

Analysis and Selection of Communication Protocols

Networks and Embedded Software

Module 5.2.2

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Analysis (1)

- Criteria
 - Mode of Addressing
 - Start/End of Connection
 - Start of Message
 - End of Message
 - Format of Message
 - Error Detection / Error Correction
 - Flow Control

Analysis (2)

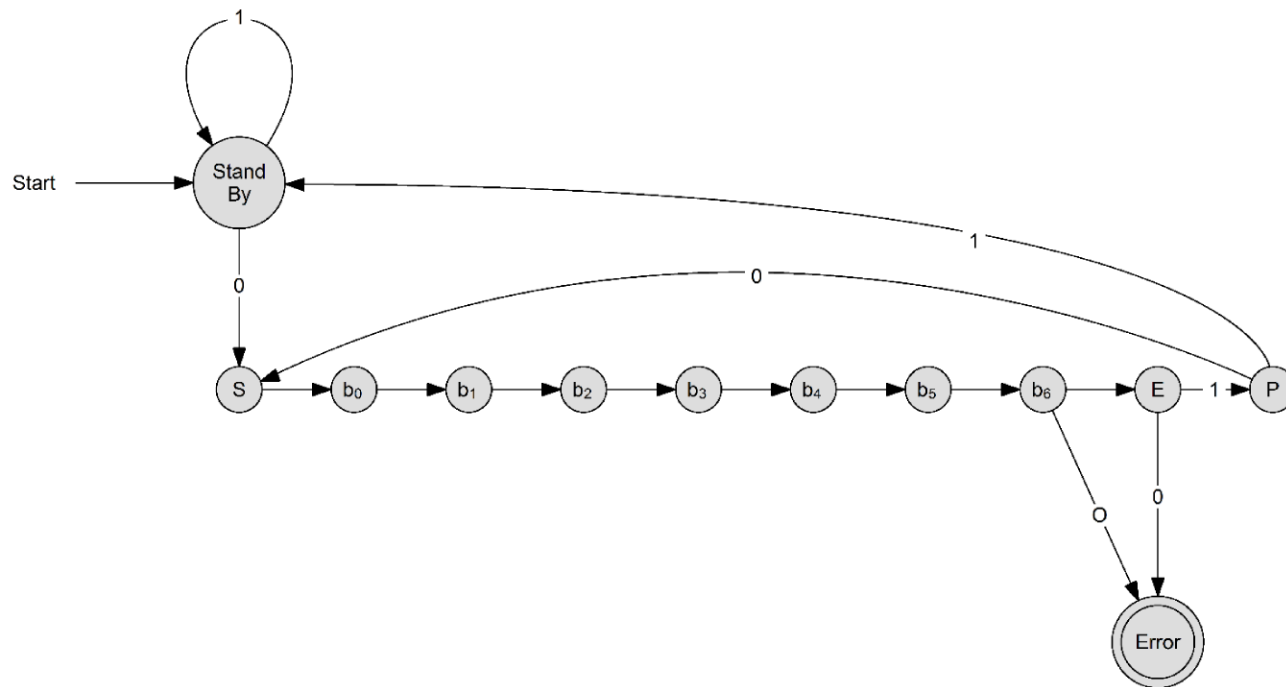
- Example: RS-232
 - Mode of Addressing
 - None: point-to-point connection
 - Start/End of Connection
 - None: connectionless protocol
 - Start of Message
 - Start Bit
 - End of Message
 - Stop Bit

Analysis (3)

- Example: RS-232 (continued)
 - Format of Message
 - Serial transmission LSB first
 - Error Detection
 - Parity error: parity bit not correct
 - Frame error: failed to receive stop bit
 - Flow Control
 - Hardware: RTS/CTS
 - Software: XON/XOFF

Analysis (4)

- Example: RS-232 (finished)
 - State diagram for configuration 7E1



Selection (1)

- Physical criteria
 - Electrical Properties
 - Type of cable and plugs
 - Maximum cable length
 - Bandwidth
 - Maximum transmission speed
 - Transmission mode
 - Parallel
 - Serial

Selection (2)

- Logical criteria
 - Standardization
 - Proprietary
 - Standardized
 - Connection type
 - Connectionless
 - Connection-oriented
 - Maximum number of partners

Selection (3)

- Example: Bandwidth
 - USART
 - Various configurable bit rates (bits per second)
 - E. g. 2400, 9600, 14400, 19200, 28800, 57600, 115200
 - SPI
 - Not specified, often maximum $\frac{1}{2} \cdot f_{\text{CPU}}$
 - I²C
 - 9 bits per data packet + address + start + stop condition
 - 100 kHz, 400 kHz (fast mode)

Selection (4)

- Example: Bandwidth (continued)
 - USB
 - USB 1.0: 1.5 Mbit/s (low speed), 12 Mbit/s (full speed)
 - USB 2.0: 480 Mbit/s (hi speed)
 - USB 3.0: 4 Gbit/s (super speed)
 - Ethernet
 - 10 Mbit/s
 - 100 Mbit/s (Fast Ethernet)
 - 1000 Mbit/s (Gigabit Ethernet)

Selection (5)

- Example: Bandwidth (continued)
 - Bluetooth
 - Bluetooth 1.0: 706kbit/s
 - Bluetooth 2.0: 2.1 Mbit/s
 - Bluetooth 3.0: 25 Mbit/s
 - WiFi WLAN
 - 802.11b: 11 Mbit/s
 - 802.11g: 54 Mbit/s
 - 802.11ac: 7 Gbit/s

Selection (6)

- Example: Bandwidth (finished)
 - Transmission of 1 Kbyte of data
 - 1 Kbyte = 8 Kbit = $8 \cdot 1024$ bit = 8192 bit
 - SPI
 - $f_{\text{CPU}} = 2 \text{ MHz} \rightarrow 8192 \text{ bit} / 1000000 \text{ Hz} = 8 \text{ ms}$ (optimum)
 - TWI
 - $8192 \text{ bit} / 100000 \text{ Hz} = 82 \text{ ms}$ (optimum)
 - USB 2.0
 - $8192 \text{ bit} / 480000000 \text{ bps} = 17 \mu\text{s}$ (optimum)
 - In fact considerably less because of protocol overhead