1].

The duration parameter should be configurable and it will be encoded in 2 Bytes. The first one indicates the time unit used and the second one contains the time interval.

- The time unit is encoded as below:
00 → Minutes
01 → Seconds
02 → Tenths of seconds
- The time interval contains a value between 1 and 255.

If during a DISPLAY TEXT command the user does not take any action related to the DISPLAY TEXT window on their device, the window must be closed when the duration timer value is reached. In this case, the device shall return the status code 12 in the TERMINAL RESPONSE.

2.4.3 Immediate Response Parameter

Some DISPLAY TEXT commands could be sent to the device including the tag “Immediate response”. In this case, the mobile must directly send back to the SIM card a TERMINAL RESPONSE containing the “Command performed successfully” information. The device must continue to display the window on the device until the timeout has been reached or the user selects the “OK” button.

If the “immediate response” parameter is present in the DISPLAY TEXT STK proactive command, the device must only display the “OK” button.

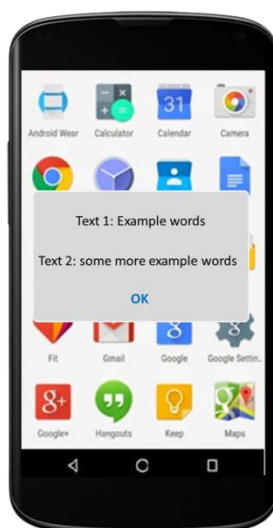


Figure 3: DISPLAY TEXT with immediate response tag

2.4.4 Idle Mode

If the device is in the idle mode when receiving a DISPLAY TEXT STK proactive command, the device must move from this standby mode to display the associated pop up window.

Once the STK command handling is completed (e.g. the user has selected the “OK” button), the device must return to its initial state.

2.4.5 Locked Screen – Manual Unlocking with Notification

If the device is in the idle mode and locked when receiving a DISPLAY TEXT STK proactive command, the device must move from this standby mode, display a notification on the screen and allow the user to manually unlock his device. Once unlocked, the device must display the pop up window associated to this DISPLAY TEXT command.

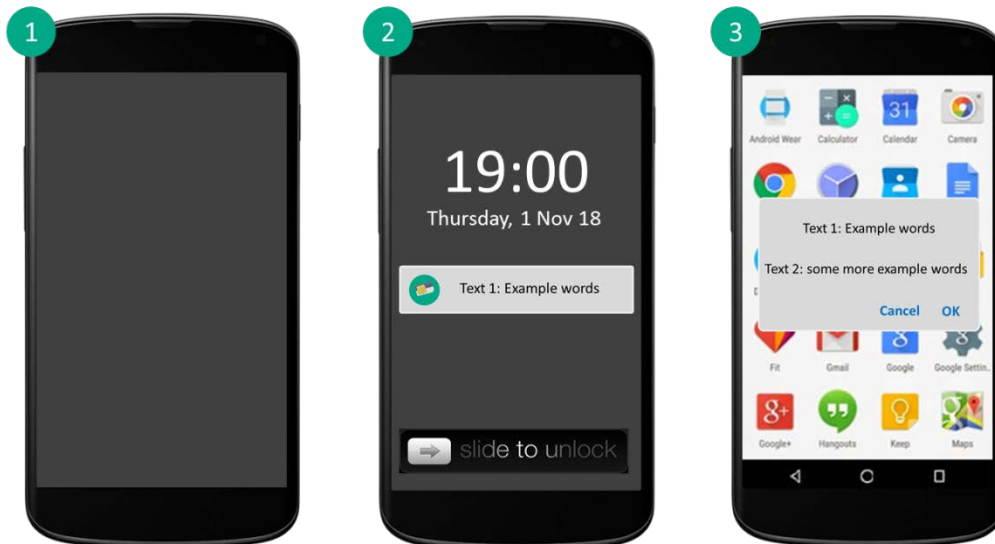


Figure 4: DISPLAY TEXT arriving on a device in locked screen

State	Description
1	Mobile Phone in locked state.
2	Binary SMS received and display triggered by SIM Applet. Message display in screen based on user lock screen configuration: -No display notifications. -Display notifications but no content -Display notification and content.
3	Message displayed after user unlocks screen. (DISPLAY TEXT command)

2.4.6 External Interactions

The device must implement the following behaviour to avoid conflicts between call/SMS and the DISPLAY TEXT STK proactive command:

- An incoming phone call arrives during the DISPLAY TEXT process → The user must be able to accept/reject this call or to stay on the DISPLAY TEXT window. If the user rejects the call, the DISPLAY TEXT window should still be displayed on the mobile screen. If the user accept the call, the DISPLAY TEXT window should still be displayed

on the device screen or should be displayed after the user completes the call (if the timeout of the DISPLAY TEXT command has not been reached).

- An incoming text SMS arrives during the DISPLAY TEXT process → The DISPLAY TEXT window should still be displayed on the device screen.
- A DISPLAY TEXT command is sent during an established phone call → The DISPLAY TEXT window must be displayed on the device screen. Once the STK command handling (*i.e.* user select OK, Cancel, timeout, ...), the DISPLAY TEXT window is closed but the phone call must stay established all the time during this process.
- A DISPLAY TEXT command is sent at the same time as an incoming call establishment or an incoming text SMS → The device must handle the DISPLAY TEXT STK command without any interference to the incoming call or the incoming text SMS

2.5 GET INPUT Command

The device must be compliant with the GET INPUT SIM Toolkit proactive command as described in the ETSI TS 102 223 [1] specification regarding the parameters and the text format.

The device must handle the 3 text encoding:

- Data Coding Scheme 00 → GSM default alphabet 7 bits packed
- Data Coding Scheme 04 → GSM default alphabet 8 bits
- Data Coding Scheme 08 → 16 bits UCS2 alphabet

The device must also support the command qualifier describing the user entry:

- bit 1:
 - 0 = digits (0 to 9, *, #, and +) only;
 - 1 = alphabet set.
- bit 2:
 - 0 = SMS default alphabet;
 - 1 = UCS2 alphabet.
- bit 3:
 - 0 = terminal may echo user input on the display;
 - 1 = user input shall not be revealed in any way (see note).
- bit 4:
 - 0 = user input to be in unpacked format;
 - 1 = user input to be in SMS packed format.

If the device integrates a virtual keyboard, this one must directly display the keyboard digits.

The device must neither display on the screen the characters and the length expected (e.g. "Digits (0-9,*,#,+) 1-9") nor any tittle on the top of the window (e.g. "SIM Toolkit).

If the command qualifier indicates that the user input shall not be revealed in any way, the terminal shall prevent, as stated in the ETSI TS 102223, the text string from being identified by any means (e.g. stars could be displayed instead of characters).

Pressing home or the back buttons on the device should not make the pop up window disappear. The pop up window should remain on top and can only be exited with ok/cancel.

The device must handle the min-max characters that are required in the STK command thanks to the “Response length” value.

It is recommended to use the word “OK” not “Send”

The picture below represents the expected display:

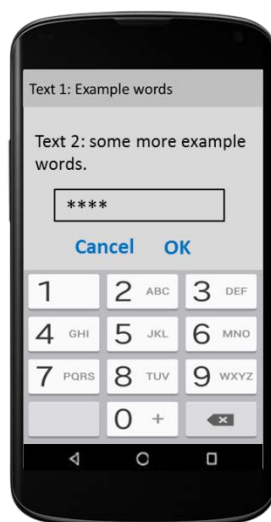


Figure 5: GET INPUT User Interface

2.5.1 Buttons Handling

On reception of the GET INPUT SIM Toolkit proactive command, the device must display on its screen the text message, a field allowing the user to enter numeric characters and the two options which are “OK” and “Cancel” (if not displayed on the screen, the “Cancel” option must be found in a contextual menu). It is highly recommended to display the “Cancel” button in addition to the “OK” on the screen.

The device must return the result code of the user’s action including the characters entered to the applet in the TERMINAL RESPONSE.

Pressing home or the back buttons on the device should not make the pop up window disappear. The pop up window should remain on top with the only exist possible with “OK” or “Cancel” commands.

It would be desired to be able to display a window title (Text 1).

It should be possible to provide the test (Text 1) within the GET INPUT command.

If a URL is displayed within the text 2 content it should be automatically detected as hyperlinks. By clicking on the link, the default phone browser should be triggered to open the URL.

The returned code and the device behaviour must follow the principle detailed below:

User's action	MC Result	STK Result	Returned code (hex)	Device behavior
Characters entered & OK pressed	Validation	Command performed successfully	00	Window closing
Cancel pressed	Cancellation	Proactive UICC session terminated by the user	10	Window closing
Home pressed (if present)	Cancellation	Proactive UICC session terminated by the user	10	Window closing
Back pressed (if present)	Cancellation	Backward move in the proactive UICC session requested by the user	11	Window closing
Multi task button (if present)	None	None	None	No action, The user is able to reactivate the window using the Multi-task button (if no action is taken by the user before the timeout the device must close the STK channel including in the TERMINAL RESPONSE the returned code 12)
User clicks beside the displayed window (if possible)	None	None	None	No action (window still displayed)
No user action (timeout)	Cancellation	No response from user	12	Window closing after the timeout

Table 2: GET INPUT result code according to user's action

NOTE: Certain buttons present in the above array may be not implemented according to the device's OS, manufacturer, etc.

2.5.2 Timeout handling

The GET INPUT command could contain a value in a "Duration" tag. This requirement is not specified in the ETSI TS 102 223 [1]. However this feature is already implemented in most devices, and is required by certain applications.

The duration parameter should be configurable and it will be encoded in 2 Bytes. The first one indicates the time unit used and the second one contains the time interval.

- The time unit is encoded as below:
 - 00 → Minutes
 - 01 → Seconds
 - 02 → Tenths of seconds
- The time interval contains a value between 1 and 255.

If during a GET INPUT command the user does not do any action on the device, the window must be closed when the duration value is reached. The device must also send to the SIM card the status code 12 in the TERMINAL RESPONSE.

2.5.3 Idle Mode

If the device is in idle mode when receiving a GET INPUT STK proactive command, the device must get out of the standby mode to display the associated pop up window.

Once the STK command handling is done (e.g. user has entered characters and selected the “OK” button), the device must return to its previous state.

2.5.4 Locked Screen – Manual Unlocking with Notification

If the device is in idle mode and locked when receiving a GET INPUT STK proactive command, the device must get out of the standby mode and display a notification message on the screen and allow the user to manually unlock the device. Once unlocked, the device must display the pop up window associated to the GET INPUT STK proactive command.



Figure 6: GET INPUT STK proactive command arriving on a device in locked screen

State	Description
<div style="background-color: #00a651; border-radius: 50%; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin: 0 auto;">1</div>	Mobile Phone in locked state.

State	Description
2	Binary SMS received and display triggered by SIM Applet. Message display in screen based on user lock screen configuration: -No display notifications. -Display notifications but no content -Display notification and content.
3	Message displayed after user unlocks screen. (GET INPUT command)

2.5.5 External Interactions

The device must implement the following behaviour to avoid any conflicts between call/SMS and the GET INPUT STK proactive command:

- An incoming phone call arrives during the GET INPUT process → The user must be able to accept this call, to reject this call or to stay on the GET INPUT window. If the user rejects the call, the GET INPUT window is still displayed on the device screen. If the user accepts the call, the GET INPUT window is still displayed on the device screen or is displayed after the user hangs up (if the timeout of the GET INPUT command has not been reached).
- An incoming text SMS arrives during the GET INPUT process → The GET INPUT window is still displayed on the device screen.
- A GET INPUT command is sent during an established phone call → The GET INPUT window must be displayed on the device screen. Once the STK command handling (*i.e.* user select OK, Cancel, timeout, ...), the GET INPUT window is closed but the phone call must stay established all the time during this process.
- A GET INPUT command is sent at the same time as an incoming call establishment or an incoming text SMS → The device must handle the GET INPUT STK command without any trouble on the incoming call or the incoming text SMS.

2.6 SEND SHORT MESSAGE Command

The device must be compliant with the ETSI TS 102 223 regarding the SEND SHORT MESSAGE STK proactive command.

If this STK command contains the “Alpha Identifier” with a length set to “00”, the device must not display any message on the device screen (*i.e.* no message such as “the SIM card has sent a SMS”).

If the SMS-C address is not present in the “address” tag of the STK command, the device must retrieve it from the EF_{SMSP} SIM card file.

2.7 SELECT ITEM Command

The device should support SELECT ITEM command.

2.8 SEND USSD Command

The device should support the SEND USSD command.

If the SIM applet calls the SEND USSD command and then exits, it is expected that the USSD service takes over the display and the STK exits.

If the customer exits the USSD service then the USSD session must terminate and the user must see the phone in the state before the STK was started.

2.9 STK APPLICATION TERMINATION

When a SIM Applet exits the user should not be taken to the SIM Menu unless the SIM applet was launched from the SIM Menu. The phone should be returned to the state before SIM Applet was called.

2.10 DUAL SIM Services

If there is already a Proactive Session for SIM 1 and there is a trigger for a SIM applet in SIM 2, the user should be notified and give the option to exit the current proactive session and launch the SIM applet on SIM2.

If the user rejects the notification, the SIM 2 applet must wait until SIM 1 applet terminates before SIM 2 applet is launched.

2.11 Logging / Reporting Mechanism

In order to avoid security issues, the device must not log the STK exchanges. Specifically, the exchanges of the DISPLAY TEXT, the GET INPUT and the SEND SHORT MESSAGE commands.

2.12 Launch browser

If the device provides browser support, the OEM must provide support for browser launch function within the SIM Toolkit.

Annex A Document Management

A.1 Document History

Version	Date	Brief Description of Change	Approval Authority	Editor / Company
1.0	July 2016	The first version of this document was published as PDATA.12	TG	Olivier Gruson and Anne-Claire Laval/ ORANGE
2.0	March 2019	TSG have taken ownership of this document and are making SIM Toolkit User Interface generic.	TSG#35	Angel Aranda G+D Mobile Security

A.2 Other Information

Type	Description
Document Owner	TSG
Editor / Company	Angel Aranda / G+D Mobile Security

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Your comments, suggestions & questions are always welcome.