
Test Strategies for XPS Consumers

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Abstract

This paper provides information about XPS for the Microsoft® Windows® family of operating systems. It provides guidelines for software quality engineers to implement a testing strategy for XPS consumer implementations. Topics covered include a brief overview of factors impacting the interoperability between XPS producers and consumers, and recommendations regarding specific testing strategies that can be used to help ensure an interoperable XPS ecosystem.

This information applies for the following operating systems:

- Microsoft Windows Vista™
- Microsoft Windows Server™ 2003
- Microsoft Windows XP

References and resources discussed here are listed at the end of this paper.

Contents

Introduction	2
Document Format Characteristics.....	2
Producers.....	2
Consumers.....	3
Comprehensive Conformance Tests.....	3
Functional Conformance Tests	3
Compatibility Testing.....	4
Reference Devices.....	4
Optimization and Problem Solving	4
Summary.....	5
Author	5
Resources.....	5



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Introduction

The XML Paper Specification (XPS) is an XML-based document description format, which is packaged in a standard ZIP file format. *Producers* of XPS packages include Windows operating system components, software applications, and device drivers. *Consumers* of XPS packages include device drivers, printers, viewers, editors, and file converters.

As a document format, XPS plays a role similar to PostScript, PCL, or PDF. Each of these formats can describe a document using a well-defined syntax, which a printing consumer can decompose into a set of graphics primitives and then render as a bitmap image.

A large body of industry experience exists regarding the factors that influence the interoperability between a disparate set of producers that generate document formats and a wide range of consumers of these formats. This experience has resulted in the development of test strategies that can be applied to a page description language, including XPS, in order to help ensure a high degree of interoperability.

This white paper provides a brief synopsis of the key factors that will impact the interoperability between XPS producers and consumers, and provides some guidance to XPS implementers regarding test strategies.

Document Format Characteristics

The intrinsic attributes of the document format have a significant impact on the integrity, consistency, and testability of both producer and consumer implementations.

Formats with simple syntax, low complexity, efficient command sets, clear specifications, and that use existing standards are far more likely to result in interoperable implementations. XPS contains all of these desirable document format characteristics.

Producers

A key aspect of maintaining an interoperable XPS ecosystem is to ensure that XPS packages generated by producers are conformant to the specifications for XPS, Open Packaging Conventions and Open XML Markup Compatibility. Conformance testing consists of validating that the consumer can correctly process the full breadth of allowable XPS content and is well behaved when encountering invalid XPS content.

Microsoft recognizes that interoperability is difficult to achieve without methods to ensure specification conformance. They have employed two methods to reduce the likelihood of non-conformant XPS Document format proliferation by the producer community.

The first approach is to provide the industry with two utility programs that can statically analyze the output of an XPS producer. The *IsXPS* utility performs schema validation of the XPS Document markup, analysis of the packaging conventions, and checks the integrity of various resource files, such as fonts and images. The *PTConform* utility validates the markup in PrintTickets, a key part of most XPS Documents. The rigorous use of these utility programs will help ensure that only conformant XPS Documents are generated by XPS producers.

The second approach to ensuring producer conformance is to strictly apply all conformance rules to the XPS Viewer's behavior, and to generate exceptions for any non-conformant XPS Documents. Outside the XML Paper Specification, the XPS Viewer is the official reference authority for XPS Documents. The XPS Viewer will be widely used by consumers to view paginated documents in the XPS Document format. This will provide producers with significant motivation to ensure XPS markup they generate does not trigger exceptions in the XPS Viewer.

It is also important to note that the XPS Viewer will likely play the role of arbiter of proper XPS Document behavior from a consumer perspective, strongly influencing the quality expectations for other XPS consumers that enter the market.

Consumers

To ensure that XPS consumers are interoperable with a wide diversity of XPS producers, both conformance and compatibility testing is required. Compatibility testing involves testing XPS Documents generated by a wide diversity of real-world producers by the consumer.

Comprehensive Conformance Tests

Companies writing their own XPS consumer software will need to use a set of comprehensive tests consisting of the following test elements:

- Combination testing that exercises all the various permutations of XPS attributes and child elements
- Range testing that exercises the full legal range of attribute values
- Tests that illustrate the influence of brush types, clipping paths, transforms, and opacity on other XPS elements
- Resource tests that use a diversity of fonts, images, and color profiles
- Complex test scenarios demonstrating the full breadth of XPS usage
- Testing of the Open Packaging Conventions requirements, including relationships, optional parts, interleaving, and fragmentation
- Testing the Interactions between XPS markup and PrintTickets.
- Validating that consumers gracefully exit when encountering illegal or corrupted XPS content

The intent of the comprehensive testing is to fully characterize the XPS consumer implementation. These tests usually consist of thousands of custom designed test scenarios.

Functional Conformance Tests

Functional tests focus on testing the breadth rather than the depth of XPS, focusing on simple test scenarios that will quickly isolate obvious XPS implementation problems. Functional tests provide an ideal tool for regression testing during development as the number of test scenarios is modest in comparison to the more comprehensive tests, with attribute values in the middle of the bell curve relative to typical usage scenarios

Companies licensing XPS consumer software from a core technology provider should first verify that the supplier has completed comprehensive testing of their XPS Document consumption code. After the licensed XPS code is integrated into the consumer, functional testing must be conducted to validate that the integration process has not corrupted the integrity of the licensed XPS implementation.

Compatibility Testing

A conformance test, no matter how extensive, cannot capture all the potential scenarios an XPS producer might generate. Therefore, it is crucial to exercise XPS consumers with a representative sample of real-world content. This content should include XPS Documents generated using the following scenarios:

- Popular Win32-based application test pages routed through the GDI to XPS conversion path available in Windows Vista or using the Microsoft XPS Document Writer print driver.
- Popular Windows Presentation Foundation (WPF)-based application test pages routed through the XPS Print Path in Windows Vista, or using the application's "Save to XPS" feature.
- XPS Documents generated from a wide variety of producers that generate their own XPS Document files. This should include both vertical and horizontal applications.
- To the extent that a large body of XPS Documents emerge on the Internet (as with PDF), then some statistical sampling of this population of XPS Document files would be an important test resource.

Comprehensive, functional, and compatibility test suites for XPS are rapidly becoming available to implementers. QualityLogic has a full line of XPS test suites. Microsoft has recently released a limited set of test files, and many core technology providers have developed their own test files.

Reference Devices

In the context of hard copy consumers, interoperability has traditionally focused on ensuring that new products emulate the behavior of a specific hard copy reference device. Hewlett-Packard's products have traditionally been the reference devices for PCL, while PostScript reference devices have shifted over time depending on the success of various printer manufacturers that license Adobe PostScript.

The XPS Viewer will fulfill the role of official reference device for XPS consumers. The rendering rules for XPS Documents are fully compatible to the rendering rules used by the Windows Presentation Foundation graphics engine of the XPS Viewer. However, using a viewer as a reference device for hard copy output devices can be problematic. In XPS there are a number of areas where PrintTicket settings interact with the XPS markup, influencing the appearance of the rendered document. The XPS Viewer ignores most PrintTicket settings, making it impractical to use the viewer as the reference device in some corner cases.

Microsoft ships a reference XPS raster image processor (RIP) for test and development purposes that can assist vendors in their print implementation when the XPS Viewer cannot provide print-specific rendering guidance. However, the XML Paper Specification is the ultimate authority on XPS conformance. Questions related to specification ambiguity should be directed to Microsoft at xpsinfo@microsoft.com for final guidance.

Optimization and Problem Solving

In addition to the static analysis tools noted earlier, Microsoft provides a very useful interactive XPS markup editor called XamiPad, which is installed as part of the WinFX Software Development Kit (SDK). This utility provides a great way to debug isolated fragments of XPS markup.

Based on our experience working with XPS, the following additional utilities are critical to fully optimize and debug XPS implementations:

- The ability to see a frequency distribution of XPS elements and attribute usage in a file
- The ability to view the stream ordering of parts in an XPS Package
- The ability to interactively edit PrintTickets and globally apply PrintTickets to a set of test files
- The ability to view and edit a fragmented XPS Document file using its logical structure

Summary

Robust interoperability between XPS producers and consumers will play a pivotal role in the rapid adoption of XPS as a document format. XPS has the potential to quickly achieve a high degree of interoperability. Tools are available now to start testing XPS implementations.

Author

The author of this paper is Jim Zuber, a co-founder of QualityLogic, Inc. and the architect of the company's line of XPS testing suites and testing utilities. QualityLogic has provided the printer industry with testing tools for over 20 years, and their test suites are considered a de facto standard in the industry.

Resources

XML Paper Specification

(Information about XPS and related topics as well as links for end users, IT professionals, ISVs, and IHVs)
<http://www.microsoft.com/xps>

White Papers:

XPS and Color Printing Enhancements in Windows Vista

http://www.microsoft.com/whdc/xps/vista_print.mspx

PrintTicket and PrintCapabilities Support in Windows Print Drivers

http://www.microsoft.com/whdc/device/print/XPSDrv_PrintTicket.mspx

Reading and Printing XPS Documents

<http://www.microsoft.com/whdc/xps/xps-read.mspx>

Kits:

Windows Driver Kit

<http://www.microsoft.com/whdc/driver/WDK/aboutWDK.mspx>

Windows SDK

<http://windowssdk.msdn.microsoft.com/library/>

Platform SDK

http://msdn.microsoft.com/library/default.asp?url=/library/en-us/sdkintro/sdkintro/contents_of_the_platform_sdk.asp

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