

## Cards for all seasons

by Chris Stanford, ITSO Technical consultant on card development and specification

**W**e all, almost without exception, carry plastic cards, which are now used to help us spend money, talk to friends, travel around and enter our office. Such ubiquitous use could only have been facilitated by International Standards.

The requirement for international standardization of cards was historically driven by the needs of the financial services industry for a globally-accepted method of payment. Subsequent to the introduction of the credit card in the 1950s, the technical interoperability, test methods and number registration, standards for magnetic stripe financial cards were developed and are still in widespread use today.

### Innovating with smartcard

Smartcards first appeared in the late 1970s. Being a novel mix of electronics carried within the same size printed plastic card, they gave the global payments industry the opportunity to add "intelligence" – albeit limited – to the dumb magnetic stripe card.

Having a card that could keep secrets – whilst at the same time being able to check an interrogating terminal was genuine – and the cardholder was entitled to use it. It was a big step forward in the security functions that could be carried out with or without the assistance of a transaction processing system somewhere at the other end of the planet. Smartcards were a new technology that gave the global payments industry an opportunity to address some of the problems emerging in its established market.

**“Smartcards would have been unachievable, in the global marketplace, without International Standards.”**

### New technology for new markets

Smartcards are a new technology looking to establish new markets, even though conventional wisdom says not to start a new market with a new technology! Either opportunity would have been unachievable, in the global marketplace, without International Standards.

Thus smartcards, which rapidly become a commodity item when used in significant numbers, needed International Standards before they could be used in any quantity at all. High volume production and lower prices in turn facilitated their use in non global markets. This led to the development of the contact smartcard standards, without which the use of 2 billion mobile phones and 0.5 billion payment smartcards would not have happened.

Interestingly, the new technology did establish a new market for the use of mobile phones throughout the world; it did this before the financial community (outside of France) began to adopt the new technology in its existing

market. One of the reasons for this apparent reverse logic was the need to alter an existing terminal and systems infrastructure versus starting from scratch as in mobile telephony.

### Standards for contactless cards

Contact smartcards have to be plugged into a terminal when used. This was seen by some as having all the disadvantages of a plug and socket – especially a plug that was potentially covered in dirt, and a socket that might have had all kinds of nasty things pushed into it! Some of these fears (perhaps exaggerated by early protagonists of contactless smartcards), have indeed proved groundless but the convenience and that "little bit of magic" of a slot-less high speed touch-and-go approach to the use of a plastic card, appealed to the public transport industry. More recently immigration control and the global payments industry have identified the benefits. Thus the development of contactless card standards was born.

When I wrote a new work item proposal for a contactless card standard in 1988, I did not realize the extent of what would transpire. Today, there are three published families of contactless card standards, alongside their associated test method standards, and a raft of business sector specifications that use them. In addition, new standards for tagging radio frequency identification (RFID) and mobile terminal communications, known as Near Field Communications (NFC), use the same radio frequency interfaces as specified in the card standards.

All these standards maintain a high-level of backwards compatibility with the previous generation of technology, and each generation of technology has not only given existing card issuers new opportunities but opened up new markets for new card issuers. The **Figure** illustrates the main market drivers and the array of standards developed to satisfy the demands for global services using cards or card technology.

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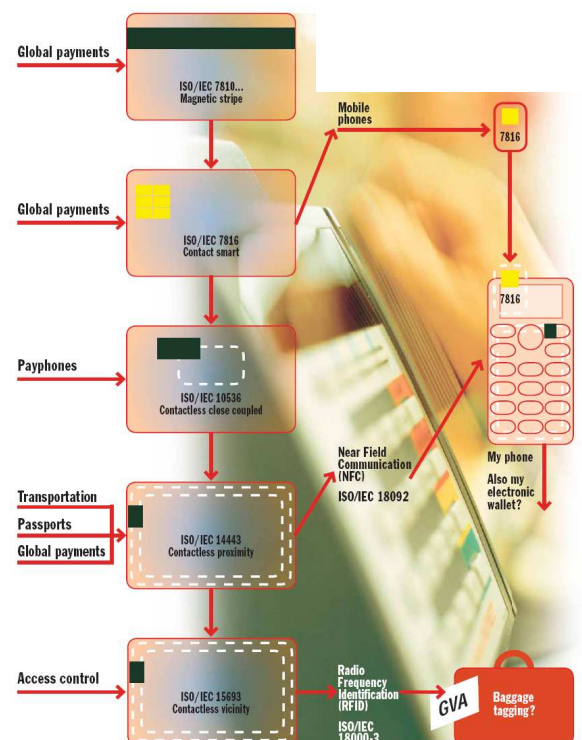
ITSO launched the new section of its website dedicated to ITSO suppliers.

You can find information about their products, services and contact details of key people involved with ITSO related issues.

ITSO Suppliers willing to contribute to the Suppliers Directory or amend their entry should send their material to [admin@itso.org.uk](mailto:admin@itso.org.uk).

Please note that material provided by those who are ITSO Registered Suppliers will not be uploaded to the ITSO web-site but will be included into e-mail distribution of Suppliers Directory only.

This is a restriction of the Registered Supplier status against the Full ITSO Membership status.



### Creating a low-cost communications interface

The development of several contactless card standards has seen a number of pioneering technologies come and go, and some pioneering companies disappear altogether! The common thread throughout the development of these standards was to create a low-cost communications interface that did not use any direct electrical connections but could transfer data between a card and a terminal, whilst at the same time powering the card. The techniques needed for such an interface are distinctly different depending on the operating distance between the card and a target on the interrogating terminal.

Three different contactless standards were developed, largely in order of range of operation with each subsequent standard gaining from the technology and expertise harvested from its predecessor (see table on the right).

### Developing "slotless" cards

Developed with the remit of a direct contactless replacement for the contact card, the main market driver was a more reliable potentially slotless equivalent, of the hundreds of millions of pre-paid optical, magnetic and contact cards used in payphones. The advantages being that without a slot to become blocked up, reliability would be improved and maintenance costs reduced.

This first contactless standard was largely based on a combination of inductive coupling and modulation techniques, which became a common thread through all three varieties of contactless card standards, and reached by the modification and harmonization of technologies. This was offered by three major organizations : AT&T Worldnet Service, GEC<sup>1</sup> and Philips, of which only Philips remains involved with contactless card technology today.

With the success of the mobile phone, the pre-pay card payphone market disappeared very quickly, and with it, the critical mass needed for use of products based on this standard evaporated. Although this standard is now seldom used outside of Japan, it created a nucleus of experts familiar with the technology to contribute to the development of the globally successful proximity card standard.

Whilst ISO/IEC 10536, *Identification cards – Contactless integrated circuit(s) cards – Close-coupled cards*, consolidated the early interest shown in contactless card technology as manifested in technology trials in payment systems (Midland Bank at Loughborough University in 1988) and in the transport industry (London buses in 1989), the proximity card standard evolved to capitalize on these opportunities.

### Driving high speed transaction capability

The requirements for proximity contactless technology are driven by the high speed touch-and-go operation of the card with the terminal.

Transport authorities throughout the world latched on to the fact that they could validate tickets and speed throughput at barriers, and at the same time cut costs by the replacement of mechanically complex magnetic ticket readers. Consumers would be able to use their card without letting it go or losing sight of it and simply present it to the terminal to perform a transaction. Any market looking for high speed transaction capability, could become the driver for the proximity card standard.

Year of publication	Contactless card variety	Standard	Distance of operation
1996	Close coupled	ISO/IEC 10536	Touching the target
2001	Proximity	ISO/IEC 14443	Up to 100 mm from the target
2001	Vicinity	ISO/IEC 15693	Up to 1m from the target

By looking at the challenges presented for the accomplishment of longer range operation the contactless cards became inextricably linked to those parts of the radio frequency (RF) spectrum available for global use. This linkage and the calculation that the most cost-effective technology would be achieved by using a frequency between 6 and 15 Mhz led to the migration of the standard to the globally available ISM frequency of 13.56 Mhz, a range of frequencies used for license-free wireless communication. Even so the regulations covering the use of this frequency varied between the USA, Europe and Japan, thus an effective contactless card standard involved influencing the RF regulatory bodies to globally harmonize their national requirements at this frequency. This proved to be a slow process but success was gradually achieved.

The proximity cards standards were driven by technology from two organizations (Mikron (later to become part of Philips) and Motorola). The basic inductive coupling and modulation principles were migrated to 13.56 Mhz from the 3 to 5 Mhz used by ISO/IEC 10536, *Identification cards – Contactless integrated circuit(s) cards*, and the communications interface enhanced by the introduction of an option to use lower modulation depths. In recognition that there may be more than one contactless card in a person's wallet, "anti-collision" protocols were introduced to detect and select one card from many. The standard evolved and embraced two similar communications techniques known as type A and type B, but mandated that both would be accepted by a standard terminal. For the lower OSI layers contactless cards are of necessity different from contact card standards, however, for the higher layers the command set converges with and uses the contact card standards for compatibility.

It has been said that the contactless interface is an "order of magnitude", more difficult to characterize and test under all conditions than contact cards. To this end much work was done to develop the test methods in ISO/IEC 10373-6, *Identification cards – Test methods – Part 6: Proximity cards*. Work still continues to refine the test methods and develop a more embracing test environment for the interface.

### Reaping the rewards of innovative technology

The success of the proximity card is now self evident, over 200 million are used in public transport applications in the Far East, Europe and in the Americas. There are a number of transport industry open specifications using ISO/IEC 14443, *Remote coupling communication between an ISO card and related device*, as a foundation, notably those in France, Germany and the United Kingdom, and these specifications are converging on the work – now largely complete – in the European Committee for Standardization (CEN) for an interoperable public transport application standard. A more recent development has been to fast track another CEN standards initiative in ISO, to cover the back office architecture of interoperable fare management

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## ENGLISH CONCESSIONARY TRAVEL TO GO NATIONWIDE

The Chancellor's 2006 budget statement that England will have free nationwide concessionary travel on local buses from April 2008 has significant implications for smartcard schemes.

Whilst details of how the provision will be delivered in April 2008 have yet to emerge, there are some requirements that are already obvious and for which there is an answer now.

Imagine, someone from Cumbria, where the concessionary pass is a Mifare smartcard, visits Cornwall, where the indigenous concessionary

pass is a JCOP card. When they use the local transport system, the equipment must be capable of recognising both types of card and the entitlements upon them.

It may also be that both Cornwall and Cumbria will need to know about that journey (although the reimbursement procedures are not yet known), and so data records recognisable to all may need to be transmitted nationwide.

However these issues are to be resolved, and if the Cumbrian card is to be accepted in Cornwall, there is a requirement for a common specification for interoperable smartcards across disparate and varied

schemes – in other words an industry standard.

That standard already exists in the form of the ITSO Specification. Sponsored originally by the DfT and Crown Copyright, it is now being implemented by suppliers and scheme operators alike. It is the only industry standard that meets Local Authority procurement rules in that it is the only specification that complies with existing European standards such as EN 1545.

For more details please refer to ITSO website [www.itso.org.uk](http://www.itso.org.uk) or contact Peter Stoddart, ITSO Head of Marketing, at [marketing@itso.org.uk](mailto:marketing@itso.org.uk).

### ITSO & ROAD TOLLING

ITSO was specifically created to handle road tolling, as well as interoperable travel products. It also has a secure Stored Value product suitable both, as a national or operator specific purse.

For a road tolling scheme the in-car and roadside unit would both be treated as part of a POST, with the ISAM residing in the road-side unit, securely communicating with the in-car unit with its ITSO card and reader, by a secure protocol and interface.

The ITSO specification requires complete end-to-end transaction processing to be complete in less than 200mS. This is achievable because the ISAM runs at up to 5Mhz, and has 4MB of storage allowing over 300k typical transactions per hour. A new ISAM is in preparation with even higher specification. The road tolling IPE would not be seen as a particularly high demand product on the ISAM. The ITSO process is loss-less, and includes anti-tear with a transient ticket log to support check-in/check-out tolling as well as pay-on-entrance or exit.

ITSO also supports a range of media, ranging from Phillips Ultralite and Innovision Jewel, to secure cards such as Phillips Desfire and generic Microprocessor cards such as JCOP30. To date we have over 25 different cards/media either approved or certified through our testing and certification service.

Details of our Road Tolling product entity (TYP26) can be found in Part 5 of our Specification, which is on our web site [www.itso.org.uk](http://www.itso.org.uk). To gain access to the Security elements of our specification (Part 8), your company will need to complete an NDA. This can be obtained from [admin@itso.org.uk](mailto:admin@itso.org.uk).

The ITSO Specification is free for use throughout the world, but does have Crown Copyright. Any copies used in other schemes must give reference to this copyright. The ITSO SAM is also available for sale for use outside the UK; the cost is currently about Euro100 per unit.



## Cheshire County Council awarded DfT contract for Low Cost Smart Card Investigation

Cheshire County Council has recently been awarded by DfT a two year contract for Low-cost Smartcard Investigation. It is expected that low cost or disposable smart cards will provide the potential for enhanced flexibility, availability and distribution opportunities. The proposed card trials will align with the Cheshire scheme's current ITSO development and will be fully researched and evaluated.

Chester University and a range of sub-projects with employers' statutory Travel Plans across Cheshire. The trials will account for up to 20,000 cards (Mifare Ultralight and Innovision Jewel), using all the small memory IPEs (i.e. 27,28 & 29). The products available to passengers will include a range of multi-journey options, day rover carnets and period passes, available in a variety of durations. With Magnadata Cheshire County Council has recently achieved ITSO certification for the Mifare Ultralight card, and certification for the Innovision Jewel will follow in June.

Helen Mitchell, Travelcard Development Officer for Cheshire County Council, commented 'The Low-cost Smartcard Investigation will allow Cheshire to use its strong scheme basis to experiment with and trial other card media in the ITSO specification, alongside conventional media. The research and subsequent evaluation will not only play an important role in terms of Cheshire adopting Low cost cards permanently, but will also provide strong evidence for other schemes looking to utilise the media.'

The trials will include Chester's successful Park & Ride scheme (converting paper books of tickets to low cost smart multi-journey tickets). Chester's Park & Ride is the fourth largest in the UK and operates over four sites with more than two million passenger journeys year. Other trials include applications to a Cheshire visitors' pass, home-to-school travel,

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systems. In addition to Europe, this is well supported by both the USA and Japan.

### Payment

More recently the financial services industry has recognized that the speed and ease of use of contactless cards is appreciated by the consumer. The global payment schemes have now joined forces to use a common specification for contactless cards based on ISO/IEC 14443. Very successful trials of contactless card technology for payments have been carried out and a number of major banks in the USA are planning large scale rollouts involving millions of cards.

### Immigration

The same requirements for ease of use and speed of data transfer have been identified by the International Civil Aviation Organisation (ICAO) in defining the electronic equivalent of the passport. Impelled by the Patriot Act<sup>2</sup> in the USA there is currently much activity to prescribe the use of contactless technology for storing identity data, facial images and other biometric data in an electronic passport. Add to this the possibility that the same passport may well contain electronic visas, ISO/IEC 14443 provides a good foundation.

### Vicinity contactless cards

Whilst the laws of electromagnetism and today's technology allow the proximity card to provide an ideal platform to perform transactions involving reading and writing to the card at close (100mm) range, the vicinity card exploits similar technology to allow them to be powered and read from a distance of up to 1m (whilst acknowledging that writing to a card that far away is beyond the reach of current technology). The vicinity card standard, built on the lessons learnt from its predecessors, uses the same frequency. The drivers for evolving this technology brought together two industries: the card industry, with a requirement for "hands-free" operation in applications like access control and public transport, and the RFID industry with a requirement for asset tracking systems that do not use bar codes.

The standard was completed quickly and relied heavily on the work done for ISO/IEC 14443. The development of this standard involved a compromise between the technology developed by two organizations (Philips and Texas Instruments) who agreed to converge on a single card technology that could configure itself to suit the environment within which the target was sited. Thus, in a high noise environment, operating range was sacrificed in order to increase noise immunity and vice versa.

### Access control

The most popular use of this standard to date is in access control applications, where the hands-free nature of reading is a bonus and the ability to write to the cards at close range allows for more sophisticated dynamic access rights management. The mass market for access control cards is many millions per annum and whilst this technology has only recently begun to make inroads into the existing market, its main success is in the USA.

### Baggage tracking

The development of the vicinity card standard was also driven by the requirement from airlines to migrate to a means of identifying hand baggage that avoided the use of barcode labels. Especially where bags are transferred between aircraft, significant numbers of barcode labels become unreadable by the automatic scanners and have to be handled manually. A significant increase in reliable identification of baggage and hence reduced costs results if radio frequency identity tags replace the bar codes. Whilst there are a number of different RF tagging technologies that could be used, it is encouraging to see that the work in JTC 1, *Information technology*, SC 17, *Cards and personal identification*, and SC 31, *Automatic identification and data capture techniques*, has converged, with SC 31 embracing ISO/IEC 15693, *Identification cards - Contactless integrated circuit(s) cards - Vicinity cards*, within its series of RFID standards as ISO/IEC 18000-3:2004, *Information technology - Radio frequency identification for item management - Part 3: Parameters for air interface communications at 13.56 MHz*.

### Connecting to a vast range of consumer devices

Perhaps one of the most exciting new developments to evolve from the work on contactless card standards is the emergence of the Near Field Communications (NFC) standard. Initially developed by the European Telecommunications Standard Institute (ETSI), this standard made a fast track through ISO and was published as ISO/IEC 18092:2004. Although not a card standard, NFC uses proximity technology (ISO/IEC 14443) as one of its foundation stones, another came from Japan. NFC is a communications interface that capitalizes on the low cost (a few gates in silicon) of adding contactless operation to a device designed for other applications. Importantly an NFC coupled device can act like a card whilst being powered from another terminal or act as a terminal and power a card, or both.

The market for NFC is seen as bringing ease of connection to a vast range of consumer devices, thus a set top box could communicate with a TV screen by merely being placed upon it. A personal digital assistant might be able to collect pictures from a display screen, again by a touch-and-go connection. Much early interest is in incorporating NFC into mobile phones. Such devices are now under trial as a payment mechanism or public transport ticketing device, since around one quarter of the world's population now carries a mobile phone, a lot of the infrastructure may be paid for by the consumer and we are likely to see far more of this recent development.

The progressive introduction of innovation in the family of international card standards has provided a foundation for the supply of global financial, communications and travel services to a significant proportion of the world's population. •

## ITSO new prices

At the March 2006 Board Meeting a decision was made to increase the ITSO prices by 3%. This took effect from **1 April 2006**. You can download a copy of the new Price List from the Pricing page of the ITSO Website [www.itso.org.uk](http://www.itso.org.uk).

Notes:

- 1) The General Electric Company of the United Kingdom (GEC).
- 2) USA Patriot Act, 2001: An act passed by the US Government to provide the appropriate tools to intercept and obstruct terrorism

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