

# The CajunBot Task Planner Architecture for the Urban Challenge



2007 DARPA Urban Challenge (Workshop Presentation)

By

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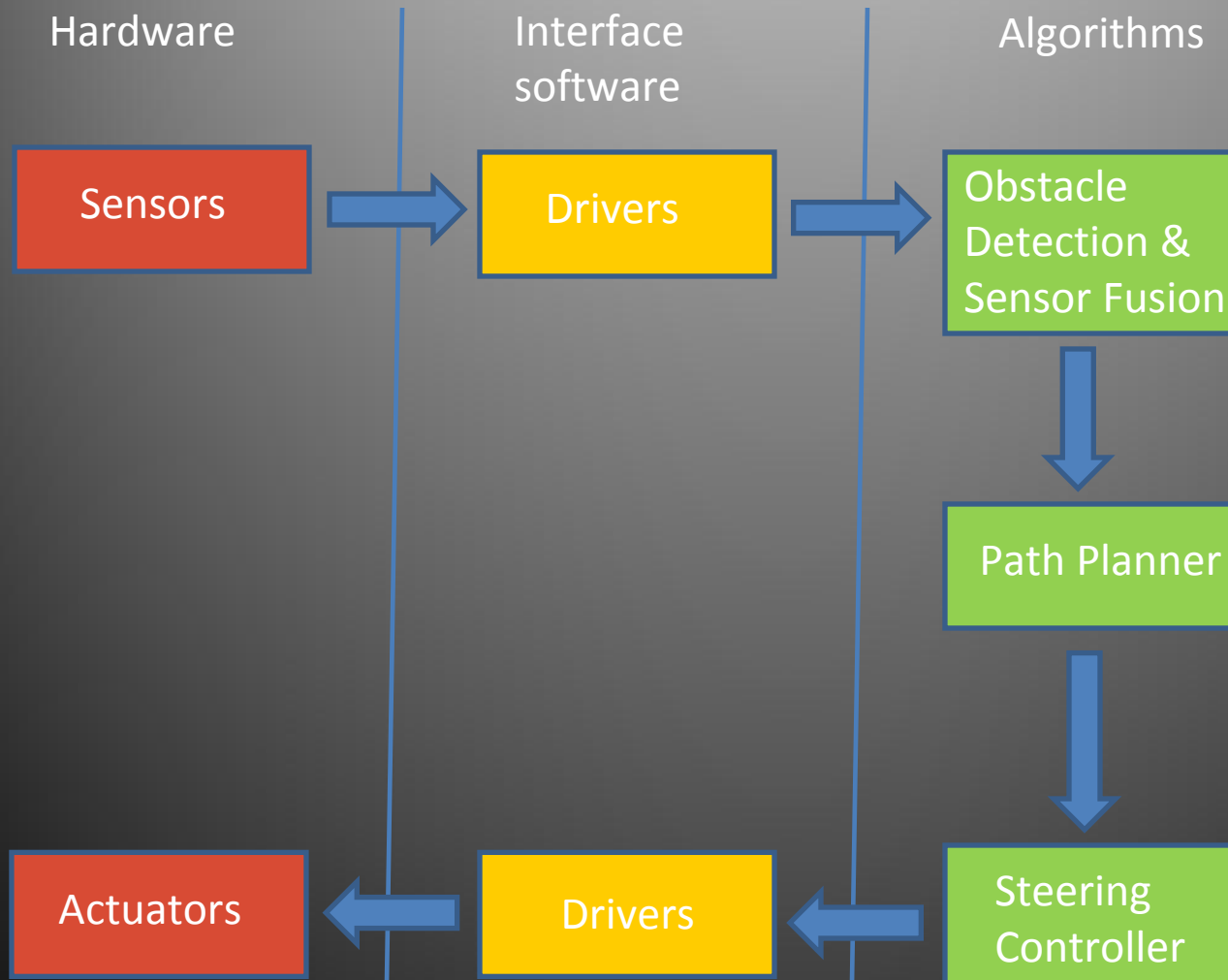
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[www.cajunbot.com](http://www.cajunbot.com)

# Presentation Overview

- Overall Software Architecture
- Problem Analysis & Basic Idea
- Basic Example Scenario
- Advanced Example Scenario
- Advantages of TP Architecture
- Conclusion & Question

# Autonomous Vehicle's Software System



# Problem Analysis & Basic Idea

- Requires diverse capabilities

{follow lanes, change lanes, uturn, park, unpark, follow traffic rules, etc}

- Independent capabilities

**Task Planner:** Intelligent agent specialized in handling specific scenario.




Like follow lane task planner, parking task planner

- Requires modification of the plan based on new situations

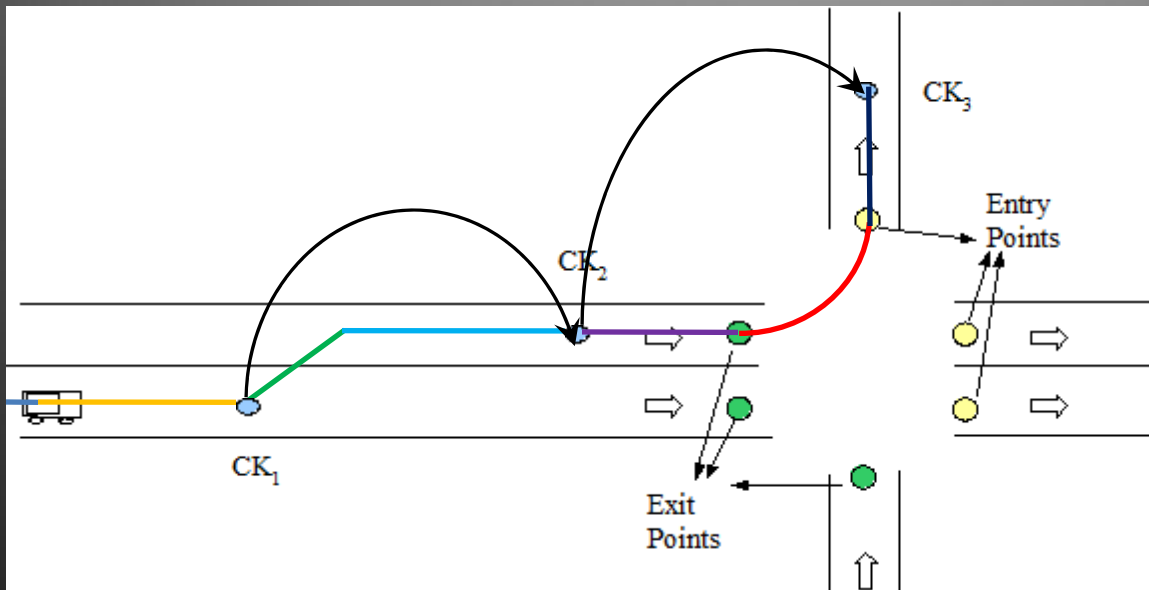
**Supervisor:** Plan initial system and handle real time situations by modifying 'Task Planner'

# Task planners

| Task planner   | Acronym | Description  |
|----------------|---------|--|
| Follow lane    | FL_TP   | Follow the center of the lane from one waypoint to another or for certain distance                 |
| Change lane    | CL_TP   | Generate a smooth path to change from one lane to its neighboring lane                             |
| Traffic lane   | TL_TP   | Generate a smooth path to drive over blocked lane using an on-coming traffic lane                  |
| Uturn          | UT_TP   | Generate a 3 point uturn and staying within the road   |
| Intersection   | IT_TP   | Generate a curved path through intersection and worry about stop sign, traffic, right of way, etc. |
| Parking        | PK__TP  | <i>Generate a path to park the vehicle in a specified spot at specified orientation</i>            |
| Unparking      | UP_TP   | Generate a path to pull out of a parking spot  |
| Zone navigator | ZN_TP   | Generate a path to drive through an open area avoiding obstacles.                                  |

-  On road task planners
-  Transition task planner
-  Within zone task planners

# Example



## Task Plan

FL\_TP

CL\_TP

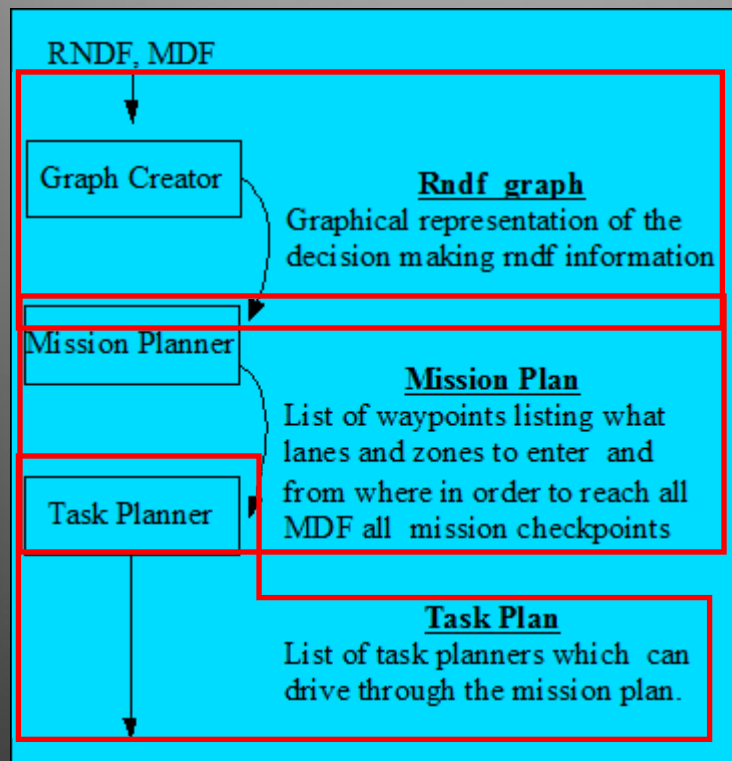
FL\_TP

FL\_TP

IT\_TP

FL\_TP

# Supervisor: Task Plan



# Example: Plan modification

Initial Task Plan

FL\_TP

New Task

Plan FL\_TP

CL\_TP

FL\_TP

CL\_TP

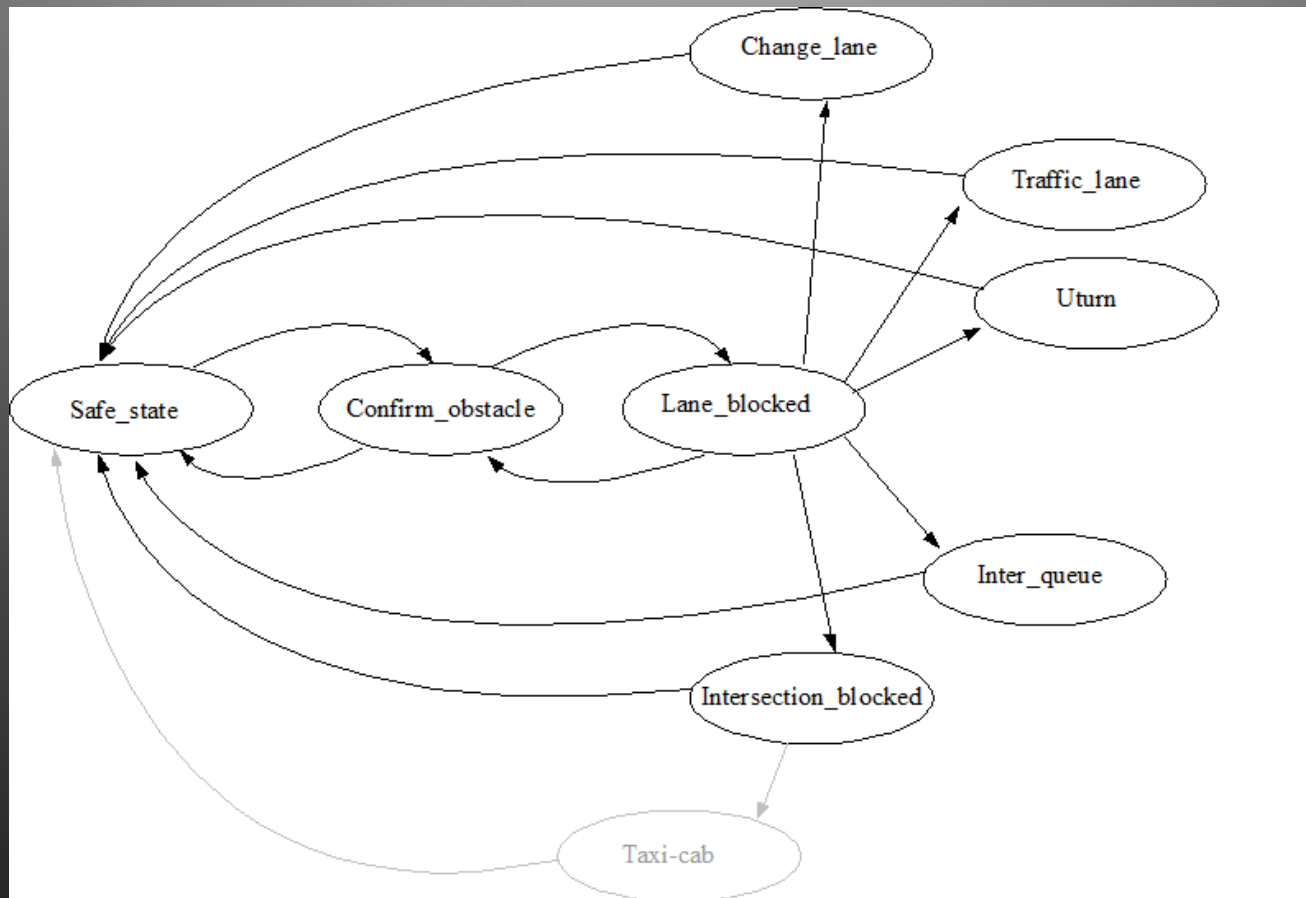
FL\_TP





# Supervisor Modify Plan

State machine when following lane



# Advantages of TP Architecture

- Simplified problem statement
- Incremental development & independent upgrades
- Easy handling of real-time situation encountered (by making decision in terms of task planners)
- Task planner list can guide obstacle detection where to concentration
- Easy modification of path planner's behavior

# Possible Issues with TP Architecture

- TP Communication
- Incompatible TPs
- Incompatible TP paths
  - Path direction {forward, reverse}
  - Path tightness {tight path, regular path}

Conclusion

Question?

# Questions?

# Path Planner Hierarchy

## Two level path planner

- Task Planner Handler
  - Determine task planners
  - Maintain & use task planners
  - Modify task planners for situations encountered
- Task Planner
  - Generate path

# Path Planner

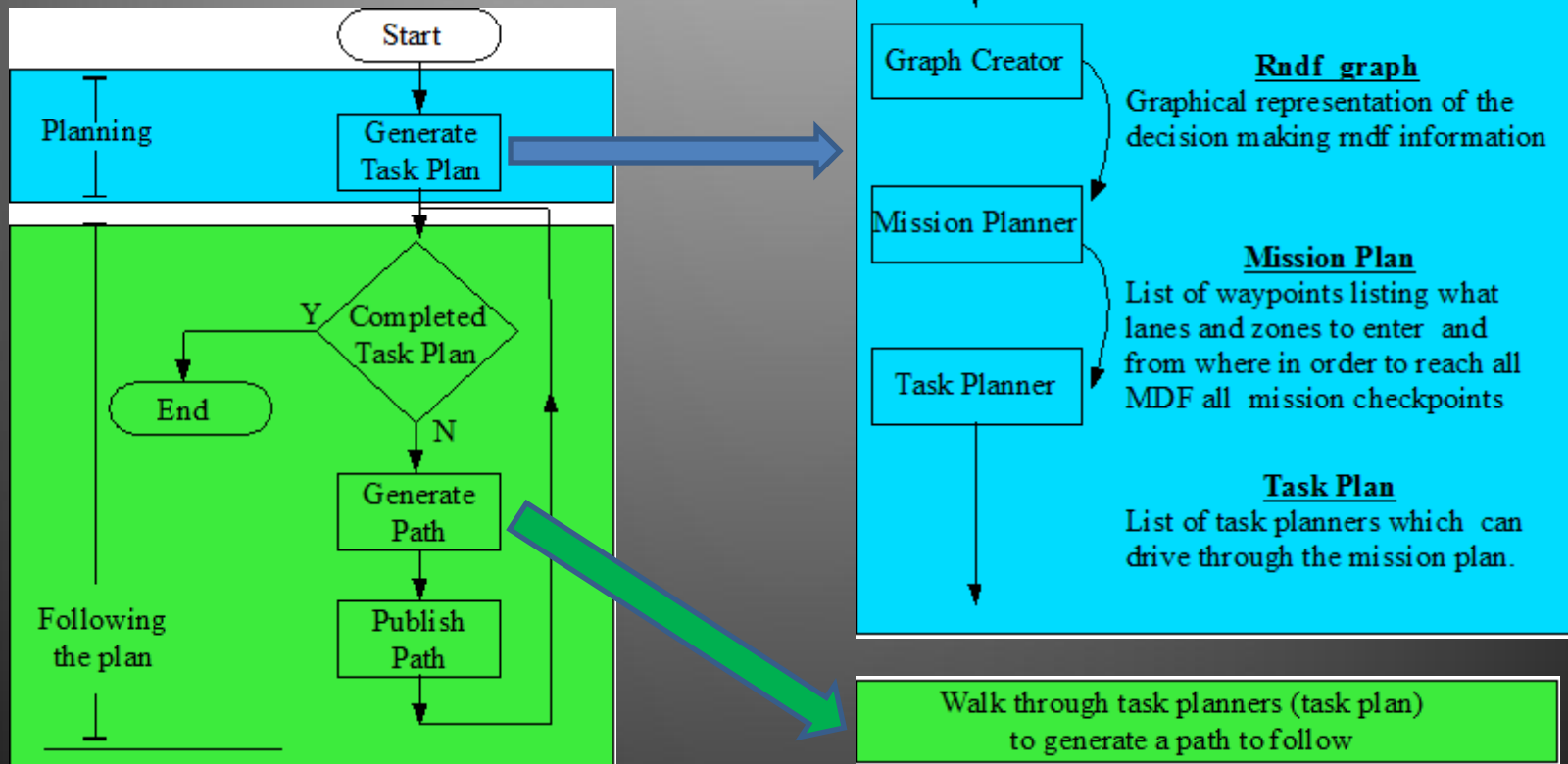
- **Basic Path Planner:**

Driving through urban world with no traffic or lane blockages

- **Advanced Path Planner:**

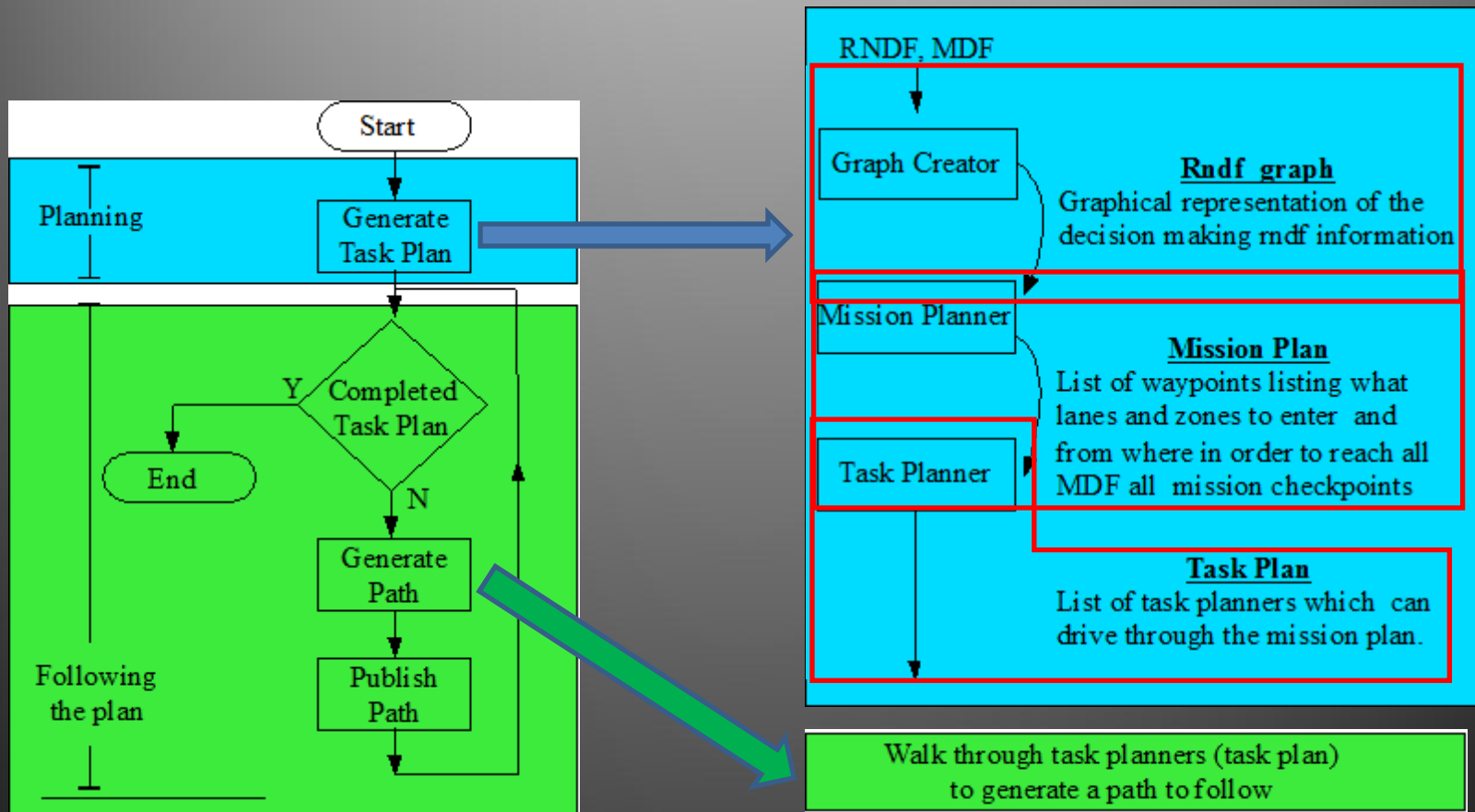
Driving lane blockages and traffic

# Basic Path Planner Architecture

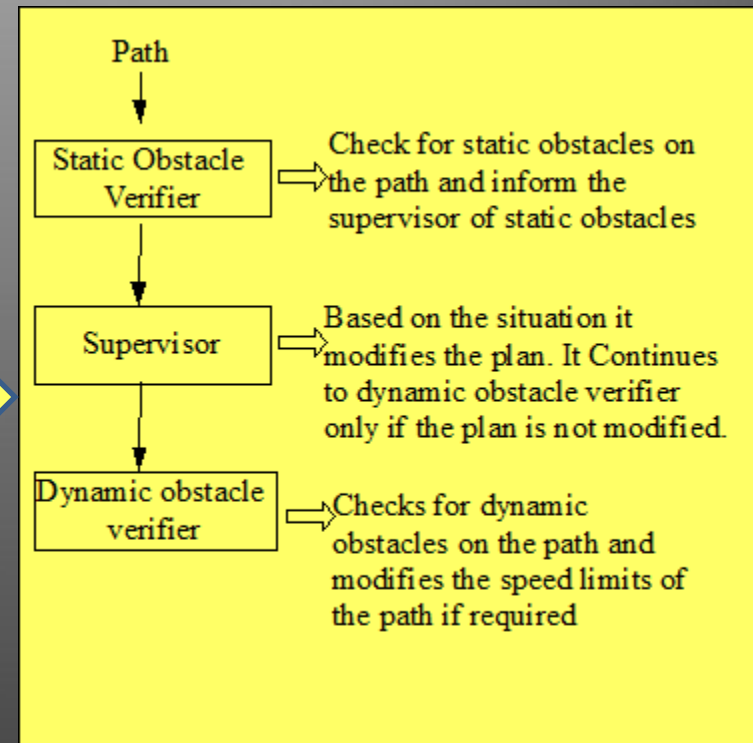
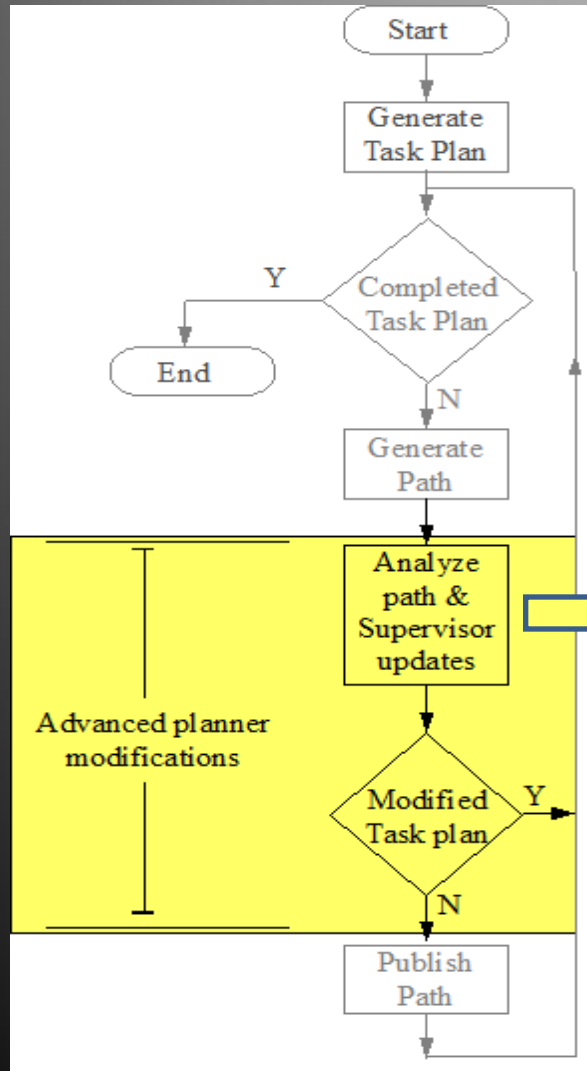




# Basic Path Planner Architecture



# Advanced Path Planner



# Future Upgrades

- Ability to backup for new plan
- Take dynamic traffic more serious
- Look for dynamic traffic off the lane
- Supervisor to handle situations that 'zone task planner' cannot handle locally

# Basic Idea

Develop intelligent agents each of which are specialized in handling a specific scenario, like follow lane, change lane, etc. (*Task Planner*)

Perform the planning of mission and handling of new situations encountered by using these Task Planners (**Task Plannner Handler**)