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The Relationship between Geometry and Traffic Operations (W.I.I.W.&H.Y.C.U.T.T.F.E.D.D.T.)

ATS/American

Gilbert Chlewicki, PE
Advanced Transportation Solutions

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Three Ways to Address Congestion

1) Add **Capacity** (i.e. add lanes)
2) Reduce **Demand**
   a) Demand Management (Carpooling, Mode Choices, Telecommuting)
   b) Placing destinations to where supply exists (ex. TOD)
   c) Contain Sprawl
   d) Spreading demand across a network
3) Improve **Traffic Flow**
   a) Signals (Phases, Cycles, Progression)
   b) Weaving, Merging, Diverging (Flow Friction)

Innovative Geometric Design Focuses on **Demand** and **Traffic Flow**

Principles of Innovative Geometric Design

1) One-Way Street Progression
2) Creating Mini-Networks of Smaller Intersections
   a) T-intersections
   b) Intersections with one-way movements
3) More Efficient Signal Phases (when signalized)
4) Conflicts Reduced and Spread Out

Benefits

SAFETY

- Fewer conflict points
- Significant Before/After Crash Reductions

MOBILITY

- Less delay
- Reduced congestion

VALUE

- Less ROW
- Less construction costs
- Implemented quicker

One-Way Street Progression

Simple to Synchronize Signals

Variable: Speed determines offset of signal

Speed controlled by signals and/or geometry (i.e. roundabouts)

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Two-way progression relies on:

Speed,

Distance (between signals),

And Cycle Length

Cities Have Full Networks of Small Intersections

Mini-Networks of Smaller Intersections

Why are Networks Good?

- Spreads out Demand
- Spreads out Conflicts

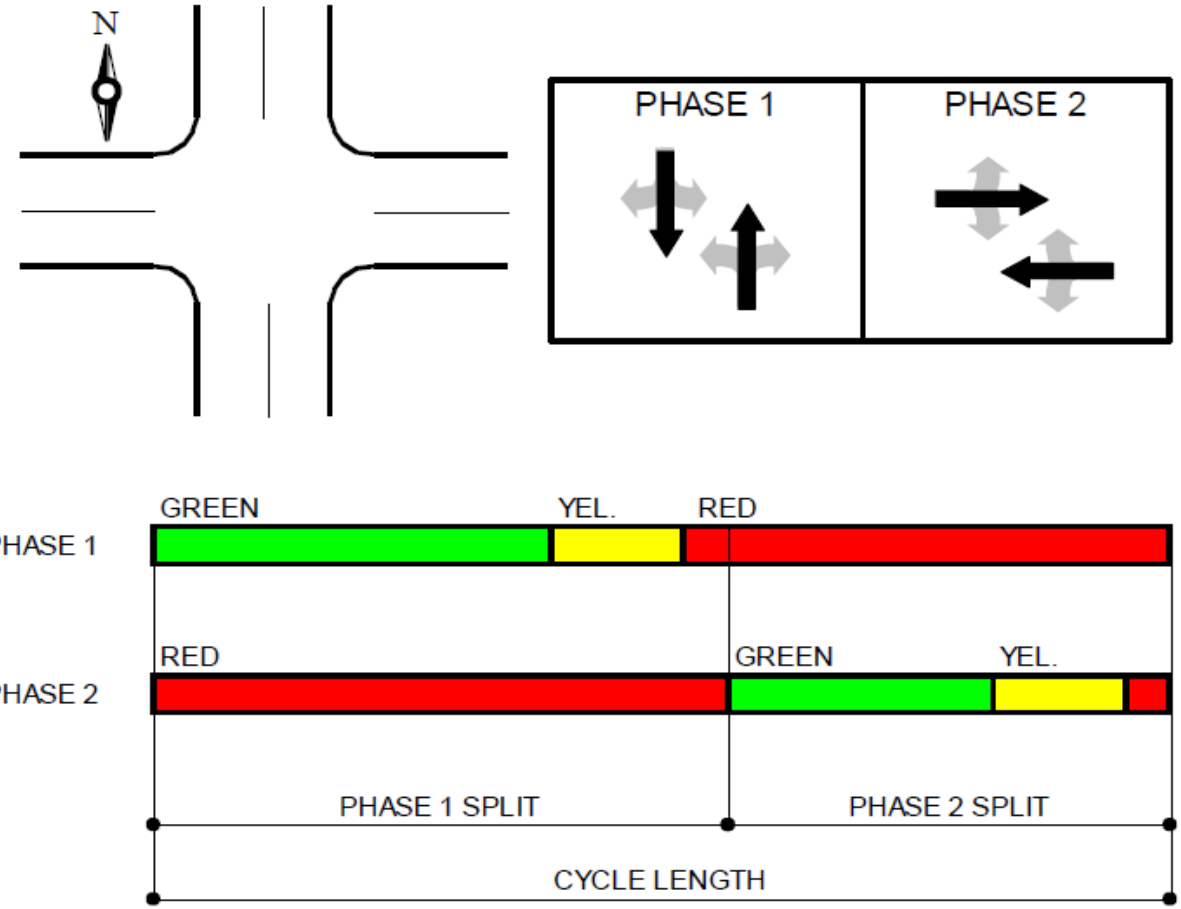
Why are Small Intersections Good?

- Shorter Clearance Time
- Less Exposure for Pedestrians and Bicycles to Moving Vehicles

So why are we so anti-network outside of cities?

i.e. Build larger Intersection vs smaller Intersections?

Signal phasing

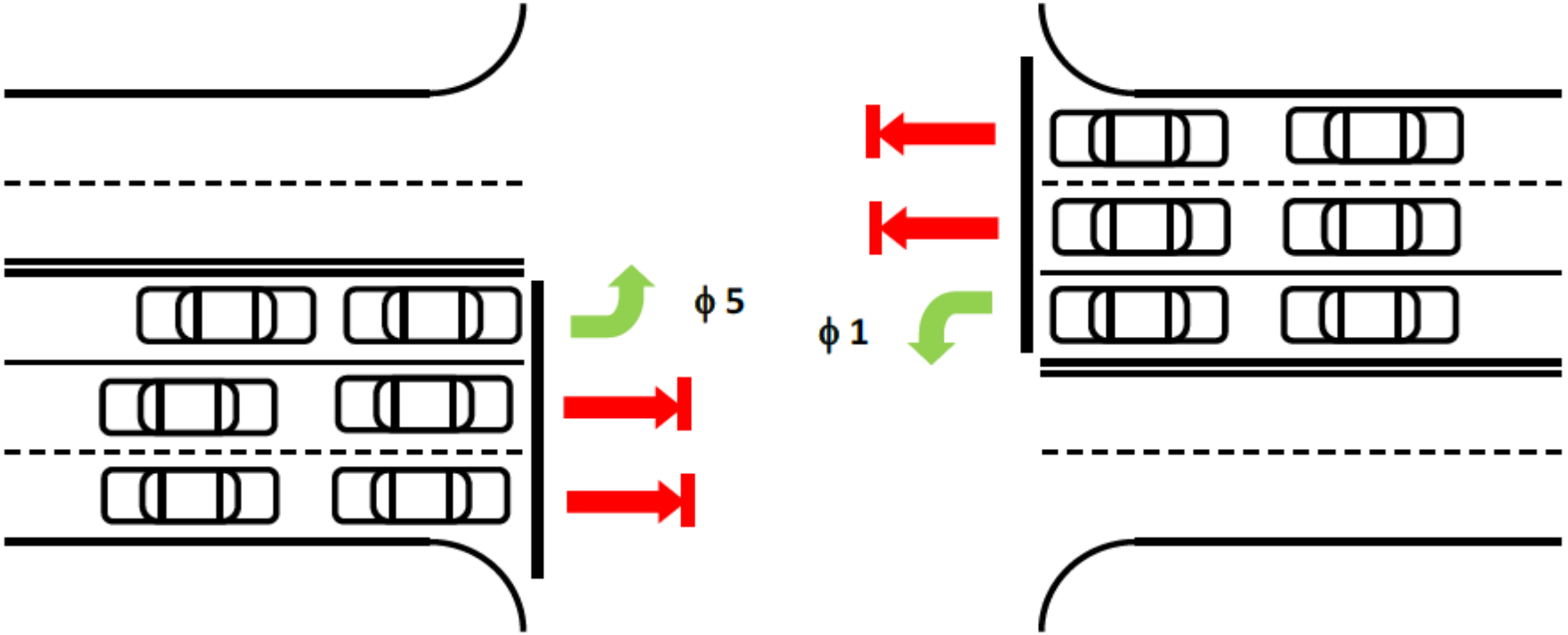


Basic two-phase signal operation

Source: MnDOT Traffic Signal Timing and Coordination Manual

Signal phasing

Adding “protected” left-turn phases is common as volumes increase



Source: MnDOT Traffic Signal Timing and Coordination Manual

Signal phasing

Adding more phases essentially “steals” time away from the major through movement and can increase intersection delays

Signal phasing

4 Phase Signal				
	Minor Street	Minor Street	Major Street	Major Street

Strategically relocating movements to reduce phases can provide more green time to through traffic

Fewer phases – GOOD / Left turns - BAD

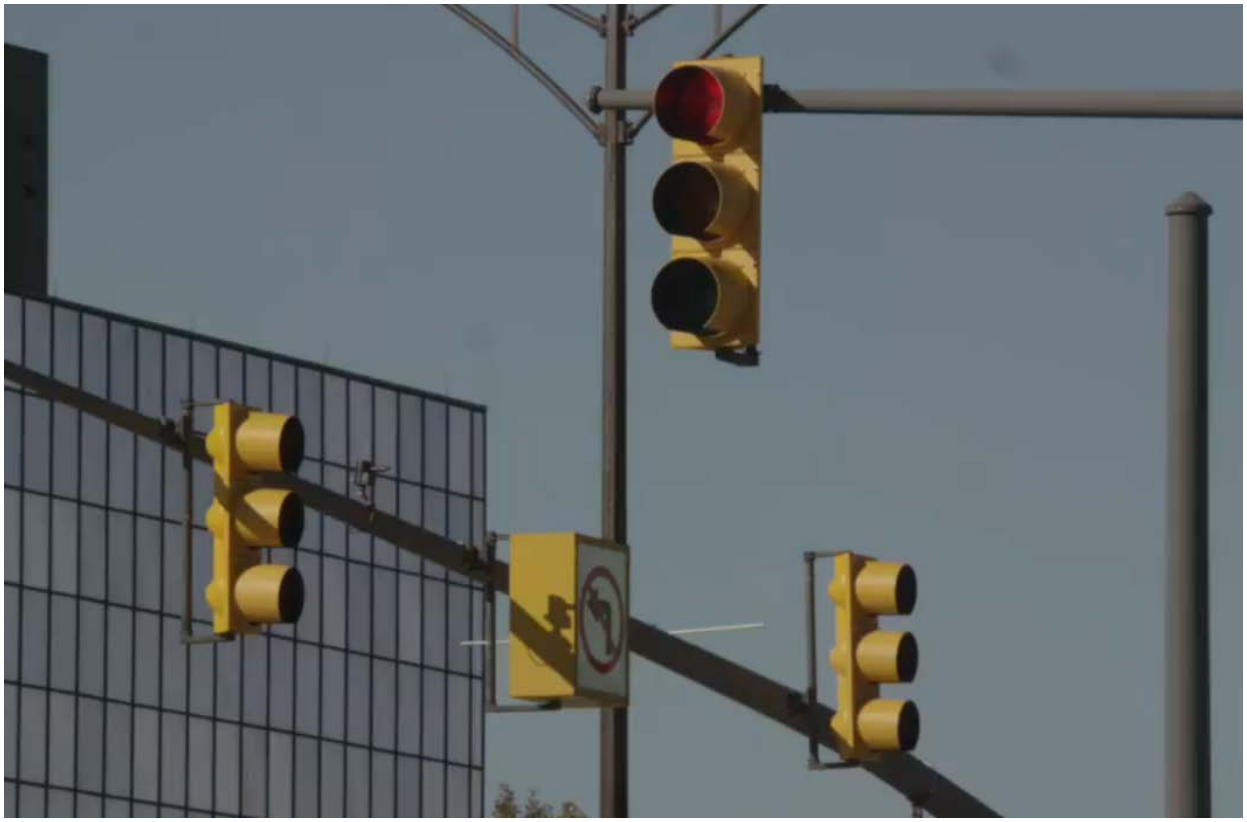
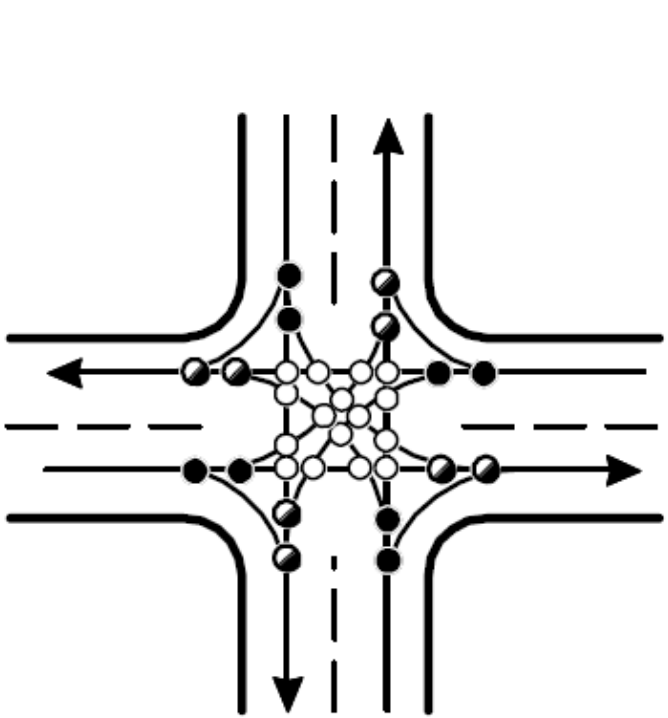
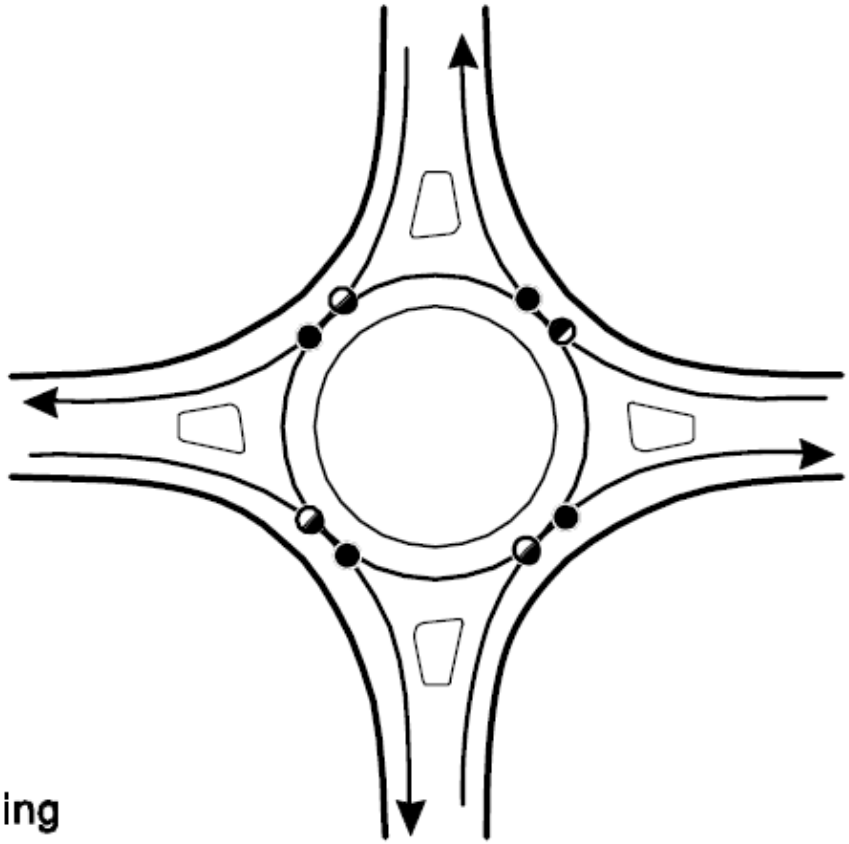


Photo: 2-Phase operation at a Median U-turn Intersection

Conflict Points Reduced and Spread Out





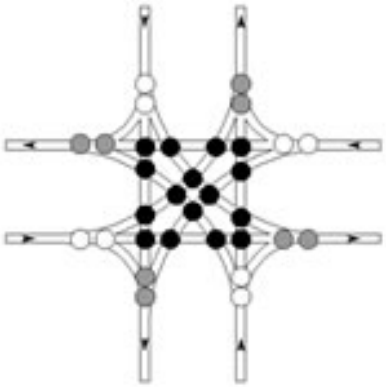
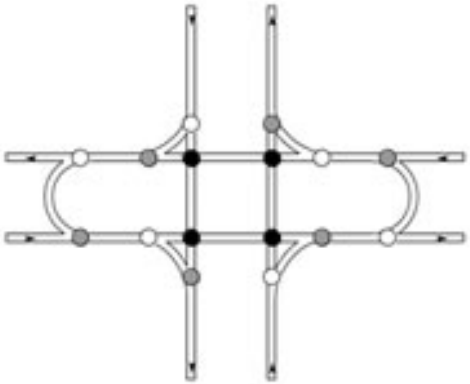
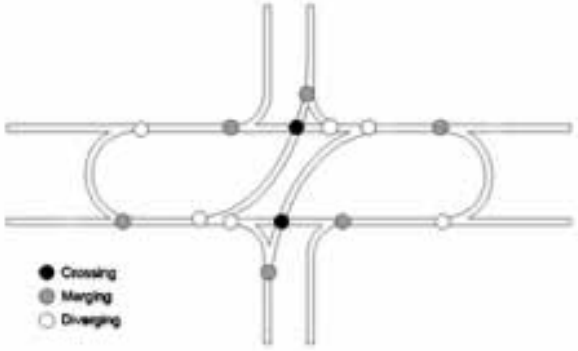
Diverging
Merging
Crossing

32 Conflicts

8 Conflicts

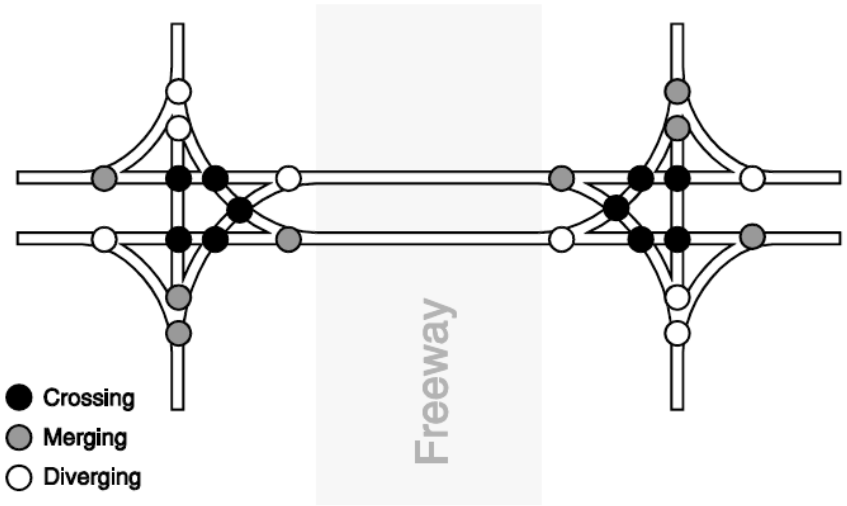
Source: NCHRP Report 672

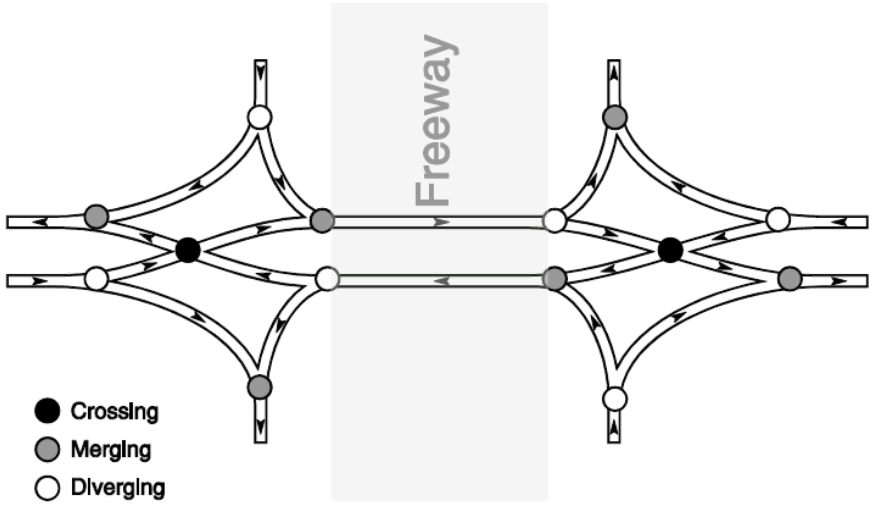
Conflict Points Reduced and Spread Out

Vehicle-Vehicle Conflict Points	Conventional	MUT	RCUT
● Crossing ● Merging ○ Diverging			
Crossing	16	4	2
Merging	8	6	6
Diverging	8	6	6
Total	32	16	14

Conflict Points Reduced and Spread Out

	Crossing	Merging	Diverging	Total
Conventional diamond	10	8	8	26
Diverging diamond	2	6	6	14





Principles of Innovative Geometric Design

H.Y.C.U.T.T.F.E.D.D.T.

1) One-Way Street Progression
   a) Lead-Lag Left
   b) Partial Median Openings
   c) Convert to One-Way Pairs when Practical
2) Creating Mini-Networks of Smaller Intersections
   a) Strategic Mini-Network for Access Management
   b) Smaller T-Intersections over one 4-legged
   c) Separate Right Turns

Principles of Innovative Geometric Design

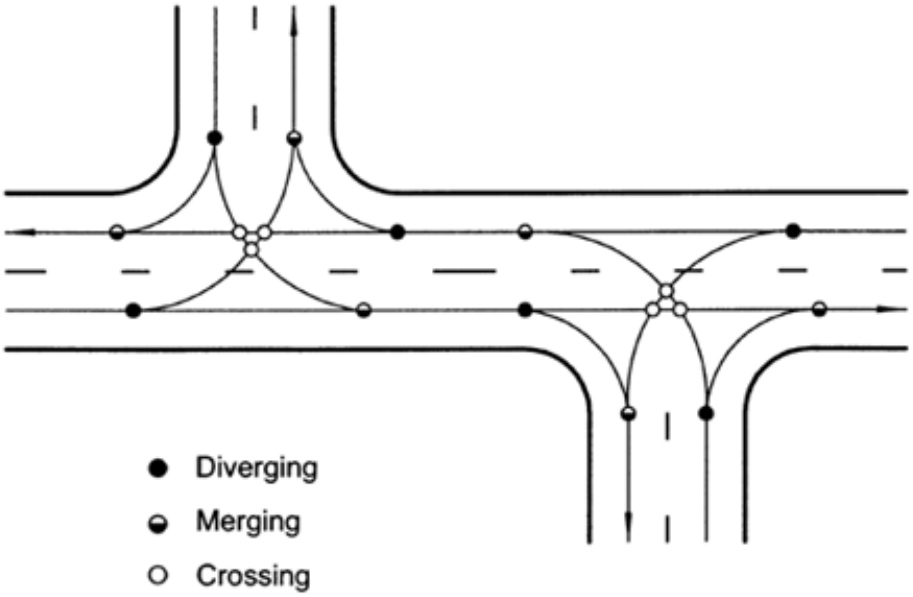
H.Y.C.U.T.T.F.E.D.D.T.

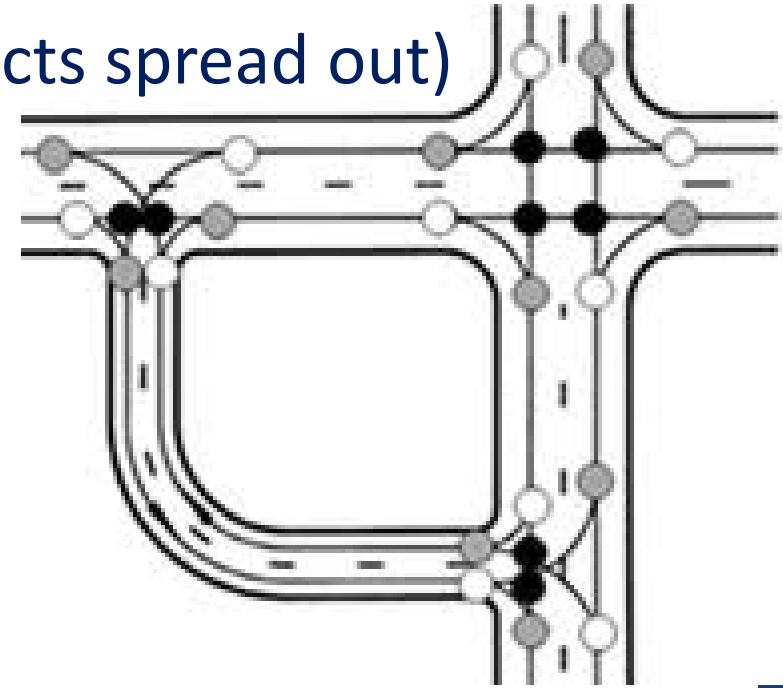
3) More Efficient Signal Phases (when signalized)
   a) T-intersections max out at 3 phases
   b) Eliminate Left Turn Phasing when Possible through other alternatives
   c) Strategize Signal Spacing based on Speeds and Cycle Lengths

Principles of Innovative Geometric Design

H.Y.C.U.T.T.F.E.D.D.T.

4) Conflicts Reduced and Spread Out
   a) Two T-intersections 18 Total Conflict Points, 6 Crossing
   b) Alternative Left Turn Options within an Existing Network (30 conflicts spread out)





Final Thoughts

- Congestion can be addressed by adding capacity, reducing demand, and improving traffic flow
- Designs work a lot better when we integrate geometry with traffic operations at the same time
- Can be in the form of an Innovative Intersection
- Can be in the form of more conventional design with more innovative thought
- Industry as a whole needs more “cross-training” over “specialization”

Contact Information

Questions???

Gilbert Chlewicki, PE –

Advanced Transportation Solutions

gchlewicki@ats-american.com

301.395.9971