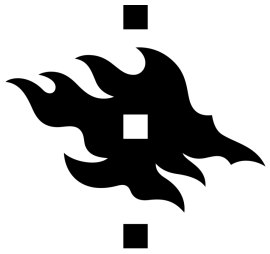
Enhanced Augmented Reality Applications in Vehicle to Edge Networks

Pengyuan Zhou, Wenxiao Zhang, Tristan Braud,

Pan Hui, Jussi Kangasharju



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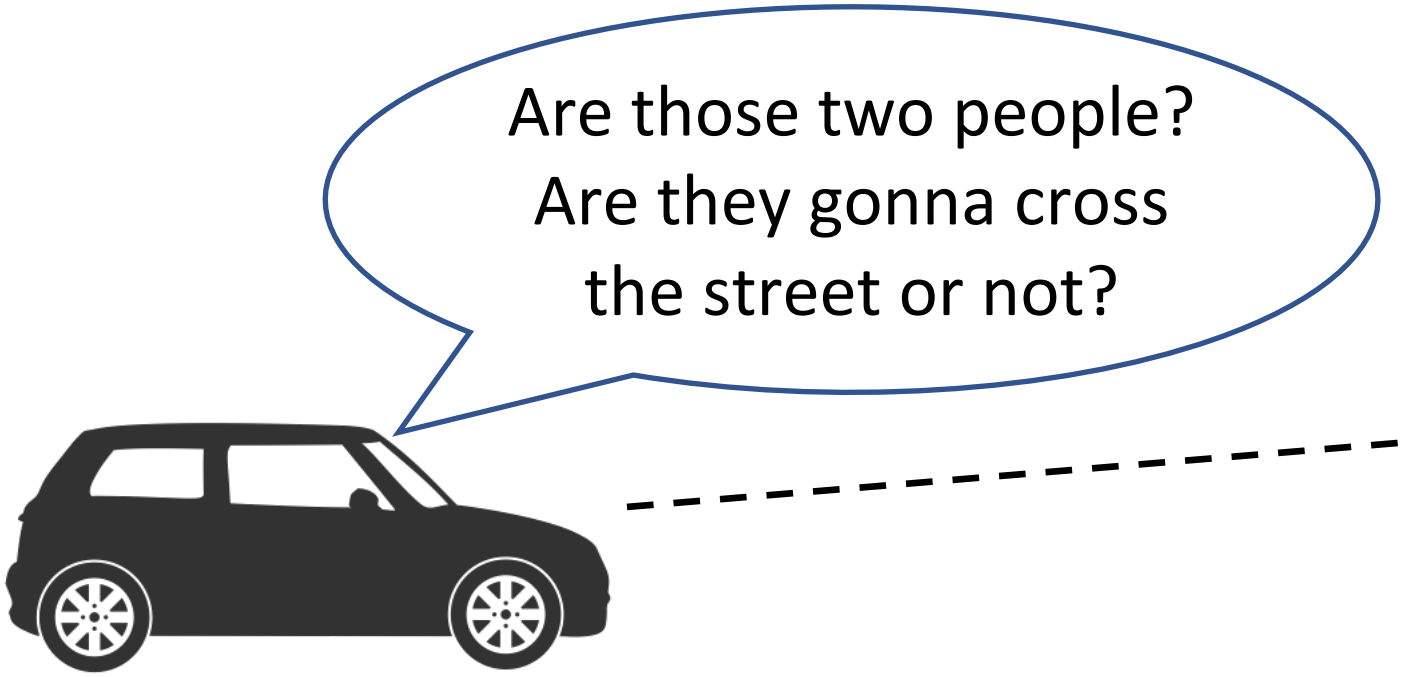
Hazards of self-driving

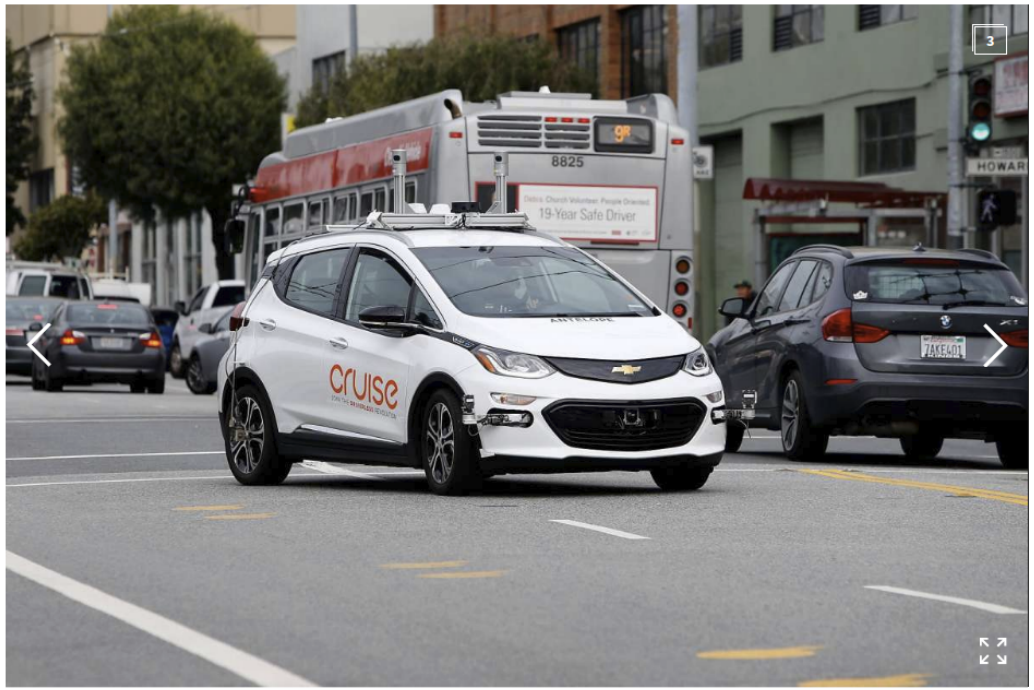


Hazards of self-driving

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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- Massive Carr Fire tornado trapped, killed Redding firefighter, report says
- Report finds 'worrisome' levels of lead, arsenic in some baby foods
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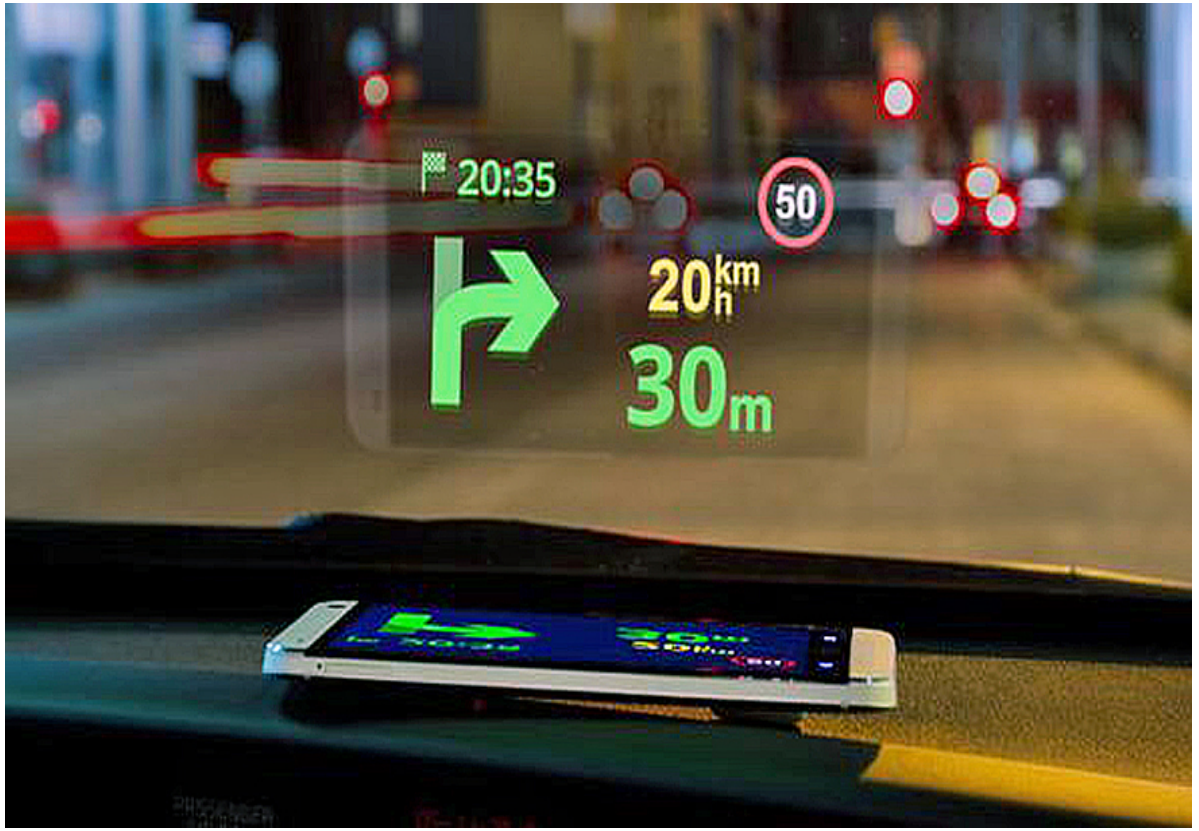
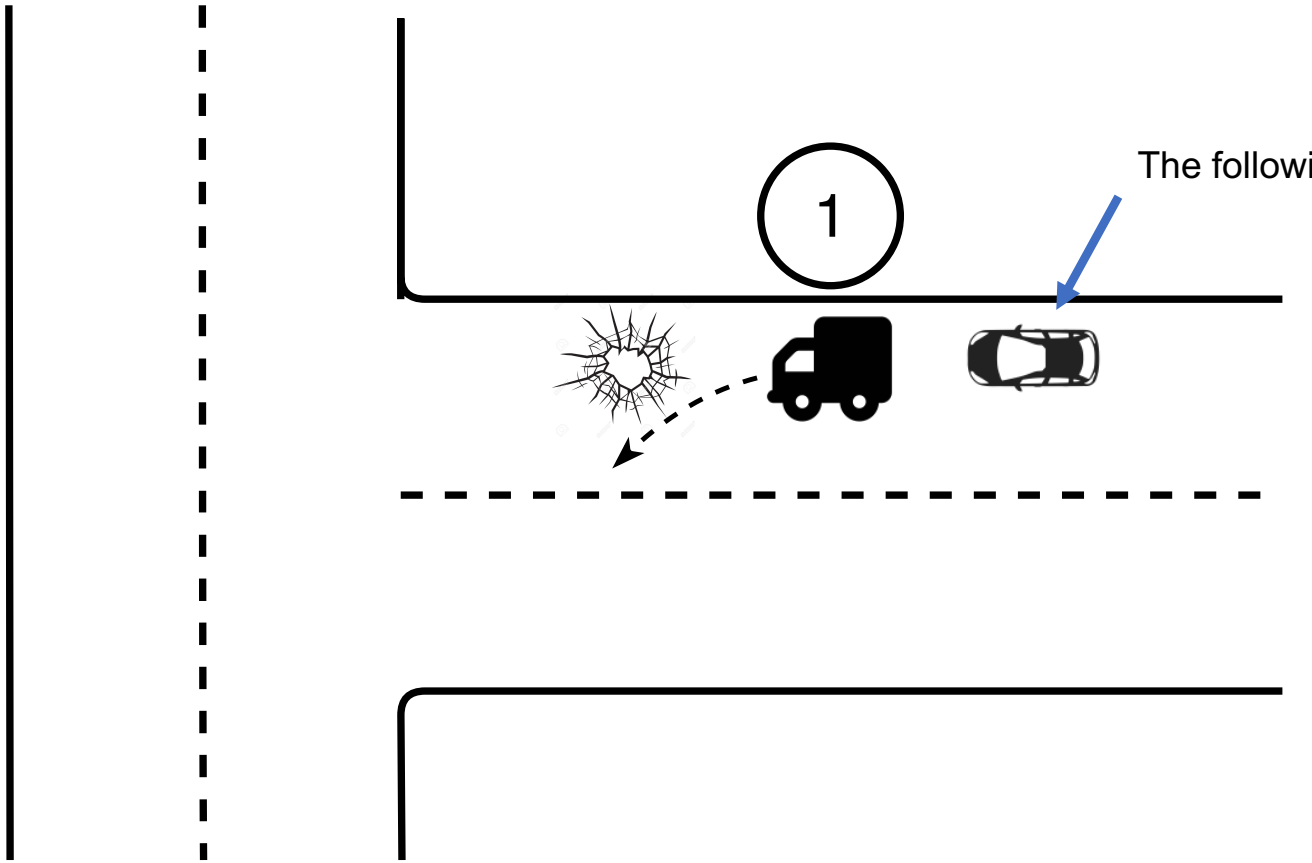
Assisted driving



AR-HUD

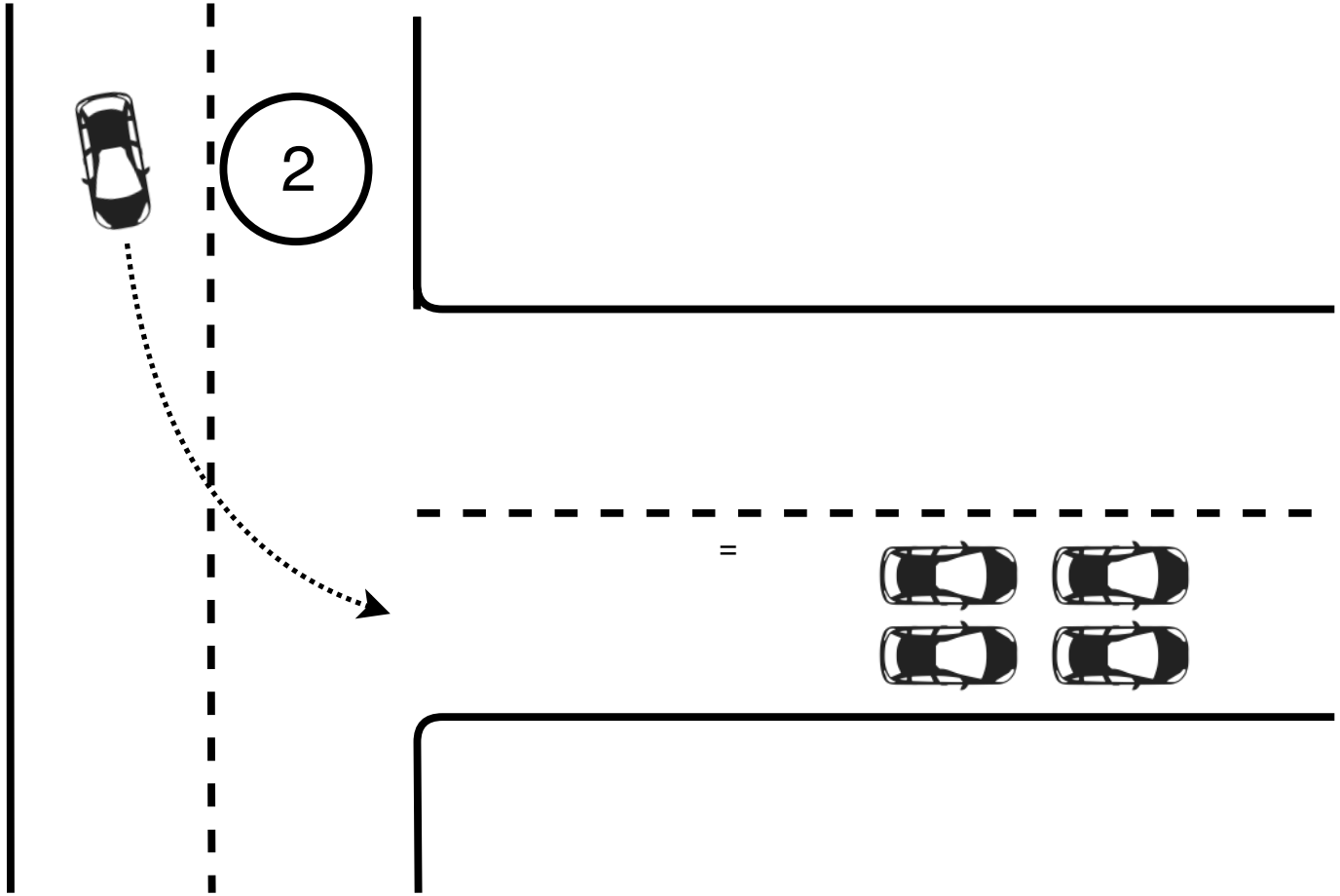
- more realistic
- more information
- faster to learn

Traffic scenario 1



Traffic scenario 2

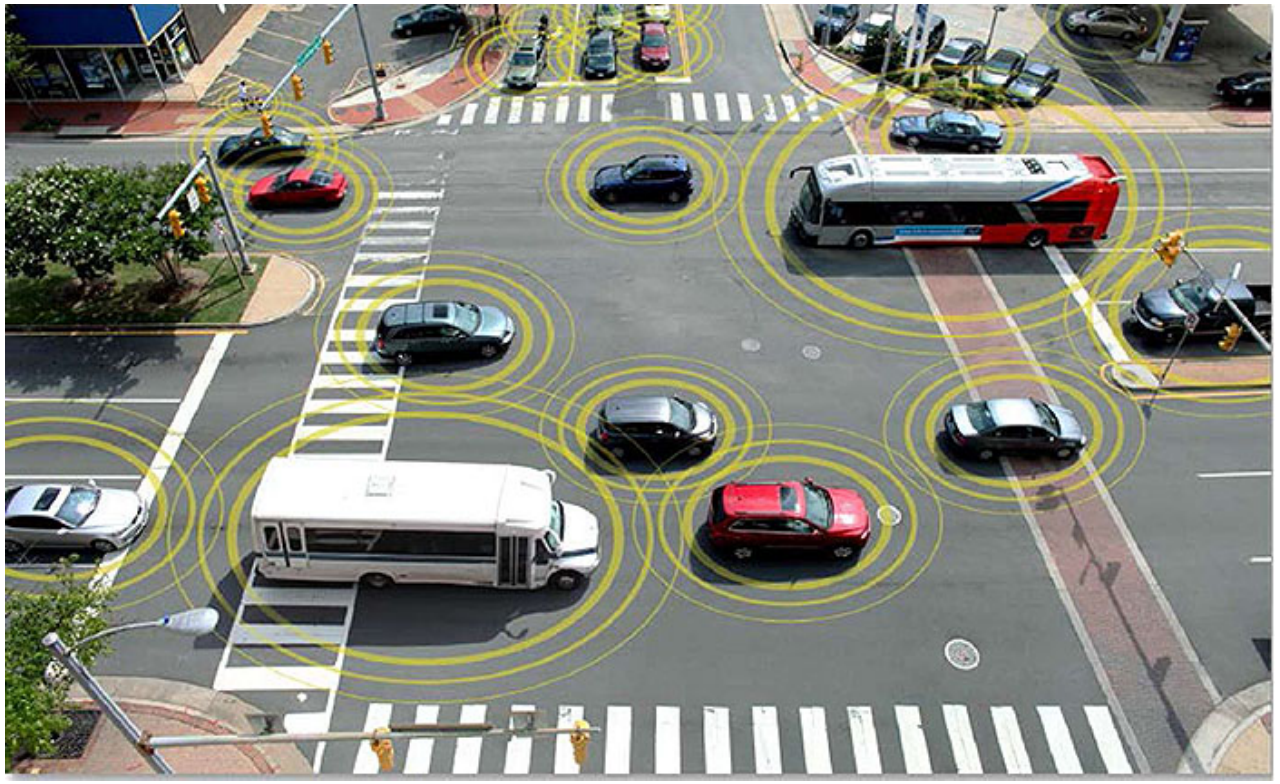
Drive into temporary traffic jam due out of sight



Challenges

Information → Gather
Information → Share
Information → Update

Fast



Options

Cloud?

Smart Vehicle?

Or

EDGE

Pros and Cons

Solution	Pros	Cons
Cloud	Global view	Large delay
Smart Vehicle	Fast computation	Limited view
Edge	1. Extended view 2. Small delay	Deployment cost

Why Edge?

Delay:
as small as possible

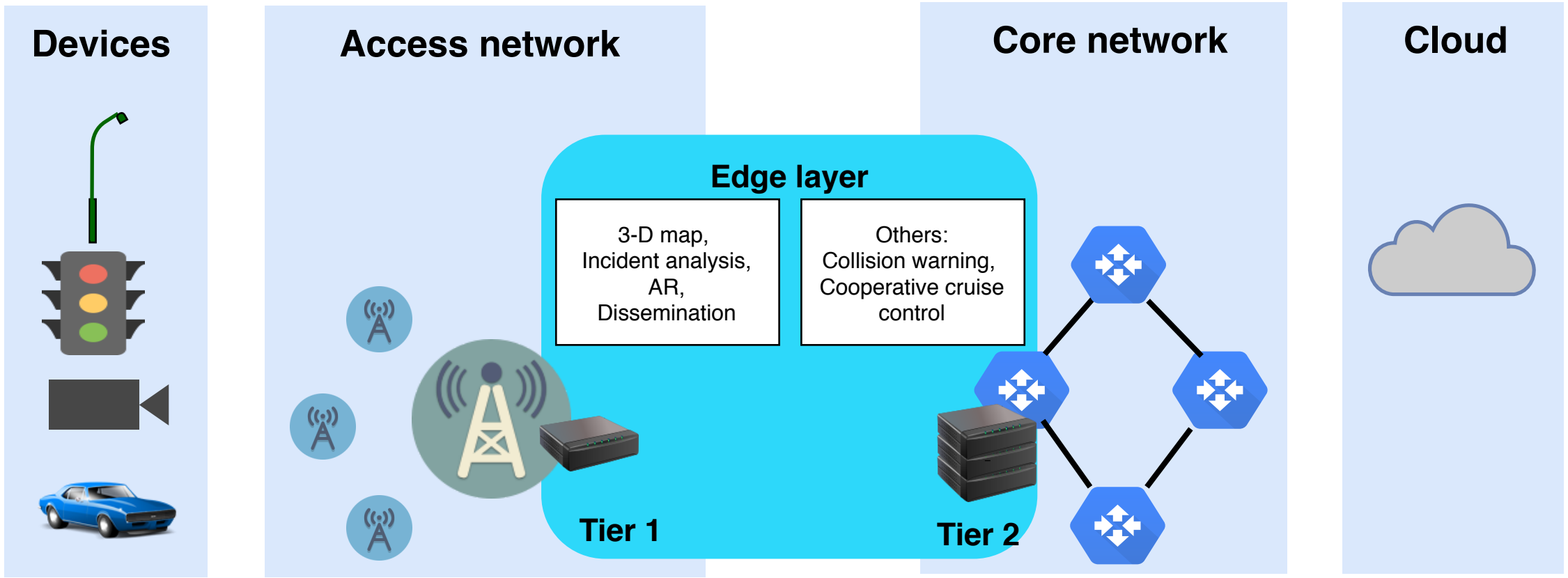
View:
large enough

Processing:
sufficient

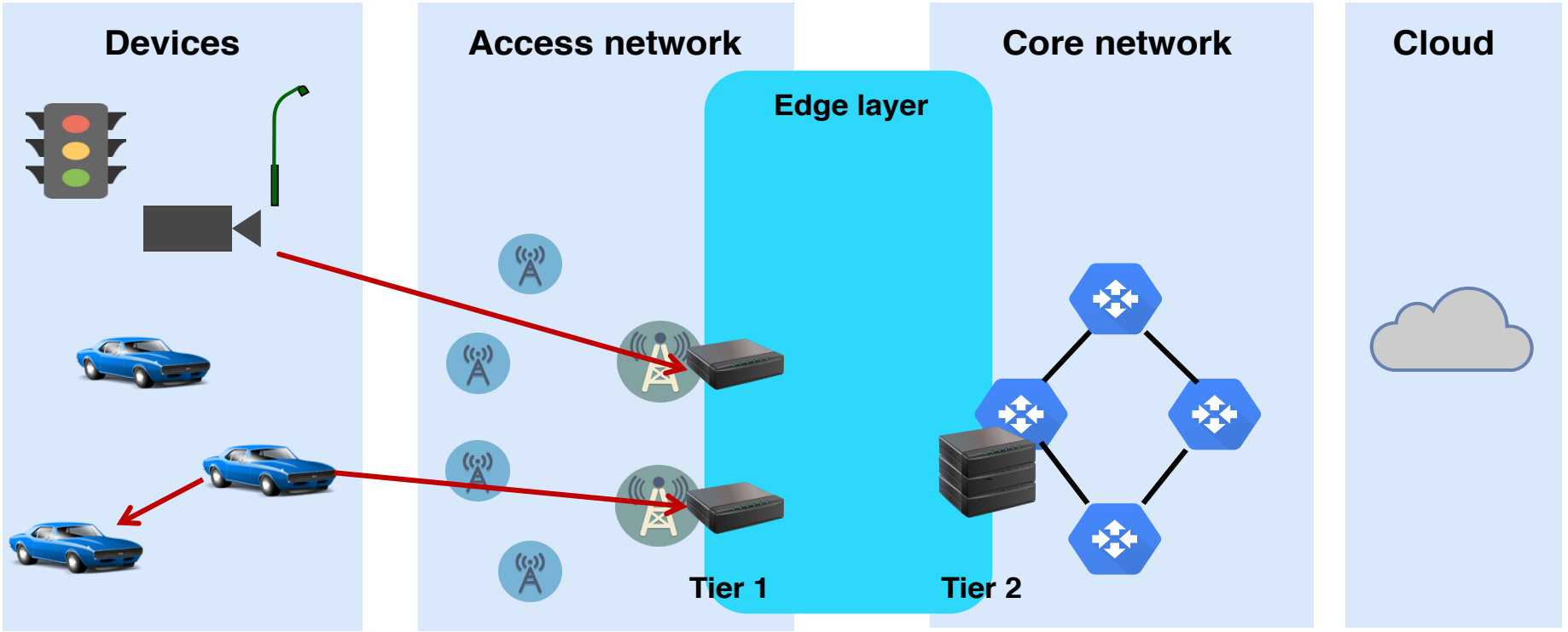
Vehicle to Edge (V2E)

- System Architecture
- Edge Server Function
- Placement
- Evaluation

System Architecture

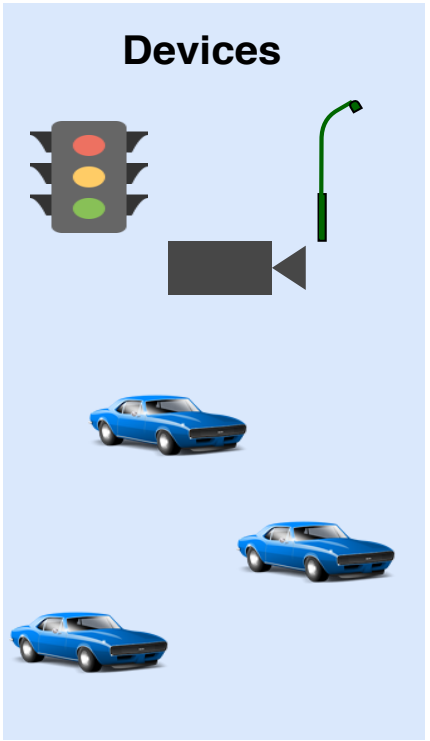


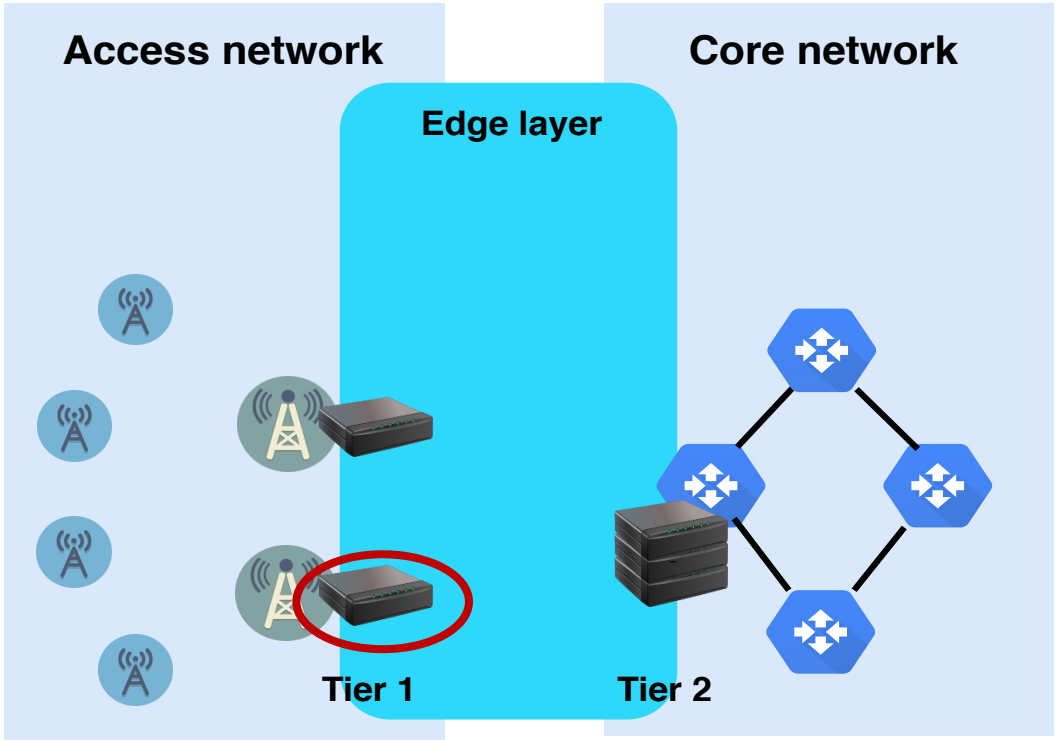
Communication Model



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

Communication Model





Neighbor notification

Data processing

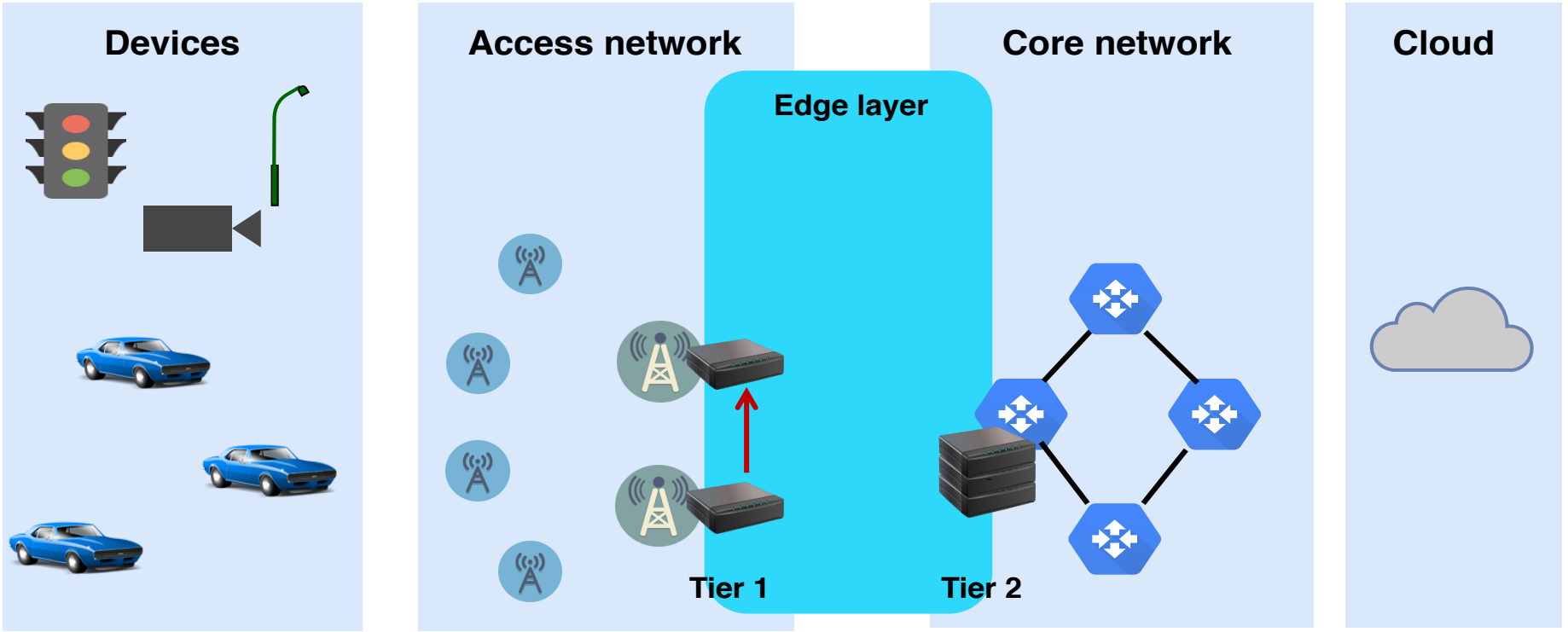
Data transmission

Data dissemination

Data aggregation

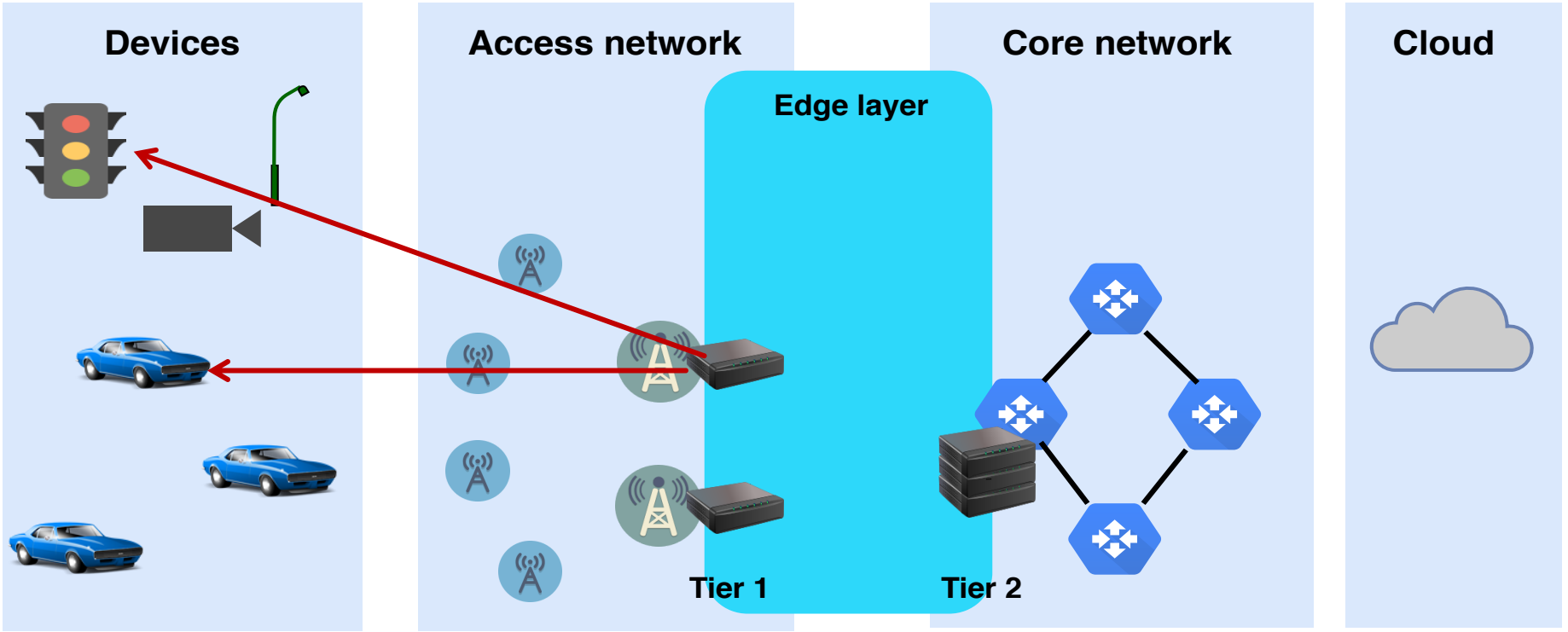
Data upload

Communication Model



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

Communication Model



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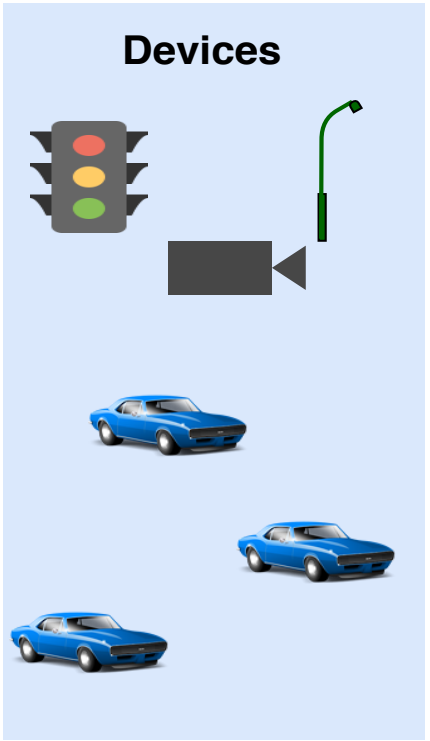
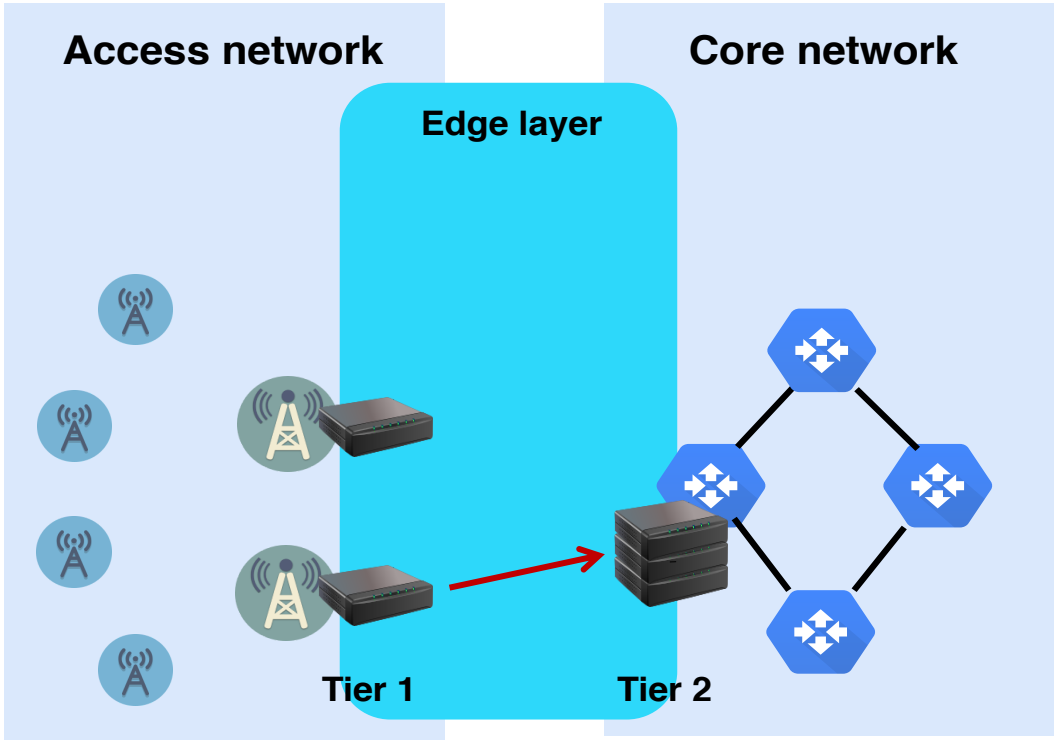
Communication Model





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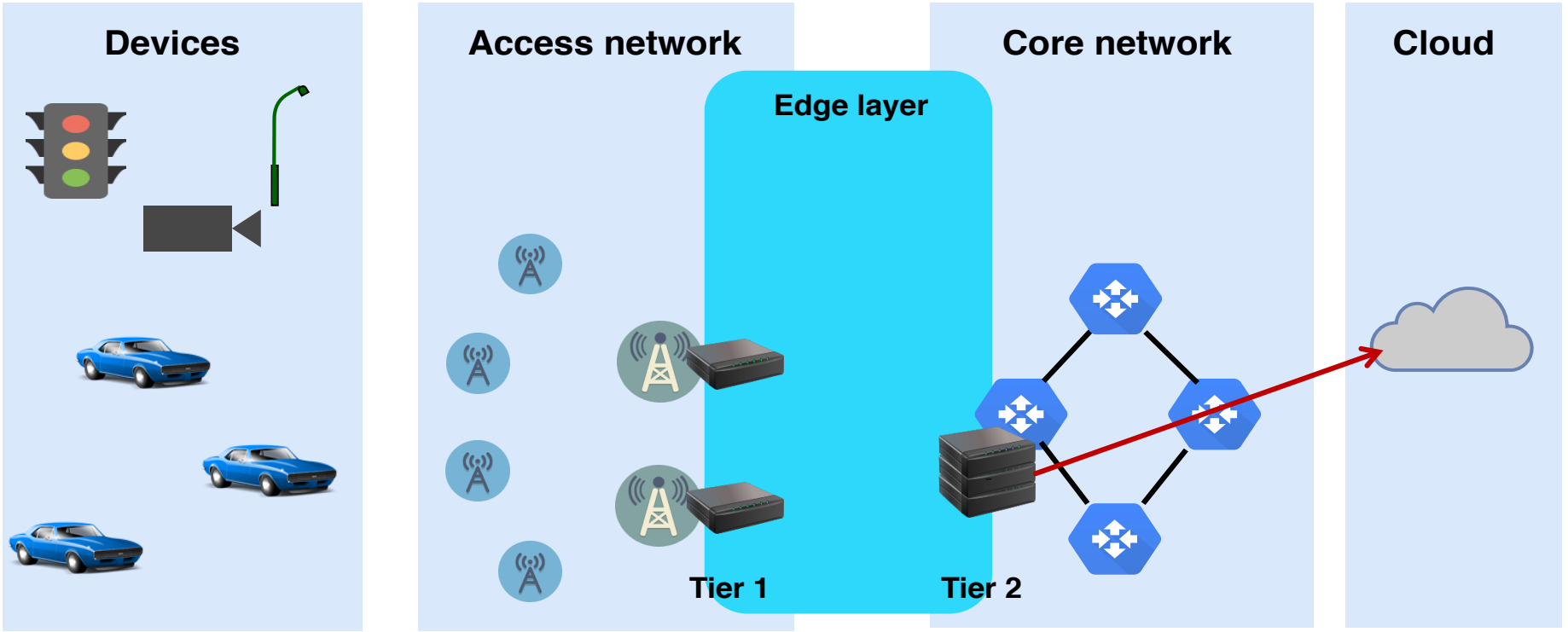
Communication Model



Neighbor notification
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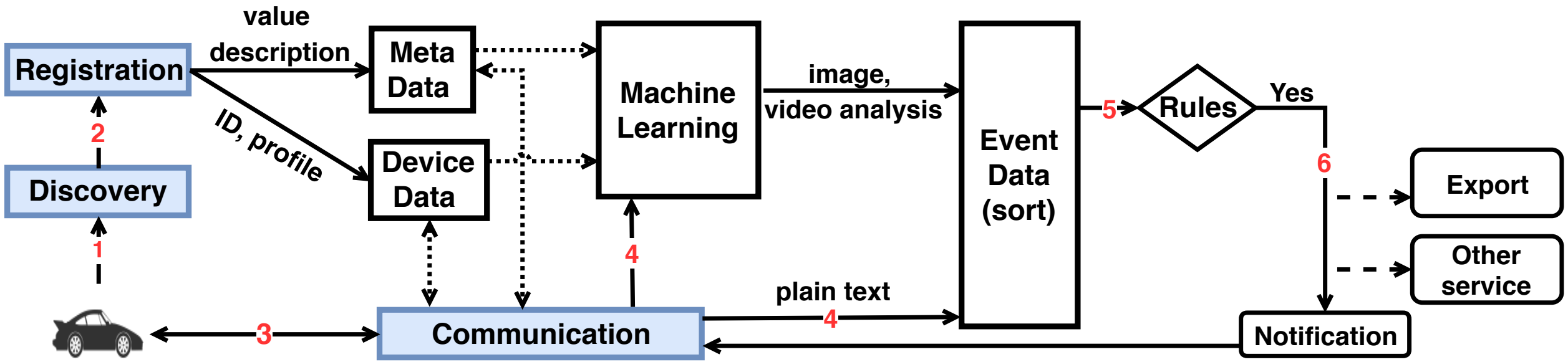
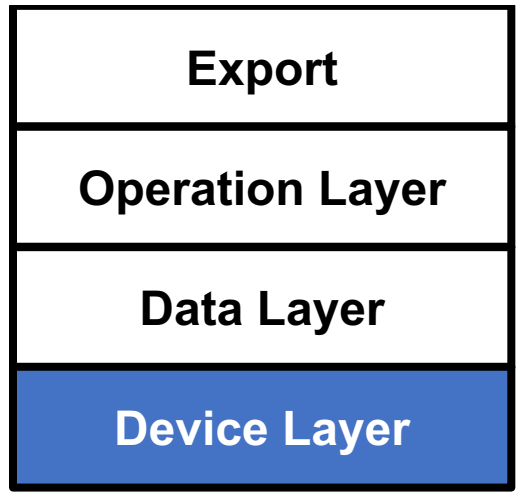
Edge Server Functions





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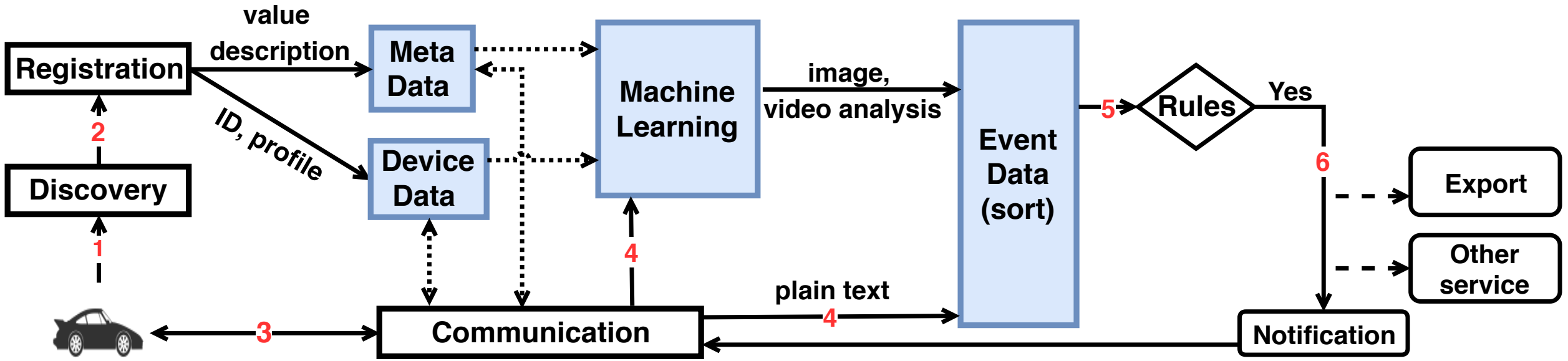

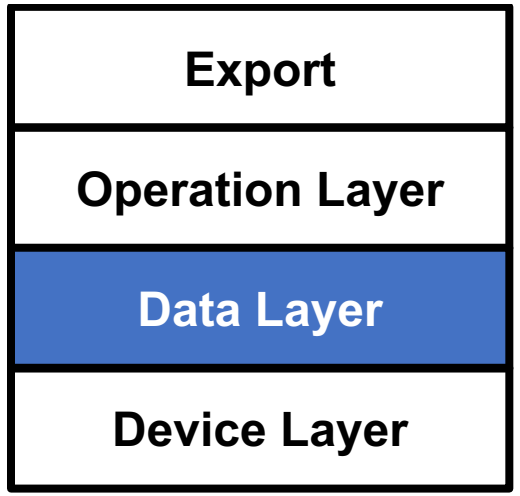

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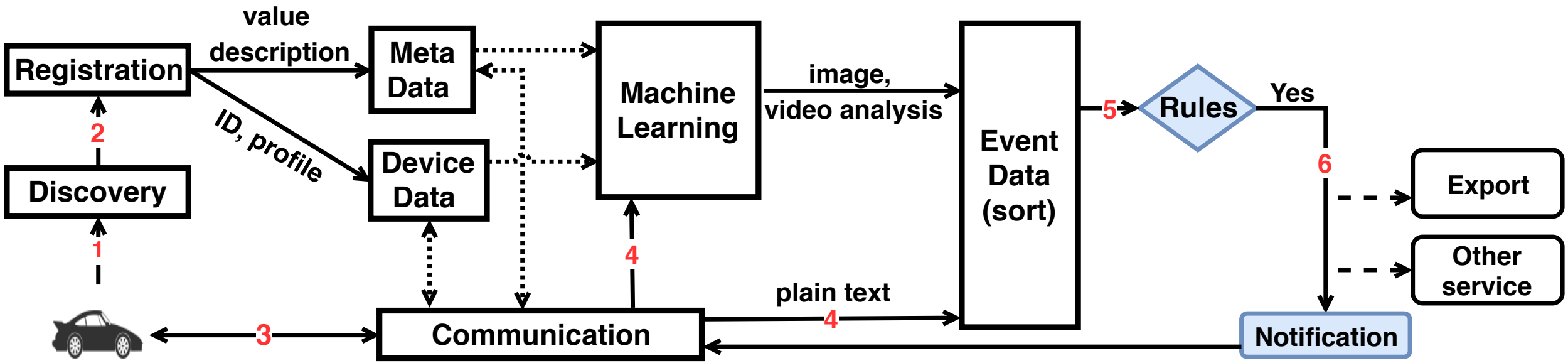

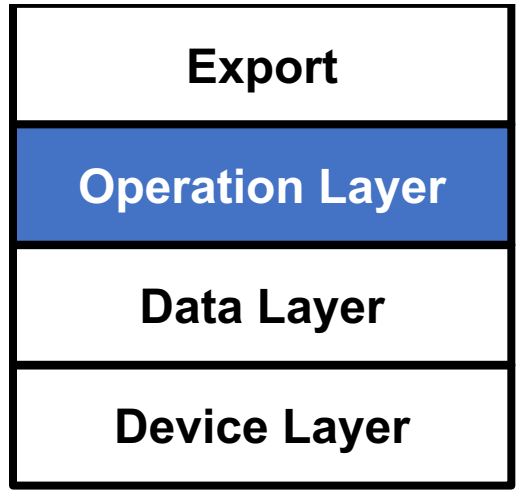

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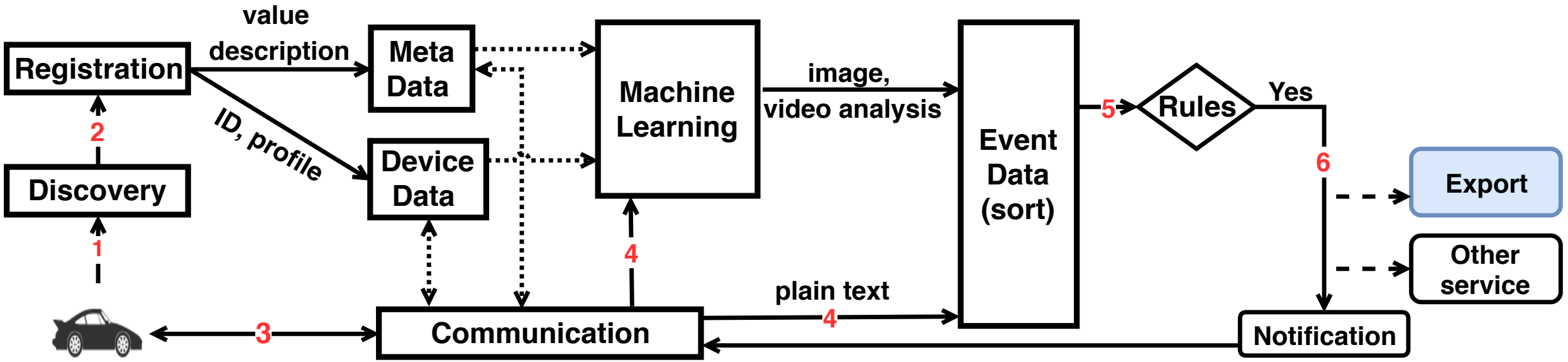
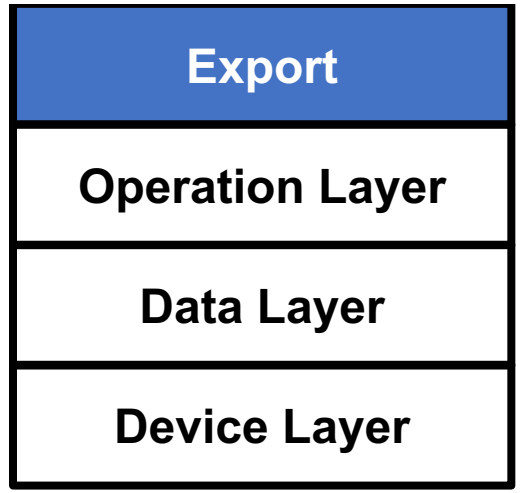
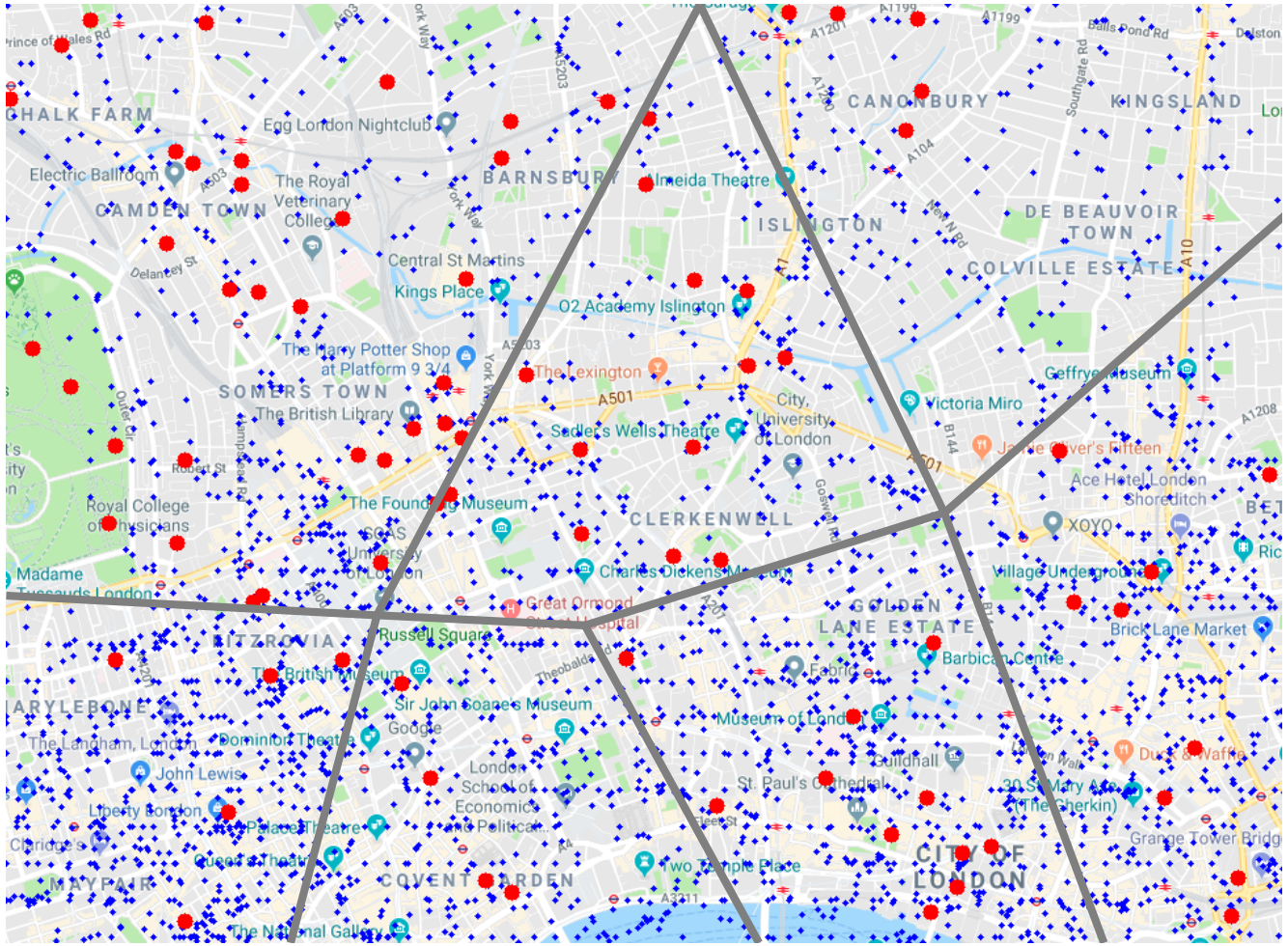




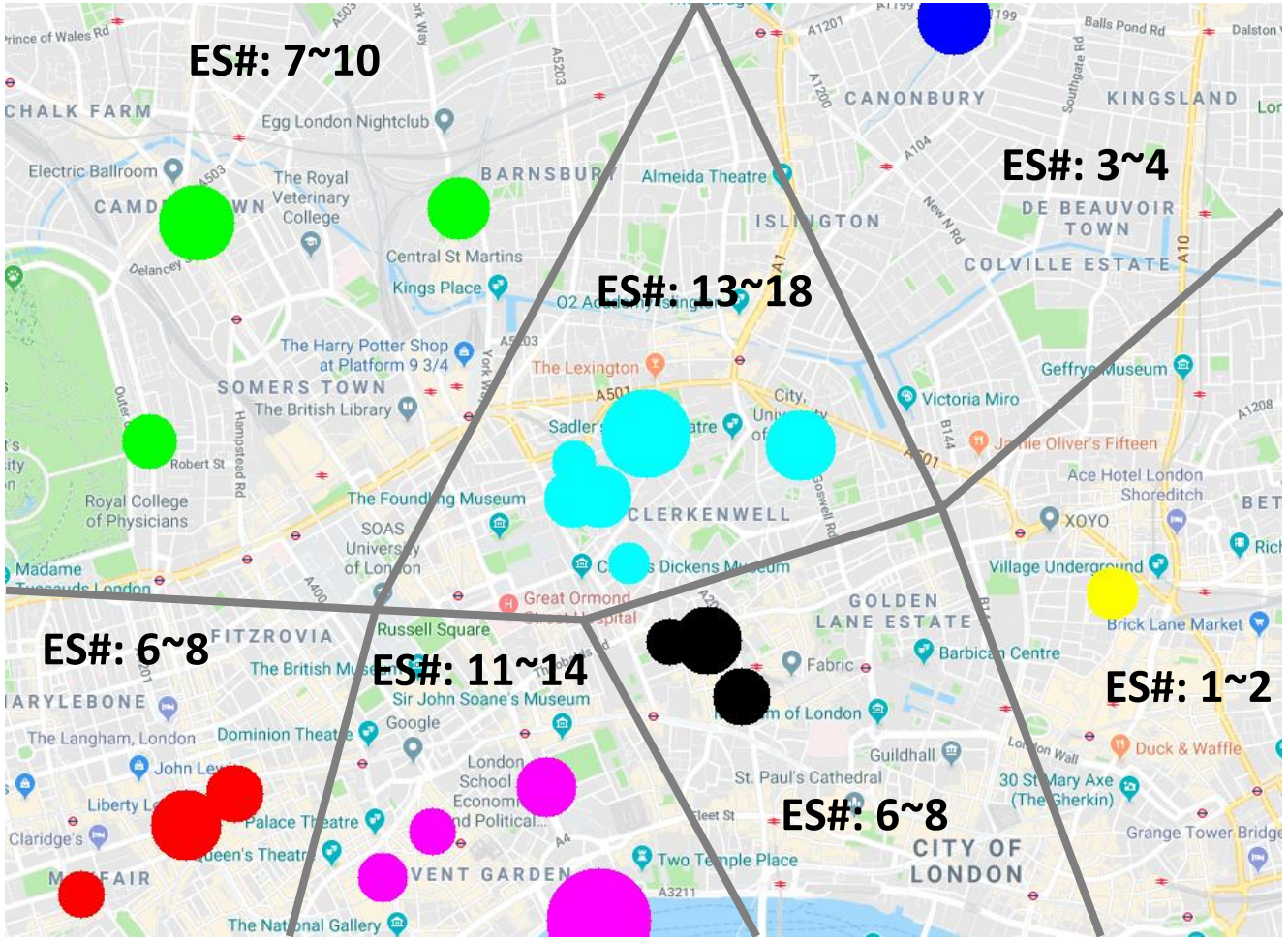
ES Deployment



https://unwiredlabs.com
3.91km * 5.75km

3455 LTE base stations in central London,
81 with radius larger than 3km

ES Placement



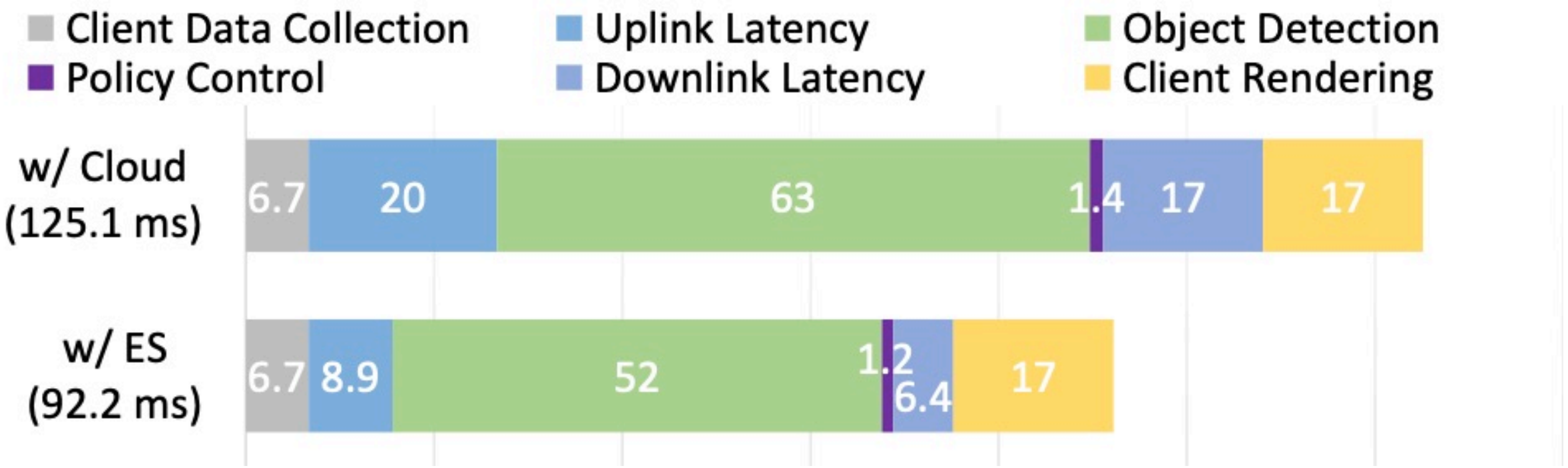
ES placement based on traffic heatmap

In total, the number of Eses is from 47 to 64.

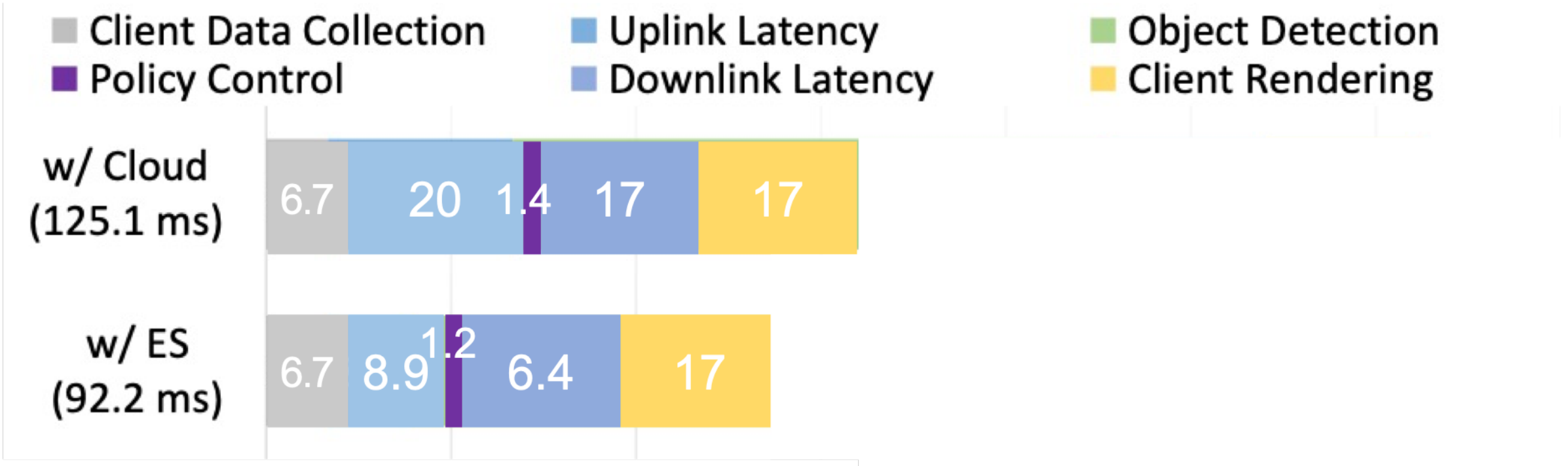
ES#:A~B means:
The number of ESes in the area is between A and B.

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

Delay


Client Data Collection
Uplink Latency
Object Detection
Policy Control
Downlink Latency
Client Rendering
w/ Cloud
(125.1 ms)
6.7
20
63
1.4
17
17
w/ ES
(92.2 ms)
6.7
8.9
52
1.2
6.4
17

Delay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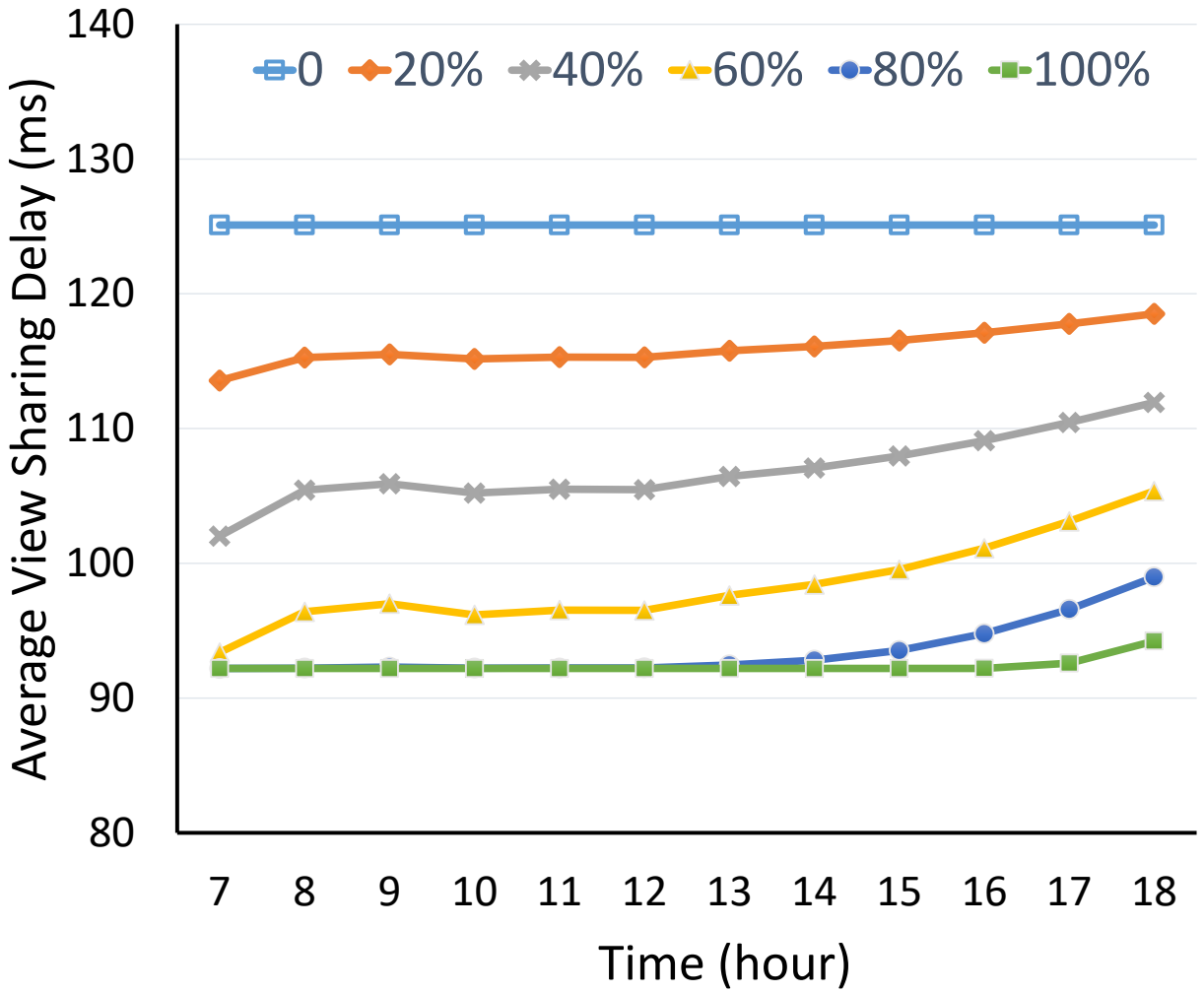

Average latency in different time periods for various load distribution between ES and cloud.

Demo

demo_link

Conclusion

- Using real traffic data from London, we show that EARVE improves vehicular network significantly with reasonable requirements in terms of number of installed edge servers.
- Our evaluation results shows that, compared to cloud solution, EARVE decreases the latency of AR applications in vehicle newtork, e.g., 26.3% for View Sharing.
- We test mixed edge and cloud solutions and find out that more ES deployments brings larger improvment.

Thank You!
Q & A

pengyuan.zhou@helsinki.fi

HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

HKUST