
LOCKSS System Manual

LOCKSS Program

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LOCKSS 2.0-ALPHA5 SYSTEM MANUAL

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Welcome to the LOCKSS 2.0-alpha5 System Manual.

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INTRODUCTION

The LOCKSS system is a distributed digital preservation software system developed by the [LOCKSS Program](#), a division of the [Digital Library Systems and Services](#) department at [Stanford University Libraries](#).

The 2.x series of the LOCKSS system stems from the LAAWS (LOCKSS Architected As Web Services) initiative, an ambitious modernization project that includes rewriting the classic LOCKSS daemon as a suite of containerized components, funded in part by a grant from the [Andrew W. Mellon Foundation](#).

This version, LOCKSS 2.0-alpha5, is the fifth preview release on the road to LOCKSS 2.0.

1.1 System Prerequisites

1.1.1 Host

The LOCKSS system runs in a **64-bit Linux** host (physical or virtual).

See the next section (*Operating System*) for operating system choices.

1.1.2 CPU

The CPU requirements depend on which components of the LOCKSS system you choose to run. We recommend at least **4 CPU cores**, preferably 8.

1.1.3 Memory

Likewise, the memory requirements also depend on which components of the LOCKSS system you choose to run. We recommend at least **8 GB** of memory, preferably 16 GB.

1.1.4 Storage

LOCKSS makes use of several storage areas. During configuration, the administrator must specify the location of these storage areas by supplying one or more directory paths. The default is to put all storage under a single directory, but different types of storage have different size and performance requirements and on a large system, if different types of storage are available it may be advantageous to place the storage areas on different devices:

- **Content data storage:** This is where all the preserved content is stored, along with an index and several databases¹. Many LOCKSS systems preserve a large amount of content and it has become common to use network-attached storage for this. LOCKSS' audit activities result in nearly continuous reading of content from

¹ Unless using external Solr and/or PostgreSQL servers.

storage; this may impact the storage server's performance, and a busy or non-performant storage server may impact LOCKSS' performance. For the repository service, multiple storage areas may be specified, and more can be added later.

The amount of space required depends on the amount of content that will be preserved. The content is efficiently stored in large, compressed WARC files. Unlike LOCKSS 1.x, inode usage is very low.

- **Log data storage:** Service logs will be written to subdirectories of this path. There is usually no reason to enter a different path unless you have specific logging requirements.
- **Temporary data storage:** The LOCKSS software makes heavy use of temporary storage, and we recommend that temporary directories be placed on a filesystem with relatively low latency. If the content storage directories are on network storage (for example NFS), system performance may be improved by using a local directory.

Caution: Depending on the characteristics of the preservation activities undertaken by the system, in some circumstances content processing may require a substantial amount of temporary space, up to tens of gigabytes. Do not use a RAM-based `tmpfs` volume, or a directory in a space-constrained partition, for temporary data storage.

What's the Minimum for Experimentation?

To review the installation instructions and test the installation of K3s in various operating systems, we routinely install and bring up minimal LOCKSS 2.0-alpha5 systems, with no metadata services or Web replay engines, and with empty embedded Postgres and Solr databases, in Vagrant virtual machines with Virtualbox using 2 CPU cores and 3 GB of memory. These minimal VMs would not support a production load, but it can be a useful tool to try out the installation instructions or evaluate the system.

1.2 Operating System

The LOCKSS system requires a **64-bit Linux** host (physical or virtual) compatible with **K3s**, a lightweight Kubernetes distribution by **Rancher**.

Rancher states¹ that "K3s is expected to work on most modern Linux systems", and that "Some OSs have specific requirements" (which are documented here and integrated into the **lockss-installer** scripts).

Flavors of Linux we have successfully tested include:

- **AlmaLinux** 8.4, 8.3.
- **Arch Linux** (rolling release).
- **CentOS** 8.4, 8.3, 8.2, 8.1, 8.0, 7.9, 7.8, 7.7, 7.6, 7.5, 7.4, 7.3, and **CentOS Stream** (rolling release).
- **Debian** 11.1, 11.0, 10.10, 10.9, 10.8, 10.7, 10.6, 10.5, 10.4, 10.3, 10.2, 10.1, 10.0, 9.13, 9.12, 9.11, 9.9, 9.8, 9.7, 9.6, 9.5, 9.4, 9.3, 9.2, 9.1, 9.0.
- **EuroLinux** 8.4, 8.3, 7.9, 7.8, 7.7, 7.6.
- **Fedora** 34, 33, 32, 31, 30, 29, 28.
- **Linux Mint** 20.2, 20.1, 20.0, 19.3, 19.2, 19.1, 19.0.

¹ Reference: <https://rancher.com/docs/k3s/latest/en/installation/installation-requirements/#operating-systems>

- [OpenSUSE Leap 15.3, 15.2, 15.1, 15.0, and OpenSUSE Tumbleweed \(rolling release\)](#)
- [Oracle Linux 8.4, 8.3, 8.2, 8.1, 7.9, 7.8, 7.7, 7.6.](#)
- [RHEL 8.3.](#)
- [Rocky Linux 8.4.](#)
- [Scientific Linux 7.9, 7.8, 7.7, 7.6.](#)
- [Ubuntu 21.10, 21.04, 20.10, 20.04 LTS, 19.10, 19.04, 18.10, 18.04 LTS.](#)

The LOCKSS system can likely be installed successfully on slightly different versions of the Linux flavors above, as well as other Linux flavors altogether.

We currently recommend Rocky Linux 8 or alternatively CentOS 7.

1.3 Next Steps

- **If you are upgrading an existing LOCKSS 2.0-alpha4 system to LOCKSS 2.0-alpha5,** go to *Upgrading From LOCKSS 2.0-alpha4*.
- **If you are migrating an existing LOCKSS 1.x system to LOCKSS 2.0-alpha5,** go to *Migrating From LOCKSS 1.x*.
- **If you are installing the LOCKSS system for the first time,** go to *Installing the LOCKSS System*.

UPGRADING FROM LOCKSS 2.0-ALPHA4

Note: This chapter describes how to upgrade an existing LOCKSS 2.0-alpha4 system to 2.0-alpha5.

If you are installing the LOCKSS system for the first time, go to *Installing the LOCKSS System* instead.

Tip: Before you begin the upgrade, we strongly recommend you first bring your operating system up to date by applying security updates and upgrading installed packages. Ask your system administrator or see *Operating System Updates* in the appendix.

2.1 Stop LOCKSS 2.0-alpha4

The first step is to stop the LOCKSS 2.0-alpha4 system.

Log in as the lockss user and run the following command in the lockss-installer directory:

```
scripts/stop-lockss
```

2.2 Update the LOCKSS Installer

The official way to download the LOCKSS Installer is now through the LOCKSS Downloader, rather than cloning the LOCKSS Installer as a Git project as in previous releases. However, advanced users may continue to use **git** if they wish (see *Downloading the LOCKSS Installer using git* for instructions).

Move the existing 2.0-alpha4 LOCKSS Installer out-of-the-way:

```
mv lockss-installer lockss-installer.alpha4
```

Then follow the steps in *Installing the LOCKSS System* to download the 2.0-alpha5 version of the LOCKSS Installer, skipping over the earlier sections of the chapter that are not required in the context of an upgrade (e.g., *Creating the lockss User*).

2.3 Run the Upgrade Script

We have provided an upgrade script to upgrade on-disk structures. To run it, log in as the `lockss` user and run the following command in the `lockss-installer` directory:

```
scripts/upgrades/upgrade-alpha4-to-alpha5
```

2.4 Re-run the Configure Script

Copy the existing LOCKSS system configuration into the new 2.0-alpha5 environment:

```
cp lockss-installer.alpha4/config/system.cfg lockss-installer/config/system.cfg
```

Then follow the instructions in configuring to ensure all existing configuration parameters are still correct and to configure any new parameters.

2.5 Next Steps

Follow the instructions in running to start your LOCKSS 2.0-alpha5 instance.

Note: The first time 2.0-alpha5 is started after an upgrade from 2.0-alpha4, it may take several minutes before the system becomes available, while it re-indexes all previously archived content.

INSTALLING THE LOCKSS SYSTEM

Note: This chapter describes how to install the LOCKSS 2.0-alpha5 system.

If you are upgrading an existing LOCKSS 2.0-alpha4 system to 2.0-alpha5, go to *Upgrading From LOCKSS 2.0-alpha4* instead.

Tip: Before you begin installing the LOCKSS system, we strongly recommend you first bring your operating system up to date by applying security updates and upgrading installed packages. Ask your system administrator or see *Operating System Updates*.

3.1 Creating the lockss User

Note: Commands in this section are run as `root`¹.

The first task is to create a system user named `lockss`, under which the LOCKSS system will run.

Run this **useradd** command as `root`¹ :

```
useradd --system --user-group --create-home --shell=/bin/bash lockss
```

or equivalently:

```
useradd -rUms /bin/bash lockss
```

This will create a `lockss` system user, a `lockss` system group, and a home directory in `/home/lockss`.

¹ See *Running Commands as root*.

3.2 Downloading the LOCKSS Installer

Note: Commands in this section are run as the `lockss` user¹.

The next task is to download the LOCKSS Installer. To do this, you will use `curl` or `wget`² to invoke the LOCKSS Downloader³. (Alternatively, for security purposes, you can inspect the LOCKSS Downloader before executing it manually⁵.)

As the `lockss` user^{Page 10, 1}, run either this `curl` command:

```
curl -sSfL https://www.lockss.org/downloader | sh -s -
```

or this `wget` command:

```
wget -q0- https://www.lockss.org/downloader | sh -s -
```

This will download and invoke the LOCKSS Downloader, which in turn will download the latest version of the LOCKSS Installer into `$HOME/lockss-installer` (in this case `/home/lockss/lockss-installer`).

Tip: To install it into another directory `DIR`, add `--download-dir=DIR` after `sh -s -`, like so:

```
... | sh -s - --download-dir=DIR
```

The `lockss-downloader` script accepts other options after `sh -s -`. You can list them by invoking it with the `--help` option.

Important:

¹ See *Running Commands as the lockss User*.

² Most typical Linux systems have at least one of `curl` or `wget` installed by default. You can check by typing `curl --version` or `wget --version` and verifying that the output is not an error message. If you need to install `curl`, see *Installing curl*. If you prefer to install `wget`, see *Installing wget*.

³ See <https://github.com/lockss/lockss-downloader>.

⁵ For security purposes, you may wish to inspect the LOCKSS Downloader before executing it.

One option is to review the contents of the script directly on GitHub to your satisfaction, then execute it as described above. The URL <https://www.lockss.org/downloader> redirects to <https://github.com/lockss/lockss-downloader/raw/main/lockss-downloader>.

Another option is to download a copy of the LOCKSS Downloader, review the `lockss-downloader` script, then execute it, all locally. To do so, follow this procedure:

1. Run either:

```
curl -Lo /tmp/lockss-downloader https://www.lockss.org/downloader
```

or:

```
wget -O /tmp/lockss-downloader https://www.lockss.org/downloader
```

to download the `lockss-downloader` script to `/tmp/lockss-downloader`.

2. Inspect `/tmp/lockss-downloader` to your satisfaction.

3. Run this command:

```
chmod +x /tmp/lockss-downloader
```

to make `/tmp/lockss-downloader` executable.

4. Type:

```
/tmp/lockss-downloader
```

to run the `lockss-downloader` script, appending options like `--download-dir=DIR` to the end as desired.

LOCKSS Installer Directory

Whether it is the default directory `$HOME/lockss-installer` or a custom directory passed to the LOCKSS Downloader via the `--download-dir` option, make a note of the LOCKSS Installer directory, as many commands in this manual are documented relative to this directory.

3.3 Running the LOCKSS Installer

Note: Commands in this section are run as a privileged user who can become `root` or `lockss` via `sudo`¹.

The next task is to run the LOCKSS Installer.

3.3.1 Overview of the LOCKSS Installer

When you invoke the LOCKSS Installer, the installation process goes through various phases:

- Checking that the `lockss` system user and group exist. No user interaction is expected.
- Configuring `iptables`, `firewalld` and `ufw` for K3s. If applicable, you will be prompted to confirm before your system configuration is modified. You may incidentally be prompted for your `sudo` password.
- Configuring CoreDNS for K3s. If applicable, you will be prompted to enter non-loopback IP addresses of DNS servers.
- Installing K3s. If applicable, you will be prompted for a Kubernetes state data storage directory.
- Testing the K3s node. No user interaction is expected.

After the LOCKSS Installer succeeds, you can also optionally run the K3s Configuration Checker.

3.3.2 Invoking the LOCKSS Installer

To start the installation process, run this command (relative to the *LOCKSS Installer Directory*) as a privileged user who can become `root` or `lockss` via `sudo`^{Page 11, 1}:

```
scripts/install-lockss
```

The installer will run through its phases, each of which is described in its own section below. The first phase is *Checking the System User and Group*.

¹ See *Running Commands as a Privileged User*.

3.3.3 Checking the System User and Group

Heading

This phase begins with the heading *Checking the system user and group...*

Description

During this phase, **install-lockss** will check that the lockss user and group exist on the host system.

Steps

1. If **install-lockss** was invoked with the `--skip-check-system-user` option, you will see the message:

```
[success] Skipping (--skip-check-system-user)
```

and **install-lockss** will successfully proceed to the next phase (*Configuring iptables for K3s*).

2. If the lockss user or group does not exist on the host system, you will see one of these error messages:

```
[ERROR] The lockss user does not exist  
[ERROR] The lockss group does not exist
```

and **install-lockss** will fail.

Troubleshooting

See the *Creating the lockss User* section to create the lockss user and group.

3. Finally, you will see the message:

```
[success] System user and group present
```

and **install-lockss** will successfully proceed to the next phase (*Configuring iptables for K3s*).

3.3.4 Configuring iptables for K3s

Heading

This phase begins with the heading *Configuring iptables for K3s...*

Description

During this phase, **install-lockss** will configure **iptables** to work with K3s, if applicable.

Steps

1. If **install-lockss** was invoked with the `--skip-configure-iptables` option (implied by `--skip-install-k3s`), or if no changes to the configuration of **iptables** are necessary, you will see one of these messages:

```
[success] Skipping (--skip-install-k3s)
[success] Skipping (--skip-configure-iptables)
[success] Skipping (iptables is not on the PATH nor run via Alternatives)
[success] Skipping (iptables version is older than 1.8.0)
[success] Skipping (iptables version is newer than 1.8.3)
[success] Skipping (iptables is in legacy mode)
[success] Skipping (iptables is not run via Alternatives)
```

and **install-lockss** will successfully proceed to the next phase (*Configuring firewalld for K3s*).

2. Otherwise, you will receive the following prompt:

Switch iptables to legacy mode via Alternatives?

Enter Y to accept the proposed **iptables** configuration or N to bypass (or hit **Enter** to accept the default in square brackets).

- If **install-lockss** was invoked with the `--assume-yes` option, Y is automatically entered for you.
- You may be prompted for your **sudo** password.

Warning: If you bypass the proposed **iptables** configuration, you will see the warning:

```
[Warning] Leaving iptables unchanged; see manual for details
```

and **install-lockss** will immediately proceed to the next phase (*Configuring firewalld for K3s*), but K3s may malfunction without further intervention. See *Troubleshooting iptables* for details.

3. If the **iptables** configuration attempt fails, you will see one of these error messages:

```
[ERROR] Error deactivating ufw
[ERROR] Error applying update-alternatives to iptables
[ERROR] Error applying update-alternatives to ip6tables
[ERROR] Error flushing iptables
[ERROR] Error reactivating ufw
```

and **install-lockss** will fail.

Troubleshooting

See *Troubleshooting iptables* for remediation details.

4. Finally, you will see the message:

```
[success] Configured iptables for K3s
```

and **install-lockss** will successfully proceed to the next phase (*Configuring firewalld for K3s*).

3.3.5 Configuring firewalld for K3s

Heading

This phase begins with the heading *Configuring firewalld for K3s...*

Description

During this phase, **install-lockss** will configure **firewalld** to work with K3s, if applicable.

Steps

1. If **install-lockss** was invoked with the `--skip-configure-firewalld` option (implied by `--skip-install-k3s`), or if **firewalld** is not present or is not running, you will see one of these messages:

```
[success] Skipping (--skip-install-k3s)
[success] Skipping (--skip-configure-firewalld)
[success] Skipping (firewall-cmd is not on the PATH)
[success] Skipping (firewalld is not running)
```

and **install-lockss** will successfully proceed to the next phase (*Configuring ufw for K3s*).

2. If **firewalld** is running, you will receive the following prompt:

```
Add 10.42.0.0/16 and 10.43.0.0/16 to firewalld's trusted zone?
```

Enter Y to accept the proposed **firewalld** configuration or N to bypass (or hit **Enter** to accept the default in square brackets).

- If **install-lockss** was invoked with the `--assume-yes` option, Y is automatically entered for you.
- You may be prompted for your **sudo** password.

Warning: If you bypass the proposed **firewalld** configuration, you will see the warning:

```
[Warning] Leaving firewalld unchanged; see manual for details
```

and **install-lockss** will immediately proceed to the next phase (*Configuring ufw for K3s*), but K3s may malfunction without further intervention. See *Troubleshooting firewalld* for details.

3. If the **firewalld** configuration attempt fails, you will see one of these error messages:

```
[ERROR] Could not add 10.42.0.0/16 to firewalld's trusted zone
[ERROR] Could not add 10.43.0.0/16 to firewalld's trusted zone
[ERROR] Could not reload firewalld
```

and **install-lockss** will fail.

Troubleshooting

See *Troubleshooting firewalld* for remediation details.

4. Finally, you will see the message:

```
[success] Configured firewalld for K3s
```

and **install-lockss** will successfully proceed to the next phase (*Configuring ufw for K3s*).

3.3.6 Configuring ufw for K3s

Heading

This phase begins with the heading *Configuring firewalld for ufw...*

Description

During this phase, **install-lockss** will configure **ufw** to work with K3s, if necessary.

Steps

1. If **install-lockss** was invoked with the `--skip-configure-ufw` option (implied by `--skip-install-k3s`), or if **ufw** is not present or is not active, you will see one of these messages:

```
[success] Skipping (--skip-install-k3s)
[success] Skipping (--skip-configure-ufw)
[success] Skipping (ufw is not on the PATH)
[success] Skipping (ufw is not active)
```

and **install-lockss** will successfully proceed to the next phase (*Configuring CoreDNS for K3s*).

2. If **ufw** is active, you will receive the following prompt:

```
Allow traffic from 10.42.0.0/16 and 10.43.0.0/16 via ufw?
```

Enter Y to accept the proposed **ufw** configuration or N to bypass (or hit **Enter** to accept the default in square brackets).

- If **install-lockss** was invoked with the `--assume-yes` option, Y is automatically entered for you.
- You may be prompted for your **sudo** password.

Warning: If you bypass the proposed **ufw** configuration, you will see the warning:

```
[Warning] Leaving ufw unchanged; see manual for details
```

and **install-lockss** will immediately proceed to the next phase (*Configuring CoreDNS for K3s*), but K3s may malfunction without further intervention. See *Troubleshooting ufw* for details.

3. If the **ufw** configuration attempt fails, you will see one of these error messages:

```
[ERROR] Could not allow traffic from 10.42.0.0/16 via ufw
```

```
[ERROR] Could not allow traffic from 10.43.0.0/16 via ufw
```

```
[ERROR] Could not reload ufw
```

and **install-lockss** will fail.

Troubleshooting

See *Troubleshooting ufw* for remediation details.

4. Finally, you will see the message:

```
[success] Configured ufw for K3s
```

and **install-lockss** will successfully proceed to the next phase (*Configuring CoreDNS for K3s*).

3.3.7 Configuring CoreDNS for K3s

Heading

This phase begins with the heading *Configuring CoreDNS for K3s...*

Description

During this phase, **install-lockss** will configure CoreDNS to work with K3s, if necessary.

Steps

1. If **install-lockss** was invoked with the `--skip-configure-coredns` option (implied by `--skip-install-k3s`), or if your system's DNS configuration will simply work with CoreDNS, you will see one of these messages:

```
[success] Skipping (--skip-install-k3s)
[success] Skipping (--skip-configure-dns)
[success] Using system resolv.conf files
```

and **install-lockss** will successfully proceed to the next phase (*Installing K3s*).

2. If your system's DNS configuration will not work with CoreDNS, or if **install-lockss** was invoked with the `--force-dns-prompt` option, you will receive a message including `CoreDNS does not allow a loopback address to be given to Kubernetes pods as an upstream DNS server`, and the following prompt:

IP address(es) of DNS resolvers, separated by ';'.

Enter a semicolon-separated list of DNS server IP addresses that are *not* loopback addresses. A suggested value will be offered to you in square brackets, consisting of non-loopback IP addresses collected from your machine's DNS configuration; you can simply hit **Enter** to accept the suggested value.

- If **install-lockss** was invoked with the `--assume-yes` option, the suggested value is automatically accepted without the prompt.

3. If the creation of the CoreDNS configuration file fails, you will see error messages similar to these:

```
[ERROR] Could not create /etc/lockss
[ERROR] Error rendering config/templates/k3s/resolv.conf.mustache to config/resolv.
↔conf
[ERROR] Could not copy config/resolv.conf to /etc/lockss/resolv.conf
```

and **install-lockss** will fail.

Troubleshooting

See *Troubleshooting CoreDNS* for remediation details.

4. Finally, you will see the message:

```
[success] Configured CoreDNS for K3s
```

and **install-lockss** will successfully proceed to the next phase (*Installing K3s*).

3.3.8 Installing K3s

Heading

This phase begins with the heading *Installing K3s...*

Description

During this phase, **install-lockss** will install K3s.

Steps

1. If **install-lockss** was invoked with the `--skip-install-k3s` option, you will see the message:

```
[success] Skipping (--skip-install-k3s)
```

and **install-lockss** will successfully proceed to the next phase (*Testing the K3s Node*).

2. Next, **install-lockss** will determine if K3s needs to be installed or upgraded. There are five cases:
 - a. If K3s is not present, **install-lockss** will display `K3s is not present`, and will install K3s in the next step.
 - b. If the expected version of K3s is already present, **install-lockss** will display `K3s version installed_version is already installed; skipping`, and will not install K3s in the next step.
 - c. If a more recent version of K3s is present, **install-lockss** will display `Detected K3s version installed_version is more recent than expected version expected_version`, and will not install K3s in the next step.
 - d. If an older version of K3s is present, **install-lockss** will display `Detected K3s version installed_version is older than expected version expected_version` and you will receive the following prompt:

```
Upgrade K3s from {installed_version} to {expected_version}?
```

Enter **Y** and **install-lockss** will install the newer K3s version in the next step, or **N** and **install-lockss** will not install the newer K3s version in the next step (or hit **Enter** to accept the default in square brackets).

- If **install-lockss** was invoked with the `--assume-yes` option, **Y** is automatically entered for you.

- e. If K3s is detected but the installed and expected version numbers cannot be compared automatically, you will see the following warning:

```
[Warning] Detected K3s version {installed_version}, expected version ${expected_
↵version}, comparison failure, skipping
```

and **install-lockss** will not install K3s in the next step.

3. If **install-lockss** determined in the previous step that it will not install K3s, it will display `Not installing K3s` and go to the next step.

Otherwise, it will display `Installing K3s version expected_version`, and K3s will be installed:

1. First, **install-lockss** will warn you that if the directory K3s uses to store state data (by default `/var/lib/rancher/k3s`) is space-limited, you should specify a different directory, but not one on NFS². You will see the following prompt:

² See <https://github.com/containerd/containerd/discussions/6140>.

K3s state data directory

Enter a non-NFS directory path for the K3s state directory, or simply hit **Enter** to accept the default in square brackets.

- If **install-lockss** was invoked with the `--k3s-data-dir=DIR` option, *DIR* will automatically be used without the prompt.
 - If **install-lockss** was invoked with the `--assume-yes` option, the default is automatically used without the prompt.
2. Next, the K3s Installer will be downloaded from <https://get.k3s.io/> and invoked with suitable options.

Depending on your operating system and other factors, the K3s Installer may install additional software packages or configure system components, using **sudo** if necessary (which may prompt for the user's **sudo** password).

If the K3s Installer does not succeed, it will display its own error messages, then **install-lockss** will fail.

Troubleshooting

Error messages that the K3s Installer may display include:

```
[ERROR] Failed to apply container_runtime_exec_t to /usr/local/bin/k3s, please_
↳install:
  yum install -y container-selinux selinux-policy-base
  yum install -y https://rpm.rancher.io/k3s/stable/common/centos/8/noarch/k3s-
↳selinux-0.3-0.el8.noarch.rpm

Error: Package: k3s-selinux-0.3-0.el7.noarch (rancher-k3s-common-stable)
  Requires: container-selinux >= 2.107-3
You could try using --skip-broken to work around the problem
You could try running: rpm -Va --nofiles --nodigest
```

See *Troubleshooting the K3s Installer* for remediation details.

4. Whether or not K3s was installed, **install-lockss** will store Kubernetes configuration data as the lockss user in the file `config/k8s.cfg`, relative to the LOCKSS Installer home directory. If the creation of the file fails, you will see one of these error messages:

```
[ERROR] Could not write k8s.cfg

[ERROR] Could not append to k8s.cfg
```

and **install-lockss** will fail.

Troubleshooting

Check file permission mismatches between the user running **install-lockss** and the `lockss-installer/config` directory, then try again.

5. Finally, you will see the message:

```
[success] Installed K3s
```

and **install-lockss** will successfully proceed to the next phase (*Testing the K3s Node*).

3.3.9 Testing the K3s Node

Heading

This phase begins with the heading *Testing the K3s node....*

Description

During this phase, **install-lockss** runs a series of tests to verify that the K3s node is operational.

Steps

1. If **install-lockss** was invoked with the `--skip-test-k3s` option (implied by `--skip-install-k3s`), you will see one of these messages:

```
[success] Skipping (--skip-install-k3s)
[success] Skipping (--skip-test-k3s)
```

and **install-lockss** will successfully proceed to the next phase (*Completion of the LOCKSS Installation Process*).

2. Next, **install-lockss** will run a series of tests. If a test fails, you will see one of these error messages:

```
[ERROR] k8s.cfg not found
[ERROR] Error reading K8S_FLAVOR
[ERROR] K8S_FLAVOR is not set
[ERROR] K8S_FLAVOR is not k3s
[ERROR] Error reading KUBECTL_CMD
[ERROR] KUBECTL_CMD is not set
[ERROR] k3s command of KUBECTL_CMD is not on the PATH
[ERROR] Command failed (kubectl version)
[ERROR] Timeout waiting for the K3s node to be ready
[ERROR] Command failed (kubectl get node)
[ERROR] Unexpected number of K3s nodes
[ERROR] Timeout waiting for the CoreDNS pod to be running and ready
[ERROR] Command failed (kubectl get pod)
[ERROR] Unexpected number of CoreDNS pods
```

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```
[ERROR] Timeout waiting for the DNS service to be present
[ERROR] Command failed (kubectl get service)
[ERROR] Unexpected number of kube-dns services
[ERROR] Unexpected kube-dns service type
[ERROR] Timeout waiting for DNS resolution
[ERROR] Unexpected Cluster-IP
```

and **install-lockss** will fail.

Troubleshooting

The reasons for some of these tests failing vary. Some wait for K3s to start up and retry a number of times but eventually give up, even though K3s will eventually come up fully. You can invoke just this portion of **lockss-install** by invoking:

```
install-lockss --test-k3s
```

or equivalently:

```
install-lockss -T
```

You can also alter the number of retries and the number of seconds between retries with `--retries=N` and `--wait=S` respectively.

Other problems may require reaching out to the LOCKSS support team at for assistance.

3. Finally, you will see the message:

```
[success] Tested the K3s node
```

and **install-lockss** will successfully proceed to the next phase (*Completion of the LOCKSS Installation Process*).

3.3.10 Completion of the LOCKSS Installation Process

If all phases completed successfully, you will see the message:

```
[success] Successful completion of the LOCKSS installation process
```

and **install-lockss** will terminate.

3.3.11 Checking the K3s Configuration

Tip: This section is optional.

K3s comes with **k3s check-config**, a configuration checker tool. The K3s configuration checker is capable of detecting complex underlying system situations that definitely require fixing (or applications running in the K3s cluster will not be able to function properly). On the other hand, the versions of the K3s configuration checker available at the time LOCKSS 2.0-alpha4 and LOCKSS 2.0-alpha5 were released contained bugs that reported spurious issues that are either inaccurate or moot. As a result, we have decided against running **k3s check-config** as part of **install-lockss** at this time, to avoid unnecessary interruptions in the installation of the LOCKSS system in many cases where there is no particular cause for concern.

That being said, we still recommend running **k3s check-config** and interpreting the results using the *Troubleshooting the K3s Configuration Checker* section of the manual:

1. Run this command:

```
k3s check-config
```

2. The following error messages in the output are indicative of system situations that require attention:

```
/usr/sbin iptables v1.8.2 (nf_tables): should be older than v1.8.0, newer than v1.8.
↪3, or in legacy mode (fail)

RHEL7/CentOS7: User namespaces disabled; add 'user_namespace.enable=1' to boot_
↪command line (fail)

apparmor: enabled, but apparmor_parser missing (fail)
```

Troubleshooting

See *Troubleshooting the K3s Configuration Checker* for details.

3. The following error messages in the output can be ignored:

```
cgroup hierarchy: nonexistent?? (fail)

links: aux/ip6tables should link to iptables-detect.sh (fail)
links: aux/ip6tables-restore should link to iptables-detect.sh (fail)
links: aux/ip6tables-save should link to iptables-detect.sh (fail)
links: aux/iptables should link to iptables-detect.sh (fail)
links: aux/iptables-restore should link to iptables-detect.sh (fail)
links: aux/iptables-save should link to iptables-detect.sh (fail)

swap: should be disabled

CONFIG_INET_XFRM_MODE_TRANSPORT: missing
```

Troubleshooting

See *Troubleshooting the K3s Configuration Checker* for details.

4. For other error messages, check the official [K3s documentation](#), search for [K3s issues database on GitHub](#) or the Web for resources matching your error message or operating system, and/or contact us so we can help investigate and document for future reference.
-

CONFIGURING THE LOCKSS SYSTEM

After installing the LOCKSS system, configure the system with the **configure-lockss** script by running this command in the lockss user's `lockss-installer` directory as `lockss`¹:

```
scripts/configure-lockss
```

If you have experience with classic LOCKSS daemon version 1.x, this is the equivalent of **hostconfig**.

Some notes about using **configure-lockss**:

- When run the first time, some of the questions asked by the script will have a suggested or default value, displayed in square brackets; hit **Enter** to accept the suggested value, or type the correct value and hit **Enter**.
- Any subsequent runs will use the previous values as the default value; review and hit **Enter** to leave unchanged.
- Password prompts will not display the previous value but can still be left unchanged with **Enter**.

4.1 Network Settings

4.1.1 Hostname

Prompt: *Fully qualified hostname (FQDN) of this machine*

Enter the machine's fully-qualified hostname (meaning with its domain name), for example `locksstest.myuniversity.edu`.

4.1.2 IP Address

Prompt: *IP address of this machine*

If the machine is publicly routable, meaning it has an IP address that can be used to identify it over the Internet, enter the publicly routable IP address. Otherwise, if the machine is accessible via network address translation (NAT), meaning it has an IP address that is valid only on your local network but it can be reached from the Internet via a NAT router, enter the internal IP address.

¹ See *Running Commands as the lockss User*.

4.1.3 Network Address Translation

1. Prompt: *Is this machine behind NAT?*

If the machine is publicly routable, enter N; otherwise, if the machine is not publicly routable but will be accessible via network address translation (NAT), enter Y.

2. If you answered Y, you will be asked an additional configuration question:

External IP address for NAT

Enter the publicly routable IP address of the NAT router.

4.1.4 Initial UI Subnet

Prompt: *Initial subnet(s) for admin UI access*

Enter a semicolon-separated list of subnets in CIDR or mask notation that should initially have access to the Web user interfaces (UI) of the system. The access list can be modified later via the UI.

4.1.5 Container Subnet

1. If **configure-lockss** detects a discrepancy between a previously used subnet for inter-container communication in the system and the subnet it would choose now, you may either see the warning:

Container subnet has changed from <former_subnet> to <new_subnet>

or be asked the question:

Container subnet was <former_subnet>, we think it should now be <new_subnet>. Do you want to change it?

in which case you should enter Y (recommended) or N.

2. Prompt: *LOCKSS subnet for inter-service access control*

Enter the subnet used for inter-container communication. We recommend accepting the proposed value by hitting Enter.

4.1.6 LCAP Port

Prompt: *LCAP V3 protocol port*

Enter the port on the publicly routable IP address that will be used to receive LCAP (LOCKSS polling and repair) traffic. Historically, most LOCKSS nodes use 9729.

4.2 Mail Settings

4.2.1 Mail Relay

Prompt: *Mail relay for this machine*

Enter the hostname of this machine's outgoing mail server, for example `smtp.myuniversity.edu`.

4.2.2 Mail Relay Credentials

1. Prompt: *Does the mail relay <mailhost> need a username and password?*

If the outgoing mail server does not require password authentication, enter N; otherwise, enter Y.

2. If you answered Y, you will be asked additional configuration questions:

1. Prompt: *User for <mailhost>*

Enter a username for the mail server.

2. Prompt: *Password for <mailuser>@<mailhost>*

Enter the password for the username on the mail server.

3. Prompt: *Password for <mailuser>@<mailhost> (again)*

Re-enter the password for the username on the mail server. If the two passwords do not match, the password will be asked again.

4.2.3 Administrator Email

Prompt: *E-mail address for administrator*

Enter the e-mail address of the person or team who will administer the LOCKSS system on this machine.

4.3 Preservation Network Settings

4.3.1 Configuration URL

1. Prompt: *Configuration URL*

Accept the default (<http://props.lockss.org:8001/demo/lockss.xml>) if you are not running your own LOCKSS network; otherwise, enter the URL of the LOCKSS network configuration file provided by your LOCKSS network administrator.

2. If the configuration URL begins with `https:`, you will be asked additional configuration questions:

1. Prompt: *Verify configuration server authenticity?*

Enter Y if you would like to check the authenticity of the configuration server using a custom keystore; otherwise enter N.

2. If you answered Y, you will be asked an additional configuration question:

Server certificate keystore

Enter the path of a Java keystore used to verify the authenticity of the configuration server.

4.3.2 Configuration Proxy

Prompt: *Configuration proxy (host:port)*

If the configuration URL can be reached directly, leave this blank; otherwise, if a proxy server is required to reach the configuration URL, enter its host and port in *host:port* format (for example *proxy.myuniversity.edu:8080*).

4.3.3 Preservation Groups

Prompt: *Preservation group(s)*

Accept the default (*demo*) if you are not running your own LOCKSS network; otherwise, enter a semicolon-separated list of LOCKSS network identifiers as provided by your LOCKSS network administrator, for example *ournetwork* or *prod;usdocsp1n*.

4.4 Storage Areas

The LOCKSS system needs storage areas to store data:

- One or more **content data storage areas** to store preserved content, as well as several databases.
- A **log data storage area** to store log files.
- A **temporary data storage area** to store temporary files.

Depending on your host system's layout, these storage areas may all be the same, or all be different mount points or paths.

Subdirectories will be created in each storage area to fit the needs of a system component; for example *lockss-stack-cfg-data* is the LOCKSS configuration service's content data directory in the content data storage areas, and *lockss-stack-repo-logs* is the LOCKSS repository service's log data directory in the log data storage area.

4.4.1 Content Data Storage Areas

1. Prompt: *Root path for primary content data storage*

Enter the full path of a directory to use as the root of the main storage area of the LOCKSS system, where preserved content will be stored along with several databases. It is the analog of */cache0* in the classic LOCKSS system.

2. Prompt: *Use additional directories for content data storage?*

If you want to use more than one filesystem to store preserved content, enter *Y*; otherwise, enter *N*.

3. If you answered *Y*, you will be asked an additional configuration question:

Root path for additional content data storage <count> (q to quit)

On each line, enter the full path of a directory to use as the root of an additional storage area, and enter *q* when done.

4.4.2 Log Data Storage Area

Prompt: *Root path for log data storage*

This directory is used as the root of the storage area for log files in the LOCKSS system. Accept the default (same directory as the content data storage directory root) by hitting **Enter**, or enter a custom path.

4.4.3 Temporary Data Storage Area

Prompt: *Root path for temporary data storage (local storage preferred)*

This directory is used as the root of the storage area for temporary files in the LOCKSS system. Accept the default (same directory as the content data storage directory root) by hitting **Enter**, or enter a custom path.

Tip: The LOCKSS software makes heavy use of temporary storage, and we recommend that temporary directories be placed on a filesystem with relatively low latency. If the content data storage directories are on network storage (for example NFS), system performance may be improved by supplying a local directory for temporary data storage.

Caution: Depending on the characteristics of the preservation activities undertaken by the system, in some circumstances content processing may require a substantial amount of temporary space, up to tens of gigabytes. Do not use a RAM-based `tmpfs` volume, or a directory in a space-constrained partition.

4.5 Web User Interface Settings

1. Prompt: *User name for web UI administration*

Enter a username for the primary administrative user in the LOCKSS system's Web user interfaces.

2. Prompt: *Password for web UI administration user <uiuser>*

Enter a password for the primary administrative user.

3. Prompt: *Password for web UI administration user <uiuser> (again)*

Re-enter the password for the primary administrative user. If the two passwords do not match, the password will be asked again.

4.6 Database Settings

4.6.1 PostgreSQL

Prompt: *Use embedded LOCKSS PostgreSQL DB Service?*

Select **either** option A **or** option B:

- A. Enter Y to use the **embedded PostgreSQL database**. This is recommended in most cases; a PostgreSQL database will be run and managed by the LOCKSS system internally. If you choose this option, see *Embedded PostgreSQL Database*.
- B. Enter N to use an **external PostgreSQL database**. Select this option if you wish to use an existing PostgreSQL database at your institution or one that you run and manage yourself. If you choose this option, see *External PostgreSQL Database*.

Embedded PostgreSQL Database

If you select this option, you will be asked additional configuration questions:

1. Prompt: *Password for PostgreSQL database*

Enter the password for the embedded PostgreSQL database.

Warning: This prompt is used to record the PostgreSQL database password in the LOCKSS system's configuration. If you change the value of the PostgreSQL database password here without actually changing the PostgreSQL database password, the LOCKSS system components will no longer be able to connect to the PostgreSQL database. See *Working with PostgreSQL* for details.

2. Prompt: *Password for PostgreSQL database (again)*

Re-enter the password for the embedded PostgreSQL database. If the two passwords do not match, the password will be asked again.

3. Complete the *Solr* section next.

External PostgreSQL Database

If you select this option, you will be asked additional configuration questions:

1. Prompt: *Fully qualified hostname (FQDN) of PostgreSQL host*

Enter the hostname of the external PostgreSQL database, for example `postgres.myuniversity.edu`.

2. Prompt: *Port used by PostgreSQL host*

Enter the port where the external PostgreSQL database can be reached, for example 5432.

3. Prompt: *Schema for PostgreSQL service*

Enter the schema name to be used by the LOCKSS system. The schema name used in the embedded PostgreSQL database is LOCKSS, but your database administrator may assign a different schema name to you.

4. Prompt: *Database name prefix for PostgreSQL service*

Enter the prefix to use for any LOCKSS-related database names in the schema. The database name prefix in the embedded PostgreSQL database is Lockss (note the uppercase/lowercase), but your database administrator may assign a different database name prefix.

5. Prompt: *Login name for PostgreSQL service*

Enter the username for the external PostgreSQL database. The username in the embedded PostgreSQL database is LOCKSS, but your database administrator may assign a different username to you.

6. Prompt: *Password for PostgreSQL database*

Enter the password for the username in the external PostgreSQL database.

Warning: This prompt is used to record the PostgreSQL database password in the LOCKSS system's configuration. If you change the value of the PostgreSQL database password here without actually changing the PostgreSQL database password, the LOCKSS system components will no longer be able to connect to the PostgreSQL database. Contact your PostgreSQL database administrator for details.

7. Prompt: *Password for PostgreSQL database (again)*

Re-enter the password for the username in the external PostgreSQL database. If the two passwords do not match, the password will be asked again.

8. Complete the *Solr* section next.

4.6.2 Solr

Prompt: *Use embedded LOCKSS Solr Service?*

Select **either** option A **or** option B:

- A. Enter Y to use the **embedded Solr database**. This is recommended in most cases; a Solr database will be run and managed by the LOCKSS system internally. If you choose this option, see *Embedded Solr Database*.
- B. Enter N to use an **external Solr database**. Select this option if you wish to use an existing Solr database at your institution or one that you run and manage yourself. If you choose this option, see *External Solr Database*.

Embedded Solr Database

If you select this option, you will be asked additional configuration questions:

1. Prompt: *User name for LOCKSS Solr access*

Enter the username for the embedded Solr database.

2. Prompt: *Password for LOCKSS Solr access*

Enter the password for the username in the embedded Solr database.

3. Prompt: *Password for LOCKSS Solr access (again)*

Re-enter the password for the username in the embedded Solr database. If the two passwords do not match, the password will be asked again.

4. Complete the *Metadata Query Service* section next.

External Solr Database

If you select this option, you will be asked additional configuration questions:

1. Prompt: *Fully qualified hostname (FQDN) of Solr host*

Enter the hostname of the external Solr database server, for example `solr.myuniversity.edu`.

2. Prompt: *Port used by Solr host:*

Enter the port used by the database server on the Solr host, for example 8983.

3. Prompt: *Solr core repo name:*

Enter name of the Solr core for the LOCKSS repository. The Solr core name used in the embedded Solr database is `lockss-repo`, but your database administrator may assign a different Solr core name.

4. Prompt: *User name for LOCKSS Solr access*

Enter the username for the external Solr database.

5. Prompt: *Password for LOCKSS Solr access*

Enter the password for the username in the external Solr database.

6. Prompt: *Password for LOCKSS Solr access (again)*

Re-enter the password for the username in the external Solr database. If the two passwords do not match, the password will be asked again.

7. Complete the *Metadata Query Service* section next.

4.7 LOCKSS Services

4.7.1 Metadata Query Service

Prompt: *Use LOCKSS Metadata Query Service?*

Enter Y if you want the metadata query service to be run, otherwise N.

4.7.2 Metadata Extraction Service

Prompt: *Use LOCKSS Metadata Extraction Service?*

Enter Y if you want the metadata extraction service to be run, otherwise N.

4.8 Web Replay Settings

4.8.1 Pywb

Prompt: *Use LOCKSS Pywb Service?*

Enter Y to run an embedded Pywb engine for Web replay; otherwise, enter N.

4.8.2 OpenWayback

1. Prompt: *Use LOCKSS OpenWayback Service?*

Enter Y to use an embedded OpenWayback engine for Web replay; otherwise, enter N.

2. If you answered Y, you will be asked an additional configuration question:

Okay to turn off authentication for read-only requests for LOCKSS Repository Service?

OpenWayback currently does not supply user credentials when reading content from the LOCKSS repository, so the repository must be configured to respond to unauthenticated read requests. Enter Y to accept this, otherwise you will see the warning:

Not enabling OpenWayback Service

and OpenWayback will not be run.

4.9 Final Steps

1. Prompt: *OK to store this configuration?*

Enter Y if the configuration values are to your liking; otherwise, enter N to make edits.

2. If you answer Y, **configure-lockss** will perform the final configuration steps. You may be asked to confirm before directories are created for the first time:

<directory> does not exist; shall I create it?

or before directory permissions are changed:

<directory> is not writable; shall I chown it?

In each case, enter Y for "yes" and N for "no".

RUNNING THE LOCKSS SYSTEM

The commands in this section are all run as the `lockss` user¹ in the `lockss` user's `lockss-installer` directory.

5.1 Starting the LOCKSS System

Run `scripts/start-lockss`. This script will call in turn:

- `scripts/generate-lockss`: This script takes your configuration data and turns it into a set of configuration files containing the right values.
- `scripts/assemble-lockss`: This script puts the configuration files and puts them in the right places, and ensures that all storage volumes are ready for use (creating them if necessary).
- `scripts/deploy-lockss`: This script deploys your LOCKSS stack by invoking Kubernetes.

The `start-lockss` accepts some options:

--update (-u)

Force the system to check for newer container images of the system's components (LOCKSS services, embedded databases, embedded Web replay engines...) before deploying the system to Kubernetes.

--wait (-w)

After deploying the system to Kubernetes and waiting for the system's containers to come up, additionally wait for an internal signal from the system that the system's components are fully initialized. (Currently this internal signal comes from the poller service.)

5.2 Shutting down the LOCKSS System

Run `scripts/stop-lockss`.

¹ See *Running Commands as the lockss User*

5.3 Restarting a Running LOCKSS System

Run `scripts/restart-lockss`.

The `restart-lockss` accepts the same options as `start-lockss`.

5.4 Removing a Configured LOCKSS System

To remove all configurations, volumes and networks configured by the LOCKSS system in Kubernetes, run `scripts/uninstall-lockss`. This will **not** remove files from the persistent store.

USING THE LOCKSS SYSTEM

This chapter describes how to use the LOCKSS system.

These sections are under construction. The user interface of the LOCKSS 2.x is currently largely similar to that of the classic LOCKSS system (1.x); you can refer to the classic LOCKSS system manual in the meantime for similar information.

6.1 Using the LOCKSS Configuration Service

Note: This page is under construction.

6.1.1 Accessing the Web User Interface

If you are already connected to the Web user interface (UI) of another component of the LOCKSS System, click *Config Service* in the top-left menu.

Alternatively, if your primary hostname is <HOST>, you can use your browser to connect to the LOCKSS Configuration Service Web user interface (UI) at <http://<HOST>:24621>.

Enter your Web UI username and password to login if prompted.

6.1.2 Adding Archival Units

To add AUs to the system for preservation:

1. In the top-right menu, click *Journal Configuration*.
2. In the center menu, click *Add AUs*.
3. Select one or more collections of AUs by selecting the checkbox next to the appropriate collection.
4. Click the *Select AUs* button. It may take a bit of time (60+ seconds) for the next screen to appear, while the list of AUs is built.
5. Select one or more AUs from the AU list. You may click *Select All* if you would like to select all AUs. If you choose to use select all AUs, please note that the next step may take some time to load.
6. Click the *Add Selected AUs* button. The time it takes for the page to refresh depends on the number of AUs added. Give the LOCKSS system some time to load the AUs and reload the page before moving on.
7. A screen will show a list of added AUs. Crawling of these new AUs will start automatically -- no further action is necessary unless prompted by a footnote next to an AU's name.

6.1.3 Configuring a Crawl Proxy

If Web crawls must be routed through a Web proxy:

1. In the top-right menu, click *Content Access Options*.
2. In the center menu, click *Proxy Client Options*.
3. Select the *Proxy crawls* checkbox.
4. Enter the hostname and port of the Web proxy in the *HTTP Proxy host* and *Port* text areas, respectively.
5. Click the *Update Proxy Client* button.

6.1.4 Managing Access to the Web User Interfaces

This section is under construction.

6.2 Using the LOCKSS Crawler Service

Note: This page is under construction.

6.2.1 Accessing the Web User Interface

Note: Currently the crawler service is run as part of the poller service.

If you are already connected to the Web user interface (UI) of another component of the LOCKSS System, click *Crawler Service* in the top-left menu.

Alternatively, if your primary hostname is *<HOST>*, you can use your browser to connect to the LOCKSS Configuration Service Web user interface (UI) at `http://<HOST>:24631`.

Enter your Web UI username and password to login if prompted.

6.2.2 Monitoring Crawl Status in the System

The Crawl status of all configured AUs is available in the Archival Unit table

1. In the top-right menu, click *Daemon Status*.
2. Open the control in the middle of the screen that says *Overview* and select *Archival Units:guilabel:* from the drop down menu.
 - If prompted, enter your Username and Password again.
 - It will take a bit of time for the next screen to appear while the AU list is being built.
3. The Archival Units screen lists statistics for each configured AU
 - the *Last Successful Crawl* column provides a timestamp of the most recent successful crawl.
 - the *Last Crawl Start* column provides a timestamp of the last attempted crawl.
 - the *Last Crawl Result* column provides the exit status of the last attempted crawl.

6.2.3 Causing an Archival Unit to Crawl

Archival units (AUs) that have been added to the system for preservation crawl periodically, but you can cause an AU to crawl on demand:

1. In the top-right menu, click *Debug Panel*.
2. Select an AU in the *AU Actions: select AU* drop-down list.
3. Click the *Start Crawl* button.
4. If the AU has crawled recently, you will be prompted to confirm that you wish to override the usual recrawl interval by clicking on the *Force Start Crawl* button.

6.2.4 Crawl Status Screen

To inspect the state of crawls, access the *Crawl Status* screen:

1. In the top-right menu, click *Daemon Status*.
2. In the center drop-down list, select *Crawl Status*. Alternatively, in the center overview, click on the second line, which says "*N* active crawls".

Top-Level Crawl Information

The top left of the Crawl Status table contains the number of active, successful or failed crawls, and a countdown until the next time the system will look at the AUs being preserved and pick some that are ready to crawl or recrawl.

Crawl Status Entry

Each line in the Crawl Status table contains:

- The name of the AU
- The type of crawl
- The start time of the crawl
- The duration of a finished or in-progress crawl
- The status of the crawl
- The number of bytes fetched over the network as part of the crawl
- The number of URLs fetched as part of the crawl
- The number of URLs parsed for more links
- The number of URLs remaining to be fetched as part of this crawl
- The number of URLs encountered as part of this crawl but excluded from being fetched
- The number of URLs fetched as part of the crawl, that received an HTTP Not Modified response
- The number of URLs that caused errors as part of this crawl
- The number of different content types encountered as part of the crawl

Most of these values can be clicked to see a list of the corresponding objects.

6.3 Using the LOCKSS Poller Service

Note: This page is under construction.

6.3.1 Accessing the Web User Interface

If you are already connected to the Web user interface (UI) of another component of the LOCKSS System, click *Poller Service* in the top-left menu.

Alternatively, if your primary hostname is `<HOST>`, you can use your browser to connect to the LOCKSS Configuration Service Web user interface (UI) at `http://<HOST>:24631`.

Enter your Web UI username and password to login if prompted.

6.3.2 Requesting Polls

This section is under construction.

6.3.3 Monitoring Polling and Voting

This section is under construction.

6.4 Using the LOCKSS Metadata Extraction Service

Note: This page is under construction.

6.4.1 Accessing the Web User Interface

If you are already connected to the Web user interface (UI) of another component of the LOCKSS System, click *Metadata Extraction Service* in the top-left menu.

Alternatively, if your primary hostname is `<HOST>`, you can use your browser to connect to the LOCKSS Configuration Service Web user interface (UI) at `http://<HOST>:24641`.

Enter your Web UI username and password to login if prompted.

6.4.2 Requesting Metadata Extraction

This section is under construction.

6.5 Using the LOCKSS Metadata Service

Note: This page is under construction.

6.5.1 Accessing the Web User Interface

If you are already connected to the Web user interface (UI) of another component of the LOCKSS System, click *Metadata Service* in the top-left menu.

Alternatively, if your primary hostname is `<HOST>`, you can use your browser to connect to the LOCKSS Configuration Service Web user interface (UI) at `http://<HOST>:24651`.

Enter your Web UI username and password to login if prompted.

6.5.2 Requesting Metadata Information

This section is under construction.

6.6 Replaying Web Content with Pywb

6.6.1 Accessing the Pywb User Interface

Given that your primary hostname is `samp:{<HOST>}`, you can use your browser to connect to the Pywb user interface (UI) at `http://<HOST>:8080`.

6.6.2 Replaying a URL

To view a URL from Pywb:

1. The Pywb screen provides a list of links to available collections. Click on the top-most collection which should be `/lockss`.
2. Enter the URL you want to replay in the URL search box.
3. Click the *Search* button.
4. Replay the most recent URL by clicking on the topmost entry of the third column.

6.6.3 Finding a URL From an AU to Replay

There are multiple ways to discover URLs belonging to an AU in the Configuration Service UI:

1. Obtaining a URL by clicking on "pages fetched" inside of crawl status
 - In the top-right menu, click *Daemon Status*.
 - Open the control in the middle of the screen that says *Overview* and select *Crawl Status* from the drop down menu.
 - Picking an AU from the active crawls, click on the number associated with *Pages Fetched* to bring up a list of URLs that have been crawled.

- Copy one of the URLs and paste it in the Pywb interface as described previously.
2. Obtaining a Substance URL
 - In the top-right menu, click *Daemon Status*.
 - Open the control in the middle of the screen that says *Overview* and select *Archival Units* from the drop down menu. If prompted, enter your Username and Password again. It will take a bit of time for the next screen to appear while the AU list is being built.
 - Select an AU by clicking on the AU title in the first column.
 - Open the *Substance URLs* link
 - Copy one of the URLs and paste it in the Pywb interface as described previously.

6.7 Replaying Web Content with OpenWayback

6.7.1 Accessing the OpenWayback User Interface

Given that your primary hostname is `samp:{<HOST>}`, you can use your browser to connect to the Pywb user interface (UI) at `http://<HOST>:8080/wayback`.

6.7.2 Replaying a URL

To view a URL from OpenWayback:

1. Enter the URL you want to replay in the URL search box.
2. Click the *Search* button.
3. Select the *Year* or leave as :guilabel: `All`*
4. Click *Take Me Back*.

6.7.3 Finding a URL From an AU to Replay

There are multiple ways to discover URLs belonging to an AU in the Configuration Service UI:

1. Obtaining a URL by clicking on "pages fetched" inside of crawl status
 - In the top-right menu, click *Daemon Status*.
 - Open the control in the middle of the screen that says *Overview* and select *Crawl Status* from the drop down menu.
 - Picking an AU from the active crawls, click on the number associated with *Pages Fetched* to bring up a list of URLs that have been crawled.
 - Copy one of the URLs and paste it in the OpenWayback interface as described previously.
2. Obtaining a Substance URL
 - In the top-right menu, click *Daemon Status*.
 - Open the control in the middle of the screen that says *Overview* and select *Archival Units* from the drop down menu. If prompted, enter your Username and Password again. It will take a bit of time for the next screen to appear while the AU list is being built.
 - Select an AU by clicking on the AU title in the first column.

- Open the *Substance URLs* link
- Copy one of the URLs and paste it in the OpenWayback interface as described previously.

6.8 Using the Kubernetes Dashboard

Kubernetes comes with the [Kubernetes Dashboard](#), a web-based user interface (UI).

To facilitate installing and interacting with the Kubernetes Dashboard, the LOCKSS Installer offers the `dashboard-util` script.

6.8.1 Installing the Kubernetes Dashboard

To install the Kubernetes Dashboard, run this command¹:

```
scripts/dashboard-util --install
```

If the installation succeeds, the program will also display the login URL and the bearer token.

6.8.2 Accessing the Kubernetes Dashboard

To access the Kubernetes Dashboard:

1. Create a secure channel to your K3s cluster with the following command:

```
k3s kubectl proxy &
```

Note: This command runs in the background "forever".

2. Obtain the login URL with the following command:

```
scripts/dashboard-util --url
```

3. Obtain the login token with the following command:

```
scripts/dashboard-util --token
```

4. Open a browser and go to the login URL.
5. Make sure the *Token* radio button is selected.
6. Copy and paste the login token into the *Enter token* text field.

¹ This command is relative to the lockss user's `lockss-installer` directory.

6.8.3 Using the Kubernetes Dashboard UI

When the dashboard comes up, it will be in the default namespace. Click on the namespace pull-down menu near the top and select the `lockss` namespace to see the LOCKSS components. If all of your deployments are running and ready, the three circles at the top should be green. In the left hand panel you can select the components you are interested in:

- Click on *Services* to see the cluster IP for each of the running services. You can click on a specific service to see more detailed information.
- Click on *Deployments* to see a list of services and their CPU and memory usage. You can access specific services and deployments from here.
- Click on *Pods*. This will give you information about all the pods running. Click on a pod of interest to obtain more granular information:

View logs

Since LOCKSS output logs are persisted to a local directory, there will be very little in the Kubernetes logs if the container came up without errors.

Exec into pods

This will open a terminal window into the container.

Edit the pod resource

This will allow you to view and edit the YAML file which was used to start the pod. The edit will not persist on restart.

Delete the pod

While this will delete the current pod, a new pod will be spawned by the deployment with a new pod ID.

6.8.4 Updating the Kubernetes Dashboard

To update the Kubernetes Dashboard to the most recent release, run this command^{Page 43, 1}:

```
scripts/dashboard-util --update
```

6.8.5 Removing the Kubernetes Dashboard

To remove the Kubernetes Dashboard from the `kubernetes-dashboard` namespace, run this command^{Page 43, 1}:

```
scripts/dashboard-util --remove
```

See Also

- [Web UI \(Dashboard\)](#) on the Kubernetes website.
-

TROUBLESHOOTING THE LOCKSS SYSTEM

This chapter contains pages of additional information about troubleshooting the LOCKSS system.

Sections include guidance for troubleshooting networking-related components like **iptables**, **firewalld**, and **ufw**, and K3s-related components like CoreDNS, the K3s Installer, the K3s Configuration Checker.

7.1 Known Issues

This page was last updated: 2021-07-07.

- **Security**

- In the "alpha" phase of development of LOCKSS 2.0, there are no access controls on Kubernetes' API. It is not accessible from outside the machine, but any local user can access the API, so they can stop the LOCKSS containers, change their contents, read secrets, etc. We plan to enable access controls in the "beta" phase.
- In the Classic LOCKSS system (1.x), the LCAP SSL key could only be read by **root**, but now it can also be read by **lockss**.

- **DNS Resolution**

K3s' default DNS cache timeout is 30 seconds, which results in enough repetitive upstream queries to trigger alarms at some institutions. One remediation is to change the CoreDNS configuration by editing its configmap.

With K3s, changes made to CoreDNS's configmap with **kubect1 apply** do not persist, because the configmap is constantly reloaded from `/var/lib/rancher/k3s/server/manifests/coredns.yaml`. Additionally, K3s overwrites the file with the defaults at startup, so changes there are not really persistent either.

The LOCKSS Installer offers the script `scripts/coredns-cron-hack`, which sets the CoreDNS cache timeout to 30 minutes. It should be run once, as **root**, after each time K3s starts. Absent a good way to do that, it is harmless to run it periodically from **root**'s crontab. The recommended use is to copy it to a **root**-owned file in `/etc/cron.hourly`.

- **Harmless PID File Errors**

The `stdout` log files of the various LOCKSS service containers contain the following error messages at startup:

```
/usr/local/bin/docker-entrpoint: line 374: can't create /var/run/docker-entrpoint.  
↪pid: Permission denied
```

This is harmless and will be addressed in the next release of the system.

7.2 Troubleshooting iptables

This section provides troubleshooting information for the *Configuring iptables for K3s* phase of *Running the LOCKSS Installer*.

7.2.1 Switch iptables to legacy mode via Alternatives

K3s 1.21.5+k3s1 (the version used by LOCKSS 2.0-alpha5) does not always work with **iptables** version 1.8.0-1.8.3 when run via Alternatives but not in legacy mode, for instance in some Debian or Ubuntu systems¹. If **install-lockss** detects this situation, you will see a warning message and the following prompt²:

Switch iptables to legacy mode via Alternatives?

Enter Y to accept the proposed **iptables** configuration. **If you bypass the proposed configuration, K3s may malfunction.**

The remediation attempted by **install-lockss** is equivalent to:

```
# Required only if ufw is active
ufw disable

# Required
update-alternatives --set iptables /usr/sbin/iptables-legacy

# Required
update-alternatives --set ip6tables /usr/sbin/ip6tables-legacy

# Optional
update-alternatives --set arptables /usr/sbin/arptables-legacy

# Optional
update-alternatives --set ebtables /usr/sbin/ebtables-legacy

# Required only if ufw was active
ufw enable
```

¹ References:

- <https://rancher.com/docs/k3s/latest/en/known-issues/>
- <https://github.com/kubernetes/kubernetes/issues/71305>
- <https://github.com/k3s-io/k3s/issues/116>
 - <https://github.com/k3s-io/k3s/issues/116#issuecomment-624770403>
- <https://github.com/k3s-io/k3s/issues/703>

² See *Configuring iptables for K3s*.

7.2.2 Post-Installation Changes to iptables

If your system did not initially need an adjustment for **iptables** at the time K3s was installed, but later does (for example because **iptables** is upgraded from a pre-1.8.0 version to version 1.8.0 or later), run this command (relative to the *LOCKSS Installer Directory*) as a privileged user who can become root via **sudo**³:

```
scripts/install-lockss --configure-iptables
```

This will run only the *Configuring iptables for K3s* phase of **install-lockss**.

7.3 Troubleshooting firewalld

This section provides troubleshooting information for the *Configuring firewalld for K3s* phase of *Running the LOCKSS Installer*.

7.3.1 Add 10.42.0.0/16 and 10.43.0.0/16 to firewalld's trusted zone

If your system is running the **firewalld** firewall, it is necessary to add K3s' pod and service subnets¹ to **firewalld**'s trusted zone for K3s to work properly². If **install-lockss** detects this situation, you will see a warning message and the following prompt³:

```
Add 10.42.0.0/16 and 10.43.0.0/16 to firewalld's trusted zone?
```

Enter Y to accept the proposed **firewalld** configuration. **If you bypass the proposed configuration, K3s may malfunction.**

The **firewalld** configuration attempted by **install-lockss** is equivalent to^{Page 47, 1}:

```
firewall-cmd --permanent --zone=trusted --add-source=10.42.0.0/16

firewall-cmd --permanent --zone=trusted --add-source=10.43.0.0/16

firewall-cmd --reload
```

³ See *Running Commands as a Privileged User*.

¹ By default, K3s' pod subnet is 10.42.0.0/16 and service subnet is 10.43.0.0/16.

² For operating systems in the RHEL family (CentOS, Rocky Linux, AlmaLinux...), the action recommended by the K3s manual is to disable **firewalld** entirely (see <https://rancher.com/docs/k3s/latest/en/advanced/#additional-preparation-for-red-hat-centos-enterprise-linux>), but **install-lockss** takes a lighter approach commonly used in the K3s community.

References:

- <https://github.com/k3s-io/k3s/issues/1556>
 - <https://github.com/k3s-io/k3s/issues/1556#issuecomment-604112415>

³ See *Configuring firewalld for K3s*.

7.3.2 Post-Installation Changes to firewalld

If your system did not initially use **firewalld** at the time K3s was installed, but later does (for example because **firewalld** becomes enabled), run this command (relative to the *LOCKSS Installer Directory*) as a privileged user who can become root via **sudo**⁴:

```
scripts/install-lockss --configure-firewalld
```

This will run only the *Configuring firewalld for K3s* phase of **install-lockss**.

7.4 Troubleshooting ufw

This section provides troubleshooting information for the *Configuring ufw for K3s* phase of *Running the LOCKSS Installer*.

7.4.1 Allow traffic from 10.42.0.0/16 and 10.43.0.0/16 via ufw

If your system is running the **ufw** firewall, it is necessary to allow traffic from K3s' pod and service subnets¹ via **ufw** for K3s to work properly². If **install-lockss** detects this situation, you will see a warning message and the following prompt³:

Allow traffic from 10.42.0.0/16 and 10.43.0.0/16 via ufw?

Enter Y to accept the proposed **ufw** configuration. **If you bypass the proposed configuration, K3s may malfunction.**

The **firewalld** configuration attempted by **install-lockss** is equivalent to^{Page 48, 1}:

```
ufw allow from 10.42.0.0/16 to any
ufw allow from 10.43.0.0/16 to any
ufw reload
```

7.4.2 Post-Installation Changes to ufw

If your system did not initially use **ufw** at the time K3s was installed, but later does (for example because **ufw** becomes enabled), run this command (which is relative to the *LOCKSS Installer Directory*) as a privileged user who can become root via **sudo**⁴:

```
scripts/install-lockss --configure-ufw
```

This will run only the *Configuring ufw for K3s* phase of **install-lockss**.

⁴ See *Running Commands as a Privileged User*.

¹ By default, K3s' pod subnet is 10.42.0.0/16 and service subnet is 10.43.0.0/16.

² References:

- <https://github.com/k3s-io/k3s/issues/1280>
 - <https://github.com/k3s-io/k3s/issues/1280#issuecomment-663269728>

³ See *Configuring ufw for K3s*.

⁴ See *Running Commands as a Privileged User*.

7.5 Troubleshooting CoreDNS

This section provides troubleshooting information for the *Configuring CoreDNS for K3s* phase of *Running the LOCKSS Installer*.

7.5.1 CoreDNS does not allow a loopback address to be given to Kubernetes pods as an upstream DNS server

If both `/etc/resolv.conf` and `/run/systemd/resolve/resolv.conf` (files used to list the IP address of DNS servers) contain loopback addresses, CoreDNS (a component of the K3s Kubernetes cluster that handles DNS resolution) will not work properly¹. If `install-lockss` detects this situation, you will see a warning message including CoreDNS does not allow a loopback address to be given to Kubernetes pods as an upstream DNS server, and the following prompt²:

IP address(es) of DNS resolvers, separated by ';'.

Enter a semicolon-separated list of DNS server IP addresses that are *not* loopback addresses or hit `Enter` to accept the proposed value.

7.5.2 Post-Installation Changes to DNS

If the DNS settings of your system change after K3s is initially installed (for example if DNS servers are added or removed), run this command (which is relative to the *LOCKSS Installer Directory*) as a privileged user who can become root via `sudo`³:

```
scripts/install-lockss --configure-coredns
```

This will run only the *Configuring CoreDNS for K3s* phase of `install-lockss`.

7.6 Troubleshooting the K3s Installer

This section provides troubleshooting information for the *Installing K3s* phase of *Running the LOCKSS Installer*.

The LOCKSS Installer's `install-lockss` script installs K3s by executing Rancher's official K3s Installer² from <https://get.k3s.io/> after making sure various firewall and DNS issues are addressed³⁴⁵⁶. However, the installer can still run into issues and fail. Some of the error messages you might encounter are documented below, but you may need to refer to the official [K3s documentation](#) or use a search engine to look up the specific error message.

¹ References:

- <https://coredns.io/plugins/loop/#troubleshooting-loops-in-kubernetes-clusters>

² See *Configuring CoreDNS for K3s*.

³ See *Running Commands as a Privileged User*.

² See *Installing K3s*.

³ See *Configuring iptables for K3s*.

⁴ See *Configuring firewalld for K3s*.

⁵ See *Configuring ufw for K3s*.

⁶ See *Configuring CoreDNS for K3s*.

7.6.1 Failed to apply container_runtime_exec_t to /usr/local/bin/k3s

In some Fedora systems, the K3s installer may fail with an error message similar to the following:

```
[ERROR] Failed to apply container_runtime_exec_t to /usr/local/bin/k3s, please install:
  yum install -y container-selinux selinux-policy-base
  yum install -y https://rpm.rancher.io/k3s/stable/common/centos/8/noarch/k3s-selinux-
↪0.3-0.el8.noarch.rpm
```

The specific commands and version numbers may vary from the example above.

To resolve this problem:

1. Run the recommended commands as root⁷.
2. Re-run **install-lockss**¹.

7.6.2 k3s-selinux requires container-selinux

In some Oracle Linux 7 systems, you may see an error message similar to the following:

```
Error: Package: k3s-selinux-0.3-0.el7.noarch (rancher-k3s-common-stable)
  Requires: container-selinux >= 2.107-3
You could try using --skip-broken to work around the problem
You could try running: rpm -Va --nofiles --nodigest
```

The specific commands and version numbers may vary from the example above.

This can occur in environments where the Oracle Linux 7 Addons Yum repository is not enabled by default, so Rancher's official K3s installer is unable to install the package `container-selinux` automatically.

To resolve this problem:

1. Run the following command as root^{Page 50, 7}:

```
yum-config-manager --enable ol7_addons
```

2. Re-run **install-lockss**¹.
-

7.7 Troubleshooting the K3s Configuration Checker

This section provides troubleshooting information for the optional *Checking the K3s Configuration* phase of *Running the LOCKSS Installer*.

After installing K3s², you may optionally run the K3s configuration checker **k3s check-config**³. This configuration checker runs through a more extensive series of tests, covering "required", "generally necessary", and "optional" system aspects needed by K3s.

Some failures, especially in "optional" aspects, may not actually prevent the cluster from working normally, in the limited ways the LOCKSS system uses Kubernetes. Some of the error messages you might encounter are documented

⁷ See *Running Commands as root*.

¹ See *Running the LOCKSS Installer*.

² See *Installing K3s*.

³ See *Checking the K3s Configuration*.

below, but you may need to refer to the official [K3s documentation](#) or use a search engine to look up the specific error message.

7.7.1 iptables should be older than v1.8.0, newer than v1.8.3, or in legacy mode

In some instances, you may encounter an error message similar to the following:

```
/usr/sbin iptables v1.8.2 (nf_tables): should be older than v1.8.0, newer than v1.8.3,
↳or in legacy mode (fail)
```

In previous versions of K3s, this error message was also sometimes phrased as `should be older than v1.8.0 or in legacy mode`.

The `install-lockss` script should detect this situation and offer to switch `iptables` to legacy mode via Alternatives (see *Troubleshooting iptables*). If the error above occurs:

- Verify that the *Configuring iptables for K3s* phase of `install-lockss` was not skipped.
- Verify that, if applicable, the proposed `iptables` configuration changes in the *Configuring iptables for K3s* phase of `install-lockss` were not bypassed.
- Using the *Troubleshooting iptables* section as reference, verify that the remediation attempted by `install-lockss` has taken effect.
- Search the [K3s issues database](#) for issues related to `k3s check-config`, `iptables` and your operating system.

7.7.2 User namespaces disabled

In the RHEL 7 family of operating systems (CentOS 7, EuroLinux 7, Scientific Linux 7...), you may receive the following error message:

```
RHEL7/CentOS7: User namespaces disabled; add 'user_namespace.enable=1' to boot command.
↳line (fail)
```

To resolve this issue⁵:

1. Edit the file `/etc/default/grub` as root⁷.

1. Look for the line beginning with `GRUB_CMDLINE_LINUX=`, for example:

```
GRUB_CMDLINE_LINUX="no_timer_check console=tty0 console=ttyS0,115200n8 net.
↳ifnames=0 biosdevname=0 elevator=noop crashkernel=auto"
```

2. Add `user_namespace.enable=1` to the space-separated list of boot arguments, for instance:

```
GRUB_CMDLINE_LINUX="user_namespace.enable=1 no_timer_check console=tty0
↳console=ttyS0,115200n8 net.ifnames=0 biosdevname=0 elevator=noop
↳crashkernel=auto"
```

2. Run the following command as root:

⁵ References:

- <https://fortuitousengineer.com/installing-kubernetes-k3s-on-centos-rhel-hosts/>

⁷ See *Running Commands as root*.

```
grub2-mkconfig -o /boot/grub2/grub.cfg
```

3. Reboot the system.
4. Re-run **k3s check-config**³.

7.7.3 apparmor enabled but apparmor_parser missing

In some OpenSUSE systems, you may receive the following error:

```
apparmor: enabled, but apparmor_parser missing (fail)
```

This is because a common tool found in most Linux environments is not installed by default in some OpenSUSE versions.

To resolve this issue, run these **zypper** commands as **root**^{Page 51, 7}:

```
zypper refresh
zypper --non-interactive install apparmor-parser
```

or equivalently:

```
zypper refresh
zypper -n install apparmor-parser
```

7.7.4 cgroup hierarchy nonexistent

In some Arch Linux, Debian and Fedora systems, you may see the following error message:

```
cgroup hierarchy: nonexistent?? (fail)
```

K3s supports cgroup2 but **k3s check-config** version 1.21.5+k3s1 (used in LOCKSS 2.0-alpha5) does not process this condition correctly. **This warning can be ignored.**

7.7.5 links: aux/iptables should link to iptables-detect.sh

In some Fedora and OpenSUSE systems, you may encounter six related error messages like the following:

```
links: aux/ip6tables should link to iptables-detect.sh (fail)
links: aux/ip6tables-restore should link to iptables-detect.sh (fail)
links: aux/ip6tables-save should link to iptables-detect.sh (fail)
links: aux/iptables should link to iptables-detect.sh (fail)
links: aux/iptables-restore should link to iptables-detect.sh (fail)
links: aux/iptables-save should link to iptables-detect.sh (fail)
```

This is due to a bug in **k3s check-config**⁶, triggered in environments where there is no **iptables** system package installed. **This warning can be ignored.**

⁶ Reference:

- <https://github.com/k3s-io/k3s/issues/4066>
 - <https://github.com/k3s-io/k3s/issues/4066#issuecomment-925137706>

7.7.6 swap should be disabled

This warning can be ignored:

```
swap: should be disabled
```

7.7.7 CONFIG_INET_XFRM_MODE_TRANSPORT missing

This warning can be ignored:

```
CONFIG_INET_XFRM_MODE_TRANSPORT: missing
```


SYSTEM ADMINISTRATION TASKS

This chapter covers some common system administration tasks related to running a LOCKSS system.

Sections include how to run commands as the `root` user, a privileged user who can become `root` via `sudo`, or the `lockss` user; how to update a Linux operating system; and how to install various system utilities like `curl` or `wget`.

8.1 Running Commands as `root`

Some commands or scripts in this manual are intended to be run as `root`. This section describes two methods for doing so.

8.1.1 Running Commands as `root` With `sudo`

If you are logged in as a user who can run commands as `root` via `sudo`, simply add the following in front of the command listed in the manual¹:

```
sudo ...
```

For example, if the command listed in the manual is `iptables -F`, you would type `sudo iptables -F`.

8.1.2 Running Commands Directly as `root`

If you are logged in as `root` directly, you can simply run the command as listed in the manual, for example `iptables -F`.

See Also

- *Running Commands as a Privileged User*
- *Running Commands as the `lockss` User*

¹ Depending on your system's `sudo` configuration, you may be prompted for the user's `sudo` password.

8.2 Running Commands as a Privileged User

Some commands or scripts in this manual are intended to be run as a privileged user who can become root via **sudo**. Compared to running an entire command or script directly as root (see *Running Commands as root*), this approach has the security advantage of being granular -- only those portions of the command or script that require root privileges will have root privileges.

To run a command in this context, simply type the command listed in the manual. Depending on your system's **sudo** configuration, you may be prompted for the user's **sudo** password.

See Also

- *Running Commands as root*
- *Running Commands as the lockss User*

8.3 Running Commands as the lockss User

Unless otherwise noted, most commands in this manual are intended to be run as the lockss user (oftentimes in the lockss user's lockss-installer directory). This section describes two methods for doing so.

8.3.1 Running Commands as lockss With sudo

If you are logged in as a user who can run commands as lockss via **sudo**:

- You can start a Bash shell session as the lockss user and run any number of commands in it:

1. Run this command¹:

```
sudo -i -u lockss
```

Tip: You can also use the slightly shorter version `sudo -iu lockss`.

2. Run commands as they are listed in the manual, for example `scripts/start-lockss --wait`.
 3. When you are done, exit the lockss shell session by typing `exit` or `logout` or hitting `Ctrl + D`.
- Alternatively, you can use **sudo** to run a single command as the lockss user.

Add the following in front of the command listed in the manual^{Page 56, 1}:

```
sudo -u lockss ...
```

For example, if the command listed in the manual is `scripts/start-lockss --wait`, you would type `sudo -u lockss scripts/start-lockss --wait`.

¹ Depending on your system's **sudo** configuration, you may be prompted for the user's **sudo** password.

8.3.2 Running Commands as lockss With su

If you are logged in as `root` but your system does not have `sudo` (or does not let `root` use `sudo`), you can use `su` instead:

- You can use `su` to start a Bash shell session as the `lockss` user and run any number of commands in it:

1. Type this command:

```
su lockss
```

2. Run commands as they are listed in the manual, for example `scripts/start-lockss --wait`.
3. When you are done, exit the `lockss` shell session by typing `exit` or `logout` or hitting `Ctrl + D`.

- Alternatively, you can use `su` to run a single command as the `lockss` user:

Put the command listed in the manual in quotation marks in the following way:

```
su -c '...' lockss
```

For example, if the command to be run as the `lockss` user is `scripts/start-lockss --wait`, you would type `su -c 'scripts/start-lockss --wait' lockss`.

Caution: You will need to take care if the command itself contains quotation marks².

See Also

- Running Commands as root*
- Running Commands as a Privileged User*

8.4 Operating System Updates

You will want to update your Linux operating system at different times:

- Before *Upgrading From LOCKSS 2.0-alpha4*.
- Before *Installing the LOCKSS System* for the first time.
- When security-related updates are released for the Linux kernel (which requires rebooting the machine) or other installed software packages.

Your system may be set up for automatic updates or your system administrator may have policies for which packages can be updated and when.

If you wish to update software packages manually, select your operating system below and follow the instructions as `root`¹:

AlmaLinux

² If the command contains quotation marks, use `-c "..."` instead of `-c '...'`, and add a backslash in front of each double quotation mark in the command (`\` instead of `"`); single quotation marks in the command are unchanged.

¹ See *Running Commands as root*.

Arch Linux

CentOS

Debian

EuroLinux

Fedora

Linux Mint

OpenSUSE

Oracle Linux

RHEL

Rocky Linux

Scientific Linux

Ubuntu

To manually update software packages, run this **dnf** command as root:

```
dnf update
```

To manually update software packages, run this **pacman** command as root:

```
pacman --sync --refresh --sysupgrade
```

or equivalently:

```
pacman -Syu
```

CentOS 7

CentOS 8

CentOS Stream

To manually update software packages, run this **yum** command as root:

```
yum update
```

To manually update software packages, run this **dnf** command as root:

```
dnf update
```

To manually update software packages, run this **dnf** command as root:

```
dnf update
```

To manually update software packages, run these **apt** commands as root:

```
apt update
```

```
apt upgrade
```

EuroLinux 7

EuroLinux 8

To manually update software packages, run this **yum** command as root:

```
yum update
```

To manually update software packages, run this **dnf** command as root:

```
dnf update
```

To manually update software packages, run this **dnf** command as root:

```
dnf update
```

To manually update software packages, run these **apt** commands as root:

```
apt update
```

```
apt upgrade
```

OpenSUSE Leap 15

OpenSUSE Tumbleweed

To manually update software packages, run these **zypper** commands as root:

```
zypper refresh
```

```
zypper update
```

To manually update software packages, run these **zypper** commands as root:

```
zypper refresh
```

```
zypper update
```

Oracle Linux 7

Oracle Linux 8

To manually update software packages, run this **yum** command as root:

```
yum update
```

To manually update software packages, run this **dnf** command as root:

```
dnf update
```

RHEL 7

RHEL 8

To manually update software packages, run this **yum** command as root:

```
yum update
```

To manually update software packages, run this **dnf** command as root:

```
dnf update
```

To manually update software packages, run this **dnf** command as root:

```
dnf update
```

To manually update software packages, run this **yum** command as root:

```
yum update
```

To manually update software packages, run these **apt** commands as root:

```
apt update  
apt upgrade
```

8.5 Installing curl

Downloading and running the LOCKSS Installer requires either **curl** or **wget**. Most typical Linux systems have at least one installed by default. You can check by typing `curl --version` or `wget --version` and verifying that the output is not an error message. This section describes how to install **curl** if necessary. (If you prefer to install **wget**, see [Installing wget](#).)

Select your operating system below and follow the instructions as root¹:

AlmaLinux

Arch Linux

CentOS

Debian

EuroLinux

Fedora

Linux Mint

OpenSUSE

Oracle Linux

RHEL

Rocky Linux

Scientific Linux

Ubuntu

To install **curl**, run this **dnf** command (as root):

```
dnf --assumeyes install curl
```

or equivalently:

```
dnf -y install curl
```

To install **curl**, run this **pacman** command (as root):

¹ See *Running Commands as root*.


```
pacman --sync --noconfirm curl
```

or equivalently:

```
pacman -S --noconfirm curl
```

CentOS 7

CentOS 8

CentOS Stream

To install **curl**, run this **yum** command (as root):

```
yum --assumeyes install curl
```

or equivalently:

```
yum -y install curl
```

To install **curl**, run this **dnf** command (as root):

```
dnf --assumeyes install curl
```

or equivalently:

```
dnf -y install curl
```

To install **curl**, run this **dnf** command (as root):

```
dnf --assumeyes install curl
```

or equivalently:

```
dnf -y install curl
```

To install **curl**, follow these instructions (as root):

1. Run this **apt** command:

```
apt update
```

2. Run this **apt** command:

```
apt install --assume-yes curl
```

or equivalently:

```
apt -y install curl
```

EuroLinux 7

EuroLinux 8

To install **curl**, run this **yum** command (as root):

```
yum --assumeyes install curl
```

or equivalently:

```
yum -y install curl
```

To install **curl**, run this **dnf** command (as root):

```
dnf --assumeyes install curl
```

or equivalently:

```
dnf -y install curl
```

To install **curl**, run this **dnf** command (as root):

```
dnf --assumeyes install curl
```

or equivalently:

```
dnf -y install curl
```

To install **curl**, follow these instructions (as root):

1. Run this **apt** command:

```
apt update
```

2. Run this **apt** command:

```
apt install --assume-yes curl
```

or equivalently:

```
apt -y install curl
```

OpenSUSE Leap 15

OpenSUSE Tumbleweed

To install **curl**, run these **zypper** (as root):

```
zypper refresh
```

```
zypper --non-interactive install curl
```

or equivalently:

```
zypper refresh
```

```
zypper -n install curl
```

To install **curl**, run these **zypper** (as root):

```
zypper refresh
```

```
zypper --non-interactive install curl
```

or equivalently:

```
zypper refresh  
zypper -n install curl
```

Oracle Linux 7

Oracle Linux 8

To install **curl**, run this **yum** command (as root):

```
yum --assumeyes install curl
```

or equivalently:

```
yum -y install curl
```

To install **curl**, run this **dnf** command (as root):

```
dnf --assumeyes install curl
```

or equivalently:

```
dnf -y install curl
```

RHEL 7

RHEL 8

To install **curl**, run this **yum** command (as root):

```
yum --assumeyes install curl
```

or equivalently:

```
yum -y install curl
```

To install **curl**, run this **dnf** command (as root):

```
dnf --assumeyes install curl
```

or equivalently:

```
dnf -y install curl
```

To install **curl**, run this **dnf** command (as root):

```
dnf --assumeyes install curl
```

or equivalently:

```
dnf -y install curl
```

To install **curl**, run this **yum** command (as root):

```
yum --assumeyes install curl
```

or equivalently:

```
yum -y install curl
```

To install **curl**, follow these instructions (as **root**):

1. Run this **apt** command:

```
apt update
```

2. Run this **apt** command:

```
apt install --assume-yes curl
```

or equivalently:

```
apt -y install curl
```

8.6 Installing wget

Downloading and running the LOCKSS Installer requires either **curl** or **wget**. Most typical Linux systems have at least one installed by default. You can check by typing `curl --version` or `wget --version` and verifying that the output is not an error message. This section describes how to install **wget** if necessary. (If you prefer to install **curl**, see *Installing curl*.)

Select your operating system below and follow the instructions as **root**¹:

AlmaLinux

Arch Linux

CentOS

Debian

EuroLinux

Fedora

Linux Mint

OpenSUSE

Oracle Linux

RHEL

Rocky Linux

Scientific Linux

Ubuntu

To install **wget**, run this **dnf** command (as **root**):

```
dnf --assumeyes install wget
```

or equivalently:

¹ See *Running Commands as root*.

```
dnf -y install wget
```

To install **wget**, run this **pacman** command (as root):

```
pacman --sync --noconfirm wget
```

or equivalently:

```
pacman -S --noconfirm wget
```

CentOS 7

CentOS 8

CentOS Stream

To install **wget**, run this **yum** command (as root):

```
yum --assumeyes install wget
```

or equivalently:

```
yum -y install wget
```

To install **wget**, run this **dnf** command (as root):

```
dnf --assumeyes install wget
```

or equivalently:

```
dnf -y install wget
```

To install **wget**, run this **dnf** command (as root):

```
dnf --assumeyes install wget
```

or equivalently:

```
dnf -y install wget
```

To install **wget**, follow these instructions (as root):

1. Run this **apt** command:

```
apt update
```

2. Run this **apt** command:

```
apt install --assume-yes wget
```

or equivalently:

```
apt -y install wget
```

EuroLinux 7

EuroLinux 8

To install **wget**, run this **yum** command (as root):

```
yum --assumeyes install wget
```

or equivalently:

```
yum -y install wget
```

To install **wget**, run this **dnf** command (as root):

```
dnf --assumeyes install wget
```

or equivalently:

```
dnf -y install wget
```

To install **wget**, run this **dnf** command (as root):

```
dnf --assumeyes install wget
```

or equivalently:

```
dnf -y install wget
```

To install **wget**, follow these instructions (as root):

1. Run this **apt** command:

```
apt update
```

2. Run this **apt** command:

```
apt install --assume-yes wget
```

or equivalently:

```
apt -y install wget
```

OpenSUSE Leap 15

OpenSUSE Tumbleweed

To install **wget**, run these **zypper** (as root):

```
zypper refresh  
zypper --non-interactive install wget
```

or equivalently:

```
zypper refresh  
zypper -n install wget
```

To install **wget**, run these **zypper** (as root):

```
zypper refresh  
zypper --non-interactive install wget
```

or equivalently:

```
zypper refresh  
zypper -n install wget
```

Oracle Linux 7

Oracle Linux 8

To install **wget**, run this **yum** command (as root):

```
yum --assumeyes install wget
```

or equivalently:

```
yum -y install wget
```

To install **wget**, run this **dnf** command (as root):

```
dnf --assumeyes install wget
```

or equivalently:

```
dnf -y install wget
```

RHEL 7

RHEL 8

To install **wget**, run this **yum** command (as root):

```
yum --assumeyes install wget
```

or equivalently:

```
yum -y install wget
```

To install **wget**, run this **dnf** command (as root):

```
dnf --assumeyes install wget
```

or equivalently:

```
dnf -y install wget
```

To install **wget**, run this **dnf** command (as root):

```
dnf --assumeyes install wget
```

or equivalently:

```
dnf -y install wget
```

To install **wget**, run this **yum** command (as root):

```
yum --assumeyes install wget
```

or equivalently:

```
yum -y install wget
```

To install **wget**, follow these instructions (as root):

1. Run this **apt** command:

```
apt update
```

2. Run this **apt** command:

```
apt install --assume-yes wget
```

or equivalently:

```
apt -y install wget
```

APPENDIX

This appendix contains pages of additional information about the LOCKSS system.

Sections including security advisories; reference information such as list of ports or component versions; and advanced topics like running the LCAP polling and repair protocol over SSL, working with PostgreSQL, or running the LOCKSS Installer from Git.

9.1 Security Advisories

9.1.1 CVE-2021-45105 and CVE-2021-44832

First published: 2021-01-02

Attention: The LOCKSS 2.x system up to and including version 2.0-alpha5 (originally released 2021-12-17), and the custom Solr and OpenWayback containers it includes, are affected by CVE-2021-45105 and CVE-2021-44832.

The recommended remediation is to upgrade LOCKSS 2.x version 2.0-alpha5 (originally released 2021-12-17) or earlier to LOCKSS 2.0-alpha5b.

See CVE-2021-45105 and CVE-2021-44832 in the LOCKSS Documentation Portal's [Security](#) pages.

9.2 Software License

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For more information, visit the [License](#) page in the LOCKSS Documentation Portal.

9.3 Network Ports

This section describes the default network ports used by the LOCKSS system.

Unless otherwise noted, all ports are **TCP**.

All ports in the 24600-24699 range should be considered reserved. The LCAP (LOCKSS polling and repair) port retains its historical value of 9729.

- 8080: OpenWayback replay engine¹
- 9729: LCAP (LOCKSS polling and repair)
- 24600: *reserved*
- 24602: PostgreSQL
- 24603: Solr
- 24606: ActiveMQ
- 24610: LOCKSS Repository Service - REST port
- 24619: *reserved* (HDFS FS port)
- 24620: LOCKSS Configuration Service - REST port
- 24621: LOCKSS Configuration Service - UI port
- 24630: LOCKSS Poller Service - REST port
- 24631: LOCKSS Poller Service - UI port
- 24640: LOCKSS Metadata Extraction Service - REST port
- 24641: LOCKSS Metadata Extraction Service - UI port
- 24650: LOCKSS Metadata Service - REST port

¹ This is a known issue. In a future version of the system, the intended port will be 24682.

- 24651: LOCKSS Metadata Service - UI port
 - 24670: LOCKSS Proxy
 - 24671: *reserved*
 - 24672: LOCKSS Audit Proxy
 - 24673: *reserved*
 - 24674: ICP server (**UDP**)
 - 24680: LOCKSS Content Server (ServeContent)
 - 24681: Pywb replay engine
 - 24682: *reserved*^{Page 70, 1}
-

9.4 Versions

9.4.1 LOCKSS 2.0-alpha5d

The LOCKSS 2.0-alpha5d system was released on 2022-01-27, to address a bug in the LOCKSS Installer. It is the most recent release of the LOCKSS 2.x system.

It consists of a configurable set of the following components:

- LOCKSS Installer version 2.0-alpha5d
- LOCKSS Repository Service version 2.12.3
- LOCKSS Configuration Service version 2.6.2
- LOCKSS Metadata Extraction Service version 2.5.2
- LOCKSS Metadata Service version 2.4.2
- LOCKSS Poller Service version 2.4.2
- PostgreSQL version 9.6.12
- Apache Solr version 8.9.0 (custom version 8.9.0-slim-2)
- Pywb version 2.4.2 (custom version 2.4.2-2)
- OpenWayback version 2.4.0 (custom version 2.4.0-4)

9.4.2 LOCKSS 2.0-alpha5c

The LOCKSS 2.0-alpha5c system was released on 2022-01-24, to address a bug in the LOCKSS Repository Service.

It consists of a configurable set of the following components:

- LOCKSS Installer version 2.0-alpha5c
- LOCKSS Repository Service version 2.12.3
- LOCKSS Configuration Service version 2.6.2
- LOCKSS Metadata Extraction Service version 2.5.2
- LOCKSS Metadata Service version 2.4.2

- LOCKSS Poller Service version 2.4.2
- PostgreSQL version 9.6.12
- Apache Solr version 8.9.0 (custom version 8.9.0-slim-2)
- Pywb version 2.4.2 (custom version 2.4.2-2)
- OpenWayback version 2.4.0 (custom version 2.4.0-4)

9.4.3 LOCKSS 2.0-alpha5b

The LOCKSS 2.0-alpha5b system was released on 2022-01-02, to address security vulnerabilities in Apache Log4j 2.x. See *CVE-2021-45105 and CVE-2021-44832* in our *Security Advisories*.

It consists of a configurable set of the following components:

- LOCKSS Installer version 2.0-alpha5b
- LOCKSS Repository Service version 2.12.2
- LOCKSS Configuration Service version 2.6.2
- LOCKSS Metadata Extraction Service version 2.5.2
- LOCKSS Metadata Service version 2.4.2
- LOCKSS Poller Service version 2.4.2
- PostgreSQL version 9.6.12
- Apache Solr version 8.9.0 (custom version 8.9.0-slim-2)
- Pywb version 2.4.2 (custom version 2.4.2-2)
- OpenWayback version 2.4.0 (custom version 2.4.0-4)

9.4.4 LOCKSS 2.0-alpha5

The LOCKSS 2.0-alpha5 system was released on 2021-12-17.

It consists of a configurable set of the following components:

- LOCKSS Installer version 2.0-alpha5
- LOCKSS Repository Service version 2.12.0
- LOCKSS Configuration Service version 2.6.0
- LOCKSS Metadata Extraction Service version 2.5.0
- LOCKSS Metadata Service version 2.4.0
- LOCKSS Poller Service version 2.4.0
- PostgreSQL version 9.6.12
- Apache Solr version 8.9.0 (custom version 8.9.0-slim)
- Pywb version 2.4.2 (custom version 2.4.2-2)
- OpenWayback version 2.4.0 (custom version 2.4.0-3)

9.5 Past Versions

- 2.0-alpha4 (2021-06-28)
- 2.0-alpha3 (2020-10-29)
- 2.0-alpha2 (2020-02-06)
- 2.0-alpha1 (2019-05-13)
- 2.0-alpha Technology Preview (2019-04-05)

9.6 Downloading the LOCKSS Installer using git

Warning: The official way to download the LOCKSS Installer is now through the LOCKSS Downloader, rather than cloning the LOCKSS Installer as a Git project as in previous releases.

Follow the instructions in *Installing the LOCKSS System* to use the LOCKSS Downloader.

Tip: Follow the instructions in /appendix/git to install **git**, if it is not yet available on your system.

Follow these instructions as the **lockss** user¹:

1. If you have not previously cloned the LOCKSS Installer, run this command to clone it from GitHub:

```
git clone https://github.com/lockss/lockss-installer
```

Troubleshooting

On early CentOS 7 systems (for example CentOS 7.1), you may receive the error message `fatal: unable to access 'https://github.com/lockss/lockss-installer/': Peer reports incompatible or unsupported protocol version`. This is due to outdated network security libraries. Run the command `yum update -y curl nss nss-util nspr` as root to update them, and retry the **git clone** command.

Tip: To avoid a harmless Git warning when updating the LOCKSS Installer from GitHub in the future, run this command within the `lockss-installer` directory created by the **git clone** command:

```
git config --local pull.rebase true
```

2. Checkout the 2.0-alpha5 branch of the LOCKSS Installer by running this command within the `lockss-installer` directory created by the **git clone** command earlier:

```
git checkout 2.0-alpha5
```

¹ See *Running Commands as the lockss User*

9.7 Working with PostgreSQL

This section of the appendix documents administrative tasks for the embedded PostgreSQL database configured by the LOCKSS 2.x system.

9.7.1 Changing the PostgreSQL Database Password

To change the password of the embedded PostgreSQL database, perform the following steps as the `lockss` user¹ in the `lockss` user's `lockss-installer` directory:

1. Ensure the Kubernetes service definitions reflect the current state of the LOCKSS configuration by running:

```
scripts/assemble-lockss
```

2. Start the PostgreSQL database container by running:

```
k3s kubectl apply -n lockss --filename=config/configs/lockss-stack/svcs/lockss-
↳postgres-service.yaml
```

3. Run the following command to store the name of the PostgreSQL database container into the variable `postgres_pod`:

```
postgres_pod=$(k3s kubectl get pod -n lockss --selector=io.kompose.service=lockss-
↳postgres-service --output=jsonpath="{.items[0].metadata.name}")
```

4. Run the following command to store the IP of the PostgreSQL database container into the variable `postgres_ip`:

```
postgres_ip=$(k3s kubectl get pod -n lockss --selector=io.kompose.service=lockss-
↳postgres-service --output=jsonpath="{.items[0].status.podIP}")
```

5. Execute the following command to alter the LOCKSS database user's password, taking care to replace `newpassword` with your new embedded PostgreSQL database password:

```
echo "ALTER USER \"LOCKSS\" WITH PASSWORD 'newpassword'" | k3s kubectl exec
↳$postgres_pod -n lockss -i -- psql --username=LOCKSS --dbname=postgres
```

Successful execution of the command results in the output `ALTER ROLE`.

6. To verify that the password change worked, run the following command:

```
k3s kubectl exec $postgres_pod -n lockss -it -- psql --username=LOCKSS --
↳dbname=postgres --host=$postgres_ip
```

and enter `newpassword` at the *Password for user LOCKSS* prompt. If the password change was successful and you enter `newpassword` correctly, you will see a PostgreSQL prompt similar to:

```
psql (9.6.12)
Type "help" for help.

postgres=#
```

which you can exit by entering `q` or hitting `Ctrl + D`. If the password change was unsuccessful or you do not enter `newpassword` correctly, you will see output similar to:

¹ See *Running Commands as the lockss User*.

```
psql: FATAL: password authentication failed for user "LOCKSS"  
command terminated with exit code 2
```

7. Stop the PostgreSQL database container by running this command:

```
k3s kubectl -n lockss delete service,deployment lockss-postgres-service &&  
k3s kubectl -n lockss wait --for=delete pod $postgres_pod --timeout=60s
```

8. Re-run **configure-lockss** so that you can record the new embedded PostgreSQL database password into the configuration of the LOCKSS stack:

```
scripts/configure-lockss
```

See the *PostgreSQL* and *Embedded PostgreSQL Database* sections of *Configuring the LOCKSS System* for details.

9.8 LCAP Over SSL

The section explains how to configure secure communication between LOCKSS boxes in a network.

Some LOCKSS networks, such as the Global LOCKSS Network (GLN), are open, in the sense that anyone may join and set up a LOCKSS box to participate in that network. The LOCKSS polling protocol (LCAP) includes several security measures to prevent rogue players from disrupting the network, but it is also possible to create a closed network, where only authorized nodes are allowed to participate. This document describes the steps needed to set up such a network.

In order to ensure that only authorized nodes may participate, each node is issued a private key, and all nodes are provided the set of corresponding public keys. This allows all inter-node communication to be both encrypted and authenticated, using SSL.

Note: The Classic LOCKSS system (version 1.x) does not support PKCS12, so if building keystores for a network that includes classic LOCKSS nodes, JCEKS should be selected.

9.8.1 Generating Keystores

The authority in charge of the private LOCKSS network (PLN) must create and distribute Java keystores to all participants. Each box receives two keystores: one containing its own private key (along with a password file containing the secret password for the private key) and another containing the public certificates for each of the boxes in the network. There are two methods available to create these keystores:

- A *Command Line Tool* run in the LOCKSS development environment.
- An *Interactive Tool* invoked in a running LOCKSS node.

In both cases, the admin creating the keystores must know the complete set of hostnames of boxes in the network. More hosts can be added at any time, but a new public keystore must be created and distributed to each box.

Command Line Tool

To use the command line tool:

1. Clone the `lockss-core` and `laaws-dev-scripts` projects from GitHub, in sibling directories.
2. Build `lockss-core`.
3. In the root directory of `lockss-core`, run this command:

```
../laaws-dev-scripts/bin/runclass org.lockss.keystore.EditKeyStores -s pubkeystore.  
->pkcs12 -o keydir box1.pln.org ... boxN.pln.org
```

This will create, in the directory `keydir`, a public keystore named `pubkeystore.pkcs12`, and a pair of files `boxK.pln.org.pkcs12` and `boxK.pln.org.pass` for each one of the N host names `box1.pln.org` through `boxN.pln.org`.

4. To add additional hosts, provide the existing public keystore as the value of the `-s` argument, and list the new hosts. The new public keys will be added to the existing public keystore.

Interactive Tool

1. Bring up a LOCKSS stack, either in the production environment or `runcluster`. In the UI, select *DebugPanel* → *Generate LCAP Keys*.
2. Enter the hostname of each of the LOCKSS boxes in the *Hostnames* text box, then click the *Generate Keystores* button. A `.tgz` or a `.zip` file will be generated and offered for download. This file will contain the private keystore and password file for each host, as well as the shared public keystore.
3. To add additional hosts, use the *Browse* button to supply the existing public keystore, and enter the new hosts in the *Hostnames* text box. The downloaded file will contain the private keystore and password files for each new host, as well as the updated shared public keystore, which must be installed on all hosts.

9.8.2 Installing the Keystores

1. **Securely** transmit to each box its two files and the public keystore. Put them in `~lockss/lockss-installer/config/keys`, and set the owner and group to `lockss:lockss` and the permissions to `600`.
2. Restart the stack and check that it is now using SSL. In the UI, select *Daemon Status* → *Comm Channels*. The page should show *SSL: TLSv1.2, Client Auth*.
3. After a few hours, select *Daemon Status* → *Comm Peer Data* to ensure that each box is successfully originating and accepting connections from all the other boxes.

9.9 Migrating From LOCKSS 1.x

An upcoming version of the classic LOCKSS system will contain an experimental tool to copy select archival units (AUs) from a production LOCKSS 1.x system to a test LOCKSS 2.x system, for testing purposes. When this tool is released, this page will be updated with instructions for how to perform a test copy. Test migrations and eventual real migrations will be available at a later time.