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# S800Base-T Auto-Negotiation

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# Outline

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- **Purpose of Auto-Negotiation**
- **How does Auto-Negotiation Work**
- **S800Base-T Auto-Negotiation Scenarios**
- **Relevant Ethernet Standards that need to be Modified**
- **Technical Proposal**
- **Summary**

# Auto-Negotiation Goals

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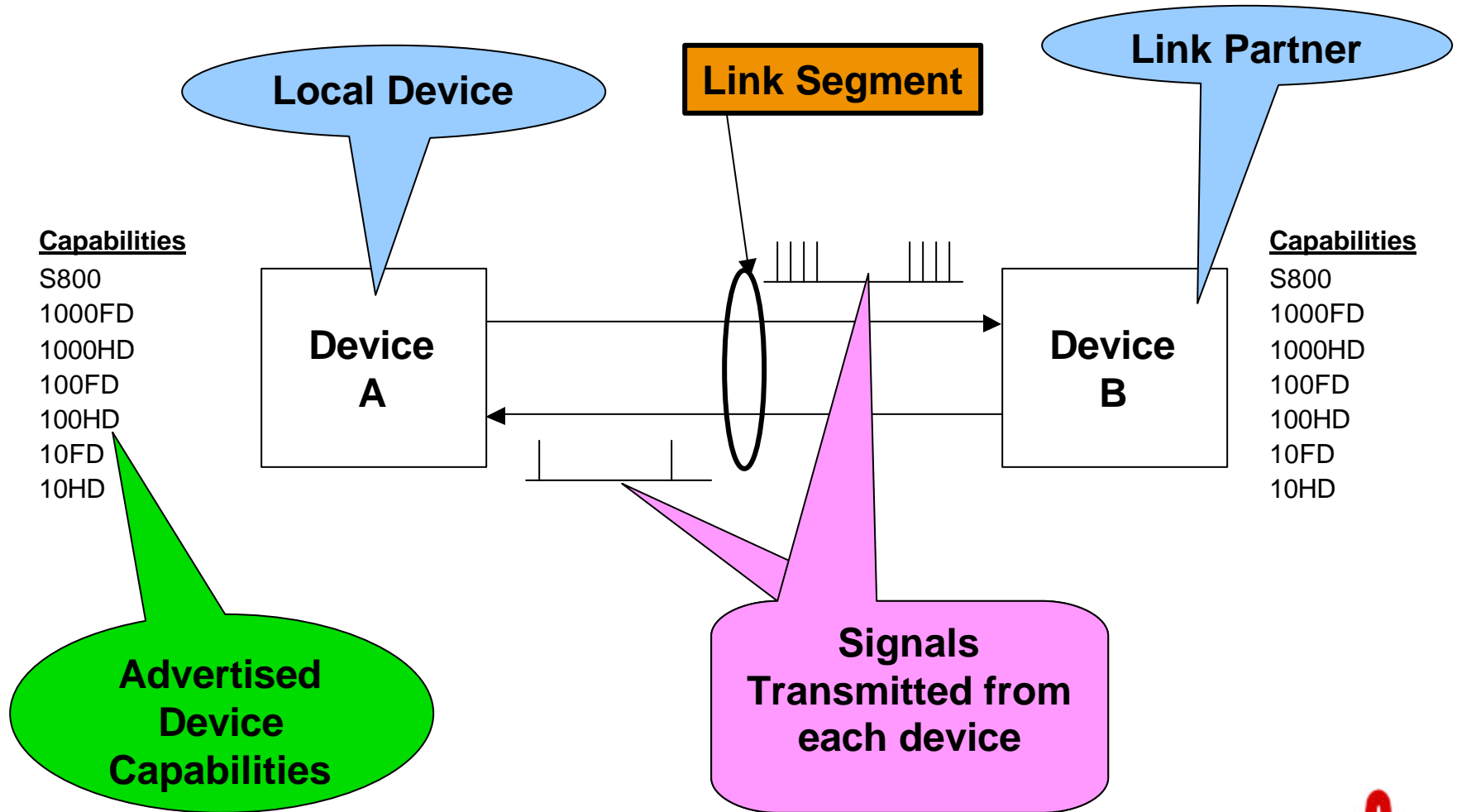
- **Enable automatic connection between two auto-negotiating devices at the best possible speed and duplex that they both possess**
- **Automatically configure technology and speed to match a legacy link partner's capabilities even though it may not support auto-negotiation**
- **Allow communication of additional link level information like flow control support**

# Auto-Negotiation in a Nutshell

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- Works between two devices on a link segment
- Exchanges and Acknowledges 16-bit data words using variation of 10Base-T Link Pulse signaling
- Data words contain information about a device's supported capabilities
- The best common technology is automatically selected and enabled
- A-N ends once the chosen technology is enabled and stays out of the way until the link status changes

# S800Base-T Auto-Negotiation Scenarios: Key to Diagrams



# Terminology

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- **Auto-Negotiation (A-N)** is a process that occurs prior to enabling a specific communication technology that determines the **Highest Common Denominator (HCD)** technology between two devices on a **Link Segment**. Auto-Negotiation hands off to the HCD technology when it is finished and stays out of the way until the **[Receive] Link Status** goes down.
- A-N Advertises the **Capabilities** of the **Local Device** (ex. Device A) it is running on to its **Link Partner** (ex. Device B). The Link Partner does the same thing.
- A-N uses a sequence of 10Base-T **Link Pulses** called **Fast Link Pulses (FLPs)** to communicate a device's capabilities.
- 17 to 33 FLPs are sent in a **FLP Burst** to convey 16 bits of encoded data.

# Terminology pt. 2

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- One ***Base Page*** of data is always sent. Additional ***Next Pages*** conveying additional device capabilities may also be exchanged.
- ***Legacy Devices*** do not implement A-N. They must be configured into a single mode of operation with a jumper or software.
- A-N uses ***Parallel Detection*** to attempt to identify Legacy Devices by examining the default signals sent out at link startup.

# Scenarios Overview

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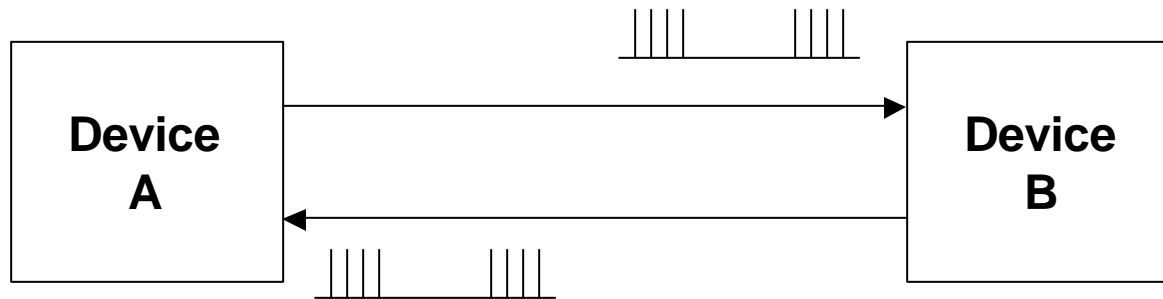
- **The following Auto-Negotiation connection scenarios have all been evaluated:**
  - 100Base-T A-N to 100Base-T A-N
  - 1000Base-T A-N to 1000Base-T A-N
  - S800Base-T Aware (GE) to S800Base-T Aware (GE)
  - S800Base-T Aware (1394) to S800Base-T Aware (1394)
  - S800Base-T Aware (All) to S800Base-T Aware (All)
  - S800Base-T Aware to Clause 40 Auto-Negotiation
  - S800Base-T Aware to Clause 28 Auto-Negotiation
  - S800Base-T Aware to Legacy 10Mb or 100Mb
  - S800Base-T Aware to Legacy 1394



# 100Base-T A-N to 100Base-T A-N

## Capabilities

100FD  
100HD  
10FD  
10HD



## Capabilities

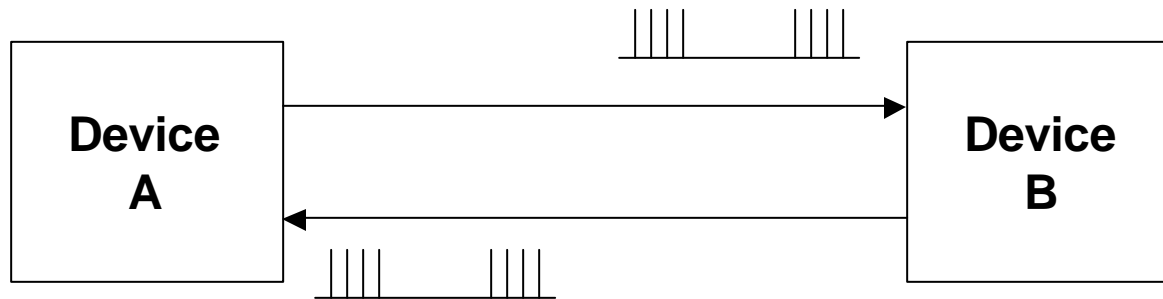
100FD  
100HD  
10FD  
10HD

- Here is an easy Auto-Negotiation scenario to warm up on!
- Both devices send out FLP Bursts advertising their capabilities
- Auto-Negotiation completes successfully and enables the HCD technology – 100Base-T Full Duplex

# 1000Base-T A-N to 1000Base-T A-N

## Capabilities

1000FD  
1000HD  
100FD  
100HD  
10FD  
10HD



## Capabilities

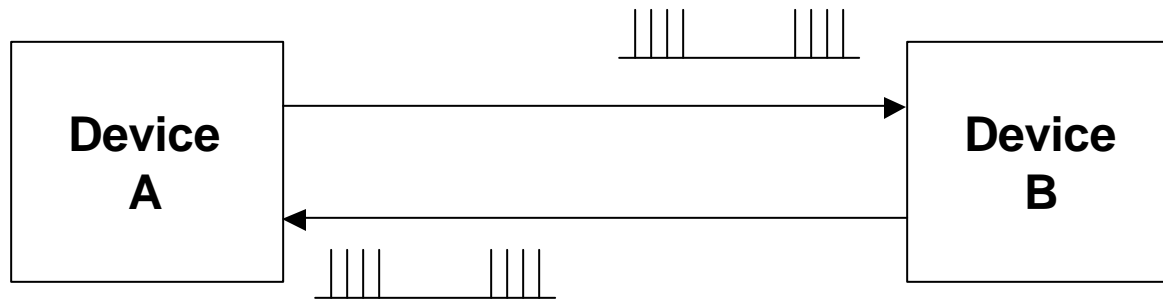
1000FD  
1000HD  
100FD  
100HD  
10FD  
10HD

- **Same behavior as 100 A-N to 100 A-N except**
  - 1000Base-T Full Duplex is the HCD
  - Negotiation requires multiple Next Pages to be exchanged in addition to the Base Page

# S800Base-T Aware (GE) to S800Base-T Aware (GE)

## Capabilities

1000FD  
1000HD  
100FD  
100HD  
10FD  
10HD



## Capabilities

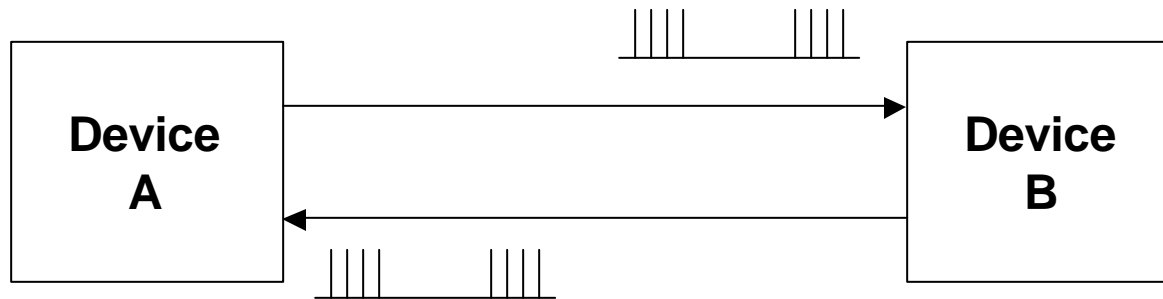
1000FD  
1000HD  
100FD  
100HD  
10FD  
10HD

- Both devices send out FLP Bursts advertising their capabilities
- Auto-Negotiation completes successfully and enables the HCD technology – 1000Base-T Full Duplex

# S800Base-T Aware (1394) to S800Base-T Aware (1394)

## Capabilities

S800  
100FD  
100HD  
10FD  
10HD



## Capabilities

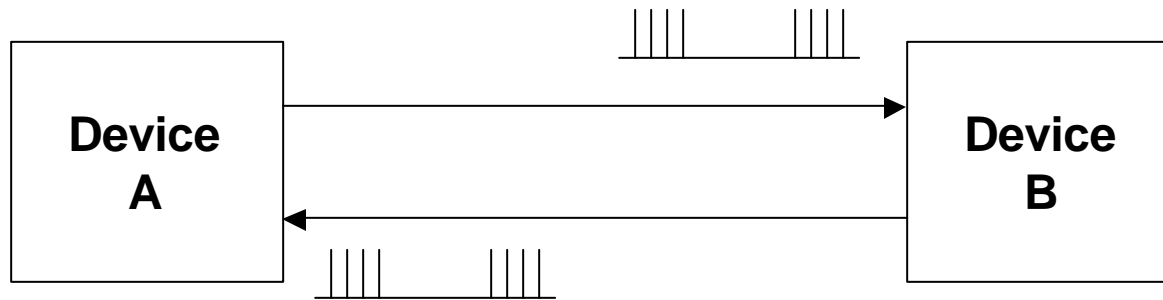
S800  
100FD  
100HD  
10FD  
10HD

- Both devices send out FLP Bursts advertising their capabilities
- Auto-Negotiation completes successfully and enables the HCD technology – S800Base-T
  - Once enabled, S800Base-T can speed select to 400 or 800 Mb/s

# S800Base-T Aware (All) to S800Base-T Aware (All)

## Capabilities

S800  
1000FD  
1000HD  
100FD  
100HD  
10FD  
10HD



## Capabilities

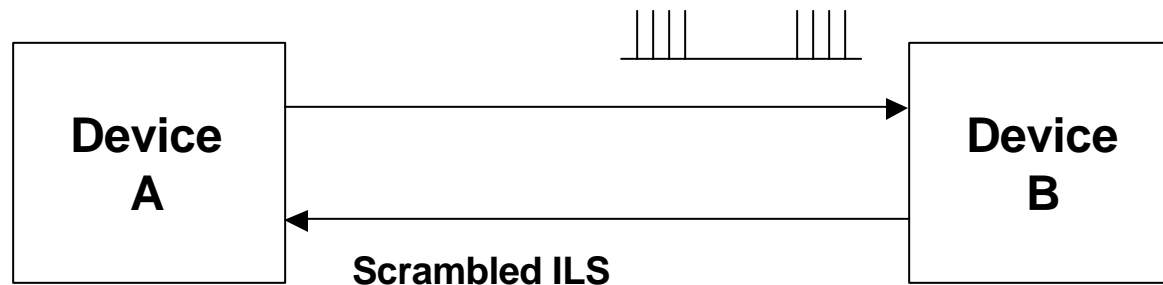
S800  
1000FD  
1000HD  
100FD  
100HD  
10FD  
10HD

- Both devices send out FLP Bursts advertising their capabilities
- Auto-Negotiation completes successfully and enables the HCD technology – S800Base-T
  - Once enabled, S800Base-T can speed select to 400 or 800 Mb/s

# S800Base-T Aware to Legacy 10Mb or 100Mb

## Capabilities

S800  
1000FD  
1000HD  
100FD  
100HD  
10FD  
10HD



## Capabilities

100HD FORCED

- The S800Base-T device sends out FLP Bursts advertising it's capabilities
- The Legacy device sends out it's native signaling – Scrambled Idle Line State
- The Auto-Negotiating device Parallel Detects the Scrambled ILS and enables 100Base-T Half Duplex, completing successfully

– NOTE: The addition of S800Base-T does not change the one weakness of A-N, in that it still can not Parallel Detect a Full Duplex legacy device.

# S800Base-T Aware to Legacy 1394

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- **Define Legacy 1394**

- 1394a vs 1394b

- Currently using keyed Plugs and Sockets to determine compatibility

- Bilingual socket can connect to

- » 1394a 4 or 6 pin with Bilingual Plug

- » 1394b with Beta or Bilingual Plug

- Beta socket can connect to

- » 1394b Beta Plug only, no 1394a support

- 1394a 4 or 6 pin socket can connect to

- » 1394a 4 or 6 pin plug respectively

- S800Base-T

- All S800Base-T devices will support Auto-Negotiation and will use an RJ-45 jack

# Relevant Ethernet Standards

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- **802.3**

- Clause 28 – Basic Auto-Negotiation
- Annex 28A – Selector Field Definitions
- Annex 28B – 802.3 Selector Base Page Definition
  - Also Priority Resolution
- Annex 28C – Next Page Message Code Field definitions
  - 1000Base-T Next Pages
    - 1xMC(=8) + 2xUP
- Annex 28D – Description of Extensions to Clause 28 and associated annexes
  - Clause 40 Extensions
- Clause 40.5
- Annex 40C – Add-on interface for additional Next Pages



# Possible Approaches

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- **Bits in 802.3 Base Page**
  - Only 1 bit left
- **1394 Selector Field**
  - Harder to do 1394 to Ethernet interoperability
    - Existing auto-negotiating devices will ignore these pages
- **Add to Gigabit Ethernet Next Page (MC=8)**
  - 6 bits leftover in 1<sup>st</sup> Unformatted Page
- **Generic Next Page mechanism (MC=9)**
  - Same way Gigabit Ethernet was done

# Technical Proposal

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- **Use the Next Page Mechanism in Auto-Negotiation**
  - MC = 9
  - UP = 1 or 2 pages
- **This gives us an approach that is completely separate from existing Auto-Negotiation standardization of other technologies**
  - Achieve interoperability
  - Probably easier to work through IEEE committee

# Base Page

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- **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

# Next Page 1 - Message Code

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- **NEW MESSAGE CODE**
- **M10:M0 = 9**
  - Means S800Base-T 1394 over Gigabit Ethernet negotiation
  - Specifies how many next pages in this sequence
    - 1xMC + 2xUP

# NP 2 - First UP - New Capabilities

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- **U10:U4 = Reserved for future use – Transmit as 0**
- **U5 = S800Base-T Capable**
- **U4 = 1000Base-T Half Duplex**
- **U3 = 1000Base-T Full Duplex**
- **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

# Next Page 3 - Second Unformatted Page - Seed Value

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- Keep if use GE pages
- Otherwise we can eliminate

# Priority Resolution Table 28B.3

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- **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

# Summary

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- **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**
- **The IEEE standards possibilities are well understood**
- **All that remains is to prepare a new draft standard and work with the IEEE committee to get it approved**