N-Squared Software N2TTG
MAP-USSD Protocol Conformance Statement

1   Document Information

1.1   Scope and Purpose

This document describes the implementation of the MAP/USSD protocol for real-time flows for text-based subscriber self-management using the N-Squared (N2) Text Telephony Gateway (TTG) running on the N-Squared Service Daemon (N2SVCD) framework. It should be read in conjunction with the N2TTG Technical Guide [R-1] and the N2SVCD Technical Guide [R-2].

This document assumes a working knowledge of the relevant MAP, SIGTRAN, and other telephony concepts, including the standard USSD interactions between an HLR and a USSD Gateway such as N2TTG.

1.2   Definitions, Acronyms, and Abbreviations

Term	Meaning
AC	Application Context (in TCAP)
AS	Application Server
ASP	Application Server Process
ASPAC	ASP Active
ASPTM	ASP Traffic Maintenance
ASN.1	Abstract Syntax Notation One
ETSI	European Telecommunications Standards Institute
GT	Global Title
GTI	Global Title Indicator
HLR	Home Location Register
IETF	Internet Engineering Task Force
IP	Internet Protocol
ITU-T	International Telecommunication Union Telecommunication Standardization Sector
M3UA	MTP3 User Adaption Layer
MAP	Mobile Application Part
MTP3	Message Transfer Part Level 3
N2	N-Squared
OCS	Online Charging Server
PC	Point Code
RFC	Request For Comments
RI	Routing Indicator
SCCP	Signalling Connection Control Part
SCP	Service Control Platform
SCTP	Stream Control Transmission Protocol
SMPP	Short Message Peer-to-Peer Protocol
SMS	Short Message Service
SSN	Sub-System Number
SSP	Service Switching Platform

Term	Meaning
SUA	SCCP User Adaption Layer
TCAP	Transaction Capabilities Application Part
TS	Technical Specification
USSD	Unstructured Supplementary Service Data

1.3   References

The following documents are referenced within this document:

Reference	Document
[R-1]	N2TTG Technical Guide
[R-2]	N2SVCD Technical Guide
[R-4]	N2SVCD SIGTRAN-TCAP PCS
[R-10]	ETSI TS 129 002 V10.2.0 (2011-04) Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Mobile Application Part (MAP) specification (3GPP TS 29.002 version 10.2.0 Release 10)
[R-20]	https://www.lua.org/

1.4   Ownership and Usage

This document, including the information contained herein, is proprietary to N-Squared Software (NZ) Limited but released for informational purposes only.

This document shall not be used or reproduced for any other purpose without the written approval of N-Squared Software (NZ) Limited.

> **N-Squared Software (NZ) Limited**
> PO Box 5035
> Terrace End
> Palmerston North 4410
> New Zealand

2   Contents

3   Introduction

3.1   N2TTG Overview

The N-Squared Text Telephony Gateway (N2TTG) is a software system for processing inbound self-management subscriber text messages from the network and performing the necessary service logic to determine the appropriate response text. This may involve follow-up interaction, e.g. offering menus or further choices.

The supported inbound network side protocols are:

   a)   MAP-USSD over SIGTRAN from the HLR, and/or
   b)   SMPP Short Message from the SMSC.

Typical uses of these subscriber self-management messages are:

   •   Balance Query
   •   Voucher Top-Up
   •   Service Pack Activation/Renewal
   •   IOU Services
   •   Friends & Family Number Management, etc.

The N2TTG platform services are defined using the Lua embedded scripting language [R-20], and the service logic may also include external service access via REST, SOAP, Diameter, etc. Refer to [R-2].

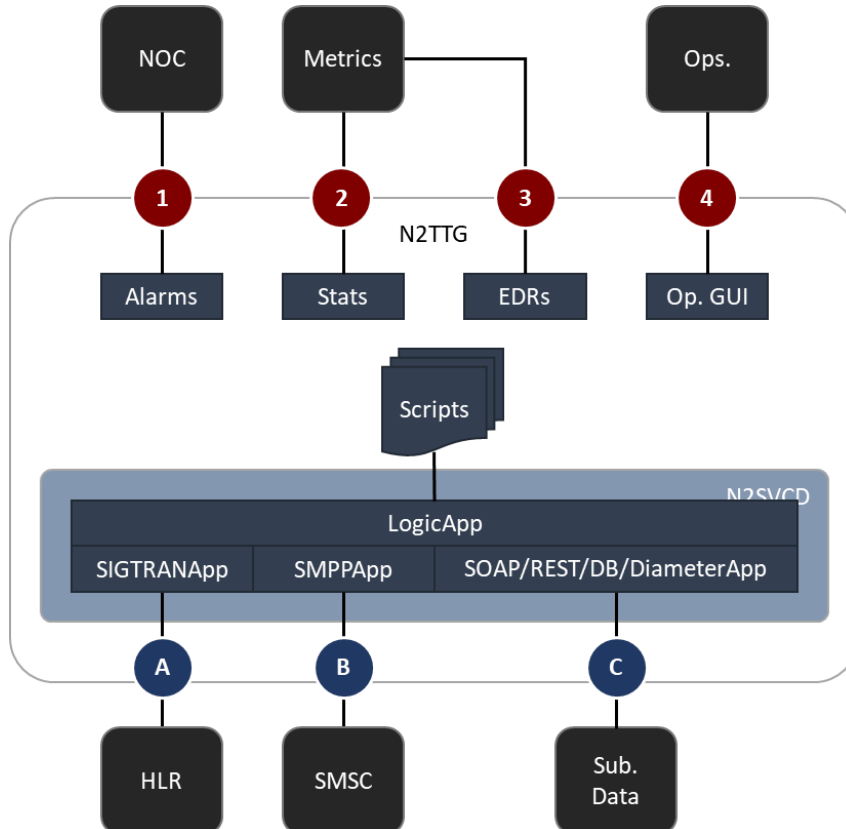A standard N2TTG deployment contains several integration points:

Figure A: N2TTG Integration

This document relates to the N2TTG Compliance for the USSD (over MAP) layer of Interface "A", which has the following stack:

- **MAP/USSD**
- TCAP
- SCCP
- SIGTRAN M3UA
- SCTP/IP

This document describes only the uppermost MAP/USSD layer. The common N2SVCD Conformance for TCAP and the lower layers of the stack are described in the separate document [R-4].

The SMPP protocol conformance is specified in a separate document.

Conformance is based on the referenced standards or other non-standard functionality but noting that solution conformance to the above is limited to the extent expressly described herein. I.e. statement of conformance to a standard in no way implies conformance to or compliance with the complete standard.

4   MAP/USSD Compliance

4.1   MAP/USSD Overview

N2TTG processes inbound TCAP transactions received from the Home Location Register (HLR) when the subscriber initiates a USSD session.

N2TTG to SCP interface compliance is formally based on ETSI document "3GPP TS 29.002 version 10.2.0 Release 10" [R-10].

Note that ASN.1 is not a backwards-compatible format. Other non-listed fields received in MAP operations will cause a decode error.

4.2   MAP Operation Support

The N2TTG supports only the following MAP operation and TCAP message combinations when communicating with the HLR. Non-MAP TCAP messages are also shown here.

TCAP	Operation	Direction
BEGIN	processUnstructuredSS-Request	From HLR
END	processUnstructuredSS-Request / ReturnResult	To HLR
END	processUnstructuredSS-Request / ReturnError	To HLR
CONTINUE	unstructuredSS-Request	To HLR
CONTINUE or END	unstructuredSS-Request / ReturnResult	From HLR
CONTINUE or END	unstructuredSS-Request / ReturnError	From HLR
CONTINUE	unstructuredSS-Notify	To HLR
CONTINUE or END	unstructuredSS-Notify / ReturnError	From HLR
END	(none)	From HLR
END	(none)	To HLR
ABORT	(none)	From HLR
ABORT	(none)	To HLR

Table 1:   MAP Operations, Results, and Errors (with TCAP)

Any other MAP/TCAP combination being received by N2TTG will cause the TCAP transaction and associated USSD subscriber session to be aborted.

4.3   TCAP Empty END

The N2TTG supports receiving and sending TCAP Empty END for the clean termination of a USSD session.

When receiving TCAP Empty END, the service logic will generate an EDR but will not typically raise an SNMP warning or alarm, as this is considered "normal" behavior in some tear-down scenarios.

4.4   TCAP ABORT

The N2TTG supports receiving and sending TCAP ABORT for the clean termination of a USSD session.

When receiving TCAP Abort, the service logic will generate an EDR but will not typically raise an SNMP warning or alarm, as this is considered "normal" behavior in some tear-down scenarios.

4.5   processUnstructuredSS-Request

The HLR sends MAP processUnstructuredSS-Request operation to N2TTG when a subscriber initiates a new USSD transaction for which the N2TTG is the configured handler.

N2TTG supports receiving the following attributes in processUnstructuredSS-Request:

Attribute	Type	Notes
map-open	MAP-OpenInfo	Note: Part of TCAP dialogue AARQ-apdu. Specifically: dialoguePDU.dialogueRequest .user-information.single-ASN1-type.MAP-DialoguePDU
.destinationReference	MAP Address String	Supported as below
.digits	Hex Digits	Address digits.
.noa	Integer	Nature of Address
.npi	Integer	Numbering Plan Indicator
.originationReference	MAP Address String	Supported as below
.digits	Hex Digits	Address digits.
.noa	Integer	Nature of Address
.npi	Integer	Numbering Plan Indicator
ussdDataCodingScheme	Cell Broadcast Data Coding Scheme	Support for 7-Bit, 8-Bit and UCS-2 encoding. Compression is not supported. User Data Header (UDH) is not supported. Language codes are passed to service logic.
ussdString	USSD String	Support for 7-Bit, 8-Bit and UCS-2 encoding. Compression is not supported. User Data Header (UDH) is not supported.
alertingPattern	Byte	Supported
msisdn	MAP Address String	Supported as below
.digits	Hex Digits	Address digits.
.noa	Integer	Nature of Address
.npi	Integer	Numbering Plan Indicator

Table 2:   MAP processUnstructuredSS-Request Attributes

Note that the map-open parameters from the containing TCAP Dialogue are also provided to the service logic. In some networks, the subscriber msisdn must be obtained from the MAP Open originationReference field rather from the msisdn field within the MAP operation argument.

N2TTG will examine the received parameters to determine the appropriate service logic based on one or more of the following:

- *Destination SSN.*
- *USSD String prefix.*
- *Destination Reference digits (exact match).*
- *Destination Reference digits (prefix match).*

Default service logic may be configured when no match detected from the above parameters.

4.5.1   ReturnResult

The TTG will send processUnstructuredSS-Request / ReturnResult as the normal, clean-shutdown mechanism to end the USSD transaction and associated subscriber session. The return result includes a final text message, which is displayed to the subscriber.

N2TTG supports sending the following attributes in processUnstructuredSS-Request / ReturnResult:

Attribute	Type	Notes
ussdDataCodingScheme	Cell Broadcast Data Coding Scheme	Support for 7-Bit, 8-Bit and UCS-2 encoding. Compression is not supported. User Data Header (UDH) is not supported. Language code is determined by service logic.
ussdString	USSD String	Support for 7-Bit, 8-Bit and UCS-2 encoding. Compression is not supported. User Data Header (UDH) is not supported.

Table 1:   MAP processUnstructuredSS-Request / ReturnResult Attributes

4.5.2   ReturnError

The TTG service logic may choose to send processUnstructuredSS-Request / ReturnError as the normal, failure-shutdown mechanism to end the TCAP transaction and associated USSD subscriber session.

Whenever sending ReturnError for processUnstructuredSS-Request, the N2TTG will always use TCAP END to end the subscriber interaction.

N2TTG service logic may choose any error value, but the following standard values are specifically documented:

Value	Error	Supported
13	Call Barred	The subscriber or originating network is explicitly or implicitly not permitted to access this service.
71	Unknown Alphabet	The specified alphabet identifier is not recognized.
34	System Failure	The system is not well-configured or is not fully operable.
35	Data Missing	An expected data value is not present.
36	Unexpected Data Value	One of the received data values cannot be interpreted.
(other)	(other)	The service logic may select any other error value.

Table 2:   MAP processUnstructuredSS ReturnError Attributes

4.6   unstructuredSS-Request

The N2TTG sends unstructuredSS-Request to the HLR as an intermediate step during a subscriber-initiated USSD interaction. The Notify causes a text message to be displayed to the subscriber and prompts for a response. Service logic processing will be suspended until a response is received, or until a timeout occurs indicating no response.

N2TTG supports sending the following attributes in unstructuredSS-Request:

Attribute	Type	Notes
ussdDataCodingScheme	Cell Broadcast Data Coding Scheme	Support for 7-Bit, 8-Bit and UCS-2 encoding. Compression is not supported. User Data Header (UDH) is not supported. Language codes are passed to service logic.
ussdString	USSD String	Support for 7-Bit, 8-Bit and UCS-2 encoding. Compression is not supported. User Data Header (UDH) is not supported.
alertingPattern	Byte	Supported
msisdn	MAP Address String	Supported as below
.digits	Hex Digits	Address digits.
.noa	Integer	Nature of Address
.npi	Integer	Numbering Plan Indicator

Table 1:   MAP unstructuredSS-Request Attributes

4.6.1   ReturnResult

After sending unstructuredSS-Request, N2TTG expects to receive unstructuredSS-Request / ReturnResult as the normal continuation. The return result includes the subscriber's response to the preceding prompt.

In the case of timeout, the service logic may choose to re-prompt, to continue with default, or to end the session.

4.6.2   ReturnError

After sending unstructuredSS-Request, N2TTG recognizes unstructuredSS-Request / ReturnError as an alternate continuation.

The return error includes an error code which is provided to the service logic. The N2TTG supports any error code value.

4.7   unstructuredSS-Notify

The N2TTG sends unstructuredSS-Notify to the HLR as an intermediate step during a subscriber-initiated USSD interaction. The Notify causes a text message to be displayed to the subscriber but does not prompt for a response.

N2TTG supports sending the following attributes in unstructuredSS-Notify:

Attribute	Type	Notes
ussdDataCodingScheme	Cell Broadcast Data Coding Scheme	Support for 7-Bit, 8-Bit and UCS-2 encoding. Compression is not supported. User Data Header (UDH) is not supported. Language codes are passed to service logic.
ussdString	USSD String	Support for 7-Bit, 8-Bit and UCS-2 encoding. Compression is not supported. User Data Header (UDH) is not supported.
alertingPattern	Byte	Supported
msisdn	MAP Address String	Supported as below
.digits	Hex Digits	Address digits.
.noa	Integer	Nature of Address
.npi	Integer	Numbering Plan Indicator

Table 2:   MAP unstructuredSS-Notify Attributes

4.7.1   ReturnResult

ReturnResult is not supported for unstructuredSS-Notify and will cause service logic to be aborted.

4.7.2   ReturnError

ReturnError is supported for unstructuredSS-Notify. It will cause an EDR to be generated, but will not generate a system warning. The service logic may expressly check for this error, but this is not enforced, and because of the asynchronous nature of ReturnError for unstructuredSS-Notify, most service logic probably will not check.

5   MAP/USSD Message Flows

In all flows in this section, note that N2TTG may perform call shutdown using TCAP Abort in the case of non-recoverable USSD session error.

5.1   Common Notes to All Scenarios

At the end of the session, the service logic may end the session with a final result or may "silently" end the session with an empty TCAP END. This "silent" end is shown in some but not all scenarios.

The interaction with the Online Charging Server ("OCS") is shown as an example "back-end" service implementation. In practice, the service may perform interactions using DB, REST, SOAP, Diameter, etc. See the N2SVCD technical guide for details on common back-end service capability.

In any exception case, N2TTG will use TCAP-ABORT to terminate the USSD transaction.

5.2   Standard Scenarios

5.2.1   USSD One-Shot

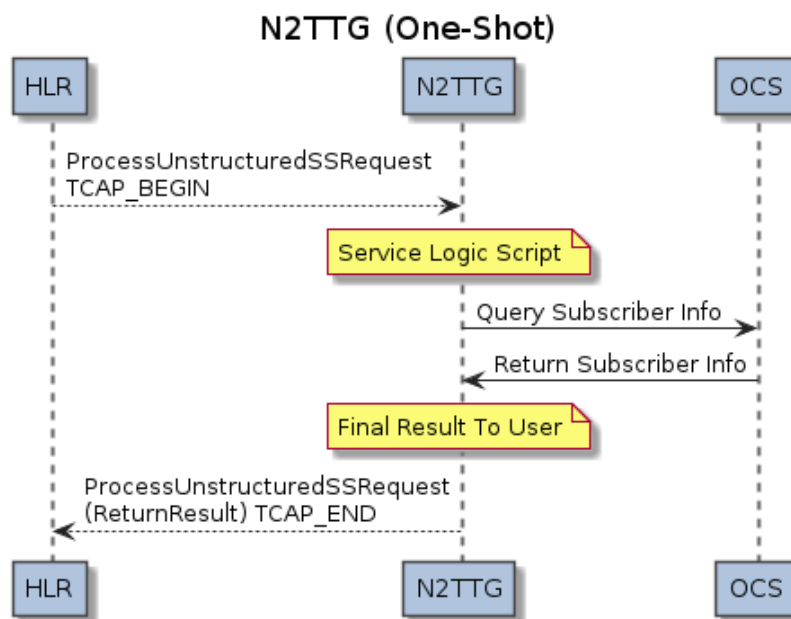The following diagram shows the MAP/USSD operation flow for a simple request/response USSD subscriber request.

Figure B: USSD One-Shot

5.2.2   USSD Extended Result

The following diagram shows the USSD operation flow for an extended result. As a result of processing, the service logic wishes to show multiple response messages with a pause in-between each text push.

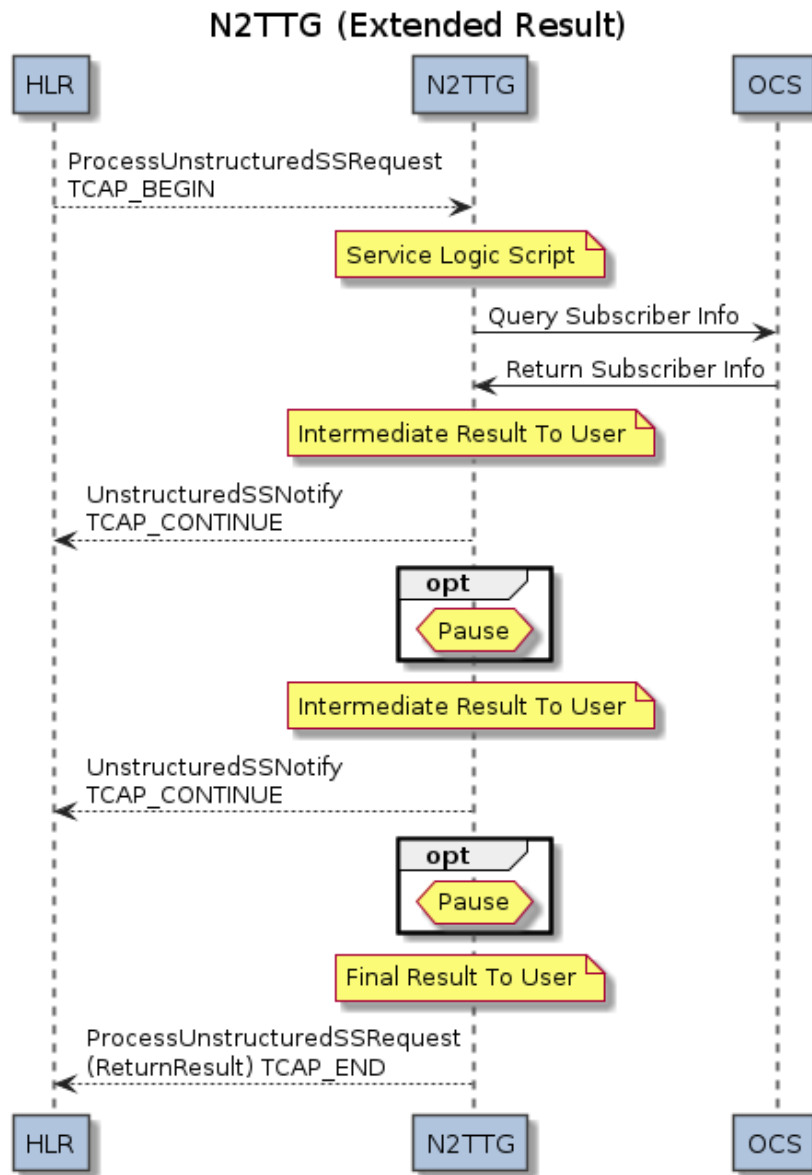A final result is given at the end, which also serves to close the transaction using TCAP_END,

Figure C: USSD Extended Result

5.2.3   USSD Menu

The following diagram shows the USSD operation flow for a menu. The user is prompted to supply input.
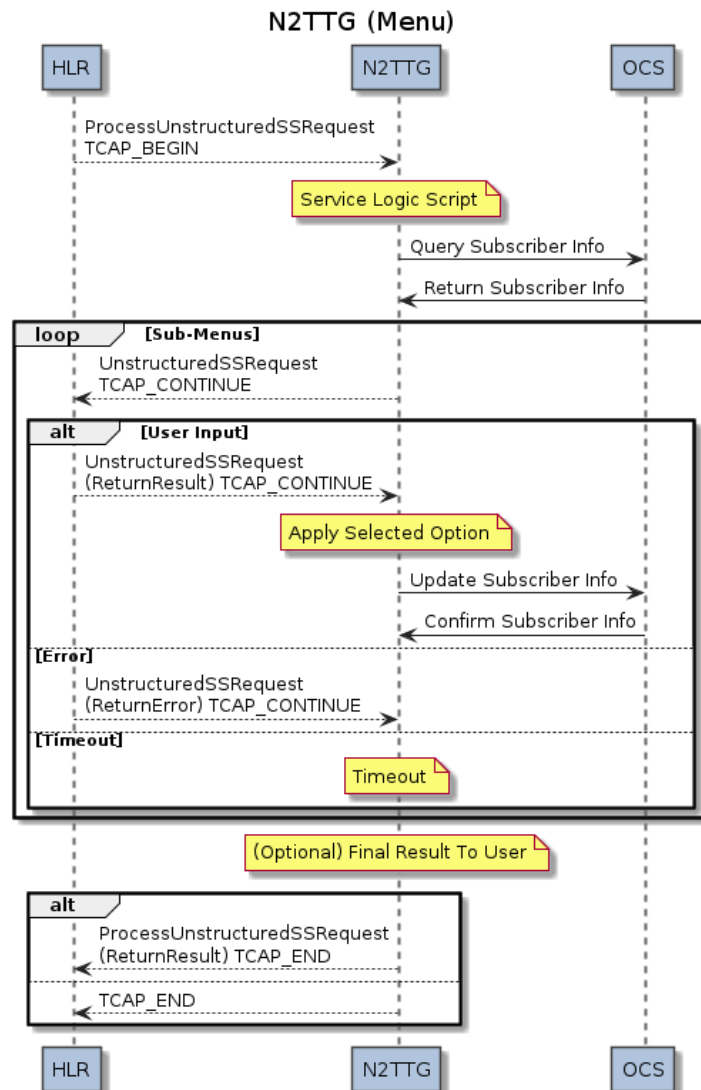

Figure D: USSD Extended Result

Scenario Notes:

- USSD extended result using unstructuredSS-Notify may be combined with USSD menu functions using unstructuredSS-Request.
- The prompt for user input will "time out" if the subscriber does not reply. In this case the service logic may choose to re-prompt, to continue with defaults, or to end the session.

5.3   End of Interaction Scenarios
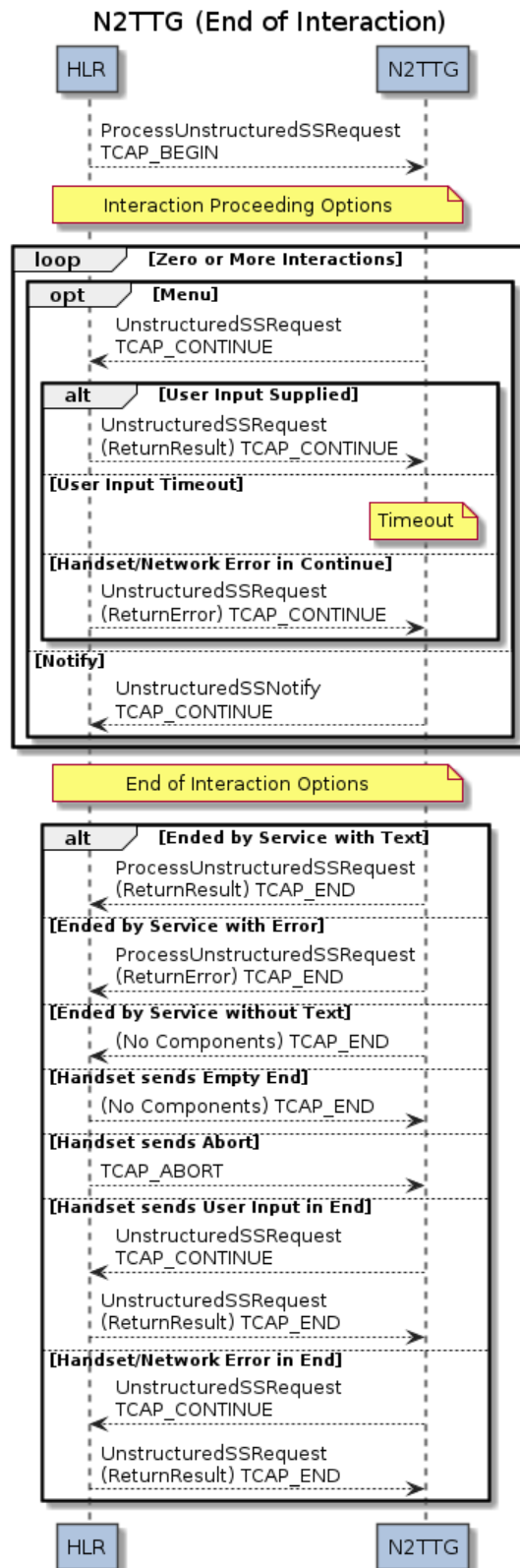
The following diagram shows the supported end of interaction scenarios for N2TTG USSD.

Figure E: USSD End of Interaction