

Enhancement of Web-based E-commerce using the TINA Retailer

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Abstract: *This paper examines the use of aspects of TINA to support e-commerce. A virtual shopping mall service provides a context for the development. The service aims to enhance the current e-commerce environment by providing the best-of-breed combination of TINA benefits with that of the WWW. The presented model allows for seamless integration with existing e-commerce solutions whilst providing a number of additional value-added services.*

1. Introduction

The advent of new information technologies has always played an important role in commerce. Businesses have been quick to embrace new technologies that allow them to reach and expand their target market. Commerce within the Internet environment presents new commercial potential not only to large companies, but also to a multitude of small and medium size enterprises (SME). This is made possible due to the nature and infrastructure of this new medium: the Internet presents an Open Service Marketplace (OSM) [1] whereby anyone has the ability of using and providing services.

The Internet however lacks a consistent and defined mechanism for billing and managing the different services offered. Internet-type services will be offered over the Next Generation Network (NGN) alongside real-time services. While the detailed mechanisms are unclear, services provided by the traditional telecom operators to subscribers will expand to include existing and new IT services such as e-commerce.

TINA [2] has defined a comprehensive framework to meet the challengers of this advanced network. A number of experiments (mostly telephony and multimedia) have been conducted to demonstrate the viability of providing services using TINA concepts. One area that is yet to benefit substantially from TINA concepts is e-commerce.

This paper examine the use of aspects of the TINA Architecture to support e-commerce. We develop the concepts by presenting a virtual shopping mall service that forms one of the demonstration services for the South African TINA trial (SATINA) [3]. The SATINA trial is a project which aims to develop an experimental TINA-based services and network connectivity platform, reflecting the requirements of future telecommunications service providers and network operators. The virtual shopping mall service looks to enhance the current e-commerce environment by providing the best-of-breed combination of TINA benefits with that of the WWW. Section 2 reviews the methods, status and difficulties of Internet-based e-commerce. Section 3 maps the e-commerce environment into the TINA Business Model. Section 4 presents the high level design of a virtual shopping mall.

2. E-Commerce Overview

E-Commerce first emerged in the early 1960's with the introduction of Electronic Data Interchange (EDI) between large organisations on their private networks. Although e-commerce is some thirty years old, it has mainly served the B2B (business-to-business) marketplace. With the introduction of the Internet, we have seen a surge in the B2C (business-to-consumer) model, with many businesses realizing the potential of providing services over this OSM. E-commerce is not only shopping over the Internet, but encompasses every business operation that involves electronic and network technologies. B2C has evolved from product advertisement and customer feedback, through to comprehensive all-encompassing business solutions. It is envisaged that nearly \$1trillion will be spent online in 2002 [4].

2.1. Evolution of e-commerce technologies

The two main technologies that initially enabled B2C e-commerce were the development of the Hypertext Transfer Protocol (HTTP) and the Hypertext Markup Language (HTML). These technologies allowed businesses to present their product information to a growing number of web users in a platform independent way. The addition of forms and CGI scripts was the next step to provide interaction between the customer, service provider, and backend systems.

The development of code that could be executed on the client-side was a response to demand for more interactive and dynamic web pages. The JAVA camp spawned the development of Applets and JavaScript, while in the Windows camp, VBScript and ActiveX entered the marketplace.

Security, which had also become a key issue for successful e-commerce transactions, led to the development of SSL, SHTML, and more recently SET (Secure Electronic Transaction). Along the same lines, the issue of certificates became the standard to allow code to execute out of the restricted sandbox that they were placed in.

The requirement for advanced online shopping stores resulted in a multitude of software that could dynamically create webpages, maintain session, manage user's profiles, and interact with backend systems over a distributed environment. Technologies ranging from ASP, JSP, cookies, servlets, JavaBeans, EJB, XML, through to object middleware technologies of CORBA, RMI and DCOM became available to developers.

Today combinations of these technologies are to provide total business solutions. E-commerce has moved into a multi-tier environment to allow for integration with all back-end and legacy systems.

2.2. Problems facing e-commerce

As has been shown in the previous section, technologies have continually evolved to meet the demand for more advanced services. In this rapidly changing environment, the time-to-market of a particular solution is a critical factor. Consequently a number of proprietary solutions with a multitude of different approaches to service provision have been adopted.

These proprietary solutions restrict service providers from vending their services in a universal manner thus narrowing the concepts of an OSM. Apart from the difficulties facing the service provider, a number of problems concerning consumer confidence in the e-commerce environment still exist:

- Consumers are hesitant to perform online purchasing due to the inherent security risks associated with the current infrastructure.
- Related to the above point, there is a lack of centralised billing, and hence no singular point of payment. Consumers are required to present their financial information to a number of different vendors.
- User's preferred services and profiles are seldom catered for on the Internet. Vendors do not federate with each other to provide global user-profile customisation.
- Consumers are frustrated with the rapidly growing frequency of transaction failure resulting from the lack of server availability.

Prospective service providers have also until recently been burdened with the management and billing aspects of vending their specific service. Solutions to this problem are starting to emerge, but they do not provide for the required OSM.

2.3. The virtual shopping mall

E-commerce has reached a mature stage for large companies to provide full end-to-end business solutions. The virtual shopping mall is an approach to promote an OSM, particularly for the benefit of small and medium enterprises. The virtual shopping mall also deals with some of the problems stated in section 2.

Virtual shopping malls allow prospective shop owners to vend their goods without having to handle the advertising, billing, and management aspects of their service. At present, malls are proprietary solutions requiring shop owners to reconfigure their service for other online shopping centres. There is also no federation between these malls. Advanced services that might include the concept of chain-stores (having a number of the same stores that can interact between malls, for example, specials that a chain-store may offer will what to be conveyed to each and every store in a number of different malls) are not yet possible.

3. TINA concepts applicable to e-commerce

The introduction of TINA concepts into the Internet can alleviate a number of the above problems and provide a common structure for the NGN. Numerous Internet-based services have been successfully integrated into a TINA environment to demonstrate the feasibility of this approach. For an e-commerce service, the main concepts applicable to this solution involve the TINA Business Model, the Service Architecture and the TINA DPE.

The TINA Business Model [5] is the enabling framework for an OSM. It separates the key business domains into different roleplayers with well-defined reference points between them. There are five main roleplayers: Retailer, Consumer, Service Provider, Broker, and Connectivity Provider, each responsible for different aspects of service provision. Reference points have also been defined between domains that are the same (e.g. Ret-Ret reference point).

The collective view of the virtual shopping mall is provided by the TINA Retailer role. Common operations such as billing for purchases in shops in the mall are also a natural function of the Retailer. Shops are treated as Third Parties. The use of a Retailer for access is consistent with both centralised billing to an authenticated customer's account as well as the provision of e-commerce services by a telco alongside services such as telephony.

Implementing the Business Model within an e-commerce environment ensures that service providers are able to vend their services with a number of different Retailers, and that Retailers in the future will be able to federate with each other to provide additional value-added services.

The Service Architecture [6] details the implementation of the Consumer, Retailer and Third Party Business Roles by specifying a number of computational objects and interfaces. The Retailer Reference Point is well developed but the Third Party Reference Point is not. Sufficient components and interfaces are defined to be of use to a variety of e-commerce applications.

The TINA Distributed Processing Environment (DPE) provides a number of important features when applied to a network as large as the Internet. It hides the underlying characteristics of the operating systems, provides location transparency, and allows for fault tolerance to the applications using it. These aspects provide powerful solutions to a number of the problems facing the e-commerce environment today.

4. Design of the Shopping Mall Service

To demonstrate how the TINA architecture can be used to effectively enhance e-commerce on the Internet, a service that implements a virtual shopping mall is detailed. Typical e-commerce transactions involve the consumer browsing an online catalog and placing selected goods into a shopping basket. The consumer wishing to purchase these goods clicks the submit key and supplies the required payment information. The proposed TINA service should seamlessly integrate with this process.

4.1. Accessing the Retailer

Before a consumer can start the virtual mall service, an access session between the Retailer and the Consumer needs to be invoked.

All end-user interactions are assumed to take place through a Web browser as the user interface. Web-based access supports user mobility. To the Consumer, the TINA Retailer looks like another Internet web site that can be visited. By browsing to a Retailer's URL, a Consumer has the facility of logging into an existing account or subscribing as a new user.

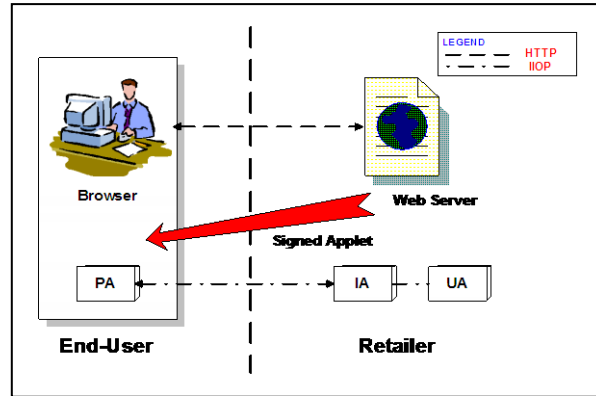


Figure 1: Accessing the Retailer

The access process is illustrated in figure 1. On accessing a designated web-server, the Provider Agent (PA) is downloaded to the user's browser. The Provider Agent (PA) component takes the form of a digitally signed applet. Applets downloaded from a web server are highly restricted in terms of the operations that they can perform on the client's machine. This 'sandbox' feature is necessary to restrict the applets from performing illegal operations and warding off virus attacks. The PA however needs to act as both a client and a server communicating to other components via the ORB. The applet housing the PA needs to be digitally signed to allow it to operate outside the bounds of the sandbox.

The downloaded PA prompts the Consumer to enter the required name and password which in turn is passed on to the Initial Agent (IA) for authentication. Once the Consumer is authenticated, their appropriate User Agent (UA) is launched with the Consumer having the ability to list subscribed services, discover new services, view billing and account status, and start a service. All these interactions take place with the Consumer using the browser as a universal GUI. An access session between the Retailer and the Consumer now exists.

4.2. Retailer-Content provider interaction

TINA-C has not yet fully specified the 3Pty Reference Point for interworking between the Retailer and the Third Party Content Provider. For this service, a number of requirements and interactions between the Retailer and the e-commerce Content Provider needs to take place:

- An access session between the two domains is required for a Consumer to be informed of the available stores.
- The billing information generated by the Content Provider needs to be relayed to the Retailer after a transaction is complete.
- The Retailer requires a mechanism for obtaining server information pertaining to the Content Provider.

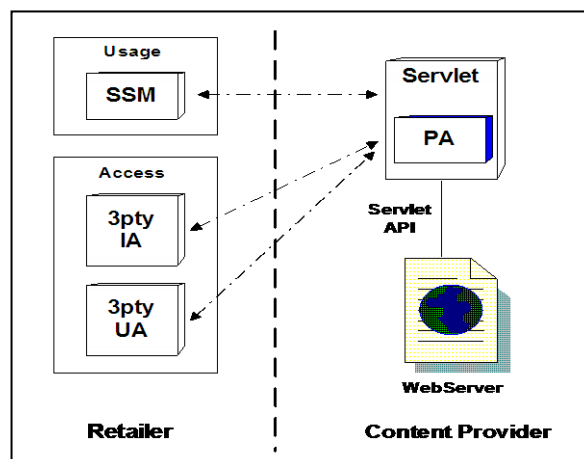


Figure 2: Retailer-Content Provider

Work on the 3Pty Reference Point has been carried out by the Eurescom P715 project [7], whereby parts of the Ret-RP have been reused. With the Eurescom scenario, the third party provider (Content Provider) contains IA and UA functionality that allow the Retailer to initiate an access session, and reuse a number of the interfaces defined by the Ret-RP. This technique however is not well suited for the virtual mall application. Due to server availability problems and the large number of possible online stores, it is desirable to have the Content Provider invoke the access session. This requirement is made possible by viewing the Content Provider as a 'User' and the Retailer as a 'Provider'.

The e-commerce provider obtains a servlet from the Retailer that interfaces with their application server. This servlet contains PA functionality allowing the Content Provider to log onto the Retailer using a 'third party' IA and UA (see Figure 2) in the same manner that the Consumer gains access to the Retailer (section 4.1). After the e-commerce provider has been authenticated, a `setUserCtx` operation registers the URL of their application server in use. A Consumer using the virtual mall service will now be able to select this store for purchasing.

The Content Provider is still responsible for providing the typical e-commerce site. This includes back-end catalogues and providing session management for their shopping basket (using cookies, URL rewriting etc.). Once the Consumer has decided to purchase chosen goods, the application server directs the billing information to the servlet via the servlet API. The servlet in turn binds to the Consumer's SSM in order to upload the corresponding billing information (see purchasing scenario below).

4.3. Consumer-Retailer Web Interaction

The web browser has become the standard for the presentation of services over the Internet. A TINA service should therefore exploit this technology by using it to present service content to the Consumer. This can be done using one of the markup languages (HTML, XML, WML etc.).

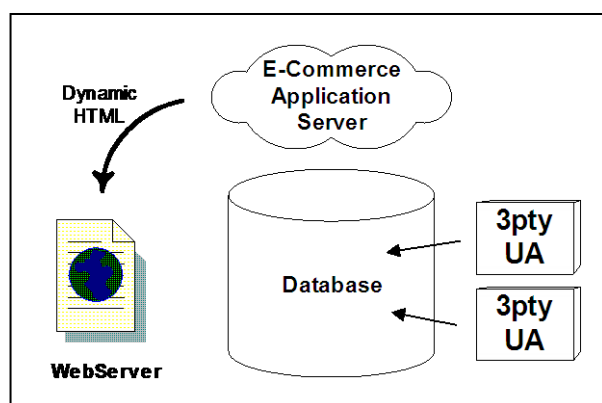


Figure 3: Online Store Generation

In the virtual shopping mall service, web pages are dynamically created (using JSP or ASP) to depict the stores that are available for business. The available stores (which are extracted from the database of Content Providers involved in an access session) can also be filtered to meet the Consumers requirements or preferences. This might include presenting stores that are physically located in the vicinity of the Consumer.

4.4. Purchasing Scenario

To outline the steps involved in providing a shopping mall service, a scenario that involves the purchase of flowers from an online store is detailed.

Preconditions:

1. The Consumer is involved in an access session with the Retailer.
2. The online flower store is involved in an access session with the Retailer.

Service Scenario:

1. The Consumer selects Shopping Mall from the list of subscribed services.
2. The UA connects to the corresponding Shopping Mall SF.

3. The SF launches the SSM, which contains the specific billing and control functionality for the Consumer.
4. The IOR of the SSM together with the URL of the Retailer's virtual mall webserver is returned to the PA. The PA launches an instance of a browser.
5. The browser attempts to retrieve the HTML document located on the Retailer's webserver from the returned URL.
6. The application server (which dynamically create webpages using JAVA Server Pages – JSP) generates a webpage based on the third party service providers that have logged into the Retailer. The generated webpage contains links to all the logged-in stores. Embedded in each link is the IOR of the Consumer's SSM.
7. The Consumer clicks on the Online Flowers store and is directed to the corresponding website. The desired goods are chosen in the usual shopping basket fashion.
8. When the final purchase button is activated, the webserver passes the billing information together with the SSM's IOR to the servlet.
9. The servlet attempts to bind to the SSM. The success of this operation results in the billing information being uploaded back to the SSM for process by the Retailer.

Additional purchasing can be done at a number of other sites. Ending the Shopping Mall service results in the deactivation of the SSM.

4.5. Benefits and Future Possibilities

The shopping mall model presents a number of solutions to the problems that were presented in section 2.2. This e-commerce TINA service provides the following:

- All billing is handled by the Retailer thus providing a convenient centralised billing mechanism.
- By providing this centralised billing mechanism, security risks are minimized boosting consumer confidence.
- Consumers are capable of profile management and customisation.
- Most importantly, by adhering to set reference points, the model promotes an OSM.

There are also a number of future possibilities that can be included in the model:

- If a store is 'closed' (offline or temporary server failure), the Consumer can request to be notified when the store comes back online.
- A Consumer can request to be pushed information when it becomes available. This feature is made possible by the DPE and can include information like news flashes, stock price activity, or auction results.
- If the Content Providers have more than one server, application-layer load balancing can be done by the Retailer.

- With the provision of the Ret-Ret reference point, Retailers (malls) will be able to federate with each other providing numerous additional advanced services.

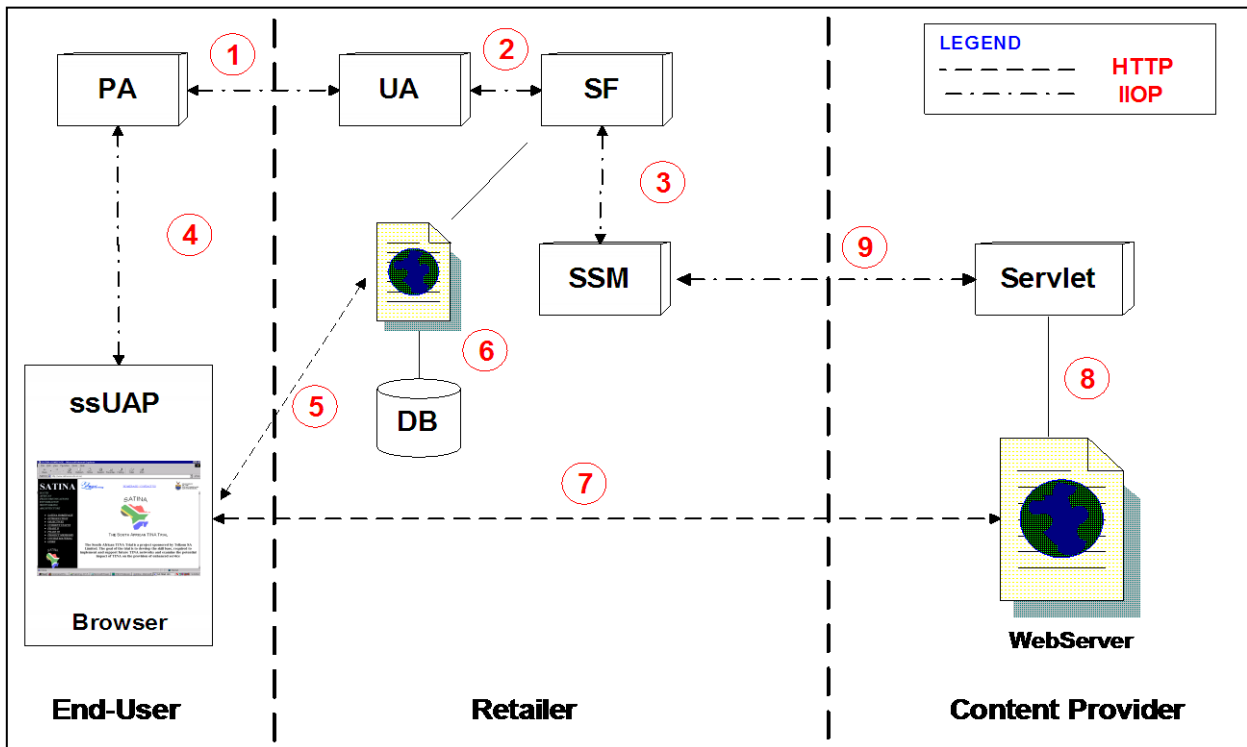


Figure 4: Purchasing Scenario

5. Conclusion

With the convergence of IT and the telecoms industry moving to the Next Generation Networks, the consumer will be offered a multitude of new and diverse services over a variety of different end-terminals. All these services need to be offered on a common framework to provide a convenient point-of-access for the Consumer. TINA is a strong candidate for meeting the requirements single-point-of-service for real time and information services including secure e-commerce.

The paper presented a prototype model for integrating the present e-commerce environment into a TINA framework. The TINA shopping mall service effectively demonstrates how TINA can integrate and enhance existing e-commerce applications. Extension of this model will require further development on the Retailer-Retailer reference point (Ret-Ret RP) to provide a complete set of interfaces for Retailer federation.

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