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1 Introduction

1.1 Overview

MATCHNow’s primary trading platform is housed in the Equinix TR2 data center in Toronto, Ontario. The secondary data center is hosted by Equinix CH2 in 350 E Cermak Chicago, IL. Clients are strongly encouraged to establish connectivity to both data centers to minimize service disruption in the event of an issue at either data center. Toronto is the “primary” or “hot” site, with Chicago being “secondary” or “warm”. Clients may receive market data from Chicago, and they may connect and heartbeat with order entry systems in Chicago. Orders submitted to Chicago will be rejected until MATCHNow declares the primary site in Toronto “down.”

It is the client’s responsibility to select their telecommunications provider and arrange for connections to the TR2 and CH2 data centers.

MATCHNow supports the following network connectivity choices:

- **IPSec VPN** via the Internet (only for certification or test sessions);
- **Co-location Cross-connect** (i.e. for clients co-located in Toronto TR2 data center);
- **Extranet** connectivity (see list in the MATCHNow Approved Extranet Provider section); and
- **Private Line Ethernet** circuit extension from a carrier to MATCHNow (see list in the Carriers section)
### 1.2 Connectivity Matrix

<table>
<thead>
<tr>
<th>Data Center Role</th>
<th>Toronto TR2 Latency Equalized</th>
<th>Chicago CH2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Center Provider</td>
<td>Equinix</td>
<td>Equinix</td>
</tr>
<tr>
<td>Site Location</td>
<td>Toronto, ON</td>
<td>Chicago, IL</td>
</tr>
<tr>
<td>Site Status</td>
<td>Hot/Primary</td>
<td>Warm/Secondary</td>
</tr>
<tr>
<td>Accepts Co-location Cross-connects?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Accepts Circuit Extension from Telco?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Access to Production Sessions/Feeds?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Access to Disaster Recovery Sessions/Feeds?</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Access to Certification Sessions/Feeds?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Access to other Cboe Markets?</td>
<td>No</td>
<td>Yes (DR)</td>
</tr>
<tr>
<td>Colocation of Network Equipment?</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>1G Monthly Recurring Connectivity Fees</td>
<td>$500/Month</td>
<td>$500/Month</td>
</tr>
<tr>
<td>10G Monthly Recurring Connectivity Fees</td>
<td>$1000/Month</td>
<td>$1000/Month</td>
</tr>
<tr>
<td>Supported Media Types</td>
<td>SMF</td>
<td>SMF, MMF, Copper</td>
</tr>
<tr>
<td>Round Trip Time to Production FIX gateways</td>
<td>8µs</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### 1.3 Physical Interfaces

The following standard physical interface specifications are supported in the 350 Cermak (CH1, CH2, and ORD1) data centers. For other interface specifications contact [noc@cboe.com](mailto:noc@cboe.com).

10G | SR (multi-mode), LR (single-mode) & ER* (single-mode)
1G | SX (multi-mode), LX (single-mode) & 1000BaseT

The following standard physical interface specifications are supported in the TR2 data centers:

10G | ER* (single-mode)
10G | LR (single-mode)
1G | LX (single-mode)

*Contact Cboe NOC for details on ER Optical Transceivers*
2 Types of Connectivity

2.1 IPSec VPN

- Clients may connect via an IPSec Virtual Private Network (VPN) over the Internet for access to order entry for certification and test purposes only. LAN-to-LAN IPSec VPN supported.
- The IP address of the host presented to MATCHNow must be registered.
- Clients must contact Cboe NOC for encryption details and to receive their pre-shared key.

*Note: MATCHNow does not offer multicast market data feeds over VPN.*

2.2 Co-location Cross-connect

MATCHNow clients may request cage space within the Equinix TR2 data center.

- Each physical port connection (1Gbps and 10Gbps) within the Toronto and Chicago data centers/PoPs will be subject to a monthly recurring charge. See the MATCHNow Fee Schedule for more information.
- Co-location cross-connect requests must come from a demarcation point on the data center floor. Roof-top access requests will not be accepted.

With data center co-location, clients can place equipment, terminate communications circuits, and establish a cross-connect to MATCHNow (or other destinations) in their space. This gives the maximum amount of control to the client. This option is neutral for the client and provides the greatest flexibility for the client in determining when and to whom to connect. Clients interested in co-location services should contact the data center/PoP Point of Contact (refer to the Connectivity Matrix section for POC information).

2.3 Extranet

Clients may provision connectivity to MATCHNow via an extranet.

- Extranets have provisioned redundant connections to MATCHNow for use by multiple clients.
- Contact information for a variety of extranet providers is found below within the MATCHNow Approved Extranet Providers section.

This method is an attractive alternative when:

- The customer would otherwise have to provision a long-haul private line;
- Outsourcing of network services and network management is an option; or
• The ease and speed of turn-up are important (when both the client and MATCHNow have an existing connection to the extranet).

2.4 **Directly Connected via Private Line Ethernet**

Clients may connect to MATCHNow via Private Line Ethernet.

• No co-location space is required. Extending a cross-connect from Telco demarcation point to MATCHNow network via an Ethernet interface will be required by the Carrier.

• Each physical port connection (1Gbps and 10Gbps) within the Toronto and Chicago data centers/PoPs will be subject to a monthly recurring charge.

• Contact information for a variety of carriers is found below within the [Carriers](#) section.
3 Ordering a Cross-Connect to MATCHNow

3.1 Submit Request via MATCHNow Portal

A MATCHNow Customer Web Portal account is required to request a new cross-connect or to decommission existing connectivity to MATCHNow. Please contact your firm’s account administrator or the MATCHNow Trade Desk for an account:

- MATCHNow Trade Desk – (416) 861-1010 Ext 0
- Email – tradedeskca@cboe.com

3.2 Required Information

- Data Center Location (Toronto or Chicago)
- Number and speed of connections requested (1G or 10G)
- Registered BGP ASN (Cboe NOC can assign a private ASN)
- Networks advertised to MATCHNow (registered public IPs or MATCHNow assigned private addresses are accepted)
- Network and billing contact information
- Transit IP address (Public or private range assigned by Cboe NOC)

3.3 LoA-CFA

Upon approval of cross-connect request, Cboe NOC will provide a Letter of Authorization (LoA) - Client Facility Assignment (CFA) with the “Z-side” cage, cabinet, panel, and port pair assignment. The client requesting the cross-connect is known as the “A-Side.”

3.4 Data Center Provider Request

The requesting client should submit a cross-connect request with the appropriate data center provider:

- Equinix – TR2 and CH2

The data center provider will need the LoA-CFA and the “A-side” details to complete the connection. The “A-Side” client is responsible for any data center setup fees and monthly recurring costs associated with the cross-connect. As the “A-Side” cross-connect owner, the client is also responsible for initiating troubleshooting and remote hands requests with the data center provider in the event of a down connection.

3.5 Latency Equalization

Cross-connects originating within TR2 data center will be engineered to provide equivalent latency between client demarcation points and the MATCHNow’s order entry gateways in TR2. Equal fiber pathway latency will be determined by Optical Backscatter Reflectometer (“OBR”) testing. WAN circuits originating outside Toronto, ON will also be subject to latency equalization.
MATCHnow Latency Equalization

- Client Cage TR2
- Equinix TR2 Spool Hub Cage
- MATCHnow Cage
  - Client Access Switches
  - Spine Layer Switches
  - Top of Rack Switches
- Matching Engines
- Inside Switches
- FIX Gateway Servers

8μs RTT
4 Bandwidth

4.1 Market Data

Clients taking MATCHNow market data feeds should allocate a minimum of 100Mb each for the primary and secondary feeds. This will allow sufficient overhead for feed microbursting and for reception of gap response feeds.

Refer to the MATCHNow Multicast Market Data specification on the Cboe web site for complete details.

4.2 FIX Order Entry

Bandwidth recommended for submitting orders via FIX depends on expected client order volume. If a client intends to submit orders to MATCHNow and will receive market data, then it is advised that the client allocate at least 100Mb or greater per physical connection. The following table shows the maximum number of inbound orders (and/or cancels) per second that can be handled without buffering or delay for each connection capacity.

<table>
<thead>
<tr>
<th>Order Protocol</th>
<th>256Kb</th>
<th>512Kb</th>
<th>1.5Mb</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIX</td>
<td>75/sec.</td>
<td>150/sec.</td>
<td>450/sec.</td>
</tr>
</tbody>
</table>
5 Telecommunications Providers

Some telecommunications providers available within the Toronto and Chicago data centers/PoPs are listed below. This list is a summary and is not indicative of MATCHNow’s preference or recommendation. For telecommunications providers not included on the list, please contact the Cboe NOC to discuss.

5.1 Extranet Providers

MATCHNow partners with several extranet providers to aggregate client connectivity and provide low cost, value-added B2B services such as multicast market data feeds. Extranet providers are required to sign Telecommunications Service Provider Agreement after meeting the requirements outlined in the MATCHNow Extranet Manual.

5.1.1 MATCHNow Approved Extranet Providers

<table>
<thead>
<tr>
<th>Company</th>
<th>Contact</th>
<th>Phone</th>
<th>Multicast Feeds*</th>
<th>Data Center(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPC Systems, Inc.</td>
<td>Jason Gellis</td>
<td>+1 (201) 253-2242</td>
<td>TBD</td>
<td>Toronto</td>
</tr>
<tr>
<td><a href="http://www.ipc.com">www.ipc.com</a></td>
<td><a href="mailto:jason.gellis@ipc.com">jason.gellis@ipc.com</a></td>
<td></td>
<td></td>
<td>Chicago</td>
</tr>
<tr>
<td>ICE Data Services – Connectivity</td>
<td>Connectivity Sales</td>
<td>US: (770) 661-0010</td>
<td>TBD</td>
<td>Toronto</td>
</tr>
<tr>
<td><a href="http://www.iceglobalnetwork.com">www.iceglobalnetwork.com</a></td>
<td><a href="mailto:iceglobalnetwork-info@theice.com">iceglobalnetwork-info@theice.com</a></td>
<td>EU: +44 207 429 4610</td>
<td></td>
<td>Chicago</td>
</tr>
<tr>
<td>TNSi</td>
<td>Melissa Trulock, Sr. Project Manager</td>
<td>(312) 859-2633</td>
<td>A/B/E</td>
<td>Toronto</td>
</tr>
<tr>
<td><a href="http://www.tnsi.com">www.tnsi.com</a></td>
<td><a href="mailto:mtrulock@tnsi.com">mtrulock@tnsi.com</a></td>
<td></td>
<td></td>
<td>Chicago</td>
</tr>
</tbody>
</table>

*A/B = Primary, E = Secondary

5.1.2 Carriers

Telecom carriers provide a dedicated circuit between clients in different data centers to a demarcation point in the Toronto, Markham, or Chicago data centers/PoPs. The circuit is extended from the demarcation point to a MATCHNow network device.

It is recommended that clients use redundant connectivity via multiple telecommunications providers to each of the MATCHNow data centers.

Contact the Cboe NOC for information about circuit ordering details (e.g., NPA-NXX, LoA/CFA requirements, demarcation information, etc.).

<table>
<thead>
<tr>
<th>Company</th>
<th>Contact</th>
<th>Phone</th>
<th>Data Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anova Technologies</td>
<td>Heather Cannon</td>
<td>(312) 540-9594 x1113</td>
<td>Chicago</td>
</tr>
<tr>
<td><a href="http://www.anova-tech.com">www.anova-tech.com</a></td>
<td><a href="mailto:hecannon@anova-tech.com">hecannon@anova-tech.com</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beanfield Technologies</td>
<td><a href="mailto:info@beanfield.com">info@beanfield.com</a></td>
<td>1-416-532-1555</td>
<td>Toronto</td>
</tr>
<tr>
<td><a href="http://www.beanfield.com">www.beanfield.com</a></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BCE Global, a Bell Canada company</td>
<td><a href="mailto:csgsales.satventes@bell.ca">csgsales.satventes@bell.ca</a></td>
<td></td>
<td>Toronto</td>
</tr>
<tr>
<td>Cogent Communications, Inc</td>
<td><a href="mailto:sales@cogentco.com">sales@cogentco.com</a></td>
<td>1-877-875-4432</td>
<td>Toronto</td>
</tr>
<tr>
<td>Company</td>
<td>Contact</td>
<td>Phone</td>
<td>Data Center</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------------------</td>
<td>--------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Crosslake Fibre</td>
<td>Christopher Borg</td>
<td>1-212-315-8203</td>
<td>Toronto</td>
</tr>
<tr>
<td><a href="http://www.crosslakefibre.ca">www.crosslakefibre.ca</a></td>
<td><a href="mailto:chris.borg@crosslakefibre.ca">chris.borg@crosslakefibre.ca</a></td>
<td></td>
<td>Chicago</td>
</tr>
<tr>
<td>Telus Corporation</td>
<td>Danny Trinca</td>
<td>1-647-464-6825</td>
<td>Toronto</td>
</tr>
<tr>
<td><a href="http://www.telus.com">www.telus.com</a></td>
<td><a href="mailto:danny.trinca@telus.com">danny.trinca@telus.com</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zayo</td>
<td>Becky Klatt</td>
<td></td>
<td>Toronto</td>
</tr>
<tr>
<td></td>
<td><a href="mailto:becky.klatt@zayo.com">becky.klatt@zayo.com</a></td>
<td></td>
<td>Chicago</td>
</tr>
</tbody>
</table>
6 Support

Please direct questions or comments regarding this manual to noc@cboe.com. Cboe NOC is a one-call shop that provides North America clients and telecommunications providers with both initial setup support as well continuing support for all connectivity issues.

6.1 Support Hours

- Phone – 647.417.6565 (CA) 913.815.7005 (US)
- Email – noc@cboe.com
- Core phone support hours are 7:00 a.m. to 11:00 p.m. ET Monday – Friday
- Outside of core support hours, to report a network issue that must be addressed prior to market open, leave a voice mail with the firm name, contact number, and the nature of the issue.
- For non-critical issues or for information, please email or NOC and your request will be responded to on the next business day.
## Revision History

<table>
<thead>
<tr>
<th>Document Version</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0.0</td>
<td>05/11/21</td>
<td>Initial version of Manual supporting Cboe/MATCHNow integration.</td>
</tr>
<tr>
<td>1.0.1</td>
<td>09/21/21</td>
<td>Added Canadian telephone support number.</td>
</tr>
<tr>
<td>1.0.2</td>
<td>01/14/22</td>
<td>Updated Connectivity Matrix with 1G and 10G monthly costs.</td>
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<tr>
<td>1.0.3</td>
<td>04/14/22</td>
<td>Added a link to the MATCHNow Fee Schedule.</td>
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<tr>
<td>1.0.4</td>
<td>03/06/23</td>
<td>Updated TNSi Extranet Provider contact information.</td>
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<tr>
<td>1.0.5</td>
<td>07/10/23</td>
<td>Revised Round Trip Time (RTT) Latency Equalization.</td>
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<tr>
<td>1.0.6</td>
<td>10/06/23</td>
<td>Revised Carrier table.</td>
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<td>1.0.7</td>
<td>10/11/23</td>
<td>Revised Carrier table.</td>
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