Gen 2 Extends Range and Possibilities for Contactless ID Cards

Contactless cards, tags and key fobs make life easier for millions of people by providing a fast and convenient way to open locked doors, enable cashless payment at gas pumps and point-of-sale (POS) stations, and eliminate the need to scrounge for tickets or exact change for public transit fares. These applications have also created misconceptions about what contactless card technology is and what it can do.

Radio frequency identification (RFID) cards do not 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 but is limited, primarily because of the actual range of the radio frequency (RF) signal. As the RF range of ID cards increases, so does the potential application space.

Many users and system designers may not realize that ID cards are readable from up to 50 feet away with secure, standardized Gen 2 ultra-high frequency (UHF) RFID technology. Only recently has it become convenient and practical for organizations to print and encode long-range cards in house — and now adoption is flourishing. 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 effective processes for employee and customer identification, security, asset management, and customer service.
Introduction

GEN 2 UHF TECHNOLOGY

Gen 2 technology holds an ironic position in the world of ID cards. While not widely used for personal identification, it is the technology behind some of the largest, highest profile and most secure ID card programs in the world. For example, the United States Passport Card program uses Gen 2 RFID to increase speed, efficiency and security at U.S. land and sea border crossings and in potentially millions more state-issued driver’s licenses.

Gen 2 contains all the elements for 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. Applications for personal identification continue to grow rapidly for two main reasons. First, organizations now have convenient options for producing and issuing Gen 2-based ID cards. Second, many people now realize they have a choice of RFID card technologies and understand Gen 2 capabilities.

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

Gen 2 sees widespread use for asset management and product identification applications, where RFID systems routinely identify and record an entire pallet of goods automatically from unattended dock door readers mounted 10 or 20 feet away. In fact, the standard specification supports identification of more than 1,000 tags per second.

Gen 2’s range and fast identification capabilities bring significant benefits to ID card applications. For example, 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, detailed in the Use Cases section of this document.

Table 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.

### Table 1 – Select Feature Comparison of Traditional and Gen 2 Contactless Card Technologies

<table>
<thead>
<tr>
<th>Feature</th>
<th>Traditional</th>
<th>Gen 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>13.56 MHz (high frequency)</td>
<td>860-960 MHz (ultra-high frequency)</td>
</tr>
<tr>
<td>Range</td>
<td>1 to 4 inches</td>
<td>User selectable, up to 50 feet</td>
</tr>
<tr>
<td>Standards</td>
<td>ISO 14443A (MIFARE®), ISO 15693</td>
<td>EPCglobal Gen 2, ISO 18000-6C</td>
</tr>
<tr>
<td>Memory</td>
<td>1K standard, up to 4K</td>
<td>96 bits, up to 1K</td>
</tr>
</tbody>
</table>
Frequency
The Gen 2 standard specification supports RF transmission in the UHF frequency band between 860 and 960 MHz. While Gen 2 technology affords worldwide uses, 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 higher end near 960 MHz. Frequency is an important variable to how RFID systems perform, affecting system range, transaction speed, and also immunity to RF interference caused by the physical environment.

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 50 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 on the frequency and 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 by using different antennas, which allow optimizations for range, sensitivity, directionality, and other factors. The same Gen 2 ID card may be readable from more than 50 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 provides employee access both to the company parking area and the building.

In this case, long range is desirable for the parking area so the gate can open as the employee approaches. To prevent unauthorized people from entering just ahead of or behind the cardholder, ID cards should not unlock more secure areas from long distances. Variable range technology lets facility operators set systems for the proper blend of security, range 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 require activation during system setup.

Each Gen 2 chip contains a unique, pre-programmed static ID number. Users can temporarily or permanently encode additional data in the chip memory and apply different levels of security to various memory blocks. By using the “permalock” feature, organizations can lock data into Gen 2 chip memory to prevent unauthorized users from overwriting data.

Another option is 32-bit password protection that enables 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 helps 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, with a full official name of “EPCglobal Class 1 Generation 2.” EPCglobal is 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, see www.gs1.org/epcglobal.


Support
Leading market research firm Venture Development Corporation (VDC) reported that the total market for Gen 2 UHF hardware grew by 140 percent in just one year. The firm expects the total Gen 2 UHF market, which includes transponders, readers and printers, to grow by a compounded annual growth rate of nearly 60 percent through 2015, to $3.7 billion.

The standard is widely supported by RFID device makers and software developers, which gives potential users a strong competitive market of choices. Gen 2 has received strong support from users and technology developers because it meets the need for long-range, secure high-speed identification, reliability, and cost effectiveness better than alternative technologies and protocols.

Most of the billions of Gen 2 RFID tags deployed include applications that identify assets and products, not people. As noted, Gen 2 ID card systems are growing in use in Gen 2-enabled ID cards and documents. The U.S. government validated the effectiveness and security of Gen 2 for personal identification by selecting it as the technology for Passport Cards, enabling fast and efficient land and sea border crossings for U.S. citizens who frequently travel to Mexico, Canada, the Caribbean and Bermuda.

As travelers approach the border control officer, a Gen 2 reader accesses a serial number on the Passport Card from several feet away. The process begins a secure database lookup. By the time the traveler reaches the checkpoint, a computer screen displays the traveler’s photo and pertinent information. This allows the officer to quickly verify the traveler for entry into the U.S. Prior to the Passport Card program, Gen 2 identification proved effective for border crossing and security when used by commercial truck drivers as part of the FAST, SENTRY and NEXUS programs.

After the Federal Government chose to use Gen 2 for the Passport Card program, four states quickly adopted the technology. Arizona, New York, Washington and Vermont use the same technology for their enhanced driver’s license (EDL) programs. The Passport Card and state initiatives drive Gen 2-based ID card usage into the hands of millions of U.S. citizens. Today, Gen 2 inlays are inside every U.S. passport card and every Green Card. As the following section shows, the technology also enables a variety of beneficial private sector uses.
Use Cases for Gen 2 ID Cards

Many of the ways to benefit from Gen 2 ID cards may not be immediately obvious. This is because users traditionally lacked a cost-effective long-range option and developed their applications and processes accordingly. **Better range, speed and memory improve most identification processes, but Gen 2 ID cards are especially beneficial when organizations want to:**

- Relieve congestion or enable identification where it is impractical to install a short-range reader
- Convenietly support a second form of identity validation, such as biometric and facial recognition
- Provide high throughput entry / exit for convenience and crowd control
- Automatically monitor specific zones and areas
- Associate people with assets
- Combine long-range identification with other shorter-range applications, such as cashless payment or access control
- Identify customers for loyalty and VIP programs to enhance service and customer experience
- Link personal experience with emerging social media platforms, automate “Check-Ins” and virtual “likes”

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 does not afford easy installation at the desired read point. Benefits extend to when it is advantageous to identify a person before he or she reaches a specific location, such as in the Passport Card program.

When a Passport Card holder reaches the front of the line, the border control officer’s computer screen immediately displays the entrant’s picture, 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 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 does not have to stop. Because the read range is customizable, long-range identification applications can be combined with other short-range applications using the same UHF ID cards.

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 find common use in monitoring zones for security and asset management applications. Whenever a tagged item enters or leaves the zone, the tracking system records the action and can issue alerts if asset movements are suspicious or fall outside set guidelines. For example, data centers often use Gen 2 to track laptops, servers and other IT assets.

With Gen 2 ID cards, RFID infrastructures can leverage exiting zone monitoring, and security departments can enhance the processes 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.

The sections that follow 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 support easy adaptability for private sector use. The results are applications that provide high security or add convenience to access control operations.

For high-security access control, businesses can use long-range contactless ID cards, together with biometrics, video surveillance and other technologies, to create layered protection. In standard contactless access control, the RFID reader looks up the unique card identification number to trigger a database check to determine cardholder access. Higher-security systems transcend basic card authorization by retrieving a photo record of the authorized cardholder (as in the Passport Card program). Sophisticated systems can also 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 sophisticated security systems because the earlier read allows more time for the system to retrieve the photo image, allowing fast inspection by a guard. Gen 2 provides various memory blocks for ID card programming that specify different levels of access control. For example, a worker may have 24-hour access to the building but can be restricted from entering high-value storage areas, secured archives, or other sensitive areas during his or her normal working hours.

Increased range provides benefits even when added security is not a requirement. For many facilities, increased range provides increased convenience. With Gen 2, the system can identify employees as they approach the door so it unlocks just as they arrive. The result is a faster access instead of presenting an ID card to a wall-mounted reader then waiting for a door to open. Another example is in employee parking lots. Long-range Gen 2 allows cars to pass without having to stop and wait for the gate to rise.

More range also means more options for portals. Because systems can identify and verify people from 50 feet away, they do not have to pass through small, inflexible areas. Long range provides flexibility for designing areas that reduce congestion. The UHF frequency band can complete successful reads through drop ceilings, allowing reader installation in discrete and aesthetically pleasing locations.

Traditional card-based time and attendance systems can also use Gen 2 cards. Now that organizations have the ability to conveniently produce Gen 2 employee ID cards in house, this application will experience significant market growth.
Long-Range Identification

Area coverage can save valuable time — and lives — during emergencies and is a key enabler for emerging long-range tracking applications. RFID sees widespread use for tracking workers in dangerous environments, such as mines or areas where exposure to chemicals, gases or radioactivity requires monitoring. Traditionally, these systems use 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 into many additional environments because readers and ID cards cost less.

Gen 2 readers afford easy outdoor or indoor installation, enabling diverse applications for managing workers in hazardous and disaster environments. Workplace regulations limit the amount of time workers can spend in a hazardous environment, such as where low-level radiation is present. These cases are excellent opportunities for installing readers 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, minshafts and other areas can produce a real-time view of employee locations — information that is invaluable in case of emergency.

The same application principles apply to non-hazardous environments, where administrators require 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 take automatic attendance daily, saving time for teachers and eliminating the need for office staff to manually enter attendance data into the computer records system. The key 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. RFID systems can track students during an evacuation and in day-to-day operations. The result is a real-time location record of each student and staff member at all times by using RFID readers to monitor classrooms, hallways, playgrounds and other areas.

Alerts could be issued when students attempt to enter restricted areas or leave the campus at unauthorized times. This added visibility of student movement also extends to school buses and other vehicles to ensure and / or confirm where and when students boarded and exited the vehicles. 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. Another application includes RFID card systems installed at prisons and security services to monitor guard locations.
Patron Management and 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. In addition, resorts are using RFID to enhance the skier experience by enabling them to capture information, connect with fellow skiers, and share through social media networks.

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. The next level includes building a simple application that communicates alerts or exception notices triggered when particularly high traffic in a specific area occurs so the retailer can deploy resources. This application is well suited to large retail areas, such as garden centers and warehouse clubs, where managers lack visibility into the entire facility. 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 customer profiles.

These applications are not limited to retail. The ability to redeploy staff based on 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. Businesses can tailor applications to serve VIPs and top customers or for general operations to ensure beverage, food service, merchandise, ticketing and service areas remain 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 ten months — 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 employees remove and return tagged assets. These systems provide data on assets that are in use but no information about who is using them. While traditional processes allowed manual asset sign-out, these processes are notoriously inaccurate and out of date. The honor 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 automatically associate with the people who remove or use them. The system does so by simultaneously and automatically reading the asset tag and ID card and 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, document management and tool crib systems.

Delivery businesses can set up fleet management applications to use RFID for identifying 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 provides real-time status information about which vehicles checked out and which vehicles are currently available on the premises. The data enables automatically created historical records for analyzing asset utilization, plan predictive maintenance, and track vehicle use by individual employees.

Document tracking applications can verify the current location of important documents at all times. Law offices can associate documents with a lawyer’s ID card to assist in time billing. In courthouses, clerks can move documents to the right courtroom on time and by authorized personnel only.

Automated tool crib and dispensing systems that feature technology-enabled automatic checkout and return have been available for years. 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 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 ten 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:

\[
(10 \text{ minutes/day} \times 5 \text{ days/week} \times 50 \text{ weeks/year}) = 2,500 \text{ minutes/year} \div 60 \text{ minutes/hour} = 41.67 \text{ hours.}
\]

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 the department cannot utilize missing assets, and they often require replacement.
Summary and 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 optimal for all ID card systems and user needs. The most effective systems take advantage of 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 in easily produced ID cards.

Zebra® Technologies offers the most robust product line of RFID printers and encoders in the industry — manufacturing and delivering thousands of ID card printers that support traditional high-frequency RFID encoding. Zebra was the first company to offer Gen 2 encoding integrated on the card printer. UHF-enabled models use the same printer drivers and ribbons as the non-UHF models. The only requirement for RFID encoding is ID cards with embedded UHF Gen 2 chips — which Zebra also designs — ensuring total solution compatibility.

The cards support all EPCglobal Gen 2 and ISO 18000-6C RFID security standards and provide 96 bits of password-protected memory. Enterprises can use Zebra’s UHF- enabled printers to create non-RFID ID cards and maintain all their standard features, including support for magnetic stripe encoding, barcode printing, full-color printing and support for a variety of card materials.

Sources
2. Ibid