



Utilization of the 4.9 GHz Band in Transportation and Emergency Response Applications

February 25, 2011

Bill Brown

Radio and Wireless Manager, VDOT

Chair, AASHTO Special Committee on Wireless Communications Technologies



Who is AASHTO

- **Nonprofit, nonpartisan association representing highway and transportation departments in the 50 states, the District of Columbia, and Puerto Rico.**
- **Five transportation modes: air, highways, public transportation, rail, and water.**
- **Foster the development, operation, and maintenance of an integrated national transportation system.**
- **Liaison between state departments of transportation and the Federal government.**
- **Setting technical standards for all phases of highway system development.**
- **Executive Director John Horsley**

Transportation Involvement in First Response and Emergency Management

- **Transportation Assets often must be the very first of all First Responders**
- **Transportation Agencies typically are the only governmental organization besides National Guard capable of heavy duty construction, removing downed trees, ice, snow**
- **Trained and prepared for emergency response situations.**
- **The more intense and widespread the event, the more likely that transportation assets must be “first in.”**
- **Integration of Transportation into regional communications systems, emergency response plans, and training is critical !**

Initial Use of 4.9 IP Ethernet Radio, Point to Point New Kent Travel Centers



Initial Use of 4.9 IP Ethernet Radio, Point to Point New Kent Travel Centers

- **Extension of Data Network from Westbound to Eastbound**
- **State IT Agency unable to find solution in six months**
 - est. \$70,000 to establish cable to EB Travel Center
- **VDOT Wireless Office – 3 weeks installation, <\$5,000 equipment**
- **Provides high speed internet access for travelers and tourists**
 - limited to T1 1.4 Mbps
- **Connected streaming video security cameras**
- **Provides 36 Mbps, 20 times the bandwidth of T1**

Initial Use of 4.9 IP Ethernet Radio, Point to Point New Kent Travel Centers Properties of 4.9 Systems



Initial Use of 4.9 IP Ethernet Radio, Point to Point New Kent Travel Centers Properties of 4.9 Systems



Initial Use of 4.9 IP Ethernet Radio, Point to Point New Kent Travel Centers Properties of 4.9 Systems

- Quick deployment
- High bandwidth
- Low cost, eliminate leased lines
- Work within constraints and limitations of 4900 MHz
- High Reliability of Equipment
 - 40 months to date, zero downtime
- Coordinate requirements with Wireless Pros within Agency!!

Initial Use of 4.9 IP Ethernet Radio, Point to Point New Kent Travel Centers Properties of 4.9 Systems

- System monitoring and management through network
 - Signal strengths and changes, available and used throughput

The screenshot displays the AirMux200 Manager software interface. The main window is titled "AirMux200 Manager - 10.10.125.97" and features a menu bar (File, Configuration, Tools, Maintenance, Help) and a toolbar with icons for Link Configuration, Link Installation, Clear Counters, Log Off, and Exit.

The interface is divided into several sections:

- Link Link:** Shows configuration details for the link, including SSID (BrownRocks), Services (Ethernet Only), Frequency (4.950 GHz), Channel BW (20 MHz), Rate (Adaptive Mbps), and Status (Link Active).
- Site West Bound New Kent:** Displays IP Address (10.10.125.97), Subnet Mask (255.255.255.0), and Trap Destination (0.0.0.0).
- Site East Bound New Kent:** Displays IP Address (10.10.125.96), Subnet Mask (255.255.255.0), and Trap Destination (10.10.125.145).
- Monitor:** The central monitoring area, showing data for two locations: West Bound New Kent and East Bound New Kent. It includes a "Radio Interface" section with RSS [dBm] values of -61 for both sites, and an "Ethernet Service" section showing Ethernet Throughput [Mbps] of 17.9 for both sites. Rx and Tx rates are all 0.0. A green button indicates the Frequency is 4.950 GHz.
- Event Log:** A table at the bottom showing system events.

Number	Date & Time	Message	Trap Source	IP Address
000001	12/12/2007 1:34:03 PM	Connected to West Bound New Kent.	Internal	

At the bottom of the interface, a status bar shows "Connection Available", "Connection Mode: Over the air", "IP Address: 10.10.125.97", and "Encrypted Link".

Use of 4.9 GHZ Systems to Support Intelligent Transportation Systems (ITS) and DOT Activities

- Real time collection of highway information, traffic and weather data, and communication to public

The screenshot shows the 511 Virginia website. At the top left is the 511 Virginia logo with the tagline "A service of the Virginia Department of Transportation". Below the logo is a navigation menu with buttons for "Select A Region", "Road Conditions", "Trip Planning", "Traffic Cameras", "Ask 511", "Commuting", "My 511 Control Room", "Weather", and "About 511". There is also an RSS feed icon. The main content area features a header "Super-powerful traffic and travel info" and a sub-header "There is more than one way to get from point A to point B. In Virginia, that is a huge understatement. With so many bridges, boats, buses, and shuttles to choose from, getting around here can get pretty overwhelming. Until now." Below this is a welcome message: "Welcome to 511 Virginia, your one-stop resource for how to get moving in Virginia. In this site, you will discover everything you need to get from A to B." There is an "ENTER" button and a checkbox labeled "Check this box to skip this page on future visits (cookies must be enabled)". At the bottom, there is a section for "Other Traveler Information Services" with links for "Tennessee | Maryland | North Carolina | West Virginia".

A grid of eight regional maps, each with a "twitter" link below it. The maps are labeled as follows:

- I-64 Corridor
- I-81 Corridor
- I-95 Corridor
- Northern Region
- Northwestern Region
- Central Region
- Southwestern Region
- Hampton Roads

Use of 4.9 GHZ Systems to Support Intelligent Transportation Systems (ITS) and DOT Activities

- Real time collection of highway information, traffic and weather data, and communication to public



New Hampshire Department of Transportation

- **Two interstate corridor intelligent transportation system (ITS) projects**
- **“Last mile” connectivity from communications hubs to roadside devices**
- **Video back haul to communication hubs**
- **Roadway Weather information systems (RWIS)**
- **Polling non-evasive pavement condition sensors**
- **Dynamic (or changeable) message signs**
- **Variable speed limit signs for poor travel**
- **Voice communication to operations staff**

- **Dave Chase, New Hampshire DOT**

Washington State Department of Transportation

“The 4.9 GHz spectrum allows us to provide low cost solutions that provide maximum return on investment using tax paying dollars.”

- **Support last mile Intelligent Transportation System (ITS)**
 - Traffic Management Centers get real time information about road conditions
 - Pan Tilt Zoom full motion video (PTZ) and snap shot cameras
 - Information processed and used to update Variable Message Signs (VMS), Variable Speed Limit signs (VSL) and Highway Advisory Radios (HAR)
 - Roadway Weather Information Stations (RWIS)
 - License plate readers for travel times
 - Increase the traveling public’s safety and awareness of road conditions
- **Connectivity to rural sheds or offices**
- **Temporary solutions for gaps in fiber networks during construction activities**
- **Connectivity to the wireless voice system.**
- **Eliminate ongoing non reliable commercial services to increase capability and productivity.**

Washington State Department of Transportation

“We see this band as an invaluable tool in creating connectivity opportunities in both rural and urban environments.”

- Distances of up to 21 miles while still providing 10 mbps IP connectivity.
- A typical medium range point to point path will cost around \$3400.
- Currently WSDOT has an estimated \$1.2 Million invested in the 4.9 GHz spectrum.
 - DSL or T1 line could costs \$100 to \$400 per month
 - 4.9 GHz systems pay for themselves and increase speeds by over 10x
 - Greater reliability and agency ownership.
- WSDOT has over 50 locations licensed in this spectrum with the FCC
 - 64 locations pending licensing
 - 66 budgeted and planed to be installed this year
- 4.9 GHz band allows for the flexibility of installing and testing prior to applying for permanent FCC location license.
 - Test a location to determine if the application works prior to any licensing activities.
 - Other bands used for ITS applications are time consuming and require additional man power to track the applications process.
- Tim McDowell, Electronic Engineering Manager, ITS Communication & Wireless Technology, Washington State Department of Transportation

Massachusetts Department of Transportation

- **Installing up to 20 4.9 Ghz wireless point to point radios for an ITS project on Rte. I-291 Springfield**
- **Transport video from roadway cameras**
- **Control of Digital Message Signs on I-291**
- **Extend fiber optic connection on I-91 for district Highway Operations center and Statewide Highway Operations Center**
- **Experienced interference issues with similar non licensed frequencies**
- **Future Plans**
 - **video from traffic and security cameras on a one mile long bridge**
 - **(The Braga Bridge) South Eastern Massachusetts**
 - **4 wire audio signals for remote control of Two way radio base stations.**
 - **Eliminate lease lines, self reliant, save money**

Michael Supple
Communications Engineer
Massachusetts Department of Transportation, Highway Division

Texas Department of Transportation

- **Video, control and return telemetry for ITS devices. Control of flood water pumps at underpasses on I-27 north of Lubbock towards Amarillo. Extends from District HQ in Lubbock from a 300 foot tower and travels by hops to north of Abernathy, Tx on I-27.**
- **Extend “last mile” from fiber optic connection on I-91 for district Highway Operations center and Statewide Highway Operations Center**
- **The Brownwood district - video and control of warning flashers on I-20 at Ranger Hill, east of Range, Texas.**
 - Steep hill, high wind and icing
 - 4.9 Ghz link from Ranger Hill to the TxDOT Eastland Office.
 - Live video, weather instruments, signage
- Paul Gilbert, Texas Department of Transportation

Maryland State Highways Administration

“We use the 4.9 GHz links wherever a need for a fast deployable bandwidth solution can be implemented.”

- **To provide control of the radio base station at SHA shops facilities and the tower site on the facility**
 - When fiber is either not possible or too expensive.
 - Used in conjunction with a VoIP modem on each end to provide tone keying.
- **As a temporary high bandwidth connection for microwave backhaul - until 6 or 11 GHz radios licensed and installed.**
- **To bring PSTN services into a temporary facility such as a trailer**
 - trenching fiber would be too costly.
 - POTS lines into trailers from the Verizon Dmarc located a distance away.
 - Used in conjunction with a VoIP modem to reconstitute dial tone.
- **Phil Lazarus, Asst. Division Chief, Engineering & Tech Support / Communications Division, Maryland State Highway Administration**

Wyoming Department of Transportation

“Focus on communications to the roadside and the traveling public, have tapped into using the 4.9 GHz spectrum.”

- **Built an ethernet/IP backbone consisting of point-to-point radios at our remote radio sites.**
- **Data from Intelligent Transportation Systems (ITS) devices deployed at the roadside to our Traffic Management Center (TMC). Data used by traffic operators, highway patrol, and maintenance personnel. Information is also disseminated to the traveling public.**
- **Creating redundant routes into cities.**
 - The unlicensed spectrum is crowded in the cities.
 - Deploying 4.9 GHz radio links carrying data affecting the safety of the traveling public.
 - Road weather systems, changeable message signs, variable speed limit signs, closure beacons & webcams.
- **Future Plans for 4.9 GHz**
 - Point-to-point links between a deployable radio site on wheels (SOW) and our remote radio sites.
 - Support connectivity into Wyoming's digital trunked VHF P-25 compliant public safety communications system (WyoLink).
 - The 4.9 GHz SOW links will be directly supporting incident management to meet coverage and/or capacity needs.
- **Paul J. Andersen, Communications Supervisor, Wyoming Department of Transportation**

Use of 4.9 GHz in the Transportation Area

- *Get critical and accurate travel information to public quickly!*
- Widely used in many State DOTs and expanding
- Compared to commercial services
 - Very affordable
 - High bandwidth
 - Reliable
- Transportation plays critical role in emergency and first response scenarios