A deeper dive into Fiery digital front ends

An overview of Fiery technology that powers industry-leading performance

A Fiery® white paper

Executive summary

A Fiery® digital front end (DFE) is a high-performance appliance designed to drive print engines and provide industry-leading performance; accurate, consistent color; plus unmatched usability and integration that enable the quality and efficiency necessary for high production print environments.

Fiery DFEs include standard and proprietary components, in both software and hardware, specially designed and configured to maximize performance for a specific print engine.

Fiery DFEs, the fastest in the industry, are powered by proprietary application-specific integrated circuits (ASICs) which take full advantage of custom-designed microprocessors, proprietary file-compression algorithms, and efficient memory management to produce industry-leading performance. As a result of unequalled processing speeds, print operators can push more data to print engines faster and engines are less likely to move into cycle-down and warm-up modes — saving valuable press time. A fast DFE also helps meet tight turnaround times and reduces bottlenecks.

Combined with its intuitive operation, a high-performance Fiery DFE enables automated workflows to deliver finished jobs faster. Print businesses can meet their tight turnaround times and accomplish more by automating time-consuming manual tasks and by removing production inefficiencies.

When evaluating DFEs, always take into account that Fiery DFEs are specific-purpose devices, customized for specific print engine brands and models. This unparalleled customization, and the ability to deliver industry-leading performance with less hardware and competing resources, makes it impossible to perform a side-by-side comparison with general-purpose computers.

Dynamic load-based memory management reduces the need to add additional RAM modules. Other competitive DFEs require two or more times the amount of RAM for processing complex data files.

Introduction

High-speed printing, colorants beyond CMYK, personalization, larger media sizes, and other needs demand a digital front end (DFE) that processes data efficiently to drive print engines at rated speeds. This white paper provides a general overview of how various technologies implemented in Fiery DFEs enable customers to meet the performance demands of today's print market.

Fiery DFEs are specialized appliances that include EFI proprietary hardware and software modules with the latest industry-standard components such as Intel® processors, solid state drives (SSDs), and operating systems.

Fiery DFEs are the critical workflow touchpoint that accept a print job and turn that job into a format that a print engine (toner or inkjet) can use to lay down the content on the substrate. The Fiery DFE is, at its core, an intelligent raster image processor (RIP), but plays a much larger role in overall workflow productivity and printing quality.

By controlling and thoroughly understanding the different hardware components, the target print engine, and the environment in which they operate, **Fiery DFEs enable maximum utilization of system resources** while providing unrivaled performance. Fiery DFEs have always been able to achieve a higher performance level using less hardware and competing resources than other competitive DFEs.

A Fiery DFE can process large amounts of complex data fast and efficiently while simultaneously performing other I/O processes.

If a high-end Fiery DFE was a video streaming server, it could process and stream about one hundred HD movies per minute!

A long history of scalability

For over three decades, Fiery DFEs have spanned the A3+ commercial cutsheet printing industry, from office MFPs to the highest speed production printers — comprising a range of hardware platforms that feature the same efficient software design at the core. The Fiery DFE's scalable design enables support for new print engine technologies and increased file complexity, such as support for higher print speeds, higher resolutions, and multiple colorants in addition to CMYK.

Fiery DFEs are customized and optimized for each printing system. The unique imaging architecture and design provides the best user experience for a wide variety of customers and printing applications.

Terms and definitions

For the purposes of this document, the following terms and definitions apply.

Print engine

The unit that does the actual printing. A print engine is specified by its resolution and speed.

Raster image processor (RIP)

Component used in a printing system which produces a raster image, also known as a bitmap. This bitmap is used at a later stage of the printing system to produce the printed output.

Page description language (PDL)

In digital printing, a page description language (PDL) is a computer language that describes the appearance of a printed page at a higher level than an actual output bitmap (known generally as raster graphics).

Raster data

In its simplest form, raster data consists of a matrix of cells (or pixels) organized into rows and columns (or a grid) where each cell contains a value representing information.

Page fault

A page fault occurs when a program attempts to access a block of memory that is not stored in the physical memory or RAM. The fault notifies the operating system that it must locate the data in virtual memory, then transfer it from the storage device, such as an HDD or SSD, to the system RAM.

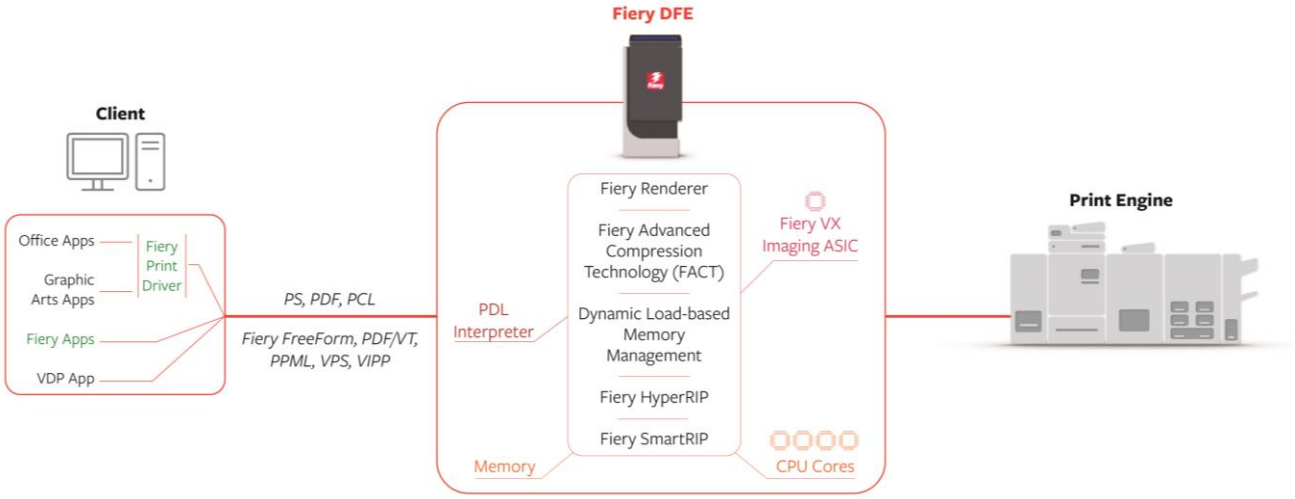
Warm-up time

The warm-up time is the time that the print engine takes from the moment the power is turned on to normal operation. If the engine does not warm up, many electronic components in the machine will not work properly.

Disk thrashing

Also called virtual memory thrashing, this refers to an issue that occurs when the hard drive works excessively during information transfer with the system memory and mainly caused from page faults.

Fiery DFE imaging architecture



Fiery DFEs incorporate numerous proprietary hardware and software technologies, designed to process print jobs fast and handle complex images with ease.

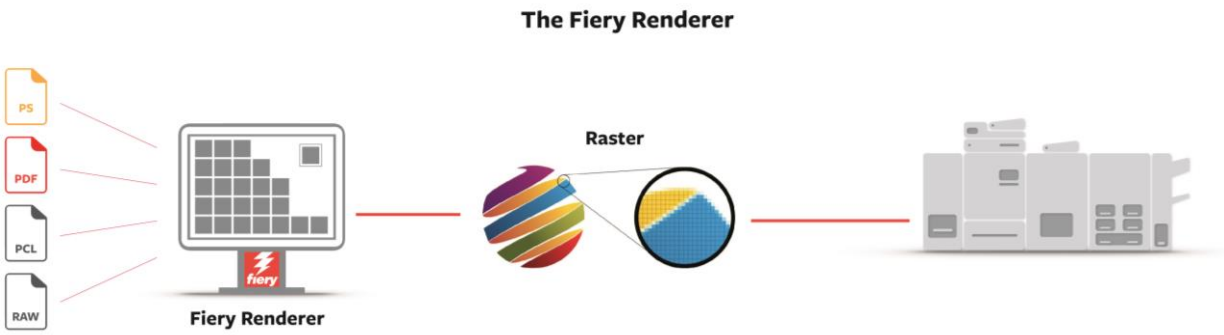
PDL interpreters

Fiery DFEs include a powerful set of PDL (page description language) interpreters including PostScript, PDF, PCL, IPDS, PPML, VIPP, and VPS. A long strategic partnership with Adobe enables Fiery DFEs to integrate the latest Adobe interpreters and create the most powerful DFE in the industry. The use of Adobe interpreters for both PDF (with the Adobe PDF Print Engine) and PostScript (with Adobe PostScript 3) means that designers using Adobe Creative Suite applications can be assured that their output will print correctly the first time, every time. The same core code libraries in the PDF Print Engine interpreter are used in Creative Suite and Adobe Acrobat.

Fiery renderer

The Fiery renderer converts graphical elements into device resolution pixels. It is extremely flexible and can handle data from not only PostScript and PDF interpreters, but also from Fiery PCL and IPDS, along with various graphic file formats including TIFF, JPEG, and proprietary raw image data formats. A close collaboration with Adobe gives Fiery DFEs extended interfaces and functionality to deliver a DFE that is unique in the industry.

This combination of Adobe technology with the Fiery renderer delivers unmatched versatility and performance. Key Fiery features best represent the designer's true intent, significantly outpacing any competitive implementations.

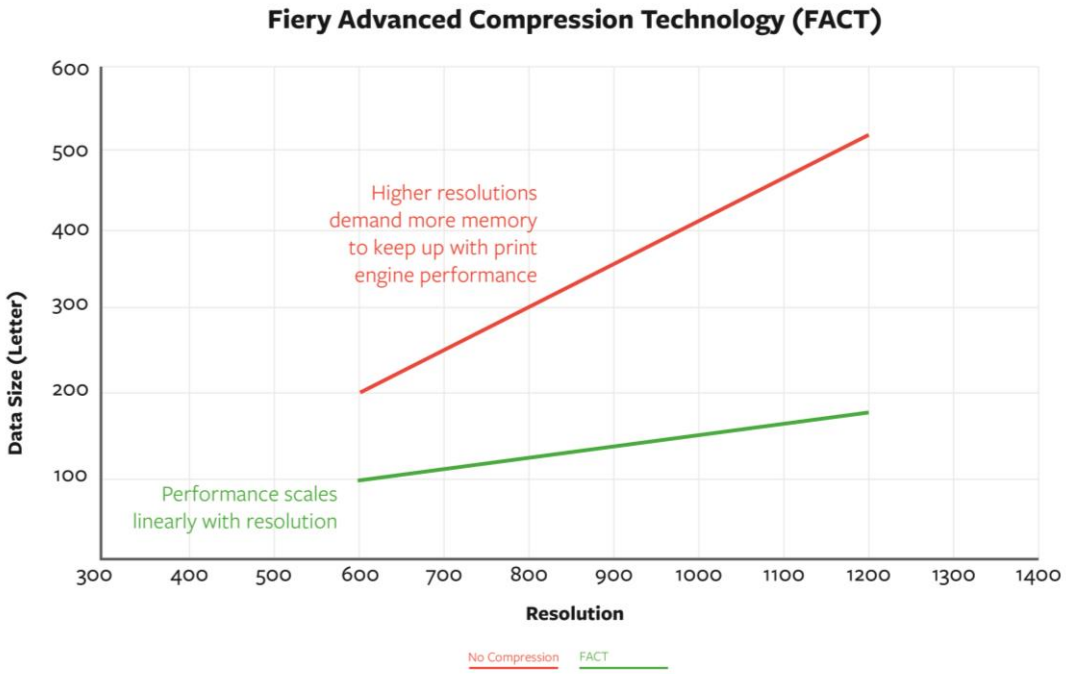


Fiery advanced compression technology

Fiery advanced compression technology (FACT) maximizes the DFE's available memory (RAM) to accelerate overall system throughput. FACT provides an effective way to increase scalability, performance, color, and imaging features while maintaining a cost-effective solution, compared to competitive DFEs and generic RIP offerings.

FACT compresses data at early stages, where appropriate, and minimizes the quantity of data handled through the different rendering steps.

One key attribute of this technique is that *performance scales linearly with resolution*, rather than as the square of resolution, as with systems using uncompressed or full-frame data approaches. This has enabled Fiery DFEs to handle higher resolutions with ease, while competitors struggle to improve their performance and incur the extra costs of adding additional RAM modules.



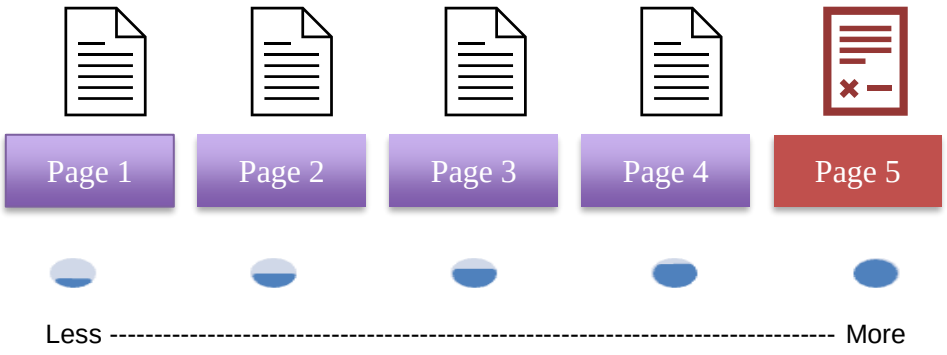
Dynamic load-based memory management

As systems grow larger and more complex, there is a tendency to have each module manage its own memory without knowledge of other memory allocations in the system. As a result, 32-bit systems will crash, and 64-bit systems will experience performance degradation with increased *page fault* operations.

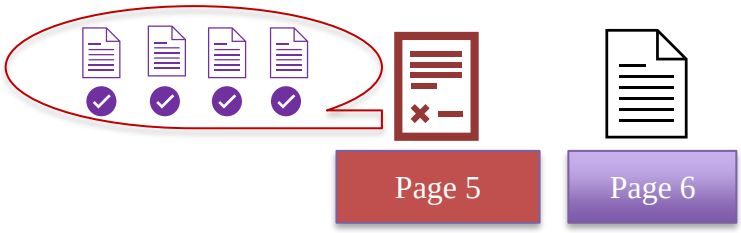
Fiery DFEs take a different approach. Memory, like CPU cores, is treated as a critical resource and managed in an effective and coordinated fashion. Significant portions of the Fiery DFE have regulated and managed system memory that results in well-defined behavior and avoids the possibility of uncontrolled memory growth. It is an intelligent, dynamic system that **monitors the needs for system resources against their availability.**

As an example, if a particular page requires more memory than the average used for a job during post-interpretation stages, the system can automatically allocate more memory to process this page while limiting other pages from processing until the heavy-memory-use page is completed. This allows much more complex jobs to complete using cache memory alone without frequent storage disk access.

To show how this works, a Fiery DFE processes five pages simultaneously and in parallel. Page 5 includes complex data that requires more memory to process than the previous four pages.



The Fiery DFE automatically allocates more memory to page 5 and delays processing any additional pages in the job. This approach prevents *disk thrashing* from frequent memory faults and avoids cache memory failures.



When pages 1 to 4 are finished, page 5 takes over the new memory available, and when it reaches its maximum memory requirement, automatically allocates the remnant memory to page 6 so it can be processed in parallel.

Dynamic load-based memory management reduces the need to add additional RAM modules. Other competitive DFEs require two or more times the amount of RAM for processing complex data files.

Fiery VX Imaging ASICs

Fiery VX Imaging ASICs enable real-time DFE operations and feed data at the print engine's rated speed. As a result, it prevents print engines from moving into cycle-down or warm-up modes, which reduce valuable production time.

The Fiery VX ASIC reduces the required system memory resources for RIP and printing. In other words, with a VX ASIC, the Fiery DFE could perform as if it has the equivalent of about four times more memory (RAM), thanks to the high-performance design of the VX.

For example, a Fiery DFE with 8GB of RAM will perform same as or better than a system with 32GB of RAM.

Fiery VX ASICs support variable data printing (VDP) in four-color print separations using Fiery advanced compression technology.

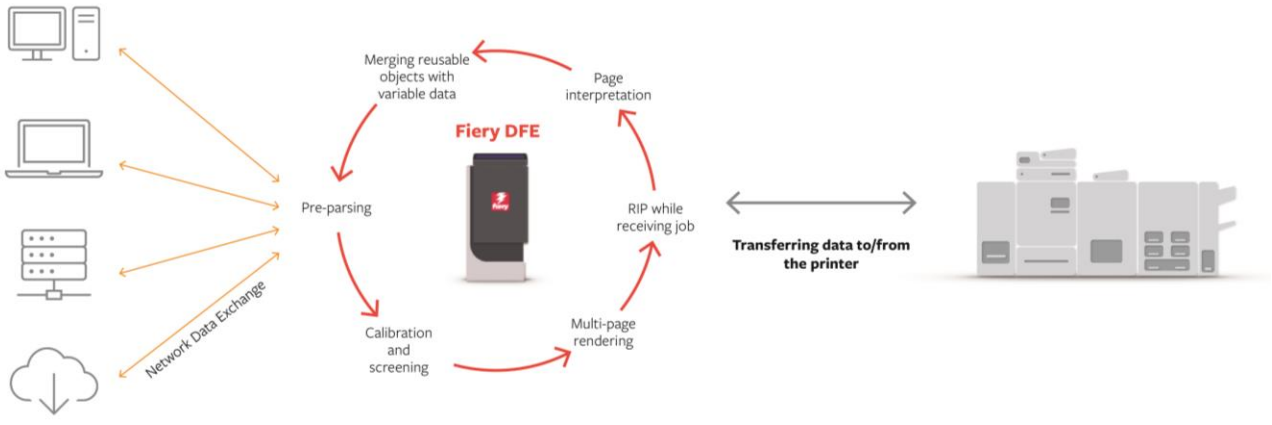
Multi-level parallel design

Fiery DFEs achieve additional performance improvements by processing many functions in parallel. Some of these functions include:

- Network data exchange
- Pre-parsing
- Interpretation of pages
- RIP while receiving a job
- Rendering parts of a page
- Rendering multiple pages simultaneously
- Merging reusable objects with variable data
- Calibration and screening
- Transferring data to the print engine
- Printing a page
- Monitor and optimize system resources
- Monitor and report print engine status
- Maintain connections with 3rd party press workflows over JDF, IPP, and others
- Report DFE and print engine status using network protocols such as SNMP

A typical parallel-processing scenario is when the Fiery DFE receives simultaneous jobs with separate pages to interpret, render, merge, calibrate, screen, and transfer to the print engine in real-time.

Fiery DFE parallel-processing scenario



Multi-level parallelism enables a Fiery DFE to scale up and drive print engines as fast as 2,400 A4/Letter impressions per minute. As of the writing of this document, Fiery DFEs are being integrated into print engines over 2 meters, printing beyond 200 meters per minute, with 1200 x 1200 dpi resolutions or higher, and with 8 or 12 ink colorants.

Fiery HyperRIP

Fiery HyperRIP is a proprietary rendering technology available in selected DFE configurations. It makes Fiery DFEs even faster by simultaneously processing print jobs (or individual pages of print jobs), while optimizing the use of the Fiery DFE interpreter and rendering engines across multiple processor cores.

Fiery HyperRIP offers two modes of parallel job processing.

Single job mode (best for longer jobs)

The single job mode simultaneously RIPs a job across up to sixteen processors, and is suitable for long print jobs over twenty pages. HyperRIP processes these types of jobs faster to make the Fiery DFE available to process upcoming jobs.

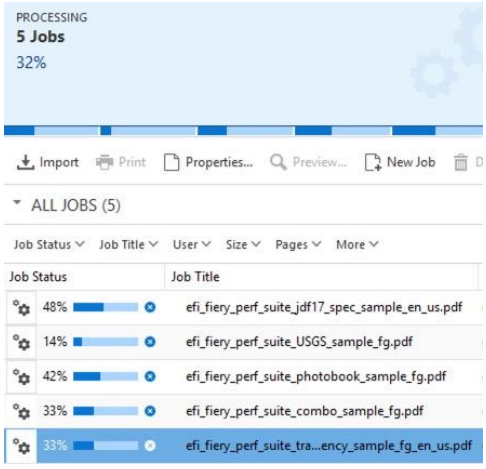
Fiery HyperRIP supports many file formats in single job mode, and determines if a particular file is not eligible for HyperRIP. In those cases, it automatically routes the job through the single RIP path.

Use single job mode when printing a range of records in a VDP job. This provides faster processing to both CPSI and PDF Print Engine processing paths.

Multiple jobs mode (best for short jobs)

The multiple jobs mode simultaneously RIPs several jobs across up to sixteen processors, and is ideal when dealing with numerous short jobs such as book covers, brochures, or flyers — or, when processing a long job and other shorter jobs need to start printing.

Jobs processed in this mode will print in the order they finished RIPping, meaning that smaller or shorter jobs will print before longer or bigger ones.



Fiery SmartRIP

Fiery SmartRIP technology uses a combination of proprietary hardware and software that processes files faster and handles higher resolutions with ease across all Fiery configurations.

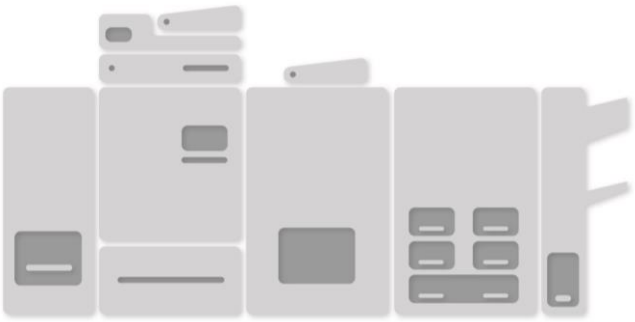
Fiery SmartRIP technology yields dramatically faster page processing by recognizing file characteristics and using adaptive techniques to accelerate color, data compression, and rendering processes.

Users will especially notice the benefits of SmartRIP technology when printing VDP jobs. The enhanced image processing allows users to print composite overprints of CMYK and spot colors — which enables Fiery DFEs to 100% pass the Altona Test and Ghent suites.

This one-of-a-kind combination of technology also gives Fiery DFEs unique competitive advantages in functionality. For example, it enabled Fiery DFEs to become the first DFE in the world to obtain a Perfect score in the VIGC PDF RIP Audit certifying PDF/X-4 compliance, including passing all elements of the challenging Altona Test Suite 2 Technical Page 2.

Customized for specific print engines

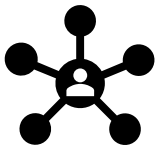
Fiery DFEs are customized and optimized for each printing system. Design starts with the specific requirements of the target engine, such as data rates, video data, out-of-band control signals, imaging, and special features. It is a bottom-up design approach, tailored to the requirements of the printing system.



- ✓ Data rates
- ✓ Video data
- ✓ Out-of-band control signals
- ✓ Imaging
- ✓ Special features

User-centered design

Fiery DFEs on the latest NX Series hardware platforms include hybrid disk storage configurations. High-speed solid-state drives (SSD) handle the operating system I/O processes, and high-capacity hard disk drives (HDD) store customer data.



This hybrid design enables faster boot times (Power ON to Idle), faster software restart times, faster opening and closing of applications, and reduced software installation times.

It also improves application responsiveness and user experience (opening and working within the application).

Fiery operators using Fiery Command WorkStation® on a Fiery NX server with a Fiery NX Station workstation will experience faster application launch times while the Fiery DFE is simultaneously spooling, RIPping, and printing jobs. The quicker launch times deliver a better user experience when working with applications directly on the Fiery DFE. Users running Fiery Command WorkStation on their Windows or macOS computers will also experience faster launch times when opening common applications such as Job Properties, Paper Catalog, Preview, Fiery Impose, and Fiery ImageViewer — among others.

The power for production printing

No one attribute or technology will provide the processing power users need for today's production printing. Fiery DFEs exceed the performance of competitive products by combining a number of proprietary technologies, integrating industry-standard formats, and optimizing the hardware and software for maximum performance on the print engine they're customized for.

For more information on some of these technologies, visit the following pages:

- Fiery digital front ends sold by Fiery partners
- Fiery HyperRIP video
- Fiery NX servers