INNOVATIVE INTERSECTION AND INTERCHANGE DESIGN

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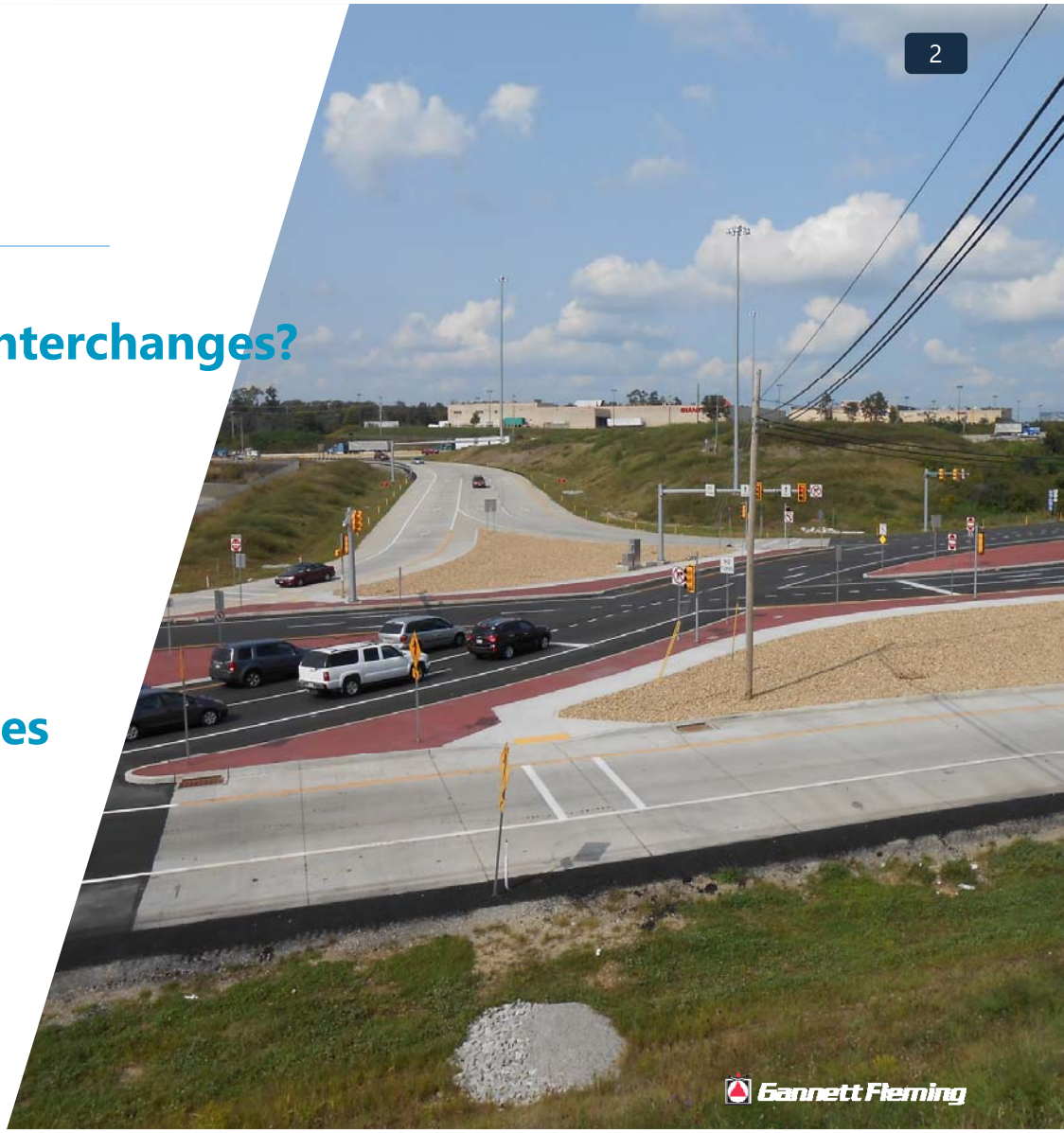
AGENDA

What are Innovative Intersections/Interchanges?

- Benefits
- Selection
- Challenges
- Types

Role of ITS in Innovative Interchanges

Resources



What are Innovative Intersections and Interchanges?

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What are the benefits?

Safety

- Reduction in crashes

Operations

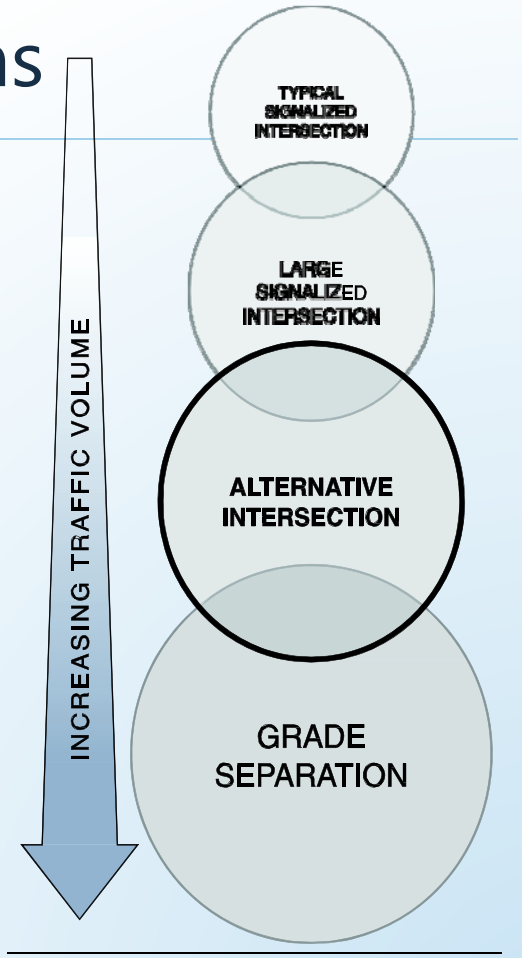
- Improved corridor progression
- Reduced travel times

Cost

- More economical than grade-separation

When to consider alternative intersections

When signalized intersections are not sufficient but grade separation may not be economically feasible



How to choose an alternative Intersection/Interchange

- **Understand the objectives**
- **Identify intended users**
- **Identify the context: surrounding land use and environment**

What are the Challenges?

- **Driver expectancy**
- **Public acceptance and education**
- **ROW**
- **Access**
- **Utilities**
- **Geometrics**

Types – Numerous!

- **Roundabouts**
- **Single Point Urban Interchanges**
- **Median U-Turns**
- **Displaced Left Turns**
- **Diverging Diamonds**

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Roundabouts

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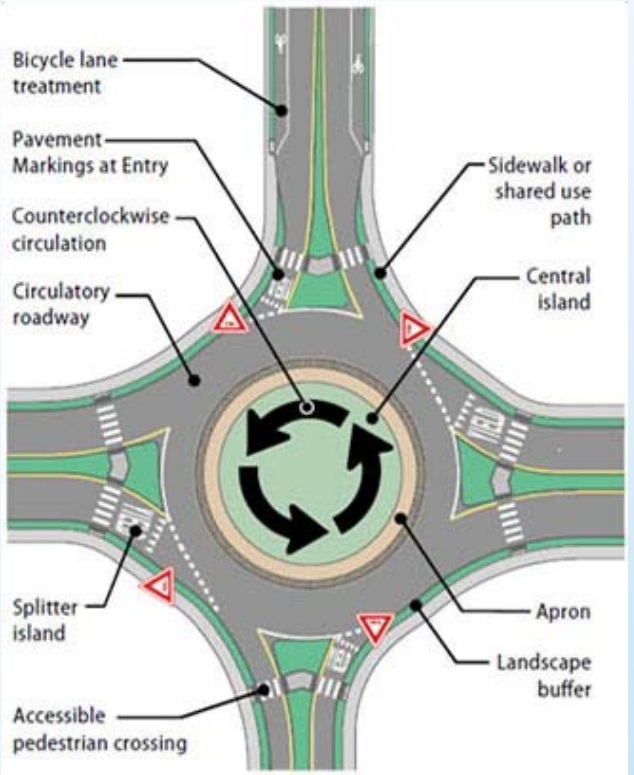
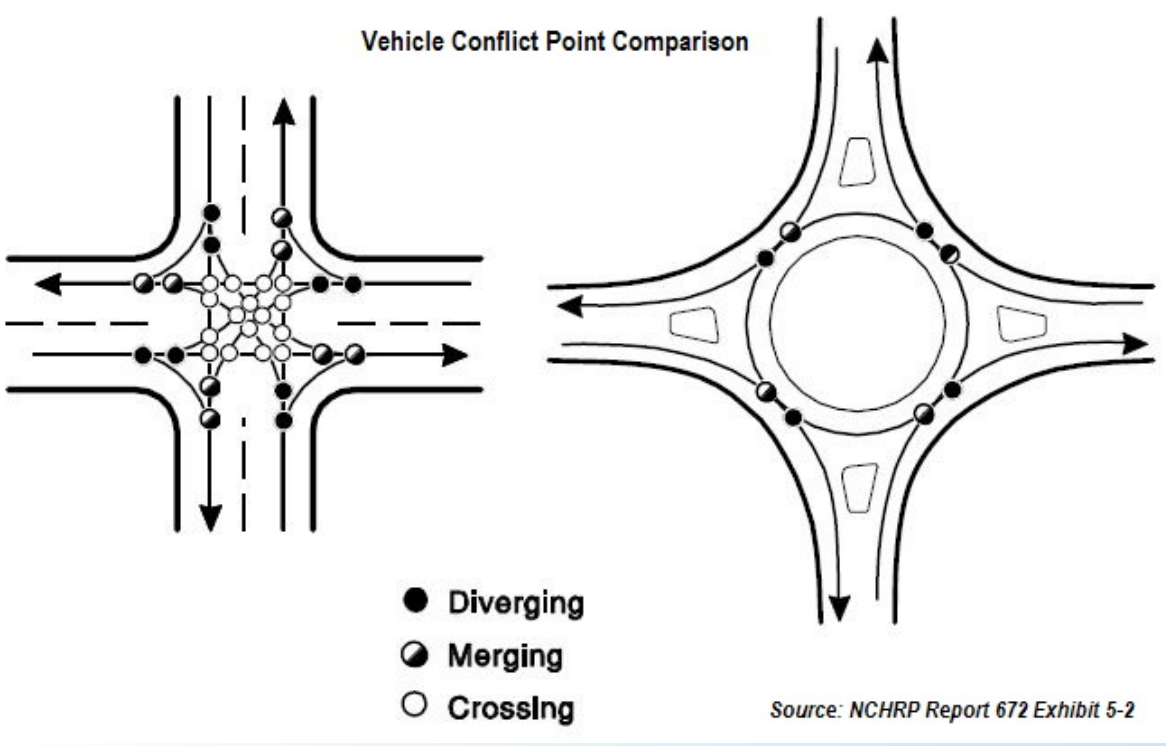
Roundabout Features

- Counterclockwise Flow
- Entry Yield Control
- Low Speed
- Deflection – Key Design Element!
- Signing
- Lighting



Roundabout Safety

- Less Conflict Points
- Lower Speeds
- "Safer" Crash Types



Roundabout Safety

- More than 90% reduction in fatalities*
- 76% reduction in injuries**
- 35% reduction in all crashes**
- Slower speeds are safer for pedestrians

* "Safety Effect of Roundabout Conversions in the United States: Empirical Bayes Observational Before-After Study." Transportation Research Record 1751, Transportation Research Board (TRB), National Academy of Sciences (NAS), Washington, D.C., 2001.

** NCHRP Report 572: Roundabouts in the United States. National Cooperative Highway Research Program, TRB, NAS, Washington, D.C., 2007.

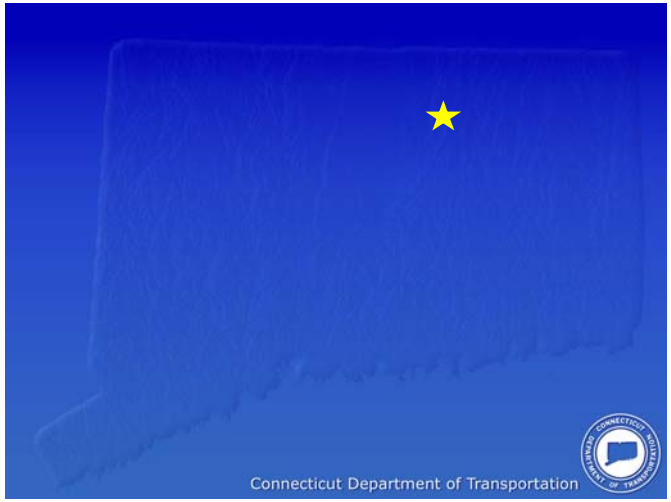
Roundabout Operations

Average delay per vehicle considering volume and left turns

	Left Turns (%)	Total Major Street Volume (vph)	Average Delay Per Vehicle (sec)	
			Signal	Roundabout
Example 1	10	700	13	<2
Example 2	10	1,000	14	<2
Example 3	10	1,300	14	<2
Example 4	10	1,500	15	<2
Example 5	50	700	15	3
Example 6	50	1,000	16	3
Example 7	50	1,300	17	5
Example 8	50	1,500	19	8

Source: Planning-Level Guidelines for Modern Roundabouts, Iowa State University and Iowa DOT, November 2008

Roundabout – Final Product



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Single Point Urban Interchange

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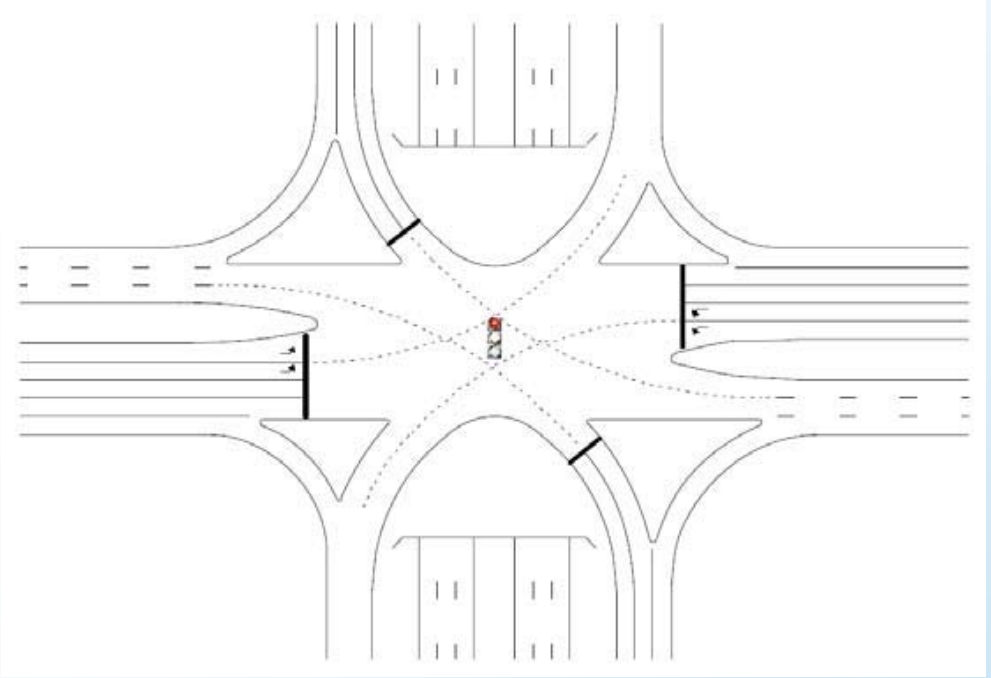
Single Point Urban Interchange - SPUI

- Single Traffic Signal
- Three Phases
- Improved Traffic Operation
- Improved Mobility
- More Compact than a Typical Grade-Separated Interchange



Single Point Urban Interchange - SPUI

- https://www.youtube.com/watch?v=mwpoPQ1SPJU

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Median U-turns

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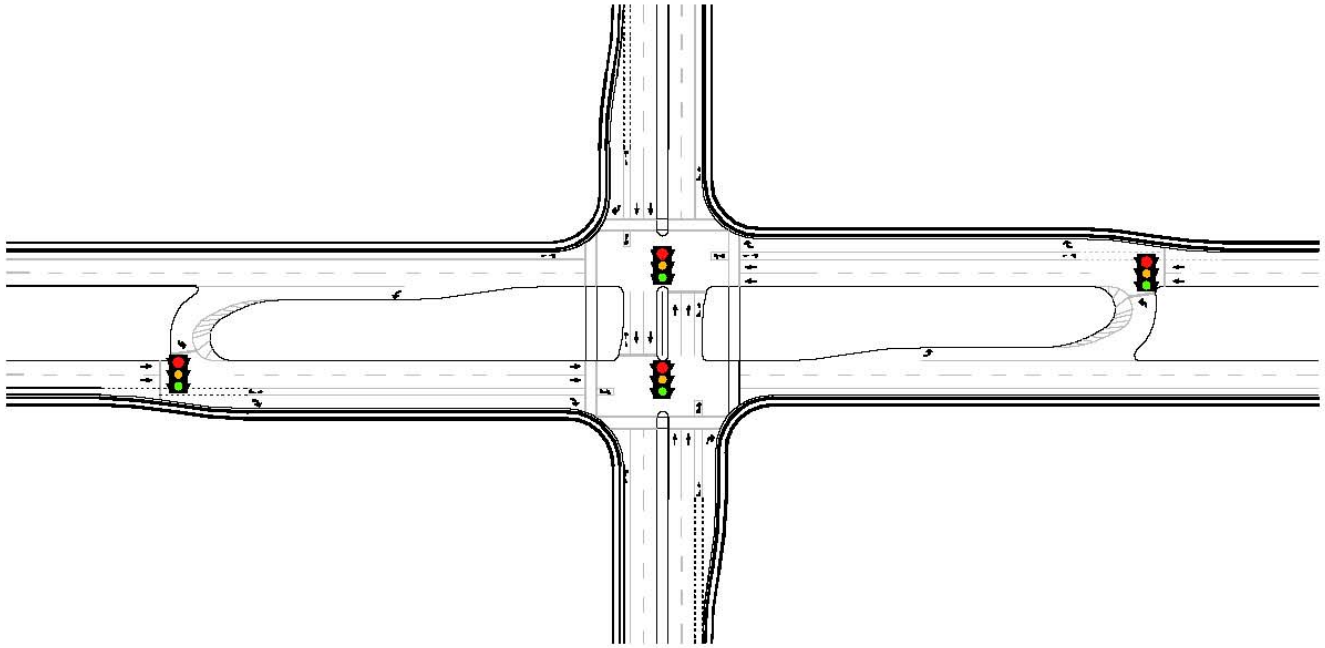
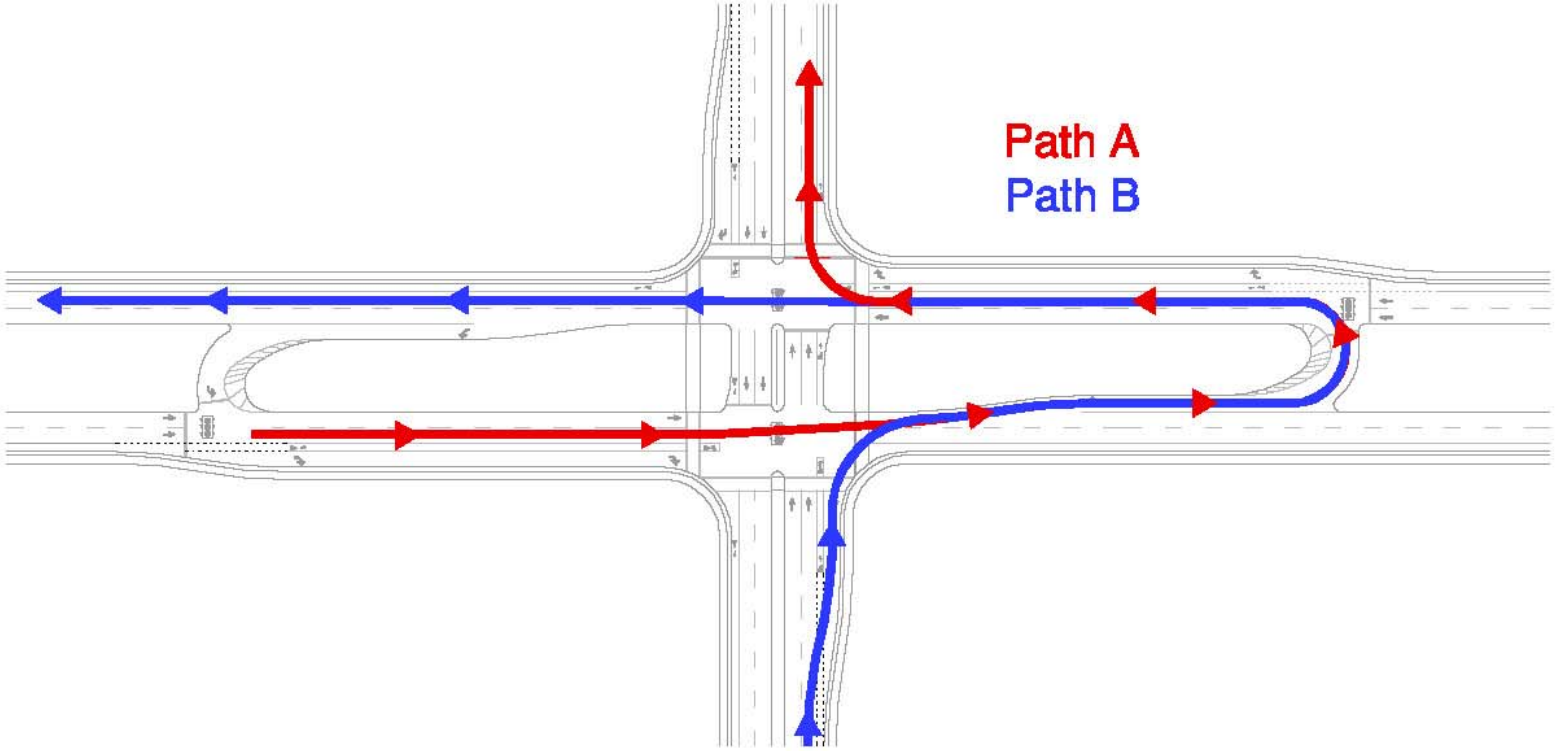
Median U-Turns - (MUT)



- Reduces signal phases and cycle lengths
- Reduces travel time in corridor
- Exist or planned in UT, TX, AZ, LA, MI, MD, WY
- Consider ROW & Design Vehicles
- Modify based on access needs

Source: FHWA Median U-Turn Intersection Informational Guide, August 2014

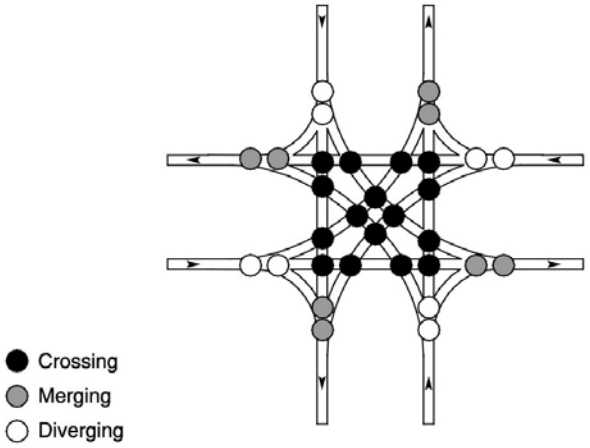
Median U-Turns - (MUT)



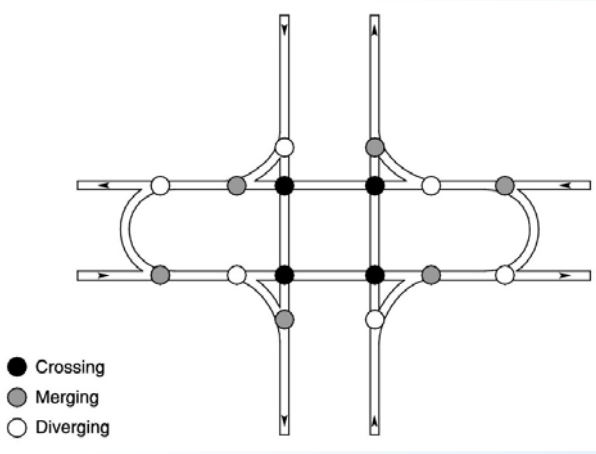
Source: FHWA Median U-Turn Intersection Informational Guide, August 2014

Median U-Turns (MUT)

Conventional Intersection



MUT Intersection



Safety Benefits:
30% Reduction in intersection-related injury crash rate

Source: FHWA Median U-Turn Intersection Informational Guide, August 2014

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Displaced Left Turns

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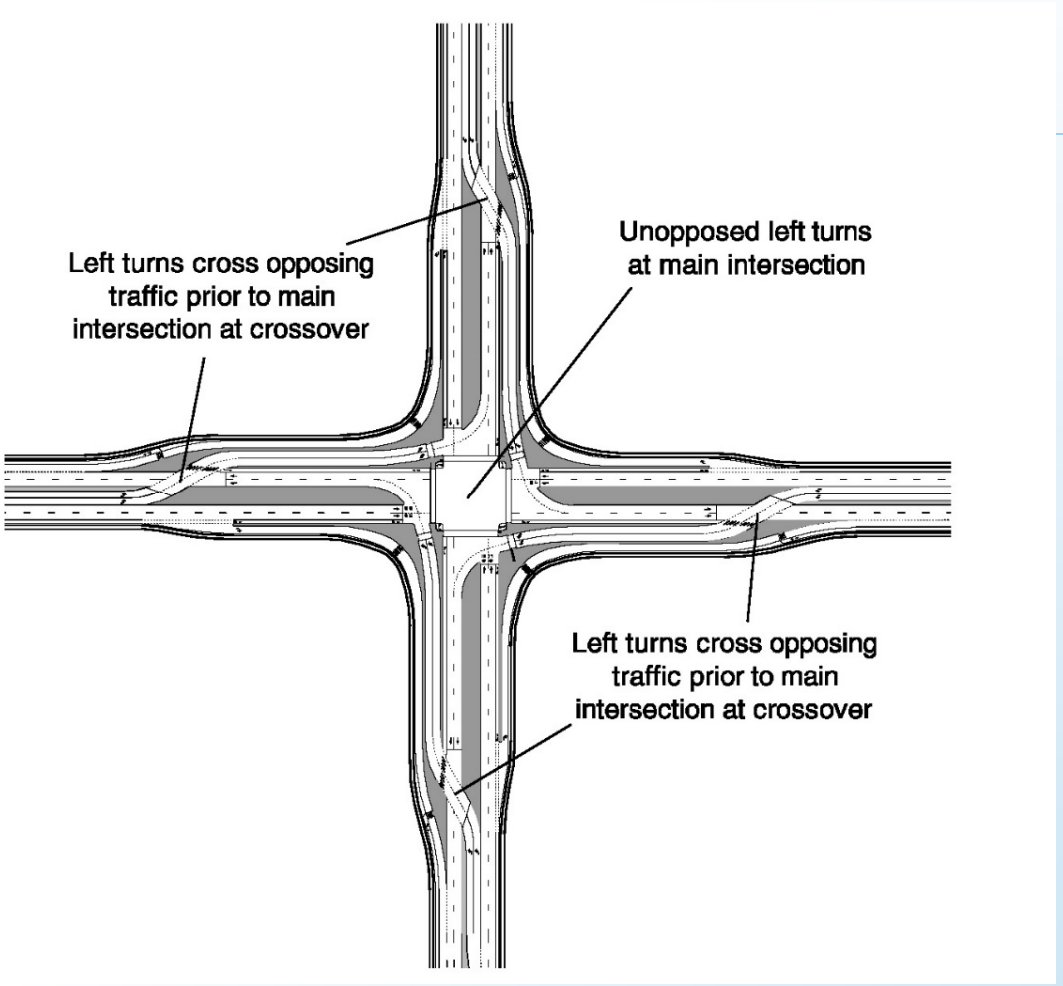
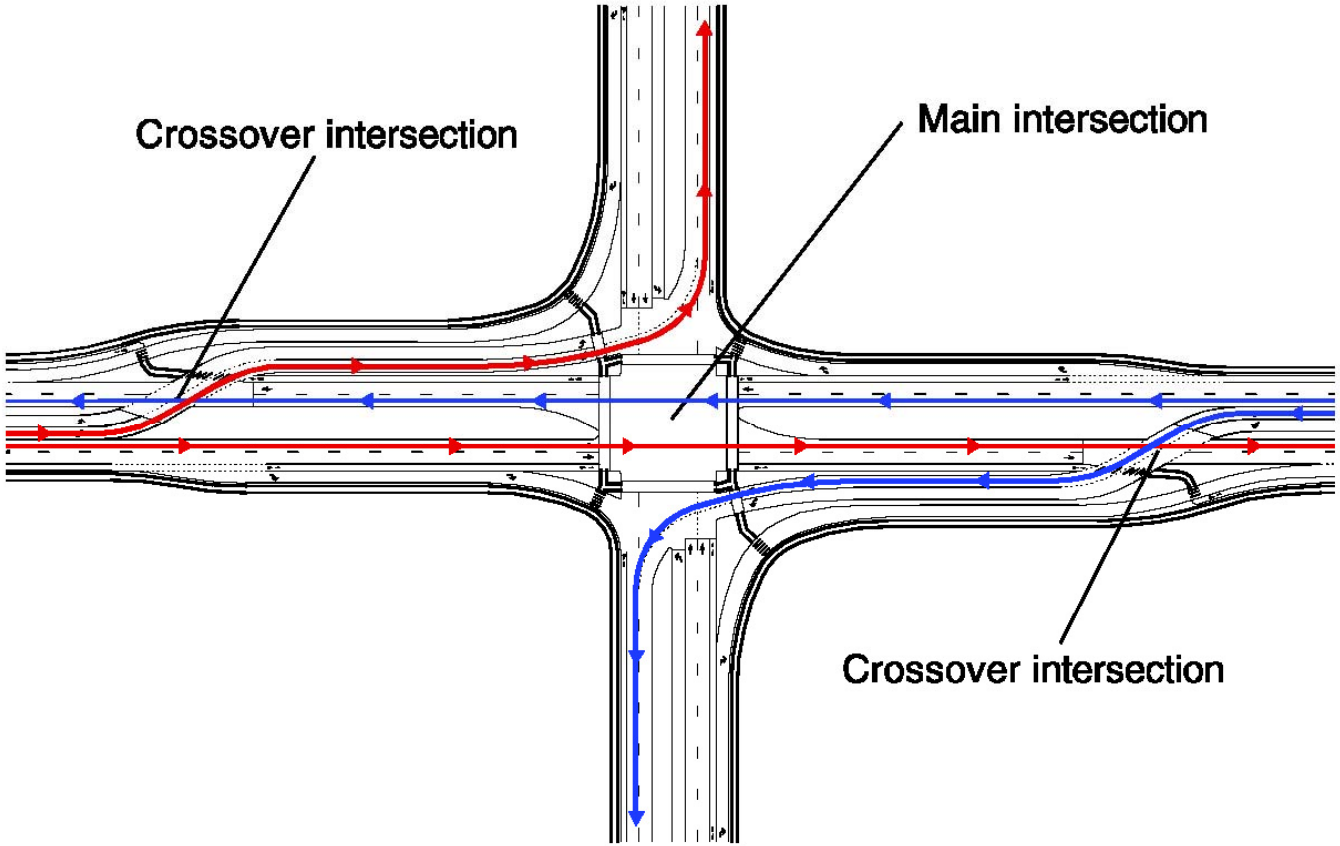
Displaced Left Turns (DLT)



Source: FHWA Displaced Left Turn Intersection Informational Guide, August 2014

Displaced Left Turns (DLT)



Source: FHWA Displaced Left Turn Intersection Informational Guide, August 2014

Displaced Left Turns (DLT)

- Maximizes throughput
- Most beneficial when heavy left turns opposing heavy thru moves
- Reduces signal phases
- Increases intersection capacity
- No significant safety improvements
- Implemented corridor-wide in UT; other locations in NJ, MO, LA, NY, MD, OH, CO

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Diverging Diamond Interchange

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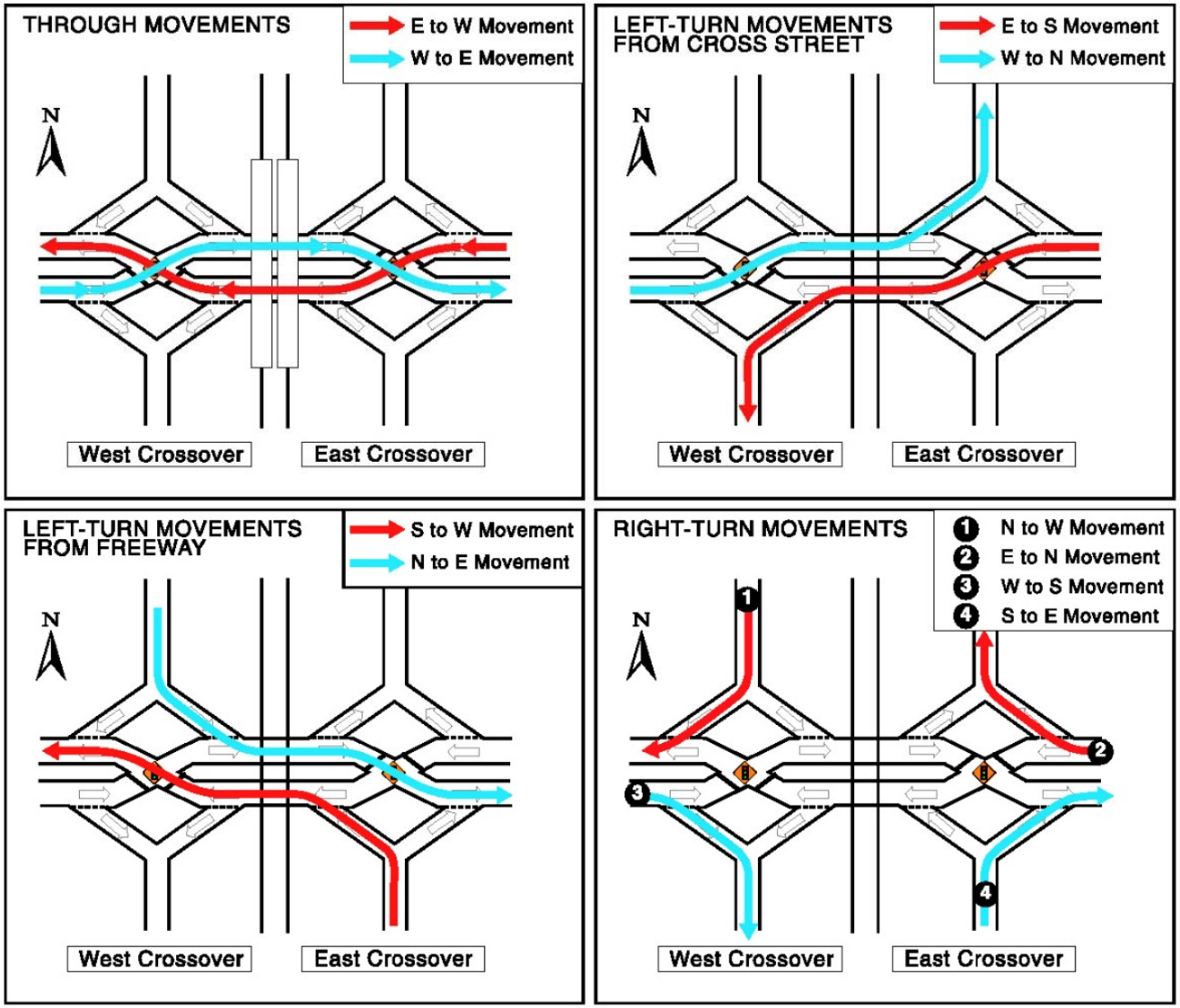
Diverging Diamond Interchange (DDI)

- https://www.youtube.com/watch?v=khFoQ-Ic6CI

DDI



Source: FHWA Diverging Diamond Interchange Informational Guide, August 2014


NO
TURNS
NO
TURNS

Diverging Diamond Interchange (DDI)

- Alternative to conventional diamond interchanges, single-point interchanges and cloverleaf
- Reduces conflict points from 10 to 2 from conventional diamond
- Two-phase signals
- Reduced queuing on ramps
- Generally fits within existing interchange ROW
- Less bridge structures
- Constructed in UT, VA, PA, WY, TN, RI, OH, NY, NV, MO, KY, MD, KS, ID, CO, GA, MN

Design Considerations

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Design Considerations

- Geometric Standards
- Lighting
- Signing
- Pavement Markings
- Signal and detector placement
- Multi-modal
- Construction Staging

Advance signing at a MUT intersection in Draper, Utah
Rodegerdts, L. Photo Credit.

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The Role of ITS in Innovative Intersections/Interchanges

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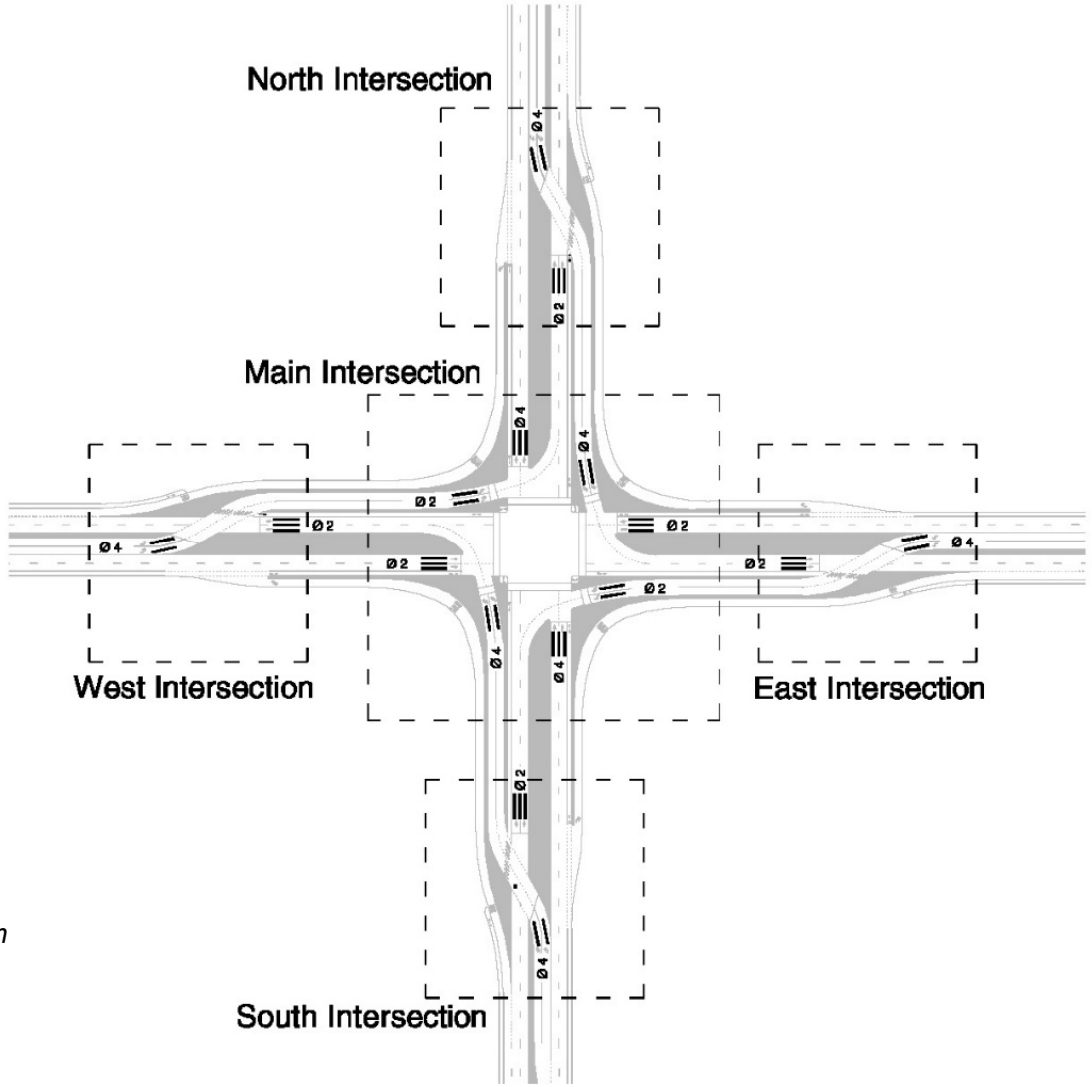
Role of ITS

- ITS elements are critical for some Innovative Intersections
  - Communications
  - Detection Technology
  - Ramp Metering

Detection



Source: FHWA Displaced Left Turn Intersection Informational Guide, August 2014

Detection Technology

- Loop detectors
- Magnetometers
- Video detection
- Microwave
- Radar

Communications

- Fiber Optics
  - Larger bandwidth capabilities
  - Coordinated systems
  - Data transmission to TMC
- Twisted copper pair
  - Stand alone intersections
  - Cost savings

Resources

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Resources

- https://safety.fhwa.dot.gov/intersection/
- https://www.udot.utah.gov/main/uconowner.gf?n=25601022404950131
- https://www.fhwa.dot.gov/policyinformation/statistics.cfm
- https://safety.fhwa.dot.gov/intersection/alter_design/pdf/fhwasa14069_mut_infoguide.pdf
- https://safety.fhwa.dot.gov/intersection/alter_design/pdf/fhwasa14068_dlt_infoguide.pdf
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- https://safety.fhwa.dot.gov/intersection/alter_design/pdf/fhwasa14067_ddi_infoguide.pdf
- https://ops.fhwa.dot.gov/publications/fhwahop06006/chapter_6.htm

Q&A

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