8th ICCRTS Command and Control Research and Technology Symposium

Track 5 – Network Centric Applications:

Delivering the Network Centric Capability to the Warfighter Today

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Abstract

This presents a practical approach to network centric warfare using next generation Ultra Thin Rich Client User Interface Web Technology (UTRC-UI). UTRC-UI technology facilitates deployment of Web-based applications by delivering real-time information within the constraints of the current network infrastructure such as narrow bandwidth and limited connectivity in the battlefield. This new way of delivering a user interface to end users overcomes limitations of current HTML-based applications and provides an extremely high performance user experience, with a rich windows-like application interface. The ultra thin client architecture also ensures a high security environment. The UTRC-UI has been deployed in production environments with much success. This presentation uses a series of mini-cases to demonstrate the power of UTRC-UI technology and the readiness for network centric applications. The potential scope of application includes information systems that support the warfighter spanning the entire life cycle of mission planning, mission execution and post-mission support. The diverse range of applications illustrates the potential for high value creation.

1.0 Introduction

This paper proposes a solution for building network centric warfare (NCW) capabilities at the warfighter level in the battlefield. While NCW has been conceptually possible for many years, realizing actual operational capabilities has encountered difficult challenges. This paper proposes that a major bottleneck to success in the field has been the "last 400 feet" of deployment, delivering the network centric capability to the warfighter for a superior position. This paper also proposes that the deployment bottleneck can be solved with a new innovation in information technology. Finally, this paper examines the four main characteristics of this new technology innovation, characteristics that have the potential to realize a transformational vision: timeliness, relevancy, accuracy, and security. Six mini-cases of real-life applications are presented to illustrate the potential to enable NCW applications today.

1.1 Overview of Current Challenges Facing Network Centric Applications

There are many hurdles to achieving the NCW capabilities: bandwidth, limited connectivity, legacy systems, dispersed force, control mindset, lengthy acquisition cycles, just to name a few. Of these, bandwidth, limited connectivity and legacy systems present the top three hurdles to the last 400 feet issue. Using current Web-based information technology, network-centric applications have been developed to support the warfighter in battlespace situations. Many information systems, particularly the logistics support systems, attempt to integrate various applications to deliver real-time information to the right location within a secure network environment. However, such Web-based information systems fall short of reaching the warfighter engaged in a battle with the enemy force. These Web-based applications are deemed not deployable due to inherent characteristics of browser interface technology, small communication bandwidth availability, limited satellite connectivity, and difficulty of integrating heterogeneous legacy systems. The resulting picture is that while the back-end of these applications may be ready for usage, the warfighter cannot access these systems because the applications can not be deployed to the battlefield in the current infrastructure and environment.

1.2 Problems and Limitations of HTML-based Applications

Deployment issues with current HTML-based applications stem from inherent weaknesses that are not easily fixed. The end-users face many limitations in terms of application experiences:

- Page based navigation of HTML applications is cumbersome
- A desktop "native" look and feel is not provided (e.g. windows look and feel)
- Real-time data can not be delivered
- Users face slow application response.

Moreover, application developers face challenging hurdles in designing and developing user friendly and high performing Web applications:

- Multiple development environments (no integrated IDE)
- Unreliable testing methodologies (in some cases untestable code)
- Limitations in graphical user interface (GUI) design and functionality
- Limitations in application performance and control
- Security concerns

1.3 Ultra Thin Rich Client User Interface Technology

The Ultra Thin Rich Client User Interface (UTRC-UI) technology overcomes the limitations of the current HTML technology. The UTRC-UI is a next generation of Web technology that has developed and matured over the last seven years in commercial settings. The UTRC-UI technology can be applied to enable currently un-deployable Web application systems to the warfighter in the battlefield, completely within the constraints imposed by existing network infrastructure investments. This new technology can deliver the same applications via satellite, for instance, to the soldiers in combat in remote locations around the globe.

2.0 Example Applications of Ultra Thin Rich Client User Interface Technology

2.1 Mini-Case 1: Combat Support System

The UTRC-UI technology has been demonstrated and proven through a project based on an actual Web-based combat support system. The system faced major deployment issues of delivering the application to the battlefield. Through a pilot effort with the USAF, the project team showed that this Web-based system can be deployed to remote locations around the globe within six to nine months using the UTRC-UI technology, enabling real-time tracking and management (Figure 1). The effort also showed the application can be used in mission operations with high availability through a fail-safe-switch-over capability.

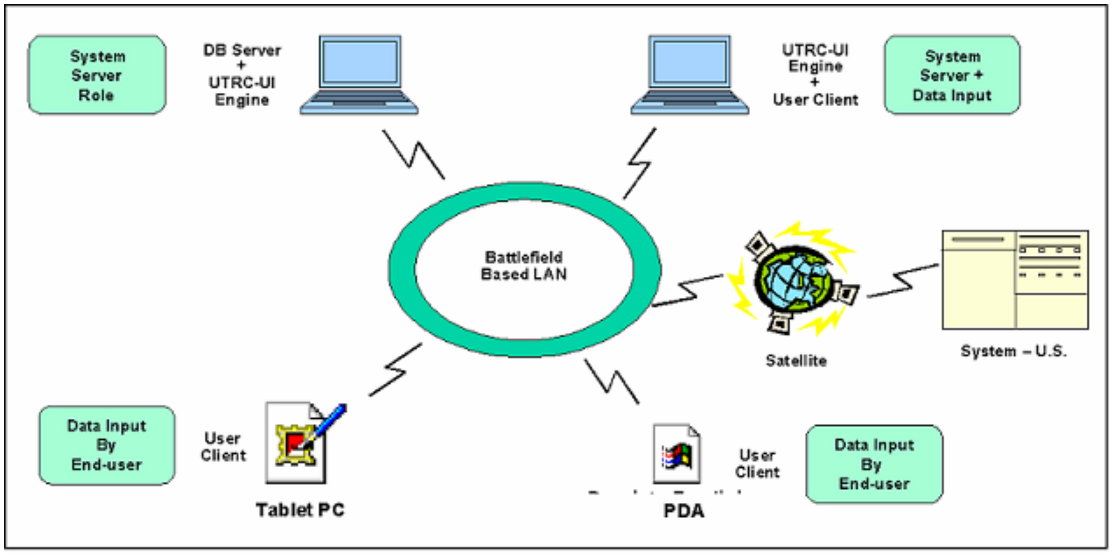


Figure 1: Combat Support System Deployment Configuration

2.1.1 Timeliness

A real-time data access capability was demonstrated with very little bandwidth consumption. Side-by-side bandwidth usage comparison tests showed the new UTRC-UI technology reduced bandwidth consumption by 90%+ on average compared to HTML-based original application. The reduction was still an impressive figure of 88%+ in SSL mode.

2.1.2 Relevancy

A high quality user interaction capability was demonstrated. The new UTRC-UI technology facilitated creating a desktop-look-and-feel in the interface design. The redesigned application looked like a windows-based application, though it was deployed through the Web. See Figure 2 below for before and after look. The end-users were able to access relevant information efficiently with high system response rate.

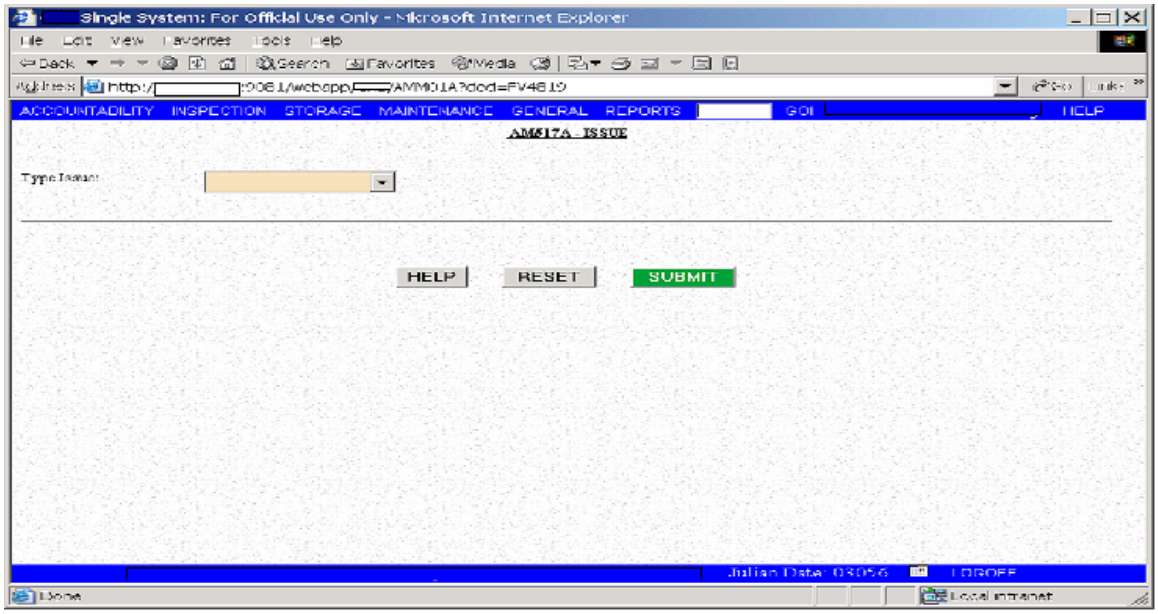


Figure 2-a: Original HTML Screen

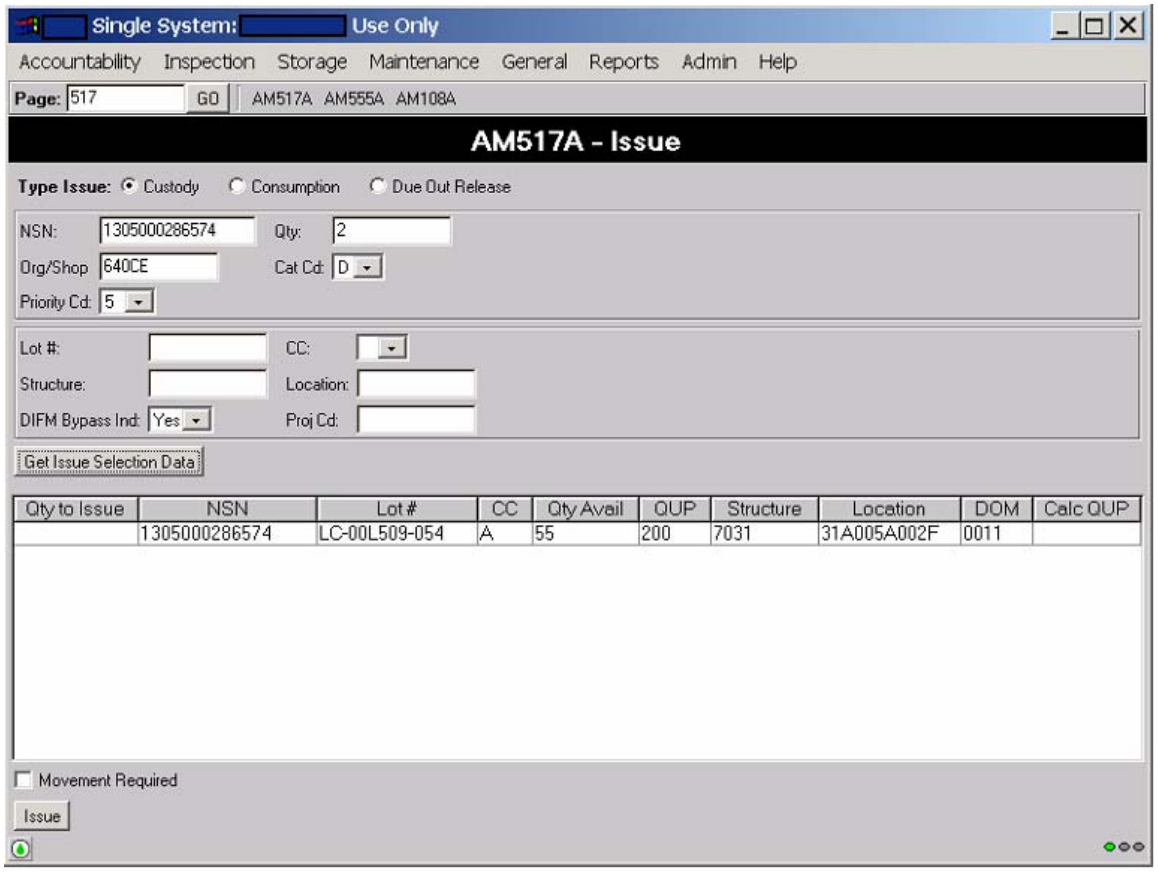


Figure 2-b: Redesigned UTRC-UI Screen

This universal UTRC-UI technology enabled role-based computing by providing only the relevant screens for specific tasks, each uniquely associated with the role(s) of each end-

user. By collapsing three HTML-based application screens into one single screen, the new UTRC-UI technology demonstrated potential for increasing user productivity (Figure 3).

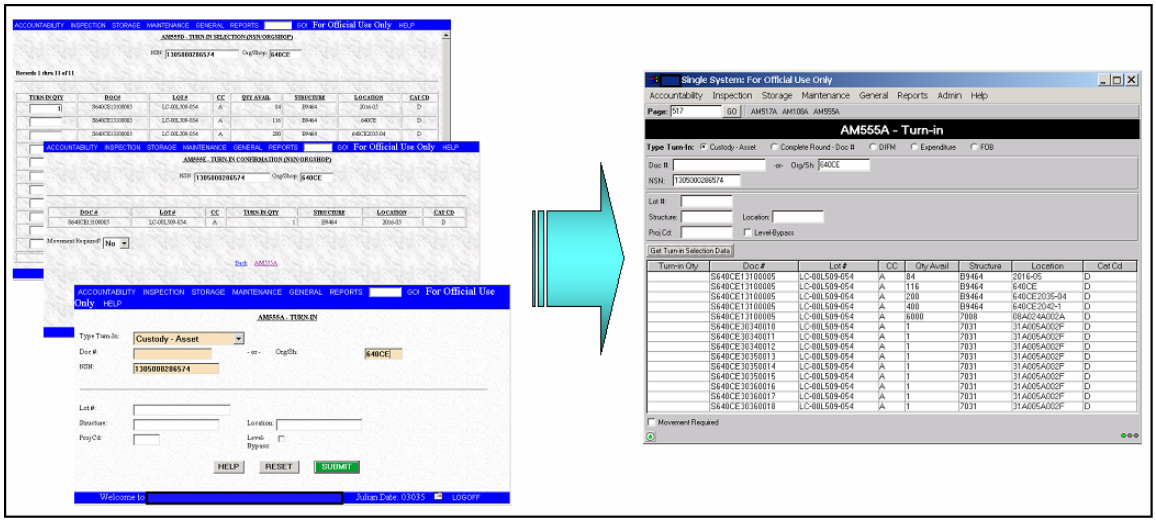


Figure 3: Collapsing Multiple Pages into Single Interaction Screen

2.1.3 Accuracy

The new UTRC-UI technology proved its capability to ensure delivery of accurate information in two ways.

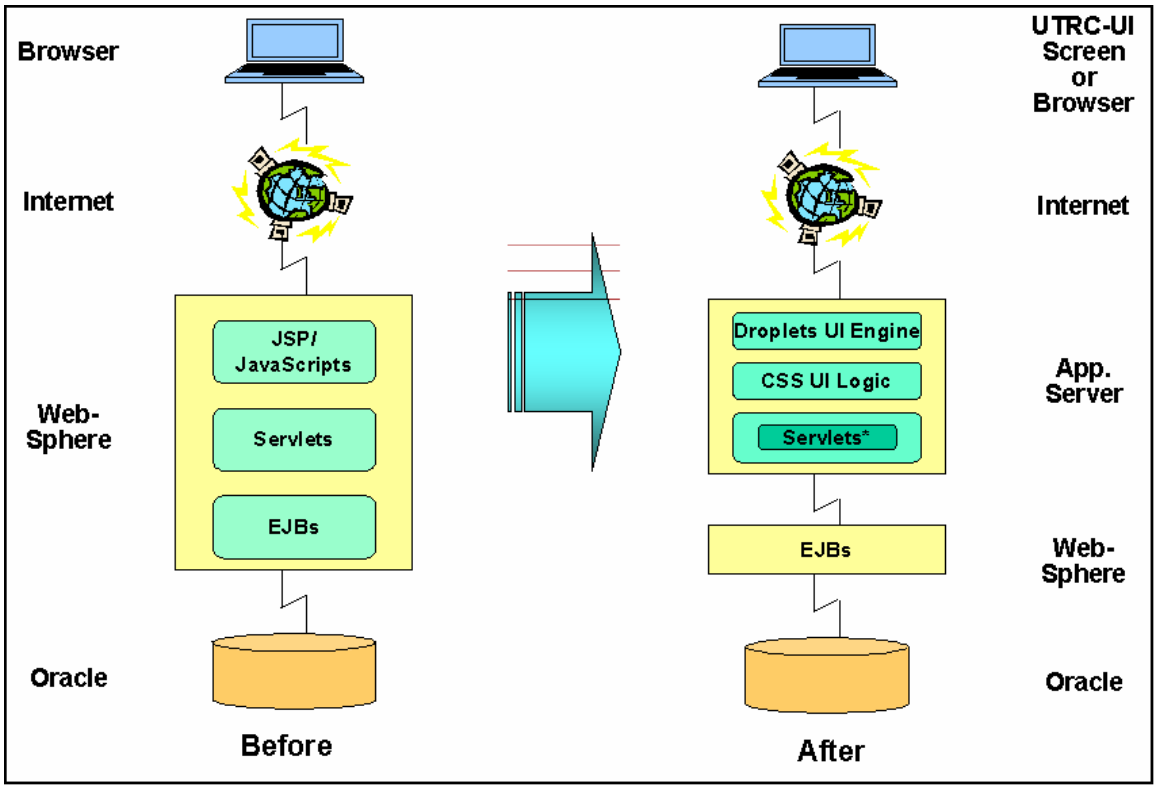


Figure 4: Tiered Architecture of UTRC-UI Technology

First, the UTRC-UI engine easily integrates with the existing legacy systems. See Figure 4 above. UTRC-UI's standards-based component architecture easily supports implementation of industry standard system architecture. The UTRC-UI engine does not alter the architectural design of the legacy systems. Because the actual processing of the data is handled by the existing application system, data accuracy is maintained throughout the user community. In the actual combat support system redeployment test case, over 90 percent of the existing code was re-used. Solutions that replicate data introduce a whole layer of potential failure or inaccuracies. The second way to enhance data accuracy is via high availability. The UTRC-UI engine(s) can be configured to provide high availability in operation, if the operation requires this level of performance, through a failsafe switch over mode. Thus, by minimizing the changes to existing systems, by directly connecting to legacy data at the source, and by maximizing application availability, data accuracy is ensured.

2.1.4 Security

The ultra-thin client architecture of the new UTRC-UI technology ensures high degree of security. All the processing is taking place on the server behind a protected wall. No application code (or business logic) is ever sent to the client, which represents a huge advantage for security. The UTRC-UI engine provides the interface to an end user by projecting an image of what the application is doing on the client screen that is generated at the time the application is accessed. The image that an end user sees on the local-computer screen is actually a mirror image of what is being processed on the central server. There is no possibility of injecting a virus or a harmful "Trojan horse" onto the local computer as no executable code is ever sent to that computer. The UTRC-UI technology also allows integration of custom encryption algorithm(s), which can assure that the message streams between local and central computers are always secure, further enhancing security. Since the UTRC-UI technology uses less bandwidth versus comparable HTML, such security measures have a lesser impact on degrading application performance

2.2 Mini-Case 2: Real-time Collaboration

The UTRC-UI technology is being used in support of Homeland Security Agencies. The Northern Command (NorthCom) has developed a collaboration system called Request-for-Information to knit together many different governmental agencies in sharing vital information concerning homeland security.

2.2.1 Timeliness

NorthCom has tried to implement a collaboration system based on Microsoft suite of tools including the Outlook. However, these systems could not facilitate real-time collaboration spanning multiple agencies across the country (NorthCom, CIA, FBI, DIA, FEMA, and HLS just to name a few). Applying the UTRC-UI technology, NorthCom now has a production system of sharing information on a real-time basis. A new user group can be instantly added to the system through a built-in feature that permits the application to be distributed through an email facility.

2.2.2 Relevancy

A work routing functionality built into the RFI system allows information to be routed to appropriate agency. Requested information can be delegated to responsible authority with ease by using mouse click operation from a selection list. See Figure 5 below for a screen of the RFI system being disseminated to more than twenty agency groups through out the country.

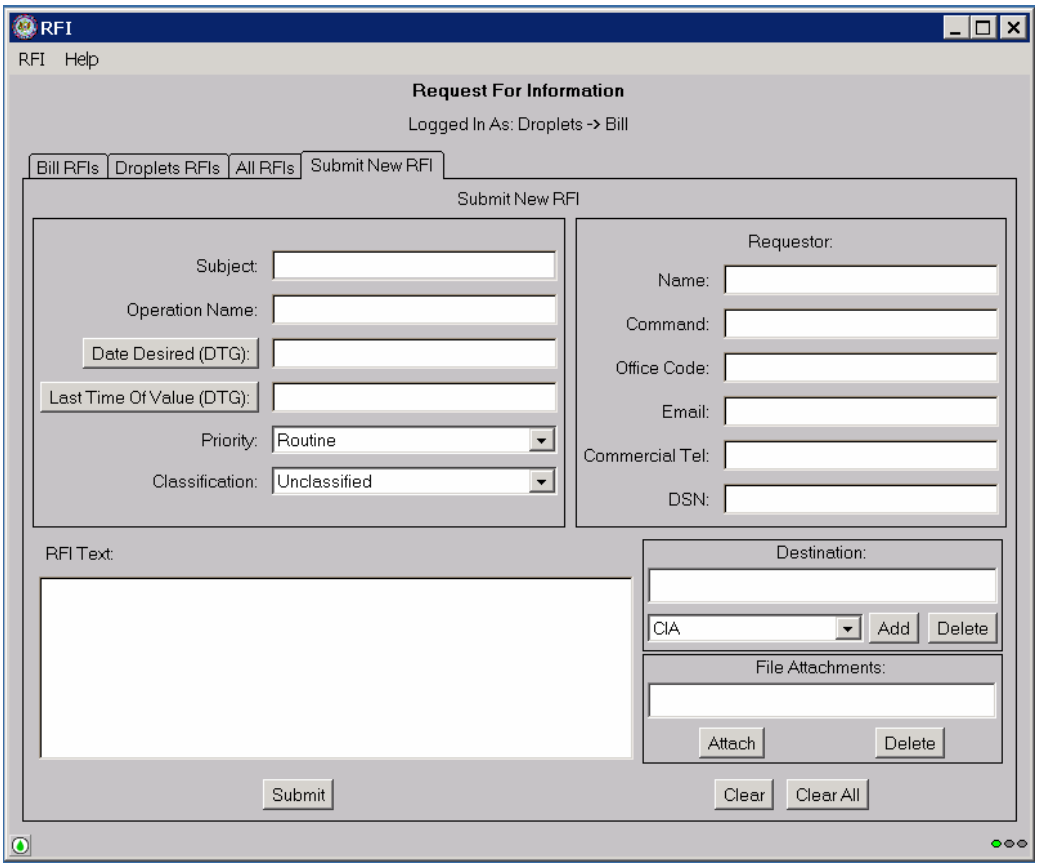


Figure 5: Collaboration Application –A Screen to Submit a Request for Information

2.2.3 Accuracy

Information accuracy is maintained in two ways. First, the work routing process requires that requested information be entered directly by the people who have the actual information. A time-stamp on the information is entered into the system providing visibility on the timeliness of requested information. Second, all information is stored and tracked in a single central repository. The system users are working off a single data set at any given time to ensure data accuracy.

2.2.4 Security

Given the nature of the information being shared related to the homeland security, it was vital to provide a secure environment for collaboration. The RFI system is being run in

the SIPRNET. This UTRC-UI technology based application encountered zero vulnerability and passed the security test the first time when the system was checked for security holes.

2.3 Mini-Case 3: Real-time Monitoring and Alerts

A multi-national electronics giant is using the UTRC-UI technology to monitor the status of production lines in factories around the world. The company has factories in nine different locations in Asia, Latin-America and Europe. The company found that monitoring and controlling the production lines based on a home grown fat-client application was ineffective for business users, time-consuming to deploy and expensive to maintain.

UTRC-UI technology allowed the company to deploy an Intranet based shop floor monitoring and control systems. This electronics giant was able to migrate its proprietary application to a central server model, while maintaining high functionality and sophistication. The company has praised the capability of UTRC-UI technology to help migrate the original stand-alone PC application to the Internet without any of the security or functionality flaws of Web browser applications. See Figure 6 for a screen shot of the system.

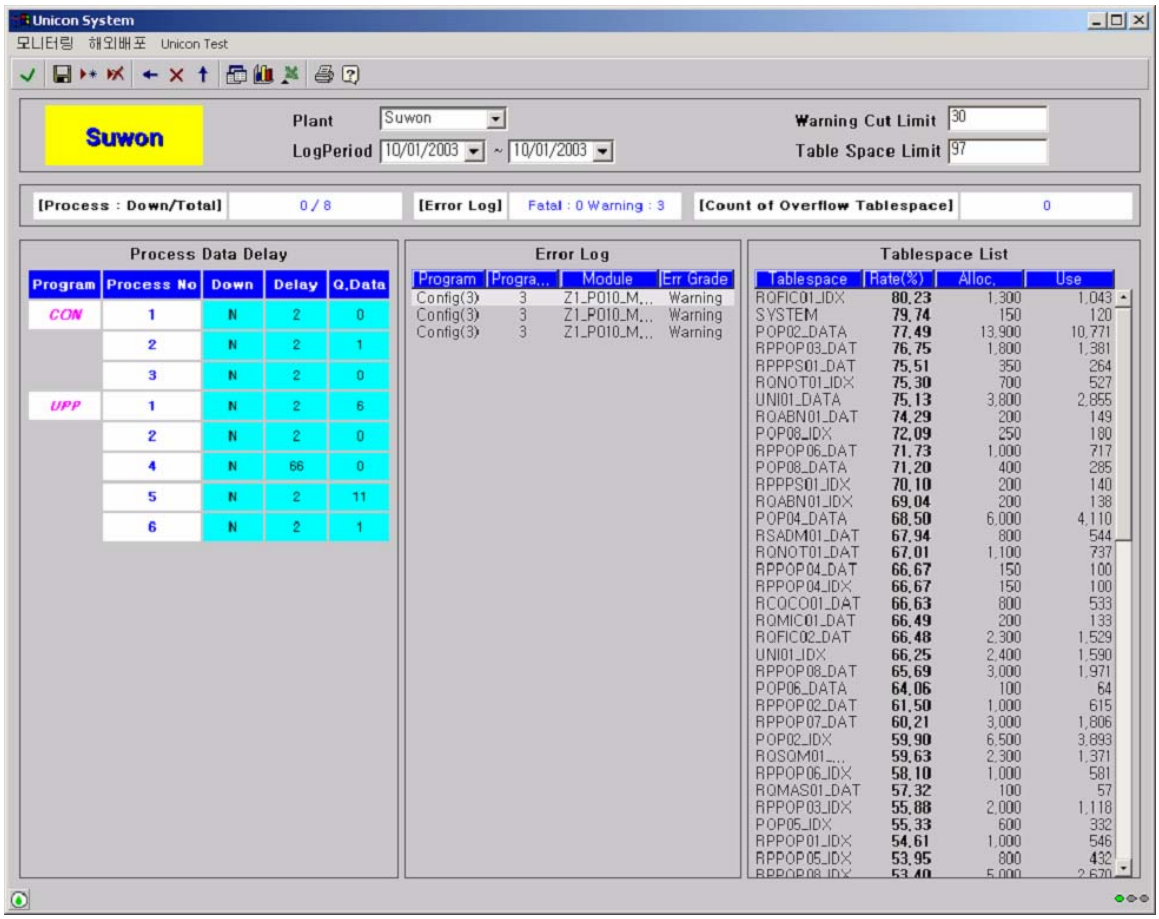


Figure 6: Real-time Remote Monitoring and Control System

The UTRC-UI technology is delivering tangible value to the company. The high usability of the application, together with real-time alerts to factory and shop floor status is helping to cut IT overhead costs while providing up-to-the-minute reporting back to headquarters on manufacturing progress in China, Mexico, Germany, Malaysia, Hungary, Korea and Brazil.

2.4 Mini-Case 4: Wireless Monitoring and Alerts

A large aircraft engine maker is experimenting with the UTRC-UI technology to monitor vital jet engine performance data through a wireless mode. A pilot project demonstrated the feasibility of collecting and sending performance data to wireless devices in real-time. Figure 7 illustrates the ability to monitor the condition of jet engines while in flight.

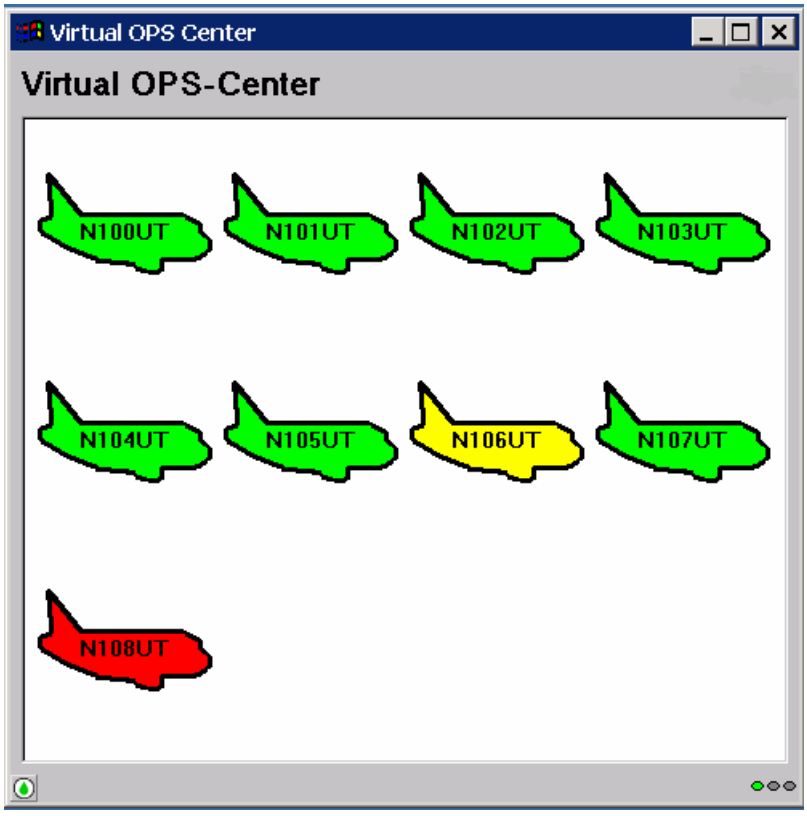


Figure 7: Wireless Monitoring on PDA

This jet engine manufacturer found a built-in wireless capability of the UTRC-UI technology very attractive. The technology allows multi-deployment of a given application to the desktop, browsers and wireless devices all based on single source code. The company was able to write the application once and used the same code to project applications on desktop PC's, on various browsers (all versions of Netscape and IE), and hand-held PDA's. Since the technology provides support for different browsers (and different versions) in native mode, the developers were able to save substantial time in developing and maintaining applications. Even for the wireless deployment, the developers can use the same code and not have to develop a separate wireless code.

2.5 Information Portals and Legacy Integration

2.5.1 Mini-Case 5-1: Custom Information Portal and Legacy Integration

The U.S. Army used the UTRC-UI technology to bring new life to old legacy systems. A pilot project demonstrated that mainframe age applications could extend their life and be used in a modern deployment model. The legacy applications with green screens were rejuvenated through the UTRC-UI technology. In the pilot project, a legacy application that supports the soldier's administrative tasks was redeployed through an information portal. The Figure 8-a shows the old green screen that supports the soldier. The same application was given a new look via UTRC-UI (Figure 8-b).

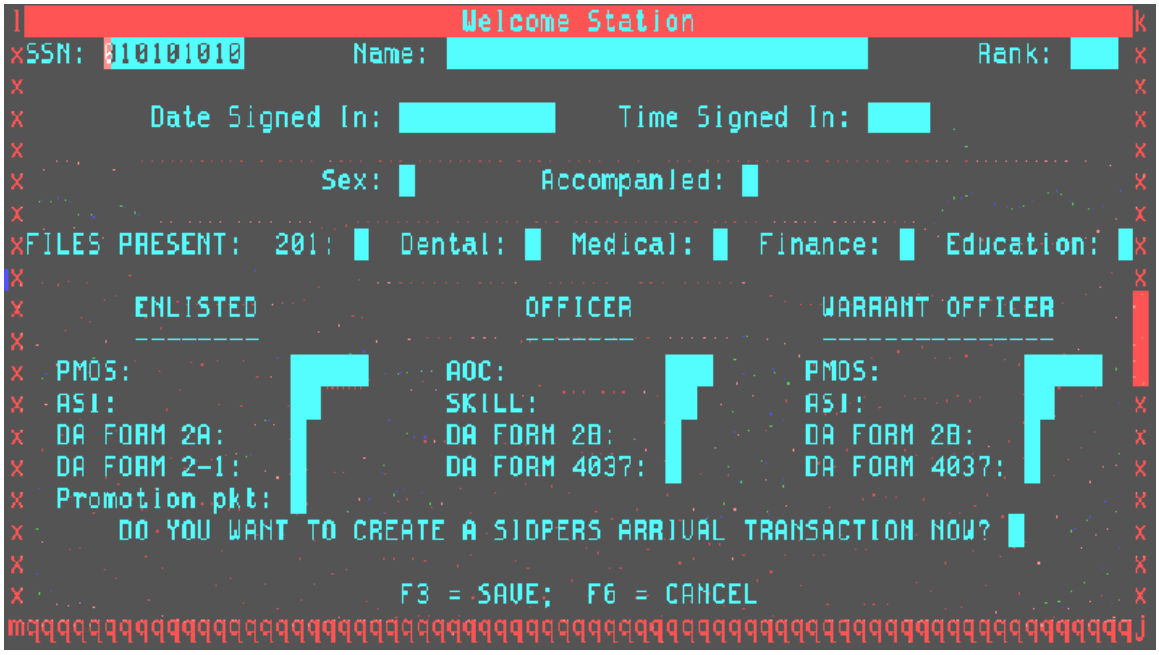


Figure 8-a: Green Screen of a Legacy Application

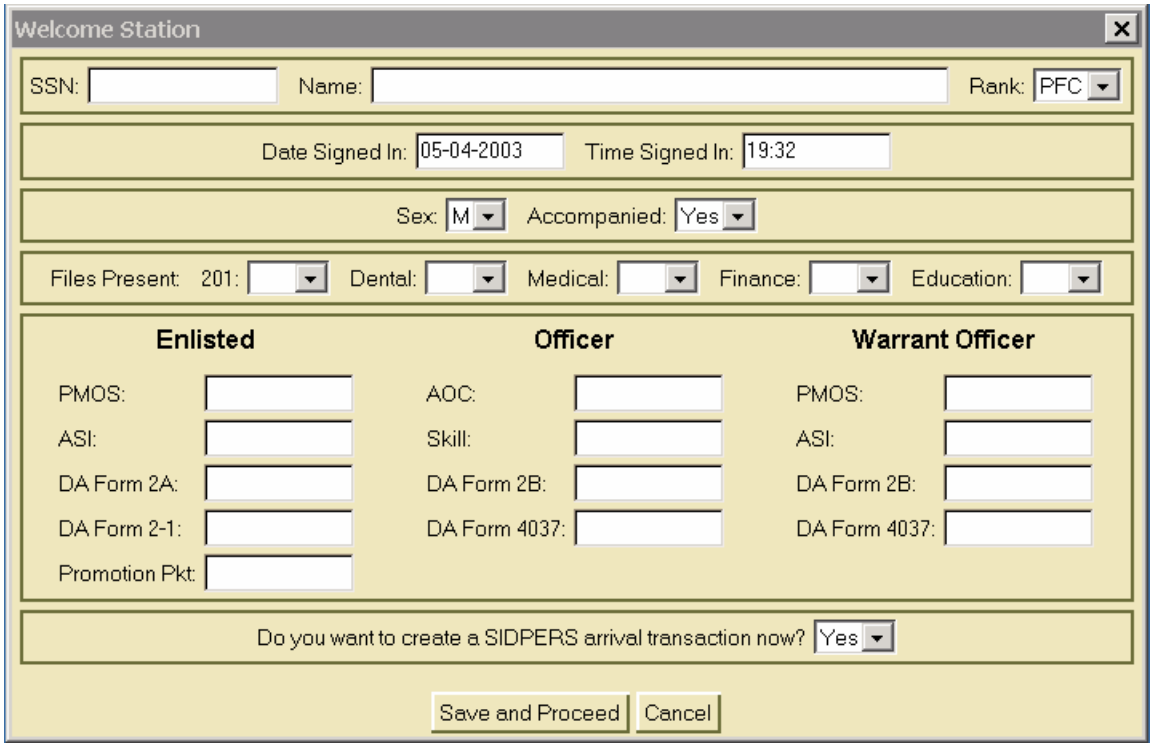


Figure 8-b: Redesigned Screen Launched from a Portal

By using the UTRC-UI technology the US Army can prolong the life cycle of legacy systems. The technology allows the old applications to be re-birthed as a user-friendly self-service application.

2.5.2 Mini-Case 5-2: Deploying Applications in Commercial Portal Products

A significant recent new development in the product offerings of most the major software infrastructure vendors has been the development of commercial "Portal Server" product offerings. By combining a set of portal development and web integration tools, major vendors such as IBM, Sun, Oracle, BEA and others are providing integrated software bundles that streamline building and deploying web-based portals.

While portal server products make it easier to build and maintain portals, they generally suffer from the same challenges as HTML-based applications. Most portals have a significant gap between the functionality and performance needed by users and what the standard portal site can deliver. UTRC-UI technology has proven to deliver the same values to these new technologies as they did for the US Army with its legacy application deployment challenges. Through UTRC-UI technology a State Government Agency of a National Government is easily adding a real-time, secure chat capability into an Oracle Portal Server-based initiative. The chat window appears as a normal window within the context of the portal site, with automatic integration with the portal site log-in and authentication services. A commercial company is using the same approach to integrate a dynamic real-time calendar application within a portal that serves its local community with information about local events, integrated chat and other useful functions. By

enhancing the performance of the portal, the community experience of the portal is significantly enhanced.

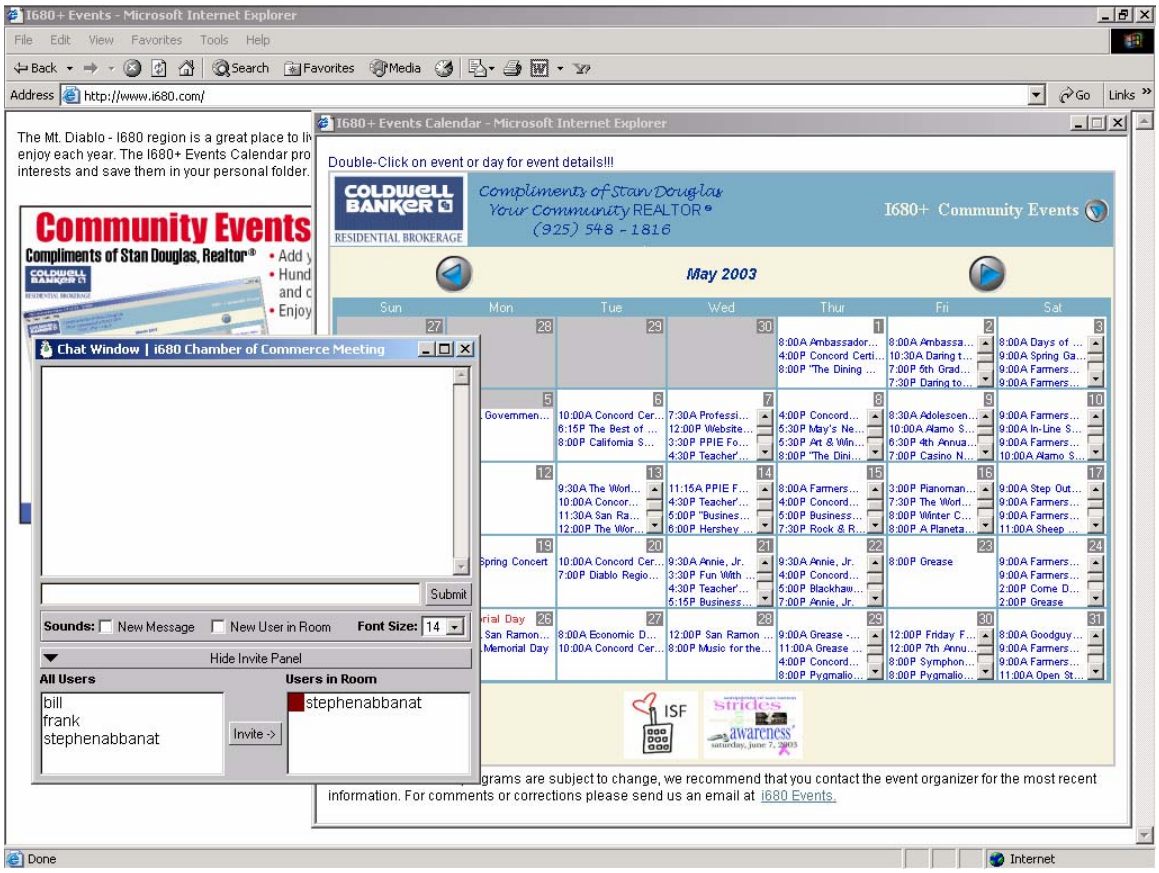


Figure 8-c: Dynamic Calendar and Chat Applications

By using the UTRC-UI technology these Portal Developers increased the use and performance of their portals while maintaining the standard portal development environment offered by a major vendor.

2.6 Integration with ERP Systems

2.6.1 SAP Integration

An engineering design firm used the UTRC-UI technology to bring a high performance application to its workforce. The company maintained a Web-based time tracking system provided by SAP, a major supplier of ERP systems. The Web-based application was connected to SAP's financial module. However, end-users found the Web-based application to be cumbersome and extremely slow. The company found that UTRC-UI technology enabled deployment of the time tracking system with a superior user experience and dramatic improvements in performance. The UTRC-UI based application (Figure 9) interconnected with SAP through BAPI, a facility provided by SAP for such purpose.

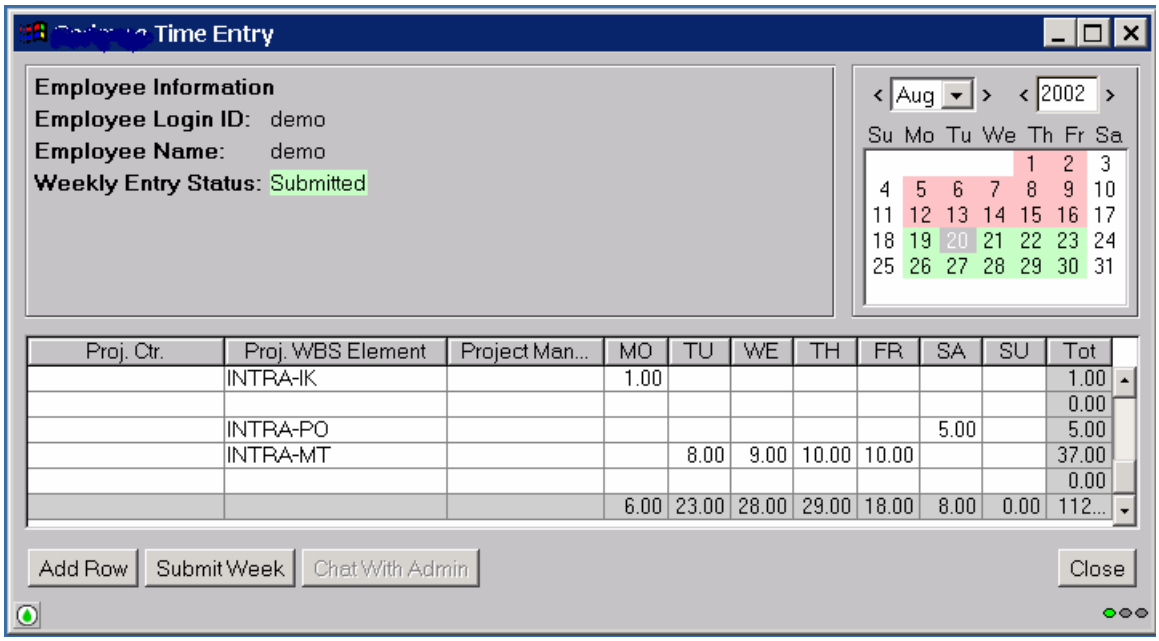


Figure 9: Time Tracking System Interfaced to SAP

2.6.2 Data Warehouse Integration

A large chemical manufacturer needed to manage its business performance with up-to-date information. The company installed a data warehouse system to provide performance-monitoring capability though a systems data mining facility. However, the company found the system to be difficult to use and the reporting tools did not provide the means for the end-users to be self-sufficient. In addition, users found that accessing the data required to see the true picture of total operations performance was residing in disparate databases. After many attempts to provide a holistic view of the company's performance using the existing tools and applications, the company decided to apply the UTRC-UI technology. The effort was a success. This company is now able to create management dashboard applications, which pull data from four different databases including a Cognos data warehouse, to deliver real-time views of business performance to managers. See Figure 10. The application tracks business performance along key performance metrics. End-users easily create reports on the fly through mouse click operations. Thanks to the new system, management can now make effective decisions based on accurate, real-time data. This capability is believed to have increased each manufacturing plant's responsiveness to market changes and customer requests, thereby enhancing the total company's business performance and customer satisfaction.

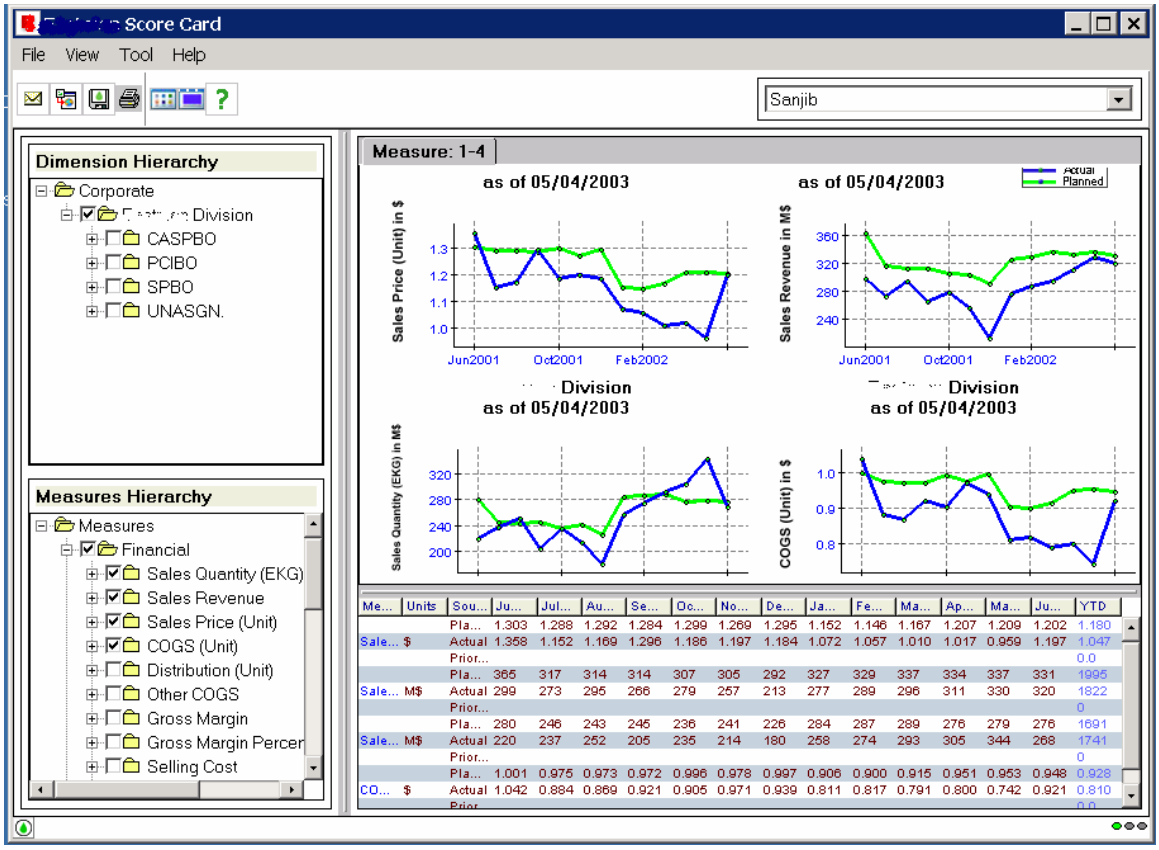


Figure 10: A Management Scorecard

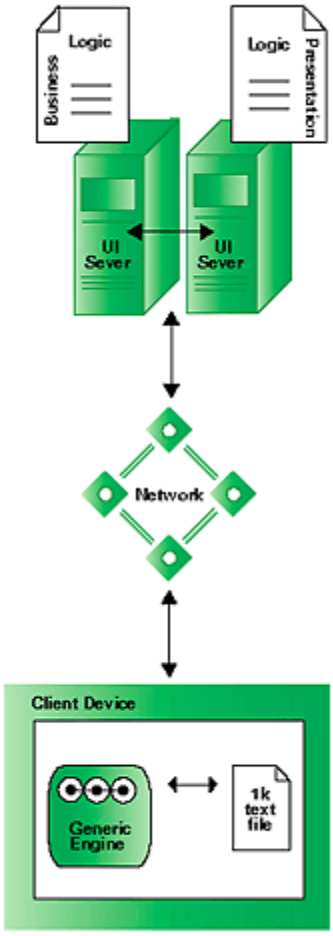
3.0 Technical Architecture of UTRC-UI Technology

3.1 Technical Architecture[1]

The UTRC-UI technology serves a JAVA-SWING or AWT-style UI remotely without transferring any of the application code to the client, thus allowing developers to write and serve thin-client applications using Java technology's highly evolved GUI development paradigms. Developers write the UI almost exactly as if they were building local software, but the application remains on the server and can be accessed from anywhere on the Internet. All of the code that the developer writes runs on the server.

Since the application logic resides on the server, the only required client-side piece, for full, browser-free interaction, is a generic, lightweight client that the user remains unaware of. All served UIs look exactly like locally installed applications. A two-way, asynchronous TCP/IP protocol transmits UI update instructions from server to client, and user actions from client to server.

[1] Adapted from Droplets' publication in Java.Sun.com: *Droplets Platform Brings GUIs to the Internet*, Janice J. Heiss, April 22, 2003



Generic, lightweight client remains hidden to users.

Whereas a Web browser must receive an entire page in response to a user action, a UTRC-UI receives only the changes necessary to update its display. Limiting client/server communication to events and updates results in a lightweight communication that increases application responsiveness dramatically and performs well over low-bandwidth devices. Because the client and server maintain a two-way connection, the communication can also deliver asynchronous UI updates to the client, enabling applications like instant messaging, a capacity that eludes Web-based platforms. The communications can tunnel through HTTP when necessary, while still supporting asynchronicity through efficient client polling. The fact that HTTP tunneling is sometimes necessary is thus hidden from the application programmer.

The UTRC-UI technology framework enables Java technology developers to write remotely served, locally presented applications to end-user desktops using the AWT/Swing paradigm they're already familiar with, while solving a number of engineering problems common to Web development. It hides all networking code and eliminates the need to track per-user session state, since values of instance variables do not disappear until the user exits the application. In addition, it eliminates Web programming problems caused by the browser's Back button, while retaining acceptable speed and full interactivity.

The UTRC-UI technology is analogous to servlets and JavaServer Pages. However, unlike servlets and JSPs, the UTRC-UI technology doesn't generate or know anything about the actual network protocol. Instead, the developer manipulates objects like windows and labels and buttons like he/she would in Swing or AWT. For example, when a developer changes the background color on a label, he/she is not manipulating a label directly in his/her code – he/she is manipulating a proxy to a label. The UTRC-UI technology sends the information over to the network on the client side with addressing information and the new attribute information, and then the color change will happen on the client side. So as a developer, his/her code is going to look very similar to Swing, but it's not exactly Swing. It's not exactly AWT, but the concepts are very similar. And where the concept is the same, the technology uses the same name as AWT.

3.2 Security

The UTRC-UI technology is a scalable, secure platform from which to serve applications across the Internet. The platform allows delivery of software that requires the highest level of encryption and authentication. In addition, the UTRC-UI technology has been designed to provide enterprises with flexibility in their security deployment, and

completely eliminates the threat of virus transmission by sending zero application code to the end-users. The key security features are summarized in Figure 11.

Area	UTRC-UI Support
Data Encryption	• SSL and HTTPS • 128 bit algorithm of Internet Explorer • Custom security algorithms and higher bit encryption supported
User Authentication	• User passwords never sent over Internet (Kerberos-style shared-secret-challenge/response algorithm) • Simple integration of existing authentication mechanism • Authentication from multiple data sources supported
Virus Protection	• Elimination of virus threat • No transmission of client-side code, including presentation logic • No opportunity to be a "Trojan Horse" for viruses

Figure 11: Security Features of UTRC-UI

3.3 Industry Standards

The UTRC-UI platform uses open-standard languages and tools. Developers build UTRC-UI based applications using a single, standard language (either Java or C++). The technology is fully able to interoperate with EJB/J2EE application servers and XML-based Web services. In addition, the UTRC-UI platform has been designed to interoperate with a wide variety of platforms, applications and standards. The platform supports essential standard technologies like SSL, challenge-response authentication, HTTP tunneling and SNMP.

The inventor of the UTRC-UI technology was chosen to be a member of the Expert Group for the Java Community Process (JCP) Java Specification Request (JSR) 127. This JSR deals with JavaServer Faces and defines an architecture and APIs which simplify the creation and maintenance of Java Server application GUIs.

The UTRC-UI platform has been tested and run on most of the technology platforms in use today. Figure 12 outlines the hardware and software platforms being supported.

Platform Tested	Details
IBM	WebSphere, eServers and Linux (z-Series, i-Series, p-Series (WIP), x-Series
Sun	Solaris, Sun Tone certified
HP	HP-UX
Oracle	9i, JDeveloper
Microsoft	Windows XP, NT, Win95 or higher

PDAs	Personal Java (iPaq, Tablet PC and others), Linux (Sharp Zaurus)
Portals	Oracel, Sun ONE, Plumtree, WebSphere, any J2EE compliant portals

Figure 12: Standard Platform Support

4.0 Value Proposition of UTRC-UI Technology

The UTRC-UI technology offers a compelling value proposition to be incorporated into building the NCW capability today (Figure 13).

Key Issues	Droplets Value to NCW	Solution Effective.*	Tech. Complex.**	Low Cost
Productivity (End-User)	Unified system front-end	●	○	●
Usability	Consolidation of multiple screens; Eliminate web pages	●	○	●
Access Points	Web, Wireless, Desktop	●	○	●
Legacy Extension	Extend ROI; Web enable, Enhance usability	●	◐	●
D,T, M, & S* **	Central control (server-based)	●	○	●
Reliability & Performance	High performance: 88%+ bandwidth reduction	●	○	●
Security	Inherently secure: NorthCom, NAS	●	○	●

* *Solution Effectiveness*
** *Technology Complexity*
*** *Deployment, Training, Maintenance, & Support*

● High ◐ Med ○ Low

Figure 13: Potential Business Impact of UTRC-UI Technology

The net results of applying this new technology to build the next generation network centric applications are:

- Lower development risks
- Faster deployment capability
- Improved systems performance and functionality
- Higher security
- Potential savings in the hundreds of millions of dollars.

The UTRC-UI technology has been proven and is ready to be used to solve immediate problems facing the military. The major benefits of the UTRC-UI technology enabled solution to current problems are outline below in Figure 14.

Problems	Complicating Factors		UTRC-UI Benefits
Inefficient Web applications (including ERPs)	• Inconsistent application coding practice • Inherent limitations of browser based applications		• Best practice GUI design • Reduces risk and cost for development and deployment • No need to rework/optimize • Works with ERP solutions
Low application performance	• High bandwidth consumption of HTML applications		• High performance even with low available bandwidth
Low availability from communication disconnects	• Low bandwidth availability • Communication line disconnects		• Allows Web applications to run in stand-alone mode • Database re-synchs when connectivity is restored
Saturation of communication infrastructure capacity	• No improvement in DISA satellite connections till 2006 • Full capacity of DISA long-haul pipes ($700MM+ annual bills) • Small capacity of base pipes (first and last 400 feet): $300MM+ fix for last 400 feet for USAF		• Works with existing base pipes without capacity upgrades • Significant bandwidth cost savings (hundreds of million dollars) • Savings from delaying the need for communication infrastructure upgrades • Enables the military to deliver mission critical applications around the world with existing infrastructure

Figure 14: Major Benefits of UTRC-UI Solutions to Current Problems

In summary, the value creation potential of this new innovative technology is real and tangible. The value creation is taking place all through out the life cycle of network centric application:

- Lowered development costs
- Lowered maintenance and upgrade costs
- Reduced application usage costs (e.g., lowered telecom charges)
- Increased productivity (higher efficiency and effectiveness of the warfighter)
- Enhanced quality of experience and user satisfaction
- Increased security

Based on experience, the UTRC-UI technology can be employed in a relatively short period of time. The author believes this new UTRC-UI technology, a field proven next generation Web technology, can be applied today to begin realizing the vision of NCW (Figure 15).

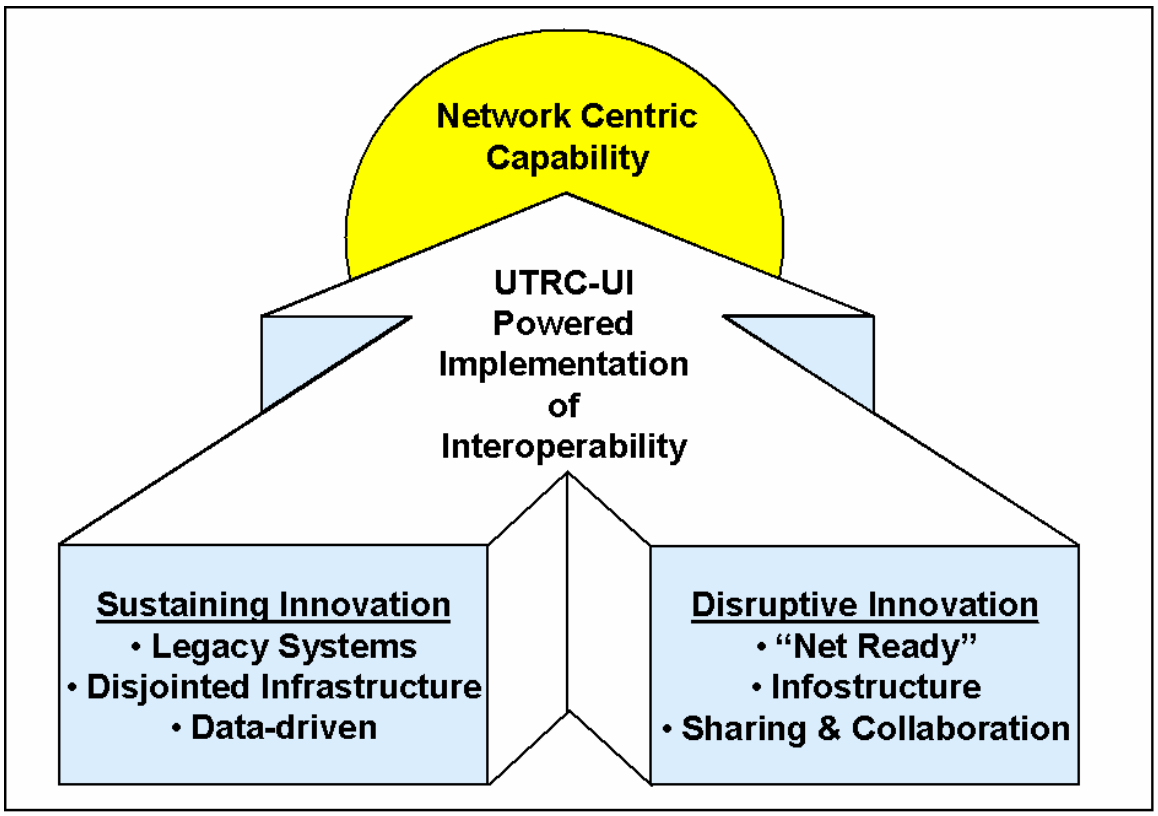


Figure 15: Delivering the NCW Vision Today