

RIA Technologies in Banking on the Example of Verax eBanking Suite

Whitepaper



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Abstract

This publication provides an overview on the Rich Internet Application (RIA) technology in the Internet banking area and the Verax eBanking Suite in particular.

RIA is a collective term used to describe technologies that enable the creation of rich applications running in the web-browser environment.

The term itself was coined in 2001 by Macromedia (now Adobe). Leading RIA technologies include Adobe Flex, Microsoft Silverlight and Sun JavaFX. Some authors include also AJAX, Curl, Apache Wicket as RIA platforms, this paper however refers to these as "classic" web application technologies.

RIA has been recently gaining popularity in the banking sector and is being adopted by its key players such as Citigroup, Morgan Stanley, Deutsche Bank, State Street Bank, Wachovia, Raiffeisen and others.

Verax eBanking Suite allows for rapid-development of secure, rich Internet and smartphone electronic banking solutions allowing banks to **increase customer loyalty, attract new clients and provide new revenue-generating services**. It is a collection of applications and frameworks providing a modern, rich, advanced graphical user interface for multi-channel, Internet and smartphone banking, featuring:

- Internet retail banking.
- Internet stock trading and portfolio management.
- Internet corporate banking.

Gartner estimates that in 2010 60% of new projects will use the RIA technology in some form, while 25% will be entirely RIA-based.

Intended audience

This paper is a publication created by Verax Systems' experts and specialists. Its purpose is to highlight the most important issues related to the use of RIA technology in Internet banking as well as present the key information on the offered products and technologies to business and technical people responsible for implementation of Internet and smartphone banking applications.

1. Introduction

As the market pressure gets higher in the Internet banking space, banks and financial institutions are looking at ways of increasing customer loyalty, attracting new clients and providing new revenue-generating services. As the Internet channel is getting more pervasive, it receives more focus from the business. Verax Systems offers solutions in the Internet channel and smartphone banking areas allowing banks to gain a competitive advantage.

Business proposition

The solutions are centered around the following topics:

- Increasing customer experience (and thus loyalty and attractiveness) of the traditional Internet channel by RIA-enabling it.
- Increasing reach of Internet banking via smartphone utilization.
- Adding new, smartphone-enabled features to the mobile banking.

Technical challenges

There are many challenges that financial institutions are facing worldwide in the field of Internet banking. The most important of these include:

- Ensuring data security.
- Ease of use and new functionalities (data visualization, video streaming, support for end users, etc.) of applications.
- Development of new functionalities while maintaining backwards compatibility.
- Ensuring market attractiveness of new applications.
- Providing 24/7 availability.
- Compatibility with various operating environments and systems, including web browsers.

Ensuring security is a vital element of Internet banking. Not only is it relevant to the operations of the financial institution, but it is also essential for its image as disclosure of data can cause severe consequences.

Increased **user experience** provides the possibility to gain a competitive edge over institutions offering similar services. Apart from the obvious product and service offer, an essential aspect for the end user is uninterrupted service. In addition, enhanced user ergonomics translates into lower costs for telephone support. User experience is also inextricably linked to the **attractiveness** of applications.

The fact that the vast majority of eBanking software is used through a web browser is directly related to its **accessibility**. The real challenge is ensuring access to eBanking to a possibly wide audience, while maintaining application functionality. Moreover, the availability rarely goes hand in hand with the **compatibility** with various environments. A universal technology gives the possibility to save a lot of effort that would have to be used for the maintenance of different environments.

All these factors contribute to increased **satisfaction and loyalty** of the end users.

2. RIA – a new approach to web applications

2.1. Overview

Like traditional web applications, the Rich Internet Applications (RIAs) are running in web browser environments, however they are characterized by features of traditional desktop programs. The key difference is that RIAs are stateful – they maintain their own state and data on the client workstation and contact the back-end, server side, mainly to exchange data.

The classic HTML applications are built on the basis of the client-server model and the concept of the *thin client*, in which the majority of user interactions require the involvement of the server. Through the use of RIAs, which can store their own data and follow the instructions on the client side, it is possible to shift the processing load from the server back to the client. In this respect, the RIA architecture is similar to the traditional desktop applications (a.k.a. the *fat client*) – which is depicted in the figure 2 on the next page.

The locality of data and execution gives ability to build applications characterized by **high user experience** factor.

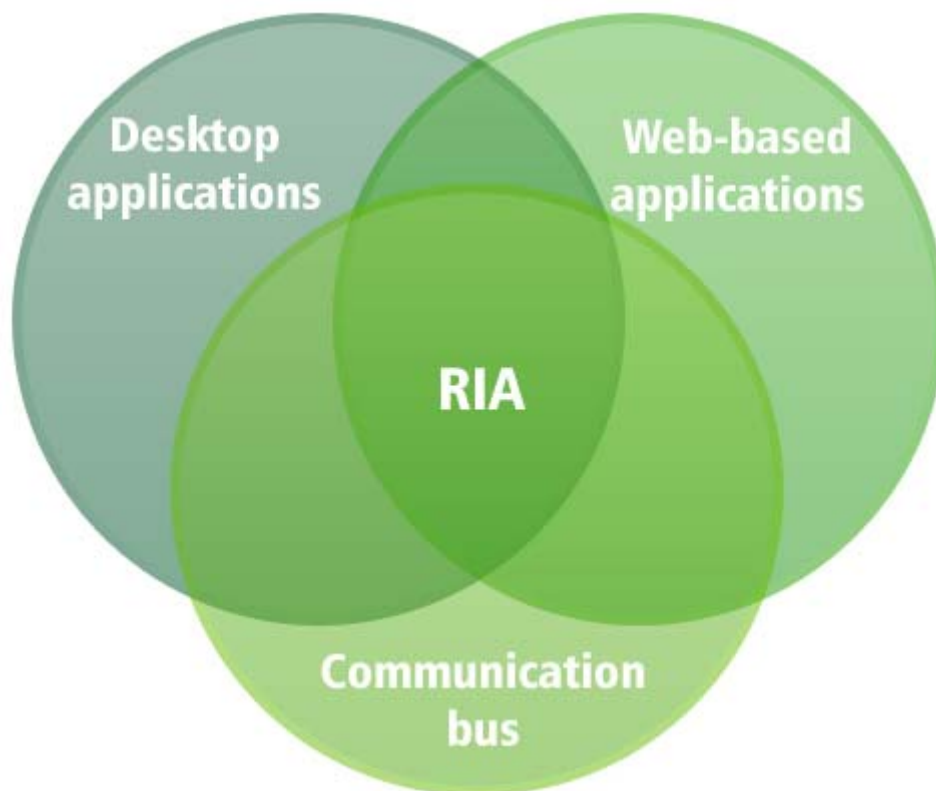


Figure 1: RIA in comparison to other technologies.

In addition to being stateful, the RIA technology has all the advantages of traditional web applications such as: ease of upgrades from a central server, working with the browser cache and others.

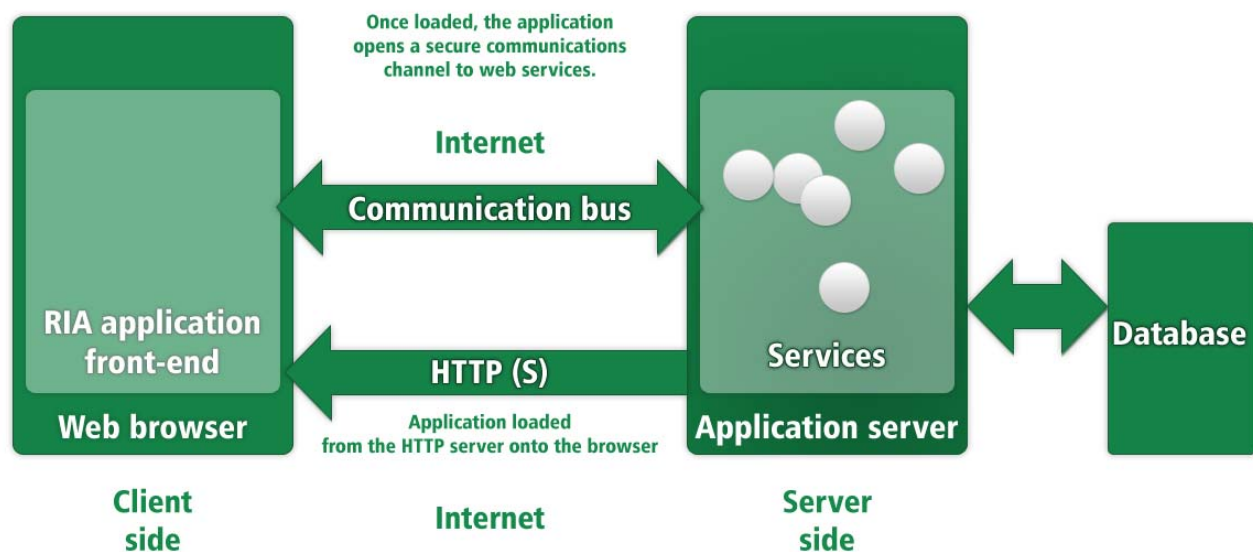


Figure 2: RIA architecture overview.

The subsequent section discusses benefits of RIA introduction for end-user, businesses and developers with the special focus on the Internet banking.

2.2. Benefits for the end user

This section contains information about the benefits of the RIA technology for the end user. In the case of Internet banking, the user is simply a bank customer.

Benefits of user interface ergonomics

As the name suggests, RIAs provide “rich” applications, i.e. applications characterized by **high ergonomics of the user interface** - from color effects such as blurring and transparency to animations. It is worth mentioning that this is important even for relatively simple applications. Companies that implement rich user interfaces, such as Apple (iPod, iPhone), Oracle (Metalink) or Adobe (portals) have had a tremendous marketing success.

Shortened response times and increased user experience

One of the main problems with traditional HTML applications is that they are based on loading of subsequent pages. If a user wants to see a new, or even the same data in another way (e.g. a change from a bar chart to a pie chart), the HTML page must be reloaded each time (it may simply be the next request POST / GET or the same operation invoked by AJAX).

Irrespective of the parameters of connection, the reloading lasts from 1 to 5 seconds (of course, the server response time itself is only part of that time; the data transmission and rendering time must also be included). It is worth mentioning that a satisfactory response time is less than 1 second – any values greater than this cause distraction, and consequently low user experience.

In the case of a properly designed RIA, the response time for the user can be significantly reduced, because the application itself does not require a reload (only data is loaded). In addition, further attention can be obtained by animations, caching or pre-fetching of the data. The advantages of such actions include:

- Increased customer satisfaction.
- Shortened user session times (increased user productivity as well as smoother action).

Asynchronous communications model

In the RIA model, the data can be transmitted from the server to the client asynchronously, i.e. the data can be sent to the client in the *push* mode. In addition to the undeniable technical advantages (smaller server load, elimination of client-initiated queries), this approach gives the user a better sense of control over the application (“I do not need to check what is happening, the system automatically informs me”) and increased convenience.

In addition, by using asynchronous techniques such as pre-fetching, the application can view the data while loading it (similarly to Google Maps that loads map segments adjacent to the currently viewed area in the background) further increasing overall application efficiency and user experience.

User productivity

Because RIA applications need only to fetch data rather than reload entire web pages, the users have no need to “reorient” in a new (even if only slightly modified) page layout. This allows for continuous focus on the tasks carried out with the use of the application, leading to increased user productivity. Any attention gap can cause the user to launch another task (e.g. launching an application or viewing other web pages), which may have significant costs (e.g. more sessions operating simultaneously). It is also worth noting that the attention of users is also interrupted by the very fact of “flickering” caused by the content rendering by the browser.

Integration with media and Web 2.0

RIA technologies enable seamless integration of multimedia content (audio, video) within the application. Multimedia content is useful not only for entertainment applications, but also for business applications. Examples of multimedia in business include:

- Customer care systems using a built-in microphone, speakers and a webcam to connect with a consultant.
- Demo movies showcasing products in product catalogues.
- Video-books and tutorials.

An additional advantage of RIAs is that multimedia content can be orchestrated with tasks performed by the user in the application – e.g. to highlight form fields as audio instructions are played on the speakers. Such approach to help system and user support has been implemented in the Verax eBanking suite.

User guidance

One of the fundamental differences in designing RIA-based user interfaces in comparison to classic HTML applications is that RIAs are focused on “state transitions” rather than a “website”. In this model, transitions between states are triggered by specific user actions. In the case of Internet banking these transitions can be caused by:

1. Selection of operation to perform (e.g. wire transfer to a predefined account).
2. Choice of operation parameters (e.g. type of payment).
3. Choosing the amount transferred.
4. Confirmation.
5. Request for a printable transfer confirmation.

Each transition between the states can be managed using user-guidance techniques such as:

- Information about the required fields (tooltips, validators, highlighting, etc.).
- Animated transitions visualizing the meaning of the transition from one state to another.

A well-designed “choreography” allows users to perform tasks in an easy and efficient manner, increasing the overall user experience factor. This approach places the user as the key actor in the design phase – resulting in applications that are easier to use and to understand.

Data locality

Web applications that exchange, process and visualize large amounts of data can be significantly optimized by using the RIA architecture. In the case of a classic application, any change in the input data (e.g. by applying a filter, changing the sort order, or scrolling down the page) triggers an interaction with the server, which has negative impacts on user productivity (delay over the network) and server-side resource utilization (request processing triggered). A RIA can use local data and process it directly on the client. This gives the effect of “data locality” (i.e. the application behaves like a desktop piece of software processing a local file) which increases the user experience factor through shorter response times.

2.3. Technical benefits

This section contains information about the benefits of the RIA technology, purely from the technical viewpoint.

Independence from the browser and the operating system

Adobe Flex technology offers true independence from the web browser and operating system (OS) used. Flex eliminates the problems of HTML rendering and JavaScript compatibility among browsers. Due to the large number of browsers available on the market (Internet Explorer, Firefox, Google Chrome, Apple Safari, Opera to mention a few) and significant differences in functionality and behavior between their versions (e.g. IE 6 and IE 7) ensuring cross-browser compatibility is a challenge for application vendors. Use of Flex significantly reduces costs at the testing stage, as well as the likelihood of potential incompatibilities (e.g. with new versions of browsers), decreasing maintenance overhead.

Easy updates and distribution

Flex RIAs are distributed and downloaded as one or more SWF files, which are browser-cacheable. This eliminates the problem with the JavaScript caching (which is highly browser-dependent) as well as reduces the network bandwidth needed for application use – once the application has been loaded for the first time, the bandwidth is needed only for data exchange. It is also easy to upgrade the application via an update on the central server.

In addition, RIA applications can be divided into modules which are loaded on-demand or in parallel in order to reduce the first load time. For instance, in case of the Verax retail banking, the first part of the application displayed to the user is the login screen and the dashboard. This module is around 450KB in size. Other modules (such as transfers) are loaded in the background and in parallel once the login and dashboard are visible to the user – these require additional 1.5 MB. As a result, the entire application loads under 2 seconds, similar to HTML applications.

Independence (decoupling) of client (GUI) code from the server code

Adobe Flex GUI applications are built independently of the server-side code and are contained in separate files served by a web server. It enables businesses to make changes in the user interface and to carry out the deployment of the front-end without disabling or modification on the server side – it only requires replacing the application file (SWF) on the server. This is highly beneficial to the Internet banking which requires 24/7 availability.

Pervasive runtime

Adobe Flash is available on a vast majority of computers connected to the Internet (according to Adobe, this value reaches 99%). In addition, the installation of the Flash Player runs fully automatically for most browsers. It is also possible to initiate an automatic upgrade to a specific minimum version of runtime (for instance, Verax eBanking Suite requires Flash version 9 or higher). The Flash runtime itself takes up only about 1.8 MB, which results in a quick download & update procedure. As a comparison, the JavaFX runtime environment requires more than 15MB, and for Microsoft Silverlight 4.6 MB is required.

Lower network load

For RIAs, a lower network load can be achieved not only through the fact that only data is exchanged between the client and the server, and the very application is loaded once. In addition, significant savings in the amount of data transferred can be achieved through more intelligent design of the services on the server side and the application, so that it collects data on request (i.e., when they are needed for the actual display). Such techniques have been implemented within Verax eBanking suite for most of long listings, such as account history.

Increase system capacity

In case of the RIA architecture, the client CPU is exclusively used for rendering of the user Interface. Since no communication to the server is required to visualize the data, a significant load reduction on the server can be observed. In one of the projects carried out by Verax Systems, the migration of application from the classic HTML/AJAX/JSP technology stack to the Adobe Flex platform allowed to double the number of concurrent users served with no upgrade of the hardware (IBM P550 platform with Oracle 10i in that particular case).

Due to the fact that modern desktop computers are very efficient, there is a possibility to use the “saved” CPU cycles to implement computationally complex features such as advanced encryption algorithms. The minimum requirements to run the application in the Adobe Flex technology are the same as the requirements for the Adobe Flash Player: a 450 MHz Pentium-class processor and 128 MB of RAM.

Full desktop integration

The choice between a browser and a desktop is not an issue for the Verax eBanking Suite applications. Due to the use of Adobe Flex and AIR technologies, all the applications can be run as Internet browser applications (running in the user's web browser) or as applications installed on the desktop.

Desktop applications enable users with additional, productivity-oriented features such as:

- System tray notifications.
- Drag and drop: e.g. exporting account history as XLS or PDF directly to disk.
- Storing of select user data on local disk in order to improve performance.

The eBanking Suite desktop applications retain all the benefits of the browser applications, such as:

- Internet based installation from a web browser.
- Automatic updates.
- Support of various operating systems (Windows, MacOS X and Linux).

2.4. Benefits for developers

Finally, it is worth mentioning business benefits to organizations who develop software. Verax Systems has chosen Adobe Flex as a core technology due to a number of benefits for including:

- High-performance graphical user interface design by using Flex Builder without the need to build applications, dramatically shortening the design time of the application's graphical elements while allowing close design work with the customer at the same time.
- Strict separation of the services from the user interface, which makes the code easier to understand, and thus cheaper to maintain.
- Ready, efficient, asynchronous and bi-directional communication bus between the client and server (LiveCycle Data Services – LCDS).
- A rich collection of components available from third parties (e.g. Yahoo! Maps, pre-loaders and others).

According to the internal estimates, the development time of RIAs compared to applications based on HTML/AJAX/JavaScript has been reduced twofold (this pertains to GUI development only, excluding the time spent on the server-side development). In addition, a 30% decrease in expenditures related to software maintenance has been observed.

3. Verax eBanking Suite

Verax eBanking Suite is a collection of applications and frameworks providing a modern, rich, advanced graphical user interface for multi-channel, Internet and smartphone banking, featuring:

- Internet retail banking.
- Internet stock trading and portfolio management.
- Internet corporate banking.

These applications consist of GUIs built on the basis of Adobe Flex and AIR technologies and can be run in a web browser or as desktop applications on the PC directly. Each application has a corresponding toolkit for integration with existing back-end systems and/or middleware software.

The subsequent sections describe the key aspects of the product from the financial institution's viewpoint.

3.1. Security model

In case of the Verax eBanking Suite, the communication between the GUI and the server-side can be configured with various levels of security. In addition to the standard HTTP(S) communication protocol, it is possible to use the SOAP technology (Web Service) and AMF for notifications. The communication channel can be encrypted using SSL for all the protocols.

3.2. Integration with banking systems

Verax eBanking Suite has been entirely designed in accordance to the service-oriented architecture (SOA). SOA allows for the integration of the eBanking Suite's server-side framework applications with the banking systems via the service layer. The eBanking Suite's server-side framework uses a RMI-based interface consisting of a number of services responsible for various functionalities in a particular application, such as retail banking.

The eBanking Suite integration requires providing a mediation layer between the eBanking Suite's server-side and provided with the banking systems. This can be achieved either by building a dedicated mediator or using standard SOA products such as TIBCO or WebMethods. In the latter case, Verax eBanking Suite can be connected using standard adapters supporting RMI.

3.3. Bandwidth and load time considerations

One of the key considerations in the eBanking Suite's design was the initial load time. While this operation is done only once (the application is later kept in the browser's cache and is re-loaded only when upgraded or once the user has cleared the cache), the load time is important from the user experience point of view.

In order to minimize the load time, Verax eBanking Suite's applications are divided into modules – only the first module is required be loaded in order to get the user started. The subsequent modules are loaded in background as the user logs in.

The initial module file size is relatively small (400-500 KB) and can be loaded within a few seconds using a broadband connection. The loading itself does not leave the user with a blank screen – relevant information with progress information is displayed.

Once loaded, the data transfer times are much lower than in the case of techniques based on HTML (also including AJAX). Detailed discussion and independent benchmarks can be found at:

<http://www.jamesward.com/blog/2007/04/30/ajax-and-flex-data-loading-benchmarks/>

3.4. Keeping backwards compatibility

Verax eBanking provides the opportunity to implement a mechanism for SSO (*single sign-on*), which allows for the use of eBanking Suite applications **simultaneously** to the classic interface. It is essential, as any financial institution will most likely have to satisfy two kinds of users:

- **Conservatives** – who are reluctant to any application changes.
- **Innovators** – who are looking for new features and gadgets.

3.5. Verax eBanking Suite – scalability

Because of the architecture of eBanking Suite, a large amount of functionalities is transferred to the user's computer. Such activities as drawing charts and graphs, data conversions, filtering, etc. are performed using the client CPU. In a large scale this can quite significantly reduce the load on the servers. Preliminary experiments show that the increase in system capacity (understood as the number of sessions supported simultaneously per a given computing power) is about twice as large.

Another significant fact is that the eBanking Suite – as opposed to applications based on HTML – typically requires smaller sessions, which translates directly to the amount of memory occupied in application servers.

3.6. Client environment compatibility

To run the application in the browser it is required to have a browser with a Flash Player installed (version 9 and later). A research carried out by Adobe shows that the required Flash Player version is present in 99% PCs in the world. In fact, the world's most popular websites such as YouTube, Amazon or CNN require Flash player be installed.

3.7. User experience

During the time when the application is running, eBanking Suite allows for full control of data download and storage. Unlike with HTML-based applications, there is no need for data collection in the *request – response* model. The data can be downloaded in the background – user actions can be predicted and the data provided to the application before it is requested. In addition, there is no need for keeping the data in the HTML session – it is kept in memory of the running application. Consequently, there is no strict limitation on the size of the active data stored. In addition, the information refreshing model is fully controlled by the application. For example, there is no need to reload the value of accounts every time the user goes to the homepage of the application (or to use the advanced session management mechanism) – the user can set an interval to determine when the data is collected. Altogether, the mechanisms described above allow for better use of the services providing data. The model used in eBanking Suite allows for savings in server resources through the use of the user sessions' size and the number of service calls.

The bandwidth-minimizing data transfer model, as well as the characteristics of the Flash Player technology create opportunities for improving the application quality from the user experience standpoint: it is possible to extend the typical e-banking applications with advanced visualization features such as interactive charts, history diagrams, portfolio graphs and others.

There are also multiple opportunities to improve user/application interaction, for instance:

- All operations of showing, hiding or dragging (typically implemented using JavaScript) can be completely smooth – the user does not lose the context and always knows what has happened on the screen.
- Fully functional pop-ups can be displayed (including the blocking of the user actions – modal windows).
- Better use of the user actions, e.g. drag the symbols of accounts or defined recipients to initiate the transfer.
- Easy to display animated trees.
- Interactive (including multimedia) support.
- Enhanced support for media (music, videos).

Verax eBanking Suite also supports PDF forms as user input.

3.8. Support for multiple locales during operation

The eBanking Suite supports multiple language versions in the user interface for all the Internet applications (for smartphone applications, the target language is selected during compilation due to restrictive size limitations for mobile applications). When the application is running, the user can switch between the languages at any time without reloading and, more importantly, without losing the context of the current operation (e.g. if defining a wire transfer in a form, after the language change, the very same form is displayed containing already entered data).

4. The future

4.1. Forecasts

According to forecasts of large IT consulting companies such as Gartner or ZapThink, the market share of RIAs will grow. The reason is not just an attractive design of such applications, but also quantifiable, financial benefits to organizations.

It is estimated that by 2010 about 60% of new projects will use RIA technology, while in 2011 the RIA market will reach a value of 3 billion dollars (Gartner).

4.2. Adobe AIR

Currently, one of the indispensable elements of Internet and mobile banking is a web browser. Until recently, this was the only feasible option due to the issues related with installation of the “fat client” application. On the other hand, using a web browser imposes certain limitations such as, for instance, inability to use the local resources of the computer: files, notification icons, on-the-desktop window for the application, sound, drag & drop and others.

Best of both worlds of desktop and web applications are brought together with the Adobe Integrated Runtime (AIR) technology. In essence, AIR is an extension that allows for building desktop versions of RIA applications from the same code-base. Each application in the eBanking Suite has a web-based and a corresponding AIR version. AIR applications run on Windows, Linux and MacOS.

Automatic updates are fully supported - as soon as a new version appears on the server, the user is informed and the update is carried out.

Adobe AIR seems to be a perfect fit for Internet banking applications that require high-responsiveness and tight desktop integration such as stock-trading and real-time tickers.

5. Summary

Verax Systems has one of the longest track records in the RIA technology implementation in the world (starting as soon as 2006). We were one of the first adopters of Adobe Flex in the banking and finance industry. The Verax eBanking Suite is aimed at rapid RIA- and smartphone- enabling of the financial institutions in order to increase customer loyalty, attract new clients and provide new revenue-generating services.

For more information, please visit our website <http://www.veraxsystems.com/en/products/ebanking>.

6. Sources

- Adobe Flex website:
<http://www.adobe.com/products/flex/>
- Adobe Flex applications portfolio:
<http://flex.org/showcase/>
- Comparison of loading times of applications in different technologies :
<http://www.jamesward.com/blog/2007/04/30/ajax-and-flex-data-loading-benchmarks/>
- Adobe statistics on pervasiveness of the Adobe Flash Player:
http://www.adobe.com/products/player_census/flashplayer/
- System requirements for running Adobe Flex applications:
<http://www.adobe.com/products/flashplayer/systemreqs/>
- Information about the spread of RIA technologies in the future:
http://findarticles.com/p/articles/mi_m0EIN/is_2006_July_25/ai_n26935125/pg_1?tag=artBody;col1
<http://www.adtmag.com/article.aspx?id=17953>