Solution

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JHCTECH® MEC Equipment Based on Intel® Architecture Accelerate V2X Commercial Deployment

JHCTECH

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Overview

As a new type of industry that integrates technologies such as automobiles, semiconductors, wireless communications and transportation, the Internet of Vehicles (a.k.a. V2X: Vehicle-to-Anything) has the great potential to improve the experiences of road users. The rapid development of 5G, Artificial Intelligence (AI) and edge computing is also driving the enrichment of V2X functions and enhancement of performance. V2X is steadily advancing to the commercial deployment.

In order to promote the development of V2X, in February 2018, the Ministry of Transport (MoT) of China issued a notice "Accelerating the Pilot Projects of a New Generation of National Traffic Control Network and Smart Highway"[1], proposing to promote the development from six directions including the infrastructure digitalization, Vehicle Infrastructure Integration (VII) and comprehensive road network management; In April 2018, the Ministry of Industry and Information Technology (MIIT) and the MoT of China jointly issued a notice on the "Management Specifications for Road Testing of Intelligent Connected Vehicles (Trial Version)"[2]; In December 2018, the MIIT issued a notice on the "Internet of Vehicles (Intelligent Connected Vehicles) Industry Development Action Plan"[3], proposing to achieve the cross-industry integration by 2020.

In order to accelerate the commercial deployment of V2X, Intel and the Shenzhen JHC Technology Development Co., Ltd. (hereinafter referred to as JHCTECH) have jointly launched the BRAV™ series of equipment for the Multi-access Edge Computing (MEC) in V2X. This series of MEC equipment are equipped with Intel® Core™ or Xeon® processors, Intel® Movidius™ Myriad™ X VPUs (Vision Processing Units) and other Intel® chip products, and are based on Intel® Distribution of OpenVINO™ Toolkit. This series of products can achieve excellent performance of Deep Learning based inference. All models of this series can be deployed at the roadside with harsh environmental conditions, and some models are also suitable for the cloud edge that require high AI processing power. They can connect to the network in a variety of ways, support a variety of V2X services, and significantly improve the experiences of road users.

Background: Deep integration of MEC and V2X enables a variety of intelligent transportation services

As an emerging 5G network architecture, MEC migrates the Cloud Computing platform from within the mobile core network to the edge of the radio access network (RAN), so that it can provide cloud-based network resources and services (such as computing, storage and networking). Compared with the Cloud Computing, MEC reduces the number of network forwarding operations and can significantly reduce the end-to-end (E2E) latency. It not only improves the user experience of service response latency, but also enables a variety of new services that are sensitive to the latency requirements (such as V2X, Industrial Control, Telemedicine, etc.). MEC completes the processing of a large amount of data at the edge of the network, significantly reducing the amount of data sent back to the core network, thereby effectively alleviating the network congestion; the services provided by MEC for users will not be affected by the core network status (such as congestion). MEC can provide customized services based on the user's wireless connection status and other user information. MEC can better guarantee the information security and protect the privacy.

The V2X includes two types: one is based on the Dedicated Short-Range Communications (DSRC) and the other one is based on the cellular mobile communications. The latter is usually referred to as the Cellular V2X (C-V2X). The MEC equipment introduced in this article fully support these two types of V2X.

C-V2X is one of the most important applications of 5G mobile communications in the vertical industry. As shown in Figure 1, the concept of MEC and C-V2X integration is to deploy the C-V2X services on the MEC platform, and provide relevant information to the road users through a wireless interface (PC5 or Uu). The road users include the connected vehicles with On-Board Units (OBUs) and the pedestrians using the smart mobile terminals (such as smartphones). Based on the above technical advantages, MEC will enrich and optimize the services that C-V2X can provide: for example, lower E2E latency is essential for many transportation services. Based on user status, MEC can provide a variety of services to improve the traffic efficiency (such as the route planning and high-definition map distribution). According to the different requirements for latency and processing power, the MEC platform supporting C-V2X can be deployed at the roadside or cloud edge. The Roadside MEC Platform or Cloud-Edge MEC Platform provides the Application Programming Interfaces (APIs) for operators or the third parties to develop the edge applications such as information and service, traffic efficiency and others. These two MEC platforms can also interface with other MEC platforms and clouds to provide richer functions. The integration of MEC and C-V2X can fully realize the coordination between the road users, road infrastructure, edge and cloud. It will play an extremely important role in improving the experiences of road users.

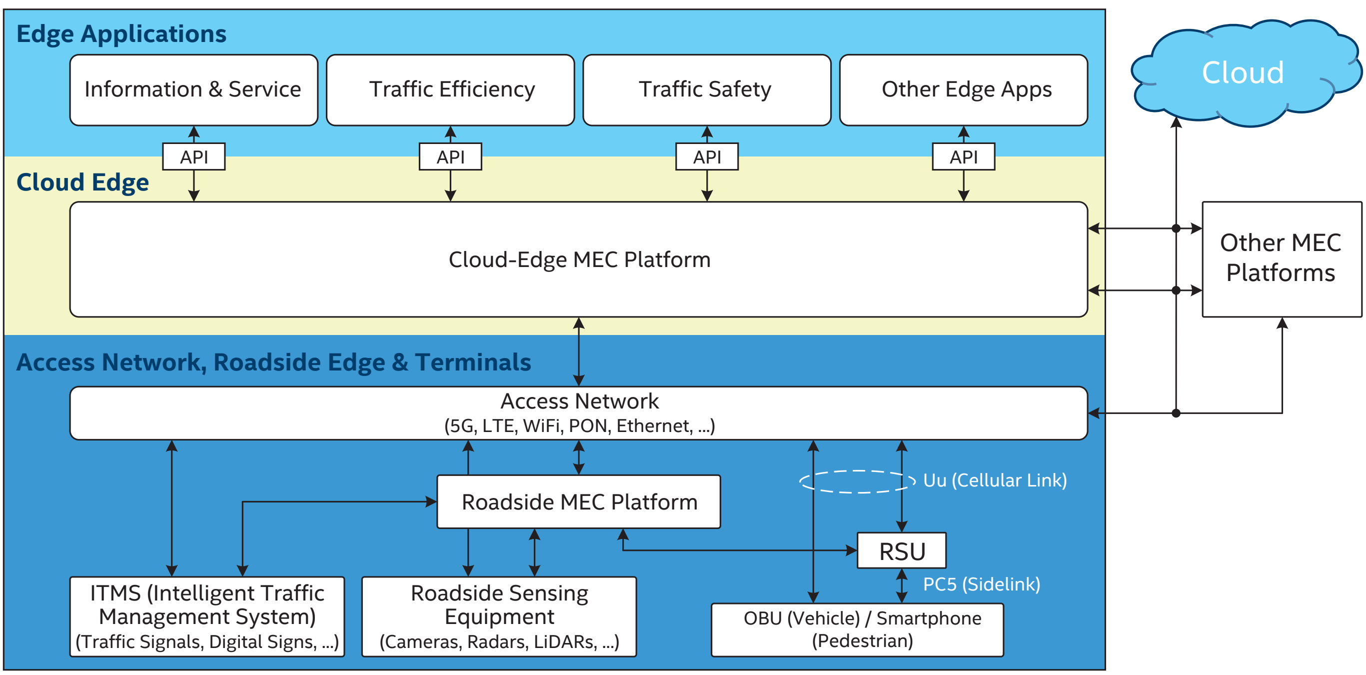

Figure 1. System architecture for the integration of MEC and C-V2X.

JHCTECH® MEC equipment are the actual products of the Roadside MEC Platform and the Cloud-Edge MEC Platform shown in Figure 1. They are connected to multiple roadside sensing devices (including the cameras, radars and lidars), and are used for the computer vision-based video analytics of the objects, incidents and status on the roads. Their functions have different focuses:

Roadside MEC Equipment

Usually used to generate V2X Messages that require very low latency; for the intersection scenario, it can be connected to a Traffic Signal Controller (TSC) also deployed at the roadside to read the real-time Signal Phase and Timing (SPaT) information; in terms of data communication capabilities, it is connected to the Roadside Unit (RSU) that broadcasts the V2X Messages and the SPaT information to the surrounding road users (i.e., vehicles and pedestrians) through the PC5 air interface (sidelink); it can also be connected to the Access Network, and transfer these traffic data to the Cloud-Edge MEC Platform, other MEC platforms and systems such as the Intelligent Traffic Management System (ITMS) in the Smart City for further processing.

Cloud-Edge MEC Equipment

Usually used to generate the non-real-time video analytic results; it is connected to a 5G or LTE base station located in the Access Network, and transmits the traffic data based on the statistical analysis to the road users through the Uu air interface (cellular link); it can also transfer these traffic data to other MEC platforms and the cloud platforms for further processing.

Figure 2 shows the deployment scenario of JHCTECH® series MEC equipment supporting C-V2X. Among them, the Roadside MEC Equipment are generally deployed with the roadside sensing devices such as cameras and LiDARs, and their computing results (such as V2X Messages) are broadcasted to the surrounding vehicles and pedestrians through the RSU. This roadside deployment scenario is very suitable for the following V2X services:

- Smart intersections (urban roads);
- Traffic merging assistance at the ramp junctions (expressways);
- Warning of reckless or fatigue driving;
- Warning of violating traffic regulations.

The Cloud-Edge MEC Equipment are usually deployed at the remote sites, and their computing results (such as the path planning and large-scale coordinated scheduling, etc.) are sent to vehicles and pedestrians through the 5G or LTE base stations, which are suitable for providing traffic efficiency services.

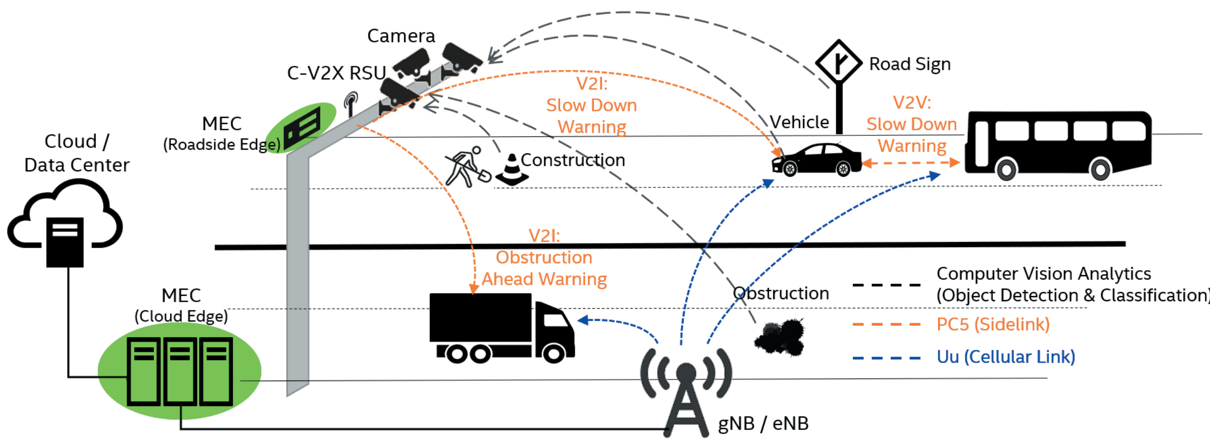

Figure 2. Deployment scenario of MEC platforms for C-V2X.

Challenges: Design of MEC equipment for V2X

In order to support V2X, the Roadside MEC Equipment and the Cloud-Edge MEC Equipment respectively carry the important roles of computing, storage and forwarding of data on the roadside and cloud edge, and need to meet the following performance requirements.

- **Powerful capabilities of general-purpose computing and AI computing**

  The MEC equipment for V2X carry the workloads of analyzing the information collected by various roadside sensing devices (such as cameras, LiDARs and mmWave radars, etc.), which include not only the video codec (coding and decoding) and traditional computer vision, but also the inference based on the Deep Neural Networks (DNNs) for the video and even the 3D point cloud information. Based on Intel's workload consolidation technology, one MEC equipment can support the information processing of multiple roadside sensing devices at the same time, which can effectively save the Total Cost of Ownership (TCO) including the cost for equipment procurement, deployment and operation. This requires the MEC equipment with powerful general-purpose computing and AI computing capabilities. At the same time, it is also necessary to meet the requirements of V2X users for overall equipment cost and power consumption, so the cost effective and high energy efficient chip products and system architecture design are required.

- **Flexible system hardware and software configuration and scalability**

  The MEC equipment needs to support the rich and diverse application scenarios and services of V2X, and meet the customized needs of users; under certain circumstances, it also needs to support the rapid development and deployment, and consider the increase in the types and numbers of connected devices, and the workload changes caused by the algorithm upgrading. This requires the MEC equipment to adopt a mature platform architecture to achieve the flexible system hardware and software configuration to provide excellent scalability. Such equipment should also be able to fully support the software algorithm products of the ecosystem partners.

- **Excellent connectivity and compatibility**

  The MEC equipment needs to be connected to a variety of peripherals such as the roadside sensing devices, communication equipment (including RSUs and Base Stations, etc.) and ITMS equipment such as the TSCs and the Digital Signs, etc., so it needs to be configured with many different types of peripheral interfaces, and support the corresponding communication protocols.

For the MEC equipment deployed at the roadside, the following features are also required.

- **Ruggedness to overcome harsh environmental impacts**

  This type of Roadside MEC Equipment supports the outdoor deployment in a wide geographic area, and the deployed environment is sometimes extremely harsh, such as the drastic changes in temperature and humidity, and impact from foreign objects. This requires such equipment to have strong environmental adaptability, to adapt to drastic changes in temperature and humidity, to be water-proof, dust-proof, corrosion-proof, and shock-proof, as well as to have excellent Electro-Magnetic Compatibility (EMC) and anti-interference capabilities. This is to ensure the uninterrupted provision of stable and reliable services throughout the product life cycle.

Solution: V2X MEC Equipment Based on Intel® Architecture

Based on Intel® architecture, JHCTECH has developed the BRAV™ MEC equipment product series for V2X, covering deployment scenarios such as the roadside and cloud edge. This product series uses the following Intel® chips and technologies.

Intel® Xeon® Processor and Intel® Core™ Processor

These two series of industry-leading processors based on Intel® architecture not only have powerful computing power, but also have the advantages of high cost performance, high energy efficiency, high security and high reliability. They support different Operating Systems (OS) and a wide range of workloads, giving users a wealth of product performance options. The mature and complete Intel® architecture standards and ecosystem can support rapid product development and deployment. In the V2X field with complex applications, software customization is frequent, and equipment are required to run uninterruptedly and stably for a long time. If the equipment that meet these requirements adopt Intel® processors, the overall cost is much lower. Intel® processors support a variety of interface types, enabling MEC equipment to integrate with a variety of built-in and external devices, and providing excellent scalability and compatibility. In addition to the above common advantages, the two series of processors have their own specific applications: the Core™ processors are suitable for equipment with strict power consumption restrictions; and the Xeon® processors are suitable for workload consolidation. They can fully meet the functional requirements of data computing, storage and forwarding of different MEC equipment in the V2X filed.

Intel® HD Graphics and Intel® UHD Graphics

The Intel® HD Graphics and Intel® UHD Graphics integrated in these two series of Intel® processors adopt a powerful and flexible architecture, and thus have leading media processing performance. They both use Intel® Quick Sync Video which can significantly improve performance and Intel® Media SDK which supports the hardware acceleration of video encoding and decoding. In addition, Intel® HD Graphics and Intel® UHD Graphics can also share memory with the processor, significantly reducing latency and power consumption. It can efficiently support MEC equipment in encoding and decoding the video information collected by multiple cameras.

Intel® Movidius™ Myriad™ X VPU

The Myriad™ X VPU is designed for the inference based on deep learning at low power consumption and high processing speed without sacrificing accuracy. It is Intel's first VPU to feature the Neural Compute Engine (NCE): a dedicated hardware accelerator for deep neural network inference. The NCE in conjunction with the 16 powerful SHAVE cores and the high-throughput intelligent memory fabric makes Myriad™ X VPU ideal for on-device deep neural networks and computer vision applications. The Myriad™ X VPU is programmable with the Intel® Distribution of OpenVINO™ toolkit for porting neural networks to the edge. It can also implement the custom vision, imaging and deep neural network workloads on the chip, via the Myriad Development Kit (MDK) which includes all necessary development tools, frameworks and APIs. In practical applications, Myriad™ X VPU shows unique advantages such as strong computing power at low power consumption.

Intel vPro® Platform

Intel vPro® platform is a comprehensive technology designed to reduce the IT maintenance costs, improve security and save energy consumption. At this platform, Intel® Active Management Technology (AMT) is a hardware-based remote management technology that allows system administrators to remotely manage, repair and protect various types of networked computing equipment, including the MEC equipment in the V2X network. Based on Intel vPro® platform, JHCTECH has successfully developed the Remote Management View software tool. This tool can be easily integrated into the V2X network, allowing system administrators to remotely manage and service the MEC equipment at any time, even when the equipment OS is not started. Since this tool does not require sending engineers to the site, it greatly reduces the response time and system operation and maintenance costs.

Intel® Chipsets (H110, Q170, Q370 and C246)

The MEC equipment can integrate different chipsets on the motherboard according to the different needs of users. H110 has a very high cost performance; while Q170, Q370 and C246 support the remote management based on Intel vPro® platform; Q170 and C246 can also support the Redundant Array of Independent Disks (RAID) that enhances the data storage reliability and the memory read and write performance. These four chipsets support different numbers of PCIe interfaces and different scalability, and fully support the connection between different MEC equipment and peripherals.

Intel® Ethernet Controllers (I219-LM, I210-AT, 82599ES and X710-DA2)

Different Ethernet controllers are used in the MEC equipment to support different network connectivity requirements. The network speed supported by I219-LM and I210-AT is 1 Gbit/s; while the network speed supported by 82599ES and X710-DA2 can be as high as 10 Gbit/s. I219-LM supports Intel vPro® platform and can be used as the management network interface for the V2X system administrators to use JHCTECH® Remote Management View software to remotely manage and service the MEC equipment; while other Ethernet controllers (I210-AT, 82599ES and X710-DA2) are used as the data network interfaces between the MEC equipment and other devices. These Ethernet controllers all support IEEE 1588, and have the advantages of low power consumption and high cost performance.

Intel® Distribution of OpenVINO™ Toolkit

The OpenVINO™ toolkit is a comprehensive and excellent toolkit from Intel, which supports the rapid development of rich and diverse applications and solutions to emulate human vision[4,5]. This toolkit can significantly improve the accuracy of video analytics, speed up the inference and save the computing resources. The OpenVINO™ toolkit is based on the Convolutional Neural Network (CNN), which can deploy the workload of computer vision (CV) in a variety of Intel® hardware platforms to achieve superior performance. The OpenVINO™ toolkit supports a wide variety of applications of both traditional computer vision and deep learning-based computer vision. The Intel® Media SDK supports high-performance video encoding and decoding on Intel® HD Graphics. The main functional modules of OpenVINO™ toolkit are shown in Figure 3.

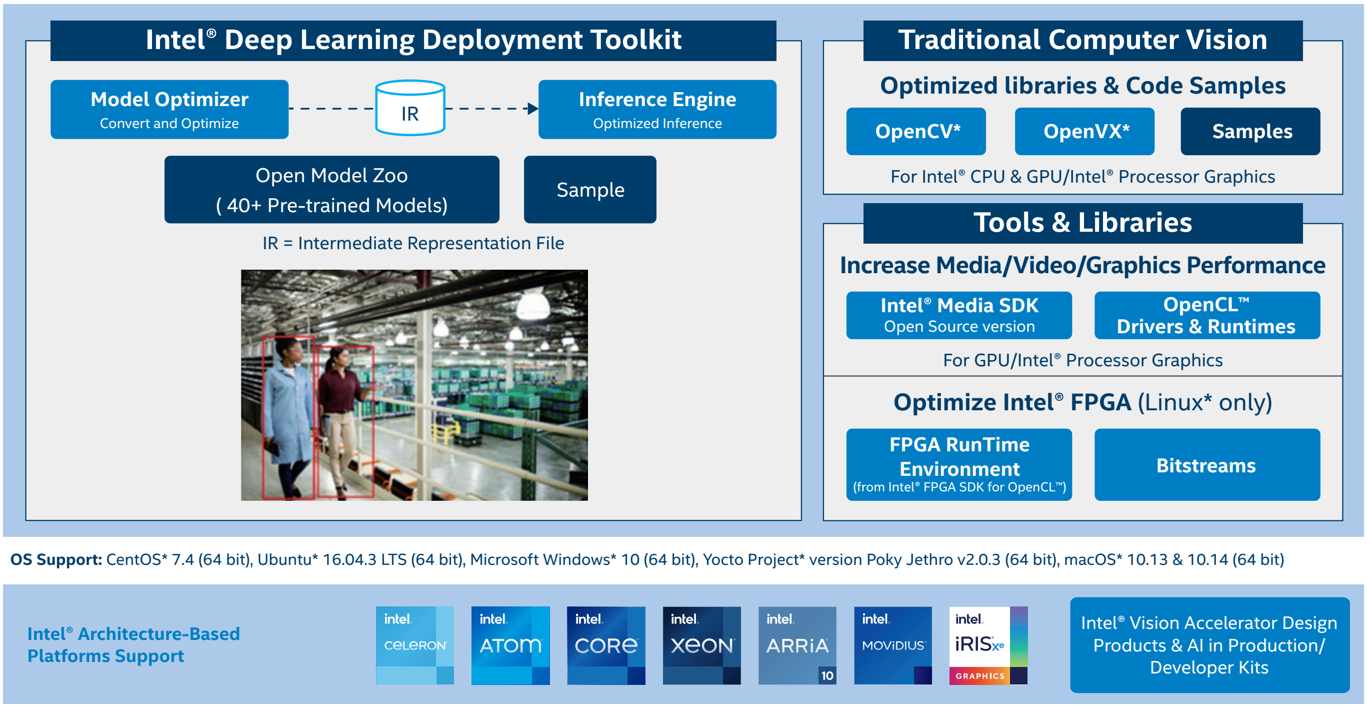

Figure 3. Main functional modules of OpenVINO™ toolkit.

The OpenVINO™ toolkit has the following features:

- Written in C++ and Python;
- Supports multiple operating systems including Windows, Linux and Mac OS;
- Supports acceleration of high-performance AI deep learning inference deployed from the edge to the cloud;
- Supports heterogeneous execution across Intel® Deep Learning Inference Accelerators, using common APIs for different Intel® hardware platforms, including CPUs, integrated GPUs, Neural Computing Sticks (NCS) and HDDL visual processing acceleration cards containing Movidius™ VPUs, FPGA, etc., can help customers achieve cross-architecture algorithm migration and optimization;
- Accelerates product development and time to market (TTM) with easy-to-use computer vision function libraries and pre-optimized kernels;
- Includes standard optimization calls for computer vision, including OpenCV, OpenCL and OpenVX.

Thanks to the excellent performance of the Intel® architecture, JHCTECH® MEC equipment have the advantages of strong processing power, low power consumption, scalable performance, high security and high reliability. They also support the remote management and maintenance. They can fully meet the requirements of various V2X scenarios. The models, application scenarios and technical parameters of this series of MEC equipment products are shown in Table 1.

Model	BRAV-7302	BRAV-7501	BRAV-7520	BRAV-7521
Picture				
Usage Scenarios	Roadside MEC Equipment	Roadside MEC Equipment & Cloud-Edge MEC Equipment		
Processor	Intel® Core™ i3, i5 or i7 (Including Skylake S & Kabylake S)	Intel® Xeon® E or Intel® Core™ i3, i5, i7 or i9 (Including Coffee Lake S & Coffee Lake Refresh S)		
Processor Graphics	Intel® HD Graphics	Intel® UHD Graphics		
Chipset	Intel® H110 or Intel® Q170	Intel® C246 or Intel® Q370		
Memory	Maximum 32 GB, DDR4 2400MHz x 2	Maximum 128 GB, DDR4 2666MHz x 4		
Massive Storage Interfaces	SATA 3.0 x 2, mSATA x 1	SATA 3.0 x 4, M.2 2280 NVME x 1	SATA 3.0 x 2, mSATA x 1, M.2 2280 NVME x 1	SATA 3.0 x 4, mSATA x 1, M.2 2280 NVME x 1
AI Processor	Myriad™ X VPU x 4	Myriad™ X VPU x 34	Myriad™ X VPU x 36	
Expansion Slots	MXM 3.1 x 1, Mini-PCIe x 1	PCIe X8 x 2, PCIe X4 x 2, Mini-PCIe x 1	Mini-PCIe x 1, M.2 E-Key 2230 x 1, M.2 B-Key 3052 x 1, PCIe X16 x 1, PCIe X4 x 1	Mini-PCIe x 1, M.2 E-Key 2230 x 1, M.2 B-Key 3052 x 1, PCIe X8 x 2, PCIe X4 x 2
Ethernet Controllers & Interfaces	Intel® I219-LM x 1, Intel® I210-AT x 6, RJ45 x 3~7	Intel® I219-LM x 1, Intel® I210-AT x 2, RJ45 x 3, Intel® 82599ES x 1, Intel® X710-DA2 x 1, SFP+ x 2		
Intel® vPro®	JHCTECH® Remote Management View software based on Intel® vPro® platform			
RAID	RAID 0, 1	RAID 0, 1, 5, 10	RAID 0, 1	RAID 0, 1, 5, 10
Display Interfaces	DP x 4, HDMI x 1, VGA x 1	DP x 2, HDMI x 1	DP x 2, VGA x 1	
Serial Port Interfaces	(RS-232 or RS-422 or RS-485) x 2, RS-232 x 2	(RS-232 or RS-422 or RS-485) x 2	(RS-232 or RS-422 or RS-485) x 2, RS-232 x 2	
Audio I/O	Audio-out x 1, MIC 3.5 x 1			
DIO	16-bit	8-bit	16-bit (with Optical Isolation)	
Operating Temperature	-35~70 ℃			

Table 1. Models, usage scenarios and technical parameters of JHCTECH® BRAV™ MEC equipment.

Effects: MEC equipment actively empowers the V2X ecosystem

The V2X technology plays an important role in improving the intelligence of transportation and optimizing the traffic efficiency. The data shows that since China's first Vehicle Infrastructure Integration (VII) demonstration road based on 5G C-V2X has been built half a year ago, the traffic safety at the intersections has increased by 60%, and the traffic efficiency has increased by 20%[6]. In the V2X system, the MEC equipment that carries the computing workload undoubtedly plays an indispensable role.

Figure 4. Deployment scenarios of Roadside MEC Equipment (in pole-mounted cabinet).

Figure 5. Deployment scenarios of Roadside MEC Equipment (in roadside cabinet).

JHCTECH® MEC equipment have been deployed in the V2X scenarios of roadside and cloud edge. The roadside deployment scenarios are shown in Figure 4 and Figure 5, and the Roadside MEC Equipment are located in the pole-mounted and roadside cabinets respectively.

Take the Roadside MEC Equipment deployed at an urban intersection as an example, its connection with other equipment and devices is shown in Figure 1: The Roadside MEC Equipment is connected to multiple traffic cameras and LiDARs to visually analyze the road traffic condition (by computer vision based on Deep Neural Network and Traditional Computational Vision), based on which to generate the V2X Messages; the Roadside MEC Equipment can also read the real-time SPaT information from the TSC in the ITMS; the Roadside MEC Equipment is connected to the roadside communication device RSU, and broadcasts the V2X Messages and SPaT information to the road users including pedestrians and vehicles around the intersection through the PC5 link, thereby improving the traffic efficiency. In addition, the Roadside MEC Equipment can also transmit the detected information and analytic data back through the access network, thus the MEC platforms located at the cloud edge can perform further data processing.

The practice has proved that this series of JHCTECH® MEC equipment has excellent performance and fully meets the requirements of edge computing in V2X.

Realizes the low-latency V2X services at the network edge

The MEC equipment completes the real-time processing of the traffic information locally, without the need to forward the data to the remote equipment for processing, and sends V2X Messages to the local pedestrians and various types of vehicles through the direct PC5 link. It fully shows the advantage of MEC's low latency, which is essential for many transportation services.

Demonstrates powerful computing capabilities including computer vision

The MEC equipment can perform the AI-based computer vision processing for the video information from multiple traffic cameras, and can perfectly detect and classify the motor vehicles (including special vehicles), non-motor vehicles, pedestrians, road traffic signs, traffic flow status and traffic events; at the same time, it can also support the signal processing of LiDAR. In addition to general-purpose computing and AI computing, the MEC equipment is also fully capable of storing and forwarding the data at the roadside edge.

Significantly alleviates network congestion

The total amount of data collected by multiple traffic cameras, LiDARs and other sensing devices could be very large, and it will inevitably occupy a large bandwidth if transmitted via the network. The MEC equipment completes the analytic processing of this information locally, and only needs to transmit some metadata to the cloud and data center. Compared with the original information, the data volume of these metadata is greatly reduced, thereby significantly alleviating the network congestion.

Ruggedness and remote management suitable for roadside deployment

The MEC equipment complies with the strict Chinese and international industrial standards and regulations, can adapt to drastic changes in temperature and humidity, has the capabilities of water-proof, dust-proof, corrosion-proof, and shock-proof, as well as excellent EMC and anti-interference capabilities, therefore can provide stable and reliable service in harsh roadside environment. In addition, the MEC equipment based on the Intel vPro® Platform supports remote management and maintenance, and there is no need to send engineers to the site, which greatly reduces the response time and the system operation costs.

Diversified product models meet different business needs

Relying on the rich Intel product family, JHCTECH® MEC equipment series products provide a wide range of system configuration options. The users can choose the most cost-effective MEC equipment products that meet their own needs in terms of deployment scenarios, computing power, storage, peripheral interface types and quantities, communication bandwidth, heat dissipation methods and costs.

Outlook: Deep integration of 5G, AI and Edge Computing accelerates the commercial deployment of V2X

Currently, 5G has been commercialized in China, laying a foundation for the inter-communication of terminal devices with a high-speed, low-latency, and extensive connection network. As one of the most eye-catching 5G vertical industry applications, C-V2X will accelerate its development. The standardization of 5G C-V2X new air interface has been completed in June 2020, and large-scale trials and tests are about to start. The computer vision empowers the V2X with intelligent perception and analysis, thereby enabling diverse new applications. The Edge Computing further deploys AI computing power closer to the road users (pedestrians and vehicles) to provide low-latency transportation services.

As shown in Figure 6, for computer vision applications in V2X, Intel provides various general-purpose processors with different computing powers (including Intel Atom®, Core™ and Xeon® processors), and dedicated vision processors (including Intel® Movidius™ VPU), and hardware acceleration processing solutions based on VPU or FPGA. In addition, in order to support the development across different chip platforms, Intel provides the OpenVINO™ toolkit which contains a wealth of software tools. It can greatly improve the work efficiency of developers and shorten the product development time. With its world's leading end-to-end computer vision technology and products, Intel joins industry partners to lay a solid foundation for the development of the global V2X industry.

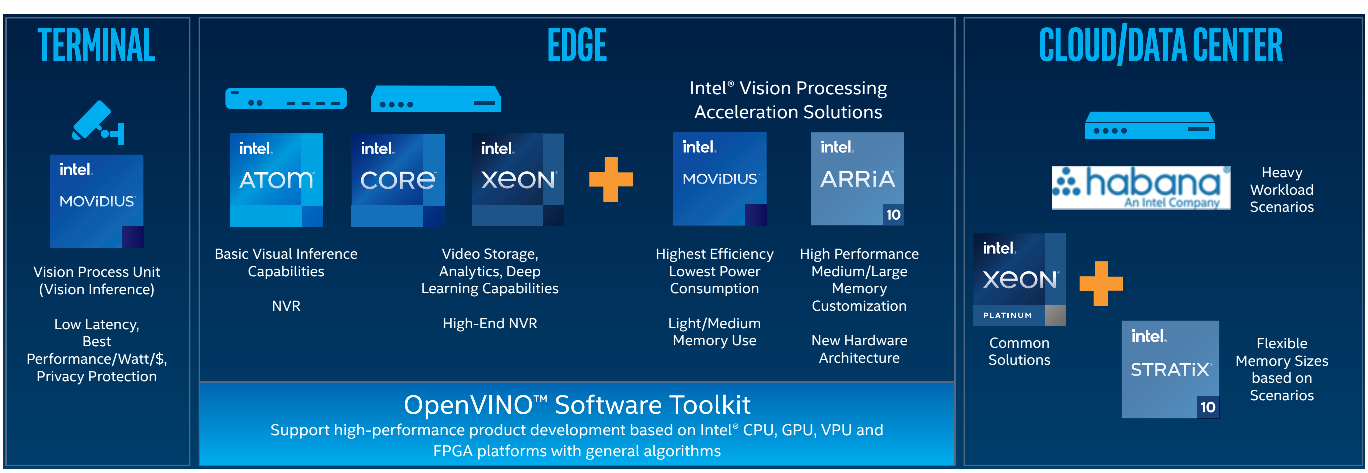

Figure 6. Intel® computer vision products support terminals, edges and clouds.

About JHCTECH

JHCTECH was established in Shenzhen, China, in April 2002, and it has become an intelligent IoT system supplier with strong capabilities in R&D, production, sales and service. Relying on its rich industry experiences and following the strategy of "Proactive Innovation and Intelligent Manufacturing Based in China", JHCTECH has been focusing on the development and production of industrial computers and system application platforms. Its diversified products and services include the industrial tablet computers, industrial touch monitors, embedded box computers, single-board computers, etc., as well as customized solutions focusing on industry applications and AI-enabled value-added services. Its products have passed the CE, FCC, E-Mark, EN50155 and other safety regulations and industry certifications, and are widely used in many areas including the Industrial Internet of Things (IIoT), Intelligent Transportation System (ITS), Smart Security, Energy and Environmental Protection, and Biological Safety. JHCTECH has built a solid foundation for the businesses of Intelligent IoT and Edge Computing.

About Intel

Intel (NASDAQ: INTC), as an industry leader, creates technologies that change the world, promotes global progress and enriches life. Inspired by Moore's Law, we are continuously committed to advancing semiconductor design and manufacturing to help our customers meet the most significant challenges. By integrating intelligence into the cloud, network, edge, and various computing devices, we unleash the potential of data and help businesses and society become better. For more information on Intel's innovation, please visit Intel China News Center (newsroom.intel.cn) and the official website (intel.cn).

References

[1] "Accelerating the Pilot Projects of a New Generation of National Traffic Control Network and Smart Highway", Feburary 2018.
http://xxgk.mot.gov.cn/jigou/zhghs/201803/t20180307_2996718.html

[2] "Management Specifications for Road Testing of Intelligent Connected Vehicles (Trial Version)", April 2018.
http://miit.gov.cn/n1146295/n1652858/n1652930/n3757018/c6128243/content.html

[3] "Internet of Vehicles (Intelligent Connected Vehicles) Industry Development Action Plan", December 2018.
http://miit.gov.cn/n1146285/n1146352/n3054355/n3057497/n3057498/c6564019/content.html

[4] "Release Notes for Intel Distribution of OpenVINO™ toolkit 2020", 5 February 2020.
https://software.intel.com/content/www/us/en/develop/articles/openvino-relnotes.html

[5] OpenVINO™ toolkit website: https://docs.openvinotoolkit.org/

[6] "The first 5G C-V2X demonstration road improves efficiency by 20%", June 2020.
http://www.xinhuanet.com/auto/2020-06/08/c_1126085617.htm