DoDWAN Apps User Manual

Version 2.1.0

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Contents

1 Introduction

DoDWAN is a middleware system that supports opportunistic (a.k.a. delay/disruption-tolerant) communication in partially or intermittently connected mobile ad hoc networks. It is distributed under the terms of the GNU General Public License, and it can be used to develop distributed applications for disconnected mobile ad hoc networks.

DoDWAN is also distributed with a demonstration application suite called **DoDWAN Apps**. This application suite can be installed on mobile hosts such as laptops, netbooks, or smartphones, and provide users with a number of predefined application services.

2 Installing DoDWAN Apps on mobile hosts

DoDWAN and DoDWAN Apps have both been developed in Java, and can be executed with the standard Java Runtime Environment (JRE) 1.6.

DoDWAN Apps is distributed as a ZIP file, which can be downloaded from DoDWAN's web site : http://www-irisa.univ-ubs.fr/CASA/DoDWAN.

After downloading the ZIP file from DoDWAN's web site, extract the files it contains and place these files in a local directory. The package contains the following tree:

```
dodwan-apps-2.1.0/
├── dodwan-apps-2.1.0-jar
├── dodwan-profile.xml
├── set-dodwan-network.ps1
├── set-dodwan-network.sh
├── start-dodwan-apps.ps1
├── start-dodwan-apps.sh
├── unset-dodwan-network.ps1
└── unset-dodwan-network.sh
```

- `dodwan-apps-2.1.0.jar` is a stand-alone JAR file, which includes a copy of the DoDWAN middleware system, as well as several application programs based on DoDWAN.
- The two shell scripts `set-dodwan-network.sh` and `set-dodwan-network.ps1` are meant to help users configure their mobile devices for ad hoc networking (on Linux platforms and Windows 7 platforms respectively). An additional file `dodwan-profile.xml` is used by the Windows script.
- The two shell scripts `unset-dodwan-network.sh` and `unset-dodwan-network.ps1` can be used to cancel the configuration for ad hoc networking with DoDWAN (on Linux platforms and Windows 7 platforms respectively).
- The two shell scripts `start-dodwan-apps.sh` and `start-dodwan-apps.ps1` can start DoDWAN Apps on Linux platforms and Windows 7 platforms respectively.

3 Starting DoDWAN Apps on mobile hosts

3.1 Configuring the Wi-Fi interface for ad hoc networking

Before starting any DoDWAN-based application on a mobile host, one must configure this host's Wi-Fi interface so it can operate in ad hoc mode. The scripts `set_dodwan_network.sh` (for Linux systems) and `set_dodwan_network.ps1` (for Windows 7 systems) are meant to help you achieve this task. If you cannot configure your Wi-Fi interface using these script files, please refer to Section B for further instructions regarding network configuration.

On a Linux platform

The shell script `set-dodwan-network.sh` must be used on a Linux platform. Note that this script must be executed with *root* privileges, as it must configure the Wi-Fi interface for ad hoc networking:

```
% sudo sh set_dodwan_network.sh
Detected Wi-Fi interface:  wlan0
Interface wlan0 is now configured for ad hoc networking (ssid=DODWAN-ADHOC,
channel=1)
```

On a Windows 7 platform

On a Windows 7 platform execute the following command in a Powershell launched with *Administrator* privileges. Note that you may additionally have to deactivate your firewall to allow DoDWAN traffic (UDP, default port 8500).

```
> set-dodwan-network.ps1
Detected Wi-Fi interface:  Wireless network connection
Profile DODWAN is added on interface Wireless network connection.
Profile "DODWAN" of interface "Wireless network connection" is updated.
Connection request is received successfully.
Ok.
```

3.2 Starting DoDWAN Apps

Once the Wi-Fi interface is configured for ad hoc networking, the scripts `start-dodwan-apps.sh` (for Linux systems) and `start-dodwan-apps.ps1` (for Windows 7 systems) can be used to start DoDWAN Apps.

Note that these scripts should be run in a non-privileged user account.

On a Linux system:

```
% sh start-dodwan-apps.sh
Wi-Fi interface:  wlan0
Wi-Fi interface IPv6 address:  fe80::222:19ff:fe2c:c68b
Launching DoDWAN Apps...
```

On a Windows 7 system:

```
> start-dodwan-apps.ps1
Wi-Fi interface:  Wireless Network Connection
Wi-Fi interface IPv6 address:  fe80::222:19ff:fe2c:c68b
Connection request is received successfully.
Launching DoDWAN Apps...
```

When DoDWAN Apps is started, the DoDWAN system starts running in the background, together with all the application services whose code is included in DoDWAN Apps JAR file. A small window opens on the screen, which lets you access the graphical user interface of each application service.

If this is the first time you launch DoDWAN Apps, a dialog window appears previously so you can enter a pseudo. This pseudo will identify you in the network as a DoDWAN Apps user. So make sure that this pseudo is unique in the network.

To date DoDWAN Apps includes the following application services:

- PresWAN is an application that makes it possible to visualize which mobile hosts –and thus which users– are in the radio range of the local host.
- FiShWAN allows users to share files (more or less selectively) in a peer-to-peer fashion.
- TextWAN allows users to exchange text messages in a peer-to-peer fashion.

Note: if you inadvertently terminate DoDWAN Apps and decide to start it again, you do not necessarily need to configure the Wi-Fi interface again. This is required only if the network configuration has changed in the meantime.

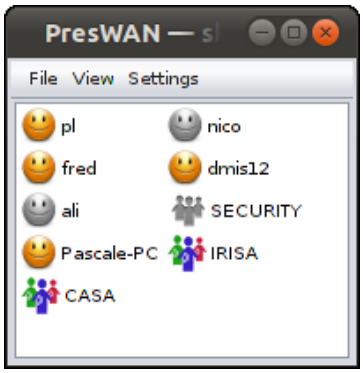
4 Overview of DoDWAN Apps

4.1 PresWAN: neighborhood visualization with DoDWAN

4.1.1 Overview

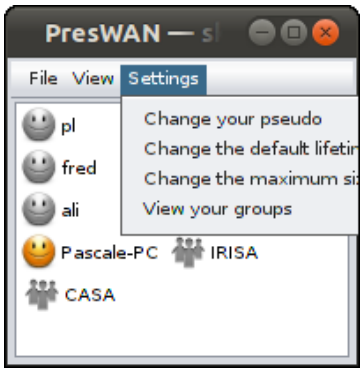
With DoDWAN Apps, each user is identified by a pseudo, and he/she can be a member of one or several groups of users.

PresWAN is an application that makes it possible to visualize which are the "neighbor" users and groups at any time (two devices running DoDWAN are considered as being neighbors when they are in radio contact with each other). In the presence window, your current neighbors are displayed with colored icons, and "former neighbors" (that are now out of radio range) with grey icons.

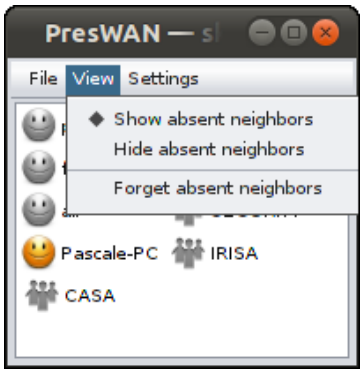


An icon representing a user appears in color when this user is in your neighborhood, and it turns grey when this user moves away (or switches his/her device off).

An icon representing a group of users appears in color when at least one member of this group is your neighborhood, and it turns grey when no member of this group is left in the neighborhood.



The icons representing former neighbors can be masked temporarily by selecting the option "Hide absent neighbors" in the View menu. These icons can also be removed by selecting option "Forget absent neighbors" in the same menu. Hidden neighbors can be displayed again with option ”Show absent neighbors”.



You can join or leave a group at any time by selecting option "Show my groups" in the Settings menu. Simply select in the proposed list the groups you want to be a member of. You can also create a new group, specifying the name of the group you want to create.

Right-clicking on a user or group icon allows you to send a message (i.e. either a text message, a voice message, or a file) to that destination. If the icon represents a single user, then DoDWAN will attempt to deliver the message to that user only. If the icon represents a group, the DoDWAN will attempt to deliver the message to each member of the group.

4.1.2 Accuracy of the presence display

Because of the communication mode implemented by the DoDWAN system, the display of neighbor devices is submitted to specific constraints. When a neighbor host is shut down or put in suspend mode, this event is advertised on the radio channel so it is usually displayed almost immediately on the local host’s presence window. On the other hand, when an active neighbor moves away and gets out of radio range it may take some time for the local host to detect this event and update the presence window accordingly.

4.1.3 Setting advanced parameters

The Settings menu in application PresWAN allows you to adjust the behavior of DoDWAN Apps:

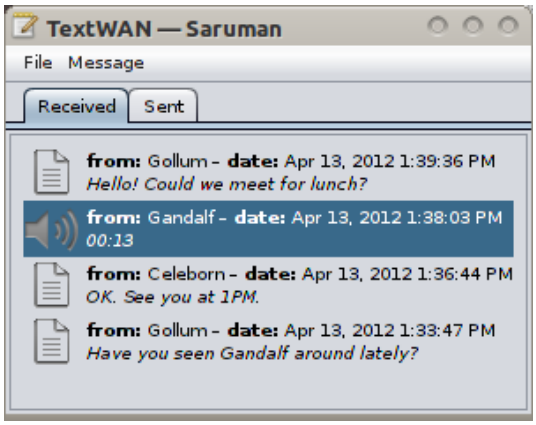
- Change your pseudo: your pseudo is the name by which other users will perceive your presence in the ad hoc network. This pseudo is normally set the first time you start DoDWAN Apps, but it can be modified at any time using this option.
- Change the default lifetime: any message or file you send to another user (or group of users) must be assigned a lifetime, so it does not propagate forever from mobile host to mobile host in the ad hoc network. The default lifetime value can be adjusted using this option.
- Change the maximum size: this option allows you to adjust the maximum size for messages and files sent with DoDWAN Apps.

- Show your groups: as explained in the former section this option allows you to create, join or leave groups of users.

4.2 TextWAN/VoiceWAN: text/voice messaging with DoDWAN

4.2.1 Overview

TextWAN (Text messaging with DoDWAN) and VoiceWAN (Voice messaging with DoDWAN) are two parts of an application that allows users of mobile devices to exchange short text/voice messages. A message is addressed to a user or a group of users identified by his/her pseudo. Since TextWAN and VoiceWAN rely on the communication mechanisms provided by the DoDWAN middleware system, a message may go through multiple mobile hosts serving as relays before reaching its destination. Any DoDWAN-enabled device may serve as a relay for a TextWAN message.



4.2.2 How to use TextWAN/VoiceWAN

Two lists are accessible in the application's window by clicking on the matching tabs: the received messages and the sent messages. Each list contains a short description of the messages received (resp. sent) by the user: the sender's (resp. recipient's) pseudo, the emission's date and the first line of the message for text messages or the duration for voice messages. A right-click on a message opens a popup menu allowing to delete or to reply to the message.

A double-click on a message in the list opens a dialog window displaying the whole message. For voice messages, the play button starts a player.

In order to send a message, select *Send text message* from the *Message* menu in the TextWAN's window or right-click on a user icon in PresWAN's window. A window will appear so that you can enter and send your message. There is currently no way to send voice messages using DoDWAN Apps for Linux or Windows. This functionality is only available using the Android version of DoDWAN Apps. You can however send files of any type (including audio messages) to users or groups of users using the *Send file* option from the *Message* menu in the TextWAN's window or right-click on a user icon in PresWAN's window. The files you receive that have been sent that way by other users will be stored in the DoDWAN-Files directory.

4.2.3 Configuration of TextWAN/VoiceWAN

Each message sent with TextWAN is assigned a set lifetime, which can be adjusted using the *Settings* menu in the PresWAN's window. When a message is sent it starts disseminating opportunistically from mobile host to mobile host in the network, and this dissemination stops automatically when the message's lifetime expires.

The embedded audio player used to play voice messages relies on VLC 2.0 and VLCJ 2.0. VLCJ is already embedded in the distribution of VoiceWAN. Consequently, you must install only VLC 2.0 (or a greater version) on your device. If you do not want to install VLC on your device, or if you want to use another player to play voice messages, select *Settings* from the *File* menu in the TextWAN's window and give the absolute path to your audio player.

4.3 FiShWAN: filesharing with DoDWAN

4.3.1 Overview

FiShWAN *(File Sharing in Wireless Ad hoc Networks)* is a P2P filesharing application that shares many characteristics with popular P2P filesharing applications that run over the Internet, such as Emule or Kaaza. With FiShWAN a user can publish files in order to put these files at the disposal of a community of users and, conversely, the user can subscribe for specific kinds of files in order to receive such files from other users of the community. File sharing is performed asynchronously: the user who wants to acquire a file asks for it beforehand and waits for the file to be automatically retrieved. This process may take a long time, so the user is notified when the file is actually received.

Two major characteristics make FiShWAN different from traditional file sharing software such as Emule or Kaaza:

- FiShWAN exploits a disconnected mobile ad hoc network. Consequently, the size of the files is limited. Do not think of sharing files of several hundreds of MB. The order of magnitude for the maximum file size is rather around 1 MB. It should also be understood that fetching a file –even if it is a small one– is a process that can take a very long time (several hours or even several days) because this can typically depend on human movements.
- FiShWAN leverages on content-based communications. Hence, it presents to the user sophisticated means for describing the content of the files he/she wants to publish or obtain. From this standpoint, the graphical interface is richer than that of traditional file sharing software, which often restricts a file description to its name and type. This richness may be seen as a constraint by the users. But it is worth making use of it to achieve a more efficient sharing.

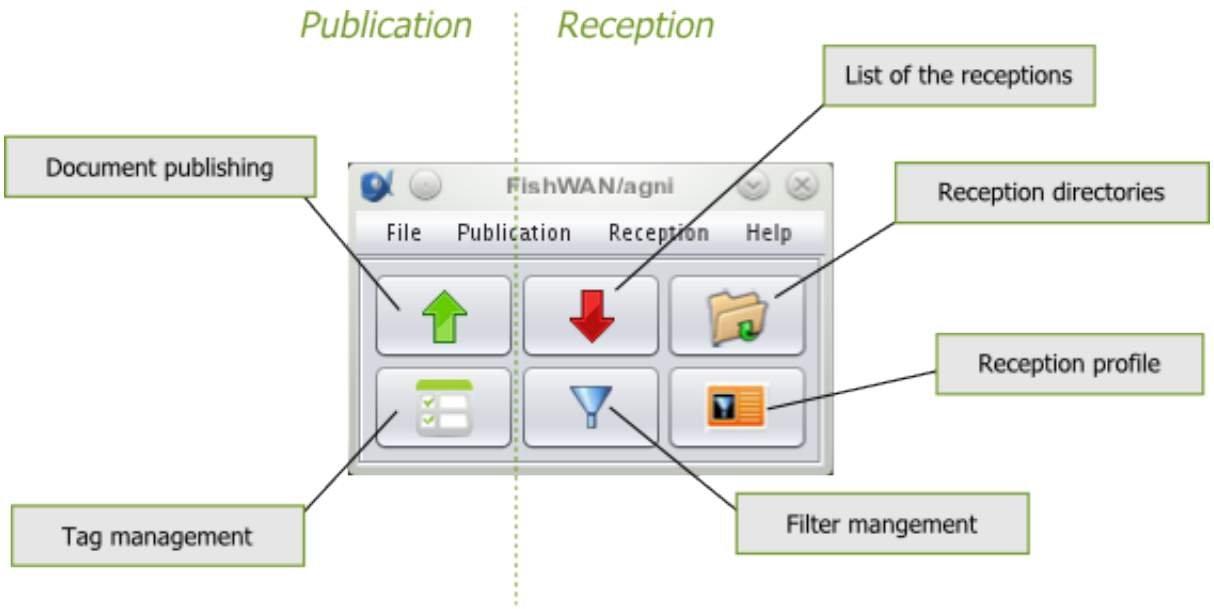
4.3.2 Structure of the application

FiShWAN is composed of two parts :

- **FiShWAN Core** is a daemon, ie a program running permanently in the background. It is autmatically launched at the beginning of the session. Its function is to continuously transmit the published files to the computers passing in the neighborhood and to download from these computers the files for which the user has put a subscription. One can verify that FiShWAN Core is active thanks to the green icon located in the status bar at the top of the screen. Normally, this icon should never turn red, stating that the daemon has stopped.
- **FiShWAN GUI** is a graphical application that enables publication, subscription, and the management of the descriptions associated with the files. It is accessible in the DoDWAN application menu (icon).

4.3.3 Main functions of FiShWAN GUI

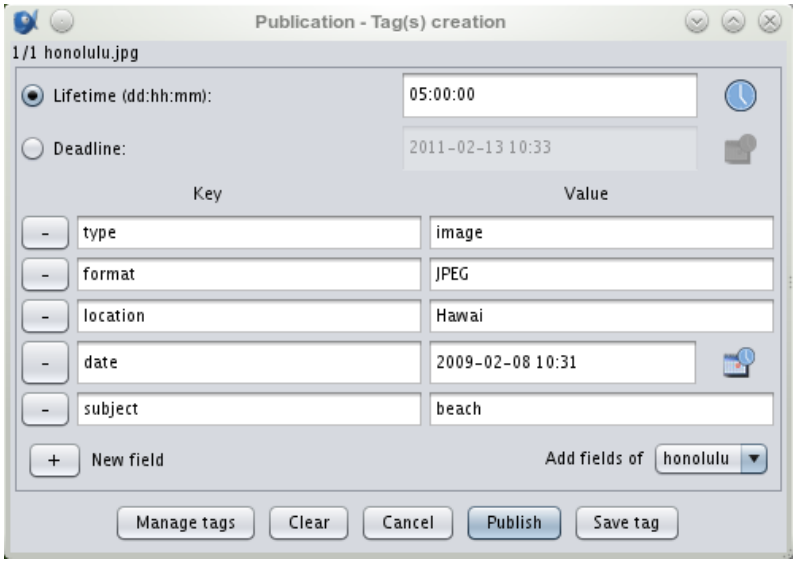
The main window of FiShWAN GUI gives access to the usual functions of the application. These functions can be classified into two large categories: publication and reception. Other functions are accessible via the menus of the window.



4.3.4 Publication of a file

Publication consists in a first time in **selecting one or several files**. Note that the size of the files and the number of files that can be published at once are limited.

A file to be published must be **associated with a tag**, ie a description that will allow its reception. A tag is a set of fields. A field is couple (key, value). Keys are typed (string, number or date). To build a tag, a set of fields is chosen that best characterize the content of the file. The window shown below gives an example of a tag composed of five fields that describes a holiday picture.



4.3.5 Management of tags

Building tags may turn out to be a rather tedious task. Hence, FiShWAN GUI allows the user to save a tag, and to add the fields of a previously saved tag when editing the current tag. Window "Tag Management" is a window dedicated to the creation, the classification and the naming of the set of saved tags, independently of the publication.

4.3.6 Lifetime

Each tag includes a special compulsory field: the lifetime. It indicates how long FiShWAN must go on publishing a file. One can specify explicetely the lifetime in days, hours and minutes, or alternatively specify a limit date,

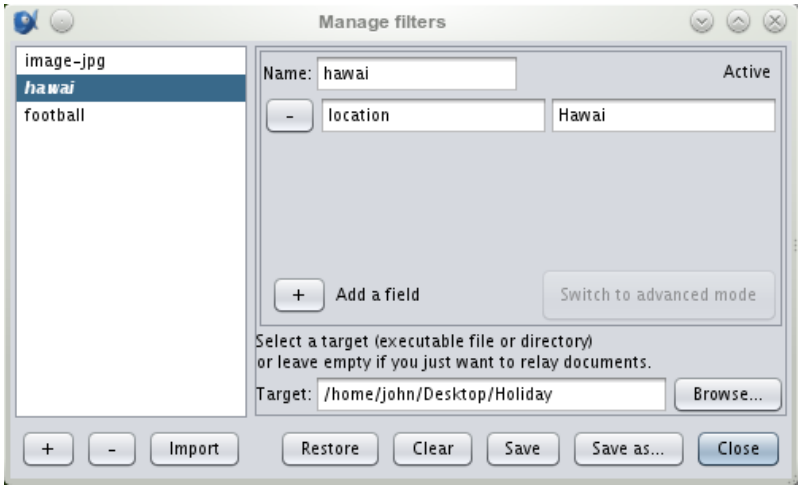
in which case the lifetime is computed as the time interval between the date of publication (ie the time at which the button "Publish" is clicked) and this limit date. After this limit date, the file no longer disseminates in the network. The limit date must be seen to be chosen as carefully as possible, namely by **avoiding to choose too long a lifetime**: all the computers of the network will strive to disseminate a file as long as its lifetime is not reached, even if all the users who wanted to fetch it have actually received a copy. This dissemination consumes resources (memory, disk, network bandwidth...) that may lack to the dissemination of other files.

4.3.7 History of publications

The list of the publications previously performed is accessible via the menu "Publication" of the main window. In this window can namely be verified the limit dates of the performed publications. A search area allows the users to visualize only the publications of the files whose names include a given string.

4.3.8 Management of filters

In order to obtain files published by other users, one must first perform a subscription by which is defined the set of the characteristics of the files that are expected to be received. This is achieved through the **creation of filters**. The window below is an example of a filter management window. It mainly allows filters to be created and saved. The left part of the window presents the already saved filers. the right part of the windows is dedicated to the edition of a filter.

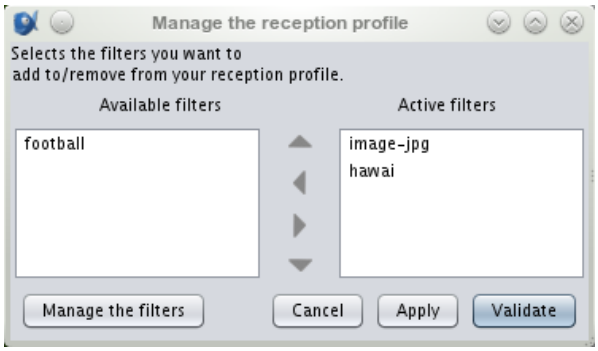


A filter is a description of the characteristcs of a file that the user wishes to receive. It is very similar to a tag: it consists in a set of couples key/value. A filter serves FiShWAN to determine if a file that is made accessible to it should be saved locally. It is the case if there exists an active filter that matches the tag associated with this file.

In addition, a target directory is defined for each filter. Every file that will be received because a filter matches the file's tag will be stored in the target directory attached to the filter. Note that as several active filter may exists, a file may be copied in more than one target directory.

4.3.9 Reception profile

FiShWAN GUI makes it possible to keep filters even if they are not intended to be used (temporarily in a normal case) for file reception. Indeed each filter is either active or non active. The set of the active filters forms the reception profile and it is this reception profile that enables the actual reception of the files. The following window of reception profile management shows the two lists of profiles. The content of these lists can be modified with the buttons in the center.

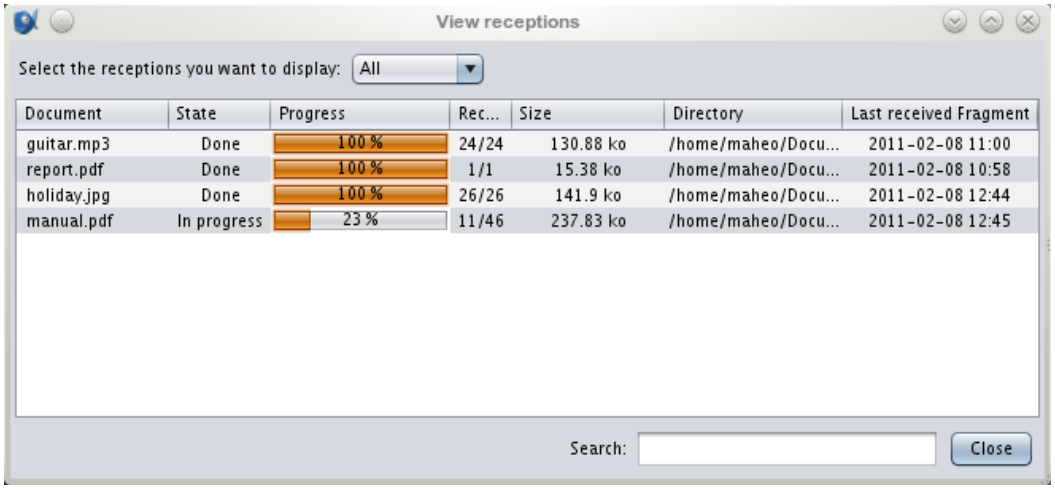


4.3.10 Reception

The reception of the files is automatic. Once the reception profile is in place, the files will automatically be put in the target directories cited in the filters. The main window offers the possibility to list these reception directories (button "Reception directories").

In order to inform the user of the actual completion of the reception of a file, a pop-up window appears temporarily at the bottom of the screen. In addition, one can visualize the progress of all the receptions (button "Visualize receptions" of the main window). An example of a window displaying the progress of receptions is shown below. The dissemination of files is performed by fragments of files. For each file, a progress bar is displayed. The file is available locally when all its fragments have been received. One can also choose the columns to be displayed and the sorting order (left click on the column title bar).

The number of received files can be large. So it is possible to display only the completed receptions or those that are still in progress. Furthermore, a search area makes it possible to enter a string that must appear in the displayed file names.



4.3.11 Questions and answers

- **Can I publish several files at once?**
  When publishing a file, you can select several files in the file selector (CTRL-click ou SHIFT-click). In this case the user is asked if she wants to use the same tag for all the files or specify a distinct one for each file. The rest of the publication process is similar to the one of a single file. Note that the number of files that can be published at the same time is limited.

- **What can I specify in the target field of filter?**
  The target field of a filter can be specified in three ways:

  – In the simplest case, the target field is the name of a directory. The received files (ie whose tags match the filter) will be deposited in this target directory.

- Another possibility is to specify a file as a target. This file must contain a programm (ie it must be an executable file). In this case the specified program will be launched after the reception of a file whose tag matches the filter. Two file names are passed as paramaters to the program: the name of the XML descriptor of the received file (in which you can find the tag), and the name of the file itself. Note that the reception can occur at any time. Therefore, it is not desirable to use interactive programs as targets.
- A third possibility is to leave the target field empty. This tells FiShWAN that you want to participate in the dissemination of some files (those whose tags match the filter) even if you don't want to have explicitely access to these files. Indeed, the files will be kept by DoDWAN and retransmitted to the neigbhors who are interested in their content. It is desirable, to some extent, to exploit this possibility and therefore to have an altruistic behavior. Collectively, this is likely to speed up the file dissemination.

- **What is the syntax of the String fields in a filter?**
  The key is necessarily a simple string. As for the value of the field, regular expressions can be used. The syntax is the one of regular expressions in Java (eg .* for a potentially empty sequence of any characters).

A Configuration properties

The behaviour of DoDWAN is determined by a set of Java properties that are defined in DoDWAN's configuration files (`dodwan.defaults` and/or `dodwan.conf`). These properties can if needed be overriden in the command line when launching DoDWAN, using options of the form `-Dproperty=value`.

In the default configuration file `dodwan.defaults`, a special property (`immutable`) contains a comma-separated list of properties whose definition cannot be overriden in `dodwan.conf` or in the command line.

The following properties are recognized by DoDWAN:

- **dodwan.interface_address** (default: ::)
  Address of the local interface used for DTN communication. This can be either an IPv4 or IPv6 address. Attempts to join the multicast group (whose address is specified in dodwan.remote_address) will be made on this interface, or on the system-default interface if none is specified (the system-default wildcard address is 0.0.0.0 in IPv4, and :: in IPv6).

- **dodwan.local_address** (default: ::)
  Address of the local interface used for DTN communication. This can be either an IPv4 or IPv6 address. The default wildcard address can normally be used here. That's 0.0.0.0 in IPv4, and :: in IPv6.

- **dodwan.remote_address** (default: FF02:0:0:0:236:1:2:3)
  Address of the multicast group used for DTN communication (for example 236.1.2.3 in IPv4, or FF02:0:0:0:236:1:2:3 in IPv6)

- **dodwan.dtn_port** (default: 8500)
  UDP port used for DTN communication

- **dodwan.console_port** (default: 8500) TCP port used by the DoDWAN console for telnet-like control. This is typically the same port number as that of the UDP communication port (specified in dodwan.dtn_port). Note that the DoDWAN console actually uses two TCP ports (that is, port numbers N and N+1, where N=dodwan.console_port), the first port being reserved for interactive use, and the second port for one-shot commands.

- **dodwan.announce_period** (default: 15)
  Period (in seconds) of the announcement broadcast by DoDWAN.

- **dodwan.announce_latency** (default: 35)
  Latency (in seconds) of an announcement. A neighbor host perceived by DoDWAN is considered as missing when the last announcement received from this host is older than the announce_latency value. The latency should always be greater than the period.

- **dodwan.fragmentation_threshold** (default: 50000)
  Fragmentation threshold (in bytes) for the segmentation and reassembly of large messages (that cannot fit in a single UDP datagram, typically). The value specified must be an integer, optionally followed by a quantifier (i.e. b or B, k or kB, M or MB).

- **dodwan.inter_message_delay** (default: 10)
  Inter-message delay (in milli-seconds). This argument is used by DoDWAN when multiple messages (typically, fragments of a large message) must be broadcast in a row on the multicast channel.

- **dodwan.max_payload_size** (default: 0)
  Maximum payload size (in bytes). Messages whose payload is larger than the specified size cannot be processed by DoDWAN, and are therefore discarded. If the value of this parameter is set to 0 (zero), then it means that there is actually no limit to the payload size (use this possibility with caution!). The value specified must be an integer, optionally followed by a quantifier (i.e. B, k or kB, M or MB).

- **dodwan.cache_capacity** (default: 0)
  Cache capacity (in bytes). DoDWAN's cache is maintained in the filesystem, and the payloads of messages are stored in a particular directory. This argument sets a limit on the total size of this directory. (Note that the size of message descriptors is not accounted for.) If the value of this parameter is set to 0, then it means that there is actually no limit to the cache capacity (use this possibility with caution!). The value specified must be an integer, optionally followed by a quantifier (i.e. B, k or kB, M or MB).

- **dodwan.start_online** (default: false)
  Boolean connectivity status (online/offline) of DoDWAN at launch time. Specifies whether DoDWAN should switch online or stay offline after its code has been loaded in the JVM.

- **dodwan.transaction_timeout** (default: 15)
  Specifies how long a transaction between two neighbour hosts can be idle before one of the hosts considers sending a new offer to its neighbour. This value is expressed in seconds. A resonable value for this parameter should be chosen in the interval between half the announcement period and the announcement period.

B Network configuration

B.1 Introduction

DoDWAN is a middleware system that supports opportunistic (a.k.a. delay/disruption-tolerant) communication in partially or intermittently connected mobile ad hoc networks. It is primarily meant to run on mobile hosts equipped with Wi-Fi interfaces.

In order to run DoDWAN-based applications on a flotilla of mobile hosts (such as laptops, netbooks or smartphones), one must first configure these devices so they can constitute an ad hoc network. Configuring a Wi-Fi interface for ad hoc communication can be quite tricky, though, so DoDWAN is distributed with two shell scripts `set-dodwan-network.sh` and `set-dodwan-network.ps1` that are meant to help users configure their mobile devices for ad hoc networking (on Linux platforms and Windows 7 platforms respectively).

On a Linux platform the Wi-Fi interface can thus be set as shown below:

```
% sudo sh set-dodwan-network.sh
Detected Wi-Fi interface:  wlan0
Interface wlan0 is now configured for ad hoc networking (ssid=DODWAN-ADHOC,
channel=1)
```

On a Windows 7 platform the Wi-Fi interface can be set by executing the following command in a Powershell launched with Administrator privilege. Note that this operation must be done only once as the produced configuration is by default persistent (to reboot) in Windows 7. You may need to previously authorize the execution of shell scripts by issuing the command `Set-ExecutionPolicy RemoteSigned` in a Powershell run with Aministrator privilege. In addition, be sure that your firewall does not prevent a Java program (like DoDWAN) to receive data on your wireless interface (you may have to deactivate your firewall or at least to define rules in it to allow Java to exploit incoming traffic on the DoDWAN network, on UDP port 8500).

```
> set-dodwan-network.ps1
Detected Wi-Fi interface:  Wireless network connection
Profile DODWAN is added on interface Wireless network connection.
Profile "DODWAN" of interface "Wireless network connection" is updated.
Connection request is received successfully.
Ok.
```

If these scripts do not run satisfactorily on your system, or if you are just curious to know what they do, please consult the following sections that provide step-by-step instructions for configuring the Wi-Fi interface on a Linux platform or on a Windows 7 platform.

Finally, if you need to cancel the Wi-Fi DoDWAN ad hoc configuration, you can run the provided script `unset-dodwan-network.sh` on Linux (as root), or the Poweshell script `unset-dodwan-network.ps1` on Windows 7 (with Administrator privilege).

B.2 Preparing to run DoDWAN on a Linux system

B.2.1 Preparing your system

Most current Linux distributions include the so-called NetworkManager, which runs continuously in the background and is supposed to ease network configuration on mobile hosts by re-configuring these interfaces automatically whenever possible.

In order to set your Wi-Fi chipset in ad hoc mode, and especially in order to ensure that it remains in this mode once it has been set, you will probably have to **disable the NetworkManager** altogether.

Likewise your Linux system probably includes Avahi support. Again you will probably need to **disable the Avahi support** on your system, as this does not help in an ad hoc network and can even disrupt interface configuration.

```
% sudo /etc/init.d/network-manager stop
% sudo /etc/init.d/avahi-daemon stop
```

Note: the actual syntax required for disabling these services on your system may depend on which distribution of Linux this system is running.

Once you are confident that *NetworkManager* and *Avahi* will not meddle with your configuration of the Wi-Fi chipset, you can proceed with this configuration.

B.2.2 Setting the Wi-Fi interface in ad hoc mode

You will need the **wireless-tools** package, which contains a number of tools for manipulating wireless interfaces.

With the **iwconfig** command provided in this package you can set your Wi-Fi interface in ad hoc mode, and set the ESSID and channel number that will identify your ad hoc network:

```
% ifconfig wlan0 down
% iwconfig wlan0 mode ad-hoc
% iwconfig wlan0 essid DODWAN-ADHOC
% iwconfig wlan0 channel 1
% iwconfig wlan0 power off
% ifconfig wlan0 up
```

In this example we assume the name of the Wi-Fi interface is **wlan0** (this name may of course be different on your own system). The network identifier (a.k.a. ESSID) is set to **DODWAN-ADHOC** in this example, and the channel is set to **1**. You can of course choose another name or channel number, provided you set the same values on all the hosts you wish to include in your ad hoc network.

Note: with some chipset drivers, some **iwconfig** commands can only be issued when the interface is down, while other commands can only be issued when it is up. Similarly, with some drivers the commands issued to configure the Wi-Fi interface must be issued in a specific order (which varies between one driver and another). You may therefore have to proceed by trial and error before your interface is configured as expected.
Likewise setting the `power off` option (which basically disables any form of power saving mode on the chipset) is optional, as many Wi-Fi chipsets do not accept this option.

B.2.3 Checking that a Wi-Fi interface is configured as desired

In order to check that your Wi-Fi interface is configured as expected, you can use the iwconfig command again:

```
% iwconfig wlan0 | head -2
wlan0     IEEE 802.11abgn ESSID:"DODWAN-ADHOC"
Mode:Ad-Hoc Frequency:2.412 GHz Cell:3A:E6:D4:D8:B4:58
```

In this example it can be observed that interface **wlan0** is running in **ad hoc mode**, and that it is set to operate on frequency **2.412 GHz** (that is the central frequency for channel 1) as part of a wireless network whose identifier is **DODWAN-ADHOC**.

B.2.4 Configuring the Wi-Fi interface for IP networking

Once your Wi-Fi chipset is operating in ad hoc mode, you still have to make sure it can be used for IP networking.

Before starting DoDWAN on your hosts, you simply need to make sure that the **wlan0** interface on each host has an automatically-assigned link-local IPv6 address (that is, an address with prefix **fe80::**), and that it is enabled for multicast networking.

On most recent distributions of Linux, network interfaces are enabled for IPv6 and multicast networking by default, so you should simply check that this is the case for the interface you intend to use. This can be done as shown below:

```
% /sbin/ifconfig wlan0 | grep "inet6\|MULTI"
inet6 addr:  fe80::222:19ff:fe2c:c68b/64 Scope:Link
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
```

In this example, the interface named **wlan0** has an **fe80::** link-local address as expected, and it is enabled for **multicast** networking. This interface can therefore be used by DoDWAN without any further configuration.

Note: a network interface may have several IPv6 addresses. This is not a problem, as long as this interface has at least an fe80:: link-local address.

If the Wi-Fi interfaces are IPv6-enabled and multicast-enabled on all the hosts you plan to use, then no further configuration is required to run DoDWAN on these hosts. You can therefore try to start DoDWAN on each host. Please refer to the appropriate sections in *DoDWAN's User Manual* or *DoDWAN's Developer Manual*, depending on your needs.

B.2.5 Dealing with a host that features multiple network interfaces

DoDWAN uses a multicast group to broadcast UDP datagrams among neighbor hosts. If one of the hosts you plan to use features several network interfaces, then you need to specify which of these interfaces is to be used by DoDWAN when joining this multicast group.

To select this interface you need to specify its address in DoDWAN's **interface_address** property (see Appendix A for details on how to set DoDWAN's configuration parameters).

You also need to set a route for multicast networking, that is, a route must be established to reach the multicast group through the selected interface:

```
% sudo ip -6 route add ff02::236:1:2:3 dev wlan0 table local
```

Of course the interface name must be adjusted to fit your own system.

B.3 Preparing to run DoDWAN on a Windows 7 system

Establishing a wireless network in Windows 7 is generally performed with the graphical user interface, via several tools accessible via the Control Panel / Network and Sharing Center. Another simple way to complete this task is to use the scripting language provided by Powershell, which will also allow us to identify and worked out possible difficulties.

B.3.1 Building a profile for DoDWAN ah hoc network

Windows 7 registers all wireless networks configurations in so-called profiles so that the user can easily "connect" to a desired network. A profile is specified in an XML file that describes a number of parameters (essentially its SSID and security mode). The profile suitable for a DoDWAN ad hoc network, available in the DoDWAN Apps and the DoDWAN SDK distributions, is the following:

```
<?xml version="1.0"?>
<WLANProfile xmlns="http://www.microsoft.com/networking/WLAN/profile/v1">
<name>DODWAN</name>
<SSIDConfig>
<SSID>
<name>DODWAN-ADHOC</name>
</SSID>
<nonBroadcast>false</nonBroadcast>
</SSIDConfig>
<connectionType>IBSS</connectionType>
<connectionMode>manual</connectionMode>
<autoSwitch>false</autoSwitch>
<MSM>
<security>
<authEncryption>
<authentication>open</authentication>
<encryption>none</encryption>
<useOneX>false</useOneX>
</authEncryption>
</security>
</MSM>
</WLANProfile>
```

We will assume that this file is saved as `dodwan-profile.xml`. You may change the SSID in this file, as far as you ensure that all the devices in your DoDWAN network share the same SSID.

B.3.2 Setting the Wi-Fi interface in ad hoc mode

The first thing to do is to identify the name of the Wi-Fi interface. This interface is named as a (long) human-readable string that is obtained with the `netsh` command:

```
> netsh wlan show interfaces
There is 1 interface on the system:
Name                   : Wireless Network Connection
Description            : Linksys WUSB600N Dual-Band Wireless-N USB Network Adapter #4
GUID                   : f87c893d-8452-4ab6-b0e2-6ed0ce0b1e60
Physical Address       : 00:1e:e5:e4:b7c:80
State                  : disconnected
```

The previously created XML profile can be associated with the Wi-Fi interface through the following command:

```
> netsh wlan add profile filename="dodwan-profile.xml" interface="Wireless Network
Connection"
Profile DODWAN is added to interface Wireless Network Connection.
```

You should then see a new entry named DODWAN (the name of the profile) in the list shown after clicking on the network icon in the status bar.

B.3.3 Connecting to the DoDWAN ad hoc network

A connection to an ad hoc network can only be done manually, unlike connections to a wireless access point for which the user may want to automatically establish a connection to, when the access point is within radio range. One can connect to the DODWAN network through the network icon in the status bar, or by using the following netsh command:

```
> netsh wlan connect DODWAN
Connection request is received successfully.
```

B.3.4 Checking that a Wi-Fi interface is configured as desired

You can use the `show interfaces` command as previously to check that the Wi-Fi interface is properly configured. Now the connection to the DODWAN network is established, this command shows more details:

```
> netsh wlan show interfaces
There is 1 interface on the system:
Name                   : Wireless Network Connection
Description            : Linksys WUSB600N Wireless-N USB Network Adapter #4
GUID                   : f87c893d-8452-4ab6-b0e2-6ed0ce0b1e60
Physical Address       : 00:1e:e5:e4:b7c:80
State                  : ad hoc network formed
SSID                   : DODWAN-ADHOC
BSSID                  : 00:22:6b:73:aa:5a
Network Type           : Ad hoc
Radio Type             : 802.11g
Authentication         : Open
Encryption             : None
Connection Mode        : Profile
Channel                : 1
Receive Rate (Mbps)    : 54
Transmit Rate (Mbps)   : 54
Signal                 : 16%
Profile                : DODWAN
```

B.3.5 Configuring the Wi-Fi interface for IP networking

Once your Wi-Fi chipset is operating in ad hoc mode, you still have to make sure it can be used for IP networking.

On Windows 7, network interfaces are enabled for IPv6 and multicast networking by default, so you should simply check the value of the IPv6 address of the interface you intend to use. For the interface mentioned above, this can be done as shown below:

```
> netsh interface ipv6 show addresses interface="Wireless Network Connection"
level=normal

Interface 12:  Wireless Network Connection

Addr Type  DAD State    Valid Life  Pref. Life  Address
---------  -----------  ----------  ----------  ------------------------
Other      Preferred    infinite    infinite    fe80::13c3:6cda:abac:a018%12
```

In this example, the interface named **`Wireless Network Connection`** has an **fe80::** link-local address as expected. This interface can therefore be used by DoDWAN without any further configuration.

Note: a network interface may have several IPv6 addresses. This is not a problem, as long as this interface has at least an fe80:: link-local address.

If the Wi-Fi interfaces are IPv6-enabled and multicast-enabled on all the hosts you plan to use, then no further configuration is required to run DoDWAN on these hosts. You can therefore try to start DoDWAN on each host. Please refer to the appropriate sections in *DoDWAN's User Manual* or *DoDWAN's Developer Manual*, depending on your needs.

B.3.6 Dealing with a host that features multiple network interfaces

DoDWAN uses a multicast group to broadcast UDP datagrams among neighbor hosts. If one of the hosts you plan to use features several network interfaces, then you need to specify which of these interfaces is to be used by DoDWAN when joining this multicast group.

To select this interface you need to specify its address in DoDWAN's **interface_address** property (see Appendix A for details on how to set DoDWAN's configuration parameters).

You also need to set a route for multicast networking, that is, a route must be established to reach the multicast group through the selected interface. Note that this command must be run with Administrator privilege (you can, for example, use the sub-menu "Run as Administrator" when you launch a Powershell for this purpose).

```
> netsh interface ipv6 add route interface="Wireless Network Connection"
ff02::236:1:2:3/128
```

Of course the interface name must be adjusted to fit your own system.

B.4 Hints and Tips

B.4.1 Warnings about ad hoc networking with Wi-Fi chipsets

Configuring a Wi-Fi ad hoc network can be quite tricky. Indeed, before going further there are a number of things you probably need to know about ad hoc networking with Wi-Fi chipsets:

1. Most Wi-Fi chipsets behave correctly in managed mode (that is, when they must associate with access points).
2. Many Wi-Fi chipsets do not behave correctly in ad hoc mode, though. Several hosts featuring different Wi-Fi chipsets (or similar chipsets but different drivers) may be unable to communicate in ad hoc mode, even if they are correctly configured for ad hoc networking.
3. Many smartphones featuring Wi-Fi chipsets simply cannot work in ad hoc mode. In some cases this is because the chipset drivers in these systems do not support ad hoc networking. In most cases, though, the reason is that smartphone vendors deliberately disable the ad hoc mode in their device. This mode can then usually be enabled by fiddling with the system.

A consequence of these observations is that if you intend to configure a number of hosts so they can chitchat in ad hoc mode, then it is recommended to first check that these hosts feature similar Wi-Fi chipsets with similar drivers, and of course that these drivers support the ad hoc mode.

If you intend to use heterogeneous hosts and Wi-Fi chipsets to constitute an ad hoc network, then please keep in mind that this is quite a challenge. Indeed, a single host with a faulty behavior may play havoc with the whole ad hoc network.

B.4.2 Switching between IPv4 and IPv6 transmissions

DoDWAN can use either an IPv4 or an IPv6 networking stack, but it uses IPv6 by default.

Using the IPv6 networking stack is recommended because network interfaces get link-local **fe80::** addresses automatically. No further configuration is therefore necessary for these interfaces.

If you need to use IPv4 networking rather than the recommended IPv6, then you will have to assign static IPv4 addresses to network interfaces manually. Do not assume your mobile hosts will get addresses from a DHCP server: there is no DHCP server in a mobile ad hoc network.

You will also need to change the following configuration properties in DoDWAN.

```
dodwan.interface_address
dodwan.local_address
dodwan.remote_address
```

Please see Appendix A for details about how to set these properties, and suggestions for generic values that can do in most circumstances.

Additionnaly, the route for sending IP packets to the DoDWAN multicast group should be set using an ipv4 address with a command such as the following one in a Linux host:

```
% sudo route add 236.1.2.3 dev wlan0
```

or this one on a Windows host:

```
> netsh interface ipv4 route add route 236.1.2.3/32 "Wireless Network Connection"
```

or this one on a Windows host:

Please note that whether you decide to use IPv4 or IPv6 transmissions, your choice must of course be consistent on all the hosts–and all instances of DoDWAN–in your network.

B.4.3 Changing the multicast group used by DoDWAN

Instances of DoDWAN running on different hosts use a single multicast group to communicate.

By default this group is an IPv6 multicast group with address **ff02::236:1:2:3**. You may of course decide to use another address, and configure all mobile hosts in your ad hoc network accordingly.

If you decide to change this address you must:

1. set the **remote_address** property in DoDWAN's configuration (see Appendix A) ;
2. ensure there is a route to reach that address in the system's routing table.

B.4.4 Changing the UDP port used by DoDWAN

Communication between instances of DoDWAN rely on the broadcast of UDP datagrams. By default UDP port #8500 is used for this purpose.

This port number can be changed by setting the **dtn_port** property in DoDWAN's configuration parameters (see Appendix A).

B.4.5 Neighbor wireless hosts fail to communicate

You may sometimes observe circumstances when two neighbor hosts do not seem to be able to communicate in ad hoc mode.

There are many reasons why such a situation should occur. First you should of course check that both hosts are configured correctly (i.e. Wi-Fi chipset settings, IP settings, etc.), and possibly try to ping one host from the other host.

It may occur that the channel used by two neigbour hosts is not the same. On Linux, you have the possibility to choose the channel when configuring the Wi-Fi interface with `iwconfig` so it shouldn't be a problem. On Windows, this parameter is not available for configuration. The system scans the differrent frequencies and adopts the channel on which it has detected a neighbor with the same SSID. When no such neighbor can be detected, the default channel is chosen. This default channel is often channel 1, so it a good idea to choose this channel if you have Windows hosts in your network. Note that some Wi-Fi chipset drivers allows a "preferred channel" to be set. This preferred channel is then chosen as the default channel.

If there is apparently no problem with the hosts' configuration, then it is worth checking that both Wi-Fi chipsets use the same BSSID. On linus thiscan be done with the following command:

```
% iwconfig wlan0 | head -2
wlan0     IEEE 802.11abgn ESSID:"DODWAN-ADHOC"
Mode:Ad-Hoc Frequency:2.412 GHz Cell:3A:E6:D4:D8:B4:58
```

In this example interface **wlan0** is configured to operate in ad hoc mode, and its current "cell" identifier (or BSSID) is **3A:E6:D4:D8:B4:58**. On Windows, the command `netsh wlan show interfaces` gives also the BSSID.

The BSSID (Basic Service Set Id), as defined by the IEEE 802.11 standard, is a value that is used as some kind of "magic cookie" by mobile hosts. Two neighbor hosts can only communicate if they use the same BSSID value.

In a Wi-Fi network operating in infrastructure mode (that is, with an access point) the BSSID is determined by the access point, so that all hosts associated with this access point adopt the BSSID it has chosen.

In a Wi-Fi network operating in ad hoc mode, however, a distributed algorithm is used to set the BSSID, but all mobile hosts are still meant to share the same BSSID. Sometimes neighbor hosts fail to adopt the same value, and although they are within radio range of one another two hosts can use different BSSID values.

When such a situation occurs there is not much you can do, except maybe ensure that all mobile hosts in your ad hoc network feature similar Wi-Fi chipsets with similar drivers (this is not a guarantee, but it usually helps...).

B.4.6 Getting rid of DoDWAN network configuration

The network configuration described above for a Linux system is not persistent, so a simple reboot of your system is sufficient for completely cancelling it. Alternatively, you can use the provided script `unset-dodwan-network.sh` (run as root).

On the contrary, on Windows 7, the configuration of the Wi-Fi interface and the multicast route are maintained even after a reboot. You can use the following commands (run with Administrator privilege, and adapted to your own Wi-Fi interface) to get rid of them. The provided Powershell script `unset-dodwan-network.ps1` (run with Administrator privilege) will normally do this job for you:

```
> netsh wlan disconnect "Wireless Network Connection"
Disconnection request is received successfully
> netsh wlan delete profile name=DODWAN
Profile "DODWAN-ADHOC" is deleted from interface "Wireless Network Connection"
> netsh interface ipv6 delete route interface="Wireless Network Connection"
ff02::236:1:2:3/128
Ok
```

B.4.7 Running DoDWAN in a wired LAN

DoDWAN is primarily meant to run in a wireless mobile ad hoc network. Yet it can also be used in a wired LAN (typically an Ethernet network), notably for testing new applications before going wireless.

Basically, you simply need to make sure that the Ethernet interface on each host has an automatically-assigned link-local IPv6 address (that is, an address with prefix fe80::), and that it is enabled for multicast networking. You may also have to adjust the multicast address, or to set a route for multicast networking as explained in the former sections.