Making Signals Work for Bicyclists and Pedestrians

Peter Koonce, PE

Portland, OR

October 18, 2017

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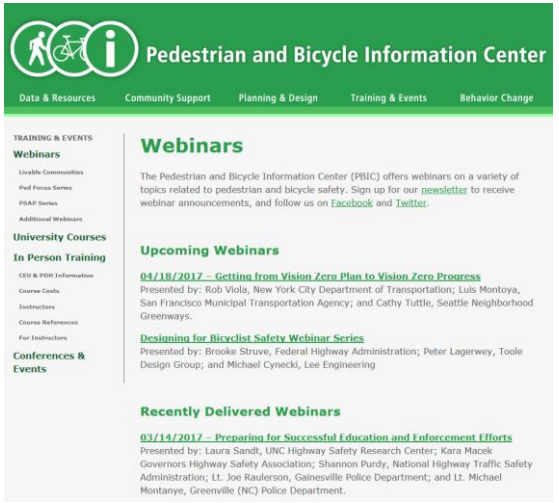


Making Signals Work for People Cycling and Walking

Peter Koonce, P.E.
Portland, OR
October 18, 2017

Webinar Outcomes

Use traffic signals to make intersections safer and more comfortable for nonmotorized road users.

Understand strategies for improving intersections through signal timing, cycle lengths, speed management, protected phasing, and more.

Discussion period featuring questions submitted by webinar attendees.

Users of the “traffic signal” vary depending on land use & transportation context

Measuring Comfort:
Levels of Traffic Stress (LTS)

LTS 1: Physically separated or mixed flow (<25 mph), comfortable for children

LTS 2: Bike lanes 5.5 feet wide or less, 30mph traffic and unsignalized crossings

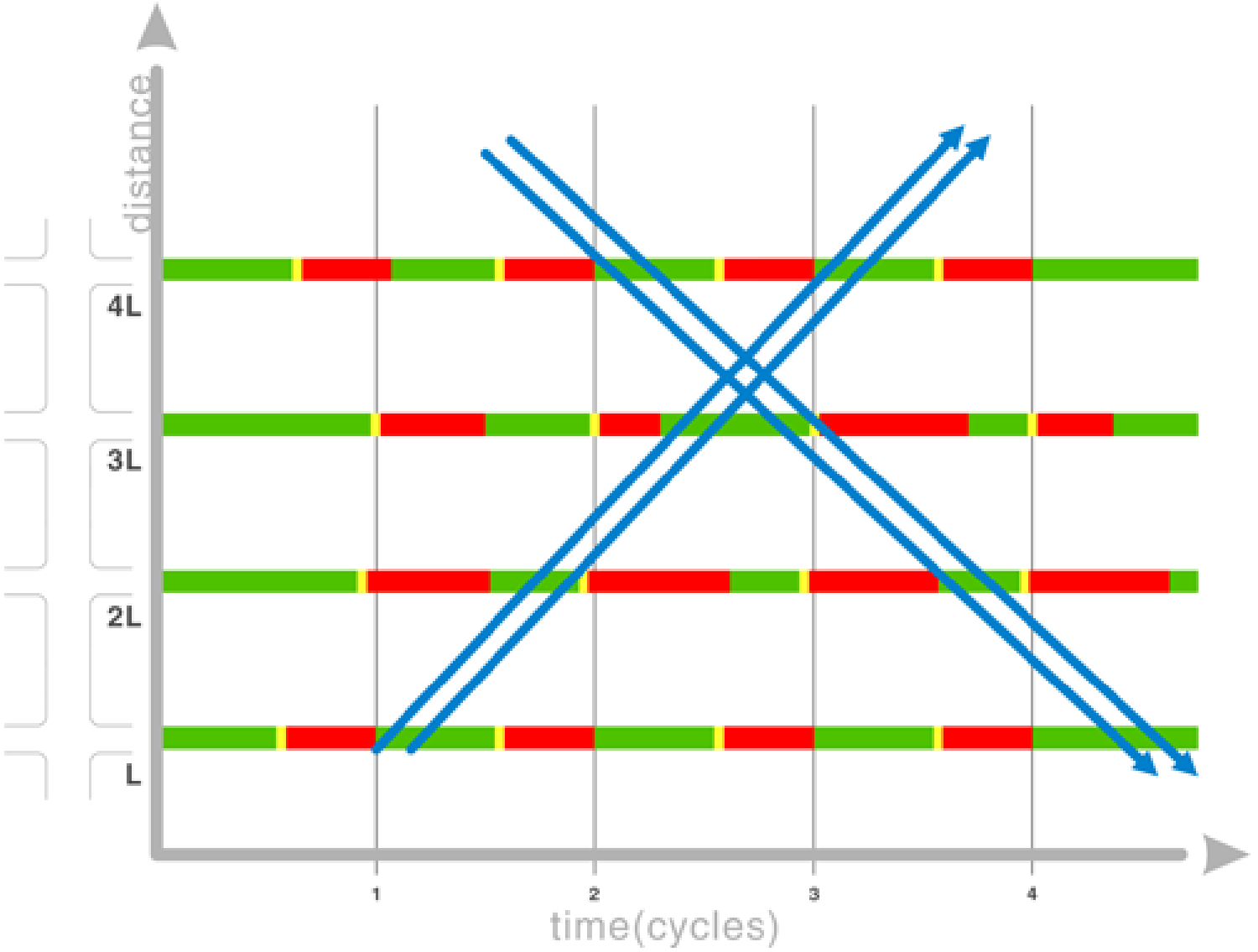
LTS 3: Bike lanes next to 35 mph traffic

LTS 4: No facilities & 40 mph

Research needed on intersection treatments

Bike/Walk to School Day

Time-Space Diagram



Outline

- Traffic signals are built to stop people
- Speed is a critical assumption
- Policy and context are important
- All of us have bias


STOP


pol·i·cy
adopted and
government,
party - action
conforming to

Today's Message

- Traffic signals help shape places
- Research is needed to improve design, operations, and meet new challenges

Integrate Time & Space

"Balance needs of and functions of different time periods"

"Streets designed for peak intervals may fail to provide a safe and attractive environment"

Source: NACTO Urban Street Design Guide, 2013


KINZIE
HOTEL
20 WEST
KINZIE
KINZIE ST
TAXI

Signalization Principles

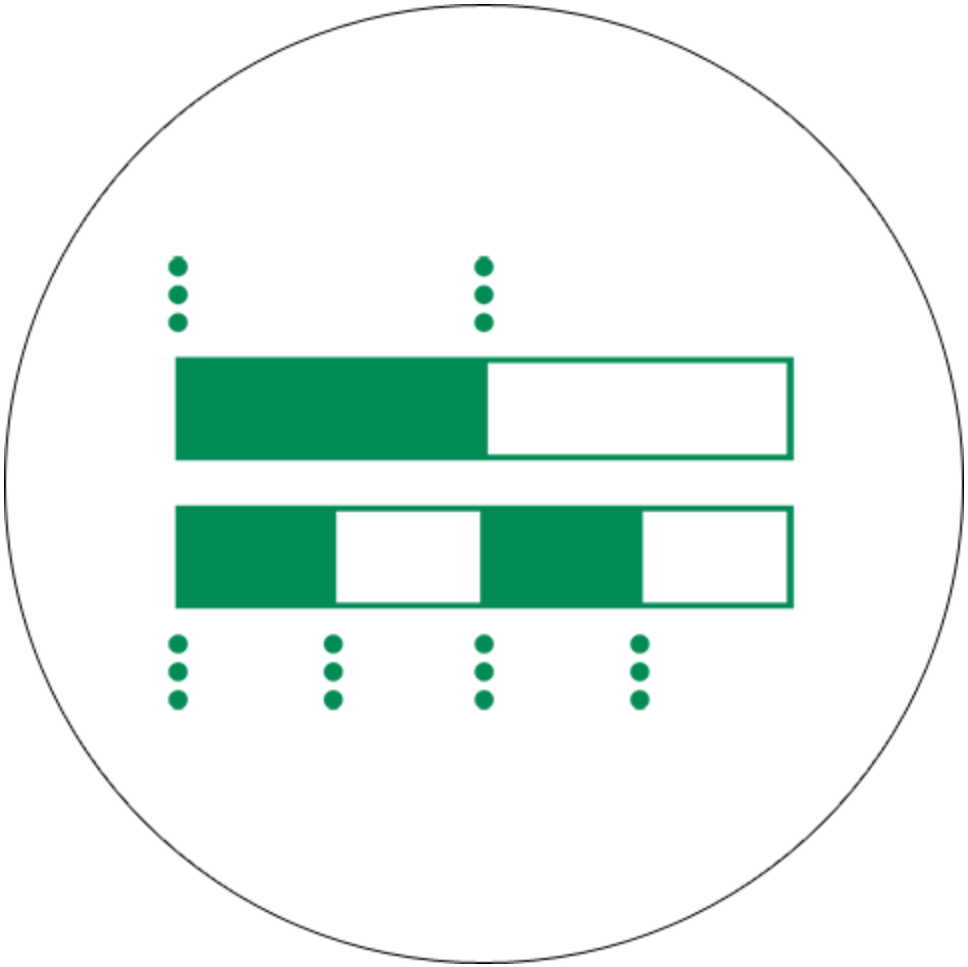
Signalization Principles

- Shorten signal cycles
- Prioritize multimodal travel
- *Minimize number of signal phases*
- Set Slow progression speeds
- Adjust timing for off-peak
- Consider fixed time signals

Source: NACTO Urban Street Design Guide, 2013

Signalization Principles

- Shorten signal cycles
- Prioritize multimodal travel
- *Minimize number of signal phases*
- Set slow progression speeds
- Adjust timing for off-peak
- Consider fixed time signals
- Employ advanced logic & detection



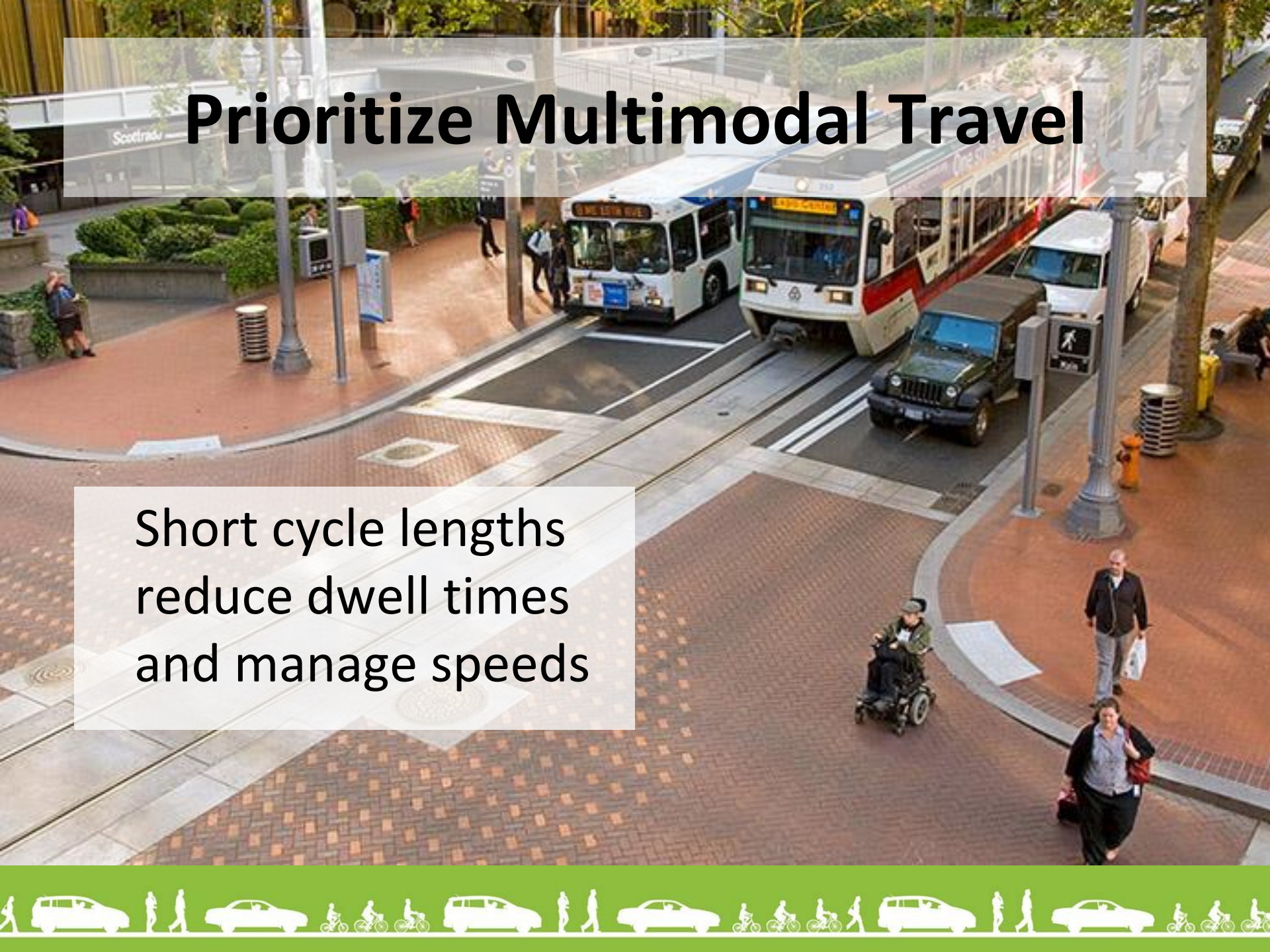
Shorten Signal Cycle Lengths

- **Long enough to accommodate pedestrian crossings**
- **Short enough to encourage compliance**

Cycle lengths of 60–90 seconds are ideal

Source: NACTO Urban Street Design Guide, 2013

Prioritize Multimodal Travel



Short cycle lengths reduce dwell times and manage speeds

***Transit** may* also benefit from shorter cycle lengths because dwell times are variable

Set Slow Progression Speeds

Synchronize signals to maintain safe vehicular travel speeds and discourage speeding

MUTCD 2H-

Progression Speed: Cycling Streets

- Signals timed for 12–15 mph focused on bicycle traffic

Green Wave

SFMTA has set reduce traffic signal speeds using the following criteria:

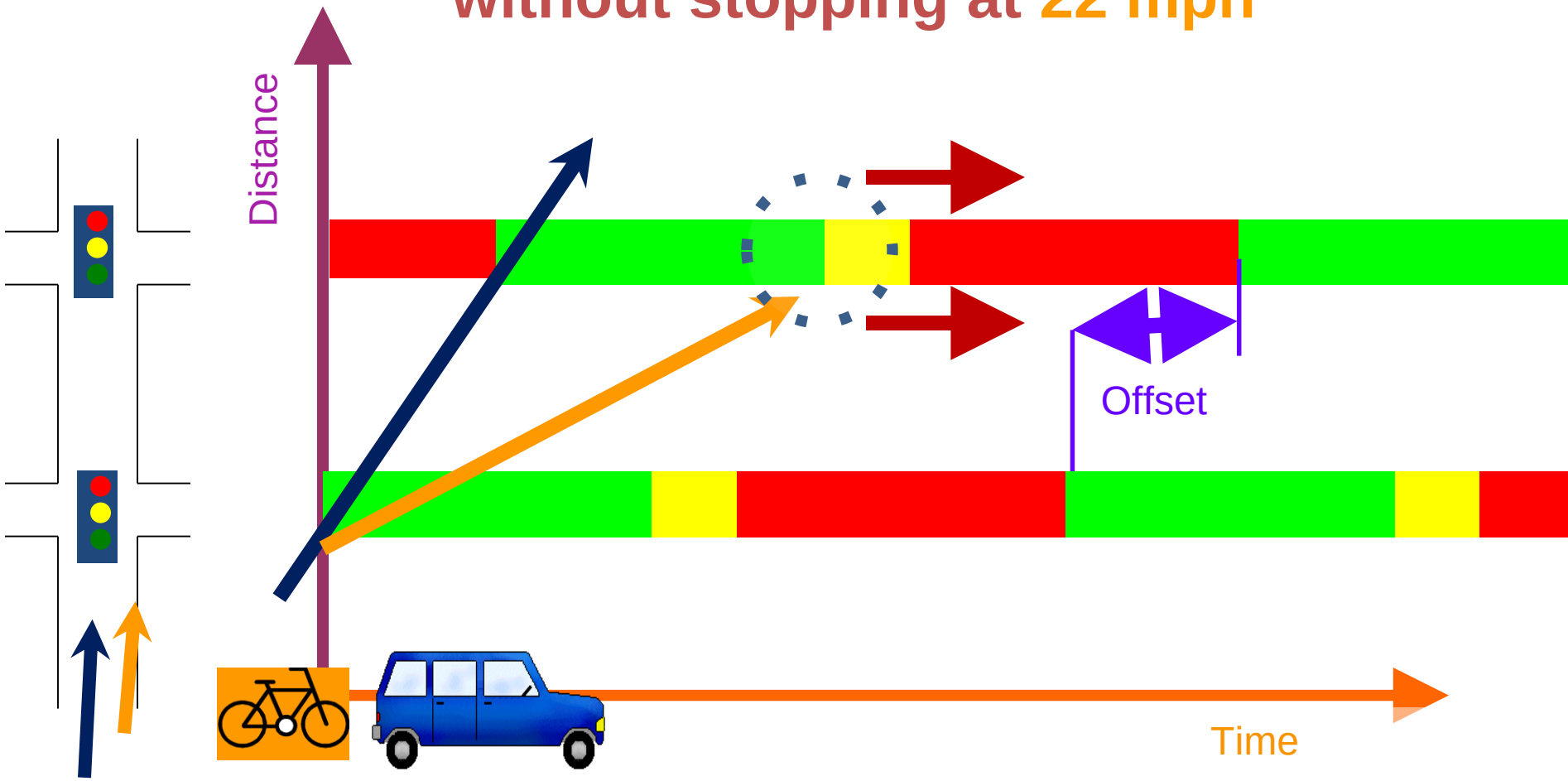
- more than 3 signals
- on City bike network
- With bike lane
- Same signal cycle
- Outside grid

Source: SFMTA, 2017

Progression Speed: Cycling Streets

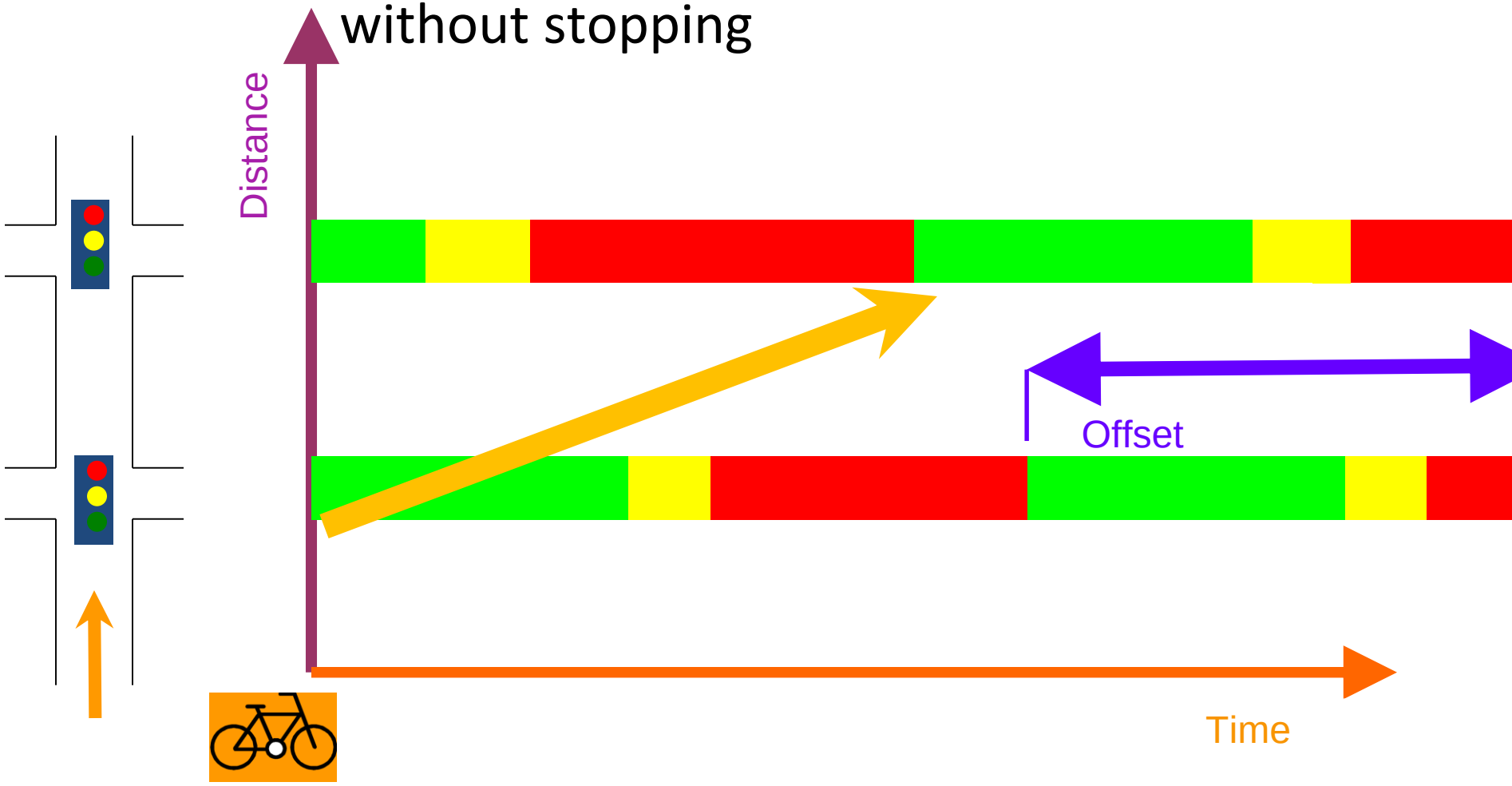
- Signal timing set to speed limit - 30 mph

bicycle traffic "could" get through without stopping at 22 mph



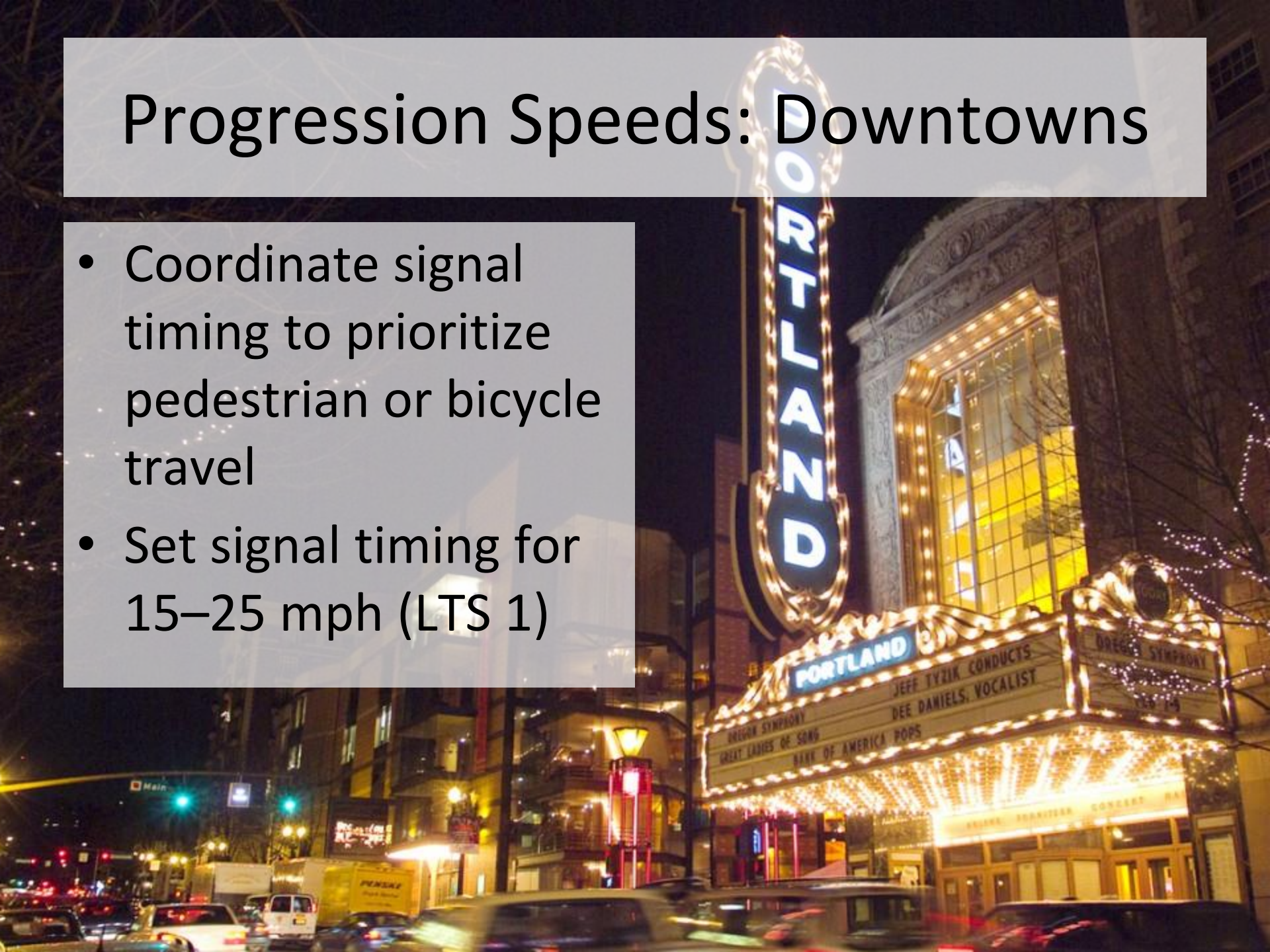
Progression Speed: Cycling Streets

- Delay green at downstream = Increased offset
  Bicycle traffic travels through at 13 mph without stopping

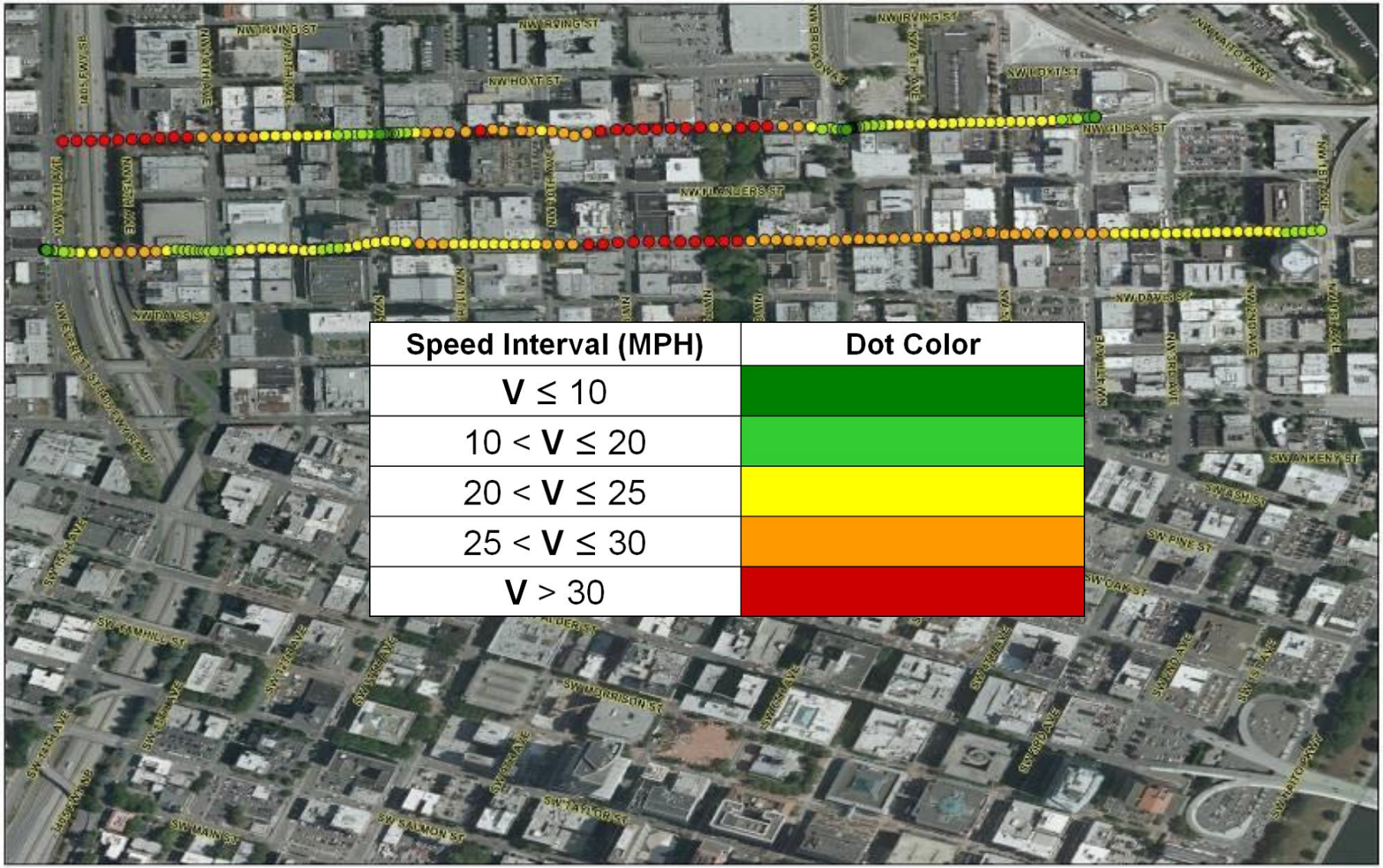


Progression Speeds: Downtowns

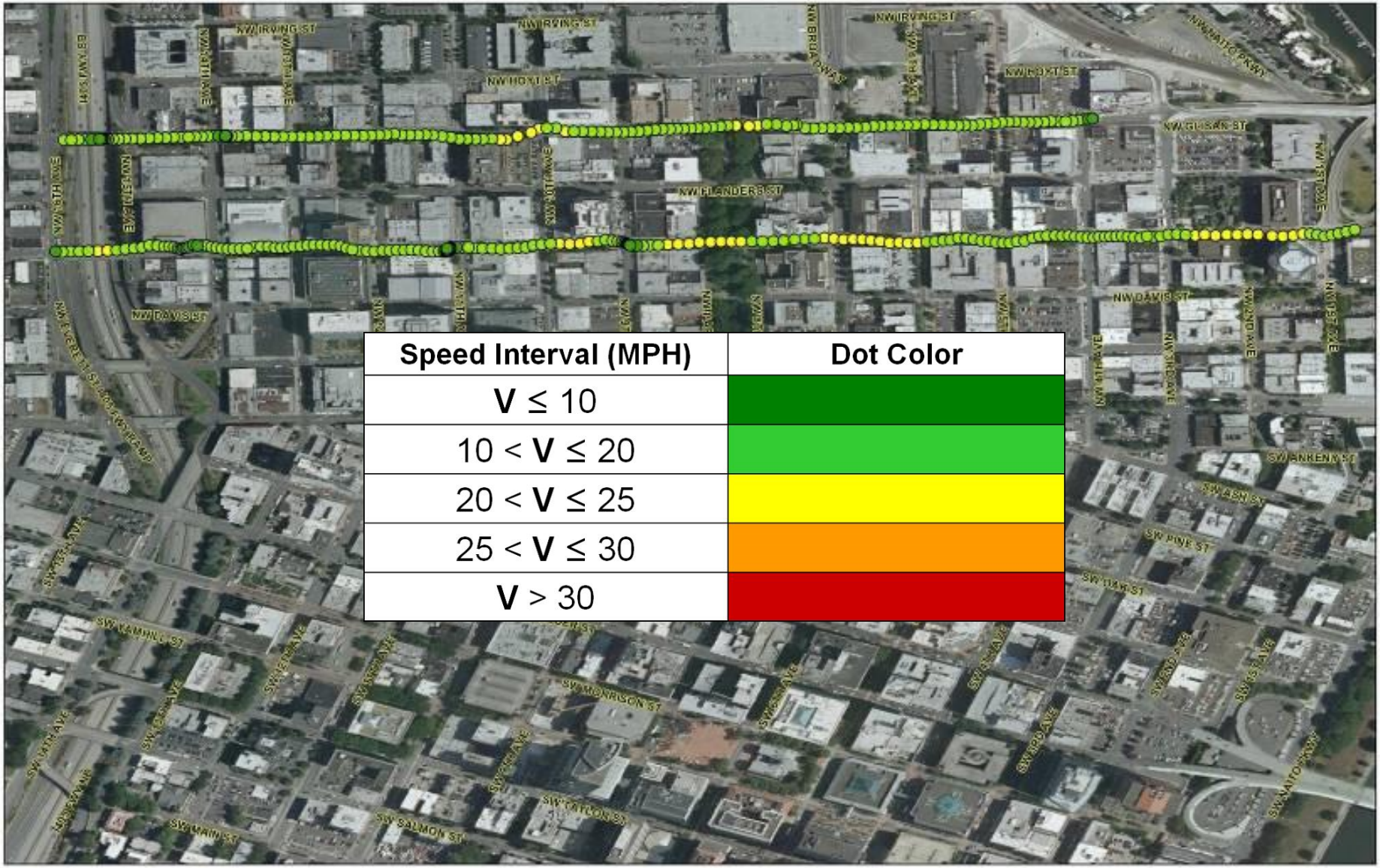
- Coordinate signal timing to prioritize pedestrian or bicycle travel
- Set signal timing for 15–25 mph (LTS 1)



Speeds Before Changes



Speeds After Changes



Speed Interval (MPH)	Dot Color
V ≤ 10	
10 < **V** ≤ 20	
20 < **V** ≤ 25	
25 < **V** ≤ 30	
V > 30	

Before and After Cycling Speed

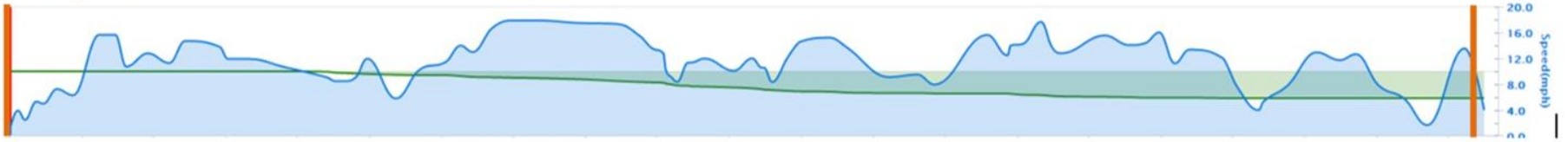
FOLSOM (After)

Southbound- (3:20 pm, 111, All other times) Travel Time 5:18 min, Distance .98 miles, Average speed = 10 mph
Hit 10 green / 0 red (slowed down once for right turning vehicle)

15th

24th

Northbound- (3:28 pm, 111, All other times) Travel Time 4:21 min, Distance .98 miles, Average speed = 14 mph
Hit 10 green / 0 red

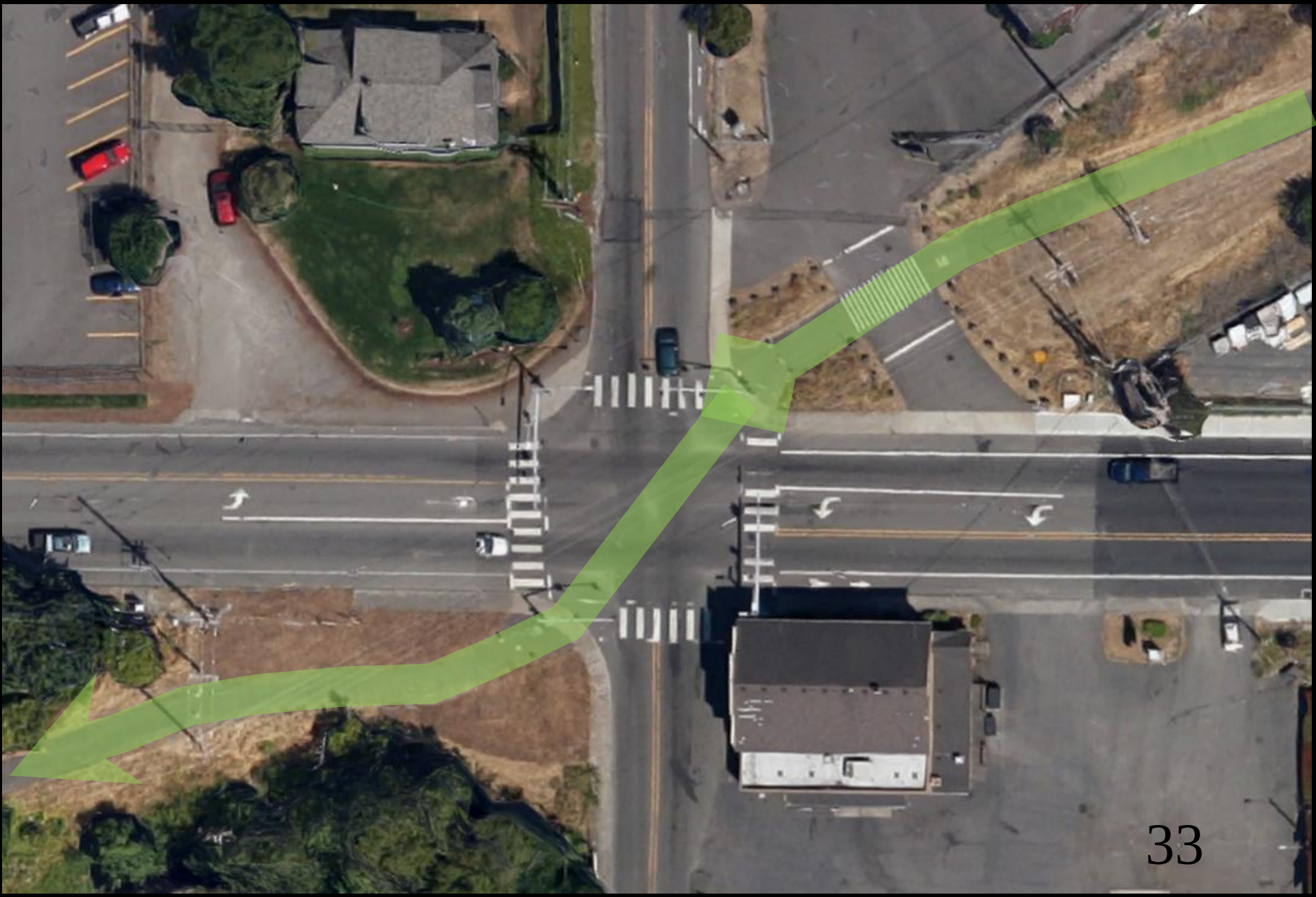


24th

15th

Source: SFMTA, 2017

Diagonal Crossing

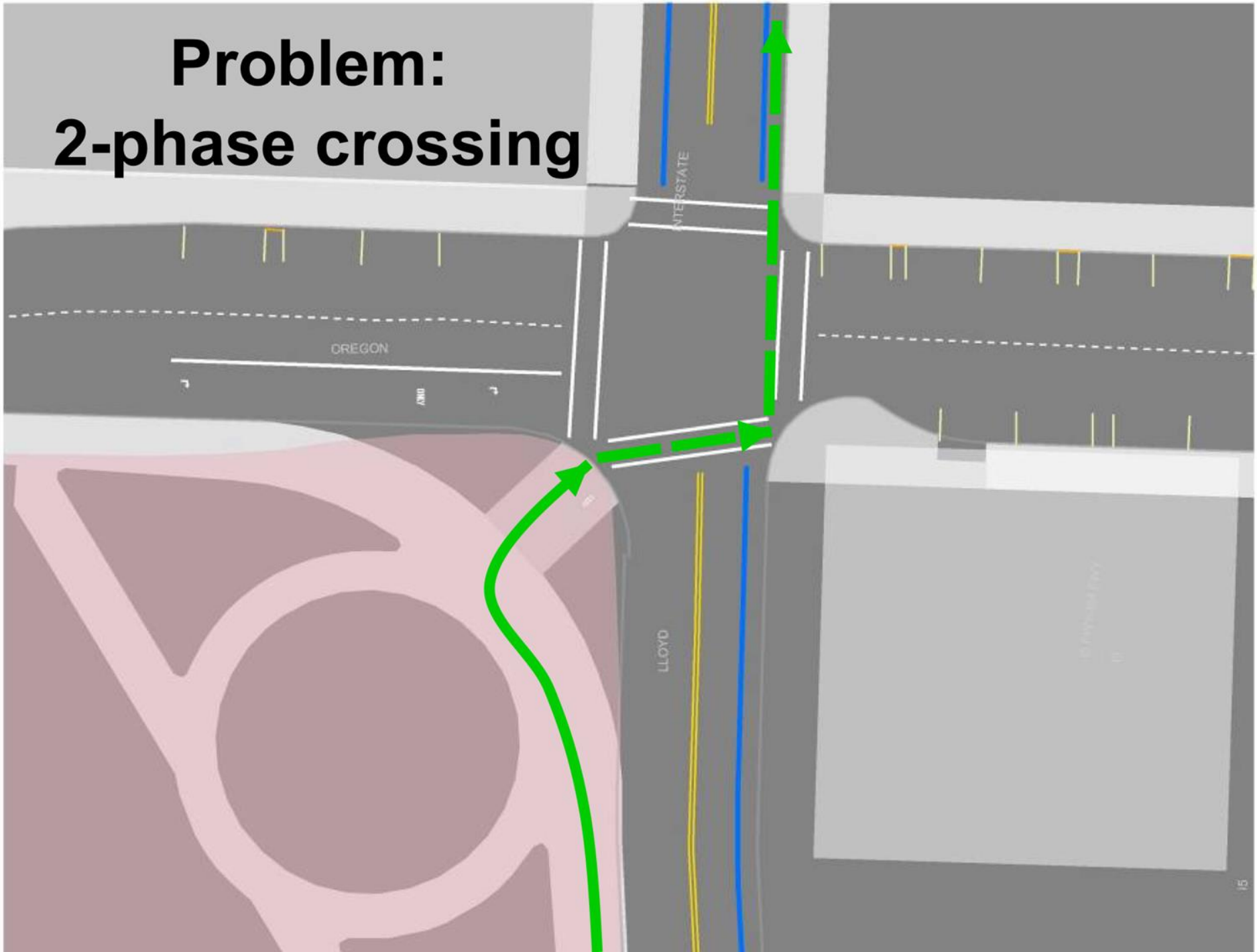


Digaonal Crossing

Bicycle Signal

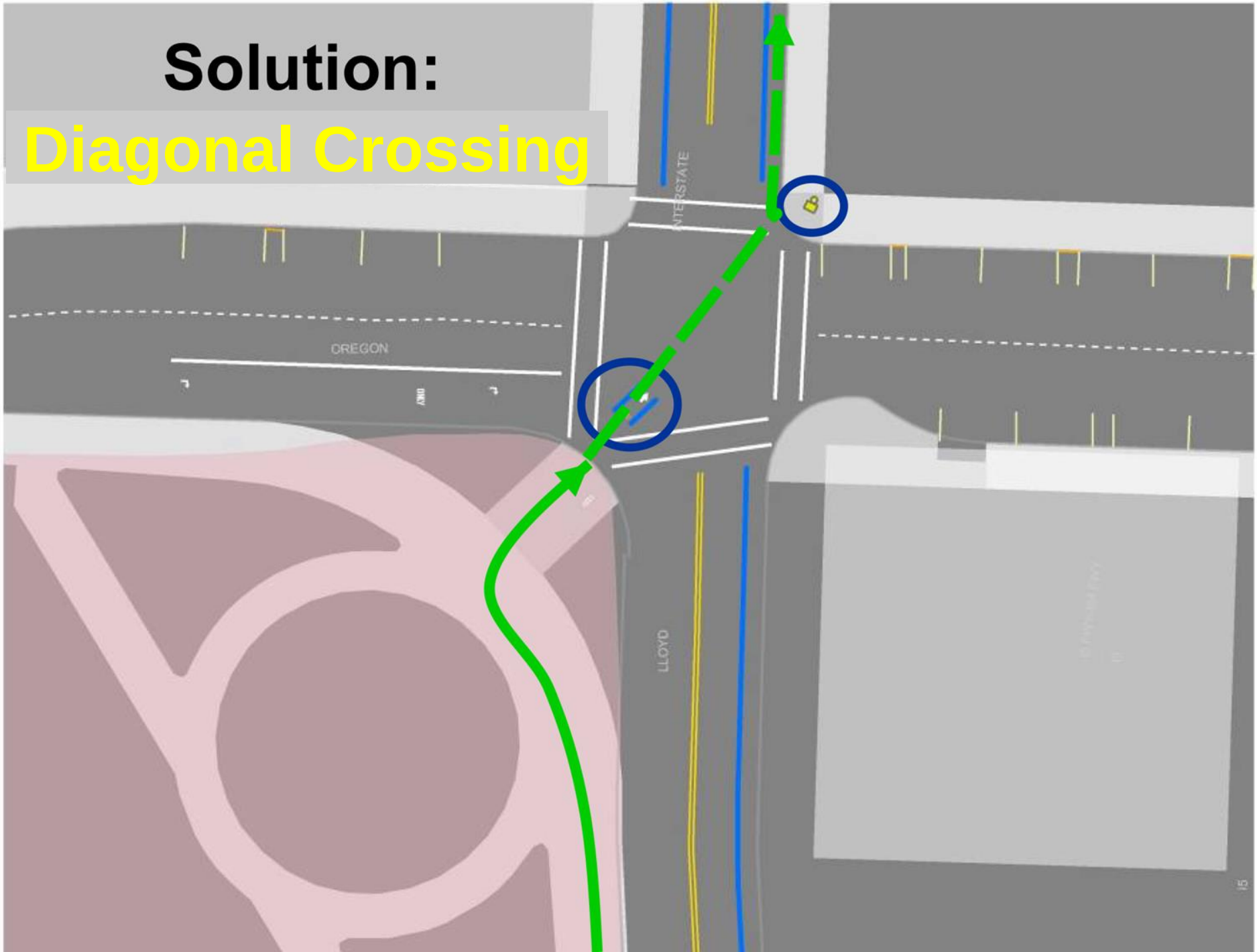
N Interstate Ave & Oregon St

- Exclusive bike & pedestrian phase
- Bikes cross diagonally from southwest to northeast
- Movement controlled by a bike signal


Problem:
2-phase crossing
INTERSTATE
OREGON
LLOYD

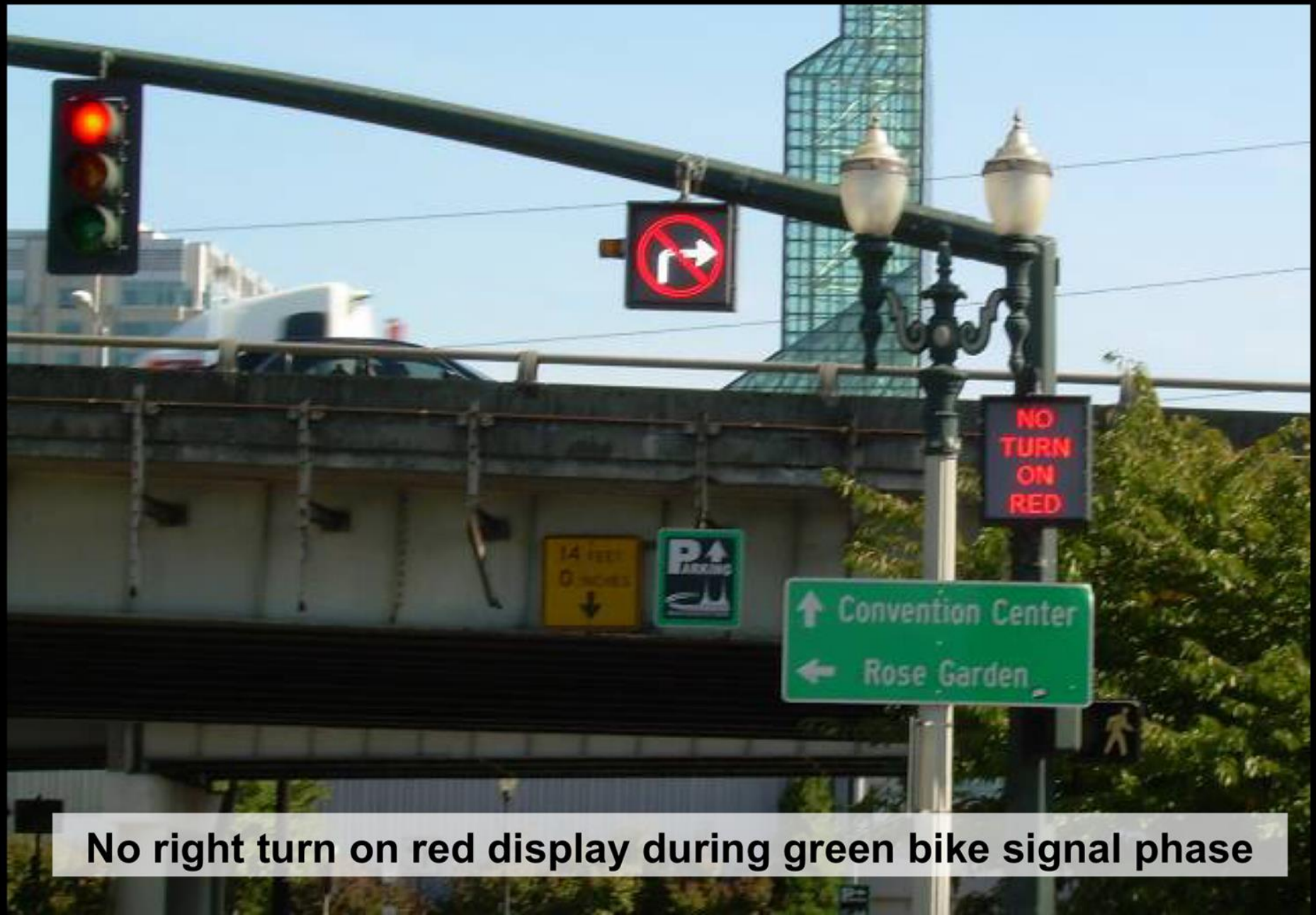
Solution:

Diagonal Crossing



Diagonal Bicycle Movement

N Interstate Ave & Oregon St

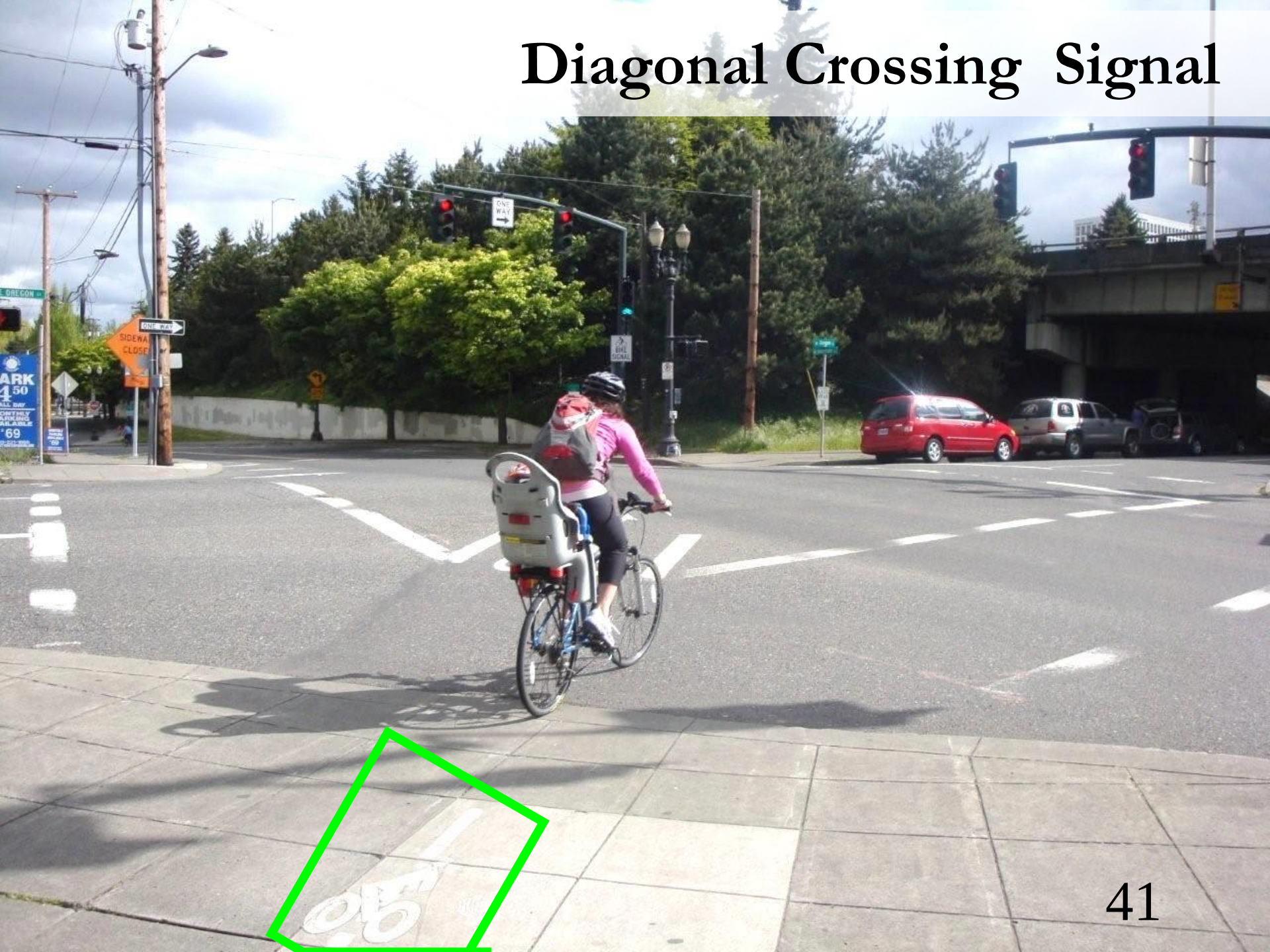


No right turn on red display during green bike signal phase

Designing for bicycle travel

Build it and they will come

Diagonal Crossing Signal




NEW
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WHOPPER
Be
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BIKE
SIGNAL
Shop at
Save
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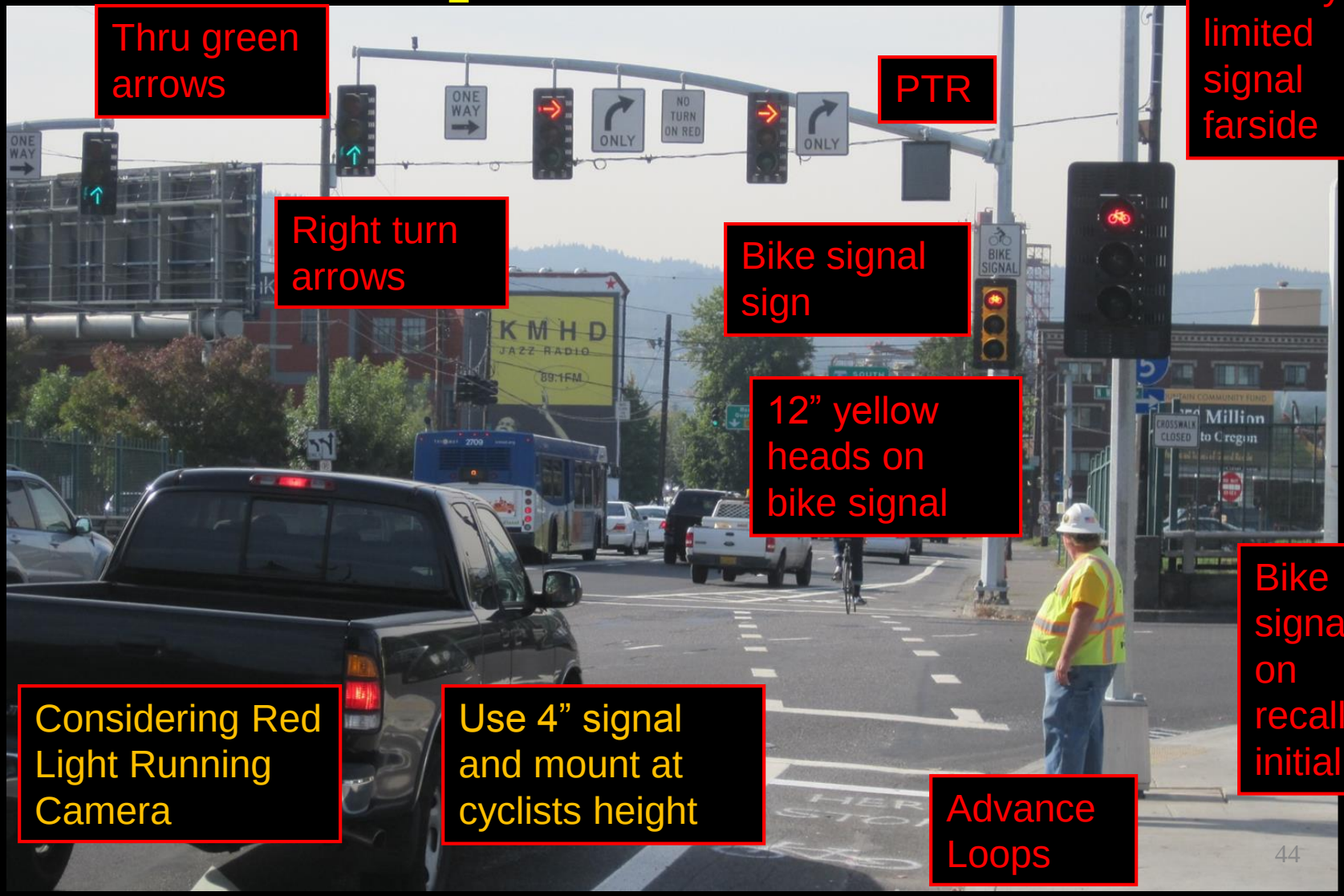
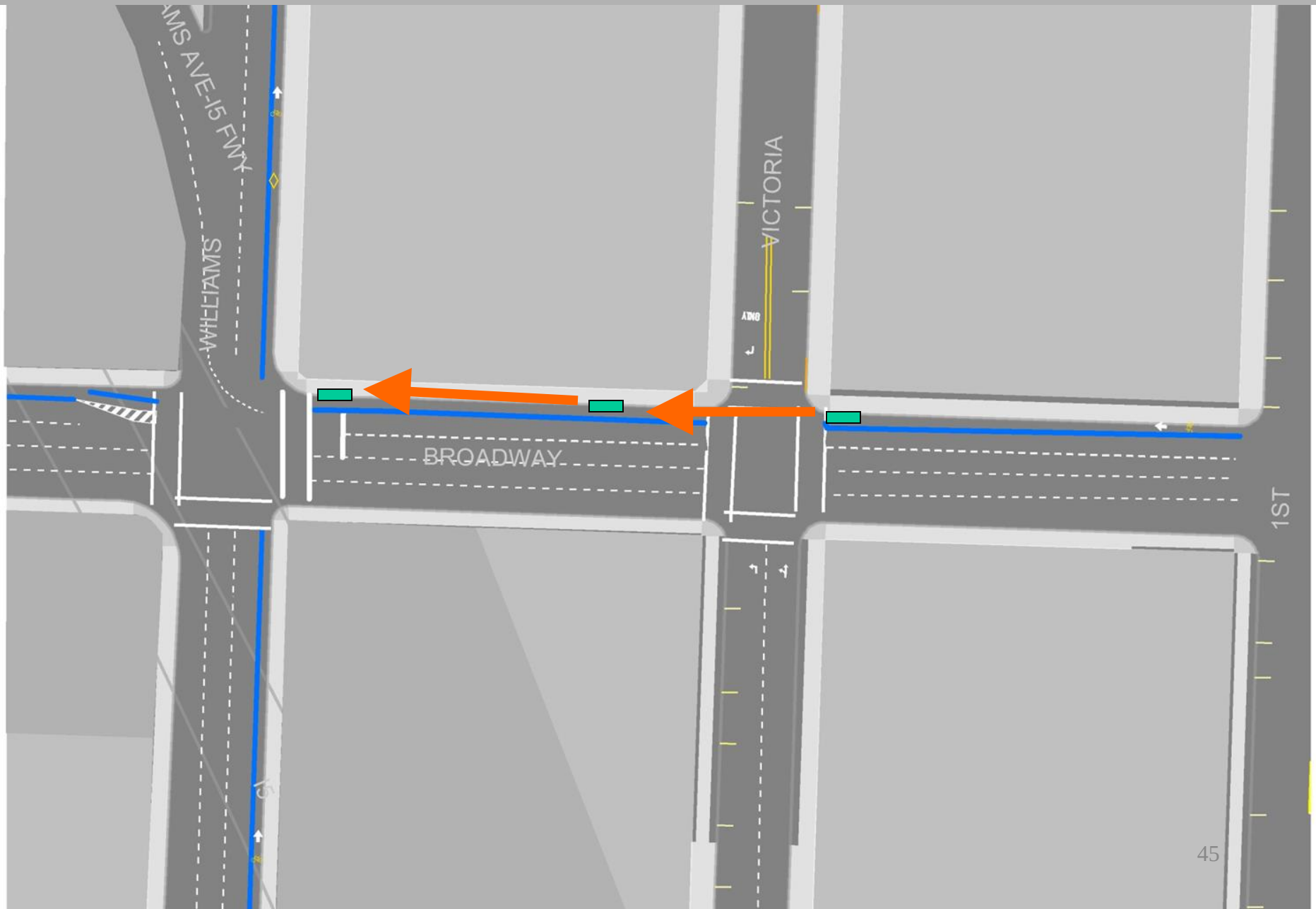
/gal
at Shell
CUSTOMER
PARKING ONLY
Frank
Caliendo


ONE WAY
ONLY
NO TURN ON RED
ONLY
BIKE SIGNAL
KMHD
JAZZ RADIO
89.1FM
SOUTH
CROSSWALK CLOSED
HERE
STOP

N Broadway & Williams Improvements

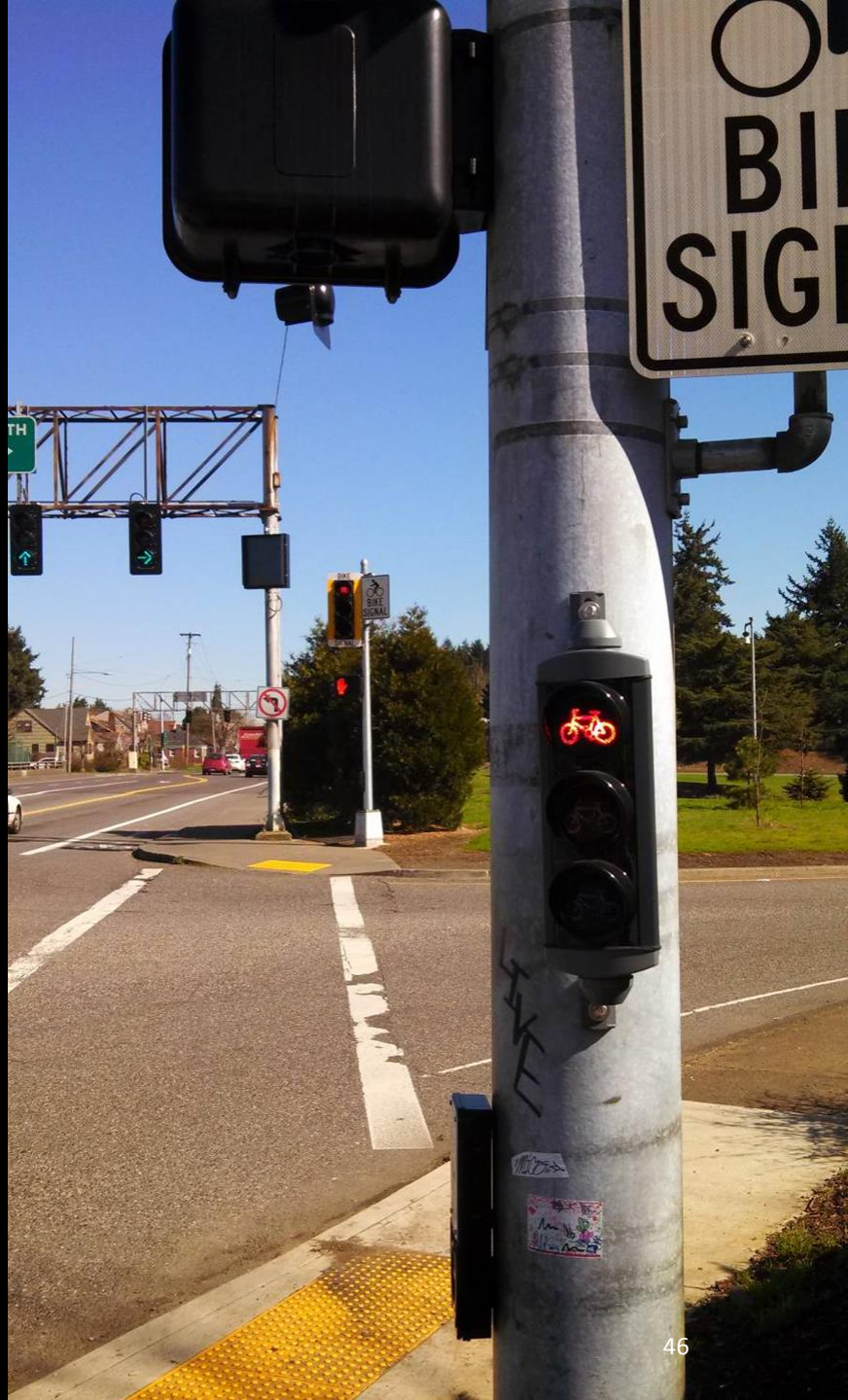


Best Treatment



Nearside 4” Bike Signal

- Additional indication to improve awareness of traffic control




NORTH
5
SOUTH
BIKE
SIGNAL

SW Naito Parkway & Lincoln

Detector marking
(more on this later)

Protected Signal Phasing

Part-Time Restriction of Turns

- No Turn on Red if bicycle phase detected

Turning Vehicle Yield to Bikes

Geometric Changes at Signals

Curb extensions
Mixing zones
Dutch style “protected” intersections
Alternative intersection design (DDI, CFI)

Background on Signal Operations

Limited knowledge regarding signal control strategies focused on pedestrians

- Existing strategies focus on safety
- Other efficiency focused options

Even more limited knowledge for cycling

- Upcoming NCHRP projects

Leading Pedestrian Interval

Implementation should be based on:

- Crash history (frequency, severity)
- Volume of people walking
- Proximity to school
- Activity of elderly residents
- Impacts on vehicle delay
- Visibility issues
- Intersections with challenging geometry

Source: Lo, 2015 & Sharma, 2017

Leading Pedestrian Interval

- **ITE Toolbox: Modify signal phasing to implement LPI - associated with a 5% decrease in pedestrian crashes.**

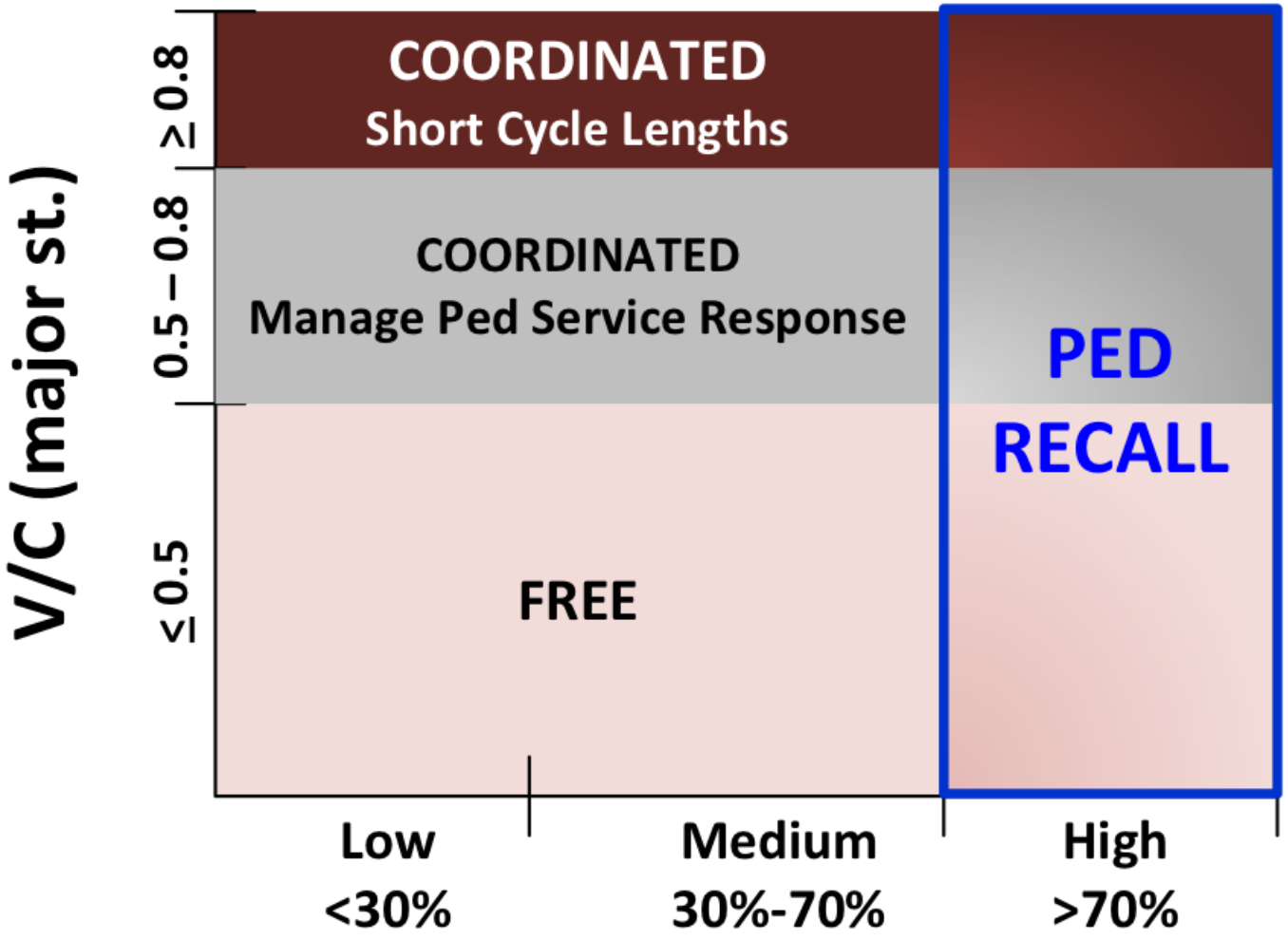
- Reference
  - Institute of Transportation Engineers (2004). Toolbox of Countermeasures and Their Potential Effectiveness to Make Intersections Safer, Briefing Sheet 8, FHWA.
  - Orlando, FL study (2000)
  - CMF Star Rating: "Cannot be rated – Insufficient information about study"

Source: DPS 201, PBIC

Signal-related Research Needs

- Connected vehicle concepts
- Bike signal phasing guidelines or warrants
  - Level of Traffic Stress (LTS) for intersections
  - Trade offs of delay and compliance (PSU research)
- Multimodal Signal Performance Measurement
- Traffic signal detection enhancement

Signal Operation Strategies

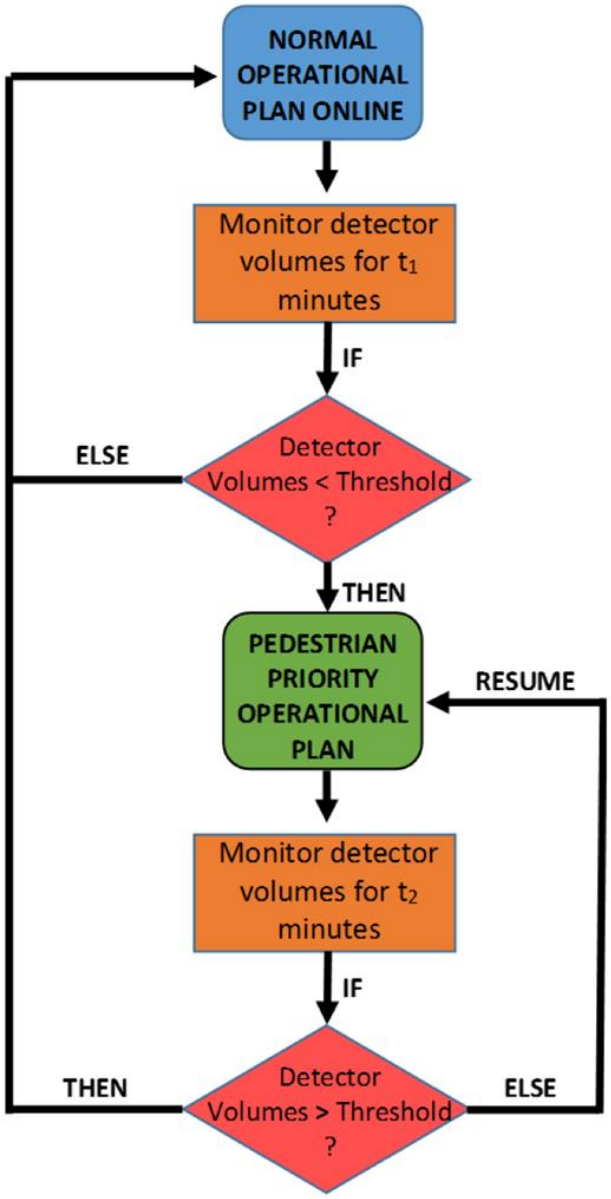


Pedestrian Priority Logic

- Two stages
  - Call the program
  - Call the pedestrian
- Options for calling program:
  - Delay threshold – Once pedestrian has waited “X” amount of time, call program
  - Specific time of day depending on local demand
  - Vehicular operational data
    - Use V/C to determine when to run ped algorithm
      - $X_i = \frac{v_i}{c_i} = \frac{v_i/s_i}{g_i/C} = \frac{v_i \cdot C}{s_i \cdot g_i}$
        - vi = flow rate (veh/h)
        - C = cycle length
        - si = saturation flow rate
        - gi = effective green time

Signal Coordination

Apply permissive lengths
Employ advanced logic
Provide priority concepts



ASC/3 Logic Processor

Menu | Configuration | Controller | Coordination | Preempt | Time Base | Detectors

Logic Statement (MM) 1-8-2

Logic #: 14 — Clear LP Sequence

If

	Assignment	#		State
IF:	LP LOGIC FLAG	7	IS	ON
AND	LP LOGIC FLAG	8	IS	ON
AND	LP LOGIC FLAG	9	IS	ON
AND	LP LOGIC FLAG	10	IS	ON
AND	LP LOGIC FLAG	11	IS	ON

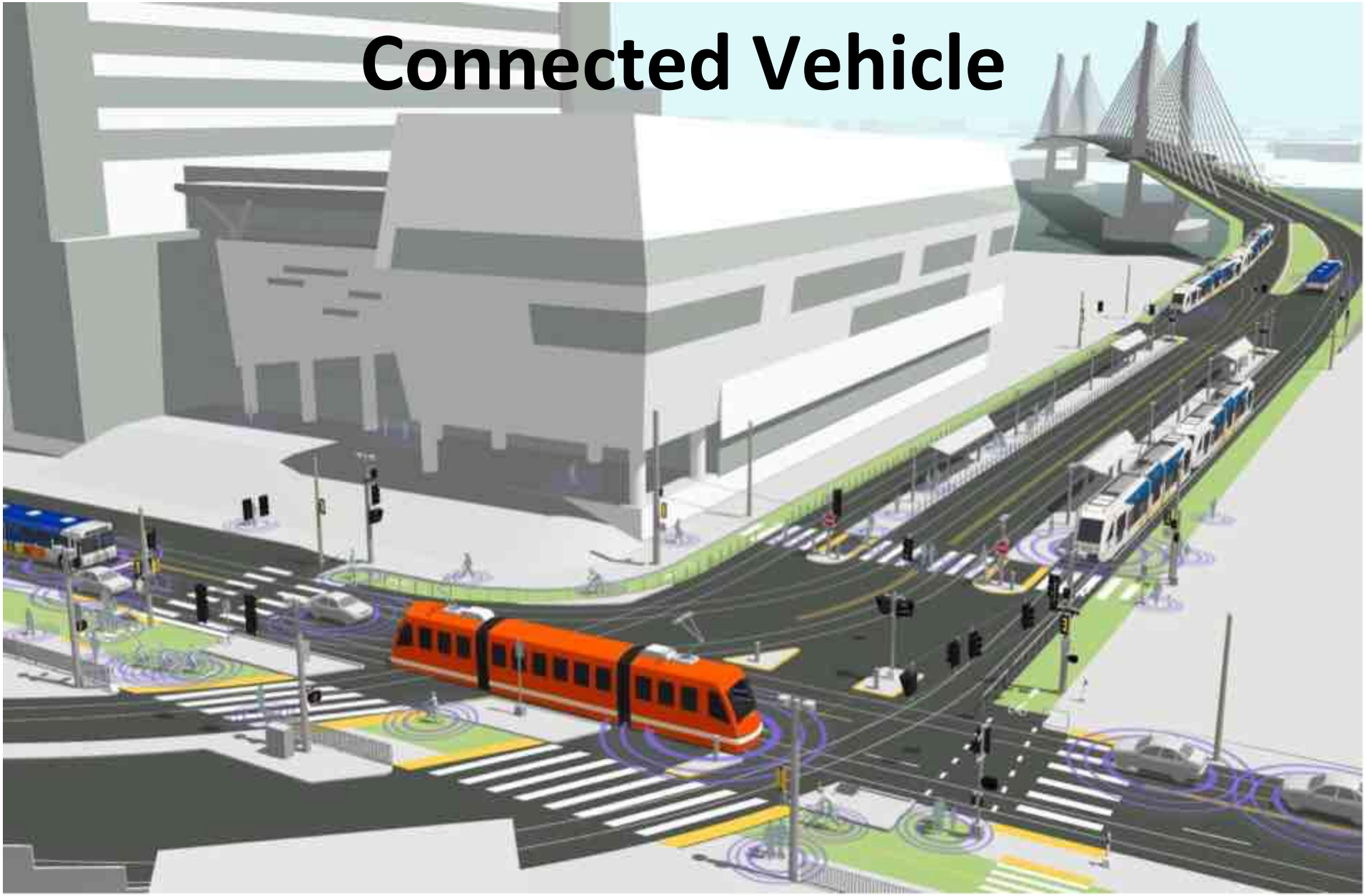
Then

Assignment	#	State
LP SET LOGIC FLAG	12	ON

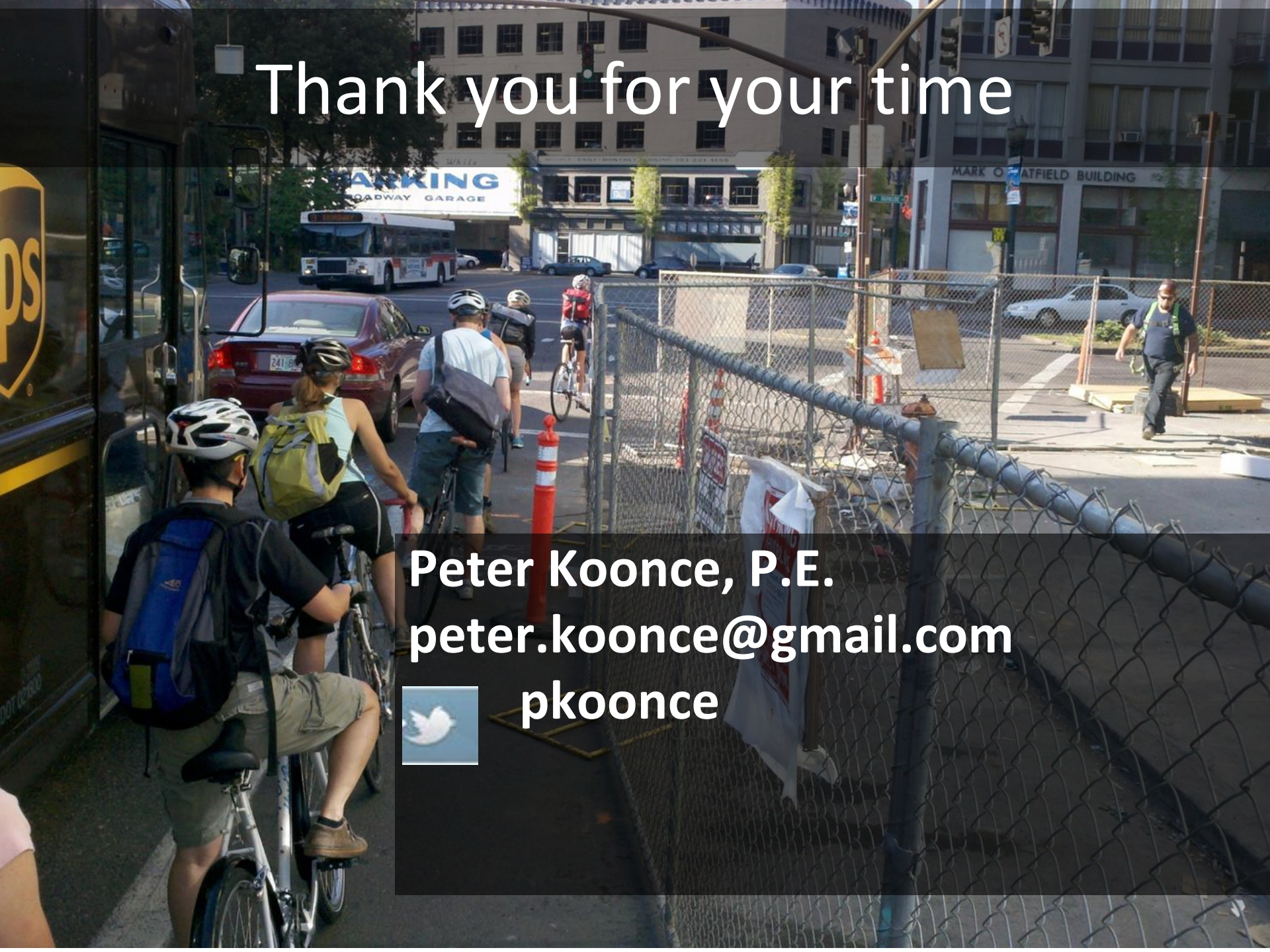
Else

Assignment	#	State

Connected Vehicle



Thank you for your time



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