Intro. of HD maps

Deriving HD Maps for Highly Automated Driving from Vehicular Probe Data (ITSC), 2016

Presentors:
Kuan-Chieh Hsu 862188621
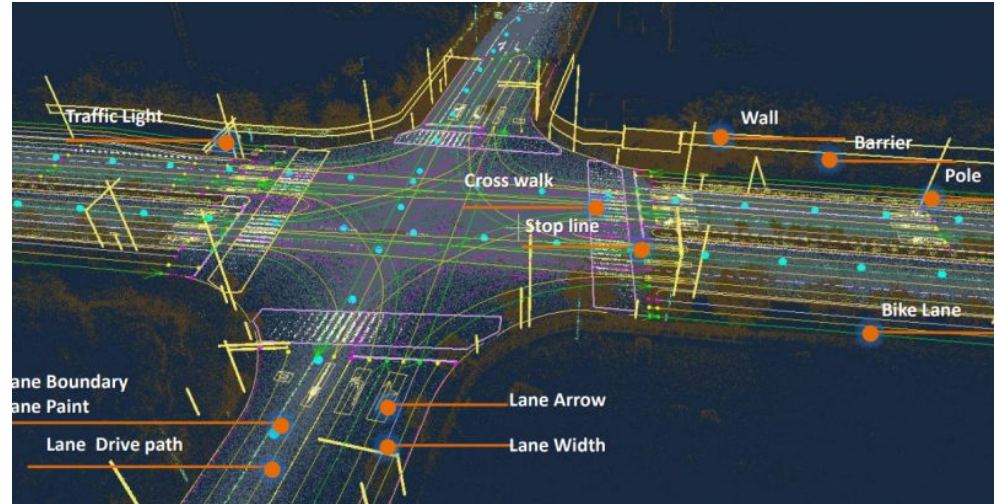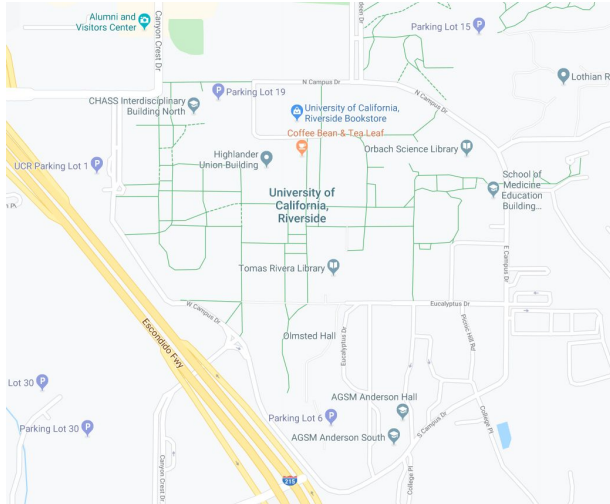Huayue Gu   862185891
Date: (Tue.) 2/11/2020

Outline

- What is HD maps in general?

- The HD map format in this work

- The process of generating architecture

- Applications
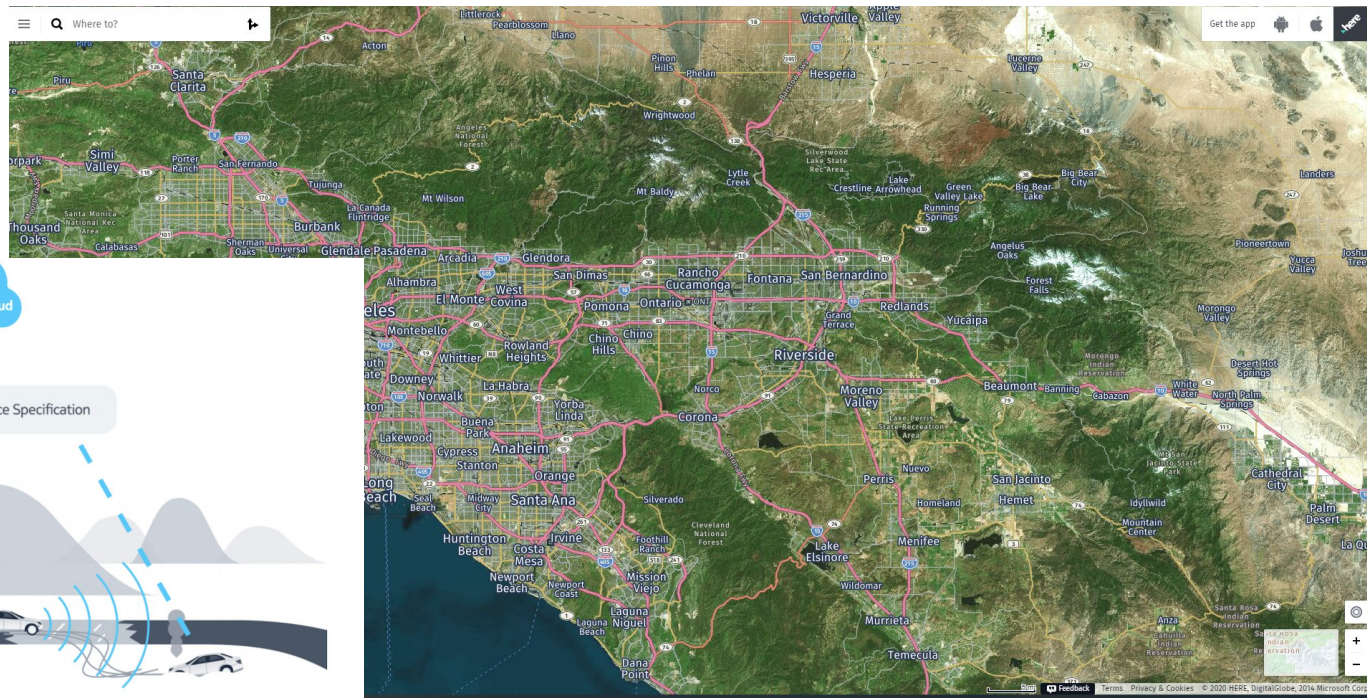
What is HD map ?

What is HD map?
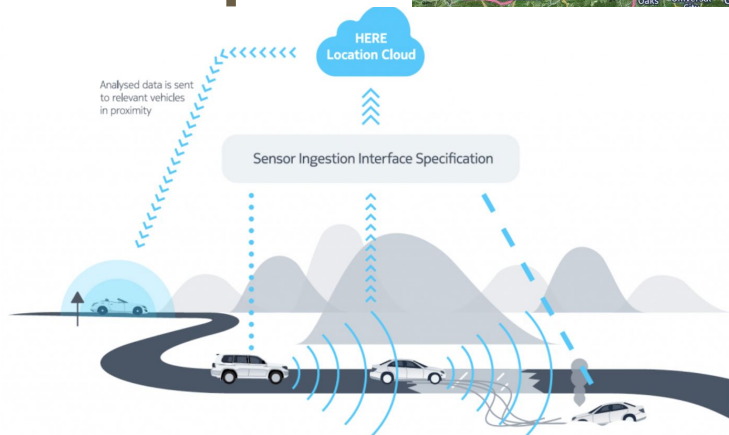
- High definition maps are detailed maps for self-driving tasks.
- It's all about high precision. (scale & comprehensiveness)

credits: https://www.geospatialworld.net/article/hd-maps-autonomous-vehicles/ and https://www.google.com/maps

HD maps: case 1

HERE map

Link: https://wego.here.com/?x=ep&map=33.9764,-117.3341,10,satellite

HD maps: case 2

- OpenDrive
  - open source format

© 2006 by VIRES

Link: http://www.opendrive.org/
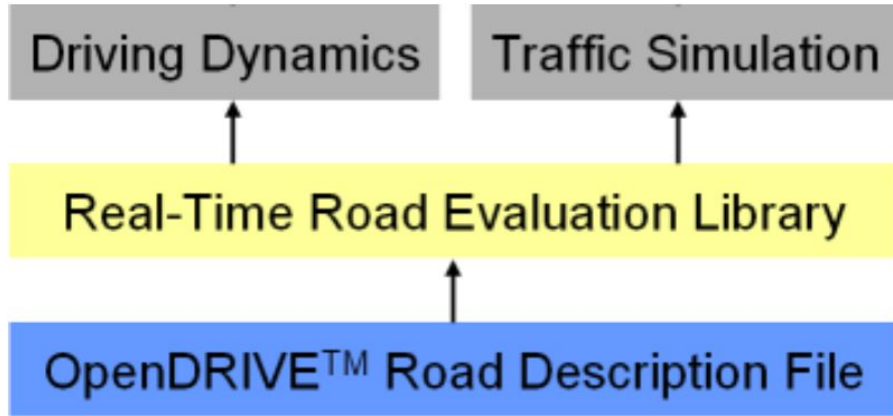
HD maps: case 3

- TomTom map
  - highway network in Germany

Link: https://www.tomtom.com/products/hd-map/
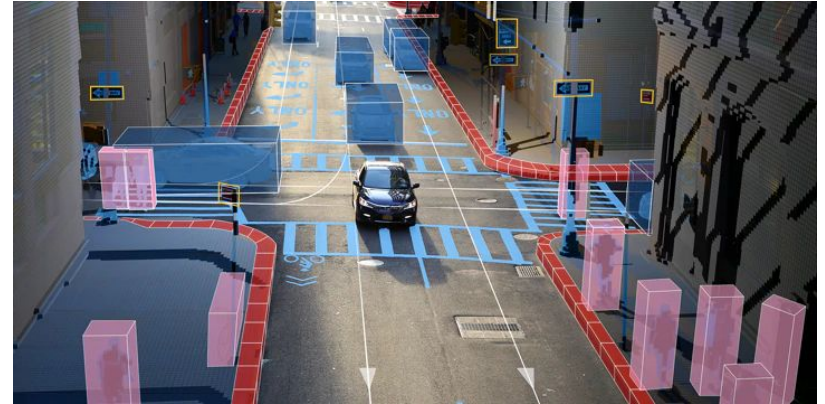
HD maps and why this paper

- HD map format standardization

- HD map generating architecture

- Adaptive to sensing data

"Find methods to exploit that probe data to generate and maintain HD maps."

The HD map format in this work

The HD map format

1. **Road geometry**
   a. **Road, lane positions**
2. **Road furniture**
   a. **Features: sign, traffic lights**
3. **Dynamic data**
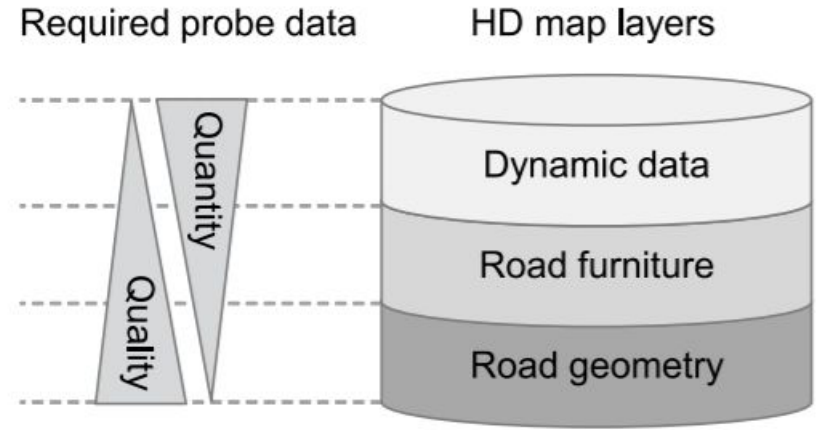   a. **Events, construction**

Figure 1: HD map feature classification and related requirements to probe data.

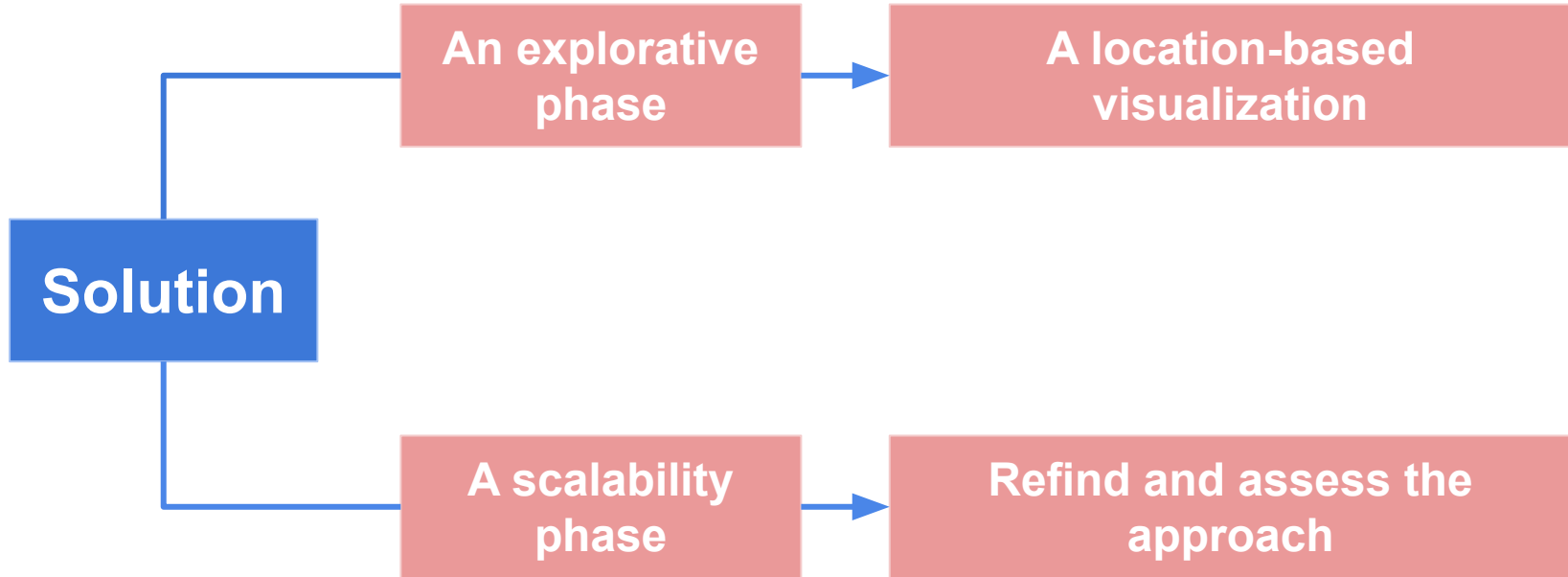# The process of generating architecture

Hypothesis

HD maps could be generated and updated by analyzing a great amount of recorded sensor data of series vehicles.
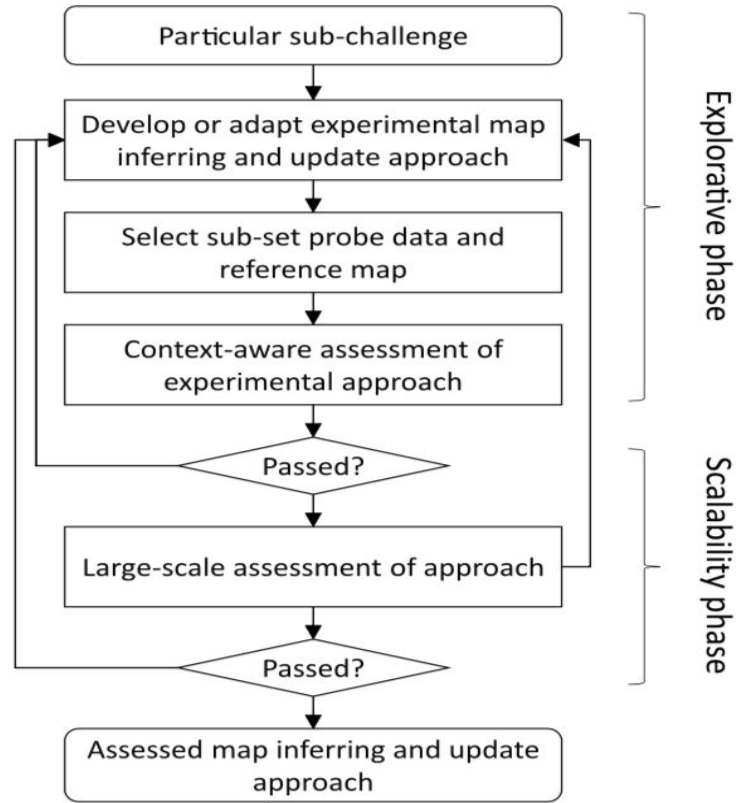
The whole idea

1. The solution to address the problem

2. A scalable infrastructure

3. The proof to support our hypothesis

4. A metric to evaluate the accuracy of the HD Maps

The whole idea--- Solution

```
                    ┌──────────────────┐        ┌──────────────────────┐
                    │  An explorative  │───────▶│  A location-based    │
                    │      phase       │        │    visualization     │
                    └──────────────────┘        └──────────────────────┘
┌──────────────┐
│   Solution   │
└──────────────┘
                    ┌──────────────────┐        ┌──────────────────────┐
                    │  A scalability   │───────▶│  Refind and assess   │
                    │      phase       │        │    the approach      │
                    └──────────────────┘        └──────────────────────┘
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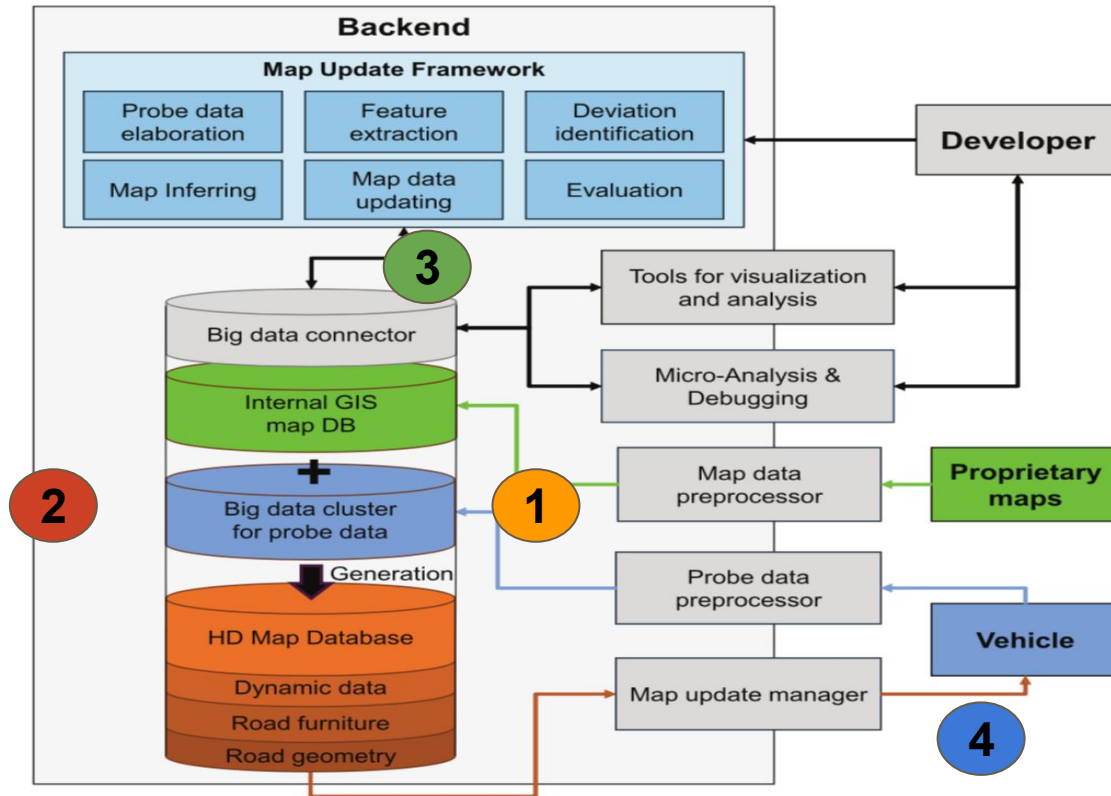
The whole idea--- Solution

The whole idea--- System Architecture

The whole idea--- A Proof of concept

Approach 1: inferring road geometry with GPS data

Figure 7: Results of Approach 1 (view in ITEF)

The whole idea--- A Proof of concept

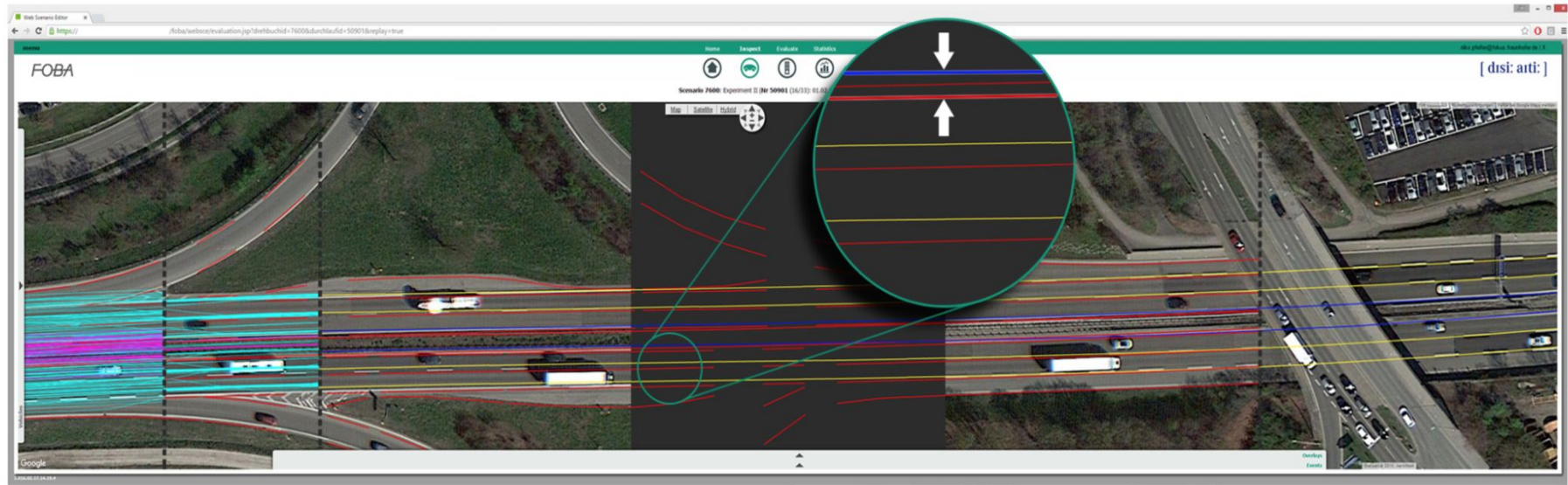## Approach 2: Lane inferring with extended probe data

Figure 10: Results of Approach 2 (ITEF)

The whole idea--- Metric

Experimental Setting (The Autobahn section in Germany)

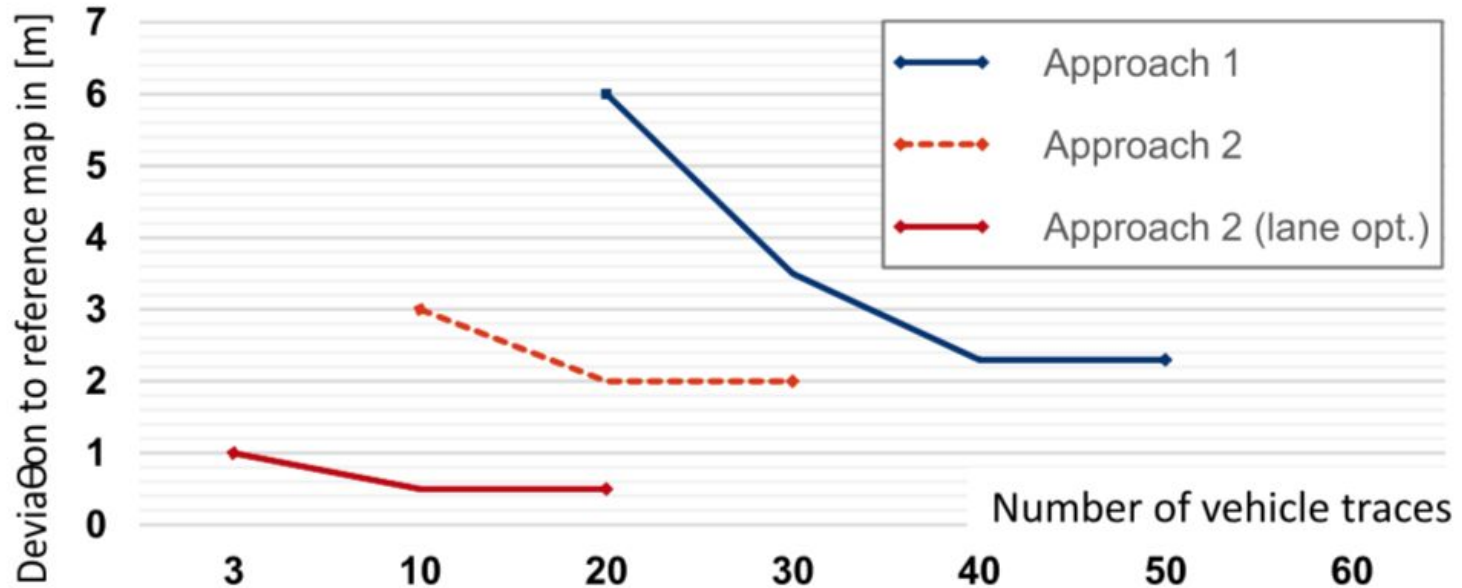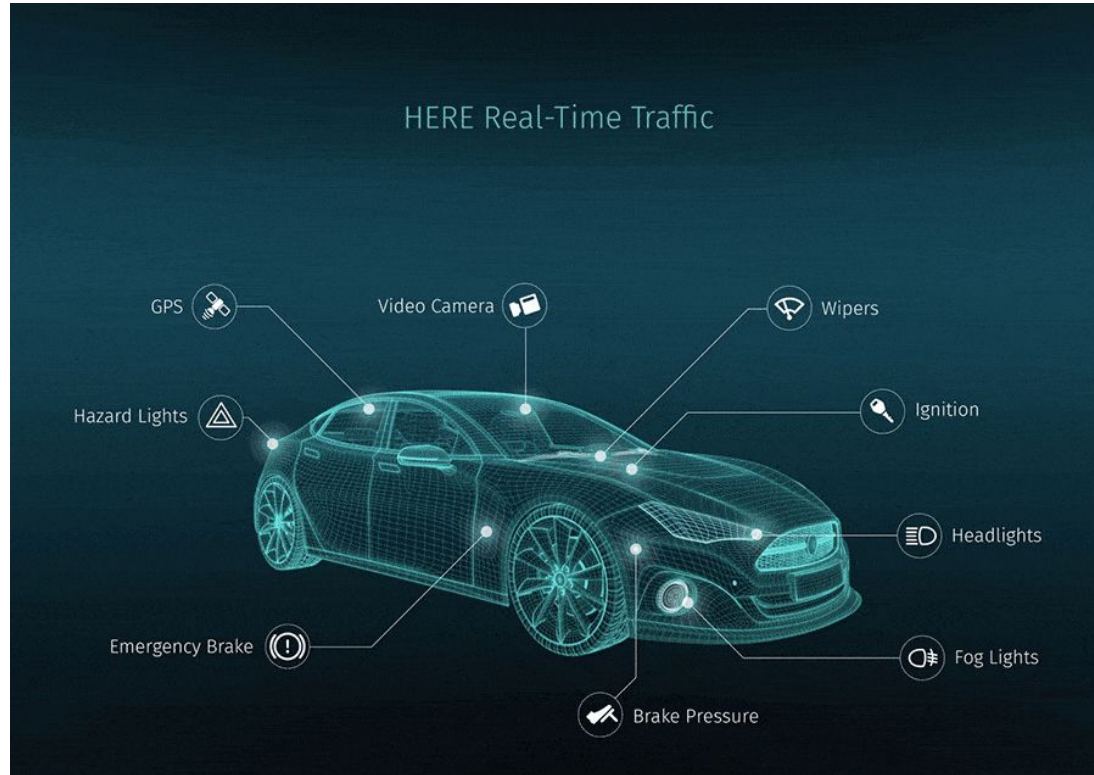| Input data	quantity
Traces	100
Probe Data	15,000,000,000

The whole idea--- Metric

Figure 11: Quality of the inferred map using Algorithm 1 and 2 based on the number of considered probe data.

Applications

Application aspects-For Platform

HERE Real-Time Traffic

GPS
Video Camera
Wipers
Hazard Lights
Ignition
Headlights
Emergency Brake
Fog Lights
Brake Pressure

Application aspects-For Users

Semantic Segmentation

Cuboids

Polygons

2D Boxes

Lines and Splines

BETA

3D Lidar Point Cloud

Conclusion

- Developing system to infer HD map from probe data

- Inferring HD maps with an accuracy of less than 1 meter is possible

- Working on improving the accuracy of resulting maps using additional sensors

- Working on detecting changes of the road layout as quickly as possible

References

[1] Massow, Kay, et al. "Deriving HD maps for highly automated driving from vehicular probe data." 2016 IEEE 19th International Conference on Intelligent Transportation Systems (ITSC). IEEE, 2016.

[2] Haklay, Mordechai, and Patrick Weber. "Openstreetmap: User-generated street maps." *IEEE Pervasive Computing* 7.4 (2008): 12-18.

[3] Vardhan, Harsha. "HD Maps: New age maps powering autonomous vehicles." Geospatial world (2017).

Thanks for your listening!