

Intelligent Transportation Systems (ITS) Architecture Comprehensive Update

Task 4 Technical Memo: Needs Analysis and Gap Assessment

Prepared For:



Northeast Ohio Areawide Coordinating Agency (NOACA)
1299 Superior Avenue East
Cleveland, OH 44114

Prepared By:

AECOM

In Association with:



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This technical memorandum presents a summary of the information gathered by the AECOM Team for the NOACA Regional ITS Architecture Comprehensive Update project. The purpose of the technical memorandum is to identify transportation needs and priorities within the NOACA region, as well as potential ITS solutions to meet those needs, based on stakeholder inputs gathered from surveys, workshops and interviews. These needs and solutions are also assessed and connected to the goals, objectives and strategies in the AIM Forward 2040 Long Range Transportation Plan.

In addition, this memo presents a summary of the existing and planned ITS inventory as well as system functionalities within the region based on stakeholder inputs gathered from surveys and workshops. The memo analyzes how stakeholder needs are addressed or partially addressed by current ITS capabilities in the region, how planned ITS solutions may enhance current capabilities and address those needs, and what gaps exist and should be considered in planning for future ITS projects. The analysis helps support next steps to be taken in the update of the ITS Strategic Plan.

Summary of Survey Responses

Regional stakeholders were surveyed in September 2018 on a series common transportation issues and needs that could be addressed through the use of ITS technologies. Respondents were asked to rank the importance of the issue while considering the existing conditions within their community or region.

A summary total of all survey responses received from agencies within the NOACA region is presented in the table below. Some agencies (e.g. Ohio DOT and Ohio Turnpike) span multiple counties in the NOACA region and are counted as a regional agency in the far right of the table.

Table 1. Summary of ITS Needs Survey Responses Received

Total Survey Responses	Cuyahoga County	Geauga County	Lorain County	Medina County	Lake County	Regional Agencies
34	11	3	7	5	3	5

Summary of ITS Needs

Table 2 presents how all survey respondents ranked the severity of the transportation issues and needs that could be addressed through the use of ITS technologies on a scale of 1 (Low) to 3 (High). An average of the scores is presented for all survey respondents in the region, as well as for those respondents within each County. Regional agencies that span multiple counties were assigned to each of those counties respectively.

Table 2. Summary of Stakeholder Needs Survey Responses

Need Areas	Specific ITS Needs	Point System: High (3 points); Medium (2 points); Low (1 point)					
		Average Scores (by County)					
		All Counties	Cuyahoga County	Geauga County	Lorain County	Medina County	Lake County
Information Management	Need to enhance communications and information sharing among regional agencies	2.4	2.4	1.7	2.3	3.0	1.3
	Need to share archived data between agencies	1.7	1.8	1.3	1.8	1.8	1.3
	Need to collect transportation information for use by planners	2.0	1.9	2.0	2.0	2.2	1.3
	Need to implement or enhance data storage and management capabilities	2.0	2.0	1.7	2.0	2.2	1.3
	Traffic counts regionally (Written-in)		3.0				

Table 2. (Continued)

Need Areas	Specific ITS Needs	Point System: High (3 points); Medium (2 points); Low (1 point)					
		Average Scores (by County)					
		All Counties	Cuyahoga County	Geauga County	Lorain County	Medina County	Lake County
Traffic Management	Need to improve traffic congestion mitigation	2.4	2.4	2.3	2.3	2.5	2.0
	Need to provide early warning of poor visibility conditions (snow squalls, sun, fog, heavy rains, etc.)	2.1	2.3	2.0	1.9	2.0	1.3
	Need to improve traffic signal interconnect and coordination to improve mobility	2.4	2.0	2.3	2.7	2.8	2.3
	Need for traffic signal interconnect across jurisdictions	1.9	1.9	1.7	1.8	2.3	1.7
	Need to provide expanded traffic signal preemption for emergency vehicles	2.1	2.0	2.3	2.2	2.3	2.0
	Need to provide traffic signal priority for transit vehicles	1.4	1.6	1.3	1.0	1.5	1.3
	Need to know travel times on major routes	1.5	1.6	1.0	1.3	2.0	1.0
	Need to know incidents on major routes	2.1	2.3	1.3	1.7	2.0	2.0
	Need to provide advanced warning of flash flood areas	2.0	2.1	2.0	1.7	2.0	1.7
	Need to alert drivers of speeding via automated alert systems	1.6	1.7	1.7	1.3	2.0	1.3
	Need to implement parking management systems in downtown area and for special events	1.3	1.4	1.0	1.0	1.3	1.5
	Need to implement hard shoulder running systems	1.3	1.3	1.0	1.0	1.3	1.0
	Need to implement ramp meters to manage freeway congestion and traffic flows	1.5	1.8	1.0	1.3	1.5	1.0
	Need for wrong way vehicle detection on exit ramps and automated wrong way alerts	1.9	1.7	2.0	1.6	2.0	2.0
	Need for queue warning systems on freeways	1.6	1.7	1.0	1.4	1.5	2.0
	Need to reduce delays due to incidents or construction	1.9	2.2	1.3	2.0	1.8	1.3
	Need to reduce deer/animal-related crashes	1.6	1.7	1.3	1.4	2.3	1.7

Table 2. Continued

Need Areas	Specific ITS Needs	Point System: High (3 points); Medium (2 points); Low (1 point)					
		Average Scores (by County)					
		All Counties	Cuyahoga County	Geauga County	Lorain County	Medina County	Lake County
Public Transportation	Need to improve on-time performance for fixed-route transit operations	1.9	2.0		1.0	2.3	
	Need to improve efficiency of demand-responsive transit operations	2.0	2.0		1.0	2.8	
	Need to provide real-time transit arrival information at bus stops and transfer locations	1.9	2.0		1.5	2.0	
	Need to improve transit connections for travelers	2.1	1.7		1.8	2.8	2.0
	Need to improve event, incident, and/or construction coordination with transit providers	1.9	2.0		1.2	2.7	
	Need for traffic signal priority for transit vehicles	1.6	2.0	1.0	1.0	1.5	
	Need to deploy AVL on transit vehicles	1.6	2.0		1.0	2.7	
	Need to improve safety and security of transit passengers on vehicles and at transit stops / platforms / park and ride lots	1.8	2.0		1.0	2.5	
	Need to provide real-time park-and-ride space availability information	1.6	2.0		1.0	2.3	
	Need automated maintenance system for transit fleets	1.6	3.0		1.0	2.0	
	Need signage at public transit stops (Written-in)					3.0	
	Need to provide a transit system (Written-in)				3.0		
	Traveler Information	Need to provide travel times / delays on freeways / turnpike to the public	1.9	2.0	1.0	1.7	1.8
Need to provide travel times / delays on major arterials to the public		1.8	2.0	1.3	1.9	1.8	1.0
Need to provide incident information for freeways / turnpike to the public		2.0	2.1	1.0	1.7	1.8	2.0
Need to provide incident information for arterial roadways to the public		1.6	2.1	1.0	1.6	1.3	1.0
Need to provide road closure / lane restriction information for freeways / turnpike to the public		2.1	2.0	1.5	2.1	2.5	1.5
Need to provide road closure / lane restriction information for arterial roadways to the public		2.0	2.0	1.5	2.3	2.3	1.0
Need to provide real-time information about weather conditions/location to the public		1.8	2.1	1.3	1.4	2.3	1.0
Need to provide special event traffic information to the public		1.7	1.6	1.3	1.7	1.8	1.3

Table 2. Continued

Need Areas	Specific ITS Needs	Point System: High (3 points); Medium (2 points); Low (1 point)					
		Average Scores (by County)					
		All Counties	Cuyahoga County	Geauga County	Lorain County	Medina County	Lake County
Traveler Information (Continued)	Need to have traveler information accessible at employment sites	1.4	1.8	1.0	1.1	2.0	1.0
Commercial Vehicle Operations and Freight Management	Need improved intermodal freight management	1.8	2.5	1.0	1.3	2.7	1.0
	Need improved electronic screening for commercial vehicle operations	1.5	1.7	1.0	1.2	2.0	1.0
	Need real-time truck parking availability for commercial vehicles	1.7	2.5		1.3	2.3	
	Need to improve hazardous cargo tracking and routing	1.9	2.3	1.3	1.5	2.3	1.0
Roadway Maintenance	Need advanced and up-to- date road closure and temporary maintenance work zone information	2.0	2.0	1.7	2.1	2.3	2.0
	Need to know locations of maintenance vehicles	1.5	1.4	1.7	1.4	1.7	1.3
	Need to provide real-time vehicle (i.e. snow plow) location information to the public	1.7	1.7	1.7	1.6	1.8	1.3
	Need to improve remote vehicle diagnostic capabilities	1.3	1.5	1.3	1.1	1.5	1.5
	Need to collect roadway surface conditions data, such as icing, from vehicle sensors	2.1	2.0	2.0	1.9	3.0	2.0
	Need improved flood monitoring on roadways susceptible to flooding	1.9	1.8	1.3	1.9	2.3	1.3
	Need improved wind/dust monitoring on major routes	1.4	1.3	2.0	1.0	1.7	1.0
	Need to improve temporary maintenance work zone safety for travelers	2.1	2.0	2.5	2.0	2.7	1.3
	Need to improve temporary maintenance work zone safety for maintenance staff	2.3	1.8	2.0	2.3	3.0	2.5
	Need to reduce delays due to temporary maintenance work zones	1.8	1.8	1.7	1.9	2.3	1.3
Incident and Emergency Management	Need to improve alternate route traffic management, including the communication of detour information	2.3	2.1	2.0	2.2	2.3	2.3
	Need improved incident detection on major routes	2.1	2.3	2.5	2.3	2.0	1.7
	Need improved incident management and coordination	2.1	2.0	2.0	2.0	2.0	2.0
	Need to identify alternate routes for the traveling public during major incidents on freeway	2.3	2.1	2.5	2.1	2.3	2.5
	Need to improve hazardous cargo tracking and routing in region	1.7	2.0	1.7	1.4	1.8	1.0

Table 2. Continued

Need Areas	Specific ITS Needs	Point System: High (3 points); Medium (2 points); Low (1 point)					
		Average Scores (by County)					
		All Counties	Cuyahoga County	Geauga County	Lorain County	Medina County	Lake County
Incident and Emergency Management (Continued)	Need to improve emergency notification / dispatch and response times	2.1	2.1	2.0	2.0	2.3	1.3
	Need improved tracking of emergency vehicles	1.7	2.0	1.3	1.6	2.3	1.5
	Need to identify alternate/quickest routes for emergency vehicles using real-time information	2.2	2.1	2.0	2.4	2.8	2.0
	Need to improve/expand roadside assistance services (i.e. roadway service patrol)	1.5	1.7	1.7	1.7	1.5	1.0
Transportation Security	Need for security and safety monitoring in public spaces (for public safety / crime deterrent)	2.1	2.4	1.7	2.0	2.5	1.3
	Need to improve evacuation plan implementation using technology	2.0	2.1	2.0	2.0	2.2	1.3
	Need to monitor the transportation infrastructure for security purposes (for terrorism)	2.0	2.0	2.0	1.7	2.3	1.3
	Need to monitor the transportation infrastructure conditions for maintenance purposes	2.0	2.0	1.7	2.1	2.0	1.7

Summary of High Priority ITS Needs

Upon reviewing the rankings of these specific ITS needs, the higher ranked needs within each Need Area are identified and presented in Table 3. These higher ranked stakeholder needs are traced to the NOACA Regional Strategic Plan Goals to illustrate how the needs relate to each goal and its respective objectives identified in the NOACA Regional Strategic Plan. The NOACA Regional Strategic Plan Goals and Objectives are presented below for reference.

Goal 1: Strengthen Regional Cohesion

Objectives:

- 1.1. Foster collaboration on issues of transportation, air and water quality that will lead to greater regional cohesion and cooperation on other issues of regional concern.
- 1.2. Work with governments in the region as well as state and federal authorities to remove barriers to joint development or maintenance of infrastructure by multiple governmental entities and by governmental and private entities.
- 1.3. Work with governments in the region as well as state and federal authorities to promote cost sharing, purchasing coordination and consolidation of services to improve the efficiency and reduce the costs of developing and maintaining transportation and water infrastructure.
- 1.4. Facilitate and promote the sharing of best practices for regional collaboration and cost sharing.
- 1.5. Ensure infrastructure investments are planned and implemented to maximize transportation benefits across all impacted communities.
- 1.6. Promote infrastructure investments that enhance the inter-relationships of communities within the region.

Goal 2: Preserve Existing Infrastructure

Objectives:

- 2.1. Provide funding and other priority and other preferences to infrastructure projects that:
 - 2.1.1. Preserve or maintain existing infrastructure that serves currently developed areas of the region
 - 2.1.2. Facilitate improvements that connect existing activity centers and reinvigorate existing communities
 - 2.1.3. Facilitate development in higher density areas
 - 2.1.4. promote environmental sustainability
- 2.2. Create mechanisms to monitor the condition of existing regional transportation assets and evaluate the social equity/environmental justice impacts of infrastructure investments.
- 2.3. Conduct benefit-cost analyses of all projects to insure that life-cycle costs and regional fiscal sustainability are considered.
- 2.4. Devote approximately 90% of the region's transportation and infrastructure funding to maintain and preserve existing transportation investments.

Goal 3: Build a Sustainable Multimodal Transportation System

Objectives:

- 3.1. Provide funding priority and other preferences with scoring criteria to projects that:
 - 3.1.1. Enhance and improve coordination for public transit, rail, pedestrian and bicycle transportation
 - 3.1.2. Improve access to regional job centers, employment opportunities, and city centers
 - 3.1.3. Facilitate intermodal transportation connections
 - 3.1.4. Reduce energy use and improve air quality
 - 3.1.5. Reduce greenhouse gas emissions
 - 3.1.6. Reduce reliance on auto travel
 - 3.1.7. Demonstrate an adequate long-term funding stream for operation and maintenance
 - 3.1.8. Integrate the control of stormwater, protection and improvement of water quality, and control of development in floodplains
 - 3.1.9. Ensure and/or enhance safety
- 3.2. Assure that the Regional Transportation Plan and TIP reflect a coherent commitment to a balanced multi-modal transportation system and to NOACA's strategic vision.
- 3.3. Encourage transit-oriented development in higher density urban corridors and other higher density areas of the region and retrofitting transit oriented elements in appropriate lower density areas.
- 3.4. Consider strategic abandonment or alternative provision of service for infrastructure elements that are underutilized or whose maintenance or reconstruction costs may exceed their benefit.
- 3.5. Achieve levels of infrastructure investment that do not exceed the region's financial capacity.

Goal 4: Support Economic Development

Objectives:

- 4.1. Provide funding priority and other preferences with scoring criteria to projects that:
 - 4.1.1. Provide for the movement of goods essential to the economic viability of the region
 - 4.1.2. Are consistent with state, regional and local economic development priorities, policies and strategies
 - 4.1.3. Support the retention and expansion of Northeast Ohio area businesses in areas served by existing infrastructure and the attraction of new businesses to Northeast Ohio
 - 4.1.4. Support the development of the region's manufacturing base, health care system, and other areas of regional economic strength and economic development focus
- 4.2. Ensure that NOACA's Board of Directors includes the expertise of representatives of the business, medical, higher education and non-profit sectors through their participation in the Community Advisory Council and Business Advisory Council.

- 4.3. Conduct focused studies that identify ways in which NOACA can direct investments and actions to create realistic opportunities for job retention and economic development.
- 4.4. Promote regional cooperation in the areas of economic development and job retention.
- 4.5. Direct investments and actions to create realistic opportunities for job retention and economic development.

Goal 5: Enhance Quality of Life

Objectives:

- 5.1. Provide funding priority and other preferences with scoring criteria to projects that:
 - 5.1.1. Promote the redevelopment of declining and abandoned areas
 - 5.1.2. Provide improved access to primary and secondary schools, colleges, universities and other educational opportunities
 - 5.1.3. Enhance the public’s access to and enjoyment of the region’s parks, cultural assets and recreational activities
 - 5.1.4. Preserve agricultural lands, open space and important habitat areas, woodlands, and wetlands
 - 5.1.5. Promote healthy and active living
- 5.2. Make prudent and necessary infrastructure improvements to minimize the economic burden of transportation investments on the region’s taxpayers.
- 5.3. Ensure that safety factors are considered in the development of regional infrastructure.

Table 3. High Priority Stakeholder Needs and NOACA Regional Strategic Goals

Need Areas	High Priority Needs	Regional Strategic Plan Goals				
		Strengthen Regional Cohesion	Preserve Existing Infrastructure	Build a Sustainable Multimodal Transportation System	Support Economic Development	Enhance Quality of Life
Information Management	Need to enhance communications and information sharing among regional agencies	X				
Traffic Management	Need to improve traffic congestion mitigation		X			X
	Need to provide early warning of poor visibility conditions (snow squalls, sun, fog, heavy rains, etc.)		X	X		
	Need to improve traffic signal interconnect and coordination to improve mobility			X	X	
	Need to provide expanded traffic signal preemption for emergency vehicles			X		
	Need to know incidents on major routes			X		

Table 3. (Continued)

Need Areas	High Priority Needs	Regional Strategic Plan Goals				
		Strengthen Regional Cohesion	Preserve Existing Infrastructure	Build a Sustainable Multimodal Transportation System	Support Economic Development	Enhance Quality of Life
Public Transportation	Need to improve efficiency of demand-responsive transit operations			X		
	Need to improve transit connections for travelers			X	X	
	Need to improve event, incident, and/or construction coordination with transit providers	X		X		
Traveler Information	Need to provide travel times / delays on freeways / turnpike to the public					X
	Need to provide incident information for freeways / turnpike to the public					X
	Need to provide road closure / lane restriction information for freeways / turnpike to the public					X
	Need to provide road closure / lane restriction information for arterial roadways to the public					X
Commercial Vehicle Operations and Freight Management	Need to improve hazardous cargo tracking and routing	X			X	
Roadway Maintenance	Need advanced and up-to-date road closure and temporary maintenance work zone information		X			X
	Need to collect roadway surface conditions data, such as icing, from vehicle sensors		X			X
	Need to improve temporary maintenance work zone safety for travelers		X			X
	Need to improve temporary maintenance work zone safety for maintenance staff		X			X

Table 3. (Continued)

Need Areas	High Priority Needs	Regional Strategic Plan Goals				
		Strengthen Regional Cohesion	Preserve Existing Infrastructure	Build a Sustainable Multimodal Transportation System	Support Economic Development	Enhance Quality of Life
Incident and Emergency Management	Need to improve alternate route traffic management, including the communication of detour information	X				X
	Need improved incident detection on major routes		X			X
	Need improved incident management and coordination		X			X
	Need to identify alternate routes for the traveling public during major incidents on freeway	X				X
	Need to improve emergency notification / dispatch and response times		X			X
	Need to identify alternate/quickest routes for emergency vehicles using real-time information	X				X
Transportation Security	Need for security and safety monitoring in public spaces (for public safety / crime deterrent)	X	X			X
	Need to improve evacuation plan implementation using technology	X	X			X

Existing ITS Capabilities, Planned Enhancements and Opportunities

Regional stakeholders were also surveyed in October 2018 on their existing and planned ITS capabilities that help to address transportation challenges. Respondents were asked to identify their agency’s existing and planned ITS inventory and capabilities by various ITS functional areas.

A summary total of the ITS capabilities survey responses received from agencies within the NOACA region is presented in Table 4. Some agencies span multiple counties in the NOACA region and are counted as a regional agency in the far right of the table.

Table 4. Summary of ITS Capabilities Survey Responses

Total Survey Responses	Cuyahoga County	Geauga County	Lorain County	Medina County	Lake County	Regional Agencies
26	11	1	4	2	6	2

Table 5 on the following pages presents a traceability of the key regional needs presented earlier against the existing and planned ITS capabilities gathered through survey responses and from stakeholder workshops. The purpose of the table is to identify gaps as well as opportunities that may exist for future ITS technology deployment within the region.

Table 5. Existing ITS Capabilities, Gaps and Opportunities to Address High Priority Needs

Need Areas	High Priority Needs	Existing Capabilities	Gaps in Deployment	Planned Enhancements	Opportunities
Information Management	Need to enhance communications and information sharing among transportation agencies at all levels of government	<ul style="list-style-type: none"> • Some key agencies send and receive traffic or transit incident data (OSHP, ODOT, Turnpike, and County EOCs). • Counties can gain ODOT CCTV camera access or request a dedicated connection. • ODOT shares volume, class, speed information from over 200 continuous monitoring stations on a 24-hour delay via transportation data management system. 	<ol style="list-style-type: none"> 1. Lack of regional clearinghouse to monitor and display traffic information off the freeway system. 2. Local agencies desire to feed incident information on their local roads to ODOT. 	<ol style="list-style-type: none"> 1. No planned enhancements for local agency information sharing with ODOT. 	<ol style="list-style-type: none"> 1. A regional data exchange system could have value for sharing incident, volume, speed, weather and other travel-related information across agencies, systems, and facilities. 2. Ohio or Smart Columbus Data Exchange system could serve as a future model. 3. It would be desirable to share local agencies' traffic surveillance cameras with ODOT where they exist.
Traffic Management	Need to improve traffic congestion mitigation	<ul style="list-style-type: none"> • ODOT uses roadway detectors (various technologies) and third-party probe data for measuring travel times. • ODOT TOAST tool identifies operational problems where improvements may be needed. • Some local agencies operate variable lane use signage that varies by time of day. 	<ol style="list-style-type: none"> 1. There is a need to deploy more CCTV cameras with improved quality and functionality to provide greater road condition monitoring coverage for freeways and arterials. 2. The region could be benefited from additional ITS systems to support active traffic control and management. ODOT and Turnpike have some of this functionality on freeways. 	<ol style="list-style-type: none"> 1. TSMO (Transportation Systems Management and Operations) Coordinators in ODOT Districts plan to focus on traffic congestion mitigation efforts, which could include the following: <ul style="list-style-type: none"> • Lane control devices • Ramp metering • Speed harmonization strategies • Hard shoulder running • Queue warning systems. 	<ol style="list-style-type: none"> 1. Active traffic management (ATM) strategies identified in recent ODOT ATM study could offer ideas for congestion mitigation. 2. A regional TMC could help mitigate traffic congestion through coordination in traffic management and information sharing, especially on arterial network. 3. Traffic signal operating agencies could implement Automated Traffic Signal Performance Measures (ATSPMs) to proactively monitor and improve signal operations. 4. Centrally controlled signal systems could feed real-time traffic volumes and speeds to ODOT and NOACA for planning and operational purposes.

Need Areas	High Priority Needs	Existing Capabilities	Gaps in Deployment	Planned Enhancements	Opportunities
	<p>Need to provide early warning of poor visibility conditions (snow squalls, sun, fog, heavy rains, etc.)</p>	<ul style="list-style-type: none"> • Social media and internet is used by many agencies for weather condition reporting. • ODOT and Turnpike use DMS. • ODOT uses RWIS for road weather condition monitoring and data collection. • ODOT has a variable speed limit (VSL) system on I-90 with decision support system for implementing speed limit changes under control by TMC operators and supervisors. 	<ol style="list-style-type: none"> 1. There is a need to deploy more CCTV cameras with improved functionality to provide greater road condition monitoring coverage. 	<ol style="list-style-type: none"> 1. TSMO Coordinators in ODOT Districts plan to support how agencies can respond to weather-related events. 2. ODOT plans to expand the VSL system on I-90. This includes introducing and integrating connected vehicle technology with the VSL system. 3. Extract weather data from maintenance vehicles (use vehicles as probes). 	<ol style="list-style-type: none"> 1. Connected vehicle technology for the I-90 VSL system could collect weather and road condition information to supplement the data collected through RWIS stations. The data could be shared with other agencies and the public and can be used to trigger alerts. 2. Collected weather and road condition data could be used to automatically adjust variable speed limits. Data could also be monitored by a regional TMC that could adjust variable speed limits and post DMS messages when needed. 3. Additional CCTV cameras could be installed strategically to provide greater monitoring coverage. 4. Additional RWIS stations could be installed at strategic locations. 5. The VSL system could be expanded to other roadways experiencing weather-related operational problems.
	<p>Need to improve traffic signal interconnect and coordination to improve mobility</p>	<ul style="list-style-type: none"> • Cities and ODOT have traffic signal interconnects to support coordinated signal timing operations along arterial roadways in their own jurisdictions. • Some areas have adaptive signal systems and central control with remote accessibility. • Some agencies operate signal systems using basic time synchronization • NOACA STOP program improves signal timings for priority corridors • ODOT has general services contract for updating signal timings. 	<ol style="list-style-type: none"> 1. There is limited interconnectivity across jurisdictions in the region. 2. Lack of reliable and centralized control of regionally significant coordinated traffic signal systems. 3. Poor maintenance of detection on coordinated signal systems. 	<ol style="list-style-type: none"> 1. Lake County / Ohio Rail Development Commission (ORDC) has plans to interconnect signals with railroad crossings. 2. TSMO Coordinators in ODOT Districts plan to support local agencies with improving traffic signal coordination across jurisdictions. 	<ol style="list-style-type: none"> 1. Local agencies could work with ODOT and NOACA to obtain funding and technical resources for improving traffic signal operations and coordination. 2. Local agencies, ODOT, and NOACA could coordinate with neighboring jurisdictions to plan, design and implement coordinate traffic signal timing plans across jurisdictions. 3. ATSPMs could be implemented to proactively identify and correct deficiencies and improve traffic signal operations.
	<p>Need to provide expanded traffic signal preemption for emergency vehicles</p>	<ul style="list-style-type: none"> • EVP technology is widely used by fire departments in many areas. • Some police departments and ambulances also use EVP. 	<ol style="list-style-type: none"> 1. EVP capability for additional police departments, ambulances and other emergency responders is needed. 2. Deployments of EVP are not standardized in the region which impacts interoperability among systems/agencies. 3. Lack of newer EVP systems that utilize radios for vehicle-to-intersection communications and GPS for vehicle location, which can be more efficient for emergency service providers and less disruptive to traffic. 	<ol style="list-style-type: none"> 1. NOACA recently updated the regional EVP policy to allow other technologies to be deployed, but this will require dual systems to enable backwards compatibility with older generations of technology in other jurisdictions. 	<ol style="list-style-type: none"> 1. Newer EVP technology could be more efficient for emergency responders and less disruptive to traffic. 2. Coordination with transit agencies on technology and deployment decisions for EVP and transit signal priority (TSP) could help reduce the amount of roadside infrastructure required to support system operations.

Need Areas	High Priority Needs	Existing Capabilities	Gaps in Deployment	Planned Enhancements	Opportunities
	Need to know incidents on major routes	<ul style="list-style-type: none"> • ODOT uses CCTV for monitoring incidents. • Some local jurisdictions use traffic surveillance cameras for incident monitoring. • Some agencies are able to access ODOT TMC live camera feeds. 	<ol style="list-style-type: none"> 1. Local agencies have limited capabilities to detect or monitor roadway incidents. There is a need for additional CCTV cameras on arterials. 2. Local agencies desire to feed incident information on their local roads to ODOT. 3. No plans for automated incident detection systems in the region. 	<ol style="list-style-type: none"> 1. ODOT plans to deploy additional CCTV cameras and expand ITS coverage in Geauga County. 	<ol style="list-style-type: none"> 1. Additional CCTV coverage at high incident locations (both freeways and major arterials) could help with incident identification and verification as well as traffic condition monitoring. 2. A regional TMC could improve incident identification and sharing of information among agencies and to the public. 3. A regional TMC could coordinate incident responses and improve response times.
Public Transportation	Need to improve on-time performance of transit services	<ul style="list-style-type: none"> • GCRTA and Laketrans use GPS/AVL technology on their vehicles to track vehicle locations and schedule adherence. • GCRTA uses TSP technology to help minimize delay and improve on-time performance. 	<ol style="list-style-type: none"> 1. Other transit agencies don't have GPS/AVL systems to monitor transit vehicle locations and perform on-time performance analysis. 2. Other transit agencies in region have not deployed TSP equipment. 3. Transit agencies have expressed desire to receive more updated information on construction / lane closures that impact bus service. 	<ol style="list-style-type: none"> 1. Lorain County Transit has plans to implement an AVL system on its fleet. 	<ol style="list-style-type: none"> 1. TSP technology could be expanded to routes where improvements in on-time performance are needed. 2. Other transit agencies could deployment GPS/AVL technology to help track their vehicles in real time and use the data for performance analysis and service planning.
	Need to improve efficiency of demand-responsive transit operations	<ul style="list-style-type: none"> • GCRTA, Laketrans, Lorain County and Medina County provide demand-responsive transit services. • GCRTA and Laketrans have GPS/AVL on their vehicles. 	<ol style="list-style-type: none"> 1. Other transit agencies providing para-transit service in region have noted lack of funding to invest in transit technology for improving service efficiency. 	<ol style="list-style-type: none"> 1. Medina County Transit plans to install a GPS/AVL system for use with demand-response service. 2. Media County Transit plans to upgrade vehicle-based radios. 	<ol style="list-style-type: none"> 1. The region could procure a common GPS/AVL system and scheduling / dispatch software shared by transit providers for fixed-route and/or paratransit services to maximize cost efficiency and improve service coordination and system interoperability.
	Need to improve transit connections for travelers	<ul style="list-style-type: none"> • GCRTA connects with Laketrans and other transit agencies at transfer points. • GCRTA and Laketrans use GPS/AVL to track transit vehicle locations and provide real-time vehicle location and arrival time information via websites and transit apps to the public. 	<ol style="list-style-type: none"> 1. County and local transit agencies do not collect or share vehicle location in real-time. 	<ol style="list-style-type: none"> 1. No planned enhancements were noted by stakeholders. 	<ol style="list-style-type: none"> 1. Transit agencies could improve service and schedule coordination to provide convenient connections for travelers. 2. Transit agencies could deployment GPS/AVL technology to help provide vehicle locations and arrival times to travelers and connecting transit services.

Need Areas	High Priority Needs	Existing Capabilities	Gaps in Deployment	Planned Enhancements	Opportunities
	Need to improve event, incident, and/or construction coordination with transit providers	<ul style="list-style-type: none"> • ODOT, Turnpike, county and city transportation agencies share planned work zone and incident information with county and local transit agencies. 	<ol style="list-style-type: none"> 1. Transit agencies have expressed desire to receive real-time information on construction / lane closures that impact bus service. 	<ol style="list-style-type: none"> 1. ODOT is developing mobile application for contractors to input closed lanes during construction, which would be seen by the public through OHGO traveler information site. This could serve as a model for sharing information with transit agencies. 	<ol style="list-style-type: none"> 1. The mobile application ODOT is developing could serve as a model for cities and counties to share the information with transit agencies and the public. 2. A regional data exchange system could have value for sharing incident information across agencies, systems, and facilities. Ohio or Smart Columbus Data Exchange system could serve as a future model.
Traveler Information	Need to provide travel times / delays on freeways / turnpike to the public	<ul style="list-style-type: none"> • ODOT uses roadway detectors (various technologies) for measuring travel times and provides information to the public through OHGO traveler information site and mobile app. • ODOT also uses third party data to supplement roadway detector data for congestion and travel times. • Turnpike also use social media for disseminating traveler information. • Turnpike is currently testing connected vehicle technology and installing DSRC units along the Turnpike and on Turnpike public service and maintenance vehicles to collect speed/travel time and road conditions information. 	<ol style="list-style-type: none"> 1. Need to increase public awareness on where to access the information. 2. Displaying travel time and delay information via DMS may not be understood by motorists not familiar with the roadway network in the region. 	<ol style="list-style-type: none"> 1. Turnpike plans to expand the connected vehicle technology deployment on a larger scale. 2. Turnpike also plans to use connected vehicle technology to support a truck platooning project along the Turnpike. 	<ol style="list-style-type: none"> 1. ODOT and Turnpike could leverage research and studies done nationally to implement effective methods for providing travel times and delays to travelers. 2. DSRC and connected vehicle technology being piloted in other parts of Ohio and other states presents opportunities on how vehicles can be used for travel time/delay estimation and dissemination.

Need Areas	High Priority Needs	Existing Capabilities	Gaps in Deployment	Planned Enhancements	Opportunities
	Need to provide incident information for freeways / turnpike to the public	<ul style="list-style-type: none"> • ODOT uses CCTV for monitoring incidents. • Turnpike inputs incident information from Waze into a web-based Turnpike map and the OHGO traveler information site. 	<ol style="list-style-type: none"> 1. There is a need to have more fixed message boards as it is challenging to get portable message boards to appropriate places timely during incident events due to congestion. 2. There is a need to improve incident detection capabilities. 3. Travelers from out of state may not be familiar with the OHGO traveler information website as a means to get information. 	<ol style="list-style-type: none"> 1. ODOT plans to expand more ITS coverage into Geauga County. 	<ol style="list-style-type: none"> 1. Potential for advertising OHGO to out-of-state travelers and neighboring states may increase awareness of OHGO as a resource for traveler information. 2. ODOT and Turnpike could test and deploy systems for traffic incident detection. 3. ODOT and Turnpike could investigate opportunities of using third party / crowdsourced data for incident detection. 4. Connected vehicle technology could be used for incident identification and collection of traffic conditions (congestion, delays, etc.). Drivers could receive real-time incident information in vehicles via the technology. 5. Potential to standardize incident / work zone reporting on one platform, either public or private (OHGO, INRIX, WAZE, Google, others).
	Need to provide road closure / lane restriction information for freeways / turnpike to the public	<ul style="list-style-type: none"> • ODOT and Turnpike provide road/lane restriction information to the public using DMS, OHGO traveler information page, media outlets and other private information service providers. • Turnpike incorporates construction / closure information from Waze. 	<ol style="list-style-type: none"> 1. Difficulties in providing accurate and timely information on short-term lane restriction/road closures due to incidents or for temporary, moving work zones. 	<ol style="list-style-type: none"> 1. ODOT is developing mobile application for contractors to input closed lanes during construction, which would be seen by the public through OHGO traveler information site. 	<ol style="list-style-type: none"> 1. A regional TMC could improve timely dissemination of road closure / lane restriction information via DMS, social media, and media outlets. 2. Potential to standardize incident / work zone reporting on one platform, either public or private (OHGO, INRIX, WAZE, Google, others).
	Need to provide road closure / lane restriction information for arterial roadways to the public	<ul style="list-style-type: none"> • Portable message signs are used for providing road closure / lane restriction information to travelers on arterials on limited basis. • OHGO traveler information page provides road closure / lane restriction information for major arterials. • Travelers utilize Waze to report traffic incidents and view other incidents posted by the public. 	<ol style="list-style-type: none"> 1. Local agencies have expressed desire for sending incident information to ODOT regarding closures / incidents on arterial roads to minimize congestion during incidents. 2. Difficulties in providing accurate and timely information on short-term lane restriction/road closures due to incidents or for temporary, moving work zones. 	<ol style="list-style-type: none"> 1. First responders in Cuyahoga County are looking into having officers tag incidents, which would be provided to Waze and seen by travelers that subscribe to Waze. 	<ol style="list-style-type: none"> 1. Partnerships with third party providers (such as Waze) could improve collection of data as well as dissemination of information to travelers. 2. A regional TMC could improve timely dissemination of road closure / lane restriction information via DMS, social media, and media outlines. 3. Potential to standardize incident / work zone reporting on one platform, either public or private (OHGO, INRIX, WAZE, Google, others).
Commercial Vehicle Operations and Freight Management	Need to improve hazardous cargo tracking and routing	<ul style="list-style-type: none"> • Freight operators monitor their hazardous cargo materials on roadways. 	<ol style="list-style-type: none"> 1. Local agencies have expressed the desire to understand what type of hazardous materials are being transported on roadway to improve emergency preparedness. 	<ol style="list-style-type: none"> 1. No planned enhancements noted from agencies to address this need. 	<ol style="list-style-type: none"> 1. Hazardous material tracking and reporting used by railroads could serve as model for improvement in tracking and monitoring hazardous materials on roads.

Need Areas	High Priority Needs	Existing Capabilities	Gaps in Deployment	Planned Enhancements	Opportunities
	Need to improve intermodal freight management	<ul style="list-style-type: none"> Ports and airports are major intermodal facilities in the region. Those facilities are connected with major Interstates to provide access. ITS capabilities include monitoring of access to interstates, as well as tracking of cargo shipments and containers. 	<ol style="list-style-type: none"> There is a need to improve and expand access to port facilities. ITS could be part of the overall improvement or expansion to include technology/systems to provide route guidance, travel time/delay information, parking availability, cargo tracking and monitoring, etc. 	<ol style="list-style-type: none"> Cuyahoga Port Authority plans to improve communication with vessels to eliminate the need for tug support for incoming vessels. Hopkins International Airport is developing a master plan to improve airport operations. The master plan will include adding freight capacity as well as improving multimodal interaction that may affect roadway and transit access. 	<ol style="list-style-type: none"> ITS technology could play a role in managing traffic in and around intermodal facilities. This could include: monitoring and managing traffic and freight movements, providing traffic condition and parking information, providing route guidance, tracking of cargo contents, etc.
	Need to provide real-time truck parking availability	<ul style="list-style-type: none"> No existing systems to automatically measure truck parking space availability in the region. Turnpike staff observes truck parking spaces at service plazas. Truckers use mobile apps to report and receive truck parking availability on Turnpike. 	<ol style="list-style-type: none"> Lack of accurate and timely truck parking space availability information for truck operators needing to rest for an extended period. 	<ol style="list-style-type: none"> No planned enhancements noted from agencies to address need. Turnpike has planned for a service plaza truck parking management system. 	<ol style="list-style-type: none"> ODOT participating in MAASTO initiative for deploying a truck parking availability system on I-70 and I-75. There may be opportunities to expand the system to the NOACA region. Connected vehicle technology could be used to track parking availability.
Roadway Maintenance	Need to improve temporary maintenance work zone safety for travelers and maintenance staff	<ul style="list-style-type: none"> Variable Speed Limit signs with flashing beacons have been utilized in work zones on freeways. 	<ol style="list-style-type: none"> Agencies have desired flashing lights to identify an “active work zone” with workers present. Other technologies to improve safety in larger work zones have not been implemented. 	<ol style="list-style-type: none"> City of Euclid plans to deploy work zone intrusion detection system. Lorain and Medina Counties plan to utilize queue notification systems for larger work zones. 	<ol style="list-style-type: none"> Potential to expand use of work zone intrusion detection systems based City of Euclid experience. Potential to expand use of queue notification systems based on Lorain / Medina County experience. Connected vehicle technology could improve work zone safety by providing advanced warning, delay and detour information, etc. directly to drivers.
	Need advanced and up-to- date road closure and temporary maintenance work zone information	<ul style="list-style-type: none"> OHGO traveler information page provides information on current and future work zones along roadways. Turnpike incorporates construction / closure information from Waze. 	<ol style="list-style-type: none"> Lack of real-time reporting for changes to work zones along roadways. Lack of accurate information on the durations/expected durations of work zones, particularly on arterials. 	<ol style="list-style-type: none"> ODOT is developing mobile application for contractors to input closed lanes during construction, which would be seen by the public through OHGO traveler information site. 	<ol style="list-style-type: none"> Mobile application could serve as a model for county and city agencies to use with contractors within their jurisdictions. Connected vehicle technology could collect as well as disseminate road closure and work zone information in real time.

Need Areas	High Priority Needs	Existing Capabilities	Gaps in Deployment	Planned Enhancements	Opportunities
	Need to collect roadway surface conditions data, such as icing, from vehicle sensors	<ul style="list-style-type: none"> • ODOT uses road weather information system (RWIS) stations to collect roadway surface data. • Lake County, Geauga County, Lakewood and Westlake have roadway sensors to detect environmental hazards (such as icy road, dense fog, etc.). • ODOT, Turnpike, counties and local agencies receive weather information from National Weather Service. 	<ol style="list-style-type: none"> 1. ODOT / regional agencies have noted desire to collect roadway surface data from vehicles to improve coverage. 2. Additional RWIS stations could expand road surface condition data collection coverage. 	<ol style="list-style-type: none"> 1. Turnpike is installing connected vehicle technology on 33 service vehicles that will collect road surface and weather data, along with other data such as vehicle speed and location. 	<ol style="list-style-type: none"> 1. Surface data collection sensors installed on snow plows could be integrated with GPS/AVL systems to provide location-specific road surface condition data. 2. Collection of roadway surface data along with GPS/AVL data from snow plows could be used for a Maintenance and Decision Support System (MDSS) to improve winter roadway maintenance. 3. Turnpike’s connected vehicle project could serve as a model for others to deploy vehicle-based data collection technology.
Incident and Emergency Management	Need to identify alternate routes for the traveling public during major incidents on freeways	<ul style="list-style-type: none"> • ODOT and Turnpike have playbooks with pre-identified alternate routes. • Limited to use of DMS messaging (i.e. “Use Alternate Routes”) and the OHGO traveler information site. • Travelers frequently use third party navigation apps to obtain routing guidance. 	<ol style="list-style-type: none"> 1. Alternate routes defined in ODOT playbook may be outdated. 2. Need to pre-identify alternate routes across the region. 3. Lack of good alternative routes in Lake and Geauga counties. 4. Need to work with third party providers to incorporate official detour information into their navigation apps. 	<ol style="list-style-type: none"> 1. TSMO Coordinators in ODOT Districts plan to support agencies in planning for incident management and coordination. 	<ol style="list-style-type: none"> 1. Regional and/or corridor-specific alternate route planning to pre-identify alternate routes and update the playbooks would be desired. 2. Colored route signage, similar to that was implemented in PA, could be considered for improve routing of traffic during incident diversion. 3. A regional TMC could improve alternate route activation, traffic management, and information dissemination.
	Need to improve alternate route traffic management, including the communication of detour information	<ul style="list-style-type: none"> • ODOT and Turnpike have playbooks with pre-identified alternate routes. • DMS messaging and the OHGO traveler information site are the primary means for providing alternate route notification and information. 	<ol style="list-style-type: none"> 1. Alternate routes defined in ODOT playbook may be outdated. Major incidents can lead to traffic congestion on arterials, which can lead to secondary incidents. 2. Need to pre-identify alternate routes across the region. 3. Ways to communicate incident and detour information to the public are limited. There is a need to explore methods in addition to using portable message boards. 4. Lack of good alternative routes in Lake and Geauga counties. 	<ol style="list-style-type: none"> 1. TSMO Coordinators in ODOT Districts plan to support agencies in planning for incident management and coordination. 	<ol style="list-style-type: none"> 1. Regional and/or corridor-specific alternate route planning to pre-identify alternate routes and update the playbooks would be desired. 2. Colored route signage, similar to that was implemented in PA, could be considered for improve routing of traffic during incident diversion. 3. A regional TMC could improve alternate route activation, traffic management, and information dissemination.
	Need improved incident detection on major routes	<ul style="list-style-type: none"> • Agencies rely on 911 calls for incident reporting. • ODOT uses CCTV for detecting and monitoring incidents. • Turnpike also uses incident information from Waze and inputs the data into a web-based Turnpike map and the OHGO traveler information site. 	<ol style="list-style-type: none"> 1. Lack of CCTV camera coverage on arterials. 2. Lack of CCTV camera coverage in Geauga County, the eastern part of Cuyahoga County and other rural areas. 3. Lack of enhanced or automated incident detection capability. 	<ol style="list-style-type: none"> 1. ODOT is expanding ITS coverage in Geauga County, including 3 to 5 CCTV cameras. 2. No plans for automated incident detection systems in the region. 	<ol style="list-style-type: none"> 1. Strategically expanding CCTV camera coverage in the region could improve incident detection and monitoring capability. 2. A regional TMC could improve incident detection and monitoring on major routes in the region.

Need Areas	High Priority Needs	Existing Capabilities	Gaps in Deployment	Planned Enhancements	Opportunities
	Need improved incident management and coordination	<ul style="list-style-type: none"> • Many public safety agencies have GPS/AVL systems on their vehicles. • Local emergency responders coordinate with ODOT and other local traffic agencies in incident responses. • Fire Departments in Cuyahoga County work closely and coordinate on sharing radio frequency and other communications tools. 	<ol style="list-style-type: none"> 1. Lack of common communications channels hinder coordinated response to incidents, particularly in Lake and Geauga Counties. 2. Need to improve agencies' ability to communicate incident and road closure information to other agencies and the public. 	<ol style="list-style-type: none"> 1. TSMO Coordinators in ODOT Districts plan to support agencies in planning for incident management and coordination. 	<ol style="list-style-type: none"> 1. Establishing common communications channels among emergency responders could improve incident response coordination and management. 2. A regional TMC could improve incident management and coordination in the region.
	Need to improve emergency notification / dispatch and response times	<ul style="list-style-type: none"> • Many public safety agencies have GPS/AVL systems and mobile computers on their vehicles. • Many 911 centers have computer-aided dispatch systems. • Emergency vehicle preemption technology is widely deployed on traffic signals in the region. 	<ol style="list-style-type: none"> 1. Lack of common communications channels hinder coordinated response to incidents, particularly in Lake and Geauga Counties. 2. Emergency responders lack of real-time traffic data to identify alternate/quickest routes for emergency vehicles and to incident scenes. 3. EVP equipment is not interoperable among neighboring jurisdictions. 	<ol style="list-style-type: none"> 1. NOACA recently updated the regional EVP policy to allow other technologies to be deployed, but this will require dual systems to enable backwards compatibility with older generations of technology in other jurisdictions 2. The region plans to implement alternative EVP systems on an as-requested basis. 	<ol style="list-style-type: none"> 1. Feeding or integrating real-time traffic condition information with emergency responders' CAD systems could improve routing of emergency vehicles and reduce incident response time. 2. Traffic agencies could use third party data (from Waze, INRIX, HERE, etc.) in real time to supplement gaps in public agencies' data. 3. Traffic agencies could manage travel speeds near incident scenes by provide advance warnings to drivers. This could improve safety for emergency responders. 4. It would be valuable for local agencies to provide incident and closure information to ODOT. 5. Centralized dispatch by County may improve response times by minimizing confusion in coordinating responses among agencies.
Transportation Security	Need for security and safety monitoring in public spaces (for public safety / crime deterrent)	<ul style="list-style-type: none"> • ODOT, counties and cities use various types of surveillance equipment for security and safety monitoring. • Cuyahoga County Sheriff's Department uses license plate readers in the field and on vehicles, monitors mobile surveillance cameras during special events, and maintains the Criminal Justice Information Sharing Data Warehouse 	<ol style="list-style-type: none"> 1. There is a need to deploy more security and safety monitoring technology along public roads, on major infrastructure (such as bridges), at rest areas, transit stops, and in downtown areas and other public spaces. 	<ol style="list-style-type: none"> 1. Agencies in the region continue to deploy, enhance, and/or expand security and safety monitoring capability independently. No specific planned enhancements were noted in workshops or survey responses. 	<ol style="list-style-type: none"> 1. Unmanned Aerial Surveillance (UAS) could be used for security and safety monitoring. UAS has been used for traffic monitoring, incident scene management and investigation, among other purposes. 2. Could consider security system similar to "Capital Shield" where private camera operators opt-in to allow law enforcement access to video feeds.
	Need to improve evacuation plan implementation using technology	<ul style="list-style-type: none"> • ODOT, counties and cities currently use different types of technology to support evacuation plans. • Cuyahoga County uses a web-based system called Knowledge Center for incident management. 	<ol style="list-style-type: none"> 1. Need for multi-agency communications and interoperability to support evacuation and major traffic disruption. 	<ol style="list-style-type: none"> 1. No planned enhancements were noted in workshops or survey responses. 	<ol style="list-style-type: none"> 1. A virtual EOC could be an effective solution. 2. A virtual EOC could be tied with the NE Ohio Regional Fusion Center to support region-wide response.