V4 raison d'être to enable intelligent CMMs and improve results for non-linear color spaces

- Benefits developed for V4 that are compatible in V2 profiles:
  - Use of Perceptual Reference Medium Gamut (PRMG) in PCS for the Perceptual rendering intent
  - The computation steps required for the mediaWhitePointTag were clarified in V4 (encoding is not changed).
  - V4 specified the proper meaning and interpretation of the multiple rendering intents in ICC profiles: The availability of clearly defined perceptual and colorimetric paths equally in source and destination profiles, the clear definition of relative colorimetric as measurement, and the emphasis on perceptual intent invertibility, enables consistent re-master, re-purpose, re-target workflows.
  - Tag precedence order in monochrome profiles: In the case of using a monochrome profile for a non-neutral colorant the AToB1Tag/ BToA1Tag typically gives better results than the grayTRCTag. A V4 CMM will ignore the grayTRCTag if AToB1Tag/ BToA1Tag are present.
- Benefits to rendering quality:
  - Parametric curves in V4: Parametric curves provide an essential quality improvement for non-linear color spaces. Large visible differences occur with such color spaces between v2 profiles using LUT curves (even 1000 pts) and v4 profiles using parametric curves in combination with CMM that uses internal float. Parametric curves are also much smaller in the profiles than the corresponding LUTs.
  - Float LUTs: New V4.3 includes use of floating point LUTs so provides improved precision for transforming between non-linear color space encodings. Note: the floating point LUTs include definition of number of grid points in each dimension.
  - PRMG: V2 profiles can be built with PRM or PRMG as PCS target so that is not a V2-V4 distinction – however – only V4 includes the tag that indicates 'prmg is used'. An intelligent CMM can improve results when informed of source and destination PCS gamut match/mismatch.
  - PCS–Device and Device–PCS transforms can be reversed in N-LUT profiles: Prior to V4, the lut8 or lut16 structures were used in either direction. Hence the same sequence of transform elements was required in either direction: (Matrix) $\Rightarrow$ (1D) $\Rightarrow$ (CLUT) $\Rightarrow$ (1D). V4 defines distinct lut types for each direction, lutAtoBType [1D - CLUT - 1D - Matrix -1D] and lutBtoAType [1D - Matrix - 1D - CLUT - 1D], enabling inverse operations in AtoB and BtoA directions. Note also this matrix is upgraded to a 3x4 array.
- Benefits to rendering quality when used by 'smart' CMM:
  - ciis tag: New V4.3 includes a tag that removes longstanding ambiguity with respect o the meaning of the data produced by the relative colorimetric intent in PCS. This clarification allows intelligent CMMs to provide accurate treatment of scene data vs. picture-referred data.
  - Directly encode ICC-absolute rendering intent: new V4.3 enables direct encoding of ICC-absolute rendering intent for use when the simple scaling relationship between the ICC relative colorimetric and ICC absolute rendering intents is not sufficient. An intelligent CMM can use this to improve cross-media proofing.
  - 4 < colorant printer profiles: The colorantTableTag is provided for xCLR colour spaces. This tag enables the names and XYZ or L*a*b* values of the colorants to be specified for these N-color device colour spaces. Intelligent application/RIP/CMMs can use this information to evaluate equivalence of device colour spaces using other colorants. The XYZ or L*a*b* values may also be used to derive the visual density of the colorant, which trapping algorithms may then use to determine overlay values.

- Named color profiles: Improved support of re-targeting spot colors to be printed using N-clr colorant sets. V4 has the new option to include colorantTableTag in named color profiles for the case in which the device color space included in the namedColor2Tag is an N-clr space (that same N-clr space is indicated in the profile header). If the color space field in the header of a named color profile is one of the NcolorData signatures then that device color space pertains to the device code values in the namedColor2Tag. For example, V4 named color profiles can associate particular spot colors and their closest hexachrome equivalent. The colorantTableTag is used to define the hexachrome device color primaries. With this information an intelligent CMM can also re-target spot colors to an alternative device colorant set.
- Chromatic adaptation tag: When device-side is not PCS viewing condition this tag allows an intelligent CMM to undo the adaptation in a RI and perform consistent chromatic adaptation through a pair of source and destination profiles.

- Benefits to profile efficiency and exchange:
  - Converted most textType Tags to multiLocalizedUnicodeType: charTargetTag is kept as textType for compatibility with referenced characterization data sets. This is a significant benefit for worldwide use of profiles.
  - lutA2B structure: Profiles for non-linear color encodings can be smaller in V4 than in V2. Using lutA2B structure allows grid step size to be specified independently in each dimension. In some cases one or more CLUT dimensions require a smaller grid step size for desired quality, whereas the step size in other dimensions can be larger without a quality problem.
  - Revised encoding of 16-bit CIELAB PCS: The new encoding provides improved interpolation consistency between the 8-bit and 16-bit CIELAB PCS encodings.
  - Defined pad bytes and MD5 fingerprint in the Profile ID field: This change provides a way to identify each profile with a checksum. Profile filenames are often used to indicate the applicability of the profile and so may be changed by users. The Profile ID can be used to determine whether profile files with different filenames are the same.