Unleashing Unlicensed Spectrum

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Silicon Flatirons presentation

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Resources

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Kenneth R. Carter, Ahmed Lahjouji and Neal McNeil, “Unlicensed and Unshackled: FCC Working Paper No. 39 (2003): 4.

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Two recent additions

FCC Proposal on Citizen Broadband Service in 3.5GHz band
- for small cells and spectrum sharing (PCAST)
- geographic restrictions due to military radar
- propagation properties not great
- 3-tiered access: Incumbents, Priority, General
- definitely a step forward

Google-Microsoft submission to FCC on incentive auctions
- white spaces in 600 MHz band
- guard band between LTE and TV, and wireless microphones
- enables small cells operating at city block level

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Unlicensed does not mean unregulated

Low Power Operation without a User License
Cardinal rules:

- No Vested Right to Continued Operation
- May Not Cause Harmful Interference
- Must Accept Any Interference
- Must Cease Operation if Notified by FCC that Device is Causing Harmful Interference
- Must Receive Equipment Authorization before Marketing and/ or Importation

There are many different licensing regimes. One important dimension is ability to deploy compliant devices without requesting permission.

History of Unlicensed Spectrum

1938: first unlicensed spectrum (for wireless record players)

1960-70: proliferation of uses: cordless microphones, garage door openers, cordless telephones

1985: FCC opened up new spectrum

1990s: WiFi alliance
- Junk spectrum: low power, low propagation
- Hugely successful
  - Smart phones ~ half the traffic?
  - Tablets ~ 90% of traffic?
- Other devices: streaming data, security cameras, medical devices

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WiFi adoption

200M households worldwide
750,000 hotspots worldwide

800M wifi-enabled devices sold every year worldwide
58% are mobile devices
over 500M smartphones in 2010

By 2015 over half of all IP traffic will go over wifi (Cisco)

WiFi is a very successful example of unlicensed spectrum

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Economic Value of WiFi in US

Half of smart phone traffic is on wifi
180M smartphones in US
Data plans cost $30 a month = $360/year

$65B a year value (= 360 x 180M)

Leaves out: laptops, tablets cameras, etc,

Economic types of goods with telecom examples

Rival: my consumption reduces your consumption
Excludable: I can exclude you from consuming the good

	Rival	**Non-rival (up to a point)**
Excludable	Private good (landline)	Club good (Cell service, public WiFi)
Non-excludable	Commons (Early radio)	Public good (Broadcast TV)

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Economics of unlicensed spectrum

Tradeoff between: interference, propagation, power
- WiFi: poor propagation, low power: minimal interference
- TV spectrum: good propagation, can adjust power

One model for unlicensed spectrum
- low power, small cells
- want frequency with good propagation

Enables
- 1 wifi per room - now
- 1 wifi per building?
- 1 wifi per city block?

Congestion control

If power is low enough (or signal is focused), congestion is not a problem

If congestion is an issue, can build congestion control into standard
- Cognitive radio (aka dynamic spectrum management)
  - Power is an extra dimension
- TCP congestion management: rate of transmission depends on packet loss rates. Not incentive compatible, but can be enforced.

Possible approaches
- Require congestion control to use system
- Gold, silver, bronze service (subscription)
  - Easy to implement, build fee into purchase price
- Run real-time auction
  - Bid on right to transmit at specific power
  - Need accounting and billing system (as with existing mobile)

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Solution to backhaul problem?

Use landline installation to install both private and public wifi
- British Telecom BTFon service: 3M customers
- SFR 1.3M users
- Kansas City: Google Fiber + wireless
- Fiber policy and spectrum policy are intimately related

Problem: outside mount v internal mount
- Propagation issue
- Power limits

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Need for experimentation

WiFi was tremendously successful due to
- low entry cost
- junk spectrum
- strong backing of powerful complementors

Impediments from incentive auctions
- Auctions allocate based on private benefit
- Hold-up for new innovations that utilize spectrum
- Diverse or ex ante unknown set of beneficiaries

Revenue considerations
- Congress is focused on revenue
- Cannot assemble entire set of beneficiaries ex ante
- Reduction in supply could increase revenue
  - Elasticity and budget considerations