

CE474: Traffic Systems Design-Fall 2004

Class 9 – Actuated Controller Operations
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Actuated Signal Control Settings

- ◆ Minimum Green Time
- ◆ Gap/Passage Time
- ◆ Pedestrian Times
- ◆ Maximum Green Time
- ◆ Yellow Time
- ◆ All Red Time

Actuated Signal Control Settings: Definition

◆ Phase [*What is a phase?*]

A unique movement for which separate timing intervals are provided

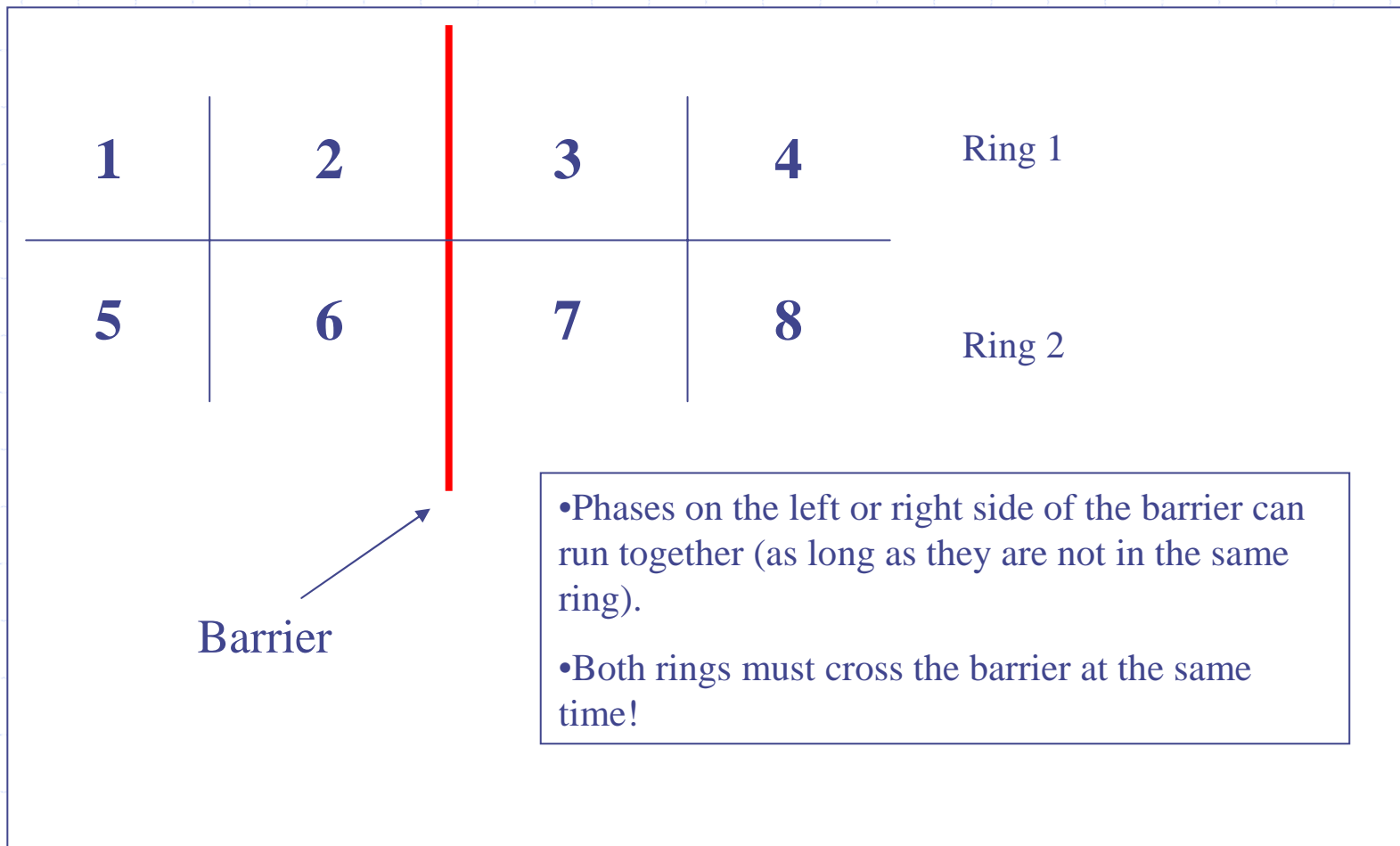
Examples:

- Protected Left Turn
- Through or Through / Right combination

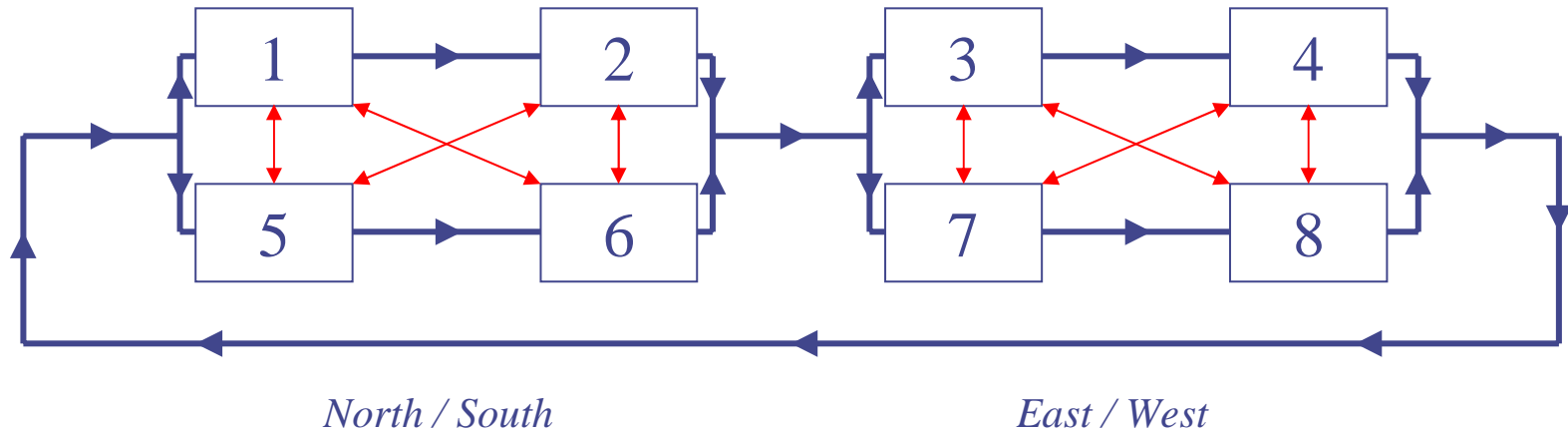
Operation of Dual-Ring Controllers

- The controller contains 2 interlocked rings arranged to time in a preferred sequence to allow concurrent timing of respective phases in both rings
- Each of the respective phase groups in the two rings must cross the barrier simultaneously to select and time phases in the phase group on the other side of the barrier

Ring / Barrier Diagram



Standard 8 Phase Sequence



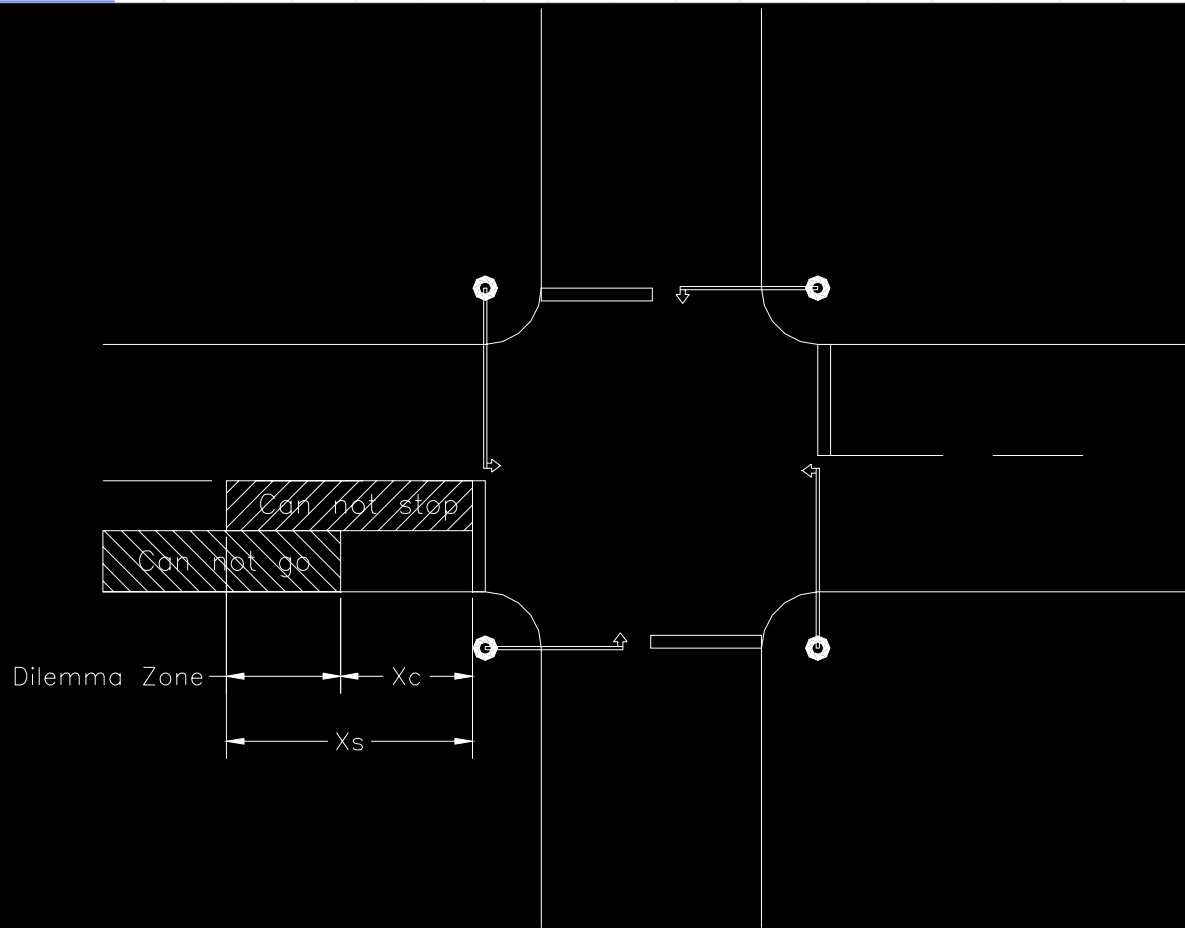
→ = NEMA Phase Sequence

→ = Phases that CAN run concurrently

Yellow and All-Red Time: Detection Dilemma Zones

- ◆ Drivers faced with “Dilemma” on whether to stop or go for yellow indication at high speed intersections.
 - Vehicle stopping distance = $[(\text{Travel speed}/60) \times 88] \times (\text{Yellow clearance interval}-1)$.
 - Requires proper loop spacing for travel speed of road.

Driver Dilemma Zone



Driver Dilemma Zone at Various Speeds and Yellow Intervals

Vehicle Speed (mph)	Stopping Distance "Xs" m(ft)	Clearance Distance "Xc" m(ft) at Yellow Interval of			Dilemma Zone m(ft) at Yellow Interval of		
		3.2 Sec.	4.0 Sec.	5.0 Sec.	3.2 Sec.	4.0 Sec.	5.0 Sec.
20	22.3(73)	19.8(65)	26.8(88)	35.7(117)	2.4(8)		
25	31.7(104)	24.7(81)	33.5(110)	44.8(147)	7.0(23)		
30	43.0(141)	29.6(97)	40.2(132)	53.6(176)	13.4(44)	2.7(9)	
35	56.1(184)	34.4(113)	46.9(154)	62.5(205)	21.6(71)	9.1(30)	
40	70.7(232)		53.6(176)	71.6(235)		17.1(56)	
45	86.9(285)		60.3(198)	80.5(264)		26.5(87)	5.8(19)
50	104.9(344)		67.0(220)	89.3(293)		37.8(124)	14.9(49)
55	124.4(408)		73.8(242)	98.4(323)		50.6(166)	25.9(85)
60	145.4(477)		80.5(264)	107.3(352)		64.9(213)	38.1(125)

Clearance Distance, X_c , equals the vehicle speed in meters (feet) per second times the Yellow Interval minus 1 second reaction time. This is the distance the vehicle would travel during the Yellow Interval if the decision were made to continue and not stop. Example: At 50 mph and a Yellow Interval of 4.0 seconds, $X_c = [(50/60) \times 88] \times (4-1) = 67.1$ meters (220 ft).

Actuated Signal Control Settings

- Yellow Time (Yellow Change)
- All Red Time (Red Clearance)

$$Y + R = T + \frac{V}{2A \pm 2G} + \frac{W + L}{V}$$

Y	length of the yellow interval;
R	length of the all-red interval;
T	driver perception/reaction time, recommended at 1.0 seconds;
V	velocity of approaching vehicle in meters/second;
A	vehicle deceleration rate;
G	Grade of the signal approach in percent;
W	width of intersection measured in meters;
L	length of vehicle clearance.

Fully-Actuated Signals – Basic Definitions

- **Minimum Green Time**

Minimum green time allowed for the green phase

- **Maximum Green Time**

Maximum green time allowed for the green phase

- **Gap/Passage Time**

Maximum gap between vehicles arriving at the detector to retain a given green phase

- **Volume Density Settings**

During peak period, it might be necessary to increase the maximum green time for the phase through volume/density setting

Actuated Signal Control Settings: Min Green

Minimum Green Time

Time for one vehicle to move into the intersection from the point of detection. Minimum green time setting should be at 4.0 to 5.0 seconds.

Should be compared against Pedestrian Times
Pedestrian Push Buttons

Pedestrian Times

Must be coordinated with vehicle signal phase (Minimum green values [4 to 7 seconds recommended by MUTCD])

Don't Walk Clearance

Must guarantee adequate crossing time for pedestrian safety (Average pedestrian walking speed is 3.5 to 4.0 feet/sec (elderly????))

Actuated Signal Control Settings: Max Green

•Maximum Green Time

Equation for through, right-turn and protected left-turn traffic.

$$G = 3.7 + 2.1N$$

Where N = Expected number of vehicles in the critical lane

Equation for unprotected left-turn, through, and right-turn traffic.

$$G = 3.7 + 2.1N + 2.7L$$

Where N = Number of opposing through, and right-turn vehicles in the critical lane, L = number of left-turn vehicles in the critical lane.

Or: $G = 1.5 \times \text{Green (fixed-time design)}$

Actuated Signal Control Settings

◆ Gap/Passage Time

- Set according to loop spacing and travel speed of the road.
- The gap/passage time should not be less than 2.0 seconds
- Example: A vehicle traveling at 25 mph covers nearly 37 feet per second. You want to allow a gap of 75 feet between vehicles. The gap/passage time should be 2.0 seconds. $(75 \div 37 = 2.027)$

Volume/Density Setting

- Time to Extend
- Maximum Extension
- Time Before Reduction
- Time to Reduce
- Seconds Per Actuation

