

Competition and cooperation



Ramesh Johari

Competition and cooperation

- Fundamental question:
When can local competition yield global cooperation?
- Fundamental limit:
The cost of failure to coordinate
- Two key subproblems:
 - Distributed coordination
 - Managing noncooperative incentives

Distributed coordination



- There exists a “good” operating point, but nodes have no way of coordinating to reach it.
- *Design the system* so individually “selfish” behavior leads to a collectively “good” outcome.

Distributed coordination

1) *Wireless resource allocation*

Cognitive radios (CRs) must find and utilize space, time, and frequency “holes.”

If many CRs are in the same area, they will all react to each other.

Distributed coordination

1) *Wireless resource allocation*

Frequency: Interference effects

Time: “Evolution of cooperation”

Space: Spatial reuse

What CR strategies perform well when the environment is reactive?

Roadmap



1) *Wireless resource allocation*

- frequency competition among CRs
(current)
- comparison of CR strategies in a temporally varying model
- spatial variation in CR strategies
- large system limits

Distributed coordination

2) *Topology formation*

If MANETs try to build a network topology (for routing, distributed computation or control, etc.), they suffer from a *lack of global information*.

Distributed coordination

2) *Topology formation*

Encourage selfish link formation and destruction, but with a “contracting model” that ensures eventual topology is efficient and robust.

What local link formation dynamic leads to a good global topology?

Roadmap

2) *Topology formation*

- study local information exchange needed to converge to good global topology
(current)
- study tradeoff between *complexity* of local exchange and *robustness* of global dynamic

Managing incentives



When some nodes are noncooperative or adversarial, the MANET must still function.

Thus we need mechanisms to:

- detect misbehavior and
- punish misbehavior

Managing incentives



Is there a distributed notion of “reputation” that can be sustained in the network?

Can benign nodes “learn” over time and cooperatively counteract adversarial behavior?

What architectures make “deviating from the norm” a bad idea?