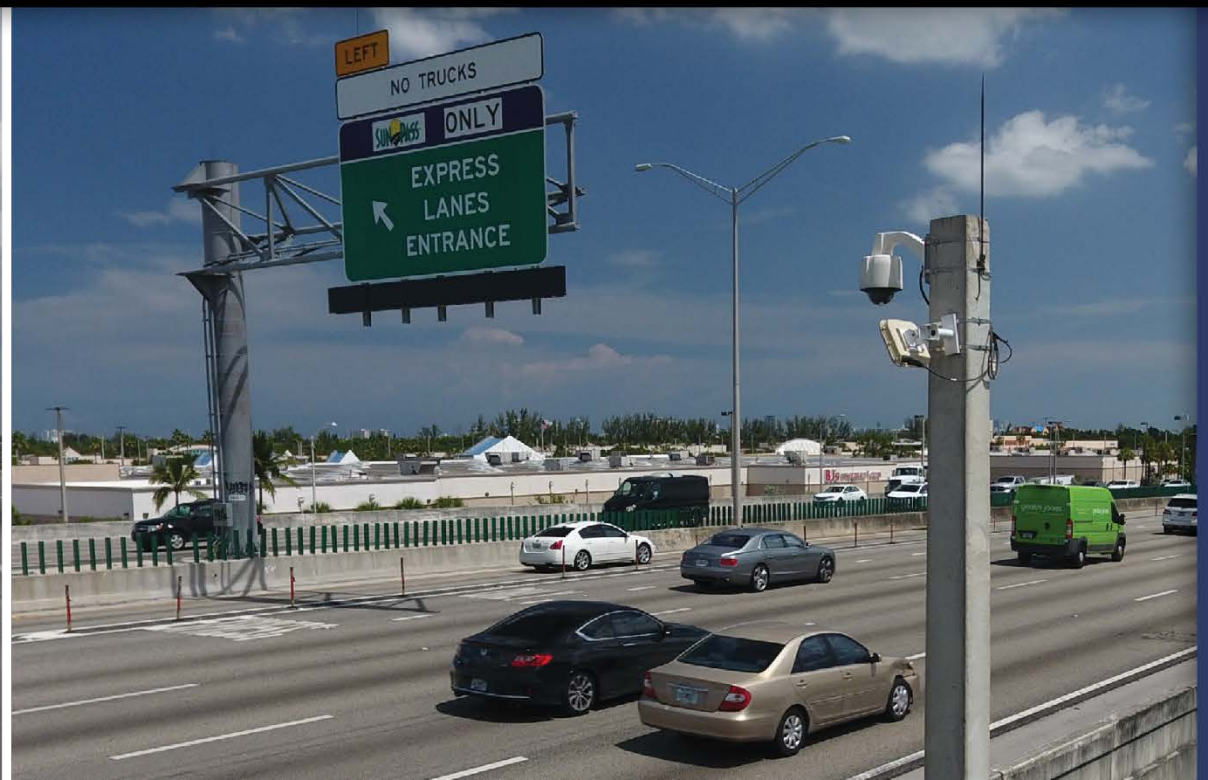
Traffic Engineering 101



Presenter:
Dale W. Cody, PE, PTOE
Senior Vice President
Metric Engineering, Inc.

Presented to: MetroPlan Orlando's Community Advisory Committee (CAC)

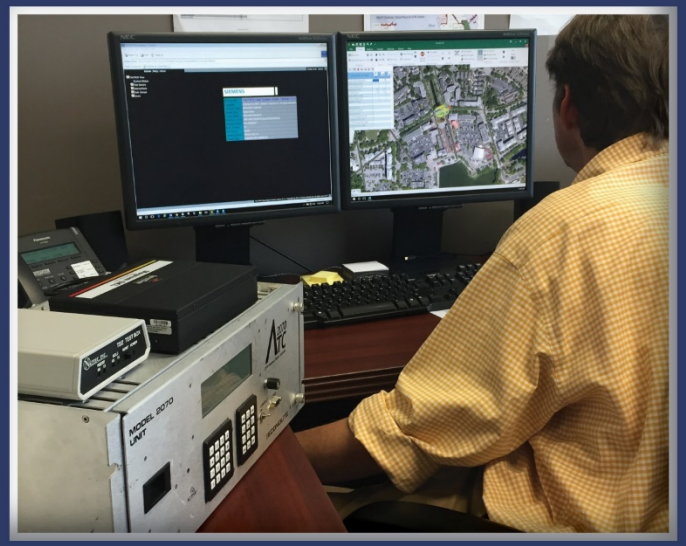
Date: February 26th, 2020

Meet the Presenter!

- Dale W. Cody, PE, PTOE
  - Metric Engineering, Inc.
  - Senior Vice President of Production
  - 22 Years of Experience
  - Certified Professional Engineer (PE) in eight states
    - Florida / Georgia / Alabama / South Carolina / Kentucky / Tennessee / Mississippi
  - Certified Florida Professional Traffic Operations Engineer (PTOE)
  - A former Florida Department of Transportation (FDOT) District 5 Assistant District Traffic Operations (ADTOE)
  - Hands-on experience in all aspects of ITS, transportation planning, traffic signal systems communications, traffic engineering/studies, and more
  - Served as Project Manager/Principal-In-Charge for 100+ ITS/Traffic Operations projects/contracts

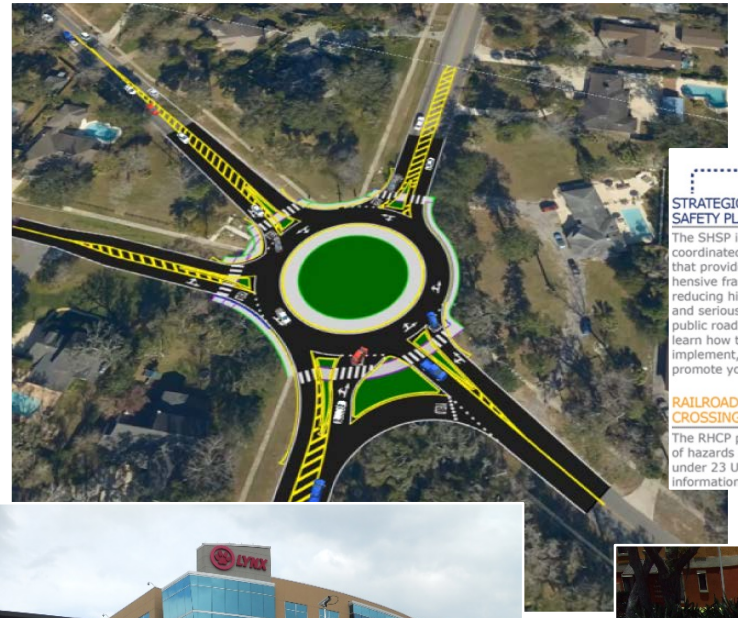
Trusted advisor on “all things transportation”
Traffic Operations, ITS, CV/AV Planning…

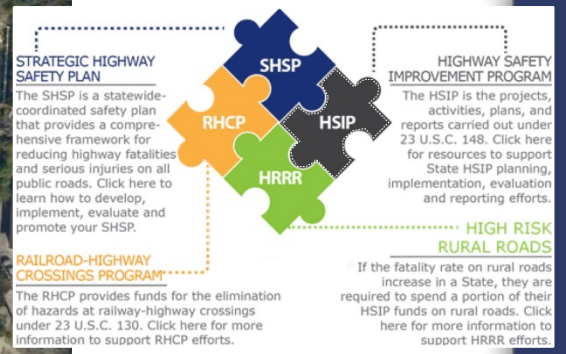
Traffic Engineering

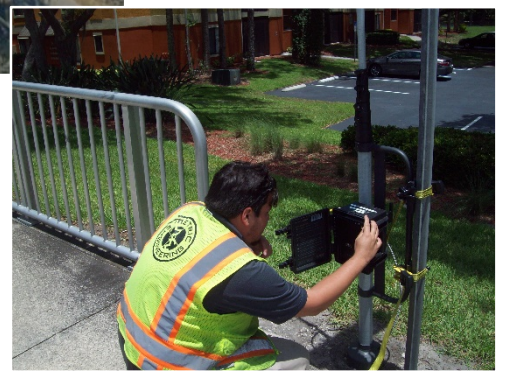


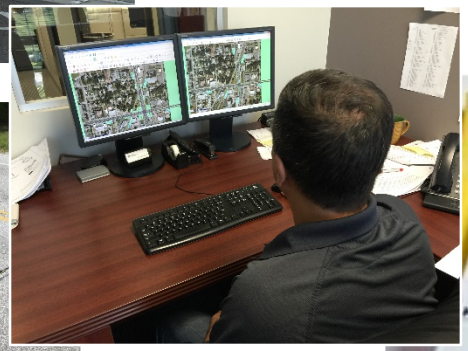
Traffic Engineering

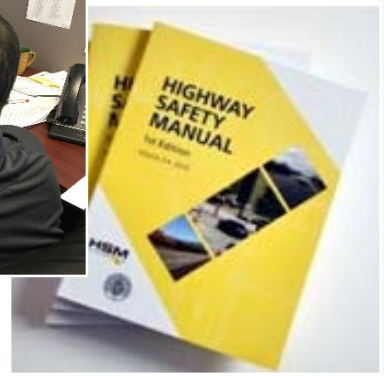
- Data Collection
- Traffic Studies
- Traffic Operations Design
- Traffic Modeling & Simulation
- Signal Retiming
- ATMS
- TSM&O
- Innovative Intersection Design
- Performance Measures







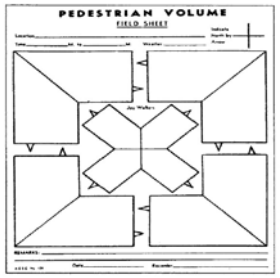


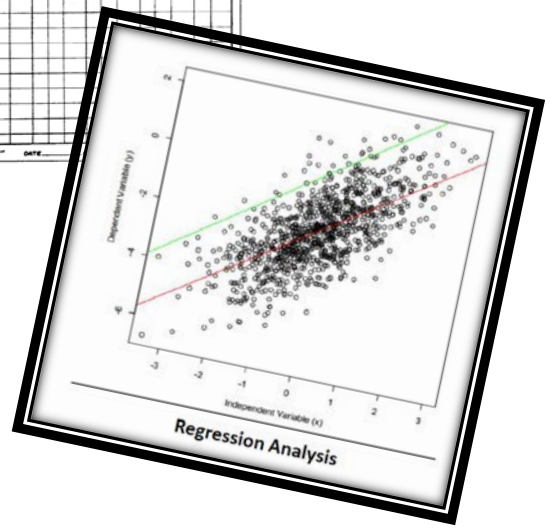


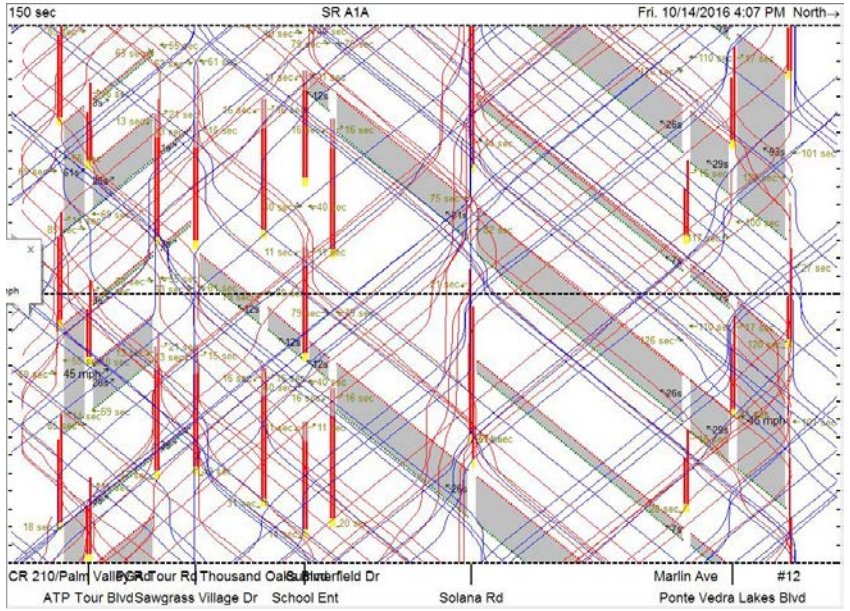
Traffic Engineering

Data Collection

- Includes:
  - Traffic Counts
    - Turning Movement Counts Pedestrian/Bicycle Counts
  - Before and After Travel Times
- Done manually with hand counters by people observing intersections
- Can also be done with MioVision cameras from the office
- New technologies have revolutionized collecting, analyzing, and appropriately documenting complex and unlimited data
- Geographic Information Systems (GIS) makes it possible to map the data gathered!





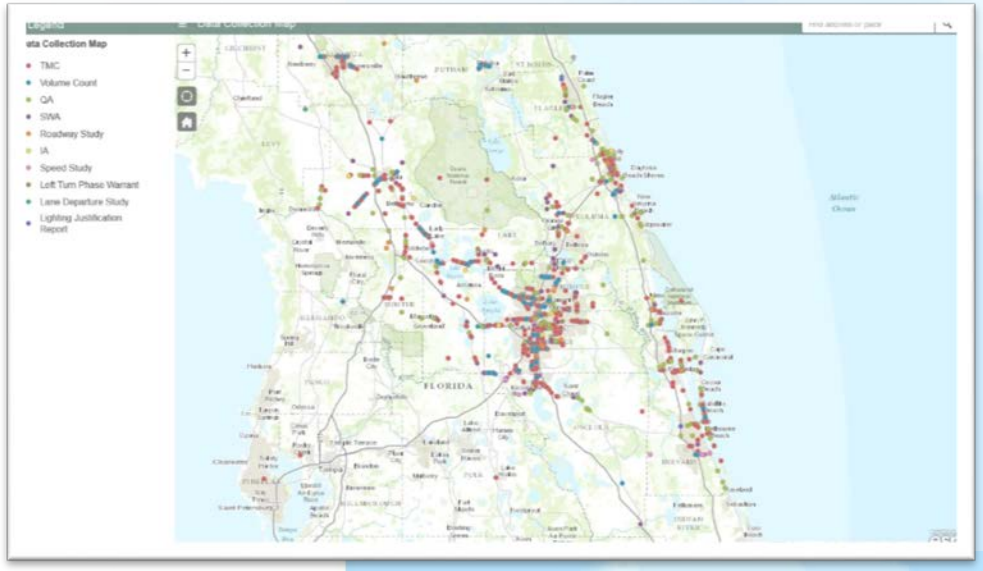


Traffic Engineering

Traffic Studies

- Traffic Impact Studies
- Safety/Operational Studies
- Travel Time & Delay Studies
- Before/After Studies

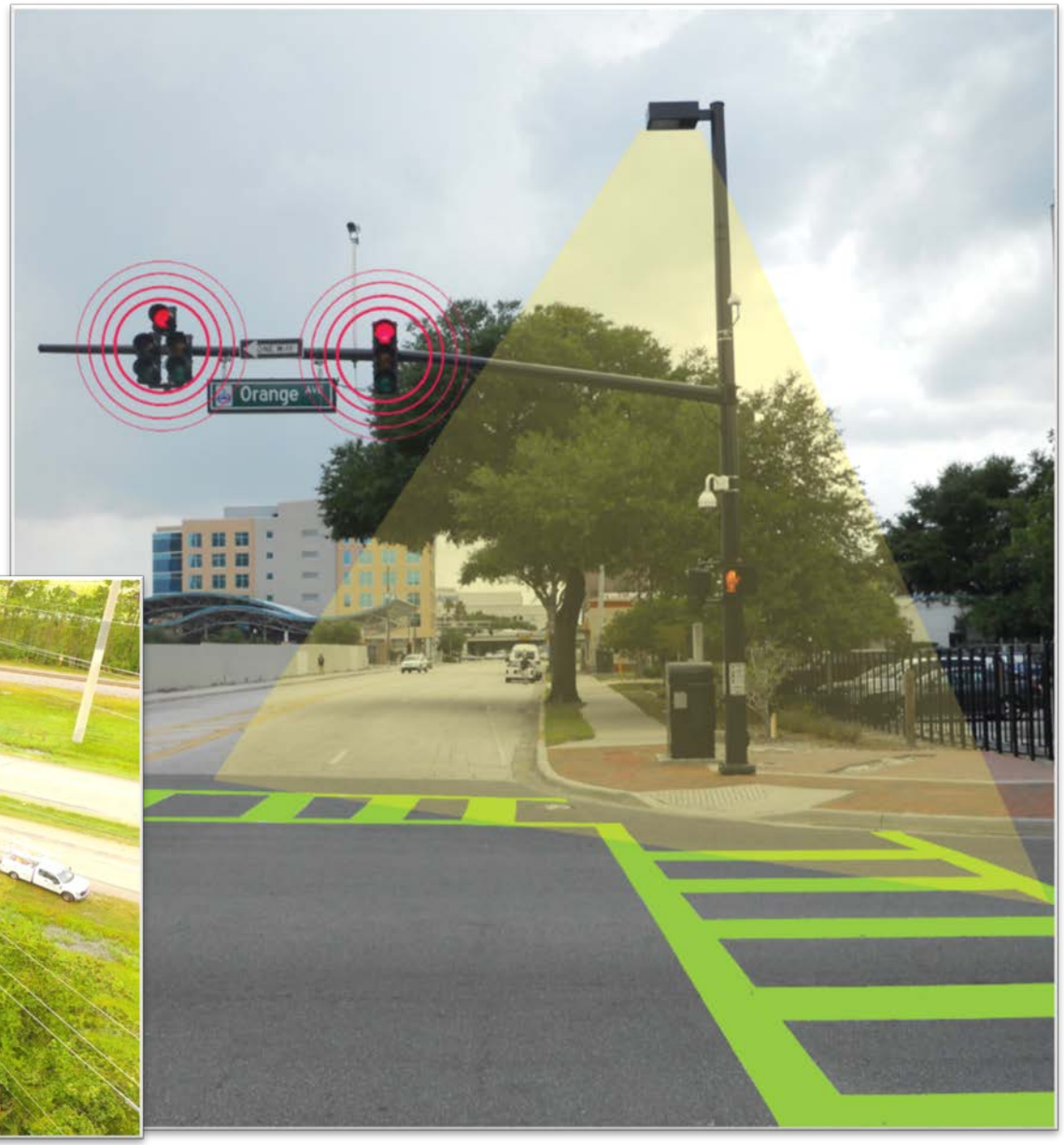
Involves heavy data collection!

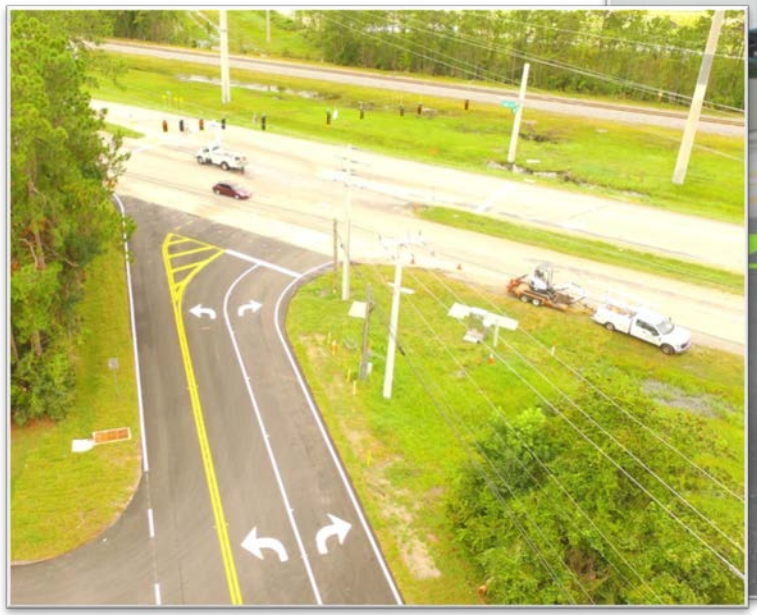


Traffic Engineering

Traffic Operations Design

- Signals
- Lighting
- Signing & Pavement Marking (S&PM)
- American Disabilities Act (ADA)





Traffic Engineering

Traffic Modeling/Simulation

- Simulation of transportation systems and **used in traffic engineering and transportation planning** such as:
  - PD&E Studies
  - Roundabouts
  - Downtown grid systems
  - Arterial Routes
  - Freeway junctions
  - Transit and more….

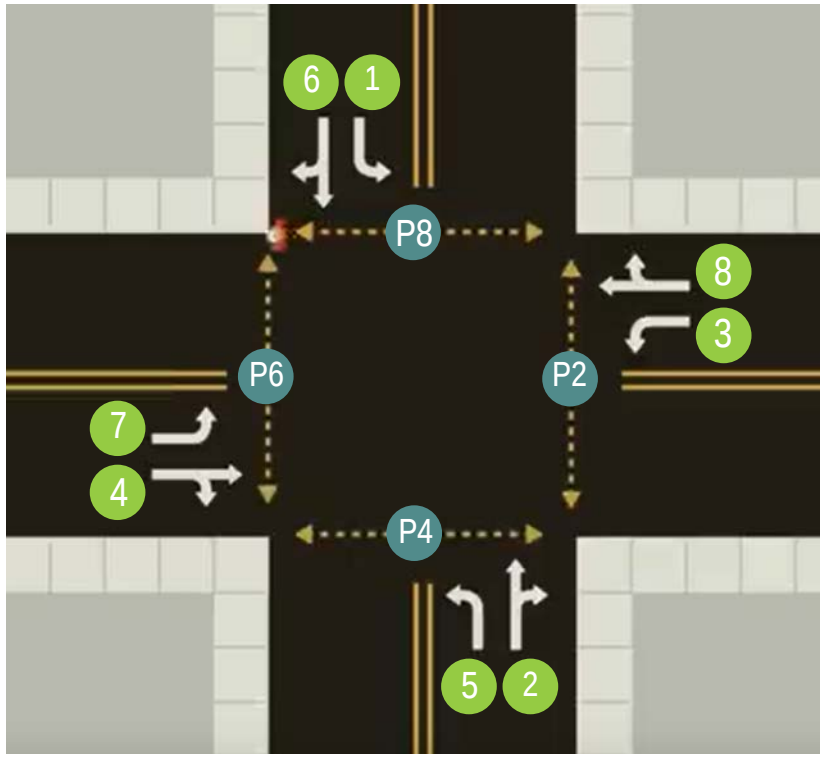
- Mathematical modeling of transportation systems through the **application of computer software** to better help plan, design, and operate transportation systems

Traffic Engineering

Traffic Signal Retiming

Traditional: Set Timing Sequence

- Each intersection has three movements
  - Right, Thru, Left
  - Common for Right & Thru to be combined; making two movements per approach
- This means there are a total of Eight (8) Vehicle movements in addition to Four (4) Pedestrian movements
- Movements are grouped into Phases (i.e. both lefts go at the same time)



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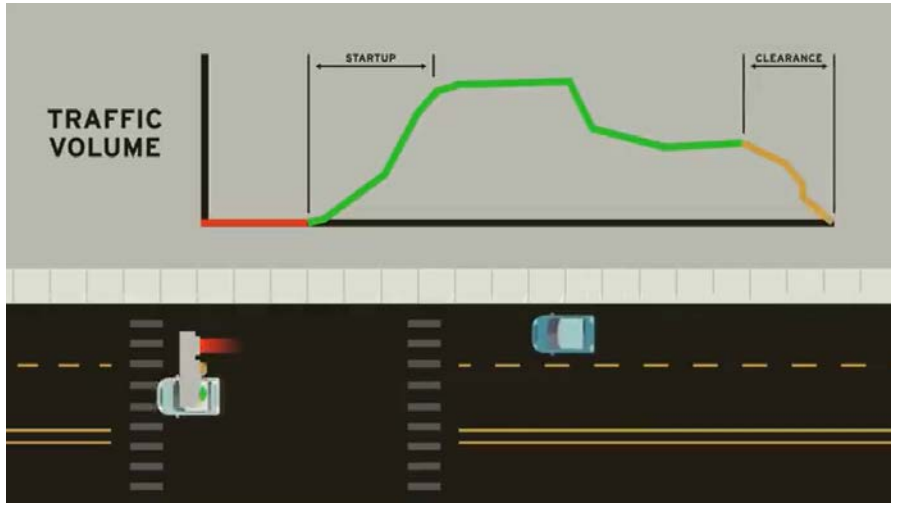
Traffic Signal Retiming

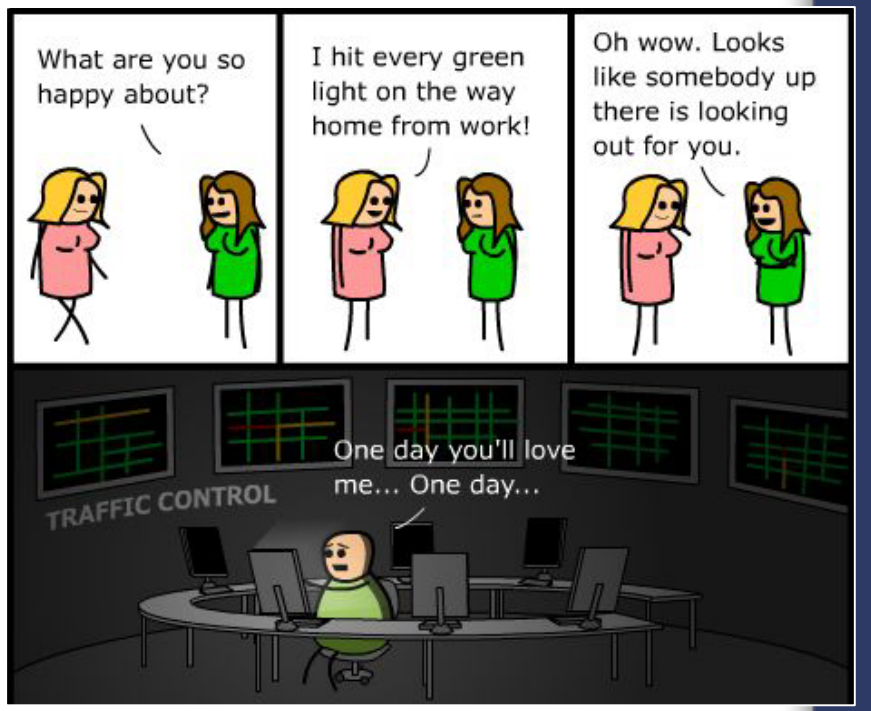
- Important considerations of an intersection:
  - Use of protected or unprotected left turns
  - How long green should be held to clear build-up during the red light
    - Not always possible at Peak periods when traffic is at its highest for the day
    - During saturated times, the green light is extended to account for start-up and clearance times (when the intersection is not being used at its highest capacity)
  - Yellow needs to be long enough to allow motorists to decelerate in preparation to stop
  - Intersections need Clearance Times – the time between the yellow and red to allow for traffic to vacate the intersection



Traffic Engineering

Advanced Traffic Management Systems (ATMS)

- Integrates technology to improve the flow of traffic and improve safety – focused on arterial/signal systems
- Traditionally:
  - Isolated and Coordinated Signal Systems (Retiming)
  - Emergency Preemption
  - Basic Signal System Maintenance
- Progressively:
  - ITS Systems (CCTVs, Detectors, DMSs, etc.)
  - Adaptive Systems
  - Transit Signal Priority



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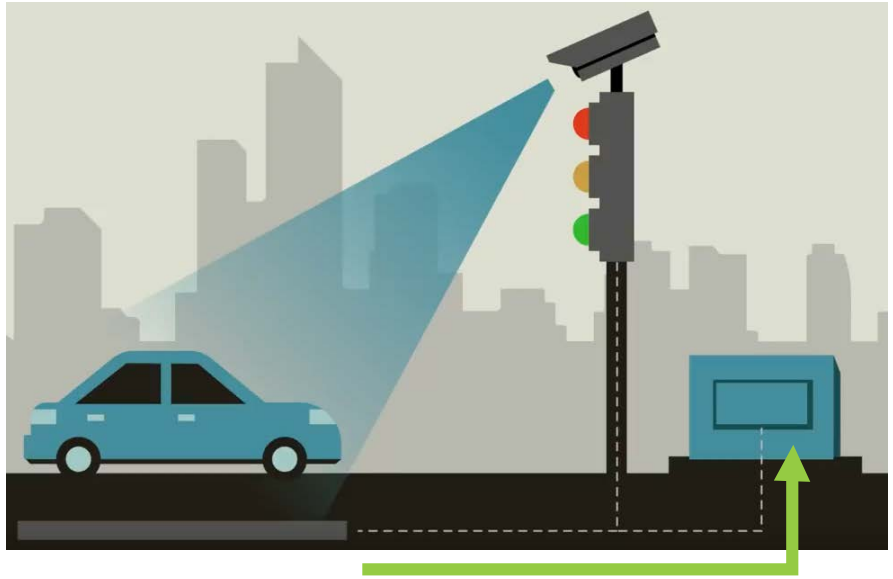
Adaptive Traffic Signal Control

- "Actuated" signals that can receive input from the outside and use that information to make sequence changes in real-time
- Equipment needed:
  - Data from traffic detection systems
    - Sensors, Radars, or Loops
    - **Loops** are basically large metal detectors that can tell when a car is at the intersection
  - Signal Cabinets with traffic signal controllers which help time phases for the intersection



*Data from **traffic detection systems** is sent to the **signal cabinet(s)** located at each intersection*

For More Information on Traffic Signal Retiming:

YOUTUBE: How Do Traffic Signals Work?

https://www.youtube.com/watch?v=DP62ogEZgkI

- *Traffic Signal Retiming Info = Minutes 3:55 – 7:34*

Traffic Engineering

Transportation Systems Management & Operations (TSM&O)

- TSM&O is a systemic, performance-driven approach to improve safety, manage congestion, and maximize highway operations
- Basically, **strategies that use technology to leverage existing roadway infrastructure** (i.e. signals, etc.)

What does TSM&O do for us?

- **Detector Failures:** Identified immediately so they can be fixed/replaced
- **Incident Management:** Ensure safety of motorists and first responders
- **Surveillance:** CCTVs allow operators to view roadways and incidents in real-time
- **Evacuations:** Arterials are often greatly under-utilized and will require improved operations

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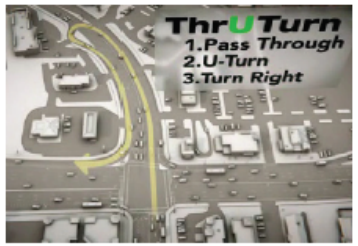
CONTINOUS FLOW INTERSECTIONS

How they work: At a traditional intersection, through traffic must wait while left turns get their "arrow." The magic of a CFI is that it allows opposing lefts and throughs to occur at the same time using one signal at the main intersection, and up to four interconnected mid-block signals (one for each leg that has the CFI strategy). For example, while east-west traffic is moving, lefts on the north-south street cross-over oncoming traffic at a mid-block intersection. Then when north-south signals turn green, both through and left movements can go at the same time, because lefts are already on the opposite side of the throughs. It looks complex, but has proven simple for drivers to understand. Controlled simulations suggest that CFIs can reduce intersection delay between 20-90%, depending upon conditions at the site. Capacity or throughput also increases by 15-30% or more. Costs are expected to be about 25-50% higher than building a traditional intersection, excluding right of way costs.

TOWN CENTER INTERSECTIONS

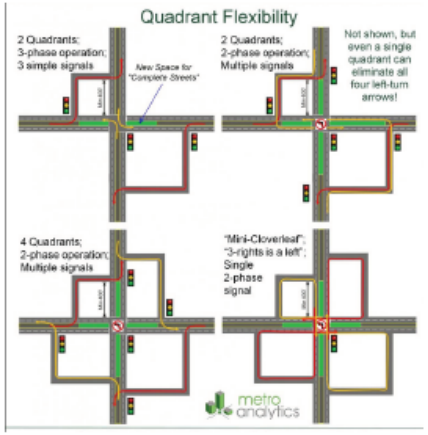
How they work: The TCI, also known as a Split Intersection, is an intersection where one or both of the streets involved are a one-way street. Where two major arterials come together and would have normally formed a single massive, unwieldy intersection, the Town Center concept instead separates each arterial into one-way couplets, creating four small, efficient, easily manageable intersections of one-way streets that merge back to a two-way street a block or two upstream. A TCI can also involve a "triplet", which is an alignment between the couplets, perhaps used as a pedestrian mall or for transit, bikes, and on-street angle parking.

THRU-TURN INTERSECTIONS



How they work: In the diagrams, some lefts are completed as "right-U-through." Others are "through-U-right." Either way, the result is that the former left turn pocket is no longer needed, so fill it with a transitway, or whatever Place-Making architects can dream up! And since there are no left-turn arrows, the intersection can handle more traffic with significantly less delay, and it is also much easier for pedestrians to cross.

QUADRANT INTERSECTIONS

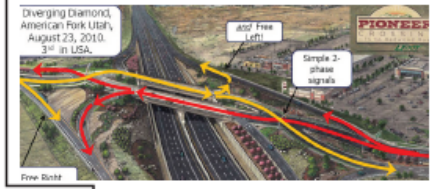


How they work: Quadrants make it easier and safer for pedestrians to cross, and they also make it possible for cars to access buildings from the back street, so you can eliminate driveways. Advantages are: Up to 40% more capacity; Level of Service B-D rather than E-F; former lefts reclaimed for center-running transit; pedestrian refuge, etc.; safer for both autos and pedestrians; expands grid connectivity; enhances and motivates TOD; often very low cost; easy access to retail; back-side auto access; compatible with traditional signals. Disadvantages: Initial confusion for drivers; resistance when adding traffic to existing residential backway; potential out of direction travel.

Innovative Intersection Design

- See Handout Provided

DIVERGING DIAMOND INTERCHANGES

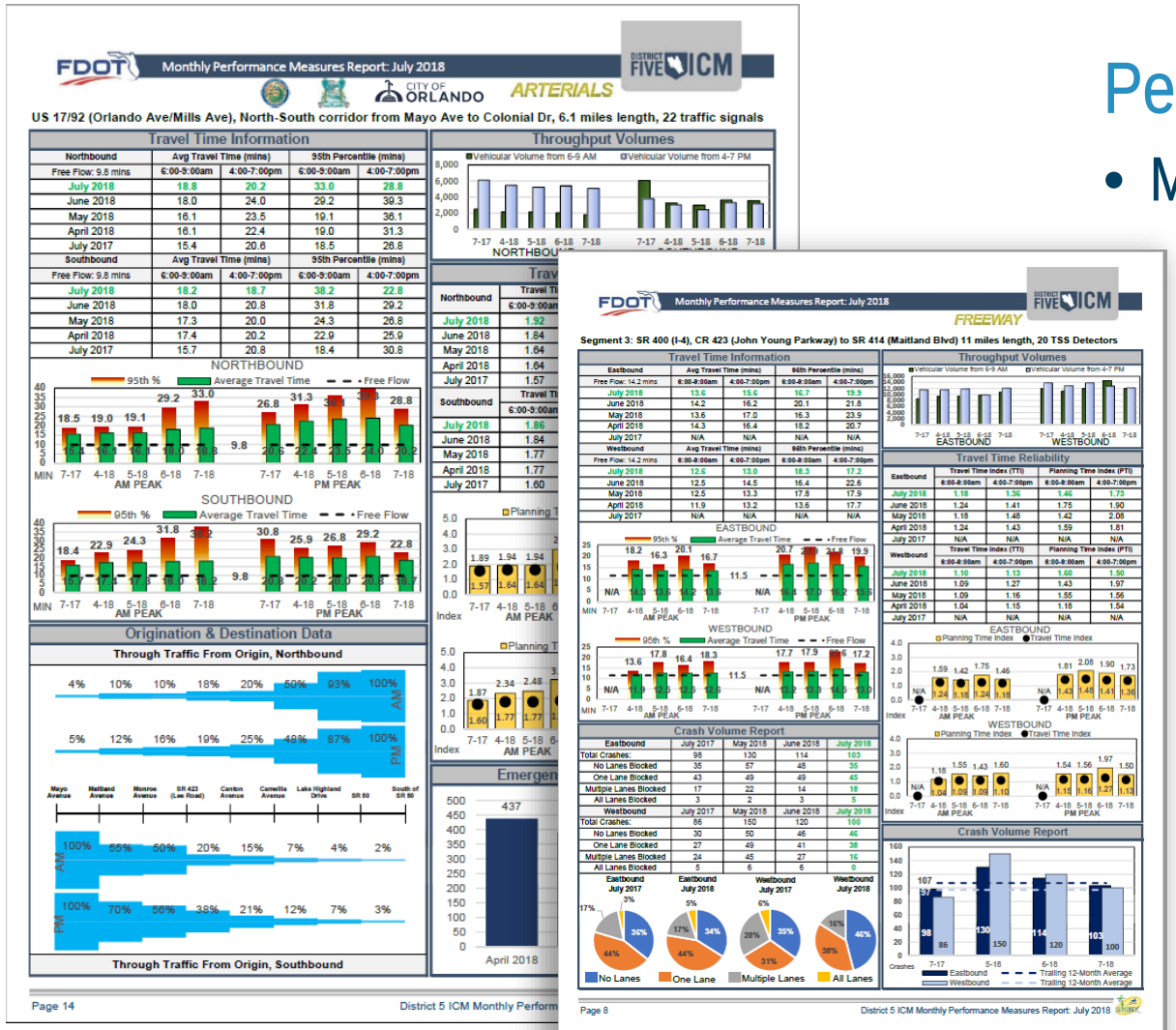


How they work: The Diverging Diamond is based on the idea that if you can eliminate the need for left-turn arrows, then signals will have maximum efficiency, fewer conflict points, and be able to serve more traffic with better safety and less congestion.

MODERN ROUNDABOUTS

How they work: The first few modern roundabouts were able to solve awkward intersections that were previously unsolvable, helping them earn a great reputation. With planters and monuments, they are attractive and help create a sense of place. They also calm oncoming traffic, which combined with far fewer conflict points, and have helped them prove to be very safe intersections for both vehicles and pedestrians.

Traffic Engineering



Performance Measures!

- Monthly Dashboards that show:
  - Benefits
    - Delay Savings
    - Emission Reductions
    - Fuel Consumption Savings
    - Safety Benefits
  - System Health
    - Device Operability
  - Travel Time Reliability Measures
    - Average Speed
    - 95th Percentile Travel Time
    - Travel Time Index
    - Buffer Time Index

Performance Measure Reporting is important to report B/C to constituents for more funding!

Questions?

Thank you!