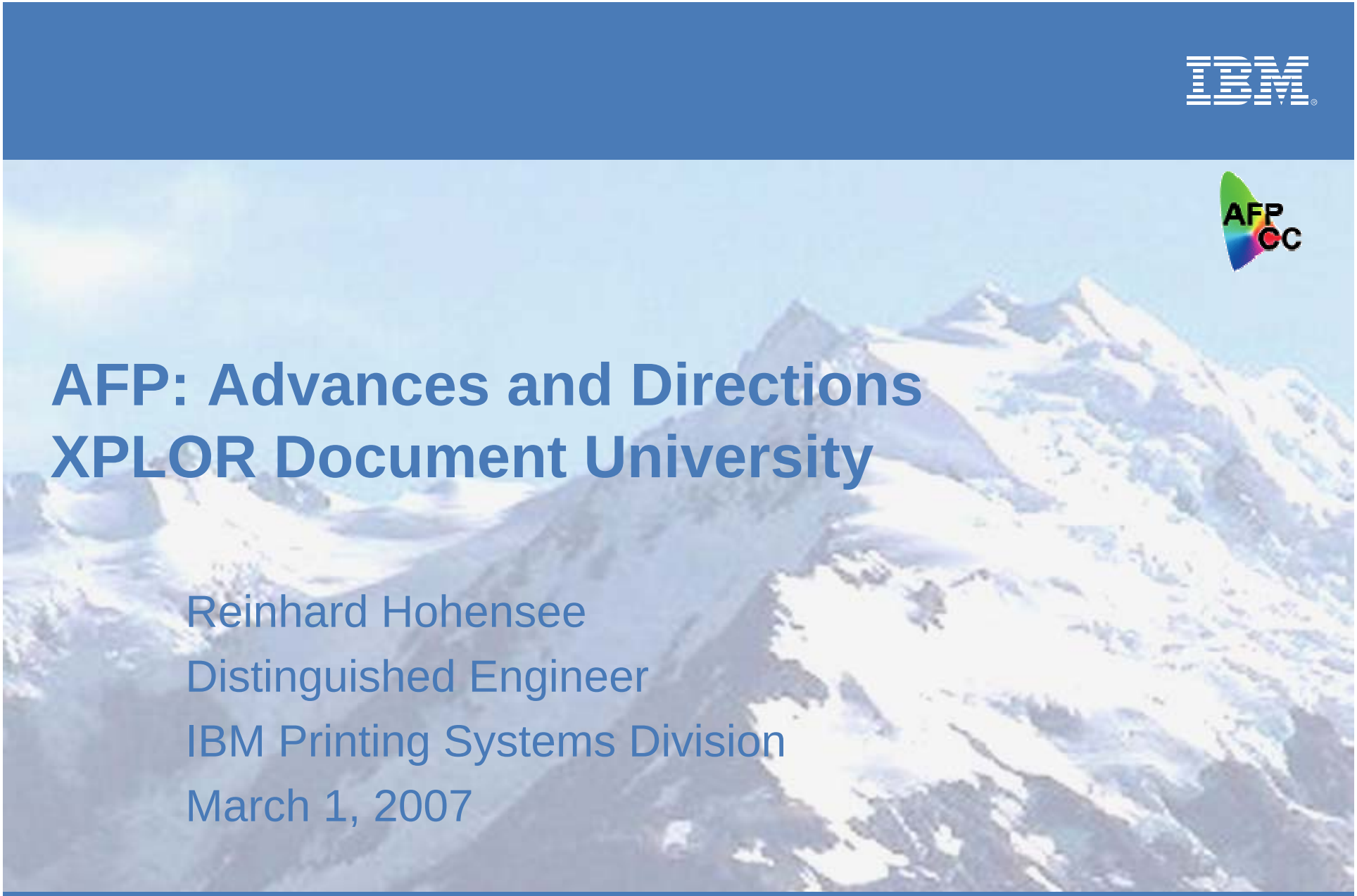

AFP: Advances and Directions
XPLOR Document University

Reinhard Hohensee
Distinguished Engineer
IBM Printing Systems Division
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Agenda

- AFP – an open architecture
  - AFP Color Consortium (AFPCC) and scope
  - Expansion of scope – AFP Consortium (AFPC)
  - Current membership
  - Status of work
- Recent advances in AFP
  - TTF/OTF Fonts
  - Unicode
  - Resource Access Tables (RATs)
  - Color Management
- Future directions
- Summary

AFP Color Consortium (AFPCC)

- Formed in October 2004
- Initial membership was 16 companies
- Scope was limited to developing a comprehensive color management capability within the AFP architecture
- Work progressed very well - first release of AFP Color Management Architecture (ACMA) was formally approved by AFPCC on January 20, 2006 and has been published; see www.afpcolor.org :
  - Overview document - *AFP Color Management Architecture (ACMA) Release 1*
  - Significant updates to the MO:DCA, IPDS, and AFP Line Data data streams; see updated references
  - New architecture reference – *Color Management Object Content Architecture (CMOCA) Reference*
    - *Provides syntax for wrapping ICC profiles and other color management objects so they can be processed as AFP resources*

AFP Consortium (AFPC)

- In May, 2006, IBM announced proposal to open development of complete AFP architecture to the AFPCC; this was accepted by all members by September, 2006
- ***AFP is now a completely OPEN architecture and the AFPCC has become the ***AFP Consortium (AFPC)*****
  - Customer benefits
    - More consistent implementations, therefore better interoperability of products
    - Broader choice of vendors and products
    - Better investment protection - standards have industry staying power
- New scope of AFPC work:
  - Data streams - MO:DCA, IPDS, AFP Line Data
  - Object Architectures:

AFP GOCA (vector graphics)	BCOCA (bar codes)
CMOCA (color management resources)	FOCA (fonts)
IOCA (image)	PTOCA (text)

  - ****Develop AFP into best-of-breed presentation architecture****

Current AFP Consortium Membership (31)

- **Document Composition & Resource Creation**:
  - Cincom
  - COPI
  - DocuCorp
  - Document Sciences
  - Elixir Technologies
  - Exstream Software
  - FormsPath
  - GMC Software Technology
  - Group 1
  - Invaris
  - Inventive Designers
  - Isis-Papyrus
  - Metavante
  - PrintSoft
  - StreamServe
- **Servers & Transforms**
  - CDP Communications
  - Compart Systemhaus
  - Crawford Technologies
  - Emtex
  - Intermate
  - LRS
  - MPI
  - Solimar Systems
  - Xenos Group Inc.
- **Printers & Controllers**
  - IBM
  - Kodak
  - Lexmark
  - Oce
  - Ricoh
  - Xeikon International
  - Xerox

Recent AFP Advances: TrueType/OpenType Font Support

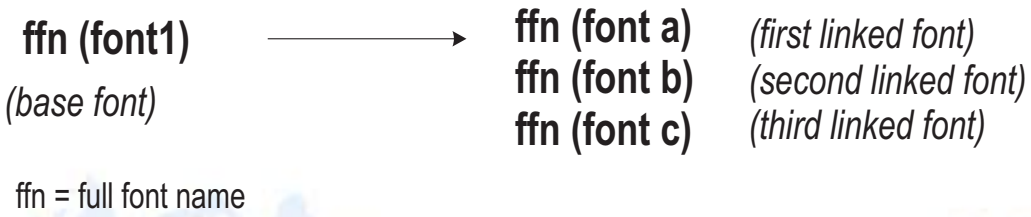
- Scalable outline technology used on the Windows and Mac platforms; most prevalent font technology in the industry
- Benefits for AFP customers:
  - Provides greater choice of typefaces, particularly non-Latin typefaces
  - Allows migration to the same single font technology on all presentation platforms, e.g. Windows, zOS, AIX
  - Provides ability to print from Windows and Mac applications without font substitutions
  - Provides ability to transform to/from other PDLs, e.g. PS/PDF, without font substitutions
  - Provides the basis for future, more advanced support of complex non-Latin scripts, e.g. Arabic, Hebrew, Indic, Thai
- Support added to AFP architecture and to AFP/IPDS products starting in 2003; rollout of support on printers, servers, and formatters continues

Installing TrueType/OpenType Fonts (TTF/OTFs) in an AFP System

- TTF/OTFs are installed using an Installer such as the IBM Font Installer for AFP Systems
  - Windows application that installs fonts in remote print server resource libraries using FTP protocol
  - Builds a Resource Access Table (RAT) for the fonts in the resource library
  - RAT is indexed from the data stream with a full font name, which matches the name specified within the font
- Fonts must support Unicode encoding
- Fonts are installed as is – they are not altered and they are not wrapped in an AFP container; therefore they can be shared with non-AFP applications

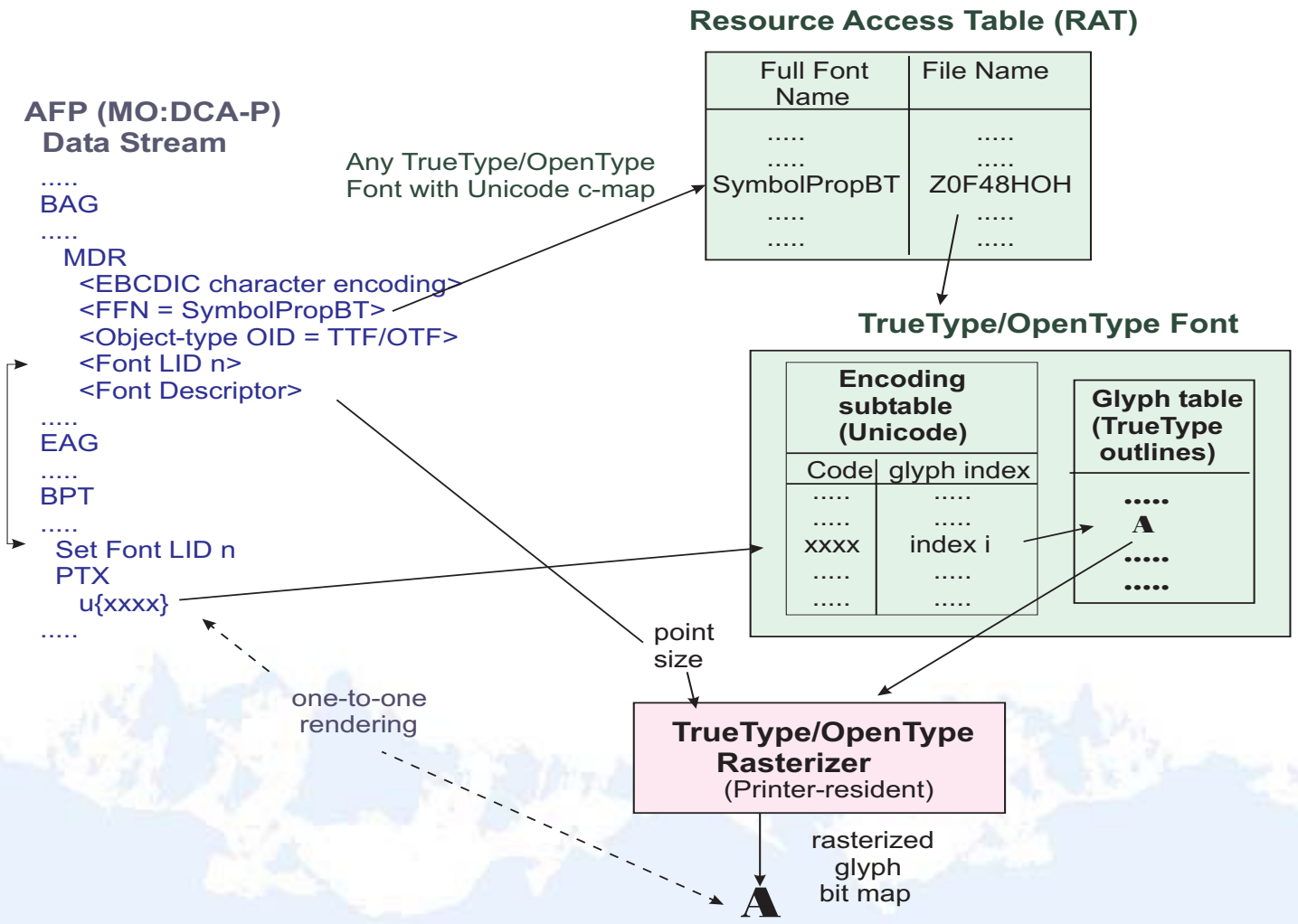
Installing TTF/OTFs (contd)

- Fonts can be installed as part of a TrueType Collection file (TTC)
  - File with common header and multiple TTF/OTFs that share tables
  - File size reduction with TTC if fonts share large number of glyphs
- Fonts can be installed with 'linked' fonts:
  - Fonts "font1", "font a", "font b", and "font "c" are treated logically as a single font; base font (font1) is always processed first, followed by the first linked font (font a), then the second linked font (font b), etc.



  - Provides ability to add additional characters (TTF/OTF file format restricts number of characters in a given font to 64K) and user-defined characters (UDCs)

TTF/OTF Reference in AFP Data Stream



Recent AFP Advances: Unicode Support

- Unicode support is an integral part of TrueType/OpenType font support
- Unicode is a standard developed by the Unicode consortium that defines a universal character encoding for the characters in all the major scripts in the world
- Basic encoding is a double-byte encoding (UTF-16) that supports 64K characters
- Encoding can be extended to a four-byte encoding using the surrogate concept:
  - High-surrogate in range X'D800' – X'DBFF'
  - Low surrogate in range X'DC00' – X'DFFF'
  - Four-byte code consists of high-surrogate code followed by low-surrogate code
  - Addresses additional 1024x1024 = 1,048,576 characters

Character Groupings in Unicode Base Plane

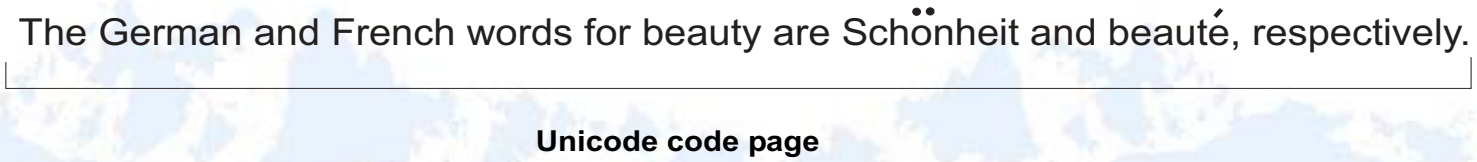
Name	Code Range	Description
General Scripts	0000-1FFF	Phonetic scripts, e.g. Latin
Symbols	2000-2DFF	Punctuation, math symbols
CJK Symbols	2E00-3FFF	
CJK Ideographs	3400-9FFF	Unified CJK ideographs
Yi Syllables	A000-A4CF	
Hangul Syllables	AC00-D743	Korean Hangul syllables
Surrogates	D800-DFFF	High/low surrogates
Private Use	E000-F8FF	
Compatibility and Specials	F900-FFFD	

Why Unicode?

Current Environment

*** Application needs to understand scripts and code pages ***

Unicode Environment



*** Application only needs to understand Unicode ***

Recent AFP Advances: Resource Access Table (RAT)

- Architected table (defined in MO:DCA Reference) for processing resources installed in resource libraries
  - Allows referencing of resources in data stream by natural, platform-independent name, e.g. TTF/OTF full font name, CMR name
  - Allows association of additional processing parameters with resource, e.g. public/private flag and object OID, in platform-independent manner
- Table consists of common header, followed by repeating groups that are defined for specific object types
  - Repeating groups consist of a header with length and object-type identifier, followed by MO:DCA triplet-like table vectors (TVs)
  - TVs are specific to object-type

Resource Acccess Table (RAT) (contd)

- Currently supported object types
  - TrueType/OpenType fonts (TTF/OTFs)
  - Color Management Resources (CMRs)
  - Data Objects, e.g. IOCA, EPS, PDF, TIFF, GIF, JFIF (JPEG)

- File name for RATs is fixed:
  - TTF/OTFs: IBM_DataObjectFont.rat
  - CMRs: AFP_ColorManagementResource.rat
  - Data Objects: AFP_DataObjectResource.rat

Resource Access Table – TTF/OTF RAT

RG Header: Length, Flags (private/public, capture,…), identifier for TrueType/OpenType font object-type

Table Vector Type	Table Vector Content
Font name	Full font name in UTF-16BE; can be repeated in multiple languages
File name	File name of font or font collection
Font OID	Object OID for font or font collection
Index into font collection	Ignored if not a collection
Linked font names	Full font names of linked fonts; can be repeated

Resource Access Table – CMR RAT

RG Header: Length, Flags (private/public, capture,…) identifier for CMR object type

Table Vector Type	Table Vector Content
CMR name	Name of CMR in UTF-16BE
File name	File name of CMR
CMR OID	Object OID for CMR
Mapped CMR name	Name of CMR that is “mapped” to this CMR; can be repeated ▪ Link CMR if this CMR is a CC CMR ▪ TTC or HT CMR if this CMR is generic

Resource Access Table – Data Object RAT

RG Header: Length, Flags (private/public, capture,…), identifier for data object type

Table Vector Type	Table Vector Content
Object name	Name of object in UTF-16BE
File name	File name of object
CMR OID	Object OID for object
Rendering Intent (RI)	Rendering Intent for object
CMR name	Name of a CMR that is to be associated with this object; can be repeated
CMR Descriptor	Processing mode for CMR (audit/instruction); paired with CMR name

Recent AFP Advances: Color Management

- Customer benefits
  - Device-independent color rendering - **accurate** colors regardless of output device
  - **Consistent** colors across multi-vendor configurations and workflows
  - **Tunable** colors at system level (in contrast to dials on printer)
- AFP Color Management is based on:
  - ICC profiles and ICC color management concepts
  - A new AFP object – the AFP Color Management Resource (CMR):
    - Provides wrapper for color management constructs, e.g. wrapper for an ICC profile (which is not modified)
    - Defined in a new formal architecture under the AFP Architecture umbrella – the Color Management Object Content Architecture (CMOCA)
    - Published in the new CMOCA Architecture Reference
    - Allows color management constructs like ICC profiles, tone transfer curves, halftones, to be **processed as AFP resources** – download once, reference multiple times, capture in device, package in inline resource group, etc.

CMR Structure

Length (bytes)	Name	Description
4	***Length***	CMR length, including length field
4	***Signature***	Eye-catcher string
2	***Reserved***	Set to zero
16	***CMR Alias***	Human-readable name
4	***CMR Type***	CMR Type
14	***CMR Version***	
28	***Device-specific fields***	
22	***Media-specific fields***	
46	***CMR-type-specific fields***	
16	***Reserved***	Set to “@...@”
8	***Reserved***	Set to zero
N	***CMRData***	CMR data

****Grayed fields in order shown define CMR name – 146 bytes = 73 characters, which is used to reference the CMR in the data stream****

CMR Types

- **Color Conversion (CC) CMRs**: contain ICC profiles (in their ICC-defined syntax) that convert a device-specific color to/from the device-independent ICC Profile Connection Space (PCS)
- **Tone Transfer Curve (TTC) CMRs**: one-dimensional curves that are used to modify the values of a particular color component, e.g. cyan
- **Halftone (HT) CMRs**: screens that are applied to multibit data
- **Indexed (IX) CMRs**: mappings of indexed (numbered) colors in the data stream to output device colors or colorant combinations
- **Link Color Conversion (LK) CMRs**: Look-up tables (LUTs) that convert directly from a device-specific input color space in the data to the device-specific output color space of the presentation device

CMR Processing Modes

- **Provides context for how a CMR that is tied to a document component should be processed**
- **Is specified along with the CMR reference and is not part of the CMR**
- **Processing modes**
  - **Audit**: an audit CMR specifies color-management processing that **has been done** on a document component; for example it may specify a color conversion that has been done on the data (similar to an ICC input profile)
  - **Instruction**: an instruction CMR specifies color-management processing that **is to be done** on a document component; for example it may specify a color conversion that is to be applied to the data (similar to an ICC output profile)
  - **Link**: a link CMR is used to convert an input color space in the presentation data directly to the output color space of the presentation device without going through the PCS (similar to an ICC device link profile)

CMR Installation

- **CMRs can be installed in an AFP resource library with an application that:**
  - uploads the CMR into the resource library of a print server
  - builds the CMR Resource Access Table (RAT) entry for the CMR
- **CMRs may also be carried in a printfile-level resource group in a BRS - BOC/EOC – ERS container, and are then called inline CMRs**
  - BRS specifies CMR name
  - Print server always searches for CMRs first in resource group, then in resource library via CMR RAT

Associating CMRs with a MO:DCA document component

- **CMRs can be associated with document components at all levels of the MO:DCA document hierarchy:**
  - Printfile (highest)
  - Document
  - Group of pages/sheets
  - Page/overlay
  - Data object (lowest)
- **A CMR at a lower level always overrides – for that document component only – a conflicting CMR at a higher level**
  - Example: CC CMR at printfile level defines RGB = scanner (y) RGB, CC CMR at page (n) level defines RGB = scanner (x) RGB. According to rule, since CC CMRs conflict, all RGB for page (n) is interpreted as scanner (x) RGB

CMR Type: Color Conversion (CC) CMR

ICC Profile Connection Space (PCS) - CIELab D50 or CIEXYZ D50 (24 bit)

TIFF image
24 bit RGB
scanner x

CC CMR: scanner x ICC profile - RGB --> PCS

Processing mode = audit

CC CMR: Infocolor 130+ ICC profile - PCS --> CMYK

Processing mode = instruction

Printer bit map
32 bit CMYK
Infocolor 130+

Link Color Conversions (contd)

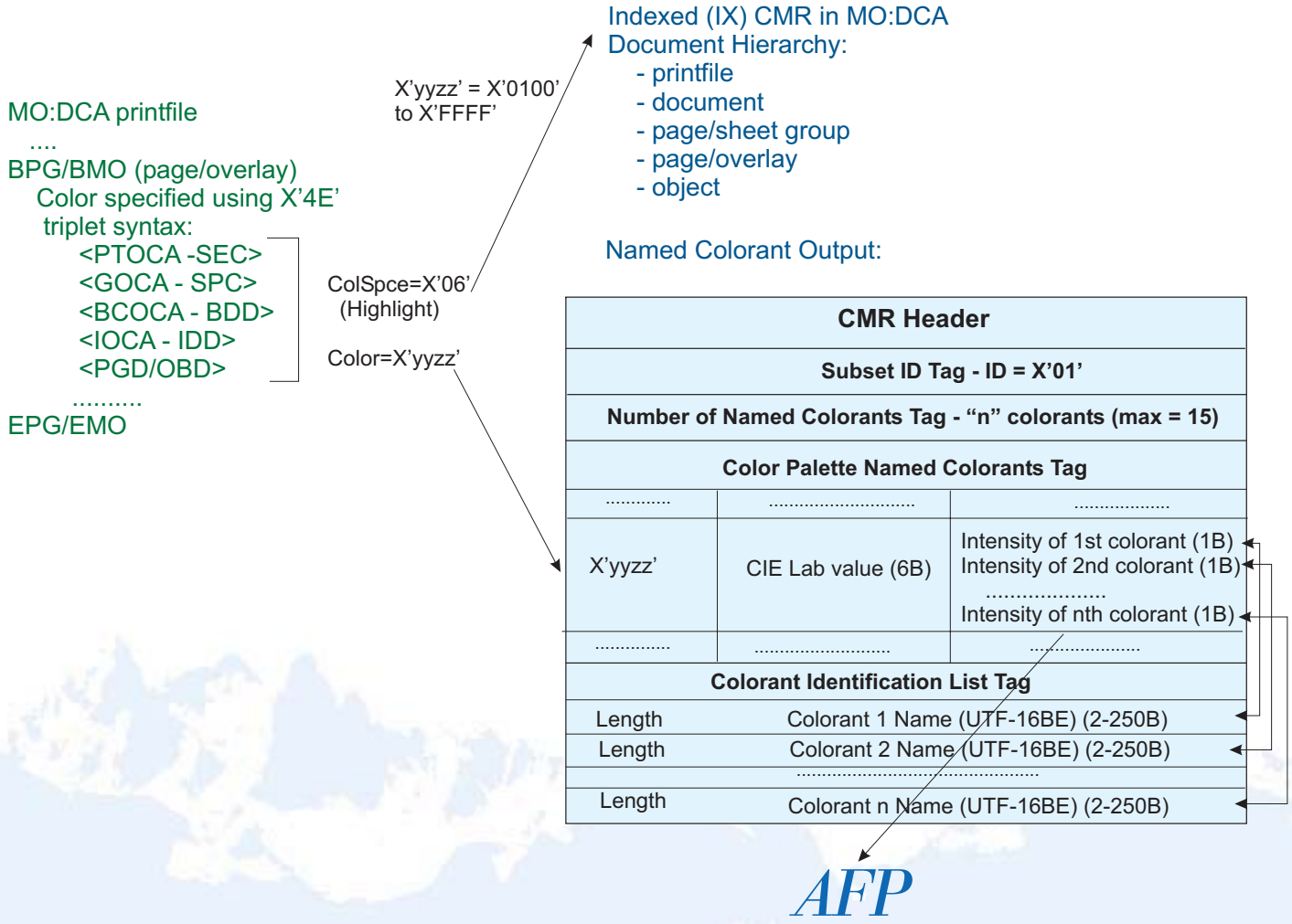
TIFF image
24 bit RGB
scanner x

LK CMR:
scanner x RGB ->
Infocolor 130+ CMYK

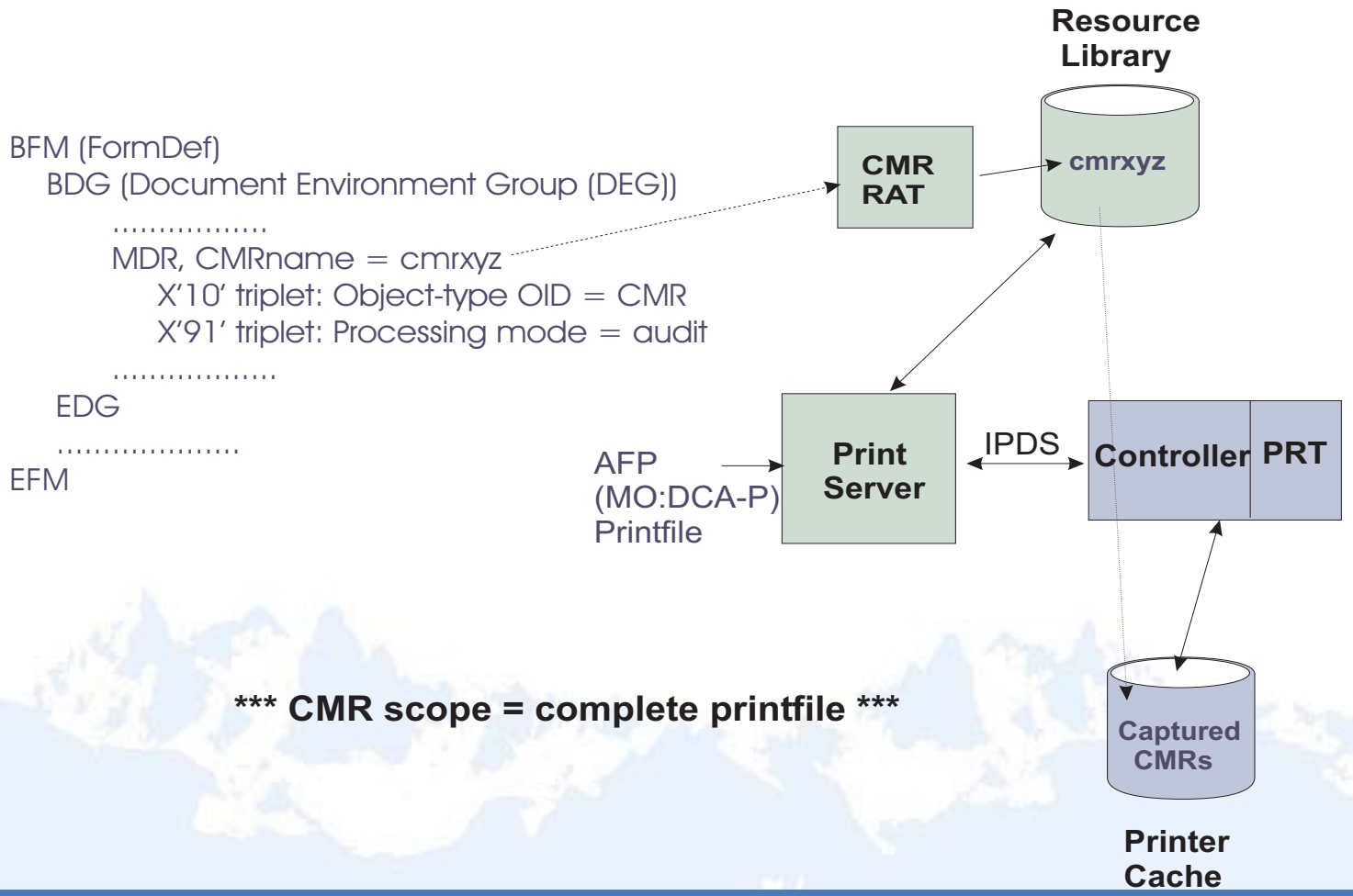
Printer bit map
32 bit CMYK
Infocolor 130+

Processing mode = link

CMR Type: Indexed (IX) CMR - named colorant output

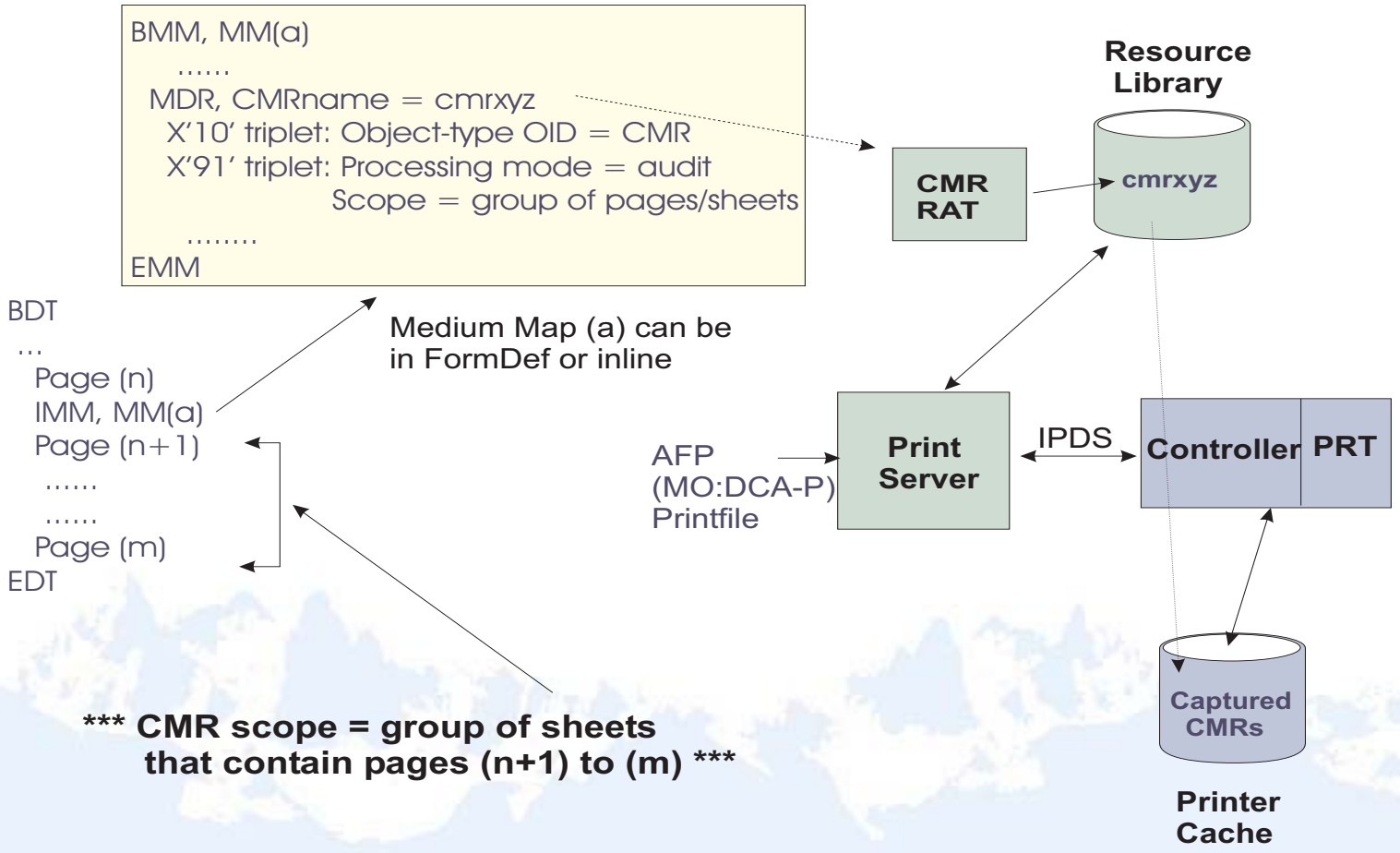


Associating CMRs with a Document Component: Printfile

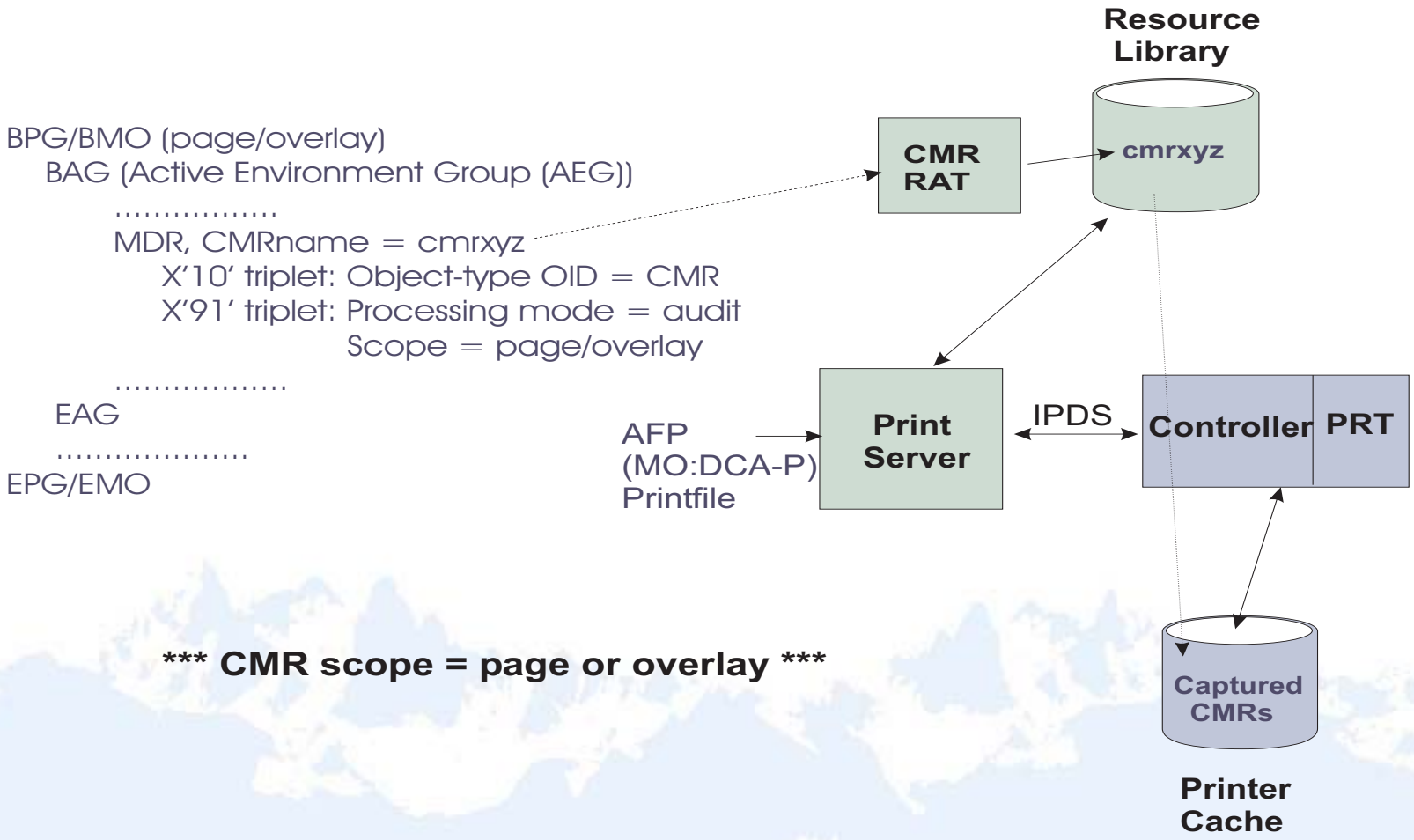


***** CMR scope = complete printfile *****

Associating CMRs with a Document Component: Group of pages/sheets

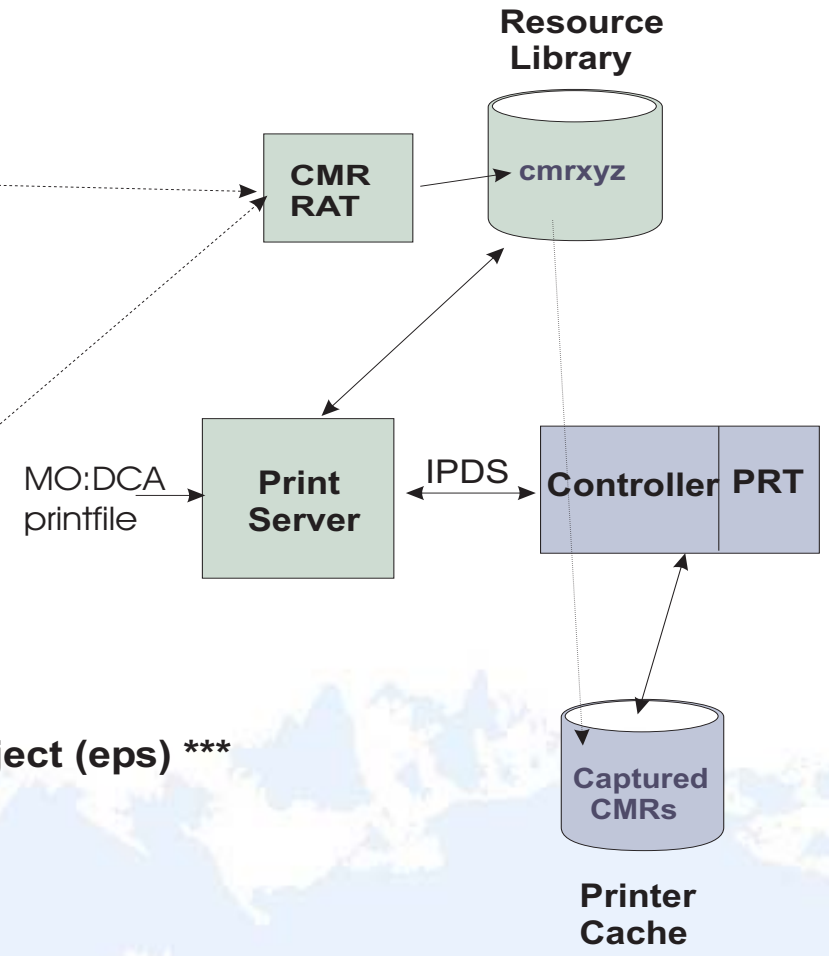


Associating CMRs with a Document Component: Page/Overlay



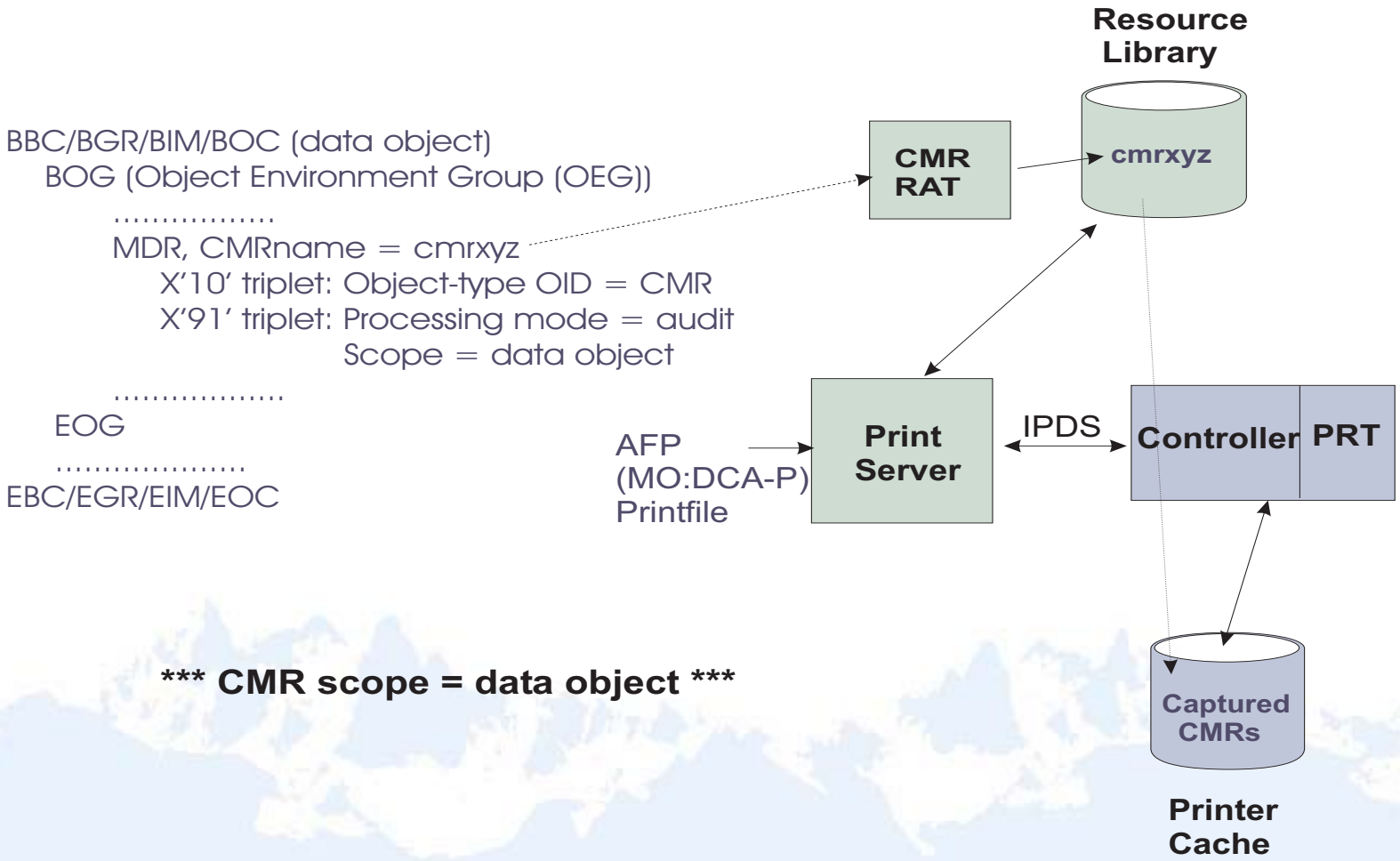
Associating CMRs with a Document Component: Data Object via IOB

BPG/BMO (page/overlay)
  BAG (Active Environment Group (AEG))
    .....
    MDR
      FQN type X'DE' triplet: cmrxyz
      X'91' triplet: Processing mode = audit
                     Scope = data object
    .....
  EAG
    .....
    IOB
      FQN type X'01' triplet: epslogo
      X'10' triplet: Object-type OID = eps
      FQN type X'DE' triplet: cmrxyz
      X'91' triplet: Processing mode = audit
                     Scope = data object
    .....
EPG/EMO

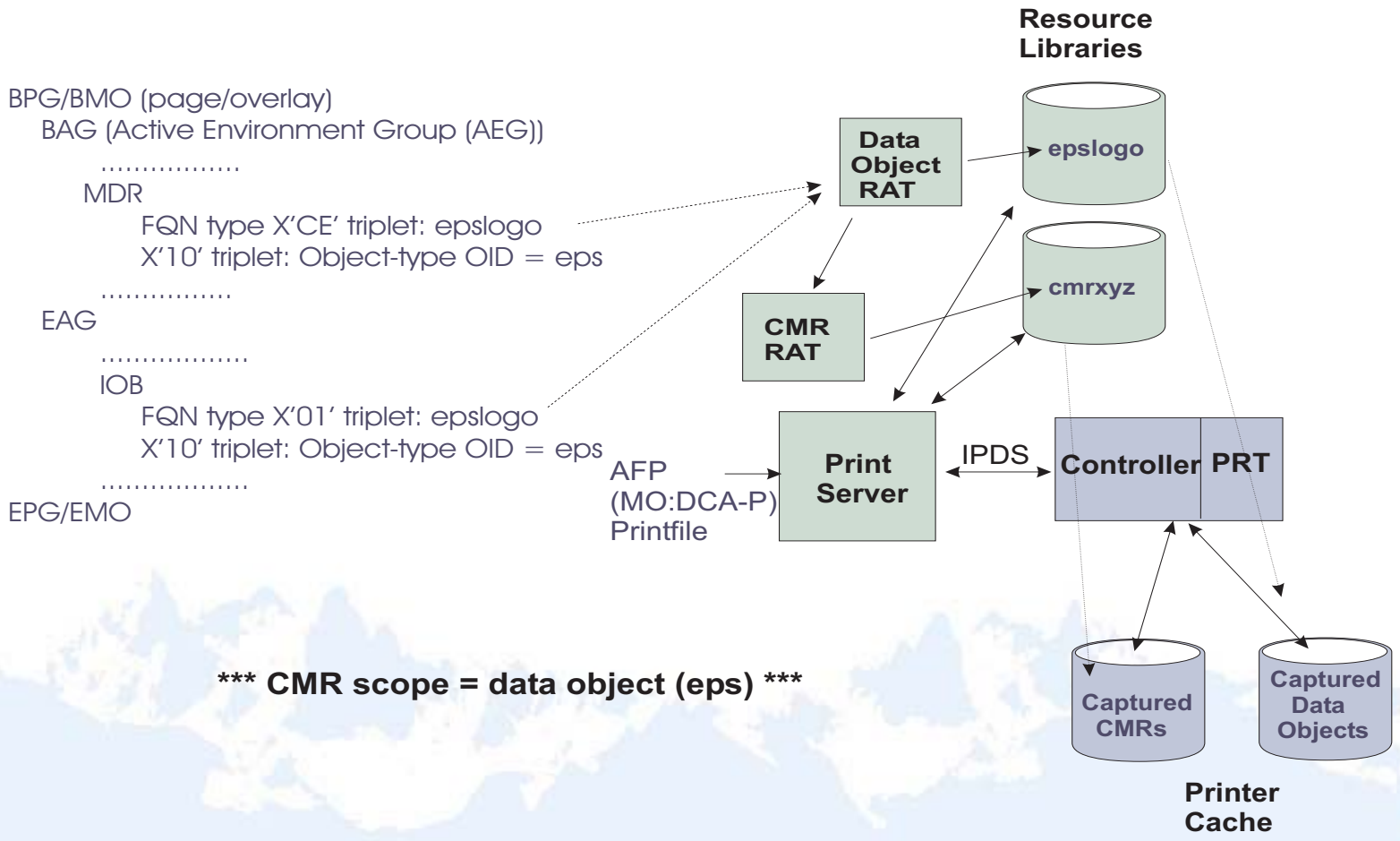


***** CMR scope = data object (eps) *****

Associating CMRs with a Document Component: Data Object via OEG



Associating CMRs with a Data Object via Data Object RAT



Rendering Intent

- **To properly process a Color Conversion CMR (that contains an ICC profile) and a Link Color Conversion CMR (that effectively provides a conversion between two ICC profiles), system needs to know user rendering intent**
- **Rendering intents defined by ICC**
  - **Perceptual**: Preserve appearance by mapping all colors into the device gamut while maintaining color relationships; typically used to render continuous-tone images
  - **Saturation**: Generate vivid, saturated colors, even at the expense of color accuracy; typically used for business graphics
  - **Media-relative colorimetric**: Maps white point of source color to white point of output media; reproduces all in-gamut colors accurately. Colors 'look right' but may not be accurate colorimetrically. Typically used for vector graphics or images.
  - **ICC-absolute colorimetric**: Does not map white point of source color to white point of output media; reproduces all in-gamut colors accurately. Colors are accurate colorimetrically but may not 'look right'. Typically used for logos or proofing, i.e., simulating output of one device/media on another device/media.

Rendering Intent (contd)

- **Associated with MO:DCA document components at the same levels of the document hierarchy as CMRs**
  - Printfile (highest)
  - Document
  - Group of pages/sheets
  - Page/overlay
  - Data object (lowest)
- **RI triplet specifies rendering intent independently for each major AFP object-type category**
  - IOCA
  - Object containers (EPS/PDF/TIFF/JFIF/GIF)
  - PTOCA
  - GOCA

Future Directions

- Develop AFP as the best-of-breed presentation architecture for monochrome and color production variable-data printing
  - Based on customer requirements, fill-in “missing” functionality in AFP formats - PTOCA, GOCA, IOCA, BCOCA
- Develop infrastructure – architecture levels, testing, certification, etc. to ensure interoperability of AFP products developed by AFPC members
  - Formatting applications
  - Transforms
  - Print Servers
  - Printers
- Develop extensions to allow AFP environments/products to better interoperate with other environments – PS/PDF, XML, web, view, archive, sort/search, index, etc; requires better *metadata* support

Summary

- AFP is now an open industry standard, developed by the AFP Consortium (AFPC)
- AFP has been extended with a number of significant advances in the past few years:
  - TrueType/OpenType font support
  - Unicode encoding
  - Resource Access Tables (RATs)
  - ICC-based color management
- Future Directions
  - Best-of-breed presentation architecture
  - Interoperability of products
  - Interoperability with other environments