USA FORENSIC LLC

REQUEST FOR ORIGINAL VIDEO CODEC / FORMAT

We are kindly requesting the original video codec, in its original format is due to signal degradation through file conversion.

- **When converting from one format of digital or analog video to another, information is lost.**
- **In digital video & audio there are over 940 Formats & Codecs in use currently. Every time an original codec or format is converted to another; critical information is lost through re-sampling, dithering and reformatting.**
- **Often the pixel array, aspect ratio, bit depth, gamut and resolution may be different.**
- **The signal to noise ratio being raised during conversion makes it much more difficult to recognize features, faces, license plates, etc when reviewing video.**
- **Correct color temperature, (Degrees Kelvin), can be skewed by bit depth and format change - making colors of clothing, for example, inaccurate.**
- **If possible a Pantone or Chip chart should be placed in front of a surveillance camera before the unit is seized. This helps accurately adjusting the color balance using a Vectorscope, Waveform scope, luminance and RGB profile. This is important to correctly identify colors in different degrees Kelvin of lighting.**
- **The Metadata from the original recording is lost during conversion. Metadata confirms the length, bit rate, format, frame-rate and codec parameters of the original recording. Often there is GPS data as well as time and date stamps.**
- **Log Files are paramount when introducing video evidence as well as Sha2 and MD5 Hash files of the video itself. Federal Rules of Evidence: 902(14) - 2017**
- **In addition, the metadata, (digital chain of custody) has been technically violated in that the original codec is not available for study. Metadata on one single frame of video can be pages long.**
- **We analyze every single frame on surveillance videos as each frame may have buffered differently due to frame buffer overload. The only way to correctly analyze frame drop out (frames missing) is using this method on the original recording.**
- **If the file is from a surveillance system, there is a corresponding log file that is lost. If it is from a cell phone or any digital medium, valuable file data is lost.**
- **The forensically sound protocol is to clone a surveillance video directly from a DVR hard drive using DME Forensics and a write blocker, making a byte by byte Physical Image.**

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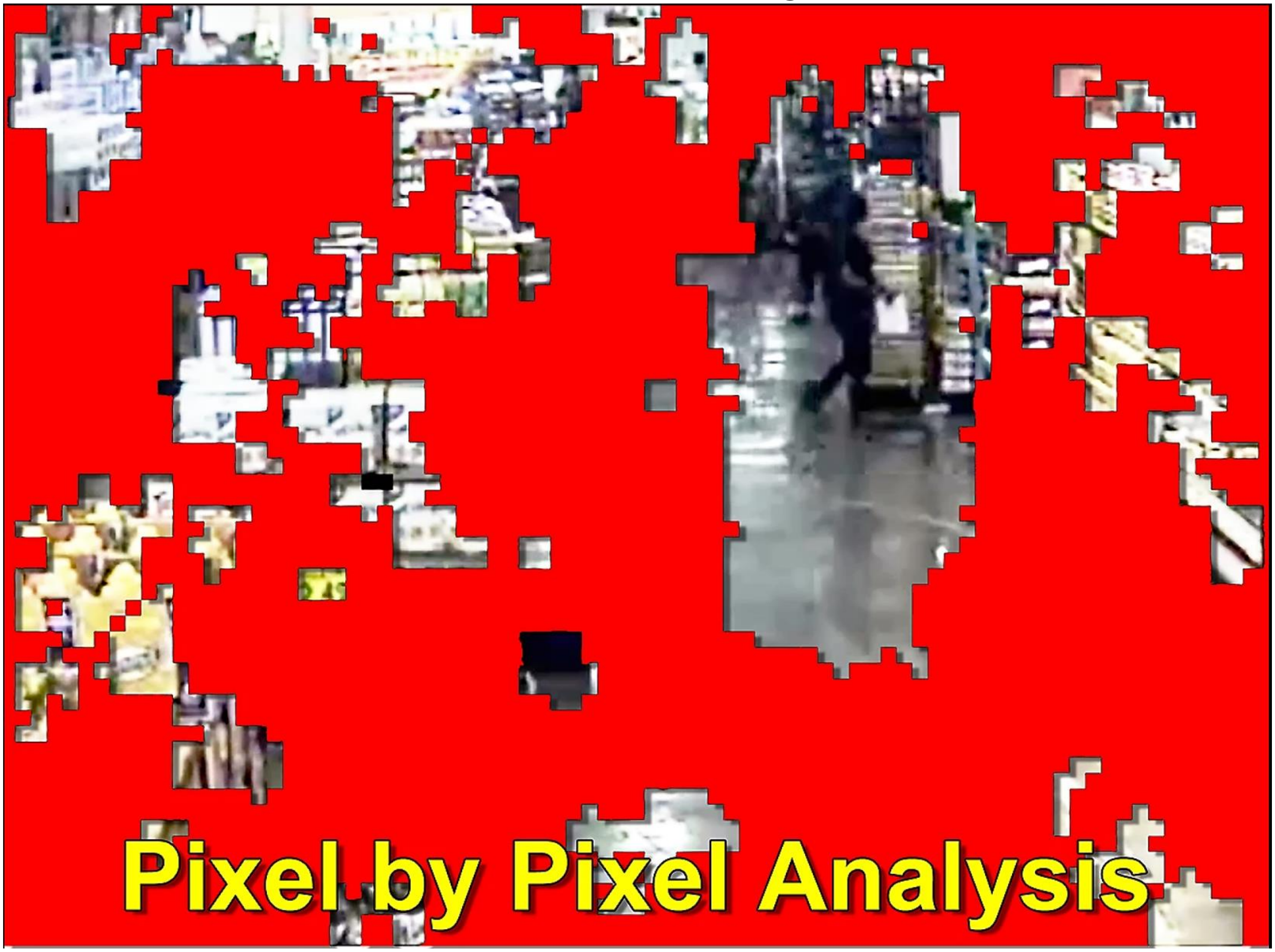
(EX-1)

The above Photo (EX-1) shows two different methods of extraction.
The upper portion of the photo was done by a Police Department *extracting it* rather than cloning. The lower was extracted using iNPUT-ACE from the Raw codec cloned by DME Forensic extraction.
Note the difference in clarity of the embedded time-code between top and bottom frames.

Pixel & Frame Buffering



(EX-2)

DVRs frame-buffer non-moving pixels, (in Red above EX-2).

Faces, birthmarks & tattoos can be smeared by artifacts due to buffered pixels mixing with sequential frames in moving video.

The only to analyze this pattern is using the original cloned file.

The DVR drive should be cloned by a program specifically coded for DVR's as their file structure is different than a computer.

DVR frame rates can differ from frame to frame an analysis of each frame of video of the original codec should be performed to understand the frame buffering rate. This can account for missing or dropped frames.

	A	B	C	D	E	F	G	H	I	J	K	L
1	media_type	stream_inde	key_frame	pkt_pts	pkt_pts_time	pkt_dts	pkt_dts_time	best_effo	best_effort_timestamp_time	pkt_duration	pkt_duration_time	pkt_pos
2	video	0	1	0	0	0	0	0	0	512	0.04	48
3	video	0	0	512	0.04	512	0.04	512	0.04	512	0.04	4171
4	video	0	0	1024	0.08	1024	0.08	1024	0.08	512	0.04	4129
5	video	0	0	1536	0.12	1536	0.12	1536	0.12	512	0.04	4200
6	video	0	0	2048	0.16	2048	0.16	2048	0.16	512	0.04	4056
7	video	0	0	2560	0.2	2560	0.2	2560	0.2	512	0.04	4300
8	video	0	0	3072	0.24	3072	0.24	3072	0.24	512	0.04	4270
9	video	0	0	3584	0.28	3584	0.28	3584	0.28	512	0.04	4328
10	video	0	0	4096	0.32	4096	0.32	4096	0.32	512	0.04	4229
11	video	0	0	4608	0.36	4608	0.36	4608	0.36	512	0.04	4389
12	video	0	0	5120	0.4	5120	0.4	5120	0.4	512	0.04	4370
13	video	0	0	5632	0.44	5632	0.44	5632	0.44	512	0.04	4406
14	video	0	0	6144	0.48	6144	0.48	6144	0.48	512	0.04	4345
15	video	0	0	6656	0.52	6656	0.52	6656	0.52	512	0.04	4467
16	video	0	0	7168	0.56	7168	0.56	7168	0.56	512	0.04	4448
17	video	0	0	7680	0.6	7680	0.6	7680	0.6	512	0.04	4484
18	video	0	0	8192	0.64	8192	0.64	8192	0.64	512	0.04	4423
19	video	0	0	8704	0.68	8704	0.68	8704	0.68	512	0.04	4545
20	video	0	0	9216	0.72	9216	0.72	9216	0.72	512	0.04	4526
21	video	0	0	9728	0.76	9728	0.76	9728	0.76	512	0.04	4562
22	video	0	0	10240	0.8	10240	0.8	10240	0.8	512	0.04	4501
23	video	0	0	10752	0.84	10752	0.84	10752	0.84	512	0.04	4623
24	video	0	0	11264	0.88	11264	0.88	11264	0.88	512	0.04	4604
25	video	0	0	11776	0.92	11776	0.92	11776	0.92	512	0.04	4640
26	video	0	0	12288	0.96	12288	0.96	12288	0.96	512	0.04	4579
27	video	0	0	12800	1	12800	1	12800	1	512	0.04	4701
28	video	0	0	13312	1.04	13312	1.04	13312	1.04	512	0.04	4682
29	video	0	0	13824	1.08	13824	1.08	13824	1.08	512	0.04	4718
30	video	0	0	14336	1.12	14336	1.12	14336	1.12	512	0.04	4657
31	video	0	0	14848	1.16	14848	1.16	14848	1.16	512	0.04	4779
32	video	0	0	15360	1.2	15360	1.2	15360	1.2	512	0.04	4760
33	video	0	0	15872	1.24	15872	1.24	15872	1.24	512	0.04	4796
34	video	0	0	16384	1.28	16384	1.28	16384	1.28	512	0.04	4735
35	video	0	0	16896	1.32	16896	1.32	16896	1.32	512	0.04	4857
36	video	0	0	17408	1.36	17408	1.36	17408	1.36	512	0.04	4838
37	video	0	0	17920	1.4	17920	1.4	17920	1.4	512	0.04	4874
38	video	0	0	18432	1.44	18432	1.44	18432	1.44	512	0.04	4813
39	video	0	0	18944	1.48	18944	1.48	18944	1.48	512	0.04	4935
40	video	0	0	19456	1.52	19456	1.52	19456	1.52	512	0.04	4916
41	video	0	0	19968	1.56	19968	1.56	19968	1.56	512	0.04	4952
42	video	0	0	20480	1.6	20480	1.6	20480	1.6	512	0.04	4891
43	video	0	0	20992	1.64	20992	1.64	20992	1.64	512	0.04	5013
44	video	0	0	21504	1.68	21504	1.68	21504	1.68	512	0.04	4994
45	video	0	0	22016	1.72	22016	1.72	22016	1.72	512	0.04	5030
46	video	0	0	22528	1.76	22528	1.76	22528	1.76	512	0.04	4969
47	video	0	0	23040	1.8	23040	1.8	23040	1.8	512	0.04	5091
48	video	0	0	23552	1.84	23552	1.84	23552	1.84	512	0.04	5072
49	video	0	0	24064	1.88	24064	1.88	24064	1.88	512	0.04	5108
50	video	0	0	24576	1.92	24576	1.92	24576	1.92	512	0.04	5047
51	video	0	0	25088	1.96	25088	1.96	25088	1.96	512	0.04	5168
52	video	0	0	25600	2	25600	2	25600	2	512	0.04	5150
53	video	0	0	26112	2.04	26112	2.04	26112	2.04	512	0.04	5184
54	video	0	0	26624	2.08	26624	2.08	26624	2.08	512	0.04	5125
55	video	0	0	27136	2.12	27136	2.12	27136	2.12	512	0.04	5243
56	video	0	0	27648	2.16	27648	2.16	27648	2.16	512	0.04	5225
57	video	0	0	28160	2.2	28160	2.2	28160	2.2	512	0.04	5259
58	video	0	0	28672	2.24	28672	2.24	28672	2.24	512	0.04	5200
59	video	0	0	29184	2.28	29184	2.28	29184	2.28	512	0.04	5318
60	video	0	0	29696	2.32	29696	2.32	29696	2.32	512	0.04	5300
61	video	0	0	30208	2.36	30208	2.36	30208	2.36	512	0.04	5334
62	video	0	0	30720	2.4	30720	2.4	30720	2.4	512	0.04	5275
63	video	0	0	31232	2.44	31232	2.44	31232	2.44	512	0.04	5393

	M	N	O	P	Q	R	S	T	U	V	W
1	pkt_size	width	height	pix_fmt	sample_aspect_ratio	pict_type	coded_picture_number	display_picture_number	interlaced_frame	top_field_first	repeat_pict
2	4008	480	270	yuvj420p	1:1	I	0	0	0	0	0
3	29	480	270	yuvj420p	1:1	B	3	0	0	0	0
4	42	480	270	yuvj420p	1:1	B	2	0	0	0	0
5	29	480	270	yuvj420p	1:1	B	4	0	0	0	0
6	73	480	270	yuvj420p	1:1	P	1	0	0	0	0
7	28	480	270	yuvj420p	1:1	B	7	0	0	0	0
8	30	480	270	yuvj420p	1:1	B	6	0	0	0	0
9	17	480	270	yuvj420p	1:1	B	8	0	0	0	0
10	41	480	270	yuvj420p	1:1	P	5	0	0	0	0
11	17	480	270	yuvj420p	1:1	B	11	0	0	0	0
12	19	480	270	yuvj420p	1:1	B	10	0	0	0	0
13	17	480	270	yuvj420p	1:1	B	12	0	0	0	0
14	25	480	270	yuvj420p	1:1	P	9	0	0	0	0
15	17	480	270	yuvj420p	1:1	B	15	0	0	0	0
16	19	480	270	yuvj420p	1:1	B	14	0	0	0	0
17	17	480	270	yuvj420p	1:1	B	16	0	0	0	0
18	25	480	270	yuvj420p	1:1	P	13	0	0	0	0
19	17	480	270	yuvj420p	1:1	B	19	0	0	0	0
20	19	480	270	yuvj420p	1:1	B	18	0	0	0	0
21	17	480	270	yuvj420p	1:1	B	20	0	0	0	0
22	25	480	270	yuvj420p	1:1	P	17	0	0	0	0
23	17	480	270	yuvj420p	1:1	B	23	0	0	0	0
24	19	480	270	yuvj420p	1:1	B	22	0	0	0	0
25	17	480	270	yuvj420p	1:1	B	24	0	0	0	0
26	25	480	270	yuvj420p	1:1	P	21	0	0	0	0
27	17	480	270	yuvj420p	1:1	B	27	0	0	0	0
28	19	480	270	yuvj420p	1:1	B	26	0	0	0	0
29	17	480	270	yuvj420p	1:1	B	28	0	0	0	0
30	25	480	270	yuvj420p	1:1	P	25	0	0	0	0
31	17	480	270	yuvj420p	1:1	B	31	0	0	0	0
32	19	480	270	yuvj420p	1:1	B	30	0	0	0	0
33	17	480	270	yuvj420p	1:1	B	32	0	0	0	0
34	25	480	270	yuvj420p	1:1	P	29	0	0	0	0
35	17	480	270	yuvj420p	1:1	B	35	0	0	0	0
36	19	480	270	yuvj420p	1:1	B	34	0	0	0	0
37	17	480	270	yuvj420p	1:1	B	36	0	0	0	0
38	25	480	270	yuvj420p	1:1	P	33	0	0	0	0
39	17	480	270	yuvj420p	1:1	B	39	0	0	0	0
40	19	480	270	yuvj420p	1:1	B	38	0	0	0	0
41	17	480	270	yuvj420p	1:1	B	40	0	0	0	0
42	25	480	270	yuvj420p	1:1	P	37	0	0	0	0
43	17	480	270	yuvj420p	1:1	B	43	0	0	0	0
44	19	480	270	yuvj420p	1:1	B	42	0	0	0	0
45	17	480	270	yuvj420p	1:1	B	44	0	0	0	0
46	25	480	270	yuvj420p	1:1	P	41	0	0	0	0
47	17	480	270	yuvj420p	1:1	B	47	0	0	0	0
48	19	480	270	yuvj420p	1:1	B	46	0	0	0	0
49	17	480	270	yuvj420p	1:1	B	48	0	0	0	0
50	25	480	270	yuvj420p	1:1	P	45	0	0	0	0
51	16	480	270	yuvj420p	1:1	B	51	0	0	0	0
52	18	480	270	yuvj420p	1:1	B	50	0	0	0	0
53	16	480	270	yuvj420p	1:1	B	52	0	0	0	0
54	25	480	270	yuvj420p	1:1	P	49	0	0	0	0
55	16	480	270	yuvj420p	1:1	B	55	0	0	0	0
56	18	480	270	yuvj420p	1:1	B	54	0	0	0	0
57	16	480	270	yuvj420p	1:1	B	56	0	0	0	0
58	25	480	270	yuvj420p	1:1	P	53	0	0	0	0
59	16	480	270	yuvj420p	1:1	B	59	0	0	0	0
60	18	480	270	yuvj420p	1:1	B	58	0	0	0	0
61	16	480	270	yuvj420p	1:1	B	60	0	0	0	0
62	25	480	270	yuvj420p	1:1	P	57	0	0	0	0
63	16	480	270	yuvj420p	1:1	B	63	0	0	0	0

Frame analysis example: Extraction of clone using DME Forensics, Analysis using & iNPUT-ACE.

Basic rules of thumb - Forensic DVR Extraction:

1. Always photograph the time on the actual DVR using a time-synced cell phone with GPS. *Time-sync from the carrier.*

2. Always photograph the time on the DVR viewing screen using a cell phone synced to time with GPS. - Don't write it down, you MUST photograph it, otherwise the video may not be allowed into evidence as there is no supporting metadata, as provided by phone, as to any time or date differences.

3. Examine any inputs for ethernet or WiFi for time-sync.

4. Clone the DRV, do not do a capture using any method that uses the cheap electronic AD/DA board on the DVR. DVR *Digital to Analog* converters are notoriously low quality and tend to introduce artifacts into an export.

5. Clone the drive using DME or similar software specifically designed for DVR codecs through a write blocker.

6. The cloned drive should be examined for frame buffer through-put using iNPUT-ACE or similar, to determine which pixels are stored in the frame buffer and which pixels are moving. This is extremely important when trying to identify faces, tattoos, logos or birthmarks as the frame buffer may not detect enough pixel movement to record accurately. Artifacts caused by frame buffering can be mistaken as tattoos or blemishes. (EX-2)

7. <u>The log file is critical</u> as it says what cameras were triggered when as well as their priority. *Most commercial DVRs in a store for example prioritize the front door and cash register.* Any technical or system errors are on the log file. The log file also has error codes attributed to any power outages or malfunctions of the system.

8 Only the original file has the pixel blocking, (EX-2) a copy does not carry that information over.

9. Know that any copy is significantly degraded from the original if there is a codec or format change because of pixel and frame rate storage latency.

10. DVRs do not record at a constant frame rate. They have a frame rate that is dependent on data flow and capacity. That range that can only be extracted from the original file. The Frame-rate on a DVR may vary extensively in a recording due to frame buffering, *whereas* a format conversion tries to maintain a pre-programed frame rate (example: 29.97 fps NTSC.)

Converting a continuously varying 2-16 fps to a constant 29.97 fps results in obvious problems. If only one camera is active it may record at the set 29.97 FPS. If more cameras are added, the load on the system grows and the system can bog down to 2 frames per second, or even freeze frame, to accommodate the demand on the system.

A DVR system attempts to buffer the amount of data coming in. If there is too much, which often happens on a DVR, you get a frame-buffer-overload. This causes various issues, depending on the priority allocation of the cameras. Artifacts, irregular frame rate, sporadic camera recording, frozen frames, dropped frames and timing issues.

11. To understand the DVR system's camera prioritization, frame rate and pixel blocking, the original file is required. That is the ONLY way to extract the complete data set. The DVR Log File has the prioritization map on it.

12. <u>The original file is critical for facial ID</u>. For a rectangular object it is not as critical. For a round object with various concave and convex properties such as a face, unless the subject is very close, there will be substantial degradation of picture not extracting the image from the original codec.

Bottom line: <u>ALWAYS</u> CLONE THE ORIGINAL CODEC IN ITS ORIGINAL FORMAT

Still Photo Lifts:

If still Frames are extracted for court use, metadata from each frame should be provided. Below is an example from one still photo's metadata:

```
  Filename: [M:\100MSDCF PPD raw  photos for keith\DSC01868.JPG]
  Filesize: [10125312] Bytes

Start Offset: 0x00000000
*** Marker: SOI (xFFD8) ***
  OFFSET: 0x00000000

*** Marker: APP1 (xFFE1) ***
  OFFSET: 0x00000002
  Length          = 45479
  Identifier      = [Exif]
  Identifier TIFF = 0x[49492A00 08000000]
  Endian          = Intel (little)
  TAG Mark x002A  = 0x002A

  EXIF IFD0 @ Absolute 0x00000014
    Dir Length = 0x000C
    [ImageDescription                    ] = "                                    "
    [Make                                ] = "SONY"
    [Model                               ] = "ILCA-77M2"
    [Orientation                         ] = 1 = Row 0: top, Col 0: left
    [XResolution                         ] = 350/1
    [YResolution                         ] = 350/1
    [ResolutionUnit                      ] = Inch
    [Software                            ] = "ILCA-77M2 v2.00"
    [DateTime                            ] = "2016:06:02 20:24:00"
    [YCbCrPositioning                    ] = Co-sited
    [ExifOffset                          ] = @ 0x016C
    Offset to Next IFD = 0x00009566

  EXIF IFD1 @ Absolute 0x00009572
    Dir Length = 0x000D
    [Compression                         ] = JPEG
    [XResolution                         ] = 72/1
    [YResolution                         ] = 72/1
    [ResolutionUnit                      ] = Inch
    [JpegIFOffset                        ] = @ +0x966C = @ 0x9678
    [JpegIFByteCount                     ] = 0x[00001B33] / 6963
    [YCbCrPositioning                    ] = Co-sited
    Offset to Next IFD = 0x00000000

  EXIF SubIFD @ Absolute 0x00000178
    Dir Length = 0x0026
    [ExposureTime                        ] = 1/3 s
    [FNumber                             ] = F4.0
    [ExposureProgram                     ] = Normal program
    [ISOSpeedRatings                     ] = 3200
    [ExifVersion                         ] = 02.30
    [DateTimeOriginal                    ] = "2016:06:02 20:24:00"
    [DateTimeDigitized                   ] = "2016:06:02 20:24:00"
    [ComponentsConfiguration             ] = [Y Cb Cr .]
    [CompressedBitsPerPixel              ] = 4/1
    [BrightnessValue                     ] = -11576/2560
    [ExposureBiasValue                   ] = 0.00 eV
    [MaxApertureValue                    ] = 1024/256
    [MeteringMode                        ] = Pattern
    [LightSource                         ] = unknown
    [Flash                               ] = Flash did not fire
    [FocalLength                         ] = 10 mm
    [MakerNote                           ] = @ 0x039A
    [UserComment                         ] = ""
    [FlashPixVersion                     ] = 01.00
    [ColorSpace                          ] = sRGB
    [ExifImageWidth                      ] = 0x[00001770] / 6000
    [ExifImageHeight                     ] = 0x[00000D30] / 3376
    [ExifInteroperabilityOffset          ] = @ 0x9548
    [FileSource                          ] = DSC
    [SceneType                           ] = A directly photographed image
    [CustomRendered                      ] = Normal process
    [ExposureMode                        ] = Auto exposure
    [WhiteBalance                        ] = Auto white balance
    [DigitalZoomRatio                    ] = 16/16
    [FocalLengthIn35mmFilm               ] = 15
    [SceneCaptureType                    ] = Standard
```

```
    [Contrast                            ] = 0
    [Saturation                          ] = 0
    [Sharpness                           ] = 0

  EXIF MakerIFD @ Absolute 0x000003A6
    Makernote decode option not enabled.

  EXIF InteropIFD @ Absolute 0x00009554
    Dir Length = 0x0002
    [InteroperabilityIndex               ] = "R98"
    [InteroperabilityVersion             ] = 01.00

*** Marker: APP2 (xFFE2) ***
  OFFSET: 0x0000B1AB
  Length          = 595
  Identifier      = [MPF]
    Not supported. Skipping remainder.

*** Marker: DQT (xFFDB) ***
  Define a Quantization Table.
  OFFSET: 0x0000B400
  Table length = 132
  ----
  Precision=8 bits
  Destination ID=0 (Luminance)
    DQT, Row #0:   1   1   1   1   1   1   1   1
    DQT, Row #1:   1   1   1   1   1   1   1   1
    DQT, Row #2:   1   1   1   1   1   1   1   1
    DQT, Row #3:   1   1   1   1   1   1   1   1
    DQT, Row #4:   1   1   1   1   1   1   1   1
    DQT, Row #5:   1   1   1   1   1   1   1   1
    DQT, Row #6:   1   1   1   1   1   1   1   1
    DQT, Row #7:   1   1   1   1   1   1   1   1
    Approx quality factor = 100.00 (scaling=2.99 variance=6.13)
  ----
  Precision=8 bits
  Destination ID=1 (Chrominance)
    DQT, Row #0:   1   1   1   1   1   1   2   2
    DQT, Row #1:   1   1   1   1   1   1   2   2
    DQT, Row #2:   1   1   1   1   1   1   2   2
    DQT, Row #3:   1   1   1   1   1   2   2   2
    DQT, Row #4:   1   1   1   1   1   2   2   2
    DQT, Row #5:   1   1   1   2   2   2   2   2
    DQT, Row #6:   2   2   2   2   2   2   2   2
    DQT, Row #7:   2   2   2   2   2   2   2   2
    Approx quality factor = 98.97 (scaling=2.06 variance=1.28)

*** Marker: DHT (Define Huffman Table) (xFFC4) ***
  OFFSET: 0x0000B486
  Huffman table length = 418
  ----
  Destination ID = 0
  Class = 0 (DC / Lossless Table)
    Codes of length 01 bits (000 total): 
    Codes of length 02 bits (001 total): 00 
    Codes of length 03 bits (005 total): 01 02 03 04 05 
    Codes of length 04 bits (001 total): 06 
    Codes of length 05 bits (001 total): 07 
    Codes of length 06 bits (001 total): 08 
    Codes of length 07 bits (001 total): 09 
    Codes of length 08 bits (001 total): 0A 
    Codes of length 09 bits (001 total): 0B 
    Codes of length 10 bits (000 total): 
    Codes of length 11 bits (000 total): 
    Codes of length 12 bits (000 total): 
    Codes of length 13 bits (000 total): 
    Codes of length 14 bits (000 total): 
    Codes of length 15 bits (000 total): 
    Codes of length 16 bits (000 total): 
    Total number of codes: 012

  ----
  Destination ID = 0
  Class = 1 (AC Table)
    Codes of length 01 bits (000 total): 
    Codes of length 02 bits (002 total): 01 02 
    Codes of length 03 bits (001 total): 03 
    Codes of length 04 bits (003 total): 00 04 11 
    Codes of length 05 bits (003 total): 05 12 21 
    Codes of length 06 bits (002 total): 31 41 
    Codes of length 07 bits (004 total): 06 13 51 61 
    Codes of length 08 bits (003 total): 07 22 71 
    Codes of length 09 bits (005 total): 14 32 81 91 A1 
    Codes of length 10 bits (005 total): 08 23 42 B1 C1 
    Codes of length 11 bits (004 total): 15 52 D1 F0 
    Codes of length 12 bits (004 total): 24 33 62 72 
    Codes of length 13 bits (000 total): 
    Codes of length 14 bits (000 total): 
    Codes of length 15 bits (001 total): 82 
    Codes of length 16 bits (125 total): 09 0A 16 17 18 19 1A 25 26 27 28 29 2A 34 35 36 
                                         37 38 39 3A 43 44 45 46 47 48 49 4A 53 54 55 56 
                                         57 58 59 5A 63 64 65 66 67 68 69 6A 73 74 75 76 
                                         77 78 79 7A 83 84 85 86 87 88 89 8A 92 93 94 95 
                                         96 97 98 99 9A A2 A3 A4 A5 A6 A7 A8 A9 AA B2 B3 
                                         B4 B5 B6 B7 B8 B9 BA C2 C3 C4 C5 C6 C7 C8 C9 CA 
                                         D2 D3 D4 D5 D6 D7 D8 D9 DA E1 E2 E3 E4 E5 E6 E7 
                                         E8 E9 EA F1 F2 F3 F4 F5 F6 F7 F8 F9 FA 
    Total number of codes: 162

  ----
  Destination ID = 1
  Class = 0 (DC / Lossless Table)
    Codes of length 01 bits (000 total): 
    Codes of length 02 bits (003 total): 00 01 02 
    Codes of length 03 bits (001 total): 03 
```

```
    Codes of length 04 bits (001 total): 04
    Codes of length 05 bits (001 total): 05
    Codes of length 06 bits (001 total): 06
    Codes of length 07 bits (001 total): 07
    Codes of length 08 bits (001 total): 08
    Codes of length 09 bits (001 total): 09
    Codes of length 10 bits (001 total): 0A
    Codes of length 11 bits (001 total): 0B
    Codes of length 12 bits (000 total):
    Codes of length 13 bits (000 total):
    Codes of length 14 bits (000 total):
    Codes of length 15 bits (000 total):
    Codes of length 16 bits (000 total):
    Total number of codes: 012

  ----
  Destination ID = 1
  Class = 1 (AC Table)
    Codes of length 01 bits (000 total):
    Codes of length 02 bits (002 total): 00 01
    Codes of length 03 bits (001 total): 02
    Codes of length 04 bits (002 total): 03 11
    Codes of length 05 bits (004 total): 04 05 21 31
    Codes of length 06 bits (004 total): 06 12 41 51
    Codes of length 07 bits (003 total): 07 61 71
    Codes of length 08 bits (004 total): 13 22 32 81
    Codes of length 09 bits (007 total): 08 14 42 91 A1 B1 C1
    Codes of length 10 bits (005 total): 09 23 33 52 F0
    Codes of length 11 bits (004 total): 15 62 72 D1
    Codes of length 12 bits (004 total): 0A 16 24 34
    Codes of length 13 bits (000 total):
    Codes of length 14 bits (001 total): E1
    Codes of length 15 bits (002 total): 25 F1
    Codes of length 16 bits (119 total): 17 18 19 1A 26 27 28 29 2A 35 36 37 38 39 3A 43
                                         44 45 46 47 48 49 4A 53 54 55 56 57 58 59 5A 63
                                         64 65 66 67 68 69 6A 73 74 75 76 77 78 79 7A 82
                                         83 84 85 86 87 88 89 8A 92 93 94 95 96 97 98 99
                                         9A A2 A3 A4 A5 A6 A7 A8 A9 AA B2 B3 B4 B5 B6 B7
                                         B8 B9 BA C2 C3 C4 C5 C6 C7 C8 C9 CA D2 D3 D4 D5
                                         D6 D7 D8 D9 DA E2 E3 E4 E5 E6 E7 E8 E9 EA F2 F3
                                         F4 F5 F6 F7 F8 F9 FA
    Total number of codes: 162


*** Marker: SOF0 (Baseline DCT) (xFFC0) ***
  OFFSET: 0x0000B62A
  Frame header length = 17
  Precision = 8
  Number of Lines = 3376
  Samples per Line = 6000
  Image Size = 6000 x 3376
  Raw Image Orientation = Landscape
  Number of Img components = 3
    Component[1]: ID=0x01, Samp Fac=0x21 (Subsamp 1 x 1), Quant Tbl Sel=0x00 (Lum: Y)
    Component[2]: ID=0x02, Samp Fac=0x11 (Subsamp 2 x 1), Quant Tbl Sel=0x01 (Chrom: Cb)
    Component[3]: ID=0x03, Samp Fac=0x11 (Subsamp 2 x 1), Quant Tbl Sel=0x01 (Chrom: Cr)

*** Marker: SOS (Start of Scan) (xFFDA) ***
  OFFSET: 0x0000B63D
  Scan header length = 12
  Number of img components = 3
    Component[1]: selector=0x01, table=0(DC),0(AC)
    Component[2]: selector=0x02, table=1(DC),1(AC)
    Component[3]: selector=0x03, table=1(DC),1(AC)
  Spectral selection = 0 .. 63
  Successive approximation = 0x00


*** Decoding SCAN Data ***
  OFFSET: 0x0000B64B
  Scan Decode Mode: No IDCT (DC only)
    NOTE: Low-resolution DC component shown. Can decode full-res with [Options->Scan Segment->Full IDCT]

  Scan Data encountered marker   0xFFD9 @ 0x00936B84.0

  Compression stats:
    Compression Ratio:  6.32:1
    Bits per pixel:     3.80:1

  Huffman code histogram stats:
    Huffman Table: (Dest ID: 0, Class: DC)
      # codes of length 01 bits:        0 (  0%)
      # codes of length 02 bits:    14871 (  5%)
      # codes of length 03 bits:   252275 ( 80%)
      # codes of length 04 bits:    24229 (  8%)
      # codes of length 05 bits:    14514 (  5%)
      # codes of length 06 bits:     7796 (  2%)
      # codes of length 07 bits:     2131 (  1%)
      # codes of length 08 bits:      639 (  0%)
      # codes of length 09 bits:       45 (  0%)
      # codes of length 10 bits:        0 (  0%)
      # codes of length 11 bits:        0 (  0%)
      # codes of length 12 bits:        0 (  0%)
      # codes of length 13 bits:        0 (  0%)
      # codes of length 14 bits:        0 (  0%)
      # codes of length 15 bits:        0 (  0%)
      # codes of length 16 bits:        0 (  0%)

    Huffman Table: (Dest ID: 1, Class: DC)
      # codes of length 01 bits:        0 (  0%)
      # codes of length 02 bits:   184871 ( 58%)
      # codes of length 03 bits:    71244 ( 23%)
      # codes of length 04 bits:    35097 ( 11%)
      # codes of length 05 bits:    15759 (  5%)
      # codes of length 06 bits:     6249 (  2%)
```

```
      # codes of length 07 bits:     2550 (  1%)
      # codes of length 08 bits:      591 (  0%)
      # codes of length 09 bits:      102 (  0%)
      # codes of length 10 bits:       37 (  0%)
      # codes of length 11 bits:        0 (  0%)
      # codes of length 12 bits:        0 (  0%)
      # codes of length 13 bits:        0 (  0%)
      # codes of length 14 bits:        0 (  0%)
      # codes of length 15 bits:        0 (  0%)
      # codes of length 16 bits:        0 (  0%)

    Huffman Table: (Dest ID: 0, Class: AC)
      # codes of length 01 bits:        0 (  0%)
      # codes of length 02 bits:  7342184 ( 57%)
      # codes of length 03 bits:  1318390 ( 10%)
      # codes of length 04 bits:  1941253 ( 15%)
      # codes of length 05 bits:  1184524 (  9%)
      # codes of length 06 bits:   389347 (  3%)
      # codes of length 07 bits:   283834 (  2%)
      # codes of length 08 bits:   169991 (  1%)
      # codes of length 09 bits:    94680 (  1%)
      # codes of length 10 bits:    42719 (  0%)
      # codes of length 11 bits:    13697 (  0%)
      # codes of length 12 bits:     6525 (  0%)
      # codes of length 13 bits:        0 (  0%)
      # codes of length 14 bits:        0 (  0%)
      # codes of length 15 bits:      247 (  0%)
      # codes of length 16 bits:     5672 (  0%)

    Huffman Table: (Dest ID: 1, Class: AC)
      # codes of length 01 bits:        0 (  0%)
      # codes of length 02 bits:   966840 ( 39%)
      # codes of length 03 bits:   279705 ( 11%)
      # codes of length 04 bits:   492716 ( 20%)
      # codes of length 05 bits:   181005 (  7%)
      # codes of length 06 bits:   197282 (  8%)
      # codes of length 07 bits:    74417 (  3%)
      # codes of length 08 bits:    86067 (  4%)
      # codes of length 09 bits:    86951 (  4%)
      # codes of length 10 bits:    45136 (  2%)
      # codes of length 11 bits:    12901 (  1%)
      # codes of length 12 bits:      130 (  0%)
      # codes of length 13 bits:        0 (  0%)
      # codes of length 14 bits:    16513 (  1%)
      # codes of length 15 bits:     5426 (  0%)
      # codes of length 16 bits:     4825 (  0%)

  YCC clipping in DC:
    Y  component: [<0=    0] [>255=    0]
    Cb component: [<0=    0] [>255=    0]
    Cr component: [<0=    0] [>255=    0]

  RGB clipping in DC:
    R  component: [<0=    0] [>255=    0]
    G  component: [<0=    0] [>255=    0]
    B  component: [<0=    0] [>255=    0]

  Average Pixel Luminance (Y):
    Y=[ 71] (range: 0..255)

  Brightest Pixel Search:
    YCC=[ 1016,   16,  -24] RGB=[250,255,255] @ MCU[181, 14]

  Finished Decoding SCAN Data
    Number of RESTART markers decoded: 0
    Next position in scan buffer: Offset 0x00936B84.0


*** Marker: EOI (End of Image) (xFFD9) ***
  OFFSET: 0x00936B84


*** Embedded JPEG Thumbnail ***
  Offset: 0x00009678
  Length: 0x00001B33 (6963)

  * Embedded Thumb Marker: SOI

  * Embedded Thumb Marker: DQT
    Length = 132
    ----
    Precision=8 bits
    Destination ID=0 (Luminance, typically)
      DQT, Row #0:   2   2   2   4   4   8  10  14
      DQT, Row #1:   2   2   4   4   6   8  10  14
      DQT, Row #2:   2   4   4   4   6   8  12  16
      DQT, Row #3:   4   4   4   6   6  10  12  16
      DQT, Row #4:   4   6   6   6   8  10  14  18
      DQT, Row #5:   8   8   8  10  10  14  16  20
      DQT, Row #6:  10  10  12  12  14  16  20  24
      DQT, Row #7:  14  14  16  16  18  20  24  28
    ----
    Precision=8 bits
    Destination ID=1 (Chrominance, typically)
      DQT, Row #0:   4   4   4   6  12  24  30  30
      DQT, Row #1:   4   4   4   6  12  24  30  30
      DQT, Row #2:   4   4   4   8  14  26  30  30
      DQT, Row #3:   6   6   8  10  18  30  30  30
      DQT, Row #4:  12  12  14  18  28  30  30  30
      DQT, Row #5:  24  24  26  30  30  30  30  30
      DQT, Row #6:  30  30  30  30  30  30  30  30
      DQT, Row #7:  30  30  30  30  30  30  30  30

  * Embedded Thumb Marker: DHT
    Length = 418
```

```
  * Embedded Thumb Marker: SOF
    Frame header length = 17
    Precision = 8
    Number of Lines = 120
    Samples per Line = 160
    Image Size = 160 x 120

  * Embedded Thumb Marker: SOS
    Skipping scan data
    Skipped 6384 bytes

  * Embedded Thumb Marker: EOI

  * Embedded Thumb Signature: 01E117EE06BD26AA7800F9A007DCFD80

*** Searching Compression Signatures ***

  Signature:           016CD0FEF8FFD4C5085BDE3C679FB2AA
  Signature (Rotated): 016CD0FEF8FFD4C5085BDE3C679FB2AA
  File Offset:         0 bytes
  Chroma subsampling:  2x1
  EXIF Make/Model:     OK   [SONY] [ILCA-77M2]
  EXIF Makernotes:     OK
  EXIF Software:       OK   [ILCA-77M2 v2.00]

  Searching Compression Signatures: (3347 built-in, 0 user(*) )

          EXIF.Make / Software        EXIF.Model                            Quality           Subsamp Match?
          -------------------------   -----------------------------------   ----------------  --------------

  Based on the analysis of compression characteristics and EXIF metadata:

  ASSESSMENT: Class 4 - Uncertain if processed or original
              While the EXIF fields indicate original, no compression signatures
              in the current database were found matching this make/model

  Appears to be new signature for known camera.
  If the camera/software doesn't appear in list above,
  PLEASE ADD TO DATABASE with [Tools->Add Camera to DB]


*** Additional Info ***
NOTE: Data exists after EOF, range: 0x00936B86-0x009A8000 (463994 bytes)
```

Verifying Video is similar to judging if a painting is real by either:
A. (Original) Analyzing the original painting, or
B. (Dub) Analyzing a <u>photo</u> of the original painting.

Using the original codec for analysis is best for all parties involved to get the best data possible.

Bryan Neumeister 602 740-6128 www.USAForensic.com