Appendix: noise

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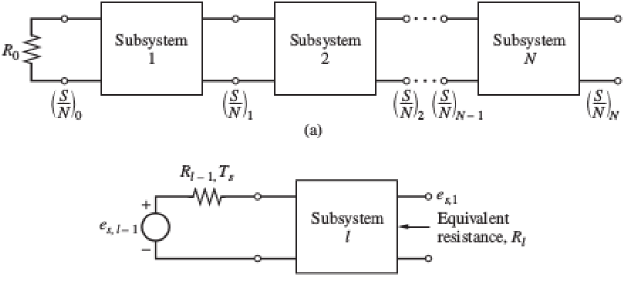
Characterization of noise in systems

- Noise can be modeled and characterized on a subsystem-basis
- Each subsystem can be analyzed separately and optimized for low noise performances



(a)

(b)

Noise Figure of a System

- Noise figure F_l: ratio between SNR at subsystem input and output: $\left(\frac{S}{N}\right)_l = \frac{1}{F_l}\left(\frac{S}{N}\right)_{l-1}$
- Ideally, $F_l = 1$ (no additional noise introduced), tipically between 2 and 8 dB
- Without having to calculate the signal power: $F_l = 1 + \frac{P_{int,l}}{G_a k T_0 B}$

$P_{int,l}$	Available, internally-generated noise power
G_a	Available power gain
k	Boltzmann's constant
T_0	Standardized temperature, $290K$
B	Frequency band

- For high gains, F_l approaches 1

Noise Temperature

- Power produced by a noisy resistor: $P_{a,R} = kTB$

  k Boltzmann's constant, $1.38 \times 10^{-23} J/K$
  T Temperature of the resistor, in Kelvin
  B Frequency band, in Hertz
  Noise power independent on the resistor value

- Equivalent noise temperature: $T_n = \frac{P_{n,max}}{kB}$

Free Space Propagation Example

- As a final work for the noise calculation, we will investigate the "free-space electromagnetic-wave propagation channel.
- To understand it fully on a practical example, we will investigate the communication tie between a synchronous-orbit relay satellite and a low-orbit satellite.