Cboe Europe

Connectivity Manual

3 January 2023• VERSION 7.5

Contents

1. Introduction

Cboe Europe Limited (Cboe) offers access to all services provided by Cboe UK Equities (Cboe UK) and Cboe NL Equities (Cboe NL) via a single cross connect. Services include order books (BXE, CXE & DXE), Trade Reporting Facility /APA, SI Quoting & SI Technology Services (SIS), Large In Scale (LIS) and Indices Quotes. Cboe Europe Limited (Cboe) offers access to Derivatives (CEDX) over latency equalised cross-connects. Cboe also offers some services via the internet. This document explains the network connectivity options available.

Connectivity is charged as per [Connectivity Pricing](#)

Participants are responsible for:

- Arranging for connectivity to the datacentre or choosing their connectivity provider.
- Paying all associated communications charges including cross-connects within the datacentre (excluding Derivatives until further notice)
- Managing and controlling network access and the traffic that traverses their chosen connectivity

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All technical documentation including this document and protocol specifications are accessible at:

http://markets.cboe.com/europe/equities/support/technical/ (Equities)
https://www.cboe.com/europe/derivatives/support/technical/ (Derivatives)

2. Scope of Services

The following connectivity Cboe services are offered at all locations. All services are offered on a fair and non-discriminatory basis.

- Physical network ports
- Market data feeds
- Order entry ports
- DROP copy port
- Indices quotes

Cboe offers all services to all Participants subject to signing required agreements.

Equinix LD4 is the primary datacentre, Equinix LD3 is the secondary datacentre. Equinix offer a range of co-location services (as defined by MiFID II RTS10), these are offered independently of Cboe, these services include space, power, cooling and cross-connects. Any Cboe customer wanting to take co-location services from Equinix must negotiate with Equinix directly, Cboe is not involved in anyway. Details are available at: Equinix co-location services

Access to SI Technology Services is not available at Interxion.

3. Simplified Network Diagram
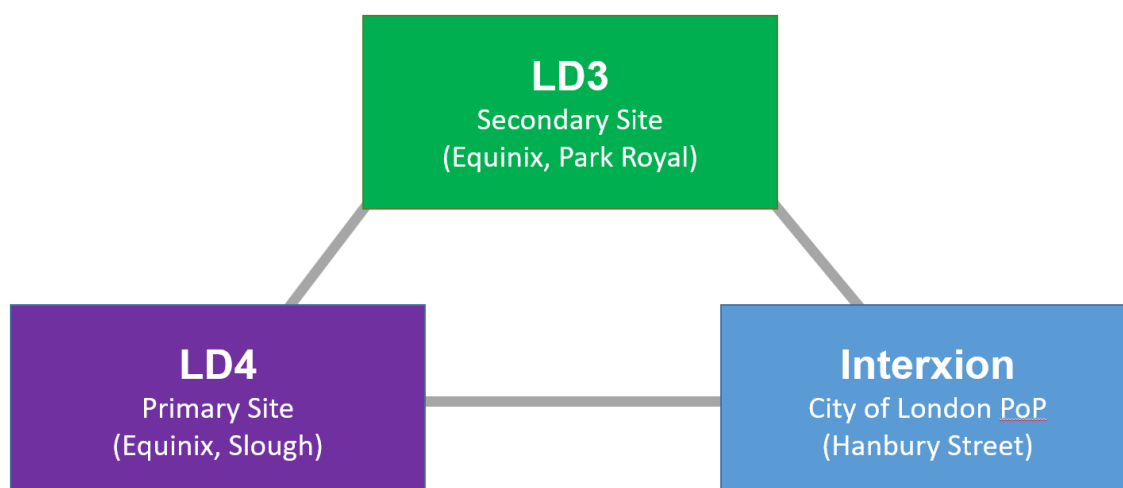
4. Connectivity Locations

Cboe connectivity is available at the following locations:

LD4	Primary datacentre, Slough
LD3	Secondary datacentre, Park Royal
Interxion	City of London point of presence

A limited number of services are available via the internet.

5. Connectivity Options

The following network connectivity options are supported:

IPsec VPN
Participants may connect using IPsec over the Internet for certification and test access only:
- Access to all TCP-based feeds for certification and test only
- LAN-to-LAN IPsec VPNs using registered IP addresses only
- Certification Multicast PITCH available using GRE tunnel over IPsec VPN.

Datacentre Cross-Connect
Participants may take datacentre space and cross connect at any of the datacentres locations:
- The technical and commercial relationship is between the datacentre provider and the Participant.
- Cboe is not involved (however, latency-equalized cross-connects are ordered by Cboe and recharged to the Participant)
- Participant orders and pays for the cross-connect

Metro Ethernet
Participants may connect via a metro Ethernet circuit:
- No co-location space is required.
- Telco's must deliver the circuit to the designated telco demarcations.
- Cboe does not host telco equipment.
- The cross-connect from telco demarcation point is ordered by Cboe and re-charged to the Participant.

Extranet
Participants may connect using an extranet provider:
- Extranet provider provisions high-speed up links for multiple Participants
- The technical and commercial relationship is between the extranet provider and the Participant
- Not all extranets carry Multicast PITCH

Internet for Market Data
Participants may consume TCP PITCH via the internet:
- Non-resilient service from LD4 only
- Each set of TCP PITCH ports are charged as per Connectivity Pricing

Internet for Trade Reporting GUI
- Allows Participant to submit details of a trade report over the internet using the secure participant portal.

6. Demarcation

- For each location Cboe offers a common physical network demarcation point
- All Participants are given the same access at each location and will have equal latency to the Cboe servers from each demarcation point
- The physical network demarcation point for all connectivity is the patch frame within the Cboe cage

7. Estimated Latency to Equinix LD4

All times are round trip, measured under normal operation. Latencies will increase if running on backup circuits.

Interxion	490uS
Equinix LD3	400uS

8. Physical Interfaces

The following physical interface specifications are supported:

| LOCATION	SPEED	MEDIA
Equinix LD4 Slough	10G	LR (single-mode)
	1G	LX (single mode)
Equinix LD3 Park Royal	10G	LR (single-mode)
	1G	LX (single mode)
Interxion (Hanbury Street)	10G	LR (single-mode)
	1G	LX (single-mode)

9. Latency Guidance

The latency of the trader experience will be impacted by:

Network port speed. 10G ports will give the lowest latency access option. Participants should take into account serialisation delays when choosing interface speed.

Multicast PITCH is the lowest latency market data feed available. WAN-shaped Multicast PITCH will experience queuing during busy times hence the Gig-shaped feed is recommended for the lowest latency experience.

Cboe offers FIX and BOE order entry protocols. As per the BOE specification, it offers CPU and memory efficiency, application and session level simplicity. Participants should consider this when choosing which order entry protocol to use.

Cboe Latency Equalization (LE) LD4/LD4.2 Only
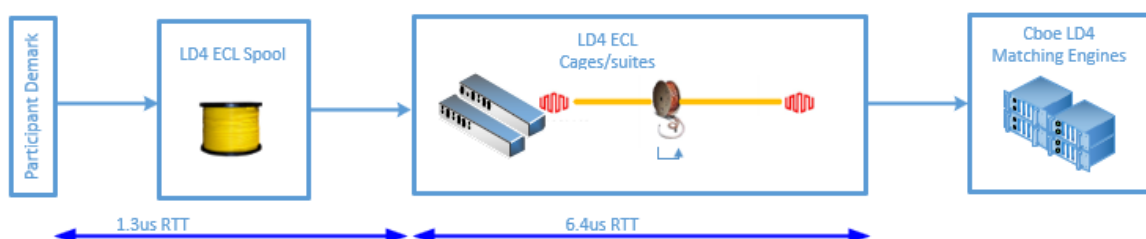
- Cboe/Equinix Latency Equalization Infrastructure provides an equal optical length of fiber to participants connecting within the LD4/LD4.2 data center.

- Latency Equalized Hubs within LD4/LD4.2 are connected via fibre trunks to the matching engines in the LD4 data centre.

- Fibre cross connects to the participant cages are run from Equinix Latency Equalized Hubs using predefined lengths of single-mode fibre to each customer cage. The additional slack is then stored on the Cboe side of the cross connect. So regardless of the customer's distance from the Equinix Latency Equalized LD4/LD4.2 Hub, the total fibre optical length is within Cboe tolerances to the assigned participant demarcation point within LD4/LD4.2.

10. Market Data

There are seven separate market data feeds
- BXE
- CXE (order book)
- CXE (indices quotes)
- DXE
- TRF Trades
- SI Quote
- CEDX

There are two market data formats: Multicast PITCH and TCP PITCH

Market data pricing can be found at: Market Data Pricing

Market Data Location Availability

Location	Sourced from LD4						Sourced from LD3		
	Gig A	Gig B	Wan C	Wan D	TCP	Unitised TCP	Wan E	TCP	Unitised TCP
LD4	✔	✔	✔	✔	✔	✔	✔	✔	✔
LD3							✔	✔	✔
Interxion	✔	✔	✔	✔	✔	✔	✔	✔	✔
Internet					✔				

Multicast PITCH

Multicast PITCH has the following key features:
- Low-latency, faster than TCP PITCH
- Two bandwidth versions - Gig shaped & WAN shaped
- Gap Response Proxy to recover data gaps
- Spin Server to efficiently recover from intra-day disconnects
- Efficient binary messaging and modify order message

Multicast PITCH Naming Prefixes (as used in Multicast PITCH spec)

LD4	LD3
BXE uses the prefix B: • Gig shaped BA & BB • WAN shaped BC & BD	BXE uses the prefix B • WAN shaped BE
CXE (orderbook) uses the prefix X: • Gig shaped XA & XB • WAN shaped XC & XD	CXE (orderbook) uses the prefix X • WAN shaped XE
CXE (indices quotes) uses the prefix XI: • WAN shaped XIC & XID	CXE (indices quotes) uses the prefix XI: • WAN shaped XIE
DXE uses the prefix D: • Gig shaped DA & DB • WAN shaped DC & DD	DXE uses the prefix D • WAN shaped DE
TRF uses the prefix T: • WAN shaped TC & TD	TRF uses the prefix T • WAN shaped TE
SI Quote uses the prefix Q: • Gig shaped QA & QB • WAN shaped QC & QD	SI Quote uses the prefix Q • WAN shaped QE
CEDX uses: • Gig shaped A & B	CEDX uses: • • WAN shaped E

Multicast PITCH Development Resources

The following resources are available specifically targeted at easing the process of developing for Multicast PITCH:
- Certification Multicast PITCH is available via the internet VPN using a GRE tunnel
- A test program to assist in debugging multicast infrastructure is available https://cdn.cboe.com/resources/membership/mcast_pitch.zip
- Multicast PITCH historic data files are available via the Participant portal

TCP PITCH

TCP PITCH has the following features:
- Full TCP PITCH includes all symbols in all markets
- Unitised PITCH offers basic market selectivity and is best suited for Participants who only require a limited sub-set of market data to reduce the cost of wide area connectivity
- Participants are encouraged to take market data via Multicast PITCH as the infrastructure load is constant irrespective of the number of data consumers

11. Bandwidth Guidance

- Participants are strongly advised to provision bandwidth to cope with peak aggregate data rates and exceptional market conditions
- All Multicast PITCH feeds have bandwidth rate limiters, as published in the Multicast PITCH spec
- A single 1G cross connect will not support all Gig shaped Multicast PITCH feeds
- Gig shaped Multicast PITCH is only available to Participants with 1G or above
- Insufficient bandwidth will cause dropped packets and gaps in the Multicast PITCH feeds

TCP PITCH Observed Bandwidth Peaks

The peak 1, 5 and 10 second bandwidth peaks of the Full TCP PITCH feed per market seen to date are below. Participants consuming both the CXE & BXE feeds can expect to see twice these peaks.

INTERVAL	INTRA-DAY PEAKS (MBPS)	INCLUDING END OF DAY PEAK (MBPS)
1	47	47
5	31	31
10	24	24

Note: There will be sub-second microbursts that will exceed the one second peak rate. The extent to which the network connection to the Participant will cope with the microbursts exceeding the available bandwidth without packet loss will depend heavily on the buffers in the end to end path.

Order Entry Observed Bandwidth Peaks

The bandwidth for order entry via the FIX or BOE interface depends on the rate of message input:

FIX or BOE Message Rate	75/sec	150/sec	450/sec
Bandwidth	256kbps	512kbps	1.5Mbps

12. IP Addressing

The details below apply to all connectivity methods other than VPN:
- Cboe hosts use registered addresses for both unicast and multicast data flows
- Cboe supports publicly registered Participant addresses
- If required, Cboe can allocate a 10.x.y.z address block. Each Participant is allocated a /24 subnet by default. This subnet can be split to provide transit P2P and host/NAT subnets
- Cboe supports static routing and dynamic routing via BGP. For multicast, Cboe supports static and dynamic IGMP and PIM Sparse
- Each TCP separate feed is allocated a unique TCP port that is part of a port range. The port is determined by the Trade Desk during the provisioning process. The GRP and SPIN ports used by Multicast PITCH are not unique

13. Certification

There are certification environments for BXE, CXE, DXE, TRF, SIS, CEDX, & LIS at LD4. Furthermore certification environments for BXE, CXE, DXE, & CEDX exist at LD3 that allow Participants to test intra-day datacentre failover.

Connectivity to the certification environments is available at all locations, and also via an internet VPN to the certification environments at LD4 only (LIS certification is not available via VPN).

Certification Multicast PITCH feeds are also available and heavily bandwidth limited as per the Multicast PITCH specification. The feed is available over an internet VPN via a GRE tunnel.

14. Out of Hours Testing

Outside of the core trading hours during the week and all weekend all TCP ports (with the exception of LIS ports) should run TCP port listeners and all multicast feeds will heartbeat. This allows Participants to QA connectivity at any time.

15. Order Form

The Connectivity Order Form to request connectivity is published at: Connectivity Order Form

The associated Terms and Conditions are published at: Connectivity Terms & Conditions

16. Port and Latency Tools

Cboe provides Participants some valuable tools accessible via the Participant portal to monitor and manage their connectivity.

- Ports Dashboard – provides port statistics including TCP re-transmit count
- Real-Time Latency Portal – provides a large amount of latency data on order and order to quote

17. Reference Data

Reference data is accessible via the internet or over customer trading connectivity.

Please consult the [Cboe reference data specification](#) for full details for all BXE, CXE, DXE, TRF, SIS & LIS.

Please consult the [Cboe Europe CEDX Reference Data Specification](#) for full details for CEDX.

18. Disaster Recovery

In the event of a catastrophic failure at the primary datacentre (Equinix LD4, Slough) Cboe Europe may invoke disaster recovery at the secondary datacentre Equinix LD3, Park Royal.

The BXE, CXE, DXE, TRF, SIS, and CEDX environments run separately, the decision to invoke disaster recovery from LD4 to LD3 may be made for only one or all environments dependant on the nature of the failure.

The BXE, CXE, DXE, and CEDX certification environments have disaster recovery environments at LD3, Participants should use these environments to test intra-day failover to LD3.

The LIS environment only exists within LD4.

A full disaster recovery guide is provided at: [Disaster Recovery Guide](#)

19. Specific TRF Connectivity Guidance

Participants of the TRF environment should note that they are strongly encouraged to have separate and resilient connectivity to both LD4 & LD3. Participants should satisfy themselves that they will be able to connect to the TRF environment under all scenarios, specifically:

1. Partial loss of a connectivity at LD4, i.e. the loss of any single cross connect or device
2. TRF environment running from LD3 with no network path via LD4

Revision History

19 Jul 2018	v6.6 P6 Physical interface options in LD4 and LD3 updated to Single Mode.
02 Nov 2018	v6.7 P20 Addition of Brexit multicast PITCH guidance for BXE and CXE.
11 Jan 2019	v6.8 P13 GRP and SPIN ports detail.
23 Jan 2019	v6.9 P14 Performance statement added
30 May 2019	v7.0 P13 Addition of DXE environment, update to Appendix A
26 Nov 2019	v7.1 P16 Legacy Feed deprecation dates amended
30 Apr 2020	v7.2Indices information added & Legacy feed information removed
17 Jun 2021	v7.3 Introduction - Addition of Derivatives to Services list. Amending

Connectivity responsibility for Participants. P5 Connectivity Options - Addition of latency-equalized cross-connects under Datacentre Cross-Connect. P13 Certification - Addition of CEDX 17 Reference Data - Addition of CEDX. P18 Disaster Recovery - Addition of CEDX.

18 Jul 2022	v7.4 More LE (ECL) references, new link for mcast zip file.
03Jan 2023	v7.5 Updated EL latency and added 10G LD3