The present invention relates to authentication and identification of articles. It also relates to the tracking in a supply chain of an article or to the authentication of an article. In a very specific, but not limiting application, the invention has been developed for meat and other food products and will be described hereinafter with reference to that application. However, the invention is not limited to that use only, and is also suitable for use other products, whether including organic or non-organic material, such as packaged human and animal blood products, food products and other than meat products, wine and other beverages, organic products other than food products, medical devices, and the like. The present invention enables tags to be interrogated in close proximity to each other.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
AN ARTICLE SUPPLY CHAIN AND/OR AUTHENTICATION, MONITORING, TRACKING AND IDENTIFICATION SYSTEM, METHOD AND DEVICE

FIELD OF THE INVENTION

The present invention relates to authentication and identification of articles. In one form, the present invention relates to the tracking in the supply chain of an article.

In another form, the present invention relates to the authentication of an article.

In a very specific, but not limiting application, the invention has been developed for meat and other food products and will be described hereinafter with reference to that application. However, the invention is not limited to that use only, and is also suitable for use other products, whether including organic or non-organic material, such as packaged human and animal blood products, food products other than meat products, wine and other beverages, organic products other than food products, medical devices, and the like.

BACKGROUND

The inventors have identified a need to label and provide traceability of all animals and meat products through the food supply chain. Furthermore, the inventors have identified that not only is there a need to label the individual animal but also that there is a need to label individual cuts of meat in a manner that the whole of the meat food supply chain can be monitored, tracked and authenticated.

Disease is very costly to the meat product industry. Billions of dollars were lost in the UK when BSE caused the culling of the entire cattle stock on infected farms and BSE has now appeared in the USA and Canada. Other animals are also susceptible to disease. Scraps in sheep and swine flu in pigs are also very damaging to the meat food industry and to consumer confidence.

Producers and consumers of meat are very concerned that the meat food supply chain not be degraded by the introduction of meat from diseased animals and also that inferior quality meat is not substituted for meat of a better quality.

Furthermore, it is difficult to track quality of food products such as meat. For example, information regarding expiry dates is currently only visually
discernible, and information regarding the environmental conditions to which the food has been exposed is not readily discernible. Thus food may be delivered to the customer not in optimal condition. This reflects poorly on the producer of the food, even though the producer has had little control over the conditions imposed on the food.

The present labelling system is considered inadequate as it does not, and cannot, identify and track the individual cut of meat once it enters the food supply chain.

In view of these concerns about quality, disease, and the proper attribution and authentication of supply, the major importing countries are all now in the process of implementing legislation concerning the import and export of meat. For example, legislation which in the USA came into force on 31 December 2003 requires the origin of all foods imported into the US to be fully documented. For the meat industry the documentation must be able to show the complete audit trail history of the meat. The EU is presently debating legislation similar to that of the USA.

At this time the legislation does not appear to be strictly enforced as it is accepted that a suitable technology solution has yet to be found.

Currently, most animals are labelled, but only with a visual ear tag. This is a coloured tag with a number. The individual cuts of meat are not labelled except at the final point of sale and even there they are usually only labelled with a bar code label. Bar code labels are read only labels. They can be read only one at time and they must have a visual line of sight between the label and reader. New information cannot be added to a bar code label once it is printed and there is usually no audit trail or ability to track, trace and authenticate. Bar code labels cannot be read in a 'stack' or inside a box of meat and thus do not meet the new requirements.

When individual cuts of meat are prepared at the abattoir they are placed inside cardboard cartons which can contain over 100 separate, different and individually labelled cuts of meat. These cuts of meat are randomly packed in all orientations inside the carton so that labels are in all positions and often overlap and touch exactly. The entire carton is then deep frozen so that, for all practical
purposes, it is a solid and frozen slab. The inventors have therefore realised that the system adopted must have the ability to read labels attached to multiple closely stacked articles, frozen solid and positioned in a completely random fashion. The inventors have also realised that the system must be able to read and write, quickly to many hundreds of separate labels at once and must also have sufficient memory capacity and functionality to provide ample room for data, for security, and for an on-board audit trail. The system must be internationally acceptable, multiple sourced, and the cost must be relatively low for the labels to be disposable.

It is known to use Radio Frequency Identification (RFID) tags in a variety of applications to assist with the identification of discrete articles. Examples of such applications include:

- Attaching tags to separate respective items of airline luggage to assist in the sorting and handling of that luggage.
- Attaching tags to pallets to facilitate identification of the pallet by a forklift operator. (See US patent application 09/992,711 in the name of Cybulski et al).
- Attaching tags to separate pieces of an animal carcass. (See US patent 6,545,604 in the name of Dando et al).

The tags typically include a substrate, chipset disposed on the substrate, and an antenna that extends across the substrate and which is connected to the chipset. When a tag is placed within an appropriate interrogating field – that is generated by as separate interrogator – the signal received by the antenna is fed to the chipset for processing. In response, the chipset generates an identification signal that is radiated by the antenna and detected by the interrogator. The identification signal includes data indicative of a sufficiently unique identity to allow the tag to be distinguished from other tags of that type. In those circumstances where the tags are respectively mounted to, say, pieces of luggage, the correct identification of the tags allows for the identification of the pieces of luggage. The chipset typically includes a processor, memory for use by the processor, and power supply circuitry. Both active and passive RFID tags are available. Active tags include an onboard energy storage source – such as a
battery – that, once exhausted, renders the tag inoperable. Passive tags – while also including energy storage devices such as capacitors – obtain and store enough energy from the interrogating field to allow the desire tag operations to be performed.

However, the inventors have further realised:

- that other RFID systems use time division simplex communication protocols to resolve the question of multiple tag replies clashing with each other. Because of this other RFID communication protocols can only read multiple tags, in a relatively static situation, very slowly, one at a time provided there are only five or ten tags present at a time. Examples of such limited technology are found in ISO 15693,

- that current RFID label and tags manufacturers use tuned antennas on the label to achieve range with unshielded readers and the labels cannot work when stacked because the tuned antennas do not work in proximity to each other,

- Single axis readers such as Panel readers can only read tags when the tags are presented to the panel reader in the same orientation as the reader itself. Single axis readers are not considered reliable readers of tags,

- Cartons of meat travel on conveyor belts at speed from 1-2m and up to 5m a second. The carton of meat is inside the reader for only a second at best,

- most other RFID labels have only a small memory is because their communication protocol and their bit rate is so slow that they cannot use a large memory as they do not have enough time to communicate with such larger memory,

- the higher RF frequencies in the 900 MHz and 2.45 GHz bands are known to lose energy by absorption if they encounter liquid or products with a high moisture content. (Typically problematical are cooking oils, shampoos, fruits and vegetables, ice cream, drinks, frozen foods, dairy products etc.) The lower RF frequencies 132 kHz require multi turn copper wire coil antennas in order to gather sufficient operating power,
the operation of unsafe and unlicensed RF emitters is illegal and opens the
user of unsafe systems to both legal liability and industrial action, and

- the cattle ranch, the cattle crush, meat packing plants and supermarket
  freezers are very hard and tough environments in which readers and tags
  must continue to function.

In prior art applications of RFID technology, it has been necessary to
maintain separate tags at relatively large distances apart when being interrogated
to prevent coupling between the tags. Where this coupling occurs it has the
effect of cancelling the interrogating field and thereby rendering the tags deficient.
The reduction in the strength of the interrogating field dramatically reduces the
amount of energy available to be obtained by each tag from the field. This limits
the amount of energy that is available for a given tag to undertake the required
processing of the interrogation signal and to generate an identification signal.
Even in the event that an identification signal is generated, the coupling between
the tags will also have the corresponding effect of cancelling the strength of that
identification signal.

The inability to consistently, reliably, and economically solve the spatial
resolution problems of the above prior art have limited the application of those
RFID tags to large items notwithstanding the considerable postulation that has
gone into the possibilities should those limitations be overcome.
The inventors have realised that RFID tags have been developed that are
based upon an un-tuned antenna design that is effective for reducing the
interference effects referred to above. Tags of this kind are described in PCT
application PCT/AU03/01072, the disclosure of which is incorporated herein by
way of cross reference.

Any discussion of documents, devices, acts or knowledge in this
specification is included to explain the context of the invention. It should not be
taken as an admission that any of the material forms a part of the prior art base or
the common general knowledge in the relevant art in Australia or elsewhere on or
before the priority date of the disclosure and claims herein.
An object of the present invention is to an improved method, system and/or device for authentication, monitoring, tagging, tracking, interrogating and/or identification of articles.

A further object of the present invention is to alleviate at least one disadvantage associated with the prior art.

SUMMARY OF THE INVENTION

The present invention provides, in one aspect, in an article management system, a method, device and/or system of enabling at least two tags to be read within relatively close proximity of each other, the method including the step of configuring each tag in accordance with any one or a combination of the following criteria:

- Periodically controlling tag antenna current to substantially reduce or eliminate current in the tag antenna, and/or
- Switching the tag between active and inactive states.

Preferably, if two tags are interrogated simultaneously and/or have interfered with each other, ignoring that interrogation event.

Preferably, the antenna current is reduced by at least 50%.

The invention has been found useful in un-tuned antennas, but may also be applied to tuned antennas.

Preferably, the proximity is less than 20 cm, preferably less than 1 cm, and more preferably less than 1 mm.

Preferably, the tags are tags as disclosed in PCT/AU03/01072.

The present invention further provides, in a second aspect of invention, a radio frequency identification (RFID) system and method for a plurality of articles, the system including:

- at least one interrogator for providing an interrogation field; and
- a plurality of RFID tags that are associated with respective articles and which are selectively responsive, when disposed within the field, for providing respective identification signals indicative of one or more characteristics of the respective articles, each tag including memory for selectively storing control data derived from the interrogation field.
The present invention further provides, in a third aspect of invention, a radio frequency identification (RFID) tag adapted to be associated with an article having at least one organic component, the tag including:

- a substrate that is mounted to the article and which is substantially impermeable to the organic component, the substrate having a first face that is opposed to the article and a second face that is opposite the first face;
- a processor circuit that is mounted to second face and which is responsive to an external wireless interrogation signal for providing a wireless identification signal indicative of one or more characteristics of the article.

In one form, the article is a piece or package of meat.

The present invention further provides, in a fourth aspect of invention, a package for an article, the package including a plurality of interconnected sidewalls for collectively defining a cavity in which the article is, in use, disposed, wherein at least part of one of the sidewalls includes a wireless tag that is responsive to an interrogation field for providing an identification signal.

The article may have a frozen exterior layer.

The present invention further provides, in a fifth aspect of invention, a storage unit having a storage volume for containing a plurality of articles each having a radio frequency identification (RFID) tag, the storage unit including:

- a base;
- at least one support structure that is mounted to the base for defining the storage volume and supporting the articles within that volume; and
- a radiating element that is mounted to one or more of the base and the at least one support structure for generating an interrogating field within the storage volume and for receiving, in response, one or more identification signals from the tags.

Other aspects and preferred aspects are disclosed in the specification and/or defined in the appended claims, forming a part of the description of the invention.

In essence, the present invention is based on the realisation that the use of closely stackable RFID tags, in association with various interrogator apparatus and tracking software and/or article management software and systems, can
provide not only an improved method, system and/or device for identification of articles which has many advantages over the prior art but a substantially complete solution in terms of authentication, reporting, monitoring, tagging, tracking, interrogating and/or identification of articles. The inventors have realised that there is a manageable relationship between tag separation (distance), the number of turns of an antenna on a tag, and current drawn. By controlling the current drawn, the impugning field created by the current of a first tag's antenna on a second tag's (adjacent or closely associated) antenna can be controlled in a manageable way, and thus, the 'normal' prior art inference which would otherwise be exhibited between two or more proximate tags can be reduced. This enables two or more tags to be associated in proximity to each other.

In a preferred embodiment, the RFID tags and related devices include those as disclosed in PCT/AU03/01072, Australian Provisional patent application number 2002950973, filed 22nd August 2002, Australian Provisional patent application number 2004901683, filed 29 March 2004 and Australian Provisional patent application number 2004903107, filed 9 June 2004, the disclosure of each of which is incorporated herein by reference. The tags use 'stackable technology', such as an un-tuned antenna design (in one embodiment only) with antenna current management which has been found to reduce interference effects, and thus has been found to be suitable in a document management system where documents are likely to be relatively closely stacked or held.

In a practical sense, what makes the shift to RFID (Radio Frequency IDentification) compelling is that, for example in application to meat, each carcass (one ear tag) is converted in the abattoir, into potentially many hundreds of individual cuts of meat. Only a highly functional, cost effective, RFID label can reliably track, trace and authenticate these many millions of cuts of meat. This requirement creates a new and very large requirement for (disposable) RFID labels.

As soon as RFID labels are accepted into the food supply chain downstream of the actual farm or paddock, then there will be new pressures and business reasons to also standardize (upstream) on the same RFID system for
ear tags. In accordance with the technology disclosed herein systems are designed to read and/or write to a population of multiple dynamic tags on, for example, a conveyor belt. The new standard ISO 18000-3 Mode 2 is a brand new ISO communication protocol and is due for publication early in 2004. The present technology is adapted to meet this new protocol. The protocol uses frequency hopping technology to handle the anti collision requirement. The term for this is Frequency and Time Division Multiple Access (FTDMA).

The present technology uses untuned (or tuned) antennae on its RFID labels together with unique and proprietary power control circuitry. This overcomes the limitation of RFID labels which use tuned antennas and which cannot work when stacked. Thus where individual cuts of meat are randomly packed in all orientations inside the carton, the tags or labels can present themselves to readers in all positions and they can often overlap and touch. The present technology preferably uses a command data rate of 424 kbit/s and a reply data rate of 106 kbit/s. The reply data rate is transmitted on each of 8 different channels. This means that the effective reply data rate can be as high as 848 kbit/s. This is in contrast to all other RFID technologies which are limited to 40 kbit/s in the best of circumstances and can be as low as 1.6 kbit/s in Europe due to regulatory issues.

The chosen operating frequency is adapted to convey relatively safely enough energy to permit RFID labels to operate reliably even when immersed in water or embedded in slabs of ice. In this regard, the frequency of choice is 13.56 MHz. It has been found that this frequency has advantages in being in an ISM band and therefore useable worldwide; of being able to be used with a relatively thin low cost foil antenna; and of being able to penetrate into blocks of ice relatively safely and without the need for unacceptable radiated power levels.

Furthermore, the present technology may be used throughout the meat food supply chain from the farm to the supermarket. In this regard, two types of tag may be provided,

1) a Tag which is used on farm animals because the requirement is for a longer range, and
2) a tag which is operational in relatively close proximity to other tags because of the requirement to read stacked meat products. The present invention has been found to result in a number of advantages, such as:

5 • Enabling the labelling or tagging and the remote identification of closely stacked articles by the use of tags within a management and tracking and tracing system,

• Information such as the actual present location of the article, date and time when the article was last issued, returned, transferred, loaned/borrowed/taken possession of and any other relevant data can be stored in the RFID tag,

• The tag acts as a distributed data base thus avoiding the need for constant access to look up tables and the consequent communication cost and time penalties,

15 • Closely stacked articles can be read from and written to,

• Articles can be made individually accountable and/or be controlled as such,

• No line of sight is required as communication and detection is via Radio Frequency which can communicate through a stack of articles,

20 • article information, such as who is the last person to have had contact with the article or past environmental impact on the article, can be stored in RFID labels associated with the article,

• Electronic files associated with the article may also be stored in the RFID tag,

25 • Key reference phrases pertaining to the article may be stored on the tag to facilitate searching through the tags electronically,

• The article and tag information may be linked, joined and/or interfaced with a knowledge management system, accounting system, office management system, and/or be available at various locations via Internet, Intranet and/or server,
The article can be tracked and traced by a series of 'in' and 'out' trays, all linked together on a LAN such that the present location of any article is made available or is visible to all persons connected to the LAN.

The ability to read and write, track and trace, authenticate and control one or even many hundreds of relatively closely stacked articles.

The invention uses 'stackable tag' technology, and as part of a complete system of tags, readers and the associated local and wide area networks, it can provide 'visibility' over any or all articles in the system at the various reading points in the system, and

The invention can function with tags that are either closely stacked or spaced some distance apart.

Throughout the specification, reference to an 'article' includes reference to one or more articles. Furthermore, reference to an article may include reference to one 'article' residing in or being associated with another 'article'. An 'article' may refer to meat and other food products, whether including organic or non-organic material, such as packaged human and animal blood products, food products other than meat products, wine and other beverages, organic products other than food products, medical devices, and the like. An 'article' may also include any other item that can be identified, traced or tracked, such a postal or courier items, parcels, or any other product or good whatsoever.

Throughout this specification, reference to an 'interrogator' or 'interrogated' includes reference to a read only or read and write device or actuator that may power a tag, communicate with a tag, receive information from a tag, read a tag, transmit information to a tag end/or signal to and/or from a tag. This includes for example an RFID enabled regions, stores and/or containers adapted to communicate with tags stored or moved therein.

Throughout this specification, reference to a 'tag' includes reference to one or more RFID tags and/or reference to a tag(s) as disclosed in the incorporated disclosures noted above. In one specific form of the invention, a tag is defined as a label or adhesive note or other method of affixing identity to an article or thing in any form, such as a device comprising an Application Specific Integrated Circuit (ASIC) 'chip' attached to an antenna or having an antenna attached to it, or
where an antenna forms past of the chip assembly itself and where the chip and the antenna structure, including optionally a capacitor or capacitors and which device functions as an inductively powered passive transponder or a battery powered electronic transponder or is a transponder powered by some other means.

The present invention is adapted to operate with tags that are relatively closely stacked such as 1mm between tags which overlap exactly and where the tags can also be actually touching. The invention is also adapted to operate with tags that are spaced much wider apart such as 5 cm or more. Furthermore, the invention is adapted to operate with tags and interrogators which can also have varying orientations. That is, the invention in certain interrogator implementations is relatively insensitive to the orientation of the tag or how the tag is presented to the interrogator.

Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

20 BRIEF DESCRIPTION OF THE DRAWINGS

Further disclosure, objects, advantages and aspects of the present application may be better understood by those skilled in the relevant art by reference to the following description of preferred embodiments taken in conjunction with the accompanying drawings, which are given by way of illustration only, and thus are not limiting of the present invention, and in which:

Figure 1 is a schematic view one embodiment of a radio frequency identification (RFID) system according to the invention;

Figure 2 is a schematic top view of an RFID tag used in the system of Figure 1;

Figure 3 is a schematic top view of an alternative RFID tag to that shown in Figure 2;

Figure 4 is a front view of a package for a quantity of human blood;
Figure 5 is a system according to the invention for allowing the identification of the packages of Figure 4;

Figure 6 is a perspective view of an interrogator of an alternative embodiment of the invention;

Figure 7 is a top view of a package for use with the interrogator of Figure 6, the package including an integral RFID tag;

Figure 8 is a sectional view taken along line 8-8 of Figure 7.

**DETAILED DESCRIPTION**

There is an important consideration in the use of tags in the working of the present invention. The nature of articles and any other articles with which the present invention is useful is that they can be stacked in relatively close proximity to each other. Because of this, the use of conventional tuned tags may not be suitable. This is because, when conventional tuned tags are stacked in relatively close proximity to each other the antenna resonant currents interfere with the tuning of adjacent tags such that the tags will not work in closely stacked applications.

In accordance with the present invention, the inventors have found that the tag(s) should have a controlled current draw when they are interrogated in close proximity to each other. The current draw may be controlled by configuring the tag(s) with at least one of the following in mind:

- Substantially reducing or eliminating resonant currents by not tuning the antenna coil (preferably at manufacture) so that it is not a resonant coil,
- Switching the tag between high and low power states or active and inactive states wherein the current drawn from the antenna is as small as possible in the low power (inactive) state.
- Each tag may be switched deliberately and/or randomly, so that there is a relatively low probably of having two tags 'active' and adjacent to each other at any one time,
- where two tags are interrogated simultaneously and/or have interfered with each other, ignoring that tag interrogation,
- when the tag is not to be read or communicated with by an interrogator, controlling the current drawn by that tag's antenna in consideration of the
distance of separation between the tag and another tag (of interest to the interrogator) and the number of turns in the tag’s antenna coil,

- Minimising functions performed by the tags when inactive,
- Utilising relatively low power circuits,

- Using on-chip capacitive devices which may charge during an ‘active’ or powered cycle such that the stored energy may also be used during the ‘un powered’ or in-active cycle, and

- Making the impedance ‘seen’ by the antenna coil as large as possible, particularly in the ‘in-active’ state of the tag.

In a preferred embodiment of the present invention, the tag is configured with any one or a combination of the following criteria:

- Periodically controlling tag antenna current to substantially reduce or eliminate current in the tag antenna, and/or

- Switching the tag between active and in-active states.

Referring to Figure 1 there is illustrated generally a radio frequency identification (RFID) system 1 for a plurality of articles in the form of meat products. The articles in system 1 take on a plurality of forms, which will be described in more detail below, as the meat product is progressively processed from a live animal to specific cuts of meat presented to the point of sale at a retail outlet. In other embodiments, the meat products are progressively processed through only a subset of the steps referred to in this embodiment. However, in further embodiments, processing other than that which is described below is also performed on the meat products.

Initially, the meat product takes the form of live animals 2. In this embodiment, and for the purposes of illustration only, the live animal is in the form of beef cattle. In other embodiments, use is made of other livestock intended for slaughter and consumption. Examples of such livestock include goats, poultry, pigs, and sheep, whether domesticated or otherwise, and game such as kangaroo, deer and venison.

Animals 2 are located at a feedlot 3 where they are tended to ensure they are in the optimal condition for subsequent slaughter. In other embodiments the feedlot is a farm or ranch where open grazing is used.
Previously, each animal has been marked by one or more of branding of the skin, a plastic ear tag or a microchip to allow those tending the animals to discriminate between individual animals or groups of individual animals. In this embodiment, each of the cattle has been provided with a plastic ear tag (not shown) that has a substantially planar sheet having two opposite faces, and an attachment device for fixedly securing the sheet to the ear of the animal. A first of the faces bears a two or three figure number for assisting with the identification of the group to which the respective cattle belong. Typically this first face is disposed, in use, substantially transversely such that one viewing the cattle head-on will also be viewing the number. The other face of the sheet provides a mounting surface for an RFID tag 5, such as that illustrated in Figure 2.

Tag 5 includes a circular flexible laminar plastics substrate 6, an antenna 7 that is formed on the substrate for receiving an interrogating signal. A processor 8 is surface mounted to substrate 6 and electrically connected with antenna 7 by copper contacts 9 and 10 for receiving the interrogating signal, or a signal derived from the interrogating signal. Processor 8 also includes memory (not shown) for storing data, and in particular, for storing control data that is indicative of one or more characteristics of the article — which, at this stage in this embodiment, is the animal — to which tag 5 is mounted, or intended to be mounted.

Processor 8 is selectively responsive to the interrogating signal for doing one or more of:

- Accessing data held in the memory.
- Writing data to the memory.
- Generating an identification signal that is transmitted wirelessly by antenna 7.

The actions undertaken by processor 8 are determined in part by the interrogation signal and in part by the software being run by the processor. For example, in some embodiments, processor 8 is responsive to the interrogation signal for determining whether it will assume an active or a standby mode. In the active mode, processor 8 is further responsive to the interrogation signal for providing an identification signal and/or writing data to memory. However, in the standby mode, processor 8 does not further process the interrogation signal.
This individual control of the tags is achieved through including addressing information within the interrogation signal. That is, once it is determined which tags are simultaneously within the field, the interrogator is able to selectively and sequentially provide instructions to the tags through included appropriate information within the interrogation signal.

The memory included with tag 5 is EEPROM, although in other embodiments use is made of other non-volatile memory. Another example of this type of memory is FRAM. In this embodiment, the memory includes a capacity of 1 kbyte, which equates to about 1,000 ASCII characters. In other embodiments, use is made of more or less memory capacity. In embodiments where the article bearing the tag is a high margin product – in that the cost of the tag is a lesser consideration – the tag have a many Mb of memory capacity.

The memory is programmable to allow once only write functionality. That is, processor 8 is able to write data to one or more specific addresses in the memory, and to have those addresses converted to read only. This allows that data to form part of a verification or audit trail for the tag and the article to which the tag is attached or associated with. This functionality will be described in more detail below.

Substrate 6 is a formed from a single continuous 0.1 mm thick layer of PET and includes a top face to which is mounted antenna 7 and processor 8. Substrate 6 also includes a bottom face (not shown) that is coated with a pressure sensitive adhesive.

The diameter of substrate 6 is about 30 mm. However, in other embodiments, alternative diameters are used.

Antenna 7 is comprised of an effectively continuous copper track having five spiral wound turns 11, 12, 13, 14 and 15 that are successively larger in diameter. The track and the contacts are formed by depositing a copper layer directly on the top surface of substrate 6, and then selectively etching the copper layer. For ease of illustration, the non-etched portions of the copper layer – that is, that which defines the track and contacts – are shown with crosshatching.

In this embodiment, each turn of the track is about 0.5 mm wide, while the pitch between each turn is about 1 mm. That is, the spacing between the centres
of adjacent turns is about 1 mm. Antenna 7 also includes a conductive bridge 16 that overlies and which is electrically insulated from the intermediate turns for allowing the outer end 17 of the outermost turn to be connected back to an inner end 18 of the centre or innermost turn that is adjacent to contact 10. That is, the track runs continuously from contact 9, in a clockwise direction. As the track passed under bridge 16, it progresses outwardly to the next turn 12, and so on, until the track reaches end 17.

In other embodiments alternative antennas are used with other numbers of turns, for example. Other alternatives include half dipole antennas, conductive tracks of material other than copper, and turns formed in other than generally circular of spiral windings. In some embodiments, use is made of different track widths and pitches. The primary function of the antenna is to receive the interrogation signal and to transmit the identification signal. Accordingly, while it will be appreciated by the skilled addressee that there are many advantages to the multiple turn antenna shown in Figure 2, that other embodiments are able to make use of other antennas and antenna configurations to provide the desired functionality.

A plurality of like tags 5 are for uniquely identifying respective articles which, as referred to above, are respective cattle. To that end, the tags are interrogated by an interrogator 21 that is disposed at feedlot 3 and which provides an interrogating field. In this embodiment, tags 5 are un-tuned and, as such, are all simultaneously disposed within the field. Tags of this general type are disclosed within PCT application PCT/AU03/01072. If use is made of tuned tags, it is typically necessary to individually dispose the tags within the field.

The respective processors are selectively responsive to the interrogating signal for writing control data to memory. In this embodiment, the memory to which the control data is written is “read only” once that writing has occurred. That is, the control data, once written, leaves a relatively secure and permanent record of the control date.

In this embodiment, the control data is indicative of one or more of:

- The breed of cattle 2.
- A time and date stamp for the interrogation.
The location of cattle 2 at the date of the interrogation.
A brand or trade mark under which cattle 2 are marketed.
The physical condition of the respective cattle.
The estimated weight or financial value of cattle 2.
The lineage of individual cattle.
The age of the cattle at the time of the interrogation.
The intended destination of the cattle.
In other embodiments, however, the control data is indicative of other characteristics of the cattle.

Once interrogated, and with the control data appropriately written to the respective memories, the tags are applied to individual cattle. Particularly, the bottom surface each tag is engaged with the other face of the ear tag for one of the cattle such that each tag 5 is adhered to a corresponding face.

In this embodiment, the control data is indicative of:

Text or an image of a trademark that is applied by the owner of feedlot 3.
The breed of the cattle.
A time and date stamp for the interrogation.
The approximate age of the cattle at that date.

Typically, tags 5 are mounted to the respective ear tags of cattle 2 shortly after they are born so that the tag data represents a continuous record from birth for each animal. Alternatively, tags 5 may be mounted to the respective ear tags of cattle 2 immediately prior to having those cattle transported to an abattoir 25 for slaughter. Accordingly, the first interrogation of tags 5 configures the tags with data that is able to be accessed subsequently to determine when the cattle left the care of the party originally tending for them and the branding associated that party.

Once cattle 2 have been slaughtered, the carcasses (not shown), which still include the respective tags, are passed through an interrogator 26 that provides an interrogation signal having control data that is added to the respective memory on tags 5. This control data is indicative of the date of the interrogation and of the location of the abattoir. Accordingly, the tags now include not only data indicative of the source of cattle 2, but also of the source of the
subsequent processing of those cattle. As will be appreciated from the teaching herein, the progressive accumulation of data is able to be used by parties further down to the process chain to verify that certain steps have or have not occurred, when they occurred, and which party was responsible for carrying them out. This is of particular importance not only to wholesalers and retailers of the end products, but also to the ultimate consumer. The information stored on the tags allows for both a verification of the history of the article, and also an assurance – by way of the branding information – of the quality of the processing.

Abattoir 25 also includes a processing station 27 where the carcasses are cleaned, skinned and then dissected into separate meat products (not shown), whether those meat products be sides of beef, a particular cut of beef, or otherwise. In any event, each carcass is converted from a single article – the carcass – to a plurality of articles – the meat products. The individual meat products are then also associated with further tags 5. In this embodiment, the further tags are adhered directly to the respective meat products as the adhesive is selected to minimise contamination of the meat product. Additionally, substrate 6 is selected to act as a barrier to the passage of any fluids from the meat product to the processor 8 and any associated electronic circuitry including the memory. In other embodiments, the meat products are first placed in respective packages, and the tags are either adhered to or placed within the packages.

The tag associated with a carcass is then passed through an interrogator 28. This interrogator provides an interrogation signal to which the tag is responsive to provide an identification signal. The identification signal includes data not only indicative of a unique identifier for the tag, but also of the read only data that has been previously stored in the memory on that tag.

Following the interrogation of the tag associated with the carcass – that is, once interrogator 28 has obtained the accumulated data about the history of the carcass – all the meat products that are derived from that carcass are also passed through the interrogator 28. The interrogator includes within the interrogation signal control data that is indicative of:

- The accumulated data gathered from the earlier interrogation.
- A cross-reference to the identifier of the tag associated with the carcass.
A time and date stamp for the interrogation by interrogator 28.

The interrogation signal also includes instructions to the further tags to store that control data in read only addresses within memory. In some embodiments, the control data is also indicative of another characteristics of the meat product. For example, the approximate weight of the meat product, the cut of the meat product, the suggested "use by date" for the meat product, or the like.

The meat products from the other carcasses are similarly passed through interrogator 28. The end result being a plurality of separate meat products whose individual origins are able to be determined, if required. For example, during the processing of the carcasses to meat products, it is usual to conduct spot tests for contamination and/or disease. However, the results of such tests are not necessarily available immediately. If such a test provides a positive indication of undesirable properties for a given carcass, it is possible to quickly and efficiently locate all the meat products emanating from the carcass for either further testing or disposal.

Because tags 5 are un-tuned, it is possible to simultaneously disposed multiple tags within the same interrogating field and still achieve accuracy not only of identification of the tags, but also accuracy of writing the desired control data to the desired tags. This becomes significant for articles such as meat products, where they are stacked or piled upon each other during the interrogation. This results not only in relatively random orientations of tags, but also in some tags being disposed extremely closely together, and in some instances, the tags are physically engaged with each other.

While in this embodiment each of the meat products is individual tagged – that is, each meat product has a separate uniquely coded tag mounted or associated with it – in other embodiments, a plurality of meat products are grouped together and use is made of a single tag for that group. For example, a plurality of meat products, say like cuts from a single carcass, are grouped together and placed within a single package. In this case, the package includes an RFID tag that, once interrogated, stores data indicative of one or more characteristics of the plurality of articles. In further embodiments, both the package and the meat products within the package include respective RFID tags.
It will also be appreciated that in some embodiments each individual meat product is separately packaged, and then a plurality of such packaged meat products are then included within a larger package. Preferably, that larger package also includes an RFID tag. For example, in some embodiments a plurality of like meat products—in the form of a plurality of specific cuts of meat from a given carcass—are placed upon one or more cardboard or foam trays. The trays are then grouped and stacked together with other trays in a plurality of cardboard cartons, which in turn are grouped and stacked together on a plurality of pallets. The trays, the cartons and pallets are all articles of the kind contemplated in the embodiments, and all include respective RFID tags to their identification, and the identification of one or more characteristics of the respective articles. As expressed above, the characteristics, in this embodiment, includes some verification or historical data for the article, or the meat product included as part of that article.

After being passed through interrogator 28, the meat products—together with any associated packaging—are placed in cold storage area 29 where the temperature is maintained below 0 °C. In other embodiments, where the meat products are intended for shorter periods of storage, area 29 is maintained at greater than 0 °C. The meat products are able to be stored in groups of like cuts of meat—that is, with like cuts from different carcasses being stored together—or in groups of meat products from the same carcass. It will be appreciated from the teaching herein, that other groups are also possible. For example, in some embodiments, the groups are based upon anticipated demand for meat products from a given customer of those products. In one such embodiment, one of the customers includes a retailer having a plurality of retail outlets that are periodically supplied with selected ones of the meat products. Based upon historical data—be that for a given week, month, season, or other timeframe—the meat products are group together in anticipation of the future ordering requirements of the respective outlets in a corresponding timeframe.

In area 29 the meat products eventually freeze and, due to atmospheric moisture, become progressively covered in a layer of ice or icy material. It is also usual for this layer to include dust particles and other detritus.
Eventually, the meat products are to be transported to another site for wholesaling or retailing. Immediately prior to the meat products being loaded to the transportation vehicle, the selected one or more of the meat products are passed through an interrogator 30. This interrogator includes with the interrogation signal control data that is indicative of:

- A time and date stamp for the interrogation.
- The intended destination.

However, before that interrogation by interrogator 30 occurs, there is a need to select those of the meat products that are to be transported at that given time and by that given vehicle. In some embodiments, this selection is assisted through the intelligent placement of the meat products within area 29 in the first instance. However, in other embodiments, there is a need to locate the desired meat products amongst all the products within area 29, and to have these located products collected together for subsequent transportation. In this embodiment, abattoir 25 includes a database server 31 that is responsive to interrogator 28 and interrogator 30 for maintaining a database of records that provides a correlation between the tags that have been interrogated by interrogator 28, but not by interrogator 30, and the position of those tags – and hence the meat products to which the tags are mounted – within area 29. As will be appreciated by those skilled in the art, this functionality is enabled by having area 29 segmented or otherwise divided into a plurality of predetermined discrete locations. In some embodiments, area 29 is collectively comprised of a number of separate and distinct cold storage areas, and the database includes records indicative of the area in which the respective meat product is to be stored.

Where a number of meat products are package together as an article that is collectively transported to area 29 – for example, where the article is a pallet on which a plurality of cartons are stacked – the database only stores location information for that article, as opposed to all the meat products within the article. However, the location of the individual meat products is able to be ascertained as the tag for the article will include cross-reference information to the individual tags in that article.
While reference has been made above to the connection between server 31 and interrogators 28 and 30, it will be appreciated that interrogator is also linked to server 31. This allows similar functionalities to be achieved for the articles having tags as they progress between interrogator 28 and 28. Regard is also had to the overall progress between interrogators 26 and 30. That is, server 31, and the database that is maintained, provides a central control and monitoring of the processing within abattoir 25 as a whole, or between any two interrogators. In some embodiments, the tags are interrogated more often than the three occasions described above. However, in other embodiments, there is only one interrogation, such as upon being taken from area 29 for transportation to another site.

Although the interrogators are shown separately, it will be appreciated that in other embodiments, use is made of a single interrogator to provide all the interrogations. That is, in general terms, an interrogator includes a radiating device for generating the interrogating field, a controller that is responsive to predetermined inputs for controlling the field, a receiver that is responsive to identification signals generated within the field, and a power circuit for supplying power to the radiating device, the controller and the receiver. The controllers used in the interrogators in abattoir 25 are programmable, and able to be configured for providing the control data to the tags that are interrogated that is relevant to the processing of the article that has just occurred, or which is about to occur.

Interrogator 30 is responsive to server 31 when interrogating the meat products to be transported from area 29. Particularly, the database maintained by server 31 includes records having a variety of flags for alerting an operator of interrogator 30 that one, some or all of the meat products within a package are not to be transported. For example, if a test result has led to a recommendation that the meat products are not fit for the intended purpose, the operator is alerted by an alarm or message, and the relevant meat products are handled accordingly.
While abattoir 25 is shown as a single site, it will be appreciated that in other embodiments, the process steps described above are able to be carried out progressively at more than one site.

The meat products that are transported are, in this embodiment, conveyed to a retail outlet 35. As the meat products – or packages containing a plurality of meat products – are unloaded from the transportation device, they are passed through an interrogator 36. While this provides the retailer with an opportunity to verify the quantity of the meat products being delivered, it also allows the retailer to communicate control data in the interrogation signal such that the data on the respective tags is indicative of a time and date stamp for the most recent interrogation. It also provides the retailer to configure the control data such that the data contained on the tag is also indicative of a brand of the retailer – for example, the trade mark used by that retailer to distinguish itself from its competitors.

The data now on the tags is, in some embodiments, provided also to the party charged with the responsibility for transporting the meat products between abattoir 25 and outlet 35. In that way, that party is able to gather information about the quantum of articles being transported, and the time taken to affect that transportation. For perishable goods such as the meat products under particular consideration in this embodiment, timeliness of delivery is paramount. However, this information is also useful for all goods, be they durable manufactures or readily perishable foodstuffs. For the party charged with the transportation of articles typically takes the view that the articles should remain in transit for a minimum time, for otherwise one needs to employ more capital resources to undertake the task then would otherwise be necessary.

Following the interrogation by interrogator 36, the meat products are stacked or otherwise arranged in shelves or cabinets 37 for display to customers at outlet 35. In some embodiments, the meat products are alternatively provided to an internal butchery within outlet 35 for further dissection or processing prior to display. It will be appreciated from the teaching herein that it is possible to include an additional interrogation following that further processing to monitor the progress of the meat products and to allow verification of one or more
characteristics of the ultimate product displayed for sale. As also discussed above, where there are a plurality of interrogations conducted before or after progressive process steps, that interrogation is delivered either by a number of respective dedicated interrogators, or by a lesser number of interrogators that are appropriately programmed to provide the desired control data for the relevant processing that has occurred prior to that interrogation, or which is to occur following that interrogation.

Where a customer selects one or more of those meat products, they are placed in a shopping trolley 38, and progressed to a point of sale station 39. In some embodiments, station 39 is a point of sale register (not shown), where the customer manually transfers the selected meat products to a conveyor or counter for subsequent manual processing by a point of sale operator. This operator enters into the register the relevant information about the meat products so that the customer is presented with a total charge for payment in consideration for the transfer of ownership of the meat products from the retailer to the customer. The customer makes the payment by cash, cheque, debit or credit – or any other means – and is able to leave outlet 35 with the products. In this embodiment, the customer is also provided with a printed receipt or docket that includes a details of the date of the transaction, and a list of: one or more characteristics of the purchased meat products; the individual cost of the products; the total cost of the products; the type and quantity of funds tendered by the customer; and any change given to the customer. Moreover, the receipt includes a printed graphical representation beside each listed item of the branding applied to the meat product by one or more of the parties responsible for the quality assurance of that product.

Outlet 35 includes a central server 40 that is linked to both interrogator 36 and station 39 for allowing information to be gathered and analysed about the incoming and outgoing products. Server 40 also stores pricing information for the products that is referenced when the products are presented to station 39. In other embodiments, however, the pricing information is included within the control data provided by interrogator 36 and subsequently stored on the tags.

It will be appreciated that the meat products are typically presented to the operator together with other articles selected by the customer from the outlet 35.
In some embodiments at least some of those other articles will also include RFID tags. In one such embodiment, all the articles offered for sale in outlet 35 – including the meat products – include respective RFID tags. In that case, station 39 includes an interrogator that generates an interrogating field in a predetermined volume. Trolley 38 is located within that volume such that all the tags contained within the trolley are, for a predetermined period, simultaneously disposed in the field. During that predetermined period, all the tags are interrogated such that the unique identifier for each tag is obtained. These identifiers are used by station 39 to obtain from server 40 the relevant price information for the products wishing to be purchased by the customer. While in some embodiments each unique identifier is separately transmitted to server 40, in other embodiments, a number of such identifiers are batched together.

In some embodiments, station 39 includes a display (not shown) for providing selected, or desired, visual information to the customer. This display preferentially displays to the customer not only a brief description of the meat product and the price of the meat product – rendered in an alphanumeric format – but also a graphical representation of one or more brands of the parties or parties wishing to provide the customer with an assurance of the quality control that has been provided during the production of the meat product.

In some embodiments, the outlet 35 includes small interrogators (not shown) disposed at convenient locations spaced apart about the outlet for allowing customers to selectively interrogate the tag associated with one or more of the meat products or any other item or product having a suitable tag. The small interrogators include a housing for accommodating a single meat product, or a small number of meat products. The small interrogators also include a display for presenting indicia to the customer that is derived from the data held within the memory of a tag being interrogated. More preferably, the indicia are indicative of one or more of: the weight of the meat product; the price of the meat product; the unit price of the meat product; and the branding of the one or more of the parties who applied their respective brand during the formation or production of the meat product. For example, in some embodiments, the branding displayed to the customer is that of the owner of feedlot 3, while in other embodiments it is
that of the owner of abattoir 25. In further embodiments, the branding displayed is that of the retailer, or a combination of the above.

In those embodiments making use of the small interrogators referred to above, those interrogators are also preferentially linked to server 40 for allowing pricing and other data to be provided to the small interrogators. In those embodiments where such data is held on the tags, the small interrogators are still preferentially linked to allow other additional functionalities. For example, in some outlets (not shown) the small interrogators provides the customer, once the tag for a particular meat product has been interrogated, with a list of competing or replacement meat products, the branding associated with those competing products, and where those products are able to be located by the customer within the retail outlet. It also opens up the opportunity for the outlet to offer special deals to those customers who take the time to interrogate the tags, by randomly or systematically allocating rewards to those customers. A further alternative is to offer a competing manufacturer with the opportunity, once the interrogation has identified the meat product, to make an instantaneous special offer to the customer as an inducement to replace the originally intended purchase with a meat product of the competing manufacturer.

Although the above functionalities have been expressed with reference to meat products, it will be appreciated that they are equally applicable to other products bearing similar tags.

The interrogators used in the embodiments described above may include tunnel reader interrogators, in that they include a tubular, and typically prismatic, housing into which are progressed the articles to be interrogated. The interrogators may also include an interrogator disclosed in US 5701121. While there are circumstances, such as with large articles, where the need to progress the articles into the housing can be less convenient, the advantages of these interrogators typically outweigh any such inconvenience. Particularly, these interrogators include three coils that are disposed within the housing, and which are driven to provide an interrogation field that has three orthogonal components. This provides greater certainty of accurate interrogation of the tags, as a more uniform interrogation field is established, and the field is less sensitive to the
orientation of the tags. Where there is less need for such accuracy, then other
interrogators — having only one coil, or two orthogonal coils — are used. For
example, the small interrogators referred to above need only be single coil
interrogators, as the customers are able to orientate the tags such that the
desired interrogation occurs.

While in Figure 1 system 1 includes a plurality of interrogators, it will be
appreciated that in broader terms embodiments of the identification system
according to the invention need include at least one interrogator for providing an
interrogation field. The interrogator, or the interrogators, interact with the plurality
of RFID tags 5 that are associated with respective articles. In the Figure
embodiment the articles take a variety of forms as cattle 2 are converted into
individual meat products bearing respective tags. However, in some
embodiments, the tags are applied to fully manufactured goods and are used only
for the internal purposes of a manufacturer, such as warehouse location or other
inventory control. In any event, the tags are selectively responsive, when
disposed within the field, for providing respective identification signals indicative
of one or more characteristics of the respective articles, where each tag includes
memory for selectively storing control data derived from the interrogation field.
That is, the interrogation of a tag allows the transmission to the tag of the control
data. Where appropriate, that control data is stored by the tag in memory for
subsequent use by the same party, or by other parties.

Tags 5 each include processor 8 that is responsive to the interrogation
field for extracting the control data and determining whether or not to have the
control data stored in the memory. Typically, the control data itself includes
commands indicative of whether or not the or part of the control data should be
stored within the memory of a particular tag. For example, when a plurality of
tags is simultaneously disposed within an interrogating field, the initial step is for
the interrogator to identify each of the tags. Once that occurs, the interrogator is
able to provide control data to which only a specific tag, or a plurality of specific
tags, are responsive. That is, the control data includes not only desired
commands for the relevant processor 8 to run, or data to store within the memory
of that tag, but also addressing information.
In the Figure 1 embodiment where a given tag is passed through a plurality of successive interrogations, the memory for that tag includes existing data that provides an indication of the history of the tag — and the associated article — or some other characteristics of the tag and/or article. When another interrogation occurs, and the interrogator provides control data to that card, the control data is selectively progressively added to existing data as the tag is subsequently disposed in the or another interrogation field. However, in other embodiments, the or predetermined portions of the existing data are replaced by the control data.

As referred to above, the control data is indicative of one or more predetermined characteristics of the respective article. For example, in some embodiments, the control data is indicative of the date and geographic location of the article at the time of interrogation. In other embodiments, however, the control data is indicative of a process that has been applied to the article. For example, in an embodiment where the article is a tray of meat and the tag is adhered to the tray, the control data is indicative of the date and location of the interrogation of the article as it enters a cold storage facility. With that control data then included as part of the existing data, when the tag is next interrogated — for example when leaving the cold storage facility — the control data includes the date and time of the more recent interrogation, together with an indication that that was the date and time of departure from the facility. Accordingly, the existing data now includes a selected history of the processing of the meat.

The use in system 1 of a plurality of spaced apart interrogators that generate respective interrogating fields allows the respective tags to accumulate progressively existing data to signify a respective process has or will be performed on or to the article.

When a tag is interrogated it provides an identification signal. In some embodiments, the identification signal is indicative of a unique identifier for that tag. However, in other embodiments, the identification signal includes some or all of the existing data. While in some embodiments the existing data is included within the identification signal in response to predetermined control data, in other embodiments that occurs automatically.
In the Figure 1 embodiment, the interrogator at station 39 includes a display that is responsive to the identification signal provided by the or each tag for providing the customer with a visual indication of the origin of the article. In that particular instance, the identification data includes branding information that had been applied to the tag as the associated article was undergoing production. Accordingly, the branding is included to indicate the quality of the article, or the one or more of the processes that has been performed on the article during its production. In other embodiments, however, the branding is applied to indicate solely the source of origin of the article.

It will be appreciated that the tags used in the embodiments described above are intended for operation when simultaneously disposed within the field with other like tags. In some embodiments, more than 100 tags are simultaneously disposed within the field, while in larger embodiments, it is possible to dispose simultaneously within the field many hundreds of such tags.

Even where use is made of many hundreds of such tags being disposed simultaneously within the field, the tags remain selectively responsive to the field notwithstanding that any two or more tags are immediately adjacent. In some embodiments the tags remain selectively responsive to the interrogation field notwithstanding that any two or more tags are abutted together.

In so far as this specification is concerned, and except where expressly stated otherwise, the term "closely adjacent" is used to signify that there is less than 500 mm between the tags. In some embodiments, however, the tags are closely adjacent if there is less than 200 mm between the tags. In a further embodiment, the tags are closely adjacent if there is less than 50 mm between the tags.

In so far as this specification is concerned, and except where expressly stated otherwise, the term "immediately adjacent" signifies that there is less than 10 mm between the tags. In some embodiments, the tags are immediately adjacent if there is less than 5 mm between the tags. In another embodiment, however, the tags are closely adjacent in that there is less than 2 mm between the tags.
Figure 3 illustrates an alternative tag 45, where corresponding features are denoted by corresponding reference numerals. In this embodiment, substrate 6 is generally rectangular and has approximate length and width dimensions of about 75 mm and 39 mm respectively. Due to the physical area of the individual turns of antenna 7 being larger than those for tag 5, only three are required on tag 45. Otherwise the functionality of tag 45 is similar to tag 5 and, indeed, both are accommodated by system 1. The choice of tag shape and/or physical configuration is dependent upon factors such as cost, the size of the article or articles to which the tags are to be attached or otherwise mounted, the affect the article or articles have on the interrogating field, and the like. For example, where the articles are primarily organic, there is only a small affect upon the interrogating field and, as such, it is possible, all else being equal, for the antenna to include turns that encompass a smaller area, or fewer turns. However, where the article is conductive or magnetically permeable, this can distort and otherwise compromise the interrogating field. Having a larger area antenna, or a greater number of turns in that antenna has been found to be a practical way of addressing this issue. Ultimately, however, as the conductive or magnetically permeable nature of an article increases, the ability for this form of compensation to assist will diminish.

In other embodiments use is made of other than generally circular or generally rectangular substrates and antennas.

Reference is now made to Figure 4 where there is illustrated a package, in the form of a flexible plastic bladder 51, for containing an organic substance which, in this embodiment, is a quantity of human blood. Bladder 51 is formed from two opposed like plastic sheets that are abutted and heat welded about a continuous join line 52 that is spaced inwardly from the common peripheries 53 of the sheets. Bladder 51 extends from a bottom end 55 to a top end 56, and defines between line 52 and peripheries 53 a continuous flexible skirt 57.

The join line forms a sealed abutment between the sheets such that the latter defines a fluid retaining cavity.

Bladder 51 includes a spout 58 that is integrally formed with the sheets, and which extends from a first end 59 that opens into the fluid retaining cavity,
a second end 60 that releaseably engages with a cap 61. In this embodiment, cap 61 is engaged with end 60 in an interference fit. In other embodiments, however, the cap is otherwise releaseably engaged such as by a screw thread or a snap-fastener, or the like. In other embodiments, cap 61 is once only removable, or includes a frangible portion that is ruptured to access the blood or other fluid that is contained with the cavity.

Bladder 51 includes two eyelets 63 and 64 that are formed within skirt 57 adjacent to end 56 for receiving, in use, respective formations of equipment used to facilitate the dispensing of the blood to a patient.

For the sake of illustration, bladder 51 includes a traditional generally rectangular printed label 65 that, in use, bears printed indicia to provide a viewer with key information about the blood packaged within the bladder. Examples of this information include the blood type and the age of the blood. Label 65 is often adhered directly to bladder 51 immediately following the quantity of blood being disposed within the fluid retaining cavity of the bladder. Conventionally, label 65 is located centrally, although toward end 56.

In this embodiment, bladder 51 also includes an RFID tag 66 that is adhered directly to bladder 51 adjacent to end 55. Tag 66 is similar to tag 45 of Figure 3. In other embodiments, tag 66 is otherwise mounted to bladder 51. In some embodiments, for example, tag 66 is disposed within the fluid retaining cavity during or closely following the welding of the sheets to define that cavity. In other embodiments, tag 66 is integrally mounted to one of the sheets. That is, the substrate for the tag is comprised of one of the sheets included in bladder 51.

In use, a plurality of like bladders 51 are manufactured, sterilised, appropriately packaged and made available for use in a system 71 that is schematically illustrated in Figure 5. Particularly, the bladders are shipped to a blood donation and collection centre 72 where donors 73 donate and/or sell blood for use within the health system of a given society. Prior to the blood being collected, relevant details are ascertained from donors 73 concerning blood type, medical history and the like. This information is collectively referred to as "the donor data" and entered into a computer system 74 together with any other relevant information ascertained. The entering of the donor data is via an
appropriate interface (not shown), from where it is stored within a database (not shown). Once the data has been entered, the respective donor is provided with a transaction number for use further along the donation process.

While system 74 is shown as a single item, it will be appreciated that in other embodiments, it includes a plurality of interlinked items, be those items disposed at the same or multiple sites. In any event, system 74 is linked to an RFID interrogator 75, similar to interrogator 21 of the Figure 1 embodiment.

As the donor data for one or more donors is gathered and appropriate stored, a plurality of still empty bladders 51 are placed within the interrogating field provided by interrogator 75. System 74 is responsive to the donor data for ensuring that the control data provided by interrogator 75 includes, for respective tags, selected portions of the donor data. That is, each of the tags – one being associated with each bladder 51 – is individually updated to include data for the respective donors. If required, label 65 is also able to be manually applied at this time.

Interrogator 75 includes a visual display (not shown) for displaying predetermined information. For example, when the relevant staff at centre 72 are allocated individual bladders sequentially, the first step in the process for those staff is to place the respective bladder within interrogator 75 – or a further similar interrogator – to display an identifier for the donor whose blood is to be placed within that bladder. This identifier is typically the transaction number referred to above. The staff member announces the transaction number, and the donor comes forward to donate the blood. During the interrogation to obtain the transaction number – either from the tag or system 74 – interrogator 75 provides control data to the tag including a time and date stamp.

Following the donation of the blood, bladder 51 is sealed through applying cap 61. Thereafter, the bladder is again disposed within the field provided by interrogator 75. However, in this instance, the interrogator is responsive to drivers from system 74 for ensuring the control data includes a time and date stamp, an indication of the location where the donation was made, and an indication of the identity of the staff member who took the donation.
A plurality of now blood-containing bladders 51 are placed into deep plastic storage trays (not shown) — in which the bladders are typically disposed in two or more rows. While the orientation of the bladders is preferentially uniform, this is dependent upon the diligence and efforts of the personnel who are charged with the manual placement of the bladders within the trays and, as such, there is often considerably variation in orientation. In this embodiment that difficulty is addressed through the use of interrogators that generate the interrogation field along three orthogonal axes.

In this embodiment, each tray also includes an RFID tag mounted to its base for facilitating identification of that tray. Once a tray has been stocked with the desired bladders 51, the tray, together with the bladders, is passed through an interrogator — be that interrogator 75 or another interrogator. More particularly, the tray is placed wholly within the interrogating field such that all the tags, including the tag mounted to the tray, are simultaneously disposed within the field. The interrogator is controlled — by computer system 74 in this embodiment — to first obtain an identification signal from each of the tags, and to selectively access data held on the tags mounted to the bladders, and to have that data included in the control data that is addressed to the tag that is mounted to the tray. This control data is written into the memory of the tag mounted to the tray as a means for facilitating the later verification of the contents of the tray. The control data is, in other embodiments, indicative of other characteristics, such as a time and date of the interrogation, an identifier for centre 72, an identifier for the intended destination of the tray, and others.

The tray, or trays, are then transported to a control environment storage site 80. Upon arrival at site 80, the trays are placed upon a conveyor (not shown) and passed through an interrogator 81 for allowing correlation of the information held on the tag mounted to the tray, and that included on the tags mounted to the respective bladders held by that tray. In this way it is possible to ascertain measures for the effectiveness and efficiency of the method of transport, and to otherwise maintain good records of movements of the bladders and the trays.

Once having passed through interrogator 81, some of the trays are progressed directly to a cold storage area 82. However, others of the trays are
directed to an analysis area 83 for testing or other review. Once the relevant
tests are conducted, the bladders that are not disposed of are passed through an
interrogator 84. This interrogator is configured to provide control data indicative
of the nature of the testing, the results of the testing, and the date and time of the
interrogation. This control data is stored on the tag mounted to the bladder in
respect of which the testing or analysis was conducted. The new data so stored,
is stored in addition to any existing data held on that tag. Preferably, any data so
stored is not able to be later modified, deleted or overwritten. That is, the data is
protected, and maintained in read only format.

Area 82 is maintained at a temperature to ensure that the blood contained
within the bladders is frozen. As the trays remain within area 82 for some time,
there is a progressive build up of condensation and other material that forms a
layer over the bladders and trays, and which makes it difficult to access individual
bladders for visual identification. Moreover, as the contents of the bladders is
initially a fluid, the bladders conform to adjacent surfaces and are awkward to
remove from the tray once the contents are frozen. Collectively, these factors
render the print information on labels 65 unusable. However, as the bladders,
and for that matter, the trays, all include respective tags, it is still possible to
easily and accurately identify the tray and bladders notwithstanding a lack of a
clear visual identification. The interrogators used in at site 80 generate the
interrogating field at a frequency that allows good penetration through water and
ice and other build up. That frequency is also selected to provide good
penetration through the bladders and the contents of the bladders. In this
embodiment, the interrogation frequency is 13.56 MHz. It has been found in
practice that when operating at this frequency – and assuming the associated
power supply circuitry is able to supply adequate power – that an interrogation
field having a cross-sectional area of 0.6 metres x 0.6 metres allows full accuracy
of identification. In other embodiments alternative interrogation frequencies are
used. However, for this application it has been found that a range of interrogation
frequencies that are best suitable are between about 10 to 20 MHz, and more
preferably between about 12 to 15 MHz.
When operating at these frequencies, and with blood products such as those described, it has been found that accuracy of detection is possible even if many tags are simultaneously disposed within the field together with the articles to which they are respectively mounted. This has been found to hold true even if substantially all the field is established through the articles — that is, the bladders — to which the tags are mounted. It has also been found that the orientation of the tags is not important to that accuracy, and nor is the fact that one or more tags may be closely adjacent to or abutting one or more other tags.

As blood products are demanded at external sites, such as hospital 85, a tray, or one or more bladders from that tray, is selected for transportation and passed through an interrogator 86. This interrogator allows an operator to confirm that the tray includes bladders having blood or blood products of the type and character demanded by hospital 85. It also allows control data to be written to the tags that are interrogated, where that control data is indicative of the date and time of the interrogation, the intended destination, and an identifier for the party undertaking the transportation. In other embodiments the control data is indicative of other characteristics.

As with the Figure 1 embodiment, all the interrogators at site 80 are centrally linked by a computer system 87. In this embodiment, system 87 is also linked to system 74 to allow additional inventory and quality control procedures to be implemented.

Once the trays and their respective contents arrive at hospital 85, they are passed through an interrogator 90 to obtain the identification signals, and to store the extracted information in a hospital inventory database (not shown) that is maintained by a computer system 91. Additionally, there is the option to provide control data to the or selected ones of the tags. This typically includes a date and time stamp corresponding to the date and time of the interrogation, and an identifier of the intended location for the tray within the hospital. In this embodiment, however, all trays that are delivered to hospital 85 are placed initially in a storeroom 92.

As the bladders are required for individual use, the relevant tray is passed through an interrogator 93 to verify the tray and the bladders contained in that
tray. The desired bladder or bladders are selected by the relevant personnel and removed from the tray. The tray, and any remaining bladders are then passed through interrogator 93 once again, before being returned to storeroom 92.

A comparison of the identification signals obtained from the first and second passes of the tray through interrogator 93 allows system 91 to determine which bladders were removed from storeroom 92, and when. Preferably, during the first pass, all the tags identified are provided with control data indicative of the identity of the individual wishing to gain access to the tray and bladders. Until such time as the second pass occurs, that individual is deemed to be responsible for the entirety of the contents of the tray. After the second pass, however, the individual is deemed responsible only for the bladders that have been assessed – from a reconciliation of the identification data from the two passes – to have been removed from the tray. In practice, the individual is issued with a card (referred to as “the personnel card”) or other device that includes an RFID tag containing a unique identifier for that individual. The personnel card is placed within the field generated by interrogator 93 immediately prior to – or alternatively, simultaneously with or immediately after – both the first and the second passes. In other embodiments, the personnel card is only placed within the field immediately after the second pass.

Hospital 85 also uses the information collected by interrogators 90 and 93 to apportion and account for the cost of acquiring and administering the trays. While in some embodiments this information is for management reporting purposes only, in other embodiments, the information is used to pass on actual costs to patients as part of a “user pays” methodology. Where the latter occurs, this requires the relevant personnel to provide input at the time of at least the second pass through interrogator 93 of the client or the client account to which the cost should be levied. In some embodiments, the input is entered manually via a keypad, keyboard, touch-pad or other pressure sensitive device, while in other embodiments use is made of a scanner or other line of sight device that scans an image, bar code, or other identifier from a card or other printed media. In the present embodiment, however, the input is provided by an RFID tag (referred to as “the patient tag”) that is issued to the patient upon admission to the
hospital. The patient card is disposed within the interrogation field provided by interrogator 93 simultaneously with the tray and the personnel card during both the first and second passes. As all the items disposed within the field during those passes are individually identified, it is possible to account for the allocation of the bladders to specific patients. Moreover, in this embodiment, as a bladder is allocated to a patient, the relevant interrogator provides control data to the patient card that is indicative of the allocation. This control data is added to the memory of the card. Similar data is also held by system 91, and these two records are able to be compared and/or reconciled during subsequent interrogations.

The records accumulated on the patient card — and/or by system 91 — are, at some point in time, used to assist in the generation of an invoice for products and services rendered to the patient.

While the Figure 5 embodiment has been described with reference to bladders containing blood or blood products, it will be appreciated that system 71 is also applicable to the distribution, storage, and inventory control of other articles whether in a hospital or other site. The embodiment has particular application to items having organic components that are closely packaged or stacked and which tend to have other than strictly uniform orientations.

It will be appreciated that there are embodiments of the invention where one or more of bladders 51 includes more than one RFID tag. Where use is made of un-tuned tags, it is possible to adhere the second tag directly on top of the first, and so on. That is, a given bladder may support a stack of such tags. In the event that the placement of the tags is less exacting — in that adjacent tags overlap, as opposed to overlapped, each other — this will not adversely affect the ability to accurately interrogate the tags. In further embodiments, the tags do not overlap, and are spaced apart on the bladder.

In some embodiments, the data maintained in the memory of a particular tag is encrypted or otherwise protected — for example by a code or password — so that it is only able to be accessed and/or read by authorised parties.

Reference has been made to passing articles "through" an interrogator. This parlance is used due to the interrogators specifically mentioned being of the tunnel reader type. That is, the interrogators typically include a longitudinally
extending base wall, two sidewalls extending upwardly from the transverse edges of the base, and a top that extends parallel to the base and between the sidewalls. This structure has two open ends collectively defined by the base, the sidewalls and the top. The articles having the tags mounted to them are passed through one of the openings to dispose it within the interrogating field, and then progressed through the other opening once the interrogation is completed. However, in other embodiments, the article or articles are progressed through only one of the openings, albeit twice. The first pass to progress the article or articles into the field, and the second pass to remove the article or articles from the field.

A further embodiment of the invention is illustrated in Figure 6, 7 and 8. Particularly, there is illustrated a radio frequency identification (RFID) system 101 for a plurality of articles in the form of packages 102 — one of which is illustrated in Figure 7 and Figure 8 — that each contain a single use hypodermic syringe 103 (which is schematically rendered in the drawings). System 101 includes an interrogator in the form of a cabinet 104 for providing an interrogation field. A plurality of RFID tags 105 are associated with respective packages 102 and are selectively responsive, when disposed within the field, for providing respective identification signals indicative of one or more characteristics of the respective syringes 103. Each tag 105 includes memory for selectively storing control data derived from the interrogation field.

Cabinet 104 includes a base 110, two sidewalls 111 and 112 that are parallel with each other and which extend upwardly from base 110, and a top 113 that extends between the sidewalls. The volume lying between the base, sidewalls and top is in which the interrogation field is established, and is referred to within this specification as “the predetermined volume”. More particularly, the base, sidewalls and top include internal coils, power supply circuitry and control circuitry for providing the required field. In some embodiments, only the coils are disposed internally, and the remainder of the circuitry, while electronically linked to the coils, is spaced apart from the cabinet.

The base, sidewalls and top are lined with metal external to the coils to provide shielding to personnel from any stray field that may extend beyond the
predetermined volume. Internal to the coils, however, the base, sidewalls and top are made from materials other than metal. Preferably, such materials include one or more of plastics, wood, fibreglass or other non-conductive material or materials. In some embodiments, the base, sidewall and top all include an outer conductive layer of metal – preferably, aluminium due to cost and lightness – that provides the screening effect referred to above. Disposed immediately inwardly of the outer conductive layer is a low reluctance layer – preferably ferrite – to provide a low reluctance path for the magnetic field on the exterior side of the coils to assist with screening of coils from the outer layer. That is, the low reluctance path allows the outer conductive layer to be brought closer to the coils. In the embodiments used in this invention, the outer conductive layer is no more than 50 mm beyond the coils. Immediately inwardly of the low reluctance layer are the coils, and then immediately adjacent the coils in an inner non-conductive layer of plastics.

Cabinet 104 includes three drawers 115, 116 and 117 that are selectively manually progressable between a closed configuration (as shown in Figure 6) and an open configuration (not shown) where access is provided to any contents within the respective drawer. In the open and closed configurations the contents of the drawers are respectively disposed within and outside the predetermined volume. Each drawer is resiliently biased to the closed configuration and provided with a handle 118 to assist the manual progression.

It will be appreciated that, in use, one or more of drawers 115, 116 and 117 will contain a plurality of articles having respective tags. For ease of illustration and description, reference is made in the drawings to only a single type of article – that is, packages 102. However, in other embodiments, the drawers contain a plurality of other articles, whether they be like articles or a variety of types of articles.

Cabinet 104 includes an electromechanical locking mechanism (not shown) that is disposed within sidewall 112 and which is normally in a locked state for preventing progression of the drawers from the closed to the open configuration. The locking mechanism is able to be toggled to an unlocked state for allowing the progression of the drawers to the open configuration. More
particularly, cabinet 104 includes an interrogator 120 that is mounted to top 113, and which includes a generally vertical rectangular front face 121 behind which is disposed a single interrogation coil (not shown). Cabinet 104 is provided within a site, such as a hospital, where relevant and authorised individuals are issued with a card (not shown) or another physical device. The card includes an RFID tag that contains a unique identifier for the individual. When the individual wishes to access cabinet 104, the card is presented to face 121 and interrogated by interrogator 120. Due to interrogator 120 only having a single coil, the orientation of the card is important. In other embodiments where the cost of doing so is justified, interrogator 120 includes two or three orthogonal coils.

The interrogation of the card will result in an identification signal being provided to interrogator 120. This signal is indicative of the unique identifier for the individual and allows for a determination of whether or not the locking mechanism should be progressed to the unlocked state. If that progression is to occur, cabinet 104 first generates the interrogating field in the predetermined volume and received the identification signals from each of the tags disposed with that volume. This allows the creation of an initial inventory of the identity of the tags — and hence the identity of the packages 102 — contained within the predetermined volume. Typically this interrogation and initial inventory creation takes less than five seconds, although that is somewhat dependent upon the mode of interrogation and the number of tags. In the present embodiment, the predetermined volume includes approximate height, width and length dimensions of about 1,200 mm x 600 mm x 600 mm. When 1,000 tags are disposed within that volume the inventory creation time is about 1 second. However, in other embodiments, the inventory creation time is greater than or less than 1 about second. It will be appreciated that this time is contingent upon a number of factors including not only the number of tags within the volume, but also the hardware used in the interrogator (particularly the processor), the configuration and characteristics of the interrogator, the software used, amongst others. As many of these factors are design dependent — in that the intended cost of the interrogator will have considerable affect upon the end result — does mean there are different inventory creation times for different applications. In some
applications a longer inventory creation time is acceptable, while in others it is not. In any event, in the preferred embodiments described herein, the inventory creation time is maintained below 3 seconds and, where cost considerations allow, below 1 second.

In the embodiments described, the tags communicate with ISO 18000-3 Mode 2 protocol. However, the choice of protocol is in no way limited to ISO18000-3 Mode 2 and other protocols may be used in alternate embodiments. The inventors have found that the ISO18000-3 Mode 2 protocol provides good performance.

A system of article management, identification and/or interrogation may be provided in accordance with the protocols disclosed by virtue of the fact that:

- the tag(s) are configured in accordance with the present invention,
- the interrogator is in accordance with US 5,258,766
- a multi-hopping feature is provided in accordance with US5302954, and
- the interrogator interrogates tags in accordance with PCT/AU98/01077

With the initial inventory created, the locking mechanism is then progressed to the unlocked state to allow the individual to progress one of the drawers to the open configuration and select and remove one or more of packages 102 from the drawer, or to place additional packages 102 in the drawer, or both. Once the drawer is returned to the closed configuration the locking mechanism automatically reverts to the locked state, and the cabinet immediately conducts a further interrogation. The results of the further interrogation are compared with the initial inventory to provide a variance report that is indicative of the net inflow and/or outflow of packages 102.

In some embodiments, in addition to the individual being provided with a card, so too is the party or cost centre to whom the cost of removed packages 102 is to be allocated to. For the present embodiment, where cabinet 104 is disposed within a hospital (not shown), the individual sequentially presents to interrogator 120 their card, and a RFID card containing a unique identifier for the patient requiring package 102. This is similar to the functionality provided in the Figure 5 embodiment. It will be appreciated that cabinet 104 is, in this
embodiment, linked to a computer system (not shown) to allow transfer of relevant data and commands.

In other embodiments, cabinet 104 includes other than three drawers. For example, in one specific embodiment, cabinet 104 includes a single hinged door. However, in further embodiments, cabinet 104 is maintained in a predetermined area, and is freely open to individuals having access to that area. In this case, the cabinet conducts periodic interrogations to update the inventory records gained by such an interrogation.

Reference is now made to Figure 7 and Figure 8. Package 102 includes a flexible composite base layer 131 upon which the electronic components of tag 105 are mounted. Layer 131 is formed from a non-conductive plastics film, at least where it abuts the electronic components.

Tag 105 is similar to tag 45 of Figure 3, and corresponding features are denoted by corresponding reference numerals.

The electronic components of the tag are overlaid with a protective layer 132 to sandwich the components between layers 131 and 132. Layer 132 extends inwardly from the periphery of layer 131 and terminates in a continuous inner peripheral edge 133. Layer 131 includes a central generally rectangular frangible region 134 that has an outer periphery defined by edge 133. Region 134 is integrally formed with the remainder of layer 131, and presents a zone of relative weakness in that layer. In other embodiments, region 134 is formed from a material other than that of which the remainder of layer 131 is formed. For example, in one embodiment, region 134 is formed from aluminium foil, while the remainder of layer 131 is formed from a sheet of PVC.

Preferably, layers 131 and 132 are adhered together with a non-conductive adhesive.

Package 102 takes the form of a blister pack, and includes a deformable plastics former 135 having a peripheral edge 136 that is adhered to the underside of layer 131. Former 135 includes a sidewall 137 that extend outwardly and away from edge 136 to define a cavity 138 in which is disposed syringe 103. When syringe 103 is required, one end of the syringe is manually progressed into
piercing engagement with region 134 to rupture that region and thereby expose the syringe.

While the above embodiment has been described with reference to packages for syringes, it will be appreciated that other packages, and other articles contained within packages, are also suitable for use with the invention. For example, in a specific embodiment of the invention, packages similar to package 102 are used to house non-consumable medical products such as: pharmaceuticals; conduits; caps; scalpels; other surgical tools; gloves; surgical face masks; and the like. It will be appreciated that the invention is particularly advantageously used with smaller articles that are contained in batches and which are regularly consumed.

The embodiments of the invention are also applicable for the identification of articles including metal or metal components, where article – or at least the component or components containing the metal – is contained within the inner cross-sectional area of antenna 7. This minimises any interference or cancellation of the article with the interrogating field and/or the identification signal.

In summary, the present invention has a number of inventive aspects, including, without limitation:

The present invention provides, in an article management system, a method, device and/or system of enabling at least two tags to be read within relatively close proximity of each other, the method including the step of configuring each tag in accordance with any one or a combination of the following criteria:

- Periodically controlling tag antenna current to substantially reduce or eliminate current in the tag antenna,
- Switching the tag between active and in-active states, and/or
- Preferably, if two tags are interrogated simultaneously and/or have interfered with each other, ignoring that interrogation event.

Preferably, the antenna current is reduced by at least 50%.

The invention has been found useful in un-tuned antennas, but may also be applied to tuned antennas.
Preferably, the proximity is less than 20 cm, preferably less than 1 cm, and more preferably less than 1 mm.

Preferably, the tags are tags as disclosed in PCT/AU03/01072.

The present Invention also provides a radio frequency identification (RFID) system for a plurality of articles, the system including:

- at least one Interrogator for providing an interrogation field; and
- a plurality of RFID tags that are associated with respective articles and which are selectively responsive, when disposed within the field, for providing respective identification signals indicative of one or more characteristics of the respective articles, each tag including memory for selectively storing control data derived from the interrogation field.

Preferably, the tags each include a processor that is responsive to the interrogation field for extracting the control data and determining whether or not to have the control data stored in the memory. More preferably, the memory includes existing data and the control data is selectively progressively added to existing data as the tag is subsequently disposed in the or another interrogation field.

In some embodiments, the, or predetermined portions of the, existing data are replaced by the control data.

Preferably, the control data is indicative of one or more predetermined characteristics of the respective article. For example, in some embodiments, the control data is indicative of the date and geographic location of the article at the time of interrogation. In other embodiments, however, the control data is indicative of a process that has been applied to the article. For example, in an embodiment where the article is a tray of meat and the tag is adhered to the tray, the control data is indicative of the date and location of the interrogation of the article as it enters a cold storage facility. With that control data then included as part of the existing data, when the tag is next interrogated — for example when leaving the cold storage facility — the control data includes the date and time of the more recent interrogation, together with an indication of the date and time of departure from the facility. Accordingly, the existing data now includes a selected history of the processing of the meat.
In as preferred form, the system includes a plurality of spaced apart interrogators for generating respective interrogating fields through which the articles are selectively passed to signify a respective process has or will be performed on or to the article.

In a preferred form, the identification signal includes some or all of the existing data. In some embodiments, some or all of the existing data is only included within the identification signal in response to a predetermined interrogation field. However, in other embodiments, some or all of the existing data is automatically included in the identification signal. More preferably, at least one of the interrogators includes a display that is responsive to some or all of the control data for providing a user with an indication of the origin of the article.

Preferably also, at least some of the control data is indicative of branding. More preferably, the branding provides an indication that the, or one of the processes has been performed on the article. In other embodiments, however, the branding is applied - that is, included as the, or part of the, control data - to indicate the source of origin of the article.

In a preferred form, more than one tag is simultaneously disposed within the field. In some embodiments, more than 100 tags are simultaneously disposed within the field.

The present invention also provides a method for the radio frequency identification (RFID) of a plurality of articles, the method including:

- providing an interrogation field with an interrogator; and

- associating a plurality of RFID tags with respective articles, the tags being selectively responsive, when disposed within the field, for providing respective identification signals indicative of one or more characteristics of the respective articles, each tag including memory for selectively storing control data derived from the interrogation field.

The present invention also provides a radio frequency identification (RFID) system for a plurality of articles, the system including:

- an interrogator for providing an interrogation field;

- a plurality of RFID tags that are associated with respective articles and which are selectively responsive, when simultaneously disposed within the field,
for providing respective identification signals indicative of one or more characteristics of the respective articles notwithstanding that any two tags are closely adjacent.

Preferably, the tags are selectively responsive to the interrogation field notwithstanding that any two tags are immediately adjacent. Even more preferably, the tags are selectively responsive to the interrogation field notwithstanding that any two tags are abutted together.

In an embodiment, the tags are closely adjacent in that there is less than 50 mm between the tags. However, in other embodiments, the tags are closely adjacent in that there is less than 20 mm between the tags. In another embodiment, the tags are closely adjacent in that there is less than 5 mm between the tags.

In other embodiments, the tags are immediately adjacent in that there is less than 2 mm between the tags. However, in other embodiments, the tags are immediately adjacent in that there is less than 0.5 mm between the tags. In another embodiment, the tags are closely adjacent in that there is less than 0.2 mm between the tags.

In a preferred form, the tags are responsive to the interrogating field notwithstanding that any five tags are closely adjacent. More preferably, the tags are responsive to the interrogating field notwithstanding that any five tags are closely adjacent. Even more preferably, the tags are responsive to the interrogating field notwithstanding that any ten tags are closely adjacent. In some embodiments, the tags are responsive to the interrogating field notwithstanding there are more than one hundred tags that are closely adjacent, immediately adjacent, or abutting.

The present invention also provides a radio frequency identification (RFID) tag for an article having at least one organic component, the tag including:

a substrate that is mounted to the article and which is substantially impermeable to the organic component, the substrate having a first face that is opposed to the article and a second face that is opposite the first face;
a processor circuit that is mounted to second face and which is responsive to an external wireless interrogation signal for providing a wireless identification signal indicative of one or more characteristics of the article.

Preferably, the tag includes a barrier layer which is substantially impermeable to the organic component and which overlies the circuit. More preferably, the barrier layer seals against the substrate for preventing contact between the circuit and the article. More preferably, the barrier layer includes a first side and a second side that is opposite to the first side, wherein the first side of the barrier layer is opposed to the second side of the substrate. More preferably, the circuit is substantially planar, and the layers have common peripheries that continuously sealingly abut. In the preferred embodiments, the housing is substantially inert. For example, in one preferred embodiment, the housing is made from PET, while in other embodiments, the housing is made from PVC. More preferably, the PET is formed in a sheet having a thickness of about 0.1 mm.

Preferably also, the substrate is mounted directly to the article. However, in other embodiments, the article is disposed within a package, and the substrate is mounted to the package.

In a preferred form, the one or more characteristics of the article are selected from the group including: the article; one or more physical dimensions of the article; the weight of the article; the date of packing of the article; the product use by date for the article; the trade source of the article; the method of processing of the article; the number of components constituting the article; and the function of the article.

Preferably, the article is entirely organic. For example, in one embodiment, the article is an item of animal meat. In another embodiment, the article is a blood product. In other embodiments, however, the article is a fluid sample.

In a preferred form, the interrogation signal emanates at between about 3 to 30 MHz. More preferably, the interrogation signal emanates at about 12 to 15 MHz. In the preferred embodiment, the interrogation signal emanates at about 13.56 MHz.
Preferably also, the tag is flexible and conforms substantively with the adjacent contour of the article to which it is mounted. More preferably, the first face includes an adhesive for facilitating the mounting of the tag to the article. In other embodiments, alternative forms of mounting are used.

In a preferred form, the circuit responds to the interrogation signal at low temperatures. More preferably, the low temperatures include temperatures below about 0 °C. In some embodiments, however, the low temperature includes temperatures below −20 °C. In further embodiments, however, the low temperature includes temperatures below −30 °C. For the tags used in the embodiments disclosed below, the circuits are design with an operating range of about −30 °C to 100 °C.

Preferably, the processor circuit includes an antenna for receiving the interrogation signal and for transmitting the identification signal. More preferably, the antenna is an un-tuned antenna. Examples of such antennas are provided in International PCT application PCT/AU03/01072 in the name of the same applicant, the disclosure of that earlier application being incorporated herein by way of cross reference.

It will also be appreciated that the processor circuit includes other electrical components such as memory, power regulation and supply circuitry, and the like.

The present invention also provides a radio frequency identification (RFID) system for a plurality of articles that are contained within a predetermined volume, the system including:

an interrogator for providing an interrogation field that extends into the predetermined volume such that at least two of the tags are simultaneously disposed within the field; and

a plurality of tags, each being associated with a respective article and containing an identifier for that article, the tags being responsive to being disposed within the field for providing identification signals indicative of the respective identifiers.

Preferably, the interrogation field extends into the predetermined volume such that all the tags are simultaneously disposed within the field.
Preferably also, the predetermined volume is defined by a container in which the articles are disposed. More preferably, the system includes a further like tag for the container. That is, not only are the individual articles independently identifiable, but so too is the container.

In a preferred form, the tags provide the respective identification signals independently of their orientation within the field. More preferably, the tags provide the respective identification signals independently of their orientation with respect to any one or other tags that are simultaneously disposed within the field. Even more preferably, the tags provide the respective identification signals even when two or more tags are adjacent when simultaneously disposed within the field.

Preferably, the interrogator includes a generator for establishing the field, and a controller that is connected with the generator for varying the field. Preferably also, the interrogator includes a receiver for receiving the identification signals and for relaying those signals to the controller. More preferably, the field includes a base component and a variable component, wherein the variable component is provided by the controller. Even more preferably, the variable component includes an interrogation signal. In some embodiments, the interrogation signal includes commands for the one or more tags.

Preferably also, the container includes a plurality of walls, and an opening for allowing the articles to be progressed into and from the container. In an embodiment, the volume is prismatic, and the walls include:

- a base having a front edge, a rear edge spaced apart from the front edge, and two side edges that extend between the front edge and the rear edge;
- two spaced apart side walls extending upwardly from respective side edges and which terminate in respective top edges;
- a top that extends between the top edges and overlies the base, wherein the top, the base and the sidewalls collectively include a rear opening and a front opening; and
- a rear wall that extends across the rear opening.

More preferably, the container includes a closure for selectively covering the front opening. Even more preferably, the closure is lockable. Preferably, the
closure is a drawer having one or more compartments for containing the articles. In other embodiments, the container includes a plurality of closures. Preferably, the closures are independently lockable.

Preferably, when unlocked, the drawer is able to be outwardly progressed from a nested configuration within the container, to an open configuration where one or more of the compartments are accessible. More preferably, the interrogator toggles between an interrogation mode and a passive mode where the interrogation field is and is not generated respectively. In one embodiment, the interrogator is in the interrogation mode and the passive mode when the drawer is in the nested configuration and the open configuration respectively. In other embodiments, the interrogator is in the interrogation mode only when the drawer is in the nested configuration. Even more preferably, the interrogator is in the interrogation mode immediately prior to the unlocking of the closure and immediately following the locking of the closure. That is, the interrogator is responsive to a person accessing the container for conducting an inventory check of the articles now contained.

The present invention also provides a radio frequency identification (RFID) tag for an article including at least one piece of meat, the tag including:

- a substrate that is mounted to the article and which has a first face that is opposed to the article and a second face that is opposite the first face;

- a processor circuit that is mounted to second face and which is responsive to an external wireless interrogation signal for providing an identification signal indicative of one or more characteristics of the article.

Preferably, the one or more characteristics of the article are selected from the group including: a unique identifier for the article; one or more physical dimensions of the article; the weight of the article; the date of packing of the article; the product use by date for the article; the trade source of the article; the method of processing of the article; the number of components constituting the article; and the function of the article. More preferably, the one or more characteristics of the article are selected from the group including: a unique identifier for the or each piece of meat; one or more physical dimensions of the or each of the pieces of meat; the weight of the or each of the pieces of meat; the
date of packing of the or each of the pieces of meat; the use by date for the or each of the pieces of meat; the trade source of the or each of the pieces of meat; the method of processing of the or each of the pieces of meat; and the number of pieces of meat included within the article.

In a preferred form, the article includes a plurality of pieces of meat, each of which includes a like tag. More preferably, the like tags are responsive to an external wireless interrogation signal for providing an identification signal indicative of one or more characteristics of the respective pieces of meat. Even more preferably, the identification signal provided by the tag is indicative of one or more characteristics other than that provided by the identification signals of the like tags. However, in other embodiments, the identification signals provided by the tag and the like tag include redundancy to facilitate verification of the contents of the article.

The present invention also provides a cabinet having a storage volume for containing a plurality of articles each having a radio frequency identification (RFID) tag, the cabinet including:

- a base having at least one base conductive element;
- two spaced apart sidewalls extending upwardly from the base and terminating in respective top edges, wherein each sidewall includes at least one sidewall conductive element;
- a top that extends between the top edges and which has at least one top conductive element, wherein the base, the side walls and the top collectively define the storage volume there between, and the conductive elements collectively define a radiating element for generating an interrogating field within the storage volume; and
- at least one storage device disposed within the volume and being substantially transparent to the field, the device being mounted to one or more of the base, the top and the sidewalls and, in use, supporting the articles.

Preferably, the cabinet includes a power source for providing an interrogation signal, and the radiating element is responsive to the interrogating signal when generating the interrogating field.
In a preferred form, the storage device is at least on shelf up which the articles are supported. Preferably, however, the storage device includes a plurality of vertically spaced apart shelves. In other embodiments, the storage device includes one or more drawers. More preferably, the drawers are slidably mounted to one or more of the base, sidewalls and top for movement between a nested configuration where the drawers are respectively wholly disposed within the storage volume, and an open configuration where the drawers are disposed such as the articles within the respective drawers are accessible.

Preferably also, the cabinet includes an opening through which the drawers are progressed during movement between the open and nested configurations. More preferably, the cabinet includes a closure for maintaining the drawers in the next configuration. More preferably, the closure is lockable for securely maintaining the drawers in the nested configuration.

The present invention also provides a package for an article, the package including a plurality of interconnected sidewalls for collectively defining a cavity in which the article is, in use, disposed, wherein at least part of one of the sidewalls includes a wireless tag that is responsive to an interrogation field for providing an identification signal.

Preferably, the tag includes memory for selectively storing data derived from the interrogation field. More preferably, the tag includes a processor that is responsive to the interrogation field for extracting the data and determining whether or not to have that data stored in the memory. Even more preferably, the data is selectively progressively added to as the tag is subsequently disposed in the or another interrogation field.

Preferably also, the data, once selectively stored in memory is converted to read only data. More preferably, some or all of the read only data is selectively included within the identification signal.

Preferably, the wireless tag includes a substrate that is integral with the sidewall. In some embodiments, the substrate constitutes the sidewall. More preferably, the tag includes an antenna for detecting the interrogation field and for radiating the identification signal. More preferably, the antenna includes at least one loop of conductive material that extends about the periphery of the substrate.
In the preferred embodiments, the antenna includes a plurality of loops to increase the antenna's sensitivity to the field. Even more preferably, the substrate is frangible within the area bounded by the loop or loops for allowing removal of the article for the package. In some embodiments, the substrate includes one or more lines of weakness within the area bounded by the loops, while in other embodiments the substrate includes a ruptureable membrane that is contained within the area bounded by the loops. While in some embodiments the ruptureable membrane is a plastics sheet, in other embodiments it is a conductive sheet such as an aluminium sheet.

In other embodiments, the sidewall including the tag is releasably connected to the, or at least one of the other sidewalls. In one particular embodiment, the sidewall including the tag is releasably adhered to the other sidewalls along respective abutting peripheries. More preferably, the sidewall including the tag has a tab for facilitating its manual separation and removal from the adhering abutment with the other sidewalls.

The present invention also provides a package for at least one article that has a frozen exterior layer, the package including:

- a housing for containing the at least one article;
- a radio frequency identification (RFID) tag mounted to the housing and which is selectively responsive to an interrogation signal for providing an identification signal, wherein the identification signal is substantially unaffected by the frozen layer.

Preferably, the tag is mounted directly to the housing. More preferably, the tag abuts the housing. In some embodiments, the tag includes a substrate that is adhered to the housing.

Preferably also, the tag is a passive tag.

In a preferred form, the layer is a result of a progressive build up of condensate and debris.

Preferably, the identification signal is transmitted at between about 3 to 30 MHz. More preferably, the identification signal is transmitted at about 12 to 15 MHz. In the preferred embodiment, the identification signal is transmitted at
about 13.56 MHz. In any event, it is preferred that the identification signal falls with in the HF band.

In a preferred form, the housing contains a plurality of articles being comprised of substantially organic material.

The present invention also provides a storage unit having a storage volume for containing a plurality of articles each having a radio frequency identification (RFID) tag, the storage unit including:

- a base;
- at least one support structure that is mounted to the base for defining the storage volume and supporting the articles within that volume; and
- a radiating element that is mounted to one or more of the base and the at least one support structure for generating an interrogating field within the storage volume and for receiving, in response, one or more identification signals from the tags.

Preferably, the at least one support structure includes two spaced apart sidewalls extending upwardly from the base, a top extending between the sidewall, and at least one storage shelf intermediate the base and the top. More preferably, the storage shelf is moveably mounted to one or more of the sidewalls and the base.

Preferably also, the radiating element is mounted within one or more of the base and the at least one support structure. More preferably, the radiating element is located wholly within one or more of the base and the at least one support structure. In one embodiment, the radiating element is located within the base and the at least one support structure.

While this invention has been described in connection with specific embodiments thereof, it will be understood that it is capable of further modification(s). This application is intended to cover any variations uses or adaptations of the invention following in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice within the art to which the invention pertains and as may be applied to the essential features hereinbefore set forth.
As the present invention may be embodied in several forms without departing from the spirit of the essential characteristics of the invention, it should be understood that the above described embodiments are not to limit the present invention unless otherwise specified, but rather should be construed broadly within the spirit and scope of the invention as defined in the appended claims. Various modifications and equivalent arrangements are intended to be included within the spirit and scope of the invention and appended claims. Therefore, the specific embodiments are to be understood to be illustrative of the many ways in which the principles of the present invention may be practiced. In the following claims, means-plus-function clauses are intended to cover structures as performing the defined function and not only structural equivalents, but also equivalent structures. For example, although a nail and a screw may not be structural equivalents in that a nail employs a cylindrical surface to secure wooden parts together, whereas a screw employs a helical surface to secure wooden parts together, in the environment of fastening wooden parts, a nail and a screw are equivalent structures.

"Comprises/comprising" when used in this specification is taken to specify the presence of stated features, integers, steps or components but does not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof." Thus, unless the context clearly requires otherwise, throughout the description and the claims, the words 'comprise', 'comprising', and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to".
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method of configuring a RFID tag to enable the tag to be read in relatively close proximity to another tag, the method including configuring at least one tag in accordance with any one or a combination of the following criteria the steps of:
   • Periodically controlling tag antenna current to substantially reduce or eliminate current in the tag antenna, and/or
   • Switching the tag between active and inactive states.

2. A method as claimed in claim 1, further including the step of, if two tags are interrogated simultaneously and/or have interfered with each other, ignoring that interrogation event.

3. A method as claimed in claim 1, wherein the antenna current is reduced by at least 50%.

4. A radio frequency tag including logic means configured to operate the tag in accordance with the method as claimed in claim 1, 2 or 3.

5. A tag as claimed in claim 4, wherein the tag is a tag as disclosed in PCT/AU03/01072.

6. A tag as claimed in claim 4, wherein the antenna is an untuned antenna.

7. A method of enabling a plurality of tags to be read in relatively close proximity to each other, the method including the step of:
   configuring at least two tags in accordance with any one or a combination of the following criteria as claimed in claim 1, 2 or 3.

8. A radio frequency identification (RFID) system adapted to be associated with a plurality of articles, the system including:
at least one interrogator for providing an interrogation field; and
a plurality of RFID tags that are associated with respective articles and
which are selectively responsive, when disposed within the field, for providing
respective identification signals indicative of one or more characteristics of the
respective articles, each tag including memory for selectively storing control data
derived from the interrogation field, wherein

- at least one tag is a tag as claimed in claim 4, 5 or 6.

9. A system as claimed in claim 8, wherein at least two of the tags have a
proximity to each other of less than 20 cm, preferably less than 1 cm, and more
preferably less than 1 mm.

10. A method for the radio frequency identification (RFID) of a plurality of
articles, the method including:
providing an interrogation field with an interrogator; and
associating a plurality of RFID tags with respective articles, the tags being
selectively responsive, when disposed within the field, for providing respective
identification signals indicative of one or more characteristics of the respective
articles, each tag including memory for selectively storing control data derived
from the interrogation field,

- at least one of the tags being configured in accordance with the method as
claimed in claim 1, 2 or 3.

11. A radio frequency identification (RFID) system for interrogating a plurality
of articles, the system including:
an interrogator for providing an interrogation field;
a plurality of RFID tags that are associated with respective articles and
which are selectively responsive, when simultaneously disposed within the field,
for providing respective identification signals indicative of one or more
characteristics of the respective articles notwithstanding that any two tags are
closely adjacent.
12. A system as claimed in claim 11, wherein the tags are selectively responsive to the interrogation field notwithstanding that any two tags are immediately adjacent.

13. A system as claimed in claim 11, wherein the tags are closely adjacent in that there is less than 50 mm between the tags.

14. A radio frequency identification (RFID) tag for an article having at least one organic component, the tag including:

- a substrate that is mounted to the article and which is substantially impermeable to the organic component, the substrate having a first face that is opposed to the article and a second face that is opposite the first face;
- a processor circuit that is mounted to second face and which is responsive to an external wireless interrogation signal for providing a wireless identification signal indicative of one or more characteristics of the article.

15. A tag as claimed in claim 14, further including a barrier layer which is substantially impermeable to the organic component and which overlies the circuit.

16. A tag as claimed in claim 14, in which the interrogation signal is provided at between about 3 to 30 MHz.

17. A tag as claimed in claim 14, in which the processor circuit includes an antenna for receiving the interrogation signal and for transmitting the identification signal substantially as described in co-pending application PCT/AU03/01072.

18. A radio frequency identification (RFID) tag for an article including at least one piece of meat, the tag including:

- a substrate that is mounted to the article and which has a first face that is opposed to the article and a second face that is opposite the first face;
a processor circuit that is mounted to second face and which is responsive to an external wireless interrogation signal for providing an identification signal indicative of one or more characteristics of the article.

19. A cabinet having a storage volume for containing a plurality of articles each having a radio frequency identification (RFID) tag, the cabinet including:
   a base having at least one base conductive element;
   two spaced apart sidewalls extending upwardly from the base and terminating in respective top edges, wherein each sidewall includes at least one sidewall conductive element;
   a top that extends between the top edges and which has at least one top conductive element, wherein the base, the side walls and the top collectively define the storage volume there between, and the conductive elements collectively define a radiating element for generating an interrogating field within the storage volume; and
   at least one storage device disposed within the volume and being substantially transparent to the field, the device being mounted to one or more of the base, the top and the sidewalls and, in use, supporting the articles.

20. A package for an article, the package including a plurality of interconnected sidewalls for collectively defining a cavity in which the article is, in use, disposed, wherein at least part of one of the sidewalls includes a wireless tag that is responsive to an interrogation field for providing an identification signal.

21. A package for at least one article that has a relatively frozen exterior layer, the package including:
   a housing for containing the at least one article;
   a radio frequency identification (RFID) tag mounted to the housing and which is selectively responsive to an interrogation signal for providing an identification signal, wherein the identification signal is substantially unaffected by the frozen layer.
22. A storage unit having a storage volume for containing a plurality of articles each having a radio frequency identification (RFID) tag, the storage unit including:
   a base;
   at least one support structure that is mounted to the base for defining the storage volume and supporting the articles within that volume; and
   a radiating element that is mounted to one or more of the base and the at least one support structure for generating an interrogating field within the storage volume and for receiving, in response, one or more identification signals from the tags.

23. Apparatus adapted to identify at least one tag, individually, from a plurality of tags, said apparatus including:
   processor means adapted to operate in accordance with a predetermined instruction set,
   said apparatus, in conjunction with said instruction set, being adapted to perform the method as claimed in any one of claims 1, 2, 3, 7 or 10.

24. A computer program product including:
   a computer usable medium having computer readable program code and computer readable system code embodied on said medium for identifying a tag associated with an article using a data processing system, said computer program product including computer readable code within said computer usable medium for executing a method as herein disclosed.

25. A method as herein disclosed.

26. An apparatus, system and/or device as herein disclosed.
Figure 4
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

Int. Cl. 7: G01S 13/74; G08B 5/22; G01V 15/00

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPAT: rfid, proximity, current, switch, active, organic, meat, impermeable, interrogate, multiple, selective and similar terms.

USPTO: rfid, proximity, current, switch, active, organic, substrate, meat, multiple, selective and similar terms.

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
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<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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[X] Further documents are listed in the continuation of Box C  [X] See patent family annex

* Special categories of cited documents:
  "A" document defining the general state of the art which is not considered to be of particular relevance
  "E" earlier application or patent but published on or after the international filing date
  "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  "O" document referring to an oral disclosure, use, exhibition or other means
  "P" document published prior to the international filing date but later than the priority date claimed

  "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  "X" document of particular relevance; the claimed inventors cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  "Y" document of particular relevance; the claimed inventors cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  "&" document member of the same patent family

Date of the actual completion of the international search
24 May 2005

Date of mailing of the international search report
03 JUN 2005

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Form PCT/ISA/210 (second sheet) (January 2004)
## INTERNATIONAL SEARCH REPORT

**C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT**

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<td>WO 2004/015613 A2 (SENSORMATIC ELECTRONICS CORPORATION) 19 February 2004 Page 2 line 18-Page 5 line 13</td>
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Form PCT/ISA/210 (continuation of second sheet) (January 2004)
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Note: For Y indications, US 6554188 can be combined with either US 5682143 or US 5566441.
INTERNATIONAL SEARCH REPORT

Box No. II  Observations where certain claims were found unsearrachable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III  Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
See the extra sheet:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☑ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
   Claims 1-10, 23-25; Claims 11-13, 26 and Claims 14-18

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (January 2004)
Continuation of Box No: III

The international application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept. In coming to this conclusion the International Searching Authority has found that there are seven inventions:

1. Claims 1-10, 23-25 are directed to a method of configuring a RFID tag wherein the tag is switched between active and inactive states. It is considered that switching the tag between active and inactive states comprises a first “special technical feature”.

2. Claims 11-13, 26 are directed to a RFID system for interrogating a plurality of articles wherein a plurality of RFID tags are associated with respective articles and which are selectively responsive when simultaneously disposed within a field for providing respective identification signals indicative of one or more characteristics of the respective articles. It is considered that a plurality of RFID tags are associated with respective articles and which are selectively responsive when simultaneously disposed within a field for providing respective identification signals indicative of one or more characteristics of the respective articles comprises a second “special technical feature”.

3. Claims 14-18 are directed to a RFID tag for an article having at least one organic component wherein a processor circuit is mounted to a second face and is responsive to an external wireless interrogation signal for providing a wireless identification signal indicative of one or more characteristics of the article. It is considered that a processor circuit is mounted to a second face and is responsive to an external wireless interrogation signal for providing a wireless identification signal indicative of one or more characteristics of the article comprises a third “special technical feature”.

4. Claim 19 is directed to a cabinet having a storage volume for containing a plurality of articles each having a RFID tag wherein a base has at least one base conductive element. It is considered that a base having at least one conductive element comprises a fourth “special technical feature”.

5. Claim 20 is directed to a package for an article wherein at least part of one of the sidewalls includes a wireless tag that is responsive to an interrogation field for providing an identification signal. It is considered that having at least part of one of the sidewalls includes a wireless tag that is responsive to an interrogation field for providing an identification signal comprises a fifth “special technical feature”.

6. Claim 21 is directed to a package for at least one article that has a relatively frozen exterior layer wherein a RFID tag mounted to the housing and which is selectively responsive to an interrogation signal for providing an identification signal and the identification signal is unaffected by the frozen layer. It is considered that having a RFID tag mounted to the housing and which is selectively responsive to an interrogation signal for providing an identification signal and the identification signal is unaffected by the frozen layer comprises a sixth “special technical feature”.

Continued in extra sheet
7. Claim 22 is directed to a storage unit having a storage volume for containing a plurality of articles each having a RFID tag wherein a radiating element that is mounted to one or more of the base and the at least one support structure for generating an interrogating field within the storage volume and for receiving, in response, one or more identification signals from the tags. It is considered that having a radiating element that is mounted to one or more of the base and the at least one support structure for generating an interrogating field within the storage volume and for receiving, in response, one or more identification signals from the tags comprises a seventh “special technical feature”.

Since the abovementioned groups of claims do not share either of the technical features identified, a “technical relationship” between the inventions, as defined in PCT rule 13.2 does not exist. Accordingly the international application does not relate to one invention or to a single inventive concept.

As the search for the other six inventions will require more than a negligible additional search effort over that for the first invention, additional search fees are warranted.
This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.