Introducing the 6 GHz Band & Wi-Fi 6E

Chuck Lukaszewski
VP, Wireless Strategy & Policy
Wi-Fi is Key to Economic Growth

– As reliable broadband connectivity becomes more important than ever, high performance Wi-Fi is a vital driver of economic growth.

– In the wake of the COVID-19 pandemic, citizens, businesses and governments are relying on Wi-Fi to remain connected with colleagues, teachers, healthcare professionals and other vital services.

– In-home Wi-Fi is helping limit the economic and societal damage caused by the pandemic.

VALUE OF WI-FI GLOBAL ESTIMATE AND SELECT MARKETS

Source: Telecom Advisory Services, 2018
Wi-Fi 6 and 4G / 5G Are Complementary

– Without the ability to offload traffic to Wi-Fi, 4G/5G networks would be more expensive. Mobile operators would need to invest more in network densification, deploying many more small cells in dense urban areas to offer high-speed throughput.

– Many “core” 4G/5G use cases depend on Wi-Fi for value creation. These include:
  – Consumer & enterprise fixed wireless access (FWA)
  – Mobile AR/VR for consumer & enterprise
  – Mobile gigabit hotspot
  – Smart home
  – 4K movie casting from smartphones to smart TVs
  – Home health monitoring devices & wearables
Wi-Fi Depends on a Contention Based Protocol

– RLANs are inherently self-coordinating
  – They integrate dynamic spectrum access techniques in the frequency and time domain to maximize utilization in license-exempt bands with no prior coordination between device owners

– The primary techniques employed by Wi-Fi are:
  – Cell silencing via backward-compatible reservation signal (preamble)
  – Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) for random channel access

– It can be shown that at least 7 channels are required for such a system to be acceptably non-blocking in real world conditions
Self-Coordination Requires Multiple Channels

Licensed Spectrum = Hand Coordinated

License-Exempt Spectrum = Self Coordinated

Operator networks are precision engineered to achieve exacting $C/(I+N)$ targets with Reuse=$\{1,3\}$ networks by a single operator and costly high quality radio components.

Wi-Fi uses combination of Energy Detect (ED) and/or Preamble Detect (PD) with Reuse=$\{3-25\}$ networks using $C/N$ operation and consumer grade components.

Sources: DAS Everywhere Brochure showing IBWave model; Aruba Networks Next-Generation Residence Halls VRD
Self-Coordination Is Critical to Low Cost Devices

Licensed Spectrum = Scheduled Access

Fully scheduled radio systems require dedicated spectrum under control of a single operator

License-Exempt Spectrum = Random Access

RLANs use listen-before-talk methods and statistical channel access to achieve uncoordinated random access with high channel utilization levels

Wi-Fi & 3GPP Technologies Achieve Similar Spectral Efficiency

- Wi-Fi and LTE are both OFDM
- When normalized at the symbol level, they have nearly identical performance
- Wi-Fi 6 delivers bidirectional OFDMA

- At the MAC layer, Wi-Fi and LTE deliver very similar efficiency after accounting for layer-2 overheads
- Wi-Fi 6 delivers additional efficiency gains

Source: Aruba Networks Research
Device Classes in 6 GHz

**Low Power Indoor (LPI) AP**
- Fixed indoor only
- Up to 63X lower energy
- No antenna connectors
- No weatherproofing
- Wired power

**Standard Power (SP) AP**
- Fixed indoor / outdoor
- Controlled by AFC database
- Automated geolocation
- Pointing angle restriction

**Very Low Power (VLP) AP**
- Mobile indoor / outdoor
- 160X lower energy

**Subordinate Indoor Device**
- Same rules as LPI AP, **plus:**
- Under AP control
- No direct Internet connection

**Mobile Client**
- Indoor / outdoor
- 4X less power than connected AP

**Fixed Outdoor Device**
- Same rules as SP AP, **plus:**
- Attached to structure

~2 Gbps throughput with sub-ms latency at 3m
Initial 6 GHz Rules in United States

– Indoor low power across the entire band without AFC @ 5 dBm/MHz; Prohibition on connectors
– Automated Frequency Coordination (AFC) required in UNII-5/7 for “full” power indoor and all outdoor APs
– FNPRM on “Very Low Power” class for portable APs and short-range applications
6 GHz Channels in United States & Europe/CEPT

- **UNII-5**
  - 59 x 20 MHz
  - 29 x 40 MHz
  - 14 x 80 MHz
  - 7 x 160 MHz

- **UNII-6**
  - 59 x 20 MHz
  - 29 x 40 MHz
  - 14 x 80 MHz
  - 7 x 160 MHz

- **UNII-7**
  - 59 x 20 MHz
  - 29 x 40 MHz
  - 14 x 80 MHz
  - 7 x 160 MHz

- **UNII-8**
  - 59 x 20 MHz
  - 29 x 40 MHz
  - 14 x 80 MHz
  - 7 x 160 MHz

- **5925 - 6425 MHz**
  - 24 x 20 MHz
  - 12 x 40 MHz
  - 6 x 80 MHz
  - 3 x 160 MHz

- **5925 - 6425 MHz**
  - 24 x 20 MHz
  - 12 x 40 MHz
  - 6 x 80 MHz
  - 3 x 160 MHz

- **Legend:**
  - 
  - = Low Power Indoor (LPI) Only
  - = LPI & Automatic Frequency Coordination (AFC)
  - = LPI & Very Lower Power (VLP)
  - = Preferred Scanning Channels (PSC)
6 GHz Timeline

- First 6 GHz Radios Announced: January 8
- AFC Multistakeholder Process
- Consumer LPI 6 GHz APs Ship in USA
- First Wi-Fi 6E Phones & Laptops
- Enterprise LPI 6 GHz APs Ship in USA
- Europe / UK LPI & VLP Shipments Begin
- AFC Certification Begins
- Enterprise Outdoor AFC APs Ship in USA
- Indoor APs Activate AFC Channels
- Wi-Fi 6E Client Penetration > 30%

Public Consultations / RFIs Issued By:
- Saudi Arabia
- Taiwan
- United Arab Emirates
How an AFC Deployment Works

- Constellation of APs under local or remote management and control
- AFC access points must be capable of determining their geolocation
- AFC access points must request a list of available channels from AFC Operator every 24 hours
- Channel availability requests include AP geolocation (with uncertainty estimate), FCCID and AP serial number
- AP or network controller chooses operating channel(s) and configures APs until its control
Thank you

chuck.lukaszewski@hpe.com