ETSI TS 155 253 V16.0.0 (2020-08)

Digital cellular telecommunications system (Phase 2+) (GSM); Specification of the GEA5 encryption and GIA5 integrity algorithms for General Packet Radio Service (GPRS); Design conformance test data (3GPP TS 55.253 version 16.0.0 Release 16)

3GPP A GLOBAL INITIATIVE
GSM GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS

Reference
RTS/TSGS-0355253vg00

Keywords
GSM,SECURITY

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (https://ipr.etsi.org/).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

Legal Notice

This Technical Specification (TS) has been produced by ETSI 3rd Generation Partnership Project (3GPP).

The present document may refer to technical specifications or reports using their 3GPP identities. These shall be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between 3GPP and ETSI identities can be found under http://webapp.etsi.org/key/queryform.asp.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

Introduction

The present document has been prepared by the 3GPP Task Force, and gives a detailed specification of the 3GPP encryption algorithm GEA5 and integrity algorithm GIA5.

The present document is the second of three, which between them form the entire specification of the 3GPP encryption algorithm GEA5 and integrity algorithm GIA5:

- 3GPP TS 55.251: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Specification of the GEA5 encryption and GIA5 integrity algorithms for GPRS; GEA5 and GIA5 specification".
- 3GPP TS 55.252: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Specification of the GEA5 encryption and GIA5 integrity algorithms for GPRS; Implementers' test data".
- **3GPP TS 55.253: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Specification of the GEA5 encryption and GIA5 integrity algorithms for GPRS; Design conformance test data".**

1 Scope

The present document defines the design conformance test data of the 3GPP encryption algorithm GEA5 and integrity algorithm GIA5.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 55.251: "Specification of the GEA5 and GIA5 encryption algorithms for GPRS; GEA5 and GIA5 specification".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

4 Introductory information

4.1 Introduction

The confidentiality algorithm GEA5 is a stream cipher that is used to encrypt/decrypt blocks of data under a confidentiality key KC128. The block of data may be between 1 and 65536 octets long. The algorithm uses SNOW 3G [2] as a keystream generator

The integrity algorithm GIA5 computes a 32-bit MAC (Message Authentication Code) of a given input message using an integrity key KI128. The approach adopted uses SNOW 3G.

4.2 Notation

4.2.1 Radix

The prefix "0x" is used to indicate hexadecimal numbers.

4.2.2 Conventions

The assignment operator "=", is used as in several programming languages. So:

<variable> = <expression>

means that <*variable*> assumes the value that <*expression*> had before the assignment took place. For instance:

$x = x + y + 3$

means:

(new value of x) becomes (old value of x) + (old value of y) + 3.

4.2.3 Bit/Byte ordering

All data variables in the present document are presented with the most significant bit (or byte) on the left hand side and the least significant bit (or byte) on the right hand side. Where a variable is broken down into a number of sub-strings, the left most (most significant) sub-string is numbered 0, the next most significant is numbered 1 and so on through to the least significant.

For example an n-bit MESSAGE is subdivided into 64-bit substrings MB_0,MB_1…MB_i so for a message:

0x0123456789ABCDEFFEDCBA98765432l086545381AB594FC28786404C50A37…

is:

MB_0 = 0x0123456789ABCDEF
MB_1 = 0xFEDCBA9876543210
MB_2 = 0x86545381AB594FC2
MB_3 = 0x8786404C50A37…

In binary this would be:

00000001001000110100010101100111100010011010101111001101111101111111111110…

with

MB_0 = 0000000100100011010001010110011111000100110101011110011011110111101111
MB_1 = 1111111011011100101110101001100001110110010101000011001000010000
MB_2 = 1000011001010100010100111000000110101011010110010100111111000010
MB_3 = 1000011110000110010000000100110001010000101000110111…

4.3 List of Variables

CONSTANT-F a 32-bit parameter which is constant for any given FRAMETYPE input.

DIRECTION the 1-bit input to both the GEA5 and GIA5 functions indicating the direction of transmission (uplink or downlink).

FRAMETYPE an 8-bit input to the GEA5 and GIA5 functions indicating the type of frame to be protected.

INPUT the 32-bit time variant input to the GEA5 function.

INPUT-I the 32-bit time variant input to the GIA5 function.

KC128 the 128-bit confidentiality key.

KI128 the 128-bit integrity key.

KS[i] the ith bit of keystream produced by the keystream generator.

L the number of 32-bit words of SNOW 3G keystream that are generated by GEA5 (equal to □M / 4□).

LENGTH a 64 bit parameter defined within GIA5 which specifies the number of bits of message to be MAC'd (equal to 8 times M).

M the input to the GEA5 function which specifies the number of octets of output required (1-65536); also the input to the GIA5 function which specifies the number of octets of message to be MAC' (1-65536).

MAC the 32-bit message authentication code (MAC) produced by the integrity function GIA5.

MESSAGE the input bitstream of LENGTH bits that is to be processed by the GIA5 function.

OUTPUT the output octets from the GEA5 function.

S1, S2, … a sequence of 64-bit words derived from MESSAGE and LENGTH which is used within GIA5 to construct the MAC.

z1, z2, … the 32-bit words forming the keystream sequence of SNOW 3G. The word produced first is z1, the next word z2 and so on.

5 Design conformance test data

This clause only available under licence.
See http://www.etsi.org/about/what-we-do/security-algorithms-and-codes/cellular-algorithm-licences.

Annex A (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2017-03	SA#75	SP-170091				Presented for approval	2.0.0
2017-03	SA#75					Upgrade to change control version	13.0.0
2017-03	SA#75	-	-	-		Promotion to Release 14 without technical change	**14.0.0**
2018-06	-	-	-	-	-	Update to Rel-15 version (MCC)	**15.0.0**
2020-07	-	-	-	-	-	Update to Rel-16 version (MCC)	**16.0.0**

History

Document history		
V16.0.0	August 2020	Publication