Opportunistic Scheduling for Wireless Networks

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Motivation
- Wireless planet: A wonderland or not?
- Skyrocketing demand for Wireless Services
- "Whenever, Wherever, Whoever" communication
- 3G, Wireless LAN (802.11 a/b), Bluetooth, Ad-hoc networks

Characteristics of wireless systems
- Time- and location-dependent channel conditions
- Limited radio frequency spectrum, capacity
- Quality of Service (QoS) support
- Cross layer design
- Mixed types of traffic and diverse QoS guarantees
- PHY layer knowledge is shared with MAC or higher layers.

Problem Formulation
Use temporal fairness scheduling as an example:
- Define: average performance of user $i$ up to time $T$:
  $U_i(T) = \frac{1}{T} \sum_{t=1}^{T} U_i(t)$, $i = 1, ..., N$.
- Goal: Find a policy that maximizes the system performance, while maintaining certain QoS constraints.

Optimal Opportunistic Policy
- Optimal temporally fair policy $\pi^*$:
  $\pi^*(t) = \arg \max \left\{ \sum_{i=1}^{N} U_i(t) \middle| \pi \right\}$
- where, for all $i$, $\pi$ satisfies:
  1. $\pi(0) = 0$
  2. $\pi(t+1) = \pi(t) + \frac{1}{2\pi(t)}$

Remarks:
- Similar results apply for other fairness/QoS criteria.
- The parameter $\pi$ satisfies a set of equations and inequalities (complementary slackness).
- $\pi$ can be estimated online in practice (e.g., via a stochastic approximation algorithm).

Numerical Results
- Performance
- Temporal Fairness

References