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In-vehicle Video Surveillance Boosts Public Safety

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Introduction: Market Needs and Trends

Terrorism, crime, and vandalism targeting public transit systems, such as the London bombings in July 2005, and killings on school buses and transit lines in recent years, have highlighted the importance of in-vehicle video surveillance. From London to Paris to Taipei, and in many other metropolitan areas around the world, an increasing number of IP surveillance solutions have been installed on buses and other rolling stock to implement recording of images both onboard and outside the vehicles. The continually declining price of IP (network-based) video surveillance equipment and improved network bandwidth have increased the affordability of the latest technology and further fueled market growth.

A typical vehicle surveillance scenario—in a bus, for example—includes two in-vehicle cameras recording interior views of the passenger compartment, and another two cameras helping eliminate external blind spots.

Vehicle surveillance serves multiple purposes: it helps protect passengers and drivers onboard as well as pedestrians and other drivers on the road. It also helps to enforce driver and rider regulations as drivers and riders know they're being watched and are more likely to follow the rules. It can help fix responsibility after an event, and even helps reduce frivolous claims.

Moreover, IP-based video surveillance of Full-HD quality can enable valuable IVA (Intelligent Video Analytics) features, such as facial detection, demographics, passenger counting, forbidden zone, and density analysis. The analysis functions sometimes can produce added business values—for example, passenger analysis can help determine media display content for in-vehicle signage during specific hours; content can be fine-tuned to impress a target audience group.

That is why IP surveillance is recommended for in-vehicle applications: it delivers many advantages over traditional closed circuit television (CCTV), including easier and less expensive installation through PoE, higher image quality that enables more effective IVA, real time remote monitoring and control, convenient video data search and retrieval, and higher software compatibility.

The following sections will introduce the required components of an in-vehicle video surveillance system for implementing the mentioned functions, the special ruggedization technologies and considerations needed for in-vehicle applications, and, finally, how the world's leading IPC maker, Advantech Technology, integrates all these requirements, technologies, and considerations in a single compact box computer.

System Requirements and Components

IP or CCTV Solution

In the past, a traditional CCTV was considerably cheaper than an IP Camera, but today the price gap has narrowed. Compared with IP surveillance, analog cameras deliver poor image quality, which makes implementing IVA difficult. The CCTV solution is also awkward when it comes to VMS compatibility due to the lack of standard encoding/decoding protocols.

IP cameras, on the contrary, can be easily installed simply via an Ethernet cable connection, and follow the industrial communication standard, ONVIF, that ensures interoperability between IP-based physical security products and provides much higher compatibility with software products developed by various companies.

Of course we have to consider the fiscal reality for emerging countries, which, due to stringent budgets, still need to opt for CCTV; it is best if an in-vehicle computer for video surveillance can provide both IP and CCTV support, as a hybrid solution.

Wireless Communications

Wireless communication is needed between vehicle and control center so that instant response is possible—such as for emergency dispatch of service personnel to take care of a break-down event en route. Adapting to varying mobile communications infrastructures at different locations, diverse and flexible wireless communications including Wi-Fi, 3G, or LTE need to be provided. An Emergency Call system can be implemented as well, with an additional voice module.

However, due to the limits of wireless bandwidth, video data transmission in real time must be in a lower definition format, with the copy and storage of full-HD quality raw data to the database made only after the bus returns to the terminal; this can be done automatically via software-enabled network transmission, or by simply retrieving the storage device. Therefore, HDD hot swappability is also an important design consideration for in-vehicle systems; it delivers convenient data retrieval and system reliability.

On-board GPS

GPS navigation is also a crucial component for in-vehicle surveillance systems; it provides real time position tracking of the vehicles and enables more well-informed and efficient fleet management, including instant reactions to incidents. The acquired data can also be used for developing value-added applications such as a bus arrival time prediction system, with the information displayed on signage at each bus stop.

CANbus

The CANbus is used to connect the onboard video surveillance system and the vehicle Electronic Control Unit (ECU) as well as Video Event Data Recorder (VEDR) to provide vehicle status information such as driving speed, gear use, braking, fuel usage, and so on. Such information can be valuable in determining responsibility or liability in traffic incidents. Some vehicle status data can be selectively incorporated into video as OSD and shown on-screen along with timeline information.

G-sensor

A G-sensor, or accelerometer, can used to detect and monitor acceleration and vibration/shock in the automotive environment, which in turn will assist in incident analysis and responsibility clarification—for example, in crash investigations or examinations of driving behaviors.

Scalability by PoE Switch

Today's IP cameras are usually enabled and powered over an RJ-45 Ethernet line connection. An in-vehicle NVR typically has four default channels for connecting four IP cameras. However, additional LAN ports should be provided that let the system scale easily; with extra ports, the customer can connect via PoE switch to add additional cameras, depending on application requirements, system performance, and bandwidth.

Software Support

Experienced in-vehicle computer system suppliers provide not only hardware, but an integrated hardware/firmware/software solution with rich SDK and APIs that exempt system integrators from the complex programming required to make low level system calls; this allows them to develop intended applications and functions with great ease and faster time-to-market benefits. Remote control software like Advantech's SUSIAccess is convenient for developing in-vehicle systems. And advanced applications like VMS or IVA can either be independently developed by system integrators or purchased from a third party.

In-vehicle Technologies

The automotive environment is beset by electrical hazards, shock and vibration, dust, and sometimes temperature extremes. To ensure safety and reliability, in-vehicle computers require special designs to combat these evils, and these design features distinguish them from standard IT products. The most important of all: tackling power challenges.

Power Compliance

In-vehicle electronics are vulnerable to impacts from so-called “dirty power”. These impacts include power surges or voltage spikes caused by a battery disconnect, a jump start, or a cold crank, or switching transients from other onboard devices or subsystems. Transient voltage can cause severe damage and failure of electrical devices. Therefore, transient protection at the hardware design level, and power ignition management at the firmware level are critical for in-vehicle video surveillance systems. Tolerance for a wide range of DC input is also important in order to ease installation of in-vehicle devices in 12/24Vdc battery systems, and to enhance resistance against cold crank, jump start, and load dump conditions.

To ensure the power design of electronic devices is robust enough to survive the hazards and trials of automotive environments, international standards with set test methodologies have been defined for certifying in-vehicle electronic appliances, such as E-mark and ISO-7637-2.

Vehicle Shock and Vibration

The automotive environment is, by nature, subject to constant vibration and occasional shock. Therefore, special mechanical designs are necessary to protect electronic components, such as the use of durable and heat-resistant adhesives, screws, and dampers that reinforce ruggedization.

Thermal Design

Due to economic spatial considerations, the industrial in-vehicle computer is more likely to be installed in the undercarriage rather than seated in a cozy, air-conditioned corner. Therefore, special mechanical designs, including the arrangement of components in the chassis to allow for better heat dissipation, are important for strengthening system reliability.

However, as the use of fans could draw in dust and threaten system lifespan, fanless design is preferred for IPCs used in vehicles. Striking the delicate balance between system performance and thermal design poses challenges for IPC makers.

EMC (Electromagnetic Compatibility) Protection

IPCs for vehicle applications are also prone to electromagnetic disturbances from other in-vehicle devices and special protection is needed to ensure system reliability and longevity. IEC-61000 contains a series of standards for verifying EMC capabilities.

Isolated I/O Interface

Optically isolated I/O designs help to eliminate noise pickup associated with PC power supplies and ground connections, thus protecting the printed circuit boards inside from damage.

Advantech Solutions

Advantech Technology's ARK V Series comprises fanless systems dedicated to in-vehicle NVR; it contains several product SKUs with varied CPU performance, suggested video qualities, and peripheral support to meet needs of a range of applications depending on customer requirements and budgets.

ARK-2151V, in the uppermost echelon of the product line, is one of the best examples of how a single fanless box computer can fulfill all the requirements and functions for in-vehicle video surveillance, with full consideration of all the automotive environmental factors mentioned in this article.

With advanced mechanical, power and thermal designs, ARK-2151V runs on the Intel® Core™ i5 processor and delivers Full HD (1920 x 1080) 120fps graphic power in a clean fanless design that tolerates -20 ~ 60 oC operating temperatures, excellent EMC protection, and rugged certifications. Its vehicle vibration and shock resistance capabilities are certified at IEC-60721-3-5 5M3, a protection level higher than MIL-STD-810F.

Offering hardware excellence combined with Advantech's rich software resources, ARK-V series are application-ready platforms for developing in-vehicle video surveillance solutions. Each ARK-V product comes with strong, Advantech SUSIAccess firmware/software support, which provides a well-developed SDK and APIs for system integrators to conveniently develop their own remote monitoring and control functions, vehicle ignition management, VMS, and peripheral connection management such as wireless modules, PoE status, GPS and G-sensor.

When it comes to developing in-vehicle video surveillance systems, proven Advantech hardware systems, along with confirmed compatible software, reduce difficulties and put System Integrators months ahead.