**Vision Document**

For Multi-Agent Control of Traffic Signals

Version 1.0

Submitted in partial fulfillment of the requirements of the degree of MSE

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# Introduction

The intent of this project is to create an efficient, scalable, modular Multi-Agent System (MAS) that controls traffic signals given sensor data. A white paper from the THALES group discusses at a high level the use of genetic algorithms with a MAS to improve traffic flow. That paper also provides a sample road network with traffic flow data that can be used for comparison.

The purpose of this project is to show a Multi-Agent System can be used to create a more positive experience for the driver and benefit the environment at the same time.

Show improvements over a baseline typical timing based network with the following metrics: travel time, loss time (# of stops), fuel consumption, hydrocarbon production. To show these improvements I will model timing based behavior with a standard SUMO model. Then I will model a simple reactive MAS, a more intelligent reactive MAS, a MAS that uses genetic algorithms and finally a MAS that uses mesh network based collaboration.

## Motivation

Adf

## Terms and Definitions

Asdf

## References

Agent

Multi-Agent System

SUMO

TraCI

RabbitMQ

MongoDB

## Risks (skip from here on)

*To be done*

## Solution Drawbacks

The system is heavily reliant on sensors and a communications path between agents.

## Constraints

*To be done*

## Direction

*To be done*

## Main product features

*To be done*

## Quality attributes

This is the section often known as the “ities.”

### Functionality

### Reliability

### Understandability

### Usability

### Modifiability

### Testability

### Portability

Mainstream open source products and tools are used to allow for maximum portability.

### Efficiency

The project should strive towards the minimum amount of communication necessary for both intra and inter organization conversations.

### Flexibility

An agent organization should be configurable to handle many types of intersections.

### Modularity

Agent organizations should be designed so that they are modular and can be dropped in and configured for a given intersection.

### Scalability

The system should be able to work with one or two intersections and be scale free. That is, it should work in a town with a single intersection as well as a large city with thousands of intersections.

### Security

Agents should not transmit or receive encrypted data from other agents that are not registered with a central certifying authority.

### Safety

The local systems should have a safety feature that does not permit scenarios that would lead to collisions between cars.

## External interfaces

*To be done – things this project interfaces with, or how can others interface with it?*

SUMO, TraCI, RabbitMQ, MongoDB

# Project Overview

Asdf

## Project Goal

Asdf

## System Context

asdf

# Project Requirements

Driving requirements of project

Use case diagrams and data flow diagrams

The requirements will describe all key functionality required of the resulting system. At a minimum, the requirements will include the valid range of inputs and the expected outputs associated with those inputs. Each requirement will also be given a unique identifier. This document will continue to evolve at least until the architecture presentation and will be continually updated.

## Critical Use Cases

### Displays Simulation

**Description:** asdf

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

### Provides current simulation state data

**Description:** asdf

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

### Produces individual intersection state data

**Description:** asdf

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

### Executes traffic light signal plan

**Description:** asdf

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

### Information about current intersection status is shared

**Description:** asdf

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

### Produce data to share with neighboring intersections

**Description:** asdf

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

### Create traffic light signal plan

**Description:** asdf

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

#### Incorporate data that was shared into planning

**Description:** asdf

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

### Verify plan is safe

**Description:** asdf

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

### Submit plan to be executed

**Description:** asdf

**Pre-Conditions:** asdf

**Details:** asdf

**Post Conditions:** asdf

**Specific Requirements:**

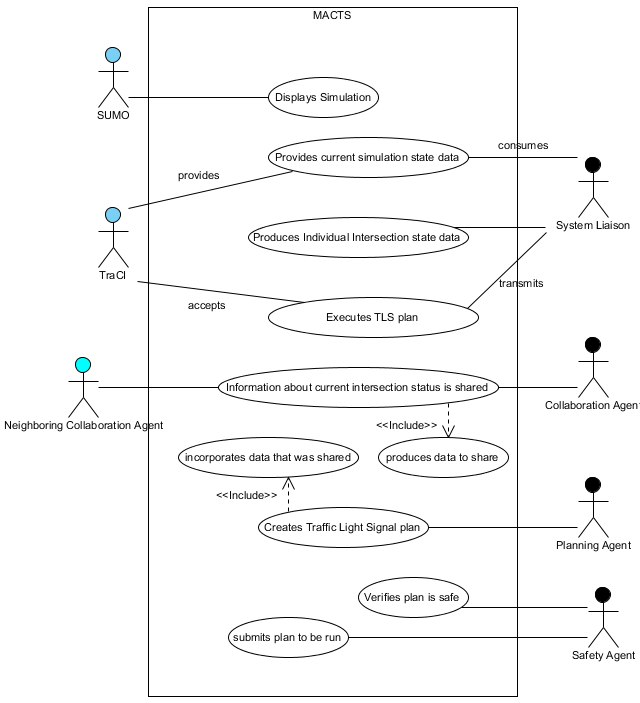


Figure Critical Use Cases

## System Activity

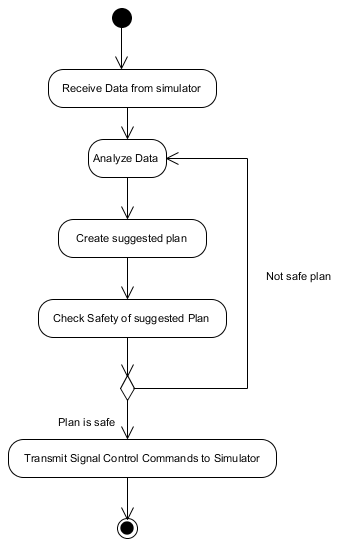


Figure UML Activity Diagram for a single simulation iteration

# Assumptions

Like has specific version of SUMO and Python, etc.

# Constraints

This system will not attempt to model the behavior of individual cars nor to visualize system behavior. Those aspects are left to the simulation engine SUMO.

# Environment

Agents written in…

Dev environment, etc. include separate environment document?