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SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS AND NEXT-GENERATION NETWORKS

Next Generation Networks – Service aspects: Service capabilities and service architecture

NGN service requirements and capabilities for network aspects of applications and services using tag-based identification

Recommendation ITU-T Y.2213

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Recommendation ITU-T Y.2213

NGN service requirements and capabilities for network aspects of applications and services using tag-based identification

Summary

Recommendation ITU-T Y.2213 describes high-level service requirements and NGN capability requirements needed to support applications and services using tag-based identification. Several examples of applications and services using tag-based identification are also described with scenarios. The scope of this Recommendation is limited to applications and services using tag-based identification and they are distinguished by the following three mandatory elements: ID tag, ID terminal and identifier.

Source

Recommendation ITU-T Y.2213 was approved on 12 September 2008 by ITU-T Study Group 13 (2005-2008) under Recommendation ITU-T A.8 procedure.

Keywords

Bar code, capabilities, capability requirements, ID tag, ID terminal, identifier, identifier resolution, RFID, service requirements and tag-based identification.

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Introduction

Numerous applications have already incorporated identifiers to support differentiated services, where identifiers are mainly used for logical identification. Emerging applications, whose examples are described in Appendices II and III, require also that logical identification be associated with physical objects. This Recommendation expects that a relationship between physical and logical objects is maintained and assumes that applications and services using tag-based identification are based on such a relationship. This relationship makes a wide variety of business opportunities available: for example, passport numbers may be applied to physical objects for identification and each physical object, i.e., passport, may be associated with a logical object such as a text content, application program, mobile executable code, or data record.

Applications and services using tag-based identification adopted and deployed widely in various business fields have used identifiers as a means for identifying physical and logical objects. Consequently, their market volume is being expanded dramatically. In addition to use cases of identifier in business fields, physical and logical objects with an identifier can enable applications and services using tag-based identification in consumer fields as well.

Existing applications and services using tag-based identification have been exploited in business-to-business (B2B) fields, but currently they are expanding to business-to-consumer (B2C) and business-to-business-to-consumer (B2B2C) fields as shown in clause II.3. Both B2B and B2C/B2B2C tag-based identification applications and services basically have similar service requirements. Additionally, B2C/B2B2C-specific service requirements and related challenges for NGN are also examined in this Recommendation, such as privacy management, identifier resolution, management, etc.

Identifier information in such applications and services using tag-based identification works as the key information used to retrieve related contents, execute certain application programs, point to a specific information resource, make an association with a specific object, and so on. The identification feature supporting hyperlink-like access will enable NGN applications and services to be performed and provided to consumers in easier and more convenient ways. For example, consumers do not have to type a URL in a phone user interface because the tag-based identification supports that automatically.

Since a number of applications and services using tag-based identification are expected to be deployed widely in NGN, the NGN architecture framework and the NGN functional entities have to support them.

Recommendation ITU-T Y.2213

NGN service requirements and capabilities for network aspects of applications and services using tag-based identification

1 Scope

This Recommendation covers extensions to NGN release 1 capabilities in order to support tag-based identification applications and services in the NGN environment and builds upon [b-ITU-T Y.Sup1] and [ITU-T Y.2201].

The scope of this Recommendation is limited to tag-based identification applications and services distinguished by the following three mandatory elements: ID tag, ID terminal and Identifier. These applications and/or services use identifiers only read from ID tags by ID terminals.

This Recommendation covers:

- description and scope of tag-based identification applications and services with some example scenarios;
- high-level service requirements of tag-based identification applications and services; and
- extended or new NGN capabilities based on the high-level service requirements.

Functional requirements and related NGN architecture extensions for support of the described capabilities are out of scope of this Recommendation.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T X.668] Recommendation ITU-T X.668 (2008) | ISO/IEC 9834-9:2008, *Information technology – Open Systems Interconnection – Procedures for the operation of OSI Registration Authorities: Registration of object identifier arcs for applications and services using tag-based identification*.

[ITU-T Y.2201] Recommendation ITU-T Y.2201 (2007), *NGN release 1 requirements*.

[ITU-T Y.2701] Recommendation ITU-T Y.2701 (2007), *Security requirements for NGN release 1*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 application network interface (ANI) [b-ITU-T Y.2012]: Interface which provides a channel for interactions and exchanges between applications and NGN elements. The ANI offers capabilities and resources needed for realization of applications.

3.1.2 end user [b-ITU-T M.3050.1]: The actual user of the products or services offered by the enterprise. The end user consumes the product or service.

3.1.3 identifier [b-ITU-T Y.2091]: A series of digits, characters and symbols or any other form of data used to identify subscriber(s), user(s), network element(s), function(s), network entity(ies) providing services/applications, or other entities (e.g., physical or logical objects). Identifiers can be used for registration or authorization.

NOTE – Identifiers can be either public to all networks, shared between a limited number of networks or private to a specific network (private identifiers are normally not disclosed to third parties).

3.1.4 name [b-ITU-T Y.2091]: The identifier of an entity (e.g., subscriber, network element) that may be resolved/translated into an address.

3.1.5 service [b-ITU-T Z.100]: A set of functions and facilities offered to a user by a provider.

3.1.6 user [b-ITU-T Y.2091]: It can be an end user, a person, a subscriber, a system, an equipment, a terminal (e.g., FAX, PC), a (functional) entity, a process, an application, a provider, or a corporate network.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 associated information: The information which is associated with an identifier.

NOTE – Example associated information instances are URL, URN, IP address, E.164 number, etc.

3.2.2 B2B tag-based identification applications and services: This term refers to tag-based identification applications and services based on business relationships which involve exchanges of identification information between business partners.

3.2.3 B2B2C tag-based identification applications and services: This term refers to tag-based identification applications and services based on integrated business relationships of B2B and B2C which involve exchanges of identification information.

3.2.4 B2C tag-based identification applications and services: This term refers to tag-based identification applications and services based on business relationships which involve exchanges of identification information between business and consumer.

3.2.5 C2C tag-based identification applications and services: This term refers to tag-based identification applications and services based on business relationships which involve exchanges of identification information between consumers.

3.2.6 forward identifier resolution: A function to resolve an identifier into an associated information.

3.2.7 identifier resolution: A function to resolve an identifier into associated information (see "Forward identifier resolution") and vice versa (see "Reverse identifier resolution").

3.2.8 identifier scheme: It is a numbering scheme that specifies the format and structure of the identifiers used within that scheme.

3.2.9 ID tag: A physical object which stores one or more identifiers and optionally application data such as name, title, price, address, etc.

NOTE – It may have a communication capability with an ID terminal depending on implementations.

3.2.10 ID terminal: A device with a data reading and optional writing capability which reads (and optionally writes) identifier(s) and optionally application data from/into an ID tag.

NOTE – The data reading (and optionally writing) capability depends on implementations.

3.2.11 reverse identifier resolution (or backward identifier resolution): A function to resolve an associated information into a corresponding identifier. It is the reverse operation of the forward identifier resolution.

3.2.12 tag-based identification: The process of specifically identifying a physical or logical object from other physical or logical objects by using identifiers stored on an ID tag.

3.2.13 tag-based identification applications and services: Applications and services which use tag-based identification.

3.2.14 tag-terminal interface: A communication interface between ID tag and ID terminal. The ID terminal reads identifier(s) and optionally application data from the ID tag and/or writes them into the ID tag.

NOTE – The interface medium may be infrared, RF, camera, optical scanner, and galvanic current. Communication techniques depend on the interface medium.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

1D	1-Dimension
2D	2-Dimension
ANI	Application Network Interface
B2B	Business-to-Business
B2B2C	Business-to-Business-to-Consumer
B2C	Business-to-Consumer
C2C	Consumer-to-Consumer
DB	Database
DNS	Domain Name System
ENUM	TElephone NUmber Mapping
FAX	Facsimile
GPS	Global Positioning System
ID	Identification
IP	Internet Protocol
IrDA	Infrared Direct Access
ISBN	International Standard Book Number
LAN	Local Area Network
MAC	Medium Access Control
NGN	Next Generation Network
OECD	Organisation for Economic Co-operation and Development
OID	Object Identifier
PC	Personal Computer
PII	Personally Identifiable Information
POS	Point Of Sale
QoS	Quality of Service
RF	Radio Frequency
RFID	Radio Frequency Identification

SCM	Supply Chain Management
TCP	Transmission Control Protocol
TTI	Tag Terminal Interface
UNI	User Network Interface
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
URN	Uniform Resource Name
WAP	Wireless Application Protocol

5 Conventions

None.

6 Tag-based identification applications and services description and high-level reference service architecture

There are many applications and services which use identifiers over various operation layers. Here are examples: MAC address is a data link layer identifier; IP is a network layer identifier; port number is a transport layer identifier; cookie identifiers associated with web applications are session layer identifiers; and passport numbers are application layer identifiers.

This Recommendation does not cover all the applications and services using identifiers but is limited to applications and services using tag-based identification. Clause 6.1 describes the basic characteristics of tag-based identification applications and services covered in this Recommendation. Clause 6.2 describes some expected impacts on NGN. Clause 6.3 describes a high-level reference service architecture model.

6.1 Basic characteristics of tag-based identification applications and services

Use of identifiers in this Recommendation involves consideration of the following four elements:

- identifier;
- ID tag;
- ID terminal; and
- associated information.

Every tag-based identification application and service is described using the following three mandatory elements: Identifier; ID tag; and ID terminal. Applications and services which are not based on these three elements are out of scope of this Recommendation. The associated information element is optional.

Using this approach, RFID is a wireless communication technology used to transmit the identifiers stored in an RFID tag to an RFID terminal. Where the RFID tag is an ID tag, the RFID terminal is an ID terminal, the identifier stored in the RFID tag is just an identifier, and the information associated with the identifier is associated information.

6.1.1 Identifier

The identifier is described in clause 3.

6.1.2 ID tag

The identifier is required to be stored on the ID tag. The ID tag, which acts as a storage medium, is required to be read by the ID terminal. Examples of ID tags are 1D or 2D barcode tags, smartcards and RFID tags.

6.1.3 ID terminal

The ID terminal is required to read the identifier stored on the ID tag and the identifier is required to be transmitted to the ID terminal. The ID terminal is required to have a data reader. Examples of data reading techniques are RF, camera, optical scanner, IrDA, galvanic wire-line, manual key-in, etc.

Additionally, the ID terminal may have a capability to write identifier(s) and optionally application data on ID tags.

6.1.4 Associated information

The identifier may be associated with application/service-related information. Such associations may be maintained by a directory service. An identifier may have multiple associations.

6.2 Impact of tag-based identification applications and services on the network

According to the assumption of growth of telecommunications data traffic, transactions are expected to increase significantly when wide adoption of tag-based identification applications and services are achieved. On the other hand, even though total traffic will show dramatic growth during the course of dissemination of broadband services, traffic generated by tag-based identification applications and services will make up only small part of the total traffic. That is, tag-based identification applications and services will show a tremendous number of transactions but with a relatively small amount of traffic. Such transaction increases have various impacts on NGN.

Network resource management is necessary to cope with such transaction increases generated by tag-based identification applications and services, and to avoid access concentration on specific resources, in addition to the appropriate traffic management of NGN.

6.3 Reference service architecture model

Tag-based identification applications and services are provided through NGN as shown in Figure 1. Three interfaces called TTI, UNI and ANI are involved; however, the TTI is out of scope of NGN. Tag-based identification applications and services are provided to end users through the following three operations with the above interfaces: identifier reading, forward identifier resolution and information access from ID terminal's point of view.

An ID terminal reads identifier(s) from an ID tag via TTI. It requests forward identifier resolution(s) and receives corresponding associated information. If the associated information received is a URL, the ID terminal accesses the information content pointed by the URL. Thus, the forward identifier resolution is followed by a content retrieval operation through NGN.

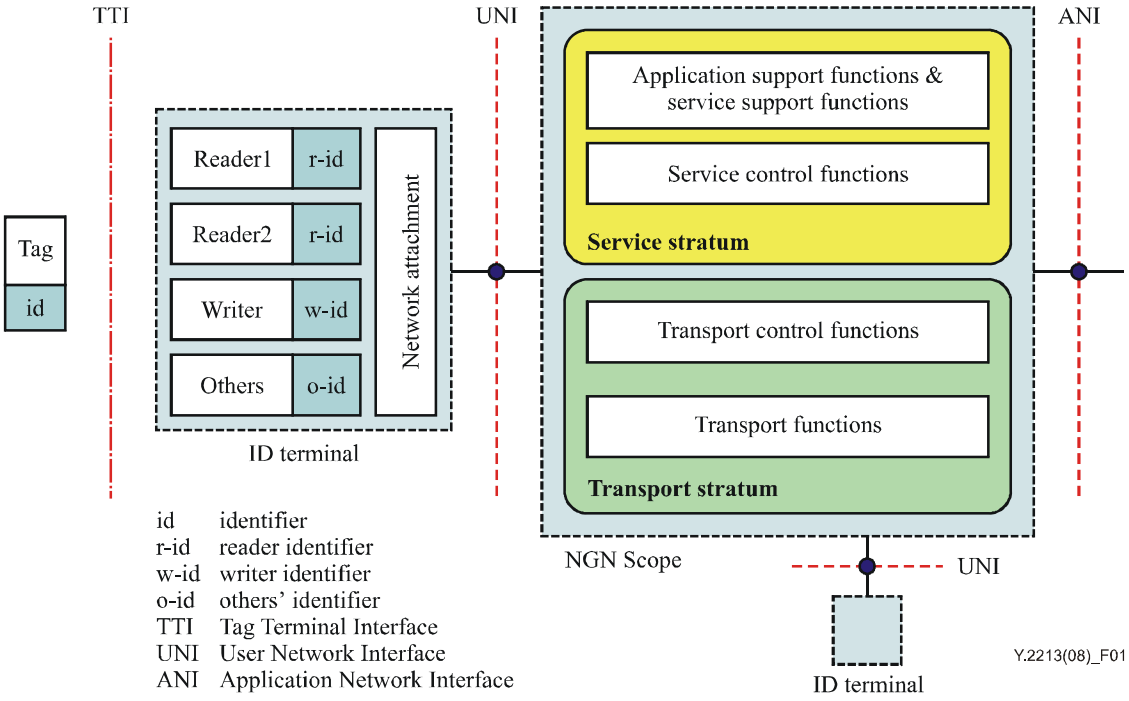

Figure 1 – Reference service architecture model

7 Service requirements of tag-based identification applications and services

The following are high-level service requirements for tag-based identification applications and services. These requirements identify the required extensions to the set of NGN release 1 capabilities. Requirements in Appendix I do not impact NGN capabilities and they are provided for informative purposes in order to develop tag-based identification applications and services over the NGN environment.

7.1 Multi-identifier interpretation requirements

An identifier constituted by sub-identifier elements is required to be interpreted into sub-identifiers by its structure information. An ID terminal is required to contain the structure information of the supported identifiers.

Tag-based identification applications and services have the following requirement to support multi-identifier interpretation:

- identifier structure information may be provided to an ID terminal.

7.2 Identifier resolution

Tag-based identification applications and services have the following identifier resolution requirements:

1) it is recommended to provide forward identifier resolution from an identifier to associated information;

2) support of a reverse identifier resolution from associated information to a corresponding identifier may be provided (see Note 1);

NOTE 1 – The reverse identifier resolution provides a means to find a specific identifier of an object and its location in the physical world, from the associated information of the object. This is like searching for a book and its location in a library by using the library catalogue.

3) it is recommended to support one-to-one association between an identifier and associated information;

4) support of one-to-many associations between an identifier and associated information instances may be provided (see Note 2);

NOTE 2 – The one-to-many associations enable different usages of an identifier among users of the identifier. For example, manufacturers may use identifiers for production planning and material/parts inventory control while retailers may use the same identifiers for store inventory management, out of stock alerts, anti-theft, etc., and consumers may use the same identifiers for product information retrieval.

5) different associated information for an identifier may be resolved according to usage context of the identifier, for example, who/when/where/why, which is called context-dependent forward identifier resolution (see Note 3).

NOTE 3 – Even though the same identifiers may be read by different users, each user is expecting different services and/or different information. Different services and different information are usually managed by different resources in different network locations. Therefore, the context-dependent forward identifier resolution is necessary to support this scenario. This forward identifier resolution will respond with different network addresses according to the context even though the same identifier is read.

7.3 ID terminal and ID tag management

Tag-based identification applications and services have the following requirements for remote management of ID terminals and ID tags:

1) it is recommended to manage ID terminals so as to read identifiers and relevant information from ID tags;

2) it is recommended to manage some types of ID tags' operation mode (e.g., active RFID tags may be booted up and/or put in sleeping mode remotely);

3) it is recommended to manage ID terminal and ID tag aspects such as:
   - radio operations;
   - networking operations;
   - software update;
   - time synchronization;
   - device identifiers (e.g., r-id, w-id and o-id in Figure 1);
   - identifier structure information;
   - filtering rules update; and
   - location registration and management;

4) when ID terminals and ID tags are managed locally, ID terminals and ID tags may report management information such as that related to the aspects listed above.

7.4 Content distribution control

Tag-based identification applications and services have the following requirement for content distribution control:

- it is recommended that facilities for control of information content distribution be supported (to accommodate possible commercial, regulatory and privacy requirements).

7.5 Privacy management

Some of the NGN services may have privacy impact for the users. Privacy invasions caused by usage of identifiers, ID tags and ID terminals may be summarized as follows: association threats, location threats, and information leakage threats. As an example, RFID technology may facilitate access to information pertaining to the merchandise that individuals wear and/or carry, and may

create an opportunity for abuse of this information such as tracking an individual's location or invading his/her privacy.

Tag-based identification applications and services have the following requirements:

1) it is recommended to meet the guidelines described in [b-OECD-Privacy-Protection];

   NOTE 1 – National situations may add other guidelines and obligations.

2) it is recommended to provide a privacy protection capability as specified in [ITU-T Y.2201];

3) it is recommended to manage PII protection policies in consistency with the general approach for security in NGN [ITU-T Y.2701]; and

4) the security approach for support of tag-based identification applications and services is recommended to be consistent with the general approach for security in NGN [ITU-T Y.2701].

   NOTE 2 – As the variety of NGN services is very wide, it is not possible to define good practices for all the possible situations. Furthermore, privacy impacts of a particular service may not be obvious. So, it is recommended to do a privacy impact assessment to identify privacy risks and take measures to mitigate them.

7.6 Location-based services support

Tag-based identification applications and services have the following requirements:

1) location information of ID terminal and/or ID tag is recommended to be registered (either statically or dynamically);

2) location information of ID terminal and/or ID tag may be provided if requested by tag-based applications and services.

7.7 Service quality control

There are many tag-based identification applications and services for business and consumer purposes. Some of them can be combined and interworked via various business agreements and partnerships. Such tag-based identification applications and services may have different service quality requirements.

Tag-based identification applications and services have the following requirement on service quality control:

- it is recommended to provide different service qualities according to service quality requirements.

7.8 Application transaction and traffic requirements

Tag-based identification applications and services place the following requirements on both NGN and application/service provider's resources:

1) it is required to manage the transaction volume generated by tag-based identification applications and services; and

2) it is recommended to be able to avoid access concentration to single resources.

8 NGN capabilities for tag-based identification applications and services

Tag-based identification applications and services use NGN release 1 capabilities but require some extended or new capabilities. The requirements given below are provided from a high-level perspective and are not intended to constitute precise functional requirements for NGN entities.

8.1 Requirements for extensions or additions to NGN release 1 capabilities

Based on the high-level service requirements described in clause 7, this clause specifies requirements for extensions or additions to NGN release 1 capabilities.

8.1.1 Multi-identifier interpretation

Based on the service requirements in clause 7.1, the following requirements are required to support the multi-identifier interpretation:

1) NGN is required to support the OID-based identification scheme specified by [ITU-T X.668] in order to distinguish identifier schemes unambiguously for tag-based identification applications and services; and

2) NGN may provide structure information of identifier schemes.

8.1.2 Identifier resolution

Based on the service requirements in clause 7.2, the following requirements are recommended to support identifier resolution capabilities of NGN:

1) NGN is recommended to provide forward identifier resolution;

2) NGN may provide reverse identifier resolution;

3) NGN may provide identifier resolution of multiple associations between an identifier and multiple associated information instances;

4) NGN may provide context-dependent forward identifier resolution, depending on usage context of identifiers;

5) NGN identifier resolution is recommended to scale in order to handle increased demand for identifier resolutions; and

6) NGN identifier resolution is prohibited from being affected by a single point of failure.

8.1.3 Privacy management

Based on the service requirements in clause 7.5, tag-based identification applications and services place the following requirement on NGN:

- NGN is recommended to adopt good privacy practices and provide a PII protection capability.

This capability is recommended to be consistent with the general approach for security in NGN [ITU-T Y.2701].

8.1.4 Content distribution control

Based on the service requirements in clause 7.4, tag-based identification applications and services place the following requirement on NGN for control of content distribution:

- NGN is recommended to support capability for content distribution control.

8.1.5 Device management

Based on the service requirements in clause 7.3, following requirements are recommended to support remote device management of ID terminals and ID tags:

1) NGN is recommended to support remote device management of ID terminal and ID tag aspects such as those listed in clause 7.3; and

2) NGN may receive updated management information of ID terminal and ID tag aspects such as those listed in clause 7.3.

8.1.6 Profile management

8.1.6.1 User profile

Based on the service requirements in clause 7.5, tag-based identification applications and services may use NGN release 1 user profile management capability with some extensions of user profile attributes as follows:

- NGN is recommended to support user profile management satisfying privacy management requirements.

8.1.6.2 Device profile

Based on the service requirements in clause 7.3, tag-based identification applications and services may use NGN release 1 device profile management capability with some extensions of device profile attributes as follows:

- NGN is recommended to support device profile management enabling remote management of ID terminal and ID tag aspects such as those listed in clause 7.3.

8.1.7 Quality of service

The transaction and traffic-related requirements in clause 7.8 place these additional requirements on NGN QoS capabilities:

1) NGN is required to support QoS capabilities to sustain the transaction volume caused by tag-based identification applications and services; and
2) NGN is recommended to support QoS capabilities to be able to avoid access concentration to single resources (e.g., identifier resolution).

8.2 Requirements supported by existing NGN release 1 capabilities

Based on the high-level service requirements described in clause 7, this clause specifies requirements supported by existing NGN release 1 capabilities.

8.2.1 Service quality control

The service quality control requirement specified in clause 7.7 is supported by existing NGN release 1 QoS capabilities.

8.2.2 Location management

NGN release 1 provides location management capability which determines and reports information regarding the location of users and devices within NGN.

The requirements in clause 7.6 are supported by existing NGN release 1 location management capability.

Appendix I

Non-NGN high-level service requirements

(This appendix does not form an integral part of this Recommendation)

This appendix describes high-level service requirements which enable new application/service provider functions and which will not affect the functional capabilities of the NGN. These requirements apply to tag-based identification applications and services. [b-ITU-T F.771] includes some service requirements from the point of view of multimedia information access.

I.1 General requirements for identifiers

An identifier is a fundamental component of tag-based identification applications and services. Applications and services may be triggered by identifiers. Identifiers have the following requirements:

1) identifiers are required to be unique, i.e., the identifier scheme is required to allow for uniqueness of identifiers;
2) identifiers may have a life time;

   NOTE – The lifetime requirement depends on applications and services.
3) identifiers may be managed by an identifier lifecycle management capability;
4) identifiers may be validated. For example, life time or revocation of identifiers may require validation of the identifiers;
5) identifiers may be used for registration or authorization [b-ITU-T Y.2091];
6) identifiers may be either "public to all networks", "shared between a limited number of networks", or "private to a specific network" [b-ITU-T Y.2091]; and
7) an identifier may be used by more than one application/service.

I.2 Requirements for identification of identifier schemes

Identifiers may be assigned using different identifier schemes and the identifiers created are required to allow for unique identification of the scheme used to create the identifier.

ID terminals of tag-based identification applications and services have the following requirement:

- identifiers assigned by a certain identifier scheme are required to be distinguishable from identifiers assigned by other identifier schemes, because NGN may handle various identifier schemes.

I.3 Requirements related to application data encoding

Identifier information may be encoded optionally with other application data like title, name, price, etc., into an ID tag. The following requirement allows for application data processing:

- application data is required to be encoded in a standardized way on ID tags that are used by tag-based identification applications and services.

For example, tag-based identification service providers can be retail shops, pubs, restaurants, taxi drivers associations, museums, galleries, movie production companies, and so on. They may want to provide enhanced and differentiated services to their consumers, which might require varying amounts of information to be captured as application data items, e.g., price, name, title, or location to be stored locally on the ID tag. To make this possible, application data needs to be stored in a standardized format (e.g., [b-ISO/IEC 15961] and [b-ISO/IEC 15962]).

I.4 Requirements for identification service interworking

Various tag-based identification applications and services have already been deployed with their own service network and without cooperative relationships because an identifier has been implemented in various fashions (e.g., ID tag types such as 1D or 2D barcode, RFID tags, contact or contactless smart cards) and service networks have been established separately. The following requirements are intended to facilitate interworking among these service networks:

- an interworking capability is recommended to be provided to allow interworking of different tag-based identification applications and services.

Following example application cases are possible:

- B2C tag-based identification applications and services can be combined with B2B into B2B2C application and service models.
- Bar code-triggered and RFID-triggered tag-based identification applications and services might be established independently but they may correspond to the same object. Integration requires interworking between these two tag-based identification applications and services.

I.5 Requirements for location information management

Location-based application models need location information. In particular, they need location information with regard to a device. For example, applications may require ID terminal location information or ID tag location information, and will know who is to use this location information.

With regard to use of location information, the ID terminal and ID tag locations can be usually assumed as being the same, because the user has to read ID tags usually within a few metres at a maximum. However, how to get the location information for the ID terminal and ID tag is different because:

1) user location, that is an ID terminal location, can be provided with an accuracy to about 10 metres by using GPS-based solutions; to a few hundreds of metres by using cell information from cellular networks; and variable accuracy depending on access network technologies used, as specified in [ITU-T Y.2201]; and
2) ID tag location may be included in the ID tag itself, or retrieved from a service provider via an identifier.

I.6 Requirements related to management of application mobility

Tag-based identification applications and services have the following management of application mobility requirement:

- application mobility is recommended to be provided among different tag-based identification applications and services, because an ID tag might be moved among them with a requirement that their communication associations be retained.

Application mobility means a communication association is handed over to other applications. A typical example is given for a transportation application. A sophisticated transportation system may charge for a single fare for the route from A to C via B where two transportation fare applications are associated from A to B and B to C. So, the association of a fare application between A and B has to be handed over to the other fare application between B and C in order to support the single fare association.

I.7 Requirements related to traceability

Traceability relates to object traceability and usage traceability. The object traceability can be seen as syntactic tracking of an object so every read point during the life time of the object can be traced regardless of application-perspective usages.

The usage traceability can be seen as semantic tracking of an object so how the object has been treated and what the object has been used for could be traced.

Tag-based identification applications and services have the following traceability-related requirements:

- it is recommended to provide the information on what ID terminals have read an ID tag for an object; and
- it is recommended to provide the information on what tag-based identification applications and services have read an ID tag for an object.

I.8 Requirements related to identifier filtering

Tag-based identification applications and services have the following filtering requirements:

- users, applications modules, middleware functions, or lower-layer read functions do not have to process unnecessary ID tags or identifier schemes. Proper filtering is recommended to be provided.

Appendix II

Classification of tag-based identification applications and services

(This appendix does not form an integral part of this Recommendation)

This appendix describes an application and service trend toward the social infrastructure, classification of relevant applications and services and some typical applications and service examples. It also describes how to identify tag-based identification applications and services that are covered by this Recommendation, by evaluating them with respect to the key elements identified in clause 6.1.

II.1 Overview of tag-based identification applications and services

Tag-based identification applications and services have already been widely adopted as business applications since its innovation. Recently, B2B tag-based identification applications and services have rapidly evolved.

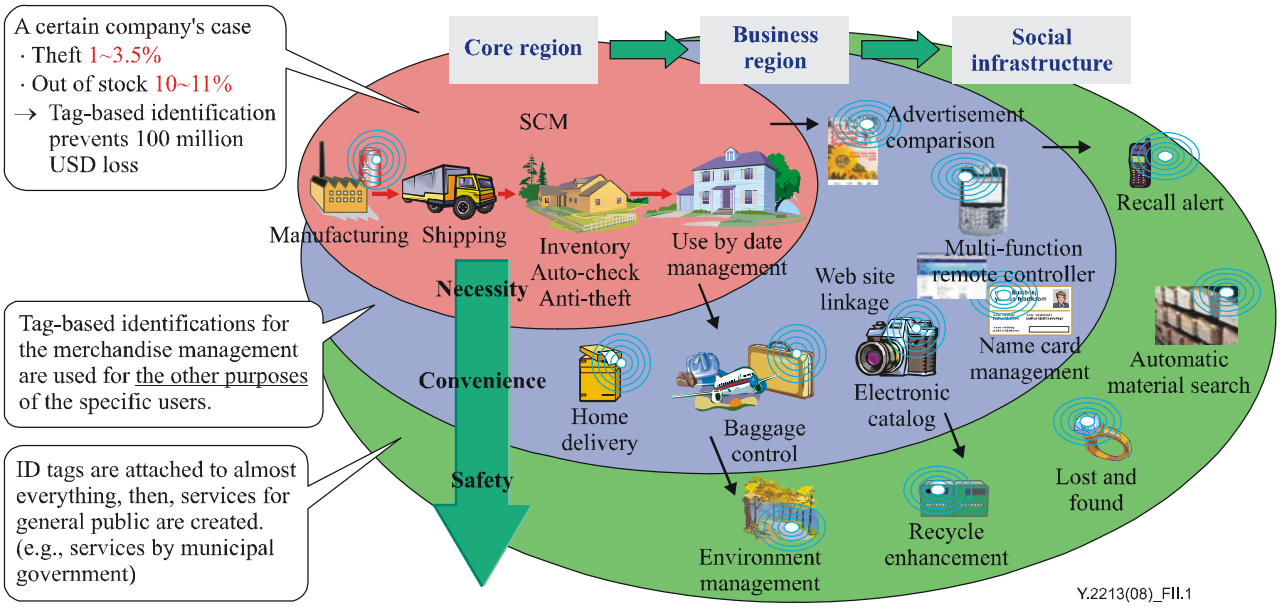

Figure II.1 – Tag-based identification application development toward social infrastructure

Figure II.1 shows a development model of tag-based identification applications and services from an application perspective. B2B applications are realized at first because they may be expected to justify the large investment of the initial implementations. An industrial entity (in many cases, the manufacturer of an object) starts the assignment of identifier to an object and the attachment of an ID tag to that object. For example, many entities are going to use the same identifier and ID tag for different purposes throughout the supply chain management (SCM). Manufacturers use these identifiers and ID tags for production control; transport companies for shipping control; wholesalers for inventory control; and retailers for inventory control; auto check-out; and anti-theft measures, respectively. This "core region" of tag-based identification applications adopted by a relevant industry is facilitated by the business necessity.

Once ID tags for objects are widely adopted by industries and resolving functions from identifiers to services and relevant databases are commonly used, many new derivatives of the "core region" applications are created by third parties for B2C/B2B2C applications; these are identified as "Business Region" in Figure II.1. The same identifiers and ID tags applied by the industrial entities

(i.e., manufacturers) are not only used for the primary industrial purposes (e.g., SCM), but also for the benefits of consumers (e.g., electronic information (instruction manual and/or catalogue) delivery of the product triggered by an identifier, home delivery management of the physical object, and so on). The convenience for consumers becomes the driving force for these new B2C/B2B2C applications.

In the further adoption of tag-based identification applications, it works for the improvement of social benefit. For example, information on the hazardous material used in consumer products is easily obtained by knowledge of the identifiers, which promotes enhancement of recycling and reduction of the environmental burden by the proper disposal by consumers. Tag-based identification applications are also quite effective for recall alerts and collection of the recalled products. In addition, ID tag-equipped "smart medicine" enables automatic alarms, when any ill effects occur with simultaneous usage of two medicines. In this stage, tag-based identification applications are incorporated into the social infrastructure.

Throughout the development to the wider usage of the tag-based identification applications and services in Figure II.1, interoperability among B2B and B2C/B2B2C tag-based identification applications and services is an essential issue and the same or interoperable technical standards are utilized by multiple entities for multiple purposes.

II.2 Classification of tag-based identification applications and services

Tag-based identification applications and services can be classified according to two viewpoints: business relationships and usage types.

From the business relationship viewpoint, tag-based identification applications and services can be classified into closed domain, B2B, B2C, B2B2C and C2C categories.

From the usage type viewpoint, tag-based identification applications and services can be classified into reader-based and tag-based categories. The tag-based category does not apply to B2B applications.

The reader-based type refers to the case where a user terminal is equipped with an identifier reader which is used to read an identifier from an ID tag. But the tag-based type refers to the case where a user terminal has an attached ID tag and other readers read an identifier from the terminal's ID tag.

II.3 Examples of tag-based identification applications and services

The feature of identification has been used in a barcode form for a long time for business purposes in retail shops, logistics, automotive and aviation, pharmaceutical industries, inventory management, manufacturing and processing, supply chain management, transportation, etc.

Such identification is used:

- to identify products at retail shops; and
- to identify and route products, monitor delivery paths of products, exchange product-related information between business partners, and so on.

The former type corresponds to a single enterprise scope without exchanging real-time business information between business partners. So, it can be just called a tag-based identification business application. Typical examples include:

- inventory management;
- security and access control;
- agriculture;
- library;
- parking management.

The latter type corresponds to a business relationship among multiple business partners. So, it can be called a B2B tag-based identification application because identification information is exchanged in a B2B manner. Typical examples include:

- supply chain management;
- food chain management;
- manufacturing and processing;
- transport and logistics;
- pharmaceutical industry.

Additionally identifier users may be human consumers. Information services and value-added services may be provided to consumers when the identifier information is processed. Such tag-based identification applications are called B2C tag-based identification applications. Examples of these include:

- personal welfare and safety;
- sports and leisure;
- bus and subway route search;
- advertisement and detail information retrieval;
- on-line shopping;
- payment;
- drug safety;
- location-based information service.

Additionally a business partnership may integrate B2B with B2C applications so that B2B2C business associations may be developed. Examples of B2B2C tag-based identification applications include:

- food chain information service;
- home delivery service;
- product origin check.

Moreover C2C applications are also possible. A typical example is the case where a cell phone user uses his cell phone, which contains both an ID terminal and an ID tag, to read an identifier and application data from other cell phones. For example, one of two movie tickets, which a man bought and of which associated data was stored in his cell phone, could be transferred to a cellular phone of his girl friend. In this example, a movie ticket transfer can be performed directly between two terminals without the use of any network communication. Additionally, a movie ticket exchanged and displayed on a receiver's screen can have embedded advertisement information content which was provided via a network operation. Resultant applications will depend on implementations. So, C2C interactions may also be involved in, and require network functions.

Example scenarios of tag-based identification applications and services are described in Appendix III.

II.4 Evaluation of tag-based identification applications and services

This clause provides examples of how to evaluate applications and services in the context of the key elements, so as to determine if they are covered by this Recommendation.

Table II.1 – Evaluation of tag-based identification applications and services

Application or service	Evaluation in the context of the key elements
General telecommunication service in which an E.164 identifier for the called party is used.	Identifier: E.164 ID tag: Not applicable: the identifier is stored in human brain, a phone book, an electronic form, or otherwise. ID terminal: Applicable: it is the telephone. The identifier is transmitted via manual key-in or dialing at the telephone. Associated information: Applicable: an E.164 identifier can be mapped to a set of information resources via the ENUM technique so that an identifier resolution process may be followed. Conclusion: [Invalid] As all of the three mandatory features are not present, it is not a tag-based service.
In the above service scenario an old father uses an identifier reader-equipped phone or terminal; an ID tag embedding an E.164 phone number for his son is affixed to a photograph for the son; he aims or touches his phone or ID terminal at/to the photograph; and then he gets an automated calling to his son.	Identifier: E.164 ID tag: Applicable: an ID tag containing the identifier is affixed to the photograph. ID terminal: Applicable: it is the phone or the ID terminal. The identifier is transmitted via RF, camera, or other identifier reading techniques to the phone or terminal. Associated information: Not applicable. Conclusion: [Valid] As all of the three mandatory elements are present, it is a tag-based service.
Internet network equipment use the IP addressing scheme to identify a termination point of datagram routing, resulting in distinguishing an IP network node over the global Internet.	Identifier: IP address ID tag: Not applicable: the identifier is stored at network equipment. ID terminal: Not applicable: the identifier is transmitted on-line between network equipment, not between ID tag and ID terminal. Associated information: Applicable: IP addresses can be mapped to domain names and DNS provides resolution of their mapping relationships. Conclusion: [Invalid] As both an ID tag and an ID terminal are not involved, it is not a tag-based application.
TCP/IP applications use the IP and port addressing scheme to identify a transport end point.	Identifier: A pair of IP/port of source and destination nodes ID tag: Not applicable: the identifiers are stored in running application programs in computer systems. ID terminal: Not applicable: the identifiers are transmitted on-line between the application programs, not between ID tag and ID terminal. Associated information: Not applicable. Conclusion: [Invalid] As both an ID tag and an ID terminal are not involved, it is not a tag-based application.

Table II.1 – Evaluation of tag-based identification applications and services

Application or service	Evaluation in the context of the key elements
Web browsers use cookie identifiers to identify a semantic association over TCP connections in networked computer systems.	Identifier: Cookie number ID tag: Not applicable: the identifier is stored in running application programs in computer systems. ID terminal: Not applicable: the identifier is transmitted on-line between the application programs, not between ID tag and ID terminal. Associated information: Not applicable. Conclusion: As both an ID tag and an ID terminal are not involved, it is not a tag-based application.
Book applications use ISBN (International Standard Book Number) to identify books.	Identifier: ISBN ID tag: Applicable: the identifier is stored mostly at a cover page of book in a barcode form. ID terminal: Applicable: the identifier is transmitted via an optical scanner, that is, ID terminal. Associated information: Applicable: the identifier is related to an information resource. An identifier resolution between them is required via a query process with a database system or via a communication protocol with a remote directory service. Conclusion: [Valid] As all of the mandatory elements are present, it is a tag-based application.
Many applications use URI (Uniform Resource Identifier) to identify a network resource with describing access protocol, transport point, access authority, network and file system location, and query and fragment information.	Identifier: URI: URI itself can be used as an identifier. ID tag: Not applicable: the identifier is stored in running application programs in computer systems. ID terminal: Not applicable: the identifier is transmitted on-line between the application programs. Associated information: Not applicable: the identifier is self-descriptive by the URI specification. Conclusion: [Invalid] As all of the mandatory elements are not present, it is not a tag-based application.
The government uses an identifier scheme to identify their people.	Identifier: Passport number, for example. ID tag: Applicable: the identifier is stored on a cover page in the passport. ID terminal: Applicable: the identifier is transmitted via an optical scanner Associated information: Applicable: an identifier resolution is required via a query process with a database system or via a communication protocol with a remote directory service. Conclusion: [Valid] As all of the mandatory elements and other optional elements as well are present, it is a tag-based application.

Table II.1 – Evaluation of tag-based identification applications and services

Application or service	Evaluation in the context of the key elements
Every network node uses a MAC address to identify network nodes within a LAN scope.	Identifier: MAC address ID tag: Not applicable: the identifier is stored in node systems. ID terminal: Not applicable: the identifier is transmitted on-line between the node systems. Associated information: Not applicable. Conclusion: [Invalid] As all of the mandatory elements are not present, it is not a tag-based application.
NOTE – "[Valid]" means the application or service is considered as a tag-based identification application or service by the evaluation result, and "[Invalid]" means the opposite case.	

Appendix III

Example scenarios of tag-based identification applications and services

(This appendix does not form an integral part of this Recommendation)

III.1 Closed-domain tag-based identification applications and services

The following tag-based identification applications operate within an enterprise scope which is not limited geographically. So they can work in a closed domain of a nation-wide or global enterprise network. The enterprise scope means identification operations are not associated with outer parties as shown in Figure III.1.

A company installs multiple ID terminals within its factory. A proprietary inventory management system within a small work domain, for example, a library, can use this network configuration.

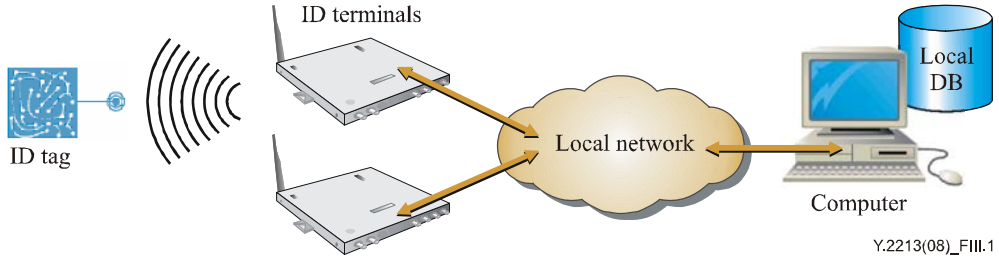

Figure III.1 – Small scale enterprise-scope configuration

An enterprise network can be expanded nationwide in a closed domain as shown in Figure III.2.

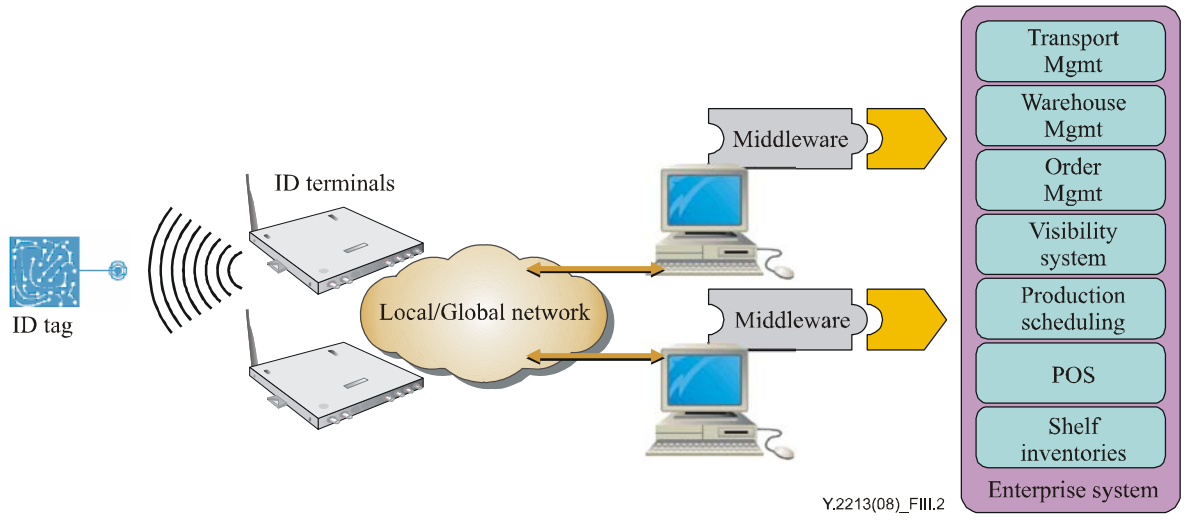

Figure III.2 – Large scale enterprise-scope configuration

III.1.1 Inventory management

A simple inventory management system is installed in a warehouse stocked with materials for manufacturing or products for sale. ID tags can be attached to item-level end products, packaged boxes, transport packages, and freight containers. Such managed objects have a transport route made by conveyer belts, transport robots, forklifts, etc. ID terminals are installed at control and monitoring points in transport routes and read identifiers from managed objects. This system allows

every incoming and outgoing object to be tracked automatically and shortages of materials can be prevented.

Usually such inventory management does not operate solely within the warehouse but typically interworks with other business application systems such as procurement, sales, manufacturing, transportation, etc., as shown in Figure III.2. Using these applications, a manufacturer can enjoy better performance of its business operations.

III.1.2 Parking management

A parking lot may adopt a tag-based parking management for parking fee, parking permit, etc. ID tags are attached to cars and an ID terminal at a gate reads identifier information from ID tags. Then the cars can be identified and parking fees can be calculated according to parking times. Entrance control also is possible with the tag-based parking management application.

A parking business company may have to handle multiple parking lots distributed in a city or nation where network functions will be needed.

III.2 B2B tag-based identification applications and services

Most existing tag-based identification applications and services correspond to the B2B type and have used identification information in a barcode form. But RF-based identification, called RFID, has been evolved dramatically with low cost solutions and is being adopted for various business applications.

A typical B2B network configuration can be depicted as shown in Figure III.3. In this case, the large scale enterprise-scope configuration is expanded to other business partners that may have their own distributed work forces. Thus, multiple networked enterprise networks are combined and then a globally networked B2B business partnership is made where identifiers are required to be globally unique.

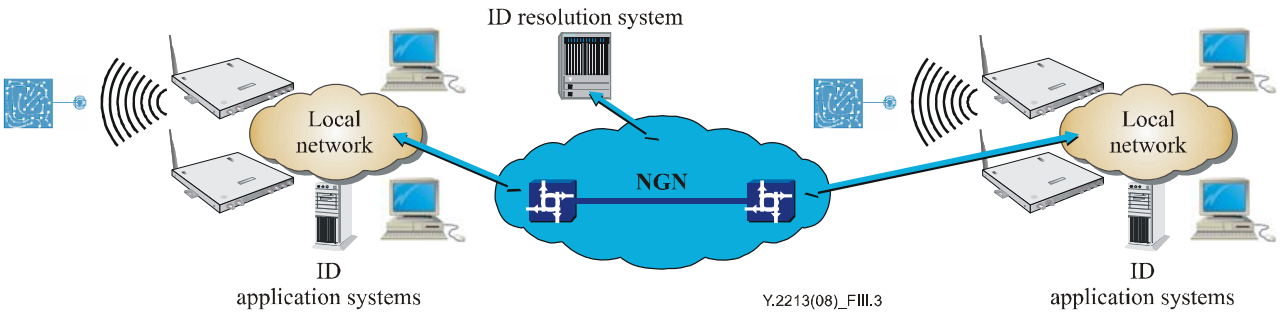

Figure III.3 – Globally networked B2B configuration model

III.2.1 Supply chain management

The supply chain management has a huge business flow with various business partners. So, application scenarios could be realized in a variety of implementation cases. The following chain is a simple case.

A company manufactures home appliances to which ID tags are attached and transports them to its warehouse in which inventory management is performed. A wholesale company orders a set of appliance goods. The manufacturer transports them from its warehouse to a warehouse of the wholesale company and then sends the wholesale company a message containing the following: the shipment notice, identifiers for the shipped appliances (read by ID terminals at the warehouse gate of the manufacturer), the volume shipped, the driver's information, etc. Such transportation is usually provided by a transport business company between the manufacturer and the wholesale company. At an entrance gate of the warehouse of the wholesale company, ID terminals read ID

tags from the appliance goods off loaded from a freight container and an SCM application of the wholesale company gathers all identifiers and analyses them to determine whether all the goods have arrived or not. Then the wholesale company responds with a reception notice to the transport company and the manufacturer.

In this scenario, identification information is exchanged between the manufacturer and transporter, the transporter and wholesaler, and the manufacturer and wholesaler in a mesh relationship. The more business partners involved, the more such chained relationships are created.

III.2.2 Manufacturing and production management

A manufacturer needs various materials to make goods at a factory and the materials are usually supplied by business partners. ID tags are affixed to materials and boxes of packaged materials in a transport unit. A supplier's ID terminals read identifiers from the materials and boxes at the originating shipping location. The supplier sends the identifiers to the manufacturer and the manufacturer receives them. ID terminals of the manufacturer read identifiers from the materials and/or transport boxes off loaded from a freight container and the manufacturer analyses the identifiers to determine whether all items were received or not. Received materials will go into a warehouse and sometime later will go out to manufacturing lines consisting of a set of conveyer belts. Materials should be routed to a proper conveyer belt. ID terminals at routing points read identifiers from the materials and provide appropriate signals to routing devices.

III.3 B2C tag-based identification applications and services

Figure III.4 shows a B2C network configuration model. Consumer terminals are connected to the service provider network which maintains and provides information contents to consumers. The information contents may be made by the service provider or content providers which are established into a logically single business domain. So the B2C model is realized as shown in Figure III.4.

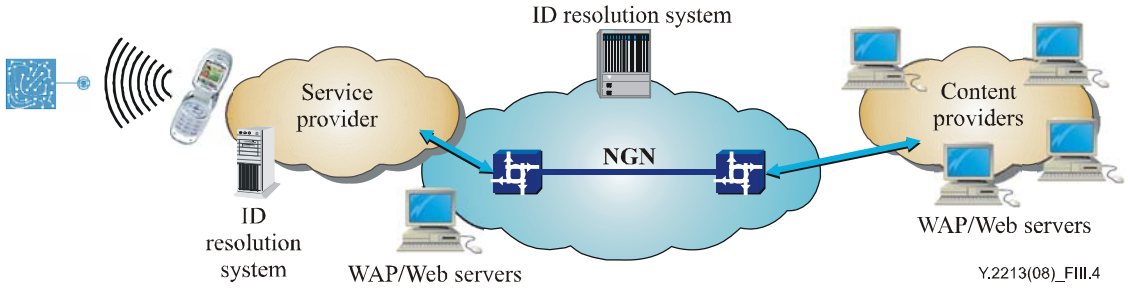

Figure III.4 – Globally networked B2C configuration model

In the B2C model, an ID terminal may be equipped additionally with an ID tag with which different types of tag-based identification applications and services can be provided as in clause III.3.3. User property is dynamic for consumer applications because service targets are human end users, but it is static for business applications because service targets are business logics of the business applications. Such different user properties produce different service characteristics as follows:

- Within a B2B environment, application information is exchanged between application systems in standardized procedures, methods, presentation styles, data structures and formats, etc., which keep used for a long time. Then an automated work process can be provided. Such service property requires a formatted data syntax which should not be changed frequently.
- Within a B2C environment, information is exchanged between business application and human. Since human users are arbitrary and may have different feelings and requirements,

an agreement on service procedures, methods, presentation styles, data structures and formats, etc., is almost impossible. So a service provider chooses a way to adapt them and provides resulting contents to end users. The contents, however, might be changed frequently by trend, culture, events, accidents, news, etc.

III.3.1 Bus and subway route search

A bus passenger reads ID tags attached to bus stop signs, gets aware of his location from the tags, inserts his destination at an input interface, and then acquires the optimum route via subways and/or buses to the destination. If he is at an inappropriate location to take a bus or subway, he gets directions on how to go to the proper location as well as the optimum route.

III.3.2 Mobile shopping

A consumer looks around a shopping mall to buy something. His cell phone equipped with an ID terminal reads ID tags attached to a shelf or items for buying and presses "order" using a shopping application user interface. In the end, he pays for chosen items as in on-line shopping. The mall packs and delivers the ordered items to his pre-registered postal address.

III.3.3 Tag-based payment

This application is a use case of payment based on ID tag, ID terminal and identifier.

When a passenger gets on a bus, he places his ID tag-attached terminal near a bus fare device and pays for the bus fare. The fare system may be connected to the network or work in the batch mode for further work flow processing. A detail payment process depends on implementations but an identifier of the passenger is transmitted to the fare device all the time.

III.4 B2B2C tag-based identification applications and services

This type of applications is a combined case between B2B and B2C applications as shown in Figure III.5. A B2B domain in the right side of Figure III.5 is connected to the B2C domain in the left side. Information resources made by the B2B domain are transmitted to the B2C domain by which they may be processed and/or upgraded for an enhanced service and then provided to consumers. The broker/gateway could be inserted into the B2C domain for intermediary proxy services such as identifier resolution, media transformation, content translation, filtering, etc.

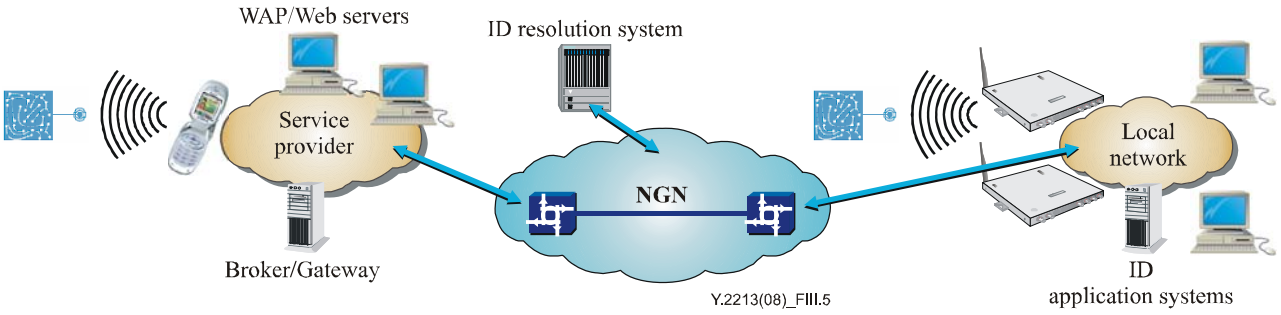

Figure III.5 – Globally networked B2B2C configuration model

III.4.1 Food chain information service

In case of vegetable goods, a tag-based distribution application scenario involving vegetable farms to wholesale markets or vegetable stores is very similar to the previous B2B cases. As before, business-oriented information including identifiers read from ID tags is exchanged between and used by business partners.

In B2B2C models, a single business corporation can care for both B2B and B2C applications or another business company provides B2C services by inter-operation with B2B applications by a business partnership contract.

At a vegetable store, a consumer browses vegetables to find better quality goods and his cell phone equipped with an ID terminal reads an identifier from a chosen vegetable to check the place of origin, harvest date, quality certification, etc. Then he can decide to buy better vegetables with such information which is prepared by a contracted business operation between B2B and B2C domains.

III.4.2 Home delivery service

This is a kind of postal service. A consumer asks a post office to send a postal package to someone. The office affixes an ID tag for delivery control in various transportation networks where many transportation agents may be involved with reading and using identifiers for routing decisions for proper delivery. That is, identification information is used in a B2B domain.

The sender reads an identifier from a receipt issued by the post office and checks delivery status for the postal package. A post man delivers the package to a receiver and his information terminal equipped with an ID terminal reads the identifier from the delivered package and sends a delivery confirmation message to the sender.

III.5 C2C tag-based identification applications and services

III.5.1 Business card exchange

The consumer-to-consumer relationship can be realized by an intervention of business domains or a direct connection between consumers. It depends on implementations.

A user terminal may have ID terminal as well as ID tag. That is, it works sometimes as a terminal and sometimes as a tag. When a user meets someone for the first time, he aims his terminal at or touches it to the other person's terminal to read identification information consisting of identifier, name, contact address, etc. Using this process business card information can be exchanged.

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