Print Standards
Putting the Jigsaw Together

(or: Why eCommerce Needs Densitometry Standards)

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Abstract: Over the last few years a number of standards for the graphic arts have been developed both by accredited standards bodies like ANSI/CGATS[i] and ISO, and by industry associations and consortia like GCA[ii], CIP3 (now CIP4[iii]), PrintTalk[iv] and the ICC[v]. Many of these may now be used as building blocks for a complete digital printing highway. They enable more efficient production of more consistent press work, and of proofs that provide a good prediction of the final print, even on sites remote from the press. Used with care the framework that they provide can already be used effectively in origination, pre-press and the press room; it's even nearly ready to support eCommerce for print.

Requirements for Efficient Production

Let's assume for a moment that you want to put an eCommerce system in place in a prepress and print shop, and look at the different areas in which standardization of systems could help you minimize operator intervention while maximizing throughput and predictability of the final output. In other words, let's see how standards could save you money.

For an eCommerce system to be effective three of the production site requirements are:

- an efficient, automated workflow

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- a clear idea of what the client wants the printer to produce

- a high probability that a received file can be printed as expected.

Don't get too hung up on the reference to eCommerce, by the way - those three requirements are also exactly the same as those for a profitable prepress and print shop using a conventional sales channel. The eCommerce front end simply makes them more obvious.

Addressing Those Requirements

Most automated workflows, especially those that extend beyond just the prepress department, are based on a central management information system (MIS) controlling and tracking a variety of processes in the workflow. In some cases that control and tracking is by direct software-to-software connection, in others it's by dropping files into hot folders, and in others it's by supplying information to an operator so that the process can be manually controlled. Obviously, at least in most cases, the more direct and automatic a connection is in place between the MIS and the process itself, the faster and more reliably things will run, with less potential for error and improved ability to respond rapidly when an error does occur.

What does this mean in practice? Essentially that a good MIS vendor must write code to control a wide variety of software from a wide variety of other vendors. If you want to add in components from a new supplier of folding machinery, for instance, it's likely that the MIS vendor won't be able to link to it in anything more than an indirect way without writing new code. The cost of writing that new code in comparison to the benefit for the MIS vendor may well mean that equipment from that new folder manufacturer is never tightly integrated with the MIS.

What would happen if there were a standard way for MIS vendors to control and track prepress, press and postpress equipment? That would mean that a new finishing machinery vendor would need to make their equipment compatible with the standard, and then every MIS (naturally also written to be compatible with that standard) would be able to drive it efficiently and immediately.

This is exactly one of the roles that the Job Definition Format (JDF) is intended to fulfil. JDF is a job ticketing specification being developed and maintained by CIP4. Version 1.0 of JDF was published in April 2001, and several major vendors are already well down the path of writing MIS and production equipment that make use of it.

A second goal of JDF is to provide the second of the three needs of an eCommerce system as listed above - a clear idea of what the client has in mind. Most JDF files will start as "product intents" - a description of the job at the level of "an eight page, self-cover, saddle-stitched booklet on un-coated, off-white stock", or "a case-bound book with roughly 250 pages, the book block being black and white, with a four color cover". These product intents can include as much or as little detail as the client and the print house require to agree on a quote.

Once the job becomes active the JDF containing the product intent can be built on, providing more and more detail about production control as it passes through successive parts of the print shop, whether that is done by the CSR or job planner or automatically by a sophisticated MIS.

The third need of the prepress department is a file format to convey content data that can be reliably rendered to plate or paper. Most importantly, it should be imaged the same on every output device, within the constraints of different resolutions and imaging technologies. Ideally it should be possible to edit the content for last minute author's corrections, but it should be difficult to accidentally alter the file.

All content file formats may be considered to form different compromises between flexibility and robustness or reliability. Designers cooperating on the construction of pages are best served by a very flexible format, such as a native application document. Such flexibility comes at the cost of a significant lack of robustness, however; moving the file from one machine to another, with a different version of operating system, printer driver, fonts, or PPD can cause the text to reflow, potentially seriously damaging the design and certainly raising questions about responsibility and accountability.

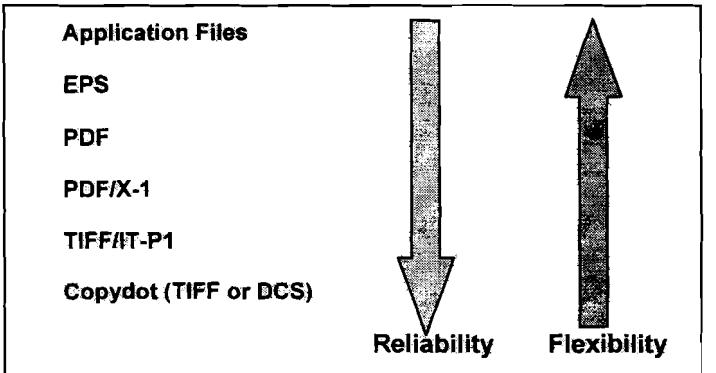

Figure 1 - Selection of a suitable file format

At the other end of the scale a screened bitmap file, whether constructed electronically, or as the result of copydot scanning film, is extremely robust. Text will never reflow in this form because there is no text, only patterns of dots. It is, however, difficult to image such a file on an output device at anything other than exactly the resolution for which it was created, and also difficult to adjust it for a different dot gain from that expected when it was created.

In between the two ends of the spectrum are a number of other points, each with more or less flexibility and more or less robustness, and each of them appropriate for specific uses in a graphic arts workflow.

When it comes to transmission of content data from the client to the prepress department, from design and construction to reproduction, a certain level of robustness must be regarded as essential. For the past few years TIFF/IT has offered that robustness for the high end of digital ad delivery and, in some markets, transmission of whole pages or imposed flats. But TIFF/IT has a tendency to produce extremely large files, and does not provide the possibility of late edits without very expensive processing systems. Indeed, TIFF/IT is widely regarded as being a very expensive format to deal with, period.

PDF is a far more widely supported format that can be created and processed with a wider range of much cheaper tools, but it too has drawbacks. While it's perfectly good for delivery of content to a prepress department if you know what you're doing and there is a strict system of pre-transmission checking, it is rather too easy to send a badly constructed or incomplete file, for example one missing a required font, leading to it being replaced with Courier if it's not caught by the prepress department's own checking.

Between the two lies PDF/X-1, a standard format developed first by the Committee for Graphic Arts Technical Standards (CGATS) under the aegis of the American National Standards Institute (ANSI), and now by the International Standards Organization (ISO). It is a focussed subset of PDF, aimed solely at the graphic arts market, rather than taking other requirements into account, such as those of corporate intranets and web publishing, as 'basic' PDF does.

PDF/X-1 is aimed primarily at digital ad delivery using CMYK data (and spots). Other PDF/X standards are being developed to address other sectors within the graphic arts market[v].

A Deeper View

So are all three of the requirements of the printer covered by JDF and PDF/X?

At the superficial level, that would appear to be true, but let's now look at what each of those specifications needs in turn.

Both JDF and PDF/X need to define color in a variety of ways. PDF/X, for instance, carries a description of *which* CMYK was assumed when the color data a file contains was prepared - preparing a job for a sheet fed press on high gloss coated paper and then running it on newsprint on a high-speed web press is not going to give you the results that you expect. In practice the information is there for two purposes - to allow the file recipient to pre-flight the file and check that it was prepared for the press and media that it will be printed on, and to allow color management for proofing. It would be possible to color manage the file to switch from one press/media combination to another, but at this point that will probably produce undesirable results in some colors, even if the two combinations have comparable color gamuts.

In PDF/X the information refers to a characterized printing condition, and is encoded as an ICC profile, a format defined by the International Color Consortium.

Perhaps the only fully defined characterized printing condition at this point is CGATS TR001 - a description of what color you get on paper for each combination of CYMK if you print following the SWOP guidelines for publication printing in the US, defined by Standards for Web Offset Publications[vii]. An equivalent characterization of print following the SNAP[viii] specification for newsprint is being developed by a consortium of industry associations and companies, including NAA, GCA and WOA in cooperation with CGATS.

Some of the work being pursued in ISO seems likely to produce characterizations for other market sectors, including more general commercial print.

A characterization of a printing condition (a combination of media, inks, TVI (dot gain) etc.) is only useful if everyone gets the same numbers when reading color patches, though. So characterizations and color profiles are supported by a whole slew of other standards, mainly developed within ISO or the CIE[ix].

Many of these standards relate to the measurement instruments to be used. To give you an idea of the scale of even this small part of the whole, here's an incomplete list of the issues that such standards are designed to address:

- the physical geometry of colorimeters, spectrophotometers and densitometers,

- light sources used inside those instruments,
- frequency range steps used in spectral analysis,
- calibration of halftone measurements from transmission densitometers,
- backing color to be used behind the sample being measured in a reflective measurement,
- whether or not polarizing filters should be used.

Others describe techniques and concepts that allow repeatable human visual assessment of printed material, such as light booth illumination. When I say repeatable, I mean repeatable to the extent that human vision is repeatable and comparable between individuals. To address this area there are, of course, standards for measuring human vision - to compare how different viewers would see the same colors. To ensure consistency in developing these standards there's even a standard lighting vocabulary developed by the CIE.

Once the mechanisms are in place to measure color consistently, the characterization of a printing process also requires a definition of the process itself. One part of this is a specification of the inks being used. ISO have published standards in the area of ink color, and the SWOP specification also includes ink details. Color is not, however, the only determinant of ink behavior and there are an enormous number of other standards related to ink rheology - its physical characteristics - and how those should be measured.

Other aspects of the characterization of a print process relate to UCR and GCR, to halftone frequencies, to the hardness of the dot and minimum and maximum densities of film, etc.

By now you must be getting the picture of an enormous and intricate web of standards developed by a large number of different organizations[x]. Each of these standards is intimately reliant on other standards, often developed by completely different organizations. I have not even mentioned the compression and encoding standards such as JPEG, CCITT G4 or ASCII85 used in PDF (and therefore in PDF/X), that JDF is an XML[xi] vocabulary using XML schema and therefore builds on a number of standards developed by the W3C[xii], that PDF/X can be put together with the Personalized Print Mark-up Language (PPML), another XML standard developed by the Print on Demand Initiative (PODi) to create a file format for reliable blind exchange of variable data printing, that the eCommerce system that may added to the front of this work flow might use a further XML vocabulary developed by PrintTalk, or a specification from the

Graphic Communications Association (GCA), which might, in turn, leverage standards for commercial data exchange such as cXML[xiii] or ebXML[xiv] ...

I started writing this paper with the intention of including a diagram showing at least a partial map of the network of standards used every day in the print industry. As I worked through the chains of connections I realized that I could not produce anything even remotely readable if I tried, so instead, I've included a partial list of ISO standards related to the print industry in appendix A.

I'm going to leave you with three thoughts:

- Standards make possible some of the most basic functions of a print workflow - you are using them every day, whether you know it or not.

- While the interaction of the organizations involved in development of standards is not always completely free of political tensions, there has been a very encouraging trend over the last couple of years towards an acceptance that unconnected islands of automation cannot provide the efficiency gains that the print industry needs to extend it's survival into the future. There is therefore an increasing willingness for such groups to cooperate more fully.

- I encourage vendors implementing products for the print industry to evaluate the available standards, and to support them wherever it is appropriate. When implementing one standard, do not ignore those that form the framework around it.

Appendix A - A partial list of ISO standards for the printing industry

Standard Images
14672
12640
12641
13655
13656

Terminology
12637-1
12637-2
5776

Color Monitors
12646

Certified reference materials
15790
12645

Computer data exchange formats
12639 (TIFF/IT)
12642
14671
12087-5
10755
10757
14670
14684
15076
15929
15930-1, 3 (PDF/X)

Film & paper densitometry
14981 (reflection)
12645 (transmission)

Plates
12218-1

Platesetters
12218-2

Inks
2846-1, 2, 3, 4 (4 color sets)
12644 (rheology)
12634 (tack)

Press process control
12647-1, 2, 3, 4, 5

Press safety and ergonomics
12648
12649
15847

Blankets
12636

Substrates
6716

Print
2834 (test print preparation)
14981 (densitometers/spectrophotometers)
15994 (gloss)
12040 (lightfastness)
2837 (reagent resistance)
11628 (reagent resistance)
12632-2 (reagent resistance)
2836 (reagent resistance)
3664 (viewing conditions)

Derived from J.W. Davison, 1998 - International Standards for the Printing Industry, Colour & Image Creation - Inks, Paints and Packaging Symposium, University of Leeds.

[i] Committee for Graphic Arts Technical Standards (CGATS), more information available from NPES, The Association for Suppliers of Printing, Publishing and Converting Technologies, www.npes.org

[ii] Graphic Communications Association (GCA), www.gca.org

[iii] International Cooperation for Integration of Processes in Prepress, Press and PostPress, www.cip4.org

[iv] PrintTalk, www.printtalk.org

[v] International Color Consortium (ICC), www.color.org

[vi] PDF/X-3 is designed for digital ad transmission in a market where delivering ads in a device independent color space is appropriate. It also has great potential in the digital press world. PDF/X-2 is designed for the very different needs of the more general commercial print sector.

[vii] Specifications for Web Offset Publications (SWOP), www.swop.org

[viii] Available from the Newspaper Association of America (NAA, www.naa.org), Graphic Communications Association (GCA, www.gca.org) or Web Offset Association (WOA, www.printing.org).

[ix] Commission Internationale de L'eclairage (CIE, International Commission On Illumination), www.cie.co.at/cie/

[x] There are those who maintain that the word "standard" should be reserved exclusively for the output of accredited standards organizations such as ANSI/CGATS or ISO. I make no apology for using it in this document for any specification developed by a group of many people where a broad enough and inclusive enough view is taken of the requirements of the industry sector to be addressed, and where the results allow useful solutions to be constructed by multiple organizations. The developing group may be an accredited standards body, a consortium of vendors like ICC or PODi an industry association like CIP4 or GCA.

[xi] eXtensible Markup Language (XML), www.xml.org

[xii] World Wide Web Consortium (W3C), www.w3c.org

[xiii] Commerce XML (cXML), www.cxml.org

[xiv] Electronic Business XML (ebXML), www.ebxml.org