CS 536 HW2

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Problem 1

a) The formula for this scenario is $\dfrac{(1-p)\cdot SizeofFrame}{RTT}$. It follows from the fact that now there is a chance that only $((1-p)\cdot SizeofFrame)$ may be transferred but the time taken for this would still be RTT. Hence, as a sanity check, the throughput is expected to fall.

b) For this scenario the RTT will be affected each time a re-transmission request is fulfilled. So the general case formula is,

$$\frac{SizeofFrame\cdot(1-p)}{RTT}\left[\frac{p^{k-1}}{k}\right]$$

.

Problem 2

Orthogonal 4-D vectors, other than basis are: $\{(\frac{2}{3},\frac{1}{3},0,0), (\frac{1}{3},\frac{-2}{3},0,0), (0,0,\frac{-2}{3},\frac{1}{3}), (0,0,\frac{1}{3},\frac{2}{3})\ \}$.

The sender agrees upon some predefined convention with the receiver wherein positive a_i would represent 1 and negative a_i would represent 0. Next, the sender construct the soup vector $S=\sum_{i=1}^{4} a_i\cdot O_i$ where a_i's are the encoded recipe intended for a specific user (that get's decoded to low or high bit) and O_i's are the orthogonal code vectors chosen aside from the basis.

Now, if the receiver wants to know the recipe of his ingredient in the soup vector he would take the dot product of soup vector S with his code vector. Due to orthogonality of the code vectors that constructed the soup vector, only the recipe intended for this user remains and the rest go to zero.

If the code vectors are not orthogonal but still independent then we could relax the orthogonality constraint by ϵ. Hence, if the dot product of the code vectors doesn't go to zero then we can accept the case that they scalar vector atleast lies within ϵ.

This is similar to the practice of demodulation in amplitude modulation. Due to inter channel interference, often contribution from small weights are ignored.

To address the problem of ICI, we have two solutions

a) We could introduce OFDM to choose frequencies that are orthogonal.

b) We could include a guard band that separates frequencies that are too close to ameliorate ICI(inter channel interference).

Problem 3

The carrier frequencies used by AM radio stations are assigned in the range 530-1600 kHz using 10kHz intervals.

Intrinsically, as each carrier is allotted only 10kHz bandwidth, whereas the human auditory system is sensitive up to 20kHz bandwidth, there is a limitation.

Yes, this does help explain that AM radio is more suited to talk radio than to music. Music can span over the entirety of the 2-20kHz frequencies whereas speech falls into the 10kHz bandwidth comfortably. As an aside note, landline supports a bandwidth of 8kHz, which supports our claim.

In AM radio the modulation is on the amplitude, bits are transmitted such that the amplitude of the signal encodes this information. On the other hand, in traditional FDMA, a specific frequency is allotted where information is transmitted.In general, AM is more suitable for an analog signal whereas FDMA is more suitable for digital signals.

If AM radio becomes digital then the devices that demodulate analog signals on the receiving end would have to be modified/replaced to accommodate the new digital requirements.

No, AM radio becoming digital would still encounter the issue that 20kHz bandwidth can't be fit into a 10kHz bandwidth.