Minimizing Storage, Maximizing Focus

How Large-Scale AI Drives the Evolution of Encoding To Intelligent Video Understanding

HIKVISION

About the author

An experienced journalist and longtime presence in the U.S. technology marketplace, Larry Anderson is the Editor of leading digital publications SecurityInformed.com and SourceSecurity.com. Mr. Anderson is the websites' eyes and ears in the fast-changing security sector, attending industry and corporate events, interviewing leaders and contributing original editorial content to the two sites. He leads a team of dedicated editorial and content professionals, guiding the editorial roadmap to ensure that SecurityInformed.com and SourceSecurity.com provide the most relevant content for industry professionals. From 1996 to 2008, Mr. Anderson was editor of Access Control & Security Systems magazine and its affiliated websites. He has written numerous articles for and about some of the largest companies in the security industry and has received numerous awards for editorial excellence. He earned a Bachelor of Arts in journalism from Georgia State University with a minor in marketing.

Content

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How Large-Scale AI Drives the Evolution of Encoding To Intelligent Video Understanding

- **By Larry Anderson**

Video encoding involves compressing and converting raw video files into a digital format compatible with various devices and platforms. However, conventional encoding techniques, which treat every pixel equally, are increasingly strained by the explosive growth in video storage, leading to greater demands on infrastructure and rising storage costs.

The next evolutionary step moves beyond encoding alone toward AI-powered semantic analysis. By leveraging large-scale visual AI models, video encoding technologies, such as Hikvision's Guanlan Encoding, can now enable selective compression based on regions of interest (ROI) and adaptive bitrate allocation — drastically reducing storage requirements while retaining essential visual information.

The application of large-scale visual AI models provides multiple benefits for video encoding. This Technology Report, developed by SourceSecurity.com in collaboration with Hikvision, will illustrate how AI-enhanced video encoding technologies are evolving from simple compression to intelligent content understanding.

> ***Video encoding is evolving from uniform compression to intelligent understanding.***

Why Video Storage Is Becoming a Critical Problem

Video storage faces several market challenges in the current business environment, ranging from expensive infrastructure and operational costs to incompatibility and integration issues.

Multiple factors are in play amid pressures to expand systems and manage infrastructure:

Video Storage Explosion:

In the security industry alone, hundreds of millions of cameras generate video 24/7. The shift from standard definition to high definition and now ultra-high-definition imaging, combined with expanding video channels per project and extended video retention periods, is driving explosive growth in video storage.

Higher Costs of Storage Devices:

Hard-drive prices remain unstable, while enterprise budgets for high-capacity, high-reliability storage solutions are steadily climbing, demonstrating a broader upward trend in storage costs across the industry.

"One-Size-Fits-All" Compression:

Conventional encoding applies uniform compression to the entire video stream, regardless of whether it contains non-essential background or critical targets. This lack of differentiation, or "one-size-fits-all" compression, results in significant storage inefficiency. Approximately 70% of surveillance footage is static or provides low-value content, yet this encoded video occupies substantial storage space.

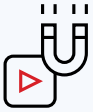
How Mordern Video Security Drives Storage Explosion

ULTRA HD CAMERAS

Higher resolution delivers greater detail, but exponentially increases data per camera.

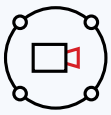
MORE VIDEO CHANNELS

More cameras per project and wider coverage create a massive increase in video streams.



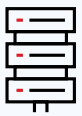
LONGER RETENTION PERIODS

Regulatory requirements and operational needs demand longer storage durations.



24/7 RECORDING

Continuous recording around the clock-every day-produces relentless data.



STORAGE EXPLOSION

The combination of higher resolution, more channels, longer retention, and non-stop recording leads to explosive storage growth.

Without smarter encoding, storage demands will continue to outpace capacity.

What Is AI-Powered Guanlan Encoding Technology?

As video encoding technology is evolving from “uniform encoding” to “intelligent understanding,” large-scale AI models provide complementary advantages to achieve “smart codecs” and region-of-interest encoding, which will help reduce storage costs and ease the pressure of storage challenges in the market.

Hikvision's Guanlan Encoding technology integrates the Guanlan Large-Scale AI Models directly into the encoding pipeline, cutting storage costs by 30%–50% on average without compromising the clarity of critical objects. The technology identifies key targets within a scene, like people and vehicles. Based on various regions in a scene, Guanlan Encoding preserves high-definition details for high-value objects while applying ultra-high compression to less important and redundant background information. In effect, this approach reduces bitrates and achieves "on-demand encoding."

BITRATE SAVINGS

30–50%

Dynamic Scenarios Average

Traditional Encoding (H.265)

Uniform Compression For All Pixels

High Storage Usage

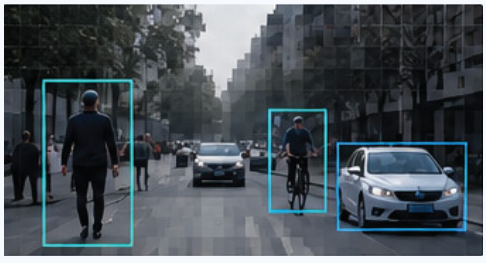
100%

Entire scene encoded equally, wasting storage on low-value areas.

VS

Guanlan Encoding

Intelligent, Region-of-Interest Encoding



Storage Reduction

30%-50%

High-value targets in HD, background compressed aggressively.

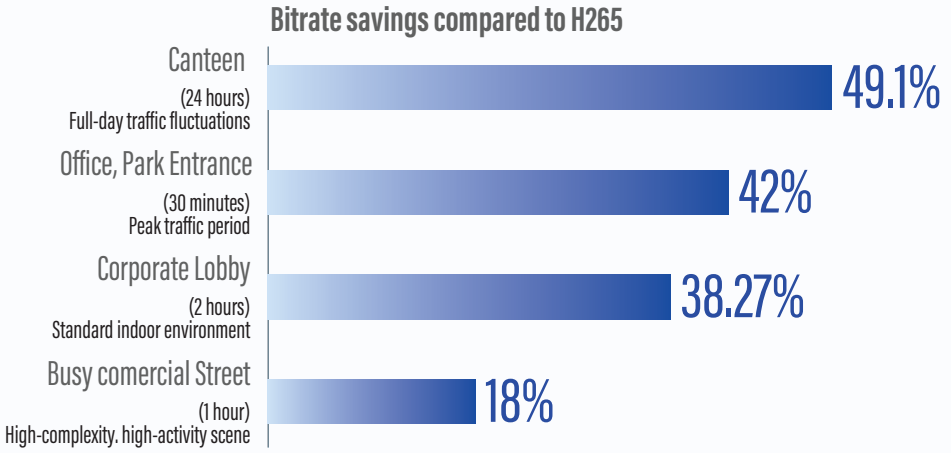
New encoding capabilities deliver positive results across a variety of vertical markets, including banks, campuses, hospitals, enterprise parks, retail, supermarkets, villas, and parking lots.

For applications involving static scenarios, bitrate savings can reach 90%, particularly in a completely static scene, such as an empty conference room. For dynamic scenes, such as park entrances or exits, average bitrate savings range from 30% to 50%, all while ensuring clear image quality for moving objects.

Hikvision's comparative tests between conventional H.265 and Guanlan Encoding in various scenarios confirm consistent bitrate savings:

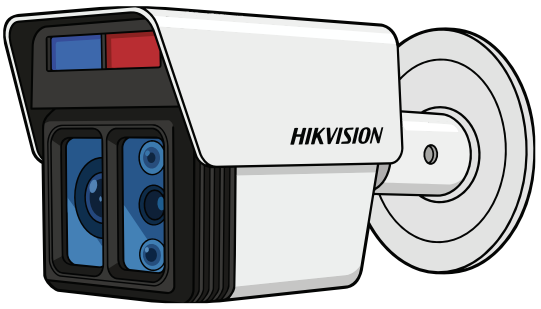
- **Canteen (24 hours):** 49.1% savings across full-day traffic fluctuations
- **Office park entrance (30 minutes):** 42% savings during peak traffic
- **Corporate lobby (2 hours):** 38.27% savings in a standard indoor environment
- **Busy commercial street (1 hour):** 18% savings in a high-complexity, high-activity scene.

REAL-WORLD RESULTS: BITRATE SAVINGS IN VARIOUS SCENARIOS



AI-powered encoding reduces storage costs by up to 50% without sacrificing critical image quality.

How Guanlan Encoding Achieves On-Demand Compression



Conventional encoding technologies treat every pixel equally, forcing operators to choose between higher-definition imagery and more efficient storage. Guanlan Encoding eliminates this dilemma as it looks at the picture first – and then decides what's worth keeping in full clarity.

1

Precise Object Recognition

Powered by large-scale AI models, Guanlan Encoding can precisely identify and classify high-value key objects in a video – such as people, motor vehicles, and non-motor vehicles – while simultaneously tracking their motion trajectories across frames. The model supports simultaneous recognition of 64 or more distinct targets within a single scene, ensuring that no critical object is overlooked even in crowded, complex environments such as busy intersections or stadium entrances.

2

Region of Interest (ROI) Segmentation

Once key objects are identified, Guanlan Encoding technology applies refined region-of-interest segmentation to accurately separate foreground targets from background areas. The quantization parameter (QP) of foreground targets, like people and vehicles, is adjusted with a lower value to ensure complete detail preservation, while non-critical background areas are assigned higher QP values for stronger compression. This intelligent bitrate allocation adjusts only the QP value without altering original pixel content, timestamps, resolution, or frame rate, thus ensuring video information integrity while maximizing efficiency.

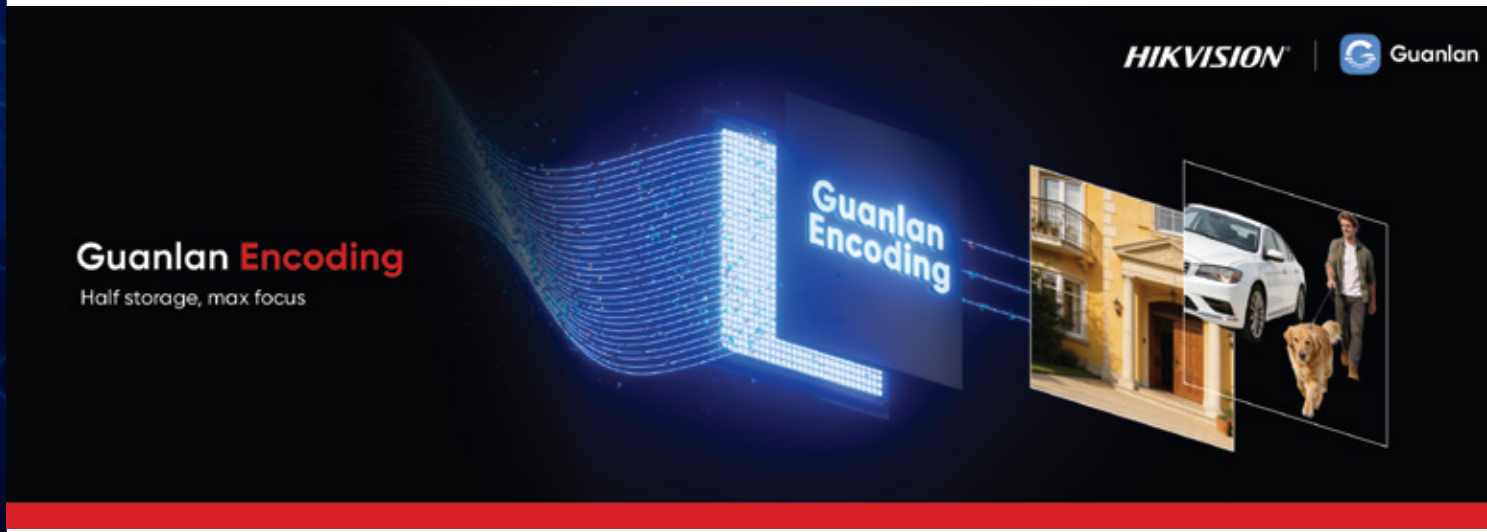
The technology combines two complementary modes. Dynamic Sensing adapts bitrate allocation in real time to preserve detail in complex, fast-moving scenes. Static Optimization applies ultra-high compression to still or low-motion footage, reducing some frames to just a few dozen bytes.

3

Standard Output to Ensure Compatibility

Built upon the H.265 (HEVC) or H.264 international standard, the output of Guanlan Encoding is a compliant standard-encoded video stream that balances image quality and efficiency, while ensuring compatibility with both Hikvision and third-party devices.

Guanlan Encoding uses AI-powered object recognition, ROI segmentation, and intelligent bitrate allocation to preserve critical details, reduce storage requirements, and maintain full compatibility with industry-standard video systems.



Core Benefits of Intelligent Video Encoding

"Intelligent video understanding" provides quantifiable benefits for systems:

Saving 30% to 50% Storage on Average

As an example, consider a project scale of 2,000 video channels (1080P @ 2Mbps) with 90-day retention. Compared to traditional encoding, Guanlan Encoding reduces hard drive requirements by 50% (from 403 to 202 units). This translates to a 50% savings in hardware, rack space, and electricity costs over 5 years, significantly lowering project costs while achieving cost reduction without efficiency loss.

Preserving HD Details of Key Objects:

Powered by precision region-of-interest segmentation, high-definition details are preserved for dynamic subjects such as people and vehicles, while static backgrounds undergo ultra-high-ratio compression, significantly reducing bitrates. In contrast, traditional compression methods treat the entire scene uniformly – applying the same level of compression to both dynamic subjects and static backgrounds alike. This often blurs critical targets, degrading the accuracy of downstream AI analytics. Guanlan Encoding eliminates this trade-off, ensuring key details stay sharp and enabling true encode-on-demand.

Bandwidth Savings:

By prioritizing critical content, intelligent video understanding enables high-definition video over SD bandwidth, lowering bandwidth consumption during both video transmission and review. For remote viewing, users can access HD-level detail of key targets using far less bandwidth than conventional streaming, ensuring critical information remains accessible even over constrained networks.

Legacy Compatibility

Analog cameras can be connected directly to the new technology without replacing platforms or devices, simply by connecting to a Guanlan Encoding DVR. There are no special requirements for camera parameters.

Deployment Flexibility

Front-end and back-end do not need to be matched exclusively. For new projects, Guanlan Encoding front-end cameras are recommended. For renovation projects utilizing existing cameras, deploying Guanlan Encoding back-end equipment offers the highest cost-performance ratio. Guanlan Encoding is designed to promote integration, including compatibility with legacy systems and flexible deployment in new projects.

50% Storage Reduction

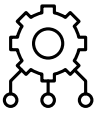
Cut infrastructure and operating costs.

HD Quality Retention

Preserve critical object details

Bandwidth Efficiency

Reduce network load during transmission.



Legacy Integration

Leverage existing camera investments

> ***The most efficient video is not the smallest file, it's the smartest one."***

Hikvision Product Portfolio with Guanlan Encoding

Guanlan Encoding provides better video compression across Hikvision products from a wide range of cameras to digital video recorders (DVRs). It is a versatile technology deployed at multiple points in the video lifecycle to maximize efficiency:

At the Edge (Cameras)

Guanlan Encoding is integrated into Hikvision DeepinView(X)-Series Network and PTZ Cameras, Ultra-Series Cameras, and Cameras with ColorVu 3.0, with continued expansion to more product lines. At the edge, it enables intelligent encoding immediately at the source, saving bandwidth during transmission.

At the Recorder (DVRs)

Available in digital video recorders, the system allows customers to apply Guanlan's intelligent compression to video streams from legacy analog cameras that may not have the feature, thus protecting existing investments.

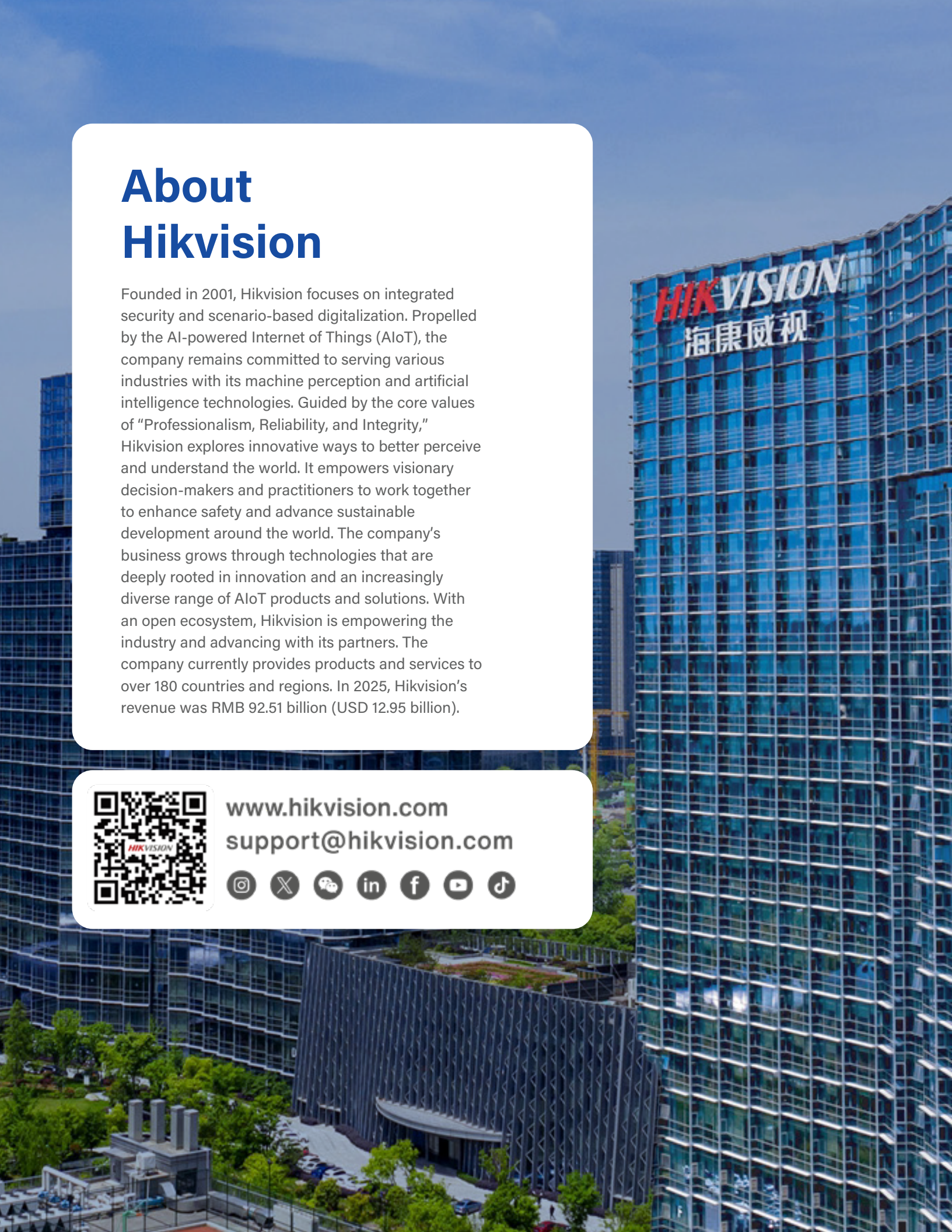
Whether deployed in cameras or DVRs, Guanlan Encoding transforms video efficiency from the source to storage.

Market Impact: From Passive Recording to Intelligent Encoding

AI-driven intelligent video encoding is set to fundamentally transform the security market. By embedding active intelligence directly into the encoding process, the technology enables the industry to transition from passive, uniform recording to proactive, content-aware storage. Benefits include lower operational costs, real-time bandwidth optimization, and greater forensic accuracy. Together, they shift video encoding from a one-size-fits-all solution toward an intelligent, encode-on-demand approach.

Intelligent video encoding uses AI to optimize storage, bandwidth, and video quality, enabling a shift from traditional recording to content-aware, encode-on-demand video security.

*AI-powered encoding transforms video storage from passive recording to **intelligent** understanding.*



About Hikvision

Founded in 2001, Hikvision focuses on integrated security and scenario-based digitalization. Propelled by the AI-powered Internet of Things (AIoT), the company remains committed to serving various industries with its machine perception and artificial intelligence technologies. Guided by the core values of "Professionalism, Reliability, and Integrity," Hikvision explores innovative ways to better perceive and understand the world. It empowers visionary decision-makers and practitioners to work together to enhance safety and advance sustainable development around the world. The company's business grows through technologies that are deeply rooted in innovation and an increasingly diverse range of AIoT products and solutions. With an open ecosystem, Hikvision is empowering the industry and advancing with its partners. The company currently provides products and services to over 180 countries and regions. In 2025, Hikvision's revenue was RMB 92.51 billion (USD 12.95 billion).

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