Satellite & Mobile Communication Network

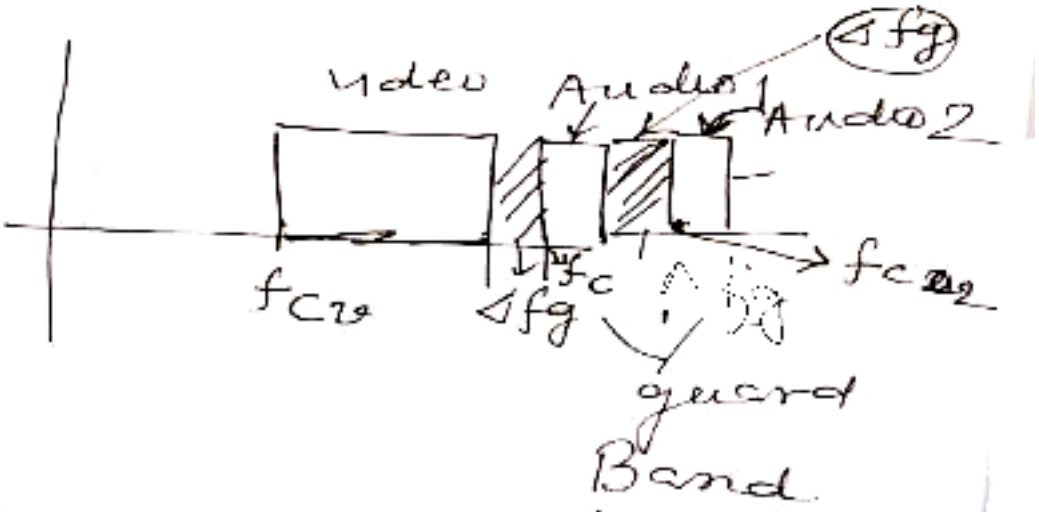
07.09.2020

TV Transmission

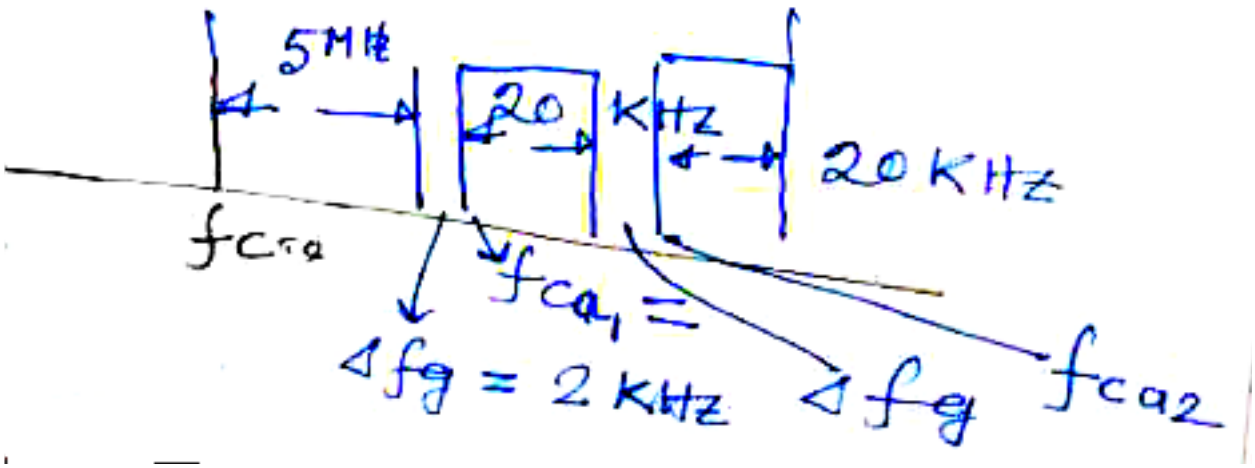
1. TV Signal:
   Video: 0 to 5 MHz
   Audio Music: 0 to 20 KHz

2. TV Music ⇒ Stereo

   2 audio channels in the image below



   f_{cv} = carrier for video
   f_{ca1} = carrier for audio channel 1
   f_{ca2} = carrier for audio channel 2
3. Assume both video and audio music Amplitude Modulated:

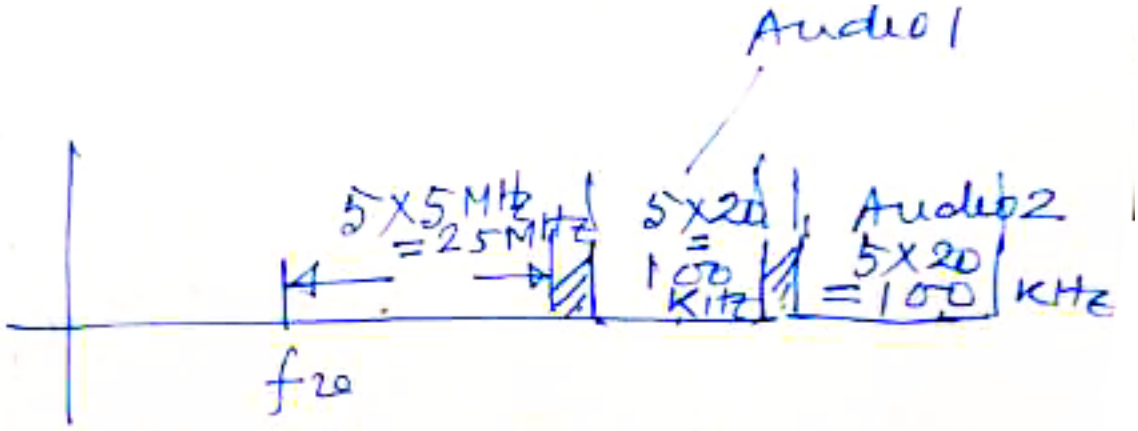


Neglecting guard band

Total TV bandwidth required = 5 MHz + 2 * 20 KHz

= 5.040 MHz

4. Assume all frequency modulated video and audio:

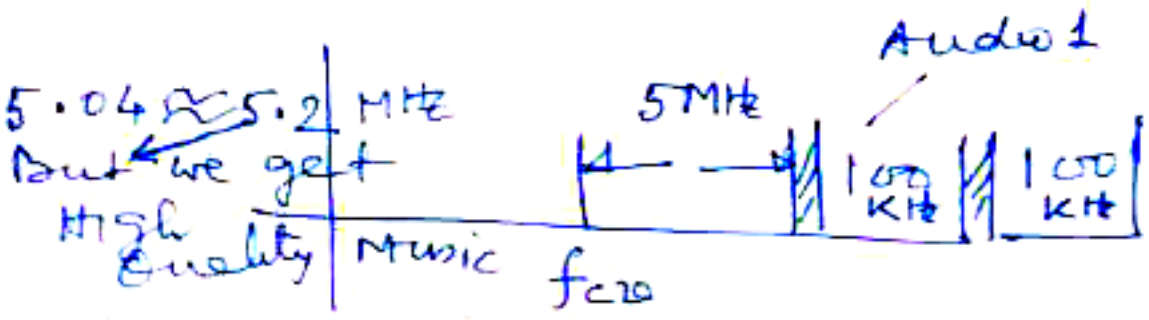


Total bandwidth required = 25 MHz + (100 + 100) KHz

= 25.2 MHz

Because of very high channel bandwidth, video FM is discarded.

5. Video AM and Audio FM:



Total bandwidth = 5 MHz + 200 KHz
= 5.2 MHz

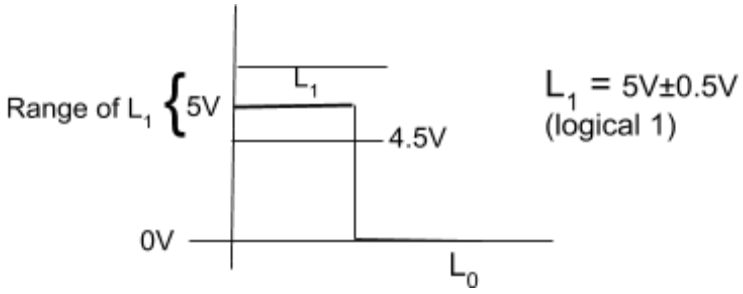
6. From (3) BW_{Total} = 5.04 MHz
   From (5) BW_{Total} = 5.2 MHz

Analog vs Digital Transmission

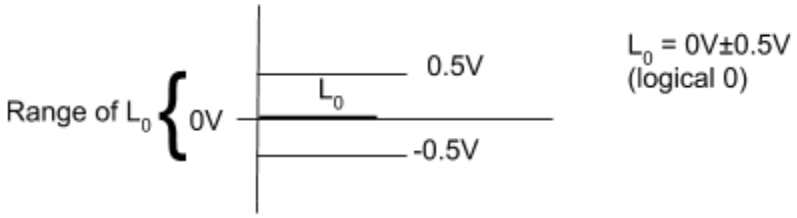
Quality of transmission of digital signals is much better than the analog signal + other benefits. **Why?**

1. Digital signal after some distance of propagation can be regenerated to its original form which the analog signal cannot be.

a.

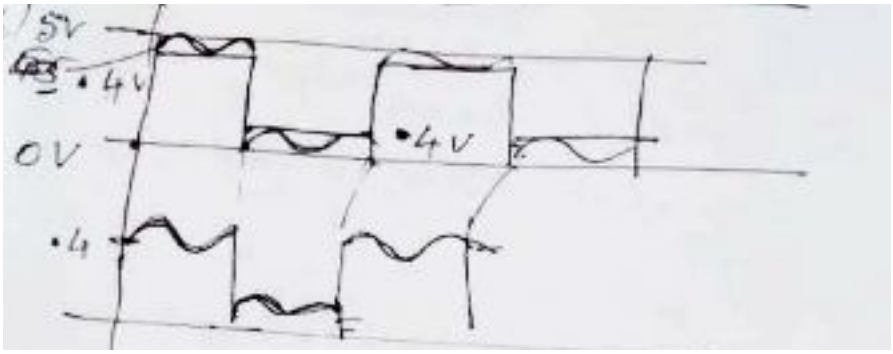


b.



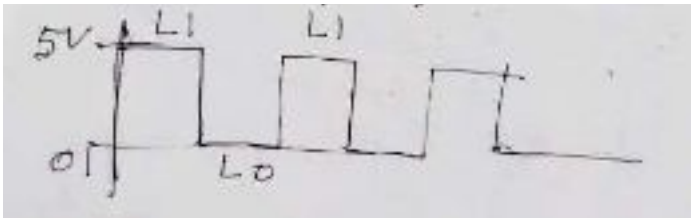
Suppose our transmission sequence is 1010...
L_1 affected by -0.4V noise (negative noise)
L_0 affected by +0.4V noise (positive noise)

c.



d. At receiver 4.5V ≤ voltage ⇒ Replace by L_1

Voltage ≤ 0.5V ⇒ Replace by L_0



e. Then amplified to compensate for the power loss.
Whole process is the regeneration of digital signals.
$Regeneration = Amplification + Reshaping$

f. If there is a positive noise > 0.5V then 0's will be affected and signal cannot be reshaped.

g. If there is negative noise where mod value > 0.5V then digital 1's will be affected.

h. Above (f) and (g) will cause transmission error which can be taken care of by digital transmission by error coding and retransmission scheme.
None of the above can be taken care of in analog transmission.

2. Digital data can be stored and processed by digital computer. This cannot be done for analog signal of analog transmission.

3. Due to the above capability (2) of digital computers the following can be done for only digital transmission.

   a. Data can be compressed to save transmission bandwidth.
   For example:
   - Digital music can be compressed using the MP3 algorithm.
   - Digital video can be compressed using MPEG4 compression algorithm.

   These compression algorithms are lossy.
   - Not Suitable for computer data.
     - Banking
     - Student result
   - But suitable for video and music.

   b. Data can be encrypted and decrypted to stop data surveillance by intruders over space.

   c. In case of transmission error:
      i. Error detecting codes (CRC) algorithm can be used to identify if any transmission error has taken place.
      ii. If so, then there can be an error recovery algorithm (like stop and wait, sliding window) protocol algorithm can be executed to take care of transmission error.
      iii. Also error correcting codes can be used but (i) and (ii) is used for computer data communication.

Digitization of Voice

1. If a signal has got maximum frequency f_{sm}, then according to Nyquist criteria or theorem.
   No. of samples per second = $2 * f_{sm}$
   Each sample is digitized using n bit/sample.

   So total transmission rate of voice/music = $2 * f_{sm} * n$

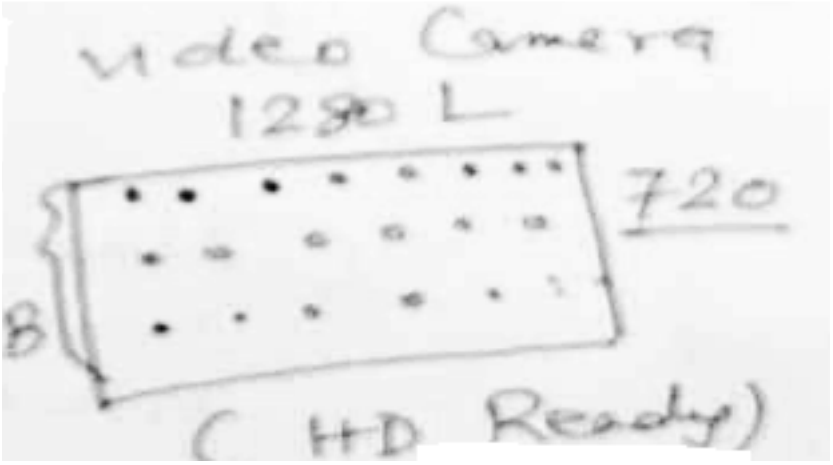
- For telephonic voice, f_{sm} = 4 kHz
  n = 8 bit
  Data rate for telephonic voice = 4 * 2 * 8 = 64 kbps

- For music, f_{sm} = 20 kHz
  n = 16 bit
  Data rate for music for mono music = 20 * 2 * 16 kbps

- For stereo music = 2 * Mono channel

Actually music bandwidth = 21.5 kHz (Not 20 kHz)
Calculate value of 2 * 21.5 * 2 * 16 kbps
⇒ Uncompressed Stereo bandwidth music
⇒ MP3 compression 144 kbps

Video Digitization: Digital Video Camera



Total aspect ratio = (B/L) = $(3/4)^2$ = 9/16
(Earlier aspect ratio = 3/4)
One Screen = One Frame = 1280 * 720
One TV frame = 1280 * 720 * 24 bit
To bring continuity of motion picture 50 frames/second
Total data rate after Digitization = 1280 * 720 * 24 * 50
Compressed by MPEG4 (MP4) = 2 to 6 Mbps (variable bit rate)
Example:
Classroom video = 2 Mbps
Horse race or mountain range = 6 Mbps