

Multimedia Communication Services

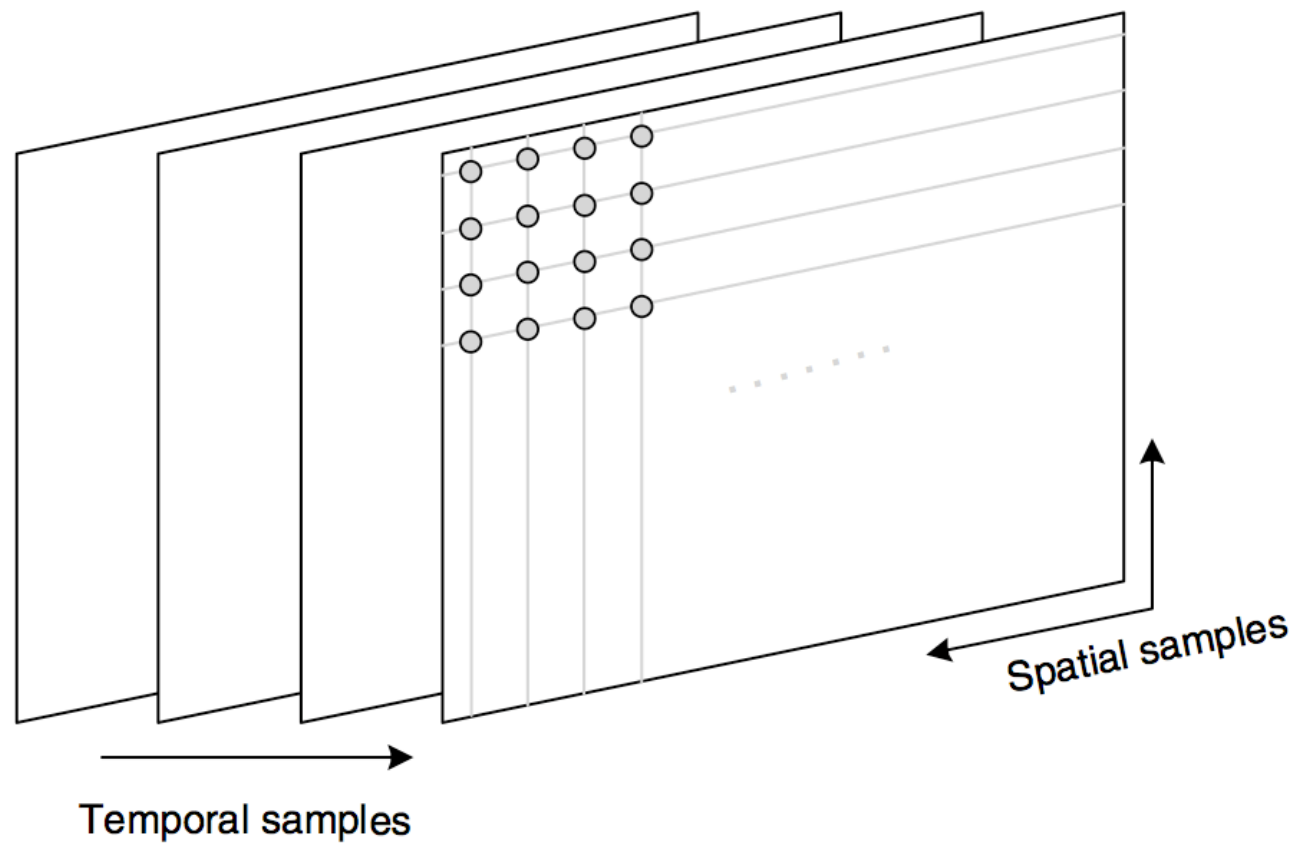
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Esercitatore: Dott. Marco Dalai

Digital Video

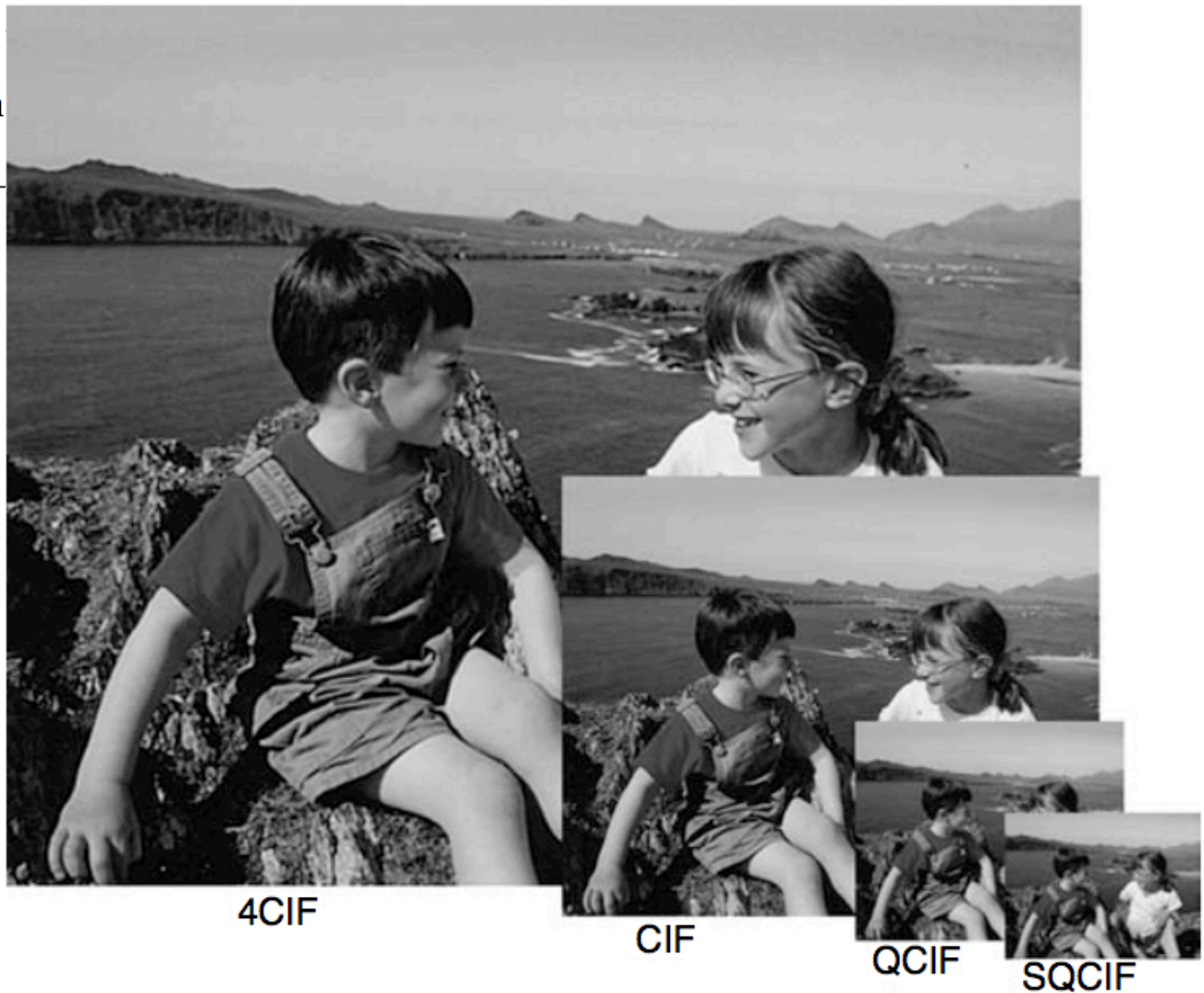
- Sampling:
 - A digital video is obtained by sampling both in space and time a real sequence
 - It is thus a sequence of matrices
 - Different formats are used (number of rows/columns, number of bits/sample etc.)
 - We will only consider the most used ones

Digital video



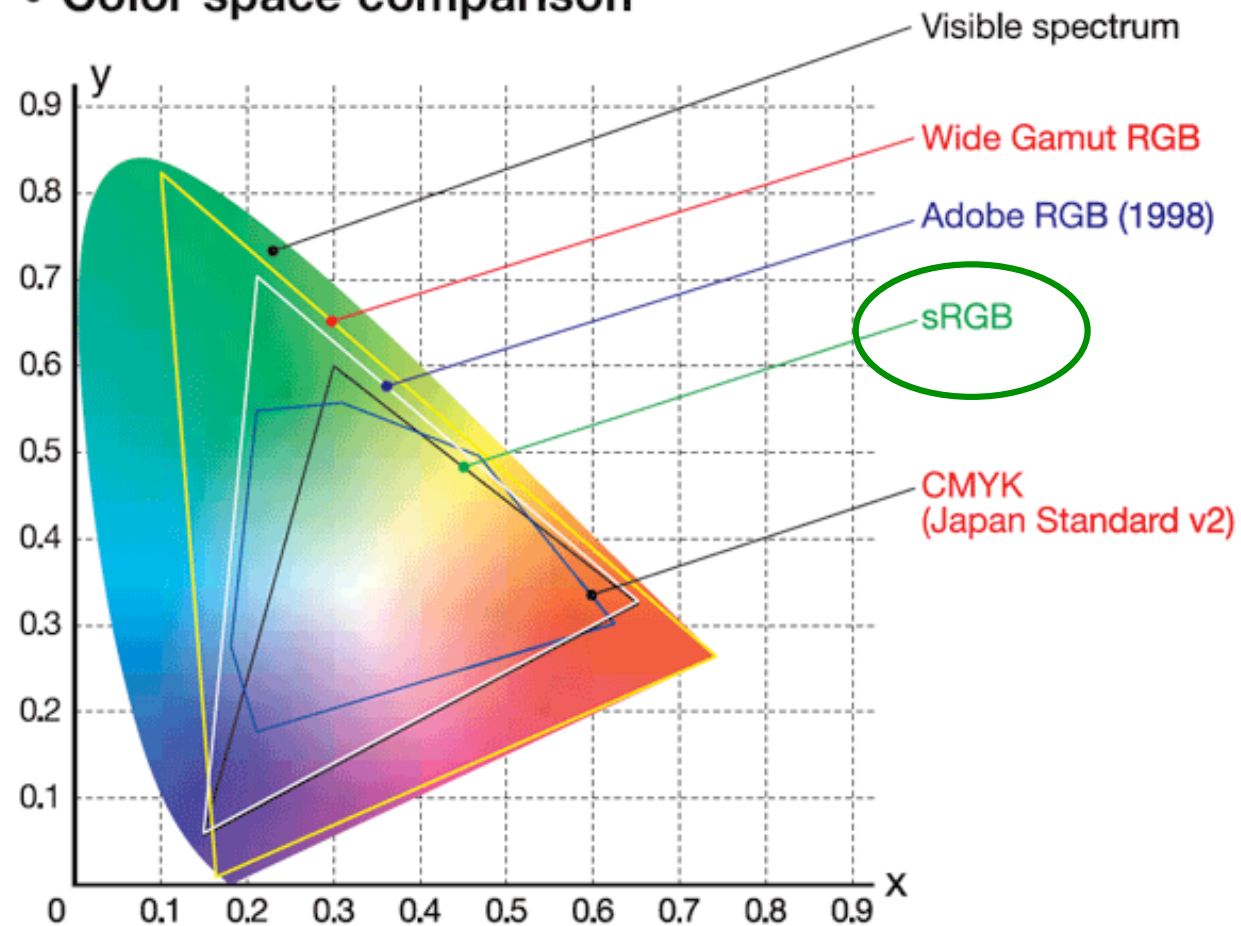
H.261 Common Intermediate Format

Format	Luminance resolution (horiz. × vert.)
Sub-QCIF	128 × 96
Quarter CIF (QCIF)	176 × 144
CIF	352 × 288
4CIF	704 × 576



Color space

- Color space comparison

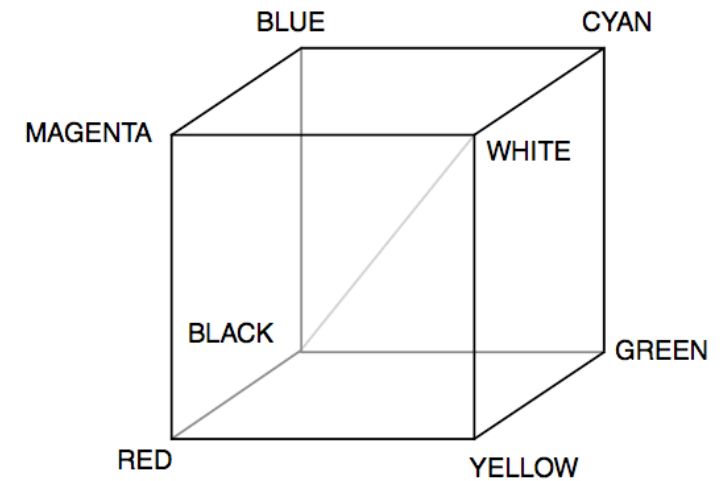


Red Green Blue (RGB)



RGB

- Usually 8 bits for each component



	Nominal Range	White	Yellow	Cyan	Green	Magenta	Red	Blue	Black
R	0 to 255	255	255	0	0	255	255	0	0
G	0 to 255	255	255	255	255	0	0	0	0
B	0 to 255	255	0	255	0	255	0	255	0

RGB

- All components have the same importance (not really true but approximately)
- Componentes are highly “correlated”
- Originally not easily handled because not compatible with black and white TV
- Usually better to first consider a gray scale image and then add colors

YUV, YCbCr, LUV etc...



Luminance



Chrominances

YUV, YCbCr, LUV etc...

$$Y = k_r R + (1 - k_b - k_r)G + k_b B$$

$$Cb = \frac{0.5}{1 - k_b}(B - Y)$$

$$Cr = \frac{0.5}{1 - k_r}(R - Y)$$

$$R = Y + \frac{1 - k_r}{0.5}Cr$$

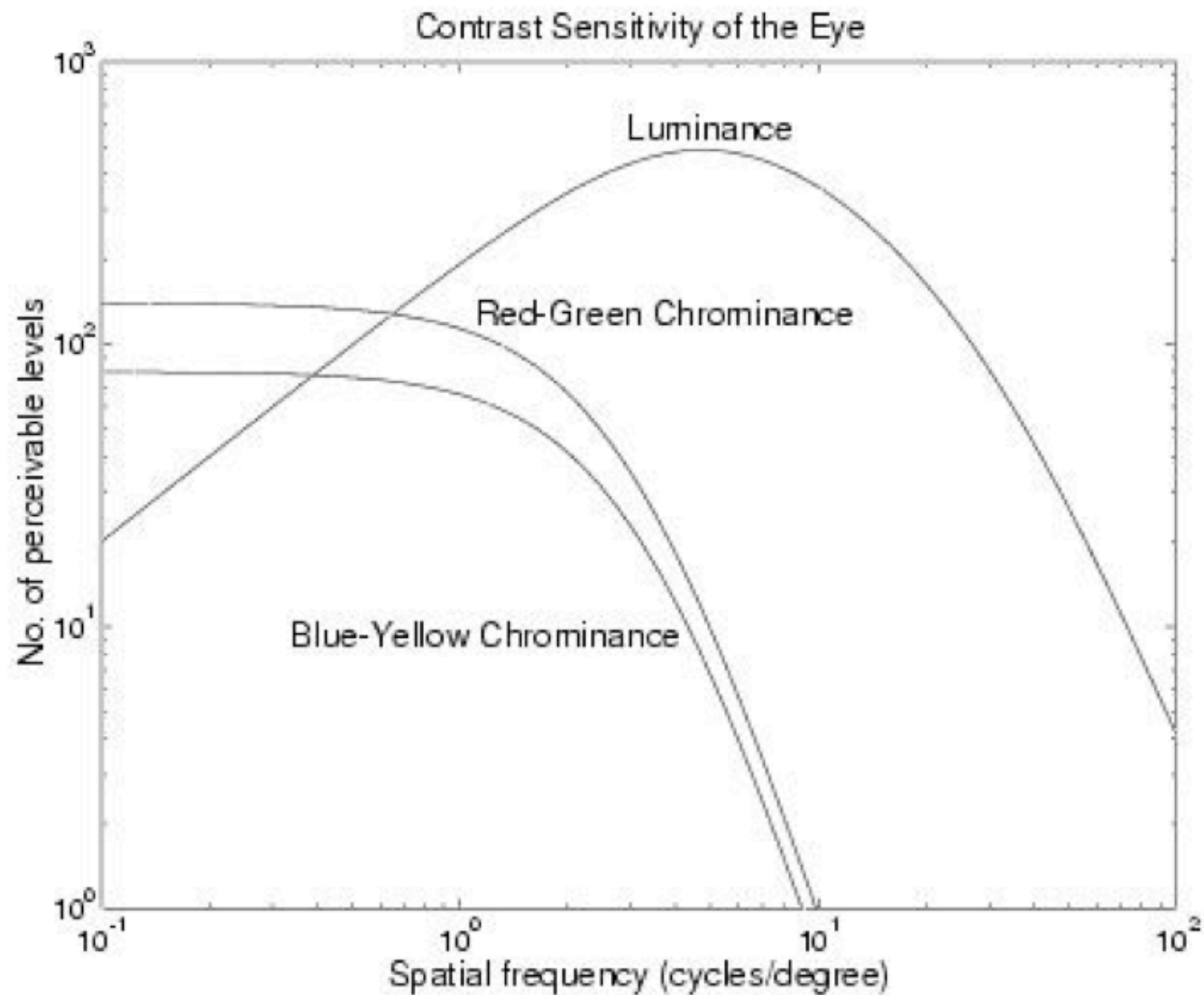
$$G = Y - \frac{2k_b(1 - k_b)}{1 - k_b - k_r}Cb - \frac{2k_r(1 - k_r)}{1 - k_b - k_r}Cr$$

$$B = Y + \frac{1 - k_b}{0.5}Cb$$

YUV, YCbCr, LUV etc...

- The gray scale version is readily available without processing
- Chrominance components usually contain less information
- The human visual system is less sensitive to chrominance details than to luminance ones

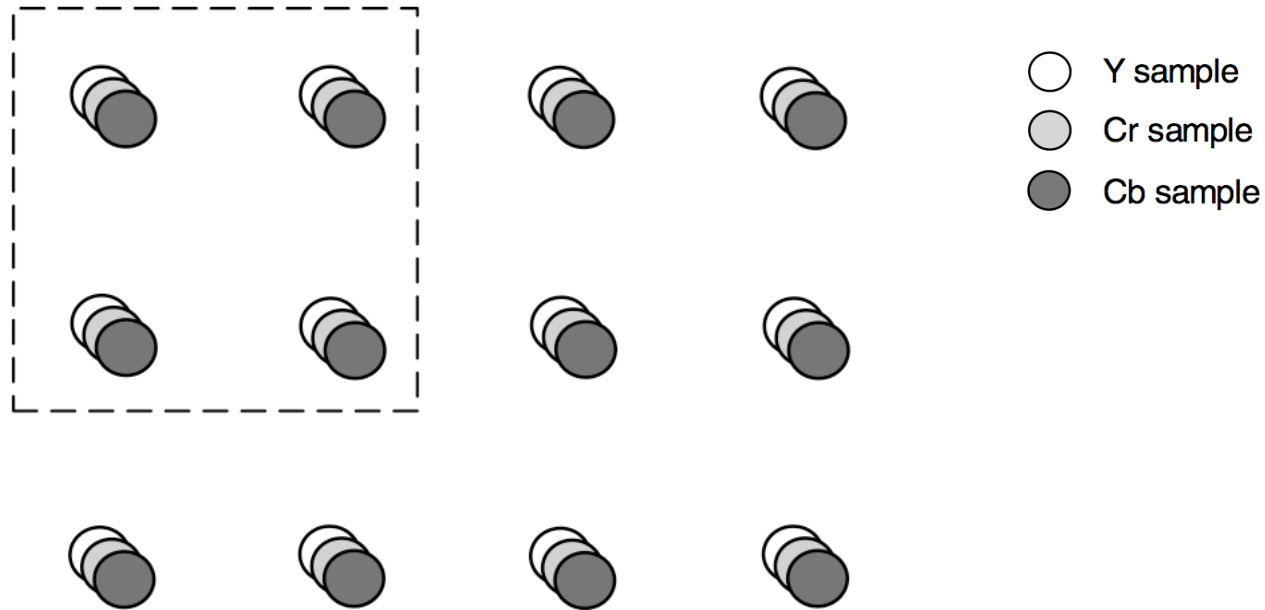
YUV, YCbCr, LUV etc...



YUV, YCbCr, LUV ecc...

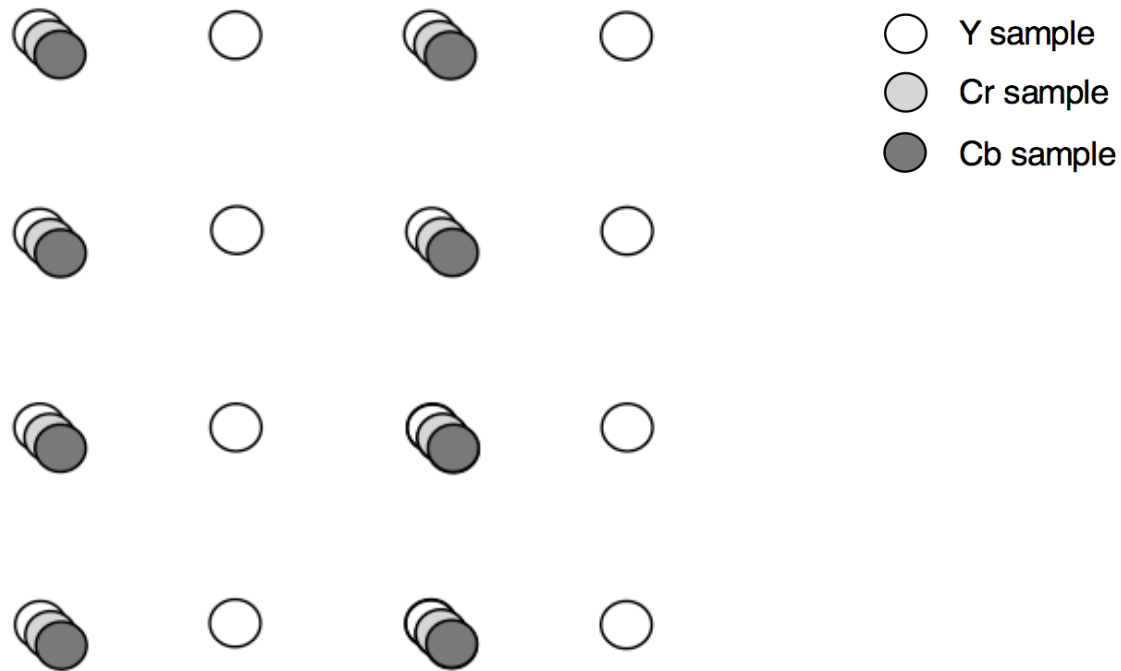
- Each component is represented with 8 bits
- Chrominance components are often decimated in space (subsampled)
- Different formats: 4:4:4, 4:2:2, 4:2:0, 4:4:1, depending on the type of decimation (vertical/horizontal factors, see next)
- The most used one is the 4:2:0 format

YCbCr 4:4:4



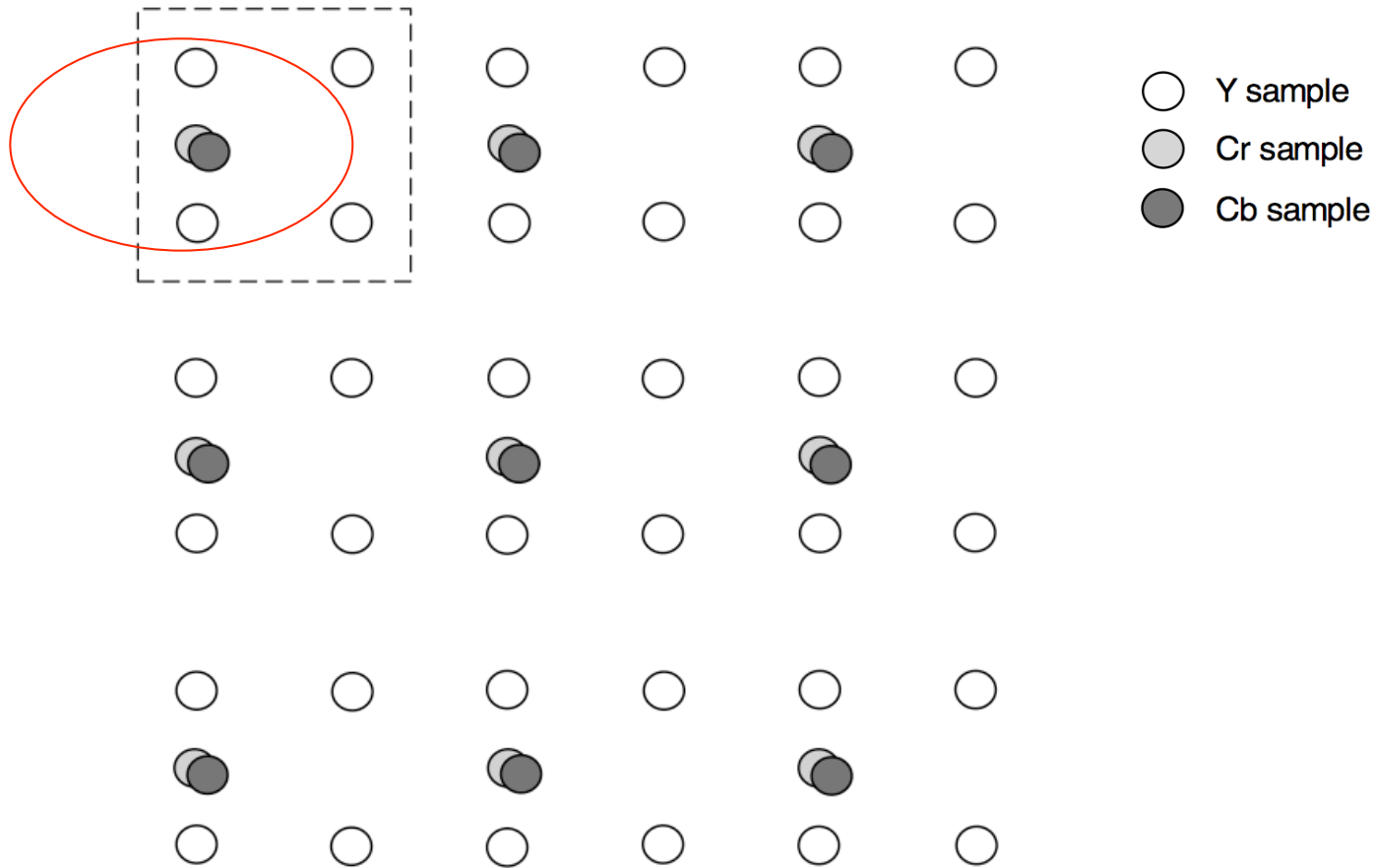
24 bits per pixel

YCbCr 4:2:2



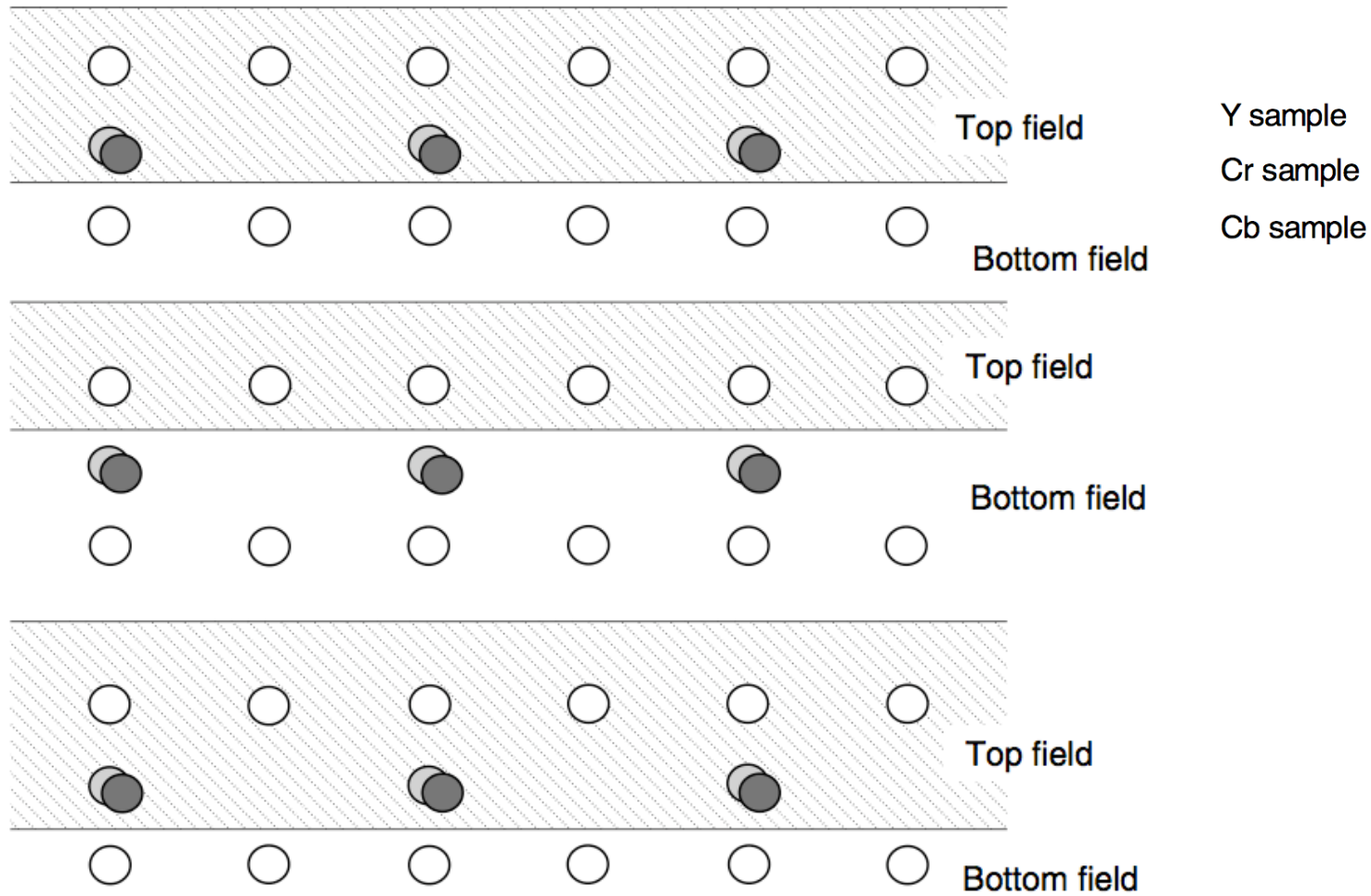
16 bits per pixel

YCbCr 4:2:0



12 bits per pixel

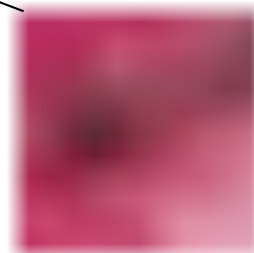
YCbCr 4:2:0 interlaced



Example



4:4:4



4:2:2

4:2:0

