S800Base-T
Auto-Negotiation

June, 2003
S800BASE-T Auto-Negotiation
Previous Discussion on Possible Approaches

- Bits in 802.3 Base Page
  - Only 1 bit left - Future Flexibility Limited

- 1394 Selector Field
  - Harder to do 1394 to Ethernet interoperability
    - Existing auto-negotiating devices will ignore these pages
    - Potential for Interoperability problems with installed base

- Add to Gigabit Ethernet Next Page (MC=8)
  - 6 bits leftover in 1st Unformatted Page
  - Defining bits in a page established for 1000BASE-T may meet resistance in 802.3 community

- Generic Next Page mechanism (MC=9)
  - Same way Gigabit Ethernet was done
  - Preferred approach for proposal
S800BASE-T Auto-Negotiation Technical Proposal

• Use the Next Page Mechanism in Auto-Negotiation
  – Message Code = 9
  – Unformatted Pages
    • Re-use info from pages from MC8 for MASTER-SLAVE resolution
    • 1 additional Unformatted Page for future flexibility

• This gives us an approach that is separate from existing Auto-Negotiation standardization of other technologies
  – Achieve interoperability
  – Probably easier to work through IEEE committee
Auto-Negotiation Pages

• BASE PAGE
  – Signals 10/100 Ethernet capabilities (if any)
  – Set bits to zero if no Ethernet

• Message Code 8 page
  – Signifies 1000BASE-T capability
  – Followed by 2 Unformatted Next Pages
    • Set 1000BASE-T half duplex bit and full duplex bit to zero, if only S800BASE-T is used
    • Otherwise, use bits as normal for 1000BASE-T
    • MASTER-SLAVE bits unchanged

• Message Code 9 page
  – Signifies 1394 capability
  – Use MASTER-SLAVE bits from previous Unformatted Page for link start-up
  – Followed by 1 Unformatted Next Page
    • 1 bit signifies S800BASE-T capability
    • 9 bits reserved for future 1394 capabilities
Base Page: Detail

- NO CHANGE

- D15 = 1 to indicate that Next Pages Follow

- D14:D1 = As specified in 28.2.1.2
  - These bits cover 10BASE-T and 100BASE-TX capabilities and provide the mechanisms needed for base page exchange

<table>
<thead>
<tr>
<th>D0</th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>D5</th>
<th>D6</th>
<th>D7</th>
<th>D8</th>
<th>D9</th>
<th>D10</th>
<th>D11</th>
<th>D12</th>
<th>D13</th>
<th>D14</th>
<th>D15</th>
</tr>
</thead>
<tbody>
<tr>
<td>S0</td>
<td>S1</td>
<td>S2</td>
<td>S3</td>
<td>S4</td>
<td>A0</td>
<td>A1</td>
<td>A2</td>
<td>A3</td>
<td>A4</td>
<td>A5</td>
<td>A6</td>
<td>A7</td>
<td>RF</td>
<td>Ack</td>
<td>NP</td>
</tr>
</tbody>
</table>

Selector Field | Technology Ability Field
Next Page 0 – Message Code 8

• M10:M0 = 8
  – Means 1000Base-T
  – Specifies how many next pages in this sequence
    • 1xMC + 2xUP

<table>
<thead>
<tr>
<th>D0</th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>D5</th>
<th>D6</th>
<th>D7</th>
<th>D8</th>
<th>D9</th>
<th>D10</th>
<th>D11</th>
<th>D12</th>
<th>D13</th>
<th>D14</th>
<th>D15</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>T</td>
<td>Ack2</td>
<td>MP</td>
<td>Ack</td>
<td>NP</td>
</tr>
</tbody>
</table>
• U10:U4 = Reserved for future use – Transmit as 0

• U5 = S1000Base-T Capable

• U4 = 1000Base-T Half Duplex : Set to “0” if S800 only

• U3 = 1000Base-T Full Duplex : Set to “0” if S800 only

• U2 = 1000Base-T Port Type
  – 1=multi-port, 0=single-port device

• U1 = 1000Base-T Master-Slave Manual Configuration value
  – 1=Master, 2=Slave

• U0 = 1000Base-T Master-Slave Manual Configuration enable
  – 1=Manual Configuration Enable
• Same as 1000BASE-T Unformatted Page

• MASTER-SLAVE Seed Values for link start-up

• Values for 1000BASE-T will be re-used for S800BASE-T, if applicable
Next Page 3 – Message Code 9

- NEW MESSAGE CODE

- M10:M0 = 9
  - Signifies 1394 Technology

<table>
<thead>
<tr>
<th>D0</th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>D5</th>
<th>D6</th>
<th>D7</th>
<th>D8</th>
<th>D9</th>
<th>D10</th>
<th>D11</th>
<th>D12</th>
<th>D13</th>
<th>D14</th>
<th>D15</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>T</td>
<td>Ack2</td>
<td>MP</td>
<td>Ack</td>
<td>NP</td>
</tr>
</tbody>
</table>
• Bit D0 =1 signifies S800BASE-T capability

• Bits D1:10 are reserved for future 1394 technologies
  – E.g. S100 or S1600

<table>
<thead>
<tr>
<th>D0</th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>D5</th>
<th>D6</th>
<th>D7</th>
<th>D8</th>
<th>D9</th>
<th>D10</th>
<th>D11</th>
<th>D12</th>
<th>D13</th>
<th>D14</th>
<th>D15</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>T</td>
<td>Ack2</td>
<td>MP</td>
<td>Ack</td>
<td>NP</td>
</tr>
</tbody>
</table>
**Priority Resolution Table 28B.3**

- Insert 1394 S800 at top of table due to Isochronous capabilities at nearly the same speed

**New Table**

- 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
## Base and Next Pages bit assignments

<table>
<thead>
<tr>
<th>Bit</th>
<th>Bit Definition</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>D15</td>
<td>1</td>
<td>Indicates that Next Pages Follow</td>
</tr>
<tr>
<td>D14:D1</td>
<td>As specified in 802.3 Clause 28.2.1.2</td>
<td>Advertises 10/100 802.3 capabilities</td>
</tr>
<tr>
<td>M10:M0</td>
<td>8</td>
<td>Advertises 1000BASE-T capabilities</td>
</tr>
</tbody>
</table>

### PAGE 0 (Message Next Page)

<table>
<thead>
<tr>
<th>Bit</th>
<th>Bit Definition</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>U10:U5</td>
<td>Reserved, transmit as 0</td>
<td></td>
</tr>
<tr>
<td>U4</td>
<td>1000BASE-T half duplex</td>
<td>1 = half duplex and 0 = no half duplex*</td>
</tr>
<tr>
<td>U3</td>
<td>1000BASE-T full duplex</td>
<td>1 = full duplex and 0 = no full duplex*</td>
</tr>
<tr>
<td>U2</td>
<td>1000BASE-T port type bit</td>
<td>1 = multi-port device, 0 = single-port device</td>
</tr>
<tr>
<td>U1</td>
<td>1000BASE-T or S800BASE-T MASTER-SLAVE Manual Configuration value</td>
<td>1 = MASTER and 0 = SLAVE</td>
</tr>
<tr>
<td>U0</td>
<td>1000BASE-T or S800BASE-T MASTER-SLAVE Manual Configuration enable</td>
<td>1 = Manual Configuration Enable</td>
</tr>
</tbody>
</table>

### PAGE 1 (Unformatted Next Page)

<table>
<thead>
<tr>
<th>Bit</th>
<th>Bit Definition</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>U10</td>
<td>1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 10 (SB10) (MSB)</td>
<td>MASTER-SLAVE Seed Value (10:0)</td>
</tr>
<tr>
<td>U9</td>
<td>1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 9 (SB9)</td>
<td></td>
</tr>
<tr>
<td>U8</td>
<td>1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 8 (SB8)</td>
<td></td>
</tr>
<tr>
<td>U7</td>
<td>1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 7 (SB7)</td>
<td></td>
</tr>
<tr>
<td>U6</td>
<td>1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 6 (SB6)</td>
<td></td>
</tr>
<tr>
<td>U5</td>
<td>1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 5 (SB5)</td>
<td></td>
</tr>
<tr>
<td>U4</td>
<td>1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 4 (SB4)</td>
<td></td>
</tr>
<tr>
<td>U3</td>
<td>1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 3 (SB3)</td>
<td></td>
</tr>
<tr>
<td>U2</td>
<td>1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 2 (SB2)</td>
<td></td>
</tr>
<tr>
<td>U1</td>
<td>1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 1 (SB1)</td>
<td></td>
</tr>
<tr>
<td>U0</td>
<td>1000BASE-T or S800BASE-T MASTER-SLAVE Seed Bit 0 (SBC)</td>
<td></td>
</tr>
</tbody>
</table>

### PAGE 2 (Unformatted Next Page)

<table>
<thead>
<tr>
<th>Bit</th>
<th>Bit Definition</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>M10:M0</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

### PAGE 3 (Message Next Page)

<table>
<thead>
<tr>
<th>Bit</th>
<th>Bit Definition</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>U10:1</td>
<td>0</td>
<td>Advertises 1394 capabilities</td>
</tr>
<tr>
<td>U0</td>
<td>1</td>
<td>Advertises S800BASE-T capabilities</td>
</tr>
</tbody>
</table>
Interoperability

- Proposed method was tested against existing 1000BASE-T PHYs
- Confirmed that Message Code 9 is properly ignored by a 10/100/1000BASE-T PHY
- Confirmed that if the 1000BASE-T half duplex and full duplex bits are set to zero in the 1st Unformatted Page, the device falls back to 10/100.
  - 1000BASE-T mode is properly Disabled
- Devices tested from the 2 highest volume 1000BASE-T PHY vendors
  - Represent >90% of the installed base of 1000BASE-T PHYs
Summary

• Implementing Auto-Negotiation for S800Base-T will allow easy interoperability with 1000Base-T and slower Ethernet devices

• There are no technical hurdles to implementing Auto-Negotiation for S800Base-T

• Requires that 802.3 assign Message Code 9 to 1394 Technology
  – No identified reason for objection

• Draft document has been created for review
  – All Auto-Negotiation bits are defined for 10/100/1000BASE-T and S800BASE-T
  • No changes required for any legacy 10/100/1000 device
  – Future flexibility via reserved code word space