Dallmeier

TRANSMITTING VIDEO STREAMS USING MINIMAL BANDWIDTH

How smart technologies can manage bandwidth efficiently

PRACTICAL GUIDE

See more.

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1. INTRODUCTION: THE TECHNICAL FALLACY

These days, powerful gigabit internet connections exist at many sites all over the world to enable remote data transfer for an enormous range of applications. Such applications also include video surveillance with IP cameras.

Can companies now neglect the „bandwidth" aspect when it comes to transmitting streams from IP surveillance cameras?

From our decades of experience with video security projects, we have to say: Unfortunately, no!

Because practice shows: In many video security projects, customers want, for example
- Monitor many company sites worldwide
- Secure remote locations with poor Internet connections
- or monitor divisions with poor network infrastructure

The effectively usable bandwidth is therefore often not sufficient to transmit the video streams of the surveillance cameras in high resolution.

This practical guide would therefore like to show how businesses
- can efficiently transmit video streams using IP-based technologies
- intelligently manage the high volume of data that high-resolution cameras generate in the network
- and use this knowledge for their purchasing decisions

2. WHO IS THIS DOCUMENT AIMED AT?

This practical guide is intended to be used by:
- Corporate security managers
- Staff with responsibility for IT- and cybersecurity
- Planners of video surveillance projects
- Installers of video surveillance projects
- Budget managers for video surveillance

3.   SCENARIOS AND REQUIREMENTS

3.1   FREQUENT REAL-WORLD SCENARIOS

Surveillance managers want to access video systems from remote or local neighbouring divisions from the corporate headquarters – both for video monitoring and for management tasks.

Another challenge may be to connect the corporate headquarters to a service control centre or security centre.
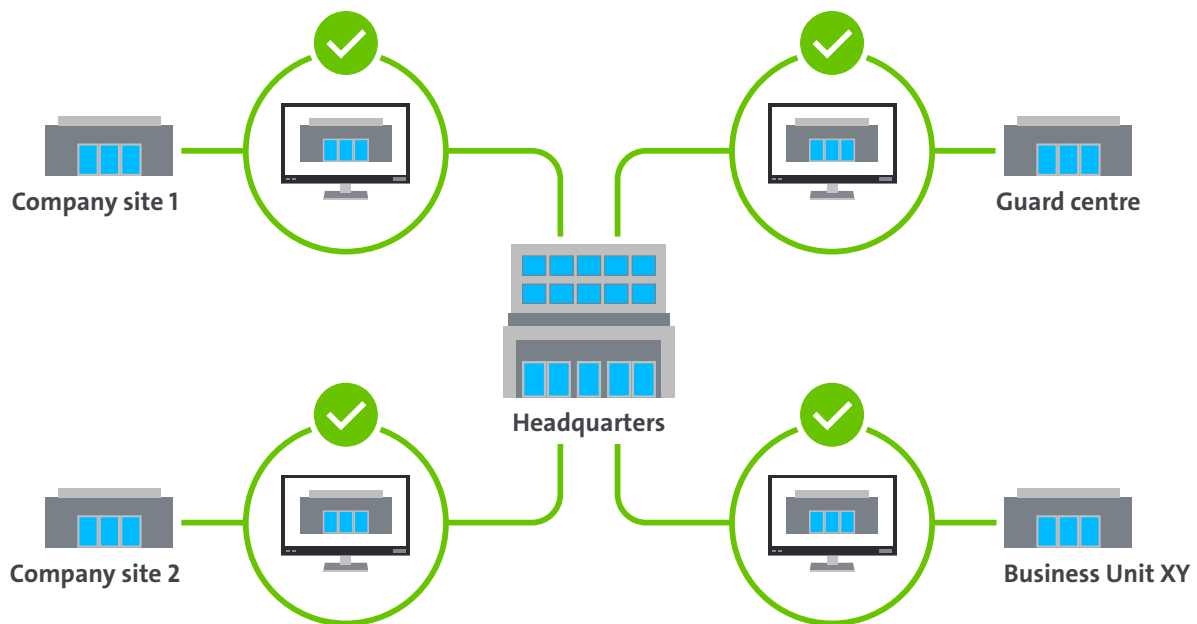

Figure 1 Different application scenarios and access types in video surveillance

In practice, however, this activity is often beset with problems:
- Company sites have poor internet connectivity or network infrastructure
- Surveillance cameras with high resolution and frame rate require a lot of bandwidth
- IT managers must prioritise or limit the available bandwidth for IP applications (data, voice, video)
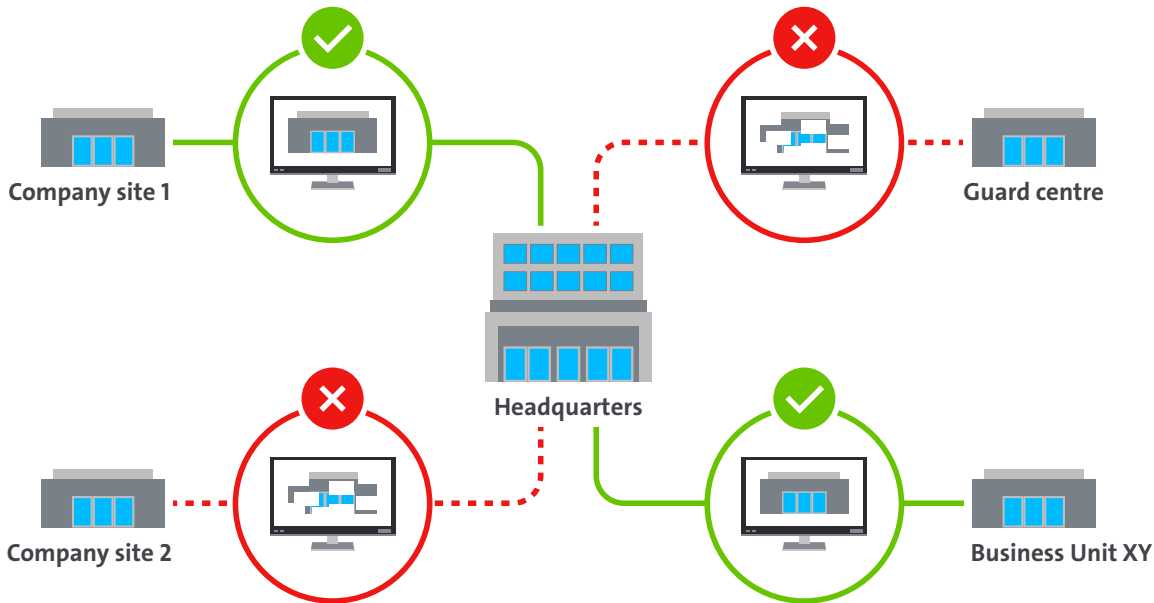
Figure 2 Possible bandwidth-related problems with video surveillance

3.2 REQUIREMENTS ACCORDING TO DIN EN 62676-4

The standard DIN EN 62676-4 „Video surveillance systems for security applications" defines about the transmission of video streams in chapter 8.1.1:

A video can be transmitted and used either as an analogue or digital data stream, and it can be compressed or uncompressed. Each type of video can be converted to another. Conversions shall be kept to an absolute minimum to preserve video quality throughout the VSS. [...]
*The purpose of the transmission subsystem in a VSS installation is to **provide reliable transmission** of video signals between the various VSS facilities in security, safety, and surveillance applications. [...]*
Currently, there are different types of video and ways of transmitting video: analogue, digital and IP, compressed and non-compressed, standard resolution and high resolution, dedicated and shared connections, wired or wireless, short distance, long range, and long distance.

In summary: The standard demands a reliable transmission of video streams – even at high resolutions.

The following chapters present various technologies that have proven themselves in practice to meet these requirements and to transmit video streams in a bandwidth-saving manner.

4. SOLUTIONS

4.1 VIDEO COMPRESSION WITH H.265 (HEVC)

High Efficiency Video Coding (HEVC) is a standard for coding video content. It reduces the data width required by as much as 50% compared to a H.264 stream without loss of resolution or image quality.

In conjunction with suitable recording systems, it is possible to reduce the network load and the required storage capacity – and costs for storage – substantially. Cameras and recording systems from many manufacturers already support video compression with H.265.

Additional optimisation potentials besides the use of the regular H.265 encoding standard result in the course of a dynamic and intelligent control of the encoding process, e.g. through:
- intelligent iFrame management (Dynamic GOP)
- dynamic frame rate/frame management (Dynamic FPS)

The goal and result are an optimal balance or intelligent trade-off between video quality, frame rate and compression on the one hand and bandwidth requirements in the form of the bit rate on the other.

Another bandwidth-determining parameter besides video compression/codec is the video bitrate mode. It controls how the bit rate of the video stream should react to changes in the complexity and movement of the scene. Here, a distinction is made between, for example, CBR (constant bit rate) or VBR (variable bit rate).

If the IP video components used also support the industry standard „ONVIF Profile T"[1], it is then possible to use video compression with H.265 regardless of the manufacturer.

Profile T was designed for IP-based video systems. Profile T supports video streaming functions such as the use of H.264 and H.265 coding formats, image settings and alarm events such as motion and sabotage detection. The prescribed functions for devices also include onscreen display and streaming of metadata, while PTZ control is also one of the prescribed functions for clients.

[1] https://www.onvif.org/profiles/profile-t/

4.2 EDGE STORAGE

An excellent solution to reduce the network load is offered by „Edge Storage" systems. Edge storage allows video streams to be recorded directly onto an integrated SD card or – even better – onto an SSD storage system. This allows the system operator to view live video images in the required resolution, while the video stream is recorded in high resolution locally on the camera via SD card or on an SSD storage.

In the event of an incident, the video stream can be retrieved from the central Video Management System (VMS).
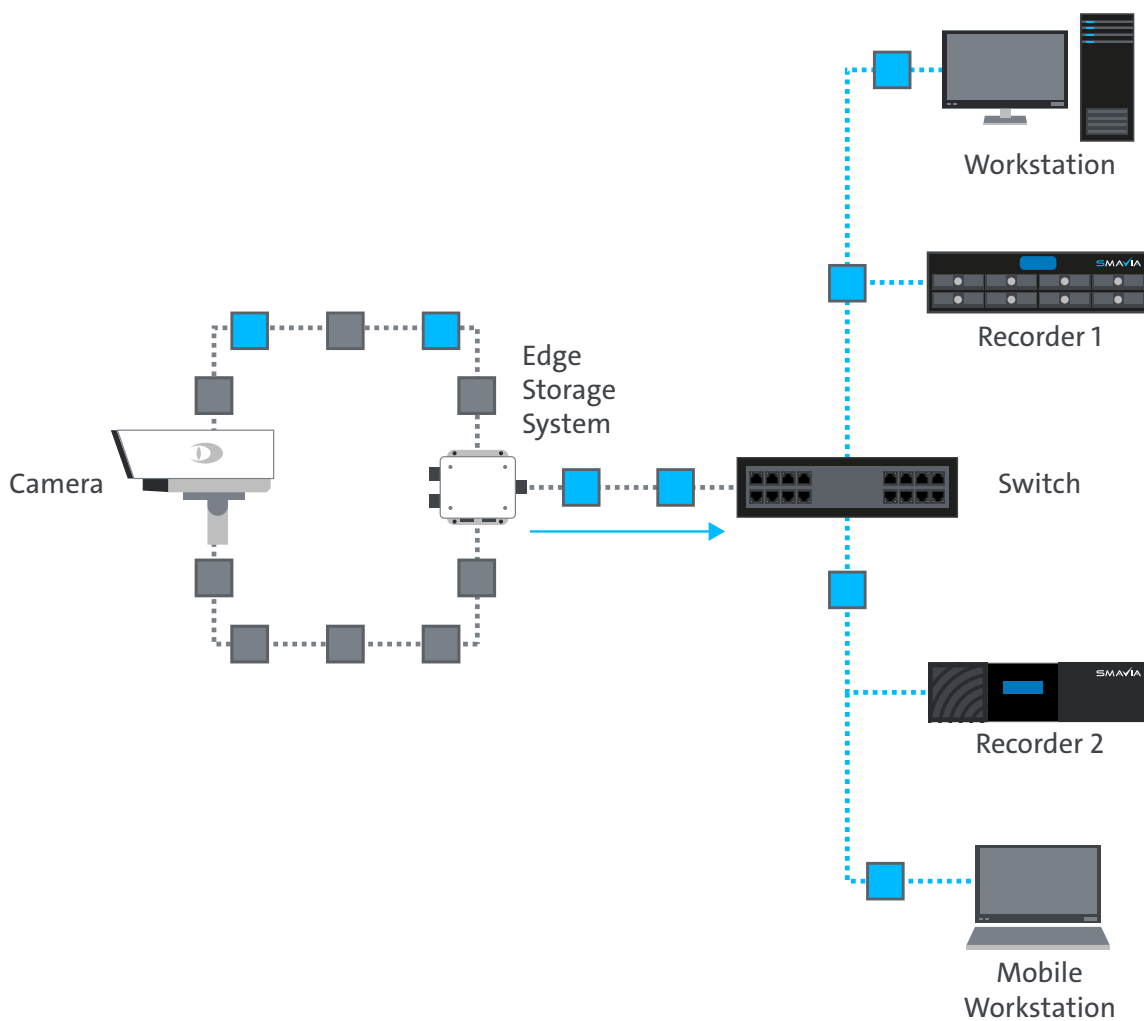

Figure 3 Edge Storage offers advantages in terms of bandwidth, storage requirement and cybersecurity

Figure 4 Edge storage systems can vary, here a high-end version for a Dallmeier Panomera® multifocal sensor system with the Mountera® mounting system

4.3 MULTICAST PROTOCOL

Multicast is the term used to describe a connection consisting of a device (encoder, camera) which transmits image data to multiple receivers (decoders). This allows the video images from one camera to be sent to many users at the same time without the need to send the data across the network multiple times.

Thus, multicast can considerably reduce the volume of network traffic that is normally generated by repeatedly displaying the same camera images.

Users log on using the Internet Group Messaging Protocol (IGMP). The network components involved (e.g., routers or switches) ensure that as far as possible only the multicast streams which are needed are transmitted.

Use of multicast based on the example of „Dallmeier Panomera®" cameras
Thanks to the multicast capability of the Panomera® cameras, several users can view video images simultaneously without having to send the data several times over the network. This significantly reduces the bandwidth required.
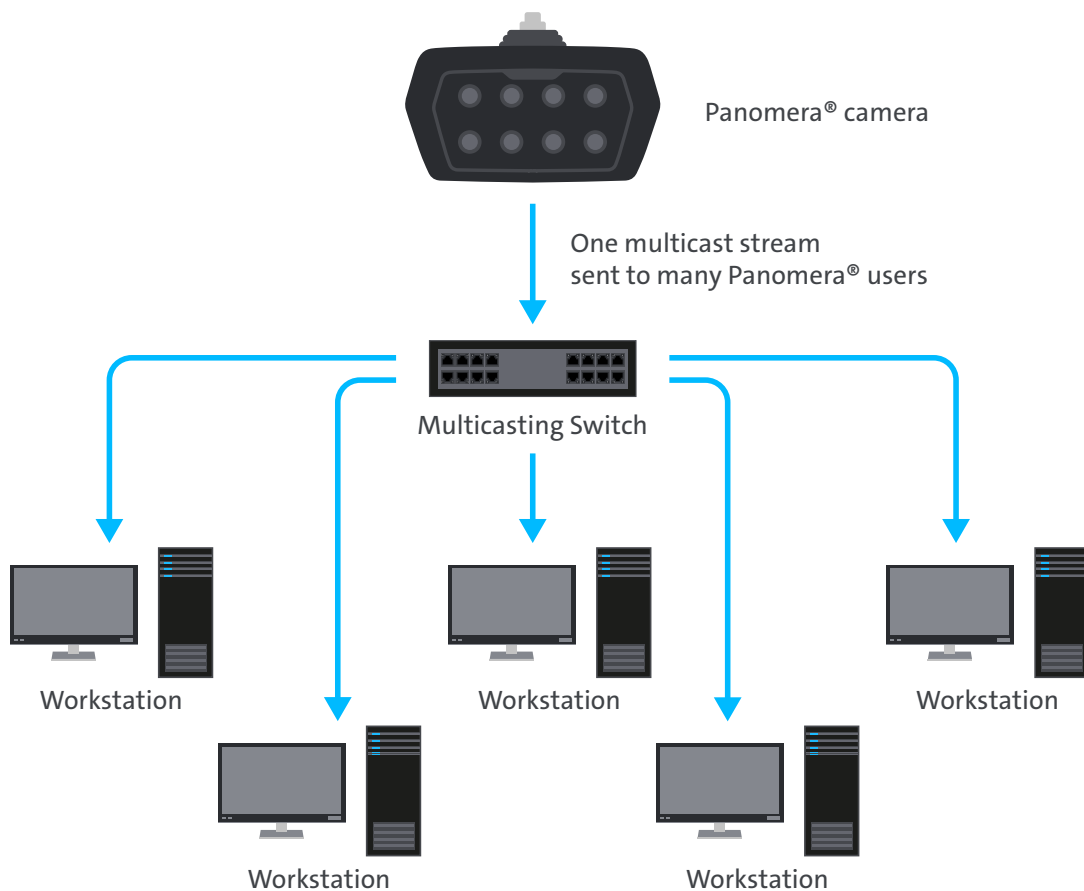

Panomera® camera

One multicast stream
sent to many Panomera® users

Multicasting Switch

Workstation Workstation Workstation

Workstation Workstation

Figure 5 Multicast makes it possible for multiple users to view camera images at the same time without the need to transmit the streams multiple times.

4.4   QUALITY OF SERVICE

Quality of Service (QoS) describes intelligent network strategies which divide the available bandwidth up logically for use by different applications, for example data, voice, and video.

The use of QoS in video surveillance helps to avoid the negative consequences of limited bandwidth such as long latencies, deteriorated and jerky video streams, lost frames, artefacts or even camera shutdowns.

Users typically implement QoS whenever they access IP applications such as IP-based video surveillance and Voice over IP (VoIP) telephones via the same network as conventional data traffic (file transmissions, internet use etc.). The use of QoS on dedicated networks is less beneficial.

Methods and prerequisites for Quality of Service
- All network switches and routers must support QoS to guarantee end-to-end functionality
- The IP video components used must be QoS-capable
- The method most widely used today for implementing QoS is DiffServ (short for Differentiated Services), the prioritised transmission of the video stream with DSCP (Differentiated Services Code Point)
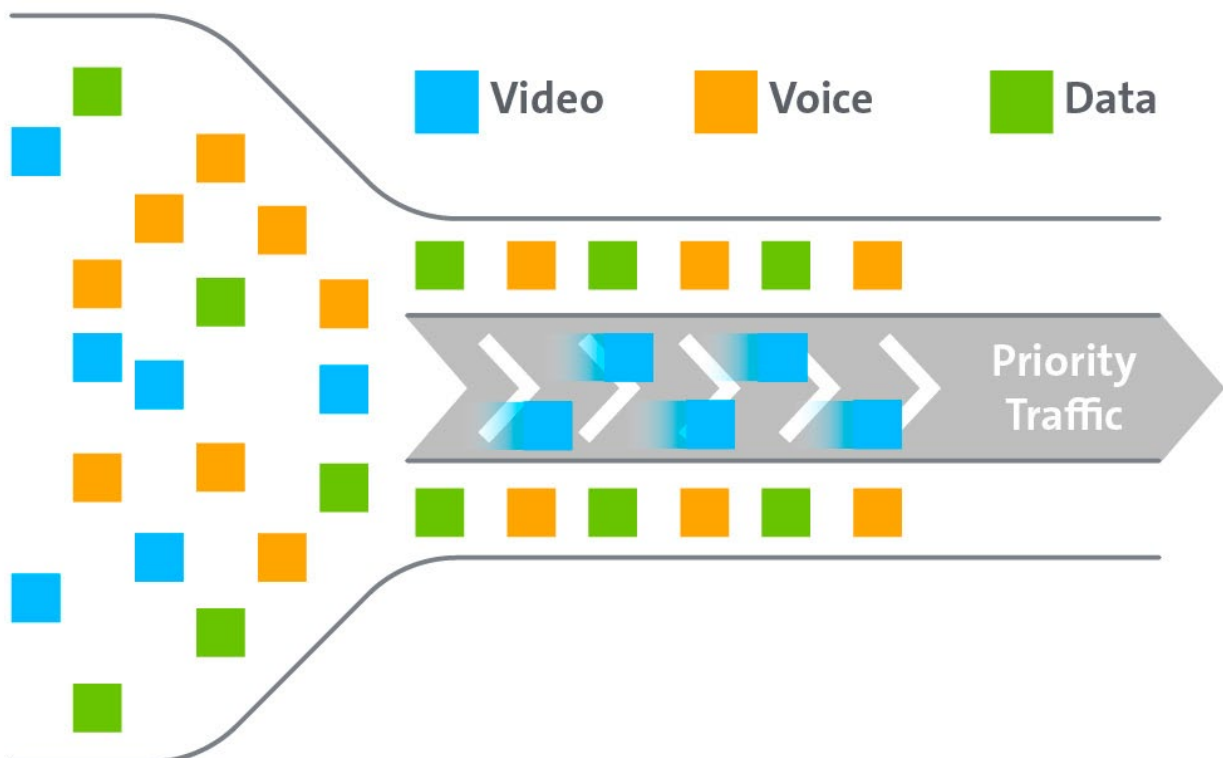- Further information: Dallmeier Handout on "Quality of Service"

Figure 6 Quality of Service can prioritise certain data streams in the network

4.5   MANUFACTURER-SPECIFIC TECHNOLOGIES

Some manufacturers of IP video products also offer proprietary technologies that have been specially developed for minimising bandwidth use when transmitting video streams. The unique transmission procedure developed by Dallmeier is called PRemote HD and uses „dual streaming". Here, an encoder generates two streams, of which one (high resoluti- on) is used for recording and the other (low resolution) is used for live transmission.

The feature of PRemote HD is that a specially developed transcoding procedure enables image material to be transmitted with minimum bandwidth use – not only for the recording but also for live review. Moreover, it is also possible to analyse the high-resolution recordings subsequently while using minimum bandwidth.
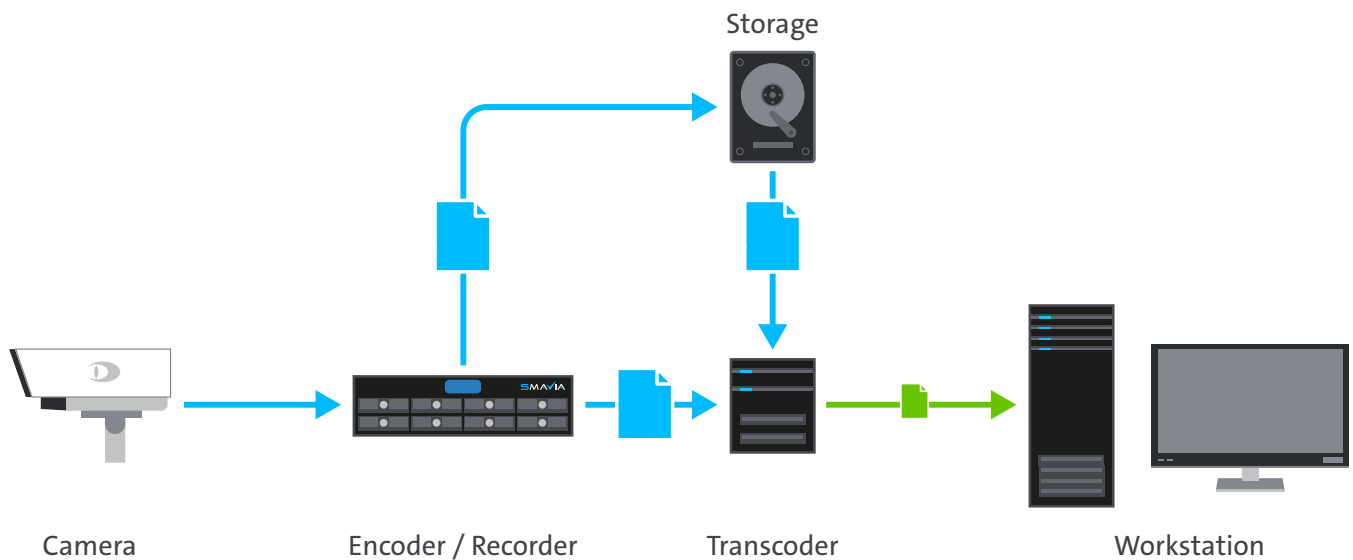

Figure 7 PRemote HD enables the display of live images in high resolution even with limited bandwidth. Recorded sequences can also be transmitted in high resolution

4.6 CAMERA-SPECIFIC TRANSMISSION TECHNOLOGIES

In addition, some surveillance cameras have integrated special technologies that enable bandwidth-saving transmission of video streams.

Example: Bandwidth-saving mode „Eco" of Dallmeier Panomera® multifocal technology:

Dallmeier's Panomera® multifocal sensor systems combine up to eight lenses of different focal lengths in one camera system. This improves the „effective" resolution and the efficiency of a camera system many times over.

Bandwidth savings are achieved thanks to smart technologies such as the „Eco Mode". This mode is a kind of „bandwidth saving mode" by focusing only on the viewer's „area of interest" in live mode. The technical trick is to intelligently "load" the initially uninteresting areas as needed. The entire observation area continues to be recorded in high resolution.

In terms of data volume, this means: When Eco Mode is used, only a fraction of the bandwidth is used for transmission to the client system.

4.7 SUMMARY

The following table summarises the typical implementation scenarios in which the technologies presented can be used to best effect, and where their potential advantages and limits lie.

TECHNOLOGY	IMPLEMENTATION SCENARIO	POTENTIAL ADVANTAGES	LIMITS
H.265	H.265 (HEVC) reduces bandwidth and storage requirement at the same time through compression	Becoming increasingly accepted as the standard for video compression; data rate reduced by up to 50%	All components (camera, recording system, etc.) must support H.265
Edge Storage	Particularly effective when video images only must be made available „when called"	May allow additional recording and storage systems to be dispensed with entirely; transmission of the high-resolution video stream only when needed	Risk of loss of data if the camera or Edge Storage is damaged and the data has not been backed up by other means Appropriate technical and organisational precautions are to be taken
Multicast	Implementation is recommended whenever several users wish to access a video stream at the same time	Reduces the transmission of multiple parallel video streams to a single stream	For the use of multicast (IGMP) to be possible, it must be supported by all components (camera, switch, recording server). A single component that does not support multicast is enough to interfere with the entire function. Multicast places high demands on switches.
Quality of Service	Whenever different IP applications are operated in the same network and „compete" for bandwidth	Selected IP applications can be prioritised above others	Not recommended if all data streams are to be dealt with equally, or if the IP applications are operated in dedicated networks
Manufacturer-specific procedures, e.g., PRemote HD	May be implemented if standard technologies are not adequate for the desired application, or if devices from different manufacturers do not allow interoperability	High potential; depending on the performance of the components used	Depending on the performance of the components used
Camera-specific transmission technologies, e.g., Eco Mode	Can be used in an auxiliary role	Enable additional bandwidth economies	Can only be with specific cameras, e.g. with multifocal sensor technology.

5. RECOMMENDED ACTIONS

Depending on the scenario and requirements, various technologies can be used that can intelligently solve bandwidth problems:

- Ask the manufacturer or partner you trust about technologies and solutions for the intelligent transmission of video streams
- Compare and test the solutions in your specific application case
- Have the mode of operation and the result of the individual solutions shown to you live
- In case of doubt or when making far-reaching investment decisions, ask for a direct comparison of the solutions available on the market

We will be glad to provide you personally with information about the advantages of Dallmeier solutions for video surveillance using minimal bandwidth. Simply send us an email: info@dallmeier.com

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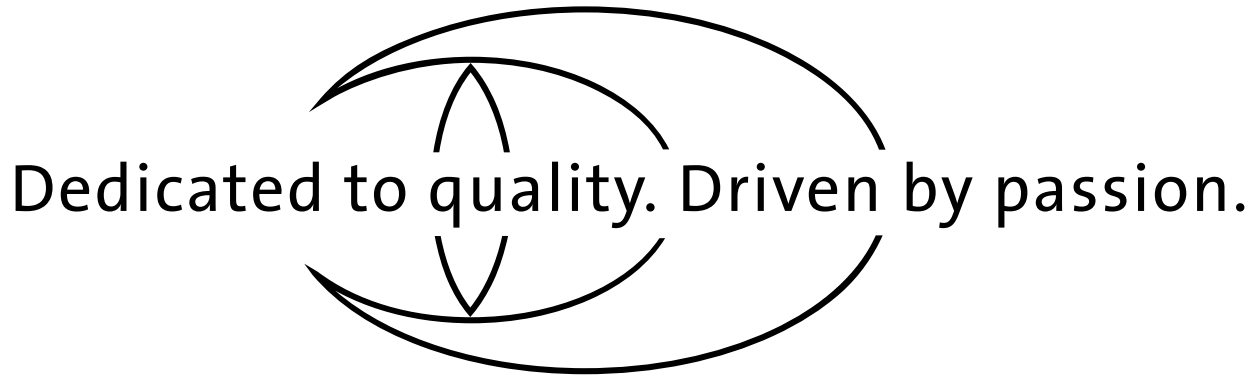
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