FINAL
DRAFT

INTERNATIONAL STANDARD

ISO/IEC FDIS 18000-1

ISO/IEC JTC **1**

Secretariat: **ANSI**

Voting begins on:
2008-03-27

Voting terminates on:
2008-05-27

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

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Reference number
ISO/IEC FDIS 18000-1:2008(E)

In accordance with the provisions of Council Resolution 21/1986, this document is **circulated in the English language only**.

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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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

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*.

This second edition cancels and replaces the first edition (ISO/IEC 18000-1:2004), which has been technically revised.

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 JTC 1/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 will be found in the appropriate 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 defines 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 (or non-compliance) with this part of ISO/IEC 18000 can be established. This part of ISO/IEC 18000 also provides a 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 — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary*

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

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

IEC 60601-1-2, *Medical electrical equipment — Part 1-2: General requirements for basic safety and essential performance — Collateral standard: Electromagnetic compatibility — Requirements and tests*

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.

3.1
MODES (standardized)
different standardized RFID systems for Item Identification operating within the same frequency range, which may or may not be interoperable but do not significantly interfere with each other

NOTE An International Standard providing parameter definitions for a particular frequency range may have one or several MODES.

3.2
significant interference
likely impedance by a system of one standardized MODE (working within the most widespread regulated power emissions) of 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
marginal measurable interference
interference that does not impede operation *in likely expected operating situations*, or that could be avoided by simple and inexpensive design improvement

NOTE Marginal measurable interference is not considered to be 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 incorrectly 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.)

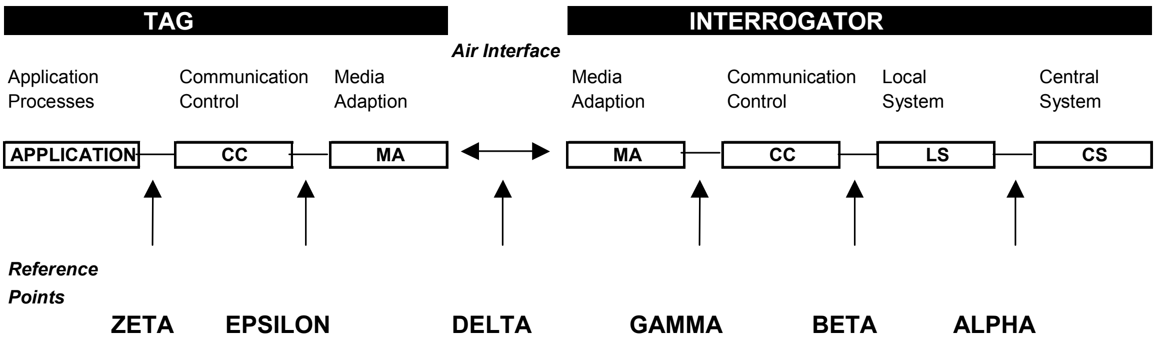

Figure 1 — RFID Reference Communications Architecture

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.**

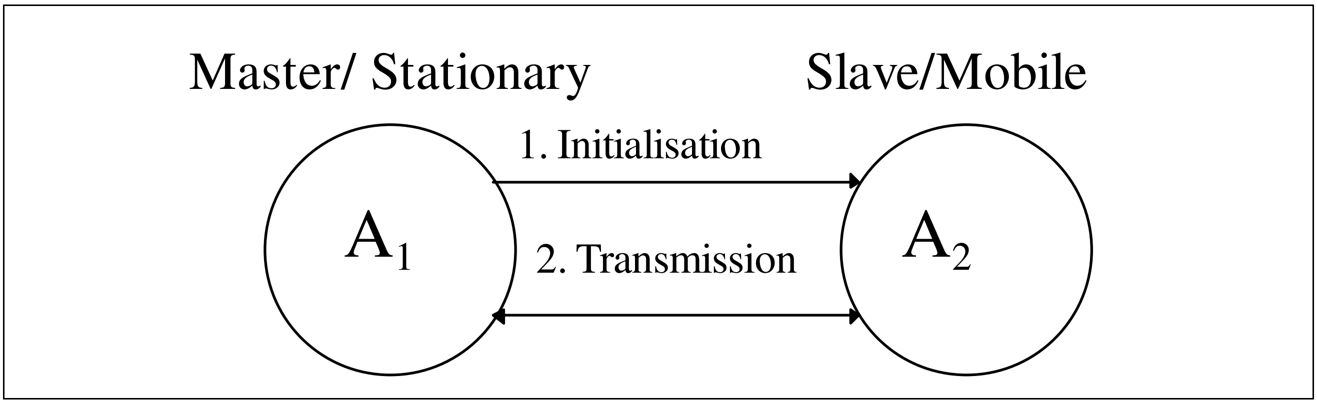

Figure 2 — Simplified context negotiation (typical tag transaction)

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.

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

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 (UII) may be required. Annex D provides a preferred form of UII. 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 UII 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.

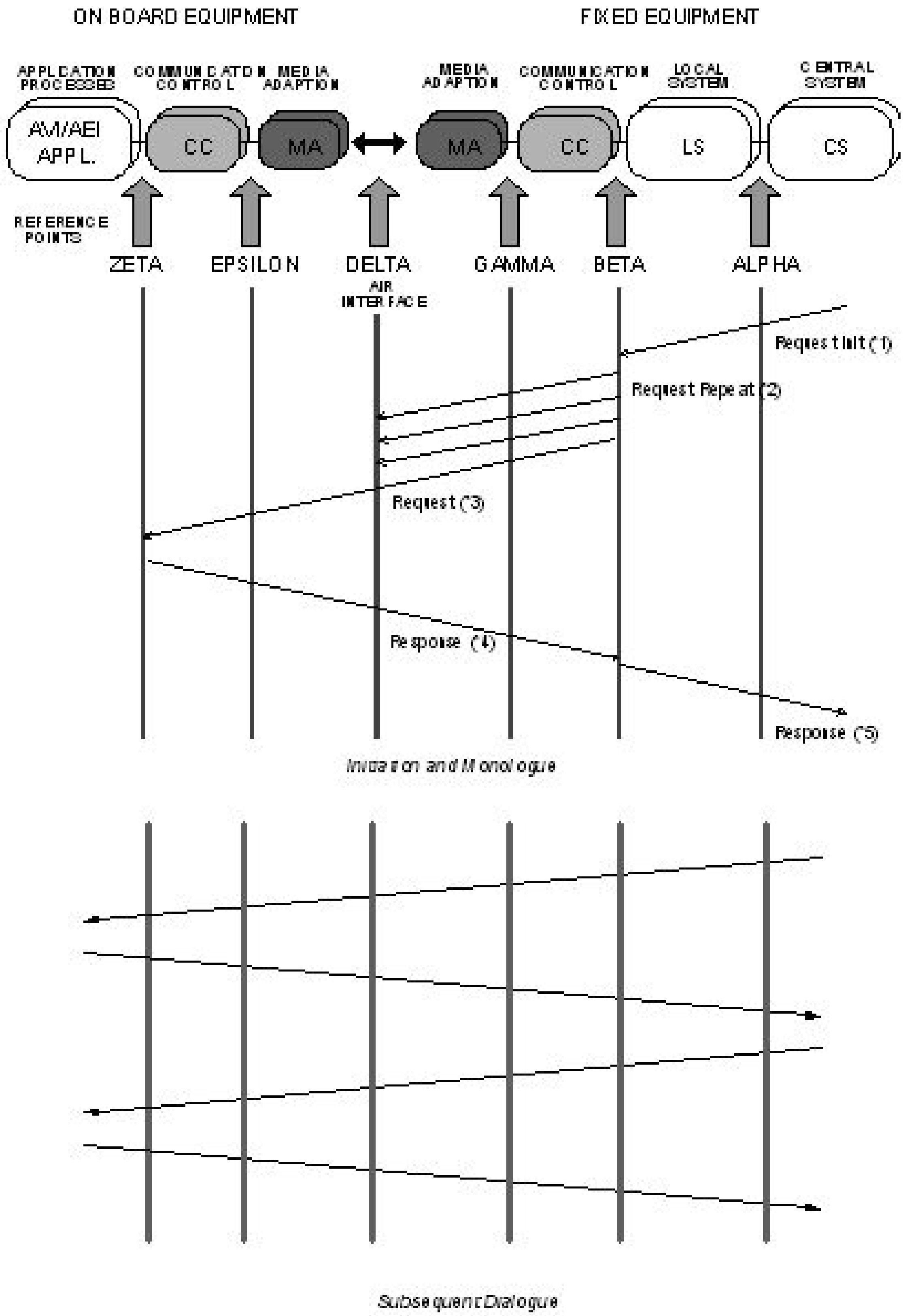

Figure 3 — Functional (information flow) interaction sequence diagram for generic general distribution logistic model communications systems

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.

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.

Device manufacturers claiming conformance to this standard shall self-certify that RF emissions and susceptibility comply with IEC 60601-1-2.

6.3.2 General conformance requirements

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

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 the relevant part of 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.

A custom command shall not solely duplicate the functionality of any mandatory or optional command defined in the International Standard by a different method. An interrogator shall use a custom command only in accordance with the specifications of the tag manufacturer .

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. All proprietary commands shall be disabled before the tag leaves the tag manufacturer. Proprietary commands are intended for manufacturing purposes and shall not be used in field-deployed RFID systems

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.

EXAMPLE MODE 1 is usually most suited to longer read ranges, MODE 2 is most suited for a large number of tags in the read zone,. 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 a*pproved* 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.

6.6 Context (OSI)

RFID applications utilise an air interface (interface “Delta” in Figure 1). Because the transactions across this interface are usually time constrained, and the read zone is also usually limited either by antenna design and the amount of power emitted, a specific protocol architecture is determined. In OSI terms this may be described as a reduced protocol stack as shown in Figure 4, built up by the application layer, the data link layer, and the physical layer. Such an architecture is very common for real-time environments.

In a bi-directional system, the air interface protocol stack is set up in accordance with the master-slave principle, where the Interrogator as the master organises the entire communication process. The air interface definitions enable compliant communication systems to serve multiple Interrogators and multiple applications in parallel.

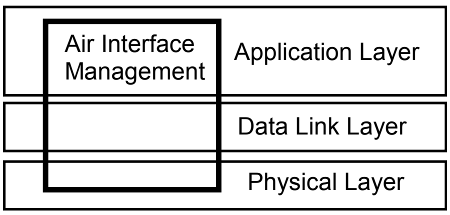

Figure 4 — Air Interface protocol stack

Subsequent parts of ISO/IEC 18000 will provide parameter definitions for that frequency operating within global radio regulations, and may also, where appropriate, provide regional definitions with regional limitations.

Where the value (or choice of values) required to meet a parameter requirement for conformance to a particular air interface definition is fixed, it (they) shall be stated clearly together with the degree of tolerance to any deviation. Where a range of values is permissible, the upper and lower limits shall be stated.

Parameter tables are required in a consistent format (as defined within this part of ISO/IEC 18000). If a parameter determined in any part of ISO/IEC 18000 is optional or not relevant, this shall be stated in the appropriate parameter table displayed within that part of ISO/IEC 18000. Unless so stated it may be assumed that values for that parameter are required and that the part of ISO/IEC 18000 is incomplete without them.

There is a practical necessity to use different frequencies. In developing these RFID International Standards, consideration has been made throughout to ensure that, wherever possible, the same protocols are used throughout to minimise the costs of migration or simultaneous function of equipment operating at different frequencies but within a single common system.

In the subsequent parts of ISO/IEC 18000, providing parameter definitions, the specifications for Layer 7 (Application Layer) shall be, as far as possible, common, and where different from the common approach, the differences shall be highlighted and explained. Layer 7 (Application Layer) issues dealt with in ISO/IEC 18000 are only those required to achieve a successful interaction between interrogator and tag data International Standards as they relate to application data shall be dealt with in other relevant International Standards (such as ISO 15962) specific application requirements are not dealt with in ISO/IEC 18000 determining air interface protocols.

In Layer 1, (Physical) whilst the physical control and management methods differ, in some cases significantly, those protocols that are common shall be defined in the same way, and the objectives and outputs of these operations shall also be common.

6.7 Bi-directional systems

A bi-directional system requires both the sending and receiving of signals by one or both parties (interrogator & tag). This part of ISO/IEC 18000 determines all of the parameters that may be expected in a complex two way exchange of data (read/write) between fixed equipment and on board equipment. Most RFID systems are bi-directional, whether they be read only or read/write. Unless otherwise stated, specifications in subsequent parts of ISO/IEC 18000 relate to bi-directional systems.

6.8 Uni-directional systems

A uni-directional signal requires only one party to transmit and the other to receive. Where such options are specified as MODES in the subsequent parts of ISO/IEC 18000, it shall be clearly identified in the title of the MODE that the specification relates to a uni-directional system. The same parameters shall be specified in the same way, although there will be many parameters noted as *“Not applicable in this option”* (see Clause 6). In such systems the interrogator is a passive radio receiver and may emit no signals to initiate a transaction (if it does so it shall be considered as a bi-directional system and must not interfere with other standardized MODES at that frequency).

The active transmitter shall not cause any "*significant interference*" to any bi-directional standardized MODE operating within the same frequency range.

6.9 Relationship to other standards

This part of ISO/IEC 18000 is one of a series of International Standards defining automatic identification standards, where RFID techniques are used for item management. ISO/IEC 18000 is marshalled under the title *Information technology — Radio frequency identification for item management.*

ISO/IEC 18000 is in several parts. This part of ISO/IEC 18000 determines the parameters to be standardized, whilst the subsequent parts provide determination of the values for particular frequency ranges.

Other relevant International Standards include:

ISO/IEC 18000, *Information technology — Radio frequency identification for item management:*

— *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*

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

ISO/IEC 15962, *Information technology — Radio frequency identification (RFID) for item management — Data protocol: data encoding rules and logical memory functions*

ISO/IEC TR 18046, *Information technology — Automatic identification and data capture techniques — Radio frequency identification device performance test methods*

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

6.10 Parameters

All air interface definitions for RFID systems for item identification shall provide a description of the parameters listed in this clause and shall define the requirements of at least these parameters using the criteria listed below.

The presented requirements shall distinguish between default and optional parameter definitions.

All measurements shall be made within a frame of reference within which either the Interrogator or the tag is static relative to the measuring equipment.

Some air interface definitions may not require all of the parameters to be defined. Any parameters that are not applicable at a particular frequency determination (or option therein) shall be explicitly and overtly described in the International Standard *as "n/a"*.

Where solutions do not require all of the parameters to be used (for example in a read only system), those parameters that *are* used shall comply to the common requirements for that air interface definition in any particular application standard.

In parameter definition International Standards each mode shall be described in a table conforming to the layout and sequence of the parameter definitions table provided in Annex B of this part of ISO/IEC 18000.

6.11 Physical and media access control parameters

The air interface links comprise the link from interrogator to tag (defined in 6.11.1) and the tag to interrogator (defined in 6.11.2).

6.11.1 Interrogator to tag link

6.11.1.1 Operating frequency range (Int:1)

This shall determine the range of frequencies over which the communications link will operate.

6.11.1.1.1 Default operating frequency (Int:1a)

This determines the operating frequency at which the interrogator and tag establish communications. The value shown is the centre frequency of the modulated signal or range of signals. All compliant tags and interrogators shall support operation at the default operating frequency.

6.11.1.1.2 Operating channels (for spread spectrum systems) (Int:1b)

This determines the number and value of the interrogator to tag link operating frequencies. The values provided shall be the centre frequencies of the modulated signals.

6.11.1.1.3 Operating frequency accuracy (Int:1c)

This determines the maximum deviation of the carrier frequency from the specified nominal frequency, expressed in parts per million. Example: 1 part per million of a 2450 MHz carrier allows the carrier frequency to be in the range of 2450 MHz ± 2,45 kHz

6.11.1.1.4 Frequency hop rate (for frequency hopping [FHSS] systems) (Int:1d)

This determines the inverse of the dwell time at an FHSS centre frequency.

6.11.1.1.5 Frequency hop sequence (for frequency hopping [FHSS] systems) (Int:1e)

This determines as a pseudo-randomly ordered list of hopping frequencies used by the FHSS transmitter to select an FHSS channel.

6.11.1.2 Occupied channel bandwidth (Int:2)

This determines the bandwidth of the communications signal occupying a specified channel. This bandwidth may or may not be equivalent to the channel spacing, although the channel spacing may equal, but shall not exceed the occupied channel bandwidth.

The allowed channel spacing for FHSS systems is regulated by the appropriate national regulatory body, e.g., in the U.S. FCC Part 15, section 15.247: the channel spacing shall be the greater than or equal to the 20dB bandwidth of the signal, between the limits of 25 kHz and 1 MHz.

The occupied channel bandwidth may be narrower than the channel spacing to allow for frequency tolerance or to provide for other guard bands necessary for reliable communication links.

For FHSS and narrowband operation, the occupied channel bandwidth shall be the maximum allowed bandwidth (measured in Hz) of the modulated signal in an occupied channel.

For direct sequence spread spectrum (DSSS) operation, the occupied channel bandwidth shall be the maximum allowed null-to-null bandwidth (frequency difference between the main lobe nulls) of the DSSS signal in an occupied channel.

6.11.1.2.1 Minimum receiver bandwidth (Int:2a)

This determines the minimum range of all or individual frequencies that are to be received by the receiver.

6.11.1.3 Interrogator transmit maximum EIRP (Int:3)

This determines the maximum EIRP transmitted by the interrogator antenna, expressed in dBm. 0 dBm equals 1 mW.

6.11.1.4 Interrogator transmit spurious emissions (Int:4)

Are determined as undesired frequency outputs, including harmonics, sub-harmonics, local oscillator, inter-modulation products, and other parasitic emission unintentionally emitted by the interrogator.

6.11.1.4.1 Interrogator transmit spurious emissions, in-band (for spread spectrum systems) (Int:4a)

Are determined as spurious emissions that occur within the allowed range of carrier frequencies.

6.11.1.4.2 Interrogator transmit spurious emissions, out-of-band (Int:4b)

Are determined as spurious emissions that occur outside the allowed range of carrier frequencies.

6.11.1.5 Interrogator transmitter spectrum mask (Int:5)

This shall be the maximum power or field strength emitted by an interrogator transmitter as a function of the frequency.

6.11.1.6 Timing (Int:6)

6.11.1.6.1 Transmit to receive turn around time (Int:6a)

This determines the maximum time after the tag has completed transmission of a reply to an interrogation until the time the tag is ready to receive another interrogation.

6.11.1.6.2 Receive to transmit turn around time (Int:6b)

This determines the maximum time after the tag has completed reception of an interrogation until the tag begins a reply transmission.

6.11.1.6.3 Dwell time of interrogator transmit power on ramp (Int:6c)

This determines the maximum time required for the interrogator transmit power to increase from 10% to 90% of the steady-state transmit output power level.

6.11.1.6.4 Decay time of interrogator transmit power down ramp (Int:6d)

This determines the maximum time required for the interrogator transmit power to decrease from 90% to 10% of the steady-state transmit output power.

6.11.1.7 Modulation (Int:7)

This determines the keying of the carrier wave by coded data. It shall be described in accordance with commonly understood methodologies. Some examples are amplitude shift keying (ASK), phase shift keying (PSK) and frequency shift keying (FSK), linear amplitude modulation (AM), and frequency modulation (FM).

6.11.1.7.1 Spreading sequence (for direct sequence [DHSS] systems) (Int:7a)

This determines the sequence of data coding elements (chips) used to encode each logical data bit.

6.11.1.7.2 Chip rate (for spread spectrum systems) (Int:7b)

This determines the frequency at which the spreading sequence modulates the carrier.

6.11.1.7.3 Chip rate accuracy (For spread spectrum systems) (Int:7c)

This determines the allowed variation in chip rate, expressed in parts per million.

6.11.1.7.4 Modulation index (Int:7d)

This shall be defined as [a-b]/[a+b] where a and b are the peak and minimum signal amplitude respectively. The value of the index shall also be expressed as a percentage.

6.11.1.7.5 Duty cycle (For OOK modulation) (Int:7e)

This is defined as the ratio of the duration (time) that a signal is ON to the total period of the signal.

6.11.1.7.6 FM deviation (For FM modulation) (Int:7f)

This determines as the difference between the maximum instantaneous frequency of the modulated wave and its carrier frequency.

6.11.1.8 Data coding (Int:8)

This determines the baseband signal presentation*, [i.e. a mapping of logical bits to physical signals. Examples are bi-phase schemes (Manchester, FM0, FM1, differential Manchester), NRZ and NRZI.]*

6.11.1.9 Bit rate (Int:9)

This determines the number of logical bits per second, independent of the data coding, expressed in bits per second.

6.11.1.9.1 Bit rate accuracy (Int:9a)

This determines the maximum deviation of the bit rate from the specified nominal bit rate, expressed in parts per million.

6.11.1.10 Interrogator transmit modulation accuracy (Int:10)

This determines the peak vector error magnitude measured during each chip transmission period.

6.11.1.11 Preamble (Int:11)

This shall provide the specific layer 1 (physical) address, independent of layer 2 (data link). It shall be determined as either an unmodulated carrier wave or a modulated carrier, in which case the requirement refers to the channel after coding.

6.11.1.11.1 Preamble length (Int:11a)

This determines the length of the preamble measured in number of bits.

6.11.1.11.2 Preamble waveform (Int:11b)

This determines the signal shape of the preamble as it is on the channel.

6.11.1.11.3 Bit sync sequence (Int:11c)

This determines the series of bits generated by the physical layer that a receiver uses to synchronize to the incoming bit stream.

6.11.1.11.4 Frame sync sequence (Int:11d)

This determines a series of bits generated by the physical layer that indicates the start of a data link layer (layer 2) message packet.

6.11.1.12 Scrambling (for spread spectrum systems) (Int:12)

An operation performed on all bits transmitted by the physical layer for the purposes of bit timing generation and improving spectral quality.

6.11.1.13 Bit transmission order (Int:13)

The order of bit transmission, either least significant bit (LSB) first or most significant bit (MSB) first.

6.11.1.14 Wake-up process (Int:14)

This parameter shall define whether or not an RF tag is to use a wake up process. When a wake up process is used this parameter:

(a) indicates to the RF tag that it is within a communication zone, i.e. that it may now communicate with an interrogator;

(b) switches the RF tag main circuitry from standby mode (sleep mode) to the active mode.

NOTE This is a feature often used to allow the RF tag to save battery power, but may also be used to minimize the number of RF tag awake in the field at any time to increase the multiple read capability of the system.

6.11.1.15 Polarization (Int:15)

This determines orientation of the emitted/received wave by the antenna.

6.11.2 Tag to interrogator link

6.11.2.1 Operating frequency range (Tag:1)

Definition as per 6.11.1.1 (Int:1)

6.11.2.1.1 Default operating frequency (Tag:1a)

Definition as per 6.11.1.1.1 (Int:1a)

6.11.2.1.2 Operating channels (for spread spectrum systems) (Tag:1b)

Definition as per 6.11.1.1.2 (Int:1b)

6.11.2.1.3 Operating frequency accuracy (Tag:1c)

Definition as per 6.11.1.1.3 (Int:1c)

6.11.2.1.4 Frequency hop rate (for frequency hopping [FHSS] systems) (Tag:1d)

Definition as per 6.11.1.1.4 (Int:1d)

6.11.2.1.5 Frequency hop sequence (for frequency hopping [FHSS] systems (Tag:1e)

Definition as per 6.11.1.1.5 (Int:1e)

6.11.2.2 Occupied channel bandwidth (Tag:2)

Definition as per 6.11.1.2 (Int:2)

6.11.2.3 Transmit maximum EIRP (Tag:3)

Definition as per 6.11.1.3 (Int:3)

6.11.2.4 Transmit spurious emissions (Tag:4)

Definition as per 6.11.1.4 (Int:4)

6.11.2.4.1 Transmit spurious emissions, in-band (for spread spectrum systems) (Tag:4a)

Definition as per 6.11.1.4.1 (Int:4a)

6.11.2.4.2 Transmit spurious emissions, out-of-band (Tag:4b)

Definition as per 6.11.1.4.2 (Int:4b)

6.11.2.5 Transmit spectrum mask (Tag:5)

Definition as per 6.11.1.5 (Int:5)

6.11.2.6 Timing (Tag:6)

6.11.2.6.1 Transmit to receive turn around time (Tag:6a)

Definition as per 6.11.1.6.1 (Int:6a)

6.11.2.6.2 Receive to transmit turn around time (Tag:6b)

Definition as per 6.11.1.6.2 (Int:6b)

6.11.2.6.3 Dwell time or transmit power on ramp (Tag:6c)

Definition as per 6.11.1.6.3 (Int:6c)

6.11.2.6.4 Decay time or transmit power down ramp (Tag:6d)

Definition as per 6.11.1.6.4 (Int:6d)

6.11.2.7 Modulation (Tag: 7)

Definition as per 6.11.1.7 (Int:7)

6.11.2.7.1 Spreading sequence (for direct sequence [DHSS] systems) (Tag: 7a)

Definition as per 6.11.1.7.1 (Int:7a)

6.11.2.7.2 Chip rate (for spread spectrum systems) (Tag: 7b)

Definition as per 6.11.1.7.2 (Int:7b)

6.11.2.7.3 Chip rate accuracy (for spread spectrum systems) (Tag: 7c)

Definition as per 6.11.1.7.3 (Int:7c)

6.11.2.7.4 On-off ratio (Tag: 7d)

For ASK modulation (including OOK): the ratio of peak amplitude to minimum amplitude of the ASK modulated signal.

6.11.2.7.5 Sub-carrier frequency (Tag: 7e)

Frequency used to modulate the carrier frequency, the sub-carrier is modulated or coded with the data information.

6.11.2.7.6 Sub-carrier frequency accuracy (Tag: 7f)

The maximum deviation of the sub-carrier frequency due to any cause. Normally it is expressed in % or in parts per million (ppm) of the sub-carrier frequency.

6.11.2.7.7 Sub-carrier modulation (Tag: 7g)

Keying of the subcarrier by coded data, as described in accordance with commonly understood methodologies. Some examples are amplitude shift keying (ASK), phase shift keying (PSK) and frequency shift keying (FSK), linear amplitude modulation (AM), and frequency modulation (FM).

6.11.2.7.8 Duty cycle (Tag: 7h)

Definition as per 6.11.1.7.5 (Int:7e)

6.11.2.7.9 FM deviation (Tag: 7i)

Definition as per 6.11.1.7.6 (Int:7f)

6.11.2.8 Data coding (Tag: 8)

Definition as per 6.11.1.8 (Int:8)

6.11.2.9 Bit rate (Tag: 8)

Definition as per 6.11.1.9 (Int:9)

6.11.2.9.1 Bit rate accuracy (Tag: 9)

Definition as per 6.11.1.9.1 (Int:9a)

6.11.2.10 Tag transmit modulation accuracy (for frequency hopping [FHSS] systems) (Tag: 10)

Definition as per 6.11.1.10 (Int:10)

6.11.2.11 Preamble (Tag: 11)

Definition as per 6.11.1.11 (Int:11)

6.11.2.11.1 Preamble length (Tag: 11a)

Definition as per 6.11.1.11.1 (Int:11a)

6.11.2.11.2 Preamble waveform (Tag: 11b)

Definition as per 6.11.1.11.2 (Int:11b)

6.11.2.11.3 Bit sync sequence (Tag: 11c)

Definition as per 6.11.1.11.3 (Int:11c)

6.11.2.11.4 Frame sync sequence (Tag: 11d)

Definition as per 6.11.1.11.4 (Int:11d)

6.11.2.12 Scrambling (for spread spectrum systems)(Tag: 12)

Definition as per 6.11.1.12 (Int:12)

6.11.2.13 Bit transmission order (Tag: 13)

Definition as per 6.11.1.13 (Int:13)

6.11.2.14 Reserved (Tag: 14)

This category purposefully left blank.

6.11.2.15 Polarization (Tag: 15)

Definition as per 6.11.1.15 (Int:15)

6.11.2.16 Minimum tag receiver bandwidth (Tag: 16)

The minimum range of frequencies that are to be received by the tag receiver.

6.12 Protocol and collision management parameters

6.12.1 Protocol definition

The parameters defined in ISO/IEC 18000 refer to a protocol definition (specification), NOT to an actual product implementation.

6.12.2 Transaction times

Transaction times defined in ISO/IEC 18000 are design parameters, not performance parameters. They shall refer to the physical and data link layers services they are using (e.g. data rates).

6.12.3 Time

Time as defined in ISO/IEC 18000 shall not include host-interrogator transaction times, but shall include interrogator-tag guard times, return times, framing etc.

6.12.4 Bi-directional systems

ISO/IEC 18000 relates only to bi-directional systems (including "tag talks first" systems where the tag transmits as soon as it receives remote power from the interrogator). ISO/IEC 18000 does not relate to uni-directional systems where the tag transmits to a duty cycle that is regardless of the presence of a receiver, and such systems are unable to be compliant with ISO/IEC 18000.

6.12.5 Read transaction

Within ISO/IEC 18000 a read or transaction is defined as being the operation consisting of sending a read request (implicit or explicit) to the tag and receiving back the data or acknowledgement that the operation was performed correctly.

6.12.6 Write transaction

Within ISO/IEC 18000 a write transaction is defined as being the operation consisting of sending a write request (implicit or explicit) to the tag establishing a communication session and transmitting the data to be written and receiving an acknowledgement that the operation was performed correctly.

6.12.7 Protocol parameters

6.12.7.1 WTF: Who talks first (P1)

This determines whether the tag starts transmitting (modulating) as soon as it is remotely powered by the interrogator (TTF: tag-talks-first) or if it waits for the reception of a logical information (e.g. SOF or command) before starting the transmission (RTF: reader-talks-first).

6.12.7.2 Tag addressing capability (P2)

This determines whether a tag can be individually addressed (generally through its UII) or not.

6.12.7.3 Tag unique identifier (UII) (P3)

Tag unique identifier shall be defined as a binary value which shall ensure a worldwide uniqueness.

Tag unique identifier ranges shall be assigned according to rules determined by either an ISO or ISO/IEC International Standard.

The responsibility for ensuring that UII's are properly issued and verified shall lie with the IC or tag manufacturer.

6.12.7.3.1 UII size (P3a)

This determines the UII size (measured in bits)

6.12.7.3.2 UII format (P3b)

This determines the UII format and state which ISO/IEC standard it is compliant with. (e.g. ISO/IEC 7816-5, ISO 14816, ISO 6346).

6.12.7.4 Read size (P4)

This determines the minimum and maximum data size (in bytes) which can be read in one transaction according to the protocol specification. The modulo shall also be specified (e.g. multiple of 8 bits or multiple of 1 byte).

6.12.7.5 Write size (P5)

This determines the minimum and maximum data size (in bytes) which can be written in one transaction according to the protocol specification. The modulo shall also be specified (e.g. multiple of 8 bits or multiple of 1 byte).

6.12.7.6 Read transaction time (P6)

This shall specify the time to perform a read transaction. It shall be expressed in milliseconds.

NOTE It is recommended that the time is expressed for data sizes of 1, 4, 8, 16 and 32 bytes (within Read size limits).

6.12.7.7 Write transaction time (P7)

Time to perform a write transaction. Expressed in milliseconds.

NOTE It is suggested that the time is expressed for data size of 1, 4, 8, 16 and 32 bytes (within Write size limits).

6.12.7.8 Error detection (P8)

Indicates whether or not the protocol includes an error detection mechanism, and which one (e.g. LRC, CRC). Both interrogator-to-tag and tag-to-interrogator shall be specified.

6.12.7.9 Error correction (P9)

This shall indicate whether or not the protocol includes an error correction mechanism, and which one.

Both interrogator-to-tag and tag-to-interrogator shall be specified.

6.12.7.10 Memory size (P10)

This shall indicate the minimum and maximum tag memory size that can be accessed using read and write functions.

6.12.7.11 Command structure and extensibility (P11)

This shall describe the structure of the command code (when applicable) from the interrogator to the tag and indicate how many positions are available for future extensions.

6.12.8 Collision management parameters

6.12.8.1 Type (A1)

This determines whether the collision management method is probabilistic or deterministic

Probabilistic: all tags that can physically communicate with the interrogator can be inventoried with a probability PA1 (PA1<1). This probability generally varies with the number of tags and possibly with the interrogator request parameters (e.g. number of slots).

Deterministic: all tags that can physically communicate with the interrogator can be inventoried without exception (PA1=1).

6.12.8.2 Linearity (A2)

This shall indicate how the total inventory time for N tags varies with N (where N = the number of tags in the read zone). It may be proportional to N (with tolerances) or exponential to N. A threshold may exist (e.g. linear till 10 tags and then exponential).

6.12.8.3 Tag inventory capacity (A3)

This determines the maximum number of tags (algorithmic capacity) that can be simultaneously present in a read zone and still be identified.

For a probabilistic mechanism, it indicates the maximum number of tags that can be simultaneously present and identified with a probability PA1 of 0.99 (99%).

For a deterministic mechanism, it indicates the maximum number of tags that can be simultaneously present and identified with a probability PA1 of 1 (100%).

7 Modulation

Each mode of each part of ISO/IEC 18000 shall describe the modulation technique.

8 Patents and intellectual property

8.1 Responsibilities regarding patents and intellectual property

Annex E provides summary information that has been identified as possibly being relevant to some or all of the parts of ISO/IEC 18000. Attention is drawn the caveats and limitations given in Clause E.1.

8.2 Patents referenced in ISO/IEC 18000

Developers of the subsequent parts of ISO/IEC 18000 are required to provide contact information in accordance with ISO/IEC directives which shall also be displayed in the Introduction clause of each of the subsequent parts.

Annex A
(informative)

Reference co-ordinates for regional and national regulations

The following web site addresses provide access to regional and national regulations.

A.1 North America

The Federal Communications Commission can be contacted via **www.fcc.gov**.

A.2 Europe & CEPT countries

A list of all contact for the 43 CEPT administrations issuing radio regulations can be found under **www.ero.dk under 'Contacts'**.

A.3 Japan & Pacific

The regulatory contacts for Japan can be contacted via

http://www.tele.soumu.go.jp

Ministry of Public Management, Home Affairs, Posts and Telecommunications (the regulator)

http://www.telec.or.jp

TELEC is an extra-departmental organization that provides a technical standard conformity certification service, which is "GITEKI" in Japanese" and a calibration service for measuring devices under the radio law;

http://www.arib.or.jp

(ARIB is a private standardization body. They publish ARIB standards for radio equipment.)

Australian Communications and Media Authority. Australia's regulator for broadcasting, the internet, radiocommunications and telecommunications

http://www.acma.gov.au/WEB/HOMEPAGE/pc=home.

Annex B
(informative)

Pro forma for parameter definition standards (including parameter definition tables)

NOTE A Parameter definition International Standard (part to ISO/IEC 18000) should be initially created using the current ISO Template (available from the ISO website: www.iso.org/sdis/templates). ISO will only accept Committee Drafts that have been prepared using this Template.

Completing the template set up will allocate the SC and International Standard number references, titling, together with International Standard ISO Text in the initial clauses.

It is recommended that for each Parameter definition International Standard, the following text extracts be cut and pasted (one clause at a time) to the new draft.

Foreword

(Text as generated by template, adapted, with the addition of:)

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

This International Standard has been developed by ISO/IEC SC31 WG4, radio frequency identification for item management, in order to provide parameter definitions for communications protocols within a common framework for internationally useable frequencies for radio frequency identification (RFID).

This part of ISO/IEC 18000 has been prepared in accordance with the requirements determined in ISO/IEC 18000-1, *Information technology — Radio frequency identification for item management — Part 1: Reference architecture and definition of parameters to be standardized.*

The International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) draw attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning [subject matter] given in [subclause].

The ISO and IEC take no position concerning the evidence, validity and scope of this patent right.

The holder of this patent right has assured the ISO and IEC that he is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with the ISO and IEC. Information may be obtained from:

[name of holder of patent right]
[address]

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those identified above. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

(The introduction clause shall provide the numbers of any patents declared by the submitters to be relevant to that part of ISO/IEC 18000 together with contact information in accordance with ISO/IEC directives.)

(The following shall be included, as a single cut and paste block, to each MODE of each submission for any part of ISO/IEC 18000 International Standard submissions.)

1 Scope

This part of ISO/IEC 18000 provides parameter definitions for (frequency) in accordance with the requirements of ISO/IEC 18000-1.

This part of ISO/IEC 18000 provides parameter definition for each MODE/TYPE determined in the requirements and parameter clauses below.

This part of ISO/IEC 18000 defines **N** non interfering MODES/TYPES.

MODES/TYPES ***** ****** ****** are interoperable

MODES/TYPES ****** ***** ****** are not interoperable, but non interfering.

2 Conformance

2.1 Claiming conformance

In order to claim conformance with this part of ISO/IEC 18000 it is necessary to comply to all of the 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 to hold a valid licence from the appropriate owner of intellectual property associated with the MODES defined herein.

Device manufacturers claiming conformance to this standard shall self-certify that RF emissions and susceptibility comply with IEC 60601-1-2.

2.2 General conformance requirements

General conformance requirements shall be specified and where possible be related to relevant ISO/IEC International Standards and Technical Reports.

2.2 Specific conformance requirements

Specific conformance requirements are defined in the requirements clauses of this part of ISO/IEC 18000.

3 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 — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary*

4 Terms and definitions

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

5 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.

6 Requirements

6.0.1 Context within ISO/IEC 18000

The context, form and general requirements for this part of ISO/IEC 18000 have been determined in ISO/IEC 18000-1. The form and presentation of this part, which provides parameter definitions for RFID systems for Item Identification operating at (frequency), are in accordance with the requirements of ISO/IEC 18000-1.

6.0.2 General conformance requirements

General conformance requirements are determined within such Technical Reports concerning RFID device conformance test methods as have been published.

6.0.3 Command structure and extensibility

ISO/IEC 18000 includes definition of the structure of command codes between an Interrogator and a tag and indicates 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’.

In accordance with ISO/IEC 18000-1, the clauses of this part of ISO/IEC 18000 make provision for ‘custom’ and ‘proprietary’ commands.

6.0.4 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.

6.0.5 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 the International Standard (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 the International Standard.

6.0.6 Custom commands

Custom commands are not permitted within this part of ISO/IEC 18000.

Or

Custom commands are permitted within this part of ISO/IEC 18000 but are not specified within it. An interrogator shall use a custom command only in accordance with the specifications of the tag manufacturer .

6.0.7 Proprietary commands

Proprietary commands are not permitted within this part of ISO/IEC 18000.

Or

Proprietary commands are permitted within this part of ISO/IEC 18000 but are not specified within it. All proprietary commands shall be disabled before the tag leaves the tag manufacturer. Proprietary commands are intended for manufacturing purposes and shall not be used in field-deployed RFID systems

6.0.8 Modes supported within this part of ISO/IEC 18000

Within the frequency range xxx MHz this part of ISO/IEC 18000 defines (n) MODES of operation. Whilst, except where stated, these MODES are not interoperable, except in countries/conditions listed in Annex A, they may be expected to operate without causing any significant interference with each other.

Each mode defined in this part of ISO/IEC 18000 is described in the form of parameter definition tables.

6.1 Parameters for MODE 1 of this part of ISO/IEC 18000

6.1.1 MODE 1: Physical and media access control (MAC) parameters

6.1.1.1 MODE 1: Interrogator to tag link

Ref.	Parameter Name	Description
M1-Int: 1	Operating frequency range	
M1-Int: 1a	Default operating frequency	
M1-Int: 1b	Operating channels (for Spread spectrum systems)	
M1-Int: 1c	Operating frequency accuracy	
M1-Int: 1d	Frequency hop rate (for Frequency hopping [FHSS] systems)	
M1-Int: 1e	Frequency hop sequence (for Frequency hopping [FHSS] systems)	
M1-Int: 2	Occupied channel bandwidth	
M1-Int:2a	Minimum receiver bandwidth	
M1-Int: 3	Interrogator transmit maximum EIRP	
M1-Int: 4	Interrogator transmit spurious emissions	
M1-Int: 4a	Interrogator transmit spurious emissions, in-band (for Spread spectrum systems)	
M1-Int: 4b	Interrogator transmit spurious emissions, out-of-band	
M1-Int: 5	Interrogator transmitter spectrum mask	
M1-Int:6	Timing	
M1-Int: 6a	Transmit to receive turn around time	
M1-Int: 6b	Receive to transmit turn around time	
M1-Int: 6c	Dwell time or interrogator transmit power on ramp	
M1-Int: 6d	Decay time or interrogator transmit power down ramp	
M1-Int: 7	Modulation	
M1-Int: 7a	Spreading sequence (for Direct sequence [DHSS] systems)	
M1-Int: 7b	Chip rate (for Spread spectrum systems)	
M1-Int: 7c	Chip rate accuracy (for Spread spectrum systems)	
M1-Int: 7d	Modulation index	
M1-Int: 7e	Duty cycle	
M1-Int: 7M1-Int:	FM deviation	
M1-Int: 8	Data coding	
M1-Int: 9	Bit rate	
M1-Int: 9a	Bit rate accuracy	

Ref.	Parameter Name	Description
M1-Int: 10	Interrogator transmit modulation accuracy	
M1-Int: 11	Preamble	
M1-Int:11a	Preamble length	
M1-Int:11b	Preamble waveform	
M1-Int: 11c	Bit sync sequence	
M1-Int: 11d	Frame sync sequence	
M1-Int: 12	Scrambling (for spread spectrum systems)	
M1-Int: 13	Bit transmission order	
M1-Int: 14	Wake-up process	
M1-Int: 15	Polarization	

6.1.1.2 MODE 1: Tag to interrogator link

Ref.	Parameter Name	Description
M1-Tag:1	Operating frequency Range	
M1-Tag:1a	Default operating frequency	
M1-Tag:1b	Operating channels (for spread spectrum systems)	
M1-Tag:1c	Operating frequency accuracy	
M1-Tag:1d	Frequency hop rate (for Frequency hopping [FHSS] systems)	
M1-Tag:1e	Frequency hop sequence (for frequency hopping [FHSS] systems)	
M1-Tag:2	Occupied channel bandwidth	
M1-Tag:3	Transmit maximum EIRP	
M1-Tag:4	Transmit spurious emissions	
M1-Tag:4a	Transmit spurious emissions, In-Band (for Spread Spectrum systems)	
M1-Tag:4b	Transmit spurious emissions, out-of-band	
M1-Tag:5	Transmit spectrum mask	
M1-Tag:6a	Transmit to receive turn around time	
M1-Tag:6b	Receive to transmit turn around time	
M1-Tag:6c	Dwell time or Transmit power on ramp	
M1-Tag:6d	Decay time or Transmit power down ramp	
M1-Tag:7	Modulation	
M1-Tag:7a	Spreading sequence (for direct sequence [DHSS] systems)	
M1-Tag:7b	Chip rate (for Spread Spectrum systems)	
M1-Tag:7c	Chip rate accuracy (for spread spectrum systems)	
M1-Tag:7d	On-Off ratio	
M1-Tag:7e	Sub-carrier frequency	

Ref.	Parameter Name	Description
M1-Tag:7f	Sub-carrier frequency accuracy	
M1-Tag:7g	Sub-Carrier modulation	
M1-Tag:7h	Duty cycle	
M1-Tag:7I	FM deviation	
M1-Tag:8	Data coding	
M1-Tag:9	Bit rate	
M1-Tag:9a	Bit rate accuracy	
M1-Tag:10	Tag transmit modulation accuracy (for frequency hopping [FHSS] systems)	
M1-Tag:11	Preamble	
M1-Tag:11a	Preamble length	
M1-Tag:11b	Preamble waveform	
M1-Tag:11c	Bit sync sequence	
M1-Tag:11d	Frame sync sequence	
M1-Tag:12	Scrambling (for spread spectrum systems)	
M1-Tag:13	Bit transmission order	
M1-Tag:14	Reserved	
M1-Tag:15	Polarization	
M1-Tag:16	Minimum tag receiver bandwidth	

6.1.2 MODE 1: Protocol parameters

Ref.	Parameter Name	Description
M1-P:1	Who talks first	
M1-P:2	Tag addressing capability	
M1-P:3	Tag ID	
M1-P:3a	Tag ID length	
M1-P:3b	Tag ID format	
M1-P:4	Read size	
M1-P:5	Write size	
M1-P:6	Read transaction time	
M1-P:7	Write transaction time	
M1-P:8	Error detection	
M1-P:9	Error correction	
M1-P:10	Memory size	
M1-P:11	Command structure and extensibility	

6.1.3 MODE 1: Collision management parameters

Ref.	Parameter Name	Description
M1-A:1	Type (probabilistic or deterministic)	
M1-A:2	Linearity	
M1-A:3	Tag inventory capacity	

6.1.4 Modulation index

The modulation type and index shall be fully described, including timing diagrams.

6.2 Parameters for MODE 2 of this part of ISO/IEC 18000

6.2.1 MODE 2: Physical and media access control (MAC) parameters

6.2.1.1 MODE 2: Interrogator to tag link

Ref.	Parameter Name	Description
M2-Int: 1	Operating frequency range	
M2-Int: 1a	Default operating frequency	
M2-Int: 1b	Operating channels (for Spread spectrum systems)	
M2-Int: 1c	Operating frequency accuracy	
M2-Int: 1d	Frequency hop rate (for Frequency hopping [FHSS] systems)	
M2-Int: 1e	Frequency hop sequence (for Frequency hopping [FHSS] systems)	
M2-Int: 2	Occupied channel bandwidth	
M2-Int:2a	Minimum receiver bandwidth	
M2-Int: 3	Interrogator transmit maximum EIRP	
M2-Int: 4	Interrogator transmit spurious emissions	
M2-Int: 4a	Interrogator transmit spurious emissions, in-band (for Spread spectrum systems)	
M2-Int: 4b	Interrogator transmit spurious emissions, out-of-band	
M2-Int: 5	Interrogator transmitter spectrum mask	
M2-Int:6	Timing	
M2-Int: 6a	Transmit to receive turn around time	
M2-Int: 6b	Receive to transmit turn around time	
M2-Int: 6c	Dwell time or interrogator transmit power on ramp	

Ref.	Parameter Name	Description
M2-Int: 6d	Decay time or interrogator transmit power down ramp	
M2-Int: 7	Modulation	
M2-Int: 7a	Spreading sequence (for Direct sequence [DHSS] systems)	
M2-Int: 7b	Chip rate (for Spread spectrum systems)	
M2-Int: 7c	Chip rate accuracy (for Spread spectrum systems)	
M2-Int: 7d	Modulation index	
M2-Int: 7e	Duty cycle	
M2-Int: 7M1-Int:	FM deviation	
M2-Int: 8	Data coding	
M2-Int: 9	Bit rate	
M2-Int: 9a	Bit rate accuracy	
M2-Int: 10	Interrogator transmit modulation accuracy	
M2-Int: 11	Preamble	
M2-Int:11a	Preamble length	
M2-Int:11b	Preamble waveform	
M2-Int: 11c	Bit sync sequence	
M2-Int: 11d	Frame sync sequence	
M2-Int: 12	Scrambling (for spread spectrum systems)	
M2-Int: 13	Bit transmission order	
M2-Int: 14	Wake-up process	
M2-Int: 15	Polarization	

6.2.1.2 MODE 2: Tag to interrogator link

Ref.	Parameter Name	Description
M2-Tag:1	Operating frequency Range	
M2-Tag:1a	Default operating frequency	
M2-Tag:1b	Operating channels (for spread spectrum systems)	
M2-Tag:1c	Operating frequency accuracy	
M2-Tag:1d	Frequency hop rate (for Frequency hopping [FHSS] systems)	
M2-Tag:1e	Frequency hop sequence (for frequency hopping [FHSS] systems)	
M2-Tag:2	Occupied channel bandwidth	
M2-Tag:3	Transmit maximum EIRP	
M2-Tag:4	Transmit spurious emissions	
M2-Tag:4a	Transmit spurious emissions, In-Band (for Spread Spectrum systems)	
M2-Tag:4b	Transmit spurious emissions, out-of-band	
M2-Tag:5	Transmit spectrum mask	
M2-Tag:6a	Transmit to receive turn around time	

Ref.	Parameter Name	Description
M2-Tag:6b	Receive to transmit turn around time	
M2-Tag:6c	Dwell time or Transmit power on ramp	
M2-Tag:6d	Decay time or Transmit power down ramp	
M2-Tag:7	Modulation	
M2-Tag:7a	Spreading sequence (for direct sequence [DHSS] systems)	
M2-Tag:7b	Chip rate (for Spread Spectrum systems)	
M2-Tag:7c	Chip rate accuracy (for spread spectrum systems)	
M2-Tag:7d	On-Off ratio	
M2-Tag:7e	Sub-carrier frequency	
M2-Tag:7f	Sub-carrier frequency accuracy	
M2-Tag:7g	Sub-Carrier modulation	
M2-Tag:7h	Duty cycle	
M2-Tag:7I	FM deviation	
M2-Tag:8	Data coding	
M2-Tag:9	Bit rate	
M2-Tag:9a	Bit rate accuracy	
M2-Tag:10	Tag transmit modulation accuracy (for frequency hopping [FHSS] systems)	
M2-Tag:11	Preamble	
M2-Tag:11a	Preamble length	
M2-Tag:11b	Preamble waveform	
M2-Tag:11c	Bit sync sequence	
M2-Tag:11d	Frame sync sequence	
M2-Tag:12	Scrambling (for spread spectrum systems)	
M2-Tag:13	Bit transmission order	
M2-Tag:14	Reserved	
M2-Tag:15	Polarization	
M2-Tag:16	Minimum tag receiver bandwidth	

6.2.2 MODE 2: Protocol parameters

Ref.	Parameter Name	Description
M2-P:1	Who talks first	
M2-P:2	Tag addressing capability	
M2-P:3	Tag ID	
M2-P:3a	UII length	
M2-P:3b	UII format	
M2-P:4	Read size	
M2-P:5	Write size	
M2-P:6	Read transaction time	
M2-P:7	Write transaction time	
M2-P:8	Error detection	
M2-P:9	Error correction	
M2-P:10	Memory size	
M2-P:11	Command structure and extensibility	

6.2.3 MODE 2: Collision management parameters

Ref.	Parameter Name	Description
M2-A:1	Type (probabilistic or deterministic)	
M2-A:2	Linearity	
M2-A:3	Tag inventory capacity	

6.2.4 Modulation index

The modulation type and index shall be fully described, including timing diagrams.

[6.1 and 6.2 shall be repeated for any additional modes (6.3 MODE 3... 6.n MODE n)]

7 Table of characteristic differences between the MODES specified in this part of ISO/IEC 18000

Annex C
(informative)

Architectural views of logistic and distribution systems

C.1 Context

C.1.1

Logistics, supply and distribution systems are an indispensable part of modern society. Such systems provide the means of moving material and product to manufacturing systems, moving materials, components, sub assemblies and product through manufacturing systems, and get product and physical items to their end delivery points. They also include delivery services for non manufactured items (such as airline baggage, post and parcel delivery systems). Such systems also manage returnable units, and provide information around the system (a function that we have described "The Information Manager").

C.1.2

This Informative Annex describes typical architecture views and contexts in which RFID for item Management is typically to be found. In this Informative Annex, architecture is described from the following perspectives:

a) Conceptual description

b) Logical definition

c) Object identification

d) Object interaction structure

 — Connectivity and workflow architecture (OSI layers 1 - 6)

 — Application architecture (OSI layer 7 and above)

C.1.3

In the majority of situations the objective of the item identification process is to uniquely identify an item. This is sometimes described as a 'licence plate' technique where a unique identification may be referred to a database for additional information. There may be in addition the monologue transfer of additional data (for example a manifest) or there may be a bi-directional exchange of data, or an interrogator initiated interrogation where all or part of the available data may be accessed. The limits to such access may be to increase transaction efficiency, or the 'interrogator' may only be authorised to access certain parts of the data available. Security authorisation and encryption may form part of such data transfer.

C.1.4

In some circumstances the position may be reversed and it may be for a moving vehicle or equipment to identify a static or moving object, such as a location identifier, timestamp, customs clearance authorisation or another moving vehicle or equipment (for example to provide a record of which tractor units a trailer has been married with).

C.1.5

In some cases it is necessary to protect the identity of an item, vehicle, equipment or load detail for reasons of privacy or security. In these cases an Item Identification system shall provide an 'unambiguous identification' that does not necessarily identify the true permanent identification of the vehicle or equipment. It may, for example, identify a smart card temporarily located in an on board unit, or a temporary trip related identification.

C.1.6

It is important to remember, however, that the equipment used may provide the functions of more than one entity, or indeed the entity may be performed by a combination of equipment (such as an interrogator plus an antenna).

C.2 Conceptual Description

Figure C.1 shows typical conceptual relationships of logistics/supply/distribution systems at a high level.

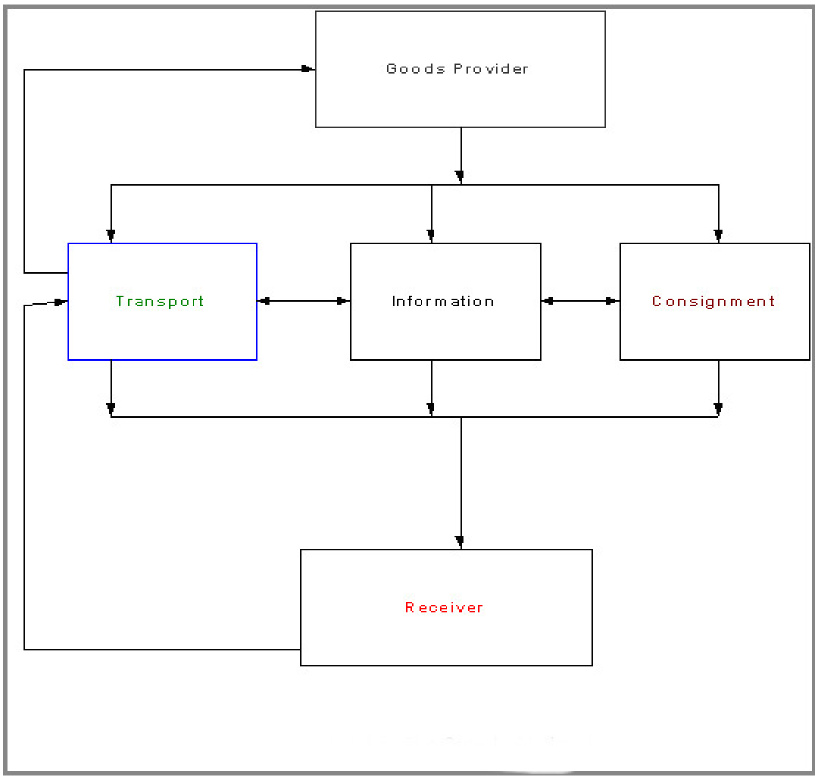

Figure C.1 — The supply chain overview

Figure C.1 shows that logistics/supply/distribution chains involve/interface with most aspects of modern society. The detail (relevant actors, classes (objects), interfaces and interactions) depend on the perspective from which they are viewed.

The following figures show the logistics/distribution/supply chain from the perspective of the key classes shown in Figure C.1 and for particular logistic distribution systems (such as airline baggage distribution).

Figure C.2 shows the view from the view of the goods provider.

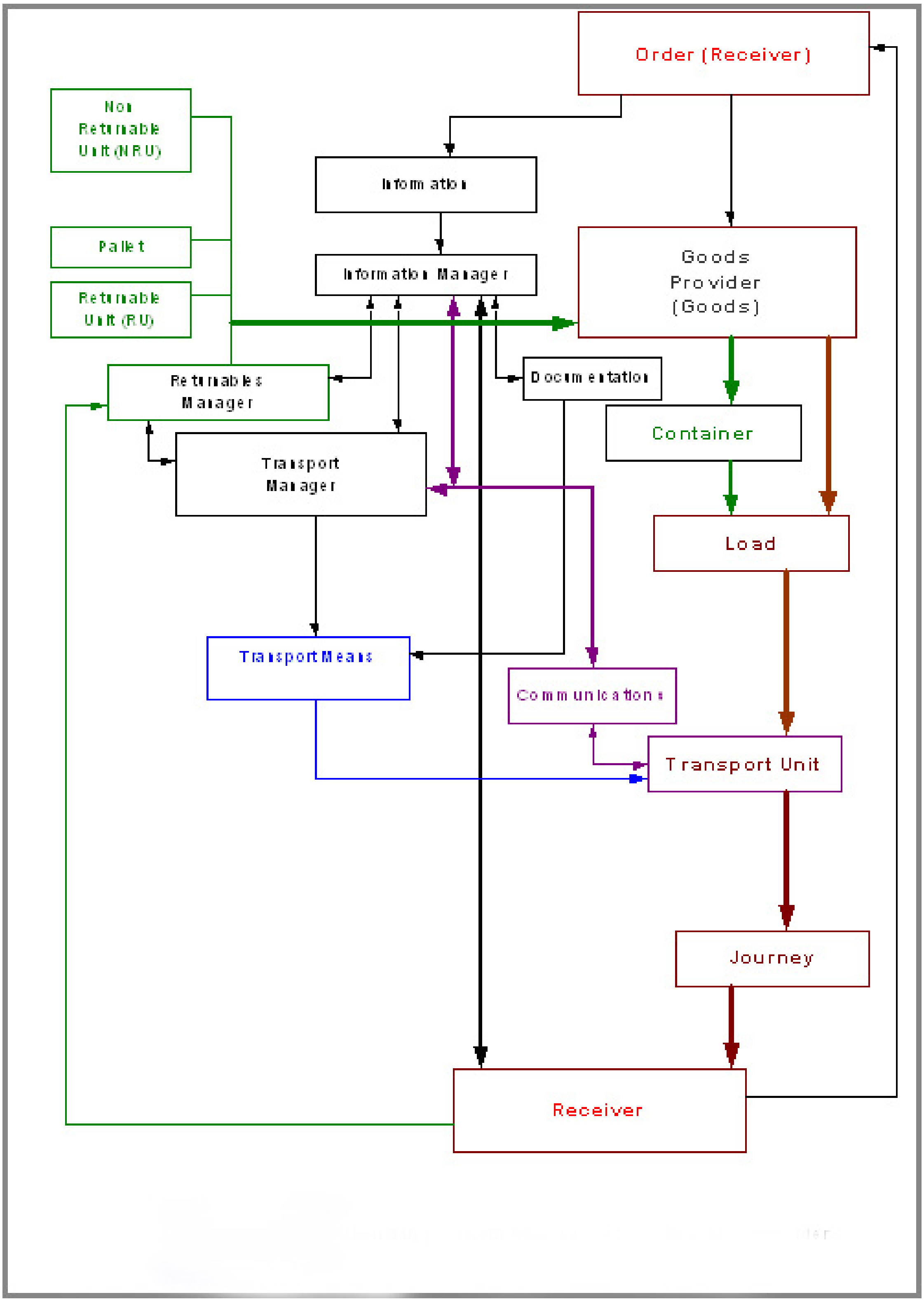

Figure C.2 — The distribution/supply chain from the view of the goods provider

The goods provider may simply be a distributor or agent, but may also be, or act in concert with, a manufacturer. Manufacturing is a specific view of the logistic/supply chain. It is a view whose complexity is often hidden from much of the supply chain, but examination shows not only external involvement, but a complex internal logistic and supply chain requirement. Figure C.3 shows such a view.

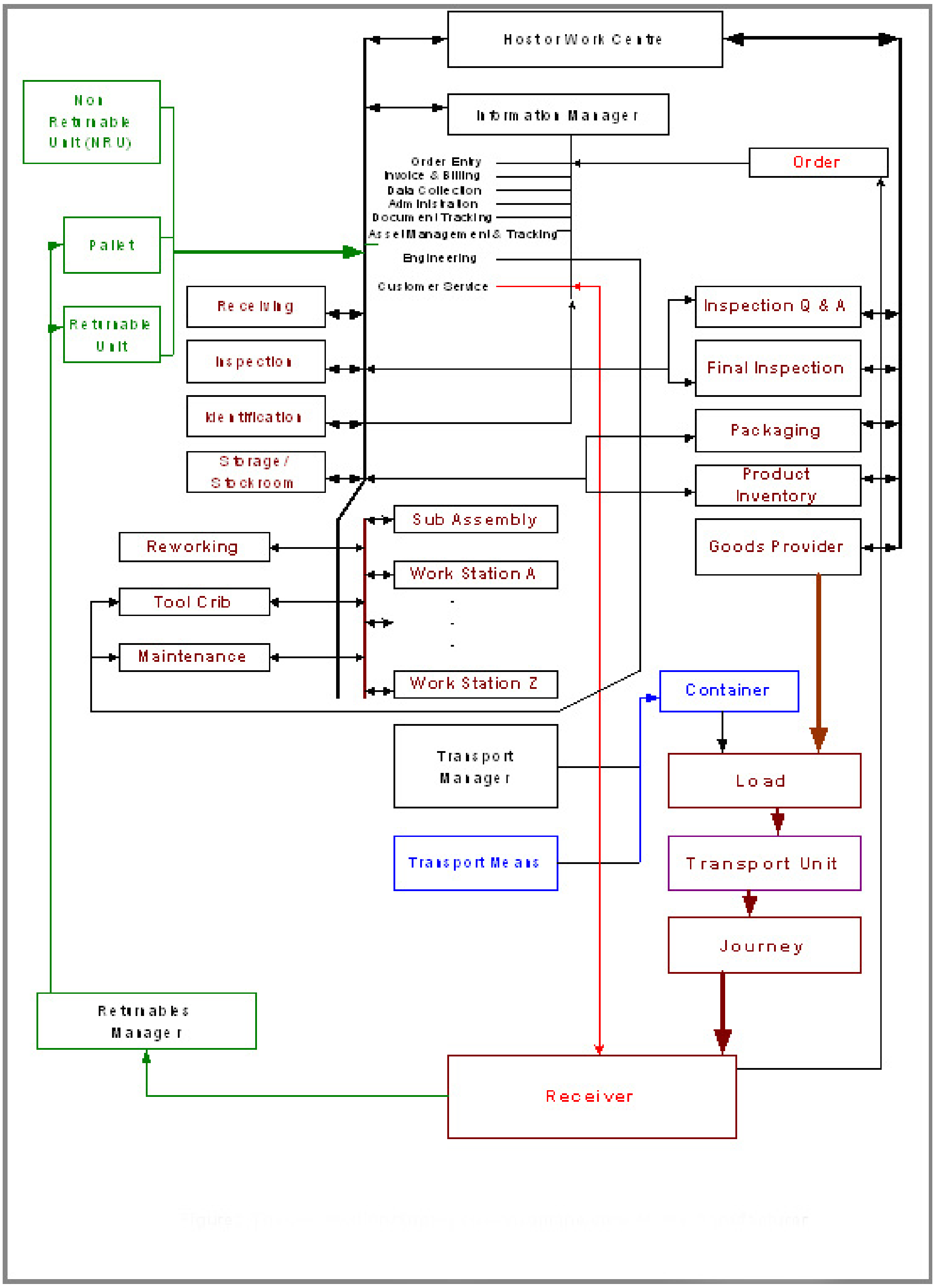

Figure C.3 — The logistics/distribution/supply chain from the view of the manufacturer

Once manufactured, and placed through the hands of the goods provider, the item(s) to be delivered become a consignment. Figure C.4 provides the logistics/distribution/supply chain, from the view of the consignment.

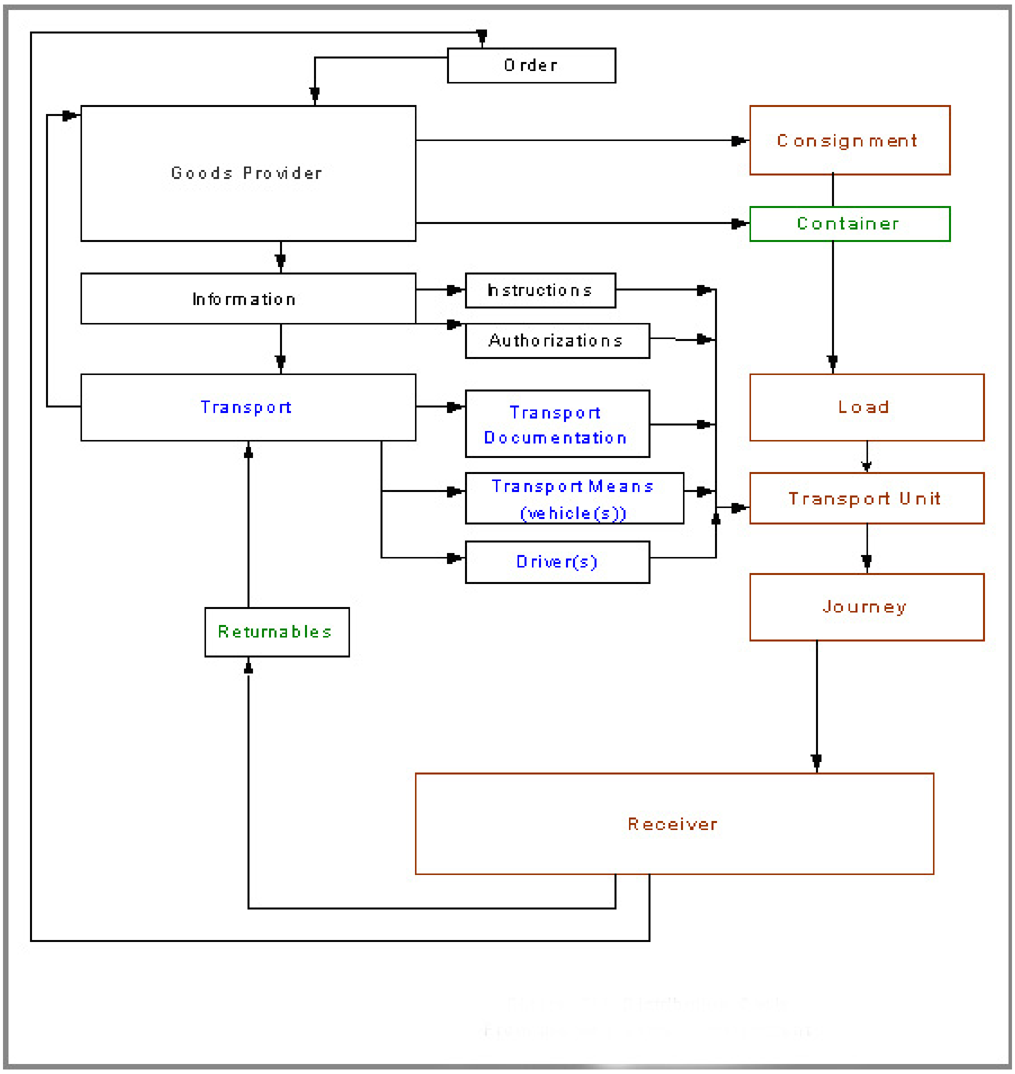

Figure C.4 — The distribution cycle from the view of the consignment

The objective of the logistic/distribution/supply chain is the receiver. The receiver may be an end user or a manufacturer or intermediary. Figure C.5 provides the chain from this point of view.

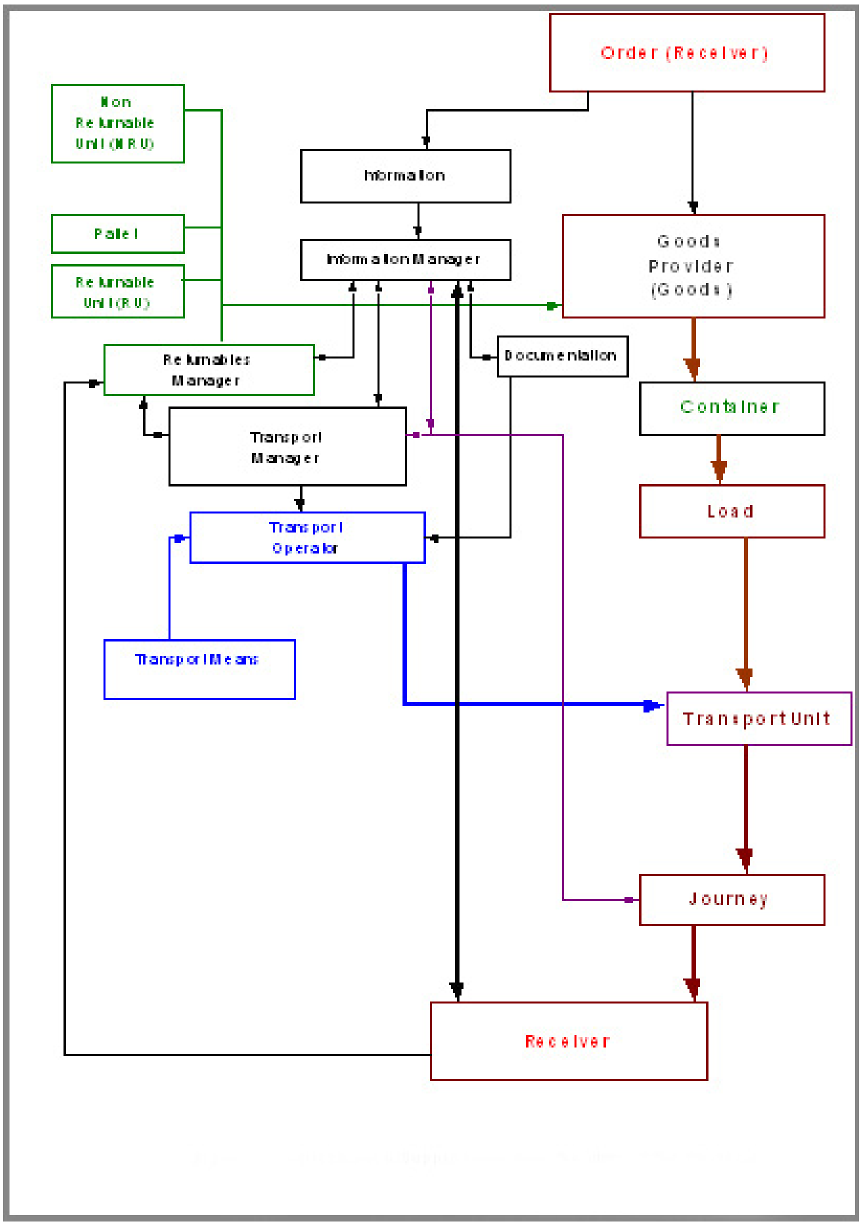

Figure C.5 — The logistic/distribution/supply chain from the view of the receiver

In order to get the item from its source to its destination it has to be moved. This involves a transportation function. This may be performed in house, through single subcontract or through a subcontract chain. Who, or how many actors fulfil these transport aspects, the functional classes remain conceptually similar and divisible.

NOTE There is an interface between "item identification" and "transport unit" identification. Within the context of ISO/IEC 18000, the relevant "items" relate to the contents of a trailer "(pallet" items; "small container" items, packets, parcels, and individual items).

This is in line with agreement between ISO/IEC SC 31 and ISO TC 204.

Identification for larger items (vehicles, trailers, Swap Bodies etc.) are standardized by ISO TC204; TC104; railway and airline equipment are standardized by other standardization bodies.

However, regardless of who originates the International Standards for various aspects, the view of transportation also shows logistic/distribution/supply chain requirements which are in the purview ISO/IEC 18000.

Figure C.6 shows the view of transportation. A view similar and consistent with Figure C.6 also appears in ISO 17261, *Automatic vehicle and equipment identification — Intermodal goods transport — Architecture and terminology*.

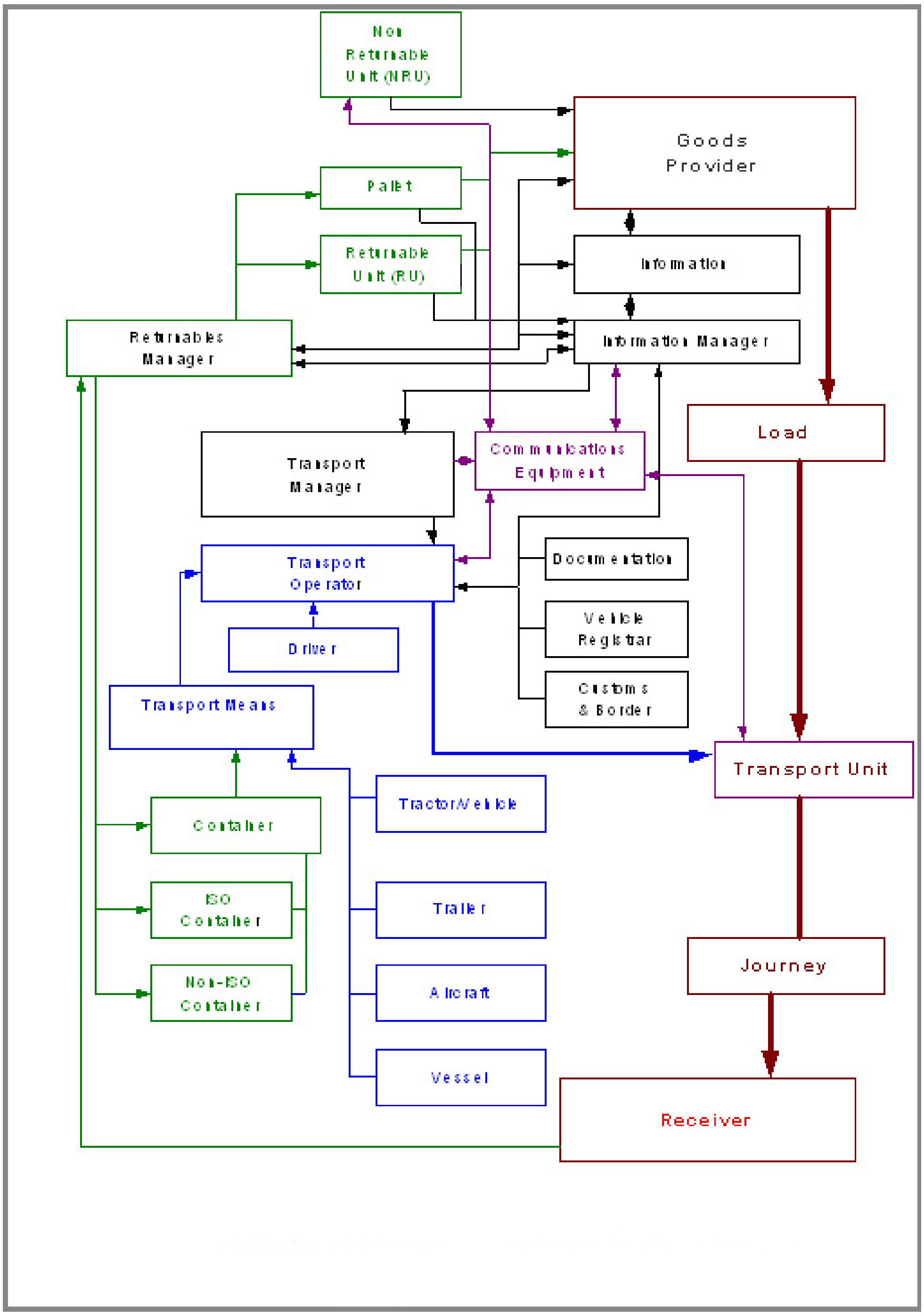

Figure C.6 — The logistics/distribution/supply chain from the view of transport

Whilst the views described in Figures C.1 to C.6 encompass most situations, they do not embrace all architecture views. Some specialized views can also benefit from further description. One such example is airline baggage handling. Figure C.7 shows such a view.

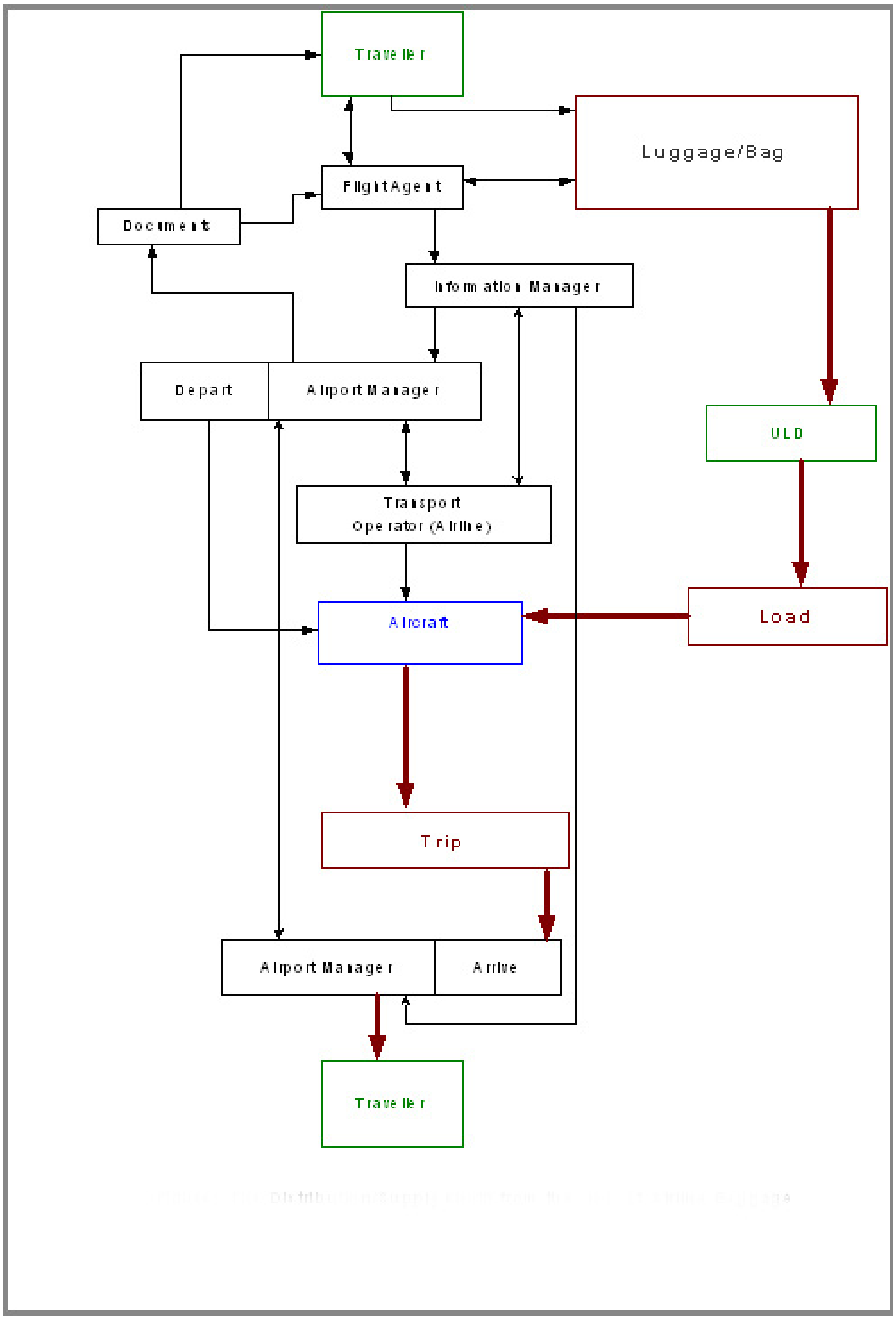

Figure C.7 — The logistics/distribution/supply chain from the view of airline baggage handling

As far as a high level generic model is concerned, this can be seen as a subset of the general model, where The flight agent, airport manager, and airline is part of the "transport operator" class. Luggage is an instance of the class "non returnable container" or "item".

The work of ISO/IEC SC31 WG4 relates to "RFID for item management". The work programme concerns the collection and management of information (primarily identification) about "items" in manufacturing/logistics/distribution/supply chains. As such it is the "information" rather than the physical movement that lies at the heart of the work programme. Key classes, which appear in every one of the views described in Figures C.1 to C.7 are those of "information" and the "Information manager" function.

Figure C.8 is therefore crucial to this series of ISO/IEC 18000. It provides the view of The "Information manager".

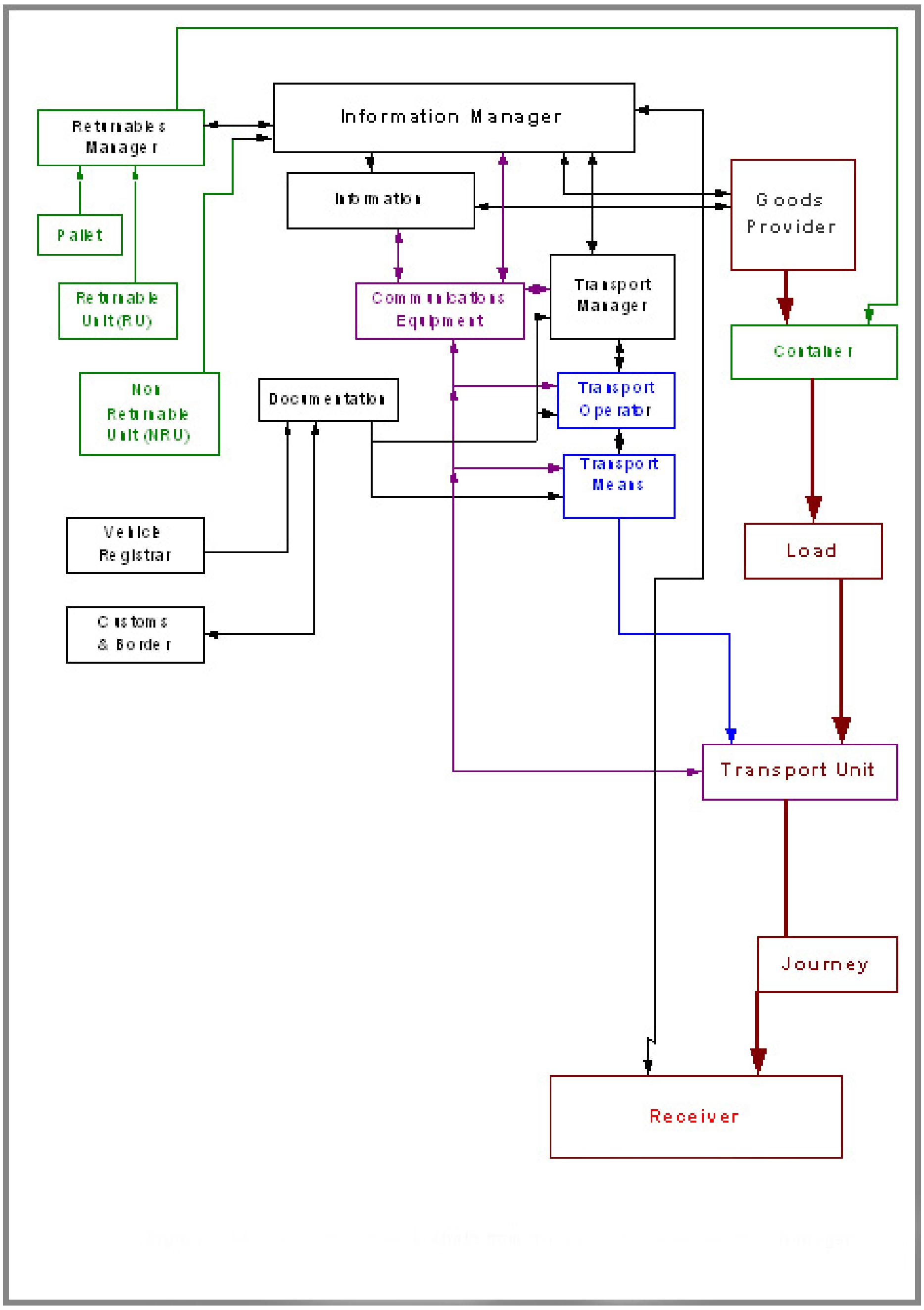

Figure C.8 — The logistics/distribution/supply chain from the view of the information manager

C.3 Relationship to the architecture views of the transport sector

The standardization committee of the intelligent transport sector (ISO TC204) has a formal liaison with ISO/IEC SC31. Its WG4 (AVI/AEI) uses the following, similar model, viewed from their perspective, and also share several of the architecture views described above in ISO 17261. They also provide an additional conceptual architecture view as shown in Figure C.9.

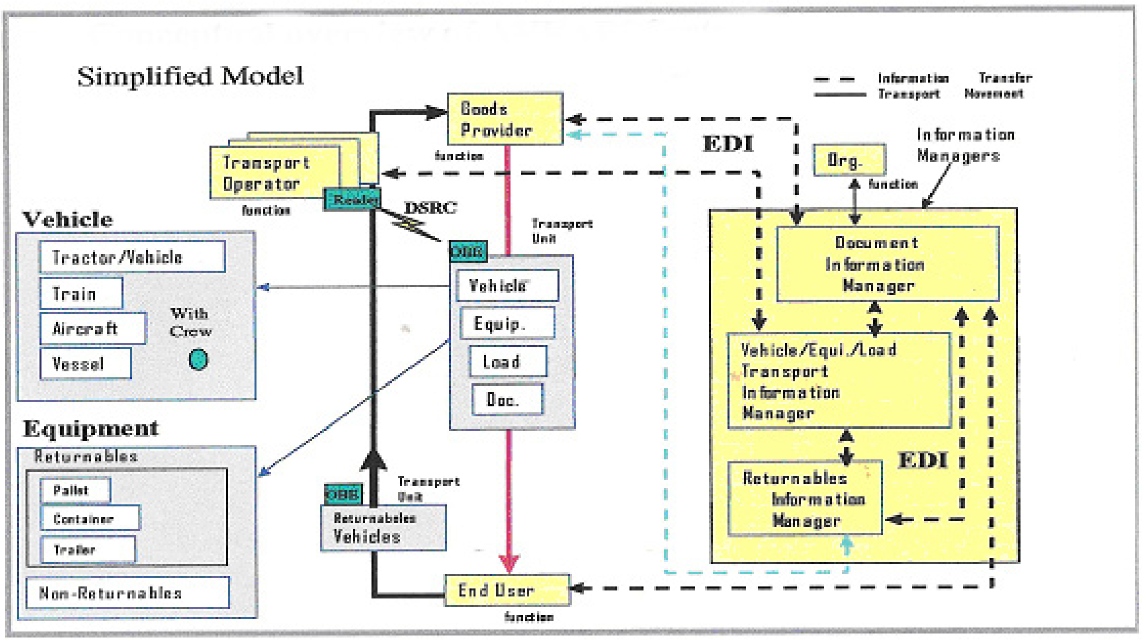

Figure C.9 — ISO TC204 WG12 Conceptual view of AVI/AEI system classes showing key attributes

C.4 Logical definition

The purpose of the **logical definition** is :

a) to provide the general distribution logistic model with a logical product independent conceptual framework that can be used to help identify and select the best in class technical components for inclusion into a coherent overall solution. This selection process will occur both during procurement and afterwards when upgrading or replacing technical products and or services.

b) to provide a road map for seamlessly evolving the system IT infrastructure in line with anticipated regional to global deployment of The system services.

c) to provide potential suppliers of system technology and services with a logical overview of the conceptual architecture.

The architecture is not intended to be prescriptive. It provides a descriptive and representative view of the classes and their interactions in the general distribution logistic model environment.

Figure C.10 shows the logical functionality of the information interactions in the system.

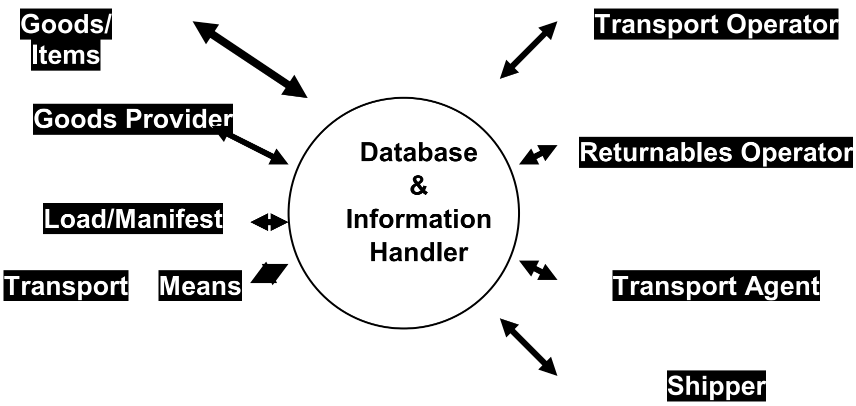

Figure C.10 — Logical Functionality showing information interactions

C.5 Functional architecture

The prime item identification function is to provide an unambiguous identification at an appropriate time. For general distribution logistic model the information flow is a simple monologue where, on receipt of an appropriate signal, the tag returns its identity, but in many cases also additional information. However, whilst the key 'item identification' transaction may be a monologue, the technical solution will often require a bi directional dialogue.

Annex D
(informative)

Tag identifier

D.1 Applicability

Where a Tag identifier is used it is recommended that the following form be used. In the case of some parts of ISO/IEC 18000, or MODES thereof, the use of this unique identifier form may be mandatory (defined in each part of ISO/IEC 18000 where mandatory).

D.2 Tag identifier

The tag serial number shall either be in accordance to D.2.1 or D.2.2 .

The TagID format "E0xxx" is preferred.

Differentiation is achieved by the leading bits in byte 0, which are 111 for unique identifiers as defined in D 2.1 and 000 for unique identifier as defined in D.2.2 .

D.2.1 Unique identifier in support of ISO/IEC 7816-6

MSB							**LSB**
Byte 0 **M L**	**Byte 1** **M L**	**Byte 2** **M L**	**Byte 3** **M L**	**Byte 4** **M L**	**Byte 5** **M L**	**Byte 6** **M L**	**Byte 7** **M L**
'E0' 8 bits	IC Mfg code acc. ISO/IEC 78 16-6	Chip Manufacturer Assigned 48 bits					

D.2.1.1 'E0' (byte 0)

E0 is the header for unique identifier followed by the manufacturer code according to ISO/IEC 7816-6.

D.2.1.2 IC Mfg code according ISO/IEC 7816-6 (byte 1)

ISO/IEC 7816-6 defines an 8 bit code for chip manufacturers.

D.2.1.3 Chip manufacturer assigned (bytes 2 – 7)

This is a 48-bit field that is defined and managed by the chip manufacturer. Different chip manufacturers will have different manufacturer codes, thus eliminating the potential for duplicated collision arbitration data (tag ID's). The numbering system employed by the chip manufacturer shall ensure that all tags produced will have a unique and unambiguous number (used by the collision arbitration algorithm). This unique number is to be "locked" prior to use. Maximum value for this field is 2^{48} -1.

Responsibility for ensuring uniqueness and for locking this unique number prior to use shall rest with the chip manufacturer.

The tag serial number shall be programmed and locked at the factory with a unique number for each tag.

D.2.1.4 Check sum (bits 0, 1)

It represents the truncated sum of the bits set to 1 for 62 bits preceding the check sum in the tag Serial Number field. Valid values are 0, 1, 2, & 3.

D.2.1.5 Fab code (bits 2 – 5)

This four bit hexadecimal code is available to provide further segregation within a registered manufacturer code to accommodate multiple chip fabricators. It is the responsibility of the registered manufacturer to administer this code (if used) in conjunction with the serial number (bits 14 – 63) field to ensure that all tags produced by the manufacturer will have a unique and unambiguous number (used by the collision arbitration algorithm).

D.2.1.6 Manufacturer code (bits 6 – 13)

This is an 8-bit hexadecimal field that has been included to meet anticipated ANSI/ISO standard requirements. This 8-bit hexadecimal field is required to segregate multiple producers of chips compliant with this air interface standard. All manufacturers will have a separate and unique number allowing them to produce chips with collision arbitration numbers that do not interfere through duplication.

Registration and management of this code shall be in accordance with the specified mechanism defined by ISO/IEC JTC 1/SC 31.

D.2.1.7 Chip manufacturer assigned (bits 14 – 63)

This is a 50-bit field that is defined and managed by the chip manufacturer. Different chip manufacturers will have different manufacturer codes (see below), thus eliminating the potential for duplicated collision arbitration data (tag ID's). The numbering system employed by the chip manufacturer must ensure that all tags produced will have a unique and unambiguous number (used by the collision arbitration algorithm). This unique number will be "locked" prior to use. Maximum value for this field is 2^{50} -1.

D.2.2 Unique identifier in support of ANS INCITS 256

MSB		LSB
AC	IC manufacturer registration number	Serial number
8 bits	As defined in ANS INCITS 256	As defined in ANS INCITS 256
'000xxxxx'	As defined in ANS INCITS 256	As defined in ANS INCITS 256

D.2.2.1 '000'

000 is the header for unique identifier followed by the manufacturer code according to ANS INCITS 256.

D.2.2.2 Registration details

The AC is followed by the convention shown in ANS INCITS 256. The total length of this unique identifier including allocation class (AC), IC manufacturer registration number, and serial number is 64 bits (or in relation to 18000-7: 32 bits).

Annex E
(informative)

Intellectual property: patents

E.1 Responsibilities regarding patents and intellectual property

Attention is drawn to the statement in the Foreword to this part of ISO/IEC 18000.

Many organizations have declared that they own Intellectual Property that may be necessary for the implementation of the ISO/IEC 18000 series of standards. Each individual part of ISO/IEC 18000 contains contact information for companies that have declared IP at time of publication.

A list of all these organizations is kept on the web server at JTC1 at the following address http://isotc.iso.org/livelink/livelink/fetch/2000/2122/3770791/JTC1_Patents_database.html?nodeid=3777806&vernum=0

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[16] ANS INCITS 256, *Radio Frequency Identification (RFID)*

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