Multiple Access Links and Protocols

Two types of "links":
- **point-to-point**
  - PPP for dial-up access
  - point-to-point link between Ethernet switch and host
- **broadcast** (shared wire or medium)
  - old-fashioned Ethernet
  - upstream HFC
  - 802.11 wireless LAN

**Ideal Multiple Access Protocol**
- **Broadcast channel of rate $R$ bps**
  1. when one node wants to transmit, it can send at rate $R$.
  2. when $M$ nodes want to transmit, each can send at average rate $R/M$.
  3. fully decentralized:
     - no special node to coordinate transmissions
     - no synchronization of clocks, slots
  4. simple
     - inexpensive to implement

**MAC Protocols: a taxonomy**
- **Channel Partitioning**
  - TDMA
  - FDMA
  - CDMA
- **Random Access**
  - ALOHA / Slotted ALOHA
  - “Taking Turns”
    - polling by a master node (e.g. Bluetooth)
    - token-passing (e.g. FDDI)
• Utilization = time spent sending packets / total time sending data
• \( P_A, P_B \) : probabilities for a successful transmission
• \( u_A, u_B \) : channel utilizations
• Let \( X, Y \) be random variables counting how many stations transmitted in networks \( A, B \) respectively.

\[ P_A = P\{X = 1\} \quad P_B = P\{Y = 1\} \]

\[ u_A = P_A \quad u_B = P_B \]

\[ u_A, u_B \] are the same (symmetry)

• The manager of network \( B \) synchronizes his channels with network \( A \).

\[ P_A = P\{X = 1\} \quad P_B = P\{Y = 0\} \]

\[ u_A = P_A \quad u_B = P_B \]

\[ u_A, u_B \] are the same (symmetry)

• The manager of network \( B \) didn’t agree with the solution from the previous section and increased the transmission power.

\[ P_A = P\{X = 1\} \quad P_B = P\{Y = 1\} \]

\[ u_A = P_A \quad u_B = P_B \]

\[ u_A, u_B \] are the same (symmetry)