BT WHOLESALE

Direct Internet Access (DIA)
Peering and Network Transit Datasheet

As your business grows, the demands on your internet connection grow too. DIA is our Wholesale leased line internet access service, offering dedicated and reliable service, incredible speeds of up to 10Gbps; and all backed by the UK's best network performance.

With the massive growth in business internet usage and in particular the use of Cloud applications like Office 365, Amazon Web Services (AWS) and Salesforce for example, it is important to have an internet service that can support your needs and offer you excellent performance. A big part of that comes down to our internet backbone and our peering arrangements.

Internet Peering

BT's extensive peering arrangements are a critical component to providing outstanding connectivity and performance for our customers as well as increased service resilience through diversified routing. Peering is the bedrock of our network and we actively expand our peering capacity in line with traffic growth to maintain world class performance.

BT's Internet network capability consists of BT's European Backbone (AS5400), the UK (AS2856), plus in-country Internet networks in Ireland, Italy and Spain. BT also has Internet networks in Latin America and the Global Infonet Internet Backbone (AS3300).

BT Peering Policy Principles

BT has a selective peering policy - we select our peers based on their performance, capability and where our traffic needs to go. Our choice of peering partner can have a direct effect on our customers, and we understand that this demands very high performance from our peering partners as well as from ourselves.

We have established extensive, geographically diverse, peering interconnections designed to ensure minimal off-net latency to and from our customer's traffic destination.

BT is a European Tier 1 provider and has connections to US and Global Tier 1 networks

Much of our customer's traffic is domestic: we aim to maximise this where possible to minimise latency. Our international traffic also benefits from our depth of reach throughout Europe at all the major European IXPs (Internet Exchange Points) and from our connectivity to US networks via IXPs in the USA.

BT is a European Tier 1 provider and has connections to US and Global Tier 1 networks. BT's Internet network outside the UK runs over our wholly owned 55,000 km fibre network and part-owned transatlantic cables.

What this means for our customers and yours

DIA delivers excellent performance across our network, with various performance targets and measures in place. This includes a <0.01% packet loss target for our core network, a <1ms round trip delay latency target on the access circuit component, and <16ms max round trip delay latency target in our core network (for radial distances <100km).

Full details of our performance targets are available in the Direct Internet Access (DIA) service handbook, available via btwholesale.com

Generally, 70% of the Internet is one 'hop' or less away from our network, and because our policy is to peer with other networks at more than one IXP (Internet Exchange Point) we can send and received traffic with other networks reliably. We have excellent connectivity with US Tier 1 networks

Our peering relationships and network are one of the great reasons why BT are best placed to be the provider of choice for the European corporate market. Customers can have confidence in our continued investment in our network and partnerships. Being a Tier 1 player in Europe helps, but it is only part of the story.

Where we peer

Our internet platform is present in major public 'Internet Exchange Points' (IXP) across the world, where most SaaS (Software as a Service) and IaaS (Internet as a Service) providers are located.

This allows us to offer excellent peering with these providers for common web applications and Cloud services. Peering allows exchange of traffic from our customers to the other Cloud service providers and platforms with high levels of service quality and low latency.

Our networks are present at the following data centres for public or private peering:

IXP Site	ASN	IXP Site	ASN
Amsterdam AMSIX (AS5400)	5400	Madrid ESPANIX (AS5400)	5400
Ashburn EQUINIX (AS3300)	3300	Miami EQUINIX (AS3300)	3300
Ashburn EQUINIX (AS5400)	5400	Milan MIX-IT (AS5400)	5400
Brussels BNIX (AS5400)	5400	New York NYIIX (AS5400)	5400
Budapest BIX (AS5400)	5400	Oslo NIX1 (AS5400)	5400
Copenhagen DIX (AS5400)	5400	Paris FRANCEIX (AS5400)	5400
Dallas EQUINIX (AS3300)	3300	Prague NIX (AS5400)	5400
Dublin INEX LAN1 (AS5400)	5400	San Jose EQUINIX (AS3300)	3300
Frankfurt DECIX (AS5400)	5400	Singapore EQUINIX (AS3300)	3300
Helsinki FICIX (AS5400)	5400	Stockholm Netnod (AS5400)	5400
Hong Kong HKIX (AS3300)	3300	Sydney EQUINIX (AS3300)	3300
Johannesburg NAPAfricaIX (AS3300)	3300	Tokyo JPIX (AS3300)	3300
London LINX LON1 (AS5400)	5400	Toronto TORIX (AS3300)	3300
London LINX LON1 UK Domestic (AS2856)	2856	Vienna VIX (AS5400)	5400
London LINX LON2 (AS5400)	5400	Warsaw EQUINIX PLIX (AS5400)	5400
London LINX LON2 UK Domestic (AS2856)	2856	Zurich SWISSIX (AS5400)	5400
Luxembourg LUCIX (AS5400)	5400		

How we Interconnect with 3rd Parties and Cloud service providers

The BT Wholesale DIA network has private and public peering relationships with more than 100 different networks. Some of the largest include Google, Akamai, Century Link, Microsoft, Netflix, Fastly, Amazon and Limelight.

We monitor all our peering links and aim to ensure that we maintain resilience to our peers under normal operation, and actively look to upgrade links when required to ensure there's always loads of spare capacity available.

BT Peering Policy Principles

Direct Private Peering

Direct private peering is, as the name suggests, a direct private connection between BT's Internet platform and a Cloud service provider. This is achieved through either an in-building connection at an IXP or a via a cross-town circuit. BT commonly uses direct private peering where there are higher traffic levels and demand and is typically delivered using multiple 100G links. With private peering we exclusively send and receive data to and from Cloud service providers via dedicated ports, which means the traffic can be handled directly with the cloud provider and without the need to route over the public internet. This allows us to prevent congestion and packet loss across the connection while helping to minimise latency.

Our Direct Private Peering relationships include:

- ➢ Amazon
- ➢ Limelight
- ➢ Google
- ➢ Akamai
- ➢ Apple
- ➢ Facebook
- ➢ Microsoft
- ➢ Century Link

Private Peering

BT — Private connections — Provider

Direct private peering between BT and the Cloud service provider, commonly used for higher traffic levels and demand and typically delivered using multiple 100G links

DIA offers direct private peering with many major Cloud service providers which offers the following benefits:

- o **Latency** - one of the key factors in determining how an application will perform. Direct connectivity to internet exchanges and minimising the number of network hops between a user and the application server improves the overall latency and its predictability.

- o **No contention** – direct private peering is just that; direct. It means we can avoid shared bandwidth and traffic between our customers and the Cloud service providers offering more reliable and consistent performance.

- o **Direct support** – we have a direct relationship with the Cloud service provider without 3rd party network providers in the middle, allowing us to better control our peering links, manage traffic and resolve any issues that may arise.

Public Peering

This is achieved using a shared port at an IXP allowing the exchange of traffic from our customers to multiple peering partners' customers. Public peering is used typically for traffic volumes less than 10G, and sometime as resilience for some smaller private peers. Multiple peers are connected over IXP (Internet exchange points) Layer2 fabric.

Public Peering

BT — IXP L2 fabric — Provider

- Used where traffic volumes don't justify dedicating 10G ports
- Multiple peers connected over IXP L2 fabric

Assuming locations for peering are the same there should be minimal difference in performance or security for our customers compared with private peering. Public peering is using shared infrastructure so *in theory* there is the potential for contention but in practice port size and IXP infrastructure is managed to avoid this as much as possible.

Transit

DIA also uses transit peering where direct or public peering is not possible or required, due to where our Points of Presence (PoPs) are located and/or due to low volumes not allowing us to reach peering agreements. Transit peering is also used where traffic volumes don't justify peering and typically used for less than 1G connections to the services via 3rd party transit. We connect using Global Tier 1 partners for maximum connectivity, but we also connect with local providers for good regional coverage.

BT uses either 3rd party transit, or in some cases uses BT as a transit provider for connecting to services that are directly connected elsewhere. Using transit peering allows us to get optimum connectivity for global internet end points even where traffic demands are low, or we have no direct peering relationship.

Transit

BT — L3 Transit provider — Provider

- Used where traffic volumes don't justify peering e.g. <1G
- Connect via tier-1 transit providers
- BT uses either 3rd party transit, or in some cases uses BT as a transit provider for connecting to services that are directly connected elsewhere

With public peering and 3rd party transit, we receive traffic from and send traffic to multiple services on the same ports. Additionally, Cloud service providers are likely sending traffic to and receiving traffic from multiple ISPs on the same ports. Packet loss and buffering over the interconnect is therefore more likely than it would be with direct peering, however we and our partners work hard to prevent this from happening.

Note that where traffic is between two DIA customer sites, the traffic will remain 'on-net' for optimum performance and will not need to use 3rd party transit.

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