Microsoft ExpressRoute

USER GUIDE

NEXT DC

Microsoft Azure

Contents

Introduction to AXON

In today's hyperconnected world our data, applications, clouds, locations and people live everywhere.

To operate and compete without limitation, we must integrate our siloed worlds. We need to be connected. Our people need access to whatever they need, whenever they need it, from wherever they are with complete confidence it is secure.

Connectivity with NEXTDC allows you to connect your physical and virtual worlds uniting the people, places and clouds most critical to your organisation.

We help you achieve this with NEXTDC's Ethernet connectivity platform, AXON.

AXON's high-speed ethernet connections give you fast, secure on-demand access to any number of services across all our locations, allowing you to connect the clouds, carriers and data centres that underpin your hybrid cloud.

Microsoft ExpressRoute

ExpressRoute is a service that enables you to create private connections between Azure data centres and infrastructure that's on your premises or in a colocation environment. ExpressRoute connections do not go over the public Internet, and offer more reliability, faster speeds, lower latencies and higher security than typical connections over the Internet.

More information

For more information on setting up ExpressRoute please visit:
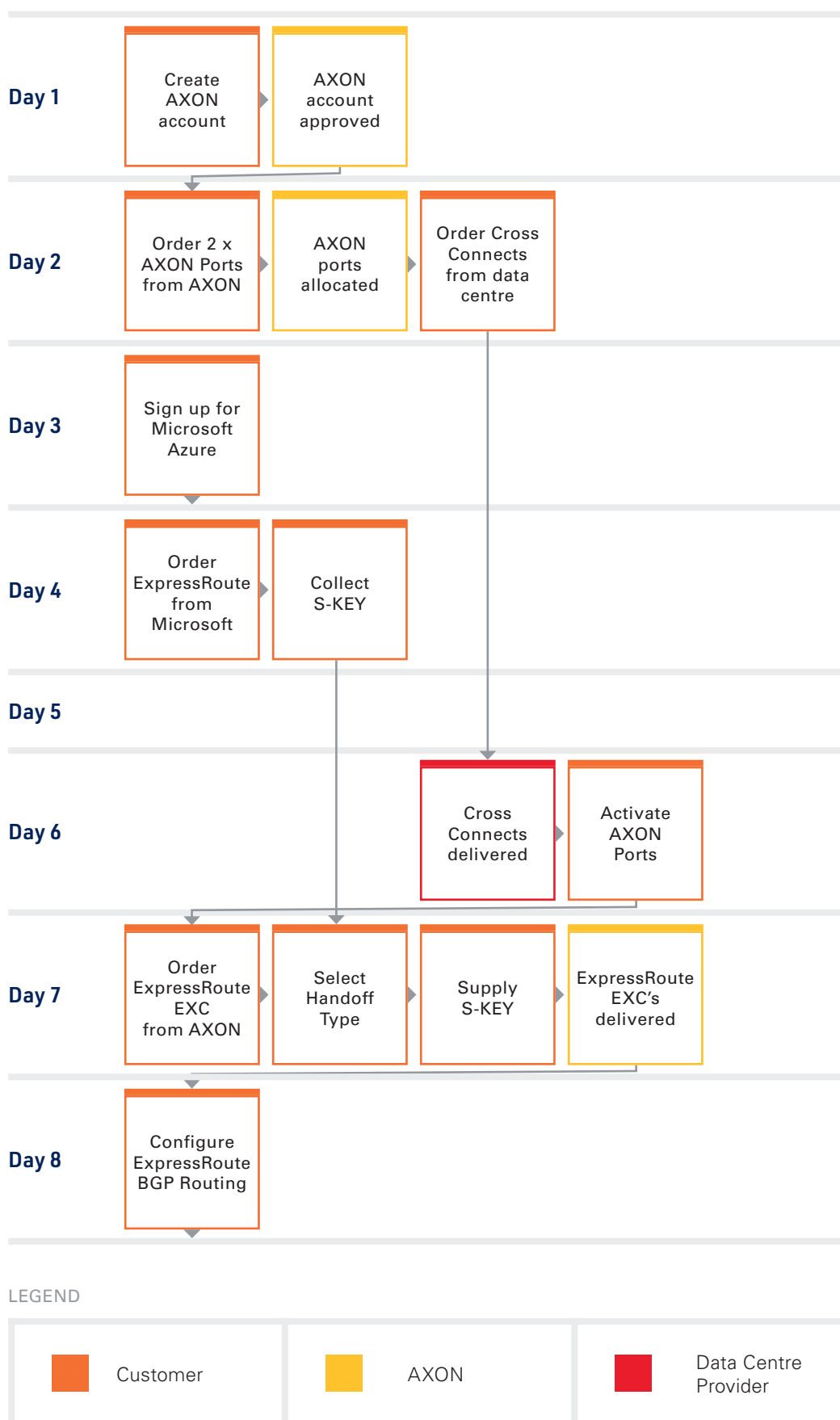
https://learn.microsoft.com/en-us/azure/expressroute/

Microsoft Azure ExpressRoute guide

Download the full setup guide for Microsoft Azure ExpressRoute written by Microsoft at this link:

https://learn.microsoft.com/en-us/azure/expressroute/

Onboarding process

Day 1	Create AXON account	AXON account approved	
Day 2	Order 2 x AXON Ports from AXON	AXON ports allocated	Order Cross Connects from data centre
Day 3	Sign up for Microsoft Azure		
Day 4	Order ExpressRoute from Microsoft	Collect S-KEY	
Day 5			
Day 6	Cross Connects delivered	Activate AXON Ports	
Day 7	Order ExpressRoute EXC from AXON	Select Handoff Type	Supply S-KEY ExpressRoute EXC's delivered
Day 8	Configure ExpressRoute BGP Routing		

LEGEND

■ Customer	■ AXON	■ Data Centre Provider

ExpressRoute technical requirements

Following are the minimum requirements to connect to Microsoft ExpressRoute via AXON:
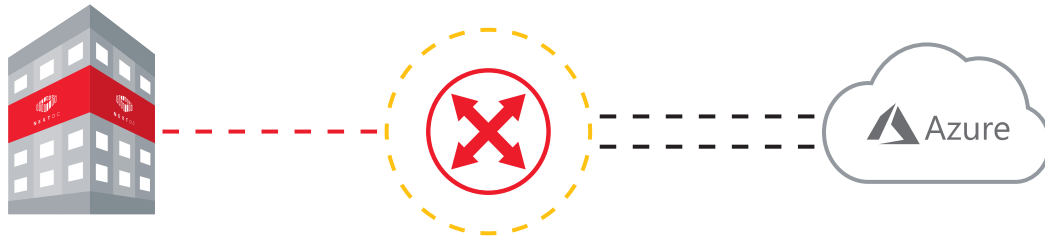
Item	Qty	Comment
Single Mode Fibre (SMOF) Cross Connect	1	1 x dual core SMOF cross connect is required to interconnect with AXON for connection to ExpressRoute. Microsoft does **not** require customers to have a pair of **physical** interconnects however, "A redundant **Layer 3** connectivity configuration **is** a requirement for our SLA to be valid." *
10 or 100Gbps Network Switch or Router	1	You can connect to AXON using either a router or a switch. If you choose to use a switch, you will need to pass ExpressRoute traffic to a BGP capable router via appropriately dimensioned connectivity.
10 or 100Gbps Network Optics	1	10 Gbps optic options are: ■ 10G-LRL (1KM) ■ 10G-LR (10KM) ■ 100G-LR4 (10KM) If your vendor only supplies LR optics and you are in the same data centre as the AXON POI, please order 1km (LRL) optics from AXON as they are compatible with 10km (LR) vendor optics.
BGP Router	1	A BGP capable router is required to connect to ExpressRoute. Two BGP virtual connections over two AXON EXCs are needed to satisfy Microsoft's requirements for "a redundant Layer 3 connectivity configuration."
Autonomous System Number (ASN)	1	You will require a BGP ASN to connect to ExpressRoute.
Microsoft Azure Account	1	To sign up for ExpressRoute you will require a working Azure account with active virtual networking resources in it.
ExpressRoute Service Key (S-KEY)	1	To sign up for ExpressRoute you will require a working Azure account with active virtual networking resources in it.

More information

For more see the redundancy section of this web page:

https://learn.microsoft.com/en-us/azure/expressroute/designing-for-high-availability-with-expressroute

NEXT DC

ExpressRoute over AXON – minimum requirements

LEGEND

– – –	Patch Cable	– – –	Elastic Cross Connect	– – –	ExpressRoute
🏢	NEXTDC Data Centre	⊗	AXON Fabric	☁ Azure	Microsoft Azure

Fully redundant design requirements

Following are the minimum requirements to connect to Microsoft ExpressRoute via AXON:

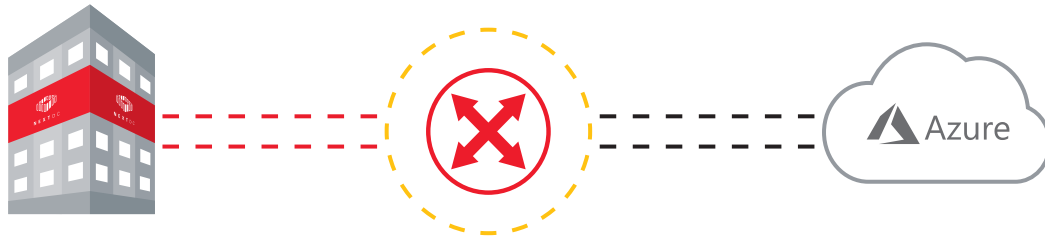| Item	Qty	Comment
Single Mode Fibre (SMOF) Cross Connect (Pair)	2	2 x dual core SMOF cross connects are required for port and switch redundancy connection to AXON. You may also consider requesting cable path diversity from your carrier and/or data centre provider.
10 or 100Gbps Network Switches or Routers	2	You can connect to AXON using either routers or switches. If you choose to use switches, you will need to pass ExpressRoute traffic to BGP capable routers via appropriately dimensioned connectivity.
10 or 100Gbps Network Optics	2	10 Gbps optics options are: 10G-LRL (1KM) 10G-LR (10KM) ■ 100G-LR4 (10KM) If your vendor only supplies LR optics and you are in the same data centre as the AXON POI, please order 1km (LRL) optics from AXON as they are compatible with 10km (LR) vendor optics.
BGP Routers	2	Two BGP capable routers to connect to ExpressRoute.
Autonomous System Number (ASN)	1	You will require a BGP ASN to connect to ExpressRoute.
Microsoft Azure Account	1	To sign up for ExpressRoute you will require a working Azure account with active virtual networking resources in it.
ExpressRoute Service Key (S-KEY)	1	To sign up for ExpressRoute you will require a working Azure account with active virtual networking resources in it.

More information

For more see the redundancy section of this web page:

https://learn.microsoft.com/en-us/azure/expressroute/designing-for-high-availability-with-expressroute

ExpressRoute over AXON – fully redundant design

LEGEND

– – –	Patch Cable	– – –	Elastic Cross Connect	– – –	ExpressRoute
🏢	NEXTDC Data Centre	⊗	AXON Fabric	☁ Azure	Microsoft Azure

AXON ExpressRoute tasks

1   Sign up for AXON via https://portal.axonvx.com/signup.

2   Order 1 x AXON ports via the AXON portal. You will receive an email with point of interconnect (POI) information.

3   Order 1 x single mode fibre (SMOF) cross connects to the AXON POI from your data centre provider.

4   Sign up for Microsoft Azure with Microsoft.

5   Activate AXON ports by plugging the cross connects in and activating the port on your network equipment.

6   Order ExpressRoute from your Microsoft Azure portal.
- Define C-TAG VLAN ID(s)
- Collect S-KEY from Microsoft

7   Order Elastic cross connects from AXON.
- Choose handoff type:
  - Single VLAN (802.1q Double Tagged) or;
  - Multi VLAN Trunk (802.1q, one VLAN per C-TAG)
  - Primary or secondary node
- Supply ExpressRoute S-KEY
- If you selected Multi VLAN Trunk handoff:
  - Supply ExpressRoute C-TAGs
- Select VLAN ID(s) for AXON to deliver ExpressRoute on your AXON port

8   AXON will provision and activate your ExpressRoute EXC.

9   Repeat the process for a redundant ExpressRoute EXC, starting with task 2 or 7, respectively, depending on whether you prefer to adhere to the minimum requirements or implement a fully redundant design.
Please note that in case of selecting Multi VLAN Trunk Mode the system will reject a secondary service on the same port as the primary service.

10   Configure Layer 3 routing via your Microsoft Azure portal.

Microsoft peering for Office 365

Connecting to Microsoft Office 365 via AXON

This section describes the technical requirements for connecting via AXON to Microsoft Office 365. Microsoft offers two types of peering via ExpressRoute – Private and Microsoft peering. The testing performed in the preparation of this document was based on the requirements set out in the Microsoft meet me specification for Microsoft peering, and summarises the key points required to establish such a connection via the AXON network.

Microsoft technical requirements

The technical requirements specified by Microsoft for connecting to Office 365 via Microsoft peering are set out below. The routing, address translation and quality of service requirements are each discussed.
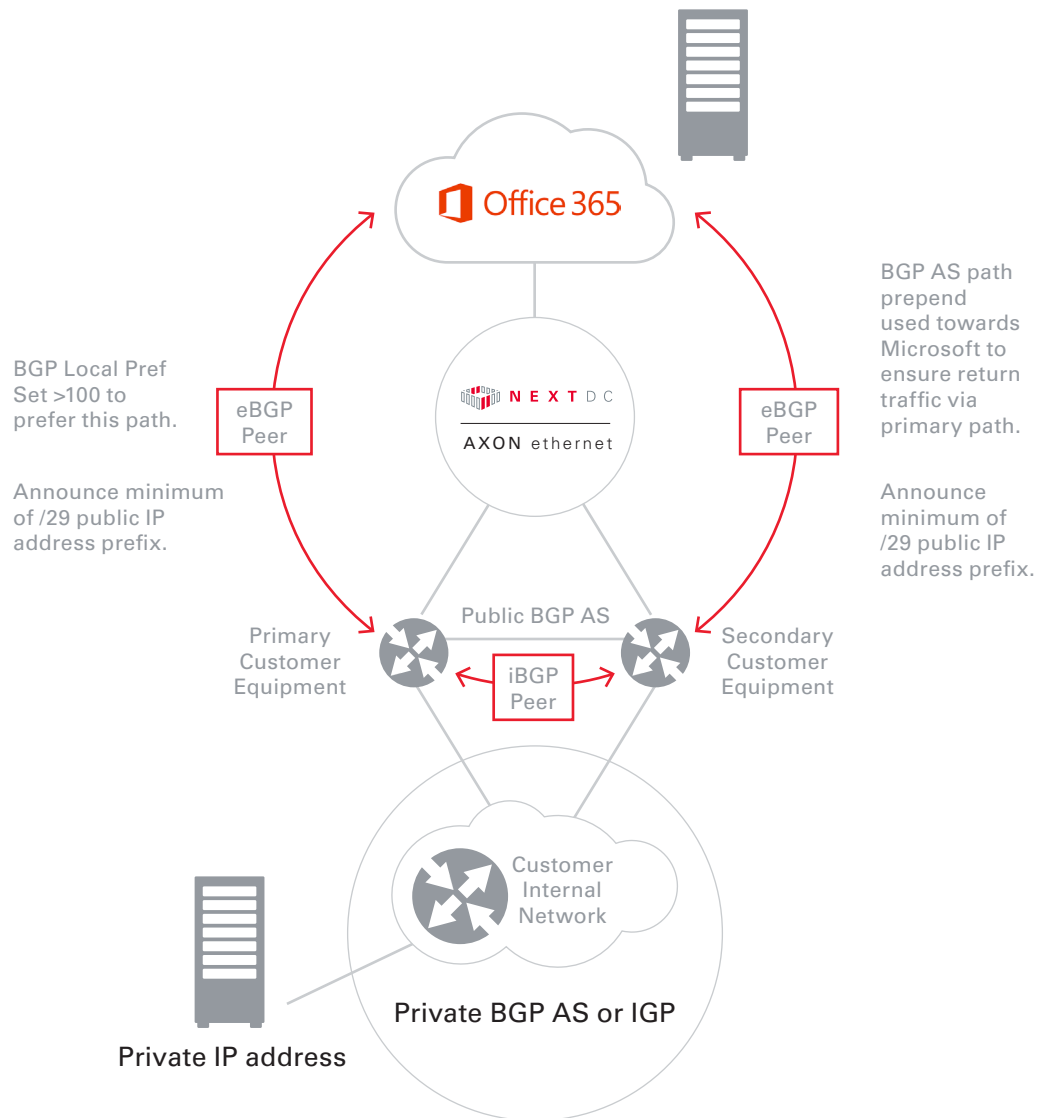
Routing

Routing via eBGP is required to establish connectivity to any of the Microsoft services. AXON does not take part in any routing decisions and only acts to facilitate layer-2 connectivity between Microsoft and the customer.

Through testing and discussions with Microsoft the following network design considerations and Microsoft pre-requisites should be considered:

- Only public IPv4 address space belonging to the customer is accepted. Microsoft checks this against the IP registries responsible for public IP address allocation – for example APNIC allocates and administers IP addresses in the Asia Pacific region.

- A minimum of a /29 public IPv4 prefix is accepted by Microsoft into their routing tables. You need to ensure that only agreed to prefixes are announced to Microsoft via route maps. You must not announce your entire internal network routing table.

- The /30 subnets used for the BGP peer links must be public address space. Private address space is not permitted.

- Only public BGP 2 or 4 byte AS numbers are allowed to peer with Microsoft (4 byte AS is only supported via PowerShell). Microsoft checks this against the IP registries responsible for public IP address allocation – for example APNIC allocates and administers AS numbers in the Asia Pacific region.

- Microsoft will be sending roughly 1000 prefixes per path

- BGP local preference should be used to determine the correct exit point (primary path) towards Microsoft

- BGP AS prepend must be used to increase the path length of the secondary path return traffic from Microsoft (this is important to ensure symmetric routing due to NAT being used).

Routing of Microsoft Peering for Office 365

BGP Local Pref
Set >100 to
prefer this path.

Announce minimum
of /29 public IP
address prefix.

eBGP
Peer

eBGP
Peer

BGP AS path
prepend
used towards
Microsoft to
ensure return
traffic via
primary path.

Announce
minimum of
/29 public IP
address prefix.

Public BGP AS

Primary
Customer
Equipment

iBGP
Peer

Secondary
Customer
Equipment

Customer
Internal
Network

Private BGP AS or IGP

Private IP address

Network address translation

Network Address Translation (NAT) must be used because only public IPv4 address space is accepted by Microsoft. Microsoft requires outbound and inbound NAT for Office 365. The following conventions are used in the discussion and diagram below:
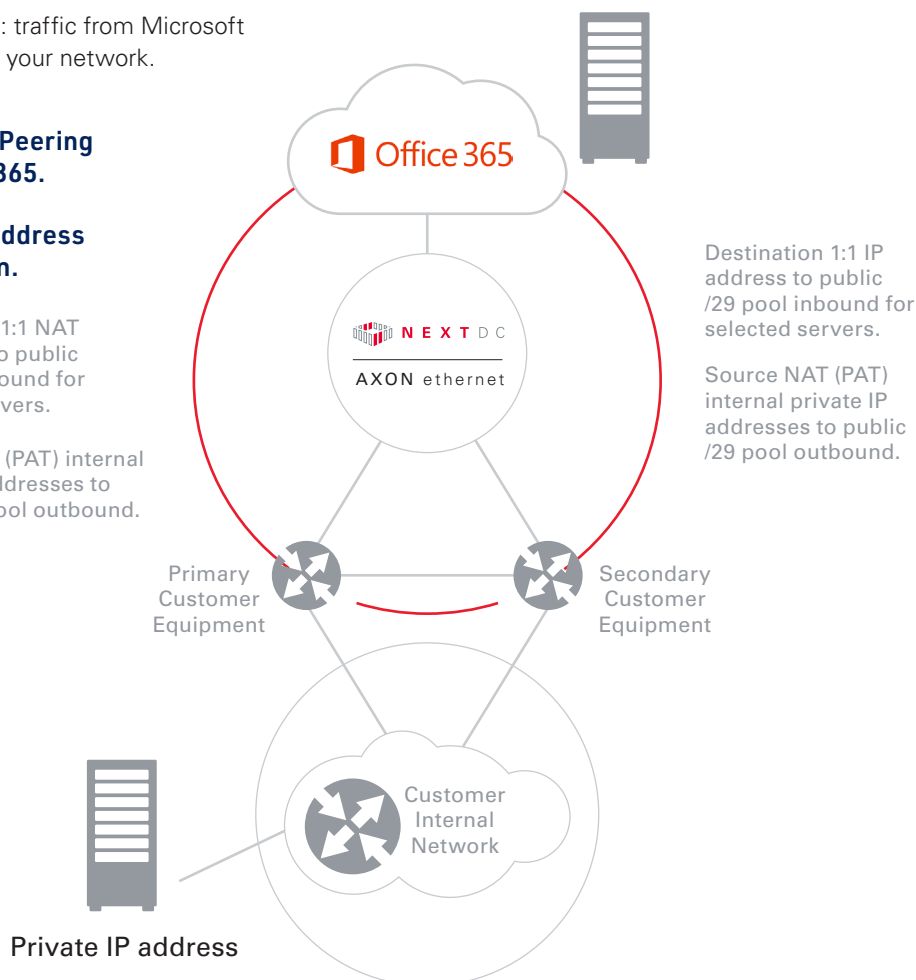
- Outbound: your network traffic towards Microsoft.

- Inbound: traffic from Microsoft towards your network.

Microsoft Peering for Office 365.

Network address translation.

Destination 1:1 NAT IP address to public /29 pool inbound for selected servers.

Source NAT (PAT) internal private IP addresses to public /29 pool outbound.

Destination 1:1 IP address to public /29 pool inbound for selected servers.

Source NAT (PAT) internal private IP addresses to public /29 pool outbound.

Office 365

N E X T D C
AXON ethernet

Primary Customer Equipment

Secondary Customer Equipment

Customer Internal Network

Private IP address

Since NAT is stateful it is important to ensure that outbound and inbound routing is symmetric via the primary and secondary Microsoft paths (this may not be the case when using clustered firewalls).

The example below uses an internal network of 192.168.1.0/24, an internal server address of 192.168.1.20 and a customer public IPv4 prefix of 20.1.1.0/29. Refer to the above diagram for traffic flow directions and location of devices.

Outbound

Source NAT should be used from your internal network to the advertised /29 public IPv4 address pool. For example source 192.168.1.0/24 source NAT to 20.1.1.1 (customer public IPv4 prefix 20.1.1.0/29 announced to Microsoft and configured as a secondary subnet on both AXON EXC's towards Microsoft).

Inbound

Some Microsoft services require inbound connectivity to your internal network. Destination 1:1 NAT is used. For example source 20.1.1.2 destination NAT's to 192.168.1.20 (your public IPv4 prefix 20.1.1.0/29 announced to Microsoft and configured as a sub-interface on both AXON EXC's towards Microsoft, inbound traffic from Microsoft destined to 20.1.1.2 connects to internal server 192.168.1.20).

Quality of service

Quality of service (diffserv or DSCP) tags from and to Microsoft must be supported and sent and received unaltered. This is particularly important for Skype for business that relies of "expedited forwarding" or diffserv EF. AXON passes tags through unaltered. AXON also does not do any 802.1q priority bit (P-bit) rewrite or mapping of diffserv. Customers need to ensure that their network "trusts" diffserv to and from Microsoft for all Microsoft services, and takes the appropriate scheduling action.

The following are the diffserv tags as specified by Microsoft that must be supported for Office 365:

Traffic Class	Treatment (DSCP Marking)	Skype for Business Workloads
Voice	EF (46)	Skype / Lync voice
Interactive	AF41 (34)	Video
	AF21 (18)	App sharing
	CS3 (24)	SIP signaling
Default	AF11 (10)	File transfer
	CS0 (0)	Anything else

Handoff options

When ordering ExpressRoute via AXON you will need to choose one of the following handoff options:

- Multi VLAN Trunk Mode (802.1q)
- Single VLAN Mode (802.1q Double Tagged)

Item	Qty	Comment
HANDOFF - Multi VLAN Trunk Mode (802.1q)		
ExpressRoute C-TAG VLAN IDs	2	You will need to provide two C-TAG VLAN IDs for each of the Microsoft peerings you wish to subscribe to: Private and Microsoft. Ethertype will be 0x8100. If you have also chosen to activate all of the Microsoft peering sessions, you will need to provide a total of four C-TAG VLAN ID's.
HANDOFF - Single VLAN Mode (802.1q Double Tagged)		
QinQ (802.1q) capable switch or router	2	To use Single VLAN QinQ mode handoff you will need a router that can unbundle double tagged 802.1q Ethernet frames. Ethertype will be 0x8100. Azure VLANs will be passed to you over a single VLAN (S-TAG). Azure services will be accessed by stripping off the outer S-TAG, allowing access to the C-TAG VLANs.

AXON port specifications

Interface options

Following are the standard interface options to connect to AXON.

Speed (Gbps)	Distance	Optic Type
1 Gbps	10 KM	1G-LX
10 Gbps	1 KM	10G-LRL
10 Gbps	10 KM	10G-LR
40 Gbps	1 KM	40G-LRL
40 Gbps	10 KM	40G-LR
100 Gbps	10 KM	100G-LR4

* LRL optics are compatible with LR optics, if your vendor only supplies LR optics and you are interconnecting with us over fibre that is shorter than 1km you should select LRL and use appropriate attenuators.

Service attributes

Service Attributes	Parameter
MAC Layer	802.3-2002
MTU	9100
Port Mode	802.1q Trunk
VLAN Ethertype	0x8100

* MTU of 9100 is valid for AXON network components. Please check the capabilities of the party you are connecting to.

NEXTDC support contacts

AXON help desk

The AXON help desk can be contacted using the information below:

Phone (Australia)
1300 698 677

Phone (International)
+61 7 3177 4799

Technical support
nxtops@nextdc.com

Service provisioning
nxtops@nextdc.com

Hours of operation:

Monday – Friday
09:00 - 18:00

Sunday & Saturday
Closed

Service faults
24 hours

Terms and Conditions and SLA

A copy of our Terms and Conditions and Service Level Agreement can be found here:

https://www.nextdc.com/axon-terms-of-service

Glossary

AXON network

Term	Explanation
AXON Enabled data centre (DC)	A data centre containing an AXON point of interconnect (POI).
Campus	A cluster of AXON DC's which are close to each other and are treated as if they are one data centre.
Cross Connect	A pair of single mode optical fibre (SMOF) cables connecting the customer to an AXON point of interconnect (POI). One Cross Connect is required for every AXON port.
Cross Connect - Local	A physical cross connect for which both the A-END and B-END reside in the same AXON DC.
Cross Connect - Carrier	A physical cross connect in which the B-END is external to the AXON DC it is connecting to. eg. A cross town dark fibre, Ethernet or wavelength service.
Edge Switch	AXON System's customer facing network equipment.
Fabric	A network region usually defined by city, state/territory or international borders. AXON is built as a series of fabrics (Sydney, Melbourne, Brisbane etc.) or network islands which are interconnected by partner carriers.
Interconnect	A Cross Connect and an AXON port used to physically connect customers to the AXON fabric.
Point of Interconnect (POI)	The fibre patch panel that customers order cross connects to. Generally located in the carrier interconnect room of an AXON DC.
Single Mode Optical Fibre (SMOF)	Optical fibre cable which complies with or exceeds ITUT Recommendations G.652 or G.652D.

AXON products

Term	Explanation
AXON port	The physical switch port on an AXON edge switch that is allocated to an AXON customer. This is the point of demarcation between AXON and its customers.
Ethernet Cross Connect (EXC)	A layer 2 interconnect between two or more AXON ports.
ExpressRoute POP	A Microsoft ExpressRoute service is delivered directly to the customer over a fibre cross connect. An ExpressRoute local POP is available in NEXTDC locations which have an onsite ExpressRoute Point of Presence and is available in 1 or 10 Gigabit per second speeds.

AXON connected entities

Term	Explanation
Customer	A business or organisation that has signed up for an AXON account with a view to consuming AXON delivered services.
Integration Partner	An IT/network service organisation that has signed up for an AXON account with a view to using AXON to deliver value added products and services to their customers.
Carrier	A licensed carrier who owns significant physical network assets, has signed a carrier agreement and has interconnected with AXON with a view to consuming AXON delivered services.
Partner Carrier	A licensed carrier who owns significant physical network assets, has signed a partner carrier agreement and has interconnected with AXON with a view to consuming and also selling AXON delivered services which can be rapidly provisioned, modified and torn down ideally via API offering on demand elastic purchasing options in line with the overall ethos of the AXON product set.
Cloud Provider	A business or organisation which delivers high value cloud based services targeted at the SMB/enterprise & government markets. Cloud providers must own unique infrastructure or intellectual property which operates at scale, can be rapidly provisioned via API and offers on demand elastic purchasing options in line with the overall ethos of the AXON product set.