Transit Preferential Treatments

Traffic Engineering Solutions to Improve Transit Speed & Reliability

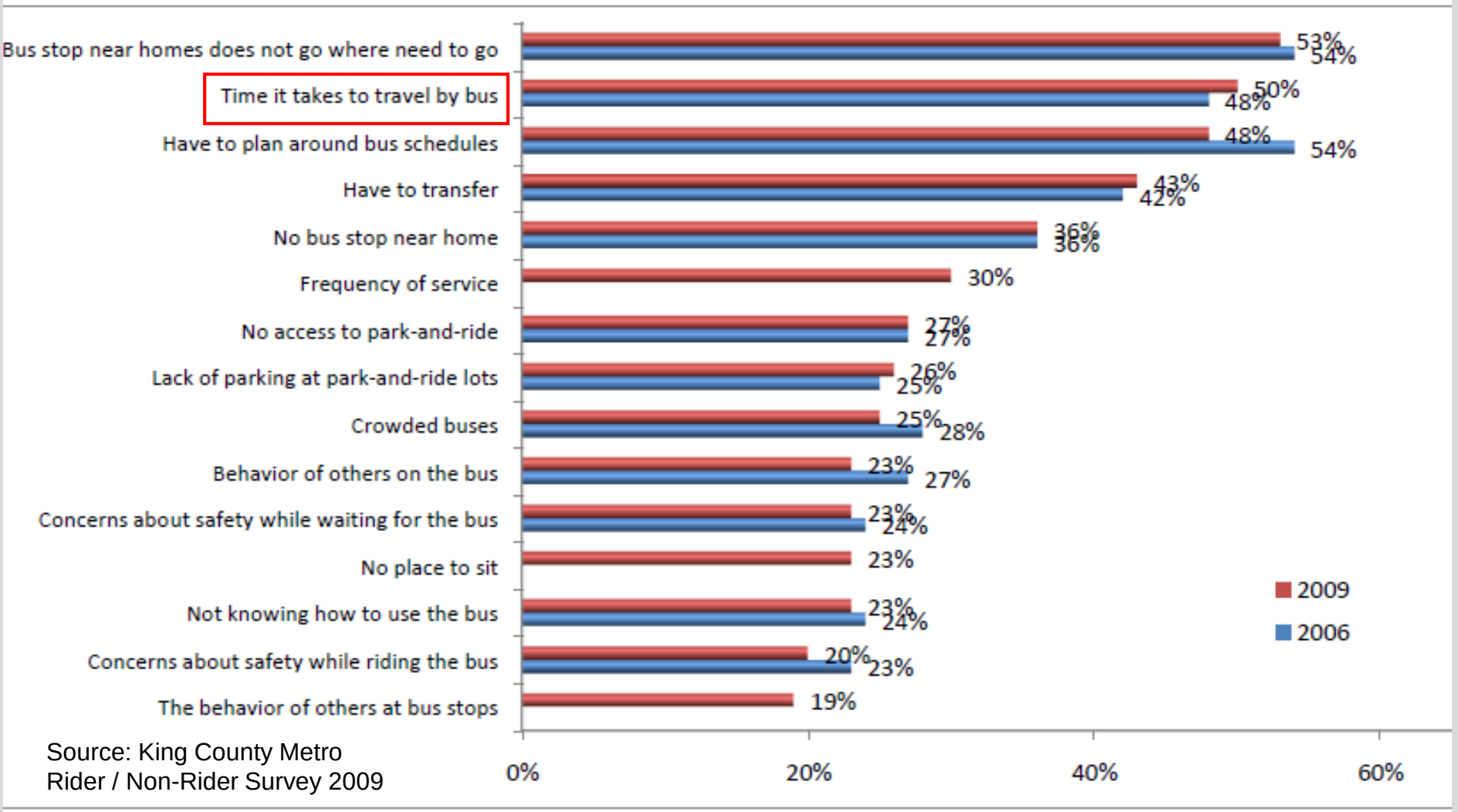
Owen Kehoe, PE, PTOE
King County Metro
Speed & Reliability Group

King County METRO
We'll Get You There

Speed & Reliability “Toolbox”

- Queue Jump Signal
- Bus Bulbs
- Parking Removal
- Channelization & Bus Lanes
- Turn Radius Improvements
- Signal Timing/Phasing
- Bus Stop Spacing
- Bus Stop Capacity Improvements
- Transit Signal Priority

Barriers to Taking the Bus



Source: King County Metro
Rider / Non-Rider Survey 2009

Queue Jump Signal

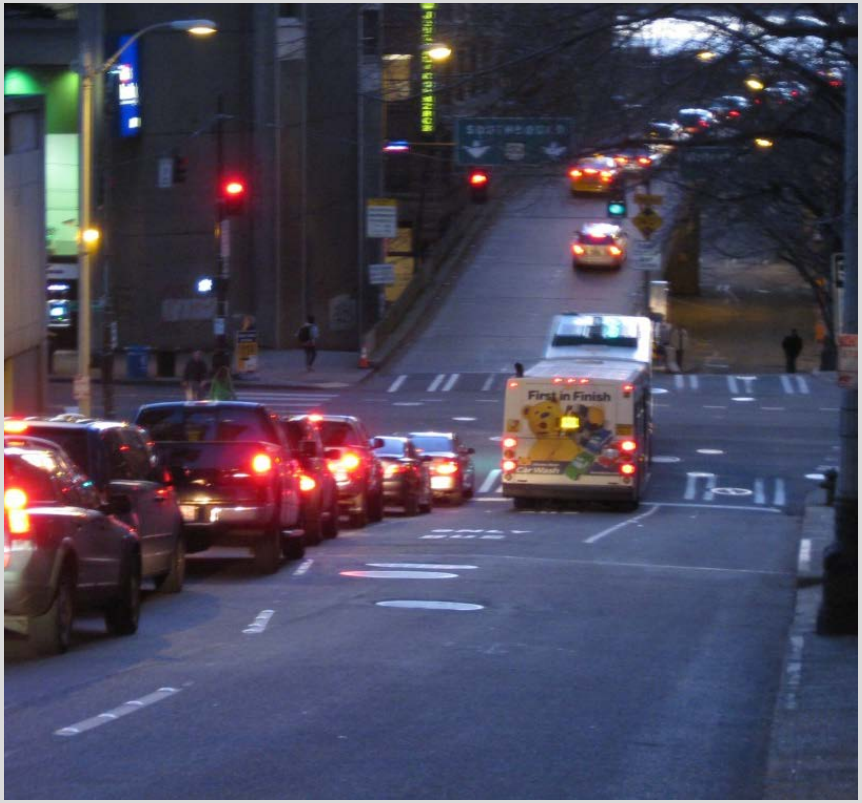
- Special bus signal
- Provides advance green for waiting buses

Columbia St & 2nd Ave

N 46th St & Green Lake Way

Queue Jump Signal

- Where queue jumps are useful:
  - Near-side bus stop pullouts
  - Merging areas
  - Set-up for a left turn
- Design Considerations
  - Right-turning traffic
  - Detection strategy
  - Bus stop location
  - Signal display type



Columbia St & 1st Ave

Queue Jump Signal

Westlake Ave & Mercer St (Left Lane Queue Jump)

LRT-type Signal Display

Bus Bulbs

- Convert pull-out stop to in-lane stop
  - Eliminates merging delay
  - Additional space for customers & amenities

Fauntleroy Way & California Ave SW

3rd Ave & Cedar St

Bus Bulbs

- Design Considerations
  - Delay to traffic & intersection operations
  - Length
  - Drainage
  - Future use

N 45th St & Woodlawn Ave N

Parking Removal

- Free the curb lane for transit use
  - Simple to implement; but opposition can be fierce

Greenwood Ave N & N 85th St

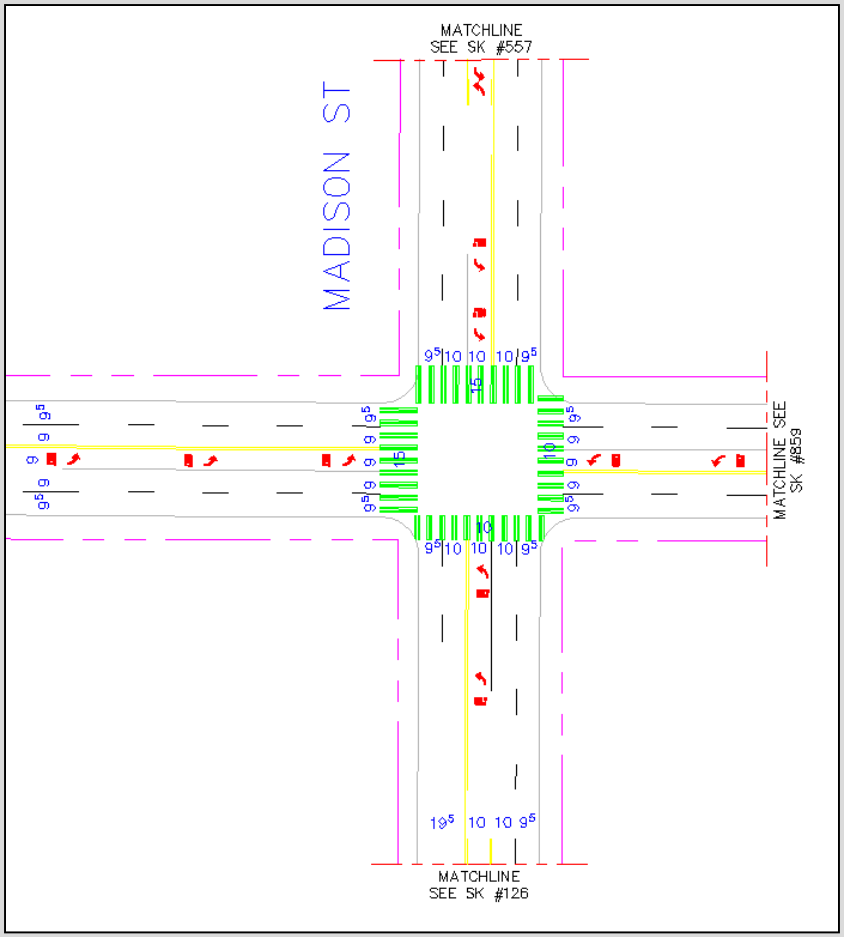
Aurora Ave N

Parking Removal

- Strategies:
  - Parking utilization study
    - "Only 60% of the parking stalls are used"
  - Parking turnover rate
    - "Vehicles are parked all day, not patronizing the businesses"
  - Find alternatives
    - "The load zone can be moved around the corner"
  - Demonstrate the benefit to transit
    - "Removing 5 stalls will save 5,000 hours of person-delay per year, and $1 million in annual operating cost"

Channelization

- Change in Lane Configuration



14th Ave & E Union St

SDOT Paintline Sketch

Bus Lanes

- Bus-Only / Transit-Only Lane
- Bus + HOV Lane
- Business Access & Transit Lane (BAT Lane)
- Transit & Right-Turn-Only Lane

Aurora Ave N

Avalon Way SW

Bus Lane/Channelization

- Design Considerations
  - Lane width 11’ minimum/desired
  - Hours of operation
  - Bus lanes require high bus volumes
  - Bike lanes & sharrows

Howell St Bus Lane

(PM Period Only)

Bus Lane/Channelization

Dexter Ave Bus Islands

Turn Radius Improvements

- Intersection changes ease turning maneuvers

Seward Park Blvd & S Othello St

(Before)

(After)

Turn Radius Improvements

- Design Considerations
  - Design vehicle: 40’ or 60’?
  - Right-of-Way availability/cost
  - Utilities/Drainage/Poles
- Cheaper Options
  - Set-back stop bar
  - Shift centerline
  - Parking restrictions

8th Ave & Seneca St

Signal Timing/Phasing

- Re-time signals to improve traffic flow
  - Coordination/Synchronization
  - Special considerations for transit movements.
  - Change signal phasing (e.g. add left turn arrow)

NE 90th St & 150th Ave NE (City of Redmond)

Signal Timing/Phasing

4th Ave & Pike Street right-turn phase

Signal Timing/Phasing

- New Traffic Signals
  - Allow new bus movements
  - Improve difficult merges, turns, or entering movements

Aurora Ave Southbound &
N 46th St On-Ramp

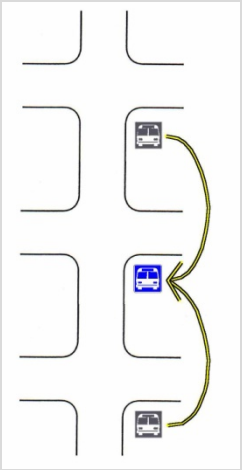
Signal Timing/Phasing

- Bus-Activated Signal Phase
  - Add bus-only movement to an existing signal

Fairview Ave N & Valley St (C-Line Terminal)

Bus Stop Optimization

- Closing/relocating selected stops on established bus route
- Goals:
  - Speed & Reliability
  - Fuel consumption and emissions
  - Improve ride comfort
  - Reduce operating and maintenance cost
  - Higher usage at stops, more amenities

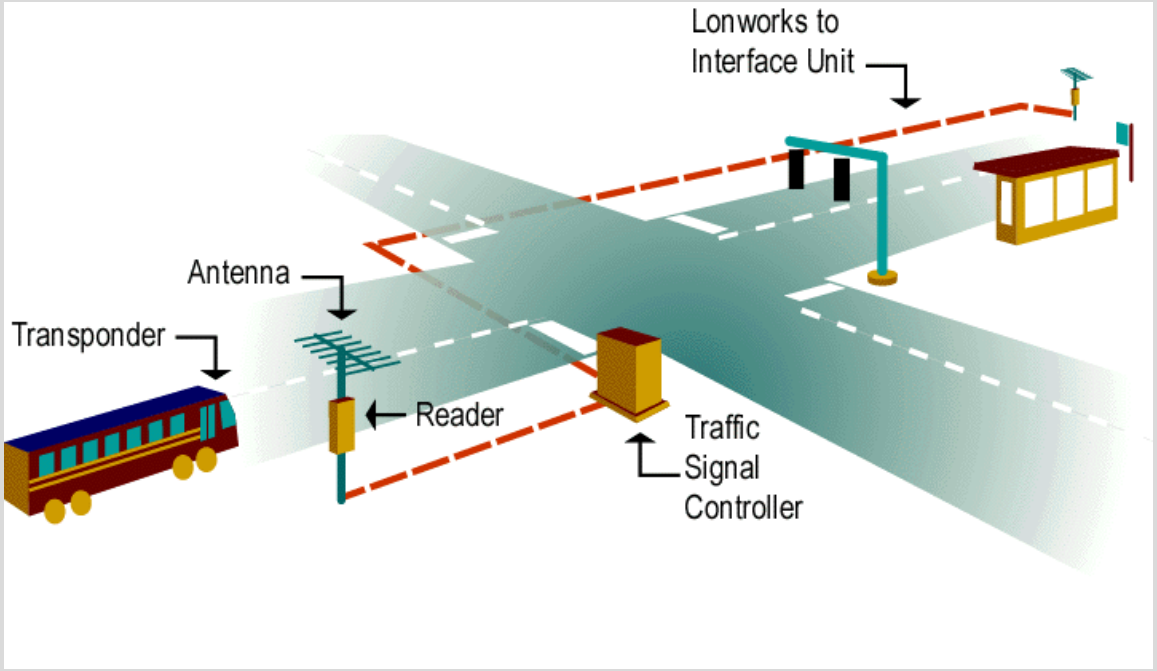


Bus Stop Optimization

Example of a candidate bus stop closure (Route 28)

Transit Signal Priority (TSP)

Using bus detection technology to give transit vehicles preferential treatment at traffic signals



The King County Legacy TSP System
(1st Generation; now obsolete)

King County TSP System

(2nd Generation; current system)

- Operating at ~200 intersections
  - Rapid Ride corridors [A,B,C,D,E,F]
  - Other high-ridership routes [44,101,120]

- Measured Benefits
  - Signal delay reduced up to 14 % [E-Line]
  - Average travel time reduced 5% [E-Line]
  - Reduced variability (Improved reliability) [C-Line]

King County TSP System

- Continuous vehicle-to-roadside communication using 4.9 GHz Wireless Access Points (WAP)
- Fiber-Optic communication backbone
- TSP events initiated by On-Board System (OBS)

Traffic/ITS Cabinet

Transit Section

Traffic Section

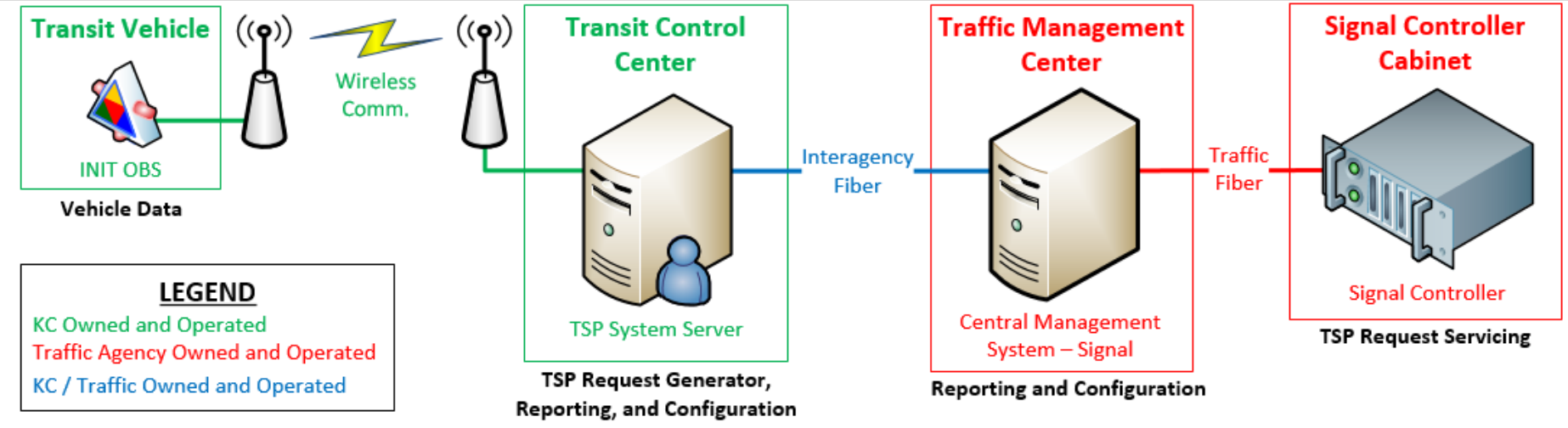
Double door signal cabinet with Transit-ITS compartment

“Technology” Pylon

- Real time arrival info
- Off-board ORCA reader for all-door boarding
- Illuminated map case
- Communicates via 4.9GHz wireless network

Next-Generation TSP

(3rd Generation; future)



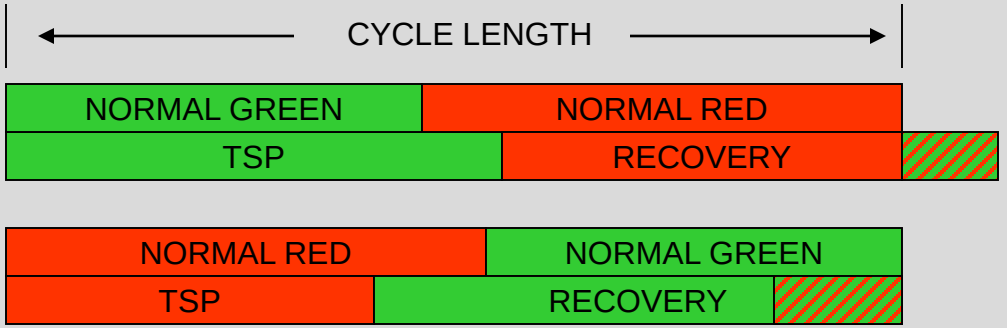
- Leverage cellular communications and Center-to-Center (C2C) links
- Reduce cost per intersection

Other TSP Detection Methods

- South Bellevue P&R
  - Buses detected using traffic loop detectors, calls TSP.
  - Blue light tells operators when bus is detected

TSP Strategies

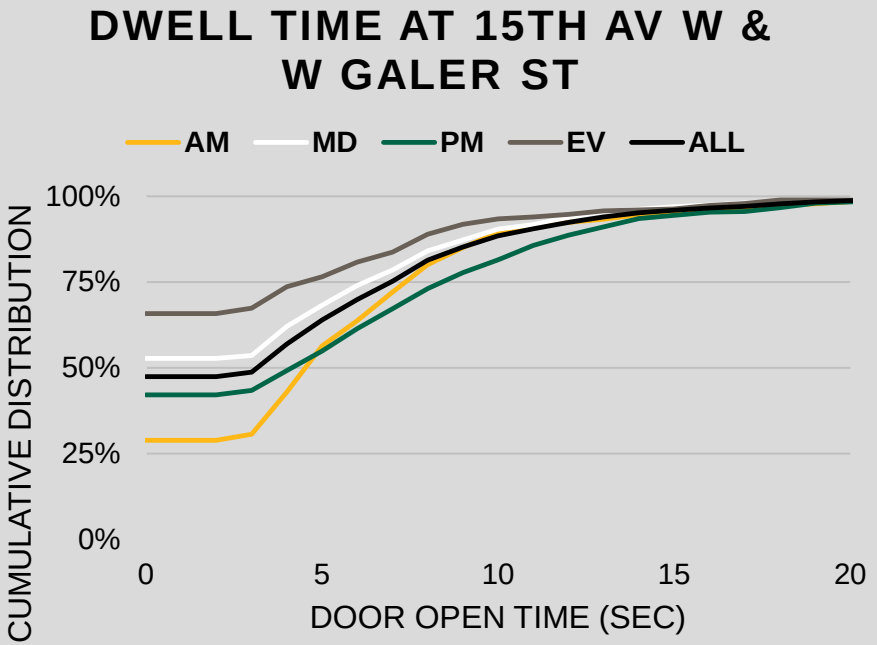
- Standard Strategies
  - Green Extension
  - Red Truncation
- Restrictions
  - Shall not shorten any minimum or clearance intervals (vehicle or ped)
  - Shall yield to emergency vehicle preempt
  - Recovery period shall be provided (1-2 cycles)



Recovery strategy depends on signal controller type

TSP Strategies

- Enhanced Strategies
  - "Full Priority" (phase skipping)
  - Cascading priority
  - Near-side stops
- Late buses > higher level of priority



Cumulative dwell time distribution for near-side stop TSP

Bus Stop Capacity Improvements

- Reduce queuing & dwell time at busy bus stops
  - Lengthen bus stop
  - Skip-Stop Operations
  - Off-board Fare Collection

Bus Stop Capacity Improvements

- Skip Stop Adjustments
  - Add new bus stops
  - Adjust route assignments

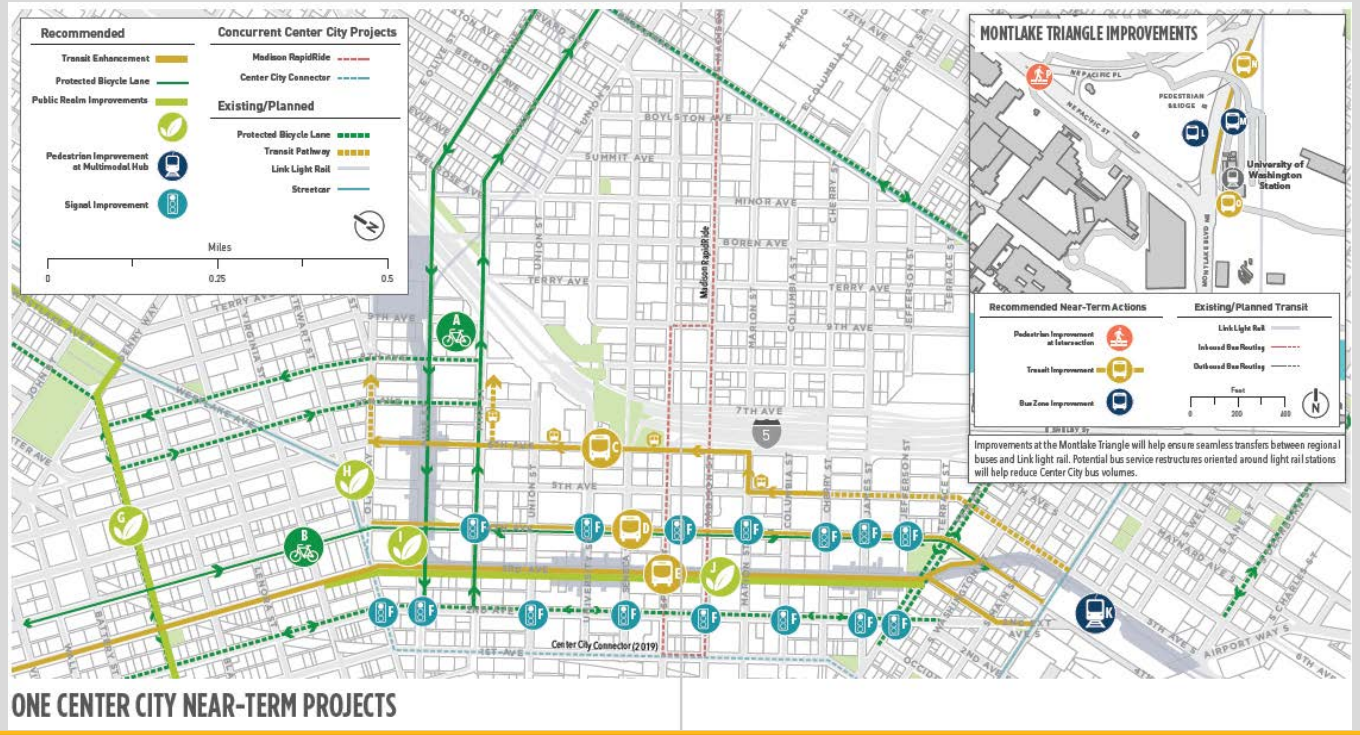
New bus stops on 3rd Ave between Pike & Union St

Changes in Downtown Seattle

- "Period of Maximum Constraint"
  - 2019 – 2021
  - Downtown Seattle Transit Tunnel (DSTT) closes to buses March 2019 (?)
  - SR-99 Construction; north portal
  - Center City Connector (?)
  - One Center City project to install improvements on surface streets
  - Bus volumes reduced in 2021 with North Link opening

One Center City Improvements

- 5th/6th Ave NB Pathway
- Signal improvements on 2nd & 4th Ave
- Hub improvements: International District & Montlake
- 3rd Ave improvements



How to get these done

- Implementation Strategies
  - Spot Improvements
  - Corridor Improvement Projects
  - Anticipation of Future Changes
- In all cases:
  - Select the appropriate tool(s)
  - Demonstrate the benefit
  - Understand the tradeoffs
  - City cooperation required

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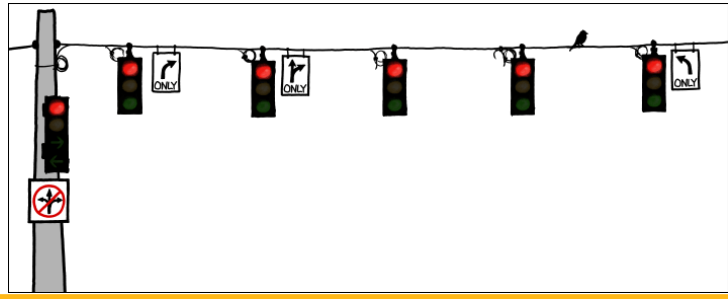

http://xkcd.com

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