Real-Time Adaptive Traffic Control on Chipman Road in Lee's Summit, MO

A joint project of the City of Lee's Summit, MO and Rhythm Engineering

CITY OF LEE'S SUMMIT

PUBLIC WORKS DEPARTMENT / ENGINEERING DIVISION
220 SE GREEN STREET
LEE'S SUMMIT, MISSOURI 64063

(816) 969-1800 FAX (816) 969-1809

March 31, 2011

MOVITE
c/o Brian Vines, President
Carter & Burgess
10816 Executive Center Suite 300
Little Rock, AR 72211

Dear Mr. Vines:

I would like to nominate the City of Lee's Summit and Rhythm Engineering for the MOVITE Transportation Achievement Award for the project, *"Real-Time Adaptive Traffic Control on Chipman Road in Lee's Summit, MO."*

Rhythm Engineering makes the InSync adaptive traffic control system which we installed at 15 busy intersections in Lee's Summit. By seeing and adapting to traffic demand in real-time, InSync reduced travel time on the Chipman Road corridor by as much as 55 percent and increased average travel speeds by up to 50 percent. Shorter travel times means that motorists' vehicles will consume less fuel and produce less harmful emissions, creating a positive economic and environmental benefit. Finally, with the elimination of stop-and-go traffic that results from inefficiently timed traffic signals, we expect to see fewer crashes and an overall improvement in safety and quality of life for our citizens.

This project shows the development of an innovative concept in transportation design and operations, successful coordination between federal government, state government, local government and private industry, and has had a significant effect on regional transportation, while promoting a major advancement in the efficiency of transportation. Moreover, this project has made a positive difference for motorists and, we believe, has truly demonstrated excellence in transportation.

Thank you for your consideration.

Sincerely,

Michael Park, PE, PTOE
City Traffic Engineer
City of Lee's Summit, MO

CITY OF LEE'S SUMMIT

PUBLIC WORKS DEPARTMENT / ENGINEERING DIVISION
220 SE GREEN STREET
LEE'S SUMMIT, MISSOURI 64063

(816) 969-1800 FAX (816) 969-1809

March 31, 2011

ATTN: KCITE – Excellence in Transportation Award
Lideana Laboy, P.E.
BHC Rhodes
6363 College Blvd., Suite 500
Overland Park, KS 66211

Dear Ms. Laboy:

I would like to nominate the City of Lee's Summit and Rhythm Engineering for the 2010 KCITE Excellence in Transportation Award for the project, *"Real-Time Adaptive Traffic Control on Chipman Road in Lee's Summit, MO."*

Rhythm Engineering makes the InSync adaptive traffic control system which we installed at 15 busy intersections in Lee's Summit. By seeing and adapting to traffic demand in real-time, InSync reduced travel time on the Chipman Road corridor by as much as 55 percent and increased average travel speeds by up to 50 percent. Shorter travel times means that motorists' vehicles will consume less fuel and produce less harmful emissions, creating a positive economic and environmental benefit. Finally, with the elimination of stop-and-go traffic that results from inefficiently timed traffic signals, we expect to see fewer crashes and an overall improvement in safety and quality of life for our citizens.

This project shows the development of an innovative concept in transportation design and operations, successful coordination between federal government, state government, local government and private industry, and has had a significant effect on regional transportation, while promoting a major advancement in the efficiency of transportation. Moreover, this project has made a positive difference for motorists and, we believe, has truly demonstrated excellence in transportation.

Thank you for your consideration.

Sincerely,

Michael Park, PE, PTOE
City Traffic Engineer
City of Lee's Summit, MO

Real-Time Adaptive Traffic Control on Chipman Road in Lee's Summit, MO

Nominees:

City of Lee's Summit, MO and Rhythm Engineering

Nominated by:

City of Lee's Summit, Missouri

220 SE Green Street

Lee's Summit, MO 64063

Project Cost

$400,000-$500,000

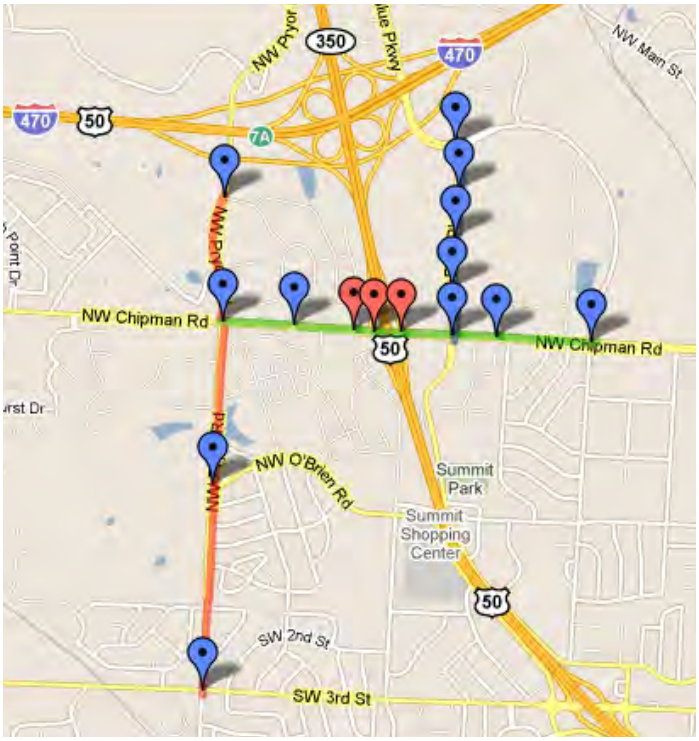
Project Overview

Timing traffic signals so that motorists are given green lights in the most efficient way possible is always a challenge. When you add the variable traffic demand created by busy shopping centers, crossing arterials, highway access ramps, changing traffic patterns due to new transportation infrastructure and unusual pedestrian volume, traffic signal timing becomes nearly impossible. These factors were just some of the challenges facing the City of Lee's Summit in the area surrounding its two largest retail centers, Summit Woods Crossing and

Summit Fair, and a very large employment center, Summit Technology Campus, located at the intersection of Interstate 470 and U.S. Highway 50.

In 2010, using America Recovery and Reinvestment Act funds from an Energy Efficiency and Conservation Block Grant (EECBG) through the U.S. Department of Energy, the City of Lee's Summit began an innovative effort to reduce traffic congestion, fossil fuel consumption and CO2 emissions using smart traffic signal technology.

The City of Lee's Summit worked with MoDOT District 4 to purchase and install the InSync adaptive traffic control system and necessary communications backbone for multiple corridors on 15 intersections that crossed both jurisdictions. The system, invented and manufactured by Lenexa, KS-based Rhythm Engineering, uses video detection and its built-in artificial intelligence to see and adapt to traffic demand in real-time. The resulting network, spanning three crossing arterials, has reduced travel time by 28-55% and increased average speeds by as much as 50%. Moreover, the City of Lee's Summit has built a sustainable traffic control infrastructure that can



handle even the most challenging conditions and consistently give motorists the best experience possible.

Unique Project Challenges

The Chipman Road corridor has an average daily traffic (ADT) of 27,000 vehicles. The area posed several challenges for an adaptive traffic control project. Those challenges were:

- **High, variable traffic volume and diverse expectations** – The Chipman Road area has a high volume of traffic, mixed with commuters throughout Lee's Summit, and influenced by the Summit Technology Campus, John Knox Village, and variable retail-oriented traffic caused by the surrounding shopping centers, Summit Woods Crossing and Summit Fair. The Summit Technology Campus, located along Chipman Road between Blue Parkway and Ward Road, employs approximately 4,000 people. John Knox Village, one of nation's largest retirement communities, is located along Chipman Road and Pryor Road. Summit Woods Crossing, opened in 2001, is an 87-acre site with 735,000 sq. ft. of retail space including SuperTarget, Lowes, Kohl's, Best Buy and other stores located along Chipman Road and Pryor Road. Summit Fair is an open-air mall opened in 2009, with 500,000 sq. ft. of retail space including tenants such as Macy's and JCPenney located along Chipman Road and Blue Parkway. With many people from fast-growing Lee's Summit and the surrounding cities shopping at these stores on a regular basis, the Chipman Road corridor experiences high and variable traffic volumes. Not only are

typical weekends a challenge; the holiday shopping season and other special events exacerbate the problem.

- **Crossing arterial coordination** – Creating timing plans for this area would be more manageable if Chipman Road (east to west) was the only arterial corridor, but it's not. Pryor Road and Blue Parkway (both going north to south) are major arterials and intersect with Chipman Road. All three arterials also provide regional access via Interstate 470 or 50 Highway. Access to Interstate 470 to/from Pryor Road and Blue Parkway has been recently constructed, and traffic patterns have not yet normalized considering these new route alternatives. Balancing and synchronizing traffic on all three corridors is important.
- **Highway access ramps** – Entrance and exit ramps connecting Chipman Road to U.S. Highway 50 created yet another challenge. Circumstances unrelated to the Chipman Road area could suddenly have an impact as highway traffic arrived in the area or tried to depart. The close spacing of these interchange intersections also creates a problem with reduced lane storage.
- **Pedestrian traffic** – Due to the two retail centers and employment campus, pedestrian traffic was another factor to consider. Traffic control had to accommodate pedestrians while still maintaining vehicle progression on the arterials.
- **Multiple agencies involved** – This project required that two agencies work together. Twelve of the 15 signals are owned and maintained by the City of Lee's Summit, while three intersections in the middle of the Chipman Road corridor are owned and maintained by the State of Missouri through MoDOT District 4.

- **Multiple communications methods** – The InSync adaptive traffic control system requires an Ethernet communications backbone so that intersections can "talk" to each other. Typically all of the intersections on an adaptive corridor run the same communications system. For the Chipman Road project, Rhythm Engineering tied a new fiber network jointly developed by the City and MoDOT as a part of the project, a new wireless Ethernet network, also installed as part of the project, and an existing copper network . The resulting network uses all three communications methods for its operations.
- **Long pedestrian clearance times** – Due to the presence of retirement centers, long pedestrian clearance times (approximately 40 seconds) were required so that senior citizens and elderly residents had adequate time to cross the road. This created yet another challenge for the adaptive traffic control system.

Project Goals

Creating a positive experience for the motorist in the midst of these many challenges required clear focus on and prioritization of the project's goals. The top goals for the Chipman Road project were to:

1. Minimize travel time for motorists along Chipman Road by synchronizing traffic signals.
2. Minimize the number of vehicle stops along Chipman Road by synchronizing traffic signals.
3. Maintain north/south progression along Pryor Road.
4. Maintain north/south progression along Blue Parkway.

5. Provide a reliable and accessible communications network to all intersections.

System specific goals for each arterial were as follows:

Chipman Road (Priority Corridor) – Eastbound traffic starting at Chipman and Pryor will progress through all intersections along Chipman without stopping through Ward. Westbound traffic starting at Chipman and Ward will progress through all intersections along Chipman without stopping through Pryor.

Pryor Road – Northbound traffic starting at Pryor and 3rd will progress through all intersections along Pryor with minimal stops through Summit Woods Entrance. Southbound traffic starting at Pryor and Summit Woods Entrance will progress through all intersections along Pryor with minimal stops through 3rd. Although it's possible and likely to achieve no stops, it is not guaranteed as North/South progression is secondary to East/West progression at Chipman and Pryor. After implementation, coordination along Pryor Road was changed to locally optimized intersection control. Although non-coordinated control was preferred, the project still provided new communication and remote monitoring throughout the Pryor Road corridor. The corridor is ready for future coordination if and when traffic volume and density is supportive.

Blue Parkway – Northbound traffic starting with the Eastbound left turning traffic from Chipman onto Blue Pkwy will progress through all intersections along Blue Parkway without stopping through Ward. Southbound traffic starting with Eastbound right turning traffic from Ward onto Blue Pkwy will progress through all intersections along Blue Pkwy with minimal stops through Chipman. Although it's possible and likely to achieve no stops with the

Southbound progression, it cannot be guaranteed as Southbound progression is secondary to East/West progression at Chipman and Blue.

Method for Achieving Project Goals

To achieve these goals, the City of Lee's Summit partnered with MoDOT District 4 to install Rhythm Engineering's InSync adaptive traffic control system on all 15 intersections.

Step 1 – Set up communications infrastructure and collect "before" data

The City of Lee's Summit had to work with MoDOT to ensure adequate communications infrastructure for the adaptive traffic control system. Chipman Road was equipped with a fiber-based communications network, and Blue Parkway had an exisitng copper-based communications network. We installed a wireless Ethernet communications network on Pryor Road since there was no existing connectivity and bridged the new fiber network along Chipman Road west of Ward Road to the existing fiber network along Douglas Street with wireless communications. We also collected "before" data on travel times and average speeds on Chipman Road as a benchmark for future comparison.

Step 2 – Install InSync processors

InSync is a plug and play system, meaning it overlays existing traffic cabinets and controllers. The City of Lee's Summit did not need to discard or replace any existing equipment, adding to the project's environmental-friendliness. Rhythm Engineering provided on-site training

covering installation, operations and maintenance. The City of Lee's Summit installed an InSync processor (small box) into the traffic cabinet at each local intersection.

Step 3 – Install InSync video detection

InSync primarily uses video detection as its method for seeing traffic demand in real-time (other forms of detection can be integrated as well). We installed Axis IP cameras on mast arms so that the system had visibility of each approach.

Step 4 – Configure adaptive system

While the City of Lee's Summit worked on establishing corridor communications and installing cameras, the engineers at Rhythm Engineering built a simulation of Chipman Road, Pryor Road and Blue Parkway so that they could configure InSync settings specifically for our project. Parameters were set using our input and recommendations based on local knowledge.

Step 5 – Turn on adaptive mode

At that point, turning on adaptive mode on the corridors was as easy as the flip of a switch. Camera views of each approach, each intersection and entire corridors is available to the City of Lee's Summit, MoDOT and Rhythm Engineering at all times through the web-based InSync user interface. By using "detection zones" to see and count cars, InSync can calculate vehicle volume and delay second by second. The system's goal is to reduce vehicle stops at intersections by synchronizing and optimizing traffic signals.

Step 6 – Finalize configuration, complete project and collect "after" data

For two weeks, Rhythm Engineering project engineers monitored the corridors from their headquarters in Lenexa and made final tweaks to ensure the system was operating correctly. The Pryor Road corridor was found to operate best without coordination, in a locally optimized mode. Chipman Road, the focal point of this project, and Blue Parkway were coordinated using real-time adaptive control.

The final step was to collect "after" data regarding travel time and average speed on Chipman Road. This data was compared against the "before" data in order to quantify the project's impact. (See tables at the end of this document.) We did not conduct a performance evaluation of the Blue Parkway corridor due to development activity, but the coordination has largely been successful. In the end, we were very happy with the system's performance and signed off on project completion.

Project Results – Shorter Travel Times, Less Emissions & Improved Safety

When the goal of a project is to minimize travel time for motorists, the clearest measurement is the data. Representatives from both the City of Lee's Summit and Rhythm Engineering drove Chipman Road multiple times for each of three time periods – AM peak, midday and PM peak, before and after the InSync deployment.

The results were as follows:

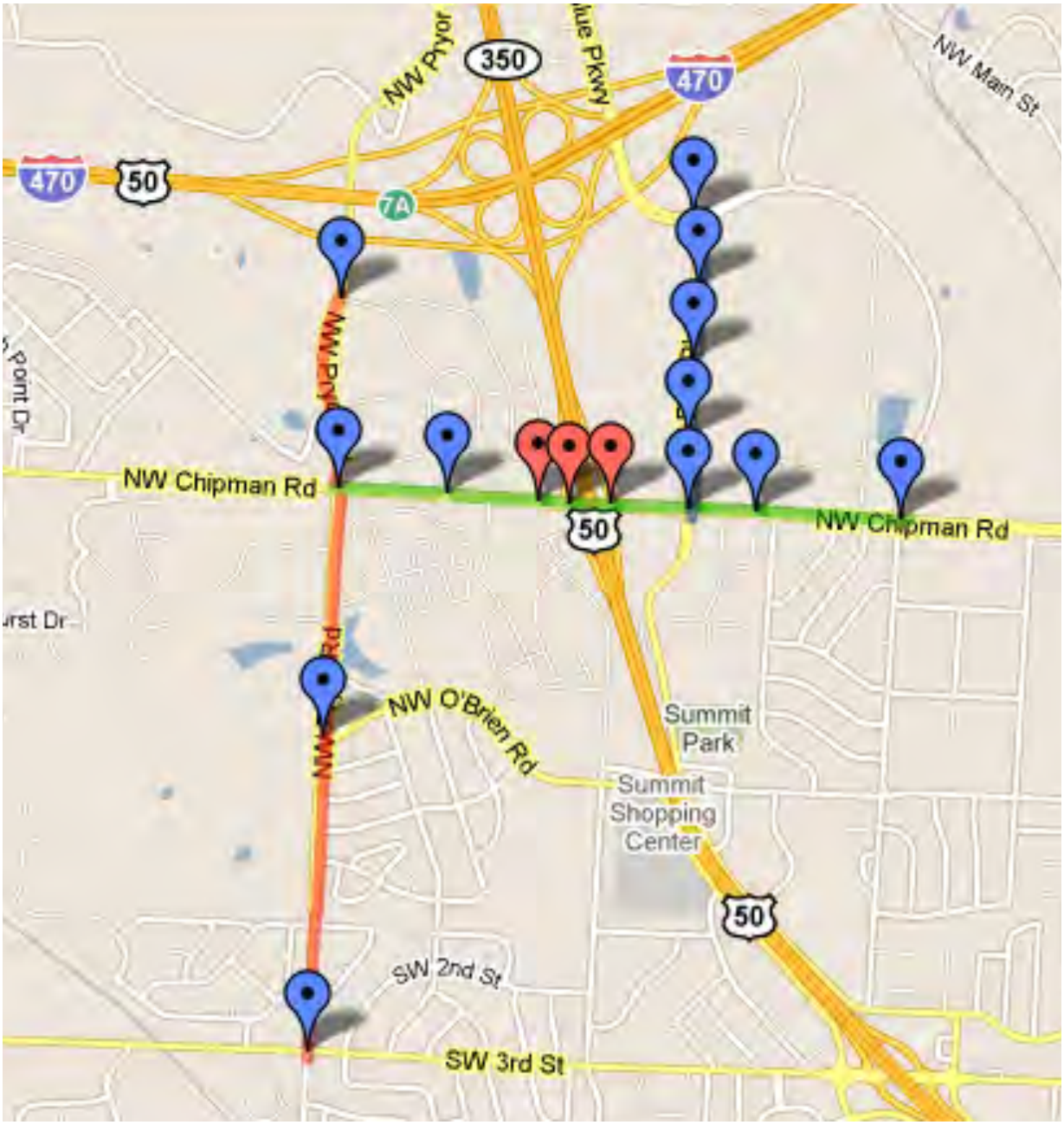
- During the AM peak period, travel time was reduced by **43-55%** and average speed increased **39-50%**
- During the midday period, travel time was reduced by **35-42%** and average speed increased **43-47%**
- During the PM peak period, travel time was reduced by **28-45%** and average speed increased **17-33%**

Motorists have expressed positive feelings toward the project's impact, and notice that they are stopping less on Chipman Road.

Shorter travel times means that motorists' vehicles will consume less fuel and produce less harmful emissions, creating a positive economic and environmental benefit.

Finally, with the elimination of stop-and-go traffic that results from inefficiently timed traffic signals, we expect to see fewer crashes and an overall improvement in safety and quality of life for our citizens.

Map of Intersections



Chipman Road Results

Eastbound - AM Peak Avg		
	Travel Time-Before	Travel Time-After
Pryor	0	0
Summit Woods	29	21
Murray	79	41
US-50 WB	98	49
US-50 EB	111	58
Blue	141	72
Penny	195	84
Ward	240	106

	Before	After	% Change
Travel Time	240	106	**-55.83%**
Avg. Speed	20.67	31.00	**+50.00%**

Westbound - AM Peak Avg		
	Travel Time-Before	Travel Time-After
Ward	0	0
Penny	36	26
Blue	74	39
US-50 EB	113	53
US-50 WB	130	62
Murray	137	69
Summit Woods	155	85
Pryor	183	104

	Before	After	% Change
Travel Time	183	104	**-43.17%**
Avg. Speed	24.67	34.33	**+39.19%**

Eastbound - Mid Day Avg		
	Travel Time-Before	Travel Time-After
Pryor	0	0
Summit Woods	55	20
Murray	91	45
US-50 WB	102	55
US-50 EB	122	63
Blue	156	76
Penny	172	95
Ward	208	119

	Before	After	% Change
Travel Time	208	119	**-42.63%**
Avg. Speed	21.67	31.00	**+43.08%**

Westbound - Mid Day Avg		
	Travel Time-Before	Travel Time-After
Ward	0	0
Penny	43	30
Blue	69	64
US-50 EB	104	79
US-50 WB	116	87
Murray	123	94
Summit Woods	165	108
Pryor	196	127

	Before	After	% Change
Travel Time	196	127	**-35.48%**
Avg. Speed	22.67	33.33	**+47.06%**

Eastbound - PM Peak Avg		
	Travel Time-Before	Travel Time-After
Pryor	0	0
Summit Woods	28	43
Murray	70	61
US-50 WB	98	68
US-50 EB	107	80
Blue	132	96
Penny	155	111
Ward	190	135

	Before	After	% Change
Travel Time	190	135	**-28.82%**
Avg. Speed	21.67	25.33	**+16.92%**

Westbound - PM Peak Avg		
	Travel Time-Before	Travel Time-After
Ward	0	0
Penny	31	37
Blue	74	53
US-50 EB	114	68
US-50 WB	126	80
Murray	150	87
Summit Woods	200	103
Pryor	220	121

	Before	After	% Change
Travel Time	220	121	**-45.08%**
Avg. Speed	22.00	29.33	**+33.33%**

Photos

A mast arm on Chipman Rd. with mounted IP video camera for vehicle detection.

Summit Woods Crossing entrance on Pryor Road. The shopping center is surrounded by I-470 to the north (pictured) and U.S. Hwy 50 to the east (not pictured).

Summit Woods Crossing is home to major retailers including SuperTarget, Lowes, Best Buy, Office Depot, Michael's, and others.

Westbound Chipman Rd. at the intersection of Blue Parkway. Summit Fair is just to the right (or north) of this photo and Summit Technology Campus is just east of Summit Fair.

Westbound Chipman Rd. progressing under U.S. Highway 50. Drivers are now typically experiencing all green lights as they move through 7-8 traffic signals in less than 2 miles.

John Knox Village, a continuing care retirement community located at the intersection of Chipman Rd. and Pryor Rd., required that the system allow for long pedestrian clearance times.

These are some of the popular businesses that make up the new Summit Fair shopping center, drawing heavy traffic. This is at the intersection of Chipman Rd. and Blue Pkwy.

The new open air shopping center draws many pedestrians and vehicles. Both types of traffic had to be taken into consideration for this adaptive traffic control project.

By talking to each other, the traffic signals can intelligently adapt to traffic demand. In this picture, you see several intersections turning green at the same time.

The InSync system installed on these traffic signals allows motorists to move through busy corridors without stopping. This saves time, fuel and frustration.