PROFIBUS slave development

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How to select a network interface

Old device?

yes

External interface

no

only one bus?

yes

> 1500 pieces p.a.?

yes

Own development

no, Different busses

Communications-Modul

Complex device?

yes

Single Chip Solution
Set of Interfaces (Hilscher)

- same firmware
- same ‘easy-to-use’ user interface
- same configurator
- same device driver
- different formfactors

Set of ASICs (SIEMENS)

- Master
- Intelligent Slave
- Simple Slave
- ASPC2
- SPC3
- LSPM2
- SPM2
- DPC31
- SIM 11
- RS 485
- 31.25 kbaud
- 12 Mbaud
- IEC 1158-2
The application defines the requirements

<table>
<thead>
<tr>
<th>Short Name</th>
<th>Application</th>
<th>Requirements</th>
<th>Bitrate / Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA/GA</td>
<td>Processautomation Buildingautomation</td>
<td>Long distances Slow processes</td>
<td>93.75 KBit/s</td>
</tr>
<tr>
<td>MPI</td>
<td>Programming</td>
<td>Compatible with SIMATIC</td>
<td>187.5 KBit/s</td>
</tr>
<tr>
<td>FMS</td>
<td>Master-Master communication</td>
<td>Not for new systems</td>
<td>500 KBit/s</td>
</tr>
<tr>
<td>DP</td>
<td>Remote I/O</td>
<td>Efficient protocols</td>
<td>1.5 MBit/s</td>
</tr>
<tr>
<td>MC</td>
<td>Motion Control</td>
<td>Short and stable cycle times</td>
<td>12 Mbit/s</td>
</tr>
</tbody>
</table>

PROFIBUS DP System Structure
### Possible internal structure of Fieldbus Data Link

- **FDL-Services**
  - SRD
  - SDN
  - PROFIBUS-FDL
- **FDL-Management**
  - Life-List
  - Activate (SAP)
  - Write Parameter
  - Read Parameter

- **Physical Layer (RS-485)**

### Implementation Technologies

- Software (C)
- Hardware (ASICs / VHDL)
- Hybrid solutions

<table>
<thead>
<tr>
<th>Bitrate</th>
<th>≤ 187.5 kBit/s</th>
<th>≤ 1.5 MBit/s</th>
<th>≤ 12 MBit/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>UART Block</td>
<td>HW</td>
<td>HW</td>
<td>HW</td>
</tr>
<tr>
<td>CODEC Block</td>
<td>SW</td>
<td>HW</td>
<td>HW</td>
</tr>
<tr>
<td>FDL Block</td>
<td>SW</td>
<td>SW</td>
<td>HW</td>
</tr>
</tbody>
</table>

For mass production and top speed special HW is mandatory.
Classification of network interfaces

Class 1
- Processor for the application
- Interface
- Network controller

Class 2
- Processor for the application
- Interface
- Network controller

Class 3
- Processor for the application and the network
- Interface
- Network controller

Class 4
- Processor for the application and the network
- Interface
- Network controller

Class 5
- Intelligent network controller (Multiplexer)

Adopted from Prof. Bender, TR-Fachkongress, 1992

Class 5: Multiplexer interface

- SPM2/LSPM2
- Process data
- 48 MHz
- Clock pulse generator
- TXD/RxD
- Port A
- Port B
- Port C
- Port D
- Port E
- I/O
- I/O/Diag
- Diagnostics
Examples of Multiplexers (SIEMENS)

- Transmission rate up to 12Mbaud
- DP Protocol completely integrated
- No processor required
- Data Volume:
  - LSPM 2 - 32 bit I/O & 8 bit diagnostic
  - SPM 2 - 64 bit I/O & 16 bit diagnostic

Serial PROFIBUS interface (Example)

Driver select: Differential voltage > 2 V

Important: Electrical isolation to bus P5 and 2P5

Shield
Class 5: Multiplexer interface

Classification of network interfaces

Adopted from Prof. Bender, TR-Fachkongress, 1992
Class 3: Simple application

Applikationsprozessor

TxD

RxD

Serielle
2-leiter
TTL-Schnittstelle

Peripherie

Peripherie

Up to 32 Byte Input and 32 Byte Outputdata

Complete interfaces (HMS)

DIL 32 Format

42 x 21 x 12 mm

AnyBus-IC includes all analog and digital interfaces of the Interface to the bus
Intelligent ASICs (SIEMENS)

<table>
<thead>
<tr>
<th></th>
<th>SPC3</th>
<th>SPC41</th>
<th>DPC3</th>
<th>ASPC2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Transmission Rate [Mbaud]</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Transm. Medium</td>
<td>RS 485</td>
<td>RS485 / MBP-IS (with SIM 11)</td>
<td>RS 485</td>
<td></td>
</tr>
<tr>
<td>Protocol</td>
<td>DP (DPV1)</td>
<td>DP/FMS/PA</td>
<td>DP/DPV1</td>
<td>DP/DPV1/FMS</td>
</tr>
<tr>
<td>Message Buffer [kByte]</td>
<td>1.5</td>
<td>1.5</td>
<td>6</td>
<td>1,000 external</td>
</tr>
<tr>
<td>Housing</td>
<td>PQFP, 44 Pin</td>
<td>PQFP, 44 Pin</td>
<td>PQFP, 100 Pin</td>
<td>MQFP, 100 Pin</td>
</tr>
</tbody>
</table>

Available Firmware for the SIEMENS ASICs

<table>
<thead>
<tr>
<th></th>
<th>SPC 3 Application Slave</th>
<th>SPC 41 Application Slave</th>
<th>DPC 31 Application Slave</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROFIBUS DP</td>
<td>PROFIBUS FDL</td>
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RS 485 (max. 12Mbaud)

Hardware
Software

PROFIBUS (intrinsic safety)

MBP-IS (31.25kbaud)
One of the most used…. SPC3 (VPC3)

- up to 244 byte of data
- automatic search of baudrate
- 3 buffers for each: input & output data; 1 for PRM; 2 for CFG & DIAG
- firmware available
- 1.5 kByte internal RAM
- DP slave protocol integrated
- interface to:
  - Intel (8032, 80x86)
  - Motorola (HC11/16/916)
  - Siemens (80166/80167)

Simple adaptation of SW libraries
Example with SIEMENS

```c
if(DPS2_GET_IND_NEW_PRM_DATA())
{
    /*=== New parameter data ===*/
    UBYTE   SPC3_PTR_ATTR * prm_ptr;
    UBYTE   param_data_len, prm_result;
    UBYTE   ii;

    prm_result = DPS2_PRM_FINISHED;
    do
    { /* Check parameter until no conflict behavior */
        prm_ptr = DPS2_GET_PRM_BUF_PTR();
        param_data_len = DPS2_GET_PRM_LEN();
        /* data_length_netto of parameter Telegram > 7 */
        if (param_data_len > 7)
            if ((*(prm_ptr+8) == 0xAA) && (*(prm_ptr+9) == 0xAA))
                prm_result = DPS2_SET_PRM_DATA_NOT_OK(); /* as example !!! */
            else
                for (ii= 0; ii<param_data_len & ii <10; ii++)   // store in the buffer
                    prm_tst_buf[ii] = *(prm_ptr+ii+7);
                prm_result = DPS2_SET_PRM_DATA_OK();
        else
           prm_result = DPS2_SET_PRM_DATA_OK();
    } while(prm_result == DPS2_PRM_CONFLICT);
}
```

User makes changes to adjust code to own application
PROFIBUS-DP – CAN Gateway for Motion-Controller

The motors to turn the CDs are controlled over a PROFIBUS-DP – CAN gateway

Project with: Balzers Process Systems

PROFIBUS-DP force interface in a connector

Singlechip 8051 controller with a SPC3

Project with: Force Measuring Systems AG
Class 3: Low power Interface
(e.g. PROFIBUS-PA Interface for temperature transmitter)

- PROFIBUS-PA Interfaces for Field devices are very small and require only a few ASICs
- The use of low power Microcontrollers and the low power PROFIBUS ASICs reduces power consumption and ensures powering over the bus at less than 10 mA.
- Direct replacement of existing "Round Boards" is possible

PROFIBUS-PA Interface for temperature transmitter

Project with: Camille Bauer AG, Wohlen
Classification of network interfaces

Class 1: High performance interface (e.g. frequency converter with PROFIdrive profile)

- Host with separate microcontroller
- Dual Port RAM
- 16 Bit Microcontroller
- RS 485 / Fibre Optic Interface
- Protocol ASIC e.g. SPC3, SPC4, EC1, PBS

- PROFIBUS Interface runs Protocol Software on separate Microcontroller
- Host computer runs application software on separate Microcontroller
Available Moduls (SIEMENS)

- IM 180 Master module
- IM 183-1 Intelligent Slave module
- IM 184 Simple Slave module
- IM 181 Carrier board for ISA
- ASPC2
- LSPM2

- 5V DC power supply
- 0 to 70 °C permissible ambient temperature
- Transmission rate up to 12Mbaud

Example of Moduls (HMS)

- Single size 54 x 86 mm
- Application interface
- Feldbus connection
- LEDs
The Hilscher Dual-port Memory

Host Side Dual-port memory CIF/COM side

- process image output data
- process image input data
- send mailbox
- receive mailbox
- protocol parameter
- protocol status
- system status
- status/handshakebits
- command/handshake bits

Memory applicable to fieldbus systems with I/O devices as opposed to a messaging system
- Size
  - 1 KByte
  - 7 KByte

Highest 1 KByte is always present and has the same structure for all fieldbus systems.

NetX High performance ASIC
Development Kit DP & PA - Test Board (SIEMENS)
Development Kit VPC3+ - Test Board (PROFIchip)

PROFIBUS Test Laboraories (PTL)
- PROFIBUS certification tests in 7 independent PTLs worldwide
- Certification in accordance with general framework defined by PROFIBUS International ensures quality standard
- Certification ensures interoperability and thus plant availability
Certification Procedure

Certification rules
- Uniform test measures and test process
- Comprehensible and documented results

More than 800 certificates awarded