Image Object Content Architecture Addendum 1.0 to Reference SC31-6805-05

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This Addendum describes some of the changes from the latest published Reference SC31-6805-05

IOCA Function Set 40 (IOCA FS40)

Function Set 40 is a subset of Function Set 45. It describes tiled images with one bit per spot (color space YCbCr or YCrCb, IDESZ=1). This function set is carried by the MO:DCA-P controlling environment. The permissible parameter groupings in FS40 are defined as follows:

Table 1. Function Set 40 Structure

	X'70'	Begin Segment parameter		
	X'91'	Begin Image Content parameter		
	X'FEBB'	Tile TOC parameter		
[	X'95'	Image Encoding parameter		]
[	X'96'	IDE Size parameter		]
[	X'9B'	IDE Structure parameter		]
[		Tiles	(S)	]
	X'93'	End Image Content parameter		
	X'71'	End Segment parameter		

Table 2. Tile Structure

	X'8C'	Begin Tile parameter		
	X'B5'	Tile Position parameter		
	X'B6'	Tile Size parameter		
[	X'95'	Image Encoding parameter		]
[	X'96'	IDE Size parameter		]
[	X'9B'	IDE Structure parameter		]
[	X'FE92'	Image Data	(S)	]
	X'8D'	End Tile		

Notes:

1. Note that the parameters in the above diagram must come in the specified order. Even though the general IOCA architecture allows different ordering for some of the parameters, the FS40 specification is more restrictive. If the parameters are given in a different order, an out-of-sequence exception is raised.
2. In the context of FS40, Image Size parameter, Image Subsampling parameter, External Algorithm parameter, and Image LUT ID parameter cause EC-0001 exception (Invalid parameter) to occur. If the first parameter after the Begin Image Content parameter is not the Tile TOC parameter, the image is not a tiled image and any of the tile-specific parameters (Tile TOC parameter, Begin Tile parameter, etc.) cause EC-0001 to occur.
3. Image Encoding parameter, IDE Size parameter, Band Image parameter, and IDE Structure parameter are shown as optional and can possibly be specified in two places. The specification within a tile takes precedence over a specification outside of the tile.
4. If IDE Size parameter is not present, the default IDE size is one bit per pel (bilevel image).
5. If the Image Encoding parameter is not present, the default compression algorithm is X'03' (No Compression). The recording algorithm defaults to X'01' (RIDIC); and the bit and byte orders default to zero.

IOCA Self-Defining Field	Parameter (Bytes)	Acceptable Value	Comments
Initial parameters in Function Set 40:			
Begin Segment	ID (1)	X'70'	
	LENGTH (1)	X'00'	
Begin Image Content	ID (1)	X'91'	
	LENGTH (1)	X'01'	
	OBJTYPE (1)	X'FF'	IOCA
Tile TOC parameter	ID (2)	X'FEBB'	
	LENGTH (2)		
	Reserved (2)	X'0000'	Reserved; should be set to zero
	Either zero repeating groups, or one per tile in the following format:		
	XOFFSET (4)	X'00000000' — X'7FFFFFFF'	Horizontal tile origin
	YOFFSET (4)	X'00000000' — X'7FFFFFFF'	Vertical tile origin
	THSIZE (4)	X'00000000' — X'7FFFFFFF'	Horizontal tile size
	TVSIZE (4)	X'00000000' — X'7FFFFFFF'	Vertical tile size
	RELRES (1)	X'01'	Relative resolution
	COMPR (1)		Compression algorithm
	DATAPOS (8)		File offset to the beginning of the tile
Image Encoding Parameter	ID (1)	X'95'	
	LENGTH (1)	X'02' — X'03'	
	COMPRID (1)	X'01', X'03', X'08', X'82'	**X'01'** IBM MMR–Modified Modified READ (see General Note) **X'03'** No Compression **X'08'** ABIC (bilevel Q-coder) (see General Note) **X'82'** G4 MMR–Modified Modified READ (see General Note)
	RECID (1)	X'01', X'04'	**X'01'** RIDIC **X'04'** Unpadded RIDIC
	BITORDR	X'00' — X'01'	**X'00'** Bit order within each image data byte is from left to right

IOCA Self-Defining Field	Parameter (Bytes)	Acceptable Value	Comments
IDE Size Parameter	ID (1)	X'96'	
	LENGTH (1)	X'01'	
	IDESZ (1)	X'01'	**X'01'** 1 bit/IDE
Initial parameters in a tile:			
Begin Tile parameter	ID (1)	X'8C'	
	LENGTH (1)	X'00'	
Tile Position parameter	ID (1)	X'B5'	
	LENGTH (1)	X'08'	
	XOFFSET (4)	X'00000000' — X'7FFFFFFF'	Horizontal tile origin
	YOFFSET (4)	X'00000000' — X'7FFFFFFF'	Vertical tile origin
Tile Size parameter	ID (1)	X'B6'	
	LENGTH (1)	X'08' — X'09'	
	THSIZE (4)	X'00000000' — X'7FFFFFFF'	Horizontal tile size
	TVSIZE (4)	X'00000000' — X'7FFFFFFF'	Vertical tile size
	RELRES (1)	X'01'	Relative resolution
Tile parameters			
Image Encoding parameter	ID (1)	X'95'	
	LENGTH (1)	X'03' — X'03'	
	COMPRID (1)	X'01', X'03', X'08', X'82'	**X'01'** IBM MMR–Modified Modified READ (see General Note) **X'03'** No Compression **X'08'** ABIC (bilevel Q-coder) **X'82'** G4 MMR–Modified Modified READ (see General Note)
	RECID (1)	X'01', X'04'	**X'01'** RIDIC **X'04'** Unpadded RIDIC
	BITORDR (1)	X'00' — X'01'	**X'00'** Bit order within each image data byte is from left to right **X'01'** Bit order within each image data byte is from right to left

IOCA Self-Defining Field	Parameter (Bytes)	Acceptable Value	Comments
IDE Size Parameter	ID (1)	X'96'	
	LENGTH (1)	X'01'	
	IDESZ (1)	X'01'	1 bit/IDE
IDE Structure Parameter	ID (1)	X'9B'	
	LENGTH (1)	X'06' — X'08'	
	FLAGS (1)		
	ASFLAG	B'0'	Additive
	GRAYCODE	B'0'	No gray coding
	RESERVED	B'000000'	Should be zero
	FORMAT (1)	X'02', X'12'	**X'02'** YCrCb **X'12'** YCbCr
	RESERVED (3)	X'000000'	Should be zero
	SIZE1 (1)	X'01'	1 bit/IDE
	SIZE2 (1)	X'00'	0 bit/IDE
	SIZE3 (1)	X'00'	0 bit/IDE
Image Data	ID (2)	X'FE92'	
	LENGTH (2)	X'0001' — X'FFFF'	
	DATA	Any	IDEs (see Note on the tile-final parameters)
End Tile	ID (1)	X'8D'	
	LENGTH (1)	X'00'	
Note on the tile-final parameters: With IDESZ=1 and LUTID=0, IDE value 0 represents an *insignificant* image point, and 1 represents a *significant* image point. The interpretation of this value is determined by the Set Bilevel Image Color parameter or, lacking that, the device default.			
Final parameters in Function Set 42:			
End Image Content	ID (1)	X'93'	
	LENGTH (1)	X'00'	
End Segment	ID (1)	X'71'	
	LENGTH (1)	X'00'	
General note: ABIC, IBM MMR–Modified Modified READ and G4 MMR–Modified Modified READ are applicable only to images whose IDE size is 1 bit per band, otherwise exception condition EC-9611 is raised.			

Set Extended Bilevel Image Color

This optional self-defining field specifies a color value and defines the color space and encoding for that value. This SDF is applicable only to significant image points of bilevel images with zero LUT IDs.

Syntax

Offset	Type	Name	Range	Meaning	M/O
0	CODE	ID	X'F4'	Set Extended Bilevel Image Color	M
1	UBIN	LENGTH	12 - 14	Length of the parameters to follow	M
2				Reserved; must be zero	M
3	CODE	ColSpce	X'01', X'04', X'06', X'08', X'40'	Color space: **X'01'** RGB **X'04'** CMYK **X'06'** Highlight color space **X'08'** CIELAB **X'40'** Standard OCA color space	M
4–7				Reserved; must be zero	M
8	UBIN	ColSize1	X'01' — X'08', X'10'	Number of bits in component 1; see color space definitions	M
9	UBIN	ColSize2	X'00' — X'08'	Number of bits in component 2; see color space definitions	M
10	UBIN	ColSize3	X'00' — X'08'	Number of bits in component 3; see color space definitions	M
11	UBIN	ColSize4	X'00' — X'08'	Number of bits in component 4; see color space definitions	M
12–*n*		Color		Color specification; see "Set Extended Bilevel Image Color Semantics" for details	M

Set Extended Bilevel Image Color Semantics

ColSpce Is a code that defines the color space and the encoding for the color specification.

Value **Description**

X'01' RGB color space. The color value is specified with three components. Components 1, 2, and 3 are unsigned binary numbers that specify the red, green, and blue intensity values, in that order. ColSize1, ColSize2, and ColSize3 are non-zero and define the number of bits used to specify each component. ColSize4 is reserved and should be set to

zero. The intensity range for the R,G,B components is 0 to 1, which is mapped to the binary value range 0 to ($2^{ColSizeN} - 1$), where N=1,2,3.

Architecture Note: The reference white point and the chromaticity coordinates for RGB are defined in SMPTE RP 145-1987, entitled *Color Monitor Colorimetry*, and in RP 37-1969, entitled *Color Temperature for Color Television Studio Monitors*, respectively. The reference white point is commonly known as *Illuminant* D_{6500} or simply *D65*. The R,G,B components are assumed to be gamma-corrected (non-linear) with a gamma of 2.2.

X'04' CMYK color space. The color value is specified with four components. Components 1, 2, 3, and 4 are unsigned binary numbers that specify the cyan, magenta, yellow, and black intensity values, in that order. ColSize1, ColSize2, ColSize3, and ColSize4 are non-zero and define the number of bits used to specify each component. The intensity range for the C,M,Y,K components is 0 to 1, which is mapped to the binary value range 0 to ($2^{ColSize_N} - 1$), where N=1,2,3,4. This is a device-dependent color space.

X'06' Highlight color space. This color space defines a request for the presentation device to generate a highlight color. The color value is specified with one to three components.

Component 1 is a two-byte unsigned binary number that specifies the highlight color number. The first highlight color is assigned X'0001', the second highlight color is assigned X'0002', and so on. The value X'0000'. specifies the presentation device default color. ColSize1 = X'10' and defines the number of bits used to specify component 1.

Component 2 is an optional one-byte unsigned binary number that specifies a percent coverage for the specified color. Percent coverage can be any value from 0% to 100% (X'00'—X'64'). The number of distinct values supported is presentation-device dependent. If the coverage is less than 100%, the remaining coverage is achieved with color of medium. ColSize2 = X'00' or X'08' and defines the number of bits used to specify component 2. A value of X'00' indicates that component 2 is not specified in the color value, in which case the architected default for percent coverage is 100%. A value of X'08' indicates that component 2 is specified in the color value.

Component 3 is an optional one-byte unsigned binary number that specifies a percent shading, which is a percentage of black that is to be added to the specified color. Percent shading can be any value from 0% to 100% (X'00'—X'64'). The number of distinct values supported is presentation-device dependent. If percent coverage and percent shading are specified, the effective range for percent shading is 0% to (100-coverage)%. If the sum of

percent coverage plus percent shading is less than 100%, the remaining coverage is achieved with color of medium. ColSize3 = X'00' or X'08' and defines the number of bits used to specify component 3. A value of X'00' indicates that component 3 is not specified in the color value, in which case the architected default for percent shading is 0%. A value of X'08' indicates that component 3 is specified in the color value.

Implementation Note: The percent shading parameter is currently not supported in AFP environments.

ColSize4 is reserved and should be set to zero. This is a device-dependent color space.

Architecture Notes:

1. The color that is rendered when a highlight color is specified is device-dependent. For presentation devices that support colors other than black, highlight color values in the range X'0001' to X'FFFF' may be mapped to any color. For bi-level devices, the color may be simulated with a graphic pattern.
2. If the specified highlight color is "presentation device default", devices whose default color is black use the percent coverage parameter, which is specified in component 2, to render a percent shading.
3. On printing devices, the color of medium is normally white, in which case a coverage of *n*% results in adding (100–*n*)% white to the specified color, or *tinting* the color with (100–*n*)% white. Display devices may assume the color of medium to always be white and use this algorithm to render the specified coverage.
4. The highlight color space can also specify indexed colors when used in conjunction with a Color Mapping Table (CMT) or an Indexed (IX) Color Management Resource (CMR). When used with an Indexed CMR, component 1 specifies a two-byte value that is the index into the CMR and components 2 and 3 are ignored. Note that when both a CMT and Indexed CMRs are used, the CMT is always accessed first. To preserve compatibility with existing highlight color devices, indexed color values X'0000' to X'00FF' are reserved for existing highlight color applications ad devices. That is, indexed color values in range X'0000' to X'00FF', assuming they are not mapped in a CMT, are mapped directly to highlight colors. Indexed color values in the range X'0100' to X'FFFF', assuming they are not mapped in a CMT, are used to access Indexed CMRs.

X'08' CIELAB color space. The color value is specified with three components. Components 1, 2, and 3 are binary numbers that specify the L, a, b values, in that order, where L is the luminance and a and b are the chrominance differences. Component 1 specifies the L value as an unsigned binary

number; components 2 and 3 specify the a and b values as signed binary numbers. ColSize1, ColSize2, and ColSize3 are non-zero and define the number of bits used to specify each component. ColSize4 is reserved and should be set to zero. The range for the L component is 0 to 100, which is mapped to the binary value range 0 to $(2^{\text{ColSize1}} - 1)$. The range for the a and b components is −127 to +127, which is mapped to the binary range $-(2^{\text{ColSize}N-1} - 1)$ to $+(2^{\text{ColSize}N-1} - 1)$.

For color fidelity, 8-bit encoding should be used for each component, that is, ColSize1, ColSize2, and ColSize3 are set to X'08'. When the recommended 8-bit encoding is used for the a and b components, the range is extended to include −128, which is mapped to the value X'80'. If the encoding is less than 8 bits, treatment of the most negative binary endpoint for the a and b components is device-dependent, and tends to be insignificant because of the quantization error.

Architecture Note: The reference white point for CIELAB is known as *D50* and is defined in CIE publication 15-2 entitled *Colorimetry*.

X'40' Standard OCA color space. The color value is specified with one component. Component 1 is an unsigned binary number that specifies a named color using a two-byte value from the Standard OCA Color Value Table. ColSize1 = X'10' and defines the number of bits used to specify component 1. ColSize2, ColSize3, ColSize4 are reserved and should be set to zero. This is a device-dependent color space.

All others
Reserved

ColSize1 Defines the number of bits used to specify the first color component. The color component is right-aligned and padded with zeros on the left to the nearest byte boundary. For example, if ColSize1 = X'06', the first color component has two padding bits.

ColSize2 Defines the number of bits used to specify the second color component. The color component is right-aligned and padded with zeros on the left to the nearest byte boundary.

ColSize3 Defines the number of bits used to specify the third color component. The color component is right-aligned and padded with zeros on the left to the nearest byte boundary.

ColSize4 Defines the number of bits used to specify the fourth color component. The color component is right-aligned and padded with zeros on the left to the nearest byte boundary.

Color Specifies the color value in the defined format and encoding. Note that the number of bytes specified for this parameter depends on the color space. For example, when using 8 bits per component, an RGB color value is specified with 3 bytes, while a CMYK color value is specified with 4 bytes. If extra bytes are specified, they are ignored as long as the self-defining field length is valid.

Architecture Note: For a description of color spaces and their relationships, see R. Hunt, *The Reproduction of Colour in Photography, Printing, and Television*, Fifth Edition, Fountain Press, 1995.

Notes:

1. This self-defining field is ignored if it is present and the image is not bilevel or with a non-zero LUT ID.
2. This field can coexist with the Set Bilevel Image Color self-defining field.
3. If multiple instances of this field and the Set Bilevel Image Color field are present, the last instance of a supported field is used, while the others are ignored.

If an invalid or unsupported value is encountered in the self-defining field, the entire self-defining field is ignored. The IOCA Process Model should notify the controlling environment if this exception condition appears, or if multiple instances of this field and/or Set Bilevel Image Color field are present.

Tile Set Color

Syntax:

Offset	Type	Name	Range	Meaning	M/O
0	CODE	ID	X'B7'	Tile Set Color	M
1	UBIN	LENGTH	X'0A' - X'10'	Length of the parameters to follow	M
2	CODE	CSPACE	X'01', X'04', X'06', X'08', X'40'	Color space: **X'01'** RGB **X'04'** CMYK **X'06'** Highlight color space **X'08'** CIELAB **X'40'** Standard OCA color space	M
3–5	UBIN	RESERVED	X'000000'	Reserved; should be zero	M
6	UBIN	SIZE1	X'01' — X'08', X'10'	Number of bits in component 1; see color space definitions	M
7	UBIN	SIZE2	X'00' — X'08'	Number of bits in component 2; see color space definitions	M
8	UBIN	SIZE3	X'00' — X'08'	Number of bits in component 3; see color space definitions	M
9	UBIN	SIZE4	X'00' — X'08'	Number of bits in component 4; see color space definitions	M
10–*n*		Color		Color specification; see "Tile Set Color Semantics" for details	M

- Notes 5, 6, 7 and 8 in the Tile Set Color description will be replaced by the new semantics section as follows:

Tile Set Color Semantics

CSPACE Is a code that defines the color space and the encoding for the color specification.

Value **Description**

X'01' RGB color space. The color value is specified with three components. Components 1, 2, and 3 are unsigned binary numbers that specify the red, green, and blue intensity values, in that order. SIZE1, SIZE2, and SIZE3 are non-zero and define the number of bits used to specify each component. SIZE4 is reserved and should be set to zero. The intensity range for the R,G,B components is 0 to 1, which is mapped to the binary value range 0 to (2^{SIZEN} – 1), where N=1,2,3.

Architecture Note: The reference white point and the chromaticity coordinates for RGB are

defined in SMPTE RP 145-1987, entitled *Color Monitor Colorimetry*, and in RP 37-1969, entitled *Color Temperature for Color Television Studio Monitors*, respectively. The reference white point is commonly known as *Illuminant* D_{6500} or simply *D65*. The R,G,B components are assumed to be gamma-corrected (non-linear) with a gamma of 2.2.

X'04' CMYK color space. The color value is specified with four components. Components 1, 2, 3, and 4 are unsigned binary numbers that specify the cyan, magenta, yellow, and black intensity values, in that order. SIZE1, SIZE2, SIZE3, and SIZE4 are non-zero and define the number of bits used to specify each component. The intensity range for the C,M,Y,K components is 0 to 1, which is mapped to the binary value range 0 to $(2^{SIZEN} - 1)$, where N=1,2,3,4. This is a device-dependent color space.

X'06' Highlight color space. This color space defines a request for the presentation device to generate a highlight color. The color value is specified with one to three components.

Component 1 is a two-byte unsigned binary number that specifies the highlight color number. The first highlight color is assigned X'0001', the second highlight color is assigned X'0002', and so on. The value X'0000'. specifies the presentation device default color. SIZE1 = X'10' and defines the number of bits used to specify component 1.

Component 2 is an optional one-byte unsigned binary number that specifies a percent coverage for the specified color. Percent coverage can be any value from 0% to 100% (X'00'—X'64'). The number of distinct values supported is presentation-device dependent. If the coverage is less than 100%, the remaining coverage is achieved with color of medium. SIZE2 = X'00' or X'08' and defines the number of bits used to specify component 2. A value of X'00' indicates that component 2 is not specified in the color value, in which case the architected default for percent coverage is 100%. A value of X'08' indicates that component 2 is specified in the color value.

Component 3 is an optional one-byte unsigned binary number that specifies a percent shading, which is a percentage of black that is to be added to the specified color. Percent shading can be any value from 0% to 100% (X'00'—X'64'). The number of distinct values supported is presentation-device dependent. If percent coverage and percent shading are specified, the effective range for percent shading is 0% to (100-coverage)%. If the sum of percent coverage plus percent shading is less than 100%, the remaining coverage is achieved with color of medium. SIZE3 = X'00' or X'08' and defines the number of bits used to specify component 3. A value of X'00' indicates that component 3 is not specified in the color value, in which

case the architected default for percent shading is 0%. A value of X'08' indicates that component 3 is specified in the color value.

Implementation Note: The percent shading parameter is currently not supported in AFP environments.

SIZE4 is reserved and should be set to zero. This is a device-dependent color space.

Architecture Notes:

1. The color that is rendered when a highlight color is specified is device-dependent. For presentation devices that support colors other than black, highlight color values in the range X'0001' to X'FFFF' may be mapped to any color. For bi-level devices, the color may be simulated with a graphic pattern.
2. If the specified highlight color is "presentation device default", devices whose default color is black use the percent coverage parameter, which is specified in component 2, to render a percent shading.
3. On printing devices, the color of medium is normally white, in which case a coverage of *n*% results in adding (100–*n*)% white to the specified color, or *tinting* the color with (100–*n*)% white. Display devices may assume the color of medium to always be white and use this algorithm to render the specified coverage.
4. The highlight color space can also specify indexed colors when used in conjunction with a Color Mapping Table (CMT) or an Indexed (IX) Color Management Resource (CMR). When used with an Indexed CMR, component 1 specifies a two-byte value that is the index into the CMR and components 2 and 3 are ignored. Note that when both a CMT and Indexed CMRs are used, the CMT is always accessed first. To preserve compatibility with existing highlight color devices, indexed color values X'0000' to X'00FF' are reserved for existing highlight color applications ad devices. That is, indexed color values in range X'0000' to X'00FF', assuming they are not mapped in a CMT, are mapped directly to highlight colors. Indexed color values in the range X'0100' to X'FFFF', assuming they are not mapped in a CMT, are used to access Indexed CMRs.

X'08' CIELAB color space. The color value is specified with three components. Components 1, 2, and 3 are binary numbers that specify the L, a, b values, in that order, where L is the luminance and a and b are the chrominance differences. Component 1 specifies the L value as an unsigned binary number; components 2 and 3 specify the a and b values as signed binary numbers. SIZE1, SIZE2, and SIZE3 are non-zero and define the number of bits used to specify each component. SIZE4 is reserved and should be set to zero. The range for the L component is 0 to 100, which is

mapped to the binary value range 0 to ($2^{SIZE1} - 1$). The range for the a and b components is −127 to +127, which is mapped to the binary range −($2^{SIZEN-1} - 1$) to +($2^{SIZEN-1} - 1$).

For color fidelity, 8-bit encoding should be used for each component, that is, SIZE1, SIZE2, and SIZE3 are set to X'08'. When the recommended 8-bit encoding is used for the a and b components, the range is extended to include −128, which is mapped to the value X'80'. If the encoding is less than 8 bits, treatment of the most negative binary endpoint for the a and b components is device-dependent, and tends to be insignificant because of the quantization error.

Architecture Note: The reference white point for CIELAB is known as *D50* and is defined in CIE publication 15-2 entitled *Colorimetry*.

X'40' Standard OCA color space. The color value is specified with one component. Component 1 is an unsigned binary number that specifies a named color using a two-byte value from the Standard OCA Color Value Table. SIZE1 = X'10' and defines the number of bits used to specify component 1. SIZE2, SIZE3, SIZE4 are reserved and should be set to zero. This is a device-dependent color space.

All others
Reserved

SIZE1 Defines the number of bits used to specify the first color component. The color component is right-aligned and padded with zeros on the left to the nearest byte boundary. For example, if SIZE1 = X'06', the first color component has two padding bits.

SIZE2 Defines the number of bits used to specify the second color component. The color component is right-aligned and padded with zeros on the left to the nearest byte boundary.

SIZE3 Defines the number of bits used to specify the third color component. The color component is right-aligned and padded with zeros on the left to the nearest byte boundary.

SIZE4 Defines the number of bits used to specify the fourth color component. The color component is right-aligned and padded with zeros on the left to the nearest byte boundary.

Color Specifies the color value in the defined format and encoding. Note that the number of bytes specified for this parameter depends on the color space. For example, when using 8 bits per component, an RGB color value is specified with 3 bytes, while a CMYK color value is specified with 4 bytes. If extra bytes are specified, they are ignored as long as the self-defining field length is valid.

Architecture Note: For a description of color spaces and their relationships, see R. Hunt, *The Reproduction of Colour in Photography, Printing, and Television*, Fifth Edition, Fountain Press, 1995.

- Item 3 in exception EC-B710 (Invalid Tile Set Color Parameter) will be changed to read ″Invalid Color values″ instead of ″Invalid CVAL values″.

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