

HOW DATA GRAVITY WILL

The way enterprises create, use, deliver and store data will change sooner than you may think. Our 26-page cover

RESHAPE OUR WORLD

story introduces you to the executives and companies managing the groundbreaking concept of data gravity.

Data rules the world. In the first waves of computing, data was primarily created, stored and processed in centralized locations. The shift to a digital economy has however transformed the way that companies create and deliver customer value. Organizations are today faced with a growing number of locations, applications and sensors, all generating information.

The sheer volumes of data being created on a daily basis has led to a new phenomenon: data gravity, or the concept of data becoming so unwieldy that it starts to generate its own mass. This can be compared to the way that a planet exerts its own gravitational pull on nearby moons, other planets and stars.

In the same way, large sets of data start to attract applications and services, and other large datasets.

This gravitational pull of data impacts the very foundation of our connected world, which includes cloud computing, edge data centers, network latency and data delivery. The ability to move data while constantly creating and attracting more data will be crucial for future enterprises.

How does one manage data gravity and the inevitable challenges? According to our two featured Digital Realty executives: Start by measuring.

In our cover story, Digital Realty's Tony Bishop and Dave McCrory speak with InterGlobix Magazine's Editor-in-Chief Jasmine Bedi about the Data Gravity Index DGx™. Our deep dive into data gravity also includes perspectives from executives at Digital Realty's key partners: AWS, NVIDIA, Zenlayer, Yellowbrick and industry analyst group, 451 Research.

THE DATA EXPLOSION

In the Zettabyte Era of today, numbers tell the entire story about the growth of data. Humans generate 2.5 quintillion bytes of data on a daily basis [One quintillion is defined as a one followed by 18 zeros]. According to IDC Research, the number of people interacting with data every day is set to grow from 5 billion currently to 6 billion by 2025. That is 75 percent of the world's population. Research from IDC says that this exponential growth is fueled by data creation from the core, the edge and connected endpoints. What's more, the number of devices connected to IP networks will be more than three times the global population by 2023 according to Cisco. It is also projected that the number of networked devices (18.4 billion in 2018) will shoot up to more than 29 billion in the next three years.

For a deeper understanding of the scale of these future growth trends, IDC's research projects that the global datasphere will expand from 45 zettabytes in 2019 to 175 zettabytes by 2025. This enormous growth in data will require enterprises to rethink IT architecture, which will inevitably give rise to a whole new set of challenges.

DATA GRAVITY: THE NEW LAWS

Later in this article, we'll get more background from when Dave McCrory coined the term "data gravity" in 2010 as a reference to the way data affects surrounding services and applications. McCrory's original blog post outlines the concept of: "Consider data as if it were a planet or other object with sufficient mass. As data accumulates (builds mass) there is a greater likelihood that additional services and applications will be attracted to this data. This is the same effect gravity has on objects around a planet. As the mass or density increases, so does the strength of the gravitational pull. As things get closer to the mass, they accelerate toward the mass at an increasingly faster velocity."

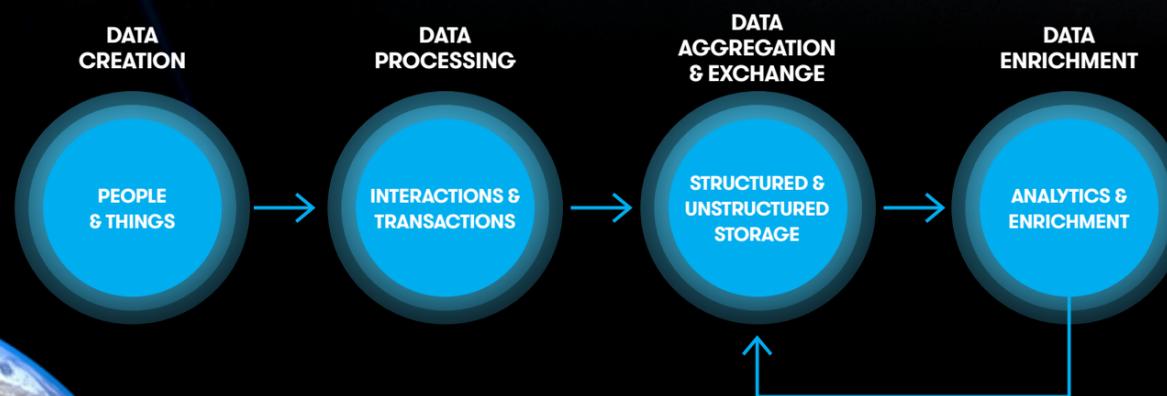
The accumulation of data makes it harder to move. This can cause management complexities and can start to hinder digital transformation. If businesses don't design their architectures to effectively manage this accumulation of information, data gravity can become the single biggest challenge to scaling digital business.

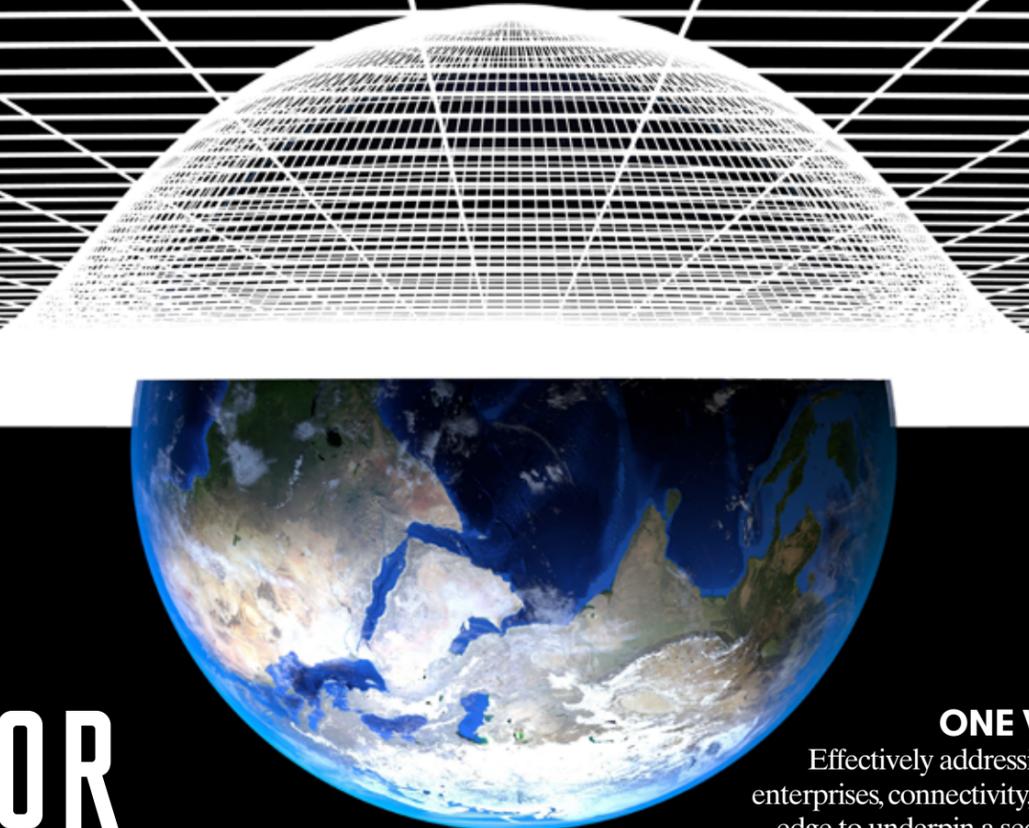


DATA LIFECYCLE

As the number of users and endpoints that enterprises serve increases, the rates of creation and exchange of data also rise. This growth of interactions and transactions between users and machines creates a need for increased data processing and storage—both structured and unstructured. Although data analytics, machine learning (ML) and artificial intelligence (AI) enable enterprises to embed workflow intelligence, they also fuel a need for additional data aggregation, enrichment and increased data exchange. This compounding effect creates complexities that inhibit digital transformation while also developing particular challenges that traditional backhauled architectures are not ready to fully address.

Continuous Data Creation Lifecycle Underpins Data Gravity





PREPARING FOR A NEW (DIGITAL) REALITY

A WATERSHED YEAR

2020 has been a watershed year; one that has accelerated our transformation into a digital society. It will forever leave its mark on the way we live, think and work. The task for IT architects, business strategists and technology leaders will be to ensure that their IT architecture can handle the demands placed on it in a post-COVID world. The massive growth of data has burdened current architectures, and these traditional backhauled infrastructures don't have the ability to address the data gravity challenges that impede digital transformation. To address this, IT architectures need to be inverted to a data-centric architecture in order to bring users, devices, networks and clouds to the data at global points of presence and at centers of data exchange. To help achieve an optimized IT infrastructure for the digital workplace, Digital Realty developed a Pervasive Data Center Architecture (PDx™) that enables enterprises to accelerate deployment and improve the precision of their infrastructure to scale digital business globally.

ONE WORLD, ONE THEME: DATA GRAVITY

Effectively addressing data gravity requires a connected community approach among enterprises, connectivity, cloud and content providers. This brings together the core, cloud and edge to underpin a secure, data-centric hybrid IT architecture at global points of business presence deployed in multi-tenant data centers. Digital Realty offers a trusted foundation supported by a connected community approach to enable global coverage and interconnected ecosystems with access to networks, leading cloud and IT providers and global enterprises. Digital Realty is also investing in the development of a unified customer experience that supports the business processes that will accelerate deployment cycles for multi-national enterprises rapidly accelerating towards a single global platform.

COMMUNITY OF PARTNERS

The digital economy is transforming industries by creating new business models, markets, capabilities and efficiencies. This rapidly changing landscape demands a new business architecture — one that is ubiquitous, real-time, intelligent and omnichannel. PlatformDIGITAL® represents the culmination of more than 15 years of innovation by Digital Realty, and was purpose-built for this reality. It is a pervasive global data center platform that integrates the physical and virtual worlds in close proximity to centers of data exchange, interconnected to digital communities of interest and tailored to business needs. PlatformDIGITAL® is a first-of-its-kind global data center platform designed to enable customers to scale digital business by transforming their IT infrastructure to operate on demand and informed by real-time intelligence. PlatformDIGITAL® provides a global data center platform that solves the challenges presented by data gravity via:

- Bringing users, things, applications, clouds and networks to the data at the centers of data exchange
- Delivering a trusted foundation to solve the connectivity needs of global coverage, capacity and communities of interest with a single data center provider
- Tailoring infrastructure deployments and controls matched to business needs irrespective of datacenter size, scale, location, configuration or interconnections
- Operating deployments as a seamless extension of any global infrastructure with the consistent experience, security and resiliency that business demands
- Enabling global distributed workflows at centers of data exchange to scale a digital business and a comprehensive multi-cloud strategy

TONY BISHOP

SVP, PLATFORM, GROWTH AND MARKETING, DIGITAL REALTY

As the global head of platform, growth and marketing at Digital Realty, Tony Bishop focuses on building and growing the leading global data center platform to best address data gravity and digital transformations for the company's enterprise, service provider and hyperscale customers. Prior to Digital Realty, Bishop worked in senior leadership positions at Equinix, 451 Research and Morgan Stanley. He is a 2nd Degree Fellow at Infrastructure Masons and the author of "Next Generation Data Centers in Financial Services: Driving Extreme Efficiency and Effective Cost Savings."

How long has Digital Realty been working on data gravity and how was the concept born?

Digital Realty is the world's largest data center provider in terms of operations and square footage. We sit at a nexus point of being able to see how various types of enterprises and service providers build out infrastructure. This enables us to spot emerging trends very early. One of the trends we identified during the past two years was that enterprises were starting to build these larger data sets. They were doing so on large compute footprints on multiple sites around the world on our platform. As we began to look deeper, we also initiated conversations with the customers to try and understand the cause and effect.

The common theme was data explosion that included where the data was created; how it was aggregated; how it was then enriched with analytics; and, how it was exchanged between many different platforms to a company (internal and external). That was the genesis of the concept of data gravity.

What does the modern digital workplace mean to the enterprise and what are the challenges that need to be addressed? How does PlatformDIGITAL® solve it?

Data is now created at endpoints that are outside of a data center or outside of the cloud itself. Anywhere you have access to a device you are creating data. Therefore, data creation happens at different endpoints that are going to come over enterprises' corporate networks via WiFi or mobile network. Data has to then be aggregated and managed for compliance purposes, security and performance. Combining these facets, you are going to overhaul an enterprise's infrastructure architecture.

The previous process to connect the endpoints and backhaul into the data centers or the cloud now has to be inverted. That means bringing everything to the data whether it's users, applications, clouds or business platforms. This is what we observed and published our findings in the report "Data Gravity Index DGx™" as an emerging infrastructure trend. Our product roadmap at PlatformDIGITAL® includes aspects of not only connectivity but also data and computing-related issues, where you integrate private enterprise infrastructure with the public infrastructure that enterprises use.

2020 has accelerated the adoption of digital applications. What kind of impact will it have on the future and what role will data gravity play?

This year is definitely creating a new norm on every level. It's creating a new set of expectations. What used to be a more bounded physical office becomes unlocked. When the world turns back, it will be a mixed model. One that offers the unbounded experience

of being able to conduct business, participate in business workflows and be part of the digital workplace from anywhere in the world. Performance, security and scale is now more vital than ever. This will force architectures and infrastructures to be even more critical, grow in size and be rearchitected to accommodate this new paradigm.

With regards to the role of data gravity, what we are seeing is that with digital workplaces and remote working, users are connected to the enterprise from many different places. Users continue to consume applications and services, and interact with many other users. This is the endpoint concept that I talked about earlier. These endpoints will need to interact with other endpoints, which creates a file, message or both. These are both—structured and unstructured—and will lead to an explosion of data that has to be processed, then aggregated and be maintained for compliance purposes.

AI, ML, autonomous cars, connected cars and IoT are all driving massive amounts of data. What are your views on these emerging technologies and how do they impact the data equation?

It is important to note three things: firstly, where the data is being generated; secondly, where it is being processed; and thirdly how those endpoints participate in business workflows. As these emerging technologies—AI, ML, autonomous cars, connected cars and IoT—unlock the ability for more intelligent workflows that can originate within the connected worlds of things, it leads to storage multipliers in terms of volume and variability.

On the other side, what AI underpins is the need to see all data. As a result, this makes the data aggregation piece become very important. The data needs to be cleansed and normalized, followed by analytics that run on top of that.

AI is dependent on automated models of analytics that enable the learning and training developed from the data. Because you have to train the models by constantly analyzing the data, and then constantly update the models, AI will fundamentally change

Our Data Gravity Index DGx™ is open. It is not specific to our platform. It is an index set in the industry designed to shape the dialogue around solving the data problem—how we are going to address data on all dimensions?

the architectural piece. Our customers continue to solve the most complex infrastructure, connectivity and workload use cases on our platform globally. This includes use cases across network peering, hyperscale, low-latency, high-performance computing, big data and artificial intelligence.

How does data gravity inhibit enterprises from achieving their digital transformation goals?

Digital business strategies are not about moving to the cloud or colocation in a silo. It is about the digitization of business processes on an end-to-end basis that creates new information flows. This entails connectivity and the integration of other applications and other users. The premise of a digital workplace is to remove the barriers of the physical world and overlay a digital architecture that is unconstrained.

Data is the central point of everything. If data is unavailable it is difficult to take action. Fundamentally, as data continues to grow and interact with more applications it becomes heavy and difficult to move. So that's why it's a gravitational force. Meaning that architecture and infrastructure must come to the data. This makes it the number one barrier to digital transformation.

How do you see your customers take advantage of the Data Gravity Index DGx™?

Our Data Gravity Index DGx™ is open. It is not specific to our platform. It is an index set in the industry designed to shape the dialogue around solving the data problem—how we are going to address data on all dimensions? That includes looking at data residency, data localization, data compliance, data security—when everything is dynamic, virtual and distributed.

The Data Gravity Index DGx™ can be used as a benchmark for people to understand the data that is coming for their industry, locations or company. It helps them answer questions such as "What is my data creation lifecycle?" or "How is this going to radically impact my infrastructure and ability to deliver while meeting my business needs today and tomorrow?" Additionally, it can be a guide for customers to think differently about how they're going to architect. As we add more information and data on a granular level, we will continue to add intelligence to the report. It will become a tool that allows them to not only benchmark, but plan and make decisions about their architecture.

What are some of the highlights of the Data Gravity Index DGx™?

A set of critical macro trends listed in the report have specific implications and drivers to the growth and creation of data on the

index itself. In the forecast, we identify that growth is astonishing. We measure it in terms of intensity, which is the number of applications in use or generating, exchanging and compounding data with analytics or enrichment. That intensity is measured by the formula used in the Data Gravity Index DGx™. The intensity globally is projected to be 139 percent CAGR throughout the next four years. This represents a significant increase in the creation, aggregation and exchange of data among enterprises in both their private infrastructure and public infrastructure globally. The index also identified that there is an affinity for metros, which model the world trade and financial flows. More data creation is triggered by information flows between key metros.

Can you talk about Digital Realty's partnership with NVIDIA, Core Scientific and PathAI?

NVIDIA has always talked about the importance of training the data where it lands. Data lands at the endpoints, the core, the edge and the cloud. That is why a multi-tenant data center provider like Digital Realty is the ideal landing place for the data. When you look at companies like PathAI, their platform uses machine learning and deep learning AI-based techniques to assist pathologists' research as part of the teams that develop new medicines for the treatment of diseases like cancer. PathAI's workloads have expanded. Data gravity became an issue for them. So, we worked with them to overcome the challenges of complexity and cost, while providing greater flexibility, as well as a more efficient solution for secure data movement and processing.

We have many analytics customers that cover the realm of data warehouse and data analytics along with AI. Similar to the enterprises that triggered us to create the Data Gravity Index DGx™, we are continuing to see that the proximity, the residency and how data is connected and exchanged matters. These data factors are such import in a way that can enable or limit strategic business.

What can we expect in future iterations of the Data Gravity Index DGx™?

We will add more metros, more countries and more locations globally. We will further unpack the enterprise definition of the Global 2000 size firms, which are the largest multinational companies, to include companies with more than \$750 million in revenue and have presence in multiple regions and countries. Additional tools to be added in the future will include downloadable spreadsheets, online benchmarking tools, an application and a portal that you can use with your smartphone.

Data Gravity Index Formula

A methodology to measure the creation, aggregation and private exchange of enterprise data globally.

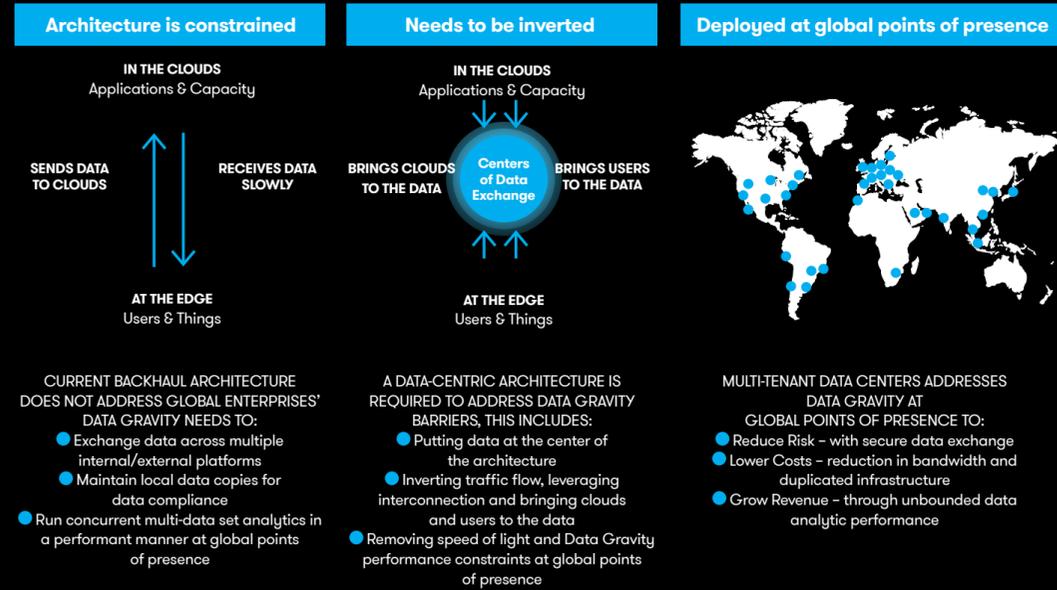
$$\frac{(DM \times DX \times BW)}{L^2}$$

DATA MASS DATA ACTIVITY BANDWIDTH LATENCY

IMPLICATIONS OF DATA GRAVITY

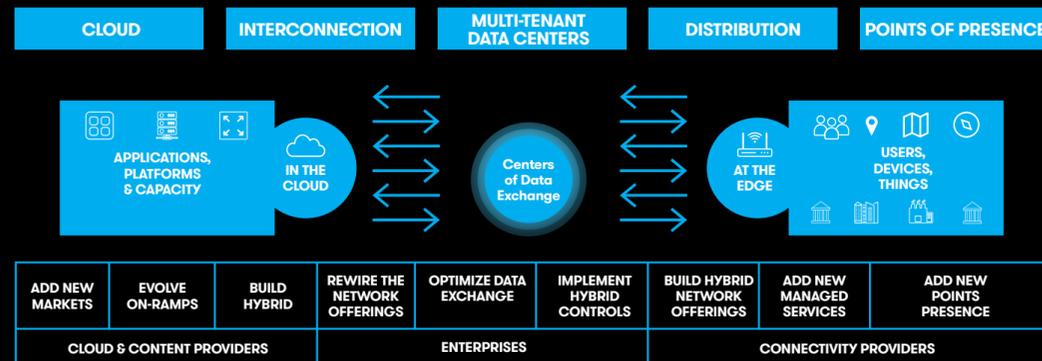
Implication #1 – A Data-Centric Architecture is Mandatory

Current backhaul architecture cannot address enterprise Data Gravity needs, including data exchange across multiple internal/external platforms, local data copies and the capabilities to run performant analytics across each global point of presence. Architecture needs to be inverted to a data-centric architecture deployed at points of presence in neutral, multi-tenant data centers to integrate private and public data sources.

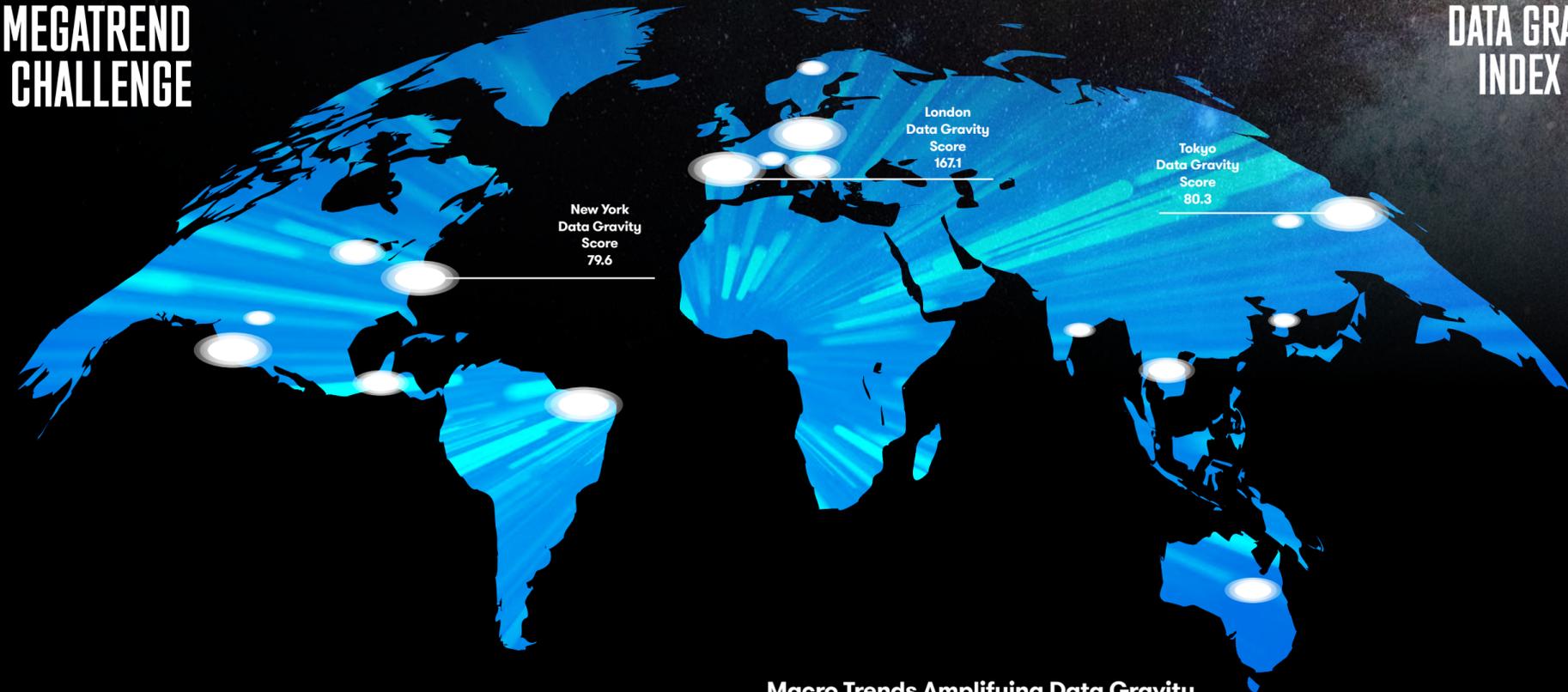


Implication #2 – Requires a Connected Community Approach

Data Gravity requires a connected community approach between enterprises, connectivity, cloud and content providers. This approach integrates core, cloud and edge at centers of data exchange, implementing a secure, data-centric hybrid IT architecture at Global Enterprise points of business presence deployed in multi-tenant data centers.



DATA GRAVITY KEY MEGATREND GLOBAL INDUSTRY CHALLENGE



Highlights

Data Gravity Index DGx™ measures, quantifies and predicts the intensity of Data Gravity across Global 2000 Enterprises.

1 Accelerating growth across all regions and metros. Data Gravity Intensity, as measured in gigabytes per second, is expected to grow by a compound annual growth rate of 139 percent globally through 2024 as data stewardship drives global enterprises to increase their digital infrastructure capacity to aggregate, store and manage the majority of the world's data.

2 Pairs of metros share unique attraction rate. Specific metro pairs were identified as having flows between each other, directly increasing their Data Gravity Intensity both within their metro and their high attraction between metros. This shift in importance towards digitally-enabled interactions across global enterprises will increase data exchange volumes exponentially.

3 Approaching quantum computing levels of data creation, processing & storage. Through 2024, it is estimated G2000 Enterprises across 53 metros will create data at a rate of 1.4 million gigabytes per second and will require nearly 20,000 petabytes of additional data storage annually. Data location matters to global enterprises as they look to meet compliance requirements by maintaining local copies of critical data.

4 Requires data-centric enterprise architecture & connected community approach to address. Current backhaul architecture cannot address enterprise Data Gravity needs, including data exchange across multiple internal/external platforms, local data copies and ability to run performant analytics across each global point of presence. Data Gravity requires a connected community approach between enterprises, connectivity, cloud and content providers integrating core, cloud and edge at centers of data exchange, implementing a secure, hybrid IT and data-centric architecture globally at points of business presence.

Macro Trends Amplifying Data Gravity

	WHAT	WHY	HOW	WHAT	WHY	HOW
	 Enterprise Data Stewardship The enterprise is fast becoming the world's data steward	 Mergers & Acquisitions Globalization is driving corporate M&A to achieve scale	 Digital-Enabled Interactions Increasing digitization of enterprise workflows	 Data Localization Expanding legal and regulatory policies requiring local data storage	 Cyber—Physical Integration of physical and digital security systems to improve enterprise cybersecurity	
	Through 2025, 80% of data worldwide will reside in enterprises ¹	M&A Volumes are expected to return to pre-Covid levels in 2021 ²	Digitally-enabled interactions rank 2x greater importance vs. physical interactions ³	Through 2022, 87% of IT Leaders will maintain local copies of customer and transaction data for compliance ⁴	Through 2023, 70% of security products will integrate IT-OT/OT systems ⁵	
	Increases the volume of data that needs to be aggregated and stored <small>Source: ¹IDC #US4413318, Data Age 2025, The Digitization of the World From Edge to Core, November 2018</small>	Increases # of data sources participating in data exchange <small>Source: ²Goldman Sachs, BRIEFINGS Newsletter June 16, 2020</small>	Increases enterprise data exchange volumes globally <small>Source: ³McKinsey, B2B Decision Maker Pulse Survey, April 2020</small>	Increases # of enterprise locations of data aggregation <small>Source: ⁴451 Research, Infrastructure Imperative – IT Leader Survey, November 2019</small>	Increases types and volumes of data creation & exchange <small>Source: ⁵Gartner, Emerging Technology Analysis- Cyber-Physical, Security, ID: G00726994</small>	

DAVE MCCRORY

VP, GROWTH AND GLOBAL HEAD OF INSIGHTS AND ANALYTICS, DIGITAL REALTY

Dave McCrory ran a data strategy and consulting business before he joined Digital Realty. Over the last 25 years, McCrory led teams at GE Digital, Basho Technologies, Warner Music Group and others. He also co-founded Hyper9 (acquired by SolarWinds) and Surgient (acquired by Quest Software). McCrory holds more than nine technology patents in virtualization, cloud and systems management and created the concept of data gravity.

How did you come up with the idea of data gravity?

I started working on virtualization almost two decades ago. I realized its potential when I was at Surgient. We filed a number of patents, including the first patent on cloud computing—a logical virtualized server cloud. From 2000-2010 there was significant growth of the cloud. By 2010, it had started to take off. Back then, I worked for Dell Data Center Solutions group. While evaluating cloud providers, I noticed the data was growing significantly. As the data grew, it attracted both services and applications closer to the data. That reminded me of gravity and led me to write a blog post about 'data gravity in the clouds'. There was a virtuous cycle of data—the more data you have, the more data you create, and applications wanted to be closer to the data. The reason for that was applications (being closer to the data) gained access to higher bandwidth and lower latencies. With this rationalization, I coined this term data gravity to apply to the concept.

What is data gravity's role in cloud computing?

Cloud providers understand the importance of data gravity and its effects. Initially at least, it is usually less expensive for enterprises to store their data in cloud platforms. The cloud providers realize that enterprises are going to want leverage these same platforms to then run their applications, do analytics and have the partners access and use this data. All of that means that increased amounts of data is going to be attracted to their cloud. Therefore, the cloud providers benefit from the effects of data gravity, and they build ecosystems leveraging those effects.

How do you take advantage of data gravity in a colocation environment?

When it comes to data, it is important to understand what is creating and interacting with it, plus where it gets stored. Ideally, data analytics and data processing should be done where the data resides. However, if your consumers are distributed, then you need to also distribute the data as rapidly as possible.

In case of an enterprise, when working with large amounts of data, you find ways to work with that data in the most efficient ways. Some enterprises work with all of their data in one place. If the data is not being consumed all in that one place, then the data architecture needs to change so that data is at the center. The emphasis is on a data-centric architecture instead of backhaul models, where processing is at the center.

If there is a reason you need to move the data, then you look for the best ways and locations. Those locations include the highly connected facilities where your company and business partners come together to exchange data in a low-latency, high-bandwidth environment.

What is the role of data gravity at the edge?

Data processing happens at the core. The emphasis is on the low-latency delivery of applications. Edge is important for faster delivery of data. However, the edge has its limitations. You neither have infinite storage, nor do you have infinite bandwidth, at the edge. You may have edge locations globally, but each location is not going to communicate with all the others. Therefore, the data has to go to either an intermediate or core facility to get aggregated. In each stage, data gravity has its effects. At the edge, you are bound by either physical limitations with its location, network bandwidth or latency. It is important to get the data in one place, so that location has high amount of gravity. Then, this location attracts partners and customers to connect to the facility, which enables them to access the data quickly and easily.

From an enterprise perspective, if you look at a SaaS application provider, they either have their own cloud or they are in a partner cloud. That is where you would want to be to interact with their applications and data. Generally, enterprises spread their workload across different cloud providers. They want to access applications in a variety of clouds, so their data gravitates towards those. Hence, data gravity is a driver for multi-cloud concept. As more and more data is generated and distributed, it brings data gravity even more to the forefront because it affects more things, people, businesses and industries in a much deeper way.

I think of bandwidth as lanes on a highway. The more lanes you have, the more traffic you can support on the highway. So, the more bandwidth you have, the better off you are in moving this data around and facilitating it being put onto and taken off something like storage.



2020-2024 DATA GRAVITY INDEX DGx™ FORECAST

DATA GRAVITY INTENSITY QUANTIFIED

Enterprise Data Creation	Through 2024, it is estimated G2000 Enterprises across 53 metros will create data at a rate of 1.4 million gigabytes per second. This represents CAGR of 28% from 2020-2024.
Enterprise Data Processing	Through 2024, G2000 Enterprises across 53 metros will require an increase of over 40% in compute processing to accommodate the increased new digital workflows. 20.76 pFLOPS of Enterprise Processing added in 2020 29.45 pFLOPS of Enterprise Processing added in 2024
Enterprise Data Storage	Through 2024, it is estimated G2000 Enterprises across the 53 metros will require nearly 20,000 petabytes of additional data storage annually. This represents CAGR of 52% from 2020-2024.

What is the methodology behind the Data Gravity Index DGx™?

The components of data gravity are included in the formula: data mass x data activity x bandwidth = result divided by latency squared.

Data mass is data at rest—or all of the stored data, including data stored in network and in traditional storage drive. This is considered a potential data mass variable. Then data activity is data in motion, either moving across the network or being processed or sent to storage. Next, you have the amount of bandwidth. I think of bandwidth as lanes on a highway. The more lanes you have, the more traffic you can support on the highway. Therefore, the more bandwidth you have, the better off you are in moving this data around and facilitating it being written to and read from storage. All of the above components are brought together as they encompass a set of variables that amplify the gravity intensity.

Everything is divided by latency squared because effectively, it is the speed limit of the highway. A high-speed limit would be good if you're trying to move across the highway quickly. But because latency is time-based, it's actually better to have lower latency. In fact, in the formula, if you had a latency of one millisecond and squared it, then it would still be one. For the vast majority of cases, just like a high-speed limit, one millisecond or less of latency is optimal.

At higher levels of latency, the impact gets to be fairly profound. When you move into hundreds of milliseconds, systems begin to be more dramatically affected by latency. If you move beyond half of a second, people start to notice. Hence, the squaring is supposed to amplify that effect. Because latency has such an extreme impact, there have been studies of latency impacting human behavior. The extreme is that with enough latency then there's no difference between latency and downtime. Imagine if you were attempting to use a website and the latency was an hour, you would assume that the system was down. It might still be working, but it's just so incredibly

slow that you assume that it's broken. At the same time, if the latency was two milliseconds or 10 milliseconds it seems instant to you. Therefore, it is important to be as close to your data as possible, as it offers the greatest opportunity to get the lowest latency and the maximum bandwidth.



Data Mass

The estimated volume of data stored in a metro over a period of time.



Data Activity

The estimated amount of data movement and interactions in a metro over a period of time.



Bandwidth

The average amount of bandwidth available in a metro or between two metros.



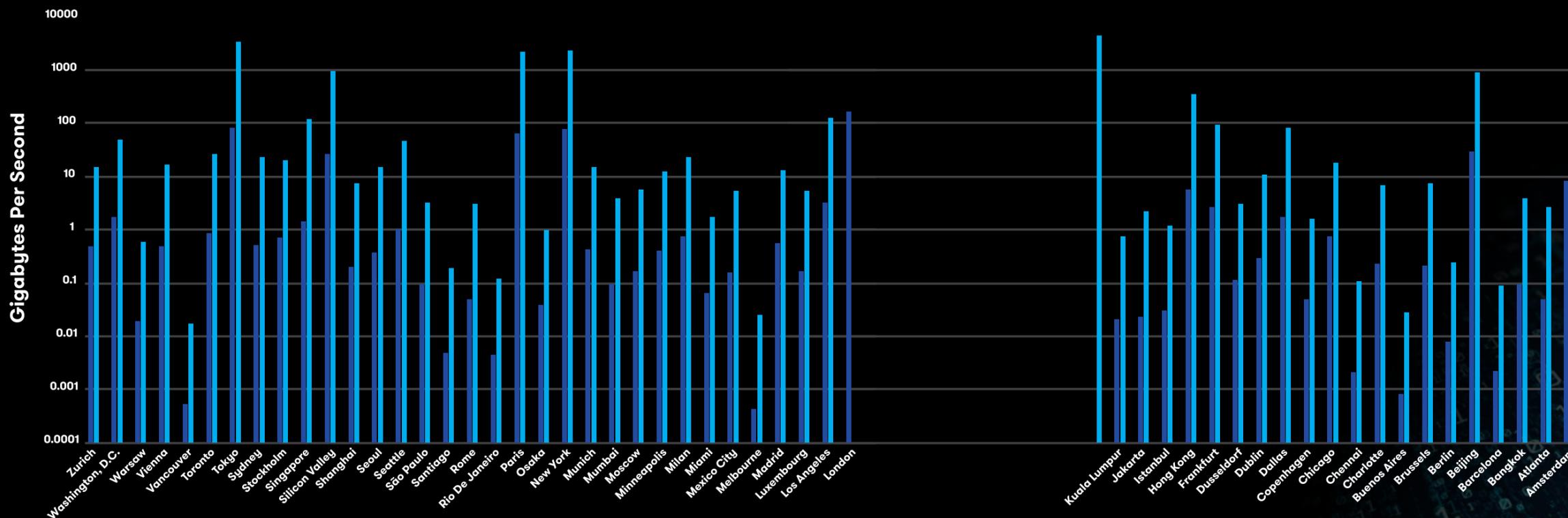
Latency

The average latency between all metros and a single metro or between two specific metros.

The development of the Data Gravity Index DGx™ referenced and/or considered various data sources, including HG Insights, Intricately, Synergy Research Group, Telegeography, PeeringDB, WonderNetworks, Dotcom-Monitor, Organization for Economic Co-Operation and Development, Wikipedia, Google Maps, Worldometers, US Census, DataUS.io, IDC, 451 Research, Gartner, McKinsey, PWC, Accenture, World Economic Forum and United Nations.

DATA GRAVITY INTENSITY METRO FORECAST

53 Metros
● 2020 ● 2024



The Data Gravity Index DGx™ is a global forecast that measures the intensity and gravitational force of enterprise data growth for 53 metros and 23 industries. From 2020 to 2024, the top 6 metros with the highest CAGR (in descending order) are: Jakarta, Singapore, Rome, Hong Kong, Melbourne, Atlanta.

In the following pages we bring you unique perspectives from Digital Realty's partner ecosystem.

AMAZON WEB SERVICES (AWS)

Digital Realty launched Data Hub featuring AWS Outposts to remove data gravity barriers for enterprises by enabling them to rapidly deploy AWS infrastructure at centers of data exchange globally on PlatformDIGITAL®. AWS Outposts is a fully managed service that offers the same AWS infrastructure, AWS services, APIs and tools to the data center, colocation space, or on-premise facility for a consistent hybrid experience. The Data Hub for AWS Outposts solution provides critical infrastructure that enables enterprises to integrate public and private data sources and achieve data compliance and control.

In Conversation with Joshua Burgin, General Manager, AWS Outposts

How does data gravity improve the deployment of AWS workloads?

Data gravity was not previously seen as a challenge. It just was a reality. With the proliferation of the Internet of Things, machine learning, AI and decentralized companies, data still has gravity, but now you have a challenge, since you have to operate in a global sense. As businesses are trying to scale themselves, they need to consider data gravity. Our AWS Outposts, as part of the PlatformDIGITAL® Data Hub, provide a unified solution as the best-in-class hybrid IT infrastructure paired with a seamless global ecosystem with consistent experience, security and resiliency. We allow customers to operate and get their data where they need and to do it in an effortless way.

What role does Data Gravity play in Multi-Cloud / Hybrid-Cloud environments?

Although companies do use multiple cloud providers, we have seen many lean heavily toward one over the other. Enterprises have a lot of workloads, and they are not always easy to move. There are increasingly regulatory regimes around the world that are causing people to have to keep their data in specific locations. AWS provides a way for enterprises to localize their data in a particular jurisdiction, while maintaining the same familiar cloud interface that their IT teams operate within the public cloud environment. A global partner like Digital Realty offers you a platform that gives customers the same experience everywhere in the world. Underneath that, for your workloads, you can have AWS Outposts. Further, you can have other workloads running in AWS regions. So the powerful partnership of Digital Realty with AWS enables enterprises to establish a presence in various data centers around the world and distribute their workloads across our platform.

Amazon is investing \$2.8 billion in India. Digital Realty also announced an intent to partner with the Adani Group. What is your perspective on the Indian market?

India has great potential when it comes to digital infrastructure. There is a Personal Data Protection Bill that was introduced in the Indian parliament last year. The bill seeks to establish a Data Protection Authority for the purpose of providing protection for an individual's personal data and create a framework for processing that data. We are seeing that trend around the world. This is driving more of the in-country data to be hosted and stored locally. If you look at Europe, they are very strict on their GDPR guidelines. The alliances are changing at the geo-political level. The second region that we are deploying in India (Hyderabad in Telangana) will address



ABOUT JOSHUA BURGIN

As General Manager of AWS Outposts, Joshua Burgin is responsible for engineering, product management, design, marketing and business development. Burgin previously worked as technical advisor to senior execs at AWS and as General Manager in Computer Services. He began his career in 1997 as one of Amazon's first 100 employees and built software to power Amazon's hyper-growth in e-commerce. He has also held product and technology executive roles at several early-stage startups, including Zynga.

There are increasingly regulatory regimes around the world that are causing people to have to keep their data in specific locations. AWS provides a way for enterprises to localize their data in a particular jurisdiction while maintaining the same familiar cloud interface that their IT teams are used to operating within the public cloud environment.

the increased regulations for critical infrastructure workloads as they move to the cloud. There is now recognition that it is going to move. The move is out of people's on-prem enterprises as they require rapid deployment of their workloads with SLAs, and that is where we (AWS + Digital Realty) come in. Using technologies and platforms, like Data Hub on AWS, we offer set it and forget it solutions meeting compliance standards around the world.

How can customers take advantage of AWS Outposts and PlatformDIGITAL® combined, and in how many markets around the world is this solution available?

AWS Outposts are available in 51 countries and can be connected to any of our regions except China. That is 22 public regions. Six additional AWS availability regions have been announced, and they should come online in 2022-23 time frame. Outposts will be supported there as well. Customers can securely connect to their desired AWS region using services like Direct Connect and Amazon's Virtual Private Cloud (VPC). VPC lets customers launch AWS resources in a logically isolated virtual network defined by the customer. In EMEA, Interxion, a Digital Realty company, provides customers with physical access to 11 AWS Direct Connect locations, and globally, Digital Realty offers more than 40 AWS Direct Connect locations.

What challenges are your customers facing?

Organizations are facing challenges globally when it comes to data explosion, and where the data is created. The global research and advisory firm Gartner has predicted that 75 percent of the data by 2025 will be generated outside of the data center (in 2018 that was 10 percent). So, customers want to know how to bring users, things, applications, clouds and networks to the data.

Can they get it closer to the edge?

We have offerings such as AWS Outposts and solutions with our 5G partners. It is basically transform or die for enterprises now. Increasingly, every decision you are making is being powered by all of the data, and the need to store enormous amounts of data. We find customers often turn to Amazon S3 to store all their data in what's known as a data lake.

What key trends do you see in the marketplace that will have an impact on the enterprise customer's rapid move to the cloud?

Fit for Purpose is the mantra. You do not have a one-size-fits-all approach anymore. You can have a massive data lake in the cloud, and a metro edge where you have a data hub on an AWS Outpost. Then, maybe at the far edge you have 5G-enabled IoT sensors, generating data, doing localized inference and sending it back to Amazon S3 on the Outposts and our regions for durable long-term storage. As customers aim to bring together the data lifecycle and compute, they need a strong partnership. Enterprises are now looking for those accommodating partners.

How has the pandemic accelerated digital transformation plans of enterprises?

A lot of companies who would not have called themselves very forward looking have realized that they can not put off their plans for another decade. There is an opportunity for people to think of technology and IT as an innovation engine. Pre-COVID, we saw analyst surveys report that 60-70 percent of spending on IT was considered a mere cost center. You now have CIOs and CTOs saying that they did some innovative things because of COVID-19, which were necessitated by the situation.

People are realizing that it is not just about the cost anymore. They now really want to get into the business of doing things that are differentiated for their business. We have many customers that have never done video conferencing before. Now, people are closing \$100 million deals over Zoom. Some of this may begin to fade away with time, but what 2020 has demonstrated is that if you embrace an innovative mindset you can transform a lot more quickly than you previously thought.

NVIDIA

Digital Realty recently announced a collaboration with NVIDIA and Core Scientific to deploy the industry's first Data Hub featuring NVIDIA DGX A100 systems at the Interxion Digital Docklands Campus in London. With access to a new AI-ready infrastructure solution, businesses can rapidly deploy AI models in close proximity to their data sets globally, opening up a new artificial intelligence platform-as-a-service (AI PaaS) solution developed specifically for data science teams.

In Conversation with Tony Paikeday, Senior Director, AI Systems, NVIDIA

How does data impact AI development?

Most enterprises make a huge investment in data science talent to build and deploy AI applications. But there is a real gap between hiring data science talent and actually building AI models that are deployable in a production environment. Many of these AI models never actually move into production. AI is fundamentally different in how it is conceived, prototyped, tested, trained at scale and gets deployed. You are not just building a single, monolithic application, like in a traditional enterprise. Even when you deploy an AI model in production, you need a human in the loop to continually evaluate if this model is performing well, and models drift and degrade over time, because they are feeding on real live data from your operation.

Data is basically the source code that builds great AI models, and data gravity—which explains the nature of large data sets to attract applications and resources towards it—is critical for AI development. Many enterprises do not realize that if there is a lot of time and distance separating critical data from the computing infrastructure that needs to work on that, then you are going to immediately suffer the impact of data gravity.

What is the importance of Data Gravity on AI projects?

Many organizations lean on the cloud as a great way to engage in early productive experimentation. The cloud is very good for making a fast start, and supporting what I would call temporal needs that power early prototyping and development, especially as your AI project is starting to get underway. Over time, your AI model inevitably starts to get more and more complex through ongoing iteration. So, as you iterate and build a more complex model, it is consuming more and more computing cycles. In parallel, the data sets that feed the model training get exponentially larger. And this is the point at which your costs can escalate.

This is a fundamental data gravity problem that many organizations face, and it presents a speed bump and kind of an escalation in the cost of building AI. What ultimately happens is that the rate at which data science teams can build a better, higher quality, more creative model starts to slow down, while the costs rise, because they're spending more time on it. When that happens, the quality of the AI model that you're trying to deliver is affected. That is the inflection point at which many organizations realize that there's a benefit to a fixed-cost infrastructure that supports rapid iteration at the lowest-cost-per-training run. But, how do you get there? You get there by moving your computing infrastructure to where your data lives. This is why we think the architecture and the offer put together by the combination of Digital Realty and NVIDIA is so valuable. You are eliminating time and distance between the data sets. You also are regaining control of your costs since you now have a highly deterministic platform that delivers incredibly fast performance, but in a predictable way.



ABOUT TONY PAIKEDAY

Tony Paikeday is Senior Director of AI systems at NVIDIA, responsible for the go-to-market for NVIDIA's DGX portfolio of AI supercomputers. Paikeday helps enterprise organizations infuse their business with the power of AI with infrastructure solutions that enable insights from data. Paikeday has also held key roles at VMware, where he was responsible for bringing desktop and application virtualization solutions to market, and at Cisco, where he built its data center solutions. Paikeday, who started his career as a manufacturing engineer at Ford Motor Company, holds an engineering degree from the University of Toronto.

We are jointly attacking the problem of helping enterprises industrialize their AI development pipeline and that's at the heart of the Data Gravity Index DGx™ and solving the Data Gravity problem. Digital Realty has the architecture to facilitate that. Our customers also need high performance AI computing, which obviously is why we built the DGX.

How can enterprises benefit from the Data Hub established by Core Scientific and Digital Realty, which features NVIDIA DGX A100?

All verticals have a similar architectural problem related to AI development and infrastructure requirements. When it comes to AI models, they need a large compute footprint that has the performance to train complex models. You also need easy and effortless access with very low latency and very high-speed interconnect to your data infrastructure. With the Data Hub, our solutions and our technology are coming together to solve the same problem and make it easier for organizations to build great AI. We are jointly attacking the problem of helping enterprises industrialize their AI development pipeline and that's at the heart of the Data Gravity Index DGx™ and solving the Data Gravity problem. Digital Realty has the architecture to facilitate that. Our customers also need high performance AI computing, which obviously is why we built the DGX.

NVIDIA DGX systems are the world's first portfolio of purpose-built AI supercomputers. What problems will it solve now and how will the platform evolve?

We are currently in our third generation of NVIDIA DGX systems; our latest generation is DGX A100. A typical enterprise data center is built on legacy computing, i.e. traditional CPU servers with three silos of server infrastructure. Each silo is designed and scaled to tackle only one kind of computational problem: analytics, AI training, and AI inference. This inflexibility has been driving up capital and operating costs in the enterprise data center. So we built DGX A100 to solve this challenge. We consider it to be a universal building block for the enterprise AI data

center supporting analytics, training and inference in one agile, flexible platform. DGX A100 is fully optimized to run the entire lifecycle, from AI development and prototyping all the way to production deployment.

What key trends do you see in the future?

In 2020, we saw organizations deploying large-scale AI infrastructure at a rapid rate. If I look to the future, I see two simultaneous trajectories. I am continually impressed by the incredible scale at which organizations are actually building out infrastructure. The need to build state-of-the-art AI solutions and to tackle complex problems with large infrastructure is one trend. Many organizations are consolidating previously siloed AI teams and centralizing people, process and infrastructure to speed AI innovation, especially as they employ AI to thrive in turbulent times.

The other is that many organizations also see that their data scientists and developers can do better work if they have computational power available to them within arm's reach.

We see a rise in putting these powerful computing resources like DGX Station A100 in the hands of data science teams, closer to development and prototyping. More and more organizations now need supercomputing power in the hands of their developers and data science teams as they build and test complex models ahead of scaled training.



“With the vast majority of workloads running in colocation facilities, enabling best-in-class AI PaaS infrastructure

in a near-cloud environment helps customers unlock the value of their data lakes. The ability to train models near your data lake, and then use the Data Hub to move around to global edge facilities via a single pane of glass is a game changer for data scientists.”

- Ian Ferreira, Chief Product Officer, AI, Core Scientific

ZENLAYER

Zenlayer and Digital Realty are working together to deliver Digital Realty Network Hub featuring Zenlayer Edge Cloud Services. Zenlayer's complete edge network approach helps enterprises harness the value of PlatformDIGITAL® in Digital Realty data centers.

In Conversation with Lawrence Lee, VP, Partnerships and Alliances, Zenlayer

How did your partnership with Digital Realty come about?

Digital Realty was and is one of our first data center partners, going back to right after Zenlayer was founded. It made sense to combine Digital Realty's top-tier data center facilities with Zenlayer's global network. Together we've enabled customers globalize their businesses in North America and the EMEA region. We are now looking to expand the partnership into the APAC region.

Where are the locations around the world that you operate in and what kind of customer problems do you solve?

Zenlayer has locations on every continent except Antarctica, and we specialize in emerging markets like China, India, Brazil, West and South Africa, Southeast Asia, and so on. When businesses expand into these regions alone, they're confronted with challenging local regulations in an unfamiliar market. Instead, we make it easy for these clients by handling every aspect of deployment for them. Whether it's on-demand content distribution, accelerating applications, or a complete managed hosting solution, Zenlayer is available to not only help but "wow." We want our clients to focus on what they do best—connecting with their customer—instead of worrying about the underlying solution.

One of the more common use cases for our services is lowering latency for interactive digital experiences. Competitive online gamers, for example, require extremely low latency and drive down the ratings for the game if they experience lag too many times. Our solutions enable gaming companies to improve user experience for their players with fast connections, an instant global network, and edge locations in every key market. We have similar clients for live streaming, online education, e-commerce—basically any business with a digital component.

There is a tremendous amount of data being generated at the edge, so we want to enable our customers to process as much of their data at the edge as possible, without having to send data back to the core for analysis.

How are Zenlayer and Digital Realty with PlatformDIGITAL® and Data Gravity Index DGx™ geared to handle more enterprises going to the cloud?

Our partnership makes it easy for any company to "go to the cloud" by providing on-demand connections, servers, and related infrastructure in markets around the world. In fact, we make it easy for companies to go to not just one cloud, but many. We are partnered with every major cloud service in the world and many smaller regional ones. Clients can gain insights from the Data Gravity Index DGx™ to decide on the best locations for them to expand in, create private clouds in under 10 minutes using Zenlayer's Bare Metal Cloud service, and then connect private and public clouds



ABOUT LAWRENCE LEE

Lawrence Lee, Zenlayer's Vice President of Global Partnerships & Alliances, has over 25 years of experience in technology, corporate strategy, channel sales and partner development. A results-oriented executive with a strong background in enterprise and channel sales initiatives, he oversees and manages some of Zenlayer's key GTM partners. Lee was previously Co-Founder/Vice President of Partner Alliances at Unitas Global.

instantly through PlatformDIGITAL® and Cloud Networking. This allows clients to easily choose and implement the right cloud service for them based on their existing infrastructure, regional preferences, and other concerns.

A lot of companies have moved to the cloud this year. What are your thoughts on this trend?

The trend to the cloud has been in process for some time now, but the COVID-19 crisis has really accelerated adoption. Obviously big drivers have been millions of employees suddenly working from home, family relying on video calls to stay connected, more gaming and video streaming while people are cooped up inside, and so on.

I expect that as we pass this crisis and the pressure is eased, cloud adoption will slow but remain accelerated compared to previous years. Now that their customers are used to improved digital experiences, businesses will want to continue to offer them those experiences and improve. Competition will increase, customers will have higher standards, and businesses will be looking for any edge to make their services preferred. Since hybrid clouds and multiclouds are obvious stepping stones to improved experiences and lower latency, I expect adoption will continue at a rapid rate followed by regional expansion.

To help those customers, we recently soft launched a new service, Global Intelligent Accelerator. It helps customers accelerate any application with dynamic content, like gaming or streaming. It's still in beta as we add locations, but has already really taken off. A highlight of working with Digital Realty is that we can easily interconnect our customers with the SaaS companies located in DRT's data centers to make acceleration happen

Our solutions enable gaming companies to improve user experience for their players with fast connections, an instant global network, and edge locations in every key market. We have similar clients for live streaming, online education, e-commerce—basically any business with a digital component. There is a tremendous amount of data being generated at the edge, so we want to enable our customers to process as much of their data at the edge as possible, without having to send data back to the core for analysis.



"We currently have over 185 edge data centers around the world, but are projected to grow to 400-500 edge data centers by 2023. Leveraging the

findings from the Data Gravity Index will help guide us as we expand globally and create long-term value for our customers. Our work with Digital Realty lets us interconnect digital workflows from edge to core to cloud, at centers of data exchange on PlatformDIGITAL."

– Joe Zhu, founder and CEO, Zenlayer

How do you see Zenlayer's customers leveraging the Data Gravity Index DGx™?

The majority of our clients are extremely latency sensitive, which means they want their data moving as fast as possible over the shortest distances to give their users optimal experiences. Data Gravity Index DGx™ is a planning tool for everyone to see where poles of influence are and where data amasses. It will help them find the best locations for storing and processing data and to choose the best clouds to utilize. Furthermore, they can use the insights of the Data Gravity Index DGx™ to look ahead to the future and make infrastructure choices not just for this year but the next decade.

What is the value proposition of Zenlayer's partnership with Digital Realty?

Together, we are able to offer clients not just a one-stop solution for network expansion and application delivery, but also key insights enabling those customers to make the best choices for their business globally. By combining our services, a customer can enjoy the advantages of being located in one of Digital Realty's top-tier data centers, take advantage of Zenlayer's on-demand servers and network infrastructure or choose custom deployments, deliver and accelerate applications around the world, and plan for the future with confidence using the Data Gravity Index DGx™ and Zenlayer's consulting services.

Networks cannot exist without connections. By connecting our services with each other and partnering together, we're able to offer stronger solutions to all of our customers.

YELLOWBRICK DATA

Yellowbrick and Digital Realty bring a modern data warehouse through hybrid-IT to centers of data exchange with Data Hub featuring Yellowbrick Data Warehouse. Leveraging PlatformDIGITAL®, Yellowbrick offers an integrated hosted data warehouse solution offered as a service to its customers, accelerating their cloud-adoption strategies.

In Conversation with Mark Cusack, CTO, Yellowbrick Data

How does the Yellowbrick platform help customers implement an effective hybrid/multi-cloud strategy?

A key part of our hybrid cloud strategy is to offer choices to our customers. We provide the Yellowbrick Data Warehouse on any public cloud platform, or even on-premises with the same guaranteed levels of performance. This year many CIOs and CFOs have had cloud-first mandates. Rather than going all in on public cloud, companies are taking a more considered approach and adopting it on a case-by-case, workload-by-workload basis. Having an integrated hybrid cloud offering for data warehousing de-risks their decision.

Everybody is pushing along and optimizing their software in one way or another. Our differentiation is that we optimize both our hardware as well as our software. This gives us another dimension to exceed performance. When you bring optimized specialized hardware instances together with software, the impact is significant. We were 182 times faster at Catalina, one of our customers, compared to their previous data warehouse environment, and more than 150 times faster in our deployment at BMW, just to name two examples. (Yellowbrick was selected by BMW Group Financial Services to improve their analytics performance and capabilities earlier this year.) We have a completely uniform infrastructure in place to deploy our specialized hardware instances. That means that we do not have to make any compromises on the supporting infrastructure in the data center to act as a platform for our hardware. We are basically thinking along the same lines as Digital Realty, which helps us get the same performance, and enables us to be geographically located closer to our customers.

What role does the Data Gravity Index DGx™ play in Yellowbrick Data's business?

The Data Gravity Index DGx™ gives us a roadmap to think about where we need to locate our data warehousing capabilities as a service. It is no good having the best-performing data warehouse on the market if you are far away from your end consumers and far away from the data.

What's going to be key for enterprises in 2021 and beyond?

You should take a very close look at the distribution of your data within your enterprise and at the number of data silos around an organization. Taking a combination of thinking about how you can start to break down these data silos, roll out more advanced analytics and further integrate your data lake alongside your data warehousing strategy are really important.



ABOUT MARK CUSACK

Mark Cusack is the CTO of Yellowbrick Data. Before joining Yellowbrick, he was vice president for Data and Analytics at Teradata. Cusack joined Teradata in 2014 when Teradata acquired RainStor, where he was a co-founding developer and chief architect. Prior to RainStor, Cusack was a lead scientist in the UK Ministry of Defence. He holds a PhD in computational physics from Newcastle University, and his thesis was centered on discovering the electronic and non-linear optical properties of quantum dots.

How will 2020 change the way enterprises approach data warehousing?

Businesses will be sorely mistaken to think that we will be returning to business as usual, even after the vaccines. Many retailers failed to predict demand around certain consumer goods, for example, and buying patterns of consumers changed overnight. There were no demand forecasting models in place to support that change. It's not only about having the models in place, but you also need the processes to go all through your supply chain down to the manufacturers to be able to react quickly. Additionally, work from home (WFH) has put immense strain on networks and workforces. They have seemingly split away from the center, further away from the data in some cases, and it introduces latency issues. Now, enterprises are starting to think about how they can start to use distributed computing ideas.

What does the future hold for data warehousing?

We are seeing a trend of more self-service and democratization of access to data. And that implies a much more cloud-led user experience around there as well. Databases typically are not known for their user experience. The most progressive data warehouse vendors, like ourselves, are investing in making that experience seamless for customers. The hybrid cloud trend is incredibly important. Data warehouses will have an increasing role in helping with real-time, predictive decision-making. The legacy data warehouses have not really been set up to deal with more predictive and prescriptive analytics. Yet, that's the direction the market is heading. That's where the demand is now.

We have a completely uniform infrastructure in place to deploy our specialized hardware instances. That means that we do not have to make any compromises on the supporting infrastructure in the data center to act as a platform for our hardware. We are basically thinking along the same lines as Digital Realty, which helps us get the same performance, and enables us to be geographically located closer to our customers.

WHY DATA HAS TO BE IN THE

RIGHT PLACE AT THE RIGHT TIME

Eric Hanselman, Principal Research Analyst at 451 Research, which is a part of S&P Global Market Intelligence, explains why better access to data is critical for enterprises and how a better understanding of data gravity can help them extract value.

In Conversation with Eric Hanselman, Principal Research Analyst, 451 Research

How do you view Data Gravity and why should enterprises take note of it?

Because we have been able to virtualize compute storage, expand our capabilities and interconnect, and it is easy to lose sight of the importance in the way data should be handled. Data gravity is important because, speaking from a physics point of view, data has mass. An organization can extract value from it if it can ensure that the data end up in the right place at the right time.

Can you talk about the impact of data gravity on global financial capitals?

Traditionally, organizations did not have to worry about where data was located simply because so much of the core enterprise infrastructure was on-prem. All those data sources were located close to us. If we think about how organizations have been transformed, and what the process of digital transformation is all about, it is about expanding that enterprise ecosystem. That key data now has to be available in many different places.

If there is specific focus on the creation of data, then there will also be a need to have better access to that data. The financial centers are quite critical, as they are the source of all this data creation. Organizations are looking to leverage that data. If they are going to do that by performing analytics alongside their own data, not only is it critical to be close to where those sources of data are, but you also have to ensure that you can get your own data close to where the data analytics is happening.

How do you see data localization and data sovereignty laws affecting data gravity?

There has been increased awareness about the various aspects of privacy and compliance concerns around data. Organizations are starting to learn what that means from an operational perspective. Not only do you have to look at the operational concerns, but also how that data is being governed. That is going to be a constraining factor. So dealing with issues of data sovereignty and privacy management have become far more critical for organizations.

What is the impact of Digital Realty's recently released Data Gravity Index DGx™? How do you envision customers using it?

One of the challenges with data management is ensuring that organizations have an understanding of what is possible while being able to leverage industry-norm benchmarks. Having benchmarks that establish those kinds of norms is important for organizations to understand where they are and where they need to go.



ABOUT ERIC HANSELMAN

Eric Hanselman is the Principal Research Analyst at 451 Research, a part of S&P Global Market Intelligence. Hanselman coordinates analysis across the broad portfolio of 451 research disciplines, with a hands-on understanding of a range of subject areas, including information security, networks and semiconductors and their intersection in areas such as SDN/NFV, 5G and edge computing. He is a Certified Information Systems Security Professional, a VMware Certified Professional and a member of 451's Center of Excellence in Quantum Technologies.

What role do you see AI, IoT, connected cars, autonomous cars and 5G playing in Data Gravity, especially pertaining to increasing the endpoints?

Organizations are transforming the way they build intelligence for decision-making. They depend on the availability of data to make those decisions. Implementing these transformative technologies depends on the effective movement of data to relevant environments. 5G is important because, even compared to 4G networks, there is so much more data that is moving around in a modern telecommunications network, from an operational perspective. A lot of the things you can do with 5G depend on the real-time availability of data.

What key trends do you foresee in the marketplace for enterprise customers' data? How do you see Data Gravity shaping the Global Digital Economy throughout the next decade?

If we think about where we have come from, then it is evident that the cloud has already rocked our world. We got into an environment in which suddenly we had scalability around the volumes of data that we could accumulate. And, it was far beyond anything we were able to do historically.

The obstacle that we did not think about is the gravity of all of that data that we created. The future, then, will focus on the flexibility that improved access to data delivers. Data gravity's importance is helping organizations understand what those forces are to be put to work for their own benefit. And, in the bigger picture, it also teaches the potential hazards of accumulating data in single large blocks, especially in places where it is hard to access.

Now, you have to not only look at the operational concerns, but also how that data is being governed. That is going to be a constraining factor. So dealing with issues of data sovereignty and privacy management have become far more critical for organizations.



“Data Gravity and its impact on our IT infrastructure is a difference-maker for our operations and will only become more

important as data continues to serve as the currency of the digital economy. As enterprises become more data-intensive, there's a compounding effect on business points of presence, regulatory oversight and increased complexity for compliance and data privacy that IT leaders are now being forced to solve.”

- Munu Gandhi, VP, Core Infrastructure Services, AON plc.