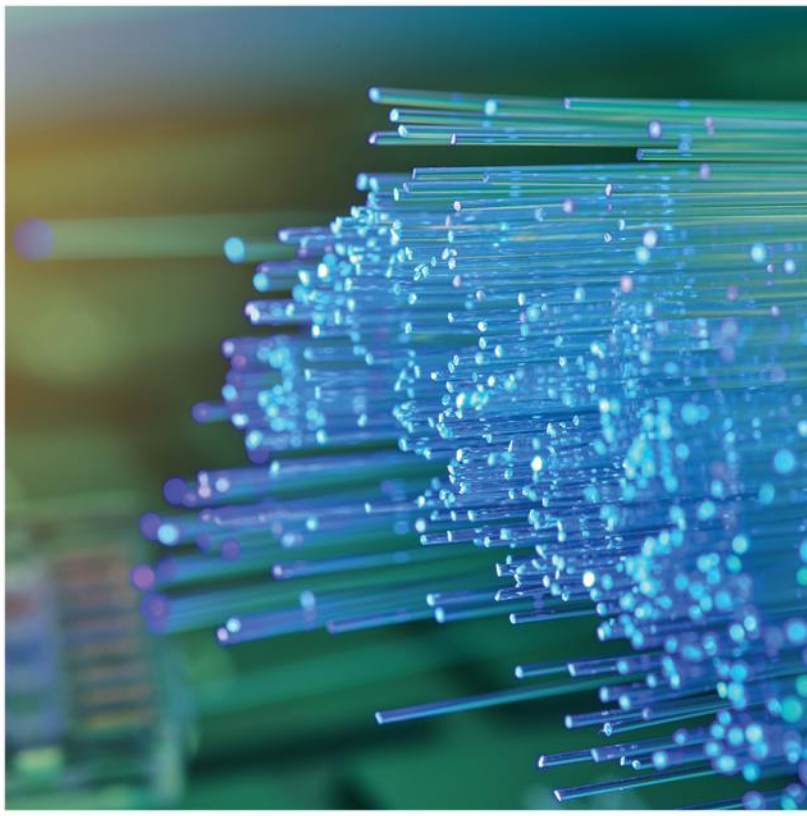
VANCOUVER AREA SMART TREK

REGIONAL COMMUNICATIONS PLAN



JULY 2023

VAST

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INTRODUCTION

OVERVIEW

This plan presents a strategy to meet the regional communications needs of the transportation system serving the transportation agencies in the Clark County, Washington region. The consortium of agencies known collectively as the Vancouver Area Smart Trek (VAST) consists of WSDOT SW Region, City of Vancouver, Clark County, C-TRAN, and SW Region Transportation Council (RTC) as the convening organization. Extended stakeholders include the cities of Camas, Washougal, Battle Ground, Ridgefield, the Port of Vancouver, Port of Ridgefield, and occasionally other entities. The communications network is a critical component of the regional transportation system and is fundamental to connecting management centers with one another and with field equipment that facilitates regional mobility. Increasingly, this communications infrastructure is a critical component laying the foundation for the future of emerging transportation elements such as Connected, Autonomous and Electric Vehicles, many of which are already here today!

The rapid growth and development of communications infrastructure has led to a greater capacity and assortment of communications supporting Intelligent Transportation Systems (ITS) and emerging mobility technologies. New ITS capabilities enable agencies to provide a greater level of service to roadway users. For instance, access to high quality detection data and real-time surveillance improve response time to incidents and other changing traffic conditions. Real-time passenger information and integrated corridor management expand mobility. Vehicle-to-vehicle and vehicle-to-infrastructure communications have the potential to increase vehicle safety and decrease emergency and transit vehicle delays.

C-TRAN's growing Bus Rapid Transit (BRT) system—branded as The Vine—is an example of a project that benefits from regional collaboration to deploy and manage communications infrastructure and ITS equipment. New BRT stations, installed on City, County and State rights-of-way, require greater communications connectivity than traditional bus stations. C-TRAN benefits from regional collaboration by leveraging Clark County's, City of Vancouver's, and WSDOT's existing fiber optic networks to backhaul video and fare information. WSDOT likewise benefits from C-TRAN's improvements to the shared communications infrastructure, including re-testing and configuration of the communications hubs and fiber segments.

Vancouver Area Smart Trek (VAST)

The VAST Program has been managed by RTC since 2001 and is one of RTC's ongoing programs. VAST program activities include regional collaboration on transportation system management and operations (TSMO) and on intelligent transportation systems (ITS). VAST is a coalition of state, regional and local agencies which have been working actively together implementing ITS and operations solutions to address the region's transportation needs. RTC implements the program in coordination with the City of Vancouver, WSDOT, Clark County, C-TRAN, and the City of Camas. The partnership has been an effective way for the agencies to coordinate project delivery, joint project funding, monitoring project development, and project integration to improve transportation operations.

This plan focuses on recommended actions and standards to maintain and enhance the regional communications network's ability to contribute to an efficient, accessible, and connected transportation system. It has been developed through a collaborative effort led by the RTC with VAST Partners.

DESCRIPTION OF THE REGION AND STAKEHOLDERS

This communication plan addresses the area bounded by Clark County, WA. Clark County is in the southwest region of Washington and borders Cowlitz and Skamania Counties in Washington and Multnomah and Washington Counties in Oregon.

The county has 8 cities and towns, and the most urbanized area is centered in Vancouver, WA adjacent to the Portland, OR metro area. The majority of the existing communications network infrastructure is located in urbanized areas. However, the plan anticipates future development and collaboration among other isolated, rural, or urbanizing areas. A map of the County is shown in Figure 1.

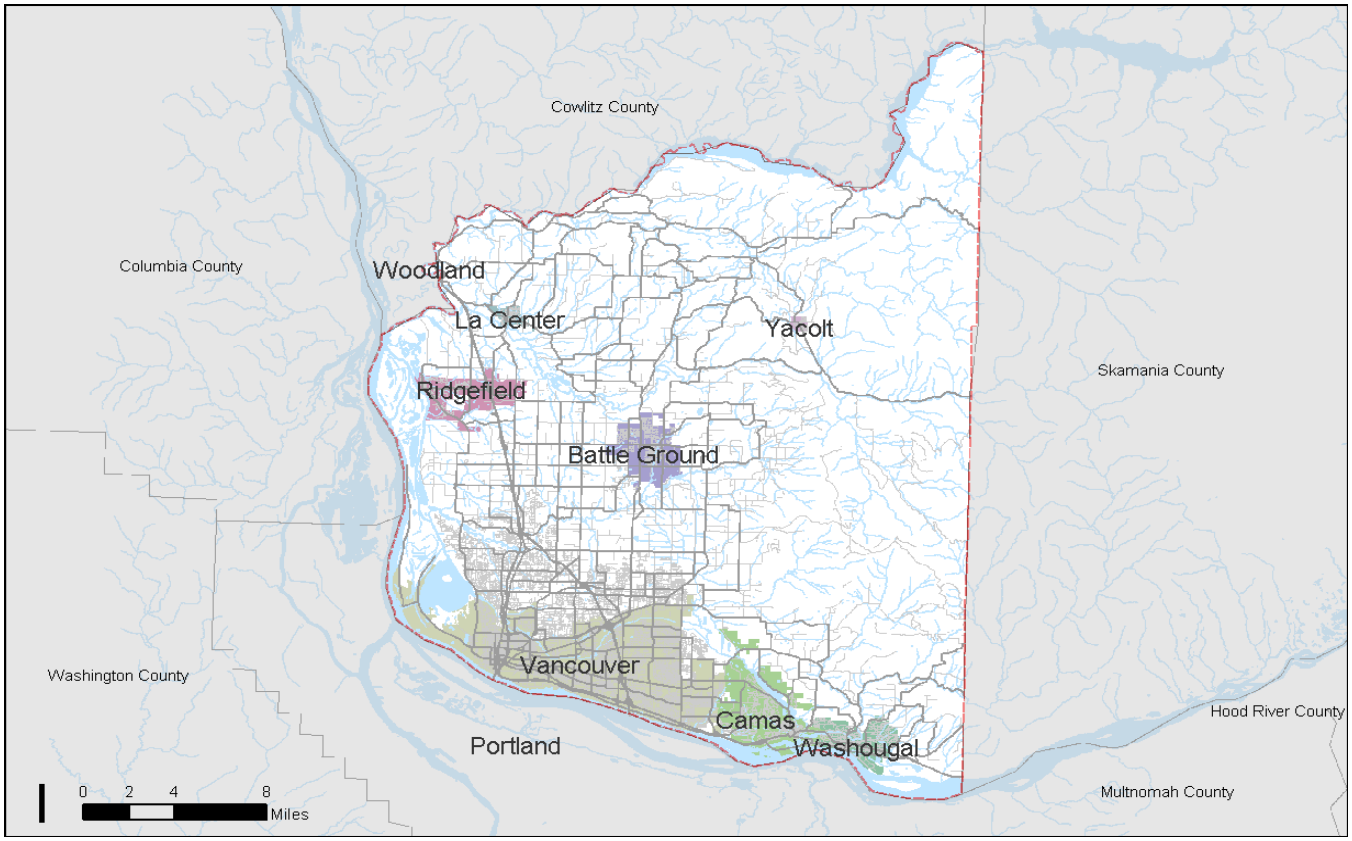

FIGURE 1: CLARK COUNTY, WASHINGTON

Throughout the development of the plan, meetings and workshops were conducted with staff from various public agencies, as shown in Table 1. The participation of these agencies was vital to the successful development of this plan and valuable to the implementation of the recommendations contained within it. Some additional regional partner agencies were also contacted with brief questions to augment the document.

TABLE 1: CORE PARTICIPATING AGENCIES

PARTICIPATING AGENCIES
CITY OF VANCOUVER
CLARK COUNTY
C-TRAN
REGIONAL TRANSPORTATION COUNCIL (RTC)
WASHINGTON STATE DEPARTMENT OF TRANSPORTATION (WSDOT)
CITY OF CAMAS
CITY OF BATTLE GROUND
CITY OF RIDGEFIELD
PORT OF VANCOUVER
PORT OF RIDGEFIELD

PURPOSE OF THE PLAN

The purpose of this Regional Communications Plan is to provide the VAST partner agencies with a strategy for meeting current and future communications infrastructure needs. The goals and objectives of the Plan are:

- Document existing conditions
- Determine agency/regional goals and needs
- Identify any network gaps
- Recommend next steps, standards, and best practices
- Identify potential project opportunities
- Investigate funding opportunities
- Review other regional communications networks
- Improve cybersecurity
- Improve video sharing

Communications infrastructure planning provides the region with the following benefits:

- Enables the best performance of existing system
- Ensures the needs of the current system and future deployments are met, including replacing radios with fiber infrastructure
- Outlines a robust network with redundant paths capable of withstanding outages

- Adds major facilities to the system
- Supports inclusion of conduit and fiber in ITS and other infrastructure projects on key corridors identified in the Plan and attempts to ensure they do not get "value engineered" out
- Provides a platform for future intelligent transportation infrastructure

Enables enhanced operations and cost savings through shared systems

APPROACH OF THE PLAN

The Open Systems Interconnect (OSI) model (Figure 2) was used to guide the plan's development. The seven OSI layers were used as a conceptual framework to categorize the features of the communications network and further guide the evaluation of the existing networks and planning of future infrastructure.

First, a baseline was established by documenting the conditions of the existing physical infrastructure (Layer 1 of the model). Second, user input was gathered through workshops with agency transportation professionals to identify the needs of users at the application and presentation layer. Third, network administration personnel were interviewed to verify the network, data link, and physical layers (which included a cursory look and discussion around redundancy and cyber-security). Finally, network engineering and user inputs were used to confirm that the baseline conditions of the communications network would meet the current and future needs of the transportation network, and include any additional physical infrastructure required to meet these needs. The process concluded with the development of recommendations that respond to gaps or unmet user needs.

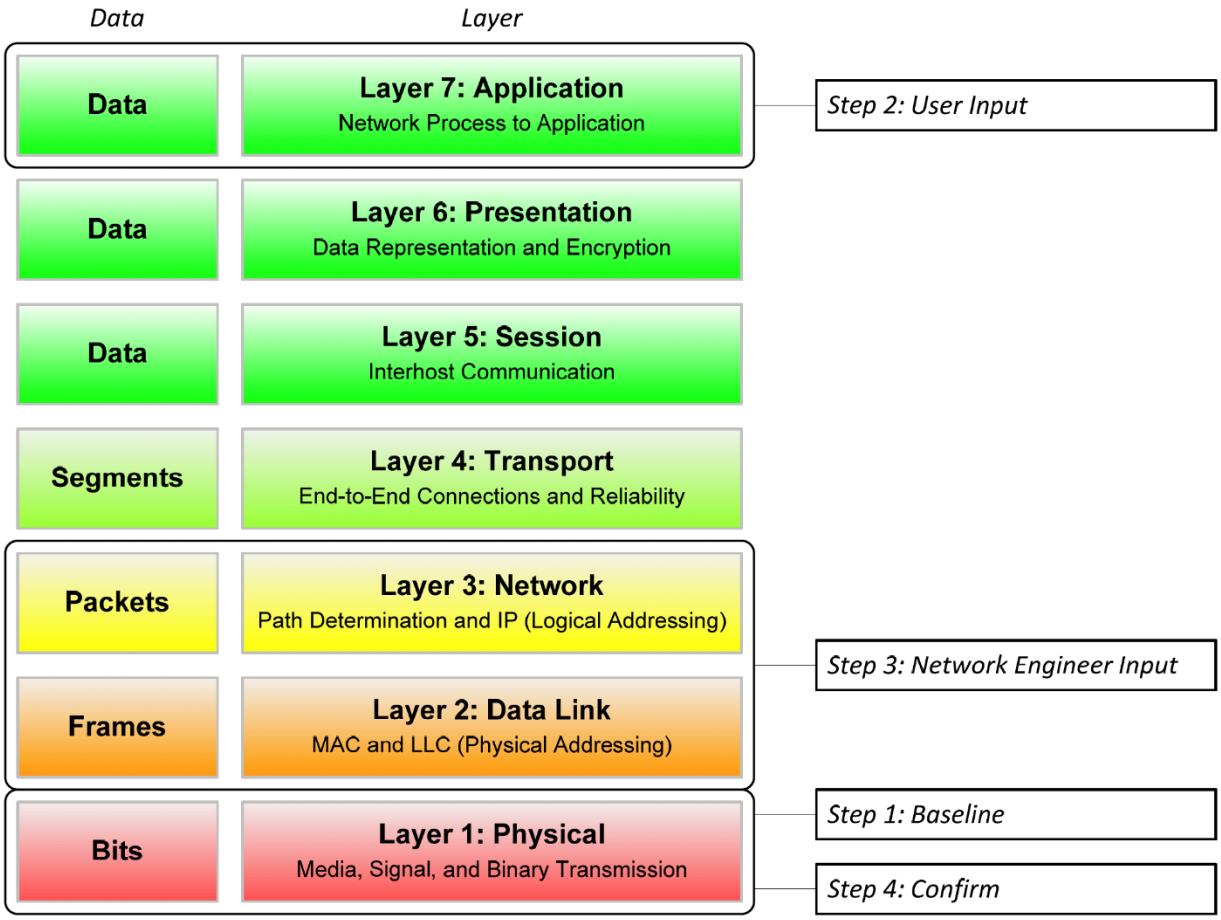

FIGURE 2: OSI MODEL APPROACH

USING THIS DOCUMENT

This document is intended to be used by stakeholders as a reference for making communications infrastructure decisions in the future.

- Chapter 2 provides a snapshot of the existing conditions of the regional communications network. It identifies the current wireline and wireless infrastructure in the region and how regional partners have increased the utility of their individual systems by sharing fiber infrastructure.
- Chapter 3 identifies the network architectures used in the region and documents the organization of the physical components of the network.
- Chapter 4 details the user needs of the communications network to support specific transportation systems in the region.
- Chapter 5 describes cybersecurity practices and protections put in place.
- Chapter 6 identifies relevant funding opportunities to support communications infrastructure investments.
- Chapter 7 presents recommendations for the region and are organized into four categories: physical infrastructure, network infrastructure, services, and additional topics.

EXISTING NETWORK CONDITIONS

COMMUNICATIONS INFRASTRUCTURE

The fiber optic communications network makes up the backbone of the regional communications infrastructure and the first or physical layer of the OSI model. This fiber network makes it possible to remotely manage devices in the field for operations, data collection, routine maintenance, and incident response. It also allows for data to be backhauled to agency centers for operational analysis and long-term planning.

The fiber network consists of fiber optic cables owned by individual agencies and joined at hubs and switches in the region. Public agencies who own fiber infrastructure in Clark County include:

- City of Vancouver
- Clark County
- WSDOT
- City of Camas
- C-TRAN[1]

Figure 3 shows the extents of the existing, programmed, and planned fiber network. In this map existing, programmed, and planned fiber are defined as follows:

- **Existing** – fiber optic cable is installed along this corridor
- **Programmed** – fiber optic cable has been programmed for installation and funding is complete; installation is imminent
- **Planned** – these corridors have been identified as likely candidates for new fiber installation, but are not programmed or funded at this time

[1] C-TRAN has "spur fiber drops" off the core network into their key facilities, the Vine stops and stations, and other strategic locations. C-TRAN is currently replacing the Mill Plain fiber corridor as part of the Mill Plain BRT project, providing a significant regional upgrade, and will be transferring ownership of the bulk of that fiber to City of Vancouver when the project is completed.

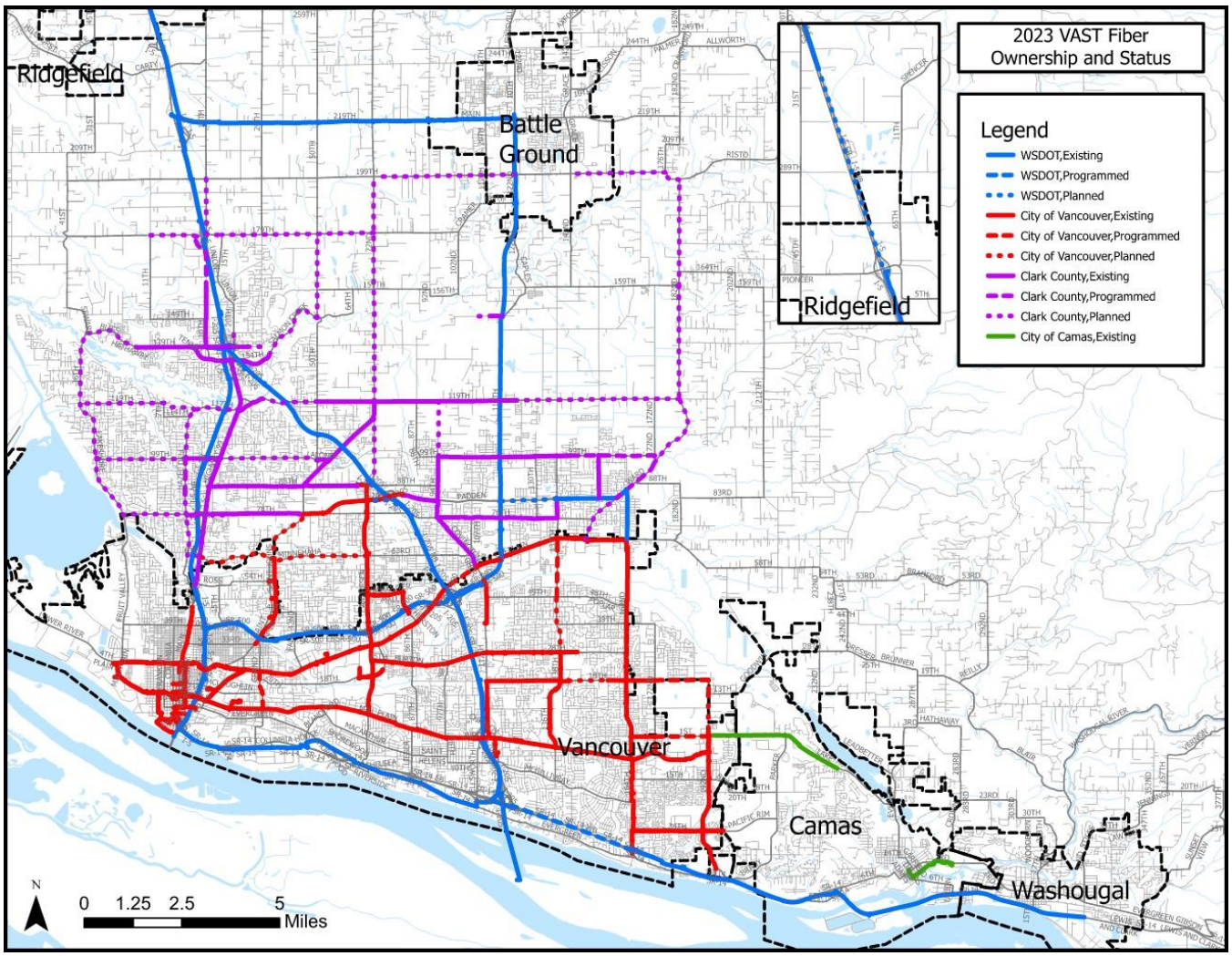

FIGURE 3: VAST FIBER OWNERSHIP AND STATUS

The City of Vancouver, Clark County, and WSDOT all use fiber to connect agency centers, traffic signals, and ITS devices along major arterials. Key arterials in the city of Vancouver are Mill Plain Road, 4th Plain Boulevard, Andresen Road, 136th Avenue, and 164th/162nd Avenue. In the County, key corridors are Highway 99, 78th Street, 88th Street, 139th Street, and 72nd Avenue.

WSDOT operates and maintains fiber along each of the interstate highways—I-5 and I-205—to connect to a network of highway detection equipment including traffic signals, CCTV, loop detectors, Wavetronix radar devices, and Variable Message Signs. WSDOT also maintains fiber along the state highways SR-14, SR-500, SR-501, SR-502, and SR-503.

In addition to the network created by these three agencies, the City of Camas owns a fiber segment on NW Lake Road from 192nd Avenue to NE Lake Road.

Fiber optic cable in the region has been installed through several separate transportation projects that span the last two decades. As a result, the fiber optic media across the region varies both in media type and quality. Figure 4 shows the fiber counts in the VAST region.

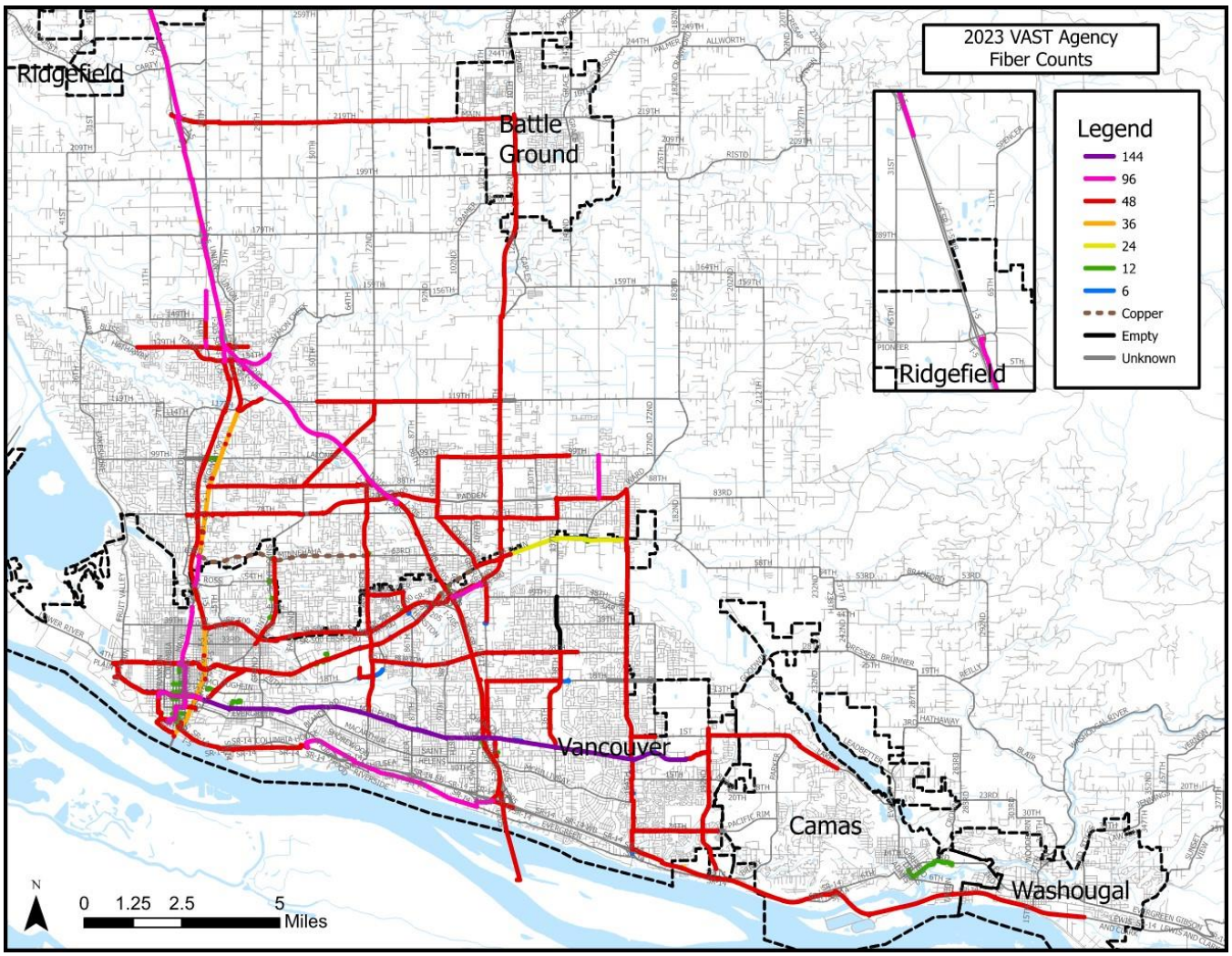

FIGURE 4: VAST AGENCY FIBER COUNTS

NOTE: At the time of development of this document, the Mill Plain fiber corridor identified above was being replaced by a 144-count fiber as part of the C-TRAN Mill Plain BRT project. This project was a co-build with the City of Vancouver where C-TRAN retains perpetual use of one third of the fiber along this entire corridor with the remaining two thirds being transferred to the City of Vancouver which will also be available for use by regional partners. The City provided the existing conduit pathway along the corridor where the new fiber was installed, as their contribution to the project. This will greatly enhance the capabilities of the regional communications network and will bring that corridor to a minimum of 1 Gigabit Ethernet (GbE) capability. This section and others in the region have also had equipment upgrades capable of increasing the bandwidth on many of the segments identified to 10+ GbE. WSDOT has a project out to advertise to install a new 144-count fiber along SR-500 between I-205 and I-5 and has an additional 144-count fiber project in construction to complete the gap between 164th Street and I-205 on SR-14.

Fiber optic cables are a communications media made up of multiple fiber strands. VAST has installed 96-count single-mode fiber optic cable for trunkline communications and has installed 144-count single mode fiber optic cables for communications along some corridors. For branch

connections, a minimum of 96-count single-mode fiber optic cable has typically been installed. Older installations including 12-, 36-, and 48-count fiber optic cable are being phased out.

Inside fiber optic cables, fiber strands are separated into tubes (each holding twelve strands) that are used to physically separate communications traffic between uses and users[2]. Fiber tubes are color-coordinated and VAST had undertaken an effort to standardize the use of the colored tubes to reflect fiber sharing rules between the agencies utilizing these color codes. As documented in the original VAST Communications Plan, the VAST partners had originally planned to use the following tube color assignments except for WSDOT owned fiber:

- Blue Tube: City of Vancouver Transportation
- Orange Tube: Clark County Transportation
- Green Tube: WSDOT Transportation
- Brown Tube: Clark County Information Services
- Other Tubes: All other tubes are reserved

WSDOT is currently in the process of re-assigning color tubes in its fiber network. WSDOT will use the following assignments:

- Blue and Orange Tube: WSDOT Transportation
- Other Tubes: All other tubes are available for sharing

Regarding the 144-count single-mode fiber along Mill Plain, the following color coding was used:

- Blue Tube: Clark County Traffic
- Orange and Green Tubes: City of Vancouver Traffic
- Brown, Slate, and White Tubes: City of Vancouver Information Technologies
- Red Tube: WSDOT Transportation
- Black Tube: Clark County Information Technologies
- Yellow, Violet, Rose, and Aqua Tubes: C-TRAN

The VAST partner agencies have agreed to a standardization of tube assignments for their own assets, as well as having individual fibers available for other VAST agency use. In addition, the VAST CIC has adopted a color-coding convention of fibers in patch panels that alert owners that fibers are being used by other agencies. Fiber optic cables are installed in larger diameter conduit tubing to protect the cables and facilitate new installations within the same conduit. All recent fiber installations have included one 3-inch conduit.

Under the interoperability agreement, the owning agency retains control of all fibers and allows partners to request permits to use them. The permit documentation allows multiple agencies to

[2] This is how VAST has configured the network. It should be noted that there are transport layer technologies that can support multiple uses and even multiple users, to share an individual fiber in secure and isolated network and subnetwork connections.

share fibers inside a single tube with permits documenting responsibilities, ownership and use with the owning agency retaining access rights to the various fiber splice and patch locations.

In addition to fiber optic cable, agencies in the region are using a variety of other media for communications between agency centers and the field—primarily for communications to traffic signals. Ethernet communications over fiber optic cable is the preferred communications media to connect traffic signals to the network. Wireless links and copper are also acceptable, but the plan is to replace both with fiber optic cable, where traffic signals are located. New installations and corridor modifications typically include fiber optic cable.

A few VAST agency Ethernet communications are reliant upon private provider assets, such as those provided by Comcast. The agencies would like to review each situation to assess the potential for migration of service to agency-owned fiber optic cable.

COMMUNICATION DEVICES

Fiber optic cables in the region are connected at the Data link (2nd) and Network (3rd) layers of the OSI model through a series of hubs (which include both routers and switches) deployed throughout the network. Major existing communications router locations are shown in Figure 5.

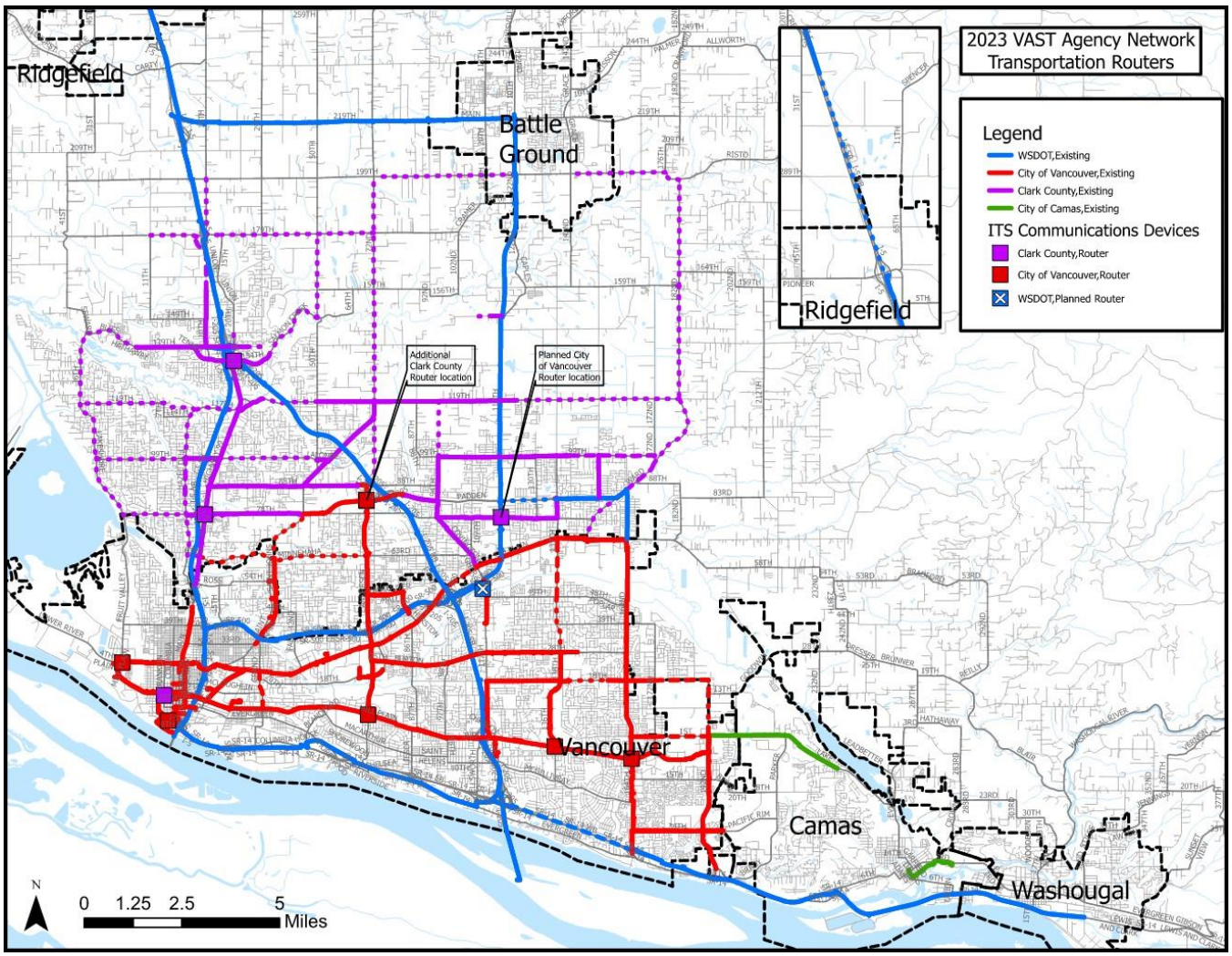

FIGURE 5: VAST AGENCY NETWORK TRANSPORTATION ROUTERS

At each of the router locations, a Layer 3 router (RUGGEDCOM RX1500 or equivalent) is deployed. Currently only Clark County has finished implementing a routed Layer 3 network; the City of Vancouver has implemented one and WSDOT has begun planning similar improvements to their network. C-TRAN runs a Layer 3 network for bus rapid transit.

Cross-connect points represent locations where major fiber lines intersect and interagency communications are possible. These locations are identified in Figure 6.

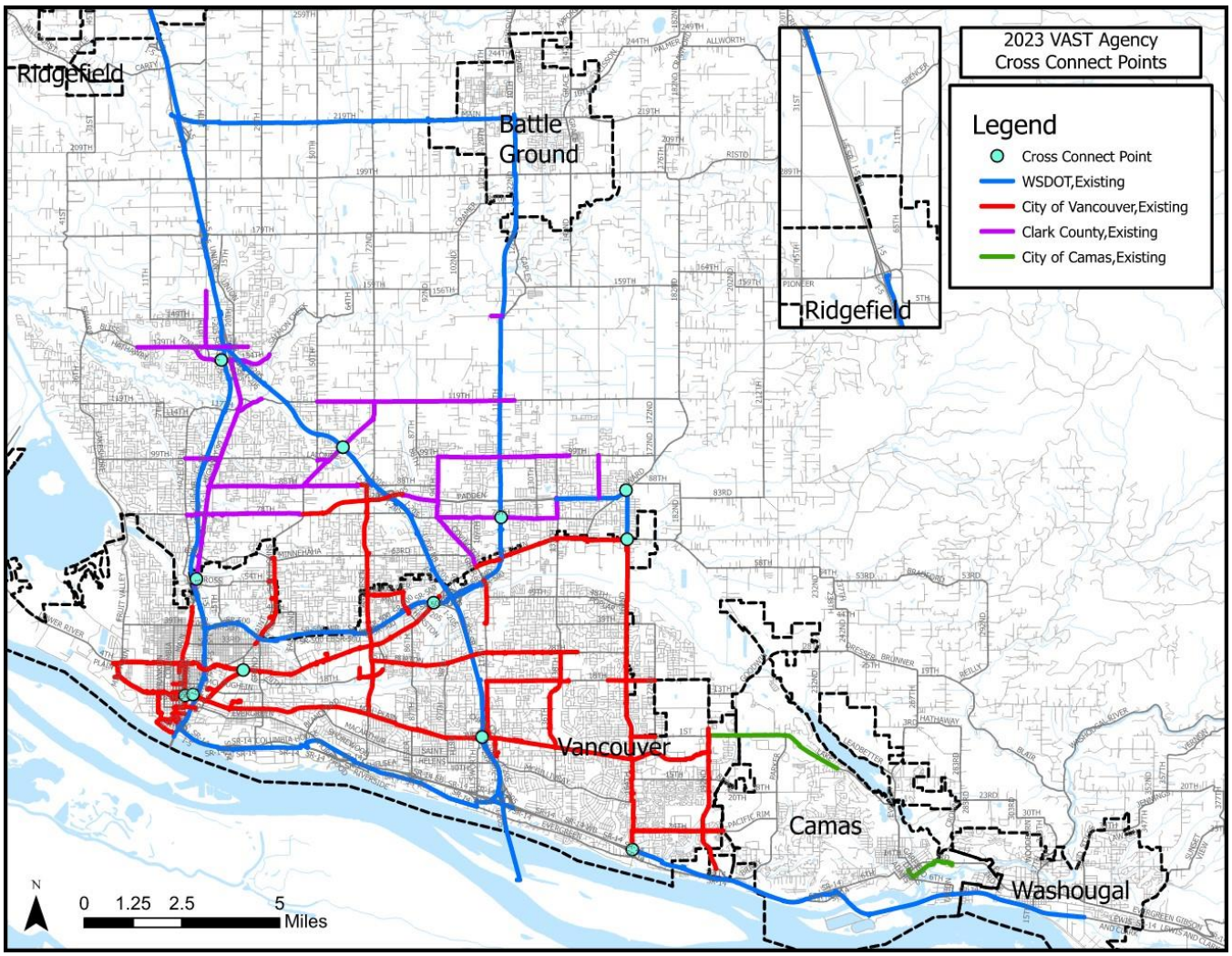

FIGURE 6: VAST AGENCY CROSS CONNECT POINTS

COMMUNICATIONS INFRASTRUCTURE SHARING

A major success in the region for the VAST partners has been the sharing of communications infrastructure between agencies. Over 100 miles of shared fiber has led to significant savings in design, construction, oversight, and contingency costs.

Fiber sharing has supported the backhaul of field video, communication service to public safety offices, creation of redundant network paths, and connection of agency centers. The network of shared fiber is shown in Figure 7.

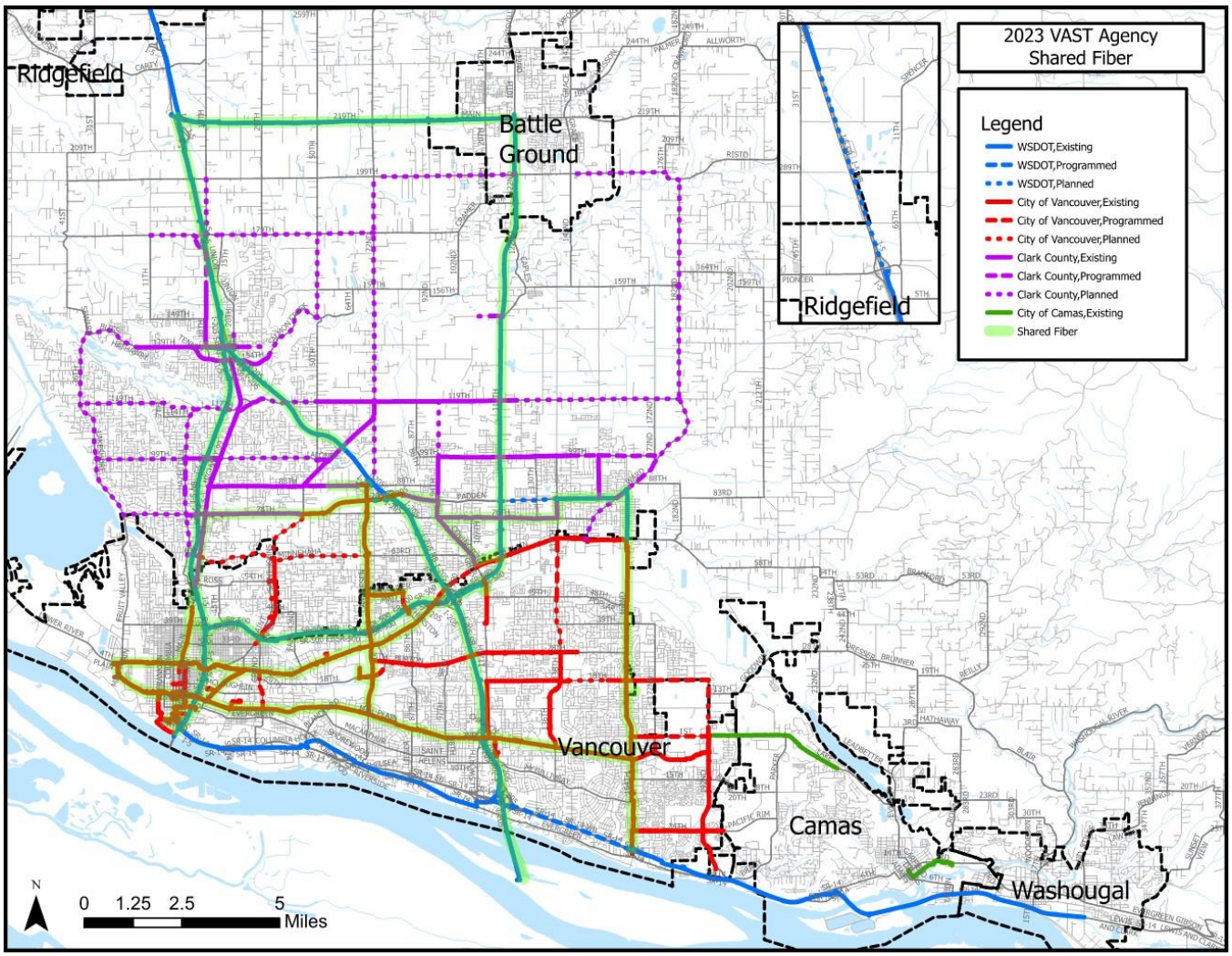

FIGURE 7: VAST AGENCY SHARED FIBER

Fiber sharing is coordinated through a permit process. This process is documented in the Communications and Interoperability Agreement which was put in place in July 2006, and it authorizes the partner agencies to enter into fiber assets sharing agreements. Under the agreement, agencies can discuss opportunities and needs for asset sharing and enter into voluntary permit agreements with other VAST agencies for unused fiber.

At the time of this plan, 29 permits affecting 101 miles of fiber were active sharing fiber between 8 agencies. Current fiber sharers and potential opportunities are shown in Table 2.

TABLE 2: AGENCY FIBER SHARING

AGENCY	VAST PARTNER/FIBER OWNER	CURRENTLY SHARING	FUTURE SHARING OPPORTUNITY
CITY OF CAMAS	X		
CITY OF VANCOUVER TRANSPORTATION	X	X	
CLARK COUNTY TRANSPORTATION	X	X	
C-TRAN	X	X	
RTC	X		
WSDOT	X	X	
CITY OF VANCOUVER FIRE DEPARTMENT		X	
CITY OF VANCOUVER INFORMATION TECHNOLOGY	X	X	
CITY OF VANCOUVER POLICE DEPARTMENT		X	
CLARK COUNTY INFORMATION SERVICES		X	
CLARK REGIONAL EMERGENCY SERVICES AGENCY (CRESA)		X	
CLARK COUNTY PUBLIC WORKS		X	X
OTHER CITIES (BATTLE GROUND, WASHOUGAL, ETC.)			X

The VAST core and extended partner agencies plan on continuing to share fiber through the Fiber Permit process as they have for years. As the network continues to expand geographically, other cities may take advantage of fiber sharing through this same arrangement. In fact, some of the "small cities" including Battle Ground, Washougal and Camas are already looking to utilize the regional fiber network to connect their central traffic signal systems to Clark County's central system. While not part of the permit process, ODOT utilizes WSDOT and City of Vancouver fiber to provide a connection between the WSDOT and ODOT TMCs.

In addition to geographic expansion, other agency departments may look to also utilize and share fiber with the VAST partner agencies. Many segments of the fiber network have restrictions on how they may be utilized, for example, if gas tax dollars were used to build out sections of WSDOT's network (as they have in many cases), the use of this network is limited to transportation purposes, as per the Revised Code of Washington (RCW). These same restrictions rarely apply to local agencies, depending on the funding source for their fiber construction projects, which opens the door for additional sharing between departments, such as Clark County Public Works.

WIRELESS COMMUNICATIONS

The VAST partners have further extended the reach of their network through the selective deployment of wireless infrastructure. Figure 8 shows the existing and planned wireless infrastructure. In the future, the VAST partners wish to replace the wireless links with fiber optic cable.

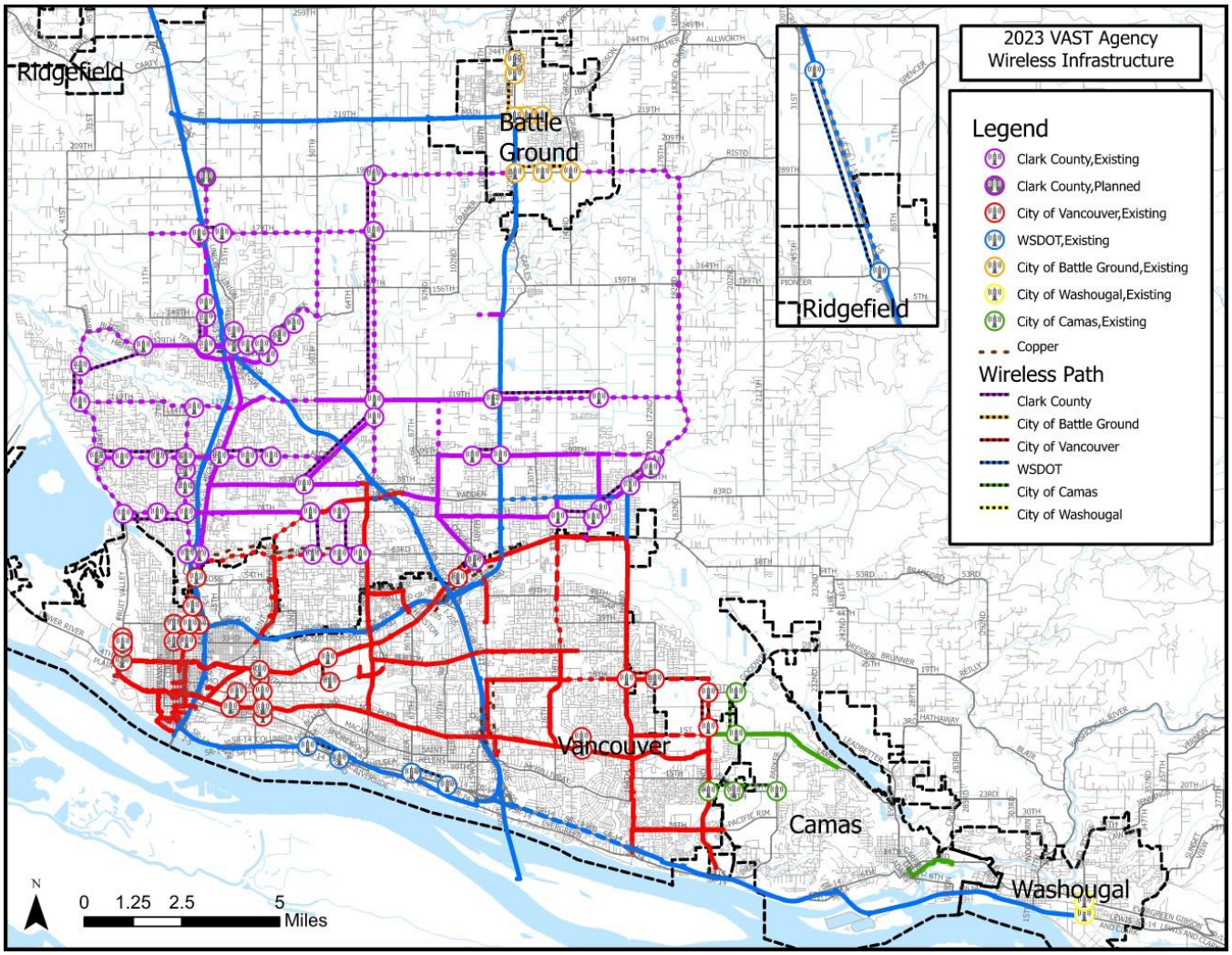

FIGURE 8: VAST AGENCY WIRELESS INFRASTRUCTURE

INFRASTRUCTURE NEEDS

Based on the existing network conditions defined above the following gaps and needs have been found:

- Several corridors in the region need to upgrade or replace existing fiber runs due to low quality fiber, low bandwidth, or existing wireless links.
- New, planned fiber installations are needed to extend the current network, connect additional ITS devices, and to create redundant paths.
- Clark County depends on the City of Vancouver and WSDOT's fiber networks to establish connection between the County Operations Center at the Clark County Public Service Center (PSC), the Operations Center at 78th and St. Johns, and County field assets. Several existing arterial segments that are not currently identified as planned fiber locations could be used strategically to create redundant network paths.
- Agencies are currently defining their own standards for fiber installations. The region would benefit from a set of minimum standards for fiber installations, including:
  - Conduit sizes and numbers
  - Fiber counts
  - Installation
  - Equipment
- OSPInSight is the database of record for capturing network information about the regional fiber infrastructure but has a backlog of project data not entered in the database. Current efforts to add information and improve accuracy of the database should be continued.

NETWORK ARCHITECTURE

The purpose of the communications network is to connect different systems in the regional transportation network. The National ITS Reference Architecture, can be used to identify the different systems and communication types that connect them[3]. The physical view of the Reference Architecture, shown in Figure 9, categorizes transportation system elements as centers, vehicles, field, personal, and support objects.

While the regional communications network exists largely to connect centers to centers and centers to field elements, it also provides the means to establish connections to vehicles and personal devices. The regional use of center-to-center and field-to-vehicle communications are discussed further in this chapter. Note that some Wide Area Wireless communications exist for transit and fleet management and are expected in the near future to support new and emerging technologies such as Connected and Automated Vehicles (CAVs).

[3] Link: https://www.arc-it.net/html/viewpoints/physical.html

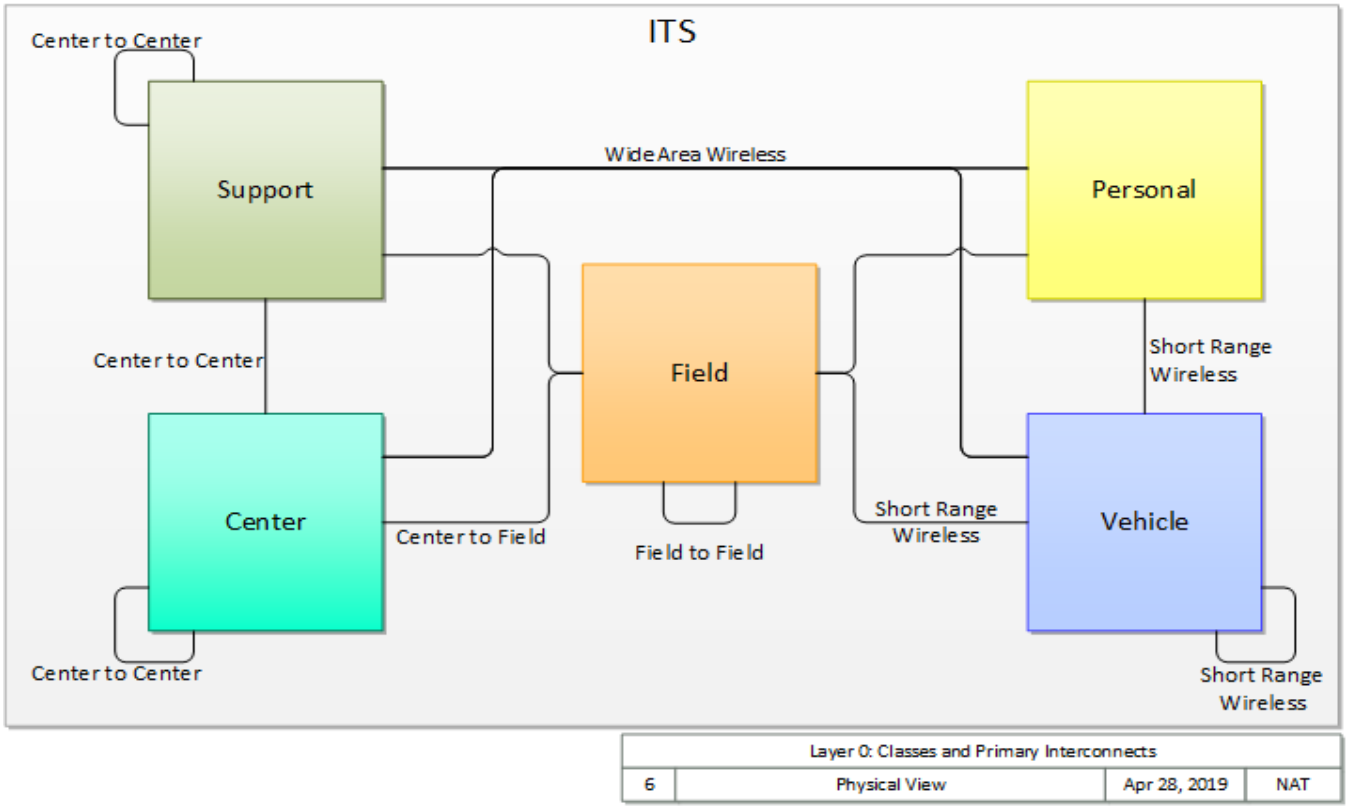

FIGURE 9: REGIONAL ITS ARCHITECTURE

AGENCY CENTER-TO-CENTER COMMUNICATIONS

A major subset of fixed-point to fixed point communications in the region are agency center to agency center communications. Connectivity of agency centers is important for the efficient operation and management of the transportation system and vital to access any jointly operated systems. The Regional Transportation Council, Clark County Public Service Center, WSDOT Southwest Region Center, C-TRAN, and the City of Vancouver Operations Center are connected to the fiber network.

Public safety offices co-located at (or near) agency headquarters locations are connected to the regional communications network. These include the CRESA 911 Center, located next to the Clark County Public Service Center and the Washington State Patrol (WSP) at the WSDOT Southwest Region Headquarters. While some limited fiber network connections support CRESA/WSP backup capabilities, for the most part, CRESA utilizes Clark County's Cat-5e Ethernet system for most communications. The Vancouver Police Department and the Vancouver Fire Department are also connected to the network at separate locations. Connected agency centers are shown in Figure 10 along with other agency facilities in the region.

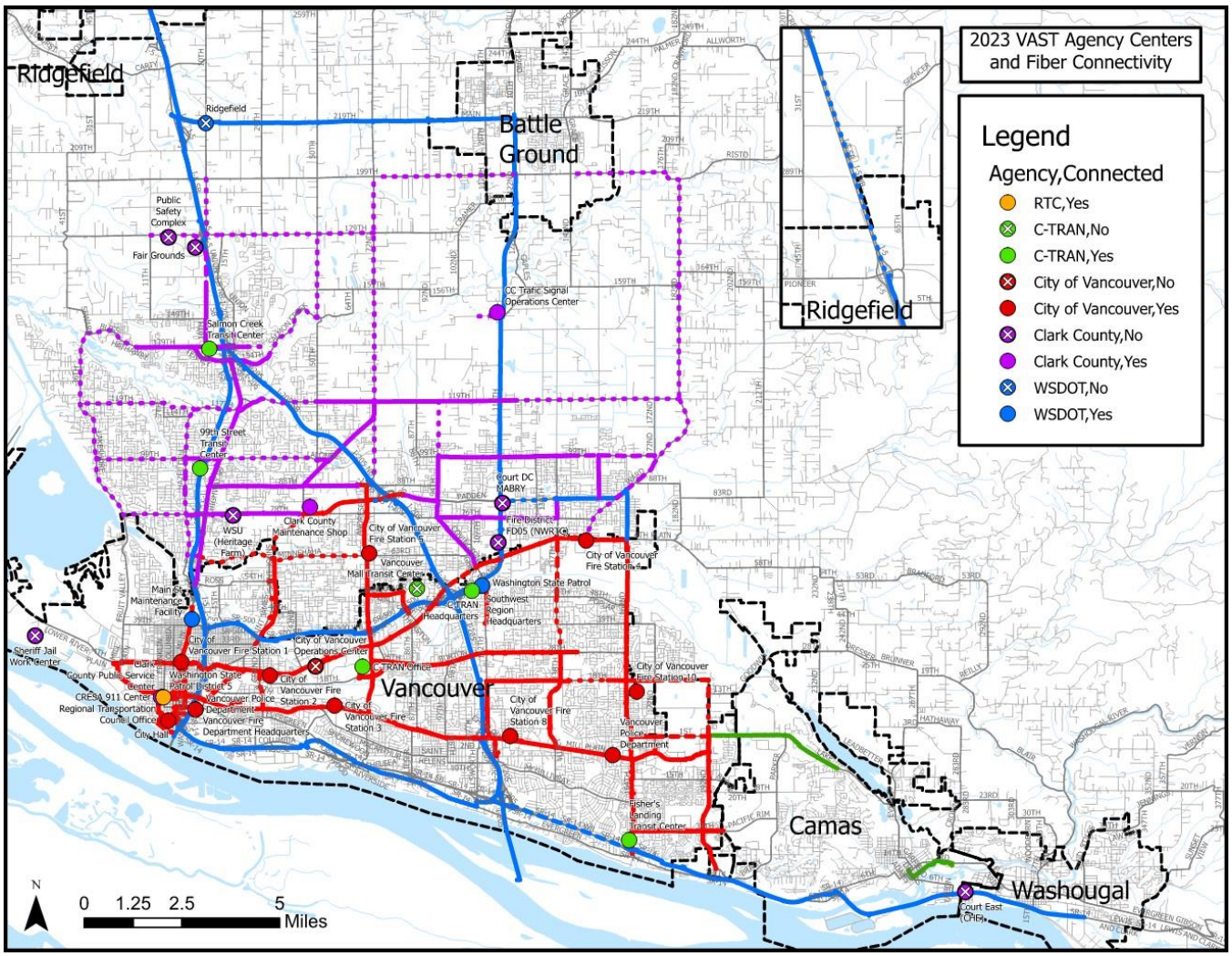

FIGURE 10: VAST AGENCY CENTERS AND FIBER CONNECTIVITY

In addition to the connected facilities, several unconnected facilities have been identified for future fiber network connectivity. These include maintenance facilities, transit centers, and other public safety facilities.

Additional planned fiber connected sites for Clark County:

- Clark County Maintenance Facility - 4700 NE 78th St, Vancouver, WA 98665
- Clark County Maintenance Facility – 11608 NE 149th St, Vancouver WA 98606
- Clark County Sheriff Jail Work Center LRR - 5197 NW Lower River Rd, Vancouver, WA 98660
- WSU (Heritage Farm) - 1919 NE 78th St, Vancouver, WA 98665
- Court DC MABRY - 8101 NW 117th Ave, Vancouver, WA 98662
- Court East (CHE) - 89 C St, Washougal, WA 98671
- Fire District FD05 (NWRTC) - 11606 NE 66th St, Vancouver, WA 98662, Ste 103
- Sheriff West Precinct (PSFT) - 505 NW 179th, Ridgefield, WA 98642
- Fair Grounds - 17402 NE Delfel Rd, Ridgefield, WA 98642

SHORT-RANGE WIRELESS (FIELD-TO-VEHICLE) COMMUNICATION

Field-to-vehicle communications in the region largely consist of emergency vehicle preemption and transit signal priority.

Emergency vehicle preemption is a system that aims to reduce traffic signal delay for emergency vehicles actively responding to an incident. Emergency vehicles in the region are equipped with Opticom infrared light emitters. Most traffic signals in the region are equipped with Opticom infrared receivers. The Opticom infrared system requires a line-of-sight infrared light to be received by a receiver at the traffic signal.

Transit signal priority (TSP) is a system that reduces the traffic signal delay for public transportation vehicles by prioritizing transit movements over other vehicle movements. While traditional TSP systems used an infrared light emitter and receiver, C-TRAN's TSP implementation uses an Opticom GPS radio. A select number of C-TRAN transit vehicles are equipped with Opticom GPS radio signal priority units. The first implementation of TSP was along Mill Plain Blvd. from 164th Ave to Fort Vancouver Way, where 22 traffic signals were equipped with Opticom GPS Radio units. Fourth Plain was the first Vine Bus Rapid Transit route to "go live" and is using fiber shared by partner agencies, particularly City of Vancouver. C-TRAN is expanding the Vine network along Mill Plain and is building new fiber. Ownership of the new fiber is being transferred to the City with four tubes dedicated for use by C-TRAN. C-TRAN is currently in the planning stage of the third main segment of the Vine network, on Highway 99.

NETWORK ARCHITECTURE NEEDS

Based on the network architecture described above, the following needs were identified:

- Redundant paths are desirable from agency centers to field devices with Layer 3 routing capabilities simplify path design and to help prevent downtime during infrastructure incidents such as fiber cuts.
- Monitor network operations to determine ways to improve throughput, security, and reliability.
- The built network must be visited regularly to ensure it continues to provide the quality of service that it was designed for.
- Agencies use best practices for managing router placements, network segmentation, VLANs, and Fail-over strategies.

ADDITIONAL TRANSPORTATION SYSTEMS APPLICATIONS

ITS systems and devices that depend on the communications network, such as traffic signals and detection devices, have their own set of communications requirements. The VAST region has made considerable investment in traffic signals, detection devices, surveillance devices, and traveler information systems. In this chapter, each of these specific applications are described and the corresponding communications network needs are presented to operate these systems at their fullest potential.

TRAFFIC SIGNALS

In the regional transportation system over 410 traffic signals are utilized to maintain the safe and efficient movement of people and goods. These traffic signals represent the core interaction between transportation professionals and roadway users.

The reliable operation and maintenance of these signals is highly dependent on the regional communications network. A majority of traffic signals in the region are directly connected to the fiber network, or indirectly through twisted pair copper cable, wireless, or through dial-up connection.

Central Signal Systems

It is common in the region for agencies to time or operate traffic signals outside their specific jurisdiction, including for cities not connected to the regional network, which allows for better signal coordination on arterials across agency boundaries.

Clark County operates 120 traffic signals using ATMS.now.

The City of Vancouver is transitioning away from Trafficware's ATMS.now and to Q-Free's MaxView to operate its 251 traffic signals.

WSDOT owns 67 signals and operates 48 signals, using ATMS.now, in the Clark County boundaries. Of the 48 operated by WSDOT, two are owned by others. WSDOT operates most of their signals that are on Clark County's central system, while a small number of the signals are operated by Clark County, per their intergovernmental agreement.

WSDOT and Vancouver are installing new servers to run the Kinetic (Q-Free) central system beginning Summer 2023.

Traffic Signal Controllers

Partner agencies had originally adopted a standard of Trafficware controllers and software for traffic signals. As functionality has expanded and costs to implement new Q-Free[4] Advanced Traffic Controllers (ATCs) have dropped significantly, Vancouver is transitioning to Q-Free controllers, although there are some Trafficware controllers still in use through the transition period. WSDOT is currently purchasing Kinetic signals and will be converting 12 signal controllers to Intelight. WSDOT and partner agencies will be using the C2C module to connect Vancouver and WSDOT signal systems at all locations Vancouver operates WSDOT-owned signals.

Figure 11 shows the location of traffic signals in the region.

[4] Q-Free, Intelight, Maxview and Kinetics are all referring to the same vendor's traffic signal solutions. Intelight was the traffic signal controller that is now part of the Q-Free suite of products with Maxview as the controller software. Kinetics is the branding of the Q-Free central signal system.

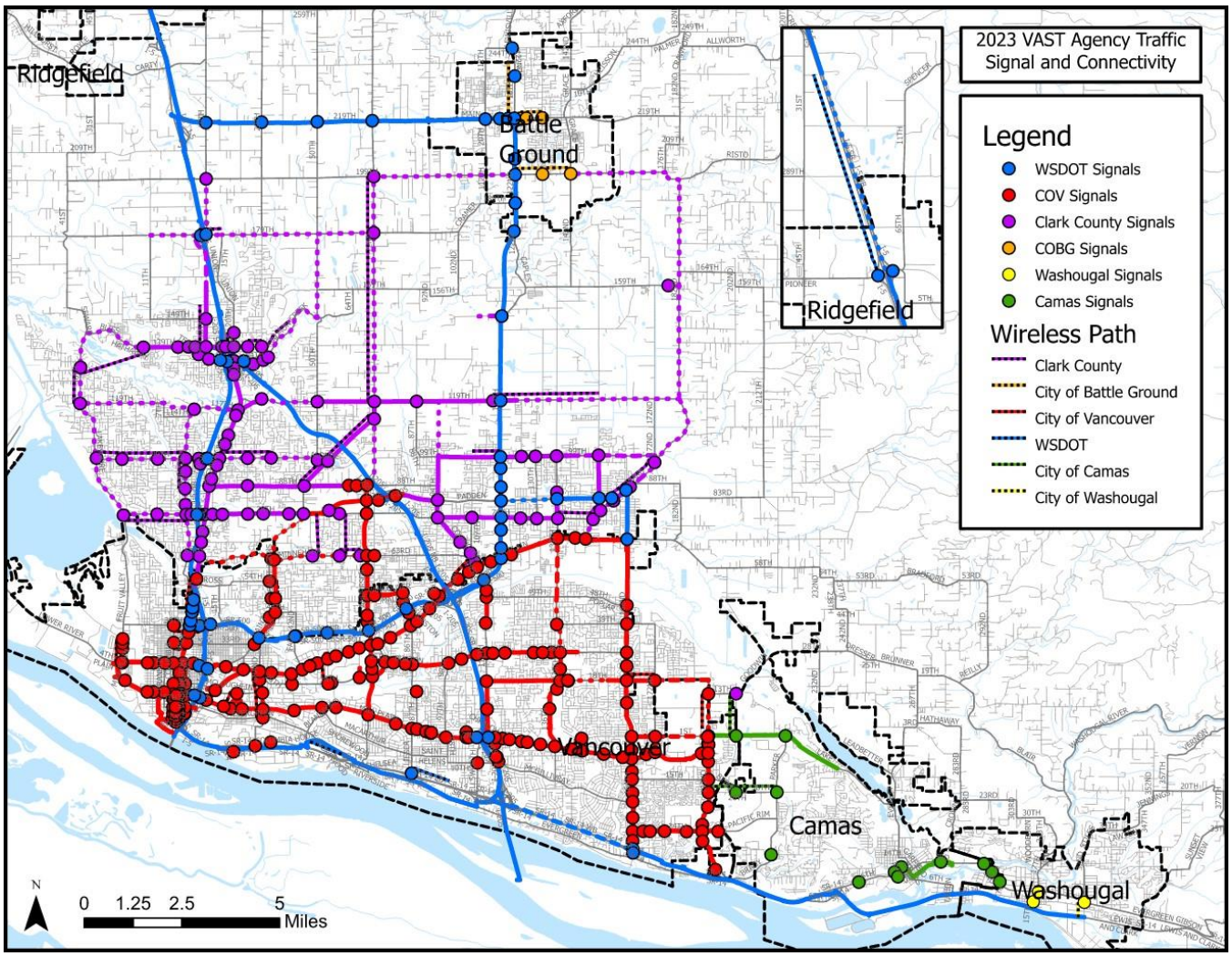

FIGURE 11: VAST AGENCY TRAFFIC SIGNALS AND CONNECTIVITY

In addition to providing safe, organized operation of street intersections, traffic signals and cabinets housing the equipment provide locations for a variety of ITS technologies and devices that connect back to agency centers through the fiber network.

Communications to these devices provides administrators with the ability to both remotely manage the devices and monitor the devices' performance. These technologies, including current and future project plans, are shown in Table 3.

TABLE 3: TRAFFIC SIGNAL TECHNOLOGIES AND COMMUNICATIONS REQUIREMENT

TRAFFIC SIGNAL TECHNOLOGIES	CITY OF VANCOUVER	CLARK COUNTY	WSDOT	COMMUNICATIONS REQUIREMENTS
REMOTE ACCESS	Nearly all traffic signals are available through MaxView or ATMS.now.	All County traffic signals are remotely accessible through ATMS.now. The cities of Battle Ground, Camas, and Washougal are coming online in 2023.	All WSDOT signals are remotely accessible through ATMS.now. Currently purchasing Kinetic signals. Will be converting 12 signal controllers to Intelight and using the C2C module to connect Vancouver and WSDOT signal systems, at all locations Vancouver operates WSDOT-owned signals.	Ethernet communications are used to connect signals to the fiber network where available. Remote Access is handled through central management programs including ATMS.now, MaxView, and Streetwise.

TRAFFIC SIGNAL TECHNOLOGIES	CITY OF VANCOUVER	CLARK COUNTY	WSDOT	COMMUNICATIONS REQUIREMENTS
EMERGENCY VEHICLE PREEMPTION	Opticom Infrared receivers are available at all signals.	Opticom Infrared receivers are available at all signals.	Opticom Infrared receivers are available at all SR-500, SR-502, and SR-503 signals, and most other WSDOT signals.	Emergency preemption is typically performed at a local intersection level using the Opticom zone or global positioning system (GPS) detection method. At this time, only Infrared Opticom detection is enabled. The field equipment at the traffic signals will allow for future installation of GPS radio antennas by others. There are no plans for centrally based emergency vehicle preemption. * Required discriminators can support Preemption and TSP in both Infrared and GPS modes.

TRAFFIC SIGNAL TECHNOLOGIES	CITY OF VANCOUVER	CLARK COUNTY	WSDOT	COMMUNICATIONS REQUIREMENTS
TRANSIT SIGNAL PRIORITY (TSP)	Opticom GPS is available on Mill Plain. TSP is also available on the Fourth Plain Vine BRT system. Future work includes Bus Rapid Transit on the Vine extension project along Main/Hwy. 99 which is currently in planning.	Opticom GPS Geofencing and Location tracking devices are located on Hwy 99. Future BRT is being planned for Hwy 99.	Future work may include Opticom GPS on WSDOT signals on Mill Plain and Fourth Plain. There is an existing SR-500 signal with TSP on Thurston Way is managed by City of Vancouver.	Transit Signal Priority is typically performed at the intersection level but managed through a Central Management System. C-TRAN has outfitted transit vehicles with Opticom GPS systems. Future signals require a supported GPS receiver and discriminator to be installed. * Required discriminators can support Preemption and TSP in both Infrared and GPS modes.
ACCESSIBLE PUSH-BUTTONS	As pavement maintenance projects occur, and based upon resident requests, accessible push-buttons buttons are being added.	Accessible push-buttons are in place at all traffic signals.	Accessible push-buttons are available at the newest intersections only. WSDOT is currently deploying accessible push-buttons at other locations, as funding allows.	APS push-buttons support IP communications and interface to a network switch.
BATTERY BACKUPS (UNINTERRUPTIBLE POWER SUPPLY - UPS)	Some locations have battery backup, but this is not typically installed with new locations.	Battery backups exist at all traffic signals.	Battery backups are only on WSDOT-owned, Clark County-operated signals.	Battery back-up units support IP communications and interface to a network switch.

TRAFFIC SIGNAL SYSTEM NEEDS

Based on the traffic signal system communication requirements identified above, the following needs were observed:

- Need to operate a shared traffic signal central system so agencies can share the benefits and costs of new modules and functionality.
- Need to upgrade traffic signal central system software to the most updated version of ATMS.now to take advantage of more functionality and performance measures.
- Need to address compatibility issues resulting from agencies using different central signal systems.
- For a future shared traffic signal system, the following are needed:
  - Access
  - Database management
  - Control/command
  - Alerts
  - Reports/performance measures

DETECTION DEVICES

Detection provides critical information necessary for safe and efficient operation of the network. Detection drives the operation of traffic signals, monitors congestion levels on the freeways, and provides travel time information to operators and roadway users.

A wide variety of detection devices are deployed regionally to collect traffic data. Table 4 summarizes these current and planned detection devices and their uses in the region.

WSDOT has the ATM corridor on I-5 that uses detection for advisory speeds, along with additional automatic congestion warning messages that post to other VMS using detection. Detection is used for ramp metering on I-5, I-205, and SR-14.

TABLE 4: DETECTION SYSTEMS AND COMMUNICATIONS REQUIREMENTS

DETECTION SYSTEMS	CITY OF VANCOUVER	CLARK COUNTY	WSDOT	COMMUNICATIONS REQUIREMENTS
LOOPS	Used at a majority of traffic signals for vehicle detection. Transitioning to video detection as loops become defective.	Used for lane-by-lane volume counts, particularly on adaptive corridors.	Used at traffic signals for vehicle detection, at ramps to support metering operations, and at wrong-way detection locations.	IP communications and interface to a network switch.

DETECTION SYSTEMS	CITY OF VANCOUVER	CLARK COUNTY	WSDOT	COMMUNICATIONS REQUIREMENTS
RADAR	Limited use of Wavetronix sensors for vehicle detection at traffic signals. A few radar count stations obtained as part of annexation from Clark County, not yet connected to the network. But City plans connect them in the future. Future projects are anticipated to add radar count stations	Wavetronix HD radar count stations to obtain traffic volume, and speed data.	Wavetronix sensors used on freeways for volume, occupancy, speed data, as input to variable advisory speeds ATM systems, ramp metering, and travel time analysis.	IP communications and interface to a network switch.
[5]				
VIDEO	FLIR and GRIDSMART VDS at traffic signals for vehicle detection. FLIR is preferred for new installations.	GRIDSMART overhead video detection used for traffic movement counts and bike box detection in select locations. All traffic signals have CCTV video surveillance.	CCTV video surveillance.	IP communications and interface to a network switch.
INFRARED	N/A	County operates infrared cameras at HAWK signals.	N/A	IP communications and interface to a network switch.
LICENSE PLATE READERS	No interest at this time.	No interest at this time.	Located on SR-502 and SR-503, but will not be	IP communications and interface to a network switch.

[5] Bluetooth was used for speed and traffic movement detection. The vendor that VAST selected no longer supports this product. VAST performed a study to replace this data source with third party data and selected TomTom and Cambridge Systematics as the data and platform provider. No specific communications needs are required by this kind of third-party data.

DETECTION SYSTEMS	CITY OF VANCOUVER	CLARK COUNTY	WSDOT	COMMUNICATIONS REQUIREMENTS
			installing them at future locations. Will be investigating other technologies in the future.	
TEMPORARY DATA COLLECTION DEVICES	The Region maintains a set of temporary collection devices including 3 Miovision video data collection devices. WSDOT owns four Scout video collection units and have ordered one additional unit.			Temporary devices use cellular communications and do no impact communications network requirements.
WEATHER STATIONS	No interest at this time.	Ice Sight Sensor at 2 locations. One full weather station. One currently under design.	RWIS stations are available at I-5 and Paradise point, Mill Plain, and NE 78th St. We have various other locations across the region.	Pavement temperature probes support IP communications and interface to a network switch.
RAILROAD CROSSING DATA RECORDERS	N/A	County operates railroad crossing data recorders at select crossings.	N/A	IP communications

DETECTION DEVICE NEEDS

Based on the detection system uses above the following needs were observed:

- Need to backhaul greater amounts of data to agency centers.

SURVEILLANCE DEVICES

Surveillance systems provide another key tool in monitoring the transportation system. Video camera systems provide visual monitoring of the transportation system and help understand issues that traffic data alone fail to solve. They can also aid in the identification of traffic incidents, and thus better equip first responders when arriving on scene.

SURVEILLANCE DEVICE NEEDS

Based on the traffic signal system requirements above, the following needs were observed:

- Need to support the anticipated new PTZ cameras to be added to the system in the near future.
- Agencies must ensure the communications system can handle the higher bandwidth, and fiber communications are highly recommended.
  - The City of Vancouver has several segments of roadway that operate using 100 Mbps switches, which would limit the ability of PTZ camera usage if there is a central sharing system for video. To fully support multi-agency video sharing over fiber, the City will need to upgrade to 1 Gbps switches.
- Need to extend video sharing capabilities to more partner agencies. Currently, WSDOT and Clark County are sharing video.
- There is interest in sharing video resources with other public safety agencies, e.g., CRESA, Fire Department, and Police Department.

TRAVELER INFORMATION

Increasing congestion and limited roadway capacity require strategies that minimize traffic incidents, reduce response time, and encourage the use of alternative transportation modes. Traveler information helps the public make informed decisions regarding trip planning and advises the public of incidents, safety hazards, weather events, and public emergencies. Transit traveler information increases the convenience and utility of transit service. Public Information Displays at the BRT Vine stops inform riders of when their next bus will arrive.

On the roadway traffic information is provided for motorists through variable message signs (VMS) and highway advisory radio (HAR). WSDOT operates VMS signs along the I-5, I-205, SR-500, SR-502, and SR-503 and SR-14 freeways, and a HAR is located at I-5 and SR-501.

The City of Vancouver has two permanent VMS signs. One is along Mill Plain westbound approaching I-205 and the other is along NE 112th Avenue southbound approaching Mill Plain. The City of Vancouver does not have a Traffic Management Center, so these VMS signs are seldom used. WSDOT and Vancouver are implementing a center-to-center connection between their signal servers which would facilitate WSDOT use City VMS when needed. Future discussion should assess this possibility for incident management.

WSDOT provides online traveler information through the WSDOT Travel website, travel time and speeds are populated from the third-party data source HERE. Other information is from WSDOT data sources. This website gives roadway users access to traffic flow, alerts, cameras, truck restrictions (oversize/weight), mountain pass reports, weather stations, rest areas, Park & Rides, border crossing wait times, wildland fires, and mileposts. A screen capture from the WSDOT Traveler Information website zoomed in to the Vancouver area is shown in Figure 12.

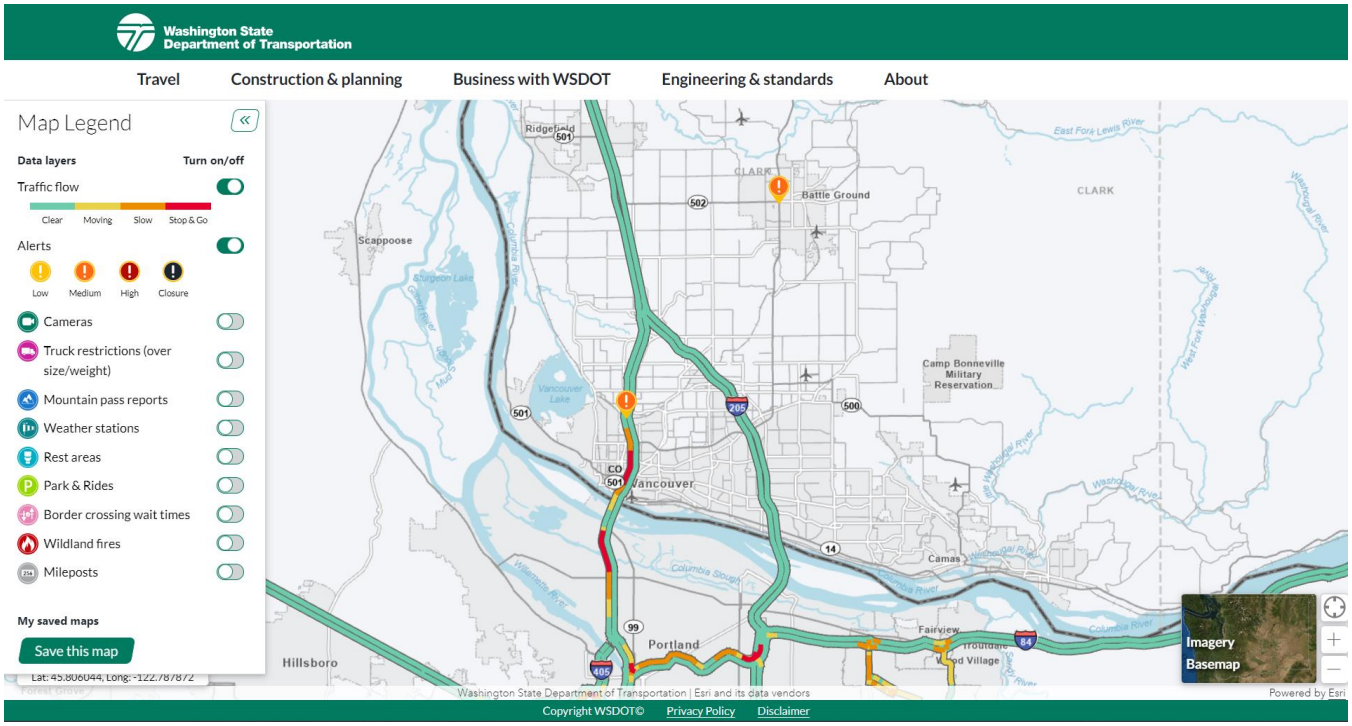

FIGURE 12: WSDOT TRAVELER INFORMATION WEBSITE

An additional source of regional traveler information is public transportation trip planning. C-TRAN routes and schedule information are published to Google Maps using the General Transit Feed Specification (GTFS) for bus schedules and associated geographic information. This information can be used to plan trips in the Google Maps web application.

This service is also integrated with route and schedule information from TriMet in Portland, OR. This common interface allows transit trips to be planned that utilize both C-TRAN and TriMet service. C-TRAN has had mobile access routers for some time.

An example trip planned from Mill Plain and 96th Avenue to Franklin and 12th (Regional Transportation Council office) is shown in Figure 13.

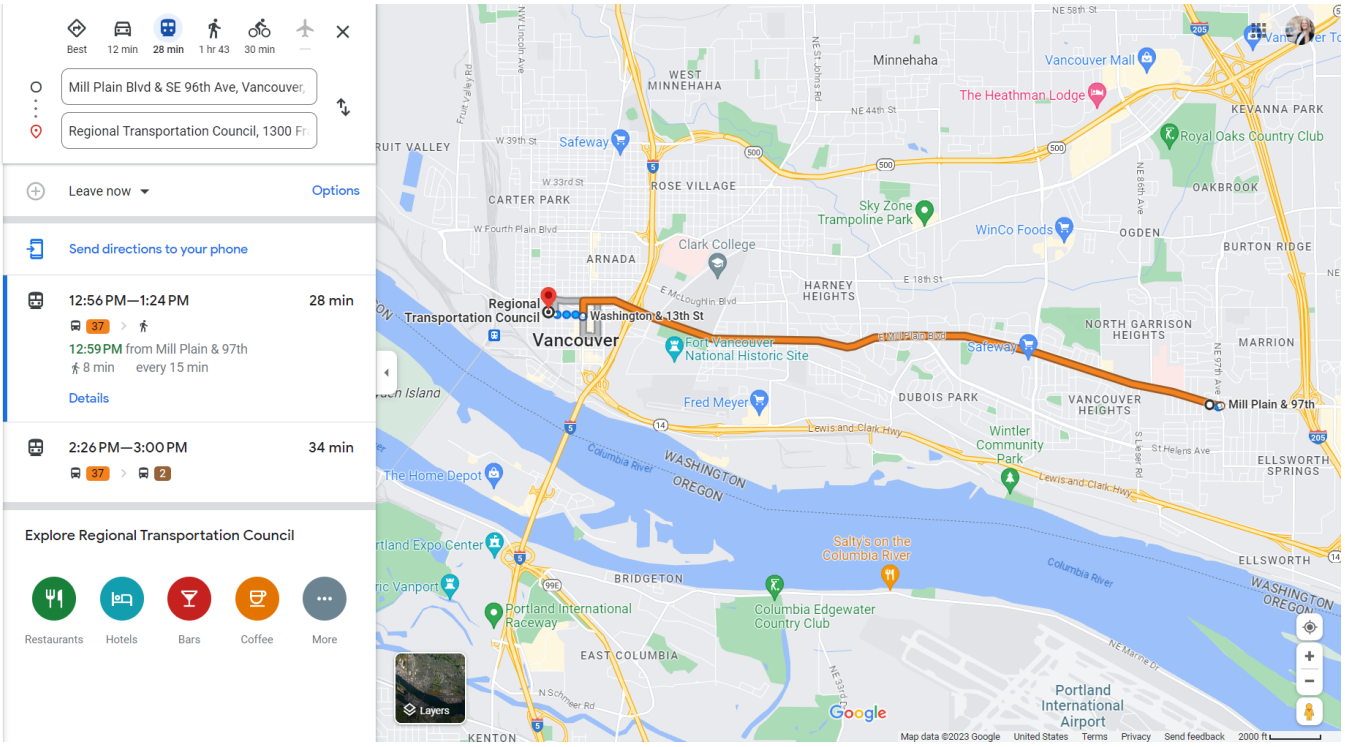

FIGURE 13: C-TRAN TRIP PLANNING AND GOOGLE MAPS

In addition to being consumers of agency data, there is a potential for 3rd parties such as Google and Waze to provide information back to agencies. These 3rd parties can be sources for flow and incident data, leveraging their broad data collection systems.

TRAVELER INFORMATION NEEDS

The following traveler information systems needs were identified:

- Clark County needs to share camera images on its public website to provide enhanced traveler information. 3-5 second clips are available through an ATMS.now module.
- Clark County needs to provide SPaT data from its high-resolution traffic signal controllers. This is currently being done via the TrafficWare TidalWave data service, and made available to subscribers.
- VAST agencies need to investigate opportunities for data sharing with private partners to facilitate expanded and improved traveler information.

ARTIFICIAL INTELLIGENCE / VIDEO ANALYTICS

As VAST adopts further advanced transportation devices, such as Artificial Intelligence and Video Analytics, further communication infrastructure will be needed. Video Analytics are used in the region to identify high crash locations and propose safety improvements.

CONNECTED AND AUTONOMOUS VEHICLES

Clark County currently operates several Connected Vehicle (CV) roadside units (RSU) at signalized intersections and roundabouts. These units are configured to be "one-way transmit only" broadcast (i.e., no vehicles broadcast data back to the roadside). This approach eliminates a significant security risk of inappropriate data being sent to the CV RSU and potentially passed to the County's network.

Clark County and WSDOT also currently operate Trafficware TidalWave, a platform for sharing near-real time signal data with CV users. This platform may be used as part of a future region-wide CV data distribution system.

CYBERSECURITY

The network needs to be protected from cyber-attacks, which is defined as a virtual attack by hackers with the goal to collect, disrupt, damage, or destroy the intended system. The United States has seen an increase in cyber-attacks on communication and electrical infrastructure from outside forces. VAST is interested in improving their cybersecurity to better control and stop attacks before they occur.

Currently, there are multiple ITS systems, each belonging to one agency and maintained by that agency with independent firewalls in place for each one. To access the systems, each VAST agency responds to requests of that agency and will coordinate as needed with other agencies for access through their firewall. Surveillance and traffic count cameras and other ITS devices can only be accessed through the firewall.

In 2018 and 2019, Clark County commissioned a series of White Papers exploring Smart Communities and more detailed discussion around the communications needs of ITS and Connected Vehicles in the future. These covered Connected Vehicle communications needs at a high-level, Connected Vehicle and ITS network security from an "edge device out", as well as network security from the "edge device in" standpoint. There was also a White Paper on Network failover. Each of these White Papers has a series of findings and recommendations that should be considered by all VAST Partner Agencies.

FUNDING OPPORTUNITIES

To be able to meet the goals for this plan, VAST will need necessary funding. This is not a comprehensive list, but one that aimed to be as complete as it could be.

- Leasing conduit or fiber to private entities
- Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT)
- The Broadband Equity, Access, and Deployment (BEAD) Program
- For adding fiber optics as part of a larger capital project:
  - Surface Transportation Block Grant (STBG) Program
  - Congestion Mitigation and Air Quality (CMAQ) Improvement Program

COMMUNICATIONS NETWORK RECOMMENDATIONS

PHYSICAL INFRASTRUCTURE

REPLACE, REPAIR, AND UPGRADE FIBER ALONG CERTAIN CORRIDORS

Enhancing the communications infrastructure quality and reliability should remain a high priority in the region. The following practices and policies are recommended:

- The routine end-of-life replenishment of field equipment schedule should be maintained.
- As funding opportunities allow, the region should continue to develop increased network quality and reliability by increasing fiber counts where possible and creating redundant paths and rings where needed.
- When new fiber and conduit is placed, the owner should notify the other VAST members and provide capacity details.
- The TIP Programming Guidebook also contains the following policies and procedures that relate to TSMO and ITS infrastructure:
  - Policy 1.3 – All TSMO project elements must be consistent with the strategies contained in the Regional Transportation Systems Management and Operations (TSMO) Plan for Clark County. TMSO elements of projects shall be coordinated with agency transportation operations staff.
  - Policy 1.3.1 – At a minimum all projects that open the road for utilities must include conduit.
  - Policy 1.3.2 – RTC ITS Grant Eligibility. To be eligible for a grant through RTC, all ITS hardware and software must have approval of the VAST Steering Committee prior to seeking grant funding. If ITS hardware or software changes after grant approval, VAST Steering Committee approval is required before expenditure on the technology.
- Each new connected device Clark County manages and supports should be connected to the communications network, either through fiber optic cable or wireless. It should also be capable of 1 Gbps throughput with routing redundancy.

A significant portion of the network in the City of Vancouver relies on 100 Mb Ethernet communications. While some of the corridors, such as Mill Plain, have Gb Ethernet trunk lines supporting the corridor, the VLAN's, traffic signals, and other devices are limited to 100 Mb Ethernet communications. The region should begin identifying corridors with copper or low bandwidth Ethernet to be replaced and/or upgraded as indicated.

COMMUNICATION ROUTES

In addition to repairing and replacing existing fiber corridors, it is important to maintain alternative communication routes to provide redundancy in the event of network infrastructure failure. In Figure 14, a set of network gaps are identified that if completed with fiber, would provide additional redundant paths. For instance, Fruit Valley Rd. in west Clark County would provide an additional redundant path for Clark County field devices to communicate with the agency center at the RTC.

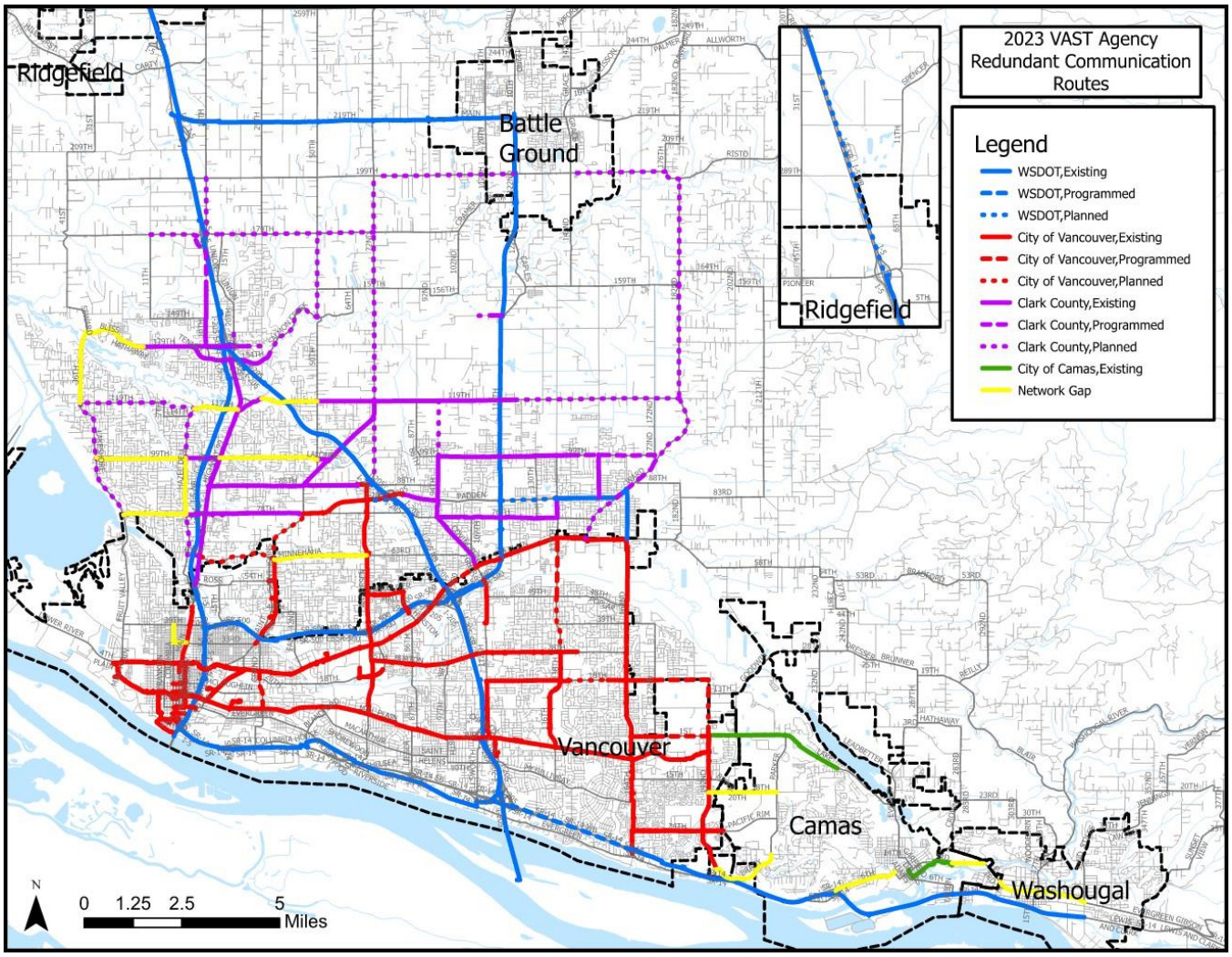

FIGURE 14: VAST AGENCY REDUNDANT COMMUNICATION ROUTES

NETWORK TRANSPORT LAYER

Clark County and City of Vancouver have recently completed updates to their communication network to add Layer 3 routers in key locations. Layer 3 routers can automatically reroute network traffic in the event of a down communication route. Currently, WSDOT relies on Layer 2 switches that are unable to automatically reroute network traffic in such an incident. C-TRAN deploys Layer 3 switches for the VINE networks. As Clark County and Vancouver continue to expand their router-based network, and WSDOT is also considering similar strategies for ensuring alternative network paths between devices are available as networks grow.

Figure 15 identifies potential Layer 3 router locations that would provide this redundant communications ability to the City of Vancouver and WSDOT.

VLANS AND IP ADDRESS SUPPORT

A review and redesign of VLANs are needed where improvements can be made to connect more VLANs and VLAN members to the fiber network.

The proliferation of devices on the network requires agencies to ensure the distribution network is designed to responsibly use the growing number of IP addresses.

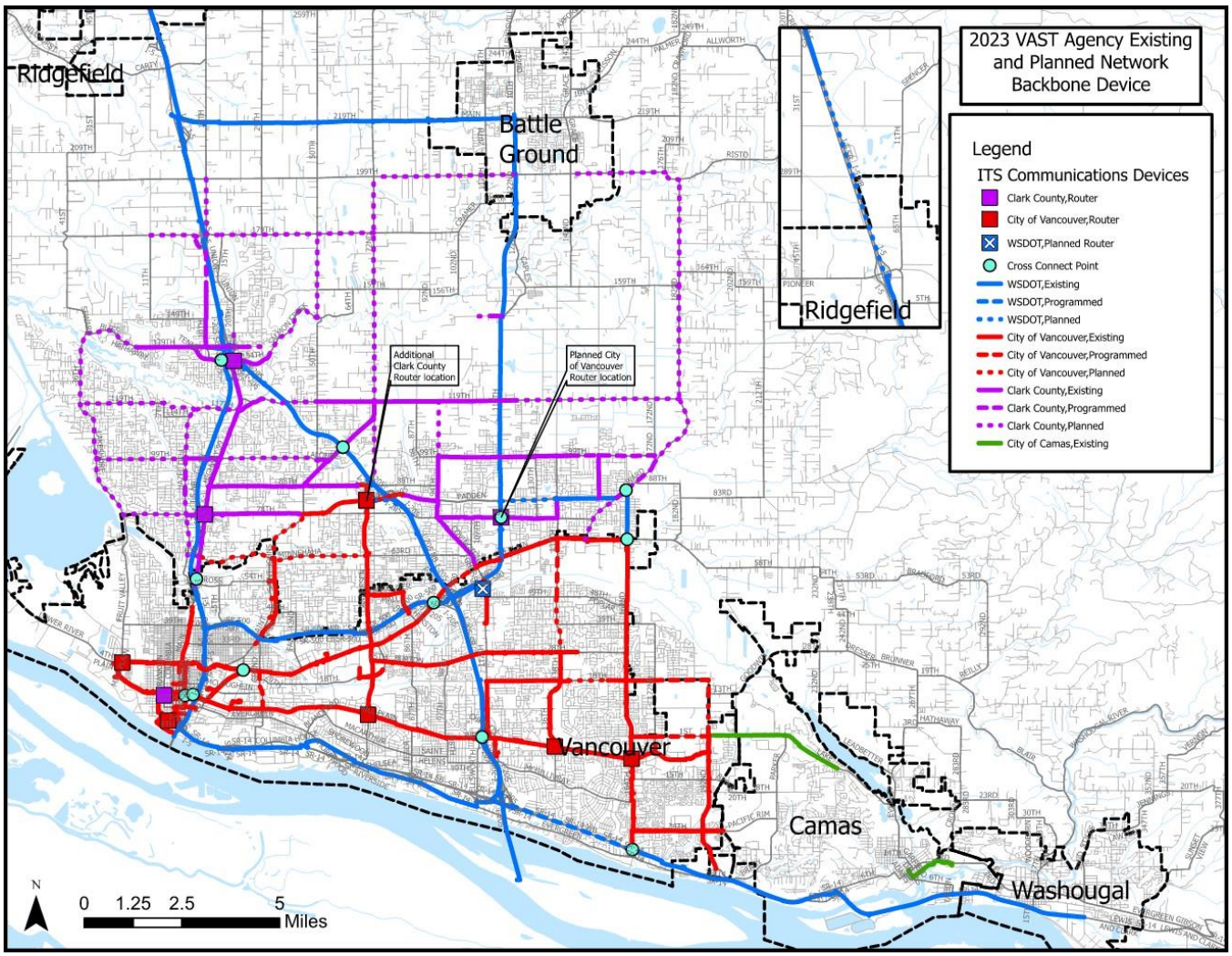

FIGURE 15: VAST AGENCY EXISTING AND PLANNED NETWORK BACKBONE DEVICES

INSTALLATION AND DEPLOYMENT

Increasing the communications capabilities of the regional network is important to future proof the system and meet the bandwidth and fiber needs of new systems and projects. Figure 16 defines the minimum fiber counts that should be installed in the Clark County region to meet these needs. In most cases the minimum number of fibers to be installed in the region should be 48 fibers. In areas closer to the downtown core a minimum of 96 fibers should be installed. Agencies performing fiber installation or repair on major arterials should consider using at least 144 fibers.

In the event that fiber is not to be installed during a project, agencies should lay conduit along project paths to allow for future fiber installations.

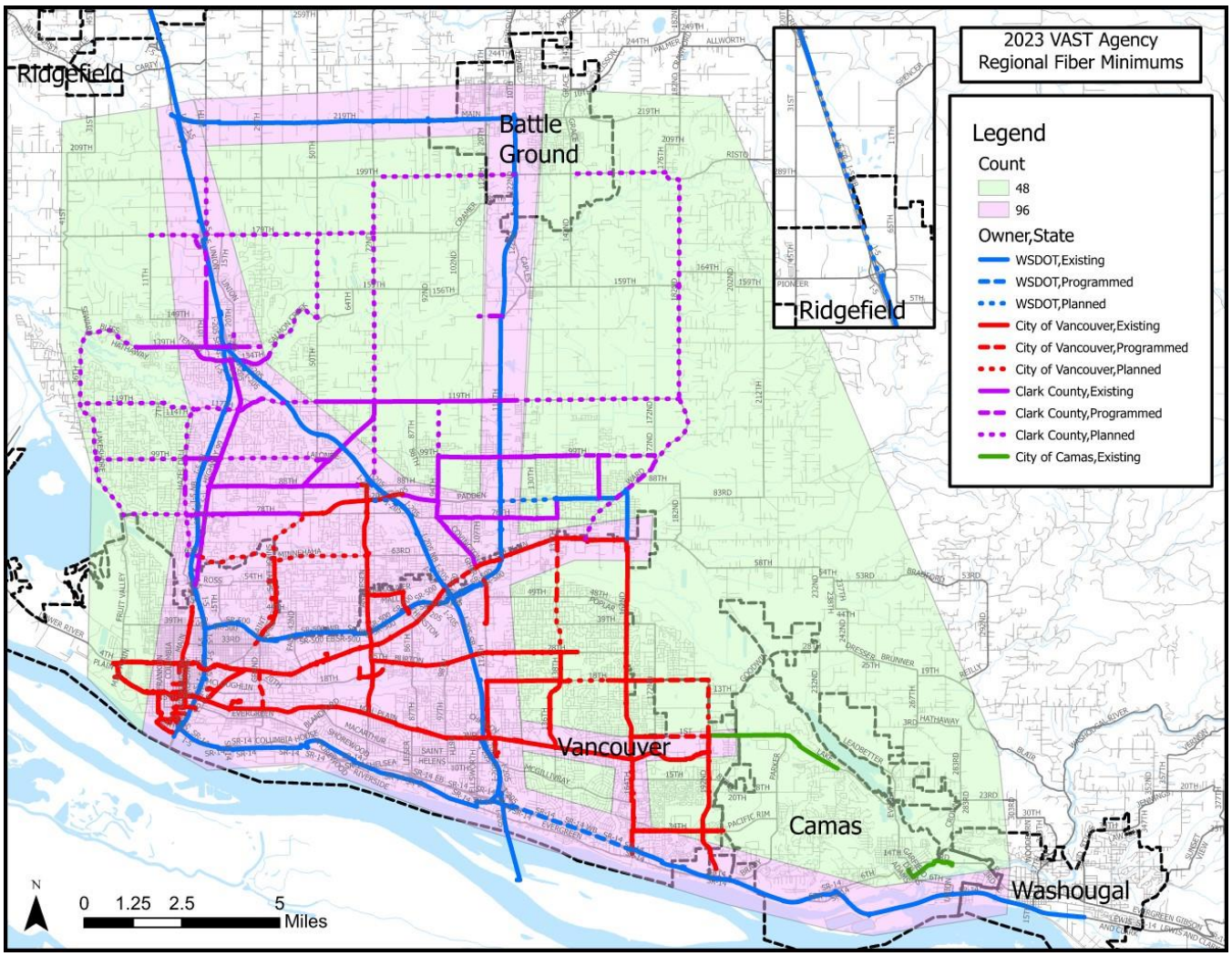

FIGURE 16: VAST AGENCY REGIONAL FIBER MINIMUM

NETWORK INFRASTRUCTURE DOCUMENTATION

DOCUMENT CURRENT FIBER CONDITIONS AND OTHER COMMUNICATIONS INFRASTRUCTURE IN OSP

OSPInSight (OSP) is an extension for ArcGIS systems to combine database and spatial analysis tools to manage fiber optic networks. OSP was chosen by the VAST group as the database-of-record for maintaining up to date fiber network data. Capturing the latest changes in the fiber network is important if OSP is to be a database of record and planning tool.

Currently a backlog of regional OSP updates exists relating to fiber network projects and fiber sharing permits. Recording these updates in OSP is necessary to bring the database up to date. In Figure 17, the fiber documented in OSP is shown overlaid on the existing fiber network. Where the existing fiber is not overlaid by documented OPS fiber, there is data missing in the OSP database.

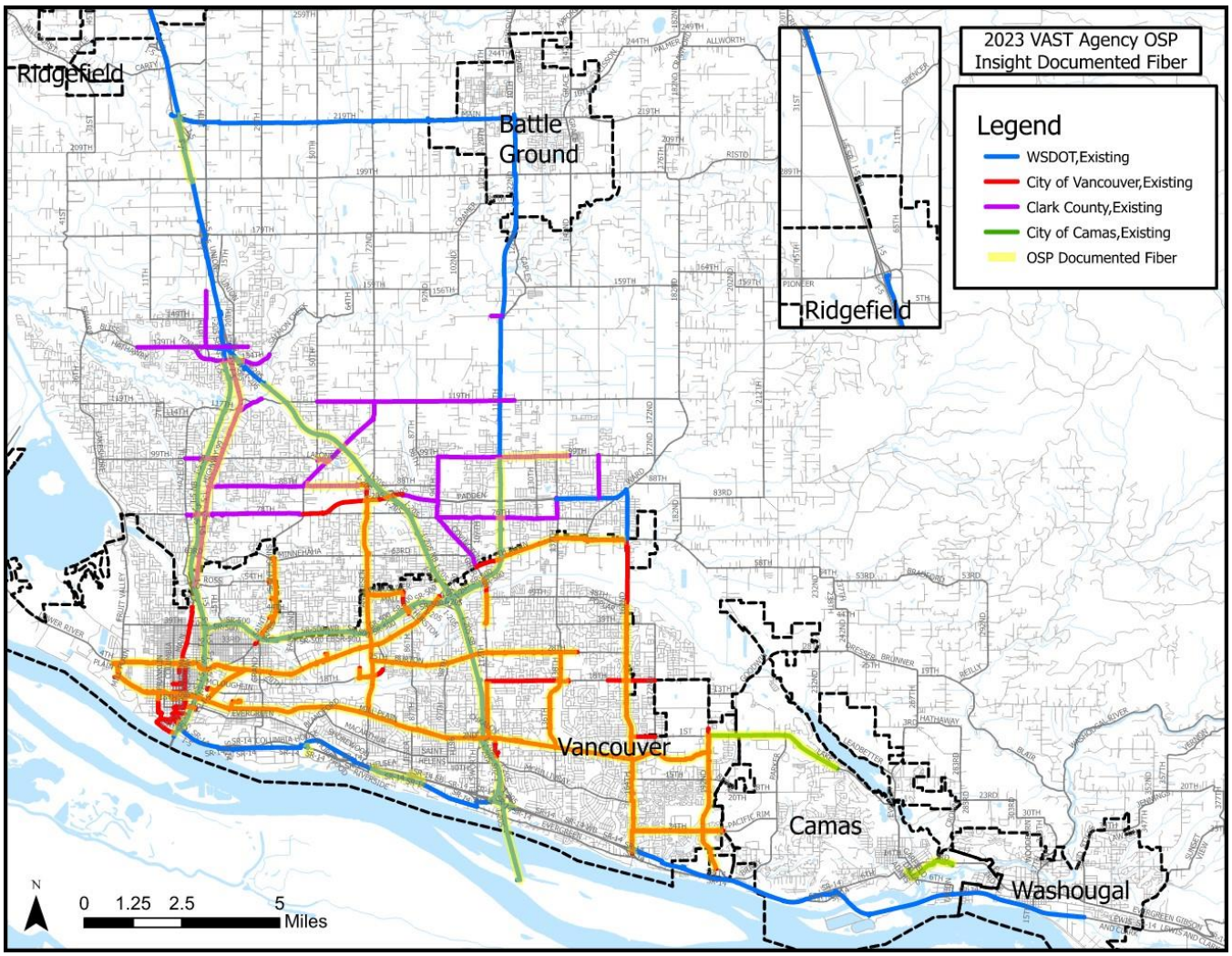

FIGURE 17: VAST AGENCY OSPINSIGHT DOCUMENTED FIBER

Partner agencies have noticed that recording recent fiber network changes in OSP is an unfamiliar process with no clear rules on what data should be collected and maintained in OSP. There is a need for standards to be created for what data should be maintained in OSP, and best practices identified to streamline the process.

Additionally, accurate information in OSP can drive decisions on where to prioritize fiber upgrades. While upgrading fiber media and bandwidth is an important long-term goal for the region, it is important to find segments with capacity constraints and plan capacity increases or identify alternate routes. Agencies need to collect documentation in the form of plans, as-builts, and contractor changes need to be captured and entered in OSP going forward.

Agencies should agree on an approach for a single point of entry to update and maintain the database as well as a funding strategy for ongoing support of OSP.

PORTAL DATA ARCHIVE

Portal is the transportation data archive for the greater Portland, OR and Vancouver, WA area. Portal exists to assist regional transportation partners in archiving data and to create tools to analyze system performance and inform decision makers.

Currently, VAST partners, C-TRAN, WSDOT, and Clark County are working to provide data to Portal. C-TRAN has developed a process to export Computer Aided Dispatch and Automatic Vehicle Locations (CAD/AVL) into Portal. C-TRAN will use Portal to analyze transit performance by leveraging existing CAD/AVL data visualizations developed with TriMet.

Clark County will use Portal to develop visualizations for travel times and origin and destination reports.

VAST should continue to work towards delivering regional data to Portal through the ITS data network. VAST should then continue to find opportunities for new data sources to be pushed into the data archive. Specifically, VAST should work with Portal to develop Congestion Management Plan reporting capabilities. The ability to feed the detection system data, Third Party Data, License Plate Readers, and Wavetronix, to the PORTAL Regional Data Archive for further analysis.

THIRD-PARTY DATA SHARING

Third-party information service providers such as Google and Waze provide travelers with journey planning information such as trip routes, estimated travel times, and congestion and incident warnings. These companies gather data from cell phone data providers, GPS receivers, and public agencies, and combine these data to provide accurate information to travelers.

Agencies should consider partnerships with these and other third-party data providers to release transportation data such as traffic flows, travel times, traffic signal phasing. Further, agencies should use these partnerships to acquire flow and incident data from the third parties in return. RTC is leading a regional effort to identify and evaluate third-party subscription data service providers and may purchase a subscription for use by region agency partners. The evaluation considers travel time and origin-destination data and addresses both transportation planning and traffic engineering use cases.

JOINT SYSTEMS

Jointly operated systems offer partner agencies benefits in cost sharing, shared operation opportunities, and reduce the communications requirements. While the region is currently exploring video sharing systems, opportunities for other shared systems should be identified and the advantages and disadvantages determined.

Possible systems that should be considered for joint administration include:

- **ATMS.now** and Q-Free's central signal system (MaxView and Kinetic Signals) – Both Clark County and the City of Vancouver currently use ATMS.now for managing traffic signals in the region, however, they are currently separate management systems. The ATMS.now system managed by Clark County is also shared with WSDOT and several of the small cities. In addition,

City of Vancouver also uses Q-Free's MaxView for managing some of their traffic signals and is in the process of migrating from ATMS.now to Q-Free's Kinetic Signals central signal system. WSDOT has been working with Clark County and City of Vancouver to establish a joint traffic operation center. The joint operation center will utilize both the ATMS.now and the upcoming Kinetic Signals systems to manage the traffic signals in the region and provide regionwide traffic management services.

- **SINEC Network Management** Server – Rugged Com CMS is being replaced by a system called SINEC, from Siemens. SINEC will provide SNMP monitoring of all IP devices on the traffic network. It provides proprietary MIBs that will enable data rich communications with all devices. SNMP messages provide instantaneous, detailed status and health information for devices. SINEC will provide SNMP services for up to 2,000 devices and can be expanded in blocks of 500 devices.
- **VDG Sense video sharing** – While the pilot project to share video between Clark County, WSDOT, and the City of Vancouver, is moving forward, agencies should plan to continue to add traffic surveillance cameras to maximize the potential. Further, traffic agencies can work with other agencies, i.e., public safety, fire, and police, to share video in the event of traffic and other incidents requiring responses from multiple agencies.
    - Approximately 200 PTZ cameras may be added to the system in the near future. Any number of new cameras added to the surveillance system will require a significantly higher bandwidth. Agencies must ensure the communications system can handle the new bandwidth, and fiber communications are highly recommended.
- **GTT Opticom CMS Server** – Currently all agencies in the region are using GTT Opticom systems for emergency vehicle pre-emption. C-TRAN, having completed a Transit Signal Priority Pilot project in 2012, is planning on using TSP on three additional corridors in the near future. TSP systems require significant set up using a central management server (CMS), especially during initial configuration. Agencies could benefit from managing all TSP operations from a single CMS. Regional Preemption and TSP policies are needed to ensure compatibility between existing and future systems.

As jointly operated systems provide benefits to partners, and agencies depend more on the systems it becomes increasingly important to make efforts to support, maintain, and keep these systems online. Shared systems use should include agreements between partners on management and incident response.

ADDITIONAL COMMUNICATIONS INFRASTRUCTURE COMMITTEE TOPICS

The VAST partner agencies have a long history of successfully working together to improve the regional transportation network. Throughout the development of this plan several topics were identified that, while outside the scope of this plan, are important to the future collaboration of agencies in the region. To facilitate such collaboration and plan for future changes in transportation, upcoming CIC discussion should include:

- **Best Practice Guidelines** – Agencies are currently defining their own standards for fiber installations. The region would benefit from a set of minimum standards for fiber installations including:
  - Conduit sizes and numbers
  - Fiber counts
  - Installation
  - Equipment
- **Fiber Tube Assignment Guidelines** – The VAST Partner agencies may want to revisit the Fiber Tube Assignment Policies. Agencies may want to standardize fiber tube assignments for sharing purposes, or simply, document how each agency is assigning tubes.
- **Asset Management** – VAST's continued success in regional collaboration has made progress in increasing the regional transportation system infrastructure. However, as some of these systems are nearing end of life and others need repairs, agencies are finding problems locating funding sources for management of transportation communications assets. Clark County is required to set aside funds for Early Retirement and Replacement (ER&R) when purchasing new equipment. C-TRAN similarly has life-cycle replacement program, based on their asset inventory tracking spreadsheet, that is submitted to the budget process to request funding. The VAST CIC should make a priority to identify strategies for funding the ongoing maintenance and replacement of communications infrastructure.
- **Fiber Sharing Guidelines** – The current fiber sharing permit process has been largely successful in facilitating the sharing of fiber network resources between partner agencies. New permits have been proposed that fall outside of the intent of the original permit process. The current permit process should be documented and new rules should be developed for new permit types with an emphasis on flexibility. Additional policies need to be developed between the lessor and lessee when the borrowing agency needs fiber repair in an accelerated time frame. VAST CIC may also want to review the "first come, first serve" basis of the fiber sharing policy, particularly when it comes to non-VAST member agencies or departments borrowing fiber on constrained corridors.
- **Network Sharing Guidelines** – The VAST Partner Agencies may want to discuss network sharing, and more specifically data flow, data usage, and bandwidth. Emerging transportation technologies such as connected vehicles, described in the next section, will require improvements to current network approaches in order to develop networks that have higher bandwidth and low latency to address future system demands.
- **Connected and Autonomous Vehicles** – Connected and Autonomous Vehicles (CAVs) represent some of the emerging technologies that traffic agencies must prepare for. CAVs include both connected vehicles that include communications technologies to communicate with roadway devices and other vehicles, and autonomous vehicles that utilize a number of on-board sensors to assist a driver or take complete control of driving responsibilities. Currently standards

for these emerging vehicle types are still being developed. The CIC should continue to follow these standards discussions and begin developing policies and projects that will future-proof current systems (e.g. upgrading signal controller CPUs). Finally, any future discussions of Connected and Autonomous Vehicles should identify private partnerships with automobile manufacturers or software service providers.