



HIGHLY RELIABLE SYSTEMS

"Making Network Backup Invisible"

RAIDFrame Overview and Usage Guidelines (6/1/8)

Introduction

The High-Rely RAIDFrame is a unique backup device intended to replace conventional tape and even stand-alone removable hard drive solutions. Designed for small and mid-size organizations whose backup needs have exceeded typical tape capacities and who need a more reliable solution, the 4U rack mountable RAIDFrame houses 5 removable "RAIDPacs" that each consist of 3 SATA drives and a RAID controller. A fully populated RAIDFrame will house a maximum total of 15 SATA hard drives. This unique approach to backup provides the first self-contained and portable RAID solution. Among the many benefits to the RAIDFrame solution:

- **Size.** Largest capacity (2TB – 3TB) Removable RAID5 or RAID0 backup cartridge in the world using three 1TB SATA drives.
- **Redundancy.** The only removable cartridge with built in RAID redundancy, allowing for a single drive failure while still retaining valuable data.
- **Emergency Access.** RAIDPacs are designed with a hidden Molex power connector and Standard SATA port, which allows an individual RAIDPac to be powered up in an emergency to access data without the need for any drivers or the RAIDFrame. A RAIDPac simply shows up as a single hard drive to the host system.
- **Compatibility.** The RAIDFrame system is fully compatible with popular backup software such as Backup Exec, Arcserve and other industry standard packages that support backup to removable hard drives.
- **Ease of Use.** Each RAIDPac is seen as a separate drive letter from Windows, allowing easy verification of backup jobs using Windows Explorer. Software is included to manage drive letters before, during, & after drive swaps.
- **Cost.** RAIDPacs use standard 7200 RPM SATA hard drives, which means lower cost for backup media than tape when analyzed over the life of the product. Replacement drives or larger sizes are easily installed
- **Support.** Highly Reliable Systems provides extended warranties and free telephone technical support. The products are also supported by local value added resellers who can install and repair the product.
- **Speed.** Faster restores due to the use of random access media. Because tapes require sequential access restoring from tape takes considerably longer. Backup times meet or exceed those of many tape drives when RAIDPac-A media is used in RAID5 mode. When using RAIDPac media configured in RAID0 mode, the RAIDFrame will be up to 5 times faster than most tape systems on the market.
- **Simple Interface.** The RAIDFrame system is a "Direct Attached Storage" (DAS) device. It plugs into any Server or PC via an industry standard eSATA port. Direct attached storage is fully compatible with the security of the host computer, and faster than Network Attached Storage (NAS).



HIGHLY RELIABLE SYSTEMS

"Making Network Backup Invisible"

Available Configurations

RAIDPacs

The RAIDFrame may be ordered with 1 or more populated RAIDPacs. Each RAIDPac can be configured 2 ways, RAID5 for redundancy or RAID0 for speed and capacity.

RAIDPac-0	3drives	RAID 0 (Striping across 3 drives)	3TB (FW and OS Limit)
RAIDPac-5	3drives	RAID 5 (Striping with redundancy)	2TB

RAIDPacs are a removable media cartridge that consists of 3 SATA hard drives and an in-stream RAID5 controller. The in-stream controller means that the host system is completely unaware of the RAID functionality. All RAIDPacs, no matter how they are configured, appear to the host as a single hard drive with no additional drivers required. RAIDPacs are purchased by specifying the size hard drives desired and either RAID0 or RAID5 configuration. RAIDPacs supports up to 3 Terabytes of storage (set at RAID0) and 2TB (set at RAID5). Writing to the RAIDPac configured in RAID5 mode is slower than writing to it in RAID0 mode because of the additional overhead to write the Parity data. However, writing to the RAIDPac configured as RAID0 is extremely fast because the write load is spread over 3 physical drives, resulting in faster writes than a stand-alone hard drive could support. Using three 1TB SATA hard drives, a RAIDPac configured as RAID5 would have a capacity of 2TB. RAID5 array capacities always incur the loss of one of the hard drives in the array due to the need for redundancy. The same 3 hard drives would produce a 3TB cartridge when configured in RAID0 mode.

RAIDFrames

The RAIDFrame itself can be ordered in one of 3 versions: Single Channel, Dual Channel, or 5 Channel. The most common configuration is single channel, in which one and only one file server or PC acts as a "backup server" that hosts the RAIDFrame. This host machine must have a multi-drive compatible eSATA controller (available in PCI, PCI-e, PCI-X, and PCMCIA versions). A single eSATA cable up to 2 Meters in length is used to connect the RAIDFrame to the host machine. Best practice is to order the High-Rely controllers for support and warranty reasons.

In the Dual Channel configuration, 2 host machines may be connected to the RAIDFrame via individual and separate eSATA cables. 2 of the RAIDPacs are hardwired to Host #1 and the other 3 are hardwired to Host#2. In the 5 channel configuration, the RAIDFrame has 5 separate ESATA connections on the back of the unit. Each channel is hard wired to an individual RAIDPac. This allows up to 5 host machines to be physically attached to 5 individual RAIDPacs. As long as all 5 machines are within 2 Meters of the RAID Frame, this allows a single 4U RAIDFrame unit to backup 5 individual servers. Obviously, if additional Network attached storage or servers need to be backed up, this



HIGHLY RELIABLE SYSTEMS

"Making Network Backup Invisible"

can be done by simply pulling data over the network to a host server. It should be noted that when backing up over Gigabit Ethernet, considerable overhead is incurred in the TCP/IP stack and the Ethernet frames. For this reason, "over the wire" network backups can be expected to be slower than directly connected backups. Best Practice is to physically attach the RAIDFrame to any Server(s) with large amounts of data and use an across the network strategy for smaller servers.

Typical Installation

The first step in installing a RAIDFrame is to choose a host machine (or machines) and install an eSATA Host Bus Adapter (HBAs). These controllers can be purchased from High-Rely in PCI, PCI-e, or PCI-X versions to match the bus connectors in your host server. These controllers provide one or more Industry standard external eSATA ports to plug the RAIDFrame into. Drivers are available for Windows and an open source driver (without High-Rely tech support) is available under Linux.

When using single channel or dual channel RAIDFrames It is absolutely critical that the controller is multi-drive capable. If the eSATA port used is not multi-drive capable the symptom will be that only the first of the five RAIDPacs will show up to the host operating system. The best option is to buy the controller from High-Rely. After installation, High-Rely controllers and drivers will expose the "Safely Remove" icon in the tool tray of Windows. Not all eSATA controllers will do this. Although it is not absolutely necessary for the operator to notify the Windows operating system using "Safely Remove" before a RAIDPac is about to be removed, it is considered "best practice" to do so. The safely remove process will notify the operator if the drive is in use by software. This avoids the potential for a drive to accidentally be in use (being written to) by a remote network user while the operator is removing the RAIDPac. High-Rely can provide automated scripts to safely remove all RAIDPacs (take them offline) after a backup.

Like any controller, a driver will be needed before the operating system is recognized. Windows, Mac and Linux drivers are included on the CD.

The eSATA standard allows for a cable up to 2 Meters in length. Once the controller is installed and drivers are operational, the RAIDFrame can be plugged in. Since eSATA supports hot-swap, it is possible to plug this cable in while the server is already powered up. Windows should detect the new devices (Similar to what happens when a USB drive is plugged in). Since RAIDPacs are generally configured, partitioned, and formatted as basic NTFS drives at the factory, five individual drive letters corresponding to the 5 RAIDPacs will show up in explorer or "My Computer". In some cases a reboot may be necessary. Occasionally it may be necessary to go into Windows Drive Manager and initialize, format, or assign drive letters.

At this point the High-Rely Drive Manager (HRDM2) should be installed. This software is a sophisticated service that loads and monitors the plugging and unplugging of RAIDPac cartridges. Since Windows sees RAIDPacs as just 5 individual hard drives, by default it



HIGHLY RELIABLE SYSTEMS

"Making Network Backup Invisible"

will randomly assign the "next available" drive letter to each RAIDPac, which makes directing nightly backup jobs to a given RAIDPac unpredictable. HRDM2 handles this problem. HRDM2 will associate the serial number assigned when a drive is formatted with a drive letter for each RAIDPac. This data is stored in a .ini file and insures that when setting up backup jobs the RAIDPac always has the same drive letter. For example, one common configuration is to give the 5 RAIDPacs the drive letters F:, G:, H:, I:, and J:. Then, Monday night's backup job might always go to the F: drive, Tuesday to G:, Wednesday to H: etc. If subsequently the "Monday" RAIDPac were removed and put on the shelf for months, HRDM2 would insure that when it was brought back into the rotation, it would be assigned "F:", even if it were installed in a completely different slot in the RAIDFrame.

Further documentation on the use of HRDM2 and assigning drive letters is available in the HRDM2 online help.

Performance

RAID5 should be used for those who want redundant backup media in which the failure of any one of the 3 drives does not result in loss of data. RAID0 should be used for those who want larger backup media and/or high speed backups. Jumpers on the back of the RAIDPac dictate which RAID version will be used. No RAID configuration or management software is included or needed with the RAIDFrame system since all RAID configuration and initialization is managed in firmware using either jumpers or switches on the back of each RAIDPac. Status reporting is via simple LED displays on the front. Backup speeds will vary widely because it depends on many variables such as host machine CPU speed, file sizes, size/fullness and fragmentation of both source & destination drives, whether real-time scanning anti-virus software or other file I/O services are loaded, etc. In one Lab test a RAIDPac configured in RAID5 mode achieved backup speeds of approximately 140GB/HR versus 210GB/HR when configured as RAID0. We cannot represent this as typical because every system will be different but this should give a general idea of possible performance.

Some clients will want to backup to multiple RAIDPacs simultaneously. An example would be where each of the 5 RAIDPacs are backing up each of 5 different servers. Obviously, when using a 5 channel RAIDFrame each channel has the full eSATA bandwidth connected to a separate drive. In these cases, the drive speeds, CPU speed, or network speeds will generally be the limiting factor on speed (rather than the eSATA bandwidth).

What about the Single Channel RAIDFrame? By doing some simple calculations, we can see that the engineers that designed the RAIDFrame made sure a single channel could still handle five simultaneous backup sessions. The 3Gbps eSATA cable is capable of simultaneously handling data to 5 separate RAIDPacs at approximately 60Megabits per second or 216Gigabytes of data per hour, which usually exceeds the mechanical ability of even a RAID0 RAIDPac to store data. To get this number take 3.0Gbps/5 drives to get 600Megabits per second per drive. Assuming 10bits per byte (a reasonable



HIGHLY RELIABLE SYSTEMS

"Making Network Backup Invisible"

approximation in serial communication streams - 8bits per byte plus 2 additional timing bits) gives 60Mbps per drive. This is about the same as the maximum data transfer rate to the outer tracks of an empty 7200 RPM hard drive. As hard drives get full, data moves to inner tracks and is written more slowly. For this reason, when doing backup performance testing - large backup sets will always be considerably slower than small backup sets (which can be written primarily to the outer drive tracks on an empty hard drive). Another thing to consider is that if backing up 5 separate servers to a single channel eSATA RAIDFrame, at least 4 of those servers are generally having their data pulled over a 100Mbps or 1Gbps Ethernet line. Our experience suggests that no more than about 30Gigabytes of backup data per hour can be moved over a Gigabit Ethernet connection due to Ethernet frame and TCP/IP overhead. In conclusion, a single channel eSATA RAIDFrame will generally handle 5 simultaneous backups without saturating or limiting overall backup speed.

Backup Strategies

Specific details of your backup strategy will depend on which backup software you use. Many backup packages are available and more are coming out all the time. Some software is the conventional file based software used for many years with tape such as the built in Windows NTBackup, Symantec Backup Exec, or Computer Associates Brightstor (Arcserve). The High-Rely RAIDFrame product line works with the latest versions of most such products because backup is simply done to "removable disk". These products support "always open" files such as Windows Active Directory, Exchange, or SQL that are common in today's domain based networks. Less costly file based backup software often ignores the need for backing up critical domain files such as Active Directory, meaning that although user data is backed up, the ability to restore an entire Windows server environment will not be possible. Such a strategy impacts how fast an organization can recover from complete failure. Without Active Directory and proper "always open" file backup, 2-3 days are often needed to repair the hardware, reconfigure the Windows environment, and then recreate users and other network devices. For this reason, High-Rely recommends enterprise level file backup software that specifically supports backing up multiple servers, Active Directory, Exchange, SQL and open files.

Bare Metal Restore

A newer class of backup software is the "image" based products such as "Backup Exec System Recovery", Acronis True Image, or StorageCraft ShadowProtect. These products are similar to the old "Ghost", in that a snapshot at the block level of the entire drive is taken. With the new VSS service in later versions of Windows, it has become possible to snapshot a drive even when Windows, exchange, and SQL are up and running. Assuming you can install drivers for your backup device on a boot CD, and assuming the image based backup products have the ability to adjust to different hardware, "bare metal" restores become easier to do. Bare metal restore means you do not have to install a base level version of Windows and your backup software prior to recovering a



HIGHLY RELIABLE SYSTEMS

"Making Network Backup Invisible"

catastrophically failed system. Instead, you boot from a CD or other boot device and restore in one step from the ground up. High-Rely recommends image based products over file based unless a substantial investment in file based products has not already been made.

Full Backup vs. incremental or differential

With tape backup products, many IT professionals chose to do "full" backups every night. This was because tape often failed or had errors, and having full data multiple times provided the best chance of recovery. Incremental strategies in which a full backup was done on Monday, and then only changed files backed up Tuesday thru Friday were often avoided. With the redundancy possible in the High-Rely RAIDFrame, and with backup software that supports a "database" type approach to incremental backups, the need to constantly backup the same files over and over again largely disappears. Instead, the data stored on the RAIDPacs can be "refreshed" each night with only files that have changed. Nightly backup windows thus shrink dramatically. This is not to say that Full backups every night are not possible or recommended with the RAIDFrame. When configured as RAID0, full backups will be possible at speeds never achieved with tape. Write speeds to RAID5 configured RAIDPacs can be 4 times slower than when using RAID0. Thus, the slower speed but additional reliability provided by using RAID backup media may cause you to rethink the need to do full nightly backups.

Warranty & Support

The RAIDFrame product comes with a full 18 month warranty that covers all parts and labor, including hard drives that ship with the unit. Typical turnaround time on repairs is 5 working days. The company provides free technical support from 9am to 5pm Monday-Friday PST. Warranty upgrades for all products are available for a nominal price that provides 3 year and 5 year warranty as well with advance replacement on components.



HIGHLY RELIABLE SYSTEMS

"Making Network Backup Invisible"

Summary

The High-Rely RAIDFrame is a unique and flexible backup solution for organizations that need large backup volume, redundancy and high performance. Backup is done to removable RAIDPacs containing hard drives that can be accessed in an emergency even without the RAIDFrame itself. As part as an overall Disaster recovery plan and monitored backup strategy, the RAIDFrame provides a full solution to data recoverability.

Frequently Asked Questions

Q. How many drives are in a RAIDPac?

A. There are 3 drives in a RAIDPac (Configured as either RAID 0 or RAID 5)

Q. Can you mix and match RAID-0 and RAID-5 in the same RAIDFrame?

A. Yes. Each RAIDPac is independently configurable and stands alone as an individual unit (drive letter) so they can be configured differently and may even have different size drives.

Q. Can each RAIDPac be a different size?

A. Yes. Each RAIDPac will appear to the host computer as its own drive with its own characteristics like any other hard drive.

Q. Does each drive have to be the same within a RAIDPac?

A. It is best if they are identical but it is not required. If you mix drive types and sizes within each RAIDPac-0/5, then the final RAID size will be three times the capacity of the smallest drive in RAID 0 or two times the capacity of the smallest drive for RAID 5.

Q. What is the reliability or rated operational life of a RAIDPac?

A. On average a complete RAIDPac with new drives should last around 5 years when powered up continuously. Most hard drives are rated for three to 5 years of continuous operation. The other components in a RAIDPac are rated for 5 to 8 years of continuous operation under normal operating conditions.

Q. What is the Shelf life? How long can I store a RAIDPac without power before it loses data?

A. RAIDPacs store the data on internal hard drives. Therefore, data retention is dependent on the data retention life of the internal hard drives. Information on this subject is not made available by hard drive manufacturers. They are reluctant to make shelf-life guarantees for simple liability reasons. Our discussions with industry pioneers reveal that most experts believe that hard drives shelf life is in excess of 5 years. We have been able to power up 10 year old drives in internal testing with no data loss. These informal observations are not meant to be scientifically or statistically significant. We believe that due to obsolescence of hardware both tape and hard drives the technology changes every 5 to 8 years, necessitating the need for data migration to newer platforms anyway.

Q. Does it matter what slot each RAIDPac is plugged into?

A. No. Also, the associated drive letter is not attached to a slot, it is attached to the actual RAIDPac itself. When using the included HRDM2 management service, regardless of where you plug the RAIDPac into the RAIDFrame, the associated drive letter will follow it

Q. Can I reconfigure a RAIDPac?

A. You can change the configuration yourself. Doing so requires that you move some Jumpers in the back of the RAIDPac and then reinitialize the RAIDPac. Initialization is a process that must be performed on each RAIDPac before it can be formatted and recognized as a drive by your operating system. It is similar to a "low level format". This is a task which should be performed by someone with a fair amount of computer experience.

Q. What happens if I put a RAIDPac in upside down?

A. Not possible, the RAIDPac's are intentionally mechanically "keyed" so they can only be installed in one direction.

Q. What happens if I install a RAIDPac between the rails?

A. Again, not mechanically possible.

Q. How do I remove a RAIDPac?

A. Press and hold in the release lever for the pack you wish to remove. As soon as you depress the lever, the RAIDPac will power down (not affecting any other RAIDPac's). While holding the Release lever in, remove the RAIDPac. To install, simply push the RAIDPac in until the Release lever clicks, the RAIDPac will then power up.



HIGHLY RELIABLE SYSTEMS

"Making Network Backup Invisible"

Q. My RAIDFrame was lost or destroyed. Is there a way to retrieve data from my off-site RAIDPac?

A. Yes, by removing the backside metal cover of your RAIDPac, a standard drive molex power connector and SATA connector are available to plug into another computer system. Since each RAIDPac contains its own RAID controller, no other hardware, drivers or software is necessary. So long as the new machine's operating system understands the format and file system you originally formatted the RAIDPac with from the previous host, it should become immediately available for reading and writing after boot up. If you prefer not to unscrew the back of the RAIDPac, you can purchase a low cost adapter that exposes the Molex and SATA connectors by simply plugging it into the back of the RAIDPac.

Q. Does the RAIDFrame spin hard drives down when they are not in use?

A. No. We have determined that better operating life and subsequent shelf life are achieved by powering all drives continuously while they are in use. In addition, better performance is achieved by having the drives available on-line for immediate access. The data supporting better longevity for spinning drives is supported by studies done at Google.

http://209.85.163.132/papers/disk_failures.pdf

Q. Does RAIDFrame have any remote monitoring?

A. No, but it does have local LED displays as well as local audible alarms. These are relatively inexpensive and effective ways of monitoring drive health. Most backup software has verify operations and logs that allow you to remotely assess whether your backup is good. We feel this is the most reliable way to monitor backup status. Lower level drive monitoring is not as reliable according to a study by Google that incorporated a large number of drives. The study found that more than 56% of failed drives do not have either SMART-reported scan errors, sector reallocations, offline reallocations nor sector probational counts. http://209.85.163.132/papers/disk_failures.pdf The best monitoring strategy is to review logs and periodically restore files.

Q. Is the RAIDFrame available as a Network Attached Storage (NAS) device?

A. No. There is no Ethernet connection on the box.

Part Numbers and Ordering Info

HRRF-1	RAIDFrame – Single Channel Empty RAIDFrame, One 6ft eSATA cable, CD
HRRF-2	RAIDFrame –Dual Channel Empty RAIDFrame, Two 6ft eSATA cables, CD
HRRF-5	RAIDFrame – Five Channel Empty RAIDFrame, Five 6ft eSATA cables, CD
HRRF1B-1	RAIDFrame One bay, one 6ft eSATA cable, CD
HRRF-1EXT3WAR	3 Year Warranty upgrade with advance replacement.
HRRF-1EXT5WAR	5 Year Warranty upgrade with advance replacement

RAIDPac

HRRP3-1000-0	3TB RAIDPac [3 1TB drive RAID 0 configuration]
HRRP3-1000-5	2TB RAIDPac [3 1TB drive RAID 5 configuration]
HRRP3-0750-5	2.25TB RAIDPac [3 750GB drive RAID 0 configuration]
HRRP3-0750-5	1.5TB RAIDPac [3 750GB drive RAID 5 configuration]
HRRP3-0500-5	1.5TB RAIDPac [3 500GB drive RAID 0 configuration]
HRRP3-0500-5	1TB RAIDPac [3 500GB drive RAID 5 configuration]

**3 and 5 year warranties are available for all RAIDPacs

HRRPB	Additional Blanks for RAIDFrame when RAIDPacs are not installed.
HR1EIPCI	PCI eSATA Controller
HR2IPCIE	PCI-e eSATA Controller
HR4EPCIX	PCI-X eSATA Controller
HRRPCase	1 RAIDPac Hard Carrying Case
RPADAPT	RAIDPac Emergency access power & SATA adapter
RPRAILS	Set of Rails for mounting RAIDPac Case in 19" Rack (comes with RAIDFrame)

1900 Vassar Street Reno, Nevada 89502-2109
Telephone 877-384-6838 • Fax 775-322-5397 • www.High-Rely.com