

BROADBAND SOLUTIONS TO SERVE NON- LINE-OF-SIGHT CUSTOMERS

Gen3 RuralConnect® TV White Space System

- **Great NLOS throughput & low latency for video streaming/ gaming & VoIP**
- **Much lower CAPEX than 900 MHz or Fixed LTE networks**
- **Large & ubiquitous NLOS coverage areas**
- **Unlicensed & uncongested spectrum in rural markets**



Since the 1990's, Carlson Wireless has provided wireless equipment to ISPs and telecom carriers that deliver high-quality broadband and telephony to rural and remote areas throughout the world. CWT's leading-edge TV White Space products have been deployed in over 30 countries since entering the market in 2011.



BREAKTHROUGH: GREATER NLOS PERFORMANCE AND LOWER BUILD-OUT COST

Broadband solutions to serve non-line-of-sight customers and rural areas

- Low-band signal penetrates through trees, foliage, walls, and weaves around hills
- 900 MHz and fixed LTE systems cannot deliver as robust NLOS or provide large & ubiquitous coverage area
- “Clean” TV White Space spectrum avoids 900 MHz overcrowding and scarcity/costs of 3.5 GHz licenses

Single base station serves hundreds of subscribers

- Aggregate throughput of 96 Mbps per base station
- 32 Mbps combined DL/UL per subscriber
- Very low latency (25 to 35 ms round trip) for video streaming, VoIP, and gaming
- Delivers sustained rate of 10/1 Mbps for up to 30 subscribers
- Optional second radio module per CPE doubles the subscriber’s throughput using proprietary link aggregation.
- OTA data rates as high as 24.0 Mbps using 64 QAM 5/6
- OTA data rate as high as 14.4 Mbps using 16 QAM 3/4

Leverages Reliability and Capability of IEEE 802.11af standard

- Leading edge standard with multiple enhanced features, including auto-negotiation/modulation
- IEEE 802.11af developed from 20 years of “know how” based on WLAN IEEE 802.11

In a NLOS environment, much lower deployment costs than the alternatives, including fixed LTE, 900 MHz, or LOS networks

- Fewer backhaul links, fewer towers, lower operational and maintenance costs
- Lower CPE and base station prices than any TV White Space manufacturer
- Single outdoor base station unit in rugged enclosure simplifies time & expense of installation and setup

Large coverage areas: 10 to 15 km radius from a single base station

- Reach distances as far as 25 km LOS. 5 to 10 km NLOS with obstructions



Base Station



CPE Unit

RURALCONNECT® THE BEST NLOS SOLUTION

	RuralConnect (TVWS)	900 MHz	Fixed LTE
Great speed/low latency	Yes	Yes	Yes
Affordable CAPEX	Yes	Yes	No
Heavy NLOS Performance	Yes	No	No
Large amount of available free spectrum	Yes	No	No



3rd Generation RuralConnect® TV White Space Radio

Uses TV White Space technology for signals strong enough to penetrate through hills, trees, and foliage to provide broadband services to communities in rural remote locations.

USE CASES

- Rural Broadband Internet Access and VoIP for Homes and Businesses
- WLAN Hotspot Backhaul
- Schools & Libraries Broadband Access
- Internet of Things Monitoring
- Point to Point Backhaul
- Public Safety & Border Patrol
- Video Surveillance and Security
- M2M SCADA Communications
- Smart Grid & Metering
- Positive Train Control
- Oil & Gas Well and Pipeline

GEN 3 RURALCONNECT® SPECIFICATIONS

Below are examples of different distances and modulation settings to show throughputs and link margin in a single 8 MHz channel. With an additional radio module in the client station, use of two 8 MHz channels would deliver end-user throughputs ~twice that of the 8 MHz channel. Note that the OTA data rate has to be divided between uplink and downlink, e.g., if 80/20, then 36 Mbps = 29 DL and 7 UL. To understand how many CPE's can be used with a Base station, divide the base station capacity by the number of CPE's multiplied by the contention ratio (typically 6). For example, Base cap = 32 x 3 = 96Mb/s. 48 CPEs x 6 = 96/288 = 3Mbps for 48 active CPE's.

Modulation and Coding	OTA Data Rate in Mbps	Range in km*	Base Ant Gain in dBi	CPE Ant Gain in dBi	Frequency in MHz	Base EIRP in dBm	Free Space Loss in dB	RX Signal in dBm	CPE Sens in dBm	Link Margin in dB**	Rayleigh Fading %
QPSK 3/4	7.2	33	7.8	10.3	569	28.5	118.0	-79.7	-95.2	15.5	98.21
16 QAM 3/4	14.4	16	7.8	10.3	545	28.5	111.3	-73.0	-88.2	15.1	98.07
64QAM 5/6	24	5.0	7.8	10.3	521	28.5	100.8	-62.5	-77.9	15.3	98.15
256QAM5/6	32	2.5	7.8	10.3	473	28.5	94.0	-55.7	-71.0	15.3	98.14

*The distance is optimized for 98% availability

** if the path is unobstructed

GENERAL SYSTEM SPECIFICATIONS

System Architecture	3 Independent IEEE 802.11af Base Station Radios
Aggregate Data Capacity	96 Mbps
Frequency Bands	UHF 470-790 MHz (ETSI)
Channel Spacing	8 MHz (ETSI) 2-channel aggregation selectable
Round Trip Ping Latency	5-35 ms, depending on user load
Data Rate Control	Adaptive or fixed
ACP and Spectrum Mask Standardization	Meets FCC and ETSI specifications IEEE 802.11af Fully Compliant

BASE STATION

RF Transmit Power	+21dBm within +/- 1dB
Antenna Connector	3 F-type female 75 Ohms
POWER - OUTDOOR TOWER MOUNT	
Voltage	100-240 VAC, 50-60 Hz or 24-48 VDC
Power	Idle: 6W; Rx: 10W, Tx: 25W
Connector	RJ 45 POE

MECHANICAL SPECIFICATIONS

Unit Dimensions	7.5" x 3.25" x 9"
Enclosure Material	Painted anodized aluminum
Weight	6 lbs. 4 oz.
Mounting	1" to 2" vertical mast

NETWORK SPECIFICATIONS

RX Blocking Resistance	-48 dB TV transmission on chan N+2 -20 dBm cellular station transmissions
Operating Mode	CSMA (TDMA optional)
User Ports	10/100 baseT Ethernet
Management	Web-based, SNMP (NMS & Billing opt)

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature	-30° to 55° C
Operating Humidity	Up to 95%, non-condensing
Shock and Vibration	MIL-STD-810
Security	WPA2 - PSK (156 AES)

CPE CLIENT STATION

RF Transmit Power	+21dBm within +/- 1dB
Antenna Connector	F type female 75 ohm
POWER	
Voltage	100-240 VAC, 50-60 Hz or 24-48 VDC
Power	Idle: 3.8W, Rx: 6.5W, Tx: 10.3W
Connector	RJ 45 POE

MECHANICAL SPECIFICATIONS ODU

Unit Dimensions	7.5" x 3.25" x 9"
Enclosure Material	Painted anodized aluminum
Weight	5 lbs. 8 oz.
Mounting	1" to 2" vertical mast

U.S. Patent No. 9,849,844 on RuralConnect® Gen 3



Carlson Wireless Technologies, Inc.
3134 Jacobs Ave, Suite C
Eureka, CA 95501 USA

T: +1 707.443.0100

E: info@carlsonwireless.com
www.carlsonwireless.com