

# **WISP-Dist User Guide**

# WISP-Dist User Guide

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# Chapter 1. Introduction

## What is WISP-Dist?

WISP-Dist is an embedded Linux distribution for wireless routers, but can be used for other purposes as well. Entire system fits in 8 MB flash/16 MB RAM. The goal is to create an open, customizable and easy to use solution for wireless routers. Development was sponsored by ThunderWorx.

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## WISP-Dist features

- Completely open system based on Linux kernel 2.4
  - Entire distribution fits in 8 MB flash, of which 1.2MB are currently free for additional packages
  - Works on 16 MB RAM
  - Simple to use menu-based configuration system for basic functionality
  - Command-line access for advanced configuration
  - Remotely upgradable via automatic script
  - Modular: you can add/remove packages
  - Local access via console or serial port
  - Remote access via SSH
  - Statistics available via SNMP, including wireless statistics, such as signal levels
  - Layer 3 bridging support (based on proxy ARP) – unlike standard bridging, works well for connecting networks behind wireless nodes
  - OSPF, RIPv2 dynamic routing support integrated; networks built this way are much easier to debug and tune than bridging-based networks
  - NAT (with H.323, PPTP pass-through support)
  - Bandwidth shaping
  - PPP is supported (useful for automatic backup)
  - PPPoE client
  - VTUN software allows for encrypted PtP tunnels between locations and Layer 2 unification of networks.
  - VLAN trunking support: service several customers from one CPE connected to a switch
  - Access Point support for Prism2/2.5/3/Atheros
  - MAC filter (access list) support for AP
  - Advanced network diagnostics: NTOP, tcpdump, bmon etc
  - Can log all system events to remote system via SYSLOG protocol
  - checking: system will reboot if some of the specified hosts are unreachable (useful when radios get stuck)
  - Easy to service: all files are stored on standard FAT partition
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## WISP-Dist hardware requirements

- x86 compatible CPU – 100+ Mhz recommended
  - 16 MB RAM (more if temporary read/write partition is in RAM)
  - 8 Mb disk space; less if the temporary read/write partition is in RAM
  - Most of the PCMCIA/LAN/wireless equipment is supported
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## Hardware tested with WISP-Dist

### Motherboards

- Soekris net4511
  - Soekris net4521
  - Teletronics CPR (year 2001 and 2002 revisions)
  - DemarcTech SBC
  - Nagasaki Geode-based SBCs
  - Mikrotik RouterBoard (with BIOS ver. 1.1.1+)
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### Wireless cards

- ZCom/Teletronics XI-300 low power 30mW Prism2-based cards, Access Point mode supported
  - ZCom/Teletronics/DemarcTech XI-325H/HP high power 100/200 mW Prism2.5-based cards, Access Point mode supported
  - ZCom/DemarcTech XI-325H high power 180 mW Prism2-based cards, Access Point mode supported
  - Cisco AiroNet 350 350 series
  - Lucent/Avaya/Agere 802.11b Orinoco series
  - Atheros-based cards
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### Other hardware

If the hardware is supported by any of the Linux distributions, then there is a good chance that it is supported under WISP-Dist as well.

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### Hardware known NOT to work

- 22 mbps wireless cards based on TI chipset (Dlink DWL-520+, DWL-650+)
  - Various USB-based wireless adapters
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# Chapter 2. Installation

## Supported target media

WISP-Dist is designed to be installed on 8+ MB CF (Compact Flash) media and the documentation assumes that you do so. However the procedures for installation on hard disk, DoC or LS-120 are very similar, usually you just need to change name of the target disk device accordingly.

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## Partition-less installation from WISP-Dist image (.bin/.img file)

### Image installation under Linux

- Image will boot only if the disk on which it resides is Primary Master (/dev/hda). If you want it to be from anything else, mount the image after you have written it and change the boot device in syslinux.cfg.

You can use IDE-to-CF converter or USB CF reader, such as SanDisk ImageMate.

The syntax is:

```
$dd if=[image filename] of=[CF block device]
```

If you use IDE-to-CF converter, then your USB CF reader uses /dev/hd[a-z] device, if you use USB CF reader, then it uses /dev/sd[a-z] device (usually /dev/sda if you don't have any other SCSI devices). Look at /var/log/messages to find where it really is.

For example, if WISP-DIST image is in file wisp-dist\_2397\_img\_wdist.bin and your CF reader is on /dev/sda, you need to type the following to copy the image:

```
$dd if=image-2002-05-30(2000).img of=/dev/sda
```

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### Image installation under Microsoft Windows

You can use PhysDiskWrite utility to write WISP-Dist images. You can download a copy of this utility from WISP-Dist's website.

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## Partition-based installation from WISP-Dist package distribution (.zip file)

This type of installation is useful when you're very tight on RAM and want to save some memory by placing temporary files into the flash instead of RAM. You have to manually partition the disk yourself using "fdisk" utility, which is included with both Linux and Windows.

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1. First partition should be at least around 6800Kb in size, and should be set to ACTIVE. Size required may vary depending on the amount of packages you place on it. If you use Linux, run "mkfs.msdos [device]" to format the partition with FAT file system; if you use Windows, do the same using "format" command. Set the partition type to FAT.
  2. Second partition should be at least 1300Kb in size. It is used for storing read-write files (configuration) once the system is booted. If your flash is tight, but you have more than 16 MB of RAM, then the second partition is not needed. If it is not found, system will create a RAM disk (tmpfs) and use it instead of the second partition. WISP-Dist uses Minix filesystem on the second partition; however the partition type is ignored so you don't have to set it to Minix.
  3. Download and install SYSLINUX on the first partition (SYSLINUX is available both for Linux & Windows).
  4. Unzip WISP-Dist package distribution in a separate directory and copy files from it to the first partition. Minimum system should have the following files: initrd.lrp, ldlinux.sys, linux, root.cfs, root.lrp, root.md5, syslinux.cfg, syslinux.dpy.
  5. If you have removed/added some of the packages, edit LRP= parameter in syslinux.cfg. This parameter specifies list of packages system will try to install during startup.
  6. In syslinux.cfg, add statement "rwfs=/dev/hdX2" and change all occurrences of "boot=.../dev/hda" with "/dev/hdX1", where hdX is the disk from which you're going to boot, which is usually IDE Primary Master (/dev/hda), or /dev/hdb for Primary Slave, /dev/hdc for Secondary Master etc.
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# Chapter 3. Initial setup & configuration

## Control/configuration methods

The following ways of configuration/control are supported:

- Keyboard
  - Serial Port
  - Remote control via SSH
  - Remote control via telnet (unsecure, not recommended)
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## Default configuration

A freshly installed WISP-Dist image has the following default configuration:

- Empty root password
  - First Ethernet interface (eth0) has IP address 192.168.1.1/24 (255.255.255.0 netmask), no default gateway
  - Serial console on ttyS0 (COM1), 9600 8N1
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## Initial configuration walkthrough

- Login as root (there will be no password)
- You'll see a menu. Use arrow keys and ENTER to navigate.

Go to "Network Configuration". You'll get a menu for network configuration.

- Change the hostname by going to "Configure hostname".

Enter desired hostname and press Enter. You'll get back to network configuration menu.

- Change the default gateway by selecting "Configure default gateway" option.
- Change the DNS settings by going to "Configure name resolution (DNS)". You'll be asked for your name server IP addresses and default search domain (leave it empty if you don't have a use for it).
- Now proceed with configuration of individual network interfaces by going to "Interface-specific configuration". You'll get a list of network interfaces.
- You can change IP address of the first Ethernet device (eth0) by selecting eth0 and pressing ENTER. You'll get a network interface configuration menu.

Go to "IP Address/Netmask" option. Change the IP address. IP addresses are entered in a.b.c.d/masklen notation, e.g. 192.168.1.1/24 for IP address of 192.168.1.1 and netmask of 255.255.255.0. You can have more than IP address on the same interface, just separate them by space.

- Go back to the main menu. You can do it by pressing "Right" arrow button while in the menu (it will move highlight to "Cancel") and clicking Enter.

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When in the main menu, change the password by going to "Change root (Administrator) password". You'll have to enter a new password two times.

- Initial configuration is complete. Save configuration by going to "Save configuration for all packages". The system will take some time to save the configuration.
  - Reboot to make sure all new settings are applied. Select "Reboot" from the main menu and press Enter.
  - Congratulations, initial configuration complete!
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# Chapter 4. Administration Guide

## Main Menu

Main Menu is used for accessing all other configuration menus and facilities of WISP-Dist:

- Network Configuration – this leads to a section where you can configure various network aspects of your router (IP addresses, bridging etc).
- Wireless Parameter Configuration – various wireless aspects are configured there; for example, ESSID, Access Point and so on.
- System Logging (syslog) Configuration – various aspects of how WISP-Dist handles log/debug information from it's various facilities can be configured there.
- Statistics – leads to a menu where you can get various information and statistics of how your router is performing, as well as ability to perform various tests and debugging.
- SNMP Configuration – WISP-Dist has full-featured SNMP support (see chapter on SNMP). Use this sub-menu to configure SNMP parameters such as community.
- Network diagnostics configuration – this option leads to a submenu to configure diagnostics utilities included with WISP-Dist.
- OSPF/RIP (Zebra) configuration – OSPF and RIP are protocols used for dynamic routing. You can enable/disable them using this sub-menu, as well as set other configuration parameters as such authentication key. WISP-Dist by default comes with a configuration which allows OSPF/RIP to start working as soon as you enable them, without any additional tweaking of configuration files.
- Change root (Administrator) password – if you want to change your login password, select this option.
- Save configuration from all packages – in order for your changes to become permanent, you have to save them.
- Restart networking, apply all new network settings – this option can be used if you want to apply new interface settings. It will reset all of interfaces and start them again. It is much faster than doing a reboot, however it doesn't apply non-network related changes.
- Reboot – self explanatory.
- WISP-Dist provides a method for non-destructive remote upgrade to a new version of the image. In order to start it, you have to select this option and use "upload-wdist" script on your workstation to upload the new image. More information in "Performing remote upgrades" chapter.
- Quit – the menu will close and a Linux command line will appear.
- Standard LEAF Configuration Interface – you can get to old LEAF configuration through this menu. For experts only. This is not supported and you can break your system.

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## Network Configuration sub-menu

- Configure hostname – by default the hostname is "wisprouter". Use this option to change it.
- Configure network adapters to start during boot – by default only eth0 and netcs0 are activated during boot. Use this menu if you want to active other adapters as well.
- Interface-specific configuration – leads to a sub-menu where you can configure network parameters of individual interfaces.
- Default gateway – you change your default gateway using this option.
- Configure name resolutions – configure DNS settings of your router using this option. Many functions will be slowed down if the DNS is not correctly configured.

- Bridging – leads to bridging configuration. There can be two types of bridges: layer 3 and layer 2. Layer 3 bridges can only bridge IP packets (so, no DHCP), however it works on all kinds of wireless devices. Layer 2 bridge can bridge any type of Ethernet packets, however, it is not supported on wireless cards in non–AP mode. Note that Layer 3 bridging requires that you have IP addresses on all of your interfaces and a default gateway configured on your router.
  - Configure NAT – NAT stands for Network Address Translation, and is also known as "Masquerading". It allows for several computers with private IP address (10.x.x.x, 192.168.x.x, 172.16.x.x) to use a single public Internet IP address to go the Internet. You will be asked for an Interface which is used to access the Internet. IP address from this interface will be used for NAT.
  - Configure network checks – WISP–Dist has a service which can ping a set of defined IP addresses. If some of them are unreachable, the unit will reboot. This is useful when hardware is not very stable.
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### Interface–specific configuration sub–menu

This menu gives you ability to configure various network parameters of individual network interfaces. Select an interface from a list and press ENTER. You will get a network interface configuration screen.

- IP Address/Netmask – use this option to assign an IP address to an interface. The IP address are specified by a.b.c.d/masklen form, e.g. 192.168.1.1 means IP address of 192.168.1.1 with netmask 255.255.255.0. More than one IP address can be assigned, to do this enter several IP addresses/masklen pairs separated by space. E.g.: 192.168.1.1/24 10.200.200.1/24
  - Transmit Rate / Traffic Shaping – use this menu to limit the maximum speed with which the data will be going out from this interface.
- 

### Wireless Parameter Configuration sub–menu

This menu is used to configure wireless configuration in general and individual parameters of wireless devices.

- Configure hostnames to MAC addresses mapping – each wireless station is known by it's MAC address, which is expressed in form of 6 hexadecimal digits (AA:BB:CC:DD:EE:FF). MAC addresses are hard to remember, so WISP–Dist provides you an ability to configure aliases for MAC addresses. This aliases are then used when showing access point statistics and during MAC filter configuration.
  - KarlNet TurboCell Configuration – KarlNet is a proprietary wireless protocol is used for outdoor wireless networks. If your image supports KarlNet, you'll be able to enable it by entering this sub–menu.
  - To configure individual wireless device, select it from the list and press ENTER. You will get a wireless interface configuration screen.
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### Wireless Device Configuration sub–menu

- MAC filter – if you use this wireless device as an access point, you can set MAC filtering policy using this sub–menu. MAC filter is used to allow or disallow specific MAC addresses from associating with your station.

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- Mode – the wireless card can be in Infrastructure (Access Point client), Ad-Hoc or Access Point (base station) mode. Access Point mode is currently supported only on Intersil Prism-based wireless cards.
  - ESSID – each wireless network is identified by its own identifier (ESSID). This ID is set using this option.
  - Channel – used to set the frequency (channel) on which the wireless device operates. In Infrastructure mode, this parameter is ignored and frequency of the Access Point is used instead.
  - Nick – sets station name which is transmitted to the Access Point.
  - Rate – 802.11 transmit rate/modulation is set using this option.
  - Encryption Mode – configure encryption (WEP) mode using this option.
  - Encryption Key – configure encryption (WEP) key using this option.
  - RTS/CTS threshold – when a packet with size greater than RTS/CTS threshold is about to be sent, a Request to Send (RTS) will be sent to an Access Point, which should answer with Clear to Send (CTS). This setting is used to mitigate "hidden node" problem with CSMA/CA (802.11) wireless networks.
  - Transmit Power – some cards (Cisco Aironet) support adjustment of transmit power. It should be noted that you should not try to send power above the card's maximum as it can result in interference on neighboring channels.
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## Statistics sub-menu

- Show network/wireless/system statistics – routing table, ARP table, wireless statistics etc.
  - Access Point statistics for cards in AP mode – list of stations associated with their signal levels, TX/RX statistics and so on.
  - Show system log – show's contents of the system logfile.
  - Signal statistics for a selected IP/MAC address – if you use Ad-Hoc, use this option to see signal levels of stations you're communicating with.
  - Advanced Traceroute (mtr) – mtr is a very useful tool which combines ping and traceroute functionality.
  - Network Benchmark Tool (ttcp) – use this to test throughput between two routers.
  - Bandwidth Utilization Monitor (bmon) – this console tool draws a graph which shows current utilization of selected interface.
  - Wireless statistics monitor (wavemon) – this tool shows status of wireless connection in real-time. Useful for alignment.
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# Chapter 5. Performing Remote Upgrades

*Currently upgrade is only supported from Linux/Unix platforms.*

1. Download WISP-Dist package distribution (.zip) and uncompress it in a separate directory on your workstation.
2. If you do not have upload-wdist script on your workstation, [download it](#). This script requires scp & ssh.
3. Login to the target router as root and select "Start upgrade procedure" option from the main menu.
4. Run upload upload-wdist on your PC. Specify the remote host IP and directory with packages as the parameters.
5. Switch back to the screen with the remote router running "upgrade-wdist". Follow the instructions.

The system tries its best not to upgrade configuration files which were edited. In order to do this, md5 fingerprints of all read-write files are kept and are compared during the upgrade process. If file's MD5 fingerprint is different, it will not be upgraded.

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## Chapter 6. SNMP support

Apart from providing SNMP statistics using standard facilities in `ucd-snmplib`, WISP-Dist also provides statistics specific to wireless interfaces using `.1.3.6.1.4.1.2021.254` (`enterprises.ucdavis.254`) MIB.

*ifnum* is the interface number, and starts from 1.

Wireless interface name:  
`enterprises.ucdavis.254.1.[ifnum]`  
Wireless interface status:  
`enterprises.ucdavis.254.2.[ifnum]`  
Signal quality:  
`enterprises.ucdavis.254.3.[ifnum]`  
Signal level:  
`enterprises.ucdavis.254.4.[ifnum]`  
Noise:  
`enterprises.ucdavis.254.5.[ifnum]`  
Discarded packets due to wrong network ID:  
`enterprises.ucdavis.254.6.[ifnum]`  
Discarded packets due to crypto error:  
`enterprises.ucdavis.254.7.[ifnum]`  
Discarded packets due to fragmentation:  
`enterprises.ucdavis.254.8.[ifnum]`  
Discarded retry packets:  
`enterprises.ucdavis.254.9.[ifnum]`  
Other/miscellaneous discarded packets:  
`enterprises.ucdavis.254.10.[ifnum]`  
Missed beacons:  
`enterprises.ucdavis.254.11.[ifnum]`  
Total discarded packets:  
`enterprises.ucdavis.254.12.[ifnum]`  
Current bit rate:  
`enterprises.ucdavis.254.13.[ifnum]`  
MAC address of the Access Point:  
`enterprises.ucdavis.254.14.[ifnum]`  
Current ESSID:  
`enterprises.ucdavis.254.11.[ifnum]`

If the card is in Access Point mode, then the following statistics will be available:

*stanum* is the number of the associated station (STA), and starts from 1.

MAC address of the STA:  
`enterprises.ucdavis.254.11.[ifnum].[stanum].1`  
Alias of the STA (if not set, identical to MAC address):  
`enterprises.ucdavis.254.11.[ifnum].[stanum].2`  
Signal level of the last packet received:  
`enterprises.ucdavis.254.11.[ifnum].[stanum].3`  
Noise level from the last received packet:

enterprises.ucdavis.254.11.[ifnum].[stanum].4

Transmit rate the access point uses for this station:

enterprises.ucdavis.254.11.[ifnum].[stanum].5

Rate of the last packet received from this STA:

enterprises.ucdavis.254.11.[ifnum].[stanum].6

Total bytes transmitted to the station:

enterprises.ucdavis.254.11.[ifnum].[stanum].7

Total bytes received from the station:

enterprises.ucdavis.254.11.[ifnum].[stanum].8