Fujitsu's Pervasive Retailing™ Framework

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ABOUT THE AUTHOR

Ron Brunt's career spans more than forty years of systems innovation with ICL and Fujitsu, including 12 years dedicated to the retailing industry. Having started with mainframes, where he focused on operating system design and large-scale databases, he then gravitated to systems architecture and created OPENframework, a 15-book methodology that is still recognized as one of the leading approaches to applying best practices to IT business applications using open systems. During his time working with clients in the retail industry, he architected the first large-scale, on-line loyalty system and customer data warehouse, which remains deployed today, serving more than 50 million customers across more than 1,800 stores. Ron's many contributions were recognized when he became an ICL Fellow, the highest engineering honor at ICL.

Premise

The retailing industry is in the midst of a revolution, where consumers are taking charge. The traditional measures of value – choice, quality, convenience and low price – are now assumed by consumers, who are becoming more focused on reducing the time, effort and risk associated with their shopping experiences. In many cases, shoppers arrive at the store more informed than those who they expect to serve them. Consumer facing technology is fueling this new wave with a plethora of new devices and applications, and at a time when major changes to operational systems, like RFID, are looming.

As a result, retailing enterprises face an escalating challenge to personalize interaction with their customers. The coming intersection of consumer technology with retail store systems highlights this challenge. The management of this convergence will be up to the retailer – at least to those who seek competitive differentiation from addressing the challenge. The integration of this wide range of devices and applications with appropriate business processes will require software tools that are designed to speed and simplify the interoperability of any device on any platform with any application.

Background

This paper describes what we believe to be one of the most critical periods of change the retail industry has faced over the past 50 years. It is a straightforward task to summarize the significant contributions of information technology to the retail industry over this period. Electronic point-of-sale systems radically changed the retailing model and enabled large scale formats. Computer applications for the retail enterprise came to support the new found efficiencies in the store, and led to inventory control and category management, which fostered valuable productivity increases. The rate of change has, as ever, increased over the past ten years, giving rise to CRM, internet shopping, the use of data analysis to provide competitive intelligence, step function improvements in computer affordability and networking, and now the promise, or possibly the threat, of RFID and other wireless devices.

Not all of these phases, waves, phenomena, however we choose to view them, have been overly successful in their own right, but together they have extended the very nature of retailing. The dot.com era is easy to joke about, in retrospect, but with just a few exceptions, it has driven us into understanding the importance of multi-channel retailing. CRM has been a roller coaster of confusing definition, but

undoubtedly, the value of the customer is now firmly ingrained into the culture of most retailers, as it was before this 50 year review began.

It is also true that the rush to implement new IT applications, as well as the retention of older solutions, has led to disconnects between functions that, today, need to be removed in order to remain competitive. We believe that the success or failure of any new technology initiative for retail stores has been, and will continue to be seriously affected by the state, age and adaptability of the supporting infrastructure, and the architecture of the systems currently in place.

Consider the pending arrival of RFID tags in the supply chain, even to the point of item-level tags in some retail segments. Assuming that the objective is to earn competitive advantage from the use of RFID, we will need to decipher an order of magnitude increase in detailed data flowing through the store networks and around the chain. We will want to use this data to maintain accurate, real-time inventory, to avoid empty shelves, to assist in loss prevention; in fact, to engender a new step function in productivity. Are the networks capable enough? Do we have the servers, database systems and communication mechanisms in place to make it work? Can we increment from the current application set to accommodate the newcomers without unacceptable disturbance?

Ever demanding, modern shoppers are internet savvy, pressed for time and aware that they have choices – and can help themselves. They like the control, the privacy and the accuracy they have when they can do their own thing, but the instant they want expert help, they expect to get it, as most users of self-checkout systems will confirm.

Once we address these issues, we can give our store employees handheld computers/communicators, all wirelessly connected. We can think of work-flow systems that trigger messages when stocks are low, signals that direct a customer service associate with specific expertise to a relevant customer, or simply a broadcast that a customer wants help in a certain department. This will require wireless and wired LAN transmissions.

What about a customer who questions an associate regarding availability of a specific item? The associate will have a powerful device at hand that can access the "accurate inventory picture" and can proceed to answer the question. If the answer is negative, the associate will check instantly on availability in other stores or on the internet site. A positive result ends with a sale that would otherwise have been unfulfilled.

So, envision that we have a wireless, handheld device in the hands of an associate, who can access in-store inventory views that are accurate to the minute or better, and is able to move smoothly into cross-chain systems or the internet to complete the sale, which looks the same to the customer, regardless of the route that produced the item. How can this be done? Some of the systems involved already exist, some must be added. All require inter-communication with no

bandwidth issues, and fast response. Adding new capabilities to what currently exists has been a fundamental issue in retail technology for a long time. Starting afresh is not an option.

And yet, the biggest challenge is still to come. Ever demanding, modern shoppers are internet savvy, pressed for time and aware that they have choices – and can help themselves. They like the control, the privacy and the accuracy they have when they can do their own thing, but the instant they want expert help, they expect to get it, as most users of self-checkout systems will confirm.

The pioneers among self-helping consumers appreciate the avoidance of the line, but these same pioneers – who will be engulfed by the masses when they catch up – will themselves move on to wanting more. Why should they not be allowed to scan their shopping as they go, or at some future point, just collect it and leave, since RFID has enabled us to register their purchases? Implied here is that they can pay in some way without pausing to produce money, or a card, or a check. Also implied is that they can see a version of the receipt as they shop, which shows them what they will pay. None of this can be achieved today without improvement to the store infrastructure to handle heavily uplifted message rates and greatly amplified inter-operability between systems, some of which already exist and cannot be disturbed.

At every stage, the modern consumer is looking for value with a mindset that has convinced them that there is always another place to shop. Value, though, is a very personal facet, some immeasurable combination of quality, price, selection, convenience, ease of shopping, guarantee of satisfaction and often more. Helping them to save time, simplify their effort, and reduce their risk, while being available when they want to shop is critical, and requires a seamless multi-channel shopping experience.

For some, who shop frequently for food, as an example, linking an internet shopping list to an in-store self-serve shopping device will be a great attraction. For others, special on-the-spot offers will motivate them, and the more personally relevant the better. A few years ago, we could have satisfied such a shopper with a coupon – today, we need to use data analysis to make relevant offers, or risk our communications being drowned in a flood of unwanted solicitations. Data analysis requires data collection, which gets to our store systems via our store networks. Once more, this scenario cuts across systems in a novel way, from the shopper, who may be wirelessly identified to the loyalty program, to the point-of-sale system, to the payment process, with any number of possible incursions into

customer service, service department pre-ordering, or various informative sources – and let's not forget the inevitable "where do I find the XXX"?

Needless to say, if we go to the lengths of enabling shoppers to do nearly everything themselves, we have the right, in fact the strong desire, to track them as they do it. And when appropriate, we want to influence them, particularly as they are about to buy, or not buy. Influencing is strongly associated with advertising. In-store advertising is moving rapidly to digital media, either static screens or mobile ones on self-help devices. The connection between location, time and advertising message is paramount. To make these connections, however, requires a combination of knowing where the shopper is, what products are nearby, what of those products can be advertised at that time, digital media itself, and plenty of data about the whole affair to back up the effectiveness of the process to the advertiser. Consider the interaction between systems and the LAN traffic to do this, but the return for both the consumer and the retailer will cause it to happen – more quickly than we might imagine.

The Pervasive Retailing Experience is Fujitsu's vision of the emerging retail market, as described above. Our commitment is to help retailing organizations deal with the challenge of introducing numerous, distributed, inter-operating functions.

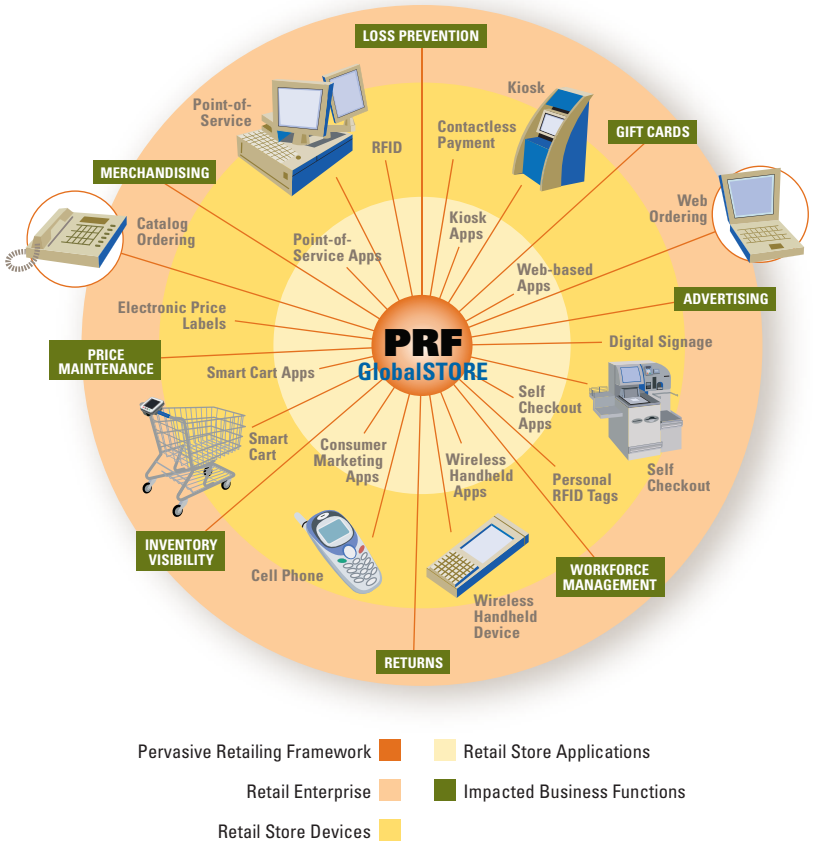
Can the infrastructure, the architecture, the very backbone of technology that has and still supports the retail operation today continue to do so in the light of the above? The rate of adding new function to existing systems is accelerating every year. The rate of change demanded of the store is far greater than that of the enterprise. The unexpected interoperability required between operational, cross-chain, supply chain and customer-oriented systems is a relatively new factor to consider.

Extending legacy systems, increasing real-time interaction rates, and ensuring interoperability between discrete functions across the retail operation require a dynamic infrastructure and system architecture. We can no longer isolate individual systems. The retail eco-system has become dynamic – it needs to flex by the day, even by the minute, or the second in some cases. This flexing is the necessary response to the demands of the modern retailing environment, which is being pervaded with growing frequency, by increasingly detailed interactions and much higher volumes of data. We call this happening the 'pervasive retailing experience'.

A well executed response to the 'pervasive retailing experience' will result in a competitive value proposition, enabling decision making via a single, real-time, cross-chain view of customers, products and the effectiveness of operations. A "Sense and Respond" approach becomes possible. In the sections that follow, we explain how you can address the pervasive retailing challenge and how Fujitsu can provide much of the necessary know-how, hardware and software required to do so.

The Pervasive Retailing™ Experience

The Pervasive Retailing Experience is Fujitsu's vision of the emerging retail market, as described above. Our commitment is to help retailing organizations deal with the challenge of introducing numerous, distributed, interoperating functions. To do so, we have spent many years developing the Pervasive Retailing Framework (PRF), and a set of applications, devices and solutions that use it. The picture below is a comprehensive summary of the classes of applications that fall within the scope of the PRF. Retailers have many of these in place today, but often they do not interoperate with other functions to the degree desired, and it is both expensive and risky to improve the situation. This can result in an ineffective multi-channel operation. Often older software is in place, and it would be desirable if, rather than replacement, a "modernization" approach could be taken – adding a Graphical User Interface to an old PoS system, for example. New challenges must be faced, as RFID, smart shopping devices, digital media, electronic price labeling and others arrive on the scene.



The Pervasive Retailing Framework

Fujitsu's Pervasive Retailing Framework (PRF) provides the essential applications for running the store – the GlobalSTORE application set – and includes the infrastructure to integrate both those applications and others in the store, or in the enterprise, into the current retail environment with minimum disruption to the ongoing operation. GlobalSTORE is architected to exploit the benefits of simplicity and scalability offered by the Service Oriented Architecture (SOA) in the Pervasive Retailing Toolkit (PRT). The framework itself is open and can be used to integrate applications and functions from other vendors. It allows multiple functions in the store and across the enterprise to work together at a granular level in real-time, in such a way that does not require invasive surgery to existing systems. When two functions interact, one is dependent on the other for the performance of a certain task, but beyond that, the interests of rapid and easy integration are best served by the loosest coupling possible between the functions. These techniques apply just as well to making existing functions interoperate as to giving a face-lift to older systems.

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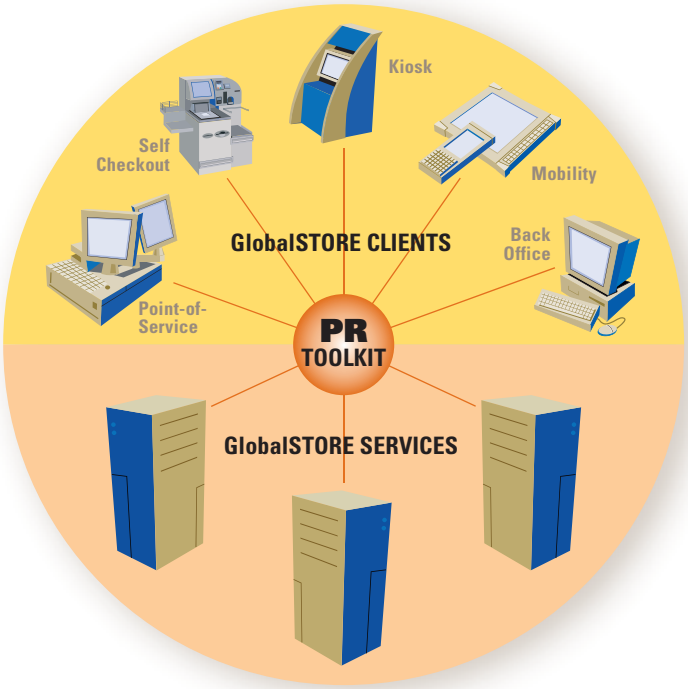

LOOSE COUPLING

How can this framework be used to deliver the capabilities needed to support the pervasive retailing experience? And how can we do so in a way that is manageable, affordable and causes minimum disruption, if any, to business critical operations?

First, consider that many required functions are already in place. They are likely of differing ages, from various sources, and exhibit their own implementation styles. In the main, they should be reused, but sometimes there are compelling reasons to replace them. Consider also that many other functions will have to be added, not all at the same time, and we need the flexibility to add without fear. When we add a function or replace an existing one, we want to do so in a way that minimizes changes, if any, to what we already have in place.

The function by function growth idea requires that we understand the dependencies between functions and address interoperability by exploiting the dependencies properly. We all do this in real life; for example, if you go to a restaurant, you will place an order with a waiter who will transport your request to the kitchen. Your order is descriptive, a selection from a menu, often with your conventional preferences. It is not instructive; you do not tell the chef how to prepare the dish step by step. This is a loose coupling between you and the kitchen, which is providing a service to you, and on this occasion you are dependent on that service. Now, what if the menu is in French and you do not understand it? This is a surmountable problem even if it has introduced a complication, but the eventual communication with the kitchen remains the same.

With loose coupling, we have to separate the real dependency between functions from the artificial ones that creep in from time to time. This means that there has to be a prescribed way for two elements to communicate what is agreed between them.

Now let's imagine that you exercise certain preferences that are more unusual; for example, you would like the pasta dish but with a different sauce, or if there is garlic in the mashed potato, you will take a baked one with sour cream, but not butter or chives. You are beginning to impinge on the normal function of the kitchen and you may still get what you want, but there is an increased risk that you will not. We have to think of interoperating functions similarly by keeping simplicity in mind.

Think of the chef as the expert providing a service to you the consumer, or client, and for maximum effectiveness your request for service should be simple and transmitted in a prescribed manner. Of course you and the chef are really software components and the sort of loose coupling we are after is achieved by what is called a Service Oriented Architecture, or SOA. A SOA is an architectural style whose goal is to achieve loose coupling among interacting software agents. A service is a unit of work done by a service provider to achieve desired end results for a client. Both service provider and client are roles played by software agents on behalf of their owners.

SOAs are not new, but there are options in the way they are designed. In the Pervasive Retailing Experience, the evolving store requirements mandate that an SOA be able to handle a very wide range of interoperating agents, an equally wide range of scale to cope with the smallest store and the largest, and also very high concurrencies and bandwidth. The two goals of capability and simplicity are combined in Fujitsu's approach, which is specifically designed to handle the evolution of pervasive retailing solutions, to enable ambitious retailers to gain competitive advantage, and to enable retailers who are held back by aging technology to move forward at low risk.

The Pervasive Retailing Toolkit

Fujitsu's Pervasive Retailing Toolkit (PRT) is the software to support an SOA along with other tools to aid the development, and/or integration of both existing and new functions in the store and across the chain. The toolkit includes the messaging infrastructure to enable the intercommunicating clients and services to be readily deployed, changed or involved in interoperation with other applications. The toolkit is the minimal core of a pervasive environment and can be used to incorporate PoS systems and retail applications from other vendors, as well as Fujitsu.

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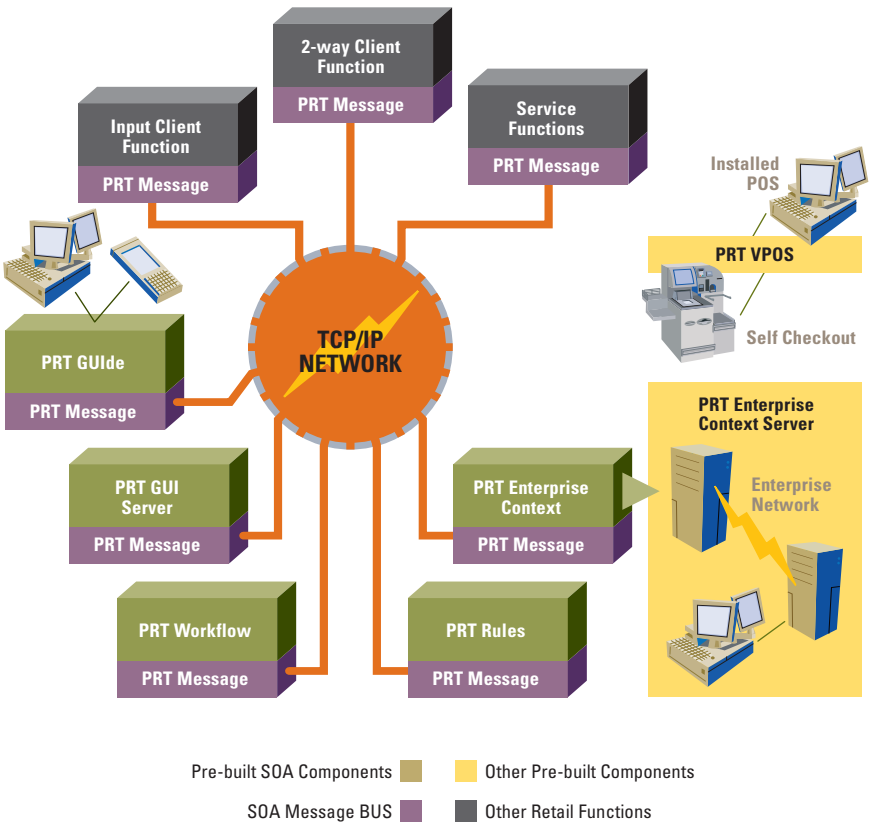


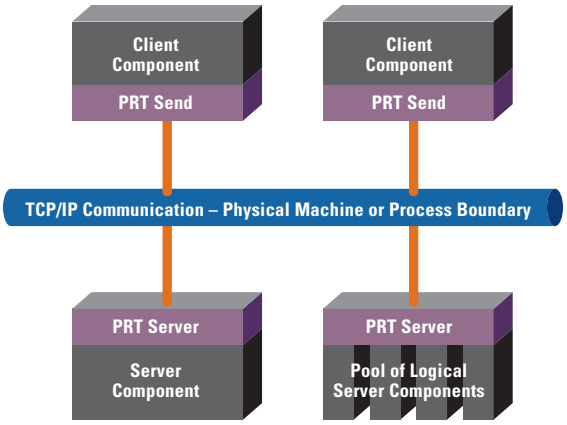
PRT MESSAGE

The fundamental building block of Service Oriented Architectures (SOAs) is the messaging infrastructure that relays all the data between logical components that provide services and perform work within applications. The message bus is a collection of proxies for connecting to remote or local services, such as:

- TCP/IP endpoints
- Web Services (SOAP/WSDL)
- XML Messaging
- Custom network services
- Message queuing
- Enterprise business logic invocation
- UI Controls

PRT Message provides connection ports for remote applications to connect into local applications. Application data can be shared via namespaces and data persistence. It supports message corollary and coordination services, application instance pooling and message event scheduling.

PRT Message drives store environments into new age SOA architectures and provides a framework to extend legacy application life.



The PRT Message system of software components was developed to facilitate the transmission of application level protocol messages between large numbers of client applications and multiple sets of pooled applications. There are many types of client-server systems that facilitate the transmission of messages, so what makes PRT Message different from the rest? Capable simplicity is the best answer to this question. The PRT Message system is composed of the correct blend of technologies, based on the need for:

- Scalability and high performance
- Expandability and potential for change
- Non-complex application implementation requirements

It is a message transport host for components interested in data, either in raw form or structured and syntactically precise, and enables peer-to peer exchange of data synchronously or asynchronously. PRT Message is responsible for connection, communication, transport and addressing integrity – the end components are entirely responsible for the message content. PRT Message ensures that security of access is limited to registered components and relies on the network transport for data level security.

PRT Message was developed to fulfill a need to effectively pool multiple instances of stateless business applications, without the overhead and dependencies of many of the third-party software modules delivered with the operating system and its associated components. PRT is hosted on the Microsoft Windows platform. The PRT Message system requires TCP/IP and uses the Component Object Model (COM) and .net system components that must be installed to handle interface instantiation and call invocations.

The "service" part of PRT Message is a simple Winsock application that uses the Win32 I/O completion port technology for extremely fast throughput. Connections are made to the server via TCP/IP to a specific port and are then posted to a thread pool of already initialized applications waiting for commands. The TCP/IP boundary may be a physical machine one or may be a process boundary resulting in flexibility over the physical distribution of processing. The data received from the connection is passed to the application via an API. The application processes the commands that are passed and returns any results back to PRT Message which returns the information to the client application. Wait! This sounds like the old client/server programming paradigm. It is true that this is a client/server package; but the difference between it and the traditional package is that PRT Message can be scaled and tiered to fit an n-tiered or web-like environment, including those that require severe load balancing schemes to obtain high transaction throughput. ***PRT Message is not a closed or proprietary architecture.*** As applications are written and installed, a PRT Message installation's capability is extended to suit the needs of the system. This is analogous to the way a web site's features are extended

PRE-BUILT SOA COMPONENTS

The Pervasive Retailing Toolkit provides pre-built software components to speed the introduction of new application functionality, new data components,

new smart devices and management of hardware peripherals. The key to reducing integration costs and speeding new application functionality lies in the ability to re-use pre-built Service Orientated Architectural components to link to legacy systems and provide gateways into other functional components wherever they exist in the retail enterprise.

PRT GUIde

The PRT Graphical Use Interface device engine, GUIde is a service which serializes the UI events and controls the display changes. The GUIde is a generic component that processes GUI data stored in a specified format, e.g. forms and graphics. Changing the stored data is one way to customize the user interface. The GUIde also manages the peripheral set of input and output into any application. The separation of this unique pre-built component reduces time and increases speed to implement new hardware components and can be implemented on multiple platforms extending the life of older hardware components.

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PRT GUI Server

The PRT GUI Server is a generic service that controls the data of what is displayed. It is a set of data elements in XML of forms and graphics. This component also contains tools and templates for changing the look and feel of screens. Thus the management of the user interface is separated from the data that actually get utilized by the system

PRT Workflow

The PRT Workflow is a generic engine that controls the application flow. It manages both external links to web sites and application services that are available. It is a pre-built component that contains flow data to drive in-store application flow. As a separate component, it drives unlimited 'user exists' to obtain services anywhere within the enterprise.

PRT Rules

PRT Rules is a generic business logic service. Fujitsu has pre-populated a version for the PoS function. Application specific versions can be created. This pre-built component enables rapid changes to application flow to be made.

PRT Enterprise Context

PRT Enterprise Context is a generic service which resides at enterprise level and provides points of service with a real-time look-up capability. It stores data about specific objects, usually but not necessarily customers, so that a single view of the object can be provided wherever and whenever such a view is required

across the chain. It enables rapid implementation of a repository of data that is relevant in all channels and all points of service, like customer details, loyalty data, sales receipts, payment methods, and registries.

OTHER PRE-BUILT COMPONENTS

PRT VPOS

Many connections into the store systems require data and data elements that exist in the PoS system. Fujitsu's Virtual Point-of-Sale (VPOS) is an abstraction layer between PoS applications and other applications requiring PoS data and data elements. The usage of VPOS can speed the implementation of Self-Checkout systems within store environments.

The VPOS component can exist as a monolithic part of a PoS application, or it can be a separate application running on a different logical component. In any case, it hides the PoS implementation and behavior details from the Self-Checkout system.

VPOS performs the following services:

- Creates a connection object
- Persists messages
- Receives messages
- Sends messages

The abstraction combined with the ability to persist messages reduces the complexity of integration with legacy POS systems.

Concluding Remarks

The Pervasive Retailing Experience is driven from the edge, not from the center of the retail enterprise, primarily because the rate of innovation in customer facing interactions has risen as retailers battle for market share. The persistent increase in internet shopping may not yet embrace a large segment of the population, but it is defining the way consumers will buy in the years ahead. Consumer behavior will likely drive retailing technology, and their intersection will occur in the store. Loose coupling is fundamental to interoperability, especially at the store level.

Nearly every technology change on behalf of shoppers brings with it a change to the retailer's operational systems, usually store systems. There are some who believe that a more centralized approach to integrating retail technology is the way forward, but this likely will stifle innovation at the customer level. The Pervasive Retailing Framework encourages development to proceed at its required rate across all parts of the enterprise.