PROPOSAL

WAHKIAKUM COUNTY, WASHINGTON

EMERGENCY RADIO REPEATER AND INFRASTRUCTURE PROJECT UPGRADES

February 20, 2024

RACOM

AN EASTERN COMMUNICATIONS COMPANY

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EXECUTIVE SUMMARY

## WAHKIAKUM COUNTY, WASHINGTON

EMERGENCY RADIO REPEATER AND INFRASTRUCTURE PROJECT UPGRADES

February 20, 2024

RACOM

AN EASTERN COMMUNICATIONS COMPANY

MEETING YOUR NEEDS – FULLY COMPLIANT AND EXCEEDING RFP REQUIREMENTS

Thirty-five years of lessons learned, designing and operating radio networks, is being utilized in this design.

Wahkiakum County, WA VHF Channel & Linking Network Overview
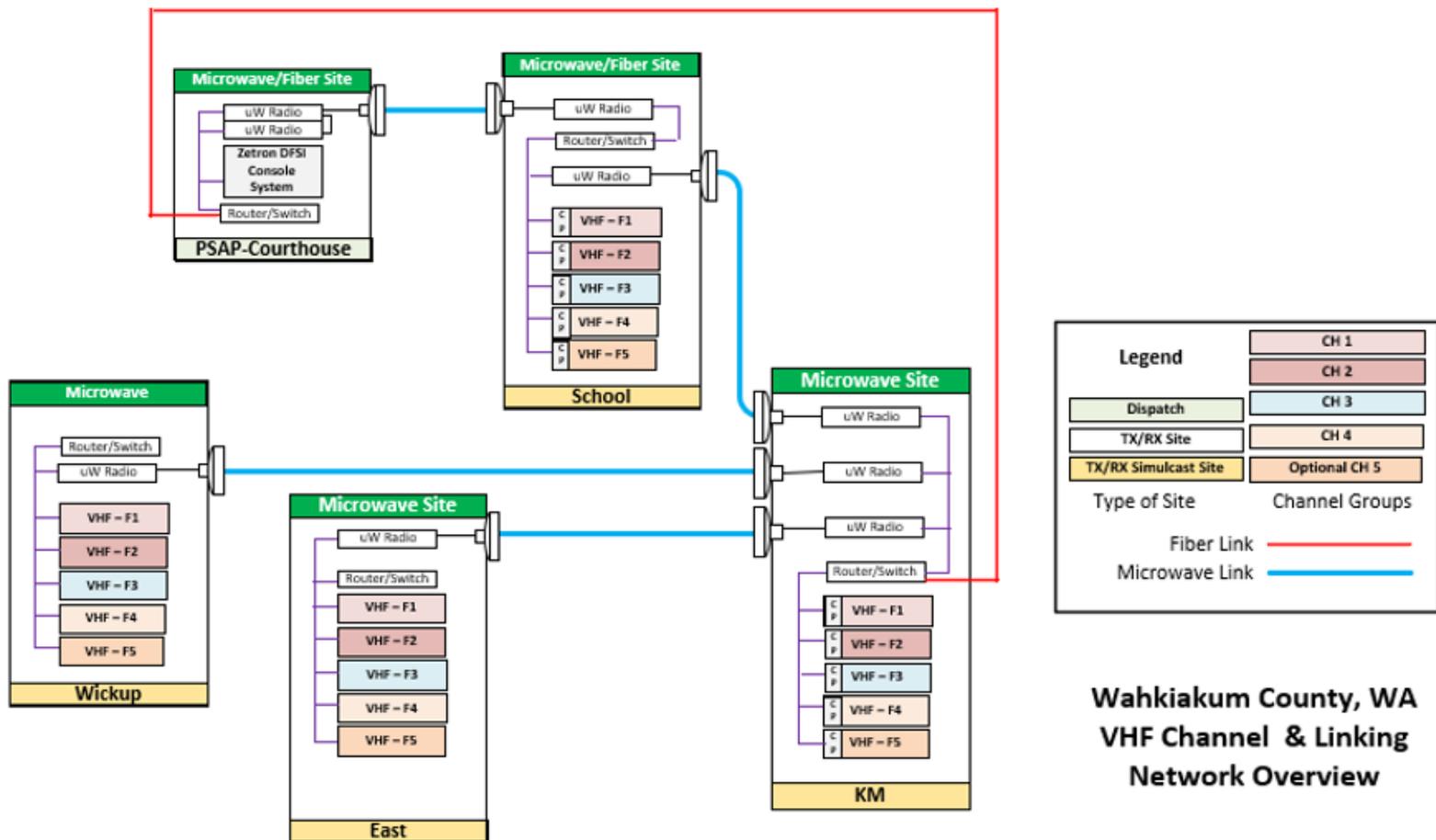
Everything you want:

- Four (4) Site TaitNet ASIP Analog Simulcast System
- Four (4) Transmit and Receive (TX/RX) sites
- All sites have four (4) Channels with option to add a fifth Channel
- Backhaul utilizing existing Fiber Links and new Microwave Links
- Zetron Max three (3) Position Console System
- Tait end-user portable and mobile equipment
- Easily Upgradeable to P25

RACOM - A TRUSTED PARTNER

1

LOCAL/TRUSTED

Agencies demand local support that will always be there for them through the entire life of the system

2

DEDICATED TO PUBLIC SAFETY AGENCIES

Agencies demand their partners have knowledge and expertise that is specific to the challenges & needs of Public Safety

3

EXPERIENCE

Today's technology is more complex and integrated requiring greater expertise in radio, IT, software, hardware & other Public Safety applications

4

24x7x365 SUPPORT

Public Safety is a 24x7 operation. System monitoring and emergency response should be too

WAKIAKUM COUNTY CAN HAVE A KNOWN TRUSTED PARTNER WITH CONTINUED SUPPORT OF YOUR CRITICAL COMMUNICATIONS

RISK FREE

RACOM SERVICE AND SUPPORT IS STANDARD

☑ All of your calls for support are answered live by RACOM employees, never by voicemail, and never by a third-party answering service. Our live system monitoring and 24x7 customer support combine to provide an immediate response to all your issues.

☑ Emergency support results in the immediate dispatch of a local service technician. Our factory-trained technicians and system engineers are on call, 24 hours a day, 7 days a week, 365 days a year to serve you.

☑ With RACOM's Lacey, Washington Service Center, we can be at your locations within 1-2 hours with support when you need us.

WHY RACOM?

- **Largest Tait dealer and distributor in the world means best pricing and manufacturer influence to ensure your needs are a priority.**

- **Installed 100+ Tait ASIP systems throughout North America, means more SME's and less problems for you.**

- **Only 24x7x365 network monitoring offered = immediate problem resolution.**

- **Simpler installation and remote maintenance abilities will save you considerable time and operations costs. Your organization can spend less time working on radio systems, and more time protecting your community.**

- **We have installed more Tait AS-IP solutions than any other provider in the word, reducing risk of getting your system implemented correctly, on-budget, and on-time.**

RACOM - PROJECT MANAGEMENT & IMPLEMENTATION - WITHOUT RISK!

TRUSTED

We provide Contract Language that is Simple and Straightforward with No Risk.

The industry is notorious for contract language that is skewed toward the manufacturer at the expense of the end user.

We'll be committed to you every step of the way

Migration does not have to mean interruption

It's important to minimize the impact of transition to your Simulcast System. We'll collaborate and agree on a migration plan that allows the implementation to happen in parallel with using your current systems. Both systems can be fully operational during the transition and your newer radios can be preprogrammed and ready for use.

MINIMAL DISRUPTION

Your users need to talk to each other and dispatch throughout the entire build process. We'll keep your existing system operational until all sites, channels and users are migrated.

EXPERIENCE

We've successfully upgraded and migrated more agencies to AS-IP than any other integrator in the US. We'll leverage the tools and strategies we've developed over the years, along with the initial phase upgrades you've already accomplished with radios, stations and consoles to make the migration a success.

CRITICAL ELEMENTS

SCOPE
We'll collaborate and mutually agree on your required scope through a detailed design review process

TIME
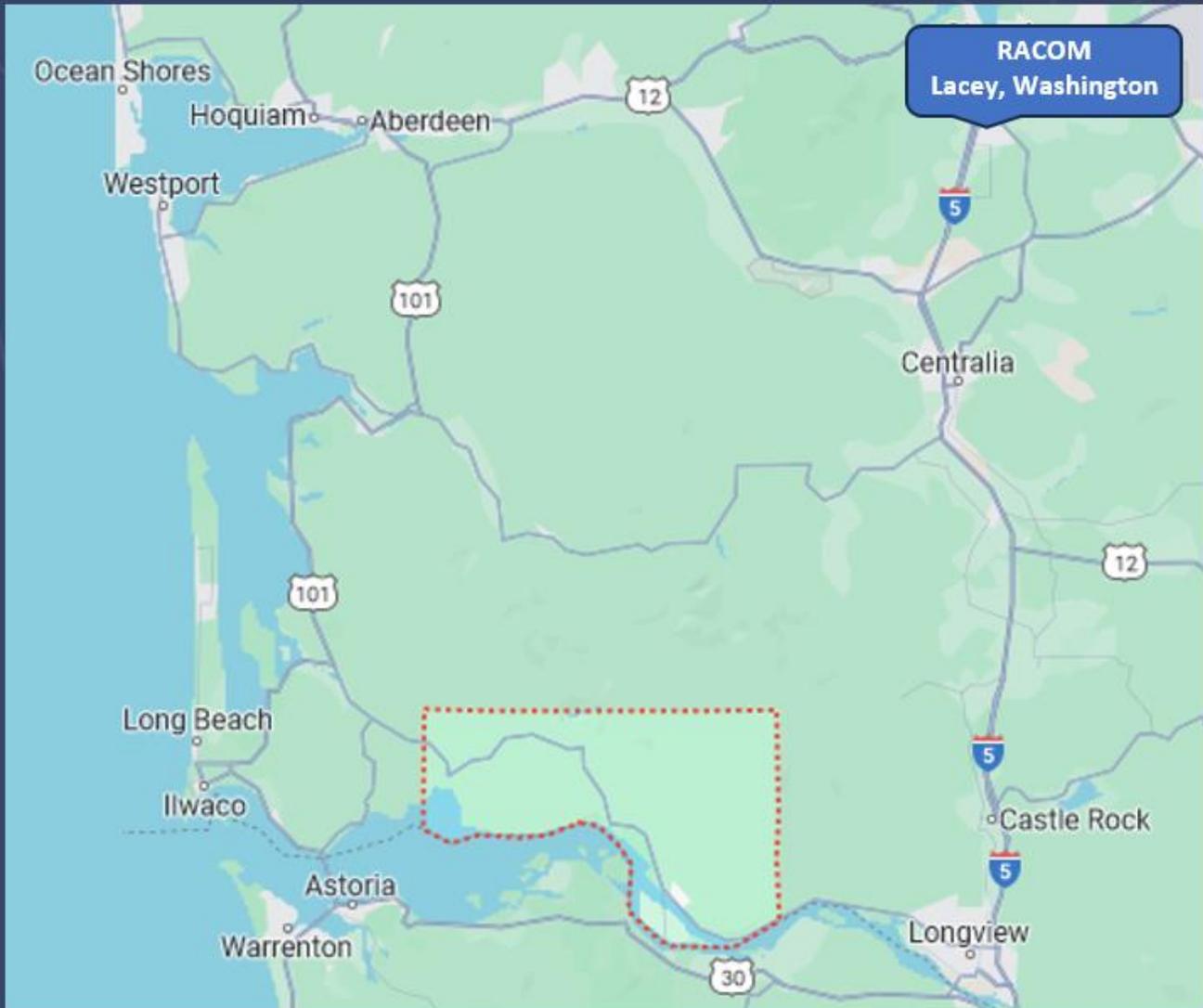A time-frame that meets your needs, 2/20/24 to 12/30/24

QUALITY
We should all demand Public Safety-Grade products and implementation services

COST
Our proposed costs are transparent, without hidden fees or unanticipated change orders

IMMEDIATE LOCAL RESPONSE

All of your calls for support are answered live by RACOM employees, never by voicemail, and never by a third-party answering service. Our live system monitoring and 24x7 customer support combine to provide an immediate response to all your issues. Emergency support results in the immediate dispatch of a local service technician. Our factory-trained technicians and system engineers are on call, 24 hours a day, 7 days a week, 365 days a year to serve you. With our Lacey, Washington Service Center, we are able to respond to your locations in 1-2 hours with on-site support when you need us.

NOTHING IS MORE IMPORTANT THAN COVERAGE!

SIMULCAST ALLOWS MULTIPLE SITE COVERAGE WITHOUT THE USERS NEEDING TO CHANGE CHANNELS

SITE SELECTION

The main objective of the coverage design was to meet or exceed coverage requirements by optimizing antennas and equipment at your identified tower sites.
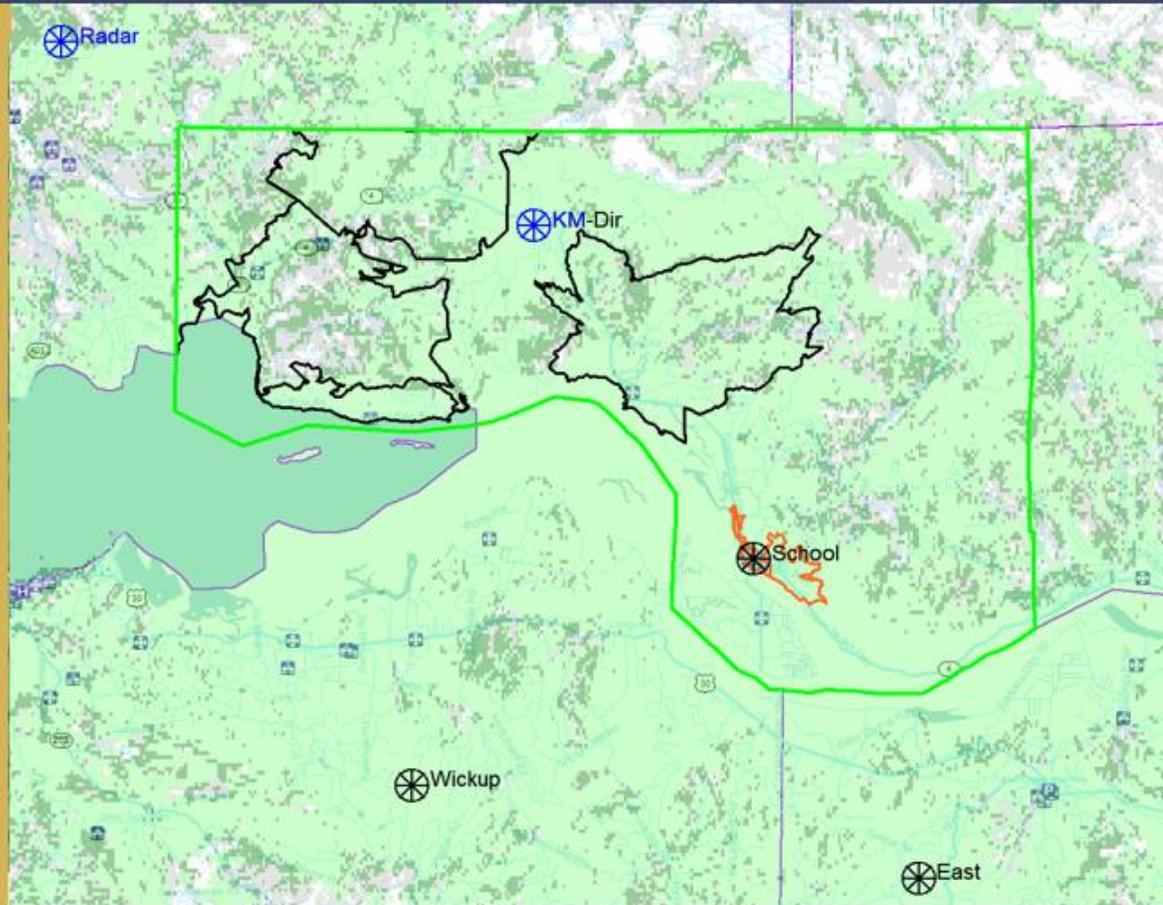
Wahkiakum County Mobile Talk-Out Coverage
95% Bounded Area Coverage Countywide at 95% Reliability
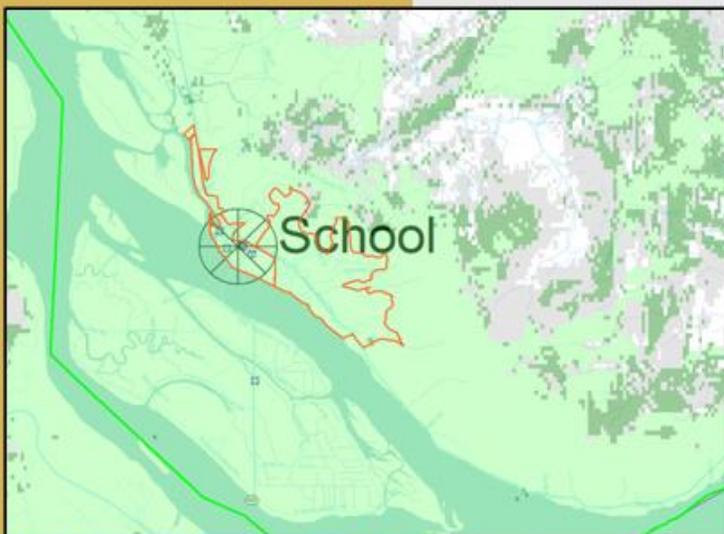
Wahkiakum County Portable Talk-Out Street Coverage
>95% Bounded Area Coverage within Cathlamet and 80% Bounded Area Coverage Countywide Portable Street Coverage at 95% Reliability

SIGNAL LEGEND	SIGNAL LEVEL	DAQ LEVEL
	< 0 dBm	4 .5-5
	< -80 dBm	3 - 4.5
	< -95 dBm	2 - 3
	< -107 dBm	0 - 2

tait AS-IP

BETTER COVERAGE | BETTER MIGRATION PATH | INTEGRATED EQUIPMENT

Tait AS-IP networks deliver a lower total cost of ownership by providing advanced functionality with less equipment, better coverage on a single frequency, and investment protection for your future needs.

BETTER COVERAGE
Our Linear Simulcast technology and design provides the best mobile, portable and paging coverage

EASY MIGRATION PATH
It's the same hardware platform for AS-IP and P25. Migration to P25 conventional and/or trunking is accomplished with low cost software options

INTEGRATED EQUIPMENT
Integrated voting and site control makes your system more reliable and less costly to operate and suport

ADVANCED FUNCTIONALITY - The Tait AS-IP system architecture is composed of a master base station with multiple satellite base stations forming a channel group. Connection to Whitcom's Dispatch Consoles will be provided through a DFSI connection. The overall system will be monitored with Tait's Enable Monitor Application.

INVESTMENT PROTECTION - The Tait AS-IP network portfolio is based on the latest 9400 Tait products, providing a compact solution that can grow with your customer's needs for both Analog and P25 solutions.

YOUR tait
AS-IP Solution

A BETTER INSTALLATION

Tait has taken several steps to ensure the transition from your VHF Repeater System to Tait AS-IP is as quick and painless as possible.

Historically, simulcast networks have been notoriously difficult to build and sync correctly.

We've removed the need for a 3rd party voter, simplifying the initial setup and reducing the equipment required. This also saves rack space, power consumption, and system reliability. There are fewer points of failure.

Another major setup challenge with simulcast is tuning. If every site isn't tuned perfectly, reception will be erratic. Even a microsecond of difference can ruin the signal.

Tait's new transmitter design removes all tuning and equalization. Syncing of all sites happens instantly through IP connectivity and internal GPS. This results in an easier set-up, less user training, and better audio quality.

BETTER REDUNDANCY & RELIABILITY

Voting is key to effective simulcast networks and ensures that each radio user gets the best possible reception.

Every Tait AS-IP system has a primary central voting site and backup site voter, to provide unparalleled voting redundancy. Should voting on the central site fail for any reason it is automatically detected and the backup site voter will seamlessly take over. You have the flexibility to choose the backup voting site to ensure this functionality is transferred to the most robust site available.
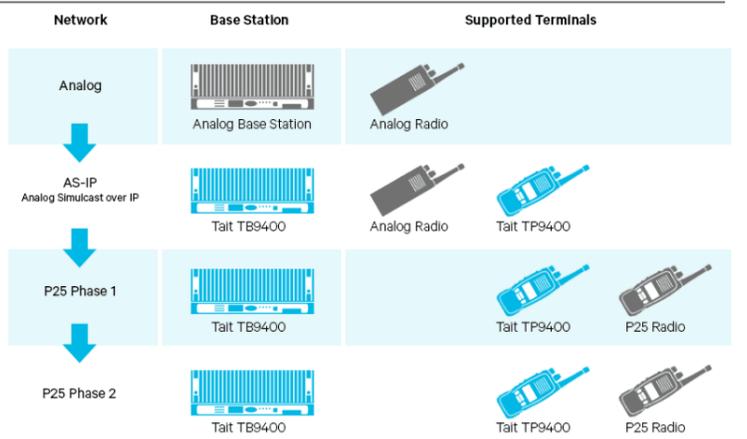
MORE UPGRADEABLE... P25

Tait AS-IP provides the best migration to P25. Imagine it's 2 or 3 years down the road, and your organization decides to upgrade to P25. You can upgrade your entire network and all TB9400 terminals in your fleet to P25. All you'll need to do is add new feature software licenses. It just doesn't get any easier.

MIGRATE TO P25
WHEN YOU'RE READY

If ever or whenever you want to migrate to P25, you can keep all your same hardware - sites, stations, and radios.

Many of our customers migrate a channel at a time to accommodate different agency needs.

Network	Base Station	Supported Terminals	
Analog	Analog Base Station	Analog Radio	
AS-IP Analog Simulcast over IP	Tait TB9400	Analog Radio	Tait TP9400
P25 Phase 1	Tait TB9400	Tait TP9400	P25 Radio
P25 Phase 2	Tait TB9400	Tait TP9400	P25 Radio

WHY UPGRADE TO P25?

INTEROPERABILITY BETWEEN AGENCIES

GREATER CHOICE OF DEVICES

**INCREASED SECURITY THROUGH ENCRYPTION**

NEXT GENERATION DIGITAL FEATURES

- P25 is an open standard for public safety digital radio. Its real beauty is interoperability, allowing different departments to coordinate in emergency situations.

- P25 devices from different vendors are compatible, and there is a wide range to choose from. This offers peace of mind to agencies that need specific features within budget restrictions.

- To facilitate the need for security in public safety, P25 includes a robust encryption standard. In a sensitive law enforcement situation, users can community with confidence that their calls are only being received by intended recipients.

- P25 takes advantage of modern features that add convenience and life-saving capability to your network. GPS location services, Man Down and Lone Worker functionality protect the safety of your staff in the field.

CHOOSING THE BEST

TAIT TB9400 BASE STATION

There are only three parts you need to stock

tait communications

Power Management Unit (PMU) ①

Power Amplifier (PA) ②

③ Reciter
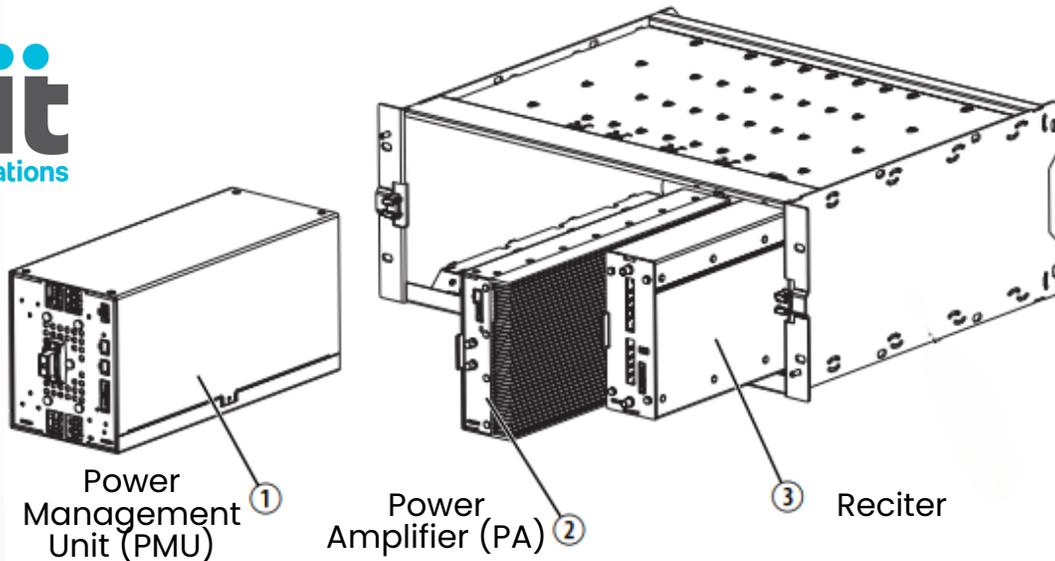
TAIT ENABLE MONITOR

Tait EnableMonitor watches the health of your network and associated equipment using SNMP. EnableMonitor helps us anticipate and resolve issues before they threaten your communications. This provides all the tools needed to monitor the health of your radio network and reduce downtime.

KEY FEATURES & BENEFITS

≫ Real-time system health status for early issue diagnosis

≫ Proof that your network is operating correctly

≫ Alerts and alarms when there is an issue

≫ Secure access to performance data anywhere, anytime

≫ Automatic discovery and configuration for easy setup

≫ Standards-based technology for interoperability

≫ Redundancy options for guaranteed performance

WE UNDERSTAND YOUR PROJECT

We recognize you can't perform a major upgrade on your land mobile radio system very often, so it better be done right the first time. Everything about this upgrade is **Public-Safety-Grade** – to ensure it meets and exceeds all the needs of your city and each of your user agencies..... Now, and for the next generation. We've taken no shortcuts to make sure you have a comprehensive solution that brings three critical elements together. **It takes all three!**

TECHNOLOGY | IMPLEMENTATION | SUPPORT

Technology

- Tait Simulcast for better coverage
- Software Upgradeable
- Multimode Analog + P25
- Environmentally Friendly
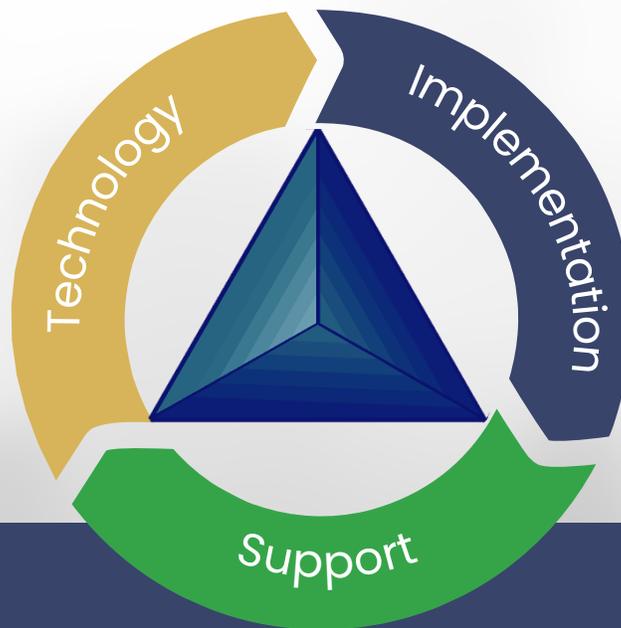
Implementation

- Project Management Expertise
- More installation experience than any other U.S. company
- Distinguished and Certified by Tait

Support

- Our Lacey staff is within one to two hours to support Wahkiakum County and all your responders
- Your system can be monitored and protected 24x7x365, and we'll customize notification and response procedures for Wahkiakum County
- Comprehensive Maintenance is available as an option to include -immediate emergency response 24x7, PMs, all parts, labor, software upgrades and travel, software upgrades

SECURE, RESILIENT AND DEPENDABLE

Local **Ownership** and **Control**

This means you decide what's best and get to make all the decisions – technical, financial, and operational. No restrictions, no delays.

Redundant voters and redundant controllers maximize uptime.

Always on, Always Ready

PUBLIC-SAFETY GRADE

Upgrading your existing Avtec Console means little to no additional training for your dispatchers.

Simplify The Migration

Leverage Your Current Investments

Leverage the investment you've already made in radios, statics, and consoles.

LOCAL TRAINING

In addition to the proposed training as part of the project, we can provide ongoing retraining of your personnel by our local technicians, through web-based classes, in-person classes in Wahkiakum County or our Lacey Service Center.

TECHNICAL EXPERTS AVAILABLE AROUND THE CLOCK

When critical communication systems malfunction, you'll want fast, responsive support to get your equipment back up and running. Our Optional Network Monitoring provides immediate response to your team and activates on-site emergency support by our local technicians 24/7/365.

OUR COMPREHENSIVE MAINTENANCE PROGRAM ENSURES YOUR SYSTEM OPERATES AT A

PUBLIC SAFETY GRADE OF SERVICE

NETWORK MONITORING (OPTIONAL)

24/7/365 REAL-TIME REMOTE MONITORING

Proactive monitoring helps us identify and address issues before they become larger problems for you.

To keep you updated on the status of all issues and resolutions, we'll customize notification processes for you and your team based on time/shifts and types of events.

Safety is no accident
Critical Communications should be monitored 24 x 7

CUSTOMIZED Standard Operating Procedure (SOP) Examples:

- Notification processes
- Response requirements
- Escalation procedures
- Dispatching service
- Call tracking
- Verification of cleared alarms
- Resolution/Disposition

RACOM REFERENCES

TAIT AS-IP OR SIMULCAST INSTALLATIONS

Bonner County, Idaho

Umatilla-Morrow Radio Data District (UMRDD) Oregon

Walla Walla, Washington

Columbia County 911, Washington

Boundary County, Idaho

Avista Utilities, Washington

Washington Department of Transportation WSDOT

Klickitat County 911, Washington

Pepin County, Wisconsin

City & County of Eau Claire, Wisconsin

St. Croix County, Wisconsin

Marathon County, Wisconsin

TESTIMONIALS

Shane Bazile - Communication Captain
Waupaca County, Wisconsin

"We've been a RACOM Customer for over five years. Having one local number to call with a live person to help us is invaluable. RACOM monitors our system 24/7/365. Often, they are working on a problem before we know there is one. One vendor under the same roof means no finger-pointing, as we've had in the past. It'great insurance knowing RACOM can get the job done."

Charlie McClintock - Communications Director
City of Cedar Rapids, IA

"RACOM's implementation of our P25 system was outstanding. They were always there. The ongoing support received was prompt, proficient and professional. I've never experienced this level of service before."

Andrew Carlin - Emergency Management Director
Waupaca County Emergency Management | Wisconsin

"Waupaca County Sheriff has been using the Tait TB9400 Base Station for analog simulcast and RACOM performed a flawless install. Because of the professionalism of the employees and exceptional service, the system has continuously performed beyond expectations."..

Terry Andersen - Emergency Communication Manager
St. Croix Emergency Support Services | Wisconsin

"RACOM installed our 5-channel, 14-site Tait system. During the entire project, we never had a change order for additional money on what was quoted. The ongoing support has been fantastic. They monitor our system 24/7/365. Their people are on site supporting our system automatically as needed if an issue comes about."

OUR BEST TEAM

Eric Olsen

Business Development Manager

Rod Ekholm

System Solutions Engineer

Kevin Timmons

Senior Systems Technician

Ron Bender

General Manager - RACOM NW

Thor Wiegman

Senior Systems & PSAP Technician

Phil Carey

Project Manager

Scott Skibness

Business Development Manager

Mike Miller

President

RACOM

16608

BEYOND NATURAL DISASTERS

Forest Fires, earthquakes, floods, hurricanes, volcanic eruptions, landslides, or any other phenomena are considered when engineering any RACOM system.

Going above and beyond is part of RACOM's everyday life. Natural disasters of any size present significant challenges to any business and often strain the procedures and systems they use to communicate and coordinate.

RACOM has personal experience navigating a natural disaster. It's important to have redundant equipment and standard operating procedures. We design and engineer all of our systems with worst-case scenarios in mind.

The RACOM Headquarters building experienced a direct hit by an EF3 Tornado in July 2018. The RACOM network NEVER blinked during or after the tornado.

This picture sequence tells the story of the damage, the rebuild, and the status of the headquarters building today.

RACOM
AN EASTERN COMMUNICATIONS COMPANY

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Cover Letter

WAHKIAKUM COUNTY, WASHINGTON

EMERGENCY RADIO REPEATER AND INFRASTRUCTURE PROJECT UPGRADES

February 20, 2024

February 20th, 2024

Wahkiakum County Sheriff's Office
ATTN: Beau Renfro
PO BOX 65
Cathlamet, WA 98612

Subject: Emergency Responder Radio System Upgrades Project

Dear Mr. Beau Renfro,

Enclosed is our response to your Request for Proposal for the Wahkiakum County Emergency Radio Repeater and Infrastructure Project Upgrades. We thank you for the opportunity to bid on this project and to provide a comprehensive public safety grade radio system for Wahkiakum County's Public Safety Community.

RACOM's storied history of partnering with customers nationwide enables us to understand and execute on the main pillars of our proposed solution for you – the best coverage, the most comprehensive reliability, and unmatched system performance always at the ready to serve Wahkiakum County and your users.

Your solution has been optimized to provide the following:

1. *Enhanced Radio Coverage* – Nothing is more important than radio coverage, and your users will rely on that coverage daily. By deploying state-of-the-art Tait base stations, you'll have better receive sensitivity to capture those important radio calls for assistance.

2. *Increased System Reliability* – Your users won't have to worry about their radio system functioning correctly. We deploy Public-Safety Grade Communication Systems with redundancies to always maintain normal user operations even when something fails, while also monitoring them to proactively address issues before they could impact you.

3. ***System for Today and Tomorrow*** – Your new system assures your users of improved radio communications today while providing a platform for future enhancements to comply with nationally recognized P25 standards-based technology when needed for maximum interoperability in the future.

The County's solution will be built on the foundation that makes our organization unique: our People. RACOM's team of engineers, technicians, and field support staff are most passionate about ensuring your mission critical communications are always ready. Our team will help to implement and adapt the system to meet all your operational needs, not just provide you with equipment. Our culture of support expands well beyond the four walls of our service centers nationwide – We put your needs first and are proud to support public safety professionals' mission to serve and protect their communities.

Users demand the best in-class implementation experience with a seasoned team. As the country's largest and most-experienced systems integrator of Tait solutions, we would be honored to continue working with you on this next phase of your communications upgrade. Thank you for this opportunity, and we look forward to a long-term partnership with Wahkiakum County and your entire Public Safety Community.

In conclusion, RACOM has reviewed the RFP in detail and is confident that all requirements have been addressed and/or will be met as the project moves forward. RACOM is committed to meeting Wahkiakum County's needs through the process of contract review, final design review, and the notice to procced, Clear timely communication is critical for successful completion of this project, and RACOM has the commitment and experience to do so.

Kindest Regards,

Eric Olsen
Business Development Manager

Mike Miller
RACOM President
Head of Business Development

Mark Peters
Vice President of Sales

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RACOM Qualifications/Experience/References

WAHKIAKUM COUNTY, WASHINGTON

EMERGENCY RADIO REPEATER AND
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RACOM
AN EASTERN COMMUNICATIONS COMPANY

RACOM QUALIFICATIONS

Wahkiakum County, Washington

At RACOM, we understand that our communications solutions and equipment play a vital role in our customers' lives every day. Leveraging the latest technologies, listening, responding to our customer's needs, and continually seeking ways to improve - this is who we are. It shows in the value we create today and the progress we are making for tomorrow. It's the kind of innovative thinking that has led customers to choose the technology and services we have to offer.

We've included a synopsis of RACOM on the following pages:

1. RACOM History/Company Background
2. RACOM Manufacturer Relationships
3. RACOM Network Monitoring
4. RACOM Experience
5. RACOM References

RACOM

AN EASTERN COMMUNICATIONS COMPANY

RACOM is a systems integrator that designs, installs and maintains all the technologies used to respond to E911 calls and emergencies

*…**providing everything from NextGen E911 phone systems to console furniture, fire pagers to station alerting, radios and dispatch consoles to logging recorders, warning lights and sirens.***

OUR CORE VALUE:
"Our Word is Our Bond"

The RACOM Story

Our History…

RACOM is an Iowa-based company nationally recognized for innovation and a history of being the first to bring advanced capabilities to the communications industry. We have been serving Public Safety Agencies and Utilities in the upper Midwest for nearly 50 years. There are 15 RACOM Service Centers sprinkled throughout the United States and 60 plus dealer partners to respond to your needs.

RACOM has been a technology innovator, designing and delivering end-to-end solutions that meet customers' mission-critical needs since 1972. We provide dependable solutions for Public Service and utility customers - tools for those who provide the critical services that our communities rely upon every day – water, electric, gas, telephone, and street services.

RACOM has years of experience in designing, installing and maintaining IP networks for Analog, DMR, SCADA and Project 25 solutions. Combined with local project resources for implementation and support, the results are cost-effective solutions that meet the demanding needs of system coverage and performance for voice and data communications.

As part of Eastern Communications, we are 200+ full-time workers, including over 100 engineers and technical staff.

RACOM Territory –U.S.A

24x7 Network Monitoring

Public Safety-Grade

Today's advanced systems provide unparalleled levels redundancies to avoid catastrophic failures. But by design, underlying issues are masked and transparent to the users. Instead, they are alarmed and logged for the technical support personnel.

For your system to be considered **Public Safety-Grade,** it should be live-monitored 24x7x365 to proactively address these minor issues before they result in unacceptable downtime.

When alarms are generated or back-up systems have been activated, it is imperative that technical support evaluate these issues immediately to determine their severity and the appropriate course of action. A system operating in a backup condition is vulnerable to further failures if not addressed.

At the core of RACOM's Customer Support offerings is the Network Operations Center (NOC). It operates 24x7x365 to monitor, manage and maintain solutions on behalf of public safety agencies.

Services include a customer-support hotline, live network monitoring, network management, performance reporting, remote surveillance, service response and trouble-ticket escalation, response notification and updates.

All services are customized to develop a set of SOPs specific to your organization and needs.

The NOC is staffed 24x7 and will promptly answer your phone calls and emails. You will never be sent to voicemail or a 3rd-party answering service.

RACOM is owned by Eastern Communications, Queens, NY.

RACOM Industry-Leading Solutions

- **Mission Critical Voice Communications**
  From conventional operations to advanced P25 and DMR trunking protocols. Complete system design, sale, construction, maintenance and financing

- **Dispatch Center Solutions**
  NextGen 911 Telephone systems, Dispatch Consoles, Console Furniture, Logging Recorders, Fire Station Alerting and Paging

- **Video Surveillance**
  Including video courtroom, jail security, tower-site and exterior surveillance

- **Wireless Communications**
  Narrowband and broadband applications

- **LAN and wireless LAN expertise**
  Including IP networking and routing

- **GPS and AVL solutions**
  For user safety and productivity.

- **Premier Upfitting Solutions**
  Of Police, Fire, EMS, Municipal, Utilities and Specialty Vehicles

- **FCC Frequency Coordination and Licensing Services**

- **The SARA/RACOM Network**
  The **S**hared **A**rea **R**adio **A**greement (SARA) Network is the largest P25 trunking network in Iowa. It's shown to be the best model of local reliability, ownership, and control with maximum in-building coverage interoperability for local police, fire and EMS.

BEST-IN-CLASS PARTNERS

RACOM and Eastern Communications are the Tait Master Distribution Partners and System Integrators for the entire United States. We specialize in engineering, design, and build, as well as technical support services to Tait Major Utility and Public Safety customers.

RACOM and Eastern Communications serve customers nationally with our extensive L3Harris network of partners Serving as the distribution, project implementation, and customer support partners for all L3Harris dealers in the U.S.

Premier Manufacturer Partners

L3HARRIS™   tait communications   ZETRON   Aviat NETWORKS   mimomax

BeOn™   Phoenix US DIGITAL DESIGNS   MAX SOLUTIONS   SoundOff Signal   SWISSPHONE DiCal

SYMPHONY   EFJohnson TECHNOLOGIES   JVCKENWOOD   Eventide   NexLog COMMUNICATIONS RECORDERS

Cambium Networks   NEWMAR A MISSION CRITICAL ELECTRONICS BRAND   exACOM   cisco

NETWORK MONITORING

INFORMATION SECURITY POSTURE

INFORMATION SECURITY

Information Security is a significant piece of monitoring customer networks. RACOM owns the responsibility of monitoring not only our network but all our customer networks. RACOM is proactive in maintaining a secure environment for both end-customers and RACOM Corporation itself. The tools available to malicious-intentioned individuals are numerous in today's age of the internet of things (IoT). By maintaining a proactive posture, protection is at its highest level for Network Monitoring.

RACOM NETWORK MONITORING

The RACOM monitoring network is a privately addressed network that is not allowed access to the internet except through secure Site-to-Site VPN tunnels, defining permitted traffic. By excluding access to the internet, RACOM provides a much smaller attack vector by which malicious individuals can attempt access and destruction on the network.

ZERO TRUST POLICY

ZERO TRUST STATEMENT

RACOM has a Zero Trust Policy for all networks, even its own. As the world evolves and tools are constantly improving to detect attackers, the attacker toolset also improves. By adopting a "Zero Trust" mindset internally and externally, RACOM and customer information are held to a standard of care over the length of contracts.

WHAT IS ZERO TRUST?

Zero Trust is the realization and mobilization against the world of malicious intent by assuming all sources of information are potential attackers. For example: If a known good user brings their device (BYOD) to a network of information, although that user's intentions may be the best, their equipment is a new vector of compromise and should be treated as such. Just because the user is trustworthy, it does not mean that the device they are utilizing is. Zero Trust is in the shorter-term: "No access unless you and your device are cleared."
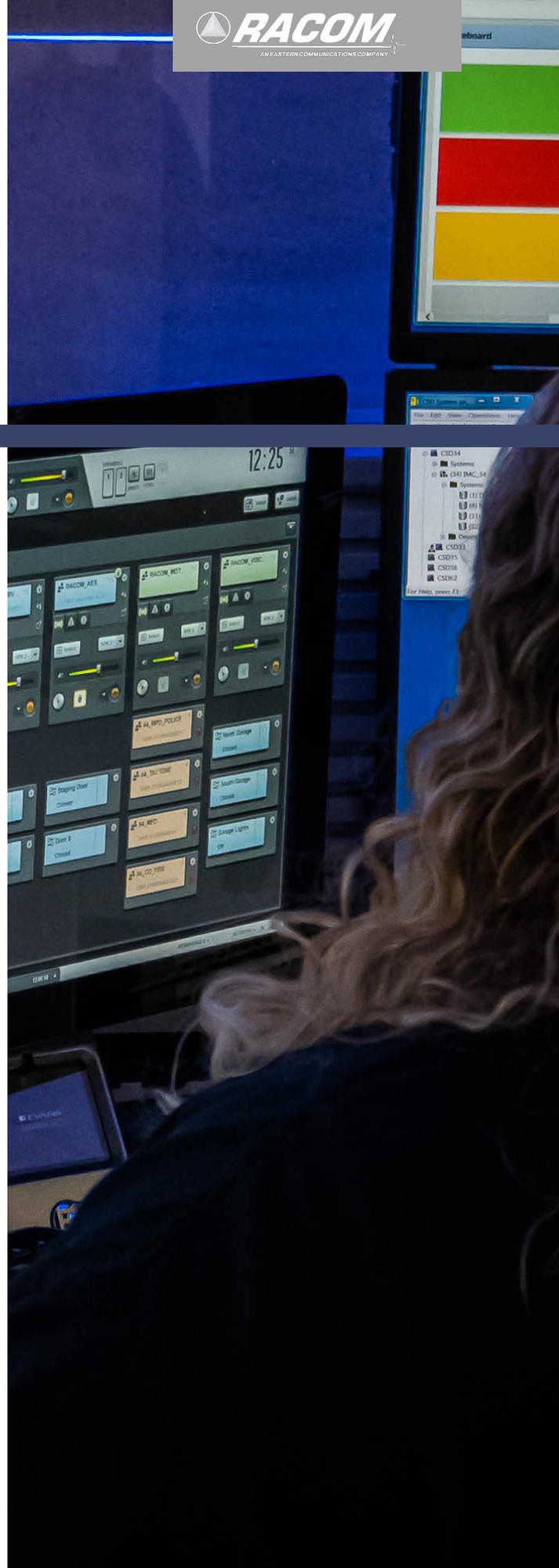
PENETRATION TESTING

INTERNAL

RACOM is routinely performing internal penetration tests to find possible avenues of attack within our networks. Once identified, these avenues are rectified immediately to ensure the continuity of our trusted network.

EXTERNAL

RACOM performs periodic external double-blind and single-blind penetration tests. These tests are designed to test our systems and help ensure that the highest level of security is being met. Reports from these external tests are used to remediate any missed shortcomings.

REMEDIATION
EXTERNAL

RACOM performs off-site backups for data to ensure protection from natural disasters and data corruption/exploitation. These backups are available at any time of the day to remediate file systems that RACOM manages. These are a way to repair a system in cases of disaster or attack.

THE THREE STEPS OF REMEDIATION

01

ISOLATION
In the unlikely event of an attack on a RACOM network, the attack vector is isolated to include the PC/Servers, the network leg itself, and any other involved devices.

02

FORENSICS
After isolation, the devices/networks in question are analyzed to help provide insight into remediation against future attacks.

03

REPAIRS/ADJUSTMENTS
After a forensics period, the devices/networks are adjusted to protect against future attacks of a matching nature. Data files are restored from backup as needed, and any user training required is provided.

RELEVANT EXPERIENCE

Wahkiakum County, Washington

We have installed and maintained numerous simulcast radio systems throughout the Pacific Northwest and Midwest that employ the same technology as the proposed Wahkiakum County system. We likewise have vast experience with other simulcast technologies.

Below is a partial list of relevant projects to represent the size and scope of projects recently/previously installed or being upgraded.

Customer	Tait Technology	System Size
Bonner County, ID	VHF Analog Multicast	9 Sites, 8 Tait TB9400 base stations
Umatilla-Morrow Radio Data District (UMRDD), OR	700MHz Phase II Trunking	15 Sites, 72 Tait TB9400 base stations
Walla Walla, WA	VHF AS-IP Simulcast	10 Sites, 30 Tait TB9400 base stations
Columbia County 911, WA	VHF Analog Multicast	6 Sites, 18 Tait TB9400 and TB8100 base stations
Boundary County, ID	VHF QS2 Analog Simulcast	4 Sites, 8 Tait TB8100 base stations
Avista Utilities, WA	220MHz MPT & DMR Trunking	27 Sites covering over five states
Washington Department of Transportation (WSDOT), WA	700MHz Conventional Coverage Supplementation	10 Sites, Tait TB9400 base stations
Pepin County, WI	VHF AS-IP Analog Simulcast	4 Sites, 8 Base Stations
Crawford County, IA	VHF Analog Simulcast	7 Sites, 35 Base Stations
Grant County, WI	VHF Analog & P25 Simulcast	11 Sites, 55 Base Stations
Chippewa County, WI	VHF AS-IP Analog Simulcast, VHF Voted Receive	10-Sites, 46 Base Stations
St. Croix County, WI	VHF AS-IP Analog Simulcast	15 sites, 90 Base Stations
Eau Claire County, WI	VHF AS-IP Analog & P25 Simulcast	12 Sites, 48 Base Stations
Burnett County, WI	VHF AS-IP Analog Simulcast	8 Sites, 32 Base Stations
Jackson County, WI	QS2 Simulcast	9 Sites, 36 Base Stations
Waupaca County, WI	QS2 & VHF AS-IP Analog Simulcast	7 Sites, 52 Base Stations
Marathon County, WI	QS2 (p25) & vhf Analog Simulcast	14 Sites, 36 Base Stations
Oneida County, WI	QS2 to AS-IP Analog & Linear CPQSK Simulcast Multi-mode Network	8 Sites, 32 Base Stations
Wood County, WI	VHF Analog Simulcast	7 Sites, 28 Base Stations
Barron County, WI	QS2 Simulcast, Steered Transmit	9 Sites, 6 Base Stations
Winneshiek County, IA	VHF Analog & P25 Simulcast	7 Sites – (Current Project: 2 Site expansion & 2 Site Relocation), 8 Base Stations
Allamakee County, IA	VHF Analog & P25 Simulcast	9 Sites-P25, 8 Sites Analog

RACOM REFERENCES

Tait AS-IP References - Installed by RACOM

Organization	Bonner County, Idaho
Contact Name	Marcus Robbins
Title of Contact	Bonner County Sheriff Technology Manager
Address	4001 N Boyer Ave., Sandpoint, Idaho 83864
Phone & Email	(208) 263-8417	Marcus.Robbins@bonnercountyid.gov
Contract Duration	Ongoing Project, Ongoing Maintenance
Type of System	Bonner County operates a multicast voted VHF analog radio system for all public safety agencies within the County. 9 Sites in all. Ongoing replacement of legacy base stations with Tait TB9400 100W VHF base stations.

Organization	Umatilla-Morrow Radio (UMRDD), Oregon
Contact Name	Brett Mueller
Title of Contact	
Address	4700 N W Pioneer Pl., Pendleton, Oregon 97801
Phone & Email	(541) 966-3774	Brett.mueller@umrdd.org
Contract Duration	Project Complete, On-going Maintenance
Type of System	UMRDD operates a Tait P25 700MHz Phase II Trunked Radio System with TB9400 base stations.

Organization	Walla Walla, Washington
Contact Name	Steven Ruley
Title of Contact	Public Safety Communications Manager
Address	15 North 3rd Ave., Walla Walla, Washington 99362
Phone & Email	(509) 527-1959	sruley@wallawallawa.gov
Contract Duration	Project Complete, Self-Maintained
Type of System	Walla Walla County operates a VHF Simulcast System utilizing Tait TB9400 VHF 100W base stations.

Organization	Columbia County, Washington
Contact Name	Tina Bobbitt
Title of Contact	Communications Supervisor
Address	341 E Main Street, Dayton, Washington 99328
Phone & Email	(509) 382-3928	Tina_bobbitt@co.columbia.wa.us
Contract Duration	Ongoing Project, Ongoing Maintenance
Type of System	Columbia County operates a multisite VHF analog radio system for all public safety agencies within the County. 6 Sites in all. Ongoing replacement of legacy base stations with Tait TB9400 100W VHF base stations.

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Organization	Boundary County, Idaho
Contact Name	Andrew O'Neel
Title of Contact	Emergency Manager
Address	6566 Main Street, Bonners Ferry, Idaho 83805
Phone & Email	(208) 290-0406 | aoneel@boundarycountyid.org
Contract Duration	Ongoing Project, Ongoing Maintenance
Type of System	Boundary County operates a Tait QS2 VHF analog radio system for Fire and EMS agencies within the County. 4 Sites in all. The county is working on a project to upgrade existing TB8100 base stations with Tait AS-IP TB9400 100W VHF base stations & expanding the system capacity to include the Boundary Sheriff's Office

Organization	Avista Utilities (Washington, Idaho, Oregon & Montana)
Contact Name	Scott Grimmett
Title of Contact	RF Systems Engineer
Address	1411 East Mission Ave., Spokane, Washington 99252
Phone & Email	(509) 993-9968 | Scott.grimmett@avistacorp.com
Contract Duration	Ongoing Project, Self-Maintained
Type of System	Avista Utilities operates a 220MHz Analog MPT-1327 LMR system with Tait TB8100 base stations and is in the process of upgrading legacy base stations with Tait TB9300 220MHz base stations to support DMR Tier-III Trunking. 27 Sites in all throughout 4 States.

Organization	WSDOT
Contact Name	Tim McDowell
Title of Contact	ITS Communications and Wireless Mgr.
Address	HQ Transportation Operations, 7345 Linderson Way SW, Tumwater, Washington 98501-6054
Phone & Email	360-705-7028 | McDoweT@wsdot.wa.gov
Contract Duration	Project Complete, Self-Maintained
Type of System	WSDOT uses Tait TB9400 700MHz base stations to expand LMR coverage into remote locations and for interoperability.

Organization	Pepin County Sheriff
Contact Name	Joel D. Wener
Title of Contact	Sheriff
Address	740 7th Aveneu/PO Box 39, West Durand, Wisconsin 54736
Phone & Email	715-672-3443-Direct | 715-279-2997-Cell | jwener@co.pepin.wi.us
Contract Duration	Project Complete, Self-Maintained
Type of System	TAIT AS-IP Solution, 4-Sites, 2-Channels, uWave connectivity

Organization	City and County of Eau Claire, WI
Contact Name	Dena Clark
Title of Contact	Director of Emergency 911 Communications
Address	203 S. Farwell, Eau Claire, Wisconsin 54702
Phone & Email	(715)-839-1690 | Dena.clark@eauclairewi.gov
Contract Duration	Ongoing Maintenance, System expansion & Support
Type of System	The City and County of Eau Claire operate a 12-site, 4-channel Tait AS-IP system.

Organization	St. Croix County, WI
Contact Name	Terry Anderson
Title of Contact	Emergency Communications Manager
Address	1101 Carmichael Road, Hudson, Wisconsin 54016
Phone & Email	(715)-381-4910 | Terry.anderson@sccwi.gov
Contract Duration	Project complete, ongoing maintenance.
Type of System	Modernized St. Croix's existing VHF Analog Conventional LMR and console equipment with a turn-key Tait AS-IP Analog Simulcast solution with a migration path to P25 Digital Simulcast [Phase1], Linear Modulation (LSM) via software upgrade.14 Sites and 7 Avtec console positions.

Organization	Marathon County, WI
Contact Name	William Millhausen
Title of Contact	Captain of Communications
Address	500 Forest St., Marathon County Courthouse, Wausau, Wisconsin 54403
Phone & Email	(715)-261-1200 | william.millhausen@co.marathon.wi.us
Contract Duration	Project complete, ongoing maintenance.
Type of System	Upgrade QS2 System to Tait AS-IP simulcast system, 9-site, 1 channel.

Organization	Waupaca County, WI Sheriff
Contact Name	Shane Bazile, Communications Captain
Title of Contact	Shane Bazile, Communications Captain
Address	1402 Royalton St., Waupaca, Wisconsin 54981
Phone & Email	(715)-412-2808 | Shanel.bazile@co.waupaca.wi.us
Contract Duration	Ongoing Maintenance, System expansion & Support
Type of System	Tait 7-Site 35 Channel AS-IP System. Two additional sites are to be added for Fire Paging.

Organization	Burnett County, WI
Contact Name	Jim Tolbert
Title of Contact	Director of Emergency Management
Address	7410 County Road L, Siren, Wisconsin 54872
Phone & Email	(715)-349-2171 | Jtolbert@burnettcounty.org
Contract Duration	Ongoing Maintenance, System expansion & Support
Type of System	Tait 9-Site, 4-Channel VHF Simulcast System

Organization	Oneida County, WI
Contact Name	Ken Kortenhof
Title of Contact	Emergency Management Director
Address	2000 E Winnebago Street, Rhinelander, Wisconsin 54501
Phone & Email	(715) 361-5167 | kkortenhof@co.oneida.wi.us
Contract Duration	Ongoing 5-year Contract to upgrade QS2 System to AS-IP TB9400 Simulcast and provide on-site maintenance
Type of System	Formerly, a Tait QS2 System, which RACOM maintained, then Upgraded to Tait AS-IP Analog and Simulcast Linear CPQSK simulcast multi-mode network, 8 Site 24 Channel AS-IP Analogue Simulcast, Tait 8 Site, 1 Channel AS-IP P25 Multi-Mode Linear Simulcast.

Organization	Chippewa County
Contact Name	Tamee Foldy
Title of Contact	Emergency Communications Director, Chippewa County Sheriff's Office
Address	32 E. Spruce St., Chippewa Falls, Wisconsin 54729
Phone	715-726-7989 Office I 715-726-7701 #1 Communications Center
Contract Duration	Ongoing Maintenance, System expansion & Support
Type of System	TAIT AS-IP Solution, 10-Sites, 4-Channels, Fiber & uWave connectivity

Organization	Crawford County, IA
Contact Name	Gregg Miller
Title of Contact	Emergency Management Coordinator
Address	1202 Broadway, Denison, Iowa 51442
Phone & Email	(712)-269-2422	ema@crawfordcounty.org
Contract Duration	Ongoing Maintenance, System expansion & Support
Type of System	Upgrade the existing radio system on the VHF band to a current 3-site VHF analog simulcast Tait AS-IP P25 solution. Future plans include a buildout of 7 sites. They recently purchased a Zetron MAX Dispatch solution with installation beginning in October.

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TECHNICAL PROPOSAL

WAHKIAKUM COUNTY, WASHINGTON

EMERGENCY RADIO REPEATER AND INFRASTRUCTURE PROJECT UPGRADES

February 20, 2024

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Table of Contents

Conventional Simulcast System

Proposed System Overview

RACOM is proposing a four (4) site TaitNet ASIP Analog simulcast system consisting of four (4) transmit and receive (TX/RX) sites. The system or induvial channels can easily be upgraded to P25 and RACOM has included the cost to upgrade a channel in our offer. Once upgraded the channel can operate in both Analog and P25 based on the type of call being received, meaning if non P25 users need to communicate on the channel, their calls can be heard both by the users in the field and the dispatchers without any additional user intervention. All four of the sites, School, KM, East and Wickup will have four channels with the option to add a fifth at any time at a fixed known price.

The sites will be connected using the existing fiber links and four (4) new microwave links being provided by RACOM using public safety grade linking equipment by Aviat. RACOM as currently proposed is recommending 11GHz links with indoor equipment as preferred by the County in the responses to questions.

To support a couple of the links and maintain the reliability level for a public safety system and to maximize the bandwidth available between the sites, RACOM had to put some of the dishes at higher heights then those outlined in the RFP and provided by the County to achieve a clear path. Details on the paths and the proposed heights are provided later in this overview. Once site surveys and confirmation on the actual height and any path obstructions it may be determined that additional options may need to be used for some of the paths proposed by RACOM. Based on all our initial studies and evaluation of the various options available, we are confident that even if we need to use one of the other linking options, a link can be provided to every site to support the system being proposed with the required bandwidth and reliability required for a public safety system.

The County should also realize that RACOM has proposed the more expensive of all the options we looked at, to make sure if we need to move ahead with a different option or if the County decides they would prefer one of the other options available, the cost to the County will not be more than already proposed but will more likely be lower, not because of lower reliability but because of lower overall available bandwidth and/or the use of outdoor mounted equipment.

For the requested console solution RACOM is proposing a Zetron Max three (3) position console system that will include interfaces to the various existing channels and a Digital Fixed System Interface (DFSI) IP based link to the new channels being provided. Using a DFSI connection to the system will allow the dispatchers access to new capability not supported by older hard wire connections, like preemption capability on the outbound traffic to the users while still being able to listen to the users in the field talking to them. As requested in the RFP, back-up radios will still be available if the link to any of the channels is lost.

The back up radios will be connected to the console so the dispatcher will be able to still communicate using the console but still have the ability if something should happen to the console itself to talk direct over the radio at their position.

RACOM has also included new DC power systems at all the sites as outlined in the RFP. We have based the supported run time based on loading of the equipment being provided to support their operation for eight plus hours. If during the detail design it is determined that there is other equipment at the sites that needs to be supported, additional batteries can be added to support those loads or additional run time as needed without any changes to the power system, other than the addition of more batteries.

The overall system will be monitored by Tait's Enable Monitor applications. Enable Monitor will provide a single place to view the status of all the system equipment status and alarms using standard SNMP, syslog and contact closures from the sites.

SIMULCAST SITES:

For Public Safety users, Radio Coverage is critical. Our design was built around the coverage requirements outlined in the RFP. RACOM's engineering team has produced a design that meets your requirements. Our design is based on 95% reliability with a 3.4 DAQ for outdoors and in-building coverage. A 95% BAPC within the boundaries outlined and shown in our response was the final goal. This simulcast design will help to minimize the number of channels that will be needed to support the system. An outline of the sites being used is in the Coverage section below.

While the County provided five sites to use, RACOM is proposing only four. In a simulcast system, since several of the site's coverage will overlap each other, when engineering the overall design, we need to make sure that in these areas of overlap, the system itself is not causing interference (delay spread) that creates unusable audio to the end user even in those areas with strong signal levels. This is the case we found when we included the Radar site with the other four. We lost more coverage because of delay spread than gained. If during detail design there are some areas that only Radar can cover that are needed, there are ways it can be added in but will take extra frequencies to make it work and RACOM wanted to be able to discuss these with the County before they are used.

Site Conditions:

Since site visits were not part of the RFP process, RACOM based our pricing on the information provided by the County in the RFP. If during the detail design process of the project, a deficiency at any of the sites is found that needs to be corrected to support the system that is outside of the scope of the project, the County will be responsible to address these deficiencies.

GUARANTEED COVERAGE:

Since coverage is important to all our customers, we go above the requirements in our coverage guarantee and not just what is asked for in the RFP. RACOM will commit that each of the areas outlined coverage matches what we have proposed. If not, we will fix it at our cost.

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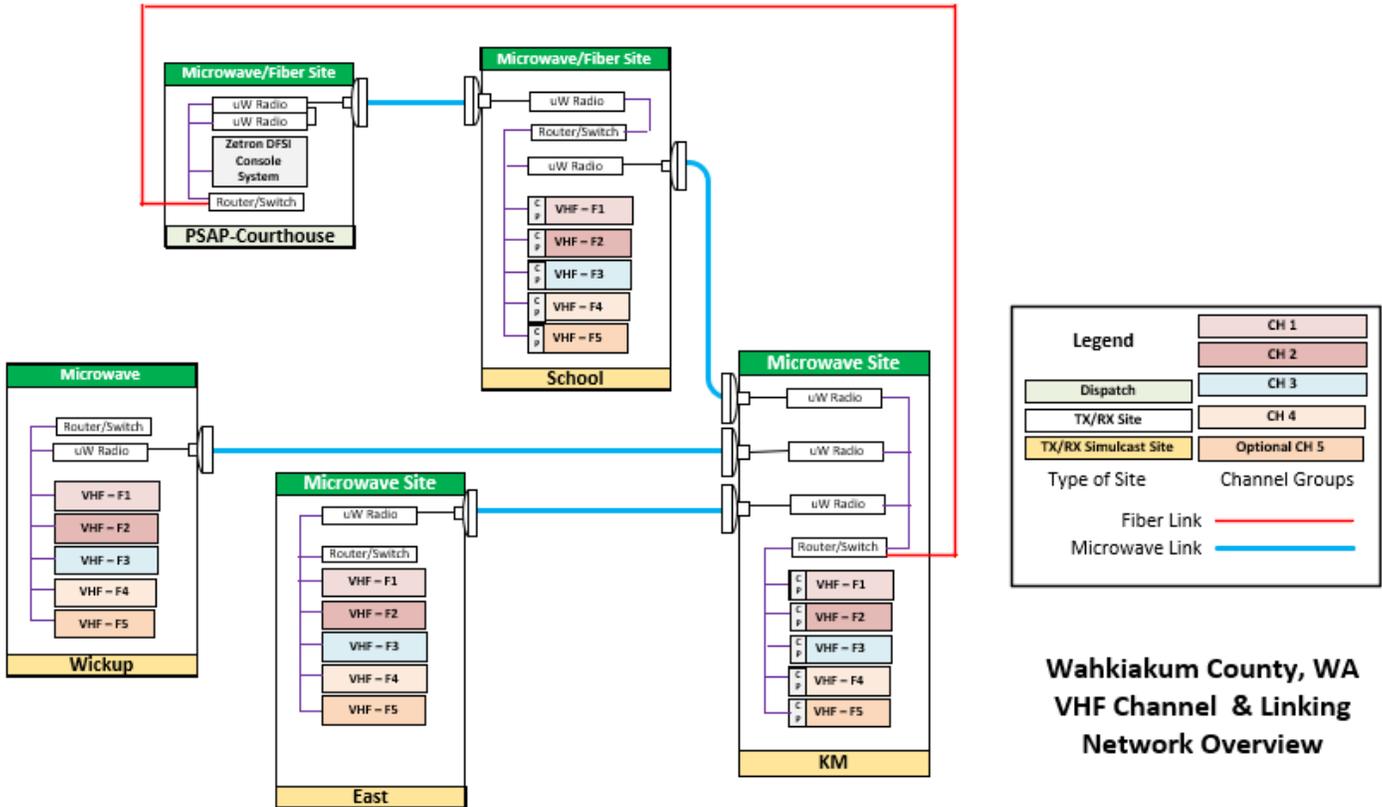
Wahkiakum County, WA
VHF Channel & Linking
Network Overview

Radio System Overview

For the Radio System RACOM is proposing a TaitNet ASIP network which is a set of interconnected Tait base stations. Each TB9400 Station can receive from and transmit to mobile and portable radios, just like any base station/repeater. However, TB9400s also have built-in networking capabilities that enable them to combine to form one or more logical channels (Chanel Groups) with wide area coverage.

For the proposed VHF system, RACOM is proposing a four (4) site solution using those outlined in the RFP. All four of the sites will have four (4) TB9400 TX/RX base stations with an option to add a fifth one if needed and frequencies are available to support it.

The connection to the new Zetron dispatch console will be integrated into the network using the DFSI standard interface.

Proposed four Site System

The following outlines the 4-sites RACOM is proposing for the project. The table to the right outlines the Type, Channels and Function for each of the sites.

Site	Type	Channels	Funtion
Cathlamet - School	TX/RX - Simulcast	5	Control Point
Clatskanie Mnt - East	TX/RX - Simulcast	5	
KM Hill	TX/RX - Simulcast	5	Control Point
Wickup Mountain	TX/RX - Simulcast	5	
PSAP-Dispatch	Dispatch	0	DFSI

The Sites are divided up into three different types: TX/RX Simulcast Control Point, TX/RX Simulcast, and Dispatch.

The simulcast system consists of either TX/RX Simulcast Control Point or Standard sites. For each Channel Group (the station that share the same frequency across those simulcast sites) have at least one station in the group is configured with a voter and simulcast control capability. This station is commonly referred to as the Control Point (CP). For the County's solution, RACOM has included two CPs, a primary and backup for each Channel Group.

Per the RFP, the channels (frequencies outlined in the table below) RACOM is proposing to use are as outlined in the table. The frequency # is ordered lowest to highest TX frequency. The channel name is based on which frequencies RACOM is proposing for that channel based on the available frequencies provided in the RFP and our estimate on which

Freq #	TX	RX	Name/License
1	152.2850	157.5450	Channel 4 - WQVH328
2	153.9275	159.9300	Channel 5 - WQOP660
3	154.8000	158.8500	Channel 2 - WPPC748
4	155.0700	158.9400	Channel 1 - WPPC748
5	155.9850	158.3400	Channel 3 - WRG734

ones the licenses can be modified for the new system as proposed. Final channels and frequencies will be based on final coordination and FCC approval that will be completed as part of the detail design effort.

Coverage Analysis

RACOM uses the L3Harris Radio Analysis and Propagation Tool Repository (RAPTR) when designing new radio systems. RAPTR is an advanced propagation and system design tool compatible with TIA TSB88-B and uses the Okumura-Hata-Davidson model for propagation loss, the United States Geological Survey (USGS) Digital Elevation Model (DEM) for terrain elevation data and the USGS National Land Cover Data (NLCD) database for environmental data.

This program is a complete system design tool for the analysis and design of land mobile radio systems. The software incorporates many large databases from the FCC, GIS, Cable Manufactures and Antenna Manufactures to bring together every parameter it takes to design a highly reliable RF system model. RACOM's RF Engineer can adjust numerous critical parameters to achieve the perfect site balance for the predicted coverage the system needs to provide. The RAPTR software is constantly being upgraded and adjusted to stay ahead of technology.

Many considerations are used in determining your coverage for the proposed system. The modeling of terrain and environmental data are just two of the characteristics considered in providing the most realistic coverage prediction and solution. The terrain map is a product of the United States Geological Survey (USGS) digital elevation model generated from RAPTR showing the contour of the County.

A larger version is at the back of this section, but the levels start at 52' and go es to 3,148' with each color change at 320'. The green boundary is the County and the black one within the County is various area available within the tool. These are Altoona CDP, Cathlamet, Deep River CDP, East Cathlamet CDP, Grays River CDP, Rosburg CDP, and Skamokawa Valley CDP. The elevation changes and the site locations are some of the items that impacted the design.
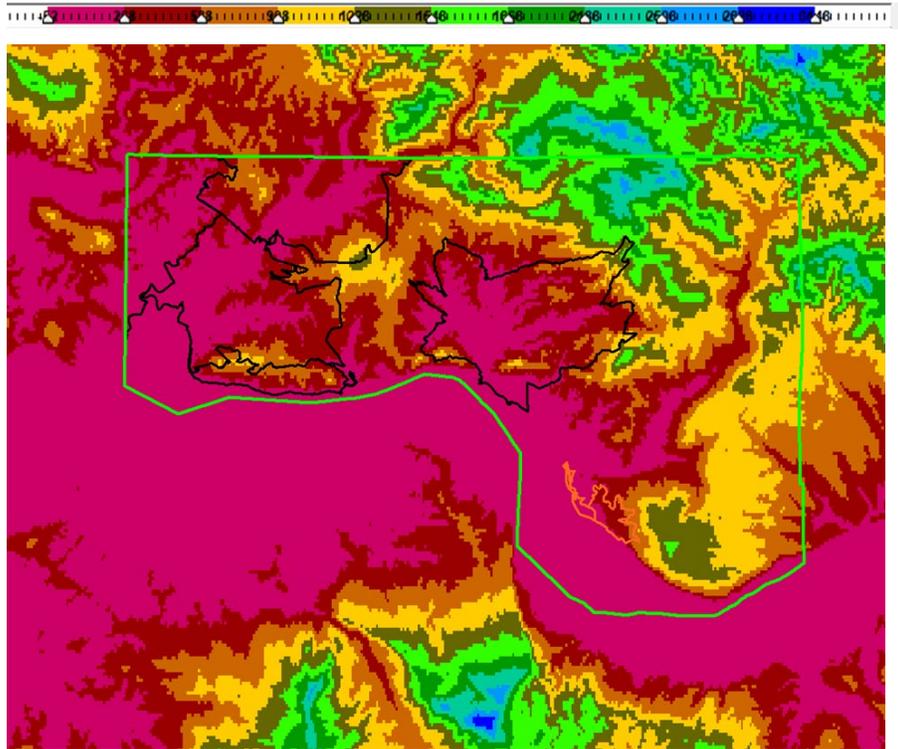
Environmental data or Land Use Land Clutter (LULC) was used to classify areas based on the way the land is used per NLCD. This allows our coverage model to distinguish areas used for but not limited to agriculture, commercial buildings, residential homes and industrial. This attention to detail ensures that the Wahkiakum County and its users are getting the most accurate coverage model possible.

This data is used in two ways when predicting coverage, one way is for additional Clutter Loss. TBS-88 defines these losses to be used based on the type of area. The other is for the loss of buildings within that area for additional inbuilding loss. While the County has not asked for any specific in-building coverage in the RF, outdoors only. RACOM has included maps based on the default TSB-88 level outlined. The table outlines what RACOM has used for our maps and

LULC Color Customization

Color	Description
	Water
	Snow Ice
	Wetland
	Open Land
	Rangeland
	Transportation
	Agricultural
	Residential
	Forest
	Mix Urban Buildings
	Commercial/Industrial
	High Density Urban

Wahkiakum County Environment Date Used for Maps (dB)				
			Additional Loss Added for Inbuilding by Type	
	Clutter Loss	Street	Default	Category
Water	0	0	0	Lakes
Snow & Ice	0	0	0	Snow Pack
Wetland	3	0	3	Non-forested
Open Land	5	0	3	Bare Land
Rangeland	9	0	3	Herbaceous
Transportation	3	0	3	Roadways
Agricultural	3	0	3	Grassland
Residential	14	0	6	Suburban
Forest	8	0	3	Pine (>30')
Mixed Urban/Buildings	15	0	10	Apartment (<4 stories)
Commercial/Industrial	14	0	15	Commercial Services
High Density Urban	15	0	20	Skyscrapers

the percentage of areas covered information we have included for each. We have included an additional column with an alternative name for the TSB-88 labels for each type, labeled Category, as some people like these definitions of the area better. The more detail area so the LULC levels within the County limits.
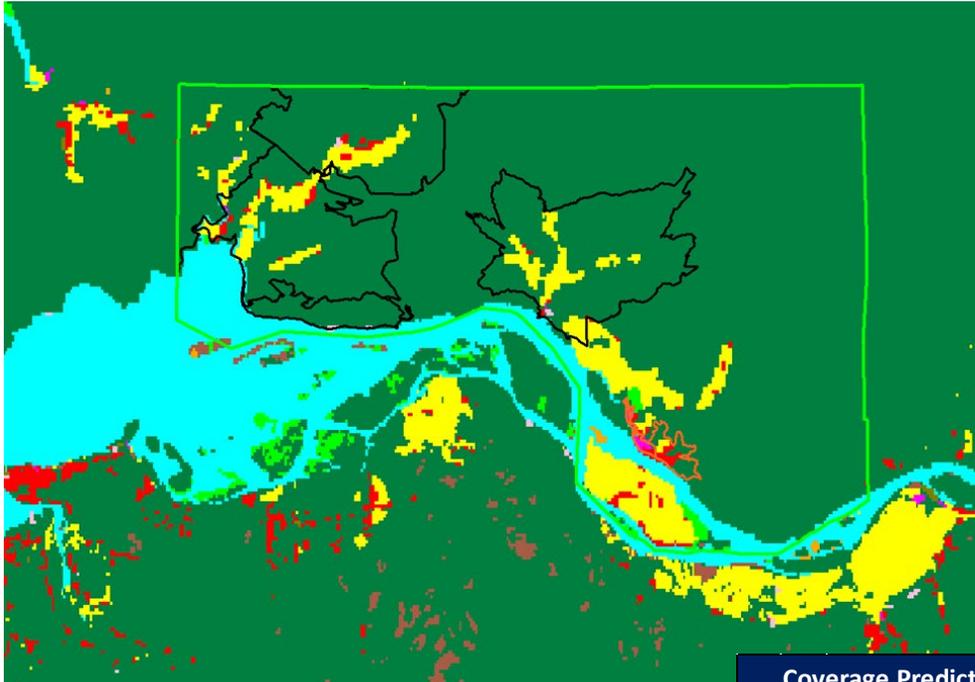
The different classifications of environmental data can include water, agriculture, forest, residential, mixed urban and commercial definitions. Understanding how the land is used allows the RACOM Engineer to concentrate coverage where the radio users will need it most. The map to the side shows the Land Use Land Clutter data collected for the area in and around the County.

In addition to the environmental and LULC information outlined RACOM has used the additional information outlined for the VHF proposed system and sites as shown in the following tables.

Coverage Prediction Assumptions For Wahkiakum County				
1	**General Project Parameters**			
	A	Project/Site Datum	NAD83-CONUS	
	B	Frequency	150-174 Mhz	
	C	Project Sensitivity	a. Mobile -107dBm b. Portable -107dBm	
	D	Terminal Antenna Height	a. Mobile 5.0 feet b. Portable 3.5 feet	
	E	Prediction Model	Harris Okumura	
	F	Body Loss/ Harris Portables	Hip: 15dB Head: 8dB	
	G	Service Area/Design Target	Portable 95%/95% Mobile 95%/95%	
2	**Mobile Radios**			
	A	Transmit Power	50.0 watts	
	B	Receiver	Noise Figure 10 /-107dBm Faded/1.0uV, 50ohms	
	C	Mobile Antenna Gain	-1.0 dB	Net Gain (0dB antenna and -1 line/connector)
	D	Vehicle Distortion Margin	(-)1.2dB	
	E	Antenna Mounting Position	Center of Roof with a light bar	
3	**Portable Radios**			
	A	Transmit Power	6.0 Watts	
	B	Receiver	Noise Figure 10 /-107dBm Faded/1.0uV, 50ohms	
	C	Portable Antenna Gain	1/2 wave Unity Gain 0 dB gain	
4	**Environment**			
		Clutter Loss (dB)		**Building Loss - TSB 88 (dB)**	
	A	Water	0	0	Lakes
	B	Snow & Ice	0	0	Snow Pack
	C	Wetland	3	3	Non-Forested
	D	Open Land	3	3	Bare Land
	E	Rangeland	9	3	Herbaceous
	F	Transportation	3	3	Roadways
	G	Agricultural	3	3	Row Crops
	H	Residential	14	6	Suburban
	I	Forest	8	3	Pine (>30')
	J	Mixed Urban/Buildings	15	10	Apartments (<4 stories)
	K	Commercial/Industrial	14	15	Commercial Services
	L	High Density Urban	15	20	Skyscrapers

Site Name	Cathlamet - School	Clatskanie Mnt - East	KM Hill	Wickup Mnt
Site ID	School	East	KM	Wickup
Latitude	46° 12' 06.400" N	46° 03' 58.200" N	46° 20' 36.400" N	46° 06' 20.200" N
Longitude	123° 22' 52.500" W	123° 16' 57.100" W	123° 30' 46.500" W	123° 35' 09.200" W
Datum	NAD83	NAD83	NAD83	NAD83
Site Elevation	148 ft	2113 ft	886 ft	2635 ft
Base Station	TB9400-P25 Ph1	TB9400-P25 Ph1	TB9400-P25 Ph1	TB9400-P25 Ph1
Frequency Range	150 - 174 MHz	150 - 174 MHz	150 - 174 MHz	150 - 174 MHz

Site Transmit

	Cathlamet - School	Clatskanie Mnt - East	KM Hill	Wickup Mnt
Station Output Power	100.0 W	100.0 W	100.0 W	100.0 W
Combiner Model	DS4345D (5 ch.)	DS4345D (5 ch.)	DS4345D (5 ch.)	DS4345D (5 ch.)
Tx to Tx Spacing	200	200	200	200
Combiner Loss	5.1 dB	5.1 dB	5.1 dB	5.1 dB
Filter/Duplexer Model				
Filter/Duplexer Loss	0.0 dB	0.0 dB	0.0 dB	0.0 dB
Coax Type	7/8" Foam	7/8" Foam	7/8" Foam	7/8" Foam
Coax Length	110 ft	115 ft	150 ft	130 ft
Coax Loss	0.5 dB	0.5 dB	0.7 dB	0.6 dB
Antenna Model	ANT150F2	ANT150F2	CL7-150	ANT150F2
Antenna Height (C.L)	60 ft	65 ft	100 ft	80 ft
Antenna Azimuth	0°	0°	331°	0°
Antenna Mechanical Tilt	0°	0°	-14°	0°
Antenna Gain (Hzn)	2.5 dBd	2.5 dBd	7.3 dBd	2.5 dBd
Maximum ERP (Hzn)	49.3 W	49.3 W	141.3 W	48.2 W
HAAT	-280.0 ft	1424.0 ft	296.0 ft	1874.0 ft

Site Receive

	Cathlamet - School	Clatskanie Mnt - East	KM Hill	Wickup Mnt
Total System Gain	0.9 dB	1.0 dB	0.8 dB	0.9 dB
Multicoupler Model	DB7300 (8 ch.)	DB7300 (8 ch.)	DB7300 (8 ch.)	DB7300 (8 ch.)
Coax Type	7/8" Foam	7/8" Foam	7/8" Foam	7/8" Foam
Coax Length	150 ft	130 ft	170 ft	150 ft
Tower Top Amp Model	(None)	(None)	(None)	(None)
TTA Pad	0.0 dB	0.0 dB	0.0 dB	0.0 dB
Distribution Pad	0.0 dB	0.0 dB	0.0 dB	0.0 dB
Duplexer Loss	0.0 dB	0.0 dB	0.0 dB	0.0 dB
Antenna Model	ANT150F2	ANT150F2	ANT150F2	ANT150F2
Antenna Height (C.L)	100 ft	80 ft	120 ft	100 ft
Antenna Azimuth	0°	0°	0°	0°
Antenna Mechanical Tilt	0°	0°	0°	0°
Antenna Gain (Hzn)	2.5 dBd	2.5 dBd	2.5 dBd	2.5 dBd
HAAT	-240.0 ft	1439.0 ft	316.0 ft	1894.0 ft

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The two maps below are the round-trip balance reports for the proposed VHF system. The green is the area the Talk Out and Talk In are the same, the pink is Talk back only and the blue is Talk Out only. Both the mobile and Portable maps show the system is balanced to slightly Talk back limited.

Round Trip Analysis
Round Trip
Talkout Only
Talkback Only
No Coverage

Mobile Talk Out Balance Report

Portable Talk Out Balance Report
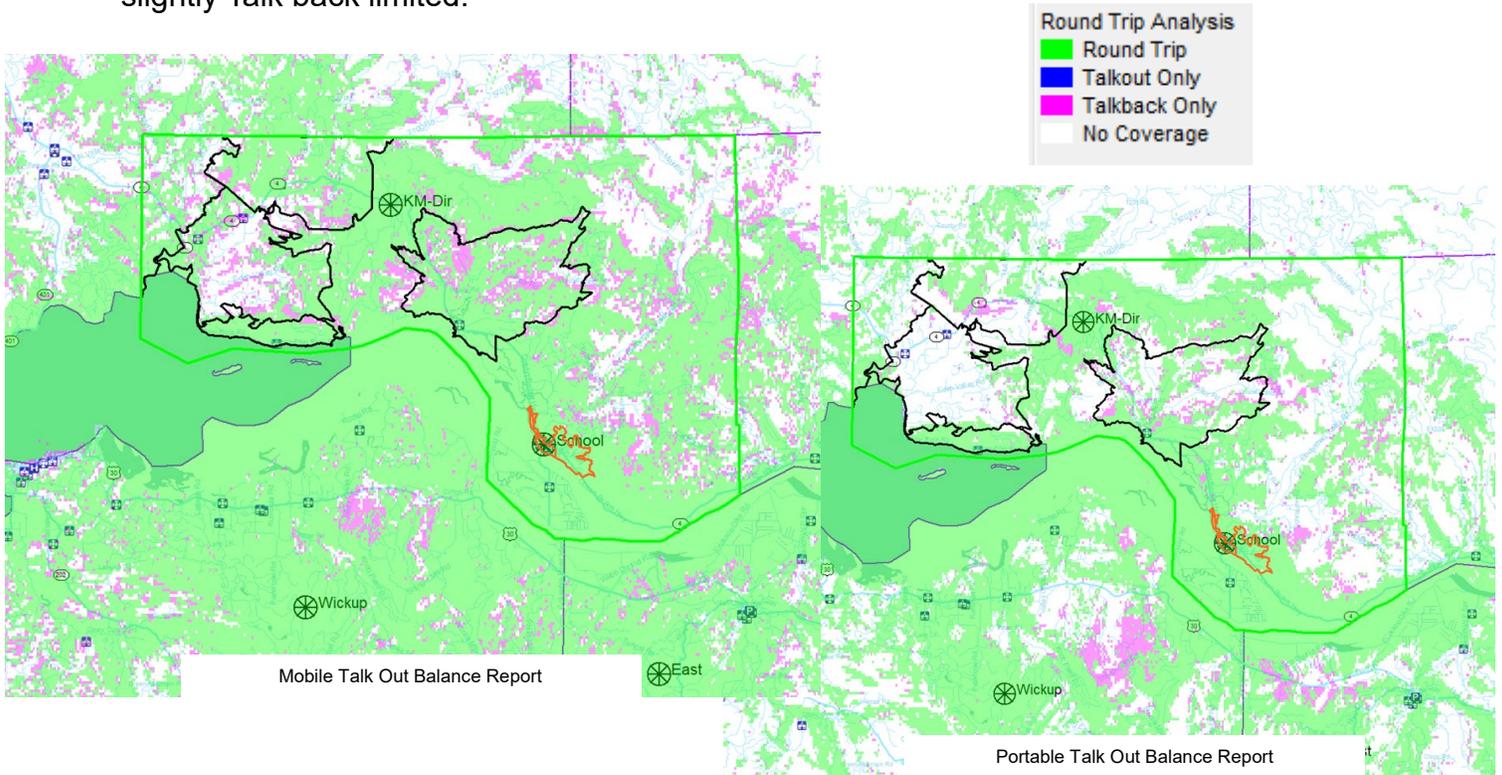
On the coverage maps that follow, the gray areas are covered, and the brown (2% BER or greater) black/dark (Greater than 5% BER) is simulcast delay spread areas. Since the system as outlined above is balanced or slightly talk-back limited, the maps shown are for talk-out only. We have provided three different maps, Mobile talk-out, Portable talk-out (on the street, and Portable talk-out (indoors TSB-88 levels). All Portable maps assume the radio is at the hip.

For each of the coverage maps shown, the tool provides the percentage of that area (County and City/CDP Limits) that is predicted to be covered. These will be listed after each map. The highest level RACOM will guarantee is 95% BAPC. If the level is greater than that we will use >95% but not the actual predicted number.

While these are the percentages of the area covered, it does not include the area with 2% to 5% BER. This level of BER still supports intelligent audio just not totally clear so the actual area with useable audio, <5% BER is greater than 95% for all areas within the County except the Roseburg CDP which is 94% covered for a mobile or as shown for each of the different maps.

Larger maps are provided at the end of the System Overview in the attachments section.
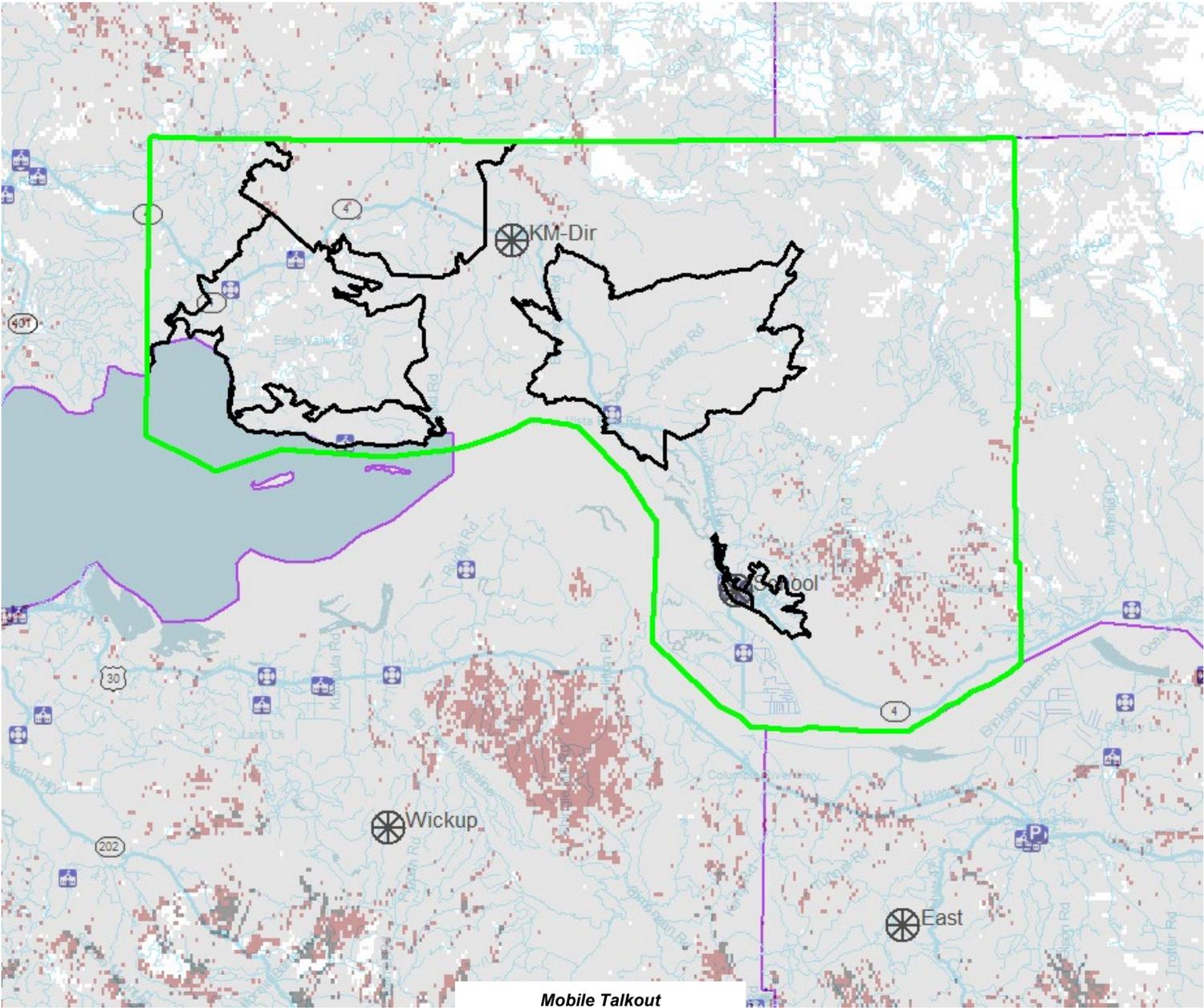
Mobile Talkout

Mobile Talk Out BAPC is >95% for area except for the County and Rosburg CDP which is 94%

Portable Talkout - Street
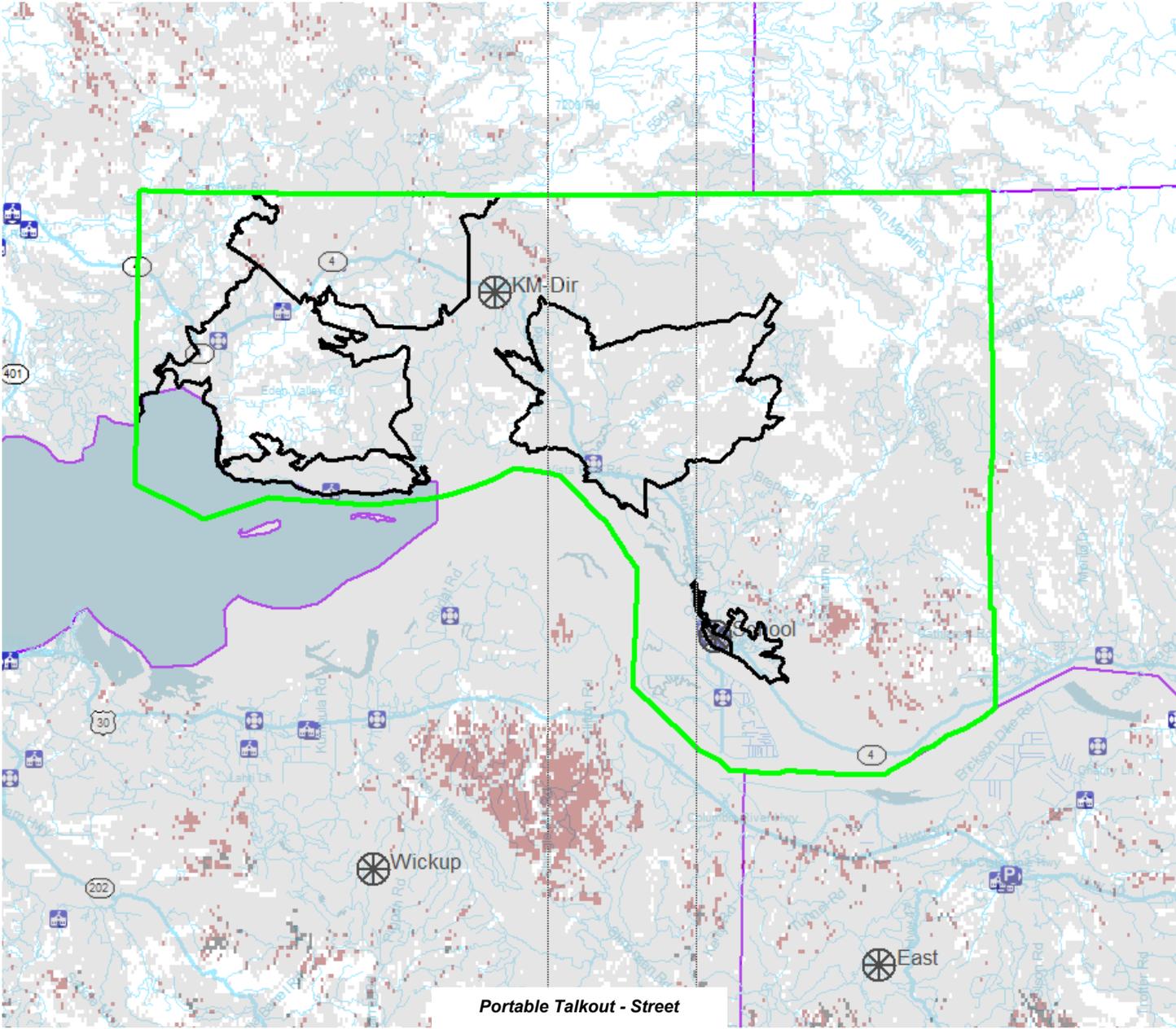
Portable Talk Out - Street BAPC is >95% for the Cathlamet and East Cathlamet, 90% for Altoona CDP, 80% for the County, Gray's River CDP and Skamokawa Valley CDP, 70% for Deep River CDP and 60% for Rosburg CDP.

Portable Indoor Default Levels
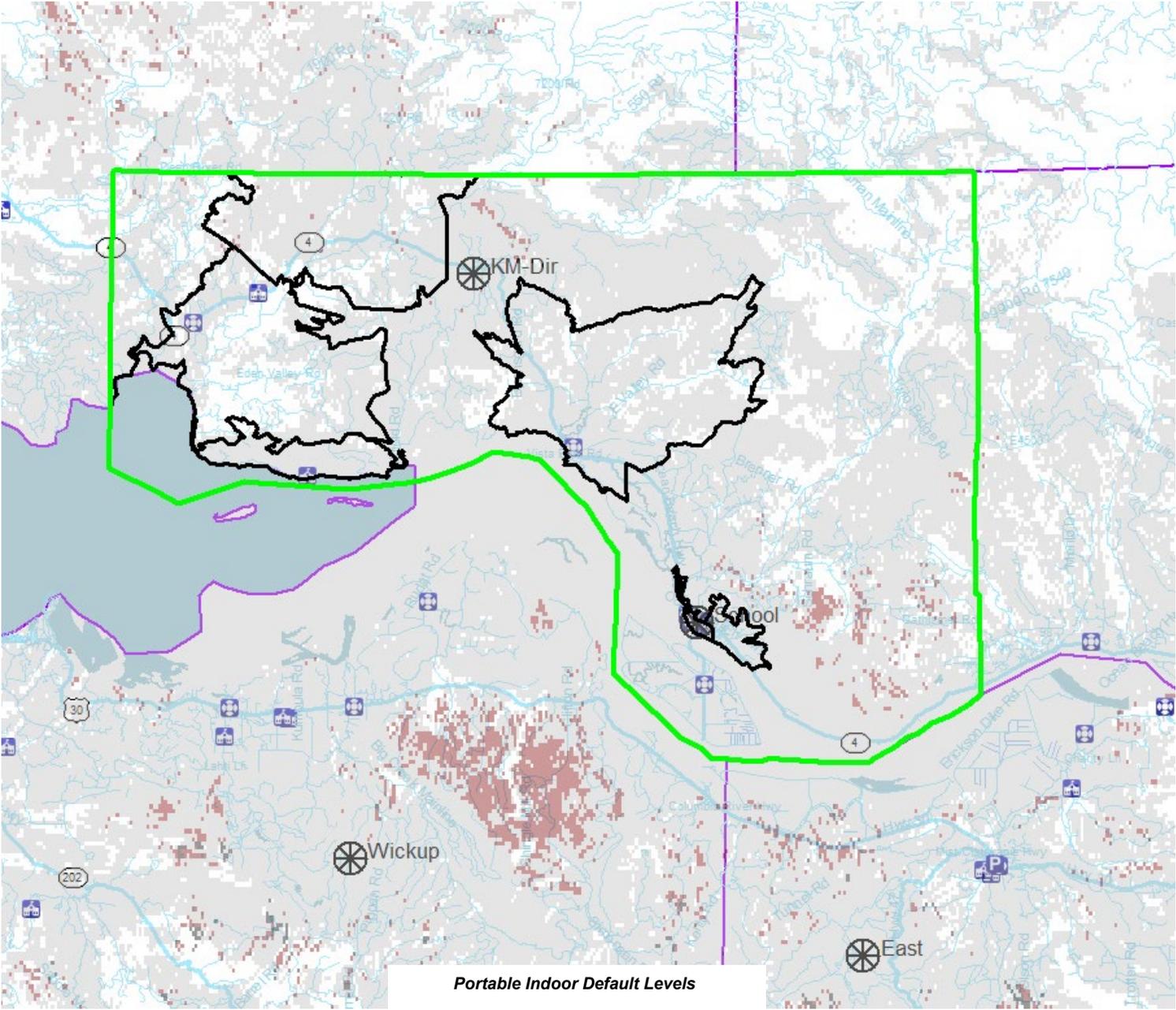
Portable Talk Out - Indoors BAPC is >95% for the Cathlamet and East Cathlamet, 90% for Altoona CDP, 80% for Gray's River CDP and Skamokawa Valley CDP, 75% for the County, 60% for Deep River CDP and 55% for Rosburg CDP

The following maps show coverage for the f system based on combiner signal levels as outlined in the legend shown 0dB to -85dB light green, -85.1dB to -95dB dark green, -95.1dB to -107dB light gray and >-107 white.

Mobile Talkout

	< 0 dBm
	< -85 dBm
	< -95 dBm
	< -107 dBm

Portable Talkout - Street

![green]	< 0 dBm
![darkgreen]	< -85 dBm
![gray]	< -95 dBm
![white]	< -107 dBm
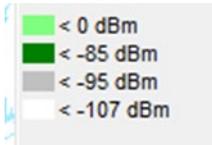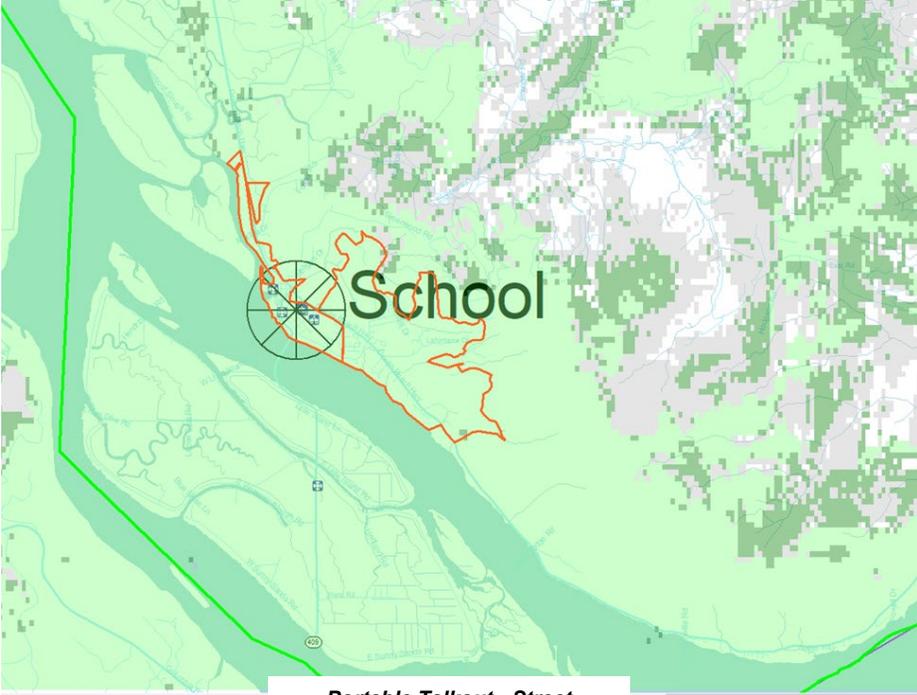
Portable Talkout - Street

Portable Indoor Default Levels

Overview of the Tait TB9400 ASIP Solution

TB9400 base stations have built voting capabilities and an Ethernet interface, so extra modules such as voting comparators and digital interfacing equipment are not required. They are interconnected over an IP-based linking infrastructure that is part of the County's new linking system being proposed as art of the RFP.

The TaitNet network is managed using a standard web browser to access a TB9400 station. The browser can connect to any Tait network element from anywhere in the network or beyond. It can remotely monitor and configure the connected network element. It can also carry out diagnostic tests and upgrade firmware. The L3H ENM network monitor included in PC1 will provide as an alarm center, receiving alarms and call records from any network element, displaying them, and storing them in the logs.

TaitNet networks comply with the APCO P25 set of standards. This means, for example, that they support dual mode (digital P25 and analog FM) operation and the use of P25-compliant mobiles and portables from other manufacturers.

Network Signal Paths

The base stations receive calls from SUs. In digital P25 mode, these communications are in the IMBE format, with forward error correction added. The base stations correct any errors and remove the forward error correction bits. They put the result on the network as 'voice over IP' using RTP (the Internet real-time protocol). Routers or switches pass the RTP packets to the router, and then over the bearer network to other network elements.

Analog FM calls can also be networked and sent using RTP. The received voice is put into the G.711 digital format and sent out using RTP. G.711 that uses more bandwidth than IMBE for each channel.

In addition to this voice traffic, the linking infrastructure carries alarm messages (SMTP) and management communications with the stations and between them. Alarms and other status indications can be sent to a network monitor.

Dual Mode

The TaitNet network supports dual-mode operation. TB9400s can receive and transmit in digital P25 and in analog FM mode and the network can carry speech for both modes. If a TB94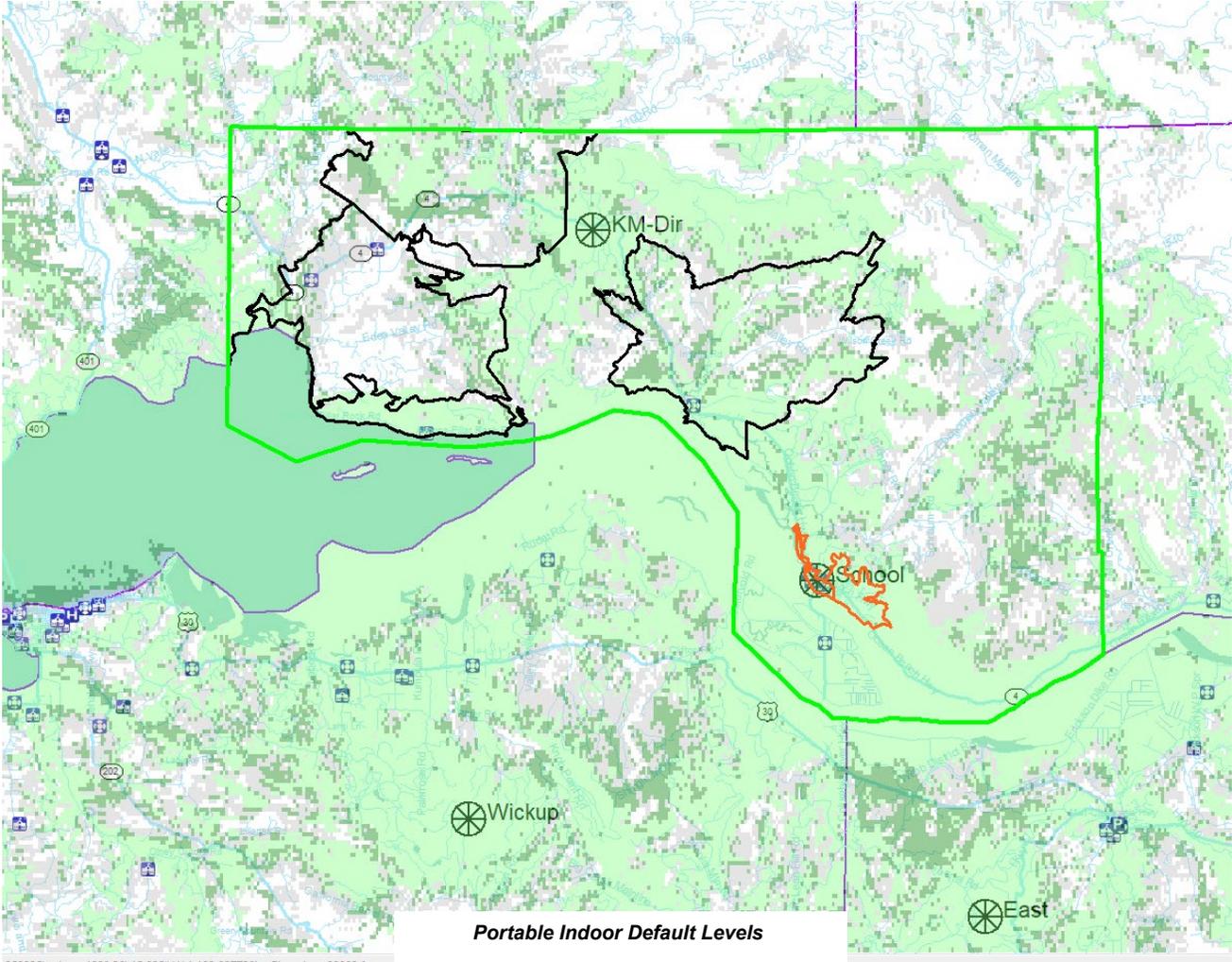00 receiver's RF interface is configured for dual mode, it listens for digital P25 signals. If it detects them, it switches to digital P25 mode, otherwise it receives in analog FM mode. When a dispatcher initiates a call, the TB9400 transmits in the default mode for the channel, unless the console selects a different calling profile. Base stations operating in dual mode operate to their full specification, even if the analog FM mode is wide-band. An additional filter in the digital front end means that the receiver can listen for analog FM with a wide-band setting and for digital P25 using a narrow-band filter. Sensitivity and selectivity for digital P25 signals are largely unaffected by dual-mode operation.

Encryption

All TaitNet P25 networks support end-to-end encryption between radios. No additional network licenses or configuration settings are required. The network simply passes on the encrypted data or voice.

Simulcast

Simulcast is the simultaneous broadcast of the same signal from several base stations, all of which transmit on the same frequency.

Simulcast brings the following benefits to conventional operation:
- Economical in use of frequencies. The transmitters in a simulcast area all use the same frequency.
- Seamless roving. Users do not need to manually switch channels as they move out of the coverage area of one base station and into another. The SU always receives and transmits on the same frequency. Uplink voting handles the handover from one coverage area to another. Downlink voting is not needed or used.
- All-informed coverage over a very wide area.

Simulcast systems can improve signal quality because the combined signal from several transmitters is stronger. However, there can also be a degradation in signal quality in some parts of the area of overlapping coverage, but this is minimized using a modulation scheme designed for simulcast (such as LSM), by tight control of the carrier frequency and the deviation accuracy, and by careful site planning and managing overlap areas.

Simulcast requires exact timing of transmissions. This timing is provided to each transmitter by a 1PPS pulse from a GPS-disciplined timing reference.

Channel Group Overview

TB9400 base stations are designed to work together as channel groups. A channel group is a single logical channel that provides a distributed RF receive and transmit function. Often, a channel group has one member at each site in the network, so that it can provide coverage over the full network coverage area.

The members of a channel group communicate with each other using an IP-based proprietary Tait protocol. If desired, the channel group can have a voting function enabled by software. This voting provides the best available RF signal for repeating and providing external interfaces.

A channel group member can provide a gateway function, offering an analog line interface, a trunking (TCCP) or a digital dispatcher (DFSI) interface to an external device. This member is referred to as the channel group master, as it exerts control over the channel group, based on commands it receives from the external device.

Channel Group Size

Channel groups normally have up to 14 members. This number can be extended to 30, for example to provide coverage over remote areas with low traffic density or to add receive-only sites to improve uplink coverage. The linking infrastructure must be able to handle the additional bandwidth requirements. A system design with multiple hops can significantly increase call setup time. The central voter can handle up to 14 simultaneous incoming voice streams. If this number is exceeded, for example when a radio is transmitting from a helicopter or a high-powered mobile is at the top of a mountain, voice dropouts can result.

Channel Group Reliability

Channel groups may cease operating as expected due to:
- base station failure (while the channel group re-converges)
- base station going offline or online.
- base station configuration change
- base station alarm activating.

As a distributed collection of base stations, a channel group must 'settle' during events before all the base stations can be coordinated. For this reason, the channel group is not reliable during the following events. These can cause the audio to be not guaranteed for periods of around 5 to 10 seconds.
- At start-up of the channel group as all the base stations are powered up
- Following a change of configuration
- When the central voter has disappeared from the channel group and the backup central voter has become the active central voter.
- When the original central voter has been restored to the channel group and is regaining the role of active central voter

Voting

The channel group itself can continually vote at packet level on the voice streams it receives from its RF interfaces. This enables it to repeat the best possible received signal and to provide that signal to the channel group's interfaces. In effect, voting blends or combines multiple voice streams, always picking the best packet out of those on offer. Voting is centralized at one channel group member, the central voter. This should be positioned centrally, to reduce the maximum network delay for voice streams, which must travel from a receiver to the central voter and then out to all members with transmitters.

Using the DFSI, digital dispatch equipment can override the channel group's normal voting operation. It can select the voice stream from any channel group member or disable any member so that it does not participate in voting.

All voice streams are sent to the central voter. P25 voice streams originating at an RF interface are voted on every voice codeword (20ms), resulting in a high-quality voice stream. Analog FM voice streams are voted 5 times per second. Voice streams that didn't originate at an RF interface also pass through the central voter's switch.

A skew (differences in the arrival time of different streams from the same caller) of up to 100ms can be compensated for in digital P25 mode but not in analog FM.
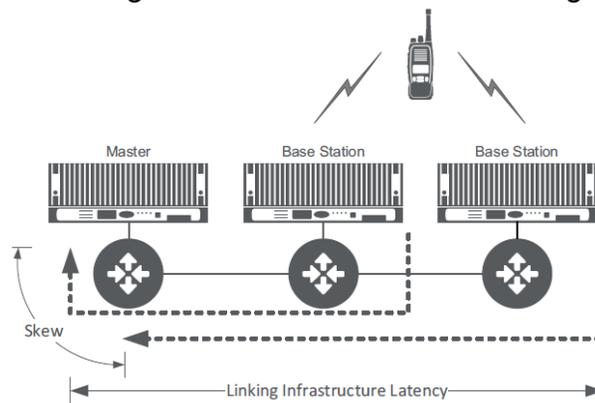
To avoid having a single point of failure, a second channel group member can be configured for central voting. It will take over as the central voter if the first member fails (this can take up to 30 seconds). When more than one member is configured as a central voter, the member with the lower receiver number becomes the central voter. The other member operates as a satellite voter.   RACOM has proposed two voters for each channel being proposed.

The central voter gives optimal results if the longest network delay from a member to the central voter is <40ms and reasonable results if the longest delay is <80ms.

The following criteria determine the outcome of central voting:
- If the streams have the same type, the stream with the best signal quality wins the vote. For analog FM signals, the impairment is used. This is the inverse of signal quality, and its value is included in voice streams. The impairment varies between 0 (best signal quality) and 15 (worst signal quality). The voting of digital P25 streams uses the number of corrected errors instead of impairment.
- If the streams have the same signal quality, the stream at the member with the lowest receiver number wins the vote. However, if the central voter's own stream has no errors, it will be used.

Transmit Timing

When there are multiple transmitters in a channel group, they need to begin transmitting a call together. 'Together' may not mean at the exact same time, but within an appropriate timing window. The size of this timing window varies with the system design.
- If the transmitters use different frequencies, transmit timing needs to ensure that one transmitter does not transmit so much later than the other that it interferes with natural conversation. Network designers should aim for a timing window of around 100ms.
- If the channel group has downlink voting, the transmit timing window needs to be small enough so that when SUs start scanning and voting, all members are transmitting. Network designers should aim for a timing window of a few milliseconds.

- If the channel group is simulcast, transmit timing needs to be exact, so that in areas of overlapping coverage, the signal arrives simultaneously from the transmitters involved. Members have a 1PPS timing pulse that enables timing with microsecond precision. The central voter automatically adjusts the marshalling duration to compensate for network delay and jitter. System installers can adjust the launch time in microsecond increments, to shift the area within which the signal arrives simultaneously.

Transmit timing is adjusted by means of voter configuration parameters. These parameters configure the preamble duration and compensate for network delay and jitter. Channel groups use different parameters, depending on whether they are synchronized or not.

Function of the Transmit Buffer

Each base station has a transmit buffer. This buffer plays an essential role in transmit timing. After the voice stream has begun arriving at a base station and before it's time to start transmitting the call, the transmit buffer stores the arriving packets, later providing them to the transmitter as needed. In this way, it is able to compensate for differences in network delays between members of the channel group so that they transmit together.

The transmit buffer has two other functions: compensating for jitter and storing arriving packets while a call preamble is transmitted. In unsynchronized channel groups, the size of the transmit buffer at the beginning of the call is determined by the configured duration of the preamble.

Jitter is the variation in packet arrival time. If packets arrive late, the transmit buffer provides stored packets to the transmitter. It empties until the packets arrive. The larger the jitter, the bigger the jitter buffer needs to be, and the greater the call delay, because more packets need to be stored in the buffer before the call can begin. If the jitter is so large that the buffer runs out of packets, a buffer underflow occurs. The transmitter fills the gap with packets that encode silence. If several silence packets are needed to fill a gap, users notice the glitch.

Jitter has various sources. The network element providing the voice stream produces a jitter of about 10ms. This is the delay variation in clocking out packets onto the Ethernet interface. Switches and routers also contribute to jitter. If there are packets in a queue, the switch or router takes longer to pass a packet through.

The preamble in many networks, transmitters need to preface calls with a preamble. While the transmit buffer is filling, the transmitter transmits a preamble. If there is downlink voting, SUs can scan and vote during the preamble, acquiring a channel before the call begins. Even in networks without voting, a preamble can help SUs to synchronize to the transmission more easily.

In unsynchronized channel groups, the duration of the preamble is determined by the Preamble parameter.

In simulcast networks, a preamble is only required if there are multiple simulcast channels and SUs need to vote between them. If the marshalling time is self-regulating, the duration of the preamble is determined by the Buffer min setting. The regulation process ensures that the base station furthest from the central voter uses a preamble that is about the duration of the Buffer min setting. Other base stations receive the voice stream earlier, start transmitting preamble earlier, and therefore have a longer preamble.
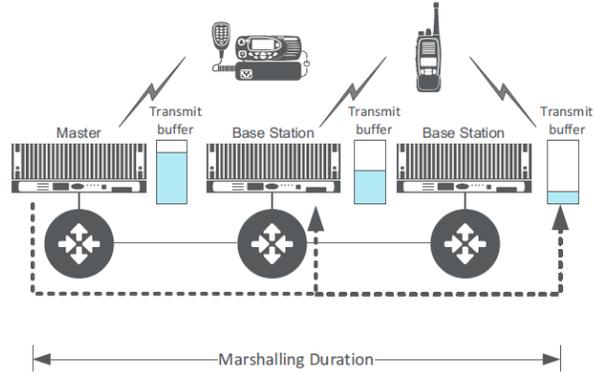
Transmit Timing in Simulcast Channel Groups

Simulcast channel groups are always voted. They are synchronized, which means that transmit timing is under the control of the central voter.

Configuration parameters (other than the local transmit offset) at other members have no effect. All voice streams pass through the central voter and are time-stamped. Members receive these time-stamped voice streams and transmit at the time indicated by the time-stamp. (They can delay transmission by a configurable local transmit offset of a few microseconds.) The time on the timestamp includes an allowance that gives the voice stream time to reach the furthest member and fill its transmit buffer to an adequate level. This allowance is referred to as the marshalling duration.

Normally, the central voter regulates the marshalling duration based on feedback it receives from members. If the size of a member's transmit buffer falls below the configured Buffer min value, the central voter increases the marshalling duration. If the smallest transmit buffer is greater than this value, the central voter reduces the marshalling duration. In this way, the central voter automatically regulates the marshalling duration around the configured minimum buffer size.
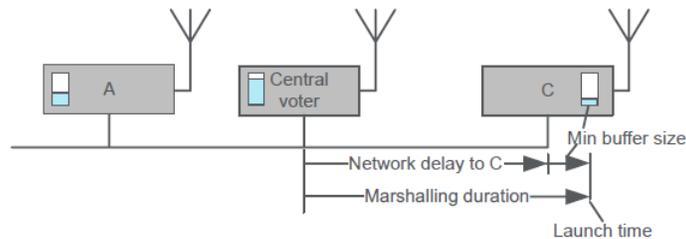
Alternatively, the central voter can be configured with a fixed marshalling duration, overriding the automatic regulation.

Under fault conditions, synchronization can be lost. If the transmitter is configured to transmit when unsynchronized, it does not apply any transmit timing but simply begins

transmitting when it receives the voice stream. When synchronization is restored, the transmitter flushes its buffer and transmits based on the timestamp. This causes a glitch.

Dispatcher Control of Channel Group

Channel control messaging is handled by the channel group coordinator in each channel group member. When a member with a DFSI has a channel control command, the coordinator acknowledges the command and multicasts it to the channel group. The coordinator also resolves any contention (for example if there is more than one dispatcher connected to the channel group) and ensures that members maintain a consistent state. The coordinators can handle members entering or leaving the channel group because of power failure, channel change, or other uncontrolled activities.

When a dispatch console is connected to a channel group, the dispatch commands to change channel, enable/disable RF repeat, or enable/disable monitor need to be carried out by each member of that channel group. As they are only received by a base station with an analog line or DFSI, there needs to be a process that passes on these commands to the other channel group members. This enables the dispatcher to exert control over the channel as a whole. This process is carried out by the channel group coordinator.

The channel control coordinator is a software process inside the channel module of each channel group member. The channel control coordinators work together to implement channel control commands and to ensure that the states of all members are consistent. If collective channel control is enabled, a channel control coordinator sends any commands it receives to other members.

Network Design

This chapter presents general considerations regarding bandwidth and QoS, provides generic information about IP address planning, port configurations, and central authentication. The IP network of a conventional network can be very complex beyond older four wire analog circuits. In addition, simulcast systems add an additional layer of design consideration that needs to be taken into consideration during the design phase to minimize issues during and after deployment.

General Bandwidth Considerations

Quality of Service

Quality of Service (QoS0 is the ability of the network to transport data packets with low loss, low delay, low variation in delay while preserving packet sequencing. Good simulcast operation requires good network QoS.

To achieve good voice performance, you should configure the network switching fabric for strict priority queuing for real time traffic (service class EF). Base stations in a channel group offer facilities for checking the quality of transmission because of network QoS.

Facility	Description	Advantages	Disadvantages
QoS support	Prioritize the real-time (voice) stream ahead of other traffic	Minimal additional delay when other traffic is present	Requires routers
Switches	Use a VLAN without routers. No other traffic shaping required.	Network is simple and predictable Delays are minimized	Cannot use QoS and so must over-provision to accommodate non-voice traffic

Bandwidth Requirements

Bandwidth requirements vary because the network is host to a range of traffic:
- voice
- control packets for channel groups
- maintenance traffic for SNMP, Syslog, web interface.

SNMP

In particular, the bandwidth required for SNMP traffic among base stations and console gateways is made variable by:
- the number of devices
- the polling period
- the number of monitoring parameters per device
- the period of traps.

Standard Requirements

For a single link (counting all network 'hops') between the base station and another element the standard requirements are:

Parameter	Recommended	Required
Out of order packets	Less than 0.01%	
Packet Loss	Less than 0.01%	
Delay	Less than 40 ms	150 ms max
Jitter	Less than 20 ms	100 ms max
Skew[d]		80 ms max
Minimum bandwidth to carry C+U[1] traffic	108 kb/s per physical channel	50 kb/s per physical channel
Minimum bandwidth to carry M[2] traffic		100 kb/s per site
Minimum bandwidth to meet recommended jitter limits on non-fragmenting link (see non-fragmenting linking and bandwidth below)	600 kb/s per site up to 5 physical channels	

1. C traffic - Control plane traffic such as call signaling, trunked registration, and mode changes. U traffic - User plane traffic, such as voice or packet data from or to subscriber equipment (e.g. portables, mobiles, dispatchers, PSTN, and data terminals).
2. M traffic - Management plane traffic for monitoring and configuration. Includes the aggregation of SNMP, HTTPS, Syslog, firmware downloads, backup/restore, etc.

Notes:
- Parameters within the recommended limit should result in good audio performance.
- Parameters within the required limit should result in correct base station operation.
- C traffic—control plane traffic such as call signaling and mode changes.
- U traffic—user plane traffic, such as voice, from or to subscriber equipment (e.g. portables, mobiles, dispatchers, PSTN, and data terminals).
- M traffic—management plane traffic for monitoring and configuration. Includes the aggregation of SNMP, HTTPS, Syslog, firmware downloads, backup/restore, etc.
- Skew is the allowed differential delay between voter inputs from a satellite close to the central voter and a satellite further away (in term of IP latency) that ensures the input will be voted.
- The channel group master sends voice packets to the other base transceivers in the channel group using multicast. Accordingly, networks, whether simulcast or non-simulcast, must have their linking equipment set up to support IP multicast.
- TN-2532a has advice on network setup and diagnosis of QoS issues.

A few of the possible effects of not meeting the timing requirements are listed below:
- For all systems, increasing network latency causes a direct increase in call setup delay or voice end-to-end delay.
- If the jitter exceeds the specification, the system may not be operational.
- Voice communications can tolerate some loss/late packets.

The table below lists the various packet types carried on Tait networks, together with their recommended DSCP classification, based on their criticality for the network.

Service Class	Packet Type	Protocol/Port Number	DSCP
Expedited Forwarding (EF)	RTP	UDP 9050 [TBC]	46 (EF)
	RTP (channel group)	UDP 27260 UDP 27261	46 (EF)
	Base station/console gateway	UDP 9017 [TBC]	46 (EF)
	NTP	TCP/UDP 123	46 (EF), preferably
Assured Forwarding (AF)	ICMP (echo/ping)	ICMP	26 (AF31)
Best Effort	Web Interface (http/https)	TCP 80/443	0
	Domain Name Server (DNS)	TCP 53	0
	Secure shell (ssh)	TCP 22	0
	Syslog	UDP 514	0
	SNMP	UDP 161/162	0

IP Protocols and Ports

A variety of IP-based protocols are used between network elements. In some situations, firewalls must be configured to allow this traffic to pass across the IP bearer network.

All wide-area communications are unicast IP, and the IP backhaul should not pass the traffic to this unicast IP on to the rest of the network.

The following table lists the default values of ports used for normal communications on the base station only.

Type	Usage	Ports/Protocols
Core Interfaces		
■ DFSI	Communications between console and base station	UDP 7000-7002
■ Console Gateway	Communication between the console gateway and master base station	50,000 UDP and 50,001 UDP
■ NTP	time-stamping for logs and simulcast operation	TCP and UDP 123
Management interfaces		
■ Web interface (https)	Management PC to base stations, NMS, switches and routers	TCP 443
■ Secure shell (ssh)	Base stations, switches and routers to NMS	TCP 22
■ Syslog	Base stations, switches and routers to NMS	UDP 514
■ Simple network management protocol (SNMP)	Base stations, switches and routers to NMS	UDP 161/162 (10161 for SNMP v3)
■ ICMP	NMS and management PC to base stations, switches and routers	ICMP
■ RDP	SNMP Manager Remote Desktop. (Not required but preferred for VPN access if EnableMonitor is deployed.)	TCP 3389

Avoiding Multicast Port Number Conflicts

The channel group protocol allows base stations when operating in a voted channel to communicate their presence and status and agree on which base station is the channel group master. The channel group protocol operates among base stations in one channel group providing one voted channel.

Multicast IP addresses and port numbers do not behave in quite the same way as unicast. It is important to avoid aliases between port numbers with multicast operation. The following rule should help you avoid problems. This advice assumes a switched network without special time-to-live rules: Give all channel groups in the network a distinct channel group

IP multicast address. Channel groups that have distinct multicast addresses can use the same port number for channel group operation.

Central Authentication

IT security is essential for police, utility and public safety organizations. Human lives may depend on their ability to block unauthorized access to data and communications. IT security is a standard government requirement for such organizations. AAA stands for:

- Authentication: confirming that a user is who they claim to be.
- Authorization: centralized control over all authentications on a system.
- Accounting: providing an audit trail.

The AAA security feature provides:

- Centralized control over all who use an IT network.
- The ability to grant access to a network and define the level of access.
- The ability to change or terminate the level of access of a specific user.
- A record of all attempts to access the network.

It was designed to comply with NERC CIP-004-3a (Personnel and Training) requirement 4.2, which requires the ability to revoke access to a network within 24 hours.

The existing LDAP system can also be used to manage passwords with the TaitNet System.

Network Time Protocol

Network Time Protocol (NTP) is a software algorithm that keeps computers and other technologies synchronized to within milliseconds of each other. Time synchronization is essential for networks, especially those that conduct time sensitive transactions. Time-stamps are used by computers to identify when a transaction has taken place or needs to take place. Different time measurements across a network can cause a range of problems, from transactions not occurring to data being lost. Simulcast and voted channel operation require an accurate source of NTP.

Because of the importance of synchronization, a time server system is required, first, to keep all devices on a network running at the same time, and second, to ensure that the different computer networks which speak to each other are also synchronized. This is where NTP comes in. But NTP only works if it has a reliable form of time with which to use as a master time source.

Microwave System

Backhaul

Aviat has the trusted, reliable solutions required for the critical applications to support Wahkiakum County today and in the future. With over 2 billion in-service operating hours, Aviat's high-performance, mission-critical microwave radios are proven dependable for applications that just need to work.

RACOM is pleased to provide the County with the following microwave design as the backhaul solution for their mission-critical needs.

System Description

Microwave Network

The proposed system involves adding four new links between the following sites: School/KM, School/PSAP, KM/East and KM/Wickup. The microwave radio platform being provided is an Aviat's Eclipse Radio with IRU600v4 indoor mounted radios. The new Aviat ProVision Network Management System will be used to support four (4) new Eclipse IRU600v4 radio hops:

- 4 links of Standard Power (SP) 11GHz Non-Protect (NP)

Network Diagram

Figure 1 to the right shows the backhaul network for the County consists of four (4) links operating at the 11GHz frequency bands and the existing fiber connection. Each hop operates with an indoor Aviat IRU600v4 unit. The configuration for ring hops is non-protected (NP) because and will use the existing fiber connection with KM to help create a link within that group of sites. The channel bandwidth of the links operating within the ring and the spur will be 40MHz or greater. All links will operate with fixed 128QAM modulation with the ability to add the Adaptive Code Modulation (ACM) feature if needed. Table 1 shows the air link capacity for various modulation rates assuming a 40 MHz channel bandwidth.
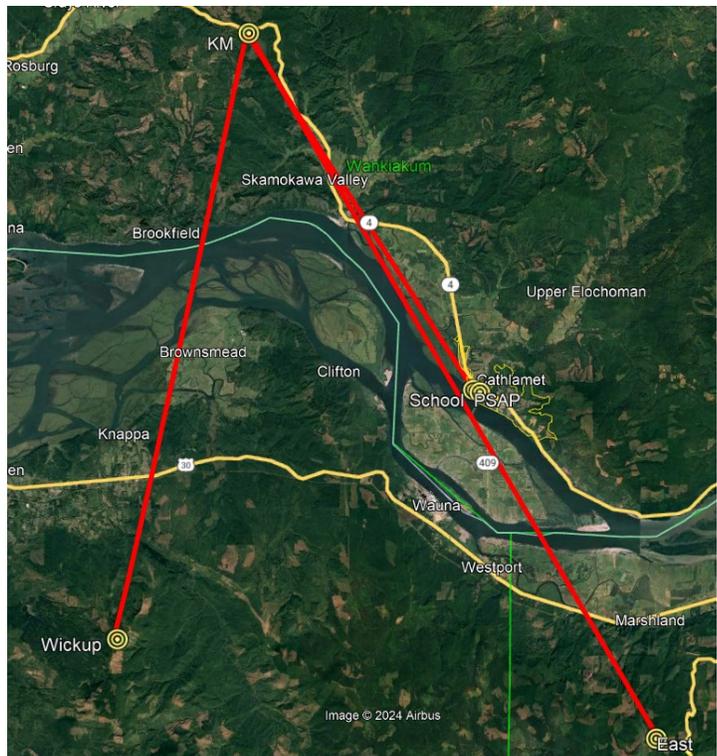
Figure 1: Network Topology Diagram

Modulation Steps	Air Link Capacity for 40 MHz Channel (Mbps)
256QAM	237
128QAM*	207
64QAM	178
32QAM	146
16QAM	121
QPSK	25

Table 1: Air Link Capacity for Various Modulation Steps
Note * will be the modulation initially configured for the links radios.

Aviat Eclipse Equipment Details

Eclipse Packet Node INUe

The INUe shown in Figure 2 replaces the traditional terminal or single link-based approach to networking with a nodal solution, supporting up to six links in a nodal configuration. Radio paths and customer interfaces are customized by plug-in cards, now supported by two switched planes: packet and circuit. Each Site will have one INUe Node.

Figure 2: Aviat INUe

Each Eclipse Packet Node INUe shelves will be equipped with the following plug-in units:
- Node Controller Card (NCC)
- Node Protection Card (NPC)
- Radio Access Cards (RAC70)
- Gigabit Ethernet Data Access Cards for 10/100/1000 MBs Ethernet traffic (DAC GEV3)
- Auxiliary Cards (AUX) for third party alarm connections

The NCC will provide node management and control, primary DC power, and interfaces for Portal and NMS. A removable Compact Flash card holds configuration data and software License. The NPC provides redundancy protection for the INUe controller and DC power supply.

RAC 70

The RAC70 (Radio Access Card) modem shown in Figure 3 can be software configured to support ANSI channels from 3.75 to 80MHz, supports a modulation range of QPSK to 4096QAM (with and without Adaptive Coding and Modulation (ACM)), and can be paired to support hot-standby and diversity configurations. The ACM software option will not be included for the project but can be added at a future time if needed.

Figure 3: RAC70 Modem

DAC GE3 Card

The DAC GEv3 shown in Figure 4 provides a Gigabit Ethernet interface and advanced packet processing for the Eclipse platform. It includes a 5 Gbit/s Packet Plane that inter-operates with INUe backplane that supports hybrid mixed-mode TDM+IP or all-IP transport.

The DAC GE delivers Quality of Service (QoS) controls and performance monitoring internal link aggregation (IEEE 802.3ad), Rapid Spanning Tree Protocol (IEEE 802.1w), and VLAN support.

Each DAC GE3 has the following ports enable:
- Three RJ-45 10/100/1000Base-T ports

Each looped Sites INUe shelf will be equipped with two DAC GE3 cards, one facing east and another facing west at each location on the ring hops configured in protected mode. Spur Sites will have one DAC GE3 card.

Figure 4: DAC GE3 Card

AUX Card

The Eclipse AUX card shown in Figure 5 provides synchronous RS-422 and/or asynchronous RS-232 auxiliary data service channels and alarm input/output functions. It can support physical Alarm I/O for up to six (6) alarm inputs or up to four (4) Form C relay outputs and two (2) alarm inputs.

Each Sites INUe will include 1 AUX card to support the requirement for alarms inputs and outputs of the Microwave system.

Figure 5: AUX Card

ECLIPSE'S IRU600V4 RADIOS

The IRU600 shown in Figure 6 is available in three power output levels: Standard Power (SP), High Power (HP), and Extra High Power (EHP). The IRU600 radios will be mounted in the racks with Aviat's INUe.

Figure 6: Eclipse IRU600V4 Radios

Draft Path Studies

Final configuration will be mutually agreed to after site surveys and path studies can be completed during the Detail Design.

KM to East
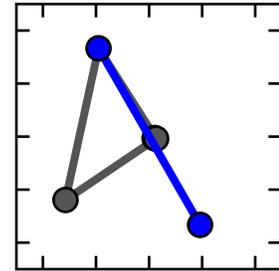
4ft Single Pol (NA & CALA Only) N110082D100 - Remote @ 80 ft (Shared)

2ft Single Pol (Global) N110082D072 - Remote @ 90 ft (Shared)

Performance to KM (Primary)				
	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
Mean IP	332.55 Mbps	311.90 Mbps	311.90 Mbps	264.84 Mbps
IP Availability	99.9991 % for 10.0 Mbps	99.9986 % for 10.0 Mbps	99.9986 % for 10.0 Mbps	99.9977 % for 10.0 Mbps

Performance to East (Primary)				
	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
Mean IP	332.55 Mbps	311.90 Mbps	311.90 Mbps	264.84 Mbps
IP Availability	99.9991 % for 10.0 Mbps	99.9986 % for 10.0 Mbps	99.9986 % for 10.0 Mbps	99.9977 % for 10.0 Mbps

Link Summary				
	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
Link Length	22.089 mi.	22.089 mi.	22.089 mi.	22.089 mi.

Performance Charts (Primary to Primary)
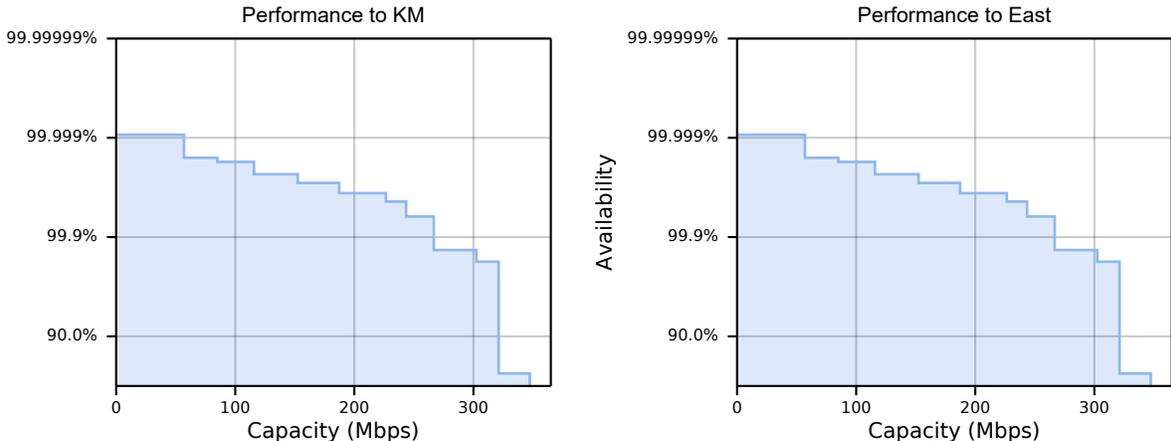
Performance to KM

Performance to East

Climatic Factors, Losses and Standards				
	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
dN/dH not exceeded for 1% of time	-174.37 N units/km	-174.37 N units/km	-174.37 N units/km	-174.37 N units/km
Area roughness 110x110km	187.15 metre	187.15 metre	187.15 metre	187.15 metre
Geoclimatic factor	1.04e-05	1.04e-05	1.04e-05	1.04e-05
Fade Occurrence Factor (P0)	6.41e-03	6.41e-03	6.41e-03	6.41e-03
Path inclination	10.39 mr	10.39 mr	10.39 mr	10.39 mr
Value of K Exceeded for 99.99% (ke)	0.73	0.73	0.73	0.73
Excess Path Loss at ke	0.00 dB	0.00 dB	0.00 dB	0.00 dB
0.01% Rain rate	35.45 mm/hr	35.45 mm/hr	35.45 mm/hr	35.45 mm/hr
Rain Attenuation	1.14 dB/km	1.14 dB/km	1.14 dB/km	1.14 dB/km
Free Space Path Loss	144.45 dB	144.45 dB	144.45 dB	144.45 dB
Gaseous Absorption Loss	0.47 dB	0.47 dB	0.47 dB	0.47 dB
Profile Type	Line-of-Sight	Line-of-Sight	Line-of-Sight	Line-of-Sight
Excess Path Loss	0.00 dB	0.00 dB	0.00 dB	0.00 dB
Annual 2-way Availability	100.0000 %	99.9999 %	99.9999 %	99.9998 %
Annual 2-way Unavailability	10 secs/year	28 secs/year	28 secs/year	1.2 mins/year
Rain Availability	99.9991 %	99.9986 %	99.9986 %	99.9977 %
Rain Unavailability	4.6 mins/year	7.4 mins/year	7.4 mins/year	12.2 mins/year

Climatic Factors, Losses and Standards (continued)				
	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
Atmospheric Gasses	ITU-R P.676-12, ITU-R P.835-6	ITU-R P.676-12, ITU-R P.835-6	ITU-R P.676-12, ITU-R P.835-6	ITU-R P.676-12, ITU-R P.835-6
Diffraction Loss	ITU-R P.526-15	ITU-R P.526-15	ITU-R P.526-15	ITU-R P.526-15
Propagation	ITU-R P.530-17	ITU-R P.530-17	ITU-R P.530-17	ITU-R P.530-17
Rain Rate	ITU-R P.837-7	ITU-R P.837-7	ITU-R P.837-7	ITU-R P.837-7
Refractivity Index	ITU-R P.453-14	ITU-R P.453-14	ITU-R P.453-14	ITU-R P.453-14

KM to Wickup
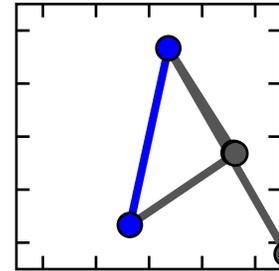
2ft Single Pol (Global) N110082D072 - Remote @ 100 ft (Shared)   2ft Single Pol (Global) N110082D072 - Remote @ 100 ft (Shared)


Performance to KM (Primary)				
	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
Mean IP	239.17 Mbps	217.62 Mbps	217.62 Mbps	197.42 Mbps
IP Availability	99.9993 % for 10.0 Mbps	99.9988 % for 10.0 Mbps	99.9988 % for 10.0 Mbps	99.9979 % for 10.0 Mbps

Performance to Wickup (Primary)				
	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
Mean IP	239.17 Mbps	217.62 Mbps	217.62 Mbps	197.42 Mbps
IP Availability	99.9993 % for 10.0 Mbps	99.9988 % for 10.0 Mbps	99.9988 % for 10.0 Mbps	99.9979 % for 10.0 Mbps

Link Summary				
	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
Link Length	16.833 mi.	16.833 mi.	16.833 mi.	16.833 mi.

Performance Charts (Primary to Primary)
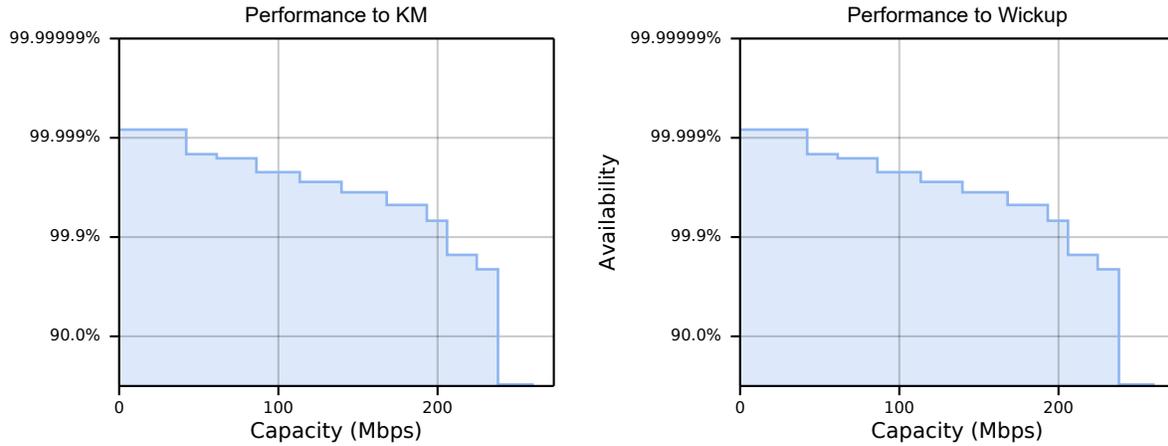
Performance to KM

Performance to Wickup

Climatic Factors, Losses and Standards				
	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
dN/dH not exceeded for 1% of time	-164.78 N units/km	-164.78 N units/km	-164.78 N units/km	-164.78 N units/km
Area roughness 110x110km	174.76 metre	174.76 metre	174.76 metre	174.76 metre
Geoclimatic factor	1.01e-05	1.01e-05	1.01e-05	1.01e-05
Fade Occurrence Factor (P0)	1.33e-03	1.33e-03	1.33e-03	1.33e-03
Path inclination	19.55 mr	19.55 mr	19.55 mr	19.55 mr
Value of K Exceeded for 99.99% (ke)	0.66	0.66	0.66	0.66
Excess Path Loss at ke	0.00 dB	0.00 dB	0.00 dB	0.00 dB
0.01% Rain rate	36.96 mm/hr	36.96 mm/hr	36.96 mm/hr	36.96 mm/hr
Rain Attenuation	1.20 dB/km	1.20 dB/km	1.20 dB/km	1.20 dB/km
Free Space Path Loss	142.09 dB	142.09 dB	142.09 dB	142.09 dB
Gaseous Absorption Loss	0.35 dB	0.35 dB	0.35 dB	0.35 dB
Profile Type	Line-of-Sight	Line-of-Sight	Line-of-Sight	Line-of-Sight
Excess Path Loss	0.00 dB	0.00 dB	0.00 dB	0.00 dB
Annual 2-way Availability	100.0000 %	100.0000 %	100.0000 %	99.9999 %
Annual 2-way Unavailability	2 secs/year	7 secs/year	7 secs/year	19 secs/year
Rain Availability	99.9993 %	99.9988 %	99.9988 %	99.9979 %
Rain Unavailability	3.6 mins/year	6.2 mins/year	6.2 mins/year	10.9 mins/year

Climatic Factors, Losses and Standards (continued)				
	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
Atmospheric Gasses	ITU-R P.676-12, ITU-R P.835-6	ITU-R P.676-12, ITU-R P.835-6	ITU-R P.676-12, ITU-R P.835-6	ITU-R P.676-12, ITU-R P.835-6
Diffraction Loss	ITU-R P.526-15	ITU-R P.526-15	ITU-R P.526-15	ITU-R P.526-15
Propagation	ITU-R P.530-17	ITU-R P.530-17	ITU-R P.530-17	ITU-R P.530-17
Rain Rate	ITU-R P.837-7	ITU-R P.837-7	ITU-R P.837-7	ITU-R P.837-7
Refractivity Index	ITU-R P.453-14	ITU-R P.453-14	ITU-R P.453-14	ITU-R P.453-14

School to KM

2ft Single Pol (Global) N110082D072 -
Remote @ 80 ft (Shared)

2ft Single Pol (Global) N110082D072 -
Remote @ 80 ft (Shared)
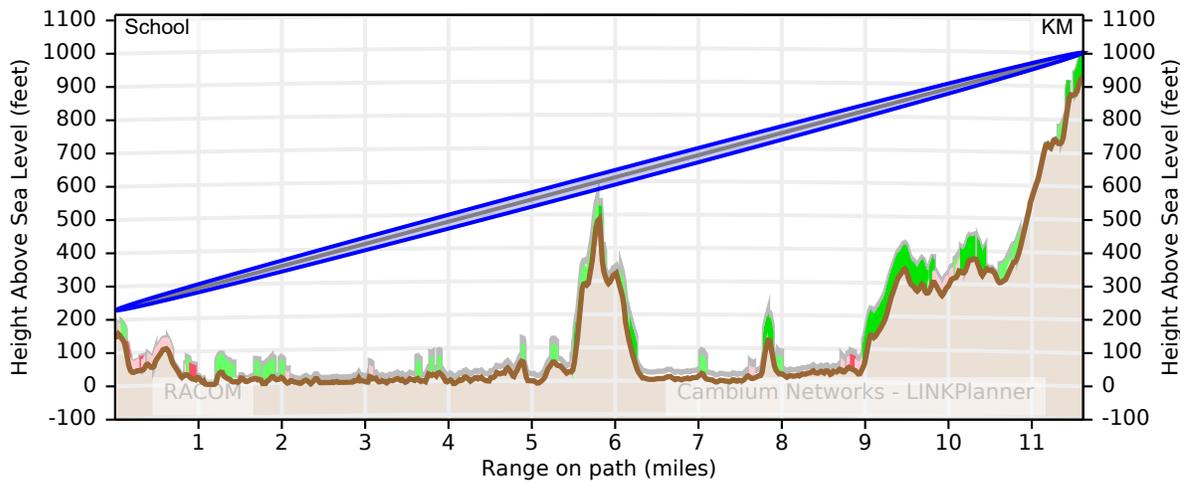
Performance to School (Primary)				
	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
Mean IP	257.28 Mbps	237.42 Mbps	237.42 Mbps	207.87 Mbps
IP Availability	99.9999 % for 10.0 Mbps	99.9998 % for 10.0 Mbps	99.9998 % for 10.0 Mbps	99.9995 % for 10.0 Mbps

Performance to KM (Primary)				
	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
Mean IP	257.28 Mbps	237.42 Mbps	237.42 Mbps	207.87 Mbps
IP Availability	99.9999 % for 10.0 Mbps	99.9998 % for 10.0 Mbps	99.9998 % for 10.0 Mbps	99.9995 % for 10.0 Mbps

Link Summary				
	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
Link Length	11.616 mi.	11.616 mi.	11.616 mi.	11.616 mi.

Performance Charts (Primary to Primary)
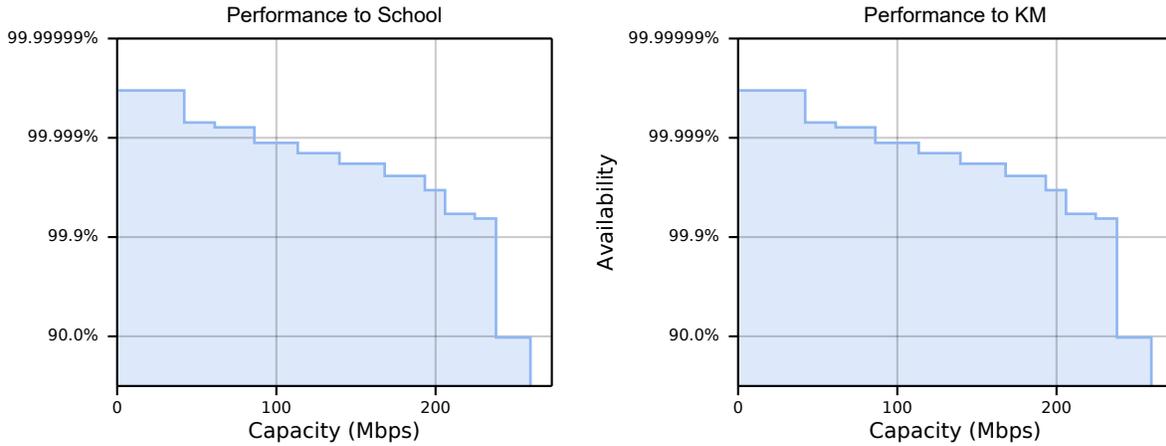
Performance to School

Performance to KM

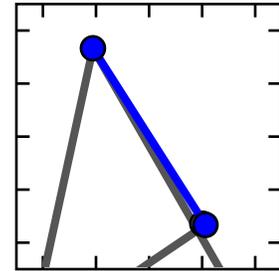## Climatic Factors, Losses and Standards

	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
dN/dH not exceeded for 1% of time	-172.39 N units/km	-172.39 N units/km	-172.39 N units/km	-172.39 N units/km
Area roughness 110x110km	176.47 metre	176.47 metre	176.47 metre	176.47 metre
Geoclimatic factor	1.05e-05	1.05e-05	1.05e-05	1.05e-05
Fade Occurrence Factor (P0)	9.18e-04	9.18e-04	9.18e-04	9.18e-04
Path inclination	12.63 mr	12.63 mr	12.63 mr	12.63 mr
Value of K Exceeded for 99.99% (ke)	0.57	0.57	0.57	0.57
Excess Path Loss at ke	0.00 dB	0.00 dB	0.00 dB	0.00 dB
0.01% Rain rate	36.34 mm/hr	36.34 mm/hr	36.34 mm/hr	36.34 mm/hr
Rain Attenuation	1.17 dB/km	1.17 dB/km	1.17 dB/km	1.17 dB/km
Free Space Path Loss	138.87 dB	138.87 dB	138.87 dB	138.87 dB
Gaseous Absorption Loss	0.27 dB	0.27 dB	0.27 dB	0.27 dB
Profile Type	Line-of-Sight	Line-of-Sight	Line-of-Sight	Line-of-Sight
Excess Path Loss	0.00 dB	0.00 dB	0.00 dB	0.00 dB
Annual 2-way Availability	100.0000 %	100.0000 %	100.0000 %	100.0000 %
Annual 2-way Unavailability	1 secs/year	2 secs/year	2 secs/year	6 secs/year
Rain Availability	99.9999 %	99.9998 %	99.9998 %	99.9995 %
Rain Unavailability	35 secs/year	1.2 mins/year	1.2 mins/year	2.5 mins/year

Climatic Factors, Losses and Standards (continued)				
	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
Atmospheric Gasses	ITU-R P.676-12, ITU-R P.835-6	ITU-R P.676-12, ITU-R P.835-6	ITU-R P.676-12, ITU-R P.835-6	ITU-R P.676-12, ITU-R P.835-6
Diffraction Loss	ITU-R P.526-15	ITU-R P.526-15	ITU-R P.526-15	ITU-R P.526-15
Propagation	ITU-R P.530-17	ITU-R P.530-17	ITU-R P.530-17	ITU-R P.530-17
Rain Rate	ITU-R P.837-7	ITU-R P.837-7	ITU-R P.837-7	ITU-R P.837-7
Refractivity Index	ITU-R P.453-14	ITU-R P.453-14	ITU-R P.453-14	ITU-R P.453-14

School to PSAP

2ft Single Pol (Global) N110082D072 - Remote @ 80 ft (Shared)

2ft Single Pol (Global) N110082D072 - Remote @ 65 ft (Shared)

Performance to School (Primary)

	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
Mean IP	259.57 Mbps	259.57 Mbps	259.57 Mbps	259.57 Mbps
IP Availability	100.0000 % for 10.0 Mbps	100.0000 % for 10.0 Mbps	100.0000 % for 10.0 Mbps	100.0000 % for 10.0 Mbps

Performance to PSAP (Primary)

	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
Mean IP	259.57 Mbps	259.57 Mbps	259.57 Mbps	259.57 Mbps
IP Availability	100.0000 % for 10.0 Mbps	100.0000 % for 10.0 Mbps	100.0000 % for 10.0 Mbps	100.0000 % for 10.0 Mbps

Link Summary

	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
Link Length	0.187 mi.	0.187 mi.	0.187 mi.	0.187 mi.

Performance Charts (Primary to Primary)
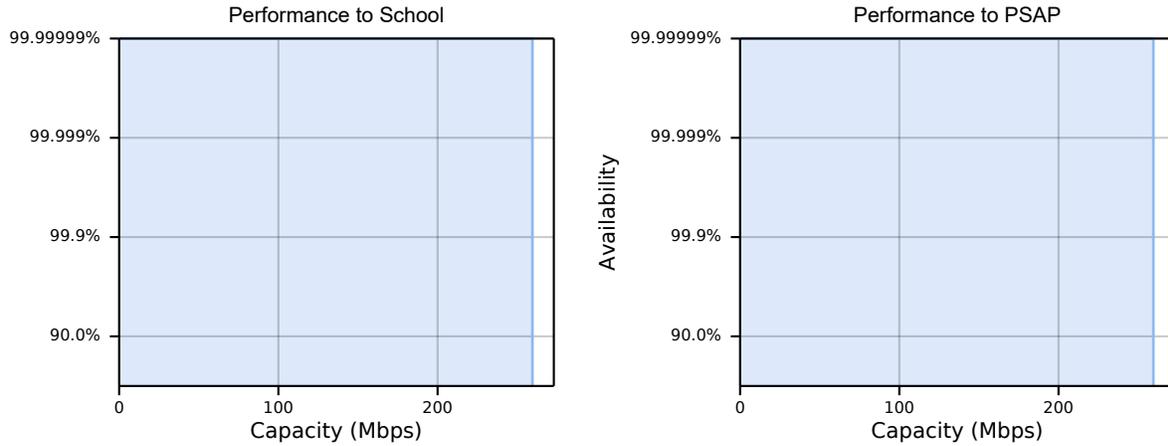
Performance to School

Performance to PSAP

Climatic Factors, Losses and Standards				
	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
dN/dH not exceeded for 1% of time	-175.20 N units/km	-175.20 N units/km	-175.20 N units/km	-175.20 N units/km
Area roughness 110x110km	188.65 metre	188.65 metre	188.65 metre	188.65 metre
Geoclimatic factor	1.04e-05	1.04e-05	1.04e-05	1.04e-05
Fade Occurrence Factor (P0)	8.78e-11	8.78e-11	8.78e-11	8.78e-11
Path inclination	110.82 mr	110.82 mr	110.82 mr	110.82 mr
Value of K Exceeded for 99.99% (ke)	0.40	0.40	0.40	0.40
Excess Path Loss at ke	0.00 dB	0.00 dB	0.00 dB	0.00 dB
0.01% Rain rate	35.31 mm/hr	35.31 mm/hr	35.31 mm/hr	35.31 mm/hr
Rain Attenuation	1.14 dB/km	1.14 dB/km	1.14 dB/km	1.14 dB/km
Free Space Path Loss	102.99 dB	102.99 dB	102.99 dB	102.99 dB
Gaseous Absorption Loss	0.00 dB	0.00 dB	0.00 dB	0.00 dB
Profile Type	Line-of-Sight	Line-of-Sight	Line-of-Sight	Line-of-Sight
Excess Path Loss	0.00 dB	0.00 dB	0.00 dB	0.00 dB
Annual 2-way Availability	100.0000 %	100.0000 %	100.0000 %	100.0000 %
Annual 2-way Unavailability	0 secs/year	0 secs/year	0 secs/year	0 secs/year
Rain Availability	100.0000 %	100.0000 %	100.0000 %	100.0000 %
Rain Unavailability	2 secs/year	2 secs/year	2 secs/year	2 secs/year

Climatic Factors, Losses and Standards (continued)			
	Primary to Primary	Primary to Secondary	Secondary to Primary	Secondary to Secondary
Atmospheric Gasses	ITU-R P.676-12, ITU-R P.835-6	ITU-R P.676-12, ITU-R P.835-6	ITU-R P.676-12, ITU-R P.835-6	ITU-R P.676-12, ITU-R P.835-6
Diffraction Loss	ITU-R P.526-15	ITU-R P.526-15	ITU-R P.526-15	ITU-R P.526-15
Propagation	ITU-R P.530-17	ITU-R P.530-17	ITU-R P.530-17	ITU-R P.530-17
Rain Rate	ITU-R P.837-7	ITU-R P.837-7	ITU-R P.837-7	ITU-R P.837-7
Refractivity Index	ITU-R P.453-14	ITU-R P.453-14	ITU-R P.453-14	ITU-R P.453-14

Provision - Network Management System

The Aviat ProVision NMS (network management system) monitors the health & performance of the backhaul network. The existing ProVision NMS will be used to support these new sites.

Provision - Network Management System

ProVision monitors the health & performance of the RACOM backhaul network. Our design includes redundant servers. It can provide executive summary reports of the network. When ProVision detects an alarm, the operator can use the ProVision GUI to drill down and examine the location and details of the alarm. The level of detail provided by ProVision allows the Wahkiakum County backhaul caretakers to assess quickly, respond to, and remedy any failure.

ProVision can also generate inventory reports, perform periodic configuration backup for disaster recovery, and facilitate bulk software upgrades.

Network Assurance features are:
- Highly scalable tree, map, and tabular views of network resources
- Automatic discovery of devices, configurations, RF links
- Event collection with browsers, notifications (email, SMS, etc.), and graphical scoreboards views
- Device and RF (G.826, RX/TX, etc.) performance collection with history and trend views, and alarm thresholding
- Ethernet interface performance collection with history and trend views, and alarm thresholding
- Ethernet bandwidth utilization network analysis
- Automatic backup of changed device configurations with the ability to restore
- RF, Ethernet, and Clock sync network health analysis and reporting

Service Assurance features for Eclipse platforms are:
- Ethernet services
- VLAN, Ethernet OAM, and ERPS automated discovery and visualization
- Automated end-to-end continuity testing
- Loopback and Link-Trace diagnostic testing

Provisioning features are:
- Provisioning of settings for multiple devices in bulk through predefined Configuration Profiles
- Software loading of devices in bulk
- License loading of devices in bulk
- Device integration

ProVision User Interface

From the main ProVision interface, users can perform all the required functions to manage network responsibilities quickly and effectively.
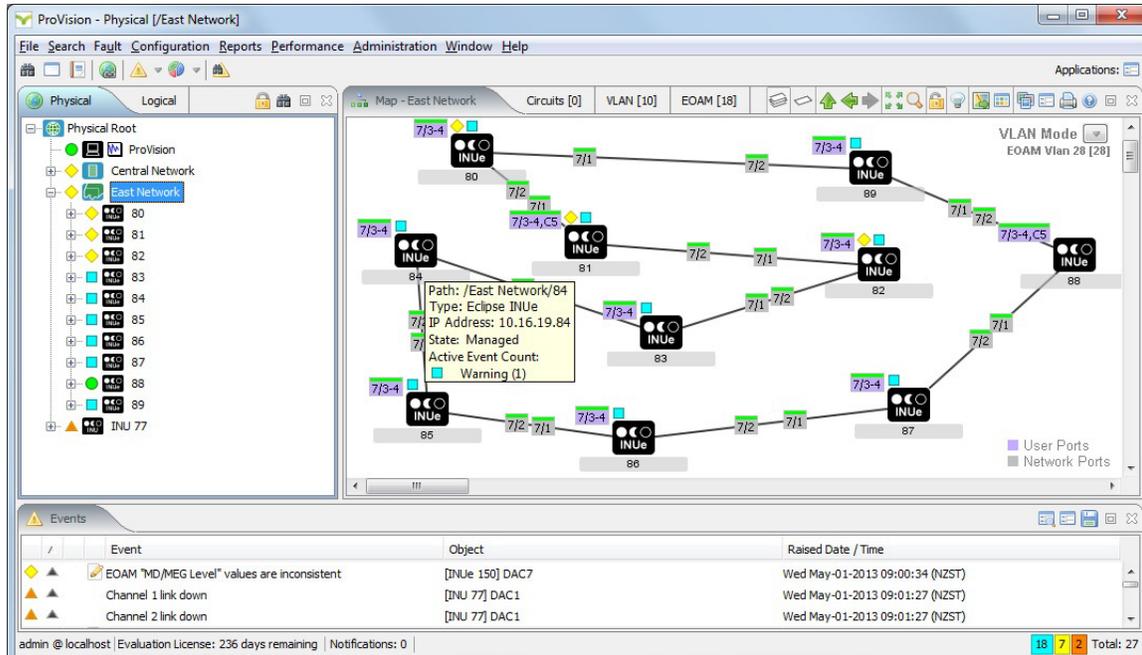
Four tabs provide views of ProVision devices:
- Physical - Displays the entire network's complete "tree view."
- Circuits - Displays TDM circuits.
- VLAN - Displays VLAN connections and related devices.
- EOAM - Displays Ethernet OAM connections and related devices.

The Map Viewer provides two different views of the network: Physical and Flat Map. The following object types are supported in the Map Viewer:
- Region
- Site
- Rack
- Device objects
- RF links
- Logical links
- Ethernet cable links

Proposed Dispatch Solution

The MAX Dispatch solution proposed for Wahkiakum County is a single-site solution equipped with three console positions, up to twelve (12) conventional channels, and five (5) DFSI channels. Each of the console positions include the following:

- One NEMA headset jack box
- One wired headset
- Two speakers
- One desktop microphone
- One footswitch
- One media dock
- Console Light pole (red/yellow/green)
- One PC workstation with keyboard, mouse
- One Touch Screen Monitor
- Instant Call Recorder
- Backup Control Station Radio

MAX Dispatch Project Objectives

In providing you with a MAX Dispatch console system, RACOM & Zetron are committed to the following project objectives:

- **Provide a state-of-the-art communications system** that employs the best available equipment, technologies, and methods to ensure the highest levels of quality, reliability, and performance.
- **Deliver a console solution that is designed and planned to minimize interruptions** to your existing critical systems and operations.
- **Develop strategic a partnership with you** to not only ensure the successful completion of this project, but to also foster the long-term, ongoing relationships necessary to support your operations well into the future.

About Zetron's MAX Dispatch

Zetron's MAX Dispatch is an IP-based console system designed to meet the changing needs of the dispatch community while still delivering a low cost of ownership. Because MAX Dispatch employs the latest, standards-based IP protocols and IT best practices, it offers the highest levels of interoperability, scalability, and usability.

Control-room functions and operations are evolving along with the increasing availability of multiple data sources to the dispatcher. The MAX Dispatch system's hardware and software foundation is designed to adapt to this rapidly changing environment. It provides an easy path to move forward—whether you want to add positions and interfaces to a system, share resources across multiple systems, increase mobility options for staff, or ensure that your control room can interface to both legacy and emerging technologies.

Key Benefits of MAX Dispatch

Interoperability across Many Radio Interfaces

MAX Dispatch is highly interoperable and uses over-the-air and Fixed Station Interface (FSI) protocols to support both legacy and emerging radio technologies. The growing list of interfaces and technologies MAX Dispatch supports includes NEXEDGE®, DMR, and Project 25 (P25). Choosing MAX Dispatch as your console solution will provide you with the broadest range of connectivity now and well into the future.

End-to-end Network Redundancy

MAX Dispatch supports network redundancy for every endpoint. This allows MAX Dispatch to tolerate any single failure in the IP network infrastructure with no loss of service.

Geographically Diverse Operations

The MAX Portal software allows you to place consoles and radio gateways remotely from your main center. This safeguards your system against service interruptions and protects the integrity and reliability of your operations. It allows agencies to share and access resources from separate MAX Dispatch systems and to serve as backup for each other. The Portal also acts as a network tunnel that allows systems to pass traffic over a WAN. This eliminates the need for multicast support between locations.

The MAX Dispatch Geo-diverse Portal:
Share resources and backup across sites.

Reduced Clutter, Simpler Operation, Lower Training Costs

MAX Dispatch's innovative user interface (UI) reduces screen clutter, response times, and user stress. Its blend of unique and traditional console element results in an easy-to-use UI that requires minimal training and fewer steps to perform tasks and access information. Its flexibility also allows you to create screen layouts that match the unique needs of your dispatch center.

Enhanced Broadband Push-To-Talk

MAX Dispatch integrates broadband Push-to-Talk (PTT) capabilities with cell phones enabling communications with dispatch and directly through to radios and radio talkgroups. This benefits both non-mission critical and mission critical users needing backup to augment their LMR radio systems.

Minimized Maintenance Time and Costs

Maintenance personnel can configure, troubleshoot, and maintain most of MAX Dispatch from the convenience of their office. This reduces or eliminates the time and expense required to travel to the system site to perform these tasks.

Flexible, Scalable System Architecture

The MAX Dispatch system consists of three key elements that work together over an IP network. These elements are: the MAX Radio Gateway, MAX Central, and the MAX Console with Media Dock.

The core of MAX Dispatch system is its use of commercial-of-the-shelf (COTS) Internet Protocol (IP) network equipment. MAX Dispatch is based on Voice-over Internet Protocol (VoIP) technology and can be deployed on a dedicated or shared IP network.

With its utilization of the IP infrastructure and Zetron's engineered hardware and software, many MAX Dispatch system elements are highly scalable. As a result, it can support a range of operations, from modest solutions to large, state-wide networks. It can also scale up or down to accommodate your changing operational needs.
The drawing below depicts a simplified overview of the MAX Dispatch system architecture.
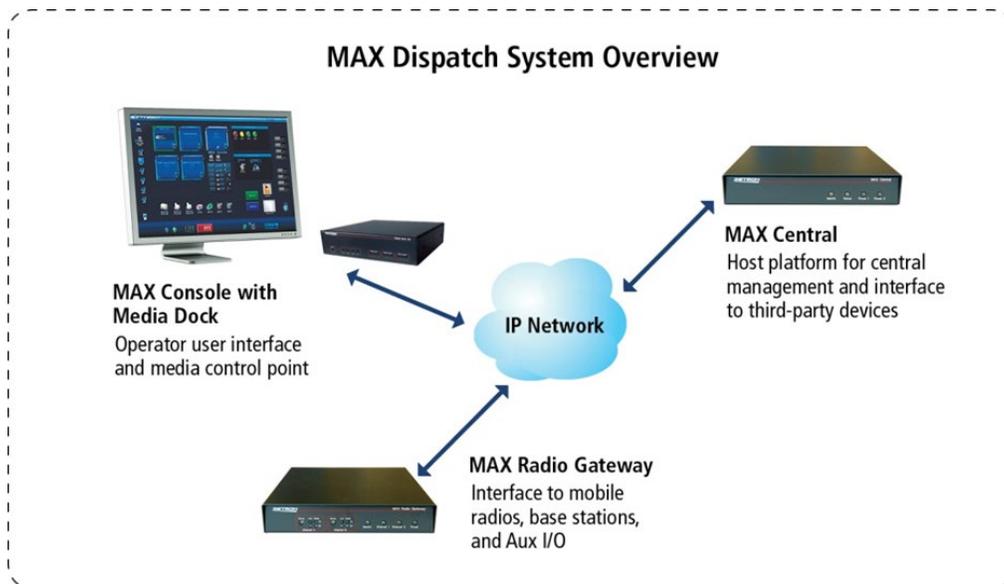
System Components

MAX Radio Gateway

The MAX Radio Gateway serves as the interface point between a radio or base station and the rest of the MAX system. Radio gateways are available for legacy analog as well as modern digital schemes. The gateway converts the radio-specific messaging into MAX messaging for use throughout the internal system. Radio Gateways can interface to up to two radios. They are equipped with physical I/O to provide system-wide radio-site I/O functions that can be used for monitoring site alarms and controlling site devices such as generators.

MAX Central

MAX Central is a hardware platform that hosts several software services (applications) that make up the MAX Dispatch System. These software services provide essential management and control to the system and also act as gateways or interfaces to other network devices for additional functionality. The MAX Central hardware is designed for high performance, reliability and rugged operations.

MAX Dispatch System Network Architecture
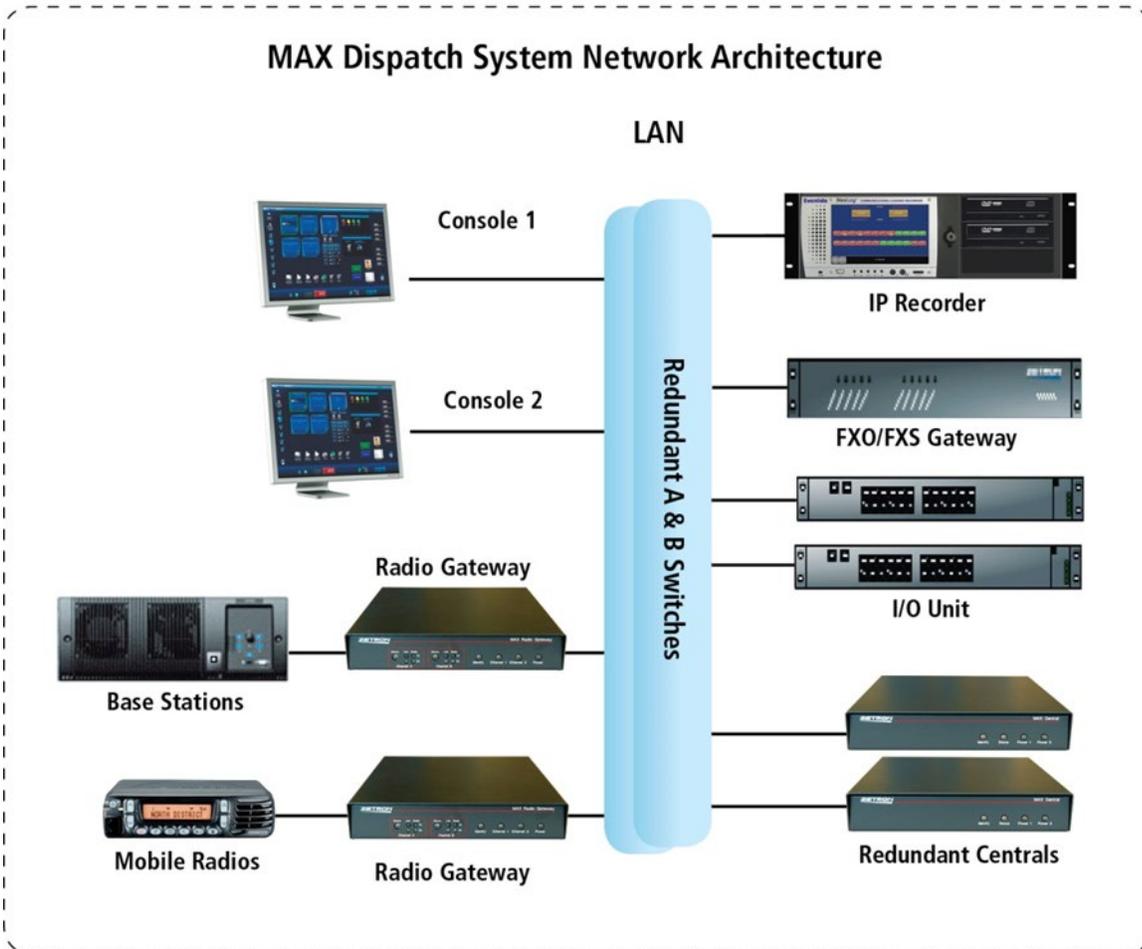
MAX Console with Media Dock

The MAX Dispatch console presents the user interface to dispatchers. Each console consists of a Windows-based client running the MAX Dispatch application software and the Media Dock. The Media Dock provides the audio interface and connection point for accessories such as microphones, speakers, headsets, and PTT footswitches. The console can also be hosted on a laptop for mobile dispatching and system maintenance purposes.

One of the most unique and important features of MAX Dispatch console is its flexible, intelligent user interface.

As control-room functions and operations expand, features such as video integration, AVL and mapping, and text messaging to field units are becoming more prevalent.

Dispatchers need to be able to understand what to do with this additional Dispatch user interface is designed assist with this screen clutter, information overload and on the dispatcher.

Furthermore, the console screens can be configured and laid out to suit the needs and preferences of an individual user, or they can be based on the role of the dispatcher. They can be configured to mimic previous and more traditional console layouts to ease the transition to the new system. Dispatchers can also drag and drop communication resources onto their workspace as needed, which gives them more control over their workflow environment. Even with this freedom, however, system administrators are able to lock down the console completely on a workspace-by-workspace or element-by-element basis to ensure that they have control over screen layouts that should not change.

Portables and Mobiles Radios

RACOM understands the scope and requirements outlined in the RFP for the Portable, Mobile and Control Station Radio. The following outlines the package included in our pricing for each of the different radios.

Pricing for installation and programming has also been included in our pricing response.

For more details on the radios and to see their specifications please refer to the literature section in our response for that information and details on the radio being offered.

TP9800 Tait Portable - One Band

TP9855N0BC-T	P25 4Key VHF/UHF/700-800MHz - Black
TPA-AN-002	TP8/TP9 Ant 136-151MHz Helical
T03-00011-EAAA	TP9 Battery High Capacity Li-Ion 3300mAh
T03-00045-NDAA	TP3/TP9 SpkMic TSM3e IP67 F-bttn-org 3.5
TPA-CA-201	TP8/9 Belt Clip 55mm
T03-00012-AEAA	TP8/TP9 Charger Single Fast Li-Ion US/CAN Plug Pack

Optional Items

TPAS050	P25 Conventional

TM9400 Tait Mobile

TM9400B1DA-T	136-174MHz MUHF 50Watts Body ExtAlm Only
T02-00071-CAAB	TM9400 Large Primary Remote Control Head Black
T02-00034-EAAA	Cable Ignition Sense 4m (13.12ft)
T02-00026-1004	Kit Mobile Cable MUHF 30-50Watts
T02-00026-2001	Kit Mobile Mount U-Cradle
T02-00005-AAAA	TM Standard Microphone TDMA
T02-00004-0205	TM External Speaker 10Watts for 30-50W Radio

Optional Items

TMAS050	P25 Conventional (CAI included) (No Prerequisite)
T02-00009-0203	Cable Shielded 8 Core RJ45M/F Ext 6m (20ft)

TM9400 Desktop Control Station

TM9400B1DA-T	136-174MHz MUHF 50Watts Body ExtAlm Only
T02-00071-CAAB	TM9400 Large Primary Remote Control Head Black
T02-00034-EAAA	Cable Ignition Sense 4m (13.12ft)
T02-00026-4016	Kit Desktop Install MUHF 30-50Watts Plinth
T02-00036-AACA	Desktop Power Supply 23A DC 120V AC US/CAN
T02-00005-ACAA	TM Desktop Microphone TDMA

Optional Items

TMAS050	P25 Conventional (CAI included) (No Prerequisite)

DC Power Systems

RACOM understands the scope and requirements outlined in the RFP for the DC Power Systems Installation and following the information outlines what we have proposed to be used for each of the areas outlined. While these are one of several vendors that offer solutions that meet the specification outlined, RACOM is happy to and has worked with many of the suppliers if the County has a product, they prefer over one of those proposed.

RACOM has proposed a -48VDC solution and has not included any DC-to-DC converts to support other voltages. If these are needed at a site for other equipment that requires 12VDC or 24VDC, these can be added as needed but have not been included in what we have proposed.

The sizing for the DC Power System proposed is based on the following assumptions as to what will need to be supported at each of the sites and what RACOM has included in our proposed solution. Our expectation is that these will be reviewed and updated during detailed design phase and adjustments made if needed.

Site Power @ -48VDC		5 Channel Site		4 Channel Site	
Description	Unit Current (Amps)	Qty	Total Current (Amps)	Qty	Total Current (Amps)
Network Switch	3.62	1	3.62	1	3.62
RX Multicoupler/TTA	0.60	1	0.60	1	0.60
Spectracom Freq Standard	0.90	1	0.90	1	0.90
Active Channel Repeater	7.40	5	37.00	4	29.60
TB9400 RX Mode	0.48	5	2.40	4	1.92
Max Reg'd Power (Amps)			52.23		44.35
Ave Req'd Power (Amps)			34.69		25.28
Heat Generation (BTU/hour)			2175		1796

Power Distribution

RACOM has included one DC Distribution panel per Rack with DC equipment in it. RACOM will typically use TRIMM Panels but are willing to use other panels if the County has a preference.

Inverters

While RACOM has not included any inverter/convertors as our proposed solution is all 48VDC equipment if it should it be determined that DC to AC or DC to DC are needed RACOM typically will use the Wilmore products unless the County prefers something else.

Rectifiers

RACOM is proposing the Newmar DC Power System with Commander II+ Rectifiers. The Commander II Series offers top of the line power and reliable performance while providing complete customization when it comes to functionality, scale, and management. The system comes with a web-based monitoring and troubleshooting platform that can be entirely tailored to fit individual needs, providing a completely remote management tool that delivers real-time data at your fingertips.

This system offers hot-swappable modules for quick and easy deployment, minimizing installation time and maximizing uptime, and comes with a one-year warranty. When searching for dependable and reliable DC power systems for your next deployment, trust the Commander II & II+ to offer the Powerful Difference with unparalleled network availability.

Batteries

RACOM has included for all the sites getting a new power system a battery tray and batteries for 100Ah based on the current loading outlined above. RACOM typically prefers NorthStar, Power Safe, or DEKA, and will work with the County on which solution will work best for you and your needs.

Larger Drawings, Images and Maps

Land Use and Loss Clutter (LULC) Maps and Coverage Prediction Assumptions

LULC Color Customization

Color	Description
	Water
	Snow Ice
	Wetland
	Open Land
	Rangeland
	Transportation
	Agricultural
	Residential
	Forest
	Mix Urban Buildings
	Commercial/Industrial
	High Density Urban
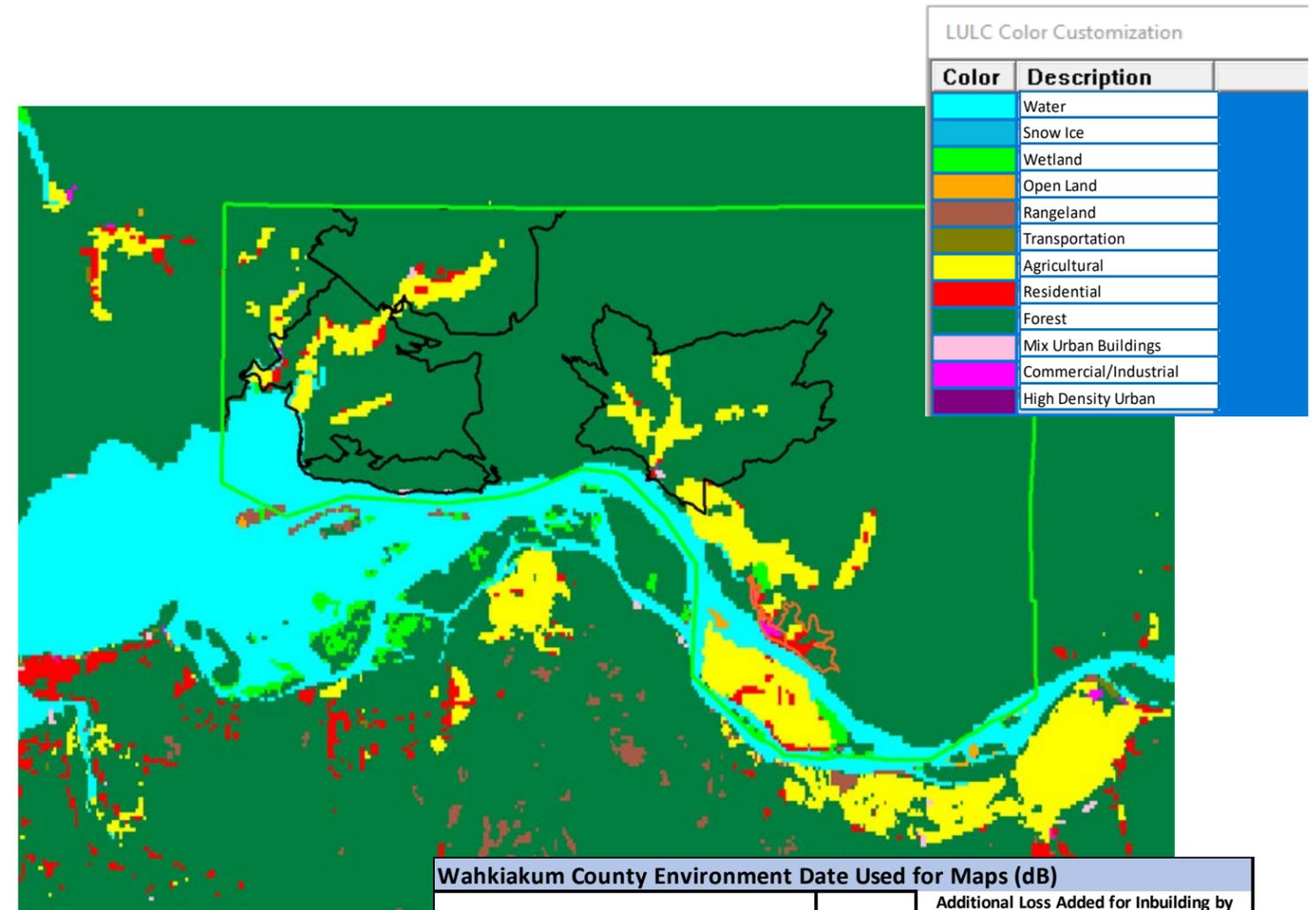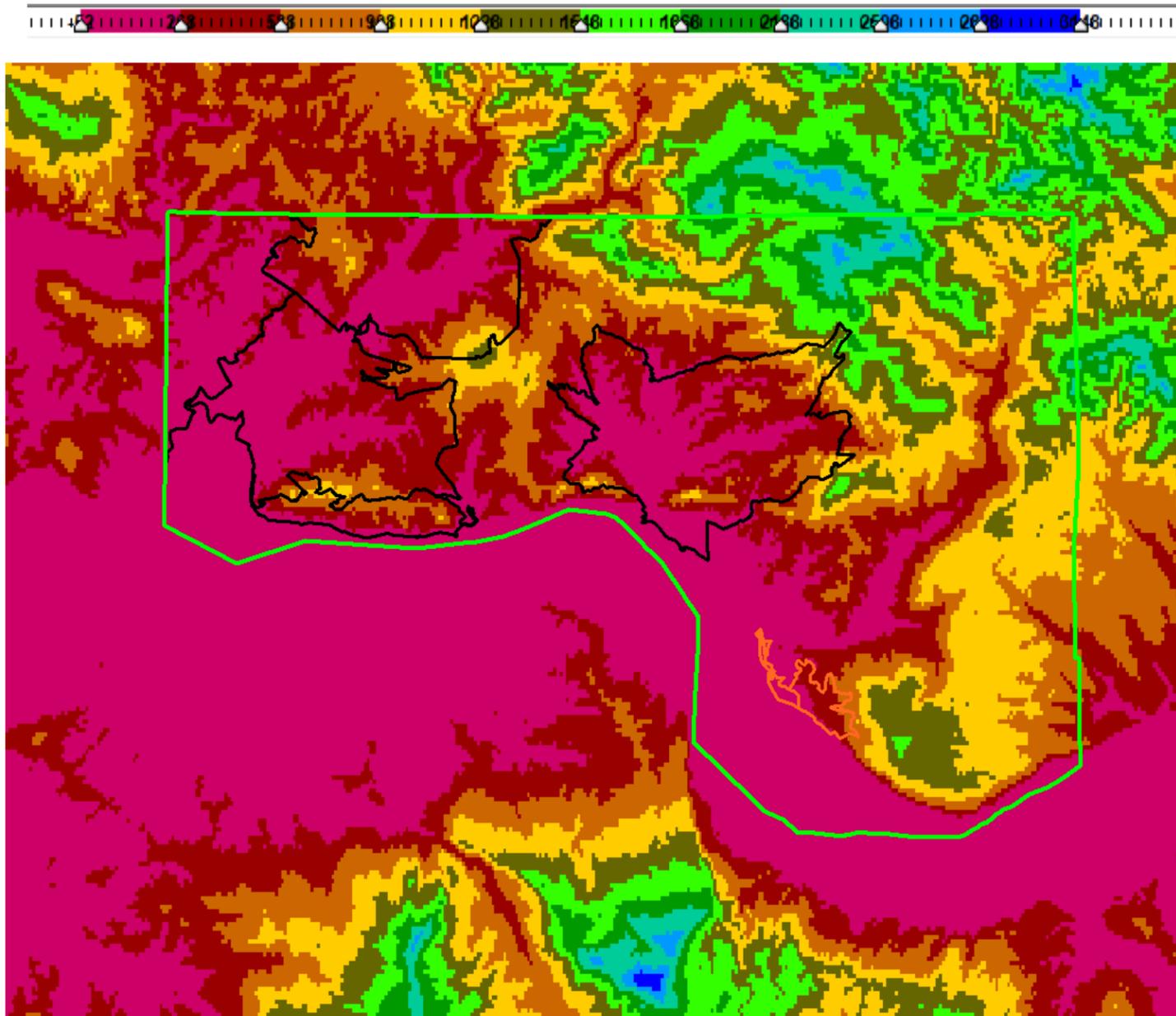
Wahkiakum County Environment Date Used for Maps (dB)

	Clutter Loss	Street	Additional Loss Added for Inbuilding by Type	
			Default	Category
Water	0	0	0	Lakes
Snow & Ice	0	0	0	Snow Pack
Wetland	3	0	3	Non-forested
Open Land	5	0	3	Bare Land
Rangeland	9	0	3	Herbaceous
Transportation	3	0	3	Roadways
Agricultural	3	0	3	Grassland
Residential	14	0	6	Suburban
Forest	8	0	3	Pine (>30')
Mixed Urban/Buildings	15	0	10	Apartment (<4 stories)
Commercial/Industrial	14	0	15	Commercial Services
High Density Urban	15	0	20	Skyscrapers

Land Use and Loss Clutter (LULC) Maps and Coverage Prediction Assumptions

LULC Color Customization

Color	Description	
	Water	
	Snow Ice	
	Wetland	
	Open Land	
	Rangeland	
	Transportation	
	Agricultural	
	Residential	
	Forest	
	Mix Urban Buildings	
	Commercial/Industrial	
	High Density Urban	
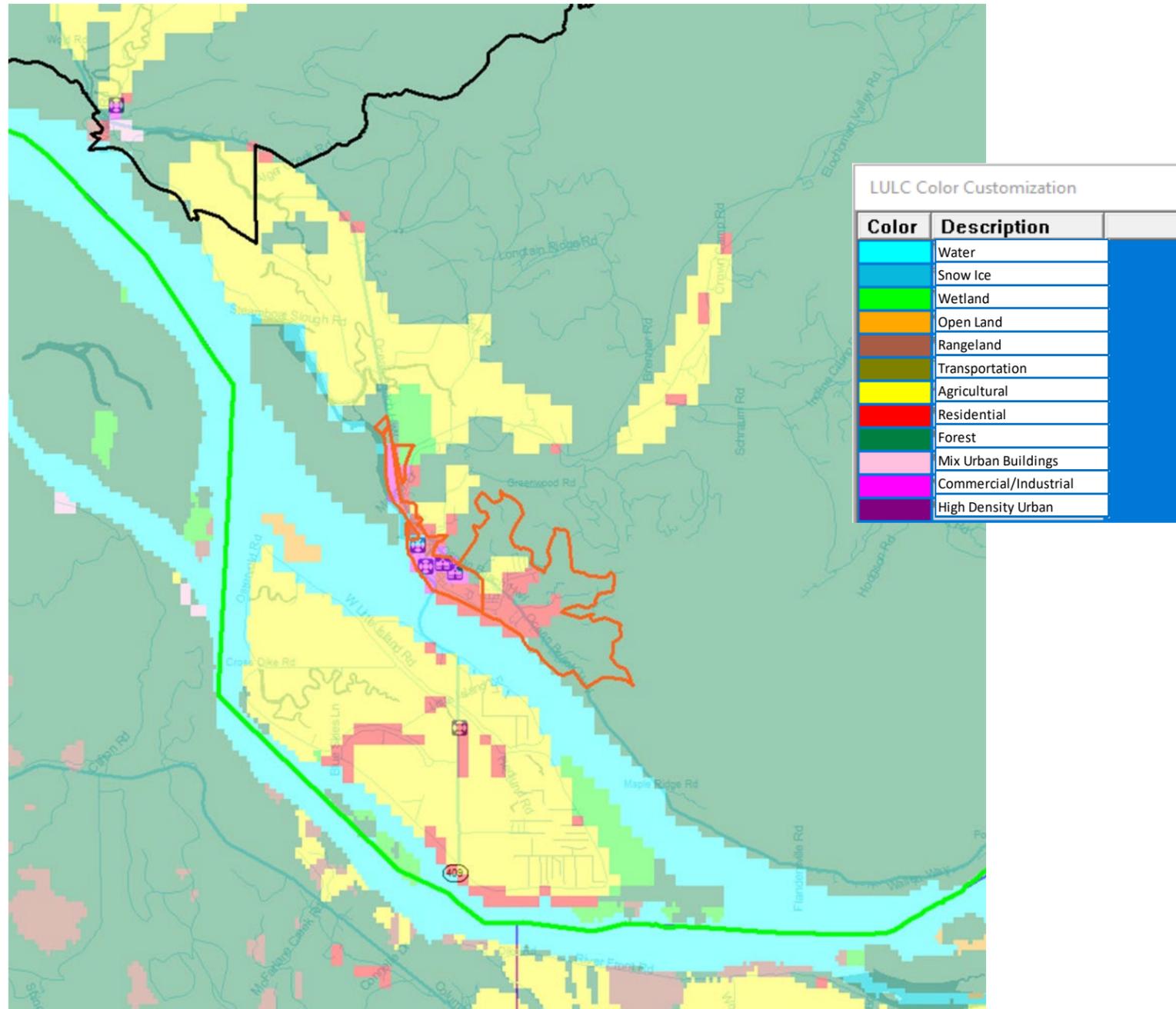
Land Use Land Clutter Map
City of Cathlamet

	Coverage Prediction Assumptions For Wahkiakum County		
1	**General Project Parameters**		
	A	Project/Site Datum	NAD83-CONUS
	B	Frequency	150-174 Mhz
	C	Project Sensitivity	a. Mobile -107dBm b. Portable -107dBm
	D	Terminal Antenna Height	a. Mobile 5.0 feet b. Portable 3.5 feet
	E	Prediction Model	Harris Okumura
	F	Body Loss/ Harris Portables	Hip: 15dB Head: 8dB
	G	Service Area/Design Target	Portable 95%/95% Mobile 95%/95%
2	**Mobile Radios**		
	A	Transmit Power	50.0 watts
	B	Receiver	Noise Figure 10 /-107dBm Faded/1.0uV, 50ohms
	C	Mobile Antenna Gain	-1.0 dB Net Gain (0dB antenna and -1 line/connector)
	D	Vehicle Distortion Margin	(-)1.2dB
	E	Antenna Mounting Position	Center of Roof with a light bar
3	**Portable Radios**		
	A	Transmit Power	6.0 Watts
	B	Receiver	Noise Figure 10 /-107dBm Faded/1.0uV, 50ohms
	C	Portable Antenna Gain	1/2 wave Unity Gain 0 dB gain
4	**Environment**		

		Clutter Loss (dB)		Building Loss - TSB 88 (dB)	
	A	Water	0	0	Lakes
	B	Snow & Ice	0	0	Snow Pack
	C	Wetland	3	3	Non-Forested
	D	Open Land	3	3	Bare Land
	E	Rangeland	9	3	Herbaceous
	F	Transportation	3	3	Roadways
	G	Agricultural	3	3	Row Crops
	H	Residential	14	6	Suburban
	I	Forest	8	3	Pine (>30')
	J	Mixed Urban/Buildings	15	10	Apartments (<4 stories)
	K	Commercial/Industrial	14	15	Commercial Services
	L	High Density Urban	15	20	Skyscrapers

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VHF Site Details for Coverage Predictions

Site Name		Cathlamet - School	Clatskanie Mnt - East	KM Hill	Wickup Mnt
	Site ID	School	East	KM	Wickup
	Latitude	46° 12' 06.400" N	46° 03' 58.200" N	46° 20' 36.400" N	46° 06' 20.200" N
	Longitude	123° 22' 52.500" W	123° 16' 57.100" W	123° 30' 46.500" W	123° 35' 09.200" W
	Datum	NAD83	NAD83	NAD83	NAD83
	Site Elevation	148 ft	2113 ft	886 ft	2635 ft
	Base Station	TB9400-P25 Ph1	TB9400-P25 Ph1	TB9400-P25 Ph1	TB9400-P25 Ph1
	Frequency Range	150 - 174 MHz	150 - 174 MHz	150 - 174 MHz	150 - 174 MHz
Site Transmit	Station Output Power	100.0 W	100.0 W	100.0 W	100.0 W
	Combiner Model	DS4345D (5 ch.)	DS4345D (5 ch.)	DS4345D (5 ch.)	DS4345D (5 ch.)
	Tx to Tx Spacing	200	200	200	200
	Combiner Loss	5.1 dB	5.1 dB	5.1 dB	5.1 dB
	Filter/Duplexer Model				
	Filter/Duplexer Loss	0.0 dB	0.0 dB	0.0 dB	0.0 dB
	Coax Type	7/8" Foam	7/8" Foam	7/8" Foam	7/8" Foam
	Coax Length	110 ft	115 ft	150 ft	130 ft
	Coax Loss	0.5 dB	0.5 dB	0.7 dB	0.6 dB
	Antenna Model	ANT150F2	ANT150F2	CL7-150	ANT150F2
	Antenna Height (C.L)	60 ft	65 ft	100 ft	80 ft
	Antenna Azimuth	0°	0°	331°	0°
	Antenna Mechanical Tilt	0°	0°	-14°	0°
	Antenna Gain (Hzn)	2.5 dBd	2.5 dBd	7.3 dBd	2.5 dBd
	Maximum ERP (Hzn)	49.3 W	49.3 W	141.3 W	48.2 W
	HAAT	-280.0 ft	1424.0 ft	296.0 ft	1874.0 ft
Site Receive	Total System Gain	0.9 dB	1.0 dB	0.8 dB	0.9 dB
	Multicoupler Model	DB7300 (8 ch.)	DB7300 (8 ch.)	DB7300 (8 ch.)	DB7300 (8 ch.)
	Coax Type	7/8" Foam	7/8" Foam	7/8" Foam	7/8" Foam
	Coax Length	150 ft	130 ft	170 ft	150 ft
	Tower Top Amp Model	(None)	(None)	(None)	(None)
	TTA Pad	0.0 dB	0.0 dB	0.0 dB	0.0 dB
	Distribution Pad	0.0 dB	0.0 dB	0.0 dB	0.0 dB
	Duplexer Loss	0.0 dB	0.0 dB	0.0 dB	0.0 dB
	Antenna Model	ANT150F2	ANT150F2	ANT150F2	ANT150F2
	Antenna Height (C.L)	100 ft	80 ft	120 ft	100 ft
	Antenna Azimuth	0°	0°	0°	0°
	Antenna Mechanical Tilt	0°	0°	0°	0°
	Antenna Gain (Hzn)	2.5 dBd	2.5 dBd	2.5 dBd	2.5 dBd
	HAAT	-240.0 ft	1439.0 ft	316.0 ft	1894.0 ft

Site Balanced Report Mobile and Portable Round Trip Analysis Map

High level System Drawing

Freq #	TX	RX	Name/License
1	152.2850	157.5450	Channel 4 - WQVH328
2	153.9275	159.9300	Channel 5 - WQOP660
3	154.8000	158.8500	Channel 2 - WPPC748
4	155.0700	158.9400	Channel 1 - WPPC748
5	155.9850	158.3400	Channel 3 - WRG734

**Wahkiakum County, WA
VHF Channel & Linking
Network Overview**

Legend:
- Dispatch
- TX/RX Site
- TX/RX Simulcast Site
- CH 1
- CH 2
- CH 3
- CH 4
- Optional CH 5

Type of Site | Channel Groups

Wahkiakum County, WA		
VHF Simulcast Radio System Drawings		
		Rev A
Jan 2024		
Confidential, Proprietary & Competition Sensitive		

Coverage Maps

Mobile Talkout

🟩	< 0 dBm
🟩	< –85 dBm
⬜	< –95 dBm
⬜	< –107 dBm

Portable Talkout – Street

	< 0 dBm
	< -85 dBm
	< -95 dBm
	< -107 dBm
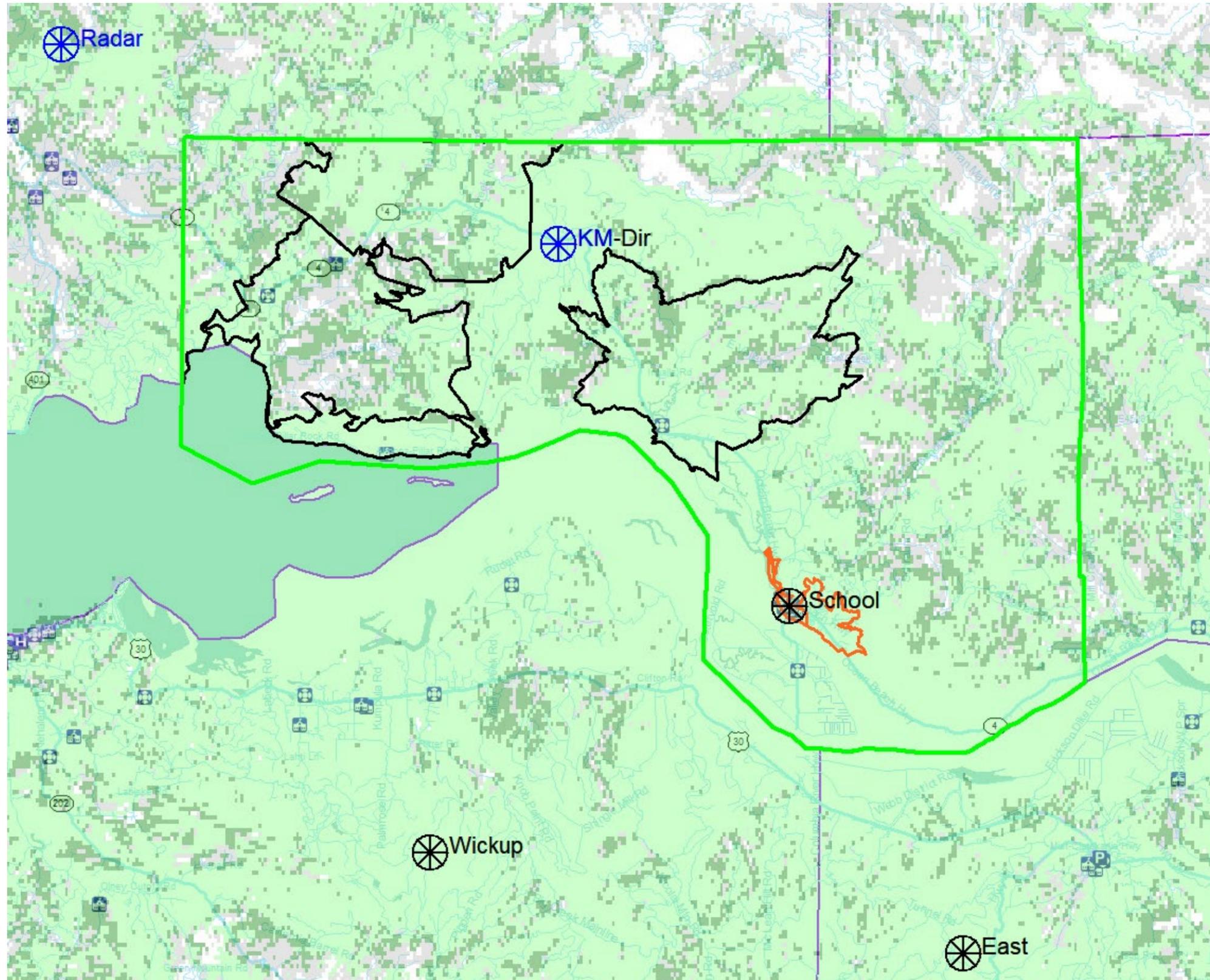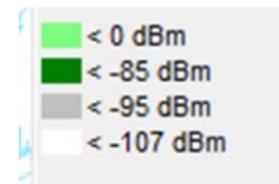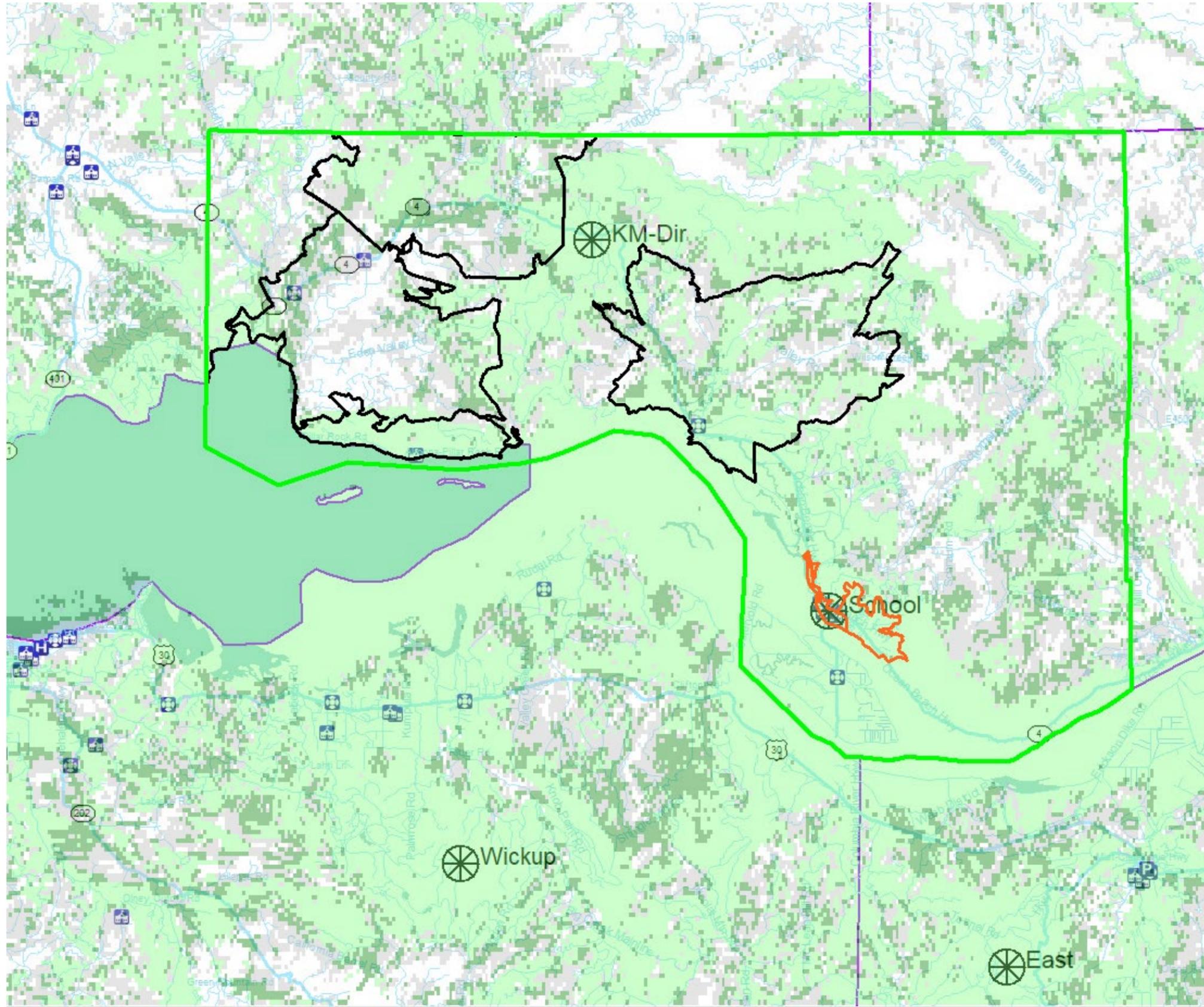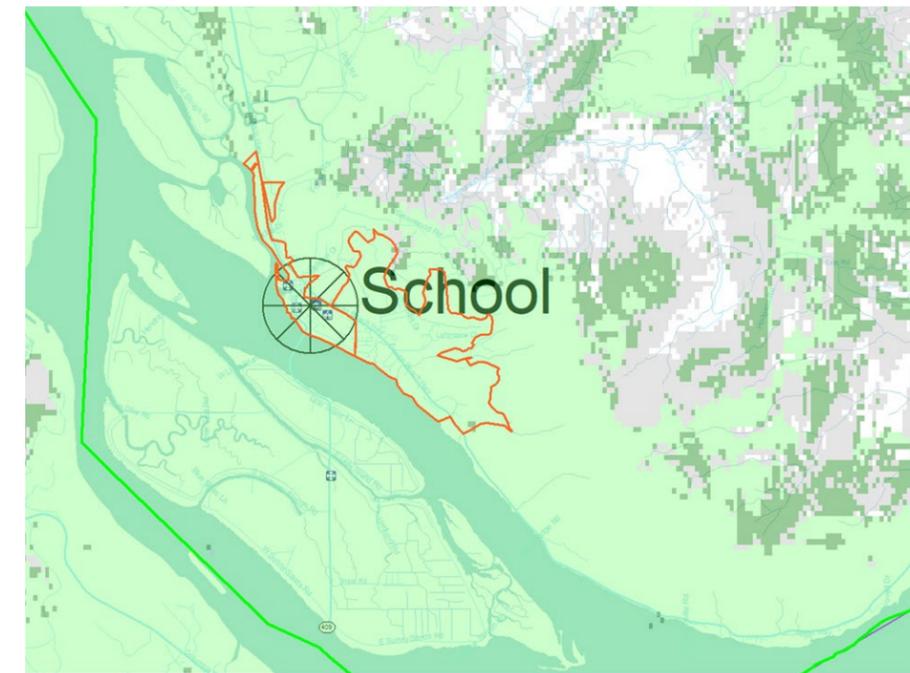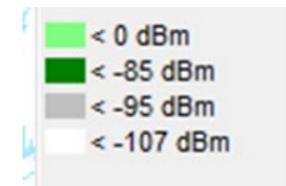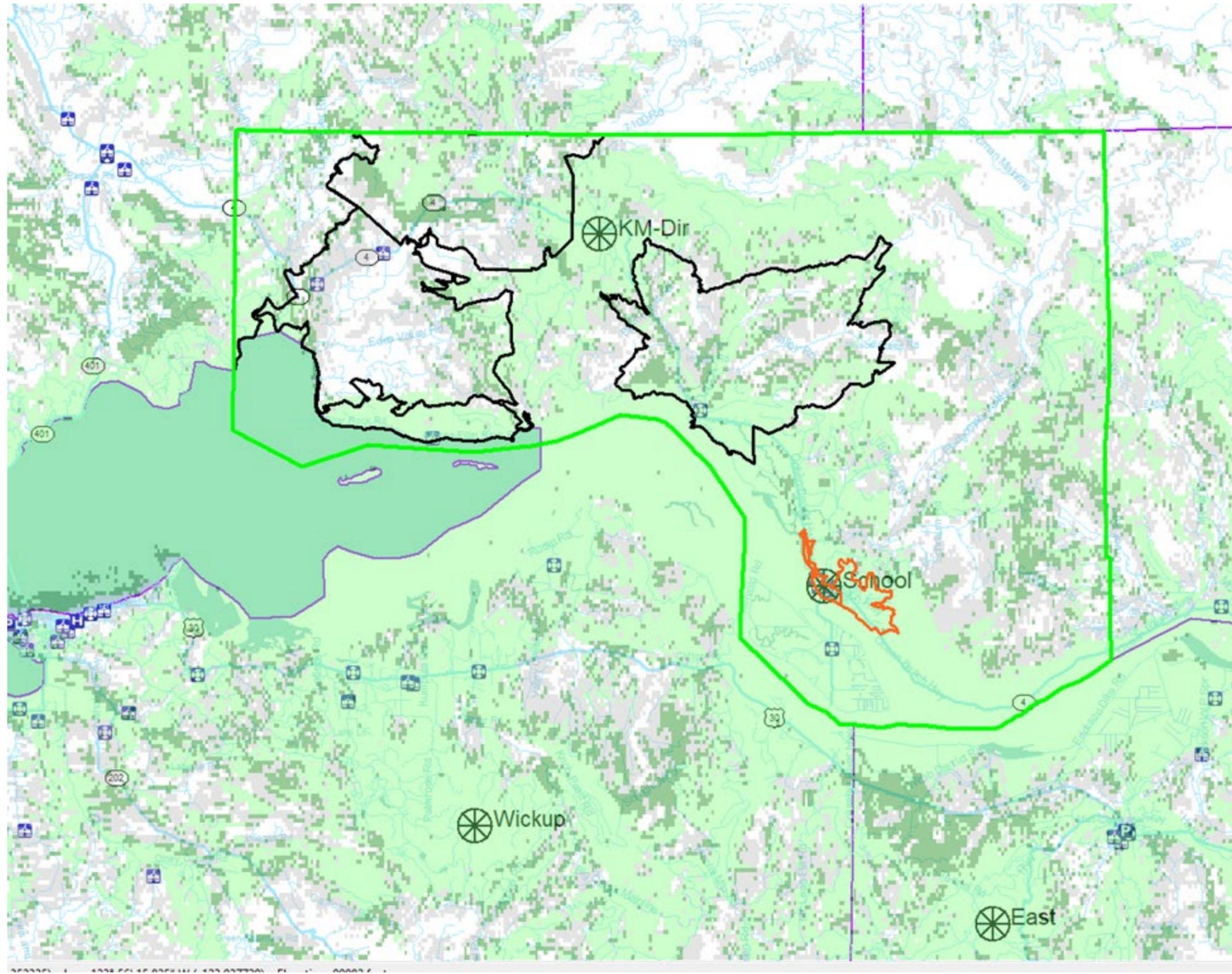
Portable Talkout – Indoors Default

Simulcast Delay Spreed Maps
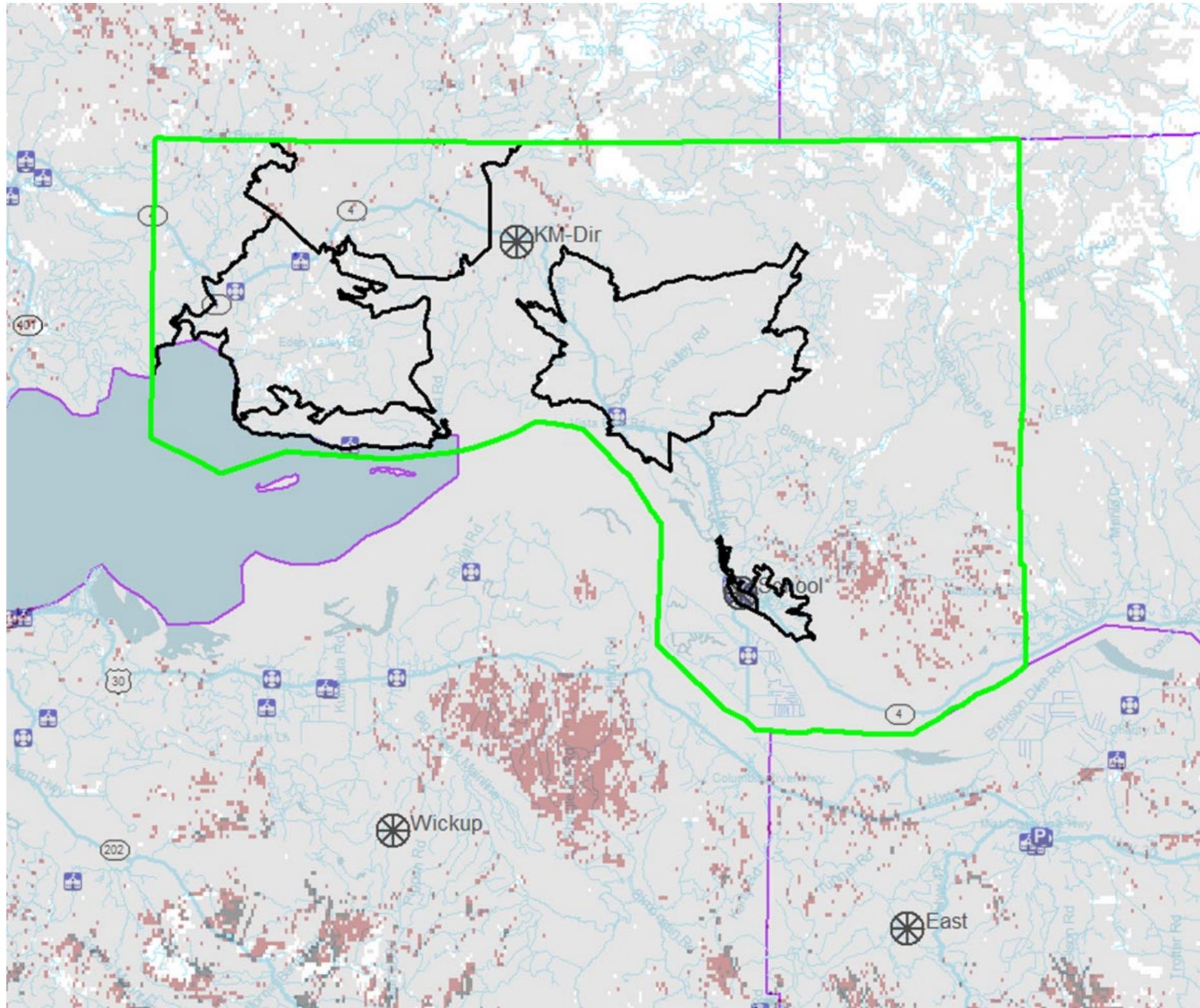
Mobile Talkout

System Jitter: 10.0 µs
Confidence: 95.0%

	< -107 dBm
	BER > 0.0%
	BER > 2.0%
	BER > 5.0%
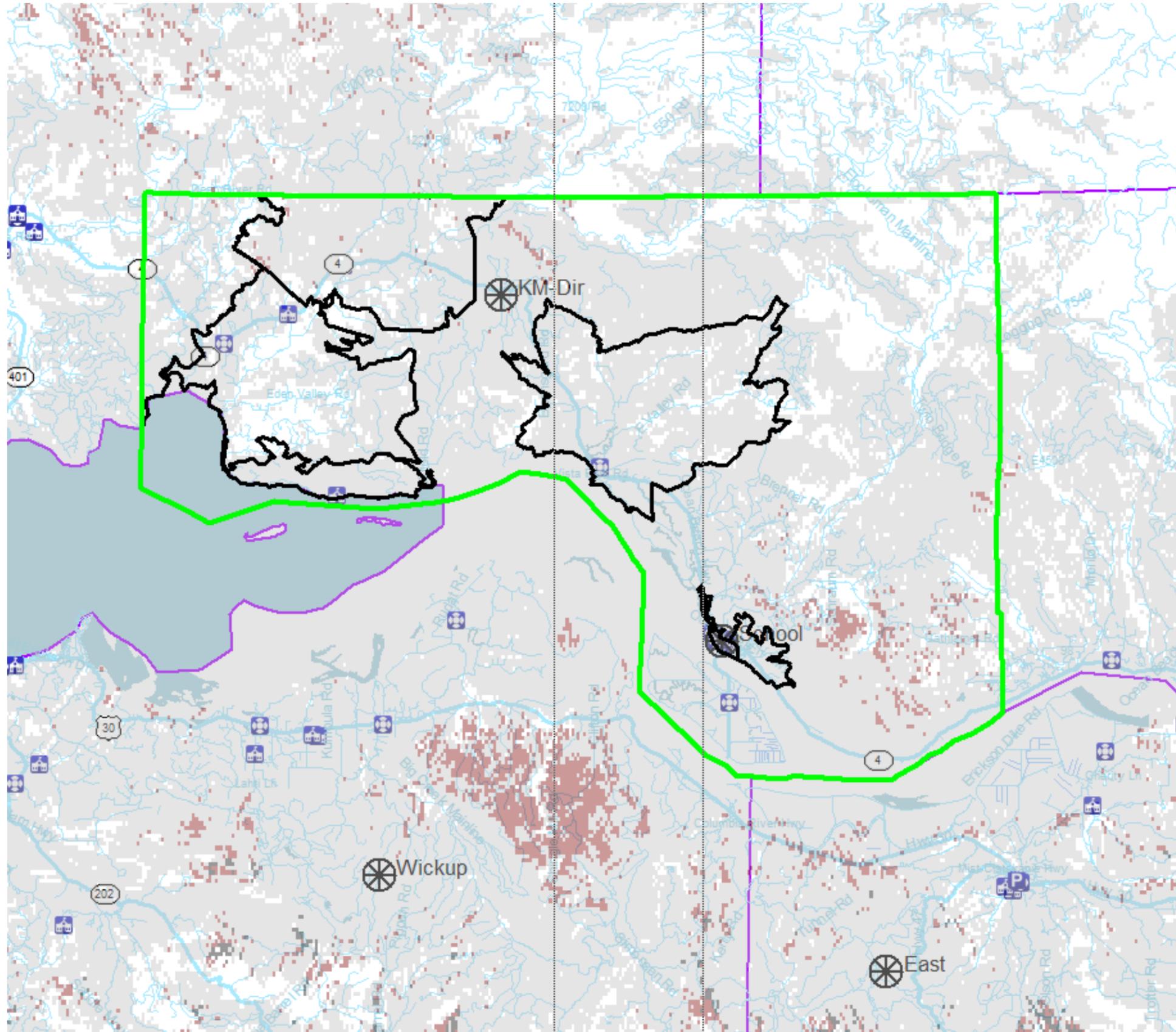
Portable Talkout – Street

System Jitter: 10.0 µs
Confidence: 95.0%

	< –107 dBm
	BER > 0.0%
	BER > 2.0%
	BER > 5.0%
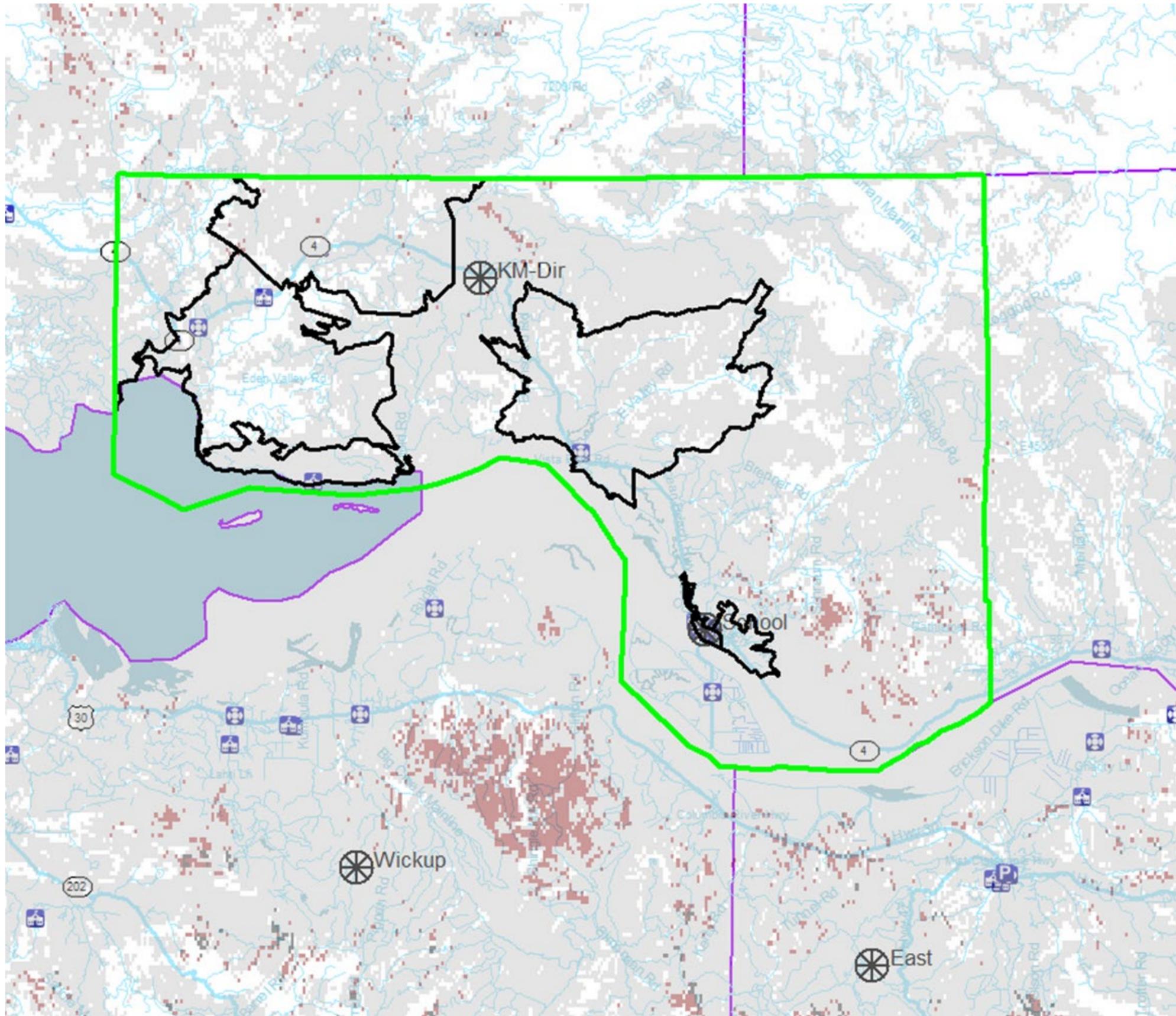
Portable Talkout – Indoors Default

System Jitter: 10.0 µs
Confidence: 95.0%
< -107 dBm
BER > 0.0%
BER > 2.0%
BER > 5.0%

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Product Approach and Management Plan

WAHKIAKUM COUNTY, WASHINGTON

EMERGENCY RADIO REPEATER AND INFRASTRUCTURE PROJECT UPGRADES

February 20, 2024

RACOM

AN EASTERN COMMUNICATIONS COMPANY

WORK PLAN & SCHEDULE

Wahkiakum County

RACOM has decades of experience in providing TAIT AS-IP networks, with successful deployments all around the United States. Regardless of your migration choice, we'll minimize the impact of your system transition. Our gradual migration process diminishes the need for a system-wide "cutover," reducing interruptions to day-to-day operations.

The following documents summarize our Work Plan and Project Schedule. The migration plan we will develop (after the award, with your input) will allow for the system's transition to happen in parallel, with both systems fully operational during the transition of the end User's subscriber radios.

1. Implementation Details
2. Project Timeline (Gantt Chart)
3. Ability to Meet Future Service

Design

Kick-off Meeting and Design Reviews

The RACOM project manager initiates project implementation with a kick-off meeting and a preliminary design review. The RACOM Team, and Wahkiakum County, will mutually agree on the timing of these meetings. The objectives of the meeting include:

IMPLEMENTATION DETAILS

Wahkiakum County

1	2	3	4	5	6

- Introduction of all project participants
- Review the roles of the project participants

Review the overall project scope, goals, and deliverables

Review the current site status

Review Customer-owned site documentation and schedule site surveys

Review the status of Customer site acquisition efforts (in any)

Review the preliminary project schedule

After the kick-off meeting, the RACOM team working with the Wahkiakum team will complete and finalize the detailed design document that will be used as the guide for the remainder of the project, including the configuration and optimization of the system, the installation, commissioning testing and migrations of the Users.

1	2	3	4	5	6
DESIGN	PRODUCTION	IMPLEMENTATION	ACCEPTANCE TESTING	CUTOVER	FINAL ACCEPTANCE

Production

System Integration and Test –Staging

Immediately following the approved Detailed Design Review, the RACOM Team procures material and schedules system integration & testing.

Running the Staging Acceptance Test demonstrates that the radio system functionality will perform correctly on-site after delivering the equipment. The test plan defines each test, with instructions on how to set up and run the test and compares the actual results to the expected results. The test team scores and initials each test.

RACOM has included pricing for the Staging.

Shipping, Warehousing, and Inventory

After a successful staging acceptance test, the equipment will be warehoused at RACOM – Lacey, WA until deployed to the field.

1	2	3	4	5	6

Implementation

Implementation Guideposts

As we think about implementing a new system, there are several things we want to design the system around. Implementation of a system this size has multiple challenges. Those include:

1. **Minimal Disruption:** During the system migration period, all your Users still need to be able to talk to each other and the outside agencies that you interact with for mutual aid. Even though some entities may be migrating to the new System, others remain on conventional VHF or UHF; they need to be able to communicate seamlessly. This is a unique feature in the RACOM plan and a key differentiator between us and other offerings.

2. Concurrent Activities: The system, as designed for Wahkiakum County, will allow many tasks to be performed concurrently instead of sequentially.

3. Aggressive but Realistic Schedule: We believe that every project like this has four key attributes with respect to implementation:

    a. Scope – Ensuring the work done does not short-change your required Scope.

    b. Time – We are always upfront about how much time it realistically takes to complete the required tasks. There are many 3rd party dependencies, especially regulatory, that the County nor RACOM can control. We have calculated a scheduled path that can get the project completed within the time frame expectations

    c. Quality – This work will be completed with the Highest Quality

    d. Cost – Our proposed Costs are transparent, without hidden costs that creep in later in the form of unexpected change orders. The potential costs are represented as options in our proposal.

    Everyone wants a land mobile radio system migration project completed quickly, and many vendors purposely underestimate the project timeline to show a faster and less expensive implementation. They will make unrealistic assumptions about the Scope and Quality within their alternative contract language or the effort and time involved in your responsibilities. Such insincerities can strap you with costly change orders during the detailed design review

(after you have already signed a contract). We have never done this to any other Customers and will not do it to you.

One of our implementation guideposts is to give you an aggressive implementation schedule. Still, one that is realistic, does not sacrifice your required Scope or demanded Quality, and never results in any downstream surprises.

4. End-User Coordination: You dispatch for several different agencies with many different radios. Ensuring Users' radios are programmed, radios installed correctly, channel plans are developed professionally, and Users trained clearly are all items where we have demonstrated our competence with simulcast solutions for over 20 years. Additionally, our unique ability to help manage the coordination required between your system partners in Wahkiakum County puts us in the best position to ensure your new system is successful.

The RACOM Team

The RACOM project team has decades of relevant expertise in integrating, implementing, and supporting complex communications systems. The team will be led by one of our highly trained Project Managers, each with years of industry experience.

Project Manager

A Project Manager (PM) will be assigned to lead your project. Their primary responsibility is the project's successful implementation, integration, optimization, and acceptance. The PM will manage all project phases from the beginning through acceptance. All official communications regarding the project will funnel through the PM and your designated Wahkiakum County project manager.

The project manager and implementation team will collaborate with any subcontractors and vendors to prepare for the upcoming installation. We will determine when site surveys are required, assign a site survey team to begin work, and ensure that services are coordinated to support the project schedule.

 The project manager's responsibilities include but are not limited to the following:

- Managing all aspects of the project
- Setting up and managing the project team
- Conducting project activities according to the contract and within Scope, time, cost, and quality constraints
- Working with internal/external functional units to perform certain services
- Develop and maintain the formal project schedule
- Reviewing, approving, and distributing all plan changes

- Approving, validating, and distributing design decisions

- Maintaining quality control procedures and practices

- Managing risks

- • Communicating safety plans and scheduling safety meetings with the project team and subcontractors

- Managing required subcontractors

- Monitoring and controlling the project budget

- Holding team progress meetings

- Holding issue resolution meetings

- Submitting progress reports to Wahkiakum County

- Maintaining project records and files

- Communicating directly with your designated Wahkiakum County Project Manager

During implementation, RACOM's project manager will have weekly or bi-weekly progress reviews with the implementation teams to compare actual performance to the planned schedule established at the Detailed Design Review. If a situation arises where performance is not meeting plans, the PM will work with the implementation team to develop and implement corrective actions. Risk management is employed at the same time to prepare for contingencies.

A Communications Management Plan will establish and define regular meetings, reporting structure, and other communication activities. It will determine who and what information needs to be communicated, the means of communication, how often communication is needed, and where it is stored.

The Detailed Design Review will communicate the final engineering design. RACOM will present the communication plan at the Kick-Off meeting. RACOM will then schedule and deliver this information to the stakeholders through the project lifecycle. Formal communications with the county's project manager will include monthly reports with an executive summary and quarterly on-site status meetings. Weekly conference calls will be held with the RACOM project team and the County Project team.

System Engineering

Our System Engineering team is experienced in IT, RF, and Microwave and works with our OEM partners to optimize every solution design we provide. System Engineering has full technical responsibility for the proposed system and will integrate all Tait and vendor products into a complete operational system.

RACOM has designed your system to provide the maximum amount of coverage and interoperability while being fiscally conservative. We have chosen sites that will ultimately

provide Wahkiakum County with the most optimal solution. Our System Engineers will work with the Project Manager to ensure the successful implementation of your system.

The System Engineer is responsible for:

- Creating documents for Customer Design Review (CDR) such as:
  - ✓ Frequency plan
  - ✓ Combiner plan
  - ✓ Antenna drawings
  - ✓ Rack drawings
  - ✓ Electrical power loads/BTUs
  - ✓ Acceptance Test Plan (ATP)
  - ✓ Coverage maps
  - ✓ Network plan
  - ✓ Microwave/fiber/T1 layout System
  - ✓ block diagrams
- Finalizing system design and reviews
- Performing coverage prediction and acceptance testing
- Providing fleet map planning support
- Configuring the system
- Providing implementation support
- Creating final system and as-built document

MAJOR TASK DATES AND PROJECT SCHEDULE

RACOM will provide a preliminary project schedule for the AS-IP (Analog Simulcast over IP) system design as a Microsoft Project Gantt chart. The high-level schedule will show the time frames for the various project activities, including the detailed design phase. The schedule includes a kickoff and preliminary project planning session. RACOM will conduct thorough site surveys and meet with Wahkiakum County to review its results and the contract materials to formulate the final design. During the Detailed Design Review, more detailed schedules will be presented. The schedule lists each major milestone and defines each party's responsibility so the reader can understand the timing and inter-relationships. Throughout the project, RACOM's project manager will review the project progress as compared to the schedule. The PM will take the necessary action to work around issues or focus on a problem to maintain the schedule. Monthly project updates will be provided to Wahkiakum County's project lead.

A project schedule, in the form of a Gantt chart, has been included.

Project Planning Meeting

RACOM will meet with Wahkiakum County shortly after the contract award for a project planning session. Together the teams will develop the project plan. Some points of discussion will include:

- Develop a Project Description Statement
- Develop a Project Management approach
- Develop a Statement of Work that provides for deliverables and objectives
- Develop a Work Breakdown Structure
- Update schedule start dates and responsibility assignments
- Review major milestones
- Project staffing
- Perform Project Risks analysis
- Project Management plans for schedule and scope management, a project budget, change controls, acceptance testing, and project closure A Project
- Communications Plan

Detailed Design Phase

In preparation for the Detailed Design Review (DDR), RACOM will gather all submittal materials and any feedback received. RACOM will also pull the information from the Project Planning meeting and preliminary design.

The DDR will be an opportunity to present the detailed system design and operation to Wahkiakum County. The engineers will present design decisions used to support the project design, and the Project Manager will present site plans for site development needed at each site. Wahkiakum County will review the material and approve the final RACOM system design. RACOM and Wahkiakum County can mutually agree to proceed with system implementation and review open issues later if additional information is available and design solutions need to be modified.

RACOM will provide the following material for review and approval:

DETAILED DESIGN REVIEW DOCUMENTATION DELIVERABLES

Detailed Design Review Description

DDR is a final design based upon details discussed and approved during contract negotiations and agreed to in the final contract.

Before DDR is finalized, Customers must perform certain tasks to the best of their abilities.

Site locations should be finalized with reasonable assurance that the county can contract, lease, or own the location.

Changes in locations from the contract may cause coverage changes; thus, it is imperative that locations are viable.

Significant changes in site locations will cause a system coverage redesign. They could be subject to a change order for LMR RF design, microwave path design, and analysis for additional engineering labor.

The DDR consists of detailed drawings and documents describing the complete system infrastructure, including LMR, Microwave/Fiber Backhaul, Interoperability, Coverage, Dispatch, and initial Project schedule.

Documents that may be included in DDR (depending on design, scope, and options)

    A. System Overview Package

        1) Systems Block Diagram

        2) Trunked System Design

        3) Interoperability System

        4) Network Sentry Sub-System

        5) Interconnect Diagram

        6) Network Topology

        7) Site Tunnel Topology

        8) Interop Gateway Network Drawing

        9) Microwave Overview

        10)Microwave Detailed Overview

        11)Microwave-Fiber Paths

        12)MPLS Ring

        13)Interop Overview

        14)Interop Detail

        15)Alarm Overview

16) Standard Dispatch Block Diagram

17) Dispatch Backup Radios

B. Site Drawing Package (separate set of drawings for each Site)

1) Site Interconnect Overview

2) Power Specifications

3) Electrical Overview

4) DC Plant Block Diagram

5) AC Breaker Panel Overview

6) DC Breaker Panels

7) Electrical Distribution

8) Site Floor Plan

9) Port Window

10) Equipment Rack Diagram

11) MPLS Router

12) Site Access Router

13) Site Access Switch

14) Site Alarms

15) RX Antenna System

16) TX antenna System

17) TX Combiner

18) GPS Antenna System

19) Interop Antenna System

21) uWave Antenna System, for each path

22) Site Info

C. LMR Coverage Package (package varies depending on coverage requirements)

1) Portable Outdoor Talk Out

2) Portable Outdoor Talk Back

3) Mobile Talk Out

4) Mobile Talk Back

5) Project Report

6) Site Balance Report

D. Microwave/Fiber Package

1) Microwave Path Profiles

2) Microwave Overview

3) Microwave Overview (Detailed)

4) Microwave Details

5) Fiber Paths

6) Microwave-Fiber Paths

7) MPLS Ring

E. Project Schedule Package
1) Project Schedule (in MS Project)

Following site surveys, the county will begin obtaining approvals for the selected sites and preparing to acquire/lease the properties to minimize delays.

Site expectations

Following the kickoff meeting and preliminary design review, the RACOM project manager will work with Wahkiakum County to supply the site information needed to support the RACOM system design. RACOM will conduct site inspections of all approved RF sites and dispatch centers to confirm the actual equipment installation locations used in the design.

Ordering and Delivery of Equipment

Following the final design approval, RACOM will process equipment orders for procurement. All equipment will be shipped to RACOM for implementation.

Factory Acceptance Test (FATP)

Factory Acceptance Testing will be conducted at RACOM. Our system engineer will make all rack connections for each Site's equipment. Ethernet crossover cables between routers will be used to simulate the microwave network. Engineers will set IP addresses and verify the

operation of the network. A test database will be used to evaluate radio functionality on the system. Individual microwave links will be staged and evaluated.

Wahkiakum County is encouraged to attend the Factory Acceptance Testing. Each test will be defined and signed off as part of the FAT documentation. Participating in and viewing the test will help the County personnel become familiar with the system.

System Installation Plan

System installation will begin as the site preparation work is completed, following the backbone equipment delivery schedule after staging.

System Optimization

Once the infrastructure installation is complete, RACOM will work with the installation and microwave technicians to optimize and commission the system. Alarm systems and fallback modes at each Site will be tested. RACOM will conduct a preliminary Acceptance Test with the county

System Commissioning

RACOM will complete system commissioning and conduct live system testing from end to end. System commissioning will include but not be limited to:

- Redundancy Testing
- Call Processing
- Failure Modes
- Alarm Functionality
- Call Patching
- Encryption
- Talk Around
- Emergency Calls
- Protective Ring Switching
- Interoperability
- Reporting Features

System Technical Training

Using RACOM support services dramatically reduces the county's need for system administration responsibilities, and therefore technical training courses are presented as options for the county. Tait and RACOM conduct such courses and may be available on or off-site.

1	2	3	4	5	6
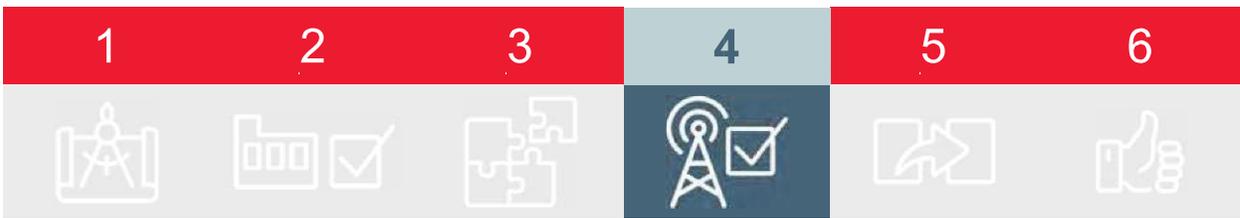
Acceptance Testing

RACOM will perform systems acceptance testing per the agreed-upon Acceptance Test Plan (ATP). The RACOM Team will notify Wahkiakum County when installation and optimization are complete and the system is ready for acceptance testing.

System Acceptance Testing

Once system installation and optimization have been verified, the new system will be confirmed by completing the Acceptance Test procedures defined in the contract document. RACOM has included preliminary acceptance testing documents with this proposal.

30-Day Burn-In and Validation

RACOM will conduct a performance test encompassing 30 consecutive days of uninterrupted radio system operation following the Functional and Coverage tests. The 30-day reliability test is intended to prove reliable system operation. Several essential aspects of the reliability test are no disruption in communication and no reduction in the Quality of communications.

Failure modes, categories, and correction scenarios will be discussed at the DDR.

- Major Failures might include items such as loss of network switching equipment, loss of trunking mode operation, etc. After correcting the issue, a major system failure results in the test period being stopped and restarted from zero.

- Minor failures could include non-critical features that don't affect system operation. In general, minor system failures do not result in Testing being suspended. Minor system failures are added to an incident report tracking document, and these items are fixed while the reliability testing is ongoing.

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RACOM will perform functionality tests; once completed and approved by the RACOM Team and the Customer, Users will migrate to the new system, whereas the 30-day period begins.

CUSTOMER ACCEPTANCE

Once the 30-day Burn in and Validation are complete, the RACOM project manager will submit a letter requesting final acceptance. The signing of the final acceptance document will initiate the beginning of the warranty period.

1	2	3	4	5	6

Cutover Approach

RACOM and Wahkiakum County will work together to prepare the cutover plan before User integration.

RACOM is confident that we all share the same overarching goals in the process – that there are no missed calls, and that each User maintains adequate communications during the cutover process.

Other than the bulleted items below, the cutover plan may also include topics such as the timing of the cutover, systematic fleet-by-fleet or department-by-department Users' cutover, initial trial window or live system test window for the first batch of migrated Users, milestones during cutover process, and finally, a fallback plan in case of any uncertainty. The entire cutover plan will be broken into multiple phases to ensure the smooth transition to the new system.

The cutover plan will address the following:■
Timing and Use of New and Existing
■RF Frequencies – The migration of existing frequencies must be carefully planned and balanced against traffic loading to minimize the impact on end Users.

■ System User Migration – A transition plan will be jointly developed to schedule the County Users radio programming and migrating the
■frequencies from the legacy system to the new system.

■ User Unit Personalities – RACOM will assist the Wahkiakum County project ■manager in developing a series of User profiles for the radio system Users. These profiles will determine the User defined parameters for each agency and radio.

Dispatch Support During Cutover – Since there may be a period when dispatchers may need to coordinate Users on both systems, an interim solution will be created where the new dispatcher positions can talk to field units on both the existing system and the new system during the transition phase.

Dispatch Center Cutover – Reconfiguration of the existing consoles will be verified before the cutover is to begin.

Dispatcher and Radio User Training Radio Users will need to be trained on the subscriber radios' operation. Our training team will help Wahkiakum County develop quick-reference materials and produce seminar-oriented train-the trainer documents to facilitate this.

After completion of cutover planning, the RACOM Team and Wahkiakum County agree on a day and time for the cutover to begin. The RACOM Team will be present with Wahkiakum County to provide any last-minute answers to Users as they go live on the new system.

Migration

RACOM will carefully manage migration activities to minimize any disruption to ongoing services. Any service-affecting installation activities will be carefully coordinated with Wahkiakum County.

After the testing and optimization phase is complete (including any performance test), RACOM will coordinate with Wahkiakum County and identify which groups of Users can start migrating over to the new system.

During the migration period, RACOM will have personnel in the field to monitor and support Wahkiakum and its Users. A technician will be on-hand to respond to alarm calls or assist in helping a new User adjust to the changes introduced by the new system. Wahkiakum County will have the full support of the RACOM team during this transition.

User Equipment

Wahkiakum County schedules and coordinates the fleet of vehicles and Users that will use the mobile and portable User equipment per the cutover plan.

Transition/Cut-over

RACOM and the County will work together to prepare a mutually agreed upon cut-over plan 120 days before the system is available for User integration. The unique advantages of RACOM's migration capabilities give the county multiple options. Agency by Agency transitions, live trials by small groups of Users, and complete fallback plans will be defined in the cut-over plan.

The cut-over plan will include the following:

- RACOM will minimize disruptions and balance traffic loading during system testing and migration
- User migrations will be jointly developed to move emergency responders from the legacy systems to the new system.
- RACOM will assist the county in developing User profiles for the radio system Users. These will determine the parameters for each radio and agency.
- RACOM will support dispatch through the transition. An interim solution will be provided to talk to field units about the existing system and the new system.
- RACOM will conduct dispatcher and Radio User Training. Our training team will help the county develop quick-reference guides and train-the-trainer materials.

Because the new system will have undergone extensive testing and a "30-day performance period", it is improbable that the new system will experience a critical failure.

However, plans for reverting to the old system can be established in case it becomes necessary.

SYSTEM DOCUMENTATION

All systems and subsystems provided under the contract shall be included in the written documentation plan as supplied by RACOM, plus all ID, IP addresses, voltage and testing outcomes, model/serial numbers, and operating manuals that the county will verify.

PROJECT CLOSE-OUT AS-BUILT DOCUMENTATION DELIVERABLES

The System Close-Out Package is based on the same drawings included in the DDR. These drawings will include all changes in design and equipment layout captured during installation.

It will also include serial numbers for infrastructure equipment, and terminals, along with IP addressing scheme, access info, training documentation, FCC licenses, system test results, and system manuals.

Due to the size of the Close-Out Package (several thousand pages), it will be presented in digital form only.

| ID	Task Name	Duration	Start	Finish	Predecessors	Resource Names	C
1	**Wahkiakum County**	**225 days**	**Tue 2/20/24**	**Mon 12/30/24**			
2	**Proposal Due**	**0 days**	**Tue 2/20/24**	**Tue 2/20/24**			
3	**Contract Award**	0 days	Tue 3/5/24	Tue 3/5/24	2FS+11 days		
4	**Design Phase**	**42 days**	**Wed 3/13/24**	**Thu 5/9/24**			
5	Internal kickoff	1 day	Wed 3/13/24	Wed 3/13/24	3FS+5 days		
6	Kickoff Meeting	1 day	Mon 3/25/24	Mon 3/25/24	5FS+7 days		
7	Site Surveys	2 days	Mon 3/25/24	Tue 3/26/24	6SS		
8	**Detailed Design Review**	**26 days**	**Thu 4/4/24**	**Thu 5/9/24**			
9	DDR Development	3 days	Thu 4/4/24	Mon 4/8/24	6FS+7 days		
10	Preliminary Design Review	1 day	Tue 4/9/24	Tue 4/9/24	9		
11	Final Design Review	1 day	Tue 4/30/24	Tue 4/30/24	10FS+14 days		
12	Final Design Approval	0 days	Thu 5/9/24	Thu 5/9/24	11FS+7 days		
13	**Procurement Process (Ordering and Delivery)**	**115 days**	**Thu 5/9/24**	**Fri 10/18/24**			
14	Place orders on factory for Infrastructure Equipment	0 days	Thu 5/9/24	Thu 5/9/24	12		
15	Place orders for MW equipment	0 days	Thu 5/9/24	Thu 5/9/24	12		
16	Place orders for Antenna Subsystems	0 days	Thu 5/9/24	Thu 5/9/24	12		
17	Place orders for Console Equipment	0 days	Fri 5/10/24	Fri 5/10/24	12		
18	Place orders for DC Plants	0 days	Thu 5/9/24	Thu 5/9/24	12		
19	**VHF Conventional System Staging**	**115 days**	**Fri 5/10/24**	**Fri 10/18/24**	**18**		
20	Equipment Lead Time	90 days	Fri 5/10/24	Thu 9/12/24	18,14,15,16,17		
21	System Staging	20 days	Fri 9/13/24	Thu 10/10/24	20		
22	Staging Acceptance Testing	5 days	Fri 10/11/24	Thu 10/17/24	21		
23	Prepare Cut-over plan (T-Plan)	5 days	Tue 8/27/24	Mon 9/2/24	47FS-120 edays		
24	Site readiness Go / No-Go	0 days	Fri 10/18/24	Fri 10/18/24	22		
25	Installation Go / No-Go	0 days	Fri 10/18/24	Fri 10/18/24	24		
26	**MW/LMR/GPS antennas and MW/LMR/DC Installation**	**31 days**	**Fri 9/13/24**	**Fri 10/25/24**			
27	KM	7 days	Fri 9/13/24	Mon 9/23/24	18,20		
28	Wickiup	7 days	Tue 9/24/24	Wed 10/2/24	27,20		
29	East	7 days	Thu 10/3/24	Fri 10/11/24	28,20		
30	School	7 days	Mon 10/14/2	Tue 10/22/24	29,20		

ID	Task Name	Duration	Start	Finish	Predecessors	Resource Names	
31	Dispatch	3 days	Wed 10/23/2	Fri 10/25/24	30,20		
32	Console Installation	3 days	Fri 9/13/24	Tue 9/17/24	20		
33	Interop Gateway Installation	4 days	Fri 9/13/24	Wed 9/18/24	20		
34	**LMR Installation**	**25 days**	**Tue 9/24/24**	**Mon 10/28/24**			
35	KM	4 days	Tue 9/24/24	Fri 9/27/24	27		
36	Wickiup	4 days	Thu 10/3/24	Tue 10/8/24	28		
37	East	4 days	Mon 10/14/2	Thu 10/17/24	29		
38	School	4 days	Wed 10/23/2	Mon 10/28/24	30		
39	LMR Install Complete	0 days	Mon 10/28/2	Mon 10/28/24	35,36,37,38		
40	**Field and Coverage Testing**	**34 days**	**Tue 10/29/2**	**Fri 12/13/24**			
41	Perform Simulcast Optimization Testing	3 days	Tue 10/29/24	Thu 10/31/24	39		
42	System Acceptance Testing	3 days	Fri 11/1/24	Tue 11/5/24	41		
43	Perform Coverage Testing	6 days	Wed 11/6/24	Wed 11/13/24	42		
44	30-day burn in	30 edays	Wed 11/13/2	Fri 12/13/24	43		
45	**PUNCH LIST**	10 days	Thu 11/14/24	Wed 11/27/24	44SS		
46	**System Acceptance**	1 day	Mon 12/16/2	Mon 12/16/24	44		
47	**Cutover Phase**	6 days	Tue 12/17/24	Tue 12/24/24	46		
48	**Transition to 1 year System Warranty**	0 days	Tue 12/24/24	Tue 12/24/24	47		
49	**End User Training**	10 days	Tue 12/17/24	Mon 12/30/24	46		
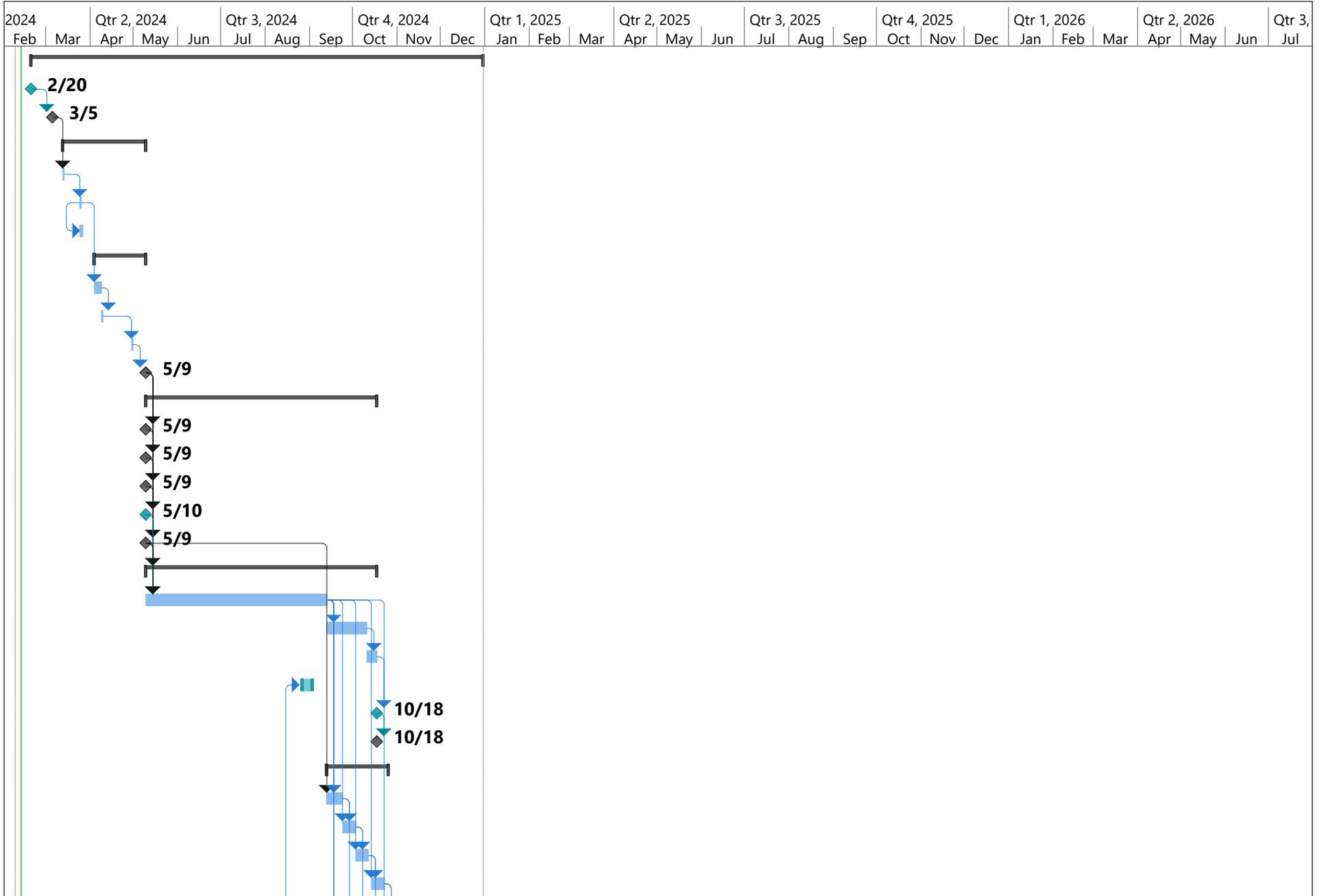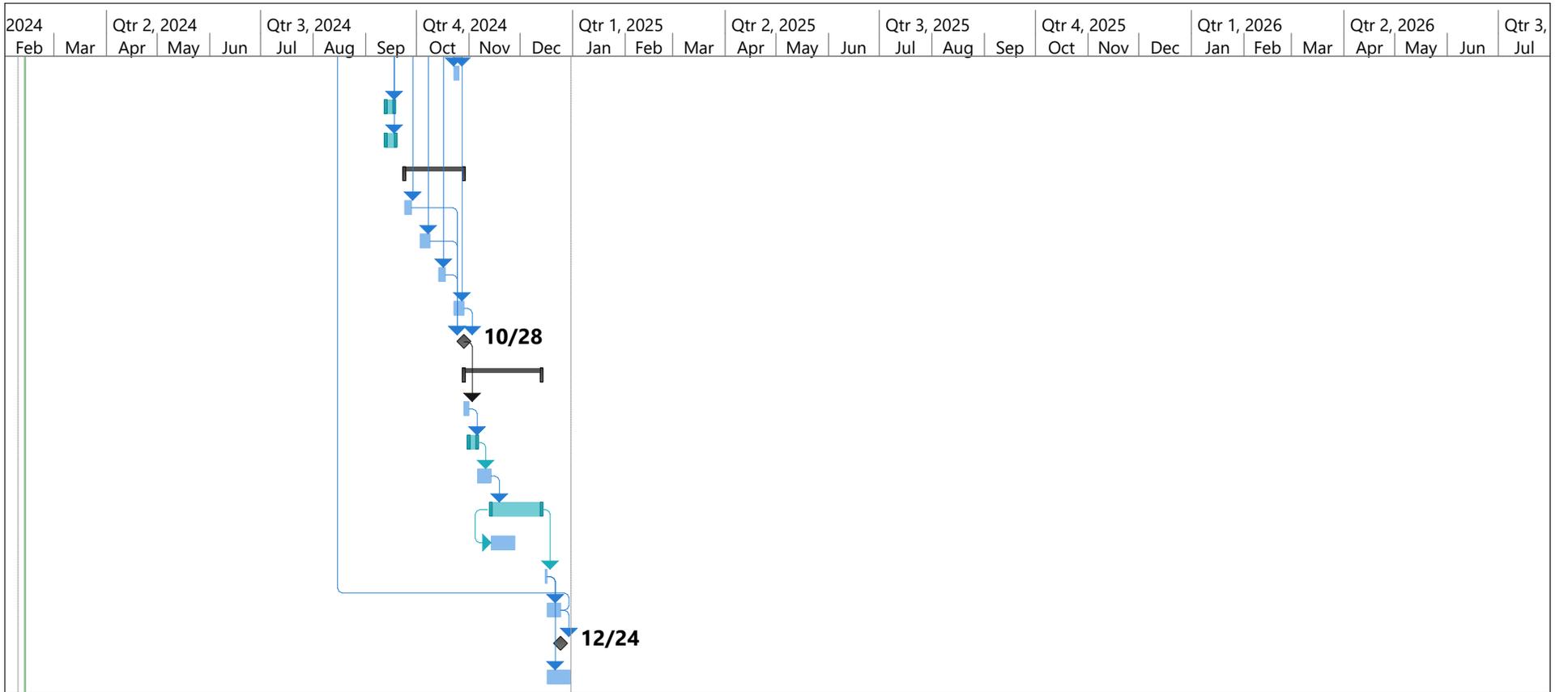
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PRICING

WAHKIAKUM COUNTY, WASHINGTON

EMERGENCY RADIO REPEATER AND
INFRASTRUCTURE PROJECT UPGRADES

February 20, 2024

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RACOM Pricing
Wahkiakum County

Total System Price for Segment 1-6	**$**	**1,416,195**
Total Services Price for Segment 7	**$**	**458,850**
One Time Discount	**$**	**(292,500)**
(Assumes All Segments & Services are contracted)		
Total System and Services Price	**$**	**1,582,545**
Estimated Sales Tax (7.8%)	**$**	**123,439**
Total with Tax	**$**	**1,705,984**

Site	Description	Qty	Segment Price
01 -School			$ 181,203
	Rack	2	$ 1,892
	Cisco Ethernet Switch	1	$ 7,613
	Cisco Fiber Module	1	$ 643
	GPS Oscillator, 48VDC	1	$ 6,380
	Newmar Power Plant	1	$ 16,720
	Tait ASIP, 100W, Central Voter	4	$ 16,985
	dbSpectra Equipment (4Ch TxRx)	1	$ 33,314
	Antenna Systems	1	$ 15,580
	Aviat MW System to KM	1	$ 26,405
	Misc. Items	1	$ 4,050
02 - KM			$ 214,727
	Rack	2	$ 1,892
	Cisco Ethernet Switch	1	$ 7,613
	Cisco Fiber Module	1	$ 643
	GPS Oscillator, 48VDC	1	$ 6,380
	Newmar Power Plant	1	$ 16,720
	Tait ASIP, 100W, Central Voter	4	$ 16,985
	dbSpectra Equipment (4Ch TxRx)	1	$ 33,314
	Antenna Systems	1	$ 15,580
	Aviat MW System to School, East & Wickup	3	$ 19,569
	Misc. Items	1	$ 4,050
03 - East			$ 164,930
	Rack	2	$ 1,892
	Cisco Ethernet Switch	1	$ 7,613
	GPS Oscillator, 48VDC	1	$ 6,380
	Newmar Power Plant	1	$ 16,720
	Tait ASIP, 100W, Satellite	4	$ 12,771
	dbSpectra Equipment (4Ch TxRx)	1	$ 33,314
	Antenna Systems	1	$ 15,580
	Aviat MW System to KM	1	$ 26,405
	Misc. Items	1	$ 4,050

RACOM Pricing
Wahkiakum County

04 - Wickup $ **164,930**

Rack	2	$	1,892
Cisco Ethernet Switch	1	$	7,613
GPS Oscillator, 48VDC	1	$	6,380
Newmar Power Plant	1	$	16,720
Tait ASIP, 100W, Satellite	4	$	12,771
dbSpectra Equipment (4Ch TxRx)	1	$	33,314
Antenna Systems	1	$	15,580
Aviat MW System to KM	1	$	26,405
Misc. Items	1	$	4,050

05 - PSAP-Dispatch $ **148,847**

Tait EnableMonitor	1	$	14,264
Cisco Ethernet Switch	1	$	7,613
Cisco Fiber Module	2	$	643
Zetron Core	1	$	24,245
Zetron Analog Gateway	3	$	4,691
Tait Digital Gateway	1	$	3,649
Zetron DFSI Interface	4	$	1,442
Zetron Console Position	3	$	25,984

06 - User Devices $ **541,559**

Portable	194	$	2,044
Mobile	104	$	1,764
Control Station	15	$	2,136

07 - Services $ **458,850**

Project Management	1	$	48,000
Engineering	1	$	33,250
Documentation	1	$	6,750
Coverage Testing	1	$	34,400
Radio & MW Installation and Configuration	1	$	31,500
Console Installation and Configuration	1	$	25,400
Training	1	$	18,000
1st Year Warranty Services	1	$	-
Estimated Bonds (will be actual cost)	1	$	9,820
Tower Work	1	$	90,750
Removal of Existing Equipment	1	$	17,400
Radio Programing, Installation, and Removal	1	$	143,580

08-Optional Items (Not included in the Total System Price above)

Add P25 Per Site Per Channel	0	$	6,700
Add 5th Channel Per Site	0	$	37,415
Add P25 to User Devices	0	$	225
Vehicle Repeater	0	$	3,790
Add P25 to Vehicle Repeater	0	$	2,790
Aviat MW System School to PSAP	0	$	57,097

08-Optional Items Continued (Not included in the Total System Price above)

Recommended Spares

Microwave	0	$	13,820
Console	0	$	25,100
Base Stations	0	$	16,990
Network Switch	0	$	7,600
GPS	0	$	6,400
Radios 1% to 5%			

Support Warranty + 4 Years
Software Updates, Extened Warrant & 24/7 Phone Support

Microwave	0	$	36,800
Console	0	$	32,224
Base Stations	0	$	88,870
Enable Monitor	0	$	8,150

Radio Package Configuration

TP9800 Tait Portable - One Band

TP9855N0BC-T	P25 4Key VHF/UHF/700-800MHz - Black
TPA-AN-002	TP8/TP9 Ant 136-151MHz Helical
T03-00011-EAAA	TP9 Battery High Capacity Li-Ion 3300mAh
T03-00045-NDAA	TP3/TP9 SpkMic TSM3e IP67 F-bttn-org 3.5
TPA-CA-201	TP8/9 Belt Clip 55mm
T03-00012-AEAA	TP8/TP9 Charger Single Fast Li-Ion US/CAN Plug Pack

Portable Optional Items

TPAS050	P25 Conventional (CAI included) (No Prerequisite)

TM9800 Tait Mobile - One Band

TM9800B1DA-T	136-174MHz MUHF 50Watts Body ExtAlm Only
T02-00071-CAAB	TM9400 Large Primary Remote Control Head Black
T02-00034-EAAA	Cable Ignition Sense 4m (13.12ft)
T02-00026-1004	Kit Mobile Cable MUHF 30-50Watts
T02-00026-2001	Kit Mobile Mount U-Cradle
T02-00005-AAAA	TM Standard Microphone TDMA
T02-00004-0205	TM External Speaker 10Watts for 30-50W Radio

TM9800 Desktop Control Station - One Band

TM9800B1DA-T	136-174MHz MUHF 50Watts Body ExtAlm Only
T02-00071-CAAB	TM9400 Large Primary Remote Control Head Black
T02-00034-EAAA	Cable Ignition Sense 4m (13.12ft)
T02-00026-4016	Kit Desktop Install MUHF 30-50Watts Plinth
T02-00036-AACA	Desktop Power Supply 23A DC 120V AC US/CAN
T02-00005-ACAA	TM Desktop Microphone TDMA

Mobile Optional Items

TMAS050	P25 Conventional (CAI included) (No Prerequisite)
T02-00009-0203	Cable Shielded 8 Core RJ45M/F Ext 6m (20ft)

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PRODUCT LITERATURE

WAHKIAKUM COUNTY, WASHINGTON

EMERGENCY RADIO REPEATER AND INFRASTRUCTURE PROJECT UPGRADES

February 20, 2024

RACOM

AN EASTERN COMMUNICATIONS COMPANY

TB9400

High performing, multi-mode base stations for mission critical networks.

The Tait TB9400 "High level" base station is a multi-mode platform for analog conventional, MPT, DMR and P25 systems.

It provides both digital frequency and time division multiple access for FDMA and TDMA operations.

The TB9400 offers a spectrally efficient solution, enabling migration path between modes, with greater capacity and thus future proof your investment. It delivers operational efficiency through features such as internal voter capability, Linear Simulcast Modulation (LSM) and remote network management.

KEY FEATURES

- Multi-mode platform supporting Analog Conventional, AS-IP (Analog Simulcast over IP), MPT, DMR Conventional and Trunking, P25 Conventional and P25 Trunking modes
- Simple change of mode through the web interface, or program complex operations with TaskBuilder
- Dual mode automatic switching between Analog and P25 conventional
- Dual mode automatic switching between Analog and DMR Tier 2 (single repeater)
- P25 and analog conventional simplex and DFSI support for ease of migration
- Adherence to P25 standards Phase1 and Phase2 (ultra-narrowband 6.25 kHz) for interoperability
- Tait DMR Access and Express solution compatible
- Simulcast and Voting in AS-IP, DMR and P25 networks
- DMR fallback into single site operation
- Linear Simulcast Modulation (LSM) to increase P25 coverage efficiency
- Migration capability from Tait AS-IP to P25 Conventional network, with dual mode, simplex and DFSI capabilities or to Tait DMR simulcast
- Analog line (supporting 4 wire E&M) in analog mode for RF linking connection and local console support
- Efficient system infrastructure scalability based on IP network connectivity
- Extensive range of remote management and monitoring capabilities with a security focus
- Built-in basic spectrum analyzer provides on-site diagnostics
- Modular structure offers variety of build options to satisfy serviceability or space constraints
- Designed to military standard MIL-STD-810G

FEATURES AND BENEFITS

Delivering on operational needs

- Flexible network design through IP connectivity and linking

- TB9100 channel group compatibility mode

- Transfer data and voice across a packet-switched infrastructure using standard IP communications

- Robust design provides mission-critical voice communications

- P25/DMR Voice over IP (VoIP) support

- Cornerstone of a Tait P25 software-upgradable system

- Quality of Service (QoS) assignments for voice and signalling to allow optimal network packet routing

- Simulcast and Voting solutions for analog conventional, DMR Tier 2 and Tier 3, P25 conventional and trunking systems

- Built-in optional central voting facility selects the best quality signal for transmission

- LSM support means digital P25 simulcast networks require fewer sites

- C4FM simulcast operation

- Multi-DFSI support with full control or audio connectivity only in P25 and analog conventional modes

- Simplex support with antenna relay management in P25 and analog conventional modes

- Analog line support in analog conventional mode for console and system connectivity as well as relay and RF linking configurations

- Built-in Continuous Wave Identification (CWID) generation meets FCC call-sign requirements

- Remote software downloads with no impact to operations

- Built-in basic spectrum analyzer provides on-site diagnostics, by way of plotting signal level

- Control, customize, and enhance base station operations with TaskBuilder, by creating rules that extend the functionality of the base station. Rules can control channel changes, digital outputs, timers, and alarms, based on events and external signals

Resiliency to manage risk and enhance safety in challenging environments

- Dual software image support for fast rollback

- Dual diversity not required due to Simulcast and automatic macro diversity

- Integrated Web https secured application to remotely monitor, diagnose and configure

- Tait smart power supply with auto change from AC to DC for easy battery back-up

- Rated for continuous full output power at 60ºC ambient

- Rugged construction with efficient heatsinks and front-to-rear fan-forced cooling

- Meets relevant MIL-STD-810G test methods

Designed to support effective deployment

- Compact modular design to minimize rack space and improve serviceability

- Migration paths between analog/ P25 conventional/ P25 trunked networks with extensive re-use

- Migration paths from analog/ MPT networks to DMR with extensive re-use

- Front panel user interface to set device IP address, where required

Delivers on Public Safety

- Benefit from the spectral efficiency, multi-vendor interoperability, security, migration and data capability demanded by P25 standards

- Designed and tested with the DMR Tier 2 Conventional and Tier 3 Trunking standards to provide customers with choice of vendor and equipment

- 6.25 kHz equivalent 2-slot TDMA for both voice and data offers spectral efficiency operation

- Ongoing communications during an outage with failsoft

- Tested using the CAP certification program, providing confidence of multi-vendor interoperability

Efficient management with a focus on security

- Remote network management utilizing built-in secure https web server and SNMP V3 support

- Detailed alarm monitoring and reporting of critical base station/repeater parameters

- 12 digital inputs to monitor external equipment

- Inbuilt diagnostics to allow technicians to remotely confirm optimal operation and identify network faults

- Enhanced security through password protection and access level control on web server

- Multiple user accounts

- System logs to provide audit records

- Ability to configure 4,000 channels to allow single configuration across sites

Future-proofed to protect your investment

- Software configurable, including mode and feature upgrades through software licenses as required

- Software upgradeable to add new features and functionality to ensure that your analog, DMR, or P25 solution is maintained and updated with the ever-changing needs of your market and environment

Wide range of configuration options available

- Configurable as a single channel 100W or 50W unit, or a dual channel 50W unit, with a range of DC and AC power supply options

This document refers to the TB9400 range, including the TB9415, TB9435, TB9444, TB9460, and TB9465. For more details on these products, please see the TB9400 Catalog.

TB**9400**
SPECIFICATIONS

tait communications

FREQUENCY BANDS

Frequency	Range	Tait Band	Configuration
VHF	136-174MHz	B1	50W & 100W
UHF	378-420MHz	HH	50W & 100W
	400-440MHz	H1	50W & 100W
	440-480MHz	H2	50W & 100W
	470-520MHz	H3	50W & 100W
700/800MHz	Tx: 762-870MHz*, Rx: 794-824MHz	K4	50W & 100W

* The actual Tx frequency coverage in this band is 762-776MHz, and 850-870MHz

REGULATORY

	P25, Analog FM	DMR
USA (CFR 47)	B1, HH, H1, H2, H3, K4	B1, H1, H2, H3, K4
Canada (RSS-119)	B1, HH, H1, H2, K4	B1, H1, H2, K4
Europe (EN300-113, EN300-086, EN301-489)	B1[1, 2], H1, H2[1], H3	B1[1, 2], H1, H2[1], H3
Australia/New Zealand (AS/NZS4768)	B1[1, 2], H1, H2[1], H3	B1[1, 2], H1, H2[1], H3

[1] CE EN300086 Wideband Approved
[2] EN301929 Marine Wideband Approved on 100W B1 model

GENERAL

Radio specifications

Frequency stability	±0.5 ppm
Channels	4,000
Channel spacing	12.5 kHz and 25kHz** in analog
	Phase 1 - FDMA channel is 12.5KHz, and Phase 2 - 2 TDMA voice channels is 6.25 kHz equivalent in P25
Frequency increment/channel step	VHF 2.5kHz/3.125kHz, UHF 5kHz/6.25kHz, 700/800MHz 5kHz/6.25kHz
External frequency reference	10 MHz/12.8 MHz (auto detect)

Physical specifications

Dimensions (HxWxD)	7 x 19 x 15.8 in (177 x 483 x 400 mm)
	4U rack space
Weight	Single 100 W: 46.5 lb (21.1 kg)
	Dual 50W : 54.7lb (24.8kg)
	Single 50W 43.2lb (19.6kg)
Operating temperature	-22ºF to +140ºF (-30ºC to +60ºC)

Power specifications

Power Supply	
DC	12V, 24V, 48V, PMU (+ve or -ve earth)
AC	88-264V (with Power Factor Correction)

Power consumption* (UHF)	120VAC	230VAC	12VDC	24VDC	48VDC
Standby (Single 50 and 100 W)	0.370A, 30W	0.510A, 31W	2A, 24W	0.975A, 23W	0.480A, 23W
Tx @ 50W Single	1.9A, 235W	1.1A, 220W	18A, 216W	9A, 216W	4.2A, 202W
Tx @ 100W	3.3A, 395W	1.7A, 375W	32A, 385W	15.5A, 370W	7.4A, 355W

* Note Transmitter: These figures are specific to UHF, for other bands consult the product specification manual.
** When P25/AS-IP capable firmware is loaded (not available with DMR/Analog firmware)

MILITARY STANDARDS 810G

Applicable MIL-STD	Method	Procedure
Low pressure (Altitude 15,000ft (4,572m))	500.5	2
Humidity	507.5	2
Vibration	514.6	1
Shock	516.6	1

ANALOG LINE

|	Input	Output
Audio interfaces	600Ω Balanced	600Ω Balanced
Audio interface level	-30dBm to 0dBm nominal (300Hz to 2,550Hz)	-30dBm to 0dBm nominal (300Hz to 2,550Hz)
Frequency response	+0.5/-2.0dB rel. 1kHz (300Hz to 3,000Hz)	
Passband ripple	-3 ~ +1dB	-3 ~ +1dB
Audio distortion	<3% typical (line to RF)	<3% typical (RF to line)

TB**9400**
SPECIFICATIONS

tait communications

TRANSMITTER

Modulation types	FM, C4FM, LSM, H-DQPSK, FFSK, 4FSK
P25 Modulation fidelity (TIA-102)	<2%
Adjacent channel power	-60dBc (ETSI) and -67dBc (TIA-102)
Conducted spurious emissions	
VHF	<-36dBm 9kHz to 1GHz and <-30dBm 1GHz to 4GHz
UHF	<-36dBm 30MHz to 1GHz and <-30dBm 1GHz to 4GHz/12.75GHz
700/800/900MHz	<-20dBm to 9GHz
Output power	
50W	Programmable 5-50W
100W	Programmable 10-100W
Duty cycle	100%

RECEIVER

Modulation types	C4FM, H-CPM, Analog FM, FFSK, 4FSK
Radiated spurious emissions	<-57dBm EIRP to 1GHz
Conducted spurious emissions	<-90 dBm to 1GHz
P25 (TIA102)	
Sensitivity	0.22μV (-120 dBm) @ 5% BER
Intermodulation response attenuation	85dB
Adjacent channel rejection	60dB
Co-channel rejection	9dB
DMR	
Unfaded sensitivity ETS 300 113	
Typical	-119dBm (0.25μV) @ 1% BER
Selectivity ETS 300 113	
@ 1% BER	≥82dB (VHF), ≥79dB (UHF)
Intermodulation response attenuation	≥78dB @ 1% BER unfaded
Blocking rejection	
> 1MHz	100dB @ 1% BER
Analog	
Sensitivity	-120dBm @ 12dB SINAD (0.22μV)
Selectivity (EIA-603)	85dB (VHF & UHF), 79dB (700/800MHz)
Intermodulation	80dB
Spurious response attenuation	≥100dB (ANSI/TIA) and ≥90dB (ETSI)
FM hum and noise	
VHF/UHF	45dB (ANSI/TIA), 50dB (ETSI)
700/800/900MHz	43dB (ANSI/TIA)

FRONT PANEL
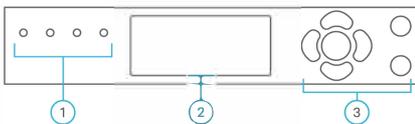
1. Status LEDs
2. 20-character 4-row LCD Display
3. Keypad
4. Flow through ventilation fans x 3 (not pictured)

TAIT NETWORK SOLUTIONS

Backed up by our proven radio network expertise, the TB9400 is part of our larger network offering. The Tait network solution consists of radio units, infrastructure, applications, services and integration with third party interfaces to ensure that your organization can reap all the benefits of the DMR or P25 standard in a mission critical environment.

Tait has taken every care in compiling this specification sheet, but we're always innovating and therefore changes to our models, designs, technical specification, visuals and other information included in this specification sheet could occur. For the most up-to-date information and for a copy of our terms and conditions please visit our website www.taitcommunications.com.

The words "Tait" , "TAIT AXIOM", "Tait Unified", the "Tait " logo and are trademarks of Tait International Limited.

Tait International Limited offices and facilities are certified for ISO 9001:2015 (Quality Management System), ISO 14001:2015 (Environmental Management System) and ISO 45001:2018 (Occupational Health and Safety Management System) for aspects associated with the design, manufacture and distribution of radio communications and control equipment, systems and services. Tait Managed Services are certified for ISO 27001:2013 (Information Security Management System).

Authorized Partners

Quality Management ISO 9001

Environment Management ISO 14001:2015

Occupational Health & Safety Management ISO 45001:2018

DMR DIGITAL MOBILE RADIO ASSOCIATION

P25 DIGITAL WIRELESS • SANS FIL NUMÉRIQUE INALÁMBRICO DIGITAL

EnableMonitor

Overseeing your network health

Real-time monitoring gives assurance that your network is operating as expected, and allows you to minimize impacts if problems occur.
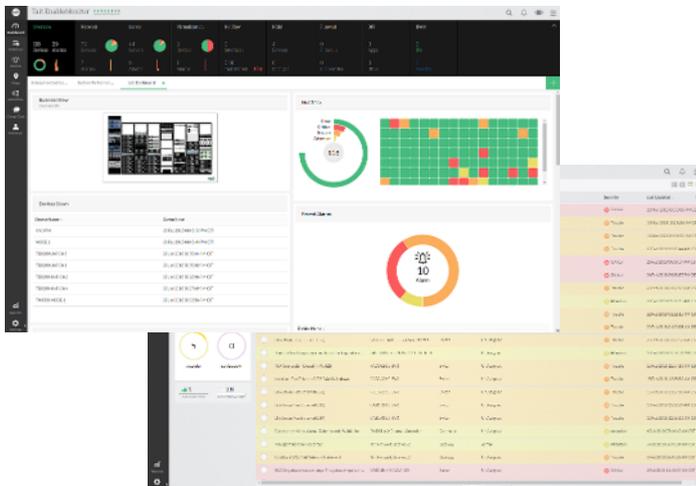
KEY FEATURES

- Real-time system health status that helps you diagnose issues early, and reduce your network downtime
- Proof that your network is operating efficiently
- Reporting on your IT network availability and infrastructure
- Alerts and alarms when there is an issue
- Standards-based technology for interoperability
- Automatic discovery and configuration for simplified setup
- Secure access to performance data anywhere, anytime
- Redundancy options for guaranteed performance
- Support for peace of mind

EnableMonitor
SPECIFICATIONS

FEATURES AND BENEFITS

Real-time system health status for early issue diagnosis

EnableMonitor shows real-time status information about your network, including latency and packet loss. This information enables you to quickly identify potential issues and resolve them before they affect your communications system, reducing your network downtime and maximizing your return on investment.
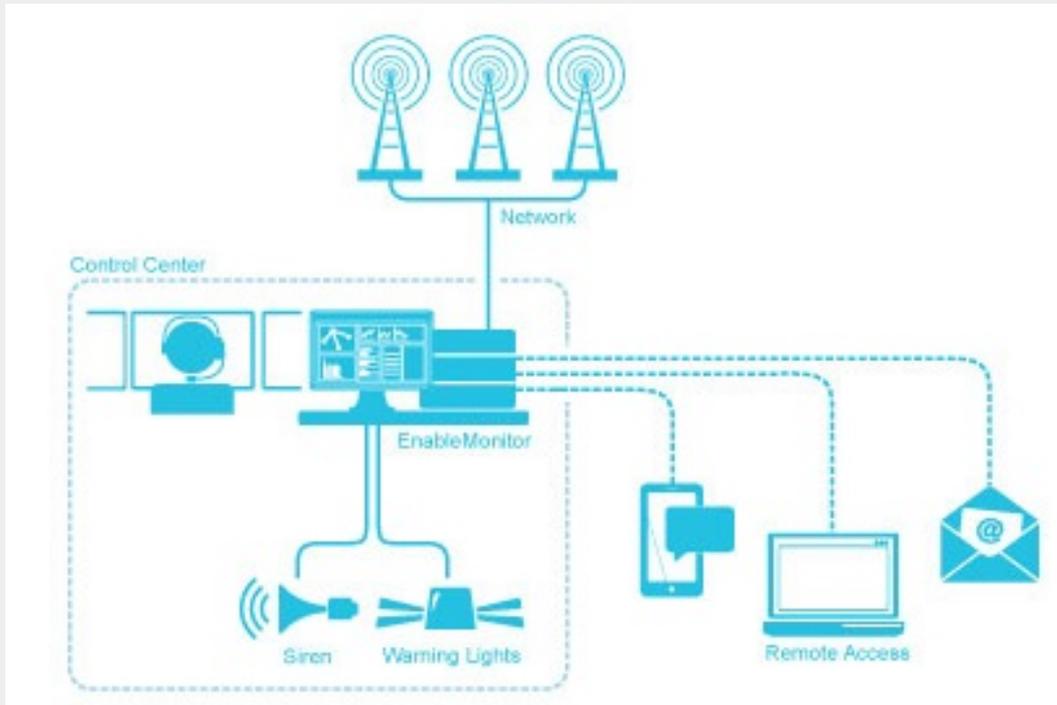
Reporting on your IT network availability and infrastructure

EnableMonitor can also report on the health and availability of infrastructure on your IT network. Each object in your network is represented by an icon that changes color as its status changes. Operators can quickly scan the list of objects and easily determine where problems are occurring and what the problems are.

Alerts and alarms when there is an issue

Network administrators can set up email or SMS notifications for specific alarms, or flashing lights and sirens if there is a major problem, so you can quickly identify and isolate the cause of a problem and resolve it.

Proof that your network is operating efficiently

It has never been easier to see what is happening on your Tait radio network. EnableMonitor has configurable viewing and reporting options to suit your specific network application, including topological maps, schematic diagrams and lists of devices.

FEATURES AND BENEFITS cont.

Standards-based technology for interoperability

EnableMonitor uses Internet standards such as SNMP, ICMP and Windows Management Instrumentation (WMI) to monitor and communicate with devices attached to the network.

For a complete view of your network, EnableMonitor can also be configured to communicate with non-SNMP devices through a protocol mediator and devices from third-party suppliers.

Automatic discovery and configuration for simplified setup

EnableMonitor uses automatic discovery to quickly identify and configure the Tait-supported devices on your network.

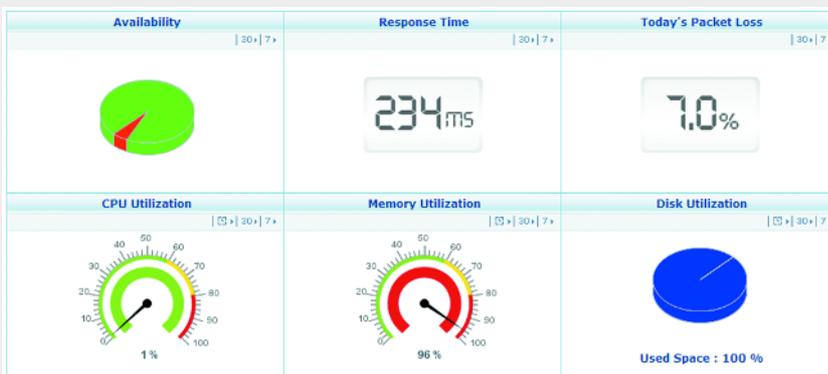### Secure access to performance data anywhere, anytime

EnableMonitor can be securely accessed via the web, including from smartphones, so that you can remotely view network alarm and monitoring information whenever and wherever you need to.

Redundancy options for guaranteed performance

A secondary or standby server can automatically start monitoring the radio network if a primary server fails. The standby server also triggers an alert about the failure, and once the primary server is restored, it automatically returns to standby mode.

Support for peace of mind

Tait engineers and support staff work alongside you to provide a comprehensive and clear commissioning process. Tait also provide installation and managed services for the Tait Enable suite.

EnableMonitor
SPECIFICATIONS

GENERAL		
Delivery Options	EnableMonitor is delivered as a complete hardware and software solution, configured and installed for ease of use.	
Minimum Hardware Requirements	Essential Architecture - one server Enterprise-class Distributed Architecture - minimum of two servers Dell R220 Server	
Licensing Options	**100 or 250 Interfaces**	**500, 1000, 2500 Interfaces**
Processor	2.0 GHz	Dual Core 3.5 GHz
Memory	4GB	4GB
Free Hard Disk Space	20GB	40GB
NIC	10 Mbps	100 Mbps
Video Display Resolution	1024 x 768 or higher	1024 x 768 or higher
Operating Systems Supported	Windows Server 2012 R2, Operating System 64-bit	
Recommended Browsers	IE 11 and above Firefox 18 and above Chrome 24 and above	
Accessories	Ontrack ADU208 Control Relay	
Supported Protocols	SNMP SNMP Trap WMI Syslog Ping/ICMP Telnet/SSH http/https	
Support Devices	Tait TB8200, TB9100, TB9300 & TB9400 Tait TN8271, TN8291, TN9300 & TN9400* Tait TD9300 GridLink Tait EnableProtect Key Management Facility Tait EnableReport Cassidian Site and RFSS Controllers Spectracom SecureSync timing unit Zetron ACOM consoles AVTEC Scout consoles Cisco switches and routers Lantronix switches Moxa switches Mimomax NDL NetGuardian (420)	

*Support for monitoring of operating system and server status.

TAIT COMMUNICATIONS

Our clients protect communities, power cities, move citizens, harness resources and save lives all over the world. We work with them to create and support the critical communication solutions they depend on to do their jobs.

Digital wireless communication forms the central nervous system of everything we do. Around this resilient, robust core we design, develop, manufacture, test, deploy, support and manage innovative communication environments for organizations that have to put their total trust in the systems and people they work with. We've worked hard to develop genuine insight into our clients' worlds, and have pursued engineering, operational and services excellence for more than 40 years. This understanding, and our belief in championing open standards technology, means we can give our clients the best possible choice and value to achieve the human outcomes they're driven by.

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Tait International Limited facilities are certified for ISO 9001:2015 (Quality Management System), ISO 14001:2015 (Environmental Management System) and BS OHSAS 18001:2007 (Occupational Health and Safety Management System) for aspects associated with the design, manufacture and distribution of radio communications and control equipment, systems and services. In addition, all our Regional Head Offices are certified to ISO 9001.

Authorized Partners

Telarc. Registered — Quality ISO 9001
Telarc. Registered — Environment ISO 14001
Telarc. Registered — Health & Safety OHSAS 18001

MAX Dispatch System

Maximize Your Control

Improving your operations, preparing you for the future

There's a lot riding on your dispatch system. That's why we've designed MAX Dispatch to be one of the most effective tools available for managing a range of operations—from routine to mission-critical. It links those who need services with those who provide them. It connects the control center with staff in the field and field staff with each other. It coordinates operations that span departments, agencies, or geographic regions. And it gets your critical messages through, even when other communication modes can't.

What is MAX Dispatch?

Zetron's IP-based MAX Dispatch integrates a full range of tools and resources into a single console system and presents them to the dispatcher through a streamlined graphical user interface (GUI). This gives your dispatchers instant access to the information they need from a single, centralized point. MAX Dispatch can be set up to display information pertinent to an incident only when it's needed. Its IP functionality not only eliminates the need for costly leased lines, but supports mobile, remote, and geographically diverse operations.

How MAX Dispatch Works

Three basic components—the **MAX Console with Media Dock**, the **MAX Gateway**, and **MAX Central** —form the building blocks of each MAX Dispatch system. The size and capabilities of your system will determine how many of each of the three basic components your system will require. The flexibility and simplicity of the MAX Dispatch architecture allows you to easily scale your system up or down to accommodate changes in your organization.

IP Network

MAX CONSOLE WITH MEDIA DOCK
The MAX Console with Media Dock is the point through which the dispatcher interacts with the MAX Dispatch system.

MAX RADIO GATEWAY
The MAX Gateways serve as the interface point between a radio, base station or radio system and the rest of the MAX Dispatch system. These allow MAX to be ready for whatever the market demands.

MAX CENTRAL
MAX Central hosts and serves as the control point for a variety of centralized system functions, such as voice-logging services and administrative telephone lines.

Why MAX Dispatch?

→ **A streamlined UI that improves response times and efficiency.**
The clean design of the MAX Dispatch user interface (UI) reduces screen clutter, operational steps, and response times. It gives dispatchers instant access to information pertinent to the task at hand. And it's easy for dispatchers to grasp—trainers report that it takes about 30 minutes to learn. This reduces training time and costs. Plus, MAX Dispatch is highly configurable, allowing you to create screen layouts that meet the unique needs of your dispatch center.

→ **Redundancy you can rely on.**
Because MAX Dispatch supports network redundancy for every end point, it can tolerate any single point of failure in the IP network with no loss of service. This keeps your vital operations up and running, even if a fault condition occurs.

→ **Low-cost expansion, upgrades, and maintenance.**
MAX Dispatch is built to not only support your current operations, but to adapt as your operations change over time. You can easily add channels and consoles to MAX Dispatch. The system hardware and software architecture also provides an easy upgrade path that keeps your technology current without the need for a large-scale system overhaul. Plus, it can be configured and maintained remotely. This keeps your costs low and ensures that changes and updates can be made quickly.

→ **High interoperability.**
Its compatibility with all major radio interfaces and major radio manufacturers' equipment makes MAX Dispatch one of the most interoperable systems available. This is critically important when you have to manage events across departments or jurisdictions.

→ **Resource sharing and backup across geo-diverse locations.**
MAX Dispatch can be used with the MAX Geo-diverse Portal to link and share resources across geographically distributed locations. This maximizes the efficient use of resources, reduces costs, and allows systems at different sites to back each other up—with just the click of a mouse.

→ **Dispatch from anywhere.**
Because MAX Dispatch can be operated over a laptop or tablet, it gives you the flexibility to deploy remote, temporary, backup, or mobile operations quickly and securely. And delivers all of the features, functionality, and interoperability available in the control room.

→ **MAX Dispatch is future ready.**
Its design is well suited for anywhere the market moves.

Why Zetron?

Zetron services and support

Your MAX Dispatch system comes with a standard 12-month hardware warranty, 12-month software warranty, operator web training, and exclusive membership into the Zetron MAX Users Group (ZMUG). Zetron also offers a range of optional support services to ensure that your system is installed and configured to run optimally. These services include: 24/7 telephone support, software maintenance, hardware replacement and repair, remote and on-site configuration assistance, system re-optimization, and technical and operational training. Many of these options are available as standalone services.

Help with financing

Looking for alternate ways to fund your new dispatch system? Zetron is partnering with a leader in public finance to offer tax-exempt financing to help public-safety agencies purchase new equipment. The program not only applies to a full range of public-safety products, but can be "bundled" to include installation and dispatch furniture as well as other equipment.

Performance you can count on

Zetron has a reputation for the reliability and robustness of its products. They are specifically designed to meet the needs of mission-critical operations that must stay up and running 24/7. Zetron solutions are also known for their longevity. Not only do they continue to deliver a rock-solid performance over time, but they have the flexibility to keep pace with emerging technologies and changing operational requirements.

About Zetron

Founded in 1980, Zetron manufactures and provides communications systems designed to equip the entire mission-critical control room. Its integrated solutions include IP-based dispatch, NG9-1-1 call-taking, voice logging, IP fire station alerting, CAD, mapping, and automatic vehicle location (AVL) systems. Zetron has offices in the United States, the United Kingdom, Australia, and numerous field locations; and a worldwide network of resellers, system integrators and distributors. Zetron is a member of the Codan group of companies.

ZETRON

Always on, always ready.

MAX Dispatch

Zetron's IP-based MAX Dispatch console system is designe to meet the varying needs of the dispatch community while providing a low cost of ownership to the customer. Whether it is expanding the positions and interfaces of one system, sharing resources across multiple systems, increasing mobility options for staff or ensuring your control room can interface to legacy and emerging technologies, the MAX Dispatch radio dispatch console provides the customer an easy path on which to move forward.

FEATURES

- **Simpler operation, lower training Cost:** The user interface is designed to focus attention on the incident by reducing screen clutter, improving response times, and therefore reducing user stress. MAX Dispatch requires minimal training and fewer steps to perform tasks and access information.

- **Three workstations** supports standard PC with Media Dock, laptop version, and CommandIQ complete desktop station.

- **Map-based dispatching:** Available for systems that support location services.

- **High reliability:** End-to-end network redundancy keeps the system up and running even if the IP network goes down. Minimize Maintenance Time and Cost: Configure, troubleshoot and maintain the system from the convenience of the office.

- **Scalable Operations:** The architecture provides scalability for system designs ranging from dedicated LAN network to multi-node, geographically diverse WAN applications.

- Support for PTToC applications.

## MAX Dispatch Standard Console with Media Dock

The MAX Dispatch console is the system element that provides the critical user interface to dispatchers. Each console consists of a Windows®-based client running the MAX Dispatch application software and the optional Media Dock. The console PC is equipped with two, full-duplex Ethernet ports for full network redundancy If your system has a Media Dock it provides additional audio interfaces and connection points for accessories.

MEDIA DOCK INTERFACES SUPPORT

- Up to eight speakers
- Desktop microphone
- 4-wire or 6-wire headset jackbox
- PTT and monitor footswitches
- Four local binary inputs and output that can be used for workstation status
- Four local relay contact closure outputs

WORKSTATION REQUIREMENTS

Operating System:	Windows 7 x 64 Windows 10 Professional
Video Monitor(s):	1920 x 1080 required DirectX 10-compatible graphics processor with a Windows Display Drive Model (WDDM) 1.1 driver pixel shader 3.0 in hardware 1GB of video RAM (minimum)
Processor:	i5 3.0 GHz or better
Memory:	16GB
Drive:	256GB SSD or larger
Network:	100/1000 Ethernet Connection
VideoCard:	AMD Radeon R5 430, 2GB, HH (DP/DP)
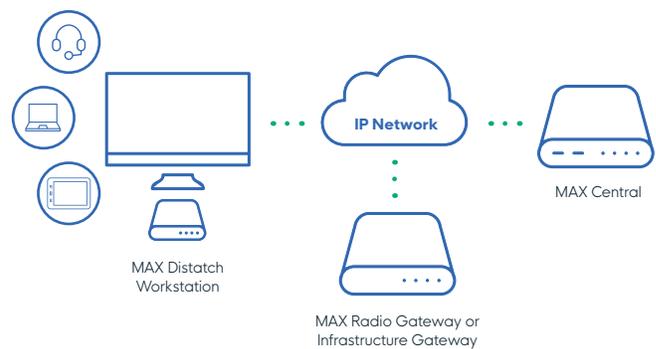
CommandIQ for MAX Dispatch

The CommandIQ workstation is a compact, fully functional hardware console option for MAX Dispatch with an embedded PC, internal speaker and microphone, 10.1″ touchscreen display, handset, and supports external accessories (e.g., additional speakers, headsets, microphones, footswitches, etc.). It's efficient 15″ X 10″ x 4.5″ footprint saves space on desks, enables it to be stored easily, and is configured to easily wall mount. The CommandIQ workstation provides mobility, flexibility, and adaptability to meet any command center, office, or field work environment while maintaining full access to radio, telephone, auxiliary I/O, and paging networks.

MAX Radio Gateway

The Radio Gateway serves as the interface point between a radio or base station and the rest of the MAX system. Radio Gateways are available in both analog and digital forms depending on the radio interface requirement.

SUPPORTED FEATURES

- Analog gateways support up to two radio connections.
- Digital gateway supports Ethernet connection to digital base station infrastructure.
- Dual Ethernet ports for network redundancy.
- Analog voice logger output.
- Four binary inputs and outputs for generic site monitoring and control use (analog gateways only). Relay closures available via optional Zetron Model 6080.

ZETRON

SUPPORTED RADIO INTERFACES (INQUIRE FOR ADDITIONAL RADIOS SUPPORTED)

- 2-wire, 4-wire local (PTT/COR).
- Tone Remote Control (per TIA102.BAHA Section 7).
- Analog/conventional radios: Kenwood TK-x180, Motorola XTL 5000 (O5), Harris M7300/XG75, & XG100.
- P25 conventional/trunking radios: Kenwood TK-5x10, Motorola APX 7500 (O5 Mobile), Motorola XTL 5000 (O5 Mobile), Motorola Quantar with DIU-3000 (conventional only), Harris M7300/XG75 & XG100., Viking VM5000.
- Smartnet/SMARTZONE radios: Motorola APX 7500 (O5 Mobile), Motorola XTL 5000 (O5 Mobile), EFJ VM400/600/900.
- EDACS radios: Harris M7300/XG75 & XG100.
- P25 Digital Fixed Station Interface (DFSI) per TIA102.BAHA.
- Kenwood NEXEDGE radios: NX-700/800/900, NX-720/820
- Kenwood NEXEDGE NXR-700/800 Conventional and Trunking Repeaters.
- DMR AIS Tier II and Tier III, Hytera, Tait and JVCKenwood
- MotoTRBO

MAX Infrastructure Gateway (IG)

The IG serves as the interface point between the radio system and the rest of the MAX system. It is server-based and supports both CSSI and DMR Tier III.

SUPPORTED FEATURES

- Unit ID Display
- Talkgroup selection
- Group calls (inbound/outbound)
- Inbound emergency group call
- Individual calls (inbound/outbound)
- Inbound emergency alert
- Inbound call alert
- Encryption (non-FIPS, not to console position)
- Manual encryption key load
- KVL encryption key load support
- Static talkpath to talkgroup mapping through console system acceptable
- Long term voice logging support for voice
- Long Term Logging support for Group call source id
- Patching of talkgroups by operator
- Console behavior same as with current radio interfaces providing consistent visual indications for transmit, receive, audio routing, call state
- Console Pre-emption of inbound calls

MAX Central

The Central is the hardware platform that hosts several software services used in the MAX Dispatch system. These software services provide essential management and control to the system as well as act as a gateway to various third party devices for additional functionality such as telephony gateways, IP voice loggers, MODBUS IP auxiliary I/O devices and Location Services (AVL). It also hosts the service that provides remote console, remote radio gateway and multiple MAX Dispatch site linkage.

SUPPORTED FEATURES

- Dual network connections
- Dual power connections
- Hot standby capability for Z-Node Manager, Telephony Gateway, Portal services and Location Gateway service.
- Long term IP voice loggers supported: Eventide, Exacom, Stancil, CVDS, REVCORD, Higher Ground, NICE, Verint, DSS Corporation.

Specifications

HARDWARE

Dimensions (HxWxD)
Media Dock XS: 2.5 x 7.5 x 10 in. (64 x 192 x 254mm)
Central: 1.25 x 7.5 x 10 in. (31.75 x 191 x 254mm)
Radio Gateway: 1.25 x 7.5 x 10 in. (31.75 x 191 x 254mm)

Weight
Media Dock XS: 2.6 lbs (1.2 kg)
Central: 2.5 lbs (1.13 kg)
Radio Gateway: 2 lbs (0.91 kg)

Operating Temperature
Media Dock XS: 0 to 60 ° C
Central: 0 to 50 ° C
Radio Gateway: 0 to 50 ° C

Maximum Power Draw
Media Dock XS: 3W, 200mA (no speakers), 21W (with speakers)
Central: 1.8A @ 10.5 VDC
Radio Gateway: 1A @ 10.5 VDC

NETWORK

Radio Gateway Payload (per radio):	168 kbps active. Less than 5kbps idle
Console Workstation Payload:	84 kbps maximum for each active audio stream (Tx or Rx) N*84 kbps for simultaneous Tx on N channels.
Packet Loss:	< 0.1% (< 1% for non-mission critical)
Packet Delay:	< 40 ms for LAN environments; up to 2 seconds for longhaul (long delay) environments.
Packet Jitter:	< 20 ms (< 40 ms for-non mission critical)
Network Infrastructure:	100 Mbps minimum, full-duplex Ethernet Switches and routers must be multicast aware. Mission-critical applications should use a dedicated network

ZETRON

Always on, always ready

005-1401-01

THE POWERFUL DIFFERENCE

COMMANDER II/II+ DC POWER SYSTEMS

Ensure your site has power when it needs it most with the Commander II Series of DC power systems, the next generation of robust power plants.

The Commander II Series offers top of the line power and reliable performance while providing complete customizability when it comes to functionality, scale, and management. The system comes with a web-based monitoring and troubleshooting platform entirely tailored to fit individual needs, providing a completely remote management tool that delivers realtime data at your fingertips.

This system offers hot-swappable modules for quick and easy deployment, minimizing installation time and maximizing uptime with a one-year warranty. Trust the Commander II & II+ for reliable and dependable DC power system to offer **The Powerful Difference.**

COMMANDER II SERIES FEATURES

- 19" rack mount shelf with integrated power distribution
- 90-250 VAC input, Power Factor Corrected
- Standard 4x 125A Battery Circuit Breakers
- Standard 18x 18mm 6A to 63A user selected Load Circuit Breakers
- Output temperature compensated for precise battery charging

- EM4x Controller with comprehensive controls (local and web UI), data collection and alarm monitoring/logging via v2 and v3 SNMP
- General Purpose Digital Inputs for user configured external alarms
- Hot swappable power bays
- Low Voltage Battery Disconnect built-in
- Easily configures to meet site power requirements

COMMANDER II

- 6U rack height with integrated cable management
- 12 power bays accept 3000W, -48V rectifiers
- 36kW max. output capacity @ -54VDC

COMMANDER II+

- 7U rack height with integrated cable management
- 8 power bays accept 3000W, -48V rectifiers
- 8 power bays accept 4800W. 12V or 24V DC-DC converters
- 28.8kW max. output capacity @ -54VDC

TP9800 MULTIBAND PORTABLES

RUGGED, LIGHTWEIGHT, MULTI-AGENCY COOPERATION
Multiple bands. One portable. Customized for you. Increase worker safety and productivity across multiple radio networks and frequency bands with the TP9800 Multiband Portable, a versatile, lightweight and compact radio designed for maximum reliability and interoperability.

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TP9800 MULTIBAND PORTABLES

FEATURES & BENEFITS

3W speaker with water shedding grille and active noise cancellation.

Glove-friendly control options for volume and channel selection.

Large color screen to keep you fully informed at a glance.

SEAMLESS MULTIBAND PERFORMANCE

Connect across all your bands from one dynamic portable. The TP9800 Multiband Portable is configurable to operate on any combination of VHF, UHF and 700/800MHz bands. Flexible and simple ordering and deployment of single, dual, and multiband operation at time of purchase, or subsequently over the air. Bands are not locked and can be reconfigured.

RUGGED, LIGHTWEIGHT DESIGN

Experience the lightest P25 multiband portable radio on the market with high capacity battery and compact design. Bridge communications between agencies, or roam between network coverage areas, without the need for several bulky devices.

MAXIMUM CONNECTIVITY

Connect to the range of networks you will encounter in current operations or future technology migrations: Conventional Analog, P25 Conventional Digital, P25 Trunking Phase 1 and Phase 2, with integrated GNSS option for Location Services, Bluetooth® for wireless voice accessories, and WiFi OTAP.

EXCEPTIONAL AUDIO

Hear and be heard, even in the most extreme environments, with a powerful 3W speaker, and dual microphone active noise cancellation that removes background noise in both analog and digital modes.

ENHANCED WORKER SAFETY

Ensure your workers are safer and better connected. Combined with location data, safety alerts can be automated using Man Down, Lone Worker and Tait GeoFencing software options, or triggered using the programmable Emergency key.

ERGONOMIC USER EXPERIENCE

Enhance operational efficiency and user experience when it matters most. The TP9800 is designed for easy use in emergency situations, with ergonomic, glove-friendly control options; four programmable function keys and a three-way selector; and a range of accessories to tailor your experience.

PROVEN P25 INTEROPERABILITY

Enable multi-agency response and multi-vendor compatibility for voice, data and encryption methods – the TP9800 is designed to meet TIA-102 P25 Compliance Assessment Program requirements.

SECURE COMMUNICATION

Ensure only authorized personnel can hear your communications with end-to-end encryption management options, FIPS 140-2 certified module, AES, DES and ARC4 algorithms, Tait EnableProtect Key Fill Device and Key Management.

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TP9800 MULTIBAND PORTABLES

TECHNICAL SPECIFICATIONS

GENERAL	
Frequency stability	±0.5ppm (-22°F to +140°F/-30°C to +60°C)
Channels/zones	2,000 channels/100 zones
Talk groups	1000 talk groups, up to 2,000 members total
Scan groups	300 with up to 10 members each, maximum of 2,000 members total
Bluetooth®	Supported
Encryption (via Key-Fill Device or OTAR)	Supported in P25 Operation (FIPS Certified 256-bit AES, DES, ARC4)
OTAP	Supported (P25 Trunking, WiFi) – Requires Tait EnableFleet
Dimensions (with High Capacity battery)	1.77 x 2.56 x 5.71in / 45 x 65 x 145mm (DxWxH excluding knobs and antenna)
Weight (with High Capacity battery)	13.42oz / 382g (without antenna)
Supported Languages	English, German, French, Spanish, Portuguese, Czech, Russian, Polish, Bulgarian
Channel Spacing	6.25/12.5/15/20/25/30kHz [1]
Frequency increment	2.5/3.125/5/6.25kHz
Radio Operating temperature	-22°F to +140°F (-30°C to +60°C)
Water and dust protection	IP68 & IP65
Audio Output	3W
Signaling options (analog)	MDC1200 encode and decode, Two Tone decode, PL (CTCSS), DPL (DCS), Selcall
Vocoder type	AMBE +2™

MILITARY STANDARDS 810G					
Applicable MIL-STD	Method	Procedure	Applicable MIL-STD	Method	Procedure
Low pressure	500.5	2	Humidity	507.5	2
High temperature	501.5	1,2	Salt fog	509.5	1
Low temperature	502.5	1,2	Sand & Dust	510.5	1, 2
Temperature shock	503.5	1	Immersion	512.5	1
Solar radiation	505.5	1	Vibration	514.6	1
Rain	506.5	1,3	Shock	516.6	1, 4, 5, 6

BATTERY [2]	
P25 Phase 2 / TDMA Mode Shift Life (5/5/90) with High Capacity battery	18 hours
Analog and P25 Phase 1 / FDMA Mode Shift Life (5/5/90) with High Capacity battery	12 hours

CHARGER	
Charger options (Li-Ion)	Fast desktop single charger, 6-way multi charger, vehicle charger and battery only vehicle charger

REGULATORY DATA	USA (FCC)	CANADA (ISED)	EUROPE/UK (CE)	AUSTRALIA/NEW ZEALAND (AS/NZ)
VHF (136-174MHz)	✔	✔	✔	✔
UHF (378-520MHz)	✔	✔	✔	✔ [3]
700/800MHz	✔	✔	-	-

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TP9800 MULTIBAND PORTABLES

TECHNICAL SPECIFICATIONS continued

TRANSMITTER	VHF	UHF	700/800MHz
(Note – Radio can be configured to operate on any combination of the supported bands)			
Frequency range	136-174MHz	378-520MHz	757-870MHz
Output power (nom)	5W, 3W, 2W, 1W	4W, 2.5W, 2W, 1W	3W, 2.5W, 2W, 1W
Modulation limiting			
12.5/15kHz channel	±2.5kHz	±2.5kHz	±2.5kHz
25/30kHz channel [1]	±5kHz	±5kHz	±5kHz
FM hum and noise			
12.5kHz channel	-45dB	-45dB	-40dB
25kHz channel [1]	-48dB	-48dB	-45dB
Radiated and conducted emissions	-75dBc	-72dBc	-75dBc
Audio response (analog)	+1/-3dB	+1/-3dB	+1/-3dB
Audio distortion (analog @1kHz, 60% mod) [4]	2%	2%	2%

RECEIVER	VHF	UHF	700/800MHz
(Note – Radio can be configured to operate on any combination of the supported bands)			
Frequency range	136-174MHz	378-520MHz	757-776MHz, 851-870MHz
Sensitivity (analog) 12dB SINAD (TA-603I)	0.22uV (-120dBm)	0.22uV (-120dBm)	0.22uV (-120dBm)
Sensitivity (P25) 5% BER	0.2uV (-121dBm)	0.2uV (-121dBm)	0.2uV (-121dBm)
Intermodulation rejection (P25) TIA-102	75dB	75dB	75dB
Adjacent channel rejection			
12.5kHz (P25) TIA-102	60dB	60dB	60dB
25kHz TIA-603 (2-tone) [1]	70dB	70dB	65dB
Spurious response rejection (P25) TIA-102	75dB	80dB	70dB
Residual audio noise ratio (P25) TIA-102	45dB	45dB	45dB
Audio distortion (rated audio)	1.5%	1.5%	1.5%
FM hum and noise (Analog)			
12.5kHz channel	-45dB	-40dB	-40dB
25kHz channel [1]	-48dB	-45dB	-45dB

NOTE:

1. Wideband operation is not available in the USA in some bands.
2. Battery performance is dependent on frequency, temperature, and operational configuration.
3. The UHF band radios are approved for use in Citizen Band in Australia and New Zealand when programmed to meet the requirements of AS/NZS4365.
4. Rated audio (for performance testing) 0.5W.

QUALIFICATIONS

P25 • DIGITAL WIRELESS • SANS FIL • HYBRIDE • INALÀMBRICO DIGITAL

TAIT TOUGH
The Toughest Radios in the Industry

Tait has taken every care in compiling this brochure, but we're always innovating and therefore changes to our models, designs, technical specifications, visuals and other information included in this brochure could occur. For the most up-to-date information and for a copy of our terms and conditions please visit our website www.taitcommunications.com

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TM9800 MULTIBAND MOBILES

FLEXIBLE, RELIABLE, MULTI-AGENCY COOPERATION
Multiple bands. One mobile. Customized for you. Increase worker safety and productivity across multiple radio networks and frequency bands with the TM9800 Multiband Mobile Radio, designed for maximum versatility, reliability and interoperability.

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Tait TM9000 mobile radios have a wide range of control heads, microphones, speakers and installation kits to suit avariety of different vehicles and types of operation. Refer to the TM9000 Control Heads Datasheet for all options.

The Hand Held Control Head (HHCH) option puts all functions in the palm of your hand with easy, flexible installation and is available in a range of colors..

TM9800 MULTIBAND MOBILES

FLEXIBLE, RELIABLE, MULTI-AGENCY COOPERATION

SEAMLESS MULTIBAND PERFORMANCE

The TM9800 Multiband Mobile is configurable to operate on any combination of 136-174MHz or 378-520MHz. Flexible and simple ordering and deployment of single band or multiband operation at time of purchase, or subsequently over the air. Bands are not locked and can be reconfigured.

MAXIMUM CONNECTIVITY

Connect to the range of networks in current operations or future technology migrations: Conventional Analog, P25 Conventional Digital, P25 Trunking Phase 1 and Phase 2.

Broadband data options boost operational performance with edge computing, applications, WiFi vehicle area networks and LTE connectivity.

Analog signaling options include Two Tone decode, MDC1200, PL (CTCSS), DPL (DCS), and Selcall.

PROVEN P25 INTEROPERABILITY

Enable multi-agency response and multi-vendor compatibility for voice, data and encryption methods – the TM9800 is designed to meet TIA-102 P25 Compliance Assessment Program requirements.

ENHANCED WORKER SAFETY

Lone Worker feature included as standard to send automated safety alerts and can combine with location data and Tait GeoFencing software options to guide an effective response. The programmable Emergency key can also send these safety alerts manually.

- The LCH supports covert microphone operation.
- Supports end-to end encryption, including AES encryption.
- Blast Alarms and Audible Alerts on P25 conventional and Selcall channel.

EFFECTIVE OPERATIONS WITH VOICE AND DATA

- Pre-set status messages
- Supports conventional and trunked IP data and P25 data such as GNSS location.
- Location services over conventional and trunked networks. Internal and external GNSS options available (refer to product catalog).

DESIGNED FOR DEMANDING ENVIRONMENTS

IP54 rated for protection against dust and splashing water, exceeds MIL-STD-810G for reliable operation in a range of environmental conditions such as the vibrations of a vehicle installation and low/high temperature extremes.

EFFICIENT, SECURITY-FOCUSED MANAGEMENT

Over-the-air-programming (OTAP) with Tait EnableFleet configuration management system delivers software and firmware changes over the Tait P25 Trunked radio network or WiFi, (when WiFi OTAP option is fitted) making it faster, easier and more affordable to update and optimize the performance of radios in your fleet.

Compatible with Tait EnableProtect Advanced System Key to allow administrators to authorize and restrict subscriber units on their network.

Encryption Management options include Tait EnableProtect Key Management Facility (KMF) supporting OTAR (Over-the-air Rekeying) and Tait EnableProtect Key Fill Device (KFD) for quick, reliable encryption key programming.

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TM9800 MULTIBAND MOBILES

TECHNICAL SPECIFICATIONS

GENERAL	
Frequency stability	±0.5ppm (-22ºF to +140ºF/-30ºC to +60ºC)
Channels/zones	1,000 channels/50 zones (2,000 channels/100 zones optional enhancement with software license)
Talk groups	1000 talk groups, up to 1,000 members total (2,000 members optional enhancement with software license)
Scan groups	300 with up to 50 members each, maximum of 2,000 members total
Power supply	10.8-16VDC
Active standby current	0.15A
Channel spacing	12.5/15/20/25/30kHz
Frequency increment	2.5/3.125/5/6.25
Dimensions (DxWxH) - Large Control Head	1.38 x 7.24 x 2.8in (35x 184 x 71mm)
- Radio Body	6.9 x 6.3x 2.1in (175x 160 x 52mm)
Weight - Large Control Head	0.73lb (0.33kg)
- Radio Body	2.6lb (1.2kg)
Supported Languages	English, German, French, Spanish, Portuguese, Czech, Polish, Bulgarian
Operating temperature	-22ºF to +140ºF (-30ºC to +60ºC)
Water and dust protection	IP54
RF connector	50 ohm BNC
Interface connectors	3 programmable interface connectors providing serial ports and GPIO lines for radio and accessory control, and audio connectivity
Signaling options (analog)	MDC1200 encode and decode, Two Tone decode, PL (CTCSS), DPL (DCS), Selcall

TRANSMITTER	VHF	UHF
(Note – Radio can be configured to operate on any combination of the supported bands)		
Frequency range	136-174MHz	378-520MHz
Transmit power	25W, 10W, 5W, 1W	25W, 10W, 5W, 1W
Transmit current	4.5A max	4.5A max
Modulation limiting		
12.5/15kHz channel	±2.5kHz	2.5kHz
25/30kHz channel	±5kHz	±5kHz
FM hum and noise (Analog)		
12.5kHz channel	-45dB	-40dB
25kHz channel	-48dB	-45dB
Radiated and conducted emissions	-80dBc	-80dBc
Audio response (Analog)	+1/-3dB	+1/-3dB
Audio distortion (Analog)	1 .5% @ 1kHz, 60% deviation	
Duty cycle	25W: 2min Tx, 4min Rx for 8 hrs @ +140°F (+60°C) 5W: continuous @ +104°F (+40°C)	

RECEIVER	VHF	UHF
(Note – Radio can be configured to operate on any combination of the supported bands)		
Frequency range	136-174MHz	378-520MHz
Sensitivity (analog) 12dB SINAD (TA-603I)	0.22uV (-121dBm)	0.22uV (-120dBm)
Sensitivity (P25) 5% BER	0.22uV (-121dBm)	0.22uV (-120dBm)
Intermodulation rejection (P25) TIA-102	78dB	75dB
Adjacent channel rejection		
12.5kHz (P25) TIA-102	60dB	60dB
25kHz TIA-603 (2-tone)	73dB	70dB
Spurious response rejection (P25) TIA-102	80dB	80dB
Residual audio noise ratio (P25) TIA-102	45dB	45dB
FM hum and noise (Analog)		
12.5kHz channel	-45dB	-40dB
25kHz channel	-48dB	-45dB
Audio distortion (3W rated audio)	1.5%at 1kHz 60%modulation	
Optional external speaker output	10W (into 4 ohm)	

MILITARY STANDARDS 810C, D, E, F, and G[#]					
Applicable MIL-STD	Method	Procedure	Applicable MIL-STD	Method	Procedure
Low pressure	500.5	2	Humidity	507.5	2
High temperature	501.5	1, 2	Salt fog	509.5	1
Low temperature	502.5	1, 2	Sand & Dust	510.5	1, 2
Temperature shock	503.5	1	Vibration	514.5	1
Solar radiation	505.5	1	Shock	516.5	1, 4, 5, 6
Rain	506.5	1, 3			

REGULATORY DATA	AUSTRALIA/NEW ZEALAND (AS/NZ)
VHF (136-174MHz)	✔
UHF (378-520MHz)	✔ *

* The 25W UHF band radios areapproved for use in Citizen Band in Australia and New Zealand when programmed to meet the requirements of AS/NZS4365.

\# Designed to meet MIL Standards. Compliance pending.

QUALIFICATIONS

Quality Management ISO 9001

Environment Management ISO 14001:2015

Occupational Health & Safety Management ISO 45001:2018

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TM9000 CONTROL HEADS

FLEXIBLE OPTIONS, EASY TO USE AND INSTALL

Tait solutions are designed for maximum flexibility, to be tailored to each customer's needs. Tait TM9000 mobile radios have a wide range of control heads, microphones, speakers and installation kits to suit a variety of different vehicles and types of operation.

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TM9000 CONTROL HEADS

TCH SERIES

- Bright and clear, easy to read, high resolution color displays
- Compatible with TM9300, TM9400, TM9700, and TM9800 mobiles
- Upgrade existing TM9300 and TM9400 fleets for an enhanced user experience

TCH3: LOCAL MOUNT CONTROL HEAD WITH SPEAKER

- Compact color control head (same width as TM93/94 radio body)
- Local mount (attached to radio body)
- Built-in 4W speaker, optional external speakers
- Four function keys (two softkeys)
- Standard or keypad microphone

TCH4: REMOTE CONTROL HEAD WITH SPEAKER

- DIN size color control head
- Remote mount (separate from radio body)
- Built-in 4W speaker, optional external speakers
- Five function keys (two softkeys)
- Standard or keypad microphone
- Built-in covert microphone

TCH6: REMOTE CONTROL HEAD WITH KEYPAD

- DIN size color control head
- Remote mount (separate from radio body)
- Requires external speaker
- Built-in numeric keypad
- Five function keys (two softkeys)
- Standard or keypad microphone
- Built-in covert microphone

MICROPHONE OPTIONS

- Standard Microphone
- Keypad Microphone with menu scrolling keys, two soft keys and numeric keypad
- Compatible with TCH and LCH
- Refer to the TM9000 Options and Accessories Catalog for more options including handsfree mic with remote PTT, handsets and desktop mics

PRELIMINARY - SUBJECT TO CHANGE

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TM9000 CONTROL HEADS

LCH & HHCH SERIES

- Flexible installation options
- Compatible with TM9300, TM9400, TM9700, TM9800, and TMX450 mobiles

TM9000

LARGE CONTROL HEAD (LCH)

- Local and remote mount options
- Built-in 3W speaker, optional external speakers
- Dual Control Head capability (TM9357, TM9457)
- Color options - black, yellow or green

HAND HELD CONTROL HEAD (HHCH)

- Full control in the palm of your hand
- Highly flexible installation options
- Requires external speaker
- Dual Control Head capability (TM9357, TM9457)
- Color options - black, yellow, green, or red

SPEAKER OPTIONS

- 15W Rugged External Speaker, IP67, able to wire speakers in parallel
- 10W Standard Speaker
- Compatible with all TM9000 mobile radios and control heads
- Refer to the TM9000 Options and Accessories Catalog for more information about speaker options

PRELIMINARY - SUBJECT TO CHANGE

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TM9000 CONTROL HEADS

COMPARISON CHART

CONTROL HEAD	LCH	HHCH	TCH3	TCH4	TCH6
Physical Dimensions (W x H x D) Excluding radio body	Local Mount 184 x 71 x 50mm 2.8 x 7.2 x 248in Remote Mount 71 x 184 x 61mm 2.8 x 7.2 x 2.4in	65 x 135 x 35mm 2.6 x 5.3 x 1.4in	160 x 52 x 51mm 6.3 x 2.0 x 2.0in	178 x 52 x 72mm 7.0 x 2.0 x 2.8in (DIN size)	178 x 52 x 72mm 7.0 x 2.0 x 2.8in (DIN size)
Weight	Local Mount 340g (12.0oz) Remote Mount 400g (14.1oz)	289g (10.2oz)	210g (7.4oz)	282g (9.9oz)	282g (9.9oz)
Display Visible Area (W x H)	60 x 26mm 2.4 x 1.0in	35 x 18mm 1.4 x 0.7in	62 mm x 24mm 2.5 x 0.9in	62 mm x 24mm 2.5 x 0.9in	62 mm x 24mm 2.5 x 0.9in
Display Resolution (W x H)	160 x 64px	96 x 62px	422 x 154px	422 x 154px	422 x 154px
Display Capabilities	Four-line monochrome transflective display with icons, soft key labels and menu options		High resolution, easy to read, four-line color transmissive TFT display including icons, soft key labels and menu options		
Soft Keys	2	2	4	4	4
Programmable Function Keys (Includes Emergency Key)	4	6	4 (includes 2 soft keys)	5 (includes 2 soft keys)	5 (includes 2 soft keys)
Orange Emergency Key (Uses function key)	Yes	Yes	Yes	Yes	Yes
Covert microphone	Yes	N/A	No	Yes	Yes
Speaker	Built-in 3W External 10W or 15W options	External 10W or 15W	Built-in 4W External 10W or 15W options	Built-in 4W External 10W or 15W options	External 10W or 15W
Full Keypad (to dial numbers, or enter text)	Via Keypad Microphone	Built-in	Via Keypad Microphone	Via Keypad Microphone	Built-in
Local Mount option (Control Head attached directly to radio body)	Yes	No	Yes	No	No
Remote Mount Option (Control Head separate from radio body)	19ft and 40ft (6m and 12m) options, dual head support	19ft and 40ft (6m and 12m) options, dual head support	No	19ft and 40ft (6m and 12m) options*	19ft and 40ft (6m and 12m) options*
Housing Color Options	Black, Yellow, Green	Black, Yellow, Green, Red	Black	Black	Black

* Dual Head operation and Remote Head Extender Kits are not currently supported for TCH4 or TCH6.

Quality Management ISO 9001

Environment Management ISO 14001:2015

Occupational Health & Safety Management ISO 45001:2018

PRELIMINARY - SUBJECT TO CHANGE

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SINCLAIR™
Superior then, Superior now.
A Norsat Company n° | Norsat International Inc.

Antennas
Low Band, Aviation, and VHF Antennas
SC251-HL-PIM/PIP Certified Series

SC251D-HF2LDF(D00-G3) Collinear dual antenna, 2.3 dBd gain, low PIM, PIP rated, HD, 138-158 MHz

- Wideband 2.3 dBd gain, dual port with 35dB minimum isolation
- 500W power handling with low PIM and high PIP rating
- Rugged fiberglass radome provides superior environmental protection
- 0, 2, 4, or 6 degrees of electrical downtilt available

A side mounting kit is Mandatory when offset mounting the antenna. The SMK-345-A7 for Offset Side Mount is available separately.

The SC251-HL is a 2.3dBd collinear omni featuring low passive intermod performance with single or dual port configuration option available. Fabricated using durable components, this series of antennas is designed for ease of installation. The foam wrapped brass construction provides a light and durable structure housed in a UV protected fiberglass radome ensuring superior resistance to harsh environmental conditions. This family is fabricated to meet the most stringent wind and ice loading requirements.

Due to its wide band and high average power and PIP power handling capability, this antenna is ideally suited for VHF trunking applications or multi-channel operations.

The reliability and durability of this antenna makes it suitable for mission critical applications such as public safety and law enforcement.

SC251D-HL integrated two identical SC251-HL antennas into one radome to simplify the installation and save tower space.

www.sinctech.com

Region	United States	Europe, Middle East and Africa	Caribbean and Latin America	Canada and rest of the world
Telephone	USA: 1 800 263 3275	International: +44 (0) 1487 84 28 19	International: +1 905 726 7676	Canada: 1 800 263 3275 International: +1 905 727 0165
E-mail	salesusa@sinctech.com	salesuk@sinctech.com	salesla@sinctech.com	salescan@sinctech.com

Electrical Specifications

Frequency Range	MHz	138 to 158	
Bandwidth	MHz	20	
Connector		7/16 DIN-Female	
Gain (nominal)	dBd (dBi)	2.3 (4.4)	*1
Input VSWR (max)		1.5:1	
Polarization		vertical	
Impedance	Ω	50	
Pattern		Omni- directional	
Vertical beamwidth (typ)	degrees	37	
Average Power Input (max)	W	500	
Isolation port to port (min)	dB	35	
Passive intermod. (2x20W, 3rd ord.)	dBc	-150	
Lightning protection		DC ground	
PIP(KW, max)		25	
Electrical tilt (available)		0, 2, 4, or 6 degrees	

Mechanical Specifications

Width	in (mm)	5 (127)
Depth	in (mm)	5 (127)
Length/ Height	in (mm)	300 (7620)
Base pipe diameter	in (mm)	5 (127)
Base pipe mounting length	in (mm)	26 (660)
Radome material		fiberglass (UV protected)
Weight	lbs (kg)	97 (44.04)
Weight iced (1/2" ice)	lbs (kg)	175 (79.45)
Mounting Hardware (Optional)		Clamp006C
Actual shipping weight	lbs (kg)	148 (67.19)
Shipping dimensions	in (mm)	310x6x6 (7874x152x152)
Number of ports		2
Mounting configurations		Universal mount *2
Recommended For Offset Side Mount:		SMK-345-A7
Radome Colour		Light Blue

Environmental Specifications

|		
Temperature range	°F (°C)	-40 to +140 (-40 to +60)
Wind Loading Area (Flat Plate Equivalent)	ft² (m²)	6.4 (0.59)
Wind Loading Area (1/2" ice)	ft² (m²)	7.8 (0.72)
Rated wind velocity (no ice)	mph (km/h)	145 (233)
Rated wind velocity (1/2" radial ice)	mph (km/h)	125 (201)
Lateral thrust (100 mph No Ice)	lbs (N)	251 (1116.4)
Bending moment (100 mph No Ice)	ft-lbs (Nm)	2540 (3429)
Tip deflection (100 mph No Ice)	degrees	3.1

Notes
*1 : Gain=2.2-2.4dBd over the band
*2 : for zero degree down tilt only

Ordering Information
Order mounting clamp 006C and side mounting kit SMK-345-A7 separately.

MEASURED RADIATION PATTERN
Vertical
Relative Gain - 10 dB per Division

www.sinctech.com

# ANT150F2
FIBERGLASS COLLINEAR ANTENNA   2.5 dBd

The Telewave ANT150F2 is an extremely rugged collinear antenna, with moderate gain and wide vertical beamwidth. This compact antenna produces 2.5 dBd gain, and is designed for operation in all environmental conditions. The antenna is constructed with brass and copper elements, with a path to DC ground for lightning impulse protection.

All junctions are fully soldered to prevent RF intermodulation, and each antenna is completely protected within a rugged, high-tech radome to ensure survivability in the worst environments. The "Cool Blue" radome provides maximum protection from corrosive gases, ultraviolet radiation, icing, salt spray, acid rain, and wind blown abrasives.

The ANT150F2 includes the ANTC485 dual clamp set for mounting to a 1.5" to 3" O.D. support pipe, and a 24" removable RG-213 N-Male jumper.
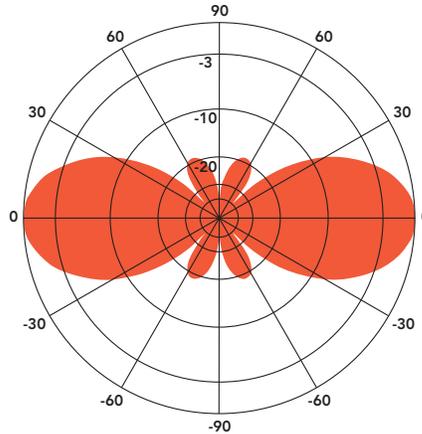
ANT150F2 156 MHz
Vertical Plane
Gain = 2.55 dBd

TYPICAL VSWR RESPONSE
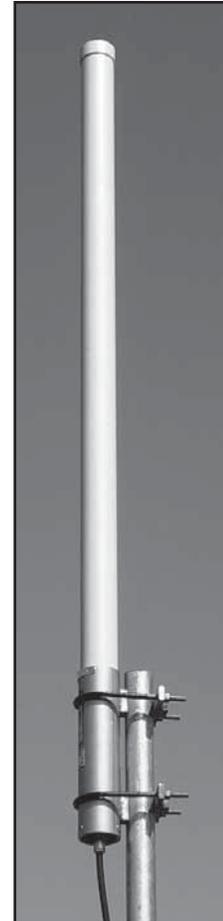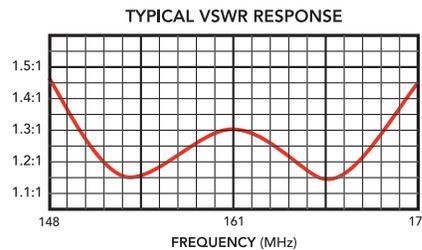
SPECIFICATIONS			
Frequency (continuous)	148-174 MHz	**Dimensions (L x base diam.) in.**	60 x 2.75
Gain	2.5 dBd	**Tower weight (antenna + clamps)**	12 lb.
Power rating (typ.)	500 watts	**Shipping weight**	16 lb.
Impedance	50 ohms	**Wind rating / with 0.5" ice**	200 / 150 MPH
VSWR	1.5:1 or less	**Maximum exposed area**	1.3 ft.²
Pattern	Omnidirectional	**Lateral thrust at 100 MPH**	50 lb.
Vertical beamwidth	38°	**Bending moment at top clamp**	67 ft. lb.
Termination	Recessed N Female 7-16 DIN-F opt.	**(100 MPH, 40 PSF flat plate equiv.)**	

TWDS-7017   Rev. 1/11

Aviat
NETWORKS

ECLIPSE IRU 600v4
MISSION CRITICAL MICROWAVE

When you can't sacrifice reliability for high capacities, the Eclipse™ IRU 600v4 represents the ultimate in high performance, high reliability and the highest capacity Mission Critical Microwave. The IRU 600v4 is the industry's most secure radio with the highest transmit output power available with extra transmit power (+ 40 dBm or 5 times more than high power) and is the industry's highest capacity all-indoor radio built for Mission Critical Applications.

INDUSTRY'S HIGHEST POWER DIGITAL RADIO EVER

With the Extra High Power (EHP) option, the IRU 600v4 improves output power to +40 dBm, or more than five times more power than the high power IRU 600v4 model, making it the highest power solution on the market today. This option enables quantum improvements in increased reliable RF performance, extending path distances and/or stepping down to smaller, less expensive antennas. The IRU 600v4 is designed with a powerful antenna coupling unit that features an exceptionally low loss switch, instead of a coupler, and an expansion port for simplified expansion and protection deployments. This supports simplified connections to existing antenna systems and quick network cutover for expanding and extending your network.

ULTRA-HIGH CAPACITY, BUILT TO LAST

The IRU 600v4 also supports wide channels and high modulation capabilities up to 4096QAM to lead the industry in capacity for all-indoor radio products with a total of 715Mbps across a 80MHz channel, or 3x more capacity than older generation radios. With the rapid growth in high definition video and other bandwidth hungry applications, capacity is rapidly becoming one of the most important considerations in microwave radios and previously, achieving higher capacities meant sacrificing network reliability and performance not anymore! The combination of the highest available transmit output power and system gain along with the highest possible capacity means you get the most reliability and the most capacity without any sacrifice of network uptime, especially as you grow your network. The IRU 600v4 not only enables reliable transport of higher capacities but it offers scalability as network demands increase and more capacity is needed. It ensures your investment can outpace changes in capacity and the speed at which networks evolve.

INDUSTRY'S MOST SECURE AND RELIABLE MICROWAVE RADIO

The IRU 600v4 is built for the toughest conditions, engineered for high reliability and bulletproof redundancy. Reliability is combined with the Eclipse Strong Security suite, the industry's highest level of microwave communications security. Security is integrated and embedded — not "added on" – providing enhanced security capabilities such as payload encryption, secure management and integrated RADIUS capability. The IRU 600v4 is built to last.

DESIGNED, BUILT, SUPPORTED IN USA

The Eclipse IRU 600v4 is uniquely designed, built and supported all within the USA. Aviat's nationwide presence includes Corporate Headquarters and R&D center, manufacturing, and comprehensive in-country deployment services and after-sales support network. Combined with our 60-year+ presence and expertise, you can be assured of superior products and support for all your mission critical microwave needs.

Key Features at a Glance

- FCC Part 101, NTIA and ISED Canada frequencies L6/U6, FCC7, 7/8, 10.5 and 11 GHz, and unlicensed 5.8 GHz in a single platform.
- Up to +40 dBm transmit power.
- Adaptive Coding & Modulation support up to 4096QAM.
- Wide channel support up to 80MHz.
- FIPS 197 / FIPS 140-2 validated.
- RF transmit switch reduces loss by up to 6.1dB on standby compared to MHSB coupler.
- 5.8 GHz, L6, and U6 in the same RFU for simple unlicensed to licensed band upgrades.
- Operation with Eclipse Packet Node and CTR 8000
- Transparent to all types of traffic, including all-IP, all-TDM, or hybrid.
- High capacity transport up to 715Mbit/s, 127xDS1 or 6xDS3 or 2xOC-3.
- Indoor, ultra compact chassis design 2 RMS for 1+1 Protected RFU + ACU.
- Front panel Tx Monitoring port for easy maintenance without traffic interruption.
- Built-in expansion port for simplified expansion, connection to existing radio antenna systems and network cutover.
- Support for unpaired frequencies in all frequency band.
- Expandable with link aggregation for ultra-high capacities and advanced configurations.
- Optional frequency re-use with XPIC for high throughput link capacities.
- 24/48VDC operation.
- Extremely low loss ACU for N+N.

SYSTEM PARAMETERS

System

	5.8 GHz	L6 / U6 GHz	FCC 7 GHz	7 GHz	8 GHz	10.5 GHz	11 GHz
Frequency Range (GHz)	5.727.5 - 5.847.5	5.925 - 6.425, 6.425 - 6.930	6.875 - 7.125	7.125 - 7.750	7.750 - 8.500	10.500 - 10.680	10.700 - 11.700
TR-Spacings Supported (MHz) (Non-standard T-R options supported with spot tuned filters)	≥65	150, 160, 170, 180, 240, 252.04, 266, 340, 345	150	150, 175, 300	300, 360	65	490, 500
Standard Frequency Assignments Supported per Regulatory Plans	FCC Part 15.407 RSS-247, Issue 2	FCC Part 101, SRSP 305.9, SRSP 306.4	FCC Part 74, 101	NTIA Red Book, SRSP 307.1	NTIA Red Book, SRSP 307.7 SRSP 308.2	FCC Part 101, SRSP 310.5	FCC Part 101, SRSP 310.7

General

Frequency Band options	5.8, L6, U6, FCC 7, 7, 8, 10.5 and 11 GHz
Modulation and Coding Options	Fixed and Adaptive QPSK, 16, 32, 64, 128, 256, 512, 1024, 2048 and 4096 QAM
Channel Sizes Supported	3.75, 5, 10, 12.5, 20, 25, 30, 40, 60 and 80 MHz
Capacity Support — Airlink Capacity	8-716 Mbit/s
Ethernet / IP Throughput	15-940 Mbit/s
Native TDM	5 to 127 DS1, 2xOC3, 6xDS3

Electrical and Mechanical

Power Consumption, typical unless stated	32.0 dBm	31.0 dBm	29.5 dBm	29.0 dBm	28.0 dBm	25.0 dBm	21.0 dBm	20.0 dBm	TX Muted
1+0 SP/HP unit 5.8 GHz	NA	NA	NA	62W	NA	55W	NA	48W	43W
1+0 SP/HP unit L6/U6/FCC 7 GHz 1+0	62W	NA	NA	NA	NA	55W	NA	48W	43W
1+0 SP/HP unit (guaranteed) 7/8 GHz	NA	62W	NA	NA	58W	NA	54W	NA	43W
1+0 SP/HP unit 10.5/11 GHz	NA	NA	60W	NA	NA	55W	NA	48W	43W

	37.5 dBm	36.0 dBm	35.0 dBm	34.0 dBm	33 dBm	32.0 dBm	27.5 dBm	27.0 dBm	26.0 dBm	25.0 dBm	TX Muted
1+0 EHP unit L6 GHz	113W	NA	NA	95W	NA	85W	77W	NA	NA	NA	46W
1+0 EHP unit U6/FCC 7 GHz	119W	NA	NA	102W	NA	90W	83W	NA	NA	NA	46W
1+0 EHP unit 7 GHz	NA	116 W	NA	NA	99 W	NA	NA	NA	87W	NA	43W
1+0 EHP unit 8 GHz	NA	NA	116 W	NA	NA	99 W	NA	NA	NA	87W	43W
1+0 EHP unit 11 GHz	NA	NA	NA	NA	97 W	NA	NA	87W	NA	NA	46W

		SP/HP units	EHP units
Size / Weight (1+1 configuration)			
ACU+Chassis+2RFU (includes waveguide terminator)	2RU 3.5 x 19 x 16.25 in, 88 x 482 x 412 mm	32.5 lb / 14.7 kg	33.9 lb / 15.4 kg
Chassis+2 RFU	2RU 3.5 x 19 x 12 in, 88 x 482 x 304 mm	28.0 lb / 12.7 kg	29.5 lb / 13.4 kg

Antenna Interface	5.8/L6/U6/FCC 7 GHz	7/8 GHz	10.5/11 GHz
ACU Main / Expansion Antenna Port Interface	CMR-137	CMR-112	UG 39
Extension Kit Antenna Port Interface, near top of rack	CPR-137G	CPR-112G	CPR-90G

Environmental

Operating Temperature	Guaranteed	-10° to +55° C (14° to +131° F)
Humidity & Altitude		0 to 95%, non-condensing, 4,500 meters(15,000 ft) AMSL

Standards Compliance

EMC	FCC CFR 47, Part 15, ICES-003
Operation, Storage, Transportation	EN 300 019, Class 3.1E, EN 300 019, Class 1.2, EN 300 019, Class 2.3
Safety	UL 62368-1, CAN/CSA C22.2 No. 62368-1-14
Electric Power Substations [1]	IEEE 1613
Radio Frequency	FCC Part 15.407, ISED RSS-247, Issue 2 (5.8 GHz only), FCC CFR47, Part 101, ISED Canada's SRSPs (L6 to 11GHz)
NEBS [2]	GR-1089-CORE, GR-63-CORE
Security	FIPS 197 validated (Certificate #C5), FIPS 140-2 validated (Certificate #3558)

IF Specifications

IF Frequency	Transmit/Receive	311 MHz/126 MHz
IF Cable Length		1000 ft (300m) max (limitation apply)
Test Point	RSSI Monitoring Point [3]	Test Points female
	TX Monitoring Port	SMA female

Emission Designators

	3.75 MHz	5 MHz	10 MHz	12.5 MHz	20 MHz	25 MHz	30 MHz	40 MHz	60 MHz	80 MHz
QPSK	3M75G7W	5M00G7W	10M0G7W	12M5G7W	20M0G7W	25M0G7W	30M0G7W	40M0G7W	60M0G7W	80M0G7W
QAM	3M75D7W	5M00D7W	10M0D7W	12M5D7W	20M0D7W	25M0D7W	30M0D7W	40M0D7W	60M0D7W	80M0D7W

Transmitter Specifications

Transmit Power Tolerance		-0 +1 dB
Transmitter Source		Synthesized
Frequency Stability		±5 ppm
Manual Transmitter Power Control Range		Configurable in 0.1 dB steps from min to max power levels (Refer to TX Power Specifications)
	Resolution	0.1 dB
Automatic Transmitter Power Control	Range	Configurable over full available manual attenuation range
	Resolution / Speed	0.1 dB steps / 6 dB per second
Synthesizer Resolution		5 KHz
Channel Selection		By software control within tuning range of RFU
Transmitter Mute		> 50 dB

Receiver Specifications

Receiver Source		Synthesized
Frequency Stability		±5 ppm
Receiver Overload	BER = 1E-6	-22 dBm
	No damage	0 dBm

Additional Protection Losses ı

IRU 600v4	Contact Aviat Networks for details

Regarding EHP L6 and U6 when using unpaired frequencies, see Eclipse user Manual for "Small non-standard T/R spacings".

[1] Complies with the exception of clause 3.1.1 (operational temperature range) and clause 10 (device cooling).

[2] IRU 600v4 complies in all areas except for R9-16 and R10-5, GR-1089-CORE. INU complies in all areas except   for R10-5, GR-1089-CORE and R4-34, O4-35, O4-36, GR-63-CORE.

[3] RSSI accuracy applies when there is no potential interferer signal present within +/- 10MHz of the Rx. Frequency.

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PROVISION® ELEMENT MANAGEMENT SYSTEM

SUPPORT FOR ALL NETWORK EQUIPMENT TYPES

ProVision provides the following Aviat Networks and third-party device support:

- CTR 8540/8300 microwave router platform
- Eclipse and Eclipse Packet Node Platform
- Aviat WTM series of all-indoor and all-outdoor microwave systems
- All Aviat current, legacy, and future devices
- Generic Device Support fault management for a wide range of third-party SNMP devices; 50+ third-party device packages currently available
- Application Integration including craft tools, PCR collector, PCR viewer, MSUU.

NETWORK INTELLIGENCE

The ProVision Element Management System delivers superior wireless networking intelligence by offering a unique feature set, based on industry standards, designed to support the increasing demands of growing networks. By leveraging Aviat Networks' innovative microwave systems, ProVision maximizes network availability and throughput while significantly reducing OPEX.
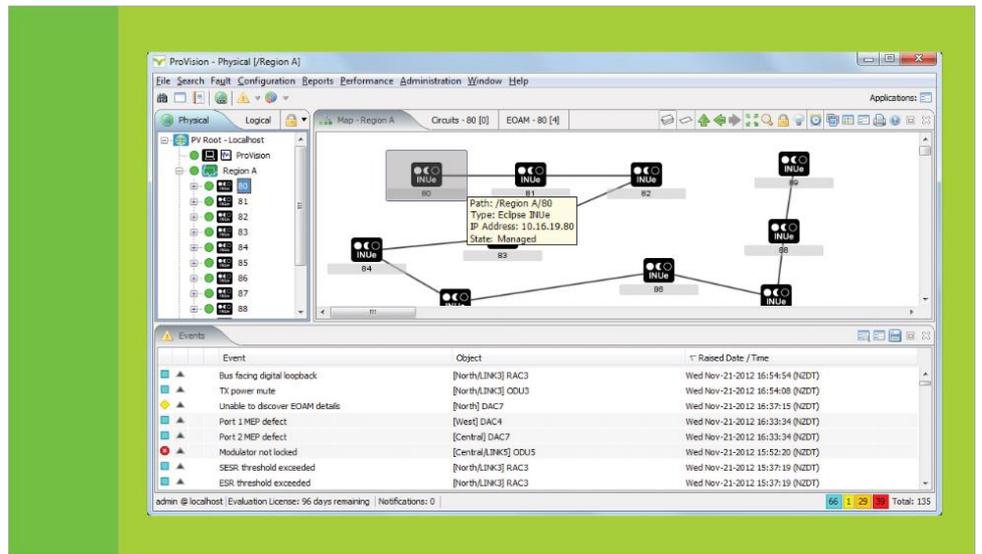
Designed with the user in mind, ProVision is intuitive and adaptable for a wide range of activities that users can customize to match their network requirements. In addition, ProVision automates time consuming and error prone processes, such as the provisioning of end-to-end TDM and Ethernet services, bulk upgrading network firmware, and diagnosing network clock distribution problems.

With the ability to provide network management across Aviat's complete product portfolio, including many key partner products, ProVision delivers an efficient, seamless end-to-end network management solution for TDM, Ethernet, and hybrid microwave networks.

SMOOTH TRANSITION TO ALL-IP

Transitioning networks from legacy TDM to all-IP takes time and money, as well as risk of network interruptions. ProVision smooths the process by harmonizing microwave, TDM and Ethernet network operations with common concepts and features, a shared operator experience, and automation of complex processes.

Advanced Carrier Ethernet capabilities spanning Synchronization, Ethernet OAM, ERPS, EVC/VLAN and protection/diversity technologies include discovery of network and service resources, end-to-end visualizations, and automated provisioning. Collectively they remove significant complexity, deliver faster rollout with fewer mistakes, assure service availability and quality, providing confidence in transitioning from TDM, hybrid, to All-IP networks.

DEPLOYMENT PROFICIENCY THROUGH AUTOMATION

Deploy new element management with:

- Quick installation on Windows and Solaris and fast upgrade installations with automated database migration
- Automated discovery of network devices, inventory, configurations and end-to-end TDM and Ethernet services

SMART FAULT MANAGEMENT

ProVision's active health monitoring of critical microwave, TDM and Ethernet resources and service performance is smarter than traditional fault monitoring, delivering:

- Network Health Reports detect faults before an outage occurs by identifying performance degradation, for RF, Ethernet, Clock Sync
- Instant alerts of degraded performance via email, SMS and messaging, with deep-dive navigation to quickly investigate and resolve events
- Simple performance threshold management
- Flexible applications for networks, device types and more, via logical containers

- Advanced end-to-end diagnostics, including Ethernet service OAM (ITU-TY.1731 and IEEE 802.1ag) and TDM circuit PRBS testing
- Ethernet clock distribution and clock synchronization related faults across Eclipse networks
- Intelligent fault monitoring using browsers with correlation and filtering, digital scoreboards with dynamic rendering, and flexible event notifications
- Smartphone and tablet client application enabling out-of-NOC fault detection, isolation and handover to field staff

-
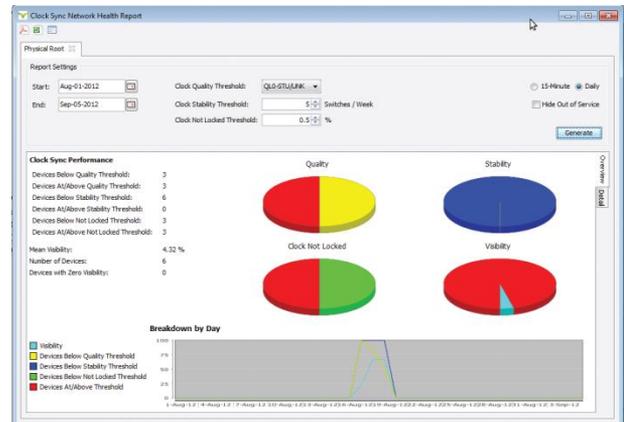
INTELLIGENT NETWORK PROVISIONING

ProVision's automated provisioning processes reduce human error and save substantially on effort, time and OPEX. Intelligent provisioning involves:

- Automated discovery of network and service resources, including end-to-end TDM and Ethernet services and network configurations
- End-to-end provisioning of TDM and Ethernet services through an intuitive graphical user interface
- Automatic and on-demand validation testing of end-to- end services and network design
- Bulk provisioning of device firmware and license upgrades
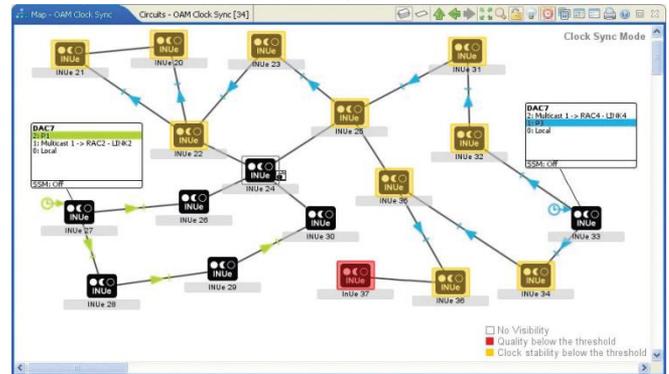
PROACTIVE NETWORK BANDWIDTH MANAGEMENT

To get the most data capacity out of networks, and to identify spare capacity, ProVision includes network bandwidth reporting. These capabilities support capacity planning, license management and congestion problem solving with:

- Ethernet Bandwidth Utilization instantly shows over or under utilization across all network ports, predicts future utilization, and provides navigation to deep-dive analysis tools
- RF Capacity Reports display the allocated, licensed, maximum & spare capacity available across all microwave interfaces in the network

SECURE, RELIABLE & TRUSTED ACCESS CONTROL

- Role based access control with Single-Sign-On
- Flexible containment based management providing access control by region, technology, etc.
- Secure device access including SNMPv3, HTTPS and SSH
- RADIUS based authentication, authorization and user access accounting
- Secure bulk provisioning of device security attributes including user accounts and Access Control Lists
- Audit logging, reporting and client session management
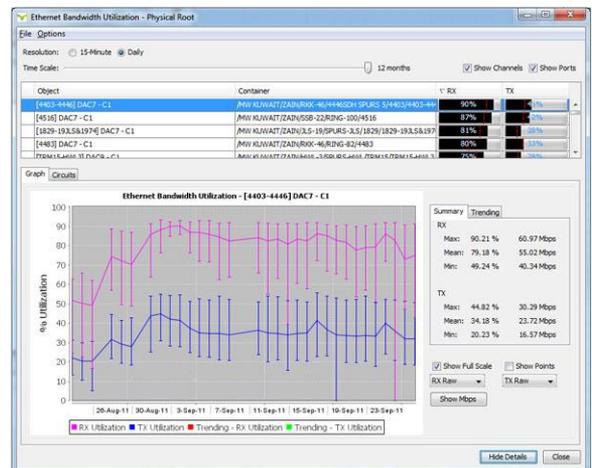
OSS AND DEVICE INTEGRATION READY

Operation Support Systems (OSS) manage networks and services on multiple levels. ProVision provides coherent management for your OSS platforms, significantly reducing system integration CAPEX:

- Proven OSS integration with many network providers and OSS vendors, spanning microwave, TDM and Ethernet resources.
- Easy to integrate traditional SNMP/XML/CSV based NBI provides events, performance, configuration/inventory, and network topology.

Scalable Solutions

- Up to 9,000 Network Elements and 150 concurrent user sessions per server
- Licensing based on network size and feature set
- Redundant server options available

Supported Platform Options

- Windows Server - 10, 2012, 2012R2, 2016, 2019
- Windows Client - 10, 2012, 2012R2, 2016, 2019
- UNIX Server - Solaris 10
- Mobile Client - Apple iOS, Android
- Internationalization available on request

Minimum Hardware Requirements

- Windows Server – 2 GHz processor, 8 GB RAM, 50 GB HD, Ethernet LAN card
- Windows Client – 2 GHz processor, 8 GB RAM (64-bit OS), 2 GB RAM (32-bit OS), 10 GB free HD, Ethernet LAN card, 10 Mbps LAN connection per Client connected to Server, Min. display resolution 1024 x 768, 32-bit color
- Solaris Server – 4-core SPARC processor, 16 GB RAM, 300 GB HD, Ethernet LAN card

Aviat Network Services And Support Options

- On-site training and installation services
- Custom software development
- 24/7 or 9/5 technical helpdesk available by email and telephone
- General Availability releases to AviatCare customers twice per year
- Expert network auditing available