



Costing Out Connected Infrastructure

Sam Morrissey, PE

April 13, 2017

The Story of a Transportation Revolution!

At the dawn of a new millennium...

...a new technology was quickly gaining in popularity...

...the new technology scared some people...

People across the country asked for improvements to accommodate the technology...

“But...

we want to talk about cool self-driving cars!”



“What’s all this ‘connected’ stuff?”

What do all Autonomous Vehicles (AVs) Need?

A blue classic car, possibly a Chevrolet or GMC, is parked on a road. The car is viewed from a front-quarter angle. A semi-transparent white horizontal bar is overlaid across the middle of the image, containing the text "AVs Need Roads" in a bold, black, sans-serif font. The background shows a dense forest of tall trees.

AVs Need Roads

Agency Roles

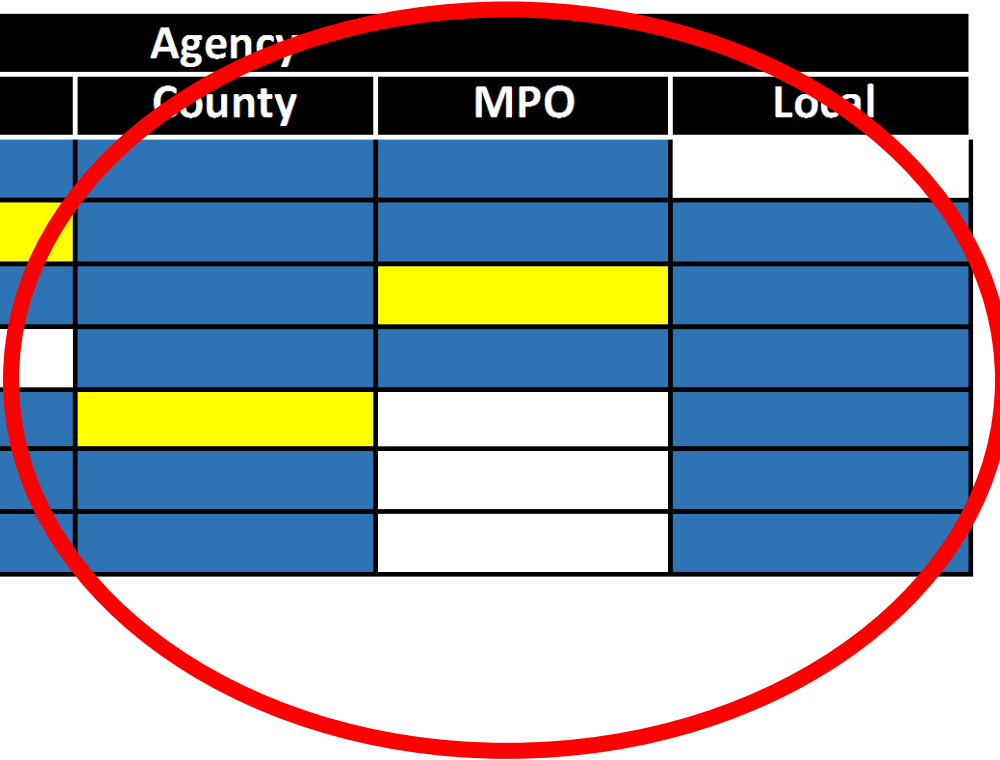
Role	Agency				
	Federal	State	County	MPO	Local
Standards	Blue	Blue	Blue	Blue	White
Funding	Blue	Blue	Blue	Blue	Blue
Planning	White	Blue	Blue	Blue	Blue
Prioritization	White	White	Blue	Blue	Blue
Implementation	Blue	Blue	Blue	White	Blue
Operation	White	Blue	Blue	White	Blue
Maintenance	White	Blue	Blue	White	Blue

Agency Activity in C/AV To-Date

Role	Agency				
	Federal	State	County	MPO	Local
Standards	Yellow	Blue	Blue	Blue	White
Funding	Yellow	Yellow	Blue	Blue	Blue
Planning	White	Blue	Blue	Yellow	Blue
Prioritization	White	White	Blue	Blue	Blue
Implementation	Blue	Blue	Yellow	White	Blue
Operation	White	Blue	Blue	White	Blue
Maintenance	White	Blue	Blue	White	Blue

What's Missing?

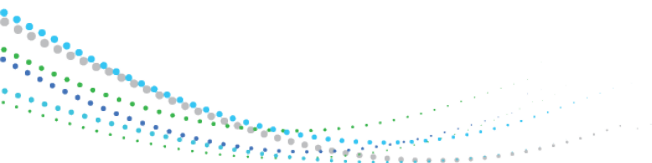
Role	Agency				
	Federal	State	County	MPO	Local
Standards	Yellow	Blue	Blue	Blue	White
Funding	Yellow	Yellow	Blue	Blue	Blue
Planning	White	Blue	Blue	Yellow	Blue
Prioritization	White	White	Blue	Blue	Blue
Implementation	Blue	Blue	Yellow	White	Blue
Operation	White	Blue	Blue	White	Blue
Maintenance	White	Blue	Blue	White	Blue



AVs Need Roads: Roads Need Agencies

“Metropolitan planning organizations and regional transportation planning agencies are responsible for planning, coordinating, and financing local transportation projects. Regional agencies and local governments operate and maintain approximately 303,700 lane miles (140,600 centerline miles) of public roads and streets.”

Source: Economic Analysis Branch, Division of Transportation Planning, California Department of Transportation





SOUVENIRS OF HOLLYWOOD
GIFTS & SOUVENIRS
1/2 HOUR PHOTO

Highland Av

Dolby Theatre →

DO NOT BLOCK INTERSECTION

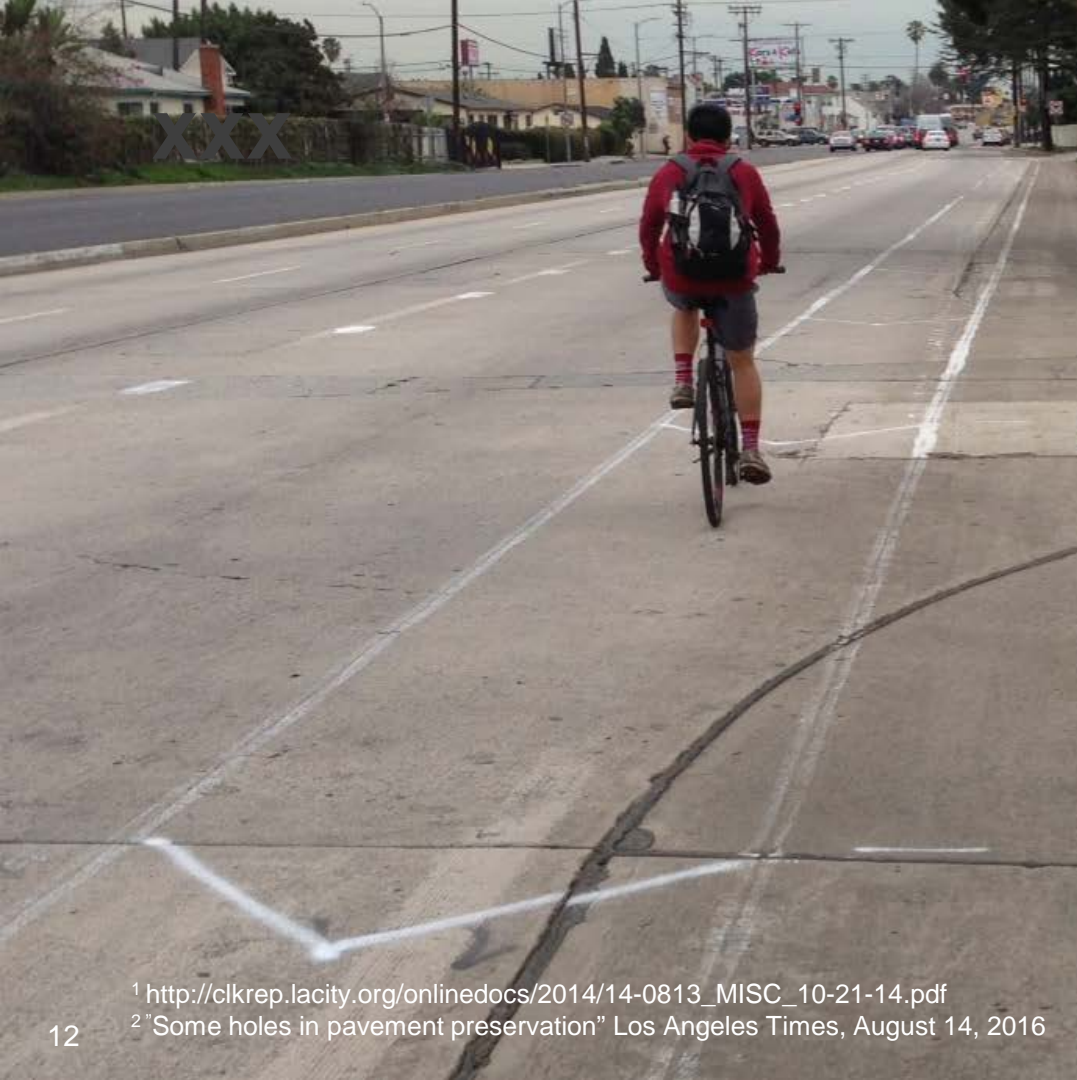
ON RED

1700 N



**"You need to paint the bloody roads here!"
– Lex Kerssemakers, CEO, Volvo North America¹**

¹Where's the lane? Self-driving cars confused by shabby U.S. roadways" <http://www.reuters.com/article/us-autos-autonomous-infrastructure-insig-idUSKCN0WX131>



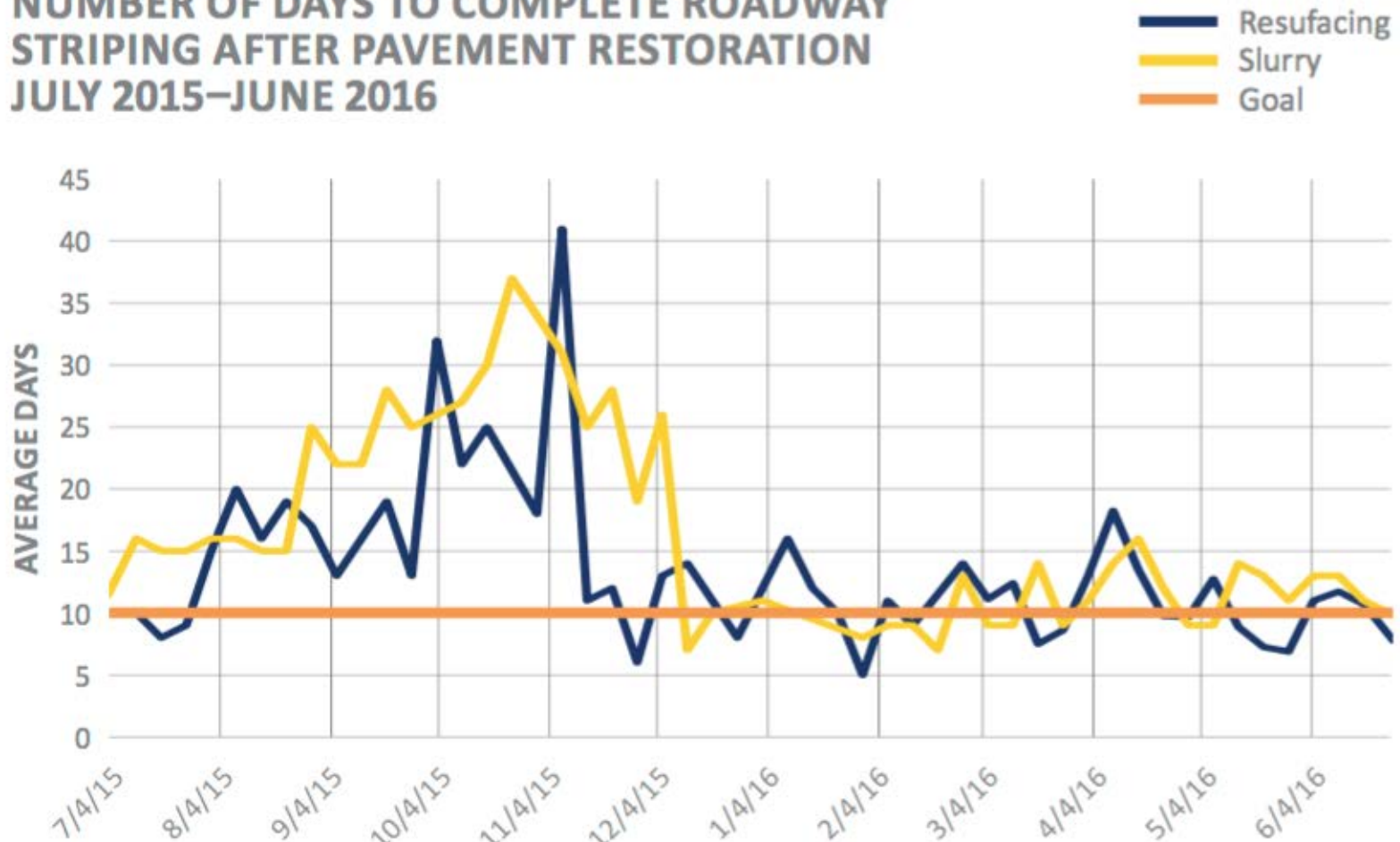
Los Angeles Markings¹

- 28,000 lane miles of paved roadways²
- Resurface approx. 550-700 miles per year (target of 2,400)
- 1 markout crew (for new striping and replacements)
- 2 “long line” crews, one for yellow and one for white lines
- 3 crews for other markings (crosswalks, etc.) and maintenance

¹ http://clkrep.lacity.org/onlinedocs/2014/14-0813_MISC_10-21-14.pdf

² “Some holes in pavement preservation” Los Angeles Times, August 14, 2016

NUMBER OF DAYS TO COMPLETE ROADWAY STRIPING AFTER PAVEMENT RESTORATION JULY 2015–JUNE 2016



Source: http://ladot.lacity.org/sites/g/files/wph266/f/LADOT_Annual_Report_2015-2016.pdf



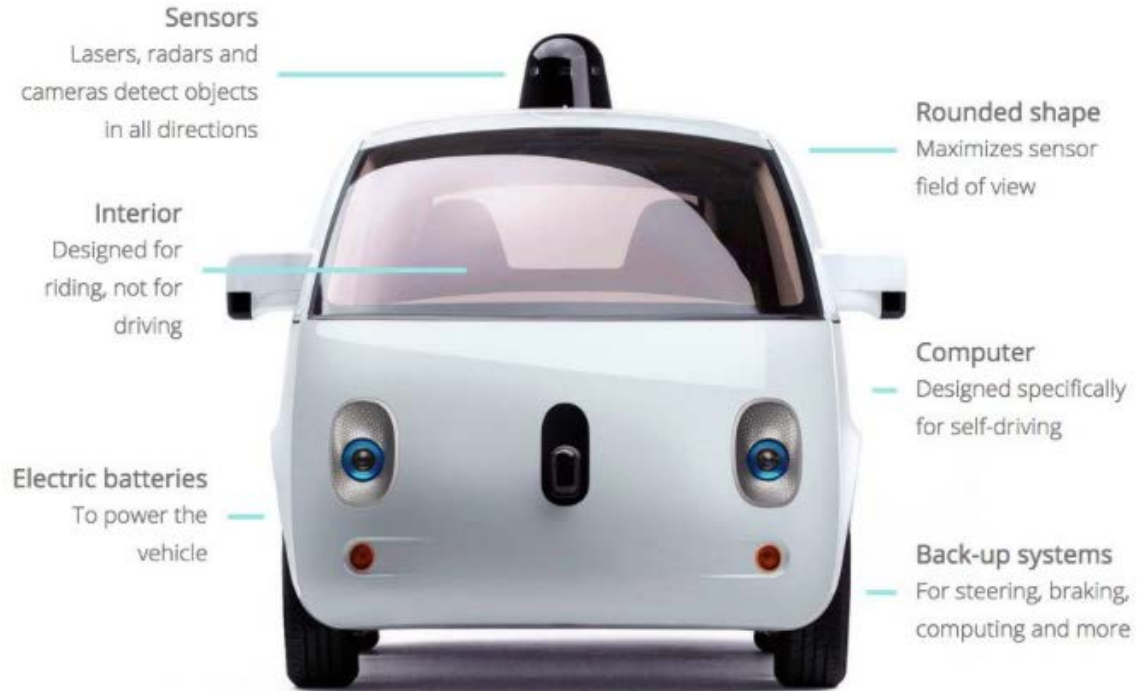
Vehicle Detectors¹

- 64,500 loops throughout the City
- 2 crews for loop replacement
- Replace 5% per year (approx. 3k)

¹http://clkrep.lacity.org/onlinedocs/2014/14-0813_MISC_10-21-14.pdf

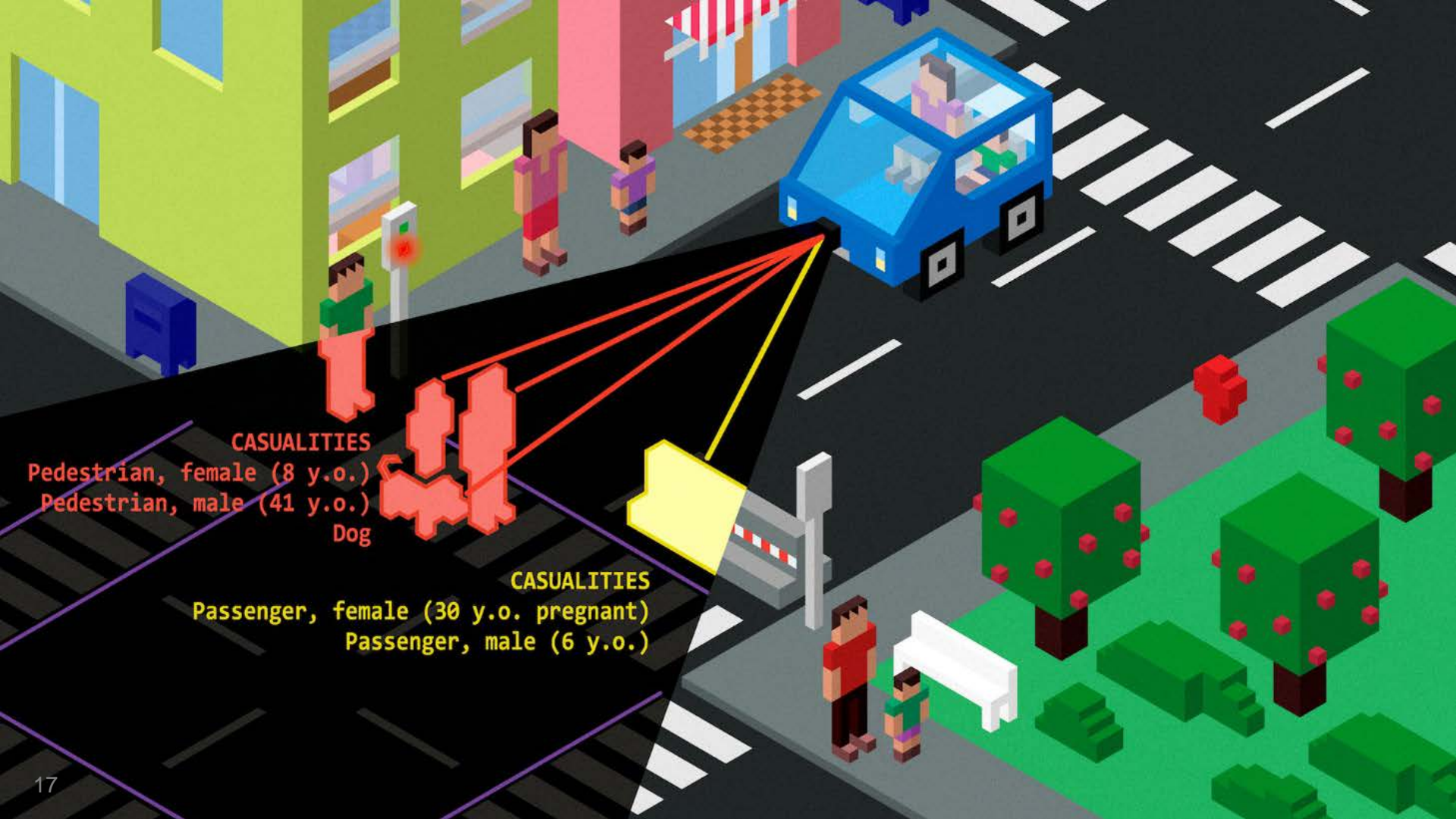
Why is this Important?

How AVs see the world



Why is this Important? (Cont'd)





CASUALTIES
Pedestrian, female (8 y.o.)
Pedestrian, male (41 y.o.)
Dog

CASUALTIES
Passenger, female (30 y.o. pregnant)
Passenger, male (6 y.o.)

M Technology ▶ Driverless cars

Google driverless car involved in 'worst crash yet' after van runs a red light

The incident has been blamed on the human driver of the van rather than the autonomous vehicle

f t G+ p 46 SHARES

5 COMMENTS

BY SOPHIE CURTIS
16:05, 26 SEP 2016 | UPDATED 18:03, 26 SEP 2016

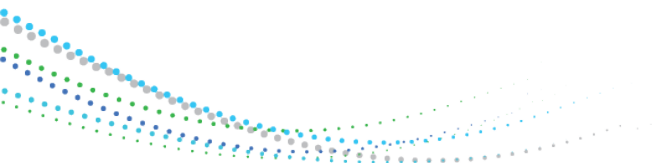
TECHNOLOGY



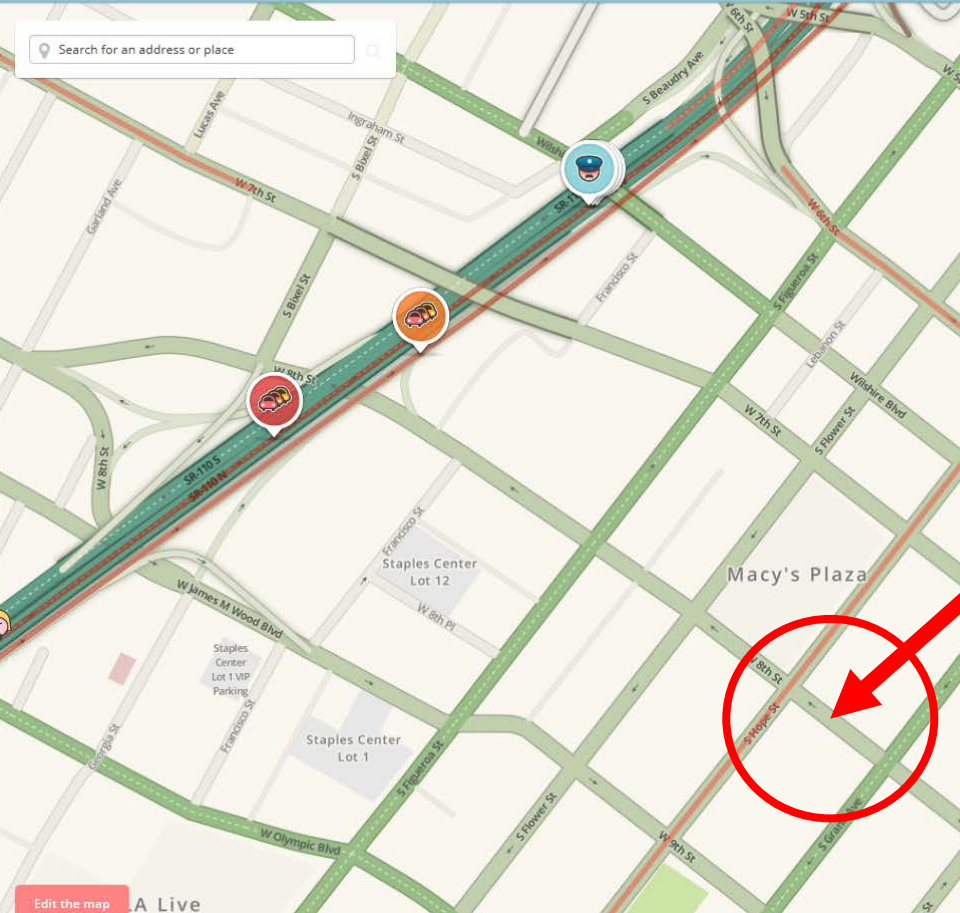
blamed on the human driver

Connectivity is Key

- Autonomy is great...
- Autonomy won't fix external human error
- Connectivity can address human error/variability/chaos
- This will be **critical** during transition
 - Not just for moving objects...



Search for an address or place



How Pedestrians Will Defeat Autonomous Vehicles

The 'game of chicken' which could be a serious problem for driverless cars

By Karinna Hurley on March 21, 2017

☰ SECTIONS 🔍 SEARCH

Los Angeles Times



THURSDAY MAR. 30, 2017

MOST POPULAR LOCAL SPORTS ENTERTAINMENT POLITICS OPINION PLACE AN AD



LOCAL / CITY HALL

Construction boom is creating obstacle courses for L.A. pedestrians

What Are Agencies Doing?

- LADOT/WAZE partnership
- Online permit systems
- ITS investment
 - \$43M (2015 Metro CFP)

METRO 2015 TIP CALL FOR PROJECTS
PRELIMINARY PROJECT RECOMMENDATIONS
INFLATED IN WHOLE DOLLARS
(Project Expense and Local Match Totals Exclude Prior Year)

	Number of Applications Submitted	Number of Applications Funded	Inflated Total Project Expenses	Inflated Total Project Requests	AMOUNT RECOMMENDED	Page	Color
Regional Surface Transportation Improvements	33	12	\$238,712,912	\$120,385,730	\$39,305,307	1	Salmon
Goods Movement Improvements	8	7	\$133,387,211	\$35,638,615	\$29,684,308	19	Yellow
Signal Synchronization and Bus Speed Improvements	16	15	\$60,760,978	\$48,075,810	\$43,742,191	23	Green
Transportation Demand Management	9	8	\$11,313,507	\$7,810,633	\$7,234,328	31	Pink
Bicycle Improvements	39	15	\$120,568,622	\$83,949,696	\$30,133,543	37	Blue
Pedestrian Improvements	31	13	\$81,022,277	\$61,317,458	\$21,622,069	59	Gold
Transit Capital*	42	14	\$148,938,424	\$116,140,445	\$21,085,327	75	Grey
	178	84	\$794,722,831	\$473,318,387	\$182,809,873		
TAC Appeals Reserve					\$6,590,127		
Total Funding Mark					\$199,400,000		

*Additional funding of \$276,957 for project F9404 is added using 2015 De-obligated Transit Capital funds.

LADOT LADOT
@LADOTofficial

Following

Mayor's Press Conference at LADOT to partner with WAZE App.



RETWEETS 5 LIKE 1



1:12 PM - 21 Apr 2015

What Can Agencies Do?

- Invest in dedicated facilities
- Investment in maintenance
- Inspection
- Enforcement

Budget

Total City Budget	\$8,582,562,666
LADOT Operating Budget	\$154,636,217
Other LADOT Funding Sources	\$496,055,488
Total LADOT Budget	\$650,691,705
Total Direct Cost of Operations	\$405,338,231

Source: http://ladot.lacity.org/sites/g/files/wph266/f/LADOT_Annual_Report_2015-2016.pdf

STREETSBLOG SF

Pedestrian Safety / Bicycling / Muni / Parking / Peninsula / California



All Muni Buses Now Have Transit Lane Enforcement Cameras

By Aaron Bialick Mar 24, 2015 33



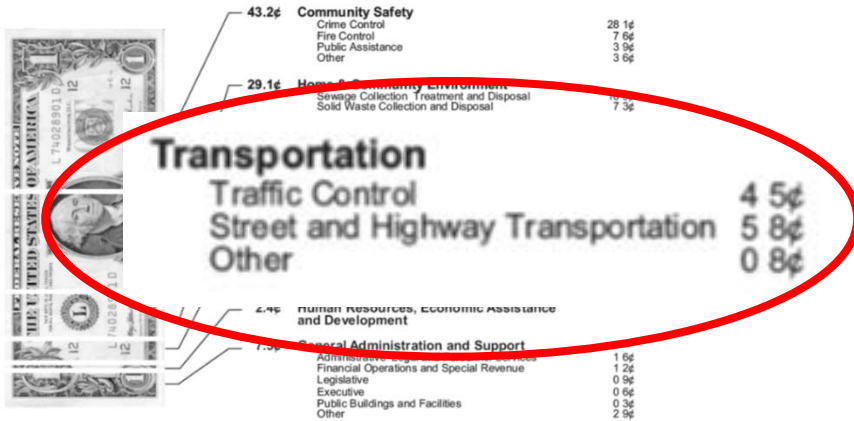
Image: KRON 4's People Behaving Badly

Challenges

Competing priorities

The 2016-17 Budget Dollar

How the Money Is Used



Source: <http://cao.lacity.org/budget/summary/2016-17BudgetSummaryBooklet.pdf>



LOS ANGELES LA TRANSPORTATION

LA's Worst Roads Might Not Improve Anytime Soon

For poorly maintained streets, Metro's sales tax increase proposal might be the only hope

BY ELIJAH CHILAND | JUN 13, 2016, 9:50PM PDT



LOS ANGELES NEWS

Los Angeles has the second-worst roads in the nation

And they cost drivers almost \$900 per year

BY ELIJAH CHILAND | NOV 5, 2016, 11:59PM PDT



LOS ANGELES NEWS

Plan moves ahead to allocate Measure M funds to protect pedestrians and bicyclists

But less would go toward fixing potholes

BY ELIJAH CHILAND | MAR 29, 2017, 6:20PM PDT

Challenges (Cont'd)

Consistency

- Changing technologies
 - Investment in ITS to-date
 - Need for upgrade



- National standards



Finishing the Story: A Revolution!

“The League was founded as the League of American Wheelmen in 1880. Bicyclists, known then as ‘wheelmen,’ were challenged by rutted roads of gravel and dirt and faced antagonism from horsemen, wagon drivers, and pedestrians.

In an effort to improve riding conditions so they might better enjoy their newly discovered sport, more than 100,000 cyclists from across the United States joined the League to advocate for paved roads.

The success of the League in its first advocacy efforts ultimately led to our national highway system.”

Source: <http://www.bikeleague.org/content/mission-and-history>

Thank You!

