



SERVICE ORIENTED ARCHITECTURE (SOA): TRANSFORMING POINT-OF-SALE TO POINT-OF-SERVICE IN RETAIL BUSINESS MANAGEMENT

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ABSTRACT

Retail technology is evolving from a point-of-sale orientation to a point-of-service (POS) orientation. The difference is that point of service delivers improved customer service through the use of flexible devices such as self-checkout stations, self-service kiosks, information kiosks, and food ordering kiosks. Point of Service is easy to set up, use, and manage due to a standard platform, Plug-n-Play support, and familiar management technologies. It empowers retailers to create the most compelling customer interactions by providing a standard, retail-optimized platform that includes the required retail specific technologies and full support for standard retail applications and device peripherals. Point of Service provides low, retail point-of-service lifecycle costs by decreasing operating system and application development costs, deployment costs, servicing and maintenance costs, and POS hardware costs. A new category of enterprise infrastructure solutions, built on a service-oriented architecture (SOA), will deliver these benefits. SOAs are based on the notion of services, which are high-level software components that include Web services. The primary objective of this paper is to discuss a retail business information system illustrating an e-business integration among a biometric attendance system, a surveillance system, distributed and centralized architecture and a point-of-sale system.

KEYWORDS: Point-of-Sale (POS), Point-of-Service (POS), Service Oriented Architecture (SOA).

1. INTRODUCTION

The retail industry is known to lag behind other industries in adopting new technology. One of the major reasons is the razor-thin margins with which retailers work, which demand the quick return on investment (ROI) that are usually granted only by established technologies and methodologies. The evolution of retail architecture has thus followed what happened in other industrial sectors, moving from mainframe-based centralized architecture towards a departmental architecture where mini and personal computers brought data processing inside the stores. However, this shift created the new problem of data exchange with corporate systems. The evolution continued with client-server and then distributed architectures and now is evolving towards service-oriented architecture (SOA).

Today's environment is rapidly changing. Business dynamics and technological innovations have left organizations with a disparate mix of operating systems, applications and databases. This makes it difficult, time-consuming and costly for IT departments to deliver new applications that integrate heterogeneous technologies. 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. Technology, permitting communication between people and devices. All vertical markets deploying POS solutions are looking for ways to develop, enhance and support new environmental policies. Hospitality, retail, healthcare, convenience store, cinema and kiosk markets are increasingly aware of their responsibility toward Green business practices and are searching for "green" point of service (POS) vendors to partner with.

2. 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. 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 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. Strong security is a necessary from the network when credit card transactions are involved

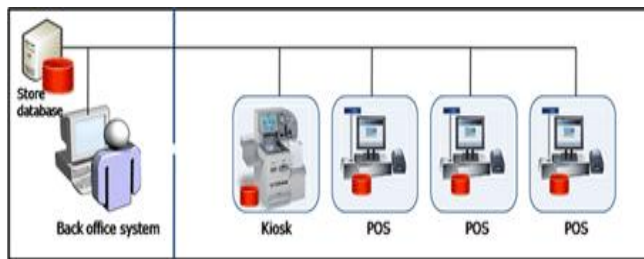


Figure 1- Point of Sale in Retail Store

3. APPLICATION OF POS

3.1 SUPPLY CHAIN MANAGEMENT

Enterprise Resource Planning (ERP); Supply Chain Planning (SCP); or the Transportation Management System (TMS) were the most important Technology in retail supply chain management is the answer of most of supply chain executives, if we ask the question, what they think the most important technology in their supply chain. However, another, perhaps more accurate answer would be the cash register, or what those in the industry formally refer to as the “Point of Sale” (POS) system. The POS represents the most critical function in a retailer’s supply chain—the checkout process due to some reason.

Firstly, The cash register is the moment of truth at which the consumer has to commit to a purchase and offer tender in exchange for the goods. The POS acts effectively as the collections system for a retailer. Consequently, it is critical that the POS correctly identify each item in the customer’s basket; match the barcode label to appropriate SKU for accurate pricing; and perform authorization of any electronic transactions. The importance of POS from a receivables perspective is probably obvious to most.

The second reason is probably less apparent to most people outside of supply chain and merchandising circles. The Point-of-Sale represents the most effective point to

collect data about customers, their buying’s and behaviors. The data is useful to a retailer to analyze buying trends. It is even more valuable to upstream distributors and suppliers for activities such as:

3.2 DEMAND PLANNING AND FORECASTING

Retailers and suppliers can avoid out-of-stock and excess inventory scenarios through better demand planning and forecasting. Point of sale (POS) data offers excellent visibility into consumer demand. Analyzing the historical sale (last week’s sales or yesterday’s sales) can help to identify low inventory positions that could result in an out-of-stock. Armed with better consumer demand insights, manufacturers and distributors can proactively address product availability issues before sales opportunities are missed. In some cases, POS data can identify issues such as distribution voids in which stores are not receiving, selling or allocating shelf space for items that should be in the merchandise mix.

3.3 CONSUMER MARKETING PROGRAMS

Armed with rich data about consumer spending patterns, manufacturers can modify trade promotions and pricing strategies to optimize product sales. POS data can also be used in efforts to rationalize product portfolios by identifying under-performing SKUs. New product development efforts benefit from POS data sharing as well. By analyzing consumer demographics and “market basket” data, which shows all the products the consumer purchased in a shopping trip, brand owners may identify new concepts they can bring to market.

4. RETAIL BUSINESS CHALLENGES

Retail Business presents some challenges. Inside the store, there are two very distinct software functions: the store front, which is the "public" part devoted to check out that accesses data on products, customers, promotions, and so on; and the store back-office or "private" part of the store systems, for stock management, replenishment, reporting, labor scheduling, and inventory management. In some really small-footprint stores, both functions are carried out on the same physical computer, but they remain very distinct in nature.

4.1 POINT-OF-SALE TRANSACTIONS

The point-of-sale (POS) transactions are extremely important. An obvious question is: Why is the problem of a delay in issuing a small valued ticket (due to a hardware or

software failure, or just slow response time) so The reason for this is twofold:

- Stores make their profits from a high number of low-value transactions, usually concentrated in part of the day or part of the week and the check-out operations cannot be delayed during these times.
- A POS interruption, even for a limited time, may cause not only significant economic losses but, even more important, losses of customers gained with expensive and long effort.

The bottom line is that POS is more mission-critical than the back office. POS must function at all times, irrespective of connectivity in the store, whereas back-office functions can wait for the connectivity to comeback. It also points to the possibility of back-office functions running either inside the store or provided by a service providers over the Internet.

4.2 POINT-OF-SALE VULNERABILITIES

Point-of-Sale (POS) systems provide the initial interface for credit card transactions. While the communications between POS systems have been hardened through the use of cryptography and a variety of authentication techniques, the devices themselves provide virtually no security. POS vendors seem to take a reactive approach to security. Security measures are generally not initiated until after credit card providers require them. Some common risks to credit card users due to POS systems such as:

4.2.1. POINT-OF-SALE TERMINAL WEAKNESSES

A single POS terminal may store hundreds of credit card numbers. The numbers are usually cleared out when the cash register is closed (at the end of the day or end of the shift) and when transactions are tallied, but not always. Exploiting a POS terminal requires physical or network access. Since POS terminals are almost never directly accessible by the Internet, the only consistently exploitable route is physical access. The degree of a storage compromise primarily depends on the storage medium used by the POS terminal. Different terminals use different storage systems. The three most common systems are static RAM, compact flash memory and hard drives.

- Many POS devices use static RAM for storing credit card information. The information is kept in memory, providing an audit trail, until either the device's memory is cleared or the memory fills and older records are overwritten. Removing power from the device usually does not clear the memory.

- Static or battery powered RAM can be expensive to upgrade and is not easily removable, leading to higher service requirements for upgrades and maintenance.
- Larger POS terminals are essentially a personal computer with a cash register in place of a keyboard. These devices usually run a variant of the Microsoft Windows operating, but Linux and custom operating systems, such as Windows Embedded for Point of Service (WEPOS), are occasionally provided. Rather than storing transaction history in memory or to CF, these devices store information on hard drives.

4.2.2 POINT-OF-SALE AUTHENTICATION

To prevent unauthorized access to the transaction information stored on a POS terminal, authentication codes are used. These passcodes attempt to restrict access to different functions on the terminal. Unfortunately, most codes can be bypassed or are set to default values. Beyond the initial authentication is the actual information stored on the terminal. Once the initial authentication bypassed, an attacker is given direct access to financial transaction information. While there are encrypted file systems for Windows and Linux, these do not appear to be used by any POS terminal. In particular, none of the manuals or documents for these devices discuss setting, resetting, or changing the password information for an encrypted file system.

4.2.3 BRANCH SERVER VULNERABILITIES

Branch servers are effectively networked PCs with a database of transactions. As with the POS terminal operating systems, these devices usually run some version of Windows or Linux, and offer no protection beyond the initial (bypassable) authentication. The only true protection comes from restrictive physical access. For small merchants, the server may be located in a back room. Larger companies may have more restrictive access.

4.3 THE DISTRIBUTED vs. CENTRALIZED ARCHITECTURE

Outside the store, there are many centralized activities, such as logistics, marketing, bookkeeping, and so on. The efficiency of the retail activity depends on quantity and quality of data flow inside and outside the store. Software architectural choices are very important and difficult, because reliability and data sharing are conflicting factors.

POS systems are autonomous systems that exchange flat files in batch mode with back-office systems for stock management and reporting. In the same offline mode and

after a role change, the back-office system exchanges sales and item data with corporate systems and other partners. This is defined as *distributed* architecture where operations are supported by a local database, so that no external failure can stop such vital operations.

The *distributed* architecture has a reliability and scalability advantage because it has no single point of failure and processing is distributed, but requires a complex synchronization activity among autonomous systems with their own databases and an expensive deployment. Store-sales information must be uploaded to the corporate systems and item and promotion information must be downloaded to the store systems. In addition, deployment of new applications, patches, and updates is not easy. There is also the issue of monitoring systems at the stores to ensure that the critical systems are functioning normally at all times.

In the *centralized* architecture, the store front-end systems (POS terminals, self service kiosks, and so forth) are connected online to the store server over a network and exchange sales information in real time. Permanent connection over a network makes richer data available, such as a customer's previous transactions, specific promotions, real-time loyalty-points management, stock availability, and next delivery date.

A centralized architecture with a single database solves the synchronization problem, but introduces a single point of failure and scalability limit, both inside the store for POS management and outside for connection to corporate systems. The central server failure or a network failure stops the business completely, with very serious consequences.

4.4 CLIENT-SERVER ARCHITECTURE

The *client-server architecture* represented an improvement over centralized architecture, because presentation and user-interaction functions are transferred from the server to the client—normally, on a PC with a processing power much higher than the old green terminals. This reduces the load on the server and leads to an improved system scalability and responsiveness to the user. However, it does not solve the "single-point-of-failure" issue.

In the retail industry, the client-server architecture is used more often inside the store — connecting POS to the back of the store—and less outside using a unique centralized server for an entire chain of stores.

5. SOA: CONCEPTUAL UNDERSTANDING

SOA is a "view" of architecture that focuses in on services as the action boundaries between the needs and capabilities

in a manner conducive to service discovery and repurposing. SOA provides Real-time connectivity among store systems, corporate systems, supplier systems, logistics, and other service providers through the Internet is a great condition that all retailers strive for. Extensive research has been devoted to overcome the limitations of terminal- or browser-based solutions. AJAX and other rich Internet application (RIA) technologies are an answer to real-time connectivity and responsiveness. However, they are not a solution for a POS where only a local application with a local database can provide the necessary functionality and availability.

Service orientation (SO) is the natural evolution of current development models. The 1980s saw the object-oriented models; then, there was the component-based development model in the 1990s; and, now, we have service orientation. Service orientation retains the benefits of component-based development (self-description, encapsulation, dynamic discovery, and loading), but there is a shift in paradigm from remotely invoking methods on objects, to one of passing messages among services. Schemas describe not only the structure of messages, but also behavioral contracts to define acceptable message-exchange patterns and policies to define service semantics. This promotes interoperability and, thus, provides adaptability benefits, as messages can be sent from one service to another without considering how the service handling those messages has been implemented.

SOA is not a technology. It is an architectural approach built around existing technologies. SOA advocates a set of practices, disciplines, designs, and guidelines that can be applied using one or more technologies. SOA encourages developing services around existing business functions offered by an application. Other applications that want communication with this application would make use of one or more services to accomplish the desired business task.

"Service-oriented architecture is all about building standard interfaces to access different business functions that are exposed by various core business backend systems. These functions could essentially be those that are frequently invoked by other business systems within the enterprise ecosystem. When these standard interfaces are built for enterprise-wide usage and are used by many different backend and client applications spanning a wide variety of business and functional boundaries—we term such an implementation as Enterprise SOA".

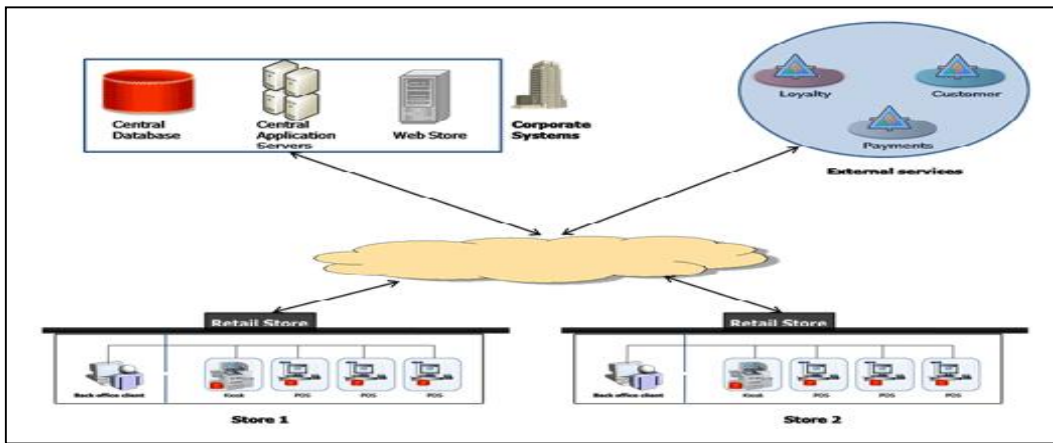


Figure 2. Service Oriented Architecture

For example, let us say Application A is a bill payment system. Applications B, C, and D need to invoke a particular business function called pay bill. This business function expects the following input parameters.

- The bill’s customer reference number
- The service provider or the company whose bill is being paid

- The account number of the customer from which the amount needs to be debited
- The date and time of payment.
- The payment amount

This function outputs the following parameters.

- The status of payment (success, failure, or pending)
- The payment transaction’s reference number.

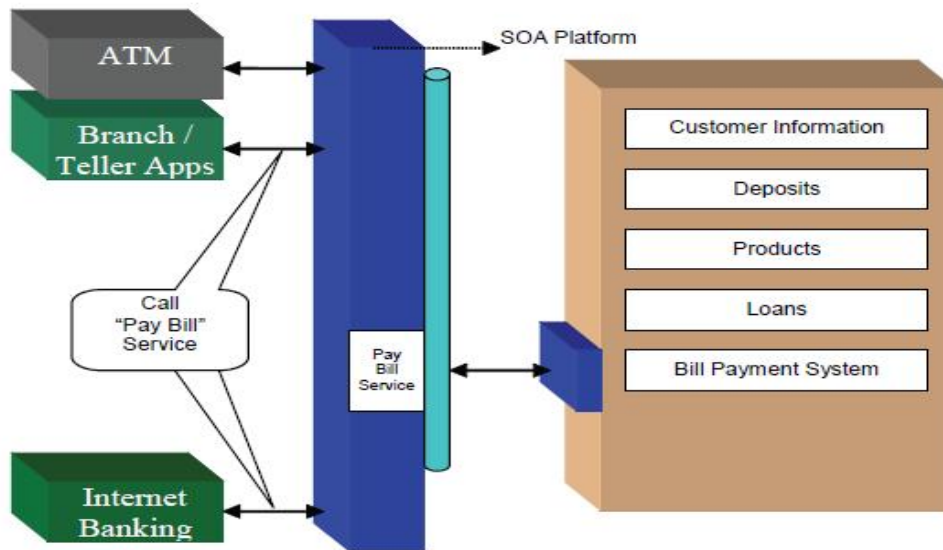


Figure 2 Bill-Pay Service

For this situation, SOA advocates that Application A should build a service called the bill-pay service and make it available to all applications. This service would consist of the following parts.

- A definition of the exact input and output data formats, preferably in the form of XML schemas, with details like mandatory and optional data elements.
- A definition of the transport protocol(s) by the means of which this service could be invoked.

- A service implementation, which is a piece of software that would accept the incoming XML, invoke the necessary back-end application function on behalf of the caller, get back the response, format the response in the service data format, and send it back to the calling client

6. RETAIL SOA BENEFITS

An SOA can deliver measurable benefits in today's demanding retail environment. SOA has proven to be workable and cost-effective in a growing number of real-world retail implementations. As shown here, SOA:

- Enables retailers to quickly adopt more profitable business models, such as SKU rationalization, revenue optimization, self-serve kiosks, e-commerce, and consumer-direct selling.
- Supports the close integration of POS, store portals, labor management systems, RFID, DSD, security, and infrastructure systems.
- Reduces the cost, complexity, and need for process oriented software customization, while minimizing the cost of subsequent integrations.
- Encourages maximum reuse of business logic and services across retail processes.
- Supports an IT approach that cuts across silo applications, supports closer integration with retail trading partners, and fosters more responsive, optimized operations.
- Enables growing businesses to more quickly capture merger-related costs and revenues
- Makes it possible for retailers to start with small, process-oriented opportunities to share resources— and then build a broader SOA environment over time.
- Helps protect and extend the useful life of current and legacy retail systems.
- Enables advanced business intelligence needed to support item- and store-level planning, forecasting, and allocation activities.
- Accelerates the capture and explosion of key trade data.

7. CONCLUSION

To survive and succeed in today's retail marketplace, your organization must adapt more quickly—and correctly—than ever before. You must deliver innovation and value across a diverse new range of distribution channels. You need precise and up-to-the-moment information on customer preferences, in-store trends, product development, inventory, and supply-chain capabilities. At the enterprise level, you must respond quickly to developing threats and emerging opportunities. Service-Oriented Architecture(SOA) allows businesses to

In short, this service will be an abstract representation of a given business function offered by Application A without implementation details of how this function is being executed. It is the responsibility of Application Clients B, C, and D to provide the necessary data inputs and receive back the response.

build on top of legacy applications or construct new applications/services in order to take advantage of the power of Web services. Over the past years, Web services have finally developed enough to allow such basic architectures to be built. Each of the components in the system will be designed and developed using a service-oriented architecture that clearly illustrates how such cutting-edge systems can be put together. By designing these components in such a fashion, the above example will focus on applying service-oriented development and integration techniques to the retail sector. The result of will be an integrated system that can be used by businesses everywhere to learn how their organizations can benefit from service-oriented architecture. Also, the application of the service-oriented development and integration to systems that were previously stand-alone and heterogeneous is discussed. All previous experiences in object-oriented architectures, component object model and design methodology are naturally streamlined with the service-oriented architecture and supporting the loose coupling of software components.

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