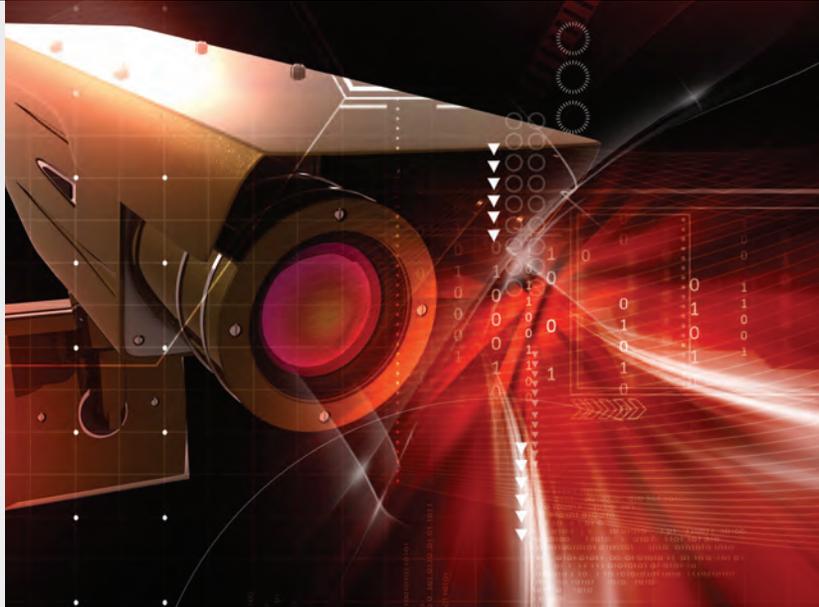
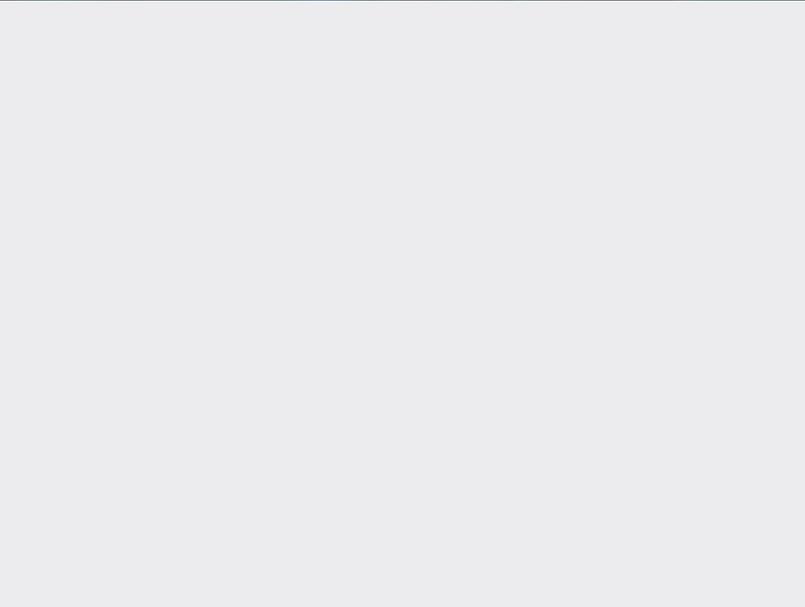
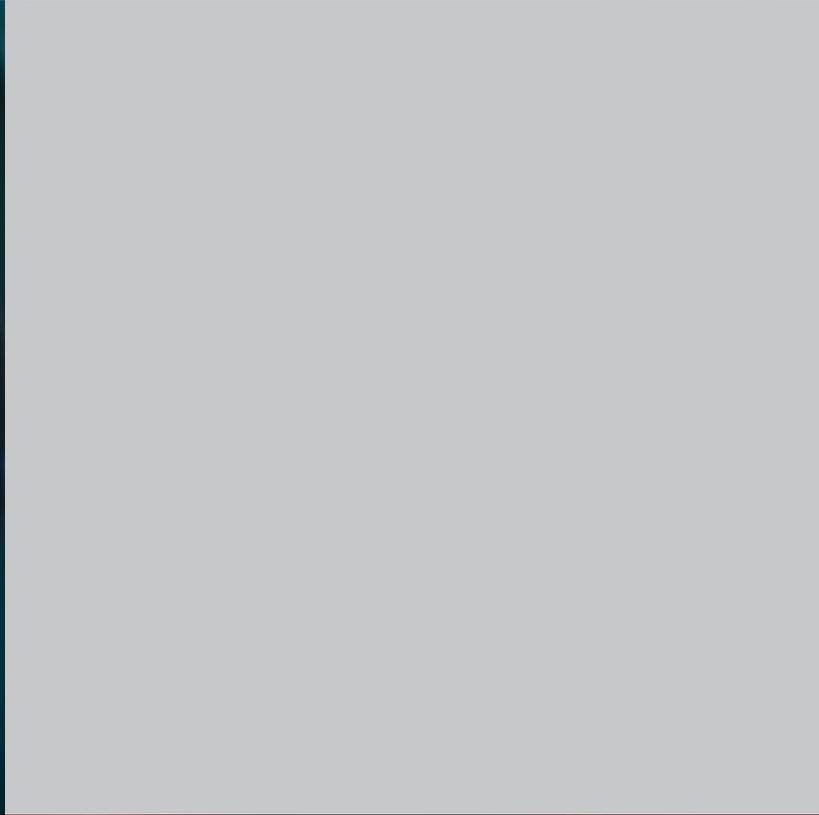
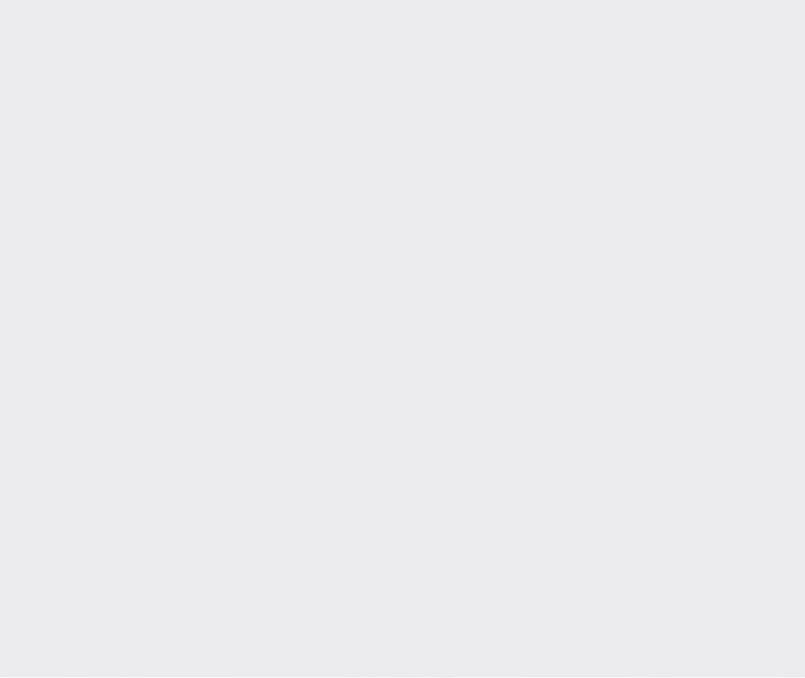




Choosing the Right Capacity and Endurance for Edge Surveillance Systems

A guide to choose the right storage solution
for surveillance requirements



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Storage at the Edge for Video Surveillance is Becoming Mainstream

In surveillance architectures, the video content can be stored locally in the camera (edge storage). A growing trend of distributed computing (ex: mesh networks, video management software (VMS) on camera) is pushing more of the compute and storage functions to the edge of the network. Deep Learning and Artificial Intelligence at the edge are enabling higher accuracy and faster response to events. Enabled with storage at the edge, surveillance systems can perform real-time analytics locally while sending other big data streams to the cloud for storage or further analysis. The trend to 4K surveillance cameras is driving higher storage needs in cameras. As a result, many surveillance cameras now support or have an expansion slot for microSD™ card storage.

Western Digital provides optimized storage solutions for surveillance with the WD Purple™ line of microSD cards. WD Purple microSD cards are designed for surveillance and provide unique features such as card health monitoring functionality, humidity resistance and operating temperatures from -25°C to 85°C. Importantly, WD Purple microSD cards offer an endurance specification so that the user can know the expected lifetime of the card. The ability of WD Purple QD312 microSD cards to meet extreme endurance requirements up to 3000 (3K) P/E cycles gives providers the opportunity to design the optimal surveillance system at the edge.

Video Bit-rate and the Impact on Storage

Bit-rate is defined as the number of bits per second that a camera generates as video. Bit-rate is dependent on the camera resolution and the quality of the video being produced. The higher the camera resolution (i.e. 720p, 1080p, 4K), frame rate or quality of video generated, the higher the bit-rate.

The bit-rate of a surveillance camera is important as it defines the number of bits that are written to the storage device. The number of bits generated by the camera, with compression, are generally equivalent to the number of bits that will be written to storage.

Since bit-rate is time dependent, the number of bits written every second determines how much storage is consumed on the device. Figure 1 shows how bit-rate varies with camera resolution and quality of video.³



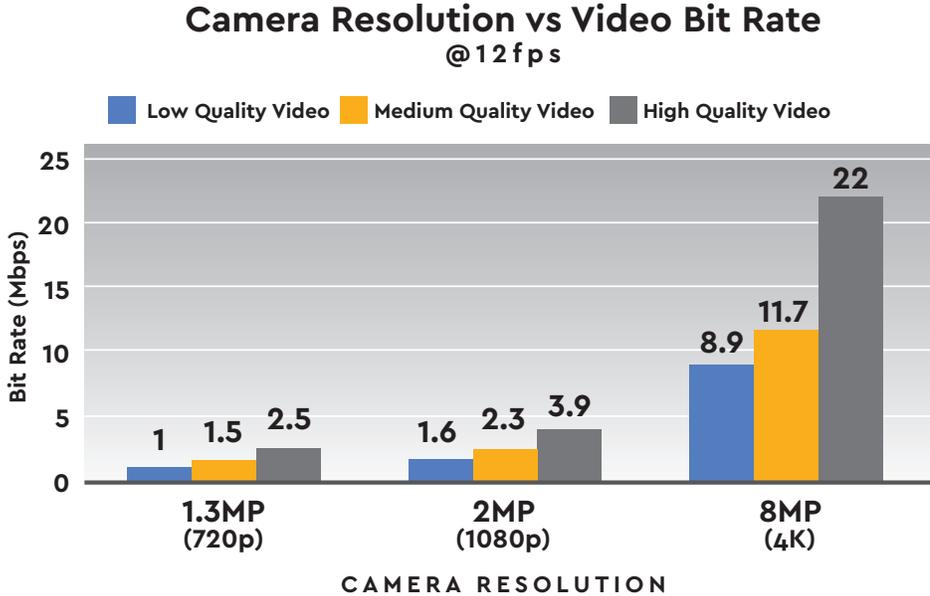


Figure 1.
Video Resolution vs. Bit Rate

Picking the Right Storage Solution

Once the bit rate is determined, the storage needs for the surveillance system can be estimated. When picking the right storage solution for surveillance there are 3 key questions to ask;

1. What is the video bit-rate?
2. What are the video retention requirements? i.e. how many hours or days of video are required to be stored on the device?
3. How long is the storage device expected to operate before being replaced?

Surveillance systems can benefit from a storage device with an endurance specification to know how long a device is expected to last based on the estimated video retention requirements. This can also help reduce maintenance and replacement costs.

The desired amount of retained video dictates the capacity of the card. Storage devices recommended for surveillance typically specify a number of P/E cycles, which helps determine approximately how much data can be written during the lifetime of a card. Storage can also be specified by an endurance rating known as Terabytes Written (TBW). TBW is defined as [number of P/E cycles] × [card capacity].²

For example, a 64GB microSD card with 3000 P/E cycles can write a total of 192TB of data, for an endurance rating of 192TBW. A 64GB card with 500 P/E cycles is specified for an endurance rating of 32TBW. Figure 2 shows the relationship of endurance rating to P/E cycles for a 64GB storage card.³

Endurance Rating vs. P/E Cycles for 64GB Storage

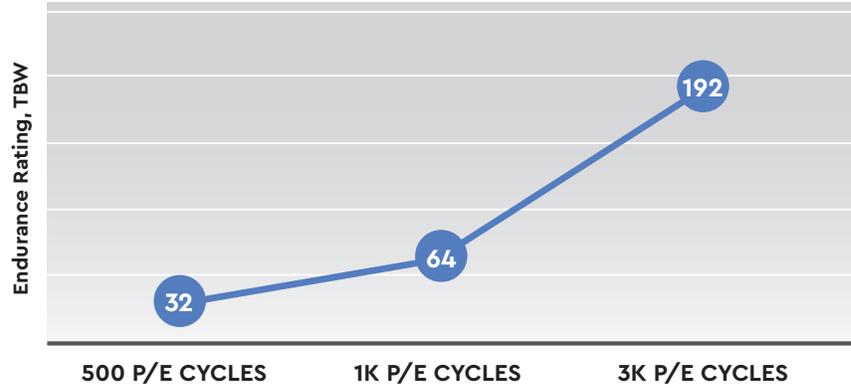


Figure 2.
Endurance Rating vs. P/E Cycles

The estimated required storage can be calculated based on the surveillance solution requirements³. Consider the following example in Table 1.

	Surveillance Requirement		
	1920x1080 (2MP camera)	4K (8MP camera)	
Resolution	1920x1080 (2MP camera)	4K (8MP camera)	
Video Format	H.264	H.265	
Video Quality	High	High	
Scene Activity	Medium	Medium	
Frame per Second (FPS)	12	12	
Bit Rate	3.9Mbps	22.0Mbps	
Hours of video stored	24	24	
P/E Cycles	500	3000	
Capacity Required	64GB	64GB	128GB
Storage Lifetime	Up to 2 years	Up to 2.2 years	Up to 4.4 years

Table 1.
Example surveillance system video requirements,
storage capacity required and storage lifetime

This example demonstrates that cards with 3000 P/E cycles and high endurance TBW are optimal for high resolution recording, high bit rates and longer storage life. Surveillance systems with lower bit rates or lower resolution recordings may be suitable for cards with 500 P/E or 1000 P/E cycles.

Design choices in the surveillance system directly affect the bit-rate, with higher quality video requiring higher bit-rates. Together with hours of video stored and P/E cycles, the bit-rate determines the amount of capacity required and the lifetime of the storage. Tables 2-4 demonstrate how to choose the right endurance for a surveillance microSD card given bit-rate, capacity and desired card life.

Months of Card Life Desired

64GB		6	12	18	24	30	36	42	48	54	60
Average Bit Rate (Mbps)	2	500 P/E Cycles									
	4	1K P/E Cycles									
	6			3K P/E Cycles							
	8							3K P/E Cycles			
	10										
	12										
	14									N/A	
	16										
	18										
	20										
	22										
	24										
	26										

Table 2.
Bit-rate vs. card lifetime @ 24 hours of video stored per day, for 64GB capacity³



Months of Card Life Desired

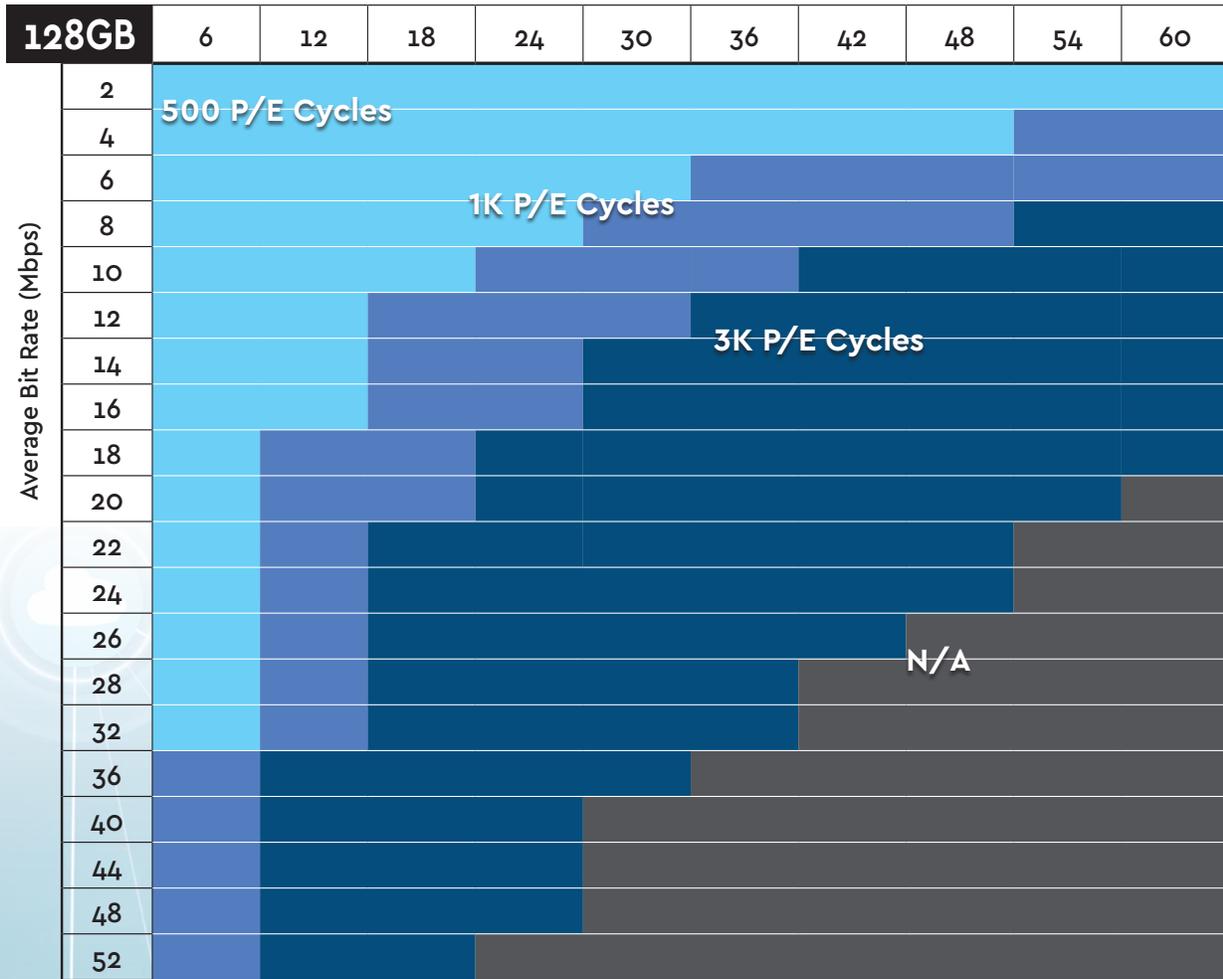


Table 3.
Bit-rate vs. card lifetime @ 24 hours of video stored per day, for 128GB capacity³

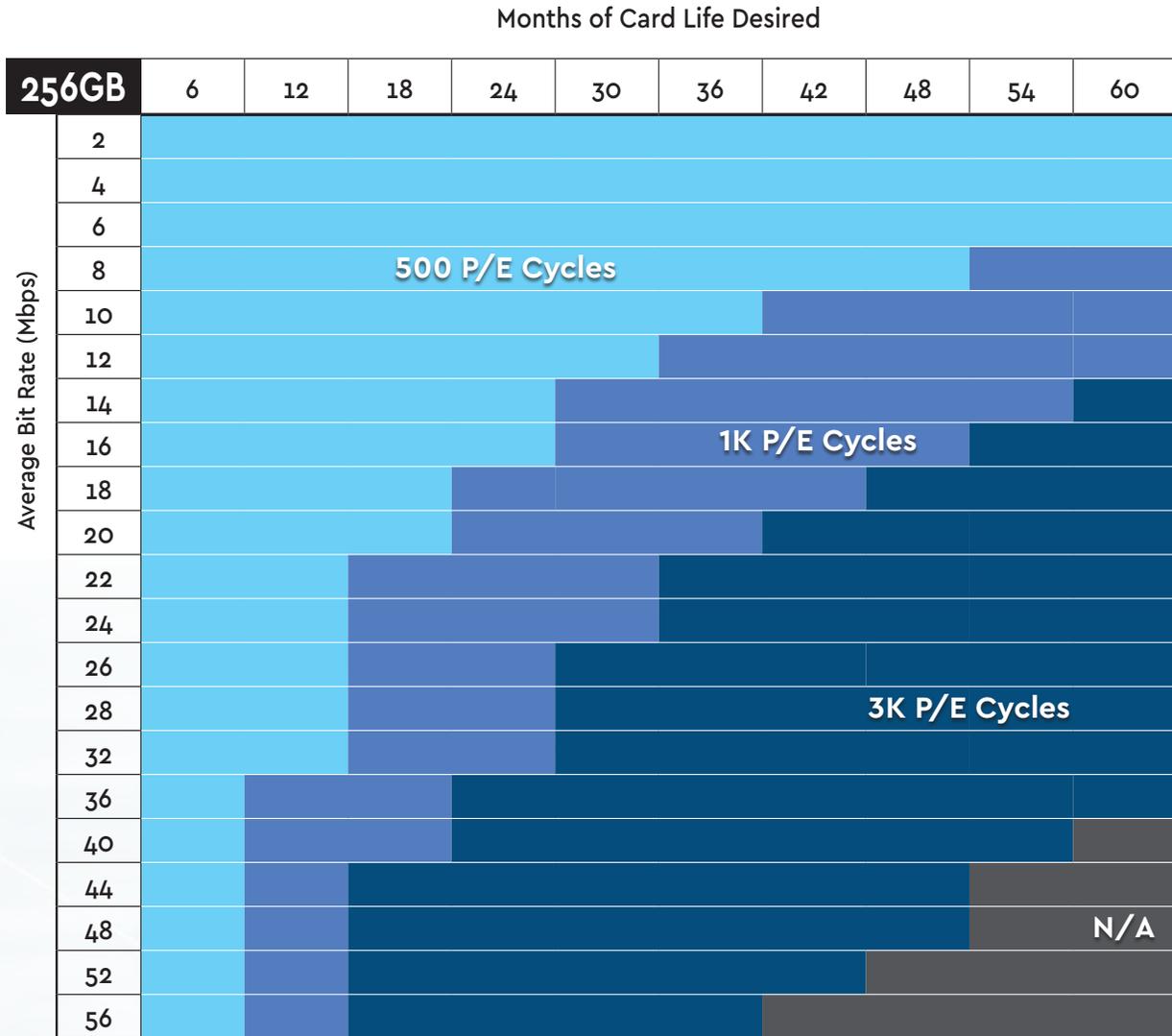
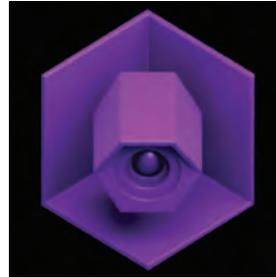


Table 4.
Bit-rate vs. card lifetime @ 24 hours of video stored per day, for 256GB capacity³

Western Digital Tools to Help Surveillance Choices

Figures 2–4 provide guidance to calculate storage needs based on the bit-rate of a surveillance camera. However, in some cases the bit-rate is unknown. Western Digital has published an online tool to provide guidance in choosing the right storage capacity using the characteristics of a surveillance solution.



<https://www.wd.com/solutions/wd-microsd-capacity-calculator.html>

Western Digital also has a downloadable App, "WD Purple Storage Calculator", in the Apple iTunes store and Google Play™ store.



Summary

Surveillance cameras at the edge can benefit from high endurance to help ensure long lasting, low maintenance operation. Video workloads for surveillance cameras can vary depending on the camera components, the requirements of the video stream and how long the video needs to be stored locally. Western Digital's WD Purple microSD cards are designed for surveillance and feature card health monitoring (for compatible cameras) and environmental resilience. They are offered with ultra, high and extreme endurance levels for different workloads. The latest model, WD Purple SC QD101 microSD card, supports capacities up to 512GB and is ideal for lower bit-rate recordings or use in backup/failover implementations. This paper describes WD tools that are provided to help surveillance system designers choose the right solution to meet the requirements of modern surveillance solutions where on-camera storage plays an increasingly important role.

Other Resources

- Link to Product Brief: **WD Purple SC QD101 Ultra Endurance microSD Card**
- Link to Product Brief: **WD Purple SC QD312 Extreme Endurance microSD Card**
- Link to Product Brief: **Edge Storage for Surveillance Camera Systems**
- Link to Whitepaper: **Endurance in Surveillance**
- Link to Whitepaper: **Role of Surveillance in Securing Cities**
- Link to Tech Brief: **WDDA for Surveillance**
- <https://www.westerndigital.com/products/embedded-removable-flash/surveillance-sd-microsd-cards>
- <https://www.wd.com/solutions/edge-to-core.html>

- 1** As used for storage capacity, one gigabyte (GB) = one billion bytes. Total accessible capacity on storage devices and total life of storage devices may vary depending on operating environment.
- 2** TBW (terabytes written) values calculated using JEDEC client workload (JESD219), assume a Write Amplification Factor (WAF) = 1, and varies by product capacity.
- 3** The surveillance card capacity and life estimations in this whitepaper are provided for illustrative purposes only. Total expected life of a card and minimum card size needed are calculated based on parameters selected and typical compression ratios determined solely by Western Digital for MJPEG, H.264, H.265, and H.265+, video formats and color depth based on 30 bits for 4K resolution and higher and 16 bits for all other resolutions. Storage capacity needs may vary depending on video format, compression ratio, camera resolution, frames per second, color depth, system capabilities, components, hardware, configurations, settings, and software, and other factors. Any reliance on these estimations and their output is at the third party's own risk. Consult specific card specifications for warranty period and endurance rating.

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