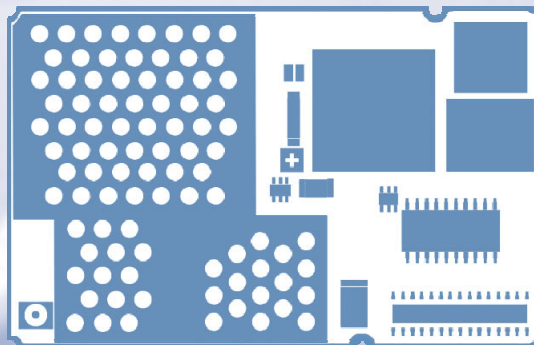


SIEMENS



Multiplexer Driver Developer's Guide

(Windows 2000 and Windows XP)

Siemens Cellular Engines

Version: 05
DocID: Mux_drv_devguide_v05

User's Guide

Document Name: **Multiplexer Driver Developer's Guide**

Version: **05**

Date: **August 26, 2005**

DocId: **Mux_drv_devguide_v05**

Status: **Confidential / Released**

General notes

Product is deemed accepted by Recipient and is provided without interface to Recipient's products. The documentation and/or Product are provided for testing, evaluation, integration and information purposes. The documentation and/or Product are provided on an "as is" basis only and may contain deficiencies or inadequacies. The Documentation and/or Product are provided without warranty of any kind, express or implied. To the maximum extent permitted by applicable law, Siemens further disclaims all warranties, including without limitation any implied warranties of merchantability, completeness, fitness for a particular purpose and non-infringement of third-party rights. The entire risk arising out of the use or performance of the Product and documentation remains with Recipient. This Product is not intended for use in life support appliances, devices or systems where a malfunction of the product can reasonably be expected to result in personal injury. Applications incorporating the described product must be designed to be in accordance with the technical specifications provided in these guidelines. Failure to comply with any of the required procedures can result in malfunctions or serious discrepancies in results. Furthermore, all safety instructions regarding the use of mobile technical systems, including GSM products, which also apply to cellular phones must be followed. Siemens or its suppliers shall, regardless of any legal theory upon which the claim is based, not be liable for any consequential, incidental, direct, indirect, punitive or other damages whatsoever (including, without limitation, damages for loss of business profits, business interruption, loss of business information or data, or other pecuniary loss) arising out the use of or inability to use the Documentation and/or Product, even if Siemens has been advised of the possibility of such damages. The foregoing limitations of liability shall not apply in case of mandatory liability, e.g. under the German Product Liability Act, in case of intent, gross negligence, injury of life, body or health, or breach of a condition which goes to the root of the contract. However, Claims for Damages arising from a breach of a condition which goes to the root of the contract shall be limited to the foreseeable damage which is intrinsic to the contract, unless caused by intent or gross negligence or based on liability for injury of life, body or health. The above provision does not imply a change on the burden of proof to the detriment of the Recipient. Subject to change without notice at any time. The interpretation of this general note shall be governed and construed according to German law without reference to any other substantive law.

Copyright notice

Transmittal, reproduction, dissemination and/or editing of this document as well as utilization of its contents and communication thereof to others without express authorization are prohibited. Offenders will be held liable for payment of damages. All rights created by patent grant or registration of a utility model or design patent are reserved.

Copyright © Siemens AG 2005

Trademark notice

MS Windows® is a registered trademark of Microsoft Corporation.

Contents

0	Document history.....	5
1	Introduction	6
1.1	Supported product versions	7
1.2	Related documents	8
1.3	Abbreviations	8
2	Architecture	9
2.1	Hierarchy chart in the system	9
2.2	Handling of the physical serial port	10
2.3	Module detection	11
2.4	Handling of control lines on virtual ports	12
2.5	Limitation of virtual ports	13
2.6	Module initializing sequence	14
2.7	Module re-initialization	15
2.8	Power down	16
2.8.1	Power down on PC suspend	16
2.8.2	Power down after closing the last port	16
2.8.3	Power down on PC shutdown	16
3	Installation	17
3.1	Files required for WinMux2k driver installation	17
3.2	Installing the WinMux2k driver	17
3.3	Deinstalling the driver	18
4	Device settings and properties	19
4.1	Settings on the Serial Multiplexer Properties page	19
4.2	Settings stored in the Windows Registry	20
5	Settings for applications	24
5.1	Dial-up network settings	24
5.2	Fax settings	24
6	Translate source code	25
6.1	Software requirements	25
6.2	Preparing the translation	25
6.3	Compiler flags	25
7	Additional source documentation	26
7.1	Interaction of the different driver objects	26
7.2	Internal driver states	27
7.3	Buffer handling	28
7.4	Data transfer	29

7.4.1	Block flow diagram for data received by the module	29
7.4.2	Block flow diagram for data sent to the module via virtual port.....	30
7.4.3	SerMuxSend function.....	31
7.5	The +++-parser	33
8	Known problems	34
8.1	Bootting the operating system	34
8.2	Shutdown of the operating system	34
8.3	Standby of the operating system	34
8.4	Wake on ring.....	35
8.5	Special environments	35

Figures

Figure 1: Driver architecture.....	9
Figure 2: Serial Multiplexer Properties page	19
Figure 3: Interaction of the different driver objects	26
Figure 4: State diagram of the internal driver states	27
Figure 5: Driver internal buffer handling	28
Figure 6: Block flow diagram for data received by the module.....	29
Figure 7: Block flow diagram for data sent to the module via a virtual port.....	30
Figure 8: SerMuxSend function.....	31
Figure 9: Send function from the virtual communication ports	32
Figure 10: State diagram of the +++-parser	33

Tables

Table 1: Physical serial port	10
Table 2: Virtual serial port with Multiplexer Protocol version 2.....	12
Table 3: Virtual serial port with Multiplexer Protocol version 3.....	12
Table 4: Module initialization of supported modules	14
Table 5: Required driver files	17
Table 6: Registry values.....	20
Table 7: Registry values for trace outputs.....	23

0 Document history

This chapter reports modifications and improvements over previous versions of this document.

Preceding document: "Multiplexer Driver Developer's Guide", Version 04

New document: "Multiplexer Driver Developer's Guide" Version **05**

Chapter	What is new
1.1	Updated list of supported products.
2.6	Changed description within table Table 4 to cover all supported modules. Deleted tables for particular modules.
3.2	Hints on migration to different modules changed.
4.2	Updated description of the Registry values "ModemInit", "ClosePort", "WaitforDSR"

Preceding document: "Multiplexer Driver Developer's Guide", Version 03

New document: "Multiplexer Driver Developer's Guide" Version 04

Chapter	What is new
Throughout manual	In several chapters, added information specific to XC18.
1.1	Updated list of supported products.
2.6	Added note regarding user profile settings
4.1	Added figure and modified description.

Preceding document: "Multiplexer Driver Developer's Guide", Version 02

New document: "Multiplexer Driver Developer's Guide" Version 03

Chapter	What is new
1.1, 1.2	Updated list of supported products and information about version control.
Throughout manual	Complete revision of all chapters. Added information specific to TC35i and TC45. Updated Description of Registry values.

1 Introduction

The multiplex mode according to the ETSI TS 101 369, GSM 07.10 Multiplexer Protocol enables one physical serial interface to be partitioned into three virtual channels. This allows you to take advantage of three simultaneous sessions running on one serial interface. For example, you can send or receive data on the first channel, while the other two channels are free to control the GSM/GPRS engine with AT commands.

In order to properly communicate with the wireless modem, the application needs to support the Multiplexer Protocol and 3 virtual ports must be installed. For this purpose a Windows 2000/XP multiplexer driver WinMux2k can be provided. The driver offers basic multiplexer functionality and serves as a reference implementation to aid developers and system integrators in designing, developing and testing customized multiplexer applications. As such, it has been tested by Siemens using a variety of applications and platforms, but naturally, even the most extensive test setup can never be adequate to cover all conceivable configurations.

The Siemens AG does not guarantee any support regarding the integration of the driver into a customer's application. However, the documentation as well as code binaries and source files can be provided and used for further development.

This document describes how to install the Windows 2000/XP multiplexer driver WinMux2k in a Windows 2000/XP based application.

1.1 Supported product versions

Please note that this User's Guide covers the two different versions of the Multiplexer Protocol.

The following products support version 2 of the Multiplexer Protocol:

- TC35, TC35 Terminal and TC37 from Release 03.10
- MC35 from Release 03.00
- AC35

The following products support version 3 of the Multiplexer Protocol with enhanced features:

- AC43
- AC45
- MC35i
- MC35i Terminal
- MC39i
- MC45
- MC46
- MC388
- MC5x
- TC35i
- TC35i Terminal
- TC45
- XC18
- XT55
- XT56
- MC75
- TC63
- TC65

Where differences occur between the two Multiplexer Protocol versions or between the supported Siemens wireless modules they are particularly noted.

The Multiplexer sources are available on request. In the case you wish to receive the source code of the MinMux2k driver packed into a zip file containing the complete source files together with corresponding MS Visual Studio 6.0 project files, see chapter 6.

1.2 Related documents

- [1] Digital Cellular Telecommunications Systems (Phase 2+); Terminal Equipment to Mobile Station (TE-MS) "Multiplexer Protocol"; ETSI TS 101 369 V7.1.0 (1999-11), GSM 07.10 Version 7.1.0, Release 1998
- [2] AT Command Set of your Siemens wireless engine
- [3] Hardware Interface Description of your Siemens wireless engine
- [4] Multiplexer User's Guide
- [5] MC35 Multiplexer User's Guide (for MC35 only)
- [6] TC3x Multiplexer User's Guide (for TC35 and TC37 only)

To visit the Siemens Website you can use the following link:

<http://www.siemens.com/wm>

1.3 Abbreviations

Abbreviation	Description
ACPI	Advanced Configuration and Power Interface
CTS	Clear to Send
DCD	Data Carrier Detect
DDK	Driver Development Kit (Microsoft driver development)
DSR	Data Set Ready
DTR	Data Terminal Ready
ETSI	European Telecommunications Standards Institute
FIFO	First in first out
GPRS	General Packet Radio Service
GSM	Global System of Mobile Communication
MS	Mobile Station
PC	Personal Computer
PDA	Personal Digital Assistant
RI	Ring Indicator
RTS	Request to Send
TE	Terminal Equipment
UART	Universal Asynchronous Receiver Transmitter

2 Architecture

2.1 Hierarchy chart in the system

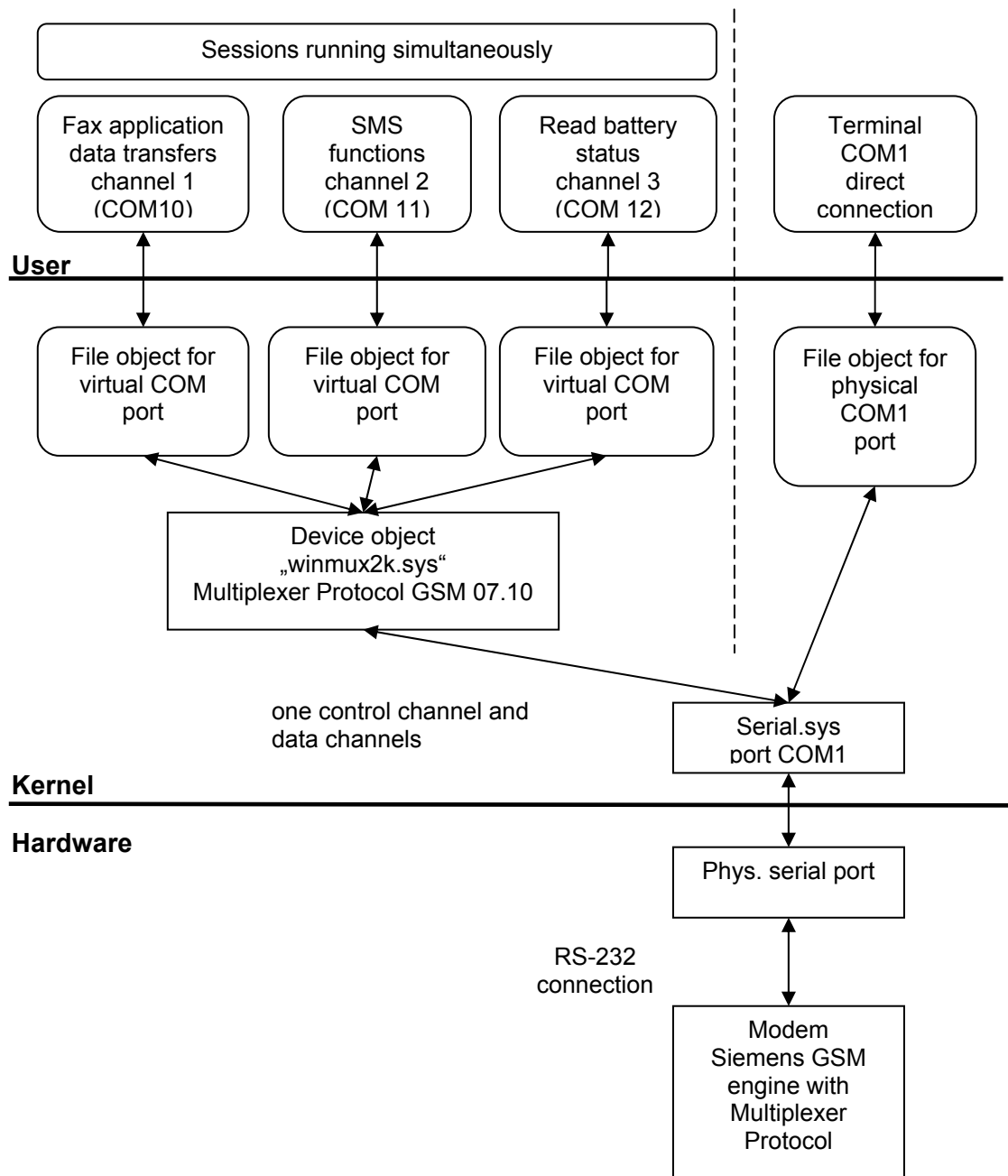


Figure 1: Driver architecture

Figure 1 shows the driver architecture of winmux2k.sys in the operating system. The device driver winmux2k.sys emulates virtual serial ports. The lower layer of the WinMux2k driver is the physical serial port driver (serial.sys). The WinMux2k driver is loaded during system startup. It creates virtual port objects. The physical port is opened, when the first virtual port is opened by an application.

If the last virtual port is closed the physical port will be released by the WinMux2k driver. This allows applications to access the module without the WinMux2k driver.

If the WinMux2k driver is opened by at least one application a special device object is attached to the driver stack of the serial.sys driver. This device object is used to control the power management request. It is detached from the stack if the last handle is closed.

2.2 Handling of the physical serial port

When the physical port is opened, the WinMux2k driver initializes it. During the initialization the physical port is set to hardware handshake. This means the RTS and CTS signals on the port side are controlled by the hardware and the WinMux2k device driver. The DTR signal is set to 1. The port mode is set to 8 bits, 1 stop bit, no parity. The baud rate can be configured using the winmux2k.inf file or the Serial Multiplexer property page. If fast baud rates are selected (e.g. 115200 bps) the receive FIFO of the UART should be configured for a size of 8 bytes. This can be done using the property page of the COM Port in the device manager.

Table 1: Physical serial port

Signal	Description
RTS/CTS	Hardware controlled
DTR	Set to 1
Baud rate	Variable, parameter read from registry
Data bits	8
Parity	No
Stop bits	1

2.3 Module detection

The module supports an auto-baud mode and constant baud rates. Furthermore, the module can stay in "normal AT command mode" or in WinMux2k mode. To establish a communication to the module the correct baud rate and the state of the module must be found. Therefore it is recommended to set the module into auto baud mode.

If the baud rate is programmed to a constant value, the driver has to find the correct baud rate. To do so, the driver sends an "AT" command to the module, trying different baud rates until the correct one is found. If the module doesn't answer to the initial "AT" sent at the first baud rate, the driver tries to disable the possibly enabled multiplexer mode. This is done because the module might still be kept in multiplexer mode due to an earlier failure. If this fails, the driver sends again the initial "AT" command using the next baud rate from the list of supported baud rates. The driver must wait for a given timeout before the decision can be made that the module does not answer at any baud rate. The timeout value can be changed in the Windows Registry (see "RequestTimeout" value in Table 6). It can take some time before the driver finds the correct baud rate or before the driver fails to call the Open() function. Even if the module is not connected to the serial port or is turned off, the long timeout period occurs.

If the connection to the module has been established the baud rate set in the Registry is used for further communications.

Closing the last port deactivates the multiplexer mode and causes the module to return to "normal AT command mode" without multiplexer. Also, autobauding (AT+IPR=0) will be enabled once again. Finally, the AT^SMSO command will be sent to switch the module off. Only in the case of TC45 and XC18, AT^SMSO will not be sent. Instead, TC45 and XC18 remain in "normal AT command mode" and can be quickly accessed from the PC debug environment.

2.4 Handling of control lines on virtual ports

Summary of control line handling

Table 2: Virtual serial port with Multiplexer Protocol version 2

Signal	Description
RING	Read from hardware port, distributed to the first virtual port
DCD	Read from hardware port, distributed to the first virtual port
DSR	Received with Modem Status Command
DTR	Set by user, sent with Modem Status Command, initialized with 1
CTS	Received with Modem Status Command
RTS	Set by user, sent with Modem Status Command, initialized with 1

Table 3: Virtual serial port with Multiplexer Protocol version 3

Signal	Description
RING	Received with Modem Status Command
DCD	Received with Modem Status Command
DSR	Received with Modem Status Command
DTR	Set by user, sent with Modem Status Command, initialized with 1
CTS	Received with Modem Status Command
RTS	Set by user, Send with Modem Status Command, initialized with 1

2.5 Limitation of virtual ports

Flow control can be set to RTS/CTS or DSR/DTR. XON/XOFF flow control is not supported. Hardware flow control on the virtual COM ports is handled internally by the Multiplexer Protocol.

The WinMux2k driver handles neither modem nor serenum IO-control requests.

The WinMux2k driver supports only 8 data bits, no parity, and one stop bit.

The function `IOCTL_SERIAL_XOFF_COUNTER` is not supported.

The following functions return "success", but have no effect at all:

- `IOCTL_SERIAL_SET_BREAK_ON`
- `IOCTL_SERIAL_SET_BREAK_OFF`
- `IOCTL_SERIAL_SET_XOFF`
- `IOCTL_SERIAL_SET_XON`
- `IOCTL_SERIAL_RESET_DEVICE`

Virtual ports accept any baud rate, though the changed setting will be ignored.

Calling the function `Open()` to a virtual port can take up to 40 seconds. It fails if the module is not connected.

2.6 Module initializing sequence

Due to different requirements of the supported products the initialization sequence varies with the module type. This means that when you migrate to another module type you are required to uninstall the driver and reinstall it with the new module. The settings are taken from the winmux2k.inf file.

The tables below list the commands sent to the module during the initialization. As the init string information is stored in the Windows Registry the corresponding values are also listed. For further details on the Registry see chapter 4.2.

Table 4: Module initialization of supported modules

Command	Response	Function	Associated Registry value
AT	OK	Detection of connected module.	
AT+IPR=115200	OK	Baud rate specified in the Windows Registry during WinMux2k installation. The value may be different according to individual settings.	"BaudRateString"
AT	OK	Check if change of baud rate was successful.	"ModemInit"
AT&S0\Q3	OK	Sets DSR always on and hardware flow control. The settings are read from the Windows Registry.	"ModemInit"
AT+ICF=3	OK/ERROR	Sets interface mode 8N1. This command works only on modules supporting different interface modes (TC35i, TC63, TC65, MC75). The settings are read from the Windows Registry. The resulting ERROR on modules without support of the AT+ICF command is ignored by the WinMux2k driver.	"ModemInit"
AT+CMUX=0	OK	Switches to multiplexer mode. This sequence is read from the Windows Registry. More AT commands can be sent to the module at this point.	"ModemInit"

Note: The initialization sequence overrides the user profile settings defined with AT&W on channel 1 for the commands AT&S, AT\Qn and AT+ICF. After restart without multiplexer, the user profile will be loaded with all your individual settings.

2.7 Module re-initialization

If the module is disconnected or powered off during normal operation, the driver detects this and tries to reinitialize the module. Because the module state can be changed while disconnected the multiplexer mode has to be completely initialized. The driver checks the following situations:

- Invalid frames from the module are received.
- Timeout occurs during sending frames.
- DSR signal goes to zero, can be turned off with Registry value.

If one of these conditions is detected the driver starts the following actions:

- Try to send an MSC command to the module. If the module answers it is assumed that the module is working and no re-initialization is required.
- Generate an RTS impulse.
- Wait for CTS to ensure that the module has been properly started after re-initialization.
- Reinitialize the module.

2.8 Power down

The module switches to Power down mode when the PC enters the suspend mode or shuts down or when the last virtual port is closed. The following sections describe the behavior of the software in these three cases.

The commands sent to the module are taken from the Registry values „PowerDown” for PC suspend, “ClosePort” for closing the last virtual port and “ShutDown” for a shut down of the PC. These values are copied from the “winmux2k.inf file into the Registry during installation of the driver. For further details on the Registry values see below and chapter 4.2.

2.8.1 Power down on PC suspend

When the PC enters the suspend mode, the module stays in multiplexer mode. A virtual channel is activated and used to send the commands from the Registry value “PowerDown” or via the “PowerDownFrame” available from Multiplexer Protocol version 3 onwards. All pending send requests are stopped.

When the PC wakes up the module gets an RTS impulse and the pending send buffers are re-enabled.

2.8.2 Power down after closing the last port

When the last virtual port is closed the module switches from multiplexer mode to “normal AT command mode”. This is accomplished by sending the strings of the Registry value “ClosePort” to the module (AT+IPR=0 and, depending on the product, AT^SMSO).

If the module is switched off with AT^SMSO, the driver waits for the DSR signal to go low after switch-off. Otherwise reopening a virtual port may fail because the module hasn't finished its shutdown procedure. This behavior is supported by Multiplexer Protocol version 3 or later and enabled by the Registry value “WaitForDSR” = 1.

Due to different requirements of the supported products the Registry values “ClosePort” and “WaitForDSR” vary with the module type. By default, all modules except for TC45 and XC18 will be switched to autobauding with IPR=0 and then turned off by AT^SMSO, with the “WaitForDSR” feature being enabled. TC45 and XC18, however, will only be set to autobauding and not switched off, and therefore the “WaitForDSR” feature is disabled. As stated in chapter 2.3, this default behavior of TC45 and XC18 was implemented for faster access from the PC debug environment.

2.8.3 Power down on PC shutdown

When the PC is shut down, the multiplexer mode is turned off and the strings from the Registry value “ShutDown” are sent to the module, if a virtual port is in use.

Note: During shutdown, some PCs may generate an impulse on the lines of the serial interface. In applications where the DTR line connects to the ignition line (IGT), an impulse received on DTR will immediately cause the module to be restarted from Power Down mode.

3 Installation

3.1 Files required for WinMux2k driver installation

Table 5: Required driver files

File	Comment
Wmuxinst.exe	WinMux2k driver installation program
Winmux2k.inf	INF file for the WinMux2k driver. It contains all driver settings and module specific settings stored in the Windows Registry during the installation. See chapter 4.2 for further details on the Registry.
Winmux2k.sys	Device driver image
Wmuxprop.dll	Property page for the module, co-installer

3.2 Installing the WinMux2k driver

Before starting the installation make sure that all files are located in the same folder as the `wmuxinst.exe`:

- `winmux2k.inf`
- `winmux2k.sys`
- `wmuxprop.dll`

1. Start the program **wmuxinst.exe**.
2. Ensure that the module is connected to a serial port and turn the module power on.
3. Press the "Scan" button of the application. All Siemens modules found will be listed in a box. If no modem has been installed yet, the virtual ports can be selected. If it is properly installed, the virtual ports are shown. If at least one modem is found, the "Install" button becomes active. Pressing this button will cause the selected modules to be installed.
4. Use the Device Manager to check that the installation was successful.

The virtual ports are available without reboot. The driver instances are visible in the device manager class "*Multi-port Serial Adapters*". If you wish to uninstall the driver see chapter 3.3.

When migrating from TC45 or XC18 to another module type or vice versa we recommend to uninstall the driver and reinstall it with the new module. This way, you can take advantage of the module specific power down sequence determined during the driver installation and executed each time after closing the last virtual port (see chapter 2.8.2 and chapter 4.2).

Although it is not recommended, it is possible to modify the driver's factory defaults by editing, prior to the driver installation, the parameters contained in the `winmux2k.inf` file. This approach can be used, for example, if you want to use another default baud rate or if you want to replace the string `AT+CFUN=0` with one of the CYCLIC SLEEP mode settings supported by your module, such as `AT+CFUN=5` or `6` or `7` or `8` or `9`. See also chapter 4.2.

Note: During the installation a pop-up dialog with "*Digital Signature Not Found*" will appear. Please ignore this message and continue the installation process. The reason for the message is that the driver has not been registered with Microsoft, but its correct functionality is ensured.

3.3 Deinstalling the driver

In order to uninstall the Windows Multiplexer Driver perform the following steps:

Windows 2000

1. Start the *Control Panel*.
2. Select *System*.
3. Select the *Hardware* property sheet.
4. Double click the *Device Manager* button.
5. Under *Multi-port serial adapters* right click *Serial Multiplexer*.
6. Choose *Uninstall Driver* and answer the confirm dialog with yes to finally uninstall the driver.

Windows XP (new desktop, not the classic desktop)

1. Start the *Control Panel*.
2. Under *Performance and Maintenance* select *System*.
3. Select the *Hardware* property sheet.
4. Double click the *Device Manager* button.
5. Under *Multi-port serial adapters* right click *Serial Multiplexer*.
6. Choose *Uninstall Driver* and select *Yes* from the *Confirm File Deletion* dialog.

4 Device settings and properties

4.1 Settings on the Serial Multiplexer Properties page

From the *Serial Multiplexer Properties* page (see chapter 3.3 for details where to find the page) select the *Port Settings* tab. The baud rate used on the physical serial port can be changed individually.

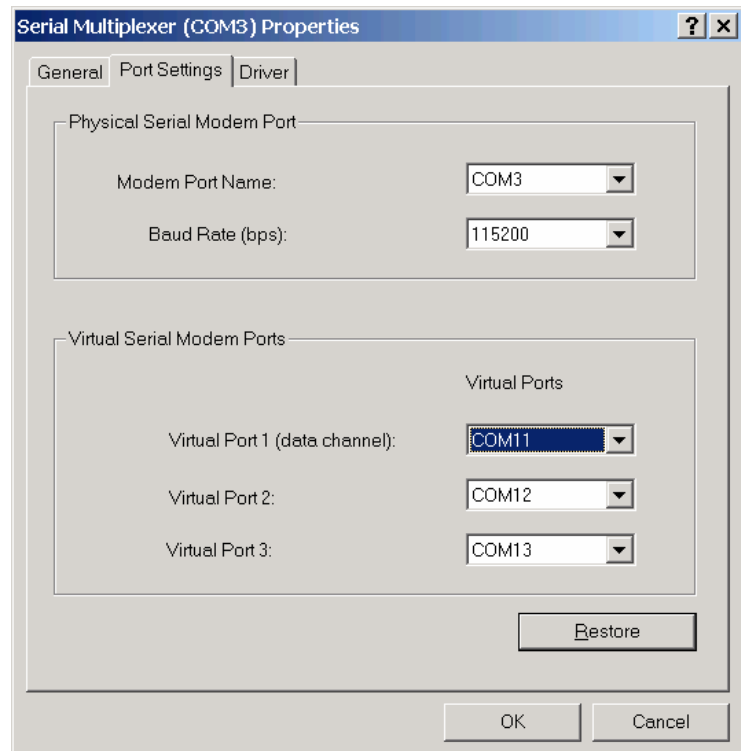


Figure 2: Serial Multiplexer Properties page

4.2 Settings stored in the Windows Registry

The WinMux2k driver parameters are located in the registry path **HKLM\System\CurrentControlSet\Enum\Root\winmux\000X\Device Parameters**. X is the number of the device instance.

All values listed below will be created during the installation of the WinMux2k driver. The settings are provided by the winmux2k.inf file. If you want to write your own preferences to the Registry you can edit the inf file before installing the driver.

Table 6: Registry values

Value	Data (Example)	Properties
BasePort	COM1	The physical serial port that connects the module to the PC.
BaudRate	115200	Baud rate used on the physical port.
BaudRateString	AT+IPR=115200	This string is used to set the module to the given baud rate. Note: This string must contain the same value as the BaudRate value. If you select a higher baud rate be sure it is supported by the module. For details see [2].
ModemInit	AT AT&S0 AT\Q3 AT+ICF=3 AT+CMUX=0	This multi-string value contains several AT commands which are used to switch the module to multiplexer mode. Possible ERROR codes resulting from unsupported commands are ignored by the WinMux2k initialization sequence.
RequestTimeout	2000	Timeout value used only during the initialization of the module. 2000 is the maximum number of milliseconds the module can take to respond to AT requests.
VirtPort1	COM10	Name of the first virtual port. Each virtual port must have a unique name. Otherwise the driver will fail to start up.
VirtPort2	COM11	See VirtPort1
VirtPort3	COM12	See VirtPort1
VirtualChannels	3	Number of Virtual Channels visible as COM ports. The WinMux2k driver supports up to 3 virtual ports. The number of VirtualChannels must be less or equal to TotalChannels.
TotalChannels	3	If the number of TotalChannels is greater than VirtualChannels and no VirtPortX value for additional channels is defined, these additional ports are not visible as COM ports. They can be accessed by the link named SERMUX_CONTROL_PREFIX defined in sermux_i.h. This allows to hide virtual ports to the user. Each physical port can have one hidden port.
WakeUpTime	4000	Timeout during module initialization. The timeout takes effect only when the driver tries to restart the module from Power Down or to wake it up from SLEEP mode

Value	Data (Example)	Properties
		AT+CFUN=0. The time is given in milliseconds.
PowerCmdPort	3	This virtual channel is used to send the power down commands to the module. The data state on this channel may be disturbed during power down and cannot be reconstructed by the driver.
ReinitOnDSR	1	<p>0 Default for XC18 The driver does not try to reconnect to the module if DSR changes. This feature can be switched off if an application controls the DSR line with AT&S.</p> <p>1 Default for all modules except XC18 The driver tries to reconnect to the module if DSR changes. The driver can detect if the module was disconnected and reinitializes it before the first data errors occur.</p>
ClosePort (not applicable to TC45 and XC18)	AT+IPR=0 AT^SMSO	A multi-string sent to the module if the last port is closed.
ClosePort (TC45, XC18 only)	AT+IPR=0	A multi-string sent to the module if the last port is closed.
PowerDown	AT+CFUN=0	<p>A multi-string sent to the module if the PC goes to suspend mode or hibernate state.</p> <p>The command AT+CFUN=0 has been chosen as factory default for compatibility with older Siemens products. If you prefer to use one of the more efficient CYCLIC SLEEP modes it can be replaced with AT+CFUN=5 or 6 or 7 or 8 or 9. See [2] and [3] to verify the SLEEP mode types supported by your product. To avoid editing the Windows Registry you can alter the corresponding parameter in the winmux2k.inf file and then reinstall the driver.</p>
ShutDown	AT+IPR=0 AT^SMSO	<p>A multi-string sent to the module if the PC is shut down or rebooted.</p> <p>Note: Some PCs generate a DTR spike during turn off and the module wakes up again.</p>
WaitForDSR	1	<p>0 Default for TC45 and XC18 The driver does not wait for the DSR signal to go low when the module is shut down. Instead, the parameter RecoverTime (see below) is used.</p> <p>1 Default for all modules except TC45 and XC18 The driver waits for the DSR signal to go low when the module is shut down. In this case the parameter RecoverTime is not used. If the module is not switched off with the AT commands defined in the parameter ClosePort this parameter must be set to 0.</p>
RecoverTime	2000	Minimum number of milliseconds between close and the next open call.

Value	Data (Example)	Properties
PowerDownFrame	2	<p>From version 3 onwards, the Multiplexer Protocol supports power saving control with a special multiplex control frame. This provides the possibility of sending power down commands to the module without accessing any data channel.</p> <p>If the connected module only supports the Multiplexer Protocol version 2 this value is not used. If the supported Multiplexer Protocol version is 3 or higher, the multiplex power control is used instead of the values "PowerCmdPort" and "PowerDown". In this case this value corresponds to the power down command of the multiplex power down frame described in [4]. If the value is greater than 255 there is no power down frame sent for Multiplexer Protocol 3.</p>

The following Registry values in the path

HKLM \System\CurrentControlSet\Services\winmux2k\Parameters are used to configure the TRACE outputs. These values are only valid for the debug version of the device driver.

Table 7: Registry values for trace outputs

Values	Data (Example)	Properties
DebugBaud	57600	Baud rate: used if DebugPort is different from 0.
DebugMask	0x0000003	<p>DebugMask determine, which reports from the device driver are printed to the DebugPort.</p> <p>Masks:</p> <p>0x0000001 Errors</p> <p>0x0000002 Warnings</p> <p>0x0000004 Information's</p> <p>0x0000008 PnP</p> <p>0x0000010 Power management</p> <p>0x0000020 Data control commands</p> <p>0x0000040 Open/Close/Cleanup</p> <p>0x0000080 Dispatch Device Control</p> <p>0x0000100 Dispatch Read/Write</p> <p>0x0000200 Submit control requests</p> <p>0x0004000 framed data read/write</p> <p>0x0008000 frequently traces submit/wrsupport</p> <p>The mask 0x7 means, that all three traces are on.</p> <p>The next masks are only for driver checks and represent internal variables and states of the serial Multiplexer Device driver.</p> <p>0x0001 0000 Frame information, send and receive</p> <p>0x0004 0000 Status information from virtual channels</p> <p>0x0008 0000 Status information from Multiplexer control channel</p> <p>0x0010 0000 Output Names from WinMux2k functions</p> <p>0x1000 0000 traces how and because a Request completed</p> <p>0x2000 0000 traces V.24 signals and change of these signals</p> <p>0x4000 0000 traces, in which state is the parser for scanning the +++ sequence</p> <p>0x8000 0000 traces states for scanning a Frame</p>
DebugPort	0x0	<p>0 Output from the driver is redirected to the kernel debugger. (default value)</p> <p>1...4: Output is redirected to a COM port</p>

5 Settings for applications

5.1 Dial-up network settings

The dial-up network settings must be configured according to the requirements of the network provider. The WinMux2k driver has no special requirements.

5.2 Fax settings

There are no special settings for the fax service of the operating systems.

Note:

If the fax service is enabled for receiving fax messages, the virtual port is opened all the time. In this case the driver cannot be disabled or unloaded. To change port settings the PC must be rebooted.

6 Translate source code

6.1 Software requirements

The Visual Studio 6.0 SP3 or higher and the Windows 2000 DDK must be installed under pathnames that do not contain any spaces. If VC6.0 is installed under c:\program files\... the translation will never run.

6.2 Preparing the translation

1. Edit the file driver\dir_env.cmd. Enter the correct paths to the Win2000 DDK and the VC 6.0.
2. Open the projects smuxprop and smuxinst. Select the project settings and edit the include and library path to the correct location of the Win2000 DDK.
3. Open the workspace sermux in the root directory. Select batch build.
4. The executable files can be found under lib\wdm\[fre|chk]\i386.

Note:

The DDK is a software tool for Windows driver development.

6.3 Compiler flags

There is only one compiler flag "MUX_MANUAL" for a conditional compile of the driver. With this compiler flag set the driver can be compiled in a special manual version where opening and closing of the multiplexer can be controlled via special DeviceIoControl() commands instead of automatic control via the opened virtual channels. This manual version is used for internal automated module testing and is not relevant for usual driver operation.

7 Additional source documentation

This chapter contains additional flow charts and state diagrams which give more detailed information on the structure and the content of the sources.

7.1 Interaction of the different driver objects

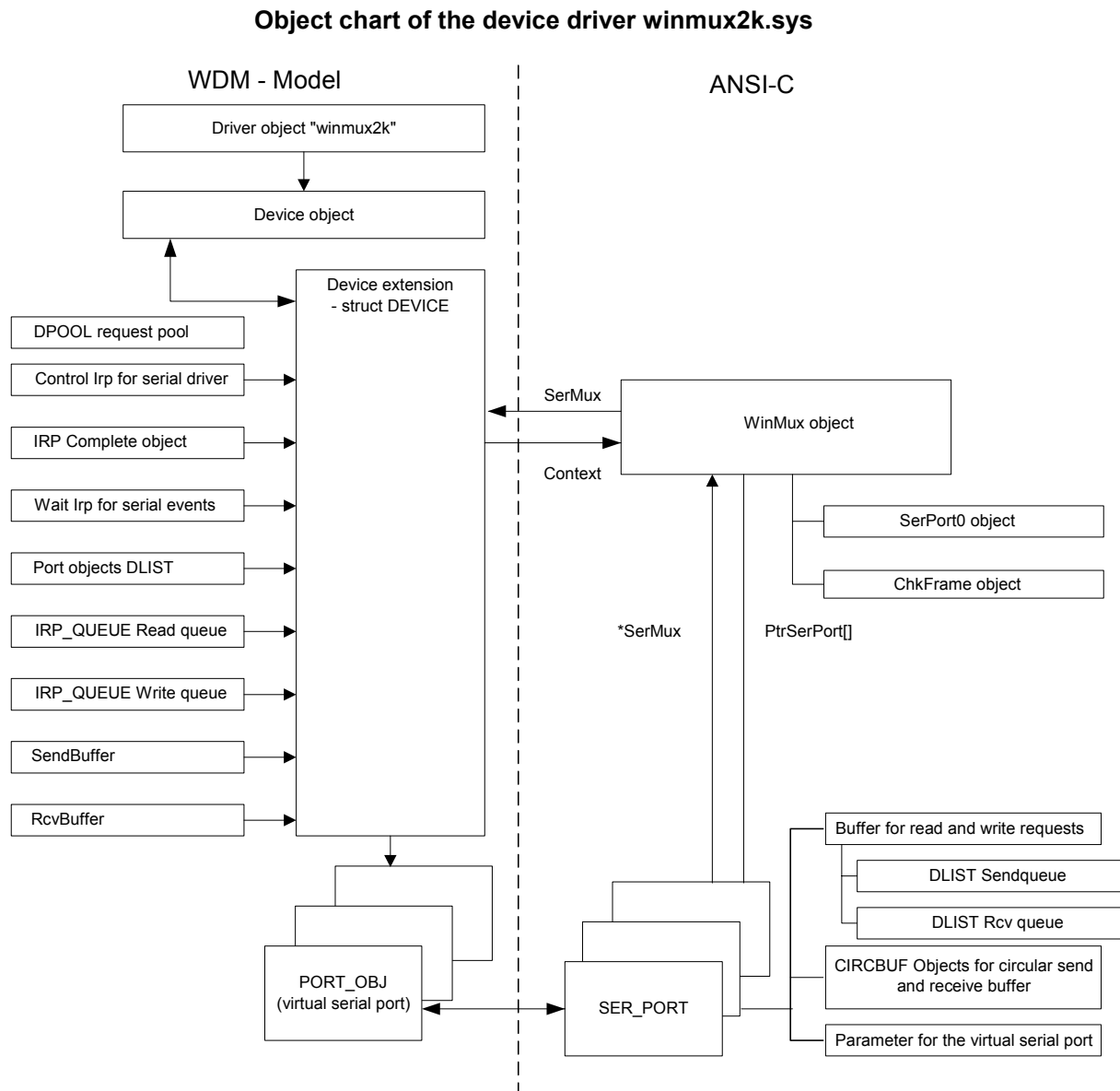


Figure 3: Interaction of the different driver objects

7.2 Internal driver states

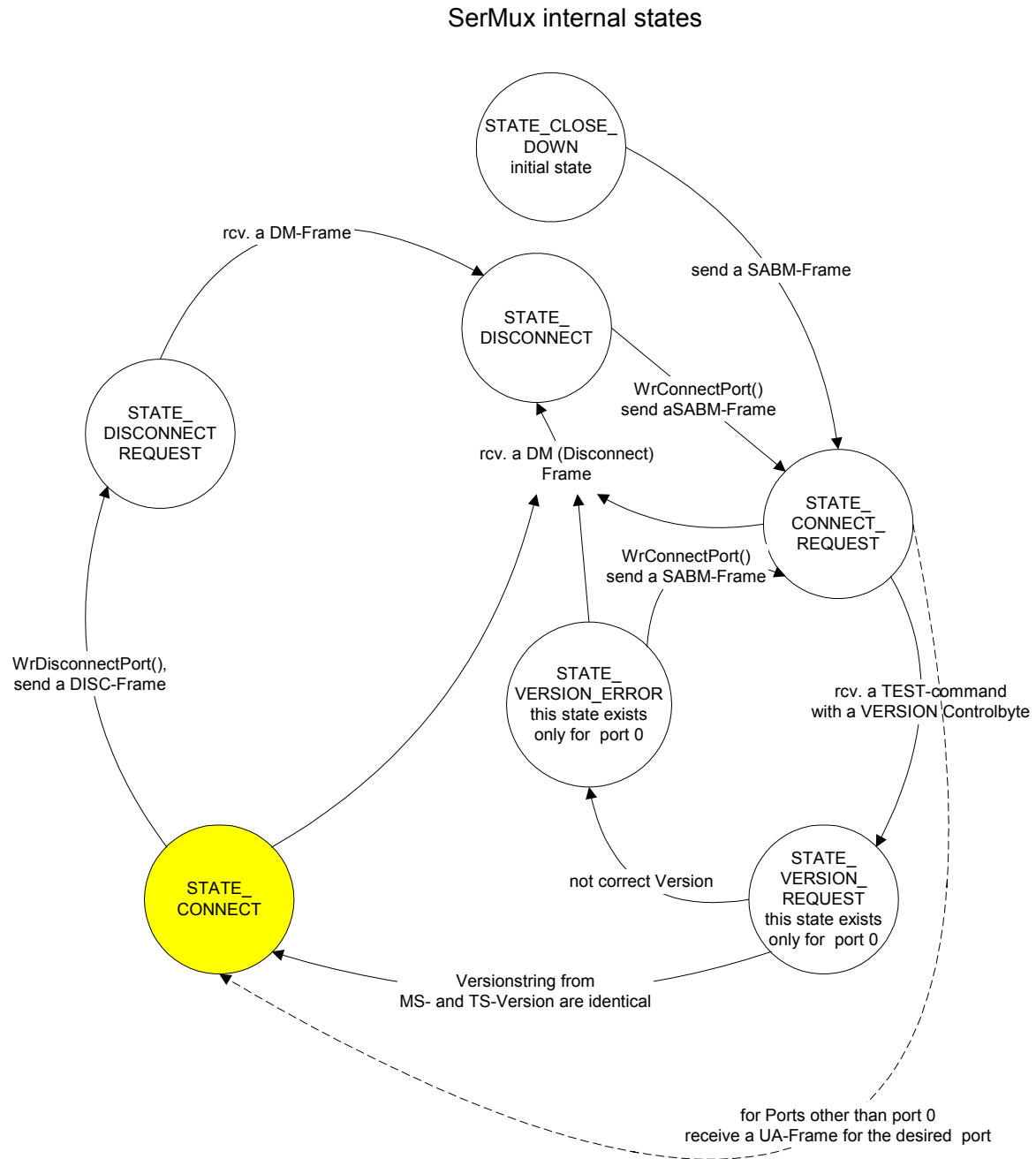
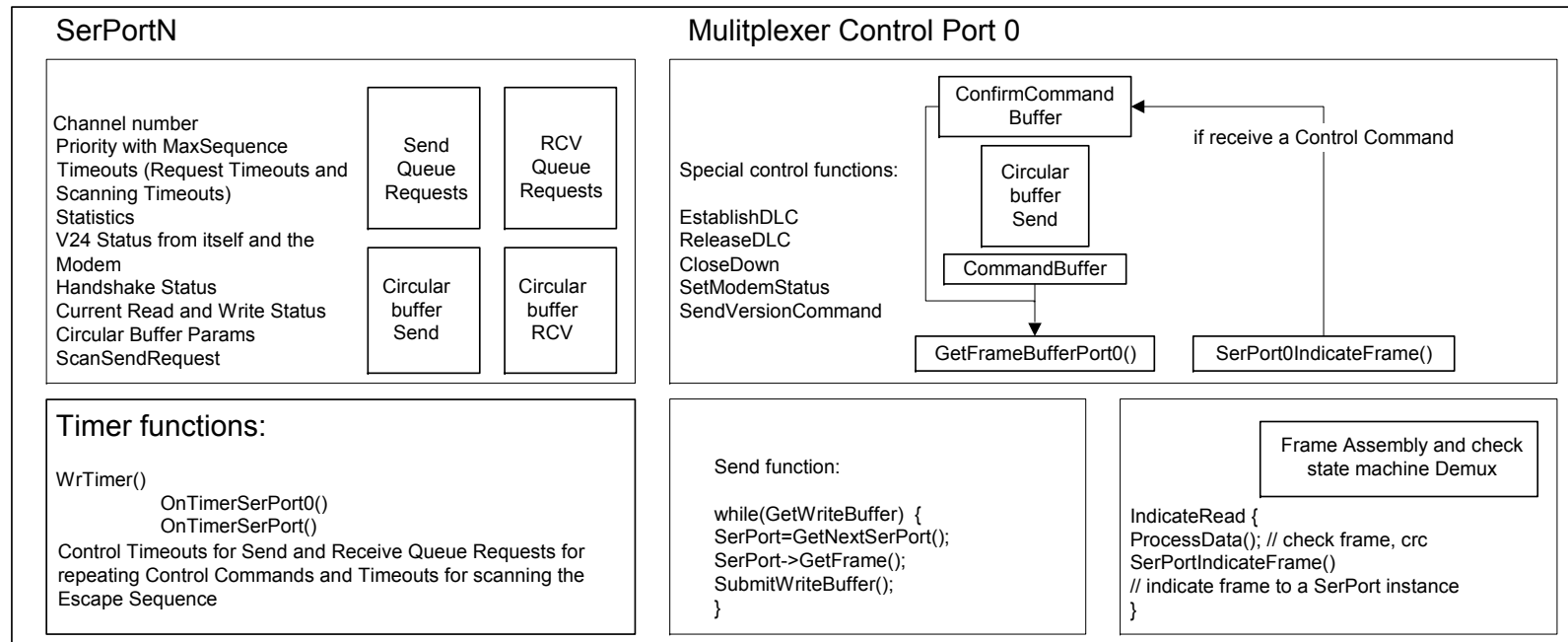


Figure 4: State diagram of the internal driver states

7.3 Buffer handling

SerMux



WrGetWriteBuffer(void *Buffer,ULONG &Length); void WrIndicateReadBuffer(void *Buffer,ULONG Length);
WrSubmitWriteBuffer(void *Buffer,ULONG Length);
WrWriteComplete();
WrReturnWriteBuffer();

Wrapper

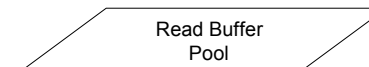


Figure 5: Driver internal buffer handling

7.4 Data transfer

7.4.1 Block flow diagram for data received by the module

SerMux functions sequence, if characters from the physical Device to the SerMux Object are indicated

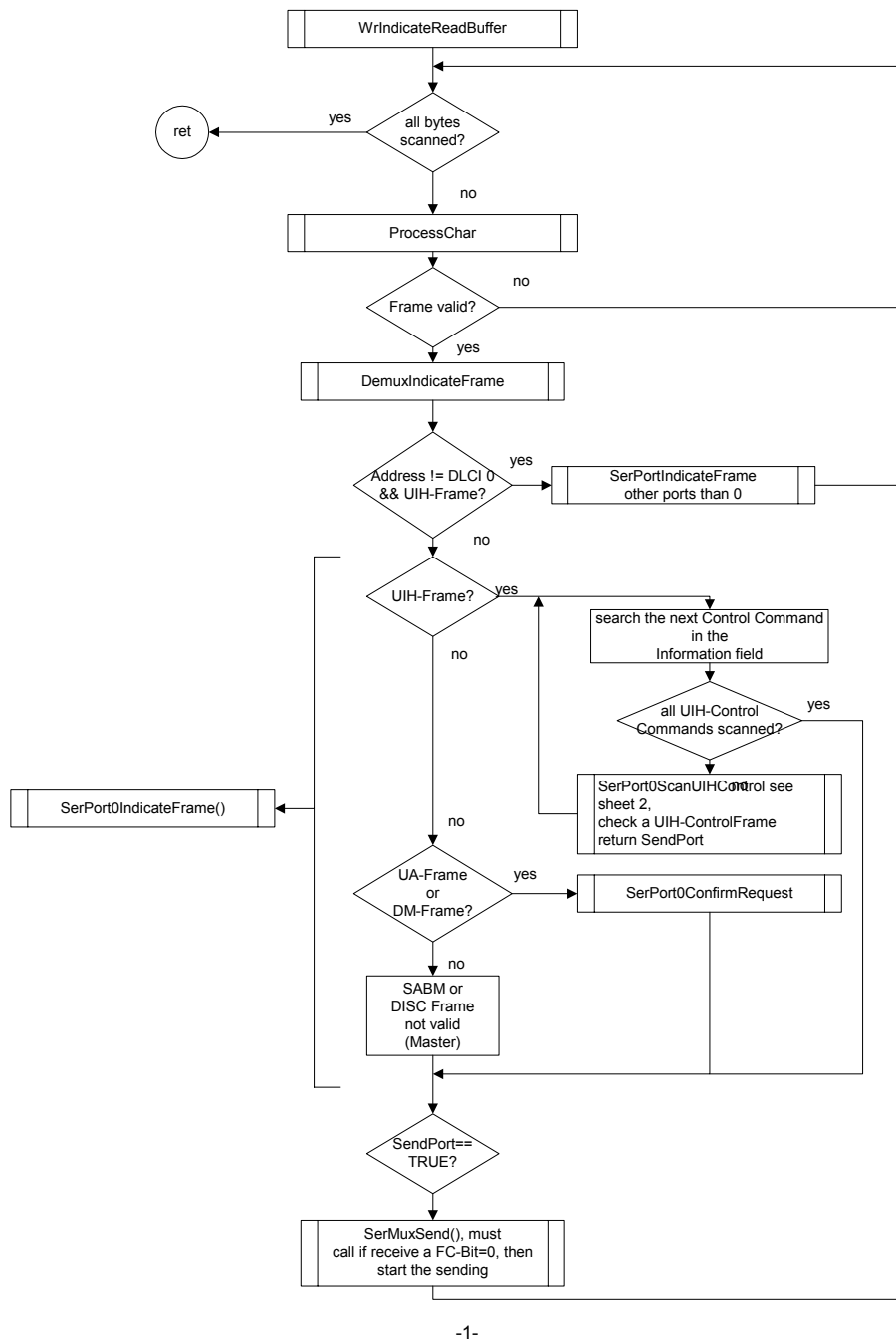


Figure 6: Block flow diagram for data received by the module

7.4.2 Block flow diagram for data sent to the module via virtual port

Send Request Flow of a virtual Channel with
scanning of Break Signal '+++'
only the schema

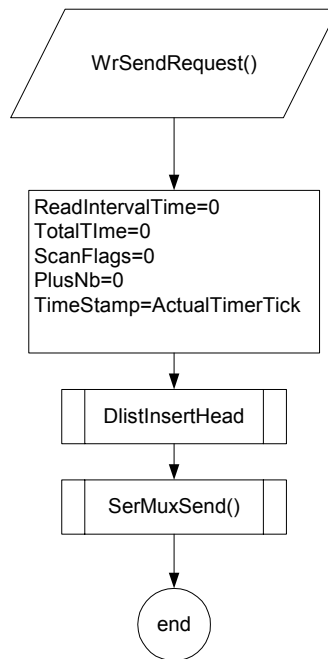


Figure 7: Block flow diagram for data sent to the module via a virtual port

7.4.3 SerMuxSend function

The figure shows the flow diagram of the SerMuxSend function which sends the data to the module.

SerMuxSend and SerMuxSendPort0 Functions

Locations from where to call the SerMuxSend Functions

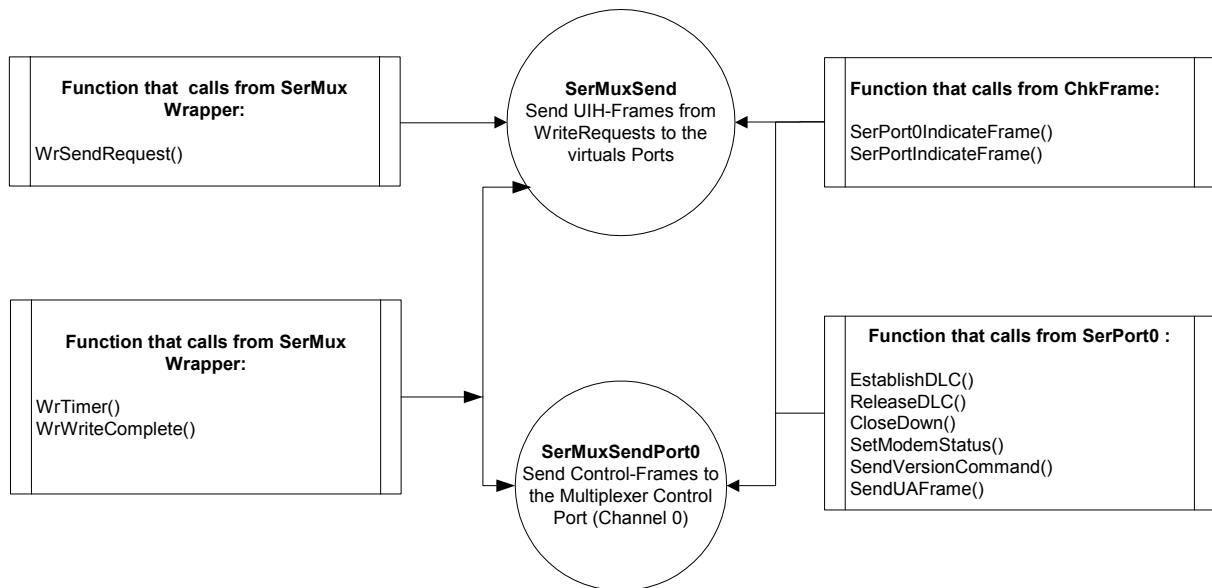


Figure 8: SerMuxSend function

Send function from the virtual Communication Ports (the SerPort Object)

Function **SerMuxSend()** only sends UIH-Frames (unnumbered information) which come in from WriteRequest to the virtual serial communication port.

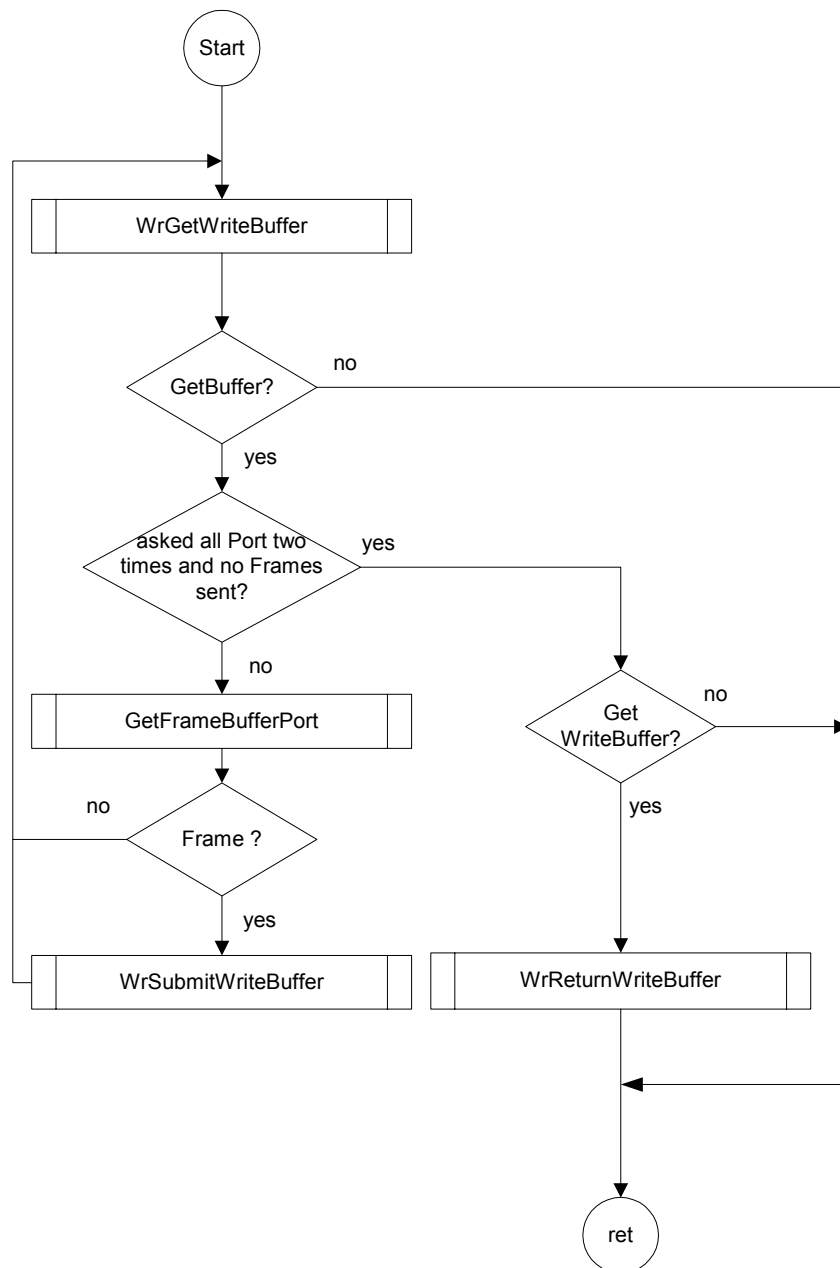


Figure 9: Send function from the virtual communication ports

7.5 The +++-parser

The following state diagram shows the states of the +++-parser.

Internal states of the ScanRequest Object for scanning each character in a Send Request for one Port Object

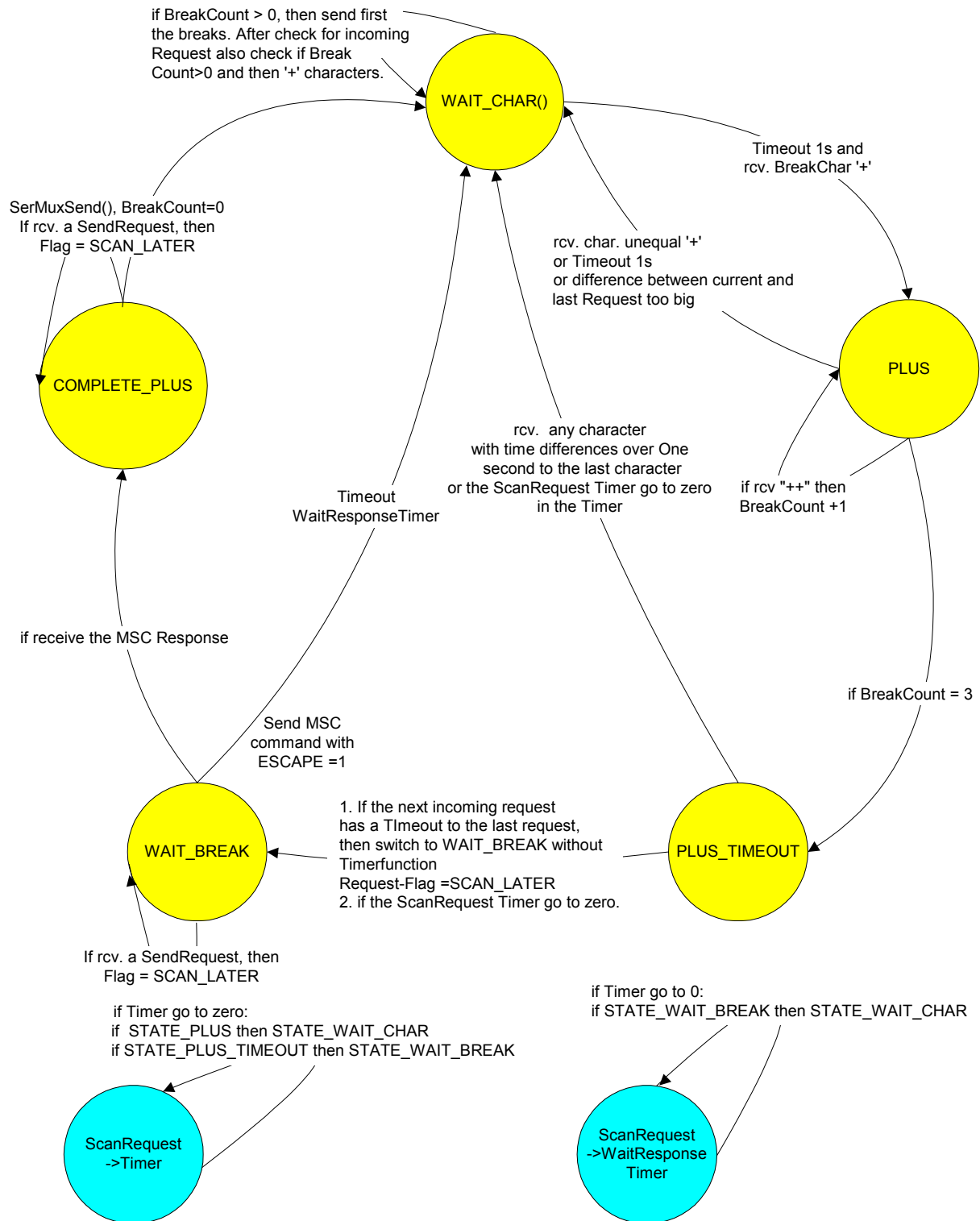


Figure 10: State diagram of the +++-parser

8 Known problems

8.1 Booting the operating system

Windows 2000 and Windows XP toggle the signals of the serial interfaces. As a result, the module will be switched on, even if the WinMux2 driver is not active. The driver accesses the connected module only when the virtual ports are accessed.

If the WinMux2k driver is used by accessing one or more of the virtual ports, it switches off the module when the last virtual port is closed again. Only TC45 and XC18 do not switch off in this case.

8.2 Shutdown of the operating system

If the supported operating system has been installed in ACPI mode, the power supply will be automatically switched off. This power down might cause pulses on those signals of the serial interfaces which are responsible for switching the module on. This may happen, even if it had correctly switched off before by the driver.

If the module has its own power supply it might stay switched on after the shutdown procedure of the computer has completed.

8.3 Standby of the operating system

If the operating system has been installed in ACPI mode, it supports improved power management by also sending computer components into suspend mode. The serial WinMux2k driver supports this power management by switching the module into standby mode, if the driver is in use by accessing one or more of the virtual ports. If the operating system has been properly configured together with the BIOS, incoming calls or real clock alarms wake the operating system up again. During this wake up the first characters sent by the module to the operating system via the serial interface are lost. This is no restriction of the serial WinMux2k driver, but caused by the operating system.

E.g. in case of an incoming call the first RING event is lost. Usually this causes no problem because the RING is repeated every few seconds. However, in case of the real clock alarm the module only sends one CALA URC. As a result, the URC will not be indicated though the alarm will be correctly executed.

Additionally, in some cases when the computer switches to suspend mode, this causes pulses on the serial interface signals which wake up the module again.

8.4 Wake on ring

If the operating system is in standby mode and the module has not been switched off, incoming calls and real time clock alarms should wake up the operating system (wake on RING). This feature belongs to the ACPI power management mechanisms which are not properly implemented on all PC systems. It is independent of the multiplexer driver. When the ring signal toggles on the serial interface like on incoming calls and real time clock alarms, this should wake up the operating system, if the PC has been properly configured. On some systems not the RING signal but data transferred to the PC (the "RING" or "CALA" messages from the module) wake up the operating system.

To avoid loss of data the multiplexer driver switches on the hardware flow control on the module. This means that the module cannot send data to the PC, if the operating system is in standby mode and therefore the serial interface is blocked by the hardware flow control. As a consequence the operating system does not wake up, if the system ignores the RING signal, because the module cannot send the "RING" or "CALA" messages to the PC.

8.5 Special environments

The driver expects a module connected to the COM port in a way where the ignition signal to start the module is connected with the DTR signal of the COM port so that the driver is able to switch the module on via the DTR signal. If the driver is used for modules built into environments where this connection does not exist (e.g. like laptops with a hard mounted module) it cannot power on the module. In this case the automatic power down of the module after closing the last virtual channel has to be disabled by replacing the line

```
HKR,,ClosePort,0x00010000,"AT+IPR=0","AT^SMSO"
```

with the line

```
HKR,,ClosePort,0x00010000,"AT+IPR=0"
```

In the case of TC45 and XC18, there is no need to alter the value "ClosePort" in the Registry.