Gen 2 Extends Range and Possibilities for Contactless ID Cards

A ZEBRA WHITE PAPER

Contactless cards, tags and key fobs have made life easier for millions of people by providing a fast and convenient way to open locked doors, enabling cashless payment at gas pumps and point-of-sale stations, and eliminating the need to scrounge for tickets or exact change for public transit fares. These applications have also created misperceptions about what contactless card technology is and what it can do. RFID cards don't need to be within a few inches of the reader to work, as is the case in most cashless payment and access control applications. Traditional contactless card technology is very reliable and effective at what it does, but what it can do is limited, primarily because of range. As the range of ID cards increases, so do the possibilities for using them.

Many users and system designers may not realize that ID cards can be read from 20 feet away with secure, standardized Gen 2 ultrahigh-frequency (UHF) RFID technology. Only recently has it become convenient and practical for organizations to create long-range cards in-house, and now adoption is set to flourish. Long-range identification is especially useful for many security, patron management, customer service and asset tracking applications.

Gen 2 and other UHF technologies remove many of the limitations traditionally associated with contactless ID cards, but create new system-planning challenges. This white paper explains how organizations can take advantage of the range, speed, security and memory of Gen 2 RFID cards to create more effective processes for employee and customer identification, security, asset management and customer service.

Introduction to Gen 2 UHF Technology

Gen 2 technology holds an ironic position in the world of ID cards. It has not been widely used for personal identification, but is the technology behind some of the largest, highest profile and most secure ID card programs in the world. For example, Gen 2 RFID is used in the U.S. government's PASS Card program to replace traditional passports to improve the security and convenience of border crossings, and in potentially millions more state-issued driver’s licenses.

Why Gen 2 ID cards are not used more widely is somewhat surprising. Gen 2 appears to have all the elements to make it a successful ID card technology—it is secure, is standardized, supports high throughput and is widely supported. Some of the largest companies and public sector organizations in the world use Gen 2 RFID systems for mission-critical operations. Use has not extended to personal identification for two main reasons. First, organizations have had few convenient options for producing and issuing Gen 2-based ID cards. Second, many people don't realize they have a choice of RFID card technologies, or don't understand what Gen 2 can do.

The Gen 2 standard was developed by EPCglobal so users could accurately identify multiple items simultaneously at distances not possible with legacy RFID technology. It was later submitted to the International Organization for Standardization (ISO) and ratified as an international standard for use worldwide.

Today Gen 2 is widely used for asset management and product identification applications, where it is routine for an entire pallet of goods to be identified and recorded automatically from unattended dock door readers mounted 10 or 20 feet away (the standard specification supports identification of more than 1,000 tags per second). Gen 2's range and fast identification capabilities are applicable and beneficial for ID card applications.

Gen 2 range and speed eliminate the need for single-file, one-at-a-time card reads. Groups of people can move through large, open entry and exit points, rather than having to pass through narrow doorways, gates or turnstiles. Gen 2 technical capabilities also support many new processes that can improve security and convenience, which will be detailed in the Use Cases section.

Figure 1 highlights some of the biggest differences between Gen 2 and traditional contactless cards. The sections that follow present Gen 2 specifications and performance characteristics as they apply to card systems.

Fig. 1: Select feature comparison of traditional and Gen 2 contactless card technologies

	Traditional	**Gen 2**
Frequency	13.56 MHz (high frequency)	860-960 MHz (ultrahigh frequency)
Range	1 to 4 inches	User selectable, up to 20 feet
Standards	ISO 14443A (MIFARE®), ISO 15693	EPCglobal Gen 2, ISO 18000-6C
Memory	1K standard, up to 4K	96 bits. Extended memory is available: NXP chip has 240 bit EPC; 512 bit user memory. Other inlay manufacturers are also introducing extended memory chips.

Frequency

The Gen 2 standard specification supports RF transmission between 860 and 960 MHz, which is in the UHF frequency band. Gen 2 technology can be used worldwide, but the entire frequency range is not available in every country because of different national telecommunications regulations. In North America, Gen 2 systems typically operate between 902 and 928 MHz. European systems operate between 865 and 867 MHz, and Asia tends to use the high end. Frequency is an important variable to how RFID systems perform. Frequency is a major determinant of system range and transaction speed, and also of how signals react to potential sources of interference.

Range

The most obvious and dramatic difference between Gen 2 and traditional contactless ID card technologies is range. Gen 2 readers can identify standard, low-cost cards without batteries from about 20 feet away (actual range depends on the installation location and other variables). Range for 13.56 MHz technology is limited to a few inches.

The range of any RFID technology depends not only on the frequency, but also the amount of reader power that the tag receives. Gen 2 users can adjust the range of their systems by adjusting the power output (and also by using different antennas, which can be optimized for range, sensitivity, directionality and other factors). The same Gen 2 ID card may be readable from more than 20 feet away in one area, but only from near contact in another. The ability to set range gives system designers tremendous flexibility. For example, imagine an ID card that is used to give employees access to the company parking area and to the building. Long range is desirable for the parking area so the gate can open as the employee approaches. ID cards should not be able to unlock more secure areas from long distances, to prevent unauthorized people from entering just ahead of or behind the cardholder. Variable range technology lets facility operators set systems for the proper blend of security and convenience.

Security

Security provisions in the Gen 2 standard include multiple levels of data protection and device authentication to prevent unauthorized reads. Several security features are optional, and therefore must be activated during system setup.

Each Gen 2 chip has a preprogrammed, unchanging unique ID number. Additional data can be temporarily or permanently encoded in the user memory, and different levels of security can be applied to different memory blocks. By using the "permalock" feature, organizations can lock data into Gen 2 chip memory to prevent it from being rewritten. Another option is 32-bit password protection to enable chips to be read or rewritten. Password protection can be applied to all or part of chip memory. Gen 2 chips can also be set only to communicate to known readers, a valuable authentication feature that can prevent hacks and skimming. Finally, many common IT and network security protocols can be applied to networked Gen 2 readers and card printer/encoders.

Standards

Gen 2 is an internationally recognized standard for use throughout the world. Its full official name is EPCglobal Class 1 Generation 2. It was developed by EPCglobal, an international RFID technology standards organization comprised mostly of end-user organizations in a variety of industries. EPCglobal is part of GS1, a leading international business process and technology standards body that maintains the UPC/EAN system and many other standards. For more information visit www.epcglobalinc.org and www.gs1.org.

EPCglobal submitted its Gen 2 standard to the International Organization for Standardization (ISO), which ratified it as an official ISO standard, number 18000-6 Part C (commonly referred to as ISO 18000-6C).

Support

Gen 2 was officially ratified as a standard in December 2004, but has already become the most-used UHF protocol. Leading market research firm Venture Development Corp. (VDC) forecasts 88 percent annual growth for Gen 2 from 2006 to 2009, aided in part by Gen 2's acceptance as an ISO standard. The standard is widely supported by RFID device makers and software developers, which gives potential users a strong competitive market to choose from. Gen 2 has received strong support from users and technology developers because it meets the need for long-range, high-speed identification more securely, reliably and cost effectively than alternative technologies and protocols.

Most of the billions of Gen 2 RFID tags deployed have been used to identify assets and products, not people. As noted, Gen 2 ID card systems are relatively rare, but the number of Gen 2-enabled ID cards and documents is growing very rapidly. The U.S. government validated the effectiveness and security of Gen 2 for personal identification by selecting it as the technology for use in PASS Cards, which will be used to facilitate fast and efficient border crossings for U.S. citizens who frequently travel to Mexico and Canada. As travelers approach the border control officer, a Gen 2 reader accesses a serial number on the PASS Card from several feet away. The reading starts a secure database lookup. By the time the traveler reaches the checkpoint, the traveler's photo and pertinent information will already be displayed on a computer screen so the officer can quickly verify the traveler for entry into the U.S. Prior to the PASS Card program, Gen 2 identification had been proven effective for border crossing and security when used by commercial truck drivers as part of the FAST, SENTRY and NEXUS programs.

Soon after the federal government's decision to use Gen 2 for the PASS Card program, four border states—Arizona, New York, Washington and Vermont—announced they would use the same technology for their enhanced driver's license (EDL) programs. The PASS Card and state initiatives will result in Gen 2-based ID cards being used by millions of U.S. citizens. As the following section shows, the technology can also be adapted for a variety of beneficial private sector uses.

Use Cases for Gen 2 ID Cards

Many ways to benefit from Gen 2 ID cards may not be immediately obvious, because users traditionally haven't had a cost-effective long-range option, and developed their applications and processes accordingly. Better range and speed improves most identification processes, but Gen 2 ID cards are especially beneficial when organizations want to:

- Relieve congestion or enable identification where it isn't practical to install a short-range reader;
- Conveniently support a second form of identity validation, such as facial recognition;
- Provide high throughput entry/exit for convenience and crowd control;
- Automatically monitor specific zones and areas;
- Associate people with assets.

Long-range reading can relieve congestion by identifying, validating or counting multiple people simultaneously, which also enables the use of larger exits and entryways. Extended range is also beneficial when the reader can't easily be installed at the desired read point, or when it is advantageous to identify a person before he or she reaches a specific location, such as in the PASS Card program. When a PASS Card holder reaches the front of the line, his or her picture is already displayed on the border control officer's computer screen, resulting from the UHF card read that took place several feet away. The photo provides another form of identification for the officer to validate when checking the cardholder's credentials. Parking gates provide a more common example of the convenience that extended read range provides. UHF ID cards or parking passes on vehicles drive user friendly systems that raise the gate so the driver doesn't have to stop.

Extended-range identification is also an excellent way to monitor an area to count passers-by or monitor traffic flow. For example, a museum could issue its patrons RFID-enabled ID cards, and install readers throughout the facility to count how many people visit different wings and exhibits.

Gen 2 readers are commonly used to monitor zones for security and asset management applications. Every time a tagged item enters or leaves the read zone the action is recorded, and systems can issue alerts if asset movements are suspicious or fall outside set guidelines. (Incidentally, Gen 2 is commonly used to track laptops, servers and other IT assets). With Gen 2 ID cards, RFID infrastructures set for zone monitoring can be leveraged and the processes can be enhanced to improve asset tracking and worker convenience. For example, using Gen 2 on items and ID cards enables accurate, unattended dispensing of tools, equipment and other assets, and other automated check-in/checkout procedures.

These are some general examples of how long-range ID cards can be used to improve service and security. The following sections provide more detailed use cases for how long-range ID can improve common business processes.

Security

Gen 2 ID cards—used today to secure U.S. borders by verifying U.S. travelers, commercial truck drivers and their vehicles—can easily be adapted for private sector use to provide high security or add convenience to access control operations.

For high-security access control, long-range contactless ID can be used together with biometrics, video surveillance and other technologies to create layered protection. In standard contactless access control, the RFID reader accesses the unique identification number from the card to trigger a database check that determines whether the cardholder is cleared to enter. Higher security systems may go beyond basic card authorization to pull up a photo record of the authorized cardholder (as in the PASS Card program), or to direct a camera to capture an image of the person for identification by a biometric technology such as facial recognition. Longer read range is beneficial for these systems because the earlier read allows more time for the photo image to be retrieved by the system and inspected by a guard. The different blocks of Gen 2 memory can be used to program an ID card to provide different levels of access control. For example, a worker may have 24-hour access to the building, but could only be allowed to enter high-value storage areas, secured archives or other sensitive areas during his or her normal working hours.

Increased range can be beneficial even when added security is not needed. For many facilities, increased range provides increased convenience. For example, instead of presenting an ID card to a wall-mounted reader then waiting for a door to open, with Gen 2, employees can be identified as they approach the door so it unlocks just as they arrive. One of the best uses for Gen 2 ID cards is in employee parking lots, so cars can pass without having to stop and wait for the gate to raise.

More range also means more options for portals. Because people can be identified and verified from 20 feet away, they don't have to pass through small, inflexible areas to be identified. This ability provides the flexibility to design areas to reduce congestion. The UHF frequency band can complete successful reads through drop ceilings, so readers can be installed in discrete and aesthetically pleasing locations.

Gen 2 cards can also be used in traditional card-based time and attendance systems, which should emerge on the market soon now that organizations have the ability to conveniently produce Gen 2 employee ID cards in-house.

People Tracking

Area coverage can save valuable time—and lives—in emergencies and is a key enabler for emerging people tracking applications. RFID has long been used to track workers in dangerous environments such as mines or areas where exposure to chemicals, gases or radioactivity must be monitored. These systems have traditionally been used on battery-powered active RFID tags, which can cost $100 a piece. Because of the cost, deployment has mostly been limited to select high-risk environments. The development of standardized Gen 2 technology makes it practical to extend wireless area monitoring to many additional environments because readers and ID cards are much less expensive.

Gen 2 readers can be installed outdoors or indoors and can be used in many ways to manage workers in hazardous and disaster environments. For situations where workplace regulations limit the amount of time workers can spend in an environment (such as where low-level radiation is present), readers can be installed to cover the area and automatically record all entries and exits. System software can track the amount of time each individual worker spends in the area, calculate real-time cumulative totals, and automatically generate alerts (by e-mail, pager or even alarm) as workers near their time thresholds. Using RFID completely automates the data entry and calculation processes and can automatically generate and store necessary records. A network of readers covering rooms, labs, test facilities, tunnels, mine shafts and other areas can produce a real-time view of employee locations, information that is invaluable in case of emergency.

The same application principles can be applied to non-hazardous environments where administrators want to have accurate, real-time information about where people are in the building or campus. These environments include hospitals, assisted living residences, schools, daycare centers and other facilities where administrators are responsible for the custody and safety of residents, patients, visitors and guests.

For example, a school could use Gen 2 staff and student ID cards to automatically take attendance every day, saving time for teachers and eliminating the need for office staff to manually enter attendance data into the computer records system. The bigger benefit is the system's ability to provide dynamic, updated information. Traditional attendance systems provide a record of who was in the building at the start of the school day. An RFID system could track students during an evacuation, and in day-to-day operations to provide real-time records of where each individual student and staff members are at all times by using RFID readers to monitor classrooms, hallways, playgrounds and other areas. Alerts could be issued when students attempted to enter restricted areas or leave the campus at unauthorized times. There is precedent for these use cases, as RFID wristband and ID card systems are already widely used in hospitals to prevent infant abduction and to detect patients wandering from Alzheimer's and psychiatric wards. Prisons and security services use RFID card systems to monitor guard locations.

Patron Management/Customer Service

Customer service and patron management applications revolve around Gen 2 loyalty cards, passes or badges. The simplest application is to track the movement of people through the facility. RFID tickets, cards and passes are becoming increasingly popular at ski resorts to control access to lifts and to provide operators with up-to-date information about where skiers are on the mountain, which can be life-saving knowledge during an avalanche.

Retailers could analyze cardholder location data to determine how much time customers spent in various areas of the store, and to collect insight on what types of merchandising and displays were effective. A next step would be to build a simple application that communicates alerts or exception notices when there is particularly high traffic in a specific area so resources can be deployed accordingly. This application is well suited to large retail areas, such as garden centers and warehouse clubs, where managers can't readily see the entire facility. Having real-time customer and location data also enables customized interactive marketing, where ID card reads trigger in-store multimedia displays or kiosks to promote special offers or services based on the customer's profile.

These applications are not limited to retail. The ability to redeploy staff based on actual customer or guest locations is especially valuable to resorts, theme parks, cruise ships, museums, clubs, sports and entertainment venues, exhibit halls, and other service and hospitality environments. Applications could be tailored to serve VIPs and top customers, or for general operations to ensure beverage, foodservice, merchandise, ticketing and service areas are adequately staffed.

Asset Protection and Management

This white paper has highlighted how proven RFID applications can be adapted and enhanced by using Gen 2 ID cards. Asset management operations represent some of the best opportunities for improvement. RFID asset tracking applications typically provide complete return on investment (ROI) in less than 10 months, according to one study, the fastest of any application. Combining asset management with other applications, such as ID and security, reduces the ROI period even more.

Billions of low-cost Gen 2 labels and tags are already in circulation and thousands more are applied every day to track computers, tools, equipment, returnable containers, files, evidence, samples, raw materials, finished goods and other assets. Portal readers automatically record each time tagged assets are removed and returned. These systems provide data on assets that are in use, but no information about who is using them. Assets can be signed out manually, but these processes are notoriously inaccurate and out of date. The honors system has its own set of problems: Multiple studies have found business lose much more due to employee theft than they do to shoplifting.

Companies can leverage existing asset tagging systems to gain another level of visibility by integrating Gen 2 ID cards so assets can be automatically associated with the people who remove or use them by simultaneously, automatically reading the asset tag and ID card, and automatically applying a date stamp to the readings. The transaction then associates the asset with an individual, which builds accountability into systems and reduces time spent searching for assets that are in use. Leading applications include fleet management and tool crib.

Fleet management applications can be set up to use RFID to identify any combination of employees, keys or vehicles. For example, a worker may use an RFID employee ID card to sign out the keys to a company vehicle. The vehicle itself could include an RFID tag that is read each time it enters and exits the parking area. Data from these read points would provide the real-time status information about which vehicles were checked out and which were currently available on the premises. The data could also be used to automatically create historical records that could be used to analyze asset utilization, plan predictive maintenance, and track vehicle use by individual employees.

Automated tool crib and dispensing systems that feature technology-enabled automatic checkout and return have been available for years, and now the practice can be extended to many other types of assets because it is relatively easy to implement long-range ID cards and area monitoring systems.

Integrating asset tracking with personal ID also helps avoid time-wasting asset searches. Instead of walking around a shop floor, warehouse or office to find out who has a particular piece of equipment or file, workers can simply consult a computer screen to see who signed it out. Speeding the search process cuts unseen costs from operating expenses. For example, if employees spend an average of only 10 minutes a day looking for tools, equipment or materials, they spend the equivalent of one full week each year on non-value added searching, as the following calculation illustrates:

(10 minutes/day x 5 days/week x 50 weeks/year) = 2,500 minutes/year ÷ 60 minutes/hour = 41.67 hours.

To find the labor cost of searches, multiply this time by the number of employees involved in searches, and by their average hourly salary. Actual costs incurred because of incomplete asset tracking are actually higher, because missing assets aren't fully utilized and often have to be replaced.

There are numerous ways to use Gen 2 tags and ID cards to automate check-in/checkout, asset protection, chain of custody and other operations. More details and examples are presented in two additional Zebra white papers, *Protecting People, Products & Property with Identification Printing* and *Increasing Profits and Productivity: Accurate Asset Tracking and Management with Bar Coding and RFID*, which can be downloaded free from the Resource Library at www.zebra.com. The site also has a Gen 2 FAQ and more information about RFID, card and related technologies.

Conclusion

By extending read range from inches to feet, Gen 2 UHF technology increases the potential uses for ID card applications and the convenience and security benefits they provide. However, no technology, including Gen 2, is best for all ID card systems and user needs. The most effective systems take advantage of technology capabilities to support the organization's desired business processes to maximize safety, security and convenience for employees, guests and customers. Organizations can begin to consider new, longer range processes to meet these needs, now that secure, standardized Gen 2 technology is available for ID cards that can easily be produced in house.

Zebra Technologies has manufactured and delivered thousands of ID card printers that support traditional high-frequency RFID encoding, and was one of the first companies to offer printers for producing Gen 2 ID cards. Zebra offers Gen 2 UHF encoding as an option for its P330i and P430i ID card printers. UHF-enabled models use the same printer drivers and ribbons as the non-UHF models. All that's needed for RFID encoding are ID cards with embedded UHF Gen 2 chips, which are available from Zebra. The cards support all EPCglobal Gen 2 and ISO 18000-6C RFID security standards, and provide 96 bits of password-protected memory. UHF-enabled P330i and P430i printers can also be used to create non-RFID ID cards and maintain all their standard features, including support for magnetic stripe encoding, bar code printing, full-color printing and support for a variety of card materials.

Contact Zebra Technologies to learn more about how to benefit from ID card systems and how to choose the best technology to meet your needs. Zebra is also a leading provider of real-time locating systems based on active RFID technology, and bar code label printing systems. We support a broad range of technologies and have the experience to provide customers with solutions that match their needs.

Zebra Technologies Corporation improves customers' business performance through products and solutions that identify, track and manage assets, transactions and people. In more than 100 countries around the world, more than 90 percent of Fortune 500 companies use innovative and reliable Zebra printers, supplies, RFID products and software to increase productivity, improve quality, lower costs, and deliver better customer service. Information about Zebra and Zebra-brand products can be found at www.zebra.com.

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