

DATA CENTER OUTSOURCING: A NEW PARADIGM FOR THE HYBRID I.T. ERA



DCD INTELLIGENCE OPINION

Decisions relating to the hosting of IT assets are reaching new levels of risk and of complexity. The availability of new technologies and services, principally those associated with the cloud, have created new possibilities for aligning IT delivery with business needs and, in the process, meeting new challenges of data traffic, mobility and the cluster of initiatives that are included under 'speed to market'.

Each new advance, whether it be in the design and operation of a data center, in colocation or hosting services or in the deployment of cloud services at either a private or public level, impacts on all others. Colocation and hosting have to adapt to new expectations created by cloud, and enterprise facilities have to match the expectations of performance created by outsourcing options. 'Adaptation' can mean competition, it can mean assimilating other technologies, partnerships, linkages, service development and often a combination of all of these approaches. The investment triangle between cloud, colocation and enterprise is already well-established and over time this will morph further into more complex, agile and transparent architectures. This is the foundation of hybrid IT.

This White Paper looks at the combination of customer requirements, the technological and operational innovation, the corporate thinking, and the wider economic and cultural drivers that have formed the context for DATA4's initiatives. In particular it looks at the questions of:

- › Where outsourcing services including colocation are heading under the influence of cloud
- › How customers are working through the IT infrastructure options available to them
- › How data center requirements for efficiency, resilience and performance are being revised in an era of IT/cloud dominance
- › How the new requirements of data sovereignty will impact on European data centers and IT operations
- › How European markets differ across a range of factors and metrics
- › The possible impacts of Brexit.

The White Paper provides a detailed exposition on each of these issues and how DATA4 have interpreted and acted on them in the design and operation of their facilities and services. The Paper describes also the experiences of a number of DATA4 clients and partners across a spectrum of industries.

CONTENTS

5	INTRODUCTION
6	GROWTH OF DATA CENTER OUTSOURCING AND DRIVERS
11	'SPEED TO MARKET': ONLY AS FAST AS THE SLOWEST LINK
12	HYBRID IT: THE NEW GRAIL?
16	ANSWERING THE CLOUD CHALLENGE
20	THE VOICE OF THE MARKET
26	DATA SOVEREIGNTY TODAY
29	THE IMPORTANCE OF PHYSICAL CAPABILITY AND COLOCATION

FIGURE & TABLE INDEX

- 7** FIGURE 1: GLOBAL CHANGES IN PROPORTION OF FOOTPRINT OF MAJOR OPTIONS 2015 TO 2020
- 7** FIGURE 2: THE EVOLUTION OF DATA CENTER OUTSOURCING
- 8** FIGURE 3: THE MIGRATION OF ENTERPRISE FOOTPRINT
- 9** FIGURE 4: GROWTH IN CAPACITY INVESTMENTS: WESTERN EUROPE 2016 TO 2020 (EURO BN)
- 12** FIGURE 5: HESITATIONS IN THE DEPLOYMENT OF PUBLIC CLOUD
- 13** FIGURE 6: ENTERPRISE INVESTMENT IN IT & CLOUD SERVICES 2014 AND 2015
- 14** FIGURE 7: KEY REASONS GIVEN FOR INVESTING IN HYBRID IT: 2015
- 15** FIGURE 8: DATA CENTER REQUIREMENTS OF CLOUD PROVIDERS IN 2014
- 18** FIGURE 9: THE DIGITAL HUB

INTRODUCTION

This White Paper has been written on behalf of the DATA4 Group in order to identify and discuss key trends in IT infrastructure and the role that colocation will play in the continuing evolution of infrastructure and IT systems.

The paper focuses on the drivers and benefits of colocation in Europe in addition to potential risks and hazards posed by the new legislation in terms of data sovereignty and the location of outsourced infrastructure for enterprises. Furthermore, the paper will touch upon the need for working with partners that have experience and a general understanding of the implications and potential penalties that the legislation will present. Learn how to prepare for these potential challenges with colocation services.

The information presented in this report has been collected from a number of sources including the DCD Intelligence annual Data Center Census and projections made from those as well as surveys, media reports and analyses provided by independent experts. The DCD Global Census has collected annually over 2,000 responses from end-user organisations and 500 from colocation, cloud and hosting providers.

GROWTH OF DATA CENTER OUTSOURCING AND DRIVERS

There are two major trends that are shaping the IT infrastructure market globally. The first is the move from in-house data centers into facilities and services provided outside the organisation. The second, related trend is towards non-physical infrastructure and components (referred to in this document as 'digital' or 'dematerialised'). This may mean components and services that are created within and sourced from virtualised, cloud-based or software-defined environments.

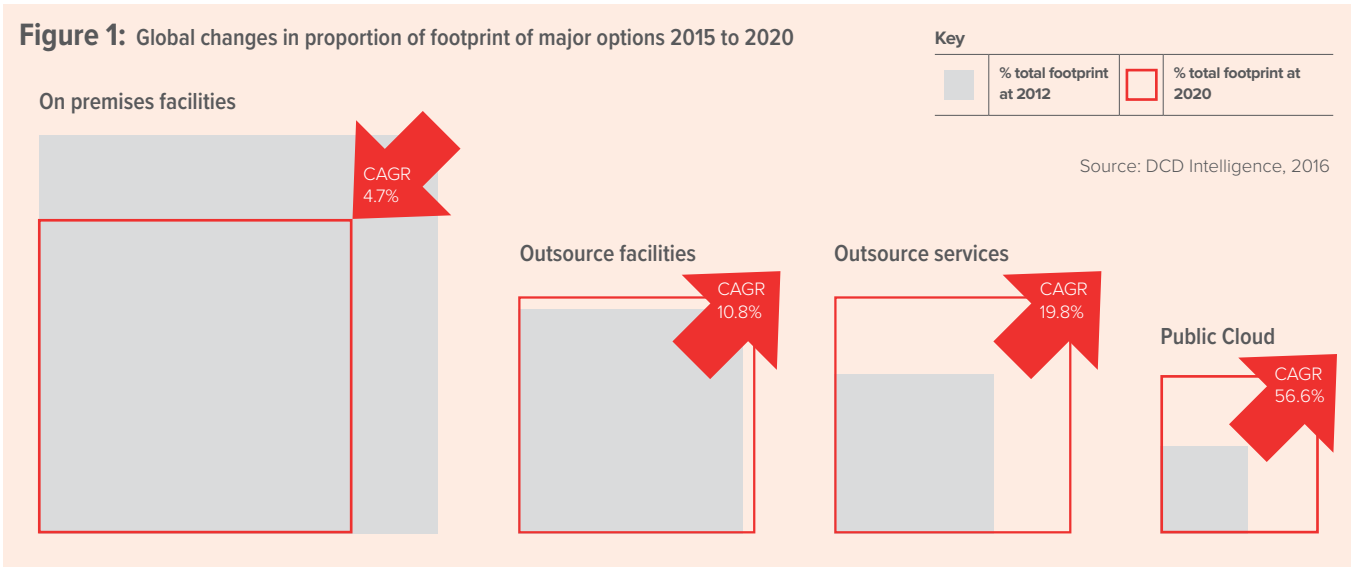
'Outsourcing' can therefore be broadly defined as the process of sourcing facilities, facility services, IT capacity or IT services from an external provider. Outsourcing providers include companies that provide data centers and/or data center services such as colocation, cloud services and managed hosting to end-users on a commercial basis, offering them an alternative to building and/or operating their own data center. Outsourcing also includes services that enable a company to run its own in-house data center more effectively.

The practice of investing in outsourcing has grown prolifically over the past 5 years, and it will continue to do so. In the time period 2012 to 2020, investment in outsourcing is expected to grow at a rate of 10.8% CAGR (Compound Annual Growth Rate) from US\$ 25 billion to US\$ 58 billion, increasing at more than double the rate of investment in data center facilities which increased from an initial amount of US\$ 70 billion at 4.7% CAGR to US\$ 101 billion. The latter investments include those made by colocation, cloud and other IT service providers in building the physical infrastructure necessary to deliver their services.

One of the major drivers towards outsourcing occurred when the global financial crisis restricted the amount of capital available for work on 'in-house' data centers and companies turned to colocation and outsourcing as a means of meeting capacity requirements more flexibly while defraying capital expenditure.

The first generation of provision was marked by the rental of physical IT components such as servers and racks under different systems of management and control as represented by colocation and hosting models. The driver here was to conserve limited and sometimes expensive resources – money, power, skills and space.

Figure 1: Global changes in proportion of footprint of major options 2015 to 2020



As requirements of IT operation have evolved and changed, so outsourcing has made a generational change towards providing IT resource rental and services. This means outsourcing provides the means of delivering increasing IT capacity on a more scalable and interconnected basis. This generation will entail the use of virtual technology and consequently hybrid architectures to enable the necessary delivery of scalable and low-latency IT. At the third generation, cloud provision has emerged as the default means of accessing IT services and the economies of the hyperscale data centers will provide a less expensive and more power efficient means of delivering IT. This evolution has changed the drivers for outsourcing, including colocation, from resource conservation and efficiency towards enabling the commercial opportunities that the fast-moving evolution of IT, technologies, architectures and networks can bring.

ENTERPRISE MIGRATION

The outsourcing and dematerialisation of IT infrastructure is not a static process. Rather, it has created a continuous dynamic whereby each category of provision and each provider within that needs to respond to innovations and developments elsewhere. The development of cloud has altered the offering of colocation beyond the original “racks + power + connectivity + security” paradigm, it has also changed end-user IT as companies developed customised hybrid or private environments.

DCD Intelligence has calculated that from 2015 to 2020, the rate of increase of ‘share’ for cloud and virtualisation environments will continue to speed up. Colocation will maintain its share at 22% to 23% of IT assets. Public cloud and other outsourcing/hosting services will take up the majority of capacity moved out of in-house servers.

Figure 2: The Evolution of Data Center Outsourcing

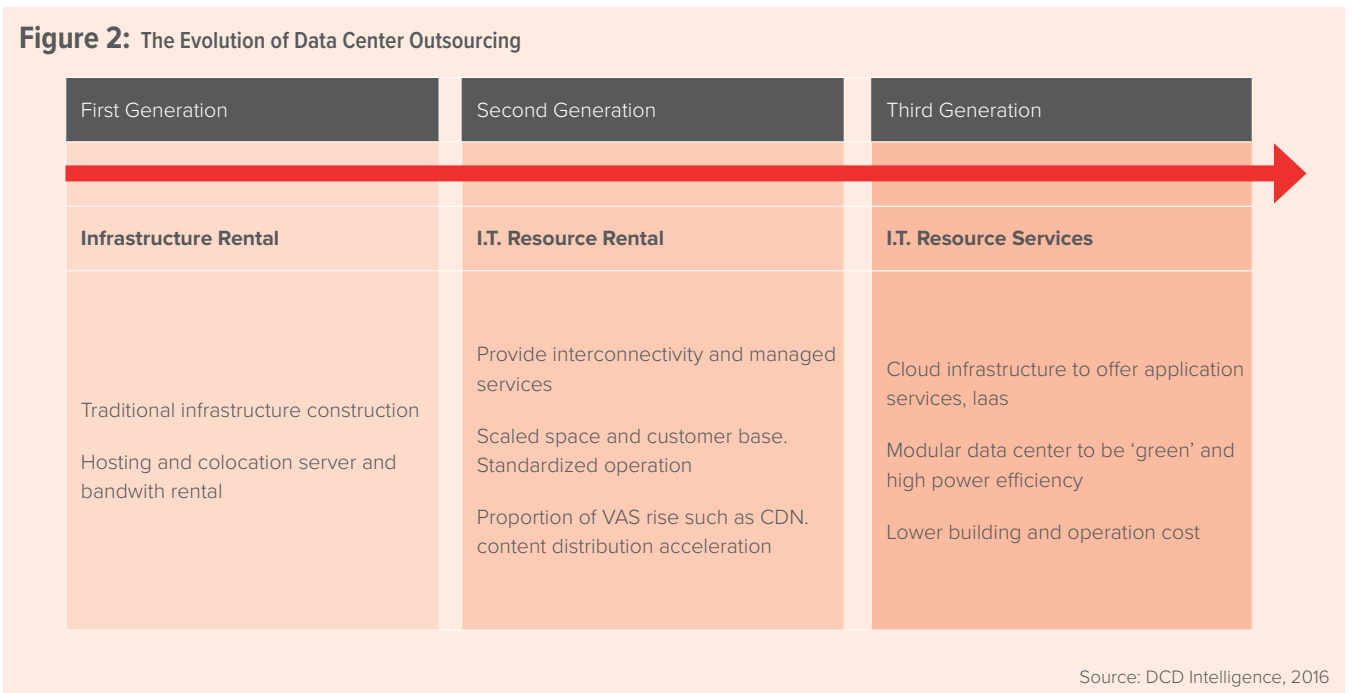
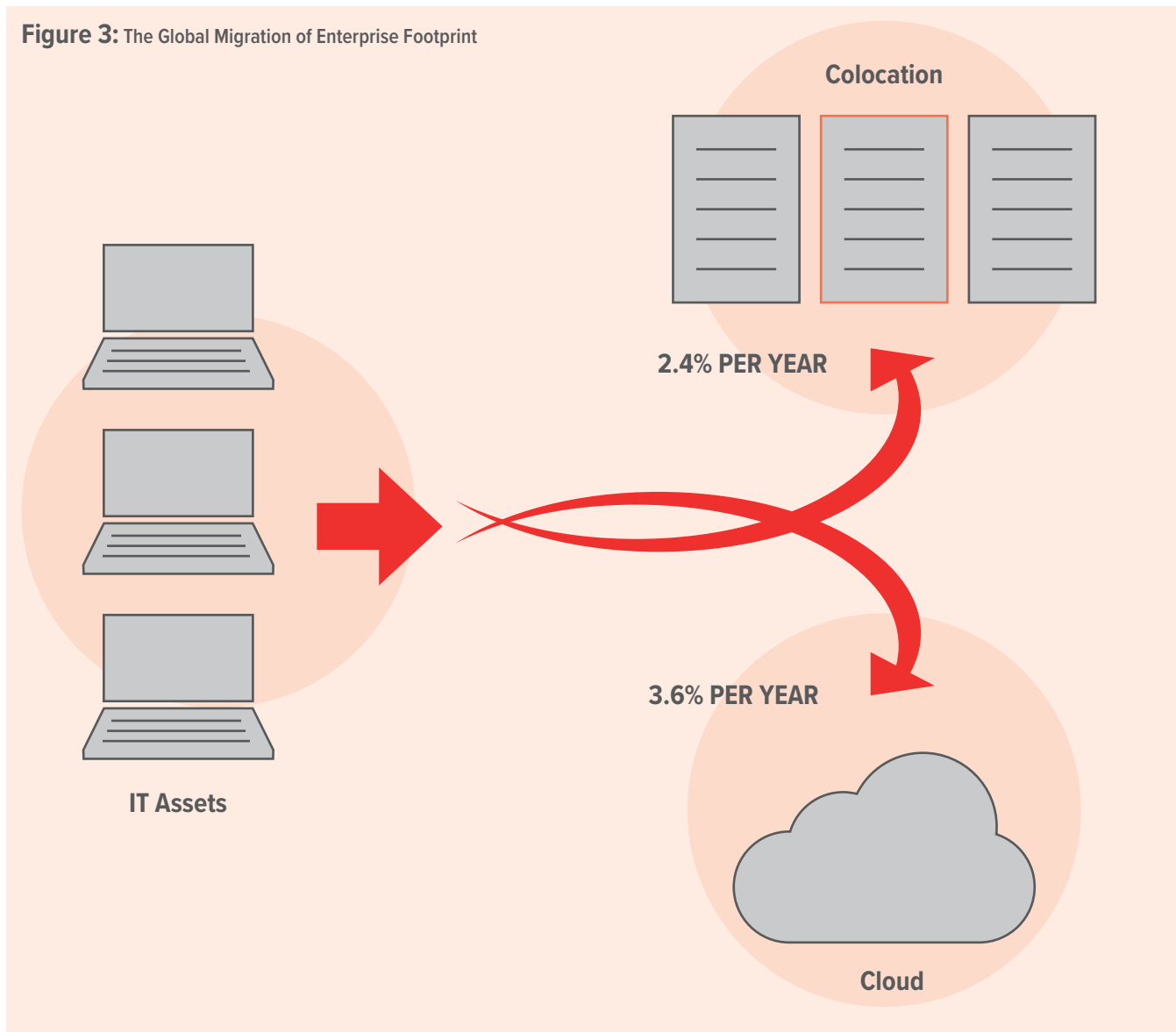


Figure 3: The Global Migration of Enterprise Footprint



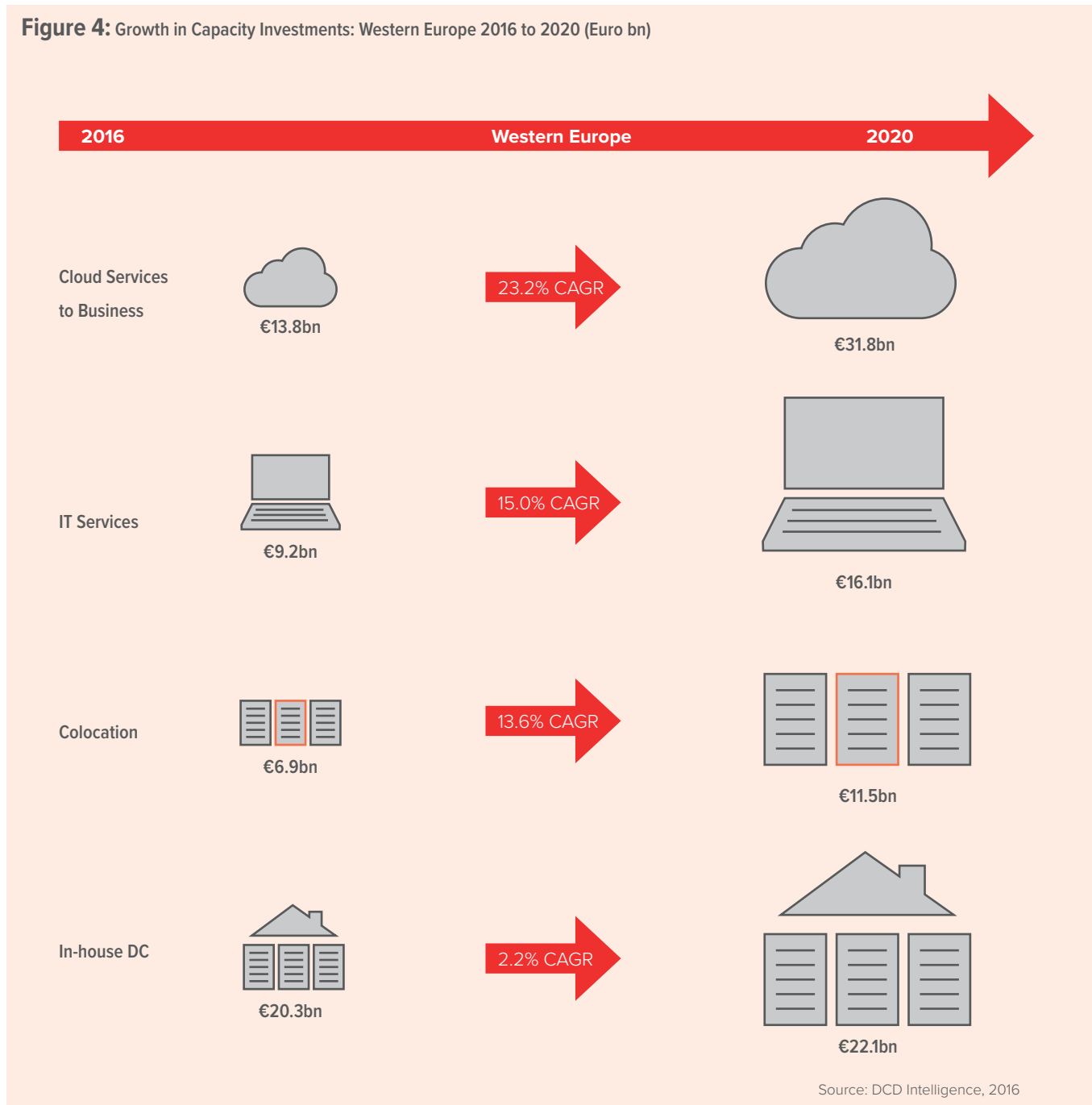
The proportion of IT infrastructure that is outsourced will increase at an average rate of 2.4% each year while the rate at which IT infrastructure is transferred from the physical to the digital layer will increase at an average rate of 3.6% each year. These figures indicate a gradual transition into both outsourcing and digitised infrastructure although 2.4% of the global total is equivalent to the entire IT infrastructure of France and 3.6% is equivalent to the UK + Ireland so, in absolute terms, it is a considerable amount.

As a result of enterprise migration, investment in colocation has risen from an estimated €6.9 bn across Europe in 2016 to €11.5 bn in 2020, a compound annual growth rate of 13.6%, a rate more than six times that of enterprise data center new build.

Colocation indicates a lower rate of growth than do IT services (a CAGR of 15.0% to a value of €16.1 bn). It has also grown slower than cloud which was an emerging trend at the beginning of this time period to be worth more than colocation and services combined by 2020.

Growth indicates the extent to which colocation represents an established option in the IT landscape. Colocation is used for a variety of reasons, for example, as a means of expanding into new markets without the need to build in each locality, as well as a means of expanding IT capabilities without needing to invest heavily in upgrading in-house facilities, and as a back-up/DRP deployment.

Figure 4: Growth in Capacity Investments: Western Europe 2016 to 2020 (Euro bn)



The criticality of outsourcing to corporate IT means that any shortage of available outsourcing space or services is viewed as a threat to IT operations. 44% of organisations across the world in the Census stated this in 2015. Levels of concern have remained similar since 2011 despite the extensive expansion of the colocation and IT service asset base – this reflects the increasing investment in the sector by enterprise, as well as heightened expectations of the services that are available.

The extent of IT dependence on colocation and outsourcing means that by 2020, although service provider facilities are very much smaller in numbers than enterprise facilities, accounting for only 6% of all data centers, they will account for 40% of all global data center space and 45% of all power capacity.

They will account for over 55% of facility investment as providers strive to meet the needs of end-user organisations. These will rely more heavily on colocation as the need to synchronise IT with business requirements may mean levels of latency, networking, and access to services that would not be available from their own data center.

The globalisation of data center networks, the digitisation of data and the trend to cloud means that a number of responsibilities have changed for companies. In particular, as legislators and pressure groups get to grips with the new technologies of data storage, processing and distribution so issues of data sovereignty and privacy protection are forcing companies to look further at their legal obligations.

BY 2020, ALTHOUGH SERVICE PROVIDER FACILITIES WILL BE VERY MUCH SMALLER IN NUMBERS THAN ENTERPRISE FACILITIES, ACCOUNTING FOR ONLY 6% OF ALL DATA CENTERS, THEY WILL ACCOUNT FOR 40% OF ALL GLOBAL DATA CENTER SPACE AND 45% OF ALL POWER CAPACITY

‘SPEED TO MARKET’: ONLY AS FAST AS THE SLOWEST LINK

Regardless of era, the quicker the time to market, the greater the potential for competitive advantage and for maximising price points, the quicker the time to reach a break-even point thereby lowering risk, increasing profit and return on investment and achieving a longer market life. These critical drivers for ‘speed to market’ remain the same for software and app development as they did for physical products and services.

The importance of the proper IT environment to delivering legacy products and services as well as software and apps, is considerable. For the former category, IT enables key processes such as the communication between different skills and teams, the scheduling of tasks, the allocation of resources and the continual revision of these processes in the light of emerging information. This process has been termed ‘agile’ since it removes existing corporate barriers to innovation and development.

The use of IT has been a feature of corporate R&D for as long as it has been available. In the new world of app and software development the IT environment has the potential to become an active part of the process, particularly as the tools become integrated into the process as part of a continuous paradigm. In this era of “Software-defined everything”, we can see an enterprise as an App and a business as an App. Therefore any enterprise has to project itself into the digital world, and reach customers by re-inventing itself as an App. The core principle here is agility (one of the most used and most difficult to define words in the IT lexicon) which explains the suitability of the approaches suggested here for the evolution of DevOps.

To enable the most effective paradigm for development, the right IT systems are crucial in order to streamline internal systems and to remove silos that may restrict innovation, to coordinate different databases (and thereby stakeholder groups) and supply chains.

The system needs also to offer the flexibility of capacity so that the process can effectively deal with big data loads and algorithms as they form part of the process. This is best achieved using a transversal network topology that permits a low-latency connection between all these apps and consequently corresponding active IT equipment. The network is therefore key. The solution can be accessed from the cloud as services, whether platform, software or infrastructure based. Unless the in-house data center has considerable reserve capacity to use for sudden increases in workload (which is unlikely given the cost and inefficiency associated with keeping large amounts of processing capacity in reserve) then access to external sources, for example via cloud bursting are the logical alternative.

HYBRID IT: THE NEW GRAIL?

Yet the migration into outsourced cloud is not a simple or a one-way process. Despite the fact that cloud is now as much valued for its agility as its cost-efficiency, there are still corporate doubts and legislative restrictions as to its deployment.

The flexibility of the cloud extends to its own ability to morph and transform into forms that will maximise opportunity and reduce risk (or the perception of such). The growth of 'hybrid' variants combining the security of 'private' with the scalability of 'public' is the most obvious manifestation of this. This development, part technological, part marketing, is now yoking together cloud and pre-cloud terms with much the same objective – 'hybrid hosting', 'managed cloud', and there will be more. As a consequence, colocation, hosting and managed service providers which are able to offer cloud systems and services can look forward more to 2017 than those serving a facility niche.

There is a higher investment trend towards architectures that are at least partly based in-house due to a mistrust of external cloud provision. The end user sample indicates a high degree of hesitation (77% make mention of some concern) about public cloud systems. Issues of network security, access service levels, physical security and access to shared services have created the greatest concern.

Hesitations about the cloud are not based on a pre-trial 'fear of technology' among companies that have yet to consider deploying any form of the cloud since these are now few in number. Rather, all concerns are higher among companies that have already adopted the cloud and this has also filtered through to companies intending to adopt cloud solutions. While these very high levels of concern appear not to have caused any major move away from public cloud providers, it is probable that they have caused those investing in cloud to be more selective about what is housed there, or to move towards a private or hybrid cloud model since these cloud modes indicates lower levels of concern (73% and 59% respectively). The key factors which enable effective speed to market are those that the cloud offers – flexibility, agility, cost efficiency, disruption even. While most organisations accept that the cloud offers these advantages, there are elements that require reassurance, in particular security, control and service levels. Migration to the cloud also raises the issue of what happens to the legacy IT on which most organisations

are based. Hybrid IT helps an organisation negotiate these transitions through a presence in a number of different IT infrastructures.

The cloud disruption model is creating a new set of expectations both inside and outside the industry. It has moved beyond being a technological solution to representing a new way to run corporate IT and therefore to operate a business. It is quite possible as this decade progresses that the cloud paradigm will represent a solution to many of the historic resource problems of the data center sector. A recent Lawrence Berkeley National Laboratory study suggested a major slowdown in the energy consumption of American data centers, principally due to the growing use of public cloud run from highly efficient ‘hyperscale’ data centers. These are the very large data centers run by multinational cloud providers such as Amazon, Google, Facebook and Microsoft which are designed to run at optimal performance while reducing waste through high levels of optimisation and, in a number of cases, through the use of renewable energy sources as well.

The outsourcing, hosting and cloud options most commonly deployed by enterprise by end-2015 are IAAS (31.4%), ‘private’ cloud (29.9%) and dedicated hosting (28.6%). Those most likely to be deployed for the first time in 2015 (by over 7% of the sample) include the ‘hybrid’ cloud, PAAS, IAAS, the ‘public’ cloud and SAAS. These figures indicate that there are still considerable sections of the global data center market that these services and solutions have yet to reach.

Figure 5: Hesitations in the Deployment of Public Cloud

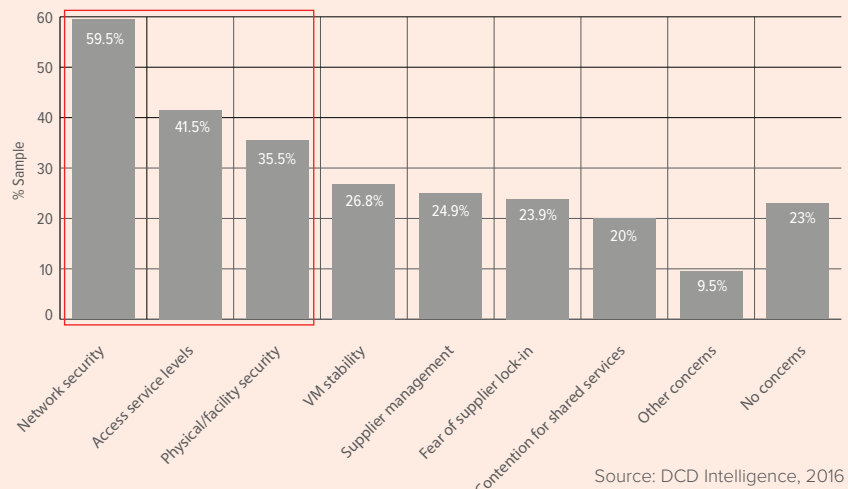
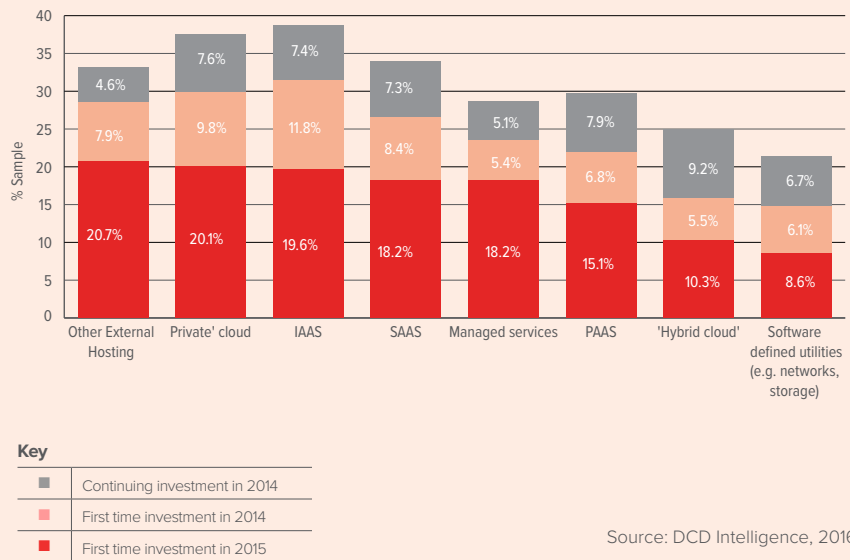


Figure 6: Enterprise Investment in IT & Cloud Services 2014 and 2015



The impetus towards the introduction of virtualisation architectures to reduce the number of 'standard' servers is not recent. Server, application and user virtualisations represent well-established technologies, and the only major new market deployments of them tend to come from smaller organisations in more recently established data center markets. Server virtualisation in particular is a mainstream option that 67.4% of sample organisations have now deployed.

The enterprise shows strong drive towards hybrid environments, particularly based on business objectives to:

- › Increase IT capacity
- › Reduce operating costs
- › Access the benefits of technologies and architectures such as cloud, virtualisation and software-defined utilities
- › Reduce the risks of IT operations
- › Become 'greener' and more sustainable
- › Meet changing corporate requirements
- › Meet legislative or accreditative requirements, (in 2015, these included Uptime Institute Tier classification, CEEDA efficiency accreditation, ISO 27001 and LEED)
- › Support the requirements of big data.

THIS STRONG DRIVERS DEMONSTRATED BY THOSE INVESTING IN HYBRID I.T. SYSTEMS INDICATES THE BALANCE THAT END-USERS ARE LOOKING FOR BETWEEN ACCESSING THE BENEFITS OF THE CLOUD WITHOUT THE PERCEIVED OR EXPERIENCED DISADVANTAGES OF EXTERNAL PROVISION.

This strong drivers demonstrated by those investing in hybrid IT systems indicates the balance that end-users are looking for between accessing the benefits of the cloud without the perceived or experienced disadvantages of external provision. Two-thirds of investors in hybrid systems see it as an effective solution to increased IT capacity requirements while almost half see it as the most effective way to access the advantages of cloud. Overall, each respondent investing in hybrid IT gives 4 reasons for so doing.

It also indicates a greater confidence in the capabilities of their own facilities due both to advances in IT optimisation and convergence (across servers, storage, networking and systems) and to the advances in cloud and virtualisation technology that enables the development of hybrid architectures whether on-premise or located in colocation.

Figure 7: Key Reasons Given for Investing in Hybrid IT: 2015

Increased IT capacity requirements	67.2%
To reduce overall operating costs	51.3%
To access new technologies such as cloud computing	48.1%
To reduce risks associated with IT & data center operations	47.2%
To be 'greener' & more sustainable	42.7%
Changing corporate requirements & priorities	40.0%
To support the requirements of big data	39.7%
To meet legislative or accreditation requirements	30.6%
Other reasons	15.1%

These market demand drivers have accelerated the move of colocation into cloud and the further development of hybrid IT options, and with these, the opportunity for the synergy between cloud and colocation. There is also risk as the cloud and IT services provider segment is one of the largest customers of colocation facilities, and there may therefore be the potential for the entry of colocation providers into cloud to disrupt that business arrangement.

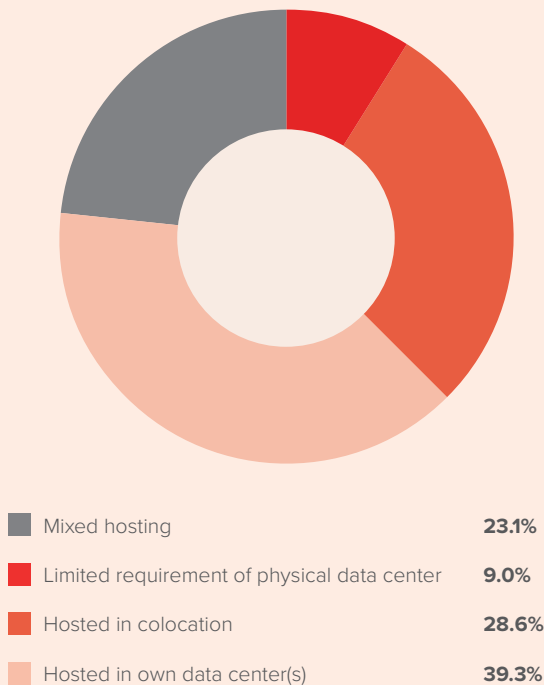
'Hybrid' cloud systems are the only architecture here where a significant proportion (22.1%) of the sample of colocation providers will enter the market for the first time in 2015. This development is necessary to ensure that they can meet the requirement of the market wanting to invest in the type of collocated environment specified for hybrid IT. It can be assumed therefore that the attention of these colocation providers will also be developing their service areas, in developing new architectures and technologies, and in reducing the costs of delivery.

Hybrid IT relies also on the low-latency availability of public clouds. Information provided in the Census by cloud providers indicates the sample splits fairly evenly into those that operate their own data centers (39.3%), those who rely on a mix of facilities (23.1%) and those that rely on colocation (28.6%). The first group includes the major global cloud providers as well as national and local providers who have moved into other areas of IT services that require facility space. Those providers relying on colocation have a similar profile although a number of the larger developers and providers of AAS delivery models also distribute from colocation facilities either to conform to legislative requirements or to expand their network away from their primary data centers on the core>edge principle, and usually on a self-build basis. The minority of companies that do not require very much physical data center space tend to be service developers and providers working in IAAS or PAAS environments.

that it is more difficult for colocation providers to predict and control their businesses. Colocation needs to cast wider for its markets than does cloud but there are benefits in this - average occupancy levels (self-reported, based on space) among the 2015 sample appear to rise once cloud is offered, from 58.1% where it is not, to 64.7% among colocation providers offering cloud services and 70.8% where cloud architectures are offered. This in itself is enough to indicate the positive effect of adapting to changing customer demand trends. Around 10% of investment into cloud is currently made by colocation providers as these providers seek to capitalise upon the market demand for cloud services.

IT service companies including cloud service developers and providers are the largest single investors into colocation, accounting for an estimated 19.3% in 2015. Therefore, there is already a considerable investment flow running between colocation and cloud providers.

Figure 8: Data center requirements of Cloud Providers in 2014



Sources: DCD Intelligence, 2016

Broadly, colocation and cloud providers have targeted the same sorts of companies for their business. Both groups give equal nomination to financial institutions, IT and outsourcing service companies, business services and retail/personal services. This focus is unsurprising as these are the sectors within the global economy where revenue is most directly dependent on IT performance and where this dependence can support a service premium. These are also some of the largest sectors in terms of size and demand.

The more dynamic and competitive data center landscape means

ANSWERING THE CLOUD CHALLENGE

Is your business 100% cloud-based? Very few organizations will answer “yes.” However if we switch the question round and ask if you plan to remain 100% on premise in the future, the number of organizations saying “yes” will be equally small.

SO WHY IS IT THAT SUCH A TENSION EXISTS IN TODAY'S INFRASTRUCTURE MANAGEMENT?

It would be an understatement to say that the emergence of cloud computing has been a disruptive force. Cloud has created an entire paradigm shift in the way that businesses manage their IT. And this shift reflects the direction of the enterprise IT landscape as a whole. It has to be more agile. At the same time it must be more cost effective. And while getting faster and cheaper, this technology must also be designed to deliver business outcomes. The role of the enterprise IT professional has never been faster paced or more challenging.

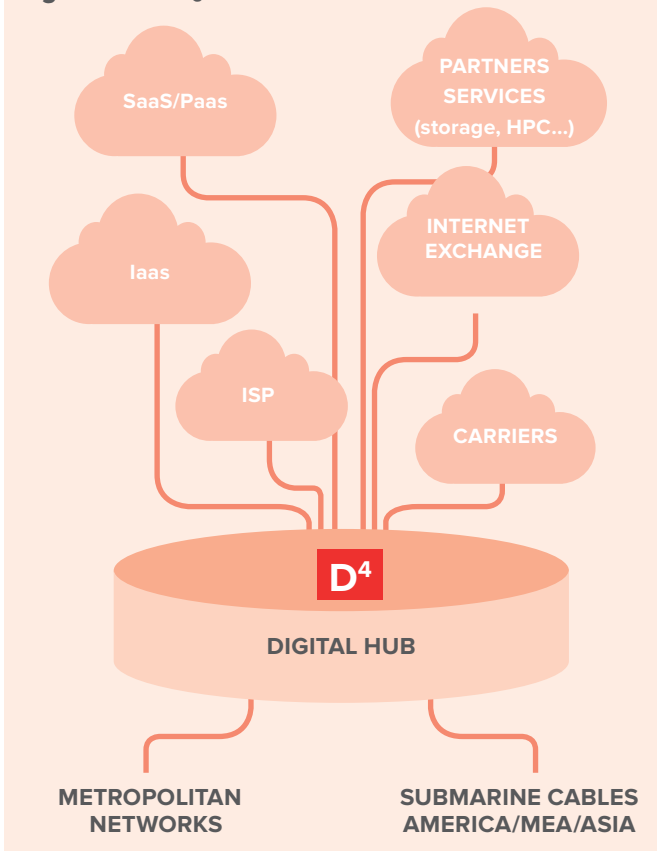
TECHNOLOGICAL EVOLUTION

The speed of technological change within businesses has made the traditional data center model difficult to maintain. The default of providing a ‘foundation’ for your IT through an on premise data center has been relevant for most of the history of ‘enterprise IT,’ but its capability for answering the rapidly changing needs of the business are diminishing. On the one hand this model may appear to provide a sense of security and certainty resulting from absolute control of the facility. On the other hand however it has led to unmanageable pressures on IT budgets as organizations grew their infrastructure. Even the perceived security benefits have proved to be misplaced as business technology has advanced.

Data center strategy is now fraught with complexity - a web of technical, engineering and management issues, requiring an ongoing juggling act of density, load and capacity. The emergence of cloud is forcing the hand of IT professionals to address these issues. It profoundly questions many ‘assumed truths’ of the legacy model of IT delivery. The large, expensive and static enterprise data center is now in stark comparison to the flexibility, pricing, agility and efficiency promised in the cloud.

Colocation initially emerged to provide an external version of the ‘on premise’ footprint, allowing enterprises to outsource the housing of their IT whilst retaining control of the physical IT platform.

Figure 9: The digital hub



It has helped redefine how IT managers view 'ownership' of their facilities. Today, colocation is providing the backbone for the transition to the cloud.

HYBRID. THE NEW REALITY

The move to a cloud-based model appears to be a 'done deal' for any cost-conscious business (few organizations today are not!). And it seems a certainty for those demanding rapid change and highly agile IT (but isn't everyone today?).

As with so many major technology innovations, theoretical benefits and practical delivery can take a long time to align. The reality is that there are pragmatic factors that have influenced how well organizations respond to the cloud opportunity. Businesses need to know where their data is located, how it is used and how it is shared. For some companies there will be external, regulatory obligations to demonstrate where their data is located, especially where that data contains sensitive information relating to their customers. On this basis, many organizations have elements of their business that they do not wish to be moved into the cloud, at least until wider proof of concept programs have been proven as a long-term success. And yet at the same time, pressure from within the business is driving cloud adoption. Today lines of business are forcing the need for technological agility, sometimes authorizing cloud-based purchases without even consulting the CIO. Many of the most exciting enterprise technologies of recent years have originated from an ability to sell technology solutions into non-techie parts of the business. As such

there are applications for ERP, CRM, Marketing, Advertising, Media, Sourcing, HR, Collaboration, Productivity and Finance - once the domain of high-cost, on premise licenses that have now been entirely devolved into the cloud.

The truth is that most businesses today are operating in a semblance of a hybrid strategy - even if IT did not make the decision to do so! However they may not be getting anything like full organizational or operational benefit from it...

HOW YOUR BUSINESS CAN BECOME HYBRID

Not every organization is in the ideal position to fully capitalize on either the cloud, or on a hybrid strategy. Traditional on premise data centers were often designed to meet the needs of a 'different era' of IT. The simple fact is that many facilities just don't have the bandwidth, latency, capacity or agility to maximize the use of hybrid IT. A hybrid strategy will therefore be rendered ineffective.

A tension exists because of the impatience to 'be more cloud-based.' The cloud ecosystem is expanding rapidly and there is exponential growth in the available solutions. This makes operations significantly more complex for the IT team, from the data center manager through to the CIO.

But it's not all doom and gloom. Colocation offers a simple route to unlocking the benefits of hybrid IT. It can deliver higher-specification converged data center solutions, which have pre-integrated and pre-tested components in which server, network and storage layers are able to operate together more effectively. Many businesses are already treating these 'hybrid IT-ready' colocation facilities as the cornerstone of their IT infrastructure, and many more are set to follow.

THE PILLARS OF A HYBRID STRATEGY

Hybrid is far more than an industry buzzword. It's a way of operating that spans the paradigm gap between on premise and the cloud, and in order for it to deliver true value it has to offer the business certain key elements:

- › A Digital Hub - no hybrid strategy can exist without access to multiple cloud and connectivity platforms, but nor can the business trust that strategy if it doesn't meet strict requirements for security and flexibility. The Digital Hub is what enables vision to be turned into reality
- › Insight and experience - Any organization looking to establish a hybrid strategy will require knowledge and support to achieve its IT goals, as well as to enable wider business outcomes. Your colocation partner should offer an advisory team to help you find the right solutions for your business
- › A smart platform - No two infrastructures are the same, as every business has unique demands and operational requirements. Having a smart platform behind your hybrid solution will enable each customer to optimize their own virtual data center environment

THE DIGITAL HUB: THE FOUNDATION OF HYBRID CLOUD STRATEGY

Is your business looking to benefit from the cloud - but on your own terms? A common stumbling block in the cloud transition is a sense of lost control. It's precisely in answering this challenge that a Digital Hub adds value. Bringing the benefits of a private network, it provides the control organizations demand in deploying cloud applications and cloud resources. The Digital Hub's defining characteristics are: Flexibility in adapting its profile, including destination and bandwidth

- › Access to all utilities and services needed to build the customer's hybrid IT platform
- › Provision of a consistent and unified means to support a global roll-out
- › A pay-as-you-go model so there is no restrictive usage threshold
- › Fully managed connectivity so companies do not need to spend money, develop new staff skills, or monopolize workforce time in network design, deployment or operation
- › Scalability, as it gives the capability to grow or reduce on demand thereby aligning with application needs and/or project requirements
- › Access to de-materialized infrastructure acting as a storage buffer to control the way data is transferred to the cloud

NO CLOUD WITHOUT CONNECTIVITY

So what exactly does a Digital Hub look like? Because hybrid IT demands "hyper-connectivity" (a network that extends the data center into the whole eco-system of the cloud and can manage end-to-end connection to cloud providers' gateways), the Digital Hub is a center of that connectivity. It will typically offer:

- › Access to multiple telecoms carriers and Internet Service Providers (ISPs), allowing the customer to connect with their own Virtual Private Network (VPN)
- › Multiple modes of connectivity such as intra-campus and inter-campus connections through dark fiber, wavelength and Ethernet services
- › Access to many national and international carriers delivering a wide range of services: MPLS; Ethernet; wavelengths; Dark Fiber; and DDOS protection
- › Access to major ISP and Tier-1 carriers in order to connect customers' platforms to the Internet

For the vast majority of businesses, cloud isn't just a 'plug and play' operation - so your hybrid strategy will rely on a breadth of connectivity. While internet protocols (IP) were initially used to connect to cloud service providers, IP connections for an inter-application network do not meet stringent enterprise requirements. The level of security and privacy across the Internet is poor, and internet routing mechanisms do not guarantee routes, sustainable and predictable performance or latency. Furthermore supervision and monitoring cannot be provided. Therefore with no internet Service Level Agreement (SLA) available it can only really be considered as a fallback option.

Colocation is providing a bridge, moving businesses from limited connectivity and an absence of cloud use cases, through a hybrid approach that enables full interaction with the leading cloud services.

CONNECTED TO THE CLOUD CROWD

A major cloud pain point can be removed if organizations answer this demand for connectivity. Colocation is supporting hybrid IT strategies by offering direct, private and secured global access to many cloud providers (inside or outside the colocation data center). But more than just direct connectivity, the Digital Hub facilitates a new kind of network service that extends the perimeter of the data center out into the whole cloud ecosystem. Because of the vastly increased interdependency between legacy and cloud applications, between server and cloud computing and storage resources, this new network model becomes critical.

In real terms, this means enabling secure, reliable, low-latency connections to the leading IaaS, SaaS and PaaS – such as Amazon Web Services (AWS), Salesforce and Google. Operating your hybrid cloud strategy through a Digital Hub model can support an enterprise-ready approach to the cloud - fast, reliable and secure. Indeed, with the right SLAs in place, services such as AWS, Microsoft Azure, Microsoft Office 365, Softlayer, Google Cloud, VCloud Air or Salesforce can be used securely within the company's network without passing through the Internet.

HIGH BANDWIDTH - LOW BARRIERS

Not every business will choose to operate a hybrid cloud approach on this basis, however. Sometimes fast is just not fast enough. For organizations whose consumption and/or production of content demands very high bandwidth, the Digital Hub offers direct access to major Internet eXchanges (IX) (for example Milan Internet Exchange, FranceIX, DECIX, AMSIX, LINX). By allowing peer-to-peer connectivity

Digital Hub Use Case

Business X operates across Europe, and has a number of proven cloud use cases which are now embedded into the firm's way of working:

- › Using the DATA4 Digital Hub, Business X can connect their servers directly to the private Amazon EC2 resources in London through an end-to-end private connection. This enables them to get the full benefit of the Amazon cloud with all the enterprise-level security requirements their industry demands
- › At the same time, they can establish a connection to a SoftLayer bare metal server resource in Frankfurt with just a few clicks. This happens in a completely agnostic way, regardless of which DATA4 campus Business X chooses to establish the connection from

Thanks to this model, as they grow and scale out their cloud needs, they can be securely connected to the global array of principal cloud providers, with several destinations, depending on their needs



“HIGH-PERFORMANCE DATA CENTERS ARE DESIGNED TO RUN THE IT EQUIPMENT AND NETWORKS THAT ENABLE OUR CUSTOMERS TO CAPITALISE FULLY UPON THE OPPORTUNITIES OF THIS HYBRID IT ERA.

OUR PORTFOLIO OF SERVICES ARE LOCATED IN CONVERGED DATA CENTERS ON OUR OWN CAMPUSES SO THAT ALL NECESSARY RESOURCES ARE AVAILABLE IN ONE PLACE.

OUR TEAM OF EXPERTS ENABLES US TO DELIVER ON OUR COMMITMENT TO OUR CUSTOMERS TO IMPLEMENT HYBRID IT AND TO MANAGE THIS EFFECTIVELY TO ENSURE OPTIMAL PERFORMANCE OF OUR CUSTOMERS’ IT RESOURCES”

JEROME TOTEL DATA4 PRODUCTS

and thereby reducing the cost to these high bandwidth consumers, the Digital Hub can serve a wide range of business cases. Once connected to the Digital Hub, it's a straightforward process to add cloud or IX destinations instantly, because the hyper-connected data center is already linked to the cloud ecosystem through a global network.

ALL CHANGE IN THE CLOUD

As a technology end user, your needs are not being ignored by the industry. Cloud providers themselves are having to expand their physical footprint for several reasons:

- › Technical: The large cloud service providers have to get content nearer to their customers by using interconnections which are based on high bandwidth and low latency between the hyper-connected data center – where their edge platforms are collocated – and end-users
- › Compliance: To comply with legislation (for example in Europe, Privacy Shield, GDPR etc.) and under pressure from citizens (especially those in Europe and Japan), data will have to be stored and (usually) processed in consumers' home countries. This pushes cloud providers to invest in edge platforms whereby they can create separated 'regional' or 'national' clouds
- › Economic: Multinational cloud providers don't have resources to invest in their own data center in every location, so instead they often choose collocation data centers which offer a large number of carrier Points of Presence (POPs) and IP providers. In response to the growing demand from their consumer base,

they will prefer collocation operators who are ready for hybrid and multi-cloud platforms.

Consequently it's easy to see the world as a global virtual data center with several layers: core hyper scale data centers at the center and edge platforms located in hyper-connected data centers closer to their users and customers. Thanks to the Digital Hub, businesses can now build a tailored, secured and efficient hybrid IT architecture to fully benefit from this cloud-centric landscape.

HYBRID MADE SIMPLE

For those businesses even further into their hybrid journey, you may be wondering about the potential complexity of multiple platforms, and of having to directly monitor and control every resource. Fortunately there's an answer to this conundrum. A Software-Driven Data Center platform allows you to monitor and manage your IT efficiently through two key software pillars:

- › A Customer Web Portal: managed via an API in real time, the portal displays an activity dashboard allowing you to manage service requests (cabling services, remote hands services, access permissions etc.) and incident notifications. Consistency of management is delivered via an online document on a shared platform, enabling you to log and store operational procedures
- › An integrated software-driven platform: providing the core capabilities for an efficient hybrid platform, this encompasses data center infrastructure management (DCIM) software and data center service optimization (DCSO). As a customer, you're able to efficiently manage capacity planning, deployment (room and racks), real time monitoring and alerts, real usage of resources (e.g. power consumption in real time), and automated processes can be programmed through workflow generation.

The software platform provides an open door to a large and secure ecosystem of partners delivering services for the hybrid IT environment. It allows crucial steps to be taken into the cloud, without taking a single step away from the security and control that businesses have traditionally relied upon.

IN SUMMARY

The enterprise IT model has been fundamentally disrupted by the cloud. This much is a given today. What's less clear is how the majority of businesses make the transition from their on premise data center, to an infrastructure that seamlessly integrates with the cloud. For end user organizations and cloud service providers alike, the answer is increasingly found in collocation. But only colo providers that can offer a true platform for hybrid IT will deliver this transition. The Digital Hub model ensures that the connectivity, reliability and security parameters demanded by the enterprise can be fully serviced. And this translates to more organizations taking advantage of the benefits of the cloud.

THE VOICE OF THE MARKET

We interviewed five customers and partners of the DATA4 Group to better illustrate how DATA4's approach to outsourcing and their operations have met their colocation and hosting requirements. The customers include a local software development company with global reach (KDS), a leading French financial institution, again with international reach (Societe Generale Group), one of the world's largest cloud service providers (SoftLayer), one of the world's largest IT companies (IBM) and a French computing innovator (Qarnot Computing). Here is what each told us:

JEAN-PHILIPPE BOUCHARLAT, HEAD OF QA AND PRODUCTION, KDS



KDS is a French-based software development company specialising in SaaS tools (Neo) for online business travel booking and expense management. Its parent company is the Business Travel division of American Express. We spoke with Jean-Philippe Boucharlat who is responsible for quality management of the software development process, and the testing of software and platforms.

Representing the established trend whereby colocation is the first step in IT expansion for a growing business, Boucharlat explains that the move out of a small office in the southern suburbs of Paris to Issy-les-Moulineux meant a change in direction:

"We wanted to become more professional. We decided to leave in-house server room to get a colocation deal. As we grew, we didn't want to have to deal with the issues of cooling or power, power protection. We wanted to focus on our key work".

KDS's focus was firmly on colocation in order that they might continue to stay in charge of their IT: *"We would not be happy for others people to manage our IT. We store and process a lot of sensitive information. We need also to segregate the work we do for different clients".* KDS is an IT-centric business and therefore Boucharlat nominates also security and resilience as key facility requirements: *"We are looking for extensive security for our servers inside the facility – inside DATA4 we get gated access only for ourselves and for the DATA4 personnel who are looking after the power and cooling equipment".*

WE CHOSE DATA4 BECAUSE THEY WERE AGILE. THEY WERE FLEXIBLE IN CHANGING PLANS ONCE WE HAD SORTED OUT WHAT WE REALLY NEEDED. THEY WERE PROFESSIONAL.

KDS drew up a shortlist of possible data centers in and around Paris and found DATA4 to offer qualities reassuring to a company making their first move into outsourcing:

"We chose DATA4 because they were agile. They were flexible in changing plans once we had sorted out what we really needed. They were professional. With all the work we were doing through 2015, we found it difficult to keep to our original migration plan and DATA4 were helpful and cooperative as we had to change our dates. They really tried to make it work. They helped with our migration".

STEPHANE MARCHINI, GLOBAL HEAD OF DATACENTERS & NETWORK SERVICES, SOCIETE GENERALE



Societe Generale Group is France's third largest bank (by total assets) and the sixth largest in Europe. The company employs 150,000 people and services 31 million customers (individual, corporate and financial) across 66 countries. Market trading activity focusses on financial and investment hubs across the world while retail services are particularly strong

in Africa. As the Global Head of Datacenters & Network Services, Stephane Marchini is in charge of the company's data centers and the local metropolitan sections of the networks the bank uses.

Societe Generale Group is one of the largest users of data centers in France. It operates ten data centers across France with a combined capacity of 10 to 11 MW, of which 6MW is currently used.

In France only one of the strategic data centers is owned by Societe Generale Group – the rest are rented. Similarly, across the world, most of the data center space is located in colocation facilities. As Stephane Marchini explains, this is part of a deliberate long-term consolidation strategy:

"In 2012 we decided on a global consolidation program. The objective was to optimize our IT operations but also to reduce the number of datacenters we use. From 21 end of 2011 then we have reduced to 10 now, and we will close another 2 to 4 by 2019."

Societe Generale Group use colocation services from a number of the major providers in and around Paris. Given the size of their IT footprint, the first requirement is that the facility has sufficient size:

"We never rent just a few racks; we go for a whole room. We are always the sole tenant in our room - we need that mainly for security. But the facility needs to be of sufficient size to allow us to expand. At DATA4, each room is 250 m2 and 300kW. For us that is considered something small so to grow we need to rent another. We have 5 rooms that are almost full so we should be looking for another 1 or 2."

A location within low-latency reach of the Paris financial district is looked for as well as the interconnectivity of the facility to telco and cloud providers:

"We look at the number of telecom and cloud providers directly hosted in the data center so we can get directly interconnected with a simple interconnect cable. It helps if the data center provider can offer that directly as a cross connect."

THEY ARE PROACTIVE AND THEY WILL ACCEPT MY WORD WHEN MAKING AN AGREEMENT – WE USE DATA CENTERS ALL OVER THE WORLD – WE'D LIKE TO SEE THEM IN SOME OF THE OTHER PLACES WE ARE LOCATED

Price is of obvious importance and this is an issue on which Stephane Marchini notes a considerable variation across the French colocation market:

"We recently had the need to compare the price of one room from a number of providers here and we found that the gap is huge, something in the range of 50% to 100% between the lowest and the highest. I cannot see anything to justify a premium at that level!"

Stephane Marchini goes on to explain that price is not just that given at day one when the contract is signed but should specify what is included. For an organization that uses upward of 5MW per year, the costs of electricity will represent a significant cost therefore the means by which the facility can improve PUE is looked at also. Since Societe Generale Group arrange many of the 'smart' IT services that need to be linked to their IT themselves, this means they need also for the colocation provider to quote for and undertake the pre-work.

Stephane Marchini inherited DATA4 at the time when he joined Societe Generale Group. At that stage the proximity and standard of connection to the main Societe Generale Group facility in Ile de France seemed to represent the major advantages. Based on his experience of DATA4, Stephane Marchini nominates a number of reasons why the relationship has prospered:

"Their facility is resilient. The quality of the relationship is good and they are flexible. We asked them to help us with contract rules relating to the release date of a particular room so we could get into another room. They are always flexible and helpful without any financial impact. They are proactive and they will accept my word when making an agreement – we use data centers all over the world – we'd like to see them in some of the other places we are located"

FRANCOIS DOMINE, DIRECTOR OF SOLUTIONS, IBM FRANCE



Francois Domine of IBM is a specialist in datacenters and manages a range of solutions across key IBM business units – Systems, Network Services, Mobility, and Resilience which includes Disaster Recovery as a Service, Back Up as a Service, and hosting services.

IBM is one of the largest providers of IT and hosting services worldwide. In France,

IBM operates several data centers, both in and around Paris as well as in regional centers via partnership arrangements. As IBM is a services company, the ease in which such facilities can enable IBM to focus on their customers is paramount. *“We look for partnerships with a close and strong working relationship. We need to respond to requests from our customers, and require providers to work hand-in-glove with our IBM teams on a day to day basis to help provide solutions to our customers”.*

This requirement will continue as IBM look to expand their business base in France:

“Having significant hosting space at our disposal enables us to offer flexible hosting solutions. Facilities with high power density are an important consideration - DATA4 in this respect is strong given their close links to EDF and associated price competitiveness. This is important as we look for power densities of between 1.5 to 2.0 kW per m² with the ability to go to more than 10 kW/rack if required. “

The need for such flexibility is due to the differing requirements within the French market. Domine identifies that customer-focused services look to cloud for their production operations and as financial, defense and pharmaceutical companies continue to re-assess their medium and long-term data center requirements for their businesses’, this will lead to the need for additional dedicated space to grow.. The advantage of DATA4 at Paris-Saclay for IBM is that it offers a site that is close to Paris without being in the main city area.. Since Domine indicates that IBM provides services to 80% of France’s largest companies, the choice of location is important.

Domine considers DATA4 to offer the highest quality hosting services in terms of technology and design. The ten onsite data centers – each offering 2000 m² – means that clients can have their own dedicated data center staffed by an IBM team with DATA4 providing all facility and security services in a partnership arrangement. This partnership has led to the integration of information on facility metrics such as humidity, temperature, and efficiency on an IBM portal. Domine also highlights DATA4’s strong connectivity to telco’s and cloud service providers as well as to their wider data center footprint in other countries:

IT IS IMPORTANT TO GET NETWORK SERVICES AS THIS IS THE MAIN COMPONENT OF HYBRID IT.

“It is important to get network services as this is the main component of hybrid IT. All services are based around the network; it is not possible without a robust and expansive network. They provide interconnectivity to other providers and to other cloud providers. This is vital – not just to provide facility services but also provide hosting services for hybrid strategies”.

The evolution of DATA4 from hosting provider towards cloud provider is perceived as a positive change:

“The main value of DATA4 is their willingness to change and not remain in the pure hosting space area, but be a player in the infrastructure of cloud. However, to do this I think they need to develop other European sites and develop partnerships with other providers in cloud and hosting”.

FRANCISCO ROMERO, CHIEF OPERATIONS OFFICER, SOFTLAYER



SoftLayer is one of the largest global providers of cloud infrastructure and managed hosting in the world. As Chief Operations Officer, Francisco Romero is responsible for the company's technical operations across the world. Since SoftLayer is operated as a single global platform this means overseeing functional groups that have global responsibilities rather than teams in individual countries or regions.

Romero outlines SoftLayer's requirements very much in terms of scale. This applies not only to facility decision making but to the prior process of selecting markets:

"To operate a cloud platform you have to do that at scale. To have a particular data center in a particular city in a particular country is not what our business model calls for. We ask: is there enough scale to operate in that particular market based on the client base that operates there or the size of the market there or the size of the market that is attractive to other markets".

**WE LOOK FOR PARTNERS THAT TENURE
IN THAT MARKET, WHO UNDERSTAND
WHAT IT TAKES TO OPERATE THERE AND
UNDERSTAND ALSO HOW WE WORK**

This evaluation formed the basis of SoftLayer's strategic expansion back in 2014/2015 when it entered 13 new markets across the world. The decision where to locate within the market is driven also by the size of the deployment and the capability of local providers to cope with SoftLayer's requirement:

"There are lots of data centers in these markets but when you show up and you say you need multi-MW deployments in the following timelines it actually shortens the list quite a bit. Then there are the technical specifications – our deployments look exactly the same wherever they are, whether they are here in the USA, at DATA4 or in Tokyo".

Romero also identifies the need to be close to the network and somewhere that is economically attractive but indicates that once core facility requirements have been met, that a lot comes down to how easy it is to deal with the operator.

"We look for partners with tenure for that market, who understand

what it takes to operate there and understand also how we work. We are signing up for a fairly long term relationship and if that partner is not the right one, bad things will happen".

Particular emphasis is placed on "the little things":

"To give you one example: we do a lot of deliveries of equipment, several hundred or thousands of servers, therefore trash management becomes an issue. So it's good having someone who recognises this as an issue and who brings in the trash containers a couple of days before we are going to be there, locates them close to where we are unloading, then when we have finished they can be cleared out. Whether we pay for that or not doesn't necessarily matter, having that perspective of "how do we help the client succeed?" distinguishes the good partners from the not so good partners".

This proactivity of facility providers can be taken to extend to the business model used to charge for facilities. Romero suggests that the influence of cloud extends to how facility providers charge:

"Cloud was obviously a big disrupter in the IT space in terms of taking a business that was built around contracts and long term commitments and investments and turning it into a valuable consumption model. That model is now being pushed down into the datacenter providers – there are a handful of them that are coming up with various ways to variablise the costs at their end".

This means that the customer is looking for technologies that enable the cloud provider to scale up or down quickly and effectively as well as a shift in the business model from a Real Estate-style landlord: tenant model to a much more cloud like approach. This he considers particularly important:

"The predictability of cloud demand is actually very low so the ability to move from 3MW at day one to 10MW is of paramount importance. You don't want to lose your place in the cloud in an industry that is growing extremely quickly. This unpredictability should be built into contracts both in a phase of growing extremely quickly but it will also be important in 8 to 10 years when everything levels off. So it's good if you can come to a global agreement for 10MW of capacity but with the flexibility of adding 3MW on one site and taking 3MW from another site".

SoftLayer's decision to use the DATA4 location outside Milan was based on the factors described above:

"Milan was the clear leader for the location in Italy that we wanted to be in. We went to market to look at people who could scale and provide the technical specification for what we needed. DATA4 was more economically attractive and offered better partnership options for us".

PAUL BENOIT, FOUNDER & CEO, QARNOT COMPUTING



Qarnot computing is internationally known as the company that designed the Q.rad, a computing device that offers remote high-performance computing (HPC) capacity while using the heat generated as part of these processes to heat buildings. Beyond this innovative and decentralized infrastructure, Qarnot provides an HPC platform as a service

(PaaS) compatible with state-of-the-art standards like Docker or OpenStack. Paul Benoit founded Qarnot in 2010 after working in high-performance computing in the banking industry, and he explains the principle behind this innovative yoking of digital process and physical output:

"The computer is a machine – it produces heat like any other machine. We have developed a computing heater that uses the computer as a heat source. It looks like a heater but inside, instead of standard resistors, we use computers that do IT work for our company and for others, and which provide heat. We developed both the hardware and the software."

The Q.rads currently provide free and green heat for more than 500 people in Paris. Qarnot's software distribution platform is now used by a number of organisations including two of France's largest banks, and 3D animation studios. The demand for both remote and local computing capacity is likely to grow, driven by increasingly energy-hungry applications.

The innovation relies on the heating unit, based on self-supporting and energy-efficient heat generation system, but also on the software and systems supporting it. A significant part of Qarnot's development efforts is dedicated to the latter. DATA4 came in as this software system was taking shape:

"Our platform creates an abstraction of infrastructure. It can also be used to provision capacity in data centers. To provide a fully extensible service, we also deployed cost and energy efficient servers in DATA4's buildings, running on the exact same software platform so that we can provide all our services in a transparent manner inside the infrastructure for their clients"

There are a range of reasons why Qarnot chose DATA4. The location and capabilities of the Paris-Saclay campus are important to Benoit. He describes the campus as 'unique' as a 'future cluster' – and capable of supporting smart buildings with more technology and smart data centers using a software platform. The scope of Paris-Saclay and its proximity to the EDF grid is also important:

"DATA4 can address the needs of very large clients and they are connected to the grid transmission system. The campus has the potential to become something very large and far more interesting than being in urban datacentre, limited by design"

DATA4's connectivity is also a critical benefit:

"We are quite good at computing and storage but we found great synergies with DATA4 around networks issues. Indeed, DATA4 have created direct connections to the cloud ecosystem and to the main Internet eXchange, powered by Intercloud's technology. So it's a great partnership for us. When we started Qarnot we were Internet focused. However, we need dedicated network access when we work with banks or large companies: we get that with DATA4. We are about to deploy access points for our API to cross-connect internally but also to get network cloud access thanks to their "Digital Hub" network, and to the Internet also of course."

WHEN WE STARTED QARNOT WE WERE INTERNET FOCUSED. HOWEVER, WE NEED DEDICATED NETWORK ACCESS WHEN WE WORK WITH BANKS OR LARGE COMPANIES: WE GET THAT WITH DATA4.

The relationship with DATA4 has developed into a partnership, based on DATA4's amenability to use software with distributed computation rather than just using clustered computing models. According to Benoit, this shared vision, along with technological development, will form the basis of the two companies moving forward together:

"For two years now, there has been a big culture of change at DATA4 moving from a bricks and mortar world into developing their services. We found great synergies between our software and hardware skills and their expertise in managing technical buildings. Beyond physical building management, the data center of tomorrow will have to bring innovative offers, and to move towards cheaper and greener computing infrastructure. Microsoft, Google and Amazon are continuously innovating, see for instance Microsoft's containerised server rooms. DATA4 can do that, they have the campus to create an ecosystem. We look for cheap hosting costs based around software, we just need electricity and a network, we can develop cheap infrastructure, based on an agile PaaS. Scalability is not a problem for them"

DATA SOVEREIGNTY TODAY

WHY IS DATA CRITICAL?

Data has become companies' critical asset as it contains IP, legal, financial, sales, customer information, e-mail exchanges, contracts, etc. Data translates into information that translates into intelligence. Therefore, it is essential to properly store and safeguard that data.

It all starts with the data center, the location where the data is stored.

WHAT HAS CHANGED?

Over the years, in a fast moving globalized world, the data center has transformed from a real estate status to technological units networked and converged internally and linked to users, customers, and other data centers. This trend has put data access, data availability, - data security and data sovereignty under the spotlight.

While the first three points, data access, availability and security are part of corporate strategic organizational and technological choices, data sovereignty is part of a bigger picture involving international legislation.

WHAT IS DATA SOVEREIGNTY?

Data sovereignty is broadly defined as the principle whereby data stored in digital form is subject to the laws of:

1. The country in which that data is located
2. The country in which the individual or the entity to which the data belongs, is located (rather than the country where the organization that has collected the data is based).

Because datacenters form part of international data chains and data is rapidly moved around the globe, the requirement and principles of data sovereignty become increasingly important.

Two key implications of data sovereignty within the EU have been identified as being potentially disruptive to data centers which are either part of international networks, or operated by companies based outside the EU.

These two implications are:

1. The need to comply with the privacy regulations of the country in which the data is stored
2. The possibility that data held in a European country (for example, an email or online content) may be required to be produced before a court outside the EU.

Both of these situations have occurred recently in terms of the data held by American companies on European citizens. Therefore, both situations have major implications for the **location** and the **operation** of a data center.

US DATA CENTERS LOCATED IN THE EU

For data centers belonging to American companies located within the EU, the issue came to prominence in October 2015 when the principles of **Safe Harbor** were challenged by an Austrian campaigner on the basis of the sanctity of his own data on Facebook and stored in the Microsoft facility in Dublin.

As a result, the Safe Harbor undertaking between the EU and the US was overturned by the European Court of Justice in October 2015 (that same month).

The Safe Harbor ruling demonstrated that the area of data sovereignty is one liable to sudden and profound change if challenged in the manner that led to the overturning of Safe Harbor.

WHAT WAS SAFE HARBOR?

Safe Harbor was a legal framework that was agreed initially between the EU and US Government as far back as 2000 to establish principles whereby companies might transfer data on EU citizens from the EU to the US while complying with EU Data Protection legislation. Such principles had been codified 20 years earlier in 1980 for the collection, storage, transfer and use of data (well before the era in which data centers became established).

FROM SAFE HARBOR TO PRIVACY SHIELD

The Safe Harbor agreement faced too many challenges. It appeared that data sovereignty principle need to be more visible and enforceable. Safe Harbor was based on self-certification and there was evidence of abuse of this system in terms of the steps that participating companies were actually taking to comply with requirements. Moreover, most relevant to future development in data sovereignty requirements is that legislation and practices keep up with the ongoing evolution of IT and networks. Safe Harbor had been agreed before the massive deployment of cloud created a far less visible and trackable layer to IT Operations. These areas have been identified and strengthened under the Privacy Shield Agreement.

WHAT IS PRIVACY SHIELD?

Privacy Shield is designed to be the new legal framework for transatlantic data flows replacing the Safe Harbor agreement. Data can move silently and invisibly across national boundaries but it requires physical machines to enable generation and access. And despite the onset of the virtual era, Governments, clients and the citizens who are

described by the data still need to know where their data is physically located when managed in the cloud or other virtual environment. According to a recent VMware survey, 95% of companies use cloud services but two-thirds don't know where their data is stored.

The European Union and US authorities negotiated to reach a further agreement and in February 2016 came up with the "EU-US Privacy Shield". This brings the principle whereby American cloud and service providers operate in Europe closer to the more stringent EU privacy requirements. It reinforces the judicial redress for EU citizens, will be subject to annual review and the US will appoint a data ombudsman* who will act as a point of recourse for EU citizens when breaches of the agreement are alleged to occur for which US companies are responsible. The Privacy Shield was agreed by a majority of European states (24 out of 28) in July 2016.

**Ombudsman*: a person independent of any entity with vested interests in the process who supervises adherence and compliance to the agreement

CULTURAL DIFFERENCES ABOUT DATA SOVEREIGNTY

Possibly compliance with data sovereignty principles represents no more than what any organization that collects, holds or uses personal data should consider as normal operating best practice. However, different countries have difference practices in regards to privacy, and one of the reasons for the need to reach agreement between the EU and the United States is that "privacy" and what "private" data is and what it can be used for, creates different expectations each side of the Atlantic. The post 9/11 USA sought to protect itself through legislation such as the Patriot Act and through the construction of mega-data centers and more comprehensive surveillance activity. Additionally, Edward Snowden's revelations created suspicion at the highest about US electronic surveillance activity. Under the Presidential Directive of January 2014, data on foreign nationals was considered to be subjected to equal treatment as that of US citizens and this was the proposition effectively struck down in the ECJ (European Court of Justice) judgement.

LEGISLATIONS FOR OTHER INTERNATIONAL PLAYERS

The understanding reached after the demise of Safe Harbor – Privacy Shield – may be subject to similar challenges, therefore countries outside the EU transferring data on EU Citizens beyond the EU legislature must be able to safeguard the arrangements they make for the data they collect inside the EU.

More than 20 countries have legislated or are in the process of legislating to ensure that personal and commercial data remains within the country, and others are legislating to allow access to data to counter threats from terrorist groups. Russia is particularly noticeable as a country which has effectively prevented digital information on its citizens being transmitted outside the borders. This has led to some halting in planned investments in Russian data centers.

The principles apply to traffic into the US as the global leader in the provision of cloud services. It is possible that in the near rather than far future, consideration will need to be given to the arrival of large Chinese and Russian providers into the EU, a process that has already started. It needs to be established how the EU's General Data Protection adopted in April 2016, applies to them.

REMAINING CHALLENGES

NOTHING IS WRITTEN IN STONE

The replacement of Safe Harbor by Privacy Shield will take time to work out. In particular, data center investors need to be wary of investing heavily in making major changes to comply with possible legislation that has still to be fully finalized and agreed, that will be subject to annual review and which is more than likely to be subject to challenges of the kind that brought down Safe Harbor.

MORE PRESSURE ON COMMERCE AND SMES

It is also most probable that legislation outcomes will accentuate the trend toward cloud provision among the European colocation providers. The burden of compliance will have greater impact on medium-size IT-dependent companies than on the global giants who have the resources to deal with any extra demands this might make on them, and it is possible that these companies may look for partnering within the EU to help comply with these demands.

The implications of legislative uncertainty for companies means that, just as the network within their data centers are best organized on the basis of topologies, so their information paths and in particular their deployment of cloud need to be organized on the basis of informational topologies. Possibly this may mean the appointment of personnel directly responsible for planning and implementing the legislative requirements for data storage and transfer – the Data Protection & Compliance Officer working under the supervision of the company's Chief Digital Officer

Strategies for developing further solutions for the issue, such as enabling customer rather than cloud provider control of information (although this will depend very much on the use case) or using encryption or tokenization to protect data cording to transfer and location, may be developed. Or a company can go looking for a cloud system that covers only one legislature. But these may, as happened with Safe Harbor, represents a further case of technology moving faster than legislation, and at the moment, this is complicating an IT delivery system valued for its simplicity and its "anywhere/anytime" benefit.

For some companies this may create the need to develop partnerships with the EU (such as between Microsoft and Deutsche Telekom). Companies that are already capable of dealing with the

requirements of operating in China will be familiar with the process of developing partnerships and corporate entities to meet legislative requirements.

WHAT DOES DATA SOVEREIGNTY MEAN FOR THE CLOUD?

The working of data sovereignty should not undermine the cloud as a key driver in IT delivery and efficiency. However, it does suggest that companies who make use of it for potentially sensitive personal of commercial data need to look more closely at the credentials of the provider in terms of security protocols, audited transparency, guaranteed of data destruction, and some flexibility in contractual arrangements in the event of unforeseen happening such as Brexit that may dramatically and significantly change the landscape.

AND THEN BREXIT CAME

At the same time the Privacy Shield was moving towards a majority agreement between EU member states, so the United Kingdom was voting to leave the EU. Once Article 50 of the Treaty on European Union is invoked to set withdrawal in place then the transfer of data from the UK to the USA might not be covered under the Privacy Shield agreement. This will depend upon the negotiations of the continuing relationship between the UK and the EU.

It can be anticipated that if the UK is to review its own privacy legislation (which it was in the process of doing before Brexit happened) then it is likely that it will seek (as Switzerland did with Safe Harbor) to pass legislation that mirrors or exceeds the EU's General

Data Protection Regulation Privacy legislation.

Measures that ensure greater personal privacy are difficult to move back to if the UK were to revert back towards more liberal US-style privacy principles it is likely that the community and

political fallout would be considerable, as would the legal challenges against it. Individual privacy rights can be limited to identify and restrict actual or perceived threats by, for example, the Patriot Act although many Western nations have at least considered similar steps.

POSSIBLE OUTCOME OF BREXIT

It is most likely that the UK and its substantial datacenter industry will attempt to keep everything as "normal" as possible including data protection practices until the specific issue of the UK's legislative relationship with the EU's GDPRP can be established.

At the same time as Privacy Shield will take effect, European cities such as Paris, Frankfurt or Amsterdam will become Tier 1 locations for international companies, both service providers and enterprise so long as they offer a suitable geographical location in Europe with competitive prices, highly stable power and large bandwidth.

DATA CENTER INVESTORS NEED TO BE WARY OF INVESTING HEAVILY IN MAKING MAJOR CHANGES TO COMPLY WITH POSSIBLE LEGISLATION THAT HAS STILL TO BE FULLY FINALIZED AND AGREED

THE IMPORTANCE OF PHYSICAL CAPABILITY AND COLOCATION

Even in a data system which is becoming increasingly digitized, the location of the data center continues to be very important. Disputes over data sovereignty, the cancellation of contracts by Governments and expensive data loss, corruption or misplacement means that where the data is stored, processed and accessed is critical. The security and availability provided by the physical location is high on the concerns of cloud users, not far behind the concerns of the security of the networks and connections that enable the activation of the process. Therefore this section provides a thumbnail profile of some of Europe's key data center markets.

Europe can be divided into a number of zones which have different economic and demographic characteristics, and accordingly different data center profiles:

- › The major established Western markets – the United Kingdom, Germany, France, Netherlands, Spain and Italy. These are still some of the largest data center markets in the world based on established and mature economies, affluence and education, a high degree of IT familiarity and dependence among individuals, businesses and Government and developed data center supply sectors. Other mature data center markets are smaller in line with the size of their economies: – Belgium, Portugal, Austria, Greece. These markets will tend to show low growth simply because of their large size (it is easier to double from 10000 square metres than it is from 1 million). The growth of their enterprise sectors will also be limited by the migration from 'on-premise' facilities into colocation, and by the increased reliance on cloud for corporate IT workload.
- › The second group of markets have cultivated data centers as an export tool and attracted a larger data center sector than is required by the national economy. Included here are the Nordic markets (Sweden, Norway, Iceland, Finland and Denmark), Ireland, Luxembourg, Switzerland and Malta. The Netherlands can also be counted as a member of this group. These markets compete for foreign investment through access to renewable fuel sources, power pricing guarantees, favourable taxation regimes and dedicated data center campuses and sites. These markets show strong growth in data center numbers and space, and in investment into IT infrastructure. This represents the drive to attract and locate very large colocation and cloud facilities in these markets; it also represents the fact that these markets with the exception of the Netherlands have smaller enterprise sectors

than the major established European markets.

- › The third major group are the markets of Central and Eastern Europe. These are closer to emerging markets as they develop IT infrastructure to meet growing public and commercial need. Some, such as the Baltic States and Hungary are host to multinational data centers. Many have small to medium colocation data centers to meet their own market needs. The largest of these markets – Russia – has suffered some disruption to data center growth for political and economic reasons.

The tables below have been compiled to indicate some of the main factors that are used to describe data center markets. The first column provides metrics from a variety of sources while the last column ranks each market.

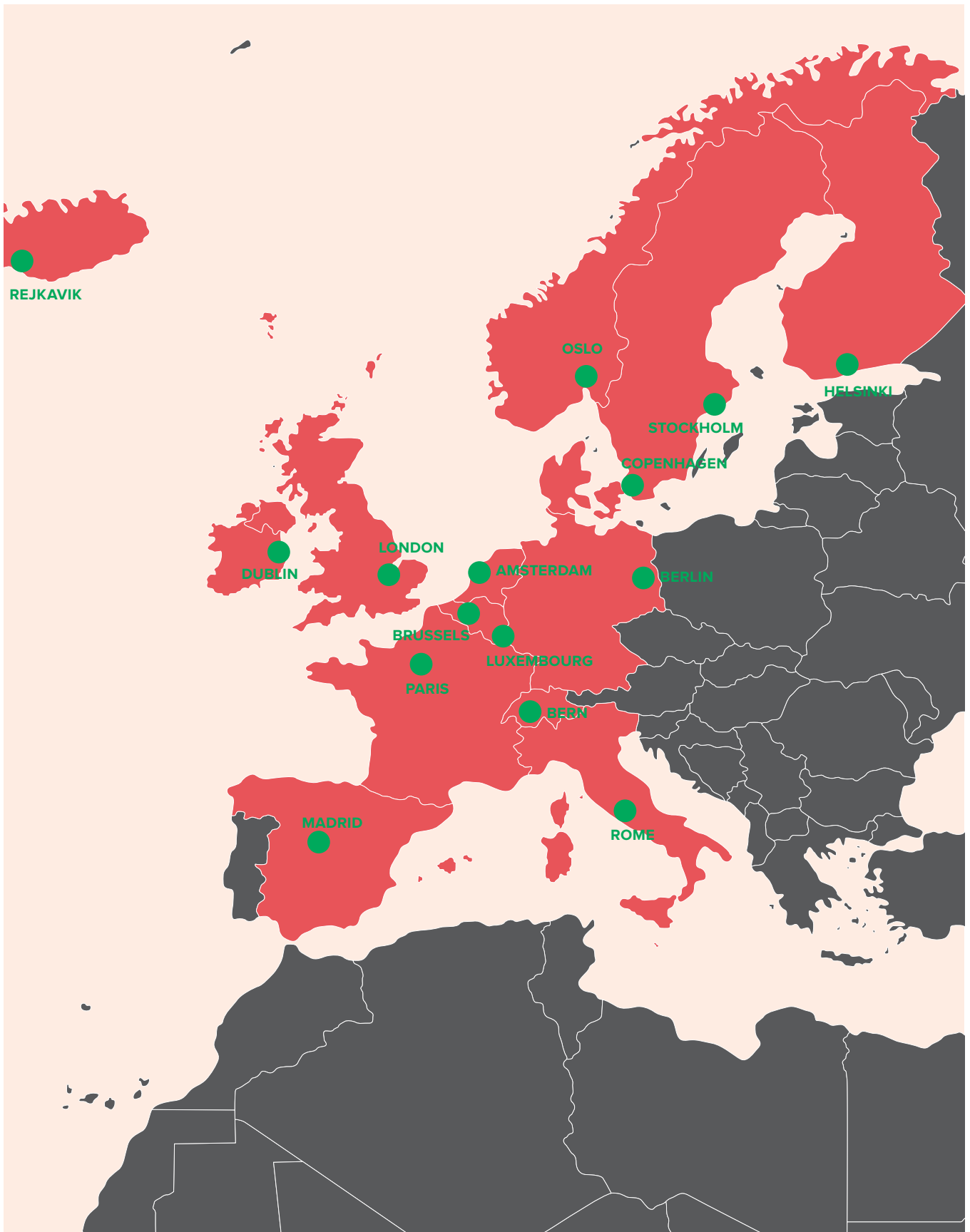
Note that an overall ranking has not been computed as that needs to make considerable assumptions as to what is important to each company. Each of the countries and country groups listed offers differentiated benefits to companies looking for a variety of facilities and services. Note also that since the time of compilation and calculation in mid-2016, some of these data will have changed.

This chart can be used as a 'guide' to reading the profile tables:

GERMANY

Cost Profile:	Data	Source	Ranking
Wages:	These data are sourced as indicated from a variety of places. Actual data and units are shown. Where an index is referred to, 100 = the Global Average. 'Incentives' is the one measure in the table where an approximate range is given due to the confidentiality of some of the data. For this reason it is not ranked	DCDi	Here a ranking of 1 means LEAST EXPENSIVE and 11 means MOST EXPENSIVE
Electricity:		Eurostat	
Operating Costs:		DCDi Index	
Taxation/Compliance:		Quoted rates	
Construction & Fit Out:		DCDi Index	
Incentives:		Media	
IT Infrastructure Deployment Profile:	Data	Source	Ranking
% In-house:	These figures have all been taken from DCDi research including the Global Datacenter Census. They are based on comprehensive representative samples from each market shown here.	DCDi	In these rankings 1 means THE HIGHEST PROPORTION or THE GREATEST RATE OF GROWTH down to 11 which means THE LOWEST PROPRTION or THE SLOWEST RATE OF GROWTH
% Colocated:		DCDi	
% Growth 2016 > 2017:		DCDi	
% Hybrid Cloud:		DCDi	
% Growth 2016 > 2017:		DCDi	
% Public Cloud:		DCDi	
% Growth 2016 > 2017:		DCDi	
Legislation:	Data	Source	Ranking
'Green':	The figures in this section are all derived or calculated from indices. This means that they have no 'actual' value. Therefore they are relative measures between markets and the rankings are the key output here.	Various Indices, reviews of legislation	A ranking of 1 means THE HIGHEST LEVEL OF LEGISLATION PERTAINING TO THIS ISSUE and a ranking of 11 means THE LOWEST LEVEL OF LEGISLATION.
Data Privacy:		Various Indices, reviews of legislation	
Ease of doing business:		World Bank 2016	
Ethics & Transparency:		Transparency Index	
IT Demand Factors:	Data	Source	Ranking
Access Internet via mobile (million):	Data related to the population in each market or market groups accessed from Eurostat, and, in the case of Switzerland and Norway from Government sources where the data is not available on Eurostat.	Calculated from Eurostat	'1' means THE LARGEST MARKET BY NUMBERS and '11' means THE SMALLEST MARKET BY NUMBERS
Households with Internet access (million):		Calculated from Eurostat	
Numbers employed in hi-tech/hi-knowledge (thousand):		Calculated from Eurostat	
Enterprises using e-Commerce (thousand):		Calculated from Eurostat	
Resource & Management:	Data	Source	Ranking
% Renewable Energy:	Data describing resource availability and management from a number of sources. Units as shown.	Eurostat	'1' means THE LARGEST (OR FASTEST) MARKET BY NUMBERS and '11' means THE SMALLEST (OR SLOWEST) MARKET BY NUMBERS
Connection Speed (Av. Peak Mbps):		Various	
Facility Investment (USD m):		DCDi	
Outsourcing Investment (USD m):		DCDi	
Data Center Workforce:		DCDi	
Data Center Supply Sector (USD bn):		DCDi	

PROFILES OF KEY WESTERN EUROPEAN MARKETS



The German market for facilities larger than 100 m2 in total accounts for around 1,750,000 square metres - the space is divided: 67% end-user and 33% colocation/telco/cloud. Asset investment growth 2015-2020: 4-5% p.a.

The key drivers that will impact investment in German data centers over the next few years are facility consolidation, the transition to virtualisation and cloud, and legislation. Germany is one of the largest data center markets in the world but it is 'flatter' than other markets of a similar size since the German economy is highly regionalised and diverse. This means the potential for consolidation and migration is large. For a market its size, Germany has been slow in the uptake of

outsourcing and cloud. As this trend reverses, so the greatest increase in investment will come from cloud and colo providers, both local and international. This part of this process driven by hybrid and internal systems will maintain investment in enterprise facilities. The decline in enterprise investment is far less prominent in Germany than in other Western European markets - this is due to Germany's more positive economic performance and its greater critical mass. Some of the 'greenest' energy legislation in the world will help define data center requirements, and very strict data privacy legislation will mean footprint will need to be built in Germany.

		Data	Ranking Cheapest > Most Expensive
Cost Profile:	Wages:	€101,700	11
	Electricity:	0.149 c/kWh	8
	Operating Costs:	133	10
	Taxation/Compliance:	15.8%	3
	Construction & Fit Out:	112	7
	Incentives:	Low	NA
		Data	Ranking Lowest > Highest
Risks:	Natural & Climatic Risk:	3.2	5
	Social & Political Risk:	1.49	5
	Economic Risk:	26.3	1
	Energy Vulnerability:	60.5	6
	Skills Vulnerability:	54.6	11
		Data	Ranking Least > Most
IT Infrastructure Deployment Profile:	% In-house:	49.3	2
	% Colocated:	18.6	9
	% Growth 2016 > 2017:	5.0	4
	% Hybrid Cloud:	16.7	7
	% Growth 2016 > 2017:	4.1	8
	% Public Cloud:	15.3	6
	% Growth 2016 > 2017:	2.1	8
		Data	Ranking Least > Most
Legislation:	'Green':	84.3	8
	Data Privacy:	23	2
	Ease of doing business:	79.7	3
	Ethics & Transparency:	81	4
		Data	Ranking Least > Most
IT Demand Factors:	Access Internet via mobile (million):x	30.7	1
	Households with Internet access (million):	38.7	1
	Numbers employed in hi-tech/hi-knowledge (thousand):	650	1
	Enterprises using e-Commerce (thousand):	745	1
		Data	Ranking Largest > Smallest
Resource & Management:	% Renewable Energy:	13.8	6
	Connection Speed (Av. Peak Mbps):	53.8	9
	Facility Investment (USD m):	3800	3
	Outsourcing Investment (USD m):	1300	3
	Data Center Workforce:	32500	2
	Data Center Supply Sector (USD bn):	8.9	2

FRANCE

The French data center market accounts in total for around 1,450,000 square metres - the space is divided: 60% end-user and 40% colocation/telco/cloud. Asset investment growth 2015-2020: 2-3% p.a.

Like all established data center markets, the majority of the asset base in the French market is accounted for by the enterprise sector and by their medium-sized facilities. The process of transition to colocation and cloud together with facility consolidation is already reducing the enterprise asset base and it will reduce the amount of investment into enterprise data centers. High levels of taxation reduce the appeal of

France to foreign investors although this has not reduced the numbers of multinational colocation providers located in and around Paris. The basis of French electricity generation in nuclear power and low power costs means that France is not driven by the need to reduce power consumption as much as other Western European markets.

		Data	Ranking Cheapest > Most Expensive
Cost Profile:	Wages:	€93,150	5
	Electricity:	0.095 c/kWh	4
	Operating Costs:	117	4
	Taxation/Compliance:	34.4%	11
	Construction & Fit Out:	119	8
	Incentives:	Low	NA
		Data	Ranking Lowest > Highest
Risks:	Natural & Climatic Risk:	2.8	4
	Social & Political Risk:	1.83	10
	Economic Risk:	24.7	6
	Energy Vulnerability:	47.6	4
	Skills Vulnerability:	32.6	4
		Data	Ranking Highest > Lowest
IT Infrastructure Deployment Profile:	% In-house:	47.7	5
	% Colocated:	18.7	8
	% Growth 2016 > 2017:	2.4	9
	% Hybrid Cloud:	19.8	4
	% Growth 2016 > 2017:	7.0	3
	% Public Cloud:	13.9	8
	% Growth 2016 > 2017:	2.3	7
		Data	Ranking More Legislated > Less
Legislation:	'Green':	88.2	3
	Data Privacy:	22	3
	Ease of doing business:	75.9	7
	Ethics & Transparency:	70.0	9
		Data	Ranking Highest > Lowest
IT Demand Factors:	Access Internet via mobile (million):	22.4	3
	Households with Internet access (million):	23.2	3
	Numbers employed in hi-tech/hi-knowledge (thousand):	265	3
	Enterprises using e-Commerce (thousand):	640	3
		Data	Ranking Largest > Smallest
Resource & Management:	% Renewable Energy:	14.3	5
	Connection Speed (Av. Peak Mbps):	41.0	10
	Facility Investment (USD m):	3300	2
	Outsourcing Investment (USD m):	1650	2
	Data Center Workforce:	27500	3
	Data Center Supply Sector (USD bn):	8.4	3

UNITED KINGDOM

The UK data center market accounts in total for around 1,750,000 square metres - the space is divided: 70% end-user and 30% colocation/telco/cloud. Asset investment growth 2015-2020: 2-3% p.a.

The UK has been one of the largest targets of inward investment in the world. This is based on its status as one of the world's largest financial and business service markets, its position both inside and outside the world's largest trading block (at least, pre-Brexit), historical links with a number of the world's growth markets, its location on GMT and its relatively tolerant immigration and business visitor policies. The UK

also has one of the world's leading data centre support industries and liberal trade regime. The UK's status may be challenged by the fallout from Brexit, the growth of other financial centres, resource shortages, particularly of power, and expensive Real Estate around London. Investment will be driven by extensive facility consolidation among the enterprise sector and migration to cloud and colo by UK companies, and by the disposition of North American companies to use the UK as a base for a presence in Europe.

		Data	Ranking Cheapest > Most Expensive
Cost Profile:	Wages:	€101,350	10
	Electricity:	0.152 c/kWh	9
	Operating Costs:	124	8
	Taxation/Compliance:	20.0%	4
	Construction & Fit Out:	107	3
	Incentives:	Moderate	NA
		Data	Ranking Lowest > Highest
Risks:	Natural & Climatic Risk:	3.7	8
	Social & Political Risk:	1.83	11
	Economic Risk:	25.9	5
	Energy Vulnerability:	41.2	3
	Skills Vulnerability:	44.2	9
		Data	Ranking Highest > Lowest
IT Infrastructure Deployment Profile:	% In-house:	47.1	6
	% Colocated:	16.1	10
	% Growth 2016 > 2017:	1.8	10
	% Hybrid Cloud:	19.3	5
	% Growth 2016 > 2017:	2.7	10
	% Public Cloud:	17.4	4
	% Growth 2016 > 2017:	2.1	9
		Data	Ranking More Legislated > Less
Legislation:	'Green':	87.4	4
	Data Privacy:	16	5
	Ease of doing business:	82.5	2
	Ethics & Transparency:	81	6
		Data	Ranking Highest > Lowest
IT Demand Factors:	Access Internet via mobile (million):	27.2	2
	Households with Internet access (million):	24.6	2
	Numbers employed in hi-tech/hi-knowledge (thousand):	292	2
	Enterprises using e-Commerce (thousand):	660	2
		Data	Ranking Largest > Smallest
Resource & Management:	% Renewable Energy:	7.0	9
	Connection Speed (Av. Peak Mbps):	60.9	6
	Facility Investment (USD m):	4300	1
	Outsourcing Investment (USD m):	1950	1
	Data Center Workforce:	35000	1
	Data Center Supply Sector (USD bn):	10.6	1

IRELAND

The Irish data center market accounts in total for around 270,000 square metres - the space is divided: 20% end-user and 80% colocation/telco/cloud. Asset investment growth 2015-2020: 8-10% p.a.

Ireland's future investment trajectory is based on its continuing ability to attract major projects from global colocation and cloud providers. It is based also on the continuing need of the UK to use Dublin colos to house footprint and upon the legislation in a number of US states that means certain types of content (gambling, for example) can only be delivered off-shore. Ireland's location as the closest point across

the Atlantic makes it a logical choice, particularly for States on the East Coast. It is assumed that one of the key planks of Ireland's business case - lower rates of corporate tax - will remain despite protests from other countries. The increased level of competition from markets in Scandinavia and Eastern Europe can be assumed to cap Ireland's growth as there will be a ceiling of power provision on the capability to house very large projects, and Ireland is less able to deliver sustainable power but this situation may be beyond the time frame of the current project as Ireland has followed the Singapore model and attracted regional offices, not just data centers.

		Data	Ranking Cheapest > Most Expensive
Cost Profile:	Wages:	€94,500	7
	Electricity:	0.136 c/kWh	7
	Operating Costs:	120	6
	Taxation/Compliance:	12.5%	2
	Construction & Fit Out:	120	9
	Incentives:	Very High	NA
		Data	Ranking Lowest > Highest
Risks:	Natural & Climatic Risk:	4.7	9
	Social & Political Risk:	1.43	4
	Economic Risk:	18.1	10
	Energy Vulnerability:	71.3	10
	Skills Vulnerability:	38.7	6
		Data	Ranking Highest > Lowest
IT Infrastructure Deployment Profile:	% In-house:	21.1	10
	% Colocated:	32.1	3
	% Growth 2016 > 2017:	8.4	1
	% Hybrid Cloud:	20.8	3
	% Growth 2016 > 2017:	11.8	1
	% Public Cloud:	26.0	1
	% Growth 2016 > 2017:	5.7	2
		Data	Ranking More Legislated > Less
Legislation:	'Green':	86.6	7
	Data Privacy:	12	7
	Ease of doing business:	79.2	4
	Ethics & Transparency:	75	8
		Data	Ranking Highest > Lowest
IT Demand Factors:	Access Internet via mobile (million):	1.9	10
	Households with Internet access (million):	1.5	10
	Numbers employed in hi-tech/hi-knowledge (thousand):	61	8
	Enterprises using e-Commerce (thousand):	96	9
		Data	Ranking Largest > Smallest
Resource & Management:	% Renewable Energy:	8.6	7
	Connection Speed (Av. Peak Mbps):	60.6	8
	Facility Investment (USD m):	1700	5
	Outsourcing Investment (USD m):	900	4
	Data Center Workforce:	6500	9
	Data Center Supply Sector (USD bn):	1.2	9

SPAIN

The Spanish data center market accounts in total for around 750,000 square metres - the space is divided: 63% end-user and 37% colocation/telco/cloud. Asset investment growth 2015-2020: 2-3% p.a.

Like all established data center markets, the majority of the Spanish market is accounted for by the enterprise sector and by their medium-sized facilities. The process of transition to colocation and cloud together with facility consolidation has already started to reduce the enterprise asset base and it will reduce the amount of investment into enterprise data centers. This process has been accentuated by recession although investment in colo and cloud continues as

companies need facilities and services. High levels of taxation and high energy costs may reduce the appeal of Spain to foreign investors although the Government continues to offer considerable incentives for development. Global cloud providers have yet to indicate interest in Spain although international telcos and colos have moved in. As in Latin American markets foreign companies are likely to break into the Spanish market through take over and acquisition. Spain is a technologically advanced market and an early adopter of cloud as a means of reducing CAPEX requirements.

		Data	Ranking Cheapest > Most Expensive
Cost Profile:	Wages:	€81,300	2
	Electricity:	0.113 c/kWh	6
	Operating Costs:	115	3
	Taxation/Compliance:	28.0%	9
	Construction & Fit Out:	104	2
	Incentives:	Moderate	NA
		Data	Ranking Lowest > Highest
Risks:	Natural & Climatic Risk:	3.4	7
	Social & Political Risk:	1.60	8
	Economic Risk:	17.3	11
	Energy Vulnerability:	64.5	7
	Skills Vulnerability:	27.2	1
		Data	Ranking Highest > Lowest
IT Infrastructure Deployment Profile:	% In-house:	52.5	1
	% Colocated:	15.2	11
	% Growth 2016 > 2017:	4.1	7
	% Hybrid Cloud:	21.4	2
	% Growth 2016 > 2017:	1.6	11
	% Public Cloud:	10.9	10
	% Growth 2016 > 2017:	1.4	11
		Data	Ranking More Legislated > Less
Legislation:	'Green':	88.9	2
	Data Privacy:	8	9
	Ease of doing business:	74.9	9
	Ethics & Transparency:	58	10
		Data	Ranking Highest > Lowest
IT Demand Factors:	Access Internet via mobile (million):	18.6	4
	Households with Internet access (million):	14.2	5
	Numbers employed in hi-tech/hi-knowledge (thousand):	118	5
	Enterprises using e-Commerce (thousand):	400	4
		Data	Ranking Largest > Smallest
Resource & Management:	% Renewable Energy:	16.2	4
	Connection Speed (Av. Peak Mbps):	64.7	5
	Facility Investment (USD m):	950	8
	Outsourcing Investment (USD m):	700	6
	Data Center Workforce:	17250	4
	Data Center Supply Sector (USD bn):	2.9	4

ITALY

The Italian data center market accounts in total for around 550,000 square metres - the space is divided: 70% end-user and 30% colocation/telco/cloud. Asset investment growth 2015-2020: 1-2% p.a.

Italy is a mature market in terms of colocation and cloud deployment. Historically, however as a market it has under-invested in its data center services and infrastructure and this may be impeding the development of its digital economy and services. Italy's southern location experiences higher average temperatures than Germany, the Netherlands and the UK, meaning free cooling technologies may not be as effective as in other countries. With energy prices high in

Italy, more and more data centers are also upgrading their facilities to reduce costs. There is also considerable investment in the end-user data center market to upgrade older facilities that are not adequate to meet current IT requirements. Italian businesses, including SMBs, are moving their IT infrastructure to the cloud and use data centers to have ICT services delivered. This combined with the demand that may have been held back by a number of years of under-investment will ensure growth in the Italian market.

		Data	Ranking Cheapest > Most Expensive
Cost Profile:	Wages:	€79,200	1
	Electricity:	0.16 c/kWh	10
	Operating Costs:	113	2
	Taxation/Compliance:	27.5%	8
	Construction & Fit Out:	103	1
	Incentives:	Low	NA
		Data	Ranking Lowest > Highest
Risks:	Natural & Climatic Risk:	4.9	10
	Social & Political Risk:	1.77	9
	Economic Risk:	18.9	9
	Energy Vulnerability:	72.6	11
	Skills Vulnerability:	31.2	3
		Data	Ranking Highest > Lowest
IT Infrastructure Deployment Profile:	% In-house:	48.5	3
	% Colocated:	20.4	7
	% Growth 2016 > 2017:	2.9	8
	% Hybrid Cloud:	18.2	6
	% Growth 2016 > 2017:	2.7	9
	% Public Cloud:	12.9	9
	% Growth 2016 > 2017:	1.9	10
		Data	Ranking More Legislated > Less
Legislation:	'Green':	84.5	9
	Data Privacy:	4	11
	Ease of doing business:	78.1	5
	Ethics & Transparency:	44	11
		Data	Ranking Highest > Lowest
IT Demand Factors:	Access Internet via mobile (million):	9.1	7
	Households with Internet access (million):	19.5	4
	Numbers employed in hi-tech/hi-knowledge (thousand):	215	4
	Enterprises using e-Commerce (thousand):	260	6
		Data	Ranking Largest > Smallest
Resource & Management:	% Renewable Energy:	17.1	3
	Connection Speed (Av. Peak Mbps):	36.5	11
	Facility Investment (USD m):	1150	7
	Outsourcing Investment (USD m):	550	7
	Data Center Workforce:	17000	5
	Data Center Supply Sector (USD bn):	1.9	6

SWITZERLAND

The Swiss data center market accounts in total for around 280,000 square metres - the space is divided: 44% end-user and 56% colocation/telco/cloud. Asset investment growth 2015-2020: 5-6%+ p.a.

Europe, good connectivity, reliable power and an educated work force. A high proportion of Swiss energy production is generated through hydroelectric power, and the country has strong privacy laws. For the past decade, Swiss IT companies have been developing data-security offerings on the back of the country's banking sector.

Switzerland runs parallel to the Netherlands in the integration of IT into economic activity in order to add value and efficiency to GDP. It is home to the headquarters of a number of large banks and multinationals, and that heritage as a financial haven has positioned it favorably as a data haven as well. In addition, it has a central location in

		Data	Ranking Cheapest > Most Expensive
Cost Profile:	Wages:	€99,200	11
	Electricity:	0.162 c/kWh	11
	Operating Costs:	133	11
	Taxation/Compliance:	8.5%	1
	Construction & Fit Out:	145	11
	Incentives:	Moderate	NA
		Data	Ranking Lowest > Highest
Risks:	Natural & Climatic Risk:	2.6	1
	Social & Political Risk:	1.37	2
	Economic Risk:	26.2	2
	Energy Vulnerability:	32.6	1
	Skills Vulnerability:	31.2	3
		Data	Ranking Highest > Lowest
IT Infrastructure Deployment Profile:	% In-house:	48.2	4
	% Colocated:	21.5	6
	% Growth 2016 > 2017:	4.2	6
	% Hybrid Cloud:	16.0	8
	% Growth 2016 > 2017:	4.8	6
	% Public Cloud:	14.3	7
% Growth 2016 > 2017:	3.3	5	
		Data	Ranking More Legislated > Less
Legislation:	'Green':	86.9	5
	Data Privacy:	8	10
	Ease of doing business:	76.0	6
	Ethics & Transparency:	86	3
		Data	Ranking Highest > Lowest
IT Demand Factors:	Access Internet via mobile (million):	3.6	9
	Households with Internet access (million):	2.8	9
	Numbers employed in hi-tech/hi-knowledge (thousand):	115	6
	Enterprises using e-Commerce (thousand):	90	10
		Data	Ranking Largest > Smallest
Resource & Management:	% Renewable Energy:	70.3	1
	Connection Speed (Av. Peak Mbps):	73.1	1
	Facility Investment (USD m):	590	10
	Outsourcing Investment (USD m):	400	9
	Data Center Workforce:	7250	8
	Data Center Supply Sector (USD bn):	1.8	8

BELGIUM

The Belgium data center market accounts in total for around 190,000 square metres - the space is divided: 43% end-user and 57% colocation/telco/cloud. Asset investment growth 2015-2020: 3-4%+ p.a.

Belgium's data center sector is far more based on meeting local IT requirements than that of the Netherlands or Luxembourg but the local data center industry is bolstered by the location in Brussels of a number of pan-national Government bodies. It forms a logical extension of the north European data center arc and a number of key global cloud and colocation providers have located in Belgium.

		Data	Ranking Cheapest > Most Expensive
Cost Profile:	Wages:	€84,500	3
	Electricity:	0.108 c/kWh	5
	Operating Costs:	119	5
	Taxation/Compliance:	33.0%	10
	Construction & Fit Out:	111	6
	Incentives:	Moderate	NA
		Data	Ranking Lowest > Highest
Risks:	Natural & Climatic Risk:	3.4	6
	Social & Political Risk:	1.53	6
	Economic Risk:	23.7	8
	Energy Vulnerability:	63.5	8
	Skills Vulnerability:	42.4	7
		Data	Ranking Highest > Lowest
IT Infrastructure Deployment Profile:	% In-house:	45.2	7
	% Colocated:	33.8	2
	% Growth 2016 > 2017:	4.4	5
	% Hybrid Cloud:	10.8	11
	% Growth 2016 > 2017:	4.8	5
	% Public Cloud:	10.2	11
% Growth 2016 > 2017:	3.7	4	
		Data	Ranking More Legislated > Less
Legislation:	'Green':	80.2	10
	Data Privacy:	8	8
	Ease of doing business:	72.5	10
	Ethics & Transparency:	77	7
		Data	Ranking Highest > Lowest
IT Demand Factors:	Access Internet via mobile (million):	4.4	8
	Households with Internet access (million):	3.0	8
	Numbers employed in hi-tech/hi-knowledge (thousand):	54	9
	Enterprises using e-Commerce (thousand):	140	8
		Data	Ranking Largest > Smallest
Resource & Management:	% Renewable Energy:	8.0	8
	Connection Speed (Av. Peak Mbps):	69.2	4
	Facility Investment (USD m):	620	9
	Outsourcing Investment (USD m):	320	10
	Data Center Workforce:	4.3	10
	Data Center Supply Sector (USD bn):	0.75	10

NETHERLANDS

The Dutch data center market accounts in total for around 680,000 square metres - the space is divided: 30% end-user and 70% colocation/telco/cloud. Asset investment growth 2015-2020: 4-5% p.a.

The Netherlands is a market based around Amsterdam which is a hub city in the style of Singapore or Hong Kong (although unlike these cities it offers a hinterland region which will see the majority of major investment during the next decade). Its data center industry is based substantially on foreign investment into both colocation and cloud as well as on the export activity of its IT manufacturing and service sectors.

The Netherlands also has an expanding enterprise sector based on finance, IT services, hi-tech industries and the high IT reliance of its economic base - logistics, agriculture, manufacturing and healthcare/ education. The Netherlands is one of the most technologically-advanced and 'greenest' markets in the world, and investment will be driven by improvement in efficiency solutions and equipment.

		Data	Ranking Cheapest > Most Expensive
Cost Profile:	Wages:	€89,750	4
	Electricity:	0.084 c/kWh	2
	Operating Costs:	122	7
	Taxation/Compliance:	25%	7
	Construction & Fit Out:	108	4
	Incentives:	Low	NA
		Data	Ranking Lowest > Highest
Risks:	Natural & Climatic Risk:	8.8	11
	Social & Political Risk:	1.54	7
	Economic Risk:	26.0	3
	Energy Vulnerability:	48.6	5
	Skills Vulnerability:	46.6	10
		Data	Ranking Highest > Lowest
IT Infrastructure Deployment Profile:	% In-house:	40.9	8
	% Colocated:	29.2	4
	% Growth 2016 > 2017:	1.6	11
	% Hybrid Cloud:	14.4	9
	% Growth 2016 > 2017:	4.4	7
	% Public Cloud:	15.5	5
	% Growth 2016 > 2017:	2.4	6
		Data	Ranking More Legislated > Less
Legislation:	'Green':	82.0	11
	Data Privacy:	12	6
	Ease of doing business:	75.9	8
	Ethics & Transparency:	87	2
		Data	Ranking Highest > Lowest
IT Demand Factors:	Access Internet via mobile (million):	9.5	6
	Households with Internet access (million):	6.2	7
	Numbers employed in hi-tech/hi-knowledge (thousand):	42	10
	Enterprises using e-Commerce (thousand):	175	7
		Data	Ranking Largest > Smallest
Resource & Management:	% Renewable Energy:	5.5	10
	Connection Speed (Av. Peak Mbps):	70.5	3
	Facility Investment (USD m):	1800	4
	Outsourcing Investment (USD m):	700	5
	Data Center Workforce:	12750	6
	Data Center Supply Sector (USD bn):	2.6	5

LUXEMBOURG

The Luxembourg data center market accounts in total for around 70,000 square metres - the space is divided: 18% end-user and 82% colocation/telco/cloud. Asset investment growth 2015-2020: 8-10% p.a.

the major European hubs and a very high practice of building and operating to Tier III and IV standards.

Luxembourg has developed a data center industry based on its location, very strong connectivity and speed of connection, a low tax regime, a liberal telecommunications policy and an active policy of encouraging data center investment. The government is actively promoting Luxembourg as an excellent place for international businesses and data centers. This promotion is based on good connectivity through its high-capacity networks that connect to

		Data	Ranking Cheapest > Most Expensive
Cost Profile:	Wages:	€93,600	6
	Electricity:	0.089 c/kWh	3
	Operating Costs:	126	9
	Taxation/Compliance:	22.47%	5
	Construction & Fit Out:	109	5
	Incentives:	High	NA
Risks:		Data	Ranking Lowest > Highest
	Natural & Climatic Risk:	2.7	2
	Social & Political Risk:	(1.4)	3
	Economic Risk:	25.9	7
	Energy Vulnerability:	67.0	9
	Skills Vulnerability:	39.8	7
IT Infrastructure Deployment Profile:		Data	Ranking Highest > Lowest
	% In-house:	20.2	11
	% Colocated:	46.7	1
	% Growth 2016 > 2017:	5.4	3
	% Hybrid Cloud:	14.3	10
	% Growth 2016 > 2017:	5.6	4
	% Public Cloud:	18.8	3
% Growth 2016 > 2017:	5.8	1	
Legislation:		Data	Ranking More Legislated > Less
	'Green':	86.6	6
	Data Privacy:	21	4
	Ease of doing business:	68.3	11
	Ethics & Transparency:	81	5
IT Demand Factors:		Data	Ranking Highest > Lowest
	Access Internet via mobile (million):	0.3	11
	Households with Internet access (million):	0.2	11
	Numbers employed in hi-tech/hi-knowledge (thousand):	1	11
	Enterprises using e-Commerce (thousand):	2	11
Resource & Management:		Data	Ranking Largest > Smallest
	% Renewable Energy:	4.5	11
	Connection Speed (Av. Peak Mbps):	60.7	7
	Facility Investment (USD m):	540	11
	Outsourcing Investment (USD m):	300	11
	Data Center Workforce:	1500	11
	Data Center Supply Sector (USD bn):	0.45	11

THE NORDIC MARKETS

The Nordic markets (Norway, Denmark, Sweden, Finland, Iceland) account in total for around 690,000 square metres - the space is divided: 17% end-user and 83% colocation/telco/cloud. Asset investment growth 2015-2020: 8-10% p.a.

The Nordic market's investment growth will be based on attracting large-scale foreign investment projects into suitable sites, designated parks and zones that have been established. The recent completion of major cabling links to the east, west and south has allowed these markets to widen their target markets for inward investment, as well

as widening the scope of the countries with which they can now compete. These markets have a small enterprise sector based on economies and populations which are technologically sophisticated as well as some locally-based colo and cloud providers. These sectors will also grow their investment as they are able to benefit from the infrastructure and services that the mega-projects require. Along with the brand benefits of having attracted significant international investment, these markets offers low energy prices, renewable energy sources and climates amenable to data centers.

		Data	Ranking Cheapest > Most Expensive
Cost Profile:	Wages:	€98,400	8
	Electricity:	0.062 c/kWh	1
	Operating Costs:	111	1
	Taxation/Compliance:	23.5%	6
	Construction & Fit Out:	121	10
	Incentives:	Very high	NA
		Data	Ranking Lowest > Highest
Risks:	Natural & Climatic Risk:	2.8	3
	Social & Political Risk:	1.36	1
	Economic Risk:	25.8	4
	Energy Vulnerability:	36.6	2
	Skills Vulnerability:	35.2	5
		Data	Ranking Highest > Lowest
IT Infrastructure Deployment Profile:	% In-house:	31.5	9
	% Colocated:	23.6	5
	% Growth 2016 > 2017:	6.6	2
	% Hybrid Cloud:	25.4	1
	% Growth 2016 > 2017:	6.4	2
	% Public Cloud:	19.5	2
	% Growth 2016 > 2017:	5.0	3
		Data	Ranking More Legislated > Less
Legislation:	'Green':	89	1
	Data Privacy:	25	1
	Ease of doing business:	82.3	1
	Ethics & Transparency:	88	1
		Data	Ranking Highest > Lowest
IT Demand Factors:	Access Internet via mobile (million):	12.5	5
	Households with Internet access (million):	10.3	6
	Numbers employed in hi-tech/hi-knowledge (thousand):	90	7
	Enterprises using e-Commerce (thousand):	340	5
		Data	Ranking Largest > Smallest
Resource & Management:	% Renewable Energy:	55.3	2
	Connection Speed (Av. Peak Mbps):	71.2	2
	Facility Investment (USD m):	1450	6
	Outsourcing Investment (USD m):	450	8
	Data Center Workforce:	9500	7
	Data Center Supply Sector (USD bn):	1.9	7



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