CE 3201: Introduction to Transportation Engineering
OASIS – Vehicle-Actuated Signal Control
Week Assigned: October 22, 2007
Due: Following week before lab

Objective:
The assignment builds upon previous labs, addressing queuing theory and traffic signal operations. It provides students with an opportunity to investigate fully-actuated signals and become comfortable with the operation.

Background:
In fully-actuated operations, all signal phases are controlled by detector actuations. In general, the minimum and maximum green times are specified for each phase. Maximum green does not begin timing until there is a serviceable, conflicting call. In this type of control, cycle length and green times vary considerably from cycle to cycle as well as the time-of-day (TOD). Certain phases in the cycle may be skipped entirely if no demand is present.

Instructions:

1. An online application for signalized intersection simulation is created to help you understand the actuated signal control logic. You can access this simulation tool at: http://street.umn.edu/OASIS/SignalControl.html.
2. Shown below in Figure 1 is a particular four-legged intersection being operated in a fully actuated mode. The timing sheet is shown in Figure 2. Shown in Figure 3 is the pattern of vehicle arrivals at the intersection; the time of each arrival is indicated by the symbol ⊗. In this figure, time is referenced to the system master (i.e., in "global time"). The row labeled "Initial Display" indicates the status of the signal display for the time period t < 51 seconds for each NEMA movement; "G" ⇔ Green, "Y" ⇔ Yellow, "AR" ⇔ All Red, "R" ⇔ Red. Assume that these initial displays have been indicated for an indefinite time prior to t = 51 seconds. The same sheet also indicated the active status of the signal displays for all NEMA movements that result from the arrival pattern show in Figure 2.

   Also, we indicate in the column labeled "Action," the controller operation that caused any transition from Green, using the following key:

   "G.O." ⇔ Gap Out
   "M.O." ⇔ Max Out

   Using these same codes, complete the Table in Figure 2 for the remaining time (i.e., to t = 133).

Figure 1: A Four-Legged Intersection

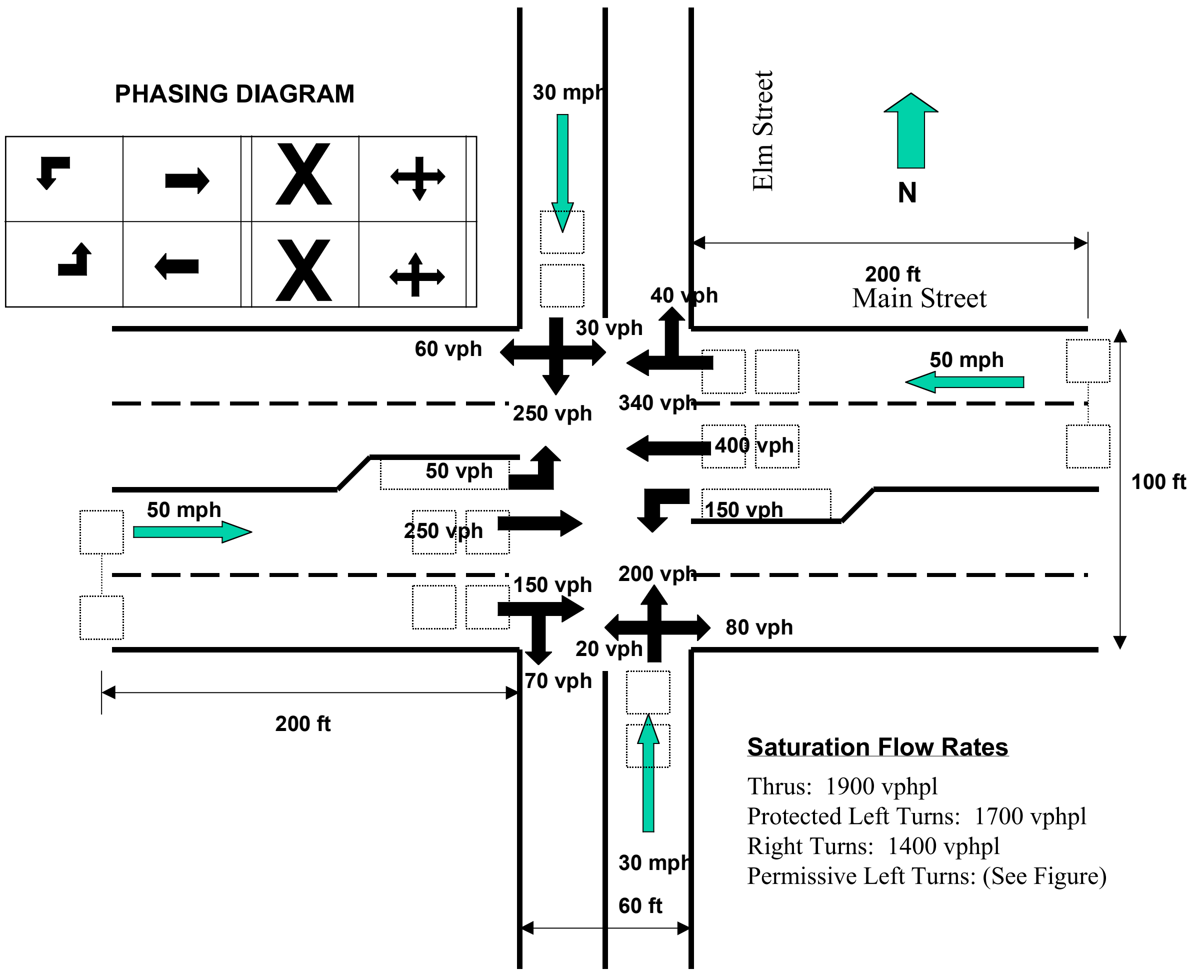

Figure 2: Timing Sheet

Phase Interval Times

Interval	Phase							
	1	2	3	4	5	6	7	8
Initial	6	20		10	6	15		10
Extension	2.0	3.0		2.0	2.0	3.0		2.0
Max1	15	60		40	15	60		40
Max2								
Yellow	3	5		4	3	5		4
Red Clearance	1	1		1	1	1		1
Permit	√	√		√	√	√		√
Max Recall								
Min Recall		√				√		
Lag Phase		√				√		

Interpretation of Timing Sheet:

- Minimum green = Initial
- Max = Maximal Green Time
- Permit - determines what phases to service.
- Lag - specifies which phase follows for each phase pair in the dual ring diagram.
- Min Recall - places a call to time minimum green, regardless of demands.
- Max Recall - places a call to time maximum extension, regardless of gap and traffic.

Figure 3: Pattern of Vehicle Arrivals and Controller Responses

Time	Arrivals								Signal Display								Conflicting Calls	Governing Clock Status				Controller Action
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8		Phase	Initial	Extension	Max	
Initial Display									R	G		R	R	G		R		2 6	0 0	3.0 3.0	60 60	
51									R	G		R	R	G		R		2 6	0 0	3.0 3.0	60 60	
52						⊗			R	G		R	R	G		R		2 6	0 0	3.0 3.0	60 60	
53									R	G		R	R	G		R		2 6	0 0	3.0 3.0	60 60	
54		⊗							R	G		R	R	G		R		2 6	0 0	3.0 3.0	60 60	
55				⊗					R	G		R	R	G		R	4	2 6	0 0	3.0 3.0	60 60	
56									R	G		R	R	G		R	4	2 6	0 0	2.0 2.0	59 59	
57		⊗		⊗					R	G		R	R	G		R	4	2 6	0 0	3.0 1.0	58 58	
58									R	G		R	R	G		R	4	2 6	0 0	2.0 0.0	57 57	
59									R	G		R	R	G		R	4	2 6	0 0	1.0 0.0	56 56	
60		⊗			⊗				R	G		R	R	G		R	4,5	2 6	0 0	3.0 0.0	55 55	
61									R	G		R	R	G		R	4,5	2 6	0 0	2.0 0.0	54 54	

62				⊗					R	G		R	R	G		R	4,5	2 6	0 0	1.0 0.0	53 53	
63						⊗			R	G		R	R	G		R	4,5	2 6	0 0	0.0 3.0	52 52	
64						⊗			R	G		R	R	G		R	4,5	2 6	0 0	0.0 3.0	51 51	
65									R	G		R	R	G		R	4,5	2 6	0 0	0.0 2.0	50 50	
66				⊗					R	G		R	R	G		R	4,5	2 6	0 0	0.0 1.0	49 49	
67		⊗							R	G		R	R	G		R	4,5	2 6	0 0	3.0 0.0	48 48	
68									R	G		R	R	G		R	4,5	2 6	0 0	2.0 0.0	47 47	
69		⊗							R	G		R	R	G		R	4,5	2 6	0 0	3.0 0.0	46 46	
70		⊗							R	G		R	R	G		R	4,5	2 6	0 0	3.0 0.0	45 45	
71									R	G		R	R	G		R	4,5	2 6	0 0	2.0 0.0	44 44	
72						⊗			R	G		R	R	G		R	4,5	2 6	0 0	1.0 3.0	43 43	
73									R	G		R	R	G		R	4,5	2 6	0 0	0.0 2.0	42 42	
74									R	G		R	R	G		R	4,5	2 6	0 0	0.0 1.0	41 41	
75		⊗							R	G		R	R	G		R	4,5	2 6	0 0	3.0 0.0	40 40	
76									R	G		R	R	G		R	4,5	2 6	0 0	2.0 0.0	39 39	
77									R	G		R	R	G		R	4,5	2 6	0 0	1.0 0.0	38 38	
78								⊗	R	G		R	R	G		R	4,5,8	2 6	0 0	0.0 0.0	37 37	G.O.

79									R	Y		R	R	Y		R	4,5,8	2 6	20 15	3.0 3.0	60 60	
80									R	Y		R	R	Y		R	4,5,8	2 6	20 15	3.0 3.0	60 60	
81									R	Y		R	R	Y		R	4,5,8	2 6	20 15	3.0 3.0	60 60	
82				⊗		⊗		⊗	R	Y		R	R	Y		R	4,5,8, 6	2 6	20 15	3.0 3.0	60 60	
83						⊗			R	Y		R	R	Y		R	4,5,8, 6	2 6	20 15	3.0 3.0	60 60	
84	⊗			⊗		⊗			R	AR		R	R	AR		R	4,5,8, 6,1	2 6	20 15	3.0 3.0	60 60	
85	⊗					⊗			R	R		G	R	R		G	5,1, 6	4 8	10 10	2.0 2.0	40 40	
86									R	R		G	R	R		G	5,1, 6	4 8	9 9	1.0 1.0	39 39	
87									R	R		G	R	R		G	5,1, 6	4 8	8 8	0.0 0.0	38 38	
88									R	R		G	R	R		G	5,1, 6	4 8	7 7	0.0 0.0	37 37	
89	⊗								R	R		G	R	R		G	5,1, 6	4 8	6 6	0.0 0.0	36 36	
90						⊗			R	R		G	R	R		G	5,1, 6	4 8	5 5	0.0 0.0	35 35	
91									R	R		G	R	R		G	5,1, 6	4 8	4 4	0.0 0.0	34 34	
92									R	R		G	R	R		G	5,1, 6	4 8	3 3	0.0 0.0	33 33	
93									R	R		G	R	R		G	5,1, 6	4 8	2 2	0.0 0.0	32 32	
94				⊗					R	R		G	R	R		G	5,1, 6	4 8	1 1	2.0 0.0	31 31	
95									R	R		G	R	R		G	5,1, 6	4 8	0 0	1.0 0.0	30 30	

96				⊗		⊗			R	R		G	R	R		G	5,1, 6	4 8	0 0	2.0 0.0	29 29	
97								⊗	R	R		G	R	R		G	5,1, 6	4 8	0 0	1.0 2.0	28 28	
98									R	R		G	R	R		G	5,1, 6	4 8	0 0	0.0 1.0	27 27	
99				⊗					R	R		G	R	R		G	5,1, 6	4 8	0 0	2.0 0.0	26 26	
100									R	R		G	R	R		G	5,1, 6	4 8	0 0	1.0 0.0	25 25	
101		⊗						⊗	R	R		G	R	R		G	5,1, 6,2	4 8	0 0	0.0 2.0	24 24	
102				⊗					R	R		G	R	R		G	5,1, 6,2	4 8	0 0	2.0 1.0	23 23	
103								⊗	R	R		G	R	R		G	5,1, 6,2	4 8	0 0	1.0 2.0	22 22	
104									R	R		G	R	R		G	5,1, 6,2	4 8	0 0	0.0 1.0	21 21	
105									R	R		G	R	R		G	5,1, 6,2	4 8	0 0	0.0 0.0	20 20	G.O.
106									R	R		Y	R	R		Y	5,1, 6,2	4 8	10 10	2.0 2.0	40 40	
107									R	R		Y	R	R		Y	5,1, 6,2	4 8	10 10	2.0 2.0	40 40	
108									R	R		Y	R	R		Y	5,1, 6,2	4 8	10 10	2.0 2.0	40 40	
109									R	R		Y	R	R		Y	5,1, 6,2	4 8	10 10	2.0 2.0	40 40	
110									R	R		AR	R	R		AR	5,1, 6,2	4 8	10 10	2.0 2.0	40 40	
111																						
112					⊗																	

113				⊗	⊗																	
114																						
115								⊗														
116					⊗																	
117																						
118					⊗																	
119		⊗						⊗														
120					⊗																	
121																						
122		⊗			⊗																	
123					⊗																	

124					⊗																	
125					⊗																	
126																						
127																						
128																						
129																						
130																						
131																						
132																						
133																						

Additional Questions –
In addition to submitting a completed Figure 3, please include your responses to the questions below.

1. What are the advantages to fully-actuated signals as opposed to fixed-time signals? Are there advantages to fixed-time signals?
2. What factors does this signal timing exercise ignore that a traffic engineer would need to take into account?
3. How should changes in land use and time-of-day effect signal timing?