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Contents

1 Cloud computing vs. edge computing **3**

2 Where is the vantage point for edge computing? **5**

3 How does it work? **7**

4 System Architecture **9**
- 4.1 ParaDrop Edge Compute Node . . . 9
- 4.2 ParaDrop Cloud Controller . . . 11
- 4.3 ParaDrop Hardware . . . 12
- 4.4 ParaDrop API . . . 13

5 Hardware Support **15**
- 5.1 Virtual Machine . . . 15
- 5.2 PC Engines APU2 . . . 18
- 5.3 Intel NUC . . . 20

6 Quick Start **23**
- 6.1 Create a ParaDrop account . . . 23
- 6.2 Boot the router . . . 23
- 6.3 Activate a ParaDrop router . . . 24
- 6.4 Install a hello-world chute . . . 24

7 Developing Applications **25**
- 7.1 Introduction . . . 25
- 7.2 Developing Light Chutes . . . 28
- 7.3 Getting Started with C . . . 29
- 7.4 Getting Started with Go . . . 32
- 7.5 Getting Started with Java . . . 34
- 7.6 Getting Started with Node.js . . . 36
- 7.7 Getting Started with Python . . . 37
- 7.8 Tutorial: Sticky Board . . . 39

8 Frequently Asked Questions **45**
- 8.1 Issues with the hardware or operating system . . . 45

9 How to Contribute **47**
- 9.1 ParaDrop daemon development . . . 47

9.2 Documentation and tests . . . 48

10 Host API Reference **51**
10.1 Host Configuration . . . 51
10.2 Chute Configuration . . . 56
10.3 Chute Management . . . 63
10.4 Device Configuration . . . 69
10.5 Device Information . . . 72

11 pdtools CLI Reference **75**
11.1 pdtools . . . 75

12 Source Code Reference **109**
12.1 Subpackages . . . 109
12.2 Submodules . . . 181
12.3 paradrop.main module . . . 181
12.4 paradrop.plan_demo module . . . 181
12.5 Module contents . . . 181

13 ParaDrop - Enabling Edge Computing at the Extreme Edge **183**

14 Getting Started **185**

15 Where to go from here? **187**

HTTP Routing Table **189**

Python Module Index **191**

ParaDrop is a platform for edge computing. This is best understood by comparison with the popular paradigm of cloud computing.

CHAPTER 1

Cloud computing vs. edge computing

Cloud computing platforms such as Amazon EC2, Microsoft Azure, and Google Cloud Platform have grown in popularity as solutions for providing ubiquitous access to services across different user devices. Cloud computing has benefits for infrastructure providers, service providers, and end users. Infrastructure providers, i.e., cloud platform providers, take advantage of the economies of scale by managing and operating resources in a centralized manner. Cloud computing also provides reliable, scalable, and elastic resources to service providers. In addition, end users can access high-performance computing and large storage resources anywhere with Internet access at any time thanks to the cloud computing.

Despite all of the benefits of cloud computing, there are some inherent trade-offs in the approach. Cloud computing requires developers to host services and data on off-site data centers. That means that the computing and storage resources are spatially distant from end-users and out of their control, which raises issues related to network latency, security, and privacy. A growing number of high-quality services can benefit from computational tasks running closer to end-users, especially within their own home or office. By moving the computation closer to the users, at the edge of the network, services can take advantage of the lower latency to provide better responsiveness and user experience as well as conserve network bandwidth.

CHAPTER 2

Where is the vantage point for edge computing?

There are various options for placing edge computing nodes within the network. Hosting options include dedicated compute nodes in the home or office or on server racks within the ISP network. ParaDrop takes the approach of placing the edge computing substrate within the WiFi access points (APs). The WiFi AP is uniquely suitable for edge computing for multiple reasons:

- WiFi APs are ubiquitous in homes and businesses and inexpensive to replace.
- WiFi APs are always on and available.
- WiFi APs reside directly on the data path between Internet services and end users.

CHAPTER 3

How does it work?

ParaDrop is a research effort to build a highly programmable edge computing platform. The name for the project draws inspiration from the military use case of airdropping resources into the battlefield wherever they are needed most. Similarly, ParaDrop enables users and developers to *paradrop* edge services into the edge of the network as needed. Based on previous research work exploring the advantages of edge computing, we focus on building a platform that is friendly to both users and developers alike.

ParaDrop provides a similar runtime environment as the cloud computing platform to developers so that developers can easily port their services from the cloud to ParaDrop in part or in whole. It does this through lightweight containerization powered by Docker, which is already immensely popular in the cloud computing space. Containers allow developers the flexibility to build services with the programming languages, libraries, and frameworks they prefer, while being less resource-intensive than virtual machines. On top of that, ParaDrop offers a well-defined API that developers can leverage to implement and deploy interesting capabilities that are only available at the edge.

CHAPTER 4

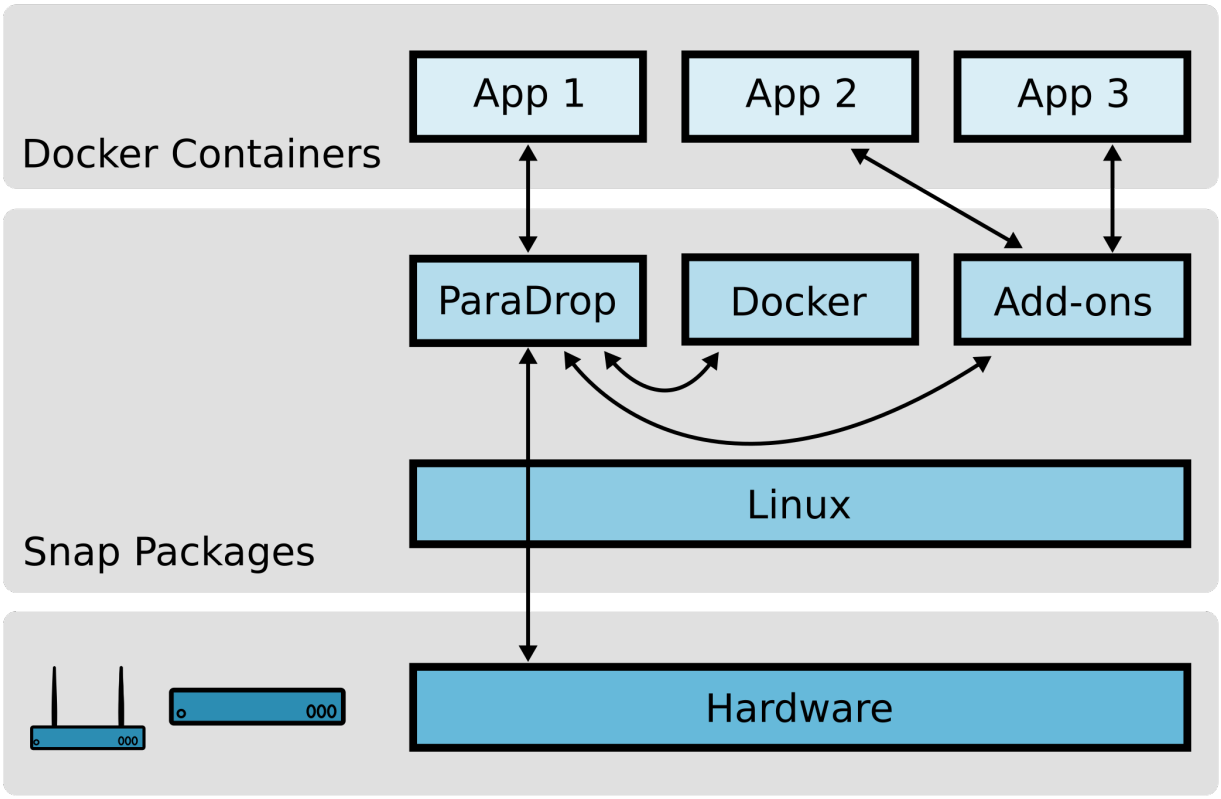
System Architecture

This section describes some of the important architectural features of ParaDrop. Our discussion will cover four major aspects of the ParaDrop design.

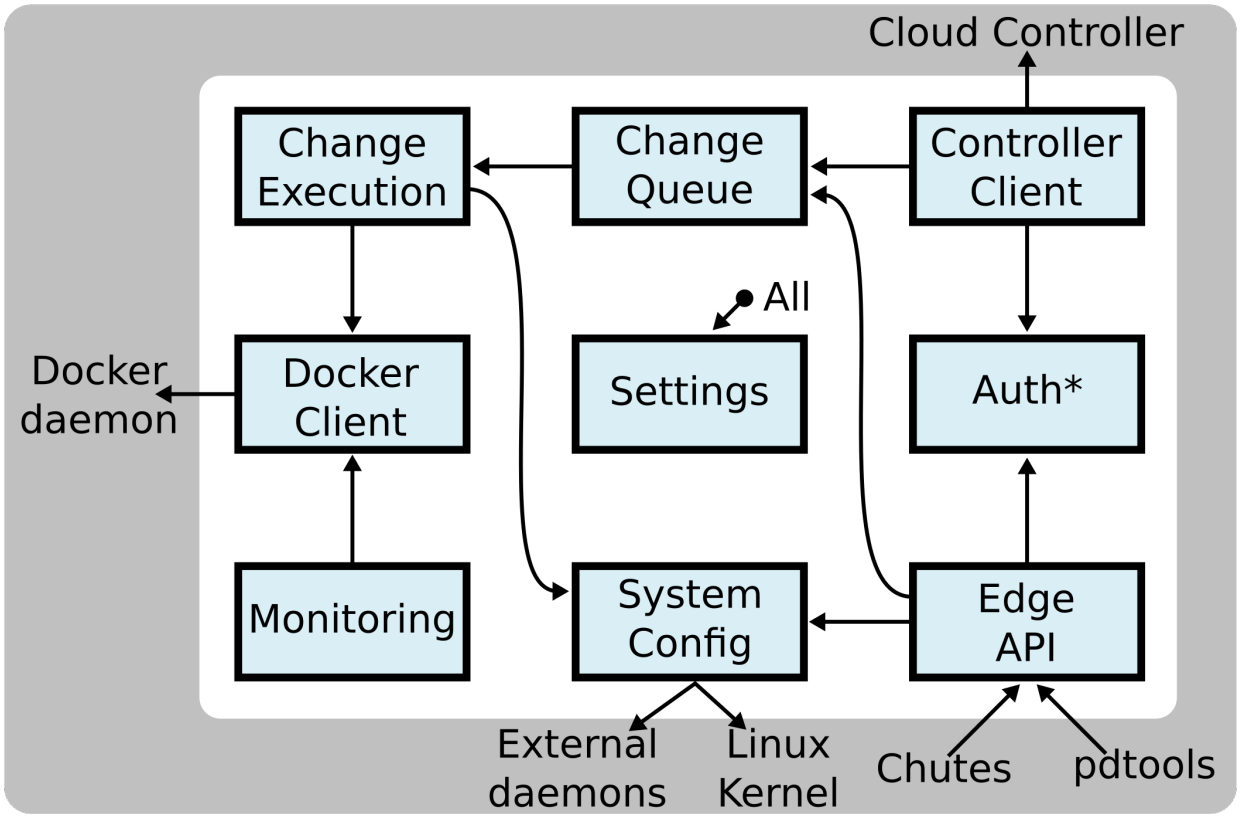
- ParaDrop Edge Compute Node
- ParaDrop Cloud Controller
- ParaDrop Hardware
- ParaDrop API

4.1 ParaDrop Edge Compute Node

The defining component of the platform, the edge compute node, is the computing platform on which your applications and services will run. We designed the software platform entirely using open source components such as Linux and Docker. For system-level packages such as Docker and the ParaDrop daemon, we use snap packages. The snap package format produces self-contained applications that are then distributed and installed in a very controlled way. This keeps the system secure and safely up-to-date through transactional updates. Edge services (called *chutes*) are deployed on the platform as Docker containers. Docker enables developers to build their services as layers on top of any of the numerous publicly available images, and complex applications can even be built by composing and networking multiple Docker containers. All together, ParaDrop is a powerful but also lean computing platform that works on a range of hardware from Raspberry Pis to rack-mounted servers.



If we zoom in to the ParaDrop module, we find this is a piece of software with many responsibilities. We have divided the ParaDrop daemon roughly into nine submodules which are depicted below. Arrows indicate dependencies and tell a story about how external events propagate through the system. This diagram also shows how the ParaDrop daemon on an edge compute node interacts with other external daemons, tools, and services.

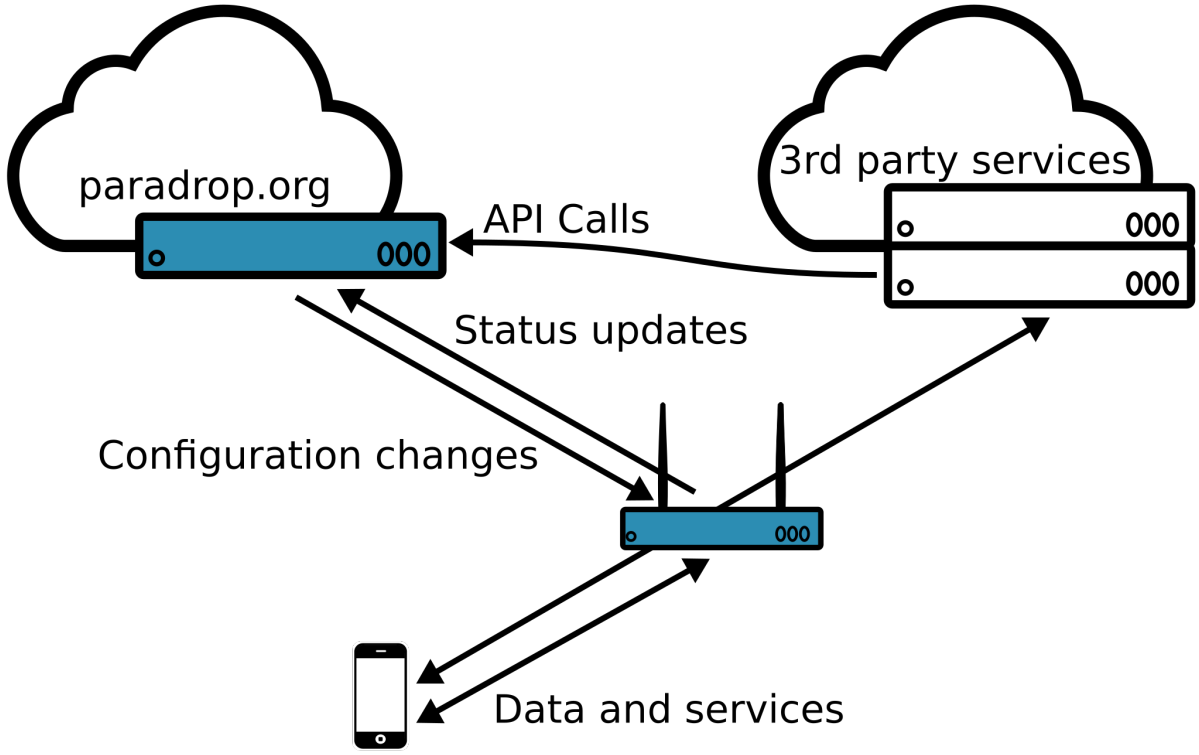


As an example, suppose a developer uses a *pdtools* command to install a chute on the node. We will describe how this event triggers changes throughout the system.

1. *pdtools* makes a call to the Edge API to install a chute.
2. Before any changes are made, ParaDrop validates the identity of the user and whether the user has permission to perform the operation through the Authentication and Authorization (Auth*) module.
3. If there are no problems, ParaDrop then appends the chute installation operation to the Change Queue. If there are other changes in progress, the chute installation will need to wait before it can proceed.
4. The Change Execution engine pops the change off the Change Queue and begins the process of installing the chute.
5. Chute installation involves making external changes to the system. Some changes are through System Configuration such as starting a child process or setting an interface IP address. Most importantly, though, ParaDrop needs to communicate with the Docker daemon in order to run the new application code.
6. After the change is complete, the new system state is reflected in the Monitoring module, in the information that ParaDrop sends to the Cloud Controller, and in any responses to future Edge API requests.

4.2 ParaDrop Cloud Controller

The ParaDrop cloud controller is hosted at paradrop.org and provides a central location for tracking and managing ParaDrop nodes. It also hosts the Chute Store for software distribution. Users and developers can sign up for a free account. For end users and administrators, it provides a dashboard to configure and monitor all ParaDrop nodes under their control. The dashboard also enables users to manage the chutes running on their nodes. For developers, it provides the interface through which applications can be registered as ParaDrop chutes available for installation on routers.



Due to the highly distributed nature of edge computing, the central cloud controller is not strictly required for edge applications to operate. Each ParaDrop edge node has a publicly-documented local API and can be directly managed using the pdtools command line utility. Considering this, we have elected not to release the source code for the cloud controller at this time. If this would have an impact on your decision to use ParaDrop, please contact us.

4.3 ParaDrop Hardware

Although the ParaDrop software platform can run on many different types of hardware, some of its more interesting capabilities are only available on a physical platform that has wireless network interfaces. Our original vision for the project has always been to run ParaDrop on high-end Wi-Fi routers where it serves as the hub for connected IoT devices and can perform computation along the path between the wireless devices and the broader Internet. Our reference implementation uses the PC Engines APU2 single board computer with either one or two 802.11ac Wi-Fi modules. The image below shows a router built with a PC Engines APU board.

You can find instructions for running ParaDrop on the PC Engines APU2 board as well as other hardware platforms and virtual machines in the *Hardware Support* section.

4.4 ParaDrop API

ParaDrop exports the platform's full capability through an API. Based on the functionality and location, the API can be divided into two parts: the cloud API and the edge API. The cloud API provides the management interfaces for applications to orchestrate the chutes from the cloud. Examples include resource permission management, chute deployment and management, and router configuration management. The edge API exports the local context information of the routers to the chutes to do some useful things locally. Examples include local wireless channel information and local wireless peripheral device access.

CHAPTER 5

Hardware Support

This section describes various hardware platforms that we support for running the ParaDrop edge compute software.

If this is your first time working with ParaDrop and you do not have access to any of the supported hardware platforms, we recommend starting with our pre-built virtual machine image, which is covered in the first section below.

After you have an edge node up and running, you will be able to activate the node with the cloud controller at paradrop.org. The page *Quick Start* gives detailed information about that.

5.1 Virtual Machine

This will quickly take you through the process of bringing up a Hello World chute in a virtual machine on your computer.

NOTE: These instructions assume you are running Ubuntu. The steps to launch a virtual machine may be different for other environments.

5.1.1 Environment setup

These steps wil download our router image and launch it a virtual machine.

1. Install required packages:

```
sudo apt-get install qemu-kvm
```

2. Download the latest build of the Paradrop disk image. https://paradrop.org/release/latest/paradrop-amd64.img.xz

3. Extract the image:

```
xz -d paradrop-amd64.img.xz
```

4. Launch the VM:

```
sudo kvm -m 1024 \
-netdev user,id=net0,hostfwd=tcp::8000-:8000,hostfwd=tcp::8022-:22,
↪hostfwd=tcp::8080-:80 \
-device virtio-net-pci,netdev=net0 -drive file=paradrop-amd64.img,format=raw
```

5.1.2 First Boot Setup

After starting the virtual machine for the first time, follow the instructions on the screen. When it prompts for an email address, enter *info@paradrop.io*. This sets up a user account on the router called *paradrop* and prepares the router to receive software upgrades. Allow the router 1-2 minutes to complete its setup before proceeding.

Please note: other than the first boot setup, the system console is not interactive. There is no username/password to log in through the system console. Instead, please follow the steps in the next sections to access your router through paradrop.org or through SSH.

5.1.3 Connecting to your Router with SSH

The router is running an SSH server, which we forwarded from localhost port 8022 with the options to the kvm command above. The router does not accept password login by default, so you will need to have an RSA key pair available, and you can use the router configuration page to upload the public key and authorize it.

1. Open tools page on the router (http://localhost:8080/#!/tools). The page might prompt you for a username and password. If so, use the username "paradrop" and an empty password.
2. Find the SSH Keys section and use the text area to submit your public key. Typically, your public key file will be found at *~/.ssh/id_rsa.pub*. You can use *ssh-keygen* to generate one if you do not already have one. Copy the text from the file, and make sure the format resembles the example before submitting.
3. After the key has been accepted by the router, you can login with the command *ssh -p 8022 paradrop@localhost*.

5.1.4 Alternative Setup Using virt-manager

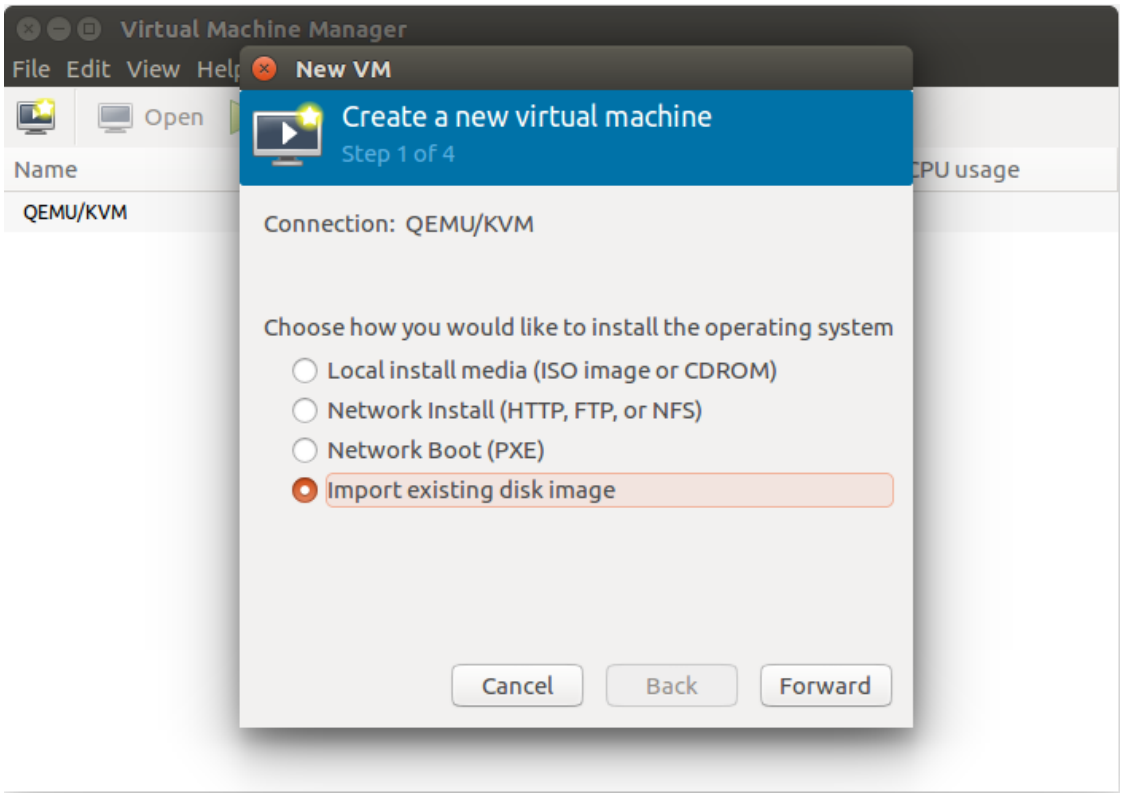
Even though many developers prefer command line tools to manage virtual machines, some developers likes to use GUI tools. In addition, GUI tools are convenient to support some advanced features, e.g., assigning some peripheral devices (USB WiFi dongle) from host to virtual machines. We recommend using "virt-manager" to run ParaDrop virtual machines. If you have not installed it on Ubuntu, you can use below command to install it:

```
sudo apt-get install virt-manager
```

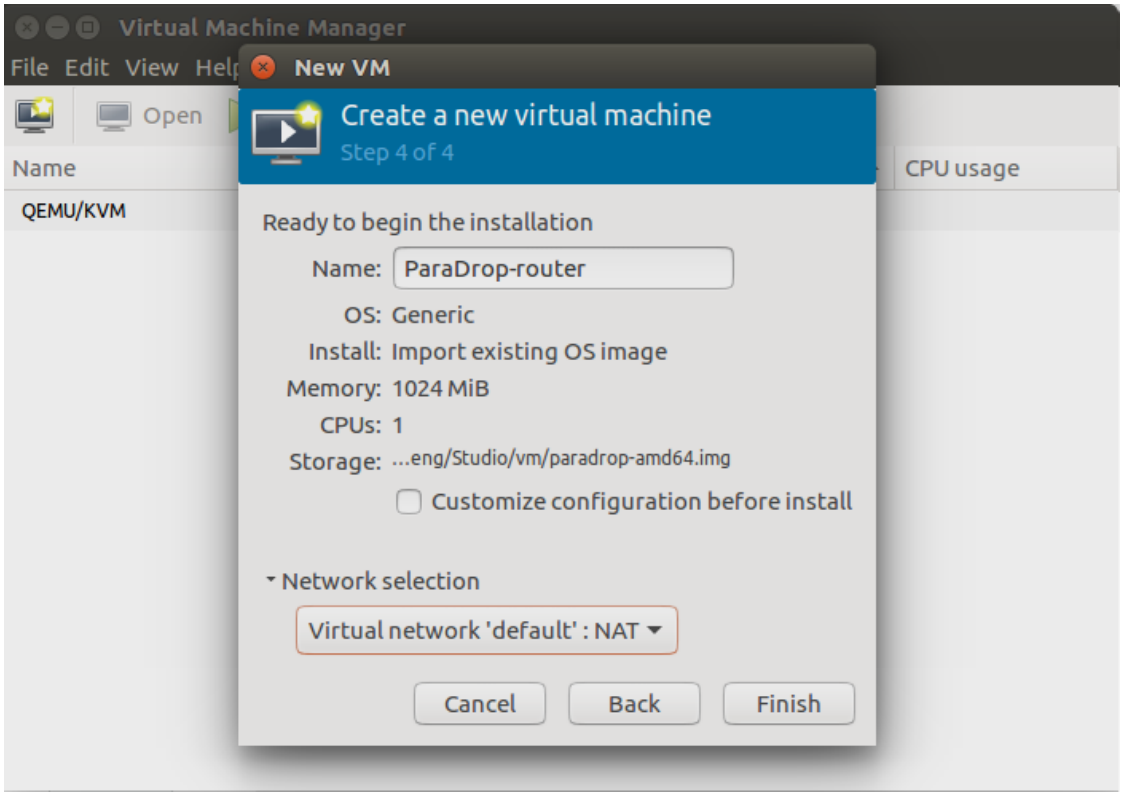
Then we can start virt-manager with below command:

```
sudo virt-manager
```

We can create a VM with the ParaDrop disk image.



Below is the configuration of the VM.



After that, we can boot the VM and configure the first boot as we do when run the VM with command line tools. However, the VM will have an IP address 192.168.122.x, so we can access http://<IP address of the VM> to access

the portal to upload ssh keys, and then login to it directly with the IP address.

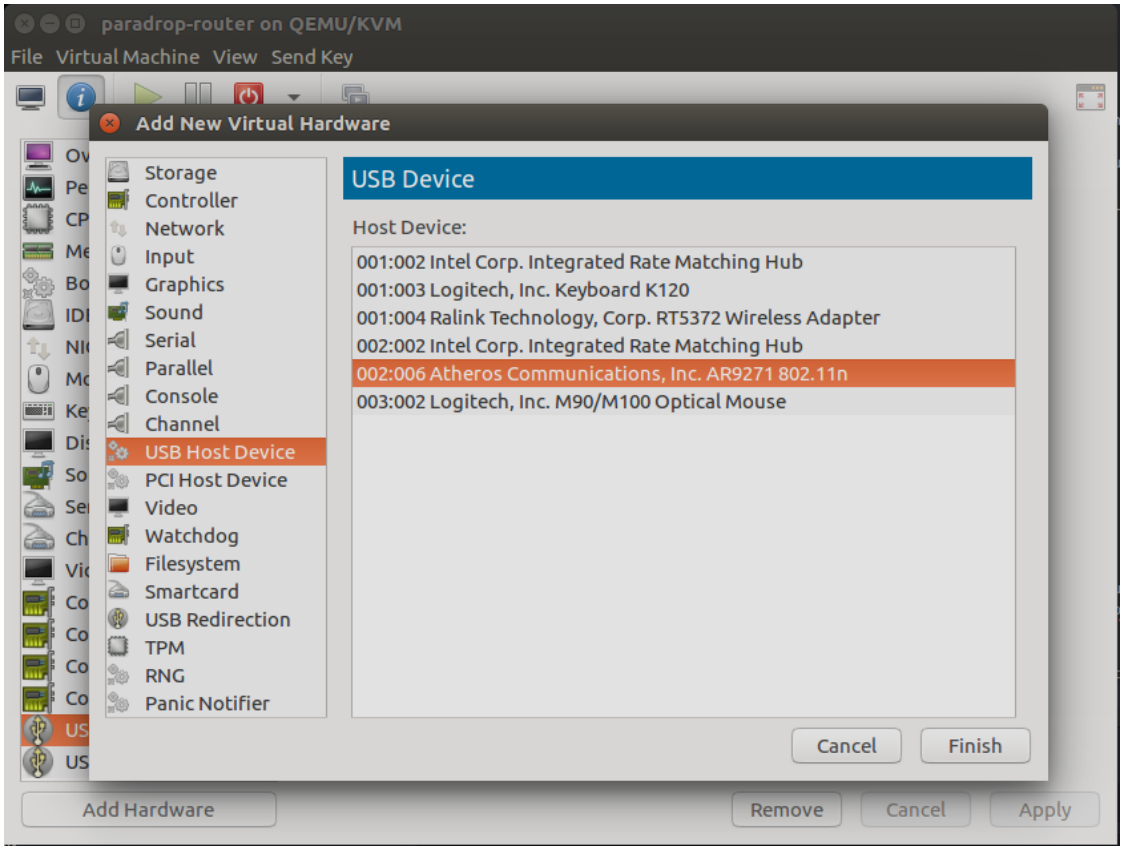
We can assign the USB WiFi dongle from the Host to the ParaDrop VM so that the ParaDrop running on the VM can support features related to WiFi. Before we do that, we need to disable the WiFi device for Host. We can do that with "rflist" command. Run below command to get the number of the WiFi device:

```
rflist list
```

Suppose the index of the WiFi device we want to assign to the ParaDrop VM is 2, then run below command to disable it for host OS:

```
rflist block 2
```

Then we can add the USB WiFi dongle to the VM.



We can run below command in ParaDrop VM to verify that the WiFi device has been detected:

```
iw dev
```

Sometimes, we have to repeat above steps to make sure the WiFi device can be used by the ParaDrop VM.

5.2 PC Engines APU2

5.2.1 Hardware requirements

- 1x system board (apu2c4)

- 1x case (case1d2u)
- 1-2x miniPCIe Wi-Fi modules (wle200nx for 802.11n or wle600vx for 802.11ac)
- 2-4x pigtails (pigsma)
- 2-4x antennas (antsmadb)
- 1x power supply (ac12vus2)
- 1x storage module (sd4b) or alternative (see below)

5.2.2 Storage Module

The APU can boot from an SD card or an m-SATA SSD. These instructions are written assuming you will use an SD card because they are easier to flash from another machine. However, we do frequently build Paradrop routers with SSDs to take advantage of the higher storage capacity and read/write speeds. The 4GB pSLC module listed above is known to be very reliable, but you may also prefer a larger SD card.

5.2.3 Preparing the SD card

1. Download the latest build of the Paradrop disk image
2. Insert the SD card into the machine you used to download the image and find the device node for the card. This is often "/dev/sdb", but please make sure, as the next command will overwrite the contents of whatever device you pass.
3. Copy ("flash") the Paradrop image to the SD card.:

```
xzcat paradrop-amd64.img.xz | sudo dd of=<DEVICE> bs=32M status=progress; sync
```

4. Remove the SD card and proceed to assemble the router.

Please note that in order to make the SD card bootable, it is not enough to copy the disk image file to an existing filesystem on the SD card. Instead, one must overwrite the contents of the SD card including MBR, partition table, and data with the provided disk image. In Linux, you can do this with the *dd* command. If you are using Windows, we suggest using the win32-image-writer tool. Follow the Sourceforge link to download the installer.

5.2.4 First Boot

If you know the IP address of the router, e.g. because you have access to the DHCP server upstream from the router, then you can skip this step and proceed with activating the router as described in the section **:doc:'../manual/index'_**.

The first time you boot the Paradrop router, you can optionally connect a serial cable to complete the Ubuntu Core setup process. The default configuration is 9600 8N1. If you are using PuTTY under Windows, make sure that you have entered the correct COM port for your serial cable. It may not be "COM1". You can use the *chgport* command or open the Windows Device Manager tool to find the correct COM port.

After the router boots, press Enter when prompted and follow the instructions on the console to configure Ubuntu Core. If you have an Ubuntu One account, you can enter the email address here. For consistency with the rest of the instructions, we recommend using the address *info@paradrop.io*. You will be able to manage your router and install chutes through paradrop.org either way, but using our email address ensures consistency with the instructions.

Take note of the IP address displayed in the console. You will need this address for the next step, activating the router. For example, the message below indicates that the router has IP address 10.42.0.162.

```
Congratulations! This device is now registered to info@paradrop.io.

The next step is to log into the device via ssh:

ssh paradrop@10.42.0.162
```

5.3 Intel NUC

These instructions will help you install the ParaDrop daemon on the Intel NUC platform. At the end of this process, you will have a system ready for installing chutes.

We have specifically tested this process on the Skull Canyon (NUC6i7KYK) platform, which we recommend for high performance edge-computing needs.

5.3.1 Hardware and software requirements

- **Intel NUC Skull Canyon NUC6i7KYK**
  - The Intel NUC devices generally do not come with memory or storage pre-installed.
  - Memory: we recommend at least one 8 GB DDR4 SODIMM.
  - Storage: we have generally found one 16 GB SD card to be sufficient for our storage needs, but we recommend using one MX300 M.2 SSD card for the higher read and write speeds.
  - We recommend updating the BIOS on the NUC. Follow the instructions on the Intel support site.
- 2 USB 2.0 or 3.0 flash drives (each 4 GB minimum)
- A monitor with an HDMI interface
- A network connection with Internet access
- An Ubuntu Desktop 16.04.1 LTS image.
- A ParaDrop disk image.

5.3.2 Preparing for installation

1. Download the Ubuntu Desktop image and prepare a bootable USB flash drive.
2. Download the ParaDrop disk image and copy the file to the second flash drive.

5.3.3 Boot from the Live USB flash drive

1. Insert the Live USB Ubuntu Desktop flash drive in the NUC.
2. Start the NUC and push F10 to enter the boot menu.
3. Select the USB flash drive as a boot option.
4. Select “Try Ubuntu without installing”.

5.3.4 Flash ParaDrop

1. Once the system is ready, insert the second USB flash drive which contains the ParaDrop disk image.
2. Open a terminal and run the following command, where <disk label> is the name of the second USB flash drive. We recommend that you double-check that /dev/sda is the desired destination **before running dd**.

```
zcat /media/ubuntu/<disk label>/paradrop_router.img.gz | sudo dd of=/dev/sda␣
↪bs=32M status=progress; sync
```

3. Reboot the system and remove all USB flash drives when prompted to do so.

5.3.5 First boot

1. At the Grub menu, press 'e' to edit the boot options.
2. Find the line that begins with "linux" and append the option "nomodeset". It should look like "linux (loop)/kernel.img $cmdline nomodeset". Adding this option will temporarily fix a graphics issue that is known to occur with the Intel NUC.
3. Press F10 to continue booting.
4. Press Enter when prompted, and follow the instructions on the screen to configure Ubuntu Core. If you have an Ubuntu One account. By connecting your Ubuntu One account, you will be able to login via SSH with the key(s) attached to your account. Otherwise, if you do not have an Ubuntu One account or do not wish to use it, you may enter "info@paradrop.io" as your email address. You will still be able to manage your router and install chutes through paradrop.org either way, but using our email address ensures consistency with the instructions.
5. Take note of the IP address displayed on the screen. You will need this address for the next step, activating the router. For example, the message below indicates that the router has IP address 10.42.0.162.

```
Congratulations! This device is now registered to info@paradrop.io.

The next step is to log into the device via ssh:

ssh paradrop@10.42.0.162
...
```

CHAPTER 6

Quick Start

This section goes through the steps to create a ParaDrop account, activate a ParaDrop router, and install a hello-world chute on the router.

If you have received a device with ParaDrop already installed, you can start here. If you do not have a ParaDrop-enabled device, please visit the *Hardware Support* section to learn about supported hardware or download an virtual machine image.

6.1 Create a ParaDrop account

With a ParaDrop account, users can manage the resources of ParaDrop through a web frontend.

1. Signup at https://paradrop.org/signup. You will receive a confirmation email from paradrop.org after you finish the signup.
2. Confirm your registration in the email.

6.2 Boot the router

Note: some of these steps are specific to the PC Engines APU/APU2 hardware.

1. Using an Ethernet cable, connect the WAN port of the ParaDrop router to a modem, switch, or other device with access to the Internet.
2. Connect the power supply. To avoid malfunctioning due to arcing, it is recommended to connect the barrel connector to DC jack on the back of the router first and connect the adapter to a power outlet second.
3. Allow the router 1-2 minutes to start up, especially on the first boot.
4. Connect a device (laptop, phone, etc.) either to one of the LAN ports on the back of the router or to its WiFi network. Typically, the router will be preconfigured with an open ESSID called "ParaDrop". If the WiFi network has a password, that information will be provided separately.

6.3 Activate a ParaDrop router

Activation associates the router with your account on paradrop.org so that you can manage the router and chutes through the cloud controller.

1. Login to paradrop.org.
2. Navigate to the Routers List page. If your router came with a Claim Token, enter that here and skip steps 3-5. Otherwise if you do not have a Claim Token, click Create Router. Give your router a unique name and an optional location and description to help you remember it and click Submit.
3. On the router page, find the "Router ID" and "Password" fields. You will need to copy this information to the router so that it can connect to the controller.
4. Open the router portal at http://<router_ip_address> (or http://paradrop.io if you are connected to the LAN port of the router or its WiFi network). You may be prompted for a username and password. The default login is "paradrop" with an empty password. If the password is set, you will have received information about that with the router.
5. Click the "Activate the router with a ParaDrop Router ID" button and enter the information from the paradrop.org router page. If the activation was successful, you should see checkmarks appear on the "WAMP Router" and "ParaDrop Server" lines. You may need to refresh the page to see the update.
6. After you activate your router, you will see the router status is online at https://paradrop.org/routers.

6.4 Install a hello-world chute

1. Make sure you have an activated, online router.
2. Go to the Chute Store page on paradrop.org. There you will find some public chutes such as the hello-world chute. You can also create your own chutes here.
3. Click on the hello-world chute, click Install, click your router's name to select it, and finally, click Install.
4. That will take you to the router page again where you can click the update item to monitor its progress. When the installation is complete, an entry will appear under the Chutes list.
5. The hello-world chute starts a webserver, which is accessible at http://<router-ip-address>/chutes/hello-world. Once the installation is complete, test it in a web browser.

CHAPTER 7

Developing Applications

This section of the document is devoted to describing the edge computing services (chutes) that run on ParaDrop. There are two categories of ParaDrop applications - pure edge applications and cloud-edge hybrid applications. The pure edge applications have standalone chutes, which can be deployed in the ParaDrop routers. Cloud-edge hybrid applications have both a cloud component and an edge component. In this section, we will focus on the chute development, in other words, the edge component.

7.1 Introduction

ParaDrop is a software platform that enables services to run on Wi-Fi routers. We call these services *chutes* as in *parachutes*.

ParaDrop runs on top of Ubuntu Core, a lightweight, transactionally updated operating system designed for deployments on embedded and IoT devices, cloud and more. It runs a new breed of secure, remotely upgradeable Linux app packages known as snaps. We support chute deployment through containerization powered by Docker.

Minimally, a chute has a Dockerfile, which contains instructions for building and preparing the application to run on ParaDrop. A chute will usually also require scripts, binaries, configuration files, and other assets. For integration with the ParaDrop toolset, we highly recommend developing a chute as a GitHub project, but other organization methods are possible.

We will examine the hello-world chute as an example of a complete ParaDrop application.

7.1.1 Structure

Our hello-world chute is a git project with the following files:

```
chute/index.html
Dockerfile
README.md
paradrop.yaml
```

The top-level contains a README, a Dockerfile, and a special file called "paradrop.yaml", which will be discussed below. As a convention, we place files that will be used by the running application in a subdirectory called "chute". This is not necessary but helps keep the project organized. Valid alternatives include "src" or "app".

7.1.2 paradrop.yaml

The paradrop.yaml file, which is unique to the ParaDrop platform, contains important metadata about the project. ParaDrop uses this information to run the chute on an edge node and also determine what to present to the user.

Here is an example from the hello-world chute:

```
name: hello-world
description: This project demonstrates a very simple...
version: 1
type: normal
config:
  web:
    port: 80
```

This example is fairly self-explanatory. It shows a name, description, and version for the chute, which will be shown on interfaces that present the running software on the node.

This example is based on an older, more limited syntax, which can only run one service per chute. For a more complete example and documentation, refer to *Chute Configuration*.

type: normal

This declaration indicates the type of the chute, which tells ParaDrop how to build and install it. *Normal* chutes build from a Dockerfile, which we see is present in this project. This is in contrast with *light* chutes described in *Developing Light Chutes*.

port: 80

This declaration indicates that the chute runs a web server on port 80. ParaDrop will use this information to expose the service externally to users.

7.1.3 Dockerfile

The Dockerfile contains instructions for building and preparing an application to run on ParaDrop. Here is a minimal Dockerfile for our hello-world chute:

```
FROM nginx
ADD chute/index.html /usr/share/nginx/html/index.html
```

FROM nginx

The FROM instruction specifies a base image for the chute. This could be a Linux distribution such as "ubuntu:14.04" or an standalone application such as "nginx". The image name must match an image in the Docker public registry. We recommend choosing from the official repositories. Here we use "nginx" for a light-weight web server.

ADD <source> <destination>

The ADD instruction copies a file or directory from the source repository to the chute filesystem. This is useful for installing scripts or other files required by the chute and are part of the source repository. The <source> path should be inside the respository, and the <destination> path should be an absolute path or a path inside the chute's working directory. Here we install the index.html file from our source repository to the search directory used by nginx.

Other useful commands for building chutes are RUN and CMD. For a complete reference, please visit the official Dockerfile reference.

Here is an alternative implementation of the hello-world Dockerfile that demonstrates some of the other useful instructions.

```
FROM ubuntu:14.04
RUN apt-get update && apt-get install -y nginx
ADD chute/index.html /usr/share/nginx/html/index.html
EXPOSE 80
CMD ["nginx", "-g", "daemon off;"]
```

Here we use a RUN instruction to install nginx and a CMD instruction to set nginx as the command to run inside the chute container. Using "ubuntu:14.04" as the base image gives access to any packages that can be installed through apt-get.

7.1.4 Persistent Data

Each running chute has a persistent data storage that is not visible to other chutes. By default the persistent data directory is named "/data" inside the chute's filesystem. Files stored in this directory will remain when upgrading or downgrading the chute and are only removed when uninstalling the chute.

7.1.5 System Information

The ParaDrop daemon share system information with chutes through a read-only directory named "/paradrop". Chutes that are configured with a WiFi access point will find a file in this directory that lists wireless clients. In future versions there will also be information about Bluetooth and other wireless devices.

dnsmasq-wifi.leases

This file lists client devices that have connected to the chute's WiFi network and received a DHCP lease. This is a plain text file with one line for each device containing the following space-separated fields.

1. DHCP lease expiration time (seconds since Unix epoch).
2. MAC address.
3. IP address.
4. Host name, if known.
5. Client ID, if known; the format of this field varies between devices.

The following example shows two devices connected to the chute's WiFi network.

```
1480650200 00:11:22:33:44:55 192.168.128.130 android-ffeeddccbbaa9988 *
1480640500 00:22:44:66:88:aa 192.168.128.170 someones-iPod 01:00:22:44:66:88:aa
```

7.1.6 Chute-to-Host API

The Paradrop daemon exposes some functionality and configuration options to running chutes through an HTTP API. This aspect of Paradrop is under rapid development, and new features will be added with every release. The host API is available to chutes through the URL "http://paradrop.io/api/v1". Paradrop automatically configures chutes to resolve "paradrop.io" to the ParaDrop device itself, so these requests go to the ParaDrop daemon running on the router and not to an outside server.

Authorization

In order to access the host API, chutes must pass a token with every request that proves the authenticity of the request. When chutes are installed on a ParaDrop router, they automatically receive a token through an environment variable named "PARADROP_API_TOKEN". The chute should read this environment variable and pass the token as a Bearer token in an HTTP Authorization header. Here is an example in Python using the Requests library.:

```
import os
import requests

CHUTE_NAME = os.environ.get('PARADROP_CHUTE_NAME', 'chute')
API_TOKEN = os.environ.get('PARADROP_API_TOKEN', 'NA')

headers = { 'Authorization': 'Bearer ' + API_TOKEN }
url = 'http://paradrop.io/api/v1/chutes/{}/networks'.format(CHUTE_NAME)
res = requests.get(url, headers=headers)
print(res.json())
```

Please refer to *Host API Reference* for a complete listing of API functions.

7.2 Developing Light Chutes

Light chutes build and install the same way as normal chutes and can do many of the same things. However, they make use of prebuilt base images that are optimized for different programming languages. We offer light chutes as a convenience for projects that only rely on one of the supported languages and do not need to install other system packages.

Light chutes offer a few advantages over normal chutes.

- **Safety:** Light chutes have stronger confinement properties, so you can feel safer installing a light chute written by a third party developer.
- **Fast installation:** Light chutes use a common base image that may already be cached on the router, so installation can be very fast.
- **Simplicity:** You do not need to learn how to write and debug a Dockerfile to develop a chute. Instead, you can use the package management tools you may already be using (e.g. package.json for npm and requirements.txt for pip).
- **Portability:** With ARM suppport coming soon for ParaDrop, your light chutes will most likely run on ARM with extra work on your part. This is not the case for normal chutes that use a custom Dockerfile.

We will look at the node-hello-world chute as an example of a light chute for ParaDrop.

7.2.1 Structure

Our hello-world chute is a git project with the following files:

```
README.md
index.js
package.json
paradrop.yaml
```

The project contains the typical files for a node.js project as well as a special file called "paradrop.yaml".

7.2.2 paradrop.yaml

The paradrop.yaml file contains information that ParaDrop needs in order to run the chute. Here are the contents for the hello-world example:

```
name: node-hello-world
description: This chute demonstrates a simple web service.
source:
  type: git
  url: https://github.com/ParadropLabs/node-hello-world
type: light
use: node
command: node index.js
config:
  web:
    port: 3000
```

Most of these fields are self-explanatory and covered in the *Introduction* section.

type: light

This indicates that we are building a *light* chute as opposed to a *normal* chute, which would require a Dockerfile be present.

use: node

This indicates that we are using the *node* base image for this chute. You should choose the base image appropriate for your project. Examples of supported images are *node* and *python2*.

This is handled in an interesting way by ParaDrop. ParaDrop does not use one single *node* image. Rather, the execution engine considers the architecture of the underlying hardware and uses a *node* image built for that architecture.

command: node index.js

This line indicates the command for starting your application. You can either specify it this way, as a string with spaces between the parameters, or you can use a list of strings. The latter format would be particularly useful if your parameters include spaces. Here is an example:

```
command:
  - node
  - index.js
```

7.2.3 Persistent Data

Each running chute has a persistent data storage that is not visible to other chutes. By default the persistent data directory is named "/data" inside the chute's filesystem. Files stored in this directory will remain when upgrading or downgrading the chute and are only removed when uninstalling the chute.

7.3 Getting Started with C

This tutorial will teach you how to build a "Hello, World!" chute using C and the microhttpd library.

7.3.1 Prerequisites

Please make sure you have pdtools v0.12.0 or newer installed.

```
pip install pdtools~=0.12
```

7.3.2 Set up

Make a new directory.

```
mkdir c-hello-world
cd c-hello-world
```

7.3.3 Create a chute configuration

Use the pdtools interactive initialize command to create a paradrop.yaml file for your chute.

```
python -m pdtools chute initialize
```

Use the following values as suggested responses to the prompts. If you have a different version of pdtools installed, the prompts may be slightly different.

```
name: c-hello-world
description: Hello World chute for ParaDrop using C.
type: normal
```

The end result should be a paradrop.yaml file similar to the following.

```
description: Hello World chute for ParaDrop using C.
name: c-hello-world
services:
  main:
    source: .
    type: normal
version: 1
```

7.3.4 Develop the Application

Create a file named `hello.c` with the following code. The code for this application comes from an example file distributed with the microhttpd library.

```
/*
 This file is part of libmicrohttpd
 (C) 2007 Christian Grothoff (and other contributing authors)
 This library is free software; you can redistribute it and/or
 modify it under the terms of the GNU Lesser General Public
 License as published by the Free Software Foundation; either
 version 2.1 of the License, or (at your option) any later version.
 This library is distributed in the hope that it will be useful,
 but WITHOUT ANY WARRANTY; without even the implied warranty of
 MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the GNU
 Lesser General Public License for more details.
 You should have received a copy of the GNU Lesser General Public
 License along with this library; if not, write to the Free Software
 Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA  02110-1301  USA
*/
```

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```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#include <microhttpd.h>

#define PAGE "<html><head><title>libmicrohttpd demo</title></head><body>libmicrohttpd␣
↪demo</body></html>"

static int
ahc_echo (void *cls,
          struct MHD_Connection *connection,
          const char *url,
          const char *method,
          const char *version,
          const char *upload_data, size_t *upload_data_size, void **ptr)
{
  static int aptr;
  const char *me = cls;
  struct MHD_Response *response;
  int ret;

  if (0 != strcmp (method, "GET"))
    return MHD_NO;              /* unexpected method */
  if (&aptr != *ptr)
    {
      /* do never respond on first call */
      *ptr = &aptr;
      return MHD_YES;
    }
  *ptr = NULL;                  /* reset when done */
  response = MHD_create_response_from_buffer (strlen (me),
                (void *) me, MHD_RESPMEM_PERSISTENT);
  ret = MHD_queue_response (connection, MHD_HTTP_OK, response);
  MHD_destroy_response (response);
  return ret;
}

int
main (int argc, char *const *argv)
{
  struct MHD_Daemon *d;

  if (argc != 2)
    {
      printf ("%s PORT\n", argv[0]);
      return 1;
    }
  d = MHD_start_daemon (
          MHD_USE_SELECT_INTERNALLY | MHD_USE_DEBUG,
                        atoi (argv[1]),
                        NULL, NULL, &ahc_echo, PAGE,
          MHD_OPTION_CONNECTION_TIMEOUT, (unsigned int) 120,
          MHD_OPTION_END);
  if (d == NULL)
    return 1;
```

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```
  pause ();
  MHD_stop_daemon (d);
  return 0;
}
```

Create a file named `Dockerfile` with the following contents. This project demonstrates what is called a multi-stage build (https://docs.docker.com/develop/develop-images/multistage-build/#use-multi-stage-builds). The first stage installs development packages for compiling the project. The second stage merely copies the compiled binary and installs binary shared libraries that are required in order to run the program.

```
FROM ubuntu:16.04
COPY hello.c .
RUN apt-get update && apt-get install -y libmicrohttpd-dev
RUN gcc -o hello hello.c -lmicrohttpd

FROM ubuntu:16.04
RUN apt-get update && apt-get install -y libmicrohttpd10
COPY --from=0 hello /usr/bin/hello
EXPOSE 8888
CMD ["hello", "8888"]
```

7.3.5 Wrap Up

The web server in this application listens on port 8888. We need to include that information in the paradrop.yaml file as well. Use the following command to alter the configuration file.

```
python -m pdtools chute enable-web-service 8888
```

After that, you can continue developing the chute and install it on a ParaDrop node.

```
python -m pdtools node --target=<node address> install-chute
```

7.4 Getting Started with Go

This tutorial will teach you how to build a "Hello, World!" chute using Go.

7.4.1 Prerequisites

Make sure you have Go installed as well as ParaDrop pdtools (v0.12.0 or newer).

```
pip install pdtools~=0.12
```

7.4.2 Set up

Make a new directory.

```
mkdir go-hello-world
cd go-hello-world
```

7.4.3 Create a chute configuration

Use the pdtools interactive initialize command to create a paradrop.yaml file for your chute.

```
python -m pdtools chute initialize
```

Use the following values as suggested responses to the prompts. If you have a different version of pdtools installed, the prompts may be slightly different.

```
name: go-hello-world
description: Hello World chute for ParaDrop using Go.
type: light
image: go
command: app
```

The end result should be a paradrop.yaml file similar to the following.

```
description: Hello World chute for ParaDrop using Go.
name: go-hello-world
services:
  main:
    command: app
    image: go
    source: .
    type: light
version: 1
```

7.4.4 Develop the Application

Create a file name `main.go` with the following code.

```
package main

import (
    "fmt"
    "net/http"
)

func GetIndex(w http.ResponseWriter, r *http.Request) {
    fmt.Fprintf(w, "Hello, World!\n")
}

func main() {
    fmt.Println("Listening on :8000")
    http.HandleFunc("/", GetIndex)
    http.ListenAndServe(":8000", nil)
}
```

Run the application locally with the following command.

```
go run main.go
```

Then load `http://localhost:8000/` in a web browser to see the result.

7.4.5 Wrap Up

The web server in this application listens on port 8000. We need to include that information in the paradrop.yaml file as well. Use the following command to alter the configuration file.

```
python -m pdtools chute enable-web-service 8000
```

After that, you can continue developing the chute and install it on a ParaDrop node.

```
python -m pdtools node --target=<node address> install-chute
```

7.5 Getting Started with Java

This tutorial will teach you how to build a "Hello, World!" chute using Java and Maven.

7.5.1 Prerequisites

Make sure you have Java 1.8+, Maven 3.0+, as well as ParaDrop pdtools (v0.12.0 or newer).

```
pip install pdtools~=0.12
```

7.5.2 Set up

Use Maven to set up an empty project.

```
mvn archetype:generate -DgroupId=org.paradrop.app -DartifactId=java-hello-world -
↪DarchetypeArtifactId=maven-archetype-quickstart -DinteractiveMode=false
cd java-hello-world
```

7.5.3 Create a chute configuration

Use the pdtools interactive initialize command to create a paradrop.yaml file for your chute.

```
python -m pdtools chute initialize
```

Use the following values as suggested responses to the prompts. If you have a different version of pdtools installed, the prompts may be slightly different.

```
name: java-hello-world
description: Hello World chute for ParaDrop using Java.
type: light
image: maven
command: java -cp target/java-hello-world-1.0-SNAPSHOT.jar org.paradrop.app.App
```

The end result should be a paradrop.yaml file similar to the following.

```
description: Hello World chute for ParaDrop using Java.
name: java-hello-world
services:
  main:
```

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```
    command: java -cp target/java-hello-world-1.0-SNAPSHOT.jar org.paradrop.app.App
    image: maven
    source: .
    type: light
version: 1
```

7.5.4 Develop the Application

Replace the automatically-generated application code in `src/main/java/org/paradrop/app/App.java` with the following code.

```
package org.paradrop.app;

import java.io.IOException;
import java.io.OutputStream;
import java.net.InetSocketAddress;

import com.sun.net.httpserver.HttpExchange;
import com.sun.net.httpserver.HttpHandler;
import com.sun.net.httpserver.HttpServer;

public class App {
    public static void main(String[] args) throws Exception {
        System.out.println("Listening on :8000");
        HttpServer server = HttpServer.create(new InetSocketAddress(8000), 0);
        server.createContext("/", new GetIndex());
        server.start();
    }

    static class GetIndex implements HttpHandler {
        @Override
        public void handle(HttpExchange t) throws IOException {
            String response = "Hello, World!";
            t.sendResponseHeaders(200, response.length());
            OutputStream os = t.getResponseBody();
            os.write(response.getBytes());
            os.close();
        }
    }
}
```

Run the application locally with the following commands.

```
mvn package
java -cp target/java-hello-world-1.0-SNAPSHOT.jar org.paradrop.app.App
```

Then load `http://localhost:8000/` in a web browser to see the result.

7.5.5 Wrap Up

The web server in this application listens on port 8000. We need to include that information in the paradrop.yaml file as well. Use the following command to alter the configuration file.

```
python -m pdtools chute enable-web-service 8000
```

After that, you can continue developing the chute and install it on a ParaDrop node.

```
python -m pdtools node --target=<node address> install-chute
```

7.6 Getting Started with Node.js

This tutorial will teach you how to build a "Hello, World!" chute using Node.js and Express.

7.6.1 Prerequisites

Make sure you have Node.js (v6 or newer) installed as well as ParaDrop pdtools (v0.12.0 or newer).

```
pip install pdtools~=0.12
```

7.6.2 Set up

Make a new directory.

```
mkdir node-hello-world
cd node-hello-world
```

7.6.3 Create a chute configuration

Use the pdtools interactive initialize command to create a paradrop.yaml file for your chute.

```
python -m pdtools chute initialize
```

Use the following values as suggested responses to the prompts. If you have a different version of pdtools installed, the prompts may be slightly different.

```
name: node-hello-world
description: Hello World chute for ParaDrop using Node.js.
type: light
image: node
command: node index.js
```

The end result should be a paradrop.yaml file similar to the following.

```
description: Hello World chute for ParaDrop using Node.js.
name: node-hello-world
services:
  main:
    command: node index.js
    image: node
    source: .
    type: light
version: 1
```

The `pdtools chute init` command will also create a package.json file for you if one did not already exist, so there is no need to run `npm init` after running `pdtools chute init`.

7.6.4 Install Dependencies

Use the following command to install some dependencies. We will be using Express as a simple web server.

The `--save` option instructs npm to save the packages to the package.json file. When installing the chute, ParaDrop will read package.json to install the same versions of the packages that you used for development.:

```
npm install --save express@^4.16.1
```

7.6.5 Develop the Application

We indicated that index.js is the entrypoint for the application, so we will create a file named `index.js` and put our code there.

```
const express = require('express')
const app = express()

app.get('/', function (req, res) {
  res.send('Hello, World!')
})

app.listen(3000, function() {
  console.log('Listening on port 3000.')
})
```

Run the application locally with the following command.

```
node index.js
```

Then load `http://localhost:3000/` in a web browser to see the result.

7.6.6 Wrap Up

The web server in this application listens on port 3000. We need to include that information in the paradrop.yaml file as well. Use the following command to alter the configuration file.

```
python -m pdtools chute enable-web-service 3000
```

After that, you can continue developing the chute and install it on a ParaDrop node.

```
python -m pdtools node --target=<node address> install-chute
```

7.7 Getting Started with Python

This tutorial will teach you how to build a "Hello, World!" chute using Python and Flask.

7.7.1 Prerequisites

Make sure you have Python 2 installed as well as ParaDrop pdtools (v0.12.0 or newer).

```
pip install pdtools~=0.12
```

7.7.2 Set up

Make a new directory.

```
mkdir python-hello-world
cd python-hello-world
```

7.7.3 Create a chute configuration

Use the pdtools interactive initialize command to create a paradrop.yaml file for your chute.

```
python -m pdtools chute initialize
```

Use the following values as suggested responses to the prompts. If you have a different version of pdtools installed, the prompts may be slightly different.

```
name: python-hello-world
description: Hello World chute for ParaDrop using Python.
type: light
image: python2
command: python2 -u main.py
```

The end result should be a paradrop.yaml file similar to the following.

```
description: Hello World chute for ParaDrop using Python.
name: python-hello-world
services:
  main:
    command: python2 -u main.py
    image: python2
    source: .
    type: light
version: 1
```

7.7.4 Install Dependencies

We will use pip and virtualenv to manage dependencies for the project. First set up a virtual enviroment.

```
virtualenv venv
source venv/bin/activate
```

Use the following command to install some dependencies. We will be using Flask as a simple web server.

```
pip install Flask==0.12.2
```

Finally, save the version information to a file called `requirements.txt`. When installing the chute, ParaDrop will use this file to install the same versions of the packages that you used during development.

```
pip freeze >requirements.txt
```

7.7.5 Develop the Application

We indicated that main.py is the entrypoint for the application, so we will create a file named `main.py` and put our code there.

```
from flask import Flask

app = Flask(__name__)

@app.route('/')
def index():
    return 'Hello, World!'

if __name__ == '__main__':
    app.run(host='0.0.0.0', port=5000)
```

Run the application locally with the following command.

```
python main.py
```

Then load `http://localhost:5000/` in a web browser to see the result.

7.7.6 Wrap Up

The web server in this application listens on port 5000. We need to include that information in the paradrop.yaml file as well. Use the following command to alter the configuration file.

```
python -m pdtools chute enable-web-service 5000
```

After that, you can continue developing the chute and install it on a ParaDrop node.

```
python -m pdtools node --target=<node address> install-chute
```

7.8 Tutorial: Sticky Board

This tutorial will teach you how to build a fully-functional ParaDrop application from scratch. Through the tutorial, we will build a "Sticky Board", a local board where visitors can post images for others to see. We will be using Node.js to build the application, so make sure you have that installed on your development machine.

7.8.1 Set Up

Make a new directory, and initialize a git repository:

```
mkdir sticky_board
cd sticky_board
git init
mkdir views
```

7.8.2 Setup Node.js Project

We will be using npm to manage Node.js packages. You can use the `npm init` command to get started or create a file called package.json. with the following contents:

```
{
  "name": "sticky_board",
  "version": "1.0.0",
  "description": "Post images for others to see.",
  "main": "index.js",
  "author": "ParaDrop Team"
}
```

7.8.3 Install Dependencies

Use the following command to install some dependencies that we will be using to build the application. We use express as a simple web server along with a plugin for accepting file uploads. We will also use Embedded JS (EJS) for simple templating, demonstrated later in this tutorial.

The `--save` option instructs npm to save the packages to the package.json file. ParaDrop will read package.json to install the same versions of the packages that you used for development.

```
npm install --save ejs@^2.5.6 express@^4.14.1 express-fileupload@^0.1.1
```

7.8.4 Hello World

Let's start with a minimal Hello World Express.js example. Create a file named `index.js` and add the following code:

```
var express = require('express');
var app = express();

app.get('/', function (req, res) {
  res.send('Hello World!');
});

app.listen(3000, function() {
  console.log('Listening on port 3000.');
});
```

Run the app with the following command:

```
node index.js
```

Then load `http://localhost:3000/` in a web browser to see the result.

7.8.5 Image Uploads

Next, we will add an endpoint to receive image uploads.

```
var express = require('express');
var fileupload = require('express-fileupload');

```

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```
var app = express();

// Use PARADROP_DATA_DIR when running on Paradrop and /tmp for testing.
var storage_dir = process.env.PARADROP_DATA_DIR || '/tmp';

app.use(fileupload());
app.use(express.static(storage_dir));
app.set('view engine', 'ejs');

app.post('/create', function(req, res) {
  var img = req.files.img;
  if (img) {
    img.mv(storage_dir + '/' + img.name);
  }

  res.redirect('/');
});

app.get('/', function (req, res) {
  res.render('home');
});

app.listen(3000, function() {
  console.log('Listening on port 3000.');
});
```

Create a new file in the views directory called home.ejs with the following contents:

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="utf-8">
    <title>ParaDrop Sticky Board</title>
  </head>
  <body>
    <h1>ParaDrop Sticky Board</h1>
    <h2>Create a Note</h2>
    <p>Upload an image file to create a note for others to see.</p>
    <form action="/create" method="POST" encType="multipart/form-data">
      <input type="file" name="img" />
      <input type="submit" value="Create" />
    </form>
  </body>
</html>
```

Right now it is just plain HTML. In the next section we will make use of templating to add images to the sticky board.

Run the app again and load `http://localhost:3000/`. Try using the form to upload an image. You should then be able to find your image by loading `http://localhost:3000/<filename>`.

7.8.6 Displaying Notes

The last thing the app needs to be able to do is display all of the notes that people have posted. First, add some logic to index.js to keep track of the most recent image uploads:

```
var express = require('express');
var fileupload = require('express-fileupload');

var app = express();

// Use PARADROP_DATA_DIR when running on Paradrop and /tmp for testing.
var storage_dir = process.env.PARADROP_DATA_DIR || '/tmp';

// Maximum number of notes to display.
var max_visible_notes = process.env.MAX_VISIBLE_NOTES || 16;

app.locals.notes = [];
for (var i = 0; i < max_visible_notes; i++) {
  if (i % 2 == 0) {
    addNote('http://pages.cs.wisc.edu/~hartung/paradrop/paradrop.png');
  } else {
    addNote('http://pages.cs.wisc.edu/~hartung/paradrop/paradrop_inverted.png');
  }
}

function addNote(img) {
  app.locals.notes.push({
    img: img,
  });

  if (app.locals.notes.length > max_visible_notes) {
    app.locals.notes = app.locals.notes.slice(-max_visible_notes);
  }
}

app.use(fileupload());
app.use(express.static(storage_dir));
app.set('view engine', 'ejs');

app.post('/create', function(req, res) {
  var img = req.files.img;
  if (img) {
    img.mv(storage_dir + '/' + img.name);
    addNote(img.name);
  }

  res.redirect('/');
});

app.get('/', function (req, res) {
  res.render('home');
});

app.listen(3000, function() {
  console.log('Listening on port 3000.');
});
```

The paradrop.png and paradrop_inverted.png are just used as fillers until people post other images. Feel free to use different images.

Also, update home.ejs:

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="utf-8">
    <title>ParaDrop Sticky Board</title>

    <style>
      div.holder {
        float: left;
        min-width: 240px;
        width: 24%;
        padding: 5px 5px;
      }

      div.separator {
        clear: both;
      }
    </style>
  </head>
  <body>
    <h1>ParaDrop Sticky Board</h1>

    <div>
      <% for(var i = 0; i<notes.length; i++) {%>
        <div class="holder">
          <img src="<%= notes[i].img %>" width="100%"></img>
        </div>
      <% } %>
    </div>

    <div class="separator"></div>

    <h2>Create a Note</h2>
    <p>Upload an image file to create a note for others to see.</p>
    <form action="/create" method="POST" encType="multipart/form-data">
      <input type="file" name="img" />
      <input type="submit" value="Create" />
    </form>
  </body>
</html>
```

We use some Embedded JS code to loop over the array of notes stored in `app.locals.notes` and generate an img element for each one with the appropriate filename.

Now when you run the app and load `http://localhost:3000/` you should see the filler images. Try using the form to upload an image, and it should appear on the board.

7.8.7 Preparing the Chute

Create a file called paradrop.yaml with the following contents:

```
name: sticky-board
description: Run a local bulletin board where guests can post images.
version: 1

services:
```

(continues on next page)

(continued from previous page)

```
  main:
    type: light
    use: node
    command: node index.js

web:
  service: main
  port: 3000
```

This file tells ParaDrop a few things about how to run your code on a ParaDrop gateway.

Finally, add all of your new files to the git repository:

```
git add index.js package.json paradrop.yaml views/home.ejs
git commit -m "Created sticky board from tutorial"
```

Create a new repository on github.com and follow their instructions to push your code to github.

7.8.8 Registering the Chute with ParaDrop

Log on to paradrop.org and go to the Chute Store tab. Click "Create Chute" and give your chute a name and description. You may need to be creative with the name because the chute store requires unique names. Then click "Submit".

Next, click "Create Version". For this tutorial, there are only two important fields to fill out on this form. First, check the box to "enable web service" and enter the number 3000 because that is the port we chose in index.js. Second, select "Download from URL" for Project source and enter the github URL for your project. Then click "Submit".

Congratulations! You have made a ParaDrop chute. If you have a ParaDrop router, you should now be able to install the chute on your router. If not, you can follow the Getting Started guide to set up a VM running ParaDrop.

CHAPTER 8

Frequently Asked Questions

Please check here for issues or questions that commonly arise.

8.1 Issues with the hardware or operating system

8.1.1 Issue 1: Docker fails to start after a reboot

This can happen if either the *docker.pid* file or the *docker-containerd.pid* file was not properly cleaned up on system reboot, which causes the Docker daemon to conclude that it is already running.

To fix this, remove the pid file on the router and reboot.

```
sudo rm /var/snap/docker/current/run/docker.pid
sudo rm /var/snap/docker/current/run/docker/libcontainerd/docker-containerd.pid
sudo reboot
```

Occasionally Docker will crash and not restart properly even after a reboot. We find that disabling and re-enabling the service helps in such cases.

```
sudo snap disable docker
sudo snap enable docker
```

8.1.2 Issue 2: WiFi devices are not detected after a reboot

Occasionally, when routers start up the WiFi devices are not detected properly. When this happens the command `iw dev` will display nothing instead of the expected devices. This is usually remedied by rebooting. A global setting to reboot the router if WiFi devices are missing is available on the router settings page.

CHAPTER 9

How to Contribute

This section focuses on the *ParaDrop Daemon*. This is the set of daemons and tools required to allow the Paradrop platform to function on virtual machines and real hardware. ParaDrop is an open source project. The source code of the ParaDrop daemon is available at github. Issue reports and pull requests are welcomed.

9.1 ParaDrop daemon development

ParaDrop repository includes a set of tools to make development as easy as possible.

Currently this system takes the form of a bash script that automates installation and execution. This page outlines the steps required to manually install the dependencies, build the package and install the package into hardware/VMs.

We recommend using Ubuntu 16.04 LTS as the development environment for this version of ParaDrop because we use snapcraft to package and distribute the ParaDrop daemon.

You will only need to follow these instructions if you will be making changes to the ParaDrop daemon. Otherwise, you can use our pre-built ParaDrop snap or disk image from ParaDrop release.

9.1.1 Building ParaDrop daemon

pdbuild.sh is the script we work with during the development. It provides following commands:

- `./pdbuild.sh setup` installs development dependencies.
- `./pdbuild.sh run` executes the ParaDrop daemon locally in the development machine. It is useful for debugging.
- `./pdbuild.sh build` builds the snap package. Check snapcraft documentation for detailed information about snap packages and snapcraft.
- `./pdbuild.sh image` builds the ubuntu core image that we can flash into SD card or SSD module of a ParaDrop router. It pre-installs the required snaps for us automatically, e.g. docker.

9.1.2 Installing ParaDrop into hardware/VMs

After the ParaDrop daemon snap is ready (paradrop-daemon_<version>_amd64.snap), we can install it on a ParaDrop router. Check *Hardware Support* for information about preparing a ParaDrop router.

Copy the paradrop snap to the router with ParaDrop image installed:

```
scp paradrop-daemon-<version>_amd64.snap paradrop@<router ip>:
```

Then we can log in to a ParaDrop router:

```
ssh paradrop@<router ip>
```

Install the dependent snaps in a ParaDrop router:

```
snap install docker
```

Install the newly created ParaDrop daemon snap package:

```
snap install --devmode paradrop-daemon-<version>_amd64.snap
```

9.1.3 Checking logs of ParaDrop daemon

After install the ParaDrop daemon, we can use 'pdlog' to check the log of ParaDrop daemon on the ParaDrop router:

```
paradrop-daemon.pdlog -f
```

9.1.4 Building ParaDrop tools

We have published the ParaDrop tools snap in the Ubuntu Snap Store. On the development machine, we can install it with below command:

```
snap install paradrop-tools
```

Get the manual of ParaDrop tools:

```
paradrop-tools.pdtools --help
```

More detailed information about ParaDrop tools can be find in *Developing Applications*. The git repository of ParaDrop includes the source code of ParaDrop tools. Developers can build the latest version of ParaDrop tools by running below command in the folder 'tools':

```
snapcraft
```

9.2 Documentation and tests

Documentation is handled by sphinx and readthedocs.

Testing is a joint effort between nosetests, travis-ci, and coveralls.

9.2.1 Documentation

Sphinx reads files in reStructuredText and builds a set of HTML pages. Every time a new commit is pushed to github, readthedocs automatically updates documentation.

Additionally, sphinx knows all about python! The directives `automodule`, `autoclass`, `autofunction` and more instruct sphinx to inspect the code located in `paradrop/daemon/paradrop/` and build documentation from the docstrings within.

For example, the directive `.. automodule:: paradrop.backend` will build all the documentation for the given package. See Docstring Conventions for details.

All docstring documentation is rebuilt on every commit (unless there's a bug in the code.) Sphinx does not, however, know about structural changes in code! To alert sphinx of these changes, use the `autodoc` feature:

```
sphinx-apidoc -f -o docs/paradrop paradrop/daemon/paradrop/
```

This scans packages in the `paradrop/daemon/paradrop` directory and creates .rst files in `docs/paradrop`.

To create the documentation locally, run:

```
cd docs
make html
python -m SimpleHTTPServer 9999
```

Open your web browser of choice and point it to http://localhost:9999/_build/html/index.html.

9.2.2 Testing

As mentioned above, all testing is automatically run by travis-ci, a continuous integration service.

To manually run tests, install nosetest:

```
pip install nose
```

Install the required packages:

```
pip install -r docs/requirements.txt
```

Run all tests:

```
nosetests
```

How does nose detect tests? All tests live in the `tests/` directory. Nose adheres to a simple principle: anything marked with `test` in its name is most likely a test. When writing tests, make sure all functions begin with `test`.

Coverage analysis detects how much of the code is used by a test suite. If the result of the coverage is less than 100%, someone slacked. Install coveralls:

```
pip install coveralls
```

Run tests with coverage analysis:

```
nosetests --with-coverage --cover-package=paradrop
```

CHAPTER 10

Host API Reference

10.1 Host Configuration

The host configuration is a YAML file that resides on the ParaDrop device and controls many aspects of system functioning, particularly network and wireless device configuration. The host configuration may also appear in JSON format when manipulating it through the Local HTTP API or through the cloud controller. This page describes the structure and interpretation of values in the host configuration.

10.1.1 Host Configuration Object

ParaDrop host configuration				
type	*object*			
properties				
• firewall	Firewall settings that apply to all network interfaces.			
	type	*object*		
	properties			
	• defaults	Refer to: firewall defaults object.		
		host-config-firewall-defaults-schema		
• lan	Configuration for LAN interfaces (wired and wireless).			
	type	*object*		
	properties			
	• dhcp	Refer to: dhcp object		
		host-config-dhcp-schema		
	• firewall	Firewall settings for the LAN interfaces.		
		type	*object*	
		properties		
		• defaults	Refer to: firewall defaults object.	
			host-config-firewall-defaults-schema	
		• forwarding	Settings for packet forwarding.	
			type	*object*

Continued on next page

Table 1 – continued from previous page

	• interfaces	List of wired interfaces to include in the LAN bridge, e.g. eth1.	
		type	*array*
		items	
		•	type: *string*
	• ipaddr	IP address to use on the LAN bridge.	
		type	*string*
	• netmask	Network mask for LAN.	
		type	*string*
	• proto	Method for setting interface IP address. 'auto' will choose a subnet that avoids conflict with the WAN interface.	
		type	*string*
		enum	auto, static
• system	Configure Paradrop system behaviors.		
	type	*object*	
	properties		
	• autoUpdate	Enable automatically updating system software packages.	
		type	*boolean*
	• chutePrefixSize	The IP network size to assign to each chute.	
		type	*integer*
		maximum	32
		minimum	0
	• chuteSubnetPool	The IP range available for chutes in CIDR notation or 'auto'. 'auto' will choose a subnet that avoids conflict with the WAN interface.	
		type	*string*
	• onMissingWiFi	Behavior if expected wireless devices are missing on boot.	
		type	*string*
		enum	ignore, reboot, warn
• telemetry	Configure telemetry function for collecting device measurements.		
	type	*object*	
	properties		
	• enabled	Enable sending device measurements to cloud controller.	
		type	*boolean*
	• interval	Reporting interval (in seconds).	
		type	*integer*
		minimum	1
• vlan-interfaces	Configure handling of VLAN tags on wired interfaces.		
	type	*array*	
• wan	Configuration for WAN interface.		
	type	*object*	
	properties		
	• firewall	Firewall settings for the WAN interface.	
		type	*object*
		properties	
		• defaults	Refer to firewall defaults object.
			host-config-firewall-defaults-schema
	• interface	Name of interface to use for WAN.	
		type	*string*
	• proto	Method of acquiring interface IP address.	
		type	*string*
		enum	dhcp

Continued on next page

Table 1 – continued from previous page

• wifi	List of physical Wi-Fi devices and their configuration.		
	type	*array*	
	items		
	•	host-config-wifi-device-schema	
• wifi-interfaces	List of virtual Wi-Fi interfaces and their configuration.		
	type	*array*	
	items		
	•	host-config-wifi-interface-schema	
• zerotier	Configure ZeroTier service, which enables VPN-like functionality.		
	type	*object*	
	properties		
	• enabled	Enable the ZeroTier service.	
		type	*boolean*
	• networks	List of ZeroTier networks to join, using their string IDs.	
		type	*array*
		items	
		•	type *string*
		uniqueItems	True

10.1.2 DHCP Object

ParaDrop host configuration - dhcp object		
type	*object*	
properties		
• leasetime	Duration of client leases, e.g. 2h	
	type	*string*
• limit	Size of address range beginning at start value.	
	type	*integer*
	minimum	1
• start	Starting offset for address assignment.	
	type	*integer*
	minimum	0

10.1.3 Firewall Defaults Object

ParaDrop host configuration - firewall defaults object			
type	*object*		
properties			
• conntrack			
• forward	type	*string*	
	enum	ACCEPT, REJECT, DROP	
• input	type	*string*	
	enum	ACCEPT, REJECT, DROP	
• masq			
• masq_src	List of source addresses or subnets to which SNAT should be applied.		
	type	*array*	
	items		
	•	type	*string*
	uniqueItems	True	
• output	type	*string*	
	enum	ACCEPT, REJECT, DROP	

10.1.4 Wi-Fi Device Object

Objects in the *wifi* array define physical device settings such as the channel and transmit power. These settings affect all interfaces in the "wifi-interfaces" array that use the corresponding device.

ParaDrop uses a deterministic system for identifying Wi-Fi devices, so that settings are applied to the same device on startup as long as there have been no hardware changes. ParaDrop numbers PCI and USB devices separately starting from zero, so a ParaDrop host with two PCI Wi-Fi cards and one USB card will have device IDs *pci-wifi-0*, *pci-wifi-1*, and *usb-wifi-0*.

The spectrum band is determined by the *hwmode* setting and the *channel* setting. They must be compatible. For 2.4 GHz channels (1-13), set *hwmode* to *11g*. For 5 GHz channels (36-165), set *hwmode* to *11a*.

Higher data rates and channel sizes (802.11n and 802.11ac) are configured with the *htmode* setting. For a 40 MHz channel width in 802.11n, set *htmode=HT40* or *htmode=HT40-*. Plus means add the next higher channel, and minus means add the lower channel. For example, setting *channel=36* and *htmode=HT40+* results in using channels 36 and 40 as a 40 MHz channel.

If the hardware supports it, you can enable short guard interval for slightly higher data rates. There are separate settings for each channel width: *short_gi_20*, *short_gi_40*, and *short_gi_80*.

Defines a physical Wi-Fi device and its configuration.		
type	*object*	
properties		
• channel	Wi-Fi channel number.	
	type	*integer*
	maximum	165
	minimum	1
• htmode	Enable 802.11n or 802.11ac modes.	
	type	*string*
	enum	None, HT20, HT40+, HT40-, VHT20, VHT40, VHT80
• hwmode	Basic operating mode (11b for old hardware, 11g for 2.4 GHz, 11a for 5 GHz).	
	type	*string*
	enum	11b, 11g, 11a
• id	Physical identifier, e.g. pci-wifi-1 or usb-wifi-0.	
	type	*string*
• rx_stbc	Indicates support for receiving frames using STBC.	
	type	*integer*
	maximum	1
	minimum	0
• short_gi_20	Enable short guard interval (higher data rates) in 20 MHz channels, must be supported by device.	
	type	*boolean*
• short_gi_40	Enable short guard interval (higher data rates) in 40 MHz channel, must be supported by device.	
	type	*boolean*
• short_gi_80	Enable short guard interval (higher data rates) in 80 MHz channel, must be supported by device.	
	type	*boolean*
• tx_stbc	Indicates support for transmitting frames using STBC.	
	type	*integer*
	maximum	1
	minimum	0

10.1.5 Wi-Fi Interface Object

Objects in the *wifi-interfaces* array configure virtual interfaces. Each virtual interface has an underlying physical device, but there can be multiple interfaces per device up to a limit determined by the hardware. Virtual interfaces can be configured as APs or in other operating modes (with limited support).

The *encryption* setting can take a number of different values. The most common options are: "none" for an open access point, "psk2" for WPA2 Personal (PSK), and "wpa2" for WPA2 Enterprise. WPA2 Enterprise requires additional configuration to interact with an external RADIUS server.

ParaDrop host configuration - Wi-Fi interface section		
type	*object*	
properties		
• device	Physical device used by this interface, must match a device id in the wifi section.	
	type	*string*
• encryption	Type of wireless network security to use, e.g. none, psk2, wpa2 (Enterprise).	
	type	*string*
• mode	Operating mode for the interface.	
	type	*string*
	enum	airshark, ap, managed, monitor
• network	Network name the interface should be attached to, typically lan for ap mode interfaces.	
	type	*string*
• ssid	ESSID for ap and managed mode interfaces.	
	type	*string*

10.2 Chute Configuration

The chute configuration is a YAML file (paradrop.yaml) that a chute developer creates to configure how resources from the host operating system should be allocated to the chute. The chute configuration may also appear in JSON format, particularly when manipulating it through the Local HTTP API or through the cloud API. This page describes the structure and interpretation of values in the chute configuration.

10.2.1 Chute Specification

type	*object*			
properties				
• **name**	Name of the chute.			
	type	*string*		
• description	Description of the chute to be shown to users.			
	type	*string*		
• version	Version of the chute.			
	anyOf	•	type	*string*
		•	type	*number*
• services	Services to be installed with the chute.			
	type	*object*		
	patternProperties			
	• w+	*Service Specification*		
• web	type	*object*		
	properties			

Continued on next page

Table 2 – continued from previous page

	• service	Name of chute service which provides the web service.	
		type	*string*
	• port	Listening port inside the chute.	
		type	*integer*
		maximum	65536
		minimum	1
	additionalProperties	False	
additionalProperties	False		
definitions			
• interface	*Interface Specification*		
	type	*object*	
	properties		
	• **type**	Network interface type.	
		type	*string*
		enum	monitor, vlan, wifi-ap
	• dhcp	type	*object*
		properties	
		• leasetime	Duration of client leases, e.g. 2h.
			type: *string*
			pattern: d+[dhms]
		• limit	Size of address range beginning at start value.
			type: *integer*
			minimum: 1
		• start	Starting offset for address assignment.
			type: *integer*
			minimum: 3
		additionalProperties	False
	• dns	List of DNS servers to advertise to connected clients.	
		type	*array*
		items	
		•	type: *string*
	• wireless	type	*object*
		properties	
		• ssid	ESSID to broadcast.
			type: *string*
			maxLength: 32
		• key	Wireless network password.
			type: *string*
			minLength: 8
		• nasid	NAS identifier for RADIUS.
			type: *string*
		• acct_server	RADIUS accounting server.
			type: *string*
		• acct_secret	RADIUS accounting secret.
			type: *string*
		• acct_interval	RADIUS accounting update interval (seconds).
			type: *integer*
			minimum: 1
		• hidden	Disable broadcasting the ESSID in beacons.
			type: *boolean*

Continued on next page

Table 2 – continued from previous page

		• isolate	Disable forwarding traffic between connected clients.			
			type	*boolean*		
		• maxassoc	Maximum number of associated clients.			
			type	*integer*		
			minimum	0		
		additionalProperties	False			
	• requirements	type	*object*			
		properties				
		• hwmode	Required operating mode (11b for old hardware, 11g for 2.4 GHz, 11a for 5 Ghz).			
			type	*string*		
			enum	11b, 11g, 11a		
		• ipv4_network	Required IP network in slash notation.			
			type	*string*		
			pattern	^d+.d+.d+.d+/d+		
		additionalProperties	False			
	• l3bridge	Bridge to another network using ARP proxying (experimental).				
		type	*string*			
	• vlan-id	VLAN tag for traffic to and from the interface.				
		type	*integer*			
		maximum	4094			
		minimum	1			
	additionalProperties	False				
• service	*Service Specification*					
	type	*object*				
	properties					
	• type	Type of chute service.				
		type	*string*			
		enum	light, normal, image			
	• source	Source directory for this service.				
		type	*string*			
	• image	Image specification for services that pull a Docker image.				
		type	*string*			
	• command	anyOf	•	type	*string*	
			•	type	*array*	
				items		
				•	type	*string*
	• dns	List of DNS servers to be used within the container.				
		type	*array*			
		items				
		•	type	*string*		
	• environment	Environment variables.				
		type	*object*			
	• interfaces	Network interfaces to be connected.				
		type	*object*			
		patternProperties				

Continued on next page

Table 2 – continued from previous page

		• w{1,16}	*Interface Specification*			
	• requests	type	*object*			
		properties				
		• as-root	Run service as privileged user.			
			type	*boolean*		
		• port-bindings	Port bindings from host to service container.			
			type	*array*		
			items			
			•	type	*object*	
				properties		
				• external	External (host) port number.	
					type	*integer*
					maximum	65536
					minimum	1
				• internal	Internal (container) port number.	
					type	*integer*
					maximum	65536
					minimum	1
				additionalProperties	False	
		additionalProperties	False			
	additionalProperties	False				

10.2.2 Chute Service Object

Chutes consist of one or more *services*, which are long-running processes that implement the functionality of the chute. Services may be built from code in the chute project, from a Dockerfile, or pulled as images from the public Docker Hub.

Service Specification

type	*object*			
properties				
• type	Type of chute service.			
	type	*string*		
	enum	light, normal, image		
• source	Source directory for this service.			
	type	*string*		
• image	Image specification for services that pull a Docker image.			
	type	*string*		
• command	anyOf	•	type	*string*
		•	type	*array*
			items	

Continued on next page

Table 3 – continued from previous page

			•	type	*string*
• dns	List of DNS servers to be used within the container.				
	type	*array*			
	items				
	•	type	*string*		
• environment	Environment variables.				
	type	*object*			
• interfaces	Network interfaces to be connected.				
	type	*object*			
	patternProperties				
	• w{1,16}	*Interface Specification*			
• requests	type	*object*			
	properties				
	• as-root	Run service as privileged user.			
		type	*boolean*		
	• port-bindings	Port bindings from host to service container.			
		type	*array*		
		items			
		•	type	*object*	
			properties		
			• external	External (host) port number.	
				type	*integer*
				maximum	65536
				minimum	1
			• internal	Internal (container) port number.	
				type	*integer*
				maximum	65536
				minimum	1
			additionalProperties	False	
	additionalProperties	False			
additionalProperties	False				

10.2.3 Chute Interface Object

Chutes may have one or more network interfaces. All chutes are configured with a default *eth0* interface that provides WAN connectivity. Chutes may request additional network interfaces of various types by defining them in the *interfaces* object. *interfaces* is a dictionary, where the key should be the desired interface name inside your chute, e.g. *wlan0*. The same key is used to reference the interface in certain API endpoints such as `/api/v1/chutes/(chute)/networks/(network)`.

Interface Specification

type	*object*
properties	

Continued on next page

Table 4 – continued from previous page

• **type**	Network interface type.		
	type	*string*	
	enum	monitor, vlan, wifi-ap	
• dhcp	type	*object*	
	properties		
	• leasetime	Duration of client leases, e.g. 2h.	
		type	*string*
		pattern	d+[dhms]
	• limit	Size of address range beginning at start value.	
		type	*integer*
		minimum	1
	• start	Starting offset for address assignment.	
		type	*integer*
		minimum	3
	additionalProperties	False	
• dns	List of DNS servers to advertise to connected clients.		
	type	*array*	
	items		
	•	type	*string*
• wireless	type	*object*	
	properties		
	• ssid	ESSID to broadcast.	
		type	*string*
		maxLength	32
	• key	Wireless network password.	
		type	*string*
		minLength	8
	• nasid	NAS identifier for RADIUS.	
		type	*string*
	• acct_server	RADIUS accounting server.	
		type	*string*
	• acct_secret	RADIUS accounting secret.	
		type	*string*
	• acct_interval	RADIUS accounting update interval (seconds).	
		type	*integer*
		minimum	1
	• hidden	Disable broadcasting the ESSID in beacons.	
		type	*boolean*
	• isolate	Disable forwarding traffic between connected clients.	
		type	*boolean*
	• maxassoc	Maximum number of associated clients.	
		type	*integer*
		minimum	0
	additionalProperties	False	
• requirements	type	*object*	
	properties		
	• hwmode	Required operating mode (11b for old hardware, 11g for 2.4 GHz, 11a for 5 Ghz).	
		type	*string*
		enum	11b, 11g, 11a

Continued on next page

Table 4 – continued from previous page

	• ipv4_network	Required IP network in slash notation.	
		type	*string*
		pattern	^d+.d+.d+.d+/d+
	additionalProperties	False	
• l3bridge	Bridge to another network using ARP proxying (experimental).		
	type	*string*	
• vlan-id	VLAN tag for traffic to and from the interface.		
	type	*integer*	
	maximum	4094	
	minimum	1	
additionalProperties	False		

WiFi AP Configuration

A WiFi AP interface is created by setting *type=wifi-ap*. There are many options for configuring the WiFi AP available through the wireless section of the interface object.

Monitor-mode Interface Configuration (Experimental)

A monitor-mode interface enables a chute to observe all detected WiFi traffic with RadioTap headers. A monitor-mode interface is created by setting *type=wifi-monitor*.

Monitor-mode interfaces are disallowed by default but can be enabled if you have administrative access to a node. This is because monitor-mode interfaces are potentially dangerous. They enable malicious chutes to record network traffic, and furthermore, the feature itself is experimental. There may be issues with kernel drivers or our implementation that cause system instability.

If you understand the risks and wish to enable monitor-mode interfaces, connect to your node using SSH and run the following command.:

```
snap set paradrop-daemon base.allow-monitor-mode=true
```

VLAN Interface Configuration

A VLAN interface allows tagged traffic on the physical Ethernet ports of the device to be received by the chute. The interface must be configured with a VLAN ID. Incoming traffic with that VLAN tag will be untagged and forwarded to the chute interface. Likewise, traffic leaving the chute interface will be tagged and sent on one the physical ports.

10.2.4 Example

The following example chute configuration sets up a WiFi access point and a web server running on port 5000. It also shows how to install and connect a database from a public image.

```
name: seccam
description: A Paradrop chute that performs motion detection using a simple WiFi␣
↪camera.
version: 1

services:
  main:
    type: light
```

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```
    source: .
    image: python2
    command: python -u seccam.py

    environment:
      IMAGE_INTERVAL: 2.0
      MOTION_THRESHOLD: 40.0
      SECCAM_MODE: detect

    interfaces:
      wlan0:
        type: wifi-ap

        dhcp:
          leasetime: 12h
          limit: 250
          start: 4

        wireless:
          ssid: seccam42
          key: paradropseccam
          hidden: false
          isolate: true

        requirements:
          hwmode: 11g

    requests:
      as-root: true
      port-bindings:
        - external: 81
          internal: 81

  db:
    type: image
    image: mongo:3.0

web:
  service: main
  port: 5000
```

10.2.5 Experimental Features

ParaDrop is under heavy development. Features marked as *experimental* may be incomplete or buggy. Please contact us if you need help with any of these features.

10.3 Chute Management

Install and manage chutes on the host.

Endpoints for these functions can be found under /api/v1/chutes.

GET /api/v1/chutes/
List installed chutes.

Example request:

```
GET /api/v1/chutes/
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

[
  {
    "environment": {},
    "name": "hello-world",
    "allocation": {
      "cpu_shares": 1024,
      "prioritize_traffic": false
    },
    "state": "running",
    "version": "x1511808778",
    "resources": null
  }
]
```

GET /api/v1/chutes/(*chute*)**/networks/***network*/**stations/***mac* Get detailed information about a connected station.

Example request:

```
GET /api/v1/chutes/captive-portal/networks/wifi/stations/5c:59:48:7d:b9:e6
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "rx_packets": "230",
  "tdls_peer": "no",
  "authenticated": "yes",
  "rx_bytes": "12511",
  "tx_bitrate": "1.0 MBit/s",
  "tx_retries": "0",
  "signal": "-45 [-49, -48] dBm",
  "authorized": "yes",
  "rx_bitrate": "65.0 MBit/s MCS 7",
  "mfp": "no",
  "tx_failed": "0",
  "inactive_time": "4688 ms",
  "mac_addr": "5c:59:48:7d:b9:e6",
  "tx_bytes": "34176",
  "wmm_wme": "yes",
  "preamble": "short",
  "tx_packets": "88",
  "signal_avg": "-44 [-48, -47] dBm"
}
```

GET /api/v1/chutes/(*chute*)**/networks/***network*/**hostapd_status** Get low-level status information from the access point.

Example request:

```
GET /api/v1/chutes/captive-portal/networks/wifi/hostapd_status
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "olbc_ht": "0",
  "cac_time_left_seconds": "N/A",
  "num_sta_no_short_slot_time": "0",
  "olbc": "1",
  "num_sta_non_erp": "0",
  "ht_op_mode": "0x4",
  "state": "ENABLED",
  "num_sta_ht40_intolerant": "0",
  "channel": "11",
  "bssid[0]": "02:00:08:24:03:dd",
  "ieee80211n": "1",
  "cac_time_seconds": "0",
  "num_sta[0]": "1",
  "ieee80211ac": "0",
  "phy": "phy0",
  "num_sta_ht_no_gf": "1",
  "freq": "2462",
  "num_sta_ht_20_mhz": "1",
  "num_sta_no_short_preamble": "0",
  "secondary_channel": "0",
  "ssid[0]": "Free WiFi",
  "num_sta_no_ht": "0",
  "bss[0]": "vwlan7e1b"
}
```

GET /api/v1/chutes/ (*chute*) **/networks/**
*network***/stations** Get detailed information about connected wireless stations.

Example request:

```
GET /api/v1/chutes/captive-portal/networks/wifi/stations
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

[
  {
    "rx_packets": "230",
    "tdls_peer": "no",
    "authenticated": "yes",
    "rx_bytes": "12511",
    "tx_bitrate": "1.0 MBit/s",
    "tx_retries": "0",
    "signal": "-45 [-49, -48] dBm",
    "authorized": "yes",
    "rx_bitrate": "65.0 MBit/s MCS 7",
```

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```
    "mfp": "no",
    "tx_failed": "0",
    "inactive_time": "4688 ms",
    "mac_addr": "5c:59:48:7d:b9:e6",
    "tx_bytes": "34176",
    "wmm_wme": "yes",
    "preamble": "short",
    "tx_packets": "88",
    "signal_avg": "-44 [-48, -47] dBm"
  }
]
```

GET **/api/v1/chutes/**(*chute*)**/networks/***network*__/leases__ Get current list of DHCP leases for chute network.

Returns a list of DHCP lease records with the following fields:

expires lease expiration time (seconds since Unix epoch)

mac_addr device MAC address

ip_addr device IP address

hostname name that the device reported

client_id optional identifier supplied by device

Example request:

```
GET /api/v1/chutes/captive-portal/networks/wifi/leases
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

[
  {
    "client_id": "01:5c:59:48:7d:b9:e6",
    "expires": "1511816276",
    "ip_addr": "192.168.128.64",
    "mac_addr": "5c:59:48:7d:b9:e6",
    "hostname": "paradrops-iPod"
  }
]
```

GET **/api/v1/chutes/**(*chute*)**/networks/***network*__/ssid__ Get currently configured SSID for the chute network.

Example request:

```
GET /api/v1/chutes/captive-portal/networks/wifi/ssid
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
```

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```
  "ssid": "Free WiFi",
  "bssid": "02:00:08:24:03:dd"
}
```

PUT /api/v1/chutes/(*chute*)**/networks/***network*/**ssid** Change the configured SSID for the chute network.

The change will not persist after a reboot. If a persistent change is desired, you should update the chute configuration instead.

Example request:

```
PUT /api/v1/chutes/captive-portal/networks/wifi/ssid
Content-Type: application/json

{
  "ssid": "Best Free WiFi"
}
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "message": "OK"
}
```

GET /api/v1/chutes/(*chute*)**/networks/***network* Get information about a network configured for the chute.

Example request:

```
GET /api/v1/chutes/captive-portal/networks/wifi
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "interface": "wlan0",
  "type": "wifi",
  "name": "wifi"
}
```

GET /api/v1/chutes/(*chute*)**/networks** Get list of networks configured for the chute.

Example request:

```
GET /api/v1/chutes/captive-portal/networks
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json
```

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```
[
  {
    "interface": "wlan0",
    "type": "wifi",
    "name": "wifi"
  }
]
```

GET /api/v1/chutes/(*chute*)**/config**
Get current chute configuration.

Example request:

```
GET /api/v1/chutes/captive-portal/config
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "net": {
    "wifi": {
      "dhcp": {
        "lease": "1h",
        "limit": 250,
        "start": 3
      },
      "intfName": "wlan0",
      "options": {
        "isolate": True
      },
      "ssid": "Free WiFi",
      "type": "wifi"
    }
  }
}
```

PUT /api/v1/chutes/(*chute*)**/config**
Update the chute configuration and restart to apply changes.

Example request:

```
PUT /api/v1/chutes/captive-portal/config
Content-Type: application/json

{
  "net": {
    "wifi": {
      "dhcp": {
        "lease": "1h",
        "limit": 250,
        "start": 3
      },
      "intfName": "wlan0",
      "options": {
```

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```
        "isolate": True
      },
      "ssid": "Better Free WiFi",
      "type": "wifi"
    }
  }
}
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "change_id": 1
}
```

GET /api/v1/chutes/ (*chute*) **/cache**
Get chute cache contents.

The chute cache is a key-value store used during chute installation. It can be useful for debugging the Paradrop platform.

GET /api/v1/chutes/ (*chute*)
Get information about an installed chute.

Example request:

```
GET /api/v1/chutes/hello-world
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "environment": {},
  "name": "hello-world",
  "allocation": {
    "cpu_shares": 1024,
    "prioritize_traffic": false
  },
  "state": "running",
  "version": "x1511808778",
  "resources": null
}
```

10.4 Device Configuration

This module exposes device configuration.

Endpoints for these functions can be found under /api/v1/config.

POST /api/v1/config/factoryReset
Initiate the factory reset process.

PUT /api/v1/config/hostconfig
Replace the device's host configuration.

Example request:

```
PUT /api/v1/config/hostconfig
Content-Type: application/json

{
  "firewall": {
    "defaults": {
      "forward": "ACCEPT",
      "input": "ACCEPT",
      "output": "ACCEPT"
    }
  },
  ...
}
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  change_id: 1
}
```

For a complete example, please see the Host Configuration section.

GET /api/v1/config/hostconfig
Get the device's current host configuration.

Example request:

```
GET /api/v1/config/hostconfig
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "firewall": {
    "defaults": {
      "forward": "ACCEPT",
      "input": "ACCEPT",
      "output": "ACCEPT"
    }
  },
  ...
}
```

For a complete example, please see the Host Configuration section.

GET /api/v1/config/new-config
Generate a new node configuration based on the hardware.

Example request:

```
GET /api/v1/config/new_config
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "firewall": {
    "defaults": {
      "forward": "ACCEPT",
      "input": "ACCEPT",
      "output": "ACCEPT"
    }
  },
  ...
}
```

For a complete example, please see the Host Configuration section.

POST /api/v1/config/provision
Provision the device with credentials from a cloud controller.

GET /api/v1/config/provision
Get the provision status of the device.

GET /api/v1/config/settings
Get current values of system settings.

These are the values from paradrop.base.settings. Settings are loaded at system initialization from the settings.ini file and environment variables. They are intended to be read-only after initialization.

This endpoint returns the settings as a dictionary with lowercase field names.

Example: {

"portal_server_port": 8080, ...

}

GET /api/v1/config/pdconf
Get configuration sections from pdconf.

This returns a list of configuration sections and whether they were successfully applied. This is intended for debugging purposes.

PUT /api/v1/config/pdconf
Trigger pdconf to reload UCI configuration files.

Trigger pdconf to reload UCI configuration files and return the status. This function is intended for low-level debugging of the paradrop pdconf module.

GET /api/v1/config/pdid
Get the device's current ParaDrop ID. This is the identifier assigned by the cloud controller.

Example request:

```
GET /api/v1/config/pdid
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  pdid: "5890e1e5ab7e317e6c6e049f"
}
```

POST /api/v1/config/sshKeys/ (*user*)
Manage list of authorized keys for SSH access.

GET /api/v1/config/sshKeys/ (*user*)
Manage list of authorized keys for SSH access.

10.5 Device Information

Provide information of the router, e.g. board version, CPU information, memory size, disk size.

Endpoints for these functions can be found under /api/v1/info.

GET /api/v1/info/environment
Get environment variables.

Returns a dictionary containing the environment variables passed to the Paradrop daemon. This is useful for development and debugging purposes (e.g. see how PATH is set on Paradrop when running in different contexts).

Example request:

```
GET /api/v1/info/environment
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "LANG": "C.UTF-8",
  "SNAP_REVISION": "x73",
  "SNAP_COMMON": "/var/snap/paradrop-daemon/common",
  "XDG_RUNTIME_DIR": "/run/user/0/snap.paradrop-daemon",
  "SNAP_USER_COMMON": "/root/snap/paradrop-daemon/common",
  "SNAP_LIBRARY_PATH": "/var/lib/snapd/lib/gl:/var/lib/snapd/void",
  "SNAP_NAME": "paradrop-daemon",
  "PWD": "/var/snap/paradrop-daemon/x73",
  "PATH": "/snap/paradrop-daemon/x73/usr/sbin:/snap/paradrop-daemon/x73/usr/bin:/
↪snap/paradrop-daemon/x73/sbin:/snap/paradrop-daemon/x73/bin:/usr/local/sbin:/
↪usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games",
  "SNAP": "/snap/paradrop-daemon/x73",
  "SNAP_DATA": "/var/snap/paradrop-daemon/x73",
  "SNAP_VERSION": "0.9.2",
  "SNAP_ARCH": "amd64",
  "SNAP_USER_DATA": "/root/snap/paradrop-daemon/x73",
  "TEMPDIR": "/tmp",
  "HOME": "/root/snap/paradrop-daemon/x73",
  "SNAP_REEXEC": "",
  "LD_LIBRARY_PATH": "/var/lib/snapd/lib/gl:/var/lib/snapd/void:/snap/paradrop-
↪daemon/x73/usr/lib/x86_64-linux-gnu::/snap/paradrop-daemon/x73/lib:/snap/
↪paradrop-daemon/x73/usr/lib:/snap/paradrop-daemon/x73/lib/x86_64-linux-gnu:/
↪snap/paradrop-daemon/x73/usr/lib/x86_64-linux-gnu",
```

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```
  "TMPDIR": "/tmp"
  ...
}
```

GET /api/v1/info/telemetry
Get a telemetry report.

This contains information about resource utilization by chute and system totals. This endpoint returns the same data that we periodically send to the controller if telemetry is enabled.

GET /api/v1/info/hardware
Get information about the hardware platform.

Example request:

```
GET /api/v1/info/hardware
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "wifi": [
    {
      "slot": "pci/0000:04:00.0",
      "vendorId": "0x168c",
      "macAddr": "04:f0:21:2f:b7:c1",
      "id": "pci-wifi-0",
      "deviceId": "0x003c"
    },
    {
      "slot": "pci/0000:06:00.0",
      "vendorId": "0x168c",
      "macAddr": "04:f0:21:0f:78:28",
      "id": "pci-wifi-1",
      "deviceId": "0x002a"
    }
  ],
  "memory": 2065195008,
  "vendor": "PC Engines",
  "board": "APU 1.0",
  "cpu": "x86_64"
}
```

GET /api/v1/info/software
Get information about the operating system.

Returns a dictionary containing information the BIOS version, OS version, kernel version, Paradrop version, and system uptime.

Example request:

```
GET /api/v1/info/software
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "biosVersion": "SageBios_PCEngines_APU-45",
  "biosDate": "04/05/2014",
  "uptime": 15351,
  "kernelVersion": "Linux-4.4.0-101-generic",
  "pdVersion": "0.9.2",
  "biosVendor": "coreboot",
  "osVersion": "Ubuntu 4.4.0-101.124-generic 4.4.95"
}
```

GET /api/v1/info/features

Get features supported by the host.

This is a list of strings specifying features supported by the daemon.

Explanation of feature strings:

hostapd-control The daemon supports the hostapd control interface and provides a websocket channel for accessing it.

Example request:

```
GET /api/v1/info/features
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

[
  "hostapd-control"
]
```

CHAPTER 11

pdtools CLI Reference

11.1 pdtools

Paradrop command line utility.

```
pdtools [OPTIONS] COMMAND [ARGS]...
```

11.1.1 chute

Utilities for developing chutes.

These commands all operate on a chute project in the current working directory. Remember, that all chutes must have a paradrop.yaml file in the top-level directory. You can create one interactively with the initialize command.

```
pdtools chute [OPTIONS] COMMAND [ARGS]...
```

add-wifi-ap

Add a WiFi AP to the chute configuration.

ESSID must be between 1 and 32 characters in length. Spaces are allowed if you enclose the argument in quotation marks.

```
pdtools chute add-wifi-ap [OPTIONS] ESSID
```

Options

--password <password>
Password for the network, must be at least 8 characters if specified.

--force
Overwrite an existing section in the configuration file.

Arguments

ESSID
Required argument

enable-web-service

Configure chute for providing a web service.

This command adds information to the paradrop.yaml file about a web server that runs as part of the chute. PORT should be the port that the chute code listens on. Paradrop will forward external requests to this port. If the chute runs multiple services, then SERVICE should be used to indicate the name of the service that runs the web server. For most chutes, the default "main" will be appropriate.

```
pdtools chute enable-web-service [OPTIONS] PORT
```

Options

-s, --service <service>
Name of service in chute which runs the web server.

Arguments

PORT
Required argument

export-configuration

Export chute configuration in JSON or YAML format.

The configuration format used by the cloud API is slightly different from the paradrop.yaml file. This command can export a JSON object in a form suitable for installing the chute through the cloud API.

The config object will usually be used in an envelope like the following: {

"updateClass": "CHUTE", "updateType": "update", "config": { config-object }

}

```
pdtools chute export-configuration [OPTIONS]
```

Options

-f, --format <format>
Format (json or yaml)

initialize

Interactively create a paradrop.yaml file.

```
pdtools chute initialize [OPTIONS]
```

Options

--legacy
Create a single-service chute using older syntax.

set

Set a value in the paradrop.yaml file.

PATH must be a dot-separated path to a value in the paradrop.yaml file, such as "config.web.port". VALUE will be interpreted as a string, numeric, or boolean type as appropriate.

Changing values inside a list is not currently supported. For that you will need to edit the file directly.

Example: set config.web.port 80

```
pdtools chute set [OPTIONS] PATH VALUE
```

Arguments

PATH
Required argument

VALUE
Required argument

validate

Validate the paradrop.yaml file.

A note about versions: this command validates the chute configuration against the current rules for the installed version of pdtools. If the chute is to be installed on a Paradrop node running a different version, then this command may not be reliable for determining compatibility.

```
pdtools chute validate [OPTIONS]
```

11.1.2 cloud

Access services provided by a cloud controller.

By default the cloud controller is assumed to be paradrop.org. This can be configured through the environment variable PDSERVER_URL.

```
pdtools cloud [OPTIONS] COMMAND [ARGS]...
```

claim-node

Take ownership of a node by using a claim token.

TOKEN is a hard-to-guess string that the previous owner would have configured when setting the node's status as orphaned.

```
pdtools cloud claim-node [OPTIONS] TOKEN
```

Options

-n, --name <name>
Name of the node

Arguments

TOKEN
Required argument

create-node

Create a new node to be tracked by the controller.

NAME must be unique among the nodes that you own and may only consist of lowercase letters, numbers, and hyphens. It must also begin with a letter.

```
pdtools cloud create-node [OPTIONS] NAME
```

Options

--orphaned, --not-orphaned
Allow another user to claim the node.

--claim <claim>
Claim token required to claim the node.

Arguments

NAME
Required argument

delete-node

Delete a node that is tracked by the controller.

NAME must be the name of a node that you own.

```
pdtools cloud delete-node [OPTIONS] NAME
```

Arguments

NAME
Required argument

describe-node

Get detailed information about an existing node.

NAME must be the name of a node that you own.

```
pdtools cloud describe-node [OPTIONS] NAME
```

Arguments

NAME
Required argument

edit-node-description

Interactively edit the node description and save.

NAME must be the name of a node that you own.

Open the text editor specified by the EDITOR environment variable with the current node description. If you save and exit, the changes will be applied to the node.

```
pdtools cloud edit-node-description [OPTIONS] NAME
```

Arguments

NAME
Required argument

group-add-node

Add a node to a group for other members to access.

GROUP must be the string ID of a group. NODE must be the name of a node that you control.

```
pdtools cloud group-add-node [OPTIONS] GROUP NODE
```

Arguments

GROUP
Required argument

NODE
Required argument

help

Show this message and exit.

```
pdtools cloud help [OPTIONS]
```

import-ssh-key

Add an authorized key from a public key file.

PATH must be a path to a public key file, which corresponds to a private key that SSH can use for authentication. Typically, ssh-keygen will place the public key in "~/.ssh/id_rsa.pub".

```
pdtools cloud import-ssh-key [OPTIONS] PATH
```

Arguments

PATH
Required argument

list-groups

List groups that you belong to.

```
pdtools cloud list-groups [OPTIONS]
```

list-nodes

List nodes that you own or have access to.

```
pdtools cloud list-nodes [OPTIONS]
```

login

Interactively login to your user account on the controller.

Authenticate with the controller using account credentials that you created either through the website or with the register command. Typically, the username will be your email address.

```
pdtools cloud login [OPTIONS]
```

logout

Log out and remove stored credentials.

```
pdtools cloud logout [OPTIONS]
```

register

Interactively create an account on the controller.

```
pdtools cloud register [OPTIONS]
```

rename-node

Change the name of a node.

NAME must be the name of a node that you control. NEW_NAME is the desired new name. It must adhere to the same naming rules as for the create-node command, namely, it must begin with a letter and consist of only lowercase letters, numbers, and hyphen.

```
pdtools cloud rename-node [OPTIONS] NAME NEW_NAME
```

Arguments

NAME
Required argument

NEW_NAME
Required argument

11.1.3 device

(deprecated) Sub-tree for configuring a device.

These commands are deprecated. Please use the equivalent commands under *pdtools node –help*.

```
pdtools device [OPTIONS] ADDRESS COMMAND [ARGS]...
```

Arguments

ADDRESS
Required argument

audio

Control device audio properties.

```
pdtools device audio [OPTIONS] COMMAND [ARGS]...
```

info

Get audio server information.

```
pdtools device audio info [OPTIONS]
```

load-module

Load a module.

```
pdtools device audio load-module [OPTIONS] NAME
```

Arguments

NAME
Required argument

modules

List loaded modules.

```
pdtools device audio modules [OPTIONS]
```

sink

Configure audio sink.

```
pdtools device audio sink [OPTIONS] SINK_NAME COMMAND [ARGS]...
```

Arguments

SINK_NAME
Required argument

volume

Set sink volume.

```
pdtools device audio sink volume [OPTIONS] [CHANNEL_VOLUME]...
```

Arguments

CHANNEL_VOLUME
Optional argument(s)

sinks

List audio sinks.

```
pdtools device audio sinks [OPTIONS]
```

source

Configure audio source.

```
pdtools device audio source [OPTIONS] SOURCE_NAME COMMAND [ARGS]...
```

Arguments

SOURCE_NAME
Required argument

volume

Set source volume.

```
pdtools device audio source volume [OPTIONS] [CHANNEL_VOLUME]...
```

Arguments

CHANNEL_VOLUME
Optional argument(s)

sources

List audio sources.

```
pdtools device audio sources [OPTIONS]
```

changes

List changes in the working queue.

```
pdtools device changes [OPTIONS]
```

chute

Sub-tree for configuring a chute.

```
pdtools device chute [OPTIONS] CHUTE COMMAND [ARGS]...
```

Arguments

CHUTE
Required argument

cache

Get details from the chute installation.

```
pdtools device chute cache [OPTIONS]
```

config

Get the chute's current configuration.

```
pdtools device chute config [OPTIONS]
```

delete

Uninstall the chute.

```
pdtools device chute delete [OPTIONS]
```

edit-environment

Interactively edit the chute environment vairables.

```
pdtools device chute edit-environment [OPTIONS]
```

info

Get information about the chute.

```
pdtools device chute info [OPTIONS]
```

logs

Watch log messages from a chute.

```
pdtools device chute logs [OPTIONS]
```

network

Sub-tree for accessing chute network.

```
pdtools device chute network [OPTIONS] NETWORK COMMAND [ARGS]...
```

Arguments

NETWORK
Required argument

station

Sub-tree for accessing network stations.

```
pdtools device chute network station [OPTIONS] STATION COMMAND [ARGS]...
```

Arguments

STATION
Required argument

delete

Kick a station off the network.

```
pdtools device chute network station delete [OPTIONS]
```

show

Show station information.

```
pdtools device chute network station show [OPTIONS]
```

stations

List stations connected to the network.

```
pdtools device chute network stations [OPTIONS]
```

networks

List the chute's networks.

```
pdtools device chute networks [OPTIONS]
```

reconfigure

Reconfigure the chute without rebuilding.

```
pdtools device chute reconfigure [OPTIONS]
```

restart

Restart the chute.

```
pdtools device chute restart [OPTIONS]
```

shell

Open a shell inside a chute.

This requires you to have enabled SSH access to the device and installed bash inside your chute.

```
pdtools device chute shell [OPTIONS]
```

start

Start the chute.

```
pdtools device chute start [OPTIONS]
```

stop

Stop the chute.

```
pdtools device chute stop [OPTIONS]
```

update

Update the chute from the working directory.

```
pdtools device chute update [OPTIONS]
```

chutes

View or create chutes on the router.

```
pdtools device chutes [OPTIONS] COMMAND [ARGS]...
```

create

Install a chute from the working directory.

```
pdtools device chutes create [OPTIONS]
```

list

List chutes installed on the router.

```
pdtools device chutes list [OPTIONS]
```

hostconfig

Sub-tree for the host configuration.

```
pdtools device hostconfig [OPTIONS] COMMAND [ARGS]...
```

change

Change one setting in the host configuration.

```
pdtools device hostconfig change [OPTIONS] OPTION VALUE
```

Arguments

OPTION
Required argument

VALUE
Required argument

edit

Interactively edit the host configuration.

```
pdtools device hostconfig edit [OPTIONS]
```

login

Log in using device-local credentials.

```
pdtools device login [OPTIONS]
```

logout

Log out by removing any stored access tokens.

```
pdtools device logout [OPTIONS]
```

password

Change the router admin password.

```
pdtools device password [OPTIONS]
```

pdconf

Access the pdconf subsystem.

pdconf manages low-level configuration of the Paradrop device. These commands are implemented for debugging purposes and are not intended for ordinary configuration purposes.

```
pdtools device pdconf [OPTIONS] COMMAND [ARGS]...
```

reload

Force pdconf to reload files.

```
pdtools device pdconf reload [OPTIONS]
```

show

Show status of pdconf subsystem.

```
pdtools device pdconf show [OPTIONS]
```

provision

Provision the router.

```
pdtools device provision [OPTIONS] ROUTER_ID ROUTER_PASSWORD
```

Options

--server <server>

--wamp <wamp>

Arguments

ROUTER_ID
Required argument

ROUTER_PASSWORD
Required argument

snapd

Access the snapd subsystem.

```
pdtools device snapd [OPTIONS] COMMAND [ARGS]...
```

connectall

Connect all interfaces.

```
pdtools device snapd connectall [OPTIONS]
```

createuser

Create user account.

```
pdtools device snapd createuser [OPTIONS] EMAIL
```

Arguments

EMAIL
Required argument

sshkeys

Sub-tree for accessing SSH authorized keys.

```
pdtools device sshkeys [OPTIONS] COMMAND [ARGS]...
```

Options

--user <user>

add

Add an authorized key from a file.

```
pdtools device sshkeys add [OPTIONS] PATH
```

Arguments

PATH
Required argument

list

List authorized keys.

```
pdtools device sshkeys list [OPTIONS]
```

watch

Stream messages for a change in progress.

```
pdtools device watch [OPTIONS] CHANGE_ID
```

Arguments

CHANGE_ID
Required argument

11.1.4 discover

Discover Paradrop nodes on the network.

```
pdtools discover [OPTIONS]
```

11.1.5 group

(deprecated) Manage a user group.

These commands are deprecated. Please use the equivalent commands under *pdtools cloud –help*.

```
pdtools group [OPTIONS] GROUP_ID COMMAND [ARGS]...
```

Arguments

GROUP_ID
Required argument

add-router

Add a router to the group.

```
pdtools group add-router [OPTIONS] ROUTER_ID
```

Arguments

ROUTER_ID
Required argument

11.1.6 help

Show this message and exit

```
pdtools help [OPTIONS]
```

11.1.7 list-groups

(deprecated) List user groups.

Please use *pdtools cloud list-groups*.

```
pdtools list-groups [OPTIONS]
```

11.1.8 node

Manage a Paradrop edge compute node.

These commands respect the following environment variables:

PDTOOLS_NODE_TARGET Default target node name or address.

```
pdtools node [OPTIONS] COMMAND [ARGS]...
```

Options

-t, --target <target>
Target node name or address

connect-snap-interfaces

Connect all interfaces for installed snaps.

```
pdtools node connect-snap-interfaces [OPTIONS]
```

create-user

Create local Linux user connected to Ubuntu store account.

EMAIL must be an email address which is registered as Ubuntu One account. The name of the local account that is created will depend on the email address used. If in doubt, use "info@paradrop.io", which will result in a user named "paradrop" being created.

```
pdtools node create-user [OPTIONS] EMAIL
```

Arguments

EMAIL
Required argument

describe-audio

Display audio subsystem information.

Display information from the local PulseAudio server such as the default source and sink.

```
pdtools node describe-audio [OPTIONS]
```

describe-chute

Display information about a chute.

CHUTE must be the name of an installed chute.

```
pdtools node describe-chute [OPTIONS] CHUTE
```

Arguments

CHUTE
Required argument

describe-chute-cache

Show internal details from a chute installation.

CHUTE must be the name of an installed chute.

This information is intended for Paradrop daemon developers for debugging purposes. The output is not expected to remain stable between Paradrop versions.

```
pdtools node describe-chute-cache [OPTIONS] CHUTE
```

Arguments

CHUTE
Required argument

describe-chute-configuration

Display configuration of a chute.

CHUTE must be the name of an installed chute.

This information corresponds to the "config" section in a chute's paradrop.yaml file.

```
pdtools node describe-chute-configuration [OPTIONS] CHUTE
```

Arguments

CHUTE
Required argument

describe-chute-network-client

Display information about a network client.

CHUTE must be the name of an installed chute. NETWORK must be the name of one of the chute's configured networks. Typically, this will be "wifi". CLIENT identifies the network client, such as a MAC address.

```
pdtools node describe-chute-network-client [OPTIONS] CHUTE NETWORK CLIENT
```

Arguments

CHUTE
Required argument

NETWORK
Required argument

CLIENT
Required argument

describe-pdconf

Show status of the pdconf subsystem.

This information is intended for Paradrop daemon developers for debugging purposes.

```
pdtools node describe-pdconf [OPTIONS]
```

describe-provision

Show provisioning status of the node.

This shows whether the node is associated with a cloud controller, and if so, its identifier.

```
pdtools node describe-provision [OPTIONS]
```

describe-settings

Show node settings.

These are settings that paradrop reads during startup and configure certain behaviors. They can only be modified through environment variables or the settings.ini file.

```
pdtools node describe-settings [OPTIONS]
```

edit-chute-configuration

Interactively edit the chute configuration and restart it.

CHUTE must be the name of an installed chute.

Open the text editor specified by the EDITOR environment variable with the current chute configuration. If you save and exit, the new configuration will be applied and the chute restarted.

```
pdtools node edit-chute-configuration [OPTIONS] CHUTE
```

Arguments

CHUTE
Required argument

edit-chute-variables

Interactively edit a chute's environment variables and restart it.

CHUTE must be the name of an installed chute.

Open the text editor specified by the EDITOR environment variable with the current chute environment variables. If you save and exit, the new settings will be applied and the chute restarted.

```
pdtools node edit-chute-variables [OPTIONS] CHUTE
```

Arguments

CHUTE
Required argument

edit-configuration

Interactively edit the node configuration and apply changes.

Open the text editor specified by the EDITOR environment variable with the current node configuration. If you save and exit, the new configuration will be applied to the node.

```
pdtools node edit-configuration [OPTIONS]
```

export-configuration

Display the node configuration in the desired format.

```
pdtools node export-configuration [OPTIONS]
```

Options

-f, --format <format>
Format (json or yaml)

generate-configuration

Generate a new node configuration based on detected hardware.

The new configuration is not automatically applied. Rather, you can save it to file and use the import-configuration command to apply it.

```
pdtools node generate-configuration [OPTIONS]
```

Options

-f, --format <format>
Format (json or yaml)

help

Show this message and exit.

```
pdtools node help [OPTIONS]
```

import-configuration

Import a node configuration from file and apply changes.

PATH must be a path to a node configuration file in YAML format.

```
pdtools node import-configuration [OPTIONS] PATH
```

Arguments

PATH
Required argument

import-ssh-key

Add an authorized key from a public key file.

PATH must be a path to a public key file, which corresponds to a private key that SSH can use for authentication. Typically, ssh-keygen will place the public key in "~/.ssh/id_rsa.pub".

```
pdtools node import-ssh-key [OPTIONS] PATH
```

Options

-u, --user <user>
Local username

Arguments

PATH
Required argument

install-chute

Install a chute from the working directory.

Install the files in the current directory as a chute on the node. The directory must contain a paradrop.yaml file. The entire directory will be copied to the node for installation.

```
pdtools node install-chute [OPTIONS]
```

Options

-d, --directory <directory>
Directory containing chute files

list-audio-modules

List modules loaded by the audio subsystem.

```
pdtools node list-audio-modules [OPTIONS]
```

list-audio-sinks

List audio sinks.

```
pdtools node list-audio-sinks [OPTIONS]
```

list-audio-sources

List audio sources.

```
pdtools node list-audio-sources [OPTIONS]
```

list-changes

List queued or in progress changes.

```
pdtools node list-changes [OPTIONS]
```

list-chute-network-clients

List clients connected to the chute's network.

CHUTE must be the name of an installed chute. NETWORK must be the name of one of its configured networks. Typically, this will be called "wifi".

```
pdtools node list-chute-network-clients [OPTIONS] CHUTE NETWORK
```

Arguments

CHUTE
Required argument

NETWORK
Required argument

list-chute-networks

List networks configured by a chute.

CHUTE must be the name of an installed chute.

```
pdtools node list-chute-networks [OPTIONS] CHUTE
```

Arguments

CHUTE
Required argument

list-chutes

List chutes installed on the node

```
pdtools node list-chutes [OPTIONS]
```

list-devices

List devices connected to the node.

```
pdtools node list-devices [OPTIONS]
```

list-snap-interfaces

List interfaces for snaps installed on the node.

```
pdtools node list-snap-interfaces [OPTIONS]
```

list-ssh-keys

List keys authorized for SSH access to the node.

```
pdtools node list-ssh-keys [OPTIONS]
```

Options

-u, --user <user>
Local username

load-audio-module

Load a module into the audio subsystem.

MODULE must be the name of a PulseAudio module such as "module-loopback".

```
pdtools node load-audio-module [OPTIONS] MODULE
```

Arguments

MODULE
Required argument

login

Interactively log in using the local admin password.

Authenticate with the node using the local username and password. Typically, the username will be "paradrop". The password can be set with the set-password command.

```
pdtools node login [OPTIONS]
```

logout

Log out and remove stored credentials.

```
pdtools node logout [OPTIONS]
```

open-chute-shell

Open a shell inside the running chute.

CHUTE must be the name of a running chute.

This requires you to have enabled SSH access to the device and installed bash inside your chute.

Changes made to files inside the chute may not be persistent if the chute or the node is restarted. Only changes to files in the "/data" directory will be preserved.

```
pdtools node open-chute-shell [OPTIONS] CHUTE
```

Options

-s, --service <service>
Service belonging to the chute

Arguments

CHUTE
Required argument

provision

Associate the node with a cloud controller.

ID and KEY are credentials that can be found when creating a node on the controller, either through the website or through *pdtools cloud create-node*. They may also be referred to as the Router ID and the Router Password.

```
pdtools node provision [OPTIONS] ID KEY
```

Options

-c, --controller <controller>
Cloud controller endpoint

-w, --wamp <wamp>
WAMP endpoint

Arguments

ID
Required argument

KEY
Required argument

reboot

Reboot the node.

```
pdtools node reboot [OPTIONS]
```

remove-chute

Remove a chute from the node.

CHUTE must be the name of an installed chute.

```
pdtools node remove-chute [OPTIONS] CHUTE
```

Arguments

CHUTE
Required argument

remove-chute-network-client

Remove a connected client from the chute's network.

CHUTE must be the name of an installed chute. NETWORK must be the name of one of the chute's configured networks. Typically, this will be "wifi". CLIENT identifies the network client, such as a MAC address.

Only implemented for wireless clients, this effectively kicks the client off the network.

```
pdtools node remove-chute-network-client [OPTIONS] CHUTE NETWORK CLIENT
```

Arguments

CHUTE
Required argument

NETWORK
Required argument

CLIENT
Required argument

restart-chute

Restart a chute.

CHUTE must be the name of an installed chute.

```
pdtools node restart-chute [OPTIONS] CHUTE
```

Arguments

CHUTE
Required argument

set-configuration

Change a node configuration value and apply.

PATH must be a dot-separated path to a value in the node configuration, such as "system.onMissingWiFi". VALUE will be interpreted as a string, numeric, or boolean type as appropriate.

Changing values inside a list is not currently supported. Use edit-configuration instead.

```
pdtools node set-configuration [OPTIONS] PATH VALUE
```

Arguments

PATH
Required argument

VALUE
Required argument

set-password

Change the local admin password.

Set the password required by *pdtools node login* and the local web-based administration page.

```
pdtools node set-password [OPTIONS]
```

set-sink-volume

Configure audio sink volume.

SINK must be the name of a PulseAudio sink. VOLUME should be one (applied to all channels) or multiple (one for each channel) floating point values between 0 and 1.

```
pdtools node set-sink-volume [OPTIONS] SINK [VOLUME]...
```

Arguments

SINK
Required argument

VOLUME
Optional argument(s)

set-source-volume

Configure audio source volume.

SOURCE must be the name of a PulseAudio source. VOLUME should be one (applied to all channels) or multiple (one for each channel) floating point values between 0 and 1.

```
pdtools node set-source-volume [OPTIONS] SOURCE [VOLUME]...
```

Arguments

SOURCE
Required argument

VOLUME
Optional argument(s)

shutdown

Shut down the node.

```
pdtools node shutdown [OPTIONS]
```

start-chute

Start a stopped chute.

CHUTE must be the name of a stopped chute.

```
pdtools node start-chute [OPTIONS] CHUTE
```

Arguments

CHUTE
Required argument

stop-chute

Stop a running chute.

CHUTE must be the name of a running chute.

```
pdtools node stop-chute [OPTIONS] CHUTE
```

Arguments

CHUTE
Required argument

trigger-pdconf

Trigger pdconf to reload configuration.

This function is intended for Paradrop daemon developers for debugging purposes. Generally, you should use edit-configuration and edit-chute-configuration for making configuration changes.

```
pdtools node trigger-pdconf [OPTIONS]
```

update-chute

Install a new version of the chute from the working directory.

Install the files in the current directory as a chute on the node. The directory must contain a paradrop.yaml file. The entire directory will be copied to the node for installation.

```
pdtools node update-chute [OPTIONS]
```

Options

-d, --directory <directory>
Directory containing chute files

watch-change-logs

Stream log messages from an in-progress change.

CHANGE_ID must be the ID of a queued or in-progress change as retrieved from the list-changes command.

```
pdtools node watch-change-logs [OPTIONS] CHANGE_ID
```

Arguments

CHANGE_ID
Required argument

watch-chute-logs

Stream log messages from a running chute.

CHUTE must be the name of a running chute.

```
pdtools node watch-chute-logs [OPTIONS] CHUTE
```

Arguments

CHUTE
Required argument

watch-logs

Stream log messages from the Paradrop daemon.

```
pdtools node watch-logs [OPTIONS]
```

11.1.9 routers

(deprecated) Access router information on the controller.

These commands are deprecated. Please use the equivalent commands under *pdtools cloud –help*.

```
pdtools routers [OPTIONS] COMMAND [ARGS]...
```

claim

Claim an existing router.

```
pdtools routers claim [OPTIONS] TOKEN
```

Arguments

TOKEN
Required argument

create

Create a new router.

```
pdtools routers create [OPTIONS] NAME
```

Options

--orphaned, --not-orphaned

--claim <claim>

Arguments

NAME
Required argument

delete

Delete a router.

```
pdtools routers delete [OPTIONS] ROUTER_ID
```

Arguments

ROUTER_ID
Required argument

list

List routers.

```
pdtools routers list [OPTIONS]
```

11.1.10 store

Publish and install from the public chute store.

By default the cloud controller is assumed to be paradrop.org. This can be configured through the environment variable PDSERVER_URL.

It is recommended that you log in with the cloud login command before using the store commands.

```
pdtools store [OPTIONS] COMMAND [ARGS]...
```

create-version

Push a new version of the chute to the store.

```
pdtools store create-version [OPTIONS]
```

describe-chute

Show detailed information about a chute in the store.

NAME must be the name of a chute in the store.

```
pdtools store describe-chute [OPTIONS] NAME
```

Arguments

NAME
Required argument

help

Show this message and exit.

```
pdtools store help [OPTIONS]
```

install-chute

Install a chute from the store.

CHUTE must be the name of a chute in the store. NODE must be the name of a node that you control.

```
pdtools store install-chute [OPTIONS] CHUTE NODE
```

Options

-f, --follow
Follow chute updates.

-v, --version <version>
Version of the chute to install.

Arguments

CHUTE
Required argument

NODE
Required argument

list-chutes

List chutes in the store that you own or have access to.

```
pdtools store list-chutes [OPTIONS]
```

list-versions

List versions of a chute in the store.

NAME must be the name of a chute in the store.

```
pdtools store list-versions [OPTIONS] NAME
```

Arguments

NAME
Required argument

register

Register a chute with the store.

The chute information including name will be taken from the paradrop.yaml file in the current working directory. If you receive an error, it may be that a chute with the same name is already registered.

```
pdtools store register [OPTIONS]
```

Options

--public, --not-public
List the chute publicly for other users to download.

watch-update-messages

Stream log messages from an in-progress update.

NODE must be the name or ID of a node that you control. UPDATE_ID must be the ID associated with an in-progress update.

```
pdtools store watch-update-messages [OPTIONS] NODE_ID UPDATE_ID
```

Options

--interval <interval>
Interval to check for new messages

Arguments

NODE_ID
Required argument

UPDATE_ID
Required argument

11.1.11 wizard

Set up environment for development.

```
pdtools wizard [OPTIONS]
```

CHAPTER 12

Source Code Reference

12.1 Subpackages

12.1.1 paradrop.airshark package

Submodules

paradrop.airshark.airshark module

class AirsharkManager
Bases: object

add_analyzer_observer(*observer*)

add_spectrum_observer(*observer*)

check_spectrum()

on_analyzer_message(*message*)

on_interface_down(*interface*)

on_interface_up(*interface*)

read_raw_samples()

remove_analyzer_observer(*observer*)

remove_spectrum_observer(*observer*)

status()

paradrop.airshark.analyzer module

class AnalyzerProcessProtocol(*airshark_manager*)
Bases: twisted.internet.protocol.ProcessProtocol

childDataReceived(*childFd*, *data*)

connectionMade()

feedSpectrumData(*data*)

isRunning()

processEnded(*status*)

stop()

paradrop.airshark.scanner module

class Scanner(*interface*)

Bases: object

cmd_chanscan()

cmd_disable()

cmd_set_samplecount(*count*)

cmd_set_short_repeat(*short_repeat*)

debugfs_dir = None

dev_to_phy(*dev*)

freqlist = None

get_debugfs_dir()

interface = None

process = None

set_freqs(*minf*, *maxf*, *spacing*)

spectrum_reader = None

start()

stop()

paradrop.airshark.spectrum_reader module

class SpectrumReader(*path*)

Bases: object

static decode()

For information about the decoding of spectral samples see: https://wireless.wiki.kernel.org/en/users/drivers/ath9k/spectral_scan https://github.com/erikarn/ath_radar_stuff/tree/master/lib and your ath9k implementation in e.g. /drivers/net/wireless/ath/ath9k/common-spectral.c

flush()

hdrsize = 3

pktsize = 73

read_samples()

sc_wide = 0.3125

Module contents

12.1.2 paradrop.backend package

Submodules

paradrop.backend.airshark_api module

APIs for developers to check whether Airshark feature is available or not

class AirsharkApi(*airshark_manager*)

routes
L{Klein} is an object which is responsible for maintaining the routing configuration of our application.

@ivar _url_map: A C{werkzeug.routing.Map} object which will be used for routing resolution.

@ivar _endpoints: A C{dict} mapping endpoint names to handler functions.

status(*request*)

paradrop.backend.airshark_ws module

class AirsharkAnalyzerFactory(*airshark_manager*, **args*, ***kwargs*)
Bases: `autobahn.twisted.websocket.WebSocketServerFactory`

buildProtocol(*addr*)
Create an instance of a subclass of Protocol.

The returned instance will handle input on an incoming server connection, and an attribute "factory" pointing to the creating factory.

Alternatively, C{None} may be returned to immediately close the new connection.

Override this method to alter how Protocol instances get created.

@param addr: an object implementing L{twisted.internet.interfaces.IAddress}

class AirsharkAnalyzerProtocol(*factory*)
Bases: `autobahn.twisted.websocket.WebSocketServerProtocol`

onClose(*wasClean*, *code*, *reason*)
Implements `autobahn.websocket.interfaces.IWebSocketChannel.onClose()`

onOpen()
Implements `autobahn.websocket.interfaces.IWebSocketChannel.onOpen()`

on_analyzer_message(*message*)

class AirsharkSpectrumFactory(*airshark_manager*, **args*, ***kwargs*)
Bases: `autobahn.twisted.websocket.WebSocketServerFactory`

buildProtocol(*addr*)
Create an instance of a subclass of Protocol.

The returned instance will handle input on an incoming server connection, and an attribute "factory" pointing to the creating factory.

Alternatively, C{None} may be returned to immediately close the new connection.

Override this method to alter how Protocol instances get created.

@param addr: an object implementing L{twisted.internet.interfaces.IAddress}

class AirsharkSpectrumProtocol(*factory*)
Bases: autobahn.twisted.websocket.WebSocketServerProtocol

onClose(*wasClean*, *code*, *reason*)
Implements autobahn.websocket.interfaces.IWebSocketChannel.onClose()

onOpen()
Implements autobahn.websocket.interfaces.IWebSocketChannel.onOpen()

on_spectrum_data(*data*)

paradrop.backend.auth module

class AuthApi(*password_manager*, *token_manager*)
Bases: object

auth_cloud(*request*)
Login using credentials from the cloud controller.

This is an experimental new login method that lets users present a token that they received from the cloud controller as a login credential for a node. The idea is to enable easy access for multiple developers to share a node, for example, during a tutorial.

Instead of a username/password, the user presents a token received from the cloud controller. The verify_cloud_token function verifies the validity of the token with the controller, and if successful, retrieves information about the bearer, particularly the username and role. Finally, we generate a new token that enables the user to authenticate with local API endpoints.

local_login(*request*)
Login using local authentication (username+password).

routes
L{Klein} is an object which is responsible for maintaining the routing configuration of our application.

@ivar _url_map: A C{werkzeug.routing.Map} object which will be used for routing resolution.

@ivar _endpoints: A C{dict} mapping endpoint names to handler functions.

check_auth(*request*, *password_manager*, *token_manager*)

get_access_level(*user*, *node*)

get_allowed_bearer()
Return set of allowed bearer tokens.

get_username_password(*userpass*)
Please note: username and password can either be presented in plain text such as "admin:password" or base64 encoded such as "YWRtaW46cGFzc3dvcmQ=". Both forms should be returned from this function.

requires_auth(*func*)
Use as a decorator for API functions to require authorization.

This checks the Authorization HTTP header. It handles username and password as well as bearer tokens.

verify_cloud_token(*token*)

verify_password(*password_manager*, *userpass*)

paradrop.backend.chute_api module

Install and manage chutes on the host.

Endpoints for these functions can be found under /api/v1/chutes.

class ChuteApi(*update_manager*)
Bases: object

create_chute(*request*)

delete_chute(*request*, *chute*)

delete_station(*request*, *chute*, *network*, *mac*)

get_chute(*request*, *chute*)
Get information about an installed chute.

Example request:

```
GET /api/v1/chutes/hello-world
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "environment": {},
  "name": "hello-world",
  "allocation": {
    "cpu_shares": 1024,
    "prioritize_traffic": false
  },
  "state": "running",
  "version": "x1511808778",
  "resources": null
}
```

get_chute_cache(*request*, *chute*)
Get chute cache contents.

The chute cache is a key-value store used during chute installation. It can be useful for debugging the Paradrop platform.

get_chute_config(*request*, *chute*)
Get current chute configuration.

Example request:

```
GET /api/v1/chutes/captive-portal/config
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "net": {
    "wifi": {
      "dhcp": {
```

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```
        "lease": "1h",
        "limit": 250,
        "start": 3
      },
      "intfName": "wlan0",
      "options": {
        "isolate": True
      },
      "ssid": "Free WiFi",
      "type": "wifi"
    }
  }
}
```

get_chutes (*request*)
List installed chutes.

Example request:

```
GET /api/v1/chutes/
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

[
  {
    "environment": {},
    "name": "hello-world",
    "allocation": {
      "cpu_shares": 1024,
      "prioritize_traffic": false
    },
    "state": "running",
    "version": "x1511808778",
    "resources": null
  }
]
```

get_hostapd_status (*request*, *chute*, *network*)
Get low-level status information from the access point.

Example request:

```
GET /api/v1/chutes/captive-portal/networks/wifi/hostapd_status
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "olbc_ht": "0",
  "cac_time_left_seconds": "N/A",
  "num_sta_no_short_slot_time": "0",
  "olbc": "1",
```

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```
  "num_sta_non_erp": "0",
  "ht_op_mode": "0x4",
  "state": "ENABLED",
  "num_sta_ht40_intolerant": "0",
  "channel": "11",
  "bssid[0]": "02:00:08:24:03:dd",
  "ieee80211n": "1",
  "cac_time_seconds": "0",
  "num_sta[0]": "1",
  "ieee80211ac": "0",
  "phy": "phy0",
  "num_sta_ht_no_gf": "1",
  "freq": "2462",
  "num_sta_ht_20_mhz": "1",
  "num_sta_no_short_preamble": "0",
  "secondary_channel": "0",
  "ssid[0]": "Free WiFi",
  "num_sta_no_ht": "0",
  "bss[0]": "vwlan7e1b"
}
```


get_leases (*request*, *chute*, *network*)

Get current list of DHCP leases for chute network.

Returns a list of DHCP lease records with the following fields:

expires lease expiration time (seconds since Unix epoch)

mac_addr device MAC address

ip_addr device IP address

hostname name that the device reported

client_id optional identifier supplied by device

Example request:

```
GET /api/v1/chutes/captive-portal/networks/wifi/leases
```

Example response:


```
HTTP/1.1 200 OK
Content-Type: application/json

[
  {
    "client_id": "01:5c:59:48:7d:b9:e6",
    "expires": "1511816276",
    "ip_addr": "192.168.128.64",
    "mac_addr": "5c:59:48:7d:b9:e6",
    "hostname": "paradrops-iPod"
  }
]
```


get_network (*request*, *chute*, *network*)

Get information about a network configured for the chute.

Example request:

```
GET /api/v1/chutes/captive-portal/networks/wifi
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "interface": "wlan0",
  "type": "wifi",
  "name": "wifi"
}
```

get_networks (*request*, *chute*)
Get list of networks configured for the chute.

Example request:

```
GET /api/v1/chutes/captive-portal/networks
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

[
  {
    "interface": "wlan0",
    "type": "wifi",
    "name": "wifi"
  }
]
```

get_ssid (*request*, *chute*, *network*)
Get currently configured SSID for the chute network.

Example request:

```
GET /api/v1/chutes/captive-portal/networks/wifi/ssid
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "ssid": "Free WiFi",
  "bssid": "02:00:08:24:03:dd"
}
```

get_station (*request*, *chute*, *network*, *mac*)
Get detailed information about a connected station.

Example request:

```
GET /api/v1/chutes/captive-portal/networks/wifi/stations/5c:59:48:7d:b9:e6
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "rx_packets": "230",
  "tdls_peer": "no",
  "authenticated": "yes",
  "rx_bytes": "12511",
  "tx_bitrate": "1.0 MBit/s",
  "tx_retries": "0",
  "signal": "-45 [-49, -48] dBm",
  "authorized": "yes",
  "rx_bitrate": "65.0 MBit/s MCS 7",
  "mfp": "no",
  "tx_failed": "0",
  "inactive_time": "4688 ms",
  "mac_addr": "5c:59:48:7d:b9:e6",
  "tx_bytes": "34176",
  "wmm_wme": "yes",
  "preamble": "short",
  "tx_packets": "88",
  "signal_avg": "-44 [-48, -47] dBm"
}
```

get_stations (*request*, *chute*, *network*)

Get detailed information about connected wireless stations.

Example request:

```
GET /api/v1/chutes/captive-portal/networks/wifi/stations
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

[
  {
    "rx_packets": "230",
    "tdls_peer": "no",
    "authenticated": "yes",
    "rx_bytes": "12511",
    "tx_bitrate": "1.0 MBit/s",
    "tx_retries": "0",
    "signal": "-45 [-49, -48] dBm",
    "authorized": "yes",
    "rx_bitrate": "65.0 MBit/s MCS 7",
    "mfp": "no",
    "tx_failed": "0",
    "inactive_time": "4688 ms",
    "mac_addr": "5c:59:48:7d:b9:e6",
    "tx_bytes": "34176",
    "wmm_wme": "yes",
    "preamble": "short",
    "tx_packets": "88",
    "signal_avg": "-44 [-48, -47] dBm"
  }
]
```

hostapd_control(*request*, *chute*, *network*)

restart_chute(*request*, *chute*)

routes

L{Klein} is an object which is responsible for maintaining the routing configuration of our application.

@ivar _url_map: A C{werkzeug.routing.Map} object which will be used for routing resolution.

@ivar _endpoints: A C{dict} mapping endpoint names to handler functions.

set_chute_config(*request*, *chute*)

Update the chute configuration and restart to apply changes.

Example request:

```
PUT /api/v1/chutes/captive-portal/config
Content-Type: application/json

{
  "net": {
    "wifi": {
      "dhcp": {
        "lease": "1h",
        "limit": 250,
        "start": 3
      },
      "intfName": "wlan0",
      "options": {
        "isolate": True
      },
      "ssid": "Better Free WiFi",
      "type": "wifi"
    }
  }
}
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "change_id": 1
}
```

set_ssid(*request*, *chute*, *network*)

Change the configured SSID for the chute network.

The change will not persist after a reboot. If a persistent change is desired, you should update the chute configuration instead.

Example request:

```
PUT /api/v1/chutes/captive-portal/networks/wifi/ssid
Content-Type: application/json

{
  "ssid": "Best Free WiFi"
}
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "message": "OK"
}
```

start_chute(*request*, *chute*)

stop_chute(*request*, *chute*)

update_chute(*request*, *chute*)

class ChuteCacheEncoder(*skipkeys=False*, *ensure_ascii=True*, *check_circular=True*, *allow_nan=True*, *sort_keys=False*, *indent=None*, *separators=None*, *encoding='utf-8'*, *default=None*)

Bases: `json.encoder.JSONEncoder`

JSON encoder for chute cache dictionary.

The chute cache can contain arbitrary objects, some of which may not be JSON-serializable. This encoder returns handles unserializable objects by returning the *repr* string.

default(*o*)

Implement this method in a subclass such that it returns a serializable object for `o`, or calls the base implementation (to raise a `TypeError`).

For example, to support arbitrary iterators, you could implement default like this:

```
def default(self, o):
    try:
        iterable = iter(o)
    except TypeError:
        pass
    else:
        return list(iterable)
    # Let the base class default method raise the TypeError
    return JSONEncoder.default(self, o)
```

class ChuteEncoder(*skipkeys=False*, *ensure_ascii=True*, *check_circular=True*, *allow_nan=True*, *sort_keys=False*, *indent=None*, *separators=None*, *encoding='utf-8'*, *default=None*)

Bases: `json.encoder.JSONEncoder`

default(*o*)

Implement this method in a subclass such that it returns a serializable object for `o`, or calls the base implementation (to raise a `TypeError`).

For example, to support arbitrary iterators, you could implement default like this:

```
def default(self, o):
    try:
        iterable = iter(o)
    except TypeError:
        pass
    else:
        return list(iterable)
    # Let the base class default method raise the TypeError
    return JSONEncoder.default(self, o)
```

class UpdateEncoder(*skipkeys=False*, *ensure_ascii=True*, *check_circular=True*, *allow_nan=True*, *sort_keys=False*, *indent=None*, *separators=None*, *encoding='utf-8'*, *default=None*)

Bases: `json.encoder.JSONEncoder`

default(*o*)

Implement this method in a subclass such that it returns a serializable object for `o`, or calls the base implementation (to raise a `TypeError`).

For example, to support arbitrary iterators, you could implement default like this:

```
def default(self, o):
    try:
        iterable = iter(o)
    except TypeError:
        pass
    else:
        return list(iterable)
    # Let the base class default method raise the TypeError
    return JSONEncoder.default(self, o)
```

chute_access_allowed(*request*, *chute*)

extract_tarred_chute(*data*)

permission_denied(*request*)

tarfile_is_safe(*tar*)

Check the names of files in the archive for safety.

Returns True if all paths are relative and safe or False if any of the paths are absolute (leading slash) or try to access parent directories (leading ..).

paradrop.backend.config_api module

This module exposes device configuration.

Endpoints for these functions can be found under /api/v1/config.

class ConfigApi(*update_manager*, *update_fetcher*)

Bases: `object`

Configuration API.

This class handles HTTP API calls related to router configuration.

factory_reset(***kwargs*)

Initiate the factory reset process.

get_hostconfig(*request*)

Get the device's current host configuration.

Example request:

```
GET /api/v1/config/hostconfig
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json
```

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```
{
  "firewall": {
    "defaults": {
      "forward": "ACCEPT",
      "input": "ACCEPT",
      "output": "ACCEPT"
    }
  },
  ...
}
```

For a complete example, please see the Host Configuration section.

get_pdid(*request*)
Get the device's current ParaDrop ID. This is the identifier assigned by the cloud controller.

Example request:

```
GET /api/v1/config/pdid
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  pdid: "5890e1e5ab7e317e6c6e049f"
}
```

get_provision(*request*)
Get the provision status of the device.

get_settings(*request*)
Get current values of system settings.

These are the values from paradrop.base.settings. Settings are loaded at system initialization from the settings.ini file and environment variables. They are intended to be read-only after initialization.

This endpoint returns the settings as a dictionary with lowercase field names.

Example: {

"portal_server_port": 8080, ...

}

new_config(*request*)
Generate a new node configuration based on the hardware.

Example request:

```
GET /api/v1/config/new_config
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "firewall": {
```

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```
    "defaults": {
      "forward": "ACCEPT",
      "input": "ACCEPT",
      "output": "ACCEPT"
    }
  },
  ...
}
```

For a complete example, please see the Host Configuration section.

pdconf(*request*)
Get configuration sections from pdconf.

This returns a list of configuration sections and whether they were successfully applied. This is intended for debugging purposes.

pdconf_reload(*request*)
Trigger pdconf to reload UCI configuration files.

Trigger pdconf to reload UCI configuration files and return the status. This function is intended for low-level debugging of the paradrop pdconf module.

provision(*request*)
Provision the device with credentials from a cloud controller.

routes
L{Klein} is an object which is responsible for maintaining the routing configuration of our application.

@ivar _url_map: A C{werkzeug.routing.Map} object which will be used for routing resolution.

@ivar _endpoints: A C{dict} mapping endpoint names to handler functions.

sshKeys(*request*, *user*)
Manage list of authorized keys for SSH access.

start_update(*request*)

update_hostconfig(*request*)
Replace the device's host configuration.

Example request:

```
PUT /api/v1/config/hostconfig
Content-Type: application/json

{
  "firewall": {
    "defaults": {
      "forward": "ACCEPT",
      "input": "ACCEPT",
      "output": "ACCEPT"
    }
  },
  ...
}
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  change_id: 1
}
```

For a complete example, please see the Host Configuration section.

paradrop.backend.cors module

Write the CROSS-ORIGIN RESOURCE SHARING headers required Reference: http://msoulier.wordpress.com/2010/06/05/cross-origin-requests-in-twisted/

config_cors(*request*)

paradrop.backend.http_server module

The HTTP server to serve local portal and provide RESTful APIs

class HttpServer(*update_manager*, *update_fetcher*, *airshark_manager*, *portal_dir=None*)

Bases: object

airshark_analyzer(*request*, **args*, ***kwargs*)

airshark_spectrum(*request*, **args*, ***kwargs*)

api_airshark(*request*, **args*, ***kwargs*)

api_audio(*request*)

api_auth(*request*)

api_changes(*request*, **args*, ***kwargs*)

api_chute(*request*, **args*, ***kwargs*)

api_configuration(*request*, **args*, ***kwargs*)

api_information(*request*, **args*, ***kwargs*)

api_network(*request*, **args*, ***kwargs*)

api_password(*request*, **args*, ***kwargs*)

app

L{Klein} is an object which is responsible for maintaining the routing configuration of our application.

@ivar _url_map: A C{werkzeug.routing.Map} object which will be used for routing resolution.

@ivar _endpoints: A C{dict} mapping endpoint names to handler functions.

change_stream(*request*, **args*, ***kwargs*)

chute_logs(*request*, **args*, ***kwargs*)

home(*request*, **args*, ***kwargs*)

logs(*request*, **args*, ***kwargs*)

paradrop_logs(*request*, **args*, ***kwargs*)

snapd(*request*, **args*, ***kwargs*)

status (*request*, **args*, ***kwargs*)

annotate_routes (*router*, *prefix*)
Annotate klein routes for compatibility with autoflask generator.

setup_http_server (*http_server*, *host*, *port*)

paradrop.backend.information_api module

Provide information of the router, e.g. board version, CPU information, memory size, disk size.

Endpoints for these functions can be found under /api/v1/info.

class InformationApi

get_environment (*request*)
Get environment variables.

Returns a dictionary containing the environment variables passed to the Paradrop daemon. This is useful for development and debugging purposes (e.g. see how PATH is set on Paradrop when running in different contexts).

Example request:

```
GET /api/v1/info/environment
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "LANG": "C.UTF-8",
  "SNAP_REVISION": "x73",
  "SNAP_COMMON": "/var/snap/paradrop-daemon/common",
  "XDG_RUNTIME_DIR": "/run/user/0/snap.paradrop-daemon",
  "SNAP_USER_COMMON": "/root/snap/paradrop-daemon/common",
  "SNAP_LIBRARY_PATH": "/var/lib/snapd/lib/gl:/var/lib/snapd/void",
  "SNAP_NAME": "paradrop-daemon",
  "PWD": "/var/snap/paradrop-daemon/x73",
  "PATH": "/snap/paradrop-daemon/x73/usr/sbin:/snap/paradrop-daemon/x73/usr/
↪bin:/snap/paradrop-daemon/x73/sbin:/snap/paradrop-daemon/x73/bin:/usr/local/
↪sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/
↪games",
  "SNAP": "/snap/paradrop-daemon/x73",
  "SNAP_DATA": "/var/snap/paradrop-daemon/x73",
  "SNAP_VERSION": "0.9.2",
  "SNAP_ARCH": "amd64",
  "SNAP_USER_DATA": "/root/snap/paradrop-daemon/x73",
  "TEMPDIR": "/tmp",
  "HOME": "/root/snap/paradrop-daemon/x73",
  "SNAP_REEXEC": "",
  "LD_LIBRARY_PATH": "/var/lib/snapd/lib/gl:/var/lib/snapd/void:/snap/
↪paradrop-daemon/x73/usr/lib/x86_64-linux-gnu::/snap/paradrop-daemon/x73/
↪lib:/snap/paradrop-daemon/x73/usr/lib:/snap/paradrop-daemon/x73/lib/x86_64-
↪linux-gnu:/snap/paradrop-daemon/x73/usr/lib/x86_64-linux-gnu",
  "TMPDIR": "/tmp"
```

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```
  ...
}
```

get_features (*request*)
Get features supported by the host.

This is a list of strings specifying features supported by the daemon.

Explanation of feature strings:

hostapd-control The daemon supports the hostapd control interface and provides a websocket channel for accessing it.

Example request:

```
GET /api/v1/info/features
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

[
  "hostapd-control"
]
```

get_telemetry (*request*)
Get a telemetry report.

This contains information about resource utilization by chute and system totals. This endpoint returns the same data that we periodically send to the controller if telemetry is enabled.

hardware_info (*request*)
Get information about the hardware platform.

Example request:

```
GET /api/v1/info/hardware
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "wifi": [
    {
      "slot": "pci/0000:04:00.0",
      "vendorId": "0x168c",
      "macAddr": "04:f0:21:2f:b7:c1",
      "id": "pci-wifi-0",
      "deviceId": "0x003c"
    },
    {
      "slot": "pci/0000:06:00.0",
      "vendorId": "0x168c",
      "macAddr": "04:f0:21:0f:78:28",
      "id": "pci-wifi-1",
```

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```
      "deviceId": "0x002a"
    }
  ],
  "memory": 2065195008,
  "vendor": "PC Engines",
  "board": "APU 1.0",
  "cpu": "x86_64"
}
```

routes

L{Klein} is an object which is responsible for maintaining the routing configuration of our application.

@ivar _url_map: A C{werkzeug.routing.Map} object which will be used for routing resolution.

@ivar _endpoints: A C{dict} mapping endpoint names to handler functions.

software_info(*request*)

Get information about the operating system.

Returns a dictionary containing information the BIOS version, OS version, kernel version, Paradrop version, and system uptime.

Example request:

```
GET /api/v1/info/software
```

Example response:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
  "biosVersion": "SageBios_PCEngines_APU-45",
  "biosDate": "04/05/2014",
  "uptime": 15351,
  "kernelVersion": "Linux-4.4.0-101-generic",
  "pdVersion": "0.9.2",
  "biosVendor": "coreboot",
  "osVersion": "Ubuntu 4.4.0-101.124-generic 4.4.95"
}
```

paradrop.backend.log_sockjs module

class LogSockJSFactory(*chute*)

Bases: twisted.internet.protocol.Factory

buildProtocol(*addr*)

class LogSockJSProtocol(*factory*)

Bases: twisted.internet.protocol.Protocol

check_log()

connectionLost(*reason*)

connectionMade()

paradrop.backend.password_api module

class PasswordApi(*password_manager*)
Bases: object

For now, we only support set/reset password for the default user: 'paradrop'

change(*request*)

clear(*request*)

routes
L{Klein} is an object which is responsible for maintaining the routing configuration of our application.

@ivar _url_map: A C{werkzeug.routing.Map} object which will be used for routing resolution.

@ivar _endpoints: A C{dict} mapping endpoint names to handler functions.

paradrop.backend.password_manager module

class PasswordManager
Bases: object

DEFAULT_PASSWORD = ''

DEFAULT_USER_NAME = 'paradrop'

add_user(*user_name*, *password*)

change_password(*user_name*, *newPassword*)

remove_user(*user_name*)

reset()

verify_password(*user_name*, *password*)

paradrop.backend.snapd_resource module

class SnapdResource
Bases: twisted.web.resource.Resource

Expose the snapd API by forwarding requests.

https://github.com/snapcore/snapd/wiki/REST-API

do_snapd_request(*request*)
Forward the API request to snapd.

isLeaf = True

render(*request*)
Fulfill requests by forwarding them to snapd.

We use a synchronous implementation of HTTP over Unix sockets, so we do the request in a worker thread and have it call request.finish.

paradrop.backend.status_sockjs module

class StatusSockJSFactory(*system_status*)
Bases: twisted.internet.protocol.Factory

buildProtocol(*addr*)

class StatusSockJSProtocol(*factory*)
Bases: twisted.internet.protocol.Protocol

connectionLost(*reason*)

connectionMade()

dataReceived(*data*)

Module contents

12.1.3 paradrop.base package

Submodules

paradrop.base.cxbr module

Wamp utility methods.

class BaseClientFactory(*factory*, **args*, ***kwargs*)
Bases: autobahn.twisted.websocket.WampWebSocketClientFactory, twisted.internet.protocol.ReconnectingClientFactory

clientConnectionFailed(*connector*, *reason*)
Called when a connection has failed to connect.

It may be useful to call connector.connect() - this will reconnect.

@type reason: L{twisted.python.failure.Failure}

clientConnectionLost(*connector*, *reason*)
Called when an established connection is lost.

It may be useful to call connector.connect() - this will reconnect.

@type reason: L{twisted.python.failure.Failure}

initialDelay = 1

maxDelay = 60

class BaseSession(*config=None*)
Bases: autobahn.twisted.wamp.ApplicationSession

Temporary base class for crossbar implementation

call(*procedure*, **args*, ***kwargs*)
Implements autobahn.wamp.interfaces.ICaller.call()

leave()
Implements autobahn.wamp.interfaces.ISession.leave()

onJoin(***kwargs*)
Implements autobahn.wamp.interfaces.ISession.onJoin()

publish(*topic*, **args*, ***kwargs*)
Implements `autobahn.wamp.interfaces.IPublisher.publish()`

register(*endpoint*, *procedure=None*, *options=None*)
Implements `autobahn.wamp.interfaces.ICallee.register()`

classmethod start(*address*, *pdid*, *realm='paradrop'*, *start_reactor=False*, *debug=False*, *extra=None*, *reconnect=True*)
Creates a new instance of this session and attaches it to the router at the given address and realm.

reconnect: The session will attempt to reconnect on connection failure and continue trying indefinitely.

stockCall(*procedure*, **args*, ***kwargs*)

stockPublish(*topic*, **args*, ***kwargs*)

stockRegister(*endpoint*, *procedure=None*, *options=None*)

stockSubscribe(*handler*, *topic=None*, *options=None*)

subscribe(*handler*, *topic=None*, *options=None*)
Implements `autobahn.wamp.interfaces.ISubscriber.subscribe()`

class BaseSessionFactory(*config*, *deferred=None*)
Bases: `autobahn.twisted.wamp.ApplicationSessionFactory`

paradrop.base.exceptions module

Exceptions and their subclasses

TODO: Distill these down and make a heirarchy.

exception AuthenticationError
Bases: *paradrop.base.exceptions.PdServerException*

exception ChuteNotFound
Bases: *paradrop.base.exceptions.ParadropException*

exception ChuteNotRunning
Bases: *paradrop.base.exceptions.ParadropException*

exception DeviceNotFoundException
Bases: *paradrop.base.exceptions.ParadropException*

exception InteralException
Bases: `exceptions.Exception`

exception InvalidCredentials
Bases: *paradrop.base.exceptions.PdServerException*

exception ModelNotFound
Bases: *paradrop.base.exceptions.PdServerException*

exception ParadropException
Bases: `exceptions.Exception`

exception PdServerException
Bases: `exceptions.Exception`

exception PdidError
Bases: *paradrop.base.exceptions.PdServerException*

exception PdidExclusionError
Bases: *paradrop.base.exceptions.PdServerException*

exception ServiceNotFound(*name*)
Bases: *paradrop.base.exceptions.ParadropException*

paradrop.base.nexus module

Stateful, singleton, paradrop daemon command center. See docstring for NexusBase class for information on settings.

SETTINGS QUICK REFERENCE: # assuming the following import from paradrop.base import nexus

nexus.core.info.version nexus.core.info.pdid

class AttrWrapper
Bases: object

Simple attr interceptor to make accessing settings simple.

Stores values in an internal dict called contents.

Does not allow modification once _lock() is called. Respect it.

Once you've filled it up with the appropriate initial values, set onChange to assign

setOnChange(*func*)

class NexusBase(*stealStdio=True*, *printToConsole=True*)
Bases: object

Resolving these values to their final forms: 1 - module imported, initial values assigned(as written below) 2 - class is instatiated, passed settings to replace values 3 - instance chooses appropriate values based on current state(production or local)

Each category has its own method for initialization here (see: resolveNetwork, resolvePaths)

PDID = None

VERSION = 1

connect(***kwargs*)
Takes the given session class and attempts to connect to the crossbar fabric.

If an existing session is connected, it is cleanly closed.

getKey(*name*)
Returns the given key or None

onInfoChange(*key*, *value*)
Called when an internal setting is changed. Trigger a save automatically.

onStart()

onStop()

provision(*pdid*, *pdserver='https://paradrop.org'*, *wampRouter='wss://paradrop.org/ws'*)

provisioned()
Checks if this[whatever] appears to be provisioned or not

save()
Ehh. Ideally this should happen asynchronously.

saveKey(*key*, *name*)
Save the key with the given name. Overwrites by default

createDefaultInfo(*path*)

loadYaml(*path*)
Return dict from YAML found at path

resolveInfo(*nexus*, *path*)
Given a path to the config file, load its contents and assign it to the config file as appropriate.

validateInfo(*contents*)
Error checking on the read YAML file. This is a temporary method.

:

param contents: the read - in yaml to check

:

type contents: dict.

:

returns: True if valid, else false

writeYaml(*contents*, *path*)
Overwrites content with YAML representation at given path

paradrop.base.output module

Output mapping, capture, storange, and display.

Some of the methods and choice here may seem strange – they are meant to keep this file in

class BaseOutput(*logType*)
Bases: object

Base output type class.

This class and its subclasses are registered with an attribute on the global 'out' function and is responsible for formatting the given output stream and returning it as a "log structure" (which is a dict.)

For example: out.info("Text", anObject)

requires a custom object to figure out what to do with anObject where the default case will simply parse the string with an appropriate color.

Objects are required to output a dict that mininmally contains the keys message and type.

formatOutput(*logDict*)
Convert a logdict into a custom formatted, human readable version suitable for printing to console.

class ExceptionOutput(*logType*)
Bases: *paradrop.base.output.BaseOutput*

Handle vanilla exceptions passed directly to us using out.exception

class Level
Bases: enum.Enum

ERR = 6

FATAL = 8

HEADER = 1

INFO = 3

PERF = 4

SECURITY = 7

USAGE = 9

VERBOSE = 2

WARN = 5

class Output(***kwargs*)

Class that allows stdout/stderr trickery. By default the paradrop object will contain an @out variable (defined below) and it will contain 2 members of "err" and "fatal".

Each attribute of this class should be a function which points to a class that inherits IOutput(). We call these functions "output streams".

The way this Output class is setup is that you pass it a series of kwargs like (stuff=OutputClass()). Then at any point in your program you can call "paradrop.out.stuff('This is a string

')".

This way we can easily support different levels of verbosity without the need to use some kind of bitmask or anything else. On-the-fly output creation is no longer supported due to the metadata and special processing added. It is still possible, but not implemented.

This is done by the __getattr__ function below, basically in __init__ we set any attributes you pass as args, and anything else not defined gets sent to __getattr__ so that it doesn't error out.

endLogging()

Ask the printing thread to flush and end, then return.

getLogsSince(*target*, *purge=False*)

Reads all logs and returns their contents. The current log file is not touched. Removes old log files if 'purge' is set (though this is a topic for debate...)

The server will be most interested in this call, but it needs to register for new logs first, else there's a good chance to see duplicates.

NOTE: don't open all log files, check to open only the ones that might be relevant. This is certainly a bug and can cause memory issues.

Parameters

- **target** (*float.*) – seconds since the GMT epoch. Method returns logs that have timestamps later than this.
- **purge** (*bool.*) – deletes the old log files (except today's) if set

Returns a list of dictionaries containing log information. Not ordered.

handlePrint(*logDict*)

All printing objects return their messages. These messages are routed to this method for handling.

Send the messages to the printer. Optionally display the messages. Decorate the print messages with metadata.

Parameters **logDict** – a dictionary representing this log item. Must contain keys

message and type. :type logDict: dict.

logToConsole(*newStatus*)

messageToString(*message*)
Converts message dicts to a format suitable for printing based on the conversion rules laid out in in that class's implementation.

Parameters **message** (*dict.*) – the dict to convert to string

Returns str

startLogging(*filePath=None*, *stealStdio=False*, *printToConsole=True*)
Begin logging. The output class is ready to go out of the box, but in order to prevent mere imports from stealing stdio or console logging to vanish these must be manually turned on.

Parameters

- **filePath** (*str*) – if provided, begin logging to the given directory. If not provided, do not write out logs.
- **stealStdio** (*bool.*) – choose to intercept stdio (including vanilla print statements) or allow it to passthrough
- **printToConsole** (*bool.*) – output the results of all logging to the console. This is primarily a performance consideration when running in production

stealStdio(*newStatus*)

class OutputRedirect(*output*, *contentAppearedCallback*, *logType*)
Bases: object

Intercepts passed output object (either stdout and stderr), calling the provided callback method when input appears.

Retains the original mappings so writing can still happen. Performs no formatting.

flush()

trueWrite(*contents*)
Someone really does want to output

write(*contents*)
Intercept output to the assigned target and callback with it. The true output is returned with the callback so the delegate can differentiate between captured outputs in the case when two redirecters are active.

class PrintLogThread(*path*, *queue*, *name*)
Bases: threading.Thread

All file printing access from one thread.

Receives information when its placed on the passed queue. Called from one location: Output.handlePrint.

Does not close the file: this happens in Output.endLogging. This simplifies the operation of this class, since it only has to concern itself with the queue.

The path must exist before DailyLog runs for the first time.

run()
Method representing the thread's activity.

You may override this method in a subclass. The standard run() method invokes the callable object passed to the object's constructor as the target argument, if any, with sequential and keyword arguments taken from the args and kwargs arguments, respectively.

class TwistedException(*logType*)
Bases: *paradrop.base.output.BaseOutput*

class TwistedOutput(*logType*)
Bases: *paradrop.base.output.BaseOutput*

blacklist = ['Starting factory', 'Stopping factory', 'Log opened']

parseLogPrefix(*tb*)
Takes a traceback returned by 'extract_tb' and returns the package, module, and line number

silentLogPrefix(*stepsUp*)
logPrefix v2– gets caller information silently (without caller intervention) The single parameter reflects how far up the stack to go to find the caller and depends how deep the direct caller to this method is wrt to the target caller

NOTE: Some calls cannot be silently prefixed (getting into the twisted code is a great example)

Parameters **stepsUp** – the number of steps to move up the stack for the caller

paradrop.base.pdutils module

lib.utils.output. Helper for formatting output from Paradrop.

class Timer(*key=''*, *verbose=True*)
Bases: object

A timer object for simple benchmarking.

Usage:

with Timer(key='Name of this test') as t: do.someCode(thatTakes=aWhile)

Once the code finishes executing the time is output.

check(*pkt*, *pktType*, *keyMatches=None*, ***valMatches*)
This function takes an object that was expected to come from a packet (after it has been JSONized) and compares it against the arg requirements so you don't have to have 10 if() statements to look for keys in a dict, etc..

Args: @pkt : object to look at @pktType : object type expected (dict, list, etc..) @keyMatches : a list of minimum keys found in parent level of dict, expected to be an array @valMatches : a dict of key:value pairs expected to be found in the parent level of dict

the value can be data (like 5) OR a type (like this value must be a @list@).

Returns: None if everything matches, otherwise it returns a string as to why it failed.

convertUnicode(*elem*)
Converts all unicode strings back into UTF-8 (str) so everything works. Call this function like:

json.loads(s, object_hook=convertUnicode)

class dict2obj(*aDict=None*, ***kwargs*)
Bases: object

explode(*pkt*, **args*)
This function takes a dict object and explodes it into the tuple requested.

It returns None for any value it doesn't find.

The only error it throws is if args is not defined.

Example: pkt = {'a':0, 'b':1} 0, 1, None = pdcomm.explode(pkt, 'a', 'b', 'c')

json2str(*j*, *safe=' '*)
Properly converts and encodes all data related to the JSON object into a string format that can be transmitted through a network and stored properly in a database. Arguments:

@j : json to be converted @safe : optional, string of chars to pass to urlEncodeMe that are declared safe (don't encode)

jsonPretty(*j*)
Returns a string of a JSON object in 'pretty print' format fully indented, and sorted.

stimestr(*x=None*)

str2json(*s*)

timedur(*x*)
Print consistent string format of seconds passed. Example: 300 = '5 mins' Example: 86400 = '1 day' Example: 86705 = '1 day, 5 mins, 5 sec'

timeflt()

timeint()

timestr(*x=None*)

urlDecodeMe(*elem*)
Converts any values that would cause JSON parsing to fail into URL percent encoding equivalents. This function can be used for any valid JSON type including str, dict, list. Returns:

Same element properly decoded.

urlEncodeMe(*elem*, *safe=' '*)
Converts any values that would cause JSON parsing to fail into URL percent encoding equivalents. This function can be used for any valid JSON type including str, dict, list. Returns:

Same element properly encoded.

paradrop.base.settings module

This file contains any settings required by ANY and ALL modules of the paradrop system. They are defaulted to some particular value and can be called by any module in the paradrop system with the following code:

from paradrop import settings print(settings.STUFF)

These settings can be overriden by a KYE:VALUE array

If settings need to be changed, they should be done so by the initialization code (such as pdfcd, pdfc_config, etc. . .)

This is done by calling the following function: settings.updateSettings(settings_array)

iterate_module_attributes(*module*)
Iterate over the attributes in a module.

This is a generator function.

Returns (name, value) tuples.

loadSettings(*mode='local'*, *slist=[]*)
Take a list of key:value pairs, and replace any setting defined. Also search through the settings module and see if any matching environment variables exist to replace as well.

Parameters **slist** (*array.*) – the list of key:val settings

Returns None

load_from_file(*path*)
Load settings from an INI file.

This will check the configuration file for a lowercase version of all of the settings in this module. It will look in a section called "base".

The example below will set PORTAL_SERVER_PORT.

[base] portal_server_port = 4444

parseValue(*key*)
Attempts to parse the key value, so if the string is 'False' it will parse a boolean false.

Parameters **key** (*string*) – the key to parse

Returns the parsed key.

updatePaths(*configHomeDir*, *runtimeHomeDir='/var/run/paradrop'*)

Module contents

12.1.4 paradrop.confd package

Submodules

paradrop.confd.base module

class ConfigObject(*name=None*)
Bases: object

PRIO_CONFIG_IFACE = 30

PRIO_CONFIG_QDISC = 45

PRIO_CREATE_IFACE = 20

PRIO_CREATE_QDISC = 40

PRIO_CREATE_VLAN = 25

PRIO_IPTABLES_RULE = 37

PRIO_IPTABLES_TOP = 35

PRIO_IPTABLES_ZONE = 36

PRIO_START_DAEMON = 60

apply(*allConfigs*)
Return a list of commands to apply this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

classmethod build(*manager*, *source*, *name*, *options*, *comment*)
Build a config object instance from the UCI section.

Arguments: source – file containing this configuration section name – name of the configuration section

If None, a unique name will be generated.

options – dictionary of options loaded from the section comment – comment string or None

copy()
Make a copy of the config object.

The copy will receive the same name and option values.

dump()
Return full configuration section as a string.

findByType(*allConfigs*, *module*, *typename*, *where={}*)
Look up sections by type (generator).

where: filter the returned results by checking option values.

classmethod getModule()
Get the module name (e.g. "dhcp", "wireless") for a ConfigObject class.

getName()
Return section name.

Subclasses that do not have names (anonymous sections) should override this to return some other unique identifier such as an interface name.

getTypeAndName()
Return tuple (section module, section type, section name).

lookup(*allConfigs*, *sectionModule*, *sectionType*, *sectionName*, *addDependent=True*)
Look up a section by type and name.

If addDependent is True (default), the current object will be added as a dependent of the found section.

Will raise an exception if the section is not found.

maskable = True

nextId = 0

options = []

optionsMatch(*other*)
Test equality of config sections by comparing option values.

static prioritizeConfigs(*reverse=False*)
Assign priorities to config objects based on the dependency graph.

Priority zero is assigned to all configs with no dependencies.

priority(config1) > priority(config2) means config1 should be applied later than config2, and config1 should be reverted earlier than config2. For configs with the same priority value, it is presumed that order does not matter.

If reverse is True, the priorities are made negative so that traversing in increasing order gives the proper order for reverting.

Returns a list of tuples (priority, config). This format is suitable for heapq.

removeFromParents()
Remove this section from being tracked by its parents.

Call this before discarding a configuration section so that later on, if the parent is updated, it doesn't try to update non-existent children.

revert(*allConfigs*)
Return a list of commands to revert this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

setup()
Finish object initialization.

This is called after the config object is initialized will all of its options values filled in. Override to do some preparation work before we start generating commands.

typename = None

updateApply(*new*, *allConfigs*)
Return a list of commands to update to new configuration.

Implementing this is optional for subclasses. The default behavior is to call apply.

Returns a list of (priority, Command) tuples.

updateRevert(*new*, *allConfigs*)
Return a list of commands to (partially) revert the configuration.

The implementation can be selective about what it reverts (e.g. do not delete an interface if we are only updating its IP address). The default behavior is to call revert.

Returns a list of (priority, Command) tuples.

class ConfigOption(*name*, *type=<type 'str'>*, *required=False*, *default=None*)
Bases: object

default

name

required

type

interpretBoolean(*s*)
Interpret string as a boolean value.

"0" and "False" are interpreted as False. All other strings result in True. Technically, only "0" and "1" values should be seen in UCI files. However, because of some string conversions in Python, we may encounter "False".

paradrop.confd.client module

reload(*path*)
Reload file(s) specified by path.

This function blocks until the request completes. On completion it returns a status string, which is a JSON list of loaded configuration sections with a 'success' field. For critical errors it will return None.

reloadAll()
Reload all files from the system configuration directory.

This function blocks until the request completes. On completion it returns a status string, which is a JSON list of loaded configuration sections with a 'success' field. For critical errors it will return None.

systemStatus()
Return system status string from pdconf.

waitSystemUp()
Wait for the configuration daemon to finish its first load.

This function blocks until the request completes. On completion it returns a status string, which is a JSON list of loaded configuration sections with a 'success' field. For critical errors it will return None.

paradrop.confd.command module

class Command(*command*, *parent=None*, *ignoreFailure=False*)
Bases: object

execute()

success()
Returns True if the command was successfully executed.

class CommandList
Bases: list

append(*priority*, *command*)
L.append(object) – append object to end

commands()
Iterate over commands in order by priority.

Commands are first sorted by assigned priority. Within each priority level, the order in which they were added is maintained.

class ErrorCommand(*error*, *parent=None*)
Bases: *paradrop.confd.command.Command*

Special command object that indicates an error occurred.

execute()

success()
Returns True if the command was successfully executed.

class FunctionCommand(*parent*, *function*, **args*, ***kwargs*)
Bases: *paradrop.confd.command.Command*

Command that runs a Python function.

execute()

class KillCommand(*pid*, *parent=None*)
Bases: *paradrop.confd.command.Command*

Special command object for killing a process

execute()

getPid()

kill(*pid*, *kill_signal=4*, *timeout=8*)
Kill a child process and wait with timeout.

1. Send a SIGTERM signal to the process.
2. Wait up to *kill_signal* seconds for the process to exit.
3. If process is still running, send a SIGKILL signal.
4. Wait up to *timeout* seconds (cumulative with *kill_signal*) for the process to exit.

Returns True if the process exited before *timeout* seconds elapsed.

paradrop.confd.dhcp module

class ConfigDhcp(*name=None*)
Bases: *paradrop.confd.base.ConfigObject*

options = [ConfigOption(name='interface', type=<type 'str'>, required=True, default=No

typename = 'dhcp'

class ConfigDnsmasq(*name=None*)
Bases: *paradrop.confd.base.ConfigObject*

apply(*allConfigs*)
Return a list of commands to apply this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

options = [ConfigOption(name='authoritative', type=<type 'bool'>, required=False, defa

revert(*allConfigs*)
Return a list of commands to revert this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

typename = 'dnsmasq'

class ConfigDomain(*name=None*)
Bases: *paradrop.confd.base.ConfigObject*

getName()
Return section name.

Subclasses that do not have names (anonymous sections) should override this to return some other unique identifier such as an interface name.

options = [ConfigOption(name='name', type=<type 'str'>, required=False, default=None),

typename = 'domain'

paradrop.confd.firewall module

class ConfigDefaults(*name=None*)
Bases: *paradrop.confd.base.ConfigObject*

apply(*allConfigs*)
Return a list of commands to apply this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

getName()
Return section name.

Subclasses that do not have names (anonymous sections) should override this to return some other unique identifier such as an interface name.

get_iptables()
Get the list of iptables commands to use (iptables / ip6tables).

options = [ConfigOption(name='input', type=<type 'str'>, required=False, default='ACCE

revert(*allConfigs*)
Return a list of commands to revert this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

typename = 'defaults'

updateApply(*new*, *allConfigs*)
Return a list of commands to update to new configuration.

Implementing this is optional for subclasses. The default behavior is to call apply.

Returns a list of (priority, Command) tuples.

updateRevert(*new*, *allConfigs*)
Return a list of commands to (partially) revert the configuration.

The implementation can be selective about what it reverts (e.g. do not delete an interface if we are only updating its IP address). The default behavior is to call revert.

Returns a list of (priority, Command) tuples.

class ConfigForwarding(*name=None*)
Bases: *paradrop.confd.base.ConfigObject*

apply(*allConfigs*)
Return a list of commands to apply this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

options = [ConfigOption(name='src', type=<type 'str'>, required=True, default=None), C

revert(*allConfigs*)
Return a list of commands to revert this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

typename = 'forwarding'

class ConfigRedirect(*name=None*)
Bases: *paradrop.confd.base.ConfigObject*

ANY_PROTO = set(['none', None, 'any'])

apply(*allConfigs*)
Return a list of commands to apply this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

options = [ConfigOption(name='src', type=<type 'str'>, required=False, default=None), (

revert(*allConfigs*)
Return a list of commands to revert this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

typename = 'redirect'

class ConfigRule(*name=None*)
Bases: *paradrop.confd.base.ConfigObject*

apply(*allConfigs*)
Return a list of commands to apply this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

get_iptables()
Get the list of iptables commands to use (iptables / ip6tables).

options = [ConfigOption(name='name', type=<type 'str'>, required=False, default=None),

revert(*allConfigs*)
Return a list of commands to revert this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

typename = 'rule'

class ConfigZone(*name=None*)
Bases: *paradrop.confd.base.ConfigObject*

apply(*allConfigs*)
Return a list of commands to apply this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

get_iptables()
Get the list of iptables commands to use (iptables / ip6tables).

options = [ConfigOption(name='name', type=<type 'str'>, required=True, default=None),

revert(*allConfigs*)
Return a list of commands to revert this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

setup()
Finish object initialization.

This is called after the config object is initialized will all of its options values filled in. Override to do some preparation work before we start generating commands.

typename = 'zone'

paradrop.confd.main module

This module listens for messages and triggers reloading of configuration files. This module is the service side of the implementation. If you want to issue reload commands to the service, see the client.py file instead.

listen(*configManager*)

run_thread(*execute=True*)
Start pdconfd service as a thread.

This function schedules pdconfd to run as a thread and returns immediately.

paradrop.confd.manager module

class ConfigManager(*writeDir*, *execCommands=True*)
Bases: object

changingSet(*files*)
Return the sections from the current configuration that may have changed.

This checks which sections from the current configuration came from files in the given file list. These are sections that may be changed or removed when we reload the files.

execute(*commands*)
Execute commands.

Takes a CommandList object.

findMatchingConfig(*config*, *byName=False*)
Check the current config for an identical section.

Returns the matching object or None.

getPreviousCommands()
Get the most recent command list.

loadConfig(*search=None*, *execute=True*)
Load configuration files and apply changes to the system.

We process the configuration files in sections. Each section corresponds to an interface, firewall rule, DHCP server instance, etc. Each time we reload configuration files after the initial time, we check for changes against the current configuration. Here is the decision tree for handling differences in the newly loaded configuration vs. the existing configuration:

Section exists in current config (by type and name)?

- No -> Add section, apply changes, and stop.
- Yes -> Continue.

Section is identical to the one in the current config (by option values)?

- **No -> Revert current section, mark any affected dependents,** add new section, apply changes, and stop.
- Yes -> Continue.

Section has not changed but one of its dependencies has?

- No -> Stop.
- **Yes -> Revert current section, mark any affected dependents,** add new section, apply changes, and stop.

readConfig(*files*)
Load configuration files and return configuration objects.

This method only loads the configuration files without making any changes to the system and returns configuration objects as a generator.

statusString()
Return a JSON string representing status of the system.

The format will be a list of dictionaries. Each dictionary corresponds to a configuration block and contains at the following fields.

type: interface, wifi-device, etc. name: name of the section (may be autogenerated for some configs) comment: comment from the configuration file or None success: True if all setup commands succeeded

unload(*execute=True*)

waitSystemUp()
Wait for the first load to complete and return system status string.

findConfigFiles(*search=None*)
Look for and return a list of configuration files.

The behavior depends on whether the search argument is a file, a directory, or None.

If search is None, return a list of files in the system config directory. If search is a file name (not a path), look for it in the working directory first, and the system directory second. If search is a full path to a file, and it exists, then return that file. If search is a directory, return the files in that directory.

paradrop.confd.network module

class ConfigInterface(*name=None*)
Bases: *paradrop.confd.base.ConfigObject*

DEV_PLUS_VID = <_sre.SRE_Pattern object>

addToBridge(*ifname*)
Generate commands to add ifname to bridge.

apply(*allConfigs*)
Return a list of commands to apply this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

maskable = False

options = [ConfigOption(name='proto', type=<type 'str'>, required=True, default=None),

removeFromBridge(*ifname*)
Generate commands to add ifname to bridge.

revert(*allConfigs*)
Return a list of commands to revert this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

setup()
Finish object initialization.

This is called after the config object is initialized will all of its options values filled in. Override to do some preparation work before we start generating commands.

typename = 'interface'

updateApply(*new*, *allConfigs*)
Return a list of commands to update to new configuration.

Implementing this is optional for subclasses. The default behavior is to call apply.

Returns a list of (priority, Command) tuples.

updateRevert(*new*, *allConfigs*)
Return a list of commands to (partially) revert the configuration.

The implementation can be selective about what it reverts (e.g. do not delete an interface if we are only updating its IP address). The default behavior is to call revert.

Returns a list of (priority, Command) tuples.

paradrop.confd.qos module

class ConfigClass(*name=None*)
Bases: *paradrop.confd.base.ConfigObject*

options = [ConfigOption(name='packetsize', type=<type 'int'>, required=False, default=

typename = 'class'

class ConfigClassgroup(*name=None*)
Bases: *paradrop.confd.base.ConfigObject*

get_class_id(*class_name*)
Get ID for a traffic class in this group.

Returns None if the class is not a member of the group.

options = [ConfigOption(name='classes', type=<type 'str'>, required=True, default=None

setup()
Finish object initialization.

This is called after the config object is initialized will all of its options values filled in. Override to do some preparation work before we start generating commands.

typename = 'classgroup'

class ConfigClassify(*name=None*)
Bases: *paradrop.confd.base.ConfigObject*

apply(*allConfigs*)
Return a list of commands to apply this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

make_iptables_cmd(*action*, *ifname*, *class_id*)

options = [ConfigOption(name='target', type=<type 'str'>, required=True, default=None)

revert(*allConfigs*)
Return a list of commands to revert this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

typename = 'classify'

class ConfigInterface(*name=None*)
Bases: *paradrop.confd.base.ConfigObject*

apply(*allConfigs*)
Return a list of commands to apply this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

options = [ConfigOption(name='enabled', type=<type 'bool'>, required=True, default=Non

revert(*allConfigs*)
Return a list of commands to revert this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

typename = 'interface'

compute_hfsc_params(*classes*, *capacity*)

paradrop.confd.wireless module

class ConfGenerator
Bases: object

writeHeader(*output*)

writeOptions(*options*, *output*, *title=None*)

class ConfigWifiDevice(*name=None*)
Bases: *paradrop.confd.base.ConfigObject*

apply(*allConfigs*)
Return a list of commands to apply this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

detectPrimaryInterface()
Find the primary network interface associated with this Wi-Fi device.

By primary we mean the first interface (e.g. wlan0 or wlan1) that exists at system startup before any *interface add* commands. We will use the primary interface first, and create additional virtual interfaces after that.

That seems overly complicated, but it is required in cases where the Wi-Fi device does not support virtual interfaces.

Returns interface name or None.

nextInterfaceName()
Get the next available interface name.

options = [ConfigOption(name='type', type=<type 'str'>, required=True, default=None),

releaseInterfaceName(*ifname*)
Mark an interface name as no longer used.

revert(*allConfigs*)
Return a list of commands to revert this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

setup()
Finish object initialization.

This is called after the config object is initialized will all of its options values filled in. Override to do some preparation work before we start generating commands.

typename = 'wifi-device'

class ConfigWifiIface(*name=None*)
Bases: *paradrop.confd.base.ConfigObject*

apply(*allConfigs*)
Return a list of commands to apply this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

getIfname(*device*, *interface*)
Returns the name to be used by this WiFi interface, e.g. as seen by ifconfig.

This comes from the "ifname" option if it is set. Otherwise, we use the interface name of the associated network.

getName()
Return a unique and consistent identifier for the section.

If ifname is set, then that is a good choice for the name because interface names need to be unique on the system.

If ifname is not set, then we use the combined string device:network. The assumption is that no one will put multiple APs on the same device and same network, or if they do, (e.g. multiple APs on the br-lan bridge), then they will configure the ifname to be unique.

getRandomMAC()
Generate a random MAC address.

Returns a string "02:xx:xx:xx:xx:xx". The first byte is 02, which indicates a locally administered address.

makeHostapdConf(*wifiDevice*, *interface*)

makeWpaSupplicantConf(*wifiDevice*, *interface*)

options = [ConfigOption(name='device', type=<type 'str'>, required=True, default=None)

revert(*allConfigs*)
Return a list of commands to revert this configuration.

Most subclasses will need to implement this function.

Returns a list of (priority, Command) tuples.

typename = 'wifi-iface'

updateApply(*new*, *allConfigs*)
Return a list of commands to update to new configuration.

Implementing this is optional for subclasses. The default behavior is to call apply.

Returns a list of (priority, Command) tuples.

updateRevert(*new*, *allConfigs*)
Return a list of commands to (partially) revert the configuration.

The implementation can be selective about what it reverts (e.g. do not delete an interface if we are only updating its IP address). The default behavior is to call revert.

Returns a list of (priority, Command) tuples.

class HostapdConfGenerator(*wifiIface*, *wifiDevice*, *interface*)
Bases: *paradrop.confd.wireless.ConfGenerator*

generate(*path*)

get11acOptions()

get11nOptions()

get11rOptions()
Get options related to 802.11r (fast BSS transition).

getMainOptions()

getRadiusOptions()

getSecurityOptions()

readMode(*device*)
Determine HT/VHT mode if applicable.

writeHeader(*output*)

class WpaSupplicantConfGenerator(*wifiIface*, *wifiDevice*, *interface*)
Bases: *paradrop.confd.wireless.ConfGenerator*

generate(*path*)

getMainOptions()

writeHeader(*output*)

getPhyFromMAC(*mac*)

getPhyMACAddress(*phy*)

get_cipher_list(*encryption_mode*)
Get list of ciphers from encryption mode.

Example: get_cipher_list("psk2+tkip+aes") -> ["TKIP", "CCMP"]

isHexString(*data*)
Test if a string contains only hex digits.

Module contents

12.1.5 paradrop.core package

Subpackages

paradrop.core.agent package

Submodules

paradrop.core.agent.http module

class CurlRequestDriver
Bases: *paradrop.core.agent.http.HTTPRequestDriver*

code_pattern = <_sre.SRE_Pattern object>

curl = <MagicMock name='mock.Curl()' id='140110836734736'>

header_pattern = <_sre.SRE_Pattern object>

lock = <twisted.internet.defer.DeferredLock object>

receive(*ignore*)
Receive response from curl and convert it to a response object.

receiveHeaders(*header_line*)

request(*method*, *url*, *body=None*)

class HTTPRequestDriver
Bases: object

request(*method*, *url*, *body*)

setHeader(*key*, *value*)

class HTTPResponse(*data=None*)
Bases: object

class JSONReceiver(*response*, *finished*)
Bases: twisted.internet.protocol.Protocol

JSON Receiver

A JSONReceiver object can be used with the twisted HTTP client to receive data from a request and provide it to a callback function when complete.

Example (response came from an HTTP request): finished = Deferred() response.deliverBody(JSONReceiver(finished)) finished.addCallback(func_that_takes_result)

Some error conditions will result in the callback firing with a result of None. The receiver needs to check for this. This seems to occur on 403 errors where the server does not return any data, but twisted just passes us a ResponseDone object the same type as a normal result.

connectionLost(*reason*)
internal: handles connection close events.

dataReceived(*data*)
internal: handles incoming data.

class PDServerRequest(*path*, *driver=<class 'paradrop.core.agent.http.TwistedRequestDriver'>*, *headers={}*, *setAuthHeader=True*)
Bases: object

Make an HTTP request to pdserver.

The API is assumed to use application/json for sending and receiving data. Authentication is automatically handled here if the router is provisioned.

We handle missing, invalid, or expired tokens by making the request and detecting a 401 (Unauthorized) response. We request a new token and retry the failed request. We do this at most once and return failure if the second attempt returns anything other than 200 (OK).

PDServerRequest objects are not reusable; create a new one for each request.

URL String Substitutions: router_id -> router id

Example: /routers/{router_id}/states -> /routers/halo06/states

get(***query*)

classmethod getServerInfo()
Return the information needed to send API messages to the server.

This can be used by an external program (e.g. pdinstall).

patch(**ops*)
Expects a list of operations in jsonpatch format (http://jsonpatch.com/).

An example operation would be: {'op': 'replace', 'path': '/completed', 'value': True}

post(***data*)

put(***data*)

receiveResponse(*response*)
Intercept the response object, and if it's a 401 authenticate and retry.

request()

classmethod resetToken()
Reset the auth token, to be called if the router's identity has changed.

token = None

class PDServerResponse(*response*, *data=None*)
Bases: object

A PDServerResponse object contains the results of a request to pdserver.

This wraps twisted.web.client.Response (cannot be subclassed) and exposes the same variables in addition to a 'data' variables. The 'data' variable, if not None, is the parsed object from the response body.

class TwistedRequestDriver
Bases: *paradrop.core.agent.http.HTTPRequestDriver*

pool = <twisted.web.client.HTTPConnectionPool object>

receive(*response*)
Receive response from twisted web client and convert it to a PDServerResponse object.

request(*method*, *url*, *body=None*)

sem = <twisted.internet.defer.DeferredSemaphore object>

urlEncodeParams(*data*)
Return data URL-encoded.

This function specifically handles None and boolean values to convert them to JSON-friendly strings (e.g. None -> 'null').

paradrop.core.agent.reporting module

class NodeIdentitySender(*model='states'*, *max_retries=None*)
Bases: *paradrop.core.agent.reporting.ReportSender*

send(*report*)

class ReportSender(*model='states'*, *max_retries=None*)
Bases: object

increaseDelay()

send(*report*)

class StateReport
Bases: object

toJSON()

class StateReportBuilder
Bases: object

prepare()

class TelemetryReportBuilder
Bases: object

prepare()

sendNodeIdentity()

sendStateReport()

sendTelemetryReport()

paradrop.core.agent.wamp_session module

The WAMP session of the paradrop daemon

class WampSession(**args*, ***kwargs*)
Bases: *paradrop.base.cxbr.BaseSession*

onChallenge(*challenge*)
Implements autobahn.wamp.interfaces.ISession.onChallenge()

onConnect()
Implements autobahn.wamp.interfaces.ISession.onConnect()

onDisconnect()
Implements autobahn.wamp.interfaces.ISession.onDisconnect()

onJoin(***kwargs*)
Implements autobahn.wamp.interfaces.ISession.onJoin()

onLeave(*details*)
Implements autobahn.wamp.interfaces.ISession.onLeave()

classmethod set_update_fetcher(*update_fetcher*)

update(*pdid*, *data*)

update_fetcher = None

updatesPending(***kwargs*)

Module contents

paradrop.core.chute package

Submodules

paradrop.core.chute.chute module

class Chute(*description=None*, *name=None*, *owner=None*, *state='running'*, *version=None*, *config=NOTHING*, *environment=NOTHING*, *services=NOTHING*, *web=NOTHING*, *cache=NOTHING*)
Bases: object

This Chute class provides the internal representation of a Paradrop chute.

This class encapsulates the complex configuration details of a chute and provides a stable interface for the execution path even as the chute specification language evolves over time.

The Chute class has minimal external dependencies, e.g. no dependency on the Docker API. Chute objects should be immutable, since they describe a desired software state at a fixed point in time.

Args: name (str): The name of the chute. description (str): The human-friendly description of the chute. state (str): Desired run state of the chute ("running", "stopped"). version (str): The version of the chute. config (dict): Configuration settings for the chute. environment (dict): Environment variables to set for all chute services.

STATE_DISABLED = 'disabled'

STATE_FROZEN = 'frozen'

STATE_INVALID = 'invalid'

STATE_RUNNING = 'running'

STATE_STOPPED = 'stopped'

add_service(*service*)
Add a service to the chute.

create_specification()
Create a new chute specification from the existing chute.

This is a completely clean copy of all information necessary to rebuild the Chute object. It should contain only primitive types, which can easily be serialized as JSON or YAML.

getCache(*key*)
Get a value from the cache or None if it does not exist.

getCacheContents()
Get the contents of the cache as a dictionary.

getConfiguration()
Get the chute's configuration object.

getHostConfig()
Get the chute's host_config options for Docker.

Returns an empty dictionary if there is no host_config setting.

getWebPort()
Get the port configured for the chute's web server.

Returns port (int) or None if no port is configured.

get_default_service()
Get one of the chute's services designated as the default one.

This is more for convenience with existing API functions where the caller did not need to specify a service because prior to 0.12.0, chutes could only have one Docker container. We use some heuristics such as the service's name is "main" to identify one of the services as the default.

get_environment()
Get the chute environment variables.

These are defined by the developer or administrator and passed to all services that belong to the chute.

get_owner()
Get the name of the user who owns this installed chute.

get_service(*name*)
Get a service by name.

get_services()
Get a list of services installed by this chute.

get_web_port_and_service()
Get the port and Service object that provides this chutes web service.

Returns a tuple containing the port number and Service object. Both values will be None if a web service is not configured.

inherit_attributes(*other*)
Inherit attributes from another version of the chute.

If any settings are None or missing in this chute but present in the other version, they will be copied over. The return value is a dictionary containing changes that were applied.

isRunning()
Check if the chute is supposed to be running.

isValid()
Return True only if the Chute object we have has all the proper things defined to be in a valid state.

setCache(*key*, *value*)
Set a value in the cache.

Deprecated: Most of the cache functionality has been moved to the Update object because they are values that are used as temporary storage between one update step and the following steps. However, there are a few instances of cache values that we do still read from chute storage. Any calls to the getCache method throughout the project are still depending on this functionality, so we have corresponding calls to setCache that ensure the required information is present in the chute cache and not just in the update cache. Eventually, we should remove this dependency either by using a less stateful design or by formalizing the process for storing persistent chute state, such as the networkInterfaces list.

updateCache(*other*)
Update the chute cache from another dictionary.

paradrop.core.chute.chute_storage module

class ChuteStorage(*filename=None*, *save_timer=0*)
Bases: *paradrop.lib.utils.pd_storage.PDStorage*

ChuteStorage class.

This class holds onto the list of Chutes on this AP.

It implements the PDStorage class which allows us to save the chuteList to disk transparently

attrSaveable()
Returns True if we should save the ChuteList, otherwise False.

chuteList = {}

clearChuteStorage()

deleteChute(*ch*)
Deletes a chute from the chute storage. Can be sent the chute object, or the chute name.

getAttr()
Get our attr (as class variable for all to see)

getChute(*name*)
Returns a reference to a chute we have in our cache, or None.

getChuteList()
Return a list of the names of the chutes we know of.

classmethod get_chute(*name*)

saveChute(*ch*)
Saves the chute provided in our internal chuteList. Also since we just received a new chute to hold onto we should save our ChuteList to disk.

setAttr(*attr*)
Save our attr however we want (as class variable for all to see)

paradrop.core.chute.restart module

Contains the functions required to restart chutes properly on power cycle of device. Checks with pdconfd to make sure it was able to properly bring up all interfaces before starting chutes.

reloadChutes()
Get update objects to chutes that should be running at startup.

This function is called to restart any chutes that were running prior to the system being restarted. It waits for pdconfd to come up and report whether or not it failed to bring up any of the interfaces that existed before the power cycle. If pdconfd indicates something failed we then force a stop update in order to bring down all interfaces associated with that chute and mark it with a warning. If the stop fails we mark the chute with a warning manually and change its state to stopped and save to storage this isn't great as it could mean our system still has interfaces up associated with that chute. If pdconfd doesn't report failure we attempt to start the chute and if this fails we trust the abort process to restore the system to a consistent state and we manually mark the chute as stopped and add a warning to it.

Returns (list) A list of UpdateChute objects that should be run before accepting new updates.

updateStatus(*update*)
This function is a callback for the updates we do upon restarting the system. It checks whether or not the update completed successfully and if not it changes the state of the chute to stopped and adds a warning. :param update: The update object containing information about the chute that was created and whether it was successful or not. :type update: obj :returns: None

Module contents

paradrop.core.config package

Submodules

paradrop.core.config.airshark module

class AirsharkInterfaceManager
Bases: object

add_observer(*observer*)

interface_available()

remove_observer(*observer*)

reset_interface()

set_interface(*interface*)

configure(*update*)
Configure an Airshark interface.

paradrop.core.config.configservice module

configservice module: This module is responsible for "poking" the proper host OS services to change the host OS config. This would include things like changing the networking, DHCP server settings, wifi, etc..

reloadAll(*update*)
Reload pdconf configuration files.

reload_placeholder(*update*)
This function successfully does nothing.

It serves as a placeholder so that we can attach an abort function to a specific point in the update pipeline.

paradrop.core.config.devices module

Detect physical devices that can be used by chutes.

This module detects physical devices (for now just network interfaces) that can be used by chutes. This includes WAN interfaces for Internet connectivity and WiFi interfaces which can host APs.

It also makes sure certain entries exist in the system UCI files for these devices, for example "wifi-device" sections. These are shared between chutes, so they only need to be added when missing.

class SysReader(*phy*)
Bases: object

PCI_BUS_ID = <_sre.SRE_Pattern object>

USB_BUS_ID = <_sre.SRE_Pattern object>

getDeviceId(*default='????'*)
Return the device ID for the device.

This is a four-digit hexadecimal number. For example, our Qualcomm 802.11n chips have device ID 002a.

getSlotName(*default='????'*)
Return the PCI/USB slot name for the device.

Example: "pci/0000:04:00.0" or "usb/1-1:1.0"

getVendorId(*default='????'*)
Return the vendor ID for the device.

This is a four-digit hexadecimal number. For example, our Qualcomm 802.11n chips have vendor ID 168c.

read_uevent()
Read the device uevent file and return the contents as a dictionary.

class UCIBuilder
Bases: object

UCIBuilder helps aggregate UCI configuration sections for writing to files.

FILES = ['dhcp', 'network', 'firewall', 'wireless', 'qos']

add(*file_*, *type_*, *options*, *name=None*)
Add a new configuration section.

getSections(*file_*)
Get sections associated with a single file.

Returns: list of tuples, [(config, options)]

write()
Write all of the configuration sections to files.

checkSystemDevices(*update*)
Check whether expected devices are present.

This may reboot the machine if devices are missing and the host config is set to do that.

detectSystemDevices()
Detect devices on the system.

The result is three lists stored in a dictionary. The three lists are indexed by 'wan', 'wifi', and 'lan'. Other devices may be supported by adding additional lists.

Within each list, a device is represented by a dictionary. For all devices, the 'name' and 'mac' fields are defined. For WiFi devices, the 'phy' is defined in addition. Later, we may fill in more device information (e.g. what channels a WiFi card supports).

flushWirelessInterfaces(*phy*)
Remove all virtual interfaces associated with a wireless device.

This should be used before giving a chute exclusive access to a device (e.g. monitor mode), so that it does not inherit unexpected interfaces.

getMACAddress(*ifname*)

getPhyMACAddress(*phy*)

getSystemDevices(*update*)
Detect devices on the system.

Store device information in cache key "networkDevices" as well as "networkDevicesByName".

getWirelessPhyName(*ifname*)

get_hardware_serial()
Get hardware serial number.

The most reliable way we have that works across many hardware platforms is to check the eth0 MAC address.

Returns a numeric serial number.

handleMissingWiFi(*hostConfig*)
Take appropriate action in response to missing WiFi devices.

Depending on the host configuration, we may either emit a warning or reboot the system.

isVirtual(*ifname*)
Test if an interface is a virtual one.

FIXME: This just tests for the presence of certain strings in the interface name, so it is not very robust.

isWAN(*ifname*)
Test if an interface is a WAN interface.

isWireless(*ifname*)
Test if an interface is a wireless device.

listSystemDevices()
Detect devices on the system.

The result is a single list of dictionaries, each containing information about a network device.

listWiFiDevices()

readHostconfigVlan(*vlanInterfaces*, *builder*)

readHostconfigWifi (*wifi*, *networkDevices*, *builder*)

readHostconfigWifiInterfaces (*wifiInterfaces*, *networkDevices*, *builder*)

readSysFile (*path*)

resetWirelessDevice (*phy*, *primary_interface*)
Reset a wireless device's interfaces to clean state.

This will rename, delete, or add an interface as necessary to make sure only the primary interface exists, e.g. "wlan0" for a wireless device, e.g. phy0.

resolveWirelessDevRef (*name*, *networkDevices*)
Resolve a WiFi device reference (wlan0, phy0, 00:11:22:33:44:55, etc.) to the name of the device section as used by pdconf (wifiXXXXXXXXXXXX).

Unambiguous naming is preferred going forward (either wifiXX or the MAC address), but to maintain backward compatibility, we attempt to resolve either wlanX or phyX to the MAC address of the device that currently uses that name.

select_brlan_address (*hostConfig*)
Select IP address and netmask to use for LAN bridge.

Behavior depends on the proto field, which can either be 'auto' or 'static'. When proto is set to 'auto', we check the WAN interface address and choose either 10.0.0.0 or 192.168.0.1 to avoid conflict. Otherwise, when proto is set to 'static', we use the specified address.

setConfig (*chuteName*, *sections*, *filepath*)

setSystemDevices (*update*)
Initialize system configuration files.

This section should only be run for host configuration updates.

Creates basic sections that all chutes require such as the "wan" interface.

paradrop.core.config.dhcp module

getVirtDHCPSettings (*update*)
Looks at the runtime rules the developer defined to see if they want a dhcp server. If so it generates the data and stores it into the chute cache key:virtDHCPSettings.

revert_dhcp_settings (*update*)

setVirtDHCPSettings (*update*)
Takes a list of tuples (config, opts) and saves it to the dhcp config file.

paradrop.core.config.dockerconfig module

dockerconfig module: This module contains all of the knowledge of how to take internal pdfcd representation of configurations of chutes and translate them into specifically what docker needs to function properly, whether that be in the form of dockerfiles or the HostConfig JSON object known at init time of the chute.

abortCreateVolumeDirs (*update*)

createVolumeDirs (*update*)
Create directories required by the chute.

generateToken (*bits=128*)

getVirtPreamble(*update*)
Prepare various settings for Docker containers.

paradrop.core.config.firewall module

findMatchingInterface(*iface_name*, *interfaces*)
Search an interface list for one matching a given name.

iface_name can contain shell-style wildcards (* and ?).

getDeveloperFirewallRules(*update*)
Generate other firewall rules requested by the developer such as redirects. The object returned is a list of tuples (config, options).

getOSFirewallRules(*update*)
There is a set of default things that must exist just for the chute to function at all, generate those here.

Stored in key: osFirewallRules

revert_os_firewall_rules(*update*)

setOSFirewallRules(*update*)
Takes a list of tuples (config, opts) and saves it to the firewall config file.

paradrop.core.config.haproxy module

This module is responsible for configuration haproxy.

generateConfigSections()

reconfigureProxy(*update*)
Reconfigure haproxy with forwarding and redirect rules.

writeConfigFile(*output*)

paradrop.core.config.hostconfig module

The host configuration controls system settings of the host OS.

This module operates as follows:

1. The first time, we try to detect all devices and auto-generate a reasonable configuration, which we store to a persistent file.

2. (TODO) We present the configuration to the owner sometime around provisioning or first chute creation and allow him to change settings.

3. (TODO) We have some kind of update operation that can manipulate settings.

generateHostConfig(*devices*)
Scan for devices on the machine and generate a working configuration.

getHostConfig(*update*)
Load host configuration.

Read device information from networkDevices. Store host configuration in hostConfig.

load(*path=None*)
Load host configuration.

Tries to load host configuration from persistent file. If that does not work, it will try to automatically generate a working configuration.

Returns a host config object on success or None on failure.

prepareHostConfig(*devices=None*, *hostConfigPath=None*, *write=True*)
Load an existing host configuration or generate one.

Tries to load host configuration from persistent file. If that does not work, it will try to automatically generate a working configuration.

write: if True and host config was automatically generated, then write the new host config to a file.

revertHostConfig(*update*)
Restore host configuration from before update.

Uses oldHostConfig cache entry.

save(*config*, *path=None*)
Save host configuration.

May raise exception if unable to write the configuration file.

setAutoUpdate(*enable*)

setHostConfig(*update*)
Write host configuration to persistent storage.

Read host configuration from hostConfig.

paradrop.core.config.network module

abortNetworkConfig(*update*)
Release resources claimed by chute network configuration.

chooseExternalIntf(*update*, *iface*)

chooseSubnet(*update*, *cfg*, *iface*)

fulfillDeviceRequest(*update*, *cfg*, *devices*)
Find a physical device that matches the requested device type.

Raises an exception if one cannot be found.

getExtraOptions(*cfg*)
Get dictionary of extra wifi-iface options that we are not interpreting but just passing on to pdconf.

getInterfaceAddress(*update*, *name*, *cfg*, *iface*)
Dynamically select IP address for the chute interface.

This function will use a subnet from the chute subnet pool and assign IP addresses to the external (in host) and internal (in chute) interfaces.

The addresses are stored in the iface object.

getL3BridgeConfig(*update*)
Creates configuration sections for layer 3 bridging.

getNetworkConfig(*update*)
For the Chute provided, return the dict object of a 100% filled out configuration set of network configuration. This would include determining what the IP addresses, interfaces names, etc...

Store configuration in networkInterfaces cache entry.

getNetworkConfigLan(*update*, *name*, *cfg*, *iface*)

getNetworkConfigVlan(*update*, *name*, *cfg*, *iface*)

getNetworkConfigWifi(*update*, *name*, *cfg*, *iface*)

getOSNetworkConfig(*update*)
Takes the network interface obj created by NetworkManager.getNetworkConfiguration and returns a properly formatted object to be passed to the UCIConfig class. The object returned is a list of tuples (config, options).

getWifiKeySettings(*cfg*, *iface*)
Read encryption settings from cfg and transfer them to iface.

get_current_phy_conf(*update*, *device_id*)
Lookup current configuration for a network device.

This includes information such as the Wi-Fi channel.

Returns a dictionary, which may be empty if no configuration was found.

reclaimNetworkResources(*chute*)
Reclaim network resources for a previously running chute.

This function only applies to the special case in which pd starts up and loads a list of chutes that were running. This function marks their IP addresses and interface names as taken so that new chutes will not use the same values.

revert_l3_bridge_config(*update*)

revert_os_network_config(*update*)

satisfies_requirements(*obj*, *requirements*)
Checks that an object satifies given requirements.

Every key-value pair in the requirements object must be present in the target object for it to be considered satisfied.

Returns True/False.

select_chute_subnet_pool(*host_config*)
Select IP subnet to use as pool for chutes.

Behavior depends on whether a static subnet is configured or auto configuration is requested. If the chuteSubnetPool option is set to 'auto', then we check the WAN interface address and choose either 10.128.0.0/9 or 192.168.128.0/17 to avoid conflict. Otherwise, we used the specified subnet.

setL3BridgeConfig(*update*)
Apply configuration for layer 3 bridging.

setOSNetworkConfig(*update*)
Takes a list of tuples (config, opts) and saves it to the network config file.

split_interface_type(*itype*)

paradrop.core.config.osconfig module

osconfig module: This module is in charge of changing configuration files for pdfcd on the host OS. This relates to things like network, dhcp, wifi, firewall changes. Pdfcd should be able to make simple abstracted calls into this module so that if we need to change what type of OS config we need to support only this module would change.

revertConfig(*update*, *theType*)
Tell the UCI module to revert changes to the old state of the chute.

paradrop.core.config.power module

reboot(*update*)
Reboot the node.

shutdown(*update*)
Power down the node.

paradrop.core.config.reservations module

Module for checking resource reservations by chutes.

One idea motivating this design is to reduce the amount of state in memory for resource reservations. We have the chute list, which contains information about what devices the chute is using. If we also maintain a separate list of devices used by chutes, we need to keep them synchronized. This becomes messy when a chute fails to install or uninstall correctly. The getDeviceReservations function iterates over the chute list and returns an up-to-date view of device usage. This can be called as needed.

class DeviceReservations
Bases: object

add(*chute*, *dtype*, *mode=None*)

count(*dtype=None*, *mode=None*)
Return the number of reservations matching the given criteria.

None is used as a wildcard, so if no arguments are passed, the count returned is the total number of reservations.

class InterfaceReservationSet
Bases: object

add(*interface*)

class SubnetReservationSet
Bases: object

add(*subnet*)

getDeviceReservations(*exclude=None*)
Produce a dictionary mapping device names to DeviceReservations objects that describe the current usage of the device.

The returned type is a defaultdict, so there is no need to check if a key exists before accessing it.

exclude: name of chute whose device reservations should be excluded

getInterfaceReservations(*exclude=None*)
Get current set of interface reservations.

Returns an instance of InterfaceReservationSet.

exclude: name of chute whose interfaces should be excluded

getReservations(*update*)
Get device and resource reservations claimed by other users.

getSubnetReservations(*exclude=None*)
Get current set of subnet reservations.

Returns an instance of SubnetReservationSet.

exclude: name of chute whose reservations should be excluded

paradrop.core.config.resource module

computeResourceAllocation(*chutes*)

getResourceAllocation(*update*)
Allocate compute resources for chutes.

Sets cache variables "newResourceAllocation" and "oldResourceAllocation".

paradrop.core.config.services module

Configure optional additional services such as telemetry.

configure_telemetry(*update*)

paradrop.core.config.snap module

updateSnap(*update*)

paradrop.core.config.state module

removeAllChutes(*update*)

revertChute(*update*)

saveChute(*update*)
Save information about the chute to the filesystem.

paradrop.core.config.uciutils module

restoreConfigFile(*chute*, *configname*)
Restore a system config file from backup.

This can only be used during a chute update operation to revert changes that were made during that update operation.

configname: name of configuration file ("network", "wireless", etc.)

setConfig(*update*, *cacheKeys*, *filepath*)
Helper function used to modify config file of each various setting in /etc/config/ Returns:

True: if it modified a file False: if it did NOT cause any modifications

Raises exception if an error occurs.

paradrop.core.config.wifi module

getOSWirelessConfig(*update*)
Read settings from networkInterfaces for wireless interfaces. Store wireless configuration settings in osWirelessConfig.

revert_os_wireless_config(*update*)

setOSWirelessConfig(*update*)
Write settings from osWirelessConfig out to UCI files.

paradrop.core.config.zerotier module

configure(*update*)

getAddress()
Return the zerotier address for this device or None if unavailable.

get_auth_token()
Return the zerotier auth token for accessing its API or None if unavailable.

get_networks(*ignore_error=False*)
Get list of active ZeroTier networks.

manage_network(*nwid*, *action='join'*)
Join or leave a ZeroTier network.

nwid: ZeroTier network ID, e.g. "e5cd7a9e1c8a5e83" action: either "join" or "leave"

wait_for_zerotier(*max_delay=120*)
Wait for ZeroTier to start up and create the authtoken file.

Module contents

paradrop.core.container package

Submodules

paradrop.core.container.chutecontainer module

class ChuteContainer(*name*, *docker_url='unix://var/run/docker.sock'*)
Bases: `object`

Class for accessing information about a chute's container.

getID()
Look up the container ID as used by Docker.

getIP()
Look up the IP address assigned to the container.

getPID()
Look up the PID of the container, if running.

getPortConfiguration(*port*, *protocol='tcp'*)
Look up network port configuration. This tells us if a port in the host is bound to a port inside the container.

Returns a list, typically with zero or one elements.

Example:

[{ “HostIp”: “0.0.0.0”, “HostPort”: “32768”

}]

getStatus()
Return the status of the container (running, exited, paused).

Returns “missing” if the chute does not exist.

inspect()
Return the full container status from Docker.

isRunning()
Check if container is running.

Returns True/False; returns False if the container does not exist.

paradrop.core.container.dockerapi module

Functions associated with deploying and cleaning up docker containers.

build_host_config(*update*, *service*)
Build the host_config dict for a docker container based on the passed in update.

Parameters **chute** (*obj*) – The chute object containing information about the chute.

Returns (dict) The host_config dict which docker needs in order to create the container.

call_in_netns(*service*, *env*, *command*, *onerror='raise'*, *pid=None*)
Call command within a service’s namespace.

command: should be a list of strings. onerror: should be “raise” or “ignore”

call_retry(*cmd*, *env*, *delay=3*, *tries=3*)

check_image(*update*, *service*)
Check if image exists.

cleanup_net_interfaces(*update*)
Cleanup special interfaces when bringing down a container.

This applies to monitor mode interfaces, which need to be renamed before they come back to the host network, e.g. “mon0” inside the container should be renamed to the appropriate “wlanX” before the container exits.

create_bridge(*update*)
Create a user-defined bridge network for the chute.

getBridgeGateway()
Look up the gateway IP address for the docker bridge network.

This is the docker0 IP address; it is the IP address of the host from the chute’s perspective.

getPortList(*chute*)
Get a list of ports to expose in the format expected by create_container.

Uses the port binding dictionary from the chute host_config section. The keys are expected to be integers or strings in one of the following formats: “port” or “port/protocol”.

Example: port_bindings = {

“1111/udp”: 1111, “2222”: 2222

} getPortList returns [(1111, ‘udp’), (2222, ‘tcp’)]

prepare_environment(*update*, *service*)
Prepare environment variables for a chute container.

prepare_image(*update*, *service*)
Prepare a Docker image for execution.

This is usually the longest operation during a chute installation, so instead of running this step in the update thread, we spin off a worker thread and return a Deferred. This will suspend processing of the current update until the worker thread finishes.

prepare_port_bindings(*service*)

removeAllContainers(*update*)
Remove all containers on the system. This should only be used as part of a factory reset mechanism.

Returns None

remove_bridge(*update*)
Remove the bridge network associated with the chute.

remove_container(*update*, *service*)
Remove a service's container.

remove_image(*update*, *service*)
Remove a Docker image.

restartChute(*update*)
Start a docker container based on the passed in update.

Parameters **update** (*obj*) – The update object containing information about the chute.

Returns None

revertResourceAllocation(*update*)

setResourceAllocation(*update*)
Adjust compute resources assigned to chute containers.

setup_net_interfaces(*update*)
Link interfaces in the host to the internal interfaces in the Docker container.

The commands are based on the pipework script (https://github.com/jpetazzo/pipework).

Parameters **chute** – The chute object containing information about the chute.

Returns None

start_container(*update*, *service*)
Start running a service in a new container.

stopChute(*update*)
Stop a docker container based on the passed in update.

Parameters **update** (*obj*) – The update object containing information about the chute.

Returns None

writeDockerConfig()
Write options to Docker configuration.

Mainly, we want to tell Docker not to start containers automatically on system boot.

paradrop.core.container.dockerfile module

This module generates a Dockerfile for use with light chutes.

class Dockerfile(*service*)
Bases: object

getBytesIO()
Geterate a Dockerfile and return as a BytesIO object.

getString()
Generate a Dockerfile as a multi-line string.

isValid()
Check if configuration is valid.

Returns a tuple (True/False, None or str).

requiredFields = ['image', 'command']

writeFile(*path*)
Generate Dockerfile and write to a file.

paradrop.core.container.downloader module

This module downloads a package from a given URL using one of potentially many different methods. We currently support the github web API and simple HTTP(S). The github method is more developed and returns meta data about the project (the commit hash and message), but support for other methods, e.g. download a tar file that was uploaded to a web server, are not precluded.

Private downloads are supported with the HTTP Authorization header. For github, we need to use the github API to request a token to access the owner's private repository. That part is not implemented here.

class Downloader(*url*, *user=None*, *secret=None*, *repo_owner=None*, *repo_name=None*)
Bases: object

download()

extract()

fetch()
Download the project.

Returns the full path to the temporary directory containing the project and a dictionary containing meta data.

meta()

class GitSSHDownloader(*url*, *checkout='master'*, ***kwargs*)
Bases: *paradrop.core.container.downloader.Downloader*

download()

meta()

class GithubDownloader(*url*, *checkout='master'*, ***kwargs*)
Bases: *paradrop.core.container.downloader.Downloader*

download()

meta()
Return repository meta data as a dictionary.

class WebDownloader(*url*, *user=None*, *secret=None*, *repo_owner=None*, *repo_name=None*)
Bases: *paradrop.core.container.downloader.Downloader*

download()

meta()
Return repository meta data as a dictionary.

downloader(*url*, *user=None*, *secret=None*, ***kwargs*)
Return an appropriate Downloader for the given URL.

This should be used in a "with ... as ..." statement to perform cleanup on all exit cases.

Example: with downloader("https://github.com/...") as dl:

path, meta = dl.fetch() # do some work on the repo here

paradrop.core.container.log_provider module

Provides messages from container logs (STDOUT and STDERR).

class LogProvider(*chute*)
Bases: object

attach()
Start listening for log messages.

Log messages in the queue will appear like the following: {

'service': 'main', 'timestamp': '2017-01-30T15:46:23.009397536Z', 'message': 'Something happened'

}

detach()
Stop listening for log messages.

After this is called, no additional messages will be added to the queue.

get_logs()

monitor_logs(*service_name*, *container_name*, *queue*, *tail=200*)
Iterate over log messages from a container and add them to the queue for consumption. This function will block and wait for new messages from the container. Use the queue to interface with async code.

tail: number of lines to retrieve from log history; the string "all" is also valid, but highly discouraged for performance reasons.

Module contents

paradrop.core.plan package

Submodules

paradrop.core.plan.executionplan module

This module contains the methods required to generate and act upon execution plans.

An execution plan is a set of operations that must be performed to update a Chute from some old state into the new state provided by the API server.

All plans that are generated are function pointers, as in no actual operations are performed during the generation process.

abortPlans (*update*)
This function should be called if one of the Plan objects throws an Exception. It takes the PlanMap argument and calls the getNextAbort function just like executePlans does with todoPlans. This dynamically generates an abort plan list based on what plans were originally executed. Returns:

True in error : This is really bad False otherwise : we were able to restore system state back to before the executeplans function was called

aggregatePlans (*update*)
Takes the PlanMap provided which can be a combination of changes for multiple different chutes and it puts things into a sane order and removes duplicates where possible.

This keeps things like reloading networking from happening twice if 2 chutes make changes.

Returns: A new PlanMap that should be executed

executePlans (*update*)
Primary function that actually executes all the functions that were added to plans by all the exc modules. This function can heavily modify the OS/files/etc.. so the return value is very important. Returns:

True in error : abortPlans function should be called False otherwise : everything is OK

generatePlans (*update*)
For an update object provided this function references the updateModuleList which lets all exc modules determine if they need to add functions to change the state of the system when new chutes are added to the OS.

Returns: True in error, as in we should stop with this update plan

paradrop.core.plan.hostconfig module

This module generates update plans for a host configuration operation. It is separate from the modules that generate plans for chute operations because we only need to do a subset of the operations.

generatePlans (*update*)

paradrop.core.plan.name module

generatePlans (*update*)
This function looks at a diff of the current Chute (in @chuteStor) and the @newChute, then adds Plan() calls to make the Chute match the @newChute.

Returns: True: abort the plan generation process

paradrop.core.plan.plangraph module

class Plan (*func*, **args*)
Helper class to hold onto the actual plan data associated with each plan

class PlanMap (*name*)
This class helps build a dependency graph required to determine what steps are required to update a Chute from a previous version of its configuration.

addMap(*other*)
Takes another PlanMap object and appends whatever the plans are into this plans object.

addPlans(*priority*, *todoPlan*, *abortPlan=[]*)
Adds new Plan objects into the list of plans for this PlanMap.

Arguments: @priority : The priority number (1 is done first, 99 done last - see PRIORITYFLAGS section at top of this file) @todoPlan : A tuple of (function, (args)), this is the function that completes the actual task requested

the args can either be a single variable, a tuple of variables, or None.

@abortPlan [A tuple of (function, (args)) or a list of tuple or None.] This is what should be called if a plan somewhere in the chain fails and we need to undo the work we did here - this function is only called if a higher priority function fails (ie we were called, then something later on fails that would cause us to undo everything we did to setup/change the Chute).

getNextAbort()
Like an iterator function, it returns each element in the list of abort plans in order.

Returns: (function, args) : Each todo is returned just how the user first added it None : None is returned when there are no more todo's

getNextTodo()
Like an iterator function, it returns each element in the list of plans in order.

Returns: (function, args) : Each todo is returned just how the user first added it None : None is returned when there are no more todo's

registerSkip(*func*)
Register this function as one to skip execution on, if provided it shouldn't return the (func, args) tuple as a result from the getNextTodo function.

sort()
Sorts the plans based on priority.

paradrop.core.plan.resource module

generatePlans(*update*)
This function looks at a diff of the current Chute (in @chuteStor) and the @newChute, then adds Plan() calls to make the Chute match the @newChute.

Returns: True: abort the plan generation process

paradrop.core.plan.router module

This module generates update plans for router operations such as factory reset.

generatePlans(*update*)

paradrop.core.plan.runtime module

generatePlans(*update*)
This function looks at a diff of the current Chute (in @chuteStor) and the @newChute, then adds Plan() calls to make the Chute match the @newChute.

Returns: True: abort the plan generation process

paradrop.core.plan.snap module

This module generates update plans for a snap operation.

generatePlans(*update*)

paradrop.core.plan.state module

generatePlans(*update*)
This function looks at a diff of the current Chute (in @chuteStor) and the @newChute, then adds Plan() calls to make the Chute match the @newChute.

Returns: True: abort the plan generation process

generate_service_plans(*update*)
Generate plans that depend on the services configured for the chute.

This needs to happen after the chute configuration has been parsed.

validate_change(*update*)
Check if the update is a valid change.

paradrop.core.plan.struct module

generatePlans(*update*)
This function looks at a diff of the current Chute (in @chuteStor) and the @newChute, then adds Plan() calls to make the Chute match the @newChute.

Returns: True: abort the plan generation process

paradrop.core.plan.traffic module

generatePlans(*update*)
This function looks at a diff of the current Chute (in @chuteStor) and the @newChute, then adds Plan() calls to make the Chute match the @newChute.

Returns: True: abort the plan generation process

Module contents

paradrop.core.system package

Submodules

paradrop.core.system.system_info module

Get system information

getDMI()
Read hardware information from DMI.

This function attempts to read from known files in /sys/class/dmi/id/. If any are missing or an error occurs, those fields will be omitted from the result.

Returns: a dictionary with fields such as bios_version and product_serial.

getOSVersion()
Return a string identifying the host OS.

getPackageVersion(*name*)
Get a python package version.

Returns: a string or None

paradrop.core.system.system_status module

Get system running status including CPU load, memory usage, network traffic.

class SystemStatus
Bases: object

INCLUDED_PARTITIONS = set(['/writable', '/'])

classmethod getNetworkInfo()

classmethod getProcessInfo(*pid*)

getStatus(*max_age=0.8*)
Get current system status.

max_age: maximum tolerable age of cached status information. Set to None to force a refresh regardless of cache age.

Returns a dictionary with fields 'cpu_load', 'mem', 'disk', and 'network'.

classmethod getSystemInfo()

refreshCpuLoad()

refreshDiskInfo()

refreshMemoryInfo()

refreshNetworkTraffic()

Module contents

paradrop.core.update package

Submodules

paradrop.core.update.update_fetcher module

Fetch new updates from the pdserver and apply the updates

class UpdateFetcher(*update_manager*)
Bases: object

pull_update(***kwargs*)
Start updates by polling the server for the latest updates.

This is the only method that needs to be called from outside. The rest are triggered asynchronously.

Call chain: pull_update -> _updates_received -> _update_complete

_auto: Set to True when called by the scheduled LoopingCall.

start_long_poll(***kwargs*)

start_polling()

paradrop.core.update.update_manager module

class UpdateManager(*reactor*)
This class is in charge of making the configuration changes required on the chutes. It utilizes the ChuteStorage class to hold onto the chute data.

Use @updateChutes to make the configuration changes on the AP. This function is thread-safe, this class will only call one update set at a time. All others are held in a queue until the last update is complete.

add_update(***update*)
MUTEX: updateLock Take the list of Chutes and push the list into a queue object, this object will then call the real update function in another thread so the function that called us is not blocked.

We take a callable responseFunction to call, when we are done with this update we should call it.

assign_change_id()
Get a unique change ID for an update.

This should be used to set the change_id field in an update object.

clear_update_list()
MUTEX: updateLock Clears all updates from list (new array).

find_change(*change_id*)
Search active and queued changes for the requested change.

Returns an Update object or None.

paradrop.core.update.update_object module

This holds onto the UpdateObject class. It allows us to easily abstract away different update types and provide a uniform way to interpret the results through a set of basic actionable functions.

class UpdateChute(*obj*, *reuse_existing=False*)
Bases: *paradrop.core.update.update_object.UpdateObject*

Updates specifically tailored to chute actions like create, delete, etc...

has_chute_build()
Check whether this update involves building a chute.

updateModuleList = [<module 'paradrop.core.plan.name' from '/home/docs/checkouts/readt

class UpdateObject(*obj*)
Bases: object

The base UpdateObject class, covers a few basic methods but otherwise all the intelligence exists in the inherited classes.

All update information passed by the API server is contained as variables of this class such as update.updateType, update.updateClass, etc...

By default, the following variables should be utilized: responses : an array of messages any module can choose to append warnings or errors to

failure [the module that chose to fail this update can set a string message to return] : to the user in the failure variable. It should be very clear as to why the : failure occurred, but if the user wants more information they may find it : in the responses variable which may contain debug information, etc...

add_message_observer(*observer*)

cache_get(*key*, *default=None*)
Get a value from the cache or the default value if it does not exist.

cache_set(*key*, *value*)
Set a value in the cache.

complete(***kwargs*)
Signal to the API server that any action we need to perform is complete and the API server can finish its connection with the client that initiated the API request.

execute()
The function that actually walks through the main process required to create the chute. It follows the executeplan module through the paces of:

1. Generate the plans for each plan module
2. Prioritize the plans
3. Execute the plans

If at any point we fail then this function will directly take care of completing the update process with an error state and will close the API connection.

has_chute_build()
Check whether this update involves building a chute.

progress(*message*)

remove_message_observer(*observer*)

started()
This function should be called when the updated object is dequeued and execution is about to begin.

Sends a notification to the pdserver if this is a tracked update.

updateModuleList = []

class UpdateRouter(*obj*)
Bases: *paradrop.core.update.update_object.UpdateObject*

Updates specifically tailored to router configuration.

updateModuleList = [<module 'paradrop.core.plan.hostconfig' from '/home/docs/checkouts

class UpdateSnap(*obj*)
Bases: *paradrop.core.update.update_object.UpdateObject*

Updates specifically tailored to installing snaps.

updateModuleList = [<module 'paradrop.core.plan.snap' from '/home/docs/checkouts/readt

parse(*obj*)
Determines the update type and returns the proper class.

Module contents

Module contents

12.1.6 paradrop.lib package

Subpackages

paradrop.lib.misc package

Submodules

paradrop.lib.misc.pdinstall module

sendCommand(*command*, *data*)
Send a command to the pdinstall service.

Commands: install - Install snaps from a file path or http(s) URL.

Required data fields: sources - List with at least one snap file path or URL. The snaps

are installed in order until one succeeds or all fail.

Returns True/False for success. Currently, we cannot check whether the call succeeded, only whether it was delived. A return value of False means we could not deliver the command to pdinstall.

paradrop.lib.misc.procmon module

The ProcessMonitor class ensures that a service is running and that its pid file is consistent.

This addresses an issue we have had with Docker on Ubuntu Snappy, where its pid file sometimes persists and prevents the service from starting.

class ProcessMonitor(*service*, *cmdstring=None*, *pidfile=None*, *action='restart'*)
Bases: object

allowedActions = set(['reboot', 'restart'])

check()
Check that the service is running and consistent with pid file(s).

Returns True or False.

ensureReady(*delay=5*, *tries=3*)
Look through checking and restarting the service until it is ready or the maximum number of tries has been reached.

delay: time delay (seconds) between retries. tries: maximum number of restart-wait-check cycles.

restart()
Restart the service.

paradrop.lib.misc.resopt module

Resource optimization functions.

allocate(*reservations*, *total=1.0*)
Allocate resources among slices with specified and unspecified reservations.

Returns a new list of values with the following properties: - Every value is >= the corresponding input value. - The result sums to *total*.

Examples: allocate([0.25, None, None]) -> [0.5, 0.25, 0.25] allocate([0.4, None, None]) -> [0.6, 0.2, 0.2] allocate([0.2, 0.2, 0.2]) -> [0.33, 0.33, 0.33] allocate([None, None, None]) -> [0.33, 0.33, 0.33] allocate([0.5, 0.5, 0.5]) -> ERROR

paradrop.lib.misc.snapd module

class SnapdClient(*logging=True*, *wait_async=False*)
Bases: object

Client for interacting with the snapd API to manage installed snaps.

connect(*plug_snap=None*, *plug=None*, *slot_snap='core'*, *slot=None*)
Connect an interface.

get_change(*change_id*)
Get the current status of a change.

installSnap(*snapName*)
Install a snap from the store.

listSnaps()
Get a list of installed snaps.

updateSnap(*snapName*, *data*)
Post an update to a snap.

Valid actions are: install, refresh, remove, revert, enable, disable.

Example: updateSnap("paradrop-daemon", {"action": "refresh"}

paradrop.lib.misc.ssh_keys module

addAuthorizedKey(*key*, *user='paradrop'*)

getAuthorizedKeys(*user='paradrop'*)

writeAuthorizedKeys(*keys*, *user='paradrop'*)

Module contents

paradrop.lib.utils package

Submodules

paradrop.lib.utils.addresses module

checkPhyExists(*radioid*)
Check if this chute exists at all, a directory /sys/class/ieee80211/phyX must exist.

getGatewayIntf(*ch*)
Looks at the key:networkInterfaces for the chute and determines what the gateway should be including the IP address and the internal interface name.

Returns: A tuple (gatewayIP, gatewayInterface) None if networkInterfaces doesn't exist or there is an error

getInternalIntfList(*ch*)
Takes a chute object and uses the key:networkInterfaces to return a list of the internal network interfaces that will exist in the chute (e.g., eth0, eth1, . . .)

Returns: A list of interface names None if networkInterfaces doesn't exist or there is an error

getSubnet(*ipaddr*, *netmask*)

getWANIntf(*ch*)
Looks at the key:networkInterfaces for the chute and finds the WAN interface.

Returns: The dict from networkInterfaces None

incIpaddr(*ipaddr*, *inc=1*)
Takes a quad dot format IP address string and adds the @inc value to it by converting it to a number.

Returns: Incremented quad dot IP string or None if error

isIpAvailable(*ipaddr*, *chuteStor*, *name*)
Make sure this IP address is available.

Checks the IP addresses of all zones on all other chutes, makes sure subnets are not the same.

isIpValid(*ipaddr*)
Return True if Valid, otherwise False.

isStaticIpAvailable(*ipaddr*, *chuteStor*, *name*)
Make sure this static IP address is available.

Checks the IP addresses of all zones on all other chutes, makes sure not equal.

isWifiSSIDAvailable(*ssid*, *chuteStor*, *name*)
Make sure this SSID is available.

maxIpaddr(*ipaddr*, *netmask*)
Takes a quad dot format IP address string and makes it the largest valid value still in the same subnet.

Returns: Max quad dot IP string or None if error

paradrop.lib.utils.datastruct module

Utilities for reading from data structures.

getValue(*struct*, *path*, *default=None*)
Read a value from the data structure.

Arguments: struct can comprise one or more levels of dicts and lists. path should be a string using dots to separate levels. default will be returned if the path cannot be traced.

Example: getValue({'a': [1, 2, 3]}, "a.1") -> 2 getValue({'a': [1, 2, 3]}, "a.3") -> None

paradrop.lib.utils.pd_storage module

class PDStorage(*filename*, *saveTimer*)
Bases: object

ParaDropStorage class.

This class is designed to be implemented by other classes. Its purpose is to make whatever data is considered important persistant to disk.

The implementer can override functions in order to implement this class: getAttr() : Get the attr we need to save to disk setAttr() : Set the attr we got from disk importAttr(): Takes a payload and returns the properly formatted data exportAttr(): Takes the data and returns a payload attrSaveable(): Returns True if we should save this attr

attrSaveable()
THIS SHOULD BE OVERRIDEN BY THE IMPLEMENTER.

exportAttr(*data*)
By default do nothing, but expect that this function could be overwritten

importAttr(*pyld*)
By default do nothing, but expect that this function could be overwritten

loadFromDisk()
Attempts to load the data from disk. Returns True if success, False otherwise.

saveToDisk()
Saves the data to disk.

paradrop.lib.utils.pdos module

basename(*x*)

copy(*a*, *b*)

copytree(*a*, *b*)
shutil's copytree is dumb so use distutils.

exists(*p*)

fixpath(*p*)
This function is required because if we need to pass a path to something like tarfile, we cannot overwrite the function to fix the path, so we need to expose it somehow.

getFileType(*f*)

getMountCmd()

isMount(*mnt*)
This function checks if @mnt is actually mounted.

isdir(*a*)

isfile(*a*)

ismount(*p*)

listdir(*p*)

mkdir(*p*)

move(*a*, *b*)

open(*p*, *mode*)

oscall(*cmd*, *get=False*)
This function performs a OS subprocess call. All output is thrown away unless an error has occured or if @get is True Arguments:

@cmd: the string command to run [get] : True means return (stdout, stderr)

Returns: None if not @get and no error (stdout, retcode, stderr) if @get or yes error

readFile (*filename*, *array=True*, *delimiter='\n'*)
Reads in a file, the contents is NOT expected to be binary. Arguments:

@filename: absolute path to file @array : optional: return as array if true, return as string if False @delimiter: optional: if returning as a string, this str specifies what to use to join the lines

Returns: A list of strings, separated by newlines None: if the file doesn't exist

read_sys_file (*path*, *default=None*)
Read a file and return the contents as a string.

This is best suited for files that store a single line of text such as files in /sys/.

Returns the default value if an error occurs.

remove (*path*, *suppressNotFound=False*)

symlink (*a*, *b*)

unlink (*p*)

write (*filename*, *data*, *mode='w'*)
Writes out a config file to the specified location.

writeFile (*filename*, *line*, *mode='a'*)
Adds the following cfg (either str or list(str)) to this Chute's current config file (just stored locally, not written to file.

paradrop.lib.utils.pdosq module

Quiet pdos module. Implements utility OS operations without relying on the output module. Therefore, this module can be used by output without circular dependency.

makedirs (*p*)
Recursive directory creation (like mkdir -p). Returns True if the path is successfully created, False if it existed already, and raises an OSError on other error conditions.

safe_remove (*path*)
Remove a file or silently pass if the file does not exist.

This function has the same effect as os.remove but suppresses the error if the file did not exist. Notably, it must not be used to remove directories.

Returns True if a file was removed or False if no file was removed.

paradrop.lib.utils.uci module

class UCIConfig (*filepath*)

Wrapper around the UCI configuration files. These files are found under /etc/config/*, and are used by OpenWrt to keep track of configuration for modules typically found in /etc/init.d/*

The modules of interest and with current support are:

- firewall

- network
- wireless
- qos

- This class should work with any UCI module but ALL others are UNTESTED!

New configuration settings can be added to the UCI file via addConfig().

Each UCI config file is expected to contain the following syntax:

config keyA [valueA] option key1 value1 ... list key2 value1 list key2 value2 ... list key3 value1 list key3 value2

Based on the UCI file above, the config syntax would look like the following: config is a list of tuples, containing 2 dict objects in each tuple:

- **tuple[0] describes the first line (config keyA [valueA])** {'type': keyA, 'name': valueA} The value parameter is optional and if missing, then the 'name' key is also missing (rather than set to None).
- **tuple[1] describes the options associated with the settings (both 'option' and 'list' lines)** {'key1': 'value1', ... }

  If a list is present, it looks like the following:

  { ..., 'key2': [value1, value2, ...], 'key3': [value1, value2, ...]

  }

So for the example above, the full config definition would look like: C = {'type': 'keyA', 'name': 'valueA'} O = {'key1': 'value1', 'key2': ['value1', 'value2'], 'key3': ['value1', 'value2']} config = [(C, O)]

addConfig(*config*, *options*)
Adds the tuple to our config.

addConfigs(*configs*)
Adds a list of tuples to our config

backup(*backupToken*)
Puts a backup of this config to the location specified in @backupPath.

delConfig(*config*, *options*)
Finds a match to the config input and removes it from the internal config data structure.

delConfigs(*configs*)
Adds a list of tuples to our config

existsConfig(*config*, *options*)
Tests if the (config, options) is in the current config file.

getChuteConfigs(*internalid*)

getConfig(*config*)
Returns a list of call configs with the given title

getConfigIgnoreComments(*config*)
Returns a list of call configs with the given title. Comments are ignored.

readConfig()
Reads in the config file.

restore(*backupToken*, *saveBackup=True*)
Replaces real file (at /etc/config/*) with backup copy from /tmp/*-@backupToken location.

Arguments: backupToken: The backup token appended at the end of the backup path saveBackup : A flag to keep a backup copy or delete it (default is keep backup)

save(*backupToken='paradrop'*, *internalid=None*)
Saves out the file in the proper format.

Arguments:

[backupPath] [Save a backup copy of the UCI file to the path provided.] Should be a token name like 'backup', it gets appended with a hyphen.

chuteConfigsMatch(*chutePre*, *chutePost*)
Takes two lists of objects, and returns whether or not they are identical.

getLineParts(*line*)
Split the UCI line into its whitespace-separated parts.

Returns a list of strings, with apostrophes removed.

getSystemConfigDir()

getSystemPath(*filename*)
Get the path to the system configuration file.

This function also attempts to create the configuration directory if it does not exist.

Typical filenames: network, wireless, qos, firewall, dhcp, etc.

isMatch(*a*, *b*)

isMatchIgnoreComments(*a*, *b*)

singleConfigMatches(*a*, *b*)

stringify(*a*)
Recursively convert all primitives in a data structure to strings.

stringifyOptionValue(*value*)
Convert option value from in-memory representation to a suitable string.

In particular, boolean values are converted to '0' or '1'.

paradrop.lib.utils.uhttp module

class UHTTPConnection(*path*)
Bases: `httplib.HTTPConnection`

Subclass of Python library HTTPConnection that uses a unix-domain socket.

Source: http://7bits.nl/blog/posts/http-on-unix-sockets-with-python

connect()

Module contents

Module contents

12.2 Submodules

12.3 paradrop.main module

Core module. Contains the entry point into Paradrop and establishes all other modules. Does not implement any behavior itself.

class Nexus(*update_fetcher*)

Bases: *paradrop.base.nexus.NexusBase*

onStart(***kwargs*)

onStop()

main()

12.4 paradrop.plan_demo module

This module is here purely to help with understanding the rather complex execution plan in Paradrop. Simply run it (python -m paradrop.plan_demo), and it will walk through all of the functions that make up a chute creation operation.

loadPriorityMap()

Make a map of priority values back to their names for reference.

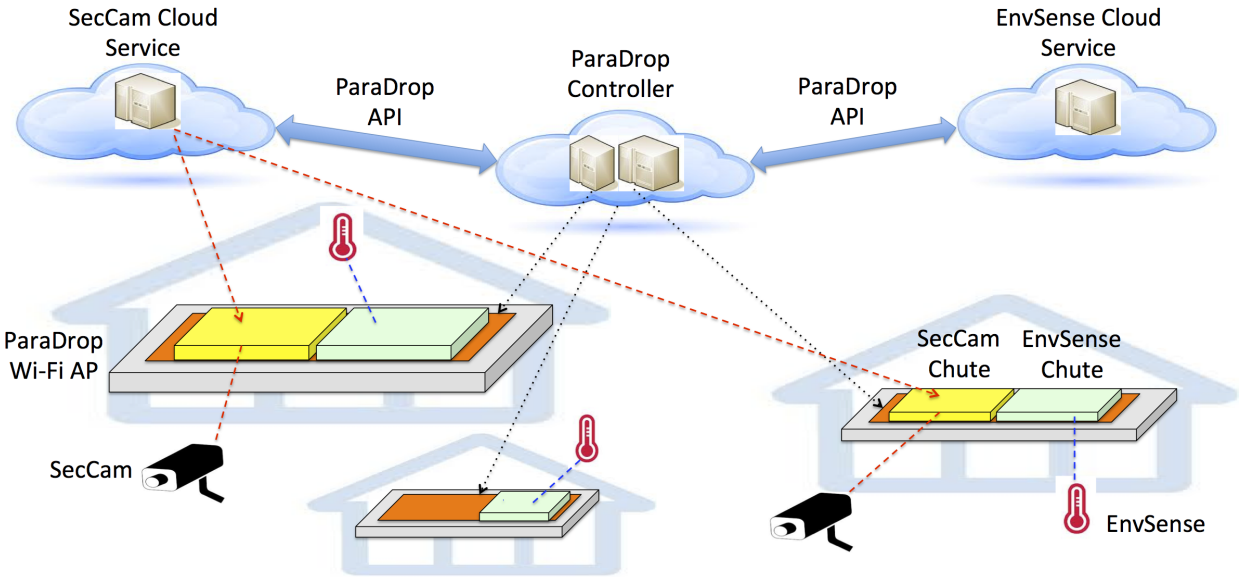
These are defined as constant integer values in paradrop.backend.exc.plangraph. For example, for priority 9 (STRUCT_GET_SYSTEM_DEVICES), the dictionary produced by this function would contain the entry 9: "STRUCT_GET_SYSTEM_DEVICES".

12.5 Module contents

CHAPTER 13

ParaDrop - Enabling Edge Computing at the Extreme Edge

ParaDrop is an open source edge computing platform developed by the WiNGS Lab at the University of Wisconsin-Madison. We built the ParaDrop platform with WiFi routers, so that we can "paradrop" services from the cloud to the extreme wireless edge - just one hop from user's mobile devices, data sources, and actuators of IoT applications. The name "ParaDrop" comes from the ability to "drop" supplies and resources ("services") into the network edge.



The above figure gives a high level overview of ParaDrop, including the ParaDrop platform and two example applications. With the ParaDrop API, third-party applications can deploy services into the network edge - the WiFi routers. More information about the design and evolution of ParaDrop can be found in the paper.

CHAPTER 14

Getting Started

Please visit the *Quick Start* page for a quick introduction about how to use ParaDrop.

CHAPTER 15

Where to go from here?

We have document about ParaDrop application development found under *Developing Applications*. If you are interested in working on the development of the ParaDrop platform (our github code) then check out: *How to Contribute*.

HTTP Routing Table

/api

GET /api/v1/chutes/, 63
GET /api/v1/chutes/(chute), 69
GET /api/v1/chutes/(chute)/cache, 69
GET /api/v1/chutes/(chute)/config, 68
GET /api/v1/chutes/(chute)/networks, 67
GET /api/v1/chutes/(chute)/networks/(network),
67
GET /api/v1/chutes/(chute)/networks/(network)/hostapd_status,
64
GET /api/v1/chutes/(chute)/networks/(network)/leases,
66
GET /api/v1/chutes/(chute)/networks/(network)/ssid,
66
GET /api/v1/chutes/(chute)/networks/(network)/stations,
65
GET /api/v1/chutes/(chute)/networks/(network)/stations/(mac),
64
GET /api/v1/config/hostconfig, 70
GET /api/v1/config/new-config, 70
GET /api/v1/config/pdconf, 71
GET /api/v1/config/pdid, 71
GET /api/v1/config/provision, 71
GET /api/v1/config/settings, 71
GET /api/v1/config/sshKeys/(user), 72
GET /api/v1/info/environment, 72
GET /api/v1/info/features, 74
GET /api/v1/info/hardware, 73
GET /api/v1/info/software, 73
GET /api/v1/info/telemetry, 73
POST /api/v1/config/factoryReset, 69
POST /api/v1/config/provision, 71
POST /api/v1/config/sshKeys/(user), 72
PUT /api/v1/chutes/(chute)/config, 68
PUT /api/v1/chutes/(chute)/networks/(network)/ssid,
67
PUT /api/v1/config/hostconfig, 69
PUT /api/v1/config/pdconf, 71

Python Module Index

p

paradrop, 181
paradrop.airshark, 111
paradrop.airshark.airshark, 109
paradrop.airshark.analyzer, 109
paradrop.airshark.scanner, 110
paradrop.airshark.spectrum_reader, 110
paradrop.backend, 128
paradrop.backend.airshark_api, 111
paradrop.backend.airshark_ws, 111
paradrop.backend.auth, 112
paradrop.backend.chute_api, 113
paradrop.backend.config_api, 120
paradrop.backend.cors, 123
paradrop.backend.http_server, 123
paradrop.backend.information_api, 124
paradrop.backend.log_sockjs, 126
paradrop.backend.password_api, 127
paradrop.backend.password_manager, 127
paradrop.backend.snapd_resource, 127
paradrop.backend.status_sockjs, 128
paradrop.base, 136
paradrop.base.cxbr, 128
paradrop.base.exceptions, 129
paradrop.base.nexus, 130
paradrop.base.output, 131
paradrop.base.pdutils, 134
paradrop.base.settings, 135
paradrop.confd, 148
paradrop.confd.base, 136
paradrop.confd.client, 138
paradrop.confd.command, 138
paradrop.confd.dhcp, 139
paradrop.confd.firewall, 140
paradrop.confd.main, 142
paradrop.confd.manager, 142
paradrop.confd.network, 144
paradrop.confd.qos, 145
paradrop.confd.wireless, 146
paradrop.core, 174
paradrop.core.agent, 151
paradrop.core.agent.http, 148
paradrop.core.agent.reporting, 150
paradrop.core.agent.wamp_session, 151
paradrop.core.chute, 154
paradrop.core.chute.chute, 151
paradrop.core.chute.chute_storage, 153
paradrop.core.chute.restart, 154
paradrop.core.config, 163
paradrop.core.config.airshark, 154
paradrop.core.config.configservice, 155
paradrop.core.config.devices, 155
paradrop.core.config.dhcp, 157
paradrop.core.config.dockerconfig, 157
paradrop.core.config.firewall, 158
paradrop.core.config.haproxy, 158
paradrop.core.config.hostconfig, 158
paradrop.core.config.network, 159
paradrop.core.config.osconfig, 160
paradrop.core.config.power, 161
paradrop.core.config.reservations, 161
paradrop.core.config.resource, 162
paradrop.core.config.services, 162
paradrop.core.config.snap, 162
paradrop.core.config.state, 162
paradrop.core.config.uciutils, 162
paradrop.core.config.wifi, 163
paradrop.core.config.zerotier, 163
paradrop.core.container, 167
paradrop.core.container.chutecontainer, 163
paradrop.core.container.dockerapi, 164
paradrop.core.container.dockerfile, 166
paradrop.core.container.downloader, 166
paradrop.core.container.log_provider, 167
paradrop.core.plan, 170
paradrop.core.plan.executionplan, 167
paradrop.core.plan.hostconfig, 168

paradrop.core.plan.name, 168
paradrop.core.plan.plangraph, 168
paradrop.core.plan.resource, 169
paradrop.core.plan.router, 169
paradrop.core.plan.runtime, 169
paradrop.core.plan.snap, 170
paradrop.core.plan.state, 170
paradrop.core.plan.struct, 170
paradrop.core.plan.traffic, 170
paradrop.core.system, 171
paradrop.core.system.system_info, 170
paradrop.core.system.system_status, 171
paradrop.core.update, 174
paradrop.core.update.update_fetcher, 171
paradrop.core.update.update_manager, 172
paradrop.core.update.update_object, 172
paradrop.lib, 181
paradrop.lib.misc, 175
paradrop.lib.misc.pdinstall, 174
paradrop.lib.misc.procmon, 174
paradrop.lib.misc.resopt, 174
paradrop.lib.misc.snapd, 175
paradrop.lib.misc.ssh_keys, 175
paradrop.lib.utils, 181
paradrop.lib.utils.addresses, 175
paradrop.lib.utils.datastruct, 176
paradrop.lib.utils.pd_storage, 176
paradrop.lib.utils.pdos, 177
paradrop.lib.utils.pdosq, 178
paradrop.lib.utils.uci, 178
paradrop.lib.utils.uhttp, 180
paradrop.main, 181
paradrop.plan_demo, 181

Index

Symbols

–claim <claim>
pdtools-cloud-create-node command line option, 78
pdtools-routers-create command line option, 104
–force
pdtools-chute-add-wifi-ap command line option, 75
–interval <interval>
pdtools-store-watch-update-messages command line option, 107
–legacy
pdtools-chute-initialize command line option, 77
–orphaned, –not-orphaned
pdtools-cloud-create-node command line option, 78
pdtools-routers-create command line option, 104
–password <password>
pdtools-chute-add-wifi-ap command line option, 75
–public, –not-public
pdtools-store-register command line option, 106
–server <server>
pdtools-device-provision command line option, 88
–user <user>
pdtools-device-sshkeys command line option, 89
–wamp <wamp>
pdtools-device-provision command line option, 88
-c, –controller <controller>
pdtools-node-provision command line option, 99
-d, –directory <directory>
pdtools-node-install-chute command line option, 96
pdtools-node-update-chute command line option, 103
-f, –follow
pdtools-store-install-chute command line option, 105
-f, –format <format>
pdtools-chute-export-configuration command line option, 76
pdtools-node-export-configuration command line option, 94
pdtools-node-generate-configuration command line option, 95
-n, –name <name>
pdtools-cloud-claim-node command line option, 78
-s, –service <service>
pdtools-chute-enable-web-service command line option, 76
pdtools-node-open-chute-shell command line option, 99
-t, –target <target>
pdtools-node command line option, 91
-u, –user <user>
pdtools-node-import-ssh-key command line option, 95
pdtools-node-list-ssh-keys command line option, 98
-v, –version <version>
pdtools-store-install-chute command line option, 105
-w, –wamp <wamp>
pdtools-node-provision command line option, 99

A

abortCreateVolumeDirs() (in module paradrop.core.config.dockerconfig), 157
abortNetworkConfig() (in module paradrop.core.config.network), 159
abortPlans() (in module paradrop.core.plan.executionplan), 168
add() (DeviceReservations method), 161
add() (InterfaceReservationSet method), 161
add() (SubnetReservationSet method), 161
add() (UCIBuilder method), 155
add_analyzer_observer() (AirsharkManager method), 109
add_message_observer() (UpdateObject method), 173
add_observer() (AirsharkInterfaceManager method), 154
add_service() (Chute method), 152
add_spectrum_observer() (AirsharkManager method), 109
add_update() (UpdateManager method), 172
add_user() (PasswordManager method), 127

addAuthorizedKey() (in module paradrop.lib.misc.ssh_keys), 175
addConfig() (UCIConfig method), 179
addConfigs() (UCIConfig method), 179
addMap() (PlanMap method), 168
addPlans() (PlanMap method), 169
ADDRESS
pdtools-device command line option, 81
addToBridge() (ConfigInterface method), 144
aggregatePlans() (in module paradrop.core.plan.executionplan), 168
airshark_analyzer() (HttpServer method), 123
airshark_spectrum() (HttpServer method), 123
AirsharkAnalyzerFactory (class in paradrop.backend.airshark_ws), 111
AirsharkAnalyzerProtocol (class in paradrop.backend.airshark_ws), 111
AirsharkApi (class in paradrop.backend.airshark_api), 111
AirsharkInterfaceManager (class in paradrop.core.config.airshark), 154
AirsharkManager (class in paradrop.airshark.airshark), 109
AirsharkSpectrumFactory (class in paradrop.backend.airshark_ws), 111
AirsharkSpectrumProtocol (class in paradrop.backend.airshark_ws), 112
allocate() (in module paradrop.lib.misc.resopt), 174
allowedActions (ProcessMonitor attribute), 174
AnalyzerProcessProtocol (class in paradrop.airshark.analyzer), 109
annotate_routes() (in module paradrop.backend.http_server), 124
ANY_PROTO (ConfigRedirect attribute), 141
api_airshark() (HttpServer method), 123
api_audio() (HttpServer method), 123
api_auth() (HttpServer method), 123
api_changes() (HttpServer method), 123
api_chute() (HttpServer method), 123
api_configuration() (HttpServer method), 123
api_information() (HttpServer method), 123
api_network() (HttpServer method), 123
api_password() (HttpServer method), 123
app (HttpServer attribute), 123
append() (CommandList method), 139
apply() (ConfigClassify method), 145
apply() (ConfigDefaults method), 140
apply() (ConfigDnsmasq method), 139
apply() (ConfigForwarding method), 141
apply() (ConfigInterface method), 144, 145
apply() (ConfigObject method), 136
apply() (ConfigRedirect method), 141
apply() (ConfigRule method), 141
apply() (ConfigWifiDevice method), 146
apply() (ConfigWifiIface method), 146
apply() (ConfigZone method), 142
assign_change_id() (UpdateManager method), 172
attach() (LogProvider method), 167
attrSaveable() (ChuteStorage method), 153
attrSaveable() (PDStorage method), 177
AttrWrapper (class in paradrop.base.nexus), 130
auth_cloud() (AuthApi method), 112
AuthApi (class in paradrop.backend.auth), 112
AuthenticationError, 129

B

backup() (UCIConfig method), 179
BaseClientFactory (class in paradrop.base.cxbr), 128
basename() (in module paradrop.lib.utils.pdos), 177
BaseOutput (class in paradrop.base.output), 131
BaseSession (class in paradrop.base.cxbr), 128
BaseSessionFactory (class in paradrop.base.cxbr), 129
blacklist (TwistedOutput attribute), 134
build() (paradrop.confd.base.ConfigObject class method), 136
build_host_config() (in module paradrop.core.container.dockerapi), 164
buildProtocol() (AirsharkAnalyzerFactory method), 111
buildProtocol() (AirsharkSpectrumFactory method), 111
buildProtocol() (LogSockJSFactory method), 126
buildProtocol() (StatusSockJSFactory method), 128

C

cache_get() (UpdateObject method), 173
cache_set() (UpdateObject method), 173
call() (BaseSession method), 128
call_in_netns() (in module paradrop.core.container.dockerapi), 164
call_retry() (in module paradrop.core.container.dockerapi), 164
change() (PasswordApi method), 127
CHANGE_ID
pdtools-device-watch command line option, 90
pdtools-node-watch-change-logs command line option, 103
change_password() (PasswordManager method), 127
change_stream() (HttpServer method), 123
changingSet() (ConfigManager method), 142
CHANNEL_VOLUME
pdtools-device-audio-sink-volume command line option, 82
pdtools-device-audio-source-volume command line option, 83
check() (in module paradrop.base.pdutils), 134
check() (ProcessMonitor method), 174
check_auth() (in module paradrop.backend.auth), 112
check_image() (in module paradrop.core.container.dockerapi), 164

check_log() (LogSockJSProtocol method), 126
check_spectrum() (AirsharkManager method), 109
checkPhyExists() (in module paradrop.lib.utils.addresses), 175
checkSystemDevices() (in module paradrop.core.config.devices), 156
childDataReceived() (AnalyzerProcessProtocol method), 109
chooseExternalIntf() (in module paradrop.core.config.network), 159
chooseSubnet() (in module paradrop.core.config.network), 159
CHUTE
  pdtools-device-chute command line option, 83
  pdtools-node-describe-chute command line option, 92
  pdtools-node-describe-chute-cache command line option, 92
  pdtools-node-describe-chute-configuration command line option, 92
  pdtools-node-describe-chute-network-client command line option, 93
  pdtools-node-edit-chute-configuration command line option, 94
  pdtools-node-edit-chute-variables command line option, 94
  pdtools-node-list-chute-network-clients command line option, 97
  pdtools-node-list-chute-networks command line option, 97
  pdtools-node-open-chute-shell command line option, 99
  pdtools-node-remove-chute command line option, 100
  pdtools-node-remove-chute-network-client command line option, 100
  pdtools-node-restart-chute command line option, 100
  pdtools-node-start-chute command line option, 102
  pdtools-node-stop-chute command line option, 102
  pdtools-node-watch-chute-logs command line option, 103
  pdtools-store-install-chute command line option, 106
Chute (class in paradrop.core.chute.chute), 151
chute_access_allowed() (in module paradrop.backend.chute_api), 120
chute_logs() (HttpServer method), 123
ChuteApi (class in paradrop.backend.chute_api), 113
ChuteCacheEncoder (class in paradrop.backend.chute_api), 119
chuteConfigsMatch() (in module paradrop.lib.utils.uci), 180
ChuteContainer (class in paradrop.core.container.chutecontainer), 163
ChuteEncoder (class in paradrop.backend.chute_api), 119
chuteList (ChuteStorage attribute), 153
ChuteNotFound, 129
ChuteNotRunning, 129
ChuteStorage (class in paradrop.core.chute.chute_storage), 153
cleanup_net_interfaces() (in module paradrop.core.container.dockerapi), 164
clear() (PasswordApi method), 127
clear_update_list() (UpdateManager method), 172
clearChuteStorage() (ChuteStorage method), 153
CLIENT
  pdtools-node-describe-chute-network-client command line option, 93
  pdtools-node-remove-chute-network-client command line option, 100
clientConnectionFailed() (BaseClientFactory method), 128
clientConnectionLost() (BaseClientFactory method), 128
cmd_chanscan() (Scanner method), 110
cmd_disable() (Scanner method), 110
cmd_set_samplecount() (Scanner method), 110
cmd_set_short_repeat() (Scanner method), 110
code_pattern (CurlRequestDriver attribute), 148
Command (class in paradrop.confd.command), 138
CommandList (class in paradrop.confd.command), 139
commands() (CommandList method), 139
complete() (UpdateObject method), 173
compute_hfsc_params() (in module paradrop.confd.qos), 146
computeResourceAllocation() (in module paradrop.core.config.resource), 162
ConfGenerator (class in paradrop.confd.wireless), 146
config_cors() (in module paradrop.backend.cors), 123
ConfigApi (class in paradrop.backend.config_api), 120
ConfigClass (class in paradrop.confd.qos), 145
ConfigClassgroup (class in paradrop.confd.qos), 145
ConfigClassify (class in paradrop.confd.qos), 145
ConfigDefaults (class in paradrop.confd.firewall), 140
ConfigDhcp (class in paradrop.confd.dhcp), 139
ConfigDnsmasq (class in paradrop.confd.dhcp), 139
ConfigDomain (class in paradrop.confd.dhcp), 140
ConfigForwarding (class in paradrop.confd.firewall), 141
ConfigInterface (class in paradrop.confd.network), 144
ConfigInterface (class in paradrop.confd.qos), 145
ConfigManager (class in paradrop.confd.manager), 142
ConfigObject (class in paradrop.confd.base), 136
ConfigOption (class in paradrop.confd.base), 138
ConfigRedirect (class in paradrop.confd.firewall), 141
ConfigRule (class in paradrop.confd.firewall), 141
configure() (in module paradrop.core.config.airshark), 154

configure() (in module paradrop.core.config.zerotier), 163
configure_telemetry() (in module paradrop.core.config.services), 162
ConfigWifiDevice (class in paradrop.confd.wireless), 146
ConfigWifiIface (class in paradrop.confd.wireless), 146
ConfigZone (class in paradrop.confd.firewall), 142
connect() (NexusBase method), 130
connect() (SnapdClient method), 175
connect() (UHTTPConnection method), 180
connectionLost() (JSONReceiver method), 149
connectionLost() (LogSockJSProtocol method), 126
connectionLost() (StatusSockJSProtocol method), 128
connectionMade() (AnalyzerProcessProtocol method), 110
connectionMade() (LogSockJSProtocol method), 126
connectionMade() (StatusSockJSProtocol method), 128
convertUnicode() (in module paradrop.base.pdutils), 134
copy() (ConfigObject method), 136
copy() (in module paradrop.lib.utils.pdos), 177
copytree() (in module paradrop.lib.utils.pdos), 177
count() (DeviceReservations method), 161
create_bridge() (in module paradrop.core.container.dockerapi), 164
create_chute() (ChuteApi method), 113
create_specification() (Chute method), 152
createDefaultInfo() (in module paradrop.base.nexus), 130
createVolumeDirs() (in module paradrop.core.config.dockerconfig), 157
curl (CurlRequestDriver attribute), 148
CurlRequestDriver (class in paradrop.core.agent.http), 148

D

dataReceived() (JSONReceiver method), 149
dataReceived() (StatusSockJSProtocol method), 128
debugfs_dir (Scanner attribute), 110
decode() (SpectrumReader static method), 110
default (ConfigOption attribute), 138
default() (ChuteCacheEncoder method), 119
default() (ChuteEncoder method), 119
default() (UpdateEncoder method), 120
DEFAULT_PASSWORD (PasswordManager attribute), 127
DEFAULT_USER_NAME (PasswordManager attribute), 127
delConfig() (UCIConfig method), 179
delConfigs() (UCIConfig method), 179
delete_chute() (ChuteApi method), 113
delete_station() (ChuteApi method), 113
deleteChute() (ChuteStorage method), 153
detach() (LogProvider method), 167
detectPrimaryInterface() (ConfigWifiDevice method), 146
detectSystemDevices() (in module paradrop.core.config.devices), 156
DEV_PLUS_VID (ConfigInterface attribute), 144
dev_to_phy() (Scanner method), 110
DeviceNotFoundException, 129
DeviceReservations (class in paradrop.core.config.reservations), 161
dict2obj (class in paradrop.base.pdutils), 134
do_snapd_request() (SnapdResource method), 127
Dockerfile (class in paradrop.core.container.dockerfile), 166
download() (Downloader method), 166
download() (GithubDownloader method), 166
download() (GitSSHDownloader method), 166
download() (WebDownloader method), 167
Downloader (class in paradrop.core.container.downloader), 166
downloader() (in module paradrop.core.container.downloader), 167
dump() (ConfigObject method), 136

E

EMAIL
    pdtools-device-snapd-createuser command line option, 89
    pdtools-node-create-user command line option, 91
endLogging() (Output method), 132
ensureReady() (ProcessMonitor method), 174
ERR (Level attribute), 131
ErrorCommand (class in paradrop.confd.command), 139
ESSID
    pdtools-chute-add-wifi-ap command line option, 76
ExceptionOutput (class in paradrop.base.output), 131
execute() (Command method), 138
execute() (ConfigManager method), 143
execute() (ErrorCommand method), 139
execute() (FunctionCommand method), 139
execute() (KillCommand method), 139
execute() (UpdateObject method), 173
executePlans() (in module paradrop.core.plan.executionplan), 168
exists() (in module paradrop.lib.utils.pdos), 177
existsConfig() (UCIConfig method), 179
explode() (in module paradrop.base.pdutils), 134
exportAttr() (PDStorage method), 177
extract() (Downloader method), 166
extract_tarred_chute() (in module paradrop.backend.chute_api), 120

F

factory_reset() (ConfigApi method), 120
FATAL (Level attribute), 131
feedSpectrumData() (AnalyzerProcessProtocol method), 110

fetch() (Downloader method), 166
FILES (UCIBuilder attribute), 155
find_change() (UpdateManager method), 172
findByType() (ConfigObject method), 136
findConfigFiles() (in module paradrop.confd.manager), 144
findMatchingConfig() (ConfigManager method), 143
findMatchingInterface() (in module paradrop.core.config.firewall), 158
fixpath() (in module paradrop.lib.utils.pdos), 177
flush() (OutputRedirect method), 133
flush() (SpectrumReader method), 110
flushWirelessInterfaces() (in module paradrop.core.config.devices), 156
formatOutput() (BaseOutput method), 131
freqlist (Scanner attribute), 110
fulfillDeviceRequest() (in module paradrop.core.config.network), 159
FunctionCommand (class in paradrop.confd.command), 139

G

generate() (HostapdConfGenerator method), 147
generate() (WpaSupplicantConfGenerator method), 148
generate_service_plans() (in module paradrop.core.plan.state), 170
generateConfigSections() (in module paradrop.core.config.haproxy), 158
generateHostConfig() (in module paradrop.core.config.hostconfig), 158
generatePlans() (in module paradrop.core.plan.executionplan), 168
generatePlans() (in module paradrop.core.plan.hostconfig), 168
generatePlans() (in module paradrop.core.plan.name), 168
generatePlans() (in module paradrop.core.plan.resource), 169
generatePlans() (in module paradrop.core.plan.router), 169
generatePlans() (in module paradrop.core.plan.runtime), 169
generatePlans() (in module paradrop.core.plan.snap), 170
generatePlans() (in module paradrop.core.plan.state), 170
generatePlans() (in module paradrop.core.plan.struct), 170
generatePlans() (in module paradrop.core.plan.traffic), 170
generateToken() (in module paradrop.core.config.dockerconfig), 157
get() (PDServerRequest method), 149
get11acOptions() (HostapdConfGenerator method), 147
get11nOptions() (HostapdConfGenerator method), 147
get11rOptions() (HostapdConfGenerator method), 147
get_access_level() (in module paradrop.backend.auth), 112
get_allowed_bearer() (in module paradrop.backend.auth), 112
get_auth_token() (in module paradrop.core.config.zerotier), 163
get_change() (SnapdClient method), 175
get_chute() (ChuteApi method), 113
get_chute() (paradrop.core.chute.chute_storage.ChuteStorage class method), 153
get_chute_cache() (ChuteApi method), 113
get_chute_config() (ChuteApi method), 113
get_chutes() (ChuteApi method), 114
get_cipher_list() (in module paradrop.confd.wireless), 148
get_class_id() (ConfigClassgroup method), 145
get_current_phy_conf() (in module paradrop.core.config.network), 160
get_debugfs_dir() (Scanner method), 110
get_default_service() (Chute method), 152
get_environment() (Chute method), 152
get_environment() (InformationApi method), 124
get_features() (InformationApi method), 125
get_hardware_serial() (in module paradrop.core.config.devices), 156
get_hostapd_status() (ChuteApi method), 114
get_hostconfig() (ConfigApi method), 120
get_iptables() (ConfigDefaults method), 140
get_iptables() (ConfigRule method), 141
get_iptables() (ConfigZone method), 142
get_leases() (ChuteApi method), 115
get_logs() (LogProvider method), 167
get_network() (ChuteApi method), 115
get_networks() (ChuteApi method), 116
get_networks() (in module paradrop.core.config.zerotier), 163
get_owner() (Chute method), 152
get_pdid() (ConfigApi method), 121
get_provision() (ConfigApi method), 121
get_service() (Chute method), 152
get_services() (Chute method), 152
get_settings() (ConfigApi method), 121
get_ssid() (ChuteApi method), 116
get_station() (ChuteApi method), 116
get_stations() (ChuteApi method), 117
get_telemetry() (InformationApi method), 125
get_username_password() (in module paradrop.backend.auth), 112
get_web_port_and_service() (Chute method), 152
getAddress() (in module paradrop.core.config.zerotier), 163
getAttr() (ChuteStorage method), 153
getAuthorizedKeys() (in module paradrop.lib.misc.ssh_keys), 175

getBridgeGateway() (in module paradrop.core.container.dockerapi), 164
getBytesIO() (Dockerfile method), 166
getCache() (Chute method), 152
getCacheContents() (Chute method), 152
getChute() (ChuteStorage method), 153
getChuteConfigs() (UCIConfig method), 179
getChuteList() (ChuteStorage method), 153
getConfig() (UCIConfig method), 179
getConfigIgnoreComments() (UCIConfig method), 179
getConfiguration() (Chute method), 152
getDeveloperFirewallRules() (in module paradrop.core.config.firewall), 158
getDeviceId() (SysReader method), 155
getDeviceReservations() (in module paradrop.core.config.reservations), 161
getDMI() (in module paradrop.core.system.system_info), 170
getExtraOptions() (in module paradrop.core.config.network), 159
getFileType() (in module paradrop.lib.utils.pdos), 177
getGatewayIntf() (in module paradrop.lib.utils.addresses), 175
getHostConfig() (Chute method), 152
getHostConfig() (in module paradrop.core.config.hostconfig), 158
getID() (ChuteContainer method), 163
getIfname() (ConfigWifiIface method), 147
getInterfaceAddress() (in module paradrop.core.config.network), 159
getInterfaceReservations() (in module paradrop.core.config.reservations), 161
getInternalIntfList() (in module paradrop.lib.utils.addresses), 176
getIP() (ChuteContainer method), 163
getKey() (NexusBase method), 130
getL3BridgeConfig() (in module paradrop.core.config.network), 159
getLineParts() (in module paradrop.lib.utils.uci), 180
getLogsSince() (Output method), 132
getMACAddress() (in module paradrop.core.config.devices), 156
getMainOptions() (HostapdConfGenerator method), 148
getMainOptions() (WpaSupplicantConfGenerator method), 148
getModule() (paradrop.confd.base.ConfigObject class method), 137
getMountCmd() (in module paradrop.lib.utils.pdos), 177
getName() (ConfigDefaults method), 140
getName() (ConfigDomain method), 140
getName() (ConfigObject method), 137
getName() (ConfigWifiIface method), 147
getNetworkConfig() (in module paradrop.core.config.network), 159
getNetworkConfigLan() (in module paradrop.core.config.network), 160
getNetworkConfigVlan() (in module paradrop.core.config.network), 160
getNetworkConfigWifi() (in module paradrop.core.config.network), 160
getNetworkInfo() (paradrop.core.system.system_status.SystemStatus class method), 171
getNextAbort() (PlanMap method), 169
getNextTodo() (PlanMap method), 169
getOSFirewallRules() (in module paradrop.core.config.firewall), 158
getOSNetworkConfig() (in module paradrop.core.config.network), 160
getOSVersion() (in module paradrop.core.system.system_info), 171
getOSWirelessConfig() (in module paradrop.core.config.wifi), 163
getPackageVersion() (in module paradrop.core.system.system_info), 171
getPhyFromMAC() (in module paradrop.confd.wireless), 148
getPhyMACAddress() (in module paradrop.confd.wireless), 148
getPhyMACAddress() (in module paradrop.core.config.devices), 156
getPID() (ChuteContainer method), 163
getPid() (KillCommand method), 139
getPortConfiguration() (ChuteContainer method), 163
getPortList() (in module paradrop.core.container.dockerapi), 164
getPreviousCommands() (ConfigManager method), 143
getProcessInfo() (paradrop.core.system.system_status.SystemStatus class method), 171
getRadiusOptions() (HostapdConfGenerator method), 148
getRandomMAC() (ConfigWifiIface method), 147
getReservations() (in module paradrop.core.config.reservations), 161
getResourceAllocation() (in module paradrop.core.config.resource), 162
getSections() (UCIBuilder method), 155
getSecurityOptions() (HostapdConfGenerator method), 148
getServerInfo() (paradrop.core.agent.http.PDServerRequest class method), 149
getSlotName() (SysReader method), 155
getStatus() (ChuteContainer method), 164
getStatus() (SystemStatus method), 171
getString() (Dockerfile method), 166
getSubnet() (in module paradrop.lib.utils.addresses), 176
getSubnetReservations() (in module paradrop.core.config.reservations), 161
getSystemConfigDir() (in module paradrop.lib.utils.uci),

180
getSystemDevices() (in module paradrop.core.config.devices), 156
getSystemInfo() (paradrop.core.system.system_status.SystemStatus class method), 171
getSystemPath() (in module paradrop.lib.utils.uci), 180
getTypeAndName() (ConfigObject method), 137
getValue() (in module paradrop.lib.utils.datastruct), 176
getVendorId() (SysReader method), 155
getVirtDHCPSettings() (in module paradrop.core.config.dhcp), 157
getVirtPreamble() (in module paradrop.core.config.dockerconfig), 157
getWANIntf() (in module paradrop.lib.utils.addresses), 176
getWebPort() (Chute method), 152
getWifiKeySettings() (in module paradrop.core.config.network), 160
getWirelessPhyName() (in module paradrop.core.config.devices), 156
GithubDownloader (class in paradrop.core.container.downloader), 166
GitSSHDownloader (class in paradrop.core.container.downloader), 166
GROUP
pdtools-cloud-group-add-node command line option, 79
GROUP_ID
pdtools-group command line option, 90

H

handleMissingWiFi() (in module paradrop.core.config.devices), 156
handlePrint() (Output method), 132
hardware_info() (InformationApi method), 125
has_chute_build() (UpdateChute method), 172
has_chute_build() (UpdateObject method), 173
hdrsize (SpectrumReader attribute), 110
HEADER (Level attribute), 131
header_pattern (CurlRequestDriver attribute), 148
home() (HttpServer method), 123
hostapd_control() (ChuteApi method), 117
HostapdConfGenerator (class in paradrop.confd.wireless), 147
HTTPRequestDriver (class in paradrop.core.agent.http), 149
HTTPResponse (class in paradrop.core.agent.http), 149
HttpServer (class in paradrop.backend.http_server), 123

I

ID
pdtools-node-provision command line option, 99
importAttr() (PDStorage method), 177
incIpaddr() (in module paradrop.lib.utils.addresses), 176
INCLUDED_PARTITIONS (SystemStatus attribute), 171
increaseDelay() (ReportSender method), 150
INFO (Level attribute), 131
InformationApi (class in paradrop.backend.information_api), 124
inherit_attributes() (Chute method), 153
initialDelay (BaseClientFactory attribute), 128
inspect() (ChuteContainer method), 164
installSnap() (SnapdClient method), 175
InteralException, 129
interface (Scanner attribute), 110
interface_available() (AirsharkInterfaceManager method), 154
InterfaceReservationSet (class in paradrop.core.config.reservations), 161
interpretBoolean() (in module paradrop.confd.base), 138
InvalidCredentials, 129
isdir() (in module paradrop.lib.utils.pdos), 177
isfile() (in module paradrop.lib.utils.pdos), 177
isHexString() (in module paradrop.confd.wireless), 148
isIpAvailable() (in module paradrop.lib.utils.addresses), 176
isIpValid() (in module paradrop.lib.utils.addresses), 176
isLeaf (SnapdResource attribute), 127
isMatch() (in module paradrop.lib.utils.uci), 180
isMatchIgnoreComments() (in module paradrop.lib.utils.uci), 180
isMount() (in module paradrop.lib.utils.pdos), 177
ismount() (in module paradrop.lib.utils.pdos), 177
isRunning() (AnalyzerProcessProtocol method), 110
isRunning() (Chute method), 153
isRunning() (ChuteContainer method), 164
isStaticIpAvailable() (in module paradrop.lib.utils.addresses), 176
isValid() (Chute method), 153
isValid() (Dockerfile method), 166
isVirtual() (in module paradrop.core.config.devices), 156
isWAN() (in module paradrop.core.config.devices), 156
isWifiSSIDAvailable() (in module paradrop.lib.utils.addresses), 176
isWireless() (in module paradrop.core.config.devices), 156
iterate_module_attributes() (in module paradrop.base.settings), 135

J

json2str() (in module paradrop.base.pdutils), 134
jsonPretty() (in module paradrop.base.pdutils), 135
JSONReceiver (class in paradrop.core.agent.http), 149

K

KEY
pdtools-node-provision command line option, 99

kill() (in module paradrop.confd.command), 139
KillCommand (class in paradrop.confd.command), 139

L

leave() (BaseSession method), 128
Level (class in paradrop.base.output), 131
listdir() (in module paradrop.lib.utils.pdos), 177
listen() (in module paradrop.confd.main), 142
listSnaps() (SnapdClient method), 175
listSystemDevices() (in module paradrop.core.config.devices), 156
listWiFiDevices() (in module paradrop.core.config.devices), 156
load() (in module paradrop.core.config.hostconfig), 158
load_from_file() (in module paradrop.base.settings), 135
loadConfig() (ConfigManager method), 143
loadFromDisk() (PDStorage method), 177
loadPriorityMap() (in module paradrop.plan_demo), 181
loadSettings() (in module paradrop.base.settings), 135
loadYaml() (in module paradrop.base.nexus), 131
local_login() (AuthApi method), 112
lock (CurlRequestDriver attribute), 148
LogProvider (class in paradrop.core.container.log_provider), 167
logs() (HttpServer method), 123
LogSockJSFactory (class in paradrop.backend.log_sockjs), 126
LogSockJSProtocol (class in paradrop.backend.log_sockjs), 126
logToConsole() (Output method), 132
lookup() (ConfigObject method), 137

M

main() (in module paradrop.main), 181
make_iptables_cmd() (ConfigClassify method), 145
makedirs() (in module paradrop.lib.utils.pdosq), 178
makeHostapdConf() (ConfigWifiIface method), 147
makeWpaSupplicantConf() (ConfigWifiIface method), 147
manage_network() (in module paradrop.core.config.zerotier), 163
maskable (ConfigInterface attribute), 144
maskable (ConfigObject attribute), 137
maxDelay (BaseClientFactory attribute), 128
maxIpaddr() (in module paradrop.lib.utils.addresses), 176
messageToString() (Output method), 132
meta() (Downloader method), 166
meta() (GithubDownloader method), 166
meta() (GitSSHDownloader method), 166
meta() (WebDownloader method), 167
mkdir() (in module paradrop.lib.utils.pdos), 177
ModelNotFound, 129
MODULE
    pdtools-node-load-audio-module command line option, 98
monitor_logs() (in module paradrop.core.container.log_provider), 167
move() (in module paradrop.lib.utils.pdos), 177

N

NAME
    pdtools-cloud-create-node command line option, 78
    pdtools-cloud-delete-node command line option, 79
    pdtools-cloud-describe-node command line option, 79
    pdtools-cloud-edit-node-description command line option, 79
    pdtools-cloud-rename-node command line option, 81
    pdtools-device-audio-load-module command line option, 82
    pdtools-routers-create command line option, 104
    pdtools-store-describe-chute command line option, 105
    pdtools-store-list-versions command line option, 106
name (ConfigOption attribute), 138
NETWORK
    pdtools-device-chute-network command line option, 84
    pdtools-node-describe-chute-network-client command line option, 93
    pdtools-node-list-chute-network-clients command line option, 97
    pdtools-node-remove-chute-network-client command line option, 100
new_config() (ConfigApi method), 121
NEW_NAME
    pdtools-cloud-rename-node command line option, 81
nextId (ConfigObject attribute), 137
nextInterfaceName() (ConfigWifiDevice method), 146
Nexus (class in paradrop.main), 181
NexusBase (class in paradrop.base.nexus), 130
NODE
    pdtools-cloud-group-add-node command line option, 79
    pdtools-store-install-chute command line option, 106
NODE_ID
    pdtools-store-watch-update-messages command line option, 107
NodeIdentitySender (class in paradrop.core.agent.reporting), 150

O

on_analyzer_message() (AirsharkAnalyzerProtocol method), 111

on_analyzer_message() (AirsharkManager method), 109
on_interface_down() (AirsharkManager method), 109
on_interface_up() (AirsharkManager method), 109
on_spectrum_data() (AirsharkSpectrumProtocol method), 112
onChallenge() (WampSession method), 151
onClose() (AirsharkAnalyzerProtocol method), 111
onClose() (AirsharkSpectrumProtocol method), 112
onConnect() (WampSession method), 151
onDisconnect() (WampSession method), 151
onInfoChange() (NexusBase method), 130
onJoin() (BaseSession method), 128
onJoin() (WampSession method), 151
onLeave() (WampSession method), 151
onOpen() (AirsharkAnalyzerProtocol method), 111
onOpen() (AirsharkSpectrumProtocol method), 112
onStart() (Nexus method), 181
onStart() (NexusBase method), 130
onStop() (Nexus method), 181
onStop() (NexusBase method), 130
open() (in module paradrop.lib.utils.pdos), 177
OPTION
    pdtools-device-hostconfig-change command line option, 87
options (ConfigClass attribute), 145
options (ConfigClassgroup attribute), 145
options (ConfigClassify attribute), 145
options (ConfigDefaults attribute), 140
options (ConfigDhcp attribute), 139
options (ConfigDnsmasq attribute), 140
options (ConfigDomain attribute), 140
options (ConfigForwarding attribute), 141
options (ConfigInterface attribute), 144, 145
options (ConfigObject attribute), 137
options (ConfigRedirect attribute), 141
options (ConfigRule attribute), 142
options (ConfigWifiDevice attribute), 146
options (ConfigWifiIface attribute), 147
options (ConfigZone attribute), 142
optionsMatch() (ConfigObject method), 137
oscall() (in module paradrop.lib.utils.pdos), 177
Output (class in paradrop.base.output), 132
OutputRedirect (class in paradrop.base.output), 133

P

paradrop (module), 181
paradrop.airshark (module), 111
paradrop.airshark.airshark (module), 109
paradrop.airshark.analyzer (module), 109
paradrop.airshark.scanner (module), 110
paradrop.airshark.spectrum_reader (module), 110
paradrop.backend (module), 128
paradrop.backend.airshark_api (module), 111
paradrop.backend.airshark_ws (module), 111
paradrop.backend.auth (module), 112
paradrop.backend.chute_api (module), 63, 113
paradrop.backend.config_api (module), 69, 120
paradrop.backend.cors (module), 123
paradrop.backend.http_server (module), 123
paradrop.backend.information_api (module), 72, 124
paradrop.backend.log_sockjs (module), 126
paradrop.backend.password_api (module), 127
paradrop.backend.password_manager (module), 127
paradrop.backend.snapd_resource (module), 127
paradrop.backend.status_sockjs (module), 128
paradrop.base (module), 136
paradrop.base.cxbr (module), 128
paradrop.base.exceptions (module), 129
paradrop.base.nexus (module), 130
paradrop.base.output (module), 131
paradrop.base.pdutils (module), 134
paradrop.base.settings (module), 135
paradrop.confd (module), 148
paradrop.confd.base (module), 136
paradrop.confd.client (module), 138
paradrop.confd.command (module), 138
paradrop.confd.dhcp (module), 139
paradrop.confd.firewall (module), 140
paradrop.confd.main (module), 142
paradrop.confd.manager (module), 142
paradrop.confd.network (module), 144
paradrop.confd.qos (module), 145
paradrop.confd.wireless (module), 146
paradrop.core (module), 174
paradrop.core.agent (module), 151
paradrop.core.agent.http (module), 148
paradrop.core.agent.reporting (module), 150
paradrop.core.agent.wamp_session (module), 151
paradrop.core.chute (module), 154
paradrop.core.chute.chute (module), 151
paradrop.core.chute.chute_storage (module), 153
paradrop.core.chute.restart (module), 154
paradrop.core.config (module), 163
paradrop.core.config.airshark (module), 154
paradrop.core.config.configservice (module), 155
paradrop.core.config.devices (module), 155
paradrop.core.config.dhcp (module), 157
paradrop.core.config.dockerconfig (module), 157
paradrop.core.config.firewall (module), 158
paradrop.core.config.haproxy (module), 158
paradrop.core.config.hostconfig (module), 158
paradrop.core.config.network (module), 159
paradrop.core.config.osconfig (module), 160
paradrop.core.config.power (module), 161
paradrop.core.config.reservations (module), 161
paradrop.core.config.resource (module), 162
paradrop.core.config.services (module), 162
paradrop.core.config.snap (module), 162

paradrop.core.config.state (module), 162
paradrop.core.config.uciutils (module), 162
paradrop.core.config.wifi (module), 163
paradrop.core.config.zerotier (module), 163
paradrop.core.container (module), 167
paradrop.core.container.chutecontainer (module), 163
paradrop.core.container.dockerapi (module), 164
paradrop.core.container.dockerfile (module), 166
paradrop.core.container.downloader (module), 166
paradrop.core.container.log_provider (module), 167
paradrop.core.plan (module), 170
paradrop.core.plan.executionplan (module), 167
paradrop.core.plan.hostconfig (module), 168
paradrop.core.plan.name (module), 168
paradrop.core.plan.plangraph (module), 168
paradrop.core.plan.resource (module), 169
paradrop.core.plan.router (module), 169
paradrop.core.plan.runtime (module), 169
paradrop.core.plan.snap (module), 170
paradrop.core.plan.state (module), 170
paradrop.core.plan.struct (module), 170
paradrop.core.plan.traffic (module), 170
paradrop.core.system (module), 171
paradrop.core.system.system_info (module), 170
paradrop.core.system.system_status (module), 171
paradrop.core.update (module), 174
paradrop.core.update.update_fetcher (module), 171
paradrop.core.update.update_manager (module), 172
paradrop.core.update.update_object (module), 172
paradrop.lib (module), 181
paradrop.lib.misc (module), 175
paradrop.lib.misc.pdinstall (module), 174
paradrop.lib.misc.procmon (module), 174
paradrop.lib.misc.resopt (module), 174
paradrop.lib.misc.snapd (module), 175
paradrop.lib.misc.ssh_keys (module), 175
paradrop.lib.utils (module), 181
paradrop.lib.utils.addresses (module), 175
paradrop.lib.utils.datastruct (module), 176
paradrop.lib.utils.pd_storage (module), 176
paradrop.lib.utils.pdos (module), 177
paradrop.lib.utils.pdosq (module), 178
paradrop.lib.utils.uci (module), 178
paradrop.lib.utils.uhttp (module), 180
paradrop.main (module), 181
paradrop.plan_demo (module), 181
paradrop_logs() (HttpServer method), 123
ParadropException, 129
parse() (in module paradrop.core.update.update_object), 173
parseLogPrefix() (in module paradrop.base.output), 134
parseValue() (in module paradrop.base.settings), 136
PasswordApi (class in paradrop.backend.password_api), 127
PasswordManager (class in paradrop.backend.password_manager), 127
patch() (PDServerRequest method), 149
PATH
    pdtools-chute-set command line option, 77
    pdtools-cloud-import-ssh-key command line option, 80
    pdtools-device-sshkeys-add command line option, 89
    pdtools-node-import-configuration command line option, 95
    pdtools-node-import-ssh-key command line option, 96
    pdtools-node-set-configuration command line option, 101
PCI_BUS_ID (SysReader attribute), 155
pdconf() (ConfigApi method), 122
pdconf_reload() (ConfigApi method), 122
PDID (NexusBase attribute), 130
PdidError, 129
PdidExclusionError, 129
PdServerException, 129
PDServerRequest (class in paradrop.core.agent.http), 149
PDServerResponse (class in paradrop.core.agent.http), 150
PDStorage (class in paradrop.lib.utils.pd_storage), 176
pdtools-chute-add-wifi-ap command line option
    –force, 75
    –password <password>, 75
    ESSID, 76
pdtools-chute-enable-web-service command line option
    -s, –service <service>, 76
    PORT, 76
pdtools-chute-export-configuration command line option
    -f, –format <format>, 76
pdtools-chute-initialize command line option
    –legacy, 77
pdtools-chute-set command line option
    PATH, 77
    VALUE, 77
pdtools-cloud-claim-node command line option
    -n, –name <name>, 78
    TOKEN, 78
pdtools-cloud-create-node command line option
    –claim <claim>, 78
    –orphaned, –not-orphaned, 78
    NAME, 78
pdtools-cloud-delete-node command line option
    NAME, 79
pdtools-cloud-describe-node command line option
    NAME, 79
pdtools-cloud-edit-node-description command line option
    NAME, 79
pdtools-cloud-group-add-node command line option

GROUP, 79
NODE, 79
pdtools-cloud-import-ssh-key command line option
PATH, 80
pdtools-cloud-rename-node command line option
NAME, 81
NEW_NAME, 81
pdtools-device command line option
ADDRESS, 81
pdtools-device-audio-load-module command line option
NAME, 82
pdtools-device-audio-sink command line option
SINK_NAME, 82
pdtools-device-audio-sink-volume command line option
CHANNEL_VOLUME, 82
pdtools-device-audio-source command line option
SOURCE_NAME, 83
pdtools-device-audio-source-volume command line option
CHANNEL_VOLUME, 83
pdtools-device-chute command line option
CHUTE, 83
pdtools-device-chute-network command line option
NETWORK, 84
pdtools-device-chute-network-station command line option
STATION, 85
pdtools-device-hostconfig-change command line option
OPTION, 87
VALUE, 87
pdtools-device-provision command line option
–server <server>, 88
–wamp <wamp>, 88
ROUTER_ID, 88
ROUTER_PASSWORD, 88
pdtools-device-snapd-createuser command line option
EMAIL, 89
pdtools-device-sshkeys command line option
–user <user>, 89
pdtools-device-sshkeys-add command line option
PATH, 89
pdtools-device-watch command line option
CHANGE_ID, 90
pdtools-group command line option
GROUP_ID, 90
pdtools-group-add-router command line option
ROUTER_ID, 90
pdtools-node command line option
-t, –target <target>, 91
pdtools-node-create-user command line option
EMAIL, 91
pdtools-node-describe-chute command line option
CHUTE, 92
pdtools-node-describe-chute-cache command line option
CHUTE, 92
pdtools-node-describe-chute-configuration command line option
CHUTE, 92
pdtools-node-describe-chute-network-client command line option
CHUTE, 93
CLIENT, 93
NETWORK, 93
pdtools-node-edit-chute-configuration command line option
CHUTE, 94
pdtools-node-edit-chute-variables command line option
CHUTE, 94
pdtools-node-export-configuration command line option
-f, –format <format>, 94
pdtools-node-generate-configuration command line option
-f, –format <format>, 95
pdtools-node-import-configuration command line option
PATH, 95
pdtools-node-import-ssh-key command line option
-u, –user <user>, 95
PATH, 96
pdtools-node-install-chute command line option
-d, –directory <directory>, 96
pdtools-node-list-chute-network-clients command line option
CHUTE, 97
NETWORK, 97
pdtools-node-list-chute-networks command line option
CHUTE, 97
pdtools-node-list-ssh-keys command line option
-u, –user <user>, 98
pdtools-node-load-audio-module command line option
MODULE, 98
pdtools-node-open-chute-shell command line option
-s, –service <service>, 99
CHUTE, 99
pdtools-node-provision command line option
-c, –controller <controller>, 99
-w, –wamp <wamp>, 99
ID, 99
KEY, 99
pdtools-node-remove-chute command line option
CHUTE, 100
pdtools-node-remove-chute-network-client command line option
CHUTE, 100
CLIENT, 100
NETWORK, 100
pdtools-node-restart-chute command line option
CHUTE, 100
pdtools-node-set-configuration command line option

PATH, 101
VALUE, 101
pdtools-node-set-sink-volume command line option
SINK, 101
VOLUME, 101
pdtools-node-set-source-volume command line option
SOURCE, 101
VOLUME, 101
pdtools-node-start-chute command line option
CHUTE, 102
pdtools-node-stop-chute command line option
CHUTE, 102
pdtools-node-update-chute command line option
-d, –directory <directory>, 103
pdtools-node-watch-change-logs command line option
CHANGE_ID, 103
pdtools-node-watch-chute-logs command line option
CHUTE, 103
pdtools-routers-claim command line option
TOKEN, 104
pdtools-routers-create command line option
–claim <claim>, 104
–orphaned, –not-orphaned, 104
NAME, 104
pdtools-routers-delete command line option
ROUTER_ID, 104
pdtools-store-describe-chute command line option
NAME, 105
pdtools-store-install-chute command line option
-f, –follow, 105
-v, –version <version>, 105
CHUTE, 106
NODE, 106
pdtools-store-list-versions command line option
NAME, 106
pdtools-store-register command line option
–public, –not-public, 106
pdtools-store-watch-update-messages command line option
–interval <interval>, 107
NODE_ID, 107
UPDATE_ID, 107
PERF (Level attribute), 132
permission_denied() (in module paradrop.backend.chute_api), 120
pktsize (SpectrumReader attribute), 110
Plan (class in paradrop.core.plan.plangraph), 168
PlanMap (class in paradrop.core.plan.plangraph), 168
pool (TwistedRequestDriver attribute), 150
PORT
pdtools-chute-enable-web-service command line option, 76
post() (PDServerRequest method), 149
prepare() (StateReportBuilder method), 150
prepare() (TelemetryReportBuilder method), 150
prepare_environment() (in module paradrop.core.container.dockerapi), 164
prepare_image() (in module paradrop.core.container.dockerapi), 165
prepare_port_bindings() (in module paradrop.core.container.dockerapi), 165
prepareHostConfig() (in module paradrop.core.config.hostconfig), 159
PrintLogThread (class in paradrop.base.output), 133
PRIO_CONFIG_IFACE (ConfigObject attribute), 136
PRIO_CONFIG_QDISC (ConfigObject attribute), 136
PRIO_CREATE_IFACE (ConfigObject attribute), 136
PRIO_CREATE_QDISC (ConfigObject attribute), 136
PRIO_CREATE_VLAN (ConfigObject attribute), 136
PRIO_IPTABLES_RULE (ConfigObject attribute), 136
PRIO_IPTABLES_TOP (ConfigObject attribute), 136
PRIO_IPTABLES_ZONE (ConfigObject attribute), 136
PRIO_START_DAEMON (ConfigObject attribute), 136
prioritizeConfigs() (ConfigObject static method), 137
process (Scanner attribute), 110
processEnded() (AnalyzerProcessProtocol method), 110
ProcessMonitor (class in paradrop.lib.misc.procmon), 174
progress() (UpdateObject method), 173
provision() (ConfigApi method), 122
provision() (NexusBase method), 130
provisioned() (NexusBase method), 130
publish() (BaseSession method), 128
pull_update() (UpdateFetcher method), 171
put() (PDServerRequest method), 149

R

read_raw_samples() (AirsharkManager method), 109
read_samples() (SpectrumReader method), 110
read_sys_file() (in module paradrop.lib.utils.pdos), 178
read_uevent() (SysReader method), 155
readConfig() (ConfigManager method), 143
readConfig() (UCIConfig method), 179
readFile() (in module paradrop.lib.utils.pdos), 178
readHostconfigVlan() (in module paradrop.core.config.devices), 156
readHostconfigWifi() (in module paradrop.core.config.devices), 156
readHostconfigWifiInterfaces() (in module paradrop.core.config.devices), 157
readMode() (HostapdConfGenerator method), 148
readSysFile() (in module paradrop.core.config.devices), 157
reboot() (in module paradrop.core.config.power), 161
receive() (CurlRequestDriver method), 148
receive() (TwistedRequestDriver method), 150
receiveHeaders() (CurlRequestDriver method), 148
receiveResponse() (PDServerRequest method), 150

reclaimNetworkResources() (in module paradrop.core.config.network), 160
reconfigureProxy() (in module paradrop.core.config.haproxy), 158
refreshCpuLoad() (SystemStatus method), 171
refreshDiskInfo() (SystemStatus method), 171
refreshMemoryInfo() (SystemStatus method), 171
refreshNetworkTraffic() (SystemStatus method), 171
register() (BaseSession method), 129
registerSkip() (PlanMap method), 169
releaseInterfaceName() (ConfigWifiDevice method), 146
reload() (in module paradrop.confd.client), 138
reload_placeholder() (in module paradrop.core.config.configservice), 155
reloadAll() (in module paradrop.confd.client), 138
reloadAll() (in module paradrop.core.config.configservice), 155
reloadChutes() (in module paradrop.core.chute.restart), 154
remove() (in module paradrop.lib.utils.pdos), 178
remove_analyzer_observer() (AirsharkManager method), 109
remove_bridge() (in module paradrop.core.container.dockerapi), 165
remove_container() (in module paradrop.core.container.dockerapi), 165
remove_image() (in module paradrop.core.container.dockerapi), 165
remove_message_observer() (UpdateObject method), 173
remove_observer() (AirsharkInterfaceManager method), 154
remove_spectrum_observer() (AirsharkManager method), 109
remove_user() (PasswordManager method), 127
removeAllChutes() (in module paradrop.core.config.state), 162
removeAllContainers() (in module paradrop.core.container.dockerapi), 165
removeFromBridge() (ConfigInterface method), 144
removeFromParents() (ConfigObject method), 137
render() (SnapdResource method), 127
ReportSender (class in paradrop.core.agent.reporting), 150
request() (CurlRequestDriver method), 148
request() (HTTPRequestDriver method), 149
request() (PDServerRequest method), 150
request() (TwistedRequestDriver method), 150
required (ConfigOption attribute), 138
requiredFields (Dockerfile attribute), 166
requires_auth() (in module paradrop.backend.auth), 112
reset() (PasswordManager method), 127
reset_interface() (AirsharkInterfaceManager method), 154
resetToken() (paradrop.core.agent.http.PDServerRequest class method), 150
resetWirelessDevice() (in module paradrop.core.config.devices), 157
resolveInfo() (in module paradrop.base.nexus), 131
resolveWirelessDevRef() (in module paradrop.core.config.devices), 157
restart() (ProcessMonitor method), 174
restart_chute() (ChuteApi method), 118
restartChute() (in module paradrop.core.container.dockerapi), 165
restore() (UCIConfig method), 179
restoreConfigFile() (in module paradrop.core.config.uciutils), 162
revert() (ConfigClassify method), 145
revert() (ConfigDefaults method), 140
revert() (ConfigDnsmasq method), 140
revert() (ConfigForwarding method), 141
revert() (ConfigInterface method), 144, 145
revert() (ConfigObject method), 137
revert() (ConfigRedirect method), 141
revert() (ConfigRule method), 142
revert() (ConfigWifiDevice method), 146
revert() (ConfigWifiIface method), 147
revert() (ConfigZone method), 142
revert_dhcp_settings() (in module paradrop.core.config.dhcp), 157
revert_l3_bridge_config() (in module paradrop.core.config.network), 160
revert_os_firewall_rules() (in module paradrop.core.config.firewall), 158
revert_os_network_config() (in module paradrop.core.config.network), 160
revert_os_wireless_config() (in module paradrop.core.config.wifi), 163
revertChute() (in module paradrop.core.config.state), 162
revertConfig() (in module paradrop.core.config.osconfig), 160
revertHostConfig() (in module paradrop.core.config.hostconfig), 159
revertResourceAllocation() (in module paradrop.core.container.dockerapi), 165
ROUTER_ID
  pdtools-device-provision command line option, 88
  pdtools-group-add-router command line option, 90
  pdtools-routers-delete command line option, 104
ROUTER_PASSWORD
  pdtools-device-provision command line option, 88
routes (AirsharkApi attribute), 111
routes (AuthApi attribute), 112
routes (ChuteApi attribute), 118
routes (ConfigApi attribute), 122
routes (InformationApi attribute), 126
routes (PasswordApi attribute), 127

run() (PrintLogThread method), 133
run_thread() (in module paradrop.confd.main), 142

S

safe_remove() (in module paradrop.lib.utils.pdosq), 178
satisfies_requirements() (in module paradrop.core.config.network), 160
save() (in module paradrop.core.config.hostconfig), 159
save() (NexusBase method), 130
save() (UCIConfig method), 180
saveChute() (ChuteStorage method), 154
saveChute() (in module paradrop.core.config.state), 162
saveKey() (NexusBase method), 130
saveToDisk() (PDStorage method), 177
sc_wide (SpectrumReader attribute), 110
Scanner (class in paradrop.airshark.scanner), 110
SECURITY (Level attribute), 132
select_brlan_address() (in module paradrop.core.config.devices), 157
select_chute_subnet_pool() (in module paradrop.core.config.network), 160
sem (TwistedRequestDriver attribute), 150
send() (NodeIdentitySender method), 150
send() (ReportSender method), 150
sendCommand() (in module paradrop.lib.misc.pdinstall), 174
sendNodeIdentity() (in module paradrop.core.agent.reporting), 150
sendStateReport() (in module paradrop.core.agent.reporting), 151
sendTelemetryReport() (in module paradrop.core.agent.reporting), 151
ServiceNotFound, 130
set_chute_config() (ChuteApi method), 118
set_freqs() (Scanner method), 110
set_interface() (AirsharkInterfaceManager method), 154
set_ssid() (ChuteApi method), 118
set_update_fetcher() (paradrop.core.agent.wamp_session.WampSession class method), 151
setAttr() (ChuteStorage method), 154
setAutoUpdate() (in module paradrop.core.config.hostconfig), 159
setCache() (Chute method), 153
setConfig() (in module paradrop.core.config.devices), 157
setConfig() (in module paradrop.core.config.uciutils), 162
setHeader() (HTTPRequestDriver method), 149
setHostConfig() (in module paradrop.core.config.hostconfig), 159
setL3BridgeConfig() (in module paradrop.core.config.network), 160
setOnChange() (AttrWrapper method), 130
setOSFirewallRules() (in module paradrop.core.config.firewall), 158
setOSNetworkConfig() (in module paradrop.core.config.network), 160
setOSWirelessConfig() (in module paradrop.core.config.wifi), 163
setResourceAllocation() (in module paradrop.core.container.dockerapi), 165
setSystemDevices() (in module paradrop.core.config.devices), 157
setup() (ConfigClassgroup method), 145
setup() (ConfigInterface method), 144
setup() (ConfigObject method), 137
setup() (ConfigWifiDevice method), 146
setup() (ConfigZone method), 142
setup_http_server() (in module paradrop.backend.http_server), 124
setup_net_interfaces() (in module paradrop.core.container.dockerapi), 165
setVirtDHCPSettings() (in module paradrop.core.config.dhcp), 157
shutdown() (in module paradrop.core.config.power), 161
silentLogPrefix() (in module paradrop.base.output), 134
singleConfigMatches() (in module paradrop.lib.utils.uci), 180
SINK
    pdtools-node-set-sink-volume command line option, 101
SINK_NAME
    pdtools-device-audio-sink command line option, 82
snapd() (HttpServer method), 123
SnapdClient (class in paradrop.lib.misc.snapd), 175
SnapdResource (class in paradrop.backend.snapd_resource), 127
software_info() (InformationApi method), 126
sort() (PlanMap method), 169
SOURCE
    pdtools-node-set-source-volume command line option, 101
SOURCE_NAME
    pdtools-device-audio-source command line option, 83
spectrum_reader (Scanner attribute), 110
SpectrumReader (class in paradrop.airshark.spectrum_reader), 110
split_interface_type() (in module paradrop.core.config.network), 160
sshKeys() (ConfigApi method), 122
start() (paradrop.base.cxbr.BaseSession class method), 129
start() (Scanner method), 110
start_chute() (ChuteApi method), 119
start_container() (in module paradrop.core.container.dockerapi), 165
start_long_poll() (UpdateFetcher method), 172
start_polling() (UpdateFetcher method), 172

start_update() (ConfigApi method), 122
started() (UpdateObject method), 173
startLogging() (Output method), 133
STATE_DISABLED (Chute attribute), 152
STATE_FROZEN (Chute attribute), 152
STATE_INVALID (Chute attribute), 152
STATE_RUNNING (Chute attribute), 152
STATE_STOPPED (Chute attribute), 152
StateReport (class in paradrop.core.agent.reporting), 150
StateReportBuilder (class in paradrop.core.agent.reporting), 150
STATION
    pdtools-device-chute-network-station command line option, 85
status() (AirsharkApi method), 111
status() (AirsharkManager method), 109
status() (HttpServer method), 123
StatusSockJSFactory (class in paradrop.backend.status_sockjs), 128
StatusSockJSProtocol (class in paradrop.backend.status_sockjs), 128
statusString() (ConfigManager method), 143
stealStdio() (Output method), 133
stimestr() (in module paradrop.base.pdutils), 135
stockCall() (BaseSession method), 129
stockPublish() (BaseSession method), 129
stockRegister() (BaseSession method), 129
stockSubscribe() (BaseSession method), 129
stop() (AnalyzerProcessProtocol method), 110
stop() (Scanner method), 110
stop_chute() (ChuteApi method), 119
stopChute() (in module paradrop.core.container.dockerapi), 165
str2json() (in module paradrop.base.pdutils), 135
stringify() (in module paradrop.lib.utils.uci), 180
stringifyOptionValue() (in module paradrop.lib.utils.uci), 180
SubnetReservationSet (class in paradrop.core.config.reservations), 161
subscribe() (BaseSession method), 129
success() (Command method), 139
success() (ErrorCommand method), 139
symlink() (in module paradrop.lib.utils.pdos), 178
SysReader (class in paradrop.core.config.devices), 155
SystemStatus (class in paradrop.core.system.system_status), 171
systemStatus() (in module paradrop.confd.client), 138

T

tarfile_is_safe() (in module paradrop.backend.chute_api), 120
TelemetryReportBuilder (class in paradrop.core.agent.reporting), 150
timedur() (in module paradrop.base.pdutils), 135
timeflt() (in module paradrop.base.pdutils), 135
timeint() (in module paradrop.base.pdutils), 135
Timer (class in paradrop.base.pdutils), 134
timestr() (in module paradrop.base.pdutils), 135
toJSON() (StateReport method), 150
TOKEN
    pdtools-cloud-claim-node command line option, 78
    pdtools-routers-claim command line option, 104
token (PDServerRequest attribute), 150
trueWrite() (OutputRedirect method), 133
TwistedException (class in paradrop.base.output), 133
TwistedOutput (class in paradrop.base.output), 133
TwistedRequestDriver (class in paradrop.core.agent.http), 150
type (ConfigOption attribute), 138
typename (ConfigClass attribute), 145
typename (ConfigClassgroup attribute), 145
typename (ConfigClassify attribute), 145
typename (ConfigDefaults attribute), 140
typename (ConfigDhcp attribute), 139
typename (ConfigDnsmasq attribute), 140
typename (ConfigDomain attribute), 140
typename (ConfigForwarding attribute), 141
typename (ConfigInterface attribute), 144, 146
typename (ConfigObject attribute), 137
typename (ConfigRedirect attribute), 141
typename (ConfigRule attribute), 142
typename (ConfigWifiDevice attribute), 146
typename (ConfigWifiIface attribute), 147
typename (ConfigZone attribute), 142

U

UCIBuilder (class in paradrop.core.config.devices), 155
UCIConfig (class in paradrop.lib.utils.uci), 178
UHTTPConnection (class in paradrop.lib.utils.uhttp), 180
unlink() (in module paradrop.lib.utils.pdos), 178
unload() (ConfigManager method), 143
update() (WampSession method), 151
update_chute() (ChuteApi method), 119
update_fetcher (WampSession attribute), 151
update_hostconfig() (ConfigApi method), 122
UPDATE_ID
    pdtools-store-watch-update-messages command line option, 107
updateApply() (ConfigDefaults method), 140
updateApply() (ConfigInterface method), 144
updateApply() (ConfigObject method), 138
updateApply() (ConfigWifiIface method), 147
updateCache() (Chute method), 153
UpdateChute (class in paradrop.core.update.update_object), 172
UpdateEncoder (class in paradrop.backend.chute_api), 119

UpdateFetcher (class in paradrop.core.update.update_fetcher), 171
UpdateManager (class in paradrop.core.update.update_manager), 172
updateModuleList (UpdateChute attribute), 172
updateModuleList (UpdateObject attribute), 173
updateModuleList (UpdateRouter attribute), 173
updateModuleList (UpdateSnap attribute), 173
UpdateObject (class in paradrop.core.update.update_object), 172
updatePaths() (in module paradrop.base.settings), 136
updateRevert() (ConfigDefaults method), 141
updateRevert() (ConfigInterface method), 144
updateRevert() (ConfigObject method), 138
updateRevert() (ConfigWifiIface method), 147
UpdateRouter (class in paradrop.core.update.update_object), 173
UpdateSnap (class in paradrop.core.update.update_object), 173
updateSnap() (in module paradrop.core.config.snap), 162
updateSnap() (SnapdClient method), 175
updatesPending() (WampSession method), 151
updateStatus() (in module paradrop.core.chute.restart), 154
urlDecodeMe() (in module paradrop.base.pdutils), 135
urlEncodeMe() (in module paradrop.base.pdutils), 135
urlEncodeParams() (in module paradrop.core.agent.http), 150
USAGE (Level attribute), 132
USB_BUS_ID (SysReader attribute), 155

V

validate_change() (in module paradrop.core.plan.state), 170
validateInfo() (in module paradrop.base.nexus), 131
VALUE
    pdtools-chute-set command line option, 77
    pdtools-device-hostconfig-change command line option, 87
    pdtools-node-set-configuration command line option, 101
VERBOSE (Level attribute), 132
verify_cloud_token() (in module paradrop.backend.auth), 112
verify_password() (in module paradrop.backend.auth), 112
verify_password() (PasswordManager method), 127
VERSION (NexusBase attribute), 130
VOLUME
    pdtools-node-set-sink-volume command line option, 101
    pdtools-node-set-source-volume command line option, 101

W

wait_for_zerotier() (in module paradrop.core.config.zerotier), 163
waitSystemUp() (ConfigManager method), 143
waitSystemUp() (in module paradrop.confd.client), 138
WampSession (class in paradrop.core.agent.wamp_session), 151
WARN (Level attribute), 132
WebDownloader (class in paradrop.core.container.downloader), 166
WpaSupplicantConfGenerator (class in paradrop.confd.wireless), 148
write() (in module paradrop.lib.utils.pdos), 178
write() (OutputRedirect method), 133
write() (UCIBuilder method), 155
writeAuthorizedKeys() (in module paradrop.lib.misc.ssh_keys), 175
writeConfigFile() (in module paradrop.core.config.haproxy), 158
writeDockerConfig() (in module paradrop.core.container.dockerapi), 165
writeFile() (Dockerfile method), 166
writeFile() (in module paradrop.lib.utils.pdos), 178
writeHeader() (ConfGenerator method), 146
writeHeader() (HostapdConfGenerator method), 148
writeHeader() (WpaSupplicantConfGenerator method), 148
writeOptions() (ConfGenerator method), 146
writeYaml() (in module paradrop.base.nexus), 131