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1. 1394B Speed Signaling

This is a proposal for a speed signaling technique that further develops the method described in draft 0.05, clause 8.2.2. This proposal is based on discussions between myself and Dave Wooten, and is submitted for the 1394b group to review and improve where necessary.

1.1 Definitions:

Beta mode port: a 1394B port that is using 8B10B coding, not DS coding.
DS port: a 1394-1995 or 1394B port that is using Data Strobe coding, not 8B10B coding.
Character: a 10 bit codeword
Operating speed: the rate at which data is transmitted from a beta mode port.
symbol: a numerical value representing a 1394B control state
padded data: a stream of data characters at the port operating speed containing data from a lower speed packet.
packet prefix: the combination of data prefix and speed signals that precede a packet.

1.2 Introduction

A beta mode port is required to transport packets at all 1394 rates up to and including the operating speed of that particular port. 1394B must therefore provide a mechanism for signaling the speed of a packet during the data prefix. In particular, when a beta mode port is repeating a packet that has been received on a Data/Strobe (DS) port at S100, S200 or S400, the common mode speed signaling voltage received on the DS port must be represented in the stream of 10 bit characters transmitted on the beta mode port.

1.3 Requirements

The requirements for the 1394B speed signaling mechanism are as follows:

- For a given packet speed, the time duration of the speed signal should be constant regardless of the operating speed of the beta mode port through which the packet is being forwarded. This ensures that when a packet is being forwarded from one beta mode port to another, but the beta mode ports are operating at different speeds, then no buffering of data is required to allow for the speed signal being stretched in time.

- For a given beta mode port operating speed, the duration of the speed signal should be less than or equal to the time taken to assemble and transmit one data character. This maintains a constant delay between the speed signal and the start of data as a packet propagates across a bus, without data buffering.

- For the particular cases of S200 and S400 speed packets, a beta mode port that has started to transmit an S200 speed signal should be able to change this to an S400 speed signal in a manner that allows the change to be detected rapidly by the receiving port. (This is to allow for the situation where the speed signal detected for a packet arriving on a DS port is initially determined to be S200 and then corrected to S400. The forwarding beta mode port should be able to start an S200 speed signal prospectively and then switch to S400.)

1.4 Proposal

The proposed speed signals are detailed in the table below:

Table 1-1—

Port operating speed	Packet speed					
	S100	S200	S400	S800	S1600	S3200
S100	-					
S200	-	S_a				
S400	-	S_aS_a	S_b			
S800	-	$S_aS_aS_aS_a$	S_bS_b	S_a		
S1600	-	$S_aS_aS_aS_aS_aS_aS_aS_a$	$S_bS_bS_bS_b$	S_aS_a	S_a	
S3200	-	$S_aS_aS_aS_aS_aS_aS_aS_aS_aS_aS_aS_aS_aS_aS_aS_a$	$S_bS_bS_bS_bS_bS_bS_bS_b$	$S_aS_aS_aS_a$	S_aS_a	S_a
speed signal duration (nsecs)	0	40	20	10	5	2.5

Notes:

1) For any particular packet speed, the speed signal has constant duration at all port speeds. At all packet speeds other than S100, the number of speed symbols used at a particular port operating speed is equal to the number of symbols transmitted per byte of packet data at that port operating speed.

2) S_a represents the control state SPEEDa. S_b represents the control state SPEEDb. It is proposed that these two states replace the current SPEED control state, and that each is mapped to a single control symbol independent of the disparity. i.e. control state mapping is changed to:

Table 1-2—Control State Mapping

Control state	**Control symbol SRQP**	
	rd>0	**rd<0**
SPEEDa	0100	
SPEEDb	1000	

1.5 General packet format

In general a beta mode port shall prefix any packet with a combination of data prefix and speed signals as shown below:

.....<data prefix symbols><speed symbols><data prefix symbols><revised speed symbols><data prefix symbols><padded data>.....

The <> delimiters indicate elements of the packet prefix that may be optional at some (or all) combination of operating speed and packet speed, as described below. The [] delimiters indicate mandatory elements of the packet prefix.

1.6 S100 packet speeds

No speed signal is sent for an S100 packet at any operating speed. Since there is no common mode speed signal used on DS ports for S100, it would be impossible to forward a speed signal on a beta mode port until data started. At this point it would then be necessary to buffer data for the length of the speed signal. The packet prefix for a S100 packet forwarded on any beta mode port shall be:

.....[data prefix symbols][padded data].....

The duration of the data prefix symbols shall be greater than or equal to the minimum duration of DATA_PREFIX required on a DS port, as specified in the 1394-1995 standard i.e. 120nsecs.

Note: this requirement ensures that if the packet is subsequently forwarded to a DS port, the DS port will be able to generate a minimum length DATA_PREFIX without buffering data.

1.7 S200 & S400 packets

The packet prefix for S200 and S400 packets forwarded on any beta mode port shall be:

.....<data prefix symbols>[speed symbols][data prefix symbols]<revised speed symbols><data prefix symbols><padded data>.....

The duration of the data prefix symbols and speed symbols shall be greater than or equal to the minimum duration of DATA_PREFIX required on a DS port, as specified in the 1394-1995 standard i.e. 120nsecs.

The time between completion of the final speed symbol and completion of the first byte of padded data shall be greater than or equal to 140nsecs.

Note: this requirement ensures that if the packet is subsequently forwarded to a DS port, the DS port will be able to generate a minimum length speed signal followed by a delay of DATA_PREFIX_TIME before starting data, without buffering data.

1.7.1 S200 to S400 transitions

The speed signals for S200 and S400 packets are distinguished by the use of the alternate speed codes, SPEEDa and SPEEDb. This allows for rapid transition from an S200 speed signal to an S400 speed signal. When an S200 speed signal is detected on a DS port, the beta mode port starts to send the S200 speed signal. For the case of a beta mode port operating at S800, the packet prefix would be:

.....<data prefix symbols>[$S_aS_aS_aS_a$][data prefix symbols]<padded data>.....

Should speed signal detected on the DS port subsequently change to S400, the beta mode port may change the speed signal to S400 before the S200 signal is completed, provided that the total number of SPEEDa or SPEEDb symbols transmitted is an integer multiple of the number of SPEEDb symbols in the S400 speed signal. In practice this means that the S400 speed signal can either be started exactly half way through the S200 speed signal, or after completion of the S200 speed signal. For the same example, the following packet prefixes are permitted:

S400 speed signal follows immediately after completed S200 speed signal:

.....<data prefix symbols>[$S_aS_aS_aS_aS_bS_b$][data prefix symbols]<padded data>....

S400 speed signal is started half way through S200 speed signal:

.....<data prefix symbols>[$S_aS_aS_bS_b$][data prefix symbols]<padded data>

S400 speed signal follows S200 speed signal, and is delayed:

.....<data prefix symbols>[$S_aS_aS_aS_a$][data prefix symbols][S_bS_b][data prefix symbols]<padded data>....

1.8 S800 and higher speed packets

Packets at rates greater than or equal to S800 will never be forwarded on a DS port. The packet prefix rules for such packets are therefore different, and much shorter, than for lower rate packets.

The packet prefix for S800, S1600 and S3200 packets forwarded on any beta mode port shall be:

.....[speed symbols][padded data | data prefix symbols].....

For packet speeds less than or equal to the port operating speed, the beta mode port shall transmit the specified speed signal followed immediately by padded data.

In the case of a packet speed that is greater than the port operating speed, the speed signal (if any) transmitted by the beta mode port shall be the speed signal defined for the packet speed that corresponds to the port operating speed (i.e. a single occurrence of SPEEDa). This speed signal shall be followed immediately by data prefix symbols.

1.9 Examples

1.9.1 Example 1

An S200 packet forwarded through a beta mode port operating at S800:

```
....[DP][DP][DP][DP][DP][Sa][Sa][Sa][Sa][DP][DP][DP] ....... [DP][DP][padded data]

   >  20ns  <
```

Same packet forwarded from beta mode at S800 to beta mode at S400:

```
....[DP    ][DP    ][DP    ][Sa    ][Sa    ][DP    ] ....... [DP    ][padded data]

   >  20ns  <
```

1.9.2 Example 2

An S400 packet forwarded from DS port through an S400 beta mode port; DS port reports S200 speed signal before S400 speed signal:

```
....[DP    ][DP    ][Sa    ][Sb    ][DP    ][DP    ] ....... [DP    ][padded data]

   >  20ns  <
```

Same packet forwarded from S400 beta mode port through an S800 beta mode port:

```
....[DP][DP][DP][DP][Sa][Sa][Sb][Sb][DP][DP][DP][DP] ....... [DP][DP][padded data]

   >  20ns  <
```

1.9.3 Example 3

An S800 packet transmitted through an S1600 beta mode port:

```
....[Sa][Sa][padded data]

   >  10ns  <
```

Same packet forwarded through an S800 beta mode port:

```
....[Sa    ][padded data]

   >  10ns  <
```