

TURQUOISE

Technical Specifications Guide to Connectivity and Hosting

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Contents

1.	About This Document	3
1.1	Introduction	3
2.	Turquoise Systems Overview	4
2.1	Two Sites – Two Systems	4
2.2	Production Environment.....	4
2.3	Customer Testing Environment	4
2.4	Beta Test Environment.....	5
2.5	Project Test Environment	5
3.	Client Connectivity Information.....	6
3.1	Physical Connectivity	6
3.2	Connectivity Protocol.....	6
3.3	Interfaces	6
3.4	Bandwidth Recommendations.....	6
3.5	Turquoise Addresses and Ports.....	7
3.6	Connections	7
3.7	Service Hours	7
3.8	Connectivity Contacts	8
3.9	Hosting.....	8
3.10	Connectivity Testing.....	8
3.10.1	Live Connectivity Testing	8
3.10.2	Website	9
3.10.3	Telnet	9
3.10.4	Trace Route	9
3.10.5	Ping.....	9
4.	Information for Third Party Connectivity Providers.....	10
4.1	General Requirements for Layer 2 Network Service Providers	10
4.2	General Requirements for Layer 3 Network Service Providers	10
4.3	Bandwidth Requirements	10
4.4	IP Addressing Requirements	10
4.4.1	Production Environment.....	11
4.4.2	Customer Test Environment	12
4.5	Delivery Confirmation of Customer Connectivity	13
4.6	Reporting of Third Party Circuit Service Availability	13
4.7	Fault Reporting Procedures	13
4.8	Procedure on Resolution of an Issue	14
4.9	Escalation	14

1. About This Document

1.1 Introduction

The purpose of this document is to provide a detailed description of the process for connecting to the Turquoise Trading System. The document is intended for individuals who require a detailed knowledge of the implementation as well as those who require a high level overview.

2. Turquoise Systems Overview

2.1 Two Sites – Two Systems

The Turquoise Trading System is designed to provide a fast, resilient service with full redundancy over site and hardware failure. The distributed nature of the matching engines and the duplicate processing over two sites ensures continuous trading in the event of hardware or site failure. The sites are located 20km apart with diverse high speed fibre connections.

All messages are routed through the primary site regardless of the site they are initially transmitted to. The message is then processed through each site before being routed back through the primary. At this point the first response message to be received is transmitted back to the customer and the second response is discarded. This ensures the customer always receives the fastest response from either site.

Both sites are managed by a third party provider. This allows customers the option of locating their systems within either site or using a third party network provider for connectivity. Turquoise does not provide a managed network to either site but allow customers to select the provider of their choice. Customers should ensure that their chosen network providers can meet the connectivity requirements of Turquoise as detailed in section 4: [Information for Third Party Connectivity Providers](#).

The locations of the two sites are Great Sutton Street, EC1 and Croydon. Further details, such as the full address, are available on request.

The systems located at the two sites are the Production Environment, Customer Testing and Beta Test. The Project Test environment is located at a separate offshore site.

2.2 Production Environment

Access to the Turquoise Trading System Production environment is available to all Members, Market Data Vendors and Trading Access Providers who have meet the relevant criteria. For example,

- in order to be enabled to trade on Turquoise Members must have completed the membership process in full and be accepted for trading by EuroCCP in the markets they wish to trade on,
- all systems connected to the Production environment must use certified software,
- prior to go-live all customers must pass a Live Connectivity Test.

Further details on these requirements can found in the Membership Pack, the Guide to Testing and in later sections of this document.

2.3 Customer Testing Environment

The purpose of the Customer Testing system is to allow customers an environment in which they can develop and test their systems. The Customer Testing environment is a functional replica of the Production system to ensure development and testing can be done in an environment as close to that used in live service as possible. This includes a previous day's image of the Production reference

TURQUOISE

data. The Customer Testing environment has a reduced capacity compared to the Production system and there may be differences in the Member and User IDs to those used in Production. There are also instruments on the Customer Testing environment which are not on the Production environment. The Customer Testing system is duplicated across both sites and can be connected to from either site.

The Customer Testing Environment will also support Certification Testing. Certification Testing will be restricted to instruments which are not on the Production environment but are existing instruments. Connection to Certification Testing will use the same IP address and port number as the Customer Testing Environment but access to the instruments will be restricted.

2.4 Beta Test Environment

The Beta Test environment is designed to support testing against the next release of the trading system. It is not intended to be used as a continuous testing facility and is not a functional replica of the Production system either in terms of software or hardware. The Beta Test system is only hosted at the Primary site but is accessible from either site. As the Beta Test environment is used by Turquoise for internal testing it may be unavailable for extended periods.

2.5 Project Test Environment

The Project Test environment is designed to provide additional testing support during project implementation phases outside of normal working hours. It is not intended to be used as a continuous testing facility and is not a functional replica of the Production system either in terms of software or hardware. The Project Test system is only available over the internet and as it is used by Turquoise for internal testing it may be unavailable for extended periods. Connectivity to the Project Test Environment is strictly limited. Details are available from your Turquoise Technical Account Manager.

3. Client Connectivity Information

3.1 Physical Connectivity

Turquoise does not support direct leased line connectivity. Connectivity to the Turquoise Trading System is via customer ordered third party Network Providers. Third party Network Providers must aggregate their customer connections to provide a small number of physical connections into the Turquoise architecture. Separation of traffic from Network Providers is done with VLANs using 802.1q.

3.2 Connectivity Protocol

Connectivity to the Turquoise Trading System is based on the TCP/IP Protocol Suite. All traffic is TCP and uses IP v.4. No UDP/Multicast traffic is disseminated.

3.3 Interfaces

The Turquoise Trading System supports two interfaces, FIX and EMAPI. EMAPI is a proprietary protocol which is used for both order entry and receiving market data. FIX is only used for order entry.

In order to connect to the EMAPI interface a connection is made to a TAX server. This is done by connecting to a pre-allocated IP address to send the logon request to. Once a successful logon is in place a customer can then perform further activities to subscribe to the data they want and submit orders. Full details on how to logon to the EMAPI interface can be found in the EMAPI Technical Specifications.

Connecting to the FIX interface a connection is made to the FIX servers. The actual logon procedure follows the standard logon approach as defined by FIX Protocol Limited and is detailed in the FIX Technical Specifications.

3.4 Bandwidth Recommendations

Customer bandwidth recommendations have been calculated on the estimated peak volume of orders per second until December 2009. This model assumes a high order to trade ratio, a significant increase in order flow across all the markets supported by Turquoise and a high percentage of this order flow being directed through the Turquoise Trading System.

As longer term projections can be unreliable it is advisable that customers ensure their network provider can provide increased bandwidth from 2010 and potentially prior to this.

Turquoise will constantly monitor bandwidth requirements and advise customers on trends on a basis. However it is the responsibility of the customers to ensure they receive regular updates on their bandwidth utilisation to ensure that they do not become a slow consumer of data.

Market data bandwidth should be calculated on the number of sessions which receive data. Therefore three sessions of market data will require three times the bandwidth.

Customer Bandwidth *Minimum* Recommendations:

Service	Protocol	Trading	Market Data	Bandwidth
Production	EMAPI	Y	Y	10Mbps [^]
Production	EMAPI	Y	N	256kbps [*]
Production	EMAPI	N	Y	10Mbps [^]
Production	FIX	Y	N/A	256kbps [*]
Customer Testing/ Pre Production	EMAPI	Y	Y	1Mbps [~]
Customer Testing/ Pre Production	EMAPI	Y	N	64kbps [~]
Customer Testing/ Pre Production	EMAPI	N	Y	1Mbps [~]
Customer Testing/ Pre Production	FIX	Y	N/A	64kbps [~]

* These figures are based on order entry rates of 50 orders per second.

[^] These figures are based on one market data session subscribing to all data.

[~] Please note that these bandwidths assume high system utilisation. However, Customer Testing/Test systems are not monitored and delays may occur.

3.5 Turquoise Addresses and Ports

In order to connect to the Production, Customer Testing or Test environment customers initially connect to a TAX or FIX servers at either site. The process by which connectivity is achieved is dependent on the protocol being used. This is described in section 3.2: [Interfaces](#)

Customers connect to Turquoise through third party Network Providers. As Network Providers may perform Network Address Translation customers should contact their Network Addresses to confirm the destination Turquoise addresses and ports.

The assigned public registered IP addresses are detailed in section 4.4: [IP Addressing Requirements](#)

All customers are required to have separate addresses to access the test and production environments.

3.6 Connections

Customers can request up to 10 connections per site. Each connection will be allocated a User Id for EMAPI or a SenderCompId for FIX. Each User Id/SenderCompId will only support one connection. Any subsequent connection attempts will be rejected. A connection is required for each session type. The session types are EMAPI Order Entry, EMAPI Market Data, EMAPI Replay and FIX.

3.7 Service Hours

On a trading day connectivity to the Production Turquoise Trading System will be available from 04:00 to 18:00. The Customer Testing environment will mirror production hours but may not be available to customers during internal testing phases. The Beta and Project Test environments will be made available as and when necessary.

3.8 Connectivity Contacts

The following contacts have been provided to Turquoise as Sales contacts for the relevant Network Providers:

Company	Contact	Number	Service Provided	Email
Atrium Network	Russell Williams (UK) Thomas Lanute (Fr)	+44 (0)20 3194 2504 (UK) +33 (0)17842 5662 (Fr)	Layer 3	contact-emea@atriumnetwork.com
BT Radianz	James Barrett	+44 (0)20 7650 9053	Layer 3	james.barratt@bt.com
COLT	Marcus Sheppard	+44 (0)20 7947 1845	Layer 2	Marcus.Sheppard@colt.net
euNetworks	Jan Willem Meijer	+31 6 52 402 109	Layer 2	jan-willem.meijer@eunetworks.com
Fixnetix	Anthony Kingsnorth	+44 (0)20 3008 5080	Layer 3	anthony.kingsnorth@fixnetix.com
Options IT	Richard Kingsley-Smith	+44 (0)20 7070 5010	Layer 3	Richard.Kingsley-Smith@options-it.com
TNS	John Owens	+ 44 (0)20 7264 0820	Layer 3	jowens@tnsi.com
Verizon	Connie Ryan	+ 44 (0)118 905 7044	Layer 3	connie.ryan@verizonbusiness.com

3.9 Hosting

It is possible for customers to co-locate their hardware within either of the Turquoise data centres. This facility is managed and provided by BT who own and manage the data centres. This facility is ordered through BT via the contacts below and is subject to availability. Customers who host within the data centres are subject to exactly the same conditions as other Turquoise customers.

BT Hosting Contact:

Contact	Number	Email
James Barrett	+44 (0)20 7650 9053	james.barratt@bt.com

3.10 Connectivity Testing

In order for customers to assess connectivity Turquoise will support a number of low level tests. These should be used within the constraints detailed below.

3.10.1 Live Connectivity Testing

In order to reduce the risk of connectivity issues on the Production environment Turquoise will provide support for connectivity testing against the Production environment prior to the customers live date. Live connectivity testing is the final stage of end to end testing with Turquoise and it is advisable for customers to check connectivity to the Production environment using the tools below on notification that the customer has been enabled on the Production environment.

TURQUOISE

The Live Connectivity Test can consist of the following actions:

- Logon to the Turquoise Trading System
- Order entry/deletion/amend
- Subscription to market data
- Disconnection and re-logon to the Turquoise Trading System

This will be supported by Technical Account Management who can be contacted at connect@tradeturquoise.com. A Live Connectivity Test will only be supported after market close (16:30). Please note the Live Connectivity Test will only use test instruments on the Production environment. Testing against live instruments is prohibited.

3.10.2 Website

Turquoise provides a website to determine whether connectivity can be established to the core networking infrastructure. The Website is accessible outside of the service hours of the Turquoise Trading System:

Location	BT Radianz URL	Registered URL
GSS	http://192.199.156.252:3000	http://81.92.74.4:3000
Croydon	http://75.124.159.13:3000	http://81.92.74.132:3000

3.10.3 Telnet

Telnet can be used to open a TCP connection to the relevant Address/Port detailed above. A successful connection will usually be clearly indicated by the text “Connected to” followed by the relevant IP Address or a clear screen being presented but this can vary between implementations and environments. Failure of a telnet connection will usually be clearly indicated in a textual response.

3.10.4 Trace Route

Trace Route cannot be used to determine whether access is available into the Turquoise core network. This is due to the Network Address Translation that is required from all network providers. However, trace route may be useful to diagnose routes from a customer’s network onto a third party network.

3.10.5 Ping

Turquoise firewalls will not respond to a ping packet in order to guard against a Denial of Service (DoS) attack. Therefore a ping test is not an appropriate low level test of connectivity to Turquoise.

4. Information for Third Party Connectivity Providers

Clients may connect to the Turquoise systems via a number of third party connectivity providers. Each provider must conform to the minimum requirements detailed below.

4.1 General Requirements for Layer 2 Network Service Providers

The customer must use public registered IP addresses. These addresses will be allocated by the network provider, unless agreed otherwise. All customers are required to have separate addresses to access the test and production environments.

The Provider must connect to each Turquoise firewall (2 for the production environment and 2 for the Customer Testing environment at each data centre) using a switched copper RJ45 100/1000 Mbps Ethernet with auto negotiation turned on.

The connection between the providers' equipment and each Turquoise firewall must support multiple VLANs using 802.1q. The VLAN ids must be agreed with Turquoise.

4.2 General Requirements for Layer 3 Network Service Providers

The Provider must use public registered IP addresses. The provider must ensure that all customer addresses that are visible to Turquoise are also registered. All customers are required to have separate addresses to access the test and production environments.

The Provider must connect to each Turquoise firewall (2 for the production environment and 2 for the Customer Testing environment at each data centre) using a switched copper RJ45 100/1000 Mbps Ethernet with auto negotiation turned on.

4.3 Bandwidth Requirements

The Provider must allocate sufficient bandwidth for customers as detailed in section 2.2: [Production Environment](#). Where a Provider can support prioritization of Production traffic over Customer Testing/Test traffic, shared bandwidth can be implemented. At no point should Customer Testing/Test traffic be given priority over Production traffic.

4.4 IP Addressing Requirements

All external facing Turquoise servers will be assigned public registered IP addresses. If the connectivity provider makes use of Network Address Translation (NAT), then the provider must ensure that their customers are provided with the correctly NATTed destination IP address.

The assigned public registered IP addresses are detailed below. Translated addresses are also included where they have been provided:

TURQUOISE

4.4.1 Production Environment

Location	Protocol	Server Type	Atrium IP Address	BT Radianz IP Address	Registered IP Address	Port
GSS	EMAPI	TAX-OE1	83.151.91.1	192.199.156.249	81.92.74.1	9890
GSS	EMAPI	TAX-OE2	83.151.91.7	75.124.191.147	81.92.74.14	9890
GSS	EMAPI	TAX-OE3	83.151.91.2	192.199.156.250	81.92.74.2	9890
GSS	EMAPI	TAX-OE4	83.151.91.3	192.199.156.251	81.92.74.3	9890
GSS	EMAPI	TAX-OE9	83.151.91.16	75.124.157.123	81.92.74.24	9890
GSS	EMAPI	TAX-OE10	83.151.91.129	75.124.157.125	81.92.74.26	9890
GSS	EMAPI	TAX-MDF1	83.151.91.8	75.124.191.148	81.92.74.15	9890
GSS	EMAPI	TAX-MDF2	83.151.91.9	75.124.191.149	81.92.74.16	9890
GSS	EMAPI	TAX-MDF5	83.151.91.10	75.124.159.162	81.92.74.17	9890
GSS	EMAPI	TAX-MDF6	83.151.91.11	75.124.159.163	81.92.74.18	9890
GSS	EMAPI	TAX-MDF7	83.151.91.12	75.124.159.164	81.92.74.19	9890
GSS	EMAPI	TAX-MDF8	83.151.91.13	75.124.157.254	81.92.74.20	9890
GSS	EMAPI	TAX-REPLAY1	83.151.91.4	192.199.156.252	81.92.74.4	9890
GSS	FIX	FIX-ACTIVE1	83.151.91.14	75.124.159.223	81.92.74.21	~
GSS	FIX	FIX-PASSIVE1	83.151.91.15	75.124.205.1	81.92.74.22	~
Croydon	EMAPI	TAX-OE5	83.151.87.17	75.124.159.10	81.92.74.129	9890
Croydon	EMAPI	TAX-OE6	83.151.87.23	75.124.159.25	81.92.74.135	9890
Croydon	EMAPI	TAX-OE7	83.151.87.18	75.124.159.11	81.92.74.130	9890
Croydon	EMAPI	TAX-OE8	83.151.87.19	75.124.159.12	81.92.74.131	9890
Croydon	EMAPI	TAX-MDF3	83.151.87.24	75.124.159.26	81.92.74.136	9890
Croydon	EMAPI	TAX-MDF4	83.151.87.25	75.124.159.27	81.92.74.137	9890
Croydon	EMAPI	TAX-MDF9	83.151.87.28	75.124.159.35	81.92.74.145	9890
Croydon	EMAPI	TAX-MDF10	83.151.87.29	75.124.159.36	81.92.74.146	9890
Croydon	EMAPI	TAX-MDF11	83.151.87.30	75.124.159.37	81.92.74.147	9890
Croydon	EMAPI	TAX-REPLAY2	83.151.87.20	75.124.159.13	81.92.74.132	9890
Croydon	FIX	FIX-ACTIVE2	83.151.87.26	75.124.159.47	81.92.74.149	~
Croydon	FIX	FIX-PASSIVE2	83.151.87.27	75.124.159.48	81.92.74.150	~

~ Participants connecting to the Turquoise FIX Gateway are allocated individual ports per session

TURQUOISE

4.4.2 Customer Test Environment

Location	Protocol	Server Type	Atrium IP Address	BT Radianz IP Address	Registered IP Address	Port
GSS	EMAPI	TAX-OE1	83.151.90.251	75.124.157.65	81.92.74.69	8880
GSS	EMAPI	TAX-MDF1	83.151.90.252	192.199.156.245	81.92.74.88	8880
GSS	EMAPI	TAX-REPLAY1	83.151.90.250	75.124.157.64	81.92.74.68	8880
GSS	FIX	FIX-ACTIVE	83.151.91.121	75.124.159.217	81.92.74.91	~
GSS	FIX	FIX-PASSIVE	83.151.91.122	75.124.159.219	81.92.74.92	~
Croydon	EMAPI	TAX-OE2	83.151.87.35	75.124.159.9	81.92.74.195	8880
Croydon	EMAPI	TAX-MDF2	83.151.87.33	75.124.159.1	81.92.74.193	8880
Croydon	EMAPI	TAX-REPLAY2	83.151.87.34	75.124.159.8	81.92.74.194	8880

~ Participants connecting to the Turquoise FIX Gateway are allocated individual ports per session

4.5 Delivery Confirmation of Customer Connectivity

When a new customer is connected a notification should be sent to the connect@tradeturquoise.com contact with following information:

- Network Provider primary and secondary contact including name, email address and telephone number
- Customer primary and secondary contact including name, email address and telephone number
- Technical Details:
 - Customer IP Source Address/Addresses
 - The target Turquoise environment (i.e. Production / Customer Test) for each address
 - For Layer-2 clients:
 - the appropriate VLAN numbers
 - the allocation of function to each of the allocated IP addresses

Once the delivery notification has been confirmed Turquoise Technical Account Management will arrange for the activation of the service including the appropriate firewall changes.

4.6 Reporting of Third Party Circuit Service Availability

The third party circuit provider must whenever possible provide the following information:

- Monthly Capacity Reports for customers circuits.
- Monthly Availability Reports for customers circuits.

All monthly reports should be sent to connect@tradeturquoise.com

The following e-mail notification alerts should be available:

- E-mail alert when utilisation exceeds a pre-defined threshold customers.
- E-mail alerts for dropped/discarded packages customers.

All notification should be sent to connect@tradeturquoise.com

For all other operational queries the Network Provider should call Turquoise Technical Account Management on +44 (0)20 7382 7699 between the hours of 07:15 and 17:45.

4.7 Fault Reporting Procedures

If a customer is experiencing a problem with the Turquoise environment, they should contact Market Operations on +44 (0)20 7382 7676 or at market.operations@tradeturquoise.com between the hours of 07:15 and 17:45. Market Operations will manage the issue up to the point it is determined that the fault is outside of the Turquoise environment. At this point the customer will be advised to contact their Network Provider if appropriate.

If a customer contacts their Network Provider with an issue that is deemed as a Turquoise application related issue the Network Provider should advise the customer to contact Turquoise Market Operations.

4.8 Procedure on Resolution of an Issue

Whenever possible the Network Provider will confirm that a fault on a customer's communications has been resolved by copying market.operations@tradeturquoise.com on any Turquoise related faults.

4.9 Escalation

Should Turquoise confirm that a problem exists with a customer's network; Market Operations will advise effected participants to report the fault to their Network Provider.

The Network Provider must provide three contacts for escalation of issues. This list must be sent to connect@tradeturquoise.com.