Information:

The following instructions can be issued likewise from all higher authorization levels.

2. Change from the command mode of the authorization level one (indicated by the character " > " at the end of the command line prompt) into configuration mode by entering the command ***config***.

   The command prompt of the configuration-mode appears:

   ```
   WIMAN-II (config) >
   ```

3. Type in the command ***passwd console*** and press **ENTER**.

   You are now asked to type in a password:

   ```
   Enter password:
   ```

4. Type in the new password.

Note:

Keep in mind that the password is case-sensitive

If a password is already set it will be overwritten.

Each entered character is shown as a „*“ on the screen.

The new password is saved in the new configuration and is not yet active.

5. Type in ***exit*** and leave the configuration mode (see page 27).
6. Proceed as shown in chapter 3.4.1 on page 36.

3.5.2 To delete a Password for the Authorization Level one

To delete a password for authorization level one:

1. Access the command line prompt of the authorization level one.

   The display will show the following:

   ```
   Enter password: ****
   ```

   Type in the required password. Remember that passwords are case-sensitive.

   The command-line prompt appears, for example:

   ```
   WIMAN II >
   ```

Information:

The following instruction can be issued likewise from all higher authorization levels.

2. Change from the command mode of authorization level one (indicated by the character " > " at the end of the command line prompt) into the configuration mode by input of the command ***config***.

   The command prompt of the configuration-mode appears:

   ```
   WIMAN-II (config) >
   ```

3. Type in the command ***del passwd console*** and press **ENTER**.

   The former password is now deleted in the new configuration.

4. Leave the configuration mode by entering the command ***exit*** (see page 17).

5. Proceed as shown in chapter 3.4.1 on page 36.

3.5.3 Setting of a Password for Authorization Level two (Enable)

A password for authorization level two is always required. However, it can be changed to suit the requirements of the Provider.

To change the password for authorization level two proceed as follows:

1. Access the command line prompt of authorization level two:

   a) Access authorization level one (See chapter 3.5.1on page 40)

   b) Enter the command ***enable***.
   As a password is always required, you need to enter the correct password

   ```
   Enter password: ****
   ```

   Type in the correct password (pay attention to upper- and lowercase characters) and press ENTER.

   c) The command line prompt appears, e.g.:
   ```
   WIMAN-II #
   ```

   Proceed with No. 2.

   Direct entrance over the password-protected command line level of authorization levels one and two:

When accessing the command line prompt of authorization level one the following prompt will appear::

```
Enter password: ****
```

Enter the password for the authorization level two (pay attention to upper- and lowercase characters).

The command line prompt should appear, e.g.:

```
WIMAN-II #
```

2. Change from the command mode of authorization level two (indicated by the „#“- sign at the end of the command line prompt) into the configuration-mode by entering the command ***config***.

   The command line prompt may look as follows:

   ```
   WIMAN-II (config) #
   ```

3. Enter the command ***passwd enable*** and press **ENTER**.
4. You are now asked for entering a password:

   ```
   Enter password:
   ```

5. Enter the password.

Note:

Please note that passwords are case-sensitive.

Each typed-in character will be shown on the screen as a „*“. The already existing password will be overwritten.

The entered password will be stored in the new configuration but is not set active yet.

6. Leave the configuration mode by entering the command ***exit*** (see page 17).
7. Proceed as shown in chapter 3.4.1 on page 36.

3.5.4 Deletion of a password of the authorization level two (Enable)

A password for authorization level two (Enable-mode) is always required and cannot be deleted. However, it can only be changed (see 3.5.3, on page 42)

4 Hardware Installation

4.1 Installation instructions for the WIMAN Access-radio modem

The following sections deal with the installation of a WIMAN ACCESS radio modem on a single PC containing the operating system Windows.

Linking to a LAN requires an experienced network administrator. The method of installation depends strongly on the type of LAN

4.1.1 Setup of the WIMAN radio modem with Indoor-Set

A reception test must be successfully completed for accurate set-up (see chapter 5, on page 55)

Checklist:

You will need the following equipment:

- PC/laptop with 10 Mbit/s Ethernet Network interface card (TP-RJ-45-interface) and an available COM port,
- Frame Relay router with X.21 and Ethernet interfaces (inclusive X.21-link cable),
- Crossover cable with RJ-45-interface,
- Hybrid-cable type H1-X21C-37,
- WIMAN radio modem and indoor set.

It is advisable to execute the setup of the indoor installation in following order:

1. Install the antenna to the base foot and connect the antenna lead to the antenna.
2. Connect the antenna cable and the Hybrid-cable to the WIMAN.
3. Connect the X.21-cable of the Router to the Hybrid-cable and the crossover cable with the network card of the computer.
4. Connect the power cable of the WIMAN with the included 24V power supply. Connect the power supply of the Router.

Note:

There is no power switch on the WIMAN. The connection is successful when the operational status indicator on the front side of the WIMAN lights up green.

5. Connect the RS-232-interface to the computer interface. If you use the serial interface of a PC or Notebook, please refer to the configuration specified in Chapter 3 on page 33.

As soon as it is attached to the power supply, the WIMAN ACCESS begins to boot and starts to search for the proper WIMAN STAR. When the synchronization signal is received, the Status LED begins to light up green.

If the status indication does not light up, no data can be transmitted or received.

If this occurs, separate the WIMAN from the power supply and then reattach it. If the status indicator still does not light up, please consult your Internet Provider for support.

4.1.2 Setup of the Outdoor-Set

4.1.3 Required material

Checklist:

The following material should be supplied from your Distributor:

- WIMAN radio modem,
- WIMAN power supply,
- Router (optionally),
- 25 pin loop-back cable
- Outdoor Set consisting of:
  - Outdoor-box with security clips,
  - Planar Antenna,
  - Antenna cable, 50cm,
- X21-Hybrid-cable-set consisting of:
  - Hybrid-cable, type 2,
  - Hybrid-cable, type 3,
  - Socket 25pin and housing (2x each),
- Data cable, 12pin, length depending on installation,

- WIMAN outdoor mounting set. The following three types are available:

- J-shaped wall attachment set,
- Roof pan attachment set,
- Wall attachment set with aluminum mast,

Additionally the following tools and utensils are needed:

- PC-Laptop,
- Voltmeter,
- Phillips- and flat edge screwdrivers,
- Flat-nose pliers and/or wrench,
- Fixing bolts, wearing parts and pegs,
- Insulating tape and cable strap,
- Ladder,
- Soldering irons and tin solder,
- Side cutters,
- Stripping pliers (recommended),
- Tweezers (recommended),

4.1.4 Find a suitable place for the outdoor-set

Before you can begin with the installation you must find a suitable place for the outdoor set.

Try to choose a place on the rooftop where there is a visible line of sight to the central radio tower. Consider the following:

- For best results, the antenna on the outdoor housing should directly face the receiving station (line of sight).
- Trees, plants, other buildings, walls, etc. can prevent a clear line of sight.
- Determine the shortest path for the data cable. The maximum length of the data cable may not exceed 300ft.
- For installation, choose a discreet place that is not directly noticeable from the ground. However, aesthetic views are secondary in respect to a proper operation of the WIMAN.
- Be sure that no other antenna systems operating in the 2,4 GHz ISM band are installed at the selected installation point. If such an antenna system is installed there, contact your WIMAN Distributor.

- Be sure to discuss the details of installation with the customer in respect to the local construction and homeowner regulations.

4.1.5 First Reception Test

This first reception test serves to determine if the optimum field strength can be obtained from the installation place and adjustment of the WIMAN outdoor sets.

Further information about reception tests can be found in chapter 5 on page 55.

4.1.6 Installation of the Attachment Set and the Outdoor Housing

To set up the outdoor housing:

1. Assemble the outdoor housing.
2. Attach the antenna to the outdoor box with the plug facing down.
3. Loosen the four screws on the front of the outdoor housing and remove the cover.
4. Loosen the four fixing bolts for the WIMAN mounting plate on the inside and remove it.
5. Place the WIMAN inside the housing with the LEDs facing upwards and the backside (with the connector) towards the opening of the housing.
6. Lead a cable strap through the two holes in the mounting plate (the cable strap later serves for the attachment of the hybrid cable of the type 3).
7. Secure the mounting plate above the WIMAN.
8. Connect the appropriate ends of the hybrid cable of the type 3 with the 37Pin Sub-D-interface and to the current supply link.
9. Place the excess cable in the space between the WIMAN and the outdoor housing in such a way that the 25pin plug connector is hanging over the front the mounting plate.
10. Connect the data cable with the hybrid cable and secure the plug connectors with the cable strap. To ensure positive connection at all times, install 2 hex nuts between the connectors.
11. Use the screws, wearing parts and pegs to install the appropriate attachment set onto the roof or at the wall.

- Use the j-shaped wall mount if you are installing the WIMAN on the side of the building directly facing the radio tower.

Use the aluminum mast mounting kit if you are installing the WIMAN not facing the radio tower directly due to an obstacle (e.g. rear side of a wall etc.).

Use the tile roof mounting set if you are installing the WIMAN to a roof with roofing tiles.

4.1.7 Second Reception Test

Perform a second reception test to ensure that the selected place of installation and the selected adjustments offer a sufficient radio reception.

Separate the current supply and the RS232-plug from the Hybrid-2-cable on the WIMAN radio modem.

Further information of the execution of a receipt test can be obtained in chapter 5 on page 55.

After the radio test is completed, reconnect the current supply and the RS232-plug to the Hybrid-2-cable on the WIMAN.

4.1.8 Installation of the data cable

With some installations, it is possible to use a prefabricated cable of desired length with two 25pin Sub-D plug connectors. However, this is not possible with most installations. If no prefabricated cable can to be used, it is advisable to attach a plug connector at one end of the cable prior to installation.

Lay the data cable from the outside inward. Make sure the end with the 25pin Sub-D connector is outside. It is substantially simpler to solder the second plug connector on in the internal area than in the external area.

Be sure that the data cable is sufficiently fixed to the mounting sets, the mast and to the wall.

Wind up all surplus cables and stow them away. Wind the cable up in one or two turns. This measure serves as additional lightning protection for the router.

4.1.9 Mounting of the DB25-plug interfaces at the inside end of the data cable

Solder the two 25pin plug connectors to the data cable according to the pin allocation plans specified in chapter 10.

4.1.10 Final reception test with installed data cable

The final reception test is necessary for two reasons: First to examine the assembly position of the WIMAN, second, and more importantly, to test the data link between the Router and the WIMAN.

You will find details to the reception tests in chapter 6 on page 58.

To perform the test, connect your Laptop to the RS232-interface at the Hybrid-cable type 2.

If there is no connection to the WIMAN or if the connection is unusually slow, follow the instructions specified below to locate the source of error.

1. Make sure that the terminal program is adjusted to the correct Baud rate (9600 Bit/s).
2. The power-LED lights up in green when sufficient operating voltage is supplied, and in orange if the WIMAN performs a looptest. If an internal error occurred the power LED lights up in red.
3. Make sure that the RS-232 cable and the power-supply are correctly connected at both ends of the data cable.
4. Double-check the solder joints and the pin-allocation inside the plugs of the data cable.
5. Check the hybrid cables by alternating them one at a time.

4.1.11 Check the statistics of the X.21-interface

To check the statistics of the X.21-interface you must first test the connections between the WIMAN and the Router.

To test the connections you must:

1. Ensure that Router is attached correctly and switched on.
2. Enter the instruction "*stat serial ext*".

   This instruction displays information to the data transmitted via the Serial-interface. The last line of the display-output should look as follows.

```
Line State:     Control (C): ON     Indication (I): ON
```

If “OFF” appears in either of the signals, a connection error has occurred. Follow the instructions given below to locate the source of the error:

1. Check the X.21-connections at both ends of the data cable for correct fit.

2. Double-check the solder joints and the pin-allocation inside the plugs of the data cable.
3. Check the hybrid cables by alternating them one at a time.

4.2 Installation of a WIMAN Star

4.2.1 Additional necessary components

Checklist:

In addition to the parts specified in Chapter 4.1.2, page 45, the following components are needed for the installation of a WIMAN STAR:

- Tower standoffs
- 1 WIMAN Access with Indoor-Set for testing purposes
- 1 Router for testing
- Configuration files for all radio modems

4.2.2 Preparation

To install a WIMAN star:

1. Label all WIMAN units according to the convention: XX-YYY-ZZZ.

- XX = LM (Line Master), LS (Line Slave), SM (Star Multi-point), AS (Access)
- YYY= NetId (0-255)
- ZZZ = adjustment of the antenna (0 -359°) – towards north.

2. Install the WIMAN radio modem and Typ-3-Hybrid cable in the outdoor housings.
3. Label the remaining WIMAN utensils according to the convention indicated above. You should label:

- All data cables (upper and lower end)
- All small external housings (if used)
- All antennas on large external housings (if used)
- the radio modem designated as synchronization masters, with the additional designation "Sync master",

4.3 Installation at the Radio Tower

4.3.1 Installing the tower standoff at the radio mast

4.3.2 Installing the WIMAN hardware at the tower standoff

Attach the WIMAN hardware (external housing and antennas) to the tower standoff at the suitable positions and align. If a WIMAN is to take over the function of the synchronization-master and is not clocked from a remote location, always use the unit aligned to the north (0º) as the synchronization master.

4.3.3 Installation

Install all data cables. Connect the data cables with the Hybrid cables coming from the WIMAN radio modems.

Attention:

For correct function and error-free installation, be sure that the sync cable is installed before testing.

4.3.4 Start tests

Now test all installed components on correct function and installation. You find a specification of the tests in chapter 6 on page 58.

4.3.5 Checking the antenna adjustment

- Check to see that all antennas are facing the correct direction.
- Note the adjustments of all antennas.

4.3.6 Test all devices

- Make sure all devices on the radio tower are switched on and are connected to the synchronization cable.
- Test each WIMAN radio modem again (see chapter 6, page 58.) to make sure that there is no error caused by the synchronization cable.

4.3.7 Save all configuration data of the WIMAN radio modems at the radio tower

- Use the same name conventions used for the cables and WIMAN radio modems.
- Record the following information with a terminal program:
  - Parameter („show“-command)
  - Statistics („stat“-command)

4.4 Grounding

It is extremely important to ground all installed devices on the radio tower. This will reduce the amount of damage should lightning strike. The following steps will also help to reduce possible damage caused by lightning:

- Do not mount the WIMAN at the highest point of the radio tower. This is the point most likely to be struck by lightning.
- Check that the outdoor housing and the tower standoffs form a well-grounded metal-on-metal connection with the tower frame.
- Avoid using rubber washers or seals.
- Install lightning protection devices between the data cable and the hybrid-sets on both the top and bottom of the tower.
- Ground the data cable to the tower at (a minimum of) three different places. (1) to the center of the tower, (2) to the base of the tower where the cable bends (before the bridge from the tower to the shed) and (3) before the cable runs into the equipment shed. The best way to do this is to strip away the outer casing of the cable and affix a grounding clamp to the cable shielding, then connect this clamp to a second one which is fixed to the tower.
- Make sure that all equipment (Switches, Routers, etc.) at the base of the tower is properly grounded to the rack in which it is mounted. Also make sure that the rack itself is properly grounded.

4.5 Burst-Synchronisation

Burst-synchronization is the coordination process of frequency hopping tables, receipt, and points of transmitting time for several WIMAN networks within the same geographical area.

Burst-synchronization is achieved by both hardware and software items. The hardware item is a synchronization cable, which is only a wire, which connects the X.21-interfaces among themselves.

For the X.21 Interface, the synchronization cable is enclosed in the hybrid cable type 3. This is connected to further radio modems with additional cables and special T-connectors.

The software section for synchronization consists of the parameter SyncMode, which is to be entered in the basic configuration of a master or a Slave.

One master radio modem (STAR or LINE) is determined as synchronization master for all radio modems at that location. The synchronization master is adjusted as follows:

- SyncMode = Master

All further master radio modems should be adjusted as follows:

- SyncMode = Slave

4.6 Extended Point-to-Point Connections

An estendet Point-to-Point connection can be structured by arranging two WIMAN LINE “back-to-back”. For this application, additional hardware is necessary. Please contact your WIMAN supplier.

For an extended point-to-point connection the parameter SyncMode has to be set to the base WIMAN LINE configuration.

The example configurations specified below refer to an extended X.21 Point-to-Point-connection. In this structure, the WIMAN LINE Slave 1 is coupled to the WIMAN LINE Master 2.

***Line* Master 1**	***Line* Slave 1**
NetId = 1	NetId = 1
NodeId = 0	NodeId = 1
Destination = 1	Destination = 0
SyncMode = (according to local Network)	SyncMode = Master

Table 1 parameters of an extended point-to-point connection (connection 1)

***Line* Master 2**	***Line* Slave 2**
NetId = 2	NetId = 2
NodeId = 0	NodeId = 1
Destination = 1	Destination = 0
SyncMode = Slave	SyncMode = (according to local Network)

Table 2 parameter of an extended point-to-point connection (connection 2)

5 Reception quality and transmission speeds

For the examination of the receipt quality as well as to error detection, test loops can be generated. The type of test loop can be influenced by the configuration of the parameters L*oopData*, L*oopMode* and L*oopTest*.

The parameter *LoopData* enables the setting of the Byte-values that are to be generated (see page 18). This parameter can be produced on a WIMAN ACCESS only.

The parameter *LoopTest* enables a switching to a test loop, with which the data, which can be transmitted, is produced independently by the WIMAN radio modem (see page 19).

This test loop can already be activated in the lowest authorization level and is, in combination with the statistics analysis on the wireless interface, an outstanding inspection procedure for radio communication.

The parameter *LoopMode* determines, which bit pattern will be transferred with the back loop in the loop test operation from the WIMAN radio modem (see page 18)

Attention:

If the back loop test is execute in an operating radio net, avoid all values except ***normal.*** Use of any other value may result in loss of performance.

5.1 Configuration of a TestLoop with Independently Generated Data Communication

1. Access the command line level of authorization level one (see chapter 2 on page 13) and change into the configuration mode. You will see an output similar to:

   ```
   WIMAN-II (config) >
   ```

2. Type in the command ***looptest true***.

3. Check with ***show looptest*** the value for the parameter *Looptest*. This should now be switched to **true**. The following output appears:

   ```
   WIMAN-II (config) > show looptest
   LoopTest       false (        true)
   ```

   The present and the new configuration (in parentheses) of the parameter are displayed.

4. To take over the modifications into the current configuration leave the configuration mode by entering the command ***exit*** (see page 27).

   The following output appears:

   ```
   Configuration changed, do you want to save (y)es
   / (n)o / (c)ancel ?
   ```

   You now have the choice:

   - To transfer the new configuration into the current configuration and to leave the configuration mode by pressing the key „y“,
   - To discard the modification but to leave the configuration mode anyway by pressing the key „n“ or
   - To not take over the modification into the current configuration but to stay in configuration mode by pressing the key „c“.

   Press the „y“ key to activate the looptest. The modification of the parameter becomes part of the current configuration and the WIMAN starts transmitting bit samples.

5.2 Test after a Radio Tower Installation with Synchronisation

After all devices are correctly installed, a final test must be executed. This final test checks if all devices are installed correctly and whether a trouble free transmitting and receiving mode is possible.

- Switch on the first WIMAN radio modem. Always begin with the WIMAN determined as synchronization master.
- Radio test
  - If the synchronization Master is a WIMAN STAR or a WIMAN LINE Master, conduct a loop back test from a properly configured WIMAN ACCESS or LINE Slave.
  - It the synchronization Master is a LINE Slave, conduct a loop back test from its LINE Master.
- Check the X.21-interface by connecting the X.21-plug of the Hybrid cable type-2 to the Router.

- For the WIMAN STAR enter the commands „stat wl“ and „stat wl<nodeID>“ to ensure proper functioning of the data exchange.
- For the WIMAN LINE enter the command „stat sync“ to check the setting of both signals (both signals have to be set to „On“).

5.2.1 Continue the Tests

- Switch on the WIMAN radio modem next to the synchronization master.
- Switch off the synchronization master.
- Perform a reception test.
- Check the X.21-interface (see chapter X.21-Test above).
- Switch the synchronization master back on.
- Perform another reception test to make sure the synchronization cable does not produce any errors (the radio statistics should not differ substantially from the preceding ones).

5.2.2 Test the Remaining Modules

- Switch on the next WIMAN.
- Switch off all WIMAN radio modems that were tested before.
- Perform a reception test.
- Check the X.21-interface (see chapter X.21-Test above).
- Switch on all WIMAN units that were tested before.
- Connect the synchronization cable to the last tested WIMAN radio modem.
- Perform another reception test to make sure the synchronization cable does not produce any errors (the radio statistics should not differ substantially from the preceding ones).

5.3 Transmission Speeds

5.3.1 FTP-Download from an FTP-Server

The maximum transmission speed of the WIMAN radio modem at optimum conditions is about 25 … 30 Kbytes/s at 2FSK and about 55 … 62 Kbytes/s at 4FSK (depending on the extend of utilization of the network).

6 Frame Relay

6.1 Technical Description of the Frame of Relay Features

The WIMAN STAR supports the multiplexing of Frame Relay packages. In multiplexing procedure, the packages received from the Frame Relay Switches are transferred to the WIMAN ACCESS, which is connected to a Frame Relay Router at the user's site.

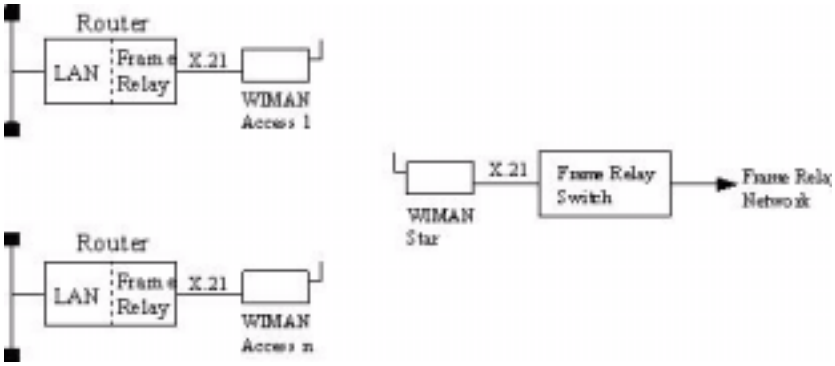

Figure 10 *Frame Relay connections with the WIMAN*

For addressing the WIMAN ACCESS the DLCI number (Data Link Connection Identifier) of the Frame of Relay protocol is used.

The following restrictions apply to the Frame Relay support:

- Only static connections are supported (PVC = Permanent Virtual Connection)
- DLCI numbers must be configured statically on the Frame Relay Switch and the Frame Relay Router
- 2-, 3- or 4- Byte-Frame Relay-address-arrays are supported,
- Since the WIMAN node address is embedded in the DLCI number (10-bit DLCI with implemented WIMAN node identifier), the DLCI allocation of numbers is reduced
- Up to four virtual connections are supported for each Frame Relay user
- Up to 250 Frame Relay users are supported at a WIMAN STAR (currently 9 users possible, Software Version T0.7).
- The following Frame of Relay features are not supported:

- LMI (Local Management Interface of ITU-T Q.933 or ANSI T1.617), since this procedure uses DLCI 1023 or DLCI 0,
- Establishing of connections for SVCs (uses DLCI 0),
- Multiple transmissions (uses DLCI 1019 ... 1022).

6.1.1 Frame Relay-Address array

2-Byte-Adress array

Table 3 shows the structure of the 2 Byte long Address array:

8	7	6	5	4	3	2	1
DLCI 10	DLCI 9	DLC I 8	DLCI 7	DLCI 6	DLCI 5	C/R	EA
DLCI 4	DLCI 3	DLCI 2	DLCI 1	FECN	BECN	DE	EA

Table 3 *Structure of the 2 Byte long address array*

Explanation:

- DLCI
  Data Link Connection Identifier
- C/R
  Command Response Bit
- EA
  Address Array Extension Bit
- FECN
  Forward Explicit Congestion Notification
- BECN
  Backward Explicit Congestion Notification
- DE
  Discard Eligibility Indicator

The node address of the WIMAN is determined by the high order-bits (DLCI 03...DLCI 10) of the DLCI number. The low order bits (DLCI 1...DLCI 2) are used for virtual connections.

DLCI value calculation

The LCI value for the Frame Relay Router of the user is calculated as follows:

$DLCI_m = 512 + NodeId * 4 + m$ m = [0 ... 3]

Table 4 lists the valid DLCI numbers for appropriate node identifiers (NodeId) on use of the 2-Byte-Frame of Relay address array.

WIMAN NodeId	DLCI array	Note
0	512 – 515	reserved (**WIMAN** *STAR*)
1	516 – 519	
2	520 – 523	
3	524 – 527	
4	528 – 531	
5	532 – 535	
6	536 – 539	
7	540 – 543	
8	544 – 547	
9	548 – 551	
10	552 – 555	
11	556 – 559	
12	560 – 563	
13	564 – 567	
14	568 – 571	
15	572 – 575	

Table 4 *NodeId with 2-Byte-Frame Relay address array*

Frame Relay-support of the WIMAN Software

In the following, the implementation of the Frame of Relay Protocol within the WIMAN software is listed briefly. Exclusively the static software-Version of the WIMAN STAR supports the Frame Relay Protocol with the following characteristics:

- The maximum size of the Frame Relay information field amounts to 4096 byte.
- The WIMAN star rejects Frame Relay framework with invalid DLCI number (transmitter and receiver).