MyBoeingFleet.com XML Applications and Web Services

Aimee **Do** <aimee.g.do@boeing.com>

Abstract

Question: How does MyBoeingFleet.com improve workflow and cut costs by utilizing the XML and web services technology?

Intended Audiences: XML project managers, product managers and system integrators.

To achieve customer satisfaction, the MyBoeingFleet project team has applied XML and web services technology to improve workflow, minimize human errors, and reduce lead times and costs. The technology enables software components from different systems to interact with each other via the Internet, by using the standard Simple Object Access Protocol (SOAP). Beginning with a pilot project in 2001, the team has implemented an XML interface that feeds Airplane Service Bulletin information to an enterprise resource planning (ERP) system outside of the Boeing Firewall. The results of the pilot has led to further development of XML applications and web services to interoperate with systems internal and external to MyBoeingFleet.com.

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1. Background

MyBoeingFleet.com is a Boeing secured web portal that provides aircraft information and services to airplane owners and operators, Maintenance Repair Overhaul (MRO) providers and regulatory agencies. The goal is to improve efficiency and drive down transaction costs of handling paper, information and services. Boeing Commercial Aviation Services has digitized maintenance and service documentation such as Airplane Service Bulletins, Wiring Diagram Manuals, Aircraft Maintenance Manuals, Maintenance Planning Documents, and the Illustrated Parts Catalog. The portal hosts these digitized documents and allows authorized users to access them anywhere and anytime through the Internet.

MyBoeingFleet.com production began in May 2000. Today, it hosts more than 6.5 million engineering drawings and 95,000 maintenance and service documents, and it continues to grow. The portal handled 240,000 hits from external users in September 2000, 2.2 million hits in September 2001, and 4.9 million hits a year later in September 2002 (Figure 1).Figure 1

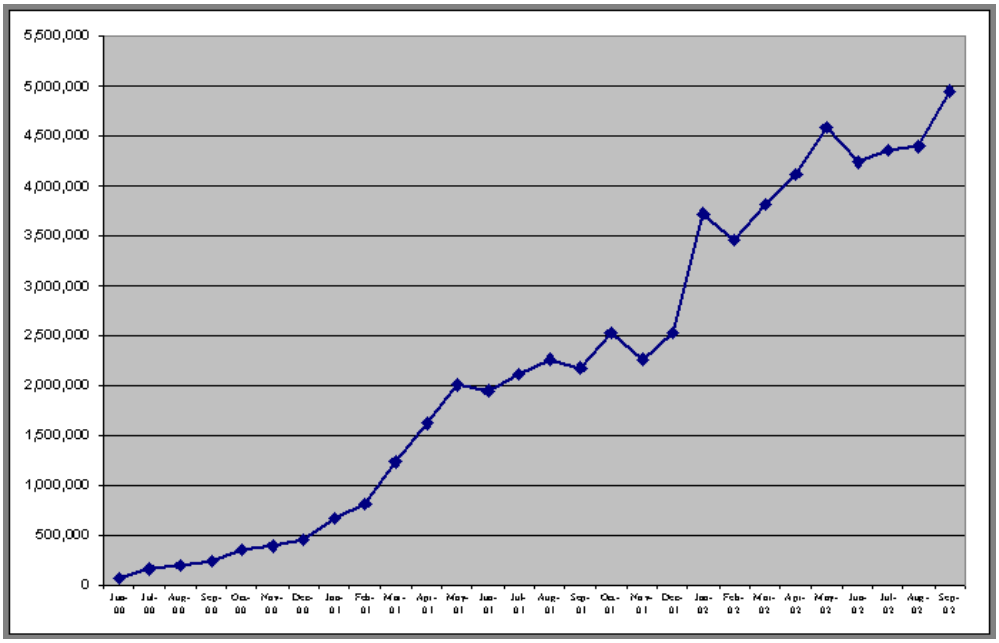

Figure 1. MyBoeingFleet.com Customer Usage Hits

With more than 30,000 external users accessing the portal, the MyBoeingFleet project team continuously seeks new ways to improve user operations. For example, the online search function enables users to quickly and precisely access the information specific to their airplane fleets. Users spend less time searching for their maintenance documents or engineering drawings. Adobe® Portal Document Format (PDF) byte-serving technology allows the display of extremely large documents to the user a page at a time without having to download the entire document. PDF is the standard for electronic document distribution for all Boeing airplanes.

For the last two years, XML (the Extensible Markup Language) and web services technologies were investigated, prototyped and tested for improving communication and workflow for MyBoeingFleet.com systems. Several operations mentioned in this paper address exchanging information between systems, submitting and synchronizing document revisions to the web portal, purchasing airplane parts from specific airplane service bulletins, and enabling system interoperability.

The Boeing vision includes allowing disparate internal and external systems to interoperate while minimizing the costs it takes to develop and maintain such capabilities. XML plays an integral part of Boeing's strategy because it becomes the standard for exchanging information electronically, and it provides several simple approaches to organize web content. Moreover, many XML tools are available for free or at reduced costs.

The web services technology extends the benefit of utilizing XML by allowing the software components from disparate systems to talk to each other over the Internet without custom APIs (application programmer interfaces), complex CORBA (Common Object Request Broker Architecture) procedures or DCOM (Distributed Component Object Model) procedures. Therefore, the development of web services is much simpler, and the use of XML allows software components to communicate and be described in a "platform-neutral" way (Hartman, 2002, p.19). Examples of XML implementation are described herein.[Hartman, Hans. (2002, January).]

2. A Basic XML Interface

Typically, an Airplane Service Bulletin provides procedures for modifying a delivered airplane or a Boeing-manufactured component, or for executing a non-routine inspection. Incorporating a service bulletin is optional. The airline operator may decide to implement based on economic payback or operational issues among others. However, Airworthiness Directive service bulletins are Federal Aviation Administration (FAA) mandated and the airline must react upon receipt of a service bulletin.

Traditionally, an airline operator or an MRO receives a new release or update of a service bulletin for its fleet through a long-established process of papers, faxes and personal communication. Papers can be mishandled causing

communication to be delayed. The process can take up to several weeks before work is initiated. Working together with an MRO, the MyBoeingFleet team designed an XML interface that allowed the MRO's enterprise resource planning (ERP) system to pull the service bulletin from MyBoeingFleet.com directly into its system. The interface is simply a metadata file in XML format describing the information in the service bulletin (Figure 2). When a new service bulletin or update is formally released, a document repository in MyBoeingFleet.com automatically dispatches the metadata to the MRO's ERP system. The content in the metadata is then used to generate a task within the workflow system at the MRO. The service bulletin can be accessed directly from the workflow task.Figure 2

```
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  <sbnbr>SB 747-21-1234</sbnbr>
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  <spl>81205</spl>
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  <subjnbr>00</subjnbr>
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Air Distribution - Wire Change </sbtitle>
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  <reldate>06/06/2002</reldate>
  <loaddate>09/19/2002</loaddate>
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    <munit>RW411-RW416</munit>
      </effdata>
</sbmeta>
```

Figure 2. An Example of Airplane Service Bulletin Metadata

3. Data Interchange and XML to HTML Transformations

Data provider systems for MyBoeingFleet.com use an agreed upon XML format to communicate the document information, including the chapter/section titles and how they relate to the PDF files. The XML file with this information serves to populate the document repository database, and is then re-used to dynamically display the document to the user.

Some Boeing documents are so large (up to 4 gigabytes in PDF format!) that they must be broken up into many PDF documents of a more manageable size. Many Boeing manuals need to be broken down this way to the chapter level. For example, the Boeing Airplane Master Illustrated Parts Catalog (IPC) is so large that it must be broken down beyond the chapter level to a PDF per chapter-section level. This often results in a single document that consists of over 400 PDF files, some of which are still several hundred megabytes. XML provides MyBoeing-Fleet.com with both a way to take delivery of such a document, and then display it to end-users.

MBF utilizes the Xerces XML parser and Xalan XSLT processor software, from the Apache XML Project, to accomplish the tasks of parsing and transforming XML information. Xerces is used as a parsing engine. Xalan dynamically generates HTML pages based upon user requests, database inputs, XML files, and a XSL stylesheet (Figure 3). This process frees the developers for having to develop and maintain countless HTML pages, while providing the flexibility to change the HTML output with simple stylesheet changes. Moreover, the XSL file can be translated to other markup languages such as wireless markup language (WML) for dynamic presentation on handheld devices.Figure 3

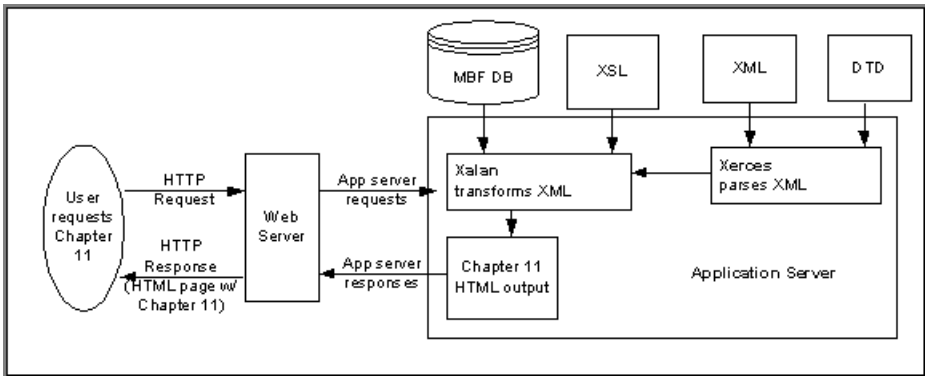

Figure 3. An XSLT Transformation

4. System Interoperability

As the airlines deal with increasingly complex maintenance operations, there is a need to improve efficiency between procurement and maintenance planning operations. In response to this customer need, the MyBoeingFleet team developed an online system, Service Bulletin Kit Page, which allows the airlines to procure parts as identified in the Airplane Service Bulletins.

The service provides an environment where the airlines can determine the availability of parts or kits in the Part Analysis and Requirement Tracking (PART) Page system for their airplane fleets. At the same time, they will be able to evaluate the cost associated with maintenance to be performed on the airplanes by utilizing a cost benefit analysis tool that is now in development. In addition, it offers a seamless access between the Service Bulletin Kit Page to the PART Page web site to purchase the airplane parts and track their shipments. Currently, the PART Page handles more than 20,000 of these transactions a day.

Within this environment, an interface called Navigation Services was created using a Boeing developed proprietary SOAP message router. This interface manages user access controls and enables message routing between the Service Bulletin Kit Page and the PART page (Figure 4).Figure 4

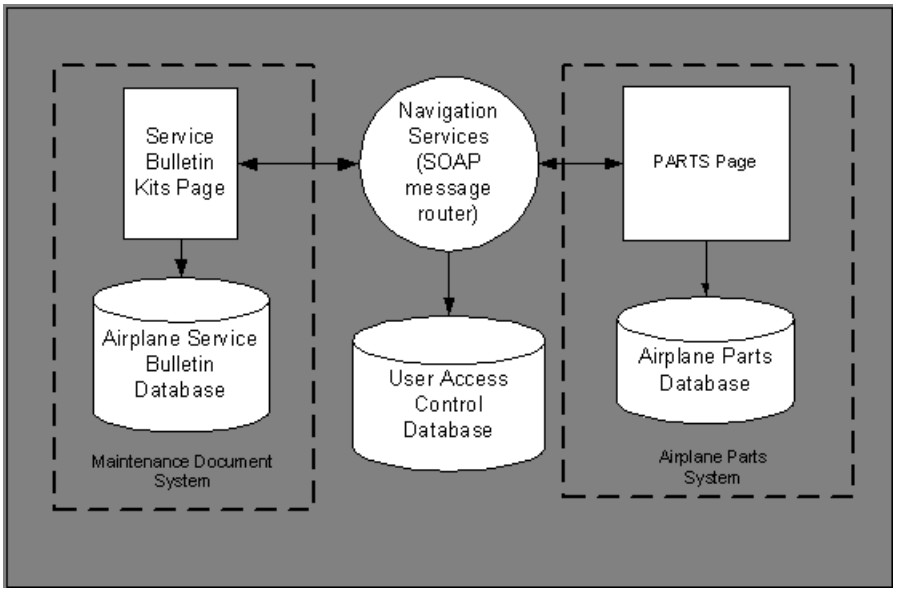

Figure 4. A SOAP Message Router

Since its release, the Service Bulletin Kit Page has proved that the online workflow operates as intended. Boeing has successfully developed an interface between systems within the Boeing firewall that are operated on different platforms using a simple, lightweight, standard protocol. By automating system linkage, this prototype has helped

customers identify relevant parts in the Service Bulletins, obtain parts information and order the parts from the PART Page. Time was saved in this workflow and customers could ensure that their transactions were accurate. The Service Bulletin Kit Page is now in production, and the Navigation Services is being used as a standard interface for other applications on MyBoeingFleet.

5. SEDS Web Services

After proving that SOAP can be used to exchange information between distributed servers, Boeing has expanded the web services development to other enterprise systems beyond the secured firewall.

Traditionally, suppliers submitted hard-copy documents (e.g. a Component Maintenance Manual) to Boeing for review and release to the airline customers. In support of digital data requirements, suppliers submit these documents to Boeing by means of the Supplier Electronic Data System (SEDS). SEDS is a secure web interface that allows manual entry of document information, and submission of data in PDF format.

To streamline this process, suppliers can implement web services to automate the online document submission and synchronize document revisions on both MyBoeingFleet.com and their own websites. This online document submission method minimizes the chance for human error and can reduce a typical fourteen-day processing cycle to as little as two days.

Boeing is developing a 'machine-to-machine web services' interface between suppliers' enterprise systems, MyBoeingFleet.com and SEDS to communicate the transfer of digital data files using XML format and SOAP with HTTPS (i.e., secure Internet) as the transport protocol (Figure 5). The SEDS can generate reports, track the approval status, identify document revisions and provide help contacts through an online look up function.Figure 5

MyBoeingFleet.com maintains its security AAA model (authentication, authorization, and access) to guarantee authentication of HTTPS messages coming from external web servers for entrance to Boeing's Intranet secured site. The security model supports the X.509 digital certificate technology.

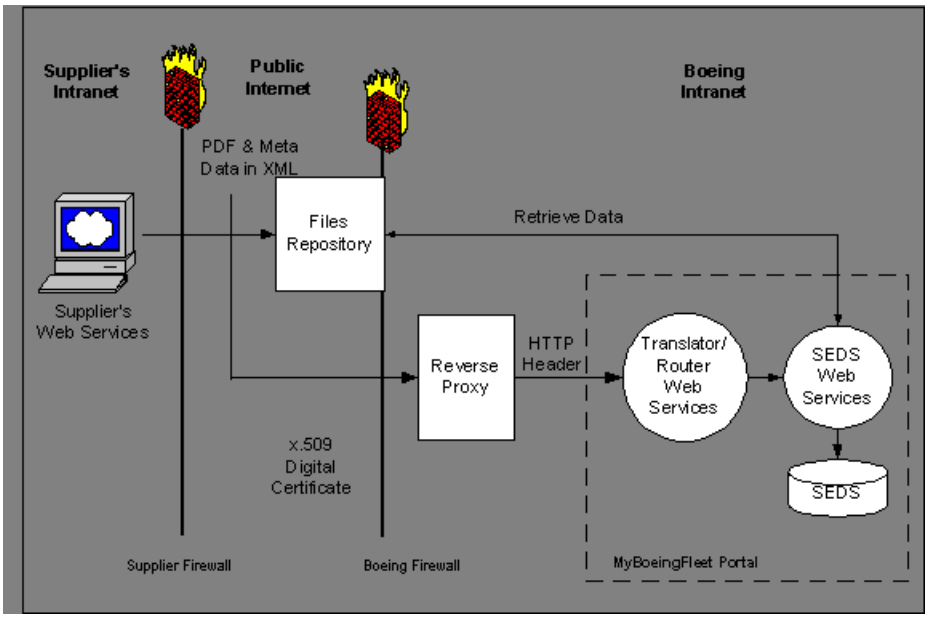

Figure 5. Boeing and Suppliers' Web Services for Component Maintenance Manuals

6. Challenges

The MyBoeingFleet project team experienced some challenges during the development of the XML and web services requirements. Legacy systems need to interoperate, but neither have standard data nor data not based on XML. Since MyBoeingFleet's primary focus is delivering information online, the team utilizes agreed upon XML messages for communication among systems and delivers mass data by other automatic online capabilities.

The Web Services Description Language (WSDL) describes how to use the web services available in MyBoeingFleet.com for its users. Boeing is investigating publishing its web services using the Universal Description, Discovery and Integration (UDDI) approach for different types of maintenance and engineering software components. UDDI requires clients to share common definitions of metadata, semantics and understandings of the business practices of the web services. Otherwise, clients cannot correctly use web services. To have all clients agree to a common definition would be very time consuming. Since Boeing works with various internal and external systems outside the Boeing Firewall, getting together with system managers, project managers and system integrators to agree upon common definition would not be an easy task and would require a lot of coordination to implement web services correctly.

Meeting customers' needs has always been a Boeing priority. During the requirements development of web services, the team focused first on customers' business needs, sought the most efficient workflow, and then designed technologies to work with the requirements. The strategy is to work with one system at a time, making sure that the design meets business intentions, while laying foundation to work with other systems. Although the XML technology is not the answer for all operational issues, its implementation with existing capabilities makes it easier to improve workflow between systems.

7. Summary

To date, the services using XML technology on MyBoeingFleet.com has been a positive experience for Boeing, its customers and its suppliers. The basic XML interface allows the MRO to act immediately upon a new release of Airplane Service Bulletins as an alternative to the traditional process that involved with papers and faxes; this nature of enhanced efficiency allows airplanes to be serviced sooner than before. The reduction from a typical fourteen-day process to a two-day process is a cost avoidance for Boeing and its suppliers. XML to HTML transformation using a simple stylesheet eliminates countless static HTML pages and results in cost reduction for development and maintenance. As a result of these XML implementations, information is delivered more quickly and accurately, human error is minimized, and workflow between Boeing internal and external systems is therefore improved. These applications will serve as a basis for additional low cost solutions to be deployed on MyBoeingFleet.com.

Acknowledgements

Works Consulted

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https://www.myboeingfleet.com

MyBoeingFleet.com September 2002 metrics

MyBoeingFleet.com SEDS requirements

MyBoeingFleet.com Service Bulletin Kit requirements

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Biography

Aimee **Do**
System Manager
The Boeing Company

Commercial Aviation Services
Seattle
United States of America
aimee.g.do@boeing.com

Aimee Do is a system manager working for the Boeing Commercial Aviation Services, and a product manager for the ERP web services deployed on MyBoeingFleet.com portal. Aimee has more than eighteen years of experiences in system and software engineering, specialized in aviation and software industries. She received her Bachelor of Science degree in Mathematics at University of Washington and her Master Degree in Engineering Management at Washington State University.