Grey Matter Data
A Distributed Data Network Framework for the Grey Matter Intelligent Service Mesh
Once thought to be the new oil, data was treated as a rare commodity – elusive and difficult to capture. But now, this paradigm has changed. Today, we live in a world of boundless information. Per research published by the data aggregation company DOMO, internet users generated 2.5 quintillion bytes per minute in 2017. This explosive growth has shown no indication of slowing.

Where once we feared a lack of data, we now fear just how much data we miss. The main reason for this concern? The realization that lost data equals lost value. Those enterprises effectively capturing, analyzing, and sharing their data grow and thrive. They improve and maintain customer satisfaction, and are better insulated against technology and business challenges. Those that fail ultimately wither and fade.

Successful enterprises realize that data comes in many shapes and sizes. Today’s enterprise data environment is a flood of content, analytics, metrics, telemetry, and abstracts, each serving many business purposes. Globally distributed systems produce countless signals and indicators. When captured and analyzed, they offer rare and valuable business insights.

Leading enterprises also realize that their data must be kept pure and accessible. Much like the air we breathe, data can harm if tainted. However, it can be deadly if deprived. Finding the right balance between data availability and security is critical to business survival.

Decipher’s Grey Matter service mesh platform supports the rapid, secure, and reliable transfer of geographically dispersed enterprise data across cloud/hybrid infrastructures running thousands of microservices. In the following pages, we discuss Grey Matter and its core aspects, with particular focus on Data, the platform’s Data Distribution Network (DDN). We close with an explanation of how the Grey Matter platform as a whole facilitates intelligent network
The DDN Explained

To understand the value of the Grey Matter Data DDN, we must first explain the DDN concept.

operations to provide maximum value for today's enterprise.

How the DDN Works

Similar to the concepts of a Content Delivery Network (CDN), a DDN brings data closer to the point of use. DDNs accomplish this by establishing a globally-distributed network of edge servers to optimize web data delivery. In its full-implementation each sidecar proxy within an Enterprise service mesh could become an “edge” node within the DDN.

The Grey Matter Data edge servers work in unison to manage data delivery in the fastest, most efficient means possible to the consumer. Without a DDN, data networks are prone to constriction and congestion. Cutting the distance between requestor and data source shortens data round-trip time, allowing for higher data throughput between the user and the delivery server. Websites, applications, and microservices can offer richer user experiences by transferring more data. Likewise, the availability of multiple regional data nodes provides a number of data availability avenues. With the DDN, the loss of one server doesn’t mean a loss of critical user connectivity to required data.

Value to the Enterprise

The DDN offers enhanced network speed and reliability at reduced cost. Our DDN scales to meet traffic requirements while offering improved security against cyberthreats such as Distributed Denial of Service (DDoS) attacks.

The explosive growth of the worldwide web in the late 90’s forced internet service providers to find a means of meeting the growing global demand for reliable, on-time data delivery. Before the introduction of the CDN, a single server delivered enterprise data to the user. This server handled every request from every user around the world. Such servers became quickly overwhelmed. Website reaction times slowed and customer satisfaction dwindled.

All of this occurred in the earliest days of online business, when users tolerated technological limitations. Today however, speed, or the lack
thereof, kills. According to 2016 research from the digital performance metrics firm Dynatrace, almost half of all users will leave an application should its content not fully load within three seconds. *Three seconds.* Making matters worse, Dynatrace estimates that for every further half second delay, the enterprise loses an additional 10% of online sales.

As web enabled applications continue to evolve and adapt to the quintillion bytes per minute created by human interactions in a ubiquitous computing world, the concepts of the CDN must be further adapted at lower levels. With Enterprises adapting cloud and hybrid infrastructure such as Kubernetes, serverless, microservices, and fully managed service mesh technologies, the need for a more granular data distribution network is required.

DDNs improve information delivery speed. Each distributed DDN node caches data such as images, video, and other common dataset elements. Since these elements make up the majority of content load time, it makes sense that they should be closest to the microservice within the mesh that requires it. This proximity reduces latency and increases the volume of data that can be supported between the user and the network. Modern applications can be enriched with greater complexity, reliably offering a wider array of depth and capability to users regardless of their distance from the enterprise.

This improvement in speed brings improvement in user experience and customer satisfaction. The meteoric rise of online video content would not have been possible without this technology. An implementation of a DDN is critical to enabling the enterprise to continue to support the user on their terms, flexing from device to device, wherever today’s nomadic user may be. Satisfied users have longer site dwell times which equals greater chance of customer satisfaction and accomplishment, accompanying user data capture, and of course, sales.

Beyond improved customer satisfaction, the enterprise also gains from reduced operational costs. Cacheable data closer to the user cuts down on bandwidth consumption and other related network costs.

The enterprise also enjoys second and third-order savings from reductions in data center capacity requirements and electricity consumption. And because the user and transactional data flow through the enterprise’s internal DDN, valuable business metrics are captured which can help further refine operations.

### The Grey Matter Service Mesh

Decipher’s Grey Matter is a platform agnostic service mesh platform that simplifies and enhances decentralized network management for the enterprise. Grey Matter is comprised of three elements: the Fabric proxy infrastructure management layer, the distributed Data network, and Sense, the cognitive network artificial intelligence layer.

The mesh is typically comprised of a network of sidecar proxies specially adapted to control communications between services. These proxies manage the network, allowing the services to focus on executing their designed business roles.

By their nature, proxies generate more telemetry and operational data than the monoliths they replace. This data is exponentially multiplied in the case of decentralized and distributed systems. Modern mesh-enabled applications may contain hundreds or even thousands of microservices across countless instances. Each may require significant tooling, management, and orchestration, generating even more data. The DDN facilitates effective capture and use of this telemetry and content data.
The Grey Matter Data DDN

The Grey Matter Data Distribution Network (DDN) enables secure enterprise data capture, store, synch, cache, move and share of any kind, to- and from- consumers and services, anywhere around the globe.

Grey Matter Data goes even deeper. Data handles massive stores of any data type, while enabling fine-grained telemetry capture and powerful data analytics. As users and systems share content, the DDN caches it, capturing the atmospheric data generated on the fringes of these transactions. This atmospheric data feeds powerful business analytics and advanced AI.

Data supports the enterprise beyond mere data storage and content delivery. With Data, the enterprise can better manage information reduction, security and compliance, human “big data” interaction, and structured and un-structured data-mining for actionable insights. For instance, several microservices within an enterprise service mesh may be responsible for handle autonomous large dataset processing. These processes are typically designed to support enhanced data augmentation, conceptualization, and understanding for human users.

The Grey Matter Data DDN In Depth

Grey Matter Data is an immutable, timestamped fact database that collectively describes a file system. They are “facts” because they are true as of a particular time. Later assertions, even those changing the attributes of an object in the system, do not change the initial assertion of fact. Hence if the first fact is about the creation of an object and the second is about its deletion, then the object will not appear in search listings at the time of search, but it will appear at any time before deletion.

User authentication and authorization by attribute labels is done via JSON Web Tokens (JWTs), negotiated via OAuth2 handshake and cryptographically signed by a trusted identity provider. Users (human or service) are authenticated at the identity provider (perhaps through PKI certificate or a Single-Sign-On portal), and then select what subset of their (perhaps large and highly-revealing) set of attributes will actually be sent to the service. This allows for minimal identification and even anonymous access where privacy-concerns are paramount. Conversely, full identification is also possible should auditing requirements dictate. Data is very flexible in this way.

Thereafter a user makes each request to Data with the given JSON Web Token (JWT) included in the request headers until it expires. Because the JWT is cryptographically signed by a trusted source, the JWT is sufficient to authenticate and authorize the user. No subsequent request is necessary. This eliminates a common extra step that may be required by other systems at every request or data item return, improving performance and security.

Grey Matter Data is “eventsourced,” meaning that an ordered log of events is sufficient to replicate the database. This makes replication easy. Remote Data installations can simply subscribe to another installation’s message queue of events, copying the database. This also enables targeted replication, whereby one installation is only authorized to receive a subset of another replica’s events. Although the installation uses a nearly identical replication mechanism, it receives a different picture of the world for which it is authorized.

Data is a DDN. This allows it to behave like a web server for static content. Certain types of files are given special treatment to ensure that entire applications can be stored (encrypted, access-controlled, and classified) and served directly to browsers without an intermediate. For example, links in HTML documents are handled appropriately without modification, relative paths are correctly routed, and content types are set in headers. This enables a very powerful model of high-performance partial-access, where unauthorized content is redacted transparently, and content such as file sub-trees and even map layers simply don’t appear to unauthorized users without otherwise damaging their experience. Even over encrypted content, Data supports range requests. This allows authorized users to stream data directly out of the DDN and seek into the middle of very large video files.

On the other side of the DDN, bulk upload of both very large files and large collections of files is supported transactionally in a single request, and data is stored encrypted with access granted only to those determined to possess Read access at time of query. Data supports both high-volume, high-speed, multi-user data manipulation and slower offline-access and reconstruction, useful both for offline field collection tasks as well as fault-tolerant global replication. This feature is supported through its hybrid consistency strategy; nodes within a data center work in lockstep for strong local consistency, and event-sourced, message-queue based replication allows for eventual consistency between data centers.
Grey Matter Data has been designed to support this ecosystem of services and applications, allowing human users to grasp concepts they would otherwise be incapable of comprehending at scale. Data’s modular components permanently solve recurring problems and provide a framework for the development of new services and applications designed to process, funnel, and present data to human decision-makers. In this use case the DDN acts as a secure, scalable platform for complex interactions involving unbounded streams or batches of data that is sufficiently malleable to serve as-yet-unforeseen business requirements.

The amount of “big data” generated in a Microservice architecture requires a multimodal de-centralized network that fits neatly within an Enterprise’s pre-existing storage layer, cloud or otherwise. Grey Matter Data provides a highly secure enterprise grade distributed data network API layer with encrypted (in-transit and at-rest) storage, simple content and metadata APIs, high throughput, low latency, and resilience features for surviving disconnected, intermittent, and low-bandwidth (DIL) network environments. Additionally, Grey Matter Data is an unstructured, multimodal hub with support for streaming data and use with online machine learning, neural networks, and monitoring in a secure, scalable, and adaptable package.

A key differentiator for Grey Matter Data is its out of the box support for sensitive data across heterogeneous datasets. The problem is only compounded when humans mainly interact with such data types in aggregate. Nuances of application in an access control policy may manifest as bias and statistical skew, subtly misleading or invalidating results. Grey Matter Data is a secure, yet flexible approach for any global microservice hybrid mesh environment. Grey Matter Data is built to provide fine-grained data access and embedded policy control. Access control ensures users can access only the files they are entitled to, and no more. However, Grey Matter offers fine-grained controls which also allow authorized users to provide tailor-made exceptions, custom implementations, and reconfigurations.

**DDN-Enabled Service Mesh Intelligence**

The Grey Matter Fabric sidecar proxy orchestration layer manages east / west network communication patterns, provides an edge out gateway, service level objective capture and policy enforcement. It also generates large volumes of user and system observations data. The Data DDN layer captures this information while delivering content and analytics throughout the network. Finally, the direct and atmospheric telemetry generated by this constant flow of data is fed to Sense, the machine learning-enabled AI layer designed to automate and optimize network operations.
The cyclical nature of these operations sustain the constant generation and capture of new and changing data. Grey Matter Data facilitates the movement of information that drives optimal service mesh operations. These optimized data delivery functions ensure customer satisfaction.

Privacy and Security at the Forefront

Today’s business environment demands businesses treat data security and user privacy as key concerns. Malicious actors constantly search for ways to steal, tamper with, or otherwise access critical data resources. Likewise, user privacy legislation demands the enterprise respect data use agreements. Striking the balance between privacy, security, and utility is a major enterprise concern. Lax practices leave the enterprise open to massive vulnerabilities and liabilities. At the same time, dated security practices stifle key communications and impact performance.

Grey Matter Data resolves these privacy/security/sharing challenges. Data contents and operational metrics are protected by a high-performance, arbitrarily flexible security policy engine designed to support military-grade security requirements. Within Data, access control supports both role and attribute-based access control, (RBAC and ABAC) as well as other BACs. Users can be granted any combination of Create, Read, Update, Delete, Execute, and Purge permissions, depending upon their attributes. The system also supports obscured attribute labels, protecting the user from exposure to unauthorized users.

Grey Matter maintains critical privacy legislation requirements...with negligible performance overhead.

Grey Matter maintains critical privacy legislation requirements for confidentiality, integrity, provenance, and authenticity, utilizing encrypted telemetry and data, with negligible performance overhead.

With Grey Matter, customers set the parameters governing their personal data’s purpose of use. Through the application of Grey Matter’s advanced access control mechanisms, access to data can be explicitly limited to individuals or services determined by the customer via attribute-based encryption (ABE).

To address the growing importance of privacy legislation, files in Data also have expiration dates. Upon expiration, the file is no longer returned in listings, and will be garbage-collected by a background process to maintain performance and meet legislative data removal requirements. Data also tracks the lineage of files by tagging each with a reference to its parent. This can be used to easily track and delete derived files, further aiding data use agreement adherence.

Conclusion

The stratospheric trajectory of global data growth is staggering. However, the challenges of today are a mere shade of what is yet to come. According to a 2017 report published by the global market intelligence firm International Data Corporation (ICD), world-wide data stores will swell to 163 zettabytes by 2025, ten times the global volume at time of reporting. ICD predicts the enterprise will generate the majority of this data.

The enterprise must leverage all of its data to deliver top ranked customer experience. There is no alternative. This will require a secure way to meet the challenge of massive global data capture, storage, analysis, and sharing. The Grey Matter service mesh platform offers flexible DDN scalability and industry-leading operational insight to optimize performance while saving enterprise CapEx and OpEx. With the Grey Matter Data DDN, enterprise will be well positioned to master tomorrow’s data deluge.
About Decipher
Decipher is an industrial AI software company. We build Grey Matter, the enterprise service mesh platform for enterprise cognitive infrastructure management.