

**BR076R01 (submitted for p1394.1 committee vote):
Peak bandwidth averaging**

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**This contribution is one of several, presented for review and incorporation.
An overall contribution, which provides an overall context for this and other contributions, is presented in BR047R10.**

Philips has presented techniques for more effectively utilizing limited bus-bridge bandwidth by specifying isochronous bandwidth requirements in terms of peak, peak-duration, and average bandwidth parameters.

This submission attempts to refine the Philips proposal, and eliminates the statistical components, as suggested by the p1394.1 working group.

Previous proposals for partitioning surplus delays (to reduce bandwidth requirements) were withdrawn due to a perceived high complexity-to-benefits ratio.

6.3.5 Bandwidth allocation

6.3.5.1 Isochronous bandwidth parameters

Isochronous connection management uses *maximumBandwidth*, *averageBandwidth*, and *creditLimit* parameters to specify traffic parameters of an isochronous connection. Only the *maximumBandwidth* parameter is used for Serial Bus allocations; the *averageBandwidth*, and *creditLimit* parameters are provided for the benefit of other bandwidth-constrained Surreal interconnects. The rationale for providing additional parameters is twofold:

- 1) Bursty traffic. The type of multimedia traffic expected to pass through bridges may be bursty and the bridge may be able to average the effects of a burst over multiple cycles.
- 2) Limited bandwidth. Some Surreal interconnects may not be able to operate at the full Serial Bus rate, due to physical media or other limitations. Possible examples of limited-bandwidth Surreal interconnects include twisted-pair phone lines as well as wireless RF and IR transmissions.

The *maximumBandwidth* parameter specifies the maximum number of quadlets transferred in an isochronous cycle. Specifying the number of bytes (as opposed to quadlets) allows other Surreal interconnects to specify alternate packet-padding schemes.

The *averageBandwidth* parameter specifies the average number of quadlets transferred in multiple isochronous cycles.

The *creditLimit* parameter specifies the extent (in quadlets) to which isochronous traffic can exceed the specified average value. Isochronous traffic may have peaks above and valleys below the specified average value, as illustrated in figure 1.

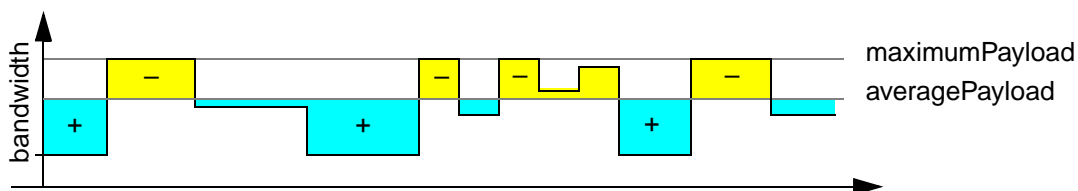


Figure 1—Nonoverlaid connection acquisition

A *credits* value is (in concept) increased or decreased in each cycle, based on the difference between the average and actual bandwidths. The *creditLimit* value specifies a maximum *credits* value can be accumulated during low-bandwidth cycles. This is more accurately defined by equation 1, computations that could (in theory) be performed in each isochronous cycle.

```
credits=Maximum(creditLimit,credits+(averageSize-actualSize));  
assert(actualSize<maximumSize && credits>=0);
```

 (1)

NOTE—Implementations are not expected to compute an actual *credits* value, but are expected to allocate isochronous bandwidth based on knowledge of the traffic pattern's *creditLimit* parameter.

The 32-bit *creditLimit* and 16-bit *maximumQuads* values are measured in units of isochronous packet quadlets, which includes the isochronous packet header and quadlet CRC values.

6.3.5.2 Average bandwidth parameters

Isochronous sources are expected to provide parameters from which a fractional *averageBandwidth* parameter can be derived. This average is represented as *intervalQuads* and *averageInterval* values, measuring the number of total number of isochronous-packet quadlets observed during a fixed number of consecutive isochronous cycles, as illustrated in figure 2. The *intervalQuads* value represents a worst case value for any of the possible *averageInterval* starting times.

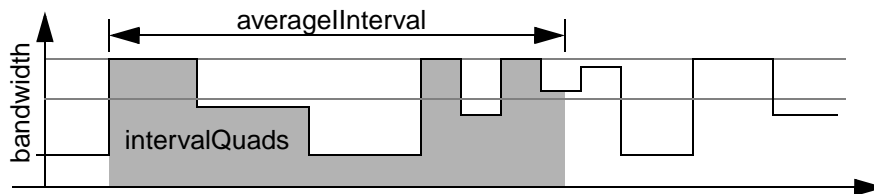


Figure 2—Average bandwidth parameters

The *averageBandwidth* parameter is easily derived from these two bandwidth parameters, as specified in equation 2.

$$\text{averageBandwidth} = \text{intervalBandwidth} / \text{averagingInterval}; \quad (2)$$

The 32-bit *intervalQuads* is measured in units of isochronous packet quadlets, which includes the isochronous packet header and quadlet CRC values. The 16-bit *averageInterval* values is the fixed number of consecutive isochronous cycles over which *intervalQuads* is measured.

6.3.5.3 Default parameter values

When a device is only knowledgeable of the *maximumBandwidth* value, then the other values included in isochronous-connection setup messages include the following:

$$\text{bandwidthCredits} = \text{averagingInterval} = \text{cumulativeBandwidth} = 0; \quad (3)$$