WI-FI AS A COMMERCIAL SERVICE: NEW TECHNOLOGY AND POLICY IMPLICATIONS

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Key Questions

1) Why is there growing confidence in Wi-Fi as a commercial wireless platform despite its unlicensed status?

2) How might this trend influence the direction of the technical specifications and spectrum policy issues associated with Wi-Fi?

Hypothesis

Activities of Wi-Fi Alliance and IEEE 802.11 replicate the functions traditionally employed by an effective band manager to sufficiently mitigate risk and justify investment in Public Wi-Fi

Growth in Public Wi-Fi

Two reasons most often cited for growing interest of service providers in Public Wi-Fi

1. Increased popularity of Wi-Fi devices
   - 1.9B shipped in 2013, average of 7 devices per Wi-Fi household according to Strategy Analytics
   - Wi-Fi mobile phones and tablets account for 59% of all Wi-Fi device shipments in 2013
2. Need of wireless operators for "data offload" to help manage congestion on their networks
   - Cisco estimates almost 50% of all mobile traffic will be offloaded by 2017

Other Reasons for Growth in Public Wi-Fi

- Technical improvements supporting larger networks
- Cost of spectrum to service provider is free
- Wi-Fi devices support new service strategy (e.g., home networking/security in residential gateways)
- Need for wireless in the service bundle

Key Band Manager Attributes of Wireless Platform: Framework for Evaluation

Attribute	Question
Interference Management	• Is there sufficient ability to manage interference impact on service quality?
Spectrum Allocation	• Is there sufficient spectrum to support current and future services?
Service Flexibility	• Are spectrum service rules, and relevant standards processes, sufficiently flexible to support new services?
Technical Evolution	• Is there a well-defined process of network evolution?
Platform Ecosystem	• Is the platform ecosystem sufficient to provide competitive options of supply for equipment?

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Notable Activity of Wi-Fi Alliance

Passpoint (Hotspot 2.0 spec)

- Network access requirements for public Wi-Fi by service providers
- Establishes user experience of network connection similar to mobile, and how to leverage Wi-Fi for data offload
- Started equipment certification program of automatic network connection
  ○ Technology tie-in: Hotspot 2.0 based on portions of IEEE 802.11u and 802.11v
    - Uses connection manager using a connection policy to connect automatically with hotspots based on the credentials of the user

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Future Directions of Wi-Fi as a Service Platform: Interference Management

- Service providers have more resources and motivation for managing technical mechanisms to mitigate interference and improve performance
- Develop cloud-based network performance optimization tools to manage Public Wi-Fi:
  - Dynamic Channel Assignment
  - Dynamic Carrier Sense Threshold Adaptation
  - Multiple Input/Multiple Output (MIMO) Antenna Optimization
  - Load Balancing
  - Transmit Power Control

Future Directions of Wi-Fi as a Service Platform: Interference Management (cont'd)

- Scenarios where service providers would improve the experience of Public Wi-Fi at expense of private users?
  - Most scenarios should improve overall noise environment for all users through more focused transmission paths at appropriate power levels
- Two observations:
  1. Public Wi-Fi access points blanketing populated areas will add interference to private users
  2. New quality of service feature in 802.11n called Enhanced Distributed Channel Access (EDCA) can prioritize traffic (e.g. voice) over others (e.g. best effort)

Future Directions of Wi-Fi as a Service Platform: Spectrum Allocation

- Self-interest of service providers aligned to additional unlicensed spectrum allocations
  - Rules that support Wi-Fi platforms capable of transmitting more information over longer distances
- In large part, this has already begun
- Equipment vendors and service providers become incumbents to the band, with legitimate concerns regarding the evolution and plan for spectrum allocation over time

Future Directions of Wi-Fi as a Service Platform: Service Flexibility

- Extraordinary strength of the platform – family of 802.11 standards now working its way through the alphabet for a second time
- FCC's Part 15 and UNII rules allow for broad interpretation of the services permitted

Future Directions of Wi-Fi as a Service Platform: Network Evolution

- IEEE 802.11 process to start new standards establishes technical evolution of Wi-Fi platform
- New standards increasingly will follow requirements of service providers
  - More control of user experience, creating smart networks that improve quality and lower cost of operations
- Formed new program: High Efficiency Wireless (HEW)
  - Goal: Define new 802.11 version that is more robust in presence of congestion
  - Recognize global view of network optimization in heterogeneous mix of access points and stations

Summary of Results

- Wi-Fi ecosystem functioning as effective spectrum manager
  - Investment in Public Wi-Fi "rational" as risk posed by saturation sufficiently reduced by technology and equipment certification
- Strategic Implications
  - Increasing influence of service provider requirements on evolution of Wi-Fi standard
    - Manage interference, monitor/improve network performance
  - Increasing voice for allocation of spectrum to Wi-Fi
  - Interference concerns likely addressed, up to a point

Recent Events

- Hotspot 2.0 adoption "slow but steady"
- Qualcomm's LTE Advanced in unlicensed proposal
  - Upcoming 3GPP Release 13 by end of 2015 (3GPP currently finalizing Release 12)

Remaining Gaps

- *Coexistence in Bands* – many users operate outside etiquette established by 802.11, though still within Part 15
  - See, for example, FCC Order regarding request by Progeny to operate new position location service on unlicensed band
- *Service Interoperability* – Wi-Fi equipment standards and testing do not address key elements of Public Wi-Fi such as roaming across service providers
  - Service providers formed Wireless Broadband Alliance to establish interoperability in areas not specified by 802.11
- *Spectrum Allocation* – What if success of Wi-Fi has been due to mainly "spectrum over-provisioning" to meet growth?
  - If true, saturation of the Wi-Fi bands would be inevitable in the absence of additional spectrum or technical fixes