
LinchPin Documentation

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Welcome to the LinchPin documentation!

LinchPin is a simple and flexible hybrid cloud orchestration tool. Its intended purpose is managing cloud resources across multiple infrastructures. These resources can be provisioned, decommissioned, and configured all using declarative data and a simple command-line interface.

Additionally, LinchPin provides a Python API for managing resources. The cloud management component is backed by [Ansible](#). The front-end API manages the interface between the command line (or other interfaces) and calls to the Ansible API.

This documentation covers LinchPin version (1.6.2). For recent features, see the updated 1.6.2.

Note: Releases are formatted using [semantic versioning](#). If the release shown above is a pre-release version, the content listed may not be supported. Use [latest](#) for the most up-to-date documentation.

Before investigating the main components of LinchPin – provisioning, topologies, hooks, layouts, etc.– you’ll learn how to get LinchPin installed and cover some basic concepts. We’ll also cover how to use the `linchpin` command line interface, some configuration basics, and of course the provisioning providers.

1.1 Installation

Currently, LinchPin can be run from any machine with Python 2.6+ (Python 3.x is currently experimental), and requires Ansible 2.3.1 or newer.

Note: Some providers have additional dependencies. Additional software requirements can be found in the *Providers* documentation.

Refer to your specific operating system for directions on the best method to install Python, if it is not already installed. Many modern operating systems will have Python already installed. This is typically the case in all versions of Linux and OS X, but the version present might be older than the version needed for use with Ansible. You can check the version by typing `python --version`.

If the system installed version of Python is older than 2.6, many systems will provide a method to install updated versions of Python in parallel to the system version (eg. `virtualenv`).

1.1.1 Minimal Software Requirements

As LinchPin is heavily dependent on Ansible 2.3.1 or newer, this is a core requirement. Beyond installing Ansible, there are several packages that need to be installed:

```
* libffi-devel
* openssl-devel
* libyaml-devel
* gmp-devel
```

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```
* libselinux-python
* make
* gcc
* redhat-rpm-config
* libxml2-python
* libxslt-python
```

For CentOS or RHEL the following packages should be installed:

```
$ sudo yum install python-pip python-virtualenv libffi-devel \
openssl-devel libyaml-devel gmp-devel libselinux-python make \
gcc redhat-rpm-config libxml2-python libxslt-python
```

Attention: CentOS 6 (and likely RHEL 6) require special care during installation. See `centos6_install` for more detail.

For Fedora 26+ the following packages should be installed:

```
$ sudo dnf install python-virtualenv libffi-devel \
openssl-devel libyaml-devel gmp-devel libselinux-python make \
gcc redhat-rpm-config libxml2-python libxslt-python
```

1.1.2 Installing LinchPin

Note: Currently, linchpin is not packaged for any major Operating System. If you'd like to contribute your time to create a package, please contact the [linchpin mailing list](#).

Create a virtualenv to install the package using the following sequence of commands (requires virtualenvwrapper)

```
$ mkvirtualenv linchpin
..snip..
(linchpin) $ pip install linchpin
..snip..
```

Using `mkvirtualenv` with Python 3 (now default on some Linux systems) will attempt to link to the `python3` binary. LinchPin isn't fully compatible with Python 3 yet. However, `mkvirtualenv` provides the `-p` option for specifying the `python2` binary.

```
$ mkvirtualenv linchpin -p $(which python2)
..snip..
(linchpin) $ pip install linchpin
..snip..
```

Note: `mkvirtualenv` is optional dependency you can install from [here](#). An alternative, `virtualenv`, also exists. Please refer to the [Virtualenv documentation](#) for more details.

To deactivate the virtualenv

```
(linchpin) $ deactivate
$
```

Then reactivate the virtualenv

```
$ workon linchpin
(linchpin) $
```

If testing or docs is desired, additional steps are required

```
(linchpin) $ pip install linchpin[docs]
(linchpin) $ pip install linchpin[tests]
```

Virtual Environments and SELinux

When using a virtualenv with SELinux enabled, LinchPin may fail due to an error related to with the libselinux-python libraries. This is because the libselinux-python binary needs to be enabled in the Virtual Environment. Because this library affects the filesystem, it isn't provided as a standard python module via pip. The RPM must be installed, then a symlink must occur.

```
(linchpin) $ sudo dnf install libselinux-python
.. snip ..
(linchpin) $ echo ${VIRTUAL_ENV}
/path/to/virtualenvs/linchpin
(linchpin) $ export VENV_LIB_PATH=lib/python2.7/site-packages
(linchpin) $ export LIBSELINUX_PATH=/usr/lib64/python2.7/site-packages # make sure to
↪verify this location
(linchpin) $ ln -s ${LIBSELINUX_PATH}/selinux ${VIRTUAL_ENV}/${VENV_LIB_PATH}
(linchpin) $ ln -s ${LIBSELINUX_PATH}/_selinux.so ${VIRTUAL_ENV}/${VENV_LIB_PATH}
```

Note: A script is provided to do this work at [<scripts/install_selinux_venv.sh>](#)

1.1.3 Installing on Fedora 26

Install RPM pre-reqs

```
$ sudo dnf -y install python-virtualenv libffi-devel openssl-devel libyaml-devel gmp-
↪devel libselinux-python make gcc redhat-rpm-config libxml2-python
```

Create a working-directory

```
$ mkdir mywork
$ cd mywork
```

Create linchpin directory, make a virtual environment, activate the virtual environment

```
$ mkvirtualenv linchpin
..snip..
(linchpin) $ pip install linchpin
```

Make a workspace, and initialize it to prove that linchpin itself works

```
(linchpin) $ mkdir workspace
(linchpin) $ cd workspace
(linchpin) $ linchpin init
PinFile and file structure created at /home/user/workspace
```

Note: The default workspace is \$PWD, but can be set using the \$WORKSPACE variable.

1.1.4 Installing on RHEL 7.4

Tested on RHEL 7.4 Server VM which was kickstarted and pre-installed with the following YUM package-groups and RPMs:

```
* @core
* @base
* vim-enhanced
* bash-completion
* scl-utils
* wget
```

For RHEL 7, it is assumed that you have access to normal RHEL7 YUM repos via RHSM or by pointing at your own http YUM repos, specifically the following repos or their equivalents:

```
* rhel-7-server-rpms
* rhel-7-server-optional-rpms
```

Install pre-req RPMs via YUM:

```
$ sudo yum install -y libffi-devel openssl-devel libyaml-devel gmp-devel libselenium-
↳python make gcc redhat-rpm-config libxml2-devel libxslt-devel libxslt-python
↳libxslt-python
```

To get a working python 2.7 pip and virtualenv either use EPEL

```
$ sudo rpm -ivh https://dl.fedoraproject.org/pub/epel/epel-release-latest-7.noarch.rpm
```

Install python pip and virtualenv:

```
$ sudo yum install -y python2-pip python-virtualenv
```

Create a working-directory

```
$ mkdir mywork
$ cd mywork
```

Create linchpin directory, make a virtual environment, activate the virtual environment

```
$ mkvirtualenv linchpin
..snip..
(linchpin) $ pip install linchpin
```

Inside the virtualenv, upgrade pip and setuptools because the EPEL versions are too old.

```
(linchpin) $ pip install -U pip
(linchpin) $ pip install -U setuptools
```

Install linchpin

```
(linchpin) $ pip install linchpin
```

Make a workspace, and initialize it to prove that linchpin itself works

```
(linchpin) $ mkdir workspace
(linchpin) $ cd workspace
(linchpin) $ linchpin init
PinFile and file structure created at /home/user/workspace
```

1.1.5 Source Installation

As an alternative, LinchPin can be installed via github. This may be done in order to fix a bug, or contribute to the project.

```
$ git clone git://github.com/CentOS-PaaS-SIG/linchpin
..snip..
$ cd linchpin
$ mkvirtualenv linchpin
..snip..
(linchpin) $ pip install file://$PWD/linchpin
```

1.2 Getting Started

Now that LinchPin is *installed*, this guide will walk you through the basics of using LinchPin. LinchPin is a command-line utility, a Python API, and Ansible playbooks. As this guide is intentionally brief to get you started, a more complete version can be found in the documentation links found to the left in the *index*.

Topics

- *Getting Started*
 - *Running the linchpin command*
 - * *Getting Help*
 - * *Basic Usage*
 - * *Options and Arguments*
 - * *Combining Options*
 - * *Common Usage*
 - *Verbose Output*
 - *Specify an Alternate PinFile*
 - *Specify an Alternate Workspace*
 - *Provide Credentials*
 - *The Workspace*
 - * *Initialization (init)*

- *Resources*
 - * *Topology*
 - * *Inventory Layout*
 - * *PinFile*
- *Provisioning (up)*
- *Teardown (destroy)*
- *Authentication*
 - * *Credentials*
 - *Credentials File*
 - *Using Credentials*
 - *Credentials Location*

1.2.1 Running the linchpin command

The linchpin CLI is used to perform tasks related to managing *resources*. For detail about a specific command, see *Commands (CLI)*.

Getting Help

Getting help from the command line is very simple. Running either `linchpin` or `linchpin --help` will yield the command line help page.

```
$ linchpin --help
Usage: linchpin [OPTIONS] COMMAND [ARGS]...

linchpin: hybrid cloud orchestration

Options:
  -c, --config PATH           Path to config file
  -p, --pinfile PINFILE       Use a name for the PinFile different from
                              the configuration.
  -d, --template-data TEMPLATE_DATA
                              Template data passed to PinFile template
  -o, --output-pinfile OUTPUT_PINFILE
                              Write out PinFile to provided location
  -w, --workspace PATH        Use the specified workspace. Also works if
                              the familiar Jenkins WORKSPACE environment
                              variable is set
  -v, --verbose               Enable verbose output
  --version                   Prints the version and exits
  --creds-path PATH          Use the specified credentials path. Also
                              works if CREDS_PATH environment variable is
                              set
  -h, --help                  Show this message and exit.

Commands:
  init    Initializes a linchpin project.
  up      Provisions nodes from the given target(s) in...
```

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```

destroy Destroys nodes from the given target(s) in...
fetch   Fetches a specified linchpin workspace or...
journal Display information stored in Run Database...

```

For subcommands, like `linchpin up`, passing the `--help` or `-h` option produces help related to the provided subcommand.

```

$ linchpin up -h
Usage: linchpin up [OPTIONS] TARGETS

Provisions nodes from the given target(s) in the given PinFile.

targets:    Provision ONLY the listed target(s). If omitted, ALL targets
            in the appropriate PinFile will be provisioned.

run-id:     Use the data from the provided run_id value

Options:
-r, --run-id run_id Idempotently provision using `run-id` data
-h, --help          Show this message and exit.

```

As can easily be seen, `linchpin up` has additional arguments and options.

Basic Usage

The most basic usage of `linchpin` might be to perform an *up* action. This simple command assumes a *PinFile* in the workspace (current directory by default), with one target *dummy*.

```

$ linchpin up
Action 'up' on Target 'dummy' is complete

Target          Run ID      uHash      Exit Code
-----
dummy           75         79b9       0

```

Upon completion, the systems defined in the *dummy* target will be provisioned. An equally basic usage of `linchpin` is the *destroy* action. This command is performed using the same *PinFile* and target.

```

$ linchpin destroy
Action 'destroy' on Target 'dummy' is complete

Target          Run ID      uHash      Exit Code
-----
dummy           76         79b9       0

```

Upon completion, the systems which were provisioned, are destroyed (or torn down).

Options and Arguments

The most common argument available in `linchpin` is the *TARGET*. Generally, the *PinFile* will have many targets available, but only one or two will be requested.

```

$ linchpin up dummy-new libvirt-new
Action 'up' on Target 'dummy' is complete

```

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```
Action 'up' on Target 'libvirt' is complete
```

Target	Run ID	uHash	Exit Code
dummy	77	73b1	0
libvirt	39	dc2c	0

In some cases, you may wish to use a different *PinFile*.

```
$ linchpin -p PinFile.json up
Action 'up' on Target 'dummy-new' is complete
```

Target	Run ID	uHash	Exit Code
dummy-new	29	c70a	0

As you can see, this PinFile had a *target* called `dummy-new`, and it was the only target listed.

Other common options include:

- `--verbose (-v)` to get more output
- `--config (-c)` to specify an alternate configuration file
- `--workspace (-w)` to specify an alternate workspace

Combining Options

The `linchpin` command also allows combining of general options with subcommand options. A good example of these might be to use the verbose (`-v`) option. This is very helpful in both the `up` and `destroy` subcommands.

```
$ linchpin -v up dummy-new -r 72
using data from run_id: 72
rundb_id: 73
uhash: a48d
calling: preup
hook preup initiated

PLAY [schema check and Pre Provisioning Activities on topology_file] *****

TASK [Gathering Facts] *****
ok: [localhost]

TASK [common : use linchpin_config if provided] *****
```

What can be immediately observed, is that the `-v` option provides more verbose output of a particular task. This can be useful for troubleshooting or giving more detail about a specific task. The `-v` option is placed **before** the subcommand. The `-r` option, since it applies directly to the `up` subcommand, it is placed **afterward**. Investigating the `linchpin -help` and `linchpin up --help` can help differentiate if there's confusion.

Common Usage

Verbose Output

```
$ linchpin -v up dummy-new
```

Specify an Alternate PinFile

```
$ linchpin -vp Pinfile.alt up
```

Specify an Alternate Workspace

```
$ export WORKSPACE=/tmp/my_workspace  
$ linchpin up libvirt
```

or

```
$ linchpin -vw /path/to/workspace destroy openshift
```

Provide Credentials

```
$ export CRED_PATH=/tmp/my_workspace  
$ linchpin -v up libvirt
```

or

```
$ linchpin -v --creds-path /credentials/path up openstack
```

Note: The value provided to the `--creds-path` option is a directory, NOT a file. This is generally due to the topology containing the filename where the credentials are stored.

1.2.2 The Workspace

What is generated is commonly referred to as the *workspace*. The workspace can live anywhere on the filesystem. The default is the current directory. The workspace can also be passed into the `linchpin` command line with the `--workspace` (`--w`) option, or it can be set with the `$WORKSPACE` environmental variable.

An functional workspace can be found in [the source code](#).

Initialization (init)

Running `linchpin init` will generate the *workspace* directory structure, along with an example *PinFile*, *topology*, and *layout* files. Performing the following tasks will generate a simple dummy PinFile, topology, and layout structure.

```
$ pwd
/tmp/workspace
$ linchpin init
PinFile and file structure created at /tmp/workspace
$ tree
.
├── credentials
├── hooks
├── inventories
├── layouts
│   └── dummy-layout.yml
├── PinFile
├── topologies
│   └── dummy-topology.yml
```

1.2.3 Resources

With LinchPin, resources are king. Defining, managing, and generating outputs are all done using a declarative syntax. Resources are managed via the *PinFile*. The PinFile can hold two additional files, the *topology*, and *layout*. Linchpin also supports hooks.

Topology

The *topology* is declarative, written in YAML or JSON (v1.5+), and defines how the provisioned systems should look after executing the `linchpin up` command. A simple **dummy** topology is shown here.

```
---
topology_name: "dummy_cluster" # topology name
resource_groups:
  - resource_group_name: "dummy"
    resource_group_type: "dummy"
    resource_definitions:
      - name: "web"
        role: "dummy_node"
        count: 1
```

This topology describes a single dummy system that will be provisioned when *linchpin up* is executed. Once provisioned, the resources outputs are stored for reference and later lookup. Additional topology examples can be found in the [source code](#).

Inventory Layout

An *inventory_layout* (or *layout*) is written in YAML or JSON (v1.5+), and defines how the provisioned resources should look in an Ansible static inventory file. The inventory is generated from the resources provisioned by the topology and the layout data. A layout is shown here.

```
---
inventory_layout:
  vars:
    hostname: __IP__
  hosts:
    example-node:
      count: 1
```

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```
host_groups:
  - example
```

The above YAML allows for interpolation of the ip address, or hostname as a component of a generated inventory. A host group called *example* will be added to the Ansible static inventory. The *all* group always exists, and includes all provisioned hosts.

```
$ cat inventories/dummy_cluster-0446.inventory
[example]
web-0446-0.example.net hostname=web-0446-0.example.net

[all]
web-0446-0.example.net hostname=web-0446-0.example.net
```

Note: A keen observer might notice the filename and hostname are appended with `-0446`. This value is called the *uhash* or unique-ish hash. Most providers allow for unique identifiers to be assigned automatically to each hostname as well as the inventory name. This provides a flexible way to repeat the process, but manage multiple resource sets at the same time.

Advanced layout examples can be found by reading `ra_inventory_layouts`.

Note: Additional layout examples can be found in [the source code](#).

PinFile

A *PinFile* takes a *topology* and an optional *layout*, among other options, as a combined set of configurations as a resource for provisioning. An example *Pinfile* is shown.

```
dummy_cluster:
  topology: dummy-topology.yml
  layout: dummy-layout.yml
```

The *PinFile* collects the given *topology* and *layout* into one place. Many *targets* can be referenced in a single *PinFile*.

More detail about the PinFile can be found in the *PinFiles* document.

Additional PinFile examples can be found in [the source code](#)

1.2.4 Provisioning (up)

Once a *PinFile*, *topology*, and optional *layout* are in place, provisioning can happen. Performing the command `linchpin up` should provision the *resources* and *inventory* files based upon the *topology_name* value. In this case, is `dummy_cluster`.

```
$ linchpin up
target: dummy_cluster, action: up
Action 'up' on Target 'dummy_cluster' is complete

Target          Run ID  uHash      Exit Code
-----
dummy_cluster   70      0446       0
```

As you can see, the generated inventory file has the right data. This can be used in many ways, which will be covered elsewhere in the documentation.

```
$ cat inventories/dummy_cluster-0446.inventory
[example]
web-0446-0.example.net hostname=web-0446-0.example.net

[all]
web-0446-0.example.net hostname=web-0446-0.example.net
```

To verify resources with the dummy cluster, check `/tmp/dummy.hosts`

```
$ cat /tmp/dummy.hosts
web-0446-0.example.net
test-0446-0.example.net
```

1.2.5 Teardown (destroy)

As expected, LinchPin can also perform *teardown* of *resources*. A teardown action generally expects that resources have been *provisioned*. However, because Ansible is idempotent, `linchpin destroy` will only check to make sure the resources are up. Only if the resources are already up will the teardown happen.

The command `linchpin destroy` will look up the *resources* and/or *topology* files (depending on the provider) to determine the proper *teardown* procedure. The *dummy* Ansible role does not use the resources, only the topology during teardown.

```
$ linchpin destroy
target: dummy_cluster, action: destroy
Action 'destroy' on Target 'dummy_cluster' is complete

Target          Run ID  uHash      Exit Code
-----
dummy_cluster   71     0446       0
```

Verify the `/tmp/dummy.hosts` file to ensure the records have been removed.

```
$ cat /tmp/dummy.hosts
-- EMPTY FILE --
```

Note: The teardown functionality is slightly more limited around ephemeral resources, like networking, storage, etc. It is possible that a network resource could be used with multiple cloud instances. In this way, performing a `linchpin destroy` does not teardown certain resources. This is dependent on each providers implementation.

1.2.6 Authentication

Some *Providers* require authentication to acquire `managing_resources`. LinchPin provides tools for these providers to authenticate. The tools are called credentials.

Credentials

Credentials come in many forms. LinchPin wants to let the user control how the credentials are formatted. In this way, LinchPin supports the standard formatting and options for a provider. The only constraints that exist are how to tell

LinchPin which credentials to use, and where they credentials data resides. In every case, LinchPin tries to use the data similarly to the way the provider might.

Credentials File

An example credentials file may look like this for aws.

```
$ cat aws.key
[default]
aws_access_key_id=ARYA4IS3THE3NO7FACEB
aws_secret_access_key=0Hy3x899u93G3xXRkeZK444MITtfl668Bobbygls

[herlo_aws1_herlo]
aws_access_key_id=JON6SNOW8HAS7A3WOLF8
aws_secret_access_key=Te4cU124FtBELL4blowSx9odd0eFp2Aq30+7tHx9
```

See also:

Providers for provider-specific credentials examples.

To use these credentials, the user must tell LinchPin two things. The first is which credentials to use. The second is where to find the credentials data.

Using Credentials

In the topology, a user can specific credentials. The credentials are described by specifying the file, then the profile. As shown above, the filename is 'aws.key'. The user could pick either profile in that file.

```
---
topology_name: ec2-new
resource_groups:
  - resource_group_name: "aws"
    resource_group_type: "aws"
    resource_definitions:
      - name: demo-day
        flavor: m1.small
        role: aws_ec2
        region: us-east-1
        image: ami-984189e2
        count: 1
    credentials:
      filename: aws.key
      profile: default
```

The important part in the above topology is the *credentials* section. Adding credentials like this will look up, and use the credentials provided.

Credentials Location

By default, credential files are stored in the *default_credentials_path*, which is `~/.config/linchpin`.

Hint: The *default_credentials_path* value uses the interpolated *default_config_path* value, and can be overridden in the *linchpin.conf*.

The credentials path (or `creds_path`) can be overridden in two ways.

It can be passed in when running the `linchpin` command.

```
$ linchpin -vvv --creds-path /dir/to/creds up aws-ec2-new
```

Note: The `aws.key` file could be placed in the `default_credentials_path`. In that case passing `--creds-path` would be redundant.

Or it can be set as an environment variable.

```
$ export CREDSPATH=/dir/to/creds
$ linchpin -v up aws-ec2-new
```

See also:

Commands (CLI) Linchpin Command-Line Interface

Common Workflows Common LinchPin Workflows

Managing Resources Managing Resources

Providers Providers in Detail

1.3 Common Workflows

Having a basic understanding of LinchPin is crucial to this section. Knowing the basic *CLI* operations leads nicely into using LinchPin in powerful ways.

Topics

- *Common Workflows*
 - *Using linchpin fetch*
 - *Fetching a Remote Workspace*
 - * *Additional Options*
 - *Contents of a Workspace*

1.3.1 Using `linchpin fetch`

The `linchpin fetch` command provides a simple way to access a resource from a remote location. One could simply perform a `git clone`, or use `wget` to download a workspace. However, `linchpin fetch` makes this process simpler, and includes some tooling to make the workflow smooth.

```
$ linchpin fetch --help
Usage: linchpin fetch [OPTIONS] REMOTE

Fetches a specified linchpin workspace or component from a remote location

Options:
```

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<code>-t, --type TYPE</code>	Which component of a workspace to fetch. (Default: workspace)
<code>-r, --root ROOT</code>	Use this to specify the location of the workspace within the root url. If root is not set, the root of the given remote will be used.
<code>--dest DEST</code>	Workspaces destination, the fetched workspace will be relative to this location. (Overrides <code>-w/--workspace</code>)
<code>--branch REF</code>	Specify the git branch. Used only with git protocol (eg. master).
<code>--protocol [git http local]</code>	Specify a protocol. (Default: git)
<code>--nocache</code>	Do not check the cached time, just copy the data to the destination
<code>-h, --help</code>	Show this message and exit.

1.3.2 Fetching a Remote Workspace

This document will cover how to use `linchpin fetch` to obtain a workspace from both a git repository. An example for fetching an http workspace can be found [here](#).

First, determine the destination. By default, the destination location is the current working directory. In this guide, we'll use `/tmp/workspaces`.

```
$ mkdir /tmp/workspaces
$ cd /tmp/workspaces
```

Using the simplest possible `linchpin fetch` command will fetch the workspaces from `git://github.com/herlo/lp_test_workspace`.

```
$ linchpin fetch git://github.com/herlo/lp_test_workspace
destination workspace: /tmp/workspaces/

$ pwd
/tmp/workspaces
$ ls -l
total 4
-rw-rw-r-- 1 herlo herlo 980 Sep  5 13:53 linchpin.log
drwxrwxr-x 5 herlo herlo 140 Sep  5 13:54 multi-target
drwxrwxr-x 2 herlo herlo  80 Sep  5 13:54 openstack
drwxrwxr-x 3 herlo herlo 120 Sep  5 13:54 os-server-addl-vols
```

The directory structure of `https://github.com/herlo/lp_test_workspace` should match the local directory as shown above.

As can be easily seen, `linchpin fetch` performed a git clone. Then copied all of the directories to the current directory. `linchpin fetch` assumes the root of the repository is a workspace.

Additional Options

If pulling all workspaces was not the intended action, there are other useful options. First, perform a little clean up.

```
$ cd && rm -rf /tmp/workspaces # remove the workspaces directory
$ ls -l /tmp/workspaces
ls: cannot access '/tmp/workspaces/': No such file or directory
```

Note: From here on in, this guide will use the LinchPin git repository. There are several `workspaces` with useful use cases. Feel free to peruse them as desired. This guide will use these workspaces going forward.

To clone from a repository with multiple workspaces (eg. the linchpin repository), a root must be specified. It is also recommended to use the `--dest` flag.

```
$ linchpin fetch git://github.com/CentOS-PaaS-SIG/linchpin \  
> --root workspaces/simple --dest /tmp/workspaces  
Created destination workspace: /tmp/workspaces/simple
```

In this example, there are additional options. Let's cover them in detail:

--root ROOT This is the root of the repository. Normally, the root of the repository is used. However, if the workspaces reside elsewhere (eg. `workspaces`), use this option.

--dest DESTINATION If the current working directory is not the desired location, use this option.

Performing a listing will show how these options affected the fetch.

```
$ ls -R /tmp/workspaces/  
/tmp/workspaces/:  
simple  
  
/tmp/workspaces/simple:  
PinFile  README.rst
```

As expected, the `simple` root was pulled down, and placed inside the `/tmp/workspaces` directory on the local machine.

To have **all** workspaces copied into `/tmp/workspaces`, a change is needed.

```
$ linchpin fetch git://github.com/CentOS-PaaS-SIG/linchpin \  
> --root workspaces --dest /tmp  
destination workspace: /tmp/workspaces
```

Note: An observant user will notice that the same destination was used. This is because `linchpin fetch` maps the `ROOT` to the destination automatically. This behavior can be adjusted by removing the `--dest` option and specifying `--workspace` instead.

Listing the files again reveals more workspaces.

```
$ ls /tmp/workspaces/  
dummy-aws  dummy-two  os-server-addl-vols  random  simple
```

Take a moment and investigate each of these workspaces.

1.3.3 Contents of a Workspace

Whether a workspace watch created, or pulled using `linchpin fetch`, they all have should some common components.

README.rst A short description of the purpose for (or use case) the workspace

PinFile A declarative file which indicates which resources should be provisioned, any inventory layout to be generated, hooks, and other configurations

Note: The `PinFile` can be in YAML, JSON format. It can also be a script that returns JSON to STDOUT

No other requirements are put on a workspace. However, there can be several other files or directories. See [Managing Resources](#) for more information.

1.4 Configuration File

Topics

- *Configuration File*
 - *Getting the most current configuration*
 - *Environmental Variables*
 - *Command Line Options*
 - *Values by Section*
 - * *General Defaults*
 - *pkg*
 - *default_config_path*
 - *external_providers_path*
 - *source*
 - *pinfile*
 - *module_folder*
 - *rundb_type*
 - *rundb_conn*
 - *rundb_conn_type*
 - *rundb_conn_schema*
 - *rundb_hash*
 - *dateformat*
 - *default_pinfile*
 - * *Extra Vars*
 - *_check_mode*
 - *_async*
 - *async_timeout*
 - *enable_uhash*
 - *generate_resources*
 - *output*
 - *layouts_folder*

- *topologies_folder*
- *roles_folder*
- *inventories_folder*
- *hooks_folder*
- *resources_folder*
- *schemas_folder*
- *playbooks_folder*
- *default_schemas_path*
- *default_topologies_path*
- *default_layouts_path*
- *default_inventories_path*
- *default_resources_path*
- *default_roles_path*
- *schema_v3*
- *schema_v4*
- *default_credentials_path*
- *inventory_path*
- *default_ssh_key_path*
- *libvirt_image_path*
- *libvirt_user*
- *libvirt_become*
- * *Initialization Settings*
 - *source*
 - *pinfile*
- * *Logger Settings*
 - *enable*
 - *file*
 - *format*
 - *dateformat*
 - *level*
 - *format*
 - *level*
- * *Hooks Settings*
 - *preup*
 - *predestroy*

```

    · postup
    · postinv
    · up
    · destroy
    · inv
* File Extensions
    · resource
    · inventory
    · playbooks
* Playbook Settings
    · up
    · destroy
    · down
    · schema_check
    · inv_gen
    · test

```

Below is full coverage of each of the sections of the values available in [linchpin.conf](#).

1.4.1 Getting the most current configuration

If you are installing LinchPin from a package manager (pip or RPM), the latest [linchpin.conf](#) is already included in the library.

An example [linchpin.conf](#) is available on Github.

For in-depth details of all the options, see the [Configuration Reference](#) document.

1.4.2 Environmental Variables

LinchPin allows configuration adjustments via environment variables in some cases. If these environment variables are set, they will take precedence over any settings in the configuration file.

A full listing of available environment variables, see the [Configuration Reference](#) document.

1.4.3 Command Line Options

Some configuration options are also present in the command line. Settings passed via the command line will override those passed through the configuration file and the environment.

The full list of options is covered in the [Commands \(CLI\)](#) document.

1.4.4 Values by Section

The configuration file is broken into sections. Each section controls a specific functionality in LinchPin.

General Defaults

The following settings are in the [DEFAULT] section of the linchpin.conf

Warning: The configurations in this section should NOT be changed unless you know what you are doing.

pkg

This defines the package name. Many components base paths and other information from this setting.

```
pkg = linchpin
```

default_config_path

New in version 1.2.0

Where configuration files might land, such as the workspaces.conf, or credentials. Generally used in combination with other configurations.

```
default_config_path = ~/.config/linchpin
```

external_providers_path

New in version 1.5.0

Developers can provide additional provider playbooks and schemas. This configuration is used to set the path(s) to look for additional providers.

```
external_providers_path = %(default_config_path)s/linchpin-x
```

The following settings are in the [init] section of the linchpin.conf

source

Source path of files provided for the linchpin init command.

```
source = templates/
```

pinfile

Formal name of the PinFile. Can be changed as desired.

```
pinfile = PinFile
```

The following settings are in the [lp] section of the linchpin.conf

module_folder

Load custom ansible modules from this directory

```
module_folder = library
```

rundb_type

New in version 1.2.0

RunDB supports additional drivers, currently the only driver is TinyRunDB, based upon tinydb.

```
rundb_type = TinyRunDB
```

rundb_conn

New in version 1.2.0

The resource path to the RunDB connection. The TinyRunDB version (default) is a file.

Default: `{{ workspace }}/.rundb/rundb.json`

The configuration file has this option commented out. Uncommenting it could enable a system-central rundb, if desired.

```
#rundb_conn = %(default_config_path)s/rundb/rundb-::mac::.json
```

rundb_conn_type

New in version 1.2.0

Set this value if the RunDB resource is anything but a file. This setting is linked to the `rundb_conn` configuration.

```
rundb_conn_type = file
```

rundb_conn_schema

New in version 1.2.0

The schema used to store records in the TinyRunDb. Many other databases will likely not use this value, but must honor the configuration item.

```
rundb_schema = {"action": "",
                "inputs": [],
                "outputs": [],
                "start": "",
                "end": "",
                "rc": 0,
                "uhash": ""}
```

rundb_hash

New in version 1.2.0

Hashing algorithm used to create the uHash.

```
rundb_hash = sha256
```

dateformat

New in version 1.2.0

The dateformat to use when writing out start and end times to the RunDB.

```
dateformat = %%m/%%d/%%Y %%I:%%M:%%S %%p
```

default_pinfile

New in version 1.2.0

The dateformat to use when writing out start and end times to the RunDB.

```
default_pinfile = PinFile
```

Extra Vars

The following settings are in the [evars] section of the linchpin.conf

LinchPin sets several *extra_vars* values, which are passed to the provisioning playbooks.

Note: Default paths in playbooks exist. `lp_path = <src_dir>/linchpin` determined in the `load_config` method of `linchpin.cli.LinchpinCliContext` if either of these change, the value in `linchpin/templates` must also change

__check_mode

Enables the Ansible `check_mode`, or Dry Run functionality. Most provisioners currently DO NOT support this option

```
__check_mode = False
```

__async

LinchPin supports the Ansible `async mode` for certain *Providers*. Setting `async = True` here enables the feature.

```
__async = False
```

async_timeout

Works in conjunction with the *async* setting, defaulting the async wait time to `{{ async_timeout }}` in provider playbooks

```
async_timeout = 1000
```

enable_uhash

In older versions of Linchpin, the *uhash* value was not used. If set to true, the unique-ish hash (*uhash*) will be appended to instances (for providers who support naming) and the *inventory_path*.

```
enable_uhash = False
```

generate_resources

In older versions of linchpin (<v1.0.4), a *resources* folder exists, which dumped the data that is now stored in the RunDB.

```
generate_resources = True
```

output

Deprecated in version 1.2.0 Removed in version 1.5.0

Horribly named variable, no longer used

```
output = True
```

layouts_folder

Used in lookup for a specific *layout* within a workspace. The PinFile specifies the layout without a path, this is the relative location.

Also used in combination with *default_layouts_path* `<conf_def_layout_path>`, which isn't generally used.

```
layouts_folder = layouts
```

topologies_folder

Used in lookup for a specific *topology* within a workspace. The PinFile specifies the topology without a path, this is the relative location.

Also used in combination with *default_topologies_path* `<conf_def_topo_path>`, which isn't generally used.

```
topologies_folder = topologies
```

roles_folder

New in version 1.5.0

Used in combination with *default_roles_path* <*conf_def_roles_path*> for external provider roles

```
roles_folder = roles
```

inventories_folder

Relative location where inventories will be written. Usually combined with the *default_inventories_path*, but could be relative to the workspace.

```
_check_mode = False
```

```
inventories_folder = inventories
```

hooks_folder

Relative location within the workspace where hooks data is stored

```
hooks_folder = hooks
```

resources_folder

Deprecated in version 1.5.0

Relative location of the resources destination path. Generally combined with the *default_resource_path*

```
resources_folder = resources
```

schemas_folder

Deprecated in version 1.2.0

Relative location of the schemas within the LinchPin codebase

```
schemas_folder = schemas
```

playbooks_folder

Relative location of the Ansible playbooks and roles within the LinchPin codebase

```
playbooks_folder = provision
```

default_schemas_path

Deprecated in version 1.5.0

Used to locate default schemas, usually *schema_v4* or *schema_v3*

```
default_schemas_path = {{ lp_path }}/defaults/%(schemas_folder)s
```

default_topologies_path

Deprecated in version 1.2.0

Default location for topologies in cases where *topology* or *topology_file* is not set.

```
default_topologies_path = {{ lp_path }}/defaults/(topologies_folder)s
```

default_layouts_path

Deprecated in version 1.2.0

When inventories are processed, layouts are looked up here if *layout_file* is not set

```
default_layouts_path = {{ lp_path }}/defaults/(layouts_folder)s
```

default_inventories_path

Deprecated in version 1.2.0

When writing out inventories, this path is used if *inventory_file* is not set

```
default_inventories_path = {{ lp_path }}/defaults/(inventories_folder)s
```

default_resources_path

Deprecated in version 1.2.0

When writing out resources files, this path is used if *inventory_file* is not set

```
default_inventories_path = {{ lp_path }}/defaults/(inventories_folder)s
```

default_roles_path

When using an external provider, this path points back to some of the core roles needed in the provider's playbook.

```
default_roles_path = {{ lp_path }}/%(playbooks_folder)s/%(roles_folder)s
```

```
default_roles_path = {{ lp_path }}/%(playbooks_folder)s/%(roles_folder)s
```

schema_v3

Deprecated in v1.5.0

Full path to the location of the `schema_v3.json` file, which is used to perform validation of the topology.

```
_check_mode = False
```

```
schema_v3 = %(default_schemas_path)s/schema_v3.json
```

schema_v4

Deprecated in v1.5.0

Full path to the location of the `schema_v4.json` file, which is used to perform validation of the topology.

```
schema_v4 = %(default_schemas_path)s/schema_v4.json
```

default_credentials_path

If the `--creds-path` option or `$CREDS_PATH` environment variable are not set, use this location to look up credentials files defined in a topology.

```
default_credentials_path = %(default_config_path)s
```

inventory_path

New in version 1.5.0

The `inventory_path` is used to set the value of the resulting inventory file which is generated by LinchPin. This value is dynamically generated by default.

Note: This should not be confused with the `inventory_file` which is an input to the LinchPin ansible playbooks.

```
#inventory_path = {{ workspace }}/{{inventories_folder}}/happy.inventory
```

default_ssh_key_path

New in version 1.2.0

Used solely in the `libvirt provider <prov_libvirt>`. Could be used to set a default location for ssh keys that might be passed via a cloud-config setup.

```
default_ssh_key_path = ~/.ssh
```

libvirt_image_path

Where to store the libvirt images for copying/booting instances. This can be adjusted to a user accessible location if permissions are an issue.

Note: Ensure the *libvirt_user* and *libvirt_become* options below are also adjusted according to proper permissions.

```
libvirt_image_path = /var/lib/libvirt/images/
```

libvirt_user

What user to use to access the libvirt services.

Note: Specifying *root* means that linchpin will attempt to access the libvirt service as the *root* user. If the linchpin user is not root, sudo without password must be setup.

```
libvirt_user = root
```

libvirt_become

When using root or any privileged user, this must be set to yes.

Note: If the linchpin user is not root, sudo without password must also be setup.

```
libvirt_become = yes
```

Initialization Settings

The following settings are in the `[init]` section of the `linchpin.conf`.

These settings specifically pertain to *linchpin init*, which stores templates in the source code to generate a simple example workspace.

source

Location of templates stored in the source code. The structure is built to resemble the directory structure explained in *linchpin init*.

```
source = templates/
```

pinfile

Formal name of the *PinFile*. Can be changed as desired.

```
pinfile = PinFile
```

Logger Settings

The following settings are in the [logger] section of the linchpin.conf.

Note: These settings are ONLY used for the Command Line Interface. The API configures a console output only logger and expects the functionality to be overwritten in subclasses.

enable

Whether logging to a file is enabled

```
enable = True
```

file

Name of the file to write the log. A relative or full path is acceptable.

```
file = linchpin.log
```

format

The format in which logs are written. See <https://docs.python.org/2/library/logging.html#logrecord-attributes> for more detail and available options.

```
format = %(levelname)s %(asctime)s %(message)s
```

dateformat

How to display the date in logs. See <https://docs.python.org/2/library/datetime.html#strftime-strptime-behavior> for more detail and available options.

Note: This action was never implemented.

```
dateformat = %m/%d/%Y %I:%M:%S %p
```

level

Default logging level

```
level = logging.DEBUG
```

The following settings are in the `[console]` section of the `linchpin.conf`.

Each of these settings is for logging output to the console, except for Ansible output.

format

The format in which console output is written. See <https://docs.python.org/2/library/logging.html#logrecord-attributes> for more detail and available options.

```
format = %(message)s
```

level

Default logging level

```
level = logging.INFO
```

Hooks Settings

The following settings are in the `[states]` section of the `linchpin.conf`.

These settings define the state names, which are useful in hooks.

preup

Define the name of the so called *preup* state. This state is set and executed prior to the ‘up’ action being called, but after the PinFile data is loaded.

```
preup = preup
```

predestroy

Define the name of the so called *predestroy* state. This state is set and executed prior to the ‘destroy’ action being called, but after the PinFile data is loaded.

```
predestroy = predestroy
```

postup

Define the name of the so called *postup* state. This state is set and executed after to the ‘up’ action is completed, and after the *postinv* state is executed.

```
postup = postup
```

```
postdestroy = postdestroy ~~
```

Define the name of the so called *postdestroy* state. This state is set and executed after to the ‘destroy’ action is completed.

```
postdestroy = postdestroy
```

postinv

Define the name of the so called *postinv* state. This state is set and executed after to the ‘up’ action is completed, and before the *postup* state is executed. This is eventually going to be the inventory generation hook.

```
postinv = inventory
```

The following settings are in the [hookstates] section of the linchpin.conf.

These settings define the ‘STATES’ each action uses in hooks.

up

For the ‘up’ action, types of hook states are available for execution

```
up = pre,post,inv
```

destroy

For the ‘destroy’ action, types of hook states are available for execution

```
destroy = pre,post
```

inv

New in version 1.2.0

For the inventory generation, which only happens on an ‘up’ state.

Note: The *postinv* state currently doesn’t do anything. In the future, it will provide a way to generate inventories besides the standard Ansible static inventory.

```
inv = post
```

File Extensions

The following settings are in the [extensions] section of the linchpin.conf.

These settings define the file extensions certain files have..

resource

Deprecated in version 1.2.0

Removed in version 1.5.0

When generating resource output files, append this extension

```
resource = .output
```

inventory

When generating Ansible static inventory files, append this extension

```
inventory = .inventory
```

playbooks

New in version 1.5.0

Since playbooks fundamentally changed between v1.2.0 and v1.5.0, this option was added for looking up a provider playbook. It's unlikely this value will change.

```
playbooks = .yaml
```

Playbook Settings

The following settings are in the [playbooks] section of the linchpin.conf.

Note: The entirety of this section is removed in version 1.5.0+. The redesign of the LinchPin API now calls individual playbooks based upon the *resource_group_type* value.

up

Removed in version 1.5.0

Name of the playbook associated with the 'up' (provision) action

```
up = site.yaml
```

destroy

Removed in version 1.5.0

Name of the playbook associated with the 'destroy' (teardown) action

```
destroy = site.yaml
```

down

Removed in version 1.5.0

Name of the playbook associated with the 'down' (halt) action

Note: This action has not been implemented.

```
down = site.yml
```

schema_check

Removed in version 1.5.0

Name of the playbook associated with the 'schema_check' action.

Note: This action was never implemented.

```
schema_check = schemacheck.yml
```

inv_gen

Removed in version 1.5.0

Name of the playbook associated with the 'inv_gen' action.

Note: This action was never implemented.

```
inv_gen = invgen.yml
```

test

Removed in version 1.5.0

Name of the playbook associated with the 'test' action.

Note: This action was never implemented.

```
test = test.yml
```

See also:

User Mailing List [Subscribe and participate](#). A great place for Q&A

LinchPin on Github [Code Contributions and Latest Software](#)

webchat.freenode.net [#linchpin](#) IRC chat channel

LinchPin on PyPi [Latest Release of LinchPin](#)

This document covers the `linchpin` Command Line Interface (CLI) in detail. Each page contains a description and explanation for each component. For an overview, see *Running the linchpin command*.

2.1 linchpin init

Running `linchpin init` will generate the *workspace* directory structure, along with an example *PinFile*, *topology*, and *layout* files. Performing the following tasks will generate a simple dummy PinFile, topology, and layout structure.

```
$ pwd
/tmp/workspace
$ linchpin init
PinFile and file structure created at /tmp/workspace
$ tree
.
├── credentials
├── hooks
├── inventories
├── layouts
│   └── dummy-layout.yml
├── PinFile
├── topologies
│   └── dummy-topology.yml
```

2.2 linchpin up

Once a *PinFile*, *topology*, and optional *layout* are in place, provisioning can happen. Performing the command `linchpin up` should provision the *resources* and *inventory* files based upon the *topology_name* value. In this case, is `dummy_cluster`.

```
$ linchpin up
target: dummy_cluster, action: up
Action 'up' on Target 'dummy_cluster' is complete

Target          Run ID  uHash      Exit Code
-----
dummy_cluster   70      0446       0
```

As you can see, the generated inventory file has the right data. This can be used in many ways, which will be covered elsewhere in the documentation.

```
$ cat inventories/dummy_cluster-0446.inventory
[example]
web-0446-0.example.net hostname=web-0446-0.example.net

[all]
web-0446-0.example.net hostname=web-0446-0.example.net
```

To verify resources with the dummy cluster, check `/tmp/dummy.hosts`

```
$ cat /tmp/dummy.hosts
web-0446-0.example.net
test-0446-0.example.net
```

2.3 linchpin destroy

As expected, LinchPin can also perform *teardown* of *resources*. A teardown action generally expects that resources have been *provisioned*. However, because Ansible is idempotent, `linchpin destroy` will only check to make sure the resources are up. Only if the resources are already up will the teardown happen.

The command `linchpin destroy` will look up the *resources* and/or *topology* files (depending on the provider) to determine the proper *teardown* procedure. The *dummy* Ansible role does not use the resources, only the topology during teardown.

```
$ linchpin destroy
target: dummy_cluster, action: destroy
Action 'destroy' on Target 'dummy_cluster' is complete

Target          Run ID  uHash      Exit Code
-----
dummy_cluster   71      0446       0
```

Verify the `/tmp/dummy.hosts` file to ensure the records have been removed.

```
$ cat /tmp/dummy.hosts
-- EMPTY FILE --
```

Note: The teardown functionality is slightly more limited around ephemeral resources, like networking, storage, etc. It is possible that a network resource could be used with multiple cloud instances. In this way, performing a `linchpin destroy` does not teardown certain resources. This is dependent on each providers implementation.

See also:

Providers

2.4 linchpin journal

Upon completion of any provision (up) or teardown (destroy) task, there's a record that is created and stored in the *RunDB*. The `linchpin journal` command displays data about these tasks.

```
$ linchpin journal --help
Usage: linchpin journal [OPTIONS] TARGETS

Display information stored in Run Database

view:          How the journal is displayed

                'target': show results of transactions on listed targets
                (or all if omitted)

                'tx': show results of each transaction, with results
                of associated targets used

(Default: target)

count:         Number of records to show per target

targets:       Display data for the listed target(s). If omitted, the latest
records for any/all targets in the RunDB will be displayed.

fields:        Comma separated list of fields to show in the display.
(Default: action, uhash, rc)

(available fields are: uhash, rc, start, end, action)

Options:
  --view VIEW      Type of view display (default: target)
  -c, --count COUNT (up to) number of records to return (default: 3)
  -f, --fields FIELDS List the fields to display
  -h, --help       Show this message and exit.
```

There are two specific ways to view the data using the journal, by 'target' and 'transactions (tx)'.

2.4.1 Target

The default view, 'target', is displayed using the target. The data displayed to the screen shows the last three (3) tasks per target, along with some useful information.

```
$ linchpin journal --view=target dummy-new

Target: dummy-new
run_id      action      uhash      rc
-----
5           up          0658       0
4           destroy     cf22       0
3           up          cf22       0
```

Note: The 'target' view is the default, making the `--view` optional.

The target view can show more data as well. Fields (`-f`, `--fields`) and count (`-c`, `--count`) are useful options.

```
$ linchpin journal dummy-new -f action,uhash,end -c 5

Target: dummy-new
run_id    action    uhash    end
-----
6         up       cd00    12/15/2017 05:12:52 PM
5         up       0658    12/15/2017 05:10:52 PM
4         destroy  cf22    12/15/2017 05:10:29 PM
3         up       cf22    12/15/2017 05:10:17 PM
2         destroy  6d82    12/15/2017 05:10:06 PM
1         up       6d82    12/15/2017 05:09:52 PM
```

It is simple to see that the output now has five (5) records, each containing the `run_id`, `action`, `uhash`, and end date.

The data here can be used to perform idempotent (repetitive) tasks, like running the `up` action on `run_id`: 5 again.

```
$ linchpin up dummy-new -r 6
Action 'up' on Target 'dummy-new' is complete

Target          Run ID  uHash  Exit Code
-----
dummy-new              7   cd00      0
```

What might not be immediately obvious, is that the `uhash` on Run ID: 7 is identical to the `run_id`: 6 shown in the previous `linchpin journal` output. Essentially, the same task was run again.

Note: If LinchPin is configured with the unique-hash feature, and the provider supports naming, resources can have unique names. These features are turned off by default.

The `destroy` action will automatically look up the last task with an `up` action and destroy it. If other resources are needed to be destroyed, a `run_id` should be passed to the task.

```
$ linchpin destroy dummy-new -r 5
Action 'destroy' on Target 'dummy-new' is complete

Target          Run ID  uHash  Exit Code
-----
dummy-new              8   0658      0
```

2.4.2 Transactions

The transaction view, provides data based upon each transaction.

```
$ linchpin journal --view tx --count 1

ID: 130          Action: up

Target          Run ID  uHash  Exit Code
-----
dummy-new              279   920c      0
libvirt              121   ef96      0
```

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=====
 In the future, the transaction view will also provide output for these items.

2.5 linchpin fetch

The `linchpin fetch` command provides a simple way to access a resource from a remote location. One could simply perform a *git clone*, or use *wget* to download a workspace. However, `linchpin fetch` makes this process simpler, and includes some tooling to make the workflow smooth.

```
$ linchpin fetch --help
Usage: linchpin fetch [OPTIONS] REMOTE

Fetches a specified linchpin workspace or component from a remote location

Options:
  -t, --type TYPE           Which component of a workspace to fetch.
                           (Default: workspace)
  -r, --root ROOT          Use this to specify the location of the
                           workspace within the root url. If root is not
                           set, the root of the given remote will be used.
  --dest DEST              Workspaces destination, the fetched workspace
                           will be relative to this location. (Overrides
                           -w/--workspace)
  --branch REF             Specify the git branch. Used only with git
                           protocol (eg. master).
  --protocol [git|http|local] Specify a protocol. (Default: git)
  --nocache                Do not check the cached time, just copy the
                           data to the destination
  -h, --help               Show this message and exit.
```

2.6 linchpin validate

The purpose of the `validate` command is to determine whether topologies are syntactically valid and, if not, provide a list of errors that occurred during validation

2.6.1 Using the validate command

The command `linchpin validate` looks at the topology file for each target in a given PinFile. If the topology is not valid under the current schema, it will attempt to convert the topology to an older schema and try again. If the topology is still invalid, the command will report the topology and a list of errors found.

Invalid Topologies

Here is a simple PinFile and topology file. The topology file has some errors and will not validate.

```

---
libvirt-new:
  topology: libvirt-new.yml
  layout: libvirt.yml

libvirt:
  topology: libvirt.yml
  layout: libvirt.yml

libvirt-network:
  topology: libvirt-network.yml

```

```

---
topology_name: libvirt-new
resource_groups:
  - resource_group_name: libvirt-new
    resource_group_type: libvirt
    resource_definitions:
      - role: libvirt_node
        uri: qemu:///system
        count: "1"
        image_src: http://cloud.centos.org/centos/7/images/CentOS-7-x86_64-
↳GenericCloud-1608.qcow2.xz
        memory: 2048
        vcpus: 1
        arch: x86_64
        ssh_key: libvirt
        networks:
          - name: default
            additional_storage: 10G
        cloud_config:
          users:
            - name: herlo
              gecost: Clint Savage
              groups: wheel
              sudo: ALL=(ALL) NOPASSWD:ALL
              ssh-import-id: gh:herlo
              lock_passwd: true

```

```

$ lynchpin validate
topology for target 'libvirt-network' is valid

Topology for target 'libvirt-new' does not validate
topology: 'OrderedDict([('topology_name', 'libvirt-new'), ('resource_groups',
↳[OrderedDict([('resource_group_name', 'libvirt-new'), ('resource_group_type',
↳'libvirt'), ('resource_definitions', [OrderedDict([('role', 'libvirt_node'), ('uri',
↳'qemu:///system'), ('image_src', 'http://cloud.centos.org/centos/7/images/CentOS-7-
↳x86_64-GenericCloud-1608.qcow2.xz'), ('memory', 2048), ('vcpus', '1'), ('arch',
↳'x86_64'), ('ssh_key', 'libvirt'), ('networks', [OrderedDict([('name', 'default'), (
↳'hello', 'world')]))]), ('additional_storage', '10G'), ('cloud_config',
↳OrderedDict([('users', [OrderedDict([('name', 'herlo'), ('gecost', 'Clint Savage'), (
↳'groups', 'wheel'), ('sudo', 'ALL=(ALL) NOPASSWD:ALL'), ('ssh-import-id', 'gh:herlo
↳'), ('lock_passwd', True)]))]))]), ('count', 1)])))]))'
errors:
  res_defs[0][count]: value for field 'count' must be of type 'integer'
  res_defs[0][networks][0][additional_storage]: field 'additional_storage' could
↳not be recognized within the schema provided

```

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```

    res_defs[0][name]: field 'name' is required

topology for target 'libvirt' is valid under old schema
topology for target 'libvirt-network' is valid

```

The `linchpin validate` command can also provide a list of errors against the old schema with the `--old-schema` flag

```

$ linchpin validate --old-schema

Topology for target 'libvirt-new' does not validate
topology: 'OrderedDict([('topology_name', 'libvirt-new'), ('resource_groups',
↳[OrderedDict([('resource_group_name', 'libvirt-new'), ('resource_group_type',
↳'libvirt'), ('resource_definitions', [OrderedDict([('role', 'libvirt_node'), ('uri',
↳'qemu:///system'), ('image_src', 'http://cloud.centos.org/centos/7/images/CentOS-7-
↳x86_64-GenericCloud-1608.qcow2.xz'), ('memory', 2048), ('vcpus', '1'), ('arch',
↳'x86_64'), ('ssh_key', 'libvirt'), ('networks', [OrderedDict([('name', 'default'), (
↳'hello', 'world')]))]), ('additional_storage', '10G'), ('cloud_config',
↳OrderedDict([('users', [OrderedDict([('name', 'herlo'), ('gecos', 'Clint Savage'), (
↳'groups', 'wheel'), ('sudo', 'ALL=(ALL) NOPASSWD:ALL'), ('ssh-import-id', 'gh:herlo
↳'), ('lock_passwd', True)]]))]), ('count', 1)]]))])'
errors:
    res_defs[0][networks][0][additional_storage]: field 'additional_storage' could
↳not be recognized within the schema provided
    res_defs[0][name]: field 'name' is required

topology for target 'libvirt' is valid under old schema
topology for target 'libvirt-network' is valid

```

As you can see, validation under both schemas result in an error stating that the field `additional_storage` could not be recognized. In this case, there is simply an indentation error. `additional_storage` is a recognized field within `resource_definitions` but not within the `networks` sub-schema. Other times this unrecognized field may be a spelling error. Both fields also flag the missing “name” field, which is required. Both of these errors must be fixed in order for the topology file to validate. Because making `count` a string only results in an error when validating against the old schema, this field does not have to be changed in order for the topology file to pass validation. However, it is best to change it anyway and keep your topology as up-to-date as possible.

Valid Topologies

The topology below has been fixed so that it will validate under the current schema.

```

---
topology_name: libvirt-new
resource_groups:
  - resource_group_name: libvirt-new
    resource_group_type: libvirt
    resource_definitions:
      - role: libvirt_node
        name: centos71
        uri: qemu:///system
        count: 1
        image_src: http://cloud.centos.org/centos/7/images/CentOS-7-x86_64-
↳GenericCloud-1608.qcow2.xz
        memory: 2048
        vcpus: 1
        arch: x86_64

```

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```
ssh_key: libvirt
networks:
  - name: default
additional_storage: 10G
cloud_config:
  users:
    - name: herlo
      geccos: Clint Savage
      groups: wheel
      sudo: ALL=(ALL) NOPASSWD:ALL
      ssh-import-id: gh:herlo
      lock_passwd: true
```

If *linchpin validate* is run on the PinFile above, this will be the output:

```
$ linchpin validate
topology for target 'libvirt-new' is valid
topology for target 'libvirt' is valid under old schema
topology for target 'libvirt-network' is valid
```

Managing Resources

Resources in LinchPin generally consist of Virtual Machines, Containers, Networks, Security Groups, Instances, and much more. Detailed below are examples of topologies, layouts, and PinFiles used to manage resources.

3.1 PinFiles

These PinFiles represent many combinations of complexity and providers.

PinFiles are processed top to bottom.

3.1.1 YAML

PinFiles written using YAML format:

- PinFile.dummy.yml
- PinFile.openstack.yml
- PinFile.complex.yml

The combined format is only available in v1.5.0+

- PinFile.combined.yml

3.1.2 JSON

New in version 1.5.0

PinFiles written using JSON format.

- PinFile.dummy.json
- PinFile.aws.json
- PinFile.duffy.json

- PinFile.combined.json
- PinFile.complex.json

3.1.3 Jinja2

New in version 1.5.0

These PinFiles are examples of what can be done with templating using Jinja2.

Beaker Template

This template would be processed with a dictionary containing a key named *arches*.

- PinFile.beaker.template

```
$ linchpin -p PinFile.beaker.template \  
  --template-data '{ "arches": [ "x86_64", "ppc64le", "s390x" ]}' up
```

Libvirt Template and Data

This template and data can be processed together.

- PinFile.libvirt-mi.template
- Data.libvirt-mi.yml

```
$ linchpin -vp PinFile.libvirt-mi.template \  
  --template-data Data.libvirt-mi.yml up
```

3.1.4 Scripts

New in version 1.5.0

Scripts that generate valid JSON output to STDOUT can be processed and used.

- generate_dummy.sh

```
$ linchpin -vp ./scripts/generate_dummy.sh up
```

3.1.5 Output PinFile

New in version 1.5.0

An output file can be created on an up/destroy action. Simply pass the `--output-pinfile` option with a path to a writable file location.

```
$ linchpin --output-pinfile /tmp/Pinfile.out -vp ./scripts/generate_dummy.sh up  
..snip..  
$ cat /tmp/Pinfile.out  
{  
  "dummy": {  
    "layout": {
```

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```

    "inventory_layout": {
      "hosts": {
        "example-node": {
          "count": 3,
          "host_groups": [
            "example"
          ]
        }
      },
      "vars": {
        "hostname": "__IP__"
      }
    },
    "topology": {
      "topology_name": "dummy_cluster",
      "resource_groups": [
        {
          "resource_group_name": "dummy",
          "resource_definitions": [
            {
              "count": 3,
              "type": "dummy_node",
              "name": "web"
            },
            {
              "count": 1,
              "type": "dummy_node",
              "name": "test"
            }
          ]
        },
        "resource_group_type": "dummy"
      ]
    }
  }
}

```

3.2 Topologies

These topologies represent many combinations of complexity and providers. Topologies process *resource_definitions* top to bottom according to the file.

Topologies have evolved a little and have a slightly different format between versions. However, older versions still work on v1.5.0+ (until otherwise noted).

The difference is quite minor, except in two providers, beaker and openshift.

3.2.1 Topology Format Pre v1.5.0

```

---
topology_name: "dummy_cluster" # topology name
resource_groups:

```

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```
- resource_group_name: "dummy"
  resource_group_type: "dummy"
  resource_definitions:
    - name: "web"
      type: "dummy_node" <-- this is called 'type`
      count: 1
```

3.2.2 v1.5.0+ Topology Format

```
---
topology_name: "dummy_cluster" # topology name
resource_groups:
  - resource_group_name: "dummy"
    resource_group_type: "dummy"
    resource_definitions:
      - name: "web"
        role: "dummy_node" <-- this is called 'role`
        count: 1
```

The subtle difference is in the *resource_definitions* section. In the pre-v1.5.0 topology, the key was *type*, in v1.5.0+, the key is *role*.

Note: Pay attention to the callout in the code blocks above.

For details about the differences in beaker and openshift, see `../topology_incompatibilities`.

3.2.3 YAML

New in version 1.5.0

Topologies written using YAML format:

- `os-server-new.yml`
- `libvirt-new.yml`
- `bkr-new.yml`

Older topologies, supported in v1.5.0+

- `os-server.yml`
- `libvirt.yml`
- `bkr.yml`

3.2.4 JSON

New in version 1.5.0

Topologies can be written using JSON format.

- `dummy.json`

3.2.5 Jinja2

New in version 1.5.0

Topologies can be processed as templates using Jinja2.

Jenkins-Slave Template

This topology template would be processed with a dictionary containing one key named *arch*.

- `jenkins-slave.j2`

The `PinFile.jenkins.yml` contains the reference to the *jenkins-slave* topology.

```
jenkins-slave:
  topology: jenkins-slave.yml
  layout: jenkins-slave.yml
```

See also:

`Pinfile.jenkins.j2`

```
$ linchpin -p PinFile.jenkins --template-data '{ "arch": "x86_64" }' up
```

3.3 Layouts

Inventory Layouts (or just *layout*) describe what an Ansible inventory might look like after provisioning. A layout is needed because information about the resources provisioned are unknown in advance.

Layouts, like topologies and PinFiles are processed top to bottom according to the file.

3.3.1 YAML

Layouts written using YAML format:

- `aws-ec2.yml`
- `dummy-new.yml`

3.3.2 JSON

New in version 1.5.0

Layouts can be written using JSON format.

- `gcloud.json`

3.3.3 Jinja2

New in version 1.5.0

Topologies can be processed as templates using Jinja2.

Dummy Template

This layout template would be processed with a dictionary containing one key named *node_count*.

- `dummy.json`

The `PinFile.dummy.json` contains the reference to the *dummy.json* layout.

```
{
  "dummy": {
    "topology": "dummy.json",
    "layout": "dummy.json"
  }
}
```

See also:

`PinFile.dummy.json`

```
$ linchpin -p PinFile.dummy.json --template-data '{ "node_count": 2 }' up
```

Advanced layout examples can be found by reading `ra_inventory_layouts`.

See also:

Providers

LinchPin has many default providers. This choose-your-own-adventure page takes you through the basics to ensure success for each.

4.1 Openstack

The openstack provider manages multiple types of resources.

4.1.1 os_server

Openstack instances can be provisioned using this resource.

- [Topology Example](#)
- [Ansible module](#)

Note: Currently, the ansible module used is bundled with LinchPin. However, the variables used are identical to the Ansible `os_server` module, except for adding a `count` option.

Topology Schema

Within Linchpin, the `os_server` resource_definition has more options than what are shown in the examples above. For each `os_server` definition, the following options are available.

Parameter	required	type	ansible value	comments
name	true	string	name	
flavor	true	string	flavor	
image	true	string	image	
region	false	string	region	
count	false	integer	count	
keypair	false	string	key_name	
security_groups	false	string	security_groups	
fip_pool	false	string	floating_ip_pools	
nics	false	string	networks	
userdata	false	string	userdata	
volumes	false	list	volumes	
boot_from_volume	false	string	boot_from_volume	
terminate_volume	false	string	terminate_volume	
volume_size	false	string	volume_size	
boot_volume	false	string	boot_volume	

4.1.2 os_obj

Openstack Object Storage can be provisioned using this resource.

- [Topology Example](#)
- [Ansible module](#)

4.1.3 os_vol

Openstack Cinder Volumes can be provisioned using this resource.

- [Topology Example](#)
- [Ansible module](#)

4.1.4 os_sg

Openstack Security Groups can be provisioned using this resource.

- [Topology Example](#)
- [Ansible Security Group module](#)
- [Ansible Security Group Rule module](#)

4.1.5 Additional Dependencies

No additional dependencies are required for the Openstack Provider.

4.1.6 Credentials Management

Openstack provides several ways to provide credentials. LinchPin supports some of these methods for passing credentials for use with openstack resources.

LinchPin honors the openstack environment variables such as `$OS_USERNAME`, `$OS_PROJECT_NAME`, etc.

See [the openstack documentation cli documentation](#) for details.

Note: No credentials files are needed for this method. When LinchPin calls the openstack provider, the environment variables are automatically picked up by the openstack Ansible modules, and passed to openstack for authentication.

Openstack provides a simple file structure using a file called `clouds.yaml`, to provide authentication to a particular tenant. A single `clouds.yaml` file might contain several entries.

```
clouds:
  devstack:
    auth:
      auth_url: http://192.168.122.10:35357/
      project_name: demo
      username: demo
      password: Openstack
      region_name: RegionOne
  trystack:
    auth:
      auth_url: http://auth.trystack.com:8080/
      project_name: trystack
      username: herlo-trystack-3855e889
      password: thepasswordissecrte
```

Using this mechanism requires that credentials data be passed into LinchPin.

An openstack topology can have a `credentials` section for each `resource_group`, which requires the filename, and the profile name.

```
---
topology_name: topo
resource_groups:
  - resource_group_name: openstack
    resource_group_type: openstack
    resource_definitions:
      .. snip ..

  credentials:
    filename: clouds.yaml
    profile: devstack
```

Provisioning with credentials uses the `--creds-path` option. Assuming the `clouds.yaml` file was placed in `~/.config/openstack`, and the topology described above, a provision task could occur.

```
$ linchpin -v --creds-path ~/.config/openstack up
```

Note: The `clouds.yaml` could be placed in the `default_credentials_path`. In that case passing `--creds-path` would be redundant.

Alternatively, the credentials path can be set as an environment variable,

```
$ export CRED_PATH="/path/to/credential_dir/"
$ linchpin -v up
```

4.2 Libvirt

The libvirt provider manages two types of resources.

4.2.1 libvirt_node

Libvirt Domains (or nodes) can be provisioned using this resource.

- [Topology Example](#)
- [Ansible module](#)

Topology Schema

Within Linchpin, the `libvirt_node` resource_definition has more options than what are shown in the examples above. For each `libvirt_node` definition, the following options are available.

Parameter	req'd	type	where used	default	comments
role	true	string	role		
name	true	string	module: name		
vcpus	true	string	xml: vcpus		
memory	true	string	xml: memory	1024	
driver	false	string	xml: driver (kvm, qemu)	kvm	
arch	false	string	xml: arch	x86_64	
boot_dev	false	string	xml: boot_dev	hd	
networks	false	list	xml: networks <ul style="list-style-type: none"> • name (req) • ip • mac 		Assigns the domain to a network by name. Each device is named with an incremented value (eth0) Note: Network must exist
image_src	false	string	virt-install		
network_bridge	false	string	virt-install	virbr0	
ssh_key	false	string	role	resource_group_name	
remote_user	false	string	role	ansible_user_id	
cloud_config	false	list	role		http://cloudinit.readthedocs.io is used here
additional_storage	false	string	role	1G	
uri	false	string	module: uri	qemu:///system	
count	false	string	N/A		

4.2.2 libvirt_network

Libvirt networks can be provisioned. If a `libvirt_network` is to be used with a `libvirt_node`, it must precede it.

- [Topology Example](#)
- [Ansible module](#)

Topology Schema

Within Linchpin, the `libvirt_network` resource_definition has more options than what are shown in the examples above. For each `libvirt_network` definition, the following options are available.

Parameter	req'd	type	where used	default	comments
role	true	string	role		
name	true	string	module: name		
uri	false	string	module: name	qemu:///system	
ip	true	string	xml: ip		
dhcp_start	false	string	xml: dhcp_start		
dhcp_end	false	string	xml: dhcp_end		
domain	false	string	xml: domain		Automated DNS for guests
forward_mode	false	string	xml: forward	nat	
forward_dev	false	string	xml: forward		
bridge	false	string	xml: bridge		

Note: This resource will not be torn down during a `destroy` action. This is because other resources may depend on the now existing resource.

4.2.3 Additional Dependencies

The `libvirt` resource group requires several additional dependencies. The following must be installed.

- `libvirt-devel`
- `libguestfs-tools`
- `python-libguestfs`
- `libvirt-python`
- `python-lxml`

For a Fedora 26 machine, the dependencies would be installed using `dnf`.

```
$ sudo dnf install libvirt-devel libguestfs-tools python-libguestfs
$ pip install linchpin[libvirt]
```

Additionally, because `libvirt` downloads images, certain SELinux libraries must exist.

- `libselinux-python`

For a Fedora 26 machine, the dependencies would be installed using `dnf`.

```
$ sudo dnf install libselinux-python
```

If using a python virtual environment, the `selinux` libraries must be symlinked. Assuming a virtualenv of `~/venv`, symlink the libraries.

```
$ export LIBSELINUX_PATH=/usr/lib64/python2.7/site-packages
$ ln -s ${LIBSELINUX_PATH}/selinux ~/venv/lib/python2.7/site-packages
$ ln -s ${LIBSELINUX_PATH}/_selinux.so ~/venv/lib/python2.7/site-packages
```

4.2.4 Copying Images

New in version 1.5.1

By default, LinchPin manages the libvirt images in a directory that is accessible only by the root user. However, adjustments can be made to allow an unprivileged user to manage Libvirt via LinchPin. These settings can be modified in the `linchpin.conf`

This configuration adjustment of `linchpin.conf` may work for the unprivileged user `herlo`.

```
[evars]
libvirt_image_path = ~/libvirt/images/
libvirt_user = herlo
libvirt_become = no
```

The directory will be created automatically by LinchPin. However, the user may need additional rights, like group membership to access Libvirt. Please see <https://libvirt.org> for any additional configurations.

4.2.5 Credentials Management

Libvirt doesn't require credentials via LinchPin. Multiple options are available for authenticating against a Libvirt daemon (`libvirtd`). Most methods are detailed [here](#). If desired, the uri for the resource can be set using one of these mechanisms.

4.3 Amazon Web Services

The Amazon Web Services (AWS) provider manages multiple types of resources.

4.3.1 `aws_ec2`

AWS Instances can be provisioned using this resource.

- [Topology Example](#)
- [Topology Example w/ VPC](#)
- `aws_ec2` module

Topology Schema

Within Linchpin, the `aws_ec2` resource_definition has more options than what are shown in the examples above. For each `aws_ec2` definition, the following options are available.

Parameter	required	type	ansible value	comments
role	true	string	N/A	
name	true	string	instance_tags	name is set as an instance_tag value.
flavor	true	string	instance_type	
image	true	string	image	
region	false	string	region	
count	false	integer	count	
keypair	false	string	key_name	
security_group	false	string / list	group	
vpc_subnet_id	false	string	vpc_subnet_id	
assign_public_ip	false	string	assign_public_ip	

EC2 Inventory Generation

If an instance has a public IP attached, its hostname in public DNS, if available, will be provided in the generated Ansible inventory file, and if not the public IP address will be provided.

For instances which have a private IP address for VPC usage, the private IP address will be provided since private EC2 DNS hostnames (e.g. **ip-10-0-0-1.ec2.internal**) will not typically be resolvable outside of AWS.

For instances with both a public and private IP address, the public address is always provided instead of the private address, so as to avoid duplicate runs of Ansible on the same host via the generated inventory file.

4.3.2 aws_ec2_key

AWS SSH keys can be added using this resource.

- [Topology Example](#)
- [ec2_key module](#)

Note: This resource will not be torn down during a *destroy* action. This is because other resources may depend on the now existing resource.

4.3.3 aws_s3

AWS Simple Storage Service buckets can be provisioned using this resource.

- [Topology Example](#)
- [aws_s3 module](#)

Note: This resource will not be torn down during a *destroy* action. This is because other resources may depend on the now existing resource.

4.3.4 aws_sg

AWS Security Groups can be provisioned using this resource.

- [Topology Example](#)

- `ec2_group` module

Note: This resource will not be torn down during a *destroy* action. This is because other resources may depend on the now existing resource.

4.3.5 Additional Dependencies

No additional dependencies are required for the AWS Provider.

4.3.6 Credentials Management

AWS provides several ways to provide credentials. LinchPin supports some of these methods for passing credentials for use with AWS resources.

One method to provide AWS credentials that can be loaded by LinchPin is to use the INI format that the *AWS CLI* tool uses.

Credentials File

An example credentials file may look like this for aws.

```
$ cat aws.key
[default]
aws_access_key_id=ARYA4IS3THE3NO7FACEB
aws_secret_access_key=0Hy3x899u93G3xXRkeZK444MITtfl668Bobbygls

[herlo_aws1_herlo]
aws_access_key_id=JON6SNOW8HAS7A3WOLF8
aws_secret_access_key=Te4cU124FtBELL4blowSx9odd0eFp2Aq30+7tHx9
```

See also:

Providers for provider-specific credentials examples.

To use these credentials, the user must tell LinchPin two things. The first is which credentials to use. The second is where to find the credentials data.

Using Credentials

In the topology, a user can specify credentials. The credentials are described by specifying the file, then the profile. As shown above, the filename is 'aws.key'. The user could pick either profile in that file.

```
---
topology_name: ec2-new
resource_groups:
  - resource_group_name: "aws"
    resource_group_type: "aws"
    resource_definitions:
      - name: demo-day
        flavor: m1.small
        role: aws_ec2
        region: us-east-1
```

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```
image: ami-984189e2
count: 1
credentials:
  filename: aws.key
  profile: default
```

The important part in the above topology is the *credentials* section. Adding credentials like this will look up, and use the credentials provided.

Credentials Location

By default, credential files are stored in the *default_credentials_path*, which is `~/.config/linchpin`.

Hint: The *default_credentials_path* value uses the interpolated *default_config_path* value, and can be overridden in the *linchpin.conf*.

The credentials path (or *creds_path*) can be overridden in two ways.

It can be passed in when running the *linchpin* command.

```
$ linchpin -vvv --creds-path /dir/to/creds up aws-ec2-new
```

Note: The *aws.key* file could be placed in the *default_credentials_path*. In that case passing `--creds-path` would be redundant.

Or it can be set as an environment variable.

```
$ export CREDS_PATH=/dir/to/creds
$ linchpin -v up aws-ec2-new
```

Environment Variables

LinchPin honors the AWS environment variables

Provisioning

Provisioning with credentials uses the `--creds-path` option.

```
$ linchpin -v --creds-path ~/.config/aws up
```

Alternatively, the credentials path can be set as an environment variable,

```
$ export CREDS_PATH=~/.config/aws"
$ linchpin -v up
```

4.4 Google Cloud Platform

The Google Cloud Platform (gcloud) provider manages one resource, *gcloud_gce*.

4.4.1 gcloud_gce

Google Compute Engine (gce) instances are provisioned using this resource.

- [Topology Example](#)
- [Ansible module](#)

4.4.2 Additional Dependencies

No additional dependencies are required for the Google Cloud (gcloud) Provider.

4.4.3 Credentials Management

Google Compute Engine provides several ways to provide credentials. LinchPin supports some of these methods for passing credentials for use with openstack resources.

Environment Variables

LinchPin honors the gcloud environment variables.

Configuration Files

Google Cloud Platform provides tooling for authentication. See <https://cloud.google.com/appengine/docs/standard/python/oauth/> for options.

4.5 Beaker

The Beaker (bkr) provider manages a single resource, `bkr_server`.

4.5.1 bkr_server

Beaker instances are provisioned using this resource.

- [Topology Example](#)

The ansible modules for beaker are written and bundled as part of LinchPin.

- `bkr_server.py`
- `bkr_info.py`

Topology Schema

Within Linchpin, the `bkr_server` resource_definition has more options than what are shown in the examples above. For each `bkr_server` role definition, the following options are available.

Parameter	required	type	ansible value	default
role	true	string	N/A	
whiteboard	false	string	whiteboard	Provisioned by LinchPin
job_group	false	string	job_group	
cancel_message	false	string	cancel_message	
max_attempts	false	string	max_attempts	
attempt_wait_time	false	integer	attempt_wait_time	
recipeseets	false	string	recipeseets	see table below

recipeseets

Because recipeseets is how beaker requests systems, it's a large part of what the topology schema includes. There are several ways to request systems. This table describes the available recipeseets options.

Parameter	required	type	sub-field layout options		
distro	false	string	N/A		
family	false	string	N/A		
tags	false	list	list of strings		
name	false	string	N/A		
arch	false	string	N/A		
variant	false	string	N/A		
bkr_data	false	string	N/A		
method	false	string	N/A		
count	false	string	N/A		
ids	false	list	N/A		
taskparam	false	list	list of strings		
keyvalue	false	list	list of strings		
hostrequires	false	list	param	required	type
			tag	true	string
			op	false	string
			value	false	int / string
			type	false	string
		dict	force	false	string
		dict	rawxml	false	string
reserve_duration	false	int	N/A		
repos	false	list	dict baseurl		
install	false	list	list of strings		

4.5.2 Additional Dependencies

The beaker resource group requires several additional dependencies. The following must be installed.

- beaker-client>=23.3

It is also recommended to install the python bindings for kerberos.

- python-krbV

For a Fedora 26 machine, the dependencies could be installed using dnf.

```
$ sudo dnf install python-krbV
$ wget https://beaker-project.org/yum/beaker-server-Fedora.repo
$ sudo mv beaker-server-Fedora.repo /etc/yum.repos.d/
$ sudo dnf install beaker-client
```

Alternatively, with pip, possibly within a virtual environment.

```
$ pip install linchpin[beaker]
```

4.5.3 Credentials Management

Beaker provides several ways to authenticate. LinchPin supports these methods.

- Kerberos
- OAuth2

Note: LinchPin doesn't support the username/password authentication mechanism. It's also not recommended by the Beaker Project, except for initial setup.

4.6 Duffy

Duffy is a tool for managing pre-provisioned systems in CentOS' CI environment. The Duffy provider manages a single resource, `duffy_node`.

4.6.1 duffy_node

The `duffy_node` resource provides the ability to provision using the `duffy api`.

- [Topology Example](#)

The ansible module for duffy exists in its own [repository](#).

4.6.2 Using Duffy

Duffy can only be run within the CentOS CI environment. To get access, follow [this guide](#). Once access is granted, the duffy ansible module can be used.

4.6.3 Additional Dependencies

Duffy doesn't require any additional dependencies, but does need to be included in the Ansible library path to work properly. See the [ansible documentation](#) for help adding a library path.

4.6.4 Credentials Management

Duffy uses a single file, generally found in the user's home directory, to provide credentials. It contains a single line, which has the API key which is passed to duffy via the API.

For LinchPin to provision, `duffy.key` must exist.

A `duffy` topology can have a `credentials` section for each `resource_group`, which requires a filename.

```

---
topology_name: topo
resource_groups:
  - resource_group_name: duffy
    resource_group_type: duffy
    resource_definitions:

      .. snip ..

    credentials: duffy.key

```

By default, the location searched for the `duffy.key` is the user's home directory, as stated above. However, the `credentials` path can be set using `--creds-path` option. Assuming the `duffy.key` file was placed in `~/.config/duffy`, using the topology described above, a provisioning task could occur.

```
$ linchpin -v --creds-path ~/.config/duffy up
```

Alternatively, the `credentials` path can be set as an environment variable,

```
$ export CREDS_PATH=~/.config/duffy"
$ linchpin -v up
```

4.7 oVirt

The `ovirt` provider manages a single resource, `ovirt_vms`.

4.7.1 ovirt_vms

`oVirt` Domains/VMs can be provisioned using this resource.

- [Topology Example](#)
- [Ansible module](#)

4.7.2 Additional Dependencies

There are no known additional dependencies for using the `oVirt` provider for LinchPin.

4.7.3 Credentials Management

An `oVirt` topology can have a `credentials` section for each `resource_group`, which requires the filename, and the profile name.

Consider the following file, named `ovirt_creds.yml`.

```

clouds:
  ge2:
    auth:
      ovirt_url: http://192.168.122.10/

```

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```
ovirt_username: demo
ovirt_password: demo
```

An oVirt topology can have a `credentials` section for each `resource_group`, which requires the filename and profile name.

```
---
topology_name: topo
resource_groups:
  - resource_group_name: ovirt
    resource_group_type: ovirt
    resource_definitions:

      .. snip ..

    credentials:
      filename: ovirt_creds.yml
      profile: ge2
```

Provisioning

Provisioning with credentials uses the `--creds-path` option. Assuming the credentials file was placed in `~/config/ovirt`, and the topology described above, a provision task could occur.

```
$ linchpin -v --creds-path ~/config/ovirt up
```

Alternatively, the credentials path can be set as an environment variable,

```
$ export CREDSPATH=~/.config/ovirt
$ linchpin -v up
```

4.8 Openshift

The openshift provider manages two resources, `openshift_inline`, and `openshift_external`.

4.8.1 openshift_inline

Openshift instances can be provisioned using this resource. Resources are detail inline.

- [Topology Example](#)

The ansible module for openshift is written and bundled as part of LinchPin.

- [openshift.py](#)

Note: The `'oc <https://docs.ansible.com/ansible/2.4/oc_module.html<_ module was included into ansible after the above openshift module was created and included with LinchPin. The future may see the oc module used.`

4.8.2 openshift_external

Openshift instances can be provisioned using this resource. Resources are detail in an external file.

4.8.3 Additional Dependencies

There are no known additional dependencies for using the openshift provider for LinchPin.

4.8.4 Credentials Management

An openshift topology can have a `credentials` section for each `resource_group`, which requires the `api_endpoint`, and the `api_token` values.

```
---
topology_name: topo
resource_groups:
  - resource_group_name: openshift
    resource_group_type: openshift
    resource_definitions:
      - name: openshift
        role: openshift_inline
        data:

      .. snip ..

credentials:
  api_endpoint: example.com:8443/
  api_token: mytokentextrighthere
```

General Configuration

Managing LinchPin requires a few configuration files. Most configurations are stored in the [linchpin configuration file](#).

Note: in versions before 1.5.1, the file was called `linchpin.conf`. This changed in 1.5.1 due to backward compatibility requirements, and the need to load configuration defaults. The `linchpin.conf` continues to work as expected.

The settings in this file are loaded automatically as defaults.

However, it's possible to override any setting in `linchpin`. For the command line shell, three different locations are checked for `linchpin.conf` files. Files are checked in the following order:

1. `/etc/linchpin.conf`
2. `~/.config/linchpin/linchpin.conf`
3. `/path/to/workspace/linchpin.conf`

The LinchPin configuration parser supports overriding and extending configurations. If `linchpin` finds the same section and setting in more than one file, the header that was parsed more recently will provide the configuration. In this way user can override default configurations. Commonly, this is done by placing a *linchpin.conf* in the root of the *workspace*.

5.1 Adding/Overriding a Section

New in version 1.2.0

Adding a section to the configuration is simple. The best approach is to create a `linchpin.conf` in the appropriate location from the locations above.

Once created, add a section. The section can be a new section, or it can overwrite an existing section.

```
[lp]
# move the rundb_connection to a global scope
rundb_conn = %(default_config_path)s/rundb/rundb-::mac::.json

module_folder = library
rundb_conn = ~/.config/linchpin/rundb-::mac::.json

rundb_type = TinyRunDB
rundb_conn_type = file
rundb_schema = {"action": "",
                "inputs": [],
                "outputs": [],
                "start": "",
                "end": "",
                "rc": 0,
                "uhash": ""}
rundb_hash = sha256

dateformat = %%m/%%d/%%Y %%I:%%M:%%S %%p
default_pinfile = PinFile
```

Warning: For version 1.5.0 and earlier, if overwriting a section, all entries from the entire section must be updated.

5.2 Overriding a configuration item

New in version 1.5.1

Each item within a section can be a new setting, or override a default setting, as shown.

```
[lp]
# move the rundb_connection to a global scope
rundb_conn = ~/.config/linchpin/rundb-::mac::.json
```

As can be plainly seen, the configuration has been updated to use a different path to the `rundb_conn`. This section now uses a user-based RunDB, which can be useful in some scenarios.

5.3 Useful Configuration Options

These are some configuration options that may be useful to adjust for your needs. Each configuration option listed here is in a format of `section.option`.

Note: For clarity, this would appear in a configuration file where the section is in brackets (eg. `[section]`) and the option would have a `option = value` set within the section.

lp.external_providers_path New in version 1.5.0

Default value: `%(default_config_path)s/linchpin-x`

Providers playbooks can be created outside of the core of linchpin, if desired. When using these external providers, linchpin will use the `external_providers_path` to lookup the playbooks and attempt to run them.

See *Providers* for more information.

lp.rundb_conn New in version 1.2.0

Default value:

- v1.2.0: /home/user/.config/linchpin/rundb-<macaddress>.json
- v1.2.2+: /path/to/workspace/.rundb/rundb.json

The RunDB is a single json file, which records each transaction involving resources. A *run_id* and *uHash* are assigned, along with other useful information. The *lp.rundb_conn* describes the location to store the RunDB so data can be retrieved during execution.

evars._async Updated in version 1.2.0

Default value: `False`

Previous key name: `evars.async`

Some providers (eg. `openstack`, `aws`, `ovirt`) support asynchronous provisioning. This means that a topology containing many resources would provision or destroy all at once. LinchPin then waits for responses from these asynchronous tasks, and returns the success or failure. If the amount of resources is large, asynchronous tasks reduce the wait time immensely.

Reason for change: Avoiding conflict with existing Ansible variable.

Starting in Ansible 2.4.x, the *async* variable could not be set internally. The *_async* value is now passed in and sets the Ansible *async* variable to its value.

evars.default_credentials_path Default value: `%(default_config_path)s`

Storing credentials for multiple providers can be useful. It also may be useful to change the default here to point to a given location.

Note: The `--creds-path` option, or `$CREDS_PATH` environment variable overrides this option

evars.inventory_file Default value: `None`

If the unique-hash feature is turned on, the default *inventory_file* value is built up by combining the *workspace* path, *inventories_folder* *topology_name*, the *uhash*, and the *extensions.inventory* configuration value. The resulting file might look like this:

```
/path/to/workspace/inventories/dummy_cluster-049e.inventory
```

It may be desired to store the inventory without the *uhash*, or define a completely different structure altogether.

ansible.console Default value: `False`

This configuration option controls whether the output from the Ansible console is printed. In the `linchpin` CLI tool, it's the equivalent of the `-v` (`--verbose`) option.

Provisioning in LinchPin is a fairly simple process. However, LinchPin also provides some very flexible and powerful features. These features can sometimes be complex, which means most users will likely not use them. Those features are covered here.

6.1 Inventory Layouts

When generating an inventory, LinchPin provides some very flexible options. From the simple *Layouts* to much more complex options, detailed here.

6.1.1 inventory_file

New in version 1.5.2

When an *layout* is provided in the PinFile, LinchPin automatically generates a static inventory for Ansible. The inventory filename is dynamically generated based upon a few factors. However, the value can be overridden simply by adding the `inventory_file` option.

```
---
inventory_layout:
  inventory_file: /path/to/dummy.inventory
  vars:
    .. snip ..
```

6.1.2 Using LinchPin or Ansible variables

New in version 1.5.2

It's likely that the inventory file is based upon specific Linchpin (or Ansible) variables. In this case, the values need to be wrapped as raw values. This allows LinchPin to read the string in unparsed and pass it to the Ansible parser.

```
inventory_layout:
  inventory_file: "{% raw -%}{{ workspace }}/inventories/dummy-new-{{ uhash }}.
↳inventory{% - endraw %}"
```

6.1.3 Using Environment variables

Additionally, using environment variables requires the raw values.

```
host_groups:
  all:
    vars:
      ansible_user: root
      ansible_private_key_file: |
        "{% raw -%}{{ lookup('env', 'TESTLP') | default('/tmp', true) }}/CSS/
↳keystore/css-central{% - endraw %}"
```

6.2 The RunDB Explained

Attention: Much of the information below began in v1.2.0 and later. However, much of the data did not exist until later on, generally in version 1.5.0 or later. Some cases, where noted, the data is only planned, and does not yet exist.

The RunDB is the central database which stores transactions and target-based runs each time any LinchPin action is performed. The RunDB stores detailed data, including inputs like topology, inventory layout, hooks; and outputs like resource return data, ansible inventory filename and data, etc.

6.2.1 RunDB Storage

The RunDB is stored using a JSON format by default. [TinyDB](#) currently provides the backend. It is a NOSQL database, which writes out transactional records to a single file. Other databases could provide a backend, as long as a driver is written and included.

TinyDB is included in a class called [TinyRunDB](#). [TinyRunDB](#) is an implementation of a parent class, called [BaseDB](#), which in turn is a subclass of the abstract [RunDB](#) class.

Records are the main way for items to be stored in the RunDB. There are two types of records stored in the RunDB, target, and transaction.

6.2.2 Transaction Records

Each time any action (eg. `linchpin up`) occurs using `linchpin`, a transaction record is stored. The transaction records are stored in the 'linchpin' table. The main constraint to this is that a target called *linchpin* cannot be used.

Transaction Records consist of a Transaction ID (*tx_id*), the action and a target information for each target acted upon during the specified transaction. A single record could have multiple targets listed.

```
"136": {
  "action": "up",
  "targets": [
    {
      "dummy-new": {
        "290": {
          "rc": 0,
          "uhash": "27e1"
        }
      },
      "libvirt-new": {
        "225": {
          "rc": 0,
          "uhash": "d88c"
        }
      }
    }
  ]
},
```

In every case, the target data included is the name, run-id, return code (rc), and uhash. The `linchpin journal` provides a transaction view to show this data in human readable format.

```
$ linchpin journal --view tx -t 136

ID: 136                      Action: up

Target          Run ID  uHash   Exit Code
-----
dummy-new       290    27e1    0
libvirt-new     225    d88c    0
=====
```

6.2.3 Target Records

Target Records are much more detailed. Generally, the target records correspond to a specific Run ID (*run_id*). These can also be referenced via the `linchpin journal` command, using the `target` (default) view.

```
$ linchpin journal dummy-new --view target

Target: dummy-new
run_id    action          uhash          rc
-----
225       up              f9e5           0
224       destroy         89ea           0
223       up              89ea           0
```

The target record data is where the detail lies. Each record contains several sections, followed by possibly several sub-sections. A complete target record is very large. Let's have a look at record 225 for the 'dummy-new' target.

```
"225": {
  "action": "up",
  "end": "03/27/2018 12:18:21 PM",
  "inputs": [
```

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```

{
  "topology_data": {
    "resource_groups": [
      {
        "resource_definitions": [
          {
            "count": 3,
            "name": "web",
            "role": "dummy_node"
          },
          {
            "count": 1,
            "name": "test",
            "role": "dummy_node"
          }
        ],
        "resource_group_name": "dummy",
        "resource_group_type": "dummy"
      }
    ],
    "topology_name": "dummy_cluster"
  },
  {
    "layout_data": {
      "inventory_layout": {
        "hosts": {
          "example-node": {
            "count": 3,
            "host_groups": [
              "example"
            ]
          },
          "test-node": {
            "count": 1,
            "host_groups": [
              "test"
            ]
          }
        },
        "inventory_file": "{{ workspace }}/inventories/dummy-new-{{ uhash_
↵}}.inventory",
        "vars": {
          "hostname": "__IP__"
        }
      }
    },
    {
      "hooks_data": {
        "postup": [
          {
            "actions": [
              "echo hello"
            ],
            "name": "hello",
            "type": "shell"
          }
        ]
      }
    }
  }
}

```

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```

    }
  ]
}
},
],
"outputs": [
  {
    "resources": [
      {
        "changed": true,
        "dummy_file": "/tmp/dummy.hosts",
        "failed": false,
        "hosts": [
          "web-f9e5-0.example.net",
          "web-f9e5-1.example.net",
          "web-f9e5-2.example.net"
        ]
      },
      {
        "changed": true,
        "dummy_file": "/tmp/dummy.hosts",
        "failed": false,
        "hosts": [
          "test-f9e5-0.example.net"
        ]
      }
    ]
  }
],
"rc": 0,
"start": "03/27/2018 12:18:02 PM",
"uhash": "f9e5",
"cfgs": [
  {
    "evars": []
  },
  {
    "magics": []
  },
  {
    "user": []
  }
]
},

```

As might be gleaned from looking at the JSON, there are a few main sections. Some of these sections, have subsections. The main sections include:

```

* action
* start
* end
* uhash
* rc
* inputs
* outputs
* cfgs

```

Most of these sections are self-explanatory, or can be easily determined. However, there are three that may need further explanation.

Inputs

The RunDB stored all inputs in the “inputs” section.

```
"inputs": [
  {
    "topology_data": {
      "resource_groups": [
        {
          "resource_definitions": [
            {
              "count": 3,
              "name": "web",
              "role": "dummy_node"
            },
            {
              "count": 1,
              "name": "test",
              "role": "dummy_node"
            }
          ],
          "resource_group_name": "dummy",
          "resource_group_type": "dummy"
        }
      ],
      "topology_name": "dummy_cluster"
    }
  },
  {
    "layout_data": {
      "inventory_layout": {
        "hosts": {
          "example-node": {
            "count": 3,
            "host_groups": [
              "example"
            ]
          },
          "test-node": {
            "count": 1,
            "host_groups": [
              "test"
            ]
          }
        },
        "inventory_file": "{{ workspace }}/inventories/dummy-new-{{ uhash }}.
↪inventory",
        "vars": {
          "hostname": "__IP__"
        }
      }
    }
  },
  {
```

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```

    "hooks_data": {
      "postup": [
        {
          "actions": [
            "echo hello"
          ],
          "name": "hello",
          "type": "shell"
        }
      ]
    }
  ],
],

```

Currently, the *inputs* section has three sub-sections, *topology_data*, *layout_data*, and *hooks_data*. These three sub-sections hold relevant data. The use of this data is generally for record-keeping, and more recently to allow for reuse of the data with linchpin up/destroy actions.

Additionally, some of this data is used to create the outputs, which are stored in the *outputs* section.

Outputs

Going forward, the *outputs* section will contain much more data than is displayed below. Items like *ansible_inventory*, and *user_data* will also appear in the database. These will be provided in future development.

```

"outputs": [
  {
    "resources": [
      {
        "changed": true,
        "dummy_file": "/tmp/dummy.hosts",
        "failed": false,
        "hosts": [
          "web-f9e5-0.example.net",
          "web-f9e5-1.example.net",
          "web-f9e5-2.example.net"
        ]
      },
      {
        "changed": true,
        "dummy_file": "/tmp/dummy.hosts",
        "failed": false,
        "hosts": [
          "test-f9e5-0.example.net"
        ]
      }
    ]
  }
],

```

The lone sub-section is *resources*. For the *dummy-new* target, the data provided is simplistic. However, for providers like openstack or aws, the resources become quite large and extensive. Here is a snippet of an openstack resources sub-section.

```

"resources": [
  {
    "changed": true,
    "failed": false,
    "ids": [
      "fc96e134-4a68-4aaa-a053-7f53cae21369"
    ],
    "openstack": [
      {
        "OS-DCF:diskConfig": "MANUAL",
        "OS-EXT-AZ:availability_zone": "nova",
        "OS-EXT-STS:power_state": 1,
        "OS-EXT-STS:task_state": null,
        "OS-EXT-STS:vm_state": "active",
        "OS-SRV-USG:launched_at": "2017-11-27T19:43:54.000000",
        "OS-SRV-USG:terminated_at": null,
        "accessIPv4": "10.8.245.175",
        "accessIPv6": "",
        "addresses": {
          "atomic-e2e-jenkins-test": [
            {
              "OS-EXT-IPS-MAC:mac_addr": "fa:16:3e:ba:0e:5e",
              "OS-EXT-IPS:type": "fixed",
              "addr": "172.16.171.15",
              "version": 4
            },
            {
              "OS-EXT-IPS-MAC:mac_addr": "fa:16:3e:ba:0e:5e",
              "OS-EXT-IPS:type": "floating",
              "addr": "10.8.245.175",
              "version": 4
            }
          ]
        },
        "adminPass": "<REDACTED>",
        "az": "nova",
        "cloud": "",
        "config_drive": "",
        "created": "2017-11-27T19:43:47Z",
        "disk_config": "MANUAL",
        "flavor": {
          "id": "2",
          "name": "m1.small"
        },
        "has_config_drive": false,
        "hostId": "20a84eb5691c546defeac6b2a5b4586234aed69419641215e0870a64",
        "host_id": "20a84eb5691c546defeac6b2a5b4586234aed69419641215e0870a64",
        "id": "fc96e134-4a68-4aaa-a053-7f53cae21369",
        "image": {
          "id": "eae92800-4b49-4e81-b876-1cc61350bf73",
          "name": "CentOS-7-x86_64-GenericCloud-1612"
        },
        "interface_ip": "10.8.245.175",
        "key_name": "ci-factory",
        "launched_at": "2017-11-27T19:43:54.000000",
        "location": {

```

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```

        "cloud": "",
        "project": {
            "domain_id": null,
            "domain_name": null,
            "id": "6e65fbc3161648e78fde849c7abbd30f",
            "name": "VALUE_SPECIFIED_IN_NO_LOG_PARAMETER"
        },
        "region_name": "",
        "zone": "nova"
    },
    "metadata": {},
    "name": "database-44ee-1",
    "networks": {},
    "os-extended-volumes:volumes_attached": [],
    "power_state": 1,
    "private_v4": "172.16.171.15",
    "progress": 0,
    "project_id": "6e65fbc3161648e78fde849c7abbd30f",
    "properties": {
        "OS-DCF:diskConfig": "MANUAL",
        "OS-EXT-AZ:availability_zone": "nova",
        "OS-EXT-STS:power_state": 1,
        "OS-EXT-STS:task_state": null,
        "OS-EXT-STS:vm_state": "active",
        "OS-SRV-USG:launched_at": "2017-11-27T19:43:54.000000",
        "OS-SRV-USG:terminated_at": null,
        "os-extended-volumes:volumes_attached": []
    },
    "public_v4": "10.8.245.175",
    "public_v6": "",
    "region": "",
    "security_groups": [
        {
            "description": "Default security group",
            "id": "1da85eb2-3c51-4729-afc4-240e187a30ce",
            "location": {
                "cloud": "",
                "project": {
                    "domain_id": null,
                    "domain_name": null,
                    "id": "6e65fbc3161648e78fde849c7abbd30f",
                    "name": "VALUE_SPECIFIED_IN_NO_LOG_PARAMETER"
                },
            },
        },
    ],
    .. snip ..

```

Note: The data above continues for several more pages, and would take up too much space to document. A savvy user might cat the runde file and pipe it to the python 'json.tool' module.

Each provider returns a large structure like this as results of the provisioning (up) process. For the teardown, the data can be large, but is generally more succinct.

6.3 Context Distiller

New in version 1.5.2

The purpose of the Context Distiller is to take outputs from provisioned resources and provide them to a user as a json file.

The distiller currently supports the following roles:

```
* os_server
* aws_ec2
* bkr_server
* dummy_node (for testing)
```

For each role, the distiller collects specific fields from the resource data.

Note: Please be aware that this feature is planned to be integrated with other tooling to make extracting resource data more flexible in the future.

6.3.1 Enabling the Distiller

To enable the Context Distiller, the following must be set in the `linchpin.conf`.

```
[lp]
distill_data = True

# disable generating the resources file
[evars]
generate_resources = False
```

Note: Other settings may already be in these sections. If that is the case, just add these settings to the proper section.

Hint: It may not be immediately obvious, as LinchPin uses the *RunDB* data to return resource data from a run. In this way, the resource data can be stored somewhere and retrieved at any time by future tooling. Because of this, the resources file is disabled. In this way, the resource data is stored solely in the RunDB for easy retrieval.

Fields to Retrieve

Warning: Modifying the distilled fields can cause unexpected results. **MODIFY THIS DATA AT YOUR OWN RISK!**

Within the `linchpin.constants` file, the `[distiller]` section exists. Described within this section is how each role gathers the applicable data to distill.

```
[distiller]
bkr_server = id,url,system
dummy_node: hosts
```

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```
aws_ec2 = instances.id,instances.public_ip,instances.private_ip,instances.public_dns_
↪name,instances.private_dns_name,instances.tags:name
os_server = servers.id,servers.interface_ip,servers.name,servers.private_v4,servers.
↪public_v4
```

If the distiller is enabled, the *bkr_server* role will distill the id, url, and system values for each instance provisioned during the transaction.

6.3.2 Output

The distiller creates one file, placed in `<workspace>/resources/linchpin.distilled`. Each time an ‘up’ transaction is performed, the distilled data is overwritten.

If no output is recorded, it’s likely that the provisioning didn’t complete successfully, or an error occurred during data collection. The data is still available in the RunDB.

This is the output for the *aws_ec2* role, using the *aws-ec2-new* target, which provisioned two instances.

```
{
  "aws-ec2-new": [
    {
      "id": "i-0d8616a3d08a67f38",
      "name": "demo-day",
      "private_dns_name": "ip-172-31-18-177.us-west-2.compute.internal",
      "private_ip": "172.31.18.177",
      "public_dns_name": "ec2-54-202-80-27.us-west-2.compute.amazonaws.com",
      "public_ip": "54.202.80.27"
    },
    {
      "id": "i-01112909e184530fc",
      "name": "demo-night",
      "private_dns_name": "ip-172-31-20-190.us-west-2.compute.internal",
      "private_ip": "172.31.20.190",
      "public_dns_name": "ec2-54-187-172-80.us-west-2.compute.amazonaws.com",
      "public_ip": "54.187.172.80"
    }
  ]
}
```


The following information may be useful for those wishing to extend LinchPin.

7.1 Python API Reference

This page contains the list of project's modules

7.1.1 Linchpin API and Context Modules

The linchpin module provides the base API for managing LinchPin, Ansible, and other useful aspects for provisioning.

class `linchpin.LinchpinAPI` (*ctx*)

bind_to_hook_state (*callback*)

Function used by LinchpinHooksclass to add callbacks

Parameters **callback** – callback function

do_action (*provision_data, action='up', run_id=None, tx_id=None*)

This function takes *provision_data*, and executes the given action for each target within the *provision_data* dictionary.

Parameters **provision_data** – PinFile data as a dictionary, with target information

Parameters

- **action** – Action taken (up, destroy, etc). (Default: up)
- **run_id** – Provided *run_id* to duplicate/destroy (Default: None)
- **tx_id** – Provided *tx_id* to duplicate/destroy (Default: None)

do_validation (*provision_data, old_schema=False*)

This function takes provision_data, and attempts to validate the topologies for that data

Parameters **provision_data** – PinFile data as a dictionary, with target information

generate_inventory (*resource_data, layout, inv_format='cfg', topology_data={}*)

get_cfg (*section=None, key=None, default=None*)

Get cfgs value(s) by section and/or key, or the whole cfgs object

Parameters

- **section** – section from ini-style config file
- **key** – key to get from config file, within section
- **default** – default value to return if nothing is found.

get_evar (*key=None, default=None*)

Get the current evars (extra_vars)

Parameters

- **key** – key to use
- **default** – default value to return if nothing is found

(default: None)

get_pf_data_from_rundb (*targets, run_id=None, tx_id=None*)

This function takes the action and provision_data, returns the pinfile data

Parameters

- **targets** – A list of targets for which to get the data
- **targets** – Tuple of target(s) for which to gather data.
- **run_id** – run_id associated with target (Default: None)
- **tx_id** – tx_id for which to gather data (Default: None)

get_run_data (*tx_id, fields, targets=()*)

Returns the RunDB for data from a specified field given a tx_id. The fields consist of the major sections in the RunDB (target view only). Those fields are action, start, end, inputs, outputs, uhash, and rc.

Parameters

- **tx_id** – tx_id to search
- **fields** – Tuple of fields to retrieve for each record requested.
- **targets** – Tuple of targets to search from within the tx_ids

hook_state

getter function for hook_state property of the API object

lp_journal (*view='target', targets=[], fields=None, count=1, tx_ids=None*)

set_cfg (*section, key, value*)

Set a value in cfgs. Does not persist into a file, only during the current execution.

Parameters

- **section** – section within ini-style config file
- **key** – key to use

- **value** – value to set into section within config file

set_ever (*key, value*)

Set a value into evars (extra_vars). Does not persist into a file, only during the current execution.

Parameters

- **key** – key to use
- **value** – value to set into evars

setup_rundb ()

Configures the run database parameters, sets them into extra_vars

class linchpin.context.LinchpinContext

LinchpinContext object, which will be used to manage the cli, and load the configuration file.

get_cfg (*section=None, key=None, default=None*)

Get cfgs value(s) by section and/or key, or the whole cfgs object

Parameters

- **section** – section from ini-style config file
- **key** – key to get from config file, within section
- **default** – default value to return if nothing is found.

Does not apply if section is not provided.

get_ever (*key=None, default=None*)

Get the current evars (extra_vars)

Parameters

- **key** – key to use
- **default** – default value to return if nothing is found

(default: None)

load_config (*search_path=None*)

Update self.cfgs from the linchpin configuration file (linchpin.conf).

NOTE: Must be implemented by a subclass

load_global_evars ()

Instantiate the evars variable, then load the variables from the ‘evars’ section in linchpin.conf. This will then be passed to invoke_linchpin, which passes them to the Ansible playbook as needed.

log (*msg, **kwargs*)

Logs a message to a logfile

Parameters

- **msg** – message to output to log
- **level** – keyword argument defining the log level

log_debug (*msg*)

Logs a DEBUG message

log_info (*msg*)

Logs an INFO message

log_state (*msg*)
 Logs nothing, just calls pass

Attention: state messages need to be implemented in a subclass

set_cfg (*section, key, value*)
 Set a value in cfgs. Does not persist into a file, only during the current execution.

Parameters

- **section** – section within ini-style config file
- **key** – key to use
- **value** – value to set into section within config file

set_evar (*key, value*)
 Set a value into evars (extra_vars). Does not persist into a file, only during the current execution.

Parameters

- **key** – key to use
- **value** – value to set into evars

setup_logging ()
 Setup logging to the console only

Attention: Please implement this function in a subclass

`linchpin.ansible_runner.ansible_runner` (*playbook_path, module_path, extra_vars, inventory_src='localhost', verbosity=1, console=True*)
 Uses the Ansible API code to invoke the specified linchpin playbook :param playbook: Which ansible playbook to run (default: 'up') :param console: Whether to display the ansible console (default: True)

`linchpin.ansible_runner.ansible_runner_24x` (*playbook_path, extra_vars, options=None, inventory_src='localhost', console=True*)

`linchpin.ansible_runner.ansible_runner_2x` (*playbook_path, extra_vars, options=None, inventory_src='localhost', console=True*)

`linchpin.ansible_runner.suppress_stdout` (**args, **kwds*)
 This context manager provides tooling to make Ansible's Display class not output anything when used

class `linchpin.callbacks.PlaybookCallback` (*display=None, options=None, ansible_version=2.3*)

Playbook callback

v2_runner_on_failed (*result, **kwargs*)
 Save failed result

v2_runner_on_ok (*result*)
 Save ok result

7.1.2 LinchPin Command-Line API

The `linchpin.cli` module provides an API for writing a command-line interface, the *LinchPin Command Line Shell implementation* being the reference implementation.

`class linchpin.cli.LinchpinCli (ctx)`

find_include (*filename, ftype='topology'*)

Find the included file to be acted upon.

Parameters

- **filename** – name of file from to be loaded
- **ftype** – the file type to locate: topology, layout (default: topology)

lp_destroy (*targets=(), run_id=None, tx_id=None*)

This function takes a list of targets, and performs a destructive teardown, including undefining nodes, according to the target(s).

See also:

lp_down - currently unimplemented

Parameters

- **targets** – A tuple of targets to destroy.
- **run_id** – An optional run_id to use
- **tx_id** – An optional tx_id to use

lp_down (*pinfile, targets=(), run_id=None*)

This function takes a list of targets, and performs a shutdown on nodes in the target's topology. Only providers which support shutdown from their API (Ansible) will support this option.

CURRENTLY UNIMPLEMENTED

See also:

lp_destroy

Parameters

- **pinfile** – Provided PinFile, with available targets,
- **targets** – A tuple of targets to provision.

lp_fetch (*src, root=", fetch_type='workspace', fetch_protocol=None, fetch_ref=None, dest_ws=None, nocache=False*)

Fetch a workspace from git, http(s), or a local directory, and generate a provided workspace

Parameters

- **src** – The URL or URI of the remote directory
- **root** – Used to specify the location of the workspace within the remote. If root is not set, the root of the given remote will be used.
- **fetch_type** – Specifies which component(s) of a workspace the user wants to fetch. Types include: topology, layout, resources, hooks, workspace. (default: workspace)
- **fetch_protocol** – The protocol to use to fetch the workspace. (default: git)
- **fetch_ref** – Specify the git branch. Used only with git protocol (eg. master). If not used, the default branch will be used.

- **dest_ws** – Workspaces destination, the workspace will be relative to this location.
If *dest_ws* is not provided and *-r/-root* is provided, the basename will be the name of the workspace within the destination. If no root is provided, a random workspace name will be generated. The destination can also be explicitly set by using *-w* (see *linchpin -help*).
- **nocache** – If true, don't copy from the cache dir, unless it's longer than the configured *fetch.cache_days* (1 day) (default: False)

lp_init (*providers=['libvirt']*)

Initializes a linchpin project. Creates the necessary directory structure, includes PinFile, topologies and layouts for the given provider. (Default: Dummy. Other providers not yet implemented.)

Parameters providers – A list of providers for which templates

(and a target) will be provided into the workspace. NOT YET IMPLEMENTED

lp_up (*targets=(), run_id=None, tx_id=None, inv_f='cfg'*)

This function takes a list of targets, and provisions them according to their topology.

Parameters

- **targets** – A tuple of targets to provision
- **run_id** – An optional run_id if the task is idempotent
- **tx_id** – An optional tx_id if the task is idempotent

lp_validate (*targets=(), old_schema=False*)

This function takes a list of targets, and validates their topology.

Parameters targets – A tuple of targets to provision

:param old_schema Denotes whether schema should be validated with the old schema rather than the new one!
usr/bin/env python

pf_data

getter for pinfile template data

pinfile

getter function for pinfile name

workspace

getter function for context workspace

class `linchpin.cli.context.LinchpinCliContext`

Context object, which will be used to manage the cli, and load the configuration file

load_config (*lpconfig=None*)

Update self.cfgs from the linchpin configuration file (*linchpin.conf*).

The following paths are used to find the config file. The search path defaults to the first-found order:

```
* /etc/linchpin.conf
* /linchpin/library/path/linchpin.conf
* <workspace>/linchpin.conf
```

An alternate *search_path* can be passed.

Parameters search_path – A list of paths to search a linchpin config

(default: None)

log (*msg*, ***kwargs*)
 Logs a message to a logfile or the console

Parameters

- **msg** – message to log
- **lvl** – keyword argument defining the log level
- **msg_type** – keyword argument giving more flexibility.

Note: Only *msg_type STATE* is currently implemented.

log_debug (*msg*)
 Logs a DEBUG message

log_info (*msg*)
 Logs an INFO message

log_state (*msg*)
 Logs a message to stdout

pinfile
 getter function for pinfile name

setup_logging ()
 Setup logging to a file, console, or both. Modifying the *linchpin.conf* appropriately will provide functionality.

workspace
 getter function for workspace

7.1.3 LinchPin Command Line Shell implementation

The *linchpin.shell* module contains calls to implement the Command Line Interface within *linchpin*. It uses the [Click](#) command line interface composer. All calls here interface with the *LinchPin Command-Line API* API.

class *linchpin.shell.click_default_group.DefaultGroup* (**args*, ***kwargs*)
 Invokes a subcommand marked with *default=True* if any subcommand not chosen.

Parameters **default_if_no_args** – resolves to the default command if no arguments passed.

command (**args*, ***kwargs*)
 A shortcut decorator for declaring and attaching a command to the group. This takes the same arguments as *command()* but immediately registers the created command with this instance by calling into *add_command()*.

format_commands (*ctx*, *formatter*)
 Extra format methods for multi methods that adds all the commands after the options.

get_command (*ctx*, *cmd_name*)
 Given a context and a command name, this returns a *Command* object if it exists or returns *None*.

list_commands (*ctx*)
 Provide a list of available commands. Anything deprecated should not be listed

parse_args (*ctx*, *args*)
 Given a context and a list of arguments this creates the parser and parses the arguments, then modifies the context as necessary. This is automatically invoked by *make_context()*.

resolve_command (*ctx*, *args*)

set_default_command (*command*)
Sets a command function as the default command.

7.1.4 LinchPin Hooks API

The `linchpin.hooks` module manages the hooks functionality within LinchPin.

class `linchpin.hooks.ActionBlockRouter` (*name*, **args*, ***kwargs*)
Proxy pattern implementation for fetching actionmanagers by name

class `linchpin.hooks.LinchpinHooks` (*api*)

prepare_ctx_params ()
prepares few context parameters based on the current `target_data` that is being set. these parameters are based on topology name.

prepare_inv_params ()

run_actions (*action_blocks*, *tgt_data*, *is_global=False*)
Runs actions inside each action block of each target

Parameters

- **action_blocks** – list of `action_blocks` each block constitutes to a type of hook
- **tgt_data** – data specific to target, which can be dict of

`topology`, `layout`, `outputs`, `inventory` :param `is_global`: scope of the hook

example: `action_block`: - name: `do_something`

type: shell actions:

- `echo 'this is 'postup' operation Hello hai how r u ?'`

run_hooks (*state*, *is_global=False*)

Function to run hook all hooks from Pinfile based on the state :param `state`: hook state (currently, `preup`, `postup`, `predestroy`, `postdestroy`) :param `is_global`: whether the hook is global (can be applied to multiple targets)

run_inventory_gen (*data*)

rundb

7.1.5 LinchPin Extra Modules

These are modules not documented elsewhere in the LinchPin API, but may be useful to a developer.

class `linchpin.utils.dataparser.DataParser`

load_pinfile (*pinfile*)

parse_json_yaml (*data*, *ordered=True*)
parses yaml file into json object

process (*file_w_path*, *data=None*)

Processes the PinFile and any data (if a template) using Jinja2. Returns json of PinFile, topology, layout, and hooks.

Parameters

- **file_w_path** – Full path to the provided file to process
- **data** – A JSON representation of data mapped to a Jinja2 template in file_w_path

render (*template, context, ordered=True*)

Performs the rendering of template and context data using Jinja2.

Parameters

- **template** – Full path to the Jinja2 template
- **context** – A dictionary of variables to be rendered against the template

run_script (*script*)

write_json (*provision_data, pf_outfile*)

exception linchpin.exceptions.**ActionError** (*args, **kwargs)

exception linchpin.exceptions.**ActionManagerError** (*args, **kwargs)

exception linchpin.exceptions.**HookError** (*args, **kwargs)

exception linchpin.exceptions.**LinchpinError** (*args, **kwargs)

exception linchpin.exceptions.**SchemaError** (*args, **kwargs)

exception linchpin.exceptions.**StateError** (*args, **kwargs)

exception linchpin.exceptions.**TopologyError** (*args, **kwargs)

exception linchpin.exceptions.**ValidationError** (*args, **kwargs)

class linchpin.exceptions.**ValidationErrorHandler** (*tree=None*)

```
messages = {0: '{0}', 1: 'document is missing', 2: "field '{field}' is required", 3:
```

class linchpin.fetch.**FetchLocal** (*ctx, fetch_type, src, dest, cache_dir, root*)

fetch_files ()

class linchpin.fetch.**FetchHttp** (*ctx, fetch_type, src, dest, cache_dir, root="", root_ws="", ref=None*)

call_wget (*fetch_dir=None*)

fetch_files ()

class linchpin.fetch.**FetchGit** (*ctx, fetch_type, src, dest, cache_dir, root="", root_ws="", ref=None*)

call_clone (*fetch_dir=None*)

fetch_files ()

See also:

[User Mailing List](#) Subscribe and participate. A great place for Q&A

[LinchPin on Github](#) Code Contributions and Latest Software

[webchat.freenode.net](#) #linchpin IRC chat channel

[LinchPin on PyPi](#) Latest Release of LinchPin

CHAPTER 8

FAQs

Below is a list of Frequently Asked Questions (FAQs), with answers. Feel free to submit yours in a [Github issue](#).

CHAPTER 9

Community

LinchPin has a small, but vibrant community. Come help us while you learn a skill.

See also:

User Mailing List Subscribe and participate. A great place for Q&A

LinchPin on Github Code Contributions and Latest Software

webchat.freenode.net #linchpin IRC chat channel

LinchPin on PyPi Latest Release of LinchPin

The following is a list of terms used throughout the LinchPin documentation.

`_async` (*boolean, default: False*)

Used to enable asynchronous provisioning/teardown. Sets the Ansible *async* magic_var.

`async_timeout` (*int, default: 1000*)

How long the resource collection (formerly `outputs_writer`) process should wait

`_check_mode/check_mode` (*boolean, default: no*)

This option does nothing at this time, though it may eventually be used for dry-run functionality based upon the provider

`default_schemas_path` (*file_path, default: <lp_path>/defaults/<schemas_folder>*)

default path to schemas, absolute path. Can be overridden by passing `schema / schema_file`.

`default_playbooks_path` (*file_path, default: <lp_path>/defaults/playbooks_folder*)

default path to playbooks location, only useful to the linchpin API and CLI

`default_layouts_path` (*file_path, default: <lp_path>/defaults/<layouts_folder>*)

default path to inventory layout files

`default_topologies_path` (*file_path, default: <lp_path>/defaults/<topologies_folder>*)

default path to topology files

`default_resources_path` (*file_path, default: <lp_path>/defaults/<resources_folder>, formerly: outputs*)

default landing location for resources output data

`default_inventories_path` (*file_path, default: <lp_path>/defaults/<inventories_folder>*)

default landing location for inventory outputs

`evars`

extra_vars Variables that can be passed into Ansible playbooks from external sources. Used in linchpin via the `linchpin.conf [evars]` section.

hook Certain scripts can be called when a particular *hook* has been referenced in the *PinFile*. The currently available hooks are *preup*, *postup*, *predestroy*, and *postdestroy*.

inventory

inventory_file If layout is provided, this will be the location of the resulting ansible inventory

inventories_folder A configuration entry in `linchpin.conf` which stores the relative location where inventories are stored.

linchpin_config

lpconfig if passed on the command line with `-c/--config`, should be an ini-style config file with linchpin default configurations (see BUILT-INS below for more information)

layout

layout_file

inventory_layout Definition for providing an Ansible (currently) static inventory file, based upon the provided topology

layouts_folder (*file_path*, *default: layouts*)

relative path to layouts

lp_path base path for linchpin playbooks and python api

output (*boolean*, *default: True*, *previous: no_output*)

Controls whether resources will be written to the `resources_file`

PinFile

pinfile A YAML file consisting of a *topology* and an optional *layout*, among other options. This file is used by the `linchpin` command-line, or Python API to determine what resources are needed for the current action.

playbooks_folder (*file_path*, *default: provision*)

relative path to playbooks, only useful to the linchpin API and CLI

provider A set of platform actions grouped together, which is provided by an external Ansible module. *openstack* would be a provider.

provision

up An action taken when resources are to be made available on a particular provider platform. Usually corresponds with the `linchpin up` command.

resource_definitions In a topology, a `resource_definition` describes what the resources look like when provisioned. This example shows two different `dummy_node` resources, the resource named *web* will get 3 nodes, while and the resource named *test* will get 1 resource.

```
resource_definitions:
- name: "web"
  type: "dummy_node"
  count: 3
- name: "test"
  type: "dummy_node"
  count: 1
```

resource_group_type For each resource group, the type is defined by this value. It's used by the LinchPin API to determine which provider playbook to run.

resources

resources_file File with the resource outputs in a JSON formatted file. Useful for teardown (destroy,down) actions depending on the provider.

run_id

run-id An integer identifier assigned to each task.

- The `run_id` can be passed to `linchpin up` for idempotent provisioning
- The `run_id` can be passed to `linchpin destroy` to destroy any previously provisioned resources.

rundb

RunDB A simple json database, used to store the *uhash* and other useful data, including the *run_id* and output data.

schema JSON description of the format for the topology.

target Specified in the *PinFile*, the *target* references a *topology* and optional *layout* to be acted upon from the command-line utility, or Python API.

teardown

destroy An action taken when resources are to be made unavailable on a particular provider platform. Usually corresponds with the `linchpin destroy` command.

topologies_folder (*file_path, default: topologies*)

relative path to topologies

topology

topology_file A set of rules, written in YAML, that define the way the provisioned systems should look after executing `linchpin`.

Generally, the *topology* and *topology_file* values are interchangeable, except after the file has been processed.

topology_name Within a *topology_file*, the *topology_name* provides a way to identify the set of resources being acted upon.

uhash

uHash Unique-ish hash associated with resources on a provider basis. Provides unique resource names and data if desired. The *uhash* must be enabled in `linchpin.conf` if desired.

workspace If provided, the above variables will be adjusted and mapped according to this value. Each path will use the following variables:

```
topology / topology_file = /<topologies_folder>
layout / layout_file = /<layouts_folder>
resources / resources_file = /resources_folder>
inventory / inventory_file = /<inventories_folder>
```

If the `WORKSPACE` environment variable is set, it will be used here. If it is not, this variable can be set on the command line with `-w/--workspace`, and defaults to the location of the *PinFile* being provisioned.

Note: `schema` is not affected by this pathing

See also:

[Source Code](#) LinchPin Source Code

—

CHAPTER 11

Indices and tables

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- [modindex](#)
- [search](#)

See also:

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