

?

Relativity



Light



$E=MC^2$



Space



Time



Traffic
Inexplicably
Clears up
Ahead !



The Physics of Traffic



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CUNY Graduate Center
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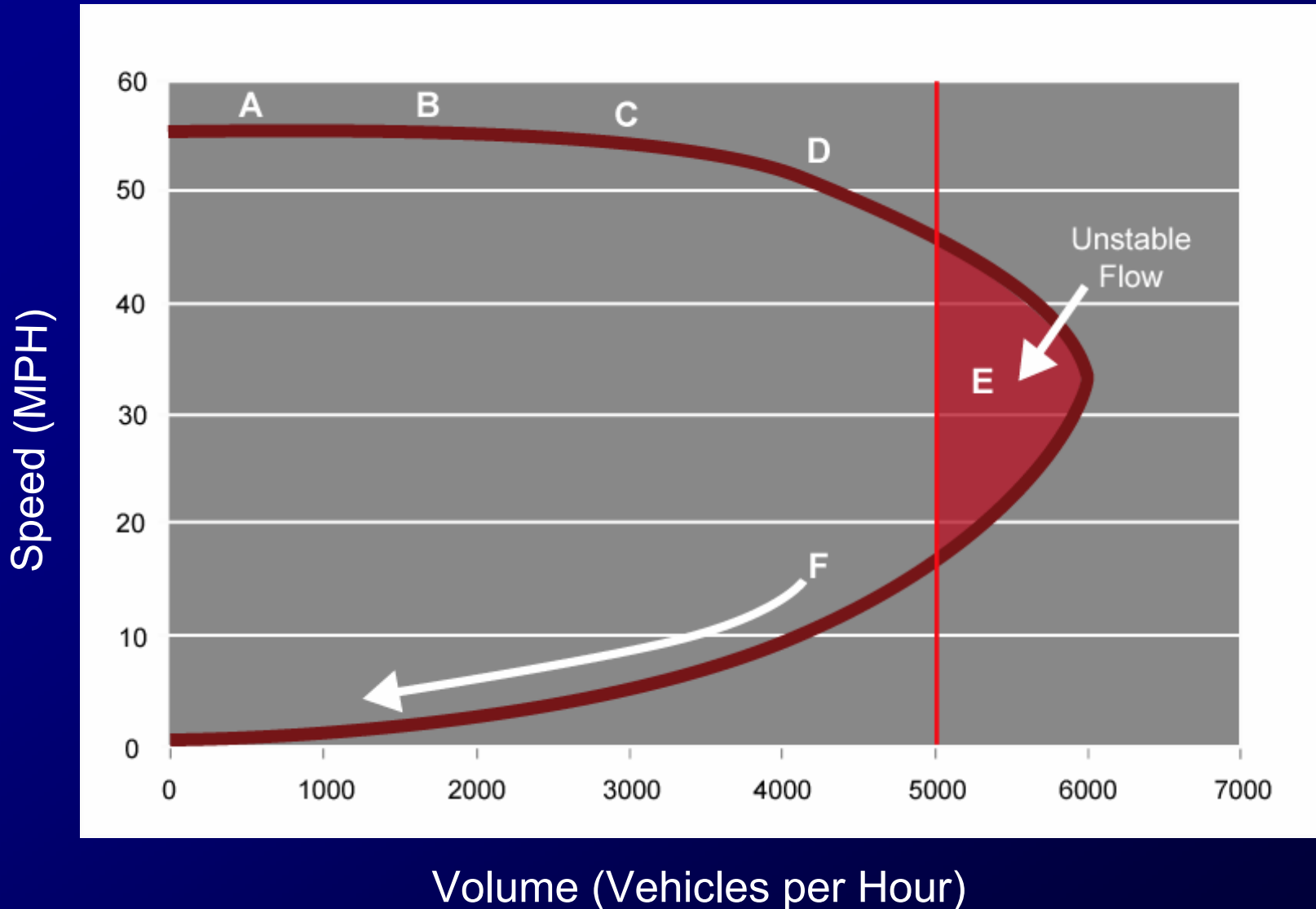
Traffic Science

- Is it really a Science?
- Is it an Art?
- Is it an Oxymoron?

Traffic

- A linear one-way problem with no intersections (Highway)
- A linear one-way problem with intersections (One Way Street)
- A linear two-way problem (Two Way Street)
- A plane four-way problem (Grid System)

Speed Volume Curve for Three Lane Roadway With No Signals



Levels of Service

- A - Free Flowing
- B - Slightly Restricted
- C - More Restricted
- D - Substantial Delays
- E - Significant Delays
- F - Jammed

The Unstable Zone

- Volume comes close to capacity
- Capacity comes close to volume
- Sudden platoons

**A linear one-way problem
with no intersections
(Highway)**

The Perfect Highway



Volume Comes Close to Capacity



Capacity Comes Close to Volume

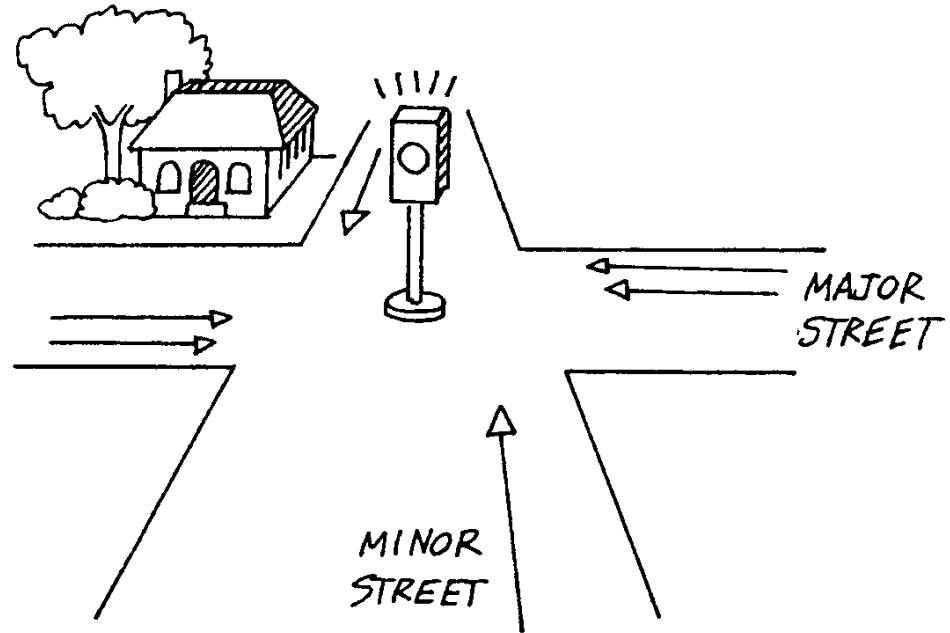


The Perfect Highway Becomes Less Perfect



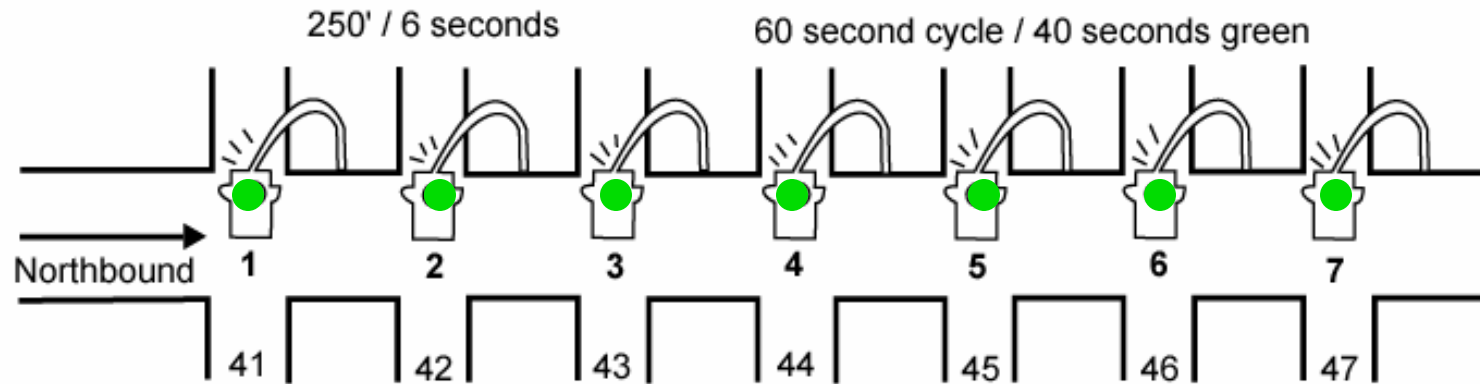
The Simple Single Signal

Every intersection has a major and minor street. The major street gets more green time than the minor street.



**A linear one-way problem
with intersections
(One Way Street)**

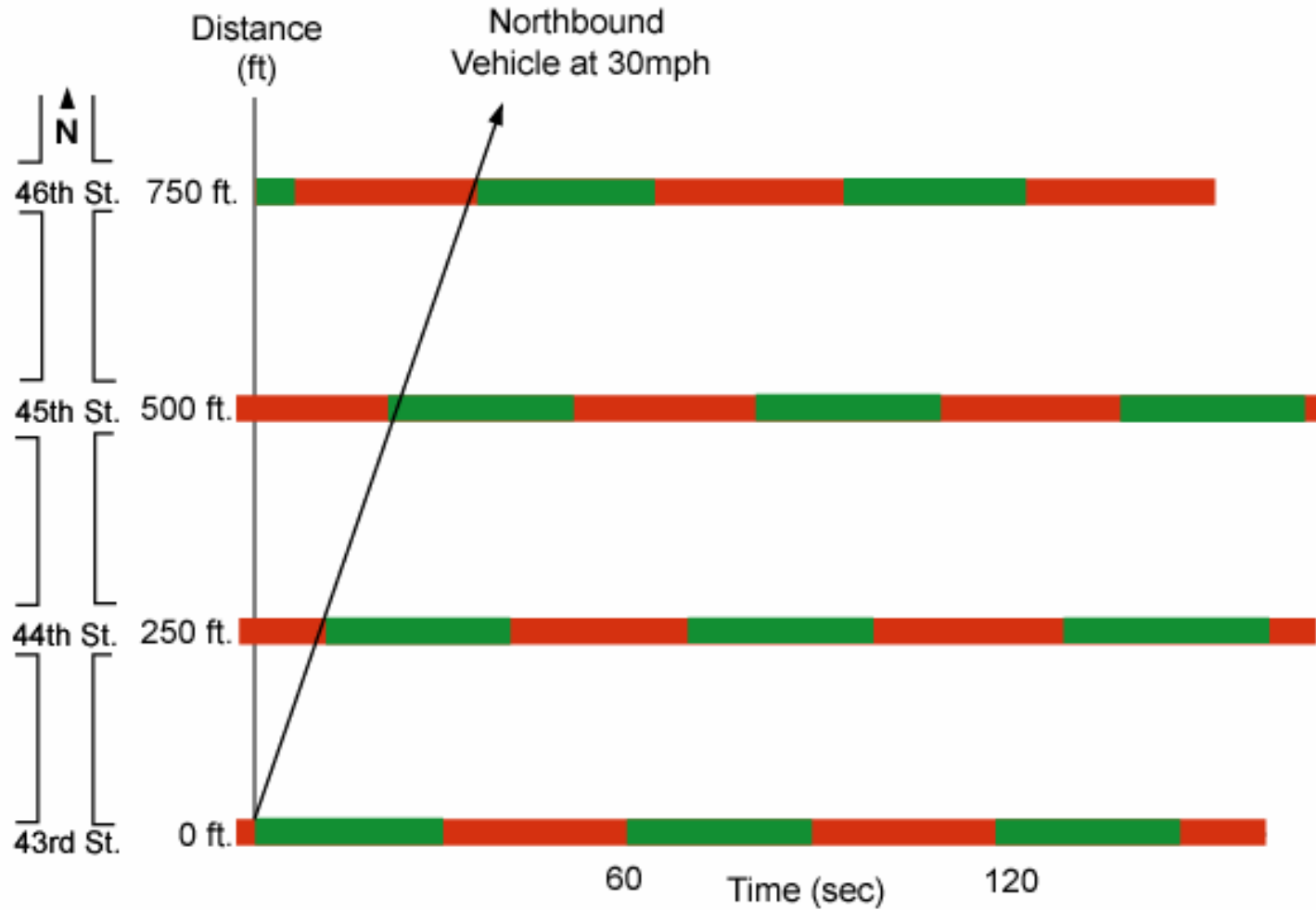
Progressive or Staggered Signal Patterns



Reduce green time at major streets 35mph

In a northbound progression, signal 1 turns green first. A few seconds later, signal 2 turns green; then signals 3,4,5...in sequence. Northbound vehicles traveling with the progression should travel great distances between stops.

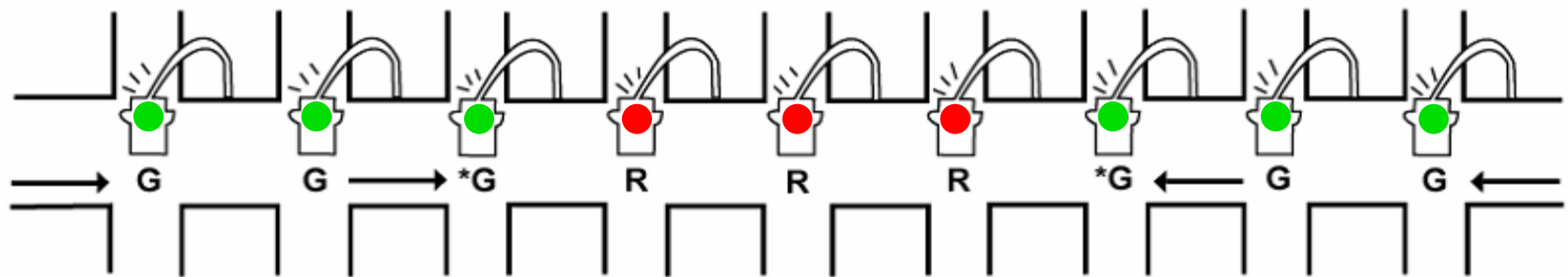
One-way Progression



The Time-Space Diagram and Ideal Offsets

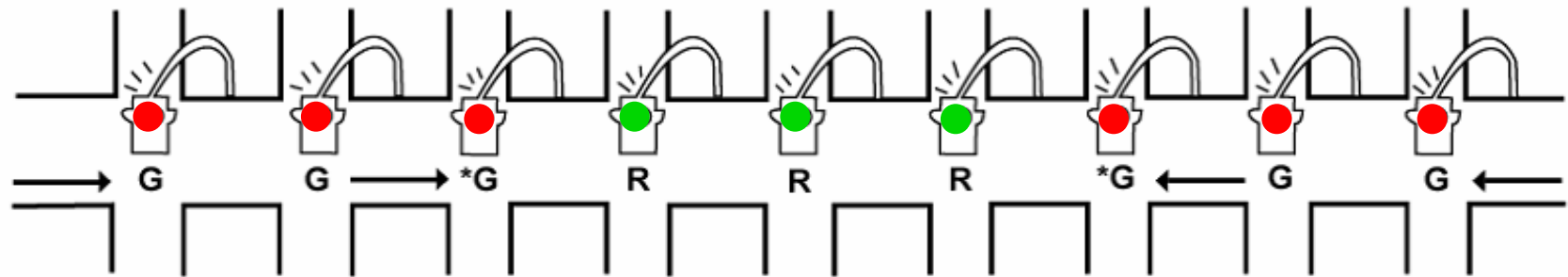
A linear two-way problem (Two Way Street)

Alternate Group Pattern



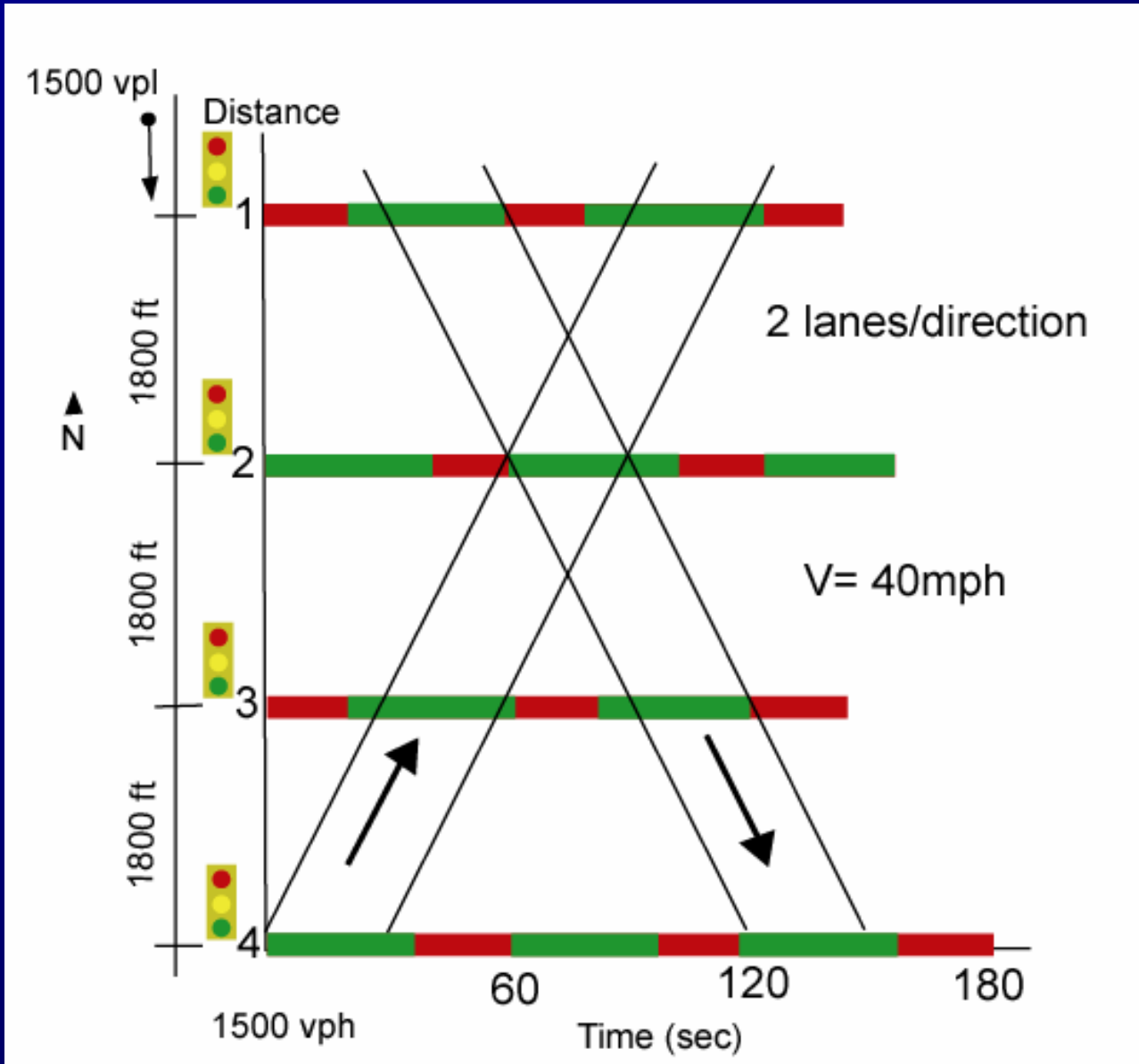
A typical alternate group pattern has a string of green lights, followed by a group of red lights. The key signal to make is the last green. If you make it, you'll easily make the next few signals. If you don't, you'll be stopped twice.

Alternate Group Pattern



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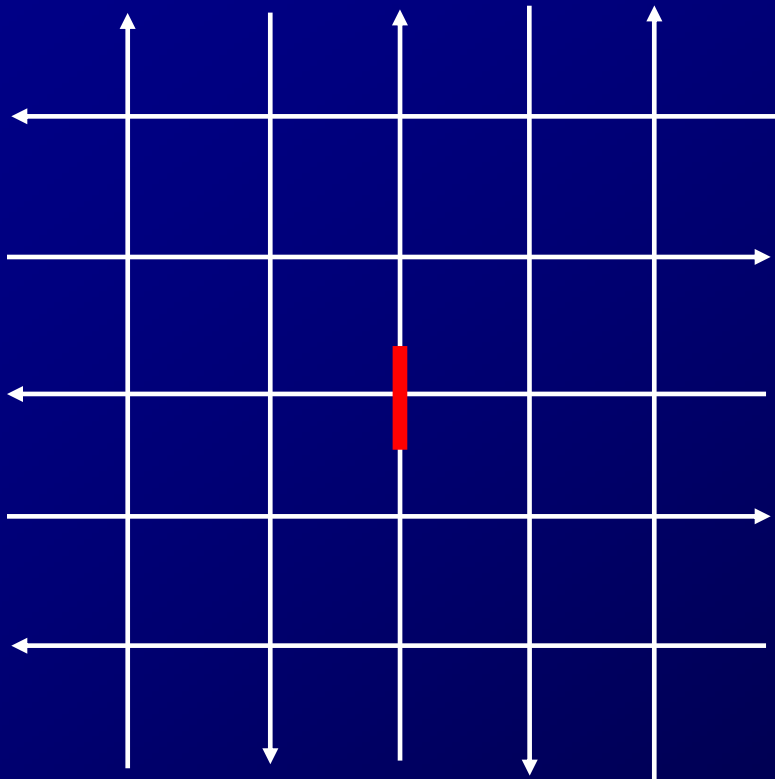
Two-Way Progression



Case Study: Four intersections with good progressions

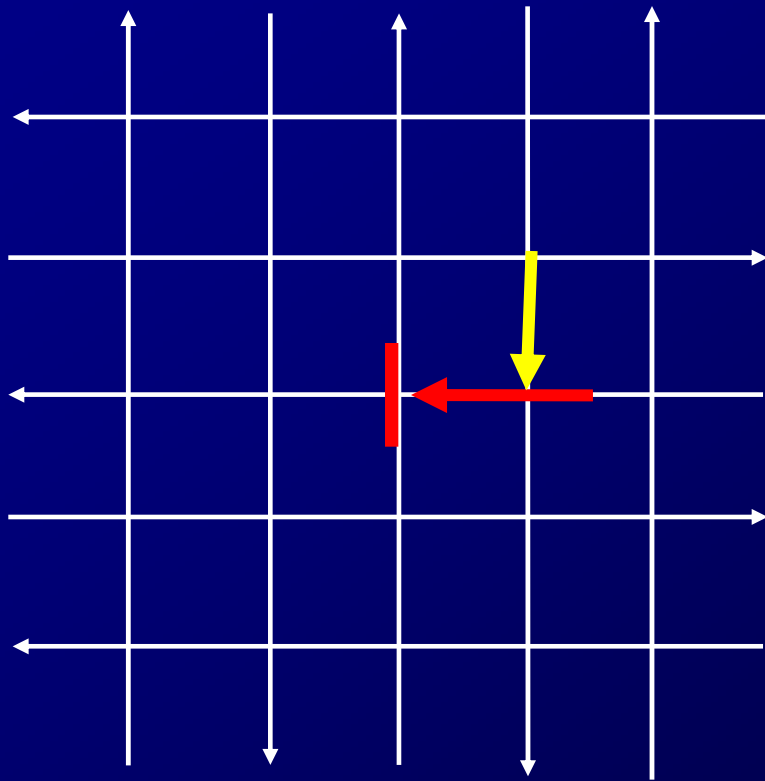
A plane four-way problem (Grid System)

Evolution of Gridlock



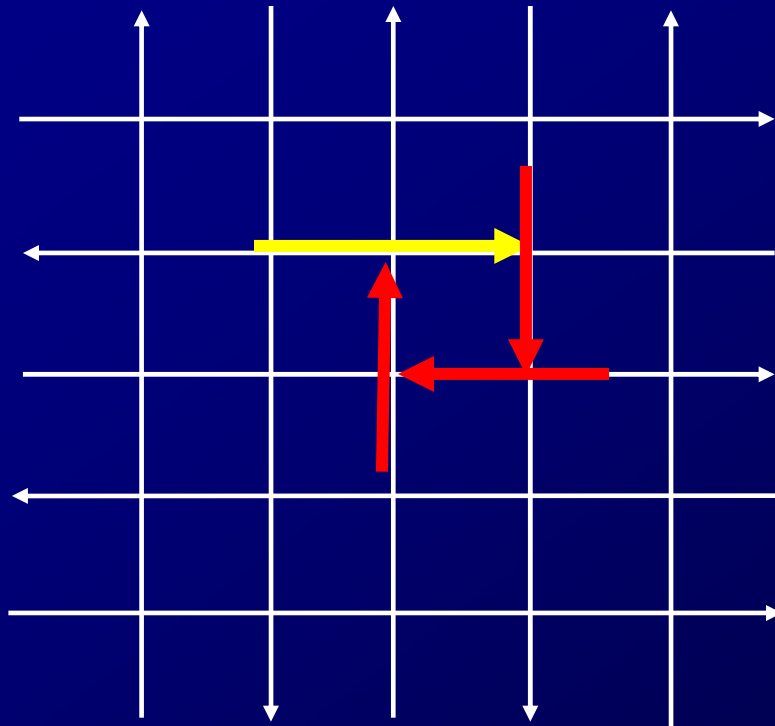
(a) Northbound car blocks westbound traffic

The Evolution of Gridlock



(b) Queue forms
blocking next
southbound street

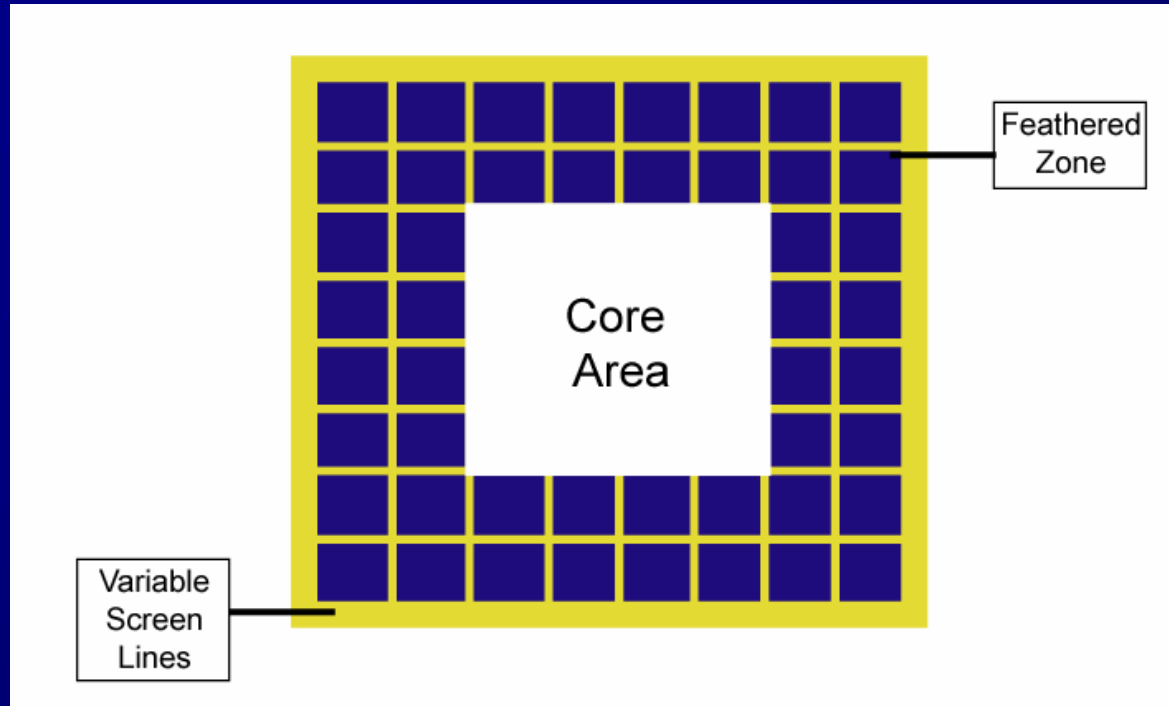
The Evolution of Gridlock



(c) Eventually car ends up blocking itself, locking the grid

Metering High Density Sectors

Metering High Density Sectors



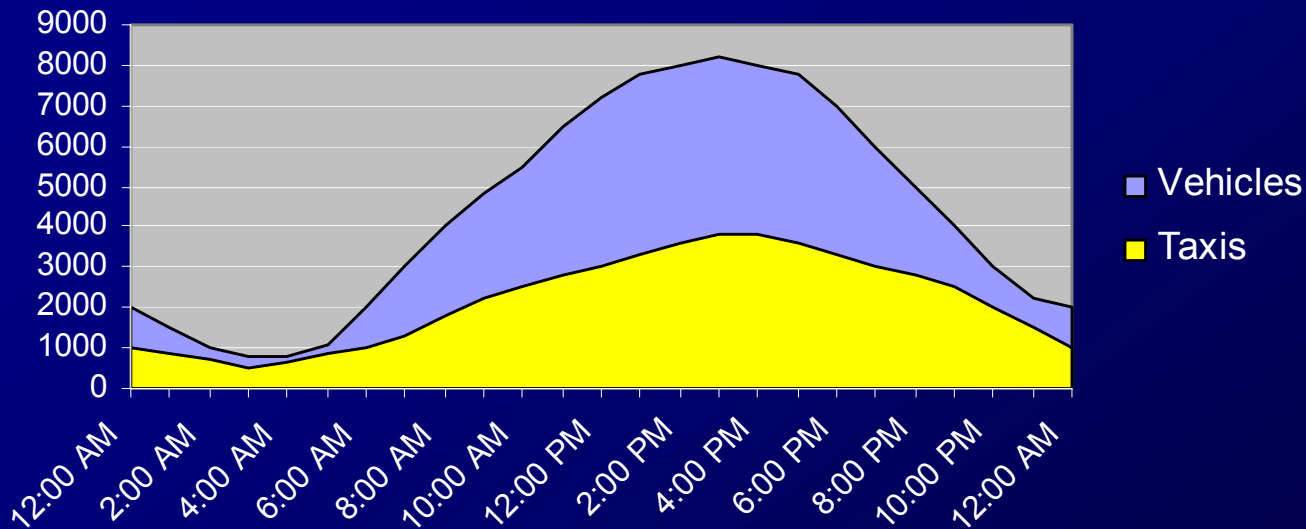
Measure Volume, Speed, Density

Response by Centralized Computer Control

Vary entry/exit rate core area

Adjust peripheral street capacity

Vehicles in Motion in Midtown Core By Time of Day

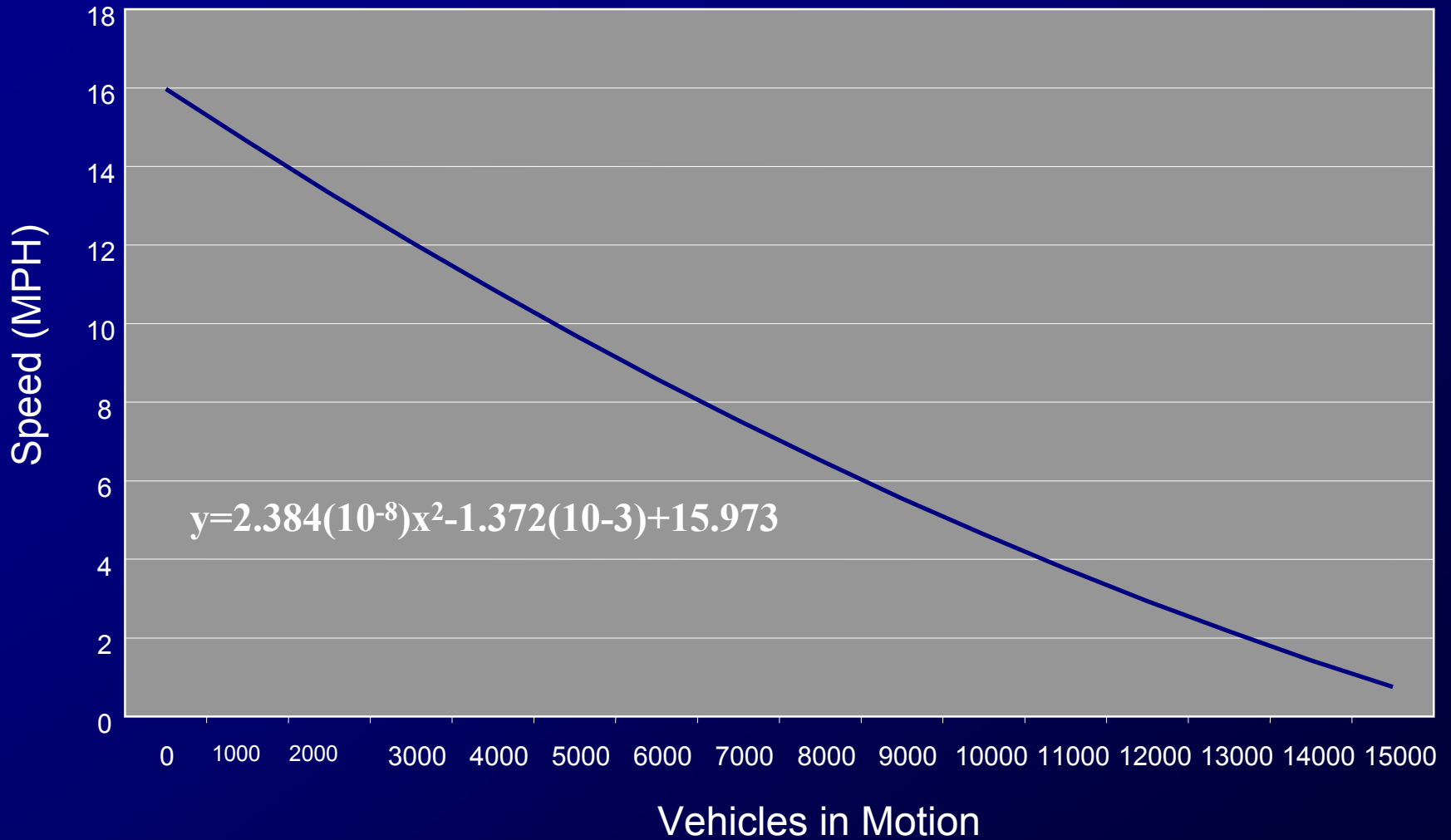


- 1.5 million vehicles enter Manhattan each day.

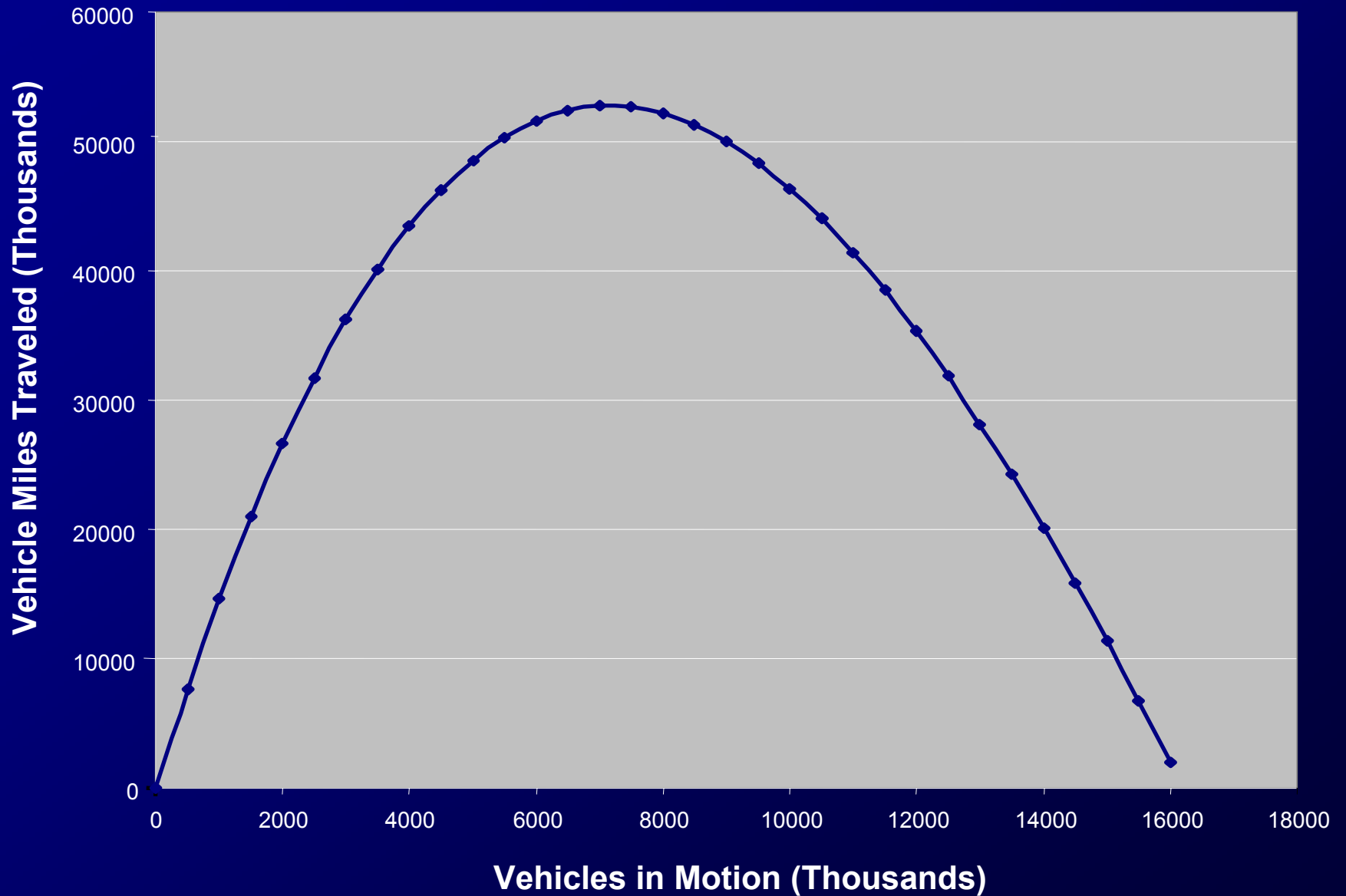
- Midtown streets carry about 8000 moving vehicles at peak times.

- Thus seemingly small difference in number of vehicles can have large impact on vehicle speeds.

Vehicle Miles Traveled vs. Vehicles in Motion



Midtown Vehicles in Motion vs. Average Speed



TMT vs. TIM

