Lotus Forms, XForms, and DB2 9 pureXML

Lotus Forms used in conjunction with DB2 9 pureXML provides the ideal end-to-end solution for creating, deploying, and processing your electronic forms.

Whether you are creating new forms from scratch, or are converting existing paper-based forms, Lotus Forms provides a solution that combines standard industry-wide XML technology with simplified design and implementation, thus reducing the cost of running your business.

The solution starts with XForms...

XForms is an XML-based, open, and free-to-use international standard for electronic forms developed by the W3C. XForms maintains a separation between the content and its presentation to the viewer. An XForms form not only defines a data payload, but also separately defines input fields, labels, lists, and other typical user interface controls for handling that data.

However, by design, an XForms form says nothing about how the user interface controls are displayed or what they look like. Fonts, colors, locations, and so on need to be defined independently of the form. For that, you need a presentation layer provided by a container. The container is an XML language that provides the presentation layer, allowing the same data to be presented in many different ways on a variety of devices.

...uses Lotus Forms for presentation...

XHTML is seen by many as the obvious choice for containing XForms data. After all, HTML is the language of the Web. But XForms support in browsers is inconsistent and the implementation details vary widely. You need to accommodate the browser, select one or more XForms plugins, and even take into account the operating system. For enterprise class solutions, XHTML might be too troublesome as an XForms carrier.

For business both large and small, XFDL in Lotus Forms may be the better choice for hosting XForms. XFDL is a freely available XML language that is designed specifically for electronic forms, in contrast with the general nature of HTML. And because of this specialized nature, it offers some distinct benefits.

For one thing, a Lotus Forms XFDL form is capable of acting as a contractual document. It has built-in, comprehensive digital signature support with the ability to capture the entire context of a business transaction. An XFDL form can have multiple signers, and those signatures can overlap. And with the high precision layout that XFDL supports, you can make sure that your form looks the same whether it is displayed on Internet Explorer, Mozilla Firefox, the Lotus Forms Viewer, or some other device. Furthermore, XFDL includes a built-in compute engine. Computes are spreadsheet-like formulas that you can use to calculate values and manipulate form data on the client side.

... and ends with XForms.

You also need to consider how the data will be stored and managed in your system. This is where DB2 comes in. DB2 9 pureXML is ideally suited to handling XForms and XFDL. The DB2 9 database stores

XML in a single column and in its native format. That is, when XML data is inserted, it is parsed and stored in a tree structure which is optimized for search and retrieval using either standard XQuery or standard SQL/XML in DB2.

With DB2 9 pureXML, you no longer need to split XML data into relational tables and columns, a process that can take weeks to design and set up, and sometimes even longer to get the kinks worked out. Instead, a single command creates a data store for you, and takes only a few seconds to type in.

For example, the command "CREATE TABLE myforms (id INT PRIMARY KEY, formdata XML)" replaces several tables and the dozens, hundreds, or even thousands of columns that would be required to store a form's data in a relational format, greatly simplifying design and drastically reducing development and maintenance time.

The pureXML technology also has other benefits over relational storage of XML data. For example, since XML data is hierarchical, it can be difficult and time consuming to convert into a relational format without error. And relational databases can be very rigid due to the cost of change; forms evolve over time, and every change in the design of a form requires a corresponding change in the relational database and in the tools that convert XML data to and from relational data.

With an XML column in DB2, a change to the form has no impact on the design of the database table. Furthermore, you can change the presentation of the form in any manner without affecting the structure or content of the data store.

How it all fits together

Lotus Forms and DB2 9 pureXML can seamlessly integrate with each other because they both speak XML; an open, free-to-use international standard developed by the W3C.

Lotus Forms provides the components for designing, deploying, and processing your forms, and DB2 provides the components for storing your forms quickly and easily in their native XML format, with substantially less overhead than storage in a relational format.

Whether you are creating a new system from the ground up or are integrating your processes one piece at a time, Lotus Forms and DB2 have you covered. The process is that flexible. DB2 allows you to mix relational and XML columns in the same table, so you don't have to convert existing systems and processes whole-scale; you can do it in short, well-defined, easily taken steps.

Together, Lotus Forms and DB2 9 pureXML provide the tools and the power you need to design, deploy, process, and store your forms. Design your forms with Lotus Forms Designer, deploy them with Lotus Forms Viewer or Lotus Forms Webform Server, process them with Lotus Forms API, and store them in DB2 9 pureXML.

Lotus Forms Designer

Designer is an Eclipse-based application that provides both a drag and drop graphical interface, and for power users, an XFDL source editing interface. Designer gives you the power and flexibility to create forms the way that best suits you and your business. You can create forms in one of the following ways:

- from scratch
- from an existing XForms data instance

- from an existing Web service (WSDL)
- from an existing schema
- automatically from an existing PDF form

Lotus Forms Viewer and Webform Server

Viewer and Webform Server are applications that provide form viewing, completing, and digital signing operations.

Viewer is a rich client that can speak XForms directly and natively with DB2 9 pureXML. It runs on the client machine either as a standalone application or embedded in a Web browser.

Webform Server is a zero-footprint solution that is "bilingual:" it speaks HTML to Web browsers and XForms to DB2 9 pureXML. Your users do not need to install a separate viewer, and they do not even need to know that they are using XForms and XFDL. Instead, Webform Server translates your Lotus Forms applications into standard HTML and JavaScript suitable for Web browsers.

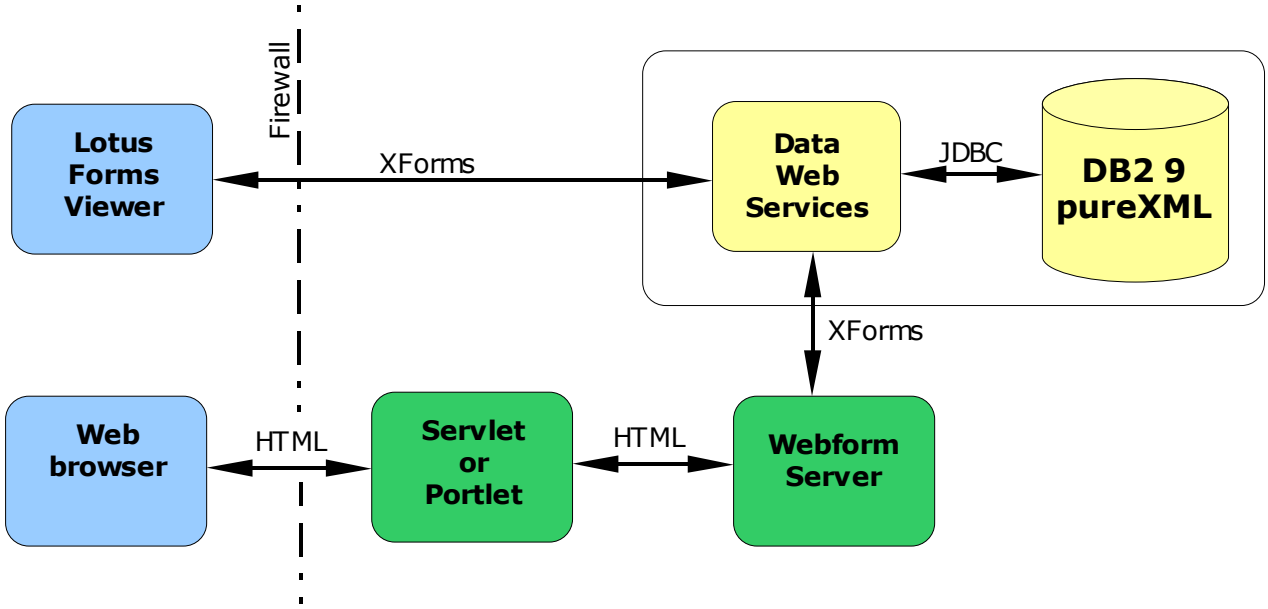


Figure 1: Shows one of many possible deployment scenarios. Because each component communicates over standard network protocols (HTTP, SOAP, JDBC) and with open standard XML-based languages, you can create the topology best suited to your business and processes.

Lotus Forms API

If your business rules require further processing of form data, you have the option of using the Lotus Forms API. The API provides low-level access to XFDL form content, including the XForms data, in Java, C, and COM. For example, you can verify and validate digital signatures, strip forms of personal data before routing them to external consumers, or implement custom data analysis algorithms.

In addition, the API allows you to extend an XFDL form. You can augment XFDL by adding your own business-specific or process-specific elements, or even add new functions to the compute engine.

DB2 9 pureXML

As stated earlier, DB2 9 pureXML is ideally suited to handling XForms and XFDL. The DB2 database stores XML in a single column and in its native format. When XML data is inserted, it is parsed and stored in a tree structure which is optimized for search and retrieval using either standard XQuery or standard SQL/XML. You do not need to convert your hierarchical XML data into relational data.

Another advantage of DB2 9 is the Web services feature, which allows you to reduce your programming and maintenance load even further. Basically, you define your XQuery and/or SQL queries, then wrap them in data Web services created by IBM Data Studio. Data Studio generates and deploys a Web service that contains the queries as stored procedures which are accessible via HTTP or SOAP. Naturally, you can write your own code to access the database directly and not take advantage of Web services.

Because Lotus Forms can consume Web services, you can easily transfer data into and out of the database without wasting time developing and deploying software that shreds the XML into relational data on the way into the database, and builds XML on the way out of the database. It's an extra layer of cost and complexity that is removed from the system, resulting in fewer errors, faster throughput, greater performance, and reduced cost. In short, you get cleaner data, faster.

A Demonstration

This overview shows how easy it is to implement the Lotus Forms and DB2 9 pureXML solution. It uses the U.S. Corporation Income Tax Return 1120, available from http://www.irs.gov/pub/irs-pdf/f1120.pdf

The form is a PDF form; it has fields where the taxpayer enters the usual data such as income and expenses. However, the form is not very intelligent. It does not do any verification, nor does it do any calculations. Also, the taxpayer needs to print out the form, sign it with a pen, then mail it to the IRS.

The Lotus Forms approach is cleaner, faster, and more accurate. Lotus Forms Designer converts the existing PDF form into an XFDL-based form which duplicates the layout and functionality of the original. After conversion, you can enhance the form by adding calculated fields and digital signature capability, automating the process and increasing its security and reliability.

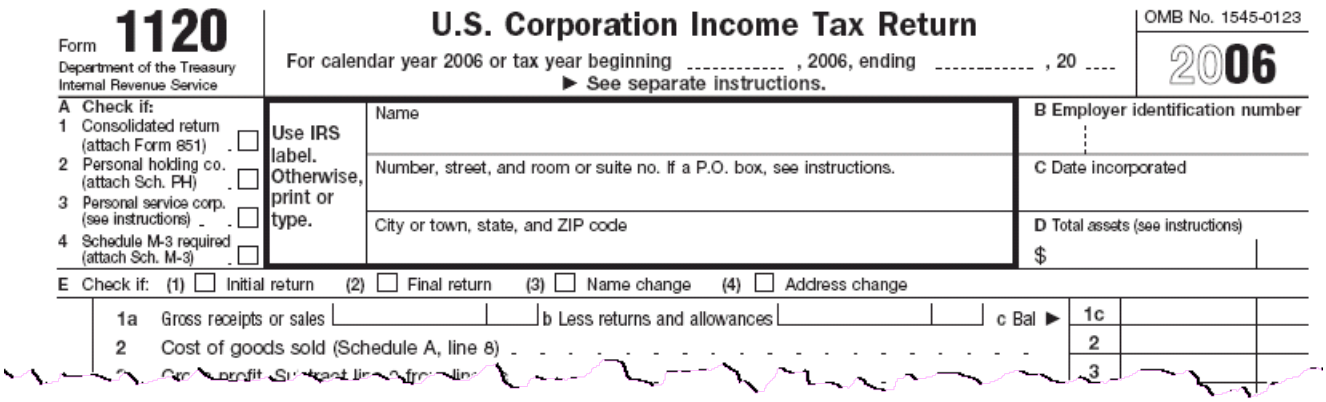
The Designer also allows you to quickly build a tabbed dialog, with custom appearance and navigation, that eases the data input process.

What follows is a high-level demonstration that starts with the PDF Form 1120 and ends with an intelligent Lotus Form that has been completed, digitally signed by both the Paid Preparer and by the corporate officer, and submitted to the IRS. A movie demonstration that covers the same material is also available; see the References section for a link.

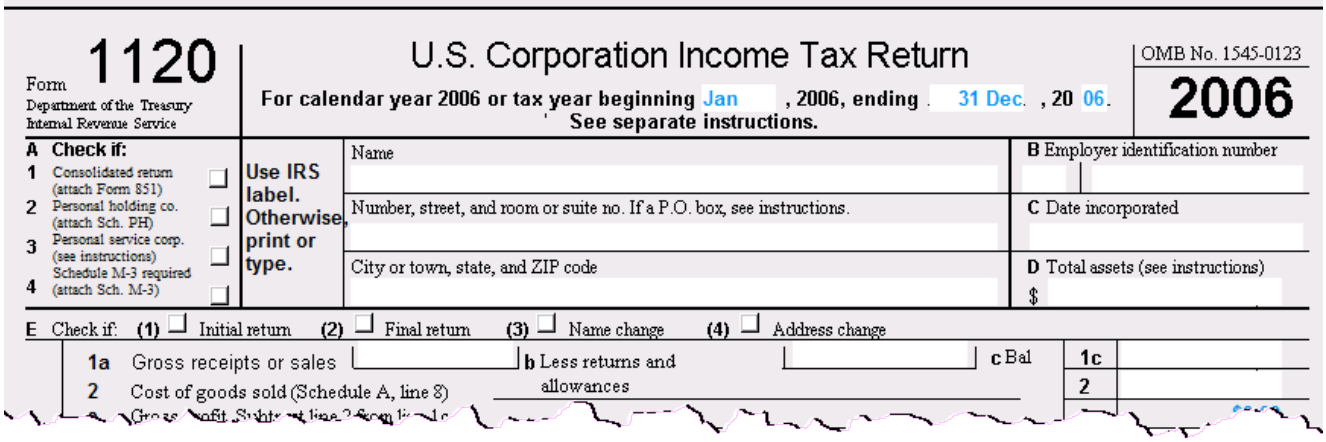
Create the solution

Start with the PDF version of the 1120 tax form, available from the IRS website at http://www.irs.gov/pub/irs-pdf/f1120.pdf. You will also need the instructions for using this form so that you can properly apply intelligent processing to it: http://www.irs.gov/pub/irs-pdf/i1120.pdf.

After you have downloaded the form, convert it to XFDL by using the Designer's conversion tool. On the File menu, click on Convert to Lotus Form. The conversion tool converts the PDF form from this:


Form 1120
Department of the Treasury
Internal Revenue Service
U.S. Corporation Income Tax Return
For calendar year 2006 or tax year beginning , 2006, ending , 20
► See separate instructions.
OMB No. 1545-0123
2006
A Check if:
1 Consolidated return (attach Form 851)
2 Personal holding co. (attach Sch. PH)
3 Personal service corp. (see instructions)
4 Schedule M-3 required (attach Sch. M-3)
Use IRS label. Otherwise, print or type.
Name
Number, street, and room or suite no. If a P.O. box, see instructions.
City or town, state, and ZIP code
B Employer identification number
C Date incorporated
D Total assets (see instructions)
$
E Check if: (1) Initial return (2) Final return (3) Name change (4) Address change
1a Gross receipts or sales b Less returns and allowances c Bal ► 1c
2 Cost of goods sold (Schedule A, line 8) 2
3

into this:


Form 1120
Department of the Treasury
Internal Revenue Service
U.S. Corporation Income Tax Return
For calendar year 2006 or tax year beginning Jan , 2006, ending 31 Dec , 20 06.
See separate instructions.
OMB No. 1545-0123
2006
A Check if:
1 Consolidated return (attach Form 851)
2 Personal holding co. (attach Sch. PH)
3 Personal service corp. (see instructions)
4 Schedule M-3 required (attach Sch. M-3)
Use IRS label. Otherwise, print or type.
Name
Number, street, and room or suite no. If a P.O. box, see instructions.
City or town, state, and ZIP code
B Employer identification number
C Date incorporated
D Total assets (see instructions)
$
E Check if: (1) Initial return (2) Final return (3) Name change (4) Address change
1a Gross receipts or sales b Less returns and allowances c Bal 1c
2 Cost of goods sold (Schedule A, line 8) 2

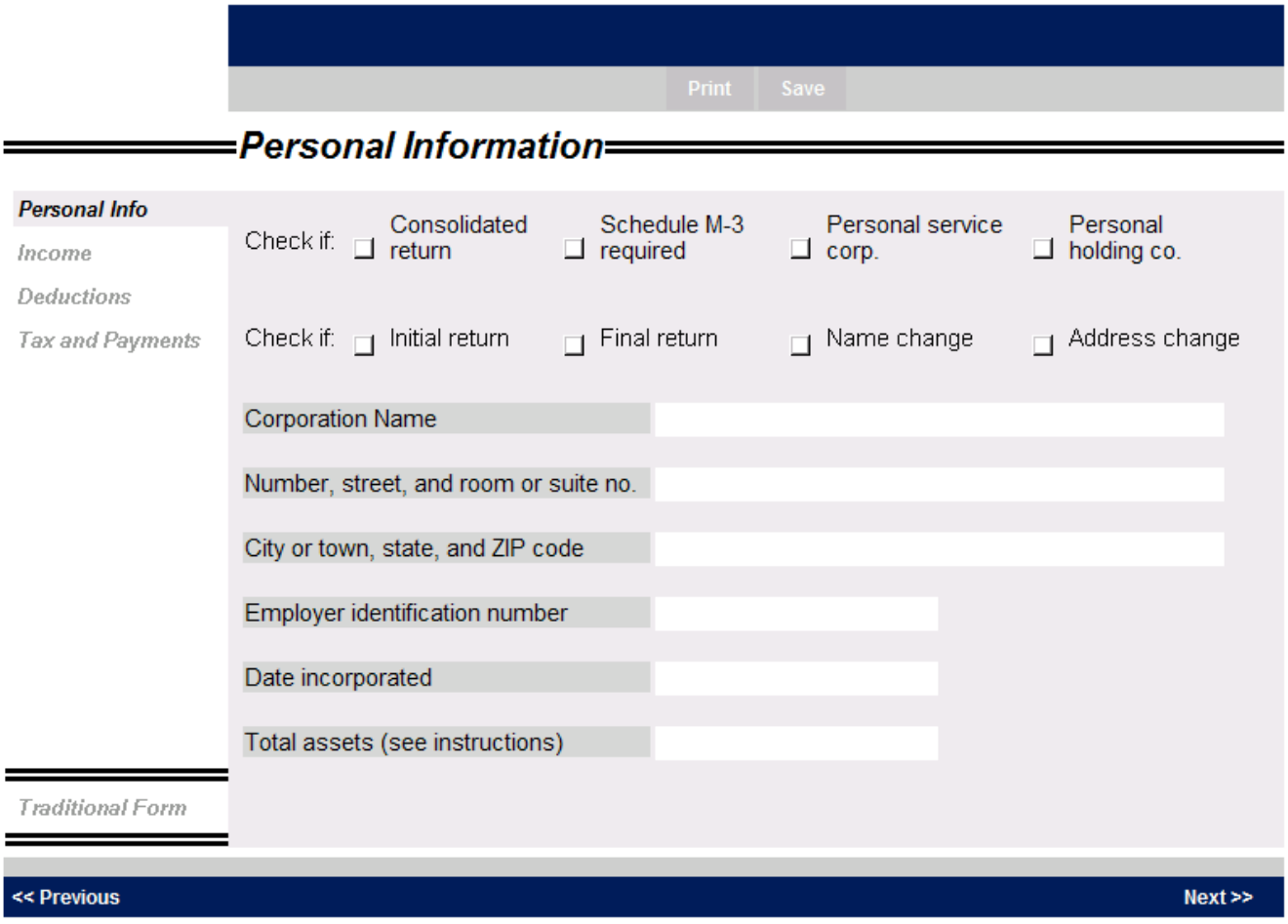
Because of the wide variablity of PDF forms, the conversion tool needs to make some “best guesses” about what is intended by the original authors of the form. Inevitably, you will need to make some tweaks to the final output to make it look “just right.” In the case of the IRS Form 1120, about an hour of manual cleanup and tweaking in the Designer is required.

The conversion tool creates a form that looks like the original PDF form, but you can use the Designer to add additional views.

In this example, the taxpayer is presented with two views:

- traditional form, so that it can be reviewed by the taxpayer, and digitally signed. The digital signature covers not only the content, but the layout of the form too.
- tabbed dialog, or wizard view, of the form. This gives a sort of "guided interview" feel to the form, and breaks the various sections up into logical parts. In this example, the wizard has four tabs; Personal Info, Income, Deductions, and Tax and Payments. In addition, it has a tab for Traditional Form, which displays the form as it would look on paper, and also contains the signature buttons.

This is what the tabbed dialog can look like, using one of the templates built into the Designer:



You also need to set up the form's submit button to access the URL of the Web service that will accept and store the form in the DB2 pureXML database. Again, Designer makes this easy.

The next step is to set up the DB2 pureXML database and associated Web services. The most critical part is the table that will hold the data. A relational solution would require careful planning and design, and could take weeks to complete, test, and implement. But because a pure XML solution is being used, a simple table with two columns is the minimum required.

This SQL statement will create the table:

```
CREATE TABLE f1120 (id INT PRIMARY KEY, data xml)
```

Inserting a form is just as easy. In this sample SQL statement, the primary key is 1 and the data is an XFDL form (only the open and closing tags are shown):

```
INSERT INTO f1120 VALUES (1, '<XFDL> ... </XFDL>')
```

To create the Web services, use IBM Data Studio, a free integrated development environment available from http://www-306.ibm.com/software/data/studio/.

After everything is set up, deploy the Web service to an application server such as WebSphere Application Server or Tomcat.

The user experience

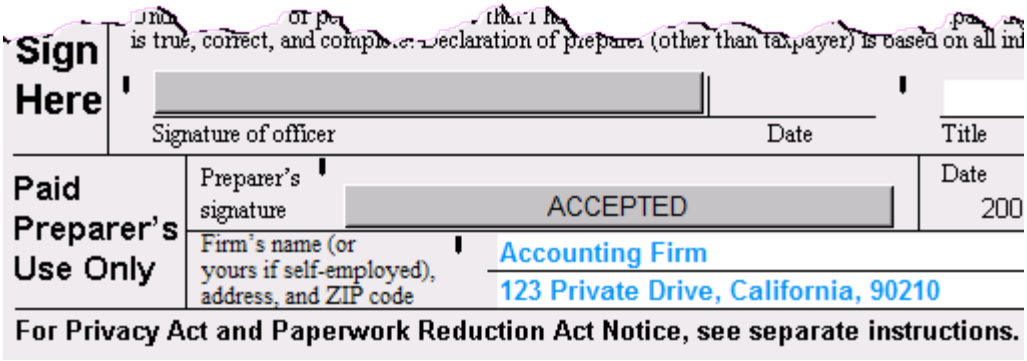
The taxpayer goes to the appropriate Web site and clicks on a button that opens the form in a Web browser.

In this example, the form is completed online, but it's possible to have the taxpayer download the XFDL and use the Viewer to complete the form, storing it on a local hard drive until it is ready to submit. In any case, the form can be partially completed, saved, and then finished at a later date.

The example shows the Income tab, with data that is entered by the taxpayer in white fields, and calculated data in grey fields.

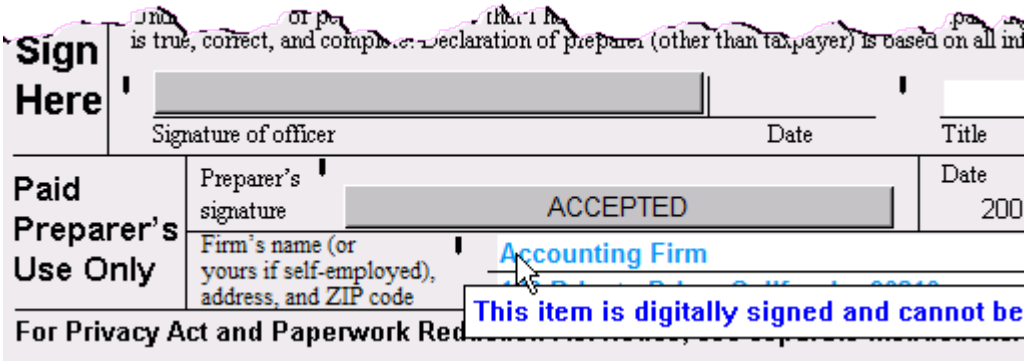
After the form is complete, the taxpayer clicks the Traditional Form tab, reviews the information, and scrolls down to the signatures area.

The first person to sign the form is the paid preparer, the person hired by the corporation to prepare the taxes. Signing is easy; the preparer clicks the button, and follows the instructions in the dialog that appears.



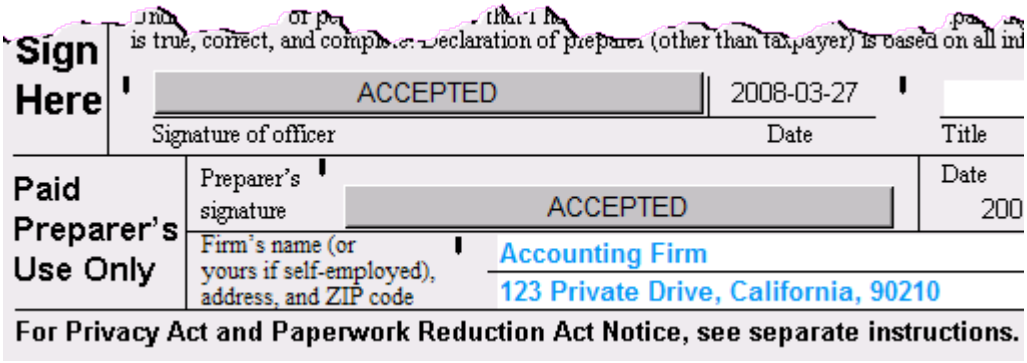
Signatures cover both data and presentation to ensure that information is represented accurately. A Lotus Form can contain more than one signature, and those signatures can overlap. In this example, the preparer's signature covers the entire form except for the officer's signature button and the officer's date and title fields.

The software does not allow signed fields to be changed, as shown in this figure:



If someone tries to tamper with the form by for example, using a text editor to change its content, the Lotus Forms software will detect the tampering and alert you to the fact in two ways. First, an error message will be displayed. Second, the signature button will have the word “INVALID” marked on it.

After the paid preparer signs the form, the officer signs it in the same manner, by clicking on the signature button and following the instructions in the dialog that appears.



After the form has been signed by everyone, a submit button appears at the top. Clicking the submit button sends the form to the DB2 database.

After the form has been submitted, you can use the Lotus Forms API to do some post-submission processing such as signature validation, financial analysis, and internal routing. In the case of a tax form or other financial document, you could even use the API to implement customized fraud detection algorithms.

The Lotus Forms and DB2 9 pureXML XForms solution

It's worth repeating that together, Lotus Forms and DB2 9 pureXML provide the tools and power you need to design, deploy, process, and store your forms.

References

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XForms basics on developerWorks: http://www-128.ibm.com/developerworks/xml/library/x-xformsbasics/

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The case for IBM Lotus Forms: ftp://ftp.software.ibm.com/software/lotus/pub/lotusweb/workplace/forms/IBMLotusFormsWhitePaperSept2007.pdf

Lotus Forms and DB2 pureXML demonstration: http://www-128.ibm.com/developerworks/wikis/download/attachments/5080391/LotusForms+and+DB2pureXML.wmv

Lotus Forms Designer demonstration: http://demos.dfw.ibm.com/on_demand/Demo/IBM_Demo_Lotus_Forms_Designer-Oct07.html

Download DB2 Express-C: http://www-306.ibm.com/software/data/db2/express/

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New to SOA and Web Services: http://www-128.ibm.com/developerworks/webservices/newto/db2websvc.html

Tax Solution Education Kit on developerWorks: http://www.ibm.com/developerworks/wikis/display/db2xml/Tax+Solution+Education+Kit