APPENDIX H: TRANSPORTATION COMMUNICATIONS PLAN (2017)

DKS
720 SW Washington St.
Suite 500
Portland, OR 97205
503.243.3500
www.dksassociates.com

MEMORANDUM

DATE: August 30, 2016

TO: Tegan Enloe, P.E., City of Hillsboro

FROM: Jim Peters, P.E.
Josh Crain, P.E., ASEP
Chris Muhs

SUBJECT: Transportation Communications Plan P16021-000

INTRODUCTION

The City of Hillsboro seeks to build and implement new central management systems for traffic signal control, lighting control, and potentially other smart cities applications. The immediate benefit of these systems is increased maintenance and operational efficiency, and engineers and technicians can remotely monitor and manage traffic signals instead of needing to travel to the signal. Communications network infrastructure is necessary in order to operate these systems.

The purpose of this communications plan is to identify the list of projects that must be constructed to support communications between devices in the field, data centers, users, and the regional communications network. The plan delivers cost savings by eliminating the need to "dig twice", combining communications projects with traffic signal and other roadway projects, and by identifying opportunities to share communications infrastructure with other public agencies.

This memorandum describes existing conditions with respect to the transportation communications network in the greater Hillsboro area, proposed projects including methods that led to their development, and the physical path infrastructure must take to provide center-to-center communications. The document concludes with transportation communications design and construction standards.

EXISTING TRANSPORTATION CONDITIONS

Understanding existing communications infrastructure is key to developing a network plan because it provides the basis for leveraging existing infrastructure to achieve the overall communications network vision. Existing communications infrastructure may be owned by the City, other public agencies, and the private sector, and provides sharing opportunities that enable each agency to expand the reach of their network with limited capital expenditure.

In the City of Hillsboro, the existing communications infrastructure is owned by the City, Washington County, Oregon Department of Transportation (ODOT), TriMet, and other private communications providers. Each of these agency partners provides opportunity to share regional network infrastructure. The City owns many information technology (IT) communications assets and continues to build more. These assets are shared with the City Public Works department for transportation. Washington County, ODOT, and TriMet also own communications infrastructure on roadway facilities in and surrounding the City.

There are also third party private fiber optic cables in the City limits, through which sharing agreements are possible. Accordingly, an inventory of City-owned existing infrastructure and assets of these agencies have been compiled and mapped. In this plan, "existing" refers to infrastructure that is either built, in construction, or funded for construction through 2016. The City held a meeting in March 2016 with DKS and Washington County staff to review existing infrastructure. The resulting map is shown in Figure 1 Existing Communications Infrastructure in Appendix A.

PROPOSED COMMUNICATIONS INFRASTRUCTURE

This section identifies the communications infrastructure to be built and why. Objectives of this infrastructure include the following:

- Connect City traffic signals to the regional traffic control system (TCS) server via a new City traffic signal central communication server (CCS)
- Connect other transportation field devices for remote monitoring and performance evaluation
- Connect key City facilities

Additional detail on how projects are identified and prioritized is presented in the following section.

Methods

First, individual communications segments were identified in order to connect traffic signals, other transportation field devices, and key data center locations. Connecting traffic signals and completing links to the City's data center were the most important components of the network. Next, segments were grouped into projects based on geographic proximity, priority of segments in forming a complete network, and priority of the devices or facilities being connected.

Key considerations included the following:

- Account for other City communications infrastructure that could be shared
- Account for other public agency planned communications infrastructure on similar routes where construction costs could be shared
- Account for private sector leased options for remote locations or even supporting backhaul links
- Account for opportunities to share regional systems such as the regional traffic signal system and/or regional data warehouse

Figure 2 in Appendix B shows the proposed communications infrastructure. This map shows existing communications infrastructure owned by the City and other regional agencies, not all of which is suitable for transportation communications. It also depicts the final proposed communications network. Proposed infrastructure is ranked high (1) to low (5). Specific layouts in future developments of South Hillsboro and North Hillsboro should be considered generic and adapted to the actual street and traffic signal layout.

Proposed projects

The proposed communications infrastructure is split into nine separate projects based on priority, constructability, and interdependence. Figure 3 Proposed Communications Projects in Appendix B shows the

projects. Table 1 Communications Plan Projects in Appendix B describes each project including extent, priority ranking, number of signals or devices impacts, and estimated capital and operational costs. Cost estimates include capital costs and operations and maintenance costs. Project cost assumptions and detailed breakdown of line items for each project are included in Appendix B.

Four of the nine projects include alternative deployment options. In these cases, cellular connections can provide an interim, low bandwidth communications backhaul instead of fiber optic cable. These alternative projects should be considered a phased solution to offset the substantial capital cost of providing more reliable fiber optic cables, which may be a barrier to programming and funding.

CENTER-TO-CENTER CONNECTIONS

The purpose of center-to-center communications is to support management of the City's traffic signals via the Portland region's central traffic control system (TCS), which is hosted by the Portland Bureau of Transportation (PBOT). The Proposed Traffic Signal Management diagram in Appendix C outlines the main components. Key links are the network paths for 1) City of Hillsboro staff to PBOT's terminal server used for signal management, and 2) the City's central communications server (CCS) to Portland's TCS server. Both of these paths can be provided using the TransPort ITS Network.

The process for the City to join the TransPort ITS Network is comprised of the following tasks:

1. Establish physical fiber optic paths to one or more existing network switches. The City can either establish fiber optic paths through direct agreements with partner agencies or join and use the fiber optic infrastructure available through the Cooperative Telecommunications Infrastructure Committee (CTIC).
2. Submit a Request to Join and sign an agreement to TransPort policies.
3. Procure and install the network-specific switch, a firewall of the City's choosing, and the CCS. This establishes the network, but the City is does not yet have access to any ITS Network services.
4. Submit ITS Network Service Requests for access to PBOT's terminal server and TCS server. Copies of the relevant policies and forms are in Appendix C.

Note that the administration process alone for the City to join the TransPort ITS Network can take several months to complete. Since the ITS Network is operated by a consortium of transportation agencies, there are no staff dedicated to process requests.

The Proposed TransPort ITS Network Architecture diagram in Appendix C shows the proposed network paths to the City of Portland. There are two existing ITS Network switches near Hillsboro, at the Washington County Walnut Street Center and the City of Beaverton. Establishing physical connections to both of these switches will provide redundant communications links for the City and other agencies. Example documentation of fiber optic paths to ODOT and City of Beaverton are included in Appendix C for reference.

The hardware requirements for the City's central communications server are minimal as the server acts only as an aggregator; it relays commands from the TCS server to the individual controllers. The CCS can operate as a Windows virtual server but will be limited to Ethernet communications. This should not be a problem since the City does not need to integrate legacy traffic signal communication systems such as serial modem banks. In

some cases, it may be convenient to connect a City traffic signal controller to the Washington County CCS. While this will not allow direct network access to the controller by City staff, the controller can be monitored and managed by City staff through the common TCS. Similarly, traffic signals operated by Washington County, City of Beaverton, and ODOT can be monitored by City staff through the TCS. This also allows for limited time of day based coordination with other agency's traffic signal systems by using the common TCS server timeclock.

DESIGN AND CONSTRUCTION STANDARDS

The purpose of the Transportation Communications Design and Construction Standards is to provide the specifications and construction requirements for implementing the transportation communications plan. The standards provide the basis for including the planned communications infrastructure in relevant development or construction work. The standards can also streamline the City's project review and approval process.

New roadway construction and significant maintenance projects should install communications infrastructure with sufficient conduit capacity for expected needs and support a "dig once" approach. Including the basic conduit raceways and junction boxes significantly reduces the cost and time for deploying future communication systems, reduces the disruption impacts and costs of repeated excavation, and can serve as regional infrastructure assets.

The standards include general design requirements, material specifications, installation requirements, documentation requirements, approved materials, and CAD plan standards. The design requirements detail where and what communications infrastructure should be installed based on this plan. The material specifications detail the requirements for equipment to be installed and prove consistency throughout different projects. Installation, setup, and finishing requirements provide guidance on how to construct the communications infrastructure and provide clear direction of contractor tasks. The documentation requirements ensure what is constructed will be identifiable and useable in the future. To simplify project review and approval, a table of pre-qualified products is included. This is a single subsection to allow for revisions as new materials are standardized and as manufacturers change specific model numbers and update products. The CAD standards detail the callouts that should be used communications infrastructure on design plans.

The draft Transportation Communications Design and Construction standards are included in Appendix D.

APPENDIX A - EXISTING COMMUNICATIONS INFRASTRUCTURE

- **Figure 1 - Existing Communications Infrastructure**

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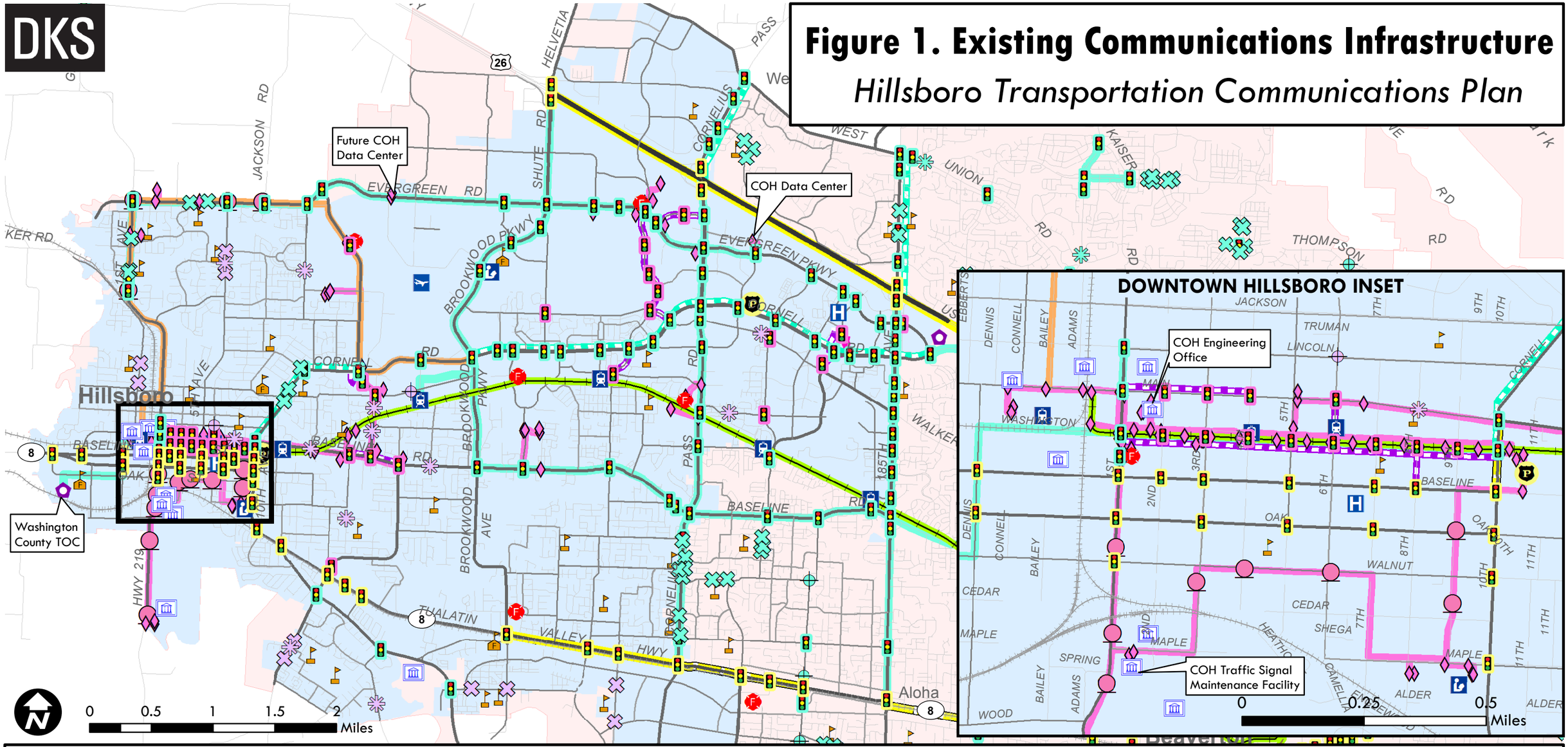
Figure 1. Existing Communications Infrastructure

Hillsboro Transportation Communications Plan



LEGEND

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Transportation Network
- Freeways & Interstates
- Major Arterial
- Arterial
- Collector
- Neighborhood Route
- Local street
- TriMet Rail
- Other Railroads

Traffic Signals
- Traffic Signal - ODOT
- Traffic Signal - Washington County
- Beacon - Washington County
- Pedestrian RRFB - Washington County
- School Zone Beacon - Washington County
- Traffic Signal - City of Hillsboro
- Beacon - City of Hillsboro
- Pedestrian RRFB - City of Hillsboro
- School Zone Flasher - City of Hillsboro

Key Facilities
- Airport
- Government Facility
- Hospital
- Library
- Light Rail Station
- Police Station
- Fire Station
- School
- School Facility
- Traffic Operations Center

Boundaries
- Hillsboro City Limits
- Urban Growth Boundary

Communications
- Fiber Network - City of Hillsboro
- Fiber Network - Washington County
- Fiber Network - ODOT
- Fiber Network - TriMet
- Fiber Network - Third Party
- Fiber Connection - City of Hillsboro
- Fiber Storage - City of Hillsboro
- Signal Twisted Pair - City of Hillsboro
- Signal Twisted Pair - Washington County
- Signal Twisted Pair - ODOT
- Wireless Network - City of Hillsboro

City of Hillsboro, Oregon is originating data source provider. Source data available online at www.hillsboro-oregon.gov

APPENDIX B – PROPOSED COMMUNICATIONS INFRASTRUCTURE

Figure 2. Proposed Communications Infrastructure

Hillsboro Transportation Communications Plan

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10 Expected Signals

Future COH Data Center

COH Data Center

COH Engineering Office

COH Traffic Signal Maintenance Facility

Washington County TOC

Hillsboro

Verboort

West Union

Aloha

DOWNTOWN HILLSBORO INSET

0 0.25 0.5 Miles

LEGEND

Existing Traffic Signals
- Traffic Signal - City of Hillsboro
- Beacon - City of Hillsboro
- Pedestrian RRFB - City of Hillsboro
- School Zone Beacon - City of Hillsboro

Planned Traffic Signals
- Kiosk - City of Hillsboro
- Traffic Signal - City of Hillsboro

Key Facilities
- Airport
- Government Facility
- Hospital
- Library
- Light Rail Station
- Police Station
- Fire Station
- School
- School Facility
- Traffic Operations Center

Boundaries
- Hillsboro City Limits
- Urban Growth Boundary

Existing Communications
- Fiber Network - City of Hillsboro
- Fiber Network - Other Agencies

Proposed Communications
- 1 - Highest priority
- 2 - Medium/high priority
- 3 - Medium priority
- 4 - Low/Medium priority
- 5 - Lowest priority

0 0.5 1 1.5 2 Miles

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Figure 3. Proposed Communications Projects

Hillsboro Transportation Communications Plan

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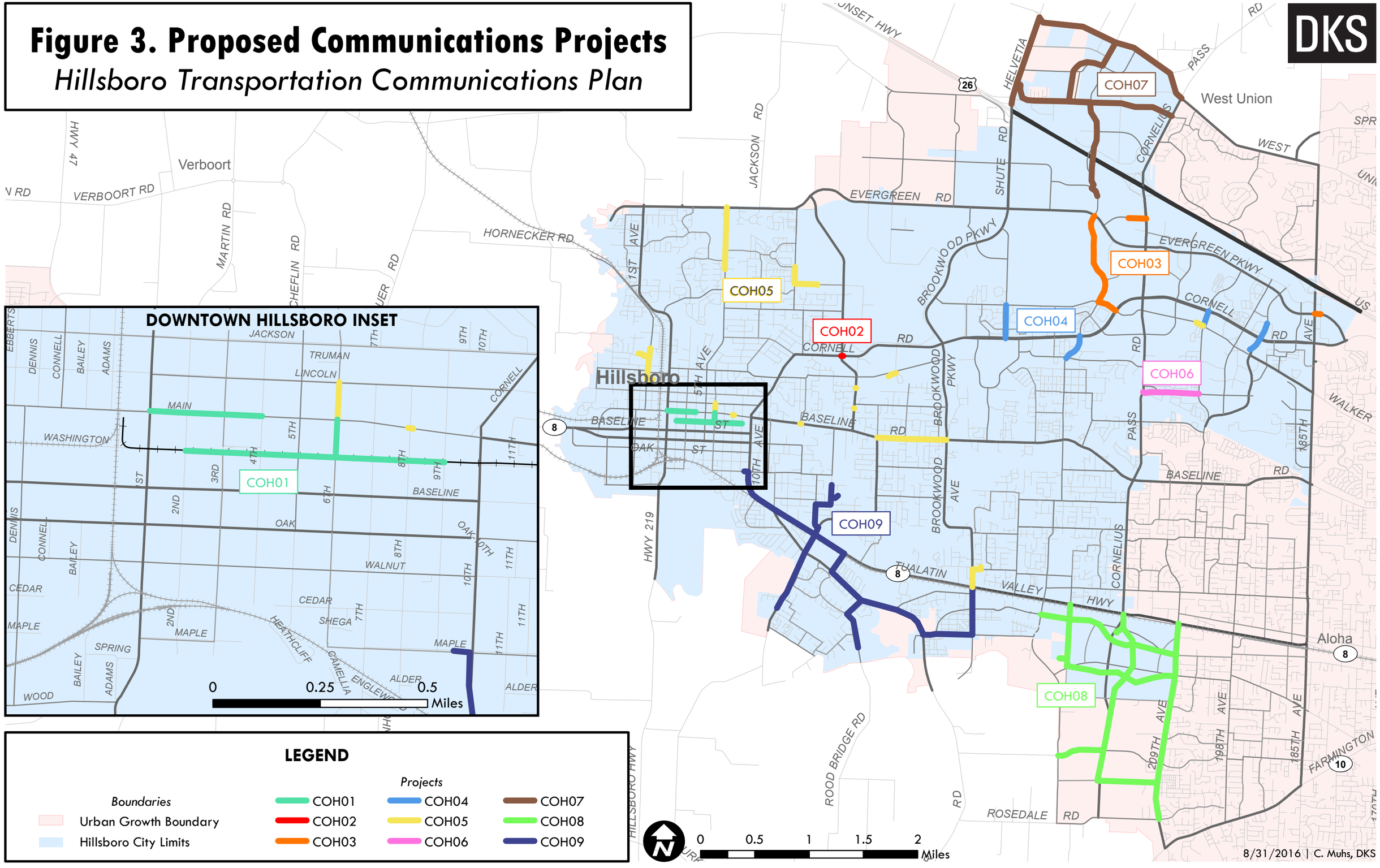

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Boundaries

- Urban Growth Boundary
- Hillsboro City Limits

Projects

- COH01
- COH02
- COH03
- COH04
- COH05
- COH06
- COH07
- COH08
- COH09

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City of Hillsboro, Oregon is originating data source provider. Source data available online at www.hillsboro-oregon.gov

Table 1. Communications Plan Projects

Project No.	Project Name	Priority	Project Description	Traffic Signals/ Devices Impacted	New Edge Switches	New Aggregate Switches	Capital Cost	Annual O & M Cost
Hillsboro Communications Projects								
COH01	Downtown fiber optic network connections	2 (medium-high)	**General description**: Install new fiber in existing interconnect conduit in downtown Hillsboro **Specific description**: Use existing interconnect conduit to replace copper with fiber and connect to the following signals: * E Main St & NE 2nd Ave, NE 3rd Ave, NE 4th Ave, NE 6th Ave * SE Washington St & SE 2nd Ave, SE 3rd Ave, SE 4th Ave, SE 5th Ave, SE 6th Ave, SE 7th Ave, SE 8th Ave, SE 9th Ave * Add aggregate switch at SE Washington St @ SE 2nd Ave to connect to Civic Center	12	12	1	$452,000	$13,560
COH02	COH to WAVE fiber optic link	1 (high)	**General description**: Connect City of Hillsboro fiber to WAVE at NE 25th Ave & NE Cornell Road **Specific description**: * Install new fiber optic cable across NE 25th Ave on North side of intersection * Install new aggregate switch	0	0	1	$74,000	$2,220
COH03	229th fiber optic project	2 (medium-high)	**General description**: Install new fiber optic cable in existing interconnect conduit along NW 229th Ave and nearby City of Hillsboro traffic signals **Specific description**: Install new fiber optic cable and edge switches to these traffic signals: * Along NW 229th Ave between NE Cornell Rd and NW Evergreen Pkwy: NE Butler St, Ronler Dr, South Intel entrance, North Intel entrance * NW Imbrie Dr & Fred Meyer * NW Evergreen Pkwy & NW Town Center Dr	6	6	0	$555,000	$16,650
COH04	Cornell Road Fiber Spurs	2 (medium-high)	**General description**: Install new fiber optic cable in existing interconnect conduit, where available, to connect City of Hillsboro traffic signals along the vicinity of Cornell Road. **Specific description**: * Install new fiber optic cable in existing interconnect conduit from NW Cornell Rd to NW Amberwood Dr & NW 206th Ave traffic signal * Install new fiber optic cable in existing interconnect conduit from NE Cornell Rd to NE Cherry St & NE 231st Ave traffic signal * Install new fiber optic cable in existing interconnect conduit from NW Cornell Rd to NW Walker Rd & NW Amberglen Pkwy traffic signal * Install new fiber optic cable in existing interconnect conduit from NW Cornell Rd to NW Stuckie Ave & NW Allie Ave/NW Thorncroft Dr traffic signal * Install new fiber optic cable and conduit between NE Cornell Rd and NE Shute Rd & NE Butler St traffic signal	5	5	0	$410,000	$12,300

Table 1. Communications Plan Projects

Project No.	Project Name	Priority	Project Description	Traffic Signals/ Devices Impacted	New Edge Switches	New Aggregate Switches	Capital Cost	Annual O & M Cost
COH04a	Cornell Road Fiber Spurs - alternative solution	2 (medium-high)	**General description**: Same as COH04 but use cellular connections as a near-term solution **Specific description**: Establish cellular connections from Cornell Road to the following devices: * NW Amberwood Dr & NW 206th Ave traffic signal * NE Cherry St & NE 231st Ave traffic signal * NW Walker Rd & NW Amberglen Pkwy traffic signal * NW Stuckie Ave & NW Allie Ave/NW Thorncroft Dr traffic signal * NE Shute Rd & NE Butler St traffic signal	5	0	0	$58,000	$2,640
COH05	Hillsboro Pedestrian Beacon Connections	4 (medium-low)	**General description**: Install new fiber optic cable and conduit to connect beacons in the City of Hillsboro **Specific description**: Connect to the following devices: * NE Lincoln St & NE 6th Ave (red stop beacon) * NE Veterans Dr & west of NE 34th Ave (pedestrian beacon) * NE Jackson School Rd & NE Estate Dr (pedestrian RRFB) * NE Jackson School Rd & NE Rogahn St (school zone beacon) * NE Jackson School Rd & NE Tipton Ct (school zone beacon) * E Main St & NE 18th Ave (pedestrian RRFB) * NE Jones Farm Pkwy & NE 15th Ave (pedestrian RRFB) * E Main St & NE 37th Ave (pedestrian RRFB) * NW Connell Ave & NW Forest St (school zone beacon) * NW Connell Ave & NW Val St (school zone beacon) * E Main St & NE 8th Ave (pedestrian RRFB) * NW Amberwood Dr & NW Sheffield Ave (pedestrian RRFB) * NE 28th Ave & NE Parkwood St (pedestrian RRFB) * NE 28th Ave & NE Laura St (pedestrian RRFB) * Brookwood Fire Station	15	15	0	$1,149,000	$34,470

Table 1. Communications Plan Projects

Project No.	Project Name	Priority	Project Description	Traffic Signals/ Devices Impacted	New Edge Switches	New Aggregate Switches	Capital Cost	Annual O & M Cost
COH05a	Hillsboro Pedestrian Beacon Connections - alternative solution	4 (medium-low)	**General description**: Same as COH05 but with cellular connections as an interim solution. **Specific description**: Connect to the following devices: * NE Lincoln St & NE 6th Ave (red stop beacon) * NE Veterans Dr & west of NE 34th Ave (pedestrian beacon) * NE Jackson School Rd & NE Estate Dr (pedestrian RRFB) * NE Jackson School Rd & NE Rogahn St (school zone beacon) * NE Jackson School Rd & NE Tipton Ct (school zone beacon) * E Main St & NE 18th Ave (pedestrian RRFB) * NE Jones Farm Pkwy & NE 15th Ave (pedestrian RRFB) * E Main St & NE 37th Ave (pedestrian RRFB) * NW Connell Ave & NW Forest St (school zone beacon) * NW Connell Ave & NW Val St (school zone beacon) * E Main St & NE 8th Ave (pedestrian RRFB) * NW Amberwood Dr & NW Sheffield Ave (pedestrian RRFB) * NE 28th Ave & NE Parkwood St (pedestrian RRFB) * NE 28th Ave & NE Laura St (pedestrian RRFB) * Brookwood Fire Station	15	0	0	$132,000	$6,660
COH06	Wilkins communication project	3 (medium)	**General description**: Install new fiber optic cable and conduit to connect devices on NW Wilkins Dr between NW Cornelius Pass Rd and NW 206th Ave **Specific description**: Connect the traffic signal at NW Wilkins St & NW 206th Ave and the pedestrian RRFB at NW Trail Walk Dr	2	2	0	$240,000	$7,200
COH06a	Wilkins communication project - alternative solution	3 (medium)	**General description**: Same as COH06 but with cellular connection as an interim solution. **Specific description**: Connect the traffic signal at NW Wilkins St & NW 206th Ave and the pedestrian RRFB at NW Trail Walk Dr	2	0	0	$36,000	$1,440
COH07	North Hillsboro Megafiber	4 (medium-low)	**General description**: Install new fiber optic cable and conduit to connect planned traffic signals in North Hillsboro. Install aggregate switch. **Specific description**: Signal locations to be determined	10	10	1	$2,303,000	$69,090
COH08	South Hillsboro Megafiber	4 (medium-low)	**General description**: Install new fiber optic cable and conduit to connect planned traffic signals in South Hillsboro. Install fiber optic cable and conduit to connect two school zone beacons by Rosedale Elementary School on SW 229th Ave. Install aggregate switch. **Specific description**: Planned signal locations to be verified.	22	22	1	$2,720,000	$81,600

Table 1. Communications Plan Projects

Project No.	Project Name	Priority	Project Description	Traffic Signals/ Devices Impacted	New Edge Switches	New Aggregate Switches	Capital Cost	Annual O & M Cost
COH09	Rood Bridge communication project	5 (low)	**General description**: Install new fiber optic cable and conduit to connect devices on Minter Bridge Road, Rood Bridge Road, Davis Road, SE 21st Avenue, and SE 24th Avenue to the library at SE 10th @ Maple St. **Specific description**: Connect the following devices: * SE Minter Bridge Rd & SE Jacquelin Dr (pedestrian RRFB) * SE Alder St & SE 24th Ave (pedestrian RRFB) * SE Minter Bridge Rd & SE Jacquelin Dr (school zone beacon) * SE Minter Bridge Rd & SE Anthony St (school zone beacon) * SW Rood Bridge Rd & Rood Bridge Park (pedestrian RRFB) * SE Davis Rd & SE Brookwood Ave (school zone beacon) * SE Davis Rd & SE Alexander St (school zone beacon) * SE Cypress St & SE 21st Ave (traffic signal)	8	8	0	$2,226,000	$66,780
COH09a	Rood Bridge communication project - alternative solution	5 (low)	**General description**: Same as COH09 but with cellular connections as an interim solution **Specific description**: Connect the following devices: * SE Minter Bridge Rd & SE Jacquelin Dr (pedestrian RRFB) * SE Alder St & SE 24th Ave (pedestrian RRFB) * SE Minter Bridge Rd & SE Jacquelin Dr (school zone beacon) * SE Minter Bridge Rd & SE Anthony St (school zone beacon) * SW Rood Bridge Rd & Rood Bridge Park (pedestrian RRFB) * SE Davis Rd & SE Brookwood Ave (school zone beacon) * SE Davis Rd & SE Alexander St (school zone beacon) * SE Cypress St & SE 21st Ave (traffic signal)	8	0	0	$80,000	$3,840
						TOTAL (NON-ALTERNATIVE PROJECTS):	$10.13 M	$303,870
						TOTAL (WITH ALTERNATIVE PROJECTS):	$6.41 M	$197,700

Table 2. Hillsboro Communications Plan Cost Estimate Assumptions

Project Element	Unit	Unit Costs	Cost Assumptions
Cabinet/Controller Upgrades			
Prep Cabinet for Fiber Edge Switch	EA	$3,500	Includes fiber distribution unit @ $225, splice closure @ $1,000, 6 pig tails & jumpers @ $55 each, 50' of fiber optic cable @ $0.70/ft, and 24 splices @ $60 each
Prep Cabinet for Fiber Aggregate Switch	EA	$6,500	Includes fiber distribution unit @ $800, splice closure @ $1,000, 24 pig tails & jumpers @ $55 each, 50' of fiber optic cable @ $0.70/ft, and 48 splices @ $60 each
Leased Services			
Cellular Router/VPN	EA	$650	Assumes Cradle Point modem based on input from Stacy Shetler
Communications Equipment			
Fiber Aggregate Switch	EA	$8,000	Ruggedcom RX1501 or similar gigabit Ethernet swith with 4+ SFP
Fiber Edge Switch	EA	$3,000	Ruggedcom RS900G or similar small gigabit Ethernete switch with 2 SFP
Wave Divison Multiplexing (Per end)	EA	$7,500	OADMs and optics
Communications Cabinet	EA	$11,000	332S style communications cabinet; no environmental control
Wireless			
Wireless Radio Installation (Per Intersection)	EA	$3,800	Point to point 5.8 GHz Ethernet radio with adjustable pole mounted bracket
Cameras			
CCTV PTZ Camera System on Traffic Signal	EA	$9,000	Includes camera @ $5,000, encoder @ $1,500, power supply @ $250, bracket @ $300, cables & misc. @ $950, and installation @ $1,000
CCTV PTZ Camera System and Camera Pole	EA	$61,000	Includes pole & foundation @ $17,000, lowering device & camera @ $17,000, camera & service cabinets @ $19,500, and wiring & underground @ $7,500
Communication Cable/Conduit Installation			
Fiber Optic Cable in New Conduit	LF	$30	Includes fiber optic cable, new fiber optic handholes, trenching, and conduit
Fiber Optic Cable in Existing Conduit	LF	$20	Includes fiber optic cable, replacing existing junction boxes with new fiber optic handholes, sidewalk restoration, and removal of existing twisted pair
Fiber Optic Cable Testing and Splicing	EA	$500	Assumes $500 for testing per splice or termination point in the project
Interface/Share Fiber with Other Agency	LS	$10,000	Cost for interfacing with another agency, including permits and coordination
SUBTOTAL			
Mobilization		10%	
TP&DT		10%	
Contingency		30%	
Project Design/Systems Engineering		20%	
Construction Engineering/Project Management		15%	
IT Network Integration		1%	
TOTAL COST			
TOTAL COST (Rounded)			
Annual Operations & Maintenance Cost		3%	Plus $15/mo per cellular if included on the project

Hillsboro Communications Plan Cost Estimate

Project Name:	Priority:	Project No:
Downtown fiber optic network connections	2 (medium-high)	COH01

Project Description:

General description: Install new fiber in existing interconnect conduit in downtown Hillsboro

Specific description: Use existing interconnect conduit to replace copper with fiber and connect to the following signals:
* E Main St & NE 2nd Ave, NE 3rd Ave, NE 4th Ave, NE 6th Ave
* SE Washington St & SE 2nd Ave, SE 3rd Ave, SE 4th Ave, SE 5th Ave, SE 6th Ave, SE 7th Ave, SE 8th Ave, SE 9th Ave
* Add aggregate switch at SE Washington St @ SE 2nd Ave to connect to Civic Center

Assumptions:

* Existing interconnect conduit is suitable and available.
* Existing signal interconnect cable will remain in place for LRT relay functions.

Problem, Purpose, Significance, Project Dependencies, Opportunities, Alternatives

Problem: Gaps in City of Hillsboro fiber communications network
Purpose: Connect traffic signals in downtown City of Hillsboro to fiber optic network and to Civic Center
Significance: Establishes Civic Center as a communications node for traffic signals in downtown core
Project Dependencies:
Opportunities:
Alternatives: Consider alternate locations for aggregate switch other than the pole mounted 336S signal cabinets on Washington Street.

Project Element	Quantity		Unit Costs	Project Costs
Cabinet/Controller Upgrades				
Prep Cabinet for Fiber Edge Switch	12	EA	$3,500	$42,000
Prep Cabinet for Fiber Aggregate Switch	1	EA	$6,500	$6,500
Leased Services				
Cellular Router/VPN	0	EA	$650	$0
Communications Equipment				
Fiber Aggregate Switch	1	EA	$8,000	$8,000
Fiber Edge Switch	12	EA	$3,000	$36,000
Wave Divison Multiplexing (Per end)	0	EA	$7,500	$0
Communications Cabinet	0	EA	$11,000	$0
Wireless				
Wireless Radio Installation (Per Intersection)	0	EA	$3,800	$0
Cameras				
CCTV PTZ Camera System on Traffic Signal	0	EA	$9,000	$0
CCTV PTZ Camera System and Camera Pole	0	EA	$61,000	$0
Communication Cable/Conduit Installation				
Fiber Optic Cable in New Conduit	0	LF	$30	$0
Fiber Optic Cable in Existing Conduit	6100	LF	$20	$122,000
Fiber Optic Cable Testing and Splicing	14	EA	$500	$7,000
Interface/Share Fiber with Other Agency	0	LS	$10,000	$0

SUBTOTAL		$221,500
Mobilization	10%	$22,150
TP&DT	10%	$22,150
Contingency	30%	$66,450
Project Design/Systems Engineering	20%	$66,893
Construction Engineering/Project Management	15%	$50,170
IT Network Integration	1%	$2,215
TOTAL COST		$451,528
TOTAL COST (Rounded)		**$452,000**
Annual Operations & Maintenance Cost	3%	**$13,560**

Hillsboro Communications Plan Cost Estimate

Project Name:	Priority:	Project No:
COH to WAVE fiber optic link	1 (high)	COH02

Project Description:

General description: Connect City of Hillsboro fiber to WAVE at NE 25th Ave & NE Cornell Road

Specific description:
* Install new fiber optic cable across NE 25th Ave on North side of intersection
* Install new aggregate switch

Assumptions:

* No connection between the two fiber optic networks exists.

Problem, Purpose, Significance, Project Dependencies, Opportunities, Alternatives

Problem: No connection exists between WAVE and City of Hillsboro fiber optic networks at NE 25th Ave and Cornell Road. Both networks terminate at this intersection on different sides of the street: WAVE on the northern side of the intersection, City of Hillsboro on the southern side of the intersection.
Purpose: Connect these two fiber optic communications networks.
Significance: The project completes a ring in the City of Hillsboro fiber optic communications network. Five City of Hillsboro traffic signals and two beacons to the south on NE 28th Ave will be connected to the WAVE network.
Project Dependencies: Completion of City of Hillsboro NE 28th Ave fiber project and completion of the WAVE fiber optic network installations.
Opportunities:
Alternatives:

Project Element	Quantity		Unit Costs	Project Costs
Cabinet/Controller Upgrades				
Prep Cabinet for Fiber Edge Switch	0	EA	$3,500	$0
Prep Cabinet for Fiber Aggregate Switch	1	EA	$6,500	$6,500
Leased Services				
Cellular Router/VPN	0	EA	$650	$0
Communications Equipment				
Fiber Aggregate Switch	1	EA	$8,000	$8,000
Fiber Edge Switch	0	EA	$3,000	$0
Wave Divison Multiplexing (Per end)	0	EA	$7,500	$0
Communications Cabinet	0	EA	$11,000	$0
Wireless				
Wireless Radio Installation (Per Intersection)	0	EA	$3,800	$0
Cameras				
CCTV PTZ Camera System on Traffic Signal	0	EA	$9,000	$0
CCTV PTZ Camera System and Camera Pole	0	EA	$61,000	$0
Communication Cable/Conduit Installation				
Fiber Optic Cable in New Conduit	330	LF	$30	$9,900
Fiber Optic Cable in Existing Conduit	0	LF	$20	$0
Fiber Optic Cable Testing and Splicing	3	EA	$500	$1,500
Interface/Share Fiber with Other Agency	1	LS	$10,000	$10,000
		SUBTOTAL		$35,900
		Mobilization	10%	$3,590
		TP&DT	10%	$3,590
		Contingency	30%	$10,770
		Project Design/Systems Engineering	20%	$10,842
		Construction Engineering/Project Management	15%	$8,131
		IT Network Integration	1%	$359
		TOTAL COST		$73,182
		TOTAL COST (Rounded)		**$74,000**
		Annual Operations & Maintenance Cost	3%	**$2,220**

Hillsboro Communications Plan Cost Estimate

Project Name:	Priority:	Project No:
229th fiber optic project	2 (medium-high)	COH03

Project Description:

General description: Install new fiber optic cable in existing interconnect conduit along NW 229th Ave and nearby City of Hillsboro traffic signals

Specific description:
Install new fiber optic cable and edge switches to these traffic signals:
* Along NW 229th Ave between NE Cornell Rd and NW Evergreen Pkwy: NE Butler St, Ronler Dr, South Intel entrance, North Intel entrance
* NW Imbrie Dr & Fred Meyer
* NW Evergreen Pkwy & NW Town Center Dr

Assumptions:

* Existing interconnect conduit can be modified for fiber optic cable installation.

Problem, Purpose, Significance, Project Dependencies, Opportunities, Alternatives

Problem: Traffic signals along NW 229th Ave rely on twisted pair for communications.
Purpose: Provide connectivity from devices to TOC and regional systems on fiber optic network
Significance:
Project Dependencies: Dependent on completion of Washington County fiber projects on NE Cornell Rd and NW Evergreen Pkwy
Opportunities: Project is adjacent to Intel campus; provides opportunity for partnership in the future.
Alternatives:

Project Element	Quantity		Unit Costs	Project Costs
Cabinet/Controller Upgrades				
Prep Cabinet for Fiber Edge Switch	6	EA	$3,500	$21,000
Prep Cabinet for Fiber Aggregate Switch	1	EA	$6,500	$6,500
Leased Services				
Cellular Router/VPN	0	EA	$650	$0
Communications Equipment				
Fiber Aggregate Switch	1	EA	$8,000	$8,000
Fiber Edge Switch	6	EA	$3,000	$18,000
Wave Divison Multiplexing (Per end)	0	EA	$7,500	$0
Communications Cabinet	0	EA	$11,000	$0
Wireless				
Wireless Radio Installation (Per Intersection)	0	EA	$3,800	$0
Cameras				
CCTV PTZ Camera System on Traffic Signal	6	EA	$9,000	$54,000
CCTV PTZ Camera System and Camera Pole	0	EA	$61,000	$0
Communication Cable/Conduit Installation				
Fiber Optic Cable in New Conduit	0	LF	$30	$0
Fiber Optic Cable in Existing Conduit	7,000	LF	$20	$140,000
Fiber Optic Cable Testing and Splicing	9	EA	$500	$4,500
Interface/Share Fiber with Other Agency	2	LS	$10,000	$20,000
		SUBTOTAL		$272,000
		Mobilization	10%	$27,200
		TP&DT	10%	$27,200
		Contingency	30%	$81,600
		Project Design/Systems Engineering	20%	$82,144
		Construction Engineering/Project Management	15%	$61,608
		IT Network Integration	1%	$2,720
		TOTAL COST		$554,472
		TOTAL COST (Rounded)		**$555,000**
		Annual Operations & Maintenance Cost	3%	**$16,650**

Hillsboro Communications Plan Cost Estimate

Project Name:	Priority:	Project No:
Cornell Road Fiber Spurs	2 (medium-high)	COH04

Project Description:

General description: Install new fiber optic cable in existing interconnect conduit, where available, to connect City of Hillsboro traffic signals along the vicinity of Cornell Road.

Specific description:
* Install new fiber optic cable in existing interconnect conduit from NW Cornell Rd to NW Amberwood Dr & NW 206th Ave traffic signal
* Install new fiber optic cable in existing interconnect conduit from NE Cornell Rd to NE Cherry St & NE 231st Ave traffic signal
* Install new fiber optic cable in existing interconnect conduit from NW Cornell Rd to NW Walker Rd & NW Amberglen Pkwy traffic signal
* Install new fiber optic cable in existing interconnect conduit from NW Cornell Rd to NW Stuckie Ave & NW Allie Ave/NW Thorncroft Dr traffic signal
* Install new fiber optic cable and conduit between NE Cornell Rd and NE Shute Rd & NE Butler St traffic signal

Assumptions:

* Existing interconnect conduit is suitable and available.

Problem, Purpose, Significance, Project Dependencies, Opportunities, Alternatives

Problem: City of Hillsboro traffic signals along Cornell Rd are not located near any other City of Hillsboro communication hubs.
Purpose: Provide connectivity from devices to TOC and regional systems on fiber network
Significance: Connects far flung devices to fiber optic network.
Project Dependencies: Completion of Washington County Cornell Road Fiber Project
Opportunities:
Alternatives: Provide cellular connections to these devices.

Project Element	Quantity		Unit Costs	Project Costs
Cabinet/Controller Upgrades				
Prep Cabinet for Fiber Edge Switch	5	EA	$3,500	$17,500
Prep Cabinet for Fiber Aggregate Switch	0	EA	$6,500	$0
Leased Services				
Cellular Router/VPN	0	EA	$650	$0
Communications Equipment				
Fiber Aggregate Switch	0	EA	$8,000	$0
Fiber Edge Switch	5	EA	$3,000	$15,000
Wave Divison Multiplexing (Per end)	0	EA	$7,500	$0
Communications Cabinet	0	EA	$11,000	$0
Wireless				
Wireless Radio Installation (Per Intersection)	0	EA	$3,800	$0
Cameras				
CCTV PTZ Camera System on Traffic Signal	0	EA	$9,000	$0
CCTV PTZ Camera System and Camera Pole	0	EA	$61,000	$0
Communication Cable/Conduit Installation				
Fiber Optic Cable in New Conduit	2,000	LF	$30	$60,000
Fiber Optic Cable in Existing Conduit	4,200	LF	$20	$84,000
Fiber Optic Cable Testing and Splicing	9	EA	$500	$4,500
Interface/Share Fiber with Other Agency	2	LS	$10,000	$20,000

SUBTOTAL		$201,000
Mobilization	10%	$20,100
TP&DT	10%	$20,100
Contingency	30%	$60,300
Project Design/Systems Engineering	20%	$60,702
Construction Engineering/Project Management	15%	$45,527
IT Network Integration	1%	$2,010
TOTAL COST		$409,739
TOTAL COST (Rounded)		**$410,000**
Annual Operations & Maintenance Cost	3%	**$12,300**

Hillsboro Communications Plan Cost Estimate

Project Name:	**Priority:**	**Project No:**
Cornell Road Fiber Spurs - alternative solution	2 (medium-high)	COH04a

Project Description: **2 (medium-high)**

General description: Same as COH04 but use cellular connections as a near-term solution

Specific description: Establish cellular connections from Cornell Road to the following devices:
* NW Amberwood Dr & NW 206th Ave traffic signal
* NE Cherry St & NE 231st Ave traffic signal
* NW Walker Rd & NW Amberglen Pkwy traffic signal
* NW Stuckie Ave & NW Allie Ave/NW Thorncroft Dr traffic signal
* NE Shute Rd & NE Butler St traffic signal

Assumptions:

Problem, Purpose, Significance, Project Dependencies, Opportunities, Alternatives

Problem: COH04 dependence on Washington County project work
Purpose: Provide connectivity from devices to TOC and regional systems
Significance:
Project Dependencies:
Opportunities:
Alternatives:

Project Element	**Quantity**		**Unit Costs**	**Project Costs**
Cabinet/Controller Upgrades				
Prep Cabinet for Fiber Edge Switch	0	EA	$3,500	$0
Prep Cabinet for Fiber Aggregate Switch	0	EA	$6,500	$0
Leased Services				
Cellular Router/VPN	5	EA	$650	$3,250
Communications Equipment				
Fiber Aggregate Switch	0	EA	$8,000	$0
Fiber Edge Switch	5	EA	$3,000	$15,000
Wave Divison Multiplexing (Per end)	0	EA	$7,500	$0
Communications Cabinet	0	EA	$11,000	$0
Wireless				
Wireless Radio Installation (Per Intersection)	0	EA	$3,800	$0
Cameras				
CCTV PTZ Camera System on Traffic Signal	0	EA	$9,000	$0
CCTV PTZ Camera System and Camera Pole	0	EA	$61,000	$0
Communication Cable/Conduit Installation				
Fiber Optic Cable in New Conduit	0	LF	$30	$0
Fiber Optic Cable in Existing Conduit	0	LF	$20	$0
Fiber Optic Cable Testing and Splicing	0	EA	$500	$0
Interface/Share Fiber with Other Agency	1	LS	$10,000	$10,000
		SUBTOTAL		$28,250
		Mobilization	10%	$2,825
		TP&DT	10%	$2,825
		Contingency	30%	$8,475
		Project Design/Systems Engineering	20%	$8,532
		Construction Engineering/Project Management	15%	$6,399
		IT Network Integration	1%	$283
		TOTAL COST		$57,588
		TOTAL COST (Rounded)		**$58,000**
		Annual Operations & Maintenance Cost	3%	**$2,640**

Hillsboro Communications Plan Cost Estimate

Project Name:	Priority:	Project No:
Hillsboro Pedestrian Beacon Connections	4 (medium-low)	COH05

Project Description:

General description: Install new fiber optic cable and conduit to connect beacons in the City of Hillsboro

Specific description: Connect to the following devices:
* NE Lincoln St & NE 6th Ave (red stop beacon)
* NE Veterans Dr & west of NE 34th Ave (pedestrian beacon)
* NE Jackson School Rd & NE Estate Dr (pedestrian RRFB)
* NE Jackson School Rd & NE Rogahn St (school zone beacon)
* NE Jackson School Rd & NE Tipton Ct (school zone beacon)
* E Main St & NE 18th Ave (pedestrian RRFB)
* NE Jones Farm Pkwy & NE 15th Ave (pedestrian RRFB)
* E Main St & NE 37th Ave (pedestrian RRFB)
* NW Connell Ave & NW Forest St (school zone beacon)
* NW Connell Ave & NW Val St (school zone beacon)
* E Main St & NE 8th Ave (pedestrian RRFB)
* NW Amberwood Dr & NW Sheffield Ave (pedestrian RRFB)
* NE 28th Ave & NE Parkwood St (pedestrian RRFB)
* NE 28th Ave & NE Laura St (pedestrian RRFB)
* Brookwood Fire Station

Assumptions:

* Beacon controllers can be upgraded to a controller that is fiber optic network capable

Problem, Purpose, Significance, Project Dependencies, Opportunities, Alternatives

Problem: Beacons are not connected to transportation communications network
Purpose: Provide connectivity from devices to TOC and regional systems over fiber optic network
Significance: Connects traffic control devices
Project Dependencies: Some segments depend on completion of other City of Hillsboro and Washington County fiber optic projects
Opportunities:
Alternatives: Provide cellular connections to devices.

Project Element	Quantity		Unit Costs	Project Costs
Cabinet/Controller Upgrades				
Prep Cabinet for Fiber Edge Switch	15	EA	$3,500	$52,500
Prep Cabinet for Fiber Aggregate Switch	0	EA	$6,500	$0
Leased Services				
Cellular Router/VPN	0	EA	$650	$0
Communications Equipment				
Fiber Aggregate Switch	0	EA	$8,000	$0
Fiber Edge Switch	15	EA	$3,000	$45,000
Wave Divison Multiplexing (Per end)	0	EA	$7,500	$0
Communications Cabinet	0	EA	$11,000	$0
Wireless				
Wireless Radio Installation (Per Intersection)	0	EA	$3,800	$0
Cameras				
CCTV PTZ Camera System on Traffic Signal	0	EA	$9,000	$0
CCTV PTZ Camera System and Camera Pole	0	EA	$61,000	$0
Communication Cable/Conduit Installation				
Fiber Optic Cable in New Conduit	14,200	LF	$30	$426,000
Fiber Optic Cable in Existing Conduit	0	LF	$20	$0
Fiber Optic Cable Testing and Splicing	20	EA	$500	$10,000
Interface/Share Fiber with Other Agency	3	LS	$10,000	$30,000
SUBTOTAL				$563,500
Mobilization			10%	$56,350
TP&DT			10%	$56,350
Contingency			30%	$169,050
Project Design/Systems Engineering			20%	$170,177
Construction Engineering/Project Management			15%	$127,633
IT Network Integration			1%	$5,635
TOTAL COST				$1,148,695
TOTAL COST (Rounded)				**$1,149,000**
Annual Operations & Maintenance Cost			3%	**$34,470**

Hillsboro Communications Plan Cost Estimate

Project Name:	Priority:	Project No:
Hillsboro Pedestrian Beacon Connections - alternative solution	4 (medium-low)	COH05a

Project Description:

General description: Same as COH05 but with cellular connections as an interim solution.

Specific description: Connect to the following devices:
* NE Lincoln St & NE 6th Ave (red stop beacon)
* NE Veterans Dr & west of NE 34th Ave (pedestrian beacon)
* NE Jackson School Rd & NE Estate Dr (pedestrian RRFB)
* NE Jackson School Rd & NE Rogahn St (school zone beacon)
* NE Jackson School Rd & NE Tipton Ct (school zone beacon)
* E Main St & NE 18th Ave (pedestrian RRFB)
* NE Jones Farm Pkwy & NE 15th Ave (pedestrian RRFB)
* E Main St & NE 37th Ave (pedestrian RRFB)
* NW Connell Ave & NW Forest St (school zone beacon)
* NW Connell Ave & NW Val St (school zone beacon)
* E Main St & NE 8th Ave (pedestrian RRFB)
* NW Amberwood Dr & NW Sheffield Ave (pedestrian RRFB)
* NE 28th Ave & NE Parkwood St (pedestrian RRFB)
* NE 28th Ave & NE Laura St (pedestrian RRFB)
* Brookwood Fire Station

Assumptions:

Problem, Purpose, Significance, Project Dependencies, Opportunities, Alternatives

Problem: Significant capital cost for COH05 may delay implementation
Purpose: Provide connectivity from devices to TOC and regional systems
Significance:
Project Dependencies:
Opportunities:
Alternatives:

Project Element	Quantity		Unit Costs	Project Costs
Cabinet/Controller Upgrades				
Prep Cabinet for Fiber Edge Switch	0	EA	$3,500	$0
Prep Cabinet for Fiber Aggregate Switch	0	EA	$6,500	$0
Leased Services				
Cellular Router/VPN	15	EA	$650	$9,750
Communications Equipment				
Fiber Aggregate Switch	0	EA	$8,000	$0
Fiber Edge Switch	15	EA	$3,000	$45,000
Wave Divison Multiplexing (Per end)	0	EA	$7,500	$0
Communications Cabinet	0	EA	$11,000	$0
Wireless				
Wireless Radio Installation (Per Intersection)	0	EA	$3,800	$0
Cameras				
CCTV PTZ Camera System on Traffic Signal	0	EA	$9,000	$0
CCTV PTZ Camera System and Camera Pole	0	EA	$61,000	$0
Communication Cable/Conduit Installation				
Fiber Optic Cable in New Conduit	0	LF	$30	$0
Fiber Optic Cable in Existing Conduit	0	LF	$20	$0
Fiber Optic Cable Testing and Splicing	0	EA	$500	$0
Interface/Share Fiber with Other Agency	1	LS	$10,000	$10,000

SUBTOTAL		$64,750
Mobilization	10%	$6,475
TP&DT	10%	$6,475
Contingency	30%	$19,425
Project Design/Systems Engineering	20%	$19,555
Construction Engineering/Project Management	15%	$14,666
IT Network Integration	1%	$648
TOTAL COST		$131,993
TOTAL COST (Rounded)		**$132,000**
Annual Operations & Maintenance Cost	3%	**$6,660**

Hillsboro Communications Plan Cost Estimate

Project Name:	Priority:	Project No:
Wilkins communication project	3 (medium)	COH06

Project Description:

General description: Install new fiber optic cable and conduit to connect devices on NW Wilkins Dr between NW Cornelius Pass Rd and NW 206th Ave

Specific description: Connect the traffic signal at NW Wilkins St & NW 206th Ave and the pedestrian RRFB at NW Trail Walk Dr

Assumptions:

* No conduit path exists on NW Wilkins St

Problem, Purpose, Significance, Project Dependencies, Opportunities, Alternatives

Problem:
Purpose: Provide connectivity from devices to TOC and regional systems on fiber optic communications network
Significance:
Project Dependencies: Dependent on completion of NW Cornelius Pass Rd fiber project (Washington County project).
Opportunities:
Alternatives: Provide cellular connection to devices

Project Element	Quantity		Unit Costs	Project Costs
Cabinet/Controller Upgrades				
Prep Cabinet for Fiber Edge Switch	2	EA	$3,500	$7,000
Prep Cabinet for Fiber Aggregate Switch	0	EA	$6,500	$0
Leased Services				
Cellular Router/VPN	0	EA	$650	$0
Communications Equipment				
Fiber Aggregate Switch	0	EA	$8,000	$0
Fiber Edge Switch	2	EA	$3,000	$6,000
Wave Divison Multiplexing (Per end)	0	EA	$7,500	$0
Communications Cabinet	0	EA	$11,000	$0
Wireless				
Wireless Radio Installation (Per Intersection)	0	EA	$3,800	$0
Cameras				
CCTV PTZ Camera System on Traffic Signal	0	EA	$9,000	$0
CCTV PTZ Camera System and Camera Pole	0	EA	$61,000	$0
Communication Cable/Conduit Installation				
Fiber Optic Cable in New Conduit	3,100	LF	$30	$93,000
Fiber Optic Cable in Existing Conduit	0	LF	$20	$0
Fiber Optic Cable Testing and Splicing	3	EA	$500	$1,500
Interface/Share Fiber with Other Agency	1	LS	$10,000	$10,000

SUBTOTAL		$117,500
Mobilization	10%	$11,750
TP&DT	10%	$11,750
Contingency	30%	$35,250
Project Design/Systems Engineering	20%	$35,485
Construction Engineering/Project Management	15%	$26,614
IT Network Integration	1%	$1,175
TOTAL COST		$239,524
TOTAL COST (Rounded)		**$240,000**
Annual Operations & Maintenance Cost	3%	**$7,200**

Hillsboro Communications Plan Cost Estimate

Project Name:	Priority:	Project No:
Wilkins communication project - alternative solution	3 (medium)	COH06a

Project Description:

General description: Same as COH06 but with cellular connection as an interim solution.

Specific description: Connect the traffic signal at NW Wilkins St & NW 206th Ave and the pedestrian RRFB at NW Trail Walk Dr

Assumptions:

Problem, Purpose, Significance, Project Dependencies, Opportunities, Alternatives

Problem: COH06 dependence on Washington County project work
Purpose: Provide connectivity from devices to TOC and regional systems
Significance:
Project Dependencies:
Opportunities:
Alternatives:

Project Element	Quantity		Unit Costs	Project Costs
Cabinet/Controller Upgrades				
Prep Cabinet for Fiber Edge Switch	0	EA	$3,500	$0
Prep Cabinet for Fiber Aggregate Switch	0	EA	$6,500	$0
Leased Services				
Cellular Router/VPN	2	EA	$650	$1,300
Communications Equipment				
Fiber Aggregate Switch	0	EA	$8,000	$0
Fiber Edge Switch	2	EA	$3,000	$6,000
Wave Divison Multiplexing (Per end)	0	EA	$7,500	$0
Communications Cabinet	0	EA	$11,000	$0
Wireless				
Wireless Radio Installation (Per Intersection)	0	EA	$3,800	$0
Cameras				
CCTV PTZ Camera System on Traffic Signal	0	EA	$9,000	$0
CCTV PTZ Camera System and Camera Pole	0	EA	$61,000	$0
Communication Cable/Conduit Installation				
Fiber Optic Cable in New Conduit	0	LF	$30	$0
Fiber Optic Cable in Existing Conduit	0	LF	$20	$0
Fiber Optic Cable Testing and Splicing	0	EA	$500	$0
Interface/Share Fiber with Other Agency	1	LS	$10,000	$10,000

SUBTOTAL		$17,300
Mobilization	10%	$1,730
TP&DT	10%	$1,730
Contingency	30%	$5,190
Project Design/Systems Engineering	20%	$5,225
Construction Engineering/Project Management	15%	$3,918
IT Network Integration	1%	$173
TOTAL COST		$35,266
TOTAL COST (Rounded)		**$36,000**
Annual Operations & Maintenance Cost	3%	**$1,440**

Hillsboro Communications Plan Cost Estimate

Project Name:	Priority:	Project No:
North Hillsboro Megafiber	4 (medium-low)	COH07

Project Description:

General description: Install new fiber optic cable and conduit to connect planned traffic signals in North Hillsboro. Install aggregate switch.

Specific description: Signal locations to be determined

Assumptions:

* City of Hillsboro ownership of signals and communication infrastructure in South Hillsboro

Problem, Purpose, Significance, Project Dependencies, Opportunities, Alternatives

Problem:
Purpose: Provide connectivity from devices to TOC and regional systems
Significance:
Project Dependencies: North Hillsboro develop has not yet been finalized
Opportunities:
Alternatives:

Project Element	Quantity		Unit Costs	Project Costs
Cabinet/Controller Upgrades				
Prep Cabinet for Fiber Edge Switch	10	EA	$3,500	$35,000
Prep Cabinet for Fiber Aggregate Switch	1	EA	$6,500	$6,500
Leased Services				
Cellular Router/VPN	0	EA	$650	$0
Communications Equipment				
Fiber Aggregate Switch	1	EA	$8,000	$8,000
Fiber Edge Switch	10	EA	$3,000	$30,000
Wave Divison Multiplexing (Per end)	0	EA	$7,500	$0
Communications Cabinet	0	EA	$11,000	$0
Wireless				
Wireless Radio Installation (Per Intersection)	0	EA	$3,800	$0
Cameras				
CCTV PTZ Camera System on Traffic Signal	0	EA	$9,000	$0
CCTV PTZ Camera System and Camera Pole	0	EA	$61,000	$0
Communication Cable/Conduit Installation				
Fiber Optic Cable in New Conduit	34,100	LF	$30	$1,023,000
Fiber Optic Cable in Existing Conduit	0	LF	$20	$0
Fiber Optic Cable Testing and Splicing	14	EA	$500	$7,000
Interface/Share Fiber with Other Agency	2	LS	$10,000	$20,000

SUBTOTAL		$1,129,500
Mobilization	10%	$112,950
TP&DT	10%	$112,950
Contingency	30%	$338,850
Project Design/Systems Engineering	20%	$341,109
Construction Engineering/Project Management	15%	$255,832
IT Network Integration	1%	$11,295
TOTAL COST		$2,302,486
TOTAL COST (Rounded)		**$2,303,000**
Annual Operations & Maintenance Cost	3%	**$69,090**

Hillsboro Communications Plan Cost Estimate

Project Name:	Priority:	Project No:
South Hillsboro Megafiber	4 (medium-low)	COH08

Project Description:

General description: Install new fiber optic cable and conduit to connect planned traffic signals in South Hillsboro. Install fiber optic cable and conduit to connect two school zone beacons by Rosedale Elementary School on SW 229th Ave. Install aggregate switch.

Specific description: Planned signal locations to be verified.

Assumptions:

* City of Hillsboro ownership of signals and communication infrastructure in South Hillsboro

Problem, Purpose, Significance, Project Dependencies, Opportunities, Alternatives

Problem:
Purpose: Provide connectivity from devices to TOC and regional systems
Significance:
Project Dependencies: South Hillsboro develop has not yet been finalized
Opportunities:
Alternatives:

Project Element	Quantity		Unit Costs	Project Costs
Cabinet/Controller Upgrades				
Prep Cabinet for Fiber Edge Switch	19	EA	$3,500	$66,500
Prep Cabinet for Fiber Aggregate Switch	1	EA	$6,500	$6,500
Leased Services				
Cellular Router/VPN	0	EA	$650	$0
Communications Equipment				
Fiber Aggregate Switch	1	EA	$8,000	$8,000
Fiber Edge Switch	19	EA	$3,000	$57,000
Wave Divison Multiplexing (Per end)	0	EA	$7,500	$0
Communications Cabinet	0	EA	$11,000	$0
Wireless				
Wireless Radio Installation (Per Intersection)	0	EA	$3,800	$0
Cameras				
CCTV PTZ Camera System on Traffic Signal	0	EA	$9,000	$0
CCTV PTZ Camera System and Camera Pole	0	EA	$61,000	$0
Communication Cable/Conduit Installation				
Fiber Optic Cable in New Conduit	38,500	LF	$30	$1,155,000
Fiber Optic Cable in Existing Conduit	0	LF	$20	$0
Fiber Optic Cable Testing and Splicing	22	EA	$500	$11,000
Interface/Share Fiber with Other Agency	3	LS	$10,000	$30,000

SUBTOTAL		$1,334,000
Mobilization	10%	$133,400
TP&DT	10%	$133,400
Contingency	30%	$400,200
Project Design/Systems Engineering	20%	$402,868
Construction Engineering/Project Management	15%	$302,151
IT Network Integration	1%	$13,340
TOTAL COST		$2,719,359
TOTAL COST (Rounded)		**$2,720,000**
Annual Operations & Maintenance Cost	3%	**$81,600**

Hillsboro Communications Plan Cost Estimate

Project Name:	Priority:	Project No:
Rood Bridge communication project	5 (low)	COH09

Project Description:

General description: Install new fiber optic cable and conduit to connect devices on Minter Bridge Road, Rood Bridge Road, Davis Road, SE 21st Avenue, and SE 24th Avenue to the library at SE 10th @ Maple St.

Specific description: Connect the following devices:
* SE Minter Bridge Rd & SE Jacquelin Dr (pedestrian RRFB)
* SE Alder St & SE 24th Ave (pedestrian RRFB)
* SE Minter Bridge Rd & SE Jacquelin Dr (school zone beacon)
* SE Minter Bridge Rd & SE Anthony St (school zone beacon)
* SW Rood Bridge Rd & Rood Bridge Park (pedestrian RRFB)
* SE Davis Rd & SE Brookwood Ave (school zone beacon)
* SE Davis Rd & SE Alexander St (school zone beacon)
* SE Cypress St & SE 21st Ave (traffic signal)

Assumptions:

* No conduit paths exist to these devices.

Problem, Purpose, Significance, Project Dependencies, Opportunities, Alternatives

Problem:
Purpose: Provide connectivity from devices to TOC and regional systems
Significance:
Project Dependencies:
Opportunities: Redundancy in network from South Hillsboro; opportunities for partnership with schools, ODOT, and Washington County
Alternatives: Provide cellular connections to these devices

Project Element	Quantity		Unit Costs	Project Costs
Cabinet/Controller Upgrades				
Prep Cabinet for Fiber Edge Switch	8	EA	$3,500	$28,000
Prep Cabinet for Fiber Aggregate Switch	1	EA	$6,500	$6,500
Leased Services				
Cellular Router/VPN	0	EA	$650	$0
Communications Equipment				
Fiber Aggregate Switch	1	EA	$8,000	$8,000
Fiber Edge Switch	8	EA	$3,000	$24,000
Wave Divison Multiplexing (Per end)	0	EA	$7,500	$0
Communications Cabinet	0	EA	$11,000	$0
Wireless				
Wireless Radio Installation (Per Intersection)	0	EA	$3,800	$0
Cameras				
CCTV PTZ Camera System on Traffic Signal	0	EA	$9,000	$0
CCTV PTZ Camera System and Camera Pole	0	EA	$61,000	$0
Communication Cable/Conduit Installation				
Fiber Optic Cable in New Conduit	33,000	LF	$30	$990,000
Fiber Optic Cable in Existing Conduit	0	LF	$20	$0
Fiber Optic Cable Testing and Splicing	10	EA	$500	$5,000
Interface/Share Fiber with Other Agency	3	LS	$10,000	$30,000

SUBTOTAL		$1,091,500
Mobilization	10%	$109,150
TP&DT	10%	$109,150
Contingency	30%	$327,450
Project Design/Systems Engineering	20%	$329,633
Construction Engineering/Project Management	15%	$247,225
IT Network Integration	1%	$10,915
TOTAL COST		$2,225,023
TOTAL COST (Rounded)		**$2,226,000**
Annual Operations & Maintenance Cost	3%	**$66,780**

Hillsboro Communications Plan Cost Estimate

Project Name:	Priority:	Project No:
Rood Bridge communication project - alternative solution	5 (low)	COH09a

Project Description:

General description: Same as COH09 but with cellular connections as an interim solution

Specific description: Connect the following devices:
* SE Minter Bridge Rd & SE Jacquelin Dr (pedestrian RRFB)
* SE Alder St & SE 24th Ave (pedestrian RRFB)
* SE Minter Bridge Rd & SE Jacquelin Dr (school zone beacon)
* SE Minter Bridge Rd & SE Anthony St (school zone beacon)
* SW Rood Bridge Rd & Rood Bridge Park (pedestrian RRFB)
* SE Davis Rd & SE Brookwood Ave (school zone beacon)
* SE Davis Rd & SE Alexander St (school zone beacon)
* SE Cypress St & SE 21st Ave (traffic signal)

Assumptions:

Problem, Purpose, Significance, Project Dependencies, Opportunities, Alternatives

Problem: Significant capital cost for COH09 may delay implementation
Purpose: Provide connectivity from devices to TOC and regional systems
Significance:
Project Dependencies:
Opportunities:
Alternatives:

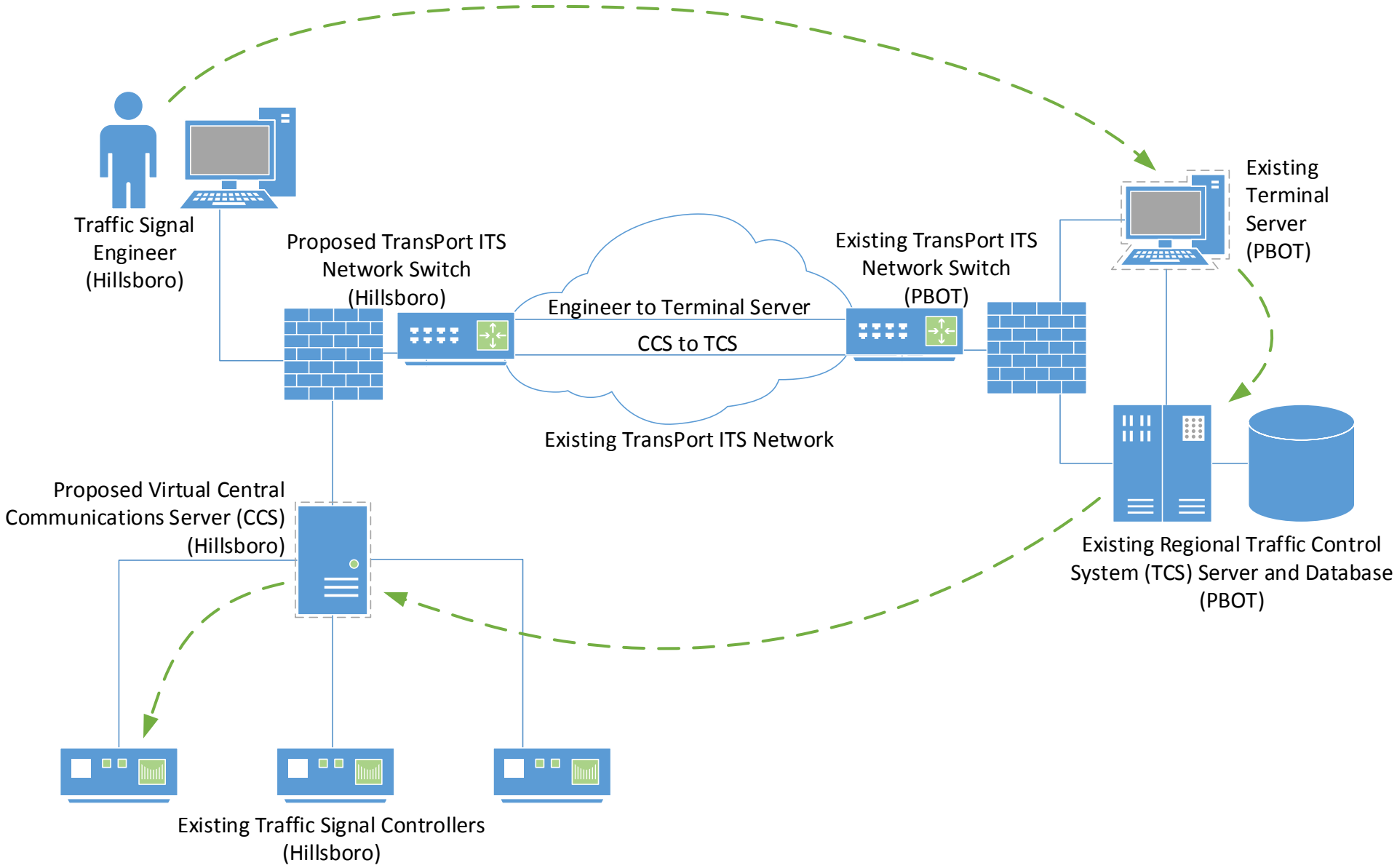
Project Element	Quantity		Unit Costs	Project Costs
Cabinet/Controller Upgrades				
Prep Cabinet for Fiber Edge Switch	0	EA	$3,500	$0
Prep Cabinet for Fiber Aggregate Switch	0	EA	$6,500	$0
Leased Services				
Cellular Router/VPN	8	EA	$650	$5,200
Communications Equipment				
Fiber Aggregate Switch	0	EA	$8,000	$0
Fiber Edge Switch	8	EA	$3,000	$24,000
Wave Divison Multiplexing (Per end)	0	EA	$7,500	$0
Communications Cabinet	0	EA	$11,000	$0
Wireless				
Wireless Radio Installation (Per Intersection)	0	EA	$3,800	$0
Cameras				
CCTV PTZ Camera System on Traffic Signal	0	EA	$9,000	$0
CCTV PTZ Camera System and Camera Pole	0	EA	$61,000	$0
Communication Cable/Conduit Installation				
Fiber Optic Cable in New Conduit	0	LF	$30	$0
Fiber Optic Cable in Existing Conduit	0	LF	$20	$0
Fiber Optic Cable Testing and Splicing	0	EA	$500	$0
Interface/Share Fiber with Other Agency	1	LS	$10,000	$10,000

SUBTOTAL		$39,200
Mobilization	10%	$3,920
TP&DT	10%	$3,920
Contingency	30%	$11,760
Project Design/Systems Engineering	20%	$11,838
Construction Engineering/Project Management	15%	$8,879
IT Network Integration	1%	$392
TOTAL COST		$79,909
TOTAL COST (Rounded)		**$80,000**
Annual Operations & Maintenance Cost	3%	**$3,840**

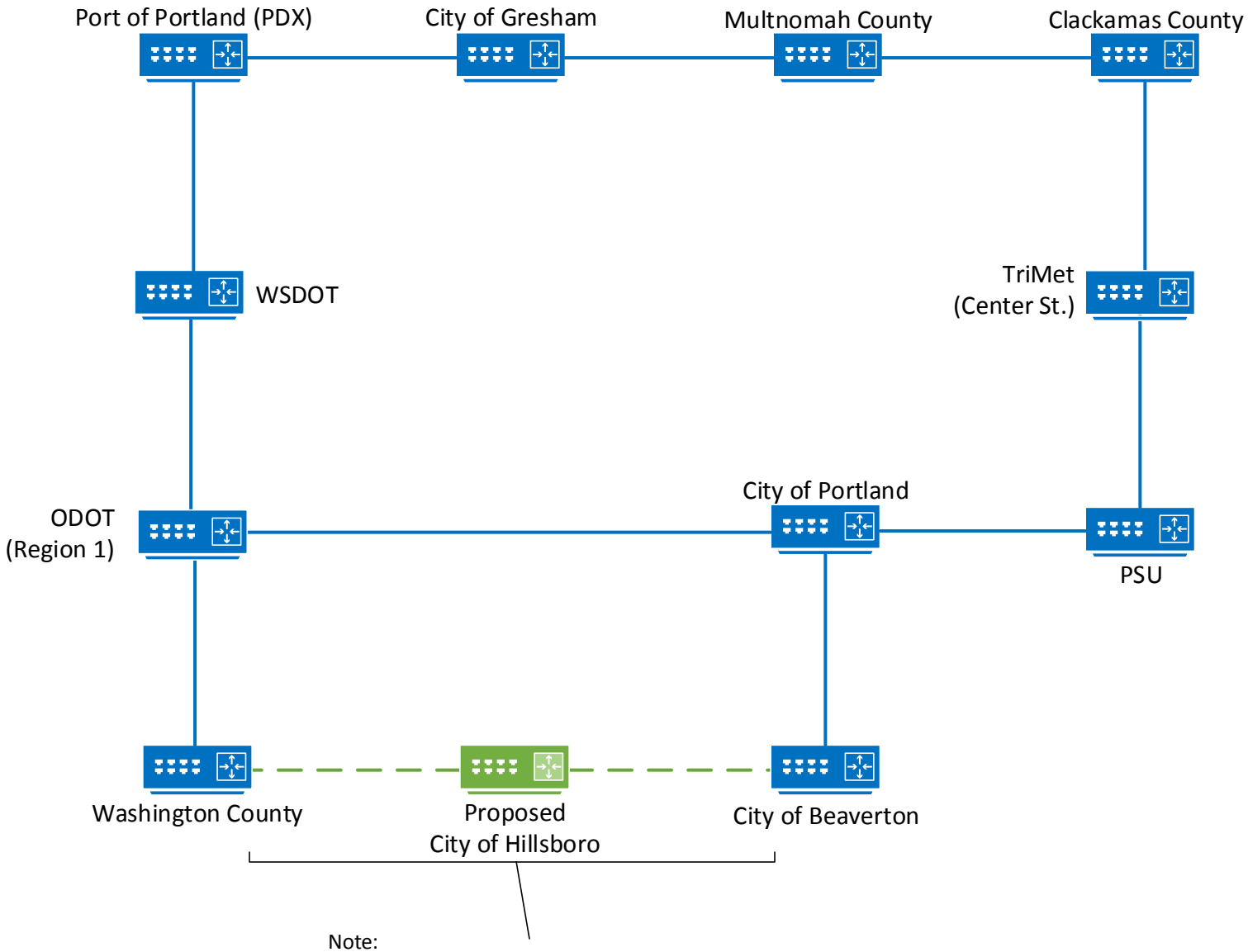
APPENDIX C – CENTER TO CENTER COMMUNICATIONS

- Proposed Traffic Signal Management
- Proposed TransPort ITS Network Architecture
- Example TransPort ITS Network Path: Traffic Signal Engineer to Terminal Server
- Example TransPort ITS Network Path: CCS to TCS
- TransPort Request to Join Network
- TransPort ITS Network Acceptable Use Policy
- TransPort ITS Network Operation Requirements Agreement
- TransPort ITS Network Service Request Process Overview
- TransPort ITS Network Service Request Form
- TransPort ITS Network Service Request Detail

Proposed Traffic Signal Management

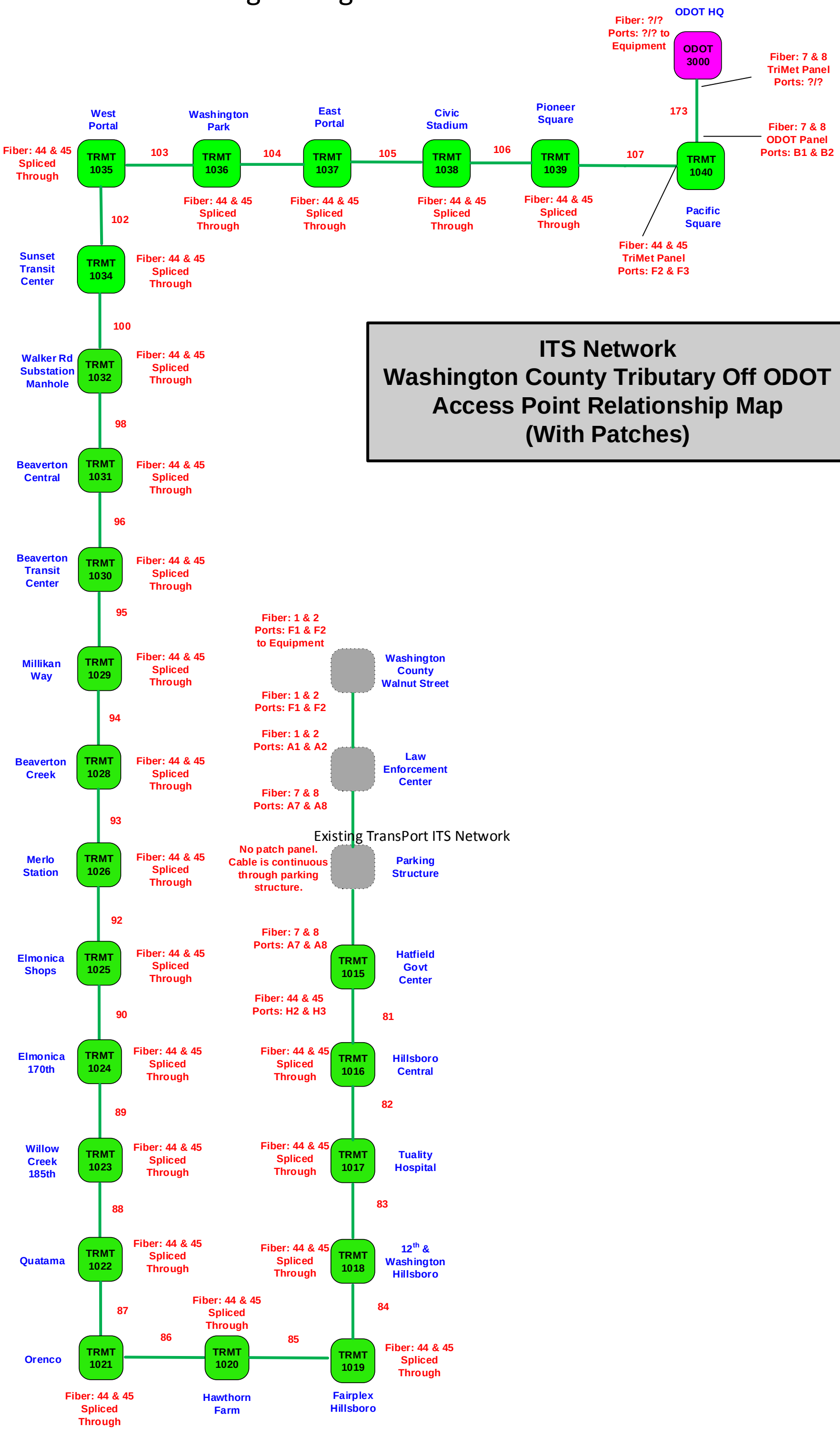


Proposed TransPort ITS Network Architecture



Note:
Only City of Hillsboro portion of network is updated as proposed.
Any other changes to the network may not be reflected.

Example TransPort ITS Network Path
Traffic Signal Engineer to TCS Terminal Server

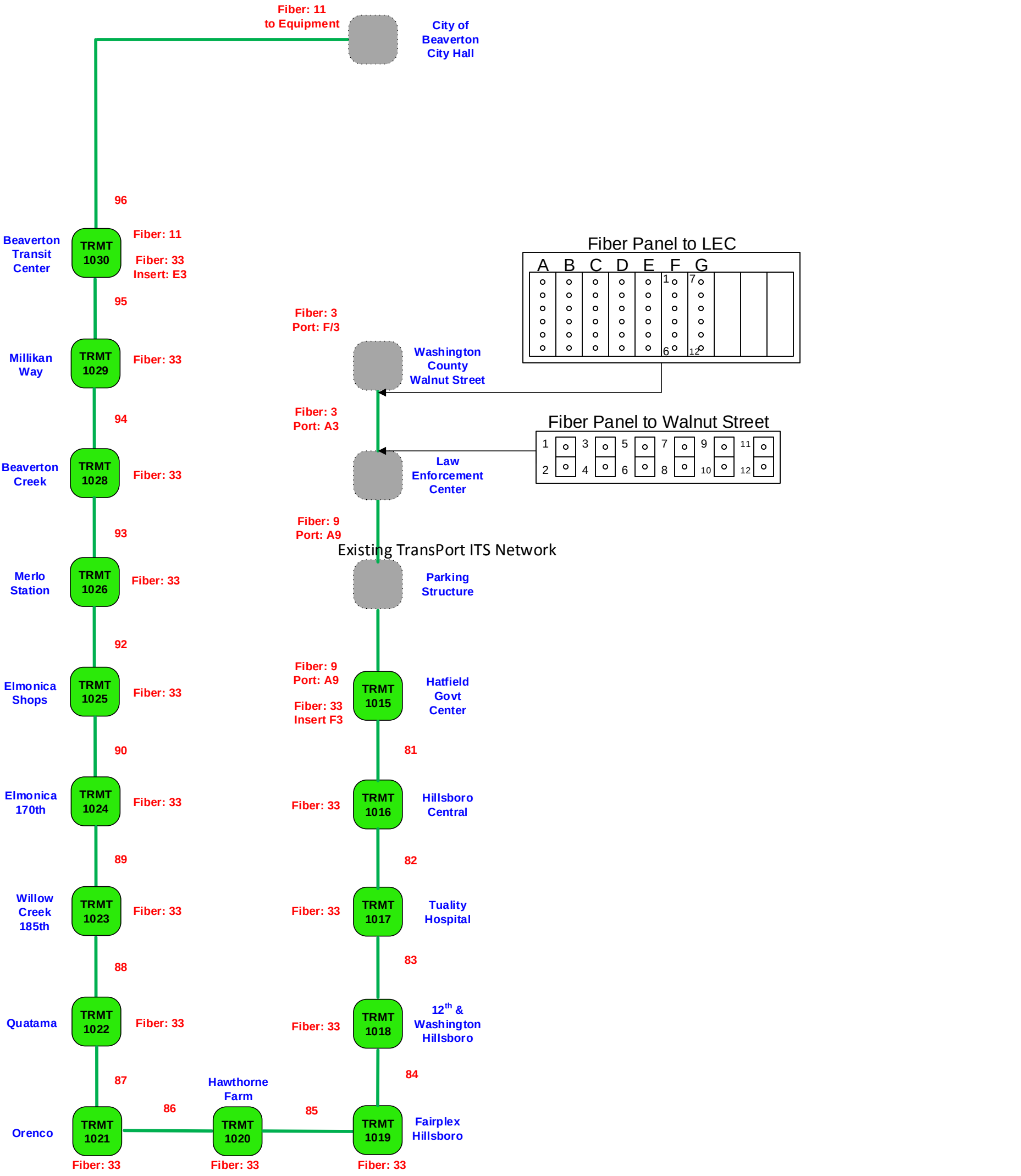


ITS Network
Washington County Tributary Off ODOT
Access Point Relationship Map
(With Patches)

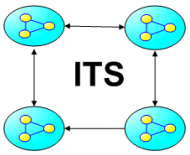
Existing TransPort ITS Network

Example TransPort ITS Network Path
CCS to TCS

TRAFFIC SIGNALS
City of Beaverton to Washington County
Access Point Relationship Map
(With Patches)



ITS Network Management



REQUEST TO JOIN NETWORK

This form is to be completed when an entity is requesting to join the ITS Network. Complete this request form and save it with the filename construct of Request to Join Network – Request Date (yyyymmdd).doc (e.g. Request to Join Network – 20061231.doc). E-mail the request to the ITS Network Management Team Chairperson. The Chairperson stores the request in the ITS Network Management Team share in the "Join Requests" folder and routes request to Team members for review and discussion.

Agency Name			
Requested By		**Date**	
Approved By		**Date**	

Agency Information	**Project Manager Name: Bikram Raghubansh & Garrett Lang**	
	Address:	
	Telephone:	**FAX:**
	E-mail:	
	Connection Address (including Lat/Long if available):	
	Current Member of Transport? ☐ **Yes** ☐ **No**	
Project Activity Tracking	**Engineering Completion Date:** _____ **Signed Agreement Receipt Date:** _____ **Implementation Completion Date:** _____ **Documentation Filing Date:** _____	

Acceptable Use of the ITS Transport Network
Policy#: 2005-01

This policy defines the acceptable use of the Intelligent Transportation Systems (ITS) Transport Network (hereinafter referred to as "the network"). The summary policy statement is as follows.

The network must only be used by public agencies for the purpose of transmitting transportation-related information defined in Transport's regional ITS architecture. Private entities cannot directly connect to the network or directly transmit any information through the network. Agencies connected to the network are responsible for insuring that information they transmit through the network has been pre-authorized as an acceptable data flow.

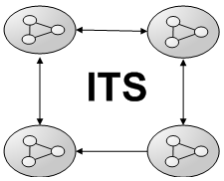
The network was designed to provide voice, video and data communications between multiple government agencies in support of Transport ITS initiatives. The network utilizes fiber optic assets provided by the Cooperative Telecommunications Infrastructure Committee (CTIC) and individual agencies participating in the Transport Committee. These fiber optic assets have diverse restrictions regarding the use of the asset, based upon funding sources used to construct the assets and specific restrictions placed upon the asset by the asset owners. Transport recognizes the need to comply with all predefined asset restrictions, and has therefore developed this policy to comply with those restrictions.

In compliance with the fiber optic use restrictions, private entities cannot directly connect to the network or directly transmit any information through the network. Any ITS data flows to or from a private entity must be brokered by a Transport public agency.

The Transport Committee has appointed the ITS Network Management Team as an official perpetual sub-committee of the Transport Committee. The ITS Network Management Team is responsible for the development and operation of the network.

The Transport Committee maintains and utilizes a set of regional ITS architecture documents that define the type of information that will flow (data flows) between each Transport member. These architecture documents are developed and maintained by Transport's Architecture Sub-committee.

The ITS architecture documents will be used by the ITS Network Management Team to determine which types of information will be allowed on the network. If the data flow exists in the architecture documents, it is allowed on the network. If a data flow has not been represented on the ITS architecture documents, the data flow must be submitted to Transport's Architecture Sub-committee to be added to the ITS architecture documents. Once the data flow has been added to the ITS architecture documents, the data flow will be allowed on the network. If the data flow is not added to the ITS architecture documents, the data flow may not be transmitted over the network.



ITS Transport Network
Operation Requirements Agreement

A. General

The ITS Transport Network (hereinafter referred to as "ITS network") is managed and operated by a collaborative group of authorized representatives from each agency connected to the ITS network. This group is referred to as the ITS Network Management Team (ITS-NMT). The ITS-NMT is an authorized perpetual sub-committee of the TransPort TAC.

This Operation Requirements Agreement describes the expectations of the ITS-NMT and agencies connected as core members to the ITS network. It defines the agency's service level expectations for network services provided by the ITS-NMT, and expectations the ITS-NMT members have of the undersigned agency (hereinafter referred to as "Agency").

Failure of an agency to provide the described resources and comply with ITS-NMT's policies, procedures, and connection requirements will be addressed on a case-by-case basis. For the protection of all agencies participating in the ITS network, possible consequences may range from a warning to removal of the Agency's ITS network connection until the failure has been resolved.

Agency Name:	
ITS Network Management Team Representative	
Primary:	Secondary:

B. Acceptable Use of the ITS Network

As stated in the ITS Transport TAC Policy #2005-01, "The ITS network must only be used by public agencies for the purpose of transmitting transportation-related information defined in Transport's regional ITS architecture. Private entities cannot directly connect to the network or directly transmit any information through the network. Agencies connected to the network are responsible for insuring that information they transmit through the network has been pre-authorized as an acceptable data flow." Requests to add new types of information onto the ITS network will be submitted to the ITS-NMT by the Agency's ITS-NMT member.

C. Participation in Transport TAC

The ITS network is a resource created by the TransPort TAC, for use by TAC members. Agencies connected to the ITS network must participate in the TransPort TAC, to insure that each agency on the network is represented during discussions and decisions relating to policies and the use of the ITS network.

D. Security

Each agency will retain control of, and thereby be solely responsible for, their network security via their firewall configurations and anti-virus solutions.

E. ITS Network Management Team Committed Service Level

The ITS network will be operated seven days a week, 24 hours per day, for 365 days per year. Based upon agency requirements to only provide "best effort" service responses, the ITS-NMT will attempt to have service disruptions (planned and unplanned) not exceed 1% (87.6 hours) during any one-year period. Agencies will be notified of planned service disruptions seven (7) days in advance.

F. Agency Requirements

1. Staff resources

The Agency will provide perpetual staff resources to perform two roles. At the Agency's discretion, these resources may be the same or a variety of individuals, based upon the Agency's organizational structure and requirements of the representatives. The two roles are as follows:

a. At least one primary representative (and preferably a secondary representative) to participate as a member of the ITS-NMT.
b. A representative must participate in the Transport TAC on a regular basis.

2. ITS Network Management Team member functions

a. Participation in team activities, including participation in team meetings and performing daily operation of the ITS network.
b. In the event of a network failure, representatives agree to respond to the failure on a "best effort" basis.
c. Coordinate the collection of their agency configuration documents as required by the ITS-NMT.
d. Insure they have appropriate contacts within their agency for resolving firewall configuration problems.
e. Communicate network activities that may potentially impact their agency.
f. Communicate all ITS network policies and procedures to their agency, and insure compliance.
g. Insure appropriate service contracts and replacement funding is obtained to service the agency's ITS network connection equipment.

3. Budget resources.

On a cyclical basis, all ITS network components will need to be replaced to insure the stability and functionality of the network. The ITS-NMT will determine the replacement cycle of all network components (estimated at every six years). The ITS-NMT will notify the undersigned agency, in writing, at least one (1) year prior to the replacement period. When replacement is required, the undersigned agency will provide for a replacement budget for the ITS network connection equipment located at their location. If budget is not available for the replacement period, upon replacement of all ITS network components the undersigned agency's network connection will be disconnected.

4. Network requirements.

The following components must be in use and up-to-date at all times within the Agency's internal network.

a. An enterprise-class firewall solution (not a personal firewall) that supports stateful packet inspection and is capable of performing Network Address Translation (NAT). Port Address Translation (PAT) is not allowed, and therefore not required. All connections to the ITS network switch equipment will be terminated in a firewall.

b. An enterprise-class Anti-Virus software used on Microsoft Windows Operating System host devices connecting to the ITS network. Windows hosts must receive auto updates of virus signatures. Host devices with Operating Systems other than Windows that are connecting to the ITS network must have current security patch releases installed at all times. Agencies must document in the "security comments" column of the Service Request spreadsheet, if any of the devices publishing or subscribing to a service do not meet the requirements of this section.

ITS Network Management Team member's signature below, certifies the member has acknowledged these requirements and agrees to abide by them for the duration of their participation in the operations of the ITS network.

[Agency Name]	ITS Network Management Team
Print Name:	Print Name:
Signature:	Signature:
Date:	Date:

ITS Network Service Request Process Overview

Legend

ITS-NMT = ITS Network Management Team

ITS-AC = ITS Architecture Committee

Team Store = Shared location for network management documentation

ITS-NMT Team Member
Completes “ITS Network Service Request” form & spreadsheet, and E-mails to ITS-NMT Chairperson

ITS-NMT Chairperson
Reviews request for completeness

Request Complete ?

NO

ITS-NMT Chairperson Notifies requestor of incomplete information

YES

Publication Request ?

NO

YES

ITS-NMT Chairperson
Sends request to Publishing Agency for review and approval

ITS-NMT Chairperson
Sends request to Transport Architecture Sub-committee Chairperson for review and approval

ITS-AC Chairperson
Reviews dataflow & determines if it’s is on architecture or will be added

Subscriber Request Approved ?

NO

YES

Dataflow Approved ?

NO

YES

ITS-NMT Chairperson
Sends Denial to requestor

Publishing Agency Contact
Sends approval to ITS-NMT Chairperson & Updates Publisher documentation with Subscriber information

ITS-AC Chairperson
Sends approval to ITS-NMT Chairperson

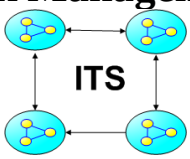
ITS-NMT Chairperson
Notifies team that request is approved

ITS-NMT Team Member
Files approved request in team store

ITS-NMT Team Members
Implement service changes and perform project closeout activities

Filename: ITS Network Service Request - Process Overview.vsd
Edit Date: 6/14/2006 RLW

ITS Network Management Team



Service Request

Complete this form if you wish to publish services on the ITS Network, or subscribe to services on the ITS Network. Instruction for processing this request are described in the "ITS Network Service Request Procedure.doc" document.

All service request forms must have a filename construct of "service name-request date (yyyymmdd).extension" (e.g. ODOT cameras-20060301.doc).

Requested By:	**Date:**
Approved By:	**Date:**

Service Name:

Publisher Information
Complete This Section to Publish New Services (Completed by the Publisher① of the Service)
Service Description: Provide a brief description of information flow, including information content (e.g. traffic incidents) and type of traffic (i.e. voice, video, data).
Complete the Publisher Information tab of the "ITS Network Service Request – Service Detail.xls" sheet, and submit with this request.
For ITS Architecture Sub-committee Chairman Use Only
Service listed on the Transport ITS Architecture? ☐Yes ☐ No

Subscriber Information
Complete This Section to Subscribe to Services **(Completed by the Subscriber② to the Service)**
Complete the Subscriber Information tab of the "ITS Network Service Request – Service Detail.xls" sheet, and submit with this request.

Project Close-out
Service Request Completion Date:
Documentation Filing Date:

Notes:
① Publisher - Agency offering a service available to ITS Network participants.
② Subscriber - Agencies requesting access to services offered on the ITS Network.

APPENDIX D – COMMUNICATIONS DESIGN AND CONSTRUCTION STANDARDS

- **Transportation Communications Design and Construction Standards**

Design and Construction Standards

City of Hillsboro

Section 3XX

3XX. TRANSPORTATION COMMUNICATIONS

3XX.1. General

Install conduit and communications junction boxes to create a complete raceway system. Install fiber optic cables and related equipment on corridors specified in the City's Transportation Communications Plan. Test the fiber optic system and document the results.

A. Design Requirements

a. On all roadways, install conduit and communications junction boxes on both sides of roadway within City right of way or utility easement. If project work is only on one side of roadway, conduit and junction boxes may only be needed on that side upon plan review.

b. All conduit and junction box raceway networks must form a single connected system. Ensure conduit system connects to existing traffic signal controller cabinets, traffic signal interconnect, and communications conduit.

c. Install three 2 inch conduit along roadway and two 2 inch conduit into traffic signal controller cabinets. Install poly pull line and tracer wire in each conduit.

d. Install communications junction box at the corners of intersections and within 25 feet of traffic signal controller cabinets.

e. For roadways identified in the Transportation Communications Plan:

i. Install one 96 strand single mode fiber optic cable on one side of the roadway as directed by City staff.

ii. At traffic signal controller cabinets install splice closure, one 12 strand single mode fiber optic cable to cabinet, fiber optic termination equipment. Fusion splice and terminate fiber optic cable in the cabinet. Perform 4 additional fusion splices in splice closure as directed by City staff.

iii. Install fiber optic cable slack storage loops equal to 10% of the total cable length, distributed throughout the cable length. Include minimum 25 feet cable slack with each cable at fiber optic distribution units and splice closures.

3XX.2. Materials

A. Conduit

a. **General**

i. Conduits shall be sized according to the requirements of the National Electric Code (NEC) current edition.

ii. Separate conduits shall be used for low voltage and high voltage circuits, such as: signal circuits, detector circuits, service wires, communications wires, and 240 volt or greater illumination circuits.

iii. When trenching or drilling new conduit runs, install three two-inch diameter conduits with pull lines and locate wires.

b. **Material:** Conduit material shall be polyvinyl chloride (PVC) schedule 40 or high density polyethylene (HDPE) schedule 40. Rigid non-metallic fiberglass schedule 40 conduit shall be used for all conduit bends or sweeps.

c. Sweeps:

i. Conduit sweeps shall be minimum 36 inch radius.

ii. Conduit shall have no more than 360 total degrees of bend.

d. **Depth:** Conduit shall be installed at a depth of 30 inches below finished ground surface.

e. **Poly Pull Line:** Install an electrical poly pull rope with minimum 1,200 pound break strength in all conduit.

f. **Locate wire:** Install a 16 AWG THWN locate wire with orange jacket and blue tracer in all conduit. Extend the wire 2 feet beyond the conduit end and install wire nut.

g. **Locatable Pull Line:** A single locatable pull line meeting the requirements of the poly pull line and locate wire may be used in place of individual poly pull line and locate wire.

h. **Fittings**: Install push-on bell style bushings on ends of conduit.

i. **Underground marking tape:** Provide underground marking tape that is red polyethylene film, 6 inches wide, 4 mils thick minimum, and imprinted with the following or similar legend: "CAUTION CAUTION CAUTION BURIED ELECTRIC LINE".

B. Communication Junction Box

a. **General**: Communication junction boxes are large style polymer concrete for use in underground systems. The communication junction boxes are used to accommodate the large bending radius of fiber optic cabling and to provide room for cable storage. Install in non-deliberate vehicular traffic areas only.

b. **Size:** Communications junction box nominal size shall be 3 feet by 2 feet with 2 foot depth.

c. **Material**: Materials shall consist of aggregate bonded with a polyester resin and reinforced with fiberglass strands. The communication junction box and cover shall be gray in color. Covers shall meet AASHTO H-20/HS-20 specifications for loads. Covers

shall have a skid resistant surface and bolt to the box with stainless steel hex head bolts. The size of the communication junction box shall be as shown.

d. **Apron:** Communication junction boxes shall be installed with a 12 inch concrete apron if located outside a paved or concrete area.

e. **Labeling:** Junction box covers shall have the legend "COMMUNICATION" or "FIBER" stamped or embossed on the cover as appropriate. Letter size shall be no smaller than 1/16 of the box width. City will install metal asset tags on all junction boxes.

C. Fiber optic cable – See Section XXX

D. Network cable

a. **Industrial Ethernet cable**: Industrial Ethernet cables shall be Waterblock/direct burial rated, shielded enhanced, Category-6 cable with 24 AWG solid bare copper conductors, PE inner jacket, overall shield, and sunlight and oil resistant PE jacket. Terminate cable with RJ-45 connectors. The cable must be rated for minimum 300 V or UL 444 listed.

b. **Patch cable**: Patch cables shall be unshielded Category-6 cable with 24 AWG stranded, bare copper conductors and factory terminated with RJ-45 connectors and strain relief boots. The outer jacket shall be pink in color.

E. Network equipment

a. **Fiber Edge Switch**: The Fiber Edge Switch must meet the following requirements:

- Two Gigabit Ethernet SFP ports with paired SFP transceivers
- Eight 10/100Base-TX Ethernet ports
- 35mm DIN rail mount
- Operating voltage: 120 V AC
- Include power cable
- Support Rapid Spanning Tree Protocol (IEEE 802.1w)
- Support Quality of Service (IEEE 802.1p)
- Support VLAN (IEEE 802.1Q) with double tagging and GVRP support
- Support Link Aggregation (IEEE 802.3ad)
- Operating temperature range: -29°F to 165°F

b. **Fiber Aggregate Switch**: The Fiber Aggregate Switch must meet the following requirements:

- Eight Gigabit Ethernet SFP ports with paired SFP transceivers
- One 10/100/1000Base-TX Ethernet port
- 19 inch rack mount
- Operating voltage: 120 V AC
- Include power cable
- Support Rapid Spanning Tree Protocol (IEEE 802.1w)

- Support Quality of Service (IEEE 802.1p)
- Support VLAN (IEEE 802.1Q) with double tagging and GVRP support
- Support Link Aggregation (IEEE 802.3ad)
- Operating temperature range: -29°F to 165°F

c. **SFP Transceivers**: Single strand bi-directional SFP transceiver for Gigabit Ethernet switches must be provided in matched pairs and meet the following requirements:

- One LC single mode fiber connector
- Nominal transmission distance 10 km
- Hot swappable
- Support 1000Base-BX
- Transmit power: -9.0 to -3.0 dBm
- Receiver sensitivity: -19.5 to -3.0 dBm
- Wavelengths: 1310 nm and 1490 nm
- Operating temperature range: -29°F to 165°F

F. Communications Bracket: Fiber optic communications bracket for powering and mounting DIN rail equipment in traffic signal controller or ITS cabinets. The communications bracket must meet the requirements defined in ODOT's Standard Specification for Microcomputer Signal Controller Appendix B.

G. ITS Cabinet: Ground mounted traffic style (332) cabinet with 8 inch riser frame and foundation. The cabinet must be UL 50 Type 3R listed. The cabinet must consist of Housing #1 and Mounting #1 cage assemblies as defined in ODOT's Standard Specification for Microcomputer Signal Controller. Provide the housing requirements listed in Chapter 6 Section 2 with the exception of the police panel. The cabinet assembly must be assembled and listed by a certified UL 508A panel shop or have the final assembly certified by an approved National Recognized Testing Laboratory.

The cabinet must come equipped with a filtered, forced air ventilation system and light. Light must automatically turn on when cabinet doors are opened.

All incoming 120 V circuits must terminate on terminal blocks. All terminal blocks must be UL 1059 listed. For No. 10 AWG conductors or smaller, use sectional, double terminal, barrier type terminal blocks with binder screw terminals. Terminal ampacities must be equal to or greater than conductor ampacities. For No. 8 AWG conductors or larger, use one-piece for factory assembled, sectional, barrier type terminal blocks with box lug terminals having a pressure plate between screw and conductor. Use terminals of the correct size for the conductor to be connected.

Bus bars must be sized to accommodate required connections and must be amperage rated for use.

Source power circuit must be protected by a main circuit breaker. All branch circuits must be protected by branch circuit breakers. All circuit breakers must be UL 489 listed.

Receptacles must be general purpose, NEMA 5-15R, duplex, white, specification grade, rated 15A, 125 V, 3 wire, grounding type, with screw terminals. Mount within receptacle box and install cover plate. All receptacles must be UL 498 listed.

Provide a rack mounted line conditioner in the cabinet that automatically regulates the incoming voltage from brownouts, overvoltages, and transient surges for the protection of electrical equipment. The line conditioner must use a transformer based voltage correction circuit for maintaining nominal 120 V AC +/- 5%, 60 Hz output with 90 V to 139 V AC, 60 Hz input; support minimum 1440 watt load; provide minimum 1,440 joules surge suppression; and be UL 1012 listed. Line conditioner must provide minimum 10 receptacles.

3XX.3. Installation, Setup, and Finishing Requirements

A. Conduit Installation: All conduit runs shall be as direct as possible from point to point, shall remain within right-of-way, shall connect with adjacent existing conduits as appropriate to form communications network, and maintain as straight an alignment as possible. Make conduit runs continuous between any pole, junction box, or cabinet. Use the same size conduit for the entire length, outlet to outlet.

Ream the ends of all conduits to remove burrs and rough edges. Plug or cap all conduit ends until wiring is installed. After wiring is installed install duct seal compound or precut closed cell polyethylene foam that will prevent debris from entering the conduit system.

In areas to be paved or landscaped, place all conduit before paving or landscaping. If corrosive soil conditions exist, coat metallic conduit with a non-metallic coating or wrap with corrosion protection tape at least 10 mils thick.

Install underground marking tape at least 12 inches above all buried conduit.

B. Communication Junction Box Installation: Install communications junction boxes no more than 500 feet apart. Spacing up to 1,000 feet may be permitted on a upon plan review.

Install the tops of junction boxes flush with the surrounding grade, sidewalk, or top of curb. If installed outside roadways or shoulders, install a 12 inch portland cement concrete apron around the junction box. In boxes having an open bottom, construct a sump of reasonably well graded 3/4-inch - 0 crushed gravel, 12 inches deep covering the approximate area of the box. Do not install conductors until the sump has been constructed.

C. Fusion splicing requirements: Use individual fusion type splices to join fibers in fiber optic cables and pigtails.

Apply appropriate protective coating to all splices, protect with a thermal shrink sleeve, and place in a splice tray. Loop individual fibers one full turn within splice tray to avoid micro-bending. Maintain two-inch minimum bend radius during installation and after placing in optical fiber splice tray. Individually restrain each fiber in splice tray. Place optical fibers in the splice tray so that there is no discernible tensile force on optical fiber.

Perform all splice work in a controlled, weatherproof, dust-proof environment.

Splicing equipment must be in good working order, have been properly calibrated within the past six months, and meet all industry standards. Prepare cables, install closures and splice fibers in accordance with accepted and approved industry standards.

Individuals performing fiber optic terminations and splices must have a minimum of two years' experience terminating, splicing, and testing fiber optic cable, and possess either a Fiber Optics Installer or Fiber Optics Technician Certification recognized by the Electronics Technicians Association (ETA) or a Fiber Optics for ITS certificate from the International Municipal Signal Association (IMSA).

D. Network Equipment Installation: Furnish and deliver all network equipment to City. City staff will configure and install network equipment.

E. Network Patch Cords and Fiber Optic Jumpers: Furnish, stow, and protect all patch cords and jumpers at locations specified. Unless otherwise specified, City staff will connect patch cords and jumpers.

F. Fiber Optic Distribution Unit Installation: Install FDUs with sufficient quantity and type of port capacities, cassettes, splice trays, and coupler plates as shown.

G. Fiber Optic Splice Closure Installation: Attach splice closure to the inside wall of communications junction boxes. Maintain sufficient clearance for routing of the fiber optic cables without exceeding the minimum bending radius of any cable. Flash-test the closure after completion of splicing work to manufacturer's recommended pressure.

H. Specified limits: Installed fiber optic system shall meet the following limits:

1. Cable attenuation at 1310nm: < 0.40 dB/km
2. Cable attenuation at 1550nm: < 0.30 dB/km
3. Connector insertion loss: < 0.75 dB (bi-directional average)
4. Connector return reflection: < -40 dB
5. Fusion splice: < 0.10 dB (bi-directional average)

3XX.4. Documentation

A. Labels: Install labels to identify cables and jumpers at all termination points, communications junction boxes, and cabinets. Install labels to identify all communications components and devices in cabinets.

Use yellow or white colored labels with permanent black lettering. Labels must be mechanically imprinted. Do not use handwritten labels. Use tubular plastic labels on cables and jumpers.

Include the following information on labels:

- Owner
- Number of fibers
- Purpose (e.g intersection served)
- Cable or connection origin
- Cable or connection destination

B. Warning Tags: All warning tags must be of a long life material, orange in color, and marked in a permanent and consistent manner with black lettering. Include the text “CAUTION FIBER OPTIC CABLE” on all warning tags and show the cable fiber count.

Attach warning tags to fiber optic cables using UV-resistant zip ties according to the manufacturer’s recommendations. Do not affix in a manner that will cause damage to the fiber optic cables. Attach warning tags to the cables in at least two locations in communications junction boxes and at least one location in cabinets.

C. Design Drawing Requirements: Provide communication system plans sheets with traffic signal plans. Communication plans must consisting of at least:

- Raceway and Cable Installation Plan
- Fiber Optic Splicing Diagram
- Network Equipment Connection Diagram

Mark as built drawings with each installed cable’s length sequential marking at each cable entry to communications junction box, cabinet, and at each splice closure and fiber optic distribution unit.

3XX.5. Approved Materials

Section	Item Name	Approved Make/Model
3XX.2.A	Conduit	See ODOT Blue Sheets
3XX.2.A	Conduit Fittings	See ODOT Blue Sheets
3XX.2.A	Locatable Pull Line	
3XX.2.A	Underground Marking Tape	See ODOT Blue Sheets
3XX.2.B	Communications Junction Box	Synertech Underground Products, Strongwell, Quazite
3XX.2.D	Industrial Ethernet Cable	
3XX.2.D	Network Patch Cable	
3XX.2.E	Fiber Edge Switch	Siemens Ruggedcom 6GK6090-0GS23-0BA0-Z A01
3XX.2.E	Fiber Aggregate Switch	Siemens Ruggedcom 6GK6022-0AS23-0DC0-Z A07+B07+C07+D07+E01
3XX.2.E	SFP Transceivers (pair)	Siemens Ruggedcom SFP1132-1BX10R and SFP1132-1BX10T
3XX.2.F	Communications Bracket	See ODOT Green Sheets
3XX.2.G	ITS Cabinet	

3XX.6. Communications Plans Standard Callouts

L E G E N D

P O L E S

- EX / 1 — Retain and protect existing power pole (Power source)
- EX / 2 — Retain and protect existing utility pole
- EX / SP — Retain and protect existing signal pole
- EX / MP — Retain and protect existing traffic signal mast arm pole
- EX / LP — Retain and protect existing luminaire pole
- EX / WP — Retain and protect existing wood pole
- RIS — Install conduit riser on pole. Coordinate size and location with utility

W I R E S & C A B L E S

- EX / W — Retain and protect existing wiring
- EX / 39 — Retain and protect existing messenger cable
- EX N / P — Retain and protect existing (N=number) twisted pair interconnect cable
- EX FO / N (x) — Retain and protect existing (N=number) single mode fiber optic cable owned by (X=jurisdiction)
- EX / NET — Retain and protect existing network cable
- EX / LW — Retain and protect existing locate wire
- EX / PL — Retain and protect existing pull line
- FO / N (x) — Install (N=number) single mode fiber optic cable for ownership by (X=jurisdiction)
- NET — Install network cable
- LW — Install locate wire
- PL — Install poly pull line
- RX / W — Remove existing wiring
- RX N / P — Remove (N=number) twisted pair interconnect cable
- RX FO / N (x) — Remove existing (N=number) single mode fiber optic cable owned by (X=jurisdiction)
- RX / PL — Remove existing pull line
- RX / LW — Remove existing locate wire
- RR / W — Remove and relocate existing wiring
- RI / W — Reinstall existing wiring

C A B I N E T S

- EX / C — Retain and protect existing cabinet
- EX / SC — Retain and protect existing service cabinet
- EX / ITS — Retain and protect existing ITS cabinet
- ITS / C — Install model 332 ITS cabinet
- DIN / F — Install Fiber Optic Interconnect Communications Bracket
- COM — See communication component schedule for cabinet communications equipment

J U N C T I O N B O X E S

- EX / JB — Retain and protect existing junction box
- JB / C — Install communications junction box
- SPC — Install fiber optic splice closure.
- RX / JB — Remove existing junction box
- RX / SPC — Remove existing fiber optic splice closure
- RR / SPC — Remove and relocate existing fiber optic splice closure
- RI / SPC — Reinstall existing fiber optic splice closure

C O N D U I T S

- S EX / CC — Retain and protect existing (S=size when shown) inch communications conduit
- S — Install (S=size) inch electrical conduit
- CJ — Splice new conduit to existing conduit
- CS — Cap conduit stub (for future use)
- HDD — Install conduit by horizontal directional drilling
- S RX / CC — Remove existing (S=size when shown) inch communications conduit
- S AX / CC — Abandon existing (S=size when shown) inch communications conduit

J U R I S D I C T I O N

CoH = City of Hillsboro
CoB = City of Beaverton
WaCo = Washington County
ODOT = Oregon Depertment of Transportation