



Enabling the Cloud: Digital Realty and the Next Generation of Data Centre Connectivity in Europe

A Digital Realty White Paper

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DIGITAL REALTY
Data Centre Solutions



Key to the continued adoption of cloud computing is the reliance placed on carriers delivering highly flexible and scalable networks.

As more and more enterprise customers view the cloud as a key strategic business tool, they are increasingly moving towards a cloud-based service delivery platform. This is placing growing pressure on data centre owner/operators to deliver greater interconnection potential and “platform” between data centres, specifically in relation to meeting expectations around driving better system efficiencies.

As a result, the need for cloud-based service providers to respond to on-demand, rapidly scalable service models, coupled with heightened expectations around availability and service levels, is encouraging a closer working relationship between carriers and data centre owner/operators.

This development, while positive for consumer-facing enterprises as well as the data centre owner/operators, has also unearthed a plethora of new challenges for organisations trying to manage all the data. Front and centre among them is the issue of fibre optics and network connectivity.

This paper aims to explore the connectivity-specific needs of Digital Realty's UK-based customers that are either providing or utilising cloud or virtualization services. In addition, we will introduce a relevant pan-European initiative that Digital Realty is undertaking to specifically address this issue and demonstrate the efforts required to overcome it.

THE CUSTOMER

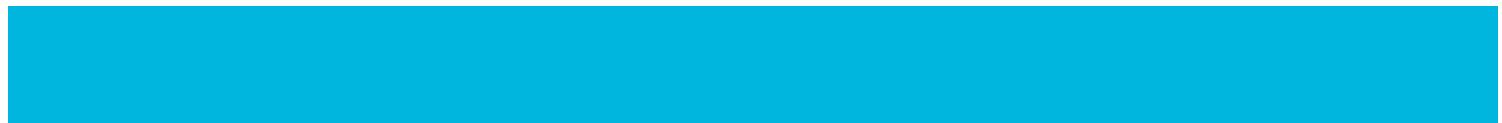
Based on ongoing conversations with current and potential customers, we know that their connectivity-related requirements within a cloud or virtualization environment include the following:

- Security or protection of the data and its associated transmission
- Flexibility (the ability to rapidly scale bandwidth, augment protocols, etc.)
- Network reliability/availability
- On-demand (or just-in-time) deployment
- Managed platforms, service bundling and network convergence
- Bespoke network and bandwidth services (i.e. dedicated networks, fully bespoke design, build-and-operate models)

Consider that enterprise companies, mindful of the potential performance impact both cloud- and virtualization-based services could have on their operations, are placing increased reliance on outsourced management of their networks to carriers offering high levels of service availability and network flexibility. The effective functioning of this model is, however, predicated on a carrier establishing highly-scalable bandwidth services across geographically diverse data centre sites and then back to the customer.

The ability to support virtualization or virtual desktop “software as a service” (SaaS) applications for London-based customers requires that the serving data centres (often peripheral to the city) are diversely interconnected via a high availability, low latency network, which is also capable of providing similar connectivity potential back to the serving office. In addition, the need to provide compute power remotely from the central London office is expected to become more and more pronounced as the 11 kilovolt (kV) power networks currently serving these buildings saturate and because the new power network provision of 33kV (used for the majority of new central London builds, including Pinnacle, Walkie Talkie,





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THE SERVICE (TECHNOLOGY)

Key to the continued adoption of cloud computing is the reliance placed on carriers delivering highly flexible and scalable networks.

Network/Service Convergence

The move to a converged network, where data/communication (Ethernet, IP or MPLS) and data storage (via fibre channel) are delivered across the same network protocol, is becoming increasingly attractive to our customers because it offers:

- *Reduced cost (no need to replicate networking hardware and software management)*

- *Improved reliability/availability*
- *Enhanced network performance*

Furthermore, the requirement for server virtualization is fueling this trend. Those companies engaged in network-based back-up and/or replication (both synchronous and asynchronous) are moving more and more towards a consolidation of networks on an Ethernet backbone.

What does this mean for the Digital Realty data centre proposition?

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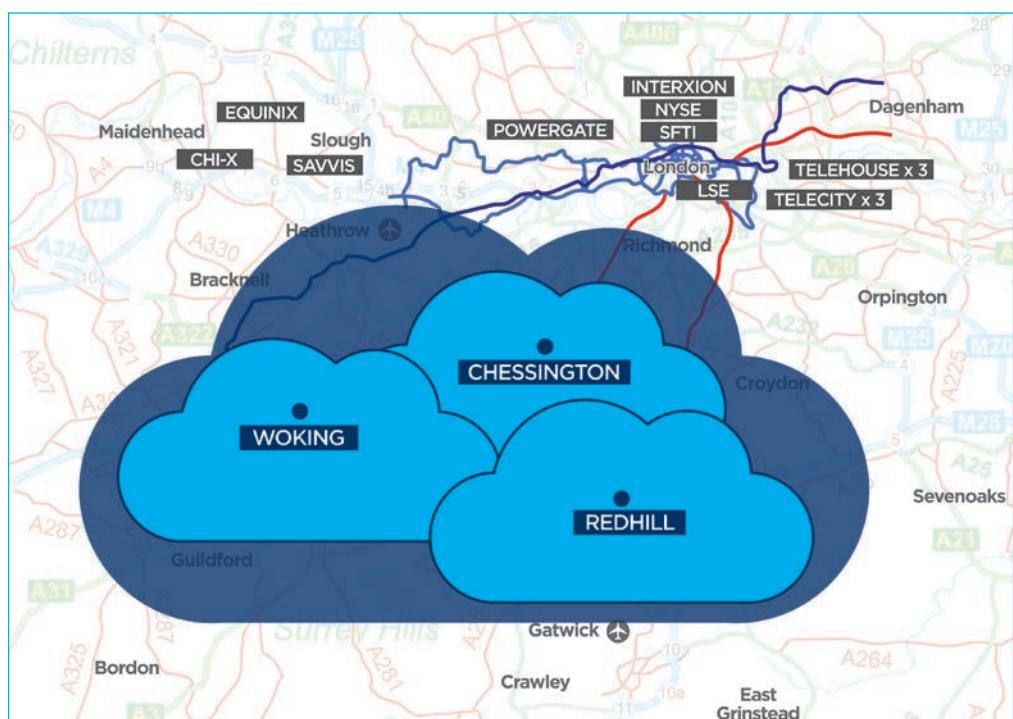


Figure 1: Digital Proprietary Cloud-Enabled Network



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replication services. The Digital Realty data centres connected via this network will essentially transport our real estate proposition into a viable public or private cloud-enabled offering for our customers (see *Figure 1*).

Evolution in Managed Service Platforms

The challenges surrounding the operation of a network, capacity planning management and performance guarantees to customers are encouraging the majority of enterprises hosting cloud and virtualization-based services to outsource operations and management of their networks to trusted and service-focused carriers.

The ability to move information effectively and efficiently between sites is framed by where a customer sits in relation to its data centre(s), which is why the connectivity piece is so critical. Fibre optic and network cables are typically contained within a duct and buried underground (although rail bed, water way, electrical utility duct allocations and sewer routing options are also practiced).

The amount of required bandwidth will vary depending on the answers to these and other queries: how long is the ‘pipe’ between the customer and its data centre? What is the information passage potential down this pipe (how much data can we squeeze through it)? Is the traffic constant or ‘bursty’? Another key dynamic for the majority of cloud-based applications is data latency and the associated requirement for deterministic routing.

Hence, a major consideration for our customers is the implication of not being on a core network with a reliable

carrier. Digital Realty consistently works with a variety of carriers to ensure that our customers have access to timely, secure and flexible telecommunications services of the highest availability. In that spirit, the focus of a recent initiative was on an interconnected ring of Digital Realty data centres, which was, in turn, connected to a broader London-based data centre network.

Customer-Driven Deployment Objectives

Already widely deployed in the United States and parts of Europe, reconfigurable optical add drop multiplexers (ROADM) represent the next generation of high capacity dense wavelength division multiplexing (DWDM) networks that offer greater reliability and are more scalable and flexible than their predecessors.

Our goal with this deployment was to position existing and potential customers to be able to:

- *Rapidly provision new connections (on-demand/just in time)*
- *Provision a protocol agnostic and protocol flexible network (with virtually unlimited bandwidth and no charges for protocol changes)*
- *Realise a high availability network (provisioning via remote software configuration rather than manual installation by engineers at intermediate nodes, which reduces the risk of inadvertent service disruption)*
- *Realise the lowest potential non-recurring and recurring cost elements of a connection proposition*
- *Maximise connection potential back into the city of London and onto a ring of broader London-based data centres.*



Infrastructure limitations are at the heart of the connectivity issue for peripheral London geographies.

With the establishment of this highly flexible and highly available ROADM network, Digital Realty is capable of transferring terabytes of data across its London-based portfolio to support cloud-based services such as enterprise cloud access, content delivery networks (CDNs), managed Ethernets, fibre channels and virtual desktops (to name but a few).

THE PHYSICAL PLATFORM

Fibre Concentrations and Interconnected Ring/Triangulated Networks

Infrastructure limitations are at the heart of the connectivity issue for peripheral London geographies. Quite simply, there is often a lack of available fibre from the office or London primary data centre to the peripheral cloud compute centres (and sometimes, more importantly, between these compute centres), which are specifically clustered around the scalability and service offerings at said sites.

An interconnected and diverse site fundamentally changes the peripheral data centre value proposition for customers because it enables connectivity at rates that are competitive with those of inner city locations. It can also offer more attractive pricing and an ability to realise both redundancy across geography, which the central London data centres cannot achieve by virtue of the city's physical concentration and infrastructure rationalisation potential for a number of cloud-based services.

Figure 2 below shows how service triangulation may be achieved from our three London properties south of the city.

Delivery Platform

The delivery platform for the cloud is predicated on a set of geographically diverse data centre "engine rooms" and the fibre optic networks that interconnect them to the end-users.

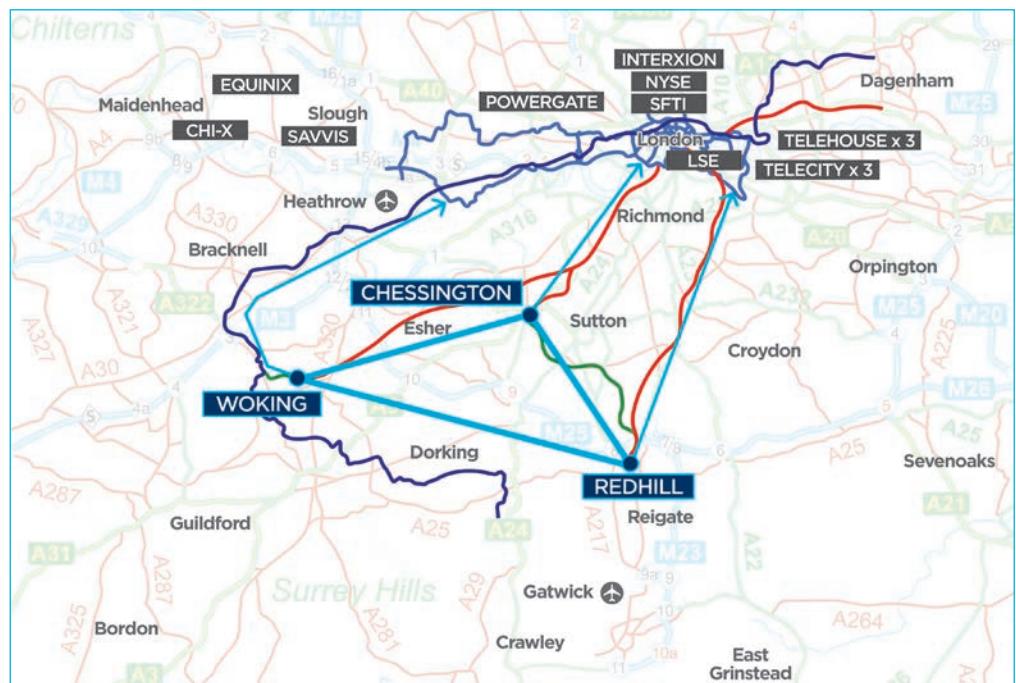
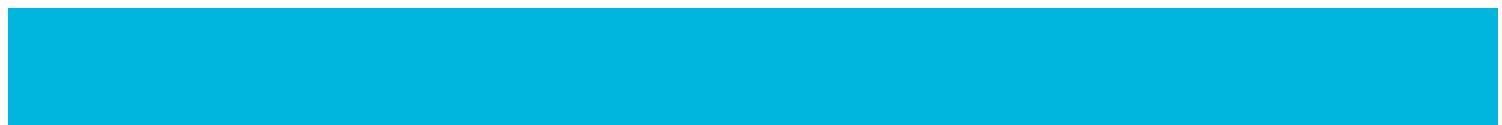


Figure 2: Service Triangulation



Digital Realty's London-based high availability data centre real estate proposition combined with a complementary connectivity solution from our carriers creates an ideal cloud delivery platform environment.

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The map in Figure 3 demonstrates the interconnectivity potential of our data centres onto the broader ROADM London data centre network.

Synchronous Replication/Mirroring

The ability to provide synchronous replication/mirroring and other low latency services is based on routing commitments from carriers. This means that customers require latency guarantees from carriers serving the interconnecting links between two computing centres.

The requirements for synchronous replication and the constraints of latency (principally governed by the speed of light down an optical fibre) have meant that backup or secondary

data centres have a distance limitation. This is typically limited to around 80 km, beyond which costly regeneration or signal amplification is required.

As the European hub for the vast majority of financial firms, London is also historically where these firms have established core data centres. Secondary data centres for these firms, on the other hand, have typically been established in and around the M25 ring-road. As illustrated in Figure 4, synchronous replication is often framed around a donut-shape, with a customer's data centre sitting on the outside ring of the donut and the office or primary data centre sitting in the core of that ring.

Regulatory pressure, in particular from markets in the Financial Instruments Directive (MiFID), has resulted in a dramatic increase in data management for firms performing investment services and those involved in tradable financial products. The result is a substantial

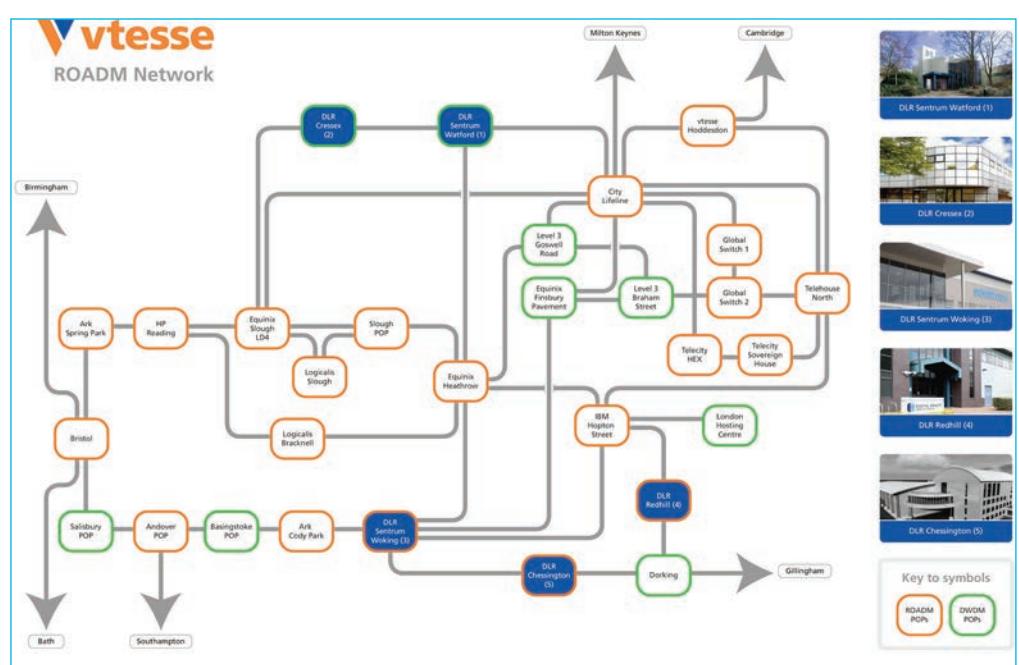


Figure 3: ROADM Platform



For the vast majority of cloud-based services, an ability to scale infrastructure at a site level is very attractive since it represents a substantial potential cost saving.

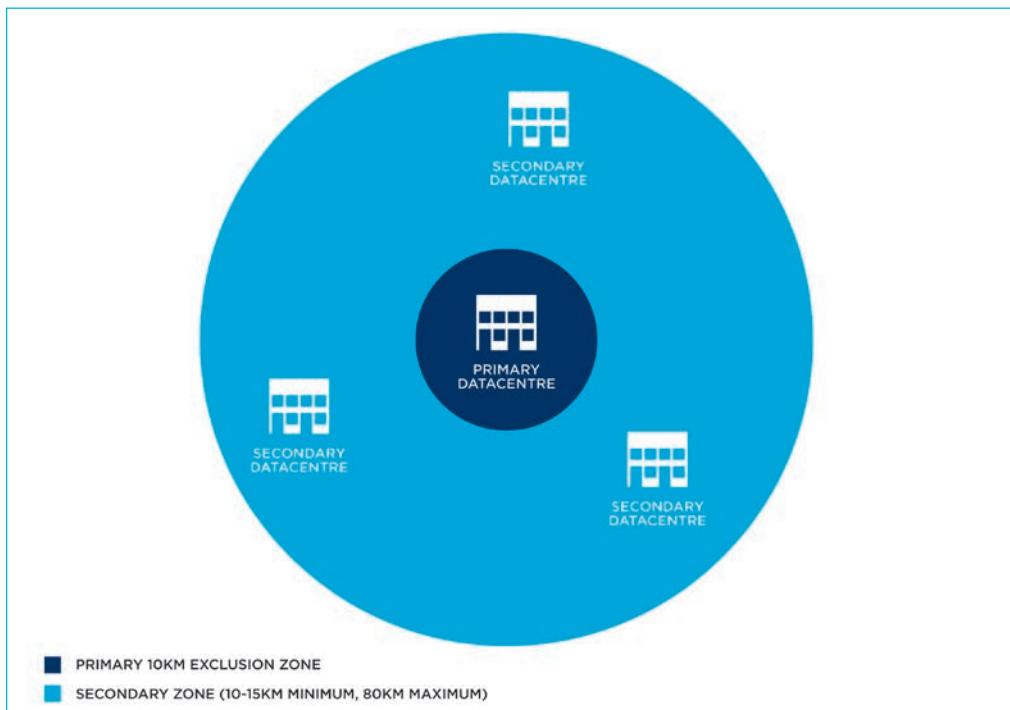


Figure 4: Synchronous Replication -'Donut'

increase in data traffic and data storage for such organisations typically framed around the requirement for synchronous replication.

Infrastructure Rationalisation

Rental price-point, be it for a London Docklands, central London or peripheral data centre is principally determined by an infrastructure choice at a site level (standby generation, uninterruptable power supplies, chillers, AHU, distribution paths, etc.). Augmentation to this supporting architecture can have a substantial influence on the overall price-point associated with a location.

An attractive consequence of achieving an interconnected ring (or triangulation) of geographically diverse data centres is that supporting infrastructure rationalisation at an individual site level can be considered by observing a “redundancy across

geography” strategy. This is not to say that infrastructure rationalisation is appropriate or applicable for every requirement, but for the vast majority of cloud-based services, an ability to scale infrastructure at a site level is very attractive since it can represent substantial cost savings.

THE DIGITAL REALTY INITIATIVE

Digital Realty has launched an initiative that we believe will ultimately provide our customers with a long-term solution to the issue of connectivity in and around London—and eventually across Europe and beyond. Again, this program is focused on the diverse interconnection of all our European properties.

The first phase of the effort, which was completed at the end of November 2012, provides inter-connection on a single network across all Digital Realty’s data centres in the greater London area.

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Phase two will be to establish, where applicable, diverse, high fibre count, dark fibre connectivity for the same network between Digital Realty data centres and key metro and access networks. Phase three will endeavor to link all of our data centres across Europe onto this proprietary backbone.

As of this writing, we have three London sites linked via the most advanced ROADM data centre connectivity network: Digital Chessington, Digital Redhill and Digital Woking (Figure 2) with Cressex and Watford on the same carrier's DWDM platform. This solution allows for rapidly scalable, highly cost competitive, diverse and route deterministic communication between each of the data centres. The benefits include multiple low latency, protocol agnostic and high bandwidth availability connections configured within 15 working days between any sites on the network, all at the same price, and with the ability to move information from any ROADM POP to any other connected POP on the network.

In addition, each of these sites offers synchronous replication/mirroring potential, which has become a key consideration for a number of our customers. A pan-European connection in the third phase will be designed to link our London sites to data centres in Dublin, Amsterdam, Paris and, when available, Frankfurt.

The third phase of this proposition has particular appeal since it enables, in select instances, the ability to service customer requirements (for example in London) from an interconnected, cloud-enabled base in Europe. ■

SUMMARY

According to IDC's Digital Universe Study, the digital universe doubles every two years, generating two zettabytes of data this year compared to just one last year¹. Therefore, it is not surprising to learn that two thirds of the small and midsize enterprises surveyed in a separate study by IBM have already implemented cloud services or intend to do so in the near future, with 45% intending to do so in the next two years².

Data centre owners and operators that can provide customers with the full range of fibre optic and network connectivity services among facilities will offer a critical competitive advantage. We are confident that the steps Digital Realty is taking today will ensure optimisation of future connectivity for the cloud. ■

^{1&2}IBM's "UK Cloud Research Study" (conducted in the second quarter of 2012 by YouGov in collaboration with IBM).



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