ARVE: Augmented Reality Applications in Vehicle to Edge Networks

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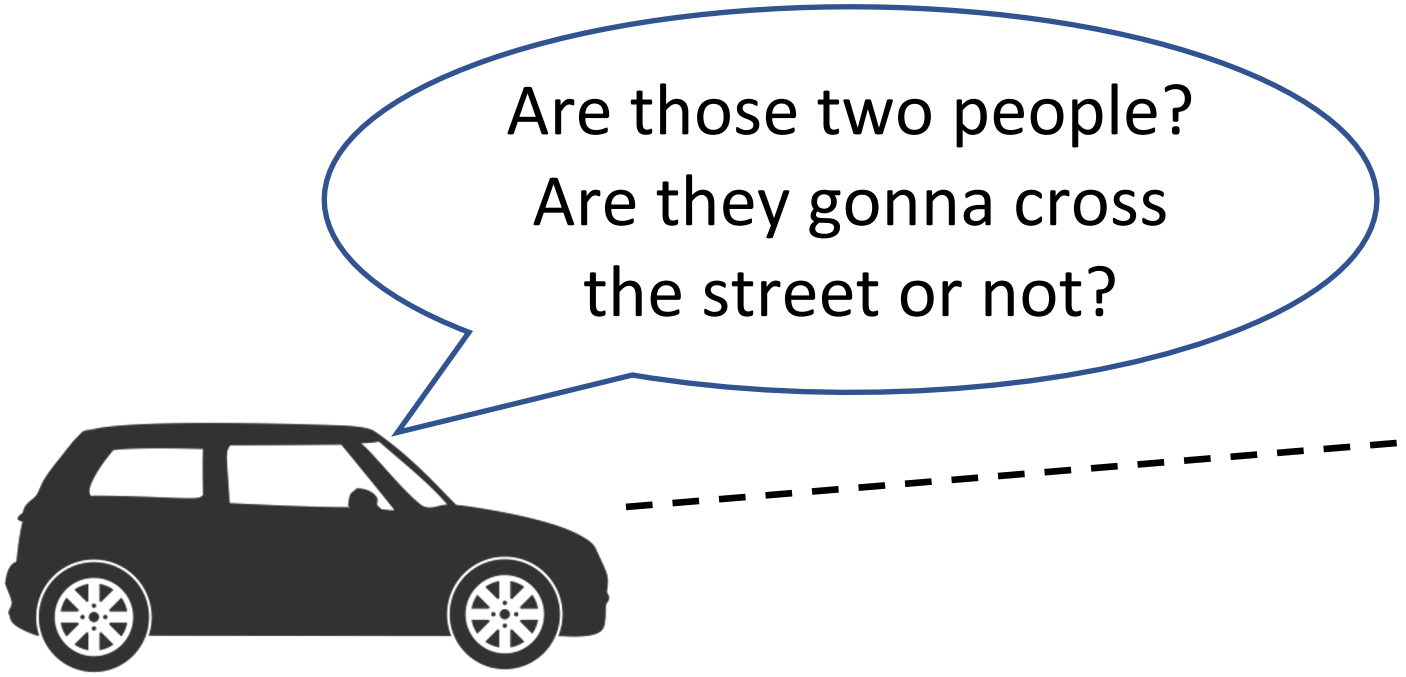
Pan Hui, Jussi Kangasharju

Hazards of self-driving

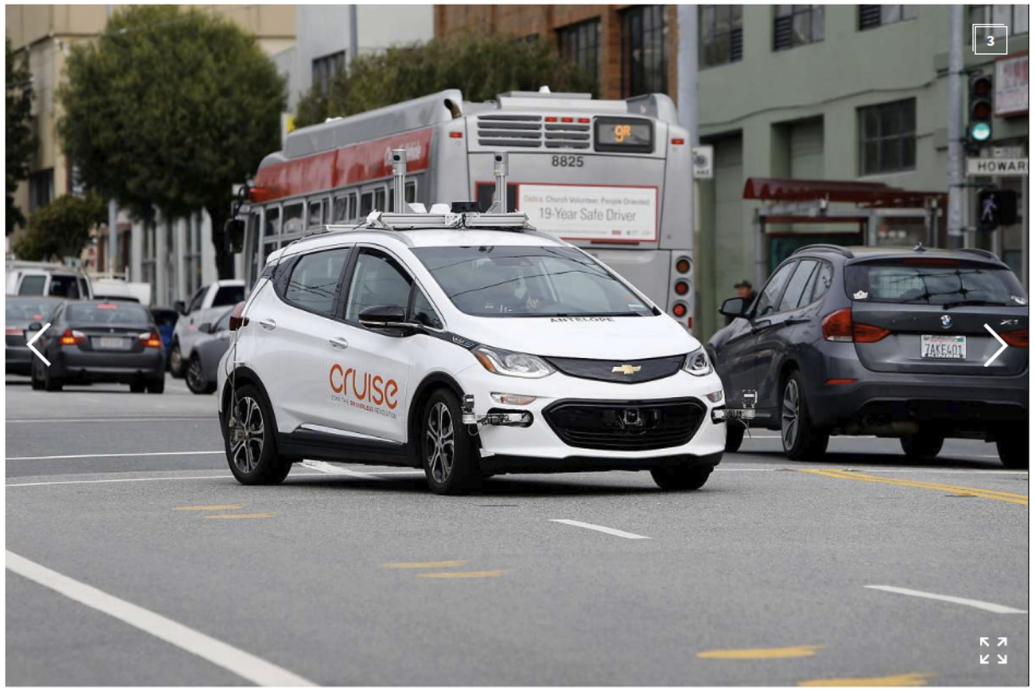


Hazards of self-driving

BIZ & TECH // BUSINESS

After Uber accident, fewer people want self-driving cars

David R. Baker | Aug. 16, 2018 | Updated: Aug. 16, 2018 4 a.m.



1 of 3

A Cruise self-driving car is tested last year on 11th Street in San Francisco.

Photo: Paul Chinn / The Chronicle 2017

Most Popular

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- Carr Fire's horrendous tornado captured in newly released videos
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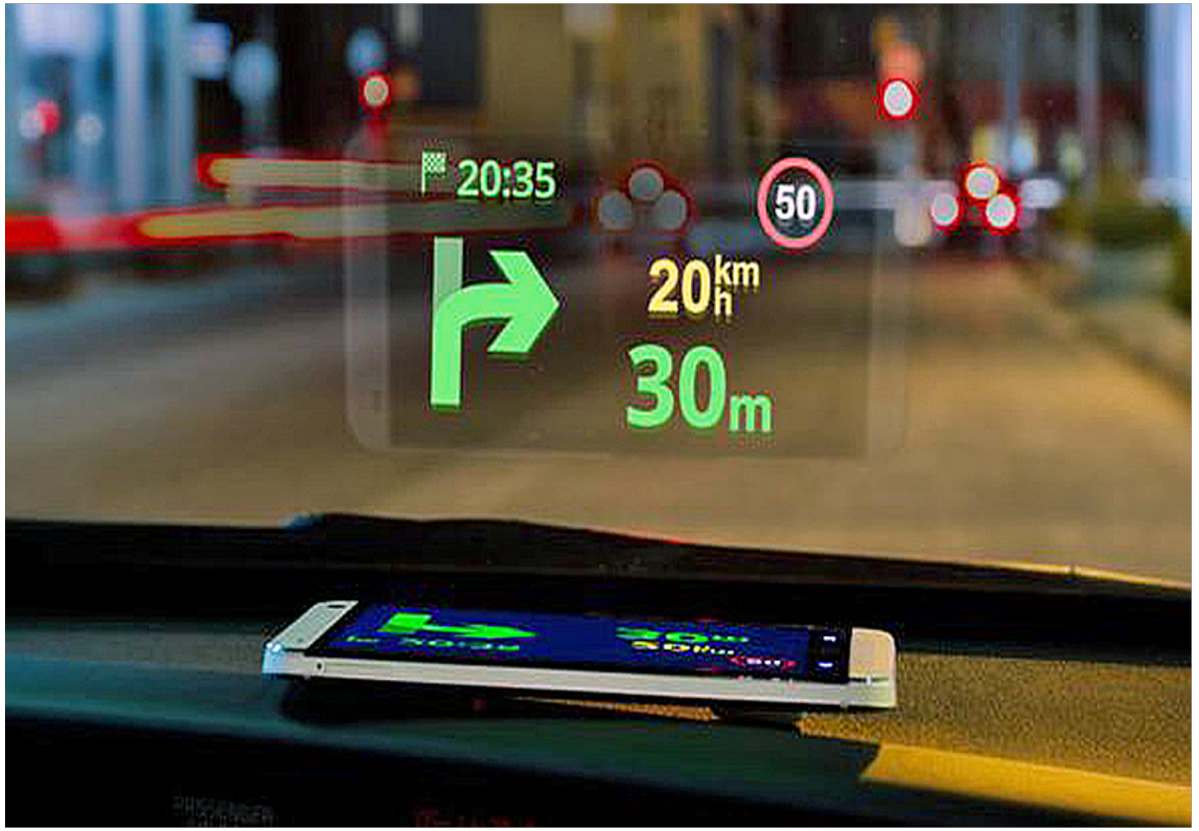
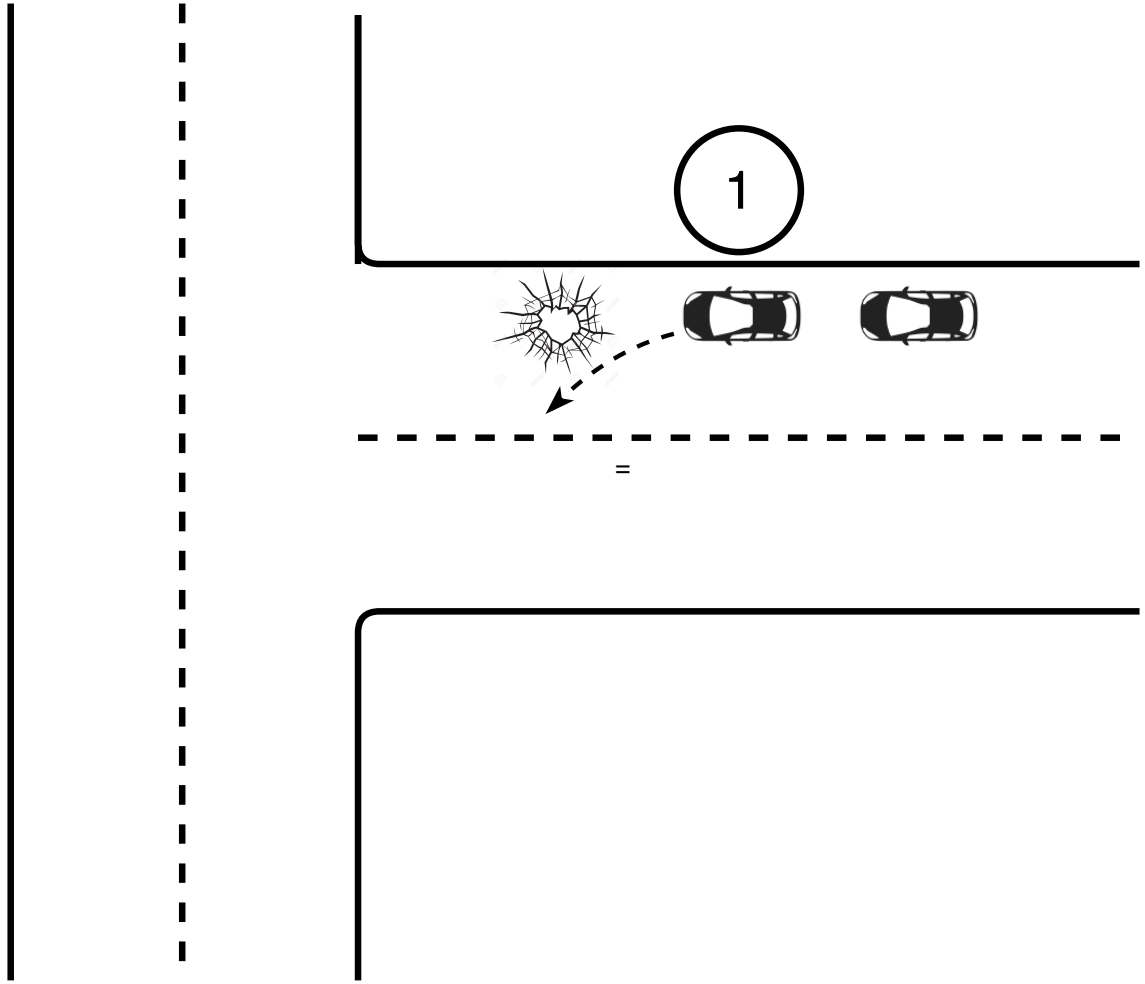
Hazards of self-driving



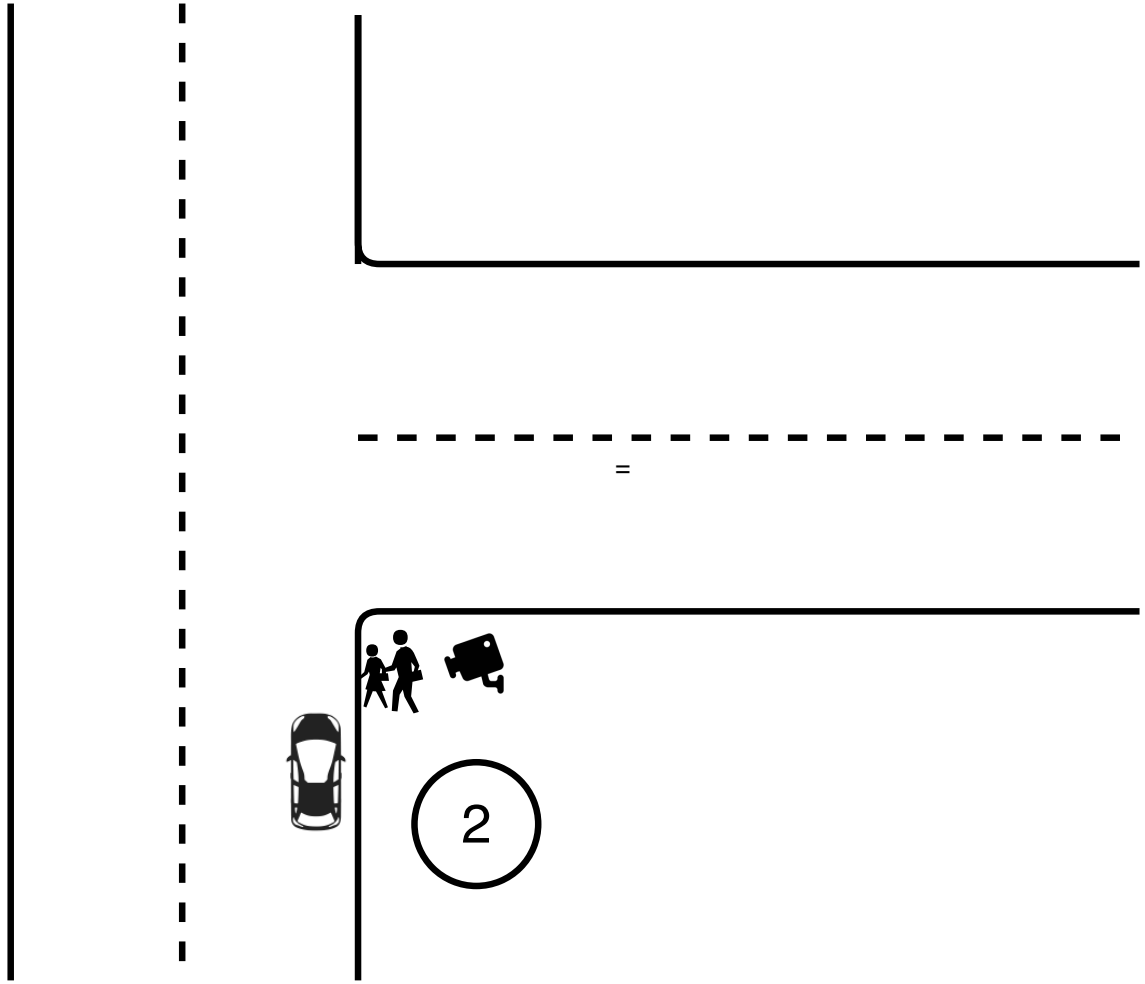
AR-HUD

- more realistic
- more information
- faster to learn

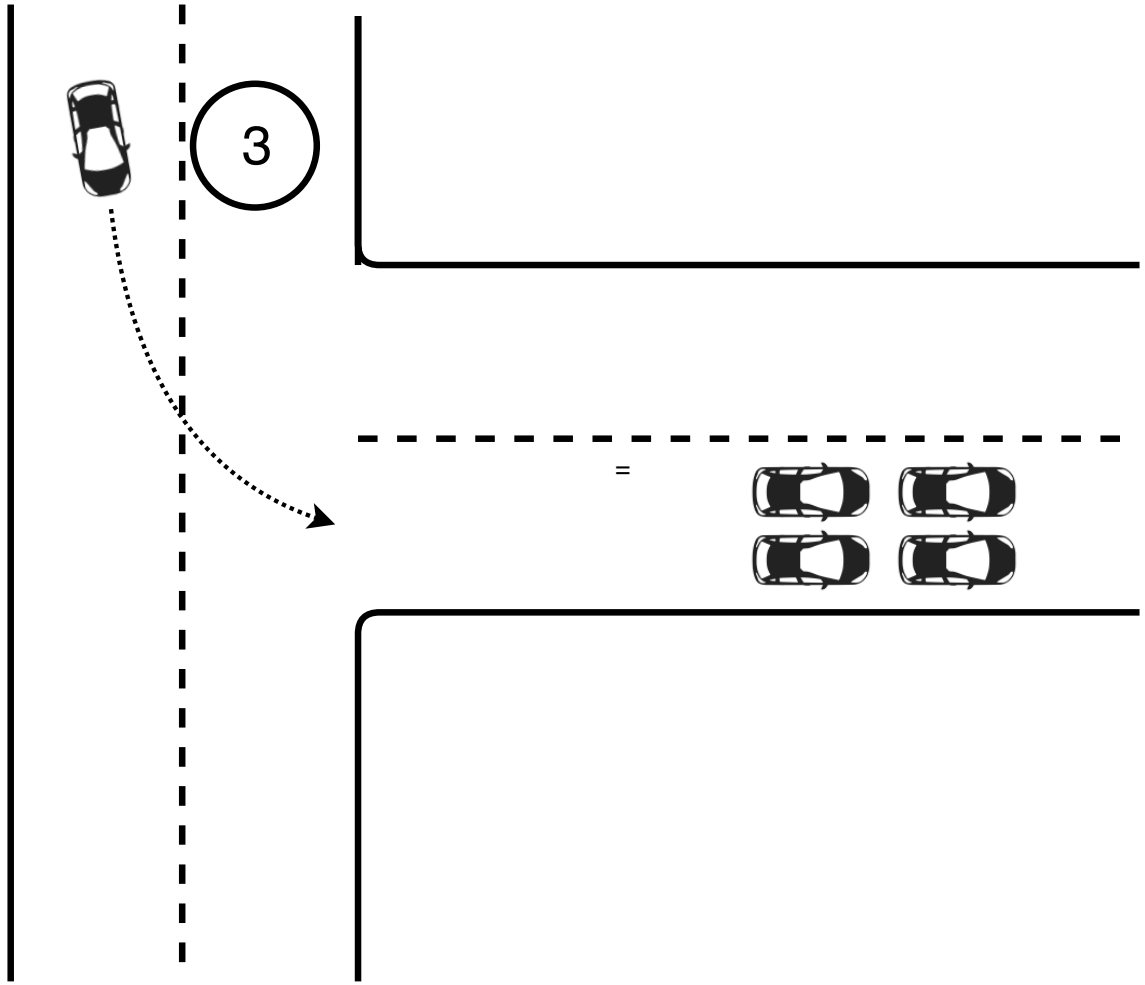
Hazards of self-driving



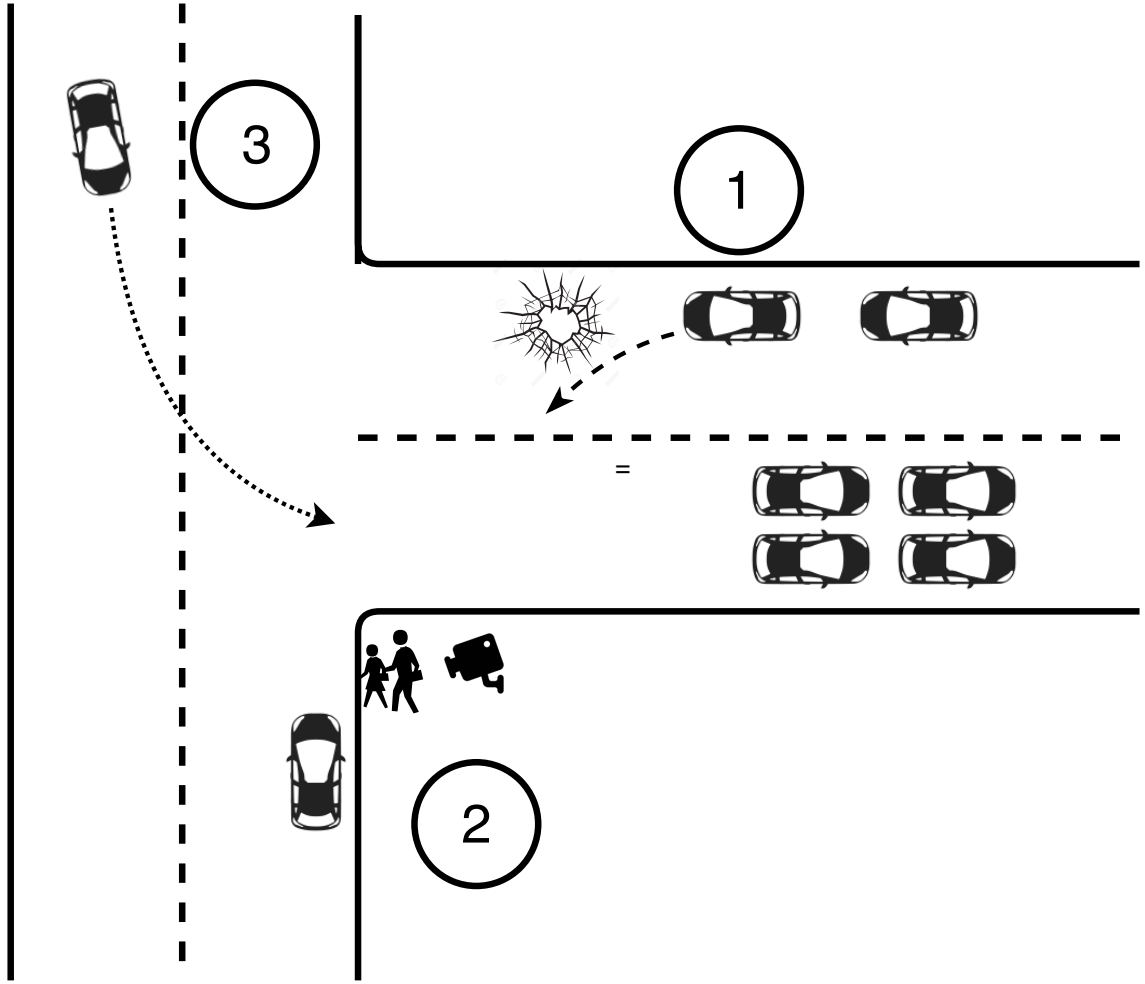
Hazards of self-driving



Hazards of self-driving



Hazards of self-driving



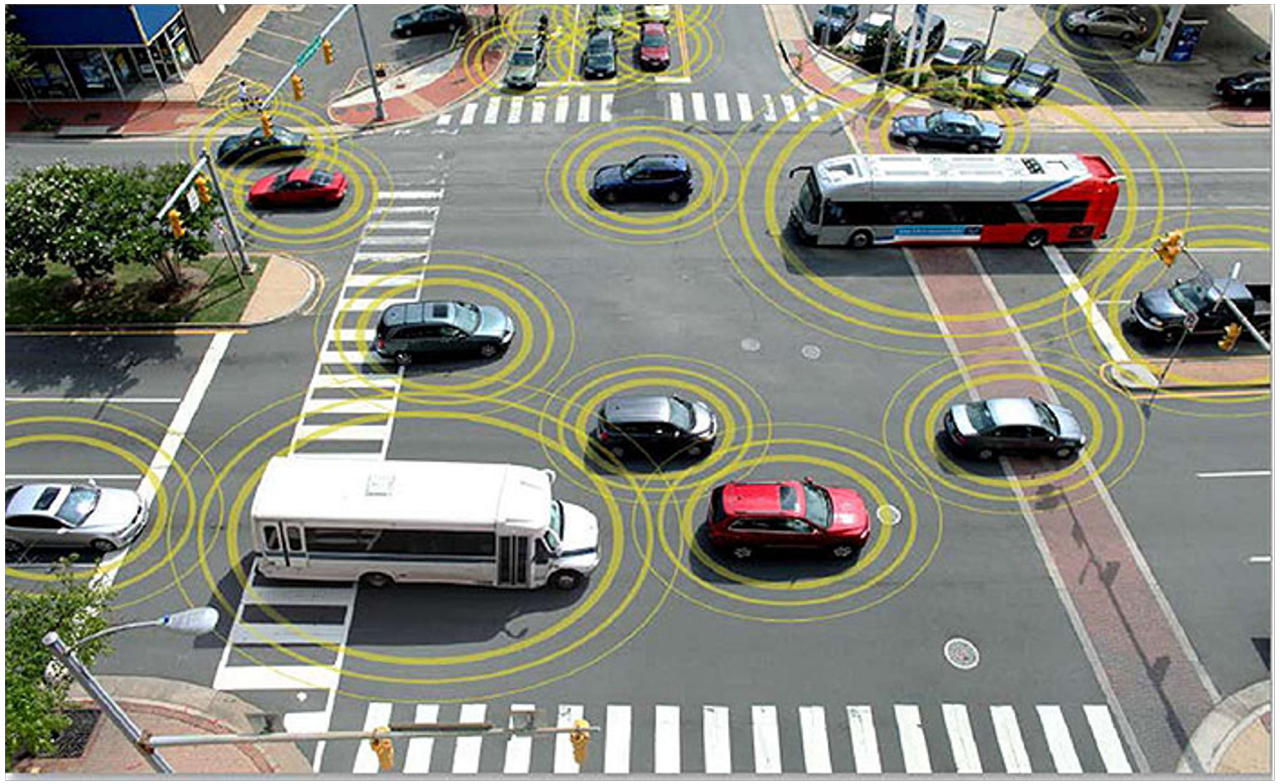
Challenges

Information → Gather

Information → Share

Information → Update

Fast



Challenges

Cloud?

Smart Vehicle?

Or

EDGE

Pros and Cons

Solution	Pros	Cons
Edge	1. Large view 2. Small delay	Delicate design
Cloud	Global view	Large delay
Smart Vehicle	Fast computation	Narrow view

Why Edge?

Delay:
as small as possible

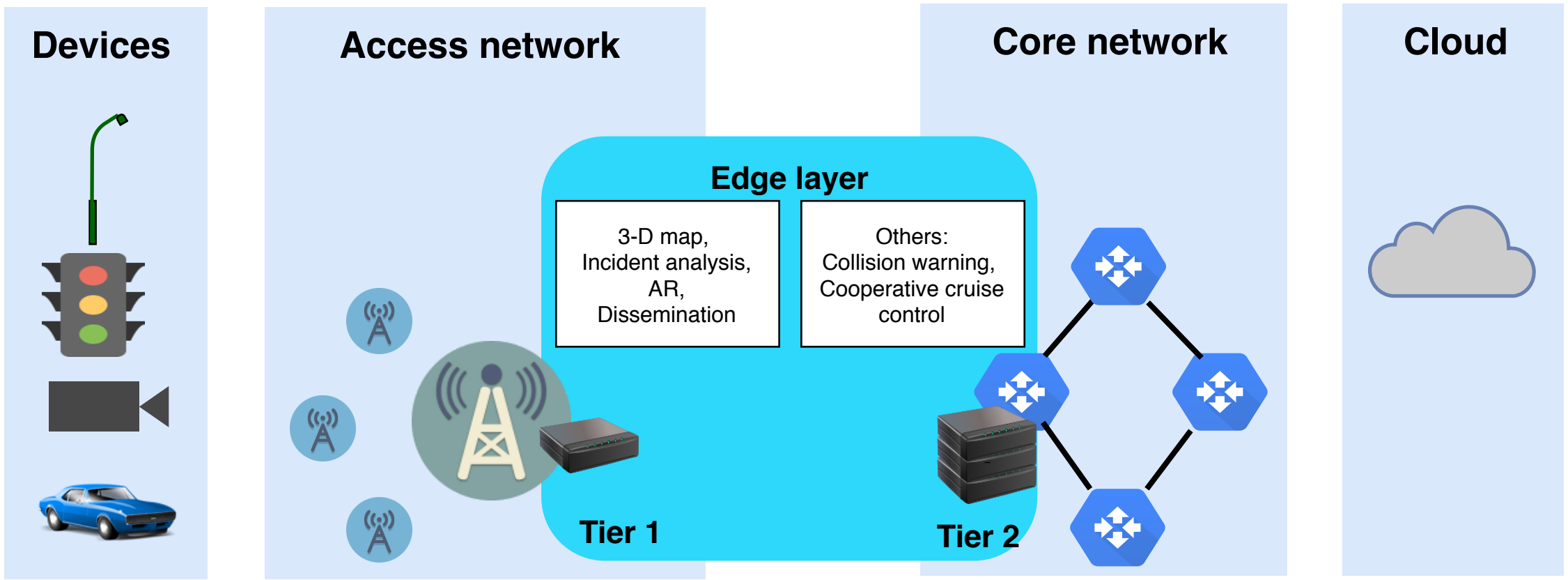
View:
large enough

Processing:
sufficient

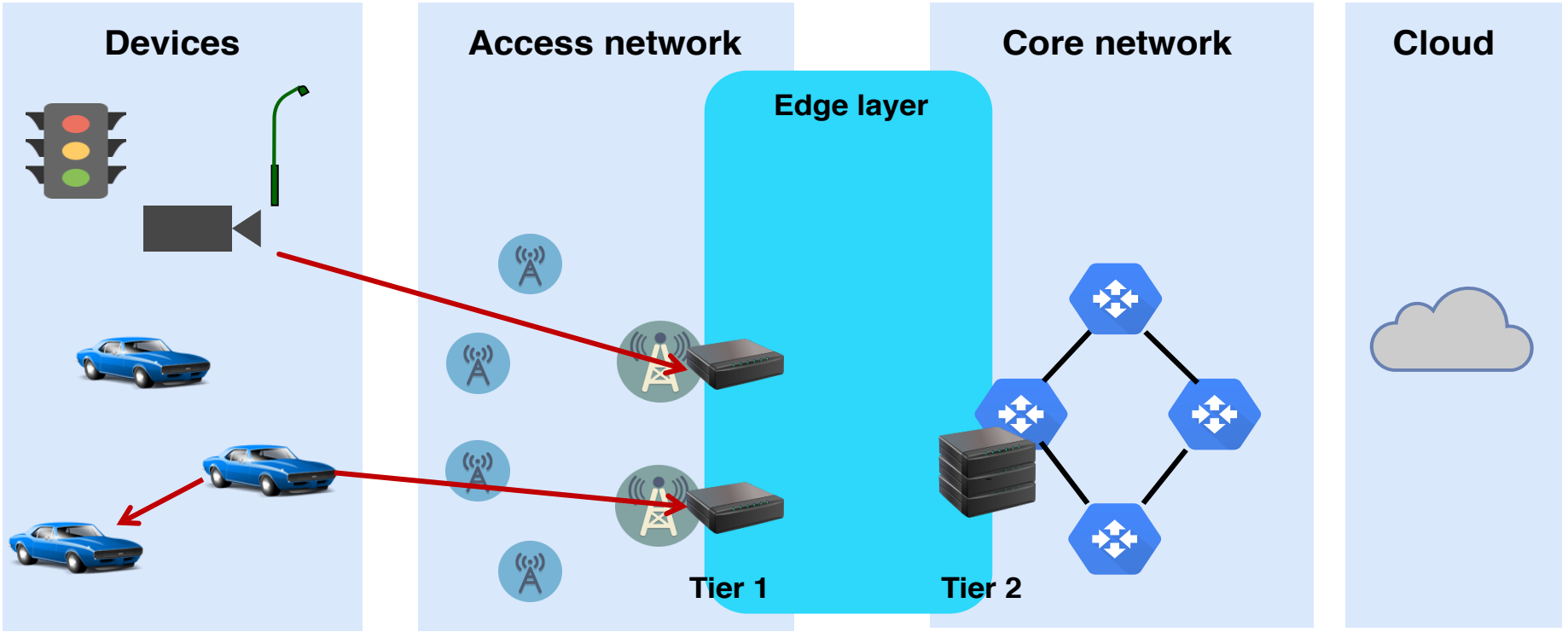
Vehicle to Edge (V2E)

- System Architecture
- Deployment/Placement
- Communication Model

System Architecture

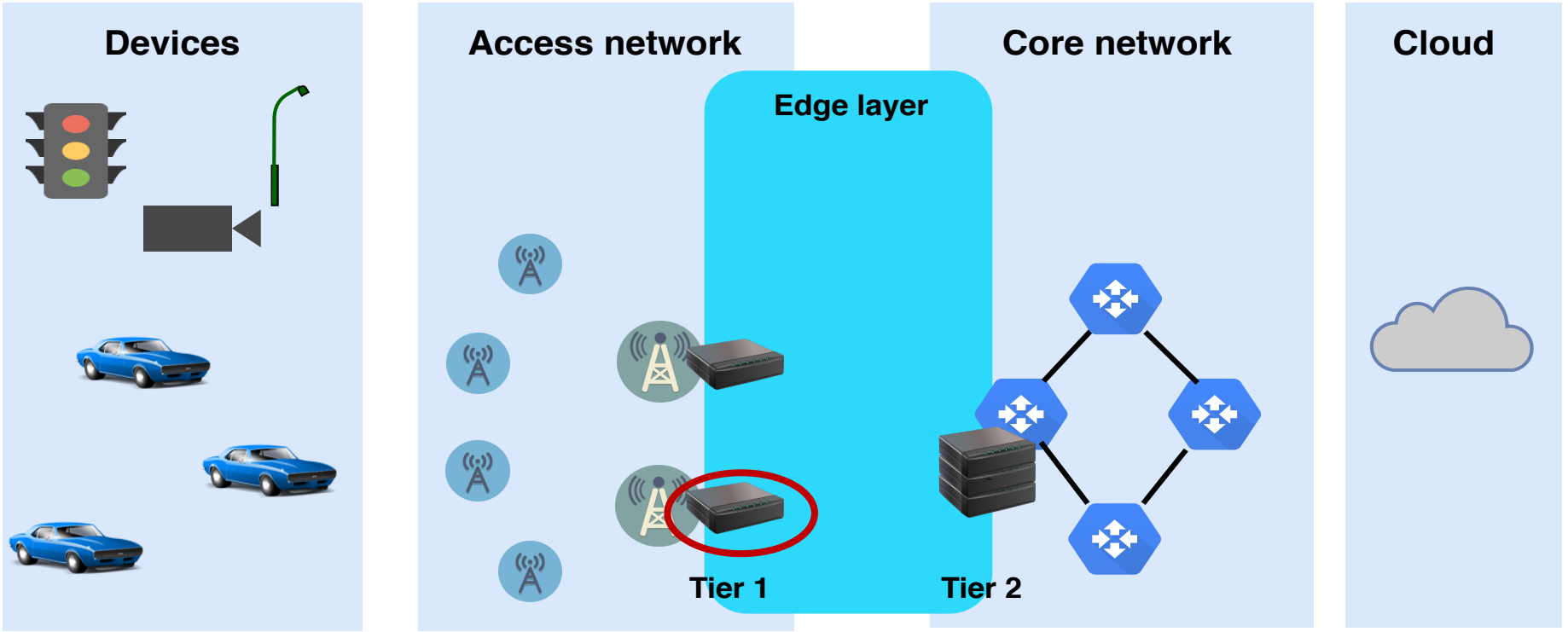


Communication Model



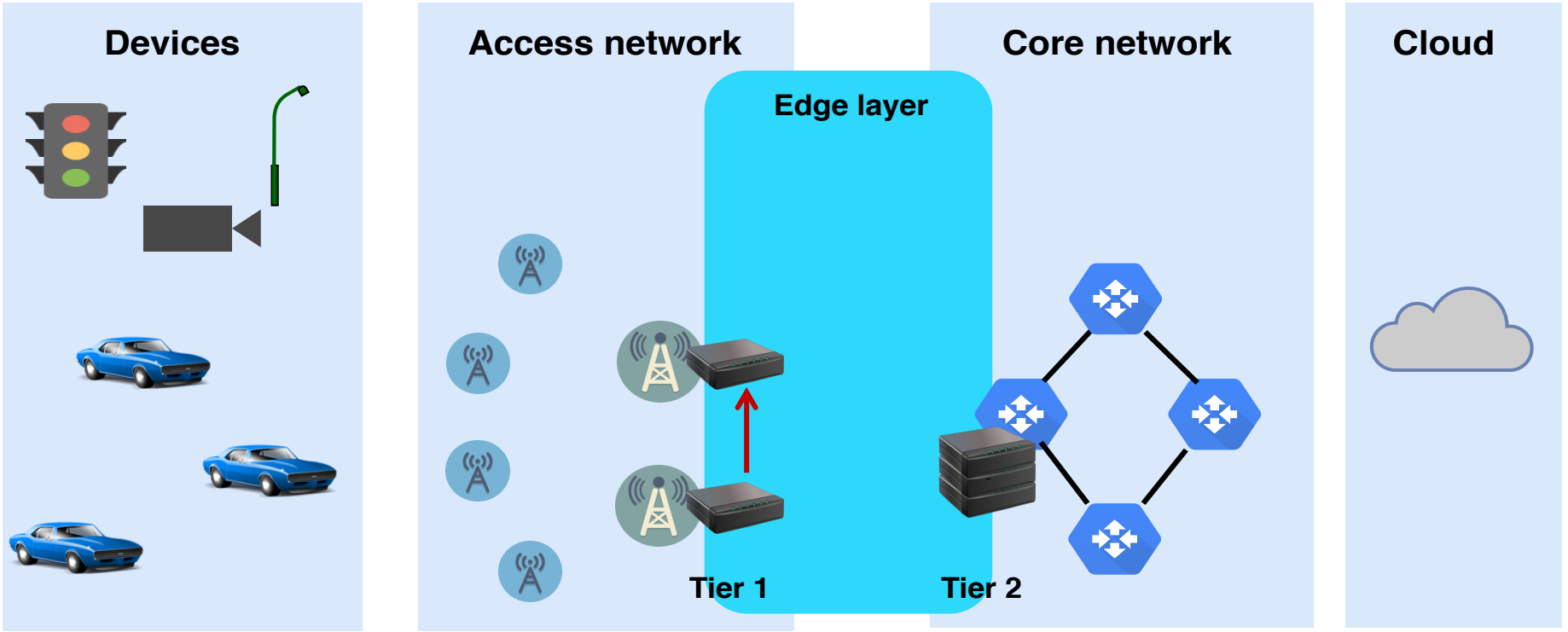
Neighbor notification
Data processing
Data transmission
Data dissemination
Data aggregation
Data upload

Communication Model



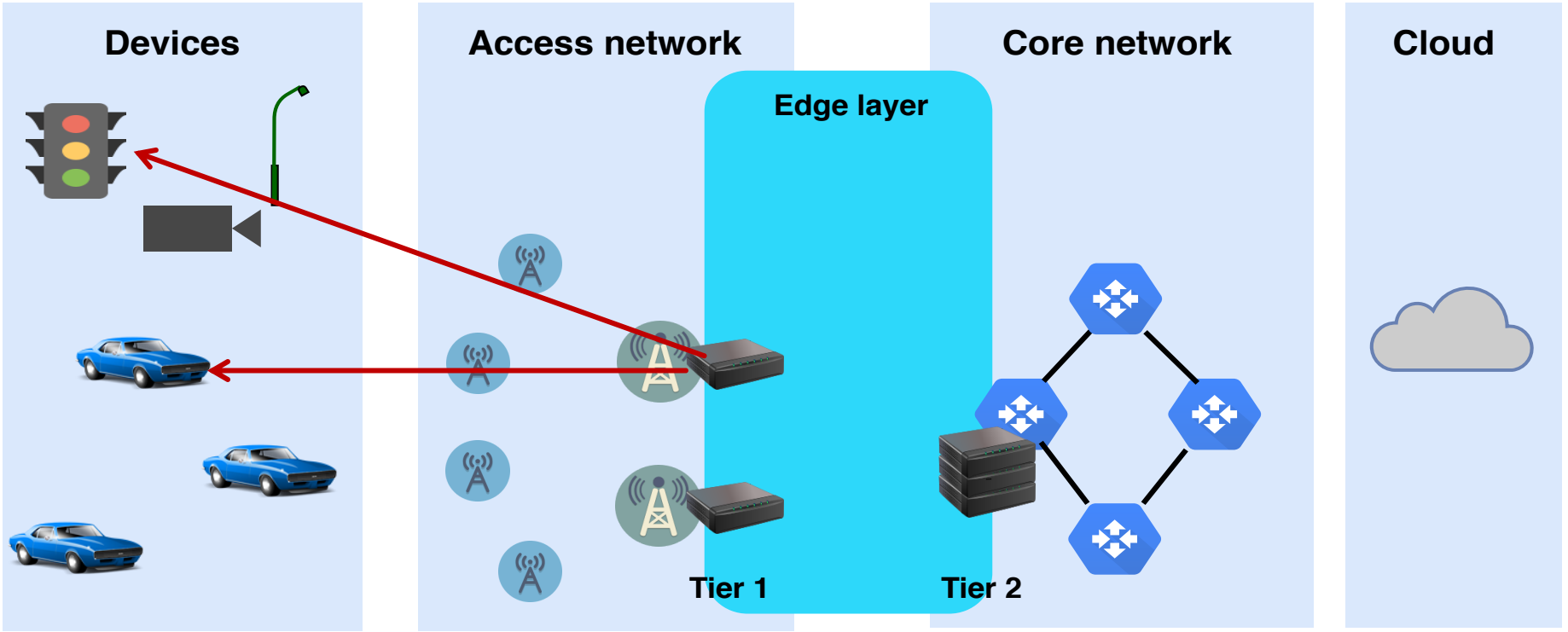
- Neighbor notification
- **Data processing**
- Data transmission
- Data dissemination
- Data aggregation
- Data upload

Communication Model



- Neighbor notification
- Data processing
- **Data transmission**
- Data dissemination
- Data aggregation
- Data upload

Communication Model



- Neighbor notification
- Data processing
- Data transmission
- **Data dissemination**
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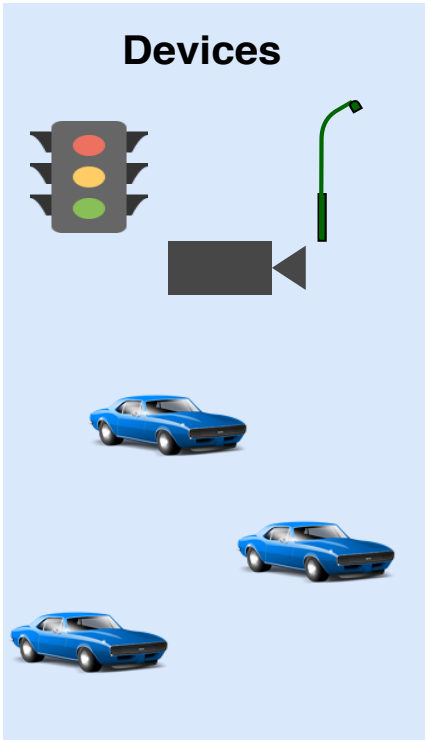
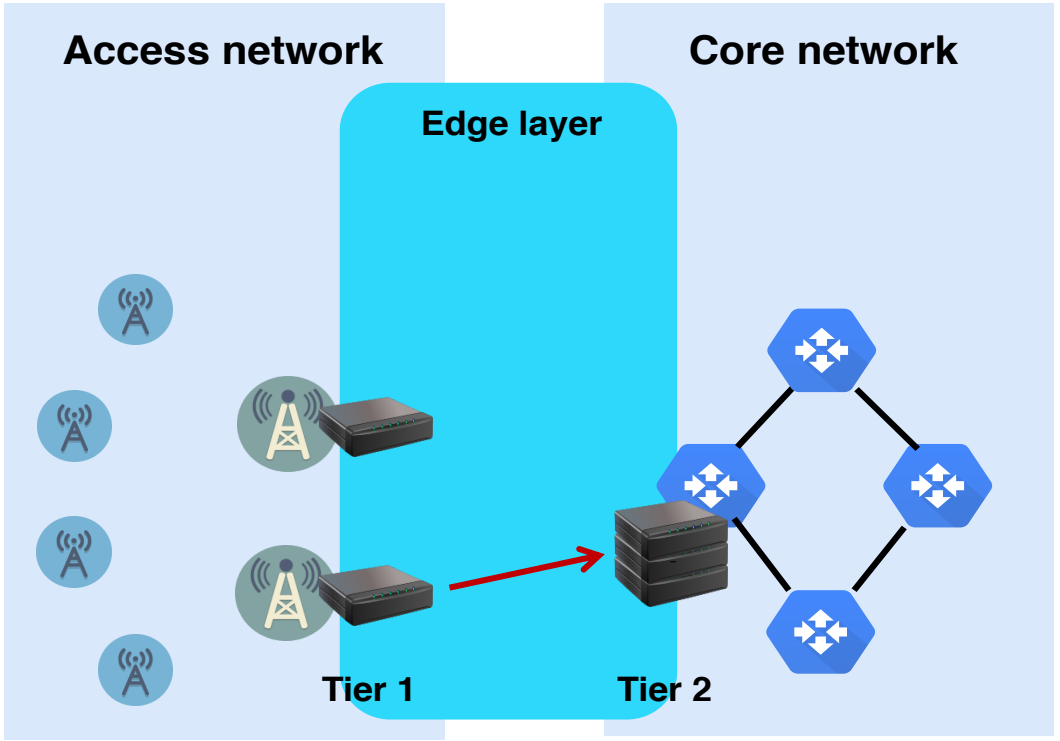
Communication Model





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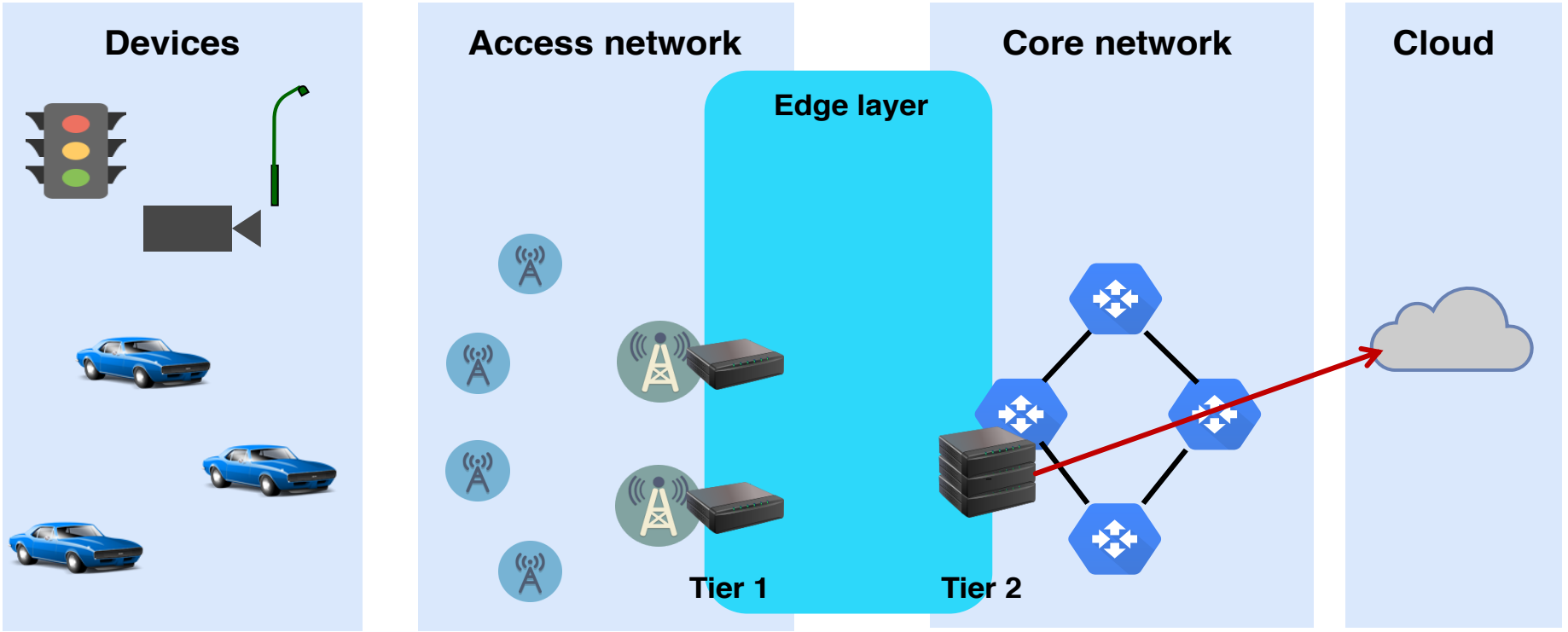
Communication Model



Neighbor notification
Data processing
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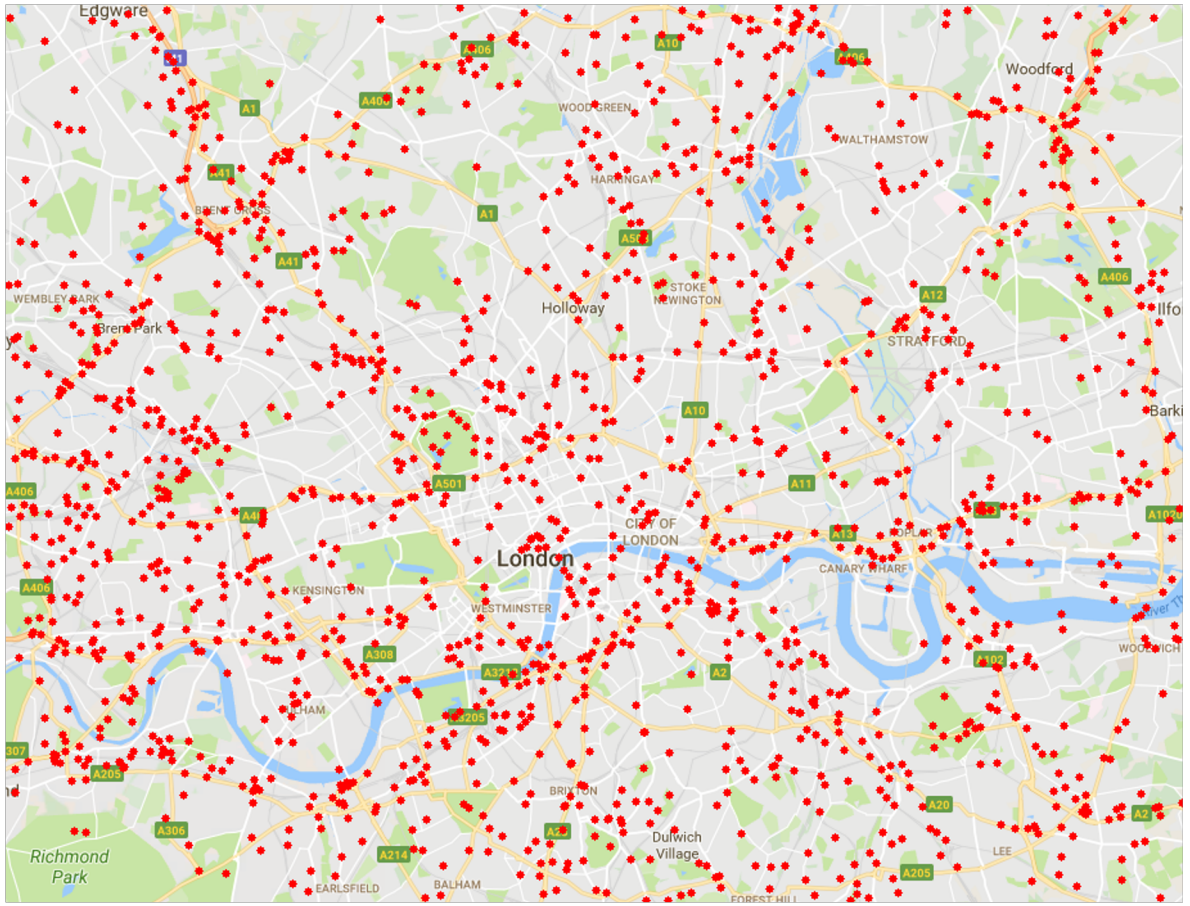
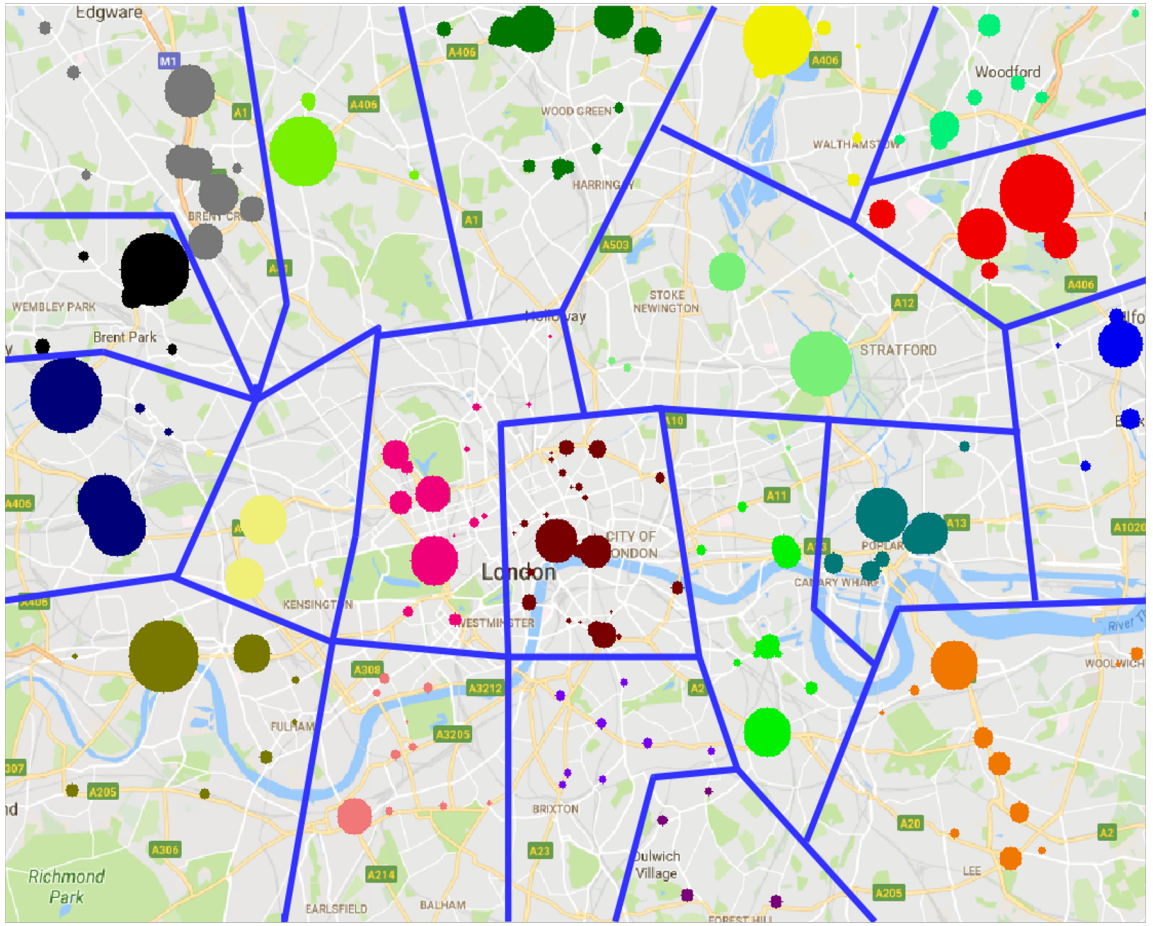
ES Deployment



https://unwiredlabs.com

22041 LTE Base Stations in selected area of London,
1538 with radius larger than 3000m

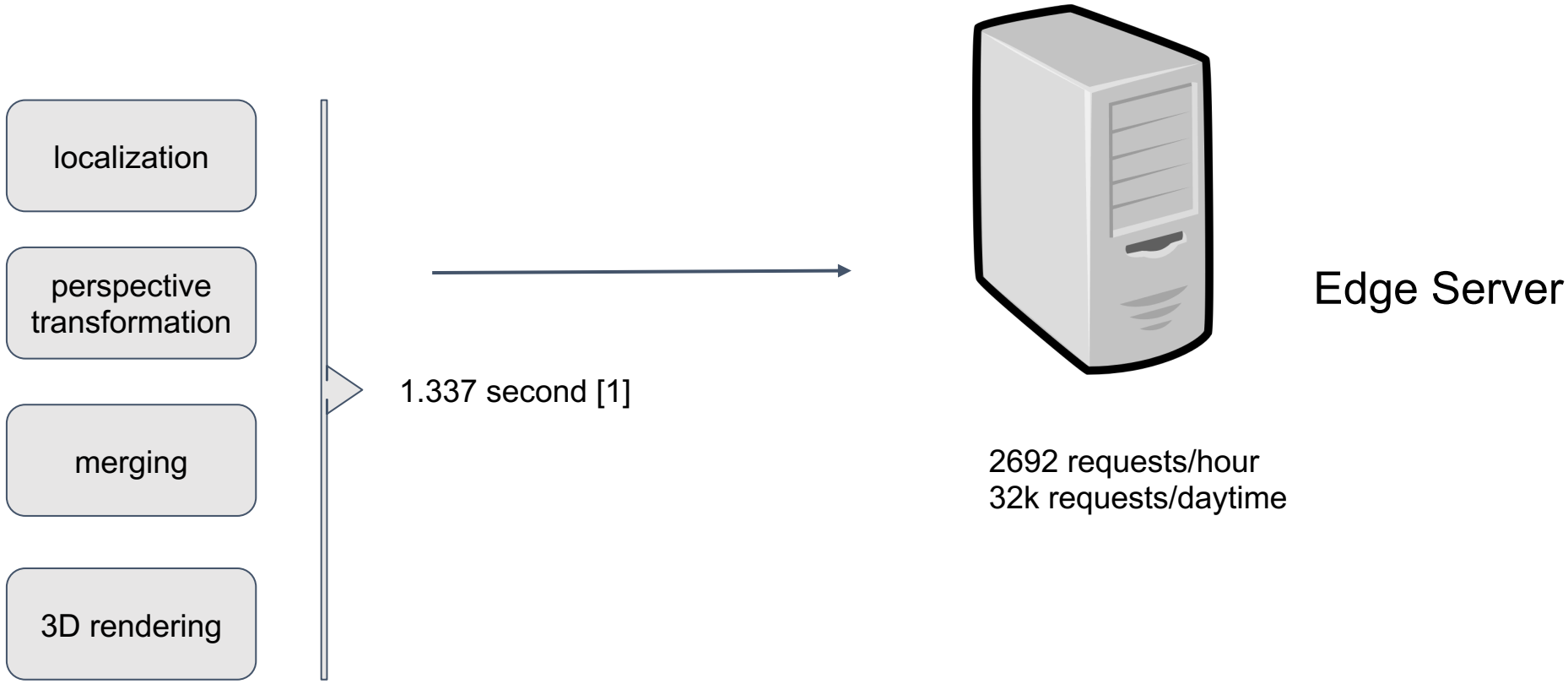
ES Placement



https://data.gov.uk/dataset/gb-road-traffic-counts

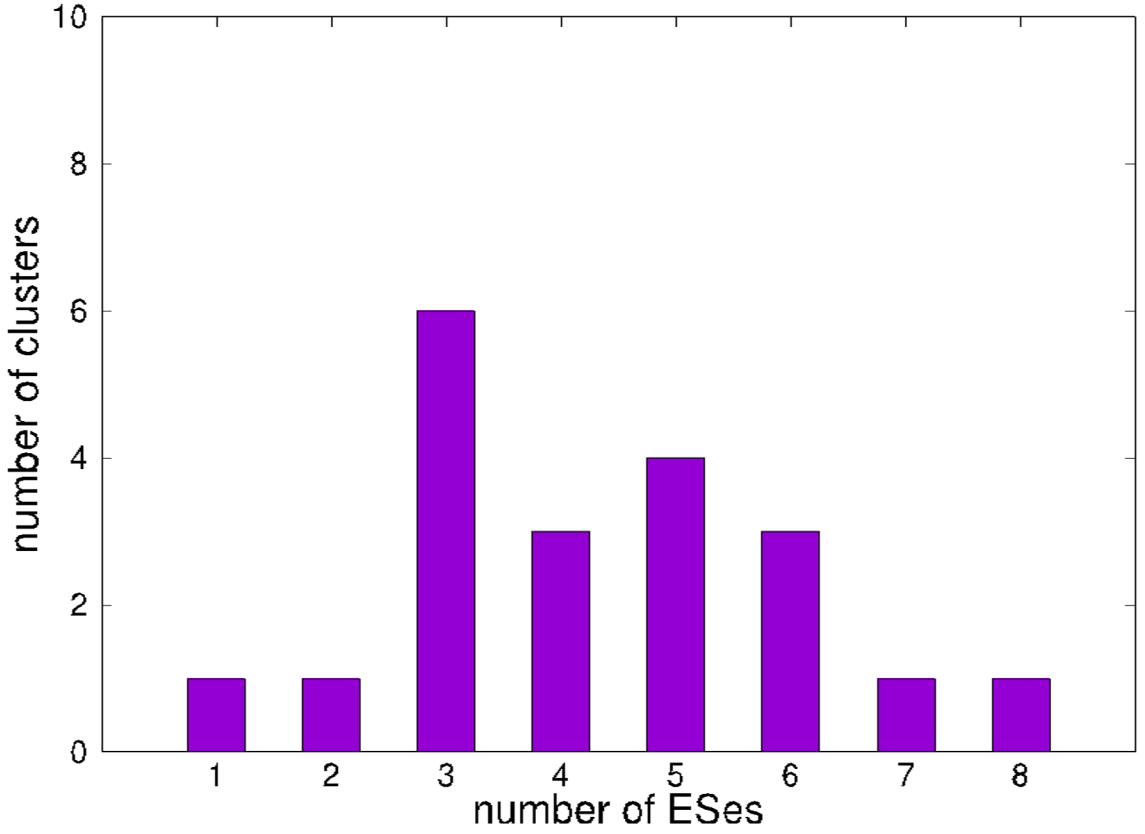
Traffic distribution in selected area of London

ES Placement



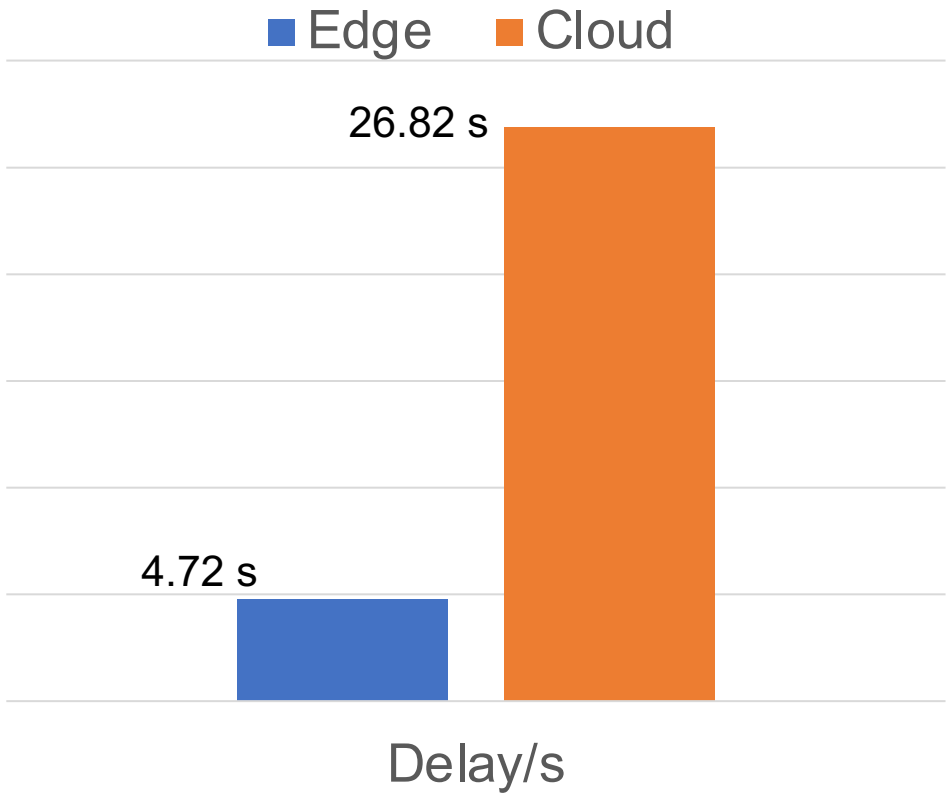
[1] Hang Qiu et al. 2017. Augmented Vehicular Reality: Enabling Extended Vision for Future Vehicles. In Proceedings of the 18th International Workshop on Mobile Computing Systems and Applications. ACM, 67–72.

ES Demand



90 Edge Servers needed in 26x20 km central London

Delay



Point cloud data size: 14.75 MB (720p)

- **Edge**: uplink bandwidth between vehicle and LTE base station achieves on average 25 Mbps[1]
- **Cloud**: taking Google Cloud Platform as an example, the average uplink bandwidth is 4.4 Mbps[2]

[1] https://www.4g.co.uk/how-fast-is-4g/
[2] https://testmy.net/hoststats/google_cloud

Demo

Thank You!
Q & A

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