
Sebastian Thrun
FOUNDER &
These are geographic maps of robot environments.
0:09 / 1:20
CC
HD
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L2 Navigation Map Vs. HD Map4.0

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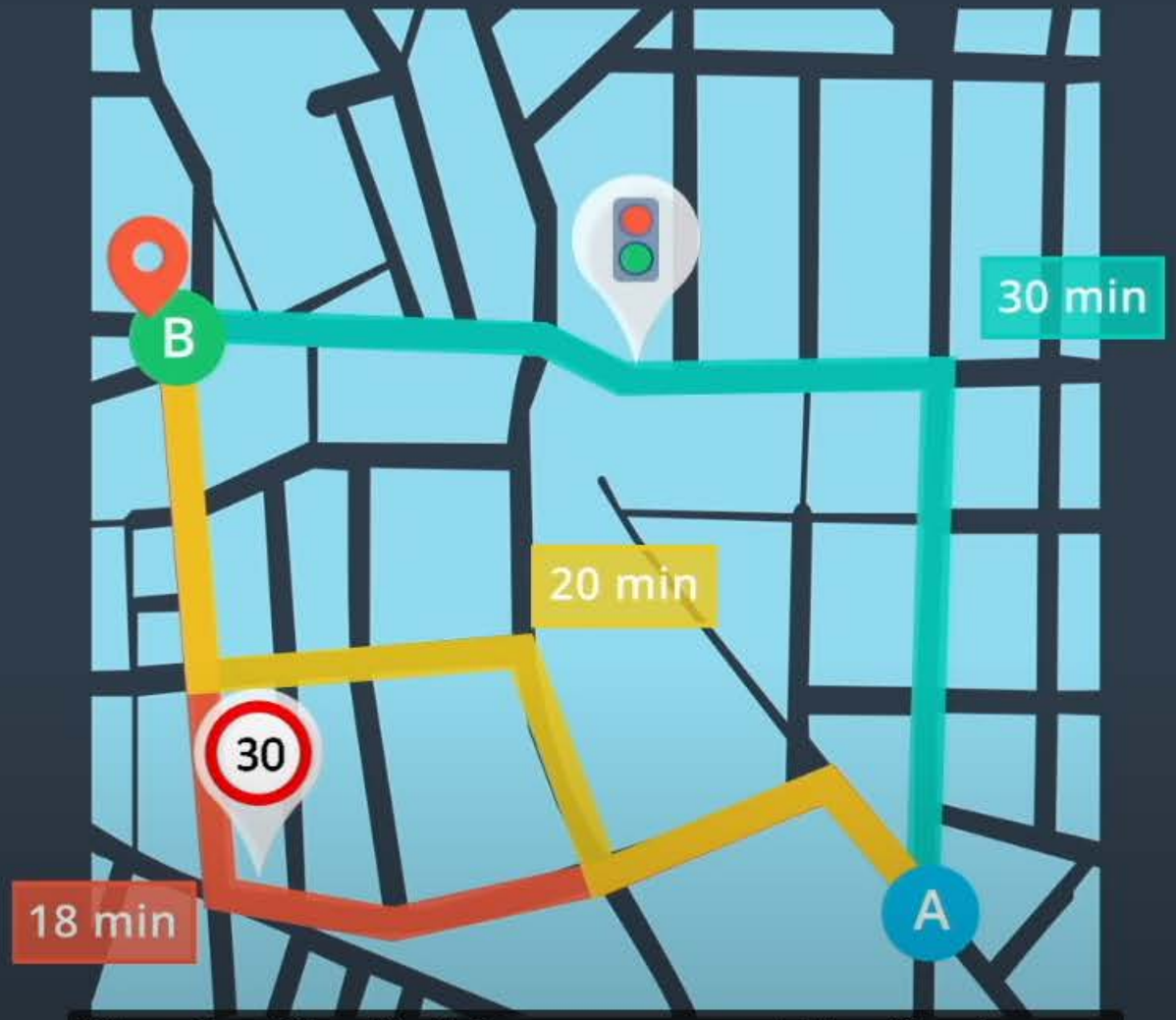

like traffic lights or speed limit signs.

0:32 / 2:09

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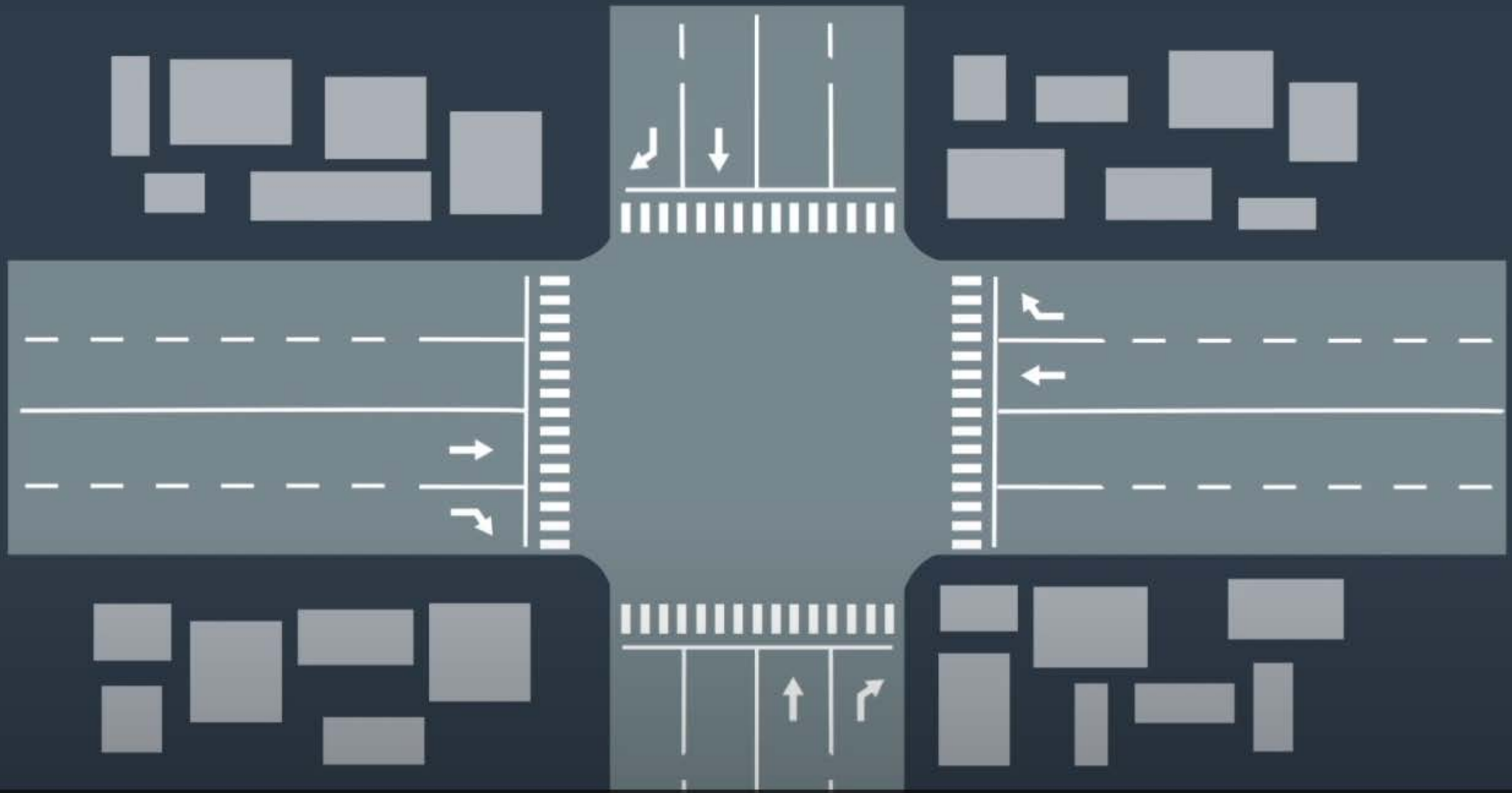

A high definition map contains a huge amount of driving assistance information.

1:07 / 2:09

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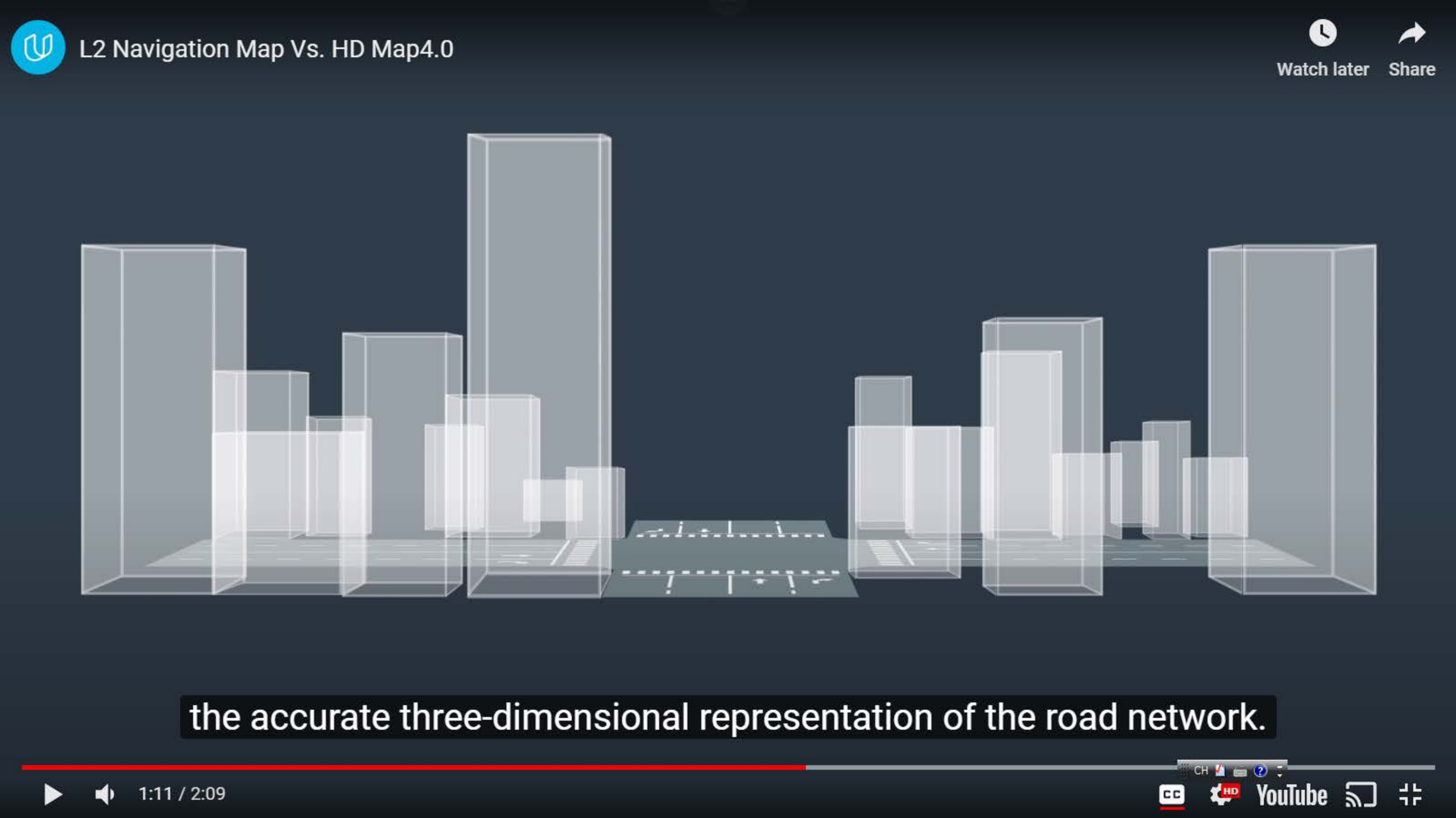
The most important information is

1:09 / 2:09


L2 Navigation Map Vs. HD Map4.0
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the accurate three-dimensional representation of the road network.
1:11 / 2:09
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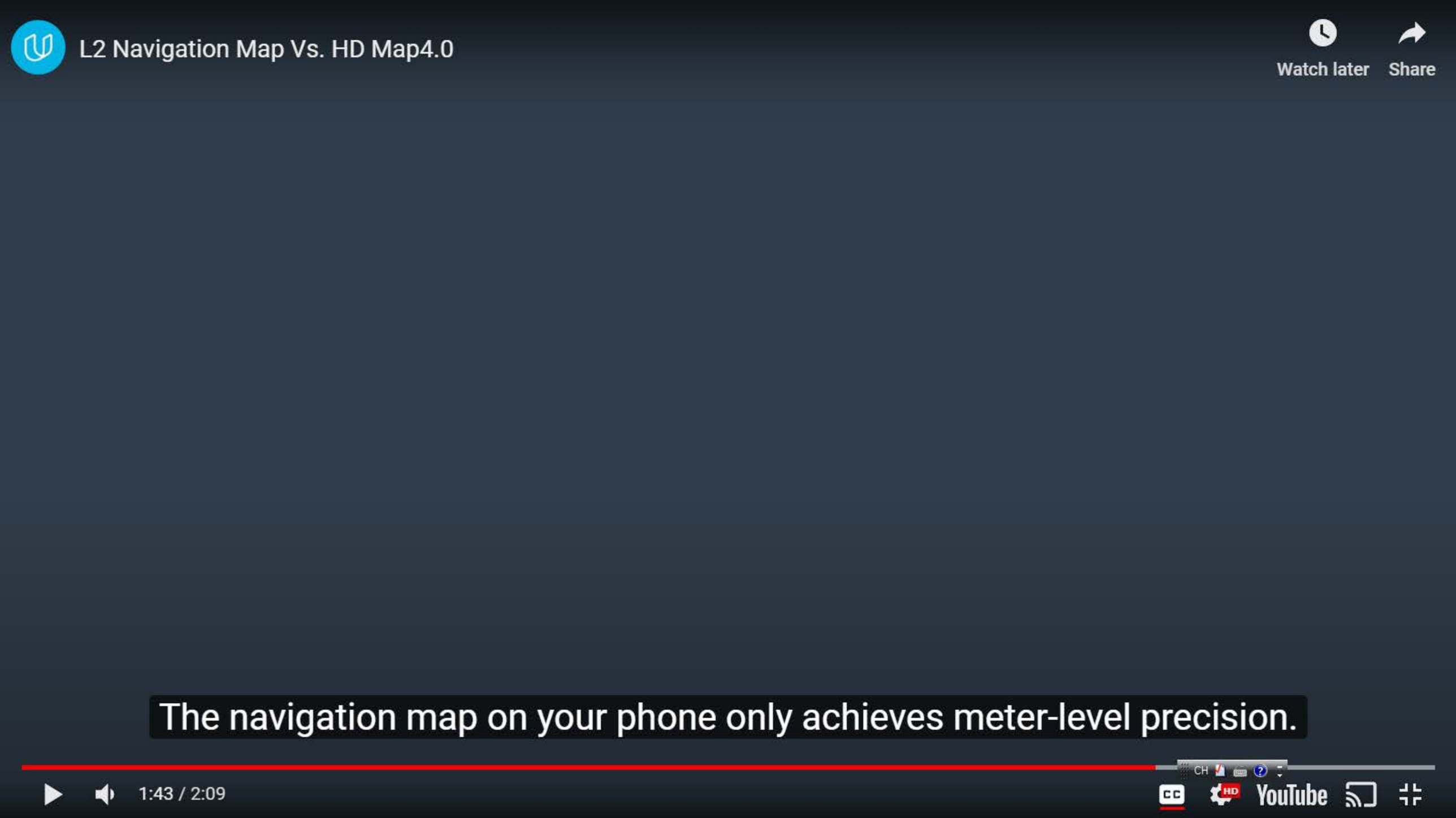
One of the most important features of a high definition map is precision.

1:34 / 2:09


L2 Navigation Map Vs. HD Map4.0
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The navigation map on your phone only achieves meter-level precision.
1:43 / 2:09
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Udacity
425K sub

Navigation Map Vs. HD Map4.0

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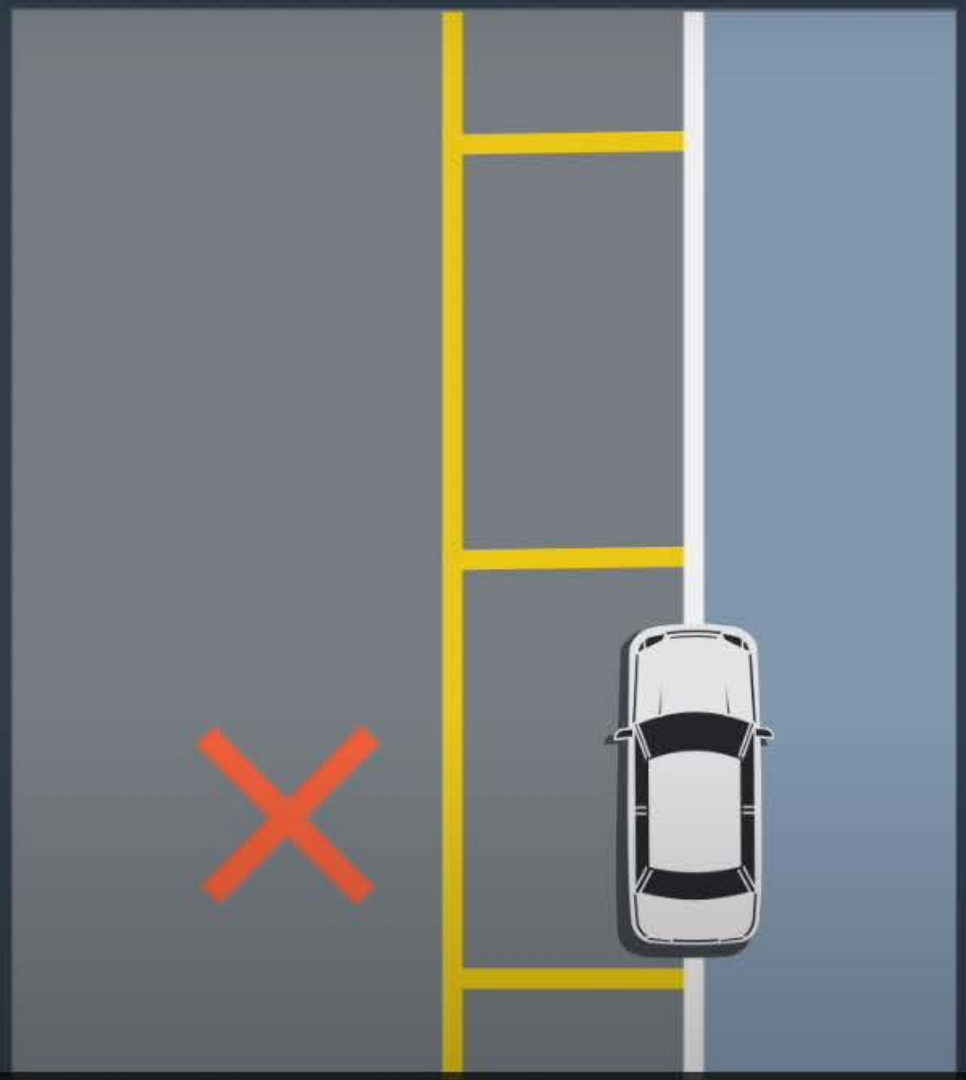


A high definition map enables the vehicle to achieve centimeter-level precision.

2:02 / 2:09

QUESTION 1 OF 2

What information do you think is necessary for creating a map of a city for self-driving cars ?

- ✓ The basic road network, road names and where points of interest are located.
- ✓ Speed limits for roads, traffic lights and other traffic control information
- ✓ A three-dimensional model of the city, including roads, buildings, tunnels, etc.

SUBMIT

QUESTION 2 OF 2

Which of the following pieces of information is probably available in HD map for the intersection shown below? Check all that apply.

- [x] The location of the traffic light.
- [ ] The indoor layouts of the building on the left.
- [x] The lane lines.
- [x] The shape of all the buildings
- [ ] The behavior of the car in front of us

SUBMIT

QUESTION 1 OF 2

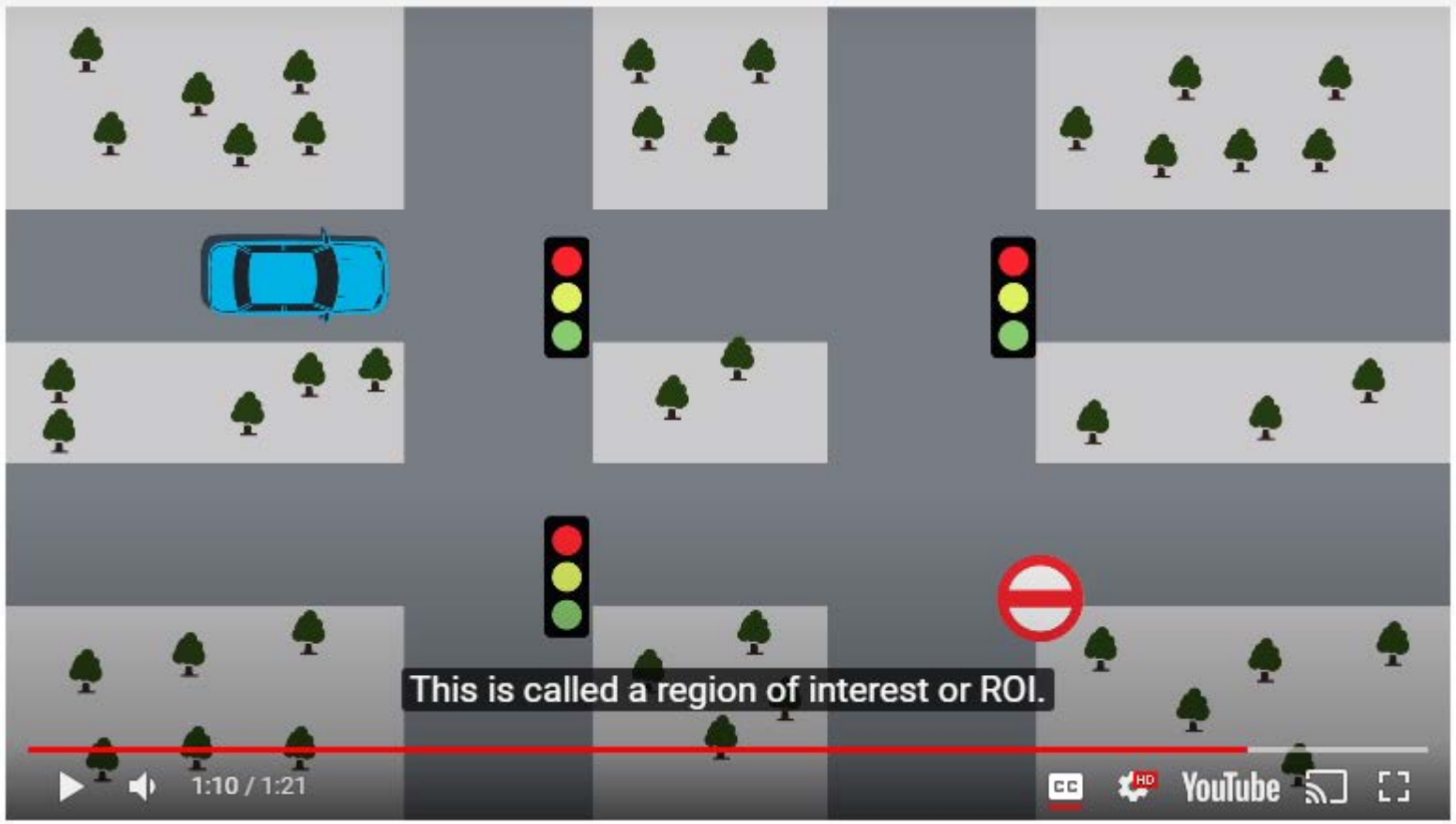
What steps does it take to describe your position to your friend in a place where both of you have never been before? Please put the following items in order.

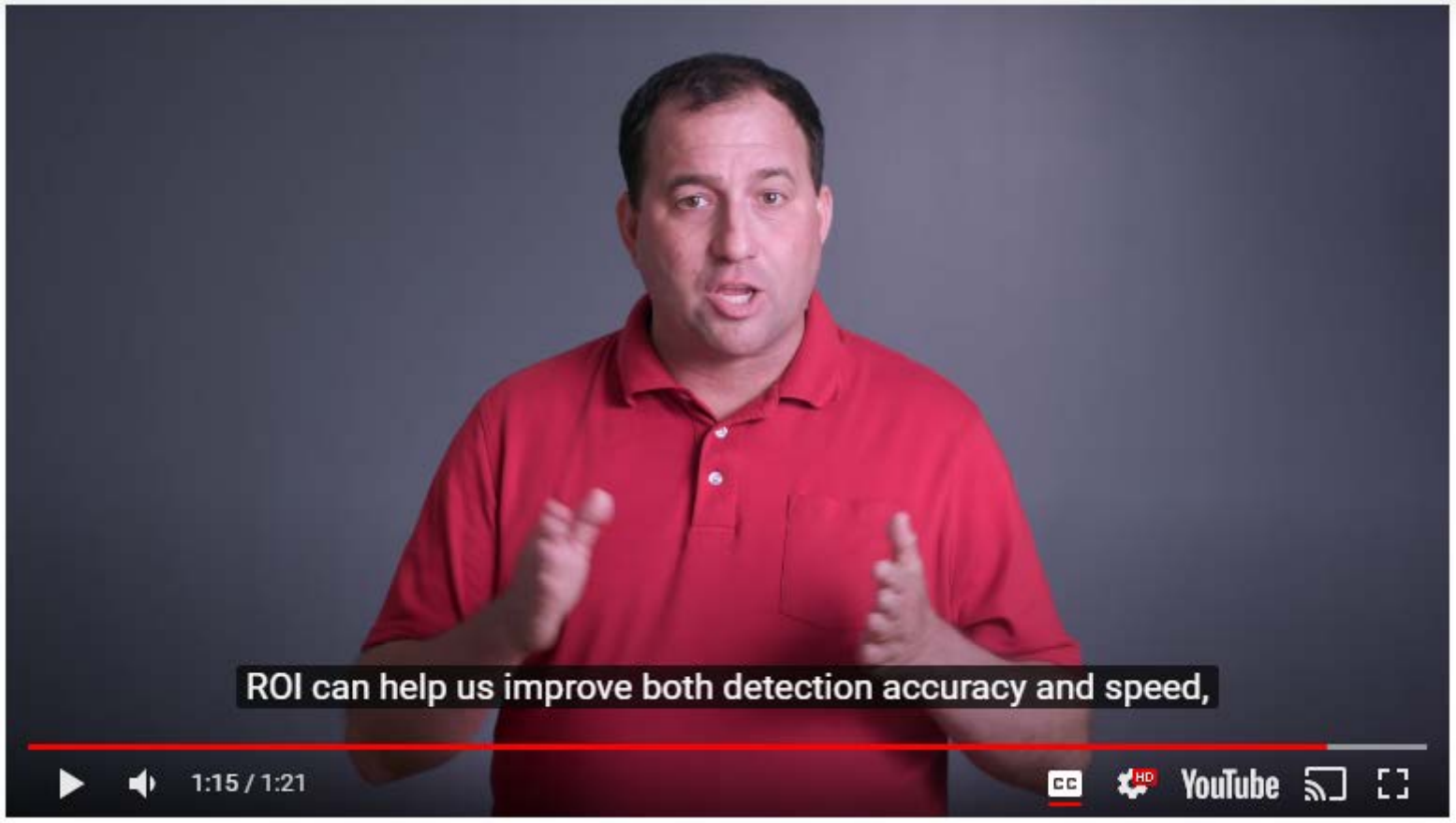
Submit to check your answer choices!

ORDER	ITEM
1	Get an approximate location using a map on your phone.
2	Check what buildings or landmarks are located near your location on the map.
3	Observe nearby buildings, road signs or landmarks

4	Look around to see if there is any building that matches what you see on your phone.
5	If you find any match, you can correctly tell your friend where you are.

SUBMIT


This is called a region of interest or ROI.
1:10 / 1:21
YouTube


ROI can help us improve both detection accuracy and speed,
1:15 / 1:21
YouTube


saving computing resources for other tasks in the vehicle.
1:18 / 1:21
YouTube

a high-definition map allows the vehicle to look ahead and slow down in advance.

QUESTION 2 OF 2

HD maps help us make better decisions. Match each decision-making scenario to the most useful information provided by HD map below!

Submit to check your answer choices!

SCENARIOS	USEFUL INFORMATION PROVIDED BY HD MAP
We want to overtake a car.	The speed limit for the current road segment.
Decide between two candidate routes which are equal in distance.	Locations of traffic lights and stop signs between the current position and the destination.

When the passenger's destination is a big metro station with multiple entrances, decide the correct spot to drop him/her.	Legal stop areas.
We want to exit the highway.	The exit positions for a highway.


Apollo HD maps use the OpenDRIVE format in industry-wide mapping standard.
1:27 / 2:01
YouTube


OpenDRIVE is like an API that makes it easy for everyone to read the same map data.
1:32 / 2:01
YouTube

Road definitions from Apollo HD Maps

Road Elements

Road Boundary
Lane Left Border
Right Lane Border
Lane Centerline
Lane Speed Limit
Lane Type
Lane Topology
Lane Line Type
Lane Direction Information
Lane Steering Type
Lane Length

Intersection Elements

Intersection Boundary
Intersection Virtual Lanes

Traffic Signal Elements

Traffic Light
Other Road Signs

Logical Relationship Elements

Map Logical Relationship

Other Elements

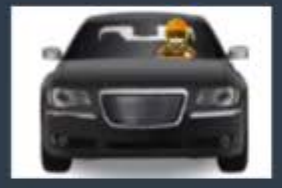
Crosswalk
No Parking Area
Stop Line
Pavement Arrow
Pavement Text
Fence
Street Light
Gantry
Building
Deceleration Zone

Standard OpenDRIVE vs. Apollo OpenDRIVE

Main Difference	Standard OpenDRIVE	Apollo OpenDRIVE
Application Scenario	Primarily used in simulation scenarios	Primarily applied to real-world self-driving scenes
Elemental Form Expression	Describe lane shape using curve equations and offsets based on reference line	Describe element shapes using absolute coordinate sequences
Elemental Richness	Provide common element types such as Road, Junction, Signal, and Object	Refine element expression and enrich element attributes. Such as adding new no-parking areas, crosswalks, deceleration belts, stop lines, parking allowance signs, deceleration allowance signs, etc.
Adaptive Driverless Algorithm	N/A	Integrate Baidu's driverless experience to enhance the feasibility and reliability of driverless algorithms.

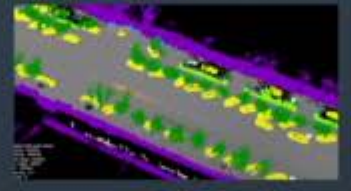
Map Production

Data Sourcing	Data Processing	Object Detection	Manual Verification	Map Products
Road	Point Cloud Registration	Object Detection	Lane , Curb	HD Map
Localization		Point Cloud Classification	Traffic Light/Sign	Localization Map
			Virtual Lane	Ponit Cloud Map











manual verification, and map publication.

Independently Developed Data Acquisition Vehicle

GPS/IMU

Antenna

LiDAR

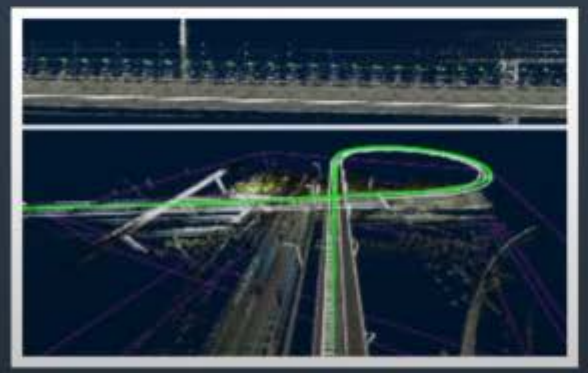
Camera

inertial measurement units, LiDAR, and camera.

Independently Developed Data Acquisition Vehicle

GPS/IMU

Antenna

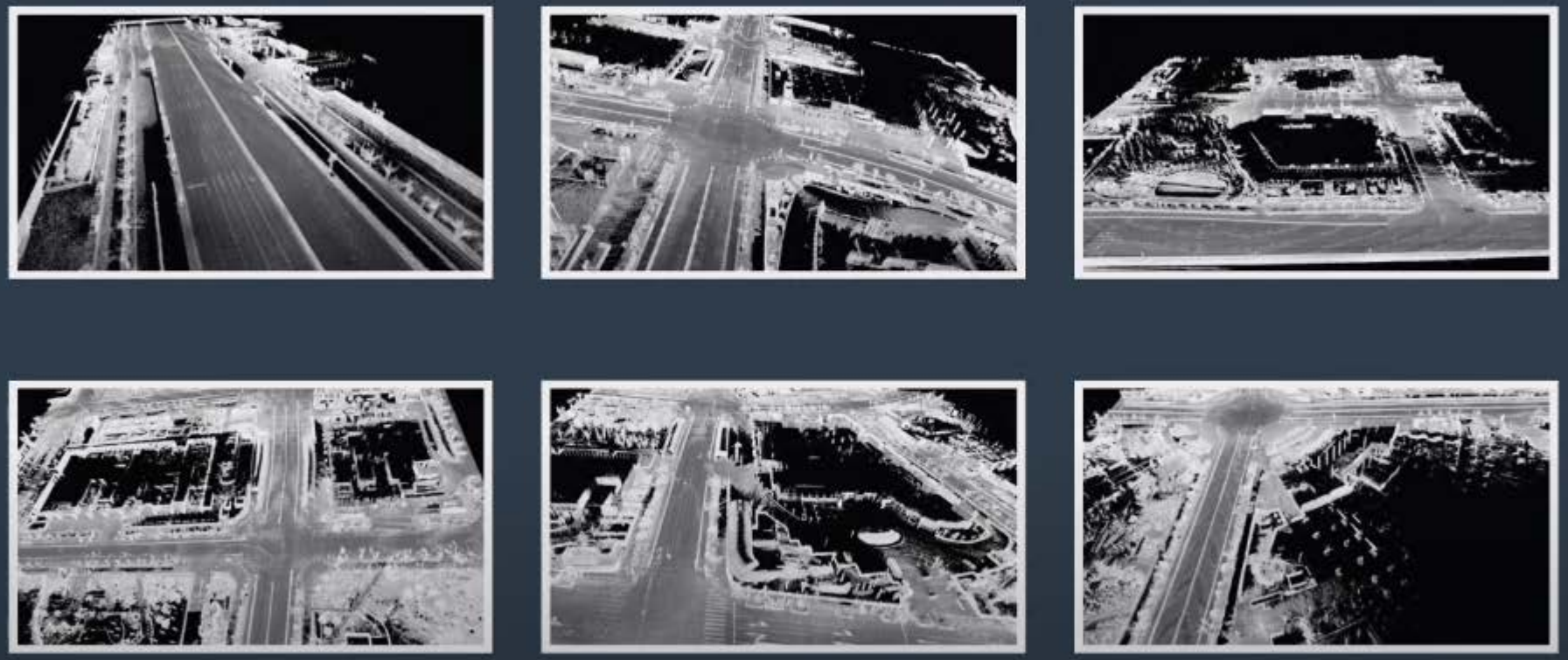


LiDAR

Camera

and ultimately, produce high definition maps.

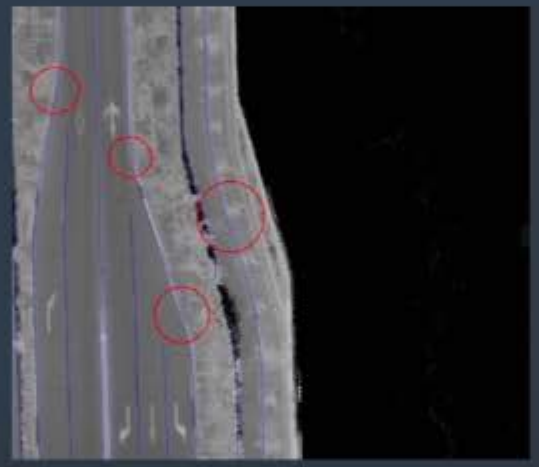
Point Cloud Registration



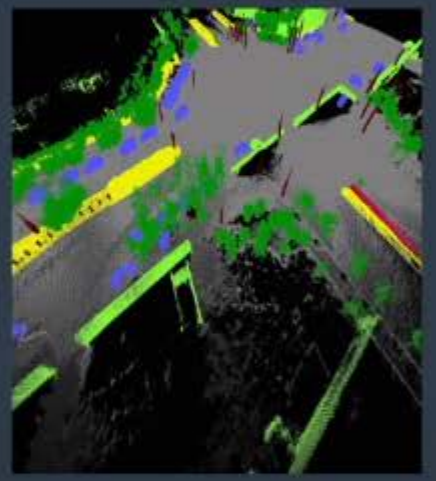
Zhongguancun, Beijing

fused from data collected in Zhongguancun, Beijing.

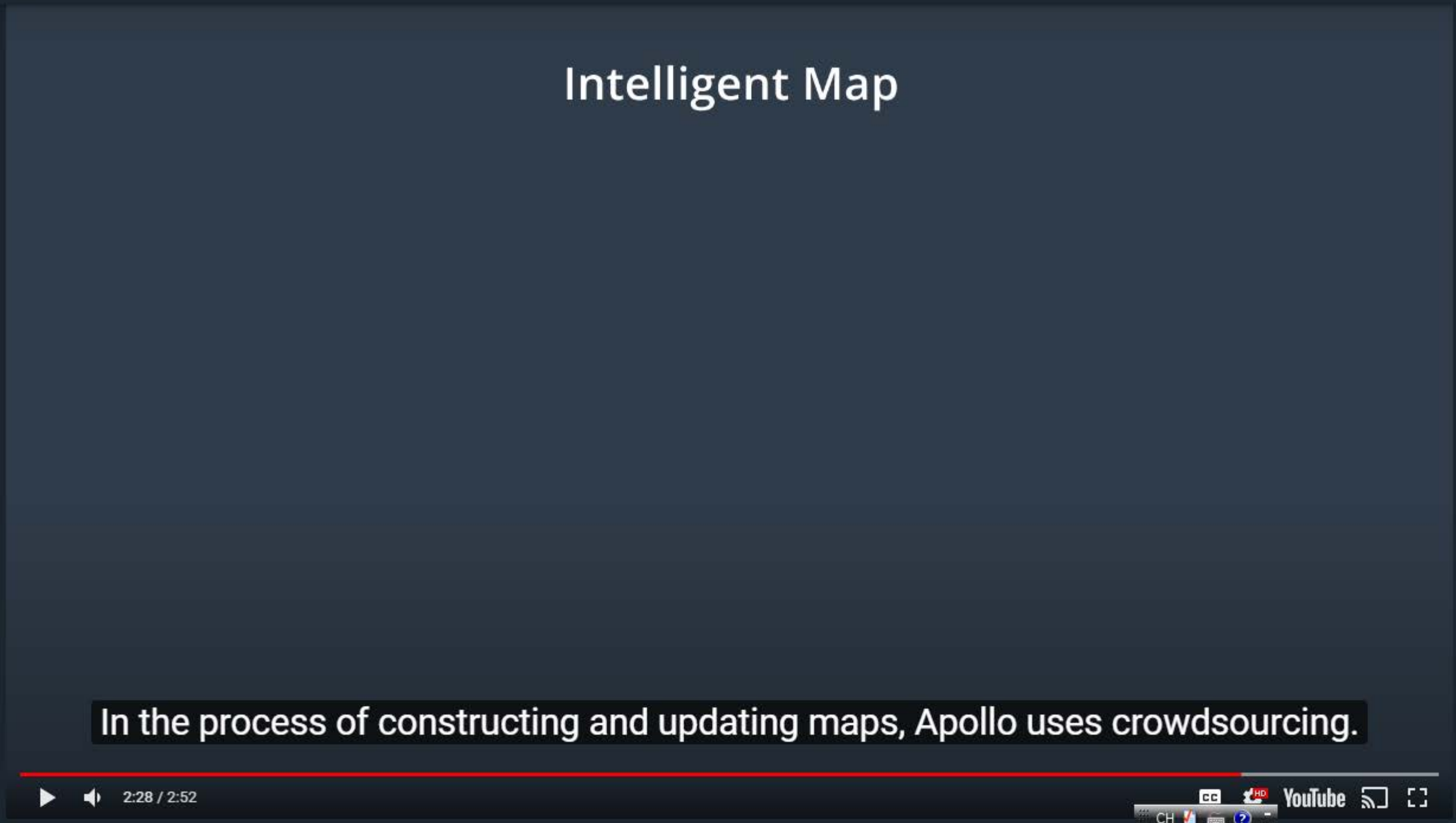
Object Detection

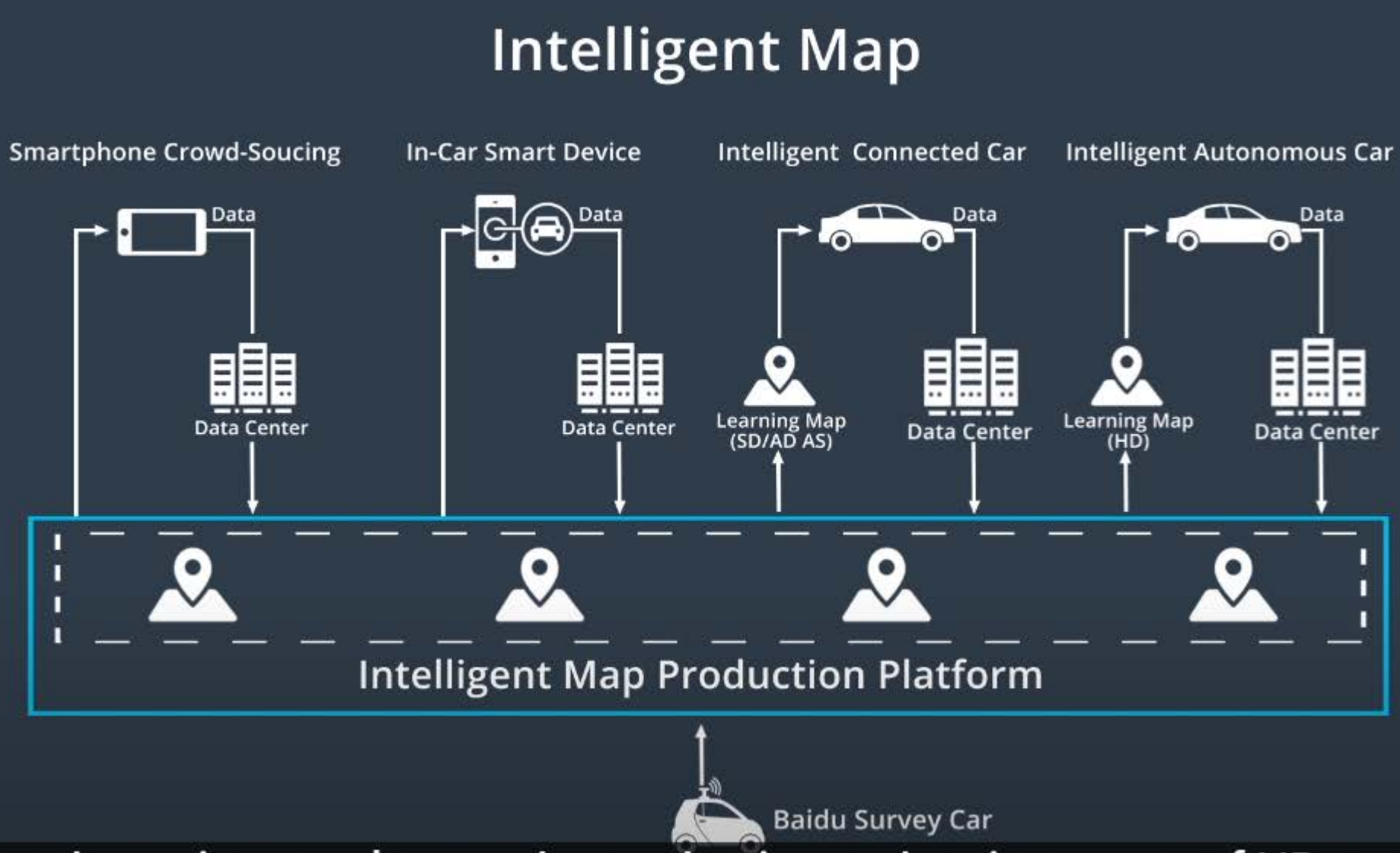


including lane lines, traffic signs, and even poles.



a top-down view and three-dimensional point cloud maps.


Intelligent Map
In the process of constructing and updating maps, Apollo uses crowdsourcing.
2:28 / 2:52
YouTube



Crowdsourcing accelerates the production and maintenance of HD maps.

HD Map Service

HD map are an essential part of Apollo. Baidu can provide students with high-accuracy map service support with the highest accuracy, highest quality, and best-fit Apollo code.

After equipping the Apollo cars with required hardware, Apollo partners can receive HD map technical support for auto-drive road tests under certain conditions.

If you want to get more information, please go to HD map cooperation.

Have fun!