YASP
Yet Another Scalable Protocol

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Abstract

YASP is a simple and open protocol to build networks with small microcontrollers. The protocol is designed to have a small footprint for easy to implementation with minimal hardware resources, but without sacrifice advanced features and future growth. The protocol scalability is implemented using variable length fields. The physical layer use the NRZ encoding as in RS-232, but using dominant and recessive bus states to provide a reliable way to detect collisions.

1 Introduction

2 Definitions

2.1 Y-Strings

An y-string is a sequence of bytes. The most significative bit of each byte (bit 7) is used to indicate the end of the sequence when it is set to zero, and that the next byte it is part of the sequence when set to one. The seven least significative bits are used for data.

Y-Strings can be used to store ASCII or numeric data. Numeric data it is stored in big endian format (most significative byte first). Here are some examples:

data	y-string
'ABC'	0xC1 0xC2 0x43
'X'	0x58
0x1234	0xA4 0x34
11001100 00110011	1:0000011 1:0011000 0:0110011
0x23	0x23

This coding is used in several YASP data structures to achieve long term scalability while keeping frames small so it can be implemented in very constrained platforms.

3 Frame format

7	6	5	4	3	2	1	0	
#	d	d	d	d	d	d	d	Dst address
#	s	s	s	s	s	s	s	Src address
#	t	t	t	t	t	t	t	Type
#	l	l	l	l	l	l	l	Length
x	x	x	x	x	x	x	x	Data byte 0
x	x	x	x	x	x	x	x	Data byte 1
			.					
			.					
			.					
x	x	x	x	x	x	x	x	Data byte n
c	c	c	c	c	c	c	c	CRC-16 High
c	c	c	c	c	c	c	c	CRC-16 Low

3.1 Fields description

3.1.1 Destination address (ddddddd)

Raw y-string representing the frame destination address. The value 0x00 is reserved for broadcast frames.

3.1.2 Source address (sssssss)

Raw y-string representing the frame source address. The broadcast address should not be used as frame source.

3.1.3 Frame type (ttttttt)

Numeric y-string representing the frame type. Even types are reserved for YASP internal use.

3.1.4 Length (lllllll)

Numeric y-string representing the number of data bytes in the frame.

3.1.5 Data bytes

Arbitrary number of data bytes carried by the frame.

3.1.6 CRC-16

The last two bytes in the frame are the CRC-16 code calculated with the polynomial $x^{16} + x^{12} + x^5 + 1$ with initial remainder 0.

3.2 Frame types

There are 127 possible frame types using one byte for the frame type field. Even frame types are reserved for YASP internal use, and odd frames types can be freely used by the user application code.

Type	Description
0	echo command
1	user defined frame type
2	echo reply
3	user defined frame type
4	get node info command
5	user defined frame type
6	get node info reply
7	user defined frame type
8	reserved
9	user defined frame type
..	
..	
126	reserved
127	user defined frame type

3.3 YASP commands.

3.3.1 Echo

Command	dst	src	00	len	data	crch	crcl
Reply	dst	src	02	len	data	crch	crcl

3.3.2 Get node info

Command	dst	src	04	00	crch	crcl			
Reply	dst	src	06	len	<field type>	<field data>	...	crch	crcl

The get info reply is composed of a variable number of field_type:field_data pairs, where field_type and field_data are y-strings. The currently defined field_types are:

00 YASP Capabilities

01 Device profile code.

02 Manufacturer code

03 Maximum address length

04 Maximum data length

3.4 Frame samples

4 Physical layer

The YASP frame format can be used over several media types and topologies. The physical layer implementation will differ to acomodateaccommodate the particularities of each media.. Here are two physical layer recommendations for wired YASP.

4.1 YASP over CAN transceivers

CAN Bus transceivers can be used to implement a robust physical layer for YASP. This variant can be used for large networks of several hundreds of meters when combined with UTP cabling. Note that we are not using CAN frame format here, we only borrowed the transceivers from the CAN spec.

<put YASP over CAN sample schematic here>

4.1.1 Medium access

YASP over CAN uses a CDMA/CD/NDA[1] bus signaling scheme based in dominant and recessive states. Logic 0 is the dominant state and logic 1 the recessive one. If two nodes intend to put the bus in different states at the same time the one putting a dominant state *wins* and gets his bit correctly transmitted. This property is used to implement the bus arbitration using the binary count-down algorithm.

A node wanting to transmit a frame must search for a minimum of 11 contiguous recessive bits on bus. It must start transmitting the frame right after the end of the 11th recessive bit. For each recessive bit trasmittedtransmitted the node must read back the bus 1/2 bit time after the start of the bit, if a dominant state is found at this reading it must abort transmission within 1/2 bit time and wait for an idle bus condition to retry the frame transmission.

The bus must remain in recessive state when idle. The frame bytes must be transmitted without spaces between them to avoid false bus idle detections by other nodes.

<put frames collision picture here>

4.1.2 Framing

Each byte of the YASP frame is transmitted as one dominant start bit, eight data bits and one recessive stop bit. The bytes in a frame are transmitted without spaces between them, so each start bit is transmitted right after the previous byte stop bit.

There must be a minimum of 11 contiguous recessive bits between a frame and the next. If a node see 11 contiguous recessive bits while receiving a frame it must abort the reception and go to idle state. If a node don't want to continue receiving the current frame in the bus it can wait for 11 contiguous recessive bits and then go to idle state.

<put frame signals picture here>

4.2 YASP over 1-wire

This is a cheaper variant of YASP over CAN. It is useful for short range networks of a few meters. The framing and medium access are the same as in YASP over CAN, but the physical media is implemented using and open collector logic output (or a diode with a standard logic output) coupled to a one wire bus. The bus has a pull-up resistor that puts it to recessive state when there are no node driving it low.

[1] Carrier Sense Multiple Access / Collision Detection / Non-Destructive Arbitration

<put 1 wire YASP schematic here>

5 YASP address space map

Prefix (hex)	Assigned to
00	Broadcast address
01 - 7F	Local manually assigned addresses
80	Device profile addresses
81	Multicast addresses
82-8F	<reserved>
9080 - FFFF	<free for use>

6 Sample implementations