# 10.5 VBN-VMEbus Adapter

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H. Ricke / J. Kanzow (Eds.)
BERKOM Broadband Communication within the Optical Fibre Network, R.v.Decker's Verlag, G. Schenck, Heidelberg 1991, 329-333

The VBN – Vermittelndes Breitband-Netz (switched broadband network) – of the DBP Telekom is a fast (140 MBit/s) fiberoptical wide area network connecting about 300 sites all over Germany. It is known as the 'Videokonferenz-Netz' but can also be used for data transmission between computers. For historical reasons there exist only a few interfaces for computers. The project 'VBN-VMEbus adapter' realizes a universal interface between the VBN and computers complying with the VMEbus standard.

## 10.5.1 Introduction

Our project supports the project 'BILUS' (Breitband-Integrierte Layout-Unterstützung – broadband-integrated layout support) by developing communications hardware and software for an application located not in the BERKOM test network but in the VBN. Sun Sparcstations are used there for communications purposes. The machine's system bus SBus has been newly designed and hence it is not widely supported.

Therefore we chose the VMEbus as system bus for reducing the interface's developing time. There is a wider range of possible applications too. In the 'BILUS' project we use an SBus-VMEbus adapter to connect the busses.

The interface at the TAE (Teilnehmeranschlußeinrichtung – telecommunication line unit) of the VBN delivers and requires a ten bit word every 70 ns. For most computers this data rate is too high to deal with directly; one has to attach additional hardware to the computer system.

The VMEbus is a fast bus system especially for computers with a Motorola 680x0 CPU. The bus timing is similar to that of the CPU, and DMA (direct memory access) yields data rates up to 40 MByte/s. Data and address busses are both 32 bits wide, but there are also access types using less than 32 bits. VMEbus cards are available as 'masters' and 'slaves'. Masters generate bus accesses while slaves only serve accesses. According to the official VMEbus specification (Rev. C.1) the VBN-VMEbus interface card is a slave (D32/D16, A32/A24, ADO) and an interrupter. The maximum data rate is 8 MByte/s without DMA.

First we explain the mode of operation then we describe the application environment and the software running the interface.

## 10.5.2 Mode of operation

For the design of the interface card a description of the TAE interface was given (see figure 10.5-1, right-hand side). There are two ten-bit wide busses – named

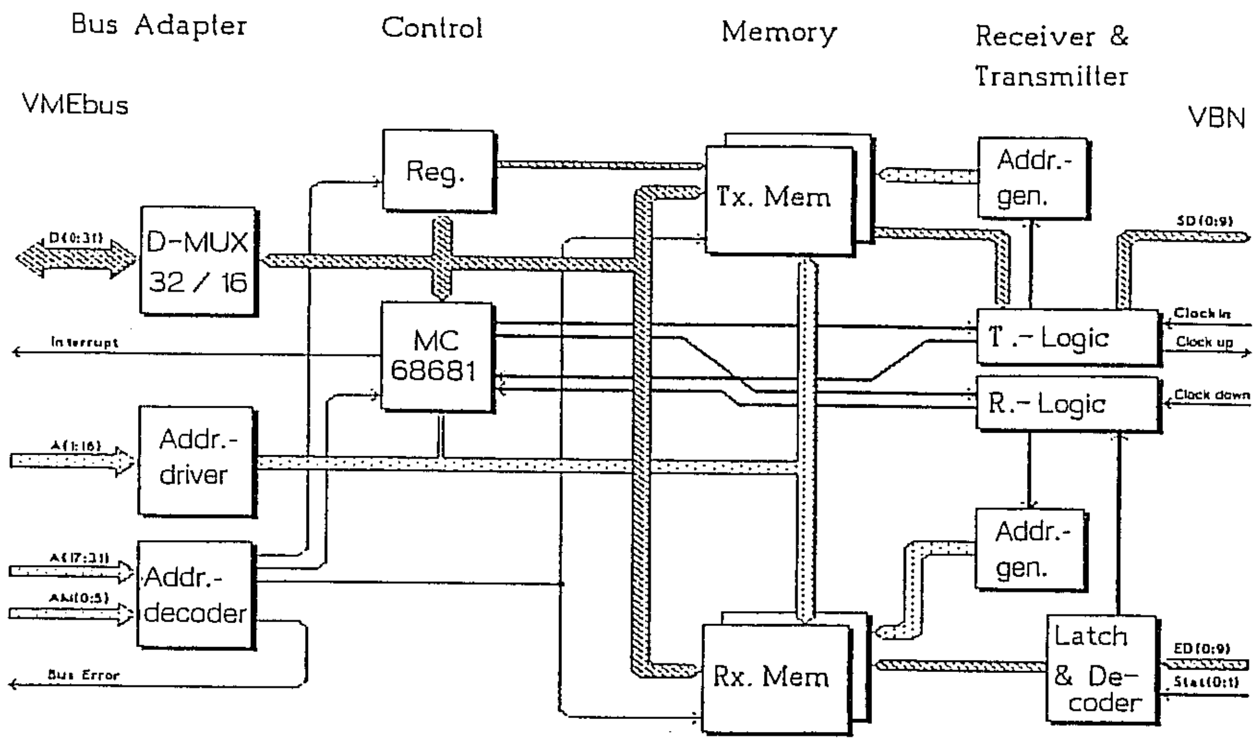


*Figure 10.5-1: VBN-VMEbus adapter*

'SD' and 'ED' (transmit data and receive data, resp.) – with their associated clocks. The 'status' signals indicate the current status of the network (ready for sending, ...).

Since the interface is to be used for communications there is a natural partitioning into transmitter, receiver and control by the host.

Whole packets are transmitted because the protocol overhead for the transmission of single bytes would be too high. So we choose the following scheme for the design: The interface core is a memory assembling a stream of bytes into a packet. When the packet has been completed it is transmitted undivided over the network.

The transmitter memory is loaded by the computer and read by the VBN transmission logic – conversely in the receiver memory. These memories are special dual ported RAM: writing is associated with the VMEbus and reading is associated with the VBN part. One can realize this type of dual ported RAM as a ping-pong buffer, i.e. memory is split into two banks and one part is attached to the VBN, the other to the VMEbus. In this way access conflicts are avoided, which are difficult to resolve at that high speed. When the VMEbus bank has been filled with a new packet the banks are switched and the cycle starts again.

The DUART (dual universal asynchronous receiver & transmitter) MC 68681 controls the interface using its I/O-port. On this card it is a multifunctional peripheral (MFP) rather than a DUART. Transmitter and receiver get commands (e.g. 'send packet') from the I/O-port and return a status word (e.g. 'whole packet transmitted'). At several states the MFP can cause an interrupt. The chip contains a programmable timer too which software can use to control the interface. The chip does not depend on the special VMEbus timing because its bus interface works asynchronously. This is of interest when using other bus systems (MULTIBUS or even SBus).

Both transmitter and receiver are mainly controlled by an address generator generating successive addresses and a control logic transferring the data between memory and VBN at the right time.

The data sent to the TAE are ten bits wide whereas computers normally use multiples of eight bits. Hence only eight bits are used as computer data. In the remaining two bits a channel number is encoded. This number is written once into the register and is transferred from there in parallel with the computer data to transmitter memory. There are three data channels and one control channel. The control channel carries information about data channels, e.g. 'beginning (or end) of a packet in data channel x'.

There are several reasons for such a procedure: firstly a packet can have a variable length restricted only by the amount of available memory (here 32 kBytes); secondly one can establish three logical connections via one physical one by using three cards and some expansion hardware. So the full bandwidth of VBN can be shared by three computers each contributing only 45 MBit/s data rate.

Normally a point-to-point connection in the VBN is dialled by hand, but it can also be done by an additional interface called TAV ('Teilnehmeranschlußvermittlung' – subscriber line switch). The serial line interface necessary for this computer dialling procedure is contained in the MC 68681.

### 10.5.3 Software and application environment

The application environment (figure 10.5-2) consists of four components. The Sun SparcStation 1+ computer is connected to a VMEbus via the Solflower SBus-VMEbus adapter. The VBN-VMEbus adapter located in the VME rack goes to the ANT '10*13.5M' interface card. This PCB (printed circuit board) replaces the X.21 interface card of the TAE.

The driver software for the SparcStation has two parts. The first part is a UNIX character device driver and uses its software interface. The other part is an Internet Protocol (IP) Driver.

Standard UNIX programs like 'telnet','ftp' or 'rcp' do data transmission via the IP (keyword: TCP/IP). The driver uses the official Sun software interface to IP as described in the paper from SMI Consulting. It gets packets from the IP and sends them off via the VBN-VMEbus adapter. On the other side it receives packets from the VBN interface and transfers them to the IP software interface. In the ISO/OSI model this driver operates on the two lowest levels, the SunOS does the rest.

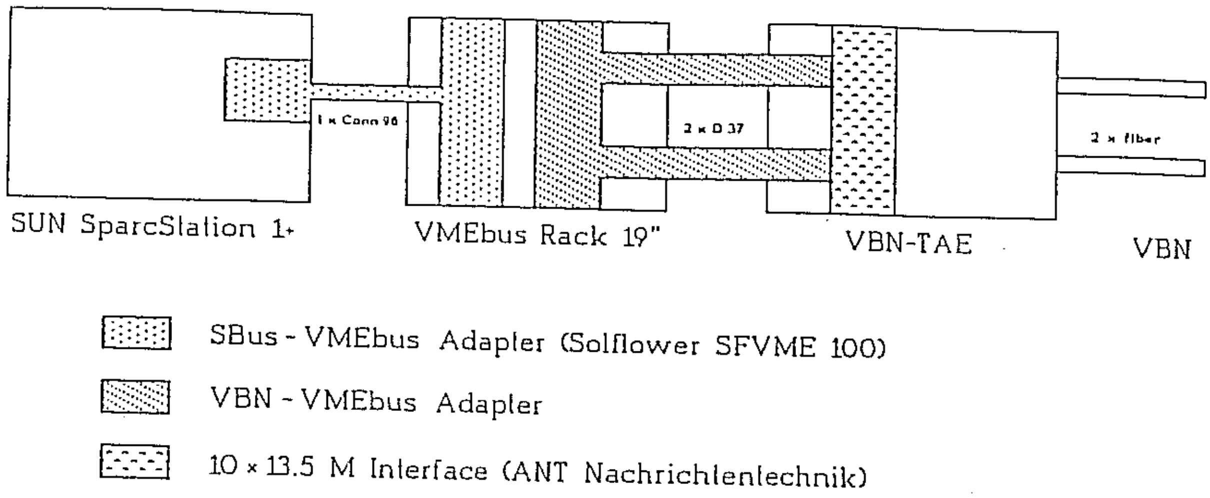


*Figure 10.5-2: Installation in the BILUS project*

The character device interface has been designed to evade the IP's time consuming protocol overhead and can be used to do a simple but unreliable data transfer. The maximum throughput is restricted by the SBus-VMEbus adapter. For sending and receiving via a test loop it is 1.8 MBytes/s measured on a SparcStation 1+.

A file transfer program has been set on the top of this character device driver. The throughput is 300 KBytes/s, for two reasons. The first reason is the low hard-disc speed on writing accesses. The second one is the data windowing of only one, i.e. for each packet sent the computer waits for the corresponding acknowledgment packet. For memory-to-memory copies the expected speed is more than 1 MByte/sec.

### 10.5.4 Project status

The project aim was to establish VBN connections between the following BILUS partners: the QUELLE mail order company in Fürth, the SEBALD printing and publishing house in Nuremberg and the GONG publishing house in Munich.

All installations are completed now and the system works very well.