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Information technology — Radio frequency identification for item management —

Part 1: Reference architecture and definition of parameters to be standardized

Technologies de l'information — Identification par radiofréquence (RFID) pour la gestion d'objets —

Partie 1: Architecture de référence et définition des paramètres à normaliser

Reference number
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Contents

Page

Foreword ... iv

Introduction ... v

1 Scope ... 1

2 Normative references ... 1

3 Terms and definitions ... 1

4 Symbols and abbreviated terms ... 2

5 Architectures, references and exclusions ... 3
5.1 Communications architecture ... 3
5.2 System specification ... 6
5.3 Interface specification ... 6
5.4 Application architecture ... 6
5.5 Information and data architecture ... 6
5.6 Implementation architecture ... 6
5.7 System security architecture ... 6
5.8 Resilience considerations ... 6
5.9 Unique identification ... 6

6 Requirements ... 6
6.1 Vision statement ... 6
6.2 Mission statement ... 7
6.3 Conformance and Commands ... 7
6.4 General (Context) ... 8
6.5 Instruction to developers of subsequent parts of ISO/IEC 18000 and to installers ... 8
6.6 Context (OSI) ... 10
6.7 Bi-directional systems ... 10
6.8 Uni-directional systems ... 11
6.9 Relationship to other standards ... 11
6.10 Parameters ... 11
6.11 Physical and media access control parameters ... 12
6.12 Protocol and collision management parameters ... 18

7 Modulation ... 21

8 Patents and intellectual property ... 21
8.1 Responsibilities regarding patents and intellectual property ... 21
8.2 Patents referenced in ISO/IEC 18000 ... 21

Annex A (informative) Reference co-ordinates for regional and national regulations ... 22

Annex B (informative) Pro forma for parameter definition standards (including parameter definition tables) ... 23

Annex C (informative) Architectural views of logistic and distribution systems ... 38

Annex D (informative) Unique identifier ... 49

Annex E (informative) Intellectual property: patents ... 51

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

ISO/IEC 18000-1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

ISO/IEC 18000 consists of the following parts, under the general title *Information technology — Radio frequency identification for item management*:

— *Part 1: Reference architecture and definition of parameters to be standardized*

— *Part 2: Parameters for air interface communications below 135 kHz*

— *Part 3: Parameters for air interface communications at 13,56 MHz*

— *Part 4: Parameters for air interface communications at 2,45 GHz*

— *Part 6: Parameters for air interface communications at 860 MHz to 960 MHz*

— *Part 7: Parameters for active air interface communications at 433 MHz*

Introduction

ISO/IEC 18000 has been developed by ISO/IEC SC 31 WG 4, radio frequency identification for item identification and management, in order to provide parameter definitions for communications protocols within a common framework for internationally useable frequencies for radio frequency identification (RFID), and, where possible, to determine the use of the same protocols for ALL frequencies such that the problems of migrating from one to another are diminished; to minimise software and implementation costs; and to enable system management and control and information exchange to be common as far as is possible.

Informative Annexes to this part of ISO/IEC 18000 provide contact information in respect of the radio regulations within which such systems have to operate, and some informational views of system architectures within which RFID for item management is likely to be used (Annexes A and C).

There are no specific patents applicable to this part of ISO/IEC 18000. Known patents relating to other parts of ISO/IEC 18000 that may be applicable to one or may be applicable to more than one part of ISO/IEC 18000 are provided in Annex E to this part of ISO/IEC 18000.

Information technology — Radio frequency identification for item management —

Part 1: Reference architecture and definition of parameters to be standardized

1 Scope

1.1 This part of ISO/IEC 18000 describes the generic architecture concepts in which item identification may commonly be required within the logistics and supply chain and defines the parameters that need to be determined in any standardized air interface definition in the subsequent parts of ISO/IEC 18000. The subsequent parts of ISO/IEC 18000 provide the specific values for definition of the air interface parameters for a particular frequency/type of air interface from which compliance to (or non compliance with) this part of ISO/IEC 18000 can be established. This part of ISO/IEC 18000 also provides description of example conceptual architectures in which these air interfaces are often to be utilized.

1.2 This part of ISO/IEC 18000 limits its scope to transactions and data exchanges across the air interface at **Reference point delta** (see Figure 1). The means of generating and managing such transactions, other than a requirement to achieve the transactional performance determined within this part of ISO/IEC 18000, are outside the scope of this part of ISO/IEC 18000, as is the definition or specification of any supporting hardware, firmware, software or associated equipment.

1.3 Standardization of other reference points is outside the scope of this part of ISO/IEC 18000. (See Figure 1.)

1.4 This part of ISO/IEC 18000 is an enabling standard which supports and promotes several RFID implementations without making conclusions about the relative technical merits of any available option for any possible application.

1.5 This part of ISO/IEC 18000 also provides reference information in respect of patents that have been declared to the developers of ISO/IEC 18000 as pertinent and provides reference addresses in respect of regulations under which ISO/IEC 18000 must operate.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 19762 (all parts), *Information technology — AIDC techniques — Harmonized vocabulary*[1)]

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19762 (all parts) and the following apply.

1) To be published.

3.1.0
MODES (standardized)
Different standardized RFID systems for Item Identification operating within the same frequency range. Such systems may or may not be interoperable, but shall not significantly interfere with each other. An International Standard providing parameter definitions for a particular frequency range may have one or several MODES

3.2.0
Significant Interference
Significant interference exists if a system of one standardized MODE (working within the most widespread regulated power emissions) is likely to impede the successful operation of a system of another standardized MODE (working within the most widespread regulated power emissions), *in likely expected operating situations*

3.3.0
Marginal measurable interference
Marginal measurable interference is interference that does not impede operation *in likely expected operating situations*, or that could be avoided by simple and inexpensive design improvement, shall not be considered cause to reject a MODE."

4 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviated terms given in ISO/IEC 19762 (all parts) and the following apply.

AFI	Application family identifier
API	Application programming interface
CW	Continuous wave
DFMFM	Double frequency modified frequency modulation
DLL	Data link layer (OSI model)
DSFID	Data Storage Format Identifier
EOF	End Of Frame
FCC	Federal Communications Commission (of USA)
FTDMA	Frequency and time division multiple access
LPB	Long power break
MFM	Modified frequency modulation
MFR Tag ID	Unique identifier known in some places as UID
n/a	Not applicable
PJM	Phase jitter modulation
PN	Pseudo-noise (as in PN Code)
SOF	Start of frame
TRAM	Temporary random access memory
VICC	Vicinity integrated circuit card

5 Architectures, references and exclusions

This part of ISO/IEC 18000 does not attempt to define a reference architecture for item identification. The communication architecture defines the reference point that is the subject of ISO/IEC 18000, and limits ISO/IEC 18000 to defining protocols and transactions across this reference point in several technical and application situations. The informative annexes provide architecture examples of application scenarios where such transactions are likely to occur. These example scenarios are informative and the protocols and transactions defined in ISO/IEC 18000 may and will occur in other situations.

5.1 Communications architecture

5.1.1 Reference point delta

This part of ISO/IEC 18000 limits its scope to transactions and data exchanges across the air interface at **Reference point delta**. (See Figure 1). The means of generating and managing such transactions, other than a requirement to achieve the transactional performance determined within this part of ISO/IEC 18000, are outside the scope of this part of ISO/IEC 18000, as is the definition or specification of any supporting hardware, firmware, software or associated equipments.

Standardization of other reference points are outside the scope of this part of ISO/IEC 18000. (See Figure 1.)

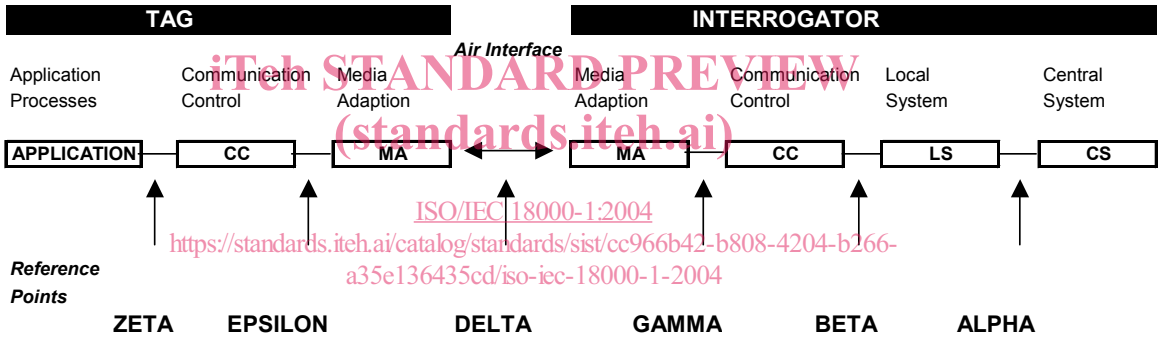

Figure 1 — RFID Reference Communications Architecture

5.1.2 Entity blocks

- **Central system**. This block contains all centralised functions of general distribution logistic model applications.
- **Local system.** This is the local (roadside) entity that handles the "real-time" and distributed parts of the general distribution logistic model application.
- **Fixed Communication Control**. Communication block that handles the medium independent part of the communication link.
- **Media Adaptation.** The medium dependent entity
- **On-board communication control**. Communication control that handles the medium independent part of the communication link .
- **Application processes.** This entity symbolises several in-vehicle applications, of which the general distribution logistic model may be only one application process.

5.1.3 Reference points

- **ALPHA.** Alpha is the reference point which delimits the functions of the central system and the local system.
- **BETA.** The reference point where data, commands, etc. are passed from the fixed communication control to the local system function, and vice-versa.
- **GAMMA.** Between fixed communication control and media adaptation.
- **DELTA.** Between on-board and fixed equipment. This reference point usually corresponds with an air interface in the nature of dedicated short range communication.
- **EPSILON.** Between media adaptation and on-board communication control.
- **ZETA.** Reference point between on-board communication control and application processes.

5.1.4 Context negotiation

Figure 2 describes the nature of the general distribution logistic model context negotiation and transaction at **Reference point delta.**

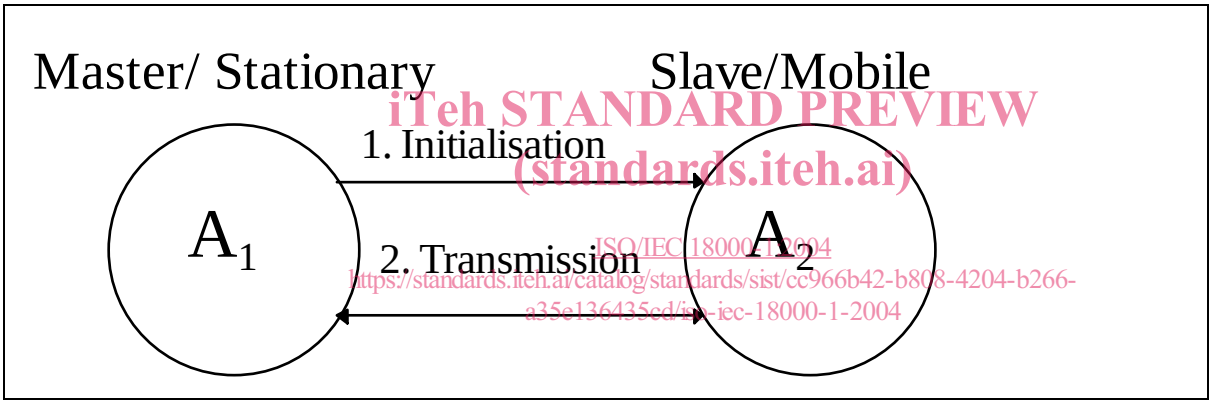

Figure 2 — Simplified context negotiation (typical tag transaction)

The communication starts with the master A_1 downloading a message to the slave A_2, referring to a list of predetermined contexts defined by (Protocol, Encoding, Applications) triplets. The slave, if prepared to handle any of these, can start the transmission referring to the chosen application.

5.1.5 Interaction sequence

An example of the interaction sequence for general distribution logistic model can be defined as described in Figure 3.

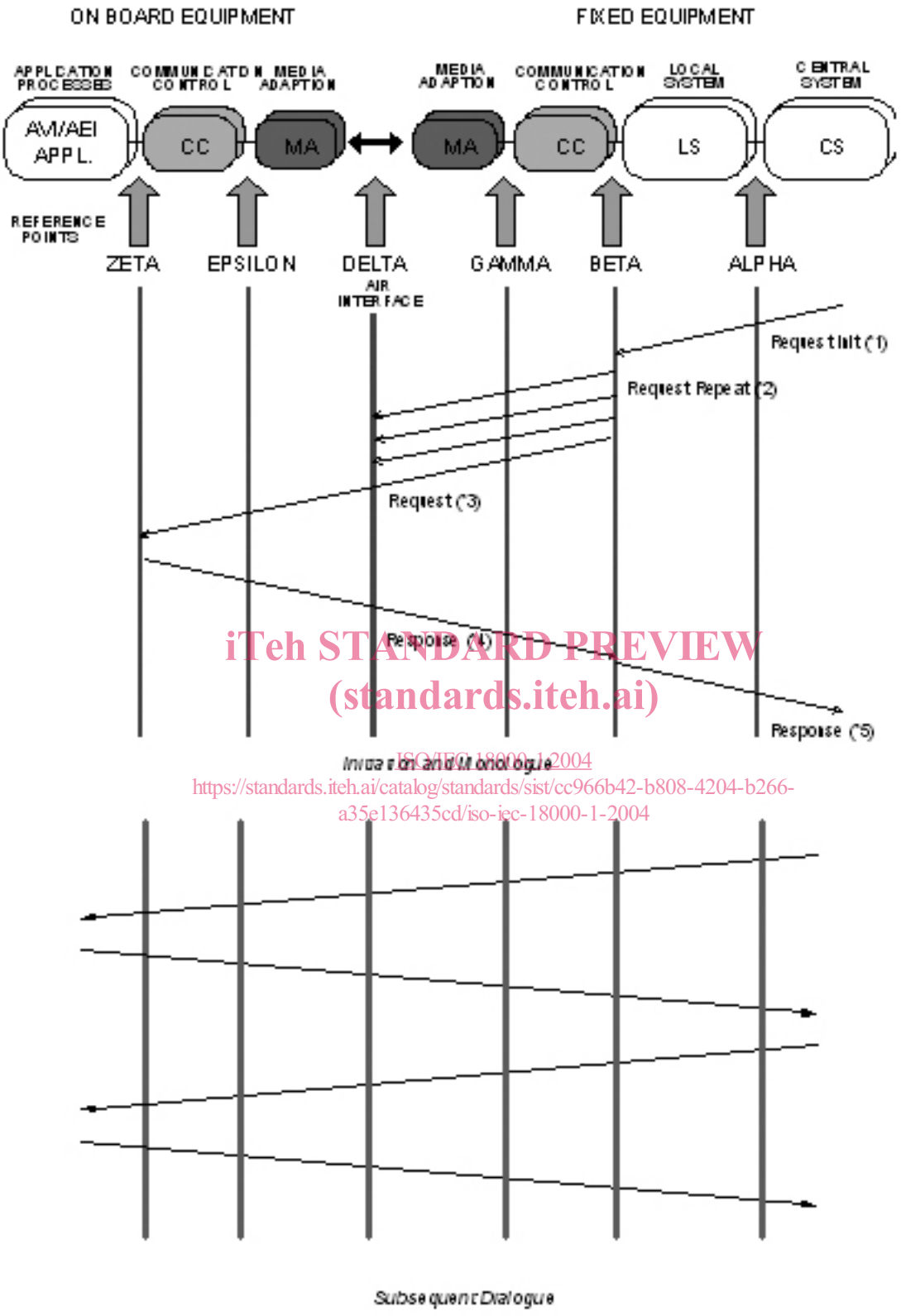

Figure 3 — Functional (information flow) interaction sequence diagram for generic general distribution logistic model communications systems

The application information flow is not defined herein, but some of these aspects may be addressed in subsequent additions to this part of ISO/IEC 18000.

5.2 System specification

System specification is not defined within ISO/IEC 18000 which relates solely to the interface between an interrogator and a transponder.

5.3 Interface specification

The subsequent parts of ISO/IEC 18000 (interface specifications at different frequencies) define, describe and specify interface(s) in physical and procedural terms in conformance to the parameters defined in 5.4 to 5.9.

5.4 Application architecture

Application architecture specification is outside the scope of this version of ISO/IEC 18000. Some example typical conceptual architecture views and contexts in which RFID for item management are likely to be used are shown in Annex C.

5.5 Information and data architecture

Information/data architecture aspects will be addressed in a future International Standard.[2]

5.6 Implementation architecture

ISO/IEC 18000 provides assistance and guidance to those implementing Item Identification systems using RFID. The 'implementation' level of architecture is the mapping of functions into physical boxes at one or a number of locations. These are a function for commercial consideration, rather than standardization, and the implementation architecture is specifically excluded from ISO/IEC 18000.

5.7 System security architecture

System security architecture is not defined within this part of ISO/IEC 18000.

5.8 Resilience considerations

Resilience considerations are not defined within ISO/IEC 18000.

5.9 Unique identification

In subsequent parts of ISO/IEC 18000, unique identification (UID) may be required. Annex D provides a preferred form of UID. In some parts of ISO/IEC 18000 this may be defined as a normative requirement, in other parts it may be advisory or not preferred. Whether this form of UID is mandatory, advisory or not applicable in any specific part is to be stated in the normative clauses of that part of ISO/IEC 18000.

6 Requirements

6.1 Vision statement

This part of ISO/IEC 18000 defines a common set of parameters that are necessary (at any frequency) in order to avoid contention or interference with other RFID systems, to establish the highest degree of interoperability as is practicable, and to ease migration between technical solutions and their supporting software. The International Standard envisions common methods of determination and description.

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2) ISO/IEC 15961, *Information technology — Radio frequency identification for item management — Data protocol: application interface*.

6.2 Mission statement

The mission of this part of ISO/IEC 18000 is to determine common parameters to be defined in an item identification air interface; the method and means of their definition, and to provide a common format for their elaboration and definition. Subsequent parts of ISO/IEC 18000 will provide the parameter definitions, at different frequencies, for each of the parameters required by this part of ISO/IEC 18000 in accordance with the common format herein determined, and may also, where appropriate, provide regional definitions with geographical constraints. If any parameter defined in this part of ISO/IEC 18000 is inappropriate at a particular frequency, it will be specifically and expressly stated in that part of ISO/IEC 18000 that the named and referenced parameter is not appropriate at that frequency. This part of ISO/IEC 18000 additionally provides relevant information in respect of radio regulations bodies and some examples of conceptual system architectures within which RFID for item identification and management is likely to be used.

6.3 Conformance and Commands

6.3.1 Claiming conformance

In order to claim conformance with ISO/IEC 18000 it is necessary to comply to all of the normative clauses of this part of ISO/IEC 18000 except those marked 'optional' and it is also necessary to operate within the local national radio regulations (which may require further restrictions) and, if appropriate, to hold a valid licence from the appropriate owner of intellectual property associated with the MODES defined herein.

6.3.2 General conformance requirements

A document on the subject is in preparation.[3)]

6.3.3 Command structure and extensibility

ISO/IEC 18000 includes definition of the structure of command codes between an interrogator and a tag and indicate how many positions are available for future extensions.

Command specification clauses provide a full definition of the command and its presentation.

Each command is labelled as being 'mandatory' or 'optional'.

The clauses of each part of ISO/IEC 18000 shall make provision for 'custom' and 'proprietary' commands.

6.3.4 Mandatory commands

A mandatory command shall be supported by all tags that claim to be compliant and all interrogators which claim compliance shall support all mandatory commands.

6.3.5 Optional commands

Optional commands are commands that are specified as such within ISO/IEC 18000. Interrogators shall be technically capable of performing all optional commands that are specified in ISO/IEC 18000 (although need not be set up to do so). Tags may or may not support optional commands.

If an optional command is used, it shall be implemented in the manner specified in ISO/IEC 18000.

6.3.6 Custom commands

Custom commands may be permitted by an ISO/IEC 18000 Standard, but they shall not be specified in that International Standard.

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3) ISO/IEC TR 18047 (all parts), *Information technology — Radio frequency identification device conformance test methods*.

A custom command shall not solely duplicate the functionality of any mandatory or optional command defined in the International Standard by a different method.

6.3.7 Proprietary commands

Proprietary commands may be permitted by an ISO/IEC 18000 Standard, but they shall not be specified in that International Standard.

A proprietary command shall not solely duplicate the functionality of any mandatory or optional command defined in the International Standard by a different method.

6.4 General (Context)

There are a number of different frequency ranges that an RFID system may legally use in any country. Whilst steps are being taken to harmonise frequency regulations throughout the world, there remain differences in frequency, bandwidth and allowed maximum power which will affect performance of systems in any specific location.

Different applications also require different performance characteristics. Some, for example, may require very short read or write range, others longer reading ranges. Some may require very high tag populations within the reading range, others few, or perhaps even only one.

ISO/IEC 18000 provides a framework within which developers of application International Standards, and users of such International Standards, may select one or more standardized options that meet their requirements in the region, or regions, of use.

Users of ISO/IEC 18000 Standards are required to ensure that the option(s) chosen are legal within the radio regulations of the countries where it is intended to operate the system. Annex A provides some guideline assistance for the situation as at the time of publication of this part of ISO/IEC 18000, but the responsibility remains for the supplier and user to ensure conformance to National regulations.

RFID application International Standards for item management may specify the use of one or more International standardized air interfaces to meet specific application requirements.

In order to maximise interoperability, a set of parameters shall be determined for each approved frequency, or a limited range of options (to be called "MODES") shall be determined.

6.5 Instruction to developers of subsequent parts of ISO/IEC 18000 and to installers

6.5.1

Developers of the subsequent parts of ISO/IEC 18000 shall limit the number of permitted modes to those of different characteristics, and, within the part, to specifically explain the differences in characteristics and the likely impact on performance that may be expected. *(For example : MODE 1 is usually most suited to longer read ranges, whilst MODE 2 is most suited for high tag in read zone populations. MODE 3 is Read only etc.)* . Where practicable a tabular comparison shall also be made.

6.5.2

Where protocol sets are offered for International standardization where there is little technical or characteristic difference between options, International Standards developers shall try to determine a compromise single MODE accommodating both parties. Where such accommodation is not possible or agreeable to the parties, the matter to be referred to the working group for decision.

6.5.3

International Standards developers shall ensure that no "significant interference" exists between standardized MODES. "Significant Interference" exists if a system of one standardized MODE (working within the most widespread regulated power emissions) is likely to impede the successful operation of a system of another

standardized MODE (working within the most widespread regulated power emissions), *in likely expected operating situations.*

Marginal measurable interference is interference that does not impede operation *in likely expected operating situations*, or that could be avoided by simple and inexpensive design improvement, shall not be considered cause to reject a MODE.

6.5.4

Where the air interface requires a tag to be battery assisted, this shall be explicitly stated.

6.5.5

Active RFID modes shall be clearly identified as such in the standard.

6.5.6

Tag talk first (TTF) modes shall be clearly identified as such in the standard.

6.5.7

Installers of RFID systems should make best efforts to be a good neighbour in installing any systems, bearing in mind that there may be other systems sharing the same bandwidth and should take precautions to minimise interference to other systems. Installers should be prepared to handle interference within the bandwidth from other users up to transmission powers permitted by local regulations.

6.5.8

Where particular local regulations are likely to cause a problem of interference in one country, but are unlikely to cause a general problem, this shall not be considered cause to reject a MODE. (For example, a country allowing a particularly high power emission may make interference between MODES possible where such interference would not cause "significant interference" in most countries, or one country enforcing particularly low power emission regulations may cause one system to be interfered with in the presence of a different, more sensitive, MODE). Annex A to that part of ISO/IEC 18000 shall state clearly the countries where such local problems may be expected.

Systems that can only operate with power emission levels that are so high that they likely to cause interference problems in the majority of countries shall not be acceptable as ISO International Standard MODES.

6.5.9

International Standards developers are instructed to take into account any *approved* International Standards or regulations from recognised International or Regional Standards or regional or national regulatory bodies in respect of human exposure to electromagnetic fields (EMFs) from devices used in radio frequency identification (RFID) and similar applications.

Where particular national regulations exist, that are not adopted by other countries, such regulations should be declared in Annex A of part of ISO/IEC 18000, stating that operation in the determined country(ies) is not permitted or significantly limited in power emission.

NOTE 1 Discussion drafts or working draft proposals in respect of human exposure to electromagnetic fields (EMFs) from devices used in radio frequency Identification (RFID) and similar applications need not be taken into account unless the developers believe that they are likely to come into force without significant amendment.

Systems that can only operate with power emission levels that are so high that they are likely to exceed emission levels in *approved* International Standards/Regulations of *recognised* International or regional Standards/regulatory bodies shall not be acceptable as ISO International Standard MODES.

NOTE 2 Recognised international or regional Standards bodies include ISO, IEC, CEN, CENELEC, CEPT, ETSI, IEEE, FCC, ARIB, ITU.