

## THE I-BANK™ SERVICE CENTER

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**Abstract:** Many banks in the world have floated to dot.com. The customers expect different online services from their banks. End-to-end security consideration includes network, data and identity security. Pexim Computers has delivered a multichannel B2C solution enforced by Cisco Powered Network and N-Tier architecture implementing the dotNET Platform. The architecture is designed to be future proof and expandable.

**Keywords:** iBank, e-banking, scalability, security, PKI, B2C, N-Tier, dotNet, C#, networking

### 1. Introduction

Many banks in the world have floated to dot.com to create a presence on the Internet and take advantage of its power. Further more, the financial institutions are starting to use the Internet not only for presentation, but also for interaction with users, offering services in addition to 'traditional' banking.

The Internet offers many opportunities to financial services providers in terms of disintermediation, which is redefining the financial marketplace. It definitely means that the interface between the bank and the user is not an exclusive right to the bank, but more to IT non-financial institutions which start to offer financial services on the market.

The customers expect different online services from their banks. They exhibit an extreme form of service usage. The expectations are high taking in account the demand for secure, fast and reliable service.

The banks are not designed to make a swift change in the way of doing business. The trend in the world is to outsource the electronic services to IT companies that have resources to offer rapid development and implementation of e-banking architecture, while leaving the banks to deal only with the financial aspects of modern banking.

## 2. Future Proof Solution

In order to provide quality of service through different communication channels, the infrastructure of the e-banking solution should meet the following requirements:

- Access to different service channels
- Sharing of common business logic
- Secure information exchange with the users
- Integration in the existing core-banking Information Systems
- Future-proof ability for expansion

To meet these requirements, Pexim Computers developed a solution that addresses three key characteristics of the service: high availability, scalability, and security. The architecture meets these requirements across the network, the service channels, the database, and the server's operating system.

The architecture is designed to separate the presentation from the business logic, which leads towards sharing of common business logic for different presentation channels.

The integration with the existing core-banking Information Systems is achieved with adapters. The adapters include support functional specifications, transaction's system and triggers that generate events in the system.

The network is scale-ready, appropriate for scale-in or scale-out. The Software is implemented in an N-Tier architecture, which allows phase upgrades. It gives a future-proof ability for expansion of the system.

## 3. Trust, Privacy and Security

The security is considered through the combination of technologies and procedures, which are identified in the components of Network Security, Data Integrity and Authentication.

The network security implements:

- Extended Access Control Lists (ACL) on routers
- IOS Firewall Feature Set (FFS)
- Secure PIX Firewalls

The Data Integrity is achieved with implementation of SSL (Secure Socket Layer) at the Transport Layer and PKI (Public Key Infrastructure) at the Application Layer.

Different methods of identity check are used to verify the user's identity. It includes the use of:

- User name and password
- Cookies
- Digital Certificates (stored on security medium; miniCD or Smart Card)

With the implementation of the end-to-end security pack, the protected services are proven to be unbreakable in a lifetime.

#### **4. Network Implementation**

Pexim Computers teamed up to create a sustainable E-Bank network architecture. As a Cisco Partner Certified, the network was developed using the Cisco framework recommendations, experience and equipment.

The network is consisted of the following building blocks:

- Edge Routers
- Access Server
- Multilayer Switch
- PIX Firewalls
- Servers
- VPN

Edge Routers are located at the perimeter of an E-Bank network and provide several functions. The Cisco 3620 server is the right choice for Internet router that connects the iBank Service Center to Internet. The Cisco 3620 has two network module slots. Dial connectivity is supported with network modules offering different services. On the side of the bank, the choice is on Cisco 1720 Router with more modest characteristics.

The Access Server is located at the edge of the network and provides Dial-In and Dial-Out access to the iBank network. The engineers decided to use Cisco 3640 server, router from the 3600 series which has, on the contrary of 3620, four network modules. It is equipped with additional modems pool. The Cisco 3600 supports the most complete set of access protocols including Point-to-Point Protocol (PPP), integrated analog and digital modems, dial-out and fax-out. It makes this server suitable for Fax, WAP and Call Center services.

The security concern is provided with the use of extended access lists (ACL-s) and IOS Firewall Features. The Cisco 3600 routers are fully scalable. The Cisco implementation of the Multichassis Multilink Point-to-Point Protocol (MMP) allows starting small and scale additional access servers as required.

The Multilayer Switch interconnects the servers with high speed. Suitable solution is Cisco Catalyst 2950. The Catalyst switches offer a high degree of intelligent network services, such as security, high availability, and scalability.

PIX Firewalls are used to secure connections from front-end to back-end servers. The high performance Cisco PIX 515 firewall is implemented. With accommodation of extensive load and fast performance, the Cisco PIX 515 is the best fit for the given iBank environment.

The Servers have different configuration, depending mainly on their function. The WEB server are Intel Board Servers with dual Intel Pentium IV 1 GHz processors, 2 GB RAM, 2-100 NIC-s, one connected to the front-end network and second through the firewall to the back-end network. The dispatcher servers are with the same configuration, placed behind the firewall. The Data Server is extended with RAID Disk Array and extra memory for additional availability and data security. The servers are designed to sustain scale-in and scale-out expansion.

VPN is an autonomous network deployed as an alternative to the wide-area network (WAN) infrastructure to replace or increase existing private networks, employing the same security and management. MPLS-based VPNs use the peer model and Layer 3 connectionless architecture to take advantage of a highly scalable VPN solution. This solution is affordable and cost effective for establishing reliable and secure connection between the iBank Service Center and Banks.

Fig. 1 shows the whole network architecture of the iBank Service Center. The design fulfills the requirements for security scalability and high availability.

The back-end network, behind the Firewall are the Data Server and the Dispatcher Servers. In the front-end is the Web server that is connected to Internet and through the Firewall to the back-end network. The Dispatcher Servers work as service providers for the various channels of communication offered to the banks customers. The WEB server sustains a large part of Centers traffic load and is designed to be scalable, secure and highly available.

Through the Internet, the Center communicates with the SMS Server of Mobimak. MPLS VPN network is formed to establish reliable private and secure link to the banks. The Center is also connected to various public service companies. The Access Server functions as a modem pool for the fax channel, an access server for the WAP service, and also as a Dial-In for the Interactive Voice Response (IVR) Call Center service.

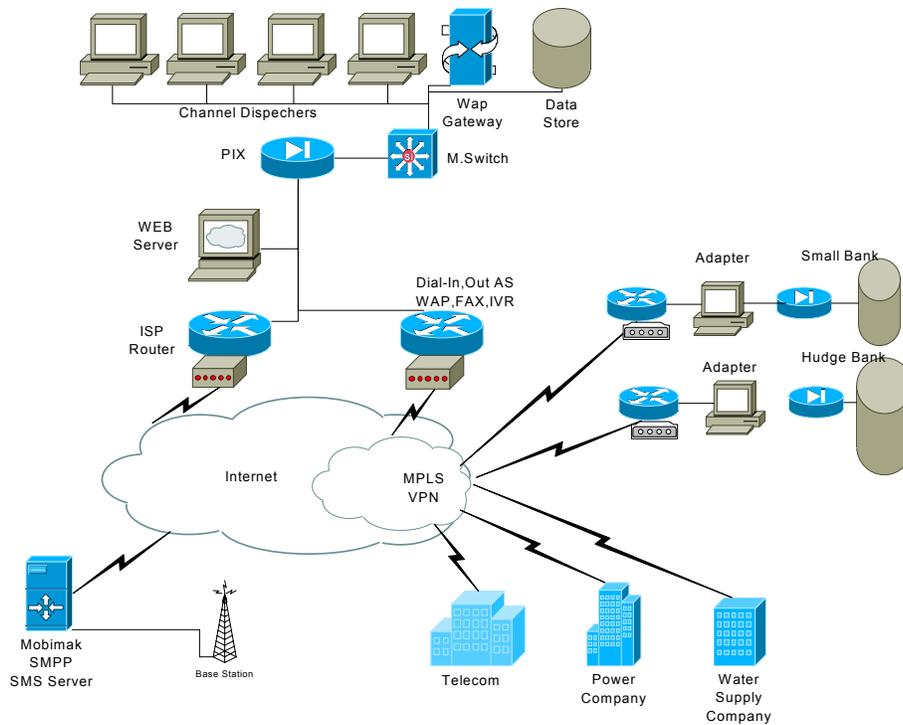


Figure 1: iBank Network Architecture

## 5. Implementation of Advanced Technologies

Considering the fact that building an E-Bank Service Center requires severe measures of security and error-free functioning, the developer's team of Pexim decided to implement the most advanced software technologies known to mankind.

The operating system used on all the servers within the iBank Architecture is Microsoft Windows 2000 Advanced Server. Windows Advanced Server provides scale-up capabilities by utilizing the latest server hardware for up to 8-way SMP and up to 8 GB of RAM.

The Windows 2000 Server operating system and the Active Directory service integrate applications, users, data, and other resources into a unified environment. Integration between Windows 2000 Server and application services allowed us to build more powerful solution on the platform by taking advantage of available features without adding layers of complexity, lengthening development time, or increasing management costs.

Because this environment is highly distributed, asynchronous way of communication trough message queuing is essential to maintain quality of service. Micro-

soft Message Queuing technology has been used because its features include, but are not limited to, extremely fast inter-application communication, message delivery guarantees, sophisticated message and queue security mechanisms and queue location independence.

During the deployment of a project, several components that should be present are:

- Open architecture
- Rapid deployment
- Workflow capabilities
- Separated content/presentation

The considered components for open architecture, rapid development and separated content from presentation have been easy to deploy using the Microsoft's platform .NET. The Microsoft .NET Platform includes a comprehensive family of products, built on XML and Internet industry standards, that provide for each aspect of developing, managing, using, and experiencing XML Web services.

The .NET Framework is a high-productivity, standards-based, multi-language application execution environment. The Framework consists of several parts, including the Common Language Runtime; a rich set of class libraries for building XML based services, and ASP .NET.

In the .NET Framework, there are available compilers for 22 programming languages. The choice was on C#. It is the Microsoft solution for bringing powerful rapid development to life. Some of the features of the new language are:

- Embraces emerging programming standards like HTML, XML and SOAP
- Eliminates costly programming errors with implementation of automatic Garbage collection, variable initialization and type-safe variables
- Reduces ongoing development costs with built-in support for versioning
- Better mapping between business process and implementation with the use of typed extensible metadata that can be applied to any object
- Extensive interoperability that includes native support for the Component Object Model (COM) and Windows-based APIs, and allowed restricted use of native pointers.

Cisco IP IVR system was deployed for the sake of the telephone automatic voice response. Cisco IP IVR is an IP-powered interactive voice response (IVR) solution that provides an open, extensible, and feature-rich foundation for the creation and delivery of IVR solutions via Internet Technology. It is designed to op-

erate upon the Cisco AVVID (Architecture for Voice, Video and Integrated Data).

Cisco IP IVR can extract and parse Web-based content and present this data to customers via a telephony interface. Cisco IP IVR architecture is open and extensible, allowing the user to incorporate custom-developed Java classes.

## 6. Multi-Channel Solution

To fulfill the requirements for scalable, secure and highly available system, Pexim Computers decided to implement N-Tier Architecture. The N-Tier application architecture is characterized by the functional decomposition of applications, service components and their distributed deployment.

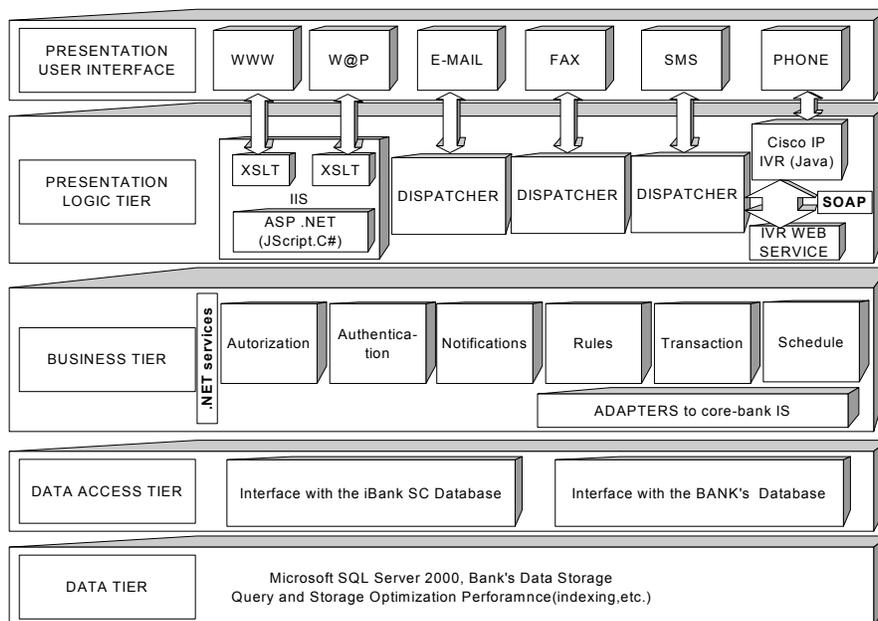


Figure 2: N-Tier iBank Architecture

The essential part of the architecture is the Data Tier. It is the Database Management System (DBMS) consisted of complex and comprehensive high-end products such as Microsoft SQL Server 2000 at the Service Center and different Data Storage Systems at the Banks IS. Optimization is achieved through query optimization, indexing and precompiled stored procedures. No business logic is placed in this tier.

The Data Access Tier includes Interfaces with the databases of the Service Center and the Banks. It includes objects that are to be used by the Business Tier. These objects encapsulate generic methods for connection and commands. This tier is a reusable interface to the databases.

The inevitable layer is the Business Tier. All the elements of business logic, business rules and data manipulation are placed in this layer. Objects assigned for authorization, authentication, notification, rules, transactions and schedule define the common business logic used by the Presentation Logic Tier and different channels of communication. All the objects are developed as .NET Services in C#. In the given position, these services are implemented as asynchronous applications with message queuing. This tier communicates with the Presentation Logic Tier through predefined XML messages exchanged with the Microsoft Message Queuing (MSMQ). Full system integration with the bank's IS is achieved with the adapter objects, developed mainly in C# as .NET services, which support functional specifications, transaction's system and triggers that generate events in the system.

The user communicates through variety of channel with different possibilities of content presentation. For the WEB and WAP channel, Internet Information Server 5.0 with .NET server extension is used. The site is developed in ASP.NET with C# code on the server's and Jscript scripting on the client's side. The information content received asynchronously with MSMQ by the Business Tier, is transformed from XML, with appropriate XSLT transformations, to HTML and DHTML.

For the sake of the WAP channel, with the use of the MS .NET Mobile Tool Kit, the content is transformed in WML pages. With the use of Access server, WAP Gateway Server and WAP site, Pexim Computers offers a complete mobile Internet solution.

Dispatcher services are offered for the Email, Fax and SMS channels. They are developed as .NET services in C#. There are different transformations in appropriate format for every channel. The Email channel with the SMTP protocol communicates with Email Server. The Fax channel implements the Active X functionality of the Fax Server that controls a modem pool. With the use of SMPP protocol and network streams, the SMS service manages to push SMS messages to the SMS server of the mobile provider.

With the design of XML Web Service and SOAP Proxy Tier, The Cisco IVR, which is fully developed in Java, communicates with the Business Tier. Here the power of the .NET architecture comes in to place to achieve communication among different platforms with the support of XML and SOAP.

## 7. Conclusion

The E-Banking is an innovative tool for banks that is fast becoming a necessity. In order for the banks to retain their competitiveness, they must focus on value add services. In addition, if they are to remain cost-effective, forming strong alliances with other non-banking entities as IT companies must become a major strategy.

The iBank Service Center meets the increasing customers demands with the offer of innovative customized services. It gives the ability to the banks to concentrate more on the quality of the financial services and isolate the technical development with outsourcing it to the Service Center.

Pexim Computer managed to fulfill the basic requirements for a successful E-Bank solution. The end-to-end solution is designed to be highly available, scalable and secure.

With the use of Cisco equipment and know-how technology, the N-Tier architecture and the Microsoft .NET platform, the Service Center manages to be fully scalable, available for scale-in or scale-out. Security is major concern, but implemented and balanced with acceptable response times and availability.

The implementation of advanced technologies enables expansion in the future of the customized services in the field of e-commerce and e-business. The .NET platform and the XML Web Services are promising future for offering financial serviced to other vendors. This definitely leads towards new advent and enormous opportunity for far-sighted companies.

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