

An abstract graphic consisting of several thick, curved lines that radiate from a central point on the left side of the page. The lines are in various colors: light blue, yellow, orange, and red. The lines extend towards the right side of the page, creating a sense of movement and expansion. The background is white.

**Technology Advances in Retail:  
Improving Margins using Wireless Networks**

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## Introduction

The retail industry is one that lives and dies on margins, with managers on a never-ending quest to increase revenue and decrease costs. Technology has been an area of intense focus in retail industries as a way to accomplish both goals. Improvements have been made in areas such as supply chain management, inventory management, customer experience, and loss prevention. Wireless technology, permitting communication between people and devices anywhere and without cables, has enabled the dramatic transformation of business processes in the past, and continues to do so. However, wireless deployments in the past have been limited by security requirements, the cost of deployment, inadequate management solutions, lack of standards, and availability of innovative solutions. Rapid advances in wireless local area network (WLAN) technology in recent years along with widespread adoption of the technology in the consumer and enterprise space have eliminated many of these roadblocks. Today, a new wave of opportunity exists for retail industries to improve margins through the use of wireless technology. This white paper discusses the applications for this technology, the security requirements in a retail environment, and considerations when selecting the right architecture for mobile network deployments.

## Retail applications for mobility

In the general enterprise market, wireless LANs are being adopted primarily as part of the networking infrastructure, to support standard desktop applications such as email, web browsing, file server access, and other conventional enterprise applications. In the retail industry, wireless LANs are deployed to support much more specific and innovative applications, with a focus on either improving existing processes or adding new ones.

### Mobile point-of-sale

Point-of-Sale (POS) is the physical location where goods are sold to customers. Traditionally, this was a counter where a cash register was located. Customers would line up in front of the counter and wait for their turn. Sales counters are a fixed size, however, and can support a fixed number of people. Increasing the size of the sales counter is not possible, so customers are forced to endure long lines during congested periods such as holidays. Studies show that as many as one in ten customers will abandon the line while waiting, leaving the store without making a purchase. Long lines also engender ill will from customers, making them less likely to return to a store in the future. Wireless LAN technology can help in two major ways:

- Fully mobile point-of-sale stations can be set up using handheld computers, scanners, and printers with integrated credit card readers. During high-volume sales periods, salespeople outfitted with these mobile POS terminals can be positioned throughout a store at small tables. For customers paying by credit card, the full transaction can be completed and a store receipt printed where it is convenient for the customer. Clearly, strong security is a requirement from the network when credit card transactions are involved. A later section in this white paper will discuss security requirements in much more detail.
- Mobile “line busting” personnel can move through checkout lines with handheld computers to accelerate the checkout process. The sales staff can use their own judgment in processing each transaction. For credit card customers with a small amount of merchandise, the entire transaction may be completed while the customer is still in line. For other customers, merchandise can be scanned with a barcode scanner and a ticket printed with prices and a master barcode on it. While waiting in line, the customer has the chance to review prices printed on the ticket. Upon reaching the checkout counter, the ticket is scanned, the total amount is recalled from a backend system, and the transaction is completed without the checkout clerk needing to process each item individually.

Traditional cash registers and desktop scanners can also be attached to backend systems via wireless LAN. This benefits retailers with both reduced cabling costs and increased flexibility in store reconfiguration. With wireless-connected equipment, checkout stations can be moved anywhere without a need to hire cabling contractors to run new network cabling.

## Inventory management

Management of in-store inventory, both in the retail space and the warehouse, is a major area of expense for retailers. Merchandise must be entered into inventory upon arrival at the loading dock, tracked when it is moved to the floor, and removed from inventory when it is sold. In addition, real-time inventory information must be available to store clerks when an item is out of stock on the floor, but is available from the store room or warehouse. Finally, accurate inventory information can reduce out-of-stock conditions. The Grocery Manufacturers of America (GMA) Direct Store Delivery committee commissioned a study that found that shoppers cannot find the product they are seeking 7.4% of the time they shop, with 40% of those shoppers postponing their purchase or going to another store instead. Reducing out-of-stock is therefore a clear way of boosting sales and increasing customer satisfaction. One clothing retailer implemented a system through which store associates using wireless handheld computers and in-store wireless kiosks were continuously connected to a regional inventory database. If a customer found an item out of stock in the store, the associate could immediately place an order to have the item drop-shipped directly to the customer's home. After implementing this system, the retailer realized a 3% increase in store revenue – paying for the new system in only four months.

In the shipping and receiving area, wireless technology can be used in the form of handheld barcode scanners and entry terminals linked to back-end systems over wireless LAN. Items can be received into inventory with the warehouse location of the items tracked instantly. Many retailers use DEX/UCS (Direct Exchange/Uniform Communication Standard) to allow delivery drivers to directly input invoices into a store's accounting system, simplifying billing and accounting. Most DEX interfaces use a wired port, requiring cabling to be run and a physical connection between delivery driver handheld terminals and the DEX port. Some vendors are now producing wireless DEX terminals that uplink over a wireless LAN. These wireless DEX terminals can be placed anywhere, and require no cabling. In the future, delivery drivers may be equipped with a wireless version of DEX that could securely connect to the retailer's system without the need for cables.

Store associates using wireless-enabled handheld computers can easily and quickly perform inventory management tasks. For example, handheld computers with integrated barcode scanners can be used during restocking periods to instantly track how much product is on the floor and how much was moved to the floor from the back room. When merchandise is available in the warehouse or back room but is out of stock on the main floor, store associates can easily use wireless terminals to view the location of merchandise. With the addition of wireless printers, price updates can also be performed on the spot.

## Customer service

Technology is a relatively inexpensive way to improve customer service. Besides long checkout lines, two of the largest sources of customer complaints in retail establishments involve pricing problems and a lack of available store associates to help locate merchandise or answer questions. Wireless technology can help on both fronts, without requiring a retailer to hire additional staff. First, price verification kiosks have become very popular with retailers and tech-savvy customers. Promotional sales, mislabeled merchandise, missing shelf price tags, and returned merchandise can make determining an accurate price difficult for customers. If a price verification kiosk is nearby, customers can take the merchandise, scan the barcode tag, and quickly determine the actual price. If a printer is attached to the kiosk, customers can print their own advisory price tags as well. While these price tags are not used by store personnel at the point of sale, they can be helpful in resolving pricing disputes because the customer can verify that the cash register records the same price the customer expected to be charged. Wireless technology assists in placing price verification kiosks because it eliminates the need for cables and makes the kiosks mobile. If a large sale is taking place in one department, it may be advantageous to place a larger number of kiosks in that department. These kiosks can then be moved to another department when the need shifts. This would be impossible if cables needed to be run each time.

Another area where wireless can improve the customer experience is in obtaining assistance with merchandise or other questions. Self-help kiosks can be easily placed around a store giving customers touch-screen access to store directories, inventory information for all nearby stores in a chain, current sales, and product information. Some retailers have augmented these self-help kiosks with a “get help” button. When pressed, the system alerts nearby store associates carrying Personal Digital Assistants (PDAs) that are voice-enabled. A store associate may respond either by voice or through pre-defined text messages such as, “I’m helping a customer now but will be there in approximately two minutes.” Such kiosks often can let customers find their own answers to questions, and eliminate the need for a customer to walk around the store trying to locate associates.

### **Wireless voice communication**

Many retailers use two-way radios or walkie-talkies for voice communication between store associates. Two types of systems are in common use – one uses licensed radio frequencies, the other uses unlicensed spectrum. Both have their share of problems – the licensed radios impose extra costs on the retailer in order to pay for the frequency license, but ensure that radios are free from interference. The unlicensed radios are free to operate, but are subject to interference from other business nearby. Both systems are subject to interception and monitoring by anyone with an off-the-shelf scanner, and both systems require store personnel to carry around a radio.

A wireless LAN can enable secure voice communication that is free from interference, operates in unlicensed spectrum, and is encrypted to prevent eavesdropping. Voice devices can include purposebuilt walkie-talkies, but today are more commonly based on converged devices such as PDAs with integrated retail features like barcode scanners. Popular application software and devices are available today that give a store associate access to store inventory, point of sale, voice communication, instant messaging, and even external data such as inventory at other stores in the region. Voice communication can be “broadcast”, where all employees hear the same thing, or “unicast” where a conversation happens between two employees. Group communication, or “multicast”, is also available which can be used to let groups of managers communicate only amongst each other.

### **Price changes and auditing**

One retailer conducted a study of the time required to process price changes and shelf labeling. This retailer averaged 800 weekly price changes, and required a 14-person team working a six-hour night shift to process all changes. Much of the time was wasted making trips to and from the printer to retrieve items such as shelf price labels and promotional flags. Other time was spent verifying price changes against large printouts and re-verifying with managers when discrepancies were found. This is time that can be saved using mobile terminals and printers connected via wireless LAN. After implementing a wireless LAN with handheld computers and printers to process price changes, the retailer was able to eliminate an entire shift. Instead, a team of six people process all price changes in the hour before the store opens. Mid-day price changes are also enabled, since an employee with a mobile terminal can print a new shelf label, place it, and update the store’s server instantaneously.

Price auditing can be equally time-consuming. With wireless handheld computers, a store associate can walk aisles scanning shelf labels with a barcode scanner. The handheld computer initiates a price lookup in the store’s UPC database – the same database linked to point-of-sale terminals that determine the price charged to customers. If a discrepancy is found between the price on the shelf and the price in the database, the store associate can immediately print a new shelf label to correct the discrepancy. Accurate pricing protects the retailer’s profits when a pricing error favors the customer. It also helps reduce the time associates must spend checking prices at checkout, and increases customer loyalty.

## RFID and location tracking

RFID (Radio Frequency Identification) has received a huge amount of attention in recent years, with many predicting that the technology will revolutionize everything from logistics to inventory processing to the customer experience. While time will tell if these predictions hold up, the use of wireless technology to track objects is certainly promising. There are two general types of RFID in use today – passive and active. Passive RFID uses small, inexpensive tags or stickers that contain a unique identifier. The cost of RFID tags is not yet low enough to place tags on every individual item, so tags today are typically placed on cases or pallets of goods. Passive RFID tags contain no battery, and must be energized by RFID readers located within a few meters. The typical use for passive RFID is to track inventory as it moves through doors, loading docks, or other “choke points” in a retail operation. Passive RFID systems keep track of events such as “Tag 125532 passed reader 26 on conveyor belt 3 at 14:52:11.” Some RFID systems can determine direction of passage, to record if a tag moved into or out of a room.

Active RFID tags, on the other hand, contain a battery and active electronics and are thus slightly larger and more expensive. The current generation of active tags uses standard 802.11 wireless LAN technology and can interoperate with other devices, such as barcode scanners and PCs, on a wireless LAN. This means that only a single network needs to be deployed and managed, with all radio devices in a retail operation using the same network. Active RFID tags need not be physically close to a wireless access point – they can communicate with access points as far as 150 feet (46 meters) away. Because of this property, active RFID tags are often used for location tracking. Location tracking works when three or more wireless access points detect a short signal, known as a “blink”, coming from an active tag. By comparing the signal strength at the different access points, a triangulation algorithm may be applied that determines the physical location of the tag within a building. Active RFID is useful for locating inventory, capital equipment such as forklifts or pallet jacks, or other high-value items that move around. Because active RFID tags are just special-purpose wireless LAN radios, location tracking may also be used with any wireless LAN radio. This includes laptop computers, PDAs, wireless barcode scanners, printers, voice handsets, and any other device that operates on the wireless LAN. Location tracking enables applications such as paging the associate physically closest to a particular department, or keeping track of how many employees are working in different parts of a store.

## Guest internet access

A large number of retailers now offer guest Internet access, either free or paid, as an enticement to keep customers in the store longer. This is particularly popular in bookstores with in-store cafes and in other food service establishments. The primary challenge in providing guest Internet access is to prevent guest usage from impacting store operations. While the same wireless LAN infrastructure may be used to deliver both services, guest network traffic must be kept entirely separate from in-store network traffic to prevent security breaches. Guest traffic loads must also be regulated so that response time for in-store applications is not impacted. Some retailers offering guest Internet access choose to contract with outside service providers to install and manage the service, but this arrangement gives up control of the radio frequency (RF) environment and also eliminates a potential source of revenue. Because of these factors, many retailers now choose to offer guest Internet access themselves.

## Wireless video

An emerging application in retail is the use of wireless LANs to connect LCD (liquid crystal display) television monitors to a central server for in-store video programming. Some systems embed a small Windows PC and hard drive in the monitor, and programming content is streamed to the PC and stored on the hard drive for local playback. Other systems connect the video display directly to a central server where all content is controlled. The use of wireless LAN technology allows these screens to be placed anywhere it is convenient and will be seen by store patrons.

## Security requirements in retail

Deployed properly, today's wireless networks are more secure than their wired counterparts. The proper implementation of authentication and encryption solves the vast majority of security problems, with authorization and wireless intrusion protection solving the rest. All four security technologies are available in integrated systems that operate under a single network management infrastructure. This centralization of wireless LAN management and security is a critical requirement when deploying in a retail environment that may contain thousands of access points spread across a large geographic area.

Early retail wireless networks were not deployed with security in mind. First, the equipment needed to talk to these wireless LANs was proprietary, expensive, and difficult to obtain. Second, the type of data moving across these wireless LANs was not deemed sensitive, consisting primarily of UPC data for inventory management. Today, much has changed. Wireless LAN equipment is easily available and inexpensive, and retailers everywhere are concerned about leaking of credit card information. The driving force behind credit card security is the Payment Card Industry Data Security Standard (PCI DSS) which applies to all merchants and service providers that store, process, or transmit credit card data. The standard, evolved from Visa's Cardholder Information Security Program (CISP), outlines twelve major requirements with which all entities that deal with credit card data must comply. All wireless LANs inside a retail environment are subject to PCI DSS requirements. Aruba Networks has published a technical brief entitled "Wireless Security for Credit Cards: Complying with PCI DSS and CISP" that contains more details on exactly how wireless LANs should be configured for compliance.

Today, many retailers are still operating older wireless LANs that are difficult to bring up to modern security standards. For example, many older networks support only static WEP (Wired Equivalent Privacy) encryption, and have systems in place to periodically rotate WEP encryption keys. Unfortunately, WEP can be broken in less than three minutes using modern attack techniques, making such networks vulnerable to intrusion with relatively little effort. While these older systems may still be suitable for inventory management applications, retailers using these systems are prevented from adding new applications such as mobile POS. It is an unfortunate reality that much of the older wireless LAN equipment has reached the end of its useful life and must be replaced. A bare minimum security standard that must be supported today is dynamic WEP with 802.1x authentication and rapid key rotation. Retailers are much better served, however, by insisting on a minimum standard of WPA (Wi-Fi Protected Access) or WPA-2. WPA-2 is the marketing name for the IEEE (Institute of Electrical and Electronics Engineers) 802.11i standard, and provides the highest level of security available today for wireless LANs. Proprietary security solutions that do not use WPA-2/802.11i should be viewed with suspicion, as these solutions receive little, if any, review by independent security experts.

## Architectures for mobile connectivity

Numerous wireless LAN systems are available on the market today, but some are better-suited for retail environments than others. Some systems are designed for consumer use, others are designed only for small enterprise deployments, and others do not meet the stringent security requirements of retailers who must deal with credit card processing. This section will discuss some of the decisions that must be made when evaluating a wireless LAN for retail use.

### The mobile edge

One approach to building a wireless LAN involves conceptually extending an existing wired network into the wireless domain, with all the same rules, restrictions, policies, and limitations. While this was the only approach available in the past, network managers deploying wireless networks today should examine the concept of a "mobile edge" of the network – a network edge where the user is assumed to be mobile on both wired and wireless connections throughout an extended enterprise network. A retail company is made up of people, and those people move around. Work locations may be localized, such as moving between the warehouse and the retail floor in a single building, or extended, such as moving between different retail stores or between a headquarters location and regional distribution centers. Further, some employees travel to visit partners, suppliers, and customers or to attend retail

conferences. These employees still need access to their enterprise network, even while in hotel rooms or in their own homes. The mobile edge is a networking concept that assumes this type of mobility and architects the network for it appropriately. The edge of the network follows employees wherever they need to work, and identity-based security policies ensure that employees have the correct level of privilege based on their role in the organization. For a more in-depth look at the Mobile Edge Architecture, see the technical brief entitled “The Mobile Edge – An Architecture for Mobility, Security, and Convergence in Enterprise Networks” available from Aruba Networks.

### Centralized vs. distributed

In the past, all wireless LANs were distributed rather than centralized. Wireless LANs were built from individual “fat” access points that contained all the intelligence and configuration needed to run the wireless network. Operating a single “fat” access point was not a challenge, but the challenge grew exponentially with each additional access point that was installed. The scalability challenges in security and operations for these large networks led vendors to create a centralized approach to wireless LANs. In the centralized approach, access points are “thin” and are responsible only for radio transmission and some limited data processing. The majority of wireless operations, including security, configuration, management, and traffic processing are handled by a central wireless LAN controller. Controllers can be responsible for as few as two access points, or as many as several hundred. By centralizing all configuration and management, additional access points can be added to the network without increasing demands on administrators. Centralization of wireless LAN control and management is the key requirement to a scalable deployment.

### Standard vs. proprietary

Technology typically evolves down a path where early adopters deploy proprietary, closed systems in order to get basic or advanced functionality. Over time as the technology is adopted by more and more users, basic features become standardized and interoperable between different vendors. Finally, as the technology matures, even advanced features become standardized. Today, standardization of wireless LAN technology has proceeded to an advanced state in some areas, with other areas still under active development:

- Client-to-AP communication over the air is highly standardized. All products with Wi-Fi Alliance (WFA) certification, including 802.11a/b/g, WPA, and WPA2 have been tested against a rigorous test plan and are certified to be interoperable with each other. Where in the past users were forced to purchase client adapters and access points from the same vendor, today multiple client types can be mixed with access points from different vendors without concern for interoperability problems. Standards exist for quality of service, power-save, rate adaptation, and roaming. The use of proprietary radio standards, “shim” software extensions, and special driver modes has been made obsolete by standardization work done in the IEEE and by the Wi-Fi Alliance.
- AP-to-controller communication over the wired network is not currently standardized, but is in the process of being standardized in the IETF (Internet Engineering Task Force) CAPWAP (Control and Provisioning of Wireless Access Points) working group. Proprietary protocols such as LWAPP (Lightweight Access Point Protocol) were offered up as potential standards, but required extensive re-work to fix known security holes. The CAPWAP group is currently working with several proposed standards to merge the best parts of each into a single unified protocol, and this work is expected to last through 2006. Once a CAPWAP protocol is finalized and adopted, it will be possible to mix “thin” access points and centralized controllers from multiple vendors.
- Controller function is not standardized, and is unlikely to be in the near future. Basic wireless functions such as authentication and encryption are normally supported equally across all controllers, but controllers from different vendors offer unique advanced features such as multi-SSID support, integrated firewalls, remote access capabilities, automatic RF management, and redundancy. It is in the area of controller functionality that users should spend the most time when evaluating wireless LAN equipment for purchase.

## Enabling rapid moves, adds, and changes

Retailers are often faced with needing to quickly add new stores, reconfigure existing stores, or move store locations. In the past, this meant a call to a telecom carrier to order leased-line or frame-relay service – a process that could delay the entire project by weeks or months. Today, the ready availability of broadband Internet connections has drastically simplified the process of obtaining network connectivity. Many enterprises now routinely connect remote offices, branch offices, and retail outlets with broadband DSL or cable modem Internet connections, and then attach VPN (Virtual Private Network) hardware to the connection to establish secure links to a central or regional corporate location. The use of VPN technology allows the corporate network to appear in any location where a link to the Internet is available, and moves and changes can be made automatically without a need for reconfiguration. A mobility architecture that is able to use private WANs or the public Internet equally in remote deployments is an advantage for retailers as it reduces costs and accelerates deployment time.

## Local site backup

Most retailers are highly centralized when it comes to IT resources. A local server usually exists in each store for local accounting and POS data, but this server ultimately pulls all data from a central location. It is extremely important, however, that an individual store be able to operate autonomously – sometimes for a period of several days – when a link to the central site is not available. Private WAN and Internet links go down for a multitude of reasons, and provisioning a backup link is often too expensive to be practical. With the wireless LAN becoming a critical component of a retail store's operational system, it too cannot fail when a WAN link to the central site is unavailable. Some retailers maintain a user database for authentication purposes at the central site, and wireless users and devices at retail stores authenticate against this database. A prime consideration when deploying a wireless LAN is how to ensure these devices and users can continue to operate even when a link to the authentication database is unavailable.

## Network and device management

A typical retail store has a variety of computing devices on-site, including barcode scanners, laptop computers, PDAs, and voice handsets. Because there are typically no local IT resources, configuration and repair of these devices must be automatic and simple. The wireless LAN deployed at a retail site should support a management system for both the network itself as well as the devices attached to that network that puts tight control of the system in the hands of central operations staff and does not require local personnel to perform diagnostics, reset devices, access management interfaces, or get on the phone to be walked through a procedure. Retailers evaluating a wireless LAN system should carefully evaluate each vendor's solution for network and device management to make sure it aligns with these goals.

## Summary

There is no magic technology that by itself can boost margins, fix operating problems, and guarantee customer loyalty. Only people can do these things, along with a well-executed operational plan – but technology can help. Successful companies today must build technology into their businesses. Wireless technology has a number of innovative uses in retail, as described in this paper, that can improve operational processes, improve the customer buying experience, give better visibility for management into store operations, and ultimately improve the bottom line.

## About Aruba Networks, Inc.

Aruba Networks is a leading provider of next-generation network access solutions for the mobile enterprise. The company's Mobile Virtual Enterprise (MOVE) architecture unifies wired and wireless network infrastructures into one seamless access solution for corporate headquarters, mobile business professionals, remote workers and guests. This unified approach to access networks enables IT organizations and users to securely address the Bring Your Own Device (BYOD) phenomenon, dramatically improving productivity and lowering capital and operational costs.

Listed on the NASDAQ and Russell 2000® Index, Aruba is based in Sunnyvale, California, and has operations throughout the Americas, Europe, Middle East, and Asia Pacific regions. To learn more, visit Aruba at <http://www.arubanetworks.com>. For real-time news updates follow Aruba on [Twitter](#) and [Facebook](#).



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