## Traffic Light Management System (TLMS) Requirements

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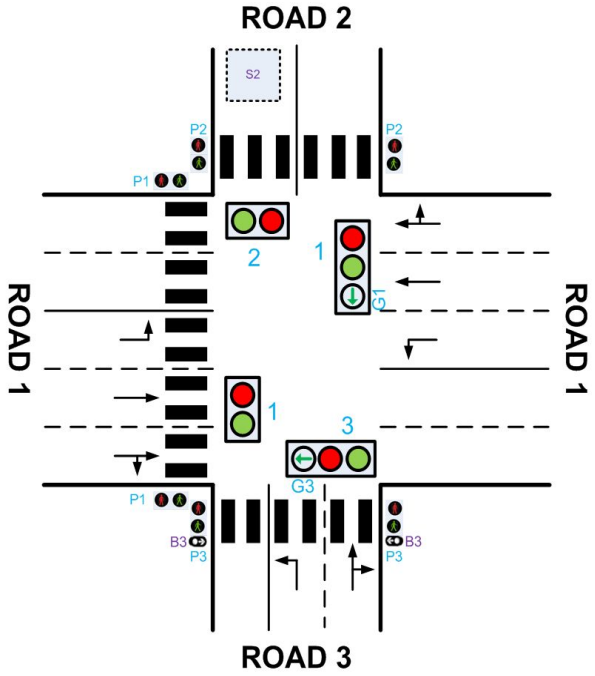
We are tasked with developing traffic light controller software for existing intersection in Edmonton. The system currently in place is outdated and the company wants a modern solution implemented. The new system will operate in 3 different modes: Default, Night, and Emergency mode. These modes are described in detail under Modes of Operation. The States section defines the seven states for the system and contains a table showing what lights will be green or red, and which timer is used for each state. The State Transition section describes how the system will transition between the seven states, and includes a transition diagram.




### System Components

1 - The green and red lights for Road 1.
2 - The green and red lights for Road 2.
3 - The green and red lights for Road 3.
G1 - The left turn blinker for Road 1.
G3 - The left turn blinker for Road 3.
P1 - The walk signal for pedestrians crossing Road 1.
P2 - The walk signal for pedestrians crossing Road 2.
P3 - The walk signal for pedestrians crossing Road 3.
B3 - The pedestrian crossing button for crossing Road 3.
S2 - A magnetic sensor for cars on Road 2.

## Hardware Restrictions

The traffic light control software will run on a microprocessor with 450 KB of memory for the program, and 54 KB of RAM. The system will have no networking capabilities and will need to be maintained and updated in person.

## CTA Standards

In each state, pedestrians and traffic who have the right of way will be able to travel safely, assuming both pedestrians and motorists obey Alberta traffic laws. The system will need to comply with all regulations set forth in the Alberta traffic safety act and by the transportation safety board of Canada.

## Modes of Operation

### Default Mode:

In default mode the traffic lights will cycle through 3-5 states depending on various inputs and two different timers. A detailed description of theses transitions is given under State Transitions. The system will operate in default mode between the hours of 6:00 AM to 10:00 PM, assuming no errors occur.

### Night Mode:

Night mode is activated between the hours of 10:00 PM and 6:00 AM. In this mode, the lights on Road 1 blink green and the lights on Roads 2 and 3 will blink red. All the pedestrian walk lights will be set to red.

### Emergency Mode:

Emergency mode is activated whenever the system encounters an error. Similar to Night mode, the lights on Road 1 blink green and the lights on Roads 2 and 3 will blink red. All the pedestrian walk lights will be set to red. The only way for the system to leave emergency mode is for a maintenance technician to manually reset the system. Emergency mode can also be activated manually by a technician in order to perform system maintenance.

## States

The system can be in one of seven states: *Default, Green G1, Green 3, Green P3, Green 2+3, Night,* and *Emergency*. Shown below is a table of what lights are active in each state.

| **States** | Light 1 | Light 2 | Light 3 | G1 | G3 | P1 | P2 | P3 | T1 | T2 |
|---|---|---|---|---|---|---|---|---|---|---|
| Default | G | R | R | R | R | R | G | R | On | Off |
| Green G1 | R | R | R | G | R | G | R | R | On | Off |
| Green 3 | R | R | G | R | G | R | R | R | Off | On |
| Green P3 | G | R | R | R | R | R | G | G | Off | On |
| Green 2+3 | R | G | G | R | R | R | R | R | Off | On |
| Night | BG | BR | BR | R | R | R | R | R | Off | Off |
| Emergency | BG | BR | BR | R | R | R | R | R | Off | Off |

## State Transitions

The system uses 2 timers. Timer 1 counts down from thirty seconds and activates signal T1 when it reaches 0. Timer 2 counts down from 15 seconds and activates signal T2 when it reaches 0. The timers are set according to the matrix above.

The Default state transitions to Green G1 when T1 is active.
Green G1 transitions to Green 3 when T2 is active.
Green 3 transitions back to the Default state when T2 is active.

If B3 is pressed, the Default state transitions to Green P3 when T1 is active.
Green P3 transitions to Green G1 when T2 is active.

Is S2 is active, Green 3 transitions to Green 2+3 when T2 is active.
Green 2+3 transitions to the default state when T2 is active.

If it is past 10:00 PM, the Default state transitions to Night state.
If it is past 6:00 AM, the Night state transitions to the Default state.

If any error is occurs, the system transitions to the Emergency state immediately.
The system will stay in Emergency mode until a manual reset.

When the system is first initialized it will enter emergency mode, then immediately go to the default state.

The state transition diagram.