

LANCOM 1722 VoIP
LANCOM 1724 VoIP

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Preface

Thank you for your confidence in us!

The LANCOM 1722 VoIP and LANCOM 1724 VoIP models offer integrated DSL, ADSL and ISDN interfaces and a LAN switch. This router allows you to connect a single workstation or even an entire local network to the high-speed Internet, easily and conveniently.

Additional to its data transfer functions, the LANCOM VoIP Router is a fully fledged, integrated VoIP communications solution. Along with Quality of Service functions which are optimized for VoIP, the LANCOM VoIP Router offers the full range of options required for voice communications over data networks and the step-by-step, cost-effective and simple migration from existing telecommunications systems to corporate VoIP.

LANCOM VoIP Router provides the comprehensive functions of an access router, professional firewall and high-quality VPN gateway in a single, compact device. It thus combines investment protection and cost savings as a reliable voice over IP solution for small and mid-sized enterprises, home and branch offices.

- SIP proxy for registration with providers and superordinated VoIP PBXs.
- SIP gateway with transparent transition between SIP and ISDN
- Intelligent call routing and number conversion
- Point-to-point and point-to-multipoint-connection support
- Multiple configurable ISDN interfaces (NT/TE)
- Life-line support (LANCOM 1722 VoIP only)
- Voltage relay to the internal ISDN bus for specific interfaces
- Stateful-inspection firewall and VPN gateway



LANCOM products undergo continuous development. For precise information about their features and for the latest version of the LCOS operating system, please visit the LANCOM website.

Security settings

For a carefree use of your device, we recommend to carry out all security settings (e.g. Firewall, encryption, access protection, charge lock), which are not already activated at the time of purchase of your device. The LANconfig wizard 'Check Security Settings' will support you accomplishing this.

We ask you additionally to inform you about technical developments and actual hints to your product on our Web page www.lancom.de, and to download new software versions if necessary.

User manual and reference manual

The documentation of your device consists of three parts: the installation guide, the user manual and the reference manual.

You are now reading the user manual. It contains all information you need to start your device. It also contains the most important technical specification for the device.


The reference manual can be found on the CD as an Acrobat (PDF) document. It is designed as a supplement to the user manual and goes into detail on topics that apply to a variety of devices. These include for example:

- Systems design of the LCOS operating system
- Configuration
- Management
- Diagnosis
- Security
- Routing and WAN functions
- Firewall
- Quality of Service (QoS)
- Virtual Private Networks (VPN)
- Virtual Local Networks (VLAN)
- Wireless Networks (WLAN)
- Voice Communications for computer networks using voice over IP (VoIP)
- Backup Solutions
- LANCAPI
- Further server services (DHCP, DNS, charge management)




This documentation was compiled ...

...by several members of our staff from a variety of departments in order to ensure you the best possible support when using your LANCOM product.

In case you encounter any errors, or just want to issue critics or enhancements, please do not hesitate to send an email directly to: info@lancom.de

 Our online services (www.lancom.de) are available to you around the clock should you have any queries regarding the topics discussed in this manual or require any further support. In addition support from LANCOM Systems is also available to you. Telephone numbers and contact information for LANCOM Systems support can be found on a separate insert, or at the LANCOM Systems website.

Notes symbols

	Very important instructions. If not followed, damage may result.
	Important instruction that should be followed.
	Additional instructions which can be helpful, but are not required.

Contents

1 Introduction	10
1.1 How does ADSL and ADSL 2+ work?	10
1.2 Which use does VPN offer?	12
1.3 Firewall	13
1.4 Voice over IP	15
1.4.1 Example applications	15
1.4.2 The central position of the LANCOM VoIP Router	19
1.5 Call switching: Call routing	22
1.5.1 SIP proxy and SIP gateway	23
1.5.2 User registration at the SIP proxy	23
1.5.3 Number translation at network transitions	27
1.5.4 The Call Manager	28
1.5.5 Making telephone calls with the LANCOM VoIP Router	29
1.5.6 VoIP characteristics of the LANCOM VoIP Routers	34
1.6 What can your LANCOM Router do?	36
2 Installation	40
2.1 Package contents	40
2.2 System preconditions	40
2.3 Introducing LANCOM Router	41
2.3.1 Status displays	41
2.3.2 The back of the unit	45
2.4 Hardware installation	46
2.5 ISDN interface configuration	48
2.5.1 Bus termination, life-line support and power relay	49
2.5.2 Protocol setting	51
2.5.3 ISDN connection timing	52
2.6 Software installation	52
2.6.1 Starting LANCOM setup	53
2.6.2 Which software should you install?	53

3 Basic configuration	55
3.1 Which information is necessary?	55
3.1.1 TCP/IP settings	55
3.1.2 Configuration protection	57
3.1.3 Settings for the DSL connection	57
3.1.4 Settings for the ISDN connection	57
3.1.5 Connect charge protection	58
3.2 Instructions for LANconfig	58
3.3 Instructions for WEBconfig	60
3.4 TCP/IP settings to workstation PCs	63
4 Setting up Internet access	65
4.1 Instructions for LANconfig	67
4.2 Instructions for WEBconfig	67
5 Configuring Voice over IP	68
5.1 Instructions for LANconfig	68
5.2 Configuration examples	68
5.2.1 VoIP telephony for stand-alone use	69
5.2.2 Using VoIP telephony to extend the downstream ISDN PBX	77
5.2.3 Using VoIP telephony to supplement existing ISDN telephones	84
5.2.4 Connecting to an upstream SIP PBX	87
5.2.5 VoIP coupling for locations without a SIP PBX	92
5.2.6 Connection diagnosis with LANmonitor	99
6 Linking two networks	100
6.1 What information is necessary?	101
6.1.1 General information	101
6.1.2 Settings for the TCP/IP router	103
6.1.3 Settings for the IPX router	104
6.1.4 Settings for NetBIOS routing	105
6.2 Instructions for LANconfig	106
6.3 Instructions for WEBconfig	106

7	Providing dial-up access	108
7.1	Which information is required?	108
7.1.1	General information	109
7.1.2	Settings for TCP/IP	110
7.1.3	Settings for IPX	111
7.1.4	Settings for NetBIOS routing	111
7.2	Settings for the dial-in computer	112
7.2.1	Dial-up via VPN	112
7.2.2	Dial-up via ISDN	112
7.3	Instructions for LANconfig	113
7.4	Instructions for WEBconfig	113
8	Sending faxes with LANCAPI	115
8.1	Installation of the LANCOM LANCOM VPN	116
8.2	Installation of the MS Windows fax service	117
8.3	Sending a fax	118
8.3.1	Send a fax with any given office application	118
8.3.2	Send a fax with the MS Windows fax service	118
9	Security settings	120
9.1	The security settings wizard	120
9.1.1	Wizard for LANconfig	120
9.1.2	Wizard for WEBconfig	121
9.2	The firewall wizard	121
9.2.1	Wizard for LANconfig	121
9.2.2	Configuration under WEBconfig	122
9.3	The security checklist	122
10	Troubleshooting	126
10.1	No WAN connection is established	126
10.2	DSL data transfer is slow	126
10.3	Unwanted connections under Windows XP	127
10.4	Cable testing	127

11 Appendix	129
11.1 Performance data and specifications	129
11.2 Contact assignment	130
11.2.1 ADSL interface	130
11.2.2 ISDN 1 interface	130
11.2.3 ISDN 2 interface	131
11.2.4 Ethernet interfaces 10/100Base-T	131
11.2.5 Configuration interface (Outband)	132
11.3 CE declaration of conformity	132

1 Introduction

LANCOM 1722 VoIP are fully-featured routers that therefore also can be used in combination with the integrated firewall for providing secure Internet access to a complete local network (LAN).

The integrated VPN option enables the devices to act as powerful Dynamic VPN gateways for external offices or mobile users.

The LANCOM Router models offer each a DSL or ADSL connector and also an ISDN connectors. One ISDN line can be used as back-up for the DSL connection, for remote management of the router, as basis for the office communication via LANCAPI or for establishing VPN connections to remote sites with dynamic IP addresses.

By using the Voice over IP function, these devices can transfer voice data over broadband Internet connections and ISDN interfaces as well.

1.1 How does ADSL and ADSL 2+ work?

ADSL (Asymmetric Digital Subscriber Line) is currently the most common broadband Internet connection technology. Standard and almost ubiquitous telephone lines (analog or DSL) are the basis for DSL data transfer to the nearest telephone exchange. From here, the data is passed directly on to the Internet over high-speed connections.

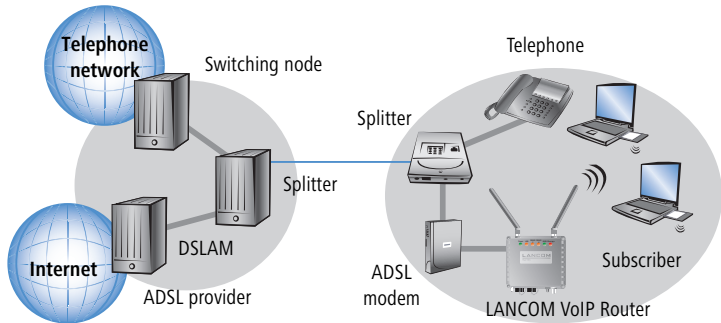
The asymmetric ADSL version of DSL was designed for applications in which the user receives high volumes of data but only transmits relatively small volumes, e.g. for accessing the world wide web (www). With an ADSL connection, a user can download at up to 8 Mbps (“downstream”) and upload at up to 800 Kbps (“upstream”). These maximum rates can be reduced as required by the ADSL provider.

To satisfy the strongly increasing demand for higher bandwidths, the standards ADSL 2 and ADSL 2+ provide higher data rates as a basis for applications such as video streaming or high-definition TV (HDTV) over the Internet. Depending on the Internet provider, ADSL 2 devices support data rates of up to 12 Mbps, and ADSL 2+ devices support up to 24 Mbps. Handshake routines during connection establishment ensure that the standards ADSL, ADSL 2 and ADSL 2+ are interoperable.

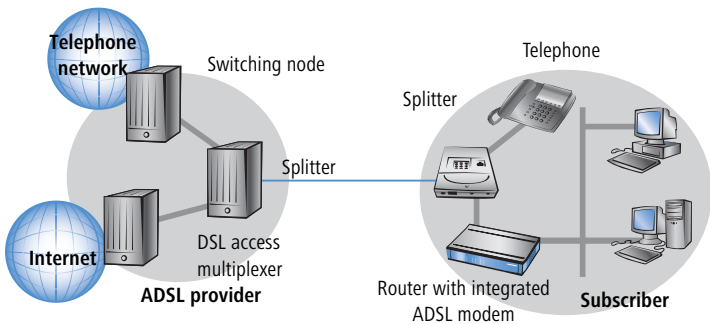
With ADSL, all traditional telephony applications (telephone, fax, answering machine, PBX) can still be used without restrictions. So-called splitters make this possible. Splitters are devices that separate the telephone line's “voice

frequencies” from the “data frequencies” and ensure that the signals are forwarded to the appropriate networks.

A splitter is also used at the subscriber end to permit ADSL modems/routers and conventional telephone equipment to be used at the same time. The router is connected to a separate ADSL modem, the ADSL modem is connected to the splitter.



In the LANCOM 1722 VoIP the ADSL/ADSL 2+ modem is integrated directly in the device. It can be directly connected to the splitter with the supplied cable.



ADSL can operate over modern ISDN telephone service as well as conventional analog service (POTS – **P**lain **O**ld **T**elephone **S**ervice). Devices with integrated ADSL modem are offered in two different versions. You can determine which telephone system a device supports by looking at the model description on the bottom of the device. The label containing the device name also con-

tains an additional code which stands for the telephone system the device supports:

Code	Supported telephone system
'Annex A'	ADSL-over-POTS
'Annex B'	ADSL-over-ISDN

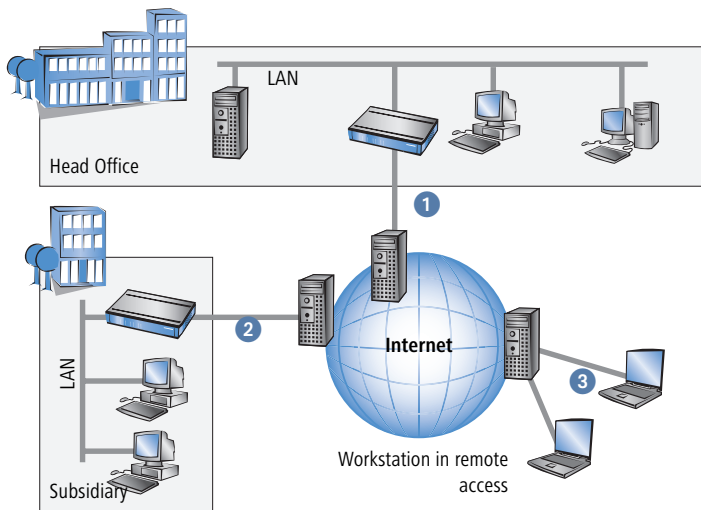
An 'Annex A' type LANCOM Router can only be used with ADSL-over-POTS service. Similarly, an 'Annex B' device can only be used with ADSL-over-ISDN service. Your network operator will be able to inform you of the version you need. Retrofitting a device to function with a different telephone system is not possible.

ADSL-over-ISDN connections also exist that do not operate in conjunction with ISDN, but which use a conventional analog telephone connection. A prominent example would be Deutsche Telekom's T-DSL service.

1.2 Which use does VPN offer?

A VPN (**V**irtual **P**riate **N**etwork) can be used to set up secure IP networks via Internet.

The following structure results when using the Internet instead of direct connections :



All participants have fixed or dial-up connections to the Internet. Expensive dedicated lines are no longer needed.

- ① All that is required is the Internet connection of the LAN in the headquarters. Special switching devices or routers for dedicated lines to individual participants are superfluous.
- ② The subsidiary also has its own connection to the Internet.
- ③ The RAS PCs connect to the headquarters LAN via the Internet.

The Internet is available virtually everywhere and typically has low access costs. Significant savings can thus be achieved in relation to switched or dedicated connections, especially over long distances.

The physical connection no longer exists directly between two participants; instead, the participants rely on their connection to the Internet. The access technology used is not relevant in this case: ideally is the use of broadband technologies such as DSL (Digital Subscriber Line). But also a conventional ISDN line can be used.

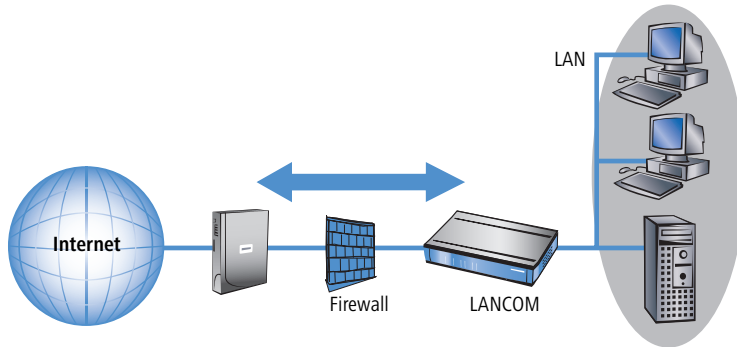
The technologies of the individual participants do not have to be compatible to one another, as would be the case for conventional direct connections. A single Internet access can be used to establish multiple simultaneous logical connections to a variety of remote stations.

The resulting savings and high flexibility makes the Internet (or any other IP network) an outstanding backbone for a corporate network.

1.3 Firewall

The integrated Stateful Inspection Firewall ensures an effective protection against undesired intrusion in your network by permitting only incoming data traffic as reaction to outgoing data traffic. The router's IP masquerading function hides all workstations of the LAN behind a single public IP address. The actual identities (IP addresses) of the individual workstations remain concealed. Firewall filters of the router permit specific IP addresses, protocols and ports to be blocked. With MAC address filters it is also possible to specifically

monitor the access of workstations in the LAN to the IP routing function of the device.



Further important features of the Firewall are

- **Intrusion Detection**

Break-in attempts into the local network or on the central Firewall are recognized, repelled and logged by the Intrusion Detection system (IDS) of the LANCOM DSL. Thereby it can be selected between logging within the device, email notification, SNMP trap or SYSLOG alarms.

- **Denial-of-Service Protection**

Attacks from the Internet can be break-in attempts as well as attacks with the aim of blocking the accessibility and functionality of individual services. Therefore a LANCOM DSL is equipped with appropriate protective mechanisms, which recognize well-known hacker attacks and which guarantee the functionality.

- **Quality-of-Service / Traffic management**

The generic term Quality-of-Service (brief: QoS) summarizes the functions of the LANCOM which guarantee certain service qualities. The advantage is that the QoS functions can take place by means of the existing powerful classification methods of the Firewall (e.g. limitation of subnetworks, single workstations or certain services).

Guaranteed minimum bandwidths give priority to enterprise critical applications, VoIP PBX installations or certain user groups.



More details about the function of the Stateful Inspection Firewall of your LANCOM Router can be found in the reference manual on the LANCOM CD.

1.4 Voice over IP



The term Voice over IP (VoIP) refers to voice communications over computer networks based on the Internet protocol (IP). The core idea is to provide the functions of traditional telephony via cost-effective and wide-spread networking structures such as the Internet. VoIP itself is not a standard, rather it is a collective term for the various technologies (equipment, protocols, voice encoding, etc.) which make voice communications in IP networks possible.

1.4.1 Example applications

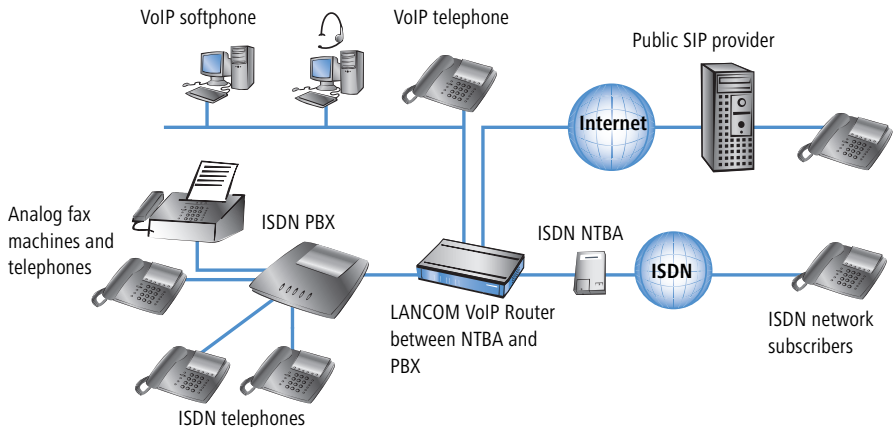
Voice over IP solutions offers advantages across a broad spectrum of applications, starting with small companies and extending to large corporations with extensive networks of subsidiaries. In the following section, we will demonstrate a number of examples.



Detailed information about configuration is available in the chapter 'Configuration of VoIP functions' or in the LCOS reference manual.

Supplementing existing ISDN PBXs

VoIP functions can be conveniently added in to existing telephone structures by using a LANCOM VoIP Router. The LANCOM VoIP Router is simply connected between the public ISDN connection (e.g. ISDN NTBA) and the ISDN PBX.



Telephone calls over the PBX and its ISDN telephones remain possible just as before; the telephones remain available under the familiar telephone numbers. This application additionally offers the following options:

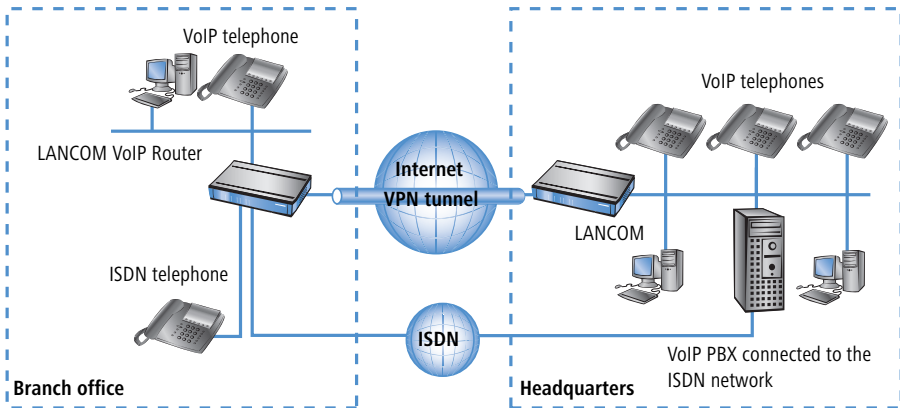
- In addition to the ISDN telephones, VoIP telephones or VoIP softphones can be included in the telephone infrastructure. VoIP subscribers in the internal LAN are also able to call external ISDN subscribers.
- The ISDN telephones continue to function, and additionally they can call all of the internal VoIP telephones and softphones in the LAN.
- Calls to external SIP subscribers who use the same Internet provider are often available at no cost.
- With the appropriate connection to a public SIP provider, any other SIP subscriber worldwide can be called, irrespective of the provider network. As an alternative to a direct ISDN connection, ISDN network subscribers can also be reached over a diversion via the SIP provider. The costs depend on the provider's particular tariff models. Frequently, long-distance and overseas calls via a SIP provider are significantly cheaper than the traditional telephone connection.

In this constellation, the LANCOM VoIP Router takes over the switching of the calls. The device can be individually configured, for example, to use the access codes to decide upon the switching of a call either via the ISDN interface, or via the Internet as a VoIP call.

Connecting subsidiaries or home offices to the headquarters

Many subsidiaries or home offices already have a connection to the network at headquarters over VPN. These connections are normally limited to conventional data transmission. By using VoIP, internal company calls can be made for free over the existing VPN connection and—thanks to the VPN encryption—these calls are secured against eavesdropping.

With a LANCOM VoIP Router located in the branch or home office, the two worlds of traditional and VoIP telephony can be united in a single telephone: A VoIP telephone or an existing ISDN telephone can be used for free telephone calls via VPN to the headquarters, or to make standard calls via ISDN.



The advantages of a telephone connection to headquarters:

- The configuration of telephone functions can be carried out centrally in the VoIP PBX at headquarters.
- Subscribers at their branch or home offices connect with the central PBX.
- Calls within the company network are free.
- Outgoing calls are automatically directed to the optimal line for cost optimization.

VoIP for companies through SIP trunking

One of the biggest hurdles for companies that fully migrate to VoIP is to maintain the existing telephone numbers. Normal provider SIP accounts come with a telephone number for the transition to the landline telephone network, but generally these numbers are selected from a pool of numbers available to the provider. However, for companies with a large number of telephone subscribers and numbers, it is of decisive importance that existing telephone and extension numbers are maintained after migrating to VoIP.

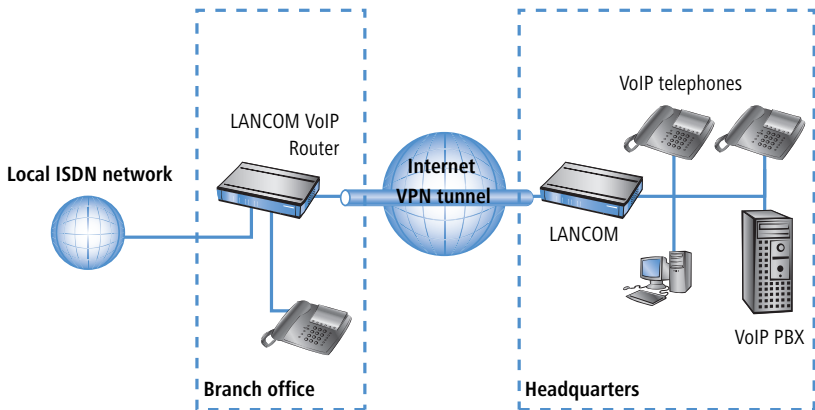
With the SIP trunking function, entire ranges of telephone numbers made up of external numbers and their associated extensions can be mapped by LANCOM VoIP Routers over a single connection to a SIP provider, assuming that the provider also supports Direct Dialing In (DDI) and can provide multiple connections simultaneously. Generally speaking, SIP providers that offer SIP trunking can acquire the existing telephone numbers from the former telcomms provider.

Connecting local ISDN lines with a remote SIP gateway

Companies with nation-wide and internationally distributed sites are often interconnected with VPN already. A LANCOM VoIP Router can be used not only to connect the SIP and ISDN telephones at a branch office to the SIP-PBX at headquarters; it can also integrate local ISDN networks into corporate communications with help of the "SIP Gateway" function.

The SIP gateway is active for outgoing and incoming calls.

- A company headquarters in New York can, for example, use a LANCOM VoIP Router with SIP gateway located at the Los Angeles branch office to telephone with customers and suppliers located in Los Angeles at local rates ("local break-out").
- For improved availability to customers located abroad, the New York headquarters can, for example, use a LANCOM VoIP Router with SIP gateway located at their sales office in Italy. Customers can then reach support or service numbers via a standard national telephone number. Calls from the local ISDN network are received and directed within the company network to the responsible employee. Call routing can be used which identifies the customer's calling number and automatically selects the appropriate connection to be used for forwarding the call.



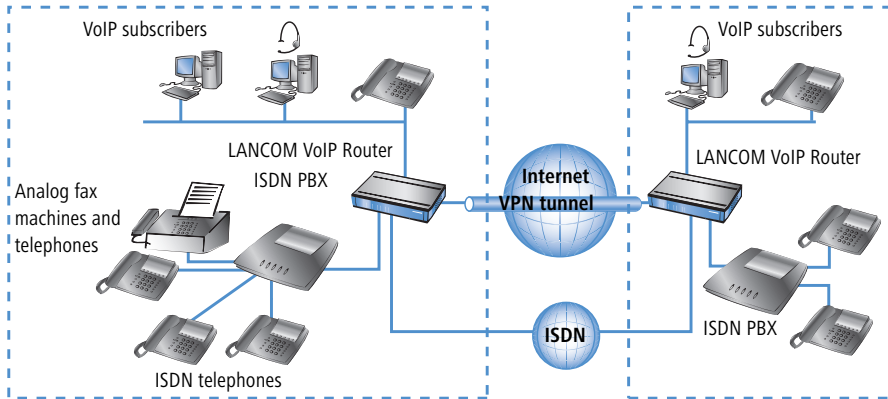
Advantages of the SIP gateway:

- The local ISDN connection at any site is available for use by any of the offices throughout the entire company.
- National and international long-distance calls can be mapped to local or regional calls, so saving costs.

- Automatic routing of incoming calls to the responsible employee.

Connecting sites without a SIP PBX

Companies with widely disperse offices and without their own SIP PBX can also take advantage of VoIP site coupling. In this "peer-to-peer" scenario, two sites are equipped with LANCOM VoIP Router.



Along with data transfer via VPN, it is also possible to use VoIP functions between the two locations.

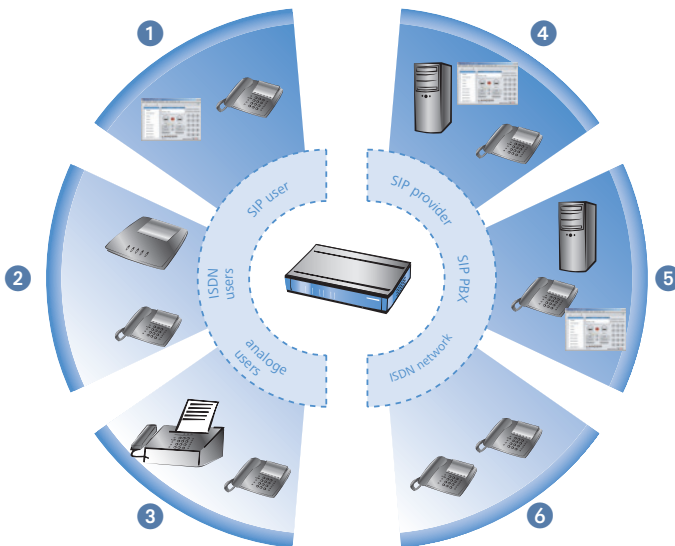
The advantages of peer-to-peer site coupling

- ISDN PBXs at different locations can form a common internal telephone network.
- An SIP PBX is not necessary.
- Calls within the company network are at no charge.
- Outgoing calls are automatically directed to the optimal line for cost optimization.
- Incoming calls can be switched directly to the appropriate employee at a different location.

1.4.2 The central position of the LANCOM VoIP Router

LANCOM VoIP Router take up a central position in the switching of telephone calls between internal and external subscribers over the different channels of communication. Depending on the model and equipment, the devices interconnect the following communication participants and channels into a common telephone infrastructure.

- 1 Internal VoIP terminal devices connected to LAN, WLAN and DMZ, such as SIP telephones and SIP softphones
- 2 The internal ISDN infrastructure with ISDN PBX and ISDN telephones
- 3 Analog terminal devices, internally connected either into the ISDN network via a PBX with a/b ports, or alternatively into the VoIP network over an ATA (Analog Telephone Adapter).
- 4 External SIP providers and all of the external subscribers attainable via them
- 5 Upstream SIP PBXs with all of the internal and external subscribers attainable through it
- 6 The external ISDN world via ISDN NTBA or upstream ISDN PBX, and all of the external subscribers available via the land-line network



Users and lines

Telephony subscribers in internal areas can take part in voice communications and, in the LANCOM VoIP environment, are referred to as "users". The LANCOM differentiates between:

- ISDN users

A maximum of 40 terminal devices connected over the ISDN network, including ISDN and analog devices connected to an upstream ISDN PBX.

When connecting downstream PBXs to point-to-point lines, the number of possible ISDN subscribers is determined by the length of the extension number (DDI). In this case, all of the telephones and terminal equipment connected to the PBX can be mapped with a single ISDN user entry.

- SIP users

A maximum of 32 SIP terminal devices connected over LAN, WLAN and DMZ and analog devices connected with an ATA.

The external paths of communication available to the users are known as "lines". The LANCOM differentiates between the following lines:

- ISDN

A connection to an ISDN NTBA over the TE interface. The NT interface can additionally be used to connect ISDN terminal devices directly or via a downstream ISDN PBX.

- SIP lines

Maximum 16 SIP lines There are three different types of SIP line:

- A "provider" line acts like a normal SIP account with a single telephone number. The internal users can all make use this account for making SIP calls, although only one call can be conducted at a time.

Depending on the provider services, these lines can be used to reach subscribers in the provider networks, subscribers in other SIP networks (partner networks), or even land-line subscribers. Your own availability at your own telephone number or even solely with an SIP name over the Internet also differs from provider to provider.

- A "trunk" line acts like an extended SIP account with a main external telephone number and multiple extension numbers. Internal users use this account in parallel and several calls can be made simultaneously (until the maximum available bandwidth is exhausted).

- As a "SIP gateway" line, the LANCOM VoIP Router provides a remote SIP PBX with a transition to the local ISDN network. The SIP gateway is registered at the SIP PBX with a single number, although several calls can be conducted at once (until the maximum available bandwidth is exhausted). The connection between the SIP PBX and the LANCOM VoIP Router is normally established over a VPN connection.

- SIP PBXs

Maximum 4 connections to upstream SIP PBXs. These lines are generally connections to large PBXs in the network at headquarters which can be reached via a VPN connection.



The precise number of users and lines available varies between models and software options.

1.5 Call switching: Call routing

All calls between internal subscribers and subscribers who can be reached over external lines are handled as SIP calls by the LANCOM—even if the connection is between two ISDN subscribers.

The call router in the LANCOM VoIP Router switches the call. The switching relies mainly on the information in two tables:

- For telephone numbers arriving at the call router, rules in the call-routing table are able to alter these numbers if needed and can decide which line to use for a call.
- The table for the locally registered user provides information about which terminal device is available at which internal telephone number.

The bandwidth reservation, QoS settings and firewall settings that are necessary for reliable transmission of voice data are carried out automatically by the LANCOM.

- When establishing a connection, the LANCOM checks (under consideration of the permitted codecs) which **maximum** bandwidth will potentially be required.
 - This bandwidth is then automatically reserved by the QoS module upon initiation of the connection.
 - If negotiation shows that the maximum bandwidth is not available, the connection will not be made.
 - If negotiations between the terminal devices can agree upon a codec with lower bandwidth requirements, then the reserved bandwidth will be lowered accordingly.
- All packets from ISDN users are given a DiffServ marking by the LANCOM (with SIP users, the QoS marking is usually handled by the telephones or softphones).
 - SIP packets for signaling are marked as CS1.
 - RTP packets are marked as EF.
- The ports required for the transmissions are activated automatically.
- LCOS 6.0 does not support QoS tags on Layer 2 (Ethernet)

1.5.1 SIP proxy and SIP gateway

The tasks involved in switching calls between the different lines of SIP and ISDN subscribers are handled by two functions in the LANCOM VoIP Router.

- SIP proxy

A SIP proxy handles the switching between callers.

- SIP gateway

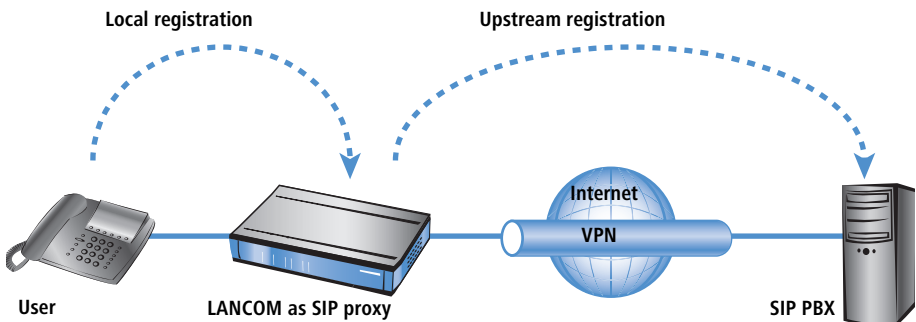
The SIP gateway handles the conversion between IP-based telephony that uses the SIP protocol and other (telephone) networks, for example the ISDN network.

1.5.2 User registration at the SIP proxy

A LANCOM VoIP Router represents the central exchange for SIP calls between different subscribers who wish to communicate over different types of line. The task of switching in the LANCOM are handled by the SIP proxy. A telephone signals the SIP proxy that it needs to establish a connection, and the SIP proxy uses certain rules to decide which line is to be used for the connection. Conversely, incoming calls are assigned to a certain terminal device by the SIP proxy according to its rules.

For terminal devices to be able to take part in this switching, they must be registered with the SIP proxy. Where the registration is limited to call switching by the LANCOM, we refer to "local registration".

If other exchanges are involved, e.g. an SIP PBX at another location, then we refer to an upstream registration. In this case, the LANCOM accepts the request for registration and forwards it upstream. In this instance, the LANCOM is described as "transparent proxy".



The great advantage with this two-stage registration comes to bear in the backup event: If the connection to an upstream SIP PBX is not available, the SIP proxy can handle the user who is registered upstream as a local user and can then direct the calls over alternative lines.

Registration at the LANCOM VoIP Router (local registration)

For local registration at the LANCOM, it is initially sufficient for the user to send a valid VoIP domain to the SIP proxy. The internal VoIP domains of the LANCOM VoIP Router are valid, as are all domains entered in a SIP line.

- For SIP terminal devices in the LAN (SIP telephone or SIP softphone), the domain is entered in the configuration. There is no need for an entry as a SIP user in the configuration of the LANCOM. This variant is known as "automatic registration".
- The domain cannot be entered into ISDN terminal equipment; instead, ISDN users have to be registered in the LANCOM configuration with a corresponding entry as an ISDN user (→ Dynamic ISDN user registration at point-to-point lines).
- To prevent unknown subscribers from registering, authentication at the SIP proxy can be set as a prerequisite to local registration (local authentication). In this case, an entry as a SIP or ISDN user in the LANCOM configuration is essential.

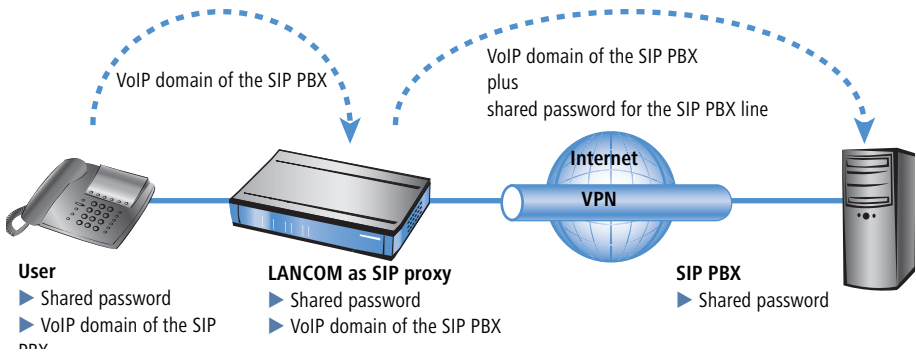


Automatic registration without entering a password is restricted to the SIP users in the LAN. SIP users in the WAN require an appropriate user entry and authentication by password.

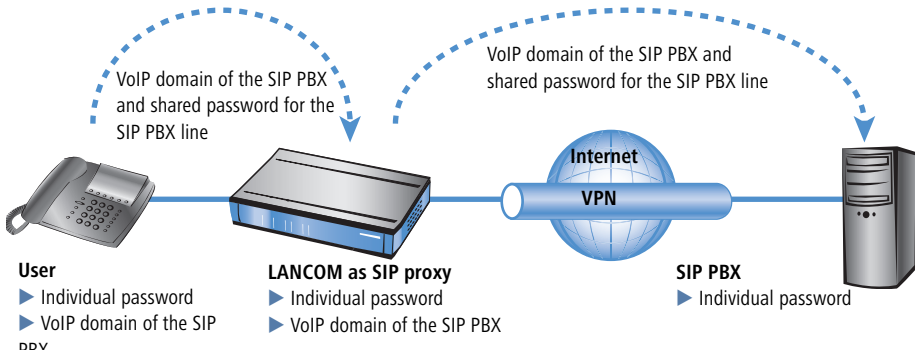
Registration at an upstream SIP PBX (upstream registration)

Generally, authentication by user and password is always required for registration at a SIP PBX. There are two possible ways of transmitting the authentication data to the SIP PBX:

- All SIP and ISDN users at the LANCOM VoIP Router end use the same shared access information. In this case, only the VoIP domain for the SIP PBX and the appropriate user ID are entered into the SIP terminal device. For ISDN users, the VoIP domain of the SIP PBX is entered into the LANCOM as an ISDN user. The SIP proxy recognizes the request for registration at the upstream SIP PBX if the domain communicated from the client agrees with a domain entered into the SIP PBX line. The proxy then forwards the registration data together with the shared password to the SIP PBX.



- If SIP or ISDN users at the LANCOM VoIP Router are entered into the SIP PBX with different passwords, then the users have to enter their individual passwords upon registration. Consequently, each SIP or ISDN user has an entry into the LANCOM with the individual passwords, which are also entered into the SIP terminal devices. Users with shared and individual passwords can be managed in parallel.



Particular aspects for ISDN users

Integrating ISDN terminal equipment into the LANCOM VoIP environment and the necessary steps for configuration depend upon the application at hand and, if applicable, upon the options available with a PBX. The main questions to be answered by the user are as follows:

- Can ISDN terminal devices telephone internally with SIP users?
- Are ISDN terminal devices available externally over SIP lines?
- Can ISDN terminal devices telephone externally over SIP lines?

To answer these questions, we differentiate between the following constellations:

- If ISDN terminal equipment can be reached over an ISDN TE interface on the LANCOM, it is described as "upstream". From the perspective of the LANCOM, the ISDN terminal devices are on an external line. This ISDN terminal equipment is normally not classified as being for local users, and so no entries for ISDN users are necessary.

ISDN terminal equipment at an upstream ISDN PBX...

- can make internal calls to SIP users if the corresponding telephone numbers are configured as internal MSNs in the ISDN PBX.
 - can receive internal calls from SIP users if the internal MSNs of the ISDN equipment are output to the ISDN line by the call-routing table, for example over a standard route.
 - can only make calls over SIP lines if the PBX is able to output certain call numbers over its internal ISDN bus. Otherwise, all calls not matching with its internal MSNs would be forwarded by the ISDN PBX to the public telephone network.
 - can only receive calls from an upstream SIP PBX if entered into the LANCOM as an ISDN user and registered as such with the SIP PBX.
- If ISDN terminal equipment can be reached over an ISDN NT interface on the LANCOM, it is described as "downstream". For the LANCOM, this is then a local subscriber that can be reached via the list of registered users. As ISDN terminal equipment cannot send domain information to register at the LANCOM, it must be entered as an ISDN user so that it can be recognized by the VoIP system.

ISDN terminal equipment at a downstream ISDN PBX...

- can make internal calls to SIP users by entering the character for an outside line as required by the PBX and then dialing the SIP user's internal number. The PBX then forwards the call to the SIP user's internal number—without the outside-line access code—over its external ISDN bus to the LANCOM.
- can receive internal calls from SIP users as long as the entry for the ISDN user contains the correct allocation of the internal number to the appropriate MSN. The LANCOM takes a call to the ISDN user's internal number, translates it to the MSN, and outputs it to the allocated ISDN bus. The PBX receives the MSN as if it were an external call and forwards it to the corresponding ISDN terminal equipment.

- can conduct incoming and outgoing calls over SIP and ISDN just like SIP users. Again, the outside-line code may be necessary for outgoing calls.

Dynamic ISDN user registration at point-to-point lines

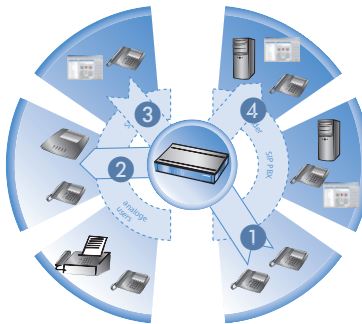
When connecting downstream PBXs to a point-to-point interface of the LANCOM VoIP Router, the number of possible ISDN terminal devices is limited by the length of the extension number. With three-figure extension numbers, almost 1000 terminal devices can be connected, all of which can be managed as ISDN users in the LANCOM VoIP Router.

Through an ISDN user entry that only defines the length of the extension number, all ISDN terminal devices with their respective extension numbers can be dynamically generated as ISDN users. For all dynamic ISDN users, the displayed name or the displayed number are all the same.

1.5.3 Number translation at network transitions

LANCOM VoIP Router switch calls between different telephone networks, e.g. the ISDN network, various SIP provider networks, and the internal telephone network. These networks generally have different ranges of numbers or even completely different conventions for addressing subscribers. Whereas the traditional land-line network uses numerical characters with country code and area access codes, the world of SIP allows alphanumeric names along with domain information.

The transition between these zones must guarantee the correct translation of "telephone numbers" so that the intended subscriber can be reached. For example, when a call from the land-line network arrives at a public MSN, the requested telephone number has to be translated to the ISDN user's internal number. This act of translation is known as "mapping". Mapping incorporates not only the **called** number, which represents the destination, but the **calling** number for the source as well.



Mapping the destination telephone number

- ① external MSN from the ISDN network
- ② internal telephone number of the ISDN user

Mapping the source telephone number

- ③ internal telephone number of the SIP user
- ④ external SIP telephone number in the SIP provider's network

Depending on the application at hand, both the called and the calling numbers have to be modified so that a return call can be made to the source number.

Call number translation at the transition to outside lines is primarily implemented by mapping entries in the ISDN and SIP lines and by rules in the call-routing table.

1.5.4 The Call Manager

The Call Manager has the central task of allocating the calls waiting to be switched to a certain line or to a certain user. The Call Manager makes this allocation by using the call-routing table and the list of registered users. The calls are switched in the following steps:

- Processing of called numbers (Calling Party ID)

First of all there is a check to see whether a numeric or alphanumeric number is available. Typical dialing separators such as "()-/" and <blank> are removed. A leading "+" is left in place. In this case, the number is still treated as a numeric number. If the check reveals any other alphanumeric character, the number is treated as alphanumeric and remains unchanged.

- Resolution of the call in the call-routing table

After processing the Called Party ID, the call is passed over to the call-routing table. Entries in the call-routing table consist of sets of conditions and instructions. The entries—with the exception of the default routes—are searched through and the first one that satisfies **all** of the conditions is executed.

- Resolution of the call with tables of local subscribers

If no entry is found in the call-routing table, then the Call Manager searches through the list of local subscribers. Call routing considers all of the users known to the call router (registered SIP users, configured ISDN users). If an entry is found that agrees with the called number and that has the matching destination domain, then the call is delivered to the corresponding subscriber.

If there is no local subscriber with matching number and destination domain, then the following cycle searches for an agreement between the number of the local subscriber and the called number; the destination domain is ignored.

■ Resolution of the call with default entries in the call-routing table

If the preceding cycles referring to the call-routing table and lists of local subscribers remain unsuccessful, then the waiting call is checked once again with the call-routing table. This pass only takes the default routes into account, however. The numbers and destination domains entered into the default routes are ignored. Only the source filters are processed, assuming that the default routes has these filters.



Specific examples of call-routing procedures can be found in the configuration examples described.

1.5.5 Making telephone calls with the LANCOM VoIP Router

Using the LANCOM VoIP Router opens up a variety of new possibilities for making telephone calls. Depending on the constellation of terminal equipment implemented (e.g. SIP or ISDN telephones, SIP or ISDN PBX systems) and, depending on the configuration for call routing in the LANCOM VoIP Router, certain information is critical for understanding the establishment of connections.

Automatic outside line access

Using the LANCOM VoIP Router and the enhancement with VoIP functionality within your telephone structure is designed to support the users' telephone behavior with the greatest possible convenience. One of the core aspects of this is the use of "spontaneous" or "automatic" outside line access, a feature that is familiar to users of standard PBX systems.

- Most PBX systems are configured in such a way that the telephone subscribers must dial a "0" before the desired telephone number in order to

gain access to an outside line - that is, to carry out a telephone conversation via a public telephone network.

Without the "0" prefix, the number dialed is considered to be an internal number from another extension line on the private PBX.

- If "automatic outside line access" is set up, all numbers dialed are directed over the public telephone network. In this case, internal telephone calls to other extensions are not possible or only possible when a special symbol is dialed before the number.

When the telephone structure is extended with a LANCOM VoIP Router, a variety of new possibilities become available for connecting telephone terminal equipment. This includes the existing analog or ISDN telephones (where necessary, connected to the respective PBX) or VoIP terminal equipment such as SIP telephones or PCs with VoIP software.

As a new and central building block in the telephone structure, the LANCOM VoIP Router assumes many of the PBX tasks for connected terminal equipment. As such, you can also set up the automatic outside line access for the terminal equipment connected to the LANCOM VoIP Router directly for the ISDN or SIP subscriber groups, thereby adapting it to existing telephone behavior.

- When automatic outside line access is turned off, subscribers must dial a "0" before the desired number in order to carry out a telephone conversation via a public telephone network.

All calls without a "0" preceding the number will be treated as calls to internal extensions within the private telephone network.

- If automatic outside line access is turned on, all numbers dialed will be directed over a public telephone network.

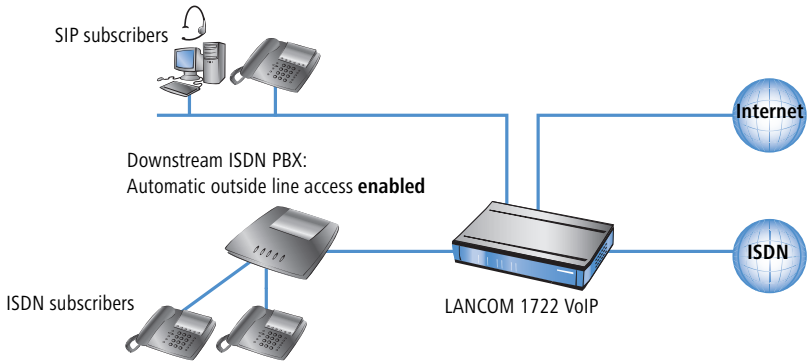
For telephone calls to internal extensions, a special symbol or a specific number combination must be dialed before the number. With the standard settings, when automatic outside line access is enabled, a star * is activated as the identification symbol for an internal number. This setting can be adjusted to match the character that you are familiar with.



If you operate the LANCOM VoIP Router on the extension line of a PBX, it is recommended that outside line access for the router be configured in the same way as for the PBX so that the behavior remains the same from the user's perspective.

■ Example of a downstream PBX

A LANCOM 1722 VoIP is switched between the ISDN outside line and the existing ISDN PBX. In the PBX, automatic outside line access is enabled, the call router settings for the LANCOM 1722 VoIP decide whether or not a "0" must be dialed for outside line access for the connected ISDN and SIP subscribers.

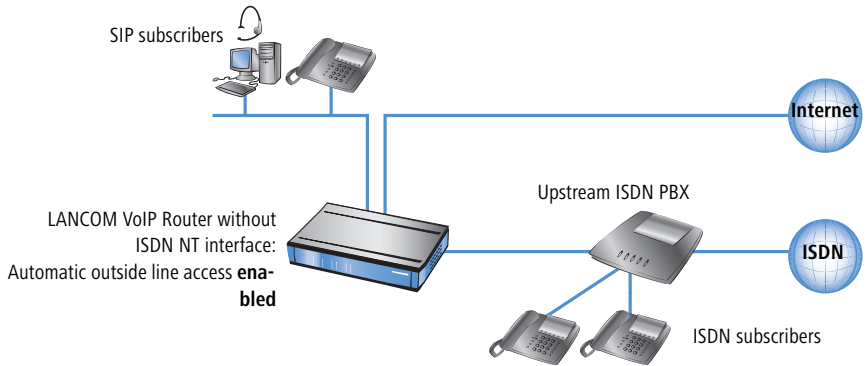


If the LANCOM VoIP Router in this constellation is not available, for example, due to a power outage, the ISDN connection for the downstream ISDN PBX is automatically "bridged" to the external ISDN connection (when life-line support is enabled). For a LANCOM VoIP Router **without** automatic outside line access, the ISDN subscribers should not dial a "0" before the number while the life-line support is active.

■ Example of an upstream PBX

A LANCOM VoIP Router is connected to an ISDN PBX extension line. In the LANCOM VoIP Router, automatic outside line access is enabled, the settings

for the upstream PBX decide whether or not a "0" must be dialed for outside line access for the connected ISDN and SIP subscribers.




Dialing various numbering areas

When dialing other parties, the following numbering areas are available for use:

- **Internal numbers** are comparable to the extension line numbers for traditional PBX systems ("extension"). Subscribers can reach each other directly using these internal numbers without having to go through a public telephone network.

The internal numbers must be unique for all subscribers within the private telephone network, this also includes any other PBX systems that may be connected!

The internal subscribers can be reached by simply dialing the internal number without a "0" preceding it.

 Depending on the settings for automatic outside line access ('Automatic outside line access' → page 29), a special preceding dialing signal may be required.

- Via **local telephone numbers** you can reach external parties who are in the same local telephone network as the LANCOM VoIP Router, i.e. users with the same area code as the public line for the LANCOM VoIP Router. In decentralized locations that extend beyond city or state boundaries, the physical location of the device is decisive, even if a central PBX is located at a different location. Therefore, for a LANCOM VoIP Router in London, all telephone subscribers in the local telephone network for London can

be reached using local numbers, even if a SIP PBX connected via VPN can be reached in Manchester.



Depending on the settings for automatic outside line access ('Automatic outside line access' → page 29), a "0" prefix may be required.

- The **national and international numbers** behave in the same way as local numbers; here, the physical location of the devices is decisive for the assignment of corresponding access codes. Therefore, a LANCOM VoIP Router in Austria belongs to the national telephone network in Austria, even if there is a VPN connection to the SIP PBX at the headquarters in Germany.



Depending on the settings for automatic outside line access ('Automatic outside line access' → page 29), a "0" prefix may be required.

Special numbers

Certain special numbers (emergency numbers, toll-free or particularly expensive service numbers) can be subjected to special treatment by the call router.

- For example, this ensures that emergency numbers for the police or fire department are always secured, even if the subscribers do not dial the correct preceding dialing signal for outside line access.

With the standard settings, the emergency numbers "110" and "112" are configured in such a way that they can be dialed correctly with or without the preceding "0".

- For toll-free numbers such as "0800", a direct connection via ISDN is usually selected in order to use the toll-free land-line to land-line connection.

Dialing using specific lines

With the LANCOM VoIP Router, other lines, in addition to the previously existing ISDN exchange lines, can be defined for voice communication, i.e. to a SIP PBX connected via VPN or to a public SIP provider via the Internet. Each time a connection is established, the call router decides which of the existing lines is to be used for the call based on pre-determined rules.

As an alternative to the automatic selection by the call router, you can direct individual calls to a certain line, for example when you want to call a party purposely via ISDN and not via the SIP PBX at the headquarters. For this purpose, the call router assigns specific code numbers to existing lines, such as

"98" for ISDN or "97" for a SIP provider. The targeted call via this line is then initiated with the corresponding identifier:

- The call with "020 123456" is assigned to a corresponding line by the call router, e.g. via the SIP PBX at the headquarters.
- However, the call with "98 020 123456" is made directly via the ISDN connection by the call router.

1.5.6 VoIP characteristics of the LANCOM VoIP Routers

Multiple ISDN interfaces

The ISDN ports (two with the LANCOM 1722 VoIP, four with the LANCOM 1724 VoIP) can be freely configured as internal or external connections and offer up to eight parallel ISDN voice channels. This allows, for example, an existing ISDN PBX to be additionally equipped with SIP and connected to an upstream VoIP PBX. Subscribers can simultaneously make calls via ISDN telephones, SIP equipment, or softphones to other SIP or ISDN subscribers, both internally and externally. The transition between SIP and ISDN is automatic and invisible to the user.

Telephone even during a power cut

With life-line support (LANCOM 1722 VoIP only) and power relay to the internal ISDN port, it remains possible to telephone via ISDN even in case of a power outage. ISDN backup, load balancing and VRRP combined with up to three Ethernet ports as WAN interfaces provide SIP connections with redundancy and high reliability. If an SIP remote station should fail, switching automatically reverts to ISDN. This ensures that telephony is just as reliable as ever, even with VoIP.

Bandwidth reservation with failover

High-performance VPN functions allow the reliable transmission of voice and data between company sites. This spares the telephone bill from internal communications. A professional firewall, versatile routing functions and excellent Quality of Service mechanisms make the LANCOM VoIP Router a comprehensive solution for secure voice and data communication in a single compact device. All functions are integrated into the central management functions.

Point-to-multipoint and point-to-point connections

LANCOM VoIP Routers support point-to-multipoint and point-to-point connections:

- Point-to-multipoint connection (point-to-multipoint): Up to 8 ISDN terminal devices can be connected to this type of connection. Terminal equipment can include ISDN telephones and ISDN PBXs, which can be used for connecting yet more equipment. As an alternative, a LANCOM VoIP Router can be connected to a point-to-multipoint connection.
- Point-to-point connection (point-to-point): This type of device is suitable for the connection of one ISDN device only, generally an ISDN PBX. As an alternative, a LANCOM VoIP Router can be connected to a point-to-point connection.

To connect a LANCOM VoIP Router, the interface that is used is set up for the type of line in use.

Equipment connected to an ISDN connection can be addressed in two ways:


- The devices are addressed with a multiple subscriber number (MSN) that is linked to the ISDN connection and cannot be influenced.
- Terminal devices are addressed via a Direct Dialing In numbers (DDI). However, only the main external number is associated with the telephone line; the extension numbers that address the individual terminal devices can be chosen at will and are merely suffixes to the main number. The main number, extension and area selection code (not including the leading zero) can be at the most 11 characters long.



The terms "point-to-multipoint connection" and "point-to-point connection" are used in many countries to describe the technical implementation of point-to-multipoint with MSN and point-to-point with DDI. Other countries may use different types of connection and other combinations of protocol and call-number type, or even different names. Please refer to your telephone network operator for the technical specifications of your ISDN connection.

1.6 What can your LANCOM Router do?

The following table shows the properties and functions of your device:

		LANCOM 1722 VoIP	LANCOM 1724 VoIP
Applications			
Internet access		✓	✓
LAN to LAN coupling via VPN		✓	✓
LAN to LAN coupling via ISDN		✓	✓
RAS server (via VPN)		✓	✓
RAS server (via ISDN)		✓	✓
IP router		✓	✓
IPX router (via ISDN), e.g. for coupling of Novell networks or dialling into Novell networks		✓	✓
NetBIOS proxy for coupling of Microsoft peer-to-peer networks via ISDN		✓	✓
DHCP and DNS server (for LAN and WAN)		✓	✓
N:N mapping for coupling networks using the same IP address ranges		✓	✓
Port-Mapping to set up LAN ports as additional WAN ports		✓	✓
Policy-based routing for policy-based selection of target routes		✓	✓
Load-balancing for bundling of multiple DSL channels		4 channels	4 channels
Backup solutions and Load Balancing with VRRP		✓	✓
NAT Traversal (NAT-T)		✓	✓
DMZ with configurable IDS check		✓	✓
LANCAPI server for the operating with office applications as fax or answering machine via ISDN interface			
VoIP functions 			
SIP proxy	Management of local SIP users (registration/authentication)	✓	✓
	Mapping of public SIP-provider accounts as telephone lines	✓	✓

		LANCOM 1722 VoIP	LANCOM 1724 VoIP
	SIP trunking for mapping SIP accounts with main external telephone numbers and extensions.	✓	✓
	Registration at and switching to upstream SIP PBXs	✓	✓
	Individual/shared password for authentication	✓	✓
	Automatic registration and forwarding of SIP users	✓	✓
	Automatic bandwidth management and prioritization of SIP connections	✓	✓
	Number of local subscribers	32 x SIP 40 x ISDN	32 x SIP 40 x ISDN
SIP/ISDN gateway	Free choice from available ISDN S0 buses	✓	✓
	Operation at exchange lines or extension lines	✓	✓
	Operation at point-to-multipoint lines or point-to-point lines	✓	✓
	Automatic registration and authentication of local ISDN subscribers as SIP users	✓	✓
	Registration of ISDN subscribers as SIP users at upstream SIP PBXs	✓	✓
	Switching between local and remote ISDN and SIP users	✓	✓
	Remote gateway function for mapping local ISDN lines to a remote SIP PBX	✓	✓
	ISDN supplementary services CLIP, CLIR	✓	✓
	En-block and individual dialing with adjustable wait time until completion	✓	✓
Call router	Central switching of all connections (SIP and ISDN)	✓	✓
	Number translation by mapping, numeral replacement and number supplementation	✓	✓
	Rules for routing according to dialed, outgoing call number, line and domain	✓	✓
	Multiple cycles, also forced after number replacement	✓	✓
	Up to two destinations per routing rule as a backup	✓	✓
	Rule-based rejection of calls	✓	✓
	Supplementation of call-number prefixes per line	✓	✓

■ Chapter 1: Introduction

		LANCOM 1722 VoIP	LANCOM 1724 VoIP
	Supplement/remove trunk numbers per line	✓	✓
Voice processing	Echo cancelling and de-jitter buffer for SIP connections	✓	✓
	Transparent pass-through for negotiated codecs	✓	✓
	Interaction on codec negotiation (filter, quality, bandwidth)	✓	✓
WAN connection			
	Connection for DSL or cable modem	✓	✓
	Integrated ADSL modem (ADSL2+ ready)	✓	✓
	ISDN S ₀ connection in NT mode for connecting downstream ISDN devices (ISDN telephones, ISDN PBXs) to the LANCOM Router. Switchable to TE mode. With LCOS version 6.0 only one ISDN interface in NT mode can be used for SIP.	1	2
	ISDN S ₀ connection in TE mode for connecting a LANCOM Router to an external ISDN connection, e.g. to an NTBA or to an upstream ISDN PBX. Switchable to NT mode. With LCOS version 6.0 only one ISDN interface in TE mode can be used for SIP.	1	2
	Life-Line Support to ensure functional telephony during power outages or with a non-configured VoIP Call Manager	✓	
	Power relay to the internal ISDN port to supply power to connected devices.	ISDN1 to ISDN2	ISDN1 to ISDN3
	Port for external modem, analogue or GSM (requires LANCOM modem adapter kit)	✓	✓
LAN connection			
	Individual Fast Ethernet LAN ports, switchable separately, e.g. as LAN switch or separate DMZ ports, auto crossover.	4	2
USB port			
	USB 2.0 Host Port for future extensions (full speed: 12 Mbps)	✓	✓
Security functions			
	IPSec encryption in external software (VPN client)	✓	✓
	5 integrated VPN tunnels for protection of network connections	✓	✓
	IPSec encryption in hardware (optional, activation via the VPN-25-Option)	✓	✓
	IP masquerading (NAT, PAT) to hide all workstations of the LAN behind one common public IP address.	✓	✓

	LANCOM 1722 VoIP	LANCOM 1724 VoIP
Stateful Inspection Firewall	✓	✓
Firewall filters for a selective locking of IP addresses, protocols and ports	✓	✓
MAC address filter control e.g. the access of LAN workstations to IP routing functions	✓	✓
Configuration protection to block "brute force attacks"	✓	✓
Configuration		
Configuration with LANconfig or with web browser, additionally terminal mode for Telnet or other terminal programs, SNMP interface and TFTP server function.	✓	✓
Remote configuration via ISDN (with ISDN-PPP connections e.g. via Windows network and dial-up connections)	✓	✓
Serial configuration interface	✓	✓
Callback function with PPP authentication mechanisms for restriction to fixed ISDN telephone numbers	✓	✓
FirmSafe with firmware versions for absolutely secure software upgrades	✓	✓
Optional software extensions		
LANCOM VPN Option with 25 active tunnels for protection of network couplings	✓	✓
Optional hardware extensions		
LANCOM Modem Adapter Kit for connection of analog or GSM modems to the serial interface	✓	✓
19" rack mount adapter	✓	✓

2 Installation

This chapter will assist you to quickly install hardware and software. First, check the package contents and system requirements. The device can be installed and configured quickly and easily if all prerequisites are fulfilled.

2.1 Package contents

Please check the package contents for completeness before starting the installation. In addition to the device itself, the package should contain the following accessories:


	LANCOM 1722 VoIP	LANCOM 1724 VoIP
Power adapter	✓	✓
LAN connector cable (green plugs)	1	1
ADSL connector cable (transparent plugs)	1	1
ISDN connector cable (light blue plugs)	1	2
Adapter to cross-over the contacts for reconfigured ISDN interfaces	1	2
Connector cable for the configuration interface	✓	✓
LANCOM CD	✓	✓
Printed documentation	✓	✓

If anything is missing, please contact your retailer or the address stated on the delivery slip of the unit.

2.2 System preconditions


Computers that connect to a LANCOM Router must meet the following minimum requirements:

- Operating system that supports TCP/IP, e.g. Windows XP, Windows Millennium Edition (Me), Windows 2000, Windows 98, Windows 95, Windows NT, Linux, BSD Unix, Apple Mac OS, OS/2, BeOS.
- Access to the LAN via the TCP/IP protocol.

 The LANtools and the LANCAPI functions also require a Windows operating system. A web browser is required for access to WEBconfig.

2.3 Introducing LANCOM Router

This section introduces your device. We will give you an overview of all status displays, connections and switches.

 While the information in this section is useful for the installation of the device, it is not absolutely essential. You may therefore skip this section for the time being and go straight forward to 'Hardware installation' → page 46.

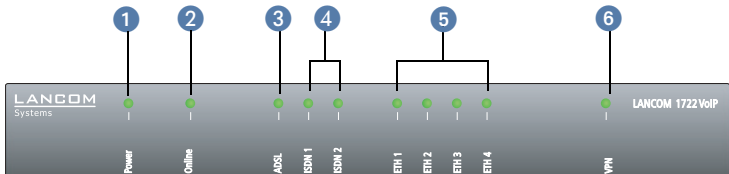
2.3.1 Status displays

The front and the rear panels of the unit feature a series of LEDs. The various LANCOM Router models have different numbers of indicators on the front panel depending on their functionality.

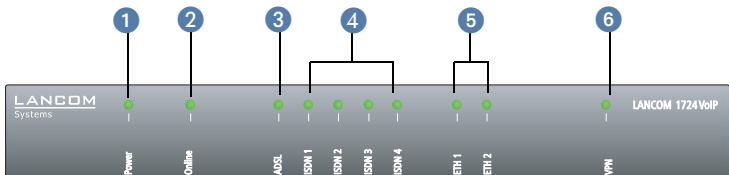
Front side

The various LANCOM Router models have different numbers of indicators on the front panel depending on their functionality.

LANCOM 1722 VoIP



LANCOM 1724 VoIP



Top panel

The two LEDs on the top panel provide a convenient overview of the most important status information, especially when the device is installed vertically.



Meanings of the LEDs

In the following sections we will use different terms to describe the behaviour of the LEDs:

- **Blinking** means, that the LED is switched on or off at regular intervals in the respective indicated colour.
- **Flashing** means, that the LED lights up very briefly in the respective colour and stay then clearly longer (approximately 10x longer) switched off.
- **Inverse flashing** means the opposite. The LED lights permanently in the respective colour and is only briefly interrupted.
- **Flickering** means, that the LED is switched on and off in irregular intervals.

Power 1

This LED indicates that the device is operational. After the device has been switched on, it will flash green for the duration of the self-test. After the self-test, either an error is output by a flashing red light code or the device starts and the LED remains lit green.

off		Device off
green	blinking	Self-test when powering up
green	constantly on	Device ready for use
red/ green	blinking alternately	Device insecure: configuration password not assigned
red	blinking	Time or connect-charge reached



The power LED flashes red/green in alternation until a configuration password has been specified. Without a configuration password, the configuration data of the LANCOM is insecure. Under normal circumstances, you would assign a configuration password during the basic configuration (see instructions in the following chapter). For informa-

tion about a later assignment of the configuration password see the section 'Security settings' → page 120.

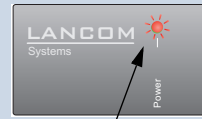
Flashing Power LED but no connection?

There's no need to worry if the Power LED blinks red and you can no longer connect to the WAN. This simply indicates that a preset time or connect-charge limit has been reached. There are three methods available for unlocking:

- Reset connect charge protection.
- Increase the limit that has been reached.
- Completely deactivate the lock that has been triggered (set limit to '0').

If a time or connect charge limit has been reached, you will be notified in LANmonitor. To reset the connect charge protection, select **Reset Charge and Time Limits** in the context menu (right mouse click). You can configure the connect charge settings in LANconfig under **Management ▶ Costs** (you will only be able to access this configuration if 'Complete configuration display' is selected under **View ▶ Options...**).

You will find the connect charge protection reset in WEBconfig and all parameters under **Expert Configuration ▶ Setup ▶ Charges-module**.



Signal for reached time or connect-charge limit

Online 2

The Online LED indicates the overall status of all WAN ports:

off		no active connection
green	flashing	Establishing first connection
green	inverse flashing	Establishing further connection
green	constantly on	At least one connection established
red	constantly on	Error establishing the previous connection

ADSL 3

Connection status of the ADSL link:

off		interface switched off
green	blinking	Initialisation
green	flashing	Establishing first connection
green	invers flashing	Establishing further connection
green	constantly on	at least one connection established
green	flickering	Data traffic (send or receive)

red	flickering	Error (CRC error, Framing error etc.)
red	constantly on	Synchronisation not successful, searching peer
orange	constantly on	Synchronisation successful
orange	blinking/flash- ing	Handshake/training phase
red/ orange	blinking	Hardware error

ISDN 4

Connection status of first and second ISDN interface:

		TE Mode (external ISDN connection)	NT Mode (internal ISDN connection)
off		Interface switched off or Layer 1 deactivated or no Layer 2 TEI	Interface switched off. When switched off, the line may, under certain circumstances, still be connected to another ISDN interface via a life-line relay (→ Seite 49).
green	blinking	Establishing D channel Layer 1 or Layer 2 TEI	
green	constantly on	D channel activated (Layer 1 aktive and Layer 2 TEI available)	D channel activated
orange	blinkend	Establishing first ISDN connection	
orange	blitzend	Establishing of further ISDN connections	
orange	invers flickering	Data traffic (send)	
red	blinking	Error on B channel	
red	constantly on	Establishing D channel Layer 1 or Layer 2 stopped due to error	Establishing D channel Layer 1 stopped due to error
red/ orange	blinking	ISDN hardware error	



If the LED of an ISDN interface automatically goes off in TE mode, this does not indicate an error at the S_0 bus. It is in fact because several ISDN connections and PBXs switch the S_0 bus into power-saving mode after a certain period of inactivity. When needed, the S_0 bus automatically reactivates and the ISDN status LED illuminates again.

ETH 5

Status of the four LAN ports in the integrated switch:

off		No network device connected
green	constantly on	Connection to network device operational, no data traffic
green	flickering	Data traffic
red	flickering	Collision of packets

VPN 6

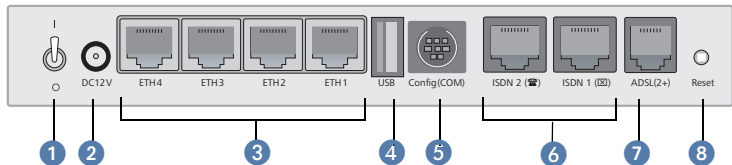
Status of a VPN connection.

off		No VPN tunnel established
green	blinking	Negotiating VPN connection
green	flashing	Establishing first connection
green	inverse flashing	Establishing further connection
green	constantly on	VPN connection established

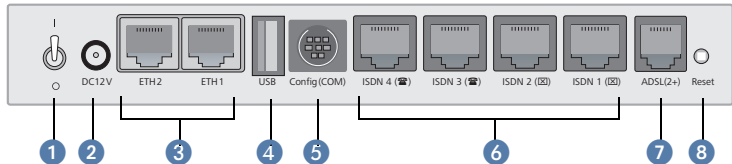
2.3.2 The back of the unit

The connections and switches of the router are located on the back panel:

LANCOM 1722 VoIP



LANCOM 1724 VoIP



- 1 Voltage switch
- 2 Connection for the included power adapter
- 3 Switch with four 10/100Base-Tx connections
- 4 USB connection
- 5 Serial configuration port

- 6 ISDN connections
 - Default LANCOM 1722 VoIP
 - ISDN 1: TE mode, equivalent to external ISDN connection
 - ISDN 2: NT mode, equivalent to internal S_0
 - Default LANCOM 1724 VoIP
 - ISDN 1 and ISDN 2: TE mode
 - ISDN 3 and ISDN 4: NT mode
- 7 ADSL port (ADSL, ADSL 2, ADSL 2+)

8 Reset switch

The reset switch has two different functions depending on the length of time that it is pressed:

- **Restarting the device** (soft reset) – push the button for less than five seconds. The device will restart.
- **Resetting the configuration** (hard reset) – push the button for more than five seconds. All the device's LEDs will light up green and stay on. As soon as the reset switch is released, the device will restart with factory default settings.

2.4 Hardware installation

Installation of the LANCOM Router involves the following steps:

- 1 **LAN** – first of all connect your LANCOM Router to the LAN or to an individual PC. Plug in one end of the supplied network cable (green connectors) to a LAN connector on the device 3, and the other end into an available network connector socket in your local network, a free socket on a switch or hub, or the networking connector of an individual PC.


The LAN connectors use autosensing to recognize the data rate (10/100 Mbit) and the type (node/hub) of attached network devices. It is possible to connect devices of different speeds and types in parallel.




Avoid having multiple unconfigured LANCOM at once within a single network segment. Any unconfigured LANCOM takes on the same IP address (ending in '254'), and so address conflicts could arise. To avoid problems, multiple LANCOMs should be configured one after

the other with the respective device being assigned with a new and unique IP address (not ending in '254') each time.


- ② **ADSL** – connect the ADSL interface ⑧ with the splitter by using the supplied ADSL connector cable (transparent connectors).
- ③ **Connection to the ISDN** – to connect the LANCOM VoIP Router to the ISDN, plug in one end of the supplied ISDN cable (light-blue connectors) to an ISDN interface in TE mode. When shipped, the ISDN interfaces marked with ☒ are set up in TE (external) mode. Plug in the other end of the ISDN cable into an ISDN/S₀ PBX connector or basic-rate interface.

 Please heed the notices about configuring the ISDN interfaces (?page 53).

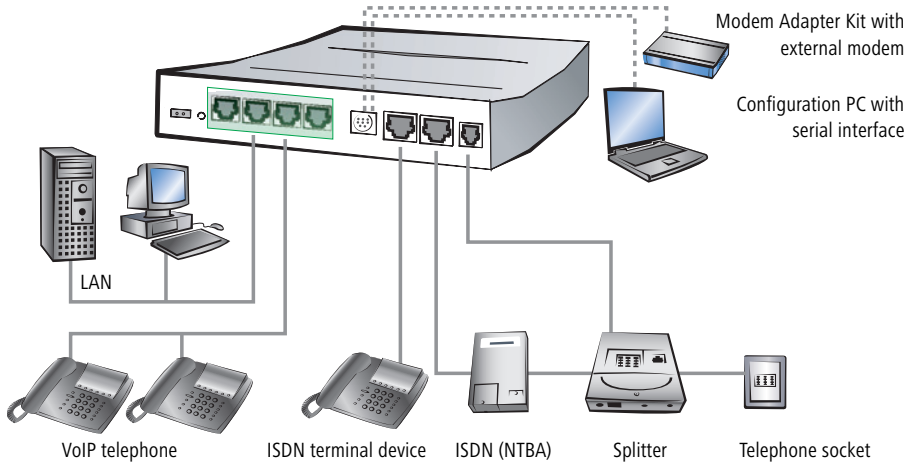
- ④ **Connect ISDN terminal devices** – to connect ISDN terminal devices (ISDN telephones or ISDN PBXs) to the LANCOM VoIP Router, plug in one end of the supplied ISDN cable (light-blue connectors) to an ISDN interface in NT mode. When shipped, the ISDN interfaces marked with ☎ are set up in NT (internal) mode. Connect the other end of the ISDN cable to the ISDN terminal device.

 Please heed the notices about configuring the ISDN interfaces (?page 53).

- ⑤ **Configuration interface** – optionally, the router can be connected directly to the serial interface (RS-232, V.24) of a PC. Use the connection cable supplied for this. Connect the LANCOM configuration interface ⑤ to an available serial interface on the PC.
- ⑥ Optionally, an external analog or GPRS modem can be connected to the device's serial interface with the LANCOM Modem Adapter Kit, so enabling tasks such as remote maintenance, backup connections or Dynamic VPN to be implemented over an additional WAN connection.
- ⑦ **Power supply** – the socket ② is for connecting the supplied power supply unit.

 Use only the supplied power supply unit! The use of the wrong power supply unit can be of danger to the device or persons.

- ⑧ **Ready for operation?** – After a brief self-test, the power LED lights up continuously. Green LAN LEDs show which LAN connectors are being used for a connection.



⚠ These example connections work only with the ISDN interfaces configured according to their factory settings!

⚡ Devices with integrated ADSL modems can become very warm during operation. For these models, environmental temperatures are not to exceed 35°C. Sufficient ventilation is of vital importance. Do not stack the devices and do not expose them to direct sunlight.

2.5 ISDN interface configuration

Routers of the type LANCOM 1722 VoIP and LANCOM 1724 VoIP feature several ISDN interfaces with which they can be connected to ISDN exchange lines, or with which ISDN terminal equipment can be connected to them.

- ISDN TE interface ("external ISDN connection"): An ISDN interface in TE mode for connection to the ISDN bus of an upstream ISDN PBX or to an ISDN NTBA. This ISDN interface can be used for backup connections over ISDN or as a dial-in interface for remote stations.
- ISDN NT interface ("internal ISDN connection"): With its ISDN interface in NT mode, the LANCOM VoIP Router itself provides an internal ISDN bus. This ISDN interface can be used to connect ISDN PBXs or ISDN telephones.

The factory settings have the ISDN interfaces marked with set to TE mode and the ISDN interfaces marked with  set to NT mode. These ISDN settings can be altered according to your requirements:

- Multiple TE interfaces provide, for example, up to eight B channels as a backup or for dial-in.
- With multiple NT interfaces, for example, a downstream ISDN PBX can be provided with up to eight B channels.

Depending on the combination of ISDN interfaces in TE and NT mode, the hardware must be set up with the functions for bus termination, life-line support and power relay, and the software must be set up with the appropriate protocol. The setting for the protocol allows for the type of ISDN connection to be used (point-to-multipoint or point-to-point).

2.5.1 Bus termination, life-line support and power relay

The hardware function modes of the ISDN interfaces are set by DIP switches on the underside of the device.

- **Bus termination** is obligatory with an ISDN interface in NT mode.

Bus termination is generally deactivated for ISDN interfaces in TE mode. If the LANCOM VoIP Router is the last device at a longer ISDN bus and this itself is not terminated, it may be advantageous to activate the bus termination for an ISDN interface in TE mode.



The supplied adapter must be used if a connection is to be made to an ISDN interface which is set differently to its default settings. This adapter serves to cross-over the contacts in the ISDN interface. Not using the adapter can cause damage to both the LANCOM VoIP Router and to the devices connected with it!

- If **life-line support** is activated, the interfaces ISDN 1 and ISDN 2 are bridged if the device is unavailable due to a power outage or if the ISDN 2 interface is switched off (default: on). The life-line support is used when the LANCOM 1722 VoIP is connected to an external ISDN line over a TE interface with the simultaneous operation of ISDN terminal devices at the internal ISDN connection of an NT interface. If bridged, the ISDN devices can then use the external ISDN bus directly.

To activate life-line support, all four DIP switches (3 to 6) must be up; to deactivate, all four DIP switches must be down.

LANCOM 1722
VoIP only



Life-line support is to be deactivated when both ISDN interfaces are to be operated in the same mode, i.e. as two TE or two NT interfaces. The interfaces are not to be bridged in case of power failure when being operated in this manner!

- The **ISDN power relay** means that the bus voltage of an external ISDN bus at ISDN 1 is switched through to the terminal equipment connected to ISDN 2 (LANCOM 1722 VoIP) and/or ISDN 3 (LANCOM 1724 VoIP). As a consequence, ISDN equipment operated at the internal ISDN bus of the LANCOM VoIP Router can be operated without its own power supply.



Be sure to deactivate the ISDN power relay if both ISDN interfaces are to be operated in TE mode, such as when both ISDN interfaces are connected to an ISDN NTBA, for example. A power relay in this situation would result in a short-circuit which would damage the device and the ISDN NTBAs!

- ① Before altering the DIP switch settings, remove all cables from their sockets.
- ② Remove the see-through cover of the DIP switch.
- ③ We suggest that you use a screwdriver to set the DIP switch to the desired position.

LANCOM 1722 VoIP			LANCOM 1724 VoIP	
DIP	Meaning	Default	Meaning	Default
1 + 2	ISDN 2 Rx/Tx (100 Ω bus termination)	up (on)	ISDN 4 Rx/Tx (100 Ω bus termination)	up (on)
3 + 4	Life-line support	up (on)	ISDN 3 Rx/Tx (100 Ω bus termination)	up (on)
5 + 6		up (on)	ISDN power relay ISDN 1 > ISDN 3	down (off)
7 + 8	ISDN power relay ISDN 1 > ISDN 2	up (on)	ISDN 2 Rx/Tx (100 Ω bus termination)	down (off)
9 + 10	ISDN 1 Rx/Tx (100 Ω bus termination)	down (off)	ISDN 1 Rx/Tx (100 Ω bus termination)	down (off)

- ④ Plug the cable in again and start the device.

A change to the software configuration is also necessary if the ISDN interfaces are to be set to a different mode.

2.5.2 Protocol setting

Parameters for the ISDN interfaces are entered into LANconfig in the configuration area 'Interfaces' on the 'WAN' tab. Under WEBconfig, Telnet or SSH client you will find the settings for the ISDN interface parameters under *Setup/Interfaces/WAN*.

Select the protocol for each ISDN interface according to its application and the ISDN connection type: Point-to-multipoint and point-to-point connections can be used in various combinations at a LANCOM VoIP Router. The following options are available:

- **Automatic** for automatic selection of the operating mode (only in TE mode)
- **DSS1 TE (Euro ISDN)** for connection to a point-to-multipoint ISDN bus.
- **DSS1 TE point-to-point** for connection to a point-to-point ISDN bus.
- **1TR6 TE (German ISDN)** for connection an ISDN bus which uses this protocol (in Germany only).
- **DSS1 NT (Euro ISDN)** to provide point-to-multipoint ISDN interfaces
- **DSS1 NT reverse** to provide point-to-multipoint interfaces while maintaining the ISDN timing of the connected ISDN line, please refer to 'ISDN connection timing'
- **DSS1 NT (point-to-point)** to provide point-to-point ISDN interfaces
- **DSS1 NT point-to-point reverse** to provide point-to-point interfaces while maintaining the ISDN timing of the connected ISDN line, please refer to 'ISDN connection timing'
- **DSS1 timing** to maintain the ISDN timing of the connected ISDN line, please refer to 'ISDN connection timing'
- **Off**



NT mode operation always has to be set manually. With the LANCOM 1722 VoIP, if the ISDN 2 connector is set to 'Off' there may be a connection to ISDN 1 in the case that the device has been set up for life-line support by means of the DIP switches.



If an ISDN device is attached to an ISDN interface that is set to auto and is not recognized properly, set the required protocol manually.

2.5.3 ISDN connection timing


To ensure trouble-free transmission, all of the components in the ISDN system (LANCOM VoIP Router, upstream and downstream ISDN PBXs and ISDN terminal devices) have to use the same ISDN timing. In the LANCOM VoIP Router, an ISDN interface in TE mode can take on the timing of the ISDN line. The TE interface enables the device itself to behave like a terminal device. In NT mode, the LANCOM VoIP Router can pass on the timing over the ISDN interfaces to any connected terminal equipment or downstream ISDN PBXs. The NT interface enables the device itself to behave like an exchange.

There are various ISDN interface settings to define the ISDN interface which is to supply the LANCOM VoIP Router with the ISDN timing to be passed on to the devices at the NT interfaces.

- **Automatic:** If no interface has been manually selected for the timing, the device automatically searches for a TE interface that is supplying a timing. To ensure that the timing is synchronous, the TE connectors constantly try to keep the connection activated. This ensures that the timing continues to be supplied even if one of multiple TE lines should be shut off. If none of the TE connectors supply a timing, then the timing system runs "freely" and uses the internal timing of the LANCOM VoIP Router.
- **DSS1 timing:** This setting takes on the ISDN timing from the connection for use by the LANCOM VoIP Router and further devices connected over the NT interface. In this way, the timing can be switched through in parallel to an existing ISDN PBX at a point-to-point connection. Apart from passing on the ISDN timing, the interface is not active.
- **DSS1 NT reverse or DSS1 NT point-to-point reverse:** When all ISDN interfaces are operated in NT mode, the timing system runs "freely" because there is no TE interface to take on the ISDN timing. If in this case the ISDN connections are connected, for example, to an ISDN PBX which is being supplied with ISDN timing from another source, then interference to the transmission may arise because the timing of the LANCOM VoIP Router is not synchronous to that of the PBX. In such cases, the reverse setting allows the ISDN timing to be taken from an NT-mode interface, so ensuring that the LANCOM VoIP Router runs synchronously with the overall system.


2.6 Software installation

This section covers the installation of the included system software LANtools for Windows.

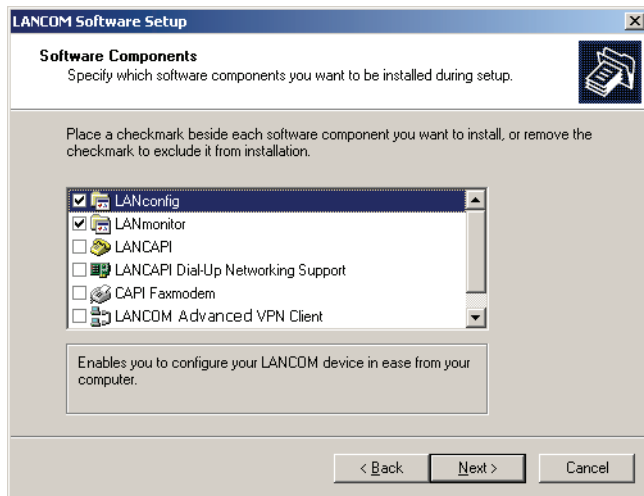
 You may skip this section if you use your LANCOM Router exclusively with computers running operating systems other than Windows.

2.6.1 Starting LANCOM setup

Place the LANCOM CD in your CD drive. The LANCOM setup program will start automatically.

 If the setup program does not start automatically, run AUTORUN.EXE in the root folder of the LANCOM CD.

In Setup select **Install LANCOM Software**. The following selection menus will appear on the screen:



2.6.2 Which software should you install?

- **LANconfig** is the configuration program for all LANCOM routers and Wireless LAN access points. WEBconfig can be used alternatively or in addition via a web browser.
- **LANmonitor** lets you monitor on a Windows PC all LANCOM routers and Wireless LAN access points.
- **LANCAPI** is a special form of the CAPI-2.0 interface that all workstations of the LAN need to get access to office communication functions as fax or EuroFile transfer. With **LANCAPI Dial-Up Networking Support**, single workstations can realize dial-up connections to an Internet provider via

■ *Chapter 2: Installation*

LANCAPI. The **CAPI fax modem** makes you available a first class fax driver.

- The **LANCOM VPN Client** enables a setting of VPN connections from a remote workstation via Internet to a router with LANCOM VPN Option.
- With **LANCOM Online Documentation**, you can copy the documentation files on your PC.

Select the appropriate software options and confirm your choice with **Next**. The software is automatically installed.

3 Basic configuration

The basic configuration can be performed on a step-by-step basis using a convenient setup wizard to guide you through the setup process and prompt you for the required information.

First, this chapter will inform you which information is required for the basic configuration. Use this section to assemble the information you will need before launching the wizard.

Next, enter the data in the setup wizard. Launching the wizard and the process itself are described step by step - with separate sections for LANconfig and WEBconfig. Thanks to the information that you have collected in advance, the basic configuration is quick and effortless.

At the end of this chapter we will show you the settings that are needed for the LAN's workstations to ensure trouble-free access to the router ('TCP/IP settings to workstation PCs' → page 63).

3.1 Which information is necessary?

The basic configuration wizard will take care of the basic TCP/IP configuration of the router, protect the device with a configuration password, and will set up the ISDN connection if required. The following descriptions of the information required by the wizard are grouped in these three configuration sections:

- TCP/IP settings
- protection of the configuration
- information on DSL connection
- information on ISDN connection
- configuring connect charge protection

3.1.1 TCP/IP settings

The TCP/IP configuration can be realized in two ways: either as a fully automatic configuration or manually. No user input is required for the fully automatic TCP/IP configuration. All parameters are set automatically by the setup wizard. During manual TCP/IP configuration, the wizard will prompt you for the usual TCP/IP parameters: IP address, netmask etc. (more on these topics later).

Fully automatic TCP/IP configuration is only possible in certain network environments. The setup wizard therefore analyses the connected LAN to determine whether it supports fully automatic configuration.

New LAN—fully automatic configuration possible

If all connected network devices are still unconfigured, the setup wizard will suggest fully automatic TCP/IP configuration. This may be the case in the following situations:

- a single PC is connected to the router
- setup of a new network

Fully automatic TCP/IP configuration will not be available when integrating the LANCOM Router in an existing TCP/IP LAN. In this case, continue with the section 'Information required for manual TCP/IP configuration' → page 56.

The result of the fully automatic TCP/IP configuration: the router will be assigned the IP address '172.23.56.1' (netmask '255.255.255.0'). In addition, the integrated DHCP server will be enabled so that the LANCOM Router can automatically assign IP addresses to the devices in the LAN.

Configure manually nevertheless?

The fully automatic TCP/IP configuration is optional. You may also select manual configuration instead. Make your selection after the following considerations:

- Choose automatic configuration if you are **not** familiar with networks and IP addresses.
- Select manual TCP/IP configuration if you are familiar with networks and IP addresses, and one of the following conditions is applicable:
 - You have not yet used IP addresses in your network but would like to do so now. You would like to specify the IP address for your router, selecting it from the address range reserved for private use, e.g. '10.0.0.1' with the netmask '255.255.255.0'. At the same time you will set the address range that the DHCP server uses for the other devices in the network (provided that the DHCP server is switched on).
 - You have previously used IP addresses for the computers in your LAN.

Information required for manual TCP/IP configuration

During manual TCP/IP configuration, the setup wizard will prompt you for the following information:

■ IP address and netmask for the LANCOM Router

Assign a free IP address from the address range of your LAN to the LANCOM Router and specify the netmask.

■ Enable DHCP server?

Disable the DHCP server function in the LANCOM Router if you would like to have a different DHCP server assign the IP addresses in your LAN.

3.1.2 Configuration protection

The password for configuration access to the LANCOM Router protects the configuration against unauthorized access. The configuration of the router contains a considerable amount of sensitive information such as your Internet access information. We therefore strongly recommend protecting it with a password.

The setup wizard for the basic configuration automatically disables remote configuration access via ISDN, thus protecting your configuration against tampering. ISDN remote configuration access can be enabled at any time using the security wizard (see 'Have you permitted remote configuration?' → page 123).

3.1.3 Settings for the DSL connection

For the WAN connection it may be necessary to enter the transfer protocol being used. The wizard will e.g. automatically enter the correct settings for major DSL providers. You only need to enter the protocol used by your access provider if the wizard does not list your provider.

3.1.4 Settings for the ISDN connection

Set up the basic configuration of your ISDN connection if required. You will need the following data:

- One or more ISDN MSNs on which the router will accept calls. MSNs are ISDN subscriber numbers that are assigned to you by your telephone provider. They are normally entered without an area code. These numbers are only relevant for the router functions (LAN to LAN coupling, RAS), not for remote configuration and LANCOM VPN Option.
- A dialing prefix for access to the public telephone network. This is normally required only when using an ISDN PBX. '0' is the usual prefix. It is used for all outgoing calls.
- Finally, you should know whether your telephone provider transmits an ISDN connect-charge pulse. This signal can be used LANCOM Router for connect-charge budgets and the accounting function.

3.1.5 Connect charge protection

Connect charge protection blocks connections that go beyond a previously set amount, protecting you from unexpectedly high connection costs.

In LANCOM Router, there are three independent budgets: For DSL access, you can set a maximum connection time in minutes. In addition to this time budget, there is also a budget for limiting ISDN connection charges.



In order for the limitations according to connect charge rates to function properly, it is necessary to enter the information for connect charge rates through ISDN.

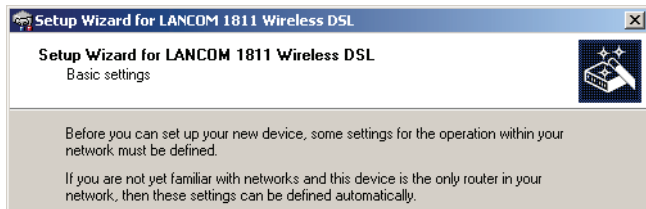
Any budget can be deactivated by entering the value '0'.

It is possible to completely turn off connect charge protection

3.2 Instructions for LANconfig

- 1 Start up LANconfig by clicking **Start ▶ Programs ▶ LANCOM ▶ LANconfig**

LANconfig automatically detects the new LANCOM Router in the TCP/IP network. Then the setup wizard starts that will help you make the basic settings of the device or will even do all the work for you (provided a suitable network environment exists).



If the setup wizard does not start automatically, start a manual search for new devices on all ports (if the LANCOM Router is connected via a serial port) or in the network (**Device ▶ Find**).




If you cannot access an unconfigured LANCOM Router, the problem may be due to the netmask of the LAN: with less than 254 possible hosts (netmask > '255.255.255.0'), please ensure that the IP address 'x.x.x.254' is located in your own subnet.

If you have chosen automatic TCP/IP configuration, please continue with Step ④.

- ② If you would like to configure the TCP/IP settings manually, assign an available address from a suitable address range to the LANCOM Router. Confirm your choice with **Next**.
- ③ Specify whether or not the router should act as a DHCP server. Make your selection and confirm with **Next**.
- ④ In the following window, specify the password for configuration access. Note that the password is case-sensitive and ensure that it is sufficiently long (at least 6 characters).


In addition, you may specify whether the device may only be configured from the local network or whether remote configuration via the WAN (i.e. a remote network) is also permissible.

 Please note that enabling this will also permit remote configuration via the Internet. You should always make sure that the configuration access is protected with a password.

- ⑤ In the next window, select your DSL provider from the list that is displayed. If you select 'My provider is not listed here,' you must enter the transfer protocol used by your DSL provider manually. Confirm your choice with **Next**.
- ⑥ Enter the ISDN subscriber numbers (as MSNs, i.e. without area code) on which the router will accept calls. Multiple numbers are separated by semicolons. If you do not specify any MSNs, the router will answer all incoming calls on the ISDN connection.

In addition, you can enter a trunk code for dialling into ISDN. Finally, you should specify whether or not the tariff information is to be transmitted at your ISDN connection. Confirm your choice with **Next**.

- ⑦ Connect charge protection can limit the cost of DSL and ISDN connections to a predetermined amount if desired. Confirm your choice with **Next**.
- ⑧ Complete the configuration with **Finish**.

 Section 'TCP/IP settings to workstation PCs' auf Seite 63 will describe the settings required for the individual workstations in the LAN.

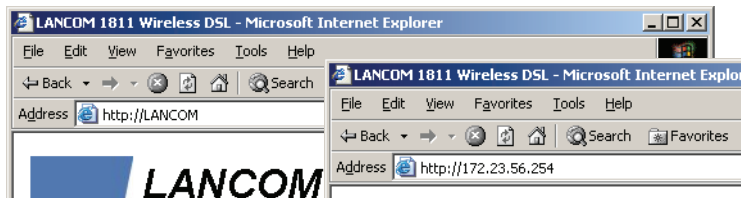
3.3 Instructions for WEBconfig

To configure the router with WEBconfig you must know how to address it in the LAN. The reaction of the devices, as well as their accessibility for configuration via web browser is dependent on whether a DHCP server and a DNS server are already active in the LAN, and whether these two server processes exchange the assignment of IP addresses to symbolic names within the LAN between each other.

After powered on, unconfigured LANCOM devices check first, whether a DHCP server is already active in the LAN. Dependent on the situation, the device is able to switch on its own DHCP server or, alternatively, to activate its DHCP client mode. In this second operating mode, the device itself can obtain an IP address from a DHCP server already existing in the LAN.

Network without DHCP server

In a network without DHCP server, unconfigured LANCOM devices activate their own DHCP server service after starting, and assign appropriate IP addresses and gateway information to the other workstations within the LAN, provided that the workstations are set to obtain their IP address automatically (auto-DHCP). In this constellation, the device can be accessed with any web browser from each PC with activated auto-DHCP function through the name **LANCOM** or by its IP address **172.23.56.254**.

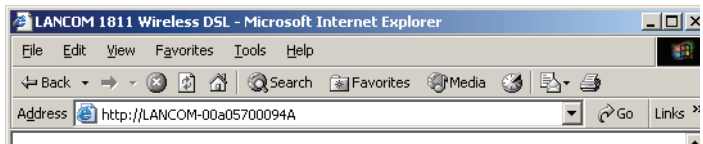


If the configuration PC does not obtain its IP address from the LANCOM DHCP server, figure out the current IP address of this PC (with **Start ▶ Execute ▶ cmd** and command **ipconfig** at the prompt under Windows 2000 or Windows XP, with **Start ▶ Execute ▶ cmd** and the command **winipcfg** at the prompt under Windows Me and Windows 9x, or with the command **ifconfig** on the console under Linux). In this case, the LANCOM is reachable under the IP address **x.x.x.254** ("x" stands for the first three blocks in the IP address of the configuration PC).

Network with DHCP server

If a DHCP server is active in the LAN to assign IP addresses, an unconfigured LANCOM device will turn off its own DHCP server. It will change into DHCP client mode and will obtain an IP address from the DHCP server of the LAN. This IP address is not known at first. The accessibility of the device depends on the name resolution:

- If there is a DNS server for name resolution in the LAN, which interchanges the assignment of IP addresses to names with the DHCP server, then the device can be accessed by the name “LANCOM <MAC address>” (e.g. “LANCOM-00a057xxxxx”).



The MAC address can be found on a label at the bottom of the device.

- If there is no DNS server in the LAN, or it is not linked to the DHCP server, then the device can not be reached by the name. The following options remain in this case:
 - Figure out the DHCP-assigned IP address of the LANCOM by suitable tools and contact the device directly with this IP address.
 - Use LANconfig.
 - Connect a PC with a terminal program via the serial configuration interface to the device.

Starting the wizards in WEBconfig

- ① Start your web browser (e.g. Internet Explorer, Netscape Navigator, Opera) and call the LANCOM Router there:

`http://<IP address of the LANCOM>`







(or with a name as described above)






If you cannot access an unconfigured LANCOM Router, the problem may be due to the netmask of the LAN: with less than 254 possible hosts (netmask > '255.255.255.0'), please ensure that the IP address 'x.x.x.254' is located in your own subnet.

The WEBconfig main menu will be displayed:


Setup Wizards
Wizards enable you to handle frequent configuration jobs easily and quickly:

-  [Basic Settings](#)
-  [Security Settings](#)
-  [Setup Internet Access](#)
-  [Selection of Internet Provider](#)
-  [Setup a RAS Account](#)
-  [Connect Two Local Area Networks](#)



Device Configuration and Status
These menu options enable you to access the device's entire configuration:

-  [Expert Configuration](#)
-  [Save Configuration](#)
-  [Load Configuration](#)

Firmware Handling

-  [Perform a Firmware Upload](#)

Extras

-  [Show/Search Other Devices](#)
-  [Get Device SNMP MIB](#)




The setup wizards are tailored precisely to the functionality of the specific LANCOM Router. As a result, your device may offer different wizards than those shown here.

If you have chosen automatic TCP/IP configuration, please continue with Step ③.

- ② If you would like to configure the TCP/IP settings manually, assign an available address from a suitable address range to the LANCOM Router. Also set whether or not it is to operate as a DHCP server. Confirm your entry with **Apply**.
- ③ In the following 'Security settings' window, specify a password for configuration access. Note that the password is case-sensitive and ensure that it is sufficiently long (at least 6 characters).

You may specify whether the device may only be configured from the local network or whether remote configuration via the WAN (i.e. a remote network) is also permissible.

 Please note that enabling this will also permit remote configuration via the Internet. You should always make sure that the configuration access is suitably protected, e.g. with a password.

④ In the next window, select your DSL provider from the list that is displayed. Confirm your choice with **Apply**.

If you select 'My provider is not listed here,' you must enter the transfer protocol used by your DSL provider manually in the next window. Confirm your choice with **Apply**.

⑤ Connect charge protection can limit the cost of DSL connections to a pre-determined amount if desired. Confirm your choice with **Apply**.

⑥ The basic setup wizard reports that all the necessary information has been provided. You can end the wizard with **Go on**.

3.4 TCP/IP settings to workstation PCs

The correct addressing of all devices within a LAN is extremely important for TCP/IP networks. In addition, all computers must know the IP addresses of two central points in the LAN:

- Default gateway – receives all packets that are not addressed to computers within the local network.
- DNS server – translates network names (www.lancom.de) or names of computers (www.lancom.de) to actual IP addresses.

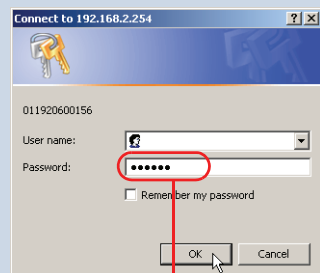
The LANCOM Router can perform the functions of both a default gateway and a DNS server. In addition, as a DHCP server it can also automatically assign valid IP addresses to all of the computers in the LAN.

Entering the password in the web browser

When you are prompted for a user name and password by your web browser when accessing the device in the future, enter your personal values to the corresponding fields. Please note that the password is case-sensitive.

If you are using the common configuration account, enter the corresponding password only. Leave the user name field blank.

Entering the configuration password



The correct TCP/IP configuration of the PCs in the LAN depends on the method used to assign IP addresses within the LAN:

■ **IP address assignment via the LANCOM Router (default)**

In this operating mode the LANCOM Router not only assigns IP addresses to the PCs in the LAN, it also uses DHCP to specify its own IP address as that of the default gateway and DNS server. The PCs must therefore be configured so that they automatically obtain their own IP address and the IP addresses of the standard gateway and DNS server (via DHCP).

■ **IP address assignment via a separate DHCP server**

The workstation PCs must be configured so that they automatically obtain their own IP address and the IP addresses of the standard gateway and DNS server (via DHCP). The IP address of the LANCOM Router must be stored on the DHCP server so that the DHCP server transmits it to the PCs in the LAN as the standard gateway. In addition, the DHCP server should also specify the LANCOM Router as a DNS server.

■ **Manual IP address assignment**

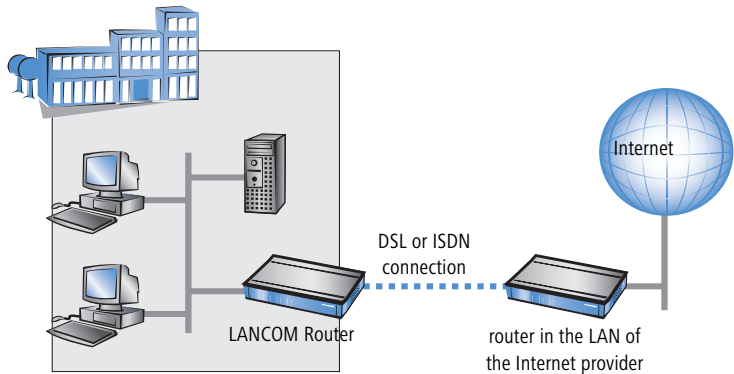
If the IP addresses in the network are assigned static ally, then for each PC the IP address of the LANCOM Router must be set in the TCP/IP configuration as the standard gateway and as a DNS server.



For further information and help on the TCP/IP settings of your LANCOM Router, please see the reference manual. For more information on the network configuration of the workstation computers, please refer to the documentation of your operating system.

4 Setting up Internet access

All computers in the LAN can take advantage of the central Internet access of the LANCOM Router. The connection to the Internet provider can be established via any WAN connection. Internet access via ISDN can be used as a backup connection for DSL, for example.



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Does the setup wizard know your Internet provider?

A convenient wizard is available to help you set up Internet access. The wizard knows the access information of major Internet providers and will offer you a list of providers to choose from. If you find your Internet service provider on this list, you normally will not have to enter any further transfer parameters to configure your Internet access. Only the authentication data that are supplied by your provider are required.

Additional information for unknown Internet providers

If the setup wizard does not know your Internet provider, it will prompt you for all of the required information step by step. Your provider will supply this information.

■ ADSL

- Protocol: PPP (PPPoA), PPPoE, Plain IP (IPoA) or Plain Ethernet
- ATM parameter: VPI (Virtual Path Identifier) and VCI (Virtual Circuit Identifier), VC or LLC-based Multiplexing
- Additionally for plain IP (IPoA) and Plain Ethernet: a dedicated public IP address with netmask (not to be confused with the private LAN IP

address), default gateway and DNS server. These values can be received automatically from providers that support DHCP.

■ DSL

- Protocol: PPPoE, PPTP or Plain Ethernet (IPoE)
- Additionally for Plain Ethernet: own public IP address with netmask (not to be confused with the private LAN IP address), default gateway and DNS server. These values can be received automatically from providers that support DHCP.
- User name and password

■ ISDN

- dial-in number
- User name and password

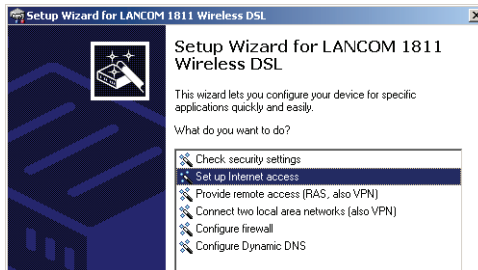
Additional connection options

You may also enable or disable further options in the wizard, depending on whether or not they are supported by your Internet provider:

- Time-based billing or flat rate – select the accounting model used by your Internet provider.
 - When using time-based billing, you can set the LANCOM Router to automatically close existing connections if no data has been transferred within a specified time (the so-called idle time).
In addition, you can activate a line monitor that identifies inactive remote stations faster and therefore can close the connection before the idle time has elapsed.
 - Active line monitoring can also be used with flat rate billing to continuously check the function of the remote station.
You also have the option of keeping flat rate connections alive if required. Dropped connections are then automatically re-established.
- Dynamic channel bundling (ISDN only)
 - if required, the second ISDN B-channel will automatically be bundled to the connection. This doubles the available bandwidth; it may also double your connect charges as well, however. What's more, your ISDN connection will be busy in this case, with all other incoming and outgoing calls being rejected.
- Data compression
 - this permits an additional increase in data throughput.

4.1 Instructions for LANconfig

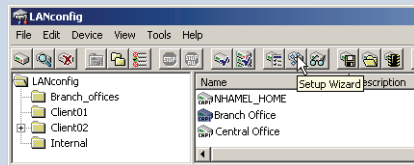
- ① Highlight the LANCOM Router in the selection window. From the menu bar, select **Tools ▶ Setup Wizard**.



- ② From the menu, select the **Setup Internet access** wizard and click **Next**.
- ③ In the following window select your country and your Internet provider if possible, and enter your access information.
- ④ Depending on their availability, the wizard will display additional options for your Internet connection.
- ⑤ The wizard will inform you as soon as the entered information is complete. Complete the configuration with **Finish**.

LANconfig: Quick access to the setup wizards

Under LANconfig, the fastest way to launch the setup wizards is via the button on the toolbar.



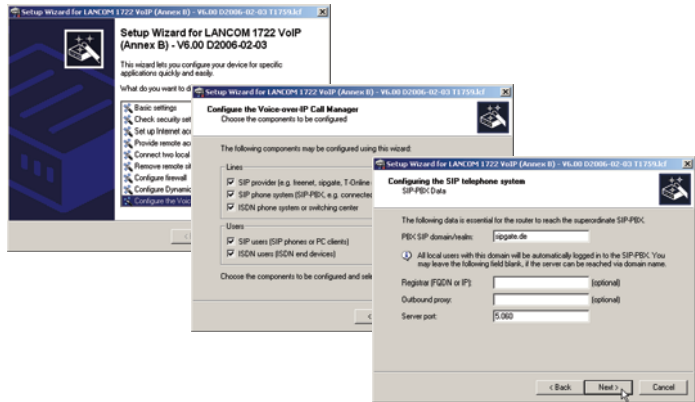
4.2 Instructions for WEBconfig

- ① In the main menu, select **Setup Internet access**.
- ② In the following window select your country and your Internet provider if possible, and enter your access information.
- ③ Depending on their availability, the wizard will display additional options for your Internet connection.
- ④ The wizard will inform you as soon as the entered information is complete. Complete the configuration with **Apply**.

5 Configuring Voice over IP

5.1 Instructions for LANconfig


- 1 Mark your LANCOM Router in the selection window. From the command line, select **Extras ▶ Setup Wizard**.



- 2 In the selection menu, select the Setup Wizard, **Configure Voice over IP Call Manager** and confirm the selection with **Continue**.
- 3 In the following windows, you will choose the lines and subscribers that you want to create. Enter the required information for this.
- 4 The wizard will inform you as soon as the entries are complete. Close the configuration with **Finish**.

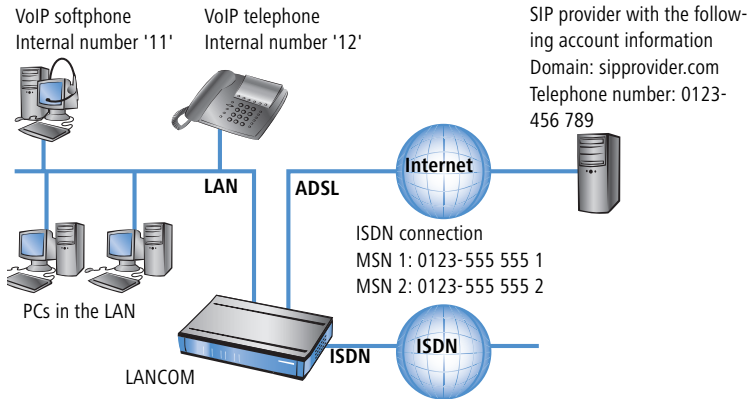
5.2 Configuration examples

The possible applications of the LANCOM VoIP Router are just as diverse as the steps required for their configuration. The following examples demonstrate the configuration of particular applications which, taken together, cover a great proportion of the possibilities.

-  To avoid redundancies, some of the examples build upon each other. We recommend that you read this in full, even if at first sight an application doesn't appear to be relevant to you.

5.2.1 VoIP telephony for stand-alone use

This example shows how to configure a LANCOM which is used as a central device for Internet connectivity and VoIP telephony at a new site.



Target

- Internal telephony with SIP telephones and SIP softphones.
- Access to internal terminal equipment via the MSNs.
- External telephony via the SIP provider with backup over ISDN.
- Calls to emergency and special numbers via ISDN.

Requirements

- LANCOM connected to the LAN and WAN, an ISDN TE interface is linked to the ISDN NTBA. The Internet connection has been set up.
- A telephone number plan with a unique internal telephone number for all terminal equipment to be connected, here, for example, the number '11' for the VoIP softphone and the number '12' for the VoIP telephone.
- A SIP provider account.

Using the information during configuration

The following table provides a summary of the information required for configuration and where it can be entered. SIP terminal equipment parameters

can be entered using the SIP telephone keypad, the corresponding configuration software, or the softphone configuration menu.

	LANCOM	SIP terminal equipment
Internal VoIP domain	✓	✓
Internal numbers	✓	✓
External SIP telephone number	✓	
Access information for SIP account	✓	
External ISDN telephone numbers (MSNs)	✓	
Country and local area code	✓	

Configuring the LANCOM

When configuring the LANCOM, the following steps must be carried out:

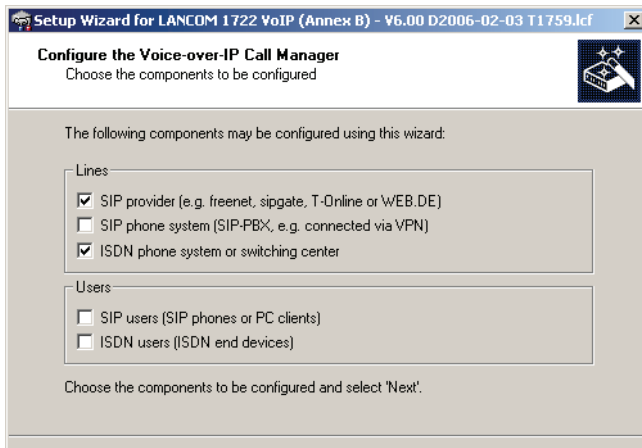
- Setting up the line to the SIP provider
- Enabling the ISDN interface and assigning MSNs to the internal numbers




In this example, it is not necessary to configure SIP users: The SIP users are registered at the LANCOM with the settings created in the terminal equipment (softphone and VoIP telephone).

Detailed instructions on configuring the LANCOM:

- ① Under LANconfig, start the setup wizard for configuring the VoIP Call Manager. Enable the options 'SIP phone system', 'ISDN phone system' and 'ISDN users'.



- ② Enter a unique domain for the local VoIP domain which describes the local VoIP range for the site (e.g. 'mycompany.internal').
- ③ Configure the line leading to the SIP provider, for example with the name 'SIPPROVIDER' with the following values:
 - Internal standard number: All calls that come in through the SIP provider are forwarded to this internal number. Enter an internal number from your telephone number plan here, e.g. '11'.
 - SIP domain/realm: You received this domain from your SIP provider; it is usually entered in the format 'sipdomain.tld' without the part that designates a specific server.
 - Registrar (FQDN / IP) (optional):
 - Outbound proxy (optional)

 The server description is generally not required; the DNS query for the SIP domain returns this information. Enter a server designation here only if your provider has informed you of the corresponding addresses.

- SIP ID / user: Enter the SIP number with local area code here, providing that the SIP provider does not require any other information.
- Display name (optional): The display name is only required if the SIP provider verifies this during registration. If you enter a display name here, then this name will be displayed at the remote site. If the field

remains empty, then the display name for the corresponding internal user is transmitted.

- Authentication name (optional): Special authentication names are not supported by all SIP providers. In many cases, the authentication name is the same as the SIP ID or the user name. Complete this field only if your SIP provider has issued you a special authentication name.
- Password: Enter the password for SIP access here.



This description applies to a "user-defined configuration". If you select a special SIP provider from the list, then some of the parameters will be pre-configured automatically.

- ④ Configure an ISDN line for VoIP telephony use. For every MSN on your ISDN connection, make an assignment to an internal number within your telephone number plan during ISDN mapping.
 - MSN 1 '555 555 1' ► internal number '11'
 - MSN 2 '555 555 2' ► internal number '12'
- ⑤ Enter the local and national area code for the device's location. Using this information, the Voice Call Manager can decide whether or not outgoing calls are local calls, national or international long distance calls.
- ⑥ Based upon the entries made so far, the LANconfig creates a suggestion for the call routing table which you can adapt to fit your requirements as follows:

Call routes							
Usage	Prio	Cld. no.	Comment	Dest. no.	Dest. line	2. no.	2
On	0	00001#	Delete own country prefix	00#	RESTART		
On	0	000800#	International free of charge call	00800#	ISDN		
On	0	000#	International call	00#	ISDN		
On	0	0010#	Modem call to Internet provider or Call-by-Call	010#	ISDN		
On	0	00180#	National service call	0180#	ISDN		
On	0	00800#	National free of charge call	0800#	ISDN		
On	0	00850#	Delete own city prefix	0#	RESTART		
On	0	00#	National call	0#	ISDN		
On	0	0110	Emergency call	110	ISDN		
On	0	0112	Emergency call	112	ISDN		
On	0	0#	City area call	0850#	ISDN	0850#	5
On	0	97#	Call via SIP provider SIPPROVIDER	#	SIPPROVIDER		
On	0	99#	Call via ISDN	#	ISDN		



The # sign is a placeholder for any character string. The entry '0#' is therefore suitable for all numbers dialed that have at least one '0' preceding them .

This suggested call routing table would place all external calls over the ISDN line. The SIP line is set up as a backup for international and national long distance calls and local calls that are not in the list of special or emergency numbers.

In order to channel calls to special destinations, such as international and national long distance calls, over the SIP provider, double-click on the corresponding entry in the table and switch the line used from 'ISDN' to 'SIPPROVIDER'. Don't forget to switch the backup line from SIP to ISDN, if necessary!

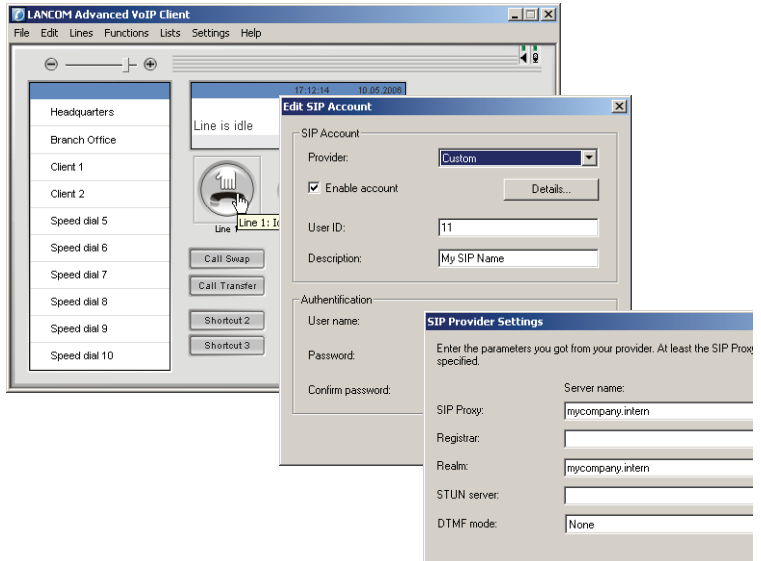
After being adapted for international ① and national ② long distance, the call routing table should appear as follows:

Usage	Prio	Clid. no.	Comment	Dest. no.	Dest. line	2. no
On	0	00001#	Delete own country prefix	00#	RESTART	
On	0	000800#	International free of charge call	00800#	ISDN	
①	On	0	000#	International call	00#	SIPPROVIDER
On	0	0010#	Modem call to Internet provider or Call-by-Call	010#	ISDN	
On	0	00180#	National service call	0180#	ISDN	
On	0	00800#	National free of charge call	0800#	ISDN	
On	0	00850#	Delete own city prefix	0#	RESTART	
②	On	0	00#	National call	0#	SIPPROVIDER
On	0	0110	Emergency call	110	ISDN	
On	0	0112	Emergency call	112	ISDN	
③	On	0	0#	City area call	0850#	ISDN
On	0	97#	Call via SIP provider SIPPROVIDER	#	SIPPROVIDER	
On	0	99#	Call via ISDN	#	ISDN	

Configuring the VoIP terminal equipment

Enter the registration information for the first SIP user in the softphone (example for LANCOM Advanced VoIP Client).

- ① Select the menu **Settings** ► **SIP accounts / Audio** and create a new SIP account with **Add**.



- ② Enter the following values:
 - User ID: Internal number for the user.
 - Description: Name of the user as it is to be displayed at the remote site.
- ③ With the button **Details**, open the dialog for the advanced settings and enter the following values:
 - SIP Proxy: Internal VoIP domain for the LANCOM.
 - Realm: Internal VoIP domain for the LANCOM.

Enter the registration data for the second SIP user in the VoIP telephone (example for Snom 190).

- ① From the **Setup** menu, select one of the possible lines, e.g. 'Line 2'.

Configuration Line 2

Operation Home Address Book Setup Preferences Speed Dial Function Keys Line 1 Line 2	Login Information: Displayname: <input type="text" value="My SIP Name 2"/> Account: <input type="text" value="12"/> Password: <input type="text" value="**"/> Registrar: <input type="text" value="mycompany.intern"/> Status: <input type="text" value="OK"/> Mailbox: <input type="text"/>
--	---

② Enter the following values:

- Registrar: Internal VoIP domain for the LANCOM.
- Account: Internal number for the user.
- Displayname: Name of the user as it be displayed at the remote site.

If you use another softphone or VoIP telephone, please consult the documentation for this device for information on configuring the software.

Call routing procedure on outgoing calls

On outgoing calls, the Call Manager first searches the call routing table from top to bottom. If the Call Router cannot find a matching entry there, it uses the list of registered users:

User	dials	correct call route	correct user	mapping, number in use	Destination line
① VoIP telephone	11	none	VoIP softphone	11	internal
② VoIP telephone	0 555 555	③ 0#		0241#: 0241 555 555	ISDN
③ VoIP telephone	0 0123 666 666	② 00#		0#: 0123 666 666	SIP provider

- ① The Call Router cannot find an entry that corresponds to '11' in the call routing table. Now it searches the list of registered users and finds the internal SIP user there.

For call routing, not just the users configured in the LANCOM, but all of the users that are actually registered on the Call Router are used. The SIP users can register themselves as long as they are not entered in the in the LANCOM. The entry for the internal VoIP domain on the LANCOM is sufficient for registration, assuming that local authentication is not required.

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- ② The entry ③ in the call routing table depicted above matches the number dialed. The call router removes the '0' outside-line access prefix, completes the area code for the local telephone network and completes the call to '0241 555 555' using the ISDN line.

The area code for the local telephone network is added on because calls via SIP providers usually require the area code to be dialed.

- ③ The entry ② in the call routing table is suitable here. The call router removes the '0' prefix for access to the outside line and completes the call to '0123 555 555' via the SIP line. If the SIP line is not available, then the call is made over the ISDN line.

Call routing procedure on incoming calls

For incoming calls, the telephone network exchange removes the prefix from the number dialed (destination number). Therefore, the LANCOM only receives the number itself, which may be treated differently depending on the source:

- Numbers from the ISDN network are translated with the ISDN mapping table to the internal number which is entered for the receiving MSN.
- Calls from a SIP network are converted to the internal destination number that is entered for the respective SIP line.

With the altered number, the Call Manager begins to search the call routing table from top to bottom. If the Call Router cannot find a matching entry there, the call is forwarded directly to the internal number:

	Remote site dials	Call Router receives	Assigned via	number in use	correct call route	Destination line
①	0 123 456 789	456 789	internal destination number for SIP line	11	none	internal
②	0 123 555 555 1	555 555 1	ISDN mapping	11	none	internal
③	0 123 555 555 2	555 555 2	ISDN mapping	12	none	internal

5.2.2 Using VoIP telephony to extend the downstream ISDN PBX

This example shows how to configure a LANCOM when a downstream ISDN PBX is enhanced with VoIP telephony capability. Until now, the MSNs '11' to '13' for the ISDN connection have been used for two ISDN telephones and one analog fax. The LANCOM will now be switched between the public ISDN connection and the ISDN PBX.

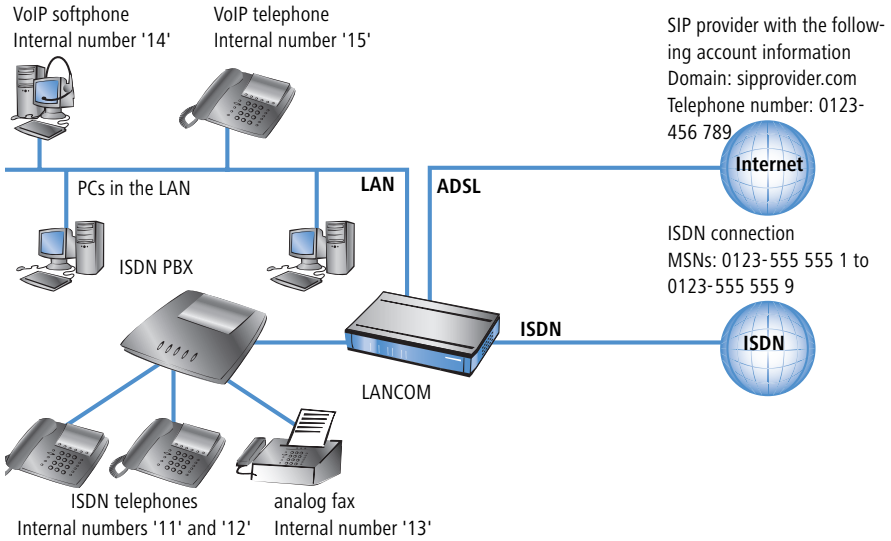


The PBX is configured to allow subscribers to receive immediate access to an outside line when they pick up the receiver.

This ISDN PBX is operated as a downstream PBX on the ISDN NT interface of the LANCOM.

■ Chapter 5: Configuring Voice over IP

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Target

- Internal telephony with ISDN and SIP telephones and SIP softphones.
- External telephony with ISDN and SIP terminal equipment over ISDN.
- Accessing internal terminal equipment (ISDN and SIP) via the MSNs.

Requirements

- LANCOM connected to the LAN and WAN, an ISDN NT interface is linked to the outside line exchange on the ISDN PBX. The Internet connection has been set up.
- A telephone number plan with a unique internal telephone number for all terminal equipment to be connected. In general, the numbers used are predetermined by the PBX, which often only allows certain number ranges.
- A SIP provider account.

Using the information during configuration

Telephone number plans with ISDN PBX systems.

When crossing from the ISDN network to the internal subscribers, the ISDN PBX converts the external MSNs to internal MSNs. When operating a LANCOM VoIP Router at the extension interface of the ISDN PBX, there is another conversion of the internal MSNs to the internal numbers of the VoIP range. For reasons of clarity, we recommend using congruent internal MSNs/numbers for terminal equipment for all connections.

The following table provides a summary of the information required for configuration and where it can be entered. SIP terminal equipment parameters can be entered using the SIP telephone keypad, the corresponding configuration software, or the softphone configuration menu.

	LANCOM	SIP terminal equipment	ISDN PBX	ISDN terminal equipment
Internal VoIP domain	✓	✓		
Internal numbers	✓	✓	✓	✓
External SIP telephone number	✓			
SIP account access information	✓			
External ISDN telephone numbers (MSNs)	✓			
Country and local area code	✓			

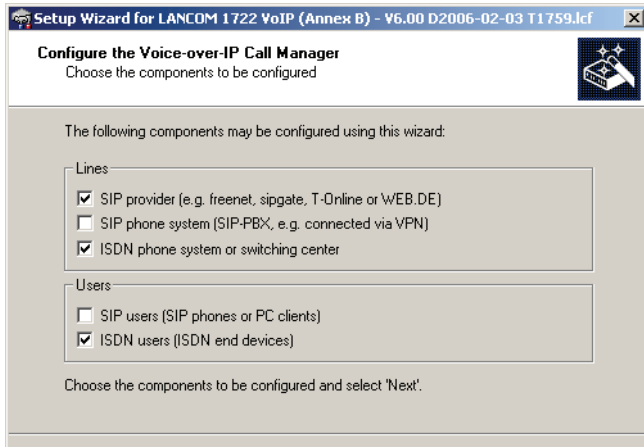
Configuring the LANCOM

When configuring the LANCOM, the following steps must be carried out:

- Setting up the line to the SIP provider
- Enabling the ISDN interface and assigning MSNs to the internal numbers in the LANCOM VoIP Router
- Creating ISDN users
- Adapting the call routing table

Detailed instructions on configuring the LANCOM:

- ① Under LANconfig, start the setup wizard for configuring the VoIP Call Manager. Enable the options 'SIP phone system', 'ISDN phone system' and 'ISDN users'.



- ② Configure the device as described in the preceding examples:
 - Unique local VoIP domains
 - One line to a SIP provider
- ③ Enable the external ISDN outside line and the internal ISDN bus in order to use the VoIP functionality. Enter all external MSNs for the ISDN outside line in the ISDN mapping table with their assignment to the internal numbers in the VoIP range.
- ④ Enter all connected ISDN terminal devices as ISDN users with the following values:
 - Telephone number / SIP name: This number will be assigned to the ISDN terminal device as an "internal number". The telephone structure will remain clear if you use the same internal number for a terminal device here as it uses in its own ISDN environment.
 - MSN/DDI: Enter the external MSNs for the ISDN outside line here; this will also be assigned to the terminal device by the ISDN PBX.
- ⑤ Enable spontaneous outside line access for ISDN and SIP users in order to keep the subscribers' telephone behavior as consistent as possible.

- ⑥ The call routing table suggested by the setup wizard automatically allows spontaneous outside line access for ISDN and SIP users ① and ②.

Routes for spontaneous outside line access

Entering the source line 'USER' is not visible in the screenshot. Using this filter, the route will only be in effect for calls that originate from a local user. The destination line 'RESTART' prompts a new pass through the call routing table, whereby the source line is deleted. Due to the missing source line, the route does not match this call during the second pass.

As a result of both of these routes, any stars '*' that might have preceded the numbers are removed before each call from a local user. For all other calls from local users, the number is preceded with a '0', as it is automatically assumed that the user is trying to establish an outside connection.

Usage	Prio	Cld. no.	Comment	Dest. no.	Dest. line	2. no.	2. line
①	On	1	*#	Escape code '*' for local call	#	RESTART	
②	On	1	#	User initiates normal external call	0#	RESTART	
	On	0	00001#	Delete own country prefix	00#	RESTART	
	On	0	000800#	International free of charge call	00800#	ISDN	
③	On	0	000#	International call	00#	ISDN	
	On	0	0010#	Modem call to Internet provider or Call-by-Call	010#	ISDN	
	On	0	00180#	National service call	0180#	ISDN	
	On	0	00800#	National free of charge call	0800#	ISDN	
	On	0	00850#	Delete own city prefix	0#	RESTART	
④	On	0	00#	National call	0#	ISDN	
	On	0	0110	Emergency call	110	ISDN	
	On	0	0112	Emergency call	112	ISDN	
⑤	On	0	0#	City area call	0850#	ISDN	0850# SIPGA
	On	0	97#	Call via SIP provider WIZ_SIPGATE	#	SIPGATE	
	On	0	99#	Call via ISDN	#	ISDN	

The other routes are used to carry out international ③ and national ④ long distance calls as well as local calls ⑤ as standard over the ISDN line. The Call Router removes the preceding zeros from the number again and sends the call out to the ISDN line.

In order to channel calls to special destinations, such as international and national long distance calls, over the SIP provider and not over ISDN, double-click on the corresponding entry in the table and switch the line used form 'ISDN' to 'SIPPROVIDER'. Don't forget to switch the backup line from SIP to ISDN, if necessary!

Call routes							
Usage	Prio	Clid. no.	Comment	Dest. no.	Dest. line	2. no.	2. line
On	1	*#	Escape code "*" for local call	#	RESTART		
On	1	#	User initiates normal external call	0#	RESTART		
On	0	00001#	Delete own country prefix	00#	RESTART		
On	0	000800#	International free of charge call	00800#	ISDN		
On	0	000#	International call	00#	SIPGATE		
On	0	0010#	Modem call to Internet provider or Call-by-Call	010#	ISDN		
On	0	00180#	National service call	0180#	ISDN		
1	On	0	00800#	National free of charge call	0800#	ISDN	
On	0	00850#	Delete own city prefix	0#	RESTART		
On	0	00#	National call	0#	SIPGATE		
2	On	0	0110	Emergency call	110	ISDN	
On	0	0112	Emergency call	112	ISDN		
On	0	0#	City area call	0850#	ISDN	0850#	SIPG
3	On	0	97#	Call via SIP provider WIZ_SIPGATE	#	SIPGATE	
On	0	99#	Call via ISDN	#	ISDN		
Default	0	#		#	ISDN		



This call routing table is only valid for PBX systems that forward the special character star '*' for internal calls on their external ISDN bus. If the PBX processes this character in a different manner, then the table must be adapted accordingly.

Configuring the VoIP terminal equipment

The VoIP terminal equipment is configured as described in the preceding examples with internal VoIP domains and internal numbers for the local site.

Configuring ISDN PBX

When configuring the PBX, external MSNs are assigned to internal MSNs. For every VoIP terminal device, a free internal MSN is linked to an external MSN. The internal number for the SIP user can be used as an external MSN for the VoIP terminal equipment in the PBX.

Configuring the ISDN terminal equipment

Configuring the ISDN terminal equipment is generally limited to entering the internal MSN used in the PBX.

Call routing procedure on outgoing calls

	User	dials	correct call route	correct user	mapping, number in use	Destination line
①	VoIP telephone	*14	① *#	VoIP softphone	#: 14	internal
②	VoIP telephone	*11	① *#	ISDN users	#: 11	ISDN

- ① Internal call between two VoIP terminal devices. On the first pass, only the star is removed from the number, the source line is deleted. During the second pass, no other route matches this call but the Call Router finds a matching entry for a SIP user in the list of registered users and can complete the call.
- ② Internal call from VoIP to ISDN. On the first pass, the star is removed from the number again, the source line is deleted. During the second pass, no other route matches this call but the Call Router finds a matching entry for an ISDN user in the list of registered users and establishes the call via the ISDN interface configured for this user. The destination number is replaced by the MSN entered for this user '555 555 1' . The PBX receives the call to '555 555 1' on its external ISDN bus and again determines that this is an external MSN and can channel the call to the corresponding ISDN telephone.

Call routing procedure on incoming calls

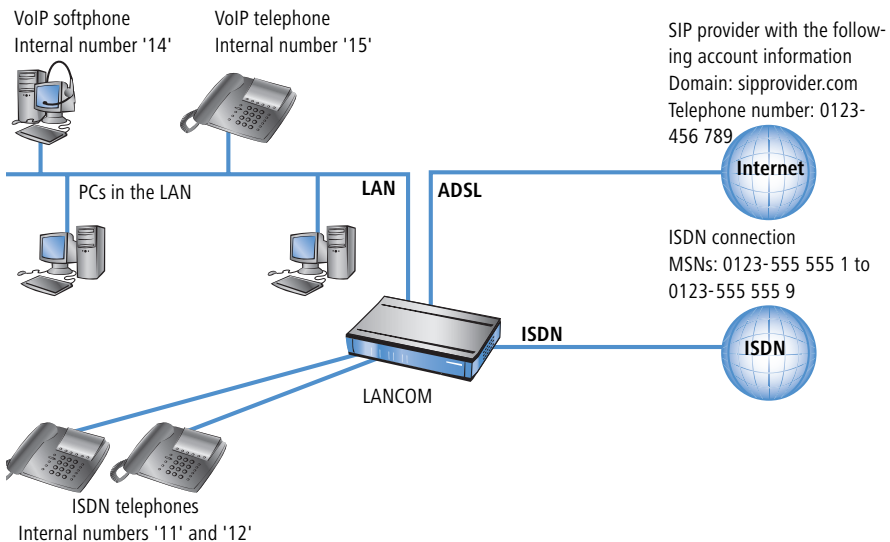
	Remote site dials	Call Router receives	Assigned via	number in use	correct call route	Destination line
①	0 123 555 555 1	555 555 1	<ul style="list-style-type: none"> ■ ISDN mapping table ■ List of local ISDN users 	11		ISDN NT

- ① The incoming call via the number to the MSNs for the connected ISDN terminal equipment is converted into an internal number by the ISDN mapping table and passed on to the Call Router. The Call Router cannot find a matching entry in the call routing table, but it can find a registered user with the matching internal number. Since the user is an ISDN user, the Call

Router directs the call to the ISDN line with the MSN entered for this user, '555 555 1'. The PBX receives the call to '555 555 1' on its external ISDN bus and again determines that this is an external MSN and can channel the call to the corresponding ISDN telephone.

5.2.3 Using VoIP telephony to supplement existing ISDN telephones

This example shows how to configure a LANCOM when the ISDN telephones used unit now are to be enhanced with VoIP telephony. The external MSNs '555 555 1' and '555 555 2' on the ISDN bus at the NTBA were used for two ISDN telephones until now. The LANCOM will now be switched between the public ISDN connection and the internal ISDN bus connected to the ISDN telephones.



Target

- Internal telephony with ISDN and SIP telephones and SIP softphones.
- External telephony with ISDN and SIP terminal equipment over ISDN.
- Accessing internal terminal equipment (ISDN and SIP) via the MSNs.

Requirements

- LANCOM connected to the LAN and WAN, an ISDN NT interface is linked to the outside line exchange on the ISDN PBX. The Internet connection has been set up.
- A telephone number plan with a unique internal telephone number for all terminal equipment to be connected.
- A SIP provider account.

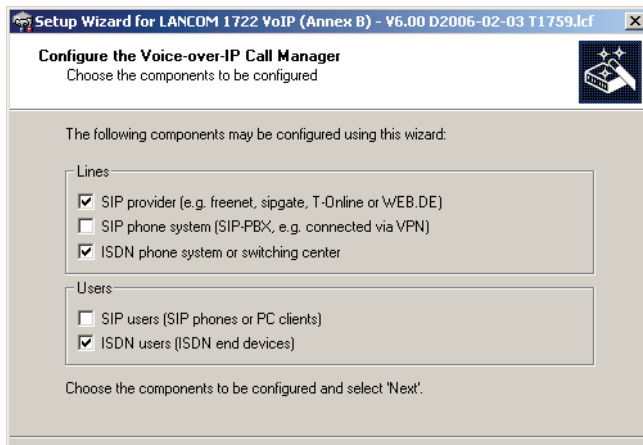
Configuring the LANCOM

When configuring the LANCOM, the following steps must be carried out:

- Setting up the line to the SIP provider
- Enabling the ISDN interface and assigning MSNs to the internal numbers in the LANCOM VoIP Router
- Creating ISDN users
- Adapting the call routing table

Detailed instructions on configuring the LANCOM:

- ① Under LANconfig, start the setup wizard for configuring the VoIP Call Manager. Enable the options 'SIP phone system', 'ISDN phone system' and 'ISDN users'.



- ② Configure the device as described in the preceding examples:
 - Unique local VoIP domains
 - one line to a SIP provider

- ③ Enable the external ISDN outside line and the internal ISDN bus in order to use the VoIP functionality. Enter all external MSNs for the ISDN outside line in the ISDN mapping table with their assignment to the internal numbers in the VoIP range.
- ④ Enter all connected ISDN terminal devices as ISDN users with the following values:
 - Telephone number / SIP name: This number will be assigned to the ISDN terminal device as an "internal number". The telephone structure will remain clear if you use the same internal number for a terminal device here as it uses in its own ISDN environment.
 - MSN/DDI: Here, enter the external MSN of the ISDN outside line which was formerly entered into the ISDN telephone.

Assigning external MSNs to internal telephone numbers

In this example, the external MSNs and the internal telephones will be assigned "crossed over":

- In the ISDN mapping table, the external MSN '555 555 1' is assigned to the internal telephone number '11', for example. An external call to '555 555 1' will be switched by the LANCOM as a call to '11'.
- By assigning the MSN '555 555 1' to the internal telephone number of the ISDN user '11', the call will be directed over the internal ISDN bus of the LANCOM with the target telephone number '555 555 1'.

Because the ISDN telephone "listens" out for its own MSN, exactly as it used to before implementing the LANCOM VoIP Router, the call is placed to the correct telephone.

Should the LANCOM VoIP Router fail due to a power outage, the life-line support and power relay over the ISDN bus, if activated, enable the connected telephones to continue to function.

- ⑤ Enable spontaneous outside line access for ISDN and SIP users in order to keep the subscribers' telephone behavior as consistent as possible.
- ⑥ The continued configuration and changes to the call routing table are carried out just as in the example 'Using VoIP telephony to extend the downstream ISDN PBX'.

Configuring the VoIP terminal equipment

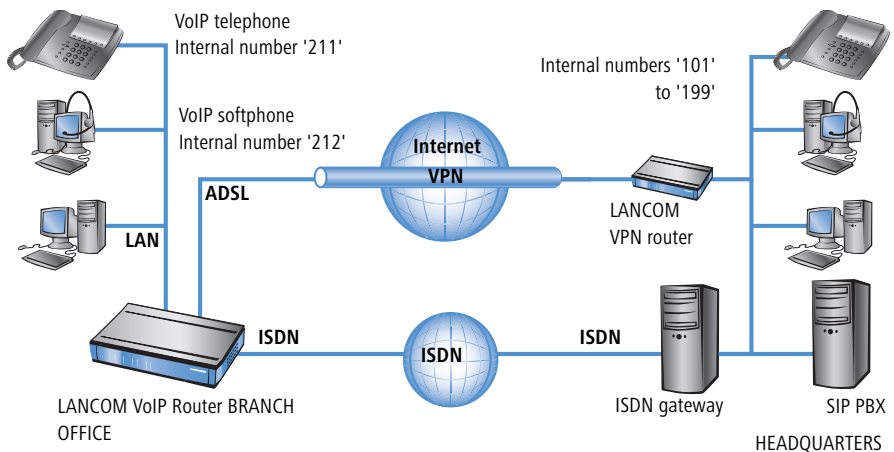
The VoIP terminal equipment is configured as described in the preceding examples with internal VoIP domains and internal numbers for the local site.

Configuring the ISDN telephones

Configuring the ISDN terminal equipment is generally limited to entering the external MSN. As a rule, the MSNs were already entered into the ISDN telephones before, and so no changes should be necessary.

5.2.4 Connecting to an upstream SIP PBX

In this example, a branch office network will be connected to the headquarters network over VPN. In addition to data transfer, the telephone structure in the branch office is also connected to the central SIP PBX. A LANCOM VoIP Router is used in the branch office network and a LANCOM VPN router, for example, could act as the VPN end point at the headquarters. The telephony subscribers at the headquarters receive internal extensions from the number range '101' to '199'; for each of the branch offices, a 10-digit block from the 200 range is reserved - in this example, '211' to '219'.



Target

- Internal telephony between all locations.
- External telephony from the branch office via the SIP PBX at the headquarters with backup over ISDN.
- Calls from the branch office into the local telephone network via ISDN.
- Calls to emergency and special numbers via ISDN.

Requirements

- LANCOM connected to the LAN and WAN, an ISDN TE interface is linked to the ISDN NTBA.
- The Internet connection has been set up, as has the network connection between both of the locations by means of a VPN tunnel. Any terminal equipment that is connected can be reached with the IP addresses used.
- A telephone number plan with a unique internal telephone number for all terminal equipment to be connected.
- A SIP provider account.

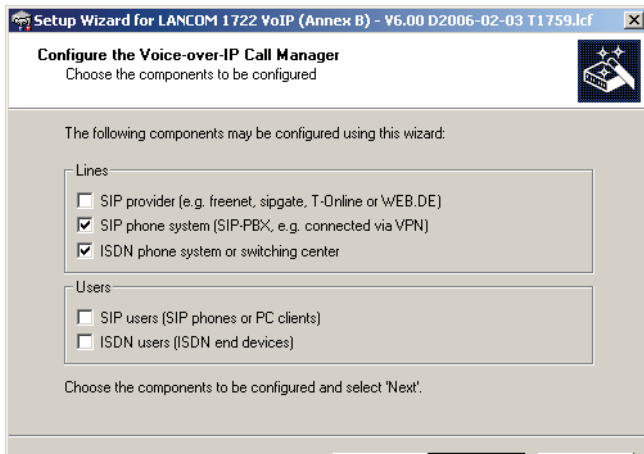
Configuring the LANCOM

The following table provides a summary of the information required for configuration and where it can be entered. Basically, all that is needed is a SIP PBX line for each location that is correspondingly setup at the remote location

	LANCOM Branch office	SIP terminal equip- ment Branch office	SIP PBX Headquarters
Internet VoIP domain	mycompany.BRANCH01	mycompany.HQ	mycompany.HQ
Internal SIP subscriber numbers at the branch office		✓	✓
External ISDN telephone numbers (MSNs)	✓		
Country and local area code	✓		
SIP PBX line	HQ		
SIP PBX domains	mycompany.HQ		
SIP PBX registration password	✓		✓
Call route	<ul style="list-style-type: none"> ■ Number called '2#' ■ Destination line 'LOCATION_B' ■ Destination number '2#' 		

Detailed instructions on configuring the LANCOM:

- ① Under LANconfig, start the setup wizard for configuring the VoIP Call Manager. Enable the options 'SIP phone system', 'ISDN phone system' and 'ISDN users'.



- ② Configure the device as described in the preceding examples:
 - ISDN line with MSN mapping
 - Area and country code for each location
- ③ Enter a unique domain for the local VoIP domain which describes the local VoIP range for the branch office, e.g. 'mycompany.BRANCH01' for the first branch.
- ④ Configure the line leading to the SIP PBX with the following values:
 - SIP PBX line name: Unique name for the line leading to the SIP PBX, e.g. 'HQ' for "Headquarters".
 - PBX SIP domain/realm: Internal VoIP domain or SIP PBX, e.g. 'mycompany.HQ'.
 - Registrar (FQDN or IP) (optional): SIP PBX address in the headquarters network, in the event that the device cannot be identified via DNS resolution of the VoIP domain (PBX SIP domain/realm).



Use the SIP PBX IP address from the private IP address range at the headquarters that can be reached via VPN here.

- Outbound proxy (optional): It is generally not necessary to designate the outbound proxy. Only enter a server designation here should your SIP PBX require corresponding addresses.

- Shared PBX password: This password is used by all SIP users when registering at the SIP PBX.


Shared or user-dependent SIP PBX password

If registration with a shared password is not desired, then an individual password can be used for each SIP user. In this case, each SIP user is configured with its own password in the LANCOM.

- Public PBX number: Here, enter the number at which the SIP PBX is to be reached over the public telephone network from the location of the LANCOM. The number is entered with the **necessary** prefixes, but without an extension number. For example, if the SIP PBX is located in London and the LANCOM is in Birmingham, then the public PBX number is '020 12345'.

- ⑤ The call routing table suggested by the setup wizard automatically allows international ① and national ② long distance calls to be made via the SIP PBX at the headquarters.

In addition, a **standard route** ④ is used in order to conduct calls from the LANCOM VoIP range to internal SIP PBX numbers via the corresponding SIP PBX lines.

-  This special entry is only used during the second pass in the call routing table, after the first pass found no corresponding entry for "normal" routes and if no matching internal number was found in the list of local users.

Call routes						
Usage	Prio	Cld. no.	Comment	Dest. no.	Dest. line	2. no.
On	0	00001#	Delete own country prefix	00#	RESTART	
On	0	000800#	International free of charge call	00800#	ISDN	
①	On	0	000#	International call	000#	HQ
On	0	0010#	Modem call to Internet provider or Call-by-Call	010#	ISDN	
On	0	00180#	National service call	0180#	ISDN	
On	0	00800#	National free of charge call	0800#	ISDN	
On	0	00850555555#	Reroute to PBX line HQ	#	RESTART	
On	0	00850#	Delete own city prefix	0#	RESTART	
②	On	0	00#	National call	00#	HQ
On	0	0110	Emergency call	110	ISDN	
On	0	0112	Emergency call	112	ISDN	
③	On	0	0#	City area call	0850#	ISDN
On	0	98#	Call via ISDN	#	ISDN	
On	0	99#	Call via SIP-PBX HQ	0#	HQ	
④	Default	0	#	Default to SIP-PBX HQ	#	HQ

Configuring the VoIP terminal equipment

The VoIP terminal equipment is configured as described in the preceding examples. However, here, the SIP PBX VoIP domain and the internal numbers configured in the SIP PBX are used.

Automatic SIP user registration with the LANCOM and the SIP PBX.




By using the SIP PBX domain with VoIP terminal equipment, the user is registered in two ways:

- Since registration takes place with a valid domain defined in the LANCOM, terminal devices are registered as "local users".
- Since the domain that is used does not correspond to the LANCOM's own VoIP domain, a simultaneous attempt is made at registering with the upstream SIP PBX. If the password used corresponds to the password stored in the SIP PBX for this user, then the registration on the SIP PBX will be successful.

Configuring the SIP PBX

In the SIP PBX, all users from the branch office network are entered with their own internal number. For this purpose, either the shared password is entered or a separate password is assigned for each user ('Shared or user-dependent SIP PBX password' → page 90).

Call routing procedure on outgoing calls

	User	dials	correct call route	correct user	mapping, number in use	Destination line
①	Branch VoIP telephone	212	none	VoIP softphone	212	internal
②	Branch VoIP telephone	199	④ #	SIP subscribers at the head-quarters	#: 199	SIP PBX
③	Branch VoIP telephone	0 555 555	③ 0#		0241#: 0241 555 555	ISDN
④	Branch VoIP telephone	0 0123 666 666	②   		00#: 0123 666 666	SIP provider

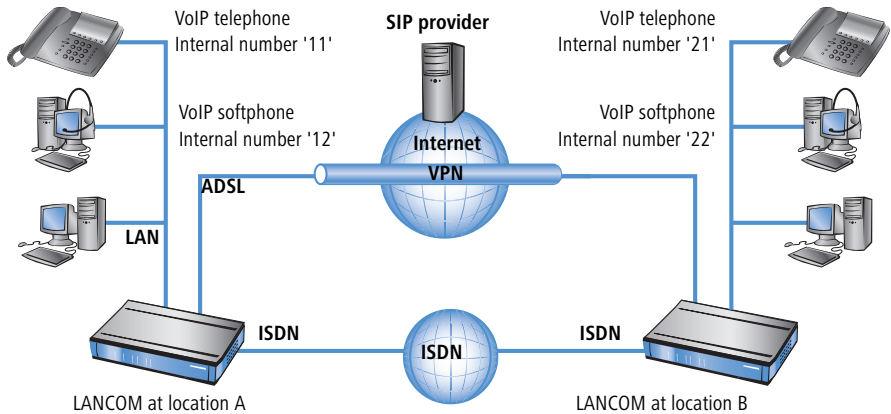
- ① Internal call between two VoIP terminal devices at the branch office. The number dialed, '212', does not match any of the routes listed in the call

routing table. Therefore, the call router searches the local user list, finds the correct entry there and can forward the call internally.

- ② Internal call between a VoIP terminal device at the branch office and the internal subscriber '199' at the headquarters. The number dialed, '199', does not match any of the routes listed in the call routing table during the first pass. Similarly, no matching entry can be found in the local user list. In the second pass through the call routing table, the standard routes are considered too. The route with the number called '#' ④ corresponds to all calls which could not be assigned earlier. The call to '199' is therefore carried out over the SIP PBX line.
- ③ External call from the branch office into the local telephone network. The number dialed, '0 555,555', matches the route '0#' ③ in the call routing table. The call router removes the '0' outside-line access prefix, completes the area code for the local telephone network and completes the call to '0241 555 555' using the ISDN line.
- ④ External call from the branch office into a national telephone network. The number dialed, '0 0123 555 555', matches the route '00#' ② in the call routing table. The call router sends the call out to the SIP PBX line **unchanged**. Only now does the SIP PBX removes the '0' outside-line access prefix and completes the call to '0123 555 555' via the ISDN outside line.

5.2.5 VoIP coupling for locations without a SIP PBX

Companies with widely disperse offices and without their own SIP PBX can also take advantage of VoIP site coupling. In this "Peer-to-Peer" scenario, a LANCOM VoIP Router has been implemented at both locations.



Target

- Internal telephony at and between both locations.
- External telephony via the SIP provider with backup over ISDN.
- Calls to emergency and special numbers via ISDN.

Requirements

- LANCOM connected to the LAN and WAN, an ISDN TE interface is linked to the ISDN NTBA.
- The Internet connection has been set up, as has the network connection between both of the locations by means of a VPN tunnel. Any terminal equipment that is connected can be reached with the IP addresses used.
- A telephone number plan with a unique internal telephone number for all terminal equipment to be connected. For each site, a separate number range is used; in this example, the internal numbers for location A begin with a '1' and the internal numbers for location B begin with a '2'.
- Each site has a SIP provider account.

Configuring the LANCOM

The following table provides a summary of the information required for configuration and where it can be entered. Basically, all that is needed is a SIP PBX line for each location that is correspondingly setup at the remote location

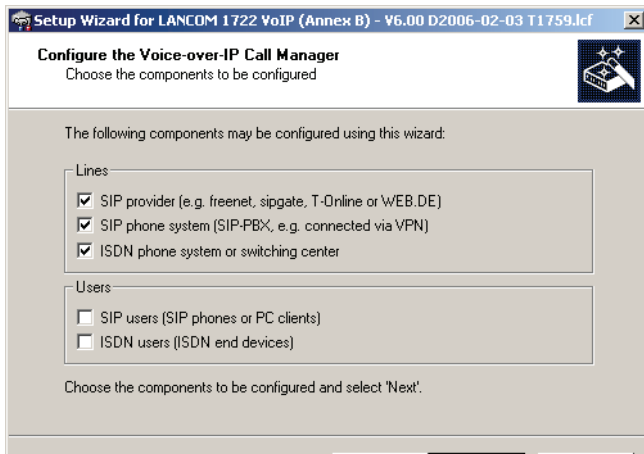
	LANCOM Location A	SIP terminal equipment location A	LANCOM Location B	SIP terminal equipment location B
Internal VoIP domain	location_A.internal	location_A.internal	location_B.internal	location_B.internal
Internal numbers		10 to 19		20 to 29
External SIP telephone number	✓		✓	
Access information for SIP account	✓		✓	
External ISDN telephone numbers (MSNs)	✓		✓	
Country and local area code	✓		✓	
SIP PBX line	LOCATION_B		LOCATION_A	
SIP PBX domains	location_B.internal		location_A.internal	
Call route	<ul style="list-style-type: none"> ■ Number called '2#' ■ Destination line 'LOCATION_B' ■ Destination number '2#' 		<ul style="list-style-type: none"> ■ Called number '1#' ■ Destination line 'LOCATION_A' ■ Destination number '1#' 	



Although SIP PBX lines are the subject of the configuration presented here, you can still use this function even without a PBX.

Detailed instructions on configuring the LANCOM:

- ① Under LANconfig, start the setup wizard for configuring the VoIP Call Manager. Enable the options 'SIP phone system', 'ISDN phone system' and 'ISDN users'.



- ② Configure the device as described in the preceding examples:
 - one line to a SIP provider
 - ISDN line with MSN mapping
 - Area and country code for each location
- ③ Enter a unique domain for the local VoIP domain which describes the local VoIP range for the site. Both sites use **different** VoIP domains, e.g. 'location_A.internal' or 'location_B.internal'.
- ④ Configure the line leading to the SIP PBX with the following values:
 - SIP PBX line name: Unique name for the line leading to the remote site.
 - PBX SIP domain/realm: Internal VoIP domain for the remote site.
 - Registrar (FQDN or IP): Address for the LANCOM at the remote site, in the event that the device cannot be identified via DNS resolution of the VoIP domain (PBX SIP domain/realm).



Use the private IP address that can be reached via VPN for the LANCOM here, not the public IP.

- Leave the field for the shared password empty when registering to the SIP PBX.
- Leave the field for the public PBX number empty.

- ⑤ The call routing table suggested by the setup wizard automatically allows international ① and national ② long distance calls to be made via remote site's line, local calls ③ are routed via ISDN.

In addition, a **standard route** ④ directs all numbers which cannot be resolved to the remote location's line.

Usage	Prio	Cld. no.	Comment	Dest. no.	Dest. line	2. no.
On	0	00001#	Delete own country prefix	00#	RESTART	
On	0	000800#	International free of charge call	00800#	ISDN	
①	On	0	000#	International call	000#	LOCATION_B 00#
On	0	0010#	Modem call to Internet provider or Call-by-Call	010#	ISDN	
On	0	00180#	National service call	0180#	ISDN	
On	0	00800#	National free of charge call	0800#	ISDN	
On	0	00850#	Delete own city prefix	0#	RESTART	
②	On	0	00#	National call	00#	LOCATION_B 0#
On	0	0110	Emergency call	110	ISDN	
On	0	0112	Emergency call	112	ISDN	
③	On	0	0#	City area call	0850#	ISDN 0850#
On	0	97#	Call via SIP provider WIZ_SIPGATE	#	WIZ_SIPGATE	
On	0	98#	Call via ISDN	#	ISDN	
On	0	99#	Call via SIP-PBX LOCATION_B	0#	LOCATION_B	
④	Default	0	#	Default to SIP-PBX LOCATION_B	#	LOCATION_B

- ⑥ Adapt the suggested call routing table in order to make international and national long distance calls via the SIP provider line with backup over ISDN. When doing so, please observe that the '0' preceding the number must be removed.

Call routes - Edit Entry

Entry active / default line: Active

Priority: 0

Called number/name: 000#

Comment: International call

Mapping

If a call matches the below mentioned attributes, it will be redirected to

Number/name: 00#

Line: SIPPROVIDER

Should the number or line not be available, you may specify alternative destinations here.

2. number: 00#

2. line: ISDN

After being adapted for international ① and national ② long distance, the call routing table should appear as follows:

Usage	Prio	Clid. no.	Comment	Dest. no.	Dest. line	2. no.
On	0	00001#	Delete own country prefix	00#	RESTART	
On	0	000800#	International free of charge call	00800#	ISDN	
①	On	000#	International call	000#	SIPPROVIDER	00#
On	0	0010#	Modem call to Internet provider or Call-by-Call	010#	ISDN	
On	0	00180#	National service call	0180#	ISDN	
On	0	00800#	National free of charge call	0800#	ISDN	
On	0	00850#	Delete own city prefix	0#	RESTART	
②	On	00#	National call	00#	SIPPROVIDER	0#
On	0	0110	Emergency call	110	ISDN	
On	0	0112	Emergency call	112	ISDN	
On	0	0#	City area call	0850#	ISDN	0850#
On	0	97#	Call via SIP provider WIZ_SIPGATE	#	WIZ_SIPGATE	
On	0	98#	Call via ISDN	#	ISDN	
On	0	99#	Call via SIP-PBX LOCATION_B	0#	LOCATION_B	
Default	0	#	Default to SIP-PBX LOCATION_B	#	LOCATION_B	

- ⑦ In this state, all calls that cannot be resolved by the call routing table and which do not have a corresponding entry in the local user list are automatically forwarded to the remote site.

If this is not desired, for example, where more than two sites are connected in this way, an additional entry can detect only the internal calls to a particular site. For this, make a new entry (for the number range '20' to '29' at location B) in the call routing table ⑤ with the following values:

- Called number / name: e.g. '2#' for all numbers that begin with a 2.
- Number / name: The number called is remains unchanged and is used as a destination number, i.e. here, also '2#'.
- Line: Enter the SIP PBX line for the remote location here, i.e. 'LOCATION_B'.

In doing so, the standard route ④ is adjusted so that all numbers which cannot be resolved are transmitted via ISDN.

After being adapted, the call routing table should appear as follows:

Usage	Prio	Cld. no.	Comment	Dest. no.	Dest. line	2. no.
On	0	00001#	Delete own country prefix	00#	RESTART	
On	0	000800#	International free of charge call	00800#	ISDN	
On	0	000#	International call	000#	SIPPROVIDER	00#
On	0	0010#	Modem call to Internet provider or Call-by-Call	010#	ISDN	
On	0	00180#	National service call	0180#	ISDN	
On	0	00800#	National free of charge call	0800#	ISDN	
On	0	00850#	Delete own city prefix	0#	RESTART	
On	0	00#	National call	00#	SIPPROVIDER	0#
On	0	0110	Emergency call	110	ISDN	
On	0	0112	Emergency call	112	ISDN	
On	0	0#	City area call	0850#	ISDN	0850#
5	On	0	2#	Call to location B	2#	LOCATION_B
	On	0	97#	Call via SIP provider WIZ_SIPGATE	#	WIZ_SIPGATE
	On	0	98#	Call via ISDN	#	ISDN
	On	0	99#	Call via SIP-PBX LOCATION_B	0#	LOCATION_B
4	Default	0	#	Default to ISDN	#	ISDN



This entry for 'LOCATION_B' is placed well down toward the end of the call routing table so as not to affect the more general rules. However, for interaction with the other routes, verify that only the internal numbers for the remote site are directed to the respective line.

Configuring the VoIP terminal equipment

The VoIP terminal equipment is configured as described in the preceding examples with internal VoIP domains and internal numbers for the local site.

Call routing procedure on outgoing calls

For this application, most calls take place as described in the preceding examples. Internal calls between locations are resolved as follows:

	User	dials	correct call route	correct user	mapping, number in use	Destination line
①	VoIP telephone location A	21	2#	none	21	LOCATION_B

① Internal call between two VoIP terminal devices at locations A and B. The number dialed '21' matches the route ⑤ '2#' in the call routing table. The call router sends the call out over the line to the remote SIP PBX without changing the number.

5.2.6 Connection diagnosis with LANmonitor

LANmonitor displays a wealth of information about calls switched in the LANCOM:

- Information about the registered users.
- Information about the lines available.
- Information about current calls, including the translation of telephone numbers and domains by the Call Manager.

The screenshot shows the LANmonitor application window with a tree view of system configuration and call details. The tree view is expanded to show the following information:

- VPN_NHAMEL
 - WAN connections: 1
 - VoIP Call Manager
 - Users: 3
 - ISDN user: 10 (Registered local)
 - Type: ISDN user
 - Number/Name: 10
 - Domain: None
 - Interface: ISDN-1
 - Local registration: Registered
 - Remote registration: Registration pending
 - SIP user: 12@isdn (Norbert Hamel (ISDN) (Registered local))
 - SIP user: 12@bridgecom.intern (Norbert Hamel) (Registered local)
 - Lines: 3
 - SIP provider: SIPGATE (Registered)
 - Type: SIP provider
 - Registration: Registered
 - Line: Ready
 - Domain: sipgate.de
 - SIP provider: FWD2 (Registered)
 - ISDN: ISDN
 - Calls: 1
 - 12@bridgecom.intern (Norbert Hamel) -> SIPGATE: 0240549936311@sipgate.de
 - Source line: USER-SIP
 - Source display name: Norbert Hamel
 - Source number/name: 12
 - Source domain: bridgecom.intern
 - Dialed number/name: 0240549936311
 - Dialed domain: bridgecom.intern
 - Destination line: SIPGATE
 - Destination number/name: 0240549936311
 - Destination domain: sipgate.de
 - Codec (source->destination): PCMA/8000 (G.711a-law)
 - Codec (destination->source): PCMA/8000 (G.711a-law)
 - Call time: 26.01.2006 14:47:15
 - Connect time: 26.01.2006 14:47:19
 - End time:

6 Linking two networks

With the network interconnection (also known as LAN to LAN coupling) of the LANCOM Router, two local networks are linked. The LAN to LAN coupling can be realized in principle in two different ways:

- **VPN:** For coupling via VPN, the connection between both LANs is established over a specially secured connection through the public Internet. A router with VPN support is required in both LANs.
- **ISDN:** For coupling via ISDN, a direct connection between both LANs is established over an ISDN connection. A router with ISDN interface is required in both LANs.

Always configure both sides

Both routers involved in the network interconnection must be configured. Care must be taken to ensure that the configuration information provided matches.



The following instructions will assume that LANCOM Router routers are being used on both sides. A network interconnection may also be realized with routers from other manufacturers. A mixed setup usually requires more extensive configuration measures for both devices, however. Please refer to the reference manual for more information in this regard.

A setup wizard handles the configuration of the connection in the usual convenient manner.

Security aspects

You must, of course, protect your LAN against unauthorized access. A LANCOM Router therefore offers a whole range of security mechanisms that can provide an outstanding level of protection:

- **VPN:** Network couplings via VPN transmit data by IPSec. The data are encrypted by AES, 3-DES, Blowfish or CAST encryption algorithms.
- **ISDN:** For network couplings via ISDN, the connection password, the checking of the ISDN number and the callback function ensure the security of the connection.



The ISDN call back function cannot be configured using the wizard. It can only be set up in the expert configuration. For details, please see the reference manual.

6.1 What information is necessary?

The wizard will prompt you for the necessary information on a step-by-step basis. If possible, however, you should have it available before launching the wizard.

To explain the significance of the information requested by the wizard, we will be using a typical deployment as an example: setting up a link between a branch office and its headquarters. The routers involved are named 'HEAD_OFFICE' and 'BRANCH'.

Please refer to the following tables for the entries to be made for each of the routers. Arrows mark the dependencies between the entries.

6.1.1 General information

The following details are required for the installation of LAN to LAN couplings. The first column indicates, whether the information is required for network couplings over VPN (standard method using “preshared keys”) and/or ISDN.



Further details to network couplings via VPN using enhanced methods (e.g. digital certificates) can be found in the LCOS reference manual.

Coupling	Entry	Gateway 1		Gateway 2
VPN	ISDN connection available?	yes/no		yes/no
VPN	Type of the local IP address	static/dynamic		static/dynamic
VPN	Type of the remote IP address	static/dynamic		static/dynamic
VPN + ISDN	Name of the local device	'HEAD'		'BRANCH'
VPN + ISDN	Name of the remote station	'BRANCH'		'HEAD'
VPN + ISDN	Remote ISDN calling number	(0123) 123456		(0789) 654321
VPN + ISDN	Remote ISDN caller ID	(0789) 654321		(0123) 123456
VPN + ISDN	Password for secure transmission of the IP address	'Password'		'Password'
VPN	Shared secret for encryption	'Secret'		'Secret'
VPN	IP address of remote station	'10.0.2.100'		'10.0.1.100'

■ Chapter 6: Linking two networks

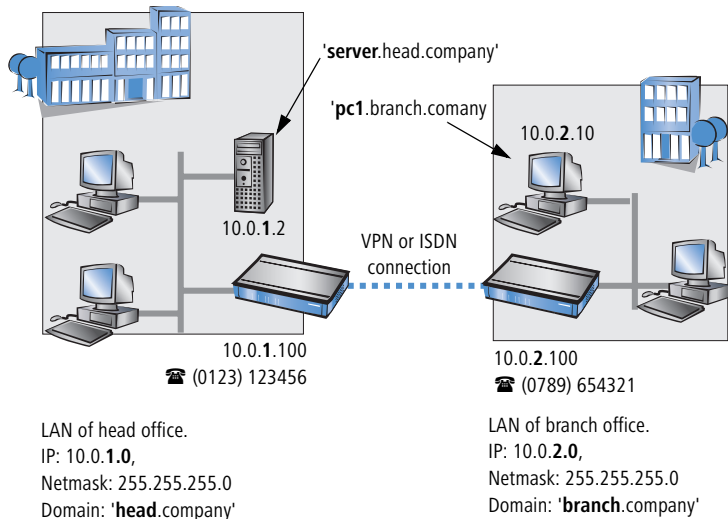
Coupling	Entry	Gateway 1	Gateway 2
VPN	IP network address of the remote network	'10.0.2.0'	'10.0.1.0'
VPN	Netmask of the remote network	255.255.255.0	255.255.255.0
VPN	Domain name of the remote network	'head'	'branch'
VPN	Hide local stations for access to remote network (Extranet VPN)?	yes/no	yes/no
ISDN	TCP/IP routing for access to remote network	yes/no	yes/no
ISDN	IPX routing for access to remote network	yes/no	yes/no
VPN + ISDN	NetBIOS routing for access to remote network?	yes/no	yes/no
VPN + ISDN	Name of remote workgroup (NetBIOS only)	'workgroup1'	'workgroup2'
ISDN	Data compression	on/off	↔ on/off
ISDN	Channel bundling	on/off	↔ on/off

- In case your device has an **ISDN connection**, the wizard asks whether the remote site has ISDN as well.
- The type of IP address must be stated for both sides for VPN connections via the Internet. There are two types of IP addresses: static and dynamic. An explanation of the two **IP address types** can be found in the reference manual.
Thanks to Dynamic VPN, connections can be enabled not only between gateways with fixed, static IP addresses, but even between gateways with dynamic IP addresses. The active initiation of VPN connections towards remote sites with dynamic IP addresses requires ISDN.
- If you haven't already named your LANCOM Router, the wizard will ask you for a new, **unique device name**. With this entry, you will rename your LANCOM Router. Be sure to give the two devices different names.
- The **name of the remote station** is needed for its identification.
- Enter the subscriber number of the remote station in the **ISDN subscriber number** field. The complete subscriber number including all necessary area and country codes is required.
- The stated **ISDN caller ID** is used to identify and authenticate callers. When a LANCOM Router receives a call, it compares the ISDN caller ID entered for the remote station with the actual caller ID transferred via the D channel. An ISDN caller ID generally consists of an area code and an MSN.

- The **password for the ISDN connection** is an alternative to the use of the ISDN caller ID. It is always used to authenticate callers that do not send an ISDN caller ID. The exact same password must be entered on both sides. It is used for calls in both directions.
- The **Shared Secret** is the central password for security within the VPN. The exact same password has to be entered on both sides
- Data compression increases the transfer speed of the connection at no additional cost. This is completely unlike the bundling of two ISDN- channels with MLPPP (**Multi Link PPP**): The transfer rate will be doubled but there will also be additional telephone costs for two connections.

6.1.2 Settings for the TCP/IP router

In TCP/IP networks, addressing has a special significance. Please note that two interconnected networks are logically separate from one another. Each must therefore have its own network number (in our example, '10.0.1.x' and '10.0.2.x'). These network numbers may not be identical.



Unlike when accessing the Internet, all of the IP addresses in the involved networks are visible on the remote side when coupling networks, not just those of the router. The computer with the IP address 10.0.2.10 in the branch office LAN sees the server 10.0.1.2 in the headquarters and can access it (assuming it has the appropriate rights), and vice versa.

DNS access to the remote LAN

Thanks to DNS, it is not only possible to access remote computers in a TCP/IP network via their IP address, but also by using freely defined names.

For example, the computer with the name 'pc1.branch.company' (IP 10.0.2.10) will not only be able to access the server of the head office via its IP address, but also via its name, 'server.head.company'. The only precondition: the domain of the remote network in the wizard must be specified.



The domain can only be specified in the LANconfig wizard. In WEBconfig, enter the appropriate information later in the expert configuration. For more information, see the LANCOM Router reference manual.

Extranet VPN

Finally, one can decide whether access to local stations is permitted. In this 'Extranet VPN' operating mode, the IP stations do not expose their IP address to the remote LAN, rather they will be hidden behind the VPN gateway's IP address instead.

Therefore, the stations within the remote LAN cannot access IP stations in the other LAN directly. For example, if a headquarters LAN in 'Extranet VPN' mode is hidden behind its gateway's address '10.10.2.100', and one of its IP stations (e.g. '10.10.2.13') accesses the IP station '10.10.1.2' of the branch office, then the branch office's IP stations deem to be accessed by '10.10.2.100'. The true IP address of the accessor ('10.10.2.13') is hidden.

If two LANs shall be coupled in Extranet mode, please ensure to enter the 'outbound' Extranet IP address of the remote site, not its Intranet address. According to the example, this was '10.10.2.100'. The appropriate netmask for the Extranet IP address would be '255.255.255.255' then.

6.1.3 Settings for the IPX router



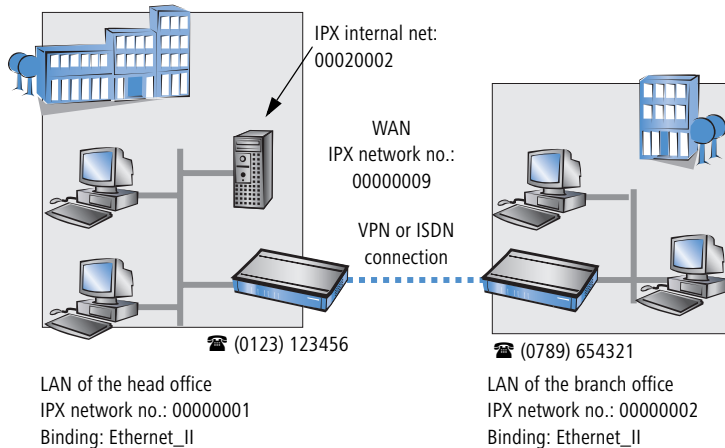
The coupling of IPX networks via VPN cannot be configured using the wizard. It can only be set up in the expert configuration. For details, please see the reference manual.

Coupling two typical IPX networks to form a WAN requires three IPX network numbers:

- for the LAN of the head office
- for the LAN of the branch office

■ for the higher-level WAN

The IPX network numbers in the head and branch offices are specified to the respective remote sides.



The three required network numbers are designated as “External Network Numbers” by the IPX conventions. Like IP network addresses, they apply to an entire LAN segment. On the other hand, internal IPX numbers are used to address specific Novell servers in the LAN. All three specified network numbers must be distinct from one another and from all used internal IPX network numbers.

In addition, it may be necessary to enter the frame type (“binding”).

Specifying the IPX network number and binding used is not necessary if the remote network also contains a Novell server. It is only necessary to enter the network number for the WAN manually in this case.

6.1.4 Settings for NetBIOS routing

NetBIOS routing can be set up quickly: All that is required in addition to the information for the TCP/IP protocol used is the name of a Windows workgroup from in the router's own LAN.

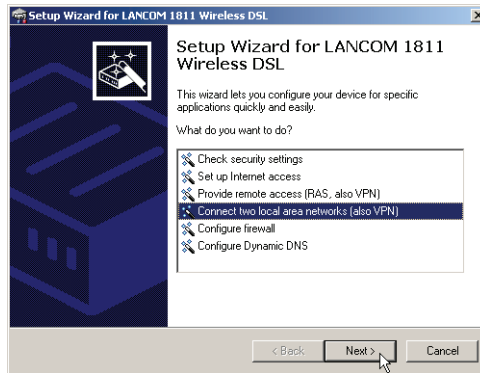


Remote Windows workgroups do not appear in the Windows Network Neighbourhood, but can only be contacted directly (e.g. via Find Computers).

6.2 Instructions for LANconfig


Perform the configuration on both routers, one at a time.

- ① Launch the 'Connect two local area networks' wizard. Follow the wizard's instructions and enter the required information.



- ② The wizard will return a message to indicate that it has all the information it needs. Close the wizard with **Finish**.
- ③ After finishing the configuration of both routers, you can test the network connection. Try to contact a computer in the remote LAN (e.g. with a ping). The LANCOM Router should automatically set up a connection to the remote station and contact the required computer.

6.3 Instructions for WEBconfig

-  Under WEBconfig, the coupling of networks via VPN cannot be configured using the wizard. It can only be set up in the expert configuration. For details, please see the reference manual.

Perform the configuration on both routers, one at a time.

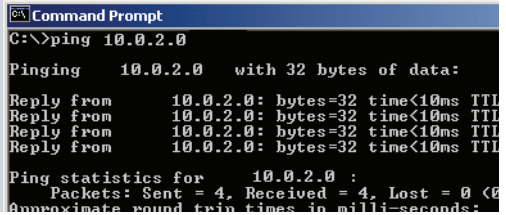
- ① From the main menu, launch the 'Connect two local area networks' wizard. Follow the wizard's instructions and enter the required information.
- ② The wizard will return a message to indicate that it has all the information it needs. Close the wizard with **Terminate**.
- ③ After finishing the configuration of both routers, you can test the network connection. Try to contact a computer in the remote LAN (e.g. with a

ping). The LANCOM Router should automatically set up a connection to the remote station and contact the required computer.

Ping – quick testing for TCP/IP connections

To test a TCP/IP connection, simply send a ping from your computer to a computer in the remote network. For more information on the 'ping' command, please see the documentation of your operating system.

IPX and NetBIOS connection can be tested by searching for a remote Novel Server or a computer in the remote Windows workgroup from your computer.



```
Command Prompt
C:\>ping 10.0.2.0
Pinging 10.0.2.0 with 32 bytes of data:
Reply from 10.0.2.0: bytes=32 time<10ms TTL
Reply from 10.0.2.0: bytes=32 time<10ms TTL
Reply from 10.0.2.0: bytes=32 time<10ms TTL
Reply from 10.0.2.0: bytes=32 time<10ms TTL
Ping statistics for 10.0.2.0 :
    Packets: Sent = 4, Received = 4, Lost = 0 (0%
    Approximate round trip times in milli-seconds:
```

7 Providing dial-up access

Your LANCOM Router supports dial-up connections to permit individual computers full access to your network. This service is also known as RAS (Remote Access Service). In principle, the RAS access can be realized in two different ways:

- **VPN:** For a RAS access via VPN, the connection between the LAN and the dial-in PC is established over a specially secured connection through the public Internet. The router in the LAN requires VPN support, the dial-in PC an access to the Internet and the LANCOM VPN Client.
- **ISDN:** For a RAS access via ISDN, a direct connection between the LAN and the dial-in PC is established over an ISDN dial-up connection. The router in the LAN requires an ISDN interface, the dial-up PC an ISDN adapter or an ISDN modem. The data transfer protocol is PPP. Therefore, the support of all usual devices and operating systems is ensured.

A setup wizard handles the configuration of the dial-up connection in the usual convenient manner.

Security aspects

You must, of course, protect your LAN against unauthorized access. An LANCOM Router therefore offers a whole range of security mechanisms that can provide an outstanding level of protection:

- **VPN:** Network couplings via VPN transmit data by IPSec. The data are encrypted by AES, 3-DES, Blowfish or CAST encryption algorithms.
- **ISDN:** For network couplings via ISDN, the connection password, the checking of the ISDN number and the callback function ensure the security of the connection.



The ISDN call back function cannot be configured using the wizard. It can only be set up in the expert configuration. For details, please see the reference manual.

7.1 Which information is required?

The wizard will set up dial-up access for only one user. Please run the wizard again for each additional user.

7.1.1 General information

The following entries are required to set up a RAS connection. The first column indicates whether the information is required for a connection via VPN (standard method using “preshared keys”) and/or ISDN .



Further details to RAS connections via VPN using enhanced methods (e.g. digital certificates) can be found in the LCOS reference manual.

Coupling	Entry
VPN + ISDN	User name
VPN + ISDN	Password
VPN	Shared secret for encryption
VPN	Hide local stations for access to remote network (Extranet VPN)?
ISDN	Incoming number of remote station
ISDN	TCP/IP routing for access to remote network
ISDN	IPX routing for access to remote network
VPN + ISDN	IP addresses for the dial-up PCs: static or dynamic by address range (IP address pool)
VPN + ISDN	NetBIOS routing for access to remote network?
VPN + ISDN	Name of remote workgroup (NetBIOS only)

Notes to the individual values:

- **User name and password:** Users authenticate themselves with this information when dialling in.
- **Incoming number:** The LANCOM Router uses the optional ISDN caller ID as an additional user authentication. This security function should not be used when users dial in from differing locations.



Please refer to chapter ‘Linking two networks’ → page 100 for advice about the other values required for the installation of a RAS access.

The ISDN calling line identity (CLI)

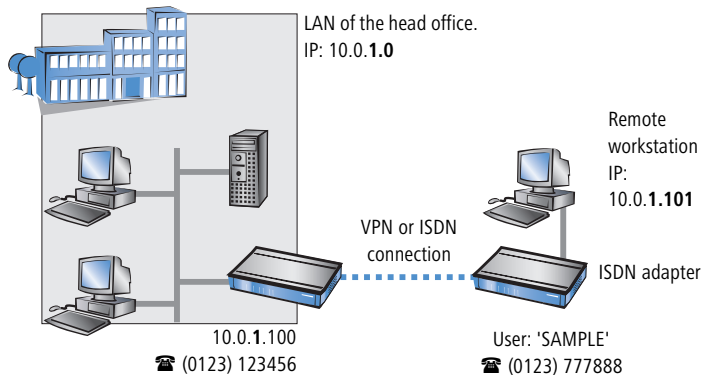
The ISDN caller ID—also known as CLI (Calling Line Identity)—this is the telephone number of the caller which is transmitted to the participant receiving the call. As a rule, it consists of the country and area codes and an MSN.

The CLI is well-suited for authentication purposes for two reasons: it is very difficult to manipulate, and the number is transferred free of charge via the ISDN control channel (D-channel).

EN

7.1.2 Settings for TCP/IP

Each active RAS user must be assigned an IP address when using the TCP/IP protocol.



This IP address can be permanently assigned when setting up a user. However, it is simpler to let the LANCOM Router automatically assign free IP addresses to users when they dial in. In this case you only need to specify the IP address range that the LANCOM Router should use for RAS users.

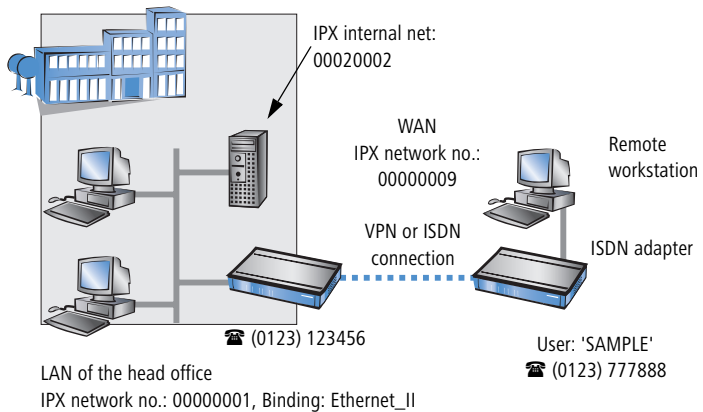
During both manual and automatic IP address assignment, please ensure that only free addresses from the address range of your local network are used. In our example, the IP address '10.0.1.101' will be assigned to the PC when connecting.

This IP address makes the computer a fully-fledged member of the LAN: with the appropriate rights, it can access all of the other devices in the LAN. The same applies in the other direction as well: computers in the LAN will also be able to access the remote machine.

7.1.3 Settings for IPX

Two IPX network numbers must be provided for remote access to an IPX network:

- the IPX network number of the head office
- an additional IPX network number for the higher-level WAN



The required network numbers are designated as “External Network Numbers”. Like IP network addresses, they apply to an entire LAN segment. On the other hand, internal IPX numbers are used to address specific Novell servers in the LAN. All three specified network numbers must be distinct from one another and from all used internal IPX network numbers.

In addition, it may be necessary to enter the frame type (“binding”).

Specifying the IPX network number and binding used is not necessary if the remote network also contains a Novell server. A network number for the WAN must also be entered manually in this case, however.

7.1.4 Settings for NetBIOS routing

All that is required to use NetBIOS is the name of a Windows workgroup from the router's own LAN.



The connection is not established automatically. The RAS user must manually establish a connection to the LANCOM Router via Dial-Up Networking first. When connected, they can search for and access computers in the remote network (via **Find ► Computers**, not through the Network Neighbourhood).

7.2 Settings for the dial-in computer

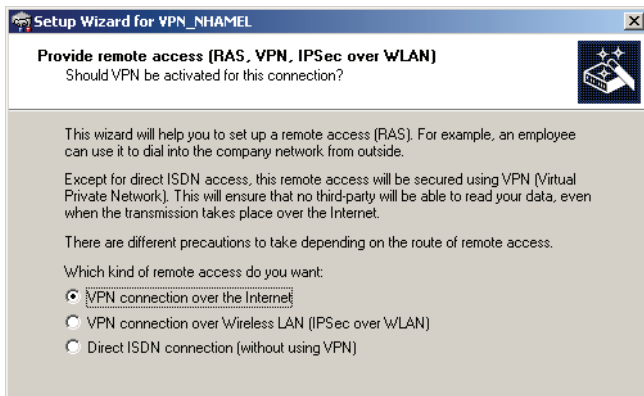
7.2.1 Dial-up via VPN

For dialing into a network via VPN a workstation requires:

- an Internet access
- a VPN client

ELSA offers a 30 days trial version of the LANCOM Advanced VPN Client on the LANCOM CD. A detailed description of the LANCOM Advanced VPN Client and a description of its installation can also be found on the CD.

For configuring a new profile, select the option 'LANCOM Advanced VPN Client' in the configuration wizard.



The wizard asks then for the values that have been defined during the installation of the RAS access in the LANCOM Router.

7.2.2 Dial-up via ISDN

A number of settings must be configured on the dial-in computer. These are briefly listed here, based on a Windows computer:

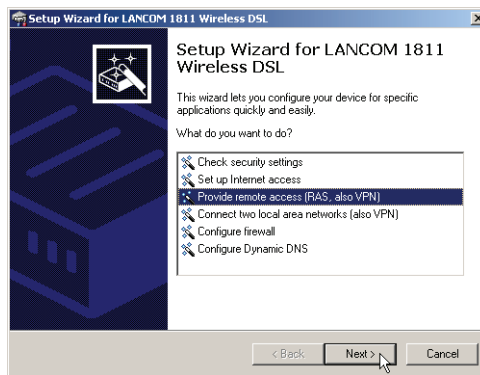
- Dial-Up Networking (or another PPP client) must be correctly configured
- Network protocol (TCP/IP, IPX) installed and bound to the dial-up adapter
- New connection in Dial-Up Networking with the call number of the router
- Terminal adapter or ISDN card set to PPPHDLC
- PPP selected as the Dial-Up server type, 'Enable software compression' and 'Require data encryption' unchecked
- Select desired network protocols (TCP/IP, IPX)

- Additional TCP/IP settings:
 - Assignment of IP address and name server address enabled
 - 'IP header compression' disabled

These settings will permit a PC to dial into a remote LAN via ISDN and access its resources in the usual manner.

7.3 Instructions for LANconfig

- ① Launch the 'Provide Dial-In access (RAS)' wizard. Follow the wizard's instructions and enter the required information.



- ② The wizard will return a message to indicate that it has all the information it needs. Close the wizard with **Finish**.
- ③ Configure Dial-Up Networking access on the dial-in PC as described. Next, test the connection (see box 'Ping – quick testing for TCP/IP connections' → page 107).

7.4 Instructions for WEBconfig

i RAS access via VPN cannot be configured using the wizard under WEBconfig yet. It can only be set up in the expert configuration. For details, please refer to the reference manual.

- ④ From the main menu, launch the 'Connect two local networks' wizard. Follow the wizard's instructions and enter the required information.

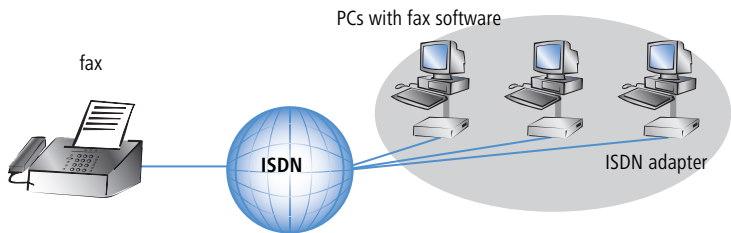
■ *Chapter 7: Providing dial-up access*

- ⑤ Configure Dial-Up Networking access on the dial-in PC as described. Next, test the connection (see box 'Ping – quick testing for TCP/IP connections' → page 107).

8 Sending faxes with LANCAPi

LANCAPi from LANCOM Systems is a special version of the popular CAPI interface. CAPI (Common ISDN Application Programming Interface) establishes the connection between ISDN adapters and communications programs. For their part, these programs provide the computers with office communications functions such as a fax machine or answering machine.

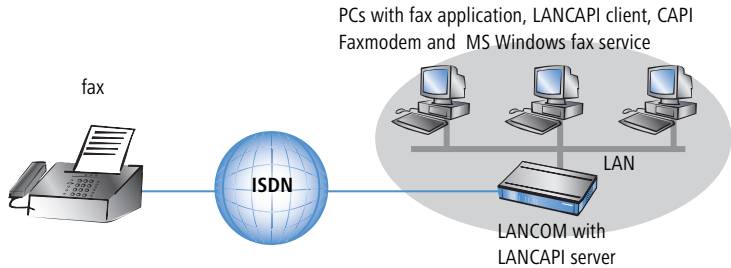
The main advantages of using LANCAPi are economic. LANCAPi provides all Windows workstations integrated in the LAN (local-area network) with unlimited access to office communications functions such as fax machines, answering machines, online banking and eurofile transfer. All functions are supplied via the network without the necessity of additional hardware at each individual workstation, thus eliminating the costs of equipping the workstations with ISDN adapters or modems. All you need do is install the office communications software on the individual workstations.



With LANCAPi by LANCOM it is possible to send faxes comfortably from your workstation PC, without having connected a fax device. To do so, you need to install several components:

- the **LANCAPi client**. It provides the connection between your workstation PC and the LANCAPi server.
- the **CAPI Faxmodem**. This tool simulates a fax device on your workstation PC.

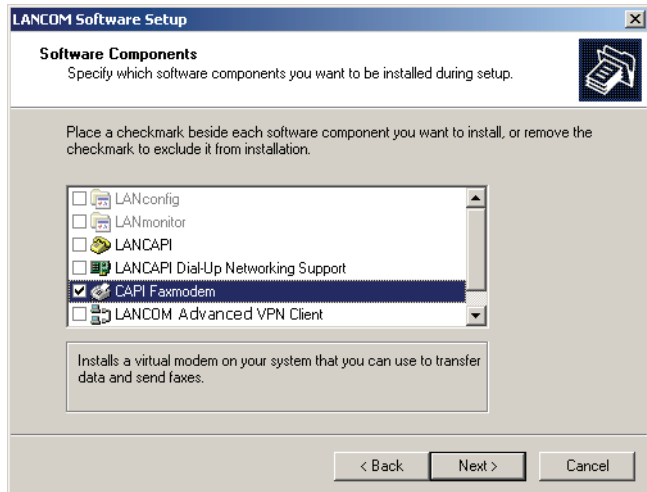
- the **MS Windows fax service**. This is the interface between the fax applications and the virtual fax.



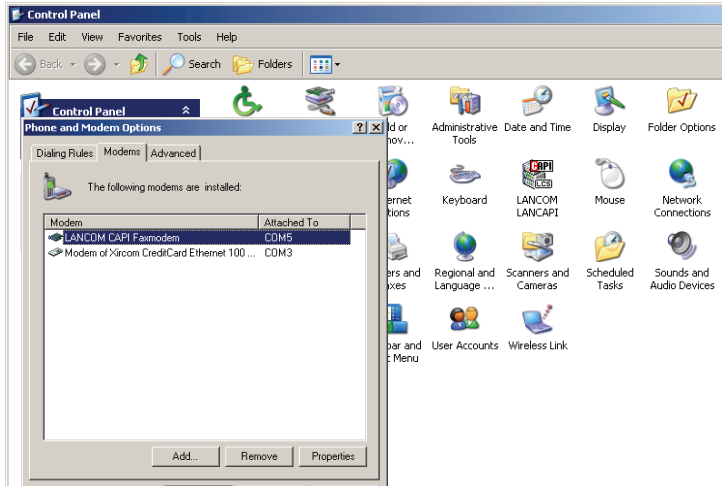
The installation of the LANCAPI client is described in the reference manual. This chapter shows the installation of **CAPI Faxmodem** and MS Windows fax service.

8.1 Installation of the LANCOM LANCOM VPN

- ① Select the entry **Install LANCOM software** in the setup program of your LANCOM CD.
- ② Highlight the option **CAPI Faxmodem**, click **Next** and follow the instructions of the installation routine.

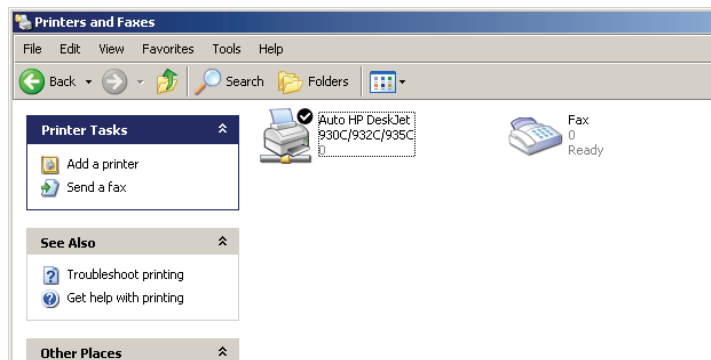


When the installation was successful, the **CAPI Faxmodem** is entered into the **Phone and Modem Options** of the control panel.



8.2 Installation of the MS Windows fax service

- ① Select the option **Printers and Faxes** from the control panel.
- ② Select the option **Set up faxing** from the window 'Printers and Fax'. Follow, if necessary, the instructions of the installation tool. Into the recent window, an icon will appear for the newly installed fax printer.



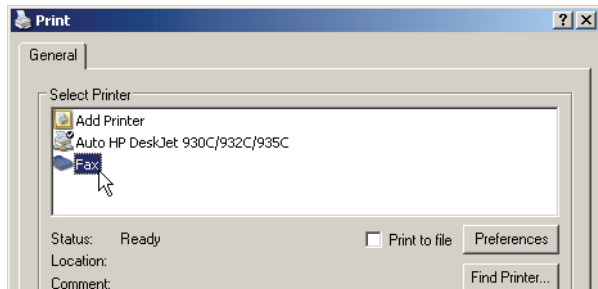
For checking the installation, click with the right mouse button on the fax-icon and select **Properties**. The **CAPI Faxmodem should now be entered into register 'devices'**.

8.3 Sending a fax

After installing all required components, you have several possibilities to send a fax from your workstation PC. If you have already an existing data file, you can send it directly from your respective application. If you only want to send a short message, select the MS Windows fax service. You can use of course any other fax software alternatively.

8.3.1 Send a fax with any given office application

- ① Open as usual a document in your office application and select the menu item **File/Print**.
- ② Adjust the fax device as printer.

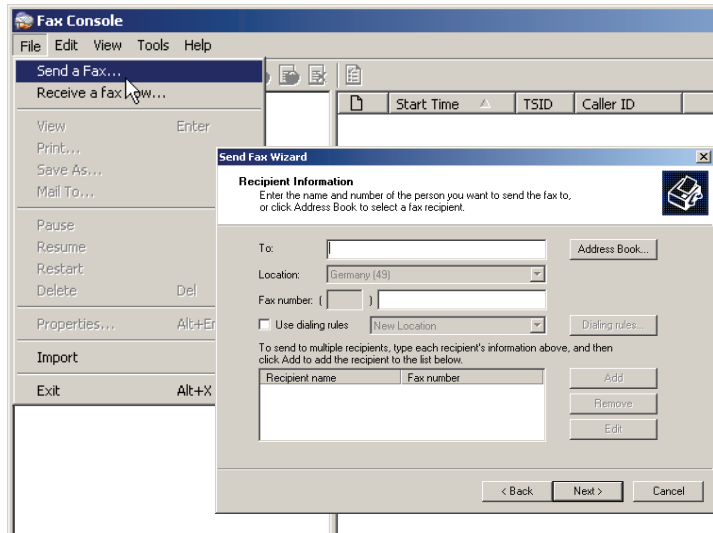


- ③ Click on OK. A wizard appears, that will guide you through the remaining sending process.

8.3.2 Send a fax with the MS Windows fax service

- ① Open the window 'Printers and Faxes' from the control panel.
- ② Double click with the left mouse button the icon of the fax device.

- ③ The fax client console will open. Select the menu item **Send a Fax**. A wizard will assist you through the remaining sending process.



9 Security settings

Your LANCOM Router has numerous security functions. You find in this chapter all information you need for an optimal protection.

9.1 The security settings wizard

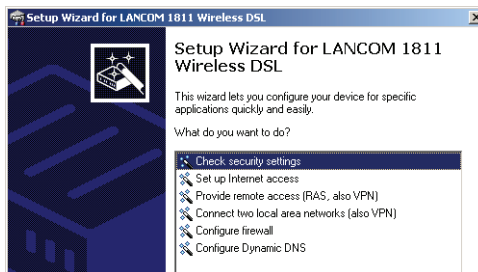
Access to the configuration of a device permits not only to read out critical information such as WEP key or Internet password. Rather, also the entire settings of the security functions (e.g. firewall) can be altered then. So an unauthorized configuration access endangers not only a single device, but the entire network.

Your LANCOM Router has a password protection for the configuration access. This protection is already activated during the basic configuration by entering a password.

The device locks access to its configuration for a specified period of time after a certain number of failed log-in attempts. Both the number of failed attempts and the duration of the lock can be set as needed. By default, access is locked for a period of five minutes after the fifth failed log-in attempt.

9.1.1 Wizard for LANconfig

- ① Mark your LANCOM Router in the selection window. Select from the command bar **Extras ▶ Setup Wizard**.



- ② Select in the selection menu the setup wizard **Control Security Settings** and confirm your choice with **Next**.
- ③ Enter your password in the following windows and select the allowed protocols for the configuration access from local and remote networks. Additionally, enter the MSN for remote configuration via ISDN.

- ④ In a next step parameters of the configuration lock like number of failed log-in attempts and the duration of the lock can be adjusted.
- ⑤ Now activate Stateful Inspection, ping-blocking and Stealth mode in the the firewall configuration.
- ⑥ The wizard will inform you when entries are complete. Complete the configuration with **Finish**.

9.1.2 Wizard for WEBconfig

Under WEBconfig you have the possibility to run the wizard **Security settings** to control and change the settings. The following values are handled:

- password for the device
- allowed protocols for the configuration access of local and remote networks
- the MSN for remote configuration via ISDN
- parameters of configuration lock (number of failed log-in attempts and duration of the lock)

9.2 The firewall wizard

The LANCOM Router incorporates an effective protection of your LAN and WLAN when accessing the Internet by its Stateful Inspection firewall and its firewall filters. Basic idea of the Stateful Inspection firewall is that only self-initiated data transfer is considered allowable. All unasked accesses, which were not initiated from the local network, are inadmissible.

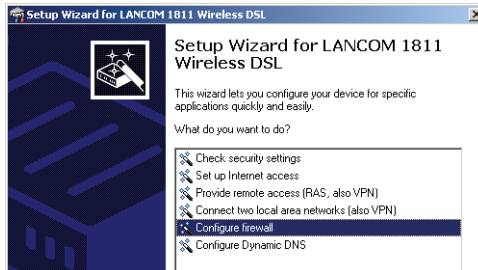
The firewall wizard assists you to create new firewall rules quickly and comfortably.

Please find further information about the firewall of your LANCOM Router and about its configuration in the reference manual.

9.2.1 Wizard for LANconfig

The firewall wizard assists you to create new firewall rules quickly and comfortably .

- ① Mark your LANCOM Router in the selection window. Select from the command bar **Extras ▶ Setup Wizard**.



- ② Select in the selection menu the setup wizard **Configuring Firewall** and confirm your choice with **Next**.
- ③ In the following windows, select the services/protocols the rule should be related to. Then you define the source and destination stations for this rule and what actions will be executed when the rule will apply to a data packet.
- ④ You finally give a name to the new rule, activate it and define, whether further rules should be observed when the rule will apply to a data packet.
- ⑤ The wizard will inform you as soon as the entries are complete. Complete the configuration with **Finish**.

9.2.2 Configuration under WEBconfig

Under WEBconfig it is possible to check and modify all parameters related to the protection of the Internet access under **Configuration ▶ Firewall / QoS ▶ Rules ▶ Rule Table**.

9.3 The security checklist

The following checklist provides a comprehensive overview of all security settings for professionals. Most of the points on this checklist are no subject of concern in simple configurations, since these generally adequate security settings are already implemented during basic configuration and by the security wizard.



Detailed information on the security settings listed here can be found in the reference manual.

■ Have you assigned a password for the configuration?

The simplest option for the protection of the configuration is the establishment of a password. As long as a password hasn't been set, anyone can change the configuration of the device. The field for entering the password is contained in LANconfig in the 'Management' configuration area on the 'Security' tab. It is particularly required to assign a password to the configuration if you want to allow remote configuration.

■ Have you permitted remote configuration?

If you do not require remote configuration, then deactivate it. If you require remote configuration, then be sure to assign a password protection for the configuration (see previous section). The field for deactivating the remote configuration is also contained in LANconfig in the 'Management' configuration area on the 'Security' tab. Select here under 'Access rights - of remote networks' for all types of configuration the option 'not allowed'.

■ Have you provided the SNMP configuration with a password?

Also protect the SNMP configuration with a password. The field for protection of the SNMP configuration with a password is also contained in LANconfig in the 'Management' configuration area on the 'Security' tab.

■ Have you activated the Firewall?

The Stateful Inspection Firewall of the LANCOM ensures that your local network cannot be attacked from the outside. The Firewall can be enabled in LANconfig under 'Firewall/QoS' on the register card 'General'.

■ Do you make use of a 'Deny All' Firewall strategy?

For maximum security and control you prevent at first any data transfer through the Firewall. Only those connections, which are explicitly desired have to be allowed by the a dedicated Firewall rule then. Thus 'Trojans' and certain Email viruses lose their communication way back. The Firewall rules are summarized in LANconfig under 'Firewall/QoS' on the register card 'Rules'.

■ Have you activated the IP masquerading?

IP masquerading is the hiding place for all local computers for connection to the Internet. Only the router module of the unit and its IP address are visible on the Internet. The IP address can be fixed or assigned dynamically by the provider. The computers in the LAN then use the router as a gateway so that they themselves cannot be detected. The router separates Internet and intranet, as if by a wall. The use of IP masquerading is set

individually for each route in the routing table. The routing table can be found in the LANconfig in the 'IP router' configuration section on the 'Routing' tab.

■ **Have you excluded certain stations from access to the router?**

Access to the internal functions of the devices can be restricted using a special filter list. Internal functions in this case are configuration sessions via LANconfig, WEBconfig, Telnet or TFTP. This table is empty by default and so access to the router can therefore be obtained by TCP/IP using Telnet or TFTP from computers with any IP address. The filter is activated when the first IP address with its associated network mask is entered and from that point on only those IP addresses contained in this initial entry will be permitted to use the internal functions. The circle of authorized users can be expanded by inputting further entries. The filter entries can describe both individual computers and whole networks. The access list can be found in LANconfig in the 'TCP/IP' configuration section on the 'General' tab.

■ **Have you closed critical ports with filters?**

The firewall filters of the LANCOM Router devices offer filter functions for individual computers or entire networks. Source and target filters can be set for individual ports or for ranges of ports. In addition, individual protocols or any combinations of protocols (TCP/UDP/ICMP) can be filtered. It is particularly easy to set up the filters with LANconfig. The 'Rules' tab under 'Firewall/QoS' can assist you to define and change the filter rules.

■ **Is your saved LANCOM Router configuration stored in a safe place?**

Protect the saved configurations against unauthorized access in a safe place. A saved configuration could otherwise be loaded in another device by an unauthorized person, enabling, for example, the use of your Internet connections at your expense.

■ **Have you activated the mechanism that protects your WAN lines if the device is stolen?**

After being stolen, the device can theoretically be operated at another location by unauthorized persons. Password-protected device configurations offer no protection from the operation of the RAS access, LAN coupling or VPN connections that are set up in the device; a thief could gain access to a protected network.

The device's operation can be protected by various means; for example, it will cease to function if there is an interruption to the power supply, or if the device is switched on in another location.

With the ISDN site verification, the device can only be operated at one particular ISDN connection. After being switched on, the device calls itself at the corresponding telephone number to check that it is still connected to the "proper" ISDN connection.

The scripting function can store the entire configuration in RAM only so that restarting the device will cause the configuration to be deleted. The configuration is not written to the non-volatile flash memory. A loss of power because the device has been relocated will cause the entire configuration to be deleted. Further information can be found in the reference manual.

10 Troubleshooting

In this chapter, you will find suggestions and assistance for a few common difficulties.

10.1 No WAN connection is established

After start-up the router automatically attempts to connect to the access provider. During this process, the Online LED will blink green. If successful, the LED will switch over to steady green. If, however, the connection can't be established, the Online LED will light up red. The reason for this is usually one of the following:

Problems with the cabling?

Only the cable provided with your device should be used to connect to the WAN. This cable must be connected to the Ethernet port of your broadband access device. The WAN link LED must light green indicating the physical connection.

Has the correct transfer protocol been selected?

The transfer protocol is set along with the basic settings. The basic setup wizard will enter the correct settings for numerous DSL providers automatically. Only if your DSL provider is not listed, you will have to enter manually the protocol being used. In any case, the protocol that your DSL provider supplies you with should definitely work.

You can monitor and correct the protocol settings under:

Configuration tool	Run command
LANconfig	Management ► Interfaces ► Interface settings ► WAN Interface
WEBconfig	Expert Configuration ► Setup ► Interfaces ► WAN Interface

10.2 DSL data transfer is slow

The data transfer rate of an broadband (Internet) DSL connection is dependent upon numerous factors, most of which are outside of one's own sphere of influence. Important factors aside from the bandwidth of one's own Internet connection are the Internet connection and current load of the desired target.

Numerous other factors involving the Internet itself can also influence the transfer rate.

Increasing the TCP/IP window size under Windows

If the actual transfer rate of a DSL connection is significantly below the fastest rate listed by the provider, there are only a few possible causes (apart from the above-mentioned external factors) which may involve one's own equipment.

One common problem occurs when large amounts of data are sent and received simultaneously with a Windows PC using an asynchronous connection. This can cause a severe decrease in download speed. The cause of this problem is what is known as the TCP/IP receive window size of the Windows operating system that is set to a value too small for asynchronous connections.

Instructions on how to increase the Windows size can be found in the Knowledge Base of the support section of the LANCOM web site (www.lancom.de).

10.3 Unwanted connections under Windows XP

Windows XP computers attempt to compare their clocks with a timeserver on the Internet at start-up. This is why when a Windows XP in the WLAN is started, a connection to the Internet is established by the LANCOM.

To resolve this issue, you can turn off the automatic time synchronization on the Windows XP computers under **Right mouse click on the time of day ► Properties ► Internet time**.

10.4 Cable testing

A cabling defect might have occurred, if no data is transmitted over LAN or WAN connection, although the configuration of the devices does not show any discernible errors.

You can test the cabling with the built-in cable tester of your LANCOM. Change under WEBconfig to menu item **Expert configuration ► Status ► LAN statistics ► Cable test**. Enter here the name of the interface to be

tested (e.g. “DSL1” or “LAN-1”). Pay attention to the correct spelling of the interfaces. Start the test for the specified interface by clicking on **Execute**.

[Expert Configuration](#)

 [Status](#)

 [LAN-statistics](#)

Cable-Test

Enter here any additional arguments for the command you are about to execute:

Arguments

Change then to menu item **Expert configuration ▶ Status ▶ LAN statistics ▶ Cable test results**. The results of the cable test for the individual interfaces are show up in a list.

[Expert Configuration](#)

 [Status](#)

 [LAN-statistics](#)

Cable-Test-Results

Port	Rx-Status	Rx-Distance	Tx-Status	Tx-Distance
DSL1	open	0m	open	0m
LAN-1	unknown		unknown	
LAN-2	unknown		unknown	
LAN-3	unknown		unknown	
LAN-4	unknown		unknown	

The following results can occur:

- **OK**: Cable plugged in correctly, line ok.
- **open** with distance “0m”: No cable plugged in or interruption within less than 10 meters distance.
- **open** with indication of distance: Cable is plugged in, but defect (short-circuited) at the indicated distance.
- **Impedance error**: The pair of cables is not terminated with the correct impedance at the other end.

11 Appendix

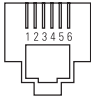
11.1 Performance data and specifications

		LANCOM 1722 VoIP	LANCOM 1724 VoIP
Connections	Ethernet LAN	4 x RJ-45 Ethernet IEEE 802.3 (Switch), 10/100Base-T-Autosensing, Node/Hub-Autodetection	2 x RJ-45 Ethernet IEEE 802.3 (Switch), 10/100Base-T-Autosensing, Node/Hub-Autodetection
	WAN/ADSL	'Annex A' devices : ADSL over POTS as per ITU G.992.1 Annex A, ANSI T1.413, ITU G.992.2 (G.Lite), G.994.1 (G.hs);, ADSL over POTS as per ITU G.992.5 Annex A, ADSL 2+; 'Annex B' devices : ADSL over ISDN as per ITU G.992.1 Annex B, as well as proprietary ADSL over ISDN (Texas Instruments, ADI, Alcatel), ETSI TS 101 388, ADSL over ISDN as per ITU G.992.5 Annex B, ADSL 2+	
	ISDN	2 ISDN interfaces, switchable with cross-over adapter to NT oder TE. Default: 1x NT, 1x TE (S ₀).	4 ISDN interfaces, switchable with cross-over adapter to NT oder TE. Default: 2x NT, 2x TE (S ₀).
		Bus termination for each interface switchable by DIP switch.	
	Outband	serial V.24/V.28 port (8 pol. mini DIN), in combination with LANCOM modem adapter kit suited for connection of external analogue or GSM modems	
	Power supply	12V over external power adapter	
VoIP	Features	SIP proxy, SIP gateway, SIP remote gateway	
	Voice processing	<ul style="list-style-type: none"> ■ echo cancelling (G.168) ■ automatic adaptive de-jitter buffer ■ transparent pass-through for negotiated codecs ■ interaction on codec negotiation (filter, quality, bandwidth) ■ voice coding with G.711 μ-Law/A-Law (64 kBps), (G.726 16, 24, 32, 40 kBps), others in preparation 	
Housing		210 x 143 x 45 mm (W x H x D), rugged plastic case, connectors on the rear side, stackable, provision for wall mounting	
Standards		EU (CE certification: EN 55022, EN 55024, EN 60950)	
Environment / temperature range		Temperature range 5 °C to + 40 °C at 80 % max. humidity (non condensing)	
Options		<ul style="list-style-type: none"> ■ LANCOM VPN Option 25 channels (hardware accelerated, max. 25 simultaneous connections, 50 connections configurable) for VPN in WAN (Art. no.60083) 	
Accessories		<ul style="list-style-type: none"> ■ LANCOM Modem Adapter Kit for connecting modems (analogue or GSM) to the serial configuration interface (Art. no. 61500) ■ LANCOM Rack Mount Option (Art. no. 61501) 	

11.2 Contact assignment

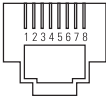
11.2.1 ADSL interface

6-pin RJ45 socket

Connector	Pin	IAE
	1	–
	2	–
	3	a
	4	b
	5	–
	6	–

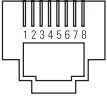
11.2.2 ISDN 1 interface

8-pin RJ45 socket, corresponding to ISO 8877, EN 60603-7, wired as ISDN TE for direct connection to an ISDN (exchange) line (NTBA)

Steckverbindung	Pin	Leitung	IAE
	1	–	–
	2	–	–
	3	T+	2a
	4	R+	1a
	5	R-	1b
	6	T-	2b
	7	–	–
	8	–	–

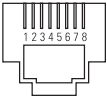
11.2.3 ISDN 2 interface

8-pin RJ45 socket, corresponding to ISO 8877, EN 60603-7, wired as ISDN NT for direct connection to ISDN terminal equipment

Steckverbindung	Pin	Leitung	IAE
	1	–	–
	2	–	–
	3	R+	2a
	4	T+	1a
	5	T-	1b
	6	R-	2b
	7	–	–
	8	–	–

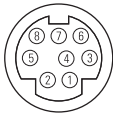
11.2.4 Ethernet interfaces 10/100Base-T

8-pin RJ45 socket, corresponding to ISO 8877, EN 60603-7

Connector	Pin	Line
	1	T+
	2	T-
	3	R+
	4	–
	5	–
	6	R-
	7	–
	8	–

11.2.5 Configuration interface (Outband)

8-pin mini-DIN socket

Connector	Pin	Line
	1	CTS
	2	RTS
	3	RxD
	4	RI
	5	TxD
	6	DSR
	7	DCD
	8	DTR
	U	GND

11.3 CE declaration of conformity

The CE declarations of conformity for LANCOM routers are available for download on the LANCOM web site (www.lancom.de).

Index

Numerics

10/100Base-TX	45
3-DES	100, 108

A

Accounting	57
ADSL	
Connect	46
Connector cable	40
Transmission rates	10
ADSL modem	11
ADSL over ISDN	129
ADSL over POTS	129
AES	100, 108
Annex A	12
Annex B	12
Autosensing	46

B

Basic configuration	55
Blowfish	100, 108

C

Call routing	22
Call routing table	28
Callback function	39, 100, 108
Calling Line Identity (CLI)	110
Calling Party ID	28
CAPI interface	115
CAST	100, 108
charge lock	43
Common ISDN Application Programming Interface (CAPI)	115
Configuration access	59, 63
Configuration file	124
Configuration interface	39
Connector cable	40
Configuration password	123
Configuration port	45

Configuration protection	39, 57
Connect charge protection	58, 59, 63
Connect-charge budget	57
Connect-charge metering	57
Contact assignment	130
ADSL interface	130
Configuration interface	132
Ethernet interface	131
LAN interface	131
Outband	132
WAN interface	131

D

Data frequencies	11
DDI	35
Declaration of conformity	132
Default gateway	63
Denial-of-Service Protection	14
DHCP	64
DHCP server	36, 56, 57, 59, 62, 64
Dialing prefix	57
Dial-up access	108
Dial-up adapter	112
Direct Dialing In	35
DNS	
access to the remote LAN	104
DNS server	36, 63, 64
Documentation	40
Domain	104
Download	10
downstream	10
DSL	
data transfer is too slow	126
provider	59, 63
transfer protocol	63
DSL transfer protocol	59

E

Encryption	100, 108
------------	----------

■ Index

F			
Fax		10	
Firewall		13, 39, 124	
Firewall filter		121	
FirmSafe		39	
Flat rate		66	
H			
Hardware installation		46	
I			
ICMP		124	
Installation		40	
ADSL		47	
Configuration interface		47	
ISDN		47	
LAN		46	
LANtools		52	
Power supply unit		47	
Interconnection		100	
Security aspects		100	
Internet access		36, 65	
Authentication data		65	
Default gateway		66	
DNS server		66	
Flat rate		66	
IP address		66	
Netmask		66	
Internet provider		65	
Intrusion Detection		14	
IP			
Filter		124	
Lock ports		124	
IP address		46, 56, 105	
IP masquerading		13, 38, 123	
IP router		36	
IPoE		66	
IPSec		100, 108	
IPX		112	
Binding		105, 111	
External Network Number		105, 111	
Frame type		105	
Internal-Net-Number		111	
IPX conventions		105	
IPX router		36	
Settings		104	
ISDN			
caller ID		102, 109, 110	
Connect charge information		59	
Connector cable		40	
D channel		110	
data compression		66	
Dial-in number		66	
dynamic channel bundling		66	
MSN		57, 59	
NTBA		48	
password for connection		103	
ISDN connection		48	
Basic settings		57	
ISDN life line		49	
ISDN modem		108	
ISDN PBX		57	
ISDN power relay		50	
ISDN S ₀ connection		38	
L			
LAN			
Connector cable		40	
LAN to LAN coupling		36, 57, 100	
Required information		101	
LANCAPI		36, 53	
LANCOM setup		53	
LANconfig		53, 58	
run setup wizards		67	
LANmonitor		53	
LANtools			
System preconditions		41	
Life line		34, 49	
Life-line support		38, 49	
Load balancing		34	
local break out		18	

- M**
- MAC address filter 13, 39
 - Minimum bandwidth 14
 - MSN 35, 110
 - Multiple subscriber number 35
- N**
- NAT – see IP masquerading
 - NetBIOS 105
 - NetBIOS proxy 36
 - Netmask 56
 - Network segment 46, 105
- P**
- Package contents 40
 - Password 57, 59, 100, 108
 - PAT – see IP masquerading
 - PBX 10
 - Ping 107
 - Plain Ethernet 66
 - Plain IP 66
 - Point-to-multipoint 35, 49
 - point-to-multipoint 37
 - Point-to-multipoint connection 35
 - Point-to-point 35, 49
 - point-to-point 37
 - Point-to-point connection 35
 - POTS 11
 - Power adapter 40, 45
 - Power relay 34, 38, 50
 - PPP 108
 - PPP client 112
 - PPPoE 66
 - PPTP 66
 - Preshared Key
 - Shared Secret 103
- Q**
- Quality-of-Service 14
- R**
- Remote Access Service (RAS)
 - Configuring the dial-in computer 112
 - Enable software compression 112
 - IPX 111
 - NetBIOS 111
 - Searching for Windows workgroups 111
 - Security aspects 108
 - Server 36
 - setup 108
 - specify MSN 57
 - TCP/IP 110
 - User name 109
 - Remote configuration 59, 63
 - Remote configuration access 57
 - Remote configuration via ISDN 39
 - Reset connect charge protection. 43
 - Reset switch 46
 - Resetting the configuration 46
 - Restarting the device 46
 - Router function 10
- S**
- Searching for Windows workgroups 105
 - Security
 - Firewall wizard 121
 - Security settings wizard 120
 - Security checklist 122
 - Security settings 126
 - Setting up access to the Internet 65
 - SIP gateway 18
 - SIP PBX 19
 - SIP provider 16
 - SIP proxy 23
 - SNMP
 - Protection of the configuration 123
 - Splitter 48
 - Stateful Inspection 13
 - Stateful Inspection Firewall 121
 - Status displays 41
 - ISDN status 44

■ Index

LAN	45	VoIP	15
Online	43	Automatic outside line access	29
Power	42, 43	Connecting subsidiaries or home offices	16
VPN	45	Downstream PBX	31
WAN status	44	Internal numbers	32
Switch	45	Local registration	23
System preconditions	40	Outside line access	29
T		Peer-to-peer	19
TCP	124	SIP proxy	23
TCP/IP	40, 112	Spontaneous outside line access	29
check connection	107	Supplementing the ISDN PBX	15
Settings	55, 59, 62	Transparent proxy	23
Settings to PCs in the LAN	63	Upstream PBX	31
Windows size	127	Upstream registration	23
TCP/IP configuration		VoIP call router	
Automatic	62	Call router	22
fully automatic	55, 56	VoIP call routing table	
manual	55, 56	Call routing table	22
TCP/IP filter	13, 39, 124	VoIP lines	21
TCP/IP router		VoIP PBX	17
Settings	103	VoIP softphone	16
Telephone	10	VoIP users	20
Telephone answering device	10	Voltage switch	45
Telephone socket	48	VPN client	112
Transfer protocol	126	VRRP	34
U		W	
UDP	124	WAN connection	
Upload	10	problems establishing the connection	126
upstream	10	WEBconfig	60
V		password	63
Virtual Private Network (VPN)	36	Starting the wizards	61
Voice communication	15	System preconditions	41
Voice frequencies	10		
Voice over IP	15		