



Aalto University  
School of Electrical  
Engineering

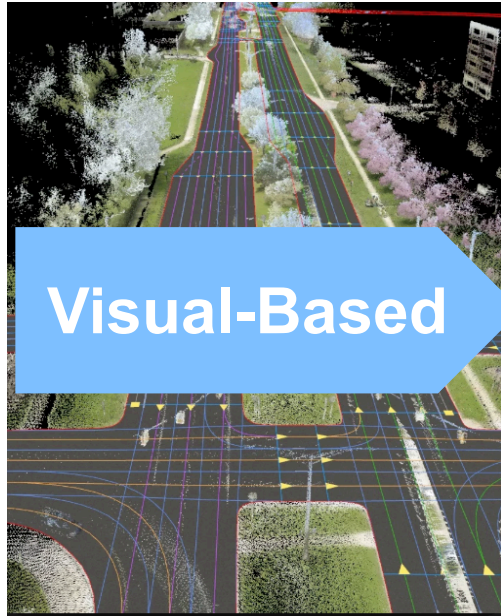
# Latency and Resolution Aware Task Offloading for Visual-based Assisted Driving

*Chao Zhu*



# Emerging Vehicular Applications

## High Definition Maps



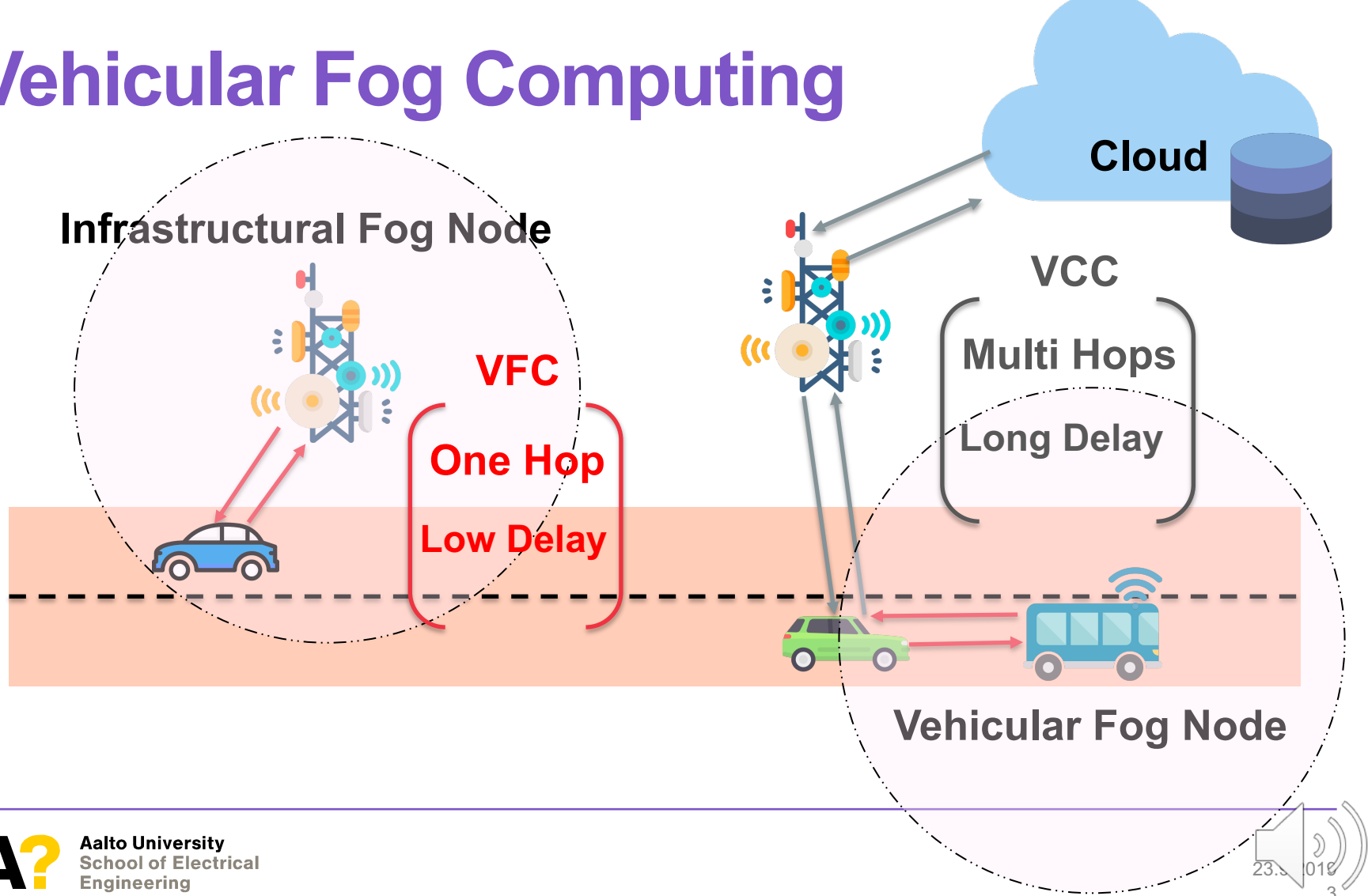
## See-Through



## Smart Lane Change



# Vehicular Fog Computing



# Task Offloading in VFC

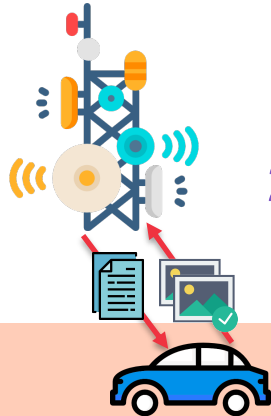


Visual-based Task

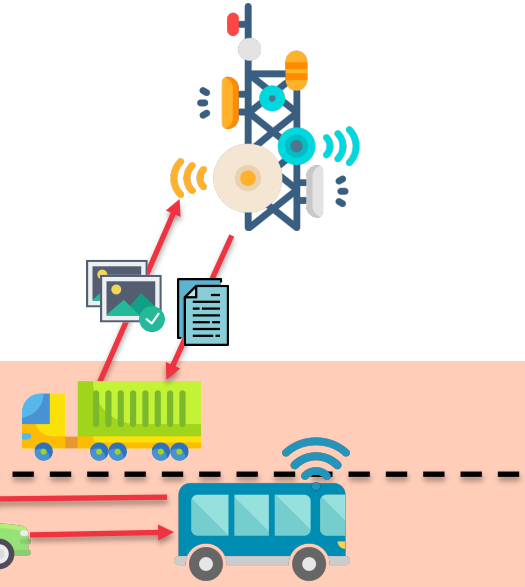


Processed Result

## Infrastructural Fog Node

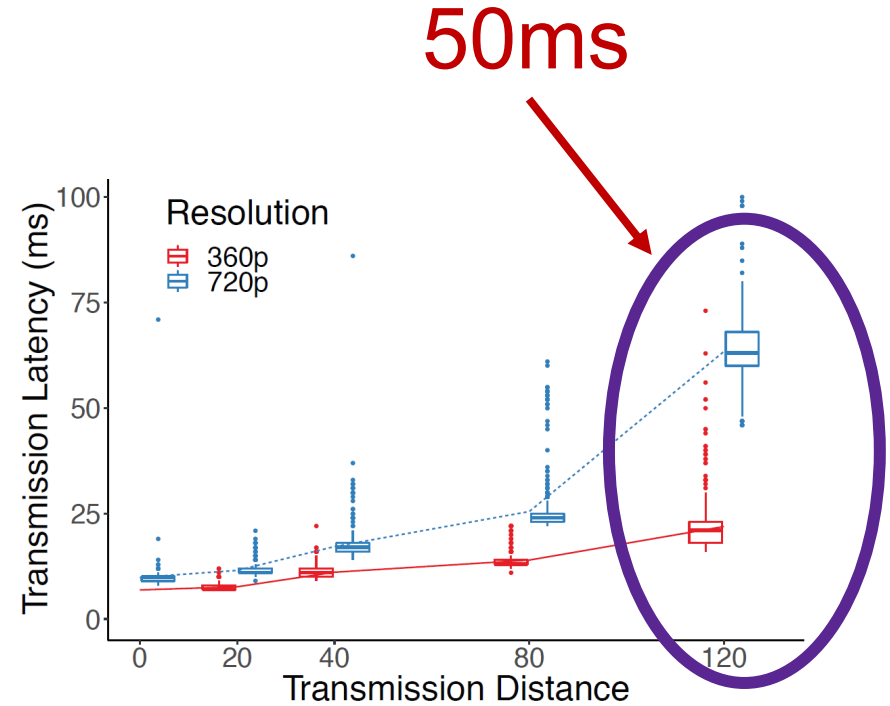


1. Higher resolution, smaller objects can be detected
2. Higher resolution, longer latency (transmission latency and processing latency)



## Vehicular Fog Node

# Resolution v.s. Transmission Latency



# Resolution v.s. Processing Latency

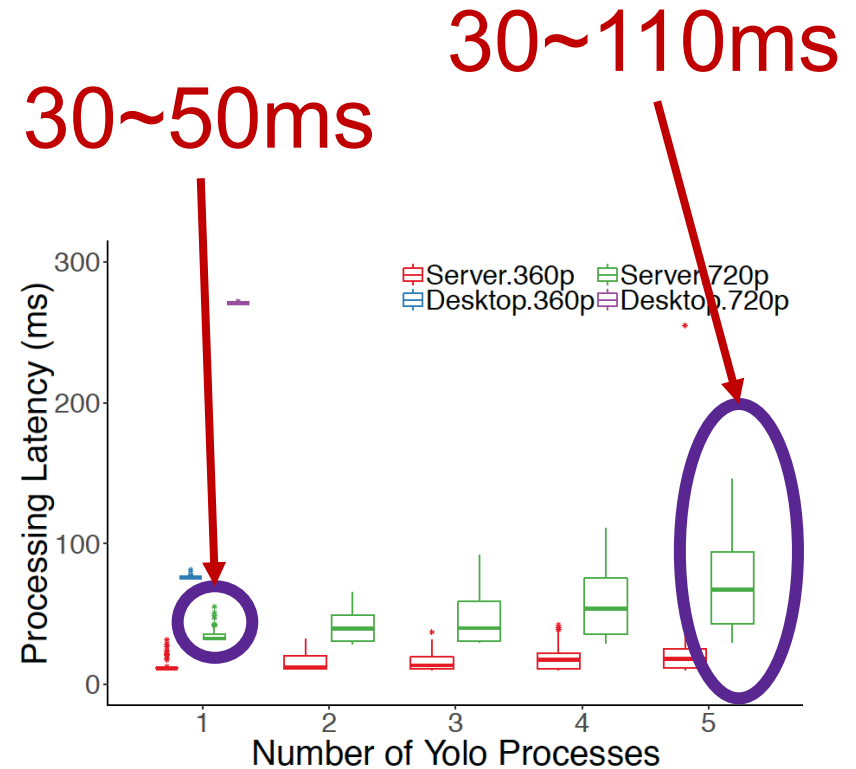
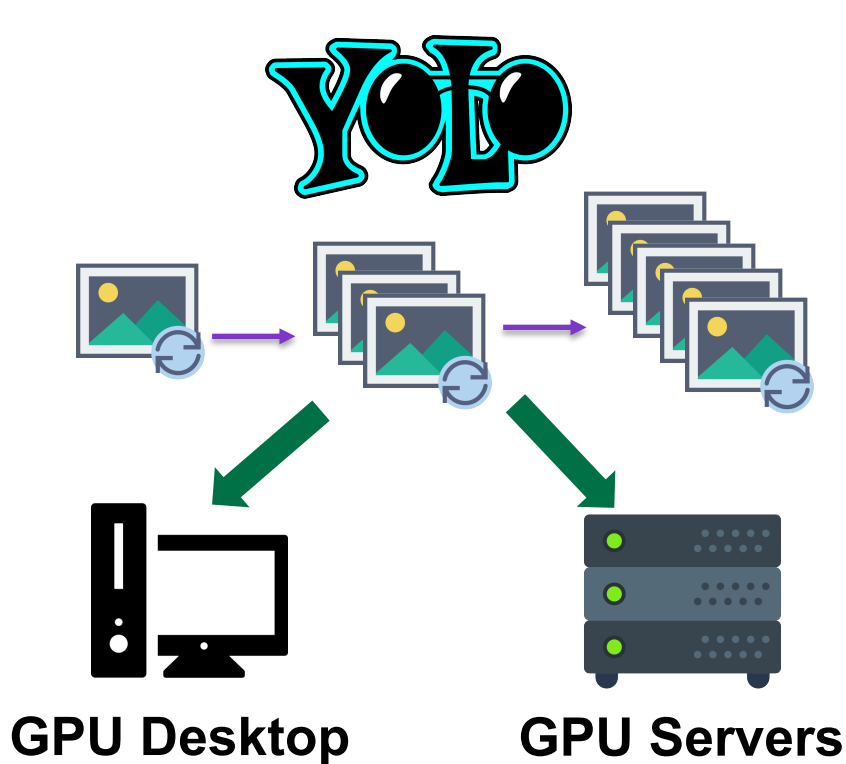


720p: 270ms



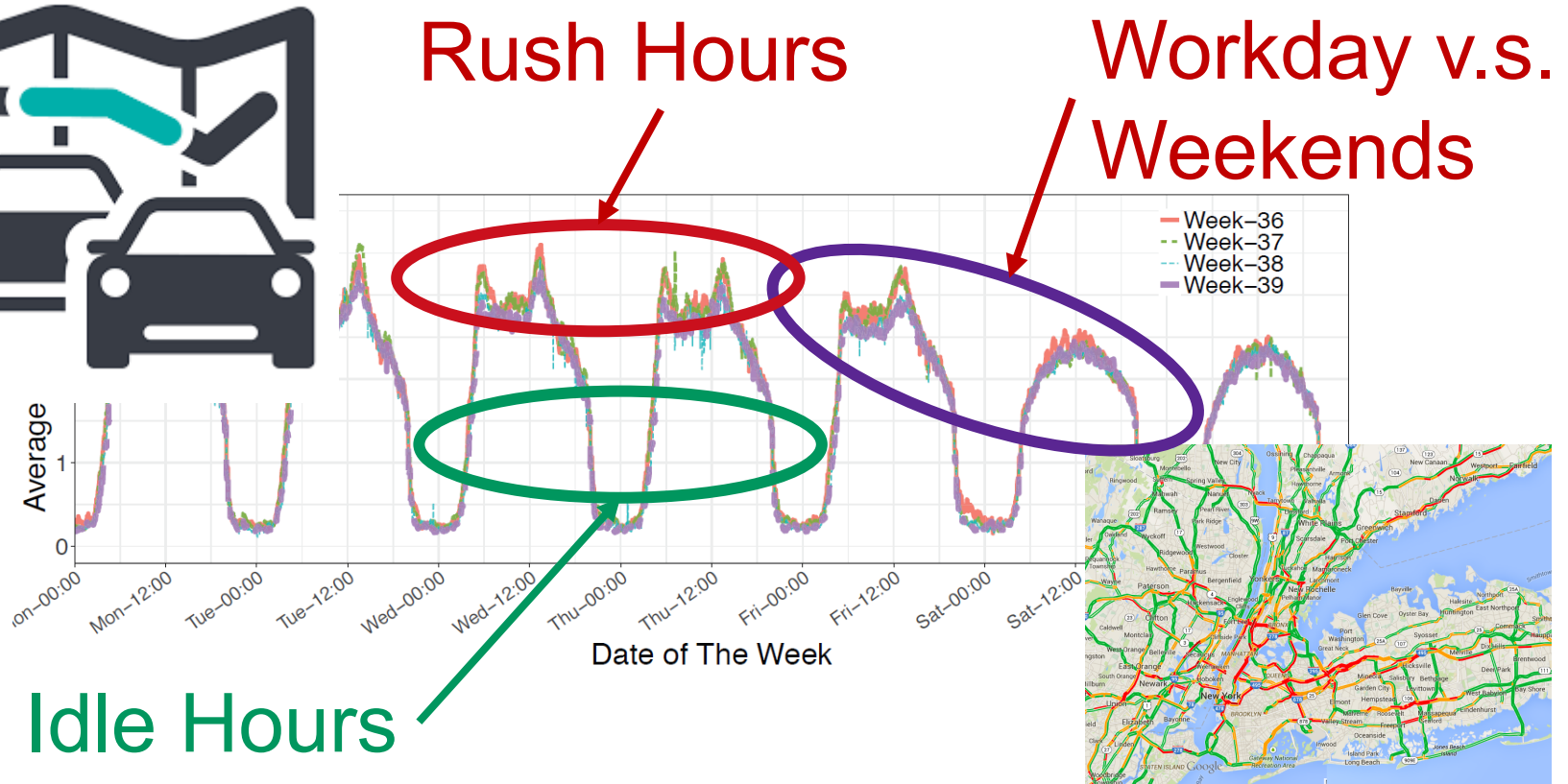
360p: 80ms

# Server Workload v.s. Processing Latency



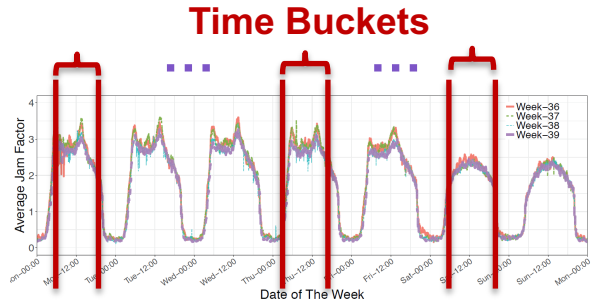


# Temporal Variation in Vehicular Traffic





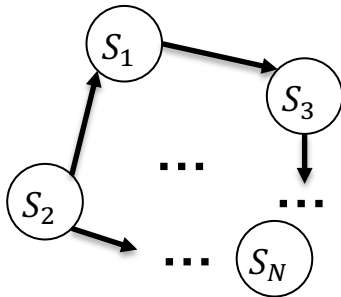
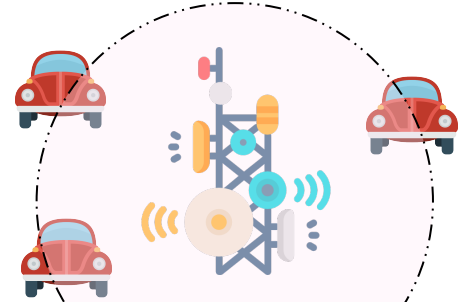
# Server Workload Variation Modeling



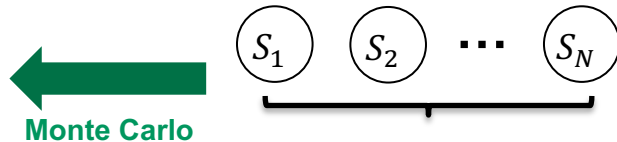
Divide one day in time buckets

Assumption: One type assisted driving application

Number of neighboring vehicles



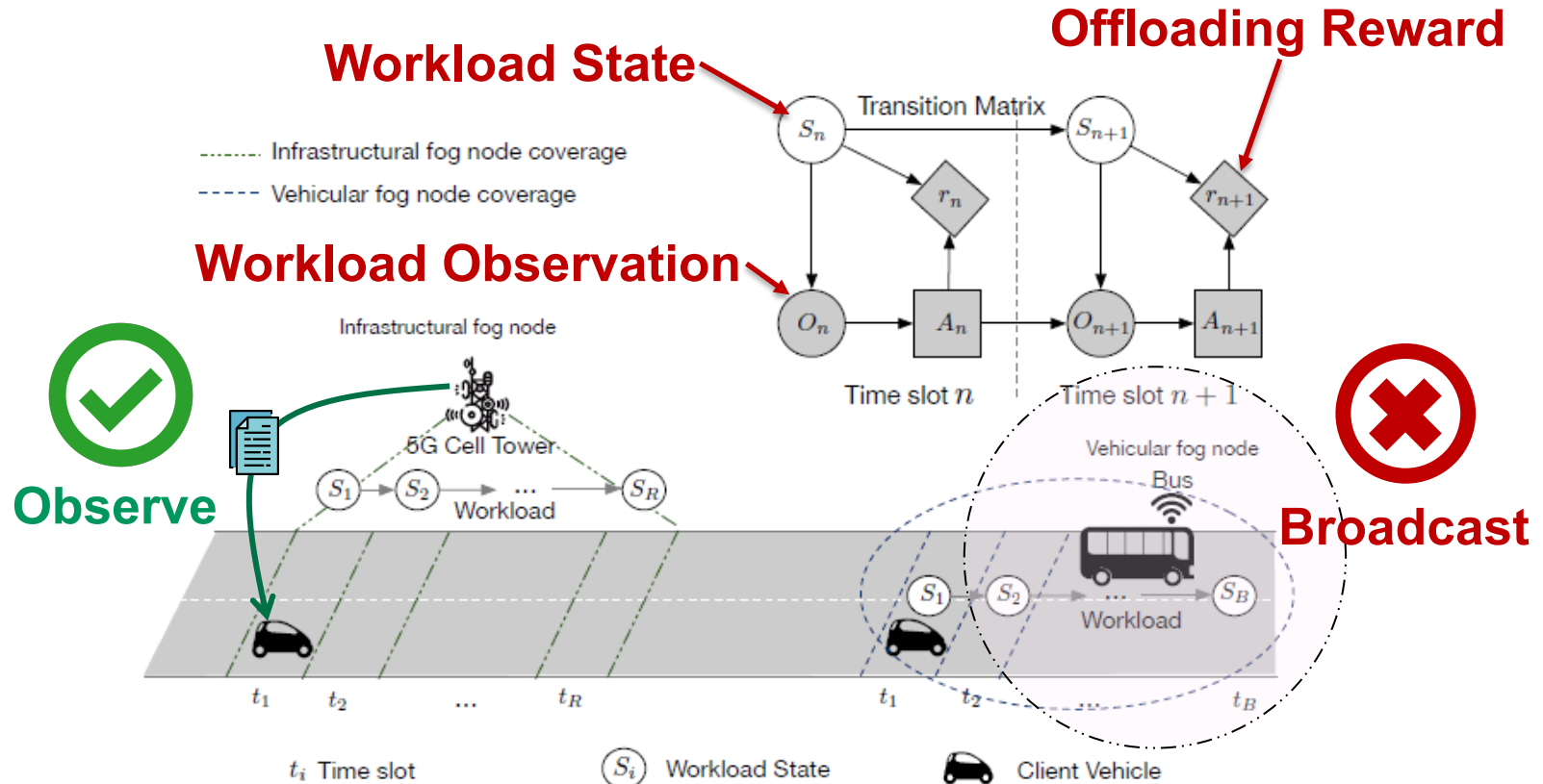
Markov Chain



Workload States

Record in each time slot

# Server Workload Observation



# Optimization Reward & Object

## Reward for Each Task Offloading

$$U_r(l_i, q_i) = \phi a(t(l_i, q_i) + p(l_i, q_i)) + (1 - \phi) b q_i$$

Latency Sensitivity Parameter

Reward per second

Reward per resolution level

Offloading Reward

Workload State

Task Resolution level

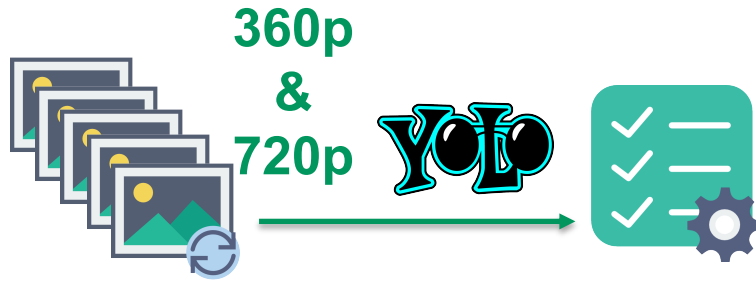
Transmission Latency

Processing Latency

## Optimization Object:

- maximize the cumulative task reward during each time bucket

# Simulation Setup



Application Profiles (1 task/s)



Transmission Performance

Two Time Buckets

I: 08:00~08:05

II: 20:00~20:05



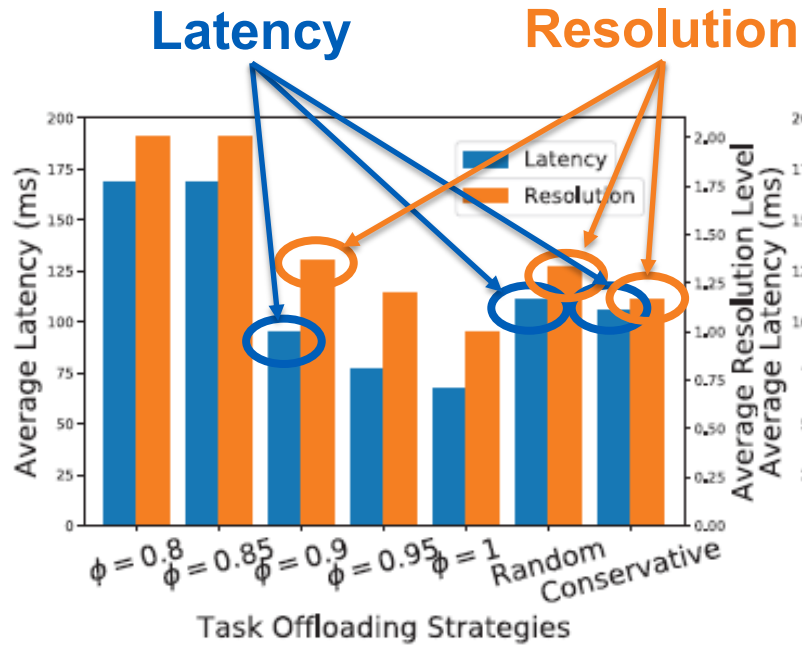
(a) Time Bucket I



(b) Time Bucket II

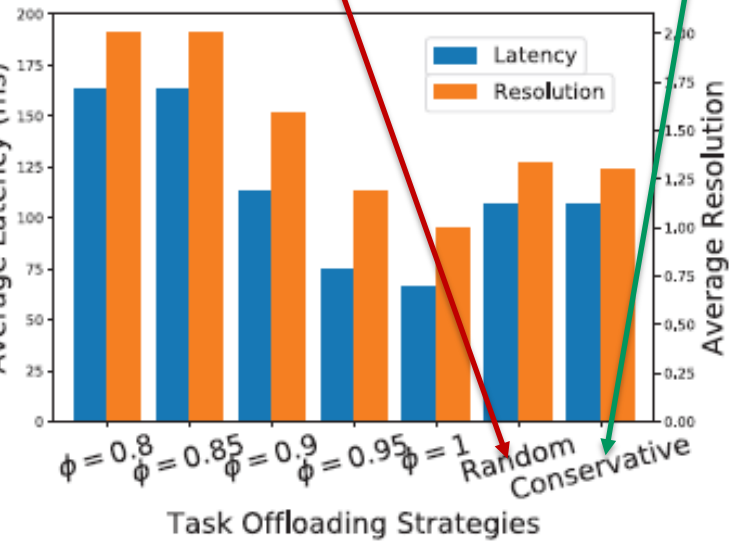
Real-world Vehicle Trajectories

# Simulation Results



(a) Time Bucket I

Random choose offloading action



(b) Time Bucket II

Choose offloading 360p when workload is heavy and 720p when workload is light

# Q & A