IOM 6010
Radio Frequency Identification (RFID) Specifications for Inflight Catering Equipment Management

The following specifications should be followed as the community develops radio frequency identification (RFID) technology to more efficiently manage (i.e. trace, track and maintain) inflight catering equipment, utilizing a unique identification number specified herein. Note that specifications contained herein only cover the first phase of RFID implementation for Inflight Services. A subsequent IOM will cover the use of RFID systems on board aircraft.

The specifications contained herein represent minimum requirements that should be followed if the community is to be able to trace, track and maintain inflight catering equipment as each unit moves from one facility to another on a worldwide basis. Of course, certain members of the community may wish to go beyond these specifications, with the understanding that some of the added functionalities may not be supported by all members of the community.

1. DEFINITIONS

1.1 Abbreviations

IEC	International Electrotechnical Commission
ISO	International Organisation for Standardisation
MHz	Mega Hertz
NEMA	National Electrical Manufacturers Association
RFID	Radio Frequency Identification
RTCA	Radio Technical Commission for Aeronautics
UHF	Ultra High Frequency

1.2 Box
Container used for inflight catering and carried by hand (box, carrier, canister, stowage unit, etc.).

1.3 Catering Equipment
All rotable equipment used for inflight catering including trolleys, boxes, ovens, coffee makers, etc.

1.4 Closed Application
A closed application is a RFID system that is implemented for the exclusive use of a single caterer or a single airline.

1.5 Community
Consists of airlines, caterers, maintenance suppliers, duty free suppliers, catering equipment suppliers, aircraft manufacturers, etc.

1.6 Encoding Capacity
Is the amount of data (in bits) capable of being held by an RFID tag. The encoding rules determine how user data relates to the actual byte string(s) within the RFID tag.
(refer to section 10 – Encoding the RFID Tag)

1.7 Equipment Operator
Is the airline that operates the catering equipment, but that does not necessarily own it.

1.8 Load Cycle
Represents each time a catering equipment unit is loaded onto an aircraft.

1.9 Management Information System
The application that processes information received from the RFID system, by linking it to information previously stored in the management information system (such as trolley type, trolley usage, etc.), produces reports and supports the management decision-making process.

1.10 Mandatory Data
Refers to data that must be encoded on the RFID tag and must be read on demand.

1.11 Memory Structure
The RFID chip comprises of 4 memory banks. Bank 00 is a reserved area, 01 contains the unique item identifier, 10 contains the tag identifier and 11 is user memory.

Memory Bank 00_2	**RESERVED (Reserved Memory)**
Memory Bank 01_2	**UII (Unique Item Identifier)**
Memory Bank 10_2	**TID (Tag Identification Memory)**
Memory Bank 11_2	**USER (User defined Memory)**

1.12 Open Application
An open application is a RFID system that is implemented for the use of several members of the community at one or multiple locations.

1.13 Optional Data
Data encoded or written on the RFID tag at the discretion of the user.

1.14 RFID Reader/Writer
An electronic device for performing the process of retrieving data from (reader) and potentially transmitting data to (reader/writer) an RFID tag. An RFID reader/writer includes one or more RFID antennas, that may have different configurations, connected to a data processing system, which includes data source decoding, error control management as appropriate, an integral display and/or a communications interface with a management information system.

1.15 RFID Tag
An electronic device consisting of an integrated circuit and antenna which, when attached to a catering equipment unit, is capable of receiving, holding and transmitting data related to the unit.

1.16 System Accuracy
The capability of avoiding undetected errors in the data read, write and storage process.

1.17 System Reliability

1.17.1 Read
The ability of a RFID system to capture data from a RFID tag properly programmed and presented which enters the RFID reader's radiation field.

1.17.2 Write
The ability of a RFID system to write data on a RFID tag which enters the RFID writer's radiation field.

1.18 Trolley
Container on wheels used for inflight catering (trolley, cart, etc.).

1.19 Turnaround Time
Represents the elapsed time between a catering equipment unit entering a facility and leaving the same facility.

1.20 (Catering Equipment) Unit
A specific unique piece of catering equipment (a specific trolley, box, etc.).

2. SCOPE

In the context of these specifications, each catering equipment unit would be allocated a unique identification number that would be encoded on an RFID tag at the time of its installation on the unit. RFID readers/writers would be operated at inbound and outbound areas of each facility where catering equipment can be expected to be sent to (i.e. kitchen, maintenance facility, airline warehouse, duty free supplier facility, etc.). In this context, the use of RFID technology is expected to improve the management of catering equipment by providing such information as:

2.1 The current inventory of each catering equipment type at each facility.

2.2 The current location and status of each unit.

2.3 The previous locations and statuses of each unit.

2.4 The turnaround time of each kitchen, maintenance facility, duty free supplier facility, etc.

2.5 The number of load cycles for each unit.

With accurate information available through RFID technology, airlines and caterers should be able to:

- Obtain real-time catering equipment stock and status visibility at each facility;
- Reduce catering equipment shrinkage;
- Improve security through chain of custody tracking;
- Determine appropriate buffer stock per catering equipment type at each facility;
- Improve requirements forecasting per catering equipment type;
- Implement a preventive maintenance programme for catering equipment;
- Implement a pay-per-use system for catering equipment leasing;
- Enforce service level agreements with service providers;
- Introduce efficient and paperless catering equipment tracing and tracking.

Of course, additional RFID readers/writers may be operated at various locations within a facility in order to capture further information about catering equipment at various steps along the process, such as whether or not catering equipment has gone through a wash bay, whether or not catering equipment has been stored in a chiller, etc. The decision to proceed with such additional operations will depend on the outcome of detailed cost / benefit analysis for each facility.

The scope of these specifications only requires writing to the RFID tag for the purpose of encoding the unique identification number once. Consequently, RFID readers could be operated at most locations, with a limited number of RFID readers/writers for RFID tag encoding. However, a larger capacity RFID tag could be used to store additional data, such as flight number, stowage ID, etc. In this case, RFID readers/writers would be required at several or all locations in order to regularly write on the RFID tag. The decision to proceed with such additional functionality will depend on the outcome of detailed cost / benefit analysis conducted by community members. Within the specifications herein, the term RFID reader/writer is used to mean either RFID reader or RFID reader/writer.

3. RFID SYSTEM

A RFID system consists of three basic elements:

3.1 The RFID tags;

3.2 The RFID readers/writers;

3.3 The management information system.

A RFID system enables:

- Use of a unique identification number for each catering equipment unit.
- Automatic data collection for asset management, accountability and security purposes, as well as other inflight processes, as appropriate.
- Reading/writing without line of sight.
- The data capacity of RFID technology enables:
    - The addition of process critical data elements to the tag for immediate reference, subject to the appropriate system support.
    - Data error detection, subject to the appropriate system support.
- A RFID tag is less susceptible than bar code or other optical identification techniques to disruption due to process activities such as cleaning and damage through handling.
- Potential for higher speed throughput at read/write locations.

4. RFID SYSTEM REQUIREMENTS

The RFID system must meet the following requirements:

4.1 Allow the automated transfer of data from the catering equipment unit's RFID tag to a data processing system by radio frequency transmission, and vice versa.

4.2 An air interface protocol in accordance with ISO/IEC 18000-6 Type C (for 860 to 960 MHz), with data encoded in memory banks 01 and 11 according to specifications herein.

4.3 Conformance testing of the RFID system in accordance with ISO/IEC 18047-6.

4.4 Be able to correctly differentiate between at least 12 RFID tags within a 2m radius.

4.5 Where applicable, be capable of determining the direction of travel of a catering equipment unit through the RFID reader's radiation field.

4.6 The components of the RFID system must be configured to achieve the highest measured reliability, taking into account the physical constraints of the airport and radio regulations. Performance must be measured in accordance with ISO/IEC 18046.

4.7 In a controlled test environment the read/write rate of the chip and antenna should be 99.7% or better.

4.8 In operational conditions the read/write rate of the chip and antenna should be 99.5% or better.

4.9 The components of the RFID system must be configured to allow reading from, and where applicable writing to, RFID tags programmed at any frequency within the range specified under item 4.3, while achieving read rates close to those specified under items 4.7 and 4.8.

4.10 Allow the automated transfer of information to and from a management information system, using airline accepted industry protocols and the information structure specified herein.

4.11 Be able to operate with both fixed and hand-held devices.

4.12 Be able to operate with multiple use RFID tags.

4.13 Not interfere with or be affected by any existing RFID system.

4.14 Not interfere with any existing application.

4.15 Not interfere with or be affected by other electronic equipment.

4.16 Not affected by other electrical equipment and/or radio emissions which can occur on the RFID system operating frequencies normally found in the airline industry.

4.17 Be capable of future enhancement to meet changing requirements, provided that previously installed RFID read/write equipment can still be utilised.

4.18 When installed or operated in a particular country, the RFID system must comply with all international, national and local governmental health, safety, aeronautical and radio regulations, and any other governmental rules and regulations which may apply, including those regarding human exposure levels and medical implants.

4.19 Address airline data privacy and security issues.

5. RFID TAG REQUIREMENTS

The RFID tag must meet the following requirements:

5.1 Capability of being quickly and easily encoded with the unique identification number assigned to each catering equipment unit.

5.2 Capability of retaining stored data and responding to a RFID reader/writer.

5.3 Capability of maintaining the integrity of stored data.

5.4 Capability of being read from and written to without error during the expected life of catering equipment (i.e. 10 years of normal operation).

5.5 Capability of being integrated into, or quickly and easily mounted on, catering equipment, while maintaining the unit's structural integrity and while protecting the RFID tag from damage.

5.5.1 In the case of trolleys, one RFID tag mounted externally on or integrated into the base, without interfering with wheel and break operations.

5.5.2 In the case of boxes, one RFID tag mounted externally on or integrated into the door in the handle recess, without interfering with handle operation.

5.6 Be small enough to be mounted on the base of each trolley and/or on the door in the handle recess of each box.

5.7 RFID tags deployed do not have to be human readable. However, as a minimum, a human readable label must be used to display the Equipment Operator and the Equipment Number (refer to 10.2.1.1 and 10.2.1.2).

6. RFID READER/WRITER REQUIREMENTS

The RFID reader/writer must meet the following requirements:

6.1 Be capable of reading from, and where applicable writing to, RFID tags attached on metal.

6.2 Be capable of being configured for fixed and hand-held devices.

6.3 Be robust to anti-collision between RFID readers/writers.

6.4 Be capable of reading from. and where applicable writing to, RFID tags at distances from 2cm to 2m.

6.5 Be capable of reading from, and where applicable writing to, each RFID tag, while being able to correctly differentiate between at least 12 RFID tags within a 2m radius.

6.6 Be capable of being integrated into a computer network, either wired or wireless.

6.7 Allow the automated transfer of information to and from the data processing system, using airline accepted industry protocols and the information structure specified herein.

6.8 Hand-held devices should incorporate keypads or other data entry capabilities that facilitate manual entries, in case of fixed device failure and to enter flight number, stowage ID, etc.

6.9 Be capable of safe operation in and around stationary aircraft, in proximity to moving aircraft and in other airport areas.

6.10 Be capable of reprogramming an RFID tag when required.

6.11 Battery powered devices must be capable of indicating low battery condition with one hour duty cycle remaining. Batteries must be capable of easy replacement and accepting a quick charge or long charge cycle as conditions demand. Additionally, battery powered devices must be capable of maintaining memory during low battery status and during change of a battery pack.

7. RFID TAG CHARACTERISTICS AND SPECIFICATIONS

7.1 General

7.1.1 The RFID tag must be UHF Class 1 Generation 2 with a minimum of 96 bits.

7.1.2 The RFID tag must scatter a field that enables omnidirectional reading in order to allow readability from not only the front position but the sides as well.

7.1.3 The RFID tag must meet IEC 60529 IP69K, in order to protect the antenna from damage. (For RFID systems used on board aircraft, refer to 12.2).

7.1.4 The RFID tag must be multiple use and designed to function properly during the expected life of catering equipment.

7.2 Environmental

7.2.1 The RFID tag must function properly in all of the environmental conditions encountered in an airline operational environment.

7.2.2 The RFID tag must be capable of resisting temperature ranges of –40ºC to +110ºC, humidity ranges of up to 99% and changes in atmospheric pressure, as well as be water and chemical (cleaning products) resistant.

7.2.3 The RFID tag must meet standard IEC 60068-2 (Mil Std 810E Method 516.4 Procedure I); 30g for 11 milliseconds, half sine pulse (Mechanical Shock).

7.2.4 The RFID tag must meet standard IEC 60068-2 (Mil Std 810E Method 514.4, Category 5, Procedure III) (Random Vibration).

7.2.5 When disposing of RFID tags, environmental regulations related to RFID tag disposal must be followed, if applicable.

7.3 Electromagnetic Compatibility and Nuclear Radiation Environment

7.3.1 The RFID tag must function properly and maintain the integrity of its stored data in the electro-magnetic environment of air traffic; e.g. in a maximum peak field strength of 200V/m peak exposure level test for 1300MHz and 2800MHz to simulate airport radar exposures.

7.3.2 The RFID tag must function properly and maintain the integrity of its stored data after being exposed to cosmic radiation during flights, for example having received a maximum exposure to thermal neutron bombardment from an 80mC Am241/Be source or its equivalent.

8. RFID READER/WRITER CHARACTERISTICS AND SPECIFICATIONS

8.1 General

8.1.1 Be able to read a RFID tag as it passes through a radiation field with the RFID tag mounted on catering equipment as specified under item 5.5.

8.1.2 Be capable of reading RFID tags with catering equipment passing through at conventional speeds.

8.1.3 Be able to correlate data received from RFID tags unambiguously to the related catering equipment unit. Optionally be capable of writing to multiple or individual RFID tags, while correlating the sent data unambiguously to the related catering equipment unit and while allowing normal operations to proceed.

8.1.4 Provide data in the required format to and from data processing systems.

8.1.5 RFID readers/writers located in close proximity to one other must not interfere with each other.

8.1.6 RFID readers/writers must send an application identifier as part of the powering or wake-up signal.

8.2 Environmental

8.2.1 All fixed and hand-held devices must be capable of operating in temperature ranges of -20ºC to +50ºC, humidity ranges of up to 99%, and be water and chemical (cleaning products) resistant. Certain site specific conditions may require higher or lower operating temperature ranges and environmental characteristics.

8.2.2 Hand-held devices must function correctly after a drop shock test IEC 60068-2 (Mil Std 810E Method 516.4, Procedure II); Height 1.5 meters to concrete.

8.2.3 Hand-held devices used outdoor must be rated NEMA 250 Type 4 or equivalent.

9. OPEN ARCHITECTURE

9.1 In order to meet international standards according to section 4 and the information structure of section 11, RFID readers/writers must be based on open architecture RFID standards, such that any manufacturer's RFID tags are read and/or written to by any other manufacturer's reader/writer; and that any one manufacturer's reading/writing equipment may read and/or write any other manufacturer's RFID tags.

9.2 In compliance with the ISO Patent Policy, if the protocols and/or technologies contained in the relevant standards are not in the public domain, the proprietor should license them throughout the world on reasonable and non-discriminatory terms and conditions.

10. ENCODING THE RFID TAG

10.1 Basic Encoding Rules

10.1.1 Data must be written to, and read from, the RFID tag using rules defined in ISO/IEC 15961. This allows airlines complete flexibility in selecting from the present set of data elements, and for supporting new data elements should these be added at a future date.

10.1.2 The encoded byte stream on the RFID tag must be encoded according to the rules of ISO/IEC 15962. These rules are implemented automatically through a system that has both ISO/IEC 15961 and 15962 as part of the complete data protocol.

10.2 ISO/IEC 15961 Related Features

10.2.1 Object Identifier

ISO/IEC 15961 requires that an object identifier structure be used to uniquely identify each type of data encoded on an RFID tag. An object identifier structure has been requested on behalf of the industry by IATA: 1 0 15961 nn

The final component of the object identifier is as defined in table 1 below. For most object identifiers, only the final component will need to be encoded.

10.2.1.1 Equipment Operator

Object ID 1 0 15961 nn 1

This element is **mandatory**.
It represents the airline that operates the catering equipment, based on the ICAO airline code.

Format is 3 characters, e.g. BAW for British Airways.

10.2.1.2 Equipment Number

Object ID 1 0 15961 nn 2

This element is **mandatory**.
It represents uniquely an airline catering equipment unit.
For example, major airlines can operate with up to 50,000 trolleys.

Format is 6 digits, e.g. up to 999,999 single catering equipment units.
For example:
000001 represents the first catering equipment unit registered with an RFID tag attached,
000002 represents the second catering equipment unit registered with an RFID tag attached.

10.2.1.3 Equipment Manufacturer Serial Number

Object ID 1 0 15961 nn 3

This element is **optional**.
It gives the equipment manufacturer serial number for each catering equipment unit.

Format is up to 20 characters but will require a 256 bits RFID tag instead of 96 bits.

Table 1: Object Identifiers & Data Elements

Object Identifier	Object	Mandatory	Status	Memory Bank	Decoded Data Characters
1 0 15961 nn 1	Equipment Operator	Y	OTP	01	3 characters
1 0 15961 nn 2	Equipment Number	Y	OTP	01	6 digits
1 0 15961 nn 3	Equipment Manufacturer Serial Number	N	OTP	11	Up to 20 characters

Equipment Operator (3 characters): ICAO airline code (e.g. BAW for British Airways and so forth).
Equipment Number (6 digits): each catering equipment unit is uniquely identified by using a unique identification number.

This Object Identifier must be written once in a memory block and be locked using a password so only the Equipment Operator can remove or change this unique identification number.

11. INFORMATION STRUCTURE

As per item 9, RFID systems installed worldwide must allow for any manufacturer's RFID tags to be read and/or written to by any other manufacturer's reader/writer; and for any one manufacturer's reading/writing equipment to read and/or write any other manufacturer's RFID tags.

Further, installed RFID systems worldwide must allow for sharing of basic information amongst all stakeholders.

For each recorded event, the information structure of the Management Information System, must therefore, as a minimum, include the items below.

Date: dd/mm/yyyy
Time: hh:mm:ss UTC 24-hour clock
Unique ID: Object Identifier + Equipment Operator + Equipment Number
Status Code:
S – Serviceable or
U – Unserviceable or
C – Condemned
Previous Location:
IATA Airport Code / Name of facility / Inbound or Outbound
(3 characters) (up to 20 characters) (In or Out)
New Location:
IATA Airport Code / Name of facility / Inbound or Outbound
(3 characters) (up to 20 characters) (In or Out)

Of course, other information may be captured as part of the process, such as
Flight Number: IATA Airline Code (2 characters) / Flight Number (4 digits)
Scheduled Departure Time: dd/mm/yyyy hh:mm:ss UTC 24-hour clock
Estimated Departure Time: dd/mm/yyyy hh:mm:ss UTC 24-hour clock
Actual Departure Time: dd/mm/yyyy hh:mm:ss UTC 24-hour clock
Scheduled Arrival Time: dd/mm/yyyy hh:mm:ss UTC 24-hour clock
Estimated Arrival Time: dd/mm/yyyy hh:mm:ss UTC 24-hour clock
Actual Arrival Time: dd/mm/yyyy hh:mm:ss UTC 24-hour clock
Destination Airport: IATA Airport Code (3 characters)
Stowage ID: No standard exists
Status Code: W – Washed ; F – Full ; …
etc.
The decision to capture such information will depend on the outcome of detailed cost / benefit analysis conducted by community members.

A more detailed information structure will be found in supplemental IOM 6011 - Radio Frequency Identification (RFID) Specifications for Inflight Catering Equipment Management – Information Structure.

12. CONSIDERATIONS

12.1 The RFID tag is to be mounted on or integrated into the unit, and meet IEC 60529 IP69K, to withstand normal handling for the life of the unit. Due to the harsh industrial washing processes, physical attachment to the unit (i.e. screwed or riveted) should be preferred over using glues or silicones.

12.2 The RFID tag should also meet standard RTCA DO-160 if the intent is to eventually use RFID systems on board aircraft.

12.3 Unless hand-held RFID devices can be designed to allow reading/writing without excessive bending and stretching for the employee, it may be necessary to use a human readable bar coded label integrating the Equipment Operator and the Equipment Number (refer to 10.2.1.1 and 10.2.1.2). This would imply location of the bar coded label on catering equipment where line of sight can be achieved without excessive bending and stretching for the employee, and use of hand-held devices combining RFID and bar code technology.

12.4 Checking of chip functionality and encoding at installation should be finished before fixation to the unit so that void RFID tags are not installed on units.

12.5 Checking of chip functionality should also be carried out after installation to ensure the RFID tag was not damaged during installation.

12.6 Unless global regulatory acceptance/approval of RFID tags as specified herein is achieved, approval from the relevant authorities (civil aviation authority, aircraft manufacturer, catering equipment supplier) must be obtained to mount RFID tags on catering equipment.

12.7 Situations may arise whereby a third party (e.g. a caterer) leases the same inflight catering equipment to several airlines. In such cases, a special three-character code that will not conflict with ICAO codes (to be determined by the community) should replace the Equipment Operator within the unique identification number.

12.8 Should there be a change in equipment operator, RFID tags would have to be re-encoded or replaced.

12.9 Should an RFID tag break or become defective, it should be replaced and the new RFID tag should be encoded with the same unique ID and attached to the same unit.

12.10 Successful tests have been conducted reading RFID tags as they pass through a radiation field in the floor plane, nominally 1.5 m x 0.5 m parallel to the flow of a trolley, with the RFID tag mounted on the base of each trolley or the RFID tag mounted on the door in the handle recess of each box. However, this does not preclude other antenna configurations from being used, as long as achieved read rates are close to those specified under items 4.7 and 4.8.

12.11 Tests conducted on boxes required the use of a cage, piling up 4 boxes on top of each other, in order to efficiently transport boxes while achieving read rates close to those specified under items 4.7 and 4.8.

12.12 RFID readers should be capable of giving a read/no-read indication. RFID readers should contain audio and visual signals capable of alerting personnel when an error has been identified.

12.13 The read/write rate of the chip and antenna specified under item 4.8 may not be sufficient to ensure adequate management of inflight catering equipment and consideration should be given to maximising read/write performance for each specific installation.

12.14 Further, means of ensuring that all inflight catering equipment entering or leaving a facility pass through a gate should be considered. Otherwise, by-passing of the gates will create serious data integrity issues.

12.15 RFID readers/writers should be protected from damage caused by catering equipment banging into them.

12.16 The RFID system should not require major modification of building structure or mechanical and electrical services due to either physical or RFID interference, including all catering facilities.

12.17 RFID systems should be manufactured, deployed and used at a cost that will encourage adoption by the airline industry.

12.18 The upgrade path within RFID should allow for the use of increased RFID tag memory size as the technology and price permits.

12.19 Note that the People's Republic of China offers two ranges, one using frequencies that are lower than 860 MHz. This particular range should not be used in this context.

12.20 Writing data on the RFID tag, other than the encoding of the unique identification number, may raise data authenticity, accuracy, synchronisation and protection issues that would need to be resolved.

13. REFERENCES

IATA's Inflight Services Private Site contains additional information on RFID for Inflight Services.

To access the Inflight Services Private Site, you must first be a Registered User. To resister, please go to:
http://www.iata.org/whatwedo/aircraft_operations/inflight/index.htm
Click on Registration (external users only). Follow instructions.

Once registered to access the site, go to
http://www.iata.org/whatwedo/aircraft_operations/inflight/index.htm
Click on Login (external users).
Enter your Username and Password. Navigate the site.

If you have forgotten your Password, click on <reset password> and follow instructions. An email will be automatically sent to you with a new Password.

External standards documents referred to in these specifications are:

IEC (International Electrotechnical Commission), 3, rue de Varembé, P.O. Box 131, CH-1211 Geneva 20, Switzerland, Telephone: +41 (22) 919 02 16 or 02 11, Facsimile: +41 (22) 919 03 00 or via e-mail at inmail@iec.ch

ISO (International Organization for Standardization), 1 rue de Varembé, P.O. Box 56, CH-1211 Geneva 20, Switzerland, Telephone: +41 (22) 749 01 11, Facsimile: +41 (22) 733 34 30 or visit the ISO web-site at http://www.iso.org

NEMA (National Electrical Manufacturers Association), 17th Street, Suite 1847, Rosslyn, VA, 22209, USA Telephone: +1 (703) 841-3200, Facsimile: +1 (703) 841-5900 or via e-mail at webmaster@nema.org

RTCA (Radio Technical Commission for Aeronautics), 1828 L Street NW, Suite 805, Washington, DC, 20036, USA Telephone: +1 (202) 833 9339, Facsimile: +1 (202) 833 9434 or via email at info@rtca.org

ISO/IEC 18000-6 Type C *Information technology -- Radio frequency identification for item management -- Part 6: Parameters for air interface communications at 860 MHz to 960 MHz -- Type C: Identical to EPCglobal's UHF Gen 2 specification.*
This standard defines:

- Anti-collision algorithm that enables one tag to be selected from many tags
- Modulation of the radio signal
- Bit encoding rules across the air interface
- Air interface commands and responses
- Some tag structuring features

ISO/IEC TR 18047-6 ***Information technology -- Radio frequency identification device conformance test methods -- Part 6: Test methods for air interface communications at 860 MHz to 960 MHz.***
This standard defines test methods for determining the conformance of radio frequency identification devices (tags and interrogators) for item management with the specifications given in ISO/IEC 18000-6.

ISO/IEC 18046 ***Information technology -- Automatic Identification and data capture techniques -- Radio frequency identification device performance test methods.***
This standard defines test methods for performance characteristics of radio frequency identification devices (tags and interrogators) for item management, and specifies the general requirements and test requirements for tag and interrogator performance which are applicable to the selection of the devices for an application.

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

- provides guidelines on how data shall be presented as objects
- defines the structure of object identifiers, based on ISO/IEC 9834-1
- defines access and formatting features such as the application family identifier, and data format
- specifies commands and responses that support the transfer data between the application and the tag

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

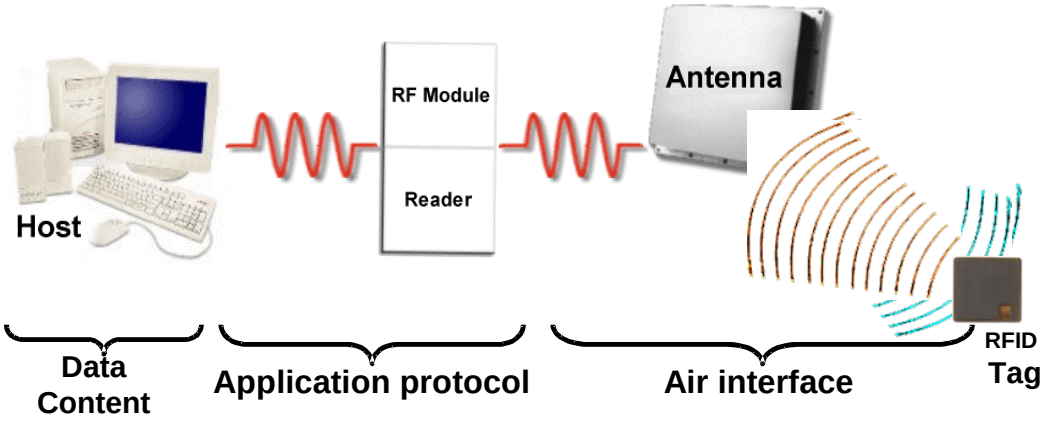
- defines the encoded structure of object identifiers
- specifies the data compaction rules that apply to the encoded data
- specifies a precursor for encoding syntax features efficiently
- specifies formatting rules for the data, e.g. depending on whether a directory is used or not
- defines how application commands, e.g. to lock data, are transferred to the tag driver

RTCA DO-160 ***Environmental Conditions and Test Procedures for Airborne Equipment.***
This standard provides standard procedures and environmental test criteria for testing airborne equipment.

IEC 60529 defines the degree of protection of the enclosure housing demonstrated using standardized test methods.
IEC 60068-2 defines various environmental testing.
NEMA 250 defines the type of enclosures for electrical equipment (1000 Volts maximum) in non-hazardous locations.

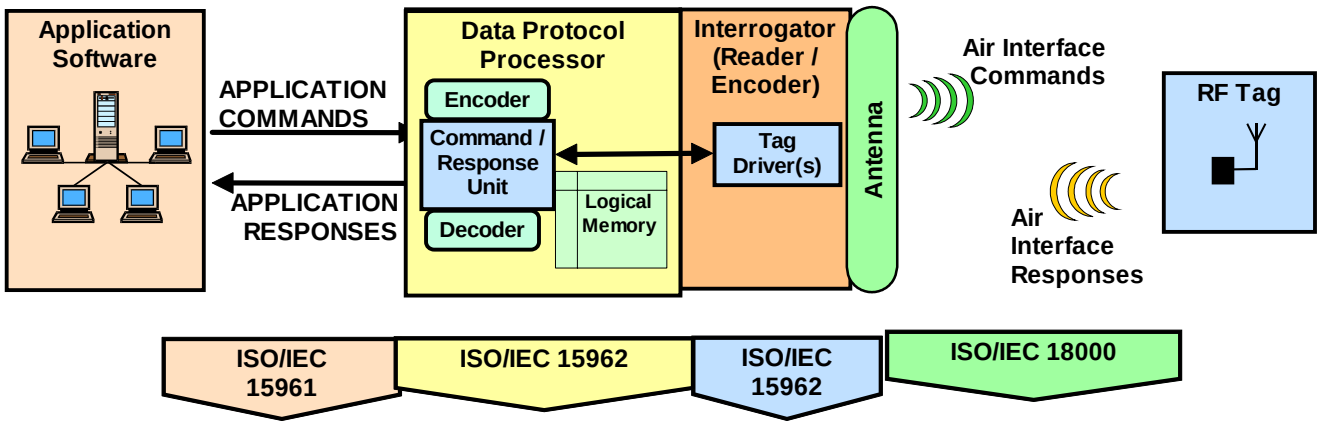
14. ISO RFID DATA PROTOCOL

A generic RFID system in shown below:



The object identifiers in section 10 of this document define the data content. ISO / IEC 15961 and 15962 define the application protocol and ISO / IEC 18000-6 Type C defines the air interface.

The general system is shown below:



The purpose of these ISO elements is as follows:

ISO/IEC 15961 Application interface

- Supports various commands: read, write, amend, append, inventory
- Defines data in a manner understood by the application
- Can encode **any** data because of use of object identifiers

ISO/IEC 15962 Data encoding rules

- Compacts data for efficient encoding
- Formats and locks data on the tag
- Supports communication with many tags i.e. supports anti-collision
- Can support many tag formats and air interface protocols

The ISO/IEC 18000-6 Type C defines how the tag interacts with the reader.