



ICC DevCon 2008

Colour management issues in Graphic Arts Workflow using PDF/X

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Overview

“I believe this education effort [how to create and use portable PDF/X documents] needs to be a coordinated and concerted effort across the entire industry and globe.”

*Extract from an email from David L Zwang
Chairman of Ghent PDF Workgroup*

In this presentation I will explore some of the aspects of portable PDF document creation, proofing, printing and retargeting. I will look at some of the current limitations and propose ways to move forward.

Colour management of complex documents

- **One goal when preparing documents is to create a document that can be reproduced with a **similar look** on all devices**
 - an advertising campaign where material will be printed on different printing presses
 - documents must be prepared before the method of printing has been determined
- **An alternative (and somewhat conflicting goal) is to define a document that can be **printed accurately** on a single device**
 - an advert is being prepared for submission to a magazine
 - a company brochure is being prepared
 - a home-shopping catalogue is being printed
- **PDF/X-4 provides a framework where both goals can be realised if care is taken when constructing and rendering the document**

Colour management of complex documents

- **There are many ways in which colour can be described in PDF documents:**
 - Relative to imaging devices
 - Device colour spaces (CMYK, RGB, Gray, N)
 - Separation colour space
 - Relative to the CIE standard observer
 - CalGray, CalRGB, Lab, **ICCBased**
 - Indirect colour spaces
 - Indexed, Pattern
- **Coloured elements can interact with other coloured elements using two mechanisms:**
 - Overprinting (slightly different for process and spot colours)
 - Transparency
- **Rendering intent modifies the behaviour of ICCBased elements**

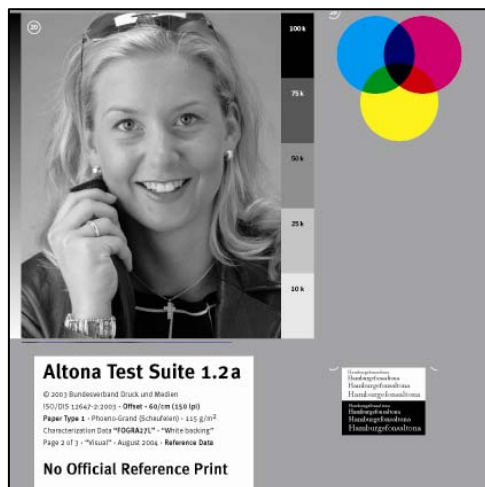
Document elements

- **PDF supports a rich set of document element types, most of which are in common use**
 - CMYK, Grey and black elements
 - RGB images
 - Spot colours
 - Duotones, tritones...
 - Transparency
 - Varnish and special inks
- **With care documents can be constructed that can be printed reliably using PDF/X**
- **In some cases proofing (monitor and hard copy) and retargeting requires additional data about the content or intended printing condition**

- ✓ Print
- ? Proof
- ? Retarget

CMYK, grey and black elements

- ✓ Print
- ✓ Proof
- ? Retarget

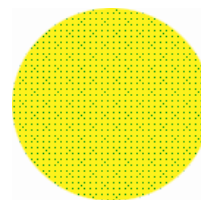


Objective

Define elements in printing space for print production reasons



Avoid fuzzy edges by
using black only



Avoid 'scum dots' by
using device yellow only



Overprinting effects
(trapping, small text...)

Print and Proof

- Total area coverage limit must be communicated separately or guessed from ICC Profile

Retarget

- No way to indicate whether pure colour or accurate colour is the objective
- Not always obvious when black-only elements should be preserved
- Object-based retargeting of elements using overprinting may be compromised

Retargeting CMYK, grey and black elements

- **When retargeting we need to know whether**
 - Black-only elements should be kept black-only
 - It isn't always clear what should be kept black-only, for example text elements that appear in images
 - Grey elements should be printed as black-only or converted to closest colour match
 - Pure coloured elements should be kept as pure-colour
 - In general can't preserve both pure colour ***and*** colour accuracy

'RGB' Images and other content

- ✓ Print
- ✓ Proof
- ? Retarget



Objective

Keep image as 'RGB' to avoid loss of colour gamut when retargeting



Print and Proof

- No way to indicate whether BlackPoint compensation should be applied

Retarget

- Retargeting may be compromised when ICC v4 profiles are not used

Preparing images for print

- **Traditionally images are converted for press before they are included in documents**
 - using Photoshop
 - RGB source ICC Profile
 - press ICC Profile
- **PDF/X incorporates the concept of ‘virtual CMYK’ in that image data and the transforms needed to convert them are included in the document**
 - RGB source ICC Profile
 - press ICC Profile (PDF Output Intent)
 - rendering intent
- **PDF/X limitation**
 - BlackPoint Compensation cannot be communicated

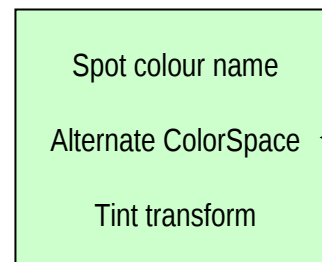
Spot colours

- ✓ Print
- ? Proof
- ? Retarget



Objective

Use special ink for corporate brand or for special design effect



Usually provides
'process equivalent'
CMYK values

Print

- Designer must use 'well known' names for spot colours
- No easy way to communicate actual printing of tints of spot colours

Proof and Retarget

- Cannot communicate both $L^*a^*b^*$ and process-equivalent colour values
- Retargeting system may need to perform spot-to-process conversion

Duotones, tritones...

- ✓ Print
- ? Proof
- ? Retarget



Objective

Small number of inks (often spot inks) used to print a grey image to achieve a special effect such as sepia-tone



Similar problem
predicting colour when
spot colour overprints
other document
elements

Proof and Retarget

- No standard way to communicate the colour of ink combinations – it is usually impractical to create ICC Profiles for each combination

Transparency

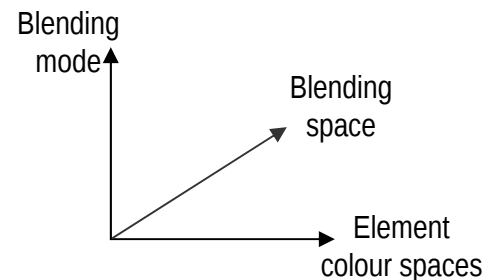
- ✓ Print
- ✓ Proof
- ? Retarget



Objective

Allow elements on the page to be blended together to achieve special design effect

Determining the colour of elements that use transparency is a multi-dimensional problem



Print and Proof

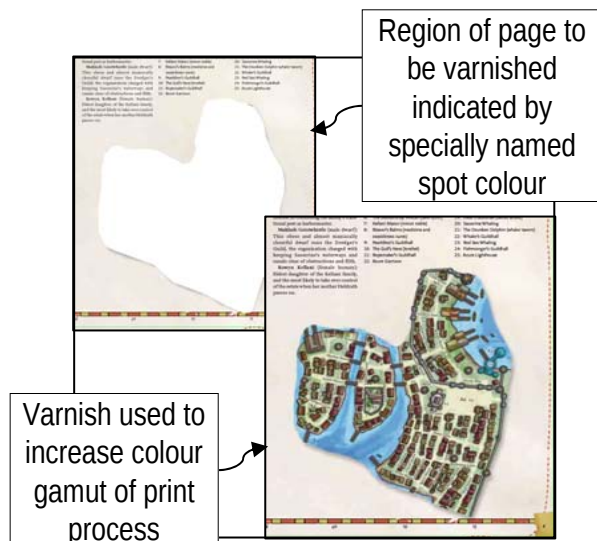
- Some RIPs (not PDF/X-4 compliant) do not handle transparency correctly

Retarget

- In some cases the result of transparency blending may be slightly different due to change in blending space

Varnish and special inks

- ✓ Print
- ? Proof
- ? Retarget



Objective

Varnish increases apparent colour gamut so that varnished area has high visual impact



Metallic ink



Fluorescent ink



Pearlescent ink

Colour matching of special inks on hard copy proof not usually practical

Proof

- Apparent colour of areas with and without varnish hard to predict on proof
- Some monitor proofing application can simulate effect of special inks but no standard means exists to communicate the additional metadata

Retarget

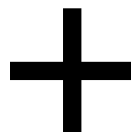
- Redesign is usually necessary

Putting the elements together



Output Intent identifies intended printing condition
and an ICC Profile that describes it

PDF/X
document



Spot inks and
characteristics

Intended print
medium

Metadata about PDF
content

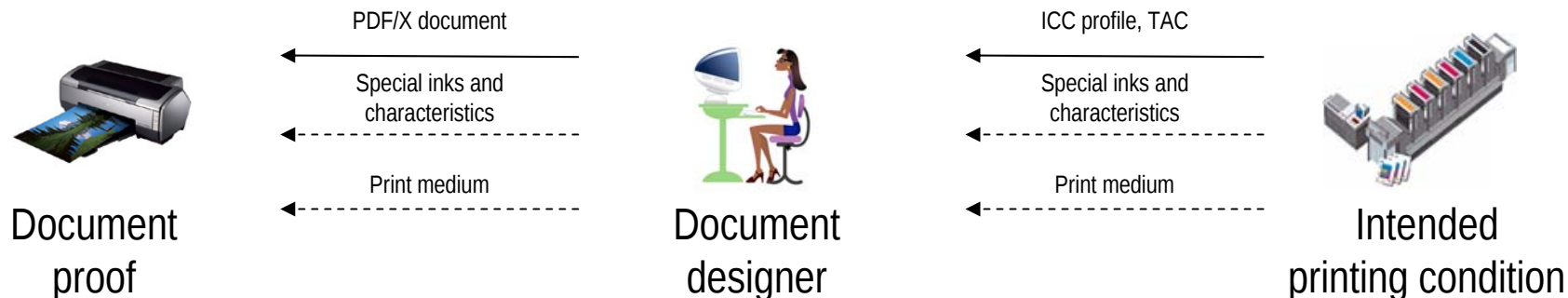
BlackPoint compensation use
Grey and black elements
Pure colours

Additional metadata that *may be*
required when proofing and
retargeting



Colour Library +
Ink Name

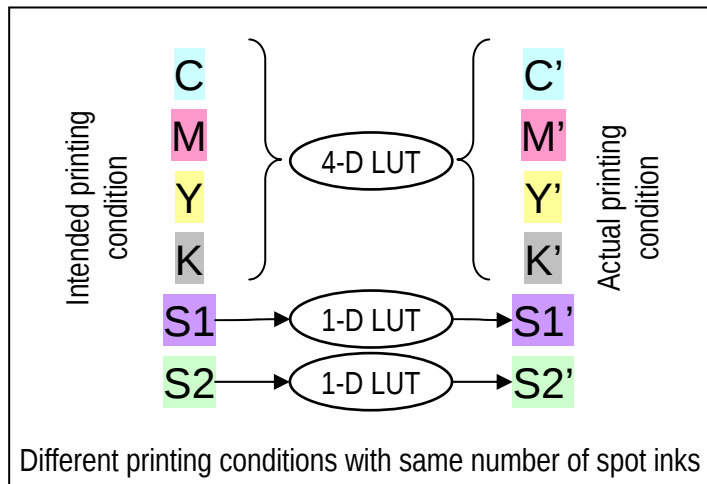
PDF/X necessary proofing communication



Proofing limitations

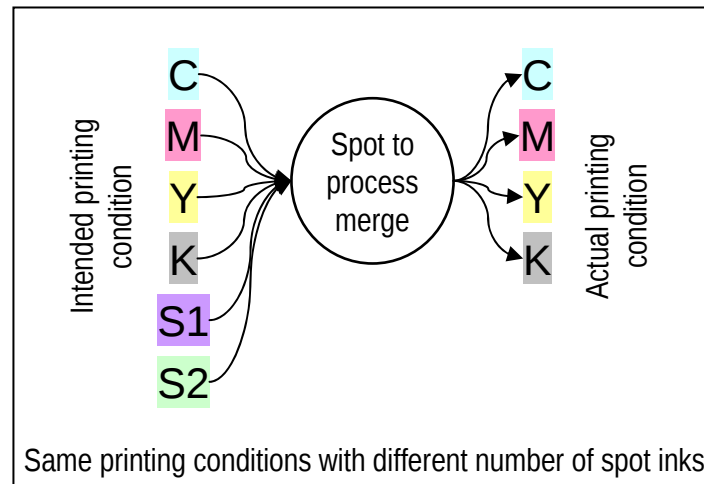
- No standard way to communicate spot colour ink print characteristics
- Varnish and special inks cannot be shown on hard copy proof
- Simulation of print medium may be inaccurate when level of fluorescence differs from that of proof medium

Retargeting – spot colour handling



Notes

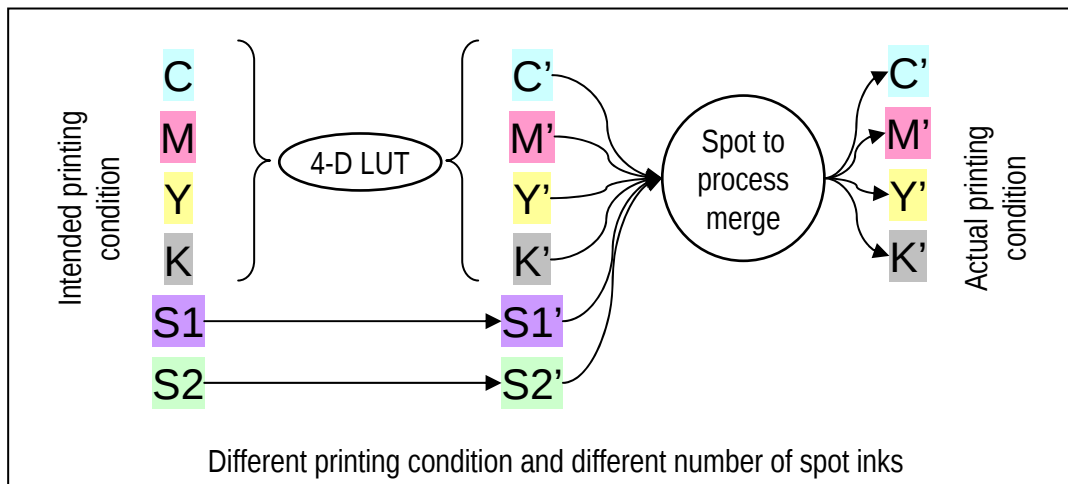
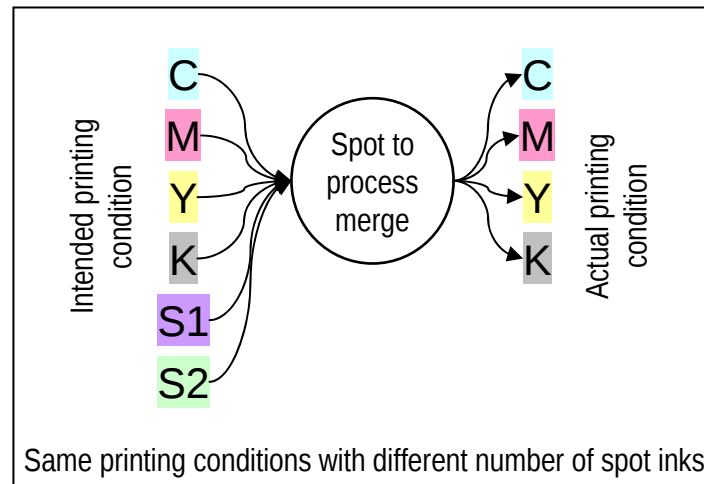
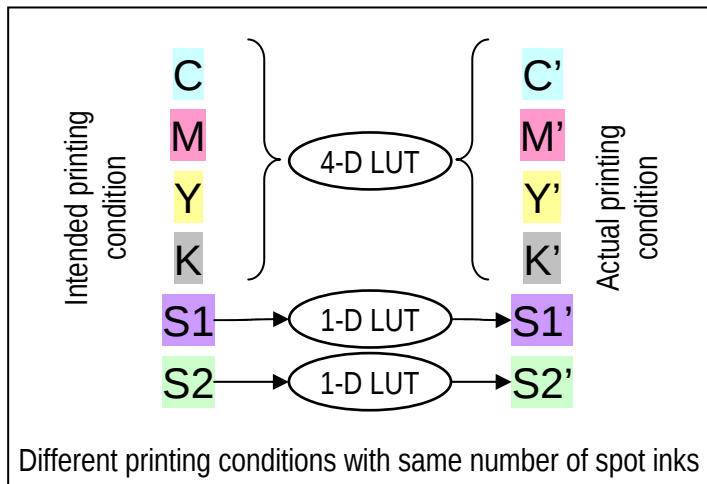
- In some cases 'RGB' content may be converted for actual printing condition
- Difference between spot colour response on intended and actual printing system must be known



Notes

- System performing retargeting must know how to convert spot colours to their process equivalent for the actual printing condition

Retargeting – spot colour handling



A general purpose
retargeting system
needs to be able to
handle both
spot-to-spot and
spot-to-process

Retargeting strategies

- **On-press**
 - Colour convert for intended printing process and use resulting CMYK + Spots data to print on actual printing process
- **PDF/X to PDF/X**
 - Colour convert PDF objects to create a new PDF document
- **Raster image**
 - Colour convert and rasterise for intended printing process then perform raster to raster conversion using ICC DeviceLink profile
- **In-RIP**
 - Use a RIP with built-in retargeting capability

On-press retargeting

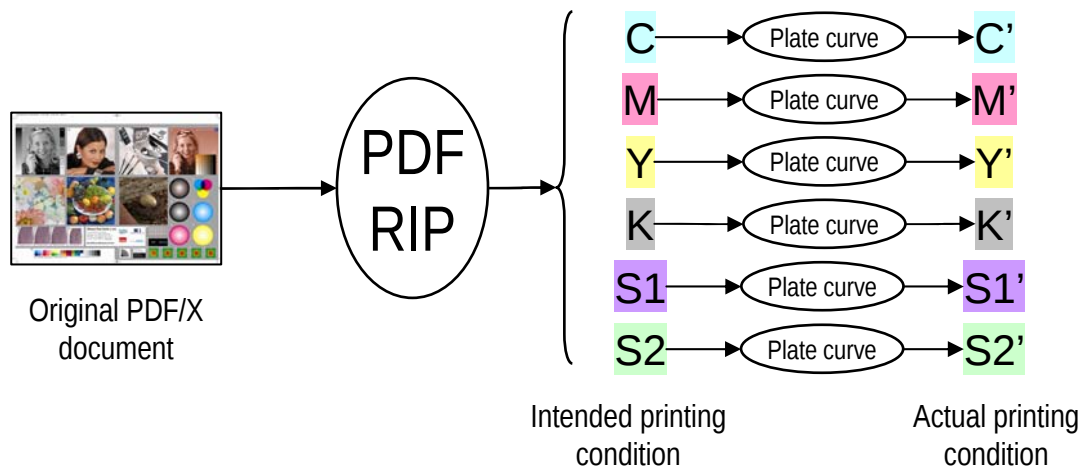
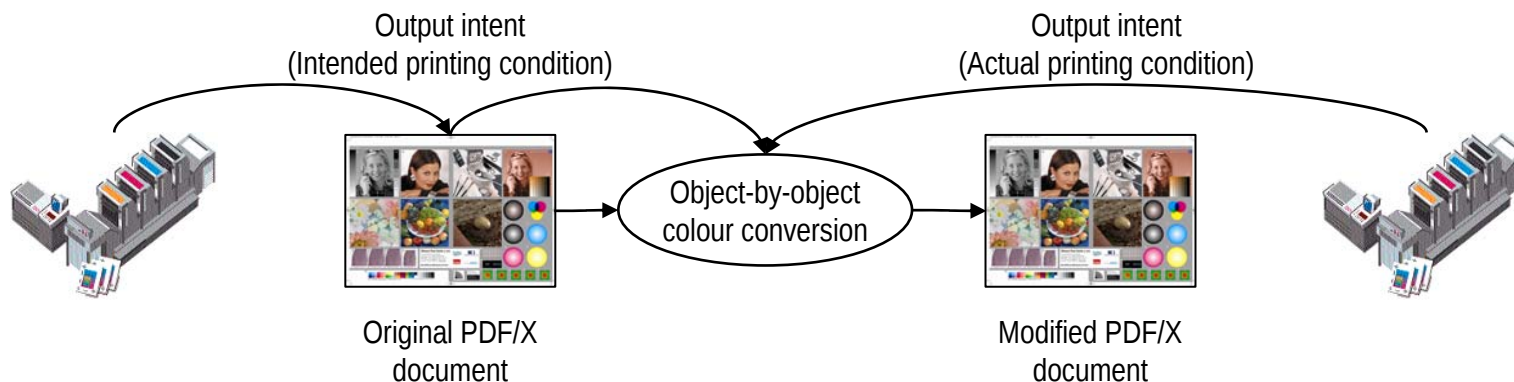


Plate curves are constructed to provide a best match between intended printing condition and actual printing condition for each ink

Support for plate curves is available in most modern RIPs

- **Colour convert for intended printing condition and use resulting CMYK + Spot inks data to print on actual printing process**
 - CMYK for printing presses has evolved to be reasonably scalable
 - Can't deal with changes in ink trap or printing sequence
 - Can't accommodate differences in printing inks

PDF/X to PDF/X retargeting



- **Required when documents with different output intents are merged**
 - For example where an advert is created for use in more than one publication
 - Could be avoided if multiple output intents are supported for PDF/X
- **Limitations**
 - Need to know when to preserve black-only and pure colour elements
 - Colour conversions wrong when elements overprint others and overprint effects may be lost
 - Object-by-object model cannot support transparency

Raster image retargeting

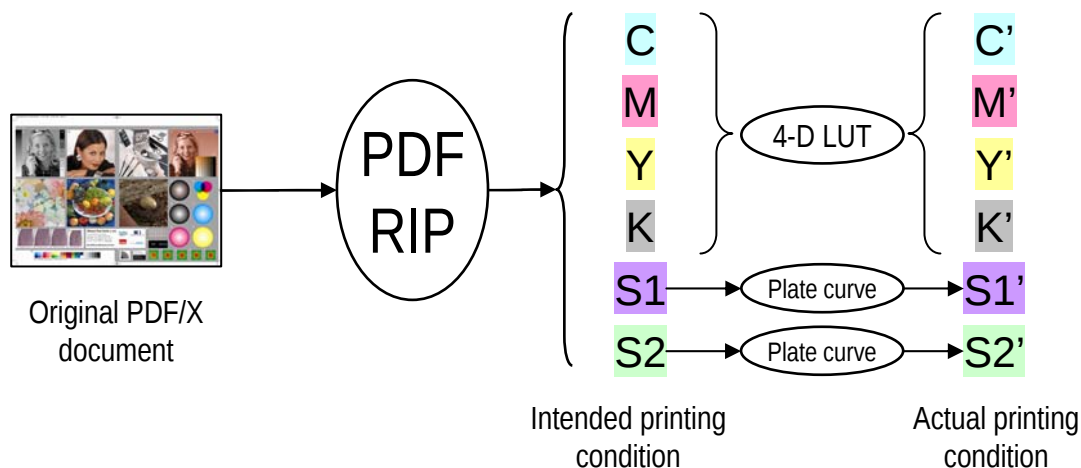
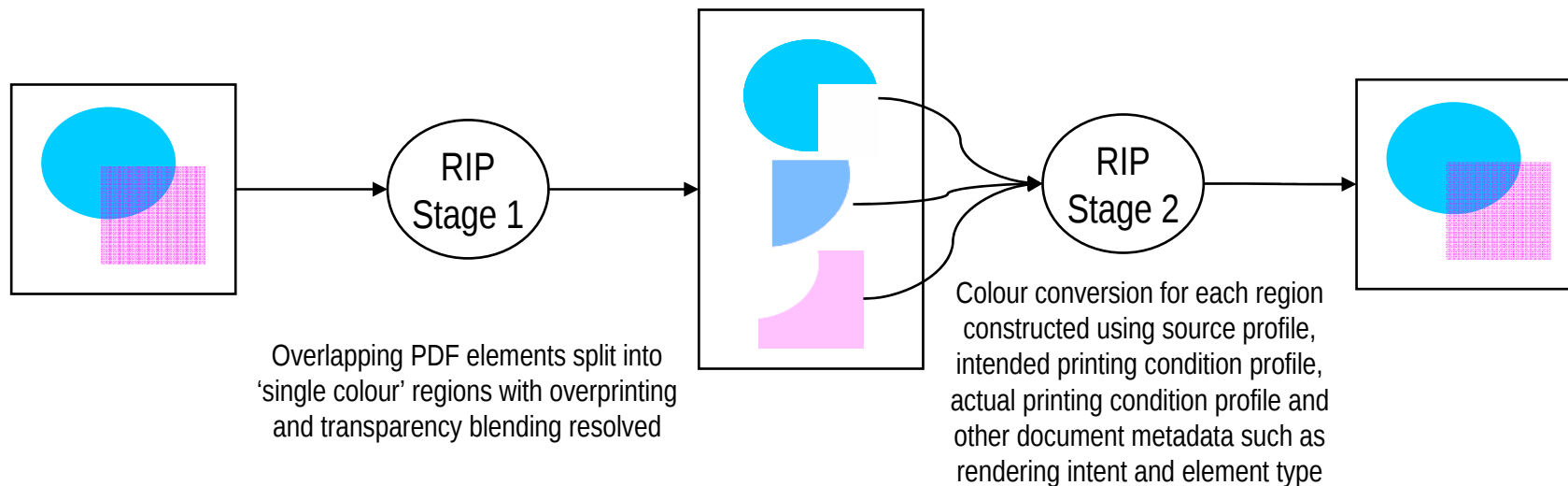


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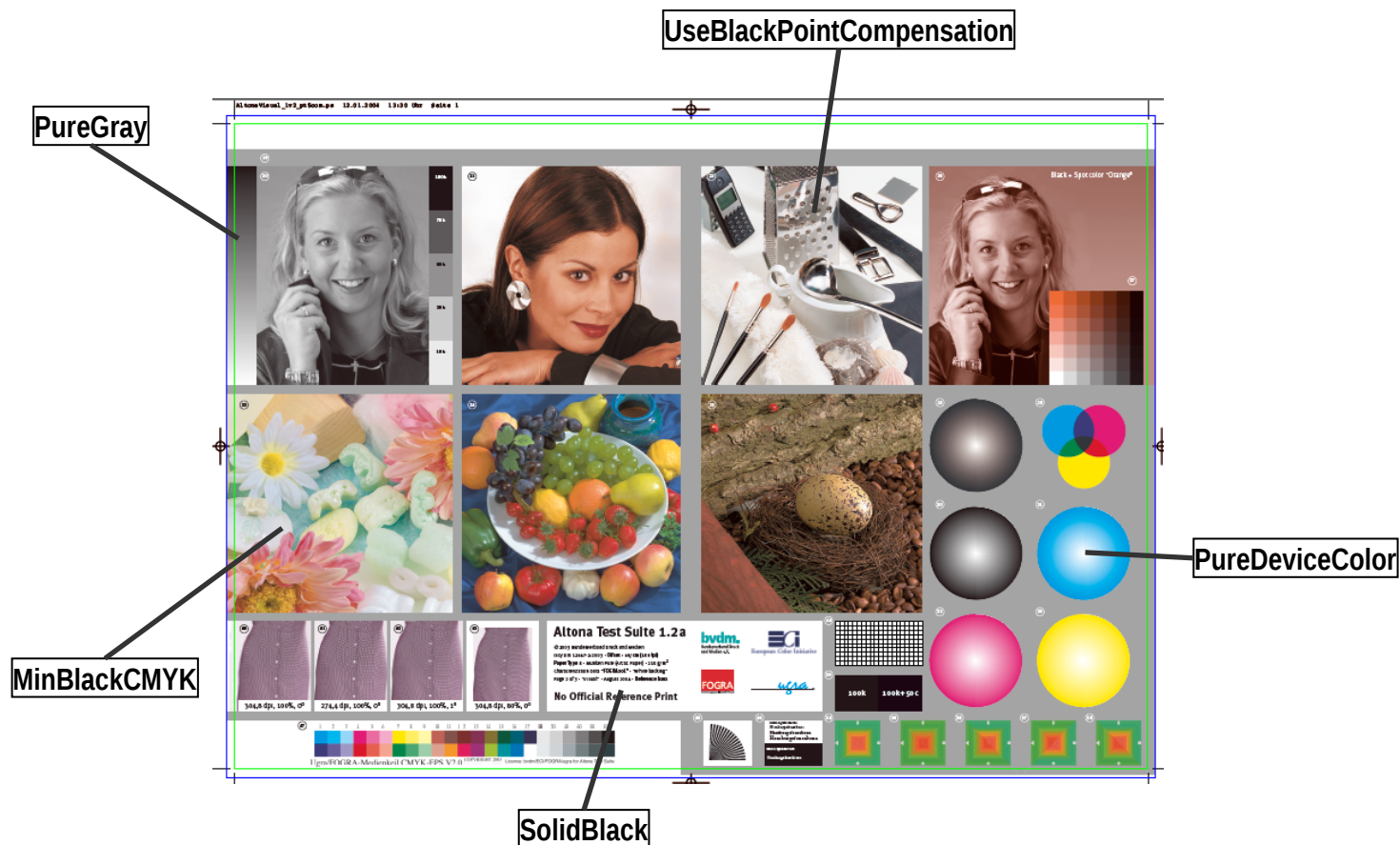
- **Colour convert and rasterise for intended printing process then perform raster to raster conversion using ICC DeviceLink profile**
 - Can be slow and may introduce artefacts
 - Creation of high quality DeviceLink profiles essential
- **Limitations**
 - Can't retarget 'RGB' images optimally

In-RIP retargeting



- **Use a PDF RIP with built-in retargeting capability**
- **Limitations in workflow**
 - No mechanism to merge PDF documents with different output intents
 - No clear way to indicate whether black-only elements or pure colour elements should be preserved
 - No standard way to indicate special inks such as varnish

Possible solution to some problems using ObjectTags to provide rendering hints (JDF)



Alternative solution – ISO 32000

- The PDF specification is now owned by ISO (ISO 32000) and is the responsibility of ISO TC171
- The following revisions have been proposed (Olaf Drummer):
 - Current Rendering intent values
 - RelativeColorimetric (this is the default value in PDF)
 - AbsoluteColorimetric
 - Perceptual
 - Saturation
 - Additional processing instruction (/PI) needed, with the following values:
 - Normal (= “use rendering intent”; this is the default value)
 - AdjustToneValuesOnly
 - DoNotConvert
 - Additional switch for black point compensation (/UseBPC) needed:
 - True | False (default value: False)

Looking back and looking forward

- **Looking back**

- Colour management of images is no longer a problem for most good printers
- Standard printing conditions are becoming widely adopted
- PDF has become the format of choice for most printers
- PDF/X-3 and PDF/X-4 make late binding colour management possible and is expected to be supported by most graphic arts applications soon

- **Looking forward**

- Improve the adoption of PDF/X-4 by developing better proofing and retargeting tools

