Commerce CITY

Traffic Signals 101

October 24, 2016

Presentation Overview

- Purpose
- Commerce City infrastructure
- Components
- Maintenance & Costs
- Warrants for Installation
- Signal Phases & Timing
- Progression/Coordination
- Left Turn Arrows/Flashing Yellow Arrow Implementation
- Upcoming Projects/Efforts

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Purpose

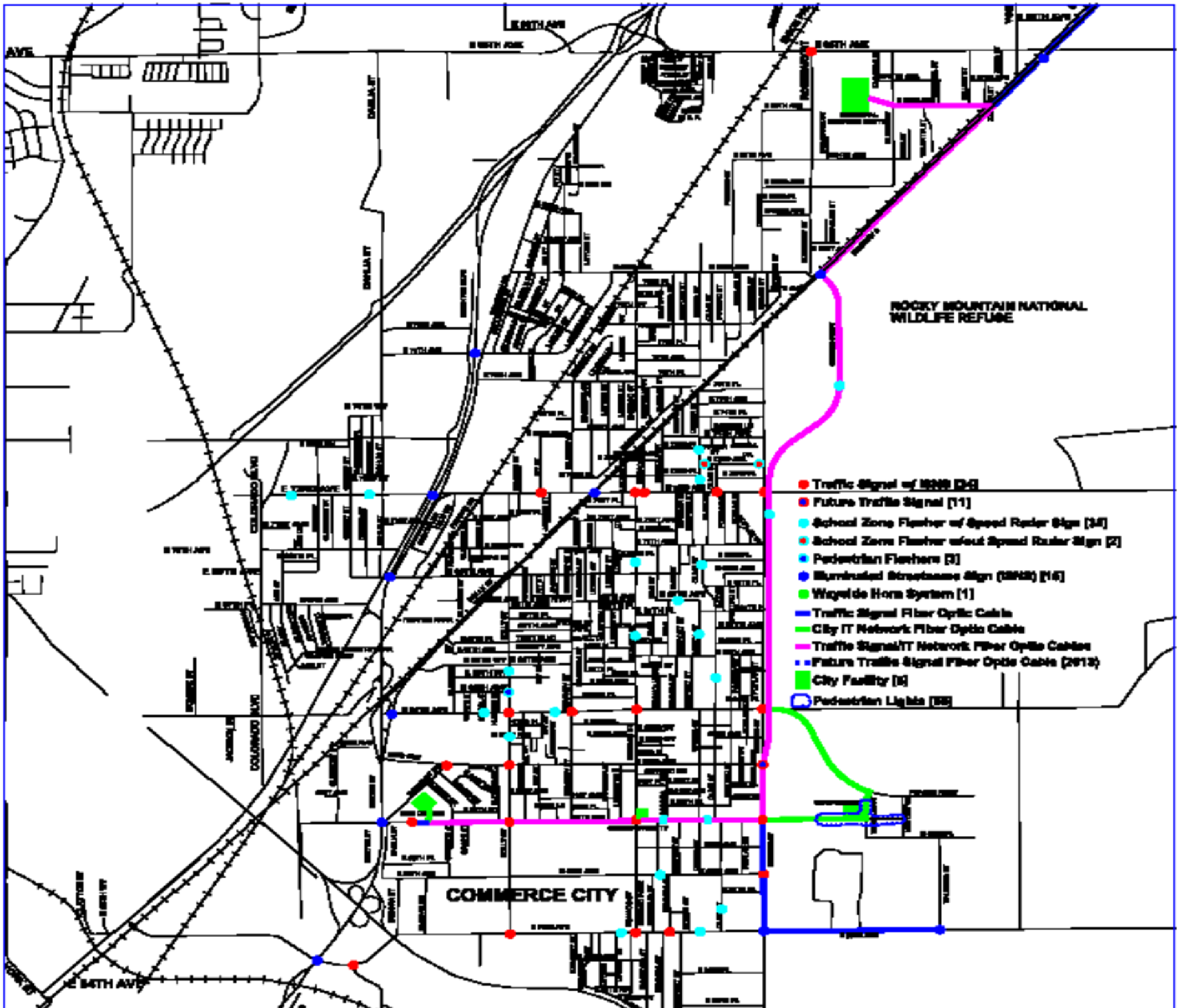
- Increase throughput
- Reduce overall delay
- Improve safety
- Provide progression on a corridor
- Access for side streets

Commerce City Traffic Signals

City owns & maintains:

- 42 traffic signals
- 2 emergency signals
- 2 pedestrian signals
- 36 school flashing beacons
- 3 pedestrian beacons & 4 rapid flashing beacons

- 17 signals are connected to the Traffic Operations Center (TOC) through fiber-optic cable or spread spectrum radio
- The TOC utilizes a computer-based traffic signal control system that monitors traffic conditions
- The control room includes multiple video monitors mounted on a wall and large screens used to display traffic conditions and weather information
- Staff can change timing manually, if required
- The control room is actively staffed only during and after major events at Dick’s Sporting Goods Park



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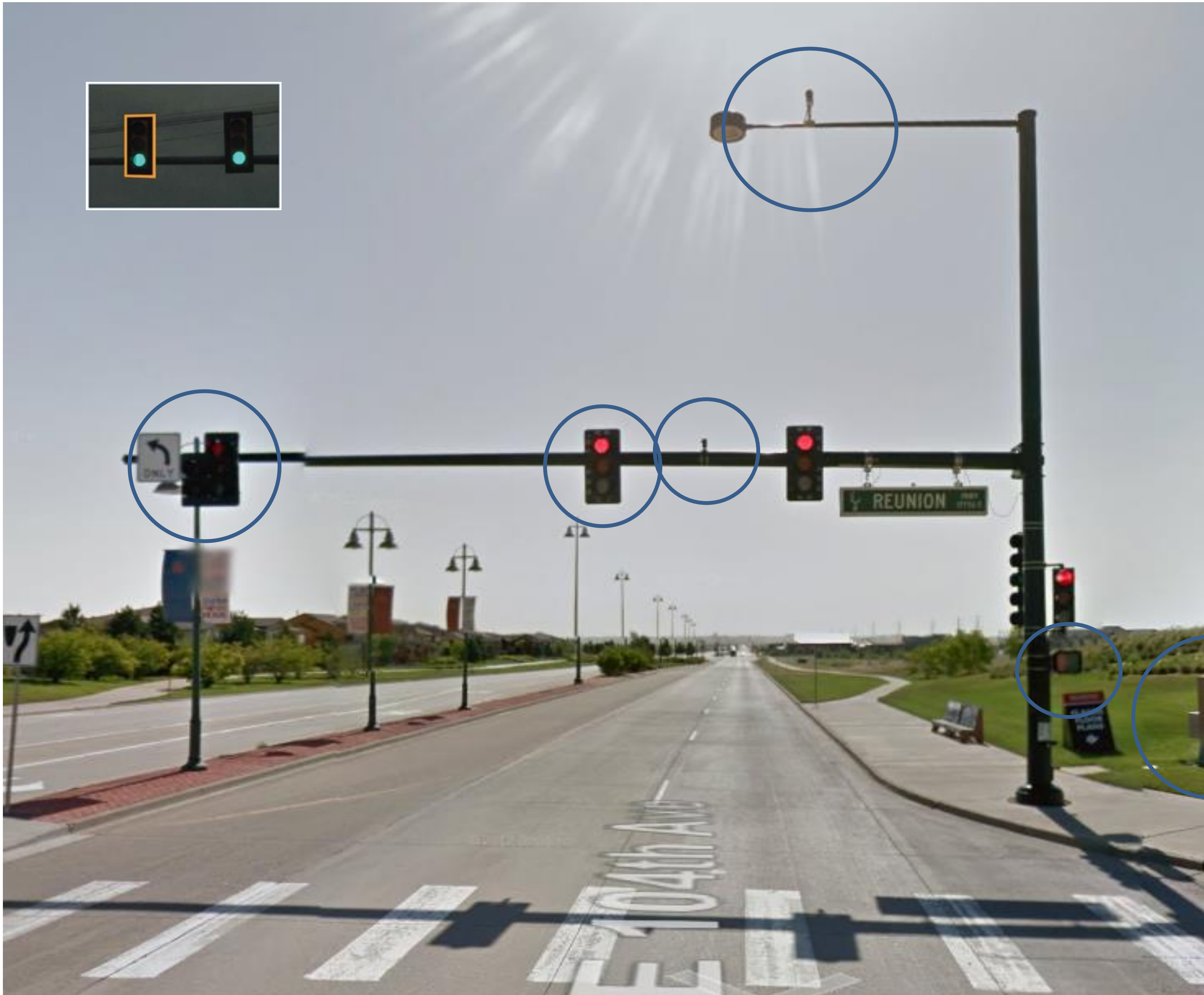
ONLY
REUNION
E 104th Ave


E 64TH AVE 6400 N
NO RIGHT TURN ON RED
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Google Earth

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Maintenance & Costs

Service contractor – WL Contractors

- Monthly maintenance
- Respond to emergency outages
- Troubleshoot problems
- Perform major repairs, upgrades or modifications
- Implement timing changes

Annual Costs:
Maintenance & repairs - $180,000 annually
Electricity - $110,000 annually

Installation Costs (including design & construction):
$275,000 - $325,000

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Installation Warrants

- New traffic signals are installed based upon criteria established nationally in the Manual on Uniform Traffic Control Devices (MUTCD)
- Unnecessary signals can cause:
  - Delays to the flow of traffic
  - Pollution & waste of gasoline from excessive starting and stopping
  - An increase the total amount of crashes at an intersection

Conditions which may warrant a signal installation:

- consistently high traffic volume
- an accident rate which may be reduced
- excessive wait time for vehicles or pedestrians to cross an intersection
- restricted visibility
- a high volume of pedestrian traffic

Traffic Signal Warrant Analysis

- Warrant 1 – Eight-hour Vehicular Volume
- Warrant 2 – Four-hour Vehicular Volume
- Warrant 3 – Peak Hour
- Warrant 4 – Pedestrian Volume
- Warrant 5 – School Crossing
- Warrant 6 – Coordinated Signal System
- Warrant 7 – Crash Experience **104th & Potomac**
- Warrant 8 – Roadway Network
- Warrant 9 – Intersection Near a Grade Crossing

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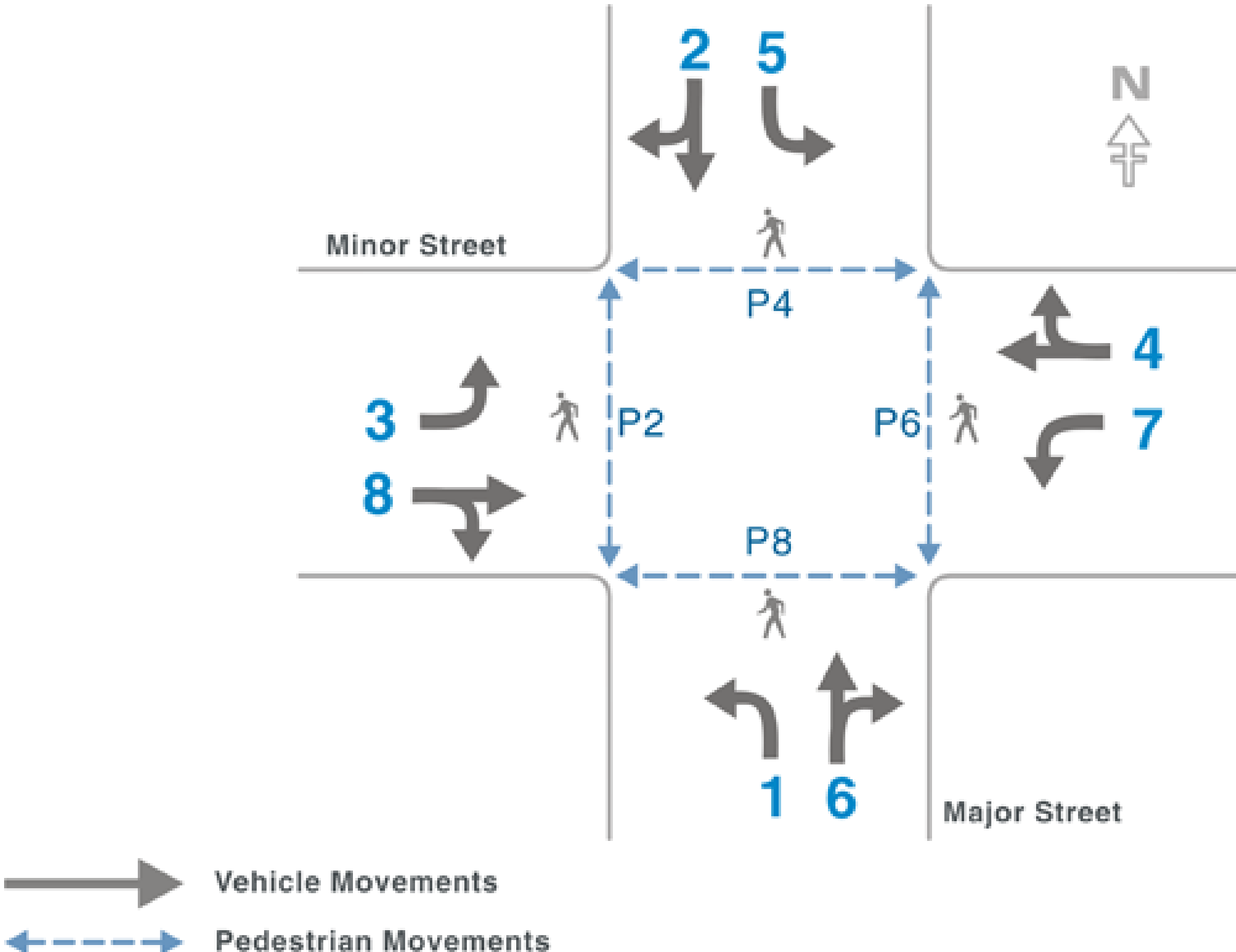
Signal Phasing



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Goals of Signal Timing

- Minimize the number of **Green** phases
- Maximize the number of vehicles moving through the intersection during all **Green** phases
  - Keep as many traffic streams flowing at all times as possible
- Minimize delay (shorter cycle lengths)
- Maximize throughput (longer cycle lengths)

These goals are oftentimes at odds with each other

Example: Semi-tractor trailers

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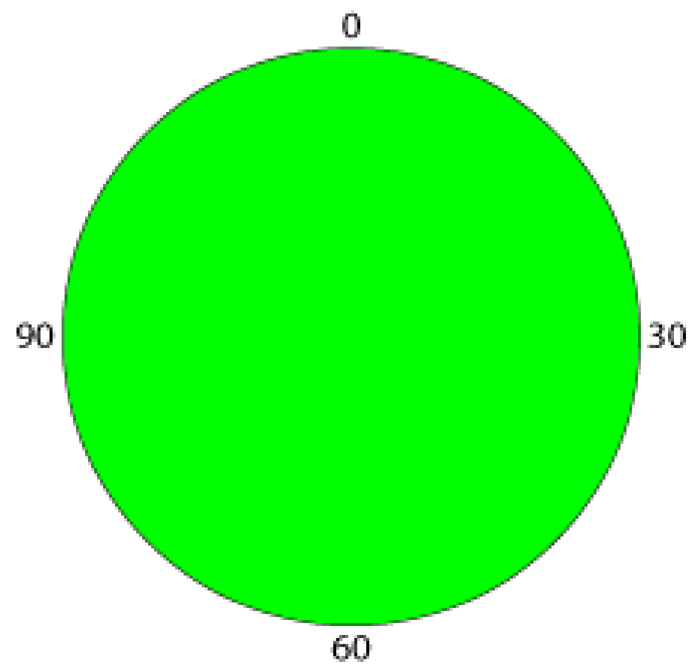
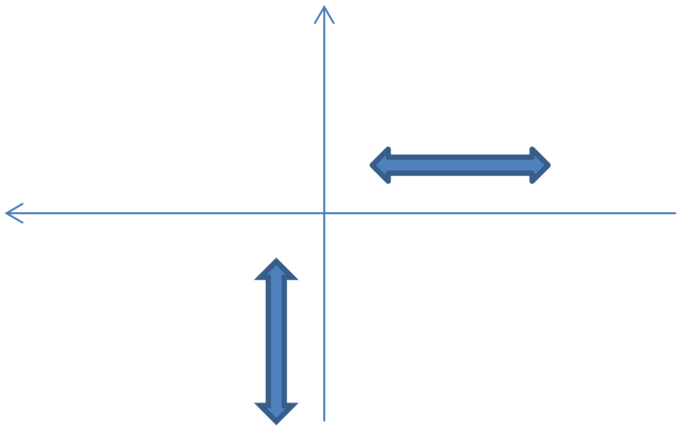
Signal Timing

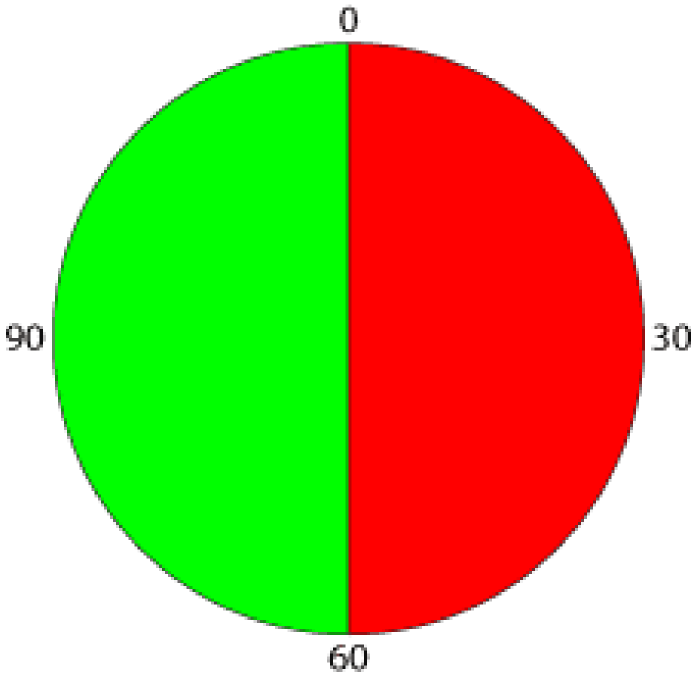
Two minutes of green time sounds like a lot, but at some major intersections, that is how much time there is to be broken up between the different traffic and pedestrian movements



Signal Timing

Assuming an even split in traffic, half of the green time goes to the east/west traffic, half goes to the north/south traffic





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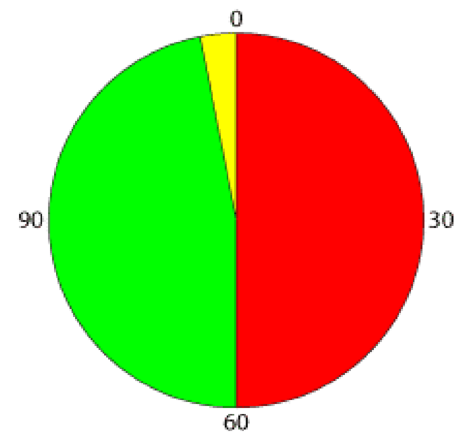
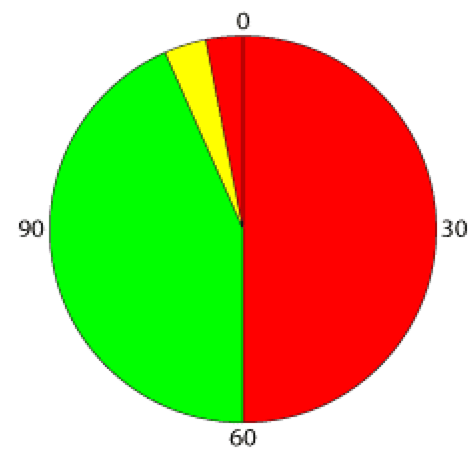
Signal Timing

Yellow time must be provided to notify traffic that the green signal will be ending



Additional all-red time is added to prevent crashes between traffic starting up and vehicles going through the intersection late in the yellow phase



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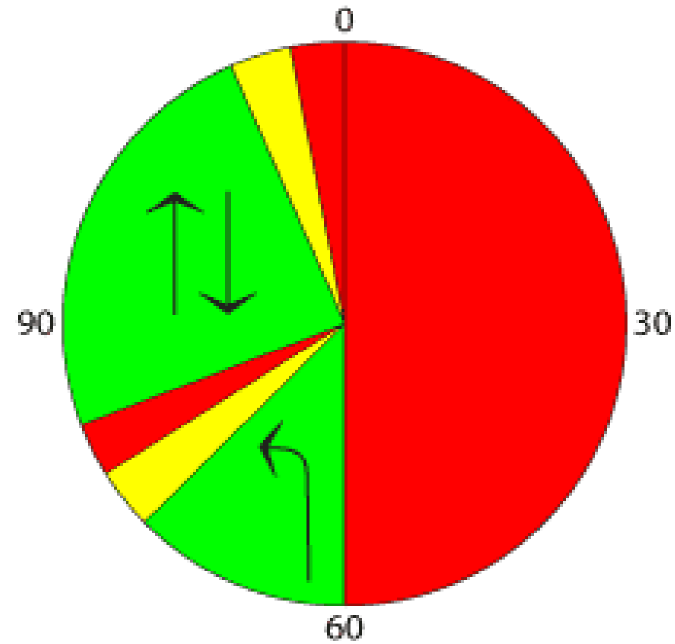
Signal Timing

Adding a left turn arrow takes away not only the time for the arrow, but also the time for the yellow and all-red phases that go with the arrow.

Only 30 seconds of green is now available for your approach, enough time to move about 12 cars per lane



Signal Timing

- Signal timing starts with knowing how much traffic is on the street
- Different timing plans can be set up for different times of the day, days of the week or for special events
- A signal's optimum timing and operation are unique to each intersection
- Corridor timing allows for vehicle progression which results in overall delay, fewer emissions and driver satisfaction

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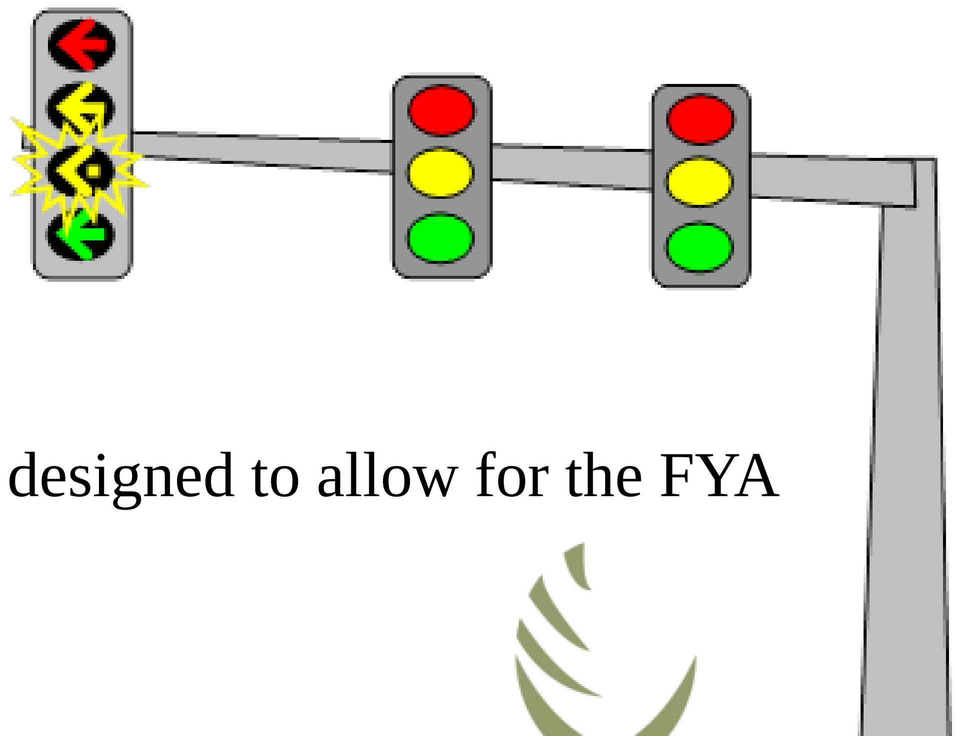
Left Turn Arrows & Flashing Yellow Arrows

- Approximate cost of $325K to convert existing signals to FYA

  Why? Under-sized controllers & new signal heads



- All new signals are being designed to allow for the FYA
  - 104^{th} & Potomac
  - Tower Road

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Frequently Asked Questions

Why aren't the signals timed so I never have to stop?

Closely spaced signals, intersections where major streets cross, and changing traffic volumes all add to the difficulty of minimizing stop and go traffic for all directions of travel. Fire trucks and ambulances have special lights that change the signal to green for them, and this disrupts the timing patterns.

Why do I have to wait when there's no one coming?

Older signals don't have the necessary equipment to detect when cars are approaching, so green times are set longer. Minor streets get less green time than major streets so that the higher volumes can keep moving and don't build up. Pedestrian crossing times (Walk and Don't Walk) may require longer green intervals.

Why don't I always get a left turn arrow?

Left turn arrows take green time away from heavier through movements. Left turns can usually be made in gaps in traffic. Left turn arrows are sometimes turned off during lower volume times of day when the turns can be made through existing gaps. Newer cabinets & larger signal heads are required to allow permissive lefts.

Will a traffic signal reduce crashes at our intersection?

Traffic signals don't always prevent collisions. Typically, when a signal is installed, the total number of crashes increases, but the severity decreases. Where signals are used, the most common result is a reduction in right-angle collisions, however, rear-end crashes are prone to show an increase. Signals also may give pedestrians a false sense of security.

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Upcoming Projects & Efforts

DRCOG corridor phasing analysis:

- Quebec Parkway & Quebec Street (Hwy 2 to 270)
- Highway 2 (62^{nd} Ave. to 104^{th} Ave.)

TSSIP Grant through DRCOG to convert 8 signals to FYA; $132,000

- Replacement or upgrade of controllers, uninterrupted power sources, and video detection cameras & mounting kits at the following traffic signals:
  - Quebec/58^{th} Ave
  - Quebec/60^{th} Ave
  - Six signals along Highway 2 between 62^{nd} Ave & 104^{th} Ave

Note: Hwy 2 signals would be fed back into the TOC

- Add Opticom to the signal at 72^{nd} Ave & Hwy as part of the Highway 2 widening project
- Implement FYA on Tower Road signals
- Identify additional signal timing plans at critical intersections
- Add retro-reflective borders to signal heads
- Proactively complete signal warrant analyses
- Modify signal design standards

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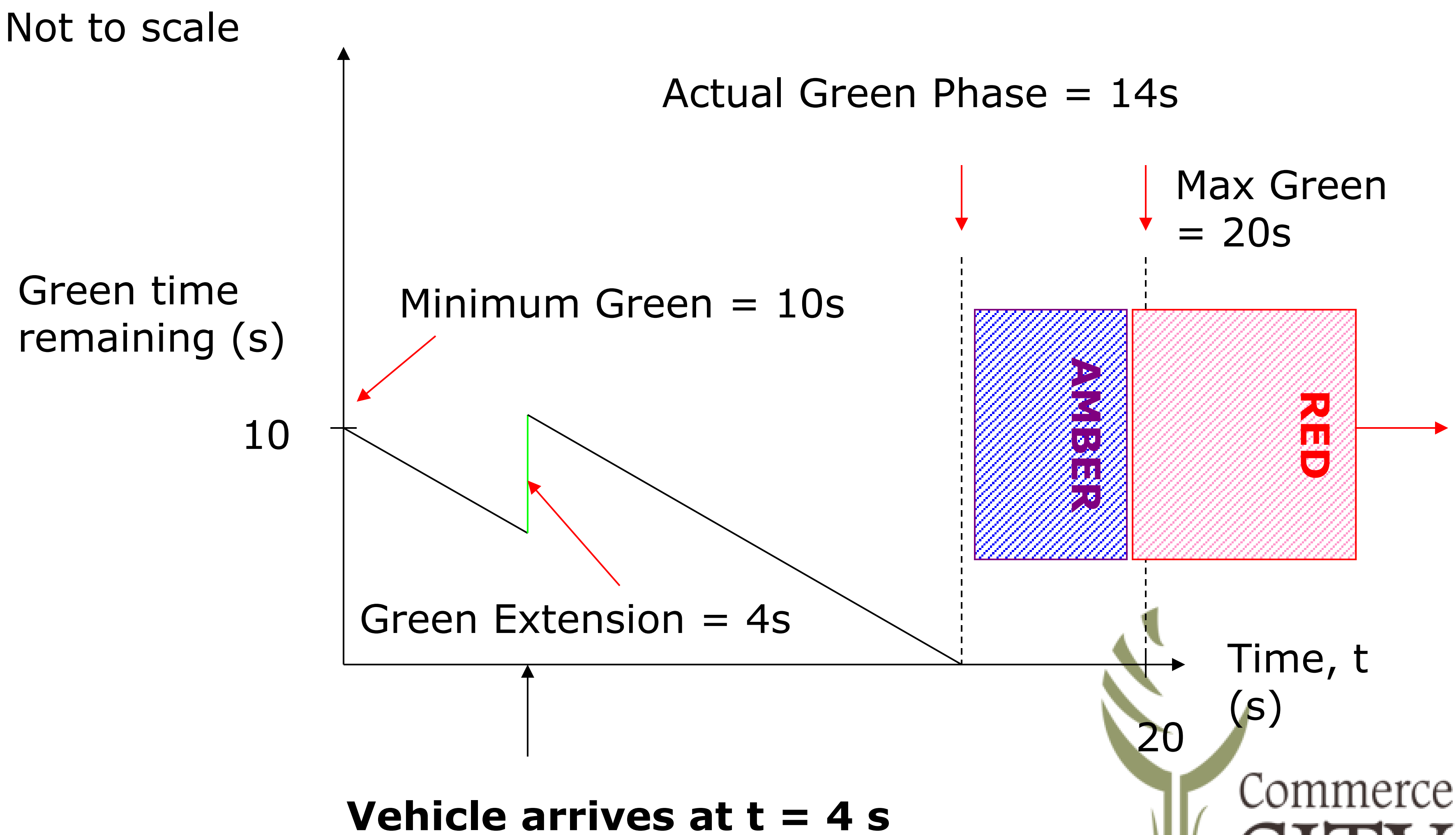
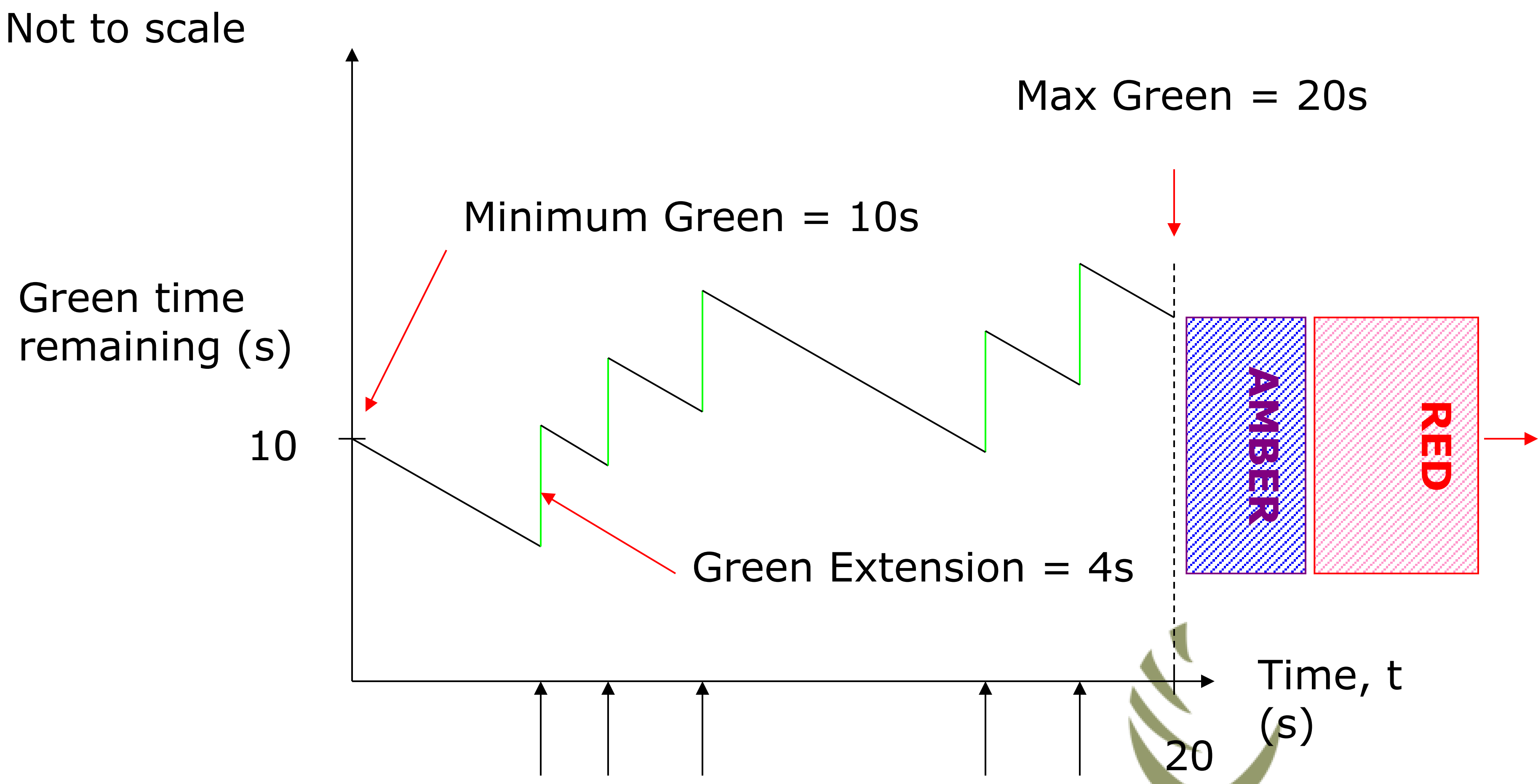
Questions & Discussion

Additional Information

Gap Out –Example Green Phase



Max Out –Example Green Phase



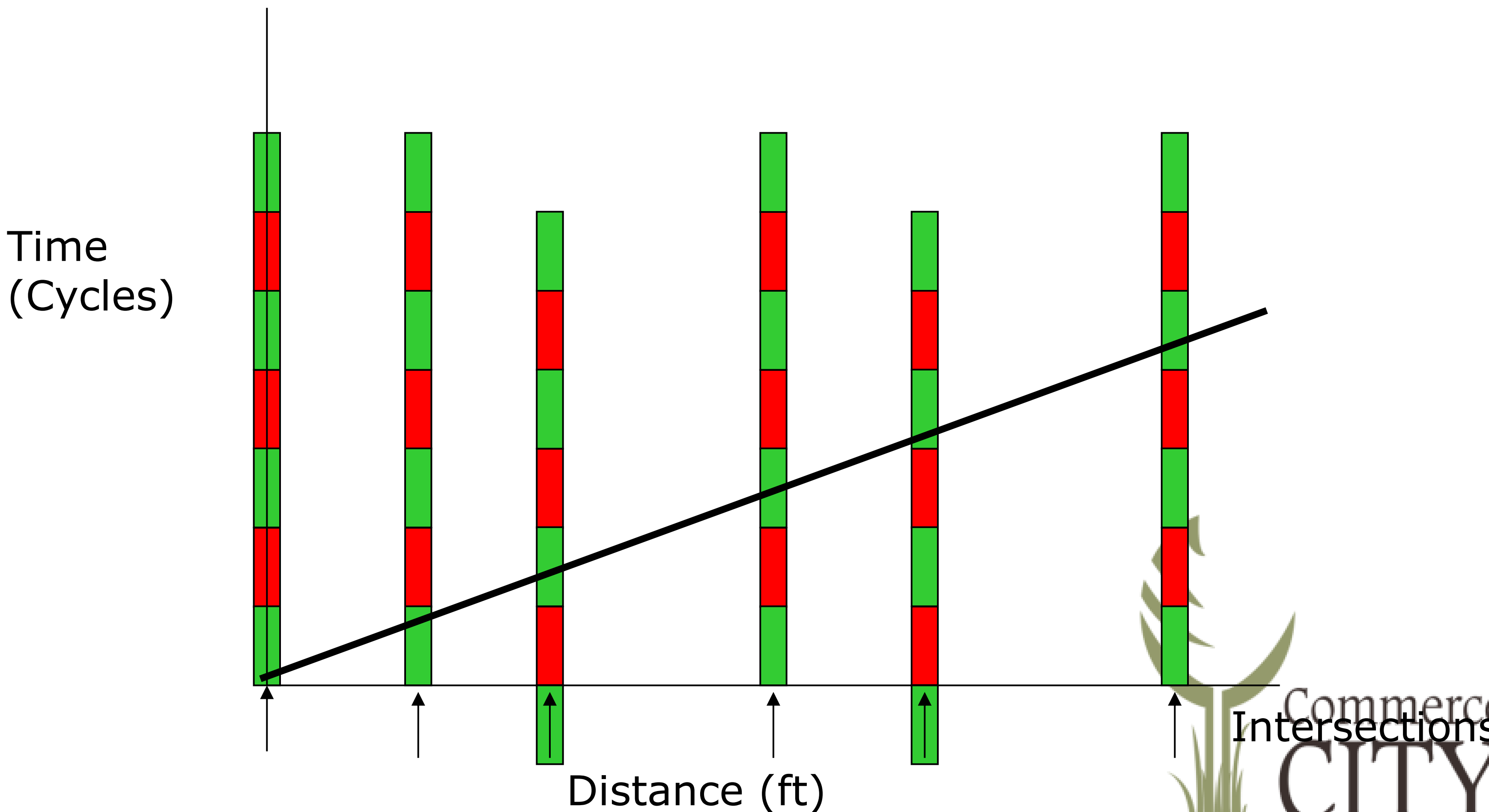
Vehicles arrive at t = 4, 5, 7, 16, 18 s

Vehicle Progression

- Moving through a series of signals without stopping
- Signals have to be spaced closely enough to allow queues of vehicles to progress together
- Assumptions:
  - You drive the speed limit
  - Uncongested traffic

Source: http://www.minagarinc.com/red.jpg

Vehicle Progression



Vehicle Progression