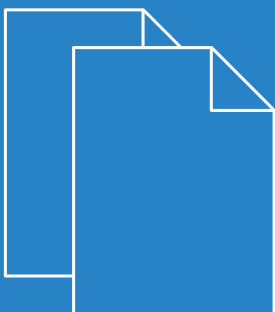


# LCOS LX 5.20

## Reference Manual



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# 1 Introduction

## 1.1 Components of the documentation

The documentation of your device consists of the following parts:

### **Installation Guide**

The Quickstart user guide answers the following questions:

- > Which software has to be installed to carry out a configuration?
- > How is the device connected up?
- > How can the device be contacted with LANconfig or WEBconfig?
- > How is the device assigned to the LANCOM Management Cloud?
- > How do I start the Setup Wizard (e.g. to set up Internet access)?
- > How do I reset the device?
- > Where can I find information and support?

### **Quick Reference Guide**

The Quick Reference Guide contains all the information you need to put your device into operation. It also contains all of the important technical specifications.

### **Reference manual**

This Reference Manual goes into detail on topics that apply to a variety of models. The descriptions in the Reference Manual are based predominantly to the configuration with LANconfig.

### **Menu Reference Guide**

The Menu Reference describes all of the parameters in LCOS LX. This guide is an aid to users during the configuration of devices by means of the CLI. Each parameter is described briefly and the possible values for input are listed, as are the default values.



All documents for your product which are not shipped in printed form are available as a PDF file from [www.lancom-systems.com/downloads/](http://www.lancom-systems.com/downloads/).

## 1.2 LCOS LX, an operating system from LANCOM

LCOS LX is the operating system for certain LANCOM access points and parts of the LANCOM family of operating systems. The LANCOM operating systems are the trusted basis for the entire LANCOM product portfolio. Each operating system embodies the LANCOM values of security, reliability and future viability.

### > **Maximum security for your networks**

as each LANCOM operating system is carefully maintained and developed in-house and with the accustomed quality. They are all guaranteed backdoor-free.

### > **Reliability of the highest order**

as they receive regular release updates, security updates, and major releases over their entire product lifetime.

### > **Future viability for your networks**

according to the LANCOM Lifecycle Policy, i.e. they are free of charge for all LANCOM products and come with major new features.

## 1.3 Validity

The functions and settings described in this manual are not all supported by all models or all firmware versions.

## 2 Operation

### 2.1 Configuration software

There is no end of different situations in which configurations have to be carried out, or ways in which operators prefer to work. This is why the device offers a wide range of ways to set up the configuration:

- **LANconfig** – the menu-driven, clearly structured and easy way to set almost all parameters for a device. LANconfig requires a configuration PC with a current Windows operating system. Refer to the chapters [LANconfig – configuring devices](#) on page 7 and [Configuring features with LANconfig](#) on page 17 for further information.
- **WEBconfig** – further information can be found in the chapters [WEBconfig – monitoring and configuring devices](#) on page 8 and [Configuring features with WEBconfig](#) on page 57.
- **CLI** – as an alternative to LANconfig, you can also use SSH to open a terminal session on the device and access the command-line interface. TCP port 22 provides access to the device via SSH programs such as PuTTY.
- **LANCOM Management Cloud** – the hyper-integrated solution for automated control of your network.



The default credentials for all configuration paths are:

- User: root
- Password: <Empty> (no password is set)

In the interests of security, you will be prompted to change the password when you use WEBconfig to access the configuration for the first time.



Please note that all methods access the same configuration data.

#### 2.1.1 LANconfig – configuring devices

From the easy commissioning of a single workplace device with convenient Installation Wizards to the overall management of large scale installations—the spectrum of applications for LANconfig is wide:

##### Basic functions

- Automatic detection of new, unconfigured devices
- (Remote) configuration of devices via IP address, URL, or via the serial interface
- Integration of Telnet, SSH, HTTPS and TFTP configuration
- Context-based help on the configuration parameters
- The Wizards provide customized input masks at every stage of installation
- Backup connection setup

##### Management of large installations

- Grouping
- Central firmware distribution
- Simultaneous configuration of multiple devices

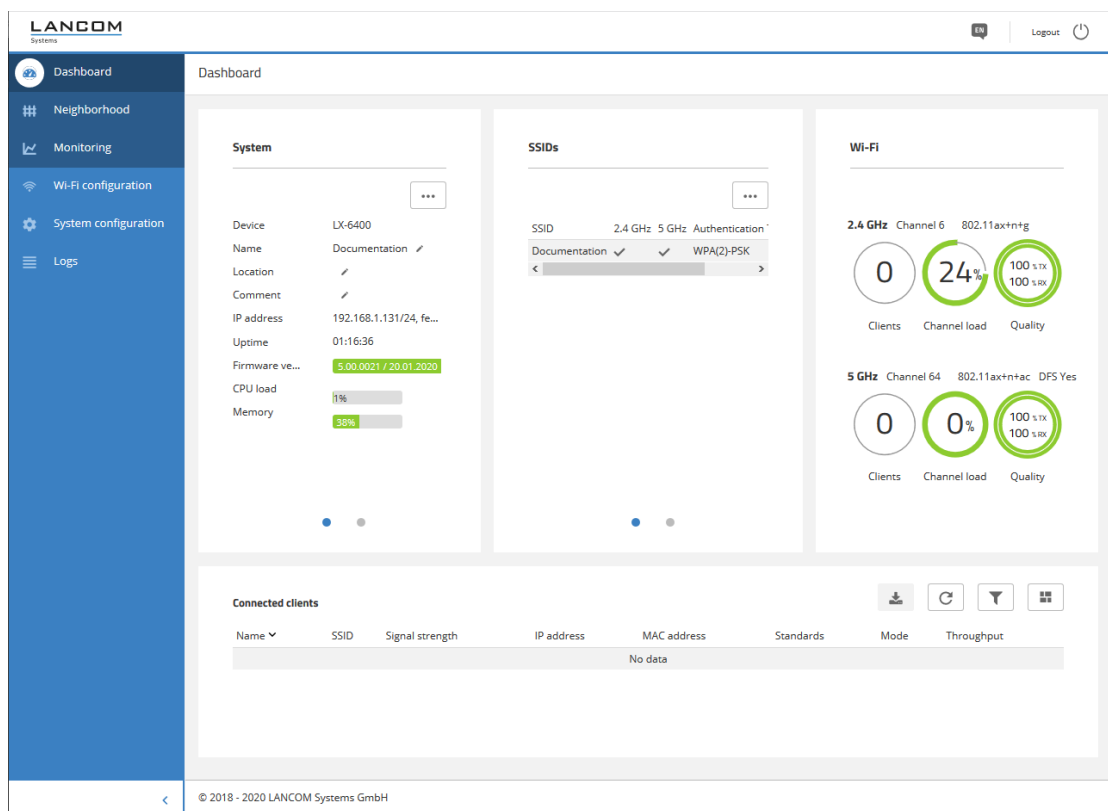
- Configuration script distribution
- WLAN group configuration
- Logging of all actions
- Creation of new “offline” configurations for all devices, for LCOS, and for versions of LCOS LX

## 2.1.2 WEBconfig – monitoring and configuring devices

Using WEBconfig, you can configure individual devices or monitor them during operation. WEBconfig is reached via HTTP and HTTPS. If you use HTTP, the device automatically redirects you to an encrypted HTTPS connection.

! WEBconfig uses a self-signed SSL certificate, so this must be added as an exception in the browser for each device.

The following provides an overview of the main components of WEBconfig, which are located in the left-hand section in the **sidebar**.



### Dashboard

The Dashboard displays status information of the device during operation.

- System – basic information about the device, e.g. the device name and the firmware version.
- WLAN – information about the load on the WLAN channels operated by the device.
- Connected stations – shows all WLAN stations currently connected to the device.
- Neighborhood – overview of the WLAN environment, especially the WLAN access points and WLAN routers that are locally active.
- Monitoring – graphical representation of the WLAN throughput, LAN throughput, number of WLAN stations and channel load over time.



### Configuration


- System configuration – configuration of basic parameters of your device, such as the device name or the IP settings for managing the device.
- WLAN – the WLAN configuration is designed to assist the user with the most common settings and to eliminate the hassle of configuring minor details. It remains possible to configure different scenarios.


### Logs

This area outputs the device SYSLOG.



## 2.1.3 Command-line interface – command summary

The command-line interface is operated with the following commands. An overview of the available configuration parameters and actions is available in the LCOS LX Menu Reference Guide.

 Which commands are available depends upon the equipment of the device.

 Changes to the configuration are not immediately boot-persistent. They have to be saved explicitly by using the command `flash`.

**Table 1: Overview of all commands available at the command line**

Command	Description
<code>add [&lt;Path&gt;]</code>	Adds a row to the table.
<code>cd &lt;Path&gt;</code>	Changes the current menu or directory.
<code>default</code>	Resets the table or the value to the default setting.
	 This command works recursively. Therefore, all values and tables in the current path and those below it will be reset.
<code>del &lt;Path&gt;</code>	Deletes the value or the table row in the branch of the menu tree referenced by <code>&lt;Path&gt;</code> .
<code>do &lt;Path&gt; [&lt;Parameter&gt;]</code>	Executes the action in the current or referenced directory. If the action has additional parameters, they can be added at the end.
<code>exit</code>	Ends the terminal session.
<code>flash</code>	Store the configuration
	 Changes to the configuration are not immediately boot-persistent. They have to be saved explicitly by using the command <code>flash</code> .
<code>ls [&lt;Path&gt;]</code>	Displays the contents of the current directory or path.
<code>passwd &lt;Password&gt;</code>	Changes the password of the current user account.
<code>set &lt;Index&gt; {&lt;Column&gt;} &lt;Value&gt;</code>	Sets the value of a table row in a specific column to <code>&lt;Value&gt;</code> .
<code>set &lt;Path&gt; &lt;Value(s)&gt;</code>	Sets the value or values of a specific path to the specified value(s).
<code>show diag [&lt;Parameter&gt;]</code>	Output diagnostic information on the CLI.
<code>show 3rd-party-licenses</code>	Output the device license information on the CLI.
<code>startlmc &lt;Activation Code&gt; [Domain]</code>	After you have generated an activation code in the LANCOM Management Cloud, you use this code to pair the device with the LANCOM Management Cloud. You can optionally specify a new LMC domain as well.
<code>sysinfo</code>	Shows the system information (e.g., hardware release, software version, MAC address, serial number, etc.).

Command	Description
<code>trace [--log] [+ - # ?] &lt;Parameter&gt;</code>	Starts (+) or stops (-) a trace command to output diagnosis data. # switches between different trace outputs and ? displays a help text. The parameter <code>--log</code> restricts the output to "historical" log information. For further information on this command refer to the section <a href="#">Diagnosis</a> on page 81.

### Legend

#### > Characters and brackets:

- > Objects, in this case dynamic or situation-dependent, are in angle brackets.
- > Round brackets group command components, for a better overview.
- > Vertical lines (pipes) separate alternative inputs.
- > Square brackets describe optional switches.

It follows that all command components that are not in square brackets are necessary information.

#### > <Path>:

- > Describes the path name for a menu or parameter, separated by "/".
- > .. means: one level higher
- > . means: the current level

#### > <Value>:

- > Describes a possible input value.
- > "" is a blank input value

#### > <Name>:

- > Describes a character sequence of [0...9] [A...Z] [a...z] [ \_ ].
- > The first character cannot be a digit.
- > There is no difference between small letters and capital letters.

#### > <Filter>:


- > The output of some commands can be restricted by entering a filter expression. Filtering does not occur line by line, but in blocks, depending on the command.
- > A filter expression starts with the "@" symbol by itself and ends either at the end of the line or at a ";" (semicolon) to end the current command.
- > A filter expression also consists of one or more search patterns, which are separated by blank spaces and preceded either by no operator (OR pattern), a "+" operator (AND pattern) or a "-" operator (NOT pattern).
- > For the execution of the command, an information block is output exactly when at least one of the "OR" patterns, all "AND" patterns or none of the "NOT" patterns matches. Capitalization is ignored.
- > For a search pattern to contain characters for structuring in the filter syntax (e.g., blank characters), then the entire search pattern can be enclosed in "". Alternatively, the symbol "\" can be placed before the special characters. If you want to search for a quotation mark (") or "\", another "\" symbol has to be placed in front of it.



Entering the start of the word, if it is unique, is sufficient.

### Explanations for addressing, syntax and command input

- > All commands and directory/parameter names can be entered using their short-forms as long as they are unambiguous. For example, the command `cd setup` can be shortened to `cd se`. The input `cd /s` is not valid, however, since it corresponds to both `cd /Setup` and `cd /Status`.

- The values in a table row can alternatively be addressed via the column name or the position number in curly brackets. The command `set ?` in the table shows the name, the possible input values and the position number for each column.
  - Multiple values in a table row can be changed with **one** command, for example in the WLAN networks (`/Setup/WLAN/Network`):
    - `add Guest Guest 1234567890` creates a new network named Guest, SSID Guest, and key 1234567890.
- 
-  The order of the values must correspond to their order in the table. Values that should not be changed can be specified with a `*`.
- `set Guest * 0987654321` changes the value Key in the network Guest. Using the `*` leaves the SSID unchanged.
  - `set Guest {Key} 1234567890` sets the value Key in the network Guest. Individual columns can be referenced by the column name in parentheses.
- Names that contain spaces must be enclosed within quotation marks (`"`).

### Command-specific help

- A command-specific help function is available for actions and commands (call the function with a question mark as the argument). For example, `show ?` displays the options available with the show command.

## 3 Feature descriptions

A selection of WLAN features is described in the following.

### 3.1 Band steering

The IEEE 802.11 standard contains virtually no criteria by which a WLAN client should select the access point for a connection. While there are, for example, general guidelines for the preference given to an access point with a higher RSSI value (i.e. the received signal strength), WLAN clients do not, in practice, adhere strictly to these definitions or the general guidelines. If both 2.4 GHz and 5 GHz are used to broadcast an SSID, there is normally no way of influencing the client as regards the preferred frequency band.

“Client steering” is based on the principle that many clients discover the available access points by means of an active scan. Active scanning here means that a client sends probe requests containing the network ID to which the client is to connect. Access points with this ID then send a test response, enabling the client to create a list of available access points. The vast majority of WLAN clients only connect to access points from which they have received a probe response, and this can be used to steer their selection process.

There are several, sometimes highly advanced, criteria for steering. One of these criteria relates to the wireless frequency ranges used for client communication. Modern dual-band WLAN clients are expected to prefer the 5-GHz frequency band over the now overcrowded 2.4-GHz band. Band Steering is the term given to purposefully assigning a WLAN client to a particular frequency band or range.

The list of detected or “seen” clients contains all clients from which the access point has received a test request packet. In combination with the radio frequency on which the WLAN client sends the probe request, this list is one of the bases used by the access point to decide whether or not to respond to the request.

Other criteria depend on the reported client IDs and the configuration of the devices. It may be the case, for example, that fewer SSIDs are reported on the preferred frequency band than are on the one with the lower preference. Similarly, too low a transmit strength when SSIDs are reported can result in the client not receiving any probe responses at all on the preferred frequency band. For the latter scenario, it is important to ensure that the access point does not suppress probe responses on the less favored frequency band.

To configure the access point's band steering function with LANconfig, go to **Wireless LAN > Client management**.

### 3.2 Fast roaming

By operating authentication according to the IEEE 802.1X standard and key management according to the IEEE 802.11i standard, modern WLAN installations offer a high degree of security and confidentiality for the transmitted data. However, these standards require transmission of additional data packets during the connection negotiation as well as additional computing power on the client and server.

IEEE 802.11 originally required up to six data packets to establish a data connection between a WLAN client and an access point. The standard extension IEEE 802.11i improved on weak points of WEP encryption; however, depending on the authentication method, it substantially increased the length of the login process.

This extra time for the WLAN client to login to the access point is not a problem for non-time-critical applications. However, for smooth, loss-free roaming of a WLAN client from one access point to the next, a delay of more than 50 ms is not acceptable. Examples include Voice-over-IP (VoIP) or the application in real-time industrial environments. In this context, roaming means that the network connection passes from one access point to the other without interruption.

Methods such as pair-wise master key caching (PMK caching), pre-authentication, opportunistic key caching (OKC) and the use of central WLAN controllers (WLC) for key management improve the time for the key negotiation between the WLAN client and access point during login. Despite this, the comparatively long time required for key negotiation between the WLAN client and the access point has still not been reduced to a viable extent.

Along with the improved encryption protocols, IEEE 802.11e makes it possible to reserve additional bandwidth with the access point. This allows the WLAN client to prevent interruptions, for example for VoIP connections at times of high network loads at the access point. For roaming from one access point to the next, the WLAN client must again reserve this additional bandwidth on the new access point. However, the additional management frames required for this considerably increase the login time.

The IEEE 802.11r standard provides a simplified authentication process for mobile WLAN clients to roam trouble-free from one access point to the next. The goal is to once again reduce the number of data packets for the login on the access point to the four to six packets known from IEEE 802.11.

Similar to opportunistic key caching (OKC), a centralized key management (preferably by a WLC) supplies the access points connected to it with the credentials of the WLAN clients. In contrast to OKC, the WLAN client performing fast roaming can detect whether the access point supports IEEE 802.11r


Access points managed by the WLC transmit the "mobility domain information element (MDIE)" to inform WLAN clients within range about, among other things, which "mobility group" the access point belongs to. Based on this information, the WLAN client detects whether it belongs to the same domain and can therefore authenticate without delay. This mobility domain is announced to a WLAN client the first time it authenticates at an access point.

The domain identifier and other special keys generated during the initial authentication and transmitted to all managed access points now reduce the stages of negotiation to the desired four to six steps when authenticating at a new access point.

To avoid futile and thus time-wasting login attempts with expired PMKs, IEEE 802.11r provides additional information about the validity periods of keys. In this manner, the client negotiates a new PMK while connected to the current access point. This is also valid on the access point that the WLAN client wants to connect to next.

Additionally, IEEE 802.11r uses "resource requests" to reserve additional bandwidth on the new access point, so that there is no need to cause added delay by transferring unnecessary data packets during the IEEE 802.11e authentication.

---

 Older WLAN clients may have trouble establishing a connection to an SSID with enabled 802.11r. Therefore, it is advisable to use two SSIDs here: One SSID for older clients without 802.11r support and another SSID with enabled 802.11r for clients that support 802.11r.

Fast roaming is setup in LANconfig under **Wireless LAN > General > Encryption > WPA2/3 key management**.

---


 Fast roaming is possible between devices based on LCOS and LCOS LX.

### Fast roaming by Inter Access Point Protocol (IAPP)

In order to use fast roaming with IAPP, you need to assign an individual IAPP passphrase in the WLAN encryption settings for each interface. This is used to encrypt the pairwise master keys (PMKs). Access points that share a matching IAPP passphrase (PMK-IAPP secret) are able to exchange PMKs between one another and ensure uninterrupted connections. When a client switches to another access point, the new access point sends a handover request to the former access point. The former access point then deletes the client from its station table. The handover request contains the client's MAC address, so that devices in the LAN are informed about the new routing and can update their mapping table.

To enter the IAPP passphrase in LANconfig, navigate to **Wireless LAN > General > Encryption > PMK-IAPP secret**.

---

 Please note that to use Fast Roaming by IAPP, it is necessary to select Fast Roaming in the encryption settings under WPA2 key management.

### 3.3 LANCOM Enhanced Passphrase Security (LEPS)

LANCOM Enhanced Passphrase Security (LEPS) allows a set of passphrases to be configured and assigned to individual users, groups or MAC addresses. This avoids having one global passphrase for an SSID. Instead, there are several passphrases, which can then be distributed individually.

This is useful for onboarding devices into the network. For example, a network operator “onboarding” multiple WLAN devices into different areas of the network does not want to configure each specific device; instead this should be done by the users of the devices themselves. In this case, users are given a preshared key for the company WLAN for use with their own devices. LEPS is configured entirely on the infrastructure side, which assures full compatibility to third-party products.

The security issue presented by global passphrases is fundamentally remedied by LEPS. Each user is assigned their own individual passphrase. If a passphrase assigned to a user should “get lost” or an employee with knowledge of their passphrase leaves the company, then only the passphrase of that user needs to be changed or deleted. All other passphrases remain valid and confidential.

Along with passphrases for users, **individual** passphrases consisting of any sequence of 8 to 63 ASCII characters can also be assigned to MAC addresses. Authentication at the access point is only possible with the correct combination of passphrase and MAC address.

This combination makes the spoofing of the MAC addresses futile—and LEPS thus shuts out a potential attack on the ACL. If WPA2 is used for encryption, the MAC address can indeed be intercepted—but this method never transmits the passphrase over wireless. This greatly increases the difficulty of attacking the WLAN, because knowledge of both the MAC address and the passphrase is required before encryption can be negotiated.

Compared to LEPS for users, the administrative overhead is slightly higher because the MAC address has to be entered for each device.



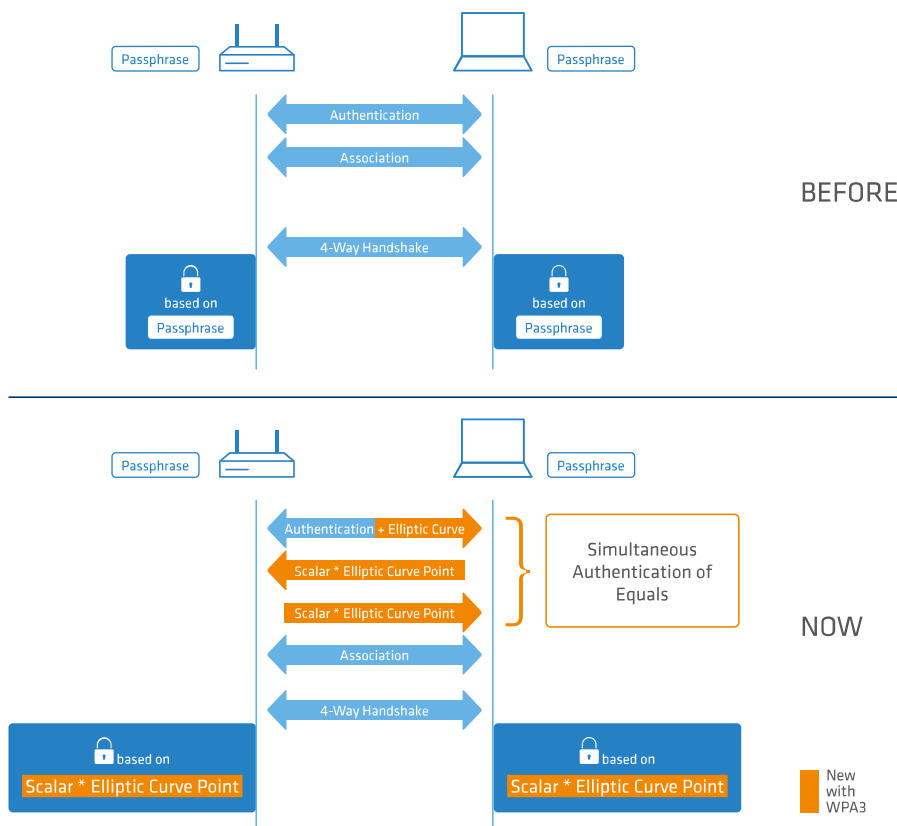
For technical reasons, LEPS is only compatible with WPA version WPA2.

### 3.4 WPA3 (Wi-Fi Protected Access 3)

Compared to the predecessor standard WPA2 introduced by the Wi-Fi Alliance in 2004, the WPA3 standard introduced in 2018 offers improved security by combining various security methods. Like WPA2, WPA3 also exists in the versions WPA3-Personal and WPA3-Enterprise.

WPA3-Personal uses the Simultaneous Authentication of Equals (SAE) authentication method, which only requires a password for authentication but which prevents brute-force and dictionary attacks. Furthermore, for the first time this

method offers forward secrecy, i.e. captured WPA3-secured traffic cannot be decrypted subsequently after the attacker gains knowledge of the pre-shared key.



In addition, the WPA3-Enterprise uses the Commercial National Security Algorithm (CNSA) Suite B cryptography. Suite B ensures that all links in the encryption chain match with one another. Suite B forms classes of bit lengths for hashed, symmetric, and asymmetric encryption in order to provide suitable levels of protection. For example, an SHA-2 hash with 256 bits matches AES with 128 bits. Where Suite B is operated, the support of all other combinations is expressly excluded. Consequently, the encryption chain consists of links of equal strength.

Both variants now require the use of protected management frames (PMF) according to IEEE 802.11w. PMF prevents attackers from computing the WLAN password from captured material gained by using fake management frames to force a disassociation and then eavesdropping the re-authentication.

### 3.4.1 WPA3-Personal

In the WLAN encryption settings under **Wireless LAN > WLAN networks > Encryption**, the WPA versions **WPA3** and **WPA2/3** are available for selection.

With **WPA3** selected, only WLAN clients that support WPA3-Personal will be able to login. This configuration enforces authentication with the Simultaneous Authentication of Equals (SAE). Similarly, this SSID enforces the use of PMF (Protected Management Frames as per IEEE 802.11w), a mandatory part of WPA3.

By selecting **WPA2/3**, these two versions of WPA are offered in parallel. This option allows clients that only support WPA2 to operate in parallel with clients that already support WPA3. For WPA3-compatible WLAN clients, this configuration enforces the use of PMF; for WPA2-compatible WLAN clients, PMF is offered as an option for backwards compatibility.

### 3.4.2 WPA3-Enterprise

WPA3-Enterprise does not fundamentally change or replace the protocols defined in WPA2-Enterprise. Rather, it set out policies to ensure greater consistency in the application of these protocols and to assure the desired level of security.

In the WLAN encryption settings under **Wireless LAN > WLAN networks > Encryption**, the WPA versions **WPA3** and **WPA2/3** are available for selection.


By selecting **WPA3**, only WLAN clients that support WPA3-Enterprise will be able to log in. This SSID enforces the use of PMF (Protected Management Frames as per IEEE 802.11w), a mandatory part of WPA3.

By selecting **WPA2/3**, these two versions of WPA are offered in parallel. This option allows clients that only support WPA2 to operate in parallel with clients that already support WPA3. For WPA3-compatible WLAN clients, this configuration enforces the use of PMF; for WPA2-compatible WLAN clients, PMF is offered as an option for backwards compatibility.

### Suite B cryptography

In addition, the WPA3-Enterprise uses the Commercial National Security Algorithm (CNSA) Suite-B cryptography. Suite B ensures that all links in the encryption chain match with one another. Suite B forms classes of bit lengths for hashed, symmetric, and asymmetric encryption in order to provide suitable levels of protection. For example, an SHA-2 hash with 256 bits matches AES with 128 bits. Where Suite B is operated, the support of all other combinations is expressly excluded. Consequently, the encryption chain consists of links of equal strength.

---

 Further information on CNSA Suite B can be found at the following link: [CNSA algorithm suite factsheet](#)


Use of the following EAP cipher suites are enforced:

- > TLS\_ECDHE\_ECDSA\_WITH\_AES\_256\_GCM\_SHA384
- > TLS\_ECDHE\_RSA\_WITH\_AES\_256\_GCM\_SHA384
- > TLS\_DHE\_RSA\_WITH\_AES\_256\_GCM\_SHA384

---

 Other cipher suites can no longer be used. Also enforced are a minimum key length of 3072 bits for the RSA and Diffie-Hellman key exchange, as well as 384 bits for the ECDSA and ECDHE key exchange. The session key type AES-GCMP-256 is also enforced.

---

 If these cipher suites are not supported by the WLAN clients or the remaining infrastructure (e.g. the RADIUS server), then no connection is possible!

---

 The RADIUS server integrated in the LCOS supports the cipher suites mentioned here.



## 4 Configuring features with LANconfig

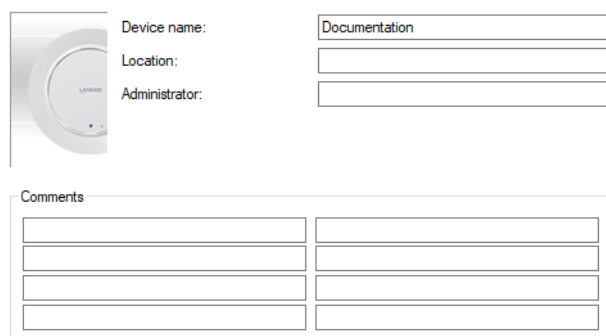
The following explains all of the options for adjusting settings with LANconfig. These depend on the device, so not all of the listed options are available with every device.

### 4.1 Management

The **Management** section contains general settings for the device.

#### 4.1.1 General

The device settings described here are to be found under **Management > General**.



Device name:	<input type="text" value="Documentation"/>
Location:	<input type="text"/>
Administrator:	<input type="text"/>

**Comments**

<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>

##### Name

Configure the device name here.

##### Location

Configure the device location here.

##### Administrator

Here you configure the name of the device administrator.

##### Comments

Use the comment fields to enter any comments about the device configuration.

## 4.1.2 Admin

The settings for changing the main device password and SNMP can be found under **Management > Admin**.

The screenshot shows two sections of the LANconfig interface. The top section, titled 'Device configuration', contains a text field for 'Administrator name' with the value 'root'. Below it is a 'Main device password' field, which is currently masked with red dots. To the right of this field is a 'Show' checkbox and a 'Set' button. A message icon with an information symbol is present, with text stating: 'The password can not be displayed in the clear because the device configuration contains the password only in hashed form. You can use this dialogue to change the password.' The bottom section, titled 'SNMP', contains the text 'Configure the access rights for all protocol versions of SNMP here.' and a button labeled 'SNMP settings...'.

### Main device password

The settings for changing the main device password are located under **Management > Admin > Device configuration**.

This screenshot is identical to the one above, showing the 'Device configuration' section of the LANconfig interface. It highlights the 'Administrator name' field (set to 'root') and the 'Main device password' field, which is masked. The 'Show' checkbox and 'Set' button are also visible, along with the informational message about password hashing.

#### Administrator name

Here you configure the login name of the device administrator. Depending on the device, this name may be fixed and will only be displayed here.

#### Main device password

Configure the main device password here. Depending on the device, this may be stored as a hash value and consequently cannot be displayed as plain text.

If you enter a new password, a field appears to repeat the entry of the changed password. Your input is not displayed, so this serves to verify your input. Alternatively, you can activate the option **Show**. Your input is then displayed in a legible form. We do not recommend this option if other individuals can view your screen while you type.

### Simple Network Management Protocol (SNMP)

The Simple Network Management Protocol (SNMP) enables devices on a network to be monitored and configured from a central instance. Since the initial release of SNMPv1 in 1988, it has continued to evolve with the versions SNMPv2 and SNMPv3 to meet the needs of increasingly complex network infrastructures and the demands for user-friendliness, security and flexibility.

The protocol SNMP (simple network management protocol) meets the highest standards for convenient management and monitoring of a network. It allows for the early detection of problems and errors on a network and offers support in eliminating them. The simple network management protocol allows a central instance to monitor and configure the devices on a network from, and it regulates the communication between the monitored devices and the monitoring station. This means that parameters such as the status of the device, CPU utilization, the temperature of a device, its connection status, errors, and others can be monitored and analyzed, for example with LANmonitor. The administrator benefits from active support with network management and is helped to detect problems at an early stage. The latest SNMPv3 version of the protocol, in contrast to the previous versions SNMPv1 and SNMPv2, now enables encrypted data communication between the network and its management system, which provides a crucial security factor. By offering

different user accounts for authentication, the integrated user administration provides optimal control over access to the configurations. You have precise control over the rights to the different levels of access that administrators receive, and the network is optimally protected.

### **SNMP components**

The typical SNMP architecture consists of three components:

#### **SNMP manager**

The SNMP manager sends SNMP requests to the SNMP agent and evaluates the SNMP responses from it. LANconfig and LANmonitor act as this type of SNMP manager. LCOS LX devices comply with the standards SNMPv1, SNMPv2, and SNMPv3, so it is possible to use an alternative SNMP administration and management software.

#### **SNMP agent**

The SNMP agent is a module that is active on the managed device. When it receives a request from the SNMP manager, it retrieves the requested status data from the MIB in the device and returns this information to the SNMP manager as an "SNMP response". Depending on the configuration, an SNMP agent that detects certain changes of state in the managed device can independently act to send an "SNMP trap" to the SNMP manager. It is also possible to send a notification to the device administrator by means of a SYSLOG message or e-mail.

#### **Managed device**

The status of this device is stored in its Management Information Base (MIB). When requested by the SNMP agent, the device reads out this information and returns it to the SNMP agent.

By default, SNMP requests and SNMP responses are exchanged between the SNMP manager and SNMP agent by the User Datagram Protocol (UDP) on port 161. SNMP traps are transmitted with the UDP via port 162 by default.

### **SNMP versions**

The differences between the various versions of SNMP can be summarized as follows:

#### **SNMPv1**

Version 1 was launched in 1988 and has long been regarded as the de facto standard for network management. In SNMPv1, the SNMP manager authenticates at the SNMP agent by means of a community string, which must be identical on both components. The security of this is very limited, as the community strings are transmitted in cleartext. The increase in demands for secure network communication necessitated a revision of version 1.

#### **SNMPv2**

After 1993, the main improvements in version 2 were to its user-friendliness. Numerous intermediate steps and the repeated rejection of concepts eventually led to the version SNMPv2c. This version allows large amounts of data to be requested via a `GetBulkRequest` command and also the communication between SNMP managers. However, the exchange of the community strings was still as cleartext as with version 1.

#### **SNMPv3**

From 1999, version 3 finally met the by then much-needed security requirements. Among other things, the communication was encrypted and the communication partners first had to authenticate and authorize themselves. Also, the structure of SNMP became more modular so that improvements, for example in encryption technologies, can be incorporated into SNMPv3, without having to completely redesign the standard.

LCOS LX supports the following SNMP versions:

- > SNMPv1
- > SNMPv2c

## > SNMPv3

### **SNMPv3 basics**

The SNMP protocol structure has changed significantly with version 3. SNMPv3 is now divided into a number of modules with clearly defined interfaces that communicate with one another. The three main elements in SNMPv3 are “Message Processing and Dispatch (MPD)”, “User-based Security Model (USM)” and “View-based Access Control Mechanism (VACM)”.

#### **MPD**

The MPD module is responsible for the processing and dispatch of inbound and outbound SNMP messages.

#### **USM**

The USM module manages security features that ensure the authentication of the users and the encryption and integrity of the data. SNMPv3 introduced the principle of the “security model”, so that the SNMP configuration in LCOS LX primarily uses the security model “SNMPv3”. However, for compatibility reasons it may be necessary to also take the versions SNMPv2c or even SNMPv1 into account, and to select these as the “security model” accordingly.

#### **VACM**

VACM ensures that the sender of an SNMP request is entitled to receive the requested information. The associated access permissions are found in the following settings and parameters:

##### **SNMPv3-Views**

“SNMPv3-Views” collect together the content, status messages, and actions of the Management Information Base (MIB) that are permitted to receive or execute an SNMP request. These views can be single values, but also complete paths of the MIB. This content is specified by the OIDs of the MIB entries.

In this way, a successfully authenticated sender of an SNMP request only has access to that data specified in the applicable SNMPv3 views.

##### **SNMPv3-Groups**

“SNMPv3-Groups” collect users with the same permissions into a specific group.

##### **Security-Levels**

“Security levels” relate to the exchange of SNMP messages. The following levels can be selected:

##### **NoAuth-NoPriv**

The SNMP request is valid without the use of specific authentication methods. Authentication merely requires the user to belong to an SNMP community (for SNMPv1 and SNMPv2c) or to specify a valid user name (for SNMPv3). Data transfer is not encrypted.

##### **Auth-NoPriv**

SNMP requests are only processed following authentication by means of the HMAC-MD5 or HMAC-SHA algorithm, but data transfer is not encrypted.

##### **Auth-Priv**

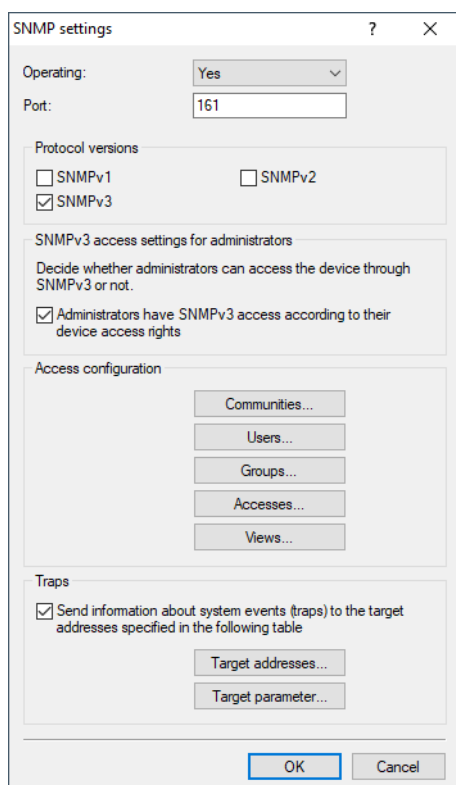
SNMP requests are only processed following authentication by means of the HMAC-MD5 or HMAC-SHA algorithm, and data transfer is encrypted by the DES or AES algorithm.

##### **Context**

“Context” is used to distinguish the various SNMP entities.

## Configuring SNMP

The SNMP settings of the device can be found under **Management > Admin > SNMP > SNMP settings**.



The image shows a screenshot of the 'SNMP settings' dialog box. It has a title bar with a question mark and a close button. The settings are organized into several sections:

- Operating:** A dropdown menu set to 'Yes'.
- Port:** A text input field containing '161'.
- Protocol versions:** A group box containing three checkboxes: 'SNMPv1' (unchecked), 'SNMPv2' (unchecked), and 'SNMPv3' (checked).
- SNMPv3 access settings for administrators:** A group box with the text 'Decide whether administrators can access the device through SNMPv3 or not.' and a checked checkbox 'Administrators have SNMPv3 access according to their device access rights'.
- Access configuration:** A group box containing five buttons: 'Communities...', 'Users...', 'Groups...', 'Accesses...', and 'Views...'.
- Traps:** A group box with a checked checkbox 'Send information about system events (traps) to the target addresses specified in the following table'. Below this are two buttons: 'Target addresses...' and 'Target parameter...'.

At the bottom of the dialog are 'OK' and 'Cancel' buttons.

### Operation

Enable SNMP for the SNMP protocol versions specified below, which the device should support for SNMP requests and SNMP traps.

### Port

If necessary, adjust the port used for SNMP. Default: 161

### Protocol versions

#### SNMPv1

Enables SNMPv1.

#### SNMPv2

Enables SNMPv2c.

#### SNMPv3

Enables SNMPv3.

### SNMPv3 access settings for administrators

#### Administrators have SNMPv3 access according to their access rights

Enable this option if registered administrators, including the root user, should also have access via SNMPv3.

## Access configuration

### SNMP communities

Administrators of networks with SNMP management systems can precisely control the access rights to various access levels. SNMP of the versions v1 and v2 do this by encoding the access credentials as part of a “community”. Authentication is optionally handled

- > by the `public` community (unlimited SNMP read access),
- > by a master password (limited SNMP read access),
- > or a combination of user name and password, separated by a colon (limited SNMP read access)

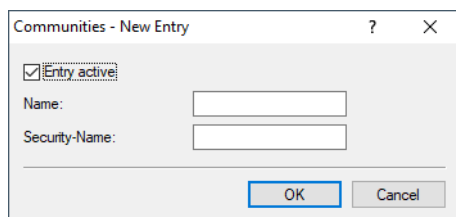
.

A community collects certain SNMP hosts into groups, in part so that it is easier to manage them. On the other hand, SNMP communities offer a certain degree of security because an SNMP agent only accepts SNMP requests from participants in a community that it knows.

By default, your device answers all SNMP requests that it receives from LANmonitor or another SNMP management system with the community `public`. Because this represents a potential security risk, especially with external access, LANconfig gives you the option of defining your own communities.



This configuration is relevant for the SNMP versions v1 and v2c only.



#### Entry active

Activates or deactivates this SNMP community.

#### Name

Enter a descriptive name for this SNMP community.

#### Security-Name

Here you enter the name for the access policy that specifies the access rights for all community members.



The SNMP community `public` is set up by default, and this provides unrestricted SNMP read access.

For SNMPv1 or SNMPv2c, you force the entry of login data for SNMP read-only access by disabling the `public` community in the list of the SNMP communities. This setting only allows information about the state of the device, current connections, reports, etc., to be read out via SNMP after the user authenticates at the device. Authorization can be conducted either with the administrator-account access credentials or an access account created for the individual SNMP community.

Disabling the community `public` has no effect on accessing for other communities created here. An individual SNMP read-only community always provides an alternative access path that is not tied to an administrator account.

## Users

Individual users can be granted access to the device in addition to the administrators registered on it. Here you configure the authentication and encryption settings for these users when operating SNMPv3.

### Entry active

Activates or deactivates this user.

### User name

Enter a descriptive name for this user.

### Authentication

Specify the method that the user is required to use to authenticate at the SNMP agent. The following options are available:

#### None

Authentication of the user is not necessary.

#### HMAC-MD5

Authentication is performed using the hash algorithm HMAC-MD5-96 (hash length 128 bits).

#### HMAC-SHA

Authentication is performed using the hash algorithm HMAC-SHA (hash length 160 bits).

#### HMAC-SHA224

Authentication is performed using the hash algorithm HMAC-SHA- 224 (hash length 224 bits).

#### HMAC-SHA256

Authentication is performed using the hash algorithm HMAC-SHA- 256 (hash length 256 bits).

#### HMAC-SHA384

Authentication is performed using the hash algorithm HMAC-SHA- 384 (hash length 384 bits).

#### HMAC-SHA512

Authentication is performed using the hash algorithm HMAC-SHA- 512 (hash length 512 bits).

### Authentication password

Enter the user password necessary for authentication here and repeat it in the box below.

### Encryption

Specify which encryption method is used for encrypted communication with the user. The following options are available:

**None**

Communication is not encrypted.

**DES**

Encryption is performed with DES (key length 56 bits).

**AES128**

Encryption is performed with AES128 (key length 128 bits)

**AES192**

Encryption is performed with AES192 (key length 192 bits)

**AES256**

Encryption is performed with AES256 (key length 256 bits)

**Privacy password**

Enter the user password required by the encryption here and repeat it in the box below.

**Groups**

By configuring SNMP groups, it is easy to manage and assign the authentication and access rights of multiple users. By default, the configuration is set up for SNMP access via LANmonitor.

**Entry active**

Activates or deactivates this group.

**Security model**

SNMPv3 introduced the principle of the "security model", so that the SNMP configuration in LCOS LX primarily uses the security model "SNMPv3". However, for compatibility reasons it may be necessary to also take the versions SNMPv2c or even SNMPv1 into account, and to select these as the "security model" accordingly. Select one of the following entries accordingly:

**Any**

Any model is accepted.

**SNMPv1**

Data is transmitted by SNMPv1. Users are authenticated by the community string in the SNMP message only. Communication is not encrypted. This corresponds to the security level "No authentication/No privacy".

**SNMPv2\_C**

Data is transmitted by SNMPv2c. Users are authenticated by the community string in the SNMP message only. Communication is not encrypted. This corresponds to the security level "No authentication/No privacy".



**SNMPv3\_USM**

Data is transmitted by SNMPv3. Security levels for the user's authentication and communication are possible, and these levels are activated with the **access rights**.

**Security-Name**

Here you select a security name you assigned to an SNMP community.

**Group name**

Here you select a group that you want to define under **Access rights**.

**Access rights**

This table brings together the different configurations for access rights, security models, and views.

**Entry active**

Activates or deactivates this entry.

**Group name**

Enter a descriptive name for this group.

**Security model**

Activate the appropriate security model here.

**Minimal security level**

Specify the minimum security level for access and data transfer.

**NoAuthNoPriv (No authentication/No privacy)**

The authentication is performed by the specification and evaluation of the user name only. Data communication is not encrypted.

**AuthNoPriv (Authentication/No privacy)**

Authentication makes use of the hash algorithms set for the user. Data communication is not encrypted.

**AuthPriv (Authentication and privacy)**

Authentication makes use of the hash algorithms set for the user. Data communication is encrypted by DES or AES algorithms.

**Read**

Set the view of the MIB entries for which this group is to receive read rights. Available values are those defined under **Views**. Previously defined views are "Full Access". "LANmonitor Access". "Setup Access" and "Status Access".

**Write**

Set the view of the MIB entries for which this group is to receive write rights. Available values are those defined under **Views**. Previously defined views are "Full Access". "LANmonitor Access". "Setup Access" and "Status Access".

**Read-only traps**

Set the view of the MIB entries for which this group is to receive read rights for traps. Available values are those defined under **Views**. Previously defined views are "Full Access". "LANmonitor Access". "Setup Access" and "Status Access".

**Views**

Here you collect the different values or even entire branches of the device MIB, which each user is entitled to view or change in keeping with the corresponding access rights.

**Entry active**

Activates or deactivates this view.

**Name**

Enter a descriptive name for this view.

**OID subtree**

Use a comma-separated list of the relevant OIDs to decide which values and actions from the MIB are included in or excluded from this view.



The OIDs can be found in the device MIB, which you can download from [www.lancom-systems.com/downloads/](http://www.lancom-systems.com/downloads/).

**Access to subtree**

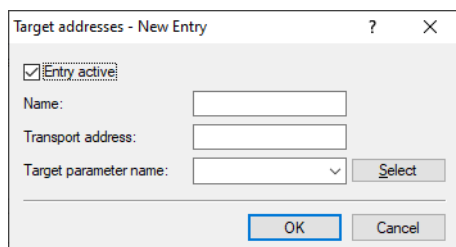
Here you decide whether the specified OID subtrees are "added" or "removed" from the view.

**Traps**

If you enable the option **Send information about system events (traps) to the target addresses specified in the following table**, the recipients configured under **Target addresses** and **Target parameters** will receive the corresponding information.

### Target addresses

The list of target addresses is used to configure the addresses of the recipients to whom the SNMP agent sends the SNMP traps.



The dialog box titled "Target addresses - New Entry" contains the following fields and controls:

- ☒ Entry active
- Name:
- Transport address:
- Target parameter name:
- 

#### Entry active

Activates or deactivates this entry.

#### Name

Give the entry a descriptive name here.

#### Transport address

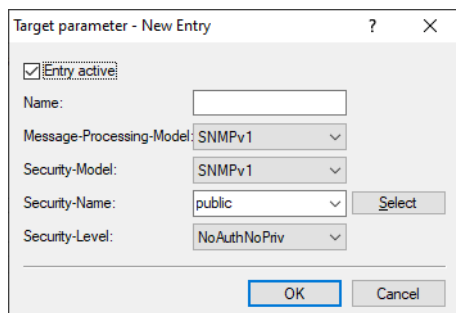
Configure the address of the recipient here. This address describes the IP address and port number of a recipient of an SNMP trap and is specified in the syntax "<IP address> : <Port>" (e.g. 128.1.2.3:162). UDP port 162 is used for SNMP traps.

#### Target parameter name

Here you select the desired entry from the list of recipient parameters.

### Target parameter name

In this table you configure how the SNMP agent handles the SNMP traps that it sends to the recipient.



The dialog box titled "Target parameter - New Entry" contains the following fields and controls:

- ☒ Entry active
- Name:
- Message-Processing-Model:
- Security-Model:
- Security-Name:
- Security-Level:
- 

#### Entry active

Activates or deactivates this entry.

#### Name

Give the entry a descriptive name here.

#### Message processing model

Here you specify the protocol for which the SNMP agent structures the message.

#### Security model

SNMPv3 introduced the principle of the "Security Model", so that the SNMP configuration in LCOS LX primarily uses the security model "SNMPv3". However, for compatibility reasons it may be necessary to allow for the

versions SNMPv2c or even SNMPv1, and to select these accordingly. Select one of the following entries accordingly:

**Any**

Any model is accepted.

**SNMPv1**

Data is transmitted by SNMPv1. Users are authenticated by the community string in the SNMP message only. Communication is not encrypted. This corresponds to the security level "NoAuthNoPriv".

**SNMPv2\_C**

Data is transmitted by SNMPv2c. Users are authenticated by the community string in the SNMP message only. Communication is not encrypted. This corresponds to the security level "NoAuthNoPriv".

**SNMPv3\_USM**

Data is transmitted by SNMPv3. This can only be selected together with SNMP users. The effective possible security level depends on the user's chosen authentication and encryption methods.

**Security-Name**

Here you select a security name you assigned to an SNMP community.

**Security level**

Set the security level that applies for the recipient to receive the SNMP trap.

**NoAuthNoPriv (No authentication/No privacy)**

The authentication is performed by the specification and evaluation of the user name only. Data communication is not encrypted.

**AuthNoPriv (Authentication/No privacy)**

Authentication makes use of the hash algorithms set for the user. Data communication is not encrypted.

**AuthPriv (Authentication and privacy)**

Authentication makes use of the hash algorithms set for the user. Data communication is encrypted by DES or AES algorithms.

### 4.1.3 LMC

Settings that relate to the configuration and monitoring of your device via the LANCOM Management Cloud (LMC) are located under **Management > LMC**.

The screenshot shows a configuration window titled "LANCOM Management Cloud". It contains the following elements:

- A message: "If you want to use the LANCOM Management Cloud to configure and monitor the device, you must specify the domain of the services."
- An "Operating:" label followed by a dropdown menu currently set to "No".
- A message: "Here you can specify the domain of the services to which the device connects."
- Four input fields with labels:
  - "LMC-Domain:" with the value "cloud.lancom.de" entered.
  - "Rollout project ID:" (empty)
  - "Rollout location ID:" (empty)
  - "Rollout device role:" (empty)

**Operation**

Specify whether the device should be managed via the LMC.

**No**

The device does not connect to the LMC.

**Yes**

The LMC manages the device.

**LMC domain**

Enter the domain name for the LMC here. By default, the domain is set to the Public LMC for the first connection. If you wish to manage your device with your own Management Cloud ("Private Cloud" or "on-premises installation"), please enter your LMC domain.

**Rollout project ID**

Enter the project ID of this device in the LMC. The first time the device connects to the LMC, it will be assigned accordingly.

**Rollout location ID**

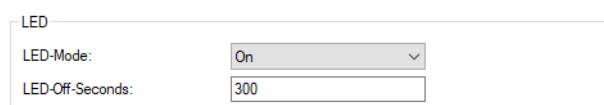
Enter the location of this device in the LMC. The first time the device connects to the LMC, it will be assigned accordingly.

**Rollout device role**

Enter the role assigned to this device in the LMC. The first time the device connects to the LMC, it will be assigned accordingly.

## 4.1.4 Extended

The settings for the LED functions are located here. These are located under **Management > Extended**.

**LED-Mode**

Choose between the different LED modes.

**On**

The LED(s) of the device are permanently in operation and signal the operating state.

**Off**

The LED(s) of the device are switched off immediately after starting.

**Timed off**

The LED(s) of the device are switched off after the configured time.



Refer to the Quick Reference Guide for device-specific details about LED signaling.

**LED off seconds**

Set a time in seconds after the device starts, after which the LED(s) of the device are switched off if the **LED mode** is set to Timed-Off.

### 4.1.5 802.1X supplicant

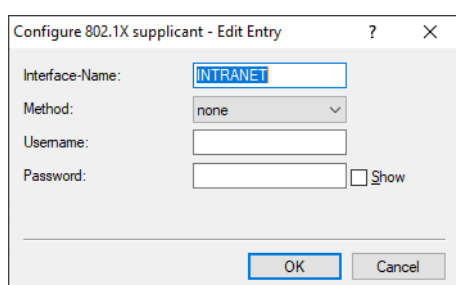
These are the settings for the 802.1X supplicant functionality, which authenticates the device towards the LAN at a switch infrastructure secured by 802.1X. These are located under **Management > 802.1X supplicant**.

Use the 802.1X supplicant feature to authenticate the device to an 802.1X secured switch infrastructure using the device's ethernet ports.

Configure 802.1X supplicant...

#### Configuring the 802.1X supplicant

You configure the 802.1X supplicant functionality under **Management > 802.1X supplicant > Configure 802.1X supplicant**.



##### Interface name

The name of the LAN interface. Currently there is only the interface INTRANET, and this cannot be changed.

##### Method

The EAP method used to authenticate at the 802.1X infrastructure.


##### User name

The user name to use to authenticate at the 802.1X infrastructure.

##### Password

The password to use to authenticate at the 802.1X infrastructure.

---

 Support for authentication by means of client certificates will follow in a future LCOS LX version.

### 4.1.6 Software update

The LANCOM Auto Updater allows the automatic updating of on-site LANCOM devices without further user intervention. LANCOM devices can search for new software updates, and download and install them without any user interaction. You can choose whether to install security updates, release updates, or all updates automatically. If you choose not to use automatic updates, the feature can still be used to check for the availability of new updates.

The LANCOM Auto Updater contacts the LANCOM update server to check for updates and firmware downloads. Communication is based on HTTPS. When contacting the server, the LANCOM device uses previously installed TLS certificates for validation. Furthermore, the firmware files for current LANCOM devices are signed. The LANCOM Auto Updater validates this signature before uploading any firmware.

The configuration for the LANCOM Auto Updater in LANconfig is located under **Management > Software update**.

Using the automatic LCOS-LX Software Update the device can check for new firmware versions and install those matching the configured update policy during certain time frames.

Mode:

Check-Interval:

Version-Policy:

Check time frame

From:  o'clock

To:  o'clock

Installation time frame

From:  o'clock

To:  o'clock

Base-URL:

## Mode

Set the operating mode here. The following modes are supported:

### Check & update

- The Auto Updater regularly checks the update server for new updates.
- The update server uses the **update policy** to find the most suitable update, it sets the time to download and install the update within a time frame configured by the user, and it sends the update to the Auto Updater.
- The firmware is installed in test mode. After installation, the Auto Updater performs a connection check. Here, the device checks whether a connection can be established to the update server to ensure that Internet access is still available. If the update server is contacted successfully, the test mode terminates and the firmware goes into regular operation. If the update server cannot be contacted, then Internet access is assumed to be impossible and the second (i.e. the previously active) firmware will be started again.

### Check

- The Auto Updater regularly checks the update server for new updates.
- The availability of a new update is signaled to the user in the LCOS LX menu tree and via syslog.
- Users can manually use the Auto Updater to initiate the latest available update.



A manual update is started with the following entry on the command line:

```
do /setup/Automatic-Firmware-Update/Update-Firmware-Now
```

### Manual

- The Auto Updater only checks for new updates when prompted by the user.
- Users can manually use the Auto Updater to initiate the latest available update.



A manual update is started with the following entry on the command line:

```
do /setup/Automatic-Firmware-Update/Update-Firmware-Now
```

## Check interval

This decides whether checks for an available update are performed daily or weekly.

## Update policy

### Latest version

Always the newest version, irrespective of the release version. Example: 10.20 Rel is installed; an update to 10.20 RU1 is performed, but also to 10.30 Rel. Updates always go to the latest version, but not back to a previous release.

### Current version

The latest RU/SU/PR within a release. Example: 10.20 Rel is installed; an update to 10.20 RU1 is performed, but not to 10.30 Rel.

### Security patches only

The latest SU within a release. Example: 10.20 Rel is installed; an update to 10.20 SU1 is performed, but not to 10.20 RU2.

### Latest version w/o REL

The newest RU/SU/PR, irrespective of the release version. Updates are only performed if a RU is available. Example: Any version of 10.20 is installed; an update to 10.30 RU1 is performed, but not to 10.30 REL.

## Check time frame

Set the time frame for checking and downloading new updates here. The daily start and end time for this time frame can be set to the hour. The default value for both of these is 0, so checks for updates and downloads can be started at any time of day. The Auto Updater schedules a random time for update checks and downloads within the configured time frame.

## Installation time frame

Set the time frame for update installations here. The daily start and end time for this time frame can be set to the hour. The default setting specifies a time frame between 2:00 AM and 4:00 AM. If an update is found, it will be installed during this time and the device will be restarted to activate the update. The Auto Updater schedules a random time for the installation within the configured time frame.

## Base URL

Specifies the URL of the server that provides the latest firmware versions.

## 4.2 Date/Time

The section **Date/Time** contains the corresponding device settings.

### 4.2.1 Configuration

The device settings date and time are to be found under **Date/Time > Configuration**.

The screenshot displays the 'Date/Time' configuration window. It is divided into three main sections:

- Timezone:** A dropdown menu is currently set to 'UTC'.
- NTP client:** A dropdown menu is set to 'No', and there is an empty text field for the 'Server'.
- Timeframes:** A text box contains the message 'Time frames for the WLAN time control feature can be defined here.' Below this text are two buttons: 'Timeframes...' and 'Holidays...'.



## Time zone

Set the correct time zone.

## NTP client

Using the Network Time Protocol (NTP), the device can read the current time from a public time server on the Internet (NTP server with an "open access" policy such as the Physikalisch-Technischen Bundesanstalt in Germany). LANCOM routers also work as NTP servers, so not every network device needs to access an external NTP server.

## Operation

### Yes

The NTP server set under **Server** is used to set the date and time.

### No

Do not use an NTP server.

## Server

Enter the address of the NTP server.

## Timeframes

Timeframes are used to switch individual SSIDs on and off according to a schedule. One profile may contain several rows with different timeframes. Add the time frame to the logical WLAN settings for it to be used with the corresponding SSID.

As an example, a number of timeframes have already been set up here to illustrate a configuration for a school day. There are two timeframes with the same name "Lessons" – but with different start and stop times in order to allow a 45-minute break between these two timeframes. This is defined in the time frame "Break". Timeframes can be restricted to certain days of the week. Holidays are also taken into account as long as they are entered in the [Holidays table](#). Summertime/wintertime is also observed based on the time zone setting.

Predefined timeframes are ALWAYS and NEVER. You can configure additional timeframes in LANconfig under **Date/Time > Configuration > Timeframes**. This section also allows you to specify public holidays for the timeframes.

The screenshot shows a dialog box titled "Timeframes - New Entry". It has a "Name:" label followed by a text input field. Below that are "Start:" and "Stop:" labels, each followed by a time selection field showing "00 : 00" and "23 : 59" respectively. Underneath is a section labeled "Weekdays" containing eight checkboxes: Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, and Holiday. At the bottom of the dialog are "OK" and "Cancel" buttons.

### Name

Enter the name of the time frame so that it can be referenced from the WLAN SSID. Several entries with the same name result in a common profile.


### Start

The start time (time of day) can be specified in the format HH:MM (default: 00:00), from which the selected profile becomes valid.

**Stop**

The stop time (time of day) can be specified in the format HH:MM (default: 00:00), from which the selected profile ceases to be valid.

---

 A stop time of HH:MM usually runs until HH:MM:00. The stop time 00:00 is an exception, since this is interpreted as 23:59:59.

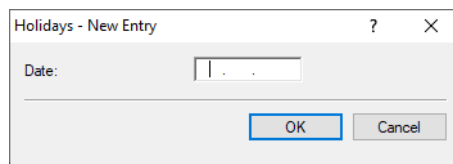
**Weekdays**

Here you select the weekday on which the timeframe is to be valid.

Possible values:

> Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday, Holiday

You can form a time schedule with the same name but with different times extending over several rows.

**Holidays**

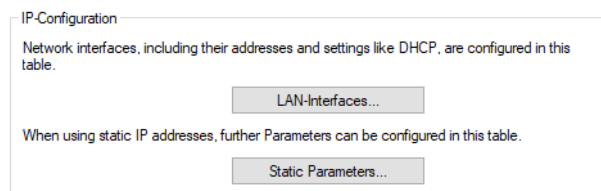
Enter the public holidays to be observed in the time frame.

---

 The year 0 stands for any year.

## 4.3 IP configuration

The settings for the IP configuration of your device are located under **IP Configuration > Configuration**.



### 4.3.1 LAN interfaces

Under **IP Configuration > Configuration > LAN interfaces** you can modify the basic configuration relating to the device's own IP settings and network access.

LAN-Interfaces - Edit Entry

Interface-Name:

Interface-ID:

VLAN-ID:

IPv4 Address Source:

IPv6 Address Source:

Static IPv4 Address:

Static IPv6 Address:

Comment:

#### Interface name

Set a meaningful name for the interface here. This name is used to reference the interface configuration from other parts of the configuration.

#### Interface-ID

The internal identifier for the interface.

#### VLAN ID

Here you specify a VLAN ID for which the interface should be active and accessible. The default value "0" means that no VLAN is used.

#### IPv4 address source

Here you select how the IPv4 address of the interface is to be obtained.

##### DHCP

The IP address is retrieved via DHCP.

##### Static

The static IP address configured for the interface is used.

#### IPv6 address source

Here you select how the IPv6 address of the interface is to be obtained:

##### Router-Advertisement

The IPv6 address is derived from router advertisements that the device receives on the respective interface.



If the flag in the router advertisement is set to Other and/or Managed, additional configuration options are obtained via DHCPv6—even if the address source is set to **Router-Advertisement**.

##### DHCPv6

The IPv6 address is obtained via DHCPv6.

##### Static

The static IPv6 address configured for the interface is used.

**Static IPv4 address**

Here you configure the IP address to be used when the IPv4-Address-Source is set to **Static**. Add the subnet mask in CIDR notation (e.g. "/24") as a suffix.

**Static IPv6 address**

Here you configure the IP address to be used when the IPv6-Address-Source is set to **Static**. Add the subnet mask in CIDR notation (e.g. "/64") as a suffix.

**Comment**

Here you can enter a comment about the interface configuration.

### 4.3.2 Static parameters

Other settings related to the IP and network configuration that are required when using static IP addresses are located under **IP Configuration > Configuration > Static parameters**.

! The settings made in this table only come into effect if the IPv4 or IPv6 address source for the corresponding LAN interface is set to **static**. Otherwise all of the necessary information is retrieved via DHCP, for example, in which case no configuration is required here.

**Interface name**

Enter the name of the interface, which the other settings made here refer to.

**IPv4-Gateway**

Here you configure the IPv4 gateway for the referenced interface.

**IPv6-Gateway**

Here you configure the IPv6 gateway for the referenced interface.

**Primary IPv4 DNS server**

Here you configure the primary IPv4 DNS gateway for the referenced interface.

**Secondary IPv4 DNS server**

Here you configure the secondary IPv4 DNS gateway for the referenced interface.

**Primary IPv6 DNS server**

Here you configure the primary IPv6 DNS gateway for the referenced interface.

**Secondary IPv6 DNS server**

Here you configure the secondary IPv6 DNS gateway for the referenced interface.

## 4.4 Wireless LAN

In the section **Wireless LAN** you will find all the settings related to the broadcasting of WLAN networks.

### 4.4.1 WLAN networks

The wireless network settings for your device are located under **Wireless LAN > WLAN networks**.

The screenshot shows two configuration panels. The top panel, titled 'General', contains a text box explaining that the country setting affects regulatory limits, followed by a 'Country:' label and a dropdown menu currently set to 'Europe'. The bottom panel, also titled 'General', contains a text box stating that WLAN networks (SSIDs) and physical (radio) WLAN settings can be configured here. Below this text are three buttons: 'Network...', 'Encryption...', and 'Radio-Settings...'.

#### In general

##### Country

Here you configure the country where the device is operated. Depending on this, the appropriate regulatory limits are set automatically.

##### Networks

General settings relating to the broadcast WLAN networks (SSIDs) are configured under **Wireless LAN > > WLAN networks > Network**. Add a line to the table for each WLAN network. By default, the table is empty.

The screenshot shows a 'Network - New Entry' dialog box with various configuration fields. The fields include: 'Network-Name' (text box with 'NETWORK'), 'SSID-Name' (text box with 'LANCOM'), 'Key (PSK)' (password field with a 'Show' checkbox and a 'Generate password' button), 'Radios' (dropdown menu set to '2.4 + 5 GHz'), 'Encryption-Profile' (dropdown menu set to 'P-PSK' with a 'Select' button), 'Idle-Timeout' (text box with '300'), 'Tx bandwidth limit' (text box with '0'), 'Rx bandwidth limit' (text box with '0'), 'VLAN-ID' (text box with '0'), 'Inter-Station-Traffic' (dropdown menu set to 'Yes'), 'Suppress SSID broadcast' (dropdown menu set to 'No'), 'Maximum client count' (text box with '0'), 'Minimal client signal str.' (text box with '0'), 'Exclude From Client Mgmt' (dropdown menu set to 'No'), and 'Timeframe' (dropdown menu set to 'ALWAYS' with a 'Select' button). At the bottom are 'OK' and 'Cancel' buttons.

**Network name**

Choose a meaningful name for the WLAN network here. This **internal** identifier is used to reference the interface configuration from other parts of the configuration.



This is **not** the name of the SSID and is not displayed by the clients. This is configured in the next step.

**SSID-Name**

Here you configure the name of the SSID to be broadcast. This name is displayed on the wireless clients when searching for WLAN networks.

**Key (PSK)**

Configure the pre-shared key (PSK) used for the WLAN network here. If you select **Show**, you can use **Generate password** to create a random password. Use the arrow next to it to set the strength, length and various other settings for the characters used for the generated pre-shared key.



This entry only applies if an encryption profile using WPA(2)-PSK is selected. If 802.1X is used, the entry has no effect and the field can be left blank.

**Radios**

Configure here the WLAN frequencies that the SSID is to be broadcast on.

**2.4 GHz + 5 GHz**

The SSID is broadcast on the frequencies 2.4 GHz and 5 GHz.

**2.4 GHz**

The SSID is only broadcast on the 2.4-GHz frequency.

**5 GHz**

The SSID is only broadcast on the 5-GHz frequency.

**none**

The SSID will not be broadcast. This can be used as a general on/off switch for the SSID.

**Encryption profile**

Here you select an encryption profile that defines the authentication and encryption method used for the SSID.

By default, the following encryption profiles are available for selection:

**P-NONE**

No encryption, the SSID is open.

**P-PSK**

The authentication method used is WPA2 with pre-shared key (PSK), also known as WPA2-Personal. A key must be configured for the WLAN network.

**P-PSK-WPA2-3**

The authentication method used is WPA2 and/or WPA3 with pre-shared key (PSK), also known as WPA-Personal. A key must be configured for the WLAN network.

**P-PSK-WPA3**

The authentication method used is WPA3 with pre-shared key (PSK), also known as WPA3-Personal. A key must be configured for the WLAN network.

**Idle timeout**

This is the time in seconds during which the access point cannot receive any further packets after a client is disconnected. The timeout is reset by any data traffic from the client.

**TX bandwidth limit**

Here you set a WLAN bandwidth limit that applies to the entire WLAN network. All of the logged in clients can only receive data with the transmission rate configured here. The value "0" means that no limitation is active. The transmission direction is considered relative to the access point, so "Tx" means the transmission rate from the access point to the client. This setting affects the download rate at the client.

**RX bandwidth limit**

Here you set a WLAN bandwidth limit that applies to the entire WLAN network. All of the logged in clients can only send data with the transmission rate configured here. The value "0" means that no limitation is active. The transmission direction is considered relative to the access point, so "Rx" means the transmission rate from the client to the access point. This setting affects the upload rate at the client.

**VLAN-ID**

This VLAN ID is used to tag the data packets arriving from the WLAN and heading for the LAN. Similarly, packets with this VLAN ID arriving from the LAN are directed to the WLAN and are de-tagged.



This operating mode corresponds to what is normally known as the "Access" tagging mode, since it is assumed that wireless clients usually transmit data untagged. Tagging mode cannot be adjusted.

**Direct traffic between stations**

Depending on the application, it may be required that the WLAN clients connected to an access point can—or expressly cannot—communicate with other clients. Here you configure whether communication between the WLAN clients on the WLAN network should be allowed.

**Suppress SSID broadcast**

Here you configure whether this SSID is displayed to clients searching for a network.

If the SSID broadcast is suppressed, the access point will not respond to probe requests with an empty SSID. In this case, establishing a connection requires the SSID to be explicitly entered into and configured on the client.

**Maximum count of clients**

This number determines the number of clients that can log on to the WLAN network simultaneously before further requesting clients are rejected.

The value "0" means that there is no limit, so unlimited number of clients can be logged in at the same time (up to a possible hardware-related limit).

**Minimal client signal strength**

Here you configure the minimum signal strength in percent that a client must "show" at the access point in order for it to be able to connect to the WLAN.

The value "0" means that there is no minimum signal strength requirement and clients are always allowed to connect.

**Exclude from client management**

This SSID may be exempted from the band steering.

**Timeframe**

Enter the name of a [Timeframe](#) here. This is used to schedule when this SSID is switched on or off.

## Encryption

The settings for encryption and authentication on the WLAN networks are configured under **Wireless LAN > WLAN networks > Encryption**. The following encryption profiles are stored by default and these can be used for the configuration of the WLAN networks.

### P-NONE

No encryption, the SSID is open.

### P-PSK

The authentication method used is WPA2 with pre-shared key (PSK), also known as WPA2-Personal. A key must be configured for the WLAN network.

### P-PSK-WPA2-3

The authentication method used is WPA2 and/or WPA3 with pre-shared key (PSK), also known as WPA-Personal. A key must be configured for the WLAN network.

### P-PSK-WPA3

The authentication method used is WPA3 with pre-shared key (PSK), also known as WPA3-Personal. A key must be configured for the WLAN network.

The screenshot shows the 'Encryption - New Entry' dialog box. It has the following fields and options:

- Profile-Name:** A text box containing 'P-PSK'.
- Encryption:** A dropdown menu set to 'Yes'.
- Method:** A dropdown menu set to 'WPA(2/3)-PSK'.
- WPA-Version:** A dropdown menu set to 'WPA2'.
- WPA1-Session-Keytypes:** A dropdown menu set to 'TKIP'.
- WPA2-3-Session-Keytypes:** A dropdown menu set to 'AES'.
- Encrypt manag. frames:** A dropdown menu set to 'No'.
- WPA-Rekeying-Cycle:** A text box containing '0'.
- Pre-Authentication:** A dropdown menu set to 'Yes'.
- WPA2-Key-Management:** A dropdown menu set to 'Standard'.
- SAE/OWE-Groups:** A section with checkboxes for 'DH-19' (checked), 'DH-20' (unchecked), and 'DH-21' (unchecked).
- PMK-IAPP-Secret:** A red text box, a 'Show' checkbox, and a 'Generate password' button.
- RADIUS-Server-Profile:** A dropdown menu and a 'Select' button.
- Buttons:** 'OK' and 'Cancel' buttons at the bottom.

### Profile name

Choose a meaningful name for the encryption profile here. This internal identifier is used to reference the encryption profile from other parts of the configuration.

### Encryption

Here you configure whether the WLAN network should be encrypted or if no encryption should be used (Open Network).

### Method

Here you configure the encryption method. The following methods are available:



**WPA**

- WPA(2/3)-PSK: WPA2 and/or WPA3 with pre-shared key (PSK), also known as WPA-Personal.
- WPA(2/3)-802.1X: WPA2 and/or WPA3 with 802.1X, also known as WPA-Enterprise



Note that 802.1X requires a RADIUS server profile to be specified as well.

**WEP**

The WEP process no longer provides adequate security and should only be used to integrate legacy clients that do not support a newer security method. If this is the case, we recommend that you isolate the WEP clients in their own VLAN to keep them separate from the rest of the WLAN infrastructure.

- WEP-40-Bits: WEP with 40-bits key length
- WEP-104-Bits: WEP with 104-bits key length
- WEP-128-Bits: WEP with 128-bits key length
- WEP-40-Bits-802.1X: WEP with 40-bits key length and 802.1X



Note that 802.1X requires a RADIUS server profile to be specified as well.

- WEP-104-Bits-802.1X: WEP with 104-bits key length and 802.1X



Note that 802.1X requires a RADIUS server profile to be specified as well.

- WEP-128-Bits-802.1X: WEP with 128-bits key length and 802.1X



Note that 802.1X requires a RADIUS server profile to be specified as well.

**WPA-Version**

Wi-Fi Protected Access (WPA) is an encryption method. Here you configure the WPA version used for the encryption methods WPA(2)-PSK and WPA(2)-802.1X. The following versions are available:

- WPA1: WPA version 1 is used exclusively.
- WPA2: WPA version 2 is used exclusively.
- WPA3: WPA version 3 is used exclusively.
- WPA1/2: Whether the encryption method WPA 1 or 2 is used depends on the capabilities of the client.
- WPA2/3: Whether the encryption method WPA 2 or 3 is used depends on the capabilities of the client.

**WPA1-Session-Keytypes**

Here you configure the session key type to be used for WPA version 1. This also influences the encryption method used. The following types are available:

**TKIP**

TKIP encryption is used.

**AES**


AES encryption is used.

**TKIP/AES**

Whether the encryption method TKIP or AES is used depends on the capabilities of the client.



Employing TKIP is only recommended for operating older WLAN clients which do not support AES.

- 
-  If a WLAN network uses only WEP or WPA with TKIP for encryption, the WLAN clients connected to it achieve a maximum gross data rate of 54 Mbps.

### WPA2/3-Session-Keytypes

Here you configure the session key type to be used for WPA version 2 and 3. This also influences the encryption method used. The following types are available:

#### TKIP


TKIP encryption is used.


#### AES

AES encryption is used.

#### TKIP/AES

Whether the encryption method TKIP or AES is used depends on the capabilities of the client.


- 
-  Employing TKIP is only recommended for operating older WLAN clients which do not support AES.

- 
-  If a WLAN network uses only WEP or WPA with TKIP for encryption, the WLAN clients connected to it achieve a maximum gross data rate of 54 Mbps.

### Encrypt management frames

By default, the management information transmitted on a WLAN for establishing and operating data connections is unencrypted. Anybody within a WLAN cell can receive this information, even those who are not associated with an access point. Although this does not entail any risk for encrypted data connections, the injection of fake management information could severely disturb the communications within a WLAN cell.

The IEEE 802.11w standard encrypts this management information (protected management frames, PMF), meaning that potential attackers can no longer interfere with the communications if they don't have the corresponding key.

- 
-  As of WPA3, management frames have to be encrypted, so this value is ignored there and is assumed to be set as "Mandatory". For WPA2, this is optional.

### WPA-Rekeying-Cycle

A 48-bit long initialization vector (IV) impedes attackers in their attempts to calculate the WPA key. WPA also introduced the use of a new key for every data packet (per-packet key mixing and re-keying). The actual key, that consists of the IV and WPA key, is only repeated every 16 million packets. In high-traffic WLANs, the key is repeated only after several hours. To avoid repetition of the key, WPA automatically renegotiates the key at regular intervals. This avoids the repetition of the actual key.

Here you configure the time in seconds after which the access point performs rekeying when operating a version of WPA.

The standard value is "0" and the key is not negotiated in advance.

### Pre-authentication

Fast authentication by means of the Pairwise Master Key (PMK) only works if the WLAN client was logged on to the access point previously. The WLAN client uses pre-authentication to reduce the time to logon to the access point at the first logon attempt.

Usually, a WLAN client carries out a background scan of the environment to find existing access points that it could connect to. Access points that support WPA2/802.1X can communicate their pre-authentication capability to any WLAN clients that issue requests. A WPA2 pre-authentication differs from a normal 802.1X authentication as follows:

- The WLAN client logs on to the new access point via the infrastructure network, which interconnects the access points. This can be an Ethernet connection or a WDS link (wireless distribution system), or a combination of both connection types.
- A pre-authentication is distinguished from a normal 802.1X authentication by the differing Ethernet protocol (EtherType). This allows the current access point and all other network partners to treat the pre-authentication as a normal data transmission from the WLAN client.
- After successful pre-authentication, the negotiated PMK is stored to the new access point and the WLAN client.



The use of PMKs is a prerequisite for pre-authentication. Otherwise, pre-authentication is not possible.

- When the client wants to connect to the new access point, the stored PMK significantly accelerates the logon procedure. The further procedure is equivalent to the PMK caching.

### WPA2 key management

Here you specify which standard the WPA2 key management should follow. Possible values:

#### Standard

Enables key management according to the IEEE 802.11i standard without Fast Roaming and with keys based on SHA-1. Depending on the configuration, the WLAN clients in this case must use opportunistic key caching, PMK caching or pre-authentication.

#### Fast roaming

Enables fast roaming according to the IEEE 802.11r standard. See also [Fast roaming](#) on page 12.



Fast roaming is possible between devices based on LCOS and LCOS LX.

#### Standard+Fast-Roaming

Combination of standard and fast roaming



Although it is possible to make multiple selections, this is advisable only if you are sure that the clients attempting to login to the access point are compatible. Unsuitable clients may refuse a connection if an option other than Standard is enabled.

### SAE/OWE groups

Contains the selection of the available Diffie-Hellman groups used by the protocol partners to create a key for exchanging data. The available groups use elliptical curves.

The authentication method SAE (Simultaneous Authentication of Equals) used by WPA3 uses these methods together with AES to generate a cryptographically strong key.

#### DH-19

256-bit random ECP group

#### DH-20

384-bit random ECP group

#### DH-21

521-bit random ECP group

### PMK-IAPP-Secret

This passphrase is used to implement encrypted opportunistic key caching. This is required to use Fast Roaming over IAPP. Each interface must be assigned an individual IAPP passphrase in the WLAN connection settings.

This is used to encrypt the pairwise master keys (PMKs). Access points that share a matching IAPP passphrase (PMK-IAPP secret) are able to exchange PMKs between one another and ensure uninterrupted connections. You should therefore ensure that this passphrase is identical on all of the access points that should operate fast roaming.

### RADIUS Server Profile

Here you configure the RADIUS server profile used when operating 802.1X. No input is required when using PSK-based encryption methods. The profiles are created under [RADIUS](#) on page 47.

## Radio settings

Settings relating to the physical radio parameters are configured under **Wireless LAN > WLAN networks > Radio settings**. By default, there is an entry in the table for every physical WLAN radio for modification as required.

Interface:	WLAN-1
Radio-Band:	2.4 GHz
5 GHz-Mode:	Auto
Sub-Band:	Band-1+2
Channel:	1
2.4 GHz-Mode:	Auto
Channel-List:	
Exclude DFS channels:	No
Max.-Channel-Bandwidth:	Auto
Antenna Gain:	3

### Interface

The internal name of the WLAN radio. This cannot be changed.

### Radio band

Shows whether this interface is operating in the 2.4-GHz or 5-GHz frequency range.

### 5-GHz mode

Here you configure the mode used for 5-GHz radio operation. This directly affects the available data rates. If a restriction is set here, a client attempting to login triggers a check to see whether the modes used by the client match with those configured here. Depending on this, the login is allowed or denied. The following modes are available:

#### Auto

All modes supported by the device are used.

#### 11an-mixed

The modes 802.11a and 802.11n are used.

#### 11anac-mixed

The modes 802.11a, 802.11n and 802.11ac are used.

#### 11nac-mixed

The modes 802.11n and 802.11ac are used.

#### 11ac-only

Only the 802.11ac mode is used.

**11anacax-mixed**

The modes 802.11a, 802.11n, 802.11ac and 802.11ax (Wi-Fi 6) are used.



Maximum compatibility and performance is available by setting the mode to **Auto**.

**Sub-Band**

Here you configure which sub-bands are used in the 5-GHz mode. The following sub-bands are available:

**Band-1**

Only sub-band 1 is used. This corresponds to the WLAN channels 36, 40, 44, 48, 52, 56, 60 and 64.

**Band-2**

Only sub-band 2 is used. This corresponds to the WLAN channels 100, 104, 108, 112, 116, 132, 136 and 140.

**Band-1+2**

Both sub-band 1 and sub-band 2 are used.



WLAN channels 120, 124 and 128 are not used because these channels are reserved for the primary user RADAR.

**Channel**

Here you configure the channel to be used for WLAN radio operations.

The value "0" allows the automatic selection of a suitable channel.



In 5-GHz mode, the channel set here represents a preferred channel. However, since the 5-GHz band requires the use of Dynamic Frequency Selection (DFS), there is no guarantee that the preferred channel will actually be used.

**2.4-GHz mode**

Here you configure the mode used for 2.4-GHz radio operation. This directly affects the available data rates. If a restriction is set here, a client attempting to login triggers a check to see whether the modes used by the client match with those configured here. Depending on this, the login is allowed or denied. The following modes are available:

**Auto**

All modes supported by the device are used.

**11bg-mixed**

The modes 802.11b and 802.11g are used.

**11g-only**

Only the 802.11g mode is used.

**11bgn-mixed**

The modes 802.11b, 802.11g and 802.11n are used.

**11gn-mixed**

The modes 802.11g and 802.11n are used.

**11bgnax-mixed**

The modes 802.11b, 802.11g, 802.11n and 802.11ax (Wi-Fi 6) are used.

**11gnax-mixed**

The modes 802.11g, 802.11n and 802.11ax (Wi-Fi 6) are used.



Maximum compatibility and performance is available by setting the mode to **Auto**.

**Channel List**

Here you configure a comma-separated list of further WLAN channels. Automatic channel selection selects a channel from this list, rather than from the full range of supported WLAN channels.

**Exclude DFS channels**

Here you configure whether to use channels in the 5-GHz band that require Dynamic Frequency Selection (DFS).

If these channels are excluded here, the channels still available in the 5-GHz band are 36, 40, 44 and 48. Since DFS is not required for these channels, they can be set with the option **Exclude DFS channels** in the radio channel and also in the **Channel list**.

**Max. channel bandwidth**

Here you configure the maximum allowed channel bandwidth. The following settings are available:

**Auto**

For a 2.4-GHz radio the channel bandwidth of 20 MHz is always used. For a 5-GHz radio the maximum possible channel bandwidth (up to 160 MHz) is always used, depending on the environment.

**20 MHz**

The channel bandwidth is always 20 MHz.

**40 MHz**

Depending on the environment, channel bandwidth is up to 40 MHz, but this can also fall back to 20 MHz.

**80 MHz**

Depending on the environment, channel bandwidth is up to 80 MHz, but this can also fall back to 40 MHz or 20 MHz.

**160 MHz**

Depending on the environment, channel bandwidth is up to 160 MHz, but this can also fall back to 80 MHz, 40 MHz or 20 MHz.

**Antenna gain**

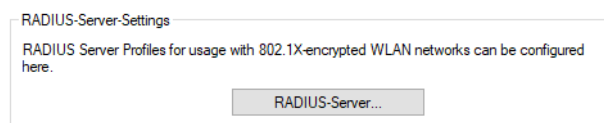
Where the transmission power of an antennae exceeds the levels permitted in the country of operation, the power must be attenuated accordingly. Here you enter the gain of the antenna minus the actual cable loss. For an AirLancer Extender O-18a antenna with a gain of 18 dBi and a 4 m cable with a loss of 1 dB/m, the 'Antenna gain' would be entered as  $18 - 4 = 14$ . This value for true antenna gain is dynamically used to calculate and emit the maximum permissible power with regards to other parameters such as country, data rate and frequency band.



Available for devices with external antennas only.

## 4.4.2 RADIUS

The settings for RADIUS server profiles when operating WLAN networks that use 802.1X as the authentication method can be found under **Wireless LAN > RADIUS**.



Configure the RADIUS server profiles in the **RADIUS server** table.

### Name

Choose a meaningful name for the RADIUS server profile here. This internal identifier is used to reference the RADIUS server profile from other parts of the configuration.

### Port

Select the port (UDP) used to contact the RADIUS server.



This is usually the port 1812 (RADIUS authentication).

### Secret

Here you configure the secret used to encrypt the traffic between the device and the RADIUS server. This secret must also be stored on the RADIUS server.

### Server IP address

Here you configure the host name or IP address where the RADIUS server is to be reached.

### Accounting port

Select the port (UDP) used to contact the RADIUS accounting server.



This is usually the port 1813 (RADIUS accounting).

### Accounting IP address

Here you configure the host name or IP address where the RADIUS accounting server is to be reached.

### Backup profile

Here you configure a backup profile, which will be used if the RADIUS server in the profile configured here cannot be reached.

**RADIUS-MAC-Check**

A user name can be authenticated with a MAC address instead of using the RADIUS server.

**Dynamic VLAN for 802.1X**

The RADIUS server uses dynamic VLAN to assign a VLAN ID to the WLAN client for 802.1X authentication. This assigns clients to the required VLAN without the need to operate a separate SSID for each VLAN.

The RADIUS server must send the following attributes in the accept message:

ID	Name	Meaning	Possible values in LCOS LX
64	Tunnel-Type	Defines the tunneling protocol which will be used for the session.	13 (VLAN)
65	Tunnel-Medium-Type	Defines the transport medium over which the tunneled session will be established.	6 (IEEE 802)
81	Tunnel-Private-Group-ID	Specifies a required VLAN ID.	1 – 4096

**4.4.3 Client Management**

The band steering settings for Wi-Fi networks can be found under **Wireless LAN > Client Management**.

WLAN Client-Management Settings

WLAN Client-Management profiles can be configured here.

Active-Profile: P-DEFAULT Select

Profiles...

2.4GHz-Sub-Profiles...

5GHz-Sub-Profiles...

**Active profile**

Here you select the profile with the settings for the band-steering module.

**P-DEFAULT**

Steering is based on the load on the medium and the interference detected on the current channel and is preferably performed with 802.11v. If the client does not support 802.11v, steering is induced by deliberately disassociating the client. Steering can be performed before association and, if necessary, once the client is already associated. This is the recommended profile.

**P-DISABLED**

No steering is performed. The client decides independently which frequency band to use.


**P-LEGACY**

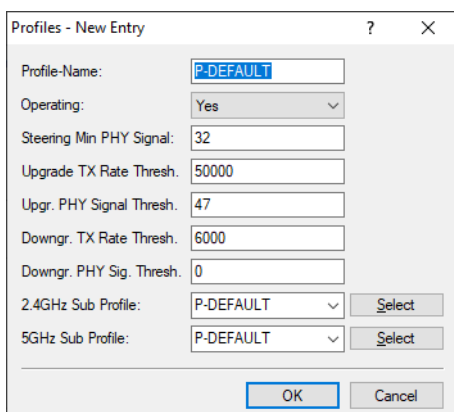
Steering is performed before the client associates by deliberately withholding probe responses. Regardless of the load, the 5-GHz band is always preferred.

**Profiles**

Adjust the detailed settings of the steering profiles or create a new profile under **Wireless LAN > Client Management > Profiles**.



 LANCOM recommends using the preset profiles.



### Profile name

Give this profile a name.

### Operation

Controls whether band steering is active for this profile.

### Steering min. PHY signal

Specifies the client signal strength (in dB) below which client steering is initiated.

### Upgrade TX rate threshold

Specifies the limit value of the transmission rate (in kbps), at which the client should potentially be steered to the 5-GHz band.

### Upgrade PHY signal threshold

Specifies the client signal strength (in dB) required as a minimum before the client is considered for steering to the 5-GHz band.

### Downgrade TX rate threshold

Specifies the limit value of the transmission rate (in kbps), at which the client should potentially be steered to the 2.4-GHz band.

### Downgrade PHY signal threshold

Specifies the client signal strength (in dB) that must be exceeded before the client is considered for steering to the 2.4-GHz band.

For steering to 2.4 GHz (downgrade), the signal strength has to fall below the value configured here and also below the **Downgrade TX rate threshold** value.

### 2.4-GHz sub-profile

Here you configure which 2.4-GHz sub-profile is used.

### 5-GHz sub-profile

Here you configure which 5-GHz sub-profile is used.

## 2.4-GHz sub-profiles

The settings for the 2.4-GHz sub-profiles are located under **Wireless LAN > Client Management > 2.4GHz sub-profiles**.

2.4GHz-Sub-Profiles - New Entry

Profile-Name: P-DEFAULT

Utilization-Check-Interval: 10

Utilization Average Period: 60

Util. Overload Threshold: 70

Util. Deviation Threshold: 50

Interference Detection: Yes

Delay Probe Si Thresh. 55

Delay Probe Time Window: 0

Delay Min Request Count: 0

OK Cancel

### Profile name

Give this 2.4-GHz sub-profile a descriptive name.

### Utilization check interval

Configures the interval (in seconds) for checking media utilization.

### Utilization average period

Configures the period (in seconds) over which the media utilization is averaged. This value must always be higher than the value configured for the **Utilization check interval**.

### Utilization overload threshold

Configures the media utilization (in percent) above which the current 2.4-GHz channel is assumed to be overloaded.

### Utilization deviation threshold

Configures the media utilization (in percent) which, together with the expected media utilization, may be reached before any further downgrade steering is stopped (until the next measurement of medium utilization).

### Interference detection

Configures whether interference on the configured 2.4-GHz channel is considered for steering decisions.

### Delay probe signal threshold

Specifies the client signal strength (in dB) that must be reached before steering-related probe responses are delayed.

### Delay probe time window

Configures the time window (in seconds) in which a client must receive at least the number of probe requests configured under **Delay min. request count** before it responds to them.

### Delay min. request count

Configures the number of probe requests that a client must receive within the period configured under **Delay probe time window** before it responds to them.

## 5-GHz sub-profiles

The settings for the 5-GHz sub-profiles are located under **Wireless LAN > Client Management > 5 GHz sub-profiles**.

### Profile name

Give this 5-GHz sub-profile a descriptive name.

### Utilization check interval

Configures the interval (in seconds) for checking media utilization.

### Utilization average period

Configures the period (in seconds) over which the media utilization is averaged. This value must always be higher than the value configured for the **Utilization check interval**.

### Utilization overload threshold

Configures the media utilization (in percent) above which the current 5-GHz channel is assumed to be overloaded.

### Utilization deviation threshold

Configures the media utilization (in percent) which, together with the expected media utilization, may be reached before any further downgrade steering is stopped (until the next measurement of medium utilization).

### Interference detection


Configures whether interference on the configured 5-GHz channel is considered for steering decisions.

## 4.4.4 Stations/LEPS

The configuration of the **Profiles** and **Users** for LANCOM Enhanced Passphrase Security (LEPS) are located in LANconfig under **Wireless LAN > Stations/LEPS > LEPS**. The switch **LEPS active** enables the LEPS feature.

When configured in LEPS, each user who should be able to authenticate client devices on the WLAN receives an individual passphrase. LEPS profiles are used to avoid having to repeat all of the settings for every new user. You then create the LEPS users with their individual passphrases and link them to one of the LEPS profiles created previously.

Alternatively, you can link the passphrase to a MAC address to set up a MAC address filter.

 For technical reasons, LEPS is only compatible with WPA version WPA2.



Note that with WPA2/3 encryption mode, the client can use both WPA versions, which can lead to unexpected behavior when used with LEPS.

## Profiles

Configure LEPS profiles here and link them to an SSID. You can then assign the LEPS profiles to the LEPS users.

### Name

Enter a unique name for the LEPS profile here.

### Network name

Here you select the SSID or, in the case of a WLC, the logical WLAN network for which the LEPS profile applies. The only users who can authenticate at the SSID or, in the case of a WLC, at the logical WLAN network are those who are connected to it via the LEPS profile.

### Check MAC address

Possible values:

#### Disabled

The MAC address plays no role during LEPS authentication. If any user-specific passphrase has been set, this will be checked.

#### Whitelist

Only clients whose MAC address is known are admitted.

#### Blacklist

Only clients whose MAC address is not known are admitted.

### VLAN

Here you specify which VLAN is assigned to a LEPS user or client who is connected to this profile.

## Users

Create individual LEPS users here. Each LEPS user must be linked with a previously created profile and assigned an individual WPA passphrase. Any client can then use this passphrase to authenticate at the SSID specified in the corresponding profile. The passphrase identifies the user, who is assigned to the VLAN specified in this table. If no VLAN

is specified here, the user is assigned to the VLAN configured in the profile. Settings for the individual user thus take priority over settings in the profile.

### Name

Enter a unique name for the LEPS user here.

### Profile

Select the profile for which the LEPS user is valid. The only LEPS users who can authenticate at the SSID are those who are connected to it via the LEPS profile.

### WPA-Passphrase

Here you can specify the passphrase to be used by LEPS users to authenticate at the WLAN.



The passphrase can be a string of 8 to 64 characters. We recommend that the passphrases consist of a random string at least 32 characters long.

### MAC-Address

Optionally specify a MAC address for a MAC filter. The setting in the profile decides whether this entry is ignored or whether the client devices listed in this table only are able to log on (whitelist). Using a blacklist, the MAC filter works the other way round: the specified MAC addresses cannot log on.

Compared to simply assigning a passphrase to a user, managing a passphrase for each MAC address requires a bit more work, but you have greater control over the devices in the network.

### VLAN

Here you specify which VLAN is assigned to the LEPS user. If no VLAN is configured here, the VLAN configured in the LEPS profile (if any) applies. If a VLAN is configured in both the LEPS profile and for the LEPS user, the VLAN configured here takes priority.

## 4.4.5 WLC

LCOS LX-based access points can be managed by a LANCOM WLAN controller (WLC). Like LCOS-based access points, they use the CAPWAP protocol.



The prerequisite for this is a LANCOM WLAN controller with LCOS version 10.40 or higher.



For background information on WLAN management with LANCOM WLAN controllers, see the section "WLAN management" in the LCOS reference manual.

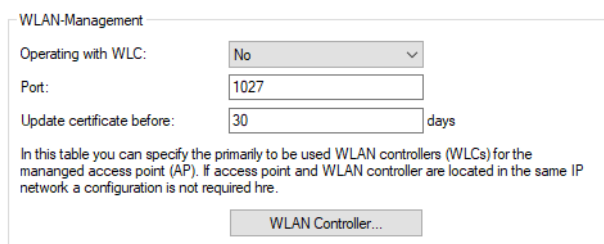
In their factory default settings, LCOS LX-based access points search the local network for a WLAN controller. They also query the DNS name "WLC-Address" to try to reach a WLAN controller.



An access point will not try to contact the LANCOM Management Cloud if it is already being managed by a WLC.

 If the access point is managed by the LANCOM Management Cloud and a WLAN configuration is rolled out to the access point by the LMC in this context, the access point will no longer attempt to contact a WLC.

This makes it possible to use zero-touch commissioning, which means that no further configuration of the access point is necessary. A manual configuration may still be necessary in certain circumstances. This can be done using LANconfig in the device configuration under **Wireless LAN > WLC**.



### Operating with WLC

This configures whether an access point actively searches for a WLC and can be managed by one.

 This option should be deactivated for operation in stand-alone mode.

### Port

Configures the port used to attempt to reach a WLC. The default value of 1027 is the default port used by the CAPWAP protocol. By default, LANCOM WLCs also use this port.

### Update certificate before

Configures how many days before its expiry that the device certificate used by the access point to authenticate at the WLC is renewed.

### WLAN Controller

Configures user-specified WLAN controllers. This may be necessary if a WLC cannot be found via the local network (e.g. with routed connections) and also the DNS name "WLC-Address" cannot be used to inform the access point about the address of the WLC.

## Supported features

LCOS LX supports the following features for WLC operations:

Area	Feature	Supported?
<b>In general</b>	Password synchronization	Yes
	WLC tunnel	No
	WLAN scheduling	Yes
<b>Logical WLAN configuration</b>	VLAN tagging	Yes
	WPA2	Yes
	WPA3	Yes
	Enhanced Open	Yes
	Enhanced Open Transitional	No
	802.1X	Yes
	RADIUS profile	Yes
	Standalone mode	Yes

Area	Feature	Supported?
	802.11u/Hotspot 2.0	No
	OKC	No
	MAC check	Yes
	RADIUS accounting	Yes
	Inter-station traffic	Yes
	Fast roaming	Yes
	Base rate adjustable	No
	Client bridge support	No
	Bandwidth limitation per SSID	Yes
	Bandwidth limitation per client	No
	Maximum count of clients	Yes
	Min. client signal strength	Yes
	Client disassociation signal strength	No
	LBS	No
	Convert to unicast	No
	Transmit only unicasts	No
	U-APSD	Activated permanently
	Encrypt mgmt frames	Yes
<b>Physical WLAN parameters</b>	Country setting	Yes
	Configure 2.4-GHz mode	Yes
	Configure 5-GHz mode	Yes
	Configure 5-GHz sub-bands	Yes
	Set DTIM period	No
	Set the background scan interval	No
	Set antenna gain	Yes
	Set TX power reduction	No
	Activate the VLAN module <sup>1</sup>	—
	ARC: Client steering	Yes <sup>2</sup>
	ARC: Adaptive RF Optimization	No
	Enable QoS according to 802.11e (WME)	Activated permanently
	Indoor-only mode activated	Yes
	Report seen unknown clients	No

<sup>1</sup> Unnecessary with LCOS LX.

<sup>2</sup> Currently, only AP-based band steering is supported. The settings **Preferred frequency band** and **Probe request age-out time** have no influence.

4 Configuring features with LANconfig

Area	Feature	Supported?
General/profile	Specify alternative WLCs	No
	Configuration delay	No
	LED profiles	Yes
	Wireless ePaper	No
	Wireless IDS	No
	AutoWDS	No
	IP parameter profiles	Yes
	Firmware management	Yes
	Script management	No
	LEPS-U	Yes
	LEPS-MAC	Yes
	Assignment of a VLAN ID via LEPS-MAC (Dynamic VLAN)	Yes
	ARC: RF optimization	No



## 5 Configuring features with WEBconfig

The following section explains how devices are installed with WEBconfig and the various settings that WEBconfig has to offer. These depend on the device, so not all of the listed options are available with every device.

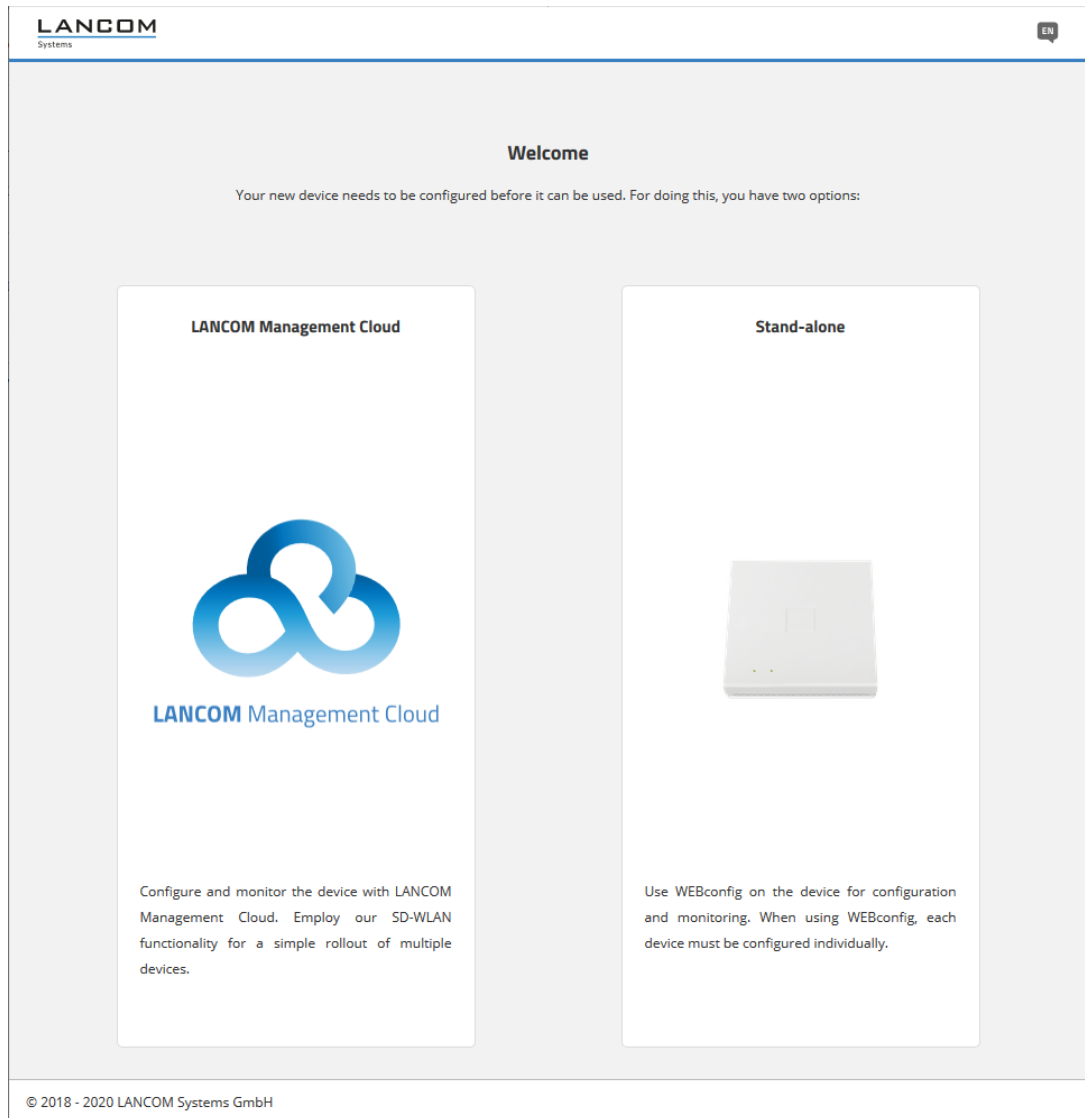
### 5.1 Commissioning of a device via WEBconfig

WEBconfig is reached via HTTP and HTTPS. If you use HTTP, the device automatically redirects you to an encrypted HTTPS connection.



WEBconfig uses a self-signed SSL certificate, so this must be added as an exception in the browser for each device.

After invoking the WEBconfig interface of an unconfigured device, you can select whether the device should be managed by the LANCOM Management Cloud or as a stand-alone device.



Click the corresponding button here to decide whether the device should be managed by the LANCOM Management Cloud or as a stand-alone device.

### 5.1.1 Management by LANCOM Management Cloud

You either connect the device to the LANCOM Management Cloud by means of the serial number and PIN (zero touch), or you use the corresponding input field to enter an activation code that you generated previously in your LANCOM Management Cloud project:


**LANCOM Management Cloud**




LANCOM Management Cloud

Please go to <https://cloud.lancom.de> to add the device to your project using the serial number and PIN. The serial number is located on the bottom side of the device. The PIN is printed on a sheet which is enclosed with the original box:

LANCOM LW-500



LAN MAC: 00A00780270E0E



Cloud Pin: 123456



Alternatively, you can enter an activation code that was generated in your LANCOM Management Cloud project:

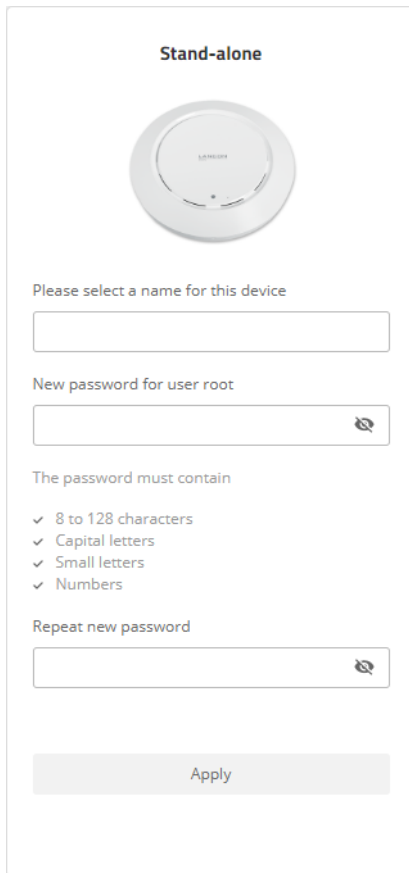
Apply

After confirming the activation code and completing the pairing process, a success message will be displayed and you will be redirected to the WEBconfig login page. The device can now be managed via the LMC.

### 5.1.2 Stand-alone management

Use the corresponding input fields to set a meaningful name for your device and set a password to be used by the user "root".

! The password set here is valid for the user “root”. This user is also used subsequently to login to WEBconfig.



**Stand-alone**

Please select a name for this device

New password for user root

The password must contain

- ✓ 8 to 128 characters
- ✓ Capital letters
- ✓ Small letters
- ✓ Numbers

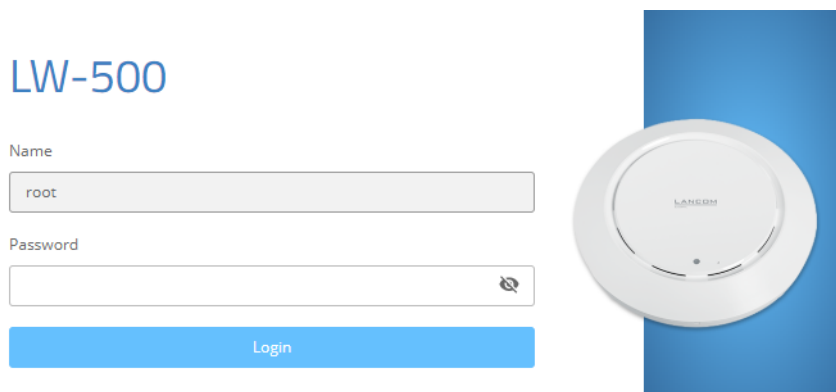
Repeat new password

Apply

Clicking on **Apply** will direct you to the login page. Use the username “root” and the previously defined password to login to WEBconfig.

## 5.2 Login

Login by entering the user name “root” and the password you set earlier:



**LW-500**

Name

root

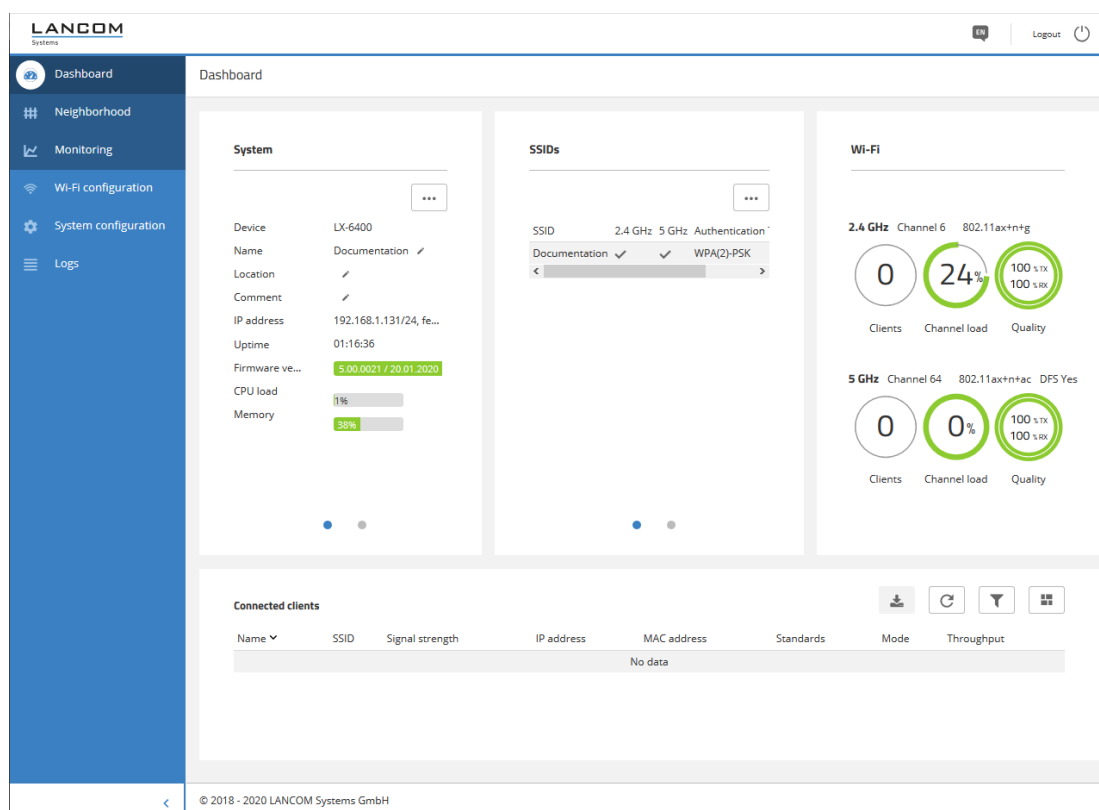
Password

Login

After logging in to WEBconfig you will be taken to the dashboard. Refer to section [WEBconfig – Dashboard](#) on page 61 for information on the dashboard.

## 5.3 WEBconfig – Dashboard

The dashboard provides an overview of the essential operating data for your device.



Below the dashboard are the areas **Neighborhood** and **Monitoring**.

### 5.3.1 Neighborhood

You reach the Neighborhood area by means of the **Neighborhood** item in the sidebar.

The Neighborhood view provides an overview of the WLAN environment, especially the WLAN access points and WLAN routers that are locally active.

5 Configuring features with WEBconfig

Click the button **Start scan** to discover the WLAN environment. After the scan is completed (duration: approx. 10 seconds), the results are shown in various diagrams and tables:



The top two bar charts visualize the number of SSIDs detected by the device on the various 2.4-GHz and 5-GHz channels, which can indicate the potential load on the channels. LANCOM access points detected by the scan and reachable on the same LAN as the current device are highlighted as “My LANCOM APs”. The WLAN channel that the current device itself is working on is also indicated. The **Neighborhood** table also provides details about the SSIDs detected by the scan, such as the name, the BSSID (MAC address), and the signal strength.

5.3.2 Monitoring

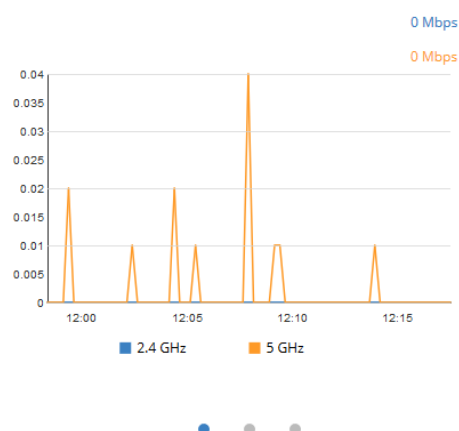
You reach the Monitoring area by means of the **Monitoring** item in the sidebar.

The Monitoring view is offers a graphical representation of the WLAN throughput, LAN throughput, number of WLAN stations and channel load over time.

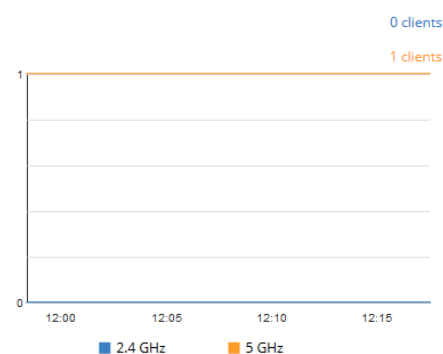


The maximum amount of historical data available corresponds to the duration of the current WEBconfig session.

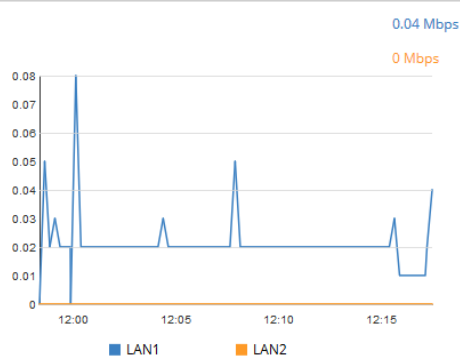
Wi-Fi throughput (total)



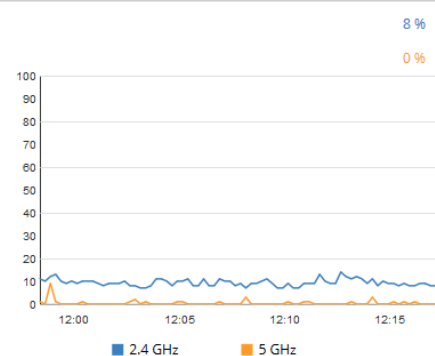
Number of Wi-Fi clients



LAN throughput (total)

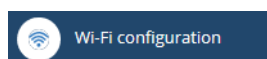


Channel load



## 5.4 Wi-Fi configuration

You reach this area by means of the **Wi-Fi configuration** item in the sidebar.



### 5.4.1 Concept

The Wi-Fi configuration is designed to assist the user with the most common settings and to eliminate the hassle of configuring minor details. It remains possible to configure different scenarios.

### 5.4.2 Operation

The available SSIDs are displayed in tabular form. Click on the **Add new SSID** button to configure a new SSID. A new line is added. To configure an SSID with WPA2-PSK, all you have to do is fill out the fields **Name**, **SSID** and **WPA2 key**.

+ Add new SSID

Networks >

SSID >

Encryption >

Technology >

QR code >

Name

Documentation

SSID


Documentation


WPA2 Key


.....

☒ 2.4GHz

☒ 5GHz





Depending on your needs, you can generate a secure WPA2 key automatically (  ) and limit the frequency bands available for selection. By default, the SSID is broadcast on 2.4 GHz and 5 GHz.

Then click on **Save** to accept your SSID. This will then be broadcast immediately by the device.

- !

On the 5-GHz band, it may take up to a minute after the initial configuration to broadcast the SSID. This is due to a regulatory requirement to monitor the band for primary users (“radar detection” for one minute, i.e. DFS).
- i

Further individual configuration is possible by clicking on the respective heading.

#### Networks

Here you can set the parameters for each SSID as follows:

Networks

Network

VLAN ID

Documentation

SSID: Documentation

0

#### VLAN-ID

This VLAN ID is used to tag the data packets arriving from the WLAN and heading for the LAN. Similarly, packets with this VLAN ID arriving from the LAN are directed to the WLAN and are de-tagged.

- i

This operating mode corresponds to what is normally known as the “Access” tagging mode, since it is assumed that wireless clients usually transmit data untagged. Tagging mode cannot be adjusted.

#### SSID

Here you can set the parameters for each SSID as follows:

SSID

Networks

Allow traffic between clients

Bandwidth limits per SSID

Roaming

IAPP-Passphrase

Timeframes

doc

SSID: doc

☒ only among own SSID


0 Mbps


☒ Standard

☐ Fast-Roaming

☐ Standard+Fast-Roaming

IAPP-Passphrase





Timeframes

ALWAYS

Edit Timeframes



### Allow traffic between clients

Depending on the application, it may be desirable—or even undesirable—for clients on a WLAN network to communicate with other clients. Here you configure whether communication between the WLAN clients on the WLAN network should be allowed.

### Bandwidth limits per SSID

Here you set a WLAN bandwidth limit that applies to the entire WLAN network. All of the logged in clients can only send and receive data with the transmission rate configured here. The value “0” means that no limitation is active.

### Roaming

Settings for switching a client from one access point to another access point that broadcasts the same SSID.

#### Standard

Enables key management according to the IEEE 802.11i standard without Fast Roaming and with keys based on SHA-1. Depending on the configuration, the WLAN clients in this case must use opportunistic key caching, PMK caching or pre-authentication.

#### Fast roaming

Enables fast roaming according to the IEEE 802.11r standard. See also [Fast roaming](#) on page 12.



Fast roaming is possible between devices based on LCOS and LCOS LX.

#### Standard+Fast-Roaming

A combination of standard behavior and Fast Roaming.



Although it is possible to make multiple selections, this is advisable only if you are sure that the clients attempting to login to the access point are compatible. Unsuitable clients may refuse a connection if an option other than Standard is enabled.

### IAPP passphrase

This passphrase is used to implement encrypted opportunistic key caching. This is required to use Fast Roaming over IAPP. Each interface must be assigned an individual IAPP passphrase in the WLAN connection settings. This is used to encrypt the pairwise master keys (PMKs). Access points that share a matching IAPP passphrase (PMK-IAPP secret) are able to exchange PMKs between one another and ensure uninterrupted connections. You should therefore ensure that this passphrase is identical on all of the access points that should operate fast roaming.

### Timeframe

Timeframes are used to switch individual SSIDs on and off according to a schedule. One profile may contain several rows with different timeframes. Add the time frame here so that it is observed for this SSID.

Edit Timeframes

Edit Timeframes

+ Add new line

Name	Start	Stop	Weekdays
ALWAYS	00:00	23:59	Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Holiday
NEVER	00:00	00:00	None

<

↑

>

Close

Save

Name

Enter the name of the time frame so that it can be referenced from the WLAN SSID. Several entries with the same name result in a common profile. Predefined timeframes are ALWAYS and NEVER.

Home

The start time (time of day) can be specified in the format HH:MM (default: 00:00), from which the selected profile becomes valid.

Stop

The stop time (time of day) can be specified in the format HH:MM (default: 00:00), from which the selected profile ceases to be valid.

i

A stop time of HH:MM usually runs until HH:MM:00. The stop time 00:00 is an exception, since this is interpreted as 23:59:59.

Weekdays

Here you select the weekday on which the timeframe is to be valid.

Possible values:

- > Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday, Holiday

You can form a time schedule with the same name but with different times extending over several rows.

Encryption

Here you can set the parameters for each SSID as follows:

Encryption

Networks

WLAN-1  
SSID: WLAN-1

Choose authentication

WPA2-PSK

Encrypt Management Frames

No

WPA Key



\*\*\*\*\*


Select authentication

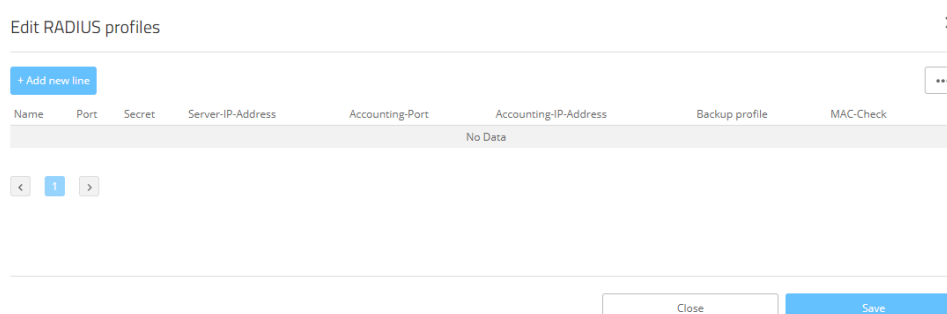
Change the encryption and authentication method here. WPA2-PSK (WPA2 with pre-shared key or WPA2-Personal) is preset by default. Optionally select **No encryption** or one of the following options:

- > WPA3-PSK – WPA3 with pre-shared key or WPA3-Personal
- > WPA(2+3)-PSK – WPA2 and/or WPA3 with pre-shared key

- WPA2-802.1X– WPA2 with 802.1X or WPA2-Enterprise
- WPA3-802.1X– WPA3 with 802.1X or WPA3-Enterprise
- WPA(2+3)-802.1X– WPA2 and/or WPA3 with 802.1X

 When using methods requiring a pre-shared key (PSK), you need to enter a **WPA key**. You can read the key by clicking on the crossed-out eye symbol. Depending on your needs, you can automatically generate a secure WPA key ().

 In the case of 802.1X you have to create a RADIUS profile. To do this, click on **Edit RADIUS profile** and add a new line there.




### Name

Choose a meaningful name for the RADIUS server profile here. This internal identifier is used to reference the RADIUS server profile from other parts of the configuration.

### Port

Select the port (UDP) used to contact the RADIUS server.

 This is usually the port 1812 (RADIUS authentication).

### Secret


Here you configure the secret used to encrypt the traffic between the device and the RADIUS server. This secret must also be stored on the RADIUS server.

### Server IP address

Here you configure the host name or IP address where the RADIUS server is to be reached.

### Accounting port

Select the port (UDP) used to contact the RADIUS accounting server.

 This is usually the port 1813 (RADIUS accounting).

### Accounting IP address

Here you configure the host name or IP address where the RADIUS accounting server is to be reached.

### Backup profile

Here you configure a backup profile, which will be used if the RADIUS server in the profile configured here cannot be reached.

MAC-Check

A user name can be authenticated with a MAC address instead of using the RADIUS server.

**!** Please note that the RADIUS server generally has to be notified about the RADIUS client by means of an entry in its configuration.

Store your changes by clicking on **Save**.

Encrypt management frames

By default, the management information transmitted on a WLAN for establishing and operating data connections is unencrypted. Anybody within a WLAN cell can receive this information, even those who are not associated with an access point. Although this does not entail any risk for encrypted data connections, the injection of fake management information could severely disturb the communications within a WLAN cell.

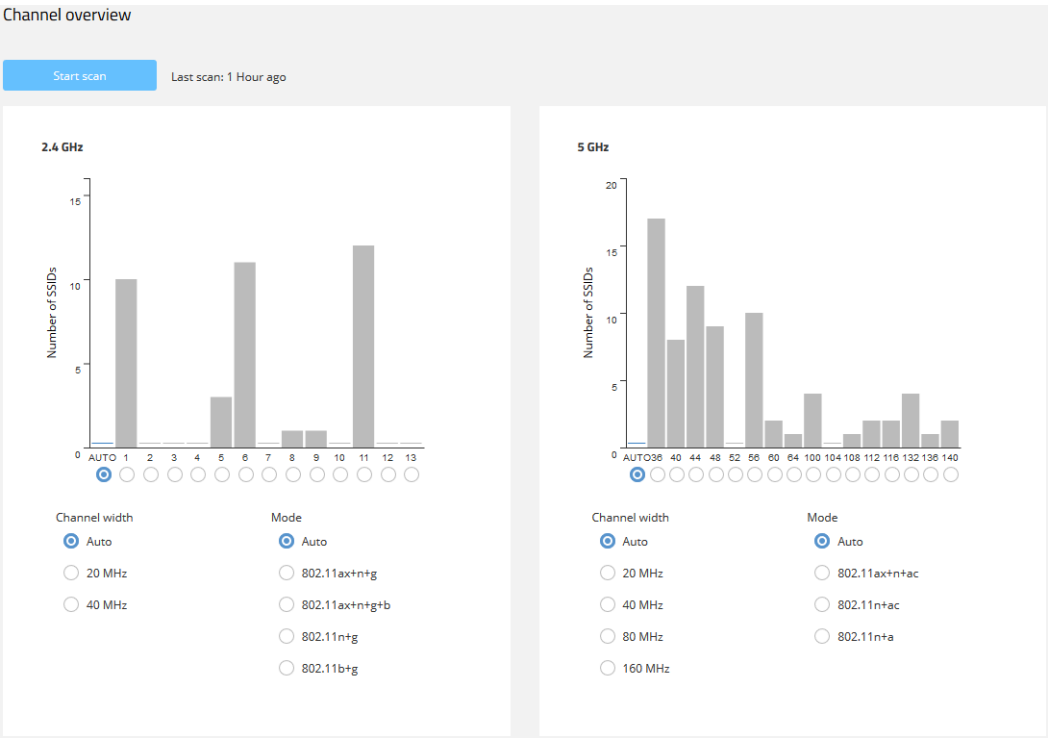
The IEEE 802.11w standard encrypts this management information (protected management frames, PMF), meaning that potential attackers can no longer interfere with the communications if they don't have the corresponding key.

**i** As of WPA3, management frames have to be encrypted, so the value there is ignored and is assumed to be set as **Mandatory**. For WPA2, this is optional.

Technology

The **Technology** page offers the option to set fixed channels for the 2.4- and 5-GHz bands, to specify the available channel width and to determine which radio mode is used. The default setting for all options is automatic selection.

**!** The physical settings that can be configured here apply to the entire frequency band and are not SSID-specific.

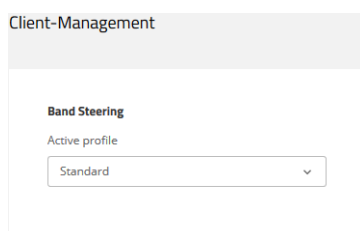


The two bar charts visualize how many SSIDs the device detected on the various 2.4- and 5-GHz channels, which can represent the potential load on the channels.

 The bar charts only contain information if a neighborhood scan has been performed under **Neighborhood**.

## Client Management

The settings for band steering for Wi-Fi networks can be found here. Band Steering allows clients to be routed from the overflowing 2.4 GHz frequency band to the 5 GHz frequency band, providing more bandwidth for each client and improving the user experience. LCOS LX provides the ability to route clients to the optimal frequency band for them using the 802.11v standard. Clients that do not support the 802.11v standard can also be routed to the 5 GHz band by delaying sample responses or by selectively disconnecting from the WLAN. See also [Band steering](#) on page 12.



### Active profile

Select the profile that defines the settings for the band steering module.

#### Standard

Steering is based on the medium load and the detected interference on the current channel and is preferably done using 802.11v. If the client does not support 802.11v, steering is performed by means of a targeted disassociation of the client. Steering is performed both before association and, if necessary, while the client is already associated. This is the recommended profile.

#### Disabled

No steering is carried out at all. The client decides autonomously which frequency band to choose.

#### Legacy

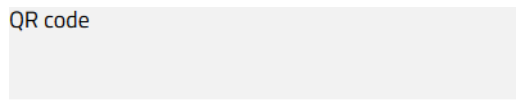
Steering takes place before the client is associated by the targeted restraint of probe responses. The 5 GHz band is always preferred regardless of the workload.

## QR code

This page provides access to a QR code for any open or WPA2-PSK secured SSID. The QR code can be scanned by current smartphones (an additional app may be required) and sets up the respective WLAN automatically on the smartphone. This spares users the laborious entry of a wireless key.

It is also possible to print out individual QR codes separately.

QR code



Documentation

SSID: Documentation




Key:

!bKlq7Lc&ph4h r2

---

Export/Print

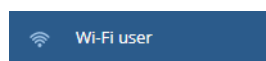
 Print QR code



QR codes cannot be used for networks secured by 802.1X as they do not use a static WLAN key (PSK).

### 5.4.3 WLAN users

You reach this section in WEBconfig by means of the **Wi-Fi user** item in the sidebar.



#### LEPS

When configured in LEPS, each user who should be able to authenticate client devices on the WLAN receives an individual passphrase. LEPS profiles are used to avoid having to repeat all of the settings for every new user. You then create the LEPS users with their individual passphrases and link them to one of the LEPS profiles created previously.

Alternatively, you can link the passphrase to a MAC address to set up a MAC address filter.

Here you configure the **Profiles** and **User** for the LANCOM Enhanced Passphrase Security (LEPS). The switch **Activate LEPS** enables the LEPS feature.

☐ activate LEPS

---

**Profiles**

[+ Add new list](#)

Name	Network-Name	Mac-List	VLAN
No Data			

< 1 >

---

**User**

[+ Add new list](#)

Name	Profile	WPA-Passphrase	MAC-Address	VLAN
No Data				

< 1 >

## Profiles

Configure LEPS profiles here and link them to an SSID. You can then assign the LEPS profiles to the LEPS users.

### Name

Enter a unique name for the LEPS profile here.

### Network-Name

Here you select the SSID or, in the case of a WLC, the logical WLAN network for which the LEPS profile applies. The only users who can authenticate at the SSID or, in the case of a WLC, at the logical WLAN network are those who are connected to it via the LEPS profile.

### Mac-List

Possible values:

#### Disabled

The MAC address plays no role during LEPS authentication. If any user-specific passphrase has been set, this will be checked.

#### Whitelist

Only clients whose MAC address is known are admitted.

#### Blacklist

Only clients whose MAC address is not known are admitted.

### VLAN

Here you specify which VLAN is assigned to a LEPS user or client who is connected to this profile.

## Users

Create individual LEPS users here. Each LEPS user must be linked with a previously created profile and assigned an individual WPA passphrase. Any client can then use this passphrase to authenticate at the SSID specified in the corresponding profile. The passphrase identifies the user, who is assigned to the VLAN specified in this table. If no VLAN is specified here, the user is assigned to the VLAN configured in the profile. Settings for the individual user thus take priority over settings in the profile.

**Name**

Enter a unique name for the LEPS user here.

**Profile**

Select the profile for which the LEPS user is valid. The only LEPS users who can authenticate at the SSID are those who are connected to it via the LEPS profile.

**WPA-Passphrase**

Here you can specify the passphrase to be used by LEPS users to authenticate at the WLAN.



The passphrase can be a string of 8 to 64 characters. We recommend that the passphrases consist of a random string at least 32 characters long.

**MAC-Address**

Optionally specify a MAC address for a MAC filter. The setting in the profile decides whether this entry is ignored or whether the client devices listed in this table only are able to log on (whitelist). Using a blacklist, the MAC filter works the other way round: the specified MAC addresses cannot log on.

Compared to simply assigning a passphrase to a user, managing a passphrase for each MAC address requires a bit more work, but you have greater control over the devices in the network.

**VLAN**

Here you specify which VLAN is assigned to the LEPS user. If no VLAN is configured here, the VLAN configured in the LEPS profile (if any) applies. If a VLAN is configured in both the LEPS profile and for the LEPS user, the VLAN configured here takes priority.



## 5.5 System configuration

This allows you to configure the basic parameters of your device, such as the device name or the IP settings for managing the device.

**LANCOM Systems**

System configuration

System configuration

Name: Documentation

**LMC-Configuration**

Round-Trip Time: 0 ms

Management-Status: Not authenticated with LMC, no cloud management

**Configure the country**

Current configuration: Europe

**Adjust the security settings of this device**

**Adjust the network settings of this device**

IPv4 mode: DHCP

IPv4 address: 192.168.1.131/24

IPv4 gateway: 192.168.1.1

IPv6 mode: Link-Local

IPv6 address: fe80::2a0:57ff:fe4c:45b3/64

IPv6 gateway: ::

802.1X-Supplicant: No

**Help**

**Device name**  
The device name is a helpful way for identifying a device, especially when managing multiple devices of the same type. If not specified explicitly, this value will be auto-generated.

**DHCP**  
This device requires additional TCP / IP settings on the following pages. If a DHCP server already exists in your network, you can operate the device as a DHCP client or select the "Off" mode. In "Client" mode, all other TCP / IP settings are made automatically in your device. In the "Off" mode, further TCP / IP settings must be made on the following pages.

**NTP server**  
Select a time server that should be used for updating the device time.

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You can edit individual fields such as the system name by clicking on the check mark next to it. An edit mask for the various sections opens after clicking on the headline.

### 5.5.1 Name

Configure the device name here.

#### System configuration

Name: Documentation

### 5.5.2 LMC configuration

Use the LANCOM Management Cloud to pair your device subsequently.

LANCOM Management Cloud Pairing

An activation code is needed to integrate one or several of your LANCOM devices securely into the cloud while simultaneously linking them to a particular project or organization.

Direct control access to your LANCOM devices is needed.

Activation Code:

☐ Public Cloud (Default)

☐ Private Cloud

LMC-Domain:

cloud.lancom.de

☒ Use current device configuration

Cancel

Confirm

#### Activation code

Enter the activation code that you generated in your LANCOM Management Cloud project earlier.

#### Public Cloud

This option specifies the LMC domain of the Public Cloud from LANCOM.

#### Private Cloud

With this option you can specify the LMC domain of your private instance of the LANCOM Management Cloud.

#### LMC domain

Shows either the LMC domain of the Public Cloud or you enter the LMC domain of your private instance of the LANCOM Management Cloud.

#### Use current device configuration

Applies the settings already configured in the device.

### 5.5.3 Country settings

Here you configure the country where the device is operated. Depending on this, the appropriate regulatory restrictions are set automatically.

Country settings

×

The country is used to determine the correct parameters for Wi-Fi networks.

Please select the country according to the location of the device:

Europe

▼

Cancel

Confirm

### 5.5.4 Security settings

Here you can change the password for the current user (usually "root").

Security settings

×

**Password**

Change the password of the currently logged in user.

Current password

👁

New password for user root

👁

The password must contain

✓ 8 to 128 characters

✓ Capital letters

✓ Small letters

✓ Numbers

Repeat new password

👁

Cancel

Confirm

### 5.5.5 Network settings

Here you have the option to change network settings of your device, such as its IP address.

Network settings

**IPv4 settings**

☒ Dynamic ☐ Static

Current configuration

IPv4 address: 192.168.1.131/24  
IPv4 gateway: 192.168.1.1

**IPv6 settings**

☐ Router Advertisement ☐ Dynamic ☒ Static

IPv6 address:  
::/64

IPv6 gateway:  
::

IPv6 primary DNS:  
::

Cancel Confirm

#### IPv4 settings

##### Dynamic

Uses DHCPv4 to configure the IPv4 parameters. This is the default value.

##### Static

Uses the IP parameters that you can configure in the fields **IPv4 address**, **IPv4 gateway**, **IPv4 primary DNS** and **IPv4 secondary DNS**.



Note that the IPv4 address must be specified in CIDR notation (for example, 192.168.1.1/24).

#### IPv6 settings

##### Router Advertisement

Uses router advertisements/SLAAC to configure the IPv6 parameters. If the received router advertisement contains the M (managed) flag, further parameters are obtained via DHCPv6.

##### Dynamic

Uses DHCPv6 to configure the IPv6 parameters.

**Static**

Uses the IP parameters that you can configure in the fields **IPv6 address**, **IPv6 gateway**, **IPv6 primary DNS** and **IPv6 secondary DNS**. This is the default value.

**802.1X supplicant**

These are the settings for the 802.1X supplicant functionality, which authenticates the device towards the LAN at a switch infrastructure secured by 802.1X.

**User name**

The user name to use to authenticate at the 802.1X infrastructure.

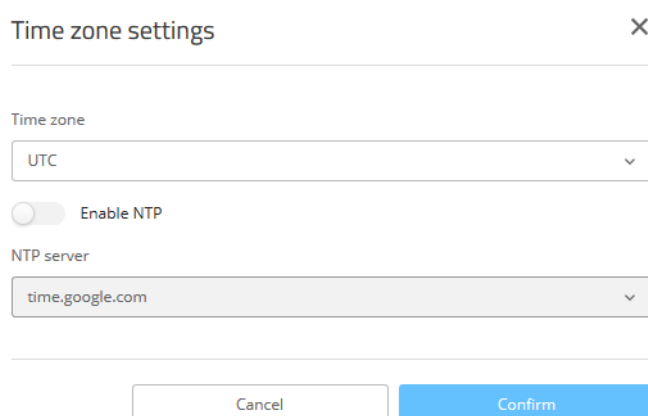
**Password**

The password to use to authenticate at the 802.1X infrastructure.

**Method**

The EAP method used to authenticate at the 802.1X infrastructure.

## 5.5.6 Time zone settings



The image shows a 'Time zone settings' dialog box with a close button (X) in the top right corner. It contains three main sections: 'Time zone' with a dropdown menu showing 'UTC'; 'Enable NTP' with a toggle switch currently turned off; and 'NTP server' with a dropdown menu showing 'time.google.com'. At the bottom, there are two buttons: 'Cancel' and 'Confirm'.

**Time zone**

Select a time zone. The default value is "UTC".

**Enable NTP**

Here you select whether the time should be obtained from a time server by means of the network time protocol (NTP).

**NTP server**

From this list you select a time server from which the time is to be obtained via NTP.

## 5.5.7 Automatic firmware update

**Firmware Update**

General Settings

Update Mode  
Check & update

Check Interval  
daily

Version Policy  
latest version

Scheduling

Start of the check time window: 0 o'clock  
End of the check time window: 0 o'clock

Start of the update time window: 2 o'clock  
End of the update time window: 4 o'clock

Update-Server

Base-URL:  
https://update.lancom-systems.de

Cancel Confirm

### Update mode

Set the operating mode here. The following modes are supported:

#### Check & update

- The Auto Updater regularly checks the update server for new updates.
- The update server uses the **update policy** to find the most suitable update, it sets the time to download and install the update within a time frame configured by the user, and it sends the update to the Auto Updater.
- The firmware is installed in test mode. After installation, the Auto Updater performs a connection check. Here, the device checks whether a connection can be established to the update server to ensure that Internet access is still available. These attempts continue for several minutes to allow for VDSL synchronization or WWAN connection setup. If the update server is contacted successfully, the test mode terminates and the firmware goes into regular operation. If the update server cannot be contacted, then Internet access is assumed to be impossible and the second (i.e. the previously active) firmware will be started again.

#### Check

- The Auto Updater regularly checks the update server for new updates.
- The availability of a new update is signaled to the user in the LCOS LX menu tree and via syslog.
- Users can manually use the Auto Updater to initiate the latest available update.



A manual update is started with the following entry on the command line:

```
do /setup/Automatic-Firmware-Update/Update-Firmware-Now
```

## Manual

- The Auto Updater only checks for new updates when prompted by the user.
- Users can manually use the Auto Updater to initiate the latest available update.



A manual update is started with the following entry on the command line:

```
do /setup/Automatic-Firmware-Update/Update-Firmware-Now
```

## Check interval

This decides whether checks for an available update are performed daily or weekly.

## Update policy

### Latest version

Always the newest version, irrespective of the release version. Example: 4.00 Rel is installed; an update to 4.00 RU1 is performed, but also to 5.00 Rel. Updates always go to the latest version, but not back to a previous release.

### Current version

The latest RU/SU/PR within a release. Example: 4.00 Rel is installed; an update to 4.00 RU1 is performed, but not to 5.00 Rel.

### Security patches only

The latest SU within a release. Example: 4.00 Rel is installed; an update to 4.00 SU1 is performed, but not to 4.00 RU2.

### Latest version w/o REL

The newest RU/SU/PR, irrespective of the release version. Updates are only performed if a RU is available. Example: Any version of 4.00 is installed; an update to 5.00 RU1 is performed, but not to 5.00 REL.

## Check time window

Set the time frame for checking and downloading new updates here. The daily start and end time for this time frame can be set to the hour. The default value for both of these is 0, so checks for updates and downloads can be started at any time of day. The Auto Updater schedules a random time for update checks and downloads within the configured time frame.

## Update time window

Set the time frame for update installations here. The daily start and end time for this time frame can be set to the hour. The default setting specifies a time frame between 2:00 AM and 4:00 AM. If an update is found, it will be installed during this time and the device will be restarted to activate the update. The Auto Updater schedules a random time for the installation within the configured time frame.

## Base URL

Specifies the URL of the server that provides the latest firmware versions.

### 5.5.8 SNMP

SNMP

×

Operating:

Yes

Port:

161

Administrators have SNMPv3 access according to their device access rights:

No

Cancel

Confirm

#### Operation

Activate SNMP.

#### Port

If necessary, adjust the port used for SNMP. Default: 161

#### Administrators have SNMPv3 access according to their access rights

Enable this option if registered administrators, including the root user, should also have access via SNMPv3.

### 5.5.9 WLAN management

Specify here whether your device is managed by a WLAN controller.

Wifi management

×

Operating

Yes

Cancel

Confirm

#### Operation

This configures whether an access point actively searches for a WLC and can be managed by one.




This option should be deactivated for operation in stand-alone mode.



## 6 Diagnosis

### 6.1 Trace output

Trace output can be used to check the internal processes in the device during or after configuration. Experienced users can read this output and discover any errors in connection establishment. One particular advantage is: The error may be located in the configuration of your own device or in the peer device.

 Trace output has a slight time delay from the actual event, but the order of events is always recorded correctly. This generally does not influence the interpretation of the display, but this should be considered when making precise analyses.

#### 6.1.1 Trace – an overview

Trace output is started in a CLI session. Set up an SSH session to the device. Call the trace with the following syntax:


```
> trace [--log] [+|-|#|?] <Parameter>
```

The command trace, the key and the parameters are each separated by a space. The keys control the trace while the parameter determines the actual output.

**Table 2: Overview of keys**

Key	Meaning
--log	Output of "historical" Information from the log
?	displays help
+	switches trace output on
-	switches trace output off
#	Toggles ""between the different trace outputs
no key	displays the current status of trace

**Table 3: Overview of parameters**

Parameter	Meaning	--log
WLAN	WLAN-related outputs, such as client log ins and log offs, key negotiation, ...	Yes
	 If the trace is not enabled, the log file will contain only a small amount of information and the "historical" output will not be particularly informative.	
IAPP	Output on IAPP (inter access point protocol)	Yes
Kernel	Output on the basic system and kernel.	Yes
SSH	Output on the SSH service.	Yes
*	Wildcard, which stands for all services.	Depends on the service

### 6.1.2 Trace – operation

The following examples illustrate the functions of trace:

- > Start one or more traces:

```
trace + ssh kernel
```

- > Stop traces:

```
trace - ssh kernel
```

- > Stop all traces:

```
trace - *
```

- > Toggle between “”switching the traces on and off:

```
trace # ssh kernel
```

- > Output “historical” information, if supported and available in the log:

```
trace --log + kernel
```

## 6.2 Logs in WEBconfig

You reach the “Logs” area by means of the **Logs** item in the sidebar.



This area outputs the device SYSLOG.

Logs

☐ Automatically refresh view every  seconds
 

Refresh now

Time	Level	Message
2019-04-24 16:10:44	warning	[700399.503763] dfs_confirm_radar: Rejecting Radar since Fractional PRI detected: searchpri=490, threshold=6, fractional PRI=24;
2019-04-24 16:05:17	warning	[700072.074115] [wifi1] FWLOG: [35570809] WAL_DBGID_SECURITY_ALLOW_DATA ( 0x4410b0 )
2019-04-24 16:05:17	warning	[700072.074101] [wifi1] FWLOG: [35570809] WAL_DBGID_SECURITY_ENCR_EN ( )
2019-04-24 16:05:17	warning	[700072.074038] [wifi1] FWLOG: [35570809] WAL_DBGID_SECURITY_UCAST_KEY_SET ( 0x5643, 0x0 )
2019-04-24 16:05:17	notice	hostapd: WLAN-2-01: AP-STA-DISCONNECTED c4:61:8b:72:56:43