

## CAT4OM on Linux — Installation and Operation Guide



This guide covers everything specific to running CAT4OM on Linux, including the Raspberry Pi: installing, updating, starting and stopping, running as a service, logs, network and radio audio.

How to configure groups and radios, and how to use the CAT4OM UI, is the same on every system and is described in the [CAT4OM User Manual](./UserManual.md).

### 1. What Runs on Linux

CAT4OM is made of two programs:

| Program                  | What it does                                                                             | Runs on Linux     |
|--------------------------|------------------------------------------------------------------------------------------|-------------------|
| <b>**CAT4OM Server**</b> | Connects to the radios, keeps their state, lets clients and other programs control them. | Yes               |
| <b>**CAT4OM UI**</b>     | The window you use to configure the Server and operate the radios.                       | No — Windows only |

**On Linux you install only the Server.** You install it on the Linux machine the radios are connected to, and you use the CAT4OM UI from a Windows computer on the same network. Section 10 explains how to let the Windows computer reach the Server.

Programs that talk to CAT4OM over the network — WSJT-X, a logbook, anything using TCI or Hamlib emulation — can run on the Linux machine itself or on any other computer that can reach it.

#### 1.1 Which machine and which download

| Your machine                                                     | Download the package ending in |
|------------------------------------------------------------------|--------------------------------|
| A normal 64-bit PC                                               | `linux-x64.tar.gz`             |
| Raspberry Pi 3, 4, 5 or Zero 2 W with a <b>**64-bit**</b> system | `linux-arm64.tar.gz`           |
| Raspberry Pi 2 or 3 with a <b>**32-bit**</b> system              | `linux-arm.tar.gz`             |

The **Raspberry Pi 1 and the original Pi Zero are not supported** — their processor is too old for the technology CAT4OM is built on.

Not sure which system you have? Open a terminal and type:

```
uname -m
```

x86\_64 means a 64-bit PC, aarch64 means 64-bit ARM, armv7l means 32-bit ARM.

## 1.2 Minimum system version

| Machine             | Minimum                                                                            |
|---------------------|------------------------------------------------------------------------------------|
| PC                  | Debian 12 or Ubuntu 22.04 (or a distribution based on them, such as Linux Mint 21) |
| 32-bit Raspberry Pi | Raspberry Pi OS <b>***"Bookworm"***</b> or newer                                   |

The older Raspberry Pi OS "Bullseye" is too old and CAT4OM will not start on it. This is not something CAT4OM can work around: it is a requirement of the technology the Server is built on.

To check which version you have, type:

```
cat /etc/os-release
```

and look for **bookworm** (or a newer name). If you see **bullseye**, install a fresh Raspberry Pi OS first.

## 2. Installing

### 2.1 Unpacking the package

The package is a compressed archive **without a folder of its own**: if you unpack it straight into your home folder, its files end up mixed with yours. Create a folder first, then unpack into it.

Replace the file name with the one you downloaded:

```
mkdir ~/cat4om
tar -xzf CAT4OM_0_11_0_0_linux-arm64.tar.gz -C ~/cat4om
cd ~/cat4om
chmod +x run-cat4om.sh
```

Any folder of your own will do — **~/cat4om**, **~/Applications/cat4om**, or anywhere else you can write to.

Two rules:

- the folder name must contain **no spaces**;
- it must be **yours**, not a system folder such as **/usr** or **/opt**.

The examples in this guide use **~/cat4om**.

### 2.2 What is in the folder

| File or Folder                      | What it is                                                                              |
|-------------------------------------|-----------------------------------------------------------------------------------------|
| <code>`run-cat4om.sh`</code>        | Starts CAT4OM in the terminal (section 4).                                              |
| <code>`install-service.sh`</code>   | Installs CAT4OM as a service that starts at boot (section 6).                           |
| <code>`uninstall-service.sh`</code> | Removes the service, keeping your files (section 8).                                    |
| <code>`README-LINUX.pdf`</code>     | This guide.                                                                             |
| <code>`README-LINUX.md`</code>      | This guide as plain text, readable in a terminal: <code>`less README-LINUX.md`</code> . |
| <code>`CONFIG/`</code>              | Everything that belongs to you: configuration, handbooks, logs.                         |

Inside **CONFIG**:

| File or Folder       | Location                                         |
|----------------------|--------------------------------------------------|
| Server configuration | <code>~/cat4om/CONFIG/cat4om-server.json`</code> |
| Radio handbooks      | <code>~/cat4om/CONFIG/handbooks`</code>          |
| Logs                 | <code>~/cat4om/CONFIG/log`</code>                |
| Radio wire logs      | <code>~/cat4om/CONFIG/log/RADIO`</code>          |

The configuration file is **not** in the package: CAT4OM creates it the first time it starts.

This is what lets you update by unpacking a new version over the old one without losing your settings (section 3).

The same folder is used whether you start CAT4OM by hand or run it as a service. The CAT4OM UI keeps its own configuration on the Windows computer.

### 2.3 Allowing CAT4OM to use the radio's USB cable and sound card

On Linux a normal user may not use serial ports or sound cards until they are added to two groups. Do this **once**:

```
sudo usermod -aG dialout,audio $USER
```

Then **log out and log back in** (or restart the computer). Until you do, nothing changes: the command adds you to the groups, but your current session still runs without them, and CAT4OM will fail to open the radio's port or its sound card.

*If you install CAT4OM as a service (section 6), the installer does this for you.*

### 2.4 Serial port names

In the radio settings, serial ports have Linux names instead of COM3, COM4: usually `/dev/ttyUSB0` for radios with a USB-serial chip, or `/dev/ttyACM0` for others.

To see the ports your computer has right now:

```
ls /dev/ttyUSB* /dev/ttyACM*
```

*Many radios create two ports, and only one of them carries CAT. A Yaesu FTDX-101, for example, shows up as `/dev/ttyUSB0` and `/dev/ttyUSB1`.*

*There is no way to tell them apart by name: choose one, and if the radio does not answer, choose the other. With two radios connected, the numbers simply count upwards in the order the computer found them.*

## 3. Updating to a New Version

Updating means unpacking the new package **over the same folder**. Your configuration is kept: the package does not contain a configuration file, so unpacking it cannot overwrite yours.

Handbooks are updated.

#### 1. Stop CAT4OM.

- Started by hand in a terminal: press **CTRL+C** twice (section 5).
- Installed as a service: `sudo systemctl stop cat4om` (section 7).

#### 2. Unpack the new version into the same folder:

```
tar -xzf CAT4OM_0_11_0_0_linux-arm64.tar.gz -C ~/cat4om
```

#### 3. Start CAT4OM again.

- By hand: `./run-cat4om.sh` (section 4).
- As a service: `sudo systemctl start cat4om`.

There is no need to install the service again: it keeps pointing at the same folder.

*Update the Server and the UI together. The UI on the Windows computer and the Server on Linux are released together; install both new versions at the same time.*

## 4. Starting CAT4OM

To start the Server in a terminal:

```
cd ~/cat4om
./run-cat4om.sh
```

CAT4OM prints its messages in the terminal and keeps running until you stop it (section 5).

*Closing the terminal stops CAT4OM. That includes disconnecting an SSH session. If CAT4OM must keep running when nobody is logged in, install it as a service (section 6).*

*While the service is installed, do not also start CAT4OM by hand. There can be only one CAT4OM on a computer, and the second one refuses to start. Stop the service first if you want to watch CAT4OM in a terminal.*

### 4.1 The status page

CAT4OM has a status page you can open in any browser, at the Management Port address:

```
http://localhost:17300/
```

CAT4OM opens it by itself only when the computer has a desktop with somebody in front of it.

On a Raspberry Pi without a screen, when you started CAT4OM from an SSH session, or when it runs as a service, it writes the address in the log instead. Open it from any computer on the network, replacing `localhost` with the address of the Linux machine — for example `http://192.168.1.20:17300/`.

To find the address of the Linux machine:

```
hostname -I
```

## 5. Stopping CAT4OM

To stop CAT4OM started in a terminal, press **CTRL+C twice within 5 seconds**. The first press only shows a red message:

Press CTRL+C again within 5 seconds to stop CAT4OM safely.

After the second press CAT4OM releases the transmitter on every radio, closes the radio connections and exits.

CAT4OM also stops safely — releasing the transmitter first — when:

- you close the terminal window;
- you disconnect your SSH session;
- you shut down or restart the computer with the normal commands (`sudo reboot`, `sudo shutdown`);
- another program asks it to stop (`kill CAT4OM.Service`).

In those cases it stops at once, without asking for a second **CTRL+C**.

*Pulling the plug is different. If the power goes, or the system crashes, no program can do anything, CAT4OM included.*

*Keep your radio's own transmit time-out timer enabled: it is the only protection that still works when the computer does not.*

## 6. Installing CAT4OM as a Service

If you want CAT4OM to start by itself every time the Raspberry Pi or the PC is switched on, with no screen, keyboard or login needed, install it as a **service**.

You do this **once**.

4. Stop CAT4OM if it is running in a terminal (**CTRL+C** twice).
5. Go to the CAT4OM folder and run the installer **as your normal user — do not type `sudo`**:

```
cd ~/cat4om
sh install-service.sh
```

6. When asked, type your password. The installer:
  - adds your user to the **dialout** and **audio** groups if needed;
  - creates the service **cat4om**, which runs as **your** user from **this** folder, with the same configuration you use when you start CAT4OM by hand;
  - starts CAT4OM straight away.

From now on CAT4OM starts by itself at every boot. If it stops because of a fault, the service starts it again after 10 seconds; after 5 failures within 5 minutes it gives up, so that a broken setup is not restarted forever.

### 6.1 If the installer refuses to run

The installer tells you why in plain words. Fix that one thing and run it again.

| The installer says                                | What to do                                                                               |
|---------------------------------------------------|------------------------------------------------------------------------------------------|
| run this script as your normal user, without sudo | Type `sh install-service.sh` without `sudo`. It asks for your password when it needs it. |
| the folder contains a space                       | Move CAT4OM to a folder without spaces, for example `~/cat4om`.                          |
| this script must stay in the CAT4OM folder        | Run the script from the folder you unpacked, not a copy placed elsewhere.                |
| this system does not use systemd                  | Services are not available on this system. Start CAT4OM with `./run-cat4om.sh`.          |
| the CAT4OM service is already running             | It is already installed. To update, follow section 3.                                    |
| CAT4OM is already running in a terminal           | Stop it there with `CTRL+C` twice, then run the installer again.                         |

If the installer ends with a note that you were added to new groups, the service already has them; log out and back in before starting CAT4OM by hand with **`./run-cat4om.sh`**.

### 6.2 Everyday commands

| To...                                                                            | Type                                     |
|----------------------------------------------------------------------------------|------------------------------------------|
| see whether CAT4OM is running                                                    | `systemctl status cat4om`                |
| watch its messages live (press `CTRL+C` to stop watching — CAT4OM keeps running) | `journalctl -u cat4om -f`                |
| stop CAT4OM                                                                      | `sudo systemctl stop cat4om` (section 7) |

|                                                          |                                              |
|----------------------------------------------------------|----------------------------------------------|
| start it again                                           | <code>`sudo systemctl start cat4om`</code>   |
| restart it, for example after changing something by hand | <code>`sudo systemctl restart cat4om`</code> |

## 7. Stopping the Service

```
sudo systemctl stop cat4om
```

CAT4OM releases the transmitter on every radio, closes the radio connections and exits. This can take up to a minute on a busy station; wait for the command prompt to come back.

After this command CAT4OM **stays stopped until you start it again** (`sudo systemctl start cat4om`) or **restart the computer** — the service is still installed, so it starts again at the next boot.

This is the command to use before updating (section 3), before restoring a backup (section 11), and before starting CAT4OM by hand in a terminal.

**To keep the service installed but stop it from starting at boot:**

```
sudo systemctl disable cat4om
```

`sudo systemctl enable cat4om` turns starting at boot back on.

## 8. Removing the Service

```
cd ~/cat4om
```

```
sh uninstall-service.sh
```

The script stops CAT4OM safely, removes the service and tells you when it is done. **Your CAT4OM folder, configuration and logs stay as they are**, and you can still start CAT4OM by hand with `./run-cat4om.sh`.

To remove CAT4OM completely, remove the service first, then delete the folder:

```
rm -rf ~/cat4om
```

*Deleting the folder deletes your configuration too. Back it up first if you may need it again (section 11).*

## 9. Logs

### 9.1 Where they are

|                                                               |                                |
|---------------------------------------------------------------|--------------------------------|
| <code>~/cat4om/CONFIG/log/CAT4OM_Service_YYYYMMdd.log</code>  | Server log, one file per day   |
| <code>~/cat4om/CONFIG/log/archive/</code><br>file grows large | Server log parts, when a day's |
| <code>~/cat4om/CONFIG/log/RADIO/</code><br>radio per day      | Radio wire logs, one file per  |
| <code>~/cat4om/CONFIG/log/RADIO/archive/</code>               | Radio wire log parts           |

`YYYYMMdd` is the date: `CAT4OM_Service_20260916.log` is the log of 16 September 2026.

The same files are written whether CAT4OM runs in a terminal or as a service. The UI log is on the Windows computer that runs the UI (see the User Manual).

To read today's Server log, or follow it as it is written:

```
less ~/cat4om/CONFIG/log/CAT4OM_Service_$(date +%Y%m%d).log
tail -f ~/cat4om/CONFIG/log/CAT4OM_Service_$(date +%Y%m%d).log
```

## 9.2 What they contain

- **Server log** — startup, configuration, groups, clients connecting and disconnecting, radios connecting and disconnecting, warnings and errors.
- **Radio wire logs** — the low-level CAT traffic between CAT4OM and each radio. How much is written depends on the server log level: at **warn** only connection events and errors; raise it to **debug** or **trace** to capture the full traffic in both directions.

**Everything CAT4OM knows about the Linux machine** is written in the Server log every time it starts, in lines beginning with **Linux environment:** — the system and its version, whether CAT4OM runs in a terminal or as a service, your user's groups, the sound servers running, the sound cards and the serial ports it found. You do not have to collect any of this by hand.

## 9.3 Changing the log level

The server log level is changed from the CAT4OM UI, in **Settings**. Raise it to **debug** or **trace** only while investigating a problem, and set it back afterwards: at those levels the files grow quickly.

## 9.4 How long logs are kept

- A day's Server log that grows beyond 10 MiB continues in a new file; up to five such parts are kept in **archive**. Radio wire logs do the same at 5 MiB, with up to three parts per radio.
- **Every time CAT4OM starts, logs from previous days are deleted.** Only today's files are kept.

*Keep the log before restarting.* If something went wrong yesterday and you want to send the log, copy it somewhere else, or send the report (section 9.6), **before** starting CAT4OM again. Restarting — by hand, by the service after a fault, or at the next boot — deletes it.

## 9.5 The service journal

When CAT4OM runs as a service, the messages it would print on the terminal are also kept by the system journal, independently of the log files:

| To...                              | Type                                                           |
|------------------------------------|----------------------------------------------------------------|
| watch messages live                | <code>`journalctl -u cat4om -f`</code>                         |
| see messages since the last boot   | <code>`journalctl -u cat4om -b`</code>                         |
| see messages of the previous boot  | <code>`journalctl -u cat4om -b -1`</code>                      |
| see messages since a date and time | <code>`journalctl -u cat4om --since "2026-09-16 08:00"`</code> |

The journal is kept by the system according to its own settings, so it often still holds the messages of a day whose log file has already been deleted.

## 9.6 Sending a support report

You do not need to collect log files by hand. In the CAT4OM UI on the Windows computer choose **Help** → **Report a problem**, with the UI connected to the Server. The report collects the Server configuration and logs from the Linux machine — including the **Linux environment:** lines — together with the UI's own files. Stored passwords are removed before the report is created.

# 10. Network, Ports and Firewall

## 10.1 Ports CAT4OM uses

| Port | Protocol | Used by | Needs to be open |
|------|----------|---------|------------------|
|------|----------|---------|------------------|

|                       |     |                                                                               |                                                                                                                            |
|-----------------------|-----|-------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| `17300`               | TCP | Management Port: CAT4OM UI (Server Control), status page                      | When the UI or a browser runs on another computer                                                                          |
| `17301`, `17302`, ... | TCP | Control Port of each group: CAT4OM UI (Radio Control), native clients         | One per running group, when its clients run on another computer                                                            |
| `40002` (proposed)    | TCP | TCI emulation, for example WSJT-X                                             | When that program runs on another computer                                                                                 |
| `4532` (proposed)     | TCP | Hamlib emulation, for example a logbook                                       | When that program runs on another computer                                                                                 |
| `17499`               | UDP | Discovery beacon: lets clients find the Server without an address being typed | Only if you want clients on other computers to find this Server automatically; not needed to connect by typing the address |
| `17498`               | UDP | Discovery request: a client asking "who is there?"                            | Same as above                                                                                                              |

The Control Ports and emulation ports are the ones you chose when creating the group and the emulation; the table shows the usual values.

Connections that CAT4OM makes **to** a radio on the network — an Icom radio over LAN (UDP 50001–50003) or a SunSDR over TCI (TCP 40001) — go outwards and do not need any port opened on the Linux machine.

## 10.2 Who is allowed to connect

Out of the box the Server answers the computers on your own local network and refuses everything else.

This, and how to change it, is set from the CAT4OM UI in **Settings → SERVER → Who can connect to the server** and is described in the User Manual, section "Network and Firewall Notes". The same section explains passwords.

That setting is CAT4OM's own filter. A firewall on the Linux machine is a separate layer, and both must let the connection through.

## 10.3 Firewall on the Linux machine

Many Linux systems, Raspberry Pi OS included, have no active firewall out of the box, and then nothing needs doing. To check:

```
sudo ufw status
```

- **Status: inactive**, or **ufw: command not found** — no firewall is blocking CAT4OM.
- **Status: active** — open the ports your clients use. For clients on your local network only, replace 192.168.1.0/24 with your own network:

```
sudo ufw allow from 192.168.1.0/24 to any port 17300 proto tcp
sudo ufw allow from 192.168.1.0/24 to any port 17301 proto tcp
```

Add one line for each further group Control Port and each emulation port reached from other computers.

For the discovery beacon (automatic "servers found" on other computers), open the UDP ports as well and allow the multicast group 239.255.15.18:

```
sudo ufw allow from 192.168.1.0/24 to any port 17499 proto udp
sudo ufw allow from 192.168.1.0/24 to any port 17498 proto udp
```

This is convenience only — typing the address always works whether or not the beacon reaches other computers.

On Fedora and other systems using `firewalld`:

```
sudo firewall-cmd --permanent --add-port=17300/tcp --add-port=17301/tcp
sudo firewall-cmd --reload
```

#### 10.4 Addresses to type in the clients

| The client runs on...           | Server address to use                                                   |
|---------------------------------|-------------------------------------------------------------------------|
| the Linux machine itself        | <code>`localhost`</code>                                                |
| another computer on the network | the Linux machine's address ( <code>`hostname -l`</code> ), or its name |

*Never expose CAT4OM directly to the internet. Connections are not encrypted, and anything that can reach the Server can put your radio on the air. For remote operation use a VPN.*

## 11. Backup and Restore

To back up the Server configuration, copy:

```
~/cat4om/CONFIG/cat4om-server.json
```

It contains groups, radios, ports and connection settings. If you have changed or added handbooks, copy `~/cat4om/CONFIG/handbooks` too.

To restore:

7. Stop CAT4OM (CTRL+C twice, or `sudo systemctl stop cat4om` if it runs as a service).
8. Copy the file back to the same place.
9. Start CAT4OM again.

## 12. Radio Audio on Linux

Listening to the radio through the computer, speaking through the computer's microphone and audio for other programs through emulation all work with the Server on Linux. The radio's USB sound card is chosen in the radio's audio settings exactly as on Windows. A TCI radio (for example a SunSDR) needs no sound card at all: its received audio comes through the TCI connection, so it works on Linux wherever the radio's own program runs. Four things are specific to Linux.

### 12.1 Your user must be allowed to use sound cards

Do this **once**:

```
sudo usermod -aG audio $USER
```

Then **log out and log back in** (or restart). If you installed CAT4OM as a service, `install-service.sh` has already done this for you.

### 12.2 On a Linux desktop, the desktop may be holding the radio's sound card

Raspberry Pi OS *Lite* and other systems without a desktop have nothing to do here. On a desktop (Raspberry Pi OS with desktop, Ubuntu, Linux Mint, Fedora...) the desktop's own sound system can take the radio's sound card for itself. CAT4OM then tells you **"Radio sound card busy"**. Tell the desktop to leave that card alone:

- **With the mouse:** open **PulseAudio Volume Control** (install it with `sudo apt install pavucontrol` if it is not in the menu), go to the **Configuration** tab, find the radio's card — usually called *USB Audio CODEC* — and set its **Profile** to **Off**.

- **From a terminal:** list the cards, find the radio's one, and switch it off:

```
pactl list cards short
```

```
pactl set-card-profile alsa_card.usb-Burr-Brown_from_TI_USB_Audio_CODEC-00 off
```

Use the name your own list shows; the one above is only an example.

The setting is remembered. The desktop's own speakers keep working, because they are a different card.

### 12.3 Better audio conversion (optional)

Most programs ask for audio at 48000 Hz, which radios provide directly, and nothing needs converting. If a program asks for a different rate, Linux converts it, and the CAT4OM log says so. For the best quality of that conversion install:

```
sudo apt install libasound2-plugins
```

(on Fedora: `sudo dnf install alsa-plugins-speex`).

### 12.4 If audio is not available at all

The Linux sound library is missing (this happens on very minimal installations). Install it and restart CAT4OM:

```
sudo apt install libasound2
```

(on the newest Debian and Ubuntu the package is called `libasound2t64`).

### 12.5 Two identical radios

Their sound cards have the same name in the list. The first time you configure them, connect **one radio at a time**, so you know which card belongs to which radio. After that CAT4OM recognises each card by the USB socket it is plugged into: keep each radio on its own socket.

## 13. If Something Does Not Work

Start from the log (section 9): CAT4OM writes there what it found and why something failed. When you ask for help, send the report from **Help → Report a problem** (section 9.6).

| What you see                                                          | What it means, and what to do                                                                                                                     |
|-----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CAT4OM does not start on a 32-bit Raspberry Pi</b>                 | The system is too old. Check section 1.2.                                                                                                         |
| <b>The radio's serial port is not in the list, or does not open</b>   | You are not in the `dialout` group, or you have not logged out and back in since adding yourself. See section 2.3.                                |
| <b>The radio does not answer on the port you chose</b>                | Many radios create two ports. Try the other one (section 2.4). Also check that the speed in CAT4OM matches the CAT speed set in the radio's menu. |
| <b>"Radio sound card busy"</b>                                        | The desktop's sound system has taken the radio's card. Set that card's profile to Off (section 12.2).                                             |
| <b>"No permission to use the radio sound card"</b>                    | You are not in the `audio` group, or you have not logged out and back in (section 12.1).                                                          |
| <b>"Radio sound card not found"</b>                                   | The radio is off, or its USB cable is unplugged.                                                                                                  |
| <b>Audio is not available at all</b>                                  | The `libasound2` package is missing (section 12.4).                                                                                               |
| <b>You press Listen, everything looks right, but you hear nothing</b> | Check the obvious first: the radio is switched on and its volume is up. Then, on the Windows computer, open                                       |

|                                                        |                                                                                                                                                                                                                                                  |
|--------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                        | <b>**Settings → AUDIO**</b> in the UI and make sure the output device is one you are actually listening to.                                                                                                                                      |
| <b>The status page does not open by itself</b>         | That is deliberate when the computer has no desktop, when you started CAT4OM over SSH, or when it runs as a service. Open it from another computer (section 4.1).                                                                                |
| <b>CAT4OM stops when you close SSH</b>                 | That is how a program started in a terminal behaves. Install it as a service (section 6).                                                                                                                                                        |
| <b>A second CAT4OM refuses to start</b>                | One is already running — in another terminal, or as the service. Check with <code>`systemctl status cat4om`</code> .                                                                                                                             |
| <b>The UI on the Windows computer cannot connect</b>   | Check, in order: CAT4OM is running; you typed the Linux machine's address, not <code>`localhost`</code> ; the Linux firewall lets the port through (section 10.3); <b>**Who can connect to the server**</b> allows your computer (section 10.2). |
| <b>The service keeps restarting, then stops trying</b> | CAT4OM fails at every start. Read why with <code>`journalctl -u cat4om -b`</code> , fix the cause, then <code>`sudo systemctl reset-failed cat4om`</code> and <code>`sudo systemctl start cat4om`</code> .                                       |