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Alternate FQTSS Observation Intervals

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AKG by HARMAN harman/kardon by HARMAN Infinity by HARMAN JBL by HARMAN lexicon by HARMAN mark levinson by HARMAN

Automotive Requirements (Infotainment)

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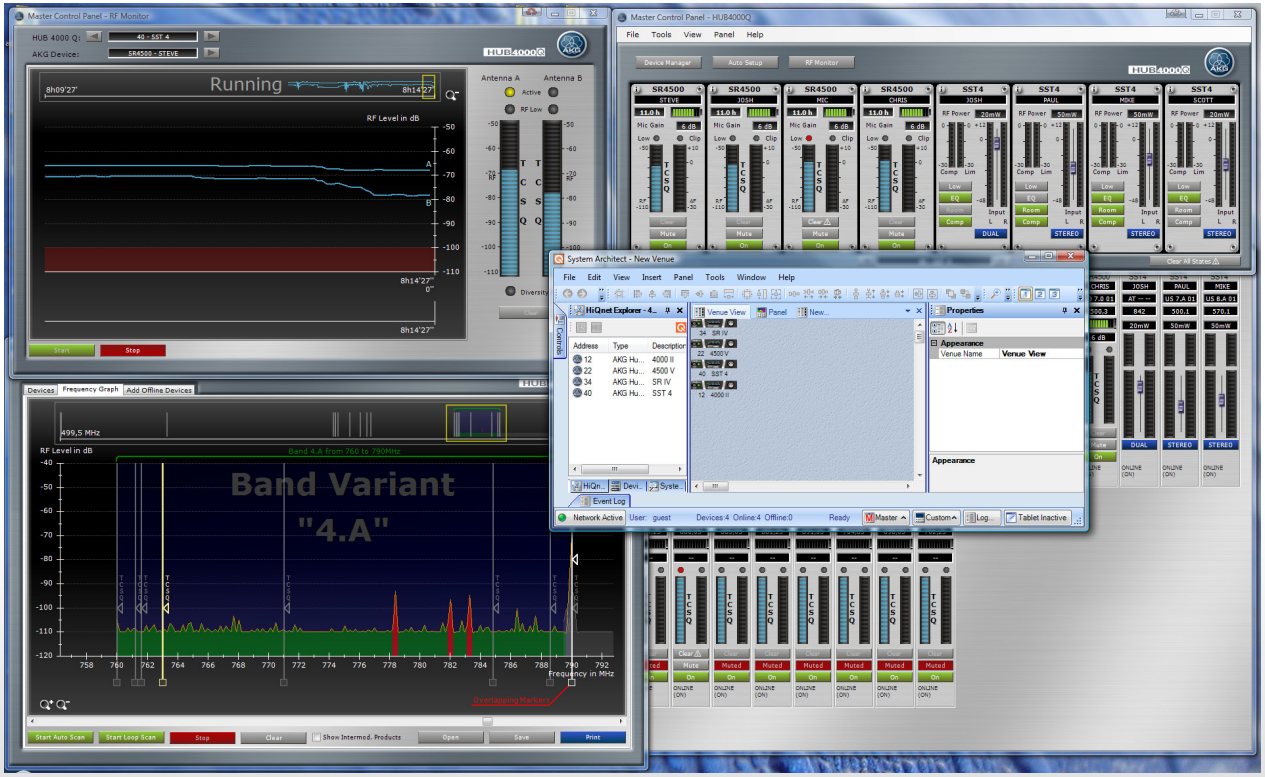
- **Lots of PCM Audio >10 streams**
  - 7.1 streams 44.1Khz 16 bit
  - Stereo streams 44.1Khz 16 bit
- **Limited Bandwidth**
  - Current automotive PHY technology limits bandwidth to 100Mbps
  - AVB limit is 75Mbps
- **Desire to use AVB Video**
  - Backup Camera
  - Rear Seat Entertainment
- **Low Latency is not critical in most applications**
  - Small network topology reduces latency

Pro Requirement

- **Time Sensitive Control Streams (IEEE P1722a)**
  - 30 to 100 packets per second
  - There is no practical way to reserve bandwidth for low bandwidth streams



How is this related to the Observation Interval?

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- **Bandwidth**
  - Bandwidth is extremely limited in the Automotive environment
  - Bandwidth can be conserved by adjusting the Qav Observation Interval with no meaningful loss of performance
  - Less that 8000 packets per second wastes bandwidth

- **Processor Load**
  - 8000 packets per second is difficult with a processor based solutions
  - 10 streams means 8000x10 packets per second

Bandwidth Calculations

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AVB Audio Bandwidth Calculation Spreadsheet

The following constants and parameters for AVB Audio frames, and generally should not be changed.

Overhead Source	**Bytes**
Inter-frame Gap	12
Preambles + SFD	8
Ethernet Header	14
802.1Q VLAN tag	2
AVTPDU Header	24
CIP Header	8
Ethernet FCS	4
Total Overhead	72

802.1Qav Interval (us)
125
Bytes per Sample
2
Max Ethernet Frame
1522

Enter the desired properties (in the grey cells) for each group of identical streams on a separate line:
A red-highlighted cell indicates a problem with the value or its inputs
All max sample rates are presumed to be referenced to the Qav interval; add some margin if an integer relationship cannot be guaranteed (e.g. @ 32 / 48 / 96 / 192 KHz Fs)

Max Sample Rate (KHz)	# of Audio Channels	Samples per Packet	Bytes per Packet	Per-Stream BW (Mbps)	# of Streams	Total BW (Mbps)
44.100	8	6	168	10.752	2	21.504
44.100	2	6	96	6.144	10	61.44
				Total		82.944

Check against available link bandwidth here; highlighted color indicates whether streams can be supported

		100 Mbit Link	1Gbit Link
Legacy Reservation	25.00%	82.944	82.944

Bandwidth Utilization

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125us – 82.944 Mbps

Max Sample Rate (KHz)	# of Audio Channels	Samples per Packet	Bytes per Packet	Per-Stream BW (Mbps)	# of Streams	Total BW (Mbps)
44.100	8	6	168	10.752	2	21.504
44.100	2	6	96	6.144	10	61.44

250us – 55.296 Mbps

Max Sample Rate (KHz)	# of Audio Channels	Samples per Packet	Bytes per Packet	Per-Stream BW (Mbps)	# of Streams	Total BW (Mbps)
44.100	8	12	264	8.448	2	16.896
44.100	2	12	120	3.840	10	38.4

500us – 40.32 Mbps

Max Sample Rate (KHz)	# of Audio Channels	Samples per Packet	Bytes per Packet	Per-Stream BW (Mbps)	# of Streams	Total BW (Mbps)
44.100	8	23	440	7.040	2	14.08
44.100	2	23	164	2.624	10	26.24

1000us – 32.832 Mbps

Max Sample Rate (KHz)	# of Audio Channels	Samples per Packet	Bytes per Packet	Per-Stream BW (Mbps)	# of Streams	Total BW (Mbps)
44.100	8	45	792	6.336	2	12.672
44.100	2	45	252	2.016	10	20.16

Assumptions: 1 packet/interval, larger packets, higher latency

Latency Calculation

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- Latency calculation from 802.1BA

$$\text{Max Latency} = t_{\text{Device}} + t_{\text{MaxPacketSize+IPG}} + (t_{\text{AllStreams}} - t_{\text{StreamPacket+IPG}}) \times \text{Rate/MaxAllocBand} + t_{\text{StreamPacket}}$$

	125us	250us	500us	1000us
tDevice (us)	5.12	5.12	5.12	5.12
tMaxPacketSize + IPG (us)	123.36	123.36	123.36	123.36
tStreamPacket (us)	8.32	10.24	13.12	20.16
tStreamPacket+IPG (us)	9.28	11.2	14.08	21.12
Rate (Mb/s)	100	100		100
MaxAllocBand (Mb/s)	75	75	75	75
tInterval (us)	125	250	500	1000
tAllStream (us)	93.75	187.5	375	750
Max Latency (us)	249.43	373.79	622.83	1120.48

Note: tStreamPacket is adjusted to represent the actual length of a 2 channel (stereo) IEEE 1722 audio packet. Assuming 1 packet/interval tStreamPacket increases as tInterval increases.

Possible Solutions

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- **Define Class C,D,E,…**
  - Maintain Plug and Play
  - If nothing is done and no other solution is available this will likely be done by outside organizations
- **Limit to Class A and B with user definable observation interval**
  - Limit the number of classes
  - No requirement for additional undefined equations.
  - Breaks Plug and Play
  - Only suitable for managed networks

IEEE Std. 802.1Q-2011 34.6.1

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- For streams that make use of SR class A or SR class B, it is a requirement that the rate at which frames for any given stream are selected for placement in its per-stream queue does not exceed the bandwidth reserved for the stream, measured over the class measurement interval for the SR class (125 μs for SR class A, 250 μs for SR class B.) For some combinations of stream bandwidth requirement and transmission Port data rate, this can place a limit on the frame size that can be used when transmitting stream data.

IEEE Std. 802.1Q-2011 5.18

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- An end station implementation that conforms to the provisions of this standard for forwarding and queuing for time-sensitive streams shall:

  a) Support a minimum of two traffic classes on all Ports, of which

     1) A minimum of one traffic class supports the strict priority algorithm for transmission selection (8.6.8.1), and

     2) One traffic class is an SR class.

  b) Support the operation of the credit-based shaper algorithm (8.6.8.2) as the transmission selection algorithm used for frames transmitted for each stream associated with the SR class.

  c) Support the operation of the credit-based shaper algorithm (8.6.8.2) on all Ports as the transmission selection algorithm used for the SR class.

  d) Use the default priority associated with SR class “B” as shown in Table 6-6 as the priority value carried in transmitted SR class “B” data frames.

IEEE Std. 802.1Q-2011 5.18

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- An end station implementation that conforms to the provisions of this standard for forwarding and queuing for time-sensitive streams may:

  e) Support two or more SR classes (a maximum of seven), and support the operation of the credit based shaper algorithm (8.6.8.2) on all Ports as the transmission selection algorithm used for those SR classes. The number of SR classes supported shall be stated in the PICS.

  f) Use the default priority associated with SR class “A” as shown in Table 6-6 as the priority valuecarried in transmitted SR class “A” data frames. If more than two SR classes are supported, the priority value carried in transmitted data frames for the additional SR classes shall be stated in the

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