BATTLESPACE SOA

SERVICE ORIENTED ARCHITECTURE FOR THE US MILITARY

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INTRODUCTION

The purpose of this paper is to introduce the webservice capabilities of Distributed Instruments and how they can apply towards bringing webservices-based integration to legacy command, control, communications, intelligence, surveillance and reconnaissance (C4ISR) systems.

Each of the major services within the US Department of Defense are currently developing wireless, self-forming, self-healing Internet-based network for the battlespace. The objective of these infrastructures is to enable mass integration of people, processes and applications on the battlefield. Distributed Instruments' expertise is specifically focused on enabling large organizations such as the US Army, the US Navy and the US Air Force to employ an Internet infrastructure for mass integration.

Our technology and capabilities enable organizations to connect people, processes and applications across organizational boundaries. Our webservice capabilities include:

- Open-source webservices development
- Uniform resource name (URN) management
- Asynchronous and instant webservices
- Legacy data translation for "bolt-on" webservices

Using these capabilities, Distributed Instruments can enable legacy defense systems to immediately and cost effectively participate in the new battlefield networks. Each of these capabilities is interrelated and directly applicable to these emerging battlespace networks. We will briefly discuss each of these capabilities. Further information is available on our website at http://www.distributedinstruments.com.

OPEN-SOURCE DEVELOPMENT

Breakthroughs rarely come from one technology, but rather from the combination of two or more complementary technologies. For instance, the information technology revolution required both the theory of the digital computer (the Turing machine) and a practical means of implementing it (electronics). Distributed Instruments believes that webservices and open-source development combine to form a true revolution in information technology industry.

Technology grows non-linearly and non-continuously, reaching asymptotic limits followed by abrupt breakthroughs. A breakthrough enables engineers to attack a whole new set of problems, unleashing a rush of increased capability. Eventually, the engineers approach the limits of the capabilities of the new technologies. Growth is no longer exponential, but rather linear. New solutions become more and more complex and cumbersome as we begin to apply the technology to problem domains that is not well suited for. Engineers begin to shove square pegs into round holes.

The explosion of the Internet and most especially the wireless Internet has made ubiquitous connectivity a reality. The emerging battlespace networks will bring this reality of ubiquitous connectivity to the battlefield. This reality brings with it a new challenge: mass integration. The previous revolution of combining client-server architecture with object-oriented programming is simply unable to meet the demands of mass integration. Mass integration can only be achieved through open-source programming and webservices architecture. The complexity of the challenge will simply collapse in on itself if attempted with object-oriented technology on proprietary client-server architectures.

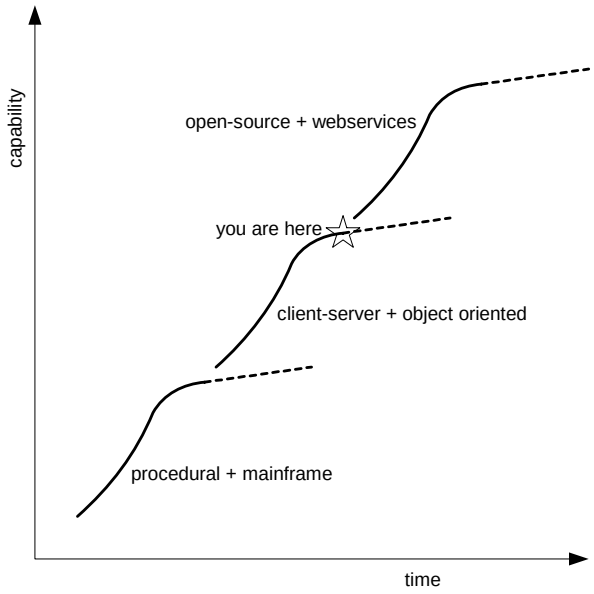

Figure 1 Technology grows non-linearly and non-continuously, reaching asymptotic limits followed by abrupt breakthroughs

The scientists and engineers at Distributed Instruments are experts in this new revolution and are ready to teach our partners how to employ this revolution in making the emerging battlespace networks a viable reality for the US Department of Defense.

UNIFORM RESOURCE NAME (URN) MANAGEMENT

A mass presence of people, processes and applications on the Internet brings with it a challenge of managing all these things, not from a machine perspective, but rather a human one. The Internet connects computers through unique four-byte numbers, such as 192.168.32.1. Very quickly the scientists that invented the Internet learned that it was difficult for them to remember the numbers of the machines, so they created the domain name service. We take the domain name service for granted any time we type in an email address or a web address in a browser such as http://www.distributedinstruments.com.

The exponential growth of the Internet has forced the Internet Engineering Task Force (IETF) to grow from its current four-byte address scheme to IPv6 16 byte address scheme, such as FEDC:BA98:7654:3210:FEDC:BA98:7654:3210.

As the numbering system has outgrown its original design, so also has the domain naming system. We currently access resources on the Internet such as a web page using a Uniform Resource Locator (URL). As the name implies, a URL is completely dependent upon the location of the resource. If a resource moves from one location to another, the URL is broken. Any one who has used the World Wide Web has experienced the frustration of broken links. In the ever-shifting chaos of the battlefield, broken links can be more than a frustration. With something like the emerging battlespace networks' self-forming, self-healing network, how can anyone expect a resource location to remain static?

Also remember that domain name system was originally designed to help humans access computers in a way that was easy for them to remember. The name of a machine is one thing, but the URL of a particular resource on that machine is quite another. What was originally designed to assist human cognitive limits is now taxing them. Accessing resources on the Internet based on their location is not intuitive. It does not match the way we are accustomed to accessing information in our regular day-to-day operations.

As of October 2002, the IETF has released a proposed standard (RFC) for making Uniform Resource Names (URN) a functional part of the Internet. URNs enable humans to access data and other Internet resources in ways that they are accustomed to. URNs also make access of Internet resources independent of their physical location. This technology is exceedingly viable to the success of the emerging battlespace networks. Distributed Instruments has spent more than a year working with this technology before its release and is ready to assist our partners in learning and applying it.

ASYNCHRONOUS AND INSTANT WEBSERVICES

The emerging battlespace networks require a spectrum of capability to integrate people, processes and applications across organizational boundaries. Webservices are key to the success of mass integration efforts because they provide a simple least common denominator for normalizing infrastructure interfaces. Webservices must address full spectrum of integrating people, processes and applications. Otherwise, it is not the least common denominator.

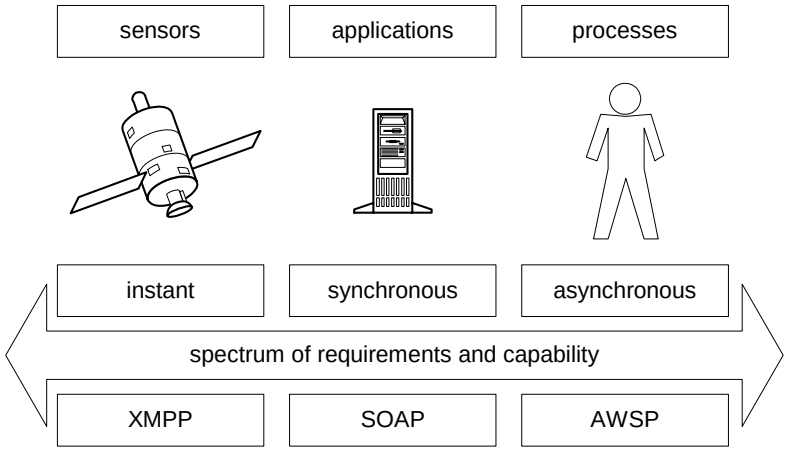

Figure 2 Distributed Instruments provides a spectrum of capability to integrate sensors, people, processes and applications

Webservices are a huge breakthrough in simplicity for systems integration, and the market has readily recognized it as such, but the limited synchronous nature of webservices means that it cannot

alone integrate people, processes and applications. By complementing webservices with both instant webservices and asynchronous webservices, Distributed Instruments is able to reach not only applications but people and processes as well.

With asynchronous webservices, manual processes and processes that require human approval can be treated and managed as if they were webservices. That means organizations can manage and integrate people, processes and applications all the same way. It also means that organizations can begin to deploy a webservices infrastructure immediately without waiting for the entire organization to be automated. Manual processes can seamlessly participate in a web-centric environment just like automated processes.

At the opposite end of the spectrum from asynchronous webservices are instant webservices. Distributed Instruments is a pioneer in applying the new XMPP technology towards solving application integration challenges. At the surface, XMPP enables people to instant message other people over any device connected to the Internet such as PCs, PDAs, pagers and mobile phones. The extensible human and machine readable nature of XMPP also enables applications to instant message people and even applications to instant message other applications. Distributed Instruments is currently working with IBM, HP, Sybase and others to leverage this technology for tool integration. We are also working with another small business partner to apply XMPP technology for battlefield sensor data fusion.

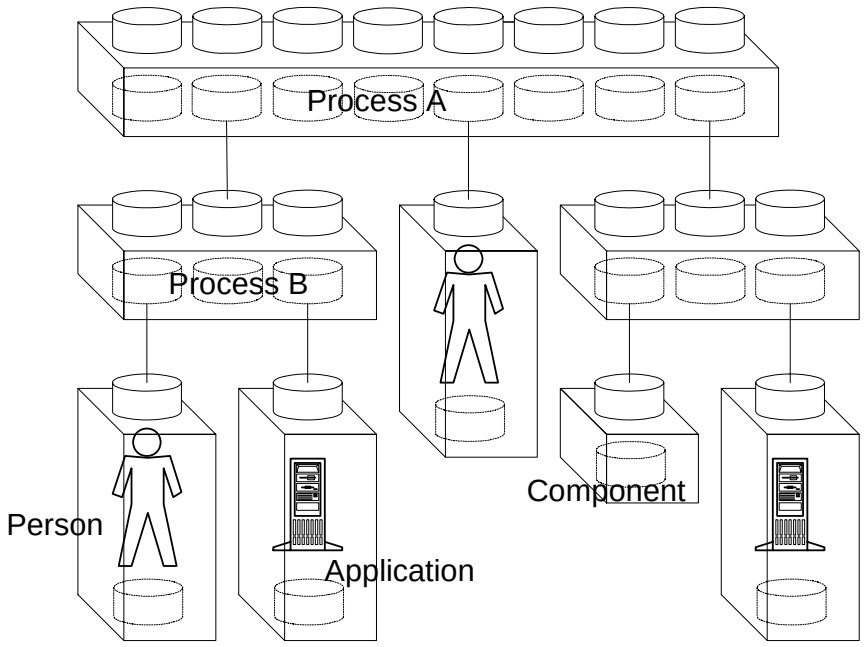

Figure 3 Distributed Instruments enables organizations to integrate people, processes and applications all the same way

With our thin wrapper technology, organizations can rapidly transform existing legacy systems into robust webservices platforms. That way, organizations such as the US Department of Defense can leverage rather than replace their existing enormous investment in information technology. Distributed Instruments translation capabilities form the basis of our ability to "bolt on" webservices interfaces to existing legacy systems.

The founders of Distributed Instruments have been pioneers in XML data translation technology since 1998. The first generation of our data translation capabilities enabled companies to rapidly migrate EDI to XML. (Lockheed Martin and Boeing were actually the earliest adopters of this technology.)

Distributed Instruments has greatly expanded its legacy data translation capabilities to include most all data formats. The Distributed Instruments Legacy Data Translator SM begins with a minimal parser that creates a one-to-one translation of legacy data into XML and vice versa as defined by an XML-based syntax grammar.

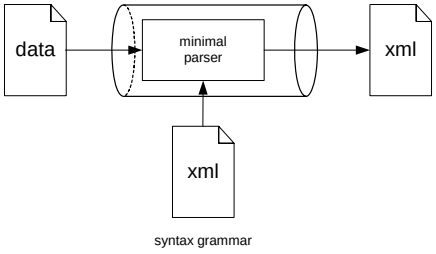

Figure 4 The Legacy Data Translator begins with a reversible syntax translator

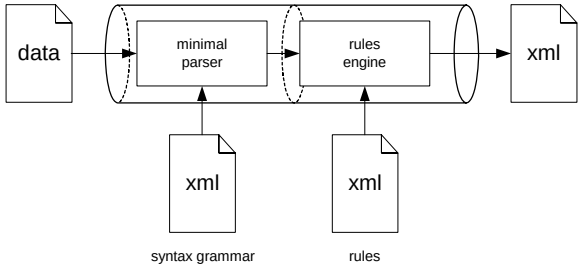

Figure 5 Other processes are bolted on to the translation stream

Capabilities are bolted on to the minimal parser to create more and more complex translations. For instance, a rules engine can validate even the most complex interrelations between data elements. Each portion of the translation pipe, however, remains simple and reversible. That means that sections of the pipe can not only be rapidly produced but also reused.

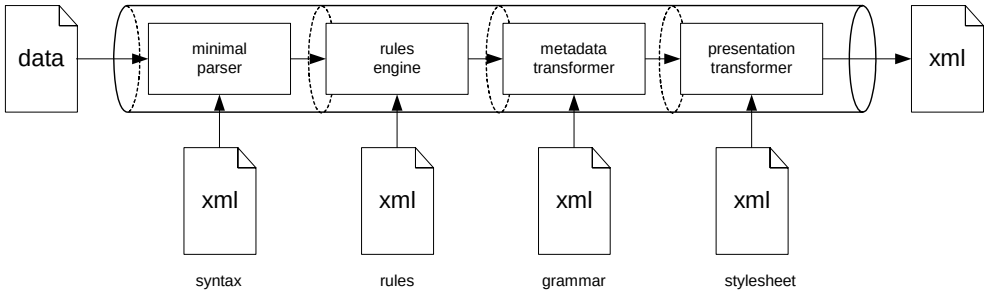

Figure 6 The Legacy Data Translator enables very complex translations from simple components

Standards-based SAX streaming technology enables the translation pipe to break the complex translation into simple, reusable steps without compromising speed. Translation pipes can be compiled and embedded for further increased performance and capability.

CONCLUSION

Each of the major services is currently developing wireless, self-forming, self-healing Internet-based networks for the battlespace. The objective of these emerging network infrastructures is to enable mass integration of people, processes and applications on the battlefield. Distributed Instruments' expertise is specifically focused on enabling large organizations such as the US Department of Defense to leverage emerging battlespace Internet infrastructure for mass integration.

Distributed Instruments webservice capabilities includes:

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