Intelligent Transportation and Autonomous Vehicles

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
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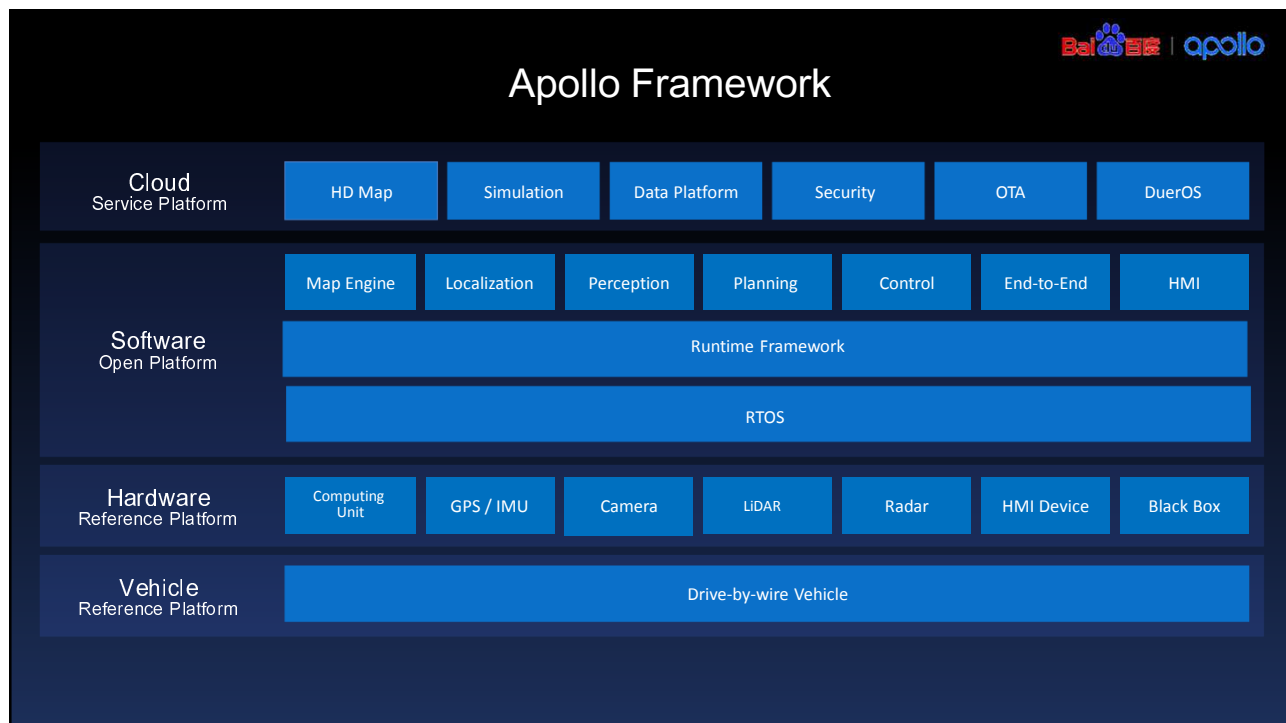
Baidu Apollo HD Map

Dr. Ma Changjie

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apollo

Open Capability **Shared Resources** **Accelerated Innovation** **Sustained Mutual Benefit**

Apollo Framework

Cloud Service Platform	HD Map	Simulation	Data Platform	Security	OTA	DuerOS

Software Open Platform	Map Engine	Localization	Perception	Planning	Control	End-to-End	HMI
	Runtime Framework						
	RTOS						

Hardware Reference Platform	Computing Unit	GPS / IMU	Camera	LiDAR	Radar	HMI Device	Black Box

Vehicle Reference Platform	Drive-by-wire Vehicle

Apollo is Accelerating Innovation for Autonomous Driving

2017.4	2017.7	2017.9	2018.1	2018.4	2018.7
Hello Apollo	Apollo 1.0	Apollo 1.5	Apollo 2.0	Apollo 2.5	Apollo 3.0
Apollo Platform Announced	Closed Venue Tracking Autonomous Driving	Fixed Lane Autonomous Driving	Autonomous Driving for Simple Urban Road Conditions	Vision-based Highway Autonomous Driving in Limited Area	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

Obstacle Evasion

Auto Lane-changing

Traffic Jam

ETC and ramps

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

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Apollo HD Map

One Road Network Architecture   **Full-Scenario Features**   **AI Driven Technology**

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One Road Network Architecture

HD Map

AD Assisted Driving Data (e.g. Speed up, Slow down, etc.)
Dynamic Data (RTTI, Traffic Events etc.)

Lane-Level Navigation Data

Sensor Feature	Parking Facility
Lane Topology	Traffic Signs
Data Adapter/Cross-reference	

SD Map

Road-Level Navigation Data

BMD	POI
Routing	Names
Road Network	
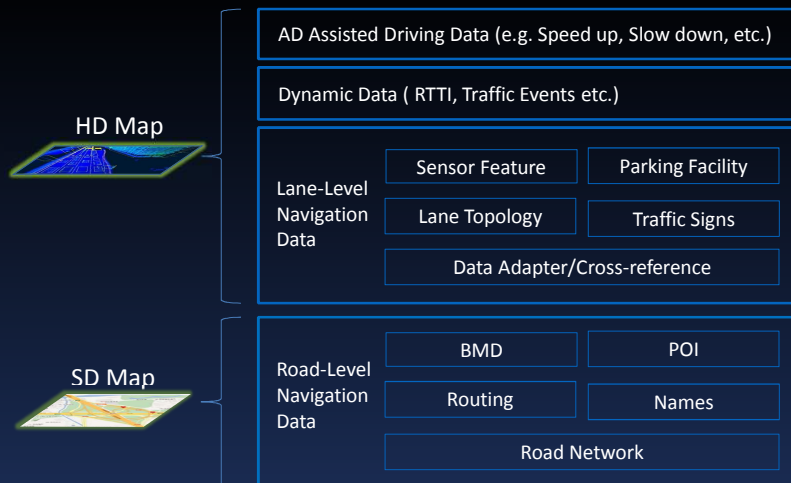
One Road Network Architecture
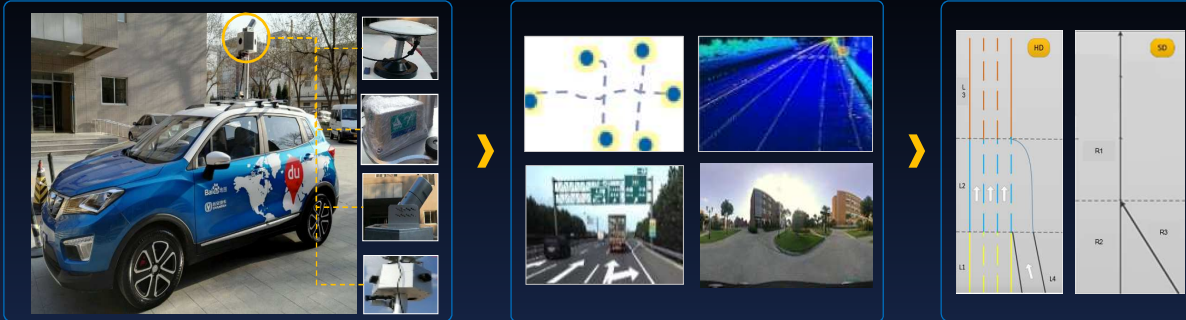
Full-Scenario Features: Highway & Expressway

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
...

Beijing

Shanghai

Lane Centerline
Lane Marking Geometry
Lane Marking Style
Lane Marking Color
Guardrail
Curb

Arrow

Overpass

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
…

Road Intersection
Speed Bumps
No Parking Area
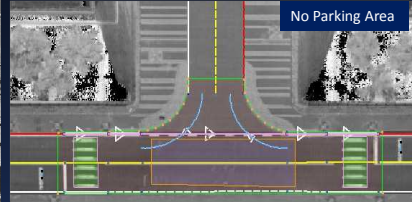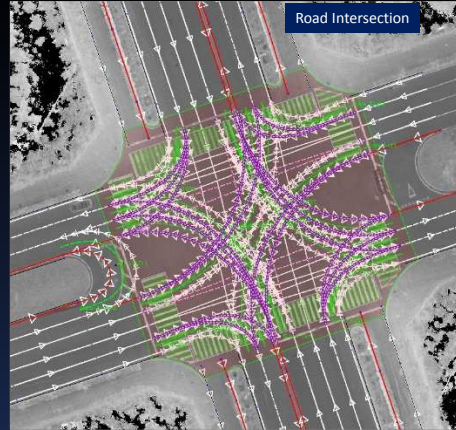
Full-Scenario Features: Parking Facility

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
…

Parking Facility Region
Parking Space ID &wheel marker
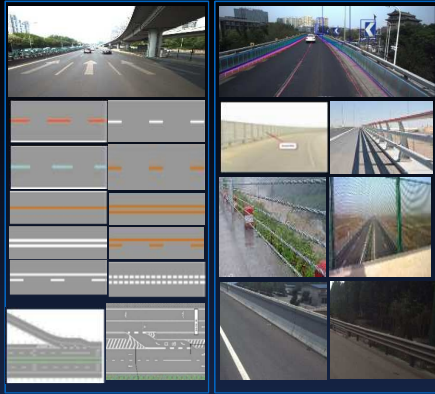Lane Marking & traffic sign
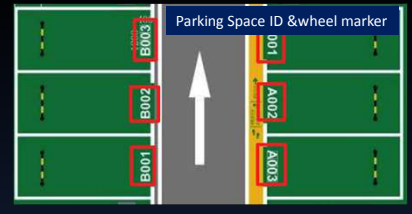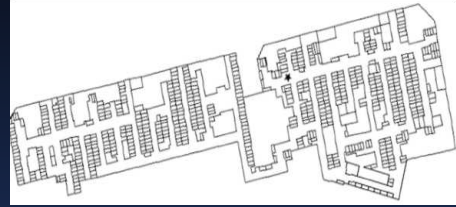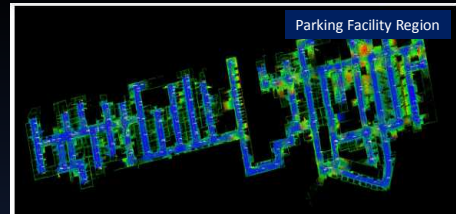
AI Driven Technology: HD Map Production Pipeline

AI Driven Technology: Point Clouds & Images Automated Processing

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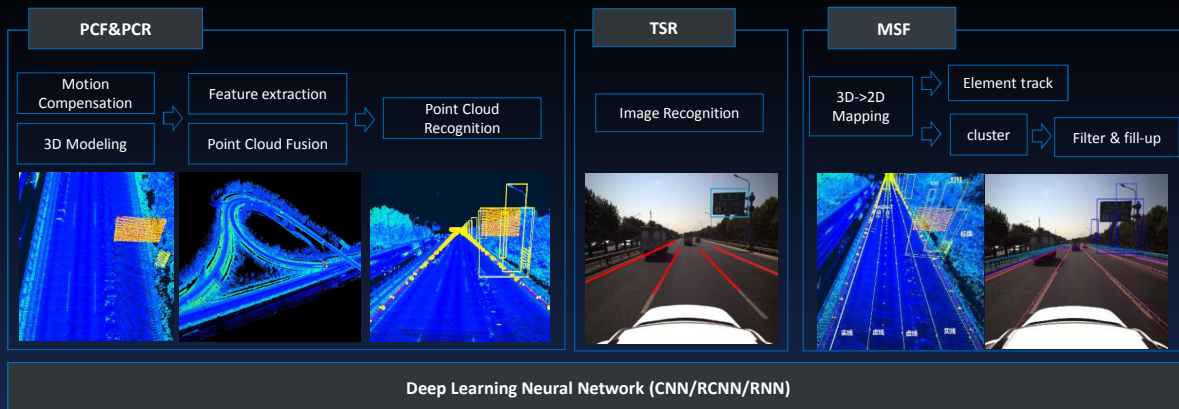
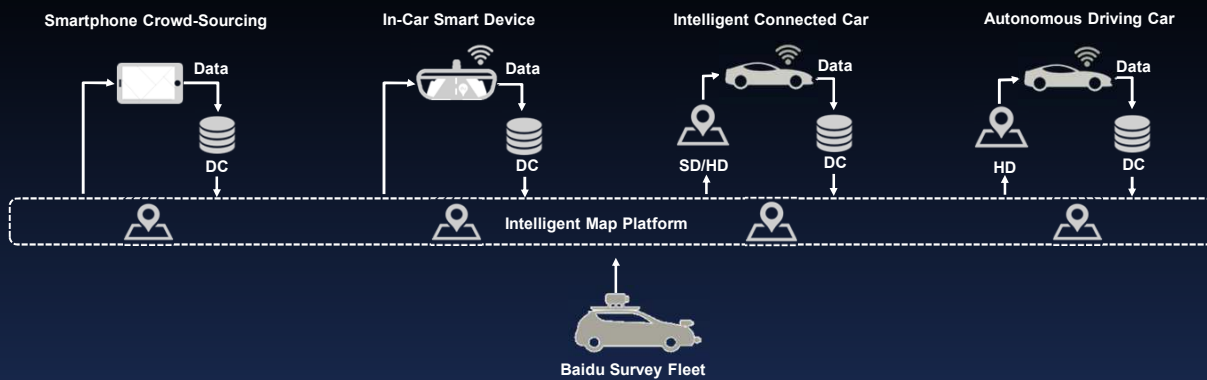# AI Driven Technology: Point Clouds & Images Automated Recognition

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

Smartphone Crowd-Sourcing   In-Car Smart Device   Intelligent Connected Car   Autonomous Driving Car

Data   Data   Data   Data

DC   DC   SD/HD   DC   HD   DC

Intelligent Map Platform

Baidu Survey Fleet

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