



White Paper

## **An Introduction to RAID 5:**

Why it is mission-critical in IP video surveillance systems

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# An Introduction to RAID 5

## Why it is mission-critical in IP video surveillance systems

This technical article will explain what RAID 5 is, why it should be used in megapixel IP camera systems, how it increases reliability and performance, and when you need to configure a video surveillance system with RAID 5.

As IP cameras gain increasing use in video surveillance systems, there is a need for larger data storage capacities. The resolution advantage that is inherent with megapixel IP cameras comes with greater data rates and file sizes. Because a 1080p IP camera contains six times the resolution of a VGA analog camera, the storage capacity required for the same amount of time recorded is six times as much. Ensuring that large amounts of data are safeguarded against disk failure should be a requirement for any surveillance system. Another challenge posed by the larger data rates and files sizes is the video system's ability to write this data to disk with sufficient speed and reliability. Having a RAID 5 storage array increases both the reliability and performance of a video surveillance system, especially a megapixel IP video system

### WHAT IS RAID 5?

RAID (Redundant Array of Independent Disks) is a method for configuring multiple disks or hard drives in a single array. While there are many levels of RAID (RAID 0, RAID 1, RAID 5, RAID 6, RAID 10) this article will only focus on RAID 5 for video surveillance.

RAID 5 requires a minimum of 3 disks and uses a combination of striping and parity. Striping writes data across all the disks rather than sequentially. By spreading the data across multiple disks, faster speeds can be achieved. Parity is an error checking technique that is used to add redundancy to a RAID 5 configuration. If a drive in a RAID 5 array fails, the parity information is used with the remaining data on the other drives to recover the missing data. Like the data, the parity information is striped across all the disks. The effective storage space of a RAID 5 array can be calculated by the formula  $1 - 1/n$ , where  $n$  is the number of disks in the array. For example, if you have 8 drives of 1TB each, the effective space is 7TB total:  $(1 - 1/8) \times 8\text{TB}$ . In other words, one drive will be used for parity.

Because RAID 5 increases performance and offers redundancy with efficient space, it is an effective configuration for megapixel IP video systems.

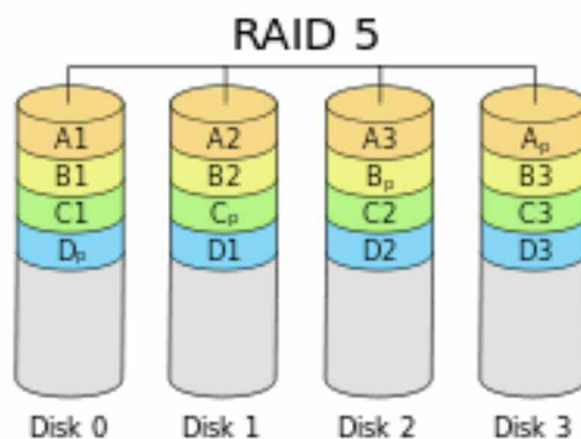
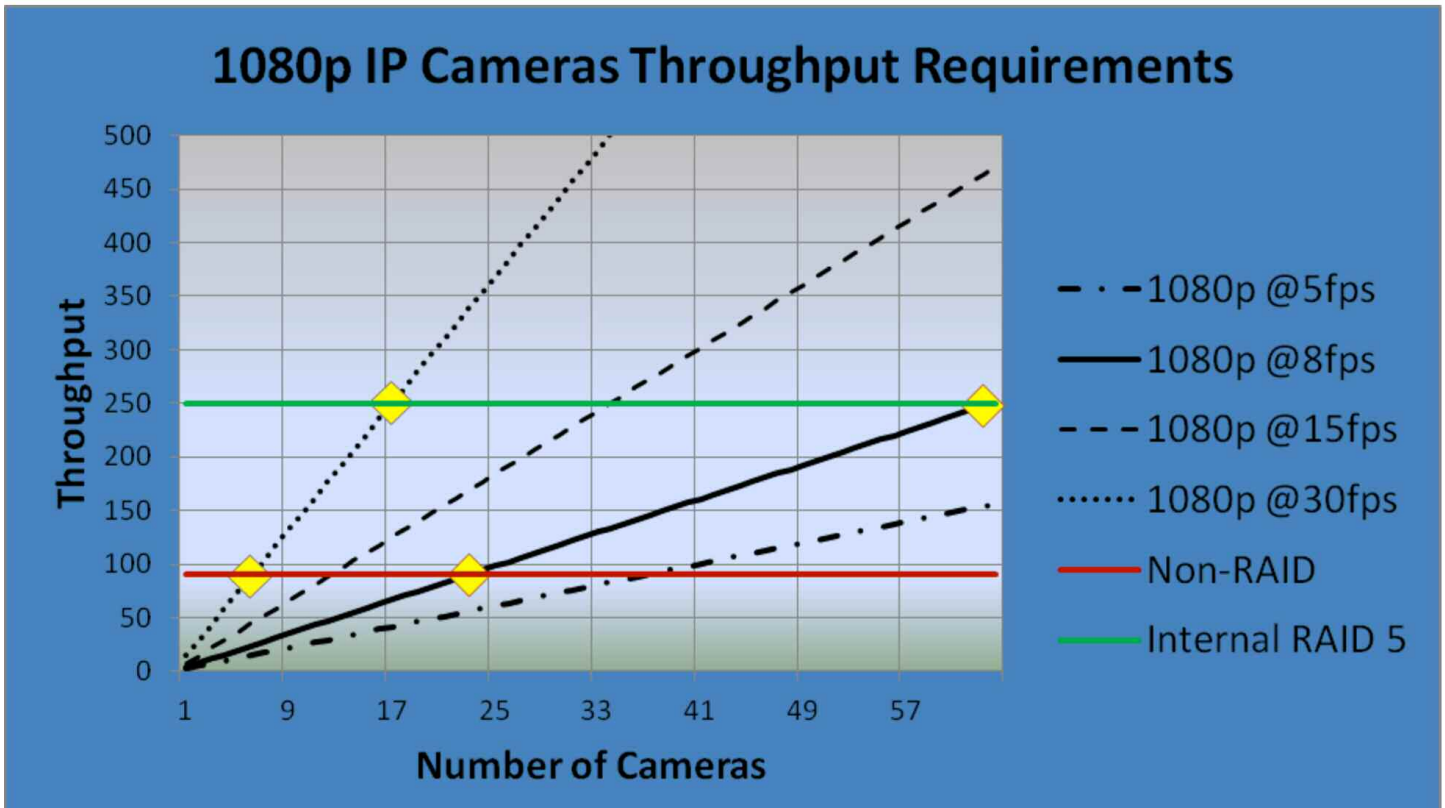


Figure 1: An example of a RAID 5 configuration showing data (A, B, C, D) striped across 4 disks along with parity information (Ap, Bp, Cp, Dp).

Image courtesy of Wikipedia author Cburnett

### RAID 5 PERFORMANCE INCREASE

Hard disk drives have read and write speed limitations because of their mechanical nature and physical limitations. By configuring drives together in RAID 5, you increase the number of locations that you can write video information to, thus increasing performance. In a megapixel video application a large amount of random disk operations occur. Video information is being stored along with the indexing of this video. If motion detection and audio is used, the motion detection index must also be stored as well as the audio. In a non-RAID 5 configuration, these non-linear disk operations are typically handled by the CPU which can cause the entire system to slow or crash.



**Figure 2:** This graph shows typical 1080p IP camera throughput requirements at various fps. In red are the throughput capabilities of non-RAID 5 and green for RAID systems.

\* Data based on H.264 compression, 1080p resolution with no audio at 50% motion. Individual results may vary.

In a RAID 5 system, a dedicated hardware RAID 5 controller manages the large number of disk operations. Depending on the quality of the RAID 5 controller, the overall system throughput can be doubled or tripled. For example, a 16 camera 1080p megapixel IP video system at 15 fps requires approximately 118 Mbps throughput. However, a Windows based NVR typically has throughput capability of 90 Mbps because of disk write limitations. When configured as RAID 5 and using a robust RAID 5 controller, this throughput increases to 250 Mbps. This result in the ability to connect 33 1080p cameras at 15 fps compared to only 12 cameras per server.

**WHEN TO USE RAID 5**

The 2 main requirements for using RAID 5 are applications that need data redundancy and applications with throughput requirements exceeding the non-RAID 5 capabilities. Data redundancy will depend on how critical the video data is. An office environment may not be as critical as a banking or public safety environment. Often the need for redundancy will be dictated by the specifications of the project. With throughput requirements, calculations may be needed to determine the required throughput and the throughput capability of the surveillance system.

	30 fps	15 fps	8 fps
<b>1080p</b>	6 / 16	12 / 33	22 / 63
<b>720p</b>	12 / 34	24 / 64	46 / 64
<b>VGA</b>	54 / 64	64 / 64	64 / 64

**Figure 3:** This chart shows maximum number of cameras per server at various resolutions and fps. In red are the capabilities of non-RAID 5 and green for RAID systems.

\* Data based on H.264 compression with no audio at 50% motion. Individual results may vary.

The camera bit rate should be determined and multiplied by the total number of cameras to determine a minimum throughput requirement. Overhead requirements such as remote client connections, backups, etc. should also be taken into consideration. This throughput value should be compared to the manufacturers' system throughput to determine if RAID 5 is needed.

### **ADVANTAGES AND DISADVANTAGES OF RAID 5**

RAID 5 gives you the security of data redundancy and the ability to recover data in the event of a disk failure. It also increases the throughput performance of a system because of its ability to write to multiple drives at once. Coupled together, these 2 factors make RAID 5 a good option for high camera count, high megapixel applications.

However, because of the added hardware and in many cases, a higher grade of hard disk drives, RAID 5 will be more costly than a non-RAID 5 system. Because of the extra parity information, the effective storage of a RAID 5 system will be decreased as well. There are also other disadvantages such as the longer build time of a RAID 5 system, complexity of adding hard drives in the field, and knowledge level needed to recover lost data in the event of a failed drive.

### **Conclusion**

Today's IP megapixel applications require more data storage as well as more performance capabilities of a system. Compared to VGA resolution, 1080p resolution has 6 times as much data. A video surveillance system must be robust enough to write this large amount of data to disk without compromising the performance and reliability of the system. RAID 5 adds data redundancy as well as performance increases to handle megapixel IP video applications. Critical video should be recorded with a fault tolerant system and high IP applications need greater performance. RAID 5 is an effective solution to both needs. ■