



ESG WHITE PAPER

Supporting Next-generation Applications at Scale with Microsoft Azure Cosmos DB

Delivering on the Promise of Enterprise-class Performance, Reliability, and Support

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Introduction

As organizations continue to focus on delivering next-generation customer experiences, a spotlight is being placed on data. This is a big reason that data strategies are taking precedence over many other business priorities. The value that can be found within data has massive disruptive power for so many organizations. Developers are being tasked with transforming organizations through next-generation applications powered by data, but data size, speed, and scale are proving to be ongoing challenges. As organizations look to embrace agility to support new use cases or capitalize on new business opportunities, better, faster, and more reliable access to data is critical. What began as an exercise in leveraging structured, relational data to power traditional applications has quickly evolved into the desire to incorporate semi-structured and unstructured data into modern applications. And the requirements that go along with making that desire a reality have forced organizations to reevaluate their underlying technology. The desire to incorporate more and diverse data into applications has paved the way for new database technologies like NoSQL. And to support the unprecedented scale of data, organizations are turning to the cloud to turn their data dreams into reality. How does NoSQL in the cloud help? What do organizations care about when evaluating and selecting the right option? And how can Microsoft Azure Cosmos DB help?

Cloud and Data Strategies

Cloud adoption continues to rise. In fact, over the last five years, public cloud adoption has almost doubled and there are no signs of this slowing down. 94% of organizations leverage public cloud services today. Nearly half of organizations now have a cloud-first mindset when it comes to deploying new applications. And events over the last year have virtually forced existing cloud adopters and net-new adopters to push the accelerator even more. 68% of organizations plan to increase their spending on public cloud services over the next year.¹ While cloud adoption is on the rise, so too are data initiatives. Organizations are embarking on their data-centric futures, relying on new tools, technologies, services, and workflows to evolve their business. In fact, when ESG asked respondents what they viewed as their organization's most important objectives for its digital transformation initiatives, 36% cited developing new data-centric products and services.²

The alignment of cloud benefits to data-driven goals is proving to be nearly perfect. Organizations want enabling technology that offers effective levels of security, ultra-reliability, and right-sized infrastructure that can easily scale to meet the real-time performance demands of a dynamic business. The cloud is delivering. From more elastic scalability and faster deployment times to better availability and security than could be guaranteed on-premises, the alignment is clear.

Further, enabling developers to more freely create data-infused applications that matter to the business based on real-time requirements is proving to be a priority. In fact, 44% of organizations are planning to increase their spending on application development and/or DevOps throughout 2021.³



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¹ Source: ESG Research Report, [2021 Technology Spending Intentions Survey](#), January 2021.

² Ibid.

³ Ibid.

The Rise of Managed Services

A natural progression for many organizations going from on-premises environments to cloud environments is moving to the consumption of infrastructure-as-a-service (IaaS). Organizations that understand the amount of resources consumed by their applications and workloads can simply consume those same resources in a lift-and-shift type migration. The same amount of storage, memory, and compute are made available in the cloud, software is deployed on those resources, and management is now done in the cloud environment.

While IaaS operating models are transforming the way organizations manage their infrastructure environments, the next wave of management simplicity and operational savings is being delivered to organizations via managed services. This simplifies, and in most cases simply eliminates, the need to manage the underlying infrastructure altogether, with the management burden falling on cloud providers or third-party application vendors. Organizations gain peace of mind knowing that resources will always be available. With ESG research showing that 24% of organizations cite skills shortages in application development and DevOps, alleviating management burdens for both developer and operations teams will prove valuable, giving both groups the time back they need to focus on what matters to the business.⁴

NoSQL in the Cloud

Organizations have turned to NoSQL databases for their scale, speed, and agility. They can deliver real-time data management at scale across a variety of data types, including semi-structured and unstructured data. With organizations prioritizing the accessibility of more data to more end-users, the idea of concurrency is important, and NoSQL can deliver high levels of end-user concurrency, while maintaining fast and consistent response times without increasing the risk of downtime. And while speed can be important from a response time standpoint, with NoSQL, it is also about better handling fast data. Organizations are embracing agility so by leveraging a database platform that can easily satisfy fast data requirements like frequent updates, organizations feel more confident in meeting the dynamic, real-time needs of a modern business. Put it all together, and relational databases are simply unable to check all the boxes.



Over the next 12-18 months, **1 in 10** organizations expect to make the most significant data-centric technology investment in NoSQL databases.

Today, organizations rely on a vast number of data services across the data pipeline from relational databases and data warehouses to business intelligence and data science platforms. While

NoSQL is a widely adopted technology, it is still primarily used in on-premises environments. Just 14% of organizations leverage NoSQL in the cloud.⁵ But major growth is on the horizon. The fact that NoSQL databases were purpose-built for cloud-like architectures is just the start. The purpose of NoSQL was to store and retrieve massive amounts of data across a distributed, fault-tolerant platform. The alignment to the cloud is, for the most part, perfect. Additionally, between NoSQL vendors prioritizing the availability of managed NoSQL database services, and a growing need to incorporate and manage vast amounts of data, it is all but guaranteed NoSQL cloud adoption will jump. In fact, out of all data analytics technology areas, 1 in 10 organizations cite NoSQL databases as one of the areas in which they expect to make the most significant investment over the next 12-18 months.⁶

⁴ Ibid.

⁵ Source: ESG Master Survey Results, [The State of Data Analytics](#), August 2019.

⁶ Source: ESG Research Report, [2021 Technology Spending Intentions Survey](#), January 2021.

What capabilities and attributes matter in cloud-based NoSQL implementations?

- Elasticity – NoSQL enables organizations to simply add or subtract nodes based on dynamic workload requirements without the need for downtime or secondary implementations.
- Scalability – Large or small volumes of data, high or low demand, more or fewer end-users at a given time, all of which are foundationally delivered to ensure SLAs are consistently met.
- High availability – The distributed nature of NoSQL enables data distribution and redundancy across geographies to not only ensure ideal response times but also to reduce risk in the potential for disruption.
- Flexibility – From supporting all data types and dynamic data schemas to pay-as-you-go cost models, NoSQL can address varying business demands from SMB to the enterprise.

Microsoft Azure Cosmos DB

Azure Cosmos DB is Microsoft's fully managed NoSQL database service that enables organizations to satisfy the speed, scale, and availability requirements of modern applications for a dynamic business. By prioritizing the delivery of right-sized resources at scale at any time across Azure regions, organizations gain peace of mind knowing their mission-critical applications are always available and performant regardless of end-user access location or end-user concurrency load. Through the seamless global distribution of replicated data, Azure Cosmos DB is redefining what always-on availability means. Recognizing that uptime and business continuity are critical to success, Azure Cosmos DB comes backed with 99.999% availability, also covering throughput, consistency, and latency. And through a rich development portfolio, developers gain access to the speed and flexibility they desire with SDKs and APIs for the top databases.

As an added benefit, Azure Cosmos DB serves as a gateway to the Azure ecosystem to enable organizations to continue transforming through application innovation powered by data. Whether more rapidly iterating on modern applications based on near-real-time data or infusing AI directly into applications, Azure Cosmos DB can significantly improve application development and lifecycle management. By minimizing data movement and tightly integrating with Azure Synapse Analytics, the availability of new data-centric services and underlying data can enable a next-generation application to continue to evolve based on the current or predicted needs of the business. And time savings extend to IT and database administration too. Since Azure Cosmos DB is a managed service, all management responsibilities of the underlying infrastructure, including updates and patching, are automatic. This extends to capacity management, with organizations benefiting from a serverless approach that auto-scales based on the exact needs of an application in real time.

Scale

Azure Cosmos DB delivers on the promise of true elasticity with purpose-built auto-scaling to ensure guaranteed speed at any scale from anywhere. SLA-backed performance delivers real-time reads and multi-region writes at low latencies across the globe, with data distribution to any Azure region with the click of a button. And since the solution independently scales storage, and more importantly throughput across those regions, organizations gain performance consistency and predictability even through peak demand or random bursts of activity. If more throughput is required, Azure Cosmos DB delivers it instantaneously. Once demand subsides, resource allocation adjusts accordingly.

Azure Cosmos DB not only delivers auto-scale at a database level, but even more granularly at a collection level, ensuring that the ideal amount of throughput is available to closely match specific workload requirements in real time. The delivery of right-sized throughput in real-time ensures there is no cost for excess capacity. Since it also includes hourly billing, Azure Cosmos DB can enable a level of cost savings unlike anything in the past. While true elasticity and auto-scale is enough for some customers alone, what about other operational tasks associated with replicas and shards? Since Azure Cosmos DB is a fully managed service, once an ideal shard key is selected with a good data model, customers can eliminate all operational burdens associated with maintaining replicas and shards of data.

CUSTOMER QUOTE

“We have already architected for the next 10 or 20 years of growth because Azure Cosmos DB has predictable scaling with their sharding system and predictable latency. We plan to reduce latency even further by using multiple write regions and other innovative Azure Cosmos DB features to keep giving our customers a faster service.”

--CEO, Web Development and Application Delivery Service Provider

Scalability and Elasticity Shortcomings from the Competition

While several NoSQL offerings have been around for longer than Azure Cosmos DB, their maturity advantage is often weighed against how they deliver a cloud-like experience. Solutions that compete with Azure Cosmos DB have been forced to deliver an underlying architecture that relies on instance types and/or VM-based implementations. And while these approaches have successfully satisfied static and minimally dynamic workload requirements, organizations want elasticity. They want to seamlessly scale up, down, in, and out without operational headaches.

Several NoSQL-managed services are available on the market today, but unlike Azure Cosmos DB, most leverage an underlying VM-based architecture that will struggle to deliver the elastic scale organizations desire. Think about how VMs scale. If organizations want to scale up, they will have to redeploy a cluster to larger VMs. The promise of auto-scale in other platforms has several areas of limitation that should be considered when compared to the instant auto-scaling and transparent and limitless auto-sharding of Azure Cosmos DB.

- **Scaling up** - It will often take time, in some cases hours, to even respond to an increase in demand and that response is usually in the form of overprovisioning. Aside from the possibility that the demand may be gone by the time more resources are available, the associated cost of those newly overprovisioned resources are now consuming customers' budgets. Additionally, a lack of granularity in how competing solutions scale means the entire database cluster will receive more resources, even if the only aspect that needs those resources is an individual collection.
- **Scaling down** - Simply scaling down resources once demand subsides is not instantaneous either. Scaling down can take several hours, and in some cases a full day. While this process may appear automatic, it is far from timely, can lead to significantly higher costs, and gives customers a false sense of elasticity.
- **Scaling out** - Horizontal scale is another area that competing NoSQL services handle differently. Adding additional nodes and sharding collections is not automatic. It is likely an operation that must be completed manually by the customer. It also adds the overhead of additional resources to manage that scale, further impacting cost.

Both Azure Cosmos DB and other managed services can help with ramp-up time and getting started. They can apply best practices and place customers on a path to success from the start. But since the other managed services rely on VM-based architectures, they are not much different than forcing customers to select their own VMs from public cloud vendors and deploying their own NoSQL databases.

Reliability

Azure Cosmos DB inherits the foundational services that make Microsoft Azure an industry leader when it comes to reliability and high availability. By decoupling storage and throughput, Microsoft can ensure the availability of the different types of resources independently. Azure Cosmos DB replicates data across regions configured within an Azure Cosmos DB account and maintains 4 replicas of data within a region. With market-leading 99.999% availability across multiple regions, business continuity is guaranteed. Organizations experience zero downtime with

automatic, multi-region write data replication across Azure region and recovery point objectives of zero when using strong consistency. End-to-end encryption-at-rest with customer-managed keys and fine-grained Azure role-based access control ensure the delivery of enterprise-grade security and compliance. Between annual investments on security research and development in the billions, thousands of employees dedicated to data security and privacy, and its position as the leader in number of compliance certifications, Microsoft Azure provides organizations peace of mind.

Flexibility

Flexibility is often discussed with a location in mind. Vendors, especially non-cloud providers, pitch flexibility as freedom-of-choice to prevent lock-in. While that angle worked well early on as a scare tactic disguised as a key selling point, today organizations care less about lock-in and more about strategic, long-term value. For Azure Cosmos DB, Microsoft's views on flexibility are focused on enabling developers.

Azure Cosmos DB was designed with developers in mind to help them alleviate the stress of making the wrong decision or creating a long-term problem. With flexibility as a core tenet of the solution, developers know any potential problem or debt can be viewed as minor and therefore can move faster, focusing on the business problem they are trying to solve instead of worrying about the underlying database. Azure Cosmos DB empowers developers, regardless of their coding backgrounds, preferences, or existing knowledge bases, to build modern applications more freely at scale with a wide range of open-source APIs, several SDKs, schema-less data, and no-ETL analytics. Deep integration with Azure data services like Azure Functions, IoT Hub, Azure Kubernetes Service (AKS), and App Service enables organizations to confidently build cloud-native applications. Developers rest easy knowing their top database APIs are readily available. By automatically

CUSTOMER QUOTE

“Our strategy is to leverage native cloud provider services and avoid the introduction of third-party services. Cosmos DB was the natural option. And with the MongoDB API, we saw that it would minimize our migration effort.”

--Data Architect, Global Insurance Provider

CUSTOMER QUOTE

“We haven't heard about upgrades for the last 4 years and that speaks for itself. It's seamless. It just happens without us even knowing.”

Director of Product Management, Engineering and Infrastructure Software Provider

indexing all data, the Azure Cosmos DB schema-less service ensures fast query response time regardless of the data model. Core (SQL) API enables using the language of choice with SDKs for .NET, Java, Node.js, and Python, along with a choice of drivers for any other database API. The Cassandra API lets organizations use Cassandra SDKs and tools, including existing drivers, to confidently deploy Cassandra as a service using Azure Cosmos DB capabilities and delivering the same SLA-backed capabilities as the Azure Cosmos DB service itself.

Native API support for MongoDB enables organizations with developers that have already developed applications with MongoDB to leverage the full benefits of Azure Cosmos DB with minimal code changes. And while Azure Cosmos DB suffers from a point-in-time single version gap between the latest version of MongoDB, when an upgrade is available, Microsoft Azure can

leverage their true managed service experience by minimizing, if not eliminating, the potential for down time during the upgrade. The traditionally complex and timely task of upgrading MongoDB becomes an afterthought, with single-click upgrades to the latest available version in the Azure cloud.

Azure Synapse Link

Leveraging Azure Cosmos DB is setting organizations on a path to data-driven success by seamlessly exposing Azure Cosmos DB users to the entire Microsoft Azure platform. One such example is Azure Synapse Link, which creates tight integration between Azure Cosmos DB and Azure Synapse Analytics. This integration enables organizations to embrace real-time hybrid transactional and analytical processing (HTAP) capabilities to run business intelligence, analytics, and machine learning pipelines on data in Azure Cosmos DB without the need to perform ETL analytics processing. Azure Synapse Link now supports API for MongoDB, meaning organizations can analyze data in Azure Cosmos DB API for MongoDB collections using Synapse Apache Spark or Synapse SQL serverless without impacting transactional workloads.

The Bigger Truth

As organizations embrace the cloud to satisfy next-generation data and application requirements, they are focusing on simplifying NoSQL operations. NoSQL is paving the way for them to adopt managed services to offset the burdens of managing these deployments at cloud scale. As more power is being given to developers to create modern applications infused with data, they should consider improved scalability, availability, and flexibility in addition to the usual platform-as-a-service benefits experienced by DBAs and developers alike. In this way, developers can free themselves from database management, issues related to leveraging platform connections, and concerns about impacting other end-users by consuming too many underlying resources.

As a true managed service, Azure Cosmos DB is helping redefine the new generation of NoSQL databases by enabling customers to take advantage of cloud flexibility, cost-effectiveness, and dynamic, limitless scale while avoiding the challenges of capacity planning and management. The result is a new level of operational efficiency. Everyone gets time back to focus on the business. And by enabling developers to leverage services on their terms, Azure Cosmos DB is setting organizations on a path to success.

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CUSTOMER SHOWCASE – GLOBAL INSURANCE PROVIDER

Introduction

With 107 million clients in 64 countries, a multinational company specializing in global insurance, investment management, and other financial services had a problem. They were using an existing data platform on-premises and had a company-wide mandate to move to the cloud, but issues with agility, annual rising support costs, and ongoing management led them to consider other options. Having already been familiar with Azure Cosmos DB from its internal use for smaller projects, the company realized it was a natural fit. They were able to reduce ongoing costs for their mission-critical applications in the cloud without the heavy lift traditionally imposed on organizations changing vendors through cloud migrations with limited in-house expertise.

Challenges

As they launched a company-wide “move to the cloud” program, business units were to first prioritize SaaS offerings, followed by PaaS offerings, with private IaaS deployments earmarked specifically for applications involved with managing sensitive data or packages not compatible with PaaS platforms. For NoSQL, existing deployments exposed some challenges. The company had some questions about agility, since providing an environment with their existing platform provider for project teams was set to take months. They were also concerned with costs. *“Year after year, we had to face significant price increases for support.”* They found patching and upgrades not only difficult to plan, but risky when it came to execution. And they lacked internal expertise to continue supporting their deployment. As they looked for options to migrate their existing MongoDB clusters to Microsoft Azure, they had the opportunity to study alternatives, which boiled down to a third-party service or Azure Cosmos DB.

Requirements

The top requirement for the company was cost efficiency. They needed to ensure cloud costs would not continue to balloon as their on-premises environment had over the years. Having already moved some workloads to Microsoft Azure, they knew that it was important to integrate with the Azure services that the company already utilized that delivered automation, operations, log management, and billing. *“As our strategy is to leverage native cloud provider services (avoiding introducing third-party services), Cosmos DB was the natural option.”* They were unwilling to sacrifice performance, so that same level of performance must be delivered in the cloud as in their on-premises environment. Finally, compatibility with MongoDB was crucial to minimize the effort for migrating their existing code.

Benefits

The business benefits that the company has achieved since moving to Azure Cosmos DB have been profound. Since Azure Cosmos DB is a managed service, it was easy to deploy, and operations are taken care of. *“Cosmos DB is much easier to operate. There is no longer a need to care about the technical layer.”* They have gained scalability and elasticity on their terms. *“With Azure Cosmos DB as our cloud database service, we are able to upscale/downscale on demand or configure auto-scale for max limit usage with RUs.”* And they have benefited from a pay-as-you-go model to deliver cost savings far beyond their expectations.

CUSTOMER QUOTE

“For our largest application running on Cosmos DB, we currently have 5 times the number of end-users than what we had on-premises, and we’re still seeing savings of 40-50%.”

--Database Administrator, Global Insurance Provider

CUSTOMER SHOWCASE – WEB DEVELOPMENT AND APPLICATION DELIVERY SERVICE PROVIDER

Introduction

As a global web development and application delivery service provider, ensuring high levels of customer satisfaction was critical. But the burden of ongoing database management, performance bottlenecks, and high costs as their user base grew was making it nearly impossible to continue meeting customer expectations. As a serverless infrastructure company themselves, they believed deeply in managed, automatically scalable solutions. Azure Cosmos DB was the answer. And the result continues to be reliably delivering consistently high levels of performance across the globe while better enabling developers to make the right decisions as they continue to enhance their offerings.

Challenges

This company tried retrofitting its own self-managed solution, as well as a managed service offering, but the database kept collapsing. The process of opening support tickets and SSHing into an underlying VM to restart the database was worrisome. *“We were becoming ‘DBAs’ but our business wasn’t that.”* They kept experiencing performance bottlenecks and high latencies. With no guardrails for developers, it was difficult to ensure they could enhance their solutions in a meaningful and reasonable way without breaking the underlying databases or exceeding budgets. They continued to feel like the underlying databases had been designed for a previous generation of hardware and software. If you do not design a database for a serverless cloud, it becomes obvious over time and easy to identify holes.

Requirements

Familiarity was essential with an ideal solution delivering a SQL-like query model. Knowing there were no database experts in house, it was essential that they implement a fully managed solution with zero operational responsibilities. Ensuring performance and predictable latency was a must, as this capability would be directly passed on to their customers. Global replication was essential to maintain business continuity and high availability. Buy-in from their developers was critical. *“I wanted to make sure the designers deeply understood the science behind the database and that it wasn’t a marketing gimmick.”*

CUSTOMER QUOTE

“We’ve seen 5-10x improvements in latency because of moving to Cosmos DB, and I can sleep at night knowing I can guarantee sub-second response times. We’ve 5xed the size of our business without having a single database bottleneck. We have already architected for the next 10 or 20 years of growth.”

--CEO, Web Development and Application Delivery Service Provider

Benefits

After writing a proof-of-concept (POC) in a matter of days through the self-service offering, they saw immediate value. Today, the company employs zero database experts and does not have a database operations team. Their customers continue to praise their dashboard experience and underlying infrastructure as much faster than the competition. And SLAs for performance and availability ensure predictable latency with painless global failover.

For developers, understanding the ramifications of a coding decision has proven to be beneficial. *“Our developers understand the “cost” of everything they do at development time thanks to the ‘credit system’ that Cosmos DB implements, which assigns a cost to each operation. In other words, we’ve upgraded our developers to also be ‘economists’ and help our business evolve in a reasonable way.”* And APIs are an order of magnitude faster, especially when under heavy load.

CUSTOMER SHOWCASE – ENGINEERING AND INFRASTRUCTURE SOFTWARE PROVIDER

Introduction

This 37-year-old company develops software used by engineers and architects, construction companies, and owner-operators around the world. It continues to be leveraged today by 49 of the 50 states to design roads across the country. But across their 60 major products and services, they had multiple data models, including information corresponding to various disciplines, including architectural, mechanical, structural, and electrical. By leveraging a NoSQL database, they could easily ingest construction data from several products, consolidate it using a dynamic data schema, and map various schemas within it. But between management inefficiencies and scalability concerns with their existing provider, they were all but forced to explore other options. Azure Cosmos DB delivered a fully managed service that was compatible with their existing applications and ensured the predictable delivery of scalable data services.

Challenges

Management was central to their ongoing challenges with their existing provider. They relied on a VM-based architecture that proved to be too resource-intensive. *“When using VMs in the cloud, you have that type of architecture where you are basically responsible for security and for all the software updates. You incur the risk on safety of the infrastructure.”* While simply deploying a NoSQL database on VMs proves to be cost-effective at first, as the infrastructure is forced to scale to meet the needs of more services and more customers, inefficiencies become more apparent. Having the operations team constantly create more instances to scale-up became too time-consuming, and they found themselves paying for unused resources.

Requirements

For their customers, every construction project could present a new, unique situation, whether it was due to different procurement restraints, design codes, or city rules. Supporting their customers’ agility remained core to their technology selection criteria. A common use case today for many of their customers is around cause and effect. They needed to ensure customers could quickly identify and understand value based on the effect or impact of a change. *“Some of the what-if scenario queries or concept comparisons can touch millions of records.”* Delivering predictable performance at scale without extending costs past projections was critical. And they needed to do this without the ongoing burden and overhead they had already experienced with the traditional management and maintenance of VMs.

Benefits

The benefits were seen immediately, with the simple transition to Azure Cosmos DB. Dynamic scaling enabled them to address cost concerns and auto scaling helped them keep costs reasonable. *“You have enough resources, and with throttling, we could figure out sweet spots to find the ideal response time back to the users.”* There is no such thing as updating anymore. They are simply able to consume new features and just reap the benefits. *“We haven’t heard about upgrades for the last 4 years and that speaks for itself. It’s seamless. It just happens without us even knowing.”*

CUSTOMER QUOTE

“We have trust in Azure - we have the level of support we want and know the quality of product that we're getting and reap the benefits.”

--Director of Product Management, Engineering and Infrastructure Software Provider