Hanwha Vision

White Paper

WiseStream
Advanced Video Data Reduction Technology

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1. Introduction

2. WiseStream Overview

2.1. AI-Based Object Detection and Selective Video Quality Control

3. WiseStream Architecture and Performance

3.1. WiseStream Mode Configuration

3.2. Data Size and Bitrate Reduction

3.3. Synergy with Wisenet 9 SoC

4. Conclusion

1. Introduction

The proliferation of high-resolution cameras and increased video encoding frame rates has led to an exponential growth in data generated by modern video surveillance systems. This surge places a substantial strain on data storage, network bandwidth, and processing infrastructure, directly contributing to elevated system deployment and operational costs. Consequently, the development of technologies that can effectively reduce data size while preserving video quality has become a critical imperative for the sustainable advancement of the video surveillance industry.

In response to this challenge, Hanwha Vision has consistently refined its data reduction technology, 'WiseStream.' This technology has transcended the limitations of conventional motion-detection-based methods. By leveraging AI to identify key objects within a video precisely, the technology intelligently optimizes image quality in areas of interest, thereby achieving a significant reduction in video data size.

This white paper provides a comprehensive overview of WiseStream's AI-based object detection, its mechanism for intelligent quality control and data reduction, and a detailed analysis of its performance and benefits in practical applications.

2. WiseStream Overview

WiseStream is an intelligent video compression technology that integrates Hanwha Vision's proprietary AI into the video encoding process. This addresses the dual objectives of **data efficiency and video quality** simultaneously, transcending the limitations of conventional compression methods. By preserving the essential value of surveillance footage while mitigating infrastructure burdens, WiseStream represents a significant step forward in video management.

2.1. AI-Based Object Detection and Selective Video Quality Control

The integration of AI in video surveillance has shifted the paradigm from mere data recording to the intelligent extraction and management of meaningful information. WiseStream directly applies these AI advantages to the video encoding process. An embedded AI engine performs real-time detection of key objects (e.g., people, faces, vehicles) and utilizes this information to selectively control the quality of the video stream.

Conventional data reduction techniques typically adjust compression based on general motion across the entire frame. While this approach maintains high quality in active areas and increases compression in static ones, it is inherently inefficient. It often dedicates high-quality encoding to background motion that is irrelevant to the actual subjects of interest. WiseStream addresses this inefficiency through its AI-driven methodology.

Here's how WiseStream's core mechanism works:

- **AI Object Detection**: An AI model precisely identifies user-defined key objects, such as people and vehicles, within the video stream. (See Figure 1)
- **Differential Quality Application**: The Region of Interest (ROI), where objects are detected, is encoded at a high quality to preserve detail. In contrast, the Non-ROI is subjected to a higher compression rate to reduce data volume. (See Figure 2)
- **Efficient Static Area Compression**: The system’s AI-based analysis minimizes unnecessary data generation in static areas, ensuring efficient compression of the entire scene.

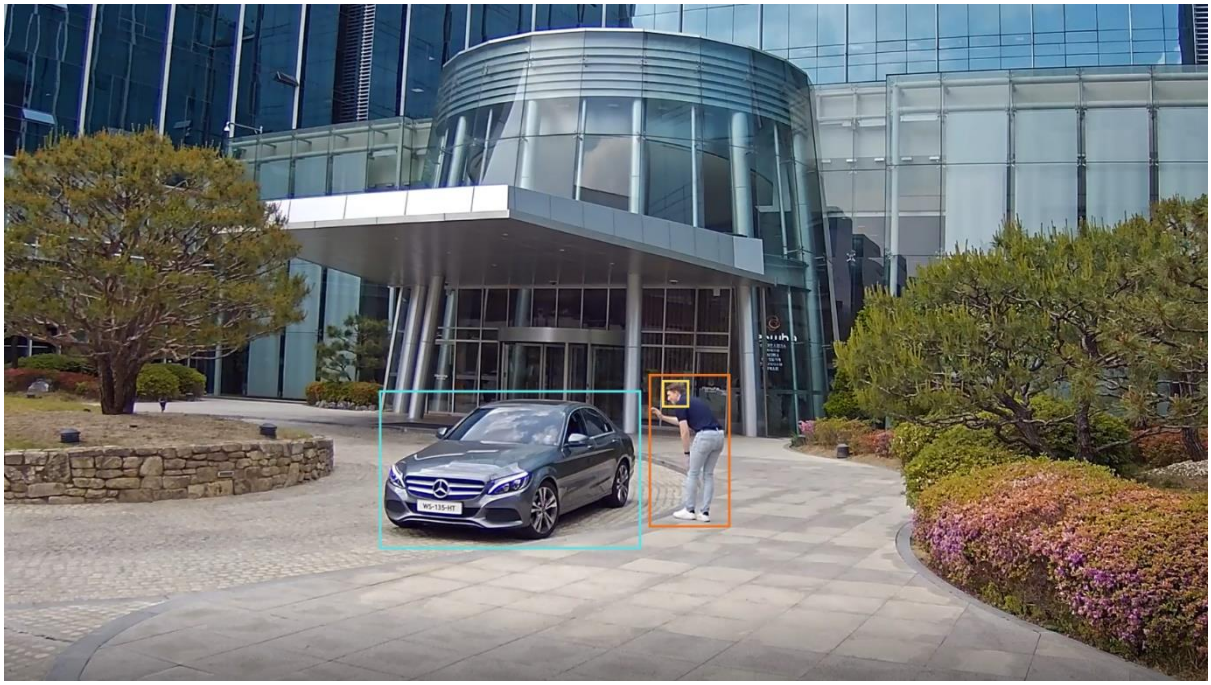

Figure 1: Example of AI Object Detection

Figure 2: Selective Quality Control Using Object Information

3. WiseStream Architecture and Performance

WiseStream provides flexible configuration options for data control, allowing users to fine-tune settings based on specific surveillance environment requirements, desired video quality, and available network bandwidth. This flexibility ensures an optimal balance between data efficiency and image quality.

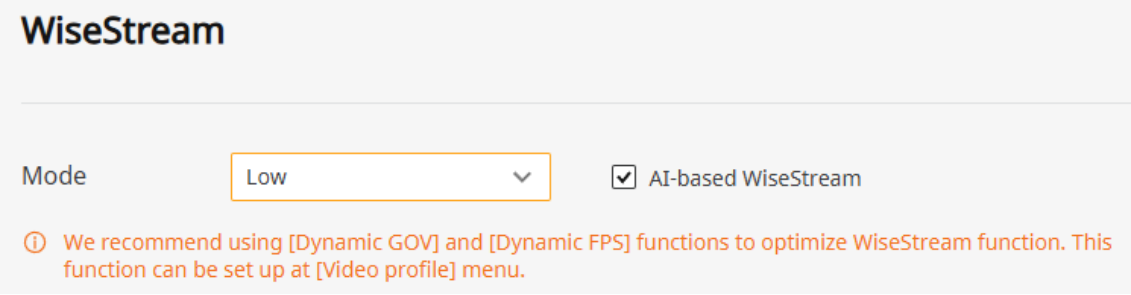

Figure 3: WiseStream Mode Option

3.1. WiseStream Mode Configuration

WiseStream offers two primary operational modes, depending on the activation of its AI features, along with a range of granular compression levels.

- **AI-Based WiseStream Activation**
  - **Off Mode**: In this mode, data reduction relies exclusively on conventional motion detection. The AI object detection function is disabled.
  - **On Mode**: This mode operates based on AI object detection. It prioritizes the preservation of image quality within AI-identified object regions while increasing compression in other areas to maximize data efficiency. (Note: Use of the AI-based WiseStream feature requires the Hanwha Vision WiseAI app to be installed.)

- **WiseStream Compression Levels**

  WiseStream offers four distinct compression levels (Off/Low/Medium/High) to enable precise control over data reduction.
  - **Off Mode**: The WiseStream function is fully disabled, and video is encoded using a standard method.
  - **Low/Medium/High Modes**: These modes apply varying degrees of data reduction based on the complexity of objects and motion. The level of data control is determined by the proportion of key objects detected in the video. Generally, when the ROI is smaller, the data reduction effect is more pronounced. The actual data reduction can fluctuate based on the specific characteristics of the video (e.g., motion, complexity). In scenes with high motion and complexity, the maximum data reduction for each setting may

be lower than the target, and the non-ROI areas may exhibit a higher degree of blurring.

3.2. Data Size and Bitrate Reduction

Performance validation was conducted by comparing video streams encoded in Off and High modes using an identical source.

Qualitatively, as shown in Figure 4, the High mode preserved sharp image quality in the ROI (the person), while the non-ROI (the mounting plate for security cameras) was subjected to blurring to maximize data reduction.

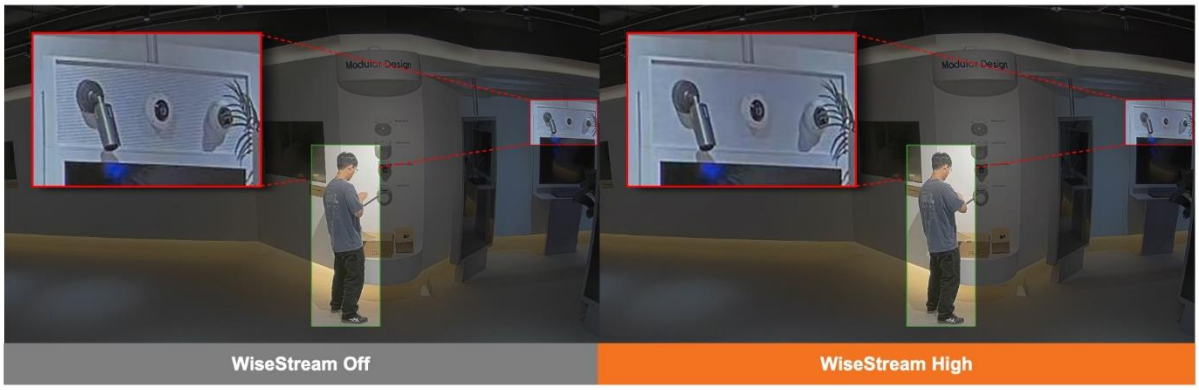

Figure 4: Quality Comparison between WiseStream Off and WiseStream High

Quantitatively, the bitrate analysis presented in Figure 5 demonstrates **an average data size reduction of 52%**, underscoring WiseStream's exceptional data efficiency. The two curves exhibit a similar trend in bitrate fluctuation in response to video content changes. However, the WiseStream High mode maintains a significantly lower overall bitrate, indicating that its AI-driven compression of the non-ROI intelligently adapts to video complexity.

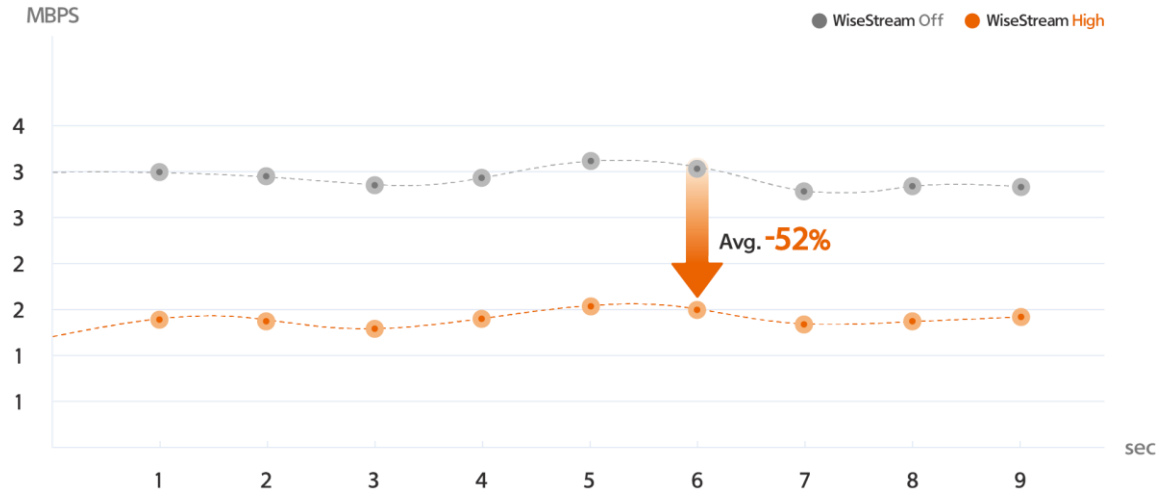

Figure 5: WiseStream Off and WiseStream High Bitrate Comparison

The bitrate reduction effect is directly correlated with the WiseStream mode setting, showing a greater reduction as the setting progresses from 'Low' to 'High'. This effect is most pronounced in videos with fewer objects, as the increased compression of the non-ROI contributes more significantly to the overall data size reduction.

Number of Objects	WiseStream Mode	Bitrate Reduction
	Off	-
	Low	23%
	Medium	26%
	High	42%
	Off	-
	Low	**24%**
	Medium	**31%**
	High	**52%**

Table 1[1]: Bitrate Reduction Based on the Number of Objects and WiseStream Mode

Furthermore, **the simultaneous use of Dynamic GOV (Group of Video)[2] and Dynamic FPS (Frames Per Second)[3] options can provide additional bitrate reduction benefits**. These options are particularly effective in static environments with minimal motion.

Number of Motions	WiseStream Mode	Dynamic GOV(480)	Dynamic FPS(1)	Bitrate Reduction
	Low	Off	Off	24%
	Low	**On**	Off	**37%**
	Low	**On**	**On**	**44%**

Table 2[4]: Synergy with Dynamic GOV and Dynamic FPS Settings

[1] These values are relative to the specific test environment and video characteristics and are subject to change based on actual deployment conditions (e.g., camera settings, video complexity).
[2] This technology dynamically adjusts the GOV length during video compression based on content. For scenes with minimal motion, the GOV length is extended to reduce data volume. Conversely, for scenes with high motion, the GOV length is shortened to maintain image quality and real-time responsiveness.
[3] This technology adjusts the video's FPS in response to the surveillance environment or system load. It records video at a lower FPS during normal conditions to conserve storage space and automatically increases the FPS when motion or an event is detected.
[4] These values are relative to the specific test environment and video characteristics and are subject to change based on actual deployment conditions (e.g., camera settings, video complexity).

3.3. Synergy with Wisenet 9 SoC

WiseStream's performance is further enhanced in products equipped with the Wisenet 9 SoC (System on a Chip). The Wisenet 9's AI Noise Reduction technology effectively eliminates video noise, enabling WiseStream to analyze essential information more accurately and reduce extraneous data. This prevents unnecessary data increases caused by noise, thereby boosting WiseStream's bitrate reduction efficiency.

Additionally, Wisenet 9-equipped products apply a technology that minimizes data generation in areas without motion. By efficiently reusing images from previous frames in static scenes, it eliminates the need for repetitive pixel data transmission. **This significantly reduces redundant data transfer while minimizing image distortion, resulting in clearer and more efficient video management**.

4. Conclusion

The escalating volume of video data in surveillance systems makes efficient data reduction a critical necessity. Hanwha Vision's WiseStream is an innovative solution that addresses this need. By integrating AI-based object detection into the video encoding process, it successfully preserves the clarity of key areas of interest while achieving a remarkable reduction in overall data size.

In environments with limited temporal and spatial complexity, WiseStream can deliver an outstanding data reduction effect of up to 80%. This goes beyond simple data savings and offers tangible benefits in real-world surveillance scenarios:

- **Reduced Infrastructure Costs**: Lowers system deployment and operational costs by decreasing the demand for storage and network bandwidth.
- **Enhanced System Scalability**: Provides the flexibility to add more high-resolution cameras to an existing network infrastructure.
- **Extended Video Storage**: Enables a significantly longer video retention period using the same recording devices, which satisfies legal and analytical requirements.

By delivering both superior image quality and exceptional data efficiency, Hanwha Vision WiseStream is positioned as a foundational technology for enhancing the performance and cost-effectiveness of modern video surveillance systems.

Hanwha Vision
13488 Hanwha Vision R&D Center,
6 Pangyo-ro 319-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, Korea
www.HanwhaVision.com