Lecture 4
(Handouts)
Delay and Offset
Delay

- **Delay**: the most commonly used performance measure
- **Types of Intersection Delays**
  - Stopped delay
  - Total delay (control delay)
  - Time in queue delay
Delay Studies

Distance vs. Time

- Deceleration
- Stopped Delay
- Acceleration
- Total Delay (Control Delay)

Stop Line

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Time in Queue Delay

Distance

Time

Distance

Time

Stopped Delay

Time in Queue Delay

Stop Line
The HCM Delay Equation

\[ d = d_1 PF + d_2 + d_3 \]

\[ d_1 = \frac{0.5C[1 - g / C]^2}{1 - \left[ \min(1, X) \times g / C \right]} \]

\[ d_2 = 900T \left[ (X - 1) + \sqrt{(X - 1)^2 + \frac{8klX}{cT}} \right] \]

Uniform Delay
Uniform Delay

\[
d_1 = \frac{0.5C[1 - g/C]^2}{1 - \left[\min(1, X) \times g/C\right]}
\]

[Diagram of cumulative arrival and departure with variables r, g_0, g, C, V, and S.]
Uniform Delay

Cumulative Arrival

Cumulative Departure

C

S

S

V

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Random and Over-saturation Delay

Cumulative Arrival

Cumulative Departure

C

C

V

S

S

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Delay with Initial Queue

Cumulative Arrival

Cumulative Departure

V

S

S

C

C
Uniform Delay with Platoon Arrival
(Platoon on Red)
Uniform Delay with Platoon Arrival
(Platoon on Green)
Example

Assume a two-lane one-way street links two intersections $i$ and $j$, which is 800 feet apart. The one-way link flow is all through traffic and has a volume of 1000 vph. Saturation flow rate is all 1800 vph. Assume vehicle travel speed is 25 mph. The system cycle is 70 sec, and the effective arterial through greens for the upstream ($i$) and downstream ($j$) intersections are 35 sec and 30 sec, respectively. The offset is 20 sec, referencing to the start of green of the arterial phases (i.e., arterial phase green at $j$ starts 20 sec later after $i$).

Calculate the uniform delay at intersection $j$. 