# U.S. Army FusionNet: Distributing 'Ground Truth' throughout the battle space

Case study
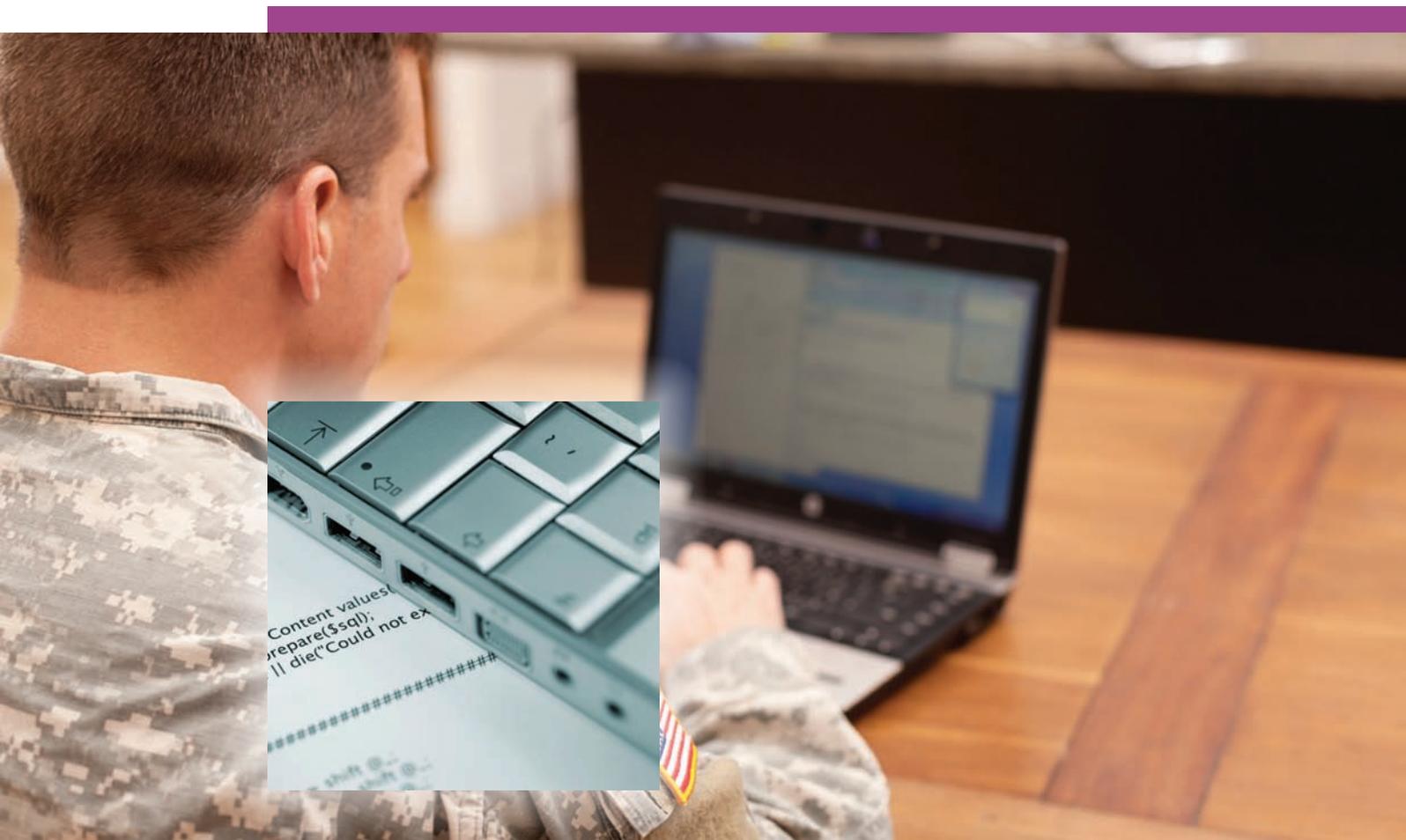
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FusionNet is a distributed system deployed by the U.S. Army to disseminate "ground truth" intelligence and unit management information throughout the Battlespace. It is associated with the Horizontal Fusion program (http://horizontalfusion.dtic.mil), which was established after the 9/11 attacks to encourage more effective collaboration and information sharing throughout the military.

Before FusionNet, battlefield event information was scattered among numerous Army systems and databases. Even worse, these stovepipes couldn't communicate with one another and were based on a variety of technologies: Microsoft Excel spreadsheets, systems of record maintained by the Army or jointly among the service branches, and Microsoft Access databases.

While most relevant battlefield information was electronically captured in one form or another, it is estimated that only about 5% of it was effectively delivered to the people who really needed it. The "muddy boots" on the front line especially suffered because they were on the wrong end of a disadvantaged network that made information delivery almost impossible at times. However, this vital information is now being liberated by FusionNet and its underlying DataXtend RE database replication technology.

"As the new version of FusionNet is implemented throughout the current theatre of operation, we expect the data capture rate, and more importantly the information availability rate for battlefield events to increase to 75% or more, an improvement of more than 1,500%," says Major Kurt Warner, Knowledge Management Officer for the U.S. Army XVIII Airborne Corps and Multi-National Corps Iraq G-6. He also serves as the FusionNet program lead.

## What's the Problem?

The extraordinarily poor quality of the Army's tactical network in many areas of the Iraq theatre presented a unique challenge to FusionNet's system architects. High packet loss rates and network delays exceeding five seconds are the rule, not the exception. Yet the system's mandate called for widespread dissemination of bulk data, including video and photographs, throughout this environment.

 Any architecture that required reliable network connectivity to a central site was a non-starter.

Traditional, centralised client-server and Web based deployments were immediately rejected. A rich-client interface was necessary, but requiring a connection to a central database was out of the question.

Database replication technology was selected as a cornerstone of the FusionNet solution, for it would allow a rich-client interface to operate uninterrupted off of a local database, even during periods of complete network unavailability. It would then allow updates to stream back and forth over the network during periods of acceptable network QoS.

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## Why DataXtend RE?

The Army and its system integration partner, CC Intelligent Solutions of Raleigh, NC, (www.ccis-inc.com), rigorously evaluated multiple database replication technologies.

Their initial impulse was to use the native replication technology in their chosen database, Microsoft SQL Server. However, after extensive on-site testing, CCIS and the Army found DataXtend RE to be a superior alternative.

The primary difference was DataXtend's ability to handle the poor network conditions encountered in the battle space. The Army tested several replication technologies using a Shunra Storm WAN emulator in order to reproduce conditions on the ground in Iraq.

Double-digit packet loss percentages and network latencies exceeding five seconds are common. Most products simply failed to complete the tests, and some even corrupted the database. DataXtend was the only replication technology that could complete the test in the most extreme conditions.

In addition, DataXtend offered flexible deployment topologies, including peer-to-peer, hub-and-spoke, and cloud-and-spoke. This was in stark contrast to alternative technologies that enforced strict master-slave or publisher-subscriber topologies.

## FusionNet architecture

To the end user, the architecture of FusionNet appears to be simple client-server. A rich .NET client delivers core services to each user's desktop, and it is supported by a Microsoft SQL Server database on the LAN.

However, this reliability and apparent simplicity is enabled by the sophistication of the DataXtend RE (DXRE) replication engine. DXRE reliably delivers reports from any node where they are entered over an unreliable WAN to every other node in the network, typically in a matter of minutes. Thus, a commander in Baghdad planning a convoy to Fallujah can learn in near-real-time of any recent insurgent activity along his planned route, without waiting for an intelligence officer to produce a report days later based on what would be stale information at that time.

Furthermore, DXRE servers are synchronised across physically separate networks, this allows the military to ensure secrecy of sensitive information while allowing information from less sensitive networks to be replicated freely across networks requiring more strict security. FusionNet leverages the intelligence of DXRE's internal data tables to manage the asymmetric distribution of this sensitive information, even via "sneaker-net" across network "airgaps."

## Results

After finalising its selection of DataXtend in December 2004, CCIS entered an intense period of development using an agile methodology and successfully deployed FusionNet in April 2005.

Now multiple releases later, FusionNet delivers its DataXtend-fuelled services in extreme conditions both to war fighters via in-theatre servers and to users globally via servers in the U.S. and Europe.

Currently, over 3,000 users are supported on multiple physical networks with approximately 15 servers and gigabytes of information distributed around the world. Over 200 new reports are entered each day, many containing rich media such as photos and video, which are then distributed within minutes throughout the FusionNet replication network.

Less than a year after its initial deployment, FusionNet's phenomenal success was recognised by its selection as the Most Innovative U.S. Government Program of 2006 by the Institute for Defense and Government Advancement (www.idga.org), as part of its annual Network Centric Warfare Awards.

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# Distributed Applications & Data

Application and data decentralization has become a major trend in the industry. When applications are deployed in this way, remote offices do not shut down when network connectivity is slow or lost. Mobile workers can bring their applications into the field with them when they need them most. And the data center is no longer a single point of failure in the enterprise.

This approach involves deploying independent, replicated database instances along with a robust client application, either in a remote office or on a user's laptop. While not necessarily requiring "real-time" data mirroring, the database needs to be synchronized at regular intervals, the frequency being dependent on the application and business requirements. This solution has a distinct advantage in that it can tolerate frequent network outages and bandwidth restrictions and still allow remote users to continue working. Additionally, off-the-shelf commodity computers can be used, thereby reducing the need for expensive, multi-processor servers at the data center. Rather than providing all access to the data and business logic from a central location, that processing is distributed to smaller servers across the enterprise. Centralized systems may still be needed for reporting purposes or to service large sites.

Depending upon the technologies chosen to construct this solution, there is a potential for several disadvantages:

- Extensive application redesign

- High bandwidth utilization

- High maintenance burden

However, constructing a distributed enterprise with the dataXtend DataXtend™ RE product eliminates these problems:

## No application redesign

Some queue or message-based middleware solutions require that special APIs be used in order for an application to communicate with the database.

DataXtend RE allows you to communicate with the database as you normally would, using any programming language currently in use. The result is that no application changes are needed to access the database. And because DataXtend RE uses "update everywhere" technology, no application changes need to be made in order to update data. This is not necessarily the case with master-slave or synchronous update architectures. It may still be necessary to modify the application to support distributed algorithms replacing, for example, a portion of the application that hands out sequential order numbers with a method that can operate in a distributed environment. Generally these changes are straightforward and well understood by the application developers.

## Minimal bandwidth utilization

Most replication solutions send the full content of all transactions to each site including all intermediate changes to the same data. Generally the complete dataset must be maintained at all sites.

DataXtend RE uses a "net change" model, so only the data that has been updated since the last replication is sent through the network. Additionally, DataXtend RE technology allows you to partition data so that only the information pertinent to that site is sent through the network.

## Low maintenance

Log-based replication solutions need to be periodically synchronized. Additionally, when sites haven't replicated for extended periods of time, the log file may fill the server's disk and result in downtime and an unscheduled synchronization session.

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## About DXSTRO

DXSTRO acquired the DataXtend RE software from Progress Software Corporation in early 2014.

The company is committed to developing the product further and supporting the many existing customers.

For further information go to www.dxstro.com or telephone +44(0)845 408 4250

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