Progresses of Networked Cars in China

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Outlines

1.Progress of standards and deployment

2. A typical application scenario of autonomous mining trucks

CCSA Organizations

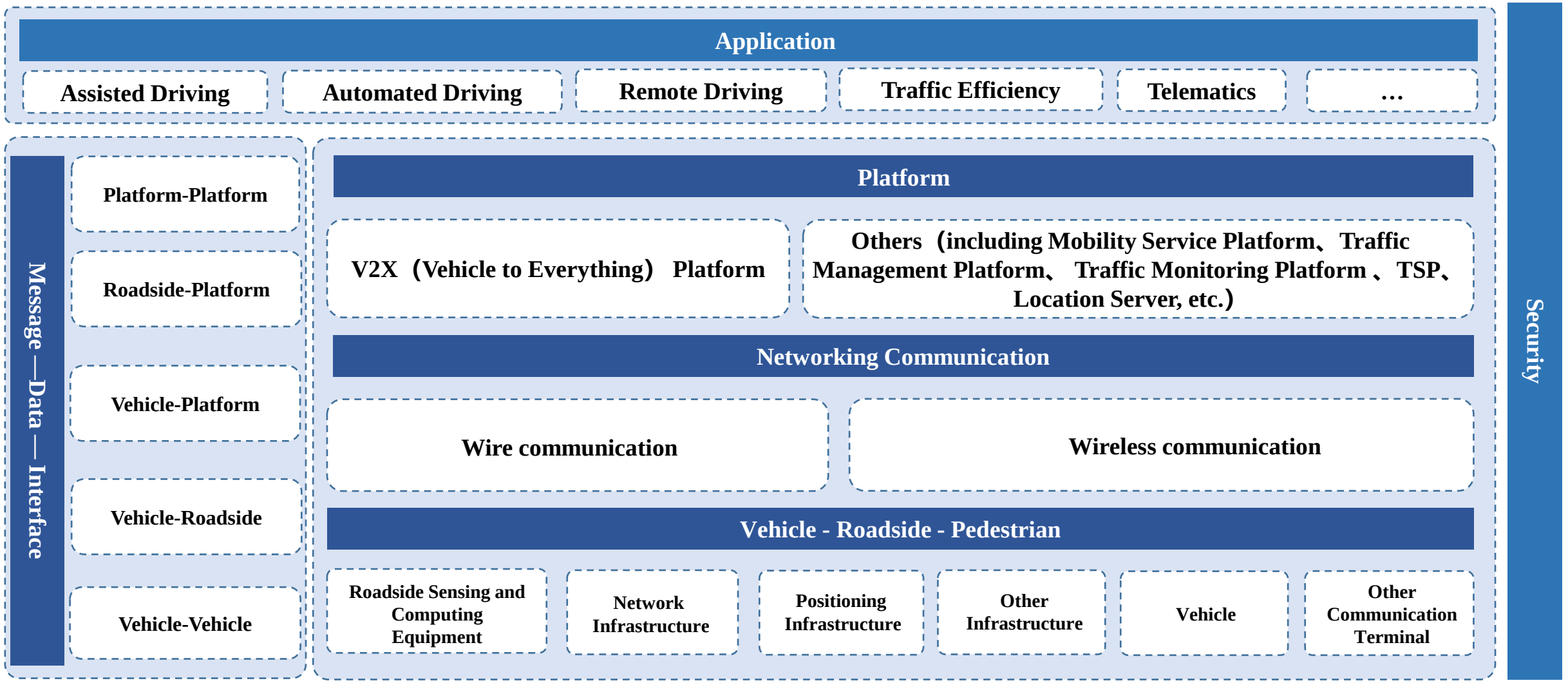
Technical Committees

- TC1:Internet and application
- TC3:Network
- TC4:Communication power supply & station operational environment
- **TC5:Wireless communication**
- TC6:Transport and access network
- TC7:Network management & operation support
- **TC8:Network & information security**
- TC9:Electromagnetic environment &protection
- **TC10:IoT**
- **TC11:Mobile internet application and terminal technical**
- TC12： Aerospace Communication Technology
- TC13： Industry Internet

Special Task Groups

- ST2:Communications Equipment Energy-saving and Comprehensive Utilization
- **ST3:Emergency Communication**
- ST7:Quantum communication and information technology
- ST9:Navigation and location services
- ST10:Information and communication cryptography application

Technology and Standardization Architecture of V2X in CCSA

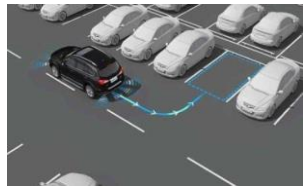


Application and Message

Application:

Based on 5G Uu, LTE-V2X, achieve V2X application scenarios:

- 5G enabled Remote Driving:



Remote control automated parking

Robotaxi

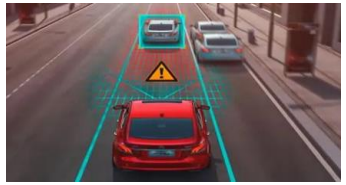
Mine operation

City operating vehicles

Logistics park

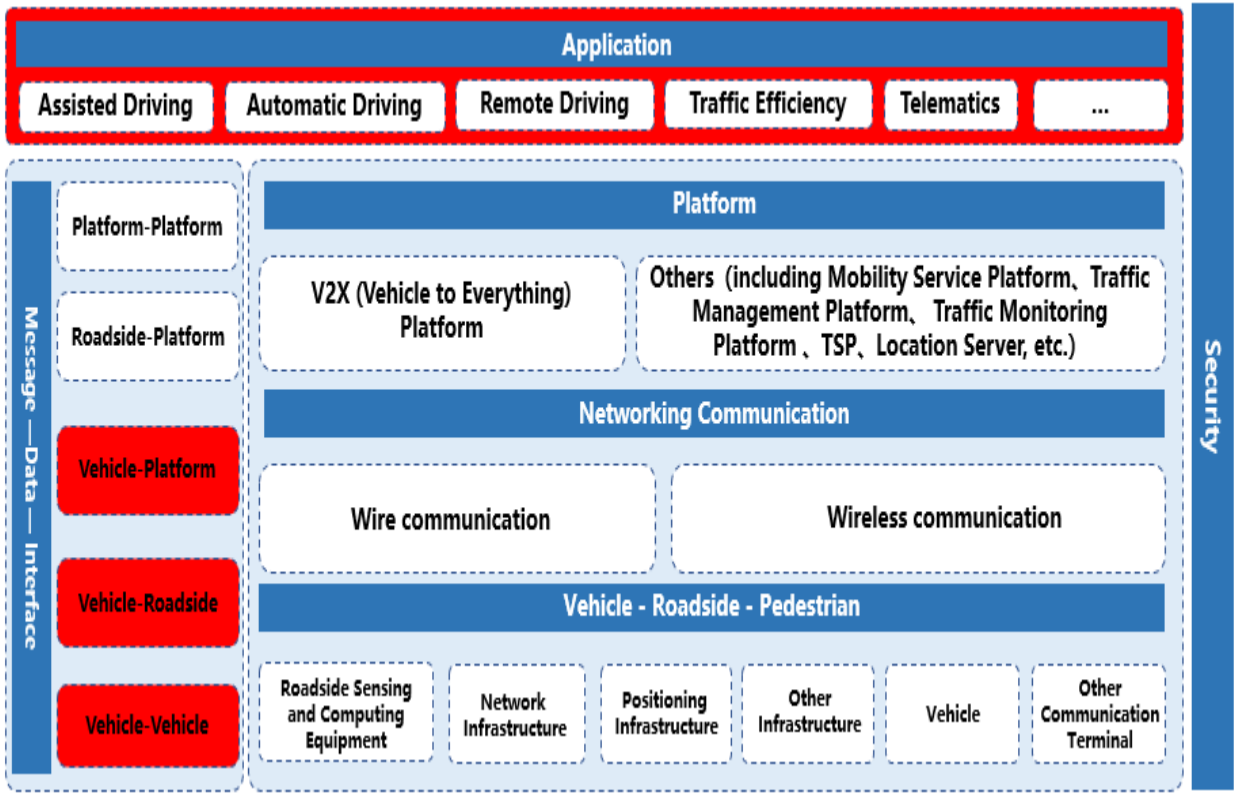
Port operation

- Based on Mobile Internet or LTE-V2X , achieve assisted driving, traffic efficiency or other V2X application scenarios



Safety warning

Traffic efficiency (GLOSA…)



Message:

In order to achieve V2X application scenarios, define the application layer's datasets, interfaces and test methods, including vehicle-vehicle, vehicle-roadside, and vehicle-platform messages.

CCSA Application and Message Related Standards

Standard name/Research report name	Leader	State	Category
Technical Requirements of Message Layer of LTE-based Vehicular Communication	CAICT	Published	Industry Standard
Technical Requirements of Message Layer of LTE-based Vehicular Communication - Amendment No.1	CAICT	New WI	Industry Standard
Test Method of Message Layer of LTE-based Vehicular Communication	CAICT	Published	Industry Standard
The Requirements Standard for Enhanced V2X Application Layer Data Interaction	ZTE，CAICT	Published	Industry Standard
Application Identity Assignment and Mapping of LTE-based Vehicle Wireless Communication Technology	Datang，CAICT	Published	Industry Standard
High Level Autonomous Driving Data Interaction Content based on Vehicle Infrastructure Cooperation	Baidu, China Mobile，etc.	Published	Industry Standard
V2X applications and technique requirements based on mobile internet	Tencent, CAICT	Draft for Approval	Industry Standard

CCSA Application and Message Related Standards

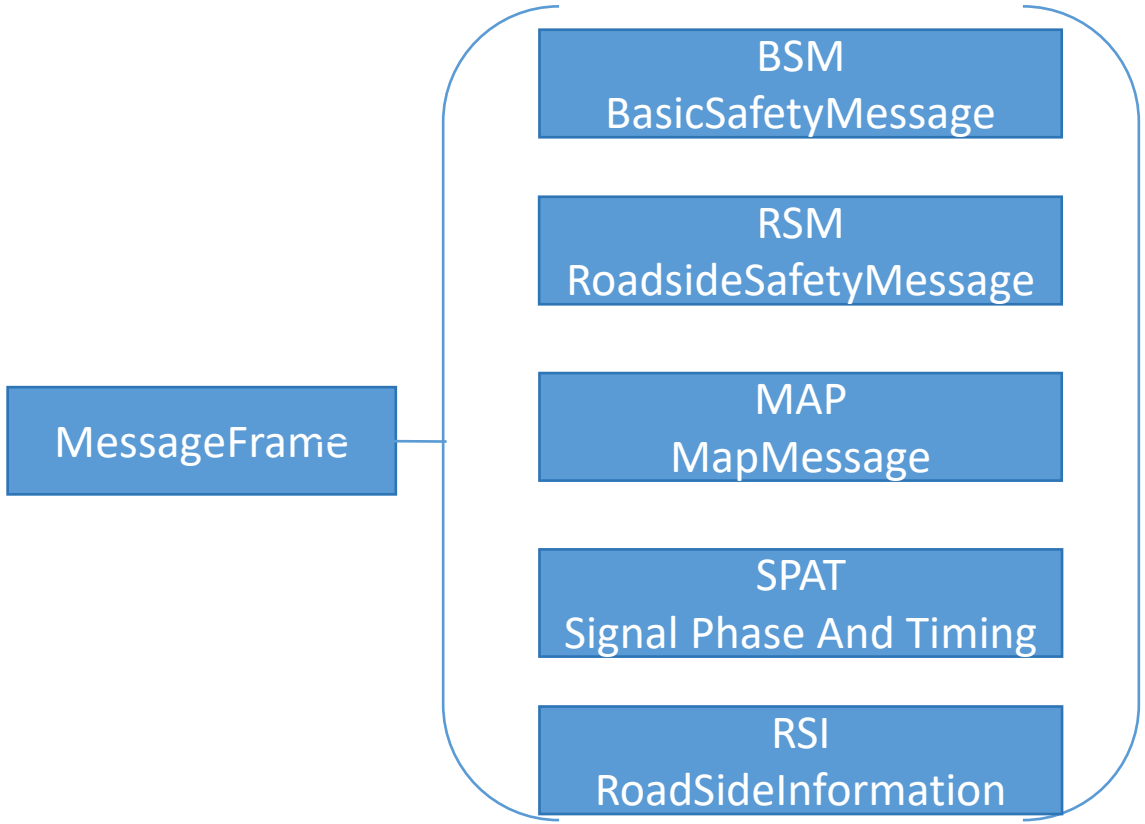
Standard name/Research report name	Leader	State	Category
5G Enables Remote Driving: Technical Requirements for 5G Communication System	ZTE	Published	Group Standard
Technical requirements of information exchange system for 5G enabled remote driving	ZTE, China Mobile，China Unicom，etc.	Draft for Approval	Industry Standard
Technical requirements of 5G enabled remote driving information exchange system Mining remote operations	China Unicom，BGRIMM，ZTE, CAICT，etc.	Draft for Approval	Industry Standard
Technical requirements of 5G enabled remote driving information exchange system Remote Parking	LAN-YOU，GAC，Zhejiang Lab，ZTE	Draft for Approval	Industry Standard
Technical requirements of 5G enabled remote driving information exchange system Highway Platooning	Tencent，ZTE，Sony	Draft for Approval	Industry Standard
Technical requirements of 5G enabled remote driving information exchange system Robotaxi remote control	BAIDU，CAICT，NOKIA	Draft for Approval	Industry Standard

CCSA Application and Message Related Standards

Standard name/Research report name	Leader	State	Category
Technical requirements of information exchang system for 5G enabled remote driving Emergency takeover of urban public traffic vehicles	CQU，China mobile，ZTE，etc.	Draft for Approval	Industry Standard
Technical requirements of information exchang system for 5G enabled remote driving Remote driving of logistics-related vehicles	CQU，Zhejiang Lab，Alibaba，etc.	Draft for Approval	Industry Standard
Technical requirements of 5G enabled remote driving information exchange system Remote operation in port	China mobile，ZTE，Alibaba，etc.	Draft for Approval	Industry Standard
Test Evaluation Methods of information exchange system for 5G enabled remote driving	CAICT，ZTE，CQU，etc.	Draft Standard for Discussion	Industry Standard
Technical Requirements of Information Exchange System for 5G enabled Remote Driving in Audio Video Transmission	Tencent，CAICT，ZTE，etc.	Draft for Approval	Industry Standard

Phase I Application Scenarios and Message Set of Internet of Vehicles in China

	Application Scenarios
1	FCW: Forward Collision Warning
2	ICW: Intersection Collision Warning
3	LTA: Left Turn Assist
4	BSW/LCW：Blind Spot Warning/Lane Change Warning
5	DNPW: Do Not Pass Warning
6	EBW: Emergency Brake Warning
7	AVW: Abnormal Vehicle Warning
8	CLW: Control Loss Warning
9	HLW: Hazardous Location Warning
10	SLW: Speed Limit Warning
11	RLVW: Red Light Violation Warning
12	VRUCW: Vulnerable Road User Collision Warning
13	GLOSA: Green Light Optimal Speed Advisory
14	IVS: In-Vehicle Signage
1	TJW: Traffic Jam Warning



Standards

- Cooperative intelligent transportation system—Vehicular communication application layer specification and data exchange standard（Phase I）
- Technical Requirements of Message Layer of LTE-based Vehicular Communication

Phase II Application Scenarios and Message Set of Internet of Vehicles in China

	应用场景名称
1	Vehicle Merge
2	Identification of Vulnerable Road User
3	Cooperative Intersection Passing
4	Guidance Service of Vehicle
5	Intersection Dynamic Lane Management
6	Dynamic Optimization of Traffic Signal Timing Based on Real Time Connected Data
7	Intelligent parking guidance
8	Platooning
9	Cooperative Fleet Management
10	Flexible management of highway dedicated lanes
11	Active and passive toll collection based on vehicle road collaboration
12	Dynamic Path Planning for Electric Vehicles
13	OTA based on vehicle road collaboration
14	In the loop simulation of autonomous driving vehicle based on vehicle road collaboration

Standard

- The Requirements Standard for Enhanced V2X Application Layer Data Interaction

MessageFrame

- TEST
- RTCM
- RSC
- SSM
- VIR
- PAM
- PSM
- CLPMM
- VPM

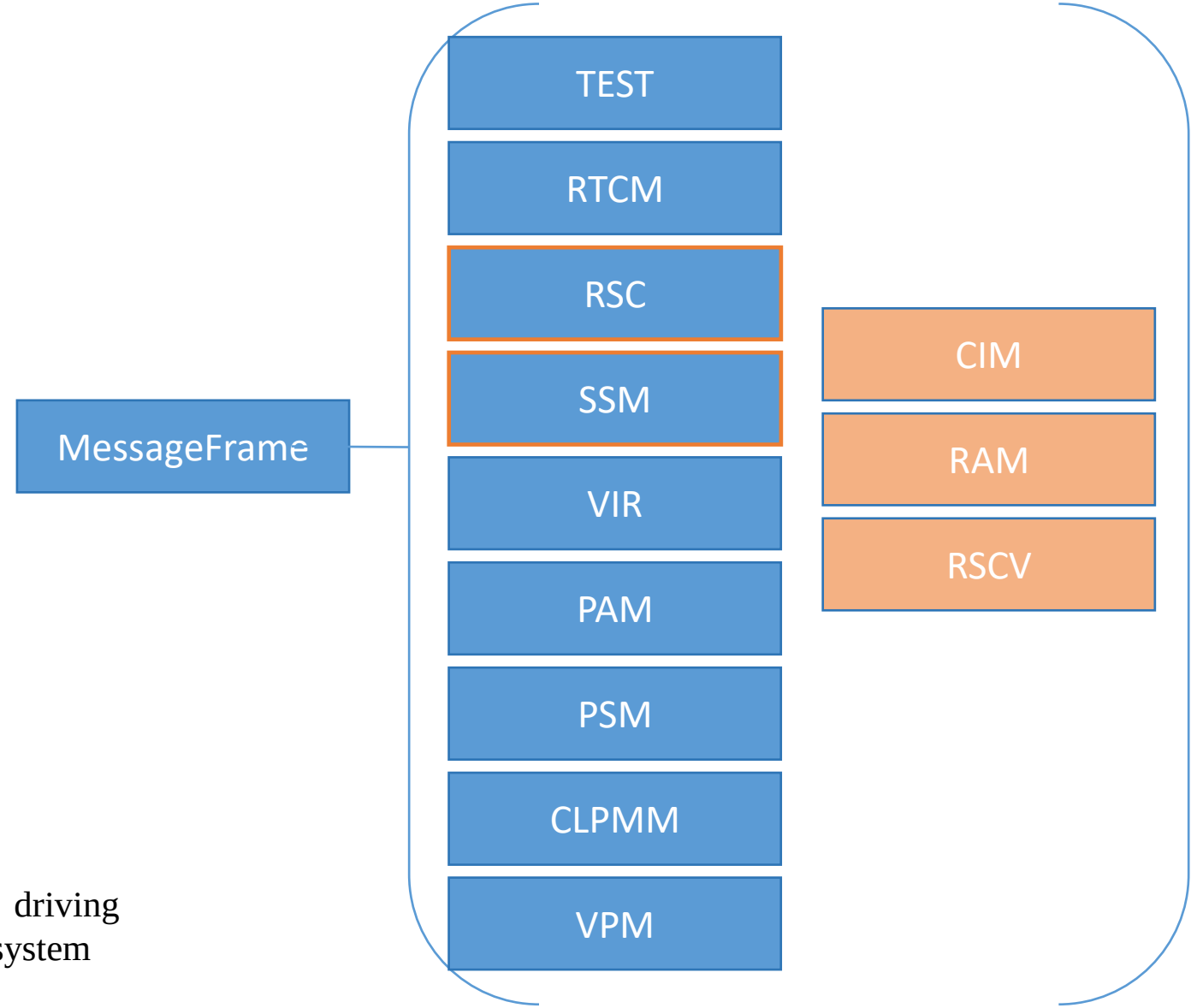
	Application Scenarios
1	SDS: Sensor Data Sharing
2	CVM: Cooperative Vehicle Merge
3	CVM: Cooperative Vehicle Merge
4	CIP: Cooperative Intersection Passing
5	DDS: Differential Data Service
6	DLM: Dynamic Lane Management
7	CHPVP: Cooperative High Priority Vehicle Passing
8	GSPA: Guidance Service in Parking Area
9	PDC: Probe Data Collection
10	VRUSP: Vulnerable Road User Safe Passing
11	CPM: Cooperative Platooning Management
12	RTS: Road Tolling Service

Standard

- Cooperative intelligent transportation system—Vehicular communication application layer specification and data exchange standard（Phase II）

High Level Autonomous Driving Application Scenarios and Message Sets Based on Vehicle Road Collaboration in China

Application Scenarios	
1	Cooperative Sensing
2	Unsigned Intersection Passing Based on Roadside Collaboration
3	Self Driving Vehicles Extrication Based on Roadside Collaboration
4	High Precision Map Version Alignment and Dynamic Updates
5	Autonomous Parking
6	Recognition of Zombie Vehicles Based on Roadside Sensing
7	Traffic Condition Recognition Based on Roadside Sensing
8	Recognition of Abnormal Driving Behavior Based on Cooperative Sensing



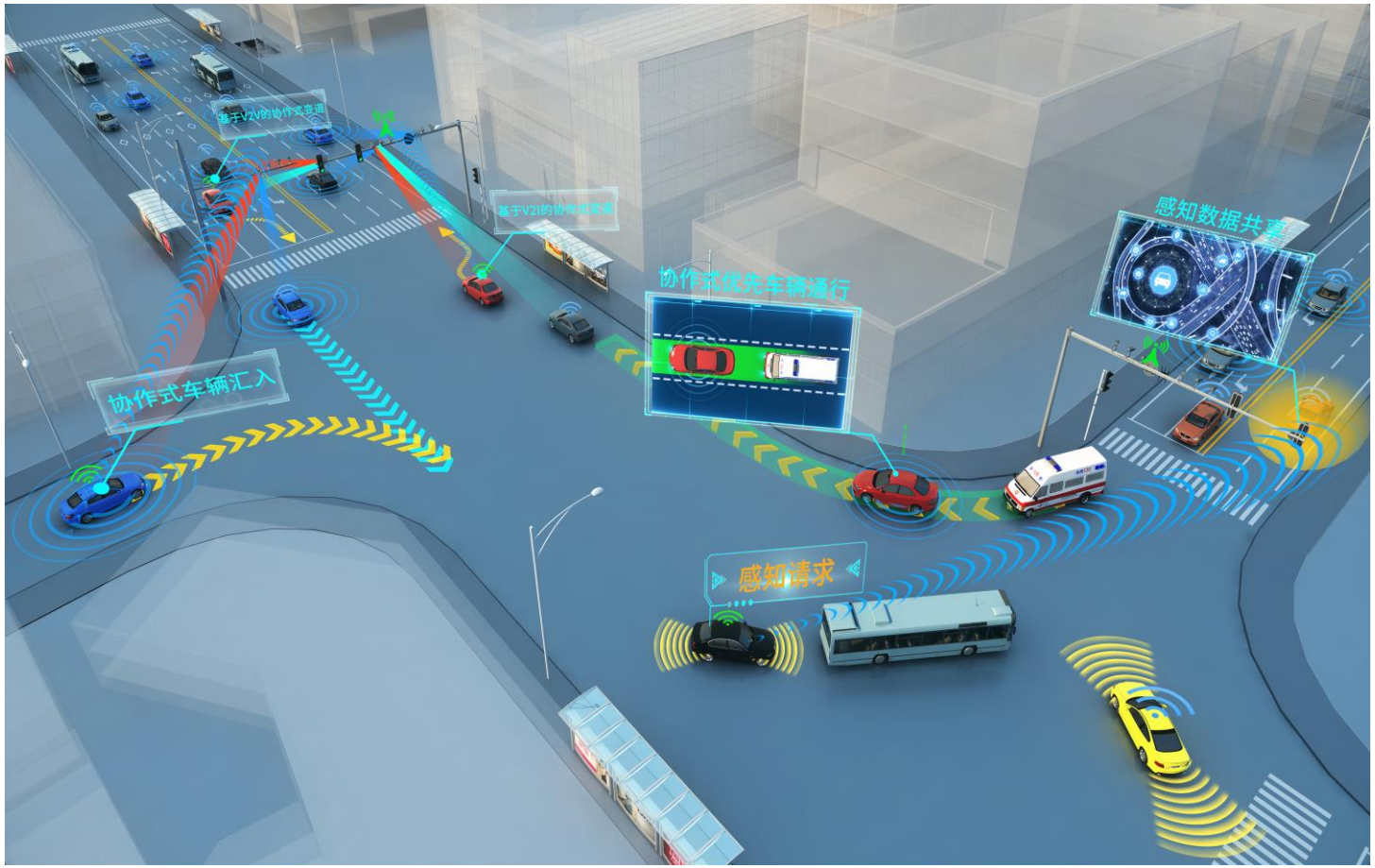
Standard

- Data exchange standard for high level automated driving vehicle based on cooperative intelligent transportation system

Phase I Assisted Driving Scenario Achieved Mass Production

- After years of C-V2X "Four-layer" verification in China, participating enterprises can generally achieve a stable stage of assisted driving scenarios, such as FCW, BSW, GLOSA, RLVW, IVS, etc.
- Different brand vehicle models can be interconnected.

Phase II Cooperative Driving Scenarios are Actively being Validated



- Since the first validation of the two-stage cooperative driving scenario for the C-V2X "Four-layer" in 2021, the data exchange process for scenarios such as Sensor Data Sharing, Cooperative Lane Change has become clearer
- Gradually explore and solve the bottleneck issues of single vehicle sensing such as "ghost probes".

Application Scenarios are Constantly Enriching

Prototype verification of L4 level unmanned driving application scenarios with pure roadside sensing

- Substantial progress has been made in the validation of ADAS+C-V2X collaborative adaptive cruise control applications
- Seven ADAS+C-V2X fusion functions have high value, including cooperative traffic signal recognition, cooperative forward collision warning, cooperative automatic emergency braking, cooperative adaptive cruise control, cooperative highway assistance, cooperative traffic congestion assistance, and cooperative autonomous valet parking.

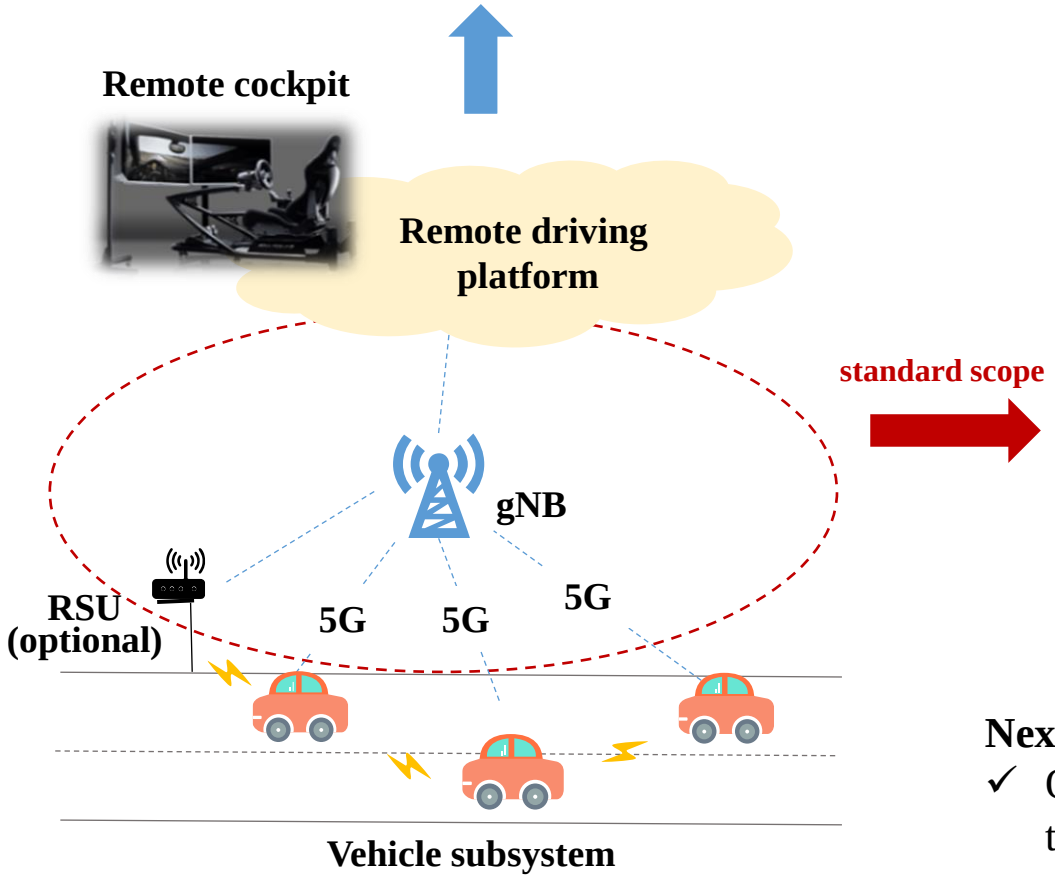
5G Enabled Remote Driving

Application

Platform

Network

Terminal



standard scope

The series of standards for 5G enabled remote driving in CCSA have defined the following:

- ✓ **System architecture**
- ✓ **Signalling process in general requirements and specific scenarios**
- ✓ **Network performance requirements**
- ✓ **Computing and processing capability requirement**

Next step:

- ✓ Organize the testing activities in different scenarios to verify the rationality of the above requirements

Intelligent transportation supported by 5G

Assisted driving

- **Shandong Zibo (normal operation)** Traffic light information remind and GLOSA application over 1200 intersections
  - Send messages to users through app on mobile phone
  - **Average speed** of the relevant road sections has increased by **28%**, **fuel consumption** has decreased by **24%**, and **carbon emissions** have decreased by **23%**

Connected autonomous robotaxi

- **Suzhou (demonstration)** China Telecom esurfing Transportation and Allride.AI have launched an **Infrastructure assisted autonomous driving solution**
  - **Real time monitoring** based on 5G
  - The platform sends **perception data or control commands** to vehicles through a low latency and high reliability 5G network

Smart bus

- **Changsha smart bus project (normal operation)** improved the operational efficiency of buses and achieved remote visual supervision, intelligent decision-making and other operational support for buses.
  - **Real time monitoring** based on 5G
  - **Bus priority and GLOSA** based on LTE-V2X

Urban Area

Intelligent transportation supported by 5G

Traffic Monitoring

Beijing JingXiong Highway (normal operation)

- Based on Beidou high-precision positioning and 5G network
- uploading of original sensor detection results of road status

Road Service

Sichuan Chengyi highway (normal operation)

- Information service on app and WeChat mini programs
- Service include safe distance maintainance，event warning，etc.

Autonomous truck remote driving

Shandong Rizhao Port (normal operation)

- Scheduling
- Video monitoring
- Remote driving

Highway

Harbour

Outlines

1.Progress of standards and deployment

2. A typical application scenario of autonomous mining trucks

YuGong Solution for Surface Applications

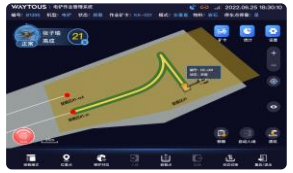
中科慧拓 WAYTOUS

Fleet Management System

Parallel Mining Simulation System

Assignment Management

Equipment monitoring safety management



Collision and Proximity warnings

Production Monitor and Report

Terrain management

Avatar Intelligent Tele-Op

Communication: 5G/4G/Wi-Fi/V2X

NAV: GNSS/RTK/SLAM

Semi-Autonomous Loading System

Semi-Autonomous Dozing System

interacting

Autonomous Haulage System

interacting

Ancillary vehicles Intelligence System

Intelligent roadside cooperative system

Loading/Dozing VCUs

Ancillary vehicles operating system

Autonomous VCUs

V2X communication terminal

Ancillary vehicles VCUs

Computing Terminal

RSU

Parallel Mining Simulation System

Thank you

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