CARLSON WIRELESS

Broadband Data and Voice Products

Innovation for Rural Broadband Solutions

CWT

Carlson Wireless Technologies Inc.

Working In Partnership with:
Spectrum Bridge and KTS Wireless

Who We Are

- Since 1986, Carlson has been designing mission-critical communications systems for public safety agencies and telephone companies in rural, remote and difficult-to-reach areas

What We Do

- We design and manufacture fixed-wireless products for terrain-based communications
- Our equipment is in use on every continent in the world, in 54 countries from north of the Arctic Circle to the Sahara Desert to the deep jungles of Africa

What We are Known for

- Our products are known for reliability, low power consumption, proprietary network security, broad spectrum use and TDM migration with fixed low latency
- Our business is known for solid customer relationships and world-class customer service

Creative Solutions for WISPs

- **RuralConnect™ IP**
  - White Space breakthrough solution for the last mile
- **LongHaul TDM**
  - High-capacity, unlicensed TDM solution for middle mile
- **LongHaul ST**
  - High-capacity, unlicensed multipoint solution for last mile

RuralConnect™ IP - Overview

- Unlicensed device that is frequency managed through the FCC's database
- GPS coordinates are used to prevent conflicts
- Transmits into valleys and through thick foliage
- VHF signal can be received indoors thus subscriber equipment may be self-installed
- Throughput comparable to DSL

RuralConnect™ IP - Usage

- Spectrum availability
  - www.ShowMyWhiteSpace.com
- Topology
  - Typically 30 subscribers per access point
- Path requirements
  - Range, typically 1 - 4 mile, margin prediction chart
  - Best non-line-of-sight coverage since CB radios
- Subscriber installation
  - Customer plug and play

RuralConnect™ IP– Product Demo

- GUI
- Configuration of AP and Remote
- Monitoring

RuralConnect™ IP TVWS Radio

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Proven in Rural, Industrial and Suburban settings

- Trials intentionally used different frequencies, data needs, density and geography
- Sustained data throughputs of 1 to 3 Mbps
- No interference to existing TV band users
- Trial networks are now in permanent operation
- Trials managed by database provider, Spectrum Bridge

Claudville, Virginia – Last-Mile Solution

- Rural and remote area of Virginia
- Deployment ranges typically a 2-mile non-line-of-sight (NLOS) radius
- Operates with 1/10 to 1/15 the nodes of Wi-Fi
- Internet access to a school, to local community via public Wi-Fi hotspots, and to residences via subscriber stations
- VHF–H channel band (Channels 7-13)

Plumas County, California – Middle-Mile and Last-Mile Solution

- Rural, mountainous and sparsely populated
- Geographically challenging 5 mile paths
- Plumas-Sierra Rural Electric Cooperative (PSREC) demonstrate cost effective Smart Grid applications
- Components included: monitoring and control of utility infrastructure including BB connectivity to substations, remote monitoring of electric use to consumers, and Internet access to several remote locations

Wilmington, North Carolina – Public Safety and Last-Mile Solution

- Urban/suburban environment
- Designed to demonstrate "smart city" applications
- Internet access to local community via public Wi-Fi hotspots, remote cameras on evacuation routes, water sensors, and remote control of city lights in parks
- Cost of project was affordable because of true NLOS performance
- Demonstrated operation in urban area without causing interference to TV broadcasters

RuralConnect IP – Ideal for Hilly Rural Areas

- Proven TVWS last mile and middle mile solution
- Unmatched NLOS range and signal penetration
- Flexible configuration and applications
- Two models cover 51 VHF and UHF channels
- Legacy compatible and future proof
- Remote management and diagnostics
- Web-based browser using https ssl interface

RuralConnect IP – product specs

RADIO SPECIFICATIONS	
Frequency Bands	174-216 MHz (ch 7-13), 470 to 698 MHz (ch 14-51)
RF Transmit Power	0.25 W to 1.6 W (+22 to +32 dBm)
Data Rates	1000, 2500, and 4000 kb/s
Modulation	FSK, SOQPSK
Channel Spacing	Part 15.709 Operation: 6 MHz
Max Tx Duty Cycle	100% with fan
Operating Mode	HDX or simplex
User Ports	RS-232, Ethernet
ENVIRONMENTAL SPECIFICATIONS	
Operating Temperature Range	-30° to 55° C
Operating Humidity	Up to 95%, non-condensing
MECHANICAL SPECIFICATIONS	
Client Dimensions	3.5″ x 5″ x 1.4″
Base Dimensions	11.8″ x 4″ x 11.8″
POWER	
Input Voltage	9 to 14 VDC
Current	Tx: 1.5 A at +32 Rx: 0.5 A (6.5W) Idle: 0.2 A (2.6W)
Connector	2.5 mm jack

Four Dimensions of Spectrum

- Frequency, Time, Power and Geography
- FCC is moving on a plan to allocate spectrum more efficiently
  - The TV channel band represents the first time an unlicensed radio is certified for use in a licensed band
  - This is possible because the device is gps located and then provided a list of unused channels from a database manager though an internet connection

SCADABlazer – Innovative Solution for Control and Monitoring of Data

- 144 to 960 MHz – 5 watts RF power output
- Large capacity multipoint – up to 250 endpoints
- Software Defined Radio allowing variable bandwidth, higher modulation scheme and data throughput
- Web based browser easily adapts to 3rd party management applications
- Versatile alarms and diagnostics
- Legacy adaptable and future ready
- Simple setup and install

LongHaul TDMA– Legacy Backhaul Solution

- Long-range microwave radio with low, fixed latency
- Fat pipe for video, voice and data services
- TDMA for excellent range and TDM to IP migration
- Large number of frequency band choices
- Proprietary design with WPA2 and AES encryption
- Web based browser using https ssl interface
- Industrial temperature rated for harsh environments
- Very low power needs for solar-powered applications

TrailBlazer–

Fractional T1 radio with Integrated Channel Bank

- Long-range for greater than 50 miles
- Interfaces include 4 Wire, POTS, V.35 and Ethernet
- Configurable for up to 8-64 kbps PCM channels
- TrueTDM™ with fixed latency technology
- Transparent to wireline service
- No license required, yet private and secure
- Plug and play simplicity and reliability
- Rugged and waterproof
- Very low power needs for solar-powered applications

TB Applications – ?

LongHaul ST– Full Featured Access Solution

- High-capacity point-to-multipoint last mile
- 150 Mbps aggregate TCP/IP throughput (120/30)
- Four 1-Gbps ports can be configured as 4 port switch or 3 port switch with WAN
- Host can support up to two radio modules
- 900 MHz, 2.4, 3.6, 4.9, 5x GHz frequencies
- Level 3 routing features e.g. BGP and DHCP server
- QOS, PPPoE server, MAC add port forwarding
- WPA, WPA2 and RADIUS encryption
- Flexible, affordable and truly interoperable

Carlson Wireless – End to End Radio Solution

- SCADA, Network Backbone, Wireless Access
- Single vendor procurement support and training (one throat to choke)
- Designed and made in the USA

Propagation Loss vs. Frequency

- Free Space Propagation Loss = 36.6 + 20 log f + 20 log d dB (f in MHz and d in miles)
- What does this mean in practical terms
  - The path loss goes up by the square of the frequency – see below examples
  - 4 watts @ 200MHz = 64 watts @ 800MHz
  - 4 watts @ 450MHz = 256 watts @ *3600MHz
- Lower frequencies are able to tolerate more foliage and terrain obstructions due to larger ground wave

*Note: antennas are more space efficient at higher frequencies

What are TV "White Spaces"?

- Unused TV channels
- Gaps created by the 2009 migration of TV channels from analog to digital in the UHF and lower VHF bands
- FCC ruled Sept 23 that unused channels now available for unlicensed public use
- Rural areas have the most amount of unused channels

"Wi-Fi on Steroids"

- Typically has 2 to 6 times the coverage of Wi-Fi in hilly areas
- Penetrates buildings and foliage
- Capable of meeting today's bandwidth demands
- Incredible potential for rural broadband

Wi-Fi vs. White Space

- Wi-Fi uses microwave radio signal (2+ GHz)
  - Requires line of sight, easily obstructed
  - Requires expensive infrastructure (towers)
  - Offers limited coverage
- TV White Space (TVWS) uses 50-700MHz
  - Can penetrate foliage, buildings, basements, etc.
  - Uses existing infrastructure
- Both have the same bandwidth capacity

What Does This Mean For Rural Broadband?

- The more rural the area, the more available TV white space
- Ideal for rugged terrain and sparsely populated areas
- Affordable and simple to deploy

Works in Rugged Terrain

- Does not require line of sight
  - penetrates foliage
  - bends around obstacles
  - works in hilly or mountainous terrain
- Requires minimal infrastructure

Economical Even in Sparsely Populated Areas

- Covers wider areas
- One access point can meet the needs of a small community