Chapter 4. Transportation Needs and Operational Issues

In the previous ROPs, completed in 2007 and 2008, two needs areas were identified by each of the three Districts. Through the stakeholder outreach for this current regional plan, these needs were found to still be applicable. They are:

- Traveler Information
- Incident and Emergency Management

In addition to the needs which remain from the previous ROP process, a number of other issues and needs were identified during the current stakeholder process. These issues and needs fall under the following additional categories:

- Transportation System Safety
- Traffic Signal Improvements
- Communications Network
- Enhanced Asset Management
- Automated Systems Management

The tables in the following sections outline the specific transportation needs and operational issues identified throughout the Region.

Traveler Information

Traveler information is vital to improving the efficiency of the transportation system. When drivers are notified of real-time operating conditions, they can make informed decisions which better distribute traffic across the roadway system, maximizing efficiency. Timely information can also keep queues from continuing to build when closures occur due to crashes or weather conditions, increasing safety for all road users.

Likely the most important traveler information need for the region was completed with the opening of the RTMC. This is now the focal point of traffic operations and traveler information dissemination to the public. Through the RTMC, travelers can be informed of roadway conditions, incidents and crashes, construction and maintenance activities, and weather conditions. RTMC operators utilize DMS and HAR to disseminate this traveler information. In addition, the information is also distributed via the 511 Pennsylvania Traveler Information System (511PA) website and app.

In the years since the last ROPs were developed, the distribution of traveler information from third party developers has greatly increased. Now many drivers use apps such as Waze as part of their daily commuting habits. Despite this change, ITS devices still provide an easy and widely used source of traveler information.

ITS Device Gaps

Though the region has been successful in deploying ITS devices, there are still important gaps that should be filled to improve traveler information. Filling ITS device gaps has been identified as a key component of the Traveler Information needs for this ROP. These gaps sometimes aligned with particular problem areas identified in the review of congestion and safety data but other gaps were identified based on location of other devices and need to fill in missing links in the ITS system, as coordinated through the stakeholder process. High-definition (HD) CCTV cameras are recommended, as are full-color DMS. The table below shows some of the key ITS gaps identified:

TABLE 15: ITS DEVICE GAPS

PennDOT District	Planning Organization	Location	ITS Devices Needed	Justification
2	Centre	I-99 @ Skytop	CCTV, RWIS	Winter-related crash cluster, gap in CCTV coverage on I-99 between Exit 61 and 68
2	Centre	I-99, Port Matilda to I-80	CCTV	Proposed project to provide full camera coverage of I-99
2	Centre	PA-350, west of Bald Eagle	RWIS	History of winter-related crashes, particularly concentrated near State Game Lands between Bald Eagle and Sandy Ridge
2	Centre	I-99 NB, south of Exit 68	DMS	Provide traveler information prior to State College
2	Centre	I-99 SB, south of Port Matilda	DMS	Lacking southbound DMS south of US 322
2	Centre	I-99 SB, north of Port Matilda	DMS	Provide traveler information prior to US 322 interchange
2	Centre	I-99 NB, north of US 322	DMS	Provide traveler information after major merge from US 322/State College
2	Centre	I-99 SB, north of Exit 78	DMS	Provide traveler information approaching State College area
2	Centre	US 322 WB, east of Boalsburg	DMS	Provide traveler information prior to Atherton St exit
2	Centre	US 322, Philipsburg to I-99	CCTV	Lacking cameras coverage for much of this section of US 322
2	North Central	I-80/US 219/PA-255, Dubois	DMS	Need DMS at interchanges to support ICM implementation
2	North Central	I-80, MM 106 and 116	CCTV	Filling gaps in CCTV coverage between DuBois and Clearfield
2	North Central	US 6 and US 219 intersection	CCTV	Lacking camera coverage in north of region, this would cover a major intersection of two US routes

PennDOT District	Planning Organization	Location	ITS Devices Needed	Justification
2	SEDA-COG	I-80, MM 178-192	CCTV	Existing 14-mile gap in CCTV coverage on I-80, including 2 interchanges
2	SEDA-COG	PA-64 near I-80	DMS	Provide traveler information prior to on-ramps to I-80
2	SEDA-COG	US 22/322, near Thompsontown	RWIS	Fill gap in coverage between existing devices at Newport and the Narrows
3	SEDA-COG	I-80 WB, prior to I-180	DMS	Provide traveler information prior to I-180 and US 15 diverge opportunities
3	SEDA-COG	PA-54 near Danville	CCTV	Need CCTV coverage of this regional Top 50 Bottleneck corridor
3	SEDA-COG	I-80, Exit 224 and 232	CCTV	Need CCTV coverage of these interchanges of I-80 with major routes
3	Northern Tier	US 6, at PA-14, US 15, and US 220	DMS	Provide traveler information prior to intersections with major routes
3	Northern Tier	US 15 at US 6	DMS	Provide traveler information prior to US 6
9	Altoona	US 220-Business, Altoona	CCTV	Monitor I-99 diversion route through Altoona
9	Altoona	US 22, east of Tunnelhill	CCTV	Monitor congested US 22 corridor approaching PA-764 and potential spillback from crashes in high curved road crash area to the west
9	Altoona	I-99 NB, south of Bald Eagle	DMS	Provide traveler information prior to PA-350 to avoid poor conditions on it during winter storms
9	Southern Alleghenies	I-70, Maryland State Line	DMS	Provide traveler information for drivers entering state

Upgrade/Replace Existing Devices

While filling gaps in ITS coverage is important, the state of existing ITS infrastructure should not be ignored either. Existing devices nearing the end of their useful life have been identified and should be considered for upgrade or replacement.

TABLE 16: EXISTING DEVICE NEEDS

PennDOT District	Planning Organization	Location	Upgrade/Replacement Needed	Justification
2	Centre	I-99, south of US 322	Retrofit existing DMS	Sign no longer supported by manufacturer
2	Centre	US 322, west of I-99	Retrofit existing DMS	Sign no longer supported by manufacturer
2	Centre	I-80/I-99	Replace cameras	End of useful life exceeded
2	North Central	US 219, near Bradford	Retrofit existing DMS	Signs no longer supported by manufacturer
2	Districtwide	I-80	Replace HAR transmitters and cabinet components	End of useful life exceeded
9	Altoona/Southern Alleghenies	Various locations	Retrofit existing DMS	Signs no longer supported by manufacturer

Incident and Emergency Management

Incident and Emergency Management refers to the ability to detect, verify, and respond to incidents within the regional transportation system. The central objective of the effort is to improve the time required to respond to incidents and weather events, and to manage the processes safely, securely, and efficiently. Improved management of incidents can significantly reduce congestion and enhance safety and mobility.

Integrated Corridor Management

Unlike most limited access highways, I-80 was not built to mirror the alignment of any particular highway. However, there are still a variety of state routes which parallel the interstate through the region. Because of this, there are multiple opportunities to provide Integrated Corridor Management (ICM). ICM is a strategy to improve the movement of people and goods through institutional collaboration and integration of existing infrastructure along major corridors, often utilizing other TSMO strategies in order to maximize underutilized capacity on parallel roadways in order to reduce overall corridor congestion.

The following TSMO strategies can be integrated in order to achieve successful ICM across the I-80 corridor, as well as other important corridors in the region:

- Traffic Incident Detection – Early and accurate detection of incidents is needed to allow authorities to respond to the scene quickly and with appropriate personnel and equipment. Detection also allows for the parallel corridor to be quickly put into place, minimizing backlog on the mainline. Detection can be provided in a variety of ways:
    - CCTV monitoring
    - Crowd-sourced data such as Waze
    - Coordination with Pennsylvania State Police (PSP) and other emergency personnel
    - Probe speed data monitoring (such as INRIX)

- Detector data showing major slowdown

- Dynamic rerouting – Present drivers with alternate routes (on parallel corridors) when I-80 is severely congested due to incidents, special events, or other abnormal traffic conditions. Alternate route information can be displayed on DMS upstream of off-ramps to the parallel corridors. This information can also be provided via 511PA.

- Traffic Signal Enhancements – integrate signal systems across adjacent jurisdictions and connect to the RTMC so that timings can be adjusted remotely to handle the increase in volume and maximize throughput along the route.

The RTMC is a key component of any ICM strategy in order to ensure success. Efficient notification of the incident would be routed through the RTMC who would then adjust DMS messaging to inform drivers of a parallel route, and signal timings would be adapted to ensure the parallel route operates as effectively as possible. **Table 17** summarizes corridors which were identified as candidates for ICM.

TABLE 17: REGIONAL ICM CORRIDOR NEEDS

PennDOT District	Planning Organization	Location	Parallel Corridor
2	North Central	I-80, Exit 97 to 101	US 219 PA-255
2	North Central	I-80, Exit 111 to 123	PA-153 US 322 PA-879 PA-970
2	Centre	I-80, Exit 147 to 158	PA-144 PA-150
2	Centre	US 322, Boalsburg to I-99	SR 3014 (Atherton Street/Boal Avenue)
2	SEDA-COG	I-80, Exit 173 to 185	PA-64 PA-477
3	SEDA-COG	I-80, Exit 232 to 241	PA-42 US 11
3	SEDA-COG	CSVT corridor	US 11 US 15 PA-61 PA-147
9	Altoona MPO	I-99, Exit 31 to 39	US 220-Business
9	Southern Alleghenies RPO	I-70/I-76 (PA Turnpike)	US 30

TIM Teams

Traffic Incident Management (TIM) is a multi-agency, coordinated effort to minimize the impact of traffic incidents. TIM requires planning and coordination between multiple entities, including local transportation departments, law enforcement, fire departments, emergency medical services, towing and recovery companies, and hazardous materials clean-up contractors. Each agency has its own diverse priorities and cultures which need to be addressed through a unified set of TIM strategies including better interagency coordination and training. A successful TIM team can lead to reduced incident response cost, decreased travel delay, and improved safety through faster, better organized incident clearance.

TABLE 18: TIM TEAM NEEDS

PennDOT District	Planning Organization	Corridor
3	SEDA-COG	CSVT Corridor
2 and 3	Various	I-80 Corridor
2 and 9	Various	I-99 Corridor

Weather Forecasting Integration

Weather, particularly winter weather, is an important transportation issue within the region. There is an existing relationship between the Central RTMC and the State College office of the National Weather Service (NWS). There is room for this relationship to grow with further collaboration and sharing of data. This can lead to improved traveler information and safer operations decisions on PennDOT's roadways. The following are recommendations to assist in more extensive integration of weather forecasting information at the RTMC:

- Increase collaboration to ensure consistent messaging between PennDOT and NWS.
- NWS is seeking to increase public knowledge of snow squall warnings. Snow squalls are particularly hazardous weather events to drivers as they severely decrease visibility and often move quickly through regions. Through collaboration between PennDOT and NWS, these snow squall warnings could be broadcast out to drivers via existing DMS signs and PA511, providing advance warning to the public to stay off the road or otherwise avoid these potentially dangerous conditions.
- PennDOT Maintenance personnel can assist NWS with gathering snowfall measurements at regional PennDOT stockpile locations. This will be particularly beneficial to NWS at rural facilities that have 24/7 staff that can provide snowfall information during the overnight hours.

Special Event Use of Portable DMS

Portable DMS, normally transported via a trailer hitch, are a very handy tool for ITS operations due to the inherit flexibility which they provide. They are often used to improve safety in work zones but can also be utilized during special events which draw large crowds and create congestion. The Central Region has the capability to program these devices from the RTMC. The stakeholder process identified the following events which could benefit from planned use of portable DMS:

- Peoples Natural Gas Field (Altoona Curve baseball stadium)

- Multiple Centre County/PSU events
- Bloomsburg Fairgrounds Events
- Benezette Elk Viewing and Elk Expo, PA-555

Transportation System Safety

With an estimated 50% of rural congestion occurring due to traffic incidents, safety is of course an important issue. While the previous section discussed ways to minimize impacts due to incidents, this regional need relates to minimizing the occurrence of incidents before they happen.

Innovative ITS devices continue to be introduced and improved upon which seek to assist drivers in warning of potential dangers and in reducing dangerous conditions in the first place. This section discusses a few of these TSMO strategies which are recommended to improve safety at particularly dangerous sections of the region's highways.

Variable Speed Displays

Variable speed displays, also known as variable speed limits, are posted by variable speed limit signs. These speed limits can be changed remotely by the RTMC or can automatically change in response to congestion, incidents, work zones, or road weather conditions.

TABLE 19: VARIABLE SPEED DISPLAY NEEDS

PennDOT District	Planning Organization	Corridor
2	Centre	US 322 west of I-99
2	Centre	I-80, Exit 147 to 158

Queue Detection

Queue warning systems alert drivers to downstream slow-moving traffic, especially in cases where the congestion would be unexpected. Queue warnings are typically delivered to motorists through DMS, though some advanced ITS applications involve in-vehicle queue warnings. Queue warning systems can be used in conjunction with portable DMS ahead of work zones with lane closures in effect or other temporary conditions which will cause atypical congestion. Queue warning systems can also be effectively paired with variable speed limits to improve their effectiveness.

TABLE 20: QUEUE DETECTION NEEDS

PennDOT District	Planning Organization	Corridor
3	Williamsport	I-180 WB, approaching SB US 15 off-ramp
9	Johnstown	US 22 Eastbound, near US 219

Dynamic Curve Warning

Dynamic curve warning systems provide feedback to vehicles entering a horizontal curve when they approach at an unsafe speed. Vehicle speeds are detected upstream of the curve by radar or other ITS devices and trigger a controller which activates electronic sign elements and/or DMS signs to warn the speeding driver to slow down prior to the curve.

In most cases, Dynamic Curve Warning should be installed only after other more low-cost improvements have been installed and not achieved the desired outcome. Low-cost improvements would include signage, delineation treatments, high friction surface treatments, and other similar solutions.

Dynamic Curve Warning Needs were identified by evaluating curved road crash clusters within PennDOT One Map. These clusters were tiered and the highest ranking curved road crash locations were evaluated to determine if an ITS solution was warranted or if low-cost improvements should be attempted first.

TABLE 21: DYNAMIC CURVE WARNING NEEDS

PennDOT District	Planning Organization	Corridor
2	Centre	I-99 near Exit 81
2	SEDA-COG	I-80 near MM 180
2	SEDA-COG	US 322 near Laurel Creek Reservoir
3	Williamsport	US 15, Southbound prior to I-180
9	Altoona	US 22 near Williamsburg
9	Johnstown	US 219 near Summerhill
9	Southern Alleghenies	US 30 near McConnellsburg

Bridge De-Icing

Heating technologies can be used to prevent snow and ice accumulation on bridge decks during winter storms. The latest technology includes burying electric resistance cables or pipes with heated liquid within the pavement to warm up the road surface and help to minimize accumulation of winter precipitation. Currently, PennDOT utilizes the Automated Fixed Location Anti-Icing System (AFLADS) at locations along I-80. This system consists of a series of spray disks that deliver a freeze point depressant agent, in a pre-prescribed amount, determined by the roadway surface condition. RWIS is utilized to determine the current roadway surface temperature and condition. RTMC personnel are notified when the system is activated. It is recommended to include bridge de-icing technology within the pavement for future installations.

Table 22 shows existing systems that need retrofits of equipment in order to stay operational.

TABLE 22: BRIDGE DE-ICING NEEDS

PennDOT District	Planning Organization	Corridor	Need
2	Centre	I-80 over Eagle Valley Road	Retrofit existing system
2	North Central	I-80 over Anderson Creek	Retrofit existing system

Slow Vehicle Warning

Slow vehicle warning systems have begun to be used, often for large construction vehicles entering the roadway from a work zone access point. Sensors can be used to detect the slow moving vehicle, triggering a message to be displayed upstream warning drivers. This could be used in the region at permanent locations as well where speed discrepancies (often due to vertical curves) create rear end crashes.

TABLE 23: SLOW VEHICLE WARNING NEEDS

PennDOT District	Planning Organization	Corridor
2	North Central	I-80 WB, MM 120 to 111
2	SEDA-COG	US 322, Seven Mountains

Automated Truck Enforcement

Automated truck enforcement systems can be used to detect certain types of unauthorized vehicles and assess violations, saving manpower that would normally be used for enforcement. Within the region, this could be used to reduce heavy vehicle usage of routes which they are banned from. The vehicle would be identified to be above a specified height, length, or weight and a camera system would record images to be used in an automated violation which would be sent to the driver. It should be noted that the state legislation would be required in order to allow for this type of automated enforcement.

TABLE 24: AUTOMATED TRUCK ENFORCEMENT NEEDS

PennDOT District	Planning Organization	Corridor
2	Centre	PA-144, west of Centre Hall

Traffic Signal Enhancements

Traffic signals can improve the safety and efficiency of roadway networks for motorists, as well as for cyclists and pedestrians. However, poor signal timing and/or poor coordination between signalized intersections can negatively impact traffic flow and the effectiveness of the signals. There are a variety of traffic signal enhancements that can allow agencies to get the most effective operations from their existing traffic signals without roadway widening or other costly improvements.

- Optimization and coordination of signal timing
- Integrating signal systems across adjacent jurisdictions to improve arterial progression
- Adaptive traffic signal control to smoothly adjust timings to account for actual traffic volumes where volumes are less predictable
- Traffic responsive operations for corridors where traffic volumes fall into typical patterns, but the volumes vary daily

- Emergency vehicle preemption to halt general traffic movements so that emergency vehicles may pass through
- Removal of unwarranted traffic signals
- Monitoring traffic signals using automated traffic signal performance measures developed from high resolution data logs

The benefits of these enhancements include:

- Decreased congestion and delay, improving travel time and travel time reliability
- Smoother traffic flow and reduced congestion between traffic signal systems in adjacent jurisdictions
- Improved safety without major modifications

Some of the Central Region's corridors which would benefit from these enhancements are shown in **Table 25**.

TABLE 25: TRAFFIC SIGNAL ENHANCEMENT NEEDS

PennDOT District	Planning Organization	Corridor	Signal Needs
2	Centre	SR 3014 (Atherton Street), State College	• Install CCTV cameras along Atherton between PA-45 and PA-26 • Command/control signal system and performance measures between PA-45 and I-99
2	Centre	US 322, PA-53, PA-350, PA-504, SR 3029, Philipsburg	• Command/control signal system
2	North Central	PA-255, DuBois	• Performance measures • Command/control signal system
2	SEDA-COG	PA-150 (Hogan Blvd), Mill Hall	• TMC integration
3	SEDA-COG	US 11, Bloomsburg to Danville	• Command/control signal system for I-80 diversion • Performance measures
3	SEDA-COG	PA-54, near Danville	• Command/control signal system • Performance measures
3	Northern Tier	US 220 Ramps/SR 1069 (Elmira Street), Sayre	• Controller upgrades • Coordination
3	Williamsport	I-180 interchanges at Market Street and Maynard Street	• Queue preemption on WB off-ramps • Timing improvements
9	Altoona	US 220-Business/Plank Road	• System improvements • Performance measures
9	Altoona	PA-36/PA-164, Roaring Spring	• Upgrade detection • LED "RED SIGNAL AHEAD" sign on westbound PA-164 prior to Spring Garden Circle
9	Johnstown	US 219 SB Off-Ramp at Elton Road	• Queue preemption on SB off-ramp
9	Johnstown	PA-56, near US 219	• Upgrade controllers/detection • Coordination

Communications Network

Fiber Backbone

In order to best operate many of the ITS device and traffic signal upgrades mentioned above, a robust communications network is required. The installation of a fiber backbone will provide PennDOT with the means for facilitating a high-bandwidth connection to ITS field devices, other agencies and equipment through a state-owned and maintained network. A properly designed fiber optic communications network

is highly reliable and will supply the bandwidth necessary to transmit current and future data and video to/from the RTMC.

By utilizing the region's interstates as a pathway to establish the backbone installation, all conduit, cabling, and communications equipment will be installed within the limited access right-of-way which will help mitigate any possible damage to cable or equipment infrastructure due to uncoordinated digging activities near PennDOT underground infrastructure (exacerbated by the fact that PennDOT is not a listed utility as part of Pennsylvania's One-Call system). In addition, the installation of primary backbone facilities along the interstate roadway network provides logical connections for expansion to major arterial facilities via interchanges.

Once deployed, the fiber optic backbone network does not require any additional leasing cost to maintain. The high bandwidth that is provided by a properly designed fiber optic backbone network also makes this alternative more scalable as additional data and video needs are realized in upcoming years. It should be noted that the up-front installation cost for a fiber backbone network is substantial when compared to leasing costs on a device-by-device basis, but the installation of fiber will begin to realize cost savings once fully deployed.

To connect the existing fiber network back to the RTMC, the following gaps were identified:

- I-99, Exit 71 to I-80
- I-80, Existing Fiber (MM 159.1) to Exit 161
- I-80, Existing Fiber (MM 153.9) to District 2-0 Office

To complete the fiber backbone on I-80 in the region, the additional gaps were identified:

- I-80, Exit 97 to District 2-0 Office
- I-80, Exit 161 to Exit 212 (I-180)
- I-180, from I-80 to Montoursville (I-180 Exit 21)

To complete the fiber backbone on I-99, an additional gap from Exit 52 to the Pennsylvania Turnpike (I-76) was also identified.

In total, approximately 49 miles of fiber are needed to connect the existing backbone to the RTMC and an additional 97 miles of fiber are needed to provide a complete backbone on I-80/I-180. An additional 52 miles of fiber are needed to complete the I-99 backbone.

P3 Fiber Potential

Elsewhere in the Commonwealth and throughout the country, Public-Private Partnerships (P3) are being undertaken to facilitate expansion of fiber networks. P3 projects involve cooperative arrangements between public and private sectors, adding important upfront funding of public projects while normally providing potential for long-term benefits to the private entity.

In the case of fiber networks, a P3 agreement could allow a private company to install a large fiber network within PennDOT's right-of-way. The network would accommodate PennDOT's existing and future data

communications needs while also allowing the private firm to generate revenue from third party broadband customers. This could aid the Department in building their fiber network while likely resulting in an overall cost savings as well.

Enhanced Asset Management

With a growing network of ITS devices throughout the Central RTMC Region, it becomes increasingly difficult to manage and maintain them. It is recommended that an Enhanced Asset Management program be deployed so that PennDOT and the planning partners are able to monitor the age and status of the various ITS devices in the region. Therefore, the devices can be best maintained and remain in operation. Also, PennDOT and the planning partners can be aware of which devices are reaching the end of their life cycles and in need of replacement. This allows for planners to determine approximate timing of future expenditures related to replacement of existing ITS devices.

A funding source for replacement of antiquated ITS devices should also be determined. This would ensure that existing devices remain operable and ITS capabilities are not lost at important locations along the region's roadways.

Automated Systems Management

Another aspect to consider with a growing network of ITS devices is the capabilities of RTMC staff to manage and utilize them. Potential solutions exist which can automate some of the operation of devices. These systems, sometimes referred to as advanced roadside information management systems, can pull data from cameras and sensors and run algorithms to determine any issues occurring in real-time. These systems can then automate the operation of variable speed displays and other devices, as well as sending appropriate messaging out to DMS signs. In the future, messaging could also be delivered to in-vehicle units via Dedicated short-range communications (DSRC).

This sort of technology is relatively new and would specifically be new to the Central RTMC Region. Therefore, no large-scale deployment is recommended at this time. However, a pilot should be considered to test the potential and capabilities of such a system.