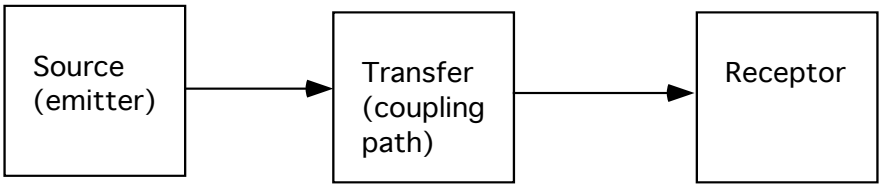
EECS 611
Lecture 1

A. Aspects of EMC
   a. EMC is concerned with the
      i. Generation
      ii. transmission
      iii. reception …. of EM energy

   b. Basic decomposition of EMC coupling problem



   c. 3 ways to prevent interference:
      i. Suppress the emission at its source
      ii. Make the coupling path as inefficient as possible
      iii. Make the receptor less susceptible to emission

   d. Kinds of interference
      i. Unintentional interference with other devices or services
         1. Controlled by FCC or EU
         2. radiated emissions (through the air)_
         3. conducted emissions (through the power grid)
      ii. Unintentional susceptibility
         1. weakly controlled by FCC
         2. bad for business
      iii. Unintentional *internal* interference
         1. degraded device performance specs (s/n ratio, etc)
         2. intermittent upsets

B. Scope of this Course
   a. EMC centers on the broad range of ways that one circuit or device can affect another, and how to minimize these interactions
   b. One aspect of EMC is high speed digital design (EECS 713), but EMC is broader
   c. EMC topics include:
      i. EMC standards and testing
      ii. Radiation and coupling mechanisms
      iii. Design techniques for low emissions and susceptibility
      iv. Design techniques for mixed signal environments
      v. Electrostatic discharge mitigation techniques

C. History of EMC regulation

a. B.C – 1960s

i. Interference mostly managed by frequency partitioning of intentional radiators

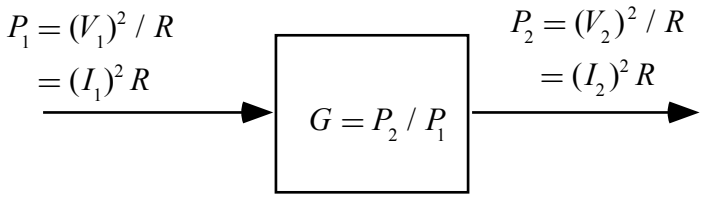
ii. The military implemented their own mill-specs that specified both radiation and susceptibility requirements.

b. 1979 +

i. FCC published regulations for all "digital devices" to have emissions below certain limits in the US

ii. Europe had country-by-country standards until 1996. After 1996, directives based on the "New Approach" according to "harmonized standards." Here, the manufacturer chooses the standard that most closely matches the intended market for the product. These standards typically involve both radiation and susceptibility requirements.

D. Decibels



$$P_2 = (V_2)^2 / R = (I_2)^2 R$$

$$G_{dB} = 10\log_{10}(P_2 / P_1)$$

a. $\text{Gain}_{dB} = 10\log_{10}(P_2/P_1) = 20\log_{10}(V_2/V_1)$

b. $P_{dBm} = 10\log_{10}(P/10^{-3})$

c. $P_{dB\square} = 10\log_{10}(P/10^{-6})$

Also:

$$G_{dB} = 10\log_{10}\left(P_2 / P_2\right) = 20\log_{10}\left(V_2\right) - 20\log_{10}\left(V_1\right)$$
$$= 20\log_{10}\left(V_2 / 10^{-3}\right) - 20\log_{10}\left(V_1 / 10^{-3}\right)$$
$$= V_{2dBm} - V_{2dBm}$$

so

$$V_{2dBm} = V_{2dBm} + G_{dB}$$