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Transducer Types

- IEEE 1451.3 Transducer Types
  - Sensor
  - Event Sensor
  - Actuator
- Embedded Transducers
  - Measure or control some aspect of another transducer channel
  - Have no effect outside the TBIM
- TransducerChannel Proxies
  - Combine the Inputs or Outputs for several Transducers into one device for data transmission efficiency
  - Do not have TEDS

Attributes and Operating Modes

- Operating modes are defined with attributes
  - Sampling Modes
  - Buffered operation
  - End-of-data-set operation
  - Streaming mode
  - Event Sensor Edge-to-report
  - Actuator-halt mode

Triggering

- Trigger Command
- An event within a TBIM
  - An event sensor detects the event
  - Transducers in other TBIMs are not triggered
- Beginning of an isochronous interval signal.
  - Usually associated with streaming operation

Synchronous Operation

- Two methods of obtaining synchronous operation
  - Group or Global Triggers
  - Use of the synchronization Signal
- Synchronization Signal
  - Two Megahertz signal
  - Modulated to aid isochronous data transmission & synchronous operation

Time Tagging of Data

- System is designed to allow the data to be time tagged.
- In most cases it can be time tagged in the NCAP using information from the TEDS.
- In other cases it can be time tagged in the TBIM
- A combination of the two methods can be used.

Command Classes

- Initialization
  - 16 commands
- Operational
  - 13 commands
- Set operating mode
  - Six attributes
- Read operating mode
- Run diagnostic
  - Run all
  - Manufacturer defined
- Query TEDS
  - Function selects the TEDS
- Read TEDS
- Write TEDS
- Update TEDS

Manufacturer Defined Commands

- Manufacturers may define additional commands in any of these classes.
- Manufacturers may define additional classes.
- Manufacturer defined commands require a Command TEDS.

Transducer Electronic Data Sheets (TEDS)

- Meta-TEDS
- Transducer Channel TEDS
- Calibration TEDS
- Frequency Response TEDS
- Transfer Function TEDS
- PHY TEDS
- Manufacturer Defined TEDS

Transducer Electronic Data Sheets (TEDS)

- Text based TEDS
- End user application specific TEDS
- Commissioning TEDS
- Commands TEDS

Addressing

- An address has been defined that is independent of the address used for the physical media or MAC.
- Two eight bit fields in the address
  - Module address (TBIM Alias) – assigned by the system
  - Transducer Channel number – assigned by the manufacturer and not changeable in the field.

Addressing

Address class	TBIM Alias	Transducer Channel number
Global	Zero	Zero
Address Group	Zero	Non-zero
TBIM	Non-zero	Zero
Transducer Channel	Non-zero	Non-zero
NCAP address	255	Zero

Communications Protocols

- Command Services
- Reply Protocol
- IEEE 1451.3 Datagram Protocol
  - Similar to UDP
- Streaming Data Protocol
- Trigger Protocol

Communications Services

- Streaming Mode Management Services
- Streaming Mode Protocol Services
- Discovery Services
- Transmitter control services
- Datagram Protocol Services
- Trigger protocol services
- Delay measurement services

MAC and Physical Layer

- Home Phoneline Networking Alliance MAC and Physical layer (HPNA)
  - Occupies spectrum from 4.75 to 9.25 MHz
- Synchronization added on the same pair of wires
  - 2 MHz synchronization signal
- DC Power
  - Power recommended but not specified by the standard.

MAC and Physical Layer

- Home Phoneline Networking Alliance MAC and Physical layer (HPNA)
  - Chosen because it was expected to be a “commodity item.”
  - IEEE 802.11 has taken over that market
  - Chips are not as readily available as expected
  - Support is event less available
  - We are looking at FPGA solutions