

Adobe® PostScript® Extreme™

Adobe Solutions for Commercial Printing

Since its introduction in 1984, the Adobe PostScript language has not only been the mainstay of desktop publishing in the commercial print world, but it has become the standard for digital commercial graphic arts production. Adobe Systems is constantly improving the capabilities of the PostScript language and its output systems as the market for digital communications grows. These extensions have covered a multitude of improvements, including color management, image manipulation, memory management, dictionaries and caches, compression, forms, filters, device controls, composite fonts, and much more. But companies under pressure in the commercial environment must integrate more than a superset of excellent features. Workflow management and process automation can optimize production and manufacturing. Adobe has extended the capabilities of the PostScript language to create its most advanced, flexible, scalable, and productive implementation: Adobe PostScript Extreme software.

Adobe PostScript Extreme technology is an architecture of related modules whose functionality optimizes throughput for commercial printing. Extreme makes use of three of Adobe's complementary core technologies: Adobe PostScript 3™ interpreters, Portable Document Format (PDF), and Portable Job Ticket Format (PJTF). There are two variants of Extreme: Extreme for Graphic Arts and Production Printing, and Extreme for High Volume Printing. This paper focuses on Extreme for Graphic Arts and Production Printing. However, the ultimate goal of both versions of Extreme is to provide a robust job management environment for commercial printing.

Understanding the Adobe PostScript Extreme architecture and modules is important to understanding how Extreme will create new flexibility and open extensibility for long-term workflow management solutions. This white paper discusses the foundations of Adobe PostScript Extreme, the modules that form its architecture, its near-term benefits, and its long-term vision. The discussion will be broken into two parts: an overview of the features and benefits of Extreme and a technical discussion, which provides practical information for system planning and development.

Architecture overview

Adobe PostScript Extreme consists of three major components:

- Extreme: a set of process modules and a communication framework for queuing these processes and automating/coordinating the transfer of data from process to process
- PDF: a page independent, reliable digital master to deliver content
- PJTF: a companion standard to PDF used as a control mechanism

Extreme process modules are known as Job Ticket Processors (JTP). JTPs get information from a Job Ticket, which is an extended set of processing information about a PDF document written in Portable Job Ticket Format, which is based on the PDF language. A Job Ticket may be included in a PDF document or exist as a separate entity. A PDF document and its associated Job Ticket contain essentially all the information (content, graphics, production specs, etc.) required for viewing, processing, and outputting a file in a self-contained package. Because a PDF document contains this key information, it can be thought of as a Digital Master, a complete and reliable description of a file's content and processing requirements.

JTPs provide independent functionality—in other words, they do things. There are different types of JTPs that are called into play by the specifications contained in the Job Ticket. Modular Job Ticket Processors provide a way to “mix-and-match” required steps from an inventory of functionality. For example, the trapping engine (mechanism) is a JTP, imposition is effected by a JTP, and even output is handled by an



In Extreme, JTPs can be sequenced flexibly so that if different jobs require different manufacturing plans, the same system can be used to structure the required processing sequences.

Underneath it all, the communication framework of Extreme has a Coordinator, which sends information to and receives information from the JTPs. The Coordinator passes instructions between the JTPs. The Coordinator contains a Sequencer that defines the internal Extreme workflow. The Sequencer reads information from Job Tickets, sets up a JTP sequence, makes process choices, and then updates Job Tickets as information is returned from each JTP. Thus rather than being a hard-wired flowchart of steps, the process itself becomes much more flexible and responsive to the real-time results of the processing. The other parts of the Extreme framework will be discussed in the second part of this white paper.

A PDF file is the Digital Master of the job information. It includes the objects that collectively make up the document's content and the Job Ticket as a collection of history, information, and instructions about the production and processing requirements. PDF documents contain everything required for commercial output. All the resources needed are self-contained in a way that significantly improves the PostScript to print workflows because a PDF file contains a vastly expanded amount of information pertaining to viewing, production, and output. With a PDF file as a Digital Master, Adobe PostScript Extreme uses the master information to create workflow automation and assure reliable processing. There is a more extensive discussion of PDF Digital Masters later in this paper, and for more information, Adobe also has a white paper entitled "Preparing Adobe PDF files for High Resolution Printing" that can be found on Adobe's Web site at www.adobe.com.

Portable Job Ticket Format is the language of the Job Ticket and is used for processing information. PJTF extends the functionality of PDF by carrying history, instructions, and process control about both the content and the document itself. A Job Ticket collects information about the state of the document and what needs to happen to it. This information is passed to the Coordinator, which determines which Job Ticket Processors are required. The JTPs then effect the required processing and pass the document to the next part of the sequence. A Job Ticket is an independent part of a PDF document, and by separating the processing information from the content, a Job Ticket becomes an unambiguous job process management tool. The Job Ticket knows what needs to be done, and the Job Ticket Processor knows how to do it. One important benefit to this structure is that Portable Job Ticket Format and Job Ticket Processors can both be independently extended as new processing technology evolves and as business markets expand.

In summary, Adobe PostScript Extreme is a process management backbone that receives a PDF Digital Master file and processes it according to the job requirements. The backbone itself is extensible, and the processes can be automated in a way that has not been possible up to this point in time.

Extreme benefits

Graphic arts production is moving rapidly toward a completely digital workflow. The obvious benefits of digital workflow have been discussed widely throughout the industry and include flexible processing and repurposing of content as well as enhancements of precision digital output on devices that range from desktop color inkjet printers to computer-to-plate machines. There are, however, other potential advantages to all-digital production that have been awaiting a system like Adobe PostScript Extreme.

Workflow automation

Prepress is a progressive process, and Adobe PostScript Extreme technology is ideal for sequencing the required steps and managing the results. As a PDF document is built and moves through its required processes, information about these processes can be specified and collected in its Job Ticket. The Job Ticket can be examined, edited, and enhanced. In an Extreme environment, the Job Ticket Processors can act on this information and, in turn, pass these specifications (or new specifications) over to other Job Ticket Processors. A Job Ticket is also an audit trail of what has happened along the way, and it is possible to use this information to configure JTPs for following steps. By collecting data in the Job Ticket, there is much less confusion about what has happened and what remains to be done to the elements of the document. Thus, a PDF Digital Master becomes a self-contained, flexible blueprint of its future processing, no longer dependent on system configurations that may be inappropriate. This allows jobs to be processed dependably with little human intervention.

Flexible editing and updating

A second advantage Extreme makes possible is the ability to make significant changes to the content and associated production instructions much later in the process. It is not necessary to return to the original applications to make and effect these changes, so an enormous amount of time is saved. This is a tremendous workflow improvement. One example of this might be a reprint of a four-color print job where budget considerations force the use of a lower quality paper than in an earlier run. Dot gain compensation of images should be adjusted because of the change in paper quality. A lower halftone screen is now necessary, so the amount of trapping required for artwork must be changed. Before Extreme, dot gain and trapping information would have been hardwired into the data, and these corrections would have had to be made image by image, artwork by artwork back in the native applications. But in an Extreme environment, these prepress specifications are contained in the Job Ticket, and only applied to the data when required at output time. Thus the content is kept in a more "generic" form until much later in the process, and can be targeted to a variety of different kinds of output much more flexibly. It's a direct byproduct of the modularity of Extreme and the integration of PDF and PJTF.

Extreme has been a natural evolution based on the composite experience of the graphic arts industry. Workflows and responsibilities have undergone re-creation and re-evaluation, and the features and capabilities of Adobe PostScript software have been steadily improved. PostScript Level 2 added many of the capabilities mentioned in this paper's introduction. PostScript 3 software brings additional output capabilities, such as smooth gradients and key workflow enhancements—like the ability to use native PDF files.

Adobe PostScript Extreme is here today, and its modular architecture has already spawned a number of differentiated systems that provide specific value-added enhancements. Equipment manufacturers and vendors can customize Extreme to create distinct implementations for different market requirements. For example, Extreme systems have an integrated ability to create PDF and use Acrobat® tools to edit and enhance the document before it is submitted for printing. Other systems add tool sets for imposition, trapping and output control within the print application or utility. Even more highly sophisticated systems add the ability to manage a distributed prepress environment in which the look and feel is that of a job manager sending groups of pages for ongoing processing.

Native PDF creation

Another key benefit of Extreme is its ability to create PDF directly. If an application that does not create PDF directly is the source of the pages, a reliable PDF Digital Master can be achieved because Extreme allows PostScript to be submitted for background conversion into PDF. This makes it easy for a job to be constructed from different sources and have its print parameters captured simultaneously. Once in Extreme, the content of the pages is represented in PDF, and its associated production information is managed within the Job Ticket. The content and its production information can therefore be handled in a unified way from within the Extreme system.

Different configurations of Extreme systems

If a PDF document is the Digital Master of the future, then the Adobe PostScript Extreme architecture is the future of output. Equipment manufacturers will be able to configure Extreme in a variety of ways to provide functionality appropriate to different market requirements. Some examples of different systems that may be implemented by Extreme OEMs and system vendors follow below.

Example 1: Direct PDF handling

Some Extreme products will create PDF natively and transparently from a client (application) connected to a PostScript 3 RIP. This will allow the PDF to be submitted directly for output. Users can continue to work in familiar applications, and then submit files for processing in a familiar workflow. The obvious benefit of this is that the mistakes people make in creating complex PostScript files can be corrected from within the print application using familiar Acrobat tools instead of returning to the application to correct them. Within an Extreme system, PDF becomes more than just a carrier of information. It is viewable and editable. The value of working in PDF extends even further because it can also be used as a tool for proofing, preflight, and page re-ordering.

Example 2: A print application workflow

Other products will have a print application that creates and describes the print job in terms of its processing requirements. These products receive page content from multiple locations, possibly at different times, and collect these disparate pieces into a unified job. This job will be represented by a single Job Ticket to describe the imposition, trapping, and rendering characteristics of the job. After the parameters are assigned, the work can be sequenced, batched, and automated as necessary. By managing the disparate content as a unified job, it is easier to coordinate the change to an all digital workflow using content and commercial data management.

Example 3: A distributed workflow

There will be products with an array of Job Ticket Processors distributed throughout a given workgroup. The JTPs will perform tasks like imposition, trapping, preflighting, and color correction directly on page content. These JTPs will control and manage the prepress system completely from within the Extreme architecture. By continuously building and extending the documents' Job Ticket(s), the document will become at once a Digital Master ready for print, and a complete log of the tasks performed and actions taken along the way. Therefore, job management becomes a reality. This type of Extreme system will present different personnel with different access to the information they need to schedule, track, verify the processing, and validate the quality of the job as it progresses. Additionally, the ability to audit for costing and billing also becomes implicit in this system.

Example 4: Production printing

Some printing environments do not need the processing complexity of the full prepress environment. Speed is the critical factor, and these businesses simply need to guarantee that every page will print and that their machines will run at full capacity. Extreme for High Volume Printing, a simpler implementation, will enable this by employing multiple RIPs to keep up with the output engines. Jobs will be split into individual pages that are then distributed to the RIPs on a "next bus out" basis, that is, whichever device is ready will get the next portion of the job. Much like the read/write heads of a RAID storage device, there will be a minimum of "inactive" time. The Extreme system is "in charge" of the workflow: by performing tasks like preflighting and color correction long before the data arrives at the print engine, costly mistakes that today are often only found late in the production cycle are avoided. This means that like other Extreme systems, this one has built-in capabilities that guarantee every page will print and print at the output engine's rated speed.

Future directions

From a technological perspective, Adobe PostScript Extreme has been designed for a future of extensibility. It has an open architecture that third-party developers can use to create their own Job Ticket Processors as well as other components that will fit easily into its architecture. This means that as new technologies enhance graphic arts production, Extreme technology will adapt to the new environment. Further advances in the renderer will enable the consumption of CEPS file formats, multiple engine support, and better integration with asset management systems.

Additions to the architecture of Extreme will enable integrated export of whole jobs for repurposing in different media like the World Wide Web or alternative printing applications. But more importantly, because Extreme is an Adobe product, Extreme is guaranteed to be compatible with all future versions of PDF and PostScript as they evolve and become available.

From a workflow perspective, Adobe PostScript Extreme will permit an ever expanding range of domains to be included in the flow of information. Through Portable Job Ticket Format, a job scheduling system can receive from and supply information to Extreme. Cost and billing systems can also be informed on the basis of actual production.

The Adobe PostScript Extreme framework will provide major improvements for today's workflows and an extensible pathway toward ongoing development and growth. The enhancement of interpreters, extensions of PDF, and creation of an architecture that is not limited to today's technology are the keys to a system with real longevity in the graphic arts production environment.

Since the introduction of Extreme, some of its original concepts have been enhanced. This has resulted in changes in functionality for some of the modules of Extreme. In the second half of this white paper, aspects

learn: Job Tickets, Job Ticket Processors, Normalizers, Coordinators, and more. This information will be especially interesting to those involved with workflow engineering or systems planning. Others who want a look at some of the underpinnings of Adobe PostScript Extreme will also find the technical discussion that follows valuable.

Technical overview

PostScript 3

Extreme is enabled by the evolution of Adobe PostScript 3 technology. Output has been improved with PostScript 3 in several important ways. Some of these improvements include better blends through the use of smooth shading operators, selectable separations, in-RIP trapping capability for separations, Hi-Fi color capabilities, and most importantly, direct printing of PDF. The ability of a PostScript 3 RIP to accept PDF directly opens the door to the adoption of Extreme workflow. Companies can begin to re-target their own production even before they own full Extreme systems by first acquiring PostScript 3 interpreters for their output devices and then converting their document base into PDF Digital Masters.

The "generic" Extreme workflow

Although there are different configurations of Extreme systems, it is possible to understand the workflow by following the progress of a specific job as it moves through Extreme. A retail mail order catalog, for example, contains all the elements of most graphic arts jobs. The content elements are text, graphics, and scans. The production elements include color management, trapping, and imposition. Pages are designed and constructed during the layout phase. In this scenario, two different workgroups use different page-layout software. The first group's software creates PDF directly, and the second group's software can generate PostScript output. The entire job is targeted for first appearance on the company's Web site, and then to be followed with a commercial print run. Because the pages are to appear on the Internet, the scans have been created as RGB data.

As the job is submitted to Extreme for prepress processing, the PostScript pages are distilled into PDF and stored in the page store. PDF pages are submitted directly to the Page Store. The Sequencer reads the Job Ticket, assigns tasks, and creates the logical flow for processing. The PDF pages are collected to a job that holds them for further processing as required. The Sequencer then manages the job by queuing pages for specific tasks (converting from RGB to CMYK in the color management JTP, trapping in the trapping JTP, and creating an imposition template in the imposition JTP). At each stage, the results are examined by the Sequencer to collect updates to the Job Ticket if required. Finally, the pages are sent for final assembly and rendering for output by the printer JTP.

The Extreme printer JTP

Extreme uses a highly optimized renderer within its architecture to take advantage of the efficiencies of a workflow system. This specially licensed component of Adobe PostScript Extreme is designed to "consume" a PDF file and its Job Ticket. Natively consuming Job Tickets means that last minute corrections can truly be last minute or even last second. A page on a flat can be changed, or the layout of the flat itself can be changed—it doesn't matter until the actual submission for print. Even page content can change up to the very last second. The renderer can be directly linked to the workflow components upstream. This means much higher productivity for the actual rendering device.

Extreme architecture

When Adobe PostScript Extreme was first introduced to the industry, the first demonstrations were targeted to an audience that was primarily concerned with high-speed print production. The initial architecture was intended to serve very fast RIPing of black and white pages. The issue raised was how to output more pages more rapidly, and the enabler was PDF. This implementation is now called Adobe PostScript Extreme for High Volume Printing, and its architecture includes the ability to "digest" PDF directly, as well as to take PostScript and convert it to PDF with the Normalizer. The workflow is optimized for high-speed printing with converted PDF pages delivered in order to the set of renderers driving the output engine. Little preprocessing is needed prior to rasterization, and speeds greater than 650 pages per minute can be achieved in commercial applications.

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