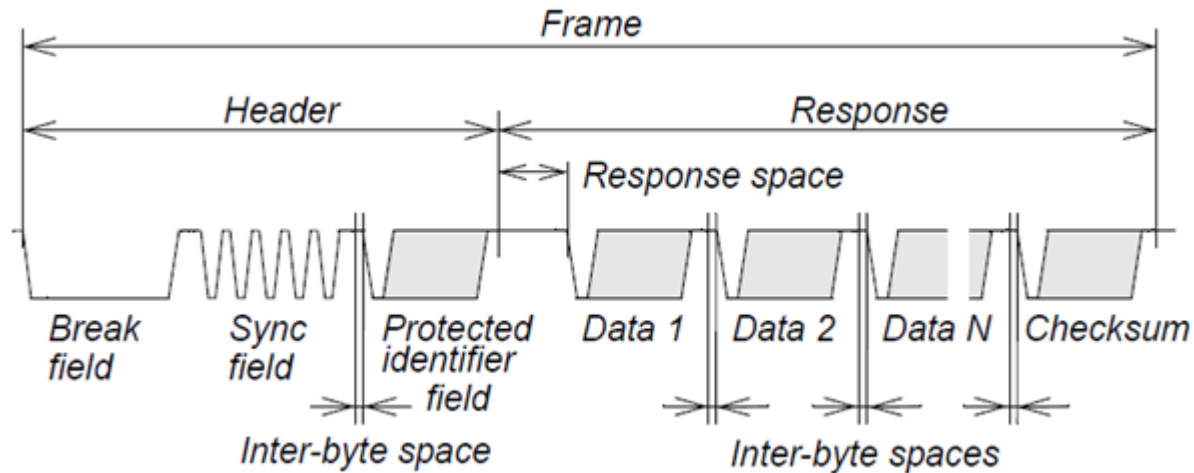


LIN (LOCAL INTERCONNECTED NETWORK)

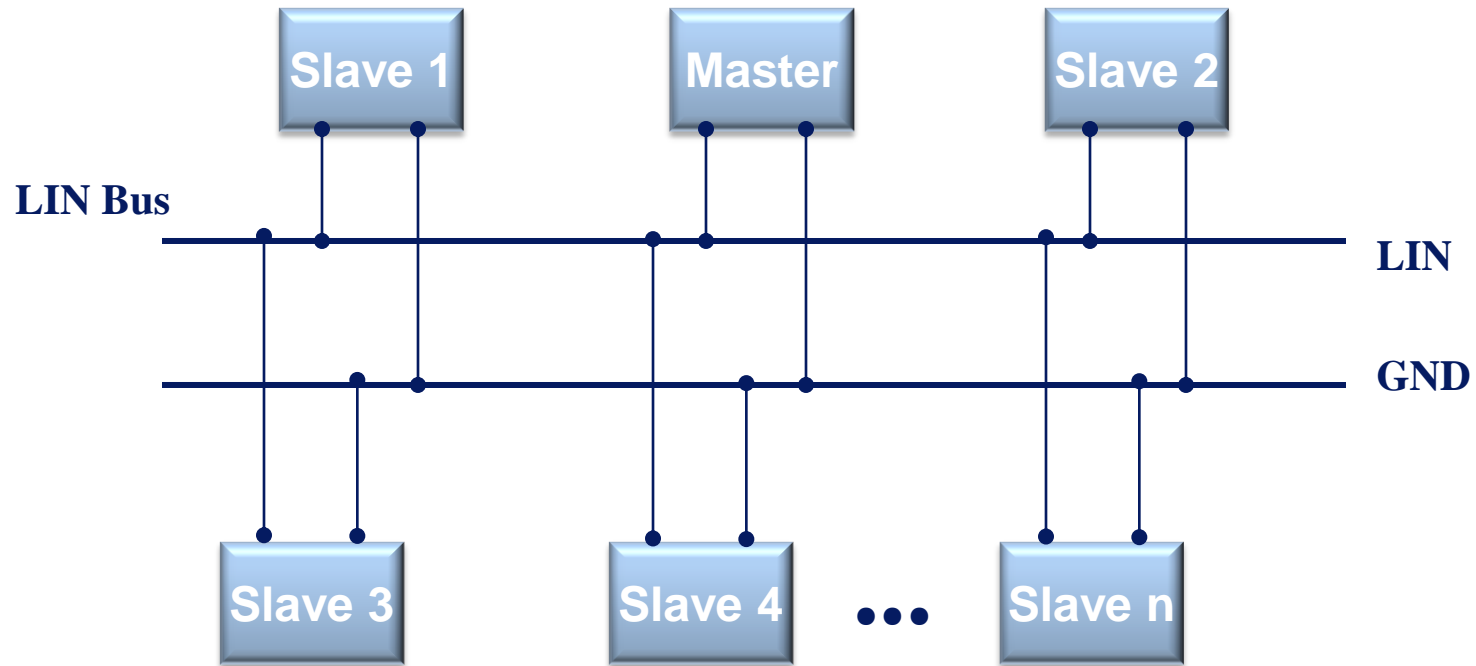


- Serial Communication Systems
 - In-Vehicle Networking
 - Introduction to LIN

- Fundamentals of the LIN Protocol
 - Signal Management
 - Frame Transfer
 - Frame Types
 - Schedule tables
 - Network Management
 - Physical Layer Specification
 - LIN Frame Timing
 - Error
 - Node Transport & Diagnostic
 - Node configuration & Identification

Communication Between Electronic Components

- The gradual increase of functions
- The distribution of functions
- Data exchange between ECUs is getting essential

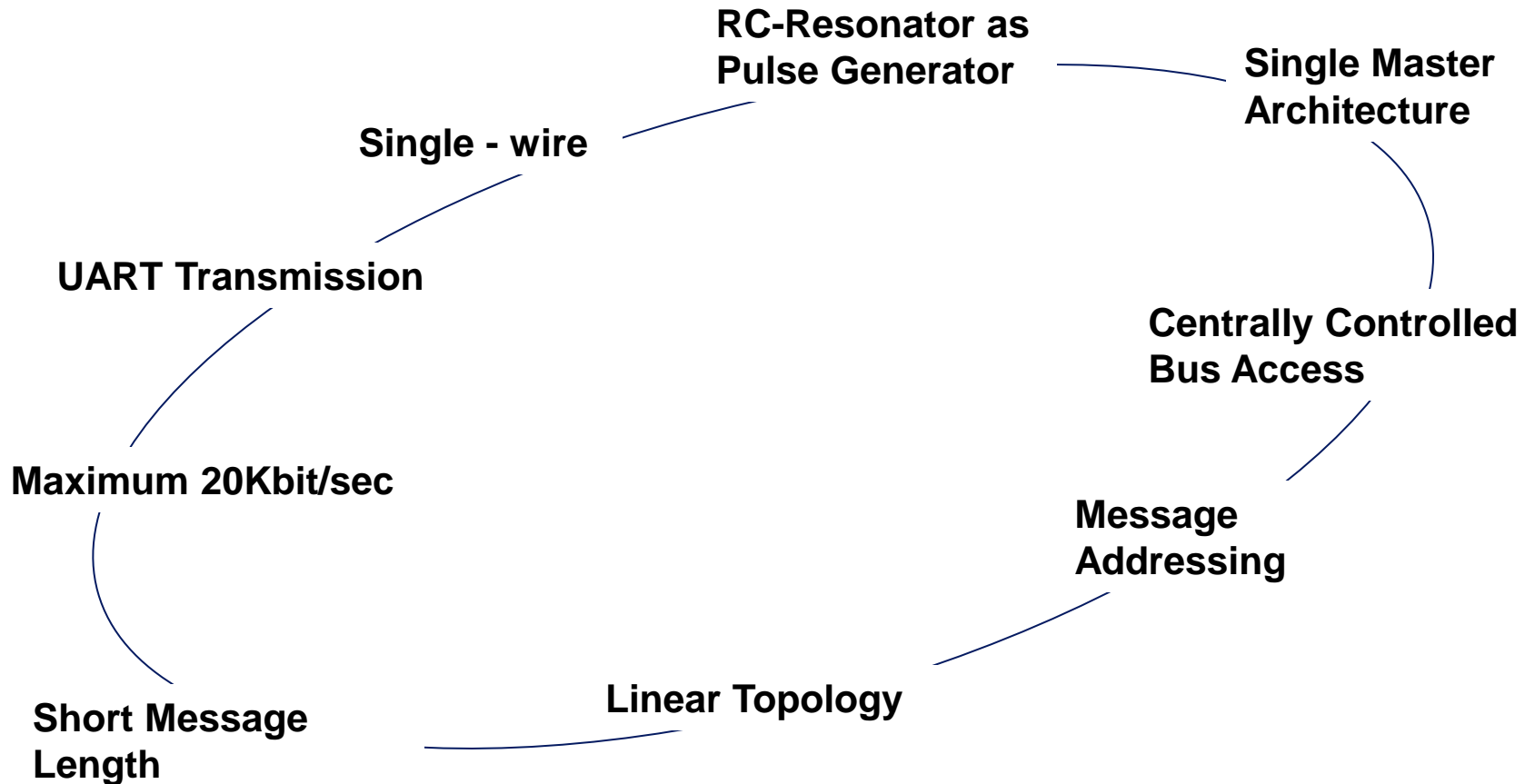


An Overview of LIN

- The LIN physical layer is based on ISO 9141 (the K-line).
- Master/slave organization
- Message distribution (Broadcast)
- Data rates up to 20KBit/sec
- Max 40 m wire length
- Single wire plus ground
- Time triggered scheduling

Questions

- Characteristics of LIN

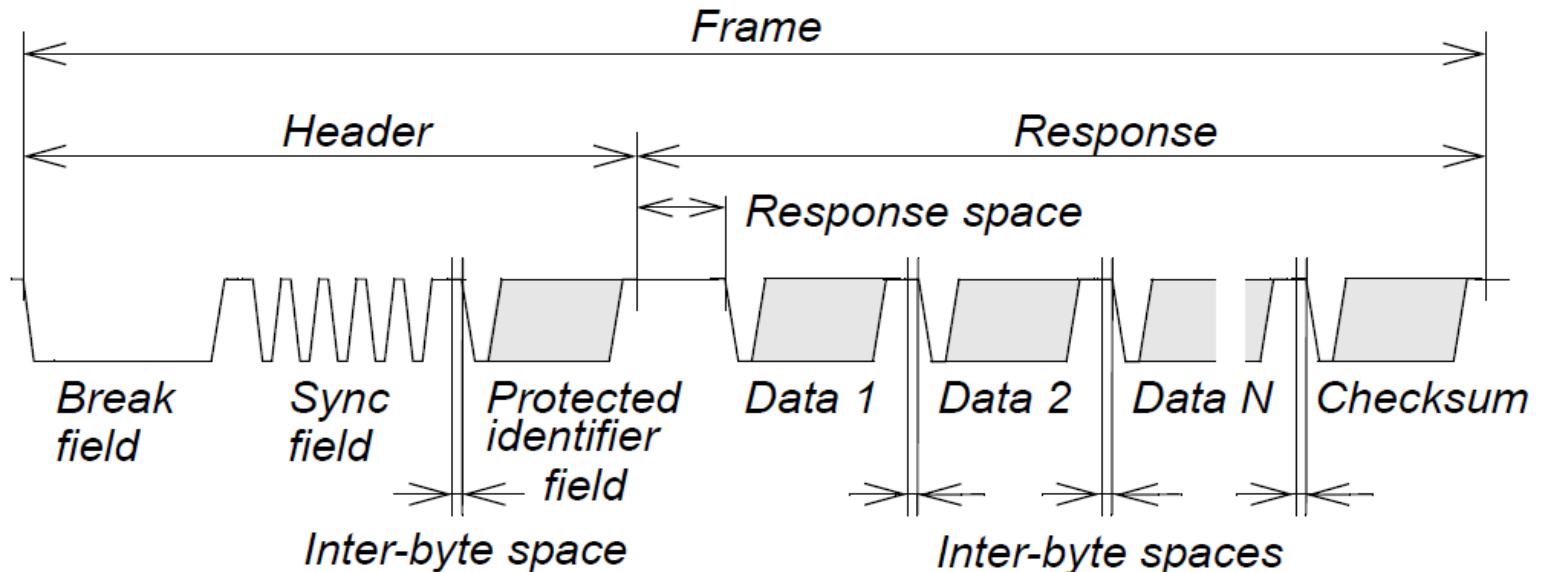


Signal Packing

- A signal is either a scalar value or a byte array
- A signal is transmitted with the LSB first and the MSB last
- All unused bits and bytes in frames shall be set to ones (recessive) by the sender since dominant bits consume more current.

Structure of a frame

- Header is sent by the LIN master, Response is added by a LIN slave.
- Inter Byte Space is used to adjust for bus jitter.
- Response is used to software runtime for PID validation and handling.



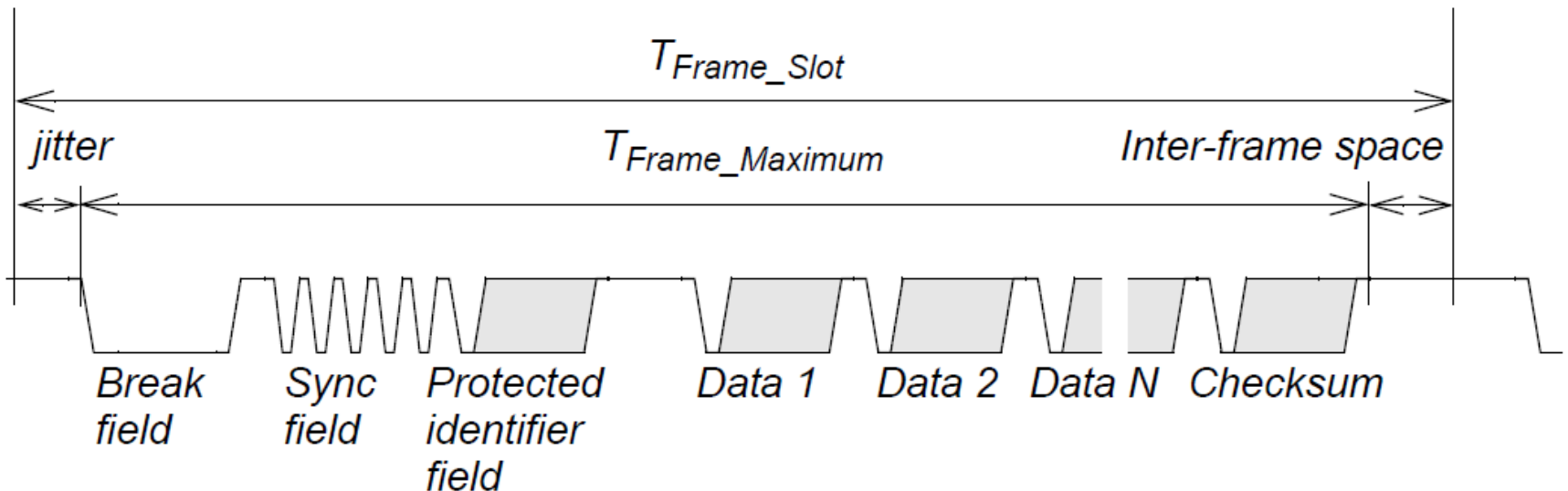
- The data bits are calculated by adding each byte value and adding any carry to the 8bit result
 - Classic checksum
 - All data bytes are used for calculation
 - Used for all LIN 1.x frame IDs
 - Used only for LIN2.x frames with IDs 60~63
 - Enhanced checksum (only LIN 2.x)
 - PID and all data bytes are used for calculation
 - Used for all LIN 2.x frame IDs 00~59

Time Definitions

- The minimum time unit that is used in a LIN cluster is the time base (T_{BASE})
- Usually a time base is 5 or 10 ms
- The T_{FRAME_SLOT} is the time from when a schedule table entry is due until the subsequent schedule entry is due

$$T_{FRAME_SLOT} = T_{BASE} * n$$

$$T_{FRAME_SLOT} \geq T_{JITTER} + T_{FRAME_MAXIMUM} + T_{INTER_FRAME_SPACE}$$



Go-to-Sleep Command

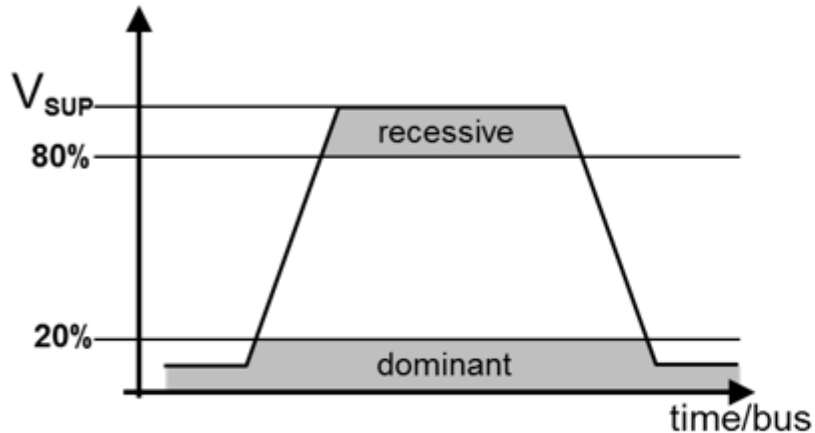
- The master sets the cluster into bus sleep mode by transmitting a go to sleep command
- The slave nodes shall ignore the data fields 2 to 8 and interpret only the first data field
- LIN 2.x slaves should automatically enter bus sleep mode 4-10 seconds after bus inactivity

MasterReq(ID = 0x3C)

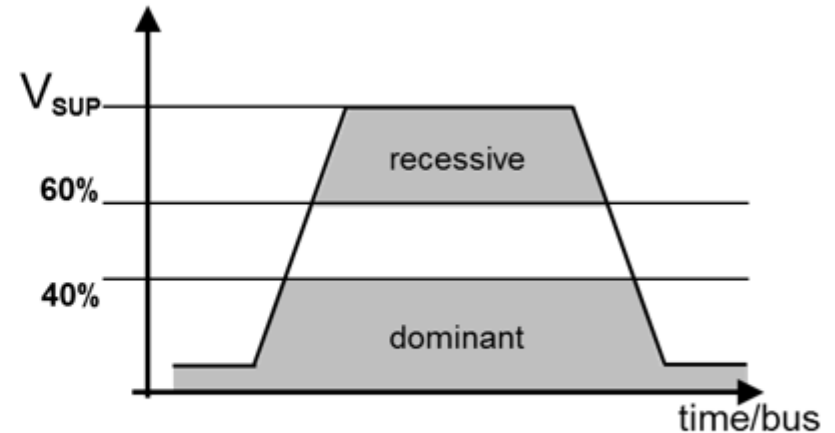
| | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|
| Data1 | Data2 | Data3 | Data4 | Data5 | Data6 | Data7 | Data8 |
| 0x00 | 0xFF | 0xFF | 0xFF | 0xFF | 0xFF | 0xFF | 0xFF |

Voltage Levels on the Bus Line

- V_{SUP} : ECU-internal supply
- Transmitter Node
 - Dominant Max = $V_{SUP} * 20\%$
 - Recessive min = $V_{SUP} * 80\%$
- Receiver Node
 - Dominant Max = $V_{SUP} * 40\%$
 - Recessive min = $V_{SUP} * 60\%$



(a) Transmitter output voltage level



(b) Receiver input voltage level

Transport Protocol and Diagnostic

PCI

- PCI (Protocol Control Information)

| Type | PCI type | | | | Additional information | | | |
|------|----------|----|----|----|------------------------|----|----|----|
| | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| SF | 0 | 0 | 0 | 0 | Length | | | |
| FF | 0 | 0 | 0 | 1 | Length / 256 | | | |
| CF | 0 | 0 | 1 | 0 | Frame counter | | | |

SF (Single Frame)

- Single Frame (SF) indicates that the transported message fits into the single.
- Maximum five data bytes.

FF (First Frame)

- First Frame (FF) is used to indicate the start of a multi message.

CF(Continuation Frame)

- A multi-message is continued with a number of Continuation Frames (CF).
- First CF frame of a message numbered 1, second 2 and so on.
- If more than 15 CF counter wraps around and continues with 0, 1....

고객과 함께 성장하는 한일프로텍이 되겠습니다.

감사합니다.

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