AP NOTE AP37

Calculating the Composite Multiplex Rate for the AL4300

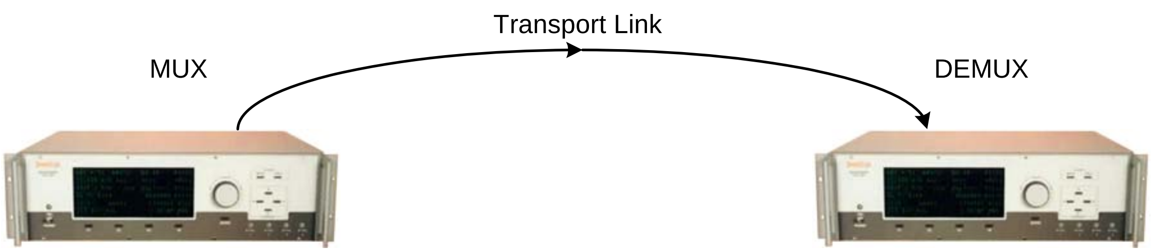

Figure 1 - Basic configuration for MUX-DEMUX system

In the Apogee Labs multiplexer, measurements are made and assembled into “packets” in a transport frame for passage to a demultiplexer. The transported composite data stream conforms to the CCSDS packet format described in CCSDS 102.0-B-5. Information from a number of data sources is combined (multiplexed) into a composite data stream (transport link). Identification of unique information in the composite stream necessitates the addition of information into the packet for this purpose, creating additional overhead.. Although overhead cannot be completely eliminated, our implementation of this packetized structure attempts to maintain system overhead to a minimum.

When configuring a system for use, knowing how much overhead is in the system is critical. The actual amount of data being transported along with the system overhead needs to be less than the rate of the composite data stream. If not, the system is placed in an overflow state. There are two layers of overhead in the packetization method used by Apogee Labs, the Transfer Frame and the Source Packet layers.

The highest layer is the Transfer Frame layer. The transfer frame contains a header that provides critical information, such as a synchronization pattern and a cyclic redundancy check pattern (CRC). These overhead bits occupy 6/512 of the available space in the transport stream, leaving 506/512 space available for measurement data packets. The measurement data packets comprise the Source Packet layer.

In the Source Packet layer, a source packet from each input channel is embedded into the data stream during every Sample Interval (SI). Each source packet has some overhead in it that is used in the reconstruction process of the channel data signals. Since a new source packet is added during every SI, the SI rate that is set on the packetizing module affects the amount of overhead in the system. A system that uses an SI of 1 millisecond has 10 times the source packet layer overhead than a system that uses a 10 millisecond SI. The cost of the lower overhead (using the 10 ms SI) is throughput delay.

The source packet layer contains three types of packets. These are: SI packets, data packets and idle packets. During every sample interval, one SI packet is added, which contributes 96 bits of overhead. For every sample interval, data packets add overhead produced by their own headers. Specific knowledge of individual source packet headers is needed to allow precise calculation of the amount of overhead added from each source packet. Generally, each channel module adds 96 bits of overhead. There are a few devices in the Apogee library of modules that contribute more or fewer bits of header information per data packet. Each empty slot in the chassis results in an idle packet, each of which adds 96 bits of overhead per SI.

The total number of bits of overhead from the SI packets, source packets and idle packets per SI are added together, then divided by the number of sample intervals per second. This calculation results in the overhead rate for the source packet layer.

The overhead from the source packet layer is added to the composite rate of transported channel data. This total is then added to the overhead from the transfer frame layer to determine the minimum total data rate accounted for in the transport. Any extra bandwidth above this minimum is filled with idle packets.

Example:

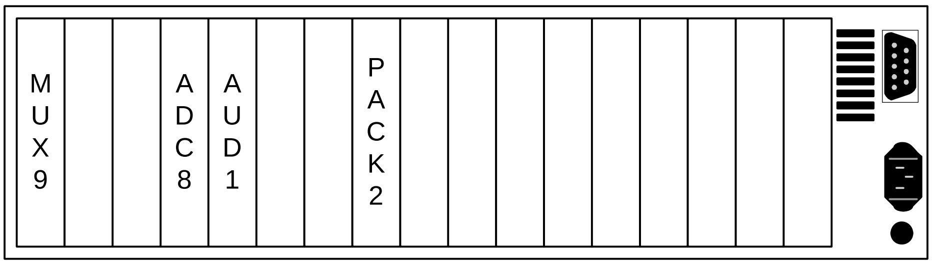

Figure 2 – Example of AL4300 chassis rear panel

The chassis in Figure 2 has four channels of data. The MUX9 has two channels and the ADC8 and AUD1 each have one channel. The MUX9 is in slot 0, the ADC8 is in slot 3, the AUD1 is in slot 4, and the PACK2 is in slot 7. For our example, assume that the system is running in 10 ms SI mode.

Calculate the source packet overhead rate contribution of the channel cards as four channels with 96 bits of overhead each. There are two empty slots in between the MUX9 and the ADC8 that contribute to the overhead calculation.

$$(4\text{channels} \times 96\text{bits})+(2\text{emptyslots} \times 96\text{bits}) = 576 \text{ bits/SI}$$

Since this example is using a 10 ms SI:

$$576bits/10ms=57{,}600bitsper\ second$$

The composite measurement data rate is then calculated by adding the data rates produced by each channel in the system. For example:

MUX9 channel 1	2 Mb/s
MUX9 channel 2	8 Mb/s
ADC8	5 Mb/s
AUD1	64 kb/s

Add the channel data and the source packet overhead to get the total amount of source packet data:

$$57{,}600+2*10^6+8*10^6+5*10^6+64*10^3=15{,}121{,}600 \text{ bits/second}$$

Considering the transfer framer layer allows completion of the calculation of the total composite data stream rate:

$$15{,}121{,}600*(512/506)=15{,}300{,}908 \text{ bits/second}$$

This is the minimal composite rate to set the packetizer to for this example so as to not loose data.

The total overhead is:

$$15{,}300{,}908-15{,}064{,}000=236{,}908 \text{ bits/second}$$