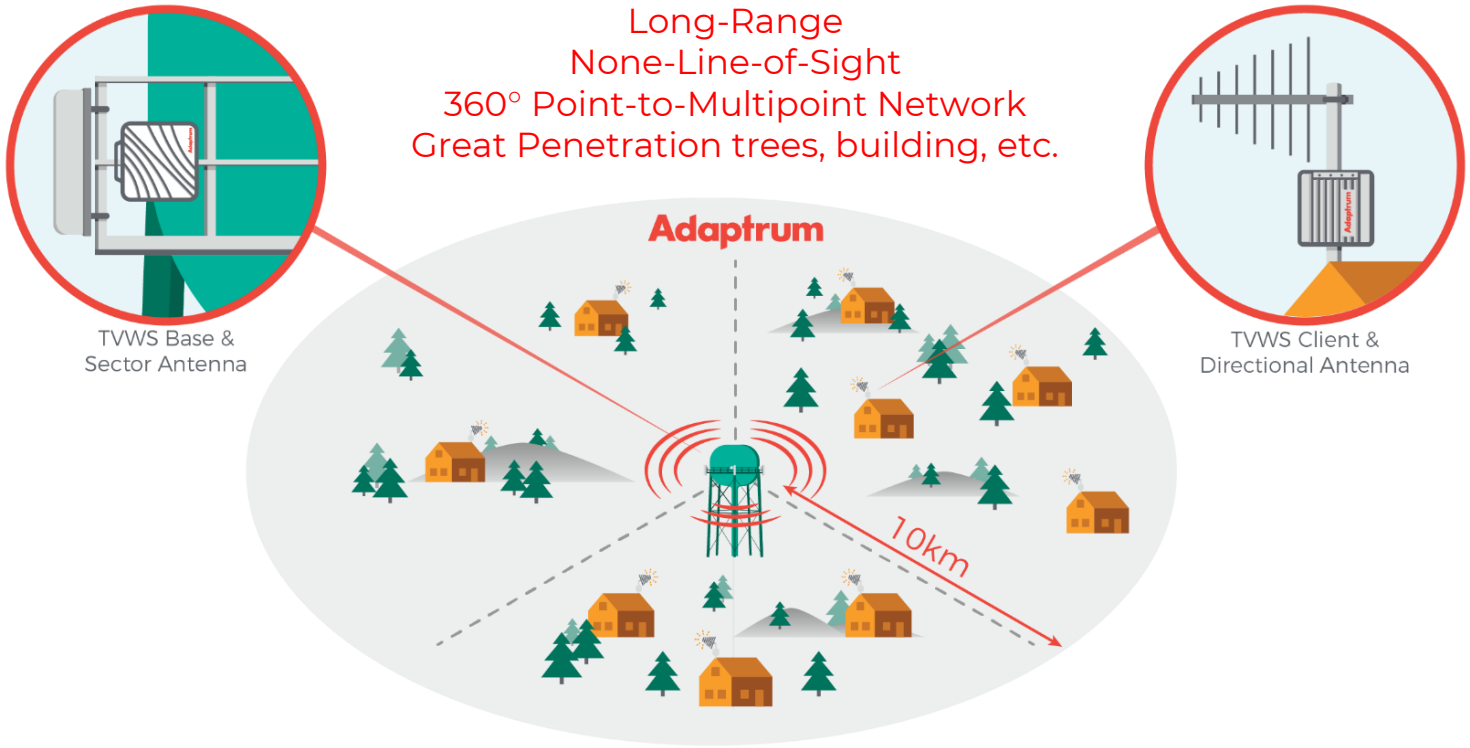
Adaptrum

ADAPTRUM SALES OVERVIEW

September 2021

Delivering Fixed Wireless Broadband over TV White Space

Long-Range
None-Line-of-Sight
360° Point-to-Multipoint Network
Great Penetration trees, building, etc.



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TVWS Standards

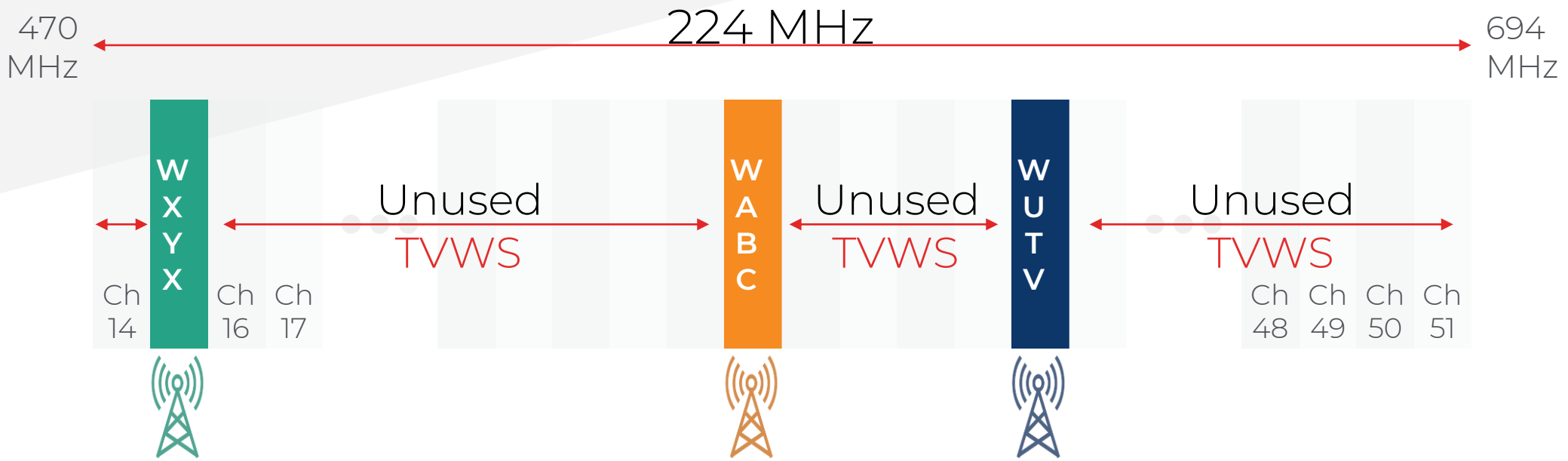
- IEEE (Institute of Electrical and Electronics Engineers)
  - **IEEE 802** standards are a family of standards dealing with local area networks and metropolitan area networks.
  - **IEEE 802.11** is a standard for Wireless Local Area Network (WLAN) with **IEEE 802.11af** being the standard for TVWS
  - **IEEE 802.22** is a standard for Wireless Regional Area Network (WRAN) using white space in the TV Bands

Spectrum Access

Licensed	Dynamic Access	Unlicensed
Cellular, Broadcast, etc.	Secondary use of licensed spectrum	WiFi, Bluetooth, etc.
Very expensive	No barrier of entry associated with purchase or lease of spectrum	2.4GHz, 5GHz
Massively underutilized		"Once thought unusable, the unlicensed bands are some of the most valuable bands in the world" *FCC Commissioner Michael O'Rielly*

What is TV White Space Spectrum?

Unused TV-band channels



Beachfront Spectrum

Sub-GHz Abundant Unlicensed

for wireless broadband

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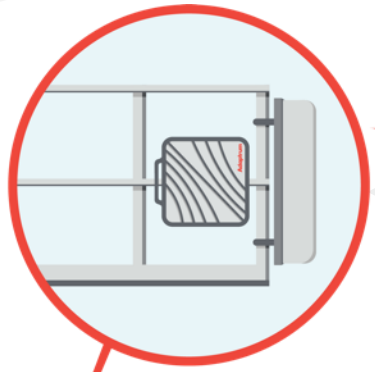
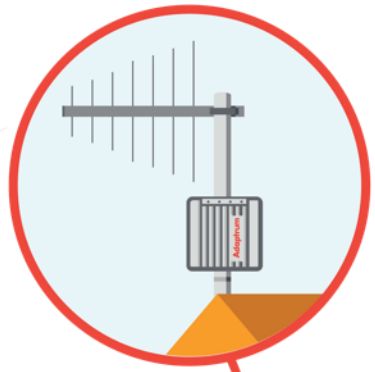
Sub-GHz TVWS Spectrum: Ideal for Wireless Broadband

Long-Range
Non-Line-of-Sight
Great Penetration
trees, building, etc.

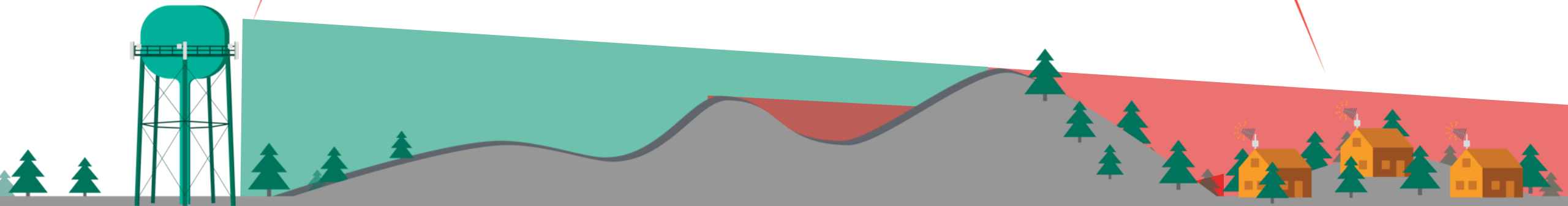
TVWS
Base

TVWS
Client(s)

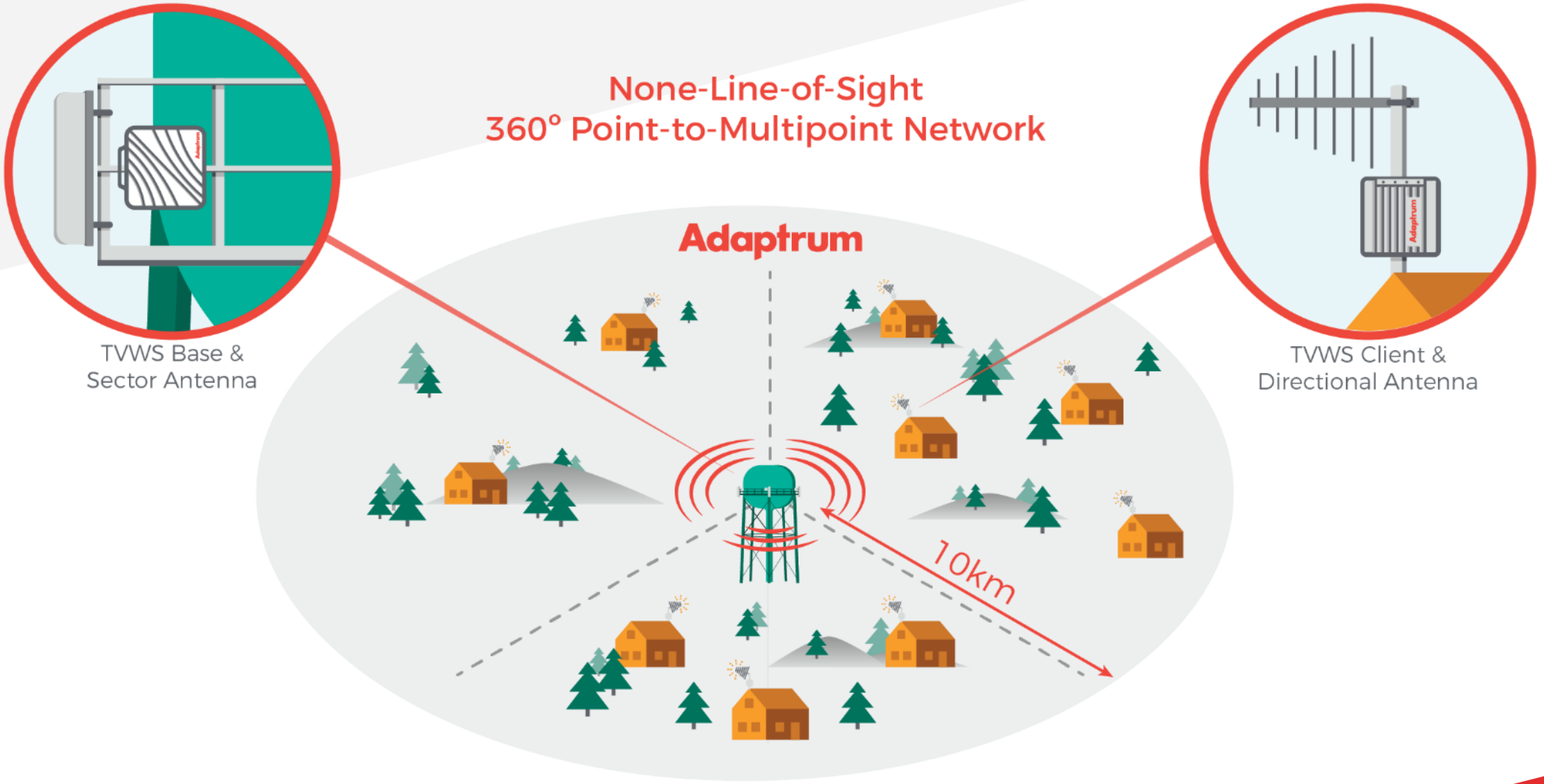




6 mi / 10 km



Delivering Fixed Wireless Broadband over TVWS



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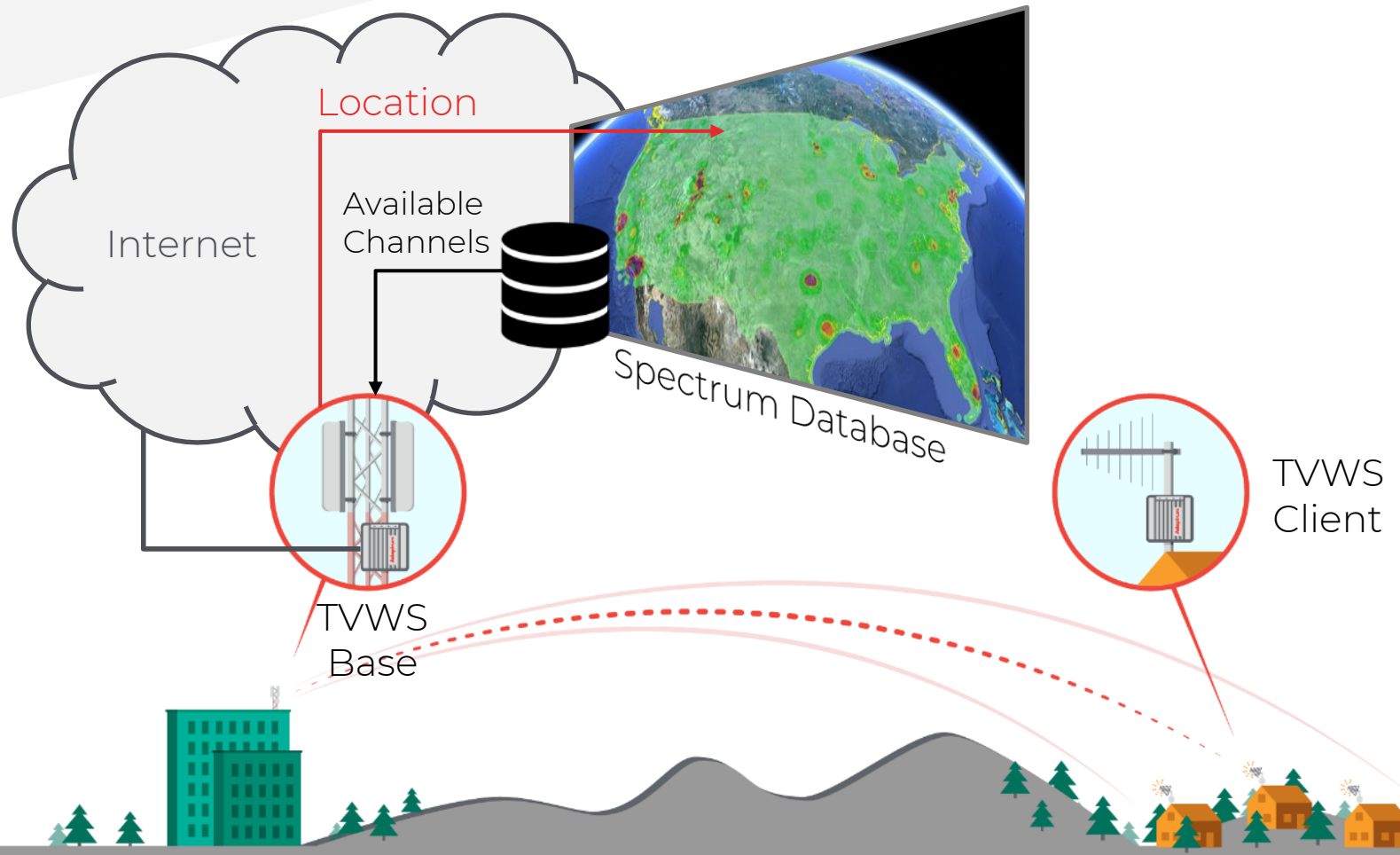
Dynamic Spectrum Access

Frequency agile radios dynamically operate across entire TVWS band



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Adaptrum Overview

About Adaptrum

Adaptrum is a pioneer in **dynamic spectrum access** technology that enables access to unused and underutilized spectrum in the worldwide **TV bands** and beyond.

Our Mission

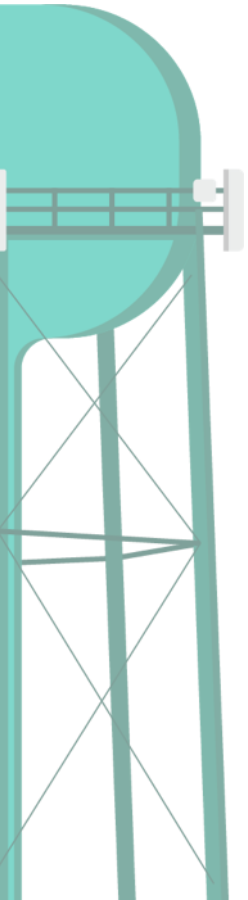
Empower next generation wireless network operators to use unlicensed and/or dynamically licensed spectrum to **serve billions of people** and **tens of billions of devices** globally

Adaptrum Deployed in over 30 countries across 6 continents

Product Overview

ACRS2 — **B1000**

- Single Radio Base station
- Ideal for low density rural deployments



18 Mbps	6/7/8 MHz UHF	Channel Expansion		
10W EIRP	Spectrum Scanning	POE	Rugged	

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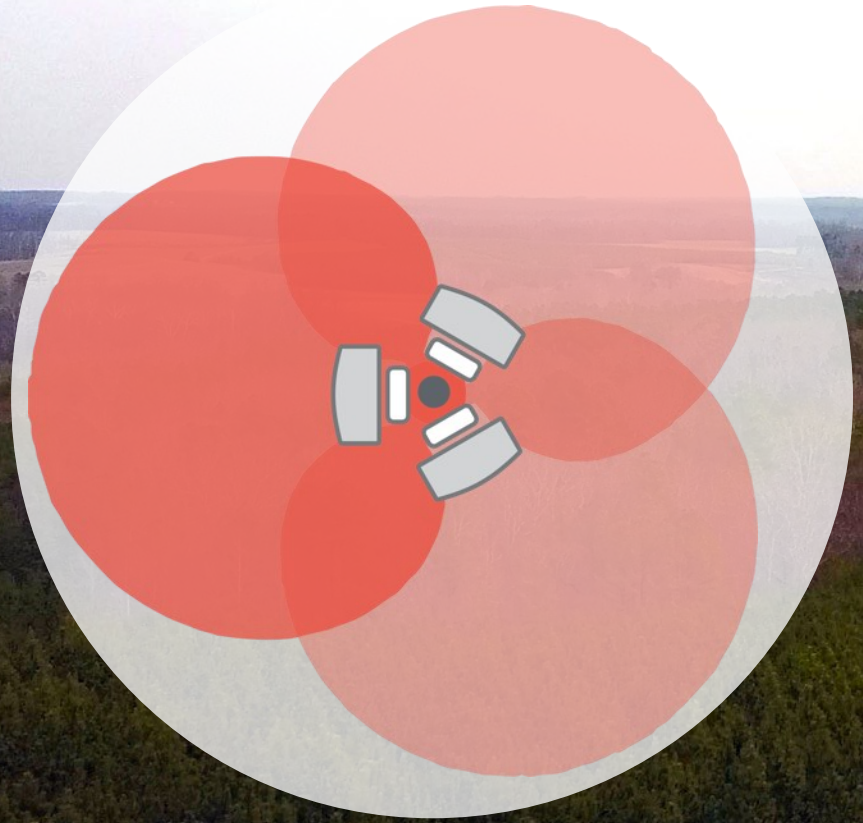
Base Antenna 360deg sectorized coverage

11	90°	0°/8°	Single Port / Dual Port	Vert Pol / X Pol
dBi	H-BW	Downtilt		

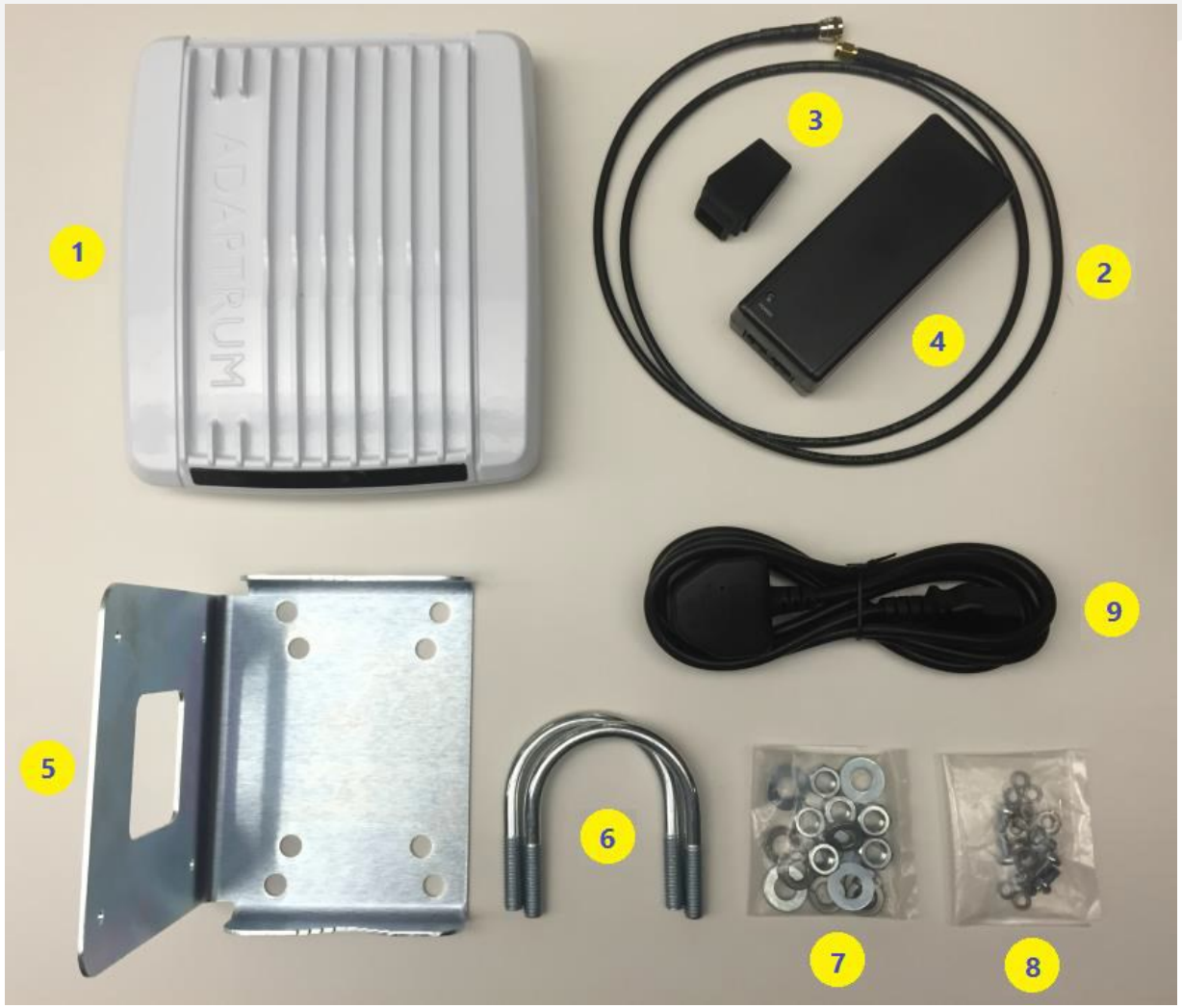


ACRS 2.0
Client Radio

Single Channel
Long-Range Client
Ultra-compact
Easy to mount

18 Mbps	Channel Expansion	8” x 8” x 1.5”	3.5 lbs
Spectrum Scan	POE	Rugged	6/7/8 MHz UHF

ARC 2.0 KIT



1. ACRS 2.0 unit (“BASE” or “CLIENT” per label on rear)
2. ACRS-to-antenna cable (only with receipt of LP45F antenna)
3. Ethernet cable weather-resistant boot
4. PoE
5. ACRS mounting bracket
6. U-bolts (2)
7. Bracket-to-pole mounting hardware (6 each nuts, split washers, flat washers)
8. ACRS-to-bracket mounting hardware (6 each Philips head screws, split washers, flat washers)
9. International power cord
10. contents sheet

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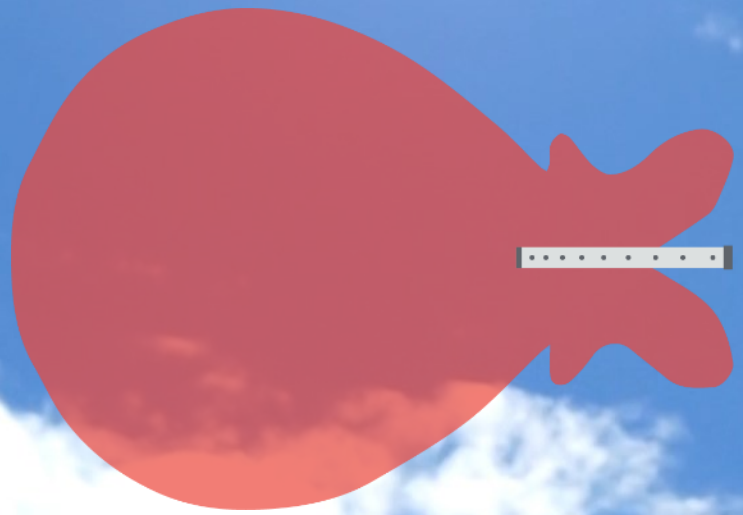
Client Antenna Easy to point high-gain yaggi

11
dBi

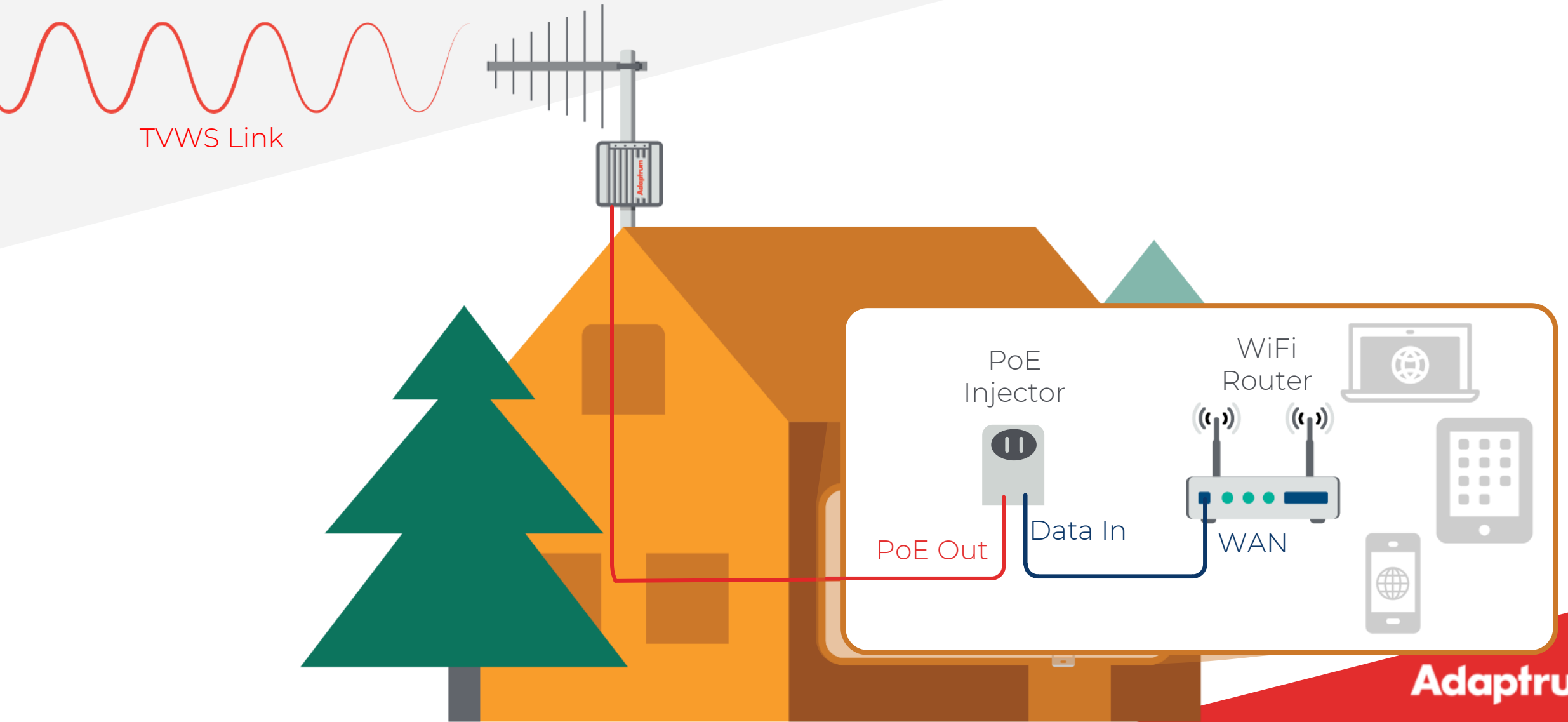
65°
H-BW

- Industry Leading Long-Range Non-Line-of-Sight Performance
- Rural Broadband Solution
- Built-in spectrum sensing



Typical Fixed Wireless Client Deployment

TVWS Outside / WiFi Inside



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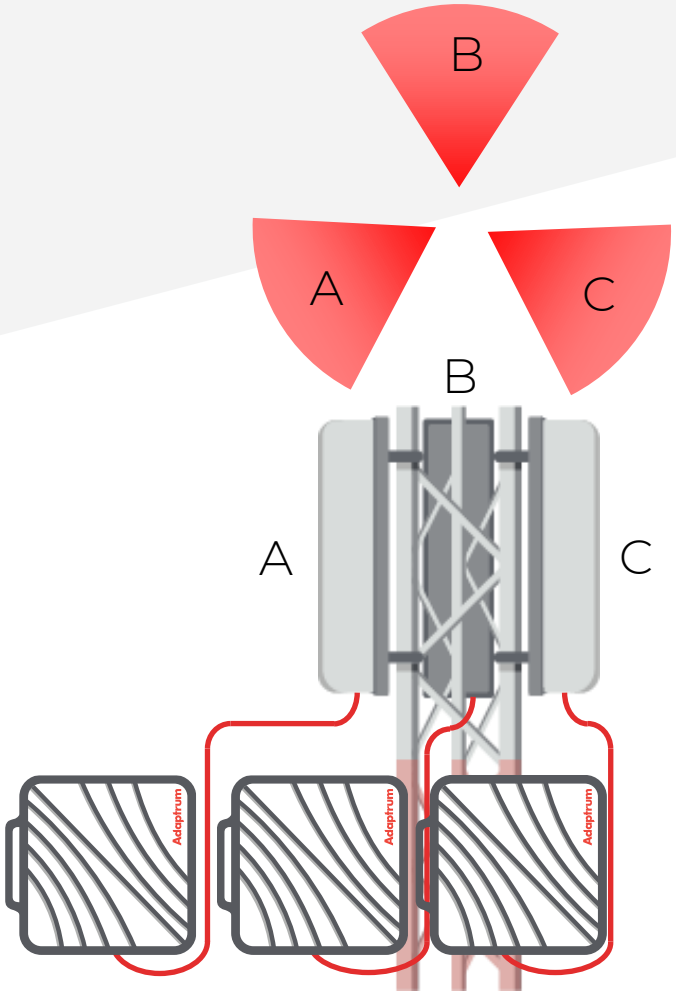
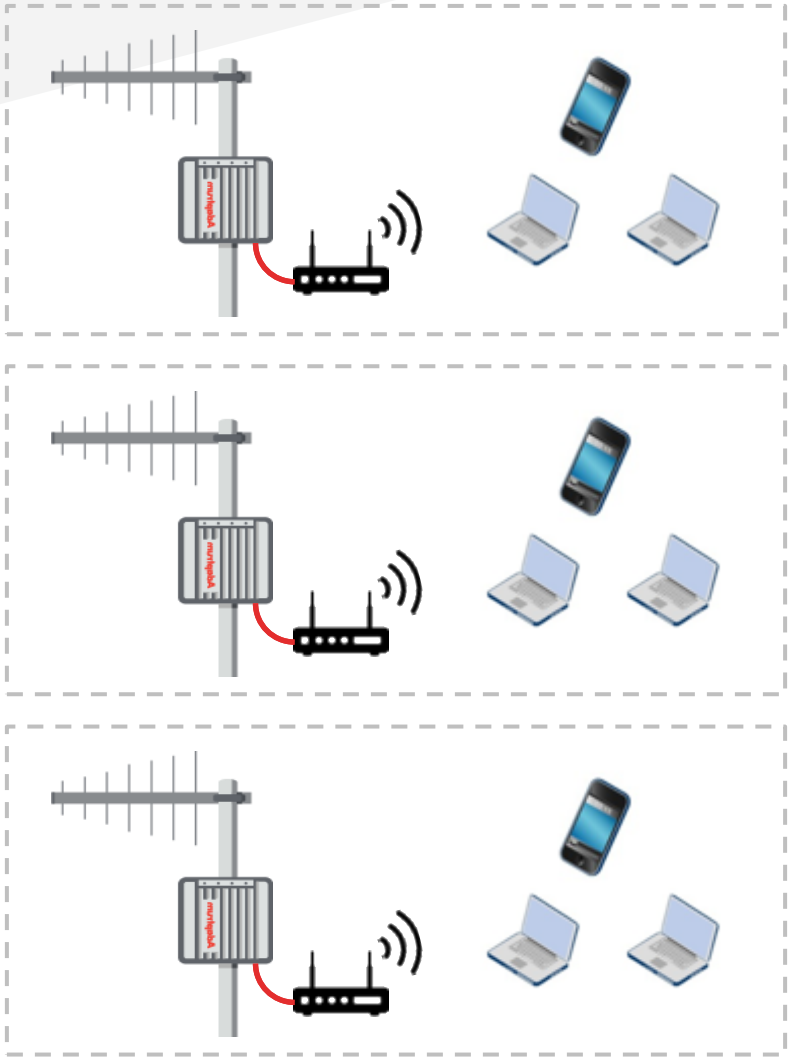
ACRS2: Point to Multi-Point



3 x ACRS2-B1000 Base Station at Tower site

Non-LOS TVWS over the air link

20 to 35 Mbps per sector



ACRS 2.0 CPE connects to an external Wifi router

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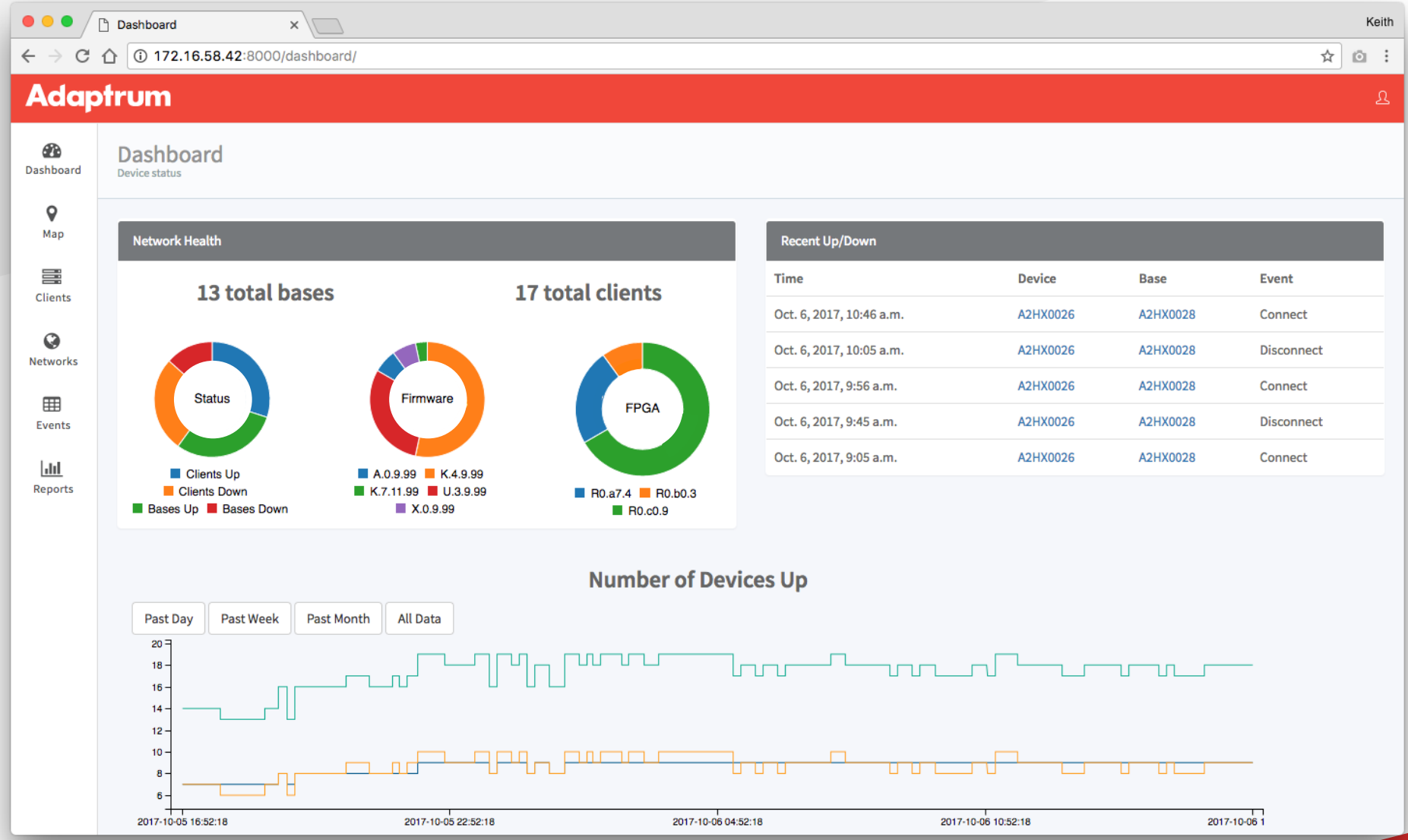
Adaptrum Network Management System

Configure, Monitor and Manage Network wide TVWS Devices



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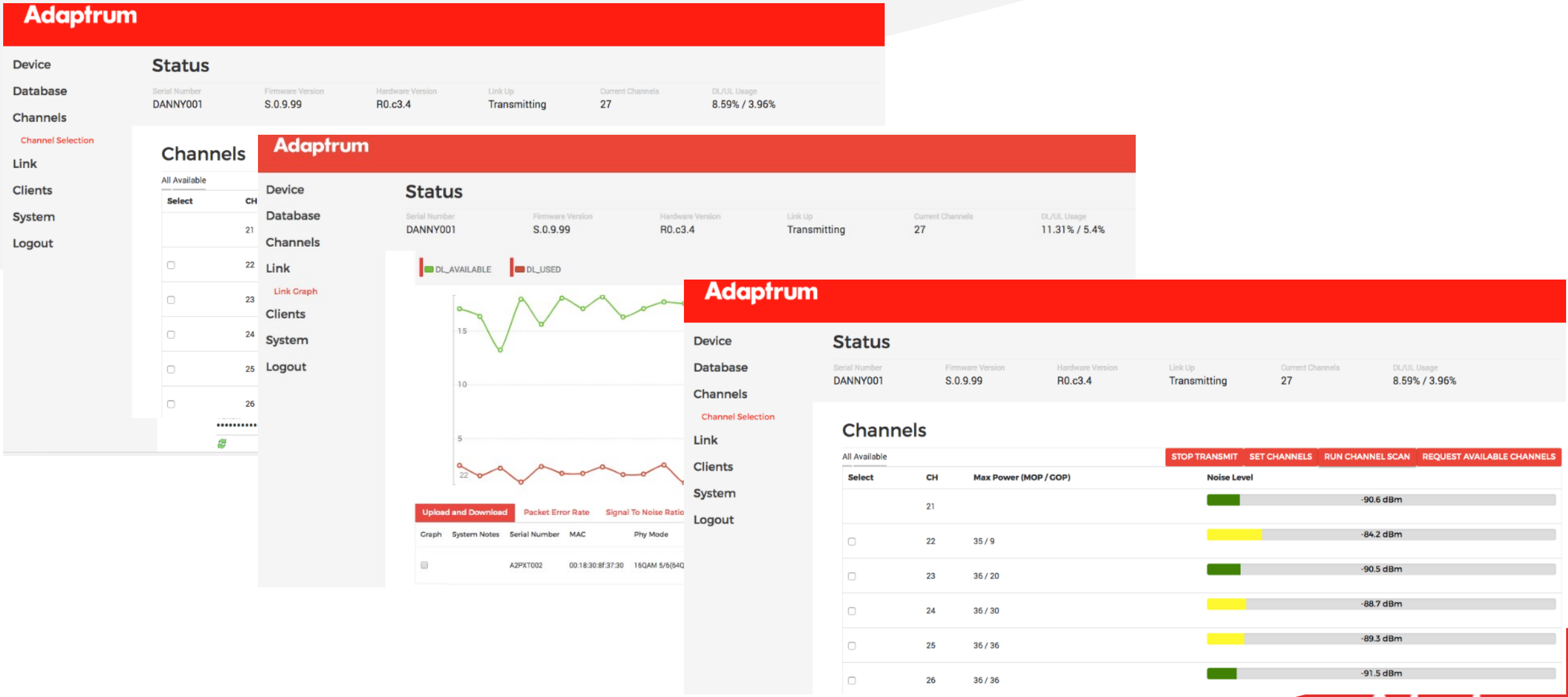
Adaptrum Device Manager

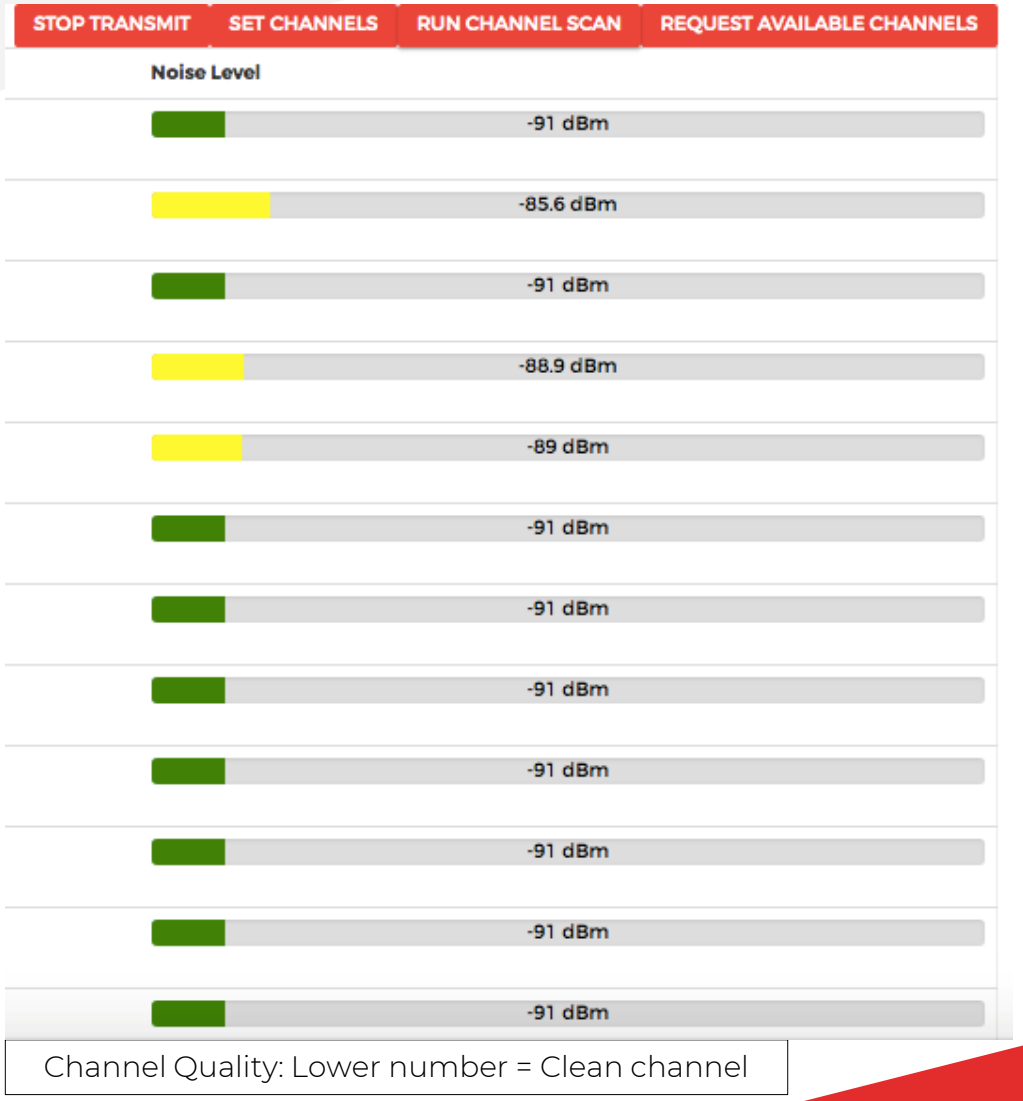
Brower based GUI running on the device



Radio Network Channel Planning

- **Patented Agile Sensing technology**
  - Real-time spectrum sensing & analysis gives instant visibility of the radio spectrum
  - ACRS radios measure channel background noise and interference level in a matter of seconds
  - Scan the complete UHF TV band (470 MHz to 800 MHz)
  - Choose the best channel(s) for operation

- **Multiday and Overnight Spectrum Scan**
  - Optimize network channel planning across conditions that change over time



Channel Quality: Lower number = Clean channel

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Going forward

Adaptrum TVWS equipment

Generation 2

ACRS 2

Designed for rural

- Single channel with channel expansion to 10Mhz (regulator dependent)
- Modulation QPSK to 64 QAM depending on range and clutter
- Network sync

Generation 3

ACRS 2.1

Scaling for speed

- Channel expansion to 20MHz (regulator dependent) and channel aggregation
- Improvements in modulation, network sync, network management platform

Generation 4

TVWS ASIC

Next generation

- Chip based devices with improved economics
- Multi-standard (802.22 & 802.11af)
- Enabling Multi-band AP & Mobile systems
- Enhanced capabilities to support IoT

- For ITU Region 1 Adaptrum supports 8Mhz channels, channel expansion to 10MHz, 470-694MHz. (Chipset supports 6,7,8 Mhz channel plans depending on ITU region)
- Range capability : Verified deployments LOS > 20km and NLOS/nLOS up to 10km (*terrain & clutter dependent)
- Power consumption 20W (ready for low power outdoor deployments)
- PAWS database compliant & implemented in multiple countries in North America, Europe, Africa and Latin America

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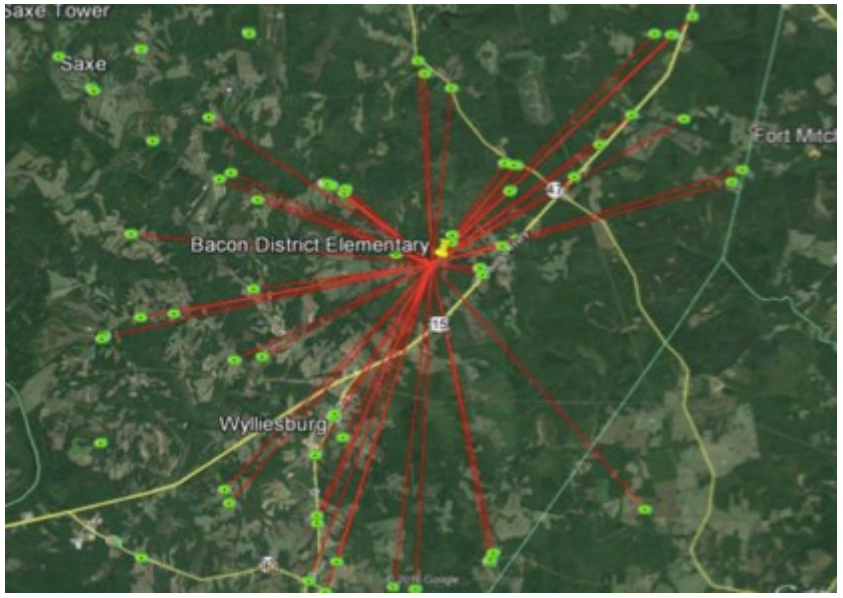
Adaptrum Projects

Virginia, USA

Mid-Atlantic BROADBAND

Closing the homework gap in rural Virginia with largest US TV White Space project

On-track to connect 1000 student homes, at no cost to families



Network spans two counties in S. Virginia.

Provides connectivity from sites at fiber-connected schools

Maine, USA

Axiom

Closing the digital divide in rural Maine

Remote rural communities
Heavy trees and foliage

Close to 100 radio deployed to date

1st commercial user to use channel expansion to increase capacity in installed network

Microsoft

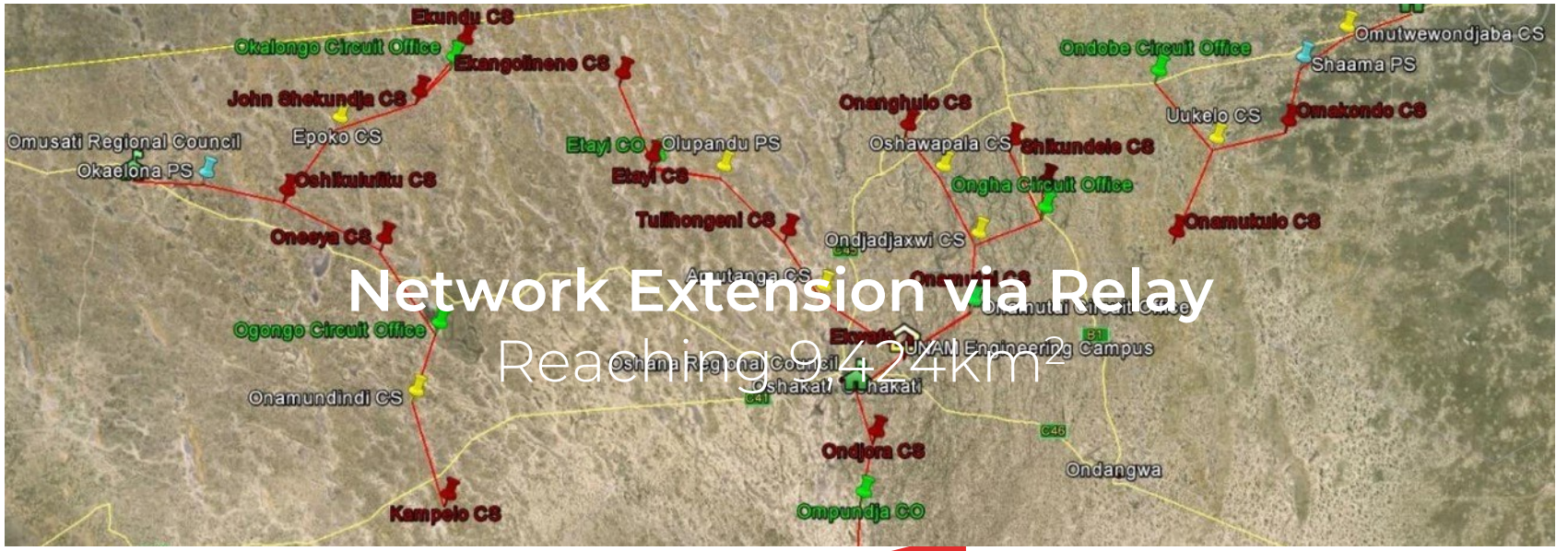
Microsoft Affordable Access Grant Recipient

Only US company

Community Broadband - Namibia

my digital bridge

World largest TVWS deployment by geographic area



Network Extension via Relay

Reaching 9424km²

Aguadas, Colombia

Microsoft

ANE
Agencia Nacional del Espectro

Pilot project connecting
Rio Arriba school

15 miles
away from
Aguadas, Caldas

Pending regulations will allow expansion into countrywide projects

Colombian President skyping with Rio Arriba school over TV White Space

Arran, Scotland

BROADWAY PARTNERS

Deploying TVWS to provide internet service in remote/rural "not spot" areas of the UK

First commercial TVWS Network in UK

Adaptrum ACRS2.0 1st Radio to receive ETSI compliance certification

Jamaica – First Caribbean Deployment

KENYA

MAWINGU WiFi™

Affordable Internet

Solar powered TV White Space network used to deliver broadband access to schools and cyber cafe.

Microsoft a key technology/business partner in IoT market

Microsoft FarmBeats with TVWS connectivity introduced by Bill Gates

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CORUS MERCOR WILL BE INTRODUCING ADAPTRUM'S PRODUCT.

www.corusmercor.com