A New Canonical Naming System for ST 2110-20 Video Formats

Creating a Video Format Registry

- or -

Saving the Industry from SDP Misery

Why a Video Format Registry?

Which one is correct for 720p HD-SDI?

```
m=video 50000 RTP/AVP 112
c=IN IP4 239.100.9.10/32
a=source-filter: incl IN IP4 239.100.9.10 192.168.100.2
a=rtpmap:112 raw/90000
a=fmtp:112 sampling=YCbCr-4:2:0; width=1280; height=720; exactframerate=60000/1001; depth=10;
TCS=SDR; colorimetry=BT709; PM=2110GPM; SSN=ST2110-20:2017;

m=video 50000 RTP/AVP 112
c=IN IP4 239.100.9.10/32
a=source-filter: incl IN IP4 239.100.9.10 192.168.100.2
a=rtpmap:112 raw/90000
a=fmtp:112 sampling=YCbCr-4:2:2; width=1280; height=720; exactframerate=60000/1001; depth=10;
TCS=SDR; colorimetry=BT709; PM=2110GPM; SSN=ST2110-20:2017;

m=video 50000 RTP/AVP 112
c=IN IP4 239.100.9.10/32
a=source-filter: incl IN IP4 239.100.9.10 192.168.100.2
a=rtpmap:112 raw/90000
a=fmtp:112 sampling=YCbCr-4:2:2; width=1280; height=720; exactframerate=600000/1001;
depth=10; TCS=SDR; colorimetry=BT709; PM=2110GPM; SSN=ST2110-20:2017;
```

Wrong Color Format

Wrong Frame Rate

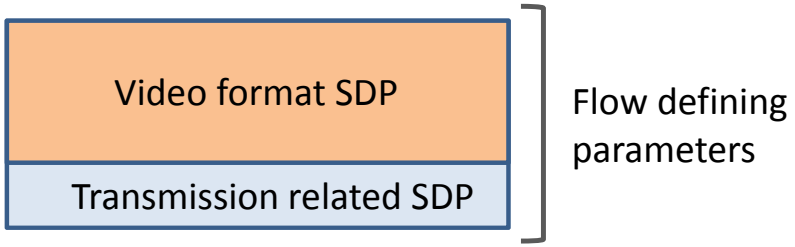
Plus, all are missing “TP=” parameter required by ST 2110-21

Describing ST 2110-20/21 Video Formats using SDP

- There are 8 mandatory SDP format parameters
  1. SSN – version ID (1 choice today)
  2. sampling – YCbCr-4:4:4 (12 choices)
  3. depth – 10 bits (5 choices)
  4. width – 1920 (32K choices)
  5. height – 1080 (32K choices)
  6. exactframerate – 60000/1001 (any M/N)
  7. colorimetry – BT601 (8 choices)
  8. PM -- 2110GPM (packing mode) (2 choices)
- There are 5 'as needed' fromat parameters
  - TCS (10 choices, SDR by default)
  - "interlace", "segmented", "PAR", "RANGE"
- Transmission related for SDP;
  - One mandatory parameter; TP = N, NL, W
  - Three 'as needed' parameters; TROFF, CMAX, MAXUDP

Total "flow defining" SDP
= 9 to 17 parameters

- 8-13, video
- 1-4, transmission



Any naming system must have an "accounting" of these 17 parameters in some manner…

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Example Canonical Name
U3300/1080i@29.97@422S/N

- U3300 – Unique ID for each registered video format
- 1080i@29.97@422S – Nickname
  - 1080 – Lines in the video image
  - i – Interlaced video
  - 29.97 – Frame rate (NOT field rate)
  - 422 – Pixel sampling format
  - S – Transfer characteristic info (SDR)
- N – Narrow transmission profile

More Examples

Unique ID	Nickname	width	height	sampling	depth	colorimetry	TCS	exactframerate	Optional SDP parameters
U1200	576i@25@422S	720	576	YCbCr-4:2:2	10	BT601	SDR	25	PAR=12:11, interlace
U120A	576i@25@422S	720	576	YCbCr-4:2:2	10	BT601	SDR	25	PAR=16:11, interlace
U1300	480i@29.97@422S	720	480	YCbCr-4:2:2	10	BT601	SDR	30000/1001	PAR=10:11, interlace
U1600	480p@59.94@422S	720	480	YCbCr-4:2:2	10	BT601	SDR	60000/1001	PAR=10:11
U1610	480p@60@422S	720	480	YCbCr-4:2:2	10	BT601	SDR	60	PAR=10:11
U2500	720@50@422S	1280	720	YCbCr-4:2:2	10	BT709	SDR	50	
U2501	720@50@420S	1280	720	YCbCr-4:2:0	8	BT709	SDR	50	
U2600	720@59.94@422S	1280	720	YCbCr-4:2:2	10	BT709	SDR	60000/1001	
U2601	720@59.94@420S	1280	720	YCbCr-4:2:0	8	BT709	SDR	60000/1001	
U2610	720@60@422S	1280	720	YCbCr-4:2:2	10	BT709	SDR	60	
U3100	1080PsF@23.98@422S	1920	1080	YCbCr-4:2:2	10	BT709	SDR	24000/1001	interlace, segmented
U3200	1080i@25@422S	1920	1080	YCbCr-4:2:2	10	BT709	SDR	25	interlace
U3201	1080i@25@420S	1920	1080	YCbCr-4:2:0	8	BT709	SDR	25	interlace
U3300	1080i@29.97@422S	1920	1080	YCbCr-4:2:2	10	BT709	SDR	30000/1001	interlace
U3301	1080i@29.97@420S	1920	1080	YCbCr-4:2:0	8	BT709	SDR	30000/1001	interlace

JSON Examples

U3100: 1080PsF@23.98@422S


```
{
    "Unique ID": "U3100",
    "Nickname": "1080PsF@23.98@422S",
    "width": "1920",
    "height": "1080",
    "sampling": "YCbCr-4:2:2",
    "depth": "10",
    "colorimetry": "BT709",
    "TCS": "SDR",
    "exactframerate": "24000/1001",
    "Optional SDP parameters": “interlace, segmented"
  },
```


U3200: 1080i@25@422S


```
{
    "Unique ID": "U3200",
    "Nickname": "1080i@25@422S",
    "width": "1920",
    "height": "1080",
    "sampling": "YCbCr-4:2:2",
    "depth": "10",
    "colorimetry": "BT709",
    "TCS": "SDR",
    "exactframerate": "25",
    "Optional SDP parameters": "interlace"
  },
```

Format Canonical Naming Proposal

- Each name is a short text notation with three (or four) fields separated by "/"
- Format is: ID/Nickname/TX_{MAN}(/TX_{OPT})
- Unique ID is assigned to every video format
  - Alpha character followed by 4 hex digits (U=Uncompressed)
  - All assigned ID's listed in public registry
- Nickname is three fields, separate by "@" symbol
  - One nickname may apply to multiple video formats
- TX_{MAN} is mandatory transmission parameter
  - N, NL or W
- TX_{OPT} are optional transmission parameters; present only if needed
  - BPM, CMAX, TROFF, MAXUDP
- All Canonical names fully described in downloadable JSON file (<50 kB)

Unique ID Naming System

- ID Format: A1234
- Alpha character – U for uncompressed
- 4 Hex Characters
  - Fix nicely into two bytes
  - Give wide range of possible IDs (65k)
- First two hex digits (1,2) have meaning
  - Image size in lines, frame rate
- Second two hex digits (3,4) try to be consistent across formats

ID Digits 1 and 2

Digit 1	Image Lines per frame	
0	1 to 479 lines	
1	480 to 719 lines	(SD)
2	720 to 1079 lines	
3	1080 to 1999 lines	(3G)
4	2000 to 3999 lines	(UHD1/4K)
5	4000 to 5999 lines	(UHD2/8K)
6	>= 6000 lines	
7-F	Reserved	

Digit 2	Frame Rate (NOT field rate)	
0	0-17	
1	18-24	Cinema
2	25-28	(25Hz SD, Interlaced video)
3	29-39	(30Hz SD, Interlaced video)
4	40-49	
5	50-58	(50Hz Progressive)
6	59-99	(60Hz Progressive)
7	100-118	
8	119-238	
9	239-478	
A	>= 479	
B-F	Reserved	

Nicknames

- Human-friendly way to identify video formats
  - Systematized to help promote widespread use, common language
  - Created for each format and stored in parameters table
  - Included in machine-readable JSON file
- Created for each registered format
- Not unique
  - Same nickname may apply to multiple formats
  - Truly unique names would be too cumbersome

Nickname Format

- Basic Format: HeightX@Framerate@SamplingZ
- "Height" is in image lines
- "X" may be appended as needed
  - "i" represents interlaced video
  - "PsF" represents progressive segmented frame
- "@" separator
- "Framerate" is in frames (NOT fields) per second
  - Non-integer frame rates are shown accurate to two decimal places
- "@" separator

Nickname Format for Sampling

- "Sampling" indicates the color sub-sampling formats
  - "444" is 4:4:4 subsampling
  - "422" is 4:2:2 subsampling
  - "420" is 4:2:0 subsampling
  - "KEY" is for key signals
- "Z" is TCS mode
  - "H" (HLG)
  - "P" (PQ)
  - "S" (SDR)
  - "X" (other formats allowed by ST 2110-20 table 7.6)

UHD1 Examples

Unique ID	Nickname	width	height	sampling	depth	colorimetry	TCS	exactframerate	Info for UNSPECIFIED colorimetry	Info for UNSPECIFIED TCS
U4150-examp	2160@24@444X	3840	2160	RGB	16f	BT2100	LINEAR	24		
U4160-examp	2160@24@444X	3840	2160	YCbCr-4:4:4	12	UNSPECIFIED	UNSPECIFIED	24	S-Gamut.Cine	Slog3
U4162-examp	2160@24@444X	3840	2160	YCbCr-4:4:4	12	UNSPECIFIED	UNSPECIFIED	24	P-Gamut.Cine	plog6
U4170-examp	2160@24@KEY	3840	2160	KEY	12	BT2100?	LINEAR	24		
U4500	2160@50@422S	3840	2160	YCbCr-4:2:2	10	BT709	SDR	50		
U4502	2160@50@422P	3840	2160	YCbCr-4:2:2	10	BT2100	PQ	50		
U4503	2160@50@422H	3840	2160	YCbCr-4:2:2	10	BT2100	HLG	50		
U4504	2160@50@422P	3840	2160	YCbCr-4:2:2	12	BT2100	PQ	50		
U4505	2160@50@422H	3840	2160	YCbCr-4:2:2	12	BT2100	HLG	50		
U4600	2160@59.94@422S	3840	2160	YCbCr-4:2:2	10	BT709	SDR	60000/1001		
U4602	2160@59.94@422P	3840	2160	YCbCr-4:2:2	10	BT2100	PQ	60000/1001		
U4603	2160@59.94@422H	3840	2160	YCbCr-4:2:2	10	BT2100	HLG	60000/1001		
U4604	2160@59.94@422P	3840	2160	YCbCr-4:2:2	12	BT2100	PQ	60000/1001		
U4605	2160@59.94@422H	3840	2160	YCbCr-4:2:2	12	BT2100	HLG	60000/1001		
U4610	2160@60@422S	3840	2160	YCbCr-4:2:2	10	BT709	SDR	60		
U4612	2160@60@422P	3840	2160	YCbCr-4:2:2	10	BT2100	PQ	60		
U4613	2160@60@422H	3840	2160	YCbCr-4:2:2	10	BT2100	HLG	60		
U4614	2160@60@422P	3840	2160	YCbCr-4:2:2	12	BT2100	PQ	60		
U4615	2160@60@422H	3840	2160	YCbCr-4:2:2	12	BT2100	HLG	60		
U4620	2160@59.94@422S	3840	2160	YCbCr-4:2:2	10	BT2020	SDR	60000/1001		

The UNSPECIFIED Issue

- Many cinema cameras use non-standard colorimetry and TCS
- Handled easily in ST 2110-20 and SDP
  - Simply use “UNSPECIFIED” as value of “colorimetry” and “TCS” SDP parameters
- However, this does nothing for interoperability
  - Each manufacturer can use their own transfer functions
- Canonical name allows specific formats to be registered
  - Additional table info (not in SDP) can be used to describe UNSPECIFIED values
  - These video formats can be registered uniquely and made interoperable

UNSPECIFIED Example JSON

"Unique ID": "U4160",
"Nickname": "2160@24@444X",
"width": "3840",
"height": "2160",
"sampling": "YCbCr-4:4:4",
"depth": "12",
"colorimetry": "UNSPECIFIED",
"TCS": "UNSPECIFIED",
"exactframerate": "24",
"Info for UNSPECIFIED colorimetry": "S-Gamut.Cine",
"Info for UNSPECIFIED TCS": "Slog3"

Canonical Name Transmission Parameters

- TX_{MAN} is N, NL or W as required by ST 2110-21
  - Does not affect video format or packet formation
  - Controls pacing of packets on sender egress
- TX_{OPT} parameters are optional
  - Do not affect video format, only packet formation and/or pacing
  - Only used if needed for a particular application

Aspects of *BPM, MAXUDP, TROFF, CMAX*

- All receivers must support BPM and GPM
  - BPM is a strict subset of GPM
- MAXUDP is defaulted to 1460
  - Not signaled unless it is otherwise
- TROFF is based on section 6.2 of ST 2110-21
  - Not signaled unless the value of TR_{OFFSET} is not equal to $TRO_{DEFAULT}$
- CMAX is computed based on section 7 of ST 2110-21
  - Not signaled unless is its value is different from computation

Future Work

- Publicize, get consensus on rules for canonical naming
  - Develop document (VSF TR) to describe this precisely
- Liaison to in-band monitoring project
- Continue research into hosts for the registry
- Develop procedures for adding new entries into registry
  - Research other examples from industry (e.g. github)
  - Create infrastructure necessary to implement this

Thank You!

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More Examples

Unique ID	Nickname	width	height	sampling	depth	colorimetry	TCS	exactframerate
U3500	1080@50@422S	1920	1080	YCbCr-4:2:2	10	BT709	SDR	50
U3501	1080@50@420S	1920	1080	YCbCr-4:2:0	8	BT709	SDR	50
U3502	1080@50@422P	1920	1080	YCbCr-4:2:2	10	BT2100	PQ	50
U3503	1080@50@422H	1920	1080	YCbCr-4:2:2	10	BT2100	HLG	50
U3504	1080@50@422P	1920	1080	YCbCr-4:2:2	12	BT2100	PQ	50
U3505	1080@50@422H	1920	1080	YCbCr-4:2:2	12	BT2100	HLG	50
U3600	1080@59.94@422S	1920	1080	YCbCr-4:2:2	10	BT709	SDR	60000/1001
U3601	1080@59.94@420S	1920	1080	YCbCr-4:2:0	8	BT709	SDR	60000/1001
U3602	1080@59.94@422P	1920	1080	YCbCr-4:2:2	10	BT2100	PQ	60000/1001
U3603	1080@59.94@422H	1920	1080	YCbCr-4:2:2	10	BT2100	HLG	60000/1001
U3604	1080@59.94@422P	1920	1080	YCbCr-4:2:2	12	BT2100	PQ	60000/1001
U3605	1080@59.94@422H	1920	1080	YCbCr-4:2:2	12	BT2100	HLG	60000/1001
U3610	1080@60@422S	1920	1080	YCbCr-4:2:2	10	BT709	SDR	60
U3611	1080@60@420S	1920	1080	YCbCr-4:2:0	8	BT709	SDR	60
U3612	1080@60@422P	1920	1080	YCbCr-4:2:2	10	BT2100	PQ	60
U3613	1080@60@422H	1920	1080	YCbCr-4:2:2	10	BT2100	HLG	60
U3614	1080@60@422P	1920	1080	YCbCr-4:2:2	12	BT2100	PQ	60
U3615	1080@60@422H	1920	1080	YCbCr-4:2:2	12	BT2100	HLG	60