**INSTRUCTIONS FOR NIS BIFROST**
*Nick Hughes, 2016-v-15*

For IAW5 the Norwegian Ice Service QGIS-based system Bifrost is supplied as two virtual computers.

## 1. Preparation

Two (free) software packages are required to be installed on your computer. These are as follows:

- Vagrant by Hashicorp (https://www.vagrantup.com/)
- VirtualBox by Oracle (https://www.virtualbox.org/)

On Linux Ubuntu-based systems these can be installed from the standard repositories. Installation files for Windows and Mac can be downloaded from the respective web pages.

Vagrant provides a mechanism for unpacking and running a virtual computer machine 'box'. VirtualBox provides the infrastructure for interacting with the virtual computer and linking it to the physical components of the host computer.

Bifrost is based on the 64-bit Ubuntu-based lightweight Lubuntu distribution (http://lubuntu.net/). Running this within virtual boxes allows all users to have the same set up, regardless of whether their host computer runs Windows, Mac or Linux.

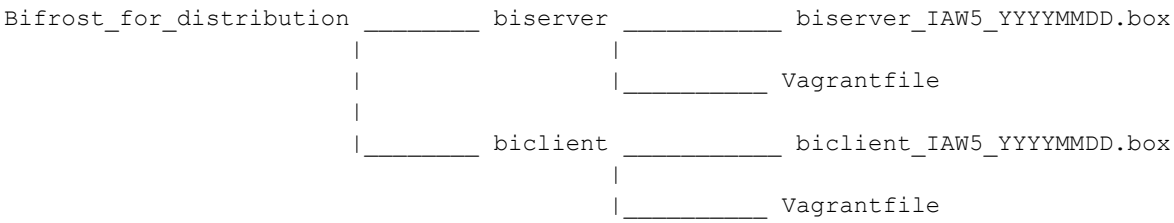
## 2. Network

For IAW5 we have set the Biforst system to use a wireless network isolated from the main National Ice Center networks and the internet. To connect use:

SSID: IAW5
Passcode: antarctica

This allocates the virtual boxes IP addresses in the range 192.168.2.2 - 192.168.2.98. The Bifrost server computer has a fixed IP address of 192.168.2.99.

## 3. Bifrost files




The installation files for Bifrost come as separate server and client box- and Vagrant- files. For the exercise, the client files should be copied to the host computer.

***The Bifrost server and client are set up to take a maximum of ~50 GB disk space each. However the actual amount used depends on how much satellite data and files are created. Additionally, a minimum of 2 GB memory is advised, as the client machine will take 1 GB. More is required (about 4 GB) if both the server and client are running on the same host computer.***

### 4. Unpacking and running/stopping the virtual box

On Windows and Linux, the virtual box can be unpacked and run by the following steps:

- Open a terminal window (Linux) or Power Shell (Windows).
- Change the current directory to the location of the box- and Vagrant- files.
- Run Vagrant by typing the following,
    - Linux: `vagrant up`
    - Windows: `C:\Hashicorp\Vagrant\bin\vagrant.exe up`
    - Mac: ?

The first time this is done, this can take some time as the installation file has to be unpacked and the virtual machine set up within VirtualBox. Subsequent starts are quicker, as only the virtual machine has to be started.

Leave the terminal window or Power Shell running.

To shutdown the virtual machine:

- Use Vagrant to shutdown by typing the following,
    - Linux: `vagrant halt`
    - Windows: `C:\Hashicorp\Vagrant\bin\vagrant.exe halt`
    - Mac: ?

### 5. Using the virtual machine

The virtual boxes are supplied with the GUI turned on, and running `vagrant up` will open a window showing the virtual computer desktop.. This behaviour can be changed by altering `vb.gui = true` to `vb.gui = false` in the Vagrantfile, in which case the virtual machine can be accessed by typing `vagrant ssh`.

The GUI has the same characteristics and menus as a standard VirtualBox window. This can be maximised to a full-screen, or changed to a seamless mode in which the desktop window disappears and the application windows appear on the host computer desktop. When changing to these modes, VirtualBox will advise as to the key combination to return to a windowed display. Currently this is set as Alt-F.

Bifrost is supplied with a number of user accounts set up. The passwords for these are the same as the usernames, which are:

| | |
|---|---|
| *vagrant* | Standard account used for vagrant boxes. |
| *bifrostadmin* | Account used for database administration and support database processing. |
| *bifrostsat* | Account used for satellite data processing. |
| *bifrostanalyst* | Account used for ice charting. |

## 6. Ice charting with Bifrost

Ice charting is done on the biclient virtual machine. This has to be able to access a biserver virtual machine to initialise an ice chart, access satellite data, and send the finished ice chart data to production.

### a) Initialising an ice chart

Login as bifrostanalyst and open a terminal window (Click on the *Start* button in the bottom-left of the screen and select *Accessories* followed by *LXTerminal*). Type cd Python/Bifrost to change to the Python scripts directory (`/home/bifrostanalyst/Python/Bifrost`). An ice chart is started by:

```
python 01_startup.py -d YYYYMMDD -t HH REGION CHART_TYPE
```

`YYYYMMDD` is the ice chart date, `HH` is the hour the ice chart is valid for, `REGION` is either *arctic* or *antarctic*, and `CHART_TYPE` is a one-character code; *P* = Production, *T* = Training, and *C* = Collaborative. The chart type affects how many analysts are allowed to work on an ice chart for a specific date and hour. There can be only one production chart for either Arctic or Antarctic, whereas training and collaborative charts can have multiple analysts.

The script creates local ice chart files in the directory `/home/bifrostanalyst/ICS/YYYYMMDD_HH_RRR` and adds an entry to the database on the biserver virtual machine.

### b) Copying satellite data

Satellite images are copied to a LiveData directory (`/home/bifrostanalyst/LiveData`) on the biclient virtual machine using the following command:

```
python 02_livedata.py
```

Although options can be specified, the script will check the database on the biserver virtual machine and determine which files to download. The script will copy AMSR2, MODIS and Sentinel-1 data from the biserver computer. Running this script (typically automatically) between 23:00 and 00:00 will clean up the LiveData directory.

Satellite images can also be copied from the `/mnt/bifrostsat/Data` directory.

### c) Running QGIS

Bifrost can be started by clicking on the *Start* button in the bottom-left corner of the screen, and selecting *Education* followed by *QGIS Desktop*. The ice chart project file can be found in the directory created in Step 6a.

### d) Checking ice chart validity

During the course of drawing the ice chart certain undesirable features can be generated by editing. These include self-intersections of polygons and duplicate edge points. There is another python script that can run as often as needed, but typically during the final stages of checking the ice chart, that alerts the analyst to these and provides an indication as to where on the ice chart these occur:

```
python 03_validate.py
```

e) Finishing the ice chart

Once the ice chart has been successfully validated, then the data can be sent to the database to start production of output files and dissemination. This is done using the script:

```
python 04_finish.py
```

This is typically “fire-and-forget”, the data is uploaded to the server and automatic routines take over.

f) Checking production status

The intention for Bifrost is to create an Ice Analysts Clock application that can be shown on the Desktop and provide information on what files have been produced and disseminated. This can be run by:

```
python 05_prodcheck.py
```

This provides a text output listing the different production routines and whether these have completed.

g) Archiving and cleaning up the ICS directory

After a number of ice charts have been produced, it may be necessary to clean up old ice charts from the ICS directory. This is done by running a script that creates a compressed archive file and uploads it to an archive folder on the server computer.

```
python 06_cleancache.py
```

The scripts here are copies of those used on the operational ice charting system of the Norwegian Ice Service. On this version of Bifrost they are very much work in progress and there may be some bugs or things that do not work as expected. The intention with Bifrost is to develop these into icons that can be integrated into the QGIS menu system.