Channel Exercises

The **due date** for this homework is **Sun 14 Apr 2013 8:00 PM EDT**.

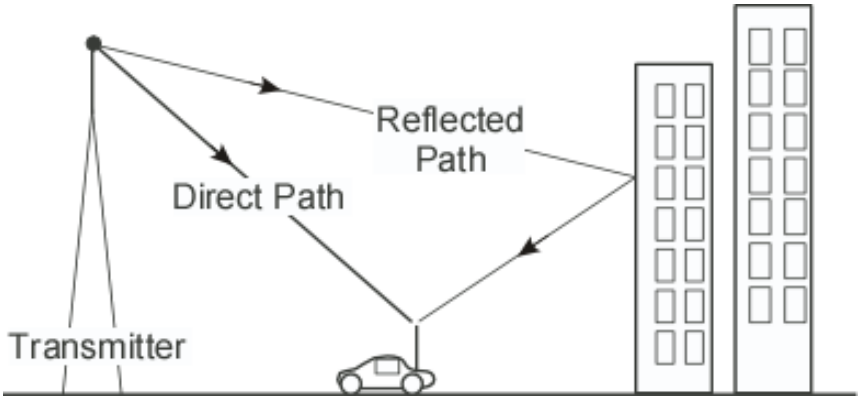
Question 1

RG-6 is a very common type of coaxial cable. One manufacturer's specifications state that the cable's characteristic impedance is $75\ \Omega$ and that its capacitance/unit length is 52 pF/m. What do these parameter values predict for the speed of propagation?

Express your answer as a fraction of the speed of light in free space c_0. If your answer is $0.5c_0$, type `0.5`. Please round your answers to two decimal places.

Question 2

In addition to white, Gaussian noise, metropolitan cellular telephone channels also contain **multipath**: in addition to a direct, line-of-sight path, reflections from buildings cause secondary paths to reach the receiving antenna.



Note that the reflected path is always longer than the direct path, which means more attenuation and a greater delay occurs along the reflected path.

Assume the direct path is 100 m long and that the secondary path is 1.5 times

longer. What are the attenuations and delays along each path? Assume here that the attenuation constant is one.

Type your answer as four numbers separated by spaces: α_{direct}, τ_{direct}, $\alpha_{\text{reflected}}$, $\tau_{\text{reflected}}$. Express the delay answers in units of microseconds (μs). For example, if your answers are .5, 1 μs, .25, 31 μs, you would type `.5 1 .25 31`.

Question 3

What is the transfer function between the transmitter and the receiving antenna?

Your answer should an expression involving complex values. For α_1 and τ_1, the attenuation and delay along the direct path, type `a1` and `tau1`. For α_2 and τ_2, the attenuation and delay along the reflected path, type `a2` and `tau2`.

Preview Help

Question 4

For the parameter values for the path lengths given above, how would you characterize the transfer function between the transmitter and the receiver?

- Lowpass
- Bandpass
- Highpass
- Multiband

Question 5

You should have found that the transfer function between the transmitter and receiver is small at certain frequencies. What are the first three “bad” frequencies?

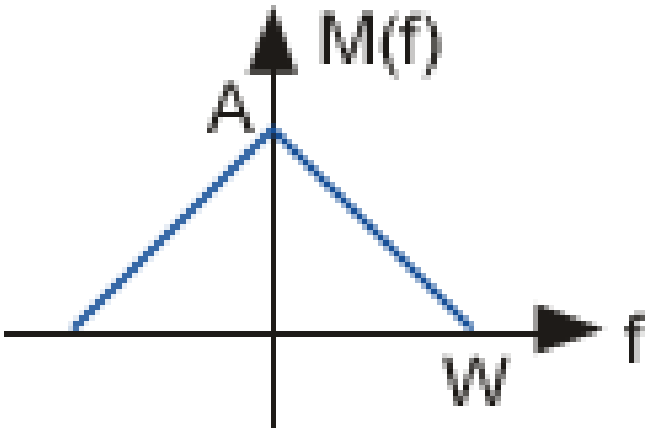
Type your answers in units of MHz as numbers separated by spaces.

Question 6

If the signal-to-noise ratio (SNR) measured 100 m from the transmitter's antenna is 30 dB, what is the SNR 10 km from the transmitter? Express your answer in decibels.

Question 7

Suppose the message has the now-familiar triangle-shaped spectrum.



This signal is sent at baseband to a receiver. The intervening wireless channel

attenuates the signal (gain α) and adds white noise of spectral height $\frac{N_0}{2}$. What is an expression for the signal-to-noise ratio of the received signal?

For the amplitude A, type `A`; for the attenuation gain α, type `a`; for the noise spectral height parameter, type `N0`; and for the bandwidth W,type `W`.

Preview Help

In accordance with the Honor Code, I certify that my answers here are my own work.

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