

# X-RAID2™ vs. Flex-RAID

## INTRODUCTION

At NETGEAR we have received a number of questions regarding X-RAID2™ and FLEX-RAID. This whitepaper is intended to be a simple introduction to the differences between the two options. Before diving in, it is important to understand a few key points:

- RAID (Redundant Array of Independent Disks) is a common storage industry term
- The primary benefit of RAID is that in multi-disk storage solutions (2-bay or greater) your data is protected against failure of any single disk.
  - At its most basic, data put on the drive is copied across all disks in the device. This is typically referred to as “striping.” If one fails, data is still safe on the other disks. The user can then replace the bad disk and the data is again copied and stored across all disks.

**X-RAID2** is the NETGEAR version of “RAID for dummies.” This is the default and requires no knowledge or configuration to get the protection from disk failure discussed above. With X-RAID2 you can also add disks and the additional capacity is added to the RAID group regardless of the initial number of disks.

**FlexRAID** is the NETGEAR version of “RAID for experts/geeks.” You have greater flexibility and can improve capacity/efficiency/etc., but you should have a working knowledge of RAID architectures and concepts. Expansion can happen only by adding a new RAID group of at least two disks.

## X-RAID2

X-RAID2 is an auto-expandable RAID technology that is available only on ReadyNAS® systems. With X-RAID2, you do not need to know intricate details about RAID to administer your system. X-RAID2 allows you to add storage space without reformatting your drives or moving your data to another location. Because the expansion happens online, you can continue to use your ReadyNAS system while the volume capacity increases.

Because X-RAID2 is a single-volume architecture, if you configure your hard disk drives to use X-RAID2, your storage system has only one volume that is made up of all installed hard disk drives. X-RAID2's single-volume architecture has two major advantages:

- Easy system management
- Auto-expansion

With X-RAID2, you can start out with one hard disk, add a second disk for data protection, and add more disks for additional storage capacity. X-RAID2 accommodates the new disks automatically. You can replace existing disks with larger-capacity disks and X-RAID2 automatically accommodates the new disks.

X-RAID2 requires a minimum of two hard disks to provide protection against disk failure. If you have a one-disk ReadyNAS storage system and want protection from disk failure, you must add a second disk that is at least as large as the first. It can be added while the system is running.

X-RAID2 uses the capacity of one disk for data storage and reserves the capacity of a second disk for data protection, which allows the volume to recreate data if a disk fails. In a two-disk system, the usable storage space is one disk. In a three-disk system, the usable storage space is two disks. In general, the total capacity of your storage system equals the capacity of all your disks minus the capacity of one disk.

X-RAID2 also allows for the automatic expansion of volume size when you replace a disk drive with a larger capacity drive. Detailed instructions are available in the software manual.

## Flex-RAID

Flex-RAID architecture has two major advantages:

- Support multiple volumes per ReadyNAS.
- RAID level can be selected for maximum capacity, redundancy, or performance.

The NETGEAR Flex-RAID technology allows you to choose from among several industry-standard RAID levels:

- **JBOD.** This most basic RAID level does not protect your data from loss if one of your drives fails. JBOD is available only on volumes consisting of a single hard disk.
- **RAID 0.** RAID 0 distributes data across multiple disks, resulting in improved disk performance compared to systems that do not use RAID formatting. The total capacity of your storage system equals the capacity of all of your disk drives. RAID 0 is available on volumes consisting of two or more hard disks.
- **RAID 1.** This RAID level provides full redundancy of your data, because it duplicates data across multiple disks. Exactly the same data is stored on two or more disks at all times. RAID 1 protects your data from loss if one disk fails. The total capacity of your storage system equals the capacity of your smallest disk.
- **RAID 5.** This RAID level also provides data redundancy, but it requires at least three disks. RAID 5 uses the capacity of one disk to protect you from data loss if one disk fails. Your data is distributed across multiple disks to improve disk performance. The total capacity of your storage system equals the capacity of all your disks minus the capacity of one disk. It is supported on systems with at least four drive bays.
- **RAID 6.** This RAID level can recover from the loss of two disks. Your data is distributed across multiple disks to improve disk performance. The total capacity of your storage system equals the capacity of all your disks minus the capacity of two disks. It is supported on systems with at least four drive bays.
- **RAID 10 (or 1+0).** This RAID level uses both RAID 1 and RAID 0 technology. First, your data is duplicated so that exactly the same data is stored on two or more disks. Then, the data is distributed across additional disks to improve disk performance. It is supported on systems with at least four drive bays.

The Flex-RAID levels that you can select depend on the number of disks included in the volume. The following table describes the Flex-RAID levels that are available for a given number of disks. It also indicates whether adding a disk for data protection is possible for each configuration.

Number of Disks per Volume	RAID Level	Can I add a disk for data protection?
1	RAID 1	Yes. (Additional disk provides redundancy.)
1	JBOD	No. (JBOD is available only for volumes consisting of one disk)
2	RAID 1	No. (Volume protection is already redundant.)
2 or more	RAID 0	No. (RAID 0 does not offer protection.)
3 or more	RAID 5	Yes. (Additional disk provides dual redundancy and converts the volume to RAID 6.)
4 or more (even number)	RAID 10	No. (Volume protection is already redundant.)
4 or more	RAID 6	No. (Volume is already protected with dual redundancy.)

Table 1. Flex-RAID levels and data protection