The advent of big data era and the innovation in big data infrastructure technology have opened a new perspective for flexible storage, fast mining and integrated application of massive secure traffic data, and also provided technical support for constructing a new E2E system for smart transportation.

As an industry leading supplier of surveillance products and solution service, Dahua Technology Co., Ltd. provides series of products in video storage, frontend, display control and smart transportation, etc. for customers around the world. It enjoys the world’s second largest market share in video surveillance on safety protection, and is the recommended brand for the construction of safe city in China and one of the most influential brands in safety protection in China. Dahua’s products are widely used in many key fields, such as public security, finance, transportation, energy and communication. Many significant projects have been installed with Dahua’s solutions, including The Three Gorges Hydropower Plant, Six-Country Summit, Olympic Venues, Shanghai World Expo, the Asian Games in Guangzhou, International Horticultural Exposition in Shaan Xi and the London Underground as well as many others. Dahua’s new Intel® architecture based E2E solution for smart transportation meets the new demands of the smart city in traffic management and delivers excellent performance in reliability, scalability, security, advancement and openness.

The smart transportation, an important part of smart city, has achieved rapid development in relevant information-based construction in recent years, and especially with the booming IoT technology, the acquisition methods and data categories of the transportation information have been greatly enriched and covered multiple data sources including video surveillance on roads, E-police at checkpoint, road condition information, road control information, operation information, GPS locating information, RFID recognition information, arrival & departure information and passenger flow information.

However, the data to be processed for realizing the automatic data generation and accelerated generation speed is increasing in an incredible speed, while the internal cross-domain correlation analysis and deep mining of value also urgently need a new E2E solution.

The urban traffic is producing big data at every moment.

The construction of smart transportation in major cities is producing more and more data about vehicles, roads and passengers, and only the transportation industry can produce PB data every day. Take Beijing as an example, there are ten million travelers every day, 50 million urban transportation cards/day, over 9 million vehicles/day, over 100,000 operating vehicles GPS monitoring data, nearly 10,000 fixed detectors, 100 million pieces of communication data/day, and TB image data/day.

While the data is becoming extremely rich and diverse content, it also cause deluge at the same time.

- The Economist “Utopia Data” issue
Challenges

With the popularization of mobile terminals and automotive electronic products as well as the continuous construction of the smart transportation system, the traffic data generated in urban areas grows exponentially, posing pressure on data storage and setting higher requirements on data analysis. The traditional smart transportation technologies can hardly meet the present situation, while the new E2E solution for smart transportation shall address the following issues:

- Frontend data pre-processing and transmission: How to effectively use the computing resources of the frontend devices to realize data pre-processing, transmission over network and effective storage and query as the smart sensors will generate a huge amount of data, such as checkpoint/E-police data and GPS data.

- Backend data center processing: How to effectively use the new big data technology and platform to execute rapid data mining and integrate applications.

- Flexible management and scheduling of data: How to effectively manage and well use the complicated structured data, unstructured data and semi-structured data (e.g. picture, video and audio) generated in the smart transportation.

Solution

The E2E transportation system is generally composed of frontend device (e.g.: web camera, NVR) and backend device (e.g. data center). In the traditional solutions, the data acquisition and storage are regarded as frontend task while the data analysis as backend task. However, the application of various sensor technologies causes complex and diversified data and the proportion of non-structured data is increasing rapidly, meanwhile the data showing a massive growth also pose a huge pressure on the transmission over network and backend processing capabilities. In the new Intel® X86 platform based E2E solution for smart transportation, the analysis of some data for pre-processing is completed on the frontend device, which effectively relieves the pressure of the backend device for data mining analysis and reduces the pressure of bandwidth in the transmission over network, so that the large-size yet small-value non-structured data will be transferred to the backend device as small-size yet great-value semi-structured and structured data after analysis and pre-processing on the frontend device. Meanwhile, the Intel® architecture delivers low power consumption and high performance for the reference platforms (including Intel® Atom™, Intel® Core™, and Intel® Xeon®) of the whole system from the embedded device to the data center, providing strong technical guarantee for the implementation of new solution.

- Frontend technology
  Intel® Atom™ and Intel® Core™

The real-time intelligent analysis system can analyze the followings:

Vehicle recognition: plate number, plate color, car body color, car model, and car logo

Clothing feature detection: clothing color of the upper and lower body

Behavior detection: running, hitting the line, intruding the region, going in a direction not allowed by traffic regulations

Face detection: detecting the face in the image

processor platforms feature performance superiorities such as high reliability, high performance per watt and high scalability. The intelligent network video recorder developed by Dahua* Technology Co., Ltd. is based on Intel® Atom™ and Intel® Core™ processor platforms that supports the access of IP camera cameras of mainstream brands and can realize up to 128-way HD access, 384Mbps access, 256Mbps storage and 384Mbps forwarding. It supports
the mainstream and the most advanced video coding format such as H.265/H.264/MPEG4/MJPEG, 2-way HDMI and 1-way VGA. It is the industry's first to support 4K HD output, enabling users to enjoy more vivid and clearer viewing experience. Moreover, it supports comprehensive intelligence, which reduces the users' maintenance, saves the users' manpower cost, and promotes the users' value. The products can be extensively applied in the professional safety surveillance and monitoring fields which have higher requirements on quality of image and transmission over network and require long-time storage, such as finance, public security, electricity and safe city.

The common NVR is only used to store video-related services without giving full play to its performance. The Smart NVR developed by Dahua Technology Co., Ltd. effectively integrates the video storage and intelligent analysis, maintaining the original video storage function of NVR and achieving real-time intelligent analysis, to retrieve the key clues about people, auto and article in the video and make structural annotation.

The Smart NVR can implement the real-time analysis for the frontend HD video. The structured information after analysis and video image resources will be stored in the local Smart NVR first and then synchronized to the backend distributed big data system by E2E technology. This technical solution fully enable the use of the powerful computing performance of Intel® processor and achieves intelligence in the frontend, improving the capability and reducing the cost of the whole E2E system.

- Backend technology

Based on Intel® Xeon® processor platform and leveraging the big data processing technologies such as Spark and Hadoop, an architecture similar to Lambda/Kappa is established to provide the real-time acquisition and summary, real-time analysis and offline mining of large-scale data about passing vehicles in a single system architecture.

We adopted open source big data technologies such as Kafka, Spark, Spark Streaming and HBase in such architecture to process the massive traffic data (structured, semi-structured and unstructured data such as text, image and video).

According to Lambda architecture, the big data processing system is logically composed of Batch Layer, Speed Layer and Servicing Layer.

On the Speed Layer, the system adopts Spark Streaming to conduct real-time streaming analysis and processing for the streaming data imported by Kafka, and the advanced analytical application such as real-time statistics and real-time fake plate analysis can be achieved on such layer. Meanwhile, the real-time data will be saved in HBase as the history data.

On the Batch Layer, the system employs Spark computing engine for batch pre-computation of data and saves the pre-computation results in
HBase. In this way, the index view is stored in HBase for query and used by the Serving Layer.

On the Servicing Layer, it can load and query the history data and batch processing view through HBase interface, or use Spark or Spark SQL computing engine to realize statistical query function.

Superiority of Spark based Platform

Real-time. The real-time analysis and processing of Spark Streaming realize the real-time statistics, real-time analysis, and other functions.

Low latency. Spark, based on memory computing, avoids dependence on IO and greatly reduces IO expenditure; and based on Lambda architecture design, effectively achieves low latency and manual fault tolerance while providing machine fault tolerance by leveraging the batch and streaming processing which complement each other.

Large-scale data processing. The distributed computing architecture can achieve linear expansion of the processing capability by adding computing nodes, thus easily processing and analyzing the large-scale data and meeting the needs of service development.

Unified system architecture. The big data applications such batch processing, streaming computing and real-time analysis are implemented in a single Spark system architecture. Compared with the popular Hadoop + Storm solution now, it does not require the code maintenance between two or more complex distributed systems, so as to avoid the expenditure on code caused by cross-system programming.

Optimized analysis and algorithm. Spark’s iterative computing can support more complex machine learning and image processing algorithm.

Case Study

The new Intel® architecture based E2E solution for smart transportation developed by Dahua® Technology Co., Ltd. meets the new demands of the smart city in traffic management and delivers excellent performance in reliability, scalability, security, advancement and openness.

Dahua® E2E solution for smart transportation has been successfully applied in one city to establish the big data judgment system for vehicles, which integrates the structured record information and non-structured image and video information of the frontend checkpoint system (including the checkpoint data from the public security and some traffic polices) and realizes the demand of safe traffic management for smart city: real-time acquisition and summary of data about passing vehicle, real-time analysis (e.g. license plate number recognition, model recognition, car color recognition, fake license plate recognition, alarming for vehicles at high risk, black and white list control, etc.) and offline data collision (e.g. suspected vehicles screening based on the location and time of the accident, statistics of traffic at the checkpoint, correlation analysis for following vehicles). Currently, the system processes about 1.5 million pieces of data about the passing vehicles every day and has achieved good operating results.