HIKVISION

Hikvision Cybersecurity White Paper

www.hikvision.com

About this Documentation

Hikvision Cybersecurity White Paper is proposed to make an overview of Hikvision's current practice on product cybersecurity issues and to provide an open and transparent angle to the public to access Hikvision's cybersecurity capabilities.

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Company intro

Hikvision is the world's leading provider of innovative video surveillance products and solutions.

Hikvision now has more than 20,000 employees, over 9,300 of which are R&D engineers. The company annually invests 7 – 8% of its annual sales revenue to research and development for continued product innovation. Hikvision has established a complete, multi-level R&D system that includes every operation from research to design, development, testing, technical support, and service. Centered at its Hangzhou headquarters, the R&D teams operate globally, including R&D centers in Montreal, Canada and Silicon Valley, California in North America, as well as Beijing, Shanghai, Chongqing, and Wuhan in China.

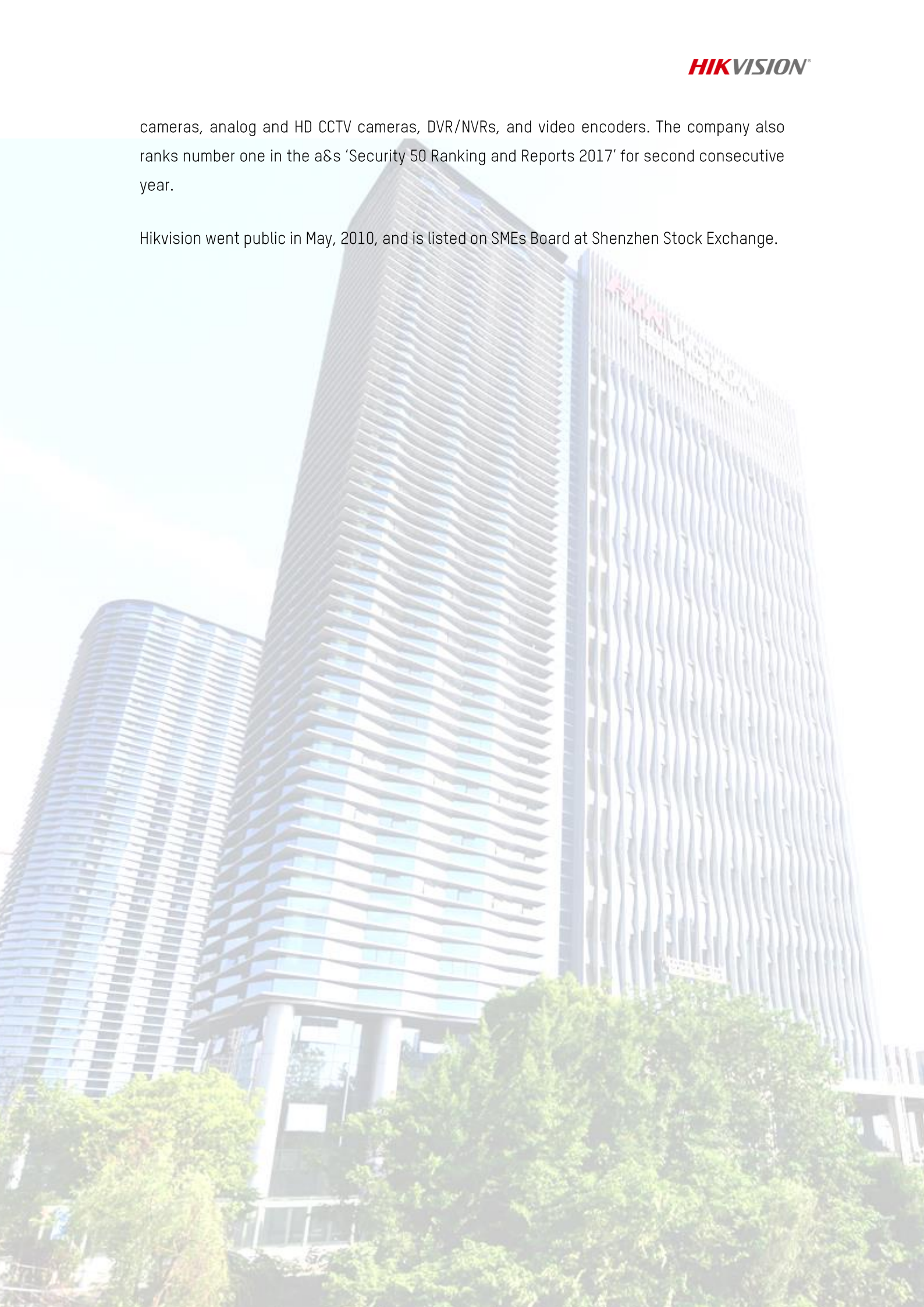
Hikvision advances the core technologies of audio and video encoding, video image processing, and related data storage, as well as forward-looking technologies such as cloud computing, big data, and deep learning. Over the past several years, Hikvision deepened its knowledge and experience in meeting customer needs in various vertical markets, including public security, transportation, education, healthcare, financial institutions, and energy, as well as intelligent buildings. Accordingly, the company provides professional and customized solutions to meet diverse market requirements. In addition to the video surveillance industry, Hikvision extended its business to smart home tech, industrial automation, and automotive electronics industries — all based on video intelligence technology — to explore channels for sustaining long-term development.

Hikvision has established one of the most extensive marketing networks in the industry, comprising 33 overseas regional subsidiaries and 35 branches throughout China mainland, ensuring quick responses to the needs of customers, users and partners. Hikvision products serve a diverse set of vertical markets covering more than 100 countries, such as the Philadelphia Recreation center in the USA, the safe city project in Seoul, South Korea, Dun Laoghaire Harbour in Ireland, Milan's Malpensa Airport, and the Bank of India, to name just a few.

As the world's largest security manufacturer, Hikvision has been a pioneer in the video surveillance industry's revolutions in digitalization, networking, and intelligence. According to IHS report, Hikvision has topped the list as the world's largest supplier of CCTV & Video Surveillance Equipment for six consecutive years (2011-2016), and retains the number one market share position in virtually all individual equipment categories, including network

cameras, analog and HD CCTV cameras, DVR/NVRs, and video encoders. The company also ranks number one in the a&s 'Security 50 Ranking and Reports 2017' for second consecutive year.

Hikvision went public in May, 2010, and is listed on SMEs Board at Shenzhen Stock Exchange.



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1. A letter from CEO

The "Internet of Everything" is turning from dream to reality. As a forerunner to the "Internet of Everything", video surveillance technology has developed rapidly over the past 10 years. It moved from the analog era to the digital era, then to the network era, and is now entering the smart era. Improvements in technology can advance human society, but they may also present new challenges. The development of Internet technology, for example, has largely benefited human society, but it has also brought about cybersecurity challenges. The same is true for Internet of Things (IoT) technology, which was developed based on the Internet, is similar to the Internet in that it vastly improves human life. However, it has also created new challenges for society. Cybersecurity is one such challenge.

The surveillance industry entered the digital era later than the IT industry, and cybersecurity awareness remains relatively weak within the surveillance industry. In 2014, Hikvision founded the "Security Emergency Response Center" to form a centralized external interface to deal with cybersecurity issues. In 2015, Hikvision established the "Network and Information Security Laboratory" which was fully incorporated into Hikvision's cybersecurity system. A product security committee was formed, as well as a Network and Information Security Laboratory and Network Security Department. The company also established a security testing laboratory and a network security system which focused on organization, procedures, and especially network security design. It was created to improve the overall cybersecurity standards of the company's products and systems.

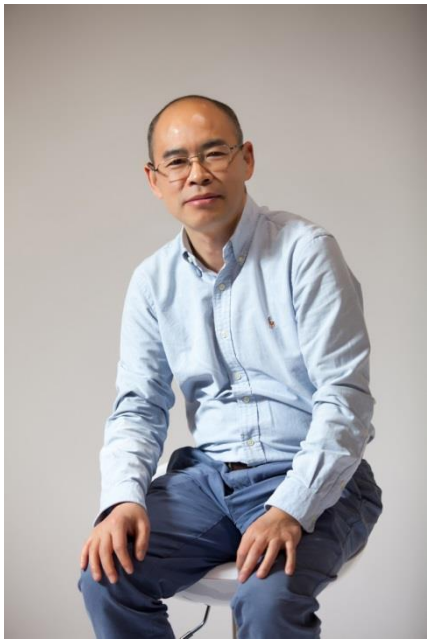
Cybersecurity is not only the responsibility of product manufacturers. Everyone who participates throughout a project's lifecycle, including users, system integrators, operators, system designers, other service providers, are all responsible for using cybersecurity best practices and face the same challenges of cybersecurity. The solution to this problem is 30 percent technology and 70 percent management; all stakeholders need to work together to contend with cybersecurity obstacles.

During this time when the surveillance industry desperately needs cooperation to solve the issues we all face, we have noticed public and media attention and concern about IoT security. This makes us keenly aware of our responsibility and mission. Hikvision upholds the company values of "corporate value dedication to client's success, value oriented, integrity and down-to-earth, pursuit of excellence" Hikvision prioritizes responsibility to our clients' network and information security over company profits.

Cybersecurity challenges will always be around, so we must remain vigilant and keep working on improving product security.

Hu Yangzhong, President

Hangzhou Hikvision Digital Technology Co., Ltd.



2. Preface

Over the past five years, we have witnessed the progression of digitalization in the surveillance industry and also seen the industry's rapid development. In these five years, we have seen how the smart surveillance industry has explored the dream of the Internet of Things and we are happy to see that the industry is at the forefront of developing, exploring and implementing IoT technology.

Without a doubt, the development of the smart surveillance industry must conform to digitalization, networking, and smart technology trends. However, cybersecurity is a completely new field for the surveillance industry and the openness of networks have interconnected security systems which were formerly independent and completely isolated, promoting data flow and sharing in ways that have drastically improved society. This has brought about even more innovative opportunities, enabled the Internet of Things industry to grow, and has pushed the development of civilization to new heights.

During the surveillance industry's transformation from "analog", "isolated", and "data acquisition", to "digital", "networked", and "smart", we have seen the benefits that the digital and networking revolution brings to the surveillance industry. However, we have also witnessed the slow spread of various types of malicious cybersecurity attacks from the Internet to the surveillance industry. Furthermore, since current security systems are based on "seamless" switching from original security systems, some of the industry's features may contain possible security defects when placed in a networked environment.

Hikvision is a global company, and services more than 155 countries and regions. As a company of such scale, Hikvision takes these challenges very seriously. As one of the world's leading security solutions providers, Hikvision deeply understands, from a technological perspective, how to support and promote the health, prosperity, and safety of the world's citizens.

Cybersecurity is not just a problem for certain countries or companies. All stakeholders, governments, and companies must understand that cybersecurity is a problem that everyone in the world faces, and that meeting these challenges requires international cooperation, risk aversion methods, and use of cybersecurity best practices. With the sharp rise in "cyber-attacks in America"[1], ransomware like "EternalBlue" and similar incidents, it is

[1] https://dyn.com/blog/dyn-analysis-summary-of-friday-october-21-attack/

apparent that we have entered a new era in the fight against cybercrime. To effectively handle security issues, various stakeholders must form mechanisms of trust and cooperation.

Hikvision makes the following commitments: We will support and adhere to internationally recognized cybersecurity standards and the best practices; we will support research efforts to increase network defense capabilities; we will continue to improve and use open and transparent methods so that users can assess Hikvision's cybersecurity capabilities.

Finally, just as we have done in the past, we encourage our clients to help us improve our procedures, technology, and cybersecurity techniques to enable us to bring even more benefits to them and their customers.

3. Security Threats in the Internet of Things

Security threats in the Internet of Things can be categorized as perception-layer threats, network-layer threats, and application-layer threats.

Perception layer

- Device theft or damage:
  Internet of Things assets that lack physical protection and are deployed in remote places are susceptible to theft and damage.

- Device tampering or counterfeiting:
  Outdoor terminals and distributed installations are easily accessed which means physical attack, tampering, and counterfeiting is possible.

- Attacks using known vulnerabilities:
  Examples of known vulnerabilities include expired OS or software, and unpatched vulnerabilities. The enormous number of IoT devices means there are challenges to the update and maintenance processes.

- Attack and authentication bypass mechanisms:
  Use of default or weak passwords in the Internet of Things environment.

- Theft of sensitive information:
  Sensitive information in plain text form is preset within the device and is easy to read and tamper with.

- Remote control devices:
  There are still test and debug ports in the firmware, making it vulnerable to remote access from attackers if the correct security protection measures are not taken.
  The debug port does not have restrictions on code execution which means that attackers can take complete control of the device via this port.

- Theft of private information:
  Private information leakage during the collection, transfer or processing of data on the Internet of Things.

Network layer

- Network penetration via wireless access:
  The defects of wireless protocols, such as the lack of effective authentication may lead to unauthorized access to private information.

- Attacking unencrypted network traffic:
  Encrypted communication is prone to hijacking, repeating, tampering, and eavesdropping by an intermediary. During communication among devices, the cloud, and mobile terminals, attackers can access sensitive data if the control commands and collected data are not encrypted.

- Attacks and intrusion from the Internet:
  Security issues faced by IP systems: attacks and intrusions from the Internet.

- Denial of service attack:
  DDoS attacks caused by viruses

Application layer

- Difficulties in managing the upgrade process and security of the various and scattered devices managed by the platform layer.

- Privacy and security risks caused by unauthorized access.

- Not updating and/or checking security configurations for an extended period of time.

After considering the many hidden security risks in Internet of Things hardware, software, and environment, and the complexities of computational capabilities, Hikvision has created its video-centric Internet of Things solution with an all new security framework in mind to establish a multidimensional security system that can ensure endpoint devices, data, applications, systems and network security, while also adhering to safety requirements.

Software, hardware, and cloud services are closely linked in Hikvision's Internet of Things solution platform. They work together to provide the most secure and transparent experience for users. Many security features are enabled by default, and key security features, such as device activation and device encryption, cannot be modified to prevent users from accidentally disabling these functions.

4. Network and Information Security in the Surveillance Industry

The surveillance industry began as analog before moving to digital. During the analog era, surveillance systems operated in private networks, so the industry was focused on product cost, performance, and ease of use. The cybersecurity features of the systems at that time were not the main focus, but as the surveillance industry developed rapidly toward network connectivity, it moved directly from analog to digital, the industry's initial failure to contemplate cybersecurity issues led to the advantages of the original analog equipment, such as its strong usability, to deviate from the best information security practices for the digital era. In the past, surveillance industry vendors generally enabled default support for all protocols to make it more convenient for users to use devices from all manufacturers. They also enabled automatic protocol selection in the server. Although these settings make it much more convenient for the client, they do not follow information security best practices.

The surveillance industry has encountered cybersecurity issues in recent years because of the way the products and the industry developed. However, the existence of these issues does not mean the entire industry is as vulnerable as some might claim. Furthermore, the industry is now making a concerted effort to deal with potential security risks, and is implementing effective counter-measures.

Objectively speaking, cybersecurity issues are not issues specific to the surveillance industry, but are issues that society as a whole face. Looking at the overall field of IT, cybersecurity issues exist in all fields, and the following basic consensus exists:

- **The Prevalence of Security Vulnerabilities**

There is no such thing as an IT system or product with no security vulnerabilities. In fact, security vulnerabilities are very common. There are millions of lines of code in each product, and if only one parameter is incorrectly set, or if the positioning of two lines of code is incorrect, this may lead to a high-risk vulnerability in a system. Currently, automated or manual techniques cannot be used to detect all potential cybersecurity issues. Therefore, product security issues are common.

- **Security is for the Entire System**

The security of a system cannot be guaranteed by the security of a single point. The entire system must be secured. To ensure the security of video surveillance systems, the front-end,

back-end, network, security devices and the platform system must work together and complement each other to form a system that provides defense in depth. A cybersecurity issue with any device in the link will be a vulnerability that could expose the entire system.

- **Third-Party Open Source Software Security**

A variety of third-party open source software is currently used in various types of systems. Such software is open, shared, and free, and is playing a growing role for software developers. Open source software is also a very important component in the software supply chain. But as companies enjoy the benefits of open source software, such products also carry huge security risks. In recent years, open source software has suffered frequent high risk vulnerabilities, for example Struts2, OpenSSL, etc. Many of these components are used in the lower layers of information systems and have a very broad scope of application. Vulnerabilities therefore exhibit critical security risks and have been detrimental to entire industries, not just specific products.

- **Security is in Dynamic Balance**

There is no such thing as "absolute" security. Security can only be relative. Offensive and defensive games are always zero-sum. Mechanisms and techniques that are considered secure today may be insecure tomorrow. Products that are considered "secure" today may be hacked tomorrow. This means that there is no final destination in security. Every product will have information security issues during its life cycle; the question is if and when these issues will be exploited.

- **Products Security Management**

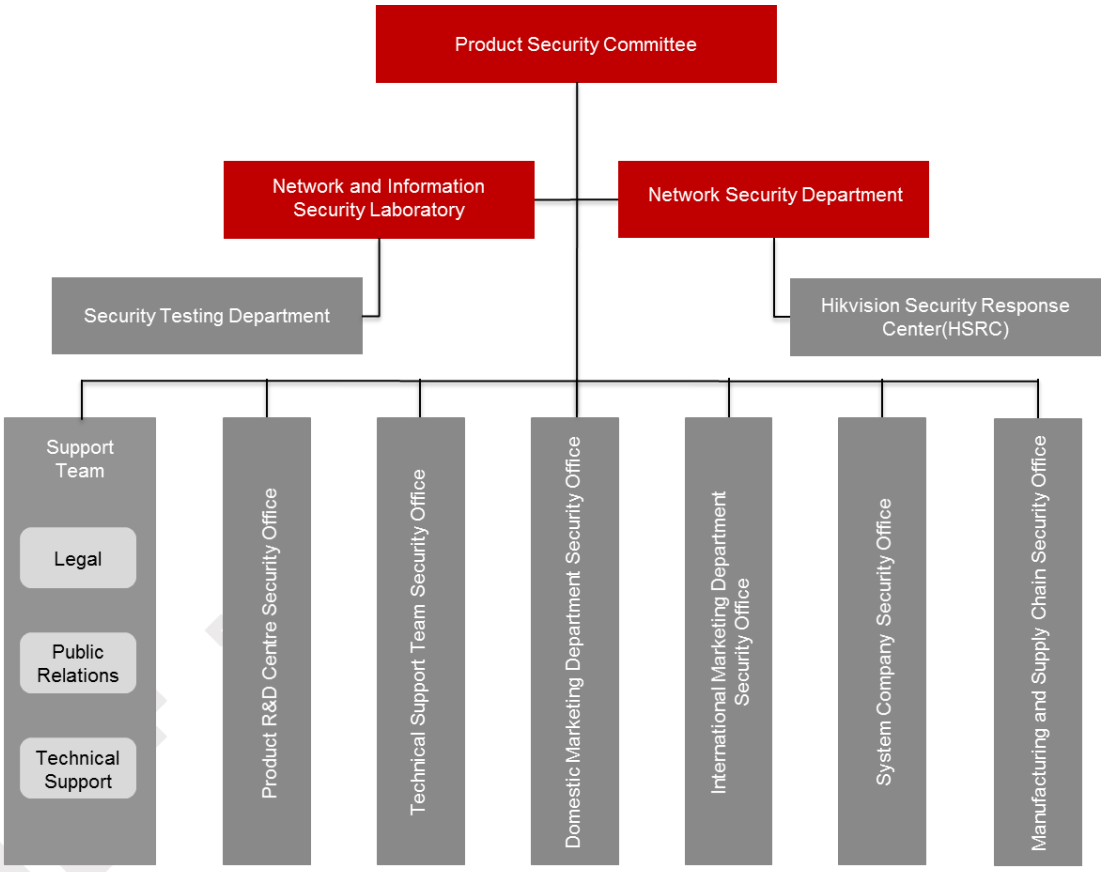
The most important element in system security is security management. Even with systems that are more secure, if the user cannot manage or operate them properly then system security cannot be maintained. Currently, some security issues within the surveillance industry are mainly due to "inappropriate" usage by users and by ineffective security management. Many cybersecurity devices still have "weak" passwords and some security systems do not have firewalls or other security equipment installed. Users also need to develop good security habits, take regular note of security announcements from manufacturers, update to the latest firmware and install patches as soon as possible. Eventually, all Internet-connected devices need to support a patching process that informs users when a patch needs to be installed.

5. Product Security Life Cycle

This section is structured as seven aspects that introduce Hikvision's work to create the product security life cycle.

5.1 Organization

To ensure that product security assurance activities are incorporated into the development, supply chain, marketing and sales, delivery, technical service and other processes, we first need to establish an organizational structure that can guarantee its implementation and assign clear responsibilities to each group. The administrative structure of Hikvision is as follows:



Product Security Committee

The Product Security Committee is responsible for strategic planning and policy making for company network and information security. In terms of network information security, if any conflict or serious issue arises, the committee has the authority to make decisions and make necessary adjustments to services. Hu Yangzhong, the President of Hikvision acts as the head of the product security committee. The Product Security Committee has set up a specialized Network Security Department which formulates network and information security strategies, policies, procedures, and standards, and manages resource allocation on a daily basis.

Network Security Department

We established the Network Security Department that operates with the R&D department and all other Hikvision departments to include security designs that can handle attacks and improve security defense. As a permanent element of the Product Security Committee, the Network Security Department is responsible for the implementation of product security strategies, the establishment of product security baselines, the implementation of product security assessments, external cooperation regarding product security, industry product security technical standards research, promotion of product security research and development, participation in reviewing major events in product security, and for providing suggestions to company leaders. It is also responsible for combining the company's product security strategy with industry requirements, establishing research and development specifications, embedding security elements into the product research and development process, and promoting its implementation in various product lines.

Network and Information Security Laboratory

The Network and Information Security Laboratory researches and implements technologies related to Internet of Things security. It mainly covers IoT awareness, product security components, security video surveillance products, penetration testing, IoT security defense and other areas. The laboratory aims to research the cutting-edge of IoT security technology and promote its improvement.

HSRC:Hikvision Security Response Center

The Hikvision Security Response Center is responsible for receiving, processing, and revealing Hikvision security vulnerabilities related to products and solutions. Hikvision values its own security and has always strived to safeguard user security. We also hope to use the center as a platform to enhance cooperation and exchange within the industry.

Product Line Security Offices

Each Hikvision product line has a product security office, which works with the Network Security Department to establish product security baselines and related product technical standards and is responsible for the implementation of processes such as product planning, R&D, and security requirement testing on the product line.

Security Testing Department

The Security Testing Department is a third-party department independent of the product lines and is responsible for the product security testing for all of Hikvision's product lines. It is responsible for inspecting the company's product security policies, and whether or not the security baselines are implemented effectively in the products. It is also responsible for ensuring that the released products are secure, and for preventing various types of security issues that may arise during the research and development process.

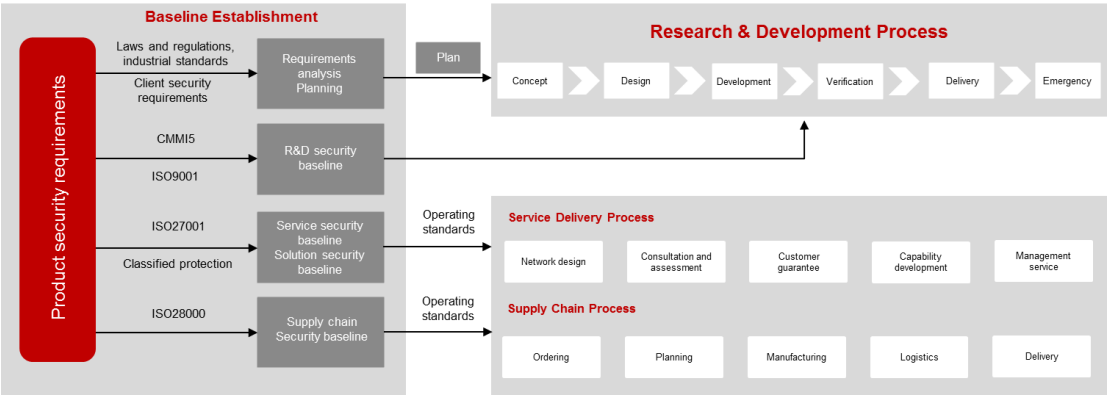
Support Departments

The Support Departments are responsible for providing related internal control, laws and regulations, brand promotion, auditing, and PR support for matters related to product security.

5.2 Procedures and Standards

Hikvision has formulated a set of general security baselines for product security based on current domestic and international laws and regulations, industry standards, customer security requirements, third-party analysis, industry activities, peer experience, and specific service security requirements. It also includes specifications and standards for security baselines for various product lines, secure coding, safe password usage, security key management, secure session management, security certification, security testing, security

incident management and so on. These specifications and standards cover all aspects of product security.



General Provisions for Product Security

The General Provisions for Product Security is an outline for the company's product security matters and mainly includes product security policies, goals, organization, management, procedures, and activities. The General Provisions for Product Security is the general outline and blueprint for the company's product security and will form the basis for all lower-level documents.

Product Security Procedure Documents

Product security has been incorporated into core company procedures, and security management procedures are formulated according to requirements. For example, the product security incident response procedures are formulated according to product security assessment details and red line requirements. Technical requirements and templates for product security baselines are formulated in accordance with the guidelines for product security requirement outlines. Product security baselines, supply chain security baselines, and service security baselines are formulated for each product line. Best practices for the security baselines are also established, and product security testing requirements and testing templates are also formulated.

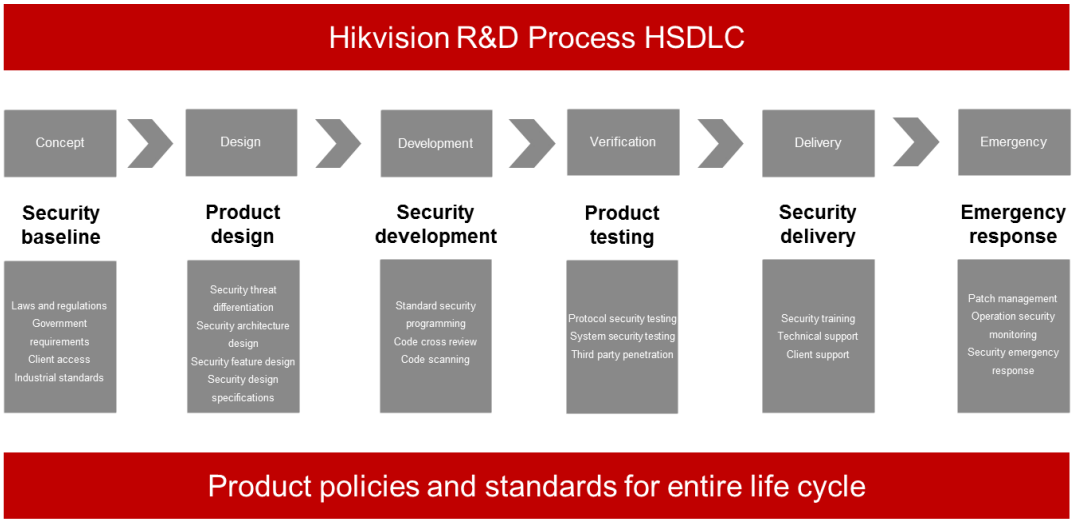
Security Baseline

Company products do not only include self-developed products, but also third-party products. Since the security standards for various products and systems are different, in order to ensure company product security standards, inspection and reinforcement is

required for the security of the delivered product so that it reaches the security baseline and so that known security threats are eliminated. Security baselines are formulated in accordance with product R&D, third-party product procurement, system operation and maintenance, security reinforcement, security testing, and security management. Before mass production of new products, security baseline checks must be performed. Only after ensuring that the requirements are met can mass production begin.

5.3 Security Research and Development Process HSDLC

We have incorporated a broad range of security activities into the R&D process, including security design, security development, security testing, combining Hikvision's wide ranging research and development activities and referencing the industry's best security practices, such as OpenSAMM, BSIMM, CSDL, MSDL and customer feedback. We ensure that the security activities are effectively implemented, and improve product health, enhance privacy protection, and provide more secure products and solutions for our clients.



Concept Stage

During the concept stage, there are two important points in product security requirement analysis:

First, the product security baseline should be in the mandatory requirement list. The product security baseline is used to guarantee the basic requirements of implementing security goals or risk control at an acceptable level. The security goals come from international or domestic laws and regulations, customer input, industrial standards, etc., and their

objective is to ensure security standards are met, to protect user communications and privacy, enhance system access control/sensitive data protection, and to increase system defensive capabilities.

Second, threat analysis will need to be performed on these products in the future at the application scenario to identify other targeted security requirements. Threat analysis is used to find the source, type, and point of attack of threats in situations where the products are used. This is performed to make it easier for us to evaluate risks and ensure that the related measures are incorporated into the product requirements list.

Design Stage

During the design stage, as the product design becomes more detailed, the threats identified during the concept stage must be further refined. Product security architecture design and safety feature design should be carried out at this stage. Hikvision references the OWASP security specifications and other industry best practices to formulate its cybersecurity design specifications.

Development Stage

During the development stage, product developers perform cross-reviews in accordance with secure coding specifications. The automatic code scanning tool, Coverity Static Analysis, is used for quick and accurate scanning for defects in highly complicated code. This reduces the chances of code security issues.

Verification Stage

In order to guarantee the security of Hikvision products and to prevent the occurrence of various types of security issues during the research and development stage, we perform security tests at every stage in this process:

- During product security testing, Hikvision enhances protocol security testing, using protocol security testing tools, Defensics from Codenomicon and Peach Fuzzer to perform network protocol security, robustness, and reliability analyses for all products, and to find unknown vulnerabilities;

- The vulnerability scanning tools, Nessus Professional and NSFOCUS Remote Security Assessment System (RSAS), are used during the system security testing stage to keep

track of CVE[2] vulnerability information. This enables the discovery of various types of weaknesses in the system, including security vulnerabilities, security configuration issues, and application system security vulnerabilities;

- Mainstream antivirus software such as Symantec or Avira are used before a product is released to find known viruses, Trojans, backdoors and other malicious software;

- The company also regularly invites well-known security companies and public testing platforms to conduct penetration testing. To minimize business risks and keep security risks under control, as many penetration tests as possible are performed.

Configuration Management

Configuration Management is an important activity to guarantee product's integrity, consistency, and traceability. Configuration management contains many processes, including strategy and planning, configuration item identification, configuration item change management, configuration status tracking, configuration activity reporting, configuration auditing, build management, release management, third-party software and open source component management, and repository management, etc. Configuration management ensures the integrity of Hikvision's product delivery, including third-party software and open source components within the product. Hikvision's configuration management process is an inseparable part of the IPD process. The aforementioned configuration management activities are conducted at each stage in the IPD process to promote the implementation of product traceability. They are a key part of security.

Build Management Specifications

Build management specifications include build resource management, build process management, and build process optimization. The segregation of duties is an important part of configuration management. The activities, roles, and responsibilities must be clearly defined in the specifications during the build process. The various stages of product development should be integrated, and the life cycle should be clearly incorporated into the IPD process.

[2] CVE：The world's most authoritative vulnerability database: Common Vulnerabilities and Exposures, http://cve.mitre.org

Compiling and Build Center

To ensure the build process is repeatable, Hikvision has established a build center where all hardware, compilation tools, third-party software, data sources and operating systems meet a rigorous set of standards and support requirements. The build center is the integrated solution for product building and compilation and it provides a cloud service to support software-building activities during the IPD process.

Standardization of the build process: Using centralized management of tools, standardization of building scripts, one-click building, and automated installation of build environments, the entire building process is automated, including environment building, source code downloading, one-click compiling, packaging, static code review, automated unit testing, and system testing. This ensures that the product build process is repeatable, traceable, and can be restored.

The build center also has two additional functions: virus scanning and digital signatures. The virus scanning center runs eight antivirus programs simultaneously and is integrated into the testing process. For security reasons, the digital signature center uses a source code compiled with a key from a key database for digital signatures. Hikvision authorizes and records signature activities to ensure that the entire process is traceable.

Component Management

Hikvision's self-developed products are managed via the component system. There are two integration concepts in the component system: CCI (Components Continuous Integration) and PCI (Products Continuous Integration). Continuous Integration engineers use different entry points to establish CCI and PCI, implementing component generation, delivery, and automated integration.

Tool and Third-party Component Management

Hikvision procures many third-party and open source programs from around the world. Third-party components pose a challenge for all companies. That is why Hikvision takes the following issues seriously:

- Reliability of the source code or component source
- Known vulnerabilities that still exist

- Authorized compliance management
- How new vulnerabilities are handled
- Life cycles of third-party components
- Incorporation of third-party components into Hikvision's product life cycle

Not only does Hikvision need to consider third-party components, we also need to ensure that the related components required by all compiled source code or third-party components are managed properly. Hikvision has formulated the "Third-party Component and Source Code Management Specifications" to ensure that third-party software complies with our requirements and can be effectively managed.

Security Delivery

Service delivery employees are the frontline of defense for any company as they have access to potentially sensitive information. Mandatory network and information security training are therefore essential so that staff can help protect customer interests and prevent access control issues, communication security issues, and privacy data protection issues. In terms of employee management, Hikvision formulated the "Hikvision Technology On-site Support Service Standards" according to ISO27001 and other standards. These specifications include codes of conduct, personal safety, information security, etc.

Hikvision strictly manages employees' network access. Employees are required to sign letters of commitment which stipulate their roles, duties, and potential legal liabilities in detail. They are also required to take cybersecurity training and participate in relevant tests.

Emergency Response

Hikvision established the Security Response Center (SRC), which is responsible for accepting, processing, disclosing, and resolving security-related vulnerability issues with Hikvision's products and solutions. Responsibilities include:

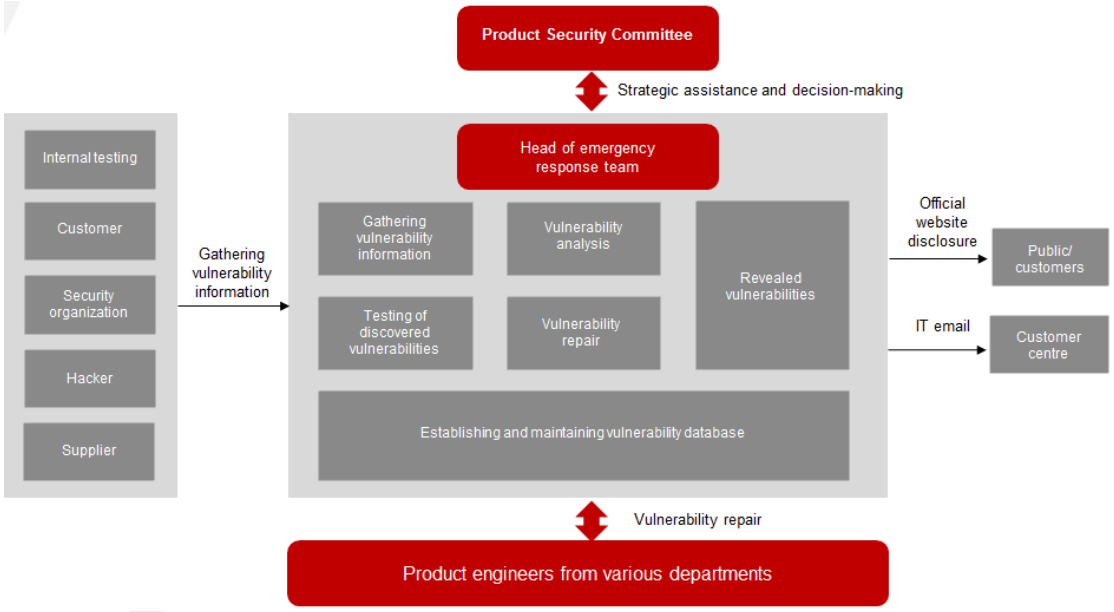
- Responding to and handling customer-submitted security incidents
- Responding and handling security matters announced by industrial associations

- Formulating the company's information security incident management strategy and procedures for handling security incidents

- Analyzing the vulnerabilities and patches announced and released by system software providers and professional security companies.

The company also specifies each department's responsibilities and the procedures for product security incident management to ensure the quality and efficiency of security incident management. The scope of the Security Response Center's management responsibility covers product security during the pre-sales, sales, and after-sales processes, and includes customers' security related interactions, cooperation with security organizations, emergency response management, security information announcement, information security compliance, and the process and implementation of legal compliance.

There are clear provisions for the effectiveness of security matters. For example, initial confirmation of security incidents must be completed in less than 24 hours, and high-risk vulnerabilities must be corrected within 30 days.



Vulnerability Management

Hikvision follows ISO/IEC 30111, ISO/IEC 29147, and other specifications to establish procedures for processing and warning about product security vulnerabilities. These include four stages:

- Vulnerability research and data collection: We obtain vulnerability information via customers, external CERT, security researchers, and related security websites. At the same time, our internal teams are constantly looking for potential security threats. We encourage responsible disclosures, that is, if an external agent discovers a vulnerability, they should give the manufacturer a suitable amount of time to process and solve the issue before disclosing it to the public.

- Security vulnerability assessments, analysis, and verifications: For suspected or confirmed vulnerabilities, the HSRC team will work with the person responsible for the product to quickly complete practical and related risk assessments.

- Tracking and solution: Once a vulnerability is confirmed, the HSRC will immediately forward information to the person who submitted the vulnerability and actively track the process and feedback. They will also investigate the vulnerability to ensure that the issues will be resolved for all affected versions and models of the product. The HSRC process and the core research and development process are tied closely together to ensure timely response to vulnerabilities.

Hikvision strives to protect customer confidentiality and information about vulnerabilities during every stage of the process. If vulnerability information falls into the hands of those with malicious intent, it may lead to far-reaching consequences. All parties must protect the confidentiality of this information.

Hikvision's Security Response Team actively participates in industry and public activities and has established long-term relationships with CERT, vulnerability disclosure platforms, client SRCs, other suppliers, researchers, and third-party coordinating agencies.

5.4 Supply Chain Security

In order to reduce security risks and ensure hardware and software integrity, Hikvision uses anti-tampering, anti-implantation, anti-replacement and other security management measures during key stages of product manufacturing, such as software provision, chip

burning/calibration, software loading, and production testing. This helps prevent unauthorized hardware replacement, software implantation and tampering, virus infection and other risks. The product data management system takes the software required by the devices and downloads them onto a secure distribution system. Before software is embedded into devices, multiple integrity checks are conducted.

The network used in the supply chain for software burning, software loading, assembly, and testing should be isolated from the company's office IT system and from the Internet.

Automated testing is implemented for Hikvision products. Hikvision uses automated testing to reduce the risk and security threat brought about by human error.

Hikvision has implemented a secure and strict maintenance process to ensure the integrity of products during the process. Information from the entire process is recorded in Hikvision's manufacturing and barcode systems. A detailed executive record and log is kept for the research and development, procurement, manufacturing (chip burning, software loading, assembly, testing, etc.), warehousing, and logistics processes to ensure traceability.

5.5 Security Compliance

The global legal environment is complicated and is constantly evolving, and industry supervision requirements are becoming increasingly complex. Particularly in the field of cybersecurity law, many countries and regions have issued laws and regulations in recent years, for example the EU (General Data Protection Regulation). Security compliance has become a major challenge for Internet of Things service providers. Hikvision strives to establish effective internal control security systems that follow and comply with the requirements of different industries, fields, and countries, while also completing its own compliance foundation in its system processes and control activities.

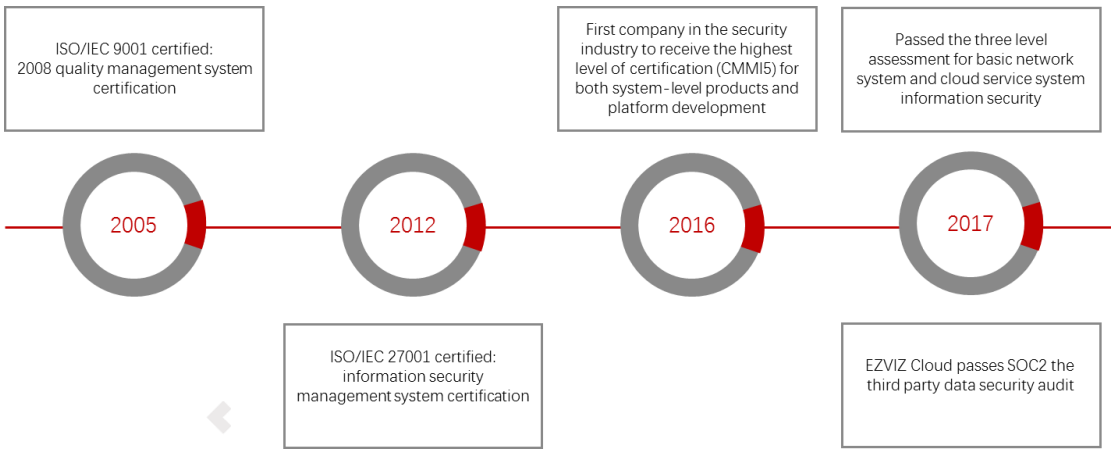
Hikvision has a team of lawyers for the investigation, identification, and tracking of laws and regulations that are applicable to the company. At the same time, Hikvision also actively establishes long-term cooperation with experienced and prestigious law firms domestically and internationally. We have established a dedicated group to integrate the applicable laws and regulations into Hikvision's operations, and to identify and control the legal risks involved in the product development, manufacturing, delivery, and service processes and also to provide compliance advice and support. We continue to conduct special compliance training for new employees, mid and high-level managers, and employees in key

cybersecurity posts as new laws and regulations are issued to improve compliance awareness.

As stated in the "Statement on the Establishment of the Cybersecurity Guarantee System for Video Surveillance Products," Hikvision strives to improve and complete the integrity of our video surveillance security. In addition to abiding by the applicable national and local security regulations, and referencing the best practices within the industry, the company has also established a complete, sustainable, and reliable security system that involves company policy, organization, process, technology, and specifications.

Hikvision supports mainstream international standards, and contributes actively to the formulation of these standards. By late 2016, Hikvision had already joined dozens of domestic and international industrial standards organizations such as TC260[3], TC100[4], CSA[5], and ONVIF[6]. Hikvision has participated in the formulation of industrial security standards which further open key security technologies to work with other industry experts and national standards organizations to perfect security standards related to Internet of Things.

Hikvision also cooperates with independent third-party assessment organizations and staff for fair security assessments and certification.



[3] http://www.tc260.org.cn/
[4] http://www.tc100.org.cn/
[5] Cloud Security Alliance: https://cloudsecurityalliance.org/
[6] Open Network Video Interface Forum: https://www.onvif.org/

ISO/IEC 9001

ISO/IEC 9001: 2008 is currently the world's most well-established quality management system. This system revolves around company products or services, and provides guiding principles and specifications. Making sure company products and services pass the entire quality management structure is fundamental for the company's growth and development.

ISO/IEC 27001

ISO/IEC 27001: The 2013 Information Security Management System is the most authoritative, strict, and widely accepted system certification standard for information security in the world. Passing this certification will mean that a company has already established a scientifically valid information security management system. Together with a unified company development strategy and information security management, it is guaranteed that information security risks will be controlled to an appropriate degree and that appropriate responses will be given. EZVIZ Cloud is the first home-use security cloud service provider in China to receive the ISO/IEC 27001:2013 certification. Using these information security management control measures and the framework for information asset protection, and continuing to follow the PDCA improvement guidelines, we are committed to information security and will provide reliable information services and related security guarantees.

CMMI5 Software Maturity Certification

Capability Maturity Model Integration (CMMI) is an enterprise-level process management framework and a best practice used by the world's top companies. It is recognized by the industry as the authoritative standard for measuring an enterprise's product and service capabilities. It is also a method for improving processes that can help companies achieve commercial goals, ensure quality, guarantee deliveries and improve customer satisfaction levels. There are five maturity levels which companies are assigned in the Software CMMI specifications. Level 5 is the highest level.

Graded Protection of Information Security

The Graded Protection of Information Security Certification is a basic system used for information security protection in China. It serves as a basis for the protection of developments in informing and maintaining national information security. The security protection levels for information systems utilize a five-level grading scale with a maximum

system rating of five. This scale is based on the system's importance in terms of national security, national economy, and society in general; it also considers the potential harm to national security, social order, public welfare, and the potential degree of damage to the legal rights and interests of citizens, legal entities, or other organizations. Level 5 is the highest system rating.

In accordance to the relevant stipulations in the "Administrative Measures for the Graded Protection of Information Security", EZVIZ Cloud and Hikvision's internal information systems have passed the Level 3 grading for information security protection and strictly adhere to the technical guarantees and security management requirements of the national information security standards. They have also established their own long-term mechanisms to guarantee the continuation of security related work in the future.

SOC Audit

System and Organization Controls (SOC) Reports are given by professional third-party accounting firms according to related standards issued by the internal control department of the American Institute of Certified Public Accountants (AICPA).

The SOC 2 report references the AICPA auditing standards of AT-C section 105, 205, and TSP section 100 2017 in SSAE No. 18, and is a report that focuses on security, availability and confidentiality related control designs for cloud service systems.

SOC 2 report: cloud user organizations, independent auditors, supervising organizations, company shareholders, and other stakeholders can use the SOC 2 report to assess the cloud provider's internal control mechanisms (including security, availability, process integrity, confidentiality and privacy).

EZVIZ Cloud passes SOC2 third party data security data security audit.

5.6 Personnel Management

Hikvision aims to create a company-wide culture of security knowledge and awareness. In order to do this, Hikvision has organized general cybersecurity awareness and educational activities and has launched educational activities and training based on various types of cybersecurity knowledge and the skills required by various services. Hikvision will also hold cybersecurity case study classes targeted at the characteristics of surveillance industry.

Hikvision will publish cybersecurity periodicals on its internal notification platform and will also use posters, pamphlets and other methods to spread information about cybersecurity.

Hikvision has identified key posts in regard to cybersecurity for each area of service and has clearly defined key posts for product security.

The following requirements apply to employees in key posts related to product security:

- Before an employee assumes the post, they must pass a background check to ensure that they possess a background and history that matches the clients' needs.

- An employee must pass qualification standards when they assume a post which encourages them to increase their awareness and improve related skills. We will also conduct regular security reviews. The behavior of employees in key cybersecurity positions is investigated to decide whether any violations have occurred.

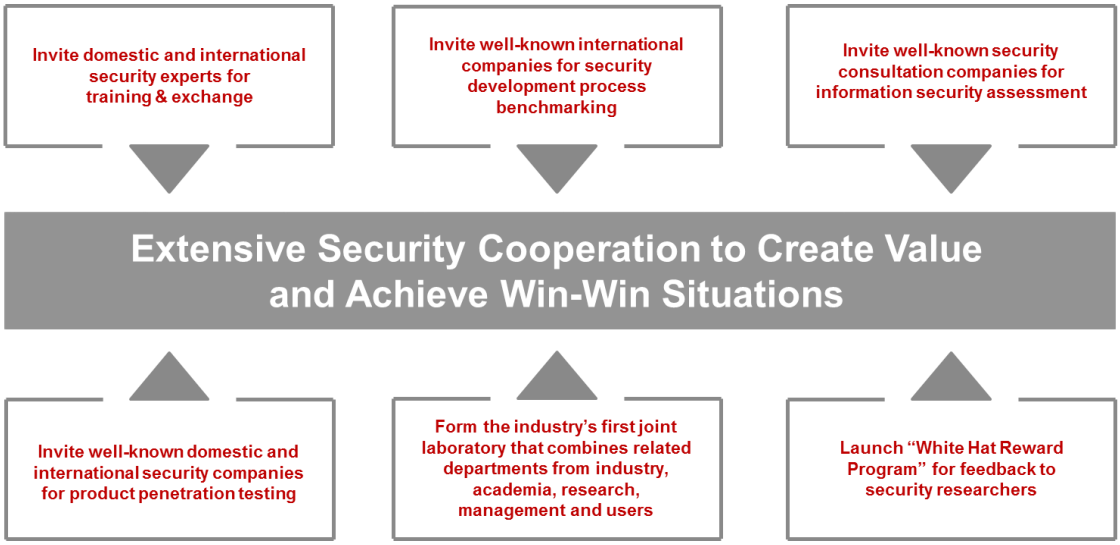
- When an employee leaves their post, the HR and security staff delete or modify the permissions and accounts of the departing employee according to a post-departure review. If necessary, the employee's assets will also be cleared. The post-departure review also applies to transfers and terminations.

In order to improve our staff's technical knowledge so that they can perform their duties effectively, Hikvision has formulated a targeted security improvement plan and baseline course which improves employee cybersecurity capabilities via a learning plan.

The company aims to improve the cybersecurity knowledge and skills of employees in key posts and encourage employees to proactively learn on their own. By launching a broad range of specialized training activities that follow practical guidelines, Hikvision hopes to improve cybersecurity knowledge and the skills of employees in key posts. For example, Hikvision hosts cybersecurity expert seminars, cybersecurity forums and cybersecurity case studies.

We require all of our employees to take technical and legal responsibility for the outcomes of their individual actions. Our employees know that cybersecurity incidents can significantly impact clients, the company and other personnel. Hikvision therefore holds employees accountable for their actions and the outcome of their actions, whether intentional or not.

5.7 Exchange and Cooperation

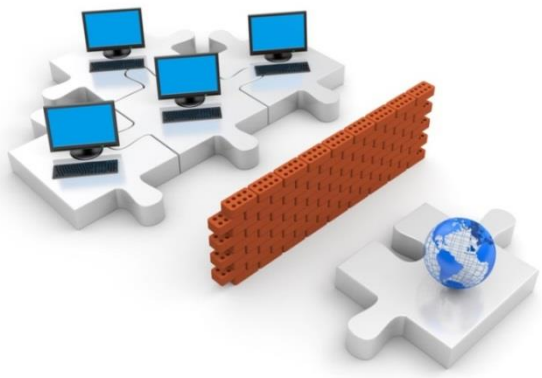


- EY from the United Kingdom was invited to evaluate Hikvision's overall information security practices and to help improve the company's cybersecurity system;
- Cisco's security department was invited to benchmark the company's research and development security management system to ensure Hikvision's R&D security system matches that of world-class companies;
- Hikvision increased exchange and cooperation with domestic and international security companies, such as Synopsys and IBM, to improve the security of the company's products.
- Hikvision invited well-known domestic and international security testing teams for penetration testing on the company's products. Minimizing risks to ensure that they remain within a controllable range;
- Hikvision invited EY from the United Kingdom for SOC2 evaluation and certification for the company's products, to ensure the security and confidentiality of cloud products;
- Hikvision invited well-known domestic and international security experts to offer classes for Hikvision's R&D personnel and to improve their security standards;
- Every year, the Network and Information Security Laboratory holds multiple product security workshops with clients to exchange knowledge regarding emergency response and security requirements, inform clients of new tactics in security, and to better grasp

client requirements;

- The company has also launched the "White Hat Rewards Program" to encourage domestic and international white hat hackers to review Hikvision's information security and give feedback so that Hikvision can continue to improve product security.

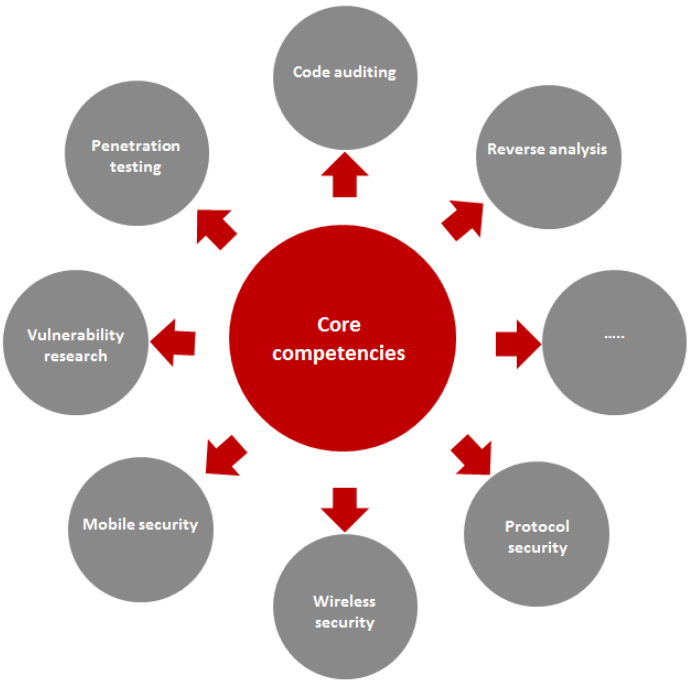
Hikvision also engages in external exchange and cooperation and accepts feedback from stakeholders. Hikvision absorbs advanced techniques and management experience from other surveillance industry leaders and constantly strives to improve the company's information security capabilities.



6.Product Security Research

6.1 Vulnerabilities Exploitation

The Network and Information Security Laboratory focuses on Internet of Things-related security research and practices, including penetration testing, code auditing, reverse analysis, vulnerability research, mobile terminal security, protocol security, and wireless security. Its goal is to discover and fix security issues before hackers do.



Core competencies:

Embedded device vulnerability discovery: combining Hikvision's experience with embedded device security and using firmware reverse engineering, serial port debugging, static analysis and other methods to discover vulnerabilities.

Protocol vulnerability discovery: integrating both commercial and self-developed fuzzy testing tools for vulnerability discovery in mainstream security protocols.

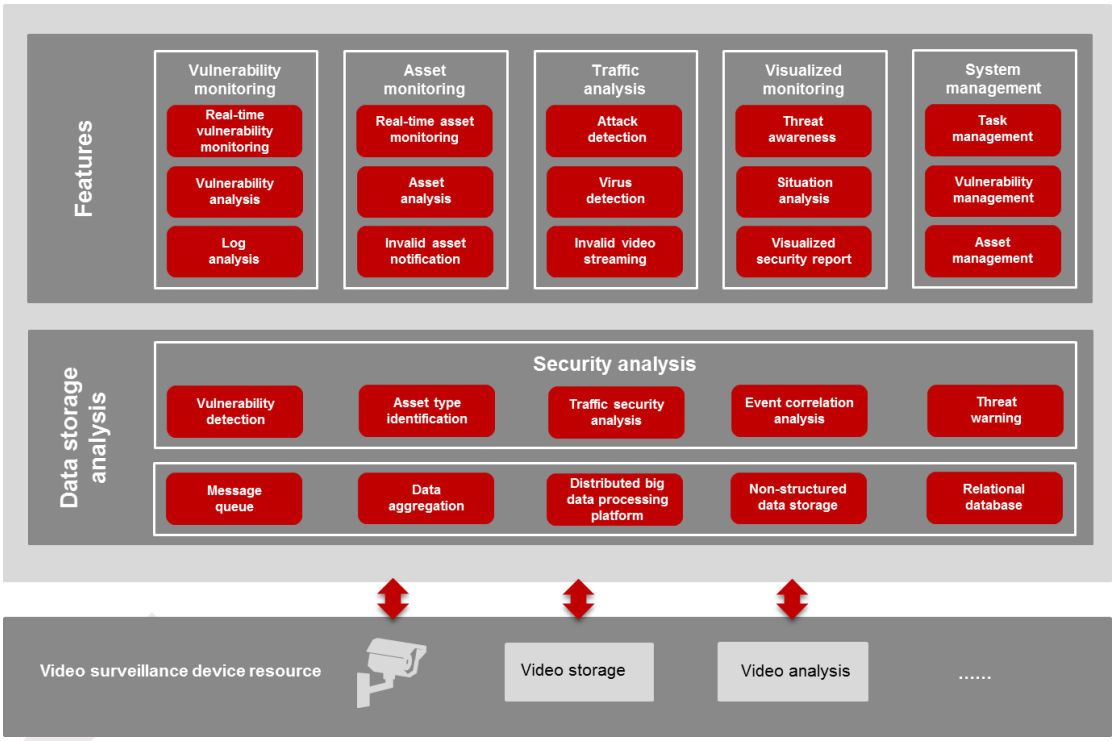
Wireless security research: a team with wireless security testing environment for hardware can simulate wireless data packet eavesdropping, wireless signal replay attacks, wireless signal spoofing attacks, and wireless signal hijacking attacks.

Web security: system integrator tools, self-developed web testing tools, crawler detection and passive proxy technologies are used for penetration testing of the web platform. These tools support the detection of SQL injection, XSS cross-site scripting, sensitive information leakage, command injection and various other types of web security issues.

6.2 Security Situational Awareness

The enormous Internet of Things network system, formed by devices, network, platforms and applications, requires multi-layer protection and cloud-based, smart, big data security analysis capabilities. The implementation of smart security situational awareness, visualization, and security for entire networks will be an emerging trend for the Internet of Things.

Security situational awareness refers to the acquisition, understanding, and display of important security elements that can cause changes in the system state within large-scale system environments.



Vulnerability Assessment

Vulnerability assessment is key to deciding whether or not the security situational awareness system can effectively detect security threats. Hikvision's security situational awareness system incorporates the mainstream industrial vulnerability database and can detect known vulnerabilities. Furthermore, Hikvision has a team of vulnerability researchers who are constantly keeping track of the security announcements by other well-known security organizations and manufacturers, and are constantly analyzing, discovering, and verifying various types of new vulnerabilities. Thanks to the continuing work of Hikvision's professional vulnerability research team, security threats are discovered in a timely manner and remediation measures are taken.

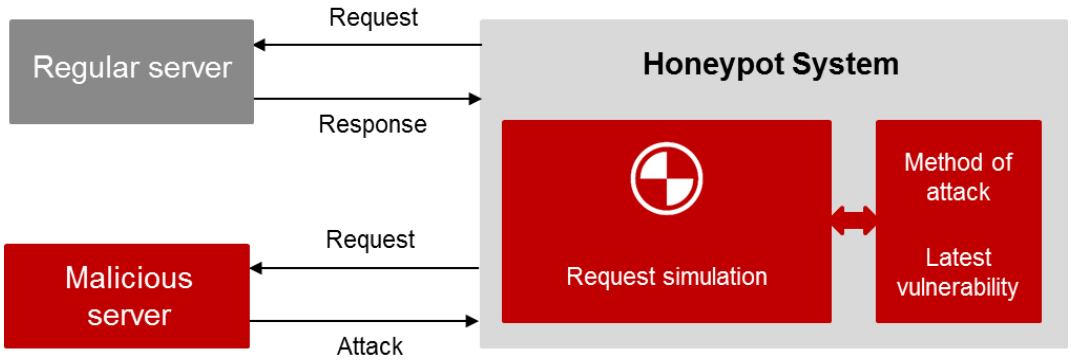
Furthermore, Hikvision's video security situational awareness system can also discover security threats and perform correlation analysis on asset information. By establishing a big data analysis model for dynamic analysis of real-time and historical data, the security status and development trend of the entire network can be accurately and effectively perceived. Reasonable security reinforcements on video surveillance network resources can then be made to ensure the security of the surveillance system.

Visualization of Security

Visualization can directly help in the display of data characteristics and make it easier for the reader to interpret data. Therefore, big data analysis (deep packet inspection, traffic analysis) results require a visualized display.

When a system is under attack, quick identification of the attack source, attack path, and a quick response is required. Effective measures must be taken before the attack causes additional damage. After an attack, measures must be quickly taken to prevent similar attacks from happening again.

6.3 Honeypot



A honeypot is essentially a mechanism for deceiving attackers. Decoy hosts, network services or information are deployed to lure attackers to access them. The attacker's behavior is then captured and analyzed so the attacker's tools, methods and intentions can be identified.

Honeypots can be classified as high- interaction or low-interaction depending on their implementation principle. High-interaction honeypots are usually implemented using an actual operating system or software application. Low-interaction honeypots capture attack behaviors by simulating protocol responses of a regular server.

A high-interaction honeypot operating system can detect various types of intrusion methods such as vulnerability exploitation and weak passwords. Attack samples can also be captured. Low-interaction honeypots can capture attack behaviors such as network scanning and password cracking. Currently, Hikvision deploys primarily high-interaction honeypot operating systems such as Conpot, Mirai, Struts2 and other hotspot honeypots.

7. Commitment to Security

Hikvision strives to use leading privacy and security technologies to protect customers' personal information and to protect user data in comprehensive ways.

Hikvision uses an integrated security infrastructure for its entire Internet of Things video surveillance ecosystem. Hikvision also has a professional security team responsible for providing support on all Hikvision products. This team provides security reviews and testing of released products and products in development. The security team also provides security training and actively monitors new security issues and threat reports. To find out how to report issues to Hikvision and how to subscribe to security notifications, please visit: http://overseas.hikvision.com/en/about_437.html.

Hikvision

Cybersecurity White Paper

See Far, Go Further

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