6.033 Spring 2017
Lecture #13

- Wireless Networks
- MAC Protocols (CSMA/CA, RTS/CTS)
- Bit Rate Selection
- Interactions with the Internet
How do we **route** (and address) scalably, while dealing with issues of policy and economy?  

How do we **transport** data scalably, while dealing with varying application demands?  

How do we **adapt** new applications and technologies to an inflexible architecture?  

- **BGP**  
- **TCP**, in-network resource management  
- **P2P Networks, CDNs** (and more)
wired networks:

two nodes can communicate directly if there is a link between them, and no other nodes can overhear the communications on that link
wireless networks:
wireless is a broadcast medium. nodes can overhear communications from other nodes
(which nodes depends on how their ranges overlap)

this is a typical 802.11 setup, with clients trying to communicate with an access point
**problem:** if two (or more) nodes send at once, their packets will interfere ("collide") and be lost where their ranges overlap
**problem:** sensing happens at the sender, but interference at the receiver is what matters

*hidden terminals* clients will send when they shouldn’t
**RTS/CTS:** clients make a request to send (RTS), and send when they get a “clear to send” (CTS).

Clients who overhear CTS messages for other clients **don’t** send.

(send RTS)
**RTS/CTS:** clients make a request to send (RTS), and send when they get a “clear to send” (CTS). Clients who overhear CTS messages for other clients don’t send.
**RTS/CTS:** clients make a request to send (RTS), and send when they get a “clear to send” (CTS)

clients who overhear CTS messages for other clients **don’t** send

clients who overhear CTS messages for other clients **don’t** send

receive CTS; send

receive CTS; don’t send (this CTS is meant for someone else)
hidden terminals
clients will send when they shouldn’t

exposed terminals
clients won’t send when they could

problem: sensing happens at the sender, but interference at the receiver is what matters
**RTS/CTS:** clients make a request to send (RTS), and send when they get a “clear to send” (CTS)

clients who overhear CTS messages for other clients **don’t** send
**RTS/CTS:** clients make a request to send (RTS), and send when they get a “clear to send” (CTS) message. Clients who overhear CTS messages for other clients **don’t** send.
**RTS/CTS:** clients make a request to send (RTS), and send when they get a “clear to send” (CTS).

Clients who overhear CTS messages for other clients **don’t** send.

(neither overhear copies of the other’s CTS)
hidden terminals
clients will send when they shouldn’t

exposed terminals
clients won’t send when they could

**RTS/CTS** solve these problems in theory, but not always in practice; moreover, it adds a large amount of **overhead** to the common case.
problem: there is still a lot of loss in wireless networks, and channel conditions can change rapidly
how does 802.11 interact with existing protocols?
• **(802.11) wireless** networks provide **broadcast** communication. They require (more complicated) **MAC protocols** to mitigate collisions, as well as **bit-rate-selection** algorithms to adapt to changing channel conditions.

• 802.11 networks cause some problems for existing protocols, such as TCP. But they also provide opportunities — mobility, mesh networks, etc. — that didn’t exist when the Internet was designed.

**after spring break:** how do we build large, distributed systems in the face of random and targeted failures?

(Also after spring break: a midterm)