

White paper

The Future of Tape

Tape technology has a long history in data protection, and even with the adoption of disk and cloud targets, it still plays a major role in many backup and archive environments.

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Executive Summary

The digital transformation results in a huge amount of data, which becomes more and more valuable to organizations. To protect the business-critical data organizations have to think of a multitier data protection strategy. Besides snapshot, replication, disk and cloud backup tape remains as the most cost-effective storage tier for long-term retention and the optimal media against malware attacks. IDC recommends 'using tape to optimize data protection costs and mitigate the risk of ransomware for data-centric organizations. ... That IT organizations view tape as an "and" technology rather than an "or" technology in their data protection strategies, especially when looking at a multitier data protection.'¹.

FUJITUS's comprehensive portfolio of tape storage solutions ranges from the scalable line of ETERNUS LT systems for small and mid-sized companies, workgroups, and branch offices to enterprise-class tape libraries from partners. Fujitsu builds individual, scalable data protection architectures and brings the benefits of current and future LTO generations to companies of all sizes.

The LTO tape libraries optimally enhance the [Fujitsu Storage ETERNUS CS data protection appliances](#) as second-tier backup, archiving or long-term retention backend storage.

Trends and Challenges in the Datacenter

■ The Challenge of Data Growth



Organizations have to deal with exploding amounts of data – both old and new data.

With exponential data growth increasing between 50 and 70 percent a year due to digitalization, compliance requirements tightening, service level agreements calling for on-the-spot access to structured and unstructured information, distributed computing, and the 'webification' of all content and services - the demands on datacenters for backup and archiving have seemed relentless and unlimited. For a good while, the response has been to deploy ever more and ever bigger disk arrays, creating enterprise-wide data pools accessible to multiple users and applications. While this approach clearly has had its merits, both professionals and analysts are increasingly critical of its limitations, especially when it comes to costs. IDC estimates that 60 % of data stored in data centers is 'cold' (data not expected to be retrieved within 30 days).

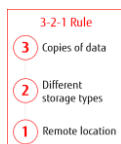
It makes sense to use a low cost storage media such as tape storage for cold, not frequently accessed data.

■ The Challenge of Cyberattacks



As data becomes more valuable to organizations, data becomes an increasingly attractive target for theft or malware attack. The latest threat is ransomware, where critical data is encrypted until a ransom is paid in Bitcoin in exchange for the unlock key. Attacks of this nature increase, and infections taking hold in seconds. Organizations that are locked out of their data face a trail of damage that can take weeks or months to rectify.

One of the timeless data protection rules that can effectively mitigate the threat of data loss is the 'three two one' backup rule:



- Keep at least three copies of your data – the primary data and two copies – to avoid losing data to a faulty backup
- Store two backup copies on different types of storage media such as tape, disk, secondary storage, or cloud
- Keep one backup copy offsite, either on tape or in the cloud, in the event of local disasters or infections within the network.

Especially for data critical to business operations, keeping an encrypted copy offline is a guaranteed way of keeping information safe from online attacks.

Small, highly portable LTO cartridges are a convenient way to store data offline. After creating copies, these cartridges can be placed in a safe, for additional security. This approach provides a new layer of protection against ransomware and other types of online cyberattack. Tape storage helps to maintain the integrity and accessibility of business-critical data even in cases of cybercrime, such as ransomware attacks.

Therefore, more organizations include tape storage in their modern data protection infrastructure.

■ Contrasting Market Realities

The storage market is being shaped more and more by the use of comprehensive solutions for data backup and archiving, which means that expertise in both homogeneous and heterogeneous system environments is required with the best products in turnkey solutions. In the market for tape storage of data, the application area encompasses all industries and authorities, which require economical backup of medium-to-large quantities of data. Economical means cost-effective over the entire lifecycle – from the purchase, to the consumables (tapes), right through to environmentally friendly disposal.

The Enterprise Strategy Group estimated in Economic Validation Summary report², "that the expected ten-year TCO for the LTO-8 data retention solution is 86% lower than that of an all-disk solution and 66% lower than that of an all-cloud storage solution, making LTO-8 the economical choice for long-term data retention."

¹ Source: IDC White Paper, sponsored by The LTO Program, Using Tape to Optimize Data Protection Costs and Mitigate the Risk of Ransomware for Data-Centric Organizations', April 2018; <https://www.lto.org/wp-content/uploads/2018/04/US43710518.pdf>

² Source: ESG Economic Validation Summary Report, Quantifying the Economic Benefits of LTO-8 Technology, August 2018. <https://www.lto.org/wp-content/uploads/2018/08/ESG-Economic-Validation-Summary.pdf>

Ongoing shipment trends demonstrate the continued role of tape technology in the ever-growing storage landscape in 2017. The LTO shipment report³ showed a record 108,457 PB of total tape capacity (compressed) shipped in 2017, an increase of 12.9% over 2016. In this press release Phil Goodwin, Research Director, IDC stated: "Many organizations continue to rely on tape for their long-term archive and high-capacity, low-cost data storage needs," said. "Moreover, having tape as part of a backup strategy can provide an 'air gap' to help protect against data loss due to ransomware. The higher capacity, faster throughput of the new LTO-8 technology offers continued price-to-performance gains for organizations using tape in their data centers."

Five Reasons Why Tape Is Still Important

In the digitalization era with exploding data and increasing cyberattacks, the tape storage solutions resurge. The future for tape continues to play a key role in any data protection environments because it provides important advantages in practical scenarios. The mix of characteristics clearly shows that tape technology maintains many benefits in the past and in the future. LTO tape technology delivers high storage capacity, blazing fast transfer rates, easy-to-use functionality and steadfast reliability.

■ **Economic:** Lowest cost storage at \$0.004 per GB for life, low power/cooling costs



While cost per gigabyte for tape, disk or cloud continue to shrink, tape maintains its advantage over disk, cloud when the overall total cost of ownership – energy, floor space and equipment – is taken into account. Tape continues to prove itself as the strongest, most cost-effective technology for long-term retention, second tier backup, archive-intensive and/or data streaming applications in many industries. Offloading of inactive data from more expensive primary and backup disk systems into an archive on tape reduces the active data and ensures easier backup and faster recovery. Tape solutions mitigates the data growth and saves money for capacity upgrades of primary disk storage.

Use the TCO tool from <https://www.lto.org/resources/tcotool/> to calculate your own environment.

■ **Efficient:** Tape is green and offline; energy consumption <2% of equivalent storage using HDDs



Tape technology, being largely inert, produced almost zero CO₂ over the same time as disk. Offline storage of tape is cheap, from an environmental perspective. Depending on your locality, you may not even have to keep the storage area air-conditioned.

Unlike unused disks in disk arrays, unused tapes do not "draw power." This minimizes expenses for electricity and cooling as well as the total carbon footprint of a datacenter. Disk arrays and replicated backup server clusters do not really have the notion of offline options. Even the power consumption for pseudo-offline disk storage is higher than that for unpowered, inactive tape.

■ **Secure:** Offline and on-premises protection against ransomware (air gap), strongest commercial data encryption



Legal and regulatory standards typically require that certain types of information – with financial and medical data at the top – are kept for a decade or more. Industry-standard hard disk drives have an average lifespan of less than 10 years, whereas tapes may achieve up to 30 years under optimum conditions.

Data that is subject to HIPAA, PII, GDPR, or other privacy regulations must be stored that non-authorized people cannot access data. LTO technology delivers powerful tape drive-based 256-bit AES encryption to protect sensitive information. In addition, LTO offers highly redundant and reliable error detection and correction with inherent read-after-write verification.

Besides that, tape provides an air gap between live and backup/archived data and it can be kept securely offline until it is needed. Using WORM (Write Once, Read Many) tape media guarantees that data cannot be deleted and fulfills strengthen compliance regulations.

Offline copies can also be kept at remote datacenters or vaults and used for inevitable recoveries, enhancing the availability of business-critical information and assuring its protection from fire, floods and other catastrophes.

These features combined turn tape storage into an indispensable component for building standards-compliant, medium- and long-term data retention and archiving.

■ **Unlimited:** Long term investment protection; LTO-8 with up to 30TB compressed capacity, rapid recovery of large data sets



Linear Tape Open (LTO) is an open standard and the predominant tape platform for open systems. LTO-8 features up to 30 TB of compressed storage per cassette, which is larger than most competing technologies and twice the compressed capacity of the previous generation. It provides transfer rates of up to 3.24 TB/h per drive. Multiple drives increase the transfer rate and provide rapid recovery of large data sets.

Every major manufacturer of tape automation systems support LTO technology and the LTO specification road map has been published through LTO-12, meaning that it has a defined and stable future. Each generation is compatible with its previous generation, so you know that you will be able to make the most of your investment, as technology needs change.

Capacity of tape library can easily updated by changing to the latest LTO tape drive and cartridges.

Disk arrays have an absolute limit to the amount of data that may be stored on one device. That limit is determined by the array's physical footprint – the maximum number and size of drives that can be built into it. Hence, organizations can only add new capacity if at some point

³ Source: Press Release of LTO Consortium, Record breaking amount in total tape capacity shipments , April 2018
https://www.lto.org/wp-content/uploads/2018/03/LTO-Shipment-Report-Release_2017-FINAL.pdf

they opt to purchase another array. Tape libraries, however, are not bound by such limitations, as their capacity mainly depends on the media footprint – the number, size and availability of tapes that with each generation reliably store more data.

Linear Tape Open (LTO) - The Continuously Evolving Standard

■ LTO Consortium

One of the reasons for tape’s ongoing success lies in its having undergone a rigid standardization process in recent years. This process is almost inextricably linked to Linear Tape-Open, or LTO, an open standards tape storage technology, and its governing body, the LTO Consortium. The consortium was created to overcome the limitations of the existing proprietary tape storage solutions, namely, a lack of interoperability between vendor-specific systems that used their own individual tape formats. LTO has finally succeeded in making information retrieval on tape as easy, if not quite as fast, as it is on disk.

The first commercial LTO tape products arrived in 2000. Since then, the LTO Consortium has continuously added many features over the years – write protection, encryption, partitioning and LTFS – that have turned tape into a tamper-proof, secure storage medium.

■ LTO-8 - the latest LTO Generation

The eighth generation, announced in late 2017, doubles the capacity of the previous generation. The capacity of up to 30TB compressed data per LTO-8 cartridge enhances tape’s cost advantage for long-term data storage and archiving. A new format feature allows customers to write up to 22.5 TB on LTO-7 tape media by using LTO-8 drives. This feature increases the capacity of LTO-7 cartridges by up to 50%.

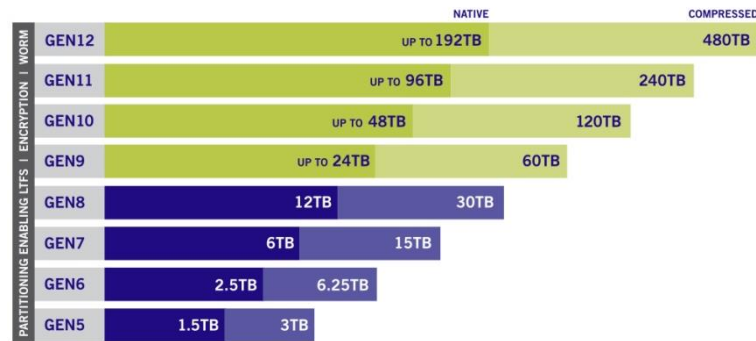
With the transfer rate of up to 750 MB/s you can write/read up to 2.7 TB compressed capacity in one hour per LTO-8 tape drive. The high throughput allows users to complete jobs faster, which is important as data growth increases. Deploying latest LTO-technology into a high-performance network, capable of supporting the drive throughput, makes it easier to stream data from high performance primary storage systems like [FUJITSU Storage ETERNUS AF all-flash storage](#) or [FUJITSU Storage ETERNUS DX hybrid storage](#) to tape.

Using latest LTO-8 technology the customer can save up to 90% slots and tape media respectively as well as 63% backup time compared to LTO-5.

■ The Future of LTO

On October 2017 the LTO Program extended their roadmap from LTO-10 to LTO-12 with LTO-12 showing 480TB per cartridge⁴. The LTO Consortium has planned at least four more LTO Ultrium generations after LTO-8, all of which will offer the regular doubling of storage space and speed increases. This means that the technology behind LTO tape will continue expanding the density, performance and cost advantages for many years into the future, providing you with the assurance that archived data will always be available.

LTO ULTRIUM ROADMAP
ADDRESSING YOUR STORAGE NEEDS



NOTE: Compressed capacity for generation 5 assumes 2:1 compression. Compressed capacities for generations 6-12 assume 2.5:1 compression (achieved with larger compression history buffer).
SOURCE: The LTO Program. The LTO Ultrium roadmap is subject to change without notice and represents goals and objectives only. Linear Tape-Open, LTO, the LTO logo, Ultrium, and the Ultrium logo are registered trademarks of Hewlett Packard Enterprise, IBM and Quantum in the US and other countries.

Figure 1: The LTO ultrium roadmap (Source: [The LTO Consortium](#))

⁴ Source: LTO Consortium, Press Release: LTO Program outlines generation 8 specifications and extends technology roadmap to 12th generation; October 2017; <https://www.lto.org/2017/10/lto-program-outlines-generation-8-specifications-extends-technology-roadmap-12th-generation/>

Use Cases



LTO Tape technology will continue to play key or supporting roles in traditional use cases and will primarily succeed in archiving or as part of “hybrid,” “layered” or “multi-tier” storage strategies, often combined with scale-out disk arrays or purpose build backup appliances (PBBA).

Tape is receiving a resurgence of interest as many leading IT organizations recognize the unique features with LTO technology with the added benefit of very low cost of ownership.

■ Backup



The baseline scenario for each company is backing up data from production servers to disk, tape or cloud. Each method has advantages and is suitable for different settings. Backup-to-disk is for productive data that must be recovered rapidly and immediately, while backup-to-tape is for data that requires long-term retention due to compliance standards, such as contracts or healthcare information. Backup-to-cloud is emerging as a viable alternative for on-premise storage. For larger quantities of data the up- and download time, download and storage costs of cloud storage can quickly eclipse tape.

The advantages of backup-to-tape lie in the significantly lower storage costs per gigabyte and greater durability of the storage media – under appropriate conditions, tapes can protect data for decades. In addition, they can store information in WORM mode (for “write once, read many”; indicating protection against subsequent changes), are easily transferred to a second secure location and consume less power than hard disk drives, which draw current even in idle mode.

Today, most companies are using both backup methods. Fujitsu’s business-centric storage portfolio - [ETERNUS DX hybrid arrays](#), [ETERNUS LT libraries](#), [ETERNUS CS backup appliances with deduplication, data protection software and more](#) - fit best to all of these basic scenarios.

■ Archiving



In the digital business world, the balance and interaction between productive storage, second-tier storage and archive storage is essential to maximize the operational and business efficiency and agility. Archives are becoming more and more an integral part of any modern, intelligent data protection strategy. As organizations continue to generate large numbers of files and new types of valuable data, there is an increasing need to retain, access, and protect these business-critical data. This explosive data growth,

along with stringent compliance requirements, rising security risks, privacy and compliance concerns are among the biggest challenges organizations face.

For any organization with large archives or extensive retention obligations – government agencies, medical and research centers, public utilities, libraries and museums, engineering companies, etc. – tape remains the storage platform of choice. Governmental requirements and legal liability are key reasons to implement a data archiving strategy with tape storage solutions because archives are typically used for long-term retention of information. The support of WORM cartridges in tape libraries ensures that archived data is held in a non-erasable, non-rewritable format to fulfill the requirements for compliance archiving.

Tape archives are also suited as target for offloading old and inactive data that will otherwise participate in the daily backup stream and cause an unnecessary burden for the overall backup process. Archives can remove tens of terabytes or more of data from the backup set. This reduces primary storage costs, as well as backup hardware and software costs. Speed and capacity improvements and added retrieval capabilities will only reinforce that position of tape storage.

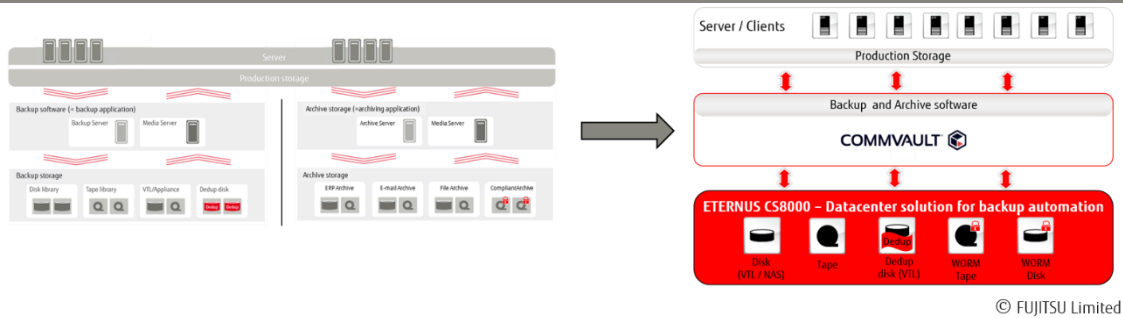
■ Data Protection



Traditionally, companies have treated backup/recovery and archiving as separate processes that run on separate systems. Over the years, this has led to the formation of two strictly distinct infrastructures, each of which maintains its own set of rules, tool chest, and upgrade cycles. While initially this parallelism made sense, it turned into a weakness as storage infrastructures evolved; nowadays, it means that the same data set is touched multiple times, by different administrators and with different software, to

achieve what is essentially the same goal – being moved from production systems through backups to archives during their lifecycle. This is a waste of time, workforce, and money.

[The ETERNUS CS8000 series of appliances with backend tape storage in combination with Commvault software](#) solve all these challenges. All traditional backup and archiving processes occur in a single operation that moves all data to secondary storage, where it serves as both backup and archive copy. This modern storage solution eliminates inefficient data silos, consolidates managed data, and automates retention and tiering according to the policies customers define. Additionally the combination provides a global, intelligent index and multiple retrieval methods so that users can easily access and find the information, whether it’s for recovery, eDiscovery or data mining. Tape as second or third tiered storage is an important part of this modern data protection by providing huge and cost-efficient data storage capacity.



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Figure 2: Traditional backup and archive infrastructure versus modern data protection with FUJITSU Storage ETERNUS CS and Commvault

■ Hierarchical Storage Management (HSM)



HSM creates a two- or three-tier infrastructure where data is moved from high-speed SAN arrays or Flash memory devices to SATA drives to tape (D2D2T) depending on age, date of (last) access, and relevance.

By moving old or non-critical data from production storage to second- or third-tier file storage, administrators can increase the usable storage capacity on the systems which run their mission-critical data. The reduction of data volume stored in productive environments results in faster backup and recovery. The data stored in second-tier file storage can then be managed with more ease at a different data protection service level. The goal is to build a cost-effective storage platform that meets all legal, professional and technical requirements.

In this context, tape continues to serve as a capacity-oriented, cost-efficient and most reliable technology for backend and long-term retention. From a management standpoint, HSM can help cut upfront hardware and media expenses; however, administrative costs vary based on the degree of automation.

The direct integration with tape enhances [the Fujitsu Storage ETERNUS CS8000 unified data protection appliance](#) for Hierarchical Storage Management (HSM) to automatically save data to disk and tape, according to defined migration policies and retention periods.

■ Active Archiving

Virtually all organizations store multiple types of data because it is required by law, national and international professional standards, or as part of a business model or internal policies. This data is usually dispersed across a host of different storage systems to accommodate varying business needs and service levels. However, due to exponential data growth and a permanent increase in regulatory requirements, such environments are anything but easy to manage.

Active archiving is an approach that combines open systems applications with disk and tape hardware. It not only automates and simplifies data migration, but it enables an organization’s employees and customers to access information on the network whenever they need it. To facilitate this, active archiving deploys a file system that extends seamlessly across various types of storage media, such as disk and tape, and integrates with LTFs. Users therefore see one big data repository (logical storage volume) of theoretically unlimited size. They may read, edit or reprocess any file at any time based on roles and group policies; but these functions are independent of storage locations, file formats or the backup/archiving software used to create the files.

From a management perspective, active archiving ensures that data is always stored on the media type and device that best meet predetermined requirements for retention, restoration, e-discovery and long-term preservation. Since all data is permanently kept online or near-line, regardless of age or usage frequency, data is much easier to restore for productive use or analysis⁵. The approach works particularly well for organizations that keep a lot of fixed content, for example, in healthcare or the insurance business.

■ Content Distribution

Another scenario involves media companies, in particular TV broadcasters, film studios, and music services. Such companies require backup and archiving of terabytes and in the future petabytes of digital data. The use of tape solutions will increase over time due to cost-effectiveness and safety/security aspects, especially as users become aware of tape’s fundamental capability to deliver consistent, high-bandwidth data streams.

■ Tape NAS

Today more and more companies subdivide their storage infrastructures into two distinct sections – one storage pool consisting of performance-optimized disk and /or flash arrays for frequently accessed data, and one storage pool for data with seldom access, but long time retention periods. Tape NAS has emerged as one of the preferable technologies to build these retention pools. It requires a classic setup: a tape library at the back end and a LTFs server in the middle that delivers files to applications and end users at the front end. The server also transfers files between both storage pools.

Due to its low cost, a single library configured as Tape NAS with second or third tape copies is the most common use case. The duplicate tapes can be exported to an offsite tape vault, or a fire safe. The hardware-based encryption feature of LTO drives ensures that if a tape is lost or stolen

⁵ For more details on active archiving, see the Active Archive Alliance home page at <http://www.activearchive.com>.

the data is protected from unauthorized access. Tape as NAS is an ideal method to store archived database records. The large file sizes facilitate tape streaming, which results in good overall throughput. Other use cases are archiving of emails, healthcare images or videos.

Fujitsu's Tape Portfolio

As a globally leading IT provider, Fujitsu consistently monitors the changing technological, strategic and organizational requirements in the datacenter. Our observations show that as the complexity of IT environments has increased in general, so has the complexity of data protection environments in particular. Consequently, efficient data protection scenarios call for infrastructure and management consolidation, with the main goals of ensuring high data availability and quick and fast disaster recoveries, while optimizing backup-to-disk in the process. To meet these requirements, we have developed a unique, consistent data protection strategy that builds on the "layered" approach discussed earlier and involves both disk and tape storage systems and solutions. Our guiding principles are that every company needs to have its individual, adequately sized data protection architecture, and that each of these architectures must allow for flexible, seamless growth according to business demands. For tape storage, Fujitsu offers a comprehensive lineup of LTO tape libraries and media for organizations of all sizes.

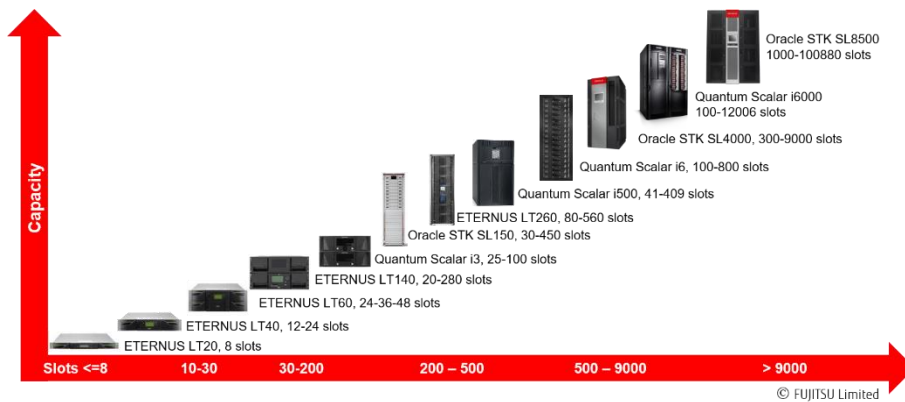


Figure 3: Fujitsu tape storage portfolio

■ Fujitsu Storage ETERNUS LT

At the heart of these offerings is the Fujitsu ETERNUS LT series, serving as a reliable platform in a wide range of demanding storage scenarios – long-term archiving, disaster recovery and unattended backup – and specifically geared to small to medium businesses, workgroups or branch office IT. All ETERNUS LT systems are certified for market-leading backup and archiving software, and optimized for highly automated, simple local and remote operation.

The ETERNUS LT systems offer "pay-as-you-grow" that ensures customers can start with small investments, and then scale their tape storage solutions as business expands. Cost-free, common extra features for all ETERNUS LT systems include mail slots for simplified media management, barcode readers to reduce initialization times, remote management utilities to reduce backup errors and ease system administration, and operator panels that help with local diagnostics and configuration.

All ETERNUS LT systems are enabled for hardware-based encryption offering enhanced security and compliance. All major backup software, like Veritas NetBackup, Commvault Software, etc., supports data encryption and manages the encryption keys. Additionally the ETERNUS LT140 and ETERNUS LT260 support either key management via the ETERNUS LT library or the KMIP key management. The white paper: [ETERNUS LT data encryption and key management](#) describes the encryption feature in more detail.

For detailed information about the ETERNUS LT family, please see the data sheets at [Fujitsu internet](#).

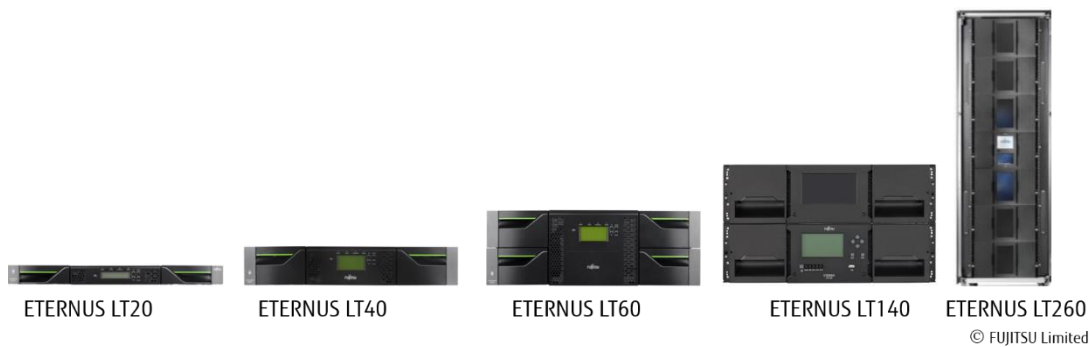


Figure 4: ETERNUS LT Family

Conclusion



Although a decade's worth of articles have announced the last and final demise of tape storage, the technology is still used in 80 percent of all datacenters worldwide.

At the same time, the prevailing LTO standard is being continuously enhanced – the eighth generation of drives and tapes allows for capacities of 12 TB native and 30 TB compressed, transfer rates of 300 MB/s and 750 MB/s (native/compressed) while providing advanced features, such as LTFs or encryption.

Tape is addressing challenging data protection needs with its capabilities and low cost. Today in the digitalization area where cyberattacks are becoming more frequent, tape can very effectively defense your business-critical data against malicious software by providing an air gap between live and backup/archive data. With high capacity and reliability, LTO tape can provide years of protection at a much lower cost than other storage solutions.

Besides disk and cloud the tape technology, especially LTO is recognized as a fundamental part of a multitier data protection solution.

As a leading IT provider, Fujitsu will continue to meet the market demand with a comprehensive portfolio of state-of-the-art tape storage solutions for businesses of all sizes.

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