White Paper

Effective Data Management Is Essential for Taming the 5G Network Complexity Beast

Sponsored by: MongoDB

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INTRODUCTION

Communications service provider (SP) traffic volumes are progressively increasing as networks evolve, user devices gain greater capacity, and applications engaging with advanced network data such as that from the 5G standalone (5G SA) network exposure function (NEF) start to deliver on customer expectations. Cloudification of network functions — virtualized network functions (VNFs) and cloud-native network functions (CNFs) — is placing new burdens on old systems and processes not designed to manage intent-based network architecture. Silos of data locked within many installed systems keep transformation efforts from reaching anticipated objectives.

5G services are breeding new expectations for both consumers and business/enterprise customers. Millions of users and billions of connected devices (mobile phones, purpose-built Internet of Things [IoT]) — and scores of applications residing on these devices — each have their own operational policies to ensure adequate network performance, service availability, and quality of experience.

This paper explains why a modern data platform built on the principles of dependability, adaptability, flexibility, scalability, and availability is so essential for addressing transformational change in today's rapidly evolving real-time business environment. Increased automation needs and AI-driven operations depend on a developer data management platform such as MongoDB that can satisfy these requirements while addressing rising network and operations complexity along with growing customer expectations.

ADVANCED NETWORK ARCHITECTURE UNDERSCORES DIGITAL SERVICES COMPLEXITY

Through the 3GPP service-based architecture (SBA) road map, the 5G core charts the use of new 5G network functions, which are designed to help communications SPs deliver transformational value while offering the potential for creating sustainable new revenue. The need for automation escalates as communications SPs manage a growing multi-technology network with increasing complexity that must also operate within a minimally used interactive partner environment (see Figure 1).

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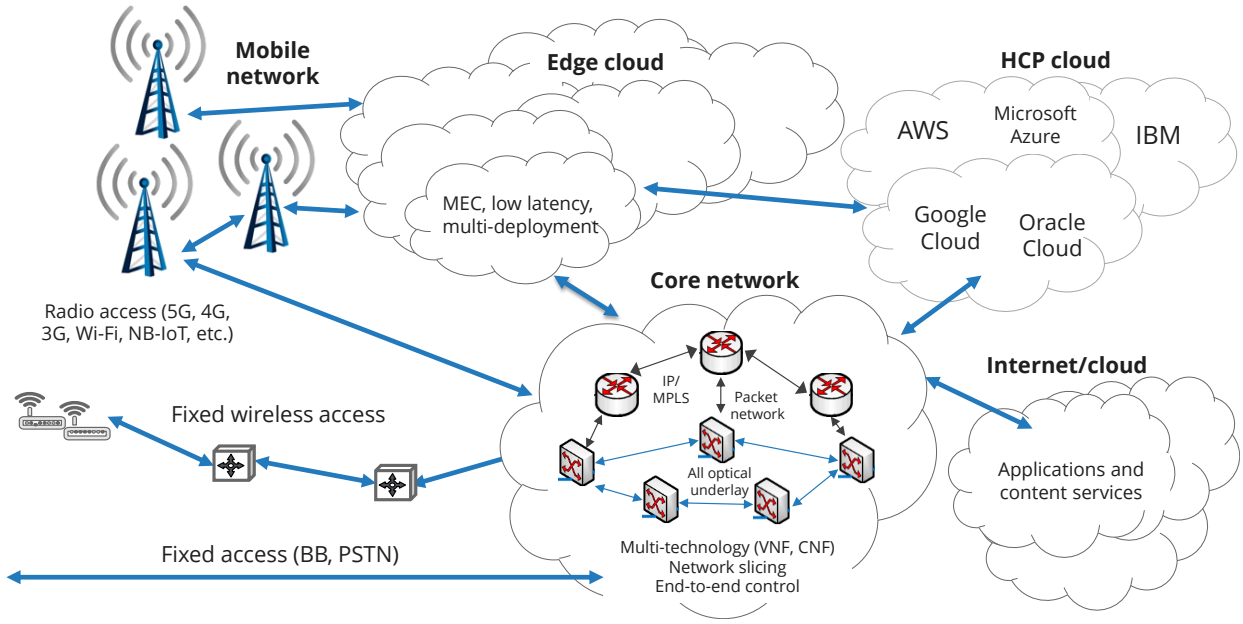
FIGURE 1

Multi-Technology Network Architecture — Complexity Abounds



Source: IDC, 2022

The 5G SA core can be orchestrated to deliver a customized service-level approach to industry verticals that offer a new tier of automation, innovation, and service agility. Enabling communications SPs to cater to customers at a deeper level is where 5G SA stands apart from prior mobile generations. 5G services also hold the greatest potential for addressing the financial challenges of finding new revenue streams that can augment a shrinking connectivity services business.

5G-Enabled New Generation Services

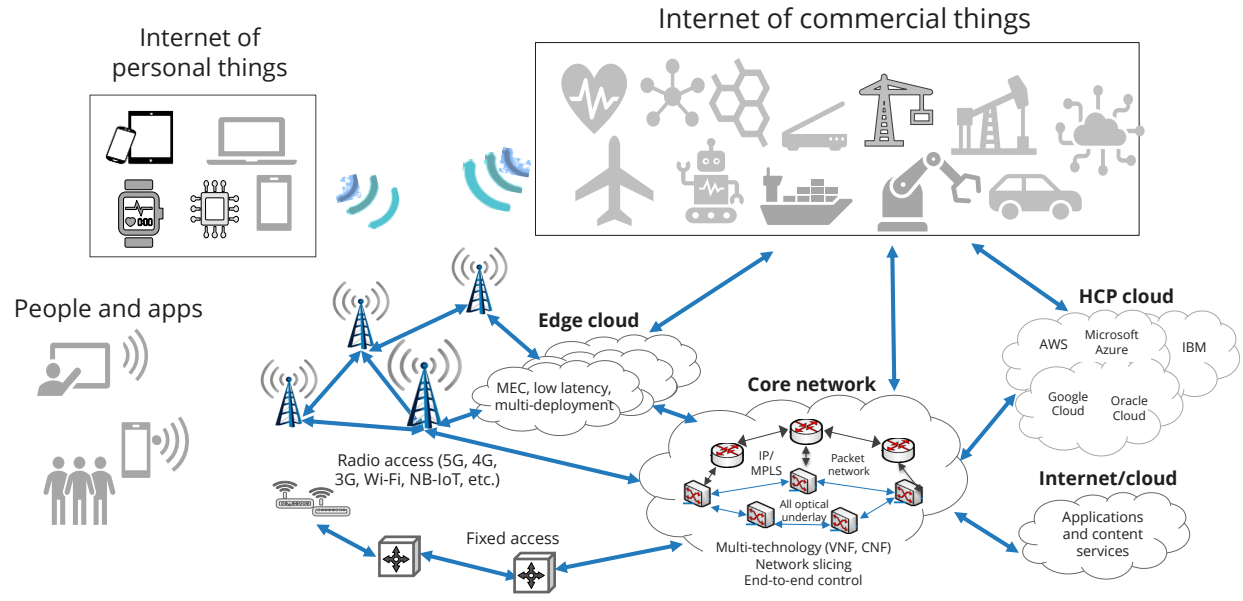
Social media, video, search, gaming, transportation, and industrial IoT are applications generating network traffic and associated data at compound rates. Business solution developers are expecting 5G-enabled networks to change how services are defined and strategic outcomes are achieved, especially when services are delivered at the network edge (see Figure 2). For example:

- **Manufacturing.** In high-speed production facilities, a combination of the right network functionality – in this case installation of a private 5G network – helps note production defects by using high-speed computer vision techniques to identify and remove incorrectly assembled circuit boards from the production process.
- **Architecture and construction.** Architectural layouts and robotically measured site dimensions collected through all stages of the construction process are recorded and stored in the cloud for access by construction teams, inspectors, and customers.

- **Sporting events.** In baseball, football, or basketball, the collection and processing of data at the edge are rapidly advancing for the delivery of value in different ways and for different reasons to customers, players, coaches, media outlets, and venue suppliers. Through multisided business models, different insights are revealed only to those who need to know. As mobile contactless experiences become the norm, and as more businesses move to digital services, edge computing is oftentimes faster and a more reliable alternative for data processing at scale. Data from different sources, processed and presented in different ways, can satisfy the expectations of multiple customer groups according to specific needs.
- **Security services.** In security, video surveillance delivers physical security at much lower costs than manual methods.
- **Healthcare.** In healthcare diagnostics, medical practitioner insight is expanded through analytics, purpose-built software, and advanced connectivity. For other healthcare applications, data is provided via low-latency and high-bandwidth slices designed to deliver the highest probability of generating positive patient outcomes.
- **Automotive.** Similar to what is happening in the manufacturing industry, vehicle sensors generate increasing data volumes, which can offer insight into preventive maintenance needs, traffic patterns, driver actions, emergency diagnostics, vehicle location, routing, proximity, unassisted responsiveness, and similar insights pertaining to the vehicle as well as its passengers and interactive content.

FIGURE 2

Customer Expectations Are Evolving Well Beyond Basic Network Connectivity



Source: IDC, 2022

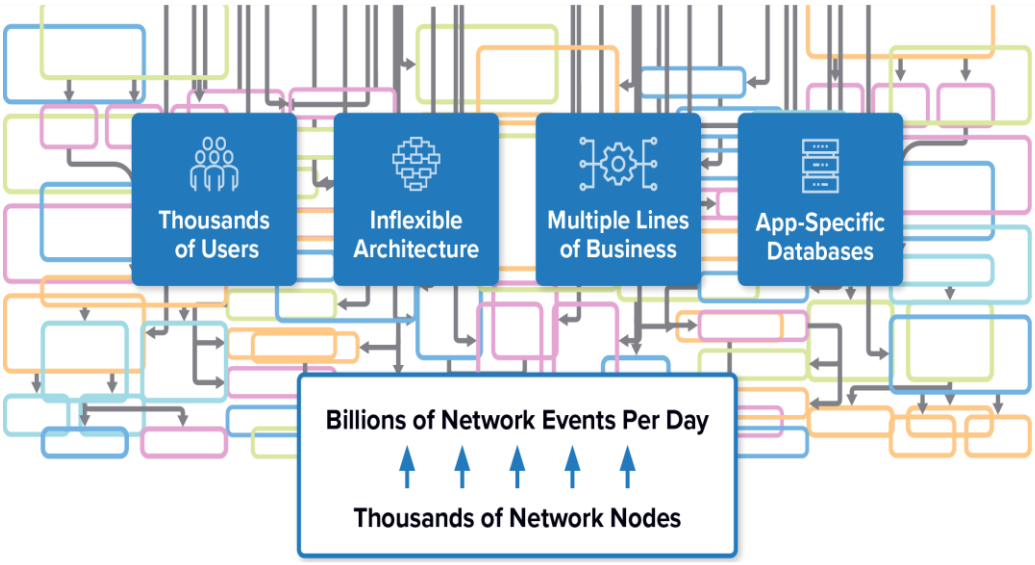
Customers desire an understanding of how services, as they have defined them, are addressing their needs. Communications SPs want a single view of how network behavior meets customer expectations. This personalized approach to network-based solution development is the basis for 5G SA network slicing with the accompanying change in how customers will forever regard network connectivity services.

NEW OPERATIONS CHALLENGES AND TODAY'S DATA MANAGEMENT CONUNDRUM

Business and operational processes today still depend on installed systems that in many cases were implemented decades ago. These systems were designed to satisfy operational functions using dedicated data silos but lack the design agility to meet the orchestrated, real-time interactions that 5G SA network slicing and multi-access edge computing (MEC) IoT business solutions require (see Figure 3). Within this tightly integrated architecture, change execution is slow as both systems and processes are optimized for long-term support of static consumer-focused service offerings. Installed systems and the processes they work in were not designed to address the dynamic change or real-time accountability that 5G technology and cloudified networking need.

FIGURE 3

Legacy Network Operations and Business Management Architecture



Source: IDC, 2022

5G is software driven and continues to evolve through a cloud-native network architecture. With this evolution, network complexity expands. Providing an ideal customer experience means operations must include network automation and extensive data analysis to enable customers to define the 5G SA parameters that meet their specific needs and then for the network to execute on those needs. Challenges plaguing communications SPs as they prepare for an onslaught of new operations and monetization requirements from 5G and MEC include:

- Existing process complexity, minimized flow through systems integration, and data inconsistencies within workflows
- Inflexible systems and embedded data that are often duplicated for the same business functions
- Order processing delays, elongated times to create new service tariffs, and disconnects between the order management function and the network resource orchestration function
- Dependencies between internal workload steps that are almost impossible to understand
- Minimal service transparency, little customer insight, and no ability to provide customers with delivery status or operational usage to plan comparative measures

- Lack of real-time or dynamic architectural capabilities
- Data to drive artificial intelligence (AI) and machine learning (ML) algorithms that is distributed across multiple installed IT systems and new cloud-based technology infrastructure

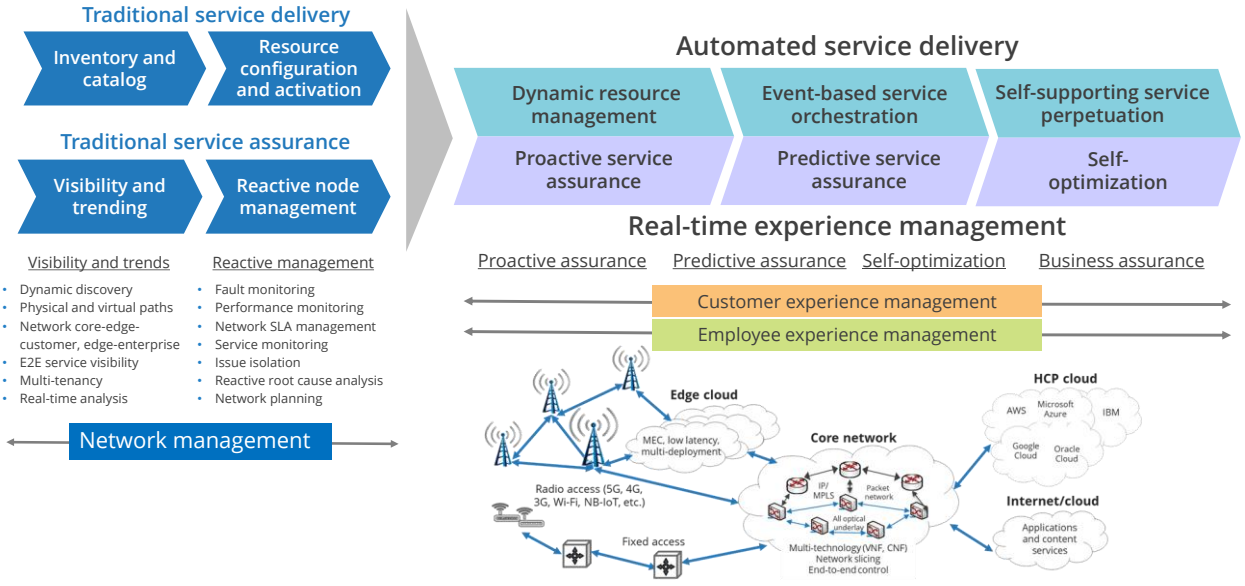
Systems powering the behind-the-scenes operations, assurance, and monetization processes must become more real time and dynamic to stay abreast of customer expectations and to meet technical requirements, especially those involving network latency, data sovereignty, and cloud traffic management. Advancing business process improvement initiatives and continuous automation plans push forward customer experience issues for systems that can demonstrate enough agility and flexibility to satisfy customer expectations now and in the future. IDC believes that building flexibility and real-time responsiveness into a communications SP's data model designs and billing functions, recognized as the most essential operations domains for achieving and maintaining positive customer relationships, is critical to long-term business success in the 5G era.

CUSTOMER AND SERVICE-LEVEL ASSURANCE

Network operations analysis, also known as service assurance, is an essential function involving network data collection for noting anomalies and for identifying the root cause of equipment failures within the traditional network fault management and performance monitoring functions. To address the real-time complexities 5G/MEC brings to bear, the assurance function is now consolidating with the service fulfillment process (see Figure 4). For example, network latency thresholds from an assembly-line process or autonomous vehicle operations have very different technical needs and tolerance limits pertaining to how a low latency, high bandwidth, and ultrafast connectivity path is used. Both, however, require real-time monitoring to guarantee that service operability stays within service-level agreement (SLA) boundaries and to make real-time adjustments when nonconformance is detected.

FIGURE 4

Automated Real-Time Service Delivery and Experience Management



Source: IDC, 2022

Advances in compute capacity and data visualization have increased how business solution and network management suppliers view portions of the service assurance processes, now known as network observability. Insight, rather than data, is fast becoming a necessity in day-to-day operations, especially as that insight powers select management processes. New business models combined with augmented technical skills from sources outside the communications SP ranks increase demand for data management and automated data analysis. However, data management challenges tied to existing data stores and new data-generating technology operating independently limit what most communications SPs can now do.

Insight at both the customer and network levels is important for measuring and managing the customer experience — the customer-facing part of service assurance. Incorporating this insight requires nonstop data analysis that when properly applied can deliver enormous operational benefits and increased customer value. A key aspect of data insight involves data management — data collection, data cleansing, data reconciliation, and data normalization. Meeting the data integrity expectations of AI/ML requires a platform upon which quality data can be assembled and accessed.

Although 5G and MEC are evolving, it is the operations and monetization functions that remain an industry concern. From a new requirements perspective, existing systems are now challenged to be more real time and to repeatedly synchronize with multiple business processes. Network slicing pushes real-time operational needs to the order management, service and network orchestration, provisioning, inventory, assurance, and monetization functions. Owing to this real-time and dynamic necessity, combined with new 5G SA network functions such as the network data analytics function (NWDAF) and NEF, several communications SP projects now use vendor solutions delivered via a software-as-a-service (SaaS) model for quickened responsiveness to new business needs and a greater ability to address change.

NETWORK APIS: ENGAGING WITH CUSTOMERS AND PARTNERS IN THE EXTREME

5G SA provides a new generation of network-embedded services tied not just to speed, data delivery, and low-latency responsiveness but also to services involving network operations data, network traffic control, routing definitions, device location, and even service quality levels. 5G SA offers the ability to provide an infinite range of programmable network permutations, underpinned by cloud-native containerized microservices for addressing 5G core network functions. One of these functions, the NEF, acts as a two-way API for external organizations, such as experience providers, API platform providers, smart manufacturing enablers, and application developers (e.g., gaming, healthcare, sports, logistics, and smart cities), to engage the network following a personalized set of connectivity conditions (network slices) and the dynamic mapping of users to these resources.

Control of a customer's "piece of the network" is what keenly defines network slicing, something that will be enabled at scale within the next 12–18 months by some of the largest communications SPs and likely another 12–18 months following for smaller network operators. The NEF can bring 5G connectivity value to simple devices with predictable behavior when the API and device both operate correctly. As necessary, the API can also be used by the app to send back to the network needed operational attributes for meeting connectivity performance requirements.

Multiple NEF-based APIs can be aggregated into IT "services." Each service will have a single interface point that certain customers can use to write apps that take advantage of services within a single communications SP's network without the complexity of each developer negotiating this advanced capability with each communications SP they may need to engage. Data from each network

API must be accessed the same way by each customer using the API and provided the same data elements each time, thus requiring a data management platform that is fit to task for how network APIs interact with a communications SP's partners. In this environment there are several operations and monetization process issues that need attention, some of which are:

- **Partner enablement.** Simple onboarding, and in some cases offboarding, of developer partners is strategic. How will the data platform digitally enable and keep track of partner inventory, usage, and contract remuneration details? How can partners (especially developer partners) access the platform simply but have every action monitored from an assurance, performance, monetization, and fraud management perspective?
- **Service assurance.** Communications SPs have always monitored each network connection to make sure service affecting issues do not occur. API management is no different. How will the quality of API service delivery be monitored? How will problems be notified? What level of automation will need to be involved and how much will require manual attention?
- **API provisioning, catalog, and access management.** API available inventory will need to be monitored for service quality and operability. How will APIs and API-based IT services be made ready for developer access? How will they be allocated by developer partners? How will available inventory be broadcast as available?
- **API activation.** Will APIs be naturally "always on?" If not, how will simple APIs and complex API-based IT services be made available to developer partners? What, if any, manual work tasks are necessary for value creation?
- **API usage charging.** How will API usage be measured? How will developer partners be charged for API access? Are all APIs priced with the same value?
- **API dashboard reporting.** Real-time usage measures by partners, their customers in some cases, and communications SPs are important. How will this information be created? How will it be conveyed when levels of detail and insight need to vary between the parties involved with the network API usage processes?

Network API service offerings will be gradually introduced over the next few years. IDC expects communications SPs to tailor engagements with enterprise verticals, systems integrators, developers, and other platform providers through customer marketplaces that enable third parties to tap into specific network connectivity features that are aligned with their application needs. Considering engagement models, communications SPs could provide access to a variety of network APIs through their own marketplace or potentially work with partners, including hyperscaler cloud providers (HCPs), by enabling white-label APIs on the back end for shared opportunities.

ENABLING MODERNIZATION WITH A NEXT-GENERATION DATA PLATFORM

Addressing the data challenges that new telecom technology brings means that a communications SP is capturing and leveraging the vast volumes and variety of available data. Databases are at the heart of every software application, and every application requires a database to store, organize, and process information. Most communications SPs have hundreds of applications and associated databases — some siloed and some sharing common data infrastructure.

A database directly impacts an application's performance, scalability, flexibility, and reliability; hence selecting the right database is a strategic decision that directly impacts developer productivity, application performance and, ultimately, an organization's attractiveness to customers. Getting the data from network and operations management sources aligned across a common presentation layer

is an added challenge that is hampering most AI/ML automation efforts today. Attributes relative to time-based responsiveness to business needs — especially when latency-sensitive service offerings are at play — along with total cost of ownership, and time to market for new applications, are critical for communications SPs that are defining new network and support management architectures.

Legacy relational databases were first developed decades ago, and their underlying architecture remains largely unchanged even though the nature of applications, how they are deployed, and their role in business have dramatically evolved. However, relational databases were not designed to support the volume, variety, and velocity of data that is generated today. In a relational database environment, developers are often required to spend significant time fixing and maintaining the linkages between modern applications and the rigid structure that is inherent in relational offerings. Relational databases were also built before cloud computing was available and were not designed for always-on globally distributed deployments.

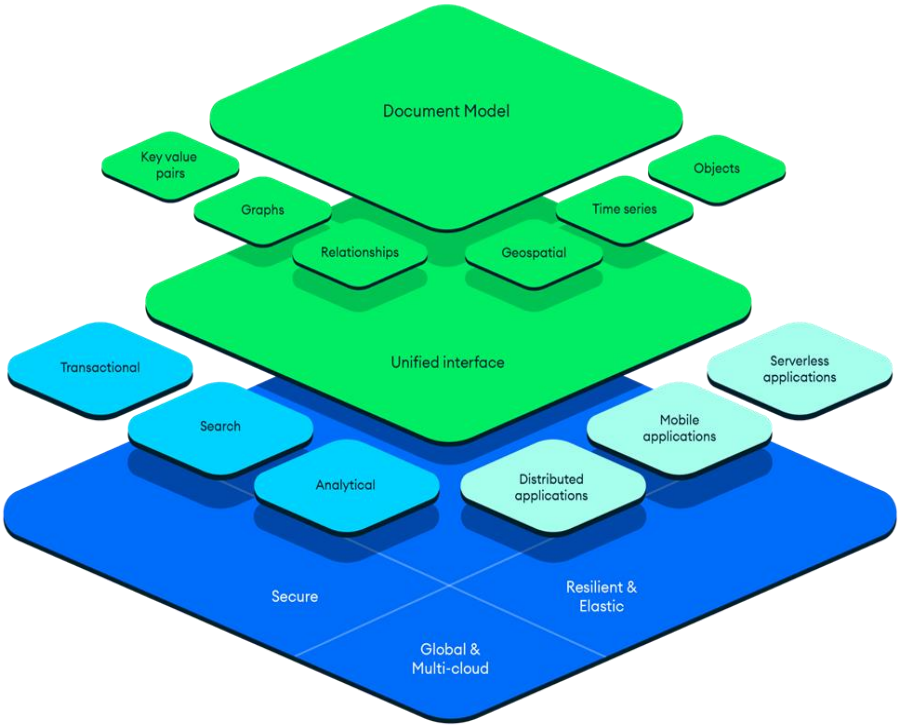
MongoDB's developer data platform combines the most essential parts of relational and nonrelational databases, enabling developers to build and modernize applications across a range of use cases. Companies deploy the platform at scale in the cloud, on-premises, or a hybrid environment. The MongoDB document-based architecture — an intuitive data model that enables developers, provides a flexible schema, and delivers horizontal scalability — maps to the objects in code. Through this architecture, the needs of an organization relative to database performance, scalability, flexibility, and reliability are accomplished while maintaining the strengths of legacy databases (see Figure 5).

Key features of the MongoDB developer data platform are:

- **Search.** An integrated full-text search is included, thereby removing the need to run a separate search system alongside the database.
- **Queryable encryption.** Users can run expressive queries on fully randomized encrypted data — security without sacrificing performance.
- **Device sync.** This enables the build of mobile applications with edge to cloud data synchronization using the Realm mobile database on the front end and MongoDB on the back end. Data is synchronized with out-of-the-box networking code and conflict resolution to accelerate application development while ensuring the mobile device experience is responsive and performant, regardless of connectivity.
- **Time series.** Database users can optimize for the demands of time series workloads — streaming data ingestion, indexing, fast query processing, and compressed storage footprint.
- **Dynamic scalability.** The platform can automatically scale up and down to accommodate increases in traffic or reduce costs during lulls in traffic.
- **Data lake.** A data lake capability supports native query, transformation, and movement of data across MongoDB clusters and cloud object storage.
- **Charts.** Customers can create visual charts and dashboards of all MongoDB data with built-in tools for sharing and collaborating on visualizations while also enabling the embedding of charts within customer applications.

FIGURE 5

MongoDB Developer Data Platform Functional Architecture



Source: MongoDB, 2022

The MongoDB developer data platform is provided to the global market in two product formats: MongoDB Atlas and MongoDB Enterprise Advanced:

- **MongoDB Atlas.** The company's hosted database-as-a-service (DBaaS) offering can be run and managed in the public cloud. It is an elastic managed offering that includes automated provisioning and healing, system monitoring, managed backup and restore, default security, and other features to reduce operational complexity and increase application resiliency.
- **MongoDB Enterprise Advanced.** MongoDB Enterprise Advanced is a license subscription package for the MongoDB developer data platform commercial database; has a suite of management tools to enable operations teams to run, manage, and configure the MongoDB developer data platform according to business needs; and has an integration point for enabling business analysts to review data in applications running on the platform by using existing analytics tools.

The MongoDB developer data platform was created to remove technical challenges, thereby enabling developers to focus on how applications use the data set, application performance, and the end-user experience rather than database infrastructure management.

CONCLUSION

Communications networks are undergoing massive change in how they are defined and deployed, but so are the business strategies of enterprise customers and large businesses globally. Everyone wants ubiquitous connectivity at faster speeds and with responsiveness measured in milliseconds. Millions of devices need to be connected in different ways to satisfy a growing array of application and business management requirements. The number of network extensions through 5G/MEC strategies is exponentially increasing, and all of the extensions generate data.

Managing the operational aspects of new technology and new business models still depends on network performance, business solution applicability, and enabling a positive customer experience. Data is the fuel that keeps these processes and the software applications that support them running. Working with next-generation data management solutions, such as the MongoDB developer data platform, helps organizations leverage new and older systems to meet business objectives and customer expectations.

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International Data Corporation (IDC) is the premier global provider of market intelligence, advisory services, and events for the information technology, telecommunications and consumer technology markets. IDC helps IT professionals, business executives, and the investment community make fact-based decisions on technology purchases and business strategy. More than 1,100 IDC analysts provide global, regional, and local expertise on technology and industry opportunities and trends in over 110 countries worldwide. For 50 years, IDC has provided strategic insights to help our clients achieve their key business objectives. IDC is a subsidiary of IDG, the world's leading technology media, research, and events company.

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