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# ETSI TS 102 165-2 V4.1.1 (2003-02)

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*Technical Specification*

## **Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 4; Protocol Framework Definition; Methods and Protocols for Security; Part 2: Counter Measures**

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## Foreword

This Technical Specification (TS) has been produced by ETSI Project Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON).

The present document is part 2 of a multi-part deliverable covering Methods and Protocols for security in TIPHON Release 4, as identified below:

Part 1: "Threat Analysis";

**Part 2: "Counter Measures".**

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# 1 Scope

The present document defines by means of an information model, a functional entity behavioural model, and by validated SDL a model of the abstract behaviour of each service and service capability identified as being essential in TIPHON R4.

The present document defines by means of meta-protocol, algorithm boundary conditions, and guidance text the security countermeasures identified in TS 102 165-1 [1].

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# 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 and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <http://docbox.etsi.org/Reference>.

- [1] ETSI TS 102 165-1: "Telecommunications and Internet Protocol Harmonization over Networks (TIPHON) Release 4; Protocol Framework Definition; Methods and Protocols for Security; Part 1: Threat Analysis".
- [2] ETSI TR 101 877: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON); Requirements Definition Study; Scope and Requirements for a Simple call".
- [3] ETSI TS 101 878: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 3; Service Capability Definition; Service Capabilities for a simple call".
- [4] ITU-T Recommendation I.130: "Method for the characterization of telecommunication services supported by an ISDN and network capabilities of an ISDN".
- [5] ISO/IEC 9798-2: "Information technology - Security techniques - Entity authentication - Part 2: Mechanisms using symmetric encipherment algorithms".
- [6] ISO/IEC 9798-3: "Information technology - Security techniques - Entity authentication - Part 3: Entity authentication using a public key algorithm".
- [7] ITU-T Recommendation Z.100: "Specification and description language (SDL)".

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# 3 Definitions and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 101 877 [2] and TS 101 878 [3] apply.

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 101 877 [2], TS 101 878 [3] and the following apply:

CK	Cipher Key
FE	Functional Entities
FFS	For Further Study
KSG	Key Stream Generator
KSS	Key Stream Segment
MSC	Message Sequence Chart
PDU	Protocol Data Unit
RSO	Random Seed
SDU	Service Data Unit
SpoA	Service point of Attachment
TpoA	Transport point of Attachment
TVP	Time Variant Parameter

---

## 4 Provision of counter-measures in TIPHON

### 4.1 Required security services

In TS 102 165-1 [1] the threats to a TIPHON system have been analysed and a set of recommended countermeasures identified that when implemented will reduce the overall risk to users of TIPHON systems. A subset of these countermeasures has been identified as essential to counter most threats.

The following security services are identified in [1] as required to minimize the risk to TIPHON to an acceptable level and are required to be standardized.

- A1 = Authentication of the terminal by the registrar (home of the user profile);
- A2 = Authentication of the registrar by the terminal;
- A3 = Authentication of the terminal by the Service point of Attachment (SpoA);
- A4 = Authentication of the SpoA by the terminal;
- A5 = Authentication of the SpoA by the registrar;
- A6 = Authentication of the registrar by the SpoA;
- C1 - C5 = Access control to services, to service data in databases, to data in terminals, and to the service provider's software and hardware, respectively;
- E1 = Confidentiality of user communication on the access interface;
- E2 = Confidentiality of signalling on the access interface;
- E3 = Confidentiality of signalling between SpoA entities;
- E6 = Confidentiality of TIPHON-id on signalling interfaces;
- E7 = Confidentiality of signalling between SpoA and Registrar;
- P1 = Bill limitations;
- P2 = Secure billing administration;
- P3 = Subscriber and terminal management;
- P9 = Security related reports to the service providers; and
- P10 = Secure subscription process.

The implementation method of these countermeasures can reduce the risk. However each countermeasure introduces new threats to the system by adding complexity, and different implementations of the same conceptual countermeasure may introduce different levels of risk. In some instances a specific countermeasure cannot be applied to a particular technology.

## 4.2 Location of standardization of security services

Not all security services are standardized in the present document. Table 1 identifies the location of standardized countermeasures.

**Table 1: Where counter-measures are provided in TIPHON specifications**

Security service	Form of standardization	Location
A1	Meta-protocol and algorithm specification	The present document, clause 6
A2	Meta-protocol and algorithm specification	The present document, clause 7
A3	Meta-protocol and algorithm specification	The present document, clause 8
A4	Meta-protocol and algorithm specification	The present document, clause 9
A5	Meta-protocol and algorithm specification	The present document, clause 10
A6	Meta-protocol and algorithm specification	The present document, clause 11
C1	Meta-protocol specification	TS 101 882-2
C2-C4	FFS	TBD
E1	Algorithm specification and application guideline	The present document, clause 12
E2	Algorithm specification and application guideline	The present document, clause 12
E3	Algorithm specification and application guideline	The present document, clause 12
E6	Application guideline	The present document, clause 12
E7	Algorithm specification and application guideline	The present document, clause 12
P1, P2, P3, P9, P10	Management framework requirements	TS 101 303

Services A1 and A5 are functionally identical and are described only once. In both cases the entity being authenticated has direct access to the shared secret, whereas the entity performing the authentication (the registrar) maintains the key to identity relationship through a third party (the authentication centre). The specific algorithms invoked in A1 and A5 may be different.

Services A2 and A6 are functionally identical and are described only once. The specific algorithms invoked in A2 and A6 may be different.

Services A3 and A4 are described in the present document as a single mutual authentication service A34.

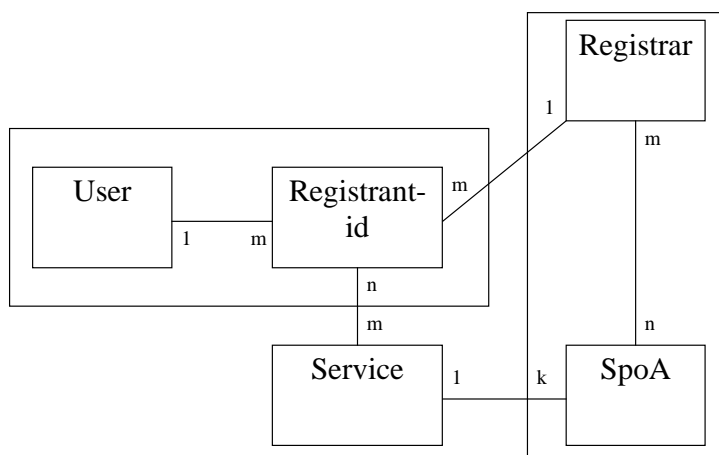
## 5 Authentication counter-measures

### 5.1 Introduction

#### 5.1.1 Description

The primary purpose of the authentication service is to counter masquerade attacks. This may prevent attack on the system by determining that the user is legitimate, and may prevent an attack on the user by determining that the system is legitimate. The authentication services when successfully performed provide the first step in provision of access control to services (C1).

The authentication services are specified with respect to the entities and identities shown in figure 1.



- NOTE 1: A single user may be associated with many registrant-ids  
 NOTE 2: A registrant-id shall be associated with only one user  
 NOTE 3: A registrant-id shall be associated with only one registrar  
 NOTE 4: A registrar may be associated with many registrant-ids  
 NOTE 5: A service may be associated with many SpoAs  
 NOTE 6: In any registration instance a service shall be associated with only one SpoA  
 NOTE 7: An SpoA shall be associated with only one Service  
 NOTE 8: A registrant-id may be associated with many Services

Figure 1: Ordinal relations in TIPHON

## 5.2 Keying policy in TIPHON

### 5.2.1 Release 4

In TIPHON Release 4 the policy towards keying will assume only symmetric keying methods. This method requires pre-arrangement between the authenticating entities but ensures that the authentication framework is able to provide a mapping to existing terminals which employ strong authentication (e.g. GSM, 3GPP-UMTS, DECT, TETRA).

In order to consider the authentication of the principal participants of TIPHON the following constraints on keying arise from the relations shown in figure 1.

- Registrant to Registrar shall use symmetric key authentication methods.
- Registrar to SpoA shall employ symmetric key authentication methods.
- Registrant to SpoA shall employ a symmetric session key to achieve authentication.

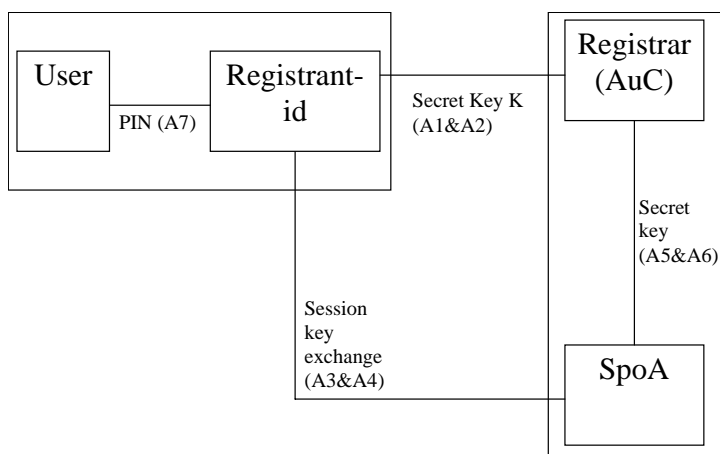


Figure 2: Key relationships in TIPHON

As a user may have many registrant-ids the user should be able to identify which to use and access to the registrant-id should be authenticated using a Personal Identification Number (PIN) or similar. The authentication service (A7) that provides for this protection of this identity is not described in this edition of the present document.

The symmetric keying authentication methods will be based upon the provisions described in ISO/IEC 9798-2 [5].

### 5.2.1.1 Review of service attributes

The authentication protocol should have the following properties:

- Bi-directional challenge-response type;
- Able to be initiated either explicitly or as part of the registration procedure;
- Able to be initiated by the terminal or the network;
- The recipient of the first authentication demand may instigate mutual authentication by use of a mutual authentication indicator, and by sending its challenge together with the response to the first challenge; and
- Where authentication is initiated as part of the registration the authentication timer TA shall always be less than or equal in value to any registration timer.

### 5.2.2 Release 5 and future

In TIPHON Release 5 and onwards the policy towards keying will encompass both symmetric and asymmetric keying methods.

The introduction of asymmetric methods may better counter the threats imposed by soft terminals and replace methods currently available that are based upon weak authentication methods (e.g. user-name and password). The public keying authentication methods will be based upon the provisions described in ISO/IEC 9798-3 [6].

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## 6 A1 = Authentication of the terminal

### 6.1 Purpose

Service A1 offers strong authentication of a terminal to minimize the risk of masquerade of a terminal to the network.

### 6.2 Definition

The terminal shall contain a unique identity known to the registrar and authentication shall confirm this identity through proof of knowledge of a secret shared by the registrar and the terminal. This countermeasure is the corollary of A2.

### 6.3 Description

NOTE: The mechanism here is similar to the three pass authentication method defined in ISO/IEC 9798-2 [5].

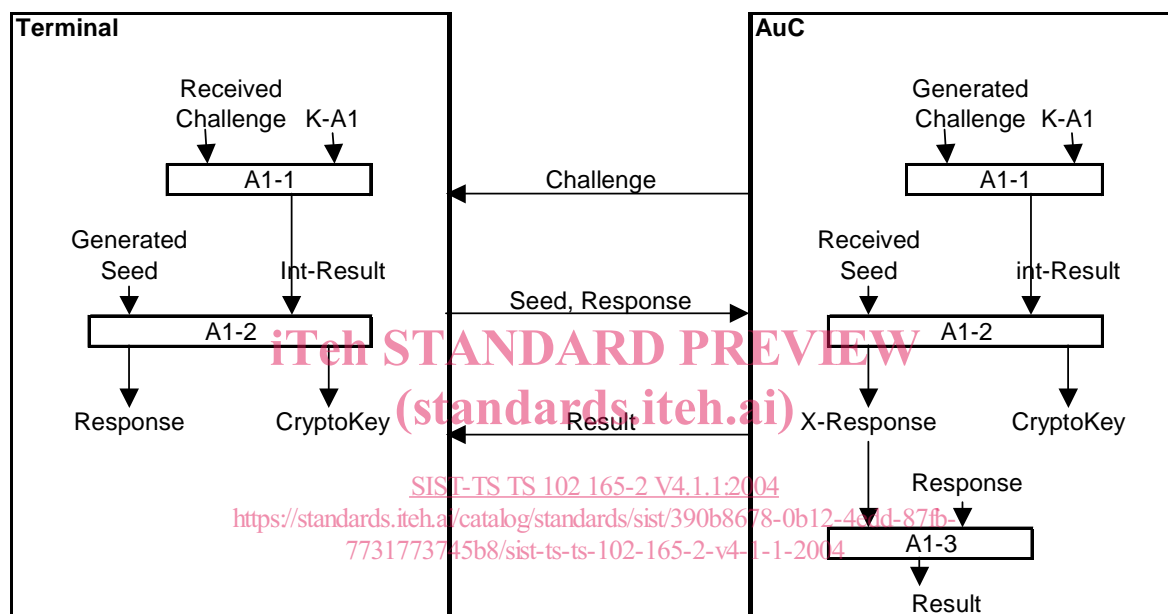
The authentication method described is a symmetric secret key type using a challenge-response protocol. In this method one secret, the authentication key (K-A1), is shared by each of the authenticating parties, and there should be strictly two parties with knowledge of the secret. Authentication is achieved by the parties proving to each other knowledge of the shared secret. The authenticating parties are the authentication centre attached to the registrar and the terminal representing the user.

The following sequence of events illustrates the requirement:

- 1) The authentication centre shall generate a random *challenge* and send it to the terminal.
- 2) Both parties shall generate the intermediate result *Intermediate-Result* from algorithm A1-1 using the random *challenge* and K-A1 as inputs.

- 3) The terminal shall generate a random *seed* for the second stage of the authentication exchange.
- 4) The terminal shall generate the cryptographic response *response* using algorithm A1-2 with inputs *seed* and *Intermediate-Result*.
- 5) The terminal shall send the random *seed* and the *response* to the authentication centre.
- 6) Upon receipt the authentication centre shall generate the expected cryptographic response using the received random *seed* and the pre-determined *Intermediate-Result* with algorithm A1-2. In addition A1-2 should generate an encryption key derived in this exchange for use in later confidentiality services.
- 7) The authentication centre shall compare the expected cryptographic response and the received *response*, if they are the same the terminal has proven knowledge of K-A1.

In addition to the above event sequence the protocol should be able to confirm randomness of the *challenge* and of the second stage *seed*.



NOTE: The split of the authentication algorithms allows K-A1 and algorithm A1-1 to be stored and maintained separately (remotely) from the location of A1-2.

Figure 3: Authentication service A1, algorithm invocations

## 6.4 Procedures

### 6.4.1 Provision/withdrawal

Authentication shall always be available.

## 6.4.2 Normal procedures

Authentication shall always be activated.

### 6.4.2.1 Invocation and operation

Authentication may be invoked on one or more of the following events:

- on registration to TIPHON;
- on change of physical point of attachment;
- on change of logical point of attachment;
- on demand by the user through some terminal function; and
- on demand by the authentication centre.

The registration and service attachment service defined in TS 101 882-2 may be used as the master service for invocation of A1.

## 6.4.3 Exceptional procedures

### 6.4.3.1 Activation/deactivation/registration/interrogation

Not applicable.

### 6.4.3.2 Invocation and operation

If the expected response is not equal to the received response authentication is not proven and services A3, A4, A5 and A6 shall not be invoked. A network may reattempt service A1, however repeated failure may be considered as an attack on the algorithms and should be deterred by denying access to the initiator of the authentication.

## 6.5 Interactions with other TIPHON services

The authentication services are linked to the registration service and shall be operated in parallel to them.

The authentication services shall provide keying material for the confidentiality services E1, E2 and E7.

The authentication services shall provide the basis for the access control service C1.

## 6.6 Interworking considerations

The authentication algorithms used by each of the participant entities have to be matched.