

IEEE Std 1394

Physical Layer link signaling for S800BASE-T Auto-Negotiation on Twisted Pair

Scope

S800BASE-T allows 1394 data to be sent over 100 meters of 4 pair unshielded twisted pair (UTP) cable with Category 5 or better specifications. A device with S800BASE-T capability may also be capable of transmitting 802.3 packets, and may be connected to other devices with the capability for transmitting either 802.3 or 1394 information, or both.

This clause describes the Auto-Negotiation function that allows a device to advertise modes of operations it possesses to a device at the remote end of a UTP link segment, and to detect corresponding modes that the other device may be advertising. This allows S800BASE-T devices to coexist in the same physical cabling infrastructure as 802.3 (Ethernet) devices. The objective of the Auto-Negotiation function is to provide the means to exchange information between two devices that share a UTP link segment, and to automatically configure both devices to take maximum advantage of their abilities.

The Auto-Negotiation function allows the devices at both ends of a link segment to advertise abilities, acknowledge receipt and understanding of the common mode(s) of operation that both devices share, and to reject the use of operational modes that are not shared by both devices. Where more than one common mode exists between the two devices, a mechanism is provided to allow the devices to resolve to a single mode of operation using a predetermined priority resolution function.

Auto-Negotiation for S800BASE-T is derived from the specifications for Auto-Negotiation in IEEE Std 802.3, Clauses 28, 37, 40, and Annexes 28A, 28B, 28C and 28D. The basic mechanism to achieve Auto-Negotiation is to pass information encapsulated within a burst of closely spaced pulses, referred to as a Fast Link Pulse (FLP) Burst. The FLP Burst contains an alternating clock/data sequence carrying a Link Code Word that identifies the operational modes supported by the remote device, as well as information used for the Auto-Negotiation function's handshake mechanism.

S800BASE-T devices shall conform to all electrical and timing specifications of FLPs as defined in IEEE Std 802.3. All Link Code Words transmitted by an S800BASE-T device shall conform to the format of Link Code Words defined in IEEE Std 802.3. This clause defines a new Link Code Word that has previously been Reserved in IEEE Std 802.3, and uses that Link Code Word (Message Code 9) to advertise 1394 capability. S800BASE-T capability is defined, and future 1394 capability are allocated a reserved space in defined Next Page.

This clause must be read together with the aforementioned clauses from IEEE Std 802.3. A new capability is added to support 1394 S800BASE-T, but with exception of redefinition of reserved bits, nothing in this clause shall change any portion of those 802.3 clauses.

Link Code Word Encoding.

IEEE Std 802.3 Clause 28 defines three general Link Code Word formats: One Base Page format, and two Next Page Formats. The Next Page formats are Message Code pages and Unformatted pages. S800BASE-T devices are required to transmit each of these types of pages, in accordance with Clause 28 and the requirements listed below. Each S800BASE-T device shall transmit a Base Page followed by five Next Pages. The five Next Pages shall be, sequentially: Message Code 8, two Unformatted Pages, and Message Code 9, and one additional Unformatted Page.

S800BASE-T Auto-Negotiation

Base Page

Each S800BASE-T device shall transmit a Base Page, as defined in IEEE Std. 802.3 Clause 28.2.1.2. Each Base Page consists of 16 bits, D0:15.

BASE PAGE

D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
S0	S1	S2	S3	S4	A0	A1	A2	A3	A4	A5	A6	A7	RF	Ack	NP
Selector Field					Technology Ability Field										

Selector Field

The Selector Field bits shall be those assigned to IEEE Std. 802.3 in Annex 28A.

S0	S1	S2	S3	S4
1	0	0	0	0
Selector Field				

This shall apply to any S800BASE-T device, regardless of whether the device is also capable of transmitting 802.3 packets.

Technology Ability Field

The Technology Field bits shall be those assigned to IEEE Std. 802. in Annex 28B.

Bit	Technology
A0	10BASE-T
A1	10BASE-T full duplex
A2	100BASE-TX
A3	100BASE-TX full duplex
A4	100BASE-T4
A5	PAUSE operation for full duplex Links
A6	Asymmetric PAUSE operation for full duplex links
A7	Reserved for future technology

An S800BASE-T device that does not support any 802.3 technology shall set all bits in the Technology Ability Field to zero. An S800BASE-T device that supports one or more of the technologies in this field shall set the appropriate bit(s) in accordance with Annex 28B.

Other Bits

The Remote Fault (RF), Acknowledge (Ack) and Next Page (NP) bits shall be set in accordance with Clause 28.2.1. The NP bit shall be set to 1 to enable advertisement of S800BASE-T capability.

Next Pages

Message Code 8

Following transmission of the Base Page, a S800BASE-T shall transmit a Next Page containing Message Code 8 as defined in Annex 28C.

PAGE 0

D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
0	0	0	1	0	0	0	0	0	0	0	T	Ack2	MP	Ack	NP

S800BASE-T Auto-Negotiation

The Toggle (T), Acknowledge 2 (Ack2), Message Page (MP), and Acknowledge (Ack) bits shall be as specified in Clause 28.2.3. The Next Page (NP) bit shall be set to 1, to indicate further Next Pages.

Note that Message Code 8 shall be transmitted for any S800BASE-T device, regardless of whether that device is capable of 1000BASE-T.

Unformatted Page 1 and 2

Following transmission of Message Code 8, a S800BASE-T shall transmit two Next Pages containing an Unformatted Page Message Code 8 as defined in Annex 28C.

These two Unformatted Next Pages shall conform to the requirements of Clause 40.5.1.2, Table 40-4-1000BASE-T Base and Next Pages bit assignments, with the exception of Page 1 bits U3 and U4.

PAGE 1

D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
U0	U1	U2	U3*	U4*	0	0	0	0	0	0	T	Ack2	MP	Ack	NP

PAGE 2

D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
U0	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	T	Ack2	MP	Ack	NP

Page 1 bits U3 and U4 shall vary with the capability of the device. A device capable of S800BASE-T with no capability for 1000BASE-T shall set bits U3 and U4 to zero. This indicates no capability for 1000BASE-T half duplex (bit U4 = 0) and no capability for 1000BASE-T full duplex (bit U3 = 0). A device capable of S800BASE-T and 1000BASE-T shall set bits U3 and U4 as defined in Clause 40.5.1.2.

The Toggle (T), Acknowledge 2 (Ack2), Message Page (MP), and Acknowledge (Ack) bits shall be as specified in Clause 28.2.3. The Next Page (NP) bit shall be set to 1, to indicate further Next Pages.

Message Code 9

Following transmission of the two Unformatted Next Pages, a S800BASE-T shall transmit a Next Page containing Message Code 9. Message Code 9 has been previously defined in IEEE Std 802.3 2000 Edition, Annex 28C Table 28C-1 as “Reserved for future Auto-Negotiation Use”. This bit is here redefined to indicate “1394 Technology Message Code”.

PAGE 3

D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
1	0	0	1	0	0	0	0	0	0	0	T	Ack2	MP	Ack	NP

The Toggle (T), Acknowledge 2 (Ack2), Message Page (MP), and Acknowledge (Ack) bits shall be as specified in Clause 28.2.3. The Next Page (NP) bit in Message Code 9 shall be set to 1 to indicated an additional Next Page follows.

MASTER-SLAVE configuration resolution

MASTER-SLAVE configuration resolution shall be performed according to Clause 40.5.2 using the information in the two Unformatted Next Pages following Message Code 8. No additional Unformatted Next Pages are required to determine the MASTER-SLAVE configuration for S800BASE-T.

Unformatted Page 4

Following transmission of Message Code 9, an S800BASE-T shall transmit one Next Page containing an Unformatted Page Message Code as defined below.

PAGE 4

D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
1	0	0	0	0	0	0	0	0	0	0	T	Ack2	MP	Ack	NP

S800BASE-T Auto-Negotiation

Bit D0 shall be set to one to indicate S800BASE-T capability. Bits D1:D10 shall be set to zero, and are reserved for future use of 1394 technology. The Toggle (T), Acknowledge 2 (Ack2), Message Page (MP), and Acknowledge (Ack) bits shall be as specified in Clause 28.2.3. Use of the Next Page (NP) bit is implementation specific. Additional Next Pages may be transmitted if required by the specific application.

Priority

S800BASE-T shall take priority resolution over 802.3 capabilities. The highest common denominator for two devices that are both capable of S800BASE-T and any 802.3 technology shall be S800BASE-T.

Priority Resolution, from highest to lowest:

- S800BASE-T
- 1000BASE-T full duplex
- 1000BASE-T half duplex
- 100BASE-T2 full duplex
- 100BASE-TX full duplex
- 100BASE-T2 half duplex
- 100BASE-T4 half duplex
- 100BASE-TX half duplex
- 10BASE-T full duplex
- 10BASE-T half duplex

S800BASE-T Auto-Negotiation

Table - S800BASE-T Base and Next Pages bit assignments

Bit	Bit Definition	Usage
BASE PAGE		
D15	1	Indicates that Next Pages Follow
D14:D1	As specified in 802.3 Clause 28.2.1.2	Advertises 10/100 802.3 capabilities
PAGE 0 (Message Next Page)		
M10:M0	8	Advertises 1000BASE-T capabilities
PAGE 1 (Unformatted Next Page)		
U10:U5	Reserved, transmit as 0	
U4*	1000BASE-T half duplex	1 = half duplex and 0 = no half duplex*
U3*	1000BASE-T full duplex	1 = full duplex and 0 = no full duplex*
U2	1000BASE-T port type bit	1 = multi-port device, 0 = single-port device
U1	1000BASE-T or S800BASE-T MASTER-SLAVE Manual Configuration value	1 = MASTER and 0 = SLAVE
U0	1000BASE-T or S800BASE-T MASTER-SLAVE Manual Configuration enable	1 = Manual Configuration Enable
PAGE 2 (Unformatted Next Page)		
U10	1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 10 (SB10) (MSB)	MASTER-SLAVE Seed Value (10:0)
U9	1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 9 (SB9)	
U8	1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 8 (SB8)	
U7	1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 7 (SB7)	
U6	1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 6 (SB6)	
U5	1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 5 (SB5)	
U4	1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 4 (SB4)	
U3	1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 3 (SB3)	
U2	1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 2 (SB2)	
U1	1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 1 (SB1)	
U0	1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 0 (SB0)	
PAGE 3 (Message Next Page)		
M10:M0	9	Advertises 1394 capabilities
PAGE 4 (Unformatted Next Page)		
U10:1	0	Reserved for future 1394 use
U0	1	Advertises S800BASE-T capabilities

* If bits U4 and U3 are both set to zero, there is no capability for either half duplex 1000BASE-T or full duplex 1000BASE-T; only S800BASE-T or lower speeds are possible. A device advertising 1000BASE-T abilities must set at least one of bits U4 and U3 to 1.