Concept of Operations

Collection and Uses of Travel Time Data

Principle Arterials and River Crossings

Northwest Region

Albuquerque Metropolitan Planning Area

Prepared by

Intelligent Transportation System Subcommittee

for

Mid-Region Council of Governments

Metropolitan Transportation Board

February 13, 2013

MR COG ITS

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Executive Summary

This Concept-of-Operations arose out of Albuquerque Metropolitan Planning Area stakeholder's need to determine the travel times along arterial roadways. Those needs vary from monitoring the performance of the signal operations to informing the public of origin and destination alternatives during their daily commutes. Though various options in determining arterial travel times exist, some stakeholders have initiated deployments that rely on bluetooth technology. Those deployments are in the early evaluation phase. To that end, the existing deployments were taken into account when looking at how the varied needs of the different stakeholders could be satisfied.

The deployments currently in place are from two separate manufacturers, Post Oak® and Blue Toad®. One of the stakeholders, the City of Albuquerque, internally host and maintain the server and application (from Post Oak®) on its private network. Bernalillo County utilizes a web-based subscription service hosted by Post Oak®. The NMDOT Signal Maintenance Lab utilizes a similar service from Blue Toad®.

When developing this Concept-of-Operations, some issues became apparent with the current configuration. Those issues are caused by the different networks, or more accurately the different server environments where each stakeholder's application resides. It creates data gaps along specific corridors and acts as an impediment in being able to consider the separate corridors as a common network.

Other than identifying those issues, the best approach on how to remedy them was not considered in this Concept-of-Operations. That is better addressed in the Systems Engineering Evaluation, which will also analyze the different alternatives, take into account the system costs for each, and the ensuing demand associated with systems maintenance and operations. The Systems Engineering evaluation will use this Concept-of-Operations as the platform in moving forward in determining the preferred option for either the region collectively or for stakeholders individually.

This Concept of Operations (Con Ops) was prepared to be consistent with the FHWA Concept of Operations Template (http://www.fhwa.dot.gov/cadiv/segb/views/document/sections/Section8/8_4_5.htm). To assist in correlating this document to the template, the heading of each section contains the relevant portions of the guidelines (*in italics).* A copy of the template in its entirety is included in the Glossary to this Document.

Purpose of the Concept of Operations

Collecting travel times on arterials is needed by transportation stakeholders in the Albuquerque Metro area so they can provide this information to the public and use it to determine the efficiency of system operations. This document's intent is to describe how such a system will be used by the various stakeholders and to provide a bridge between stakeholder needs and specific technical requirements. This document will be integral to the Systems Engineering Evaluation that will consider the various platforms available to determine arterial travel times and the impacts of each alternative to each stakeholder agency operations. More information about the Systems Engineering process can be obtained at http://www.fhwa.dot.gov/cadiv/segb/.

Scope of the Project

This short section gives a brief overview of the system to be built. It includes its purpose and a high-level description. It describes what area will be covered and which agencies will be involved, either directly or through interfaces. One or two paragraphs will suffice.

This project is for the deployment of a system that will determine travel times on arterial roadways, with an initial interest on river crossing corridors in the northwest area of the Albuquerque Metropolitan Planning Area (AMPA). Specific corridors include:

- Alameda Blvd (NM 528) from Coors Blvd (NM 45) to I-25 – River crossing
- Paseo del Norte Blvd (NM 423) from Coors Blvd (NM 45) to I-25 – River crossing
- Montaño Blvd from Coors Blvd (NM 45) to I-25 – River crossing
- Coors Blvd (NM 45) from NM 528 to I-40
- NM 528 (Pat D'Arco Highway) from US 550 to NM 45 (Coors)/Coors Bypass
- US 550 from NM 528 (Pat D'Arco Highway) to I-25 – River crossing

Figure 1 shows this area and respective arterials.

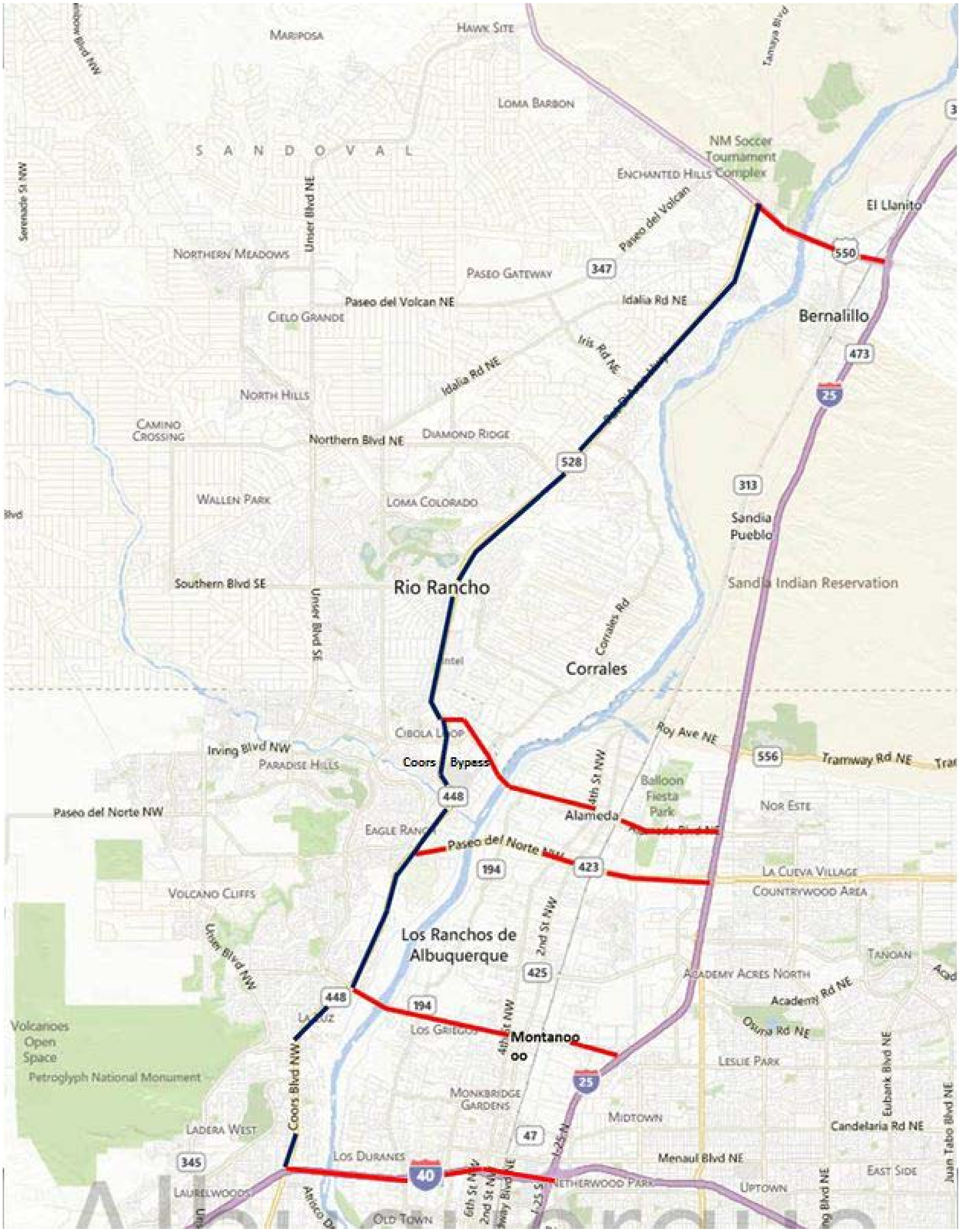


Figure 1- Arterials in the AMPA Northwest Region

Some of the corridors are multi-jurisdictional. Collectively AMPA stakeholders associated with these corridors include:

- City of Albuquerque (COA)
- Bernalillo County (BernCo)
- Sandoval County (SandCo)
- Town of Bernalillo
- City of Rio Rancho (CoRR)
- New Mexico Department of Transportation (NMDOT)
  - District 3
  - Intelligent Transportation Systems (ITS) Operations
  - Signal Maintenance Lab
- Mid-Region Council of Government (MRCOG)
- Federal Highway Administration (FHWA)

Non-agency stakeholders include:

- RealTime Solutions (RTS) – webhost and applications support to the NMDOT – ITS Bureau and applications support to COA
- Lee Engineering – On-call Engineering Consultant to City of Albuquerque , Bernalillo County and City of Rio Rancho
- ITS Subcommittee for the Region – Stakeholder Forum

Collecting travel times is needed for various reasons, depending upon the stakeholder.

- NMDOT ITS Operations – post travel times on Dynamic Message Sign (DMS) and include it as public information on the NMRoads website, app and 511
- NMDOT Signal Maintenance Lab - monitor arterial progression for signal system timing adjustments (US 550 only)
- Bernalillo County – evaluate system operations to monitor effectiveness of Adaptive Signal Control Technology (ASCT) Systems (relevant to installation warranty) and future participation in providing travel time information to the public (currently operating on the Alameda Corridor)
- City of Albuquerque – post travel times on DMSs and monitor arterial progression for signal system timing adjustments
- City of Rio Rancho – monitor arterial progression for signal system timing adjustments
- MRCOG – monitor system performance; collect information for reporting purposes.

Referenced Documents

This optional section is a place to list any supporting documentation used and other resources that are useful in understanding the operations of the system. This could include any documentation of current operations and any strategic plans that drive the goals of the system under development.

This Concept of Operations drew from information in the:

- The AMPA Regional ITS Architecture
- FHWA Guidance, *Concept of Operations* Template

The *Concept of Operations* Template is included in the Appendix of this document. Because of its size, the AMPA Regional ITS Architecture is not included in this document. However it can be accessed at various locations including both the MRCOG website http://www.mrcog-nm.gov/transportation-mainmenu-67/meetings-mtb-mainmenu-190/subcommittee-its-mainmenu-256 and the NMDOT ITS website www.itsnmdot.org. Figures depicting the relevant market packages in the architecture (now called service packages) are included in the Appendix.

In addition to the fore-mentioned, determining the travel times along the arterials being addressed in this Con-Ops has been identified as an integral strategy in the AMPA's Congestion Management Process (CMP). This process, and the documentation associated to the CMP, has placed these corridors (river crossings in the northwest quadrant of the AMPA) as priorities for congestion mitigation. Relevant documentation can be found at http://www.mrcog-nm.gov/transportation-mainmenu-67/metro-planning-mainmenu-188/congestion-management-process-mainmenu-262.

Background

This section provides a brief description of the current system or situation, how it is used currently, and its drawbacks and limitations. This leads into the reasons for the proposed development and the general approach to improving the system. This is followed by a discussion of the nature of the planned changes and a justification for them.

Commutes from and to the northwest portion of the AMPA area have grown more congested with the continued growth of that area. This has been compounded by the impact of limited river crossings (all east-west movements) available to handle the commute. Only two of the five crossings that serve the commute are access controlled (Paseo del Norte and I-40). The remaining three (Alameda, Montaño and US 550) are signalized. The two north-south corridors (Coors and NM 528 in Rio Rancho) that connect to the various river crossings are both signalized.

Recognizing the critical need for signal optimization, signal timing plans (a.m., average, p.m.) have been developed and implemented by COA and Lee Engineering for all river crossings in the northwest region of the AMPA (with the exception of US 550). These corridors are operating at, and sometimes beyond, capacity during peak commuting periods. This situation will only grow worse over time. These corridors will need to operate as efficient as possible since widening some of these corridors may be cost prohibitive, which in turn means the signals along the corridors will need to perform as best they can to accommodate progression and turning movements. Also apparent is the advantage afforded to commuters in knowing the best option available to them while making their commute. Integral to accommodating both of these initiatives is data, namely data that can accurately inform motorists what the travel times are along each of these arterial corridors and also act as an indicator of sublevel service on a corridor.

When an incident occurs on any of the corridors, it usually results in one or more lane closures. That impact is far reaching. Service is degraded not only on the corridor itself, it is also compromised on the other corridors in the area. Identifying alternatives to the impacted corridor does provide value, however the conditions of those alternatives need to be known and they need to operate in such a way to best accommodate the influx of additional traffic. Those corridors that are multi-jurisdictional (city and/or county and/or state), or more to the point, corridors that have segments that are on separate systems, severely limit the ability to operate them as a whole. To deal with the impacts of both recurring and non-recurring congestion, not only should each segment of a corridor be operated seamlessly along a route, the system of corridors should be managed as a unified network. The same holds true for the approach(s) being investigated for data acquisition, distribution and management for this network of corridors.

Concept for the Proposed System

This section describes the concept exploration. It starts with a list and description of the alternative concepts examined. The evaluation and assessment of each alternative follows. This leads into the justification for the selected approach. The operational concept for that selected approach is described here. This is not a design, but a high-level, conceptual, operational description. It uses only as much detail as needed to be able to develop meaningful scenarios. In particular, if alternative approaches differ in terms of which agency does what, that will need to be resolved and described. An example would be the question of whether or not a regional signal system will have centralized control.

There are various options for obtaining travel times. It can include continually operating probe vehicles on the corridor(s) of interest; deploying sensors that collect information, which in turn can be used to determine travel times along the corridor(s) of interest; or obtaining third party data on the operating conditions along the corridor(s) of interest.

There are also different approaches to the various options. For example, a unified approach in which all stakeholders agree to a specific option collectively, or an individual approach where each stakeholder selects their option without consideration of others, or even a variation somewhat between both (using same approach on one corridor but a different approach on another).

Option 1 - Probe Vehicles

Use of probe vehicles would only be feasible on facilities such as interstates or highways and even then its practicality for real time gathering of travel data during peak periods would be questionable. Its use on multiple arterials is even more problematic and realistically impossible for numerous reasons.

- It would require numerous vehicles at various locations along a single corridor at the same time.
- It would require concurrent coverage on the different corridors at the same time.
- Translating driving conditions (travel times) to the public in real time would be cumbersome, delayed, and could very well require multiple interfaces across various platforms.

Though discussed, because of the fore-mentioned limitations, it won't be investigated further as a potential concept for collecting operational travel times on arterials.

Option 2 - Deploying Sensors that Collect Travel Time Information and Having the Stakeholders Manage the Data

There are various sensor technologies that can support collecting travel times along arterials. They include, but are not limited to assorted vendors of bluetooth technologies, Global Positioning System (GPS) technologies, combined bluetooth and GPS technologies, magnetic technologies, Radio Frequency Identification (RFID) technologies and video technologies. In this Concept of Operations, the only consideration made with regard to the different types of technologies is that the selected technology must be able to work within the existing environment and operational platforms.

There are two systems currently deployed, both in an evaluation, along corridors in the area of interest. The first is from a vendor called Post Oak® (along Alameda Blvd, Paseo del Norte Blvd, Montaño Blvd, and Coors Blvd). The second is from a vendor called Blue Toad® (along US 550). Both systems use bluetooth technology and have successfully been capturing travel time data for the arterials they have been deployed. Neither has been incorporated into platforms for providing that information as messages for arterial travel times onto DMSs or onto web applications.

Each has demonstrated itself to be a viable deployment and will be evaluated as alternatives to each other, and to other sensor technologies, in the Systems Engineering (SE) process for which this Concept of Operations is being developed.

Option 3 – Deploying Sensors that Collect Information and Having a Third Party Process the Data

Fundamentally the same as Option 2, but the collected information is not processed by any of the stakeholders or equipment that exists on the stakeholder network. It requires the sensors to be connected to the internet so the Third Party can poll them, collect the captured data, process it, and then publish it into a useable form to meet the stakeholder's needs. If this requires data integration into stakeholder applications, it will invariably involve Applications Program Interface (API) development and likely extensible markup language (XML) feeds.

Option 4 - Obtaining Third Party Data

Third party data is typically obtained via a subscription service. Sources of this data are usually companies that deploy infrastructure on the subscriber's roadways then sell the information obtained from those deployments or companies that obtain information from sources independent of field equipment (i.e., cell phone service providers, GPS units in vehicles).

Third party data from deployed technologies along roadways is essentially the same concept as that for deployed technologies by the roadway owner. The only difference is the business model being considered. The advantages and disadvantages associated with this approach will be discussed further in the Systems Engineering documentation.

Third party data from independent sources is also essentially the same as data obtained from the owner operator from their own infrastructure, so long as it is capable of being ported out in a format that can be used by the different stakeholders in their respective applications and meets associated precision and accuracy requirements. Evaluating this option will also be done in the Systems Engineering (SE) documentation.

Approach 1 – Unity and Consensus

As indicated in this approach, the stakeholders agree not only on a single option, but they also agree on the platform or application that will be used for that option. Consideration for individual stakeholder requirements must be made to ensure user requirements aren't in conflict with each other. If user requirements are compatible, the advantages of a single platform approach are multifold. It allows the stakeholders to easily and seamlessly share data with each other. It allows users to share equipment resources with each other. It allows for the development of a regional pool of knowledge that could be shared for operations, maintenance and support activities. It easier accommodates future expansion. And it allows for easier integration into applications, both current and planned.

Approach 2 – Individual Stakeholder Initiatives

Historically, this approach has been used by the stakeholders on various activities that have occurred in the region over the years. Identifying what best suits the individual stakeholder needs, moving forward with the initiative and then trying to accommodate the transitions from one jurisdiction to the next as best as possible. Though it typically results in installations being deployed faster, thus being able to address a problem or issue quicker than otherwise, all the stakeholders have recognized the challenges associated with this approach in that sometimes it's successful but other times it's not when moving from one transition zone to the next. Any subsequent change to either of the stakeholder's infrastructure or deployments also lends itself to complications. This approach, though it's a 'path of least resistance', is counter to accepted standards of regionalization and consolidation.

User-Oriented Operational Description

This section focuses on how the goals and objectives are accomplished currently. Specifically, it describes strategies, tactics, policies, and constraints. This is where the stakeholders are described. It includes who users are and what the users do. Specifically, it covers when, and in what order, operations take place, personnel capabilities, organizational structures, personnel & inter-agency interactions, and types of activities. This may also include operational process models in terms of sequence and interrelationships.

Each stakeholder shares a common strategy, namely getting travel time information in real time so they can better support the services they currently provide, and have the flexibility to expand into services they currently don't. There is also a common position by all of the stakeholders on the approach – or the tactics of obtaining travel times. More to the point, the use of blue-tooth technologies is currently the common approach among stakeholders. Each stakeholder, however, has individual policies and constraints that could affect the selection of a specific platform to that common approach. Policies and constraints might vary for each, but could include (but not be limited to) personnel resources, budget, network constraints, or internal policies within each stakeholder's support operations (i.e., IT, finance and purchasing,…).

Data is already being collected along the access-controlled portions of the system that accommodate this commute. The NMDOT's ITS operations is capturing volumes, speeds and occupancies along both Paseo del Norte (from Coors Blvd to Jefferson St) and I-40 from permanently installed sensor stations (using Wavetronix® Microwave Vehicle Detection Systems). Because these installations are on segments of the corridors that don't have signalized intersections and the distance between the sensors is known, travel times are easily determined. That data is brought into Wavetronix® Data Command application that computes travel times and ports it out as an XML feed to create a message that can be displayed on Dynamic Messages Signs operated by NMDOT's ITS Bureau.

Determining the travel times on those remaining signalized corridors can prove challenging. Because signal timing can vary depending on numerous factors (time-of-day, day-of-week, congestion, pedestrian calls, ….) a different approach to what is used on access controlled corridors is needed. The fact that some of the corridors are multi-jurisdictional only adds to the complexity of determining travel times across segments.

Two different systems, both using Bluetooth Technology, have been deployed for evaluation and are currently collecting travel time data. Associated system, roadway, stakeholder, and functional use are as follows:

● Blue Toad®	US 550	NMDOT Signal Maintenance Lab	Monitor Signal Progression
● Post Oak®	Alameda (from Lorretta to 2nd St)	Bernalillo County	Monitor Adaptive Signal Performance
● Post Oak®	Alameda (from I-25 to Alameda Park)	City of Albuquerque	Monitor Signal Progression, Posting Travel Times on DMS
● Post Oak®	Paseo del Norte	City of Albuquerque	Monitor Signal Progression, Posting Travel Times on DMS
● Post Oak®	Montaño	City of Albuquerque	Monitor Signal Progression, Posting Travel Times on DMS
● Post Oak®	CoorsBlvd / NM528	City of Albuquerque	Monitor Signal Progression, Posting Travel Times on DMS
● Post Oak®	Unser	City of Albuquerque	Monitor Signal Progression, Posting Travel Times on DMS

Both the NMDOT Signal Maintenance Lab and Bernalillo County use a service to provide the travel time information (Option 3). Each accesses information from four intersections via an internet connection. The City of Albuquerque has paid for the individual sensors (14 in total) and deployed them on the same network that their signal systems reside. The sensors communicate with a central server within COA's network that hosts an application that converts the collected data into travel times. That application also supports an XML feed that can be used to develop a message for posting on the DMSs. This approach by the City (Option 2) was selected in large part to eliminate recurring costs associated with a subscription service.

The NMDOT Signal Maintenance Lab and Bernalillo County are actively using the data for their operations. RealTime Solutions is testing the data and connection to signs prior to deploying the travel times on the DMS. City is currently using the data for operations.

Currently, the ITS Bureau doesn't have access to any of the city's, county's or signal Maintenance Lab's collected data for incorporating into its operations – or more to the point posting travel times along these corridors on DOT-owned DMSs. The travel times currently being displayed by the Bureau is for segments along both interstates.

That information is collected from stationary roadside sensors and placed into a module of Data Command® called Data Collector®. Specific segments of interest for displaying travel times are built out in another module of Data Command® called Data Integrator®. That module also creates an XML feed that is pushed to the ITS Bureau's web host, Real Time Solutions. A travel time message set is created in their environment and sent to the Bureau's Skyline® Envoy application where it places the travel time message on the appropriate sign. Expanding that service to include arterial travel times for origin and destination segments would follow the same model. Whichever option or approach is used, it must include the capability of sharing the data into the existing envoy application. If it involves sharing information across separate networks, either virtual private network (VPN) access might be required across the private networks or if each stakeholder had access to the cloud, the internet could be used.

Operational Needs

Here is a description of the vision, goals & objectives, and personnel needs that drive the [requirements](#) for the system. Specifically, this describes what the system needs to do that it is not currently doing.

ITS Bureau

The ITS Bureau's focus is to provide this information to the public for origin and destination options during both recurring congestion (peak periods) and unplanned events (incidents). Those options would be displayed by the DOT on DOT-owned DMSs along the interstates and on some arterial approaches to the interstate. By virtue of being displayed on DMSs, that information would also be available on the NMRoads website, and subsequently on 511.

This information would need to be automatically imported into the current DMS operating system without requiring a message being prepared by TMC staff. In order to comply with federal requirements, the message would also need to be posted within 10-minutes from the time the actual field conditions are occurring.

Though this initiative is focusing on the northwest portion of the AMPA, the vision of the ITS Bureau is to provide this type of information for the entire region, and ultimately on a platform that can be used in other areas around the state. As mentioned, current travel time displays in the AMPA are limited to interstate segments and is determined from information collected from sensors along those corresponding segments. Those sensors determine the roadway conditions (vehicular volume, speeds and lane occupancy) at a specific location. Appropriately spacing the sensor along the roadway allows the determination of travel times for a defined segment. This model is generic in that it monitors roadway conditions and not individual vehicles.

Though effective for access-controlled roadways, this model wouldn't be effective on arterials where the presence of signals and associated timing phases can impact travel times along a segment. Taking into account the impact of signals along a corridor is needed for arterial travel time determination, and one way to determine that impact is by tracking individual vehicles along a corridor. Tracking enough vehicles creates a statistically valid population of data to determine travel times with a high degree of confidence. Because the current model doesn't discriminate between unique vehicles a new approach is needed.

In conjunction to the operational needs of the ITS Bureau, whatever is deployed must also satisfy the respective needs of each stakeholder as described in Section 2.0.

NMDOT Signal Maintenance Lab

The Signal Maintenance Lab's area of focus is signal operations and timing to accommodate traffic progression along US 550 from I-25 to NM 528 (Pat D'Arco Highway). There are six signalized intersections along this corridor, four of which currently have bluetooth devices - all provided through Blue Toad®. Collected information is made available via a web service. Figure 2 shows those locations.

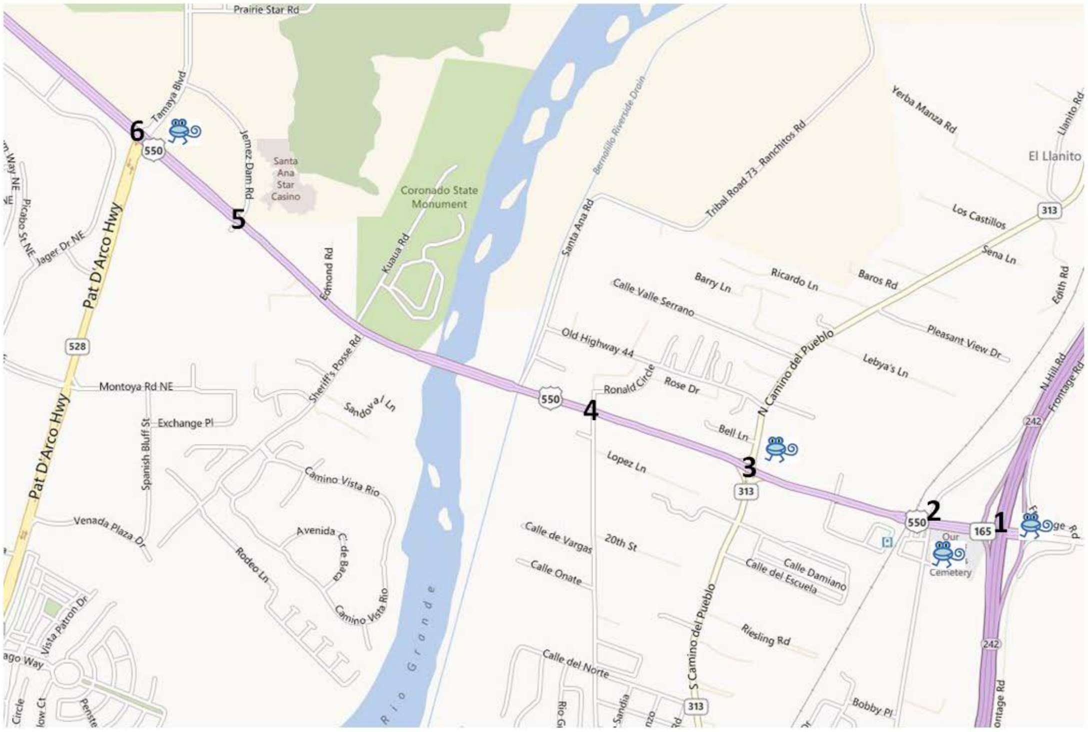


Figure 2 - NMDOT Signal Maintenance Lab Blue Toad Sensors

1.	I-25	Bluetooth
2.	Hill Road	Bluetooth
3.	NM 313	Bluetooth
4.	Don Tomas	
5.	Jemez Dam	
6.	NM 528	Bluetooth

The NMDOT Signal Maintenance Lab uses information obtained from the Bluetooth devices to monitor traffic progression on the corridor in both real time and to compare historical trends. The web service is accessed routinely by the Signal Maintenance Lab to determine if timing adjustments are needed. According to Lab personnel, the current configuration meets that need.

Bernalillo County

Like the NMDOT Signal Maintenance Lab, Bernalillo County is using bluetooth devices to evaluate the performance of signal systems they maintain and operate. That performance information is relevant to specific concerns regarding the warranty of a recently installed adaptive signal control system (In-Sync®) along Alameda. The bluetooth devices for this are being provided by Post Oak®. As noted before, the information is being provided as a web service versus residing on the Bernalillo County's internal network. Figure 3 shows these locations.

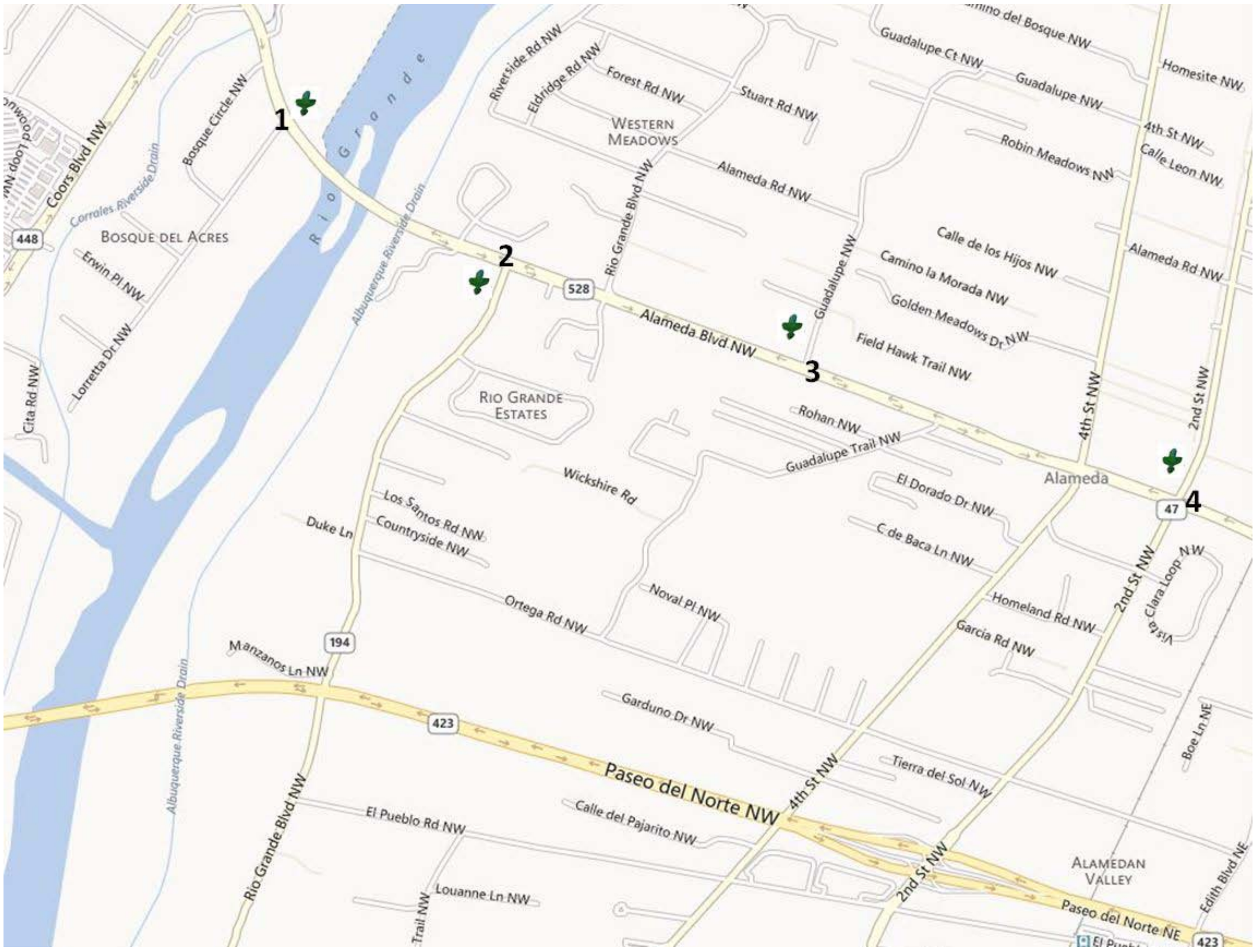


Figure 3 - Bernalillo County Post Oak Sensors

1. Loretta
2. Rio Grande South
3. Guadalupe North
4. 2nd Street

According to County Personnel, data is acquired by Post Oak bluetooth readers at each location and transmitted to a web hosting service via code division multiple access (CDMA) modules. Bernalillo County is assessed a fee for the web hosting service which provides a link to a web interface with various levels of functionality. These include a congestion mapping service covering the corridor, reader performance, origin-destination information, match rates, a display of individual data points, and an Excel compatible data export feature.

City of Albuquerque

Through a coordinated effort with the NMDOT, the current inventory for the City of Albuquerque to determine travel times along arterials in the AMPA area came from a recent ITS project during which DMSs were deployed. Of specific interest to the City was using the DMSs to display travel times during a.m. and p.m. peak periods. In addition to the DMSs, the City deployed bluetooth devices at locations as identified in Figure 4.

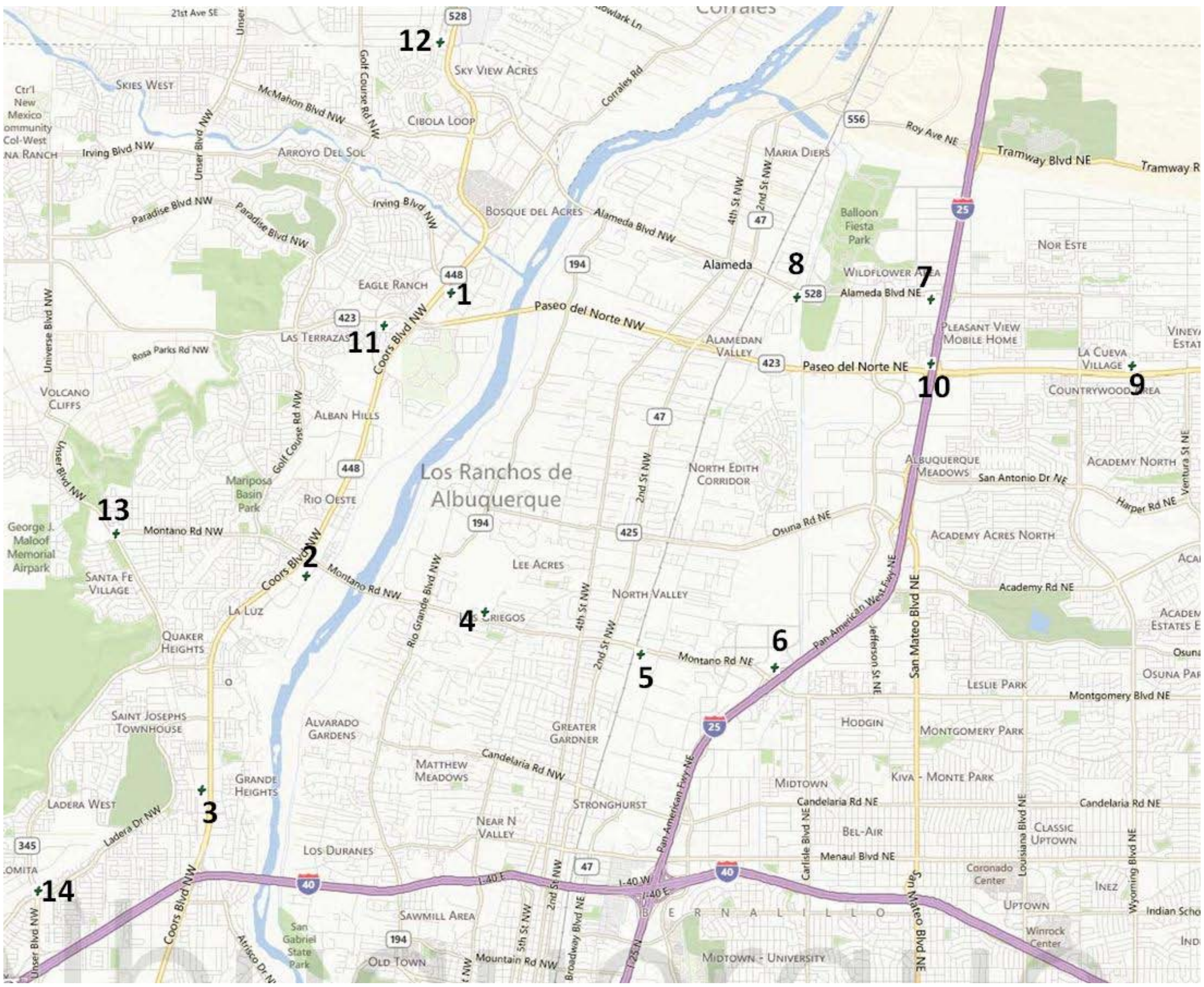


Figure 4 - City of Albuquerque Post Oak Sensors

1. Coors Blvd at Irving Blvd
2. Coors Blvd at Montaño Rd
3. Coors Blvd at Quail
4. Montaño Rd at Rancho Caballero

5. Montaño Rd at 2nd Street
6. Montaño Rd at I-25
7. Alameda Blvd at I-25
8. Alameda Blvd at Alameda Park
9. Paseo del Norte Blvd at Barstow
10. Paseo del Norte Blvd at I-25
11. Paseo del Norte Blvd at Eagle Ranch
12. NM 528 at Westside Blvd
13. Unser Blvd at Montaño Rd
14. Unser Blvd at Ladera

The City of Albuquerque purchased the server and the application resides on their internal network in conjunction with the bluetooth field devices. The API that interfaces between the bluetooth travel time application and the message development application (Skyline® Envoy) is managed by RealTime Solutions. This requires VPN access to the City's network by RTS.

City of Rio Rancho

The City of Rio Rancho (CoRR) have indicated their interest in using bluetooth devices as a tool to measure the performance of signal system operations on specific corridors of interest. Those corridors include Unser Blvd (Wellspring Ave. to King Blvd.), NM 528 (Pat D'Arco Highway, Westside Blvd. to US 550) and Southern Blvd. from Unser Blvd. to NM 528. An installation on Unser Blvd. is scheduled to be in place by the late spring of 2013. Lee Engineering is currently developing a matrix for the City of Rio Rancho to determine which option, Post Oak® or Blue Toad®, will be installed for this corridor. Figure 5 shows these proposed corridors.

Figure 6 shows the current deployments of operational sensors (both bluetooth devices and side-fire radar units) among the regional stakeholders for the northwest geographical scope of this ConOps.

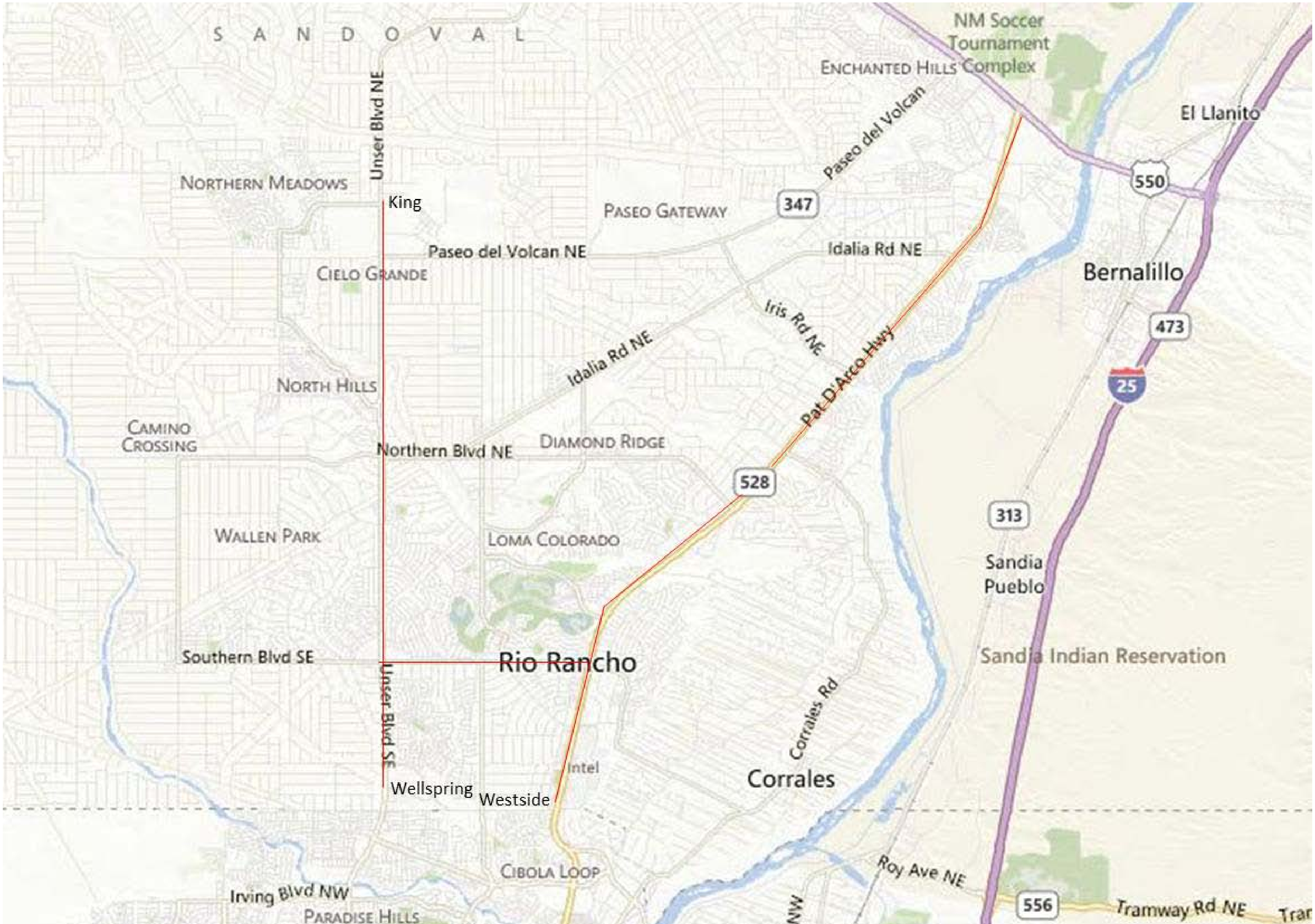
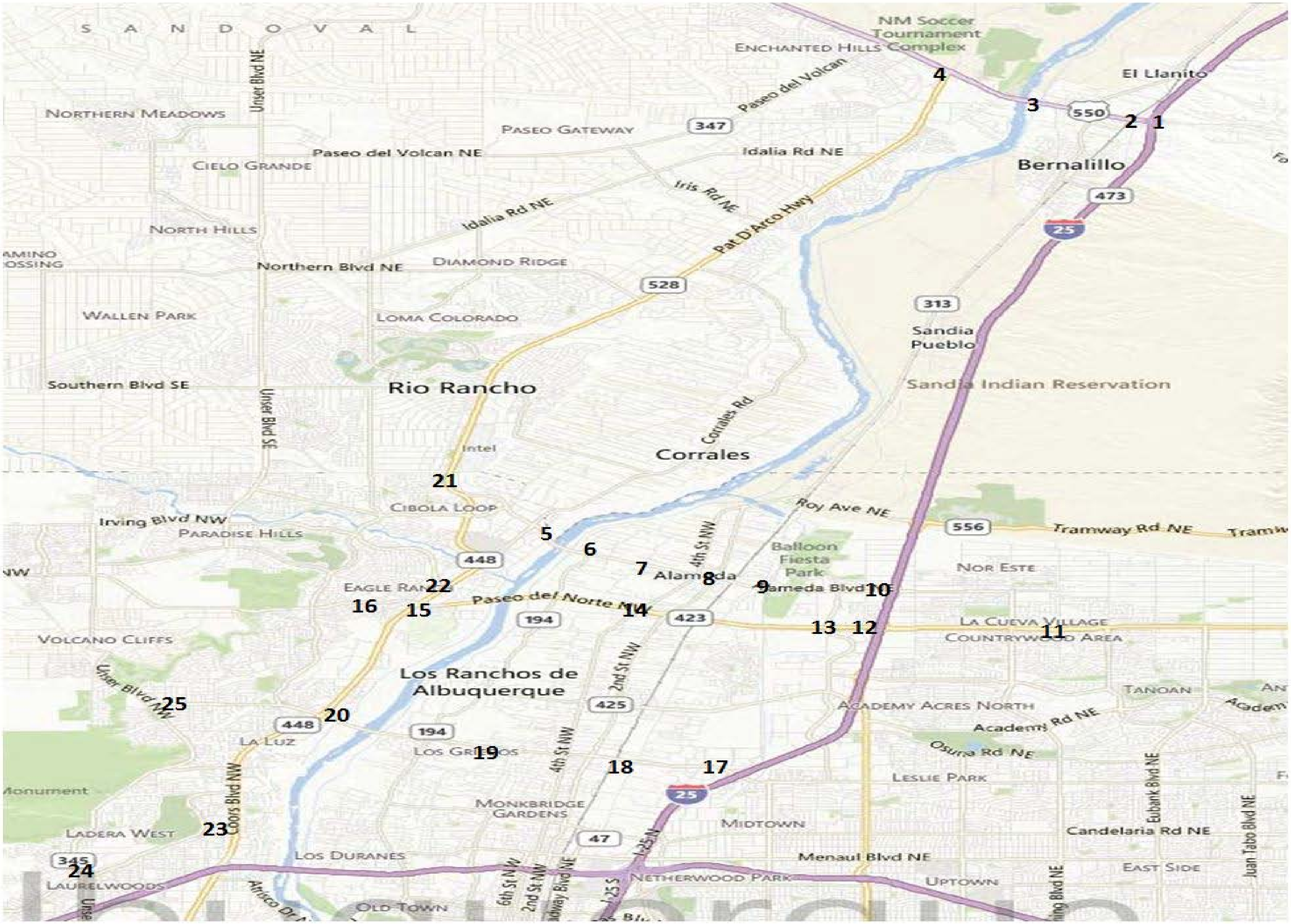

SANDOVAL
Unser Blvd NE
NM Soccer Tournament Complex
Enchanted Hills
Paseo del Volcan
El Llanito
550
Northern Meadows
King
Paseo Gateway
347
Paseo del Volcan NE
Idalia Rd NE
Cielo Grande
Bernalillo
Iris Rd NE
473
Idalia Rd NE
Pat D'Arco Hwy
25
North Hills
Camino Crossing
Northern Blvd NE
Diamond Ridge
528
313
Wallen Park
Loma Colorado
Sandia Pueblo
Southern Blvd SE
Rio Rancho
Sandia Indian Reservation
Unser Blvd SE
Corrales Rd
Intel
Corrales
Wellspring
Westside
Roy Ave NE
Cibola Loop
Irving Blvd NW
556
Tramway Rd NE
Paradise Hills

Figure 5 - Proposed Bluetooth Corridors in Rio Rancho


S A N D O V A L
NM Soccer Tournament Complex
Enchanted Hills
El Llanito
Northern Meadows
Unser Blvd NE
Paseo Gateway
Paseo del Volcan
347
550
Paseo del Volcan NE
Cielo Grande
Idalia Rd NE
Bernalillo
Iris Rd NE
473
North Hills
Idalia Rd NE
Pat D'Arco Hwy
25
Northern Blvd NE
Diamond Ridge
528
Wallen Park
313
Loma Colorado
Sandia Pueblo
Southern Blvd SE
Rio Rancho
Sandia Indian Reservation
Unser Blvd SE
Corrales Rd
Intel
Corrales
Cibola Loop
Roy Ave NE
Irving Blvd NW
Paradise Hills
556
Tramway Rd NE
4th St NW
448
Balloon Fiesta Park
Nor Este
Alameda
Alameda Blvd
Eagle Ranch
Paseo del Norte NW
194
423
La Cueva Village
Countrywood Area
Volcano Cliffs
Los Ranchos de Albuquerque
2nd St NW
Unser Blvd NW
425
Tanoan
Academy Acres North
Academy Rd NE
448
La Luz
194
Osuna Rd NE
Los Griegos
4th St NW
Coors Blvd NW
Leslie Park
Eubank Blvd NE
Monument
Monkbridge Gardens
Midtown
Ladera West
47
Candelaria Rd NE
Juan Tabo Blvd NE
345
Los Duranes
Menaul Blvd NE
East Side
Laurelwoods
Netherwood Park
Uptown
Old Town
6th St NW
2nd St NW
I-25 N
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2
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Figure 6 - Traffic Sensors on Northwest Arterials

FIGURE 5 LOCATION ID AND DESCRIPTORS

ID	Location	Owner	Type	Manufacturer
1	US 550 at I-25	NMDOT Signal Maintenance Lab	Bluetooth	Blue Toad®
2	US 550 at Hill Rd	NMDOT Signal Maintenance Lab	Bluetooth	Blue Toad®
3	US 550 at NM 313	NMDOT Signal Maintenance Lab	Bluetooth	Blue Toad®
4	US 550 at NM 528	NMDOT Signal Maintenance Lab	Bluetooth	Blue Toad®
5	Alameda Blvd at Loretta	Bernalillo County	Bluetooth	Post Oak®
6	Alameda Blvd at RG Sth	Bernalillo County	Bluetooth	Post Oak®
7	Alameda Blvd at Guad N	Bernalillo County	Bluetooth	Post Oak®
8	Alameda Blvd at 2nd St	Bernalillo County	Bluetooth	Post Oak®
9	Alameda Blvd at Alameda Pk	City of ABQ	Bluetooth	Post Oak®
10	Alameda Blvd at I-25	City of ABQ	Bluetooth	Post Oak®
11	PDN Blvd at Barstow	City of ABQ	Bluetooth	Post Oak®
12	PDN Blvd at I-25	City of ABQ	Bluetooth	Post Oak®
13	PDN Blvd at Jefferson St	NMDOT ITS	Radar	Wavetronix®
14	PDN Blvd at 4th St	NMDOT ITS	Radar	Wavetronix®
15	PDN Blvd at 2nd St	NMDOT ITS	Radar	Wavetronix®
16	PDN Blvd at Eagle Ranch	City of ABQ	Bluetooth	Post Oak®
17	Montaño Rd at I-25	City of ABQ	Bluetooth	Post Oak®
18	Montaño Rd at 2nd St	City of ABQ	Bluetooth	Post Oak®
19	Montaño Rd at Rancho Caballero	City of ABQ	Bluetooth	Post Oak®
20	Montaño Rd at Coors	City of ABQ	Bluetooth	Post Oak®
21	NM 528 at Westside Blvd	City of ABQ	Bluetooth	Post Oak®
22	Coors Blvd at Irving	City of ABQ	Bluetooth	Post Oak®
23	Coors Blvd at Quail	City of ABQ	Bluetooth	Post Oak®
24	Unser Blvd at Ladera	City of ABQ	Bluetooth	Post Oak®
25	Unser Blvd at Montaño	City of ABQ	Bluetooth	Post Oak®

System Overview

This is an overview of the system to be developed. This describes its scope, the users of the system, what it interfaces with, its states and modes, the planned capabilities, its goals & objectives, and the system architecture. Note that the system architecture is not a design [that will be done later]. It provides a structure for describing the operations, in terms of where the operations will be carried out, and what the lines of communication will be.

Though the geographical scope of this Con Ops is focusing on the northwest portion of the AMPA, the developed system should be scalable to accommodate the region as a whole while concurrently accommodating the operational scope of each of the stakeholder agencies. As previously mentioned, the operational scope is essentially two-fold in nature – one to assess progression along corridors to evaluate signal system operations (as both a performance measure for warranty purposes and for needed timing adjustments), the other is to convey travel times along arterial corridors as traveler advisories to motorists. Additionally, accessing archived data on arterial performance is of specific interest to data users and planners within each of the agencies and the MRCOG.

As previously noted in Section 2, the users/stakeholders of the systems include:

- City of Albuquerque (COA)
- Bernalillo County (BernCo)
- City of Rio Rancho (CoRR)
- NMDOT
    - ITS Operations
    - Signal Maintenance Lab
- Mid-Region Council of Government (MRCOG)

The users' goals and objectives are essentially the same, namely improving the flow of traffic on arterials in the region as a whole, during both routine modes of recurring congestion and as well as during states of having to respond to unplanned events. The planned capabilities to make that happen include the following:

NMDOT Signal Maintenance Lab	Monitor Traffic Progression, Adjust Signal Timing as necessary
Bernalillo County	Monitor Adaptive Signal Performance
City of Albuquerque	Monitor Traffic Progression, Adjust Timing as necessary, Posting Travel Times on DMS
City of Rio Rancho	Monitor Traffic Progression, Adjust signal timing as necessary
NMDOT ITS	Posting of Travel Times on DMSs
MRCOG	Regional System Performance Evaluation

The interfaces vary depending upon stakeholder and the services they either subscribe to or manage themselves. Both BernCo and NMDOT Signal Maintenance Lab requires web access to have the collected information be both transmitted and accessed (once again via a service platform provided by either Post Oak® or Blue Toad®). COA is managing the equipment, the applications and the interface of the systems are internally on their own network with the exception of travel time message development which requires an interface to an outside provider (RealTime Solutions).

The NMDOT ITS operations manages their devices on an internal network (once again, no bluetooth devices on arterials, only microwave devices on the interstates and Paseo del Norte). To create the travel time messages, the ITS operations rely on a web connection with RealTime Solutions (one for RTS to access the collected data application via an XML feed – Data Command®, the other for allowing RTS to connect to our message creation application Skyline® Envoy).

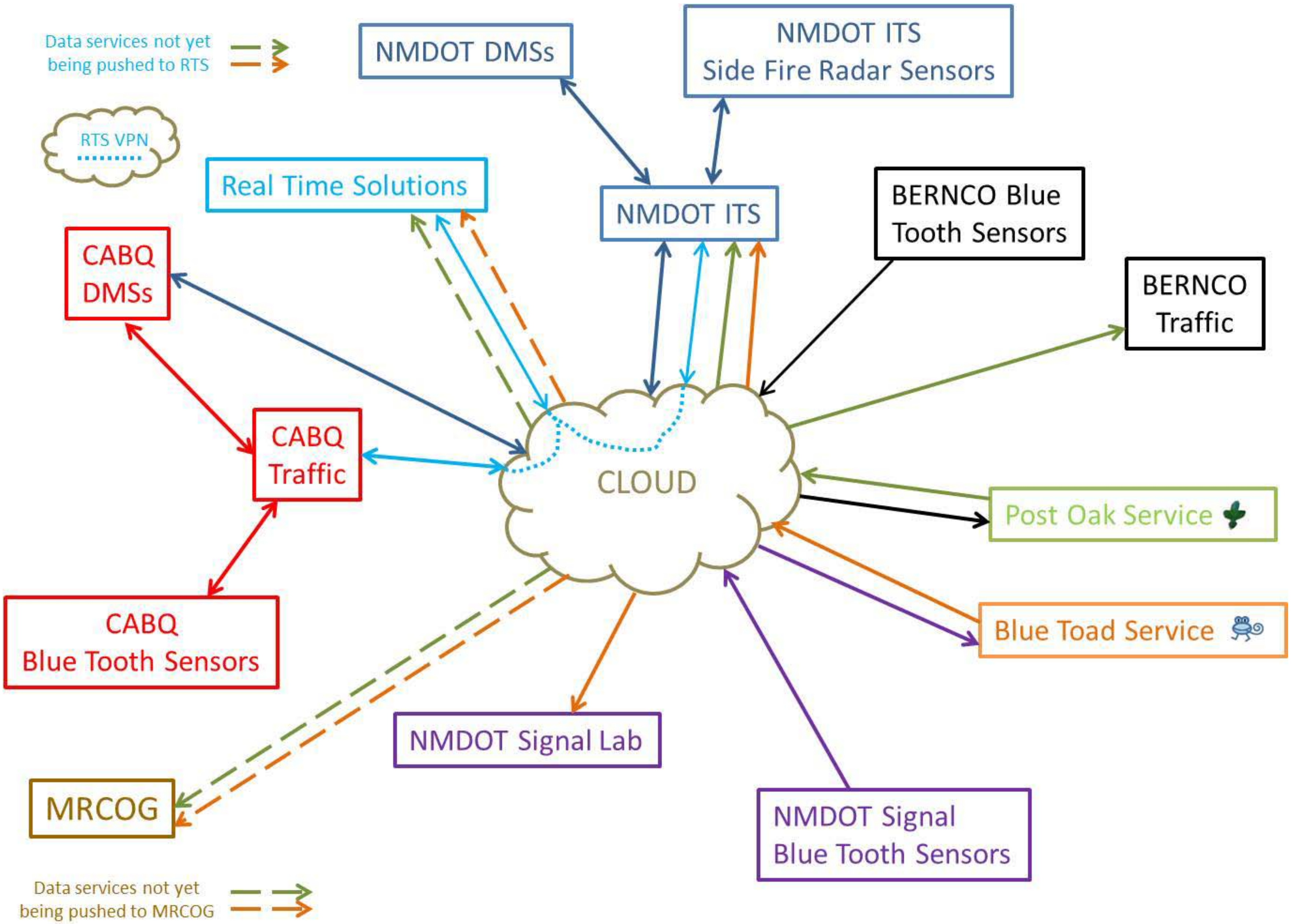
In order for the ITS operations to create Travel Time Messages for arterial roadways, access would be needed to the collected information from systems in place for BernCo, COA, and NMDOT-Signal Maintenance Lab. Or more to the point, RealTime Solutions (the service provider to NMDOT ITS Operations that currently manages travel time message displays) would need to have access to those systems. The architecture is in place to accommodate that, namely RTS has a VPN access to NMDOT ITS Bureau, COA, and can obtain web access to the services provided to BernCo and NMDOT Signal Maintenance Lab (both systems offer XML feeds to subscribers). Figure 7 depicts the information flow of existing traffic sensor information for the regional stakeholders. Figure 7 doesn't, however, show CoRR's informational flows and access in that it has not yet decided what option it will use – a server on their internal network or a service outside of their network.

Architecture and Service Packages

As it relates to arterial travel times, the functional services provided by (or proposed to be provided by) each of the stakeholders have previously been mapped in the region's ITS architecture. They're termed service packages and specifically include the following:

- Network Surveillance (ATMS 01)
- Surface Street Control (ATMS 03)
- Traffic Information Dissemination (ATMS 06)
- Regional Traffic Control (ATMS 07)
- Archived Data Mart (AD 01)
- Archived Data Warehouse (AD 02)

The regional architecture documents the relationships and informational flows both in place and will be needed to accommodate the services described above. Figures that depict each relevant package are included in the Appendix to this document.


Data services not yet
being pushed to RTS
NMDOT DMSs
NMDOT ITS
Side Fire Radar Sensors
RTS VPN
Real Time Solutions
NMDOT ITS
BERNCO Blue
Tooth Sensors
CABQ
DMSs
BERNCO
Traffic
CABQ
Traffic
CLOUD
Post Oak Service
CABQ
Blue Tooth Sensors
Blue Toad Service
NMDOT Signal Lab
MRCOG
NMDOT Signal
Blue Tooth Sensors
Data services not yet
being pushed to MRCOG

MR COG ITS

Figure 7 - FLOW OF TRAFFIC SENSOR DATA COLLECTION AND DISTRIBUTION AMONG STAKEHOLDER

Operational Environment

This section describes the physical operational environment in terms of facilities, equipment, computing hardware, software, personnel, operational procedures and support necessary to operate the deployed system. For example, it will describe the personnel in terms of their expected experience, skills and training, typical work hours, and other activities [e.g., driving] that must be or may be performed concurrently.

As implied, 'collecting arterial travel times' require 'monitoring the traffic conditions on arterials'. This operational environment is independent of the time-of-day, the day-of-week, or the weather conditions. Current deployments (bluetooth devices from either Blue Toad® or Post Oak®) are typically housed within the signal controller cabinet or mounted in dedicated NEMA cabinets. Figure 8 and 9 show typical bluetooth field deployments in the Albuquerque area.

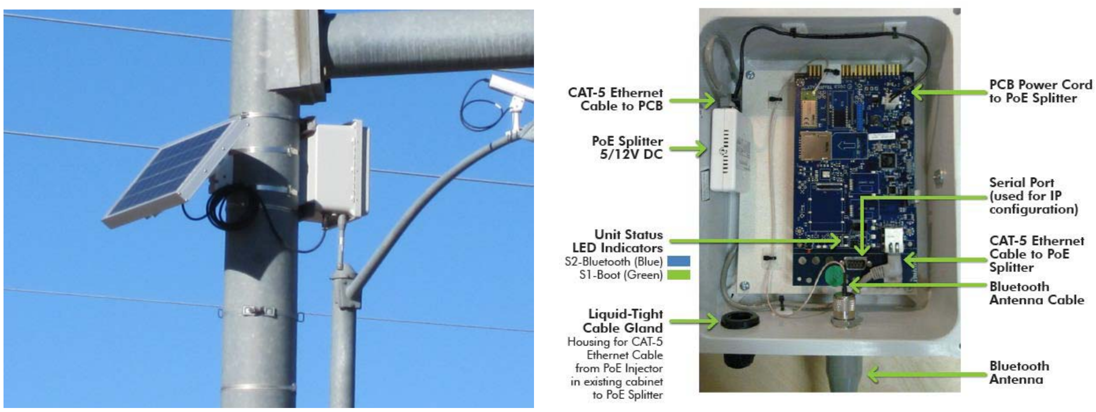


Figure 8a - 8b – Blue Toad Installation at US 550 and NM 313

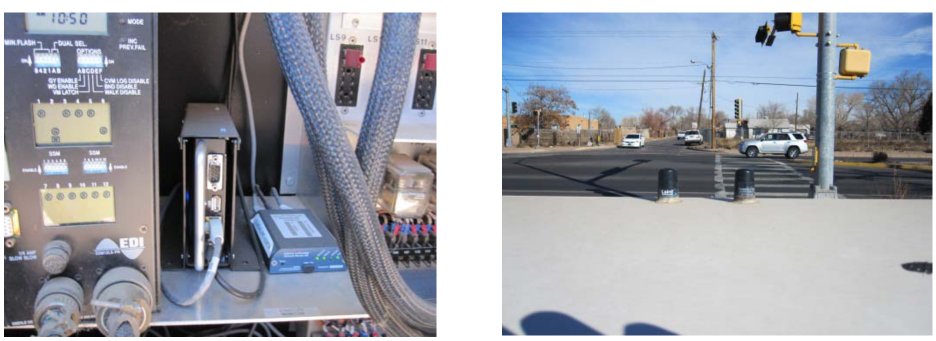


Figure 9a and 9b - Post Oak Installation at Alameda and Guadalupe North

Each sensor utilizes field controllers that aggregate data and communicate it back to applications that are specific to each manufacturer. That application's software determines the travel times and allows for sharing it to a community of users, typically in a 'dashboard' accessible through the web. Figure 10 and 11 show the dashboards from each of the service providers – these in particular present the real time congestion mapping display. Each provider offers additional features in their respective services, which will be explored further in the Systems Engineering Evaluation Report analysis that will come from this Con-Op.

Because of federal requirements associated with reporting travel conditions in real time (per 23 CFR 511), information will need to be collected and reported within relatively short time frames of actual field conditions. This invariably will require the system to operate within a computing environment that can be shared among stakeholders, and will require a level of commitment from each stakeholder to ensure resources are allocated, whether it is staff, funding or both, to manage those environment(s) regardless of it being either internal or external to a stakeholder's network. In addition to that commitment, it will require defining procedures for maintenance and operations, including response times incumbent on each stakeholder in dealing with issues that affect the services being provided.

Personnel skilled in equipment maintenance, networking and communications, web activities, application interfaces, and data management are needed to support each stakeholder's system deployments and end services. Whether those resources are internal or external to an organization will depend on the preferred model as determined by each. That said, regardless of where those resources reside, it doesn't absolve each stakeholder from their respective responsibility of providing them.

Travel times are currently displayed during both the a.m. and p.m. commute periods from Monday through Friday by NMDOT's ITS operations. This is defined as 6:30 a.m. to 9:30 a.m. and 3:30 p.m. to 6:30 p.m. Though the system's reliability is critical during these periods, it is reasonable to assume that ensuring this reliability could very well require support activities (including this skilled disciplines described in the preceding paragraph) to extend well beyond these operational windows.

The critical operational periods (and associated support activities) for other stakeholders activities will need to be respectively defined. For example, if collected information is being used to evaluate signal system performance for warranty purposes, then the required operational periods could well be defined by contractual content. If collected information is being used as a detector of poor levels-of-service on the arterials, a consideration is the accuracy of the data which can fluctuate depending upon the population of the data points. As such, monitoring during a.m. and p.m. peak periods will yield a larger community of data, which in turn allows it to be more precise and better reflect actual conditions. Having an acceptable level of precision, is critical to this functionality.

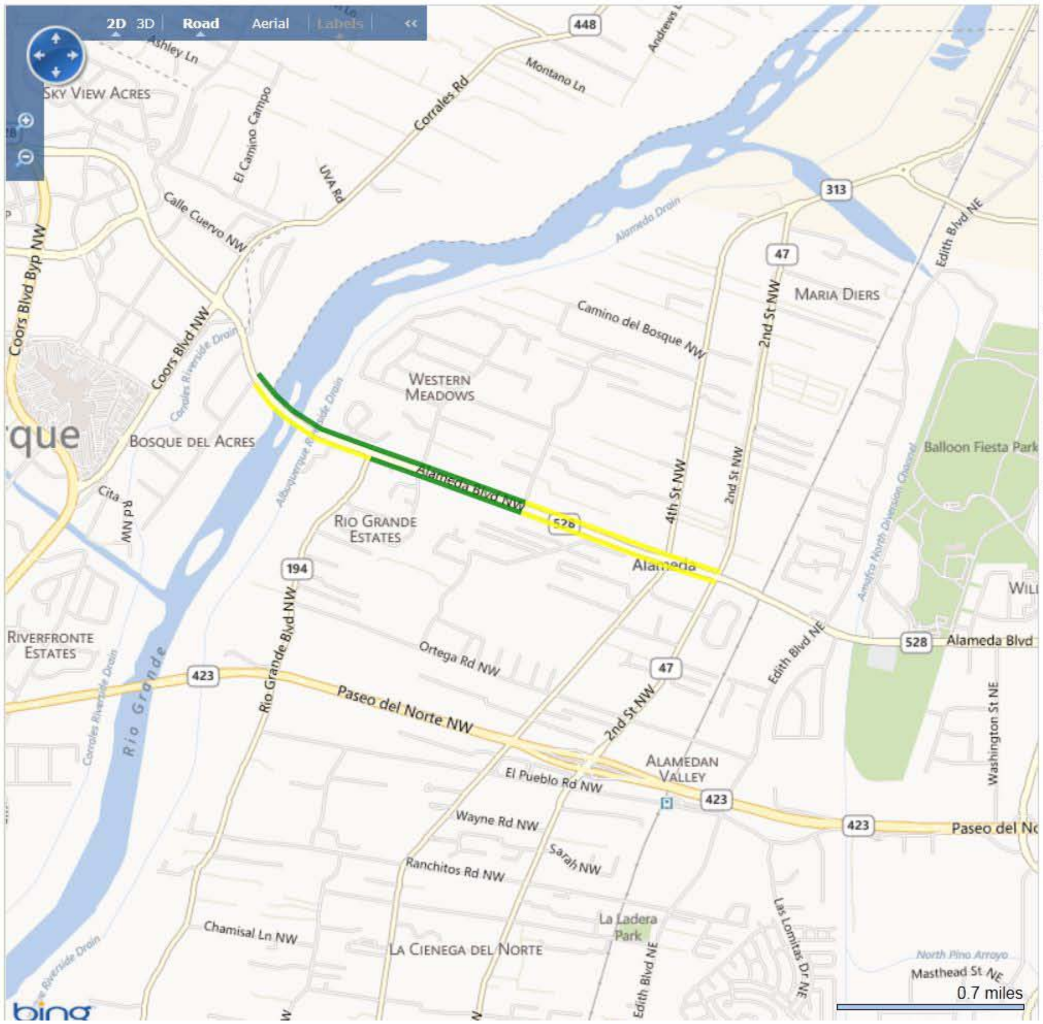
For those stakeholders that are using travel time data to evaluate progression and signal performance, it's reasonable to assume the critical times of operation would span the a.m., midday, and p.m. peak periods, or more specifically the time from 6:30 a.m. to 6:30 p.m.

Anonymous Wireless Address Matching
For Traffic Information

Post Oak Traffic Systems Incorporated

Matches | Reads | Match Sample Rates | Reader Performance | Origin-Destination Matrix | Congestion Map/Real-Time Summary | Export Data | Live Data Feed

Traffic Conditions Map - Bernalillo County, New Mexico



Street Congestion
- Moving Well
- Slow
- Heavy Traffic
- No Data

Alameda Eastbound				
Origin	**Destination**	**Length (mi)**	**Travel Time**	**Speed (mph)**
Loretta	Rio Grande South	0.53	1 minute 3 seconds	30
Rio Grande South	Guadalupe North	0.61	56 seconds	39
Guadalupe North	2nd Street	0.77	1 minute 32 seconds	30

Alameda Westbound				
Origin	**Destination**	**Length (mi)**	**Travel Time**	**Speed (mph)**
Rio Grande South	Loretta	0.53	51 seconds	37
Guadalupe North	Rio Grande South	0.61	1 minute	37
2nd Street	Guadalupe North	0.77	1 minute 38 seconds	28

TRAVEL TIME
TO 2ND STREET
4 MIN AT 2:02 PM

TRAVEL TIME
TO LORETTA
4 MIN AT 2:02 PM

MR COG ITS

Figure 10 - Post Oak Traffic Systems Congestion Map

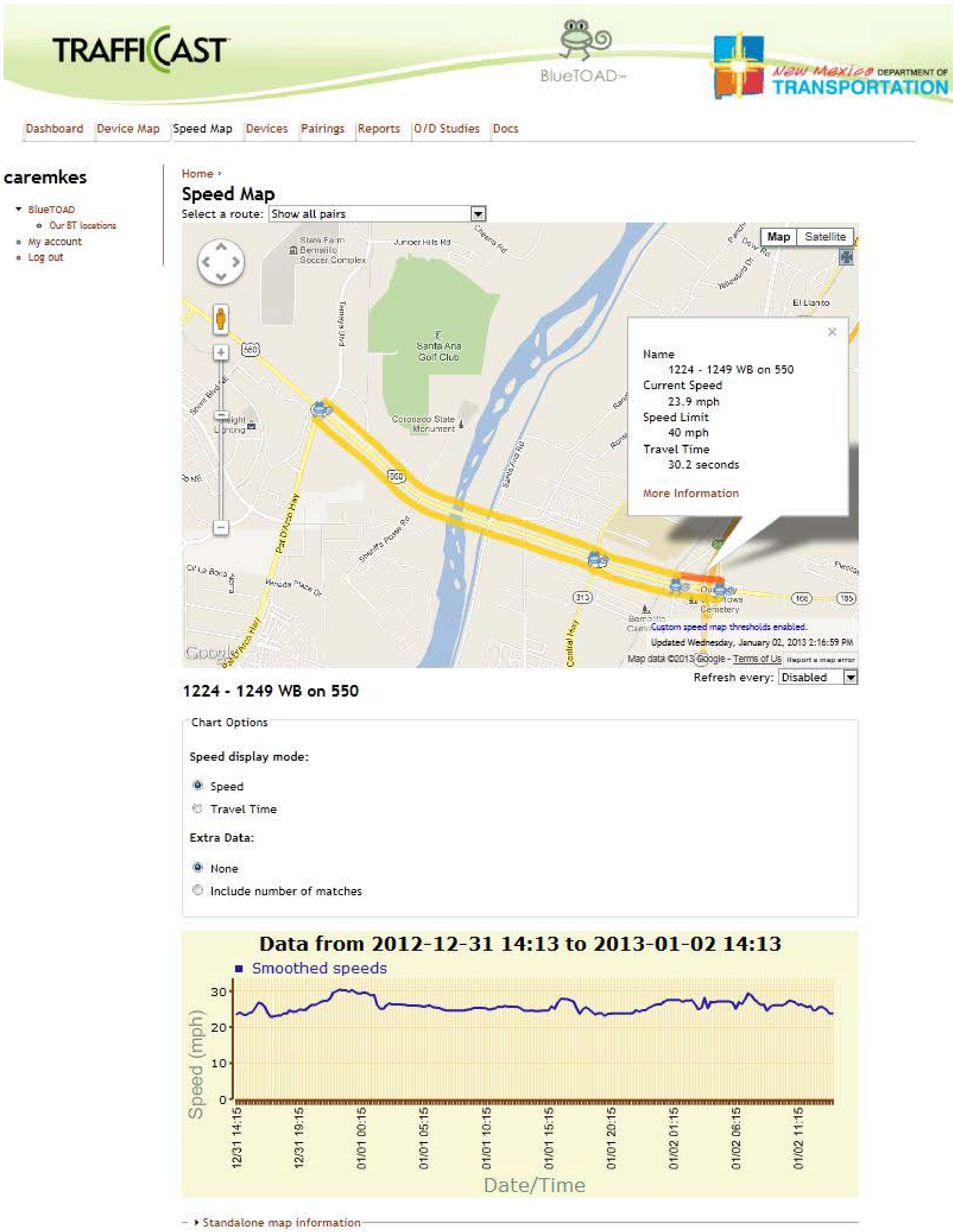


Figure 11 - Blue Toad Traffic Systems Congestion Map

Support Environment

This describes the current and planned physical support environment. This includes facilities, utilities, equipment, computing hardware, software, personnel, operational procedures, maintenance, and disposal. This includes expected support from outside agencies.

Currently, each stakeholder agency is independently responsible for maintaining their respective support environments. Some do this in-house while others use the services of an outside provider. That said, the planned functional services of some (if not all) of the stakeholders is directly dependent on other stakeholders' either their current and/or their planned support environments being fully functional and continually maintained.

Though earlier described, it would be helpful to once again present each stakeholder's current system and associated appurtenances.

NMDOT ITS Bureau

The following elements are integral to the function of displaying travel times on NMDOT-owned DMSs:

- Wavetronix® microwave vehicle detections systems (located on Interstates 25 and 40 and Paseo del Norte)
- Field Communications via NMDOT-owned 96 strand fiber optics backbone and RuggedCom® ethernet switches
- Collected data is imported into Wavetronix® Data Command Application
- Data is used to determine travel times via Data Translator Module of Data Command
- An XML feed of the travel times is created in Data Translator and sent to RealTime Solutions via a secured web connection
- XML feed is used to create a message for travel time display on DMSs
- Message command is sent to NMDOT ITS Skyline Envoy Application® via a secure web connection
- Envoy application places the message on the signs

To expand NMDOT's ITS operations to include arterial travel time displays, RTS would need to have access to the relevant collected data from the applications that are determining the travel times for each stakeholder. Each of the two applications in use reportedly can generate an XML feed of those travel times. RTS having access to that XML feed is critical. The ease in that occurring is dependent on the environment where the application resides, or more to the point - Is the application's XML feed within a private network or is publically accessible? The impact of those considerations aren't part of this ConOps, but will be examined more closely during the Systems Engineering Evaluation.

Current operations require coordination between NMDOT ITS staff and RTS personnel. This includes network administrators, applications specialists, web administrators, and field technical staff. When issues arise, there are procedures to identify the root cause and remedy the problem. Those procedures are time-sensitive and often require immediate response. Staff availability is critical.

When maintenance activities (i.e., equipment replacement) occur that could have an impact on the system's performance, staff and personnel who are responsible for system operations are contacted ahead of time in an effort to determine and mitigate potential impacts.

When dealing with unforeseen issues, both ITS staff and RTS personnel immediately respond to quickly investigate, identify, remedy and bring back into service all functions needed to provide travel time displays on DOT-owned DMSs.

Expanding operations to provide arterial travel times would require this same level of coordination between NMDOT ITS with the other responsible stakeholder agencies, and in turn, their respective coordination with RTS in dealing with both scheduled maintenance and dealing with problems that might arise.

NMDOT Signal Maintenance Lab

The following elements are integral to the function of monitoring travel times along US 550 between I-25 and NM 528:

- Blue Toad® Bluetooth Sensor Installation
- Communications to the devices via either a Wi-Fi mesh or CDMA modem
- Blue Toad® web-based service application
- NMDOT Signal Maintenance Lab internet access

The Signal Maintenance Lab accesses the information via a service provided by Blue Toad®. This service currently requires Lab personnel to routinely check the website to determine what conditions exist. This is done to determine if signal timing changes are needed on that corridor. They also use this service to view historical reports. This is sometimes done to address public concerns or claims associated with poor system operations. The frequency which personnel check the information on the website is not regimented and can vary.

City of Albuquerque

The following elements are integral to the function of displaying travel times on City-owned DMSs:

- Post Oak® Bluetooth Traffic Sensor systems
- Field Communications via city-owned fiber optics backbone and Ether-Wan® ethernet switches
- Collected data is imported into Post Oak® Application residing on the city network
- Post Oak® application determines travel times
- An XML feed of the travel times is created in Post Oak application and is retrieved by RealTime Solutions via a secured web connection (VPN) into the City's network
- XML feed is used to create a message for travel time display on DMSs
- Message command is sent to the City's Skyline Envoy Application® via a secure web connection VPN
- Envoy application places the message on the signs

To expand the City's operations to identify travel times on a commute that includes segments that aren't on the city network, information from sensors on those non-city networks (i.e., along interstates or County owned operations) will need to either be brought into the City's server or into RTS applications as relevant.

With regard to addressing issues, the frequency which personnel check the information is not regimented and can vary.

Bernalillo County

Like the NMDOT's Signal Maintenance Lab, Bernalillo County uses a web-based subscription service. The difference is that Bernalillo County is using this information in support of warranty enforcement for a soon to be installed Adaptive Signal Control timing system. Because it is web-based, the elements needed (and that are in place) to ensure this functionality include:

- Post Oak® Bluetooth Sensor Installation
- Communications to the devices via CDMA modem
- Post Oak® web-based service application
- Internet access

With regard to addressing issues, the frequency which personnel check the information is not regimented and can vary.

City of Rio Rancho

The City of Rio Rancho does not have an operational system at this time. It is currently evaluating options for deployment.

Operational Scenario

This is the heart of the document. Each scenario describes a sequence of events, activities carried out by the user, the system, and the environment. It specifies what triggers the sequence, who or what performs each step, when communications occur and to whom or what [e.g., a log file], and what information is being communicated. The scenarios will need to cover all normal conditions, stress conditions, failure events, maintenance, and anomalies and exceptions. There are many ways for presenting scenarios, but the important thing is that each stakeholder can clearly see what his expected role is to be.

Displaying travel times on DMSs is a form of conveying origin and destination information to drivers. The one main difference to other forms is that the origin is always defined, namely the DMS on which that information is being displayed. The destinations can vary. The destinations that are currently displayed are limited to interchanges along interstates that have been identified to have relevance to a large number of drivers and are of a sufficient distance away from the displaying DMS to have reasonably significant value (typically a destination of 4 minutes or more). In addition multiple destinations are typically displayed on a single DMS (for example, the I-40 westbound DMS at the Washington St overpass displays travel times to Unser Blvd, Sunport Blvd, and Alameda Blvd).

Expanding travel time displays to include arterial segments is once again supplying origin and destination information, with the added element of intending to provide motorists with a choice of different routes of getting to the same destination. As mentioned earlier, commuting traffic from and to the northwest portion of the AMPA area is very heavy. A common origin and destination point for this movement is the City of Rio Rancho. A major intersection centrally located in Rio Rancho is Southern Blvd. Ideally this would represent a central reference point for Rio Rancho, however the last sensor on the network is at Westside Blvd in Rio Rancho. As such, that will be the default reference point.

Operational Scenario 1 – No Incidents -- P.M. Commuting Period

A large percentage of P.M. commuters in the Albuquerque area are originating from business centers in Downtown Albuquerque, Southeast Albuquerque (Kirtland AFB / Sandia National Labs, the University area, and the medical complexes) and Northeast Albuquerque (Uptown area) and have a common destination, the northwest Albuquerque / Rio Rancho area. Information about their commute can be conveyed on various DMSs (see Figure 12). The DMSs having the best value in offering the most choices include:

- I-40 WB at Washington Blvd (four alternatives)
    - I-40 to Coors to Westside Blvd
    - I-40 to I-25 to Montano to Coors to Westside Blvd
    - I-40 to I-25 to Paseo del Norte to Coors to Westside Blvd
    - I-40 to I-25 to Alameda to Coors to Westside Blvd
- I-25 NB at Central Ave (four alternatives)
    - I-25 to I-40 to Coors to Westside Blvd
    - I-25 to Montano to Coors to Westside Blvd
    - I-25 to Paseo del Norte to Coors to Westside BlvdWestside Blvd
    - I-25 to Alameda to Coors to Westside Blvd
- I-25 NB at Comanche Blvd (three alternatives)
    - I-25 to Montano to Coors to Westside Blvd
    - I-25 to Paseo del Norte to Coors to Westside Blvd
    - I-25 to Alameda to Coors to Westside Blvd
- I-25 NB at San Mateo / Osuna (two alternatives)
    - I-25 to Paseo del Norte to Coors to Westside Blvd
    - I-25 to Alameda to Coors to Westside Blvd

Figure 13 shows these options. Each above alternative to the common destination requires combining travel times collected along the segments that make up that alternative. Travel times along all of the interstate segments are determined from data collected from microwave vehicle detection sensors. That data is integrated into the Wavetronix® Data Translator module of the Data Command application. Both the sensors and applications are within the ITS Bureau's internal network.

Travel times along the non-interstate segments of the corridors are determined from data collected from bluetooth devices (Post Oak® devices for all of the non-interstate alternative segments noted above) and analyzed using Post Oak® proprietary application. The devices and associated application for all of the non-interstate segments noted above are within the City of Albuquerque's internal network with the exception of the Alameda segment from 2nd St to Loretta St which is hosted in the cloud by Post Oak® on behalf of Bernalillo County.

Using the display on the on the Central Avenue NB Sign, as an example, the following segments and associated sensor/applications would be needed to create the travel times:

- Data from NMDOT – ITS sensors collected along these segments:
    - I-25 NB at Central to I-40 WB at Coors
    - I-25 NB at Central to I-25 at Montano

- I-25 NB at Central to I-25 at Paseo Del Norte

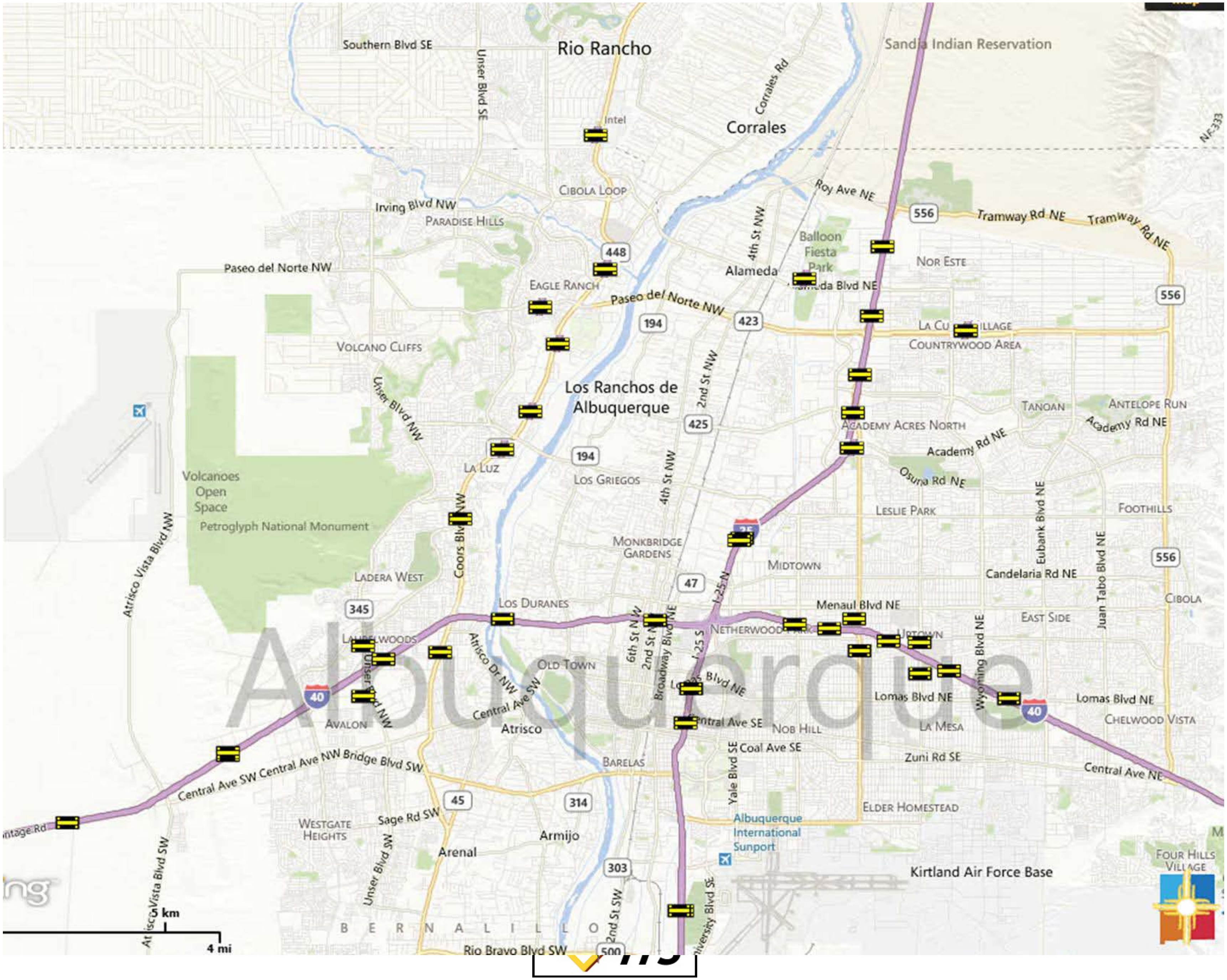

Southern Blvd SE
Unser Blvd SE
Rio Rancho
Intel
Corrales Rd
Corrales
Sandia Indian Reservation
NM333
Cibola Loop
Roy Ave NE
Irving Blvd NW
Paradise Hills
556
Tramway Rd NE
Tramway Rd NE
448
4th St NW
Balloon Fiesta Park
Paseo del Norte NW
Alameda
Nor Este
Eagle Ranch
Paseo del Norte NW
556
194
423
Volcano Cliffs
Countrywood Area
Los Ranchos de Albuquerque
2nd St NW
Unser Blvd NW
425
Tanoan
Antelope Run
Academy Acres North
Academy Rd NE
Academy Rd NE
194
La Luz
4th St NW
Osuna Rd NE
Volcanoes Open Space
Los Griegos
Atrisco Vista Blvd NW
Petroglyph National Monument
Leslie Park
Eubank Blvd NE
Foothills
Juan Tabo Blvd NE
Coors Blvd NW
Monkbridge Gardens
556
Midtown
Candelaria Rd NE
Ladera West
47
I-25 N
345
Los Duranes
Menaul Blvd NE
Cibola
6th St NW
2nd St NW
Broadway Blvd NE
East Side
Netherwood Park
Uptown
Atrisco Dr NW
Old Town
I-25 S
Wyoming Blvd NE
Albuquerque
Lomas Blvd NE
Lomas Blvd NE
Lomas Blvd NE
40
40
Central Ave SW
Avalon
Atrisco
Central Ave SE
Nob Hill
La Mesa
Chelwood Vista
Coal Ave SE
Zuni Rd SE
Barelas
Central Ave NE
Central Ave SW Central Ave NW Bridge Blvd SW
Yale Blvd SE
45
314
Elder Homestead
Vintage Rd
Westgate Heights
Sage Rd SW
Albuquerque International Sunport
Armijo
Arenal
303
Kirtland Air Force Base
Four Hills Village
Unser Blvd SW
Atrisco Vista Blvd SW
5 km
4 mi
B E R N A L I L L O
2nd St SW
University Blvd SE
Rio Bravo Blvd SW
500

Figure 12 - DMS Deployments in the AMPA

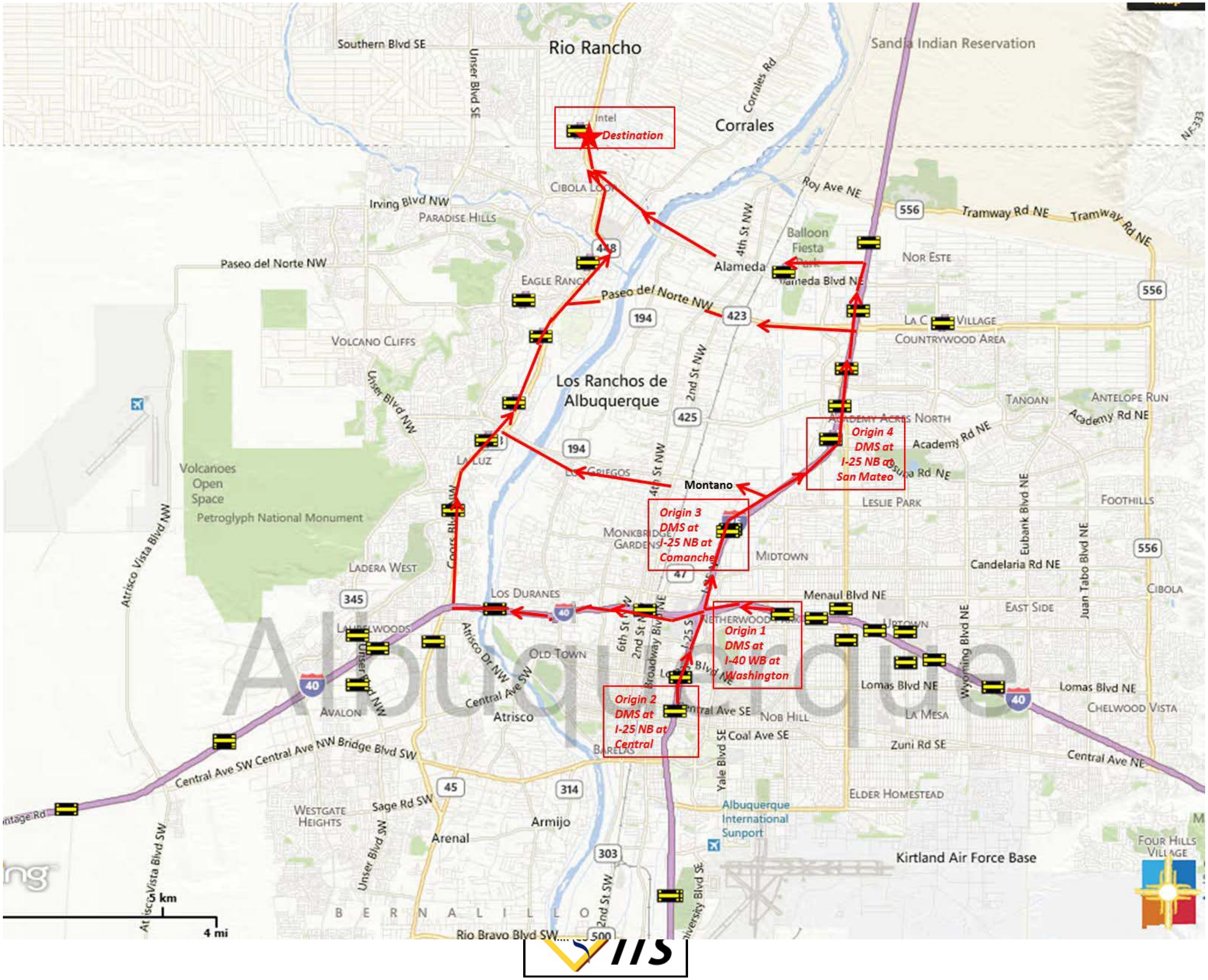

Destination
Origin 1
DMS at
I-40 WB at
Washington
Origin 2
DMS at
I-25 NB at
Central
Origin 3
DMS at
I-25 NB at
Comanche
Origin 4
DMS at
I-25 NB at
San Mateo
Montano
Alameda
Rio Rancho
Corrales
Sandia Indian Reservation
Los Ranchos de
Albuquerque
Albuquerque
Paseo del Norte NW
Tramway Rd NE
Central Ave SW
Albuquerque
International
Sunport
Kirtland Air Force Base
Volcanoes
Open
Space
Petroglyph National Monument
5 km
4 mi

Figure 13 - P.M. Commute Origin(s) - Destination Options

    - I-25 NB at Central to I-25 at Alameda
- Data Translator determines travel times for these segments and creates XML feed
- XML feed is pushed by NMDOT-ITS to Real Time Solutions (RTS) via web-based VPN connection
- Data from COA sensors collected along these segments:
    - Coors at I-40 to Coors Bypass to Westside
    - Montano at I-25 to Coors to Coors Bypass to Westside
    - Paseo del Norte at I-25 to Coors to Coors Bypass to Westside
    - Alameda at I-25 to Alameda Park …….
- Post Oak Application determines travel times for these segments and creates XML feed
- RTS pulls XML feed from COA via web-based VPN connection
- Data from BernCo Sensors collected along the segment of Alameda from 2nd St to Loretta St.
- Post Oak Application determines travel times for these segments and creates XML feed
- RTS is client to the web-based service and polls the XML feed for that segment
- RTS combines segments as appropriated to create contiguous corridors to the destination
- RTS creates a message set for placement on the Skyline® Envoy Application
- Message is pushed to NMDOT-ITS Skyline® Envoy Application via web-based VPN connection
- Message is placed into queue for posting on appropriate sign
- Message is posted
- Process is repeated for updated sensor data

Figure 14 shows an example of what such a display might appear.

FRAME 1

FRAME 2

Figure 14 - Typical Travel Time Display on DMS for PM Commute

Issues

Though both the County's sensors and the City's sensors are using the same application, those applications are not on the same server. Without the sensor data being processed in the same server environment, the time and location references for the vehicles being monitored can't be correlated. Adding sensors at the City/County interface could, however, make it possible to create contingent segments that could be combined to determine travel times on the Alameda corridor.

Also problematic is that there is a two mile stretch along the segment from Loretta to Westside where neither the City nor the County are collecting data (this also holds true for a half-mile section from Alameda Park to 2nd Street). These two segments are where the City's system ends and the County's system begins. All-in-all it accounts for approximately a four and a half (4.5) mile segmented gap from the last COA sensor on Alameda (at Alameda Park) to the Westside sensor in Rio Rancho. See Figure 15.

A portion of this gap could be covered by bringing all of the sensor data into the same server environment for processing. Logistically, it would probably be easiest to bring the four (4) County sensors into the City's server. Whether this data stream can be consolidated via an XML stream from Post Oak's web service or it will require raw data to be directly uploaded into the application is not certain. If the later, connectivity to the City's network is a potential issue. As mentioned earlier, the alternative of adding sensors at the City/County interface could, however, make it possible to create contingent segments that could be combined to determine travel times on the Alameda corridor.

Though the County has extended conduit and fiber from 2nd St to Edith Blvd, there is no communications between Edith and Alameda Park. The City has extended its infrastructure

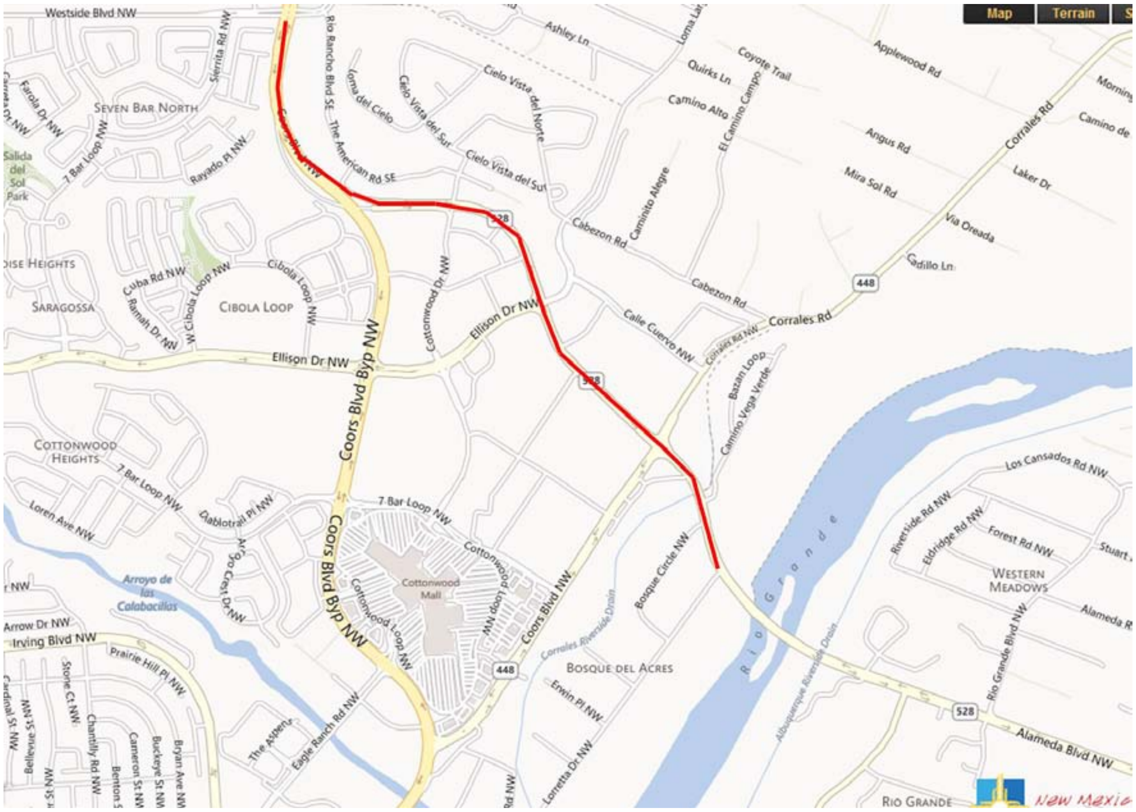


Figure 15 - Sensor Gap Along Alameda to Coors Bypass

(2- in conduit) along Alameda from Coors to a point approximately 300 ft east, however there is no communications infrastructure from that point to Loretta. However, the city has plans in its forthcoming ITS project – Phase 15 – to provide communications on this gap.

The issues between the City and the County in transitioning between different coverage areas also holds true for gaps between the NMDOT-ITS systems and the City's system. The NMDOT measures travel times along the highways and doesn't account for the segments along frontage roads and exits. Neither does the City's array of bluetooth deployments. Some accommodation must be made to account for the time it will take a vehicle to exit from the NMDOT's area of coverage to get onto the City's area of coverage.

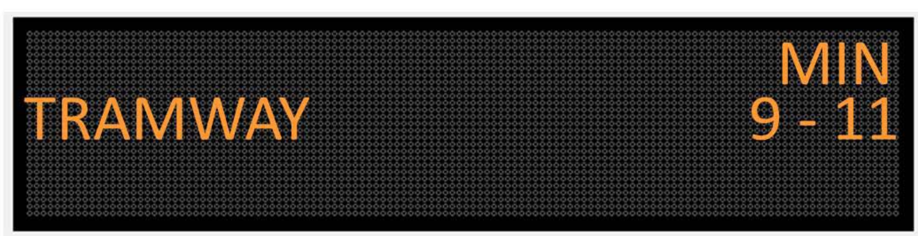
Other Considerations

In this operational scenario, we are using the NB I-25 DMS at Central as an example. That sign currently displays travel times per Figure 16. NMDOT DMS guidelines doesn't allow for using more than two frames to display messages. As such, priorities will need to be established with regards to arterial travel time displays. These priorities could be shifted depending upon time of day (a.m. commute versus p.m. commute).

Another consideration is any inherit latencies in the processes by which information is obtained, and managed (i.e., type of communications, polling periods, message queues). Because some of the processes are internally dependent on others, the latencies become cumulative and could very well affect the timeliness of displaying current conditions and run the risk of presenting stale information. This will be given further consideration in the Systems Engineering Evaluation.

And finally limitation on character length for messages. This could prove challenging in conveying an easily understood message and ensuring they are consistently structured on different signs.

FRAME 1



FRAME 2

Figure 16 - Typical Travel Time Currently Displayed

Operational Scenario 2 – No Incidents -- A.M. Commuting Period

A large percentage of A.M. commuters in the Albuquerque area are originating from the northwest area with destinations at business centers in Downtown Albuquerque, Southeast

Albuquerque (Kirtland AFB / Sandia National Labs, the University area, and the medical complexes) and Northeast Albuquerque (Uptown area).

In Operational Scenario 1 (p.m. commute with no incidents), a common destination point was established (Westside at NM 528). As mentioned, this was done in an attempt to normalize the travel times for all of the arterial options available to the commuter. As an example, telling a motorist it'll take them x minutes to get to Coors via I-40 versus y minutes to get to Coors via Alameda isn't really telling them the same information in that it doesn't account for the conditions along Coors that would have an impact on the motorist's commute. The same holds true for the a.m. commute. The most common recognizable destination is the intersection of I-25 and I-40, or the Big I.

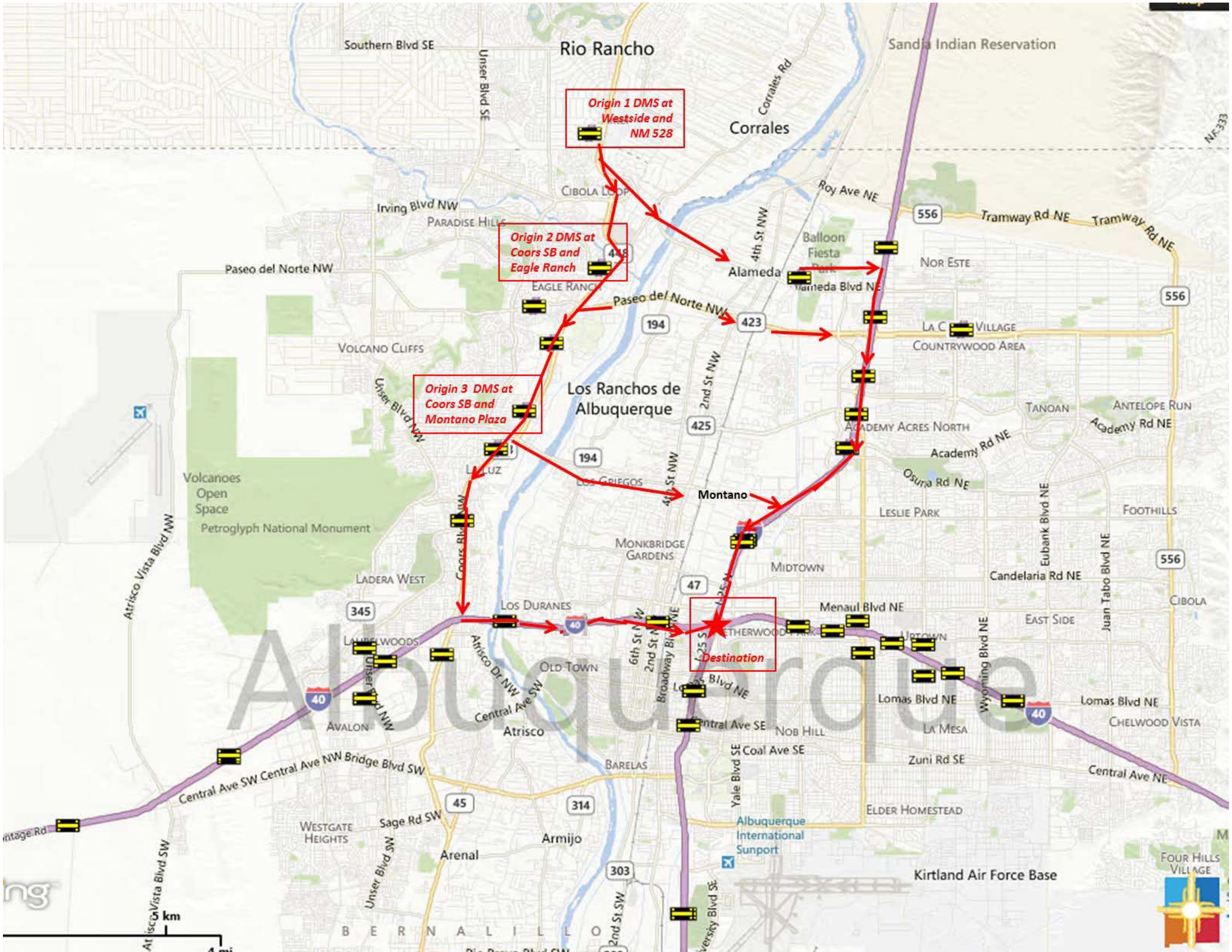
The DMSs having the best value in offering the most choices include for the a.m. commute from the northwest area are:

- Coors SB at Westside (four alternatives)
    - Alameda – I-25 - Central
    - Coors Bypass – Coors - Paseo del Norte – I-25 – Big I
    - Coors Bypass – Coors - Montano – I-25 – Big I
    - Coors Bypass – Coors – I-40 – I-25 – Big I
- Coors SB at Eagle Ranch (three alternatives)
    - Coors - Paseo del Norte – I-25 – Big I
    - Coors - Montano – I-25 – Big I
    - Coors – I-40 – I-25 – Big I
- Coors SB at Montano Plaza (two alternatives)
    - Coors - Montano – I-25 – Big I
    - Coors – I-40 – I-25 – Big I

Figure 17 shows these options. it is counter to anticipated flow, travel time displays along arterials to the Albuquerque business districts would not be displayed on the NB signs along Coors.

Using the display on the Westside Sign, as an example, the following segments and associated sensor/applications would be needed to create the travel times:

- Data from COA sensors collected along these segments:
    - Westside to Coors Bypass to Coors to I-40
    - Westside to Coors Bypass to Coors to Montano to I-25
    - Westside to Coors Bypass to Coors to Paseo del Norte to I-25
    - Westside to Alameda Park to I-25
- Post Oak Application determines travel times for these segments and creates XML feed
- RTS pulls XML feed from COA via web-based VPN connection
- Data from Bernco Sensors collected along the segment of Alameda from Loretta to 2nd St


Origin 1 DMS at Westside and NM 528
Origin 2 DMS at Coors SB and Eagle Ranch
Origin 3 DMS at Coors SB and Montano Plaza
Montano
Destination
Rio Rancho
Corrales
Los Ranchos de Albuquerque
Albuquerque
Sandia Indian Reservation
Kirtland Air Force Base
Albuquerque International Sunport
Petroglyph National Monument
Volcanoes Open Space

ITS

Figure 17 - Options for Origin(s) - Destination A.M. Commute

- Post Oak Application determines travel times for these segments and creates XML feed
- RTS is client to the web-based service and polls the XML feed for that segment
- Data from NMDOT – ITS sensors collected along these segments:
  - I-40 WB at Coors to I-25 SB to Central to
  - I-25 at Montano to Central
  - I-25 at Paseo Del Norte to Central
  - I-25 at Alameda to Central
- Data Translator determines travel times for these segments and creates XML feed
- XML feed is pushed by NMDOT-ITS to Real Time Solutions (RTS) via web-based VPN connection
- RTS combines segments as appropriated to create contiguous corridors to the destination
- RTS creates a message set for placement on the Skyline® Envoy Application
- Message is pushed to City-owned Skyline® Envoy Application via web-based VPN connection
- Message is placed into queue for posting on appropriate sign
- Message is posted
- Process is repeated for updated sensor data

Figure 18 provides an example of how this message might appear.

Figure 18 - Typical Travel Time Display on DMS for AM Commute

Issues

The same issues identified in Operational Scenario 1 holds true for Operational Scenario 2.

Operational Scenario 3 – Incident Occurring During Commuting Periods

When an incident occurs that could affect any segment of the arterials or interstates, regardless of whether it's during the a.m. or p.m. commute or the p.m., the DMSs will display information about the incident and not display travel times.

Other Operational Scenarios

The three operational scenarios presented represent those that are likely to occur. That said, absent in the consideration of being an arterial alternatives is US 550. The reasoning behind this is that for the vast majority of traffic making this commute, using US 550 would represent a large detour. If the scenario were to occur where the commuting time via US 550 would be comparable to that of the other river crossings, invariably an incident on one or more of them would have had to occur, and in that instance, once again, information about the incident would be displayed.

In addition to the above, the operational scenarios in this Con-Ops address only current and active deployments – it doesn't take into account the locations the City of Rio Rancho plans to deploy bluetooth devices.

Summary of Impacts

This is an analysis of the proposed system and the impacts on each of the stakeholders. It is presented from the viewpoint of each, so that they can readily understand and validate how the proposed system will impact their operations. Here is where any constraints on system development are documented. Metrics for assessing system performance are also included here.

To be effective in the different operational scenarios previously presented, each stakeholder will be impacted in one way or another. The degree of impact could vary from simple to complex. Going back to each stakeholder's current operational and support environment will provide a baseline from which to start.

NMDOT ITS Operations

As noted earlier, elements that are integral to the function of displaying travel times on NMDOT-owned DMSs include:

- Wavetronix® microwave vehicle detections systems (located on Interstates 25 and 40 and Paseo del Norte) – No impacts are expected
- Field Communications via NMDOT-owned 96 strand fiber optics backbone and RuggedCom® ethernet switches – No impacts are expected
- Collected data is imported into Wavetronix® Data Command Application – No impacts are expected
- Data is used to determine travel times via Data Translator Module of Data Command - New segments will need to be built out within the application
- An XML feed of the travel times is created in Data Translator and sent to RealTime Solutions via a secured web connection – XML feed will need to include the new appropriate segmentations, as such will also come from different sources (COA and/or Bernalillo County's service provider). This will require additional developer coding and subsequent additional costs to the ITS Operations.
- XML feed is used to create a message for travel time display on DMSs – Message creation will need to be adjusted to account for new destinations. API for message selection will also now include a scheduling element (a.m. commute message versus p.m. commute message). This will require additional developer coding and subsequent additional costs to the ITS Operations.
- Message command is sent to NMDOT ITS Skyline Envoy Application® via a secure web connection – No impacts are expected.
- Envoy application places the message on the signs – Potential impact to the queue length for transmitting messages.
- The issue of coverage gaps has to be addressed. These hand-off points would need to occur within the coverage boundaries instead of at the margins. That could very well require additional hardware deployments and associated configuration changes.
- The expansion of the Bureau's reliability on other stakeholders operations to ensure information being presented is accurate is another big impact. Should any of these interdependent functions fail, errors will be generated.
- Current operations require coordination between NMDOT ITS staff and RTS personnel. Processes and procedures will need to be expanded to include COA (and its associated divisions) and Bernalillo County (and its service provider).

City of Albuquerque

To recap, the elements that are integral to the function of displaying travel times on City-owned DMSs include:

- Post Oak® Bluetooth Traffic Sensor systems – No anticipated impact
- Field Communications via city-owned fiber optics backbone and Ether-Wan® ethernet switches – Potential impacts if addressing the coverage gaps require communications network expansion.
- Collected data is imported into Post Oak® Application residing on the city network – Potential impacts if addressing the coverage gaps require bringing Bernalillo County field sensors into City's application
- Post Oak® application determines travel times – Potential impact in having to revise Alameda segmentation.
- An XML feed of the travel times is created in Post Oak application and is retrieved by RTS via a secured web connection (VPN) into the City's network – No impact
- XML feed is used to create a message for travel time display on DMSs – Potential impact depending on how the issue of coverage gap between Bernalillo County and COA is addressed. Could potentially require the management of a separate XML stream by RTS.
  Actual impact if destination includes segments along the interstate (as discussed in operational scenario 2 with Central Ave being the destination. Data Translator® XML feed from NMDOT-ITS is required.
- Message command is sent to the City's Skyline Envoy Application® via a secure web connection (VPN) – No anticipated imapact
- Envoy application places the message on the signs – Because there aren't a significant number of signs in the City's inventory, there aren't any anticipated impacts to the queue lengths for message placement.
- The issue of coverage gaps has to be addressed. These hand-off points would need to occur within the coverage boundaries instead of at the margins. That could very well require additional hardware deployments and associated configuration changes.
- The expansion of the City's reliability on other stakeholders operations to ensure information being presented is accurate is another big impact. Should any of these interdependent functions fail, errors will be generated.
- Current operations require coordination between COA staff and RTS personnel. Processes and procedures will need to be expanded to include NMDOT-ITS (and its associated divisions) and Bernalillo County (and its service provider).

Bernalillo County

There are no potential impacts to Bernalillo County's continued operations other than the recurring cost of the subscription service. It is unclear how long the deployments must remain in place as part of evaluating the adaptive system for acceptance.

NMDOT Signal Maintenance Lab

There are no potential impacts to Signal Maintenance Lab's continued operations other than the recurring cost of the subscription service. Currently communications to some of these devices is via a Wi-Fi mesh that is paid for by ITS Operations. This mesh is expected to be retired in approximately one to two years. At that time, it will be the responsibility of the Signal Maintenance Lab to establish communications to these devices.

City of Rio Rancho

Potential impacts will depend on the options they choose to move forward with. Regardless of choice, it undoubtedly will require additional resource, either in the form of funds to pay for outside support or internal man-hours for system maintenance and operations.

Metrics and System Validation

How each stakeholder defines success and how they determine if they have met it will vary. Those that are using it for advising motorists can to some degree gauge their success by public sentiment and feedback. Was the information they provided both timely and accurate? In achieving that did it require cooperative effort among stakeholders that is reliable? To that end, 'Has there been any issues with the sharing of information, access to networks, or field equipment maintenance and operations?' Were the number and/or frequency of occurrences, and the time to respond to issues acceptable?

If they are using it to evaluate signal performance, did the system accurately reflect actual conditions? Was it reliable? Does it require a lot of maintenance to operate? Did it produce false positives or false negatives? Could the agency properly respond to the information provided?

Did it give the stakeholder information with enough confidence that it can be used as a binding element for contractual obligations?

Each of the questions asked above, though qualitative, can easily have quantitative elements assigned to them. Doing so implies an acceptable level of performance. Measuring and tracking those elements should be both realistic and distinguishable between the system's performance and the stakeholder's activities and associated responsibilities. It should be developed out of consensus, and objectively hold both the system and each stakeholder accountable.

Conclusion

The intent of the Con-Ops was to document how each stakeholder would use travel time data collected from arterials, to explore the functional elements of the existing systems already deployed, to identify any issues associated with the current level of deployment, and to provide a baseline of information from which a systems engineering evaluation can be performed which hopefully would provide guidance on how the move forward.

Pertinent topics such as system costs, needed resources of maintenance, and finally recommendations of the preferred alternatives are not included in the Con-Ops, but will be discussed in the SE evaluation. As part of the Alternatives Analysis in the SE, it is highly recommended that the ITS Subcommittee confer with the different manufacturers of the systems already deployed, and potentially with others (i.e., INRIX®) to have a better understanding of each capabilities and impacts. Preliminary discussions with representatives from both Blue Toad® and Post Oak® have shown their interest in presenting such information to the ITS Subcommittee.

Action Items

Appendices

This is a place to put a glossary, notes, and backup or background material for any of the sections. For example, it might include analysis results in support of the concept exploration.

FHWA Concept of Operations Template

http://www.fhwa.dot.gov/cadiv/segb/views/document/sections/Section8/8_4_5.htm

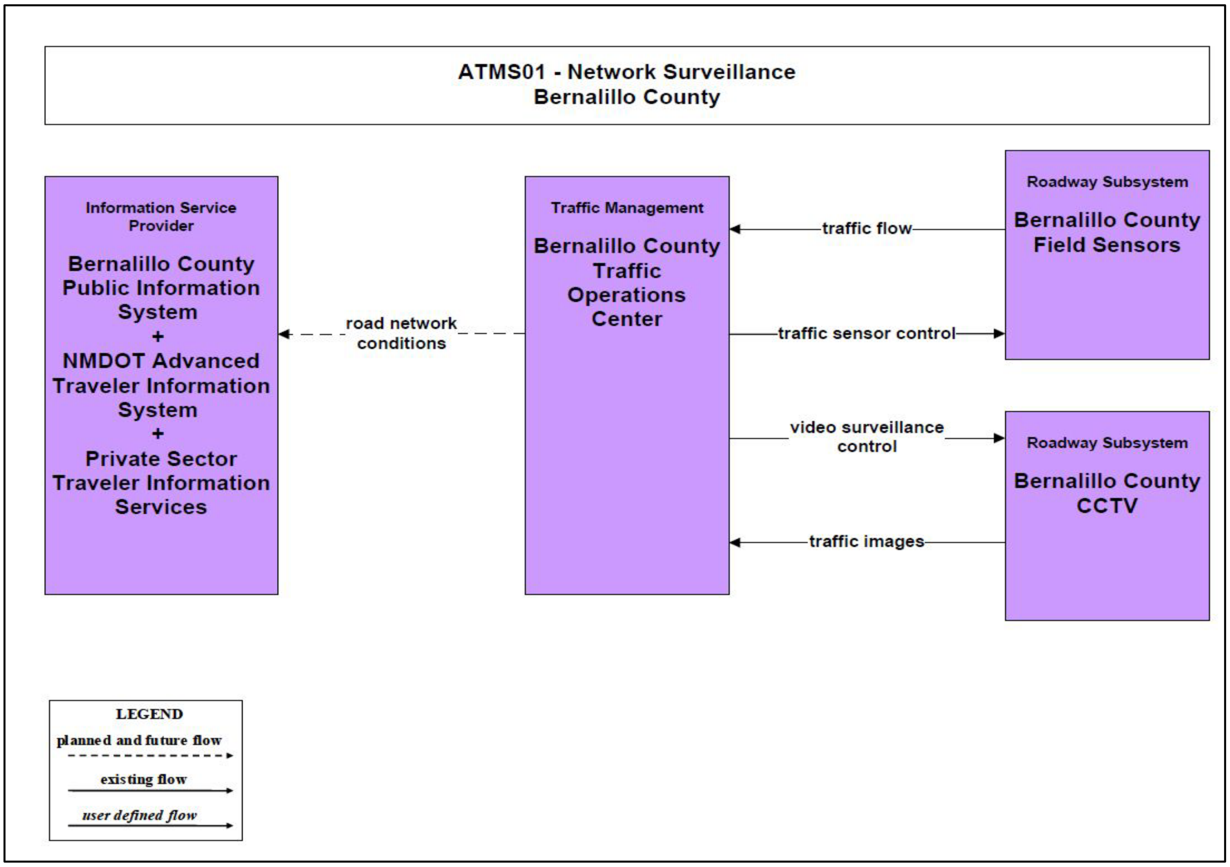
Relevant standards are the ANSI/AIAA G-043-1992standard and IEEE Standard 1362

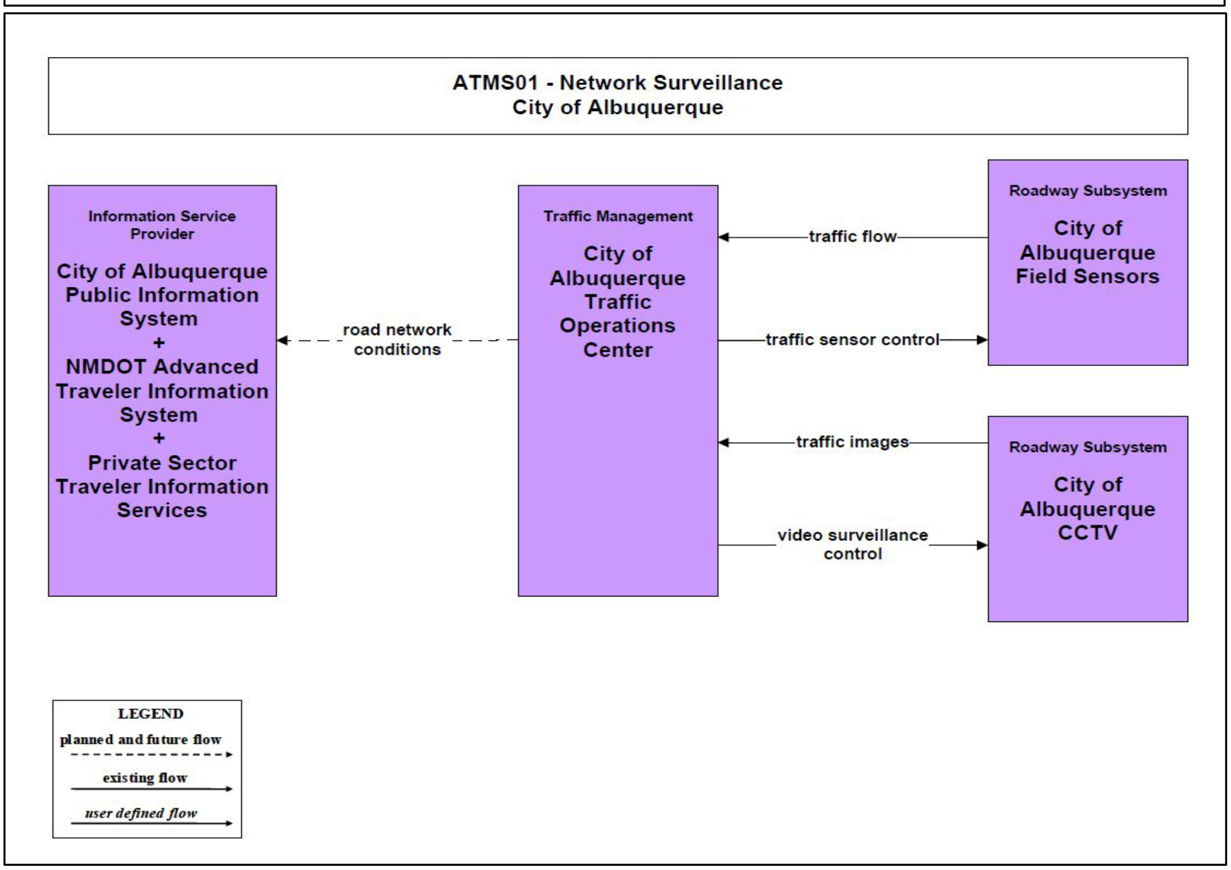
SECTION	CONTENTS
Title Page	The title page should follow the Transportation Agency procedures or style guide. At a minimum, it should contain the following information: • CONCEPT OF OPERATIONS FOR THE [insert name of project] AND [insert name of transportation agency] • Contract number • Date that the document was formally approved • The organization responsible for preparing the document • Internal document control number, if available • Revision version and date issued
2.0 Scope of Project	This short section gives a brief overview of the system to be built. It includes its purpose and a high-level description. It describes what area will be covered and which agencies will be involved, either directly or through interfaces. One or two paragraphs will suffice.
3.0 Referenced Documents	This optional section is a place to list any supporting documentation used and other resources that are useful in understanding the operations of the system. This could include any documentation of current operations and any strategic plans that drive the goals of the system under development.
4.0 Background	Here is a brief description of the current system or situation, how it is used currently, and its drawbacks and limitations. This leads into the reasons for the proposed development and the general approach to improving the system. This is followed by a discussion of the nature of the planned changes and a justification for them.
5.0 Concept for the	This section describes the concept exploration. It starts with a list and description of the alternative concepts examined. The evaluation and

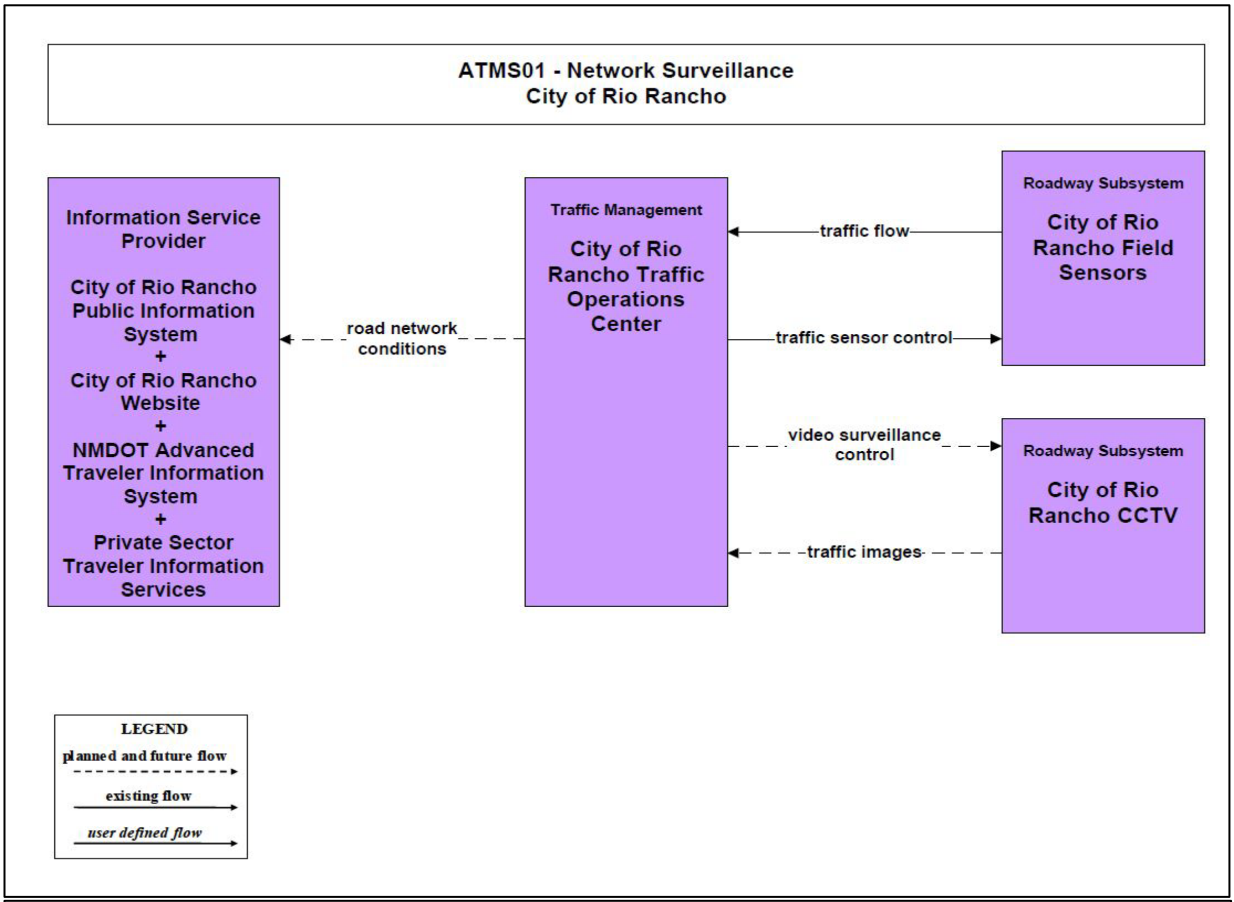
SECTION	CONTENTS
Proposed System	assessment of each alternative follows. This leads into the justification for the selected approach. The operational concept for that selected approach is described here. This is not a design, but a high-level, conceptual, operational description. It uses only as much detail as needed to be able to develop meaningful scenarios. In particular, if alternative approaches differ in terms of which agency does what, that will need to be resolved and described. An example would be the question of whether or not a regional signal system will have centralized control.
6.0 User-Oriented Operational Description	This section focuses on how the goals and objectives are accomplished currently. Specifically, it describes strategies, tactics, policies, and constraints. This is where the stakeholders are described. It includes who users are and what the users do. Specifically, it covers when, and in what order, operations take place, personnel capabilities, organizational structures, personnel & inter-agency interactions, and types of activities. This may also include operational process models in terms of sequence and interrelationships.
7.0 Operational Needs	Here is a description of the vision, goals & objectives, and personnel needs that drive the requirements for the system. Specifically, this describes what the system needs to do that it is not currently doing.
8.0 System Overview	This is an overview of the system to be developed. This describes its scope, the users of the system, what it interfaces with, its states and modes, the planned capabilities, its goals & objectives, and the system architecture. Note that the system architecture is not a design [that will be done later]. It provides a structure for describing the operations, in terms of where the operations will be carried out, and what the lines of communication will be.
9.0 Operational Environment	This section describes the physical operational environment in terms of facilities, equipment, computing hardware, software, personnel, operational procedures and support necessary to operate the deployed system. For example, it will describe the personnel in terms of their expected experience, skills and training, typical work hours, and other activities [e.g., driving] that must be or may be performed concurrently.
10.0 Support	This describes the current and planned physical support environment. This includes facilities, utilities, equipment, computing hardware,

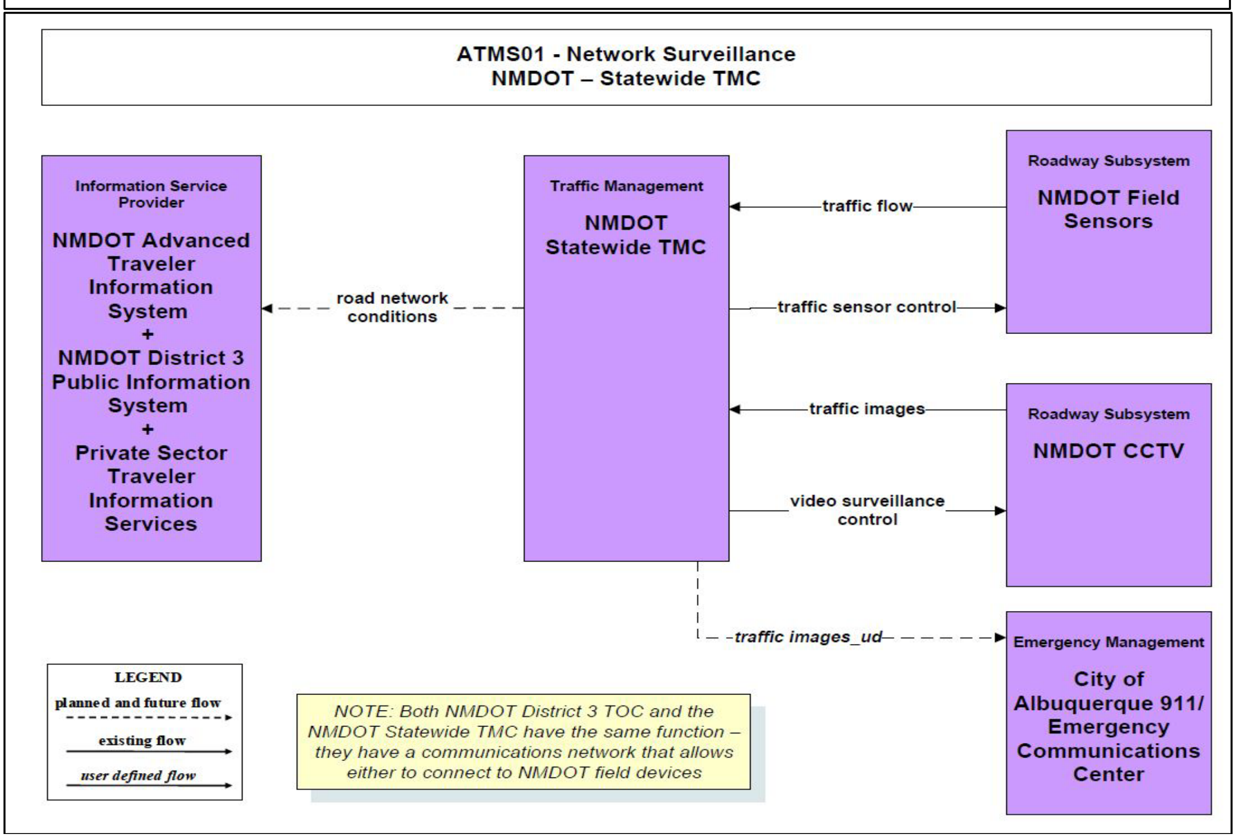
SECTION	CONTENTS
Environment	software, personnel, operational procedures, maintenance, and disposal. This includes expected support from outside agencies.
11.0 Operational Scenarios	This is the heart of the document. Each scenario describes a sequence of events, activities carried out by the user, the system, and the environment. It specifies what triggers the sequence, who or what performs each step, when communications occur and to whom or what [e.g., a log file], and what information is being communicated. The scenarios will need to cover all normal conditions, stress conditions, failure events, maintenance, and anomalies and exceptions. There are many ways for presenting scenarios, but the important thing is that each stakeholder can clearly see what his expected role is to be.
12.0 Summary of Impacts	This is an analysis of the proposed system and the impacts on each of the stakeholders. It is presented from the viewpoint of each, so that they can readily understand and validate how the proposed system will impact their operations. Here is where any constraints on system development are documented. Metrics for assessing system performance are also included here.
13.0 Appendices	This is a place to put a glossary, notes, and backup or background material for any of the sections. For example, it might include analysis results in support of the concept exploration.

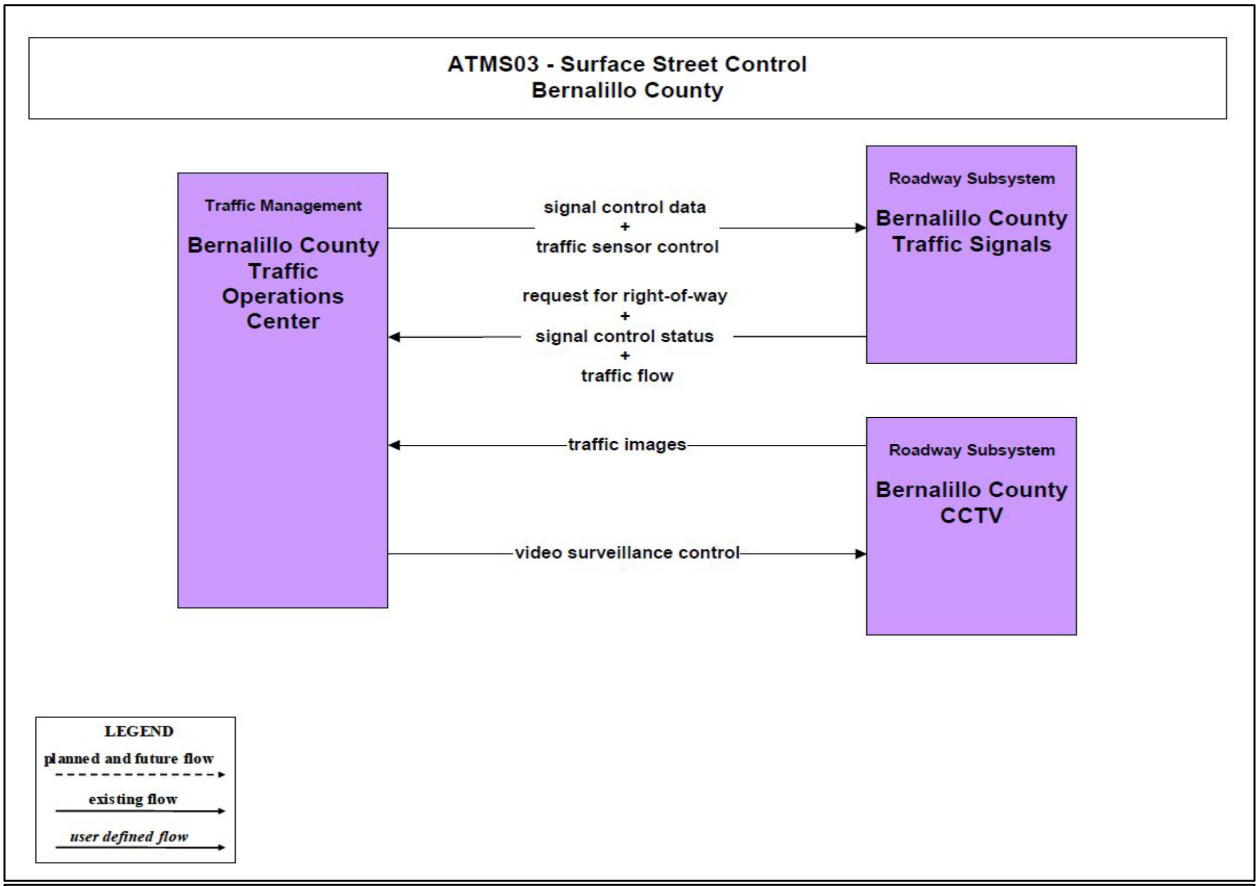
AMPA ITS Architecture Service Packages

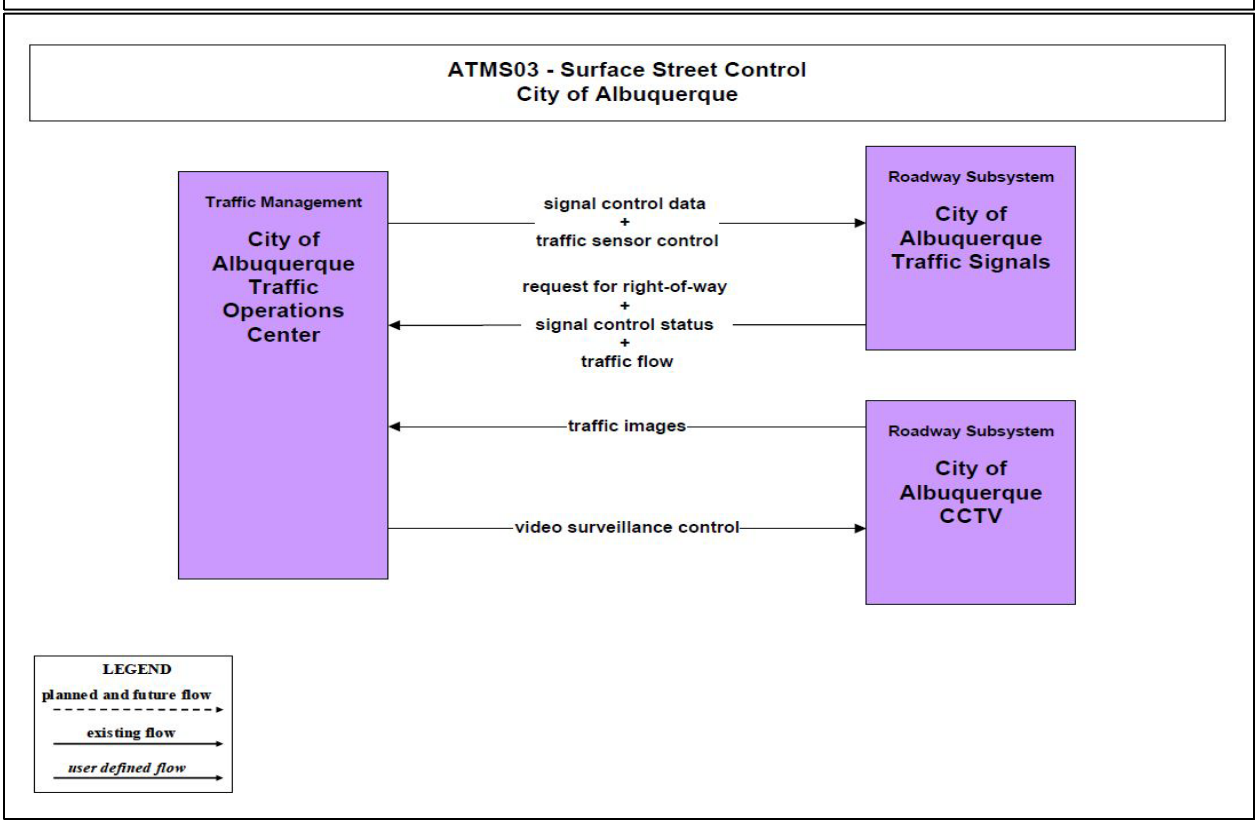

ATMS01 - Network Surveillance
Bernalillo County
Information Service Provider
Bernalillo County Public Information System + NMDOT Advanced Traveler Information System + Private Sector Traveler Information Services
road network conditions
Traffic Management
Bernalillo County Traffic Operations Center
traffic flow
traffic sensor control
video surveillance control
traffic images
Roadway Subsystem
Bernalillo County Field Sensors
Roadway Subsystem
Bernalillo County CCTV
LEGEND
planned and future flow
existing flow
user defined flow

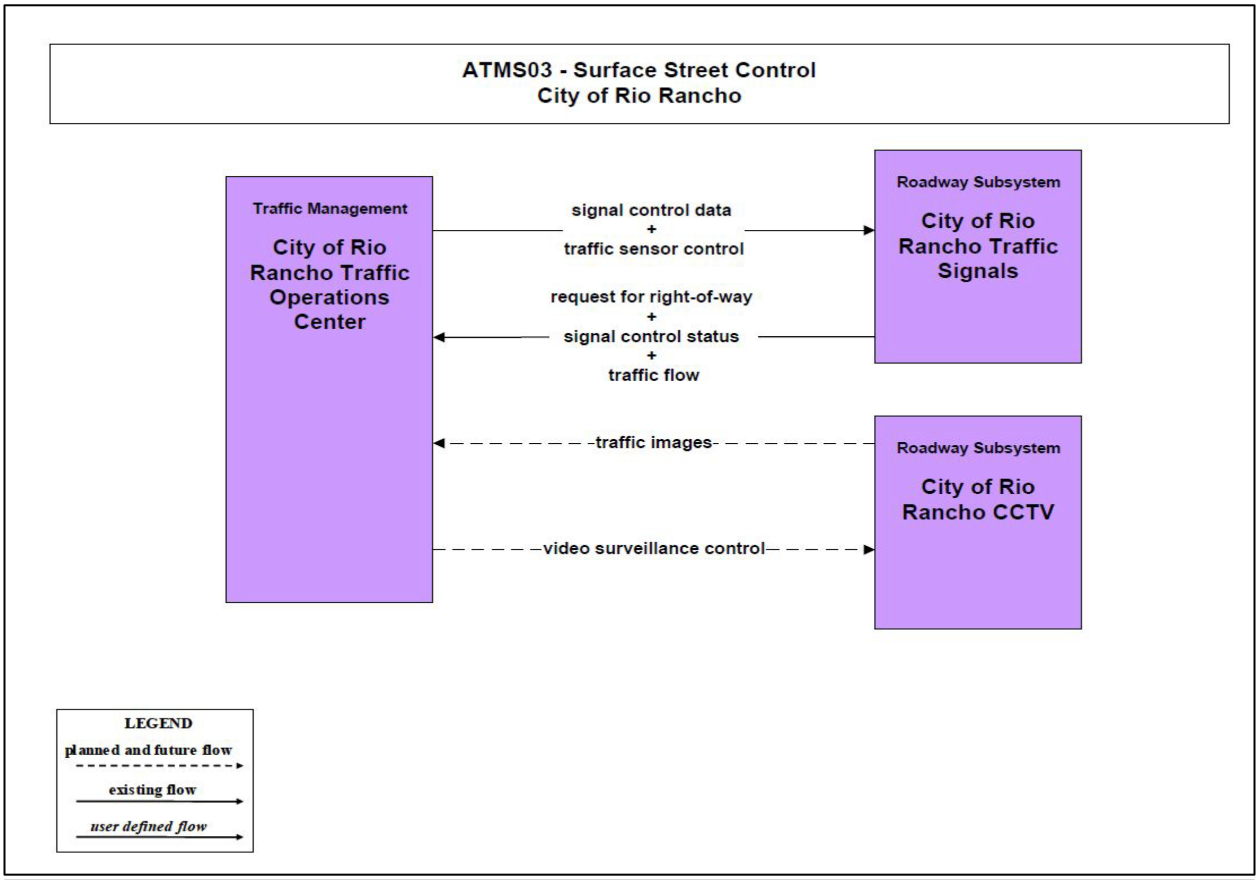

ATMS01 - Network Surveillance
City of Albuquerque
Information Service Provider
City of Albuquerque Public Information System + NMDOT Advanced Traveler Information System + Private Sector Traveler Information Services
road network conditions
Traffic Management
City of Albuquerque Traffic Operations Center
traffic flow
traffic sensor control
traffic images
video surveillance control
Roadway Subsystem
City of Albuquerque Field Sensors
Roadway Subsystem
City of Albuquerque CCTV
LEGEND
planned and future flow
existing flow
user defined flow

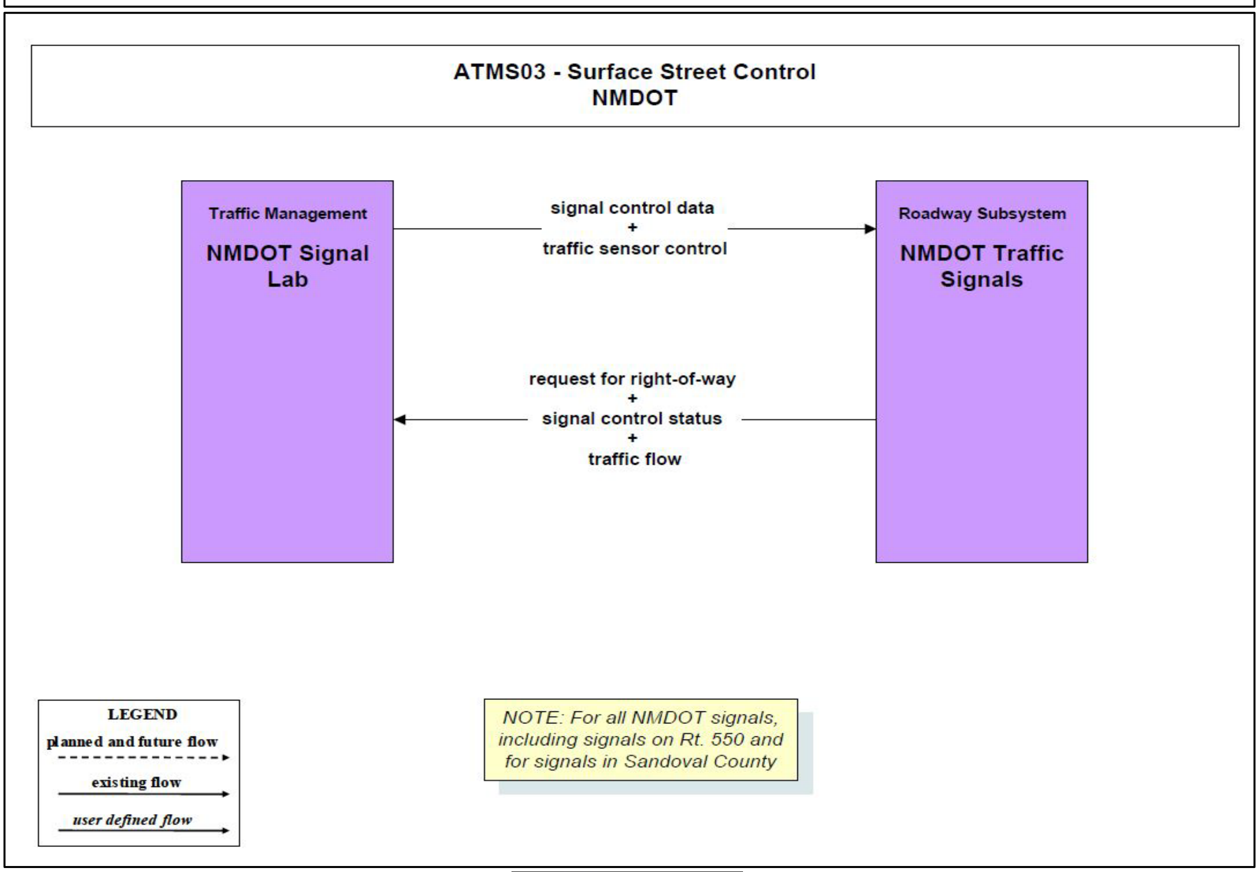

ATMS01 - Network Surveillance
City of Rio Rancho
Information Service Provider
City of Rio Rancho Public Information System
+
City of Rio Rancho Website
+
NMDOT Advanced Traveler Information System
+
Private Sector Traveler Information Services
road network conditions
Traffic Management
City of Rio Rancho Traffic Operations Center
traffic flow
traffic sensor control
video surveillance control
traffic images
Roadway Subsystem
City of Rio Rancho Field Sensors
Roadway Subsystem
City of Rio Rancho CCTV
LEGEND
planned and future flow
existing flow
user defined flow

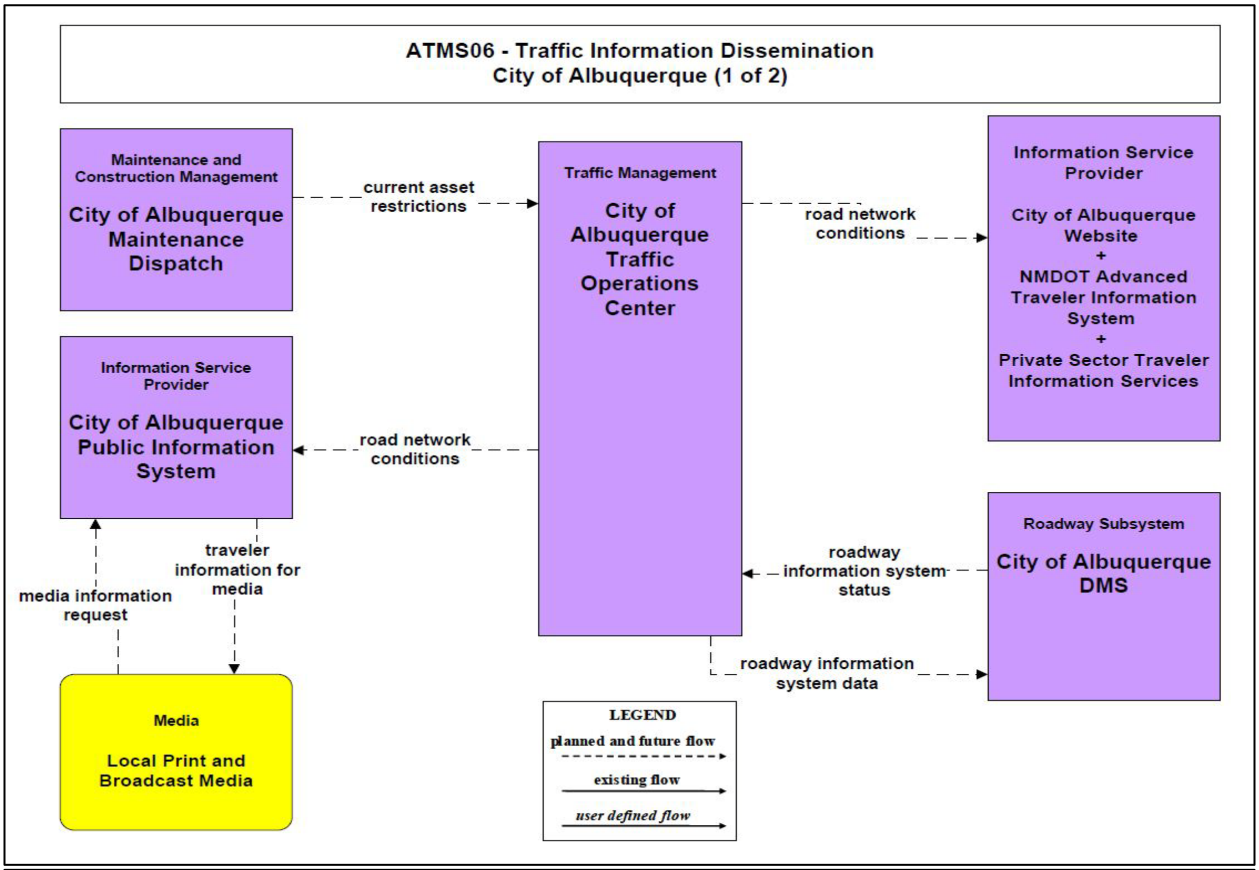

ATMS01 - Network Surveillance
NMDOT – Statewide TMC
Information Service Provider
NMDOT Advanced Traveler Information System
+
NMDOT District 3 Public Information System
+
Private Sector Traveler Information Services
road network conditions
Traffic Management
NMDOT Statewide TMC
traffic flow
traffic sensor control
traffic images
video surveillance control
traffic images_ud
Roadway Subsystem
NMDOT Field Sensors
Roadway Subsystem
NMDOT CCTV
Emergency Management
City of Albuquerque 911/ Emergency Communications Center
LEGEND
planned and future flow
existing flow
user defined flow
NOTE: Both NMDOT District 3 TOC and the NMDOT Statewide TMC have the same function – they have a communications network that allows either to connect to NMDOT field devices

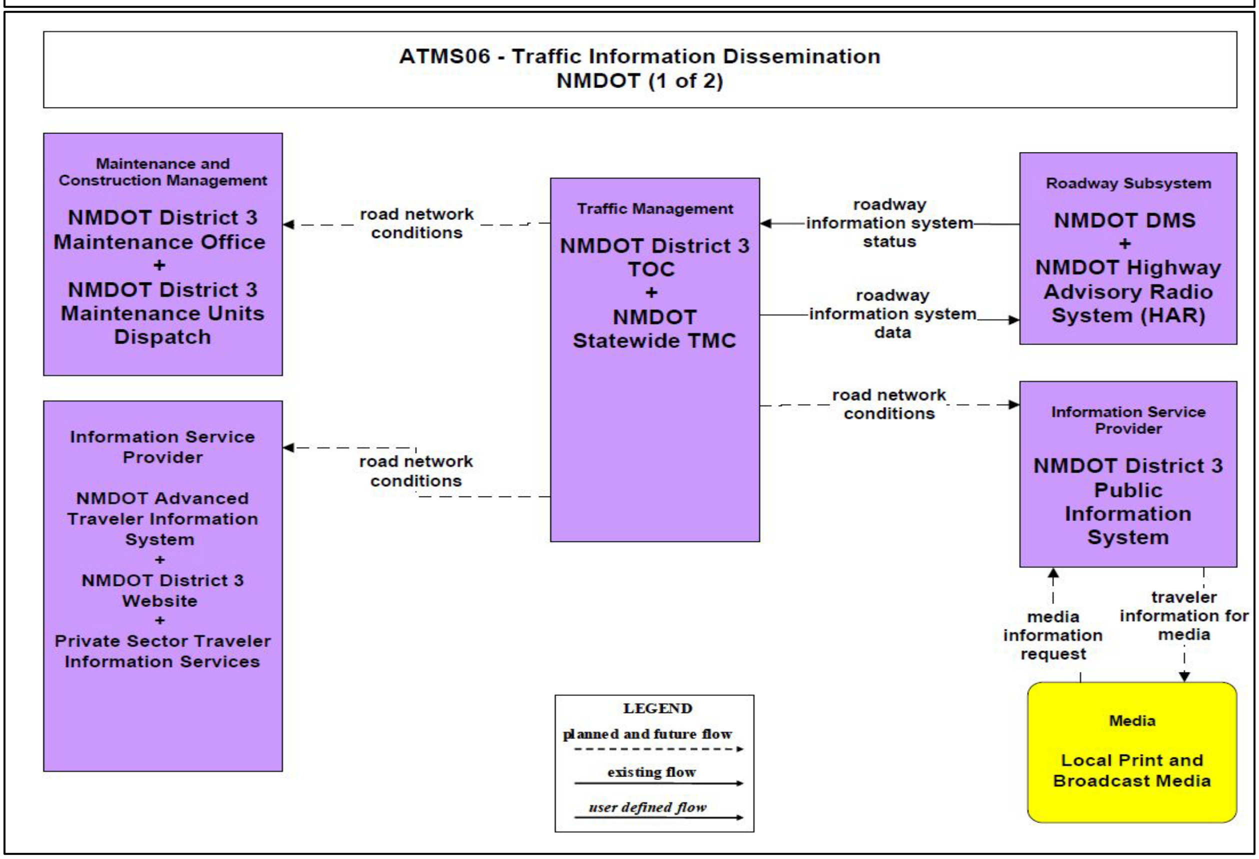

ATMS03 - Surface Street Control
Bernalillo County
Traffic Management
Bernalillo County Traffic Operations Center
signal control data + traffic sensor control
request for right-of-way + signal control status + traffic flow
traffic images
video surveillance control
Roadway Subsystem
Bernalillo County Traffic Signals
Roadway Subsystem
Bernalillo County CCTV
LEGEND
planned and future flow
existing flow
user defined flow

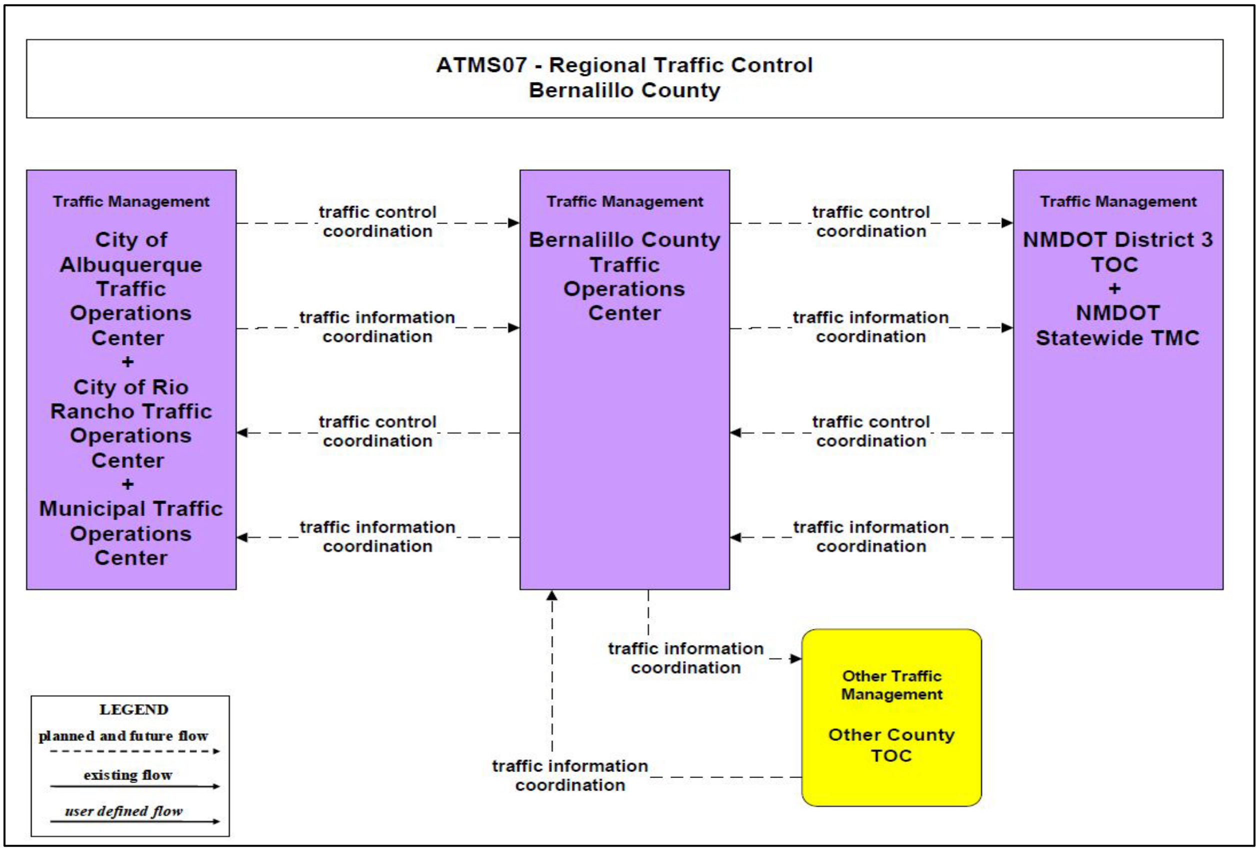

ATMS03 - Surface Street Control
City of Albuquerque
Traffic Management
City of Albuquerque Traffic Operations Center
signal control data + traffic sensor control
request for right-of-way + signal control status + traffic flow
traffic images
video surveillance control
Roadway Subsystem
City of Albuquerque Traffic Signals
Roadway Subsystem
City of Albuquerque CCTV
LEGEND
planned and future flow
existing flow
user defined flow

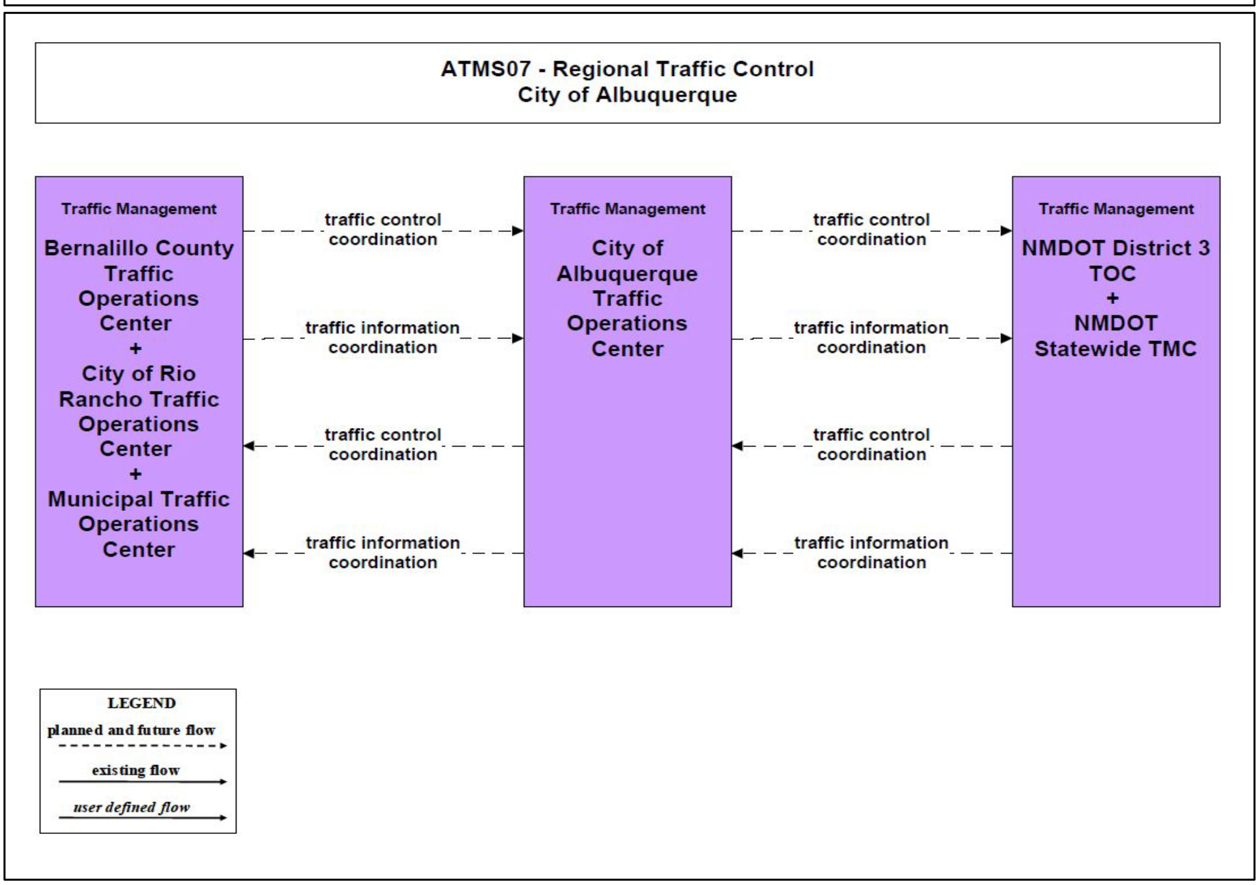

ATMS03 - Surface Street Control
City of Rio Rancho
Traffic Management
City of Rio Rancho Traffic Operations Center
Roadway Subsystem
City of Rio Rancho Traffic Signals
signal control data + traffic sensor control
request for right-of-way + signal control status + traffic flow
traffic images
Roadway Subsystem
City of Rio Rancho CCTV
video surveillance control
LEGEND
planned and future flow
existing flow
user defined flow

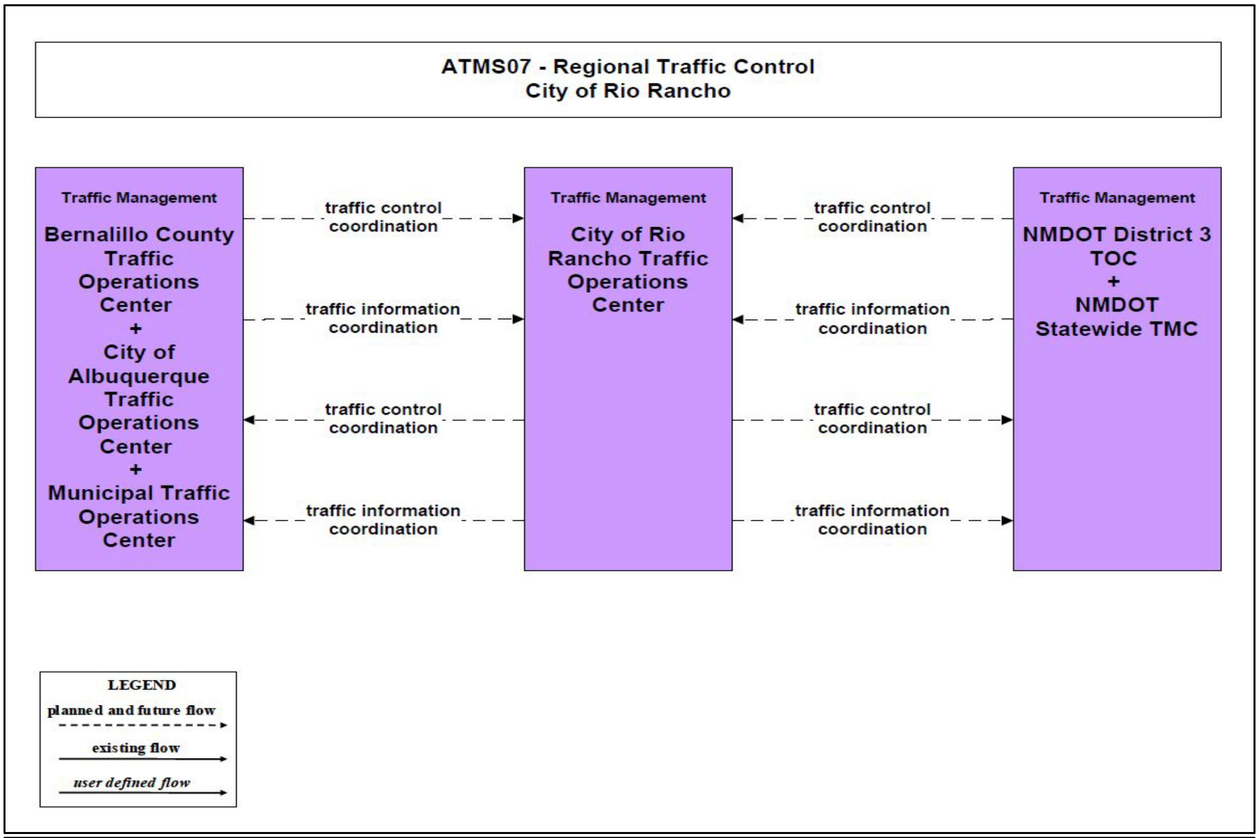

ATMS03 - Surface Street Control
NMDOT
Traffic Management
NMDOT Signal Lab
Roadway Subsystem
NMDOT Traffic Signals
signal control data + traffic sensor control
request for right-of-way + signal control status + traffic flow
LEGEND
planned and future flow
existing flow
user defined flow
NOTE: For all NMDOT signals, including signals on Rt. 550 and for signals in Sandoval County

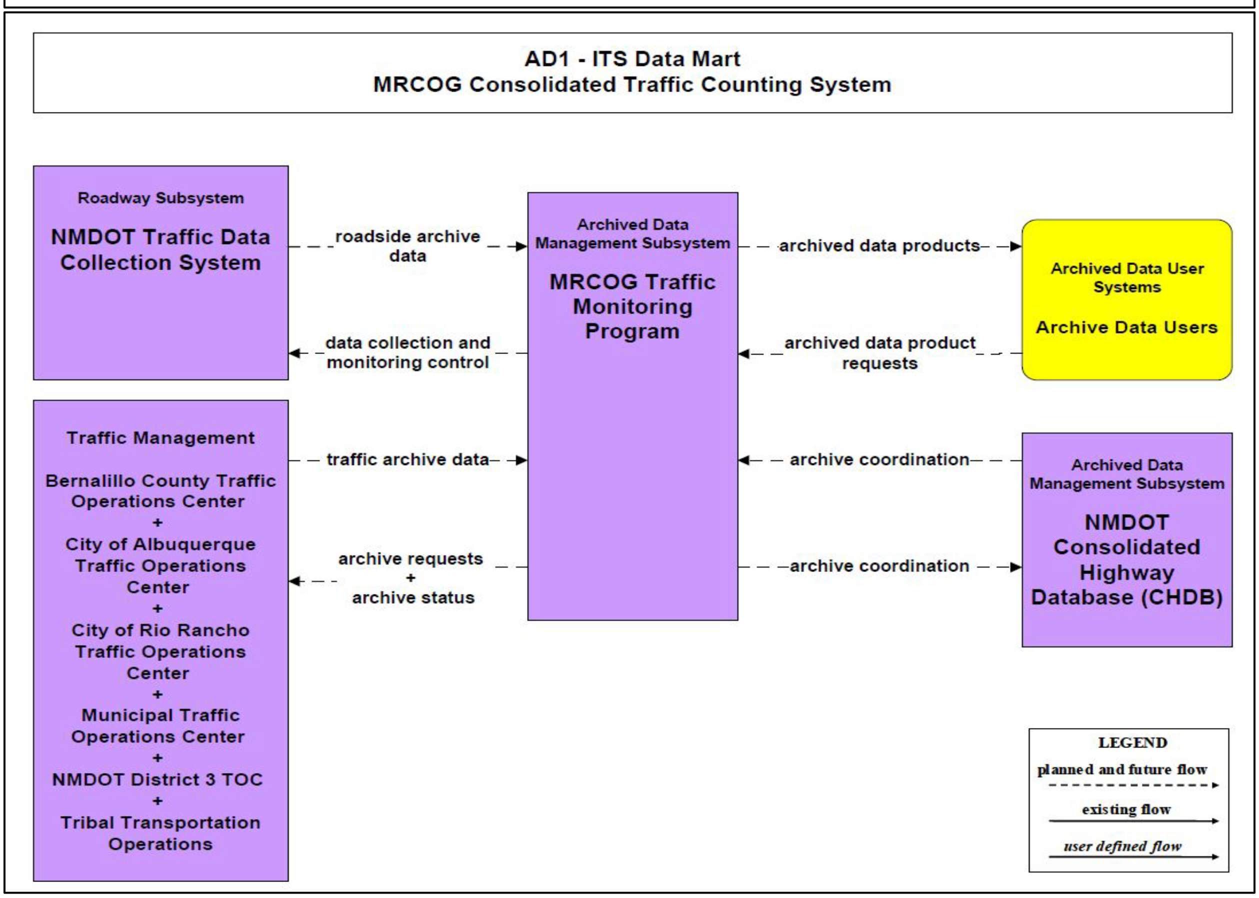

ATMS06 - Traffic Information Dissemination
City of Albuquerque (1 of 2)
Maintenance and Construction Management
City of Albuquerque Maintenance Dispatch
current asset restrictions
Traffic Management
City of Albuquerque Traffic Operations Center
road network conditions
Information Service Provider
City of Albuquerque Website
+
NMDOT Advanced Traveler Information System
+
Private Sector Traveler Information Services
Information Service Provider
City of Albuquerque Public Information System
road network conditions
roadway information system status
Roadway Subsystem
City of Albuquerque DMS
traveler information for media
media information request
roadway information system data
Media
Local Print and Broadcast Media
LEGEND
planned and future flow
existing flow
user defined flow

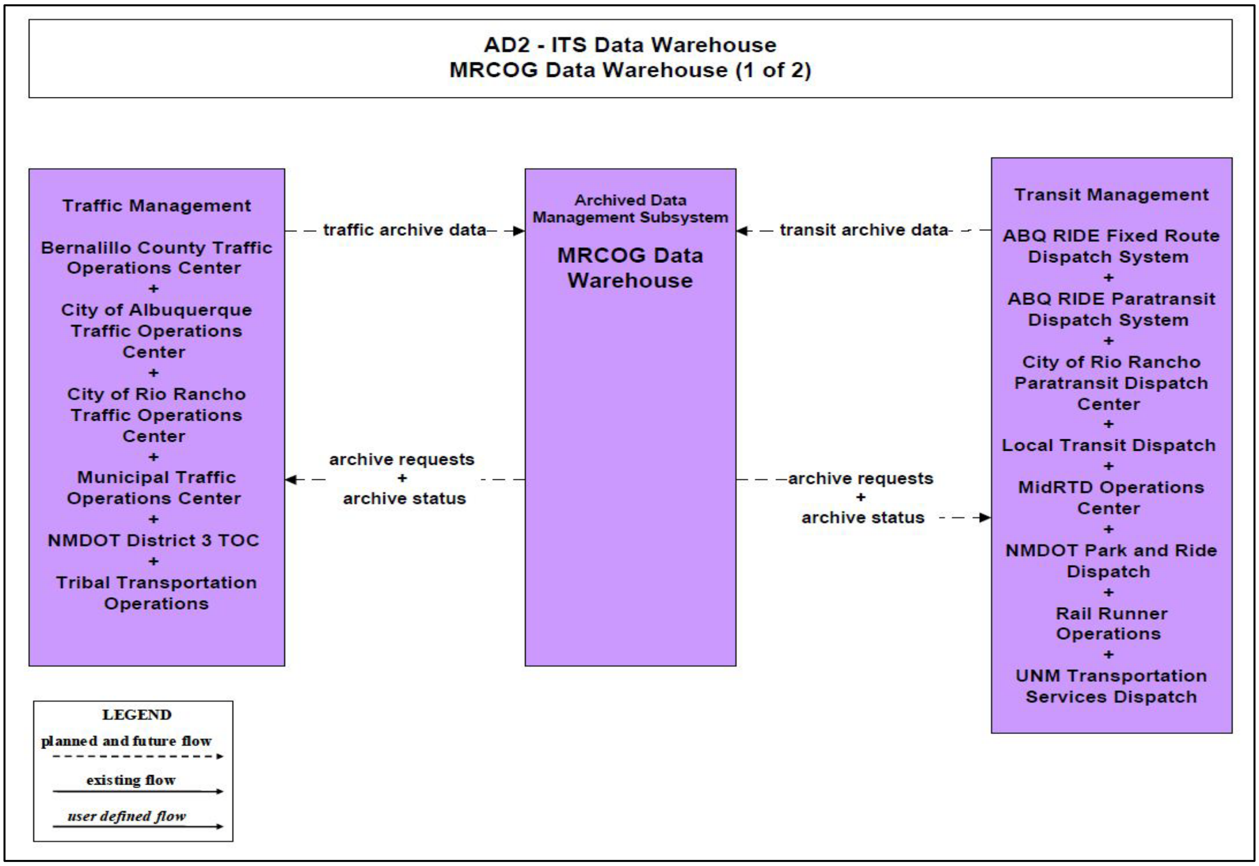

ATMS06 - Traffic Information Dissemination
NMDOT (1 of 2)
Maintenance and Construction Management
NMDOT District 3 Maintenance Office
+
NMDOT District 3 Maintenance Units Dispatch
road network conditions
Traffic Management
NMDOT District 3 TOC
+
NMDOT Statewide TMC
roadway information system status
roadway information system data
Roadway Subsystem
NMDOT DMS
+
NMDOT Highway Advisory Radio System (HAR)
road network conditions
Information Service Provider
NMDOT District 3 Public Information System
Information Service Provider
NMDOT Advanced Traveler Information System
+
NMDOT District 3 Website
+
Private Sector Traveler Information Services
road network conditions
media information request
traveler information for media
Media
Local Print and Broadcast Media
LEGEND
planned and future flow
existing flow
user defined flow


ATMS07 - Regional Traffic Control
Bernalillo County
Traffic Management
City of Albuquerque Traffic Operations Center + City of Rio Rancho Traffic Operations Center + Municipal Traffic Operations Center
traffic control coordination
traffic information coordination
traffic control coordination
traffic information coordination
Traffic Management
Bernalillo County Traffic Operations Center
traffic control coordination
traffic information coordination
traffic control coordination
traffic information coordination
Traffic Management
NMDOT District 3 TOC + NMDOT Statewide TMC
traffic information coordination
traffic information coordination
Other Traffic Management
Other County TOC
LEGEND
planned and future flow
existing flow
user defined flow


ATMS07 - Regional Traffic Control
City of Albuquerque
Traffic Management
Bernalillo County Traffic Operations Center + City of Rio Rancho Traffic Operations Center + Municipal Traffic Operations Center
traffic control coordination
traffic information coordination
traffic control coordination
traffic information coordination
Traffic Management
City of Albuquerque Traffic Operations Center
traffic control coordination
traffic information coordination
traffic control coordination
traffic information coordination
Traffic Management
NMDOT District 3 TOC + NMDOT Statewide TMC
LEGEND
planned and future flow
existing flow
user defined flow


ATMS07 - Regional Traffic Control
City of Rio Rancho
Traffic Management
Bernalillo County Traffic Operations Center + City of Albuquerque Traffic Operations Center + Municipal Traffic Operations Center
Traffic Management
City of Rio Rancho Traffic Operations Center
Traffic Management
NMDOT District 3 TOC + NMDOT Statewide TMC
traffic control coordination
traffic information coordination
traffic control coordination
traffic information coordination
traffic control coordination
traffic information coordination
traffic control coordination
traffic information coordination
LEGEND
planned and future flow
existing flow
user defined flow


AD1 - ITS Data Mart
MRCOG Consolidated Traffic Counting System
Roadway Subsystem
NMDOT Traffic Data Collection System
Archived Data Management Subsystem
MRCOG Traffic Monitoring Program
Archived Data User Systems
Archive Data Users
Traffic Management
Bernalillo County Traffic Operations Center + City of Albuquerque Traffic Operations Center + City of Rio Rancho Traffic Operations Center + Municipal Traffic Operations Center + NMDOT District 3 TOC + Tribal Transportation Operations
Archived Data Management Subsystem
NMDOT Consolidated Highway Database (CHDB)
roadside archive data
data collection and monitoring control
traffic archive data
archive requests + archive status
archived data products
archived data product requests
archive coordination
archive coordination
LEGEND
planned and future flow
existing flow
user defined flow


AD2 - ITS Data Warehouse
MRCOG Data Warehouse (1 of 2)
Traffic Management
Bernalillo County Traffic Operations Center
+
City of Albuquerque Traffic Operations Center
+
City of Rio Rancho Traffic Operations Center
+
Municipal Traffic Operations Center
+
NMDOT District 3 TOC
+
Tribal Transportation Operations
traffic archive data
archive requests
+
archive status
Archived Data Management Subsystem
MRCOG Data Warehouse
transit archive data
archive requests
+
archive status
Transit Management
ABQ RIDE Fixed Route Dispatch System
+
ABQ RIDE Paratransit Dispatch System
+
City of Rio Rancho Paratransit Dispatch Center
+
Local Transit Dispatch
+
MidRTD Operations Center
+
NMDOT Park and Ride Dispatch
+
Rail Runner Operations
+
UNM Transportation Services Dispatch
LEGEND
planned and future flow
existing flow
user defined flow