

## Introduction to Dr. Ma Changjie

- **Chief software Architect** of high-precision map of intelligent automobile department of **Baidu, Inc.**;
- **Ph.D** of China University of Geosciences(Wuhan);
- **Research interests:** Geographical Information Science, Autonomous Driving, Navigation & HD Map;



Organizer:



**浙江省自然资源厅** 测绘与地理信息管理  
Department of Natural Resources of Zhejiang Province (Administration of Surveying Mapping And Geoinformation)

# Baidu Apollo HD Map

A satellite view of Earth from space, showing the curvature of the planet and the glow of the atmosphere. The surface is dark, with numerous bright yellow and orange lights representing cities and urban areas, primarily concentrated in East Asia. The background is a deep blue gradient.

Dr. Ma Changjie

Nov. 2018



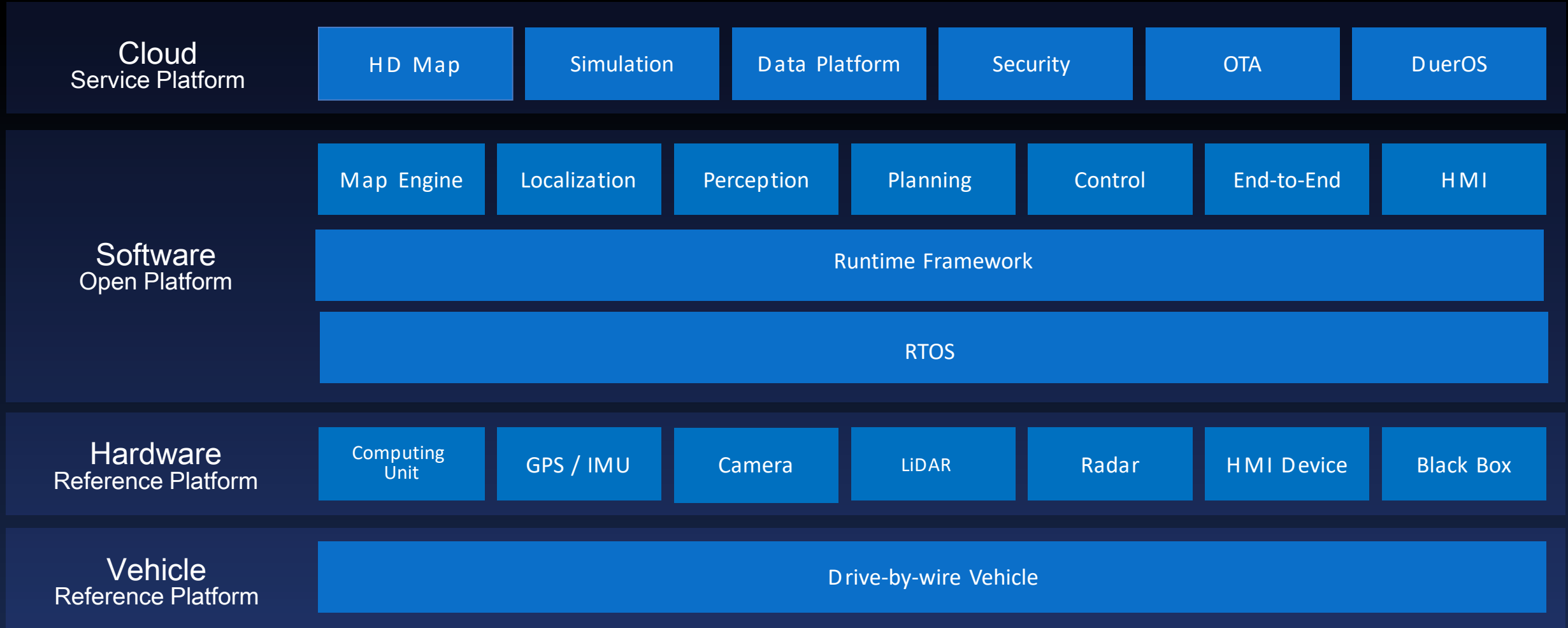
**Open  
Capability**

**Shared  
Resources**

**Accelerated  
Innovation**

**Sustained  
Mutual Benefit**

# Apollo Framework



# Apollo is Accelerating Innovation for Autonomous Driving



2017.4

Hello Apollo  
Apollo Platform  
Announced



2017.7

Apollo 1.0  
Closed Venue Tracking  
Autonomous Driving



2017.9

Apollo 1.5  
Fixed Lane  
Autonomous  
Driving



2018.1

Apollo 2.0  
Autonomous Driving  
for Simple Urban Road  
Conditions



2018.4

Apollo 2.5  
Vision-based Highway  
Autonomous Driving  
in Limited Area



2018.7

Apollo 3.0  
Upgraded  
Architecture

131  
Partners

11,000 +  
Developers

230,000 +  
Lines of code

# Apollo Pilot: Making Driving Safer

## Multi-Driving Scenarios

### Highway/Ring Road

Highway/Ring Road Cruising



Auto Lane-changing



ETC and ramps



Obstacle Evasion



Traffic Jam



### Valet Parking

Valet Parking/Summoning



Automatic Valet Parking



### Traffic Jam

Traffic Jam Pilot



Stop & Go Supported



### Campus

Autonomous shuttle /operation



Station Parking/Obstacle Evasion



## Multi-Vehicle Types

### Passenger Vehicle

Private Car



Shared Car



### Commercial Vehicle

Freight



Bus



Mid-size Mini-size



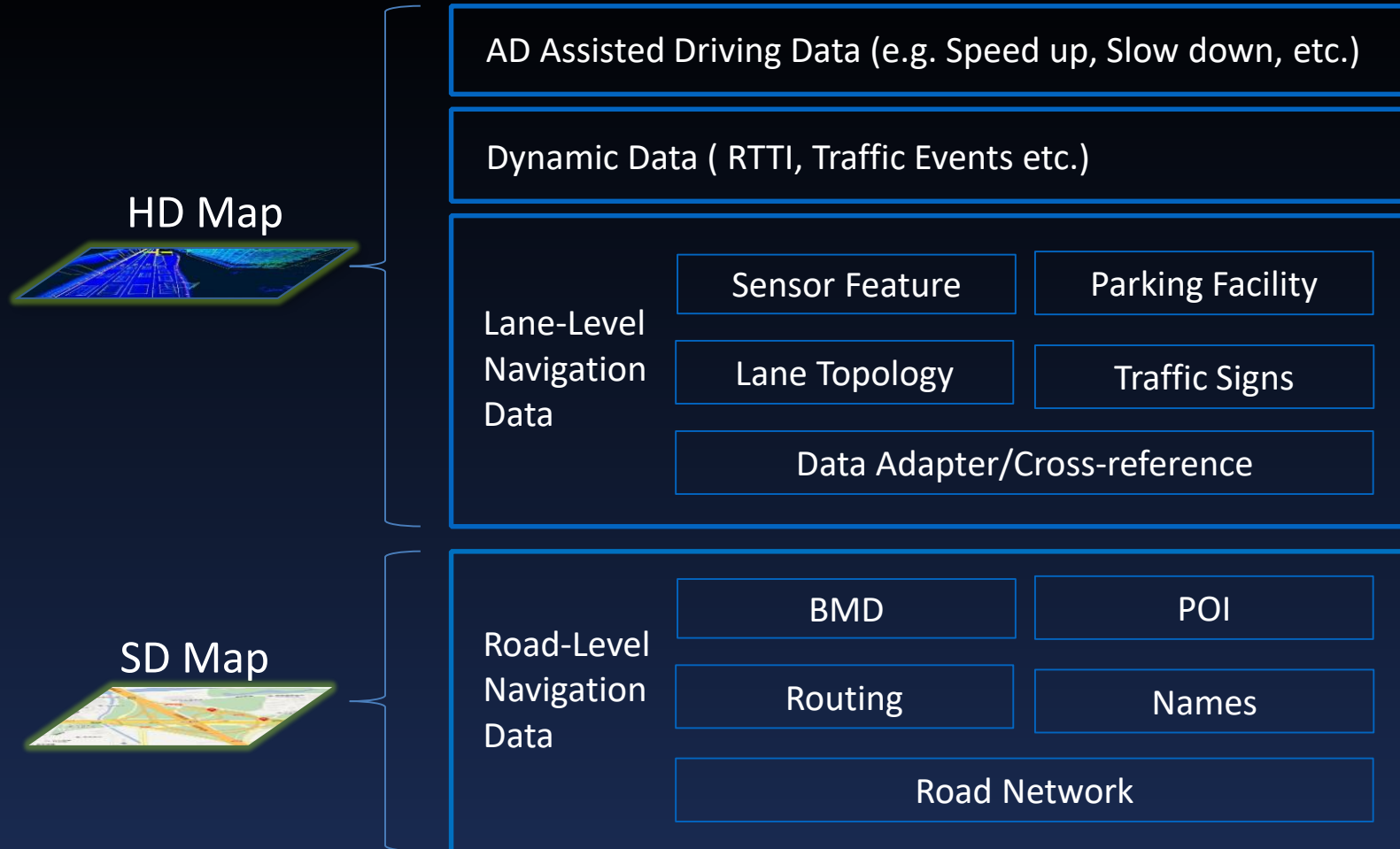
# Apollo HD Map

One Road Network  
Architecture

Full-Scenario  
Features

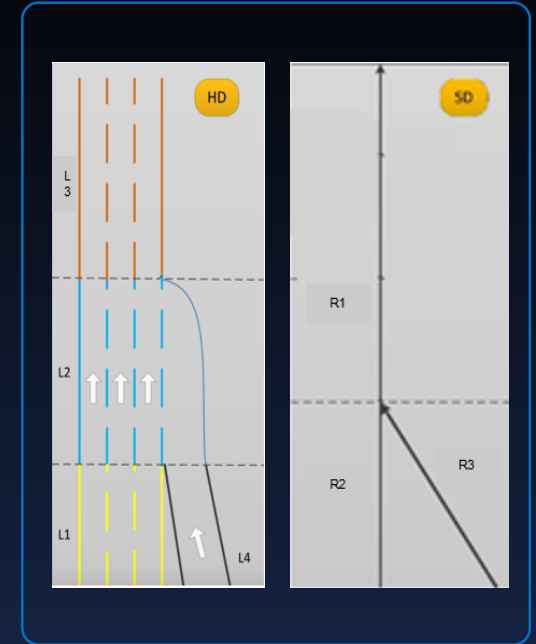
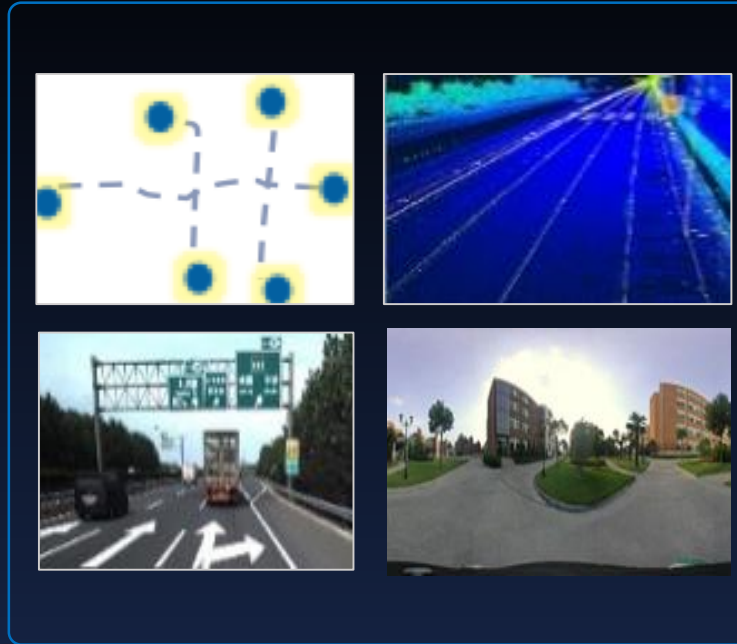
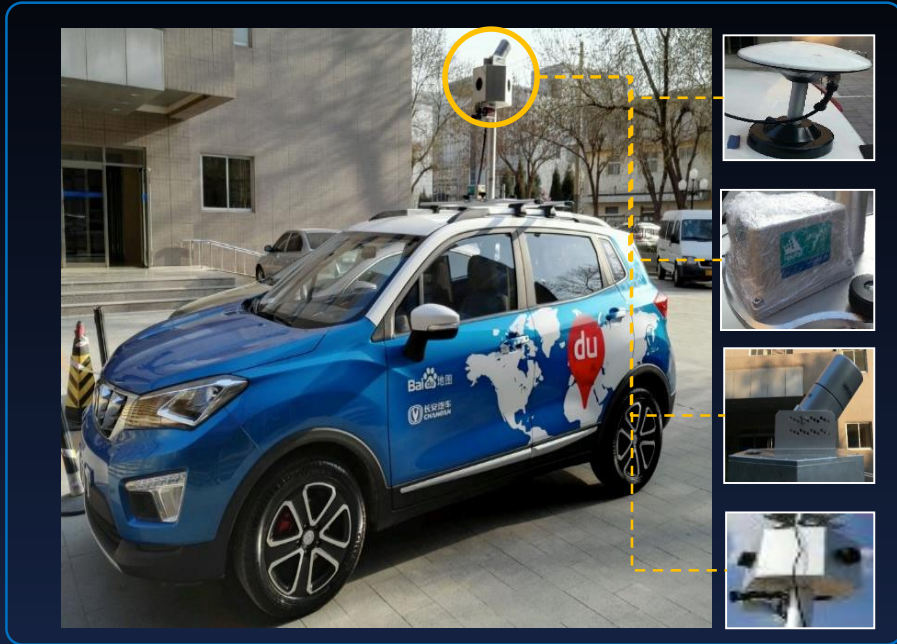
AI Driven  
Technology

# One Road Network Architecture



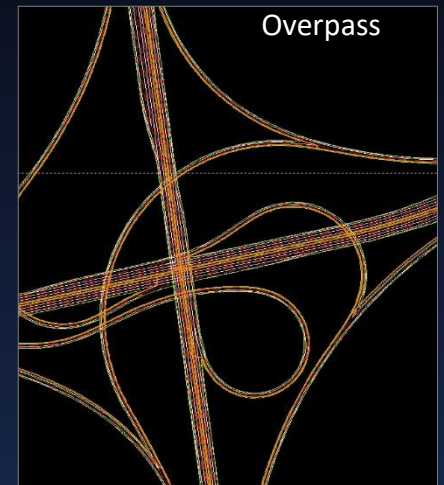
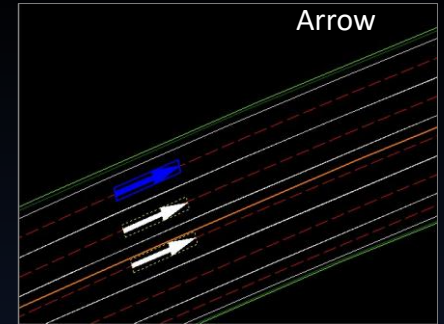
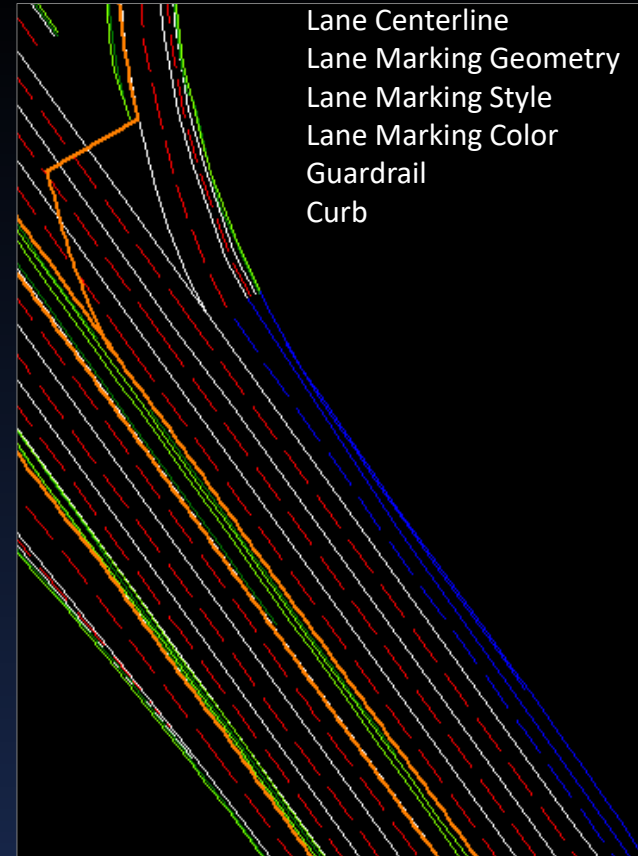
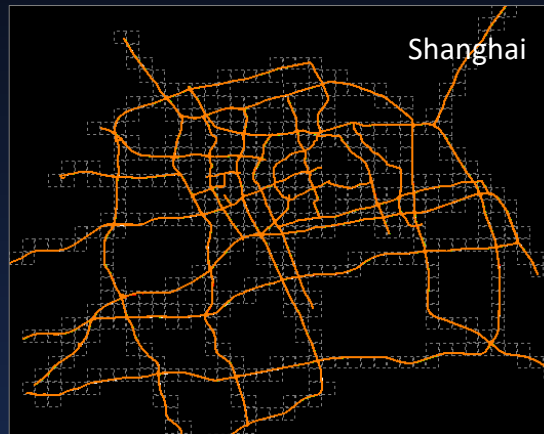
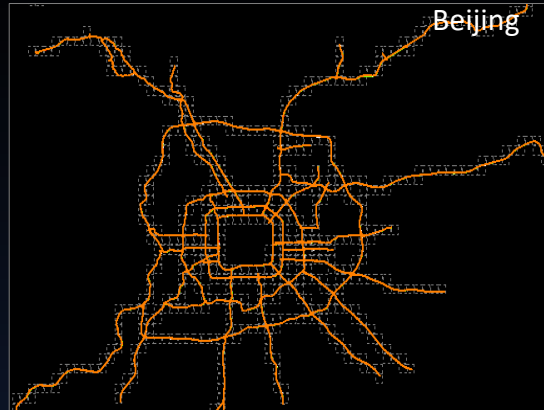


# One Road Network Architecture



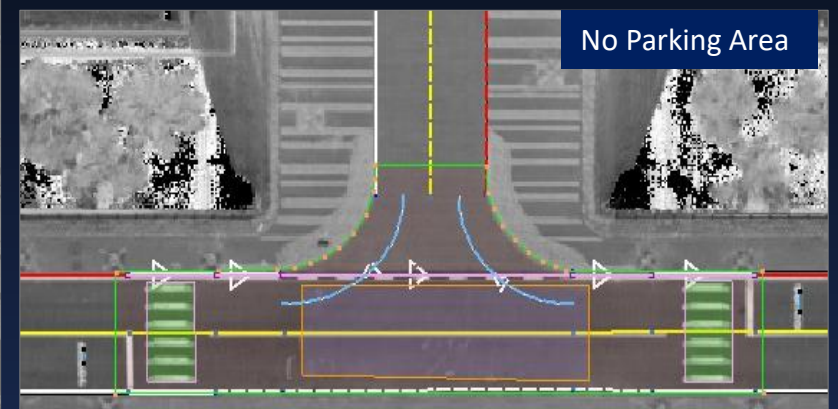
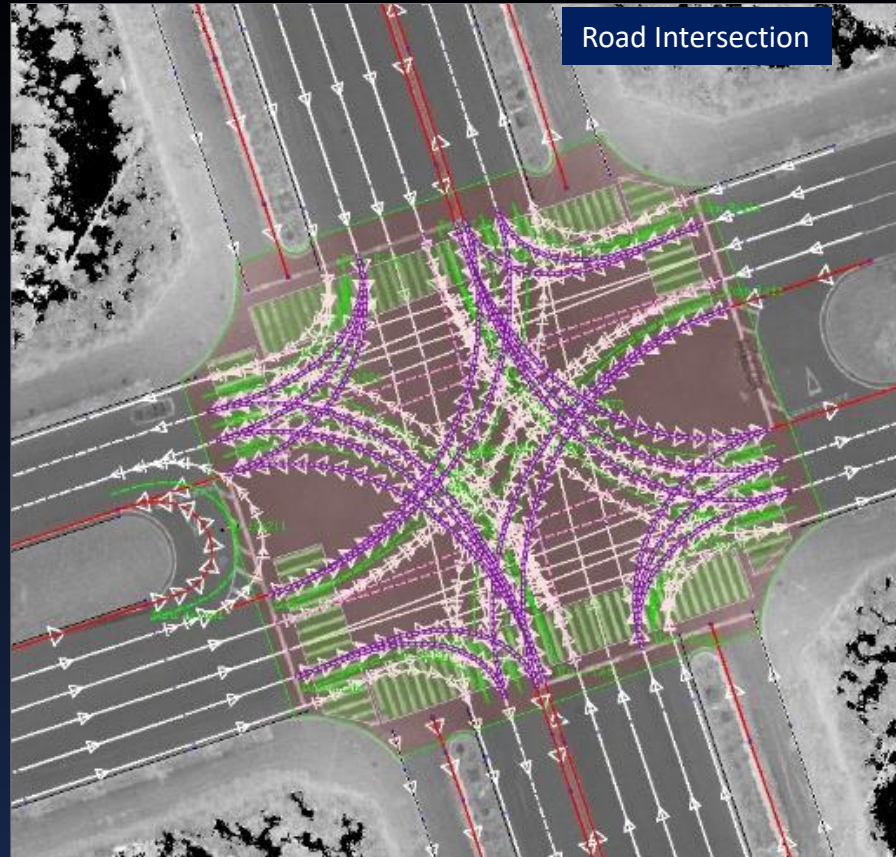
# Full-Scenario Features: Highway & Expressway

Features
Lane Marking Geometry
Lane Marking Color
Lane Marking Style
Lane Marking Material
Lane Marking Width
Lane Construction State
Lane Number
Lane Width/Type
Lane Centerline
Lane Topology
Max/Min Speed Limit
Junction
Overpass
Guardrail/Curb
Arrows/Words
...



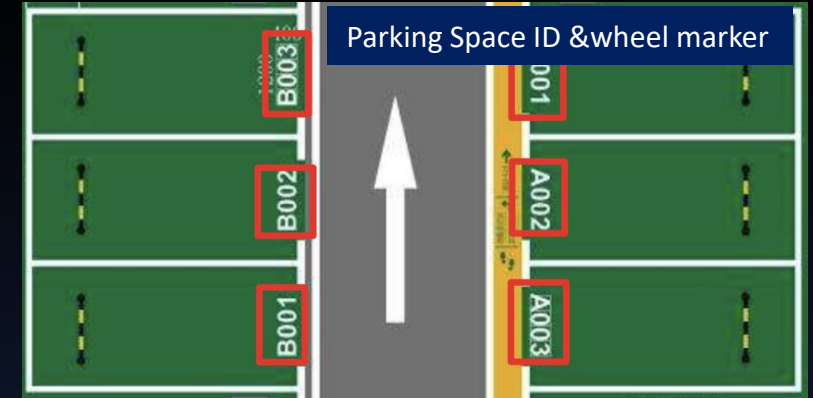
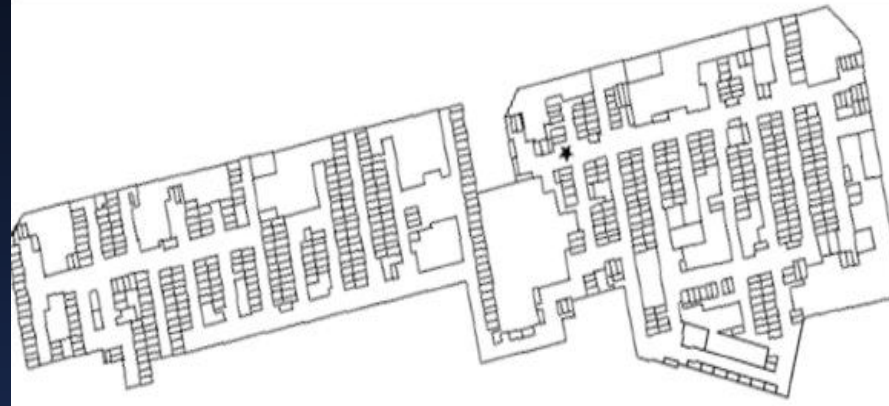
# Full-Scenario Features: Urban Road & Close Area

Features
Lane Marking Geometry
Lane Marking Color
Lane Marking Style
Lane Marking Material
Lane Marking Width
Lane Construction State
Virtual Lane Connectivity of Intersection
Intersection Boundary
Traffic Light
Stop Line
Speed Bump
Zebra Line
Overpass
Traffic Sign
No Parking Area
...



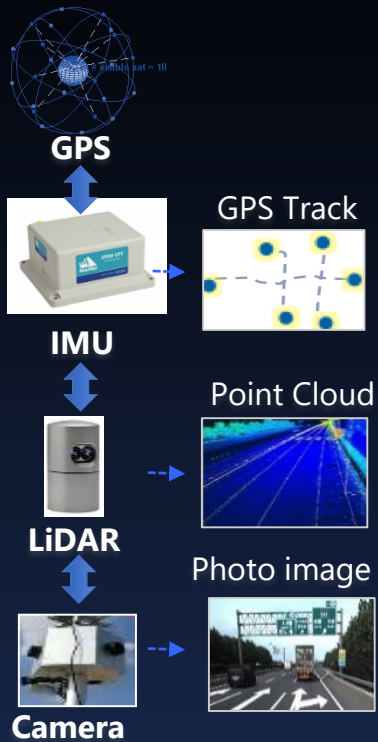
# Full-Scenario Features: Parking Facility

Features
Parking Facility Region
Parking Space ID
Parking Space Geometry
Parking Wheel Marker
Parking Lane Marking
Pole
Drivable Area
Connection to Road
Handover Zone
Arrow
No Parking Area
Zebra Line
Curvature
Traffic Sign
Ramp Area
...



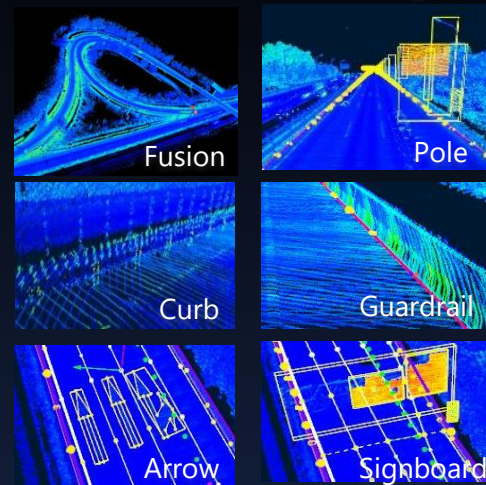
# AI Driven Technology: HD Map Production Pipeline

## Data Sourcing



## Backend Automation

### Point Cloud Fusion & Recognition



### Image Recognition



## Map making & Validation

### Mapmaker



### Map production management

子项目ID	子项目名称	城市	子项目类型	所属项目	任务件数	完成情况	操作
10063	深圳V1	深圳	多任务子项目	专项数据	58	未开始	查看详情
10049	成都V1	成都	多任务子项目	专项数据	77	未开始	查看详情
10048	杭州V1	杭州	多任务子项目	专项数据	86	未开始	查看详情
10047	广州V1	广州	多任务子项目	专项数据	137	未开始	查看详情
79	上海V1	上海	多任务子项目	专项数据	227	未开始	查看详情
72	北京V1	北京	多任务子项目	专项数据	113	未开始	查看详情

## Map Compile & Release

### NDS Release

**NDS Product Certificate**  
55\_2017012730409

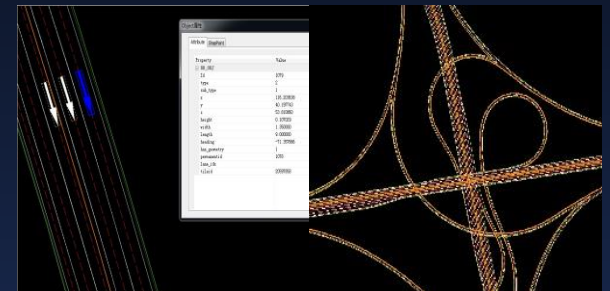
2017-03-13

**Certificate for Product Update**  
NDS Product Update no  
Certificate ID of  
original NDS Product

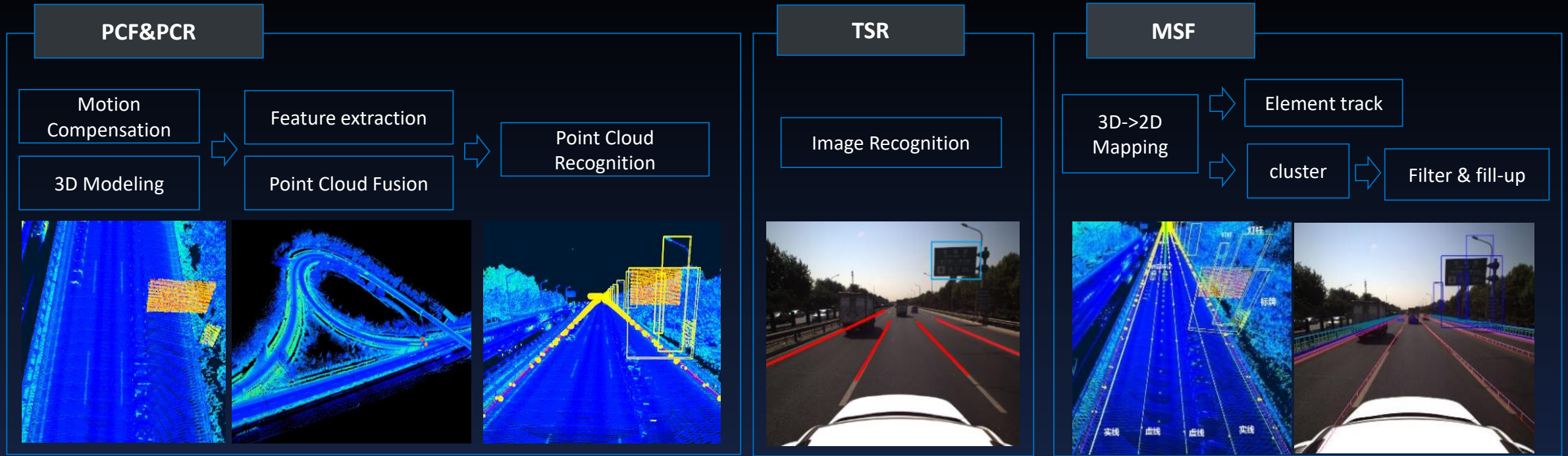
**Individual Profile Reports**

Report ID	Profile Name	Profile Version	Validation Result
55_2017012730409_V1 Profile 1.1.2		1.0	PASS

**Overall Result** Certified

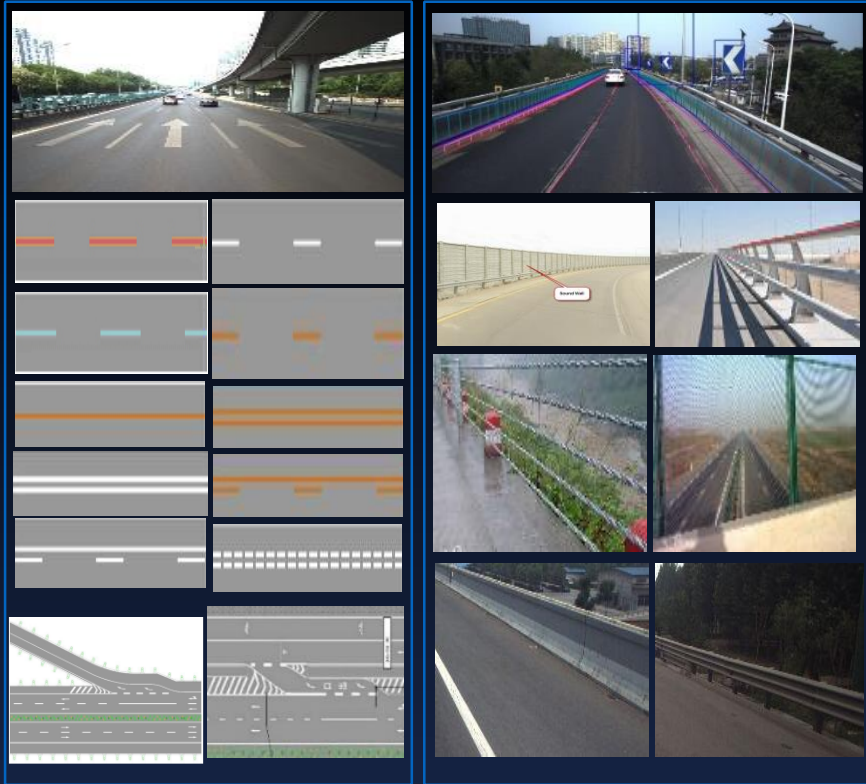


# AI Driven Technology: Point Clouds & Images Automated Processing



Deep Learning Neural Network (CNN/RCNN/RNN)

# AI Driven Technology: Point Clouds & Images Automated Recognition



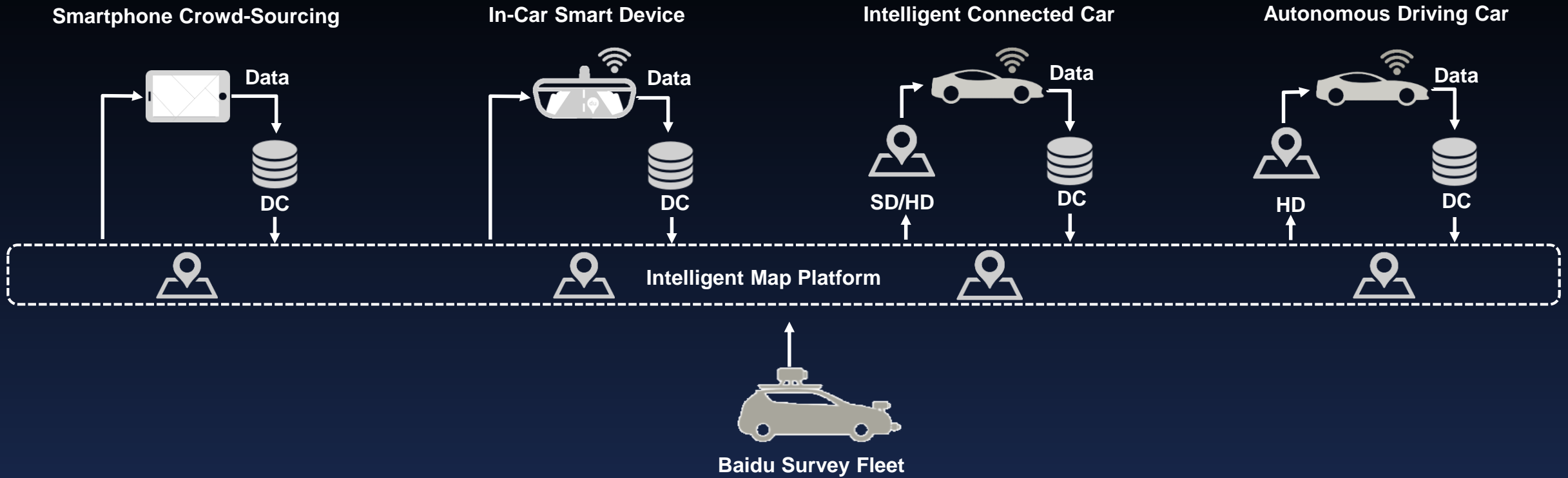
Lane marking and Guardrail in China about 50 types



Chinese standard traffic sign list above, 200 types or so.

Feature	Accuracy rate
Lane Marking	96.6%
Guardrail	99.1%
Curb	99.1%
Sign	95.4%
Pole	95.5%

# AI Driven Technology: Intelligent Map Ecosystem





# Open Road testing with BMW/Bosch/Cherry



BMW AD road testing on Open road 2016

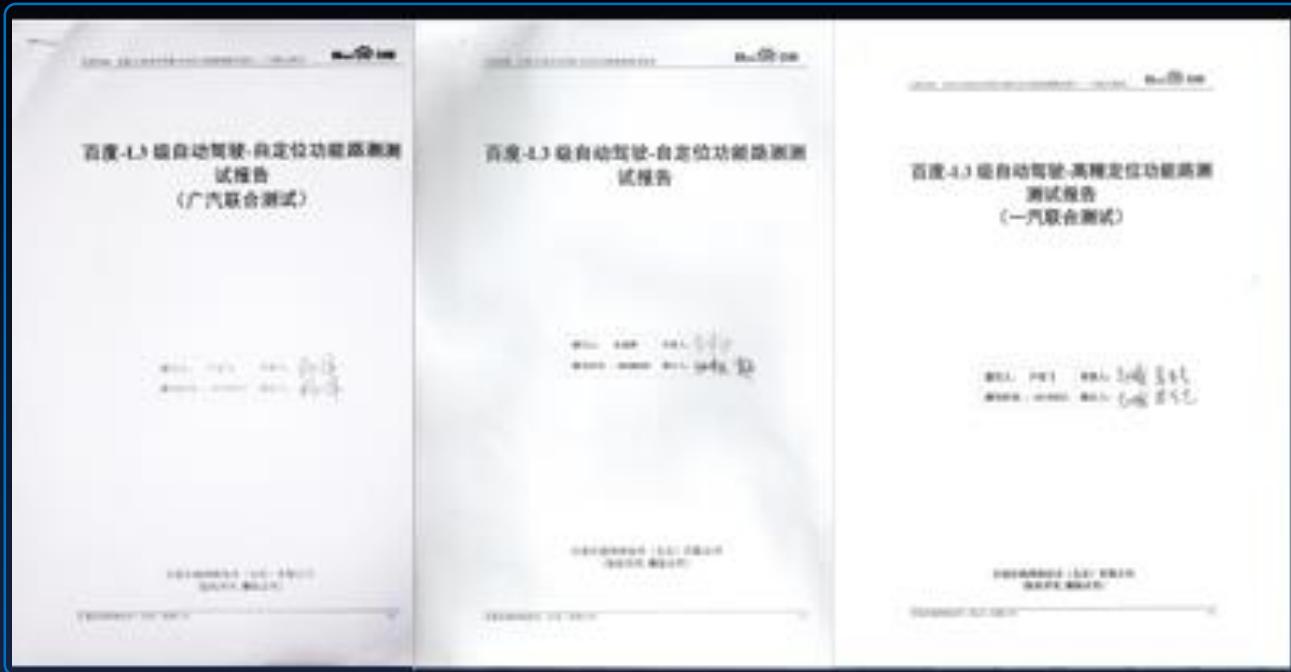


Bosch AD road testing on SuZhou Highway 2017



Cherry AD road testing on Wuhu Highway 2018

# OEM Partners Testing Reports & Nomination



# Thanks

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