Future Vision for North Avenue Smart Corridor

CEE 6602 /CP 6311 Urban Transport Planning
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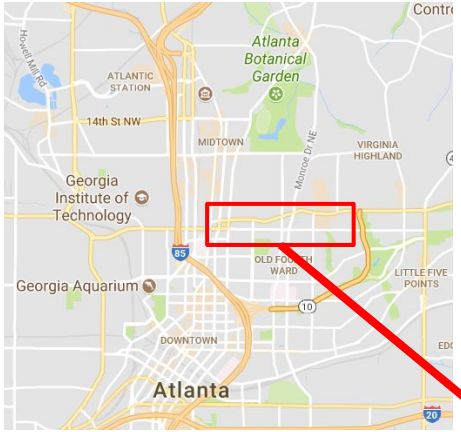
Goals and Objectives

- Discuss Smart City Technology
- Examine Smart Corridor Initiatives
- Propose a new North Avenue Corridor Smart Asset Plan
- Investigate the costs and benefits of North Avenue Corridor Smart Asset Plan



- **Scope:** North Avenue in Atlanta, Peachtree Street to Beltline
- **Length:** 1.2 miles
- **Area:** Midtown
- **Traffic volume:** 22,000 AADT (GDOT)

Smart City

A multifaceted solution for fighting against the modern day challenges of cities like pollution, Infrastructure access, congestion, mobility, safety, and public health.

Smart Infrastructure

- Fiber
- Sensors
- DSRC
- Public Wifi
- TravelSafely App

Fiber

- Fiber optic cables carry communication signals using pulses of light generated by small lasers or light-emitting diodes (LEDs).
- Fiber optic cable consists of a bundle of glass threads, each of which is capable of transmitting messages modulated onto light waves
- Fiber optic cable was added to State Route 20 that creates communication between the corridor’s traffic signals this year

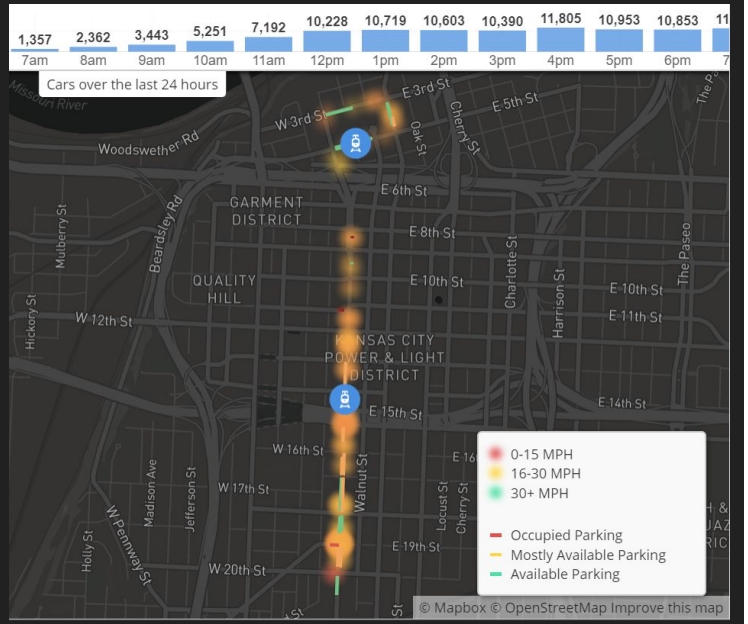
Fiber

- **Service Life: 20-25 years**
- **Capital Cost: $24/mile/count**

Benefits

- Fiber optics have a higher capacity compared to copper cable with similar thickness. Fiber cables rated at 10 Gbps, 40 Gbps and even 100 Gbps are standard
- Light can travel much longer distances down a fiber cable without losing its strength, it lessens the need for signal boosters
- Fiber optic cables have lower initial and maintenance cost than equivalent lengths of copper wire
- Fiber optic cables are thinner and lighter, which takes less space in the ground

Traffic Sensors



- Traffic Sensor is used to observe traffic flow and collect real-time data of traffic speeds, parking, and vehicle number.
- Have been widely used on traffic corridors and freeways since 2003

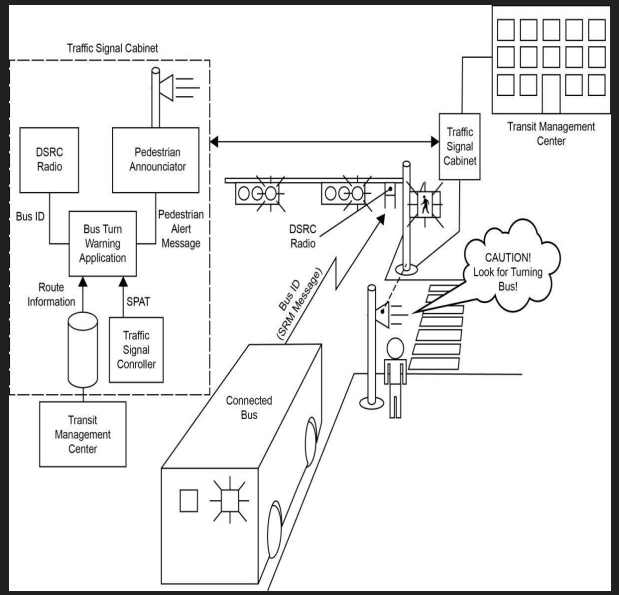
Traffic Sensors

- **Service Life: 10 years**
- **Capital Cost: $10,000/unit**
- **Maintenance Cost: $400/unit/yr**

Benefit

- Estimated to reduce delays on coordinated routes by an average of 17%
- Reductions in overall accidents by 64%
- Redcutions in merging-type accidents by 81%
- Partnered with Google to build an ultrafast broadband Internet access.

Pedestrian & Bike Sensors



- Pedestrian & Bike sensors work as the medium for the communication among vehicles, bikes and pedestrians
- DSRC detect approaching vehicles, and then a warning made to bicyclists and pedestrians based on the observation of sensors

Source: Automated and Connected Vehicle (AV/CV) Test Bed to Improve Transit, Bicycle, and Pedestrian Safe (2017). *Texas A&M Transportation Institute.*

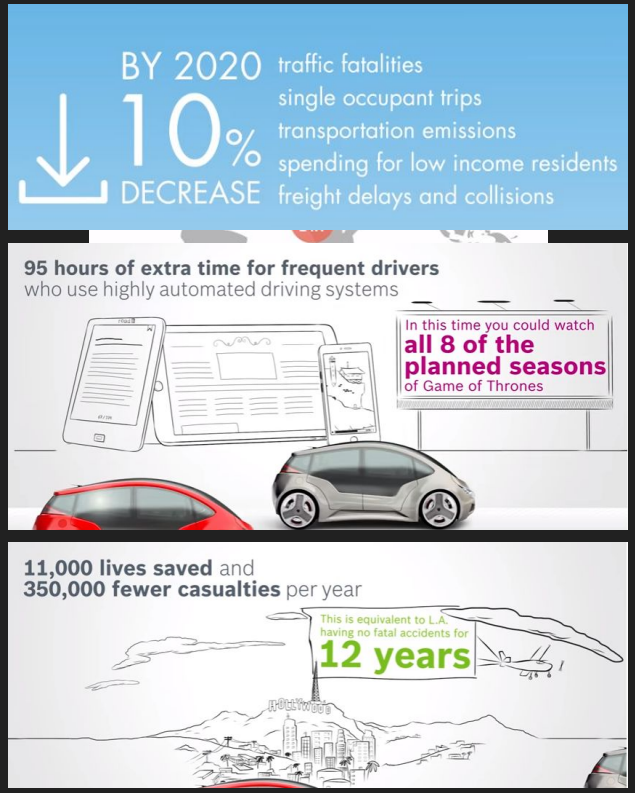
Pedestrian Sensors

- **Service Life: 10 years**
- **Capital Cost: $4,000/unit**
- **Maintenance Cost: $1,000/unit/retest**

Benefit

- Reduce the number and severity of crashes, personal injury and property damage
- Develop cost-effective approaches that require minimum alterations to exsisting designs

DSRC



Why DSRC?

- Up to 70% fewer rear-end collisions
- Up to 80% fewer crashes caused by skidding and sliding on raod
- Up to 19,000 fewer crashes caused by smartphone distraction per year
- 95 hours of extra time for frequent drivers who use highly automated driving systems
- Minimizes traffic and stress levels
- Improves air quality
- Higher fuel efficiency
- Optimal road usage

DSRC

- **Service Life: 10-20 years**
- **Capital Cost: $10,677/unit**
- **Maintenance Cost: $700/unit/yr**

Benefits

- Dedicated 7 Licensed Channels
- Technology is similar to WiFi (802.11a) which makes it easy to deploy
- Low Latency Communication
- High Data Transfer Rate
- Line Of Sight Distance up to 1000ft and Omnidirectional (360 degree Lambertian Pattern)
- Low Power Message Reception (<-90dBm)

DSRC

This technology can be implemented in two different phases to support partial and total automation:

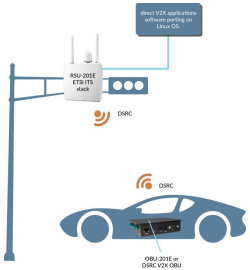
- **V2V (Vehicle to Vehicle)**
- **V2I (Vehicle to Infrastructure)**

V2V Functionalities:

1. Forward Collision Avoidance
2. Emergency Electronic Brake Lights
3. Blind Spot Warning
4. Lane Change Assist
5. Do not Pass Warning
6. Intersection Collision Warning
7. Wrong Way Driver Warning
8. Co operative cruise control

V2I Functionalities:

1. Red Light Running
2. Left and Right Turn Assist
3. Pedestrian Signal Assist
4. Emergency Vehicle Pre-empt
5. Transit Signal Priority
6. Freight Signal Priority
7. Rail Crossing Assist



Public Wi-fi

Source: Kansas City Star

- Internet access is a basic utility, not a luxury
- Public Wi-Fi and fiber networks can be installed and operated privately
- CityBridge in NYC, Sprint in Kansas City, are models for a public-private partnership
- Public Wi-Fi is revenue-generating through ads and collection of users' data

Public Wi-fi

- **Service Life: 5 years**
- **Installation and Maintenance Cost: $5 - 7M over 5 years**
- **Funded separately from ITS corridor project**

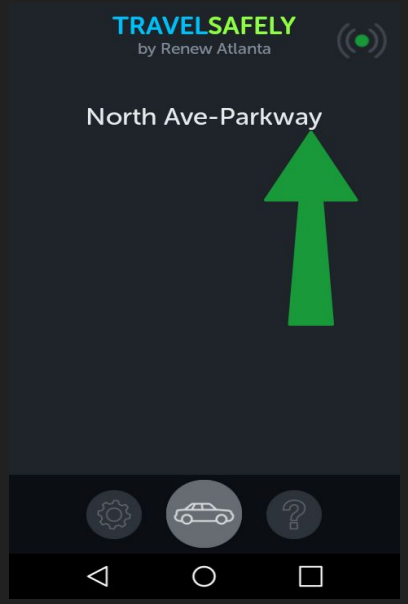
Source: Kansas City Star

- Kansas City's Main Street is a model for North Ave, as they have installed Fiber and Public Wi-Fi along a similar downtown arterial corridor

Benefits

- Internet access to commuters and tourists
- Wayfinding along a major travel corridor
- Operated and Maintained at *no cost to taxpayers*, made possible due to revenue-generating model

TravelSafely App



- Currently in Beta Testing
- Operated by Glance, Applied Info Inc. and Renew Atlanta
- Retrieves data from Smart Signals on North Ave
- Also retrieves location data from app users

Features:

- Alerts user of the signal status (i.e. about to turn green)
- Alerts users of nearby emergency vehicles and location
- Alerts cyclists of drivers and drivers of cyclists

Capabilities:

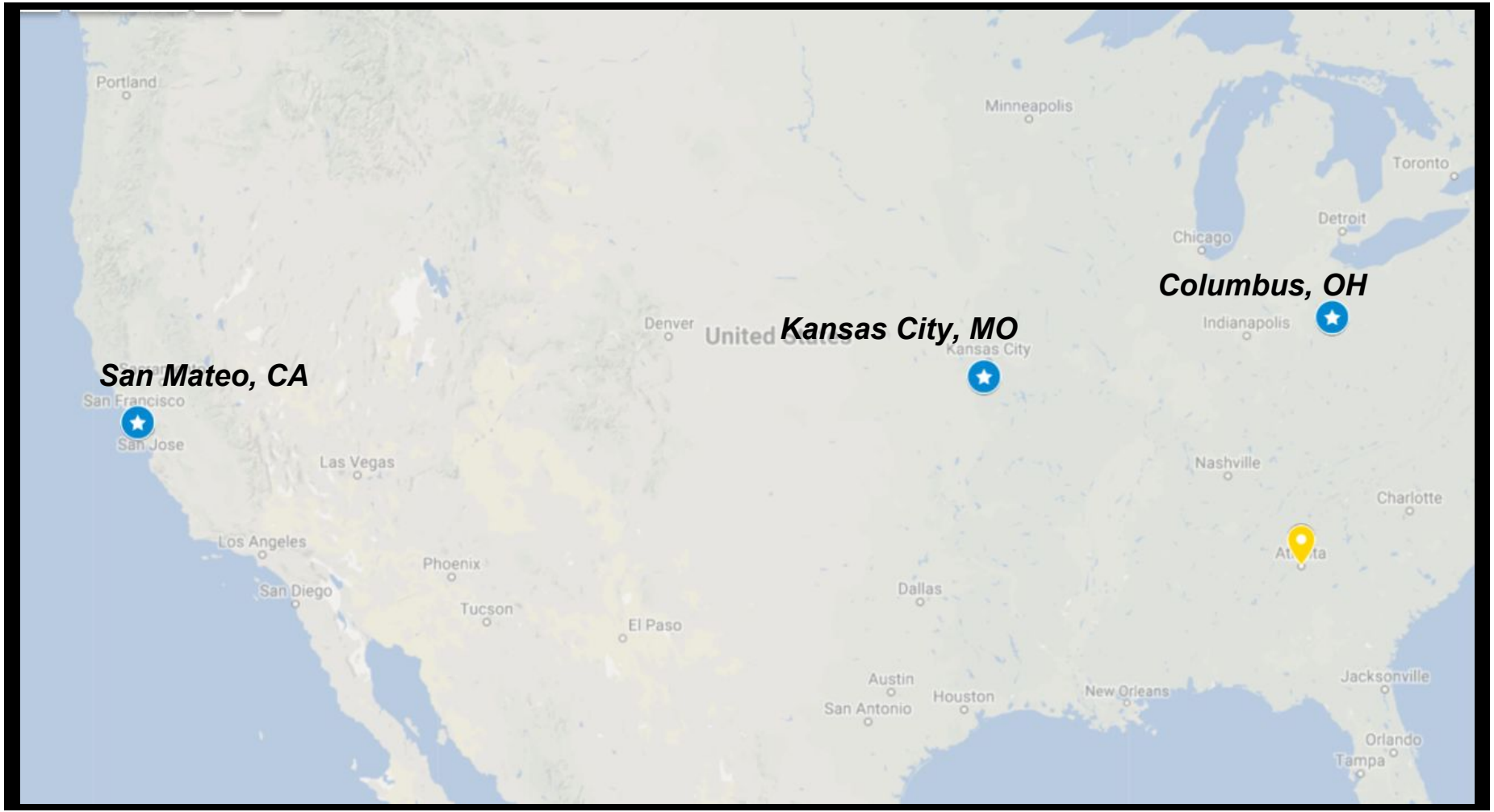
- Could affect signal timing to prioritize transit & emergency vehicles, eventually Ubers as well

Limitations:

- Many features depend on full app usership, unrealistic

Existing Smart Corridor Initiatives

- Kansas City, MO
- San Mateo, CA
- Columbus, OH

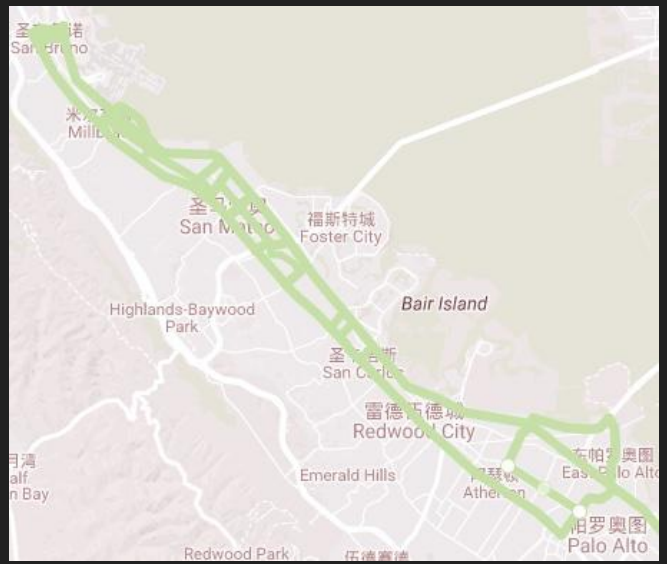

Columbus, OH
Kansas City, MO
San Mateo, CA
Portland
Minneapolis
Toronto
Detroit
Chicago
Indianapolis
Denver
United States
Kansas City
San Francisco
San Jose
Las Vegas
Nashville
Charlotte
Los Angeles
Phoenix
San Diego
Tucson
El Paso
Dallas
Austin
San Antonio
Houston
New Orleans
Jacksonville
Orlando
Tampa

Kansas City, MO

- Kansas City Smart Corridor
- Proposed Feb 2016, Launched Feb 2017
- **Length:** 2.2-mile arterial in downtown Kansas City
- **Cost:** $15M in a public-private partnership with Cisco
  - $11.9M by Cisco, $3.8M by Kansas City
- **ITS Elements:**
  - Connected streetcar and traffic signals
  - Fiber & Free Public Wifi Outdoors, Installed by Sprint and funded entirely through ad revenue
  - 125 smart LED streetlights
  - 13 Digital Info Kiosks
  - Real-time display of traffic speeds, parking, and streetcar
- **Benefits:**
  - Reduced PM peak trip time from 7:44 to 5:22 (30.6%)
  - Reduce time spent searching for parking

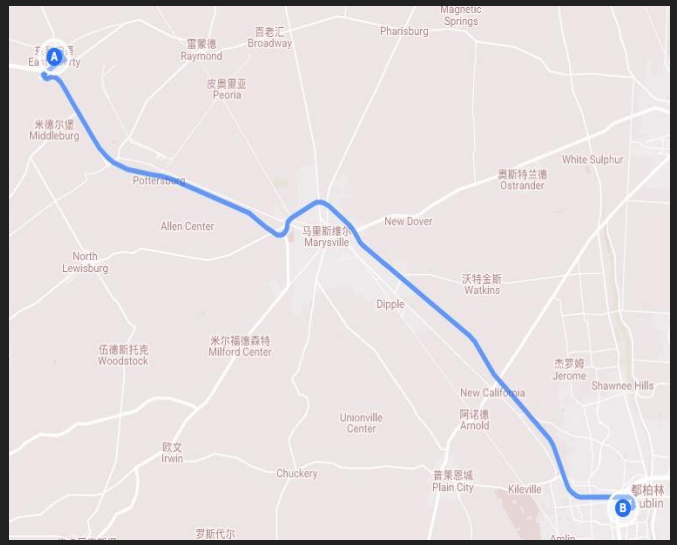
Sources: techcrunch
Kansas City Star

San Mateo, CA



- San Mateo County Smart Corridor
- Launched in September, 2012
- Length: 25-mile arterial route parallel to Highway 101
- Cost: $35.3M
    - Funded by City/ County Association of Government of San Mateo County
- ITS Elements:
    - directional signs * 113
    - closed-circuit television cameras * 263
    - power supply line and fiber
    - vehicle detection system * 37
- Benefits:
    - Enable counties to manage day-to-day traffic
    - Fiber network serves as a foundation for future expansion, and integration with new technology

Columbus, OH



- Ohio's 33 Smart Corridor
- Proposed 2015, Installation 2018
- Length: 35-mile highway corridor US-33
- Cost: $15M
    - $6M grant from U.S. DOT, $16M from Ohio DOT
- ITS Elements:
    - Fiber collaborative
    - DSRC & Smart traffic signals
    - Integrates roadway infrastructure with autonomous and connected vehicles technology
- Benefits:
    - Improve safety, congestion, and employment access
    - Data transmission for communication between AVs and CVs

Takeaways from Case Studies

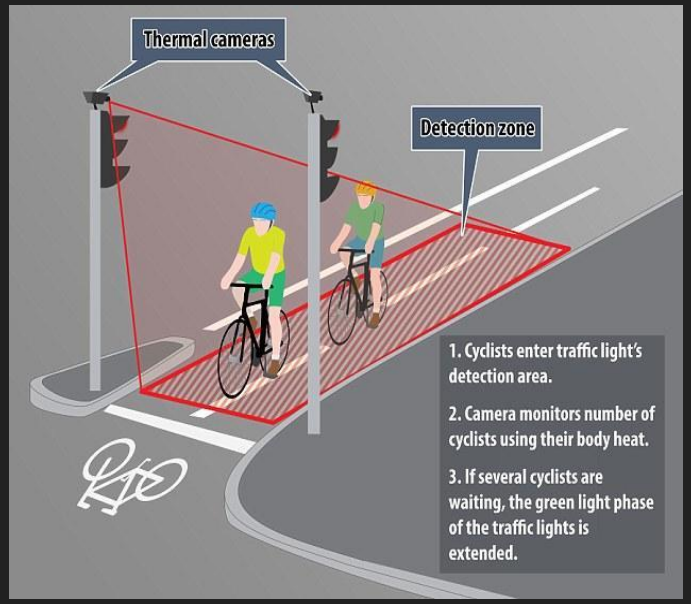
Common Assets:

- Traffic sensors
- Fiber
- DSRC
- Public WiFi

North Avenue Smart Corridor

- Current Facilities
- Future Plan
- Technologies to Add
- Cost Estimation
- Benefit Estimation

Existing Assests



- 8 Smart Signals
- 3 Rectangular Rapid Flash Beacons (RRFB)
- Connected Signals technology
- TravelSafely app
- Thermal sensors
- Fiber

Future Plan

Install and Collect Data

- Smart sensors at all major intersections
- Expand Fiber
- DSRC Roadside Units
- Public wifi

Analyze and Utilize Data

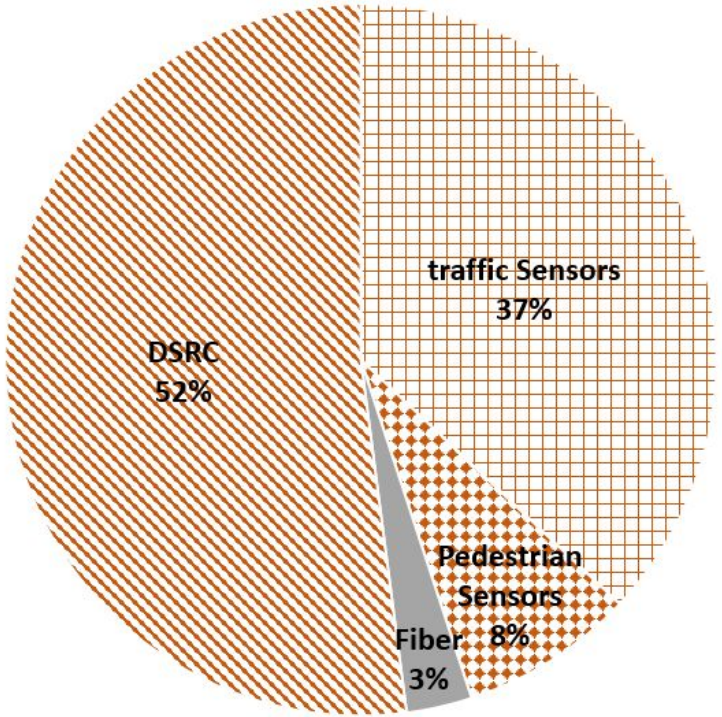
- Adaptive traffic signals, Connected to transit and emergency vehicles for priority
- Sensors adjust signal timing based on high density or delay of pedestrian/bicycle traffic
- DSRC used for instantaneous communication between compatible vehicles and infrastructure

New Tech for North Avenue Smart Corridor

- Place Smart sensors at all major intersections
  - Traffic sensors *8
  - Pedestrian sensors *2
- Expand Fiber *1.2 mile
- Install DSRC units *11
- Expand public WiFi * along corridor and Midtown

Life-cycle Cost Estimation

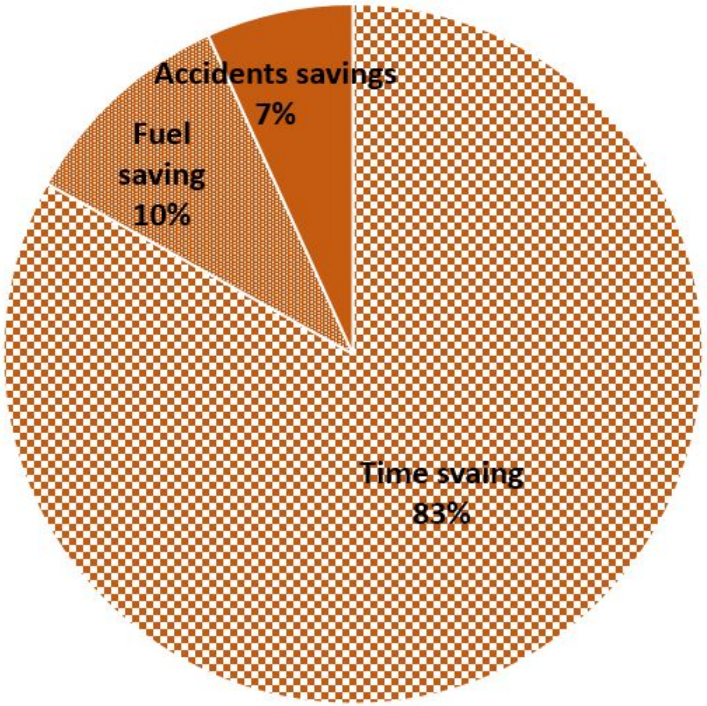
	Actual cost	Discounted cost
Traffic sensors	$316.8k	$157.7k
Pedestrian Sensors	$72k	$33.8k
Fiber	$20.43k	$12.7k
DSRC	$418.8k	$221.8k
Total	$828.0k	**$426.0k**



(25-year life cycle, 7% discount rate)

Benefit Estimation

	Actual benefits	Discounted benefits
Time savings	$5,083k	$3,282k
Fuel savings	$896k	$400k
Accidents savings	$382k	$268k
Total benefits	$6,361k	**$3,950k**



(25-year life cycle, 7% discount rate)

Source: Cobb Parkway Smart Corridor 2015 TIGER Application

Benefit Estimation

Cost

$ 426k

\+ $ 1,000k

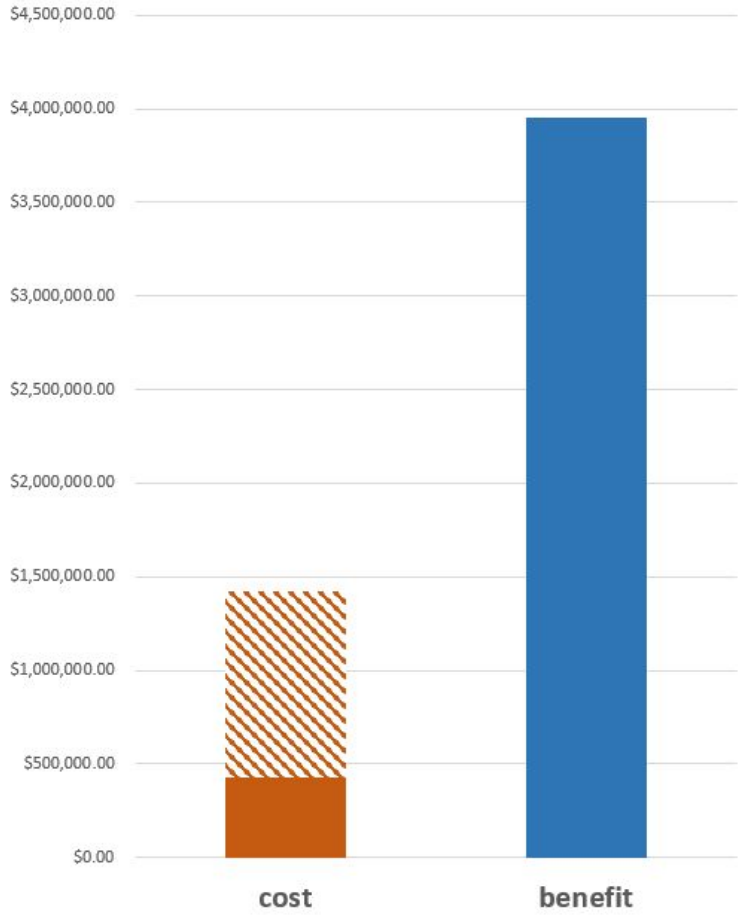
$ 1,426k

Benefit

$ 3950k

B/C ratio

2.77 > 1



Summary

- Smart infrastructures improve mobility by applying communication technologies and motinoring real-time data
- Smart technologies create significant benefits such as energy savings , time savings and accident savings
- The North Avenue Corridor has great potential to implement more Smart technologies. The plan is projected to be highly effective and will generate great benefits.

Limitations & Recommendation for Future Research

Problems:

- Difficulties in obtaning the optimal initial/maintenance cost for all Smart assets
- Methods to quantify benefits are not context sensitive
- Difficulties in acquiring data of labor cost and consulting cost to install smart assets

Proposed future research:

- Require manufacturers to publicly share market price of smart assets
- Request USDOT to update figures in the Intelligent Transportation System cost/benefit database
- Suggest more research be done that correlates Smart Corridor initiatives and changes on travel time and fuel consumptions

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