



M a n u a l
AVM ISDN-Controller

C4

High-Performance ISDN by ...



AVM ISDN-Controller C4

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Typographical Conventions

The following typographical conventions and symbols are used in this manual to make it more readable and to emphasize important information:

Highlighting

The following table presents a short overview of the highlighting conventions used in this manual.

Highlighting	Function	Example
quotation marks	keys, buttons, program icons, settings pages, menus, commands	“Start / Programs” or “Enter”
capital letters	paths and files within floating text	C4\ENGLISH or CAPIPORT.HLP
pointed brackets	variables	<CD-ROM drive>
typewriter characters	entries made using the keyboard	a:\setup
gray and italics	information, tips and warnings; always appear with the corresponding symbols	<i>... Controllers must be removed one at a time ...</i>

Symbols

The following symbols used in the manual always appear with gray, italicized text:



This symbol indicates useful tips and supplementary information.



The exclamation point designates sections which contain important information.



Indicates especially important instructions that absolutely must be observed to avoid malfunctions.

1 Introduction

The AVM ISDN-Controller C₄ is the ideal solution for all those who need more than one ISDN BRI line. Equipped with a high-performance CPU and on-board memory, the C₄ can be used for all kinds of communication tasks. All commonly used digital communication protocols are provided. Analog connections are also supported at up to 14.4 kbit/s. Incoming or outgoing telefax connections can be processed over all eight channels simultaneously.

Up to four active AVM ISDN-Controllers can be used in one PC, so that you can meet your company's growing communication needs by adding more ISDN-Controllers. This means long-term security for your investments in ISDN hardware. Mixed configurations with other active AVM ISDN-Controllers for the PCI or ISA bus in the same computer are also supported.

1.1 The AVM ISDN-Controller C₄

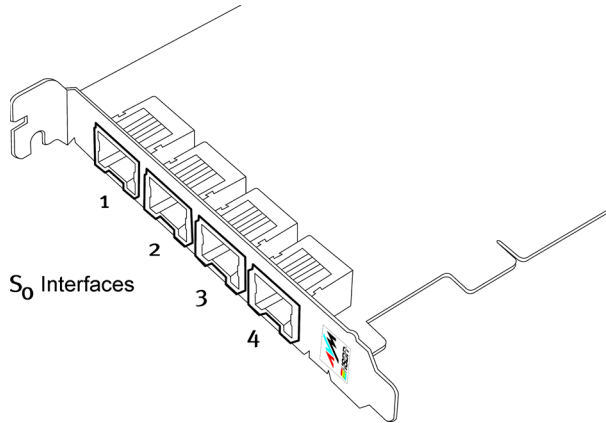
The Controller C₄ is an active ISDN-Controller with its own high-performance CPU and on-board memory. The architecture and technologies used are especially well suited to the operating conditions found in server environments.

The driver software for the AVM ISDN-Controller C₄ supports all important communication protocols. Smooth communication is thus ensured with systems in ISDN, GSM cellular, analog telephone networks and other digital networks.

The ISDN-Controller C₄ allows you to connect a computer to four basic-rate ISDN lines. You no longer need four bus slots and four times the system resources to use eight ISDN B channels. The ISDN-Controller C₄ requires only one slot and the system resources for one card.



Each of the S₀ interfaces can be configured independently. Please note the order of the S₀ interfaces during installation and configuration.



The ISDN-Controller C4's S₀ interfaces

1.2 The Driver Software for the AVM ISDN-Controller C4

The ISDN-Controller's driver software controls the communication processes and the data transfer.

The software for the C4's on-board CPU is downloaded to the ISDN-Controller card from the PC's hard disk. This technique makes it possible to update the controller software easily at any time, so that new features can be added or adapted without manipulating the ISDN-Controller hardware.

The controller software can perform data compression in accordance with the V.42bis standard. For more information on automatic data compression, please see the section "CAPI SoftCompression X.75/V.42bis" on page 32.

Furthermore, the controller software also supports analog services such as Group 3 fax and modem communication. For details, see the section "CAPI SoftFax" on page 33.

CAPI (Common ISDN API)

The ISDN-Controller C4 driver software provides the application interface CAPI 2.0 in the PC. This interface specified by the international standardization body ETSI, guarantees the universal interchangeability of ISDN applications for the use

of data, fax and voice communication services. The ISDN-Controller C₄ thus can be used with a wide variety of ISDN applications based on CAPI 2.0.

For further information on CAPI 2.0, see the section “The Applications Interface CAPI 2.0” on page 27.

Supported Protocols

The ISDN-Controller C₄'s driver software supports the international D-channel protocol DSS1 (Euro-ISDN) as well as the national protocols 5ESS and NI-1.

The controller software for these D-channel protocols is supplied with the ISDN-Controller. It is also available from the AVM Data Call Center (+49-30-399 84 300) or over the Internet (www.avm.de, [ftp.avm.de](ftp://ftp.avm.de)). The driver software supports a wide range of B-channel protocols, including the data protocols X.75, X.25, HDLC transparent, V.110 and V.120.

Supported Operating Systems

Driver software for the AVM ISDN-Controller C₄ is available for the following operating systems: Windows 2000, Windows NT 4.0, Novell NetWare 4.11 or higher and Linux.

1.3 System Requirements

The following hardware and software is required in order to use the AVM ISDN-Controller C₄:

- A PC with an Intel Pentium or compatible CPU
- An available bus slot that conforms to the specification PCI 2.1 or higher
- Operating system: Windows 2000, Windows NT 4.0, Novell NetWare 4.11 or higher or Linux
- One to four basic-rate (S₀) ISDN lines

1.4 Package Contents

The AVM ISDN-Controller C4 package includes:

- AVM ISDN-Controller C4 (plug-in adapter for the PCI bus)
- Four S₀ cables with RJ45 connectors, 6 m
- AVM ISDN-Controller C4 manual
- CD with all installation files and the AVM ISDN-Tools

The CD contains:

- Driver software for Windows 2000, Windows NT 4.0, Novell NetWare 4.11 or higher and Linux
- Configuration and diagnostic software (C4 Setup, C4 Test, Connect32)
- AVM system drivers
 - AVM ISDN CAPI Port Driver
 - AVM NDIS WAN CAPI Driver
 - AVM ISDN TAPI Services for CAPI
- AVM ISDN-Tools

The AVM ISDN-Tools are a collection of ISDN application programs based on CAPI 2.0. They include “Connect32” for convenient ISDN file transfer. See the ISDN-Tools manual on the CD for installation and operating instructions.

- AVM ISDN-Tools manual in PDF format

Other CAPI-based applications, such as FRITZ!32 or third-party products, are available from your dealer.



If you need to install the driver software from a floppy disk drive, you may copy the installation files from the CD to disks for this purpose, or you may order the necessary installation disks from AVM (see the address inside the cover of this manual). Specify the operating system in which you are installing the ISDN-Controller, and the disks will be sent to you free of charge.

2 Hardware Installation

2.1 Installation Procedures for the Various Operating Systems

The ISDN-Controller C₄ hardware is installed in the PC first, before its driver software is installed.

The ISDN-Controller C₄ can be used in a variety of operating systems. The installation procedure for the driver software is different for each operating system. Please follow the instructions for your operating system in the chapters that follow.

2.2 Installing the ISDN-Controller C₄ in the PC



The ISDN-Controller C₄ has four S₀ interfaces. When you install the driver software, you will have the opportunity to configure each of them independently. For this reason you should make a note of which S₀ interface you connect to each of your ISDN lines (see “The AVM ISDN-Controller C₄” on page 6).

To install the AVM ISDN-Controller C₄, proceed as follows:

1. First, make sure that the PC and all peripherals are switched off. Unplug their power cords.
2. Open the cover of the PC. Touch the metal of the PC housing to discharge any static electricity.
3. Choose a PCI slot, unscrew and remove the slot blanking plate at the back of the PC, and insert the ISDN-Controller C₄ in the slot.



If installing the ISDN-Controller in a Novell NetWare server: Note the number of the slot in which you have inserted the ISDN-Controller C₄ for use in the configuration procedure. Consult the mainboard manual if necessary to determine the slot number.

4. Screw the back plate of the ISDN-Controller C4 onto the back panel of the PC.
5. Close the computer and plug in the power cords.
6. Connect the ISDN-Controller to your ISDN lines. The S₀ cables supplied have an RJ45 plug at each end. Insert one end in your ISDN jack and the other end in the socket on the back plate of your ISDN-Controller C4.

The hardware installation is now complete.

3 Driver Software Installation in Windows 2000

In Windows 2000, the ISDN-Controller is integrated as a network adapter via the NDIS WAN CAPI Driver and included in the list of network adapters listed in the Device Manager.

After installation, the NDIS WAN interface and the CAPI 2.0 interface are available to the entire system; no separate driver installation is required. This means that any CAPI 2.0-based applications can be used in parallel operation with Remote Access Service or with Internet access over Microsoft's Dial-Up Networking. (With these drivers RAS and Internet can be used on only two channels, while CAPI allows operation with eight channels.)

The CAPI 2.0 applications interface supplied the Controller supports both 16-bit and 32-bit applications. Applications in DOS windows are not supported. For more information about CAPI, please see "The AVM System Drivers" on page 26.

3.1 Installing the Driver Software

Proceed as follows to install the Controller C4:

1. Start the computer.
The Add New Hardware Wizard recognizes a new device to be installed. Click "Next".
2. In the next window, select the option "Search for the best driver for your device (recommended)" and confirm by clicking "Next".
3. Insert the installation CD.
4. In the next window, select the option "CD-ROM drives" and click "Next" to confirm.
5. The Wizard displays that a driver has been found. Click "Next" to install the driver.

6. A message appears reporting that the “Digital Signature” for the Controller C4 was not found. Confirm with “Yes” to continue with installation.
7. The next dialog reports that no digital signature was found for the AVM NDIS WAN CAPI driver, either. Confirm by clicking “Yes” again to continue the installation.
8. Now enter the D-channel protocol to be used and confirm by clicking “Next”.
9. In the “ISDN Multiple Subscriber Number (MSN)” window, enter the MSNs.
Then click “Next”.
10. Close the installation by clicking “Finish”.

This concludes the Controller C4 installation. The ISDN-Controller is ready for operation.

After installation, CAPI 2.0 and the AVM NDIS WAN CAPI Driver are available for use. For detailed information about the AVM NDIS WAN CAPI Driver and the two other AVM system drivers, see the section “The AVM System Drivers” on page 30

3.2 Configuring the ISDN-Controller C4

The default settings for all four S₀ interfaces are as follows:

Line type	Point-to-multipoint
D-channel protocol	DSS1

After installation you have the opportunity to change the line types of the S₀ interfaces, the D-channel protocol of the ISDN-Controller, and the multiple subscriber numbers (MSNs).

Proceed as follows to configure the Controller C4:

1. Open the Device Manager by clicking “Start / Settings / Control Panel / System” and selecting the “Hardware” page.
2. Click the “+” preceding the “Network adapters” entry.

3. Double-click the entry AVM ISDN-Controller C₄ to open the “Properties” window.
4. On the “ISDN” page, select the desired D-channel protocol and then click “Configure...” to change the MSNs.
5. On the “S₀ Interface” page, set the line type for each S₀ interface on the Controller (multi-terminal, PBX extension or permanent connection).

3.3 Installing Additional ISDN-Controllers

If you would like to add another AVM ISDN-Controller C₄, repeat the entire installation procedure above. Begin by installing the hardware. Then switch on the computer. The Add New Hardware Wizard recognizes the new device. Follow the instructions on the screen.

Active AVM ISDN-Controllers for the ISA and PCI buses may also be combined in one computer. In this case, install the additional controller card as described in its manual, using the installation program on the original disk or CD supplied with it.



When multiple ISDN-Controllers are installed, the NDIS WAN CAPI Driver can be used only on the ISDN-Controller which was installed first.

3.4 Removing the Controller C₄

To remove the AVM ISDN-Controller C₄ from Windows 2000, proceed as follows:

1. Open the Windows 2000 Control Panel (“Start” menu, “Settings”) and double-click the “Hardware” icon.
2. The Add/Remove Hardware Wizard is started. Click “Next”.
3. In the subsequent dialog, select the option “Uninstall/Unplug a device” and click “Next”.
4. Then select the first option, “Uninstall a device”. Confirm by clicking “Next”.

5. In the next dialog, select the entry “AVM ISDN-Controller C4” and then click “Next”.
6. Confirm the uninstallation by activating the option “Yes, remove this device” and then clicking “Next”.
7. As a final step, click “Finish”.

The ISDN-Controller is removed from the system.



Only one ISDN-Controller can be removed at a time. If you have installed several controllers and want to remove them all, you must repeat the above procedure several times. Windows must be restarted only once, however, after the last uninstallation.

4 Driver Software Installation in Windows NT

Specially developed Windows NT driver software is supplied with the AVM ISDN-Controller C4. The applications interface supplied, COMMON-ISDN-API (CAPI) Version 2.0, supports both 16-bit and 32-bit applications (but DOS applications are not supported). This Windows NT driver also can be used with older applications designed for CAPI 1.1. For more information about CAPI, please see the section “The Applications Interface CAPI 2.0” on page 27.

4.1 Installing the Driver Software

The default settings for all four S_0 interfaces are as follows:

Line type	Point-to-multipoint
D-channel protocol	DSS1
CAPI SoftCompression	activated

During the installation you will have the opportunity to change the S_0 interface parameters for each of the AVM ISDN-Controller C4's S_0 interfaces, or for all four S_0 interfaces at once.

To install the driver software, proceed as follows:

1. Start Windows NT 4.0.
2. Insert the “AVM ISDN-Controller C4” driver CD in your CD-ROM drive.
3. Select “Run” in the Windows NT 4.0 “Start” menu. In the command line, enter the path to the setup files for Windows NT:

```
<CD-ROM drive>:\cardware\c4\windows.nt\  
English\setup.exe
```

You may also click the “Browse” button and find the path in the directory list. Click “OK” to start the installation.

4. The installation program's sign-on message appears. This window contains a button to display the Readme file containing the latest information about the AVM ISDN-Controller C4 and the installation procedure. To proceed with the installation, click "Continue".



To display a Help text on any step in the installation program, press the "F1" key.

5. In the next window, select "New" in the area labelled "To add a Controller". Click "Continue".
6. Enter the name of the folder in which the driver software is to be installed. Confirm your entry by clicking "Continue".
7. In the next dialog, select an S₀ interface to configure, or choose to configure all four interfaces at once. Click "Continue".
8. In the subsequent dialogs, set the ISDN line type and the D-channel protocol for the selected S₀ interface(s).
9. When you have finished, the Setup program summarizes the settings for all four S₀ interfaces: if you made any changes to the settings of an interface, they are shown here along with the default settings for the other three.
10. To change the settings for the other S₀ interfaces, click the button "Configure other S₀ interfaces". You are then prompted once more to choose which interface you want to configure. Repeat steps 7 through 9 until the settings for all four S₀ interfaces correspond to the ISDN lines you will use.
11. When the configuration is complete, click "Continue". The setup program now copies the driver files to the specified folder.
12. Finally, a message box displays the current configuration of the ISDN-Controller C4 and its four S₀ interfaces. Click "Continue" to acknowledge and close the window.

This completes the driver software installation for Windows NT 4.0. The ISDN-Controller C4 is now ready to use.

In the “Start / Programs” menu, you will find a new program group named “AVM”. This group contains the icons “C4 Load”, “C4 Unload”, “C4 Setup”, “C4 Test”, “C4 Readme” and “AVM Internet Home Page.” The last is a link to AVM’s WWW server.



By default, the ISDN-Controller is loaded automatically each time Windows NT 4.0 is started. This takes place before programs in the “Start” group run, so that you may include CAPI-based communications programs in your “Start” group if desired.

4.2 Configuring the ISDN-Controller C4

To change the settings for the D-channel protocol and line type on the S₀ interfaces, and to activate or deactivate data compression, start the program “C4 Setup” in the “AVM” program group. Select the ISDN-Controller C4 in the list of installed controllers and follow the instructions displayed.

4.3 Installing Additional ISDN-Controllers

If you would like to add another AVM ISDN-Controller C4, repeat the entire installation procedure above. Begin by installing the hardware as described in Chapter 2. Then run the program “C4 Setup” in the “AVM” group and select “New” (Add a Controller). Follow the instructions displayed by the program.

Active AVM ISDN-Controllers for the ISA and PCI buses may also be combined in one computer. In this case, install the additional controller as described in its manual, using the installation program on the original disk or CD supplied with it.

4.4 Removing the Driver Software

To remove the AVM ISDN-Controller C4 driver software from the Windows NT 4.0 system, proceed as follows:

1. Open the Windows NT Control Panel (“Start” menu, “Settings”).

2. Double-click the “Add/Remove Programs” icon.
3. The “AVM ISDN-Controller C4” appears in the list of installed programs. Select this entry.
4. Click the “Add/Remove” button. The uninstallation program starts.
5. First select the ISDN-Controller that you want to remove and click “Continue” .
6. Now the program indicates which folder contains the driver software for the selected ISDN-Controller. Confirm once more by clicking “Continue” .
7. Finally, you are prompted to restart Windows NT in order for the change to take effect.



Only one ISDN-Controller can be removed at a time. If you have installed several controllers and want to remove them all, you must repeat the above procedure several times. Windows NT must be restarted only once, however, after the last uninstallation.

5 Driver Software Installation in Novell NetWare

Two different drivers are provided for installation in Novell NetWare 4.11 or higher: a stand-alone CAPI and a version for Novell CAPI Manager. If you would like to use Novell's CAPI Manager, make sure that CAPI Manager is installed before beginning installation of the AVM ISDN-Controller C4. Also be sure to observe the differences in the installation, configuration and removal procedures for the two drivers.

5.1 Preparing the System

Before the driver software installation begins, the server must be started and the CD-ROM drive mounted. If this is not the case, proceed as follows:

- To start the server, enter the following commands at the DOS prompt:

```
cd nwserver  
server
```

- To verify whether the CD-ROM drive is installed, insert the CD and enter the following command at the system console:

```
volume
```

All mounted volumes are listed. If the volume label of the CD does not appear in the list, enter the following command at the system console:

```
cdrom
```

5.2 Installing the Driver Software



The only difference between the installation procedures for the stand-alone CAPI and the version for CAPI Manager is the path that must be entered to locate the installation files.

To install the driver software, perform the following steps:

1. Insert the installation CD in the CD-ROM drive.
2. Enter the following command at the system console:

```
nwconfig
```

Confirm by pressing “Enter”. This loads the Novell NetWare server’s configuration program. The program’s “Configuration Options” menu appears.

3. Select “Product Options” in the menu and press “Enter”.
4. A menu appears with the name “Other Installation Actions”. Select “Install a product not listed” and press “Enter”.
5. An input box appears in which the directory path to the installation files may be entered. The default path shown is the floppy disk drive, A:\. To specify a different path, press “F3”.
6. To install the stand-alone CAPI driver, enter the path as follows:

```
<CD name>:\cardware\c4\netware\capi20
```

To install the driver version for Novell CAPI Manager, enter the path:

```
<CD name>:\cardware\c4\netware\4capimgr
```

7. In the next menu, choose the option “Install on this server” and press “Enter”.

The driver files for the AVM ISDN-Controller C4 are copied to the SYS:SYSTEM directory.

8. At the end of the installation process, the file C4 README is displayed with the latest information about the AVM ISDN-Controller C4.

Press “Esc” to close the display and confirm by selecting “Yes”.

9. Press “Esc” until the “Configuration Options” menu is in the foreground again.
10. Select “Exit” to close the configuration program.



Once the ISDN-Controller C4 has been installed, it must be configured before it is ready to operate. Follow the configuration instructions in the following section.

5.3 Configuring the ISDN-Controller C4

The procedure for configuring the ISDN-Controller C4 involves setting the D-channel protocol and the line configuration for each of the S₀ interfaces.

Configuration for Stand-Alone CAPI

1. Enter the following command at the system console:
load c4setup
2. The “List of ISDN-Controllers to load” appears. This list shows the available ISDN-Controllers with their I/O address, interrupt, D-channel protocol and PCI slot settings. Use the arrow keys to select the ISDN-Controller C4 that was just installed and press “Enter”.
3. The configuration dialog that appears shows the current settings of the ISDN-Controller C4 and its S₀ lines.

Configuration of ISDN-Controller-2: AVM C4 PCI	
I/O Base	d400
Interrupt Level	7
D Channel Protocol	DSS1
S ₀ Port 1 Point to Point:	yes
S ₀ Port 2 Point to Point:	yes
S ₀ Port 3 Point to Point:	yes
S ₀ Port 4 Point to Point:	yes
Data Compression	no

4. Move the cursor to the entry you want to change and press “Enter”.
5. Select the new value for the given parameter and confirm by pressing “Enter”.
6. Repeat steps 4 and 5 until all the settings are correct.
7. Close the configuration program by pressing the “Esc” key twice.
8. When prompted to confirm that you want to save the new settings, select “Yes”.

Loading and Unloading the Driver Software

To load the driver software, enter the following command at the system console:

```
load capi20
```

Press “Enter”. A message appears to notify you that the ISDN-Controller has been loaded and the CAPI interface is available.

To unload the driver software, type

```
load capi20 -d
```

and press “Enter”.

Configuring and Loading the Driver Version for Novell CAPI Manager

To configure the AVM ISDN-Controller C4, proceed as follows:

1. Enter the following command at the system console:

```
load inetcfg
```
2. The “Internetworking Configuration” menu appears. Select the item “Boards” in this menu and press “Enter”.
3. A list of the ISDN-Controllers already configured appears. Press the “Ins” key.
4. In the menu labeled “Select A Driver”, select the entry “WHSMCAPI” and press “Enter”.

5. In the “Board Name” input box, enter a name for the new ISDN-Controller C₄.
6. In the “WHSMCAPI Board Configuration” dialog you may now configure the ISDN-Controller C₄. Select the entry “Select to View” and press “Enter”.
7. Answer “Yes” to the question about automatic loading.
8. In the next dialog, select the ISDN-Controller “AVMC₄” and press “Enter”.
9. Enter the correct settings for the following parameters:
 - Switch Type (D-channel protocol used on your ISDN line.)
 - Line Config (MTP = point-to-multipoint; PPT = point-to-point) for each S₀ interface.
10. Close the configuration dialog and then the list of ISDN-Controllers by pressing “Esc”. Answer “Yes” when prompted to confirm that you want to save the new settings.
11. To complete the configuration procedure, the system must be updated and the ISDN-Controller loaded. Select the command “Reinitialize System” in the “Networking Configuration” menu and confirm by selecting “Yes”.
12. Close the configuration program by selecting “Exit”. Answer “Yes” when prompted to confirm that you want to save the new settings.

The ISDN-Controller C₄ for CAPI Manager is now configured and loaded.

5.4 Installing Additional ISDN-Controllers

To install another ISDN-Controller C₄, first insert the ISDN-Controller card in the computer, then configure the driver software. Note the number of the PCI slot in which you install the ISDN-Controller C₄: this number is required in the driver configuration.



Each subsequent ISDN-Controller C4 must be configured with the same driver version as the first ISDN-Controller C4 installed (Stand-Alone CAPI or CAPI for Novell CAPI Manager).

Configure the new ISDN-Controller as described in the section “Configuration for Stand-Alone CAPI” on page 22, or “Configuring and Loading the Driver Version for Novell CAPI Manager” on page 23.

Active AVM ISDN-Controllers for the ISA and PCI buses may also be combined in one computer. In this case, install the ISA card as described in its manual, using the installation program on the original disk or CD-ROM that came with it.

5.5 Removing the Driver Software

Removing a Single ISDN-Controller

To remove the ISDN-Controller C4 driver from Novell NetWare 4.11 or higher, proceed as follows:

1. First remove the ISDN-Controller card from its slot in the PC.
2. Restart the server and enter the following command at the system console:

load c4setup
3. The “List of ISDN-Controllers to load” appears. The ISDN-Controller you have just removed is already missing from this list.
4. Press the “Esc” key.
5. When prompted to confirm that you want to save the changes, answer “Yes”.
6. Close the menu by selecting “Exit”.

This completes the uninstallation procedure for the ISDN-Controller C4 driver software.

Removing all ISDN-Controllers

To remove all the installed ISDN-Controllers at once, proceed as follows:

1. First remove all the ISDN-Controller cards from the PC.
2. Restart the server and enter the following command at the system console:

```
nwconfig
```

Confirm by pressing “Enter”.

3. The “Configuration Options” menu appears. Select the item “Product Options” and press “Enter”.
4. The menu “Other Installation Actions” is displayed. In this menu, select the item “View/Configure/Remove Installed Products” and press “Enter”. Now the list of installed programs appears.
5. Move the highlight to the “AVM ISDN-Controller C4” entry and press “Del” (the delete key). Select “Yes” to confirm the action.
6. Press “Esc” to close the submenus until the menu “Installation Options” is on top.

This completes the uninstallation of all ISDN-Controllers.

6 AVM System Architecture

This chapter provides information about the ISDN applications interface CAPI 2.0, about the IDM architecture, the AVM system drivers included with the ISDN-Controller C4, and about special CAPI features of the AVM ISDN-Controller C4.

6.1 The Applications Interface CAPI 2.0

Upon successful installation of the AVM ISDN-Controller C4, the ISDN interface CAPI 2.0 is available in the system. This allows applications to use all the features of ISDN.

What is CAPI?

Common ISDN API (CAPI) is a standardized software interface that provides applications with access to ISDN adapters on basic-rate and primary-rate lines. Applications that build on this standard interface use uniform mechanisms for communication over ISDN connections, and thus do not need to adapt to the peculiarities of particular manufacturers' hardware. This means that these applications are also unaffected by future extensions or hardware modifications: CAPI makes such changes transparent to the application. ISDN hardware manufacturers benefit from this standard too, since it makes a wide range of applications compatible with their products.

CAPI contains an abstract definition of ISDN services which is not dependent on the specifics of the underlying telecommunications network or the adapter card used to connect the computer to ISDN. The specification provides an interface that is easy for applications to use, and thus offers uniform access to the various ISDN services like data, voice and fax transmission, video conferencing and telephony.

Advantages of CAPI

CAPI has evolved into an internationally recognized standard. The key factor in this development has been the numerous advantages offered by this uniform interface: inde-

pendence from specific manufacturers and thus a high level of investment security; a wide variety of compatible applications for all kinds of operating systems and ISDN protocols, etc. ISDN (the **I**ntegrated **S**ervices **D**igital **N**etwork) is becoming attractive for more and more telecommunications users since it affords fast and reliable transfer of information in many different forms.

Over eleven years of experience in the growing ISDN market have gone into CAPI 2.0. This version has all the advantages of an open interface, and covers most of the features of ISDN. Since CAPI handles most ISDN subscriber interface control functions, these no longer have to be programmed. This simplifies the development of ISDN applications. Furthermore, since applications no longer have to be tailored to national or manufacturer-specific systems, a greater variety of applications is available.

For further information about CAPI, please see the CAPI Association's Web site at

<http://www.capi.org/>

Features of CAPI

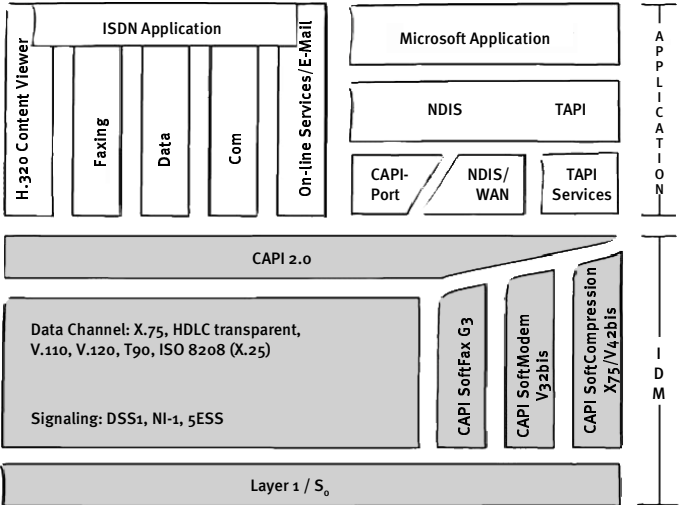
CAPI offers a number of important features:

- Support for basic call features such as call set-up and clear-down
- Support for multiple B channels for data and/or voice connections
- Support for multiple logical data connections within a single physical connection
- Selection of specific services and protocols for dialing and for answering incoming calls
- A transparent interface for protocols above Layer 3
- Support for one or several BRIs and PRIs through one or several ISDN adapters
- Support for multiple concurrent applications
- Message definitions independent of operating systems

- A message-passing mechanism tailored to specific operating systems for optimum integration into the operating system
- An asynchronous, event-driven mechanism for high throughput

6.2 IDM Architecture

The **IDSN Driver Model (IDM)** shows how ISDN is integrated in Microsoft operating systems or in any other standard operating system.



IDM Architecture

The **IDSN Driver Model** constitutes the framework for all driver components of AVM ISDN products. The **IDM** describes how ISDN services are integrated and how they are accessed by applications. It also defines the transparent integration of ISDN hardware resources in the operating system.

One of the most important functions the **IDM** makes possible is the coupling of existing communication components (such as the RAS of Windows) with CAPI-based hardware. This connection is realized by the AVM system drivers such as the AVM CAPI Port Driver or the AVM NDIS WAN CAPI Driver.

This architecture permits the simultaneous use of CAPI, modem and networking applications over ISDN. Most importantly, it also permits the definition and implementation of new, extended capabilities. Examples to date include the incorporation of V.42bis data compression and Group 3 Fax.

6.3 The AVM System Drivers

AVM provides two communication models for Windows, equipped with similar capabilities: the AVM ISDN CAPI Port Driver and the AVM NDIS WAN CAPI Driver. Both of these drivers are controlled through Dial-Up Networking, although they use different interfaces and protocols in the operating system. These drivers achieve the same transfer speeds in data communications.



The AVM ISDN CAPI Port Driver and the AVM NDIS WAN CAPI Driver can be installed and operated on the same computer if desired.

The AVM system drivers make it possible to use communication programs that do not incorporate CAPI support, such as Windows' Dial-Up Networking, concurrently with CAPI-based ISDN software.

The third AVM system driver, AVM ISDN TAPI Services for CAPI, permits the use of telephony applications with the AVM ISDN-Controller C4 in the Windows operating system.

The AVM system drivers are found on the installation CD-ROM. The latest versions are also available for downloading from the AVM Data Call Center or from AVM's FTP server in the Internet (<ftp.avm.de> or <www.avm.de>).

For a detailed description of each driver's functions, please see the Help file in the corresponding folder. The Help file also contains complete installation instructions.

AVM ISDN CAPI Port Driver

The AVM ISDN CAPI Port Driver allows your application to use the AVM ISDN-Controller C4 in Windows as if it were a modem.

The AVM CAPI Port Driver makes it possible for even programs designed for analog modems to communicate over the ISDN interface. This means that the various communication functions of Windows can be used with the AVM ISDN-Controller C4.

The AVM ISDN CAPI Port Driver provides a number of virtual modems in the Windows system. The various CAPI modems are pre-configured for different types of connections. Virtual modems allow you to dial up ISDN connections to the Internet or to BBS services, for example, or to set up RAS (**R**emote **A**ccess **S**ervice) connections to other computers over ISDN.

AVM NDIS WAN CAPI Driver

The AVM NDIS WAN CAPI driver for Windows permits the use of RAS and dial-in Internet access over ISDN.

NDIS (**N**etwork **D**evice **I**nterface **S**pecification) is a standard interface between network adapters (hardware) and network protocols (software). NDIS WAN is a Microsoft extension of this standard for Wide Area Networking (WAN). The AVM NDIS WAN CAPI Driver makes it possible to use the AVM ISDN-Controller C4 as a network adapter, mediating between network protocols and the ISDN-Controller C4's application interface CAPI 2.0.

Unlike the AVM ISDN CAPI Port Driver, the AVM NDIS WAN CAPI driver cannot be controlled by AT commands. It uses the standard protocols for network connections over ISDN (HDLC and PPP over ISDN).

AVM ISDN TAPI Services for CAPI

The AVM ISDN TAPI Services for CAPI are universal drivers for the use of TAPI applications in Windows with AVM ISDN-Controllers.

TAPI (**T**elephony **A**pplication **P**rogramming **I**nterface) is a software interface defined by Microsoft to permit the control of telephony equipment by Windows applications. The AVM ISDN TAPI Services for CAPI can be used to initiate telephone calls or to control voice mail systems. For example, Windows' "Phone Dialer" component can be used to call analog or ISDN telephones. The telephone call is placed using the PC's sound adapter and a headset or speakers and a microphone. Suitable TAPI applications can make use of numerous other features, such as direct telephone dialing to communication partners listed in programs such as Microsoft Outlook 98.

AVM ISDN-Controllers and the AVM ISDN TAPI Services for CAPI can be used in connection with TAPI applications that conform to version 2.1 (or later) of the Microsoft TAPI standard.

6.4 CAPI SoftCompression X.75/V.42bis

CAPI SoftCompression X.75/V.42bis is a feature of the ISDN-Controller C4's driver software. For data connections using the X.75 protocol, the controller can perform data compression in accordance with the V.42bis standard. This reduces transfer times and connection costs.

When the driver software is installed, CAPI SoftCompression X.75/V.42bis is activated by default. Upon request by CAPI applications that support the V.42bis standard, data compression is negotiated with the remote system for the duration of a connection.

6.5 CAPI SoftFax

The CAPI SoftFax feature allows the ISDN-Controller C₄ to send and receive faxes on all eight channels simultaneously at a rate of up to 14.4 kbit/s. The ISDN-Controller C₄ acts as a standard Group 3 fax device.

The following fax protocols are supported:

- V.17 (14.4 kbit/s)
- G3 Annex F (14.4 kbit/s)
- G3 Annex A (color fax)

6.6 CAPI SoftModem

The CAPI SoftModem feature permits connections to systems that are connected to the telephone network by an analog modem. This modem emulation allows connections at up to 14.4 kbit/s.

7 Technical Summary

This chapter contains a summary of the ISDN-Controller C4's features and technical specifications.

7.1 Connector Pin Assignments

The ISDN-Controller C4 is connected to the ISDN S₀ interface by an RJ45 plug. The following table shows the pin assignments of this connector.

Pin assignments, RJ45 connector for ISDN S₀

RJ-45	Function
1-	
2-	
- 5 (b1)	transmit
- 4 (a1)	transmit
- 3 (a2)	receive
- 6 (b2)	receive
7-	
8-	

7.2 The AVM ISDN-Controller C4 on Point-to-Point ISDN Lines

By default, the AVM ISDN-Controller C4 is installed with settings for BRI lines in point-to-multipoint configuration. However, it also can be operated with point-to-point lines (also called Direct Dial-In or DDI lines).

When using the ISDN-Controller C4 on point-to-point BRIs, please observe the following guidelines:

- Only **one** terminal device can be connected to a point-to-point BRI.

- Configure the ISDN-Controller C₄ for operation on point-to-point lines. See the section on “Configuring the ISDN-Controller C₄” in the installation chapter for your operating system.
- Your CAPI application (fax server, etc.) also must support operation on point-to-point lines.
- The CAPI application also must be configured to interpret the DDI (direct dial-in) ISDN numbers correctly. Consult the documentation accompanying your application software.

7.3 Technical Specifications and Features

- ISDN-Controller for ISDN BRI lines and the PCI bus
- One to four BRI lines
- Active ISDN-Controller with its own CPU and on-board RAM
- High-performance StrongARM SA-110 processor with 270 MIPS at 233 MHz
- 16 MB of SDRAM
- State-of-the-art technologies, including BGA devices, SDRAM, 3.3 V supply voltage, etc.
- Low power consumption: approx. 3 W
- PCI Bus Mastering DMA: minimum system load and maximum throughput; suitable for all ISDN services:
Internet access, internetworking, remote access, file transfer, fax, voice, video, digital data communication with other networks
- Common-ISDN-API 2.0 applications interface
- CAPI SoftCompression X.75/V.42bis and channel bundling in accordance with the CAPI specification
- CAPI SoftFax for fax communication at 2400, 4800, 9600 and 14400 bit/s

- CAPI SoftModem for analog modem connections at 1200/75, 2400, 4800, 9600 and 14400 bit/s
- Digital protocols:
X.75, HDLC transparent, bit-transparent, X.25, ISO 8208 (X.25 DTE-DTE), X.31 Cases A and B, T.70, T.90, Mobile ISDN (ISO 3309), V.110, V.120, DTMF recognition
- Analog protocols:
Group 3 fax (T.30, V.17, V.29, V.27ter), Group 3 fax Annex A (Error Correction Mode) and Group 3 fax Annex F (14.4 kbit/s, including two-dimensional data compression)
Modem emulation: V.21, V.22, V.22bis, V.32, V.32bis
- Support for point-to-point and leased lines
- Supplementary Services, including:
Hold & Retrieve, Suspend & Resume (TP), 3PTY, ECT, ...
- All protocol software loadable on the ISDN-Controller C4
- AVM ISDN CAPI Port Driver
- AVM NDIS WAN Driver for Windows 2000 and Windows NT 4.0
- AVM ISDN TAPI Services for CAPI Windows 2000 and Windows NT 4.0
- Operation with the operating systems Windows 2000, Windows NT, Novell NetWare and Linux
- Up to four ISDN-Controller C4s installable in one computer
- International certification

8 Troubleshooting

This chapter describes general malfunctions and specific error messages, and suggests remedies. The error messages are grouped according to the operating platforms in which the AVM ISDN-Controller C₄ can be installed.

8.1 General Malfunctions

The AVM ISDN-Controller is not detected or not initialized.

Have you installed other new hardware components or changed the configuration of existing hardware?

If you combine adapters without Plug-and-Play support and PCI or ISA Plug-and-Play cards in one system, then the resources (I/O addresses and IRQ levels) used by the hardware without Plug-and-Play support should be so designated in the computer's BIOS. Otherwise, system resources may be allocated to more than one adapter, resulting in malfunctions. Please see your PC or mainboard manual.

You are unable to establish an ISDN connection.

If the AVM ISDN-Controller C₄ is correctly installed but you are unable to establish a connection, check for the following conditions:

- Is the ISDN-Controller C₄ firmly inserted in the PCI slot? Is its slot plate screwed down?
- Are the ISDN cable connectors firmly inserted in the AVM ISDN-Controller C₄ and in your ISDN socket?
- Is your ISDN line active? Use another terminal device, such as an ISDN telephone, to check it.
- Is your network terminator (NT) installed correctly? Some NTs must be connected to an electrical outlet as well as to the incoming ISDN line.

- If your ISDN-Controller C4 is connected to a PBX extension, have you included the outside dialing prefix (usually 'o') in configuring your application software?
- Are all the pertinent services for data connections available and enabled in your PBX?

Problems arise during ISDN-Controller operation:

If problems occur regularly during operation, run the program "C4 Test", which is found in the "AVM" program group (Windows NT 4.0) or in the installation folder of the driver software. This program performs functional tests of the ISDN-Controller C4's components and displays the results.

If "C4 Test" reports no malfunctions in the ISDN-Controller hardware, attempt a test connection to the AVM Data Call Center (ISDN file transfer server). You may do so using the program "Connect32" (Windows NT 4.0), which is among the AVM ISDN-Tools included with your ISDN-Controller. The number of the AVM Data Call Center is +49-30-399 84 300.

Applications such as "Connect32" are unable to connect to analog dial-in ports.

To connect to analog systems, you need appropriate communication software in addition to the AVM ISDN-Controller C4. With fax software, for example, you can dial connections to Group 3 (analog) fax machines.

No connection charge information is displayed.

The drivers for the AVM ISDN-Controller C4 allow CAPI-based applications to display charge information. This information is available only if the corresponding ISDN service has been enabled on your ISDN lines by your ISDN service provider. Contact your ISDN service provider to request charge information on each of your ISDN lines.

Using Dual-Boot Systems

To use the AVM ISDN-Controller C4 in a dual-boot system, install the drivers for each of the relevant operating systems in a separate directory, such as \IDRIVER.WNT.

8.2 Error Messages

Error Messages in Windows 2000

Upgrade from Windows NT 4.0 to Windows 2000

Before you switch your computer over from Windows NT 4.0 to Windows 2000, both the hardware and the software of the Once the computer has been updated, the ISDN-Controller hardware and software are re-installed and configured as described below.

All other instances of errors and problems

Please refer to the Microsoft Windows 2000 documentation.

Error Messages in Windows NT

Error Message on loading the ISDN-Controller with “C4 Load”: “Installation Error. Interrupt <xx> not available”

Possible cause: There are no IRQs (interrupts) available to the PCI bus.

Remedy: Run your BIOS setup (see the PC or mainboard manual) and allocate at least one free IRQ for use by PCI adapters.

Example (Award BIOS): In the BIOS main menu, select “PnP/PCI Configuration”, then set “IRQ x assigned to: PCI/ISA PnP”.

If you combine adapters without Plug-and-Play support in a system equipped with PCI or ISA Plug-and-Play cards, then the resources (I/O addresses and IRQ levels) used by the hardware without Plug-and-Play support should be so designated in the computer’s BIOS. Otherwise, system resources may be allocated to more than one adapter, resulting in mal-functions. Please see your PC or mainboard manual.

Error Messages in Novell NetWare

Error Message on loading the ISDN-Controller: “Installation Error. Interrupt <xx> not available.”

Possible cause: There are no IRQs (interrupts) available to the PCI bus.

Remedy: Run your BIOS setup (see the PC or mainboard manual) and allocate at least one free IRQ for use by PCI adapters.

Example (Award BIOS): In the BIOS main menu, select “PnP/PCI Configuration”, then set “IRQ x assigned to: PCI/ISA PnP”.

If you combine adapters without Plug-and-Play support and PCI or ISA Plug-and-Play cards in one system, then the resources (I/O addresses and IRQ levels) used by the hardware without Plug-and-Play support should be so designated in the computer’s BIOS. Otherwise, system resources may be allocated to more than one adapter, resulting in malfunctions. Please see your PC or mainboard manual.

Error Message: “CAPI not loaded.”

Possible cause: You tried to start an ISDN application without loading the AVM-ISDN Controller C4 first.

Remedy: Load the ISDN-Controller by entering **load capi20** at the system console, then start your ISDN application.

Error Message: “Error in configuration file, no ISDN-Controller defined.”

Possible cause: During the AVM-ISDN Controller C4 installation process, the configuration file CAPI20.CFG is created. This error occurs if you later edit this file manually and corrupt the ISDN-Controller definition(s) it contains.

Remedy: Repeat the complete AVM ISDN-Controller C4 installation procedure.

Error Messages: “Deinstallation error, wrong CAPI driver loaded.”

“Installation error, wrong CAPI driver loaded.”

“Installation error, ISDN-Controller-xx unknown keyword <xx>.”

“Installation error, ISDN-Controller-xx <xxxx> value too long.”

“Installation error, ISDN-Controller-xx <xxxx> illegal value.”

Possible cause: You have replaced some files in the ISDN-Controller driver installation directory (on obtaining new drivers from the AVM Data Call Center, for example). Older files in the same directory cause version conflicts.

Remedy: Always perform the full AVM ISDN-Controller C₄ installation procedure; never replace individual files.

Error Message: “Installation error, Controller-xx with I/O address <xxx> does not answer.”

Possible cause: The ISDN-Controller C₄ was not loaded completely, or the hardware has been damaged.

Remedy: Repeat the complete ISDN-Controller installation procedure. In case of a hardware defect, please contact your dealer or AVM.

Error Message: “ ... at least one application is registered.”

Possible cause: You tried to unload or uninstall the AVM-ISDN Controller C₄ while an application (such as a terminal or fax program) was still using it.

Remedy: First close all applications that use the AVM ISDN-Controller. Then you can unload or uninstall it.

9 Technical Support from AVM

AVM provides numerous sources of information to assist you in your day-to-day work with the ISDN-Controller C4. New drivers and software updates for your AVM ISDN-Controller C4 are available for downloading free of charge from AVM's Internet site or the AVM Data Call Center. If you are not able to resolve a problem using these resources, AVM Support is available to assist you.

9.1 Information and Updates

Information about the ISDN-Controller C4 can be obtained from the following sources:

The ISDN-Controller C4 manual

The manual is contained in the ISDN-Controller package in printed form, and is also included in PDF format on the CD. See the folder \PROGRAMS\MANUAL\ENGLISH. If you do not have the Adobe Acrobat Reader to display PDF documents, you can install this program from the CD as well. See the folder \PROGRAMS\ACROBAT.

The C4 Readme file

The "C4 Readme" shortcut in the "AVM" program group displays current information that was not yet available at the time the manual was printed.

The AVM Internet Site

AVM publishes detailed information and free software updates in the Internet. Direct your browser to www.avm.de and:

- Click "Products" for detailed information on all current AVM products, as well as announcements of new products and product versions.

- Click “Service” to consult the “FAQs”: the answers to Frequently Asked Questions about AVM products. Here you will find solutions for specific situations.
- Under “Service” you will also find the latest driver software to download for the AVM ISDN-Controller C4.

The AVM Data Call Center (ADC) is a direct ISDN file transfer server that also provides all the programs and drivers found on AVM's Internet site. Dial the AVM Data Call Center using FRITZ!data (IDtrans protocol) at: +49-30-399 84 300.

9.2 AVM Support



Please take advantage of the information sources listed above before contacting AVM Support!

If the tips and information sources listed above have not assisted you in solving your problem, please contact AVM Support for further information.

AVM Support can be reached by e-mail or fax.

Support by E-mail

You may send support requests to AVM by e-mail. Please do so using our e-mail request form, which you can find at

<http://www.avm.de/en/service/support>

Fill out the form and click on “Submit” to send it to AVM Support.

Support by Fax

If you have no connection to the Internet, AVM Support can be reached at the fax number:

+49-30-399 76 266

Please supply the following information in your support request:

- Which AVM ISDN-Controller model are you having trouble with?

- What is the version number of the driver you are using? You can find this information in the Readme file in the “AVM” program group.
- Is your ISDN-Controller connected directly to the ISDN NT, or to a PBX extension line?
- What operating system is running on the computer in which you have installed the AVM ISDN-Controller?
- Please specify the exact text of all error messages you encountered.
- Describe the problem in as much detail as possible: in what context does the error occur; what application software are you using; etc.

Please answer the following questions in your support request as well, as these points can be very helpful in solving your problem:

- Is the error reproducible?
- Does the “C4 Test” program in the “AVM” group detect problems with your ISDN-Controller?

If so, what messages does it display?

- Are you able to dial up a data connection to the AVM Data Call Center (ADC) with your AVM ISDN-Controller?

Attempt to make a test connection to the ADC with the ISDN Tool Connect32, included with your ISDN-Controller, or with FRITZ!data. Use the IDtrans protocol and dial the number +49-30-399 84 300.

If the connection to the ADC fails, what error messages are displayed?

- Describe your PC configuration in as much detail as possible, including the system type, sound card type, any other components installed, and the allocated resources (interrupts and I/O addresses).

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Declaration of CE Conformity

The manufacturer AVM GmbH
Address Alt-Moabit 95
 D-10559 Berlin

herewith declares that the product

Type ISDN-Controller
Product C4

complies with the following directives:

- 1999/5/EEC R&TTE Directive:
Radio equipment and telecommuni-
cations terminal equipment
- 89/336/EEC EMC Directive:
Electromagnetic Compatibility
- 73/23/EEC Low Voltage Directive:
Electrical equipment designed for use
within certain voltage limits

The following norms were consulted to assess conformity:

- CTR₃/1998.06.17
- EN 55022/9.98 Class B
EN 55024/9.98
- EN 60950/1992+A1+A2+A3+A4+A11
EN 41003/1998



The CE symbol confirms that this product conforms with the above mentioned norms and regulations.

A handwritten signature in blue ink, appearing to read 'P. Faxel'.

Berlin, 16.03.2000

Peter Faxel, Technical Director