

# Development and Application of E-commerce System Based on Column Storage and SAP TREX Technology

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**Abstract.** In the background of continuous development of the network flattening, the e-commerce platform owned by the related enterprises shows an explosive growth in the number of users, the amount of access and the amount of business data in the background operations. As a result, enterprises require higher reliability and efficiency of e-commerce platform. The design of e-commerce systems have become critical. Under such circumstances, a data model based on column storage was designed in this paper. In accordance with data compression algorithms, the main data of the product is rebuilt on the basis of full combination with the working principles of SAP TREX high-performance unstructured index engine. And this effectively addresses the Customer's specific business needs. WCEM products in SAP mature package software were chosen to design and demonstrate the e-commerce platform of this article.

**Keywords:** column storage, SAP TREX technology, e-commerce

## 1 Introduction

At present, the popularization of the Internet is getting higher and higher. In essence, it changes the way of our life and work, and also changes the way of corporate operations and services. Many enterprises and businesses are aware of the benefits of the Internet's convenient environment without time and space limitations, and want to promote business development with it. As a result, e-commerce begins to appear. E-commerce has entered a stage of prosperity in developed countries. As for our country, e-commerce also has great room and potential for development. Therefore, it is very critical to develop e-commerce applications. How to develop the applications of e-commerce and how to build up an e-business application system to comply with the enterprise requirements are issues that must be resolved at the moment [1]. The current e-commerce model can gradually realize the use of the network to complete part or most of the transactions so that transaction time is effectively shortened, and transaction costs are significantly reduced. In this article, the purpose of this research is to propose a new data processing model, which can effectively deal with the problems of efficiency, cost and business intelligence in the development of e-commerce [2]. All e-commerce models are operating around the center of suppliers and their existing issues include: (1) information overload leads to lower efficiency; (2) exchange requires relatively high cost; (3) the current system functions are not rich enough. The research carried out in this paper is to apply the column storage technology and SAP TREX to e-commerce, and then build an intelligent e-commerce environment, which can effectively improve the efficiency of e-commerce, reduce transaction costs and achieve the goal of intelligent business transactions [3].

## 2. State of the Art

In recent years, the research on column storage is very active. In addition to the system and software of column storage, the research content also includes two aspects: optimizing storage and processing queries. In the aspect of optimizing storage, the basic storage structure, index technology and data compression technology are studied; In terms of query processing, rich research results have been achieved in query execution and optimization. These achievements are applied to the column storage system, which significantly improves the query performance of e-commerce system design and Implementation Based on column storage and SAP Trex technology [4].

Column data storage technology has a long history. At first, it was just a column memory database. In actual operation, the column storage technology can merge the database into the memory and store it in the memory in the form of "columns". Storage technology is designed to store in columns. The key is that it can only read the column content required by the query in memory and prevent reading irrelevant data during query processing

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[5]. Column storage also uses an execution mode of one column at a time. The execution mode of one column at a time can prevent problems such as slow query speed caused by the execution mode of one row at a time. By 2005, the research and development of row storage technology had applied the vector query X100 instead of the original one-column-at-a-time processing mode. This makes the column itself more flexible in each processing. This not only allows for higher CPU utilization than ever before, but also expands the column storage technology to make it a disk database. In order to query 100GB of data, the column storage technology is two orders of magnitude higher than the databases using other types of storage technologies in the same era [6].

### 3. Methodology

#### 3.1 System Operation Platform

System hardware platform includes that the central ERP server and CRM server use IBM Power 5.2 with more than 25G, and mainframe with more than 128G. Storage uses cluster storage to dynamically allocate the storage space needed for each host [7]. System operation software platform includes that the server uses A X5.0, and the database adopts MySQL memory storage [8]. The client uses Microsoft Windows 10, and Microsoft Internet Explorer 10.

#### 3.2 Function Module Design

At present, IT system construction is very mature, so all kinds of business have corresponding IT system to support the operation. E-commerce platform is only one of the business modules in the whole IT system architecture [9].

The functional modules of the overall IT system are planned as follows. In general, the IT system is divided into the following modules: the central ERP system, SAP ECC 6.0 and the central ERP system, which includes financial management, human resources management, logistics management and other sub modules [10]. The customer relationship management system in charge of sales is SAP CRM 7. In this CRM system, all order information is eventually brought together whether from network channels, telephone centers, internal sales centers or physical stores. After the pretreatment, they are then sent to the ERP terminal system to conduct financial treatments such as billing and posting, and ultimately go into the logistics distribution process [11]. The customer relationship management system in charge of sales is SAP CRM 7.0. Customer service requests, complaints and maintenance reservations are dealt with mainly in this CRM system. Background produces planning system that I2 Planning. The system is mainly used by new computer mainframe produced by computer research and development [12]. The general process is as follows. The front design department submits to the development of a new type of host supervisor request. After the supervisor has checked through, a new host model produced is returned. The system issues to computer to make the product master data system update a variety of small sub modules.

The functional modules of the e-commerce system are designed as follows. In view of e-commerce platform alone, its business can also be divided into several small areas. Depending on the different division, there are also sub-modules. This Web platform is also called “big customer network order” platform and this platform mainly serves the big customer of computer. Under normal circumstances, the large customer and computer sign a long-term order agreement or contract, and then the big customer’s order account on the platform is opened. This customer’s related personnel use account login system for bulk purchasing. B2B, namely, Business to Business Platform, this platform is used for large customers to conduct procurement directly through the telephone call center, and computer customer service commissioner orders through the platform. LPOS, Large Partner Ordering System. This platform is mainly used for partners to order, such as large agents. WebUI, Web Client User Interface. WebUI mainly refer to the user interface UI of CRM systems. SAP’s CRM system does not only have client interface access. However, users can also access it via the IE browser and the HTTP approach. The advantage is that the user terminal does not need to install complex configuration to access to the system. Public Sector Web, Public Sec to mainly refers to particular type big customers, such as schools, hospitals and public institutions. When these customers purchase goods, they can get special discounts and preferential by placing orders on this platform.

The central ERP system is SAP ECC 6.0. The central ERP system covers financial management, human resource management, logistics management and other related sub modules. The customer relationship management system in charge of sales is SAP CRM 7.0. In view of this CPM system, whether the orders are from the network channels, the telephone center, or the internal sales center and the physical stores, and they finally have to be col-

lected again. After pretreatment, financial processing such as billing and posting is launched in the ERP system. They will eventually arrive at the logistics distribution process. In view of customer service management system in charge of service, it specifically deals with customer service requests, complaints, and maintenance [13].

### 3.3 Technical Architecture Design

In this article, e-commerce platform designed is conducted custom development based on SAP WCEM2.0 of SAP CRM 7.0. WCEM2.0 runs on SAP NetWeaver 7.3 Web Application Server. This WebAS is a standard application server based on J2EE issued by official SAP. SAP Web Channel Experience Management is based on SAP NetWeaver Application Server Java (SAP NetWeaver AS Java) platform. The requirement of enterprise application system is designed to support modern, scalable, and oriented e-commerce business. SAP NetWeaver AS Java provides component-based and extensible application architecture, which is shown in Fig. 1.

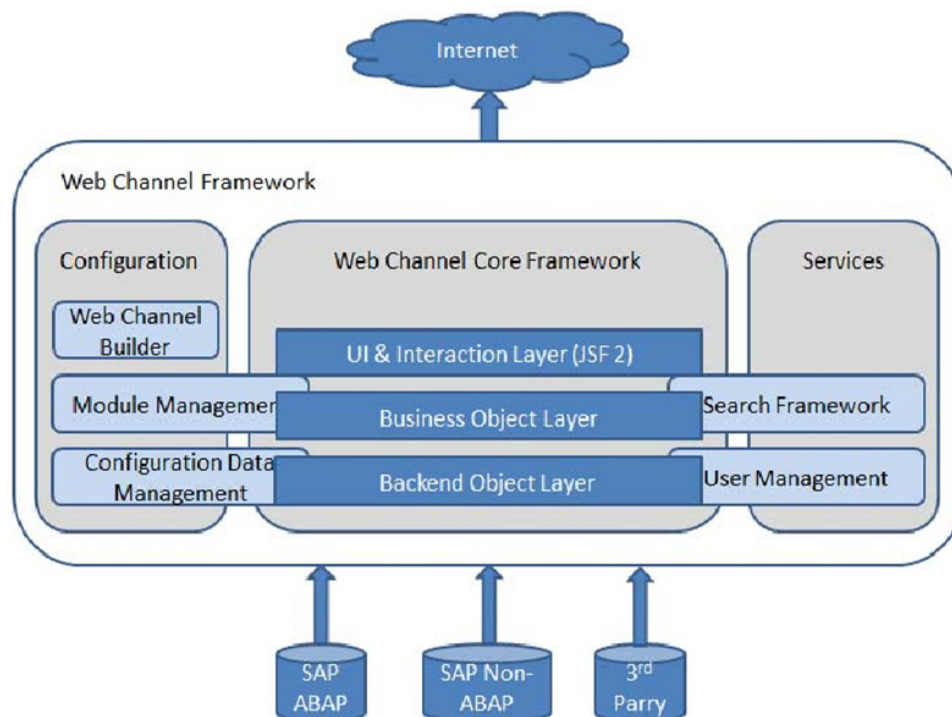


Fig. 1. SAP web channel experience management

Module management is described as follows. All business functions built on the Web Channel framework are in a modular paradigm. Based on SAP Web Channel Experience Management encapsulated module, reusable functional units are provided. The Web Channel Builder can be used to assemble into an application program at run time. As far as the technology is concerned, the meaning of the module is that it brings a package development method in the design phase. In the actual operation process, it can bring the deployment model of decoupling. Its advantages lie in: highly interchangeability and technical decoupling, improvement of maintainability, optimization of the development and deployment cycle and determination of reusable components. This approach is used to allow any type of modification to take advantage of the extended SAP module or partner module, and build a new customer module. The modules can integrate and reuse standards, which are shown in Fig. 2.

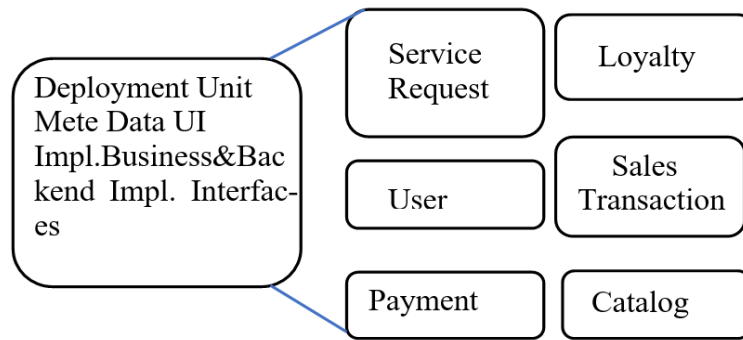


Fig. 2. Module structure

The user sends out requests by using the browser. When this situation arrives at the server side, Action-Servlet of the Controller (C) starts processing. After distribution to the corresponding Action, it first calls the Business Object of Model (M) read or writes the relevant data as well as the business logic. After that, the corresponding output is obtained. After that, Java Server Page (JSP) of View (V) is called to finally display to the user browser in order to implement a whole life cycle from Request to Response.

Since the current IT system construction has been improved, the construction of e-commerce platform must be based on the current overall IT architecture. Based on the hardware platform, this paper introduces the architecture and module design of e-commerce sub platform in detail.

## 4. Result Analysis and Discussion

### 4.1 Implementation and Application of The System

Product catalog operation is a complicated operation with large amount of data in the system. Therefore, it is appropriate to test the system application with this operation. In this paper, the application of the system is illustrated by using the operation of the catalog.

Firstly, the product catalog is created. Transaction code is COMMes PCAT\_ADM. This transaction code is applied in the CRM system to create and maintain the product catalog. And then the product catalog is activated. No matter what kind of non-activated products oysters, it will not show the peripheral system. This mechanism will be more flexible to maintain various versions of the product catalog, which is shown in Fig. 3.

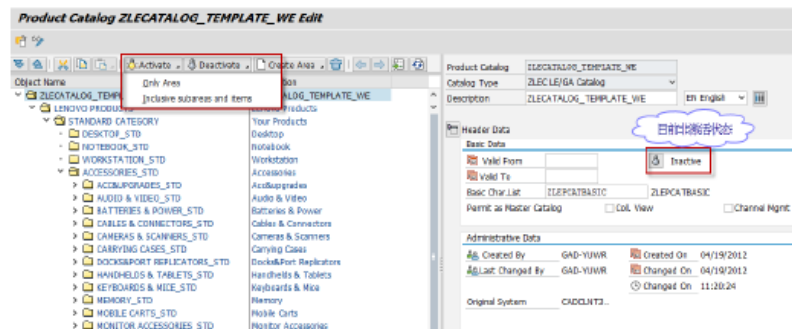


Fig. 3. Product catalog displaying

Then the product catalog is published. Transaction codes COMMes PCAT\_MS\_INIT and COMMes PCAT\_IMS\_UPDA are applied to the full release of the product catalog as well as to the differential release. In the actual process of quantitative release, only the product changed by the product catalog can it entre the release operation stage. , which is shown in Fig. 4.

Fig. 4. Product catalog replication

RFC Destination is also referred to as the target TREX server. It can run transaction code SM59, and then uses can enter the settings of the target server. In settings, various parameters including name, destination address, description and security can be set. As far as the catalog is concerned, product information of static data, such as pictures, sounds, videos, and other related content can be described. The frequency of change is small, so there is a specific Web content server in TREX to store these static contents. Publishing Compute: worker D is the target server name, and more than one target server can be configured in the system, which is shown in Fig. 5.

Next, TREX through Gateway are used to communicate. RFC, CRM, and TREX indexing servers can be used to build connection communications. This Gateway can be independent Gateway, and can also take advantage of the Gateway of CRM. With this Gateway, a protocol based on TCP/IP between CRM and TREX is constructed. TREX handles catalog content indexing for product catalogs. Specifically, the TREX index engine sends the contents of the product directory to the CRM, and stores it in a particular store to respond to the queries followed. Users log in to access online stores. The users access the product catalog. When users enter an online store, they can recognize their product catalog, and can also browse and view the operations. In view of the cache of product catalog, because users access the catalog through the online store, the user's Web side to the TREX engine will continue to communicate and query. Based on the purpose on lifting performance, TREX stores all of the product directory cache in the Web server, so that the user's query requests from the J2EE side will become more efficient.

Fig. 5. Configuration of a web content server

## 4.2 Summary of Implementation Effect

### 4.2.1 Implementation Effect

Lenovo adopts the e-commerce system and put it on line, marking that Lenovo's international business has reached a new level. This platform is mainly run in North America, and will be promoted to emerging markets such as Europe in the next one to two years.

Before implementing this system, Lenovo's retail business mainly relied on an original e-commerce platform left over from IBM. However, due to IBM's "boss" style, the operational and maintenance costs on this platform are extremely expensive. The launch of SAP's e-commerce platform this time has brought huge cost savings to Lenovo. On the whole, the system maintenance fees originally paid by Lenovo to IBM are as high as or even more than 200 million US dollars per year. After switching to SAP, although SAP also charges a lot of system maintenance fees every year, it saves a lot of money compared to the 200 million US dollars. Since the system has just been put into operation online, only a few large customers are currently participating in the trial opera-

tion. After the trial run phase, more than 100 large Lenovo customers in North America will migrate their group's procurement business to this e-commerce platform. Later, it will be promoted to customers in Europe. After the system gets online, LENOVO.COM can be accessed by more than 70 countries and regions.

On the other hand, before the launch of this e-commerce platform, a large part of Lenovo's business volume came from orders by manual telephone seats. After the customer calls the call center, the call center staff directly load the order into the CRM system, and then enters the payment, production, and delivery processes. Although this method is simple and easy to implement, in addition to the high cost of personnel, sales efficiency is also very low. After the platform gets online, large customers can browse and place orders directly in their customized online store, and the system will automatically generate corresponding orders based on valid contracts and transfer them to the ERP system for subsequent processing. This approach effectively reduces the degree of manual intervention, saves labor costs, and also improves the processing efficiency of the system and greatly reduces the possibility of errors.

#### **4.2.2 Improvement in Response Time**

The performance improvement from the launch of the new system on line is comprehensive in all aspects. Among them, the use of SAP TREX based on columnar storage technology has particularly improved the performance of the entire system.

#### **4.2.3 Performance Improvement Under High Concurrency**

Based on Lenovo's actual business situation, we also simulated the actual business scenario of concurrent access by multiple users and got the test results. For Lenovo's B2B business, there are about 200-300 corporate customers in North America + Europe, so in the extreme case, these 200-300 customers visit the e-commerce system at the same time to browse the product catalog and place orders. In fact, due to different factors such as time difference, it is almost impossible for all clients to access concurrently at the same time.

We use Load Runner to simulate concurrent access by multiple users, and we can see that when a single user accesses, the response time is slightly higher, because the test has just started at this time and there is no cached data in the system. As the test progresses, concurrent user visits gradually increase, and it can be seen that the system response time of each performance test point has not dropped too much. When the number of concurrent users reached nearly 200, the system performance remained stable, and there was no performance degradation or even downtime due to too many concurrent users.

#### **4.2.4 System Stability Test**

We simulated the whole process of a complete user visit, browse and order placement, and select two different working days to test the stability of the system, as shown in the table above. Finally, the test system on the first day generated a total of 5606 orders; the test on the second day generated 5485 orders. With such a high single-day order volume, the system did not show a significant drop in response time or inaccessibility.

### **5. Existing Problems**

Since IT systems are implemented as per human design and needs after all, the business requirements and processes of various companies are not the same. The powerful SAP system has undergone complicated and customized development and system trial operation. In view of all the above points, we found that although the efficient and fast data query engine SAP TREX is used, the biggest performance bottleneck is still the huge amount of data. Through analysis, Lenovo's product master data system contains hundreds of millions of product master data. One of the reasons for this phenomenon is Lenovo's product development model. The user puts forward the required product configuration on the website or on the phone, and the customer service staff of the call center can create a new model request for the user. After receiving this request, the back-end system will generate a new model in the master data system after being approved by the supervisor, and then return to the front-end system for the user to place an order. Along with data increase and accumulation as time goes by, the main data system has become extremely large.

## 6. Conclusions

At present, popularization of the Internet is becoming higher and higher, which causes enterprises to adopt changes in enterprise management and service methods. Enterprise e-commerce is developing rapidly, and software systems should keep pace with the development of enterprises. The objective of this paper to promote the enterprise business efficiency, and to achieve this objective, we optimize the sales and management processes and reflect the optimization in the design and implementation process of the e-commerce platform. The system selected two core subsystems, namely, “product catalog creation, release, maintenance process” and “4-step build: configuration, order process” implementation instruction, and its implementation in the system was discussed in detail. The particularly important is to optimize the original system, and resolve the issue of long display time of products’ main data, slow response, and poor performance of the system. In the study of data compression algorithms for column memory, the SAP TREX products based on this technology can improve the performance. The possibility of applying a new master data model is as mentioned above. The key in handling the performance issues is to change the master data application pattern. This proposal begins to attract attention, and its corresponding solution will be formulated and announced later. After the implementation of the new proposal, the current system will surely be expected to get optimized and its functions to get adjusted.

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