Advanced Networking Notes for the DXD Universal Clocks

In a network environment designed for audio-visual media there can be high volumes of media packet traffic on the network. The DXD-8/16 implements several strategies to filter out these packets at its network receiver(s), thus giving a clear high priority path to the reception of the PTP packets which are at the core of the DXD-8/16's operation.

In this section we shall review three aspects of these strategies:

- Multicast Address Management
- DSCP Values and Priorities
- Internal VLANs

1. Multicast Address Management

(a) PTP message packets are often transmitted on the network using multicast addressing.

(b) Media message packets also tend to use multicast addressing, and can consume large amounts of bandwidth.

(c) Our aim is to separate PTP traffic from media traffic so that PTP devices are not forced to receive large quantities of media packets, and so that PTP timing is not unnecessarily affected by that traffic..

(d) **RULE 1**: IGMP snooping should be enabled at the switch to which the DXD is connected. This will prevent the switch from "flooding" all of its ports with multicast messages that its connected devices (e.g. the DXD) have not requested to receive via the IGMP system.
IGMP (Internet Group Management Protocol) is the system by which a device registers to receive the multicast messages that it wants.

(e) The DXD automatically implements a form of IGMP snooping of its own, which should further limit multicast flooding from a switch.

(f) Caveat: IGMP snooping, even when working exactly as designed, is not perfect.
Multicast addressing as we refer to it here is a Layer 3 mechanism. It is an IPv4 address like the typical *192.168.0.xxx* addressing as might be used in a small network. An IPv4 address is classified as multicast if the first number in the address is between 224 and 239.

There are some very important multicast addresses in the ranges *224.0.0.xxx* and *224.0.1.xxx*, where *xxx* is a value between *0* and *255*. The primary PTP multicast address is *224.0.1.129*

Meanwhile, AES67 for example specifies that audio packets shall use multicast addresses in the range *239.0.0.0* thru *239.255.255.255* (i.e. *239.xxx.xxx.xxx*).

The PROBLEM is that packet forwarding at a switch is normally directed based on a packet's Layer 2 multicast address, which, while it is derived from the packet's Layer 3 multicast address, does not include all of the Layer 3 address information. The first number, *224* or *239* etc., is dropped, so that a Layer 2 switch cannot distinguish between *224.0.1.129* and any other IPv4 multicast address ending in xxx.0.1.129. This can clearly be a problem. A user can however help separate media traffic from PTP traffic by careful assignment of multicast addressing for media packets. Since the first number in the address is ignored by the switch, we must distinguish between the packet types based on other numbers in the multicast address. To this end, one or the other of the following two rules should be followed across the entire system (it is not necessary to implement both):

RULE 2A: The third number in the media multicast address should never be a *0* or a *1*.
RULE 2B: The second number in the media multicast address should never be *0* or *128*.

For example, either avoid
xxx.xxx.0.xxx AND *xxx.xxx.1.xxx*
OR avoid
xxx.0.xxx.xxx AND *xxx.128.xxx.xxx*

2. DSCP Values and Priorities

(a) In the header of each IP packet on a network is found a DSCP (Differentiated Services Code Point) value, which is a number between 0 and 63. Higher values generally infer higher priority, but IT Managers are able to use these values in various ways to classify and enhance traffic flow. Such methods however are beyond the scope of this document.

(b) PTP protocol uses two types of messages: (i) "Event" messages, which are timestamped, and (ii) "General" messages which are not. Event messages should run with priority greater or equal to that of General messages.

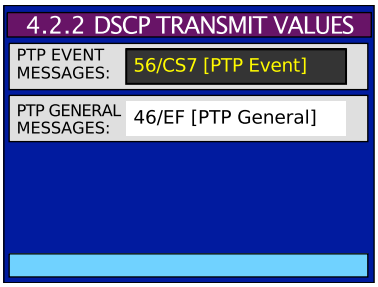
(c) Annex D of IEEE Std 1588-2008 (aka PTPv2) specifies the following:
"For PTP event messages, the value of the differentiated service (DS) field in the Type of Service (ToS) field should be set to the highest traffic class selector codepoint available."

(d) AES67-2013 specifies a default DSCP value for most PTP messages, Event and General, of decimal 46 (aka EF or Expedited Forwarding).

(e) SMPTE ST 2059-2:2015 does not include default DSCP values in its PTP Profile specification.

(f) Company "A" for its product "D" documents a DSCP value of 56 for PTP Event messages, and 46 (EF) for PTP General messages.

(g) For PTP message transmission, the DXD-8/16 also uses default values of 56 for Event messages and 46 (EF) for General messages. These values may be changed however in Menu "4.2.2 DSCP TRANSMIT VALUES" (DXD-8) or Menu "4.5.2 DSCP TRANSMIT VALUES" (DXD-16).



(h) For PTP message reception, the DXD-8/16 automatically detects the DSCP values of the PTP messages that it receives, and assigns internal queue priorities accordingly.

3. Internal VLANs

In an effort to filter out unwanted multicast receive packets, the DXD-8 makes use of an internal VLAN Id, while the DXD-16 uses two such VLAN Id's. Please note that the DXD will never tag any transmitted packets with these VLAN Id's. Care should be taken however that the DXD should not receive VLAN-tagged packets using these Id's. While it is highly unlikely that this situation will arise, if there is any possibility that it will then either the VLAN Id's should be changed at their source, or the DXD internal VLAN Id's should be changed so that the match does not occur. In the DXD-8 use Menu "4.2.1 INTERNAL VLAN ID", while for the DXD-16 use Menu "4.5.1 INTERNAL VLAN ID'S". A re-boot is required after any change to these menus.
Default ID values are: 1 for the DXD-8, 1 and 2 for the DXD-16.