Wireless That Just Works
CBRS Updates and Experience
Cambium Networks at a Glance

- Spun out of Motorola Solutions in October 2011
- Pioneer in Point-to-Multipoint & Point-to-Point IP Wireless Broadband Solutions
- Industry leader in High-Density Wi-Fi solutions
- Emerging leader in IIoT and 5G like solutions
- HQ outside of Chicago, IL with 700+ employees across 6 continents
- More than 5,000 channel partners in 150+ countries
- More than 7 million nodes shipped totaling over $1.5B
- IPO on NASDAQ in June 2019
Fixed Wireless Service Provider Use Case

**Business and residential access**

**High capacity connectivity for streaming video, voice, and data**

Licensed, unlicensed, and defined use frequencies

Proven reliability with millions of modules deployed
Cambium’s CBRS Solution – A Proven Winner

• 450 platform readiness and works with all major SAS providers

• Customer enters into *direct* business relationship with Cambium, but can choose SAS they like
  • Migration from one SAS to another is not painless, but easy to do

• Complete 3 GHz portfolio capable of graceful migration to CBRS
  • Estimate that ~75-80% of Part 90 installed base has now migrated to CBRS
  • Very few valid Part 90 licenses remain, and we suspect there are some customers that need a nudge or reminder

*All 3 GHz 450 platform equipment approved for Part 96! (as of July 10, 2019)*
Case Study
Case Study – Wireless Etc. – Hot Springs, AR

- **Problem:**
  - Connecting Rural America

- **Solution:** *cn*Medusa (both 3 and 5 GHz)

- **Results:** Able to offer high throughput (25/15 Mbps) packages, and increase coverage area with replacement of Base Stations to *cn*Medusa.

- **Update:** Since CBRS implementation, increased power levels have allowed
  - Enhanced coverage
  - Higher rate plans
  - Allows connection of additional subscribers
Main BTS Site

• Four 90 degree sectors using 3GHz 450m for increased range / coverage

• Two 5 GHz 450m sectors to supplement bandwidth requirements for LOS customers
Over 300 customers are currently connected, with capacity to service many more.

Service is available out to >8 miles from tower using CBRS.
Case Study

ZIRKEL Delivers. Internet and More!

Internet, WiFi, Phone and TV for Your Home or Business.
Zirkel – Service Provider

• Location: Steamboat Springs, CO
• Started in 2001
• Covers approximately 1,500 sq. mi.

• Mountainous and forested terrain causes challenges with nLOS and NLOS

• Became a Cambium (then “Canopy” from Motorola) network in 2006

• Began using 3.65 GHz with Telrad in 2014, but found 450 platform equipment easier to deploy and manage
Deployed on Several Sites

- Eleven separate sites operate in CBRS
  - Mixture of 450, 450i and 450m APs
  - Hundreds of SMs
  - All Part 90 devices have been migrated to Part 96

- Busiest site has 2 450m operating 30 MHz channels
  - Serving >90 Subscribers
  - Excess capacity available
CBRS Successes

• Great Results deploying CBRS
  • CBRS allows higher power, some customers as far as 24 Miles out
  • Cleaner spectrum (compared to 5 GHz) results in 2 to 3 times capacity than 5 GHz
  • Allows additional customers and extended coverage

• Migration required careful consideration
  • Geolocation of existing devices took work and auditing to get right
  • The Cambium CBRS Import Spreadsheet tool helped with triangulation calculations to get the correct Azimuth data
  • By and large Cambium customers were able to complete this activity and had great success in doing so

• Fantastic Support for Service Providers
  • Cambium Support ramped quickly and resolves issues as they arise – Feedback from customers is great
  • Relationships with all SAS Administrators is a strength of the CBRS spectrum use
    • Collaboration, fairness and transparency all lead to overall improvements to the band and its use
CBRS Challenges Remain

• Early on customer expectations were unrealistic
  • CBRS was to assign channels and manage interference automagically from day 1

• DPA/ESC Issues plagued some users in coastal regions
  • Growing pains and learning curves with various aspects of ESC affected some
  • DPA activations are still an issue (though much reduced in scope and frequency)

• PALs – Implementation has been challenging for some
  • Cross-county or inter-county deployments were not really considered in the rules
  • Channel selection wasn’t well-understood by some winners, so some feel as though they have not gotten their money’s worth

• New Features of CBRS:
  • Co-Existence
  • Alternate channel support – Currently, our radios do it… but the SAS should
  • Channel assignment enforcement – Today, recommendations are made, but nothing is forced
  • Device measurement feedback could make SAS more informed and accurate in making decisions
Questions