

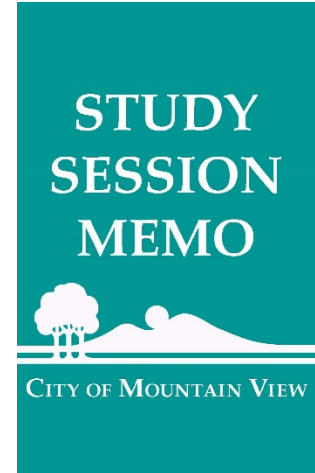
**DATE:** November 17, 2020

**TO:** Honorable Mayor and City Council

**FROM:** Carla Ochoa, Associate Civil Engineer  
Lorenzo Lopez, City Traffic Engineer  
Dawn S. Cameron, Public Works Director

**VIA:** Kimbra McCarthy, City Manager

**TITLE:** **Traffic Operations Center Feasibility Study,  
Project 19-51 – Overview**



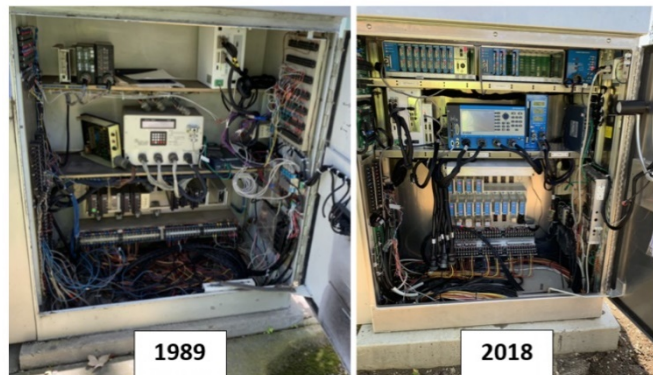
## PURPOSE

The purpose of this Study Session memorandum is to provide an overview and update on the City’s Traffic Operations Center Feasibility Study, Project 19-51, and to obtain City Council feedback and endorsement on the vision of the Traffic Operations Center and a Transportation Smart City implementation strategy.

## BACKGROUND

The City Council’s Fiscal Years 2019-20 and 2020-21 Major Goals include Goal III to develop and implement comprehensive and innovative transportation strategies to achieve mobility, connectivity, and safety for people of all ages. One of the projects selected by the City Council to help fulfill this goal is to complete the Traffic Operations Center (TOC) Feasibility Study and develop an implementation plan for making Mountain View a “Transportation Smart City.” This Study is the first step in forming an implementation plan.

Historically, traffic signals were designed to operate with the basic goal of assigning right-of-way to vehicles. Over time, the operations of traffic signals have become more complex and intricate to include pedestrian timing and better accommodate alternative modes of transportation, such as bicycles and transit. Traffic signal timing has also become more sophisticated, with coordinated timing



**Figure 1: 1989 Traffic Signal Cabinet Versus 2018 Traffic Signal Cabinet**

among multiple signals on a corridor and timing that adapts to changing traffic conditions.

Modern traffic infrastructures and technologies have developed over the last several years to move cities toward Smart City methodologies. Smart Cities utilize technology to manage, operate, monitor, and improve several municipal operations, such as water management, sanitation, utilities, transportation, and traffic operations, among others. A key feature of the transportation and traffic operations component of a Smart City is a central control facility referred to as a TOC. Technologies utilized in intelligent traffic management that support a TOC typically include an extensive communication network, monitoring cameras on traffic signals or along corridors, sophisticated signal hardware, updated software, and versatile detection systems, among others.

### **Current State of City's Signal Technology**

While these new technologies have progressed in recent years, the City has maintained a predominantly traditional traffic signal network. The City's 86 signalized intersections (Figure 2) consist of an assortment of traffic signal controller brands and types. Several of the intersections date back to the 1980s, have had minimal upgrades, and have several components that are near their end of life. Most of the existing detection systems and inductive loops are isolated to their corresponding intersections and do not support flexibility to adjust detection parameters.

Currently, the City has minimal signal communication infrastructure. The current network consists mostly of older copper lines that are limited to a few isolated corridors (Figure 3). The current layout of this network does not support an integrated system through a TOC. While some corridors, namely Grant Road and Shoreline Boulevard, have more advanced technologies, such as adaptive signal systems and video detection (see Figure 4) that were installed in the last 10 years, they can still benefit from improved communications, new traffic signal controllers, and updated technology. Currently, these two adaptive signal systems are connected to fiber-optic communications via fire stations along their corridors.



Figure 2: Snapshot of the City's 86 Signal Locations

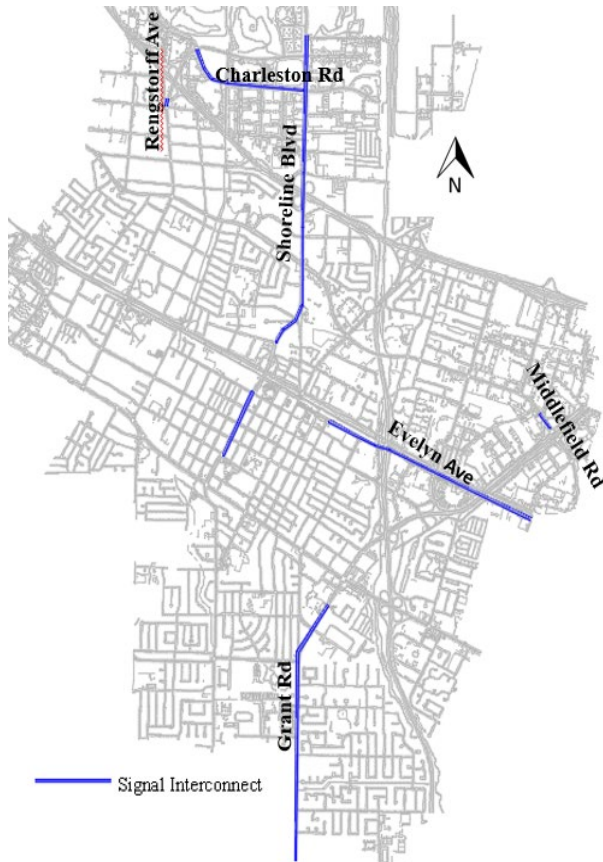


Figure 3: Existing Traffic Signal Communication Network

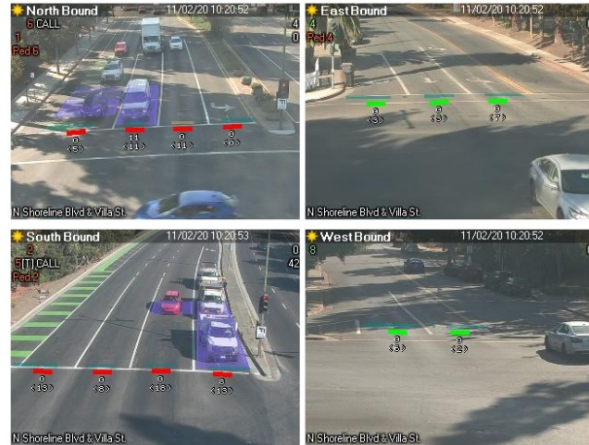


Figure 4: Existing Video Detection View of Shoreline Boulevard Intersection

The deficiency of infrastructure and technology to support a TOC set the City behind the regional transportation advancements of Silicon Valley. Several nearby jurisdictions, including the City of Palo Alto, City of Sunnyvale, City of Santa Clara, City of San Jose, and Santa Clara County, already have TOCs.

**TOC Study Scope**

The City has contracted with TJKM Transportation Consultants (Consultant) to conduct the TOC Feasibility Study (Study). The Consultant is developing a concept for the TOC by defining key aspects and supporting infrastructure. The Study is expected to be completed by April 2021.

The Study and subsequent implementation planning efforts are intended to support the vision of a TOC that is fully integrated with the City’s entire traffic signal network and supports local and regional transportation coordination and emergency services. Staff is seeking Council endorsement on the overall vision of the TOC, implementation strategy, and supporting needs.

## DISCUSSION

### Vision for TOC

The development of a TOC is a significant first step in moving the City into becoming a Transportation Smart City. The proposed vision for the TOC is to be able to provide the following functions:

- Centralized monitoring of all City signalized intersections;
- Remote management and troubleshooting of traffic signals;
- Improved Citywide traffic operations, including multi-modal flow;
- Improved maintenance of signal equipment;
- Emergency operations assistance and proactive incident response; and
- Real-time data collection and real-time information to drivers.

The technology that supports a TOC will serve to improve overall traffic operations and management throughout the City. Some of the additional benefits that can be achieved by this technology are:

- Proactive Traffic Signal Maintenance: Advanced traffic management systems often have alarm notifications for several functions of a traffic signal. These notifications give staff the opportunity to respond sooner to malfunctioning equipment or disrupted operations and reduces the reliability on resident reporting.
- Improved Traffic Flow and Reduced Greenhouse Gas Emissions: Remote access to the traffic controllers allows for monitoring of traffic along major corridors and gives staff the opportunity to implement more proactive signal timing changes for improved traffic progression. Consequently, this reduces the emissions from typical stop-and-go traffic movement.
- Emergency Services Support: Monitoring cameras can be used to support local emergency response by providing remote visuals of emergency construction work, traffic collisions, flooding during major storms, etc. The remote access to traffic signals also allows for control of all-way red flashing signals to assist officers during incident management.



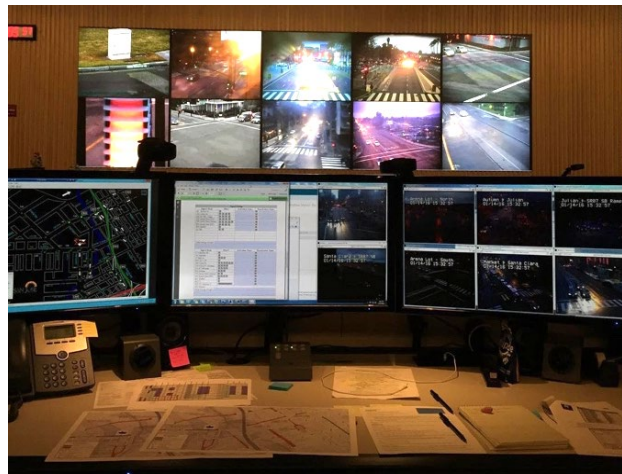
- Pedestrian and Bicyclists’ Protections: Remote management allows staff to observe and modify malfunctioning traffic signals to provide green time for pedestrians and bicyclists when detection fails.
- Framework for Future Technology Advancements: An expansive communication network will set the foundation to help the City adapt to emerging technologies in transportation, such as connected and autonomous vehicles.

***Council Question No. 1: Does Council concur with the vision, including the proposed functions and features, for the TOC?***

### TOC Feasibility Study

The Study will provide the foundation for a TOC to help guide staff in updating and standardizing the assortment of technologies and equipment to support an efficient TOC. A primary requirement for a TOC is a centralized traffic management space. The ideal features of this space include:

- A large video wall with several oversize screens that allow for viewing of several cameras and platforms at a time;
- Updated computer systems and software that allow functionalities, such as video management, real-time signal timing changes, detection adjustments, emergency rerouting, failure notifications, etc.;
- Individual workstations for each of the Traffic Engineering staff and Support Administration staff;
- Shared collaborative work areas for traffic monitoring and general operations collaboration;
- A secure facility with controlled access limited to prescreened staff;



**Figure 5: City of San Jose Video Wall and Collaborative Monitoring Area**

- An earthquake-retrofitted facility with back-up generators or power sources in order to support emergency operations;
- Secured servers dedicated to traffic management; and
- Amenities to support TOC staff expected to work overnight or have extended shifts during emergencies, such as lockers for personal items, sleeping area/showers, kitchen area, and secure off-street parking for staff.

The Consultant is evaluating the following elements to develop a plan for a TOC:

- Concept of Operations: The day-to-day operations are being evaluated in order to help identify and formalize roles, responsibilities, staffing, and procedures. The assessment of operations will incorporate City staff, including personnel from Traffic Engineering, Information Technology, Police, and Fire. The functional requirements of the Information Technology Department will also be detailed in the Study to ensure that guidelines for both normal and emergency operations are properly documented and can be included into future phases of a project(s). The Study will also help detail architectural desires and concerns so that they can be evaluated and properly coordinated with the designer in the future design stage, including preliminary power requirements. This will include items such as ergonomic features, heating and lighting features, control automation features, and structural features.
- Space Planning: A critical element of this task is to determine the space need for the TOC and subsequent placement and layout of equipment, including consoles, adjacent offices, and internal windows, to ensure the best sight lines are provided for a video display wall. Other elements of the space layout include access requirements to different areas, such as the communications area, and ensuring that employees have a functional workspace.
- Equipment and Infrastructure Evaluation: A general communication network that will consider older, existing systems as well as new systems to be deployed in the TOC, such as the video display system and operator workstations, is being evaluated and developed. Other considerations will focus on established and emerging standards, interfaces to other City networks, and regional data-sharing initiatives.

## **Supporting Infrastructure**

A significant investment in Citywide transportation infrastructure is also required to fully realize the benefits of a TOC and become a Transportation Smart City, including:

- A complete fiber network that connects to all of the City’s traffic signals;
- The latest traffic signal controllers, controller cabinets, and detection at all signalized intersections;
- Systemwide monitoring cameras with pan-tilt-zoom capabilities;
- New conduits (wire housing between equipment) at all signalized intersections that allow room for growth of technologies;
- Updated vehicle, bicycle, and pedestrian detection at all signalized intersections; and
- Traffic management software system.



**Figure 6: Existing Traffic Detection Camera that Will Need to be Updated**

## **Ongoing Needs**

Once the City develops a TOC and upgrades the Citywide transportation technology infrastructure to become a Transportation Smart City, there will be ongoing operational costs and needs, including:

- Additional staff to optimize TOC management;
- Staff training for TOC functionalities;
- Maintenance budget that supports replacement of equipment and traffic signal infrastructure; and
- Budget for updates to technology and hardware as they become available.



## **Implementation Strategies**

Upon completion of the Study and Council’s concurrence, the TOC and supporting infrastructure would be implemented gradually through various phases. Some of the anticipated projects and tasks are as follows:

- TOC office preparation;
- Installation of monitoring cameras at signalized intersections;
- Conduit replacement, repairs, or installation;
- Fiber-optic installation;
- Signal detection upgrades; and
- Updates to the City’s traffic signal specifications.

Some opportunities for implementation through smaller projects and tasks include:

- Incorporating equipment upgrades at signalized intersections through Capital Improvement Program (CIP) projects;
- Full traffic signal upgrades as stand-alone CIP projects;
- Conditioning development projects for infrastructure upgrades when warranted; and
- Continuing to replace outdated equipment that has reached end of life with new, standardized equipment.

Standardizing equipment specifications is critical to the gradual implementation of a successful traffic management system to ensure that all communication components are on compatible platforms. Traffic Engineering staff has already started to standardize



**Figure 7: Signal Infrastructure Upgrades Being Completed as Part of a Development Project**

equipment to replace outdated infrastructure as it reaches end of life or as upgrades are incorporated into other construction projects.

While these strategies provide programs for implementation, several aspects of the project execution will present challenges in fulfilling a fully functional TOC. Some of the challenges include:

- Limited Office Facilities: The City will be tasked with identifying a space to accommodate all the components of a TOC. With the City's growth in recent years, City facilities have very limited space to dedicate to equipment, staff, work areas, IT infrastructure, etc., in a single centralized space. In order to find this space, the City may have to seek off-site, non-City facilities.
- Existing Infrastructure: The challenge with the assortment of older equipment is lack of compatibility with, or interference with, newer technology. As previously discussed, several of the components of the existing infrastructure at signalized intersections would need to be upgraded or replaced. Furthermore, underground infrastructure may have very limited space left to accommodate additional technologies. Fiber-optic or other means of communication is needed from the TOC to the existing traffic signals, and the design and implementation could prove to be very challenging and costly.
- Funding: Due to the current state of the City's signal technology, cost of equipment and construction is expected to be very high. General foreseeable costs are office space, traffic signal improvements, full traffic signal reconstructions, new fiber-optic lines, additional staff for TOC operations, and increased and specialized maintenance. Full cost estimates are not available, but the cumulative cost for full implementation that includes Citywide infrastructure will likely exceed \$50 million. While some funding may be available through regional or Federal grants, these are typically highly competitive grants and will likely only fund a small percentage of overall costs.

In summary, due to the costs involved, staff is recommending a gradual implementation strategy that could take up to 20 years to fully implement for all improvements Citywide. Initial priority would be placed on developing the TOC. Overall implementation to become a Transportation Smart City would be provided through the CIP planning process, replacing end-of-life equipment with new standardized equipment, and requiring developers to help provide upgrades when there is nexus.

***Council Question No. 2: Does Council support the proposed strategy for gradual implementation of a Transportation Smart City with initial priority on developing the TOC?***

**RECOMMENDATION**

Provide input on the following questions:

1. Does Council concur with the vision, including the proposed functions and features, for the TOC?
2. Does Council support the proposed strategy for gradual implementation of a Transportation Smart City with initial priority on developing the TOC?

**NEXT STEPS**

Staff anticipates completing the Study in April 2021. The creation of the TOC and other potential initial infrastructure projects as recommended by the Study will be considered for funding in the upcoming five-year CIP process to be approved by Council in June 2021. Staff will also start seeking grants and other implementation opportunities.

**PUBLIC NOTICING** – Agenda posting.

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cc: CTE, ACE – Ochoa