SEAGATE | CORTX

CORTX: Open Source Mass-Capacity Object Storage

Democratizing Access to Data via Mass-Capacity Data Platform Solutions

Introduction

We are living in a tremendously exciting era of innovation and opportunity, and at the same time, one of unprecedented challenges. Advances in artificial intelligence (AI) are unlocking many opportunities by delivering solutions to critical challenges in almost all fields of human endeavor. From improving our health with custom DNA diagnoses to making the roads safer with autonomous vehicles, AI is poised to transform our world in unimaginable ways. A key driver of AI enhancement has been innovations in machine learning (ML)—the technique by which we train machines to act autonomously—and corresponding innovations in big data analytics, which allow us to find hidden insights in ever-larger data sets.

Our future depends on the ability of ML and big data analytics to extract actionable insights from data. Year over year, the exponential growth[1] in data is what offers the most promise for continued innovation. Research in AI has repeatedly shown that the accuracy of autonomous agents is directly related to the size of the data set on which they are trained, and the quality of data analytics also benefits from larger data sets. A recent study by IDC (Data Age 2025) is encouraging on this front, as it predicts that the amount of data the world will produce will grow from 33 zettabytes (ZB) in 2020 to 175ZB in 2025. With so much data generation, we can eagerly anticipate the tremendous benefits for our world: inches of sea level rise prevented, acres of forest saved, accidents avoided, and additional vaccines created, just to name a few.

1 https://www.seagate.com/files/www-content/our-story/trends/files/idc-seagate-dataage-whitepaper.pdf

Unfortunately, as described in the IDC report, challenges remain to the realization of all this potential.

"Only a fraction of that 175ZB of data is actually going to be stored, the vast majority of that data and the potential value it holds is going to be lost to humanity. Why is it that data, which is the lifeblood of the digital economy, is so readily discarded? We believe the one critical reason for this waste and the associated opportunity cost is the relatively high cost of storing data. If the cost of storing data could be significantly reduced, then more of that 175ZB would be stored, which in turn would lead to improved insights into our world and the critical discoveries we all need." (IDC)

This analysis is visualized in the below graph, which shows the tremendous amount of growth in data creation and the relatively small amount of this data that is actually being stored.

FIGURE 1

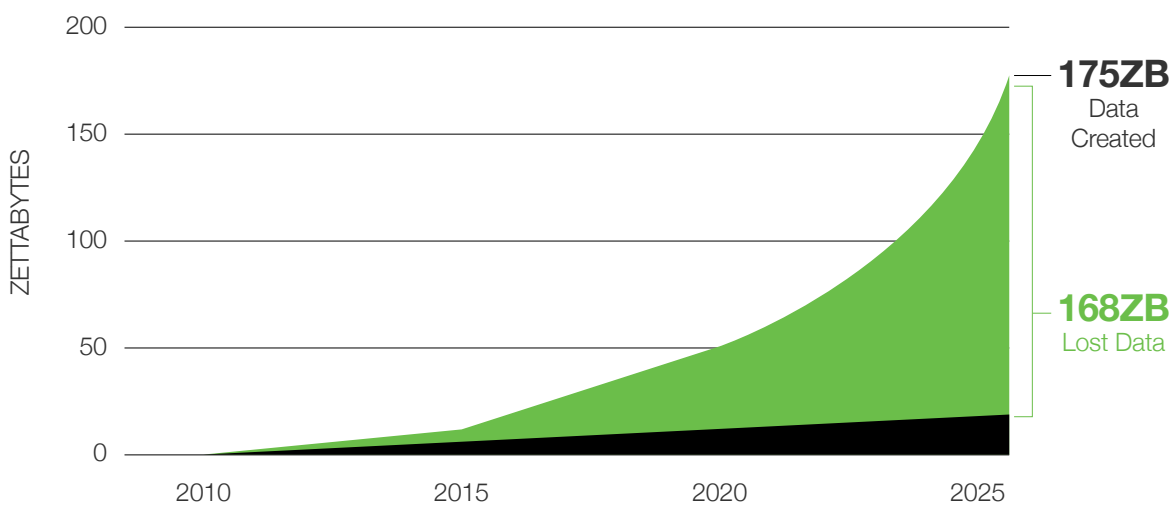


Figure 1: Stored (black) vs lost data (bright green) data

In this graph, the top right edge of the slope shows the total amount of data that IDC predicts will be created. The black sliver at the bottom is the relatively small amount of data that IDC predicts will actually be stored. Per the graph, the amount of untapped data—i.e., data that IDC predicts will not be stored—dominates the relatively small amount that's predicted to be stored. As discussed, each additional byte of data creates more accurate autonomous AI agents and higher quality insights from big data analytics.

This untapped data represents a tremendous amount of potential human benefit wasted.

From market analysis done at Seagate and at IDC, this massive amount of data and potential is lost because of the relatively high cost of current on-premise and cloud-based storage solutions.

To address this, Seagate is improving economic efficiencies of both hardware and software. Hardware innovations such as heat assisted magnetic recording (HAMR) and multi-actuator significantly lower the cost of storing and accessing each byte.[2] However, these new hardware innovations are insufficient to address the problem alone. To fully realize their benefits in the data center requires a completely new data platform designed with and for these devices. Seagate anticipated this problem, and today we are introducing CORTX: a mass-capacity object storage data platform co-developed and co-designed with Seagate's best-in-class mass-capacity storage devices.

To further demonstrate our desire to remove the limitations associated with current data platforms, Seagate is making CORTX open source with a view to making hyperscale storage capabilities accessible and affordable for all businesses and organizations. Doing so will ensure that the improved economics of our mass-capacity devices are delivered efficiently to end users while saving data from being lost.

CORTX Open Source Object Storage

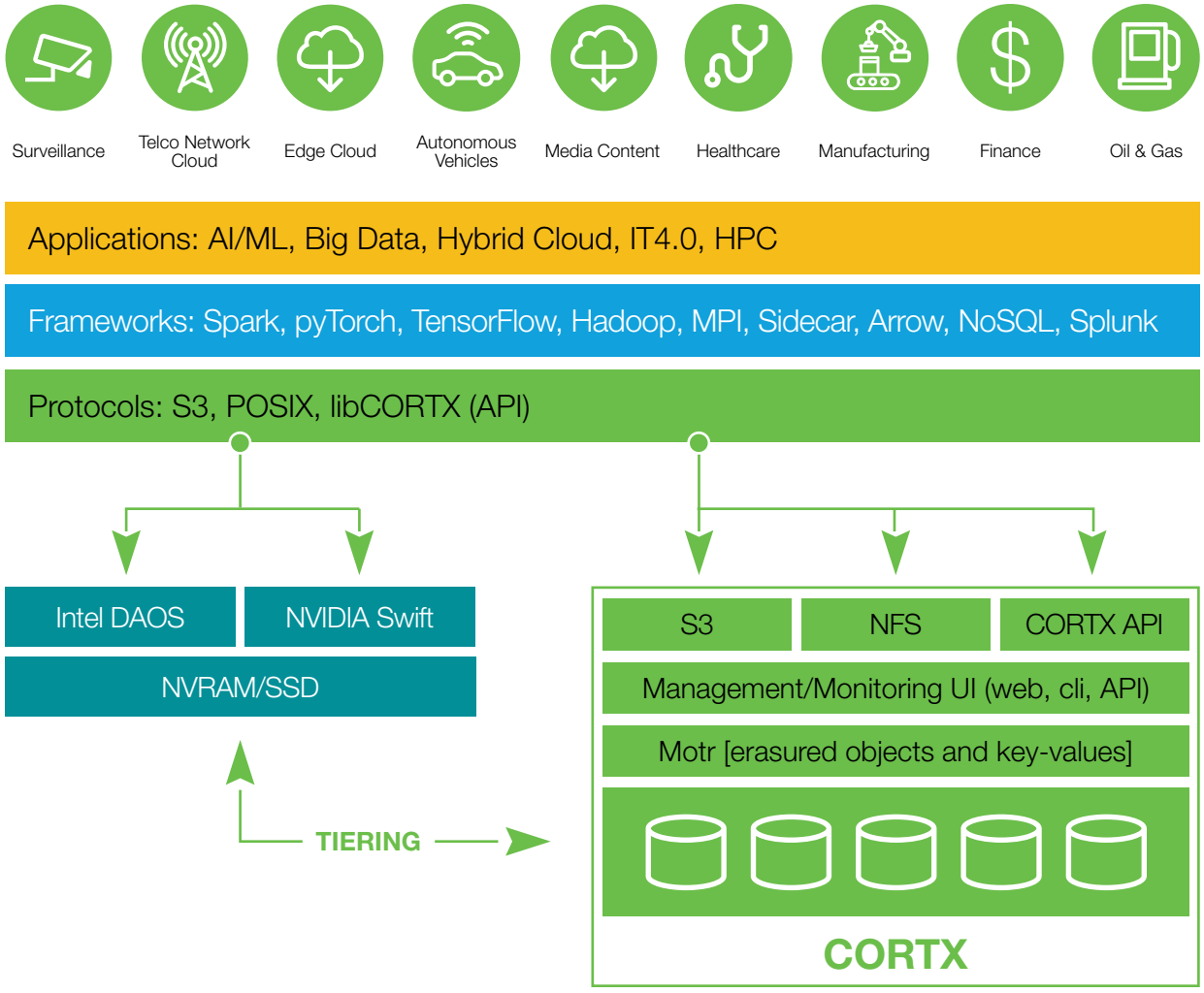
CORTX is an open-source software-defined object store backed by Seagate and designed, built, and maintained by a growing community of data scientists and big data and enterprise storage experts.

Designed by a consortium of high-performance computing (HPC) experts with an eye toward future data center requirements, CORTX enables maximum scalability, resiliency, and hardware efficiency. Without any concurrency-reducing global locks, CORTX provides immediate consistency for object access and eventual consistency for file access. For maximum scalability, concurrency, and searchability, CORTX distributes metadata management across all servers. To ensure data resilience for ever-larger data sets, CORTX erasure coding can provide multi-tiered data protection across all known data center failure scenarios. Uniquely, CORTX benefits from vertical integration. Ongoing device innovations like HAMR and multi-actuator are being developed in parallel with CORTX to ensure that their capabilities and efficiencies are delivered to end users and applications with the quickest possible path to productization. Finally, CORTX has an integrated scale-out auto-indexed key-value store (KVS) to simultaneously enable scalable labeling and search of zettabytes of data. Just saving the potentially untapped data is not enough—we must simultaneously enable fast search across these massive data sets. CORTX has been designed for extremely optimized metadata search, as well.

The diagram below shows CORTX's envisioned role in data centers servicing a wide-range of targeted segments via a host of frameworks and protocols. CORTX is uniquely optimized for mass-capacity hardware devices and supports bandwidth workloads, capacity workloads, and metadata search. While CORTX is not optimal for workloads requiring extreme rates of IOPS, it complements other object stores such as Intel's DAOS and NVIDIA's SwiftStack, which are uniquely optimized for Optane and

graphics processing units (GPU). Data centers with workloads that require efficient access to some combination of mass-capacity hardware and these other media types will benefit from a tiered solution that combines CORTX with complementary systems, as shown in the diagram below. The CORTX team is currently involved in discussions with these other systems to ensure timely delivery of complete solutions for data centers with these requirements.

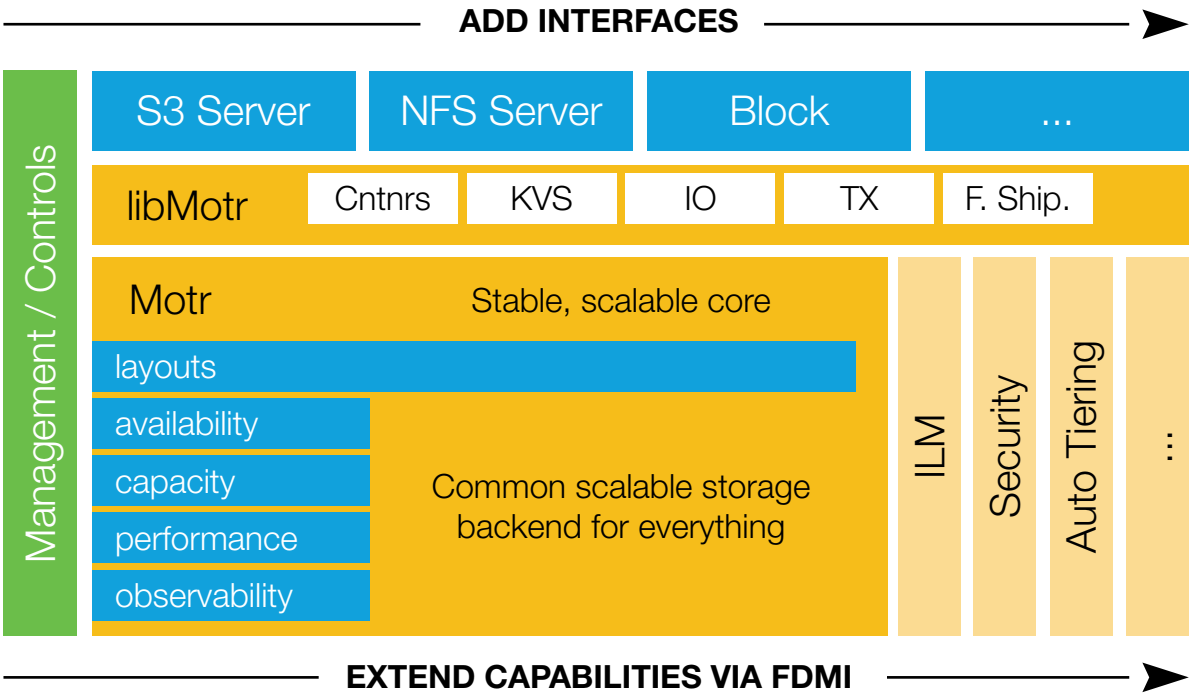
FIGURE 2



CORTX Architecture

The diagram below shows the high-level architecture and highlights the extensibility features of CORTX. Developers can easily add additional protocols and interfaces by writing modular interfaces to libMotr to complement the S3 Server, NFS Server, and Block interfaces currently designed. CORTX also provides a simple interface by which core modularity can be added into the data path. Using a low-level interface called File Data Manipulation Interface (FDMI), developers can add modules via a publish-subscribe mechanism to intercept and augment, or even transform, the CORTX data path. As is shown in this figure, FDMI can be used to add information lifecycle management, security, tiering, and more.

FIGURE 3



At the core of COTRX is our Motr module, which provides data and metadata storage. Motr uses an internal, RAM-based KVS to store object metadata—i.e., data layouts, access control information, security features, etc.—in a compact, efficient form. Motr also provides a user-facing application programming interface (API) for KVS, enabling storage systems users to use KVS for arbitrary small metadata and to provide the fastest access possible to this type of data. For example, the NFS Server module uses Motr KVS for storing abstractions like i-nodes, and user applications can use the Motr KVS to store labels about their data to enable subsequent search. More architectural information can be found in the GitHub.com repository to which Early Adopters will be invited.

CORTX Open Source Early Adopter Program

Customers and partners have clearly and resoundingly told us that our object storage system should be open source. The open source benefits of avoiding vendor lock-in and enlisting community development are clear and persuasive. Based on this feedback, Seagate is delighted to inform you, a select list of customers and partners, that we will be releasing CORTX under an open-source license.

Prior to the public release, we are launching an Early Adopter (EA) Program to provide early access to CORTX via private code repositories hosted on GitHub. As a software-defined storage platform, CORTX can run on a wide range of hardware. We also have a test hardware platform available for Early Adopters who prefer dedicated hardware.

Advantages of being an Early Adopter

In addition to using CORTX to more efficiently leverage stored data, EA program participants will also be able to influence product functionality, reliability, and direction. Early Adopters will also have access to the CORTX development and support staff to assist with their testing and development of CORTX through a mailing list, a forum, and the GitHub issues tracking page. Participants will also receive early access to in-depth technical white papers and other CORTX documentation. For enterprise customers who would prefer dedicated hardware for this initiative, we are offering our first developer platform called the Lyve Drive Rack. It offers up to 5 gigabytes (GB) of bandwidth and more than a petabyte (PB) of usable storage. Seagate can provide this hardware test kit already bundled with the CORTX software, or you can use existing hardware to install the code from the GitHub private repository.

We hope you will join us to ensure that Seagate continues building and developing systems that best aid your programmatic objectives. Note that the public announcement will be made in fall of 2020, so we ask you to please not share this news before then. Our customers and partners are our most valuable asset, and we are grateful for your consideration of this Early Adopter program.

How to sign up for the CORTX Early Adopter program

Joining the CORTX Early Adopter program requires only a few steps:

1. Create or possess an existing GitHub.com account.
2. Share your GitHub.com account with your Seagate contact or email it directly to **cortx-early-adopter-program@seagate.com**.
3. When the Early Adopter program begins, you will receive an invitation to the GitHub.com repository and will be added to a mailing list and Slack channel.

If you have multiple colleagues in your organization who would like to participate, please have them follow these steps individually or collect their information and consolidate into a single email.

How to contribute to the CORTX Early Adopter program

We envision that there will be many different types of Early Adopters and that your contributions and participation can occur in many forms:

- Participate in discussion forums
- Create GitHub Issues requesting features
- Create GitHub Issues reporting bugs in the code
- Create GitHub Issues reporting missing, incomplete, or incorrect documentation
- Create GitHub Pull Requests improving documentation
- Create GitHub Pull Requests fixing bugs
- Create GitHub Pull Requests adding third-party integrations
- Create GitHub Pull Requests adding new features to the code
- Test CORTX performance
- Test CORTX scalability
- Test CORTX interoperability across a range of hardware platforms (both physical and virtual)
- Test CORTX security via penetration testing and other mechanisms
- Create GitHub Pull Requests adding new test frameworks
- Write content such as solution briefs, reference architectures, recipes, and benchmarks
- Improve automation, devops, CI/CD, etc.
- Anything that improves the CORTX Community!

We welcome anyone who wants to make CORTX better and the value they bring to ensure that our cooperatively developed data platform will save more of the world's untapped data.

For more information, please work directly with your Seagate contact or email cortx-early-adopter-program@seagate.com.

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