Hidden Color Management

Marc Mahy
Koen Vande Velde

Overview

- Motivation
- Integrated digital workflow
- Dynamic CMM
- Quality separation tables
- Requirements for ICC Labs
- Conclusions

Motivation

Hidden color management

- **Reasoning**
  - Customer
    - Workflow: added value for the user
    - Workflow defines optimal default CMS settings

      => Easy color management
  - Application
    - Default excellent quality for given workflow
      - No tools to adjust profiles, deviceLinks, ...
      - No labor intensive resource creation process
    - Dumb profiles, dynamic CMM
    - Dynamic CMM integrated in the application

      => Hidden / automatic CMS

Hidden color management

- **Current requirements in the market**
  - Typical print workflows
    - Proofing (minimum deltaE)
    - Repurposing (preserving GCR)
    - Spot color rendering
    - Digital printing
  - Document formats
    - Mainly PDF
    - Dedicated processing
      - zero preserving links
      - pure colors
      - text

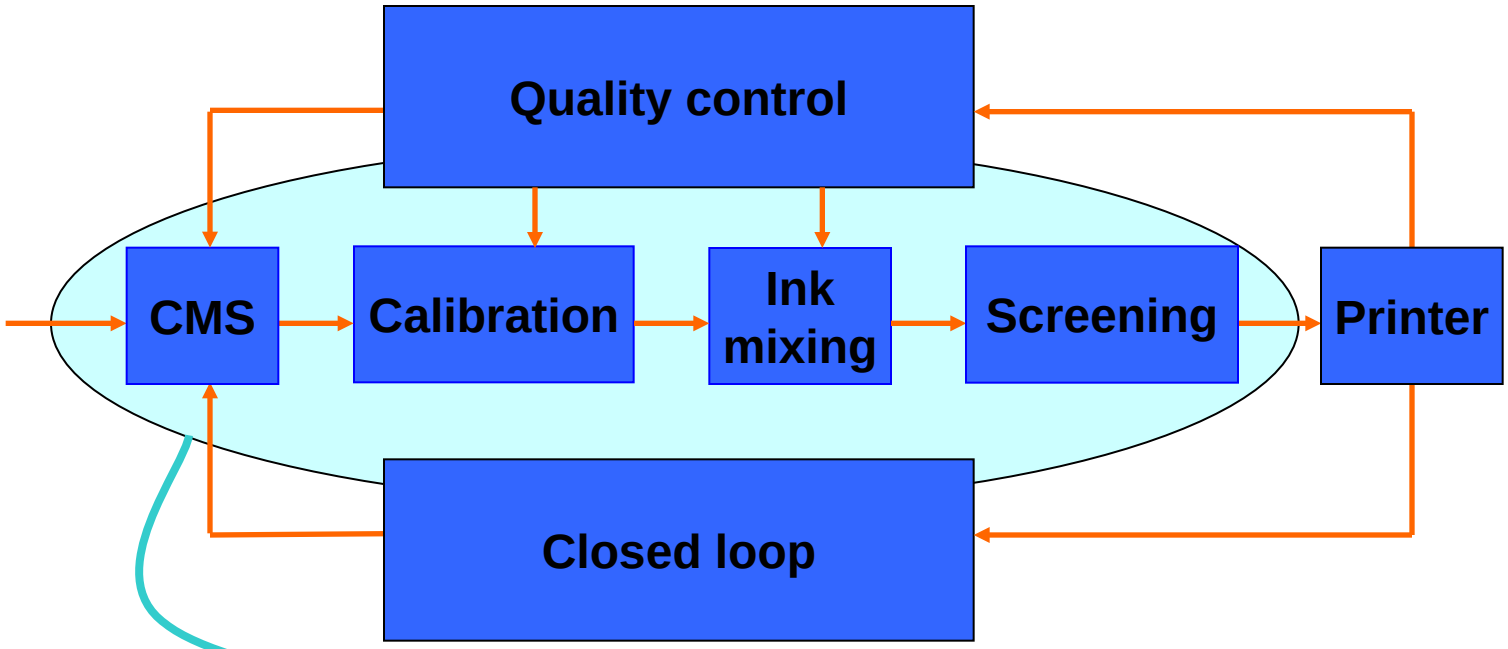
Hidden color management

- **Common practice**
  - ICC based
    - Smart profiles, dumb CMM
    - Significant first step
    - Nowadays baseline lacks some flexibility
  - Standard profiles
    - Characterization data sets
    - Predefined device links
  - Profile editing tools
    - To modify profiles
    - Closed loop on device links

Integrated digital workflow

Integrated digital workflow

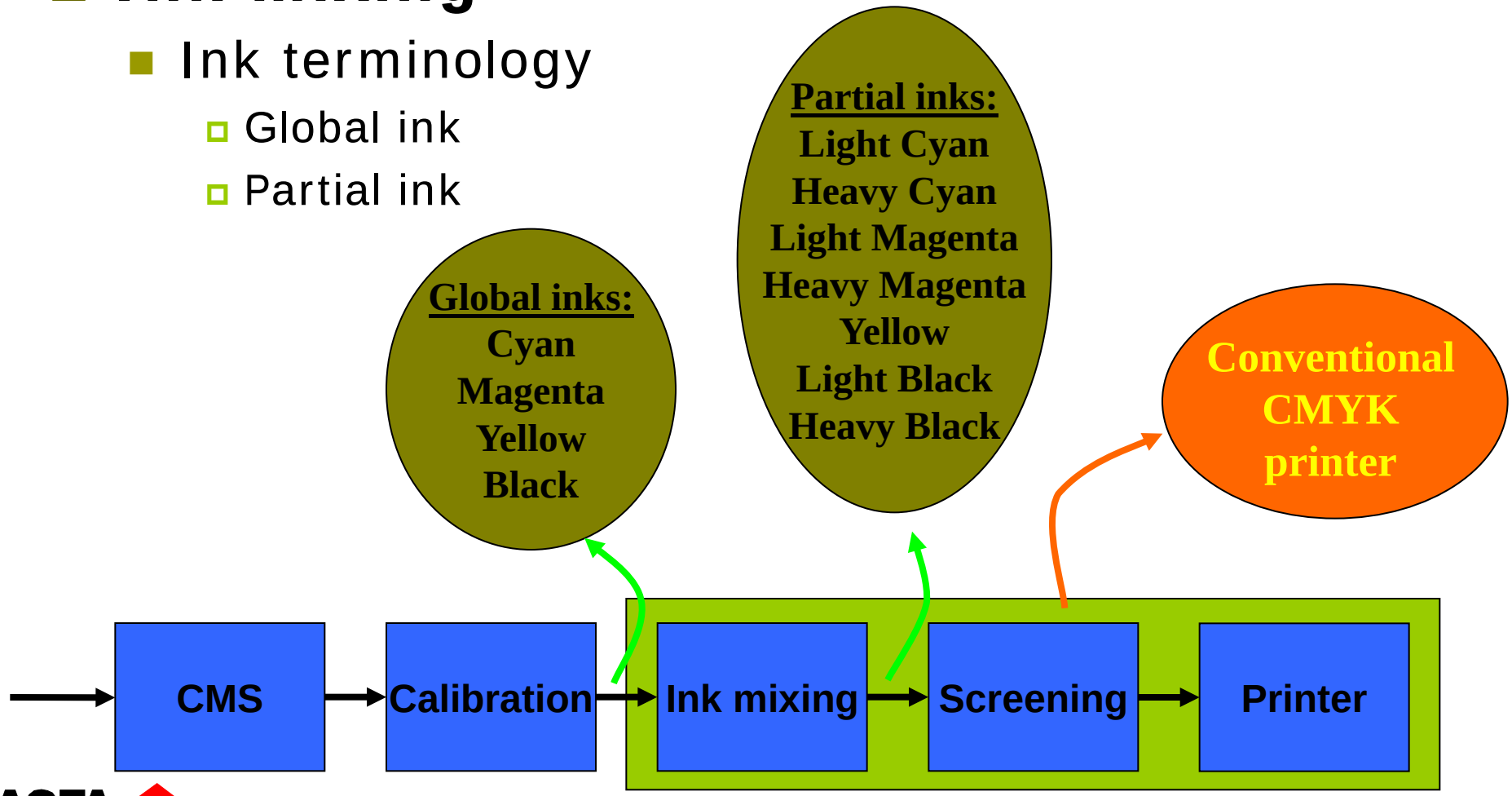
- **General approach**



-All processing blocks are optimized to each other

Integrated digital workflow

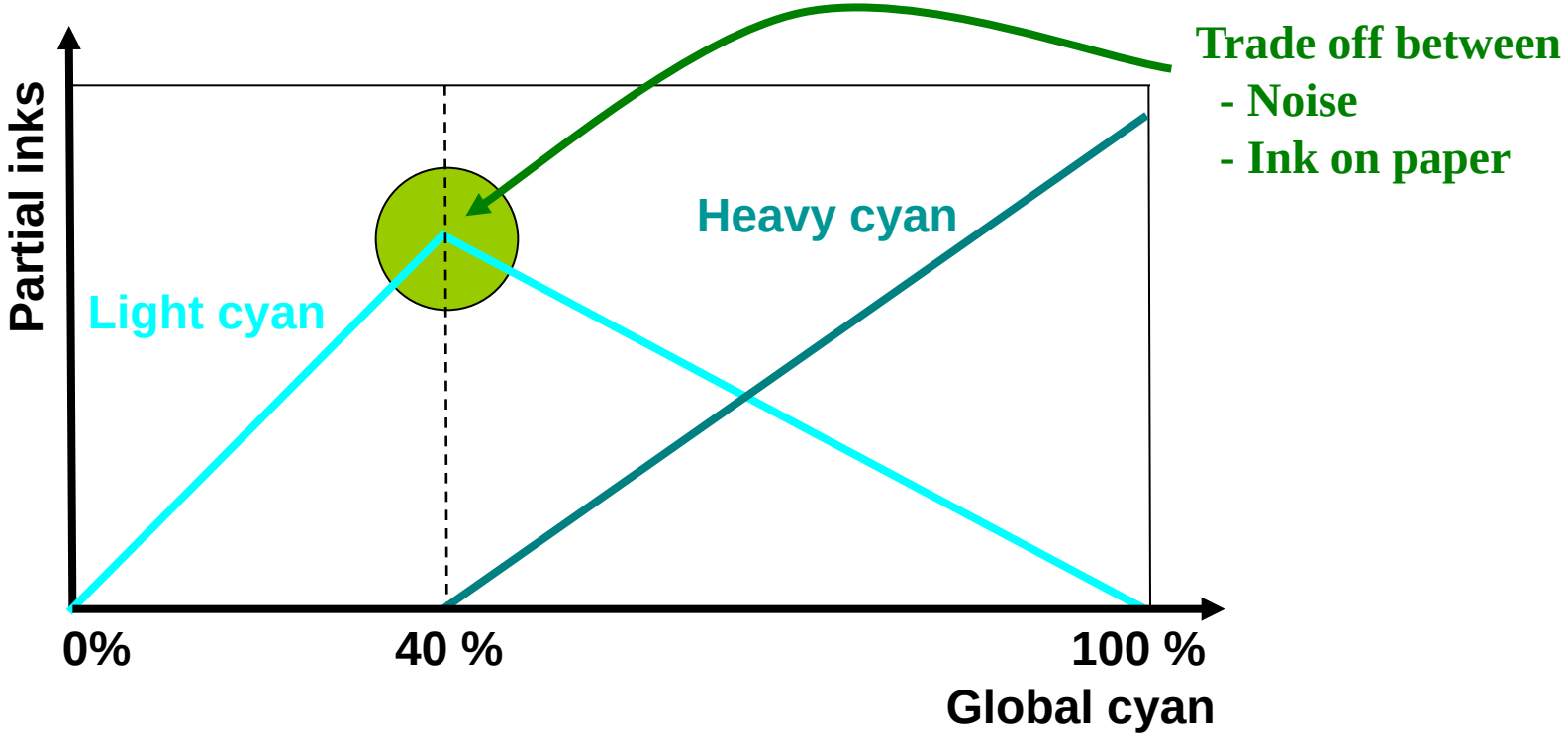
- **Ink mixing**
  - Ink terminology
    - Global ink
    - Partial ink



Integrated digital workflow

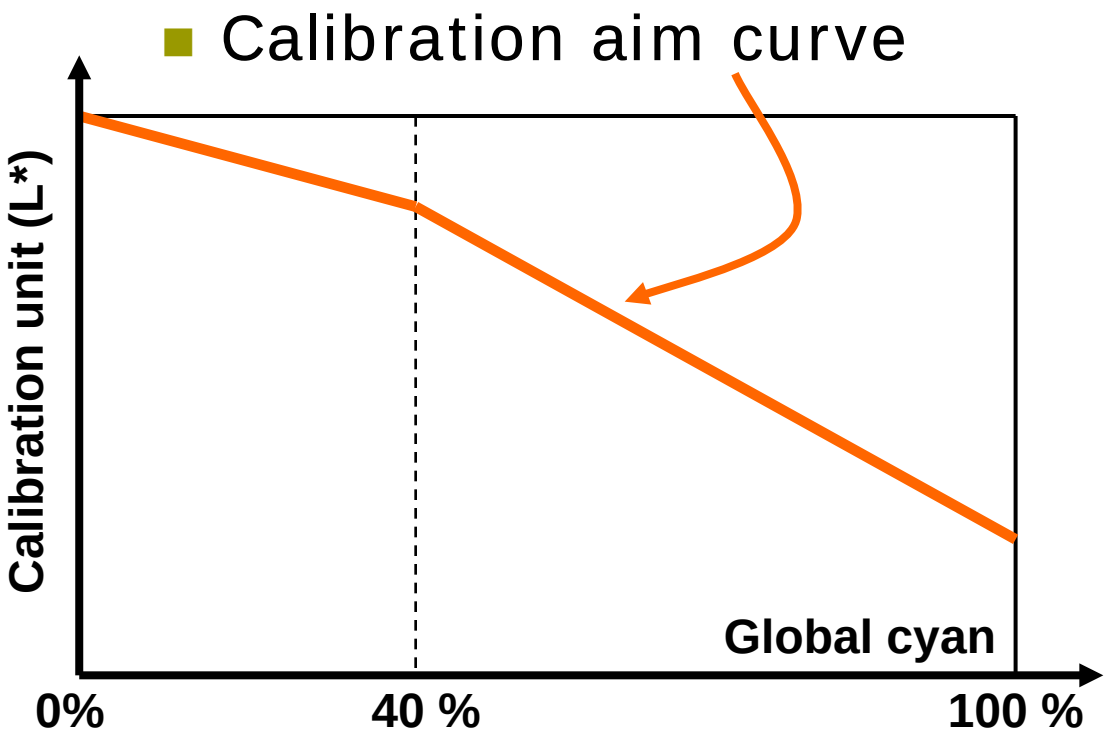
Ink Mixing (cont'd)

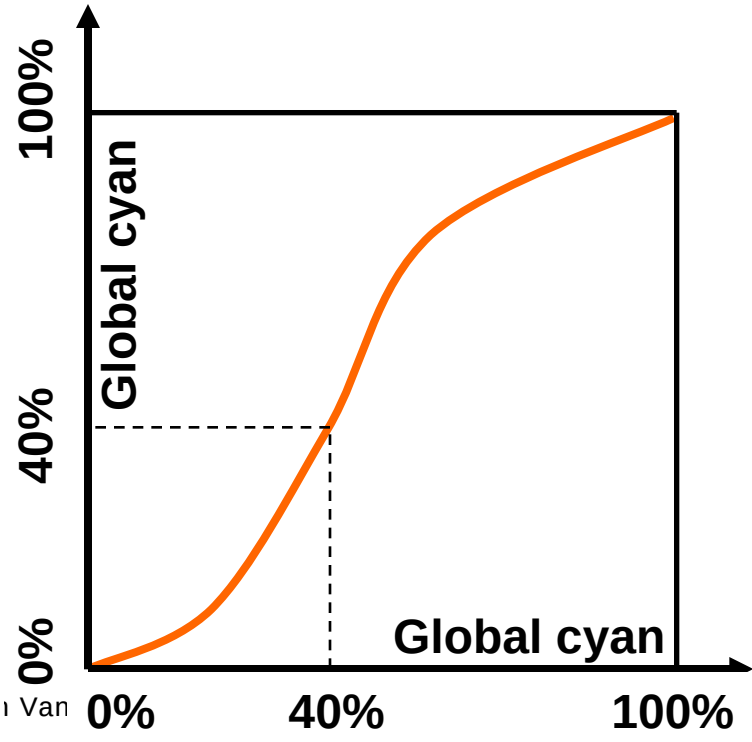
- Ink mixing curves
  - Switch points: sudden change of a partial ink value



Integrated digital workflow

- **Calibration**
  - Calibration unit
    - L* for cyan, magenta and black
    - C* for yellow
  - Calibration aim curve



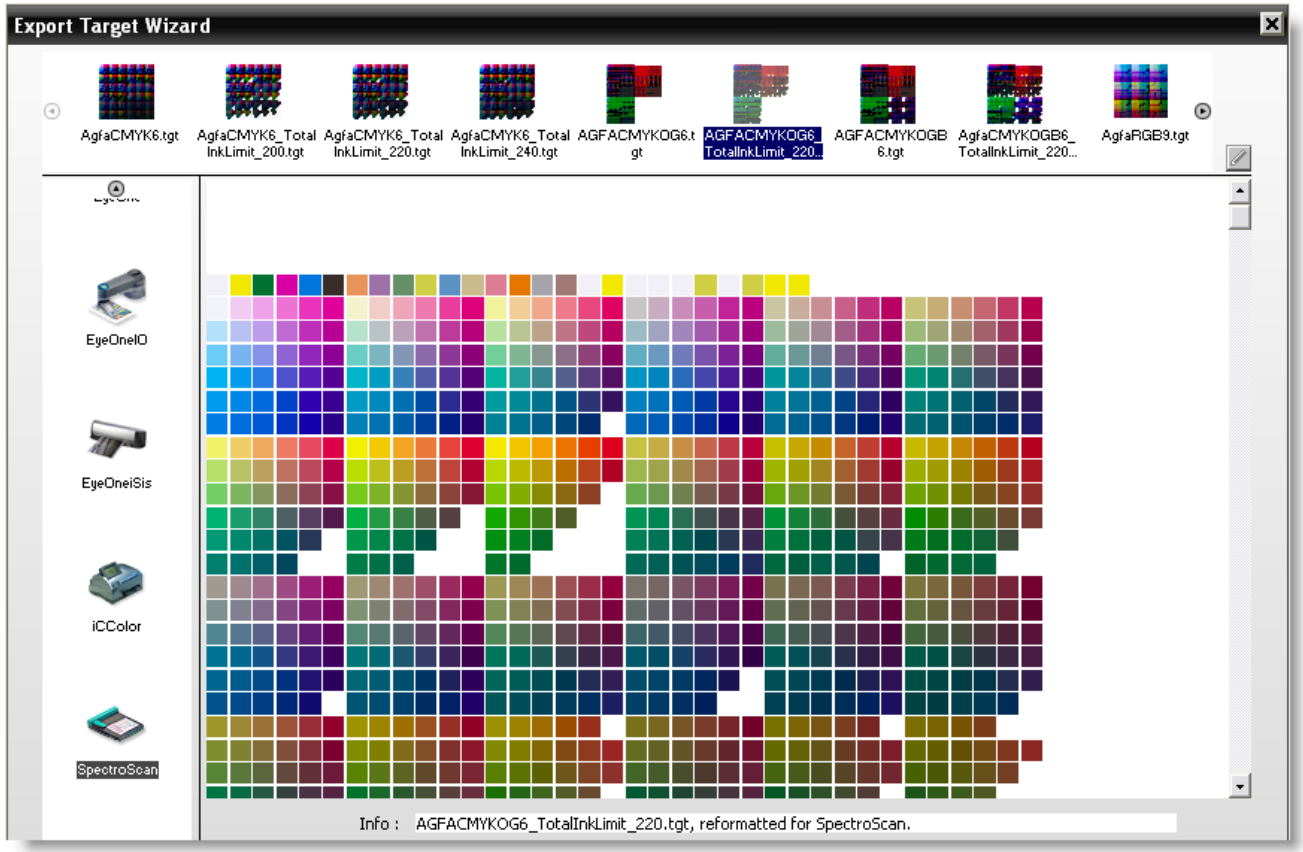


Integrated digital workflow

- **Screening**
  - Full Control Error Diffusion
    - Full control over 1-ink processes
      - Overlap of multi-density inks
      - Use of drop sizes
      - Graininess (noise / smoothness of uniform colors)
      - Ink consumption
    - Flexibility due to
      - External settings partial ink mixing
      - No software changes required

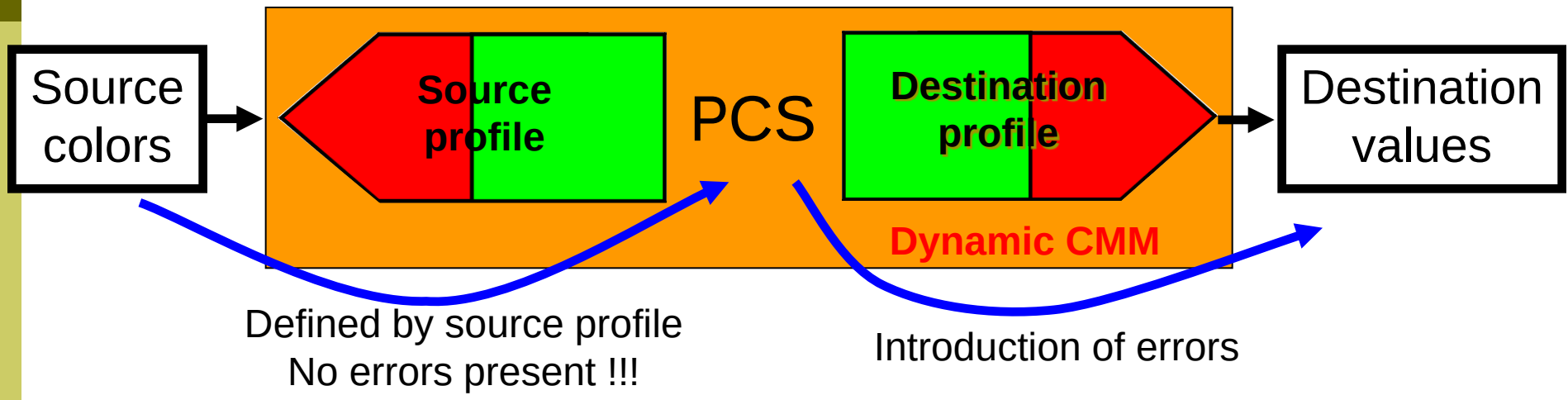
Integrated digital workflow

- **Characterization**
  - Ink limited targets for ink jet devices



Integrated digital workflow

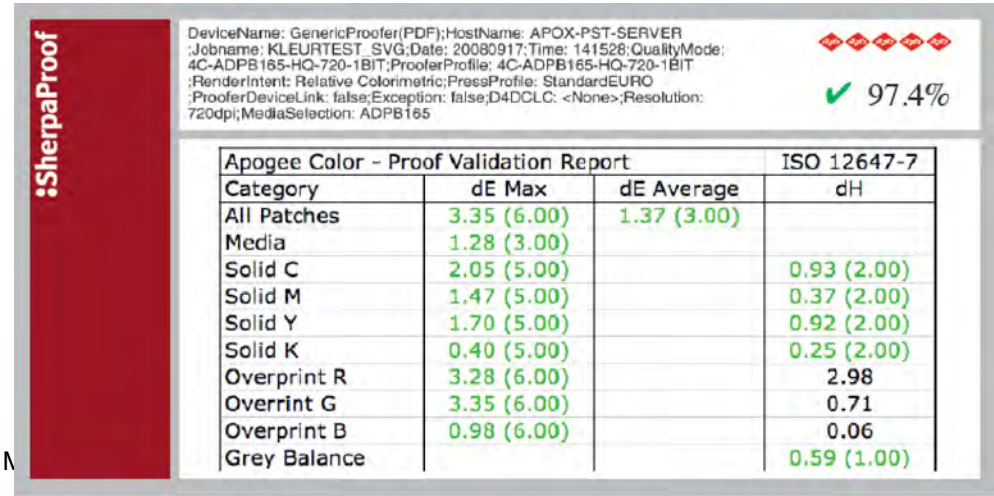
- **Closed loop**



  - Advantages
    - To increase the accuracy of the destination profile
    - Accuracy limited by measurements and printer
    - Less iterations needed compared to closed loop on a link
    - Increased accuracy available for any source data

Integrated digital workflow

- **Quality control**
  - Check different processing blocks
    - Ink mixing
    - Calibration
    - Characterization
  - Workflow
    - “Digital printer check”-strip printed
    - Measured with build-in measurement devices
    - Report printed
    - Queue placed on hold when failure



Integrated digital workflow

- **Processing blocks**
  - **Screening**
    - Applies ink mixing and calibration curves
  - **Ink mixing + Calibration**
    - Global optimization of quantization levels
    - Calibration in agreement with printer target
  - **Characterization**
    - Ink limited targets
  - **Closed loop**
    - Guarantees accuracy for any printing device
  - **Quality Control**
    - Automatic check digital workflow

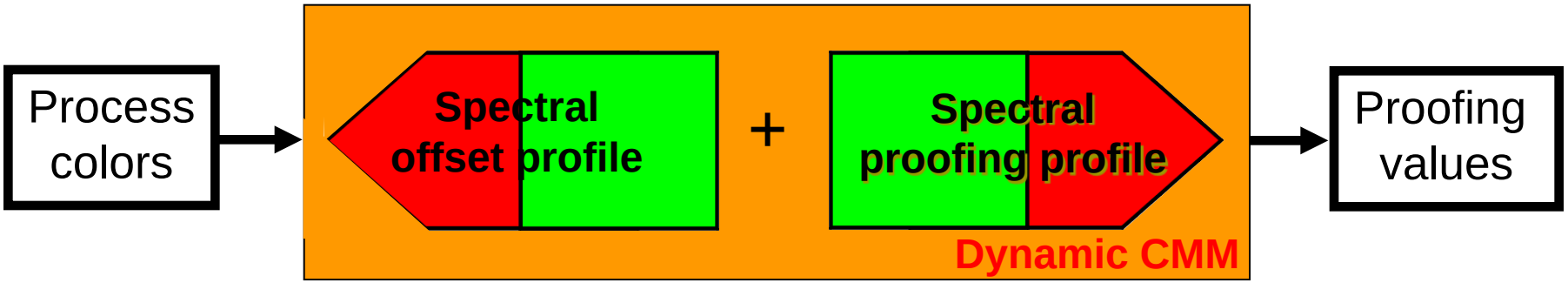
Dynamic CMM

Dynamic CMM

- **Key features**
  - Fully ICC compatible
  - Spectral data processing
  - Improved linking
  - Accurate spot color mixing
  - Repurposing
- **Based on**
  - Spectral data
  - Processing on the fly

Dynamic CMM

- **Spectral data processing**
  - Automatic illuminant and observer correction



Viewing conditions
- D50 simulator
- 2 degree Observer

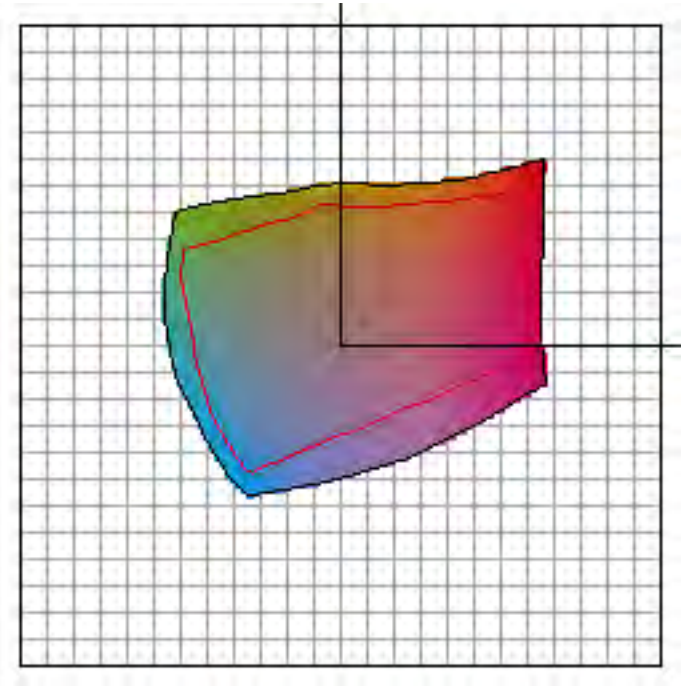
Viewing conditions
- D65
- 10 degree Observer

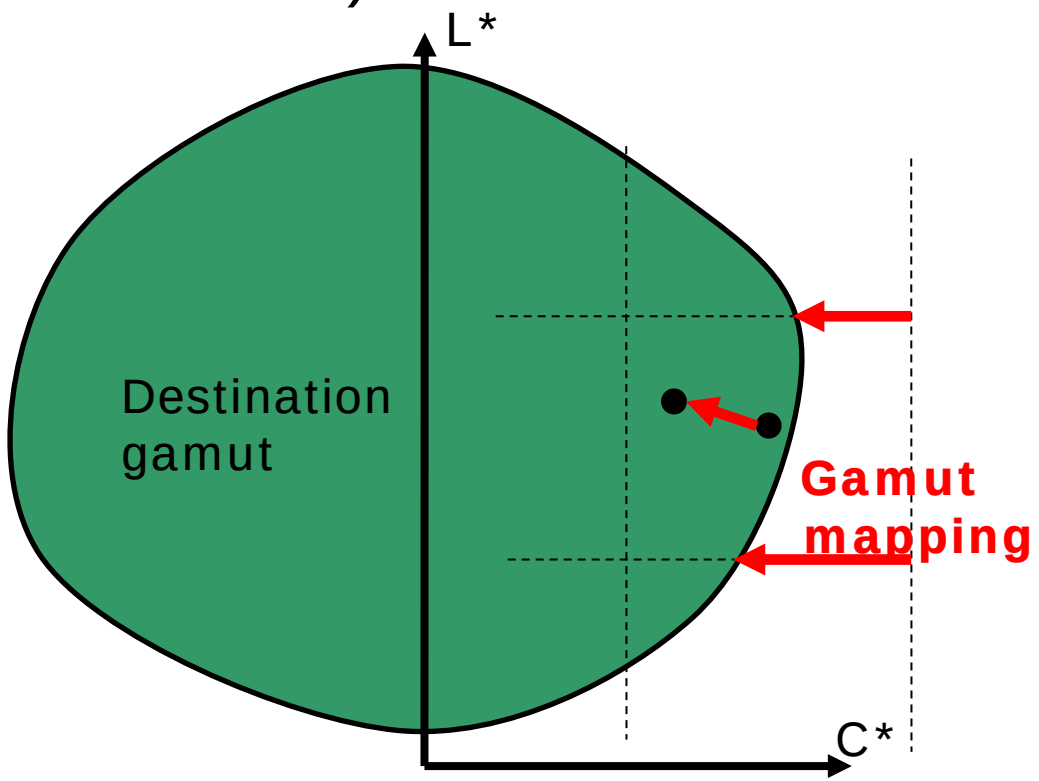
- Automatic recalculation of proofer profile for the viewing conditions of offset profile

  => Reduction of deltaE due to profile mismatches

Dynamic CMM

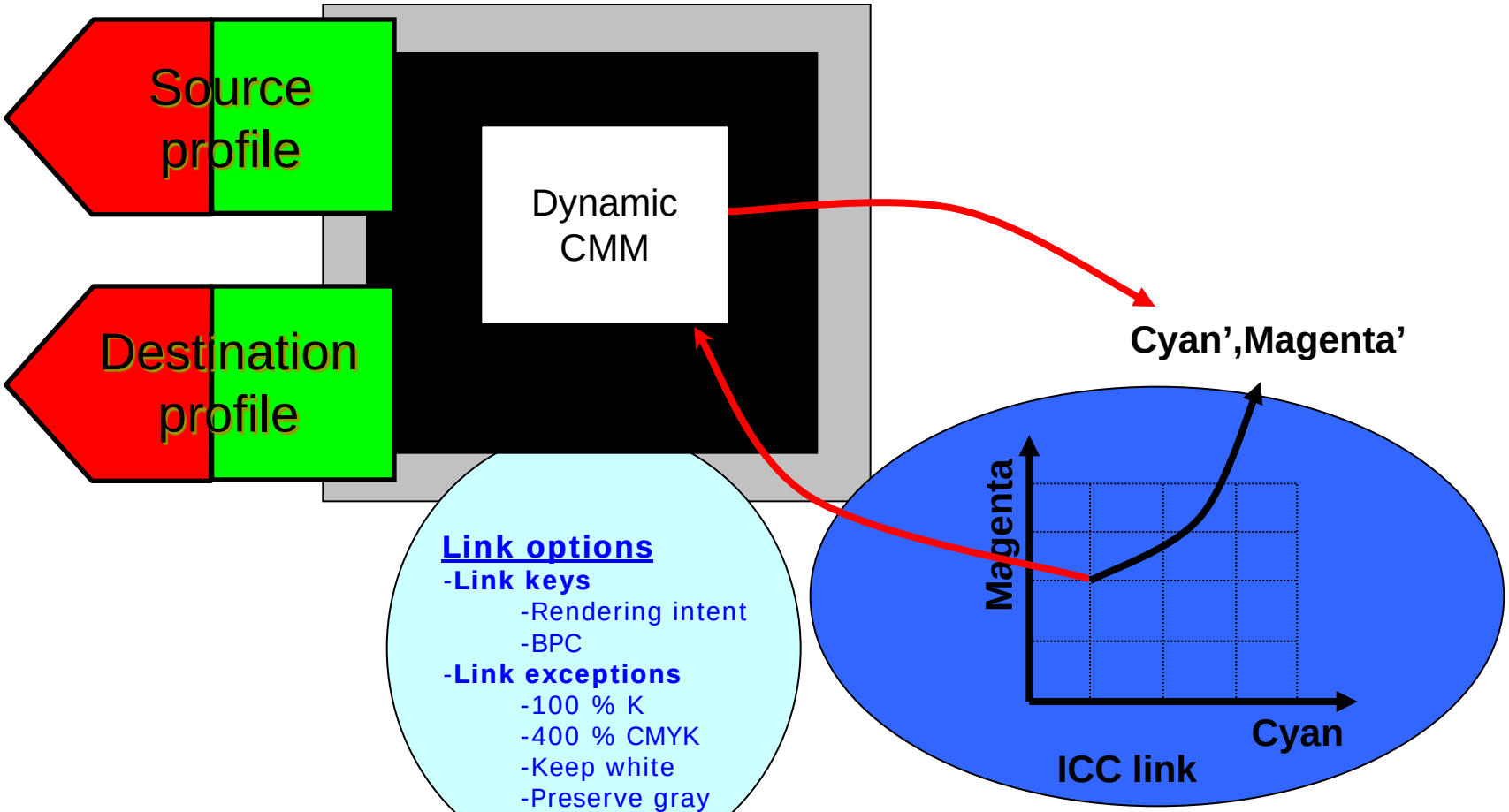
- **Improved linking**
  - Interpolation errors mainly at gamut boundary (max between 5 to 10 deltaE)





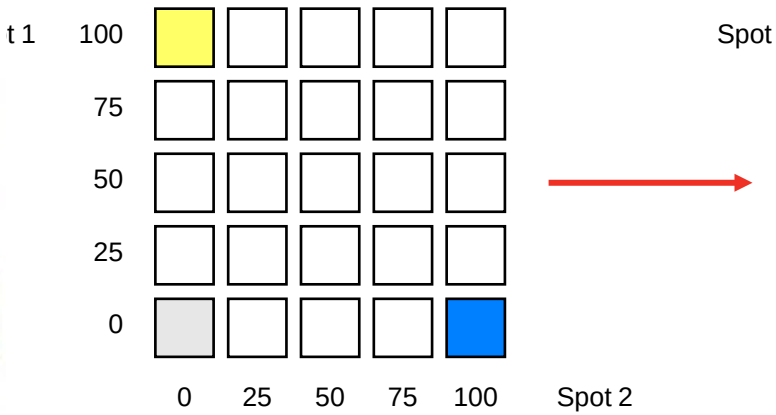
Dynamic CMM

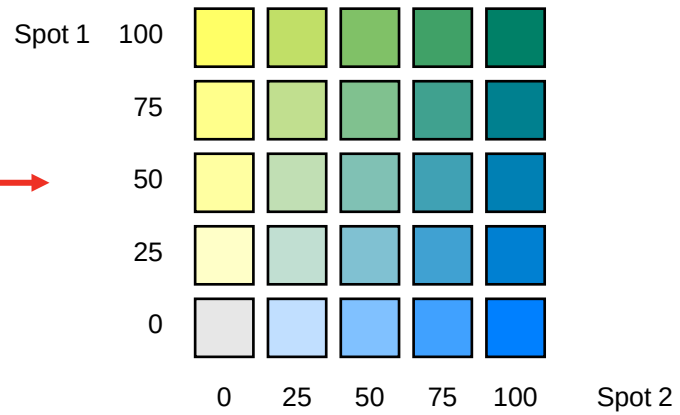
- **Improved linking (cont'd)**



Dynamic CMM

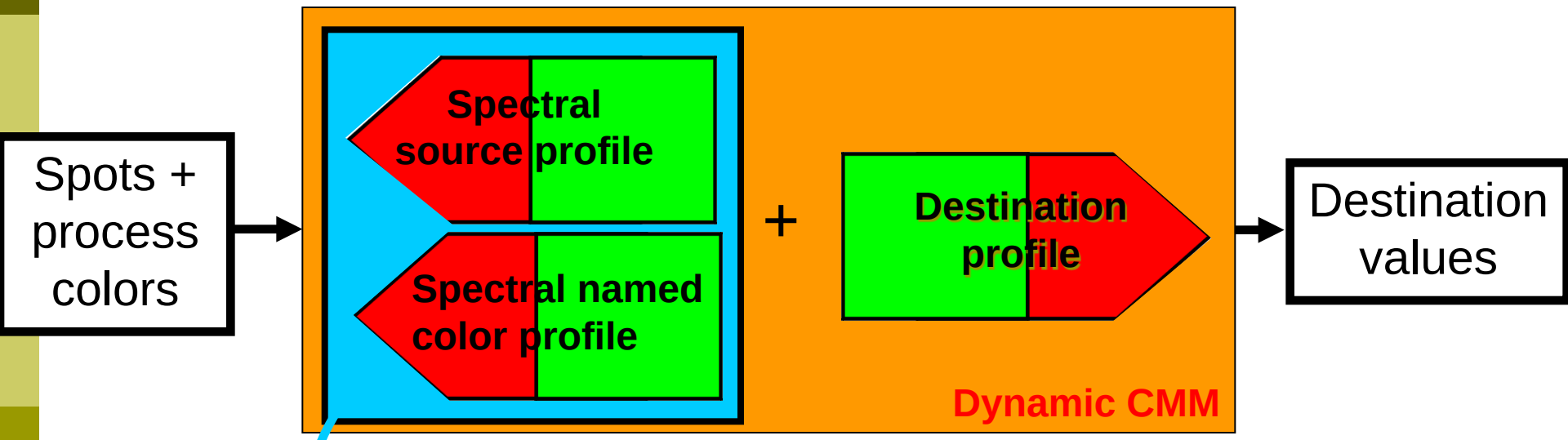
- **Accurate spot color mixing**
  - Guarantees spot color quality output
  - Ease of use: Only spectra of solid spots needed
    - No measurements of overprints required
    - On the fly calculation of overprinted spot colors
  - Spectral named color profiles required
    - Processing independent of viewing conditions and media





Dynamic CMM

- Accurate spot color mixing (cont'd)



- Profile creation on the fly for overlapping spots and process colors
  - Based on dot gain, ink densities, opacity, trapping
  - Viewing conditions defined by offset profile
  - Medium swap to medium of the offset profile

Dynamic CMM

- **Repurposing**
  - **Reasoning**
    - ICC based conversion
      - change the “color design” of the document.
      - change overprint effects.
  - **Advantages**
    - Preserving GCR settings in CMYK-CMYK conversions
      - less press problems
      - pure drop shadows
      - rosettes structure preserved
    - Zero-preserving links
      - Keep pure color
      - Keep overprint
    - Keep black
      - Preserve text

Dynamic CMM

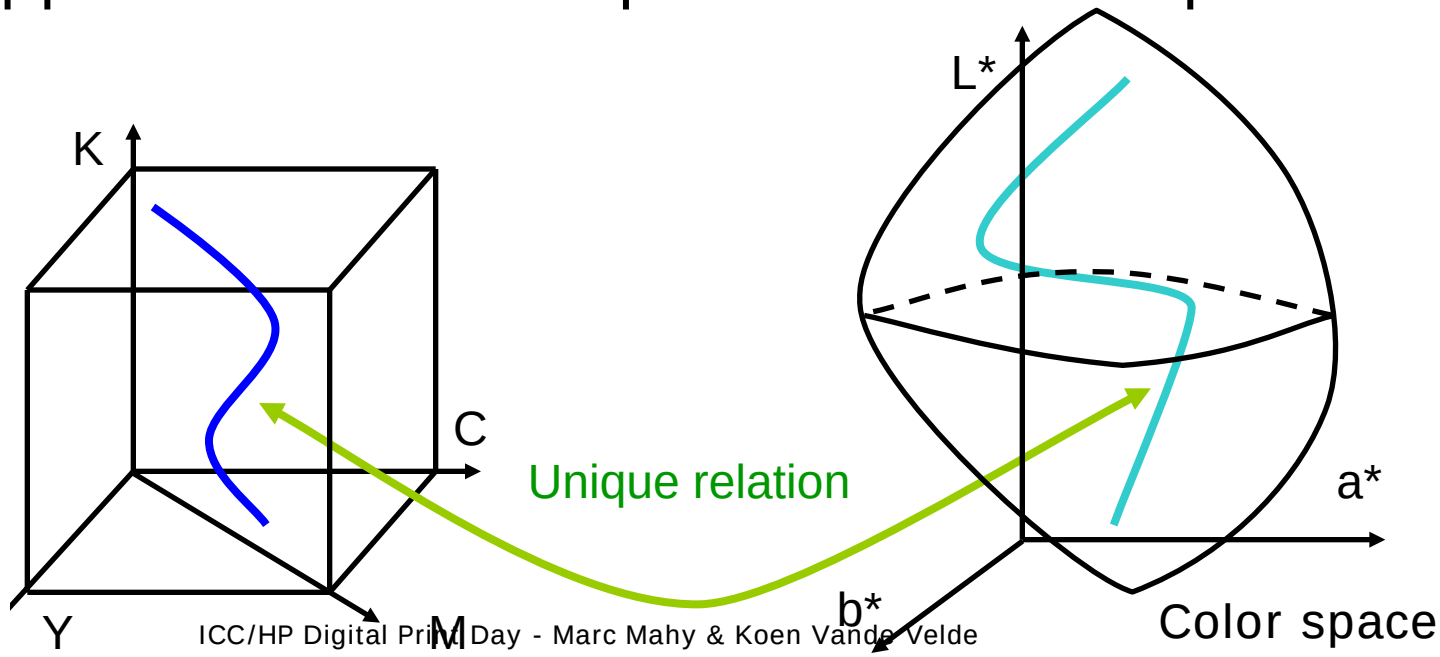
- Repurposing
  - **IsoCoated to IsoWebCoated**

Original Repurpose ICC convert

Quality separation tables

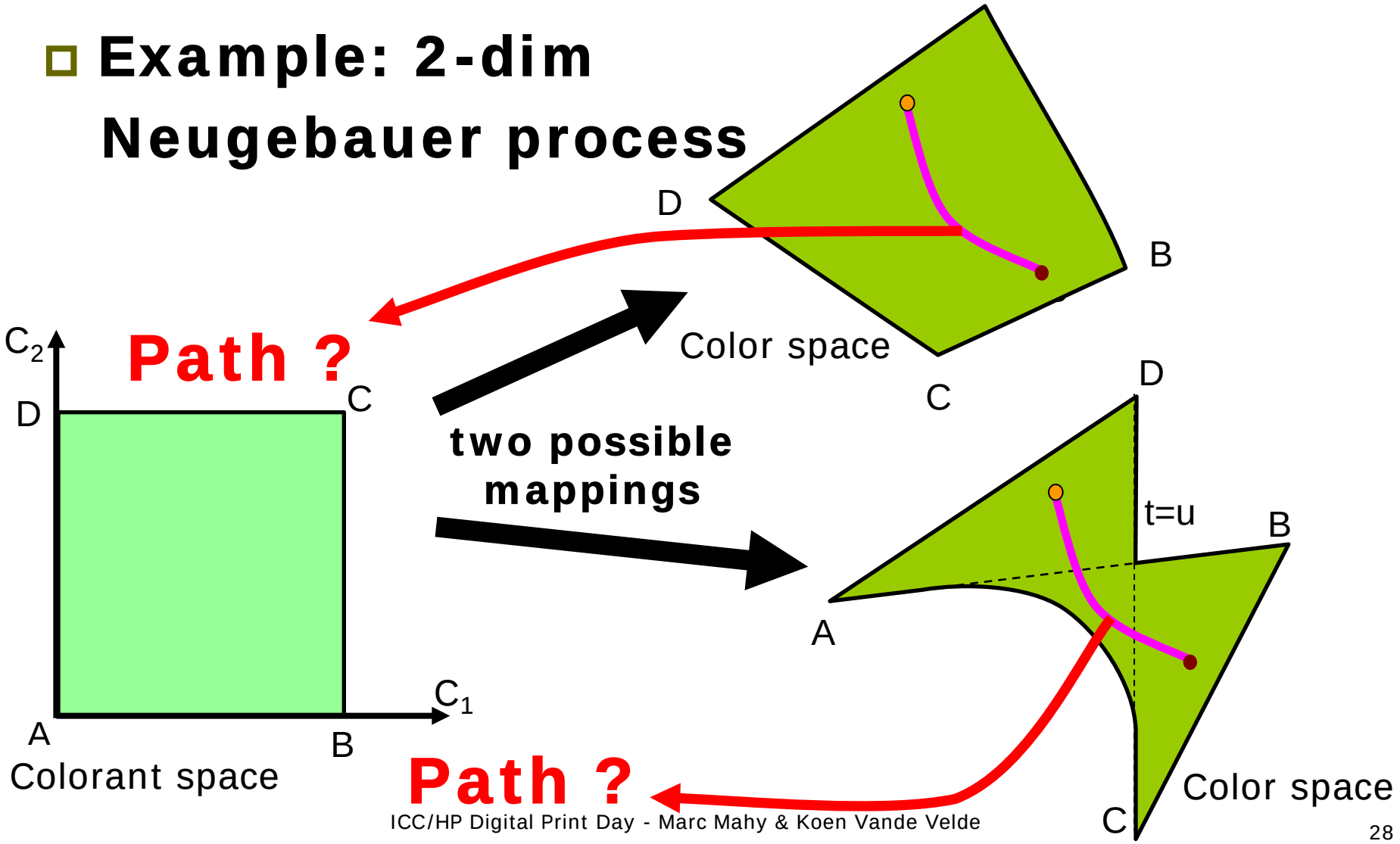
Quality separation tables

- **Requirements**
  - Smoothness and continuity
- **Condition**
  - Any connected path in gamut (color space) mapped to connected path in colorant space



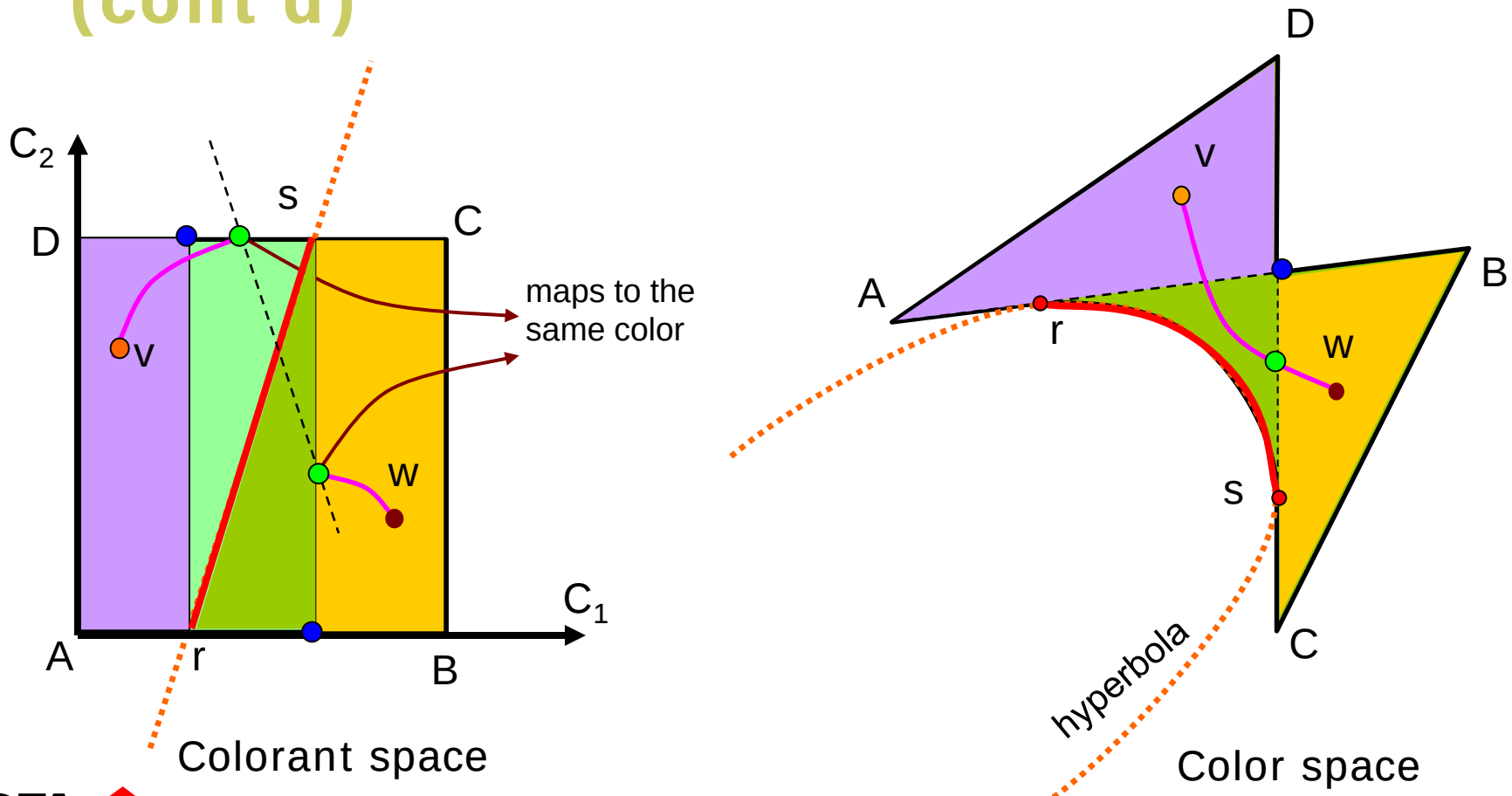
Quality separation tables

- **Example: 2-dim Neugebauer process**



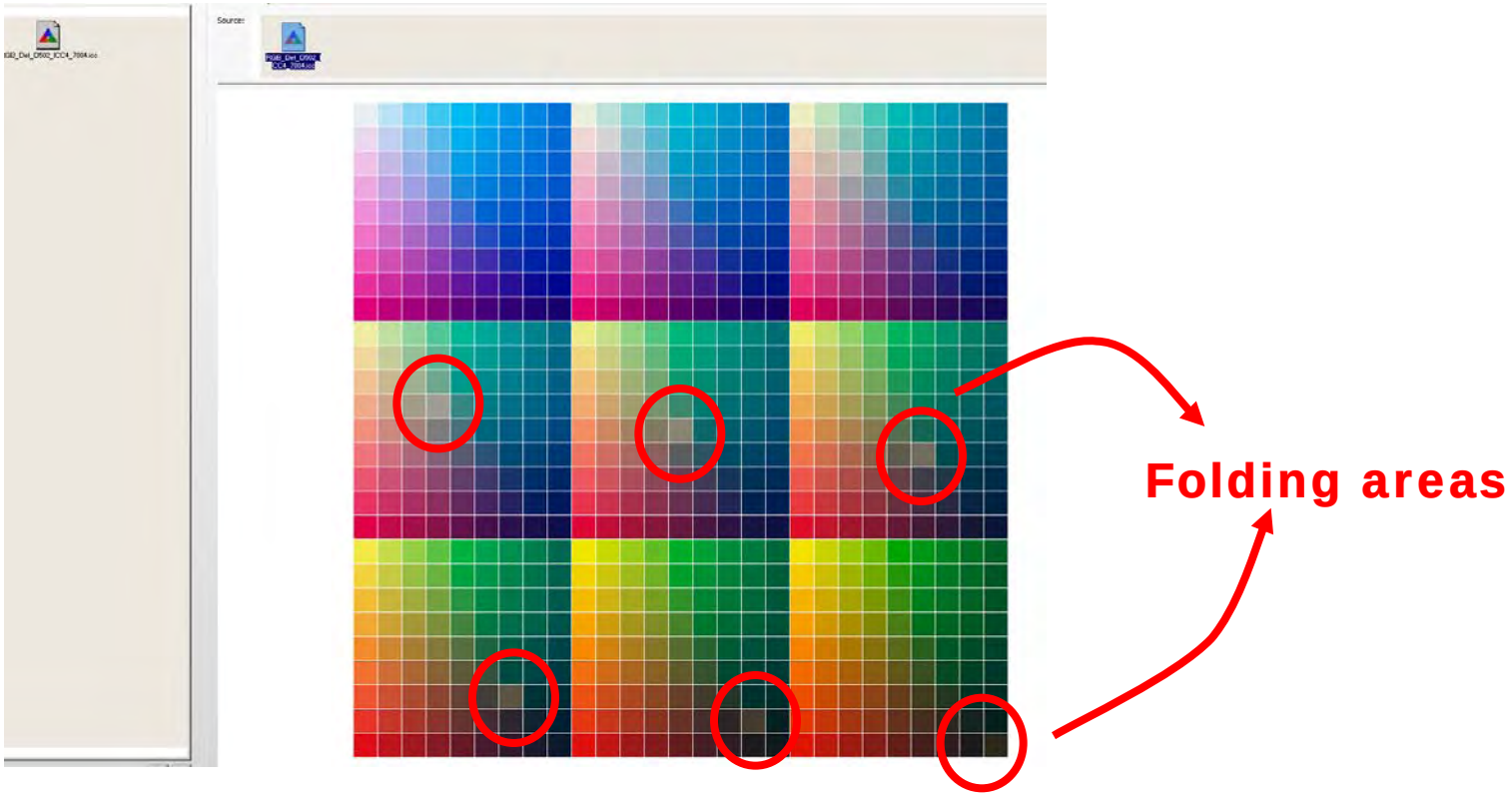
Quality separation tables

- **Example: 2-dim Neugebauer model (cont'd)**



Quality separation tables

- **Real live example: GDI drivers**



Quality separation tables

- **Quality measurement files**
  - Percentage incorrect regions

Offset	Percentage
Fogra29	2.74
Fogra39	4.27
Fogra47	9.36
Ifra26	5.20

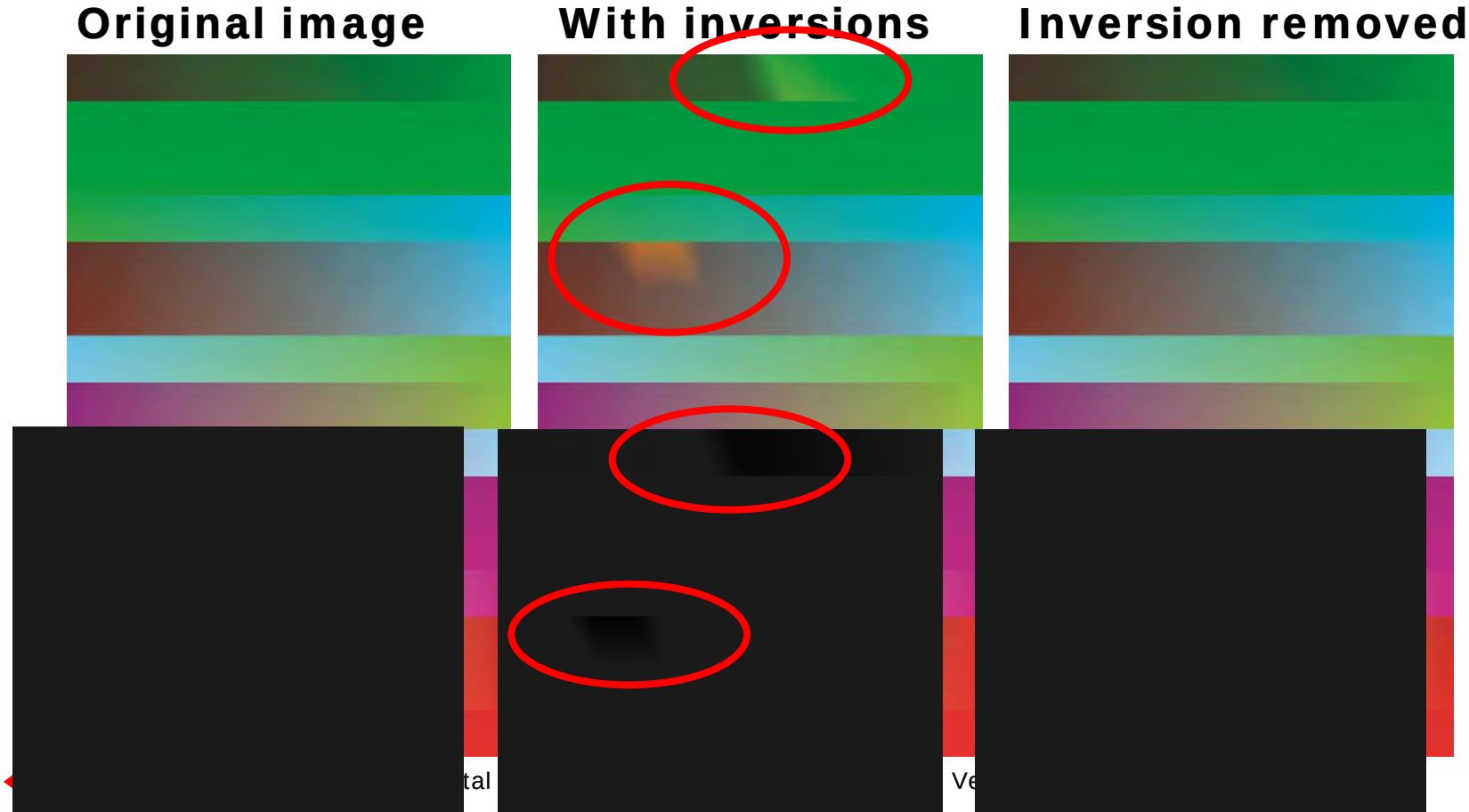
Ink jet	Percentage
Printer-M	24.72
Printer-S	28.60
Printer-L	16.59
Printer-D	16.81

  - Ink jet ink limited targets used

    => Ink jet less well-behaving measurement files

Quality separation tables

- **Example: Repurposing CMYK**
  - Fogra29 to Fogra29 (CMY and K shown separately)



ICC Labs

ICC Labs

- **Requirements**
  - Extend the ICC specification
    - To contain all basic color data
      - Measurements
      - Spot color data
      - Observer and illuminant
    - Flexible PCS
    - To use more flexible transforms
      - No bit limitations (12 bit accurate curves)
      - Extend set of basic transforms
      - Support any combination of basic transforms

Conclusions

- **Easy color management**
  - Workflow selectable applications
  - Hidden / automatic CMS
- **Digital printing**
  - Integrated digital flow
  - Dynamic CMM
  - Automatic check quality separations essential
- **ICC Labs requirements**
  - Complete profiles
  - Flexible PCS
  - Flexible transforms

Thank you

Questions?