

Colour management issues in Graphic Arts Workflow using PDF/X

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Overview

“I believe this [PDF/X colour management] education effort 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

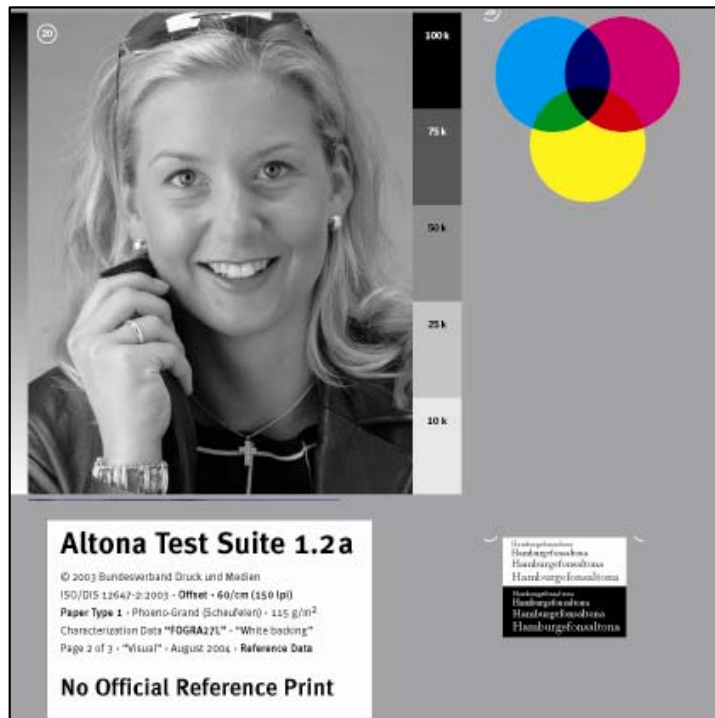
- **There are many ways in which colour can be described in PDF documents:**
 - Relative to imaging devices
 - Device colour spaces (CMYK, RGB, Gray, N)
 - Separation colour space
 - Relative to the CIE standard observer
 - CalGray, CalRGB, Lab, **ICCBased**
 - Indirect colour spaces
 - Indexed, Pattern
- **Coloured elements can interact with other coloured elements using two mechanisms:**
 - Overprinting
 - 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**
- **In some cases proofing and retargeting requires additional data about the content or intended printing condition**
 - ✓ Print
 - ? Proof
 - ? Retarget

CMYK, grey and black elements

- ✓ Print
- ✓ Proof
- ? Retarget

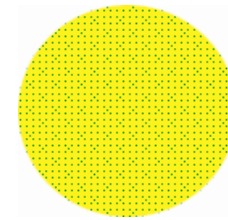


Objective

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
commonly used for
trapping

Current limitations

- No way to indicate whether an element is designed in device space
- Retargeting requires effective CMYK to CMYK conversion (DeviceLink)
- Object-based retargeting of elements using overprinting may be compromised

'RGB' Images

- ✓ Print
- ✓ Proof
- ? Retarget



Objective

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



Current limitations

- No way to indicate whether BlackPoint compensation should be applied
- No practical solution for camera-raw images (ProPhoto can be used with care)
- Retargeting may be compromised when ICC v4 profiles are not used

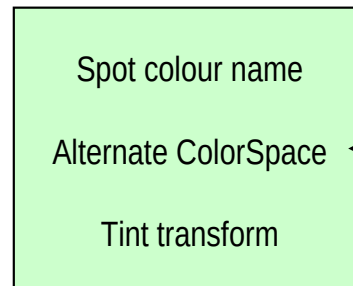
Spot colours

✓ Print
? Proof
? Retarget



Objective

Use special ink for corporate brand or for special design effect



Usually provides
'process equivalent'
CMYK values

Current limitations

- No way to communicate actual printing of tints of spot colours
- Cannot communicate Lab and process-equivalent colour values
- Two kinds of retargeting to consider: 'spot to spot' and 'spot to process'

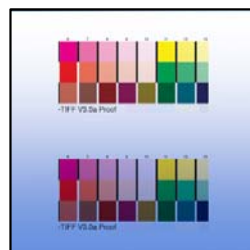
Duotones, tritones...

✓ 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

Current limitations

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

Transparency

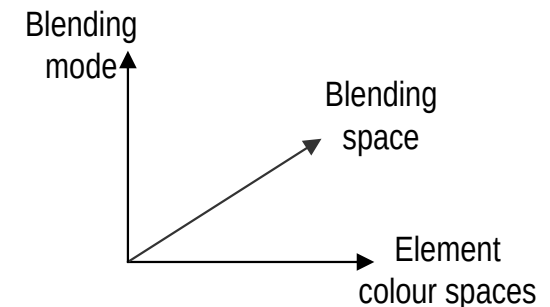
- ✓ Print
- ✓ Proof
- ? Retarget



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

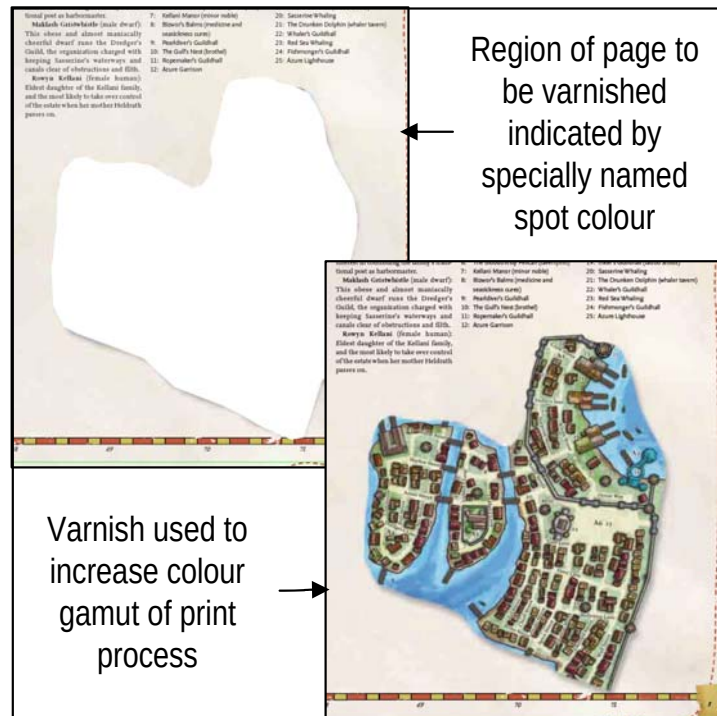


Current limitations

- In some cases, when retargeting, the result of transparency blending may be slightly different due to differences 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

Current limitations

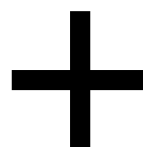
- Apparent colour of areas with and without varnish hard to predict on proof
- Some monitor proofing application can simulate effect of special inks but no standard means exists to communicate the additional metadata

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
Handling grey and black elements
Handling pure colours



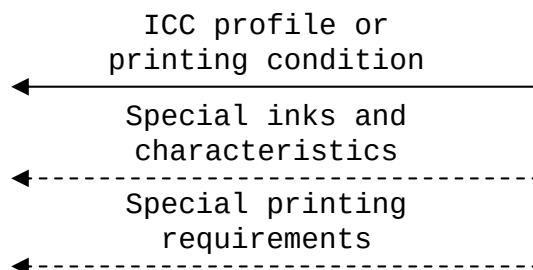
Colour Library +
Ink Name

Additional metadata that
may be required when
proofing and retargeting

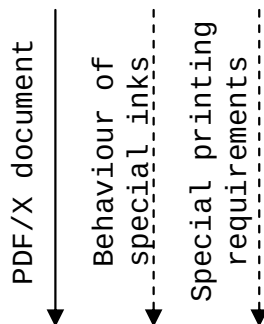
PDF/X necessary proofing communication



Document designer



Printer

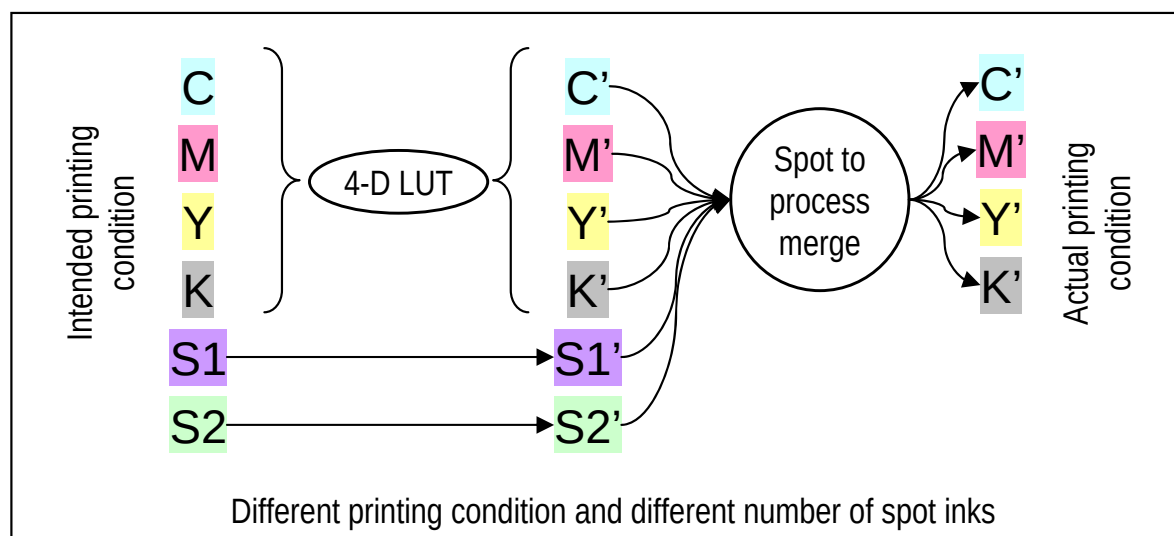
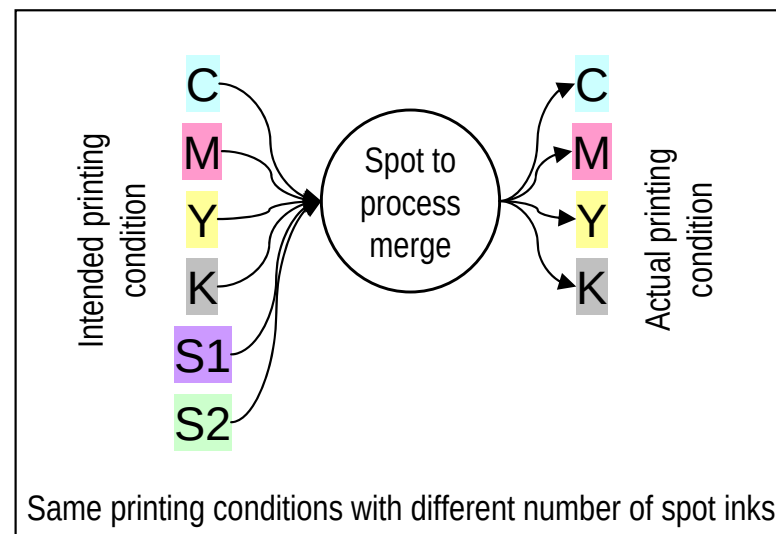
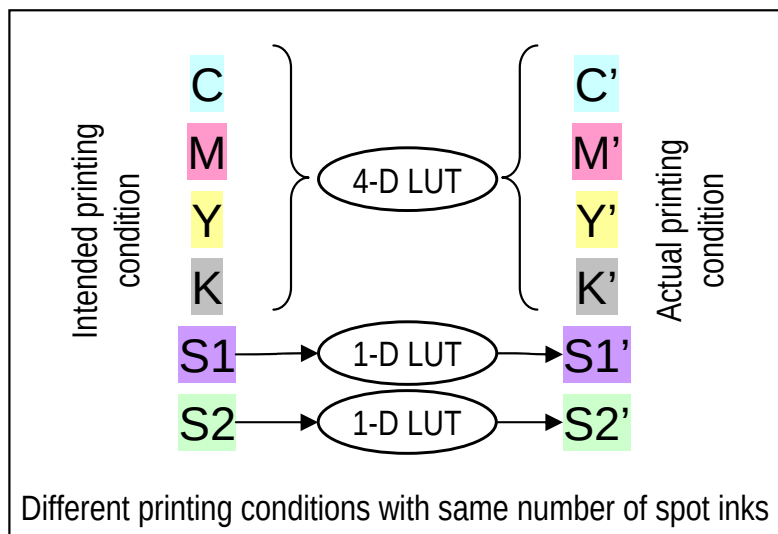


Document proof

Current 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



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

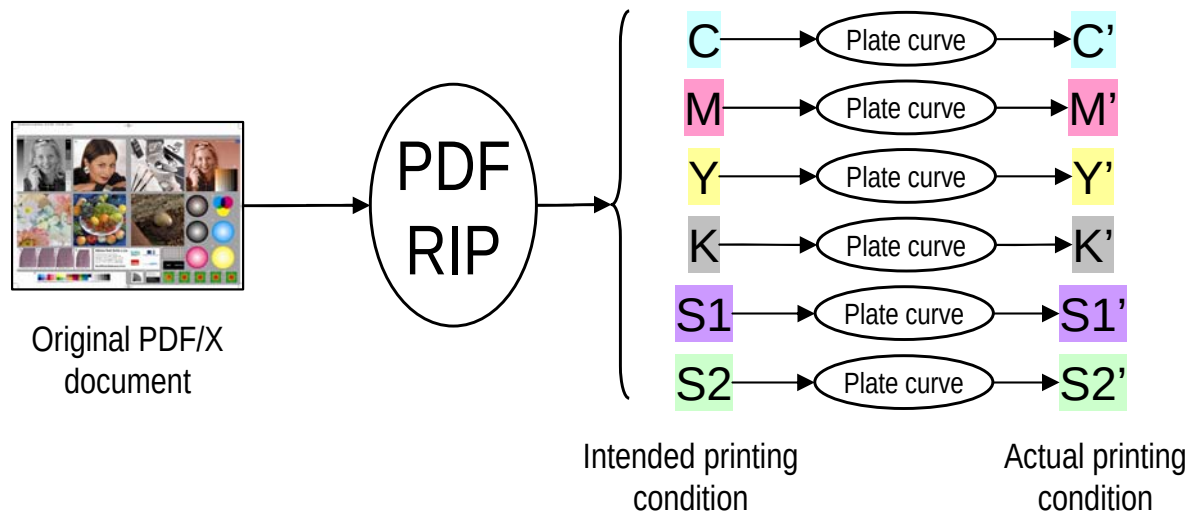
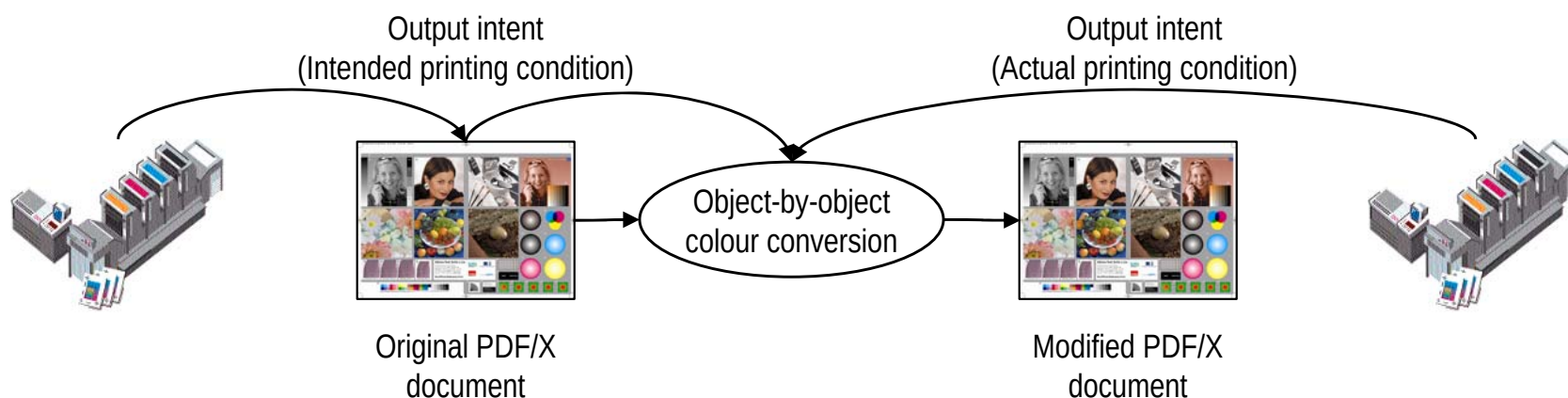


Plate curves are constructed to provide a best match between intended printing condition and actual printing condition for each ink

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

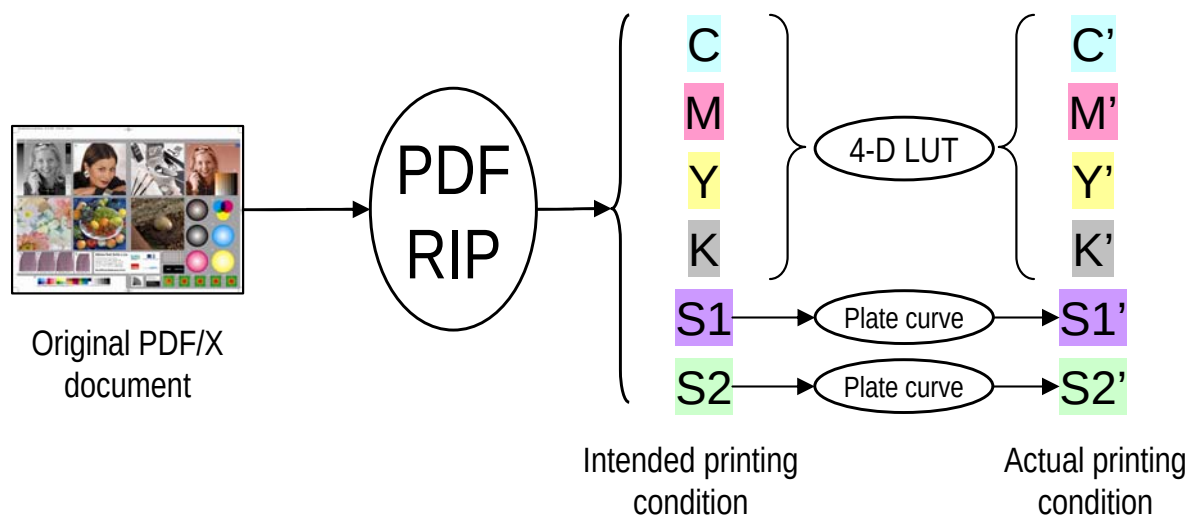
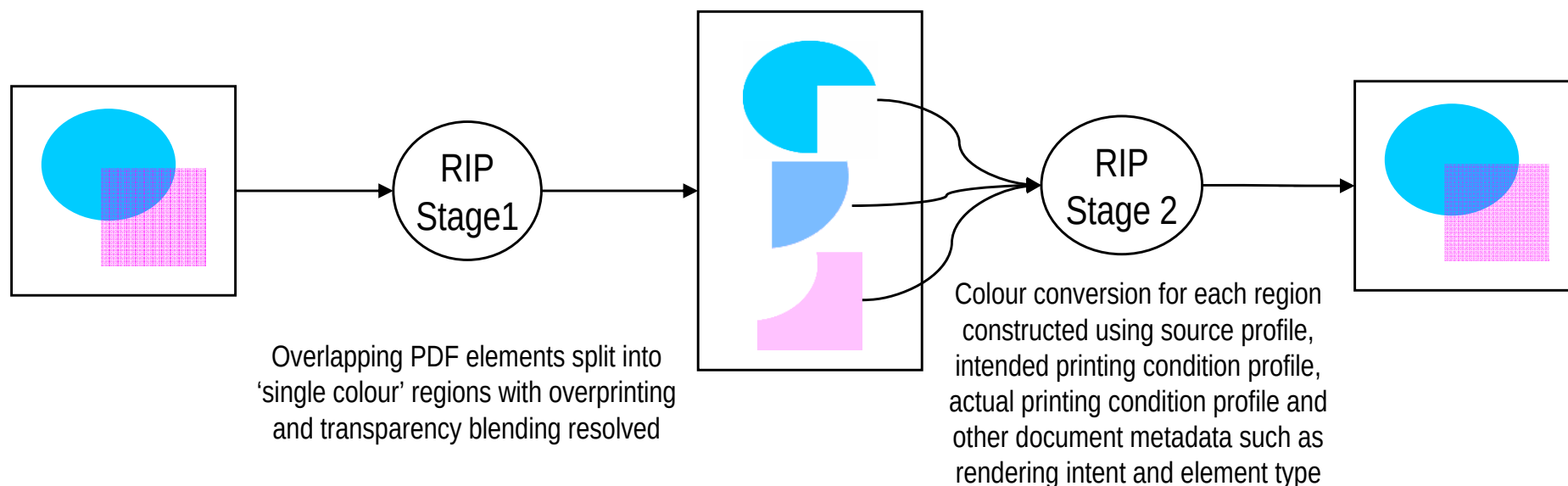


Plate curves are constructed to provide a best match between intended printing condition and actual printing condition for each ink

Support for plate curves is available in most modern RIPs

- **Colour convert 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

In-RIP retargeting



- **Use a PDF RIP with built-in retargeting capability**
 - For example, Adobe's PDF Print Engine

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**

Making colour portable

- **ICC based colour management of document elements**
 - Elements tagged with an ICC profile
 - Rendering intent provides a basic mechanism to control result
- **Named colour libraries**
 - Provide a mechanism for handling elements to be printed with special (non-process) inks
 - Special versions of the library can be constructed for each printing system
- **Document Output Intent**
 - Describes the printing condition intended to be used when printing the document
 - Provides the definition of colours defined in device colour space

Preparing images for print

- **Traditionally images are converted directly to press CMYK before they are included in documents**
- **PDF/X incorporates the concept of ‘virtual CMYK’ in that image data and the transforms needed to convert the image to press CMYK (source profile, output intent profile and rendering intent)**
 - limitation that BPC cannot be communicated
- **ICC v4 perceptual rendering is a 2-stage rendering of the image**
 - this means that repurposing of image content can be achieved

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 supported by most graphic arts applications

- **Looking forward**

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

