Various Techniques Cookbooks

The Various Techniques Cookbooks provide miscellaneous examples of how to perform various network configuration tasks. Each is a set of step-by-step instructions intended to help build your familiarity with network configuration in Linux and Windows.

Please contact us at support@candela-tech.com if you have any questions.

All Network Configuration Cookbook Examples

1. Configure Auxiliary Management
2. Find Windows IP Addresses
3. Find Windows MAC Addresses
4. Custom DOS Window Settings
5. Quickly Inspect Your DOS PATH Variable
6. Connecting with PuTTY
7. Install Arduino Mega Driver on Windows XP
8. Install Arduino Mega Driver on Windows 7
9. Install Arduino Mega Driver on Windows 10
10. Connect to LANforge Using Remote Desktop
11. Connect to LANforge Using VNC Viewer
12. Display WireShark Using Cygwin
13. Finding Report Data
14. Writing Disk Images on Windows
15. Adding a LANforge Virtual Machine
16. Configuring Serial Connection to LANforge
17. Connecting SMA Cables to LANforge
18. Diagnose GUI Problems on Windows
19. Recovering Filesystems
20. Automatically start LANforge GUI on login
21. LANforge Troubleshooting
Configure Auxiliary Management Interfaces

Goal: Allow LANforge to create its own wireless management network.

In cases where is is not convenient to use an existing management network, LANforge WiFi systems can be configured to provide their own WiFi management network. This may be especially useful when testing in environments where LANforge needs to be moved around or where you have no good access to existing management LANs. This example assumes that you already know how to create and configure VAP and Stations in LANforge.

1. Configure LANforge for Auxiliary Management.
   A. Connect LANforge systems through the normal management LAN for initial configuration. The resources should be visible in the management tab.
B. In this case, we are using wiphy0 for the Aux-Mgt interfaces. On the manager system, configure wiphy0 to be on the desired channel, create a virtual AP on wiphy0, and configure it appropriately. The **Aux-Mgt** checkbox should be selected, a static IP should be assigned, and an appropriate SSID configured. The AP Aux-Mgt port will automatically serve DHCP and will try to NAT and route packets to the wired Management interface.
C. On the other resources, configure the wlanX interface to connect to the AP on the manager system, and select the **Aux-Mgt** checkbox.

D. The Port-Mgr tab should look something like this when the Aux-Management interfaces are configured.
E. To test that it works properly, you can now remove the wired Management port connection and wait about 1 minute for the old connection to time out and re-connect to the Auxiliary Management port. Or, just reboot systems with the wired ports unplugged and they should be discovered on the Aux-Mgt ports promptly.

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**Windows IP Addresses**

**Goal:** Find and change network ip addresses on Microsoft Windows.

Here are some techniques for finding and setting IP addresses on Microsoft Windows using the Control Panel and the command line.

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1. Find the IP Address of the Windows PC. There are two methods you can use:
   - A. Using the Control Panel:
     - A. Click Start, Run, `control`, [enter]
B. Search and select Network Status and Devices

C. We click on our device, **Ethernet 3**:
D. Find and/or set the IP address: from Status, click Properties

E. double click TCP/IPv4
F. you will see and can change the IP address:

![Internet Protocol Version 4 (TCP/IPv4) Properties](image)

B. Various DOS commands to find the IP addresses on the system:
   A. `ipconfig` and `ipconfig /all`
   B. `netsh interface ipv4 show address`

C. Resetting your DHCP address via command line:
   A. `ipconfig /release`
   B. `ipconfig /renew`

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**Windows MAC Addresses**

**Goal: Find MAC Addresses in Microsoft Windows.**

Here are some techniques for finding MAC addresses on Microsoft Windows using the Control Panel and the command line.

1. Find the MAC Address of the Windows PC. There are two methods you can use:
   A. **Method 1:** use the Control Panel
A. Click Start, Run, control, [enter]

B. Search and select Network Status and Devices

C. We click on our device, Ethernet 3:
D. Click Details...

![Ethernet 3 Status]

E. Details will show the MAC address (physical address):

![Network Connection Details]

F. [Suggested] Set the IP address if you have not already. For more information see Finding Windows IP Address

B. Method 2: use the DOS command-line. You want to correlate the IP address and MAC address of the Windows ethernet port:
A. Click Start, Run, and type `cmd`, and press [Enter]

![Image of Run dialog box with `cmd` entered]

B. Show interfaces by name with the command: `netsh interface ipv4 show addresses`

```
NETSH INTERFACE SHOW ADDRESSES
```

C. (Optional) if you do not see results, you might need to start the network autodiscovery service:

```
net start dot3svc
```

![Image of command output showing network configurations]
D. (Optional) Depending on the edition of Windows, the command `netsh lan show interfaces` will display MAC addresses.

E. Show MAC addresses with: `getmac /v /fo csv`

(The CSV formatted command of the command ensures that we will see the entire name of the interface which can be trimmed short in the default output format.)

F. These commands will make it easier to copy using `notepad`:

```
netsh interface ipv4 addresses > ifnotes.txt
getmac /v /fo csv >> ifnotes.txt
notepad ifnotes.txt
```
Customizing DOS Window Settings

**Goal:** Make your DOS windows large and do cut and paste easier.

Here we review DOS window settings that will help you to work faster.

1. Customizing DOS Window Settings starts by right clicking the **Start Menu**
2. Type in `cmd` and hit **Enter**
3. To get to your DOS window faster, you can pin it to your task bar. Right click the task bar CMD window icon and select **Pin this program to taskbar**

4. On the DOS window title bar, Right click and select the **Defaults** menu item
5. Select the Quick Edit Mode setting. This allows you to highlight text in the window easily.

6. In the Font tab, select a slimmer TrueType font, like Consolas or Lucida Console, and set the font size to 10.
7. In the Layout tab, change the Window Size to 132 columns and 56 rows.

8. Click OK to save. The next DOS window you open will appear with your customized settings.
Quickly Inspect Your DOS Path

**Goal:** Find if a program or is in your %PATH%

Use this technique to inspect your DOS environment variables for specific strings using `findstr`.

1. Follow this example to see if perl is installed and your %PATH% environment variables is updated. First, open up a DOS window: `Windows + R` `cmd` `Enter`

2. Type in the DOS Window: `echo %PATH% | findstr /i perl` `Enter`

3. If perl is installed correctly, you should have it in your path.

4. You can also use this technique to find any environment variable. E.G., find if you have a temporary directory set:

   `set | findstr /i temp`
Connecting with PuTTY

Goal: Using PuTTY on Windows to connect to LANforge Linux servers.

Lots of tasks, like scripting, can be done over SSH from your Windows desktop. Here are a few steps to help you customize your PuTTY terminal to work faster.

1. Configuring a PuTTY Session

   A. When you double-click on the PuTTY icon and it launches, you can start customizing your session preferences. We’ll name this session jedtest
B. Let's default the window to something large, like 120 columns and 56 rows.

C. The Fixed font can be replaced with the Consolas font.
D. Let's turn on TCP Keep-alive and set IPv4 as the default networking protocol.

E. We login to LANforge resources with user lanforge.
F. Generating a SSH keypair is not difficult. Let’s enter the path to our public key file.

G. We have done our PuTTY config. Now back to the top Session screen, and click Save

2. Configure Pagent with your public key
   A. Create your own public ssh key. For more information see WinScp Net
   B. Start Pagent. Configure it to load on startup.
C. In the System Tray you will see the Pagent icon.

D. **Right-click** the Pagent icon and click **Add Key** to select your key.

E. You will need to provide your pass-phrase to load your key.
F. We see a loaded key.

G. Here is our key, we will view the .pub file to copy out the public key.

H. In a putty window you will log into your LANforge server and edit /home/lanforge/.ssh/authorized_keys.

I. Copy the text and place the "Comment" section at the end when you paste it into your ssh.
K. Check the permissions of the `authorized_keys` file. You might need to use the command

```
chmod 600 authorized_keys
```

to correct the permissions.

L. The next time we load the jedtest PuTTY session we should not be prompted for our password.

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**Installing the Arduino Mega Driver on Windows XP**

**Goal: Installing the Arduino Mega device driver on Windows XP.**

The automatic driver install process for Windows XP might automatically install a Microsoft Windows version of the Arduino Mega driver. This is not the driver LANforge expects. These instructions will guide you how through uninstalling an old driver and installing the new driver.

---

1. Follow the link to the Arduino project to download the latest driver: Download Arduino IDE For more information see Installing LANforge Server on Windows

2. Download the Arduino IDE zip file to your desktop. Use **Right-click → Extract All...** to expand the contents to a folder on your desktop.
3. Connect USB cable from the Attenuator to the PC

4. Click Start→Control Panel and choose the Add Hardware option.

5. In the hardware list page, select Add a new hardware device, and click Next.
6. Select the Install the hardware that I manually select option, and click Next.
7. Select the Ports (COM & LPT) option, and click Next.

8. Select [Standard port types] option, then Communications Port and then click Have Disk...

9. Click Browse
10. Navigate to your Desktop\arduino-1.8.9\drivers folder, and click Open

11. Click Next

12. Click Next
13. Click **Continue Anyway**

14. Click **Finish**

15. You should not need to reboot your system in order to run the Attenuator

16. For LANforge to recognize the new attenuator, restart the LANforge server on the machine that has the attenuator connected. On Windows, close the LANforge server CMD windows and then restart LANforge with using your
Installing the Arduino Mega Driver on Windows 7

**Goal:** Installing the the Arduino Mega device driver on Windows 7.

LANforge CT70x attenuators require recently signed Arduino drivers. The automatic driver install process for Windows 7 might automatically install a Microsoft Windows version of the Arduino Mega driver. This is not the driver LANforge expects. These instructions will guide you how through uninstalling an old driver and installing the new driver from the Arduino website.

1. If you have recently removed a driver, you might need to reboot your Windows system for it to complete the driver installation process.

1. You want to install the windows version of the LANforge Server beforehand. For more information see [Installing LANforge Server on Windows](#).
2. Follow the link to the Arduino project to download the latest driver: [Download Arduino IDE](#).

3. Download the Arduino IDE zip file to your desktop. Use **Right-click→Extract All...** to expand the contents to a folder on your desktop.
4. This process requires you to operate the Control Panel as Administrator. Some patch-levels of Windows 7 have secured this. A useful work around for this will be discussed shortly.

5. Getting to the **Device Manager**
   
   A. In Control Panel, select **Hardware and Sound**
B. Select **Device Manager**
C. In the Device Manager window, right-click on the computer and select **Scan for hardware changes**.

A. There will be an **Other devices—Unknown Device** entry. Right-click on it. If the options menu only gives you either **Scan for hardware changes** or **Properties**, you might need to restart your control panel as Administrator, that is discussed next.

B. **Using the Run as Administrator option to start the Control Panel in administrator mode.**

   I. This works best with a **CMD** window pinned to the task bar. You can do that using Start Menu→ **cmd [ENTER]**; and then right-click→ **Pin to Task Bar** option on the task bar icon for the cmd.exe window.

   II. Then right-click→ **Run as Administrator** on the **CMD** taskbar icon.

   III. Repeat your navigation steps to get to the **Device Manager**.

6. **Uninstall Old Driver**

   If you find a previously installed driver, uninstall it. Especially if this is labeled **Windows Arduino Mega**
A. Right-click → **Uninstall**

![Uninstall dialog box showing the option to unselect a driver](image1.png)

B. Select Delete the driver software for this device, and click **OK**

![Confirm Device Uninstall dialog box](image2.png)

C. Right-click on the computer, and select **Scan for Hardware Changes**

D. You might need to unplug and plug-in your Attenuator.

E. If the right-click options menu does not allow you to change drivers, reboot your system.

7. **Install new driver**
   
   Select **Browse my computer for driver software**

   A. Browse to **Desktop\arduino-1.8.9\drivers** and click **Next**

![Browse for Folder dialog box](image3.png)
8. You should not need to reboot your system in order to run the Attenuator.

**Installing the Arduino Mega Driver on Windows 10**

**Goal:** Installing the Arduino Mega device driver on Windows 10.

LANforge CT70x attenuators require recently signed Arduino drivers. The automatic driver install process for Windows 10 might automatically install a Microsoft Windows version of the Arduino Mega driver. This is not the driver LANforge expects. These instructions will guide you how through uninstalling an old driver and installing the new driver from the Arduino website.

1. If you have recently removed a driver, you might need to reboot your Windows system for it to complete the driver installation process.

1. You want to install the windows version of the LANforge Server beforehand. For more information see Installing LANforge Server on Windows

2. Follow the link to the Arduino project to download the latest driver :Download Arduino IDE
3. Download the Arduino IDE zip file to your desktop. Use **Right-click → Extract All...** to expand the contents to a folder on your desktop.

4. This process requires you to operate the Control Panel as Administrator.

5. **Getting to the Device Manager**
   - Type **Control-F** for Find
B. Search for Device

C. Select **Device Manager**
6. If you find a previously installed driver, uninstall it. Especially if this is labeled **Windows Arduino Mega**

A. Right-click → **Uninstall**
B. Select Delete the driver software for this device, and click **OK**

C. Right-click on the computer, and select **Scan for Hardware Changes**

D. You might need to un-plug and plug-in your Attenuator.

E. If the right-click options menu does not allow you to change drivers, reboot your system.

7. **Install the Arduino IDE Driver**

   A. In **Device Manager**, you want right-click on the **Unknown Device** and select **Update Driver Software**...

B. Select **Browse my computer for driver software**:
How do you want to search for drivers?

→ Search automatically for updated driver software
Windows will search your computer and the Internet for the latest driver software for your device, unless you’ve disabled this feature in your device installation settings.

→ Browse my computer for driver software
Locate and install driver software manually.

A. Browse to Desktop\arduino-1.8.9\drivers and click OK
B. Click **Next**

Browse for drivers on your computer

Search for drivers in this location:

```
C:\Users\reyolds\Desktop\arduino-1.8.9\drivers
```

- Include subfolders

→ Let me pick from a list of available drivers on my computer
This list will show available drivers compatible with the device, and all drivers in the same category as the device.

C. You will see the Update Driver Software confirmation. Click **Close**.

Update Drivers - Arduino Mega 2560 (COM4)

Windows has successfully updated your drivers

Windows has finished installing the drivers for this device:

Arduino Mega 2560

C. You should not need to reboot your system in order to run the Attenuator.
Connect to LANforge using Remote Desktop

Goal: Operate your LANforge's Linux desktop by accessing it with Windows Remote Desktop utility.

LANforge computers on Intel hardware are typically installed with a full Linux desktop. You can use the LANforge GUI, do traffic sniffing, open terminal windows, and office software to look at report data over remote desktop. LANforge computers are pre-configured with RDP and VNC desktop services.

1. From your Windows Start Menu, type "remote" and Remote Desktop Connection should be an option.

2. If you are using the Start-Run menu, type mstsc Enter
3. If you want to create a desktop shortcut, explore the folder C:\windows\system32 and right-click `mstsc.exe`

4. Configure your connection:
   
   A. Fedora version 24 and 25 have a bug in the vncserver triggered by xrdp. The effective way to use rdesktop on those systems is to select an Xorg session for connecting (not a Xvnc session).

   B. When connecting to Fedora 14-23 systems:
      
      A. User Name: `lanforge`

      B. You will not need to fill out the xrdp login screen.

   C. When connecting to Fedora 24-25 systems:
A. Do not specify a user name, and select Always ask for credentials.

B. Select Xorg as the session type.
C. Specify username lanforge and password lanforge

D. Local Resources

A. If your rdesktop session immediately closes, you might have hit the xrdp clipboard bug. If so:
B. For Windows Remote Desktop (mstsc.exe): unselect Local Devices→Clipboards
C. For Linux rdesktop, use the command: rdesktop -a16 -r cliboard:off -u lanforge [machine-name]
E. Disable remote audio settings

F. Disable local printers
G. Set Server authentication to **Connect and do not warn**

H. Connection quality can be 16-bit (millions of colors)

5. Click **Connect** to connect to the default desktop, the default password is **lanforge**

6. When you are DONE with your connection, you may close the Remote Desktop window. You will not be logged out. However, if you log in without setting the Username option, you will be logged into a new session alongside your old session. If you see this screen below, you are starting a new desktop session:
7. To reconnect to your previous desktop session, make sure you use the Username `lanforge` in your connection settings.

8. To logout of the desktop session, select `System→Log Out` from the top window of the Linux desktop.
Connect to LANforge using VNC Viewer

Goal: Operate your LANforge's Linux desktop by accessing it with the VNC Viewer utility.

LANforge computers on Intel hardware are typically installed with a full Linux desktop. You can use the LANforge GUI, do traffic sniffing, open terminal windows, and office software using a VNC Viewer program. LANforge computers are pre-configured with RDP and VNC desktop services.

1. You can download a variety of viewers:
Links to Windows Utilities

- **PuTTY (putty.exe)**
  PuTTY is a free SSH, Telnet and serial terminal client for remote access. The main advantage its low-bandwidth requirement. PuTTY can also be used for telnet and serial terminal connections.

- **Remote Desktop**
  LANforge comes installed running **xrdp** service which you can connect to using Windows Remote Desktop. Because the normal Windows certificates are not present on Linux, you might have to adjust your connection in this ways:

  1. Do not require certificate validation:

  ![Remote Desktop Connection](image)

  2. Do not attempt remote audio playback or recording.

  ![Remote Desktop Connection](image)

- **VNC Viewers**
  Remote desktop access is available on display ":1.0.0.1."
  - **TightVNC**
  - **RealVNC**

B. or download RealVnc

C. or download TightVnc

2. From your Windows Start Menu, type “vnc” and **VNC viewer** should be an option.
3. If you are using the start menu, it will be under either in All Programs > RealVNC or TightVNC

4. Double click the vnc icon and it will ask you for the IP address. You want to set the Encryption option to off because we presume you are connected directly to the LANforge.
5. VNC Viewer might warn you about connecting without encryption. This is a valid warning if you are connecting across public networks.

6. The password is Lanforge.

7. You will see the LANforge Linux desktop. This is not the same desktop that is actually running on the console if you have a monitor and keyboard connected.
8. When you are done with your connection, you may close the VNC viewer window. You will not be logged out. When you connect using VNC viewer again, it show the current state of that desktop, connect you to the last used VNC session.

9. To restart the vnc desktop session, select you can issue either of these two commands. You start using ssh (PuTTY et al.) to connect as lanforge to the LANforge machine, and:

   A. `sudo systemctl restart "vncserver@:1.service"`

   B. or

   C. `sudo vncserver -kill :1`
Display WireShark Using Cygwin

Goal: We will display the WireShark application on Windows using Cygwin when we press Sniff Packets which actually runs WireShark on the Linux LANforge machine.

The native display protocol for Linux (and Unix) is the X Display Protocol. The Cygwin.org project provides Linux software that runs natively on Windows. You can run an X display server on Windows that accepts connection from LANforge. We will walk through setting up Cygwin and configuring an X display.

1. Installing Cygwin and the X display components
2. We will start at Cygwin.org and download the Cygwin installer.
This is the home of the Cygwin project

What...

...is it?

Cygwin is:
- a large collection of GNU and Open Source tools which provide functionality similar to a Linux distribution on Windows.
- a DLL (cygwin1.dll) which provides substantial POSIX API functionality.

...isn’t it?

Cygwin is not:
- a way to run native Linux apps on Windows. You must rebuild your application from source if you want it to run on Windows.
- a way to magically make native Windows apps aware of UNIX® functionality like signals, pty’s, etc. Again, you need to build your apps from source if you want to take advantage of Cygwin functionality.

The Cygwin DLL currently works with all recent, commercially released x86 32 bit and 64 bit versions of Windows, starting with Windows Vista. For more information see the FAQ.

NOTE: As previously announced, Cygwin version 2.5.2 was the last version supporting Windows XP and Server 2003. (Instructions for obtaining that version)

Current Cygwin DLL version

The most recent version of the Cygwin DLL is 2.6.1. Install it by running setup-x86.exe (32-bit installation) or setup-x86_64.exe (64-bit installation).

Use the setup program to perform a fresh install or to update an existing installation.

Note that individual packages in the distribution are updated separately from the DLL, so the Cygwin DLL version is not useful as a general Cygwin distribution release number.

3. Download setup-x86.exe or setup-x86_64.exe as appropriate. Go to your Downloads folder and double start the program.

4. Next
Cygwin Net Release Setup Program

This setup program is used for the initial installation of the Cygwin environment as well as all subsequent updates. Make sure to remember where you saved it.

The pages that follow will guide you through the installation. Please note that Cygwin consists of a large number of packages spanning a wide variety of purposes. We only install a basic set of packages by default. You can always run this program at any time in the future to add, remove, or upgrade packages as necessary.

Setup.exe version 2.877 (32 bit)
Copyright 2000-2016
http://www.cygwin.com/

5. Next

Cygwin Setup - Choose Installation Directory

Select Root Install Directory
Select the directory where you want to install Cygwin. Also choose a few installation parameters.

Root Directory

Install For

- All Users (RECOMMENDED)
  Cygwin will be available to all users of the system.

- Just Me
  Cygwin will still be available to other users, but Desktop Icons, Cygwin Menu Entries, and important installer information are only available to the current user. Only select this if you lack Administrator privileges or if you have specific needs.

6. Next

Cygwin Setup - Select Local Package Directory

Select Local Package Directory
Select a directory where Setup to store the installation files it downloads. The directory will be created if it does not already exist.

Local Package Directory

[Path: C:\Users\Jed Reynolds\Downloads]
7. Choose a mirror that might be close to you, click Next

8. Now you see a the software selection screen, sorted by category. Some of these entries appear two or more times, because they belong to multiple categories. Try using the search box in upper middle above the software list to search for the packages listed below.

9. The items you want to search for are
   - openssh
   - xorg-server
   - xinit
   - rxvt
   - xlaunch
A. Search for `openssh` and click the Skip property once to change it to the most recent version to set it to install.

B. `xorg-server` provides the X display system

C. `xinit` helps the X system launch
D. `xlaunch` is what you will drag to your task bar to launch your Cygwig X server.

<table>
<thead>
<tr>
<th>Category</th>
<th>New</th>
<th>Br?</th>
<th>Src?</th>
<th>Size</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><code>xlaunch</code>: GUI tool for configuring and starting the XWin X server</td>
</tr>
</tbody>
</table>

E. `rxvt` and `rxvt-unicode` are more useful terminals than the `minterm` program that Cygwin provides by default.

<table>
<thead>
<tr>
<th>Category</th>
<th>New</th>
<th>Br?</th>
<th>Src?</th>
<th>Size</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><code>rxvt</code>: Lightweight VT102 terminal emulator</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><code>rxvt-unicode</code>: An improved version of <code>rxvt</code> with Unicode support</td>
</tr>
</tbody>
</table>

10. Click Next and let the installer finish the installation of the Cygwin packages. You will see a Cygwin Terminal icon appear on your desktop and new Cygwin icons in your Start menu.

11. Next we will right-click on the Cygwin Terminal icon and select Open File Location.
12. In the Explorer window, scroll to find xlaunch.exe, and drag it to the Task Bar.
13. Click the xlaunch icon on the task bar, and click Next.

14. Next

15. Check Disable Access Control and add the option: -listen tcp. Click Next.
16. Firewall, Click Allow Access

Windows Firewall has blocked some features of this app

Name: xwin.exe
Publisher: Unknown
Path: C:\cygwin\bin\xwin.exe

Allow xwin.exe to communicate on these networks:
- Private networks, such as my home or work network
- Public networks, such as those in airports and coffee shops (not recommended because these networks often have little or no security)

What are the risks of allowing an app through a firewall?

[Allow access] [Cancel]

17. If the LANforge Messages window reports 'No Access', you might need to use xhost.exe to grant X11 access.

A. Open a CMD window

B. Go to the cygwin\bin folder:

C:\> cd \cygwin\bin
C. Use `xhost.exe` to open permissions:

```bash
c:\> .\xhost.exe +
```

18. Now your X display service is running. You can check that it's running by clicking into the System Tray and seeing if the icon is there.

19. Launch the LANforge GUI from your desktop. Select a port from the Port Mgr tab. Notice how the **Disp** field has your laptop's LAN address. This is the display address the remote machine will display the Wireshark window to.

20. You will see Wireshark...
21. Resources and other Documentation:

A. http://unix.stackexchange.com/questions/227889/cygwin-on-windows-cant-open-display


Goal: Properly configured, the LANforge server or the LANforge GUI can collect connection performance information in CSV format.

By default, your LANforge server and your LANforge client do not save the data on connection and port performance. When you configure the save destination for this data, you can use it with any other tool that can read a CSV file.

Finding LANforge Report Data

Select your Save Location

You can tell the LANforge server to save data to a directory locally on the management machine, and you can configure your workstation running the LANforge GUI to save data to a local desktop folder. First, find the Reporting Manager dialog by in the Reporting menu, and select Report Manager the client.
GUI Data Collection (Desktop Folder)

Collecting data on your local workstation is very convenient if you can leave the GUI running for the duration of your test scenario. The format of the data here should be similar to the format of the data saved to the server directory. The folders for collecting data are relative to the folder you start your GUI from. If you type in `lf_data` that probably means `C:\Users\mumble\AppData\Local\LANforge-GUI\lf_data`, you probably want to put in a fully qualified path that's more intuitive, like `C:\Users\mumble\Documents\lf_data`.

![GUI Data Collection](image)

Generate Report

The Report Generator uses the local data files. In that dialog shows the Report Input Directory field is a local folder where the CSV files collect. The Save Reports to Directory field is where HTML and PDF files should collect.

![Generate Report](image)

Server Data Collection (Server Directory)

If your test scenario runs longer than your GUI can be up, you can configure the LANforge server to collect the data. The directory is relative to the `/home/lanforge` directory, so if you enter `lf_data`, you would find the CSV files in `/home/lanforge/lf_data`. 

![Server Data Collection](image)
You can take a look at the data files easily. Here is a server data collection directory:

```
lanforge@jedtest:~/lf_data
$ total 2628
-rw-r--r-- 1 root root 31465 Mar 1 16:52 wlan2_1.1.7_1488414451.csv
-rw-r--r-- 1 root root 31465 Mar 1 16:52 wlan1_1.1.6_1488414451.csv
-rw-r--r-- 1 root root 90839 Mar 1 16:52 wifiy2_1.1.4_1488414451.csv
-rw-r--r-- 1 root root 125299 Mar 1 16:52 wifiy1_1.1.3_1488414451.csv
-rw-r--r-- 1 root root 101801 Mar 1 16:52 wifiy0_1.1.2_1488414451.csv
-rw-r--r-- 1 root root 138049 Mar 1 16:52 udoo200-B_1488414451.csv
-rw-r--r-- 1 root root 137626 Mar 1 16:52 udoo200-A_1488414451.csv
-rw-r--r-- 1 root root 160328 Mar 1 16:52 tcp200-B_1488414451.csv
-rw-r--r-- 1 root root 158351 Mar 1 16:52 tcp200-A_1488414451.csv
-rw-r--r-- 1 root root 26326 Mar 1 16:52 resource_jedtestcandlelatechcom_1.1_1488414451.csv
-rw-r--r-- 1 root root 114505 Mar 1 16:52 eth1_1.1.1_1488414451.csv
-rw-r--r-- 1 root root 43917 Mar 1 16:52 eth0_1.1.0_1488414451.csv
-rw-r--r-- 1 root root 168161 Mar 1 16:52 c201-B_1488414451.csv
-rw-r--r-- 1 root root 169329 Mar 1 16:52 c201-A_1488414451.csv
-rw-r--r-- 1 root root 27937 Mar 1 16:52 wlan2_1.2.7_1488414451.csv
-rw-r--r-- 1 root root 27937 Mar 1 16:52 wlan1_1.2.6_1488414451.csv
-rw-r--r-- 1 root root 27937 Mar 1 16:52 wlan0_1.2.5_1488414451.csv
-rw-r--r-- 1 root root 114613 Mar 1 16:52 wifiy2_1.2.4_1488414451.csv
-rw-r--r-- 1 root root 100445 Mar 1 16:52 wifiy0_1.2.2_1488414451.csv
-rw-r--r-- 1 root root 327241 Mar 1 16:52 va0_1.1.0_1488414451.csv
-rw-r--r-- 1 root root 40057 Mar 1 16:52 sta205_1.2.10_1488414451.csv
-rw-r--r-- 1 root root 40057 Mar 1 16:52 sta200_1.2.8_1488414451.csv
-rw-r--r-- 1 root root 39299 Mar 1 16:52 sta100_1.2.9_1488414451.csv
-rw-r--r-- 1 root root 21691 Mar 1 16:52 resource_jedtest_1.2_1488414451.csv
-rw-r--r-- 1 root root 105065 Mar 1 16:52 eth1_1.2.1_1488414451.csv
-rw-r--r-- 1 root root 40789 Mar 1 16:52 eth0_1.2.0_1488414451.csv
```

And using a utility like `notepad`, `vi`, `more` or `less` you can look at the file contents:

```
Using Libre Office
```

![Screenshot of Libre Office](image)
Importing the file into a spreadsheet like LibreOffice Calc is simple:

You only need to separate on comma (,).

The timestamp column

Libre Office does not have a built-in formula to do this, but it has been discussed here. And the solution is a formula that
looks like this:

$=(A2/86400)+25569

and then you format the column as Date.

**Scripting with Bash**

There are a number of ways to collect and sort the data with shell utilities. The first utility to consider is `cut`, then `awk`. The first column of the endpoint file we are going to read is the timestamp, the 14th is the rx bytes.

**Reading the Data and RX Bytes**

*Converting Unix Date*

```
$ head -n2 c201-A_1488414451.csv | cut -d, -f1
TimeStamp
148841445125
$ date -d @148841445125
Mon Dec 23 19:28:45 PST 49135
```

*Using bash*

```
$ head -n2 c201-A_1488414451.csv | (while IFS=, read -a L; do echo \${L[13]}; done)
rx_bytes
33847640064
```

*Using cut*

```
$ head -n2 c201-A_1488414451.csv | cut -d, -f14
rx_bytes
33847640064
```

*Using awk*

```
$ head -n2 c201-A_1488414451.csv | awk -F, '{print \$14}'
rx_bytes
33847640064
```

```
$ head -n2 c201-A_1488414451.csv | awk -F, '{print \$1 "\t" \$14}'
TimeStamp          rx_bytes
148841445125 33847640064
```

**Scripting with Perl**

It is a lot easier to do math with a perl script than a bash or an awk script. You can pipe things into perl or perl will read the last argument of the `-ne` switches as an input file.

```
#!/usr/bin/perl
my $tt=0;
my @tstamps=();
perl -ne 'BEGIN{$tt=0; @tstamps=(); @rxb=();}
{ @v=split(/,/,$_); push(@tstamps, \$v[0]); push(@rxb, \$v[13]); } 
END{ $dt=$tstamps[\$#tstamps] - $tstamps[1]; $db=$rxb[\$#rxb] - $rxb[1]; 
 print "Time: \$dt, Total: \$db\n"; }' c201-A_1488414451.csv
$tt=0;
my @tstamps=();
```

```
perl -ne 'BEGIN{$tt=0; @tstamps=(); @rxb=();}
{ @v=split(/,/,$_); push(@tstamps, \$v[0]); push(@rxb, \$v[13]); } 
END{ $dt=$tstamps[\$#tstamps] - $tstamps[1]; $db=$rxb[\$#rxb] - $rxb[1]; 
 print "Time: \$dt, Total: \$db\n"; }' c201-A_1488414451.csv
```

Not every thing you do in perl is going to be a one-liner. Here’s an example of the same script as a more properly formatted perl file:

```
#!/usr/bin/perl
my $tt=0;
my @tstamps=();
```
my @rxb=();
while(<>) {
    @v = split('/', $_, $v[0]);
    push(@tstamps, $v[0]);
    push(@rxb, $v[13]);
}

$dt = $tstamps[$#tstamps] - $tstamps[1];
$db = $rxb[$#rxb] - $rxb[1];
print "Time: $dt, Total:$db\n";

---

**Writing Disk Images on Windows**

**Goal:** Copy an installed OS file-system image onto a drive that you will install into a LANforge system that lacks display hardware.

Many LANforge ICE WAN emulator machines are embedded systems that lack display hardware. Installing an OS using only the serial console can be very inconvenient. The easy solution is to perform the installation on similar hardware that does have display hardware, and then move the drive to the embedded device. Here, we learn how to use Etcher on Windows to write a compressed disk image to an mSata drive plugged into a USB3 adapter.

1. Here we’re using *Etcher* which handles compressed file system images without any trouble. There are other programs (like *Win32 Disk Imagaer* or *dd for windows*) but those are more complex to use.

2. Items we’ll want:
   - 30GB or larger mSATA drive
B. USB3 mSATA drive adapter

C. The image writing program Etcher

3. Download and install Etcher

4. Identify your drive in Control Panel → Hardware and Sound → Hardware and Printers.
5. Download your image file:

6. Start Etcher
7. Select the compressed image:

8. Select the removable drive
9. You might have to enable unsafe mode if the drive you plugged in has previously been used.
   A. in Settings, enable **Unsafe mode**

   **Settings**

   - Anonymously report errors and usage statistics to resin.io
   - Eject on success
   - Validate write on success
   - Include unstable update channel

   **Advanced**
   - Unsafe mode **Dangerous**

   B. Select the removable drive
10. Select the removable drive

11. Write image.
   A. click Flash
8. It might take 20 minutes to write a 20GB (uncompressed) image.

12. Make coffee.

13. When the image is finished writing, close etcher and use the Safely Eject Thing dialog in the system tray.
   A. right click

   ![Safely Remove Hardware and Eject Media](image)

   B. select device

   ![Open Devices and Printers](image)

   Eject AS2115

14. Unplug your drive from the computer, remove the msata drive drive from the USB caddy and then install into your embedded device
Adding a LANforge Virtual Machine

Goal: Add a virtual machine running LANforge to a LAN with a physical LANforge manager.

We review the configuration steps necessary to add a virtual LANforge resource. This was done using VirtualBox 5.2.10 and Fedora 27 Server edition. The guest instances will be configured to export MAC-VLAN ports to run traffic on their physical management port.

1. Create a new guest instance.
   A. When creating the guest, we should use 2 GB of RAM:
B. 20 GB of disk:

C. Omit a floppy drive, use a USB table as pointing device:
D. Allocate two or more cores and PAE/NX:

![System Settings for Allocating Cores and PAE/NX](image)

E. And the usual virtual processor features:

![System Settings for Virtual Processor Features](image)
F. We don’t need graphics on these nodes, so use minimum graphics memory:

G. Enable RDP access, that is useful. It might be a good habit to allocate separate RDP ports per host, we’ll use 9134 for the first guest, 9135 for the second.
H. Enable Host I/O caching for your SATA device. Specify the Fedora 27 Server ISO image as the DVD:

I. Disable Audio
J. Configure the network adapter to:

A. Use the LAN bridged adapter br0
B. Use a server adapter driver
C. Enable Promiscuous Mode to allow sniffing

K. Start the installation
L. Under System Automatic partitioning should be adequate for general use.

M. Set the root password to lanforge, Click Done twice.
N. Add user LANforge:

A. Make user lanforge an Administrator
   B. Set password to lanforge
   C. Click Done twice

O. When installation finishes, reboot. You will see a login prompt:

Fedora 27 (Server Edition)
Kernel 4.16.5-200.fc27.x86_64 on an x86_64 (tty1)
localhost login: 

P. Login as root. Do updates:

   [root@localhost]# dnf update -y

Q. Install perl:

   [root@localhost]# dnf install -y perl

R. Set guest's hostname:

   [root@localhost]# hostnamectl --static set-hostname atlas-fedora27s01

S. Reboot:

   [root@localhost]# shutdown -r now

2. Install LANforge on the guest instance. Start by logging in as root:
Fedora 27 (Server Edition)
Kernel 4.16.5-280.fc27.x86_64 on an x86_64 (tty1)


localhost login: root
Password: [root@localhost ~]# which wget
[0110x495][root@localhost ~]# which curl
[0110x485] [root@localhost ~]# wget http://www.candelatech.com/lf_kinstall.txt
[0110x475] [root@atlas-fedora27s01 ~]# curl -o lf_kinstall.pl http://www.candelatech.com/lf_kinstall.txt
[0110x430] [root@atlas-fedora27s01 ~]# chmod +x lf_kinstall.pl
[0110x430] [root@atlas-fedora27s01 ~]# touch /home/lanforge/did_cpuburn
[0110x430] [root@atlas-fedora27s01 ~]# ./lf_kinstall.pl --lfver 5.3.7 --kver 4.13.16+ --do_all_ct
[0110x430] [root@atlas-fedora27s01 ~]# systemctl stop vncserver@:1 xrdp.service
[0110x430] [root@atlas-fedora27s01 ~]# systemctl disable vncserver@:1 xrdp.service
[0110x430] [root@atlas-fedora27s01 ~]# systemctl daemon-reload

[root@atlas-fedora27s01 ~]# df -h
Filesystem Size Used Avail Use% Mounted on
udevtmpfs 992M 0 992M 0% /dev
tmpfs 992M 0 992M 0% /dev/shm
tmpfs 992M 0 992M 0% /sys/fs/cgroup
/dev/mapper/Fedora-root 156G 8.3G 6.8G 5% /
tmpfs 992M 0 992M 0% /devtmpfs
/dev/sda1 976M 19M 728M 2% /boot
tmpfs 992M 0 992M 0% /run/user/1000

E. You will notice that we have about 6GB of disk space left in this VM

[root@atlas-fedora27s01 ~]# shutdown -r now
G. On next boot, you will see a LANforge kernel option, it should be automatically selected:

```
Fedora (4.16.5-200.fc27.x86_64) 27 (Server Edition)
Fedora (0-rescue-12ca9f865fa417e1354f311l60f1b0b) 27 (Server Edition)
Candela Technologies 4.16.5+ CUMI 115200 Bm1
Candela Technologies 4.16.0+ CUMI 115200 Bm1
```

Press the ↑ and ↓ keys to change the selection.
Press ‘e’ to edit the selected item, or ‘c’ for a command prompt.

3. From your LANforge GUI, configure a MAC-VLAN the on default Ethernet port.

A. In the LANforge GUI, choose the Port Mgr tab, and highlight the new enp0s17 port:

![LANforge GUI screenshot](image)

B. Click the `Create` button
C. create one MAC-VLAN port

A. Select MAC-VLAN

B. Quantity: 1

C. Select DHCP-IPv4

D. Click Apply

D. You will see the new port in the GUI:
4. Add a second VM

A. Shut down the previous VM:

```
[root@atlas-fedora27s01]# shutdown -r now
```
B. clone the VM

A. Select the Reinitialize MAC addresses choice, these machine will operate simultaneously.

B. Verify the MAC address of the new guest is set

C. Boot the second guest

C. Change the hostname of the second guest:

```
[root@localhost]# hostnamectl --static set-hostname atlas-fedora27s02
```

```
[root@localhost ]# hostnamectl --static set-hostname atlas-fedora27s02
```
D. Make sure that the MAC address of the second guest is not listed in the `ifcfg-enp0s17` file.

```
[root@localhost ~]# cd /etc/sysconfig/network-scripts/
[root@localhost network-scripts# ls
ifcfg-enp0s17 ifdown-ipv6 ifdown-Team ifup-eth ifup-post ifup-tunnel
ifcfg-10 ifdown-issdn ifdown-TeamPort ifup-ipp ifup-ppp ifup-wireless
ifdown ifdown-post ifdown-tunnel ifup-ipv6 ifup-routes init.ipv6-global
ifdown-bnap ifdown-ppp ifup ifup-issdn ifup-sit network-functions
ifdown-eth ifdown-routes ifup-aliases ifup-ipv6 ifup-Team network-functions-ip6
ifdown-ipp ifdown-sit ifup-bnap ifup-plush ifup-TeamPort
```

```
[root@localhost network-scripts# cat ifcfg-enp0s17
TYPE=Ethernet
PROXY_METHOD=none
BROWSER_ONLY=no
BOOTPROTO= dhcp
DEFROUTE=yes
IPV4_FAILURE_FATAL=no
IPV6INIT=yes
IPV6_AUTOCONF=yes
IPV6_DEFROUTE=yes
IPV6_FAILURE_FATAL=no
IPV6quete.6.GenADDR=stable-privacy
NAME= enp0s17
UUID=015397f7-e866-3a65-6065-473036c73570
ONBOOT=yes
AUTOCONNECT_PRIORITY=-999
DEVICE=enp0s17
```

A. Compare the adapter to the file:

```
[root@localhost ~]# cd /etc/sysconfig/network-scripts
[root@localhost ~]# cat ifcfg-enp0s17
```

B. If it is listed, change it or remove it.

E. LANforge changes the `/etc/udev/rules.d/70-persistent-net.rules` file, edit the file those as to match the value of your mac address.

```
[root@localhost ~]# cd /etc/udev/rules.d
[root@localhost ~]# ip li show enp0s17
[root@localhost ~]# cat 70-persistent-net.rules
```
F. Stop LANforge and change the resource ID for this guest:

```bash
[root@localhost]# service lanforge stop
[root@localhost]# cd /home/lanforge
[root@localhost]# ./lfconfig
Your command: resource 5
Your command: config
```

If these values are correct, enter 'config', otherwise change the values by entering the key followed by the new value, for example:

```bash
mode manager
```

Interfaces: _wef1 emg@817# emg@817
Resource interface assignment:
  Resource 5: _wef1 emg@817
Specified Resource Addresses:

<table>
<thead>
<tr>
<th>Key</th>
<th>Acceptable Values</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>log_level</td>
<td>0-65535</td>
<td>7</td>
</tr>
<tr>
<td>log_dir</td>
<td>directory path</td>
<td>/home/lanForge</td>
</tr>
<tr>
<td>add_resource_addr</td>
<td>host[port]</td>
<td>SEE LIST ABOVE</td>
</tr>
<tr>
<td>rem_resource_addr</td>
<td>host[port]</td>
<td>SEE LIST ABOVE</td>
</tr>
<tr>
<td>realm</td>
<td>1-255</td>
<td>26</td>
</tr>
<tr>
<td>resource</td>
<td>1-511</td>
<td>5</td>
</tr>
<tr>
<td>mgmt_dev</td>
<td>ethernet device</td>
<td>emg@817</td>
</tr>
<tr>
<td>mode</td>
<td>resource, manager, both</td>
<td>resource</td>
</tr>
</tbody>
</table>

If these values are correct, enter 'config', otherwise change the values by entering the key followed by the new value, for example:

```bash
mode manager
```

G. Reboot the second guest:

```bash
[root@localhost]# shutdown -r now
```

H. Start up your first guest (resource 4)

I. In your LANforge GUI, you should see your two VMs.

J. Create a MAC-VLAN port for the second guest

5. Create a VOIP connection between the two guests.

A. In the VOIP tab, click Create
B. You configure:

A. Side-A will be resource 3
B. Side-B will be resource 4
C. Click **Apply**

C. See the newly created connection:

D. In the VOIP/RPT tab, click **Start**
Goal: Using a serial cable and terminal emulator on Windows to connect to LANforge.

If you experience crashes or system misconfiguration, a network link to LANforge can become unavailable. LANforge machines are shipped with a serial cable for just this possibility. Most LANforge servers come with standard RS232 DB9 pin serial ports, other models have a special RJ45 style connector. You might need a USB to Serial adapter to connect your laptop to the serial cable.

1. Connect Serial Cable to LANforge
   A. We will use a CT525 for our example. There are two different types of CT525, some have a I/O shield with colors, others do not. Both have DB9 serial ports:
B. Picture of an unmarked I/O plate:

C. Picture of a colorized I/O plate:

D. Picture of a colorized I/O plate plugged in:

E. Other LANforge chassis models can have either RJ45 or DB9 serial ports.

2. Connect Serial Cable to Windows
   A. Chances are you will be connecting a USB to Serial adapter to your laptop.
   B. Typically, right after you connect the cable to your USB port, you will see a message from Windows letting you know a new drive has been installed.
C. Windows will map this USB adapter to a COM port. Use Device Manager to discover the new COM port:

A. Press the Windows key and type device manager

B. Hit Enter to open the Device Manager

C. In Device Manager, select Ports

D. In this example, we see that our new USB device was assigned COM3.
3. Configure PuTTY to connect to serial port

A. Press the Windows key and search for putty

B. When you double click on the PuTTY icon and it launches, you can start customizing your session preferences
C. Start by setting your connection type (serial), serial device (com3) and speed (115200). Name your session ‘com3’

D. Select category Serial, specify the Serial Line COM3, speed (115200) and set both Parity and Flow Control to None.
E. Select the **Session** → **Logging** category, select Printable Output and name set the Log file name as you prefer. This allows you to collect your commands as notes for later.

F. Select the **Session** category, save the com3 profile and click **Save**.

G. Click the **Open** button. You will see a terminal window appear.

4. Use PuTTY to Log In over COM3
   
   A. If the screen is blank, hit **Enter** to see a login prompt.
5. Collect console output to a logfile
   A. step 1
6. **Common Commands Cheat Sheet:** Hit Enter after all commands

   A. `pwd Enter` : print current directory
   B. `ls Enter` : list items in directory
   C. `cd Enter` : change to your Home Directory
   D. `cd /home/lanforge Enter` : go to LANforge home directory
   E. `cd /root Enter` : go to root user's home directory
   F. `sudo ./serverctl.bash restart Enter` : Restart LANforge service
   G. `sudo reboot Enter` : reboot machine
   H. `ip a show Enter` : show interface addresses
   I. `df -h Enter` : show disk usage
   J. `mv script.sh.txt /home/lanforge/scripts/script.sh Enter` : move file to new name
   K. `dos2unix script.sh Enter` : Remove DOS/Windows CRLF style line endings
   L. `chmod +x script.sh Enter` : Turn script executable
   M. `./script.sh Enter` : Run script in current directory

7. **Example of clearing disk space on a LANforge machine**

   A. One common problem with any LANforge machine is cleaning out old kernels. This is an example that shows you how to check disk space and how to remove unused kernels.
### B. Check disk space with the `df -h` command

```
[lanforge@jedway2 ~]$ df -h
Filesystem  Size  Used  Avail  Use%  Mounted on
/devtmpfs   1.5G   0    1.5G   0%   /dev
tmpfs       2.6G   0    2.6G   0%   /dev/shm
tmpfs       2.6G  976K  2.6G   1%   /run
tmpfs        2.0G   0   2.0G   0% /sys/fs/cgroup
/dev/mapper/fedora-root  25G  17G   8.4G  73%   /
tmpfs         2.0G  64K  2.0G   1%   /tmp
/dev/sd1a    477M  360M   18M 81%   /boot
tmpfs        393M   0  393M   0% /run/usr/1000
[lanforge@jedway2 ~]$ 
```

### C. Use the `dmesg` command to see if there are system warnings.

```
[root@jedway2 boot]$ dmesg > /tmp/dmesg.log
[root@jedway2 boot]$ less /tmp/dmesg.log
```

D. go to the `/boot` directory. The `uname -r` command tells you which kernel you are currently running. You may remove old `ct` kernels.

```
[root@jedway2 -]# cd /boot
[root@jedway2 boot]# ls *4.7.* *4.9.* *4.13.*
ct4.13.16+.img  ct4.9.65+.img  initrd-ct4.9.29+.img  System.map-4.7.10+
ct4.7.10+.img  initrd-ct4.13.16+.img  initrd-ct4.9.65+.img  System.map-4.9.29+
ct4.5.29+.img  initrd-ct4.7.10+.img  System.map-4.13.16+  System.map-4.9.65+
[root@jedway2 boot]# uname -r
4.16.10+
[root@jedway2 boot]# rm -r *4.7.* *4.9.* *4.13.*
```

E. In addition to removing old kernels, you can remove modules that correspond to those kernels.

```
[root@jedway2 modules]# cd /lib/modules
[root@jedway2 modules]# ls -d *4.7.*/*4.9.*/*4.13.*
4.13.16+  4.7.10+  4.9.29+  4.9.65+
[root@jedway2 modules]# rm -rf *4.7.*/*4.9.*/*4.13.*
```
F. After old kernels and modules have been removed, we re-run `grub2-mkconfig` to regenerate the boot menu:

```
[root@jedway2 ~]# grub2-mkconfig -o /boot/grub2/grub.cfg
```

G. The results will look like this:

```
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-4.11.12-100.fc24.x86_64
Found initrd image: /boot/initramfs-4.11.12-100.fc24.x86_64.img
Found linux image: /boot/vmlinuz-4.10.17-100.fc24.x86_64
Found initrd image: /boot/initramfs-4.10.17-100.fc24.x86_64.img
Found linux image: /boot/vmlinuz-4.5.5-300.fc24.x86_64
Found initrd image: /boot/initramfs-4.5.5-300.fc24.x86_64.img
Found linux image: /boot/vmlinuz-0-rescue-529fbd397cc06430a6da0d2fc2f1f269ee
Found initrd image: /boot/initramfs-0-rescue-529fbd397cc06430a6da0d2fc2f1f269ee.img
```

```
[root@jedway2 ~]# df -h
Filesystem     Size  Used  Avail Use% Mounted on
devtmpfs       114G   16G   96G   14% /dev
tmpfs          20G   20G   0G   100% /run/shm
tmpfs          2.0G   2.0G   0G   100% /run/lock
tmpfs          2.0G   2.0G   0G   100% /sys/fs/cgroup
/dev/mapper/fedora-root 335G  14G   311G   4% /
tmpfs          2.0G   2.0G   0G   100% /tmp
/dev/sda1      477M  284M  93M   59% /boot
tmpfs          393M   0M   393M   0% /run/user/1000
[root@jedway2 ~]
```
Goal: Connect the antennas of your device under test to LANforge using SMA cables and a fixed attenuator.

Many WiFi testing scenarios benefit from some amount of WiFi isolation. Connecting the radios of the Device Under Test (DUT) to LANforge’s radios using SMA cables can improve connection quality. Using a fixed attenuator can reduce a direct signal so that it is heard by the radios without distortion.

1. The polarities of the cables must match

2. Begin by connecting the SMA Female end of the fixed attenuator to the SMA adapter.
RP-SMA-Male Adapter on top

3. We see that the exposed end of the sma_adapter is RP-SMA-Male. RP means Reverse Polarity.
4. Connect the attached attenuator and adapter to the LANforge radio antenna. This exposes the SMA Male end of the attenuator. Your DUT might not have adequate space to mount a fixed attenuator to it, so we suggested connecting it to the LANforge.
Mounted adapter exposes SMA-Male end of attenuator

5. The polarities of the cable end must match the end of the fixed attenuator. The cable end for this side is SMA-Female.

SMA-Female cable end attaches to SMA-Male end of attenuator

6. See how the cable connected to the lantorge has both the adapter and the attenuator. It should be safe to use.
the attenuator and adapter anywhere along a SMA path.

SMA Cable attached to attenuator connected to LANforge

7. Connect the other end of the cable to the Device Under Test (DUT). Your DUT might use different antennas so you might need to use another adapter.
SMA-RP-Male cable end attaches to SMA-Male DUT radio

8. We have connected one antenna of our DUT to the one antenna of our LANforge. Repeat this for multiple antennas.

SMA cable connecting DUT to LANforge with 30dB fixed attenuator
Diagnose Problems with GUI on Windows

Goal: Learn how to diagnose problems running LANforge client on Windows.

The LANforge client (GUI) can encounter variety of difficulties depending on the amount of RAM and version of Java running on your desktop. Read this guide to learn steps to take to collect error messages and how to fix out of memory problems.

1. The LANforge client can be both the GUI running interactively, or in headless HTTP mode.

Run the client from a CMD window

2. Right click on LANforge GUI icon and select Open File Location

3. You will see the folder where the LANforge client is installed
4. Right click on folder area to right of files, and select Run CMD here or Run PowerShell here. This might require that you Shift-Click on anything that might be selected in the directory to un-select it.

5. You will see a terminal window open

6. Start the client using the command `\lfclient.bat` ENTER
Double-clicking `ifclient.bat` in the Windows Explorer window will start the client in a CMD window, but the window will disappear when the client quit/exits/leaves.

7. **Be Aware of Quick Edit**

   A. Quick Edit allows you to highlight text quickly with the mouse; it is a feature of both the CMD and PowerShell windows. CMD windows have the distinct drawback of halting execution while text is highlighted.

   1. Press `ESC` to clear text selection

   C. You can change the setting by clicking in the upper left corner, selecting Preferences, then look for Quick Select.

   ![Windows PowerShell settings dialog](image)

   For more information see Windows Server 2016 Features

8. **Copy an Error**

9. Candelatech introduces features into LANforge quickly, and discovering a problem in the LANforge Client occasionally happens—and we want to hear when it does! You can help by copying the terminal output and emailing it to us (at support@candelatech.com). Various kinds of errors leave messages we can find in the terminal like when the LANforge client:

   A. **...will not start** after double clicking the icon. This might be caused by a missing or mismatched version of the Java runtime, an error in the start-up script, or a program error.

   B. **...unexpectedly quits.** Probably a program error.

   C. **...does not respond.** Possibly a program error, caused often you will see many exceptions printed to the terminal.

10. A Java exception is a rather long list of method calls (a stack trace) that starts with the exception message. Sometimes the exception message is `IllegalArgumentException`, sometimes it is `null` (a null pointer exception)
11. Scroll the terminal window to see the top of the exception and highlight the exception message and as much of the stack trace as possible. Below is a picture of a condition where the LANforge client script has an error and will not start.

A. Pressing **Enter** after highlighting the text copies the text into your clipboard.

B. The laptop might not have an email client installed. In that case, open **notepad.exe** or **wordpad.exe** from via the Start menu, and paste your stack trace into your text editor.

C. If your circumstances don’t allow highlighting, copying and pasting, you can take a **screen capture**, usually by pressing **Alt + [PrtScr]** shortcut.

D. When contacting us, please describe the steps you took to reach this error. We need to be able to reproduce the error in order to fix it.

**Out of Memory Conditions**
13. Candelatech provides a 32-bit and a 64-bit version of the LANforge client. We generally suggest people use the 64-bit client, because most recent laptops are running 64-bit operating systems. This is a common fix for running out of memory. For more information see LANforge Downloads.

14. When running a WiFi Capacity Test, the generated report consumes significantly more memory than a mere HTML or PDF version of the report does. If you have multiple WiFi Capacity Test reports open, we suggest you save them and close the report windows.

15. Running tests for longer periods of time (like days) can also consume significant memory. By default, the LANforge client will only allocate up to two-thirds (2/3s) of the system memory it detects available at start-up. If there are programs like Chrome, Outlook and possibly Electron based applications open, those can be using most of your laptop’s memory to begin with. You might need to exit other programs in Windows and restart the LANforge client in order allow it to have more memory.

16. You can also edit the start-up script to configure the maximum memory permitted to the Java runtime. That is discussed next.

17. **Edit the start-up script**

18. While it is possible to edit files with `notepad.exe`, that text editor has few conveniences. Please consider using Notepad++ if you don’t already have a text editor available. For more information see Download Notepad++

19. Right click on the `lfclient.bat` startup script, and select Edit with Notepad++
A. The file opens in the editor at the top. You will want to jump to the end of the file.

```bash
@echo on
set NL=^^^ 
@rem above are two blank trailing lines *required* to
if NOT EXIST settings.bat ( 
  echo "settings.txt not found. Installation problem?"
  exit /b
)
call settings.bat
setlocal EnableDelayedExpansion
set CommonJavaArgs=-XX:+UseParallelGC -Xmn15m -XX:NewG
-XX:InlineSmallCode=1500 -XX:MaxInlineSize=55 -XX:Ma:
-XX:CompileCommandFile=precompile.txt
-DsupressSwingDropSupport=true -Djava.net.preferIPv.
```

B. At the end of the file, notice the -Xmx option for the java program. You will edit this to the maximum amount of memory you want to allow the program.

```bash
"%CHosen_JAVA%" -Xmx%half%m
%CommonJavaArgs% ^
set "AddModules=--add-modules java.base,java.
:_start_1_
"%CHosen_JAVA%" -Xmx%half%m
%CommonJavaArgs% $AddModules$ ^
%ExtraJavaArgs% -cp %LFGUI_CP%^
candela.lanforge.lfclient -httpd 8080 &*
goto _exit_
:_exit_
exit /b
```
Goal:
Recover a LANforge system that boots into Emergency Mode

File system corruptions are caused by power-off events without properly shutting down the system.

For more information see Tuning Java Machines

20. Email support@candela-tech.com if you have questions or need help.

Recovering Filesystems

If your LANforge boots into Emergency Mode, your system is experiencing file-system corruption. Follow these instructions to check the filesystems. This process will require a monitor and keyboard or a serial cable connected to the LANforge.

1. The emergency mode prompt looks similar to this:

```bash
Give root password for maintenance
(or type Control-D to continue):
```

For more information see Tuning Java Machines

20. Email support@candela-tech.com if you have questions or need help.
A. The messages beforehand that begin with [ OK ] can be ignored.
B. Messages beginning with ath10k_pci can be ignored.

2. Provide the root password: 

3. The next we need to determine where our filesystems are mounted. You might have filesystems on partitions, or on LVM volumes. Use the command `mount | grep ext4` to find your partitions:

   ```bash
   # mount | grep ext4 Enter
   /dev/sda2 on / type ext4 {rw,relatime,nodelalloc}
   /dev/sda4 on /home type ext4 {rw,relatime,nodelalloc}
   /dev/sda1 on /boot type ext4 {rw,relatime,nodelalloc}
   ```

   This example shows partitions.

   Note that inspecting `/etc/fstab` often does not show you device partitions, rather it shows you volume or partition UUIDs.

4. Example of filesystems on volumes:

   ```bash
   # mount | grep ext4 Enter
   /dev/mapper/fedora-root on / type ext4 {rw,relatime,nodelalloc}
   /dev/mapper/fedora-home on /home type ext4 {rw,relatime,nodelalloc}
   /dev/sda1 on /boot type ext4 {rw,relatime,nodelalloc}
   ```

   Notice that `/boot` is typically not a LVM volume.

   We assume you'll press the Enter key when executing the commands in further examples.

6. Issuing the `fsck` commands

7. For each of those filesystems in the partition example above, you will execute the below commands:
   A. `$ fsck -fy /dev/sda2` (for /)
   B. `$ fsck -fy /dev/sda4` (for /home)
   C. `$ fsck -fy /dev/sda1` (for /boot)

8. For the volumes example above, you will execute the below commands:
   A. `$ fsck -fy /dev/mapper/fedora-root` (for /)
   B. `$ fsck -fy /dev/mapper/fedora-home` (for /home)
   C. `$ fsck -fy /dev/sda1` (for /boot)

9. Configuring Filesystems Check on Reboot

10. The commands below involve setting the 'mount count' parameter to 1. Every time the filesystem is mounted, it will perform a check. The following examples ensure that full journaling is enabled on the filesystem. This ensures the most amount of recovery. And after that, modern versions of Fedora have metadata checksumming available. Older LANforge systems do not have this.

   A. **Filesystem Check on Every Mount**

   The filesystems do not need to be unmounted to set this parameter. Only the partition example is shown, the volumes example uses similar commands.

   A. `$ touch /forcefsck` (This technique works with any model of filesystem)
   B. `$ tune2fs -c 1 /dev/sda2` (for /)
   C. `$ tune2fs -c 1 /dev/sda4` (for /home)
   D. `$ tune2fs -c 1 /dev/sda1` (for /boot)
B. **Tune the Filesystem for Full Journaling**

The filesystems do not need to be unmounted to set this parameter. The commands for the volumes version is similar to the partition example below.

A. `$ tune2fs -o journal_data /dev/sda2` *(for /)*

B. `$ tune2fs -o journal_data /dev/sda4` *(for /home)*

C. `$ tune2fs -o journal_data /dev/sd1` *(for /boot)*

C. **Note:** Inspect `/etc/fstab` for conflicting mount options. The following example shows mount options applied in the `fstab` file:

```
$ mount | grep ext4
/dev/sda2 on / type ext4 (rw,relatime,nodelalloc)
/dev/sda4 on /home type ext4 (rw,relatime,nodelalloc)
/dev/sd1 on /boot type ext4 (rw,relatime,data=writeback)
```

```
$ grep data= /etc/fstab
UUID=1c1b4732-653f-47dd-a106-ae17cf5b12a9 /boot ext4 data=writeback 1 2
```

Notice the `fstab` entry for `/boot`? It has overridden the data journaling mode. Erase that setting from the `fstab` mount options.

D. **Enable Metadata Checksumming (optional)**

It is only practical to apply metadata checksumming in the below conditions. You will not be able to apply it to the root filesystem / because it cannot be unmounted when you boot the system.

A. Fedora 27 or more recent

B. `tune2fs` 1.43 or more recent

C. `crc32` or `libcrc32` modules loaded

D. You can unmount the filesystem.

E. To Boot into Emergency Mode, follow these steps:

A. Reboot system into Emergency Mode by appending the word `emergency` at the end of your grub boot option.

B. `$ umount -f /home`

C. `$ umount -f /boot`

D. `$ fsck -FD /dev/sd1` *(remember that's /boot)*

E. `$ fsck -FD /dev/mapper/fedora-home`

F. `$ tune2fs -O metadata_csum /dev/sd1`

G. `$ tune2fs -O metadata_csum /dev/mapper/fedora-home`

F. **Disable Drive Write Caching (optional)**

Drives typically ship with write caching enabled for a performance boost. SSDs have this as well. By turning it off you trade some performance for increased data safety. LANforge systems do not ship with write caching disabled. To make this setting enabled every boot, it needs to be added to `/etc/rc.local`. LANforge systems have `rc-local.service` enabled by default.

1. Only disable write caching if your machine powers off without shutdown frequently

A. `$ vi /etc/rc.local`

B. Add the line `/sbin/hdparm -W0 /dev/sda`

C. Save the file.

D. Reboot, or issue the command for this booted session:

   `$ /sbin/hdparm -W0 /dev/sda`
Automatically Start LANforge GUI

Goal: Configure LANforge to automatically start LANforge GUI on boot or login.

Follow these steps to Configure LANforge to automatically start LANforge GUI on boot or login. Requires version 5.4.1

1. Quick Start
   A. Open a terminal or connect to your lanforge machine via ssh:
      
      B. $ cd /home/lanforge/LANforgeGUI 5.4.1
         $ cp LANforge-auto.desktop ~/.config/autostart
         $ sudo systemctl restart vncserver@:1.service

   C. If you were connected via VNC, your session will close. When you reconnect via VNC, you will see a LANforge GUI running on the desktop. This will now start again every reboot.

2. Using desktop file manager
   A. Locate your LANforge GUI Folder by right clicking on your LANforge GUI icon
A. Right-click your LANforge GUI icon

B. Select Properties

B. Your LANforge GUI directory is in the Command textbox:
C. Using the HOME desktop icon, navigate to the LANforge GUI directory

D. Highlight the **LANforge-auto.desktop** file, it might appear as **LANforge client**
E. We need to show hidden directories to place this file.

A. Using the HOME desktop icon, open your home directory and open the Edit->Preferences menu

B. Select Show Hidden Files

F. Find your .config directory
G. Navigate to `/home/lanforge/.config/autostart`.

H. Copy and paste file into the **autostart** directory.
1. In a terminal, issue the command: `sudo systemctl restart vncserver@:1.service`

J. If you were connected via VNC, your session will close. When you reconnect via VNC, you will see a LANforge GUI running on the desktop. This will now start again every reboot.