Transit Signal Prioritization (TSP)

A Path to Successful Implementation

April 18, 2013

SABRA, WANG & ASSOCIATES, INC.

Outline

- What is Transit Signal Priority (TSP)
- Benefits of TSP
- How TSP Works
- Cost of TSP Implementation
- Successful Implementation
- Implementing TSP in Montgomery County
- Implementation Factors
- Implementation Schedule

What is Transit Signal Priority (TSP)

TSP is a traffic signal operational strategy that is used selectively and conditionally to allocate priority passage for transit vehicles at signalized intersections.

Source: Streetsblog

TSP is conditional priority, not to be confused with Emergency Vehicle Preemption which is unconditional priority

Benefits of TSP

Improves travel time reliability and scheduling, reduces delay and emissions at traffic signals. May increase ridership and reduce transit operating costs.

Waiting at Traffic Signals represents an average of 15% of a bus's trip time[1].

Causes of signal delay include:

- Pedestrians Crossing
- Traffic volume-related delay/ queues
- Accommodating side-street traffic
- Multiple phases (e.g. left-turns only).

1. ("Overview of Transit Signal Priority." ITS America, 2004)

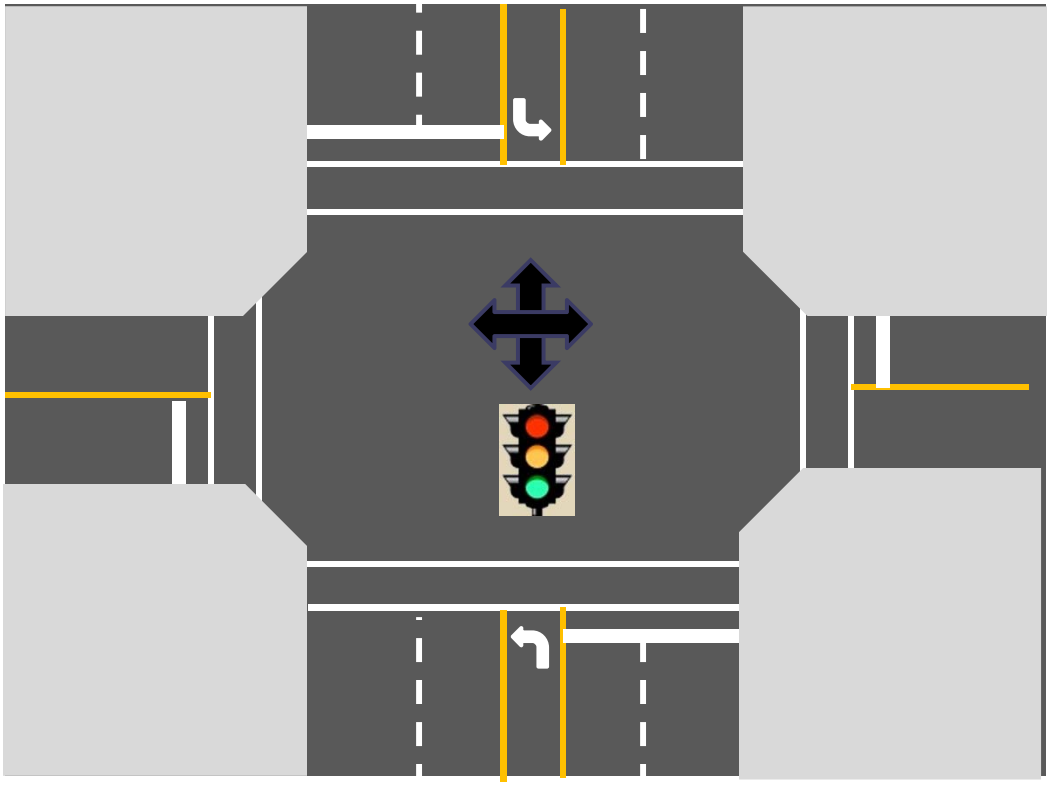
What TSP does not address

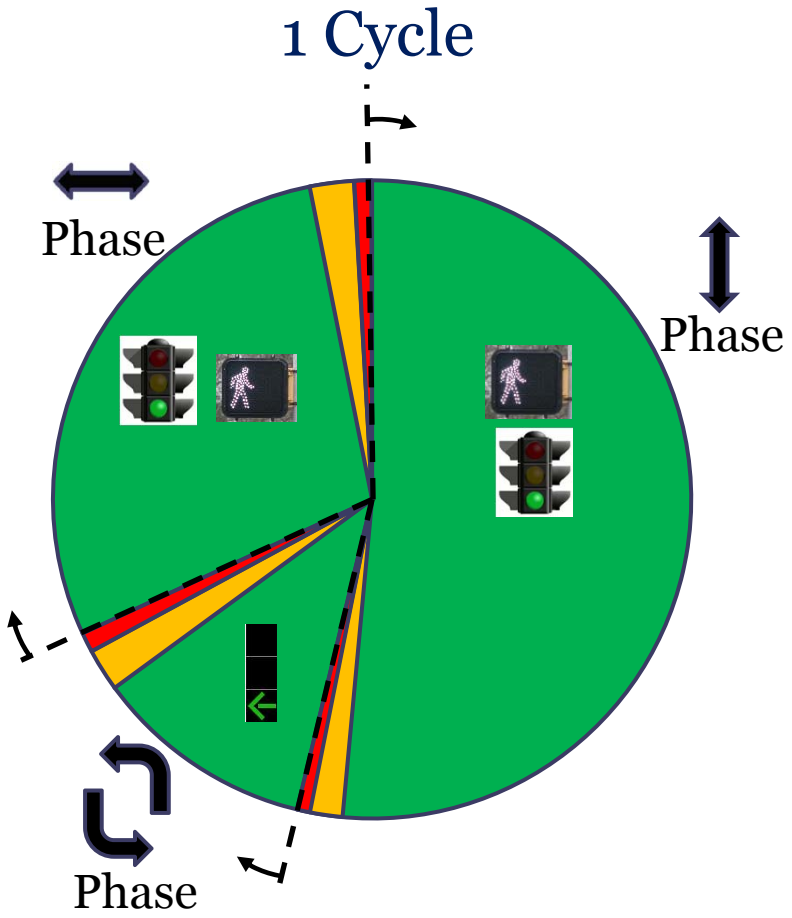
- Delay or travel time variability related to:
  - Lane merging
  - Crashes
  - Construction
  - Weather
  - Closely-spaced Bus Stops
  - Idling/Dwell Time

How TSP Works

Traffic Signals 101

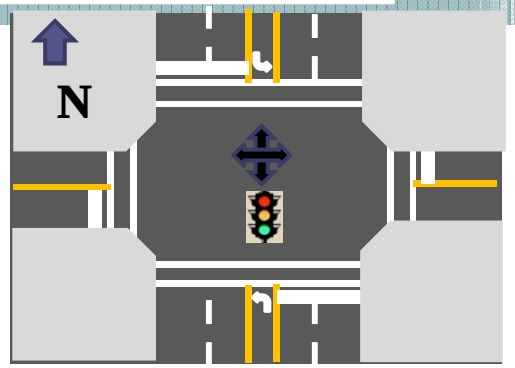
- A *Cycle* consists of multiple *Phases*
- Phases allocate time to movements competing for shared right-of-way
- Phase Length is a function of geometry, and vehicle and pedestrian volumes (demand)

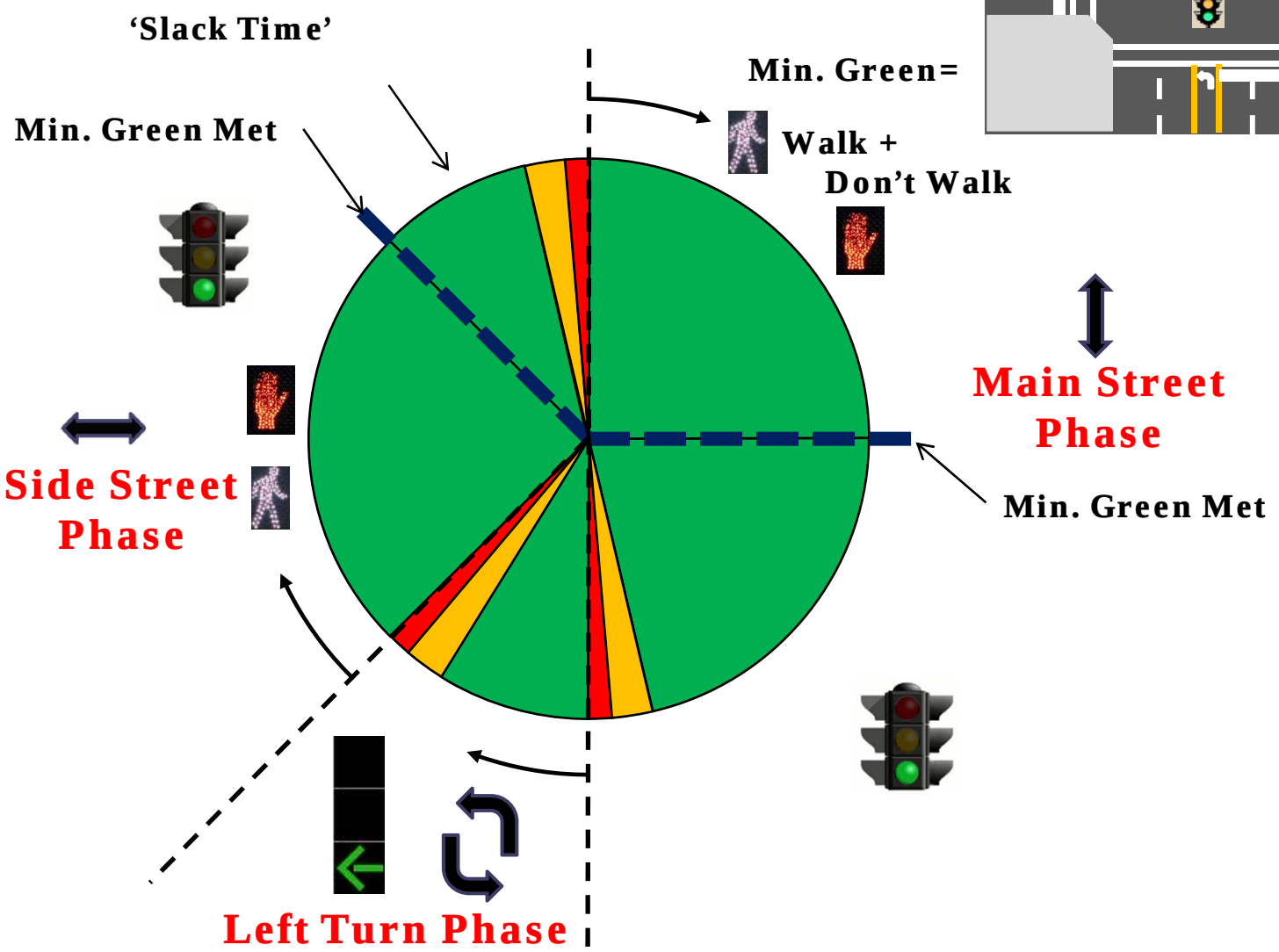




Cycle length is sensitive to many factors including coordination with adjacent signals; time of day; volume demand, and vehicle detection (e.g. loops)

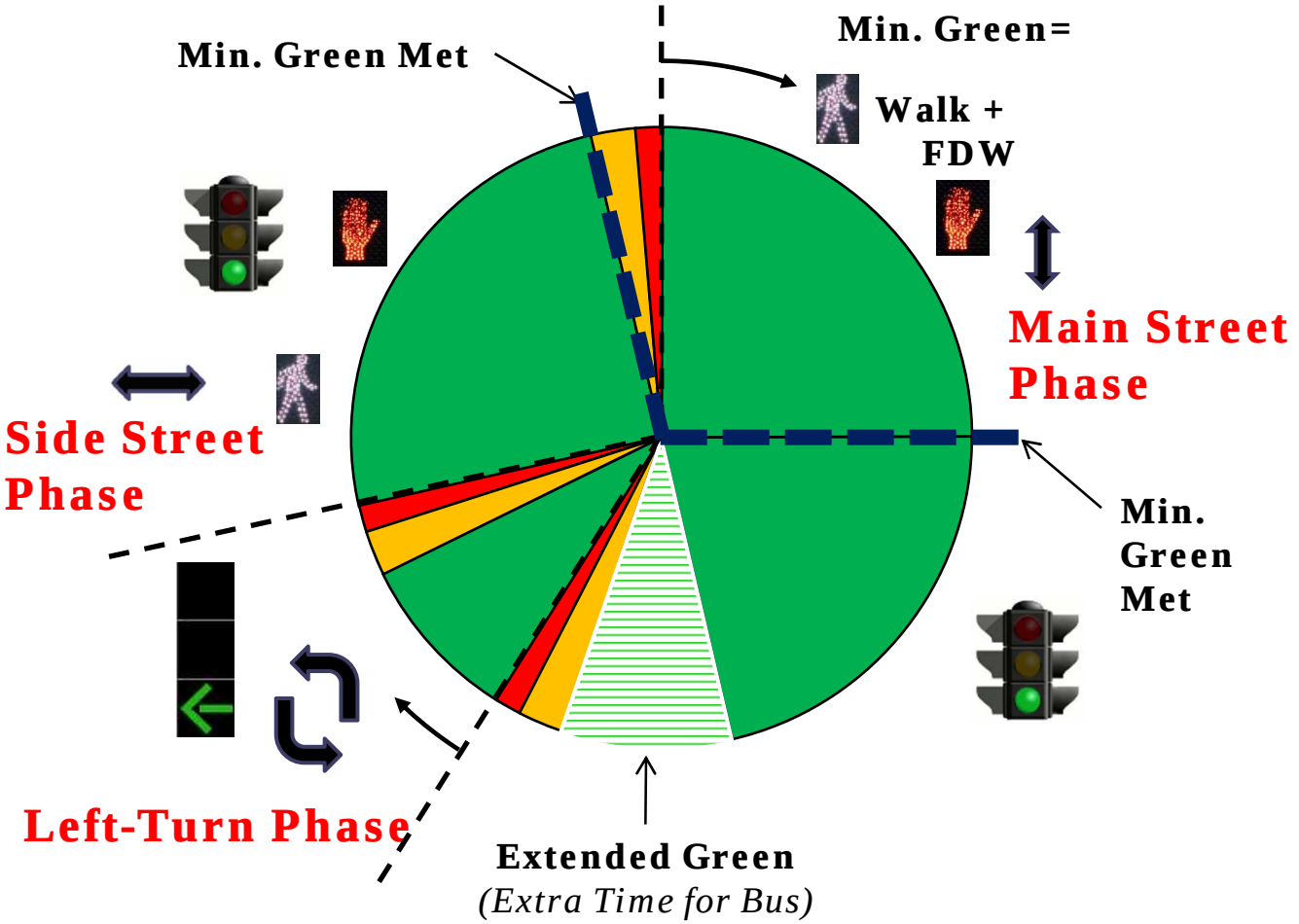
Signal Operations without TSP





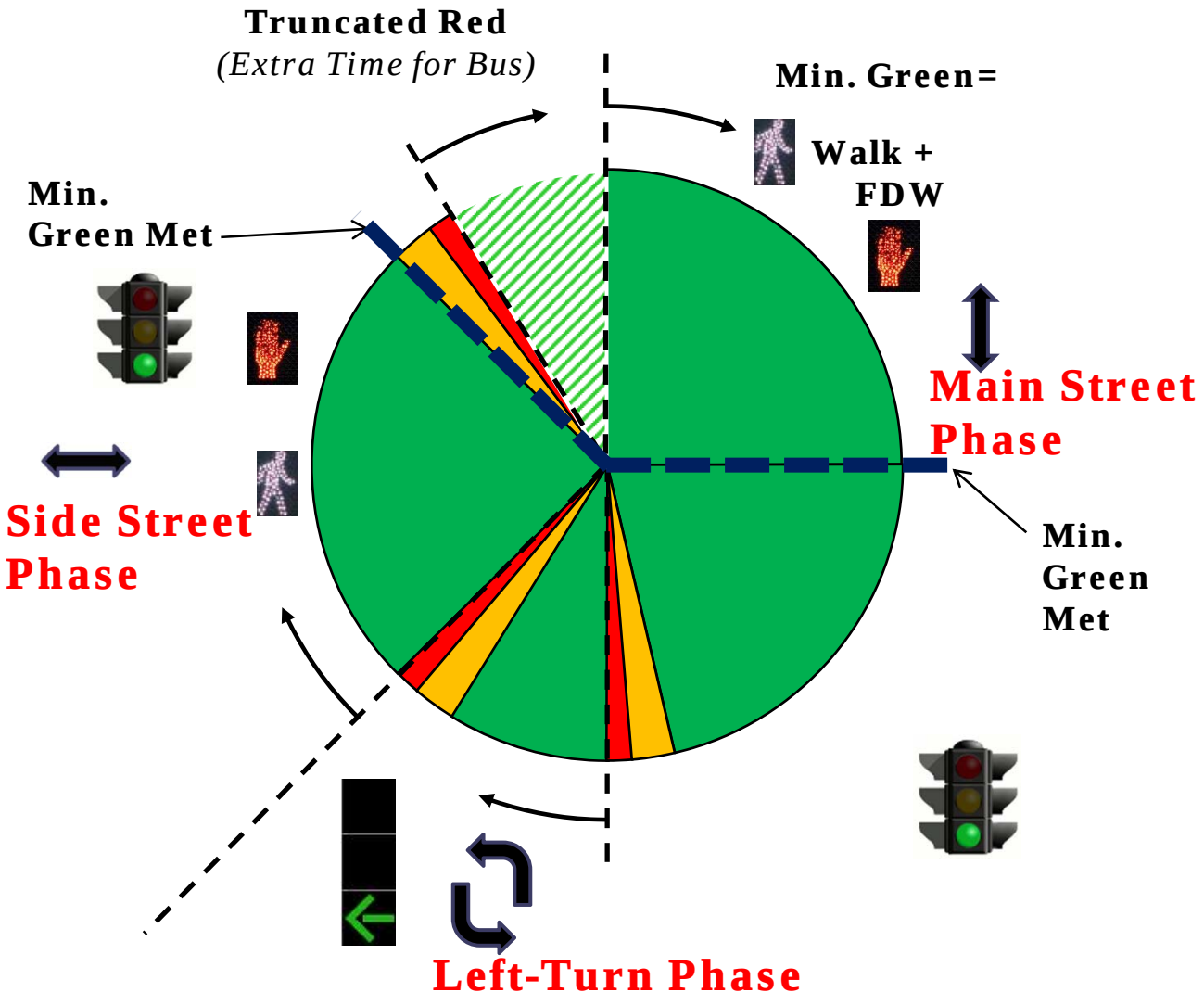
TSP Request when Main Street is GREEN

- If a bus is approaching toward the *end* of the Phase… **Extend Green.**



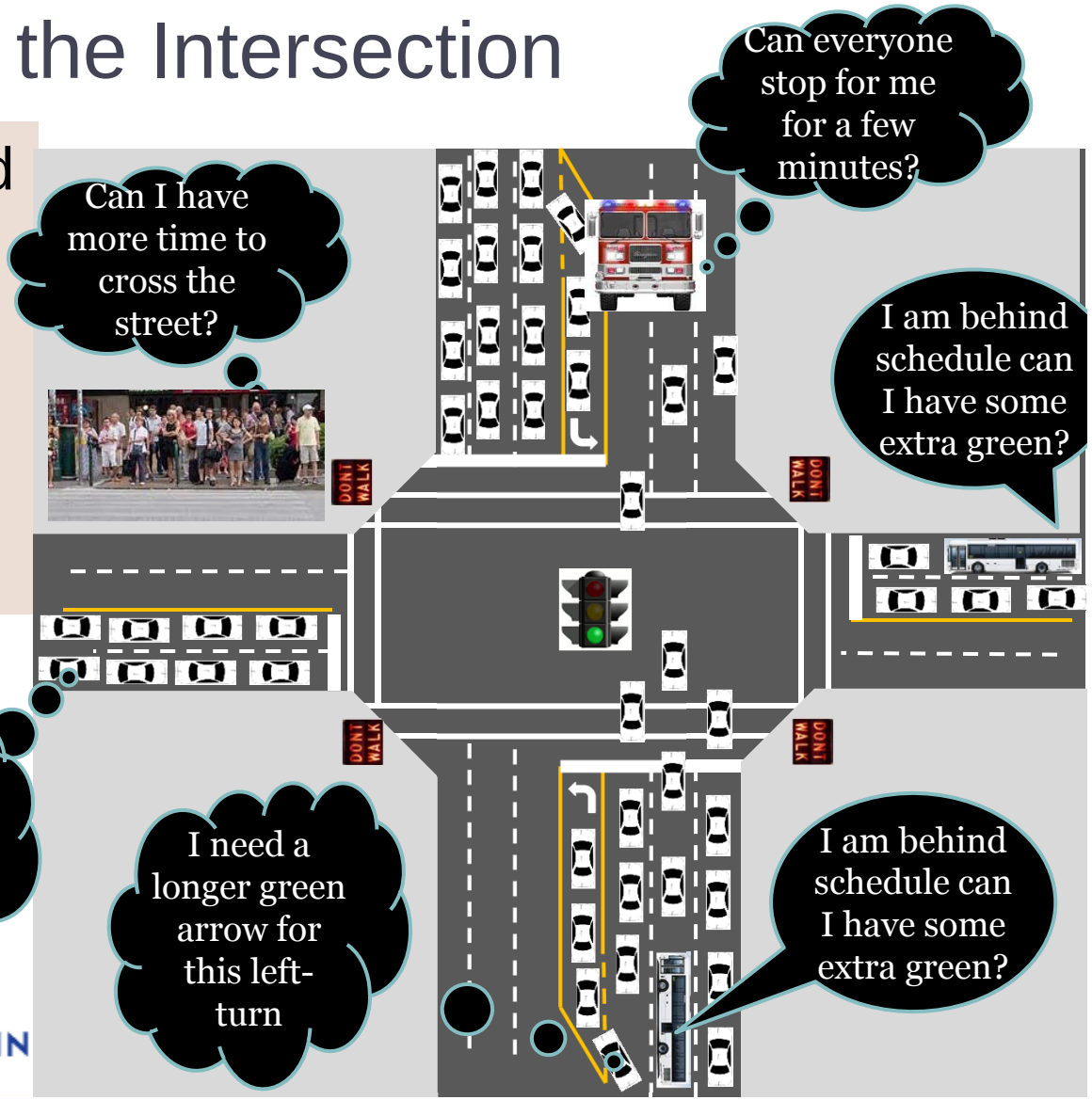
TSP Request when the Side Street is GREEN

- If a bus is approaching before the start of the main street green, EARLY GREEN ***if*** the side street has served the pedestrian Walk and Don't Walk minimums



What Happens to TSP with Competing Demands at the Intersection

- High Vehicular demand
- High Transit Demand
- High Pedestrian Demand
- Emergency Vehicle Pre-Emption

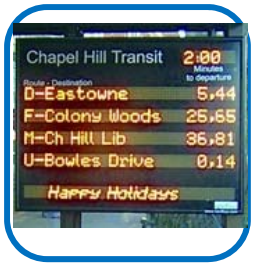


What else is usually Implemented with TSP to Increase its effectiveness?

- Geometric Improvements at intersections
  - ✓Queue jumps
  - ✓Exclusive Bus Lanes
- Signal Timing Optimization
- Transit Operational Improvements
  - Consolidation/ Relocation of bus stops
  - Schedule optimization
- Combination of above

Bus Operational "Tools" currently in use

Bus-Only Lane or Queue Jump



Next Bus

Off-board Fare Payment

Signal Priority

Signal Timing Optimization (all vehicles)

Bus Stop Consolidation

Has TSP worked Elsewhere?

- "Yes" when a systematic proactive process is followed and optimal conditions are selected.
- Most optimal conditions focus on intersections with
  - Level of service A-D
  - Not impacted by queues from upstream or downstream locations.
- "No" when installed without proper assessment and analysis of optimal conditions.

TSP Installations

- TSP has been implemented at select locations
  - LA; Portland; NYC; Salt Lake; Washington State; Florida; Charlotte; Atlanta; Baltimore
- Most common implementation strategies
  - Early Green
  - Green Extension
  - Exclusive Phase (e.g. Transit Vehicle Only)

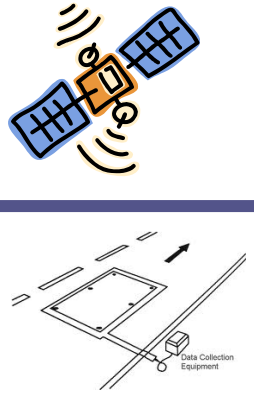
Successful TSP Installations: Lessons Learned

- Constraints in an individual route will determine how well TSP will work.
  - Requires flexibility in deployment, operations and monitoring
  - Requires adaptability to varying intersection and bus operating conditions (levels of congestion)
- Requires careful thought, detailed analysis and wise investment

TSP Components and Cost

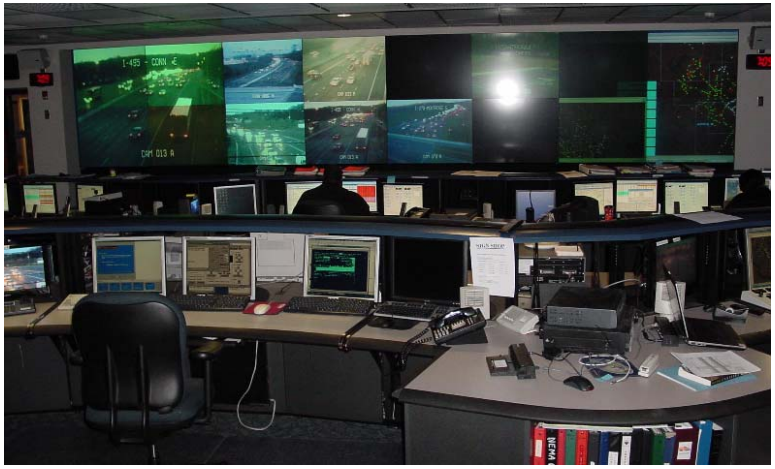
Transmitter on Bus

$7500/ea. bus



Receiver at Intersection, Controller Software, Wiring

$10,000 to 15,000/ea. Int.



TMC TSP Software Licensing and Integration

$10,000/ea. Intersection.

Operating and Maintenance Costs Not Shown

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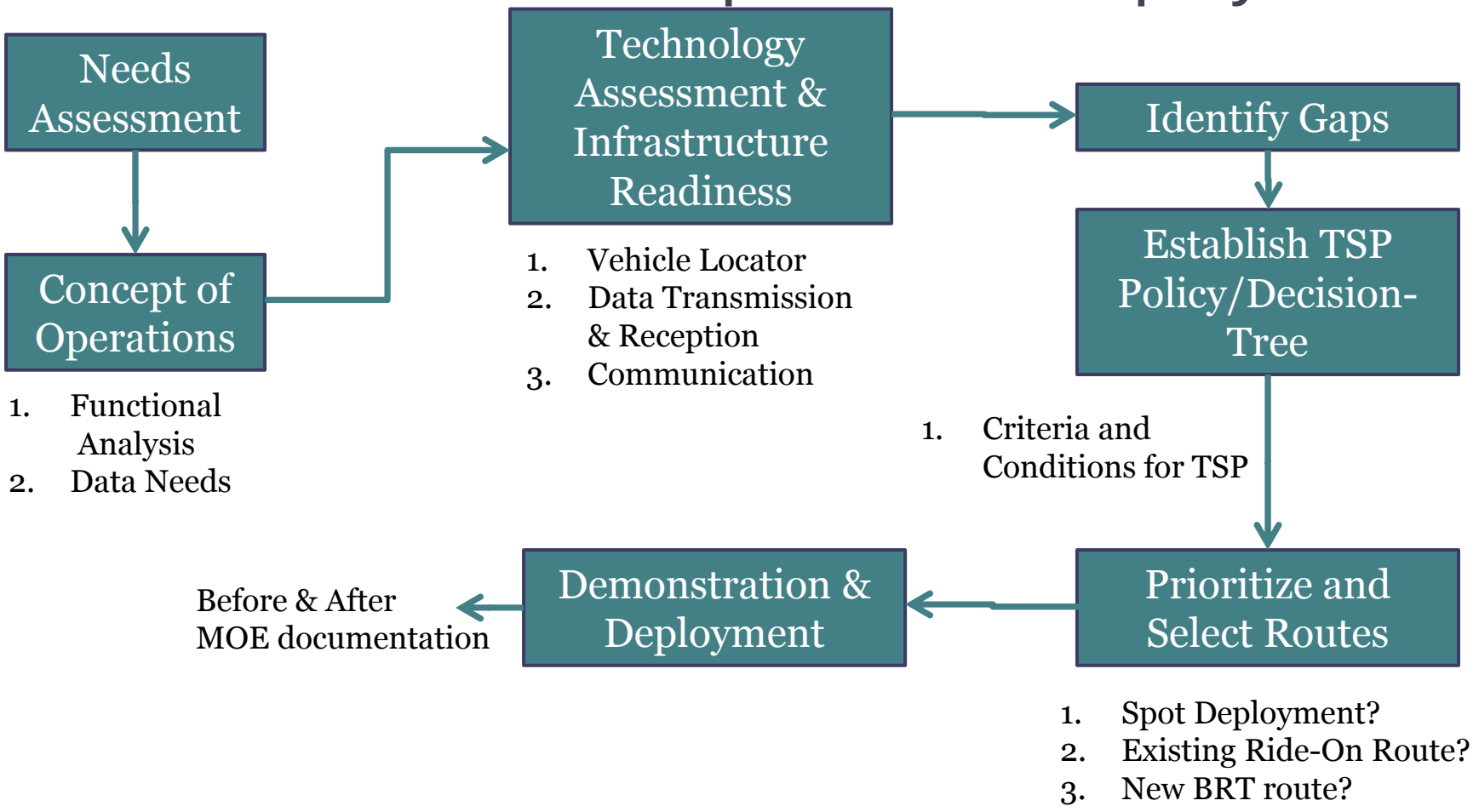
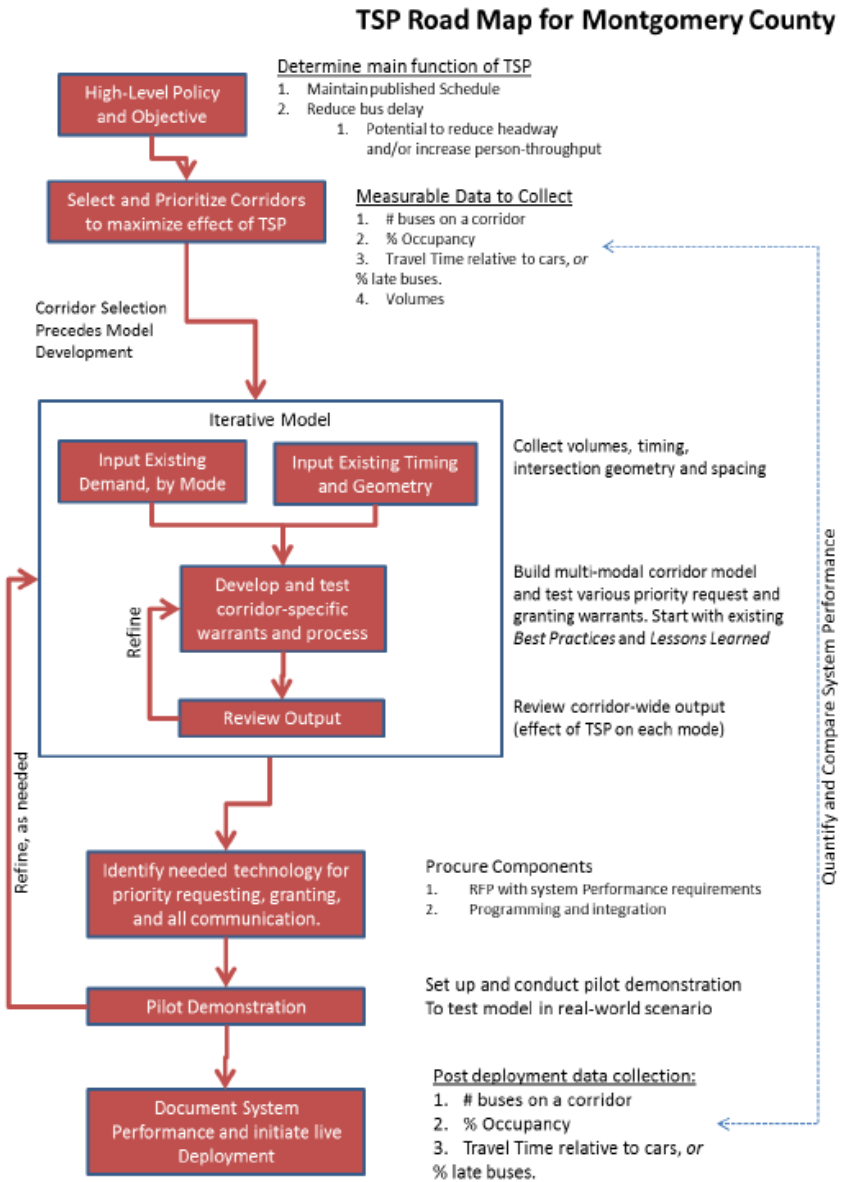
Successful Road Map to TSP Deployment



Implementing TSP in Montgomery County

Follow earlier successful implementations and lessons learned



Countywide TSP Study

- Phase I
  - State of the Practice/ Lessons Learned
  - Infrastructure and Communications System Readiness
- Phase II
  - Needs Assessment
    - Concept of Operations Development
    - Technology Assessment and Selection
      - Data Requirement
      - Procurement and Deployment
      - Pilot Study Demonstration and Evaluation
- Phase III
  - Identify, Screen and Select Routes and Performance Metrics
  - Develop TSP Policy: Warrants and Conditional Measures
  - Coordinate with agency Stakeholders (RideOn, SHA and WMATA)
  - Finalize Deployment Plan – costs and timeline

Define Objective

- What are our specific goals?
  - Minimize signal delay for buses
  - Maintain travel time reliability/ schedule adherence?
  - Move more people through a corridor?
  - Incorporate signal priority into a Rapid Transit System?
  - Balance all modes of transportation?

Establishing Performance Metrics

- Benefits and impacts can be estimated based on quantifiable **data.** May include:
  - Bus travel time
    - Total bus wait time at signalized intersections.
  - On-time performance
  - Overall person throughput/ delay
  - Pedestrian wait time
  - Vehicle delay
  - Number of calls/ frequency of calls

Establishing Policy and Warrants

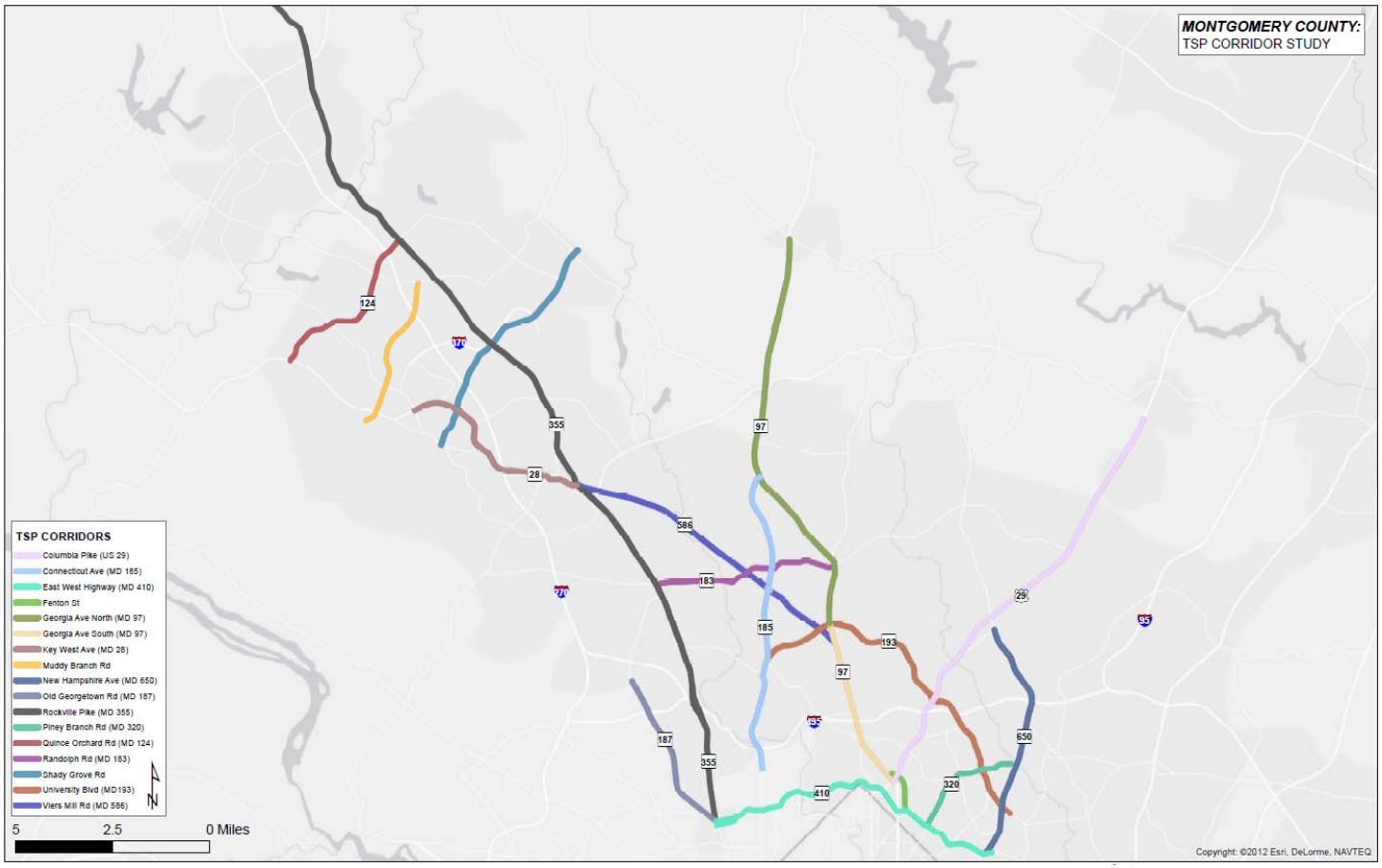
- Under what traffic and transit conditions will TSP be granted?
  - Based upon underlying data and desired performance metrics.
  - Will the conditions for priority vary by time of day?
- Is the reduction in *bus-passenger* delay (trip hours) weighed heavier than the increase in *passenger car* delay?
  - What about delay to pedestrians? Cross-street Buses?

Route Screening and Selection

- Assess opportunities and constraints for each corridor and for various times of the day (AM peak, midday, PM peak and night) and service types (local, limited, express):
  - ✓Transit: Bus volumes, bus delay, bus ridership
  - ✓Traffic: Vehicle volume, pedestrian volume, number of signals, number of failing intersections/ level of service, signal timing (phasing and splits), cross-streets functional classification
  - ✓Land use: Density, type, intermodal connections

Corridor Mapping

- 18 corridors initially identified
- Over 800 traffic signals maintained by the County
- Over 350 signals in the selected 18 corridors



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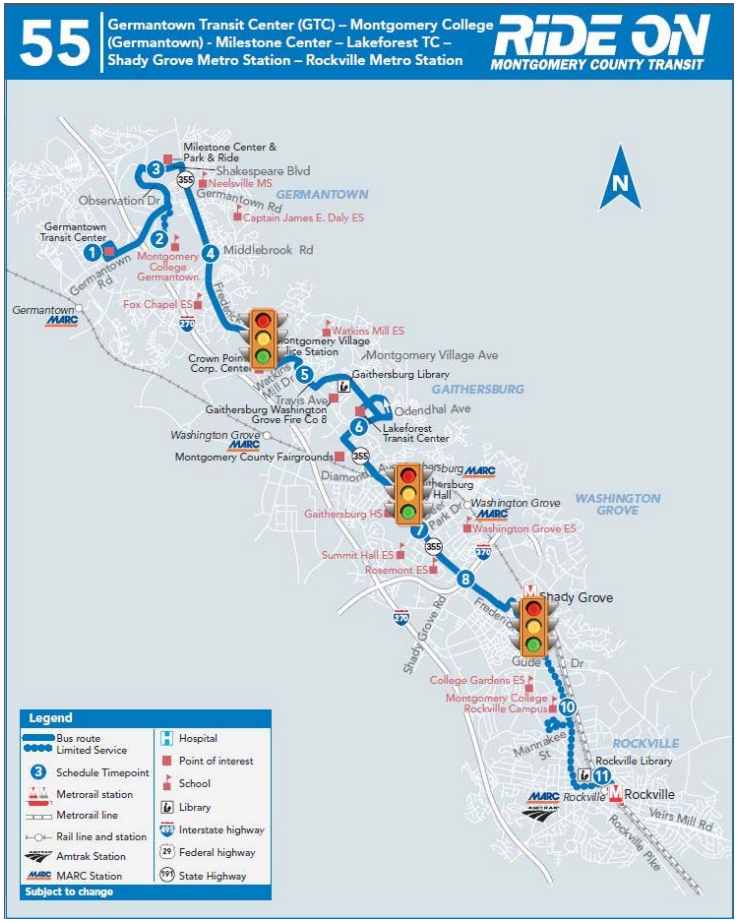
DOT Technical Assessment Status

- TSP Technology test fully operation January 2013
- Five buses equipped with emitters
- Three traffic signals equipped with roadside receivers
- Data collection underway for:
  - late buses detected by roadside equipment
  - late buses reported by ORBCAD
- Ride On evaluation underway to identify any change in bus on time performance



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Questions