Centralized Scheduling

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Centralized Scheduling

- A central coordinator ("scheduler") picks the "schedule"

- Assume time is slotted, with slots synchronized

- **Schedule** ➔ specified which node(s) transmit in each slot

- **Schedule function of channel state & traffic demands**
Rate Region

- Rate region characterizes rates that can be supported simultaneously on various links

  - As a function of channel state

\[ L = \{l_1, l_2, \cdots, l_m\} \]

Feasible Rate vector

\[ \mathcal{R}(L) = [r_1, r_2, \cdots, r_m] \]
Rate Region

Defined by

- Channel state
- Power constraints

- Physical capabilities & constraints:

  Examples:
  - Use multiple channels simultaneously?
  - Number of interfaces
Simple example scenarios

- Downlink scenario (common transmitter)

- Uplink scenario (common receiver)
Downlink Scenario

\[ P_1 + P_2 \leq P \]

- Treating interference as noise

\[
\begin{align*}
    r_1 &= W \log \left( 1 + \frac{P_1 g_{B1}}{P_2 g_{B1} + N_0 W} \right) \\
    r_2 &= W \log \left( 1 + \frac{P_2 g_{B2}}{P_1 g_{B2} + N_0 W} \right)
\end{align*}
\]
Numerical Example

- \( W = 10 \text{ MHz} \)
- **Noise** \( \frac{N_0}{2} = 4 \times 10^{-21} \text{ W/Hz} \)
- \( P = 1 \text{ mW} \)
- \( g_{B1} = 10^{-12} \text{ and } g_{B2} = 10^{-10} \)
Downlink Scenario:
Treating Interference as Noise

![Graph showing the relationship between rate and power. The graph plots rate in Mbps against power in Watts. There are two curves: one for Rate $R_1$ and another for Rate $R_2$. The graph indicates how rate decreases as power increases.]
Downlink Scenario:
Treating Interference as Noise

- Power-sharing
Downlink Scenario

- Power-sharing & Time-sharing
Downlink Scenario:
Power-sharing & Bandwidth sharing
Downlink Scenario:
Successive Interference Cancellation

At node 1, treat other Signal as interference

\[ g_{B1} \leq g_{B2} \]

\[ SINR_{11} = \frac{P_1 g_{B1}}{P_2 g_{B1} + N_0 W} \]

\[ r_1 = W \log \left( 1 + \frac{P_1 g_{B1}}{P_2 g_{B1} + N_0 W} \right) \]
Downlink Scenario: Successive Interference Cancellation

At node 2, “cancel” the interference

\[ SINR_{12} = \frac{P_1 g_{B2}}{P_2 g_{B2} + N_0 W} \]

\[ g_{B1} \leq g_{B2} \quad \Rightarrow \quad SINR_{11} \leq SINR_{12} \]
Downlink Scenario:
Successive Interference Cancellation

\[ \text{SINR}_{11} \leq \text{SINR}_{12} \]

- Decode signal for 1, and “cancel” it
- Decode signal for 2

\[ r_2 = W \log \left( 1 + \frac{P_2 g_{B2}}{N_0 W} \right) \]
Downlink Scenario:
Successive Interference Cancellation
Operating Points
Approximate Rate Region

- Link conflict
- Conflict graph