HERMES - High-frequency Emergency and Rural Multimedia Exchange System Software Description

Rafael Diniz
rafael@rhizomatica.org
Rhizomatica
Brasília - Brasil

May 14, 2020

Abstract

This document contains the description of the software stack of the HERMES system - a digital communication system for the HF band which uses ARDOP (Amateur Radio Digital Open Protocol) modem and UUCP networking (Unix to Unix Communication Protocol). Apart of ARDOP and UUCP, HERMES is composed by a Web Interface for access to the services it provides and it can be run on almost any mini-computer.

Contents

1 Reference system

- HF transceiver connected to a computer with audio I/O and ptt control (see Equipment list document)
- Mini computer running Linux (and the software stack described by this document) connected to the HF transceiver and other networks (eg. WiFi, GSM, LTE)

2 What HERMES can do

HERMES is as a system to be used with HF transceivers for digital communication. HERMES is meant to work with HF NVIS (near vertical incidence skywave) and provide hundreds of kilometers of reach for each station.

The modem we currently use (ARDOP) supports both point-to-point mode (ARQ mode - Automatic repeat request) and broadcast mode (FEC mode - Forward Error Correction). We only use the ARQ mode, which guarantees the error-free reception of the data. Broadcast mode could be used, but using a protocol different than UUCP.

We adopted UUCP as networking solution to be carried over the ARDOP modem in ARQ mode. UUCP can carry files and execute remote commands. Specific support for email exists and can be used out-of-the-box to provide email service over HF (UUCP was created in the late 70's and one of the main uses was email).

In the more basic configuration, HERMES is used for file exchange, with the option for secure (through cryptography) exchange of files.

3 HERMES software configuration

HERMES uses ARDOP (Amateur Radio Digital Open Protocol) for modem. ARDOP is a SDR (software defined radio) modem made by amateur radio operators which use modern modulation techniques (OFDM) and have support for standard and homebrew HF transceivers.

For the network layer, UUCP is used. UUCP is a system for asynchronous store-and-forward communication first released in the Bell Labs Unix V7 in the late 70's, and still used today in niches, like communication over HF.

To integrate the UUCP system with the ARDOP modem, the RHIZO-UUArdopD project was developed to provide tools that integrate UUCP to ARDOP.

A mini-computer running Linux is needed. We recommend Debian Buster (10) arm64 (multilib with armhf in case you want to use the pre-compiled " piardopc " by John Wiseman) as Linux reference system, running on a Raspberry Pi with Wifi configured in AP (Access Point) mode, for serving the system web interface.

We split HERMES network stack in the following items:

- Computer to Radio connection
- ALSA (Audio configuration)
- ARDOP (Modem configuration)
- UUCP (Network configuration)
- Rhizo-UUArdopD (UUCP / ARDOP connection tools)
- User Web Interface

3.1 Computer to Radio connection

Different setups require different configuration. In the case of using a USB (Universal Serial Bus) interface (eg. Signalink), the delay setting must be set to 0. In the case of radios with USB connection exposed an embedded sound card and transmit/receive control (eg. ICOM IC-7100) leave the bandpass filter at least 2.8kHz (or wider) for the digital operation (SSB/Data).

3.2 ALSA (Audio configuration)

Add to "/etc/asound.conf":

```
pcm.ARDOP {type rate slave {pcm "hw:1,0" rate 48000}}
```

Where "hw:1,0" is the HF transceiver's audio device.

3.3 ARDOP (Modem configuration)

Dowload link: https://github.com/DigitalHERMES/ardopc

The ardop binary should be in /usr/bin/ardop, which can be a symbolic link to /usr/bin/ardop1ofdm, ardop2, ardopofdm.

ARDOP service file for the ICOM IC-7100 (USB connection, PTT done over serial):

```
[Unit]
Description=ARDOP daemon

[Service]
Type=simple
ExecStart=/usr/bin/ardop 8515 -c /dev/ttyUSB0 ARDOP ARDOP -k FEFE88E01C0001FD -u FEFE88E01C0000F
ExecStop=/usr/bin/killall -s QUIT ardop
IgnoreSIGPIPE=no
#StandardOutput=null
#StandardError=null
StandardOutput=syslog
StandardError=syslog

[Install]
WantedBy=multi-user.target
```

Service file when using a VOX based setup (eg. when using an interface like the Signalink):

```
[Unit]
Description=ARDOP daemon

[Service]
Type=simple
ExecStart=/usr/bin/ardop 8515 ARDOP ARDOP
```

```
ExecStop=/usr/bin/killall -s QUIT ardop
IgnoreSIGPIPE=no
#StandardOutput=null
#StandardError=null
StandardOutput=syslog
StandardError=syslog

[Install]
WantedBy=multi-user.target
```

Start/stop ARDOP service:

```
systemctl start ardop.service
systemctl stop ardop.service
```

See the log:

```
journalctl -f -u ardop
```

3.4 UUCP (Network configuration)

UUCP debian package version 1.07-27 or higher should be used, for example, the version from Debian Bullseye (11): https://packages.debian.org/bullseye/uucp.

UUCP command line examples follow. In order to copy a file to a remote host, the following command adds a copy job to the uucp queue ("-r" is used for not start transmission after queuing):

```
uucp -C -r -d source.xxx AM4AAB\!/var/www/html/arquivos/${nodename}/
```

To trigger the transmission of all queued jobs for host AM4AAA:

```
uucico -S AM4AAA
```

To list the jobs:

```
uustat -a
```

To kill a job:

```
uustat -k job
uustat -K
```

See the log:

```
uulog
```

3.5 Rhizo-uuardopd (UUCP / ARDOP connection tools)

Two binaries should be installed: uuport (to be called by uucp) and uuardopd which is the daemon software which connects to the ARDOP modem for starting / stopping connection. Rhizo-uuardopd and manages the connection with UUCP through uucico or uuport.

Download link: http://github.com/DigitalHERMES/rhizo-uuardop

Start/stop UUARDOPD service:

```
systemctl start uuardopd.service
systemctl stop uuardopd.service
```

See the log:

```
journalctl -f -u uuardopd
```

3.6 User Web Interface

HERMES provides an interface for file exchange is web-based, using HTML + PHP and some shell scripts located in "gui" directory of Rhizo-Uuardopd source code (https://github.com/DigitalHERMES/rhizo-uuardop/tree/master/gui). Current implementation supports symmetric cryptography and image compression.

We use "/var/www/html/arquivos" as default UUCP path to send files through the web interface.

Requirements of the user interface:

- ImageMagic: for image manipulation
- mozjpeg: Best public JPEG encoder: https://github.com/mozilla/mozjpeg
- GnuPG: For cryptography
- hostapd: Wifi AP mode software

The Web interface can be accessed by typing any address in a browser connected to the wifi (set the DNS accordingly) or simply 192.168.1.1.