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Guidelines and Principles for protocol description and error handling;

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1. Intellectual Property Rights

2. Foreword

This description has been produced by 3GPP TSG RAN.
This description defines the general requirements of the Layer 2 and Layer 3 radio protocols on the physical layer of the UTRA Radio Interface.
The contents of this description are subject to continuing work within TSG RAN and may change following formal 3GPP TSG RAN approval.

3. Scope

This document provides a guideline for using formal languages in protocol description of UMTS stage 2 and 3 and rules for error handling. This document covers all interfaces involved in radio access protocols such as Uu, Iu, Iur and Iub.

4. References

[1] X.680, Abstract Syntax Notation One (ASN.1): Specification of the basic notation.
[2] X.681, Abstract Syntax Notation One (ASN.1): Information object specification
[3] X.682, Abstract Syntax Notation One (ASN.1): Constraint specification.
[4] X.691, ASN.1 Encoding Rules - Specification of Packed Encoding Rules (PER)
[5] CSN.1 specification, version 2.0
[6] Z.100, Specification and description language (SDL)
[7] Z.105, SDL Combined with ASN.1 (SDL/ASN.1)
[8] Z.120, Message Sequence Chart (MSC)
[9] ISO/IEC 9646-3, The Tree and Tabular Combined Notation

5. Definitions and Abbreviations

5.1 Definitions

5.2 Abbreviations

IE : Information element, (refers to e.g. GSM 04.07).

6. Principles to ensure compatibility

6.1 Introduction

The rules edicted intends to prevent incompatibilities between several phases of UMTS evolution (analog to what happened from GSM phase 1to GSM phase 2).

6.2 Level 1 of principles: Protocol level

It shall be possible to discriminate different versions of any protocol.

An unknown protocol shall not cause problems to any entity that terminates the protocol. The messages using this protocol discriminator shall be discarded by the receiving entity.

As a consequence, introduction of new protocol shall not disturb any receiving entity

6.3 Level 2 of principles: Message level

6.3.1 New messages

New message types shall be able to be introduced without causing any damage. New messages not understood shall be discarded by the receiving entity.

As an exception to this principle it can be possible to define a mechanism that allows a different behaviour when a specific reaction is requested from the receiving entity. This mechanism has to be implemented from the beginning. A special care has to be taken into account when defining broadcast messages and the associated Error handling. Further refinement on this paragraph is needed.

Such a mechanism is not required inside the network part.

6.3.2 Partial decoding

Partial decoding means that a PDU can be decoded in parts. One part forms a complete value that can be separated from other parts. A decoding error in a part does not invalidate previously decoded parts. Subsequent parts are however invalidated because if an error has occurred one can not be sure whether the trailing values are really valid.

Example: A multipurpose PDU contains a list of four PDUs. The two first PDUs are valid but the third one is invalid. The two first are decoded but the third and fourth ones are ignored.

6.4 Level 3 of principles: Information element level

6.4.1 New IE

New elements shall generally be discarded when not understood.

In some cases new elements might be taken into account when specific behaviour is requested from the receiving side (e.g. a rejection of the message is expected when the element is not understood: «comprehension required»).

6.4.2 Optional IE

Optional IE should be located after mandatory ones.

6.4.3 Adding mandatory IE

For backward compatibility reasons, addition of mandatory IE shall be avoided. In the first stage of UMTS, a set of functionality is available for each class of UE. Mandatory IE may be added only if they are mandatory for further classes of UE.

6.4.4 Missing optional IE

Missing optional element may be understood as having a certain default value hence a defined meaning.

See also missing values in Values level.

6.4.5 Comprehension required

"Comprehension required" requirement can be associated with an IE. It means that after an IE value has been decoded then the value is validated according to some specified criteria. Failure in validation causes rejection of the message.

Example: A broadcast message contains a list of recipient addresses. If a recipient's address is not included in the list then a recipient ignores the whole message.

6.4.6 Partial decoding

The notion of partial decoding shall also be applied at the IE level.

6.5 Level 4 of principles: Values level

6.5.1 Reserved values and spare fields

Reserved values shall be forbidden. Otherwise entity receiving such a value shall reject the message. This would create difficulties when provided on broadcast channel.

Spare field shall be forbidden. Otherwise entity receiving such a spare field shall not make any decoding on that field and shall not reject the message.

6.5.2 Unspecified values

As far as possible default understanding shall be provided for unspecified values.

6.5.3 Missing optional value

A default value may be specified for the receiver when the sender did not include a field containing this value.

6.5.4 Extension of value set

There are cases when a data field may originally contain only a definite set of values. In the future the set of values grows but the number new values can be anticipated. There are two alternative ways to specify extension of a value set:

1) Infinite extension of a value set. Example: The first version of a data field may contain only values 0-3. In the future the field may contain any positive integer value.
2) Finite extension of a value set. Example: The first version of a data field may contain only values 0-3. In the future values 4-15 shall also be used.

7. Message Sequence Charts

It is agreed to recommend the use MSCs as one of the formal methods.

MSCs is adapted for description of normal behaviour of protocol layers between peer entities and/or through SAPs. So it may be used in stage 2 of protocol description.

8. Specification and Description Language

The groups are encouraged to use of SDL where appropriate. The groups themselves should decide how SDL is used. Documentation on the best practice of the use of SDL can be found from the ETSI PEX group and TC-MTS, and the groups are advised to use them.

In some protocol parts, text is more adapted (eg : algorithm or multiplexing), in some other parts SDL is better.

SDLs is adapted for describing the observable behaviour of a protocol layer.

[Editor's note : the following text is appended and comes from the minutes of the ETSI SMG2 Specification Methods AdHoc #1. However, it could not be agreed whether there is always normative text description for everything and SDL may be there in addition, or whether part of the normative standard can use SDL only. Recommendation for the groups to use descriptive SDL was also discussed but cannot be agreed before the documentation (DEG MTS/00050) has been studied more.]

9. Message specification

9.1 Summary of what has been agreed

1) use subset of ASN.1 (compatible with Z.105) for definition of abstract syntax of protocol messages
2) there is a need for a default encoding, which can be applied in most cases
3) there is a need for a special encoding e.g. by means of CSN.1.
4) how to link the abstract syntax to the different encoding rules needs to be specified.
5) ASN.1 definitions can be used within SDL and TTCN parts of the specifications.

9.2 Definitions

Description of message is divided into two levels : an abstract description which defines data to be sent to the peer entity as descriptive values (analog to parameter passing), and a concrete description (also named transfer syntax) which defines the encoded PDU (i.e. : what is carried as a bit string).

9.3 Description level

The description of the protocol should utilise an abstract description of the manipulated elements which is independent from transfer syntax.
A subset of ASN.1 (compatible with Z.105) should be used for definition of abstract syntax of protocol messages.

9.4 Compilability of the transfer syntax

The transfer syntax should allow as automatic as possible compilers which transform a sequence of received bits into a sequence of IEs which can be utilised by the protocol machine. CSN.1 may be used. A link between abstract syntax and transfer syntax needs to be specified.

9.5 Efficiency/Compactness

The transfer syntax should allow to minimise the size of messages if so necessary. It should allow protocol dependant optimisations.

9.6 Evolvability/Extensibility

The abstract syntax shall allow the evolution of the protocol.

The transfer syntaxt shall keep the same level of compactness as the initial design.

9.7 Inter IE dependency

The abstract syntax shall allow that presence of IEs depends on values in previous IEs.

The description of messages should avoid dependency between values in different IE. Indeed, it would mean that values are not independent and that there is a redundancy.

9.8 Intra IE dependency

The abstract and transfer syntaxes shall allow that, within an IE, some fields depend on previous ones.

9.9 Support of error handling

The syntax used should support optional IEs, default values, partial decoding, "comprehension required" and extensibility as defined above.

10. History

Document history		
Date	**Version**	**Comment**
January 1999	0.0.0	Starting point based on UMTS YY.40 V0.1.0
January 1999	0.0.1	version after TSG RAN WG2 #1 based on the presentation of Tdoc TSG RAN WG2 018/99.

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