SECURITIES INDUSTRY AUTOMATION CORPORATION

National Market Systems

Common IP Multicast Distribution Network

Recipient Interface Specification

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1.2	3/13/97	ML		Initial Release
1.3	11/24/97	ML	18	Typo, naming conformance issue
1.4	12/15/1998	RL	All	Remove references to Bisync and make document present tense with respect to the NMS network; Remove appendix on required bandwidth
1.5	12/03/99	MC	1, 19	Added references for retransmission and playback data, and IP Group assignments
1.9	3/23/00	RL	All	Clean up and Reorganize document. Removed section on logical lines because it served no purpose Added more information on multicast protocols Remove references to Frame Relay support New IP source addresses for RAPs and MPR boxes added as an appendix
1.10	6/16/00	RL	Appendix C	Added new RAPS IPs for 2 new hosts: RAPSOPRA3 and RAPSOPRA4
1.11	10/5/00	RL	All (major)	Add time beacon specifications; add new CTS and CQS group numbers
1.12	10/18/00	RL	All (minor)	Incorporate review comments, fix page numbers
1.13	7/11/01	RL	Appendix C Appendix C.2	Added Appendix C.2. Added text to Appendix C.
1.14	11/15/01	RL	Entire document	Updates to reflect interface types available on a per service basis. T3 connectivity no longer available to new connections or upgrades.

REVISION LOG

Version	Date	Rev by	Pages affected	Comments
1.15	12/04/01	RL	Appendices C and C.2	New OPRA addresses are in production and therefore deleted Appendix C. Changed name of Appendix C.2 to C.
1.16	08/28/02	RL, CE	All	Removed Legacy Options
1.17 1.18				Internal draft update, not distributed
1.19	12/17/02	RL, CE		Include BBO info
1.20	1/03/03	RL		Correct Typo in Appendix A
1.21	3/06/03	RL, CE		Updated IP addresses for Multicast playback and retransmissions.
1.22	8/19/03	RL, CE		Removed non-BBO lines.
1.23	1/12/04	RL, CE		Transitioned to SFTI interconnection. Deleted Appendix B, renamed appendix C as B, and Appendix D as C.
1.24	1/20/05	LG	Appendix B; Throughout Document	Update of all source addresses. Removed reference to Site A and Site C. Replaced with Group A and Group B.
1.25	2/15/05	LG	Appendix B	Additional source addresses added; source addresses identified by A & B Streams.
1.26	11/02/05	MCP	Pages 1,3,4,6,7, 13 & 14 Appendix A & B	Page: 1, 4: Revised OPRA lines 1-9 to 'FCO 1' and OPRA 1-24 Page 3,4,6 & 7: Revised multicast totals Page 7, 13, &16: Added new address ranges Appendix A: Added new OPRA MCL addresses. Appendix B: Added two new source addresses.
1.27	10/10/06	MCP	Appendix B (Page 17)	Page 17 – Added new CTS/CQS source addresses - Deleted OPRA 8 Line network Addresses
1.28	12/13/06	MCP	Appendix B	Removed duplicate source IP's from CTS/CQS Production A & B stream as well as updated Time Beacon A & B stream

REVISION LOG

Version	Date	Rev by	Pages affected	Comments
1.29	2/27/07	MCP	4.2 & Appendix A	Added OPRA FAST Multicast Addresses
1.30	1/23/08	LG	4.2 & Appendix A	Added OPRA FAST for Symbology Multicast Addresses (Reused ASCII)
1.31	11/24/08	LP	- Entire Document - Appendix A - Appendix B	-Eliminated FCO References -Renamed OPRA FAST Multicast Addresses to spare OPRA addresses -Added CTS/CQS Production, and Time Beacon Source IP Addresses (reassigned CTS, CQS, and OPRA Playback Source IPs)
1.32	2/23/09	LP	Appendix A, and Pgs: 8, 10, 12, 14,	Addition of new CTS/CQS Production, Retransmission and Playback Test Data Multicast Addresses/Ports
1.33	2/27/09	LP	Appendix A, and Pgs: 8, 9, 10, 12, 14,	-Revision of new CTS/CQS Production, Retransmission and Playback Test Data Multicast Addresses/Ports
1.34	2/18/10	WG	Table of Contents update Appendix B (pages 29 – 38) Appendix C (pages 39 – 52) Appendix D (page 53)	-Addition of new CTS/CQS/OPRA/Time Beacon Production Source IP Addresses -Addition of CTS/CQS/OPRA After Hours Playback Source IP Addresses -Addition of Production Retransmission and After Hours Playback Test Source IP Addresses - Relabeled as “Current” Source Addresses on the page header - Appendix C, relabeled as “Future” Source Addresses on page header - Created new Appendix D
1.35	6/1/10	MC	Appendix C : pages 39-40	- Corrected typos in Source addresses
1.36	8/19/10	MCP	Pages : Appendix ‘A’ (23 & 27) Pages : 8,10 & 11 IP Source Addresses	- Added OPRA 25-48 HSL’s - Revised OPRA “1-24” to 1-48” Appendix ‘B’ and Appendix C’ updated to Appendix ‘B’ = Primary Site and ‘C’ for Disaster Recovery IP Source Addresses

Version	Date	Rev by	Pages affected	Comments
1.37	11/28/11	WG	Table of Contents Appendix B (pages 30 – 36) Appendix C (pages 39 – 41)	-Adjustment of page numbers -Addition of new Subnet ".53/.54" for CTS/CQS/OPRA/Time Beacon Production Source IP Addresses -Addition of new Subnet ".53/.54" for CTS/CQS/OPRA After Hours Playback and Retransmission Source IP Addresses
1.38	8/20/12	MCP	Table of Contents Page 15, 21, 24 Page 30	-Adjustment of page numbers -Addition of two Equity / Index Production test multicast lines (binary 3 and 4 to support binary output format over production) -Addition of a 48 line temporary dual network test group assignments (48-A Stream, 48-B stream) -Removed all references to SPARE addresses
1.39	6/18/13	MC	Page 28	-Addition of two Equity / Index Retransmission test multicast lines (binary 3 and 4 to support binary output format over production)
1.40	6/25/14	MCP	Page 9, 11, 12, 15, 21, 25 and 29	-addition of Extended Session
1.41	1/27/15	LP	Page 23, 27	-Removed Network A Index references (Indices Disseminated over Network B)
1.42	5/4/15	WG	Page 45 thru 49 Page 50 thru 54 Page 35 Page 36	- Added Appendix E - New Primary Data Center Source Addresses - Added Appendix E - New Disaster Recovery (Backup) Data Center Source Addresses - Removed decommissioned source addresses on network for subnets ".41 and .61". - Removed decommissioned source addresses on network for subnets ".42 and .62".
1.43	2/21/17	WG	Pages 15, 21, 23, 24, 29 and 31 Pages 23 thru 28 & 30 thru 33 Pages 27 and 28 Pages 33 thru 46 Pages 49 thru 58	-Added dedicated binary parallel multicast addresses -Added to Multicast Addresses the reference page of Source Addresses -Added CQS and CTS Temporary Dual Network Test Group Assignments -Strike through applied to IP Addresses being decommissioned -Added to Appendix E (Source Addresses) the reference page for Multicast Addresses

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1 Overview

This document provides the interface specifications for customers connecting to the National Market Systems (NMS) distribution network. This includes recipients of the Consolidated Tape System (CTS), Consolidated Quotation System (CQS), and the Options Price Reporting Authority (OPRA) real-time production data. Recipients should also use this specification for information related to receiving NMS real-time data retransmission, NMS after-hours playback data, and Time Beacon messages. The NMS distribution network disseminates all market data and Time Beacon information in the form of multicast addressed IP datagrams.

With respect to physical network connectivity, all data distributed by the NMS systems requires recipients to connect via the Secure Financial Transaction Infrastructure (SFTI). Recipients may connect directly to the physical edge of SFTI, or receive data via a third party value added service provider. For those choosing to connect directly to SFTI, a separate SFTI interface specification, "SFTI Network Interface Specification for directly connected Customers" should be referenced. For more information on the SFTI network and the services available via SFTI, please visit the SFTI website http://nyse.com/technologies, email a SFTI Customer Support representative at Support-SFTI-Technologies@nyx.com, or call 1-866-873-7422.

1.1 Data Available via the NMS Network

There are several access points to which to connect and receive NMS data via SFTI. Directly connected recipients can coordinate with SIAC and choose which multicast groups they wish to receive via each of the SFTI connectivity points.

NMS Real-Time Production Data
Two copies (Group A and Group B) of each NMS real-time production message are available. These redundant copies are delivered via two distinct multicast data streams. For each unique NMS line (**CTS Network A lines 1-12, CTS Network B lines 1-12, CTS Index lines 1-2, CQS Network E lines 1-12, CQS Network F lines 1-12, OPRA lines 1-48 (Regular Session) and OPRA lines 91-94 (Extended Session**) there are two redundant multicast data streams. SIAC refers to these streams as the 'A' and 'B' streams. The 'A' stream is available from Group A and the 'B' stream from Group B. See Appendix A for the table of multicast group mappings. Therefore there will be 204 unique multicast groups allocated for the redundant delivery of these 102 lines (102 * 2 = 204).

NMS Real-Time Data Retransmission Data
The retransmission data streams are available via SFTI access points, but are **not delivered via redundant data streams**. The recipient may choose to receive the retransmission data from either or both sites. See Appendix A for the table of multicast group mappings.

NMS After-Hours Playback Data
Playback data is available in two 'flavors':

- There is a set of Multicast data feeds dedicated for after-hours playback test data. This playback data is made available via a single set of multicast data streams. See Appendix A for the table of multicast group mappings.
- In addition to the playback test data groups, SIAC will continue to provide dual-sited redundant after-hours playback via the production system expressly for the purposes of redundancy testing.

NMS Network Time Beacon
Each application that sources multicast data within the NMS network can generate a single Time Beacon packet once a minute. Each source will issue Time Beacon packets to the same multicast group. See Appendix A for the table of multicast group mappings.

Recipients may subscribe to these packets and use the enclosed time stamp for several functions including:

- Verifying the ability to subscribe to and receive multicast data sourced within the NMS network. The Time Beacon is available 24 hours a day, 7 days a week, except during occasional scheduled off-hours maintenance periods. These time packets therefore can serve as a "heartbeat" message for indication that the multicast routing protocols are functioning and that the systems are available.

- Verifying the ability to receive multicast data from ten NMS multicast source systems.

- Synchronize to a time source accurate to within 1 second of the Global Positioning System (GPS).

The GPS is a U.S. Department of Defense developed, worldwide, satellite-based radio-navigation system. This system provides time transfer to Coordinated Universal Time (UTC) and is distributed to the NMS systems via redundant Network Time Protocol (NTP) servers. The NTP servers are connected directly to GPS based time clocks located at SIAC. These clocks receive GPS data via directly connected satellite dishes.

Bandwidth Requirements

Bandwidth requirements change with time and recipients are encouraged to contact the SFTI Help Desk and/or NMS Planning representatives regarding bandwidth requirements of each of the NMS services. For more information on the SFTI network and the services available via SFTI, please visit the SFTI website at http://nyse.com/technologies, email a SFTI Customer Support representative at Support-SFTI-Technologies@nyx.com, or call 1-866-873-7422.

Recipients should connect to NMS via SFTI, via at least two access points in order to make full use of the resiliency of SFTI and the redundant data feeds available for each service. Recipients not connecting directly should consult with their value added service provider regarding connectivity options.

Additional considerations for all recipients:
In total, the ten Time Beacon sources contribute a relatively insignificant data rate requirement; (approximately 720Bytes/minute or <100bits/sec).

Message Formats

For details of the message formats utilized by the CTS, CQS, and OPRA systems, please reference the following:

- CTS: CTS, Consolidated Tape System, Output Multicast Line, Interface Specification (www.nyxdata.com)

- CQS: CQS, Consolidated Quotation System, Output Multicast Line, Interface Specification (www.nyxdata.com)

- OPRA: OPRA, Options Price Reporting Authority, Data Recipient Interface Specification (www.opradata.com)

Please note that the message format of retransmission and playback data is also governed by the documents listed above.

The remainder of this specification addresses the communications interfacing requirements for all data types and also includes the message formats for the Time Beacon in Appendix D.

1.2 Multicast Primer

In a nutshell, Multicast is a form of subscription based IP broadcasting. In a traditional broadcasting environment, data is sent out on all links to all LANs (or sub-networks). In contrast, IP Multicasting provides a method for selective delivery of the data via a subscription-based protocol known as the Internet Group Management Protocol (IGMP). The local end-stations (e.g. application hosts) are typically responsible for issuing IGMP requests that are processed by the host's local intermediate-stations (e.g. routers/switches). In response to these IGMP requests a multicast capable network need only deliver the multicast data to those portions of the network that lay in the path between the subscribing host and the original source of the data.

Subscriptions are based on the target multicast group ID (which is synonymous with multicast address and multicast host group). The NMS distribution network **currently utilizes**:

- 204 Multicast Group ID's for Production data streams for day-time dissemination
  - 204 Multicast Group breakdown = 2 sets of 102 redundant data streams:
    CTS Network A lines 1-12, CTS Network B lines 1-12, CTS Index lines 1-2, CQS Network E lines 1-12, CQS Network F lines 1-12, OPRA lines 1-48 Regular Session (26+24+48 = 98) and OPRA lines 91-94 Extended Session (98+4=102)
- 102 Multicast Group ID's for Production retransmission streams for day-time dissemination (1 set of data streams)
- 102 Multicast Group ID's for After-Hours Playback test data streams for after-hours support (1 set of data streams)
- 2 Multicast Group ID's for Time Beacon messages

Those unfamiliar with multicast technology are encouraged to reference RFC 1075 -The Protocol Independent Multicast-Sparse Mode (PIM-SM)), and RFC 2117 and RFC 2362 - Host Extensions for IP Multicasting (which includes the Internet Group Management Protocol (IGMP)). Also of notable assistance is the text titled "TCP/IP Illustrated, Volume I" by Richard M. Stevens which provides several sections detailing multicast protocols and IGMP.

Recipients are strongly recommended to consult the SFTI interface specification, which provides additional information and considerations for receiving multicast services via SFTI.

2 NMS Data Types

The NMS network distributes data via the multicast addressing and delivery protocols. Each of the three systems (CTS, CQS, and OPRA) has a unique set of multicast addresses assigned to each of its data "lines". In each case there are redundant data streams provided for daytime production delivery of each line. The data lines for the three systems include CTS Network A lines 1-12, CTS Network B lines 1-12, CTS Index lines 1-2, CQS Network E lines 1-12, CQS Network F lines 1-12 and OPRA lines 1-48 (Regular Session) and OPRA lines 91-94 (Extended Session). Therefore there will be 204 unique multicast groups allocated for the redundant delivery of these 102 lines (102 * 2 = 204).

Each system line has a single retransmission multicast address assigned to it. Entitled recipients have the option of subscribing to any retransmission line as needed.

There are additional multicast group ID's allocated for supporting after-hours playback of the NMS data. Note that after-hours playback can also utilize the aforementioned production multicast groups.

There are 2 additional multicast group ID's used for distributing the Time Beacon messages.

In all cases, recipients will only be permitted to receive data to which they are entitled. Note that all recipients are able to receive the Time Beacon messages.

Appendix A provides tables listing of all multicast group ID's. The tables also include a listing of the UDP destination port numbers assigned to each data stream. The NMS distribution system utilizes the UDP protocol at the IP transport layer. In order to provide the recipient community with the highest level of flexibility, the NMS systems have assigned a unique UDP destination port number to each multicast data stream. Note that the real-time redundant data streams use unique multicast addresses at the IP layer and unique UDP destination port numbers at the transport layer.

Recipient application software may make use of the UDP port mappings in order to multiplex between each of the datastreams. Typically, applications use a "socket" programming interface which provides the means for requesting data on a per UDP port basis. If a port is not specified the application host's operating system might pass all IP broadcast data (including all multicast data) to a single process if the application has not specifically requested data on a per port basis. Please consult your application host's programming and system documentation for information particular to your environment.

3 Application Considerations

This section defines the application data framing and some of the key aspects of the IP distribution environment.

3.1 Application Encapsulation

In the IP environment the NMS application messages are also encapsulated in blocks, which in turn are encapsulated in an Ethernet frame as given in Figure 1 IP Data Block Format.

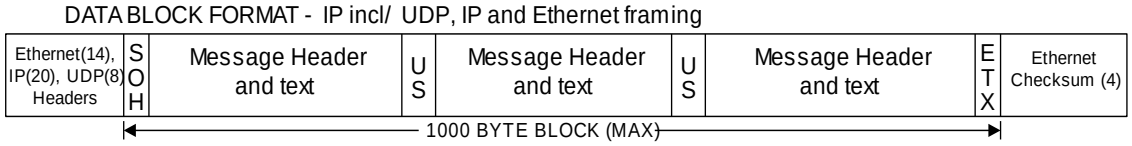
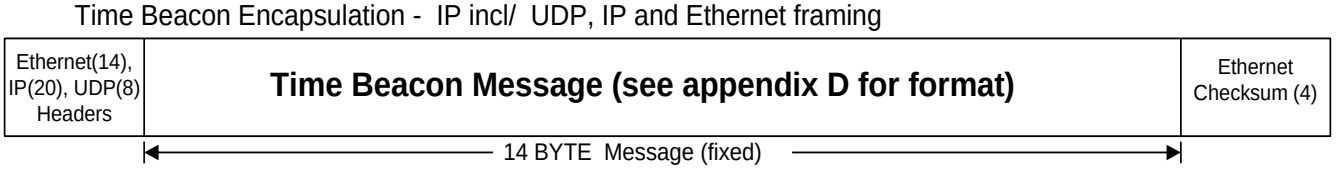


Figure 1 IP Data Block Format

There are actually several levels of encapsulation that occur within the Ethernet frame. The NMS data block, (which can be a maximum of 1000 bytes), is encapsulated within a UDP datagram, which in turn is encapsulated within an IP datagram which itself is encapsulated within an Ethernet frame. Each number shown in parentheses, e.g., IP (20) refers to the size of the particular header in bytes.

3.1.1 Time Beacon Message Encapsulation

The Time Beacon message encapsulation is illustrated below. Note that the message format for the Time Beacon is included in Appendix D of this document.



3.2 End to End Data Integrity

Integrity checking, on a per packet basis, is available via a checksum value in both the UDP header (Figure 2 UDP/IP Datagram Format) and the Ethernet frame check sequence.

In general, the Ethernet frame checksum validation is performed by the host's interface firmware and the IP checksum validation is performed within the TCP/IP stack and not by the application software.

Unlike TCP/IP based application services, the UDP/IP protocol has no "built-in" automatic retransmission functionality and therefore recipient host applications must examine the sequence numbers embedded within each NMS message on a per line basis in order to determine whether any data has been missed.

3.3 Line Concept

The term "line" refers to a specific logical data stream identified by the value pair formed by a unique IP multicast destination address and unique UDP destination port number.

Note that the following terms are all analogous to each other:

- multicast group
- multicast group ID
- multicast host group
- multicast host group ID
- multicast destination address

The NMS network currently utilizes 296 unique multicast group ID's for the purposes of providing NMS data to the recipient community. Each multicast group ID also has a UDP destination port number assigned to it, therefore each line of NMS data is uniquely identifiable by the value pair formed by its multicast group and UDP destination port number pair.

Appendix A provides the exact mappings of each line to its identifier pair. Reference section 1.2 Multicast Primer for a list summarizing the multicast groups.

The concept of "lines" does not apply to the Time Beacon. Each system in the NMS network that sources multicast also sources a single Time Beacon message once a minute. Currently, there are ten such systems and these messages will be staggered to result in approximately one Time Beacon message every 6 seconds. Five of these messages will be destined to one multicast group ID, and five to one other.

4 Network Layer Connectivity

4.1 IP Multicasting – Primer Part II

The Internet Protocol suite, referred to as IP, defines a data encapsulation method that allows data to traverse multiple networks through intermediate network devices known as routers.

4.1.1 Unicast IP Routing

Typically, IP packets are issued from a source host with a single destination host as the target. This type of addressing is usually referred to as "unicast addressing". Unicast addressed packets are routed by intermediate-stations (i.e. routers) based on the destination network number associated with the destination IP address listed in the IP header portion of the packet. The intermediate-station compares the destination with its local IP routing table and forwards the packet to the appropriate next hop device (router) or to a local host if the router is local to the destination network.

4.1.2 Multicast IP Routing

In contrast, IP multicasting uses a special class of IP addresses that are used to represent a "host group". These addresses are referred to as Class D and fall in the range of 224.0.0.0 to 239.255.255.255.

The host group ID is both an actual number and a concept. It can refer to the actual Class D IP address that is placed in the IP header's destination address field of the IP multicast packet. It also refers to the protocol's concept of a host group. A host group represents all end-stations, (or hosts), that have specifically subscribed to the multicast host group ID. The subscription functionality and the multicast routing protocols provide the underpinnings that enable a single multicast addressed packet to be delivered to all LANs connected to at least one host that has subscribed to the host group in question.

Each multicast packet sourced by an originating host is forwarded by the local intermediate-stations supporting the multicast routing protocols. Intermediate-stations replicate and forward the multicast packets out each of its interfaces that meet one of the following two criteria:

1. The interface is directly connected to a LAN where a member of the host group is attached
2. The interface connects to, either directly or via a shared LAN, to any neighboring routers that lies in the path between a subscribing host and the host that originally sourced the multicast packet

Reference section 1.2 Multicast Primer for a list summarizing the multicast groups detailing the total host groups available currently and future expansion of multicast groups.

4.2 Multicast Addressing

Multicast addresses are known as Class D IP addresses and range from 224.0.0.0 to 239.255.255.255 (using standard IP address notation). The addresses in the range of 224.0.0.0-224.0.0.255 are reserved for local multicast and are non-routable.

The NMS network uses the following ranges, which are presented in further detail in Appendix A. Note that not all these addresses are in use.

224.0.2.192 – 224.0.2.255
224.0.5.128 – 224.0.5.159
224.0.5.176 – 224.0.5.191
224.0.5.240 – 224.0.5.255
233.43.202.1 – 233.43.202.24
233.43.202.33 – 233.43.202.56
233.43.202.65 – 233.43.202.88
233.43.202.97 – 233.43.202.120
233.43.202.128 – 233.43.202.152
233.43.202.160 – 233.43.202.184
233.43.202.192 – 233.43.202.216
233.43.202.224 – 233.43.202.248
224.0.86.0-224.0.86.135

233.200.79.0 – 233.200.79.255

Dedicated for binary parallel verification

- 233.200.79.12
- 233.200.79.28
- 233.200.79.140
- 233.200.79.156
- 233.200.79.157
- 233.200.79.44
- 233.200.79.60
- 233.200.79.76
- 233.200.79.92
- 233.200.79.172
- 233.200.79.188
- 233.200.79.189
- 233.200.79.204
- 233.200.79.220
- 233.200.79.221

4.3 UDP/IP Framing

The application data is encapsulated in an UDP/IP frame as shown in Figure 2 UDP/IP Datagram Format. The IP datagram includes the IP and UDP headers plus the application data. The datagram fields can be read left to right starting at the top and working your way down through the datagram. The size of each field (excluding the UDP data field) is represented in bits across the top and bytes going down. Bits are transmitted across the link starting with bit 0,1,2 and so forth. This is called the "big endian" representation where the most significant bits are transmitted first.

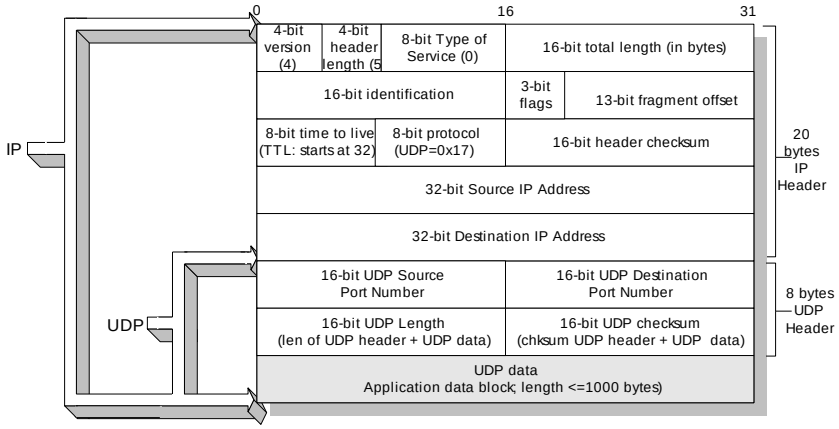


Figure 2 UDP/IP Datagram Format

4.3.1 IP Header Field Descriptions

- **Version** - This is a 4 bit field which defines the current version of the IP protocol. It is currently set to 4.
- **Header Length** - This 4 bit field contains the number of 32 bit words in the IP header portion of the datagram. For all multicast packets being generated by this network the IP header will be 20 bytes long, which means this field will contain the value 5.
- **Type of Service** - The first 3 bits are the precedence sub field and are ignored by most network equipment. The next four bits are flags that define minimize delay, maximize throughput, maximize reliability, and minimize monetary cost respectfully. They are set to zero (0) for this application. The last bit is always set to zero. Based on this description this field will always have the value of zero (0) for all multicast packets.
- **Total Length Field** - This 16 bit field contains the length in bytes of the entire IP datagram. This includes the IP and UDP header plus the application data (UDP data). Since the maximum size of the application data is 1000 bytes, the maximum value for this field is 1028.
- **Identification Field** - This 16 bit field contains a value that is incremented by one for each packet sent by the source system . It only has relevance on the receiving system when packets are either fragmented and/or TCP is used as the transport protocol. IP multicast packets use UDP and will not be fragmented by the multicast distribution network.
- **Flags and Fragment Offset** - The combined 16 bit field is only used when an IP datagram is fragmented. The multicast distribution network will not be fragmenting the data packets.

4.3.1 IP Header Field Descriptions (continued)

- **Time to Live (TTL)** - This 8 bit field contains a value that determines the number of routers that this datagram can pass through. Each router that forwards this datagram will decrement this value by one; when it reaches zero the next router throws it away. It is initially set to 32 by the multicast source systems.
- **Protocol** - This 8 bit field contains a value representing the next level encapsulated protocol. In this case it is UDP, which has a value of 0x17, which is 23 decimal.
- **Header Checksum** - This 16 bit field contains a checksum made up of the IP header fields only. The calculation is based on the ones complement sum of the header broken into 16 bit words.
- **IP Source Address** - This 32 bit field contains the IP address of the multicast datagram source system.
- **IP Destination Address** - This 32 bit field contains the IP Multicast Group address designated for this "line" (*see section 3.3)* of data packets. For the mapping of IP multicast group addresses to data lines please consult Appendix A of this document.

4.3.2 UDP Header Field Descriptions

- **UDP Source Port Number** - This 16 bit field identifies the sending process within the multicast source system. It is set by the source system.
- **UDP Destination Port Number** - This 16 bit field identifies the UDP process that should receive this datagram in the recipients receiving system. It will be uniquely set by the multicast source system based on the "line" of data being encapsulated within the packet. For the mapping of UDP port numbers to data lines please consult Appendix A.
- **UDP Length** - This 16 bit field contains the length in bytes of the UDP header plus the application data (UDP data). Its maximum value is 1008.
- **UDP Checksum** - This 16 bit field contains a checksum made up of the UDP header plus the application data (UDP data). In addition it also includes a UDP "pseudo" header, which is made up of selected fields from the IP header (IP Source Address, IP Destination Address, Protocol and UDP Length). The calculation is based on the one's complement sum of the datagram broken into 16 bit words.

4.4 Multicast Address Use

The multicast group addresses used by SIAC for the dissemination of application data on this network have been registered with the Internet Assigned Numbering Authority (IANA). No recipient will be allowed to connect to the NMS distribution network if it is found that they are using any of these addresses for their own use.

For a list of these addresses please view http://www.iana.org/assignments/multicast-addresses**.**

4.4.1 IGMP

Internet Group Management Protocol (IGMP) is a protocol that end systems use to communicate with multicast compliant routers and is defined in RFC 1112. Recipient host systems that wish to subscribe to multicast groups must be fully compliant with this RFC.

4.4.2 Subscription Control

In order to receive the multicast packets, applications running on recipient end-stations issue IGMP subscription (or "join group") packets on their locally attached LANs. The local router (which must also be multicast compliant) adds the multicast group to its registration table and begins to forward all packets destined to that group onto the LAN.

Recipients have the option of subscribing to any combination of multicast groups but as mentioned previously, SIAC will allow recipients to receive only those groups to which they have been entitled.

4.4.3 How Multicast Delivery is Implemented via SFTI

As explained in detail by the SFTI interface specification, the SFTI architecture includes providing access to the NMS services via the use of the 802.1Q protocol, which provides for the definition of logically separate virtual LANs, or VLANs. In SFTI there is a single VLAN configured for transporting the aggregate multicast traffic.

In order to facilitate the delivery of Multicast data, SFTI must employ the use of a multicast routing protocol. SFTI uses Protocol Independent Multicast (PIM) to accomplish this task.

As the SFTI specification describes, customers will have two methods for receiving multicast data from SFTI. That specification refers specifically to the configuration of the customer router port connected to SFTI. Customers can implement any network solution they wish beyond that interface. Beyond the SFTI demarcation point, SIAC places no restrictions on the manner in which a customer designs its networks to support multicast reception. This is true from both from a protocol and physical topology perspectives. Customers are responsible for implementing a working design that best suits their environments.

The following applies to customers connecting directly to SFTI, and though it may also apply to customers connecting via a third party value added service provider, customers must consult with that entity with respect to specifications for receiving multicast data because their service offerings may deviate from the following.

Method I: For Customer routers supporting PIM Sparse-Dense Mode

- Configure PIM Sparse-Dense Mode on the router that connects to SFTI.
- Use "auto-RP" to learn the SFTI RP addresses and multicast group mappings.
- Configure RIP2 in listen mode to learn the routing information for the multicast source networks and the routes to the PIM RP's.

Method II: For Customer routers unable to support PIM Sparse-Dense Mode

- Customers can use PIM Sparse or Dense mode.
- SIAC, upon the request of the customer, will define IGMP static joins on the SFTI edge router connected to the customer. This will result in statically forward all entitled multicast groups to the customer edge router.
- Customer routers learn multicast source routes by listening to RIP2.
- Customers can implement whatever solutions they require on their edge router in order to correctly forward the multicast data into their networks. Typically, router vendors provide the option of importing the multicast data at the edge into their routing trees using the routing information learned via RIP2. Some customers might implement "multicast proxies", which presumably would translate the header information of the multicast datagrams into unicast UDP destined to one or more end-stations within the customer network. As is the case with everything described within this specification, customers must check with their chosen vendor for protocol support and recommended solutions.

4.4.3.1 Multicast Entitlement Control

Multicast entitlement will be enforced at the SFTI Edge Routers by application of PIM join filters on the logical interface (and VLAN) connected to each individual Customer. The use of filters allows for the control of transmission/reception of multicast groups. Different customers will have different definitions based on their service entitlements. For those customers where SIAC has defined static IGMP joins on the SFTI edge, SIAC will by definition use the static joins to control entitlement.

Ingress traffic filters on the Edge Router logical interfaces (VLAN) supporting multicast will silently discard any incoming packets except those used by the multicast (PIM Sparse-dense mode) or unicast routing protocols. These filters will also be used to protect SFTI from any customer-originated multicast traffic.

SIAC can reconfigure these filters dynamically to allow for timely re-provisioning of entitlements.

4.4.4 Multicast Data Retransmission

Some of the multicast services offered via the various SIAC Financial Services Networks (FSNs) provide an inband retransmission request mechanism via unicast UDP based applications. These types of transmissions will not be supported via the same logical interfaces on which the Customer is receiving the multicast data. Unicast based retransmission requests will be routed handled by the unicast VLAN logical interface for the particular FSN involved. For example, CAP retransmission requests for multicast services will be handled by the CAP unicast VLAN, not by the multicast VLAN. This traffic will be transported through SFTI in the same manner as other unicast traffic to the particular destination FSN.

Inband retransmissions are not currently offered via the NMS Distribution Network, but plans are in place to provide this service in the future.

4.4.5 Availability of Multicast Services

Customers will receive a list of the multicast source networks, multicast destination group addresses, and all other relevant information from SFTI Customer Service once the customer becomes a licensed subscriber.

The multicast group addresses used by SIAC for the dissemination of application data on this network have been registered with the Internet Assigned Numbering Authority (IANA).

4.4.6 Multicast Transport Protocol

SFTI IP multicast datagrams will use the connectionless UDP protocol at the transport layer.

4.5 Logical Groups Mappings versus Physical Access Points

In order to provide a resilient/redundant distribution environment for the recipient, the recipient is provided with the ability to connect to SFTI at several geographically diverse access centers. There are seven operation access centers, including five in the New York Metro area, and two in Chicago, IL.

As mentioned previously, each NMS message is provided via redundant data streams for the purpose of allowing recipients to leverage the redundancy of SIAC's data centers. Each multicast group is available via any and all of the SFTI access centers.

4.6 Data Entitlement

For a recipient host system to receive a particular data stream it must subscribe to the data stream's corresponding multicast group ID via IGMP. Appendix A lists all multicast group ID assignments.

In order to restrict a recipient from subscribing to data streams that they are not entitled to, outbound packet filters are employed on SIAC's distribution routers interfaces connecting to the recipients. These filters block data from being sent to non-entitled recipients on a per service basis (CTS, CQS, and OPRA).

4.7 IP Addressing Considerations

Please consult the SFTI interface specification for details.

4.8 Recipient Security

SIAC protects its network and hosts using several methods. Traffic filters and routing policies prevent sharing of information and data between entities connected to the SFTI network. Additional measures are in place as well, however these security measures maintain the integrity of SIAC's distribution environment by protecting SIAC's network and hosts from intentional or accidental access from within a recipient network.

These measures are in no way intended to provide the same level of security to the recipients themselves. If a recipient believes that additional security is required to protect their network they are encouraged to take action to implement additional security measures.

For the purposes of aiding in the implementation of security measures (e.g. traffic filters), the source IP addresses associated with the NMS systems have been provided in Appendix B.

5 Physical, Media Layer, and Network Connectivity

Please consult the SFTI interface specification.

6 Appendix A - NMS IP Multicast Addresses

This appendix contains the mapping of IP multicast group ID's (addresses) to the currently available data lines. To receive a particular data stream the recipient host system would typically subscribe to that particular multicast group ID. Two multicast group ID's are available for each real-time production data line. The data originating from Group A is generally referred to as the 'A' streams and the data from Group B as the 'B' streams. Also provided in the table are the UDP destination ports associated with each logical line.

The NMS data messages are encapsulated in an identical manner in both streams. For example, a datagram issued Group A on OPRA Line 2 destined to multicast group 233.43.202.2 will have a corresponding datagram (containing the identical UDP data payload, i.e. same NMS messages and same sequence number range) sourced from Group B destined to multicast group 233.43.202.34

Multicast Address Ranges: **(All below IP address ranges fall within the /24 mask bit and 255.255.255.0 netmask)**

NMS Production IP Multicast Feeds Group A:
224.0.2.192-224.0.2.207
224.0.2.224-224.0.2.239
224.0.86.0-224.0.86.7
233.43.202.1 – 233.43.202.24
233.43.202.128 – 233.43.202.152
233.200.79.0 – 233.200.79.31
Dedicated for binary parallel verification

- 233.200.79.12
- 233.200.79.28

233.200.79.128-233.200.79.159
Dedicated for binary parallel verification

- 233.200.79.140
- 233.200.79.156
- 233.200.79.157

NMS Production IP Multicast Feeds Group B:
224.0.2.208 - 224.0.2.223
224.0.2.240 - 224.0.2.255
224.0.86.128 – 224.0.86.135
233.43.202.33 – 233.43.202.56
233.43.202.160 - 233.43.202.184
233.200.79.32 – 233.200.79.63
Dedicated for binary parallel verification

- 233.200.79.44
- 233.200.79.60

233.200.79.160 – 233.200.79.191
Dedicated for binary parallel verification

- 233.200.79.172
- 233.200.79.188
- 233.200.79.189

Production, Real-Time IP Multicast Feeds, Dual Sets

Production Group A Assignments			Production Group B Assignments		
Stream A Originated Data Lines	Multicast Group ID	Destination UDP Port Number	Stream B Originated Data Lines	Multicast Group ID	Destination UDP Port Number
TIME BEACON	224.0.2.201	53558	TIME BEACON	224.0.2.217	53559

Note: The CQS, CTS and OPRA Source Addresses which are utilized for Time Beacon dissemination can be found on page 49 thru 51 (Primary Data Center) and page 54 thru 56 (Disaster Recovery Data Center).

CQS Production, Real-Time IP Multicast Feeds, Dual Sets (CQS Network 'E' / Network 'F")

Production Group A Assignments			Production Group B Assignments		
Stream A Originated Data Lines	Multicast Group ID	Destination UDP Port Number	Stream B Originated Data Lines	Multicast Group ID	Destination UDP Port Number
CQS 1/Network E	233.200.79.0	61000	CQS 1/Network E	233.200.79.32	61032
CQS 2/Network E	233.200.79.1	61001	CQS 2/Network E	233.200.79.33	61033
CQS 3/Network E	233.200.79.2	61002	CQS 3/Network E	233.200.79.34	61034
CQS 4/Network E	233.200.79.3	61003	CQS 4/Network E	233.200.79.35	61035
CQS 5/Network E	233.200.79.4	61004	CQS 5/Network E	233.200.79.36	61036
CQS 6/Network E	233.200.79.5	61005	CQS 6/Network E	233.200.79.37	61037
CQS 7/Network E	233.200.79.6	61006	CQS 7/Network E	233.200.79.38	61038
CQS 8/Network E	233.200.79.7	61007	CQS 8/Network E	233.200.79.39	61039
CQS 9/Network E	233.200.79.8	61008	CQS 9/Network E	233.200.79.40	61040
CQS 10/Network E	233.200.79.9	61009	CQS 10/Network E	233.200.79.41	61041
CQS 11/Network E	233.200.79.10	61010	CQS 11/Network E	233.200.79.42	61042
CQS 12/Network E	233.200.79.11	61011	CQS 12/Network E	233.200.79.43	61043
CQS 1/Network F	233.200.79.16	61016	CQS 1/Network F	233.200.79.48	61048
CQS 2/Network F	233.200.79.17	61017	CQS 2/Network F	233.200.79.49	61049
CQS 3/Network F	233.200.79.18	61018	CQS 3/Network F	233.200.79.50	61050
CQS 4/Network F	233.200.79.19	61019	CQS 4/Network F	233.200.79.51	61051
CQS 5/Network F	233.200.79.20	61020	CQS 5/Network F	233.200.79.52	61052
CQS 6/Network F	233.200.79.21	61021	CQS 6/Network F	233.200.79.53	61053
CQS 7/Network F	233.200.79.22	61022	CQS 7/Network F	233.200.79.54	61054
CQS 8/Network F	233.200.79.23	61023	CQS 8/Network F	233.200.79.55	61055
CQS 9/Network F	233.200.79.24	61024	CQS 9/Network F	233.200.79.56	61056
CQS 10/Network F	233.200.79.25	61025	CQS 10/Network F	233.200.79.57	61057
CQS 11/Network F	233.200.79.26	61026	CQS 11/Network F	233.200.79.58	61058
CQS 12/Network F	233.200.79.27	61027	CQS 12/Network F	233.200.79.59	61059

Dedicated CQS Binary Parallel Production Multicast Addresses:

Production Group A Assignments			Production Group B Assignments		
Current CQS 1/Network E is now New CQS 1/Network A (binary parallel)	233.200.79.12	61012	Current CQS 1/Network E is now New CQS 1/Network A (binary parallel)	233.200.79.44	61044
Current CQS 1/Network F is now New CQS 1/Network B (binary parallel)	233.200.79.28	61028	Current CQS 1/Network F is now New CQS 1/Network B (binary parallel)	233.200.79.60	61060

Note: Production Hours - the CQS Source Addresses which are utilized for multicast dissemination can be found on page 50 (Primary Data Center) and page 55 (Disaster Recovery Data Center).

Note2: Non-Production Hours - the CQS Source Addresses which are utilized for multicast dissemination can be found on page 52 (Primary Data Center) and page 57 (Disaster Recovery Data Center).

CTS Production, Real-Time IP Multicast Feeds, Dual Sets (CTS Network 'A' / Network 'B')

Production Group A Assignments			Production Group B Assignments		
Stream A Originated Data Lines	Multicast Group ID	Stream A Originated Data Lines	Multicast Group ID	Stream A Originated Data Lines	Multicast Group ID
CTS 1/Network A	233.200.79.128	62128	CTS 1/Network A	233.200.79.160	62160
CTS 2/Network A	233.200.79.129	62129	CTS 2/Network A	233.200.79.161	62161
CTS 3/Network A	233.200.79.130	62130	CTS 3/Network A	233.200.79.162	62162
CTS 4/Network A	233.200.79.131	62131	CTS 4/Network A	233.200.79.163	62163
CTS 5/Network A	233.200.79.132	62132	CTS 5/Network A	233.200.79.164	62164
CTS 6/Network A	233.200.79.133	62133	CTS 6/Network A	233.200.79.165	62165
CTS 7/Network A	233.200.79.134	62134	CTS 7/Network A	233.200.79.166	62166
CTS 8/Network A	233.200.79.135	62135	CTS 8/Network A	233.200.79.167	62167
CTS 9/Network A	233.200.79.136	62136	CTS 9/Network A	233.200.79.168	62168
CTS 10/Network A	233.200.79.137	62137	CTS 10/Network A	233.200.79.169	62169
CTS 11/Network A	233.200.79.138	62138	CTS 11/Network A	233.200.79.170	62170
CTS 12/Network A	233.200.79.139	62139	CTS 12/Network A	233.200.79.171	62171
CTS 1/Network B	233.200.79.144	62144	CTS 1/Network B	233.200.79.176	62176
CTS 2/Network B	233.200.79.145	62145	CTS 2/Network B	233.200.79.177	62177
CTS 3/Network B	233.200.79.146	62146	CTS 3/Network B	233.200.79.178	62178
CTS 4/Network B	233.200.79.147	62147	CTS 4/Network B	233.200.79.179	62179
CTS 5/Network B	233.200.79.148	62148	CTS 5/Network B	233.200.79.180	62180
CTS 6/Network B	233.200.79.149	62149	CTS 6/Network B	233.200.79.181	62181
CTS 7/Network B	233.200.79.150	62150	CTS 7/Network B	233.200.79.182	62182
CTS 8/Network B	233.200.79.151	62151	CTS 8/Network B	233.200.79.183	62183
CTS 9/Network B	233.200.79.152	62152	CTS 9/Network B	233.200.79.184	62184
CTS 10/Network B	233.200.79.153	62153	CTS 10/Network B	233.200.79.185	62185
CTS 11/Network B	233.200.79.154	62154	CTS 11/Network B	233.200.79.186	62186
CTS 12/Network B	233.200.79.155	62155	CTS 12/Network B	233.200.79.187	62187
Index 1/Network B	233.200.79.158	62158	Index 1/Network B	233.200.79.190	62190
Index 2/Network B	233.200.79.159	62159	Index 2/Network B	233.200.79.191	62191

Dedicated CTS Binary Parallel Production Multicast Addresses:

Production Group A Assignments			Production Group B Assignments		
CTS 1/ Network A remains as CTS 1/Network A (binary parallel)	233.200.79.140	62140	CTS 1/ Network A remains as CTS 1/Network A (binary parallel)	233.200.79.172	62172
CTS 1/Network B remains as CTS 1/Network B (binary parallel)	233.200.79.156	62156	CTS 1/Network B remains as CTS 1/Network B (binary parallel)	233.200.79.188	62188
Index 2/Network B remains as Index 2/Network B (binary parallel)	233.200.79.157	62157	Index 2/Network B remains as Index 2/Network B (binary parallel)	233.200.79.189	62189

Note: Production Hours - the CTS Source Addresses which are utilized for multicast dissemination can be found on page 49 (Primary Data Center) and page 54 (Disaster Recovery Data Center).

Note2: Non-Production Hours - the CTS Source Addresses which are utilized for multicast dissemination can be found on page 52 (Primary Data Center) and page 57 (Disaster Recovery Data Center).

Production, Real-Time IP Multicast Feeds, Dual Sets (OPRA) – Regular Trading Session

Production Group A Assignments			Production Group B Assignments		
Stream A Originated Data Lines	Multicast Group ID	Destination UDP Port Number	Stream B Originated Data Lines	Multicast Group ID	Destination UDP Port Number
OPRA 1	233.43.202.1	11101	OPRA 1	233.43.202.33	12101
OPRA 2	233.43.202.2	11102	OPRA 2	233.43.202.34	12102
OPRA 3	233.43.202.3	11103	OPRA 3	233.43.202.35	12103
OPRA 4	233.43.202.4	11104	OPRA 4	233.43.202.36	12104
OPRA 5	233.43.202.5	11105	OPRA 5	233.43.202.37	12105
OPRA 6	233.43.202.6	11106	OPRA 6	233.43.202.38	12106
OPRA 7	233.43.202.7	11107	OPRA 7	233.43.202.39	12107
OPRA 8	233.43.202.8	11108	OPRA 8	233.43.202.40	12108
OPRA 9	233.43.202.9	11109	OPRA 9	233.43.202.41	12109
OPRA 10	233.43.202.10	11110	OPRA 10	233.43.202.42	12110
OPRA 11	233.43.202.11	11111	OPRA 11	233.43.202.43	12111
OPRA 12	233.43.202.12	11112	OPRA 12	233.43.202.44	12112
OPRA 13	233.43.202.13	11113	OPRA 13	233.43.202.45	12113
OPRA 14	233.43.202.14	11114	OPRA 14	233.43.202.46	12114
OPRA 15	233.43.202.15	11115	OPRA 15	233.43.202.47	12115
OPRA 16	233.43.202.16	11116	OPRA 16	233.43.202.48	12116
OPRA 17	233.43.202.17	11117	OPRA 17	233.43.202.49	12117
OPRA 18	233.43.202.18	11118	OPRA 18	233.43.202.50	12118
OPRA 19	233.43.202.19	11119	OPRA 19	233.43.202.51	12119
OPRA 20	233.43.202.20	11120	OPRA 20	233.43.202.52	12120
OPRA 21	233.43.202.21	11121	OPRA 21	233.43.202.53	12121
OPRA 22	233.43.202.22	11122	OPRA 22	233.43.202.54	12122
OPRA 23	233.43.202.23	11123	OPRA 23	233.43.202.55	12123
OPRA 24	233.43.202.24	11124	OPRA 24	233.43.202.56	12124
OPRA 25	233.43.202.129	16101	OPRA 25	233.43.202.161	17101
OPRA 26	233.43.202.130	16102	OPRA 26	233.43.202.162	17102
OPRA 27	233.43.202.131	16103	OPRA 27	233.43.202.163	17103
OPRA 28	233.43.202.132	16104	OPRA 28	233.43.202.164	17104
OPRA 29	233.43.202.133	16105	OPRA 29	233.43.202.165	17105
OPRA 30	233.43.202.134	16106	OPRA 30	233.43.202.166	17106
OPRA 31	233.43.202.135	16107	OPRA 31	233.43.202.167	17107
OPRA 32	233.43.202.136	16108	OPRA 32	233.43.202.168	17108
OPRA 33	233.43.202.137	16109	OPRA 33	233.43.202.169	17109
OPRA 34	233.43.202.138	16110	OPRA 34	233.43.202.170	17110
OPRA 35	233.43.202.139	16111	OPRA 35	233.43.202.171	17111
OPRA 36	233.43.202.140	16112	OPRA 36	233.43.202.172	17112
OPRA 37	233.43.202.141	16113	OPRA 37	233.43.202.173	17113
OPRA 38	233.43.202.142	16114	OPRA 38	233.43.202.174	17114
OPRA 39	233.43.202.143	16115	OPRA 39	233.43.202.175	17115
OPRA 40	233.43.202.144	16116	OPRA 40	233.43.202.176	17116
OPRA 41	233.43.202.145	16117	OPRA 41	233.43.202.177	17117
OPRA 42	233.43.202.146	16118	OPRA 42	233.43.202.178	17118
OPRA 43	233.43.202.147	16119	OPRA 43	233.43.202.179	17119
OPRA 44	233.43.202.148	16120	OPRA 44	233.43.202.180	17120
OPRA 45	233.43.202.149	16121	OPRA 45	233.43.202.181	17121
OPRA 46	233.43.202.150	16122	OPRA 46	233.43.202.182	17122
OPRA 47	233.43.202.151	16123	OPRA 47	233.43.202.183	17123
OPRA 48	233.43.202.152	16124	OPRA 48	233.43.202.184	17124

Note: Production Hours - the OPRA Source Addresses which are utilized for multicast dissemination can be found on page 51 (Primary Data Center and page 56 (Disaster Recovery Data Center).

Note: Non-Production Hours - the OPRA Source Addresses which are utilized for multicast dissemination can be found on page 52 (Primary Data Center) and page 57 (Disaster Recovery Data Center).

Production, Real-Time IP Multicast Feeds, Dual Sets (OPRA) – Extended Trading Session

Production Group A Assignments			Production Group B Assignments		
Stream A Originated Data Lines	Multicast Group ID	Destination UDP Port Number	Stream B Originated Data Lines	Multicast Group ID	Destination UDP Port Number
OPRA 91	224.0.86.0	11301	OPRA 91	224.0.86.128	12301
OPRA 92	224.0.86.1	11302	OPRA 92	224.0.86.129	12302
OPRA 93	224.0.86.2	11303	OPRA 93	224.0.86.130	12303
OPRA 94	224.0.86.3	11304	OPRA 94	224.0.86.131	12304
OPRA 95*	224.0.86.4	11305	OPRA 95*	224.0.86.132	12305
OPRA 96*	224.0.86.5	11306	OPRA 96*	224.0.86.133	12306
OPRA 97*	224.0.86.6	11307	OPRA 97*	224.0.86.134	12307
OPRA 98*	224.0.86.7	11308	OPRA 98*	224.0.86.135	12308

*****OPRA Lines 95-98 are reserved for future use.

Note: Production Hours - the OPRA Source Addresses which are utilized for multicast dissemination can be found on page 51 (Primary Data Center and page 56 (Disaster Recovery Data Center).

Note: Non-Production Hours - the OPRA Source Addresses which are utilized for multicast dissemination can be found on page 52 (Primary Data Center) and page 57 (Disaster Recovery Data Center).

Temporary Dual Network Test Group Assignments – CQS ASCII

Beginning **May 8, 2017**, a 48-line CQS ASCII and binary dual network with canned test data replay will be available every week day evening. In support of the dual network testing, the following 48 additional ports have been added as temporary dual network test group assignments (24 A-Stream, 24 B-Stream). The new binary output format will be generated over the production multicast group assignments while the CQS ASCII output format will be simultaneously generated over the following temporary dual network test multicast group assignments.

Production Group A Assignments			Production Group B Assignments		
Stream A Originated Data Lines	Multicast Group ID	Destination UDP Port Number	Stream B Originated Data Lines	Multicast Group ID	Destination UDP Port Number
CQS 1/Network E	233.200.79.0	61100	CQS 1/Network E	233.200.79.32	61132
CQS 2/Network E	233.200.79.1	61101	CQS 2/Network E	233.200.79.33	61133
CQS 3/Network E	233.200.79.2	61102	CQS 3/Network E	233.200.79.34	61134
CQS 4/Network E	233.200.79.3	61103	CQS 4/Network E	233.200.79.35	61135
CQS 5/Network E	233.200.79.4	61104	CQS 5/Network E	233.200.79.36	61136
CQS 6/Network E	233.200.79.5	61105	CQS 6/Network E	233.200.79.37	61137
CQS 7/Network E	233.200.79.6	61106	CQS 7/Network E	233.200.79.38	61138
CQS 8/Network E	233.200.79.7	61107	CQS 8/Network E	233.200.79.39	61139
CQS 9/Network E	233.200.79.8	61108	CQS 9/Network E	233.200.79.40	61140
CQS 10/Network E	233.200.79.9	61109	CQS 10/Network E	233.200.79.41	61141
CQS 11/Network E	233.200.79.10	61110	CQS 11/Network E	233.200.79.42	61142
CQS 12/Network E	233.200.79.11	61111	CQS 12/Network E	233.200.79.43	61143
CQS 1/Network F	233.200.79.16	61116	CQS 1/Network F	233.200.79.48	61148
CQS 2/Network F	233.200.79.17	61117	CQS 2/Network F	233.200.79.49	61149
CQS 3/Network F	233.200.79.18	61118	CQS 3/Network F	233.200.79.50	61150
CQS 4/Network F	233.200.79.19	61119	CQS 4/Network F	233.200.79.51	61151
CQS 5/Network F	233.200.79.20	61120	CQS 5/Network F	233.200.79.52	61152
CQS 6/Network F	233.200.79.21	61121	CQS 6/Network F	233.200.79.53	61153
CQS 7/Network F	233.200.79.22	61122	CQS 7/Network F	233.200.79.54	61154
CQS 8/Network F	233.200.79.23	61123	CQS 8/Network F	233.200.79.55	61155
CQS 9/Network F	233.200.79.24	61124	CQS 9/Network F	233.200.79.56	61156
CQS 10/Network F	233.200.79.25	61125	CQS 10/Network F	233.200.79.57	61157
CQS 11/Network F	233.200.79.26	61126	CQS 11/Network F	233.200.79.58	61158
CQS 12/Network F	233.200.79.27	61127	CQS 12/Network F	233.200.79.59	61159

Note: Non-Production Hours - the CQS Source Addresses which are utilized for multicast dissemination can be found on page 52 (Primary Data Center) and page 57 (Disaster Recovery Data Center).

Temporary Dual Network Test Group Assignments – CTS ASCII

Beginning **May 8, 2017**, a 52-line CTS ASCII and binary dual network with canned test data replay will be available every week day evening. In support of the dual network testing, the following 52 additional ports have been added as temporary dual network test group assignments (26 A-Stream, 26 B-Stream). The new binary output format will be generated over the production multicast group assignments while the CTS ASCII output format will be simultaneously generated over the following temporary dual network test multicast group assignments.

Production Group A Assignments			Production Group B Assignments		
Stream A Originated Data Lines	Multicast Group ID	Stream A Originated Data Lines	Multicast Group ID	Stream A Originated Data Lines	Multicast Group ID
CTS 1/Network A	233.200.79.128	62128	CTS 1/Network A	233.200.79.160	62160
CTS 2/Network A	233.200.79.129	62129	CTS 2/Network A	233.200.79.161	62161
CTS 3/Network A	233.200.79.130	62130	CTS 3/Network A	233.200.79.162	62162
CTS 4/Network A	233.200.79.131	62131	CTS 4/Network A	233.200.79.163	62163
CTS 5/Network A	233.200.79.132	62132	CTS 5/Network A	233.200.79.164	62164
CTS 6/Network A	233.200.79.133	62133	CTS 6/Network A	233.200.79.165	62165
CTS 7/Network A	233.200.79.134	62134	CTS 7/Network A	233.200.79.166	62166
CTS 8/Network A	233.200.79.135	62135	CTS 8/Network A	233.200.79.167	62167
CTS 9/Network A	233.200.79.136	62136	CTS 9/Network A	233.200.79.168	62168
CTS 10/Network A	233.200.79.137	62137	CTS 10/Network A	233.200.79.169	62169
CTS 11/Network A	233.200.79.138	62138	CTS 11/Network A	233.200.79.170	62170
CTS 12/Network A	233.200.79.139	62139	CTS 12/Network A	233.200.79.171	62171
CTS 1/Network B	233.200.79.144	62144	CTS 1/Network B	233.200.79.176	62176
CTS 2/Network B	233.200.79.145	62145	CTS 2/Network B	233.200.79.177	62177
CTS 3/Network B	233.200.79.146	62146	CTS 3/Network B	233.200.79.178	62178
CTS 4/Network B	233.200.79.147	62147	CTS 4/Network B	233.200.79.179	62179
CTS 5/Network B	233.200.79.148	62148	CTS 5/Network B	233.200.79.180	62180
CTS 6/Network B	233.200.79.149	62149	CTS 6/Network B	233.200.79.181	62181
CTS 7/Network B	233.200.79.150	62150	CTS 7/Network B	233.200.79.182	62182
CTS 8/Network B	233.200.79.151	62151	CTS 8/Network B	233.200.79.183	62183
CTS 9/Network B	233.200.79.152	62152	CTS 9/Network B	233.200.79.184	62184
CTS 10/Network B	233.200.79.153	62153	CTS 10/Network B	233.200.79.185	62185
CTS 11/Network B	233.200.79.154	62154	CTS 11/Network B	233.200.79.186	62186
CTS 12/Network B	233.200.79.155	62155	CTS 12/Network B	233.200.79.187	62187
Index 1/Network B	233.200.79.158	62158	Index 1/Network B	233.200.79.190	62190
Index 2/Network B	233.200.79.159	62159	Index 2/Network B	233.200.79.191	62191

Note: Non-Production Hours - the CTS Source Addresses which are utilized for multicast dissemination can be found on page 52 (Primary Data Center) and page 57 (Disaster Recovery Data Center).

Retransmission and Playback Test Data, Single Sets

Unlike the production real-time feeds, the day-time production retransmission data and the after-hours playback test data are provided via a single stream only, **i.e. redundant 'A' and 'B' streams are <u>not</u> available**. Playback data is only available after-hours.

In addition to the playback test data groups as shown below, SIAC will continue to provide after-hours playback via the production system expressly for the purposes of redundancy testing. The multicast groups will be identical to those listed above for the real-time production system.

Recipients wishing to receive retransmission and/or playback feeds must subscribe to the multicast feeds based on the addressing information shown in the following table.

Multicast Address Ranges:

NMS Retransmission Multicast Group ID Ranges:

224.0.5.128 – 224.0.5.136
224.0.5.138 – 224.0.5.143
224.0.5.176 – 224.0.5.191
224.0.86.8 – 224.0.86.15
233.43.202.65 – 233.43.202.88
233.43.202.192-233.43.202.216
233.200.79.64-233.200.79.95
Dedicated for binary parallel verification

- 233.200.79.76
- 233.200.79.92

233.200.79.192-233.200.79.223
Dedicated for binary parallel verification

- 233.200.79.204
- 233.200.79.220
- 233.200.79.221

NMS Playback Group ID Ranges:

224.0.5.144 – 224.0.5.155
224.0.5.154 – 224.0.5.159
224.0.5.240 – 224.0.5.255
224.0.86.8 – 224.0.86.15
233.43.202.97 – 233.43.202.120
233.43.202.224 - 233.43.202.248
233.200.79.96-233.200.79.127
233.200.79.224-233.200.79.255

CQS AND CTS Retransmission and Playback Test Data, Single Sets (CQS Network 'E' / Network 'F" and CTS Network 'A' / Network 'B')

Retransmission Group Assignments			Playback Test Group Assignments		
NMS Line Name	Multicast Group ID	Destination UDP Port Number	NMS Line Name	Multicast Group ID	Destination UDP Port Number
CQS 1/Network E	233.200.79.64	61064	CQS 1/Network E	233.200.79.96	61096
CQS 2/Network E	233.200.79.65	61065	CQS 2/Network E	233.200.79.97	61097
CQS 3/Network E	233.200.79.66	61066	CQS 3/Network E	233.200.79.98	61098
CQS 4/Network E	233.200.79.67	61067	CQS 4/Network E	233.200.79.99	61099
CQS 5/Network E	233.200.79.68	61068	CQS 5/Network E	233.200.79.100	61100
CQS 6/Network E	233.200.79.69	61069	CQS 6/Network E	233.200.79.101	61101
CQS 7/Network E	233.200.79.70	61070	CQS 7/Network E	233.200.79.102	61102
CQS 8/Network E	233.200.79.71	61071	CQS 8/Network E	233.200.79.103	61103
CQS 9/Network E	233.200.79.72	61072	CQS 9/Network E	233.200.79.104	61104
CQS 10/Network E	233.200.79.73	61073	CQS 10/Network E	233.200.79.105	61105
CQS 11/Network E	233.200.79.74	61074	CQS 11/Network E	233.200.79.106	61106
CQS 12/Network E	233.200.79.75	61075	CQS 12/Network E	233.200.79.107	61107
CQS 1/Network F	233.200.79.80	61080	CQS 1/Network F	233.200.79.112	61112
CQS 2/Network F	233.200.79.81	61081	CQS 2/Network F	233.200.79.113	61113
CQS 3/Network F	233.200.79.82	61082	CQS 3/Network F	233.200.79.114	61114
CQS 4/Network F	233.200.79.83	61083	CQS 4/Network F	233.200.79.115	61115
CQS 5/Network F	233.200.79.84	61084	CQS 5/Network F	233.200.79.116	61116
CQS 6/Network F	233.200.79.85	61085	CQS 6/Network F	233.200.79.117	61117
CQS 7/Network F	233.200.79.86	61086	CQS 7/Network F	233.200.79.118	61118
CQS 8/Network F	233.200.79.87	61087	CQS 8/Network F	233.200.79.119	61119
CQS 9/Network F	233.200.79.88	61088	CQS 9/Network F	233.200.79.120	61120
CQS 10/Network F	233.200.79.89	61089	CQS 10/Network F	233.200.79.121	61121
CQS 11/Network F	233.200.79.90	61090	CQS 11/Network F	233.200.79.122	61122
CQS 12/Network F	233.200.79.91	61091	CQS 12/Network F	233.200.79.123	61123
CTS 1/Network A	233.200.79.192	62192	CTS 1/Network A	233.200.79.224	62224
CTS 2/Network A	233.200.79.193	62193	CTS 2/Network A	233.200.79.225	62225
CTS 3/Network A	233.200.79.194	62194	CTS 3/Network A	233.200.79.226	62226
CTS 4/Network A	233.200.79.195	62195	CTS 4/Network A	233.200.79.227	62227
CTS 5/Network A	233.200.79.196	62196	CTS 5/Network A	233.200.79.228	62228
CTS 6/Network A	233.200.79.197	62197	CTS 6/Network A	233.200.79.229	62229
CTS 7/Network A	233.200.79.198	62198	CTS 7/Network A	233.200.79.230	62230
CTS 8/Network A	233.200.79.199	62199	CTS 8/Network A	233.200.79.231	62231
CTS 9/Network A	233.200.79.200	62200	CTS 9/Network A	233.200.79.232	62232
CTS 10/Network A	233.200.79.201	62201	CTS 10/Network A	233.200.79.233	62233
CTS 11/Network A	233.200.79.202	62202	CTS 11/Network A	233.200.79.234	62234
CTS 12/Network A	233.200.79.203	62203	CTS 12/Network A	233.200.79.235	62235
CTS 1/Network B	233.200.79.208	62208	CTS 1/Network B	233.200.79.240	62240
CTS 2/Network B	233.200.79.209	62209	CTS 2/Network B	233.200.79.241	62241
CTS 3/Network B	233.200.79.210	62210	CTS 3/Network B	233.200.79.242	62242
CTS 4/Network B	233.200.79.211	62211	CTS 4/Network B	233.200.79.243	62243
CTS 5/Network B	233.200.79.212	62212	CTS 5/Network B	233.200.79.244	62244
CTS 6/Network B	233.200.79.213	62213	CTS 6/Network B	233.200.79.245	62245
CTS 7/Network B	233.200.79.214	62214	CTS 7/Network B	233.200.79.246	62246
CTS 8/Network B	233.200.79.215	62215	CTS 8/Network B	233.200.79.247	62247
CTS 9/Network B	233.200.79.216	62216	CTS 9/Network B	233.200.79.248	62248
CTS 10/Network B	233.200.79.217	62217	CTS 10/Network B	233.200.79.249	62249
CTS 11/Network B	233.200.79.218	62218	CTS 11/Network B	233.200.79.250	62250
CTS 12/Network B	233.200.79.219	62219	CTS 12/Network B	233.200.79.251	62251
Index 1/Network B	233.200.79.222	62222	Index 1/Network B	233.200.79. 254	62254
Index 2/Network B	233.200.79.223	62223	Index 2/Network B	233.200.79. 255	62255

Note: The CQS and CTS Source Addresses which are utilized for multicast dissemination can be found on page 53 (Primary Data Center and page 58 (Disaster Recovery Data Center).

Dedicated CQS Binary Parallel Retransmission Multicast Addresses:

Retransmission Group Assignments		
Current CQS 1/Network E is now New CQS 1/Network A (binary parallel)	233.200.79.76	61076
Current CQS 1/Network F is now New CQS 1/Network B (binary parallel)	233.200.79.92	61092

Dedicated CTS Binary Parallel Retransmission Multicast Addresses:

Retransmission Group Assignments		
CTS 1/Network A remains as CTS 1/Network A (binary parallel)	233.200.79.204	62204
CTS 1/Network B remains as CTS 1/Network B (binary parallel)	233.200.79.220	62220
Index 2/Network B remains as Index 2/Network B (binary parallel)	233.200.79.221	62221

Note: The CQS and CTS Source Addresses which are utilized for multicast dissemination can be found on page 53 (Primary Data Center and page 58 (Disaster Recovery Data Center).

Retransmission and Playback Test Data, Single Sets (OPRA- Regular Session)

Retransmission Group Assignments			Playback Test Group Assignments		
NMS Line Name	Multicast Group ID	Destination UDP Port Number	NMS Line Name	Multicast Group ID	Destination UDP Port Number
OPRA 1	233.43.202.65	13151	OPRA 1	233.43.202.97	14151
OPRA 2	233.43.202.66	13152	OPRA 2	233.43.202.98	14152
OPRA 3	233.43.202.67	13153	OPRA 3	233.43.202.99	14153
OPRA 4	233.43.202.68	13154	OPRA 4	233.43.202.100	14154
OPRA 5	233.43.202.69	13155	OPRA 5	233.43.202.101	14155
OPRA 6	233.43.202.70	13156	OPRA 6	233.43.202.102	14156
OPRA 7	233.43.202.71	13157	OPRA 7	233.43.202.103	14157
OPRA 8	233.43.202.72	13158	OPRA 8	233.43.202.104	14158
OPRA 9	233.43.202.73	13159	OPRA 9	233.43.202.105	14159
OPRA 10	233.43.202.74	13160	OPRA 10	233.43.202.106	14160
OPRA 11	233.43.202.75	13161	OPRA 11	233.43.202.107	14161
OPRA 12	233.43.202.76	13162	OPRA 12	233.43.202.108	14162
OPRA 13	233.43.202.77	13163	OPRA 13	233.43.202.109	14163
OPRA 14	233.43.202.78	13164	OPRA 14	233.43.202.110	14164
OPRA 15	233.43.202.79	13165	OPRA 15	233.43.202.111	14165
OPRA 16	233.43.202.80	13166	OPRA 16	233.43.202.112	14166
OPRA 17	233.43.202.81	13167	OPRA 17	233.43.202.113	14167
OPRA 18	233.43.202.82	13168	OPRA 18	233.43.202.114	14168
OPRA 19	233.43.202.83	13169	OPRA 19	233.43.202.115	14169
OPRA 20	233.43.202.84	13170	OPRA 20	233.43.202.116	14170
OPRA 21	233.43.202.85	13171	OPRA 21	233.43.202.117	14171
OPRA 22	233.43.202.86	13172	OPRA 22	233.43.202.118	14172
OPRA 23	233.43.202.87	13173	OPRA 23	233.43.202.119	14173
OPRA 24	233.43.202.88	13174	OPRA 24	233.43.202.120	14174
OPRA 25	233.43.202.193	18101	OPRA 25	233.43.202.225	19101
OPRA 26	233.43.202.194	18102	OPRA 26	233.43.202.226	19102
OPRA 27	233.43.202.195	18103	OPRA 27	233.43.202.227	19103
OPRA 28	233.43.202.196	18104	OPRA 28	233.43.202.228	19104
OPRA 29	233.43.202.197	18105	OPRA 29	233.43.202.229	19105
OPRA 30	233.43.202.198	18106	OPRA 30	233.43.202.230	19106
OPRA 31	233.43.202.199	18107	OPRA 31	233.43.202.231	19107
OPRA 32	233.43.202.200	18108	OPRA 32	233.43.202.232	19108
OPRA 33	233.43.202.201	18109	OPRA 33	233.43.202.233	19109
OPRA 34	233.43.202.202	18110	OPRA 34	233.43.202.234	19110
OPRA 35	233.43.202.203	18111	OPRA 35	233.43.202.235	19111
OPRA 36	233.43.202.204	18112	OPRA 36	233.43.202.236	19112
OPRA 37	233.43.202.205	18113	OPRA 37	233.43.202.237	19113
OPRA 38	233.43.202.206	18114	OPRA 38	233.43.202.238	19114
OPRA 39	233.43.202.207	18115	OPRA 39	233.43.202.239	19115
OPRA 40	233.43.202.208	18116	OPRA 40	233.43.202.240	19116
OPRA 41	233.43.202.209	18117	OPRA 41	233.43.202.241	19117
OPRA 42	233.43.202.210	18118	OPRA 42	233.43.202.242	19118
OPRA 43	233.43.202.211	18119	OPRA 43	233.43.202.243	19119
OPRA 44	233.43.202.212	18120	OPRA 44	233.43.202.244	19120
OPRA 45	233.43.202.213	18121	OPRA 45	233.43.202.245	19121
OPRA 46	233.43.202.214	18122	OPRA 46	233.43.202.246	19122
OPRA 47	233.43.202.215	18123	OPRA 47	233.43.202.247	19123
OPRA 48	233.43.202.216	18124	OPRA 48	233.43.202.248	19124

Note: The OPRA Source Addresses which are utilized for multicast dissemination can be found on page 53 (Primary Data Center and page 58 (Disaster Recovery Data Center).

Retransmission and Playback Test Data, Single Sets (OPRA – Extended Session)

Retransmission Group Assignments			Playback Test Group Assignments		
NMS Line Name	Multicast Group ID	Destination UDP Port Number	NMS Line Name	Multicast Group ID	Destination UDP Port Number
OPRA 91	224.0.86.8	13301	OPRA 91	224.0.86.136	14301
OPRA 92	224.0.86.9	13302	OPRA 92	224.0.86.137	14302
OPRA 93	224.0.86.10	13303	OPRA 93	224.0.86.138	14303
OPRA 94	224.0.86.11	13304	OPRA 94	224.0.86.139	14304
OPRA 95*	224.0.86.12	13305	OPRA 95*	224.0.86.140	14305
OPRA 96*	224.0.86.13	13306	OPRA 96*	224.0.86.141	14306
OPRA 97*	224.0.86.14	13307	OPRA 97*	224.0.86.142	14307
OPRA 98*	224.0.86.15	13308	OPRA 98*	224.0.86.143	14308

*****OPRA Lines 95-98 are reserved for future use.

Note: The OPRA Source Addresses which are utilized for multicast dissemination can be found on page 53 (Primary Data Center and page 58 (Disaster Recovery Data Center).

7 Appendix B – Primary Data Center Source Addresses

The following table lists all the possible source IP addresses associated with the each of the NMS Multicast Data services.

NOTE: THE BELOW SOURCE ADDRESSES HAVE BEEN DECOMMISSIONED AS OF DECEMBER 2016. THE SOURCE ADDRESSES BELOW WILL BE REMOVED FROM THIS DOCUMENT IN THE NEXT UPDATE.

Service:	**CTS/CQS/Time Beacon**
Data Function Type:	**Production (A Stream)**
IP addresses listed as the source address in the Multicast packets (network number in parenthesis)	
Odd Subnets (.41 / .53 / .61)	**Even Subnets (.42 / .54 /.62)**
~~159.125.41.113 (159.125.41.112/ 29)~~ ~~159.125.41.114 (159.125.41.112/ 29)~~ ~~159.125.41.161 (159.125.41.160/ 29)~~ ~~159.125.41.162 (159.125.41.160/ 29)~~ ~~159.125.41.163 (159.125.41.160/ 29)~~ ~~159.125.41.164 (159.125.41.160/ 29)~~ ~~159.125.41.165 (159.125.41.160/ 29)~~ ~~159.125.53.168 (159.125.53.160/ 28)~~ ~~159.125.53.169 (159.125.53.160/ 28)~~ ~~159.125.53.170 (159.125.53.160/ 28)~~ ~~159.125.53.171 (159.125.53.160/ 28)~~ ~~159.125.53.172 (159.125.53.160/ 28)~~ ~~159.125.53.173 (159.125.53.160/ 28)~~ ~~159.125.53.200 (159.125.53.192/ 28)~~ ~~159.125.53.201 (159.125.53.192/ 28)~~ ~~159.125.53.202 (159.125.53.192/ 28)~~ ~~159.125.53.203 (159.125.53.192/ 28)~~ ~~159.125.53.204 (159.125.53.192/ 28)~~ ~~159.125.53.205 (159.125.53.192/ 28)~~ ~~159.125.61.113 (159.125.61.112/ 29)~~ ~~159.125.61.114 (159.125.61.112/ 29)~~ ~~159.125.61.161 (159.125.61.160/ 29)~~ ~~159.125.61.162 (159.125.61.160/ 29)~~ ~~159.125.61.163 (159.125.61.160/ 29)~~ ~~159.125.61.164 (159.125.61.160/ 29)~~ ~~159.125.61.165 (159.125.61.160/ 29)~~	~~159.125.42.113 (159.125.42.112/ 29)~~ ~~159.125.42.114 (159.125.42.112/ 29)~~ ~~159.125.42.161 (159.125.42.160/ 29)~~ ~~159.125.42.162 (159.125.42.160/ 29)~~ ~~159.125.42.163 (159.125.42.160/ 29)~~ ~~159.125.42.164 (159.125.42.160/ 29)~~ ~~159.125.42.165 (159.125.42.160/ 29)~~ ~~159.125.54.168 (159.125.54.160/ 28)~~ ~~159.125.54.169 (159.125.54.160/ 28)~~ ~~159.125.54.170 (159.125.54.160/ 28)~~ ~~159.125.54.171 (159.125.54.160/ 28)~~ ~~159.125.54.172 (159.125.54.160/ 28)~~ ~~159.125.54.173 (159.125.54.160/ 28)~~ ~~159.125.54.200 (159.125.54.192/ 28)~~ ~~159.125.54.201 (159.125.54.192/ 28)~~ ~~159.125.54.202 (159.125.54.192/ 28)~~ ~~159.125.54.203 (159.125.54.192/ 28)~~ ~~159.125.54.204 (159.125.54.192/ 28)~~ ~~159.125.54.205 (159.125.54.192/ 28)~~ ~~159.125.62.113 (159.125.62.112/ 29)~~ ~~159.125.62.114 (159.125.62.112/ 29)~~ ~~159.125.62.161 (159.125.62.160/ 29)~~ ~~159.125.62.162 (159.125.62.160/ 29)~~ ~~159.125.62.163 (159.125.62.160/ 29)~~ ~~159.125.62.164 (159.125.62.160/ 29)~~ ~~159.125.62.165 (159.125.62.160/ 29)~~

APPENDIX B - Primary Data Center Source Addresses, cont'd

The following table lists all the possible source IP addresses associated with the each of the NMS Multicast Data services.

NOTE: THE BELOW SOURCE ADDRESSES HAVE BEEN DECOMMISSIONED AS OF DECEMBER 2016. THE SOURCE ADDRESSES BELOW WILL BE REMOVED FROM THIS DOCUMENT IN THE NEXT UPDATE.

Service:	**CTS/CQS/Time Beacon**
Data Function Type:	**Production (B Stream)**
IP addresses listed as the source address in the Multicast packets (network number in parenthesis)	
Odd Subnets (.41 / .53 / .61)	**Even Subnets (.42 / .54 /.62)**
~~159.125.41.121 (159.125.41.120/ 29)~~ ~~159.125.41.122 (159.125.41.120/ 29)~~ ~~159.125.41.169 (159.125.41.168/ 29)~~ ~~159.125.41.170 (159.125.41.168/ 29)~~ ~~159.125.41.171 (159.125.41.168/ 29)~~ ~~159.125.41.172 (159.125.41.168/ 29)~~ ~~159.125.41.173 (159.125.41.168/ 29)~~ ~~159.125.53.184 (159.125.53.176/ 28)~~ ~~159.125.53.185 (159.125.53.176/ 28)~~ ~~159.125.53.186 (159.125.53.176/ 28)~~ ~~159.125.53.187 (159.125.53.176/ 28)~~ ~~159.125.53.188 (159.125.53.176/ 28)~~ ~~159.125.53.189 (159.125.53.176/ 28)~~ ~~159.125.53.216 (159.125.53.208/ 28)~~ ~~159.125.53.217 (159.125.53.208/ 28)~~ ~~159.125.53.218 (159.125.53.208/ 28)~~ ~~159.125.53.219 (159.125.53.208/ 28)~~ ~~159.125.53.220 (159.125.53.208/ 28)~~ ~~159.125.53.221 (159.125.53.208/ 28)~~ ~~159.125.61.121 (159.125.61.120/ 29)~~ ~~159.125.61.122 (159.125.61.120/ 29)~~ ~~159.125.61.169 (159.125.61.168/ 29)~~ ~~159.125.61.170 (159.125.61.168/ 29)~~ ~~159.125.61.171 (159.125.61.168/ 29)~~ ~~159.125.61.172 (159.125.61.168/ 29)~~ ~~159.125.61.173 (159.125.61.168/ 29)~~	~~159.125.42.121 (159.125.42.120/ 29)~~ ~~159.125.42.122 (159.125.42.120/ 29)~~ ~~159.125.42.169 (159.125.42.168/ 29)~~ ~~159.125.42.170 (159.125.42.168/ 29)~~ ~~159.125.42.171 (159.125.42.168/ 29)~~ ~~159.125.42.172 (159.125.42.168/ 29)~~ ~~159.125.42.173 (159.125.42.168/ 29)~~ ~~159.125.54.184 (159.125.54.176/ 28)~~ ~~159.125.54.185 (159.125.54.176/ 28)~~ ~~159.125.54.186 (159.125.54.176/ 28)~~ ~~159.125.54.187 (159.125.54.176/ 28)~~ ~~159.125.54.188 (159.125.54.176/ 28)~~ ~~159.125.54.189 (159.125.54.176/ 28)~~ ~~159.125.54.216 (159.125.54.208/ 28)~~ ~~159.125.54.217 (159.125.54.208/ 28)~~ ~~159.125.54.218 (159.125.54.208/ 28)~~ ~~159.125.54.219 (159.125.54.208/ 28)~~ ~~159.125.54.220 (159.125.54.208/ 28)~~ ~~159.125.54.221 (159.125.54.208/ 28)~~ ~~159.125.62.121 (159.125.62.120/ 29)~~ ~~159.125.62.122 (159.125.62.120/ 29)~~ ~~159.125.62.169 (159.125.62.168/ 29)~~ ~~159.125.62.170 (159.125.62.168/ 29)~~ ~~159.125.62.171 (159.125.62.168/ 29)~~ ~~159.125.62.172 (159.125.62.168/ 29)~~ ~~159.125.62.173 (159.125.62.168/ 29)~~

APPENDIX B - Primary Data Center Source Addresses, cont'd

NOTE: THE BELOW SOURCE ADDRESSES IS SCHEDULED FOR DECOMMISSION BY END OF MARCH 2017.

Service:	**CTS/CQS/OPRA**
Data Function Type:	**After-hours Playback , Production (A Stream)**

IP addresses listed as the source address in the Multicast packets (network number in parenthesis)

Odd Subnets (.41 / .53 / .61)	**Even Subnets (.42 / .54 /.62)**
~~159.125.41.65 (159.125.41.64/ 29)~~	~~159.125.42.65 (159.125.42.64/ 29)~~
~~159.125.41.66 (159.125.41.64/ 29)~~	~~159.125.42.66 (159.125.42.64/ 29)~~
~~159.125.41.67 (159.125.41.64/ 29)~~	~~159.125.42.67 (159.125.42.64/ 29)~~
~~159.125.41.68 (159.125.41.64/ 29)~~	~~159.125.42.68 (159.125.42.64/ 29)~~
~~159.125.41.69 (159.125.41.64/ 29)~~	~~159.125.42.69 (159.125.42.64/ 29)~~
~~159.125.41.193 (159.125.41.192/ 29)~~	~~159.125.42.193 (159.125.42.192/ 29)~~
~~159.125.41.194 (159.125.41.192/ 29)~~	~~159.125.42.194 (159.125.42.192/ 29)~~
~~159.125.41.195 (159.125.41.192/ 29)~~	~~159.125.42.195 (159.125.42.192/ 29)~~
~~159.125.41.196 (159.125.41.192/ 29)~~	~~159.125.42.196 (159.125.42.192/ 29)~~
~~159.125.41.197 (159.125.41.192/ 29)~~	~~159.125.42.197 (159.125.42.192/ 29)~~
~~159.125.41.209 (159.125.41.208/ 29)~~	~~159.125.42.209 (159.125.42.208/ 29)~~
~~159.125.41.210 (159.125.41.208/ 29)~~	~~159.125.42.210 (159.125.42.208/ 29)~~
~~159.125.53.78 (159.125.53.64/ 27)~~	~~159.125.54.78 (159.125.54.64/ 27)~~
~~159.125.53.79 (159.125.53. 64/ 27)~~	~~159.125.54.79 (159.125.54. 64/ 27)~~
~~159.125.53.80 (159.125.53. 64/ 27)~~	~~159.125.54.80 (159.125.54. 64/ 27)~~
~~159.125.53.81 (159.125.53. 64/ 27)~~	~~159.125.54.81 (159.125.54. 64/ 27)~~
~~159.125.53.82 (159.125.53. 64/ 27)~~	~~159.125.54.82 (159.125.54. 64/ 27)~~
~~159.125.53.83 (159.125.53. 64/ 27)~~	~~159.125.54.83 (159.125.54. 64/ 27)~~
~~159.125.53.84 (159.125.53. 64/ 27)~~	~~159.125.54.84 (159.125.54. 64/ 27)~~
~~159.125.53.85 (159.125.53. 64/ 27)~~	~~159.125.54.85 (159.125.54. 64/ 27)~~
~~159.125.53.86 (159.125.53. 64/ 27)~~	~~159.125.54.86 (159.125.54. 64/ 27)~~
~~159.125.53.87 (159.125.53. 64/ 27)~~	~~159.125.54.87 (159.125.54. 64/ 27)~~
~~159.125.53.88 (159.125.53. 64/ 27)~~	~~159.125.54.88 (159.125.54. 64/ 27)~~
~~159.125.53.89 (159.125.53. 64/ 27)~~	~~159.125.54.89 (159.125.54. 64/ 27)~~
~~159.125.61.65 (159.125.61.64/ 29)~~	~~159.125.62.65 (159.125.62.64/ 29)~~
~~159.125.61.66 (159.125.61.64/ 29)~~	~~159.125.62.66 (159.125.62.64/ 29)~~
~~159.125.61.67 (159.125.61.64/ 29)~~	~~159.125.62.67 (159.125.62.64/ 29)~~
~~159.125.61.68 (159.125.61.64/ 29)~~	~~159.125.62.68 (159.125.62.64/ 29)~~
~~159.125.61.69 (159.125.61.64/ 29)~~	~~159.125.62.69 (159.125.62.64/ 29)~~
~~159.125.61.193 (159.125.61.192/ 29)~~	~~159.125.62.193 (159.125.62.192/ 29)~~
~~159.125.61.194 (159.125.61.192/ 29)~~	~~159.125.62.194 (159.125.62.192/ 29)~~
~~159.125.61.195 (159.125.61.192/ 29)~~	~~159.125.62.195 (159.125.62.192/ 29)~~
~~159.125.61.196 (159.125.61.192/ 29)~~	~~159.125.62.196 (159.125.62.192/ 29)~~
~~159.125.61.197 (159.125.61.192/ 29)~~	~~159.125.62.197 (159.125.62.192/ 29)~~
~~159.125.61.209 (159.125.61.208/ 29)~~	~~159.125.62.209 (159.125.62.208/ 29)~~
~~159.125.61.210 (159.125.61.208/ 29)~~	~~159.125.62.210 (159.125.62.208/ 29)~~

APPENDIX B - Primary Data Center Source Addresses, cont'd

NOTE: THE BELOW SOURCE ADDRESSES IS SCHEDULED FOR DECOMMISSION BY END OF MARCH 2017.

Service:	**CTS/CQS/OPRA**
Data Function Type:	**After-hours Playback, Production (B Stream)**

IP addresses listed as the source address in the Multicast packets (network number in parenthesis)

Odd Subnets (.41 / .53 / .61)	**Even Subnets (.42 / .54 /.62)**
~~159.125.41.89 (159.125.41.88/ 29)~~	~~159.125.42.89 (159.125.42.88/ 29)~~
~~159.125.41.90 (159.125.41.88/ 29)~~	~~159.125.42.90 (159.125.42.88/ 29)~~
~~159.125.41.91 (159.125.41.88/ 29)~~	~~159.125.42.91 (159.125.42.88/ 29)~~
~~159.125.41.92 (159.125.41.88/ 29)~~	~~159.125.42.92 (159.125.42.88/ 29)~~
~~159.125.41.93 (159.125.41.88/ 29)~~	~~159.125.42.93 (159.125.42.88/ 29)~~
~~159.125.41.201 (159.125.41.200/ 29)~~	~~159.125.42.201 (159.125.42.200/ 29)~~
~~159.125.41.202 (159.125.41.200/ 29)~~	~~159.125.42.202 (159.125.42.200/ 29)~~
~~159.125.41.203 (159.125.41.200/ 29)~~	~~159.125.42.203 (159.125.42.200/ 29)~~
~~159.125.41.204 (159.125.41.200/ 29)~~	~~159.125.42.204 (159.125.42.200/ 29)~~
~~159.125.41.205 (159.125.41.200/ 29)~~	~~159.125.42.205 (159.125.42.200/ 29)~~
~~159.125.41.217 (159.125.41.216/ 29)~~	~~159.125.42.217 (159.125.42.216/ 29)~~
~~159.125.41.218 (159.125.41.216/ 29)~~	~~159.125.42.218 (159.125.42.216/ 29)~~
~~159.125.53.110 (159.125.53.96/ 27)~~	~~159.125.54.110 (159.125.54.96/ 27)~~
~~159.125.53.111 (159.125.53. 96/ 27)~~	~~159.125.54.111 (159.125.54. 96/ 27)~~
~~159.125.53.112 (159.125.53. 96/ 27)~~	~~159.125.54.112 (159.125.54. 96/ 27)~~
~~159.125.53.113 (159.125.53. 96/ 27)~~	~~159.125.54.113 (159.125.54. 96/ 27)~~
~~159.125.53.114 (159.125.53. 96/ 27)~~	~~159.125.54.114 (159.125.54. 96/ 27)~~
~~159.125.53.115 (159.125.53. 96/ 27)~~	~~159.125.54.115 (159.125.54. 96/ 27)~~
~~159.125.53.116 (159.125.53. 96/ 27)~~	~~159.125.54.116 (159.125.54. 96/ 27)~~
~~159.125.53.117 (159.125.53. 96/ 27)~~	~~159.125.54.117 (159.125.54. 96/ 27)~~
~~159.125.53.118 (159.125.53. 96/ 27)~~	~~159.125.54.118 (159.125.54. 96/ 27)~~
~~159.125.53.119 (159.125.53. 96/ 27)~~	~~159.125.54.119 (159.125.54. 96/ 27)~~
~~159.125.53.120 (159.125.53. 96/ 27)~~	~~159.125.54.120 (159.125.54. 96/ 27)~~
~~159.125.53.121 (159.125.53. 96/ 27)~~	~~159.125.54.121 (159.125.54. 96/ 27)~~
~~159.125.61.89 (159.125.61.88/ 29)~~	~~159.125.62.89 (159.125.62.88/ 29)~~
~~159.125.61.90 (159.125.61.88/ 29)~~	~~159.125.62.90 (159.125.62.88/ 29)~~
~~159.125.61.91 (159.125.61.88/ 29)~~	~~159.125.62.91 (159.125.62.88/ 29)~~
~~159.125.61.92 (159.125.61.88/ 29)~~	~~159.125.62.92 (159.125.62.88/ 29)~~
~~159.125.61.93 (159.125.61.88/ 29)~~	~~159.125.62.93 (159.125.62.88/ 29)~~
~~159.125.61.201 (159.125.61.200/ 29)~~	~~159.125.62.201 (159.125.62.200/ 29)~~
~~159.125.61.202 (159.125.61.200/ 29)~~	~~159.125.62.202 (159.125.62.200/ 29)~~
~~159.125.61.203 (159.125.61.200/ 29)~~	~~159.125.62.203 (159.125.62.200/ 29)~~
~~159.125.61.204 (159.125.61.200/ 29)~~	~~159.125.62.204 (159.125.62.200/ 29)~~
~~159.125.61.205 (159.125.61.200/ 29)~~	~~159.125.62.205 (159.125.62.200/ 29)~~
~~159.125.61.217 (159.125.61.216/ 29)~~	~~159.125.62.217 (159.125.62.216/ 29)~~
~~159.125.61.218 (159.125.61.216/ 29)~~	~~159.125.62.218 (159.125.62.216/ 29)~~

APPENDIX B - Primary Data Center Source Addresses, cont'd

NOTE: THE BELOW SOURCE ADDRESSES IS SCHEDULED FOR DECOMMISSION BY END OF MARCH 2017.

Service:	**CTS/CQS/OPRA**
Data Function Type:	**Production Retransmission/Afterhours Playback Test**

IP addresses listed as the source address in the Multicast packets (network number in parenthesis)

Odd Subnets (.41 / .53 / .61)	**Even Subnets (.42 / .54 /.62)**
~~159.125.41.97 (159.125.41.96/ 29)~~	~~159.125.42.97 (159.125.42.96/ 29)~~
~~159.125.41.98 (159.125.41.96/ 29)~~	~~159.125.42.98 (159.125.42.96/ 29)~~
~~159.125.41.99 (159.125.41.96/ 29)~~	~~159.125.42.99 (159.125.42.96/ 29)~~
~~159.125.41.100 (159.125.41.96/ 29)~~	~~159.125.42.100 (159.125.42.96/ 29)~~
~~159.125.41.101 (159.125.41.96/ 29)~~	~~159.125.42.101 (159.125.42.96/ 29)~~
~~159.125.41.105 (159.125.41.104/ 29)~~	~~159.125.42.105 (159.125.42.104/ 29)~~
~~159.125.41.106 (159.125.41.104/ 29)~~	~~159.125.42.106 (159.125.42.104/ 29)~~
~~159.125.41.107 (159.125.41.104/ 29)~~	~~159.125.42.107 (159.125.42.104/ 29)~~
~~159.125.41.108 (159.125.41.104/ 29)~~	~~159.125.42.108 (159.125.42.104/ 29)~~
~~159.125.41.109 (159.125.41.104/ 29)~~	~~159.125.42.109 (159.125.42.104/ 29)~~
~~159.125.41.225 (159.125.41.224/ 29)~~	~~159.125.42.225 (159.125.42.224/ 29)~~
~~159.125.41.226 (159.125.41.224/ 29)~~	~~159.125.42.226 (159.125.42.224/ 29)~~
~~159.125.53.142 (159.125.53.128/ 27)~~	~~159.125.54.142 (159.125.54.128/ 27)~~
~~159.125.53.143 (159.125.53. 128/ 27)~~	~~159.125.54.143 (159.125.54. 128/ 27)~~
~~159.125.53.144 (159.125.53. 128/ 27)~~	~~159.125.54.144 (159.125.54. 128/ 27)~~
~~159.125.53.145 (159.125.53. 128/ 27)~~	~~159.125.54.145 (159.125.54. 128/ 27)~~
~~159.125.53.146 (159.125.53. 128/ 27)~~	~~159.125.54.146 (159.125.54. 128/ 27)~~
~~159.125.53.147 (159.125.53. 128/ 27)~~	~~159.125.54.147 (159.125.54. 128/ 27)~~
~~159.125.53.148 (159.125.53. 128/ 27)~~	~~159.125.54.148 (159.125.54. 128/ 27)~~
~~159.125.53.149 (159.125.53. 128/ 27)~~	~~159.125.54.149 (159.125.54. 128/ 27)~~
~~159.125.53.150 (159.125.53. 128/ 27)~~	~~159.125.54.150 (159.125.54. 128/ 27)~~
~~159.125.53.151 (159.125.53. 128/ 27)~~	~~159.125.54.151 (159.125.54. 128/ 27)~~
~~159.125.53.152 (159.125.53. 128/ 27)~~	~~159.125.54.152 (159.125.54. 128/ 27)~~
~~159.125.53.153 (159.125.53. 128/ 27)~~	~~159.125.54.153 (159.125.54. 128/ 27)~~
~~159.125.61.97 (159.125.61.96/ 29)~~	~~159.125.62.97 (159.125.62.96/ 29)~~
~~159.125.61.98 (159.125.61.96/ 29)~~	~~159.125.62.98 (159.125.62.96/ 29)~~
~~159.125.61.99 (159.125.61.96/ 29)~~	~~159.125.62.99 (159.125.62.96/ 29)~~
~~159.125.61.100 (159.125.61.96/ 29)~~	~~159.125.62.100 (159.125.62.96/ 29)~~
~~159.125.61.101 (159.125.61.96/ 29)~~	~~159.125.62.101 (159.125.62.96/ 29)~~
~~159.125.61.105 (159.125.61.104/ 29)~~	~~159.125.62.105 (159.125.62.104/ 29)~~
~~159.125.61.106 (159.125.61.104/ 29)~~	~~159.125.62.106 (159.125.62.104/ 29)~~
~~159.125.61.107 (159.125.61.104/ 29)~~	~~159.125.62.107 (159.125.62.104/ 29)~~
~~159.125.61.108 (159.125.61.104/ 29)~~	~~159.125.62.108 (159.125.62.104/ 29)~~
~~159.125.61.109 (159.125.61.104/ 29)~~	~~159.125.62.109 (159.125.62.104/ 29)~~
~~159.125.61.225 (159.125.61.224/ 29)~~	~~159.125.62.225 (159.125.62.224/ 29)~~
~~159.125.61.226 (159.125.61.224/ 29)~~	~~159.125.62.226 (159.125.62.224/ 29)~~

APPENDIX B - Primary Data Center Source Addresses, cont'd

NOTE: THE BELOW SOURCE ADDRESSES IS SCHEDULED FOR DECOMMISSION BY END OF MARCH 2017.

Service:	**OPRA/Time Beacon**
Data Function Type:	**Production (A Stream)**
IP addresses listed as the source address in the Multicast packets (network number in parenthesis)	
Odd Subnets (.53 / .61)	**Even Subnets (.54 /.62)**
~~159.125.53.1 (159.125.53.0/ 27)~~	~~159.125.54.1 (159.125.54.0/ 27)~~
~~159.125.53.2 (159.125.53. 0/ 27)~~	~~159.125.54.2 (159.125.54. 0/ 27)~~
~~159.125.53.3 (159.125.53. 0/ 27)~~	~~159.125.54.3 (159.125.54. 0/ 27)~~
~~159.125.53.4 (159.125.53. 0/ 27)~~	~~159.125.54.4 (159.125.54. 0/ 27)~~
~~159.125.53.5 (159.125.53. 0/ 27)~~	~~159.125.54.5 (159.125.54. 0/ 27)~~
~~159.125.53.6 (159.125.53. 0/ 27)~~	~~159.125.54.6 (159.125.54. 0/ 27)~~
~~159.125.53.7 (159.125.53. 0/ 27)~~	~~159.125.54.7 (159.125.54. 0/ 27)~~
~~159.125.53.8 (159.125.53. 0/ 27)~~	~~159.125.54.8 (159.125.54. 0/ 27)~~
~~159.125.53.9 (159.125.53. 0/ 27)~~	~~159.125.54.9 (159.125.54. 0/ 27)~~
~~159.125.53.10 (159.125.53. 0/ 27)~~	~~159.125.54.10 (159.125.54. 0/ 27)~~
~~159.125.53.11 (159.125.53. 0/ 27)~~	~~159.125.54.11 (159.125.54. 0/ 27)~~
~~159.125.53.12 (159.125.53. 0/ 27)~~	~~159.125.54.12 (159.125.54. 0/ 27)~~
~~159.125.53.13 (159.125.53. 0/ 27)~~	~~159.125.54.13 (159.125.54. 0/ 27)~~
~~159.125.53.14 (159.125.53. 0/ 27)~~	~~159.125.54.14 (159.125.54. 0/ 27)~~
~~159.125.53.15 (159.125.53. 0/ 27)~~	~~159.125.54.15 (159.125.54. 0/ 27)~~
~~159.125.53.16 (159.125.53. 0/ 27)~~	~~159.125.54.16 (159.125.54. 0/ 27)~~
~~159.125.53.17 (159.125.53. 0/ 27)~~	~~159.125.54.17 (159.125.54. 0/ 27)~~
~~159.125.53.18 (159.125.53. 0/ 27)~~	~~159.125.54.18 (159.125.54. 0/ 27)~~
~~159.125.53.19 (159.125.53. 0/ 27)~~	~~159.125.54.19 (159.125.54. 0/ 27)~~
~~159.125.53.20 (159.125.53. 0/ 27)~~	~~159.125.54.20 (159.125.54. 0/ 27)~~
~~159.125.53.21 (159.125.53. 0/ 27)~~	~~159.125.54.21 (159.125.54. 0/ 27)~~
~~159.125.53.22 (159.125.53. 0/ 27)~~	~~159.125.54.22 (159.125.54. 0/ 27)~~
~~159.125.53.23 (159.125.53. 0/ 27)~~	~~159.125.54.23 (159.125.54. 0/ 27)~~
~~159.125.53.24 (159.125.53. 0/ 27)~~	~~159.125.54.24 (159.125.54. 0/ 27)~~
~~159.125.61.49 (159.125.61.48/ 29)~~	~~159.125.62.49 (159.125.62.48/ 29)~~
~~159.125.61.50 (159.125.61.48/ 29)~~	~~159.125.62.50 (159.125.62.48/ 29)~~
~~159.125.61.51 (159.125.61.48/ 29)~~	~~159.125.62.51 (159.125.62.48/ 29)~~
~~159.125.61.52 (159.125.61.48/ 29)~~	~~159.125.62.52 (159.125.62.48/ 29)~~
~~159.125.61.53 (159.125.61.48/ 29)~~	~~159.125.62.53 (159.125.62.48/ 29)~~
~~159.125.61.153 (159.125.61.152/ 29)~~	~~159.125.62.153 (159.125.62.152/ 29)~~
~~159.125.61.154 (159.125.61.152/ 29)~~	~~159.125.62.154 (159.125.62.152/ 29)~~
~~159.125.61.155 (159.125.61.152/ 29)~~	~~159.125.62.155 (159.125.62.152/ 29)~~

APPENDIX B - Primary Data Center Source Addresses, cont'd

NOTE: THE BELOW SOURCE ADDRESSES IS SCHEDULED FOR DECOMMISSION BY END OF MARCH 2017.

Service:	**OPRA/Time Beacon**
Data Function Type:	**Production (B Stream)**
IP addresses listed as the source address in the Multicast packets (network number in parenthesis)	
Odd Subnets (.53 / .61)	**Even Subnets (.54 /.62)**
~~159.125.53.33 (159.125.53.32/ 27)~~	~~159.125.54.33 (159.125.54.32/ 27)~~
~~159.125.53.34 (159.125.53. 32/ 27)~~	~~159.125.54.34 (159.125.54. 32/ 27)~~
~~159.125.53.35 (159.125.53. 32/ 27)~~	~~159.125.54.35 (159.125.54. 32/ 27)~~
~~159.125.53.36 (159.125.53. 32/ 27)~~	~~159.125.54.36 (159.125.54. 32/ 27)~~
~~159.125.53.37 (159.125.53. 32/ 27)~~	~~159.125.54.37 (159.125.54. 32/ 27)~~
~~159.125.53.38 (159.125.53. 32/ 27)~~	~~159.125.54.38 (159.125.54. 32/ 27)~~
~~159.125.53.39 (159.125.53. 32/ 27)~~	~~159.125.54.39 (159.125.54. 32/ 27)~~
~~159.125.53.40 (159.125.53. 32/ 27)~~	~~159.125.54.40 (159.125.54. 32/ 27)~~
~~159.125.53.41 (159.125.53. 32/ 27)~~	~~159.125.54.41 (159.125.54. 32/ 27)~~
~~159.125.53.42 (159.125.53. 32/ 27)~~	~~159.125.54.42 (159.125.54. 32/ 27)~~
~~159.125.53.43 (159.125.53. 32/ 27)~~	~~159.125.54.43 (159.125.54. 32/ 27)~~
~~159.125.53.44 (159.125.53. 32/ 27)~~	~~159.125.54.44 (159.125.54. 32/ 27)~~
~~159.125.53.45 (159.125.53. 32/ 27)~~	~~159.125.54.45 (159.125.54. 32/ 27)~~
~~159.125.53.46 (159.125.53. 32/ 27)~~	~~159.125.54.46 (159.125.54. 32/ 27)~~
~~159.125.53.47 (159.125.53. 32/ 27)~~	~~159.125.54.47 (159.125.54. 32/ 27)~~
~~159.125.53.48 (159.125.53. 32/ 27)~~	~~159.125.54.48 (159.125.54. 32/ 27)~~
~~159.125.53.49 (159.125.53. 32/ 27)~~	~~159.125.54.49 (159.125.54. 32/ 27)~~
~~159.125.53.50 (159.125.53. 32/ 27)~~	~~159.125.54.50 (159.125.54. 32/ 27)~~
~~159.125.53.51 (159.125.53. 32/ 27)~~	~~159.125.54.51 (159.125.54. 32/ 27)~~
~~159.125.53.52 (159.125.53. 32/ 27)~~	~~159.125.54.52 (159.125.54. 32/ 27)~~
~~159.125.53.53 (159.125.53. 32/ 27)~~	~~159.125.54.53 (159.125.54. 32/ 27)~~
~~159.125.53.54 (159.125.53. 32/ 27)~~	~~159.125.54.54 (159.125.54. 32/ 27)~~
~~159.125.53.55 (159.125.53. 32/ 27)~~	~~159.125.54.55 (159.125.54. 32/ 27)~~
~~159.125.53.56 (159.125.53. 32/ 27)~~	~~159.125.54.56 (159.125.54. 32/ 27)~~
~~159.125.61.73 (159.125.61.72/ 29)~~	~~159.125.62.73 (159.125.62.72/ 29)~~
~~159.125.61.74 (159.125.61.72/ 29)~~	~~159.125.62.74 (159.125.62.72/ 29)~~
~~159.125.61.75 (159.125.61.72/ 29)~~	~~159.125.62.75 (159.125.62.72/ 29)~~
~~159.125.61.76 (159.125.61.72/ 29)~~	~~159.125.62.76 (159.125.62.72/ 29)~~
~~159.125.61.77 (159.125.61.72/ 29)~~	~~159.125.62.77 (159.125.62.72/ 29)~~
~~159.125.61.185 (159.125.61.184/ 29)~~	~~159.125.62.185 (159.125.62.184/ 29)~~
~~159.125.61.186 (159.125.61.184/ 29)~~	~~159.125.62.186 (159.125.62.184/ 29)~~
~~159.125.61.187 (159.125.61.184/ 29)~~	~~159.125.62.187 (159.125.62.184/ 29)~~

8 Appendix C – Disaster Recovery Data Center Source Addresses

The following table lists all the possible source IP addresses associated with the each of the NMS Multicast Data services.

NOTE: THE BELOW SOURCE ADDRESSES HAVE BEEN DECOMMISSIONED AS OF DECEMBER 2016. THE SOURCE ADDRESSES BELOW WILL BE REMOVED FROM THIS DOCUMENT IN THE NEXT UPDATE.

Service:	**CTS/CQS/Time Beacon**
Data Function Type:	**Production (A Stream)**
IP addresses listed as the source address in the Multicast packets (network number in parenthesis)	
Odd Subnets (.41 / .61)	**Even Subnets (.42 / .62)**
~~198.140.41.113 (198.140.41.112/ 29)~~ ~~198.140.41.114 (198.140.41.112/ 29)~~ ~~198.140.41.161 (198.140.41.160/ 29)~~ ~~198.140.41.162 (198.140.41.160/ 29)~~ ~~198.140.41.163 (198.140.41.160/ 29)~~ ~~198.140.41.164 (198.140.41.160/ 29)~~ ~~198.140.41.165 (198.140.41.160/ 29)~~ ~~198.140.61.113 (198.140.61.112/ 29)~~ ~~198.140.61.114 (198.140.61.112/ 29)~~ ~~198.140.61.161 (198.140.61.160/ 29)~~ ~~198.140.61.162 (198.140.61.160/ 29)~~ ~~198.140.61.163 (198.140.61.160/ 29)~~ ~~198.140.61.164 (198.140.61.160/ 29)~~ ~~198.140.61.165 (198.140.61.160/ 29)~~	~~198.140.42.113 (198.140.42.112/ 29)~~ ~~198.140.42.114 (198.140.42.112/ 29)~~ ~~198.140.42.161 (198.140.42.160/ 29)~~ ~~198.140.42.162 (198.140.42.160/ 29)~~ ~~198.140.42.163 (198.140.42.160/ 29)~~ ~~198.140.42.164 (198.140.42.160/ 29)~~ ~~198.140.42.165 (198.140.42.160/ 29)~~ ~~198.140.62.113 (198.140.62.112/ 29)~~ ~~198.140.62.114 (198.140.62.112/ 29)~~ ~~198.140.62.161 (198.140.62.160/ 29)~~ ~~198.140.62.162 (198.140.62.160/ 29)~~ ~~198.140.62.163 (198.140.62.160/ 29)~~ ~~198.140.62.164 (198.140.62.160/ 29)~~ ~~198.140.62.165 (198.140.62.160/ 29)~~

Appendix C - Disaster Recovery Data Center Source Addresses, cont'd

The following table lists all the possible source IP addresses associated with the each of the NMS Multicast Data services.

NOTE: THE BELOW SOURCE ADDRESSES HAVE BEEN DECOMMISSIONED AS OF DECEMBER 2016. THE SOURCE ADDRESSES BELOW WILL BE REMOVED FROM THIS DOCUMENT IN THE NEXT UPDATE.

Service:	**CTS/CQS/Time Beacon**
Data Function Type:	**Production (B Stream)**
IP addresses listed as the source address in the Multicast packets (network number in parenthesis)	
Odd Subnets (.41 / .61)	**Even Subnets (.42 / .62)**
~~198.140.41.121 (198.140.41.120/ 29)~~ ~~198.140.41.122 (198.140.41.120/ 29)~~ ~~198.140.41.169 (198.140.41.168/ 29)~~ ~~198.140.41.170 (198.140.41.168/ 29)~~ ~~198.140.41.171 (198.140.41.168/ 29)~~ ~~198.140.41.172 (198.140.41.168/ 29)~~ ~~198.140.41.173 (198.140.41.168/ 29)~~ ~~198.140.61.121 (198.140.61.120/ 29)~~ ~~198.140.61.122 (198.140.61.120/ 29)~~ ~~198.140.61.169 (198.140.61.168/ 29)~~ ~~198.140.61.170 (198.140.61.168/ 29)~~ ~~198.140.61.171 (198.140.61.168/ 29)~~ ~~198.140.61.172 (198.140.61.168/ 29)~~ ~~198.140.61.173 (198.140.61.168/ 29)~~	~~198.140.42.121 (198.140.42.120/ 29)~~ ~~198.140.42.122 (198.140.42.120/ 29)~~ ~~198.140.42.169 (198.140.42.168/ 29)~~ ~~198.140.42.170 (198.140.42.168/ 29)~~ ~~198.140.42.171 (198.140.42.168/ 29)~~ ~~198.140.42.172 (198.140.42.168/ 29)~~ ~~198.140.42.173 (198.140.42.168/ 29)~~ ~~198.140.62.121 (198.140.62.120/ 29)~~ ~~198.140.62.122 (198.140.62.120/ 29)~~ ~~198.140.62.169 (198.140.62.168/ 29)~~ ~~198.140.62.170 (198.140.62.168/ 29)~~ ~~198.140.62.171 (198.140.62.168/ 29)~~ ~~198.140.62.172 (198.140.62.168/ 29)~~ ~~198.140.62.173 (198.140.62.168/ 29)~~

Appendix C - Disaster Recovery Data Center Source Addresses, cont'd

NOTE: THE BELOW SOURCE ADDRESSES IS SCHEDULED FOR DECOMMISSION BY END OF MARCH 2017.

Service:	**CTS/CQS/OPRA**
Data Function Type:	**After-hours Playback, Production (A Stream)**

IP addresses listed as the source address in the Multicast packets (network number in parenthesis)

Odd Subnets (.41 / .53 / .61)	Even Subnets (.42 / .54 /.62)
~~198.140.41.65 (198.140.41.64/ 29)~~	~~198.140.42.65 (198.140.42.64/ 29)~~
~~198.140.41.66 (198.140.41.64/ 29)~~	~~198.140.42.66 (198.140.42.64/ 29)~~
~~198.140.41.67 (198.140.41.64/ 29)~~	~~198.140.42.67 (198.140.42.64/ 29)~~
~~198.140.41.68 (198.140.41.64/ 29)~~	~~198.140.42.68 (198.140.42.64/ 29)~~
~~198.140.41.69 (198.140.41.64/ 29)~~	~~198.140.42.69 (198.140.42.64/ 29)~~
~~198.140.41.193 (198.140.41.192/ 29)~~	~~198.140.42.193 (198.140.42.192/ 29)~~
~~198.140.41.194 (198.140.41.192/ 29)~~	~~198.140.42.194 (198.140.42.192/ 29)~~
~~198.140.41.195 (198.140.41.192/ 29)~~	~~198.140.42.195 (198.140.42.192/ 29)~~
~~198.140.41.196 (198.140.41.192/ 29)~~	~~198.140.42.196 (198.140.42.192/ 29)~~
~~198.140.41.197 (198.140.41.192/ 29)~~	~~198.140.42.197 (198.140.42.192/ 29)~~
~~198.140.41.209 (198.140.41.208/ 29)~~	~~198.140.42.209 (198.140.42.208/ 29)~~
~~198.140.41.210 (198.140.41.208/ 29)~~	~~198.140.42.210 (198.140.42.208/ 29)~~
~~198.140.53.78 (198.140.53.64/ 27)~~	~~198.140.54.78 (198.140.54.64/ 27)~~
~~198.140.53.79 (198.140.53. 64/ 27)~~	~~198.140.54.79 (198.140.54. 64/ 27)~~
~~198.140.53.80 (198.140.53. 64/ 27)~~	~~198.140.54.80 (198.140.54. 64/ 27)~~
~~198.140.53.81 (198.140.53. 64/ 27)~~	~~198.140.54.81 (198.140.54. 64/ 27)~~
~~198.140.53.82 (198.140.53. 64/ 27)~~	~~198.140.54.82 (198.140.54. 64/ 27)~~
~~198.140.53.83 (198.140.53. 64/ 27)~~	~~198.140.54.83 (198.140.54. 64/ 27)~~
~~198.140.53.84 (198.140.53. 64/ 27)~~	~~198.140.54.84 (198.140.54. 64/ 27)~~
~~198.140.53.85 (198.140.53. 64/ 27)~~	~~198.140.54.85 (198.140.54. 64/ 27)~~
~~198.140.53.86 (198.140.53. 64/ 27)~~	~~198.140.54.86 (198.140.54. 64/ 27)~~
~~198.140.53.87 (198.140.53. 64/ 27)~~	~~198.140.54.87 (198.140.54. 64/ 27)~~
~~198.140.53.88 (198.140.53. 64/ 27)~~	~~198.140.54.88 (198.140.54. 64/ 27)~~
~~198.140.53.89 (198.140.53. 64/ 27)~~	~~198.140.54.89 (198.140.54. 64/ 27)~~
~~198.140.61.65 (198.140.61.64/ 29)~~	~~198.140.62.65 (198.140.62.64/ 29)~~
~~198.140.61.66 (198.140.61.64/ 29)~~	~~198.140.62.66 (198.140.62.64/ 29)~~
~~198.140.61.67 (198.140.61.64/ 29)~~	~~198.140.62.67 (198.140.62.64/ 29)~~
~~198.140.61.68 (198.140.61.64/ 29)~~	~~198.140.62.68 (198.140.62.64/ 29)~~
~~198.140.61.69 (198.140.61.64/ 29)~~	~~198.140.62.69 (198.140.62.64/ 29)~~
~~198.140.61.193 (198.140.61.192/ 29)~~	~~198.140.62.193 (198.140.62.192/ 29)~~
~~198.140.61.194 (198.140.61.192/ 29)~~	~~198.140.62.194 (198.140.62.192/ 29)~~
~~198.140.61.195 (198.140.61.192/ 29)~~	~~198.140.62.195 (198.140.62.192/ 29)~~
~~198.140.61.196 (198.140.61.192/ 29)~~	~~198.140.62.196 (198.140.62.192/ 29)~~
~~198.140.61.197 (198.140.61.192/ 29)~~	~~198.140.62.197 (198.140.62.192/ 29)~~
~~198.140.61.209 (198.140.61.208/ 29)~~	~~198.140.62.209 (198.140.62.208/ 29)~~
~~198.140.61.210 (198.140.61.208/ 29)~~	~~198.140.62.210 (198.140.62.208/ 29)~~

Appendix C - Disaster Recovery Data Center Source Addresses, cont'd

NOTE: THE BELOW SOURCE ADDRESSES IS SCHEDULED FOR DECOMMISSION BY END OF MARCH 2017.

Service:	**CTS/CQS/OPRA**
Data Function Type:	**After-hours Playback, Production (B Stream)**

IP addresses listed as the source address in the Multicast packets (network number in parenthesis)

Odd Subnets (.41 / .53 / .61)	Even Subnets (.42 / .54 /.62)
~~198.140.41.89 (198.140.41.88/ 29)~~	~~198.140.42.89 (198.140.42.88/ 29)~~
~~198.140.41.90 (198.140.41.88/ 29)~~	~~198.140.42.90 (198.140.42.88/ 29)~~
~~198.140.41.91 (198.140.41.88/ 29)~~	~~198.140.42.91 (198.140.42.88/ 29)~~
~~198.140.41.92 (198.140.41.88/ 29)~~	~~198.140.42.92 (198.140.42.88/ 29)~~
~~198.140.41.93 (198.140.41.88/ 29)~~	~~198.140.42.93 (198.140.42.88/ 29)~~
~~198.140.41.201 (198.140.41.200/ 29)~~	~~198.140.42.201 (198.140.42.200/ 29)~~
~~198.140.41.202 (198.140.41.200/ 29)~~	~~198.140.42.202 (198.140.42.200/ 29)~~
~~198.140.41.203 (198.140.41.200/ 29)~~	~~198.140.42.203 (198.140.42.200/ 29)~~
~~198.140.41.204 (198.140.41.200/ 29)~~	~~198.140.42.204 (198.140.42.200/ 29)~~
~~198.140.41.205 (198.140.41.200/ 29)~~	~~198.140.42.205 (198.140.42.200/ 29)~~
~~198.140.41.217 (198.140.41.216/ 29)~~	~~198.140.42.217 (198.140.42.216/ 29)~~
~~198.140.41.218 (198.140.41.216/ 29)~~	~~198.140.42.218 (198.140.42.216/ 29)~~
~~198.140.53.110 (198.140.53.96/ 27)~~	~~198.140.54.110 (198.140.54.96/ 27)~~
~~198.140.53.111 (198.140.53. 96/ 27)~~	~~198.140.54.111 (198.140.54. 96/ 27)~~
~~198.140.53.112 (198.140.53. 96/ 27)~~	~~198.140.54.112 (198.140.54. 96/ 27)~~
~~198.140.53.113 (198.140.53. 96/ 27)~~	~~198.140.54.113 (198.140.54. 96/ 27)~~
~~198.140.53.114 (198.140.53. 96/ 27)~~	~~198.140.54.114 (198.140.54. 96/ 27)~~
~~198.140.53.115 (198.140.53. 96/ 27)~~	~~198.140.54.115 (198.140.54. 96/ 27)~~
~~198.140.53.116 (198.140.53. 96/ 27)~~	~~198.140.54.116 (198.140.54. 96/ 27)~~
~~198.140.53.117 (198.140.53. 96/ 27)~~	~~198.140.54.117 (198.140.54. 96/ 27)~~
~~198.140.53.118 (198.140.53. 96/ 27)~~	~~198.140.54.118 (198.140.54. 96/ 27)~~
~~198.140.53.119 (198.140.53. 96/ 27)~~	~~198.140.54.119 (198.140.54. 96/ 27)~~
~~198.140.53.120 (198.140.53. 96/ 27)~~	~~198.140.54.120 (198.140.54. 96/ 27)~~
~~198.140.53.121 (198.140.53. 96/ 27)~~	~~198.140.54.121 (198.140.54. 96/ 27)~~
~~198.140.61.89 (198.140.61.88/ 29)~~	~~198.140.62.89 (198.140.62.88/ 29)~~
~~198.140.61.90 (198.140.61.88/ 29)~~	~~198.140.62.90 (198.140.62.88/ 29)~~
~~198.140.61.91 (198.140.61.88/ 29)~~	~~198.140.62.91 (198.140.62.88/ 29)~~
~~198.140.61.92 (198.140.61.88/ 29)~~	~~198.140.62.92 (198.140.62.88/ 29)~~
~~198.140.61.93 (198.140.61.88/ 29)~~	~~198.140.62.93 (198.140.62.88/ 29)~~
~~198.140.61.201 (198.140.61.200/ 29)~~	~~198.140.62.201 (198.140.62.200/ 29)~~
~~198.140.61.202 (198.140.61.200/ 29)~~	~~198.140.62.202 (198.140.62.200/ 29)~~
~~198.140.61.203 (198.140.61.200/ 29)~~	~~198.140.62.203 (198.140.62.200/ 29)~~
~~198.140.61.204 (198.140.61.200/ 29)~~	~~198.140.62.204 (198.140.62.200/ 29)~~
~~198.140.61.205 (198.140.61.200/ 29)~~	~~198.140.62.205 (198.140.62.200/ 29)~~
~~198.140.61.217 (198.140.61.216/ 29)~~	~~198.140.62.217 (198.140.62.216/ 29)~~
~~198.140.61.218 (198.140.61.216/ 29)~~	~~198.140.62.218 (198.140.62.216/ 29)~~

Appendix C - Disaster Recovery Data Center Source Addresses, cont'd

NOTE: THE BELOW SOURCE ADDRESSES IS SCHEDULED FOR DECOMMISSION BY END OF MARCH 2017.

Service:	**CTS/CQS/OPRA**
Data Function Type:	**Production Retransmission/Afterhours Playback Test**

IP addresses listed as the source address in the Multicast packets (network number in parenthesis)

Odd Subnets (.41 / .53 / .61)	Even Subnets (.42 / .54 /.62)
~~198.140.41.97 (198.140.41.96/ 29)~~	~~198.140.42.97 (198.140.42.96/ 29)~~
~~198.140.41.98 (198.140.41.96/ 29)~~	~~198.140.42.98 (198.140.42.96/ 29)~~
~~198.140.41.99 (198.140.41.96/ 29)~~	~~198.140.42.99 (198.140.42.96/ 29)~~
~~198.140.41.100 (198.140.41.96/ 29)~~	~~198.140.42.100 (198.140.42.96/ 29)~~
~~198.140.41.101 (198.140.41.96/ 29)~~	~~198.140.42.101 (198.140.42.96/ 29)~~
~~198.140.41.105 (198.140.41.104/ 29)~~	~~198.140.42.105 (198.140.42.104/ 29)~~
~~198.140.41.106 (198.140.41.104/ 29)~~	~~198.140.42.106 (198.140.42.104/ 29)~~
~~198.140.41.107 (198.140.41.104/ 29)~~	~~198.140.42.107 (198.140.42.104/ 29)~~
~~198.140.41.108 (198.140.41.104/ 29)~~	~~198.140.42.108 (198.140.42.104/ 29)~~
~~198.140.41.109 (198.140.41.104/ 29)~~	~~198.140.42.109 (198.140.42.104/ 29)~~
~~198.140.41.225 (198.140.41.224/ 29)~~	~~198.140.42.225 (198.140.42.224/ 29)~~
~~198.140.41.226 (198.140.41.224/ 29)~~	~~198.140.42.226 (198.140.42.224/ 29)~~
~~198.140.53.142 (198.140.53.128/ 27)~~	~~198.140.54.142 (198.140.54.128/ 27)~~
~~198.140.53.143 (198.140.53. 128/ 27)~~	~~198.140.54.143 (198.140.54. 128/ 27)~~
~~198.140.53.144 (198.140.53. 128/ 27)~~	~~198.140.54.144 (198.140.54. 128/ 27)~~
~~198.140.53.145 (198.140.53. 128/ 27)~~	~~198.140.54.145 (198.140.54. 128/ 27)~~
~~198.140.53.146 (198.140.53. 128/ 27)~~	~~198.140.54.146 (198.140.54. 128/ 27)~~
~~198.140.53.147 (198.140.53. 128/ 27)~~	~~198.140.54.147 (198.140.54. 128/ 27)~~
~~198.140.53.148 (198.140.53. 128/ 27)~~	~~198.140.54.148 (198.140.54. 128/ 27)~~
~~198.140.53.149 (198.140.53. 128/ 27)~~	~~198.140.54.149 (198.140.54. 128/ 27)~~
~~198.140.53.150 (198.140.53. 128/ 27)~~	~~198.140.54.150 (198.140.54. 128/ 27)~~
~~198.140.53.151 (198.140.53. 128/ 27)~~	~~198.140.54.151 (198.140.54. 128/ 27)~~
~~198.140.53.152 (198.140.53. 128/ 27)~~	~~198.140.54.152 (198.140.54. 128/ 27)~~
~~198.140.53.153 (198.140.53. 128/ 27)~~	~~198.140.54.153 (198.140.54. 128/ 27)~~
~~198.140.61.97 (198.140.61.96/ 29)~~	~~198.140.62.97 (198.140.62.96/ 29)~~
~~198.140.61.98 (198.140.61.96/ 29)~~	~~198.140.62.98 (198.140.62.96/ 29)~~
~~198.140.61.99 (198.140.61.96/ 29)~~	~~198.140.62.99 (198.140.62.96/ 29)~~
~~198.140.61.100 (198.140.61.96/ 29)~~	~~198.140.62.100 (198.140.62.96/ 29)~~
~~198.140.61.101 (198.140.61.96/ 29)~~	~~198.140.62.101 (198.140.62.96/ 29)~~
~~198.140.61.105 (198.140.61.104/ 29)~~	~~198.140.62.105 (198.140.62.104/ 29)~~
~~198.140.61.106 (198.140.61.104/ 29)~~	~~198.140.62.106 (198.140.62.104/ 29)~~
~~198.140.61.107 (198.140.61.104/ 29)~~	~~198.140.62.107 (198.140.62.104/ 29)~~
~~198.140.61.108 (198.140.61.104/ 29)~~	~~198.140.62.108 (198.140.62.104/ 29)~~
~~198.140.61.109 (198.140.61.104/ 29)~~	~~198.140.62.109 (198.140.62.104/ 29)~~
~~198.140.61.225 (198.140.61.224/ 29)~~	~~198.140.62.225 (198.140.62.224/ 29)~~
~~198.140.61.226 (198.140.61.224/ 29)~~	~~198.140.62.226 (198.140.62.224/ 29)~~

Appendix C - Disaster Recovery Data Center Source Addresses, cont'd

NOTE: THE BELOW SOURCE ADDRESSES IS SCHEDULED FOR DECOMMISSION BY END OF MARCH 2017.

Service:	**OPRA/Time Beacon**
Data Function Type:	**Production (A Stream)**

IP addresses listed as the source address in the Multicast packets (network number in parenthesis)

Odd Subnets (.41 / .61)	**Even Subnets (.42 / .62)**
~~198.140.41.49 (198.140.41.48/ 29)~~	~~198.140.42.49 (198.140.42.48/ 29)~~
~~198.140.41.50 (198.140.41.48/ 29)~~	~~198.140.42.50 (198.140.42.48/ 29)~~
~~198.140.41.51 (198.140.41.48/ 29)~~	~~198.140.42.51 (198.140.42.48/ 29)~~
~~198.140.41.52 (198.140.41.48/ 29)~~	~~198.140.42.52 (198.140.42.48/ 29)~~
~~198.140.41.53 (198.140.41.48/ 29)~~	~~198.140.42.53 (198.140.42.48/ 29)~~
~~198.140.41.57 (198.140.41.56/ 29)~~	~~198.140.42.57 (198.140.42.56/ 29)~~
~~198.140.41.58 (198.140.41.56/ 29)~~	~~198.140.42.58 (198.140.42.56/ 29)~~
~~198.140.41.59 (198.140.41.56/ 29)~~	~~198.140.42.59 (198.140.42.56/ 29)~~
~~198.140.41.60 (198.140.41.56/ 29)~~	~~198.140.42.60 (198.140.42.56/ 29)~~
~~198.140.41.61 (198.140.41.56/ 29)~~	~~198.140.42.61 (198.140.42.56/ 29)~~
~~198.140.41.153 (198.140.41.152/ 29)~~	~~198.140.42.153 (198.140.42.152/ 29)~~
~~198.140.41.154 (198.140.41.152/ 29)~~	~~198.140.42.154 (198.140.42.152/ 29)~~
~~198.140.61.49 (198.140.61.48/ 29)~~	~~198.140.62.49 (198.140.62.48/ 29)~~
~~198.140.61.50 (198.140.61.48/ 29)~~	~~198.140.62.50 (198.140.62.48/ 29)~~
~~198.140.61.51 (198.140.61.48/ 29)~~	~~198.140.62.51 (198.140.62.48/ 29)~~
~~198.140.61.52 (198.140.61.48/ 29)~~	~~198.140.62.52 (198.140.62.48/ 29)~~
~~198.140.61.53 (198.140.61.48/ 29)~~	~~198.140.62.53 (198.140.62.48/ 29)~~
~~198.140.61.57 (198.140.61.56/ 29)~~	~~198.140.62.57 (198.140.62.56/ 29)~~
~~198.140.61.58 (198.140.61.56/ 29)~~	~~198.140.62.58 (198.140.62.56/ 29)~~
~~198.140.61.59 (198.140.61.56/ 29)~~	~~198.140.62.59 (198.140.62.56/ 29)~~
~~198.140.61.60 (198.140.61.56/ 29)~~	~~198.140.62.60 (198.140.62.56/ 29)~~
~~198.140.61.61 (198.140.61.56/ 29)~~	~~198.140.62.61 (198.140.62.56/ 29)~~
~~198.140.61.153 (198.140.61.152/ 29)~~	~~198.140.62.153 (198.140.62.152/ 29)~~
~~198.140.61.154 (198.140.61.152/ 29)~~	~~198.140.62.154 (198.140.62.152/ 29)~~
~~198.140.61.155 (198.140.61.152/ 29)~~	~~198.140.62.155 (198.140.62.152/ 29)~~

Appendix C - Disaster Recovery Data Center Source Addresses, cont'd

NOTE: THE BELOW SOURCE ADDRESSES IS SCHEDULED FOR DECOMMISSION BY END OF MARCH 2017.

Service:	**OPRA/Time Beacon**
Data Function Type:	**Production (B Stream)**

IP addresses listed as the source address in the Multicast packets (network number in parenthesis)

Odd Subnets (.41 / .61)	**Even Subnets (.42 / .62)**
~~198.140.41.73 (198.140.41.72/ 29)~~ ~~198.140.41.74 (198.140.41.72/ 29)~~ ~~198.140.41.75 (198.140.41.72/ 29)~~ ~~198.140.41.76 (198.140.41.72/ 29)~~ ~~198.140.41.77 (198.140.41.72/ 29)~~ ~~198.140.41.81 (198.140.41.80/ 29)~~ ~~198.140.41.82 (198.140.41.80/ 29)~~ ~~198.140.41.83 (198.140.41.80/ 29)~~ ~~198.140.41.84 (198.140.41.80/ 29)~~ ~~198.140.41.85 (198.140.41.80/ 29)~~ ~~198.140.41.185 (198.140.41.184/ 29)~~ ~~198.140.41.186 (198.140.41.184/ 29)~~ ~~198.140.61.73 (198.140.61.72/ 29)~~ ~~198.140.61.74 (198.140.61.72/ 29)~~ ~~198.140.61.75 (198.140.61.72/ 29)~~ ~~198.140.61.76 (198.140.61.72/ 29)~~ ~~198.140.61.77 (198.140.61.72/ 29)~~ ~~198.140.61.81 (198.140.61.80/ 29)~~ ~~198.140.61.82 (198.140.61.80/ 29)~~ ~~198.140.61.83 (198.140.61.80/ 29)~~ ~~198.140.61.84 (198.140.61.80/ 29)~~ ~~198.140.61.85 (198.140.61.80/ 29)~~ ~~198.140.61.185 (198.140.61.184/ 29)~~ ~~198.140.61.186 (198.140.61.184/ 29)~~ ~~198.140.61.187 (198.140.61.184/ 29)~~	~~198.140.42.73 (198.140.42.72/ 29)~~ ~~198.140.42.74 (198.140.42.72/ 29)~~ ~~198.140.42.75 (198.140.42.72/ 29)~~ ~~198.140.42.76 (198.140.42.72/ 29)~~ ~~198.140.42.77 (198.140.42.72/ 29)~~ ~~198.140.42.81 (198.140.42.80/ 29)~~ ~~198.140.42.82 (198.140.42.80/ 29)~~ ~~198.140.42.83 (198.140.42.80/ 29)~~ ~~198.140.42.84 (198.140.42.80/ 29)~~ ~~198.140.42.85 (198.140.42.80/ 29)~~ ~~198.140.42.185 (198.140.42.184/ 29)~~ ~~198.140.42.186 (198.140.42.184/ 29)~~ ~~198.140.62.73 (198.140.62.72/ 29)~~ ~~198.140.62.74 (198.140.62.72/ 29)~~ ~~198.140.62.75 (198.140.62.72/ 29)~~ ~~198.140.62.76 (198.140.62.72/ 29)~~ ~~198.140.62.77 (198.140.62.72/ 29)~~ ~~198.140.62.81 (198.140.62.80/ 29)~~ ~~198.140.62.82 (198.140.62.80/ 29)~~ ~~198.140.62.83 (198.140.62.80/ 29)~~ ~~198.140.62.84 (198.140.62.80/ 29)~~ ~~198.140.62.85 (198.140.62.80/ 29)~~ ~~198.140.62.185 (198.140.62.184/ 29)~~ ~~198.140.62.186 (198.140.62.184/ 29)~~ ~~198.140.62.187 (198.140.62.184/ 29)~~

9 Appendix D - Time Beacon Message Format

The Time Beacon message is delivered as the data portion of a UDP/IP packet.

Each packet will contain a single message.

Each message is 14 bytes in length and consists of two fields, the Time Beacon Identifier and the Time Stamp and is formatted as shown below.

Time Beacon Identifier	Time Stamp
NN [2 Bytes]	**MMDDYYHHMMSS** [12 Bytes]

Description of each field:

Time Beacon Identifier:

2 Bytes, Numeric - Identifies the Time Beacon that initiated the message.
This number ranges from 01-99.

Time Stamp:

12 Bytes, Alphanumeric/Special Character - Format is MMDDYYHHMMSS where,

M=Month
D=Day
Y=Year
H=Hours (specified as '0' through '23', in the same manner as military time)
M=Minutes
S=Seconds

The time stamp will reflect the current local time of the United States' Eastern Time zone. The time stamp will reflect daylight savings time when in effect.

10 Appendix E - Primary Data Center Source Addresses

MULTICAST DATA SOURCE: PRODUCTION "A-STREAM" & PRODUCTION "B-STREAM"

PRODUCT NAME:	CTS / TIME BEACON				
NETWORK SUBNETS:	SIX (6) NETWORK SUBNET GROUPS PER DATA STREAM				
PRODUCTION "A – STREAM"					
ODD SUBNETS			EVEN SUBNETS		
159.125.47.0/27	159.125.47.32/27	159.125.47.64/27	159.125.46.0/27	159.125.46.32/27	159.125.46.64/27
159.125.47.1	159.125.47.33	159.125.47.65	159.125.46.1	159.125.46.33	159.125.46.65
159.125.47.2	159.125.47.34	159.125.47.66	159.125.46.2	159.125.46.34	159.125.46.66
159.125.47.3	159.125.47.35	159.125.47.67	159.125.46.3	159.125.46.35	159.125.46.67
159.125.47.4	159.125.47.36	159.125.47.68	159.125.46.4	159.125.46.36	159.125.46.68
159.125.47.5	159.125.47.37	159.125.47.69	159.125.46.5	159.125.46.37	159.125.46.69
159.125.47.6	159.125.47.38	159.125.47.70	159.125.46.6	159.125.46.38	159.125.46.70
159.125.47.7	159.125.47.39	159.125.47.71	159.125.46.7	159.125.46.39	159.125.46.71
159.125.47.8	159.125.47.40	159.125.47.72	159.125.46.8	159.125.46.40	159.125.46.72
159.125.47.9	159.125.47.41	159.125.47.73	159.125.46.9	159.125.46.41	159.125.46.73
159.125.47.10	159.125.47.42	159.125.47.74	159.125.46.10	159.125.46.42	159.125.46.74
159.125.47.11	159.125.47.43	159.125.47.75	159.125.46.11	159.125.46.43	159.125.46.75
159.125.47.12	159.125.47.44	159.125.47.76	159.125.46.12	159.125.46.44	159.125.46.76
159.125.47.13	159.125.47.45	159.125.47.77	159.125.46.13	159.125.46.45	159.125.46.77
PRODUCTION "B – STREAM"					
ODD SUBNETS			EVEN SUBNETS		
159.125.47.128/27	159.125.47.160/27	159.125.47.192/27	159.125.46.128/27	159.125.46.160/27	159.125.46.192/27
159.125.47.129	159.125.47.161	159.125.47.193	159.125.46.129	159.125.46.161	159.125.46.193
159.125.47.130	159.125.47.162	159.125.47.194	159.125.46.130	159.125.46.162	159.125.46.194
159.125.47.131	159.125.47.163	159.125.47.195	159.125.46.131	159.125.46.163	159.125.46.195
159.125.47.132	159.125.47.164	159.125.47.196	159.125.46.132	159.125.46.164	159.125.46.196
159.125.47.133	159.125.47.165	159.125.47.197	159.125.46.133	159.125.46.165	159.125.46.197
159.125.47.134	159.125.47.166	159.125.47.198	159.125.46.134	159.125.46.166	159.125.46.198
159.125.47.135	159.125.47.167	159.125.47.199	159.125.46.135	159.125.46.167	159.125.46.199
159.125.47.136	159.125.47.168	159.125.47.200	159.125.46.136	159.125.46.168	159.125.46.200
159.125.47.137	159.125.47.169	159.125.47.201	159.125.46.137	159.125.46.169	159.125.46.201
159.125.47.138	159.125.47.170	159.125.47.202	159.125.46.138	159.125.46.170	159.125.46.202
159.125.47.139	159.125.47.171	159.125.47.203	159.125.46.139	159.125.46.171	159.125.46.203
159.125.47.140	159.125.47.172	159.125.47.204	159.125.46.140	159.125.46.172	159.125.46.204
159.125.47.141	159.125.47.173	159.125.47.205	159.125.46.141	159.125.46.173	159.125.46.205

Note: Any of the above source addresses will be used to source CTS data over the Production Multicast Addresses located on page 24 and for Time Beacon on page 22.

Appendix E - Primary Data Center Source Addresses, cont'd

MULTICAST DATA SOURCE: PRODUCTION "A-STREAM" & PRODUCTION "B-STREAM"

PRODUCT NAME:	CQS / TIME BEACON				
NETWORK SUBNETS:	SIX (6) NETWORK SUBNET GROUPS PER DATA STREAM				
PRODUCTION "A – STREAM"					
ODD SUBNETS			EVEN SUBNETS		
159.125.49.0/27	159.125.49.32/27	159.125.49.64/27	159.125.48.0/27	159.125.48.32/27	159.125.48.64/27
159.125.49.1	159.125.49.33	159.125.49.65	159.125.48.1	159.125.48.33	159.125.48.65
159.125.49.2	159.125.49.34	159.125.49.66	159.125.48.2	159.125.48.34	159.125.48.66
159.125.49.3	159.125.49.35	159.125.49.67	159.125.48.3	159.125.48.35	159.125.48.67
159.125.49.4	159.125.49.36	159.125.49.68	159.125.48.4	159.125.48.36	159.125.48.68
159.125.49.5	159.125.49.37	159.125.49.69	159.125.48.5	159.125.48.37	159.125.48.69
159.125.49.6	159.125.49.38	159.125.49.70	159.125.48.6	159.125.48.38	159.125.48.70
159.125.49.7	159.125.49.39	159.125.49.71	159.125.48.7	159.125.48.39	159.125.48.71
159.125.49.8	159.125.49.40	159.125.49.72	159.125.48.8	159.125.48.40	159.125.48.72
159.125.49.9	159.125.49.41	159.125.49.73	159.125.48.9	159.125.48.41	159.125.48.73
159.125.49.10	159.125.49.42	159.125.49.74	159.125.48.10	159.125.48.42	159.125.48.74
159.125.49.11	159.125.49.43	159.125.49.75	159.125.48.11	159.125.48.43	159.125.48.75
159.125.49.12	159.125.49.44	159.125.49.76	159.125.48.12	159.125.48.44	159.125.48.76
159.125.49.13	159.125.49.45	159.125.49.77	159.125.48.13	159.125.48.45	159.125.48.77
PRODUCTION "B – STREAM"					
ODD SUBNETS			EVEN SUBNETS		
159.125.49.128/27	159.125.49.160/27	159.125.49.192/27	159.125.48.128/27	159.125.48.160/27	159.125.48.192/27
159.125.49.129	159.125.49.161	159.125.49.193	159.125.48.129	159.125.48.161	159.125.48.193
159.125.49.130	159.125.49.162	159.125.49.194	159.125.48.130	159.125.48.162	159.125.48.194
159.125.49.131	159.125.49.163	159.125.49.195	159.125.48.131	159.125.48.163	159.125.48.195
159.125.49.132	159.125.49.164	159.125.49.196	159.125.48.132	159.125.48.164	159.125.48.196
159.125.49.133	159.125.49.165	159.125.49.197	159.125.48.133	159.125.48.165	159.125.48.197
159.125.49.134	159.125.49.166	159.125.49.198	159.125.48.134	159.125.48.166	159.125.48.198
159.125.49.135	159.125.49.167	159.125.49.199	159.125.48.135	159.125.48.167	159.125.48.199
159.125.49.136	159.125.49.168	159.125.49.200	159.125.48.136	159.125.48.168	159.125.48.200
159.125.49.137	159.125.49.169	159.125.49.201	159.125.48.137	159.125.48.169	159.125.48.201
159.125.49.138	159.125.49.170	159.125.49.202	159.125.48.138	159.125.48.170	159.125.48.202
159.125.49.139	159.125.49.171	159.125.49.203	159.125.48.139	159.125.48.171	159.125.48.203
159.125.49.140	159.125.49.172	159.125.49.204	159.125.48.140	159.125.48.172	159.125.48.204
159.125.49.141	159.125.49.173	159.125.49.205	159.125.48.141	159.125.48.173	159.125.48.205

Note: Any of the above source addresses will be used to source CQS data over the Production Multicast Addresses located on page 23 and for Time Beacon on page 22.

Appendix E - Primary Data Center Source Addresses, cont'd

MULTICAST DATA SOURCE: PRODUCTION "A-STREAM" & PRODUCTION "B-STREAM"

PRODUCT NAME:	OPRA / TIME BEACON				
NETWORK SUBNETS:	SIX (6) NETWORK SUBNET GROUPS PER DATA STREAM				
PRODUCTION "A – STREAM"					
ODD SUBNETS			EVEN SUBNETS		
159.125.45.0/27	159.125.45.32/27	159.125.45.64/27	159.125.40.0/27	159.125.40.32/27	159.125.40.64/27
159.125.45.1	159.125.45.33	159.125.45.65	159.125.40.1	159.125.40.33	159.125.40.65
159.125.45.2	159.125.45.34	159.125.45.66	159.125.40.2	159.125.40.34	159.125.40.66
159.125.45.3	159.125.45.35	159.125.45.67	159.125.40.3	159.125.40.35	159.125.40.67
159.125.45.4	159.125.45.36	159.125.45.68	159.125.40.4	159.125.40.36	159.125.40.68
159.125.45.5	159.125.45.37	159.125.45.69	159.125.40.5	159.125.40.37	159.125.40.69
159.125.45.6	159.125.45.38	159.125.45.70	159.125.40.6	159.125.40.38	159.125.40.70
159.125.45.7	159.125.45.39	159.125.45.71	159.125.40.7	159.125.40.39	159.125.40.71
159.125.45.8	159.125.45.40	159.125.45.72	159.125.40.8	159.125.40.40	159.125.40.72
159.125.45.9	159.125.45.41	159.125.45.73	159.125.40.9	159.125.40.41	159.125.40.73
159.125.45.10	159.125.45.42	159.125.45.74	159.125.40.10	159.125.40.42	159.125.40.74
159.125.45.11	159.125.45.43	159.125.45.75	159.125.40.11	159.125.40.43	159.125.40.75
159.125.45.12	159.125.45.44	159.125.45.76	159.125.40.12	159.125.40.44	159.125.40.76
159.125.45.13	159.125.45.45	159.125.45.77	159.125.40.13	159.125.40.45	159.125.40.77
PRODUCTION "B – STREAM"					
ODD SUBNETS			EVEN SUBNETS		
159.125.45.128/27	159.125.45.160/27	159.125.45.192/27	159.125.40.128/27	159.125.40.160/27	159.125.40.192/27
159.125.45.129	159.125.45.161	159.125.45.193	159.125.40.129	159.125.40.161	159.125.40.193
159.125.45.130	159.125.45.162	159.125.45.194	159.125.40.130	159.125.40.162	159.125.40.194
159.125.45.131	159.125.45.163	159.125.45.195	159.125.40.131	159.125.40.163	159.125.40.195
159.125.45.132	159.125.45.164	159.125.45.196	159.125.40.132	159.125.40.164	159.125.40.196
159.125.45.133	159.125.45.165	159.125.45.197	159.125.40.133	159.125.40.165	159.125.40.197
159.125.45.134	159.125.45.166	159.125.45.198	159.125.40.134	159.125.40.166	159.125.40.198
159.125.45.135	159.125.45.167	159.125.45.199	159.125.40.135	159.125.40.167	159.125.40.199
159.125.45.136	159.125.45.168	159.125.45.200	159.125.40.136	159.125.40.168	159.125.40.200
159.125.45.137	159.125.45.169	159.125.45.201	159.125.40.137	159.125.40.169	159.125.40.201
159.125.45.138	159.125.45.170	159.125.45.202	159.125.40.138	159.125.40.170	159.125.40.202
159.125.45.139	159.125.45.171	159.125.45.203	159.125.40.139	159.125.40.171	159.125.40.203
159.125.45.140	159.125.45.172	159.125.45.204	159.125.40.140	159.125.40.172	159.125.40.204
159.125.45.141	159.125.45.173	159.125.45.205	159.125.40.141	159.125.40.173	159.125.40.205

Note: Any of the above source addresses will be used to source OPRA data over the Production Multicast Addresses located on page 25, for OPRA Extended Production Multicast Addresses on page 26 and for Time Beacon on page 22.

Appendix E - Primary Data Center Source Addresses, cont'd

MULTICAST DATA SOURCE: NON-PRODUCTION HOURS PRODUCTION "A-STREAM" & PRODUCTION "B-STREAM"

PRODUCT NAME:	CQS / CTS / OPRA
NETWORK SUBNETS:	TWO (2) NETWORK SUBNET GROUPS PER DATA STREAM
PRODUCTION "A – STREAM"	
ODD SUBNETS	EVEN SUBNETS
159.125.57.64/26	159.125.52.64/26
159.125.57.65	159.125.52.65
159.125.57.66	159.125.52.66
159.125.57.67	159.125.52.67
159.125.57.68	159.125.52.68
159.125.57.69	159.125.52.69
159.125.57.70	159.125.52.70
159.125.57.71	159.125.52.71
159.125.57.72	159.125.52.72
159.125.57.73	159.125.52.73
159.125.57.74	159.125.52.74
159.125.57.75	159.125.52.75
159.125.57.76	159.125.52.76
PRODUCTION "B – STREAM"	
ODD SUBNETS	EVEN SUBNETS
159.125.57.128/26	159.125.52.128/26
159.125.57.129	159.125.52.129
159.125.57.130	159.125.52.130
159.125.57.131	159.125.52.131
159.125.57.132	159.125.52.132
159.125.57.133	159.125.52.133
159.125.57.134	159.125.52.134
159.125.57.135	159.125.52.135
159.125.57.136	159.125.52.136
159.125.57.137	159.125.52.137
159.125.57.138	159.125.52.138
159.125.57.139	159.125.52.139
159.125.57.140	159.125.52.140

Note: Any of the above source addresses will be used to source CTS, CQS and OPRA data during non-production trading hours over the Production Multicast Addresses located on page 24 (CTS), page 23 (CQS), page 25 (OPRA) and page 26 (OPRA Extended).

Appendix E - Primary Data Center Source Addresses, cont'd

MULTICAST DATA SOURCE: PRODUCTION RETRANSMISSION & NON-PRODUCTION HOURS PLAYBACK TEST

PRODUCT NAME:	CQS / CTS / OPRA
NETWORK SUBNETS:	TWO (2) NETWORK SUBNET GROUPS SINGLE STREAM ONLY
RETRANSMISSION DATA SOURCE AND PLAYBACK TEST DATA SOURCE	
ODD SUBNETS	EVEN SUBNETS
159.125.57.0/26	159.125.52.0/26
159.125.57.1	159.125.52.1
159.125.57.2	159.125.52.2
159.125.57.3	159.125.52.3
159.125.57.4	159.125.52.4
159.125.57.5	159.125.52.5
159.125.57.6	159.125.52.6
159.125.57.7	159.125.52.7
159.125.57.8	159.125.52.8
159.125.57.9	159.125.52.9
159.125.57.10	159.125.52.10
159.125.57.11	159.125.52.11
159.125.57.12	159.125.52.12

Note: Any of the above source addresses will be used to source CQS, CTS and OPRA data over the Retransmission and Playback Test Multicast Addresses located on page 30 (CQS & CTS Retransmission – left side of page / Playback Test – right side of page) and page 32 (OPRA Retransmission – left side of page / Playback Test – right side of page) and page 33 (OPRA Extended Retransmission – left side of page / Playback Test – right side of page).

Appendix E - Disaster Recovery (Backup) Data Center Source Addresses

MULTICAST DATA SOURCE: PRODUCTION "A-STREAM" & PRODUCTION "B-STREAM"

PRODUCT NAME:	CTS / TIME BEACON				
NETWORK SUBNETS:	SIX (6) NETWORK SUBNET GROUPS PER DATA STREAM				
PRODUCTION "A – STREAM"					
ODD SUBNETS			EVEN SUBNETS		
198.140.47.0/27	198.140.47.32/27	198.140.47.64/27	198.140.46.0/27	198.140.46.32/27	198.140.46.64/27
198.140.47.1	198.140.47.33	198.140.47.65	198.140.46.1	198.140.46.33	198.140.46.65
198.140.47.2	198.140.47.34	198.140.47.66	198.140.46.2	198.140.46.34	198.140.46.66
198.140.47.3	198.140.47.35	198.140.47.67	198.140.46.3	198.140.46.35	198.140.46.67
198.140.47.4	198.140.47.36	198.140.47.68	198.140.46.4	198.140.46.36	198.140.46.68
198.140.47.5	198.140.47.37	198.140.47.69	198.140.46.5	198.140.46.37	198.140.46.69
198.140.47.6	198.140.47.38	198.140.47.70	198.140.46.6	198.140.46.38	198.140.46.70
198.140.47.7	198.140.47.39	198.140.47.71	198.140.46.7	198.140.46.39	198.140.46.71
198.140.47.8	198.140.47.40	198.140.47.72	198.140.46.8	198.140.46.40	198.140.46.72
198.140.47.9	198.140.47.41	198.140.47.73	198.140.46.9	198.140.46.41	198.140.46.73
198.140.47.10	198.140.47.42	198.140.47.74	198.140.46.10	198.140.46.42	198.140.46.74
198.140.47.11	198.140.47.43	198.140.47.75	198.140.46.11	198.140.46.43	198.140.46.75
198.140.47.12	198.140.47.44	198.140.47.76	198.140.46.12	198.140.46.44	198.140.46.76
198.140.47.13	198.140.47.45	198.140.47.77	198.140.46.13	198.140.46.45	198.140.46.77
PRODUCTION "B – STREAM"					
ODD SUBNETS			EVEN SUBNETS		
198.140.47.128/27	198.140.47.160/27	198.140.47.192/27	198.140.46.128/27	198.140.46.160/27	198.140.46.192/27
198.140.47.129	198.140.47.161	198.140.47.193	198.140.46.129	198.140.46.161	198.140.46.193
198.140.47.130	198.140.47.162	198.140.47.194	198.140.46.130	198.140.46.162	198.140.46.194
198.140.47.131	198.140.47.163	198.140.47.195	198.140.46.131	198.140.46.163	198.140.46.195
198.140.47.132	198.140.47.164	198.140.47.196	198.140.46.132	198.140.46.164	198.140.46.196
198.140.47.133	198.140.47.165	198.140.47.197	198.140.46.133	198.140.46.165	198.140.46.197
198.140.47.134	198.140.47.166	198.140.47.198	198.140.46.134	198.140.46.166	198.140.46.198
198.140.47.135	198.140.47.167	198.140.47.199	198.140.46.135	198.140.46.167	198.140.46.199
198.140.47.136	198.140.47.168	198.140.47.200	198.140.46.136	198.140.46.168	198.140.46.200
198.140.47.137	198.140.47.169	198.140.47.201	198.140.46.137	198.140.46.169	198.140.46.201
198.140.47.138	198.140.47.170	198.140.47.202	198.140.46.138	198.140.46.170	198.140.46.202
198.140.47.139	198.140.47.171	198.140.47.203	198.140.46.139	198.140.46.171	198.140.46.203
198.140.47.140	198.140.47.172	198.140.47.204	198.140.46.140	198.140.46.172	198.140.46.204
198.140.47.141	198.140.47.173	198.140.47.205	198.140.46.141	198.140.46.173	198.140.46.205

Note: Any of the above source addresses will be used to source CTS data over the Production Multicast Addresses located on page 24 (CTS) and page 22 (Time Beacon).

Appendix E - Disaster Recovery (Backup) Data Center Source Addresses, cont'd

MULTICAST DATA SOURCE: PRODUCTION "A-STREAM" & PRODUCTION "B-STREAM"

PRODUCT NAME:	CQS / TIME BEACON				
NETWORK SUBNETS:	SIX (6) NETWORK SUBNET GROUPS PER DATA STREAM				
PRODUCTION "A – STREAM"					
ODD SUBNETS			EVEN SUBNETS		
198.140.57.0/27	198.140.57.32/27	198.140.57.64/27	198.140.56.0/27	198.140.56.32/27	198.140.56.64/27
198.140.57.1	198.140.57.33	198.140.57.65	198.140.56.1	198.140.56.33	198.140.56.65
198.140.57.2	198.140.57.34	198.140.57.66	198.140.56.2	198.140.56.34	198.140.56.66
198.140.57.3	198.140.57.35	198.140.57.67	198.140.56.3	198.140.56.35	198.140.56.67
198.140.57.4	198.140.57.36	198.140.57.68	198.140.56.4	198.140.56.36	198.140.56.68
198.140.57.5	198.140.57.37	198.140.57.69	198.140.56.5	198.140.56.37	198.140.56.69
198.140.57.6	198.140.57.38	198.140.57.70	198.140.56.6	198.140.56.38	198.140.56.70
198.140.57.7	198.140.57.39	198.140.57.71	198.140.56.7	198.140.56.39	198.140.56.71
198.140.57.8	198.140.57.40	198.140.57.72	198.140.56.8	198.140.56.40	198.140.56.72
198.140.57.9	198.140.57.41	198.140.57.73	198.140.56.9	198.140.56.41	198.140.56.73
198.140.57.10	198.140.57.42	198.140.57.74	198.140.56.10	198.140.56.42	198.140.56.74
198.140.57.11	198.140.57.43	198.140.57.75	198.140.56.11	198.140.56.43	198.140.56.75
198.140.57.12	198.140.57.44	198.140.57.76	198.140.56.12	198.140.56.44	198.140.56.76
198.140.57.13	198.140.57.45	198.140.57.77	198.140.56.13	198.140.56.45	198.140.56.77
PRODUCTION "B – STREAM"					
ODD SUBNETS			EVEN SUBNETS		
198.140.57.128/27	198.140.57.160/27	198.140.57.192/27	198.140.56.128/27	198.140.56.160/27	198.140.56.192/27
198.140.57.129	198.140.57.161	198.140.57.193	198.140.56.129	198.140.56.161	198.140.56.193
198.140.57.130	198.140.57.162	198.140.57.194	198.140.56.130	198.140.56.162	198.140.56.194
198.140.57.131	198.140.57.163	198.140.57.195	198.140.56.131	198.140.56.163	198.140.56.195
198.140.57.132	198.140.57.164	198.140.57.196	198.140.56.132	198.140.56.164	198.140.56.196
198.140.57.133	198.140.57.165	198.140.57.197	198.140.56.133	198.140.56.165	198.140.56.197
198.140.57.134	198.140.57.166	198.140.57.198	198.140.56.134	198.140.56.166	198.140.56.198
198.140.57.135	198.140.57.167	198.140.57.199	198.140.56.135	198.140.56.167	198.140.56.199
198.140.57.136	198.140.57.168	198.140.57.200	198.140.56.136	198.140.56.168	198.140.56.200
198.140.57.137	198.140.57.169	198.140.57.201	198.140.56.137	198.140.56.169	198.140.56.201
198.140.57.138	198.140.57.170	198.140.57.202	198.140.56.138	198.140.56.170	198.140.56.202
198.140.57.139	198.140.57.171	198.140.57.203	198.140.56.139	198.140.56.171	198.140.56.203
198.140.57.140	198.140.57.172	198.140.57.204	198.140.56.140	198.140.56.172	198.140.56.204
198.140.57.141	198.140.57.173	198.140.57.205	198.140.56.141	198.140.56.173	198.140.56.205

Note: Any of the above source addresses will be used to source CQS data over the Production Multicast Addresses located on page 23 (CQS) and page 22 (Time Beacon).

Appendix E - Disaster Recovery (Backup) Data Center Source Addresses, cont'd

MULTICAST DATA SOURCE: PRODUCTION "A-STREAM" & PRODUCTION "B-STREAM"

PRODUCT NAME:	OPRA / TIME BEACON				
NETWORK SUBNETS:	SIX (6) NETWORK SUBNET GROUPS PER DATA STREAM				
PRODUCTION "A – STREAM"					
ODD SUBNETS			EVEN SUBNETS		
198.140.45.0/27	198.140.45.32/27	198.140.45.64/27	198.140.40.0/27	198.140.40.32/27	198.140.40.64/27
198.140.45.1	198.140.45.33	198.140.45.65	198.140.40.1	198.140.40.33	198.140.40.65
198.140.45.2	198.140.45.34	198.140.45.66	198.140.40.2	198.140.40.34	198.140.40.66
198.140.45.3	198.140.45.35	198.140.45.67	198.140.40.3	198.140.40.35	198.140.40.67
198.140.45.4	198.140.45.36	198.140.45.68	198.140.40.4	198.140.40.36	198.140.40.68
198.140.45.5	198.140.45.37	198.140.45.69	198.140.40.5	198.140.40.37	198.140.40.69
198.140.45.6	198.140.45.38	198.140.45.70	198.140.40.6	198.140.40.38	198.140.40.70
198.140.45.7	198.140.45.39	198.140.45.71	198.140.40.7	198.140.40.39	198.140.40.71
198.140.45.8	198.140.45.40	198.140.45.72	198.140.40.8	198.140.40.40	198.140.40.72
198.140.45.9	198.140.45.41	198.140.45.73	198.140.40.9	198.140.40.41	198.140.40.73
198.140.45.10	198.140.45.42	198.140.45.74	198.140.40.10	198.140.40.42	198.140.40.74
198.140.45.11	198.140.45.43	198.140.45.75	198.140.40.11	198.140.40.43	198.140.40.75
198.140.45.12	198.140.45.44	198.140.45.76	198.140.40.12	198.140.40.44	198.140.40.76
198.140.45.13	198.140.45.45	198.140.45.77	198.140.40.13	198.140.40.45	198.140.40.77
PRODUCTION "B – STREAM"					
ODD SUBNETS			EVEN SUBNETS		
198.140.45.128/27	198.140.45.160/27	198.140.45.192/27	198.140.40.128/27	198.140.40.160/27	198.140.40.192/27
198.140.45.129	198.140.45.161	198.140.45.193	198.140.40.129	198.140.40.161	198.140.40.193
198.140.45.130	198.140.45.162	198.140.45.194	198.140.40.130	198.140.40.162	198.140.40.194
198.140.45.131	198.140.45.163	198.140.45.195	198.140.40.131	198.140.40.163	198.140.40.195
198.140.45.132	198.140.45.164	198.140.45.196	198.140.40.132	198.140.40.164	198.140.40.196
198.140.45.133	198.140.45.165	198.140.45.197	198.140.40.133	198.140.40.165	198.140.40.197
198.140.45.134	198.140.45.166	198.140.45.198	198.140.40.134	198.140.40.166	198.140.40.198
198.140.45.135	198.140.45.167	198.140.45.199	198.140.40.135	198.140.40.167	198.140.40.199
198.140.45.136	198.140.45.168	198.140.45.200	198.140.40.136	198.140.40.168	198.140.40.200
198.140.45.137	198.140.45.169	198.140.45.201	198.140.40.137	198.140.40.169	198.140.40.201
198.140.45.138	198.140.45.170	198.140.45.202	198.140.40.138	198.140.40.170	198.140.40.202
198.140.45.139	198.140.45.171	198.140.45.203	198.140.40.139	198.140.40.171	198.140.40.203
198.140.45.140	198.140.45.172	198.140.45.204	198.140.40.140	198.140.40.172	198.140.40.204
198.140.45.141	198.140.45.173	198.140.45.205	198.140.40.141	198.140.40.173	198.140.40.205

Note: Any of the above source addresses will be used to source OPRA data over the Production Multicast Addresses located on page 25 (OPRA), page 26 (OPRA Extended) and page 22 (Time Beacon).

Appendix E - Disaster Recovery (Backup) Data Center Source Addresses, cont'd

MULTICAST DATA SOURCE: NON-PRODUCTION HOURS, PRODUCTION "A-STREAM" & PRODUCTION "B-STREAM"

PRODUCT NAME:	CQS / CTS / OPRA
NETWORK SUBNETS:	TWO (2) NETWORK SUBNET GROUPS PER DATA STREAM
PRODUCTION "A – STREAM"	
ODD SUBNETS	EVEN SUBNETS
198.140.59.64/26	198.140.58.64/26
198.140.59.65	198.140.58.65
198.140.59.66	198.140.58.66
198.140.59.67	198.140.58.67
198.140.59.68	198.140.58.68
198.140.59.69	198.140.58.69
198.140.59.70	198.140.58.70
198.140.59.71	198.140.58.71
198.140.59.72	198.140.58.72
198.140.59.73	198.140.58.73
198.140.59.74	198.140.58.74
198.140.59.75	198.140.58.75
198.140.59.76	198.140.58.76
PRODUCTION "B – STREAM"	
ODD SUBNETS	EVEN SUBNETS
198.140.59.128/26	198.140.58.128/26
198.140.59.129	198.140.58.129
198.140.59.130	198.140.58.130
198.140.59.131	198.140.58.131
198.140.59.132	198.140.58.132
198.140.59.133	198.140.58.133
198.140.59.134	198.140.58.134
198.140.59.135	198.140.58.135
198.140.59.136	198.140.58.136
198.140.59.137	198.140.58.137
198.140.59.138	198.140.58.138
198.140.59.139	198.140.58.139
198.140.59.140	198.140.58.140

Note: Any of the above source addresses will be used to source CTS, CQS and OPRA data during non-production trading hours over the Production Multicast Addresses located on page 24 (CTS), page 23 (CQS), page 25 (OPRA) and page 26 (OPRA Extended).

Appendix E - Disaster Recovery (Backup) Data Center Source Addresses, cont'd

MULTICAST DATA SOURCE: PRODUCTION RETRANSMISSION & NON-PRODUCTION HOURS PLAYBACK TEST

PRODUCT NAME:	CQS / CTS / OPRA
NETWORK SUBNETS:	TWO (2) NETWORK SUBNET GROUPS PER DATA STREAM

RETRANSMISSION DATA SOURCE AND PLAYBACK TEST DATA SOURCE	
ODD SUBNETS	EVEN SUBNETS
198.140.59.0/26	198.140.58.0/26
198.140.59.1	198.140.58.1
198.140.59.2	198.140.58.2
198.140.59.3	198.140.58.3
198.140.59.4	198.140.58.4
198.140.59.5	198.140.58.5
198.140.59.6	198.140.58.6
198.140.59.7	198.140.58.7
198.140.59.8	198.140.58.8
198.140.59.9	198.140.58.9
198.140.59.10	198.140.58.10
198.140.59.11	198.140.58.11
198.140.59.12	198.140.58.12

Note: Any of the above source addresses will be used to source CQS, CTS and OPRA data over the Retransmission and Playback Test Multicast Addresses located on page 30 (CQS & CTS Retransmission – left side of page / Playback Test – right side of page), page 32 (OPRA Retransmission – left side of page / Playback Test – right side of page) and page 33 (OPRA Extended Retransmission – left side of page / Playback Test – right side of page).