Technology to Enable and Complement Congestion Pricing

- **Audio:**
  - Via Computer - No action needed
  - Via Telephone – Mute computer speakers, call 1-866-863-9293 passcode 57921953
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- **Audience Q&A** – addressed after each presentation, please type your questions into the chat area on the right side of the screen
- **Closed captioning is available at:** http://www.fedrcc.us//Enter.aspx?EventID=1781245&CustomerID=321
- **Upcoming Webinars:**
  - Visit http://www.ops.fhwa.dot.gov/tolling_pricing/webinars/index.htm
- **Recordings and Materials from Previous Webinars:**
  - http://www.fhwa.dot.gov/ipd/revenue/road_pricing/resources/webinars/congestion_pricing_2011.htm

Upcoming Webinars

July 28, 2011	Dynamic Ridesharing and Congestion Pricing
August 25, 2011	Pay-as-You-Drive Insurance
September 22, 2011	Economics of Congestion Pricing and Impacts on Business
October 27, 2011	Integrating Transit with Congestion Pricing and Increasing Congestion Pricing Acceptance
November 17, 2011	Best Practices in Parking Pricing
December 15, 2011	Results of the Urban Partnership and Congestion Reduction Demonstration Programs

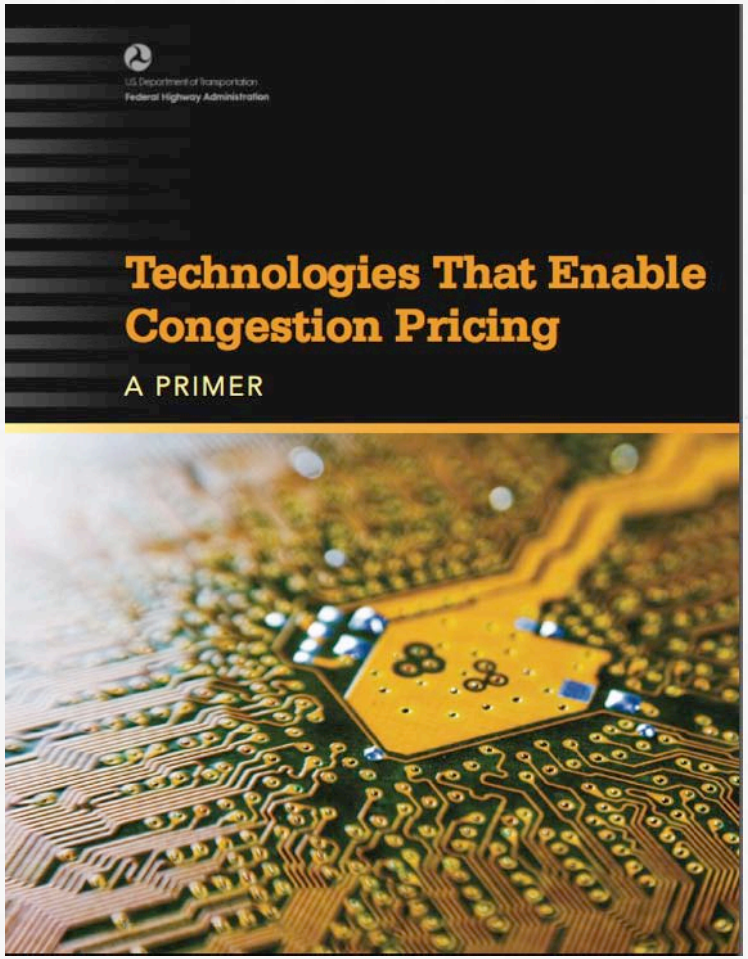
Current and Future Congestion Charging Technologies

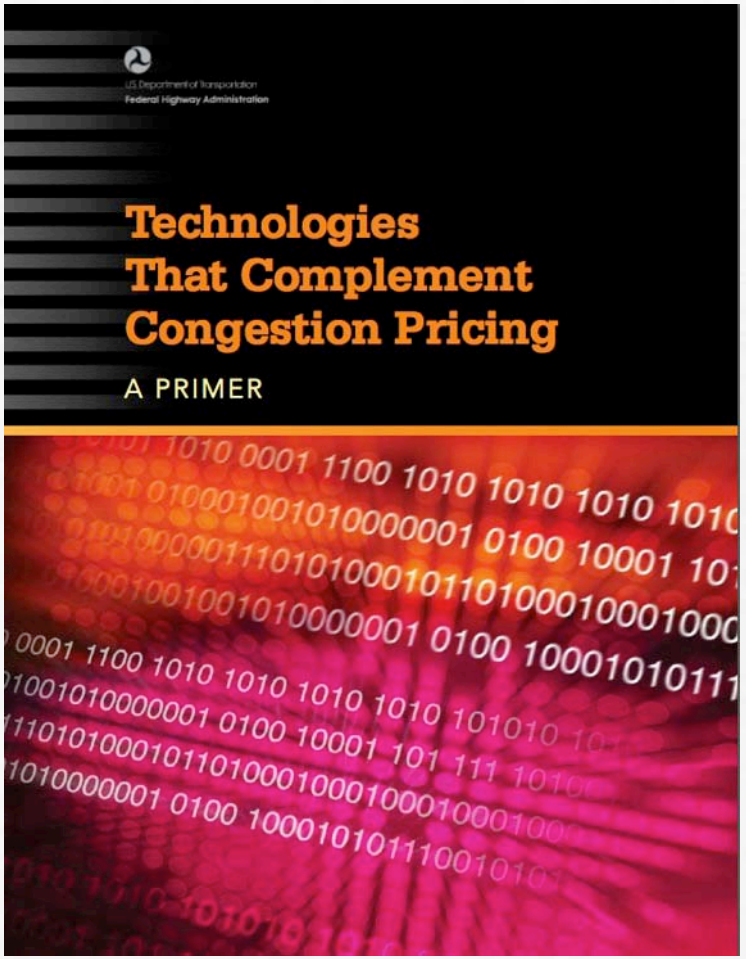
Jack Opiola
D'Artagnan Consulting LLP

Purpose

- To outline the key research and concepts in Road User Charging process and technologies;
- To present worldwide trends in Road User Charging process and technologies;
- To outline technology options for each system.

FHWA Primers





http://ops.fhwa.dot.gov/tolling_pricing/value_pricing/publications.htm

Primer Topics

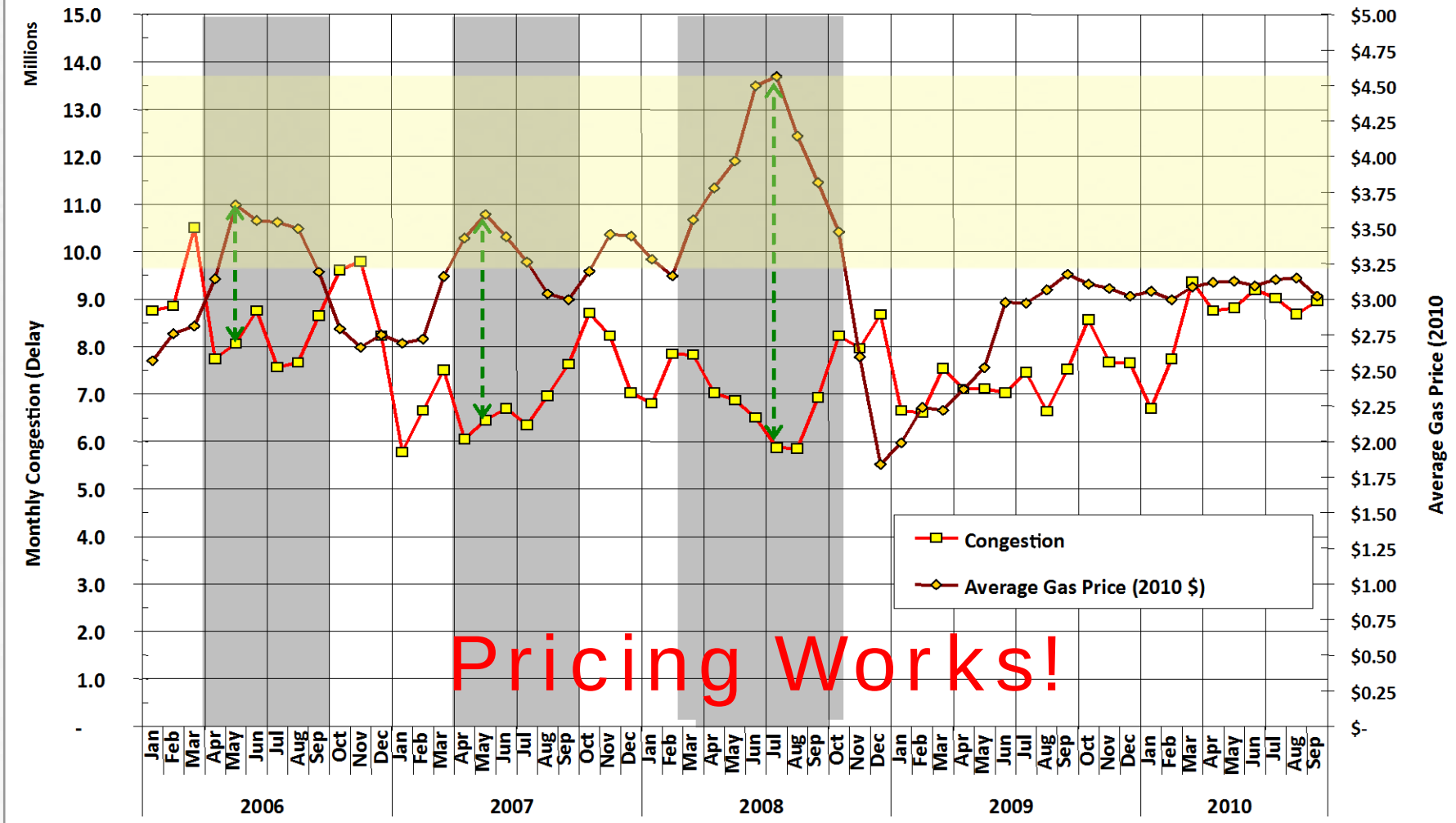
Technologies that Enable Congestion Pricing

- The functional processes for tolling and congestion pricing.
- What technologies there are to consider.
- How the technologies are applied.
- Examples of how technologies have been applied.
- What technologies may make it work better in the future.

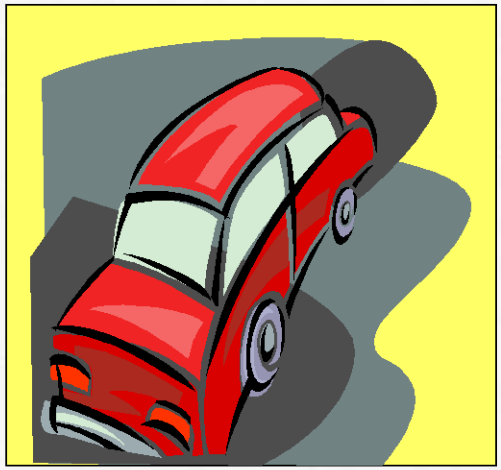
Technologies that Complement Congestion Pricing

- How technology complements congestion pricing.
- What technologies there are to consider.
- How the technologies are applied.
- Examples of how technologies were applied to retrofit congestion pricing on an existing facility.

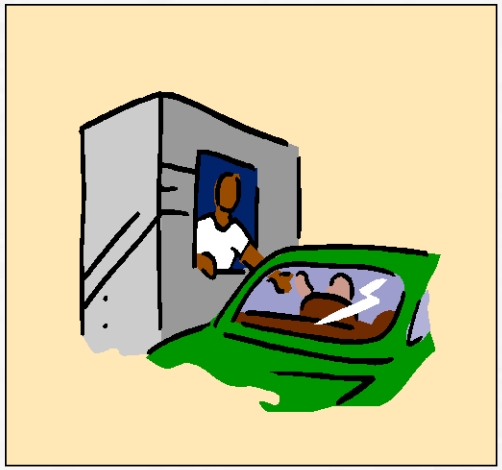
Travel behavior - Congestion related to gasoline prices in Southern California



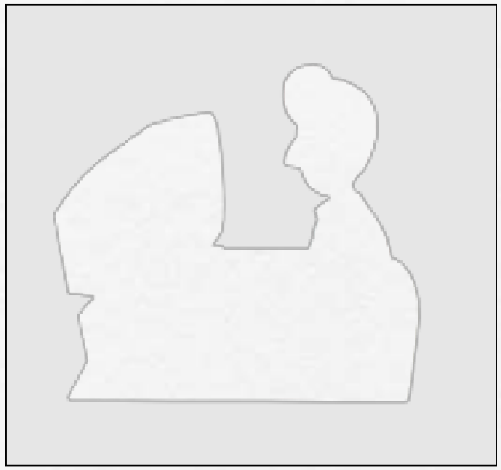
Revenue Collection Systems



Motorist/Vehicle Sub-System (MVS)

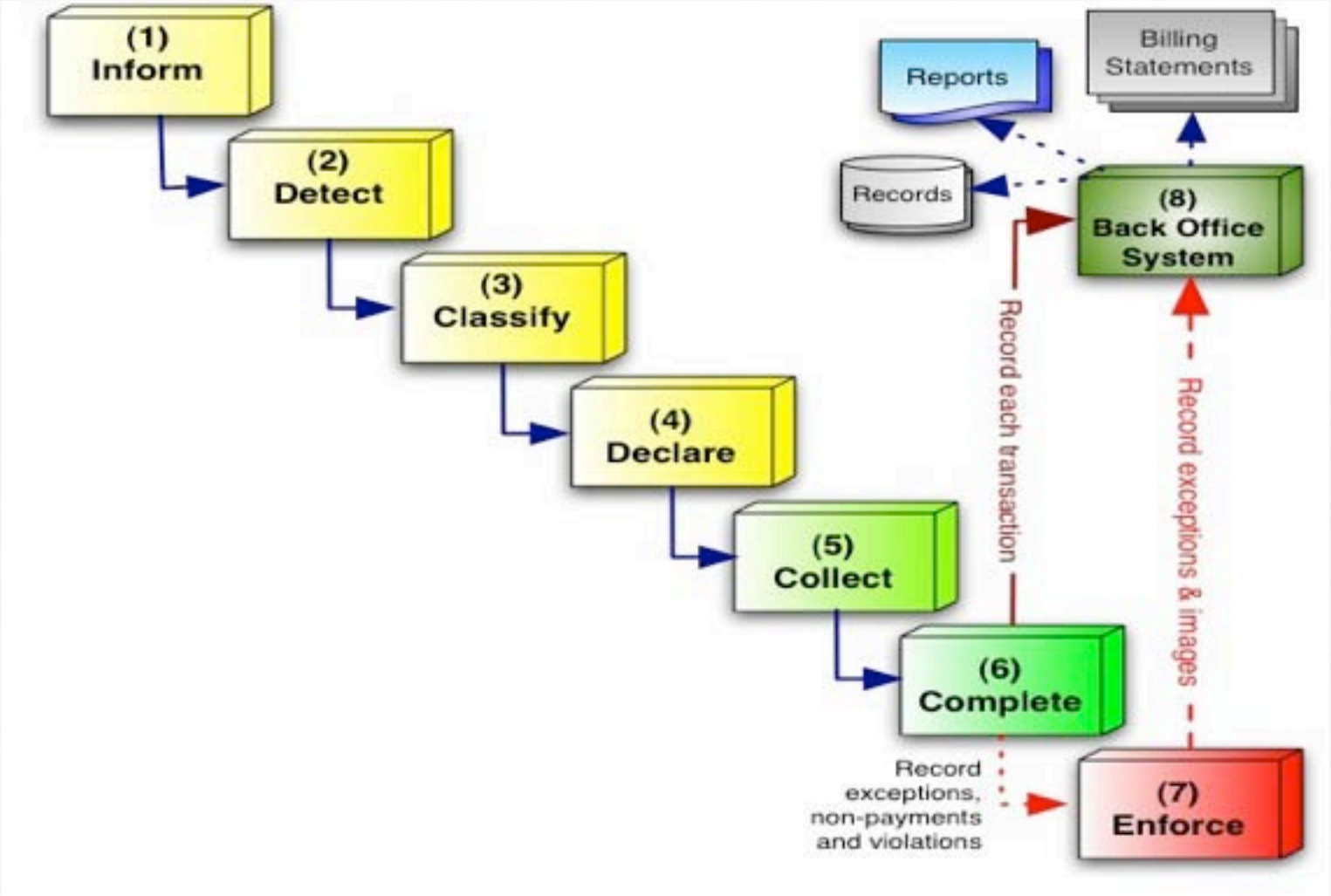


Collection Sub-System (RCS)



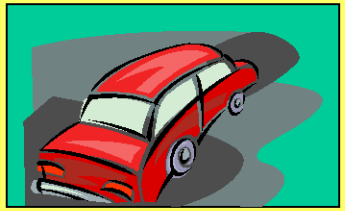
Back Office Sub-System (BOS)

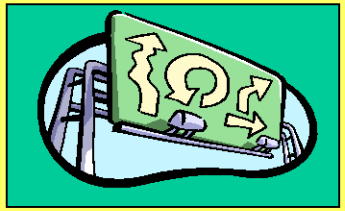
Revenue Collection Process



Revenue Collection Components

Motor Vehicle Sub-System

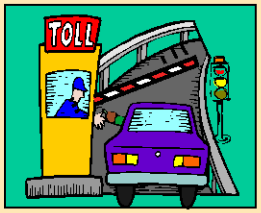




Traffic Information System

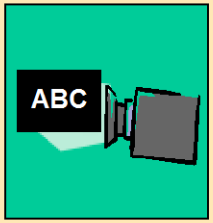
Personal Interface System

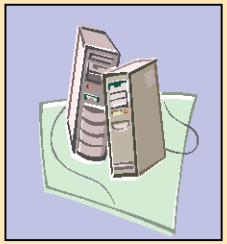
Collection Sub- System



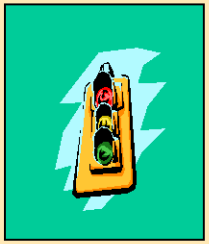
Collection Components

Video Enforcement

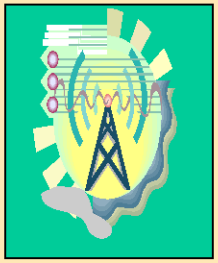




Data Storage



Traffic Control

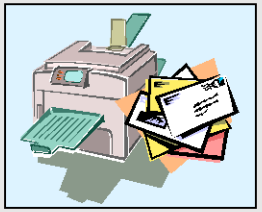


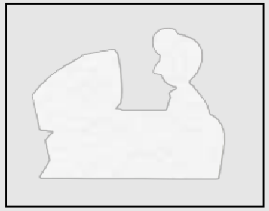
Vehicle Detection And Classification

Back Office Sub-System

Image Processing Centre

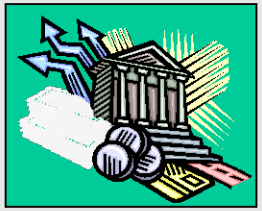
Billing & Accounting System





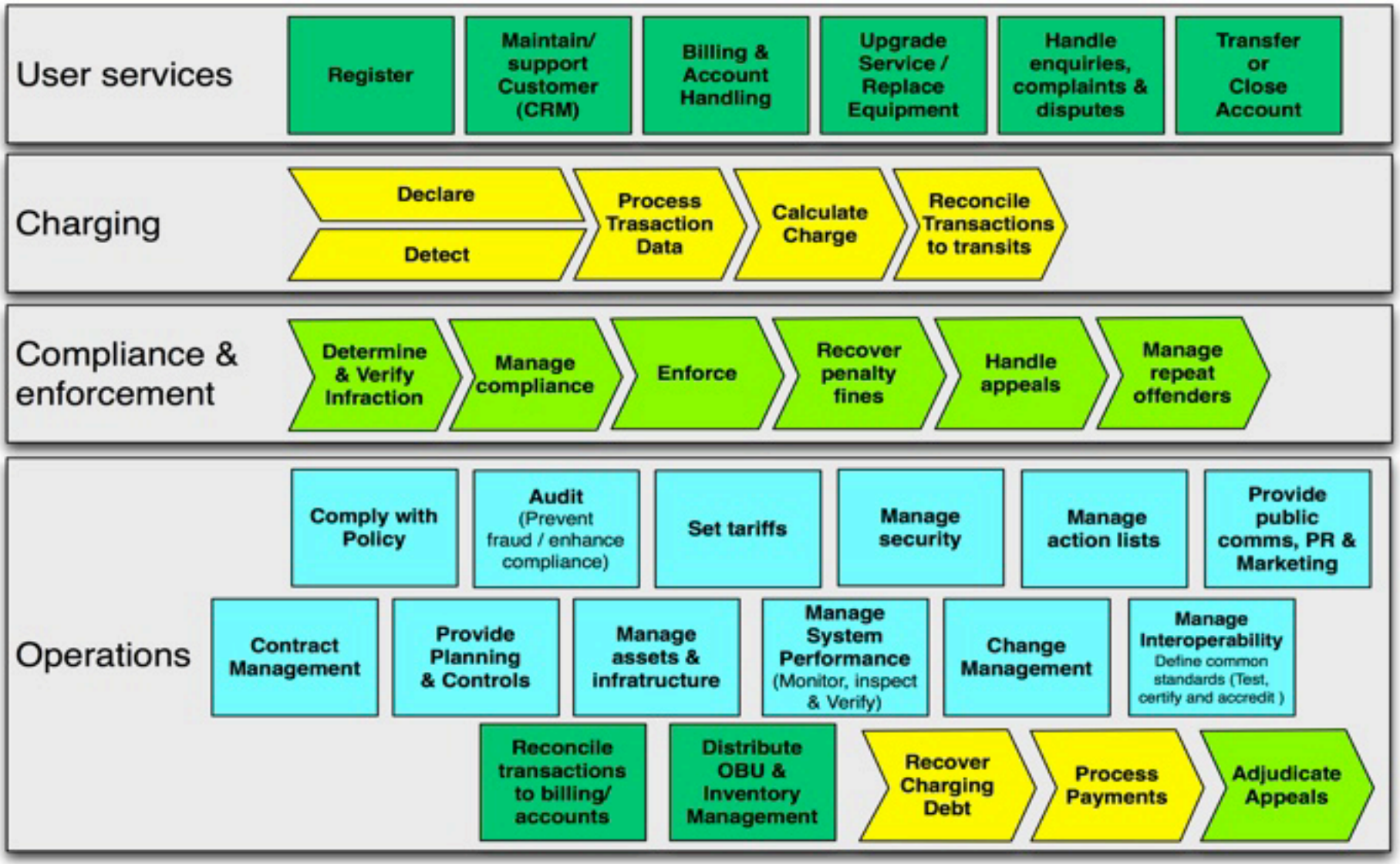
Computer System

Call Service Centre

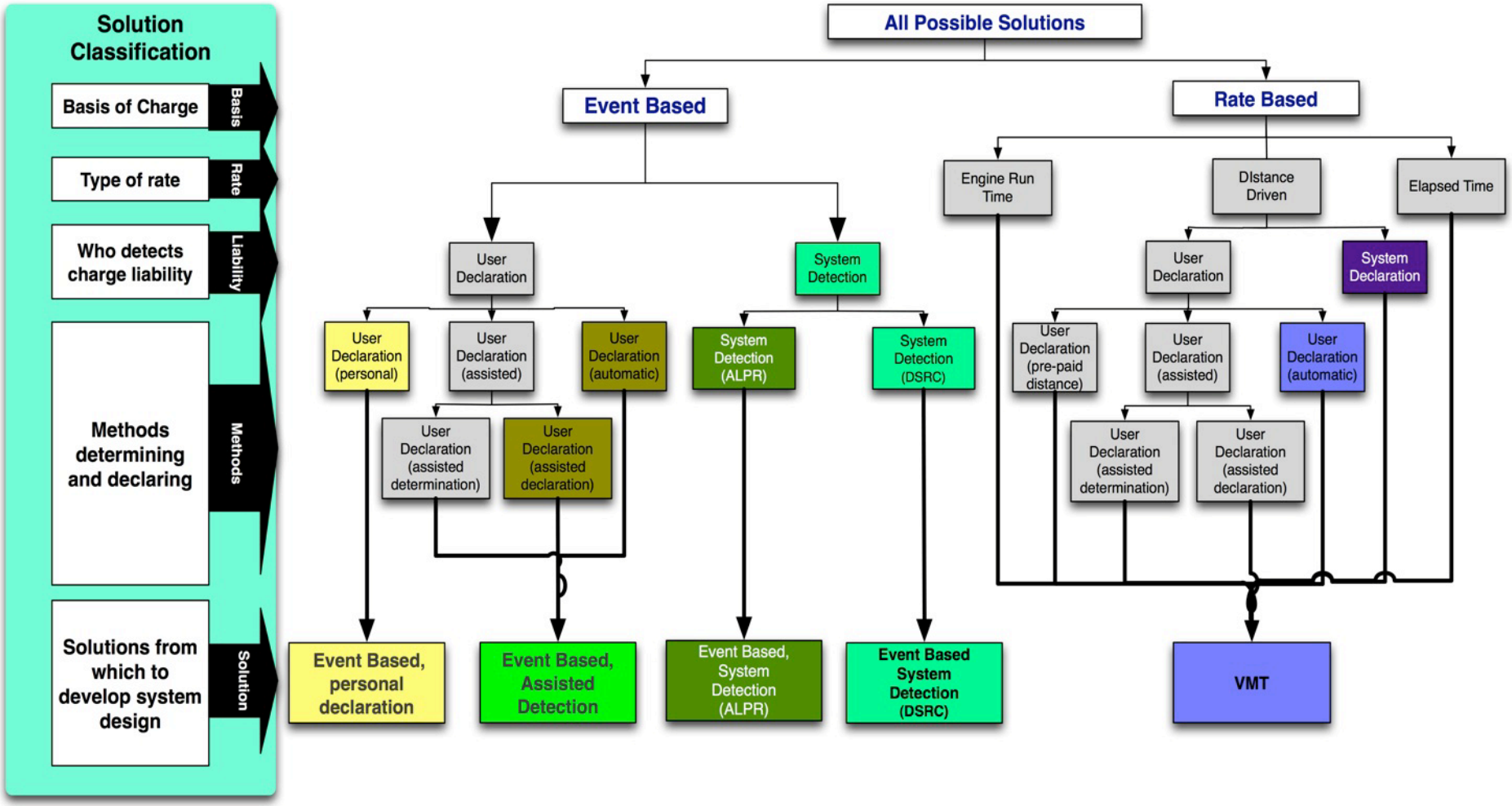


Financial System Interface

Enforcement


User services
Register
Maintain/ support Customer (CRM)
Billing & Account Handling
Upgrade Service / Replace Equipment
Handle enquiries, complaints & disputes
Transfer or Close Account
Charging
Declare
Detect
Process Trasaction Data
Calculate Charge
Reconcile Transactions to transits
Compliance & enforcement
Determine & Verify Infraction
Manage compliance
Enforce
Recover penalty fines
Handle appeals
Manage repeat offenders
Operations
Comply with Policy
Audit (Prevent fraud / enhance compliance)
Set tariffs
Manage security
Manage action lists
Provide public comms, PR & Marketing
Contract Management
Provide Planning & Controls
Manage assets & infratructure
Manage System Performance (Monitor, inspect & Verify)
Change Management
Manage Interoperability Define common standards (Test, certify and accredit)
Reconcile transactions to billing/ accounts
Distribute OBU & Inventory Management
Recover Charging Debt
Process Payments
Adjudicate Appeals

System Design Approach



Technology Options

1. Paper Based System;
2. Auto-License Plate Recognition (ALPR);
3. Radio Frequency Identification (RFID);
4. Dedicated Short Range Communication (DSRC);
5. Satellite Positioning System (GPS / GNSS); and
6. Wireless "cell based" solutions and new "smart phone" approaches

Technology Options

Image courtesy of PrimoSpot

Comparison of Technology Options

	Paper Based	ALPR	RFID/DSRC	GPS	Smart Phone
Central Business District Single Zone/Unitary Charge	✔	✔	✔	✔	✔
Central Area / Multiple Zones / Multiple Routes/Variable Charges		O	✔	✔	✔
Multiple Time Frames/Variable Charges by Location/Time of Day/Type of Vehicle / Environmental charges			✔	✔	✔
Distance Based Charging in Zones/ Combinations of above			O	✔	✔

Thank You!

Jack Opiola

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Technology for Minnesota's Managed Lanes Systems

Nick Thompson

Minnesota Department of Transportation

Agenda

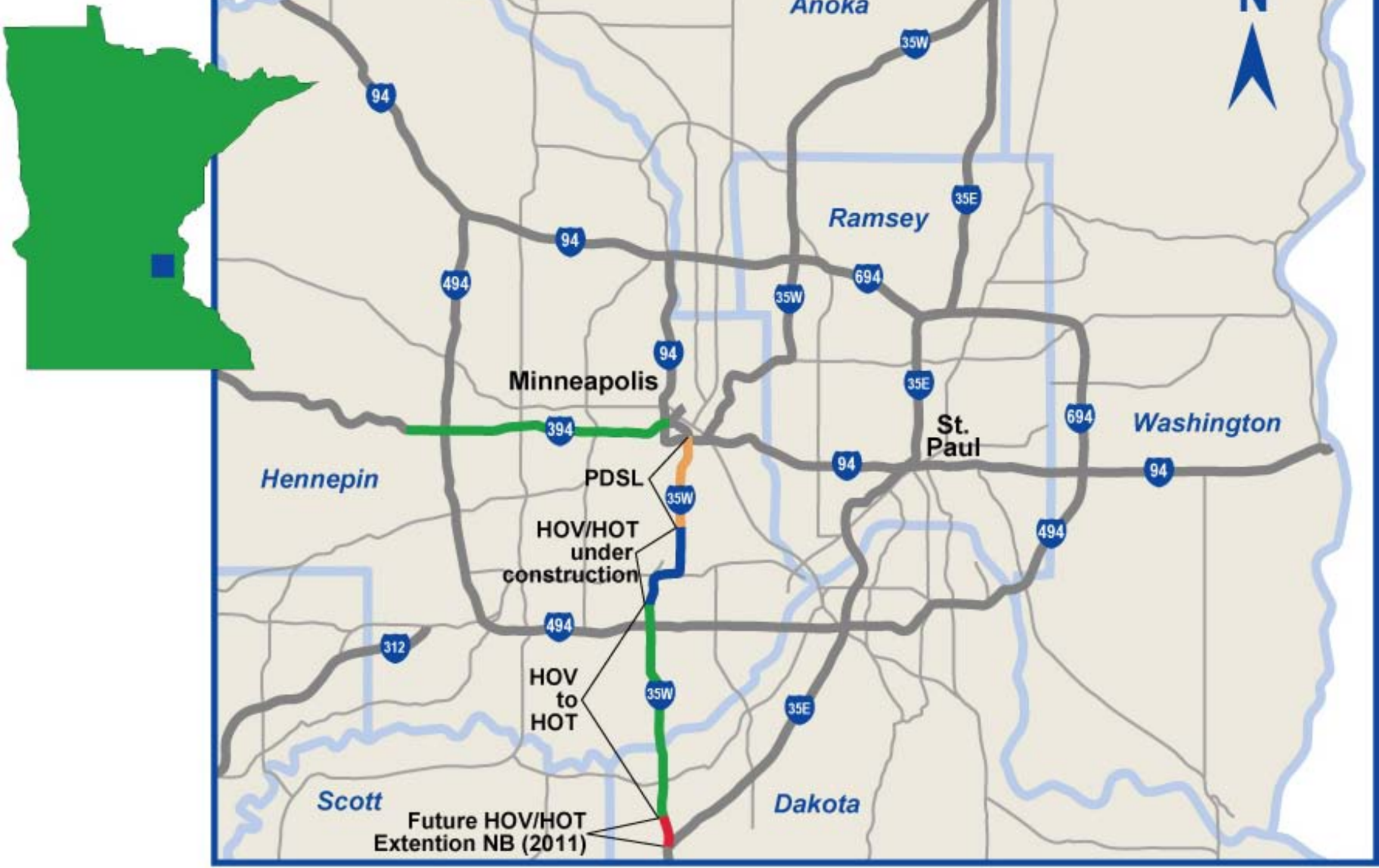
- Discuss the technology and systems needed to enable successful congestion pricing system in Minnesota

Managed Lanes in MN

- 2005 Converted 11 miles of HOV to HOT on I-394
- 2009 Expanded HOT network to 35W
  - 8 miles HOV to HOT conversion
  - 3 miles Shoulder to HOT conversion
  - 11 miles of ATM/Managed lanes system (all lanes)
- 2010 Completed additional 4 mile HOT lane/Managed Lane system on 35W

get in and go

MnPASS

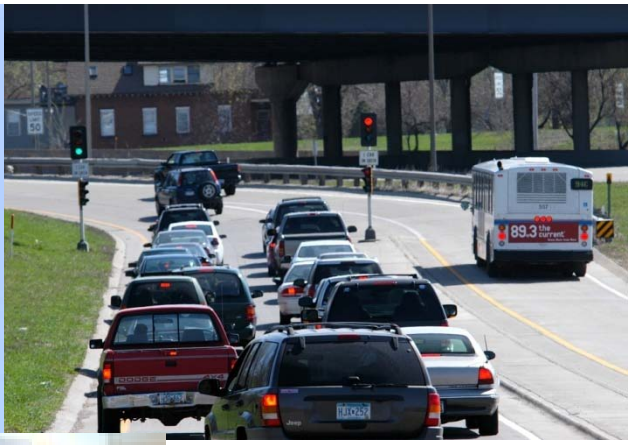


MnPASS Innovations

- Tolling on lanes directly adjacent to non-barrier separated lanes with multiple access points
- Full dynamic pricing on multiple consecutive roadway segments
- Technology applications assist in enforcement, read/write transponders and enforcement readers
- Tolling combined with Active Traffic Mgmt

MnPASS System Layer

- MnPASS enabled by underlying systems



Existing System and New

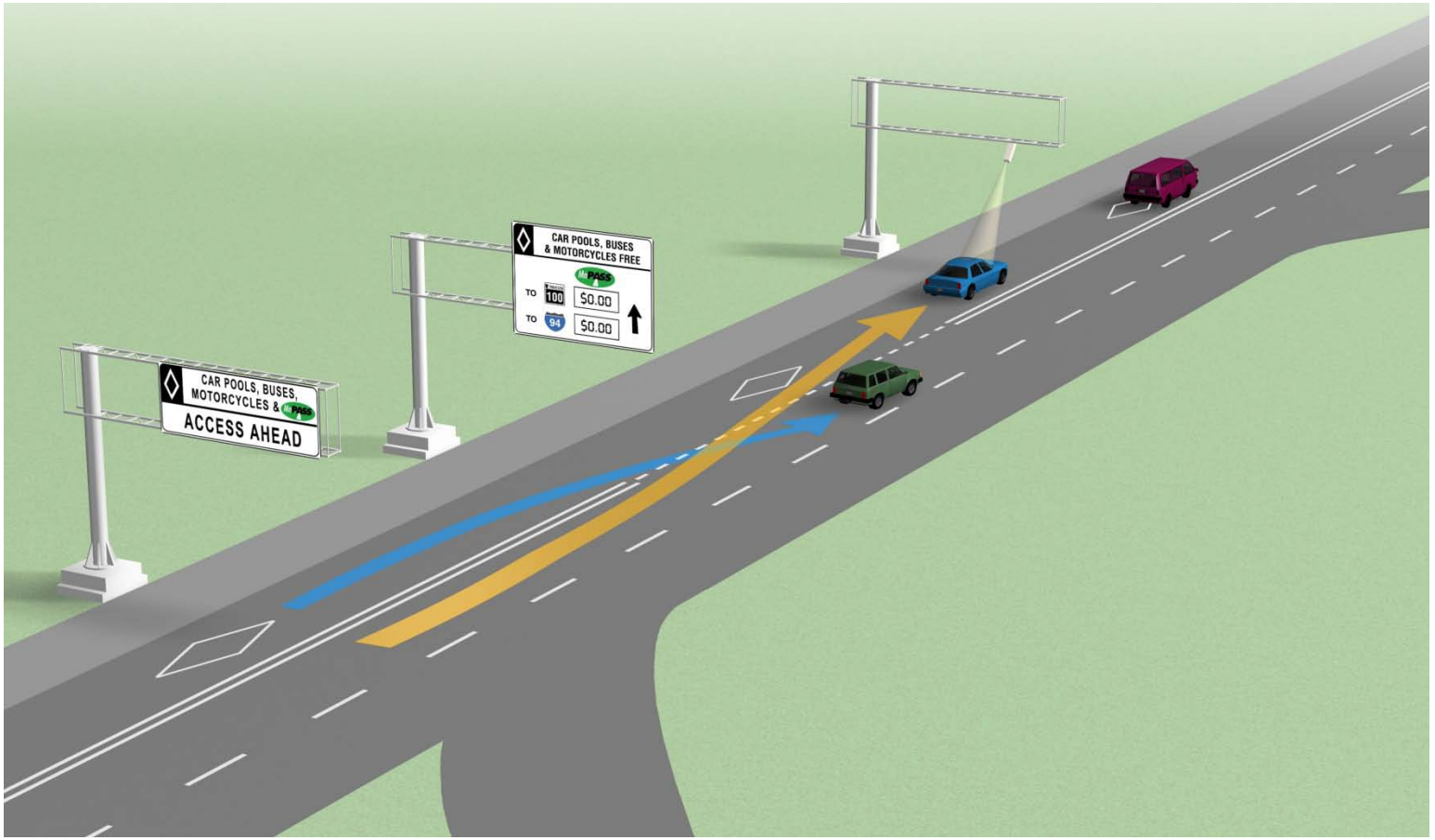
Existing

- Communication network
- Traffic Sensors
- Dynamic Message Signs
- Cameras
- Gates for Reversible Road
- Traffic Management Center/Systems
- Incident Mgmt Systems

New Technology

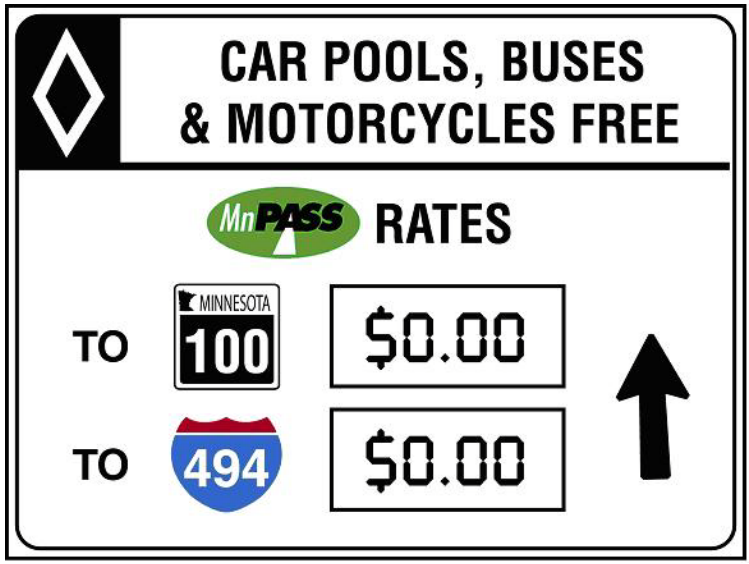
- Toll Systems
  - Transponders
  - Pricing Signs
  - Toll Readers
  - Communications
- Back office
  - Transactions
  - Customer Service
  - Monitoring
- Enforcement

I-394 MnPASS Lane Design



Establishing the Toll Price

- Min: $0.25 Max $8,00
- Price based on HOT lane traffic conditions only and priced in zones
- Data from sensors in lane every ½ mi
- Price updated every 3 minutes
- Price is set off customizable rate tables
  - Existing Price, Level of Service, and Rate of Change determine New Price
- Price based on worst traffic density point downstream of entrance
- Pricing during set hours (i.e. not 24x7)
- Displayed price needs to be linked to the toll transaction for the toll reader downstream from price sign



MnPASS Enforcement Strategy

Goal: Violation rate <10%

1. Convert violators to paying customers
2. Measure compliance, target problems
3. Be present
4. Provide technology to enforce

Desired, but unrealized, compliance strategies

- Higher fine structure, video enforcement

Results: Violation rates are <10%

Enforcement

- Supplemental tools
  - Beacons
  - Enforcement transponder
  - Mobile enforcement reader

MnPASS

Technology Provided to Enforce MnPASS

Toll Collection

- Pre-paid MnPASS account -Credit Card only
- User Install transponder
- Must have “off” switch
- License plate readers *not* allowed

- Antennae read transponder in vehicle

Back Office Operations

- Center to Center Communications
- Transaction Processing
  - cashless
- System Monitoring and testing
- Data
- Customer Service
  - Phone, web, walk-in
- Highly Reliable Systems
- Built with expansion in mind

Expansion to 35W Corridor

Build upon

- In place communication networks
- In place traffic management systems
- Toll Systems

Retain

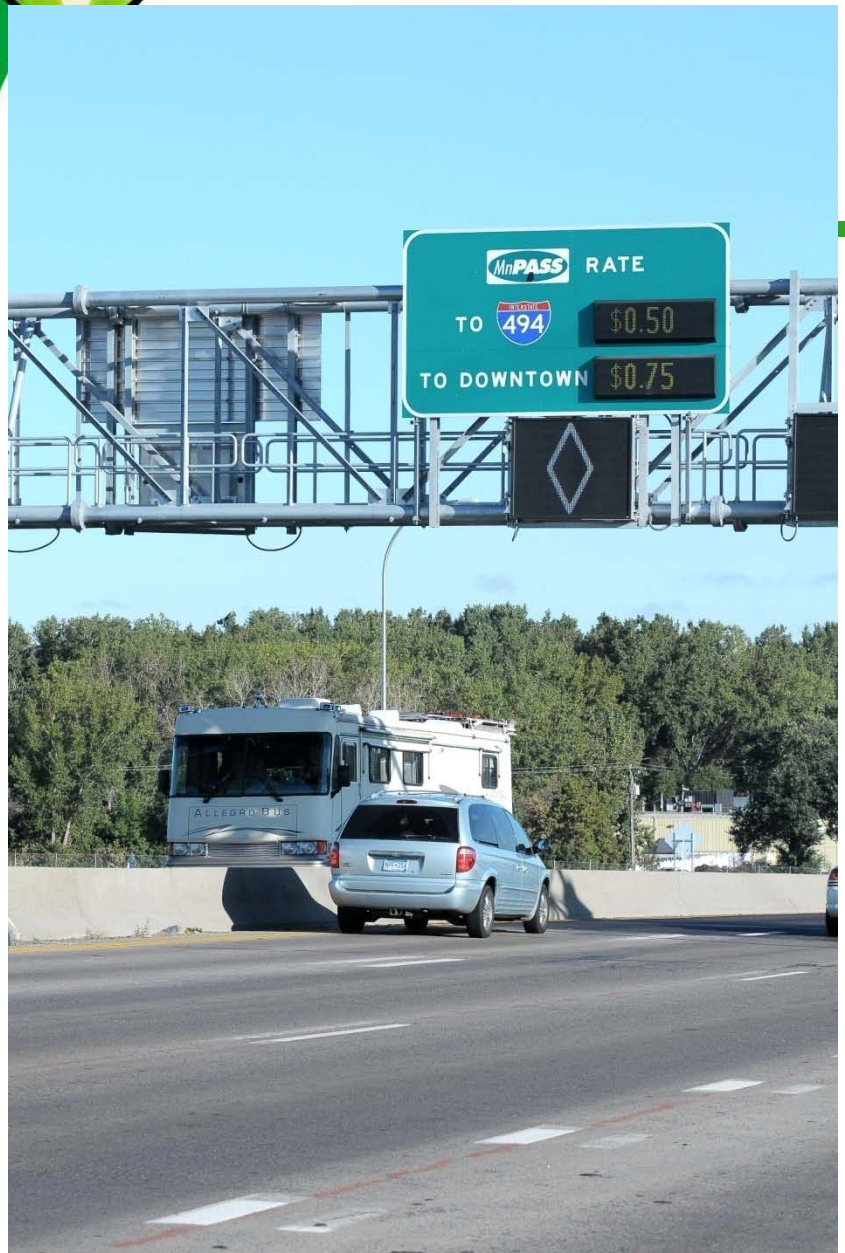
- Tolling strategy
- Enforcement Technology
- Back office

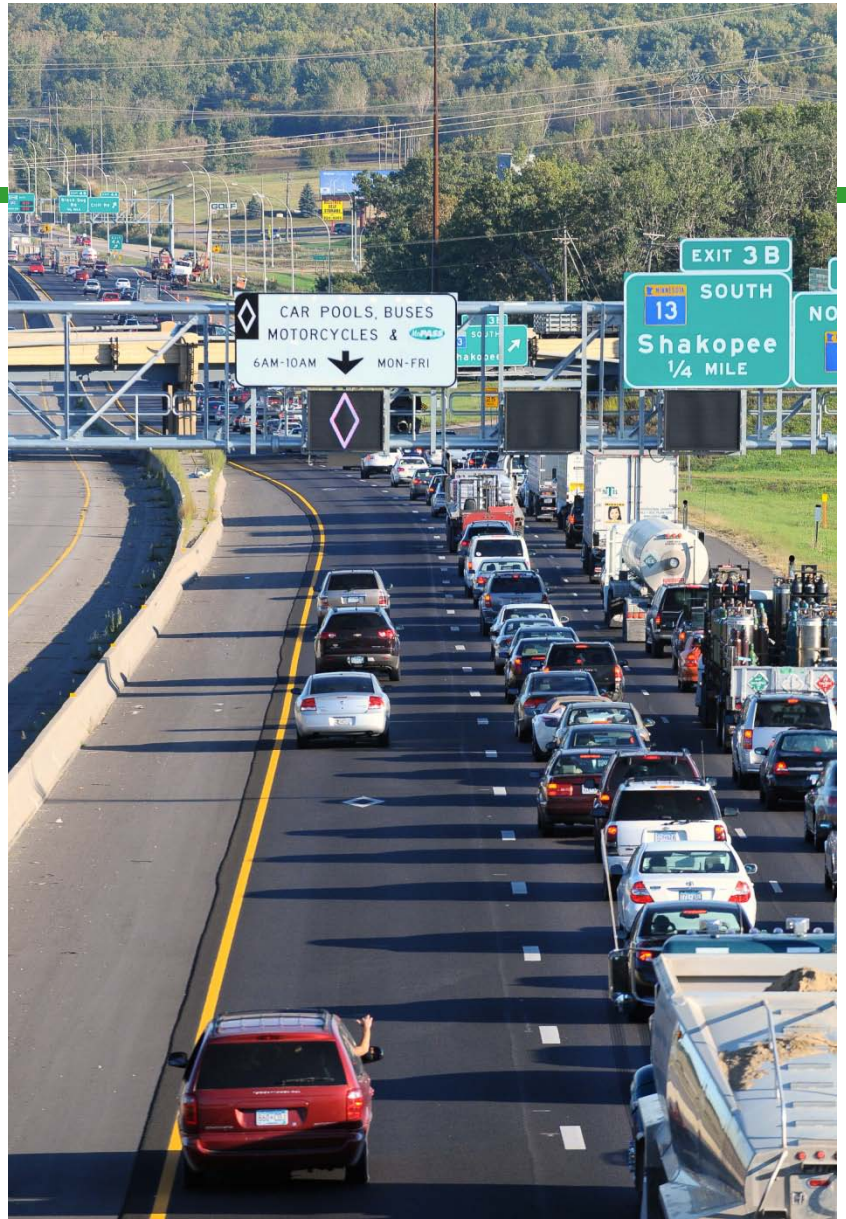
New

- Active Traffic Management all lanes
- Dynamic priced shoulder lane
- Dynamic lane signs integrated with toll pricing

get in and go

MnPASS



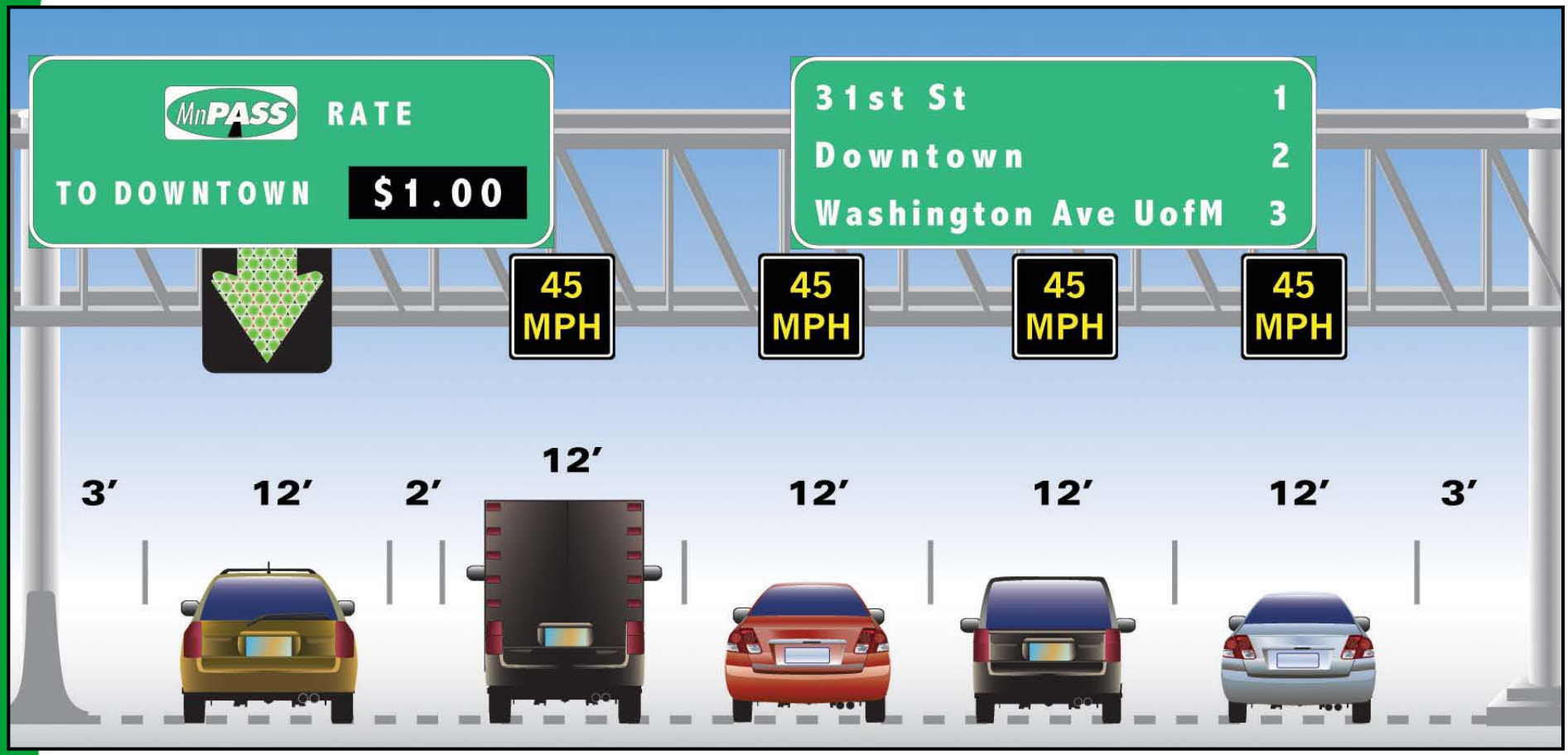


get in and go

MnPASS

I-35W MnPASS: Travel Time Advisory

PDSL/Managed Lanes: Driver Views




MnPASS RATE
TO DOWNTOWN CLOSED
MERGE


CAR POOLS, BUSES
MOTORCYCLES &
SHOULDER USE
PERMITTED ON
GREEN ARROW
EXIT 16A
DOWNTOWN EXITS
1½ MILES
35W

Questions and More Information

Visit

www.mnpass.org

Or

www.dot.state.mn.us/upa

Contact:

nick.thompson@state.mn.us

Technologies That Complement Congestion Pricing

David L. Dye
Deputy Secretary

Paula J. Hammond, P.E.
Secretary

Steve Reinmuth
Chief of Staff

Presented by:

Morgan Balogh, P.E., PTOE

Traffic Engineer, Northwest Region Operations

Congestion Pricing Webinar
June 23, 2011

Washington State Department of Transportation

Monitor, Manage, Measure

WSDOT is a nationwide expert on using technology to keep drivers informed, move more traffic safely & efficiently, and systematically measure & report on performance.

WSDOT's Long History of Freeway System Operations

- Reversible express lanes operations
- Variable message signs
- Variable speed limits
- Traffic management centers
- Traffic cameras
- Ramp meters

Traffic Management Centers

- Integrated Operations
- Coordinated Communication
- System Controls
  - Tunnel Operations
  - Ramp Metering
  - Active Traffic Management Systems
  - Central Control of Traffic Signal Systems
  - Integrated Corridor Management (ICM)
- Information Dissemination

How do we use high quality traffic data?

To develop strategies and assess the performance of the three-part Moving Washington strategy

Operating Roadways Efficiently

- Support variable pricing for HOT lanes
- Facilitate electronic tolling
- Implement Active Traffic Management – Smarter Highways
- Provide real-time traveler information
- Apply other technologies in operations to enhance safety and system efficiency

Managing Demand

- Monitor results of various efforts to reduce VMT (for GHG and congestion)
- Track HOV usage
- Validate the modeling analysis of TDM strategy impacts

Adding Capacity Strategically

- Assess the impacts of past strategies
- Customize solutions for congested corridors
- Plan, prioritize, and program capital improvement projects
- Assist legislature and governor in making investment decisions

SR 167 High Occupancy Toll (HOT) Lanes

General Purpose drivers save time:

- GP lane speeds increased by 11 percent
- Volume has increased two to three percent

HOT lane drivers save time:

- HOT lane drivers save up to eight minutes during rush hour
- Volumes increased 12 percent

Usage and Revenue is growing:

- HOT lane usage doubled during the second year of the pilot
- Revenue covers O&M costs

What are Smarter Highways?

Build upon current traffic technology

Use the successes we have to build smarter roadways for the future

Install overhead electronic signs

Alerts drivers to slow down or change lanes due to blocking incidents. Also improves emergency access.

Allow drivers to use shoulders

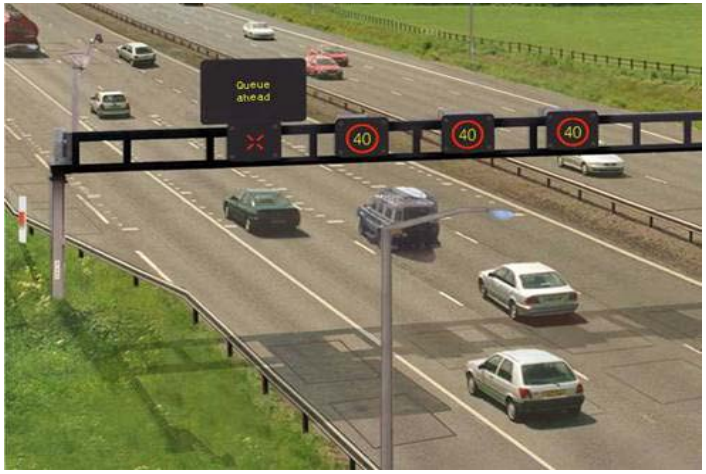
Open shoulders as a travel lane during peak commute hours where safe to do so

Build in emergency pull off areas

Gives space for vehicles to pull over in emergencies and helps keep traffic moving

Give drivers more real-time information

Electronic signs allow drivers to make better reroute decisions



Smarter Highways

- Traffic accidents are responsible for at least 25% of all congestion
- Anticipate a 30% reduction in injury collisions
- Give drivers information to make better travel decisions

- Variable speed limits
- Lane control
- Real time traffic information

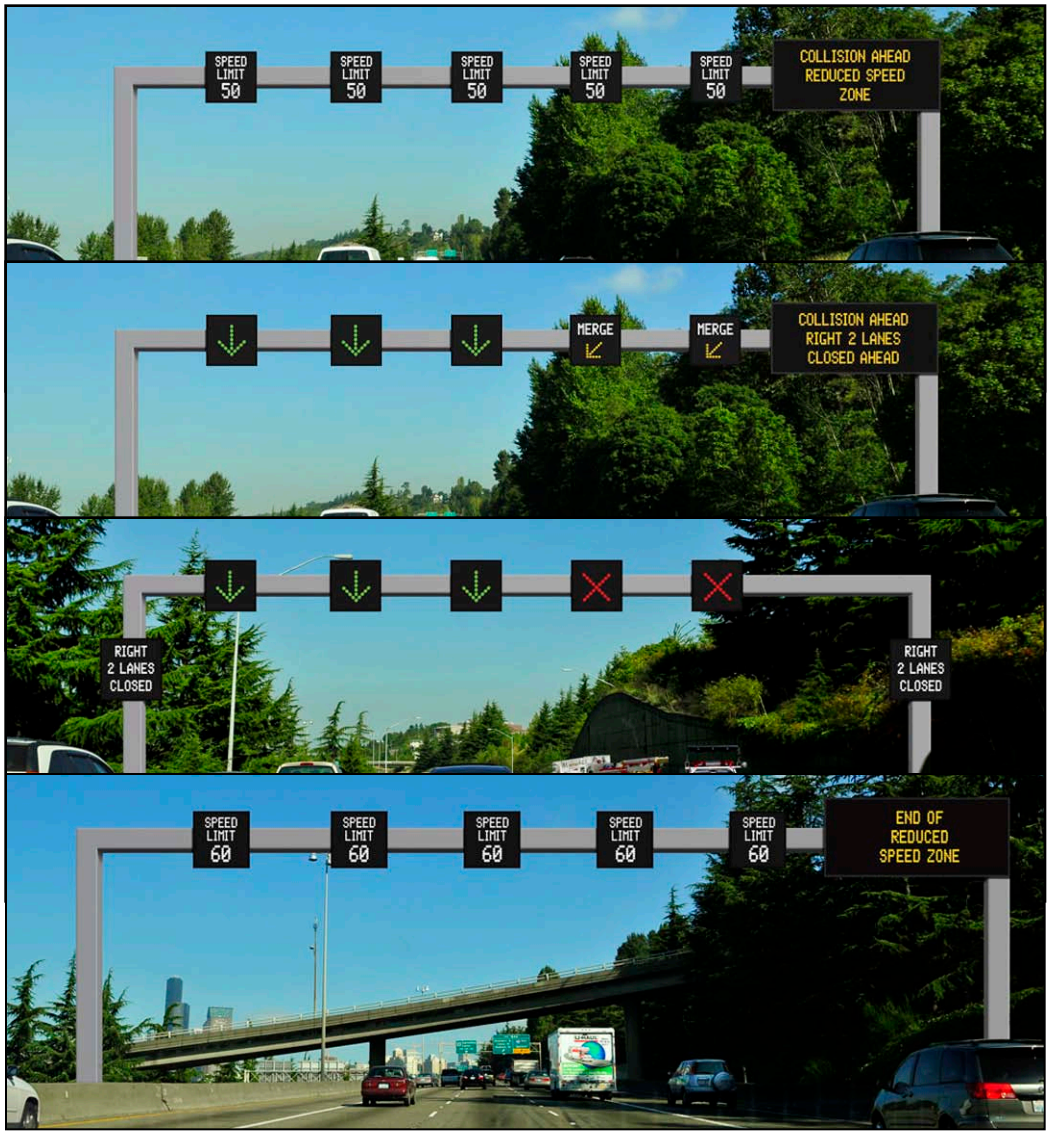
Signs every half mile

1st Sign Bridge: A collision ahead causes speed limit to drop to 50 mph.

2nd Sign Bridge: Signs display lane status. And direct drivers to begin to start moving over.

3rd Sign Bridge: At the incident, two right lanes closed.

4th Sign Bridge: After the incident, the speed limit automatically returns to the posted 60 mph.



Smarter Highways Segments Under Way

Northbound I-5
August 2010
Boeing Access Road to I-90 in Seattle

SR 520
November 2010
I-5 to 130th Avenue NE in Bellevue

I-90
June 2011
I-5 to 150th Avenue SE in Bellevue

What other highways might get smarter?

WSDOT engineers conducted a feasibility study to see where in the Central Puget Sound Region Smarter Highways might be effective in improving safety.

Future expansions of the system are currently unfunded.

Lake Washington Urban Partnership Agreement

- $154.5 million federal grant to apply these innovative approaches to reduce congestion in the SR 520 corridor
  - **Tolling** – encourages travel at off-peak hours and reduces trips
  - **Technology** – variable speed limits and real time driver info
  - **Transit** – added over 130 new daily bus trips to the 600 already in the corridor
  - **Telecommuting** – educational efforts with employers, van/carpools
- Partners:
  - Puget Sound Regional Council
  - Washington State Department of Transportation
  - King County

Funded by:

U. S. Department of Transportation
Federal Highway Administration

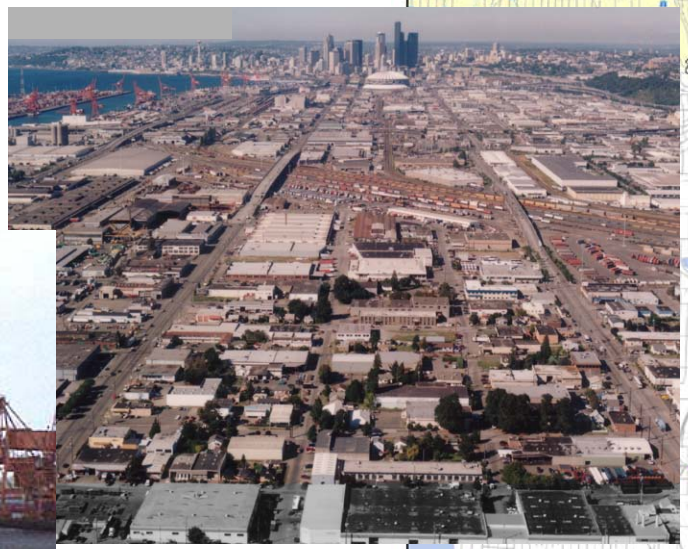
Lake Washington Travel Time Signs

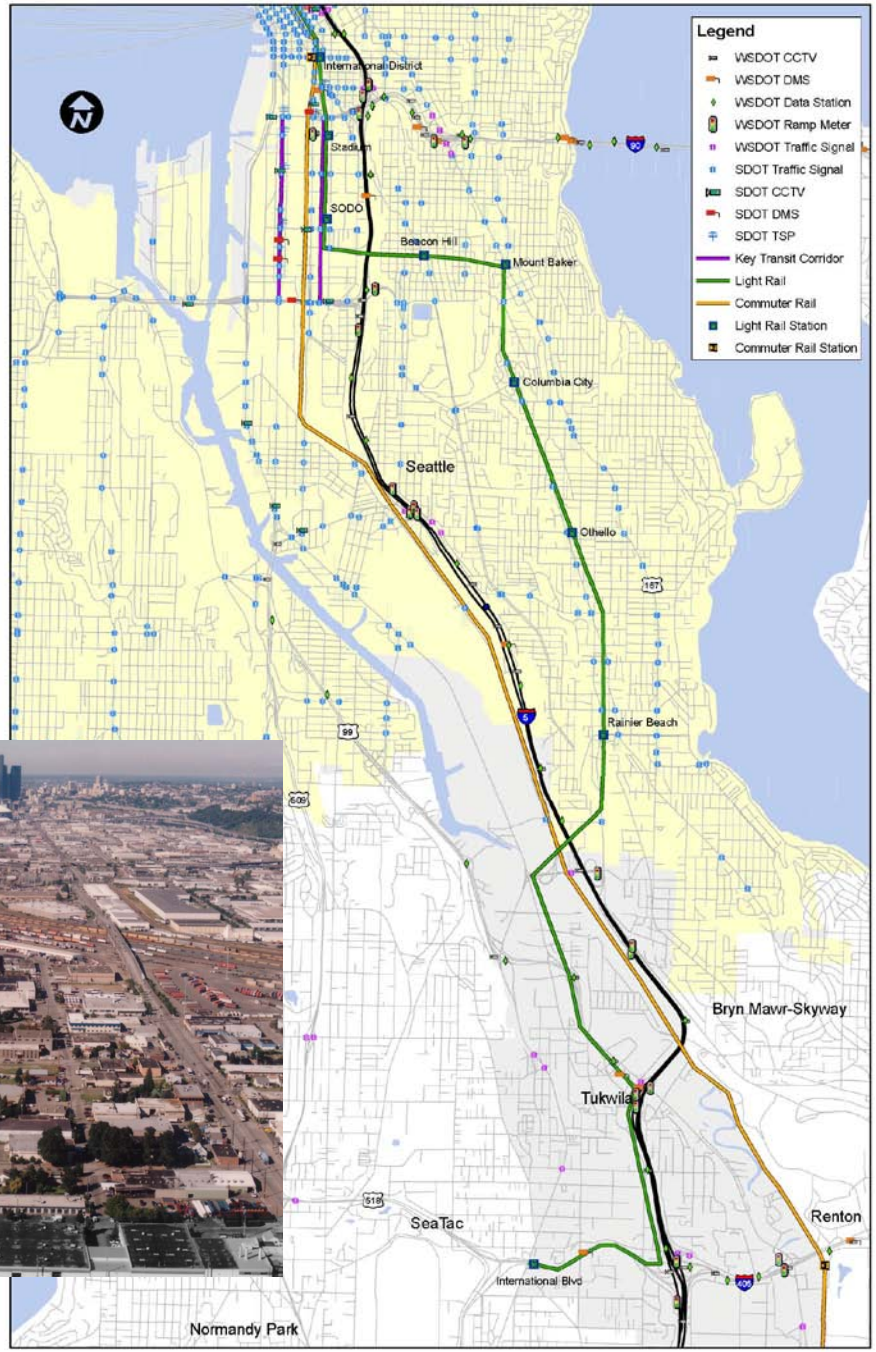
3 new dedicated travel time signs

- WB SR 520 just east of I-405
- SB I-405 at NE 72nd Place
- SR 522 at SR 202

Seattle Integrated Management Corridor

- Freeway - I-5
- Commuter Rail
- Light Rail
- Transit Corridor





Corridor Dynamics

- Regionally critical corridor
- Geographically constrained
- Complex right-of-way network
- Significant freight traffic – Port of Seattle
- Over 90 major events annually
- Major highway construction over several years - Alaskan Viaduct Replacement

Web, 511, & Other Media Comparison

- Web: Average about 1 Million page views per day.(~85% is for travel information)
- Web: Routinely see over 2 million daily page views during winter weather
- Comparatives
  - 511 calls vary from 70K to 500K per month
    - Reached our 10M 511 call after year 6
  - Blog views are 10K per month
  - YouTube views 20k per month
  - Flickr sees up to 200K views per month (although had 1 million views last month due to north cascades!)
  - Twitter has about 16,000 followers
  - Email alert pushes, minimum 400K per month
  - 2500 Facebook fans

Seattle Traffic

- Seattle Area Home
- Incidents
- Travel Times
- Travel Alerts
- List of Cameras
- Best time to leave
- Mobile Site
- Lake Washington
- Have Questions?

State Travel Info

- State View
- Weather
- Commute Options

Local Traffic

- Mount Vernon & Stanwood
- City of Bellevue
- City of Seattle
- King County
- Ferries

Seattle Area Travel Times

Travel times as of 6:35 A.M. Thursday, June 23, 2011

State Route/ Interstate	Route Description	Distance (miles)	Average Travel Time (minutes)	Current Travel Time (minutes)	Via HOV (min.)
167	Auburn to Renton	9.8	14	13	10
405	Bellevue to Bothell	9.7	10	10	11
405 5	Bellevue to Everett	26.1	27	27	26
405 5	Bellevue to Federal Way	24.6	29	28	27
405 90	Bellevue to Issaquah	9.6	9	10	10
405	Bellevue to Lynnwood	14.9	15	15	15
405 520	Bellevue to Redmond	7.0	8	8	8
405	Bellevue to Renton	11.2	14	11	11
405 90 5	Bellevue to Seattle	10.6	11	12	12
	Via Westbound	10.6	11	13	13

Search

Canadian Border Traffic

E-mail updates

Border Traffic

- Canadian Border Home
- Local Travel Alerts and Slowdowns
- Southbound Canadian Wait Times and Cameras
- US Customs Border Wait Times
- Canadian Border Wait Times
- Border Line-ups.com

Traffic & Cameras

- State View
- Seattle Area
- Ferry Cameras
- Tacoma
- Hood Canal Area
- Olympia
- Vancouver Area
- Mount Vernon
- Bellingham
- Stanwood
- Monroe
- **Canadian Border**
- Spokane
- Wenatchee

State Travel Info

- Travel Alerts & Slowdowns
- Mountain Passes
- Weather
- Construction
- Cross-state Travel Routes
- Winter Driving Tips
- Safety Rest Areas
- State Highway Map
- Interstate Exits
- Featured Services

Additional Info

- Bordering State Travel
- Driver & Vehicle Licensing
- Washington State Tourism
- Contact Us
- Disclaimer

511 Travel Info

Northbound Border Wait Times
8:15 A.M. Wednesday, August 19, 2009

I-5 General Purpose	35 Min
I-5 Nexus Lane	Less Than 5 Min
SR 543 General Purpose	10 Min
SR 543 Nexus Lane	Less Than 5 Min
SR 543 Trucks	15 Min
SR 543 Trucks FAST Lane	Less Than 5 Min
SR 539 General Purpose	20 Min
SR 9 General Purpose	Less Than 5 Min

News

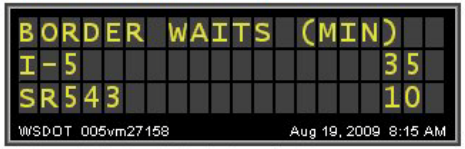
- The hottest housing deal in Western Washington is in Glacier on Wednesday – $10 for a ski cabin!
- Roundabout to open Sunday night at SR 539/Pole Road intersection near Lynden
- Second Amtrak Cascades train to Vancouver, B.C. begins service August 19
- More News...

I-5: Mitchell Ave

This image should automatically reload every 1.5 minutes.

Which way is the camera pointing?

005vm27158: I-5 NB at Loomis Trail Rd



This image should automatically reload every 5 minutes.

More Border Information

- Average Travel Delays
- Local Weather and Forecast
- Nexus Information
- Fast Application Information (Commercial Shipments)
- Archive Border Wait Times
- Questions about Crossing the Border
- Other Points of Entry
- More Local Information
- Northbound Border Wait Times

How long will your wait at the border be?

If you've ever wondered how long you might wait in line to cross the border, at noon on a summer weekend, we've got good news for you. We've compiled the statistics and created a series of average border delay graphs to help you better plan your trip.

Washington State Department of Transportation

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- Centralia & Chehalis
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- Bellingham
- Monroe & Sultan
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- Spokane
- US 97 Border
- Wenatchee

State Travel Info

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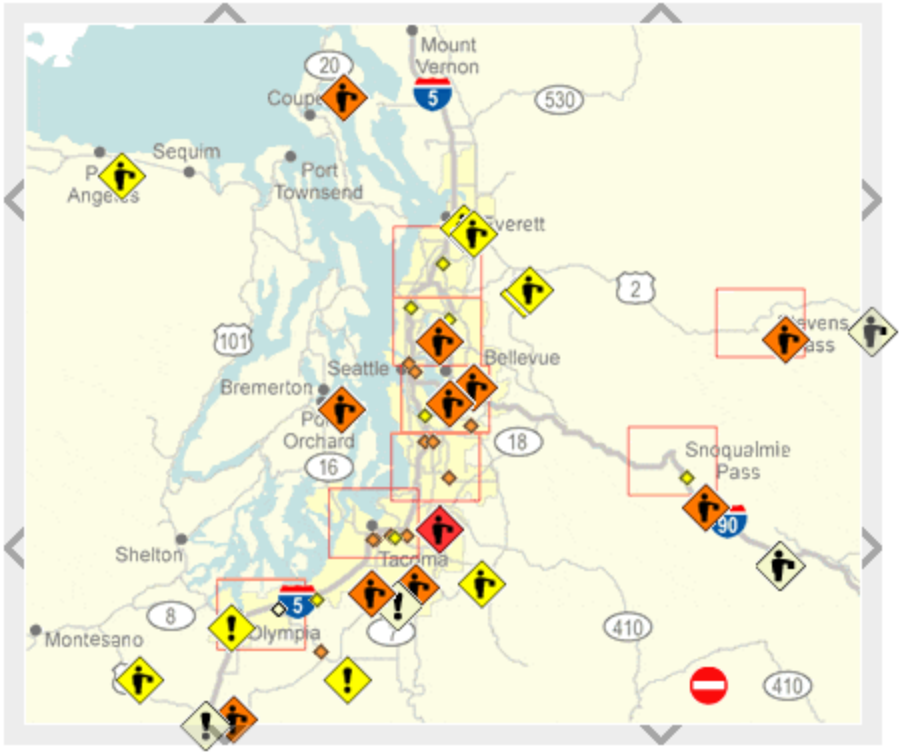
Travel Alerts Puget Sound Area



Zoom Out [1] 2 [3] Zoom In

IMPACT LEVEL/TYPE

Travel Alerts

View All Alerts For Area (Printer friendly versio

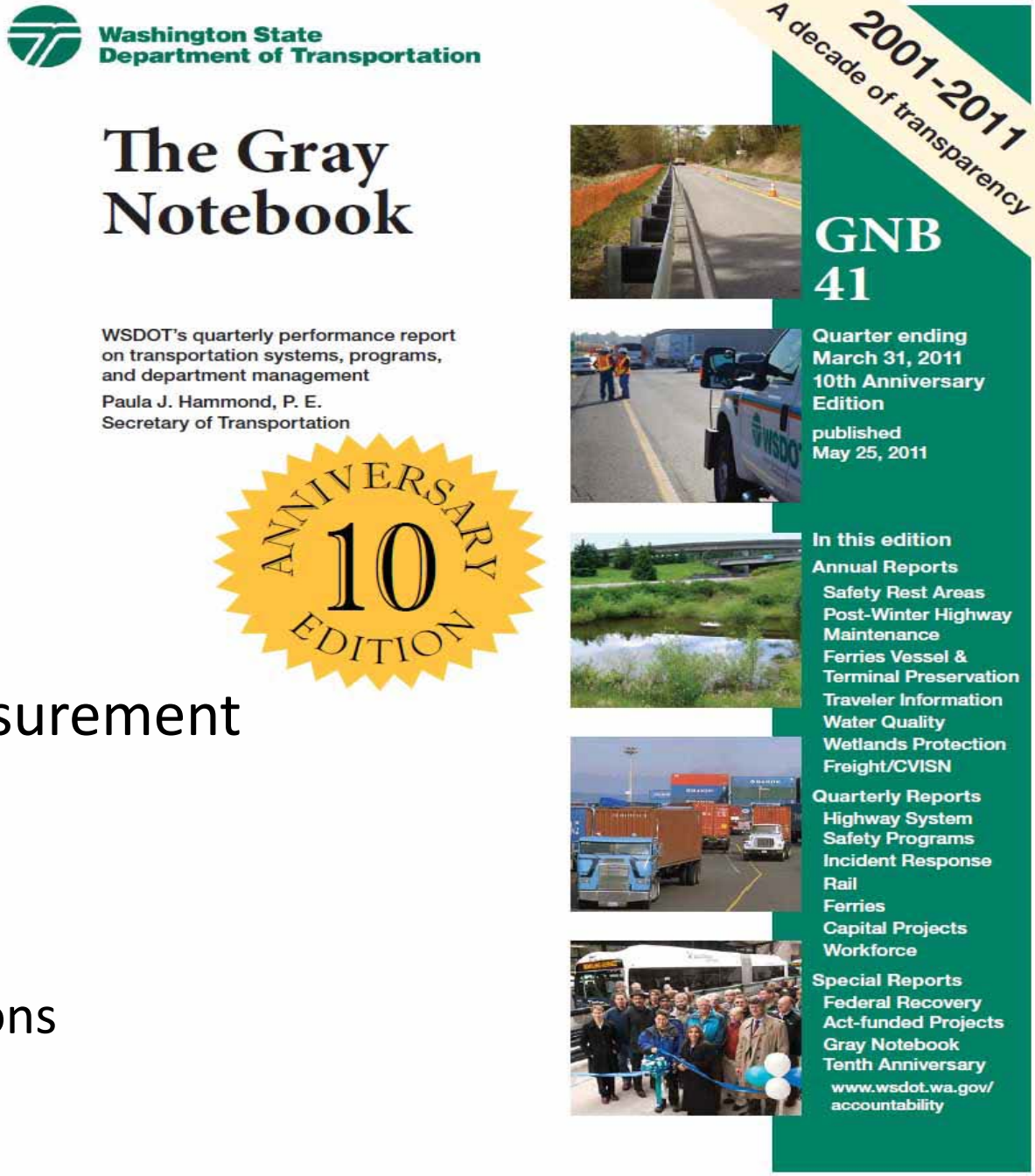
HIGH IMPACT

SR 18 Westbound - Until further notice, t ramp from Weyerhaeuser Way to westbou SR 18 is closed around the clock. The closu will allow crews to rebuild and elevate the ramp 20 feet to make room for a new flyo ramp from westbound SR 18 to southbour 5. A detour is available.
Last Updated: 6/3/2011 10:49 AM
At milepost 1 More

MODERATE IMPACT

I-90 Both Directions - Blasting Thursday begin at 8 p.m. Crews will be blasting rock closer to I-90, which could result in a closu longer than one hour. Drivers need to pla for more than an hour of added travel tim Traffic will be stopped milepost 56 to milep 61. Tuesday through Friday, delays possib for rolling slowdowns to move constructio equipment in the work zone. Monday nigh through Saturday morning, 8 p.m. to 9 a.m traffic restricted to one lane each direction loads over 12 feet wide are pr
Last Updated: 6/23/2011 12:16 AM
From milepost 56 to milepost 61 More

MODERATE IMPACT



Performance Measurement

- Accountability
- Optimization
- Investment Decisions

Travel time performance for July-December in 2007-2010 on a sample of 18 high demand commute routes

Morning (am) peak is between 6 am and 9 am; evening (pm) peak is between 3 pm and 7 pm; length of route in miles; all travel times in minutes

Route name (route length)	Direction of travel	Average travel time in minutes during peak period				Peak average travel time change in minutes			Peak volume change		Daily volume change	
		2007	2008	2009	2010	2008 vs. 2007	2009 vs. 2008	2010 vs. 2009	2009 vs. 2008	2010 vs. 2009	2009 vs. 2008	2010 vs. 2009
Morning commutes												
I-5 Federal Way to Seattle (22)	NB	42	35	31	**34**	-7	-4	+3	+5%	-1%	+5%	-1%
I-5 Everett to Seattle (24)	SB	41	36	35	**37**	-5	-1	+2	+3%	-4%	+3%	-1%
I-5/I-405 Everett to Bellevue (23)	SB	42	37	36	**40**	-5	-1	+4	0%	-2%	+3%	0%
I-405 Tukwila to Bellevue (13)	NB	35	33	20	**22**	-2	-13	+2	+33%	-2%	+10%	+1%
SR 167 Auburn to Renton (10)	NB	17	14	14	**15**	-2	0	+1	+9%	-2%	+5%	-1%
I-405/I-90/I-5 Bellevue to Seattle (11)	SB/WB/NB	14	–*	12	**12**	–*	–*	0	-1%	+1%	0%	+3%
I-405/SR 520/I-5 Bellevue to Seattle (10)	NB/WB/SB	14	13	14	**14**	-1	+1	0	0%	-3%	+2%	-2%
I-5/I-90/I-405 Seattle to Bellevue (11)	SB/EB/NB	14	14	12	**13**	0	-2	+1	-5%	0%	+1%	-1%
I-5/SR 520/I-405 Seattle to Bellevue (10)	NB/EB/SB	16	15	15	**16**	-1	0	+1	-2%	-2%	+2%	-2%
Evening commutes												

For more information

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Washington State Department of Transportation

FHWA ETC Rule

- Published October 8, 2009
- In response to SAFETEA-LU requirement in §1604 to issue rule on req'ts, standards, or performance specs for automated toll collection
- NPRM issued September 2007, included questions about need for & timing of standard

FHWA ETC Rule

- *Headlines* of Comments to NPRM
  - Sunk costs of installed base must be considered
  - Long phase-in period or grandfathering
  - Back-office is major aspect of interoperability; toll tag is only a part
  - Significant cost difference between DSRC/5.9Ghz & toll-only devices
  - Question related to timing of std: General response was “too soon” & DSRC considered when it's ready

FHWA ETC Rule

- Only applies to 3 tolling programs: Interstate Construction Pilot (1), Express Lanes Demonstration (2) and Value Pricing Pilot Program
  - Not applicable to HOV-HOT, 23 USC §129 or Interstate Reconstruction Pilot
- Requires ETC for all these programs
  - ETC defined as “ability for vehicle operators to pay tolls automatically without slowing down from normal highway speeds”

FHWA ETC Rule

- Requires FHWA concurrence of selected ETC method
  - Consider likely users, how interoperability is addressed, consider future (5-year) techniques
  - Intent is not to be a barrier or hindrance, but to ensure a collaboration between industry/deployers and Government as technologies & techniques advance
- About ½ of responders stated that any national toll collection std be pursued as an integral part of connected vehicle research (formerly known as the IntelliDrive^{SM} program)