LynxOS-178 Installation and Quick Start Guide

LynxOS-178

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Table of Contents

Preface

Typographical Conventions

The typefaces used in this manual, summarized below, emphasize important concepts. All references to filenames and commands are case-sensitive and should be typed accurately.

Kind of Text	Examples
Body text; *italicized* for emphasis, new terms, and book titles	Refer to the *LynxOS-178 Installation Guide*
Environment variables, filenames, functions, methods, options, parameter names, path names, commands, and computer data	`ls -l myprog.c /dev/null`
Commands that need to be highlighted within body text, or commands that must be typed as is by the user are **bolded**.	`login:` **`myname`** `#` **`cd /usr/home`**
Text that represents a variable, such as a filename or a value that must be entered by the user, is *italicized*.	`cat` *`<filename>`* `mv` *`<file1>`* *`<file2>`*

Blocks of text that appear on the display screen after entering instructions or commands	`Loading file /tftpboot/shell.kdi into 0x4000`
	`.....`
	`File loaded. Size is 1314816`

Keyboard options, button names, and menu sequences	`© 2019 Lynx Software Technologies, Inc. All rights reserved.` **`Enter`**`,` **`Ctrl-C`**

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How to Submit a Support Request

When you are ready to submit a support request, please include *all* of the following information:

- First name, last name, your job title
- Phone number, e-mail address
- Company name, address
- Product version number
- Target platform (for example, PowerPC)
- Board Support Package (BSP), Current Service Pack Revision, Development Host OS version
- Detailed description of the problem that you are experiencing:
- Is there a requirement for a US Citizen or Green Card holder to work on this issue?
- Priority of the problem - Critical, High, Medium, or Low?

Where to Submit a Support Request

Support, Europe	tech_europe@lynx.com +33 1 30 85 93 96
Support, worldwide except Europe	support@lynx.com +1 800-327-5969 or +1 408-979-3940 +81 33 449 3131 [for Japan]
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Where to Submit a License Request

License	license@lynx.com Fax: (408)979-3920

CHAPTER 1 Installation and Quick Start

What is LynxOS-178?

LynxOS-178 is Lynx Software Technologies Inc.'s Real-Time Operating System (RTOS) for safety-critical systems. Lynx Software Technologies, Inc. is the premier developer of POSIX conformant real-time operating systems. Our flagship product, called LynxOS, is in use in hundreds of thousands of installations where high reliability and hard real-time determinism are essential. LynxOS-178 is based on LynxOS and has the features necessary for safety-critical applications such as aviation, defense, medicine, along with other business-critical fields. Along with the operating system and the development tools, Lynx Software Technologies can optionally provide the necessary artifacts to permit LynxOS-178 to be used in systems that are certifiable up to level A of the RTCA DO-178C standard. In addition, LynxOS-178 provides the ability to run multiple levels of DO-178C criticality on the same platform.

LynxOS-178 Development Environment – Overview

This section illustrates the standard start-to-finish workflow of installing, getting a license key, and starting to use the LynxOS-178 Development System. This will involve the following steps:

1. Setup the Development Host

   Install the LynxOS-178 development tools on the host development platform. This will be the development system that the user intends to use to create LynxOS-178 kernels and applications. The development tools run on a CentOS™ 7.3 or Windows 7/10 operating system. The development tools also rely on several services that must be configured including a license server, a DHCP server, and a network boot server. To get started quickly, it is recommended that the host and the target be connected via Ethernet. The tools and services can be installed on a pre-existing customer owned installation of CentOS 7.3 or Windows 7/10.

2. Setup Cross Environment and Build the Board Support Package Kernel Downloadable Image (BSP KDI).

   The LynxOS-178 comes with a pre-built LynxOS-178 KDI with a default configuration that allows the user to load it on the target.
   Users can also choose to build a customized LynxOS-178 kernel by customizing the BSP configuration. This process is described in the LynxOS-178 Board Support Guide

3. Load the KDI on the target platform

   Target systems running LynxOS-178 must be pre-configured to enable required features in the system firmware. For more information, see the LynxOS-178 Board Support Guide. For example, this step may configure the BIOS or Firmware Setting.

   Target system: Usually purpose-built computers running a custom- configured Board Support Package (BSP) for that board. When the actual target systems are not yet available, development can be done using “reference platforms” (that is, commercially available computers for which a BSP already exists). Contact a Lynx Software Technologies representative for information about target platforms that are currently available

   Once the target is pre-configured, users should verify the connection between the development host and target to make sure it is working. Once the connection is made, the LynxOS-178 KDI can be downloaded to the target using a variety of methods. The LynxOS-178 KDI can then be booted. The boot method will be described in the LynxOS-178 Board Supported Guide.

LynxOS-178 Development Environment – Details

Set up the LynxOS-178 Development Host

Development Host Requirement

- A host machine capable of running 64-bit versions of
  - CentOS (7.3 or later)
  - Windows 7 or Windows 10.
- Disk space: 5GB or more for LynxOS-178 installation
- A dedicated Ethernet port to boot the LynxOS-178 targeting over the Network. It is recommended to have an Ethernet Port dedicated for communication with target systems. If a dedicated port is not available extra care is required when configuring TFTP or DHCP service so that it does not interfere with the normal operation of your network. This configuration is not covered in this document. In the simplest setup, the development host is the same machine as the TFTP or DHCP and License server.

Development host Network Services

As an example, this section describes the simplest setup on CentOS. The development host is the same machine as the TFTP/DHCP server:

Assuming the following:

1. The development host has 2 ethernet interfaces, named eth0 and eth1.
   - "eth0" is assumed to connect to a local LAN or shared network
   - "eth1" is connected directly to the LynxOS-178 target
2. The LynxOS-178 target supports TFTP/DHCP - that depends on the target platform, please refer to the LynxOS-178 Board Supported Guide for more detail on whether your target supports TFTP/DHCP.
3. Allow TFTP traffic to pass the firewall. The /var/lib/tftpboot is a TFTP directory.
4. Refer to CentOS Documentation for more detail on how to configure the TFTP server

   Host: 192.168.0.10 (eth1)
   Target: 192.168.0.11

Windows 7 / 10 - 64-bit systems can also install TFTP and DHCP servers – due to the variety of third party options here please see your system administrator for assistance on how to best implement this on your network.

Installing the LynxOS-178 Development Kit

Insert the provided DVD media into your development host. It requires admin or root privilege to install the LynxOS-178 product.

- The installation will start automatically on most systems
- If it does not start automatically, users may manually execute the installer from the top level of the install media:

  On Linux: Linux/Disk1/InstData/VM/install.bin

  On Windows: Windows/Disk1/InstData/VM/install.exe

Follow the instructions from the installation program to install LynxOS-178.

This will install the LynxOS-178 Development Kit at the following location on your system:

Linux:

```
/opt/Lynx/LynxOS-178-2.2.5 on Linux
```

Windows:

```
C:\Lynx\LynxOS-178-2.2.5
C:\Lynx\Cygwin-1.7.33
```

The LynxOS-178 environment contains both Development and Production environments:

- Development Environment is a superset of the Production Environment that has additional features that assist in application development and debugging on LynxOS-178
- Production Environment has a feature set which supports certification to DO-178C Design Assurance Levels A and lower

At the end of the installation process, after the software has been installed, users will be requested to supply the following information that is used to request a software license key from Lynx. Contact information including:

- A valid email address
- Product serial number
- Sale order number or purchase order number

Once complete, the file “Lynx-license-key-request.txt” will be generated at the top of level of installation path. Users can edit this file to insure the information is correct and then email it to license@lynx.com. The host where the license server is to be running must have a host name which can be resolved to an IP address, using either DNS or the /etc/hosts file on CentOS.

Below is the sample output of LynxOS-178 installation on the Linux host:

```
/opt/Lynx/LynxOS-178-2.2.5
├── arm_dev
│   ├── bin
│   ├── cdk
│   ├── docs
│   ├── ENVIRONMENT
│   ├── etc
│   ├── lcs
│   ├── lib
│   ├── Makefile
│   ├── net
│   ├── SETUP.bash
│   ├── sys
│   └── usr
├── arm_pdn
│   ├── bin
│   ├── cdk
│   ├── docs
│   ├── ENVIRONMENT
│   ├── etc
│   ├── lcs
│   ├── lib
│   ├── Makefile
│   ├── SETUP.bash
│   ├── sys
│   └── usr
├── flexlm
│   └── v11.14.1.3
├── Luminosity
│   └── 6.0.0
│       ├── eclipse
│       └── loci
└── Lynx-license-key-request.txt
```

Table 1-1: LynxOS-178 Development Kit Architectural Components

Feature	Description
Cygwin	A collection of free software that provides a UNIX-like environment and tool set for Windows users. This feature is required for Windows and is available only for Windows installations.
CDK	LynxOS-178 Cross-Development Kit components in binary form. This includes cross tools such as compilers and debuggers.
DevOS	LynxOS-178 Development Operating System Production and Development which includes user libraries, utilities, kernel objects, and other files necessary for developing both kernels and applications.
RSC	LynxOS-178 Reusable Software Components
CSP	LynxOS-178 CPU Support Package
BSP	LynxOS-178 Board Support Package
Demo	LynxOS-178 Demo Template for the Kernel Downloadable Image (KDI).
LCS	LynxOS-178 Certifiable Stack includes the TCP/IP protocol stack that has the feature necessary for use in safety critical avionics and other. applications.
Luminosity	Luminosity Integrated Development Environment (IDE)
LOCI	Luminosity Open Communication Interface toolkit
Spyker	LynxOS-178 tracing tools
FLEXlm	FLEXlm License Manager
Document	LynxOS-178, Luminosity, LOCI, and Spyker documents

Obtaining a License

All software from Lynx Software Technologies, Inc. requires that valid License Management Software be installed. Please refer to the *License Management Software User's Guide* for step-by-step instructions.

Once the License Management Software is installed and a correct License File is obtained from Lynx, the LynxOS-178 CDK Kit may then be used.

Set up the LynxOS-178 Cross Environment

After installation of the LynxOS-178 Cross Development Kit (CDK), the Board Support Package (BSP), and the FlexLM license server, the system should be ready to use.

User should clone the LynxOS-178 environment into the local project directory. It is safer to do all your work in a cloned copy of the original installation

On the Windows host, perform the following steps:

- Select the ordinary directory (e.g., `C:\Lynx\LynxOS-178-2.2.5\arm_dev`) in the **`Windows Explorer`**, right click on it and select **`Copy`**. Then select a destination folder, right click and select **`Paste`**.
- Create a shortcut for setting the environment from the Desktop. For this, right click on the `setup.bat` file in the cloned environment, select **`Create a shortcut`**. The shortcut will be created. Change its name arbitrary, for example, as `ARM_DEV`. To change standard icon for the shortcut, right click it, and select **`Properties`**. On the **`Shortcut`** tab, click **`Change icon...`** and select any icon or `setup.ico` located in the same directory or any other icon. To put the shortcut on the Desktop, right click it and drag to the desktop, then release the mouse button.
  After the actions above are performed, use the new icon to enter cloned environment. It will perform the following actions:
  - Enter the Cygwin environment.
  - Change to the cloned directory.
  - Source `SETUP.bash`. Please refer below for the description of the `SETUP.bash` file.

Note: On installation, the LynxOS-178 ARM DEV and LynxOS-178 ARM PDN icons appear on the desktop. They can be used to enter the installed environment but not the cloned one.

On the Linux host, perform the following steps:

- Start a bash shell in a new window. Users can use the copy utility to setup a cloned environment

  ```
  $ cp -rp /opt/LynxOS-178-2.2.5 <clone_dir>
  ```

  Where *`<clone_dir>`* is a clone full directory path.

  ```
  e.g.
  $ cp -rp /opt/LynxOS-178-2.2.5 $HOME
  ```

  The `$HOME/LynxOS-178-2.2.5` will be useable as a separate LynxOS-178 environment.

- Once the clone is complete it is time to setup the environment for using the tools.

Below is an example of setting up the tools on the Linux host – similar steps are used for Windows in a Cygwin bash shell.

On the Linux Host, perform the following steps:

- Change directories to *<clone_dir>/<arch>_<mode>* and setup the LynxOS-178 Cross Development environment and license manager

  ```
  $ cd <clone_dir>/<arch>_<mode>
  ```

  where

  <arch> is a target CPU architecture (arm, x86, ppc, etc.).

  <mode> is "dev" (development) or "pdn" (production)

  Example:

  ```
  $ cd $HOME/LynxOS-178-2.2.5/arm_dev
  $ source SETUP.bash
  ```

  A setup script (`SETUP.bash`) is provided to prepare the bash shell environment with the necessary paths and variables to easily execute the CDK tools. The script attempts to automatically detect the correct value for various parameters. The script will prompt the user for any required input. Default parameter values are displayed in square brackets "[…]", if the default value is correct it can be accepted by hitting the **Enter** key. It shall prompt the user to select a specific architecture and BSP if more than one exists in the environment.

  After sourcing `SETUP.bash`, the license session manager is started automatically. As described as above, LynxOS-178 requires a valid license to operate. The User will be requested to supply the license's information again if it cannot find the license information.

  A sample execution is shown below (user input is shown in **bold** font) for the Linux host development:

  ```
  $ . SETUP.bash
  The zcu102 target BSP is selected.
  Setting up Xdev tools: /opt/Lynx/LynxOS-178-2.2.5/arm_dev/cdk/linux-elf-arm
  Please enter the full path and file name of the license file(s) separated by
  ':' or NONE if you do not have license
  (@server or port@server forms may also be used): /opt/Lynx/LynxOS-178-
  2.2.5/flexlm/v11.14.1.3/linux64/bin/LICENSE
  The license specification has been saved in /opt/Lynx/LynxOS-178-
  2.2.5/arm_dev/.licensefile.
  Delete or edit this file if changes are required.
  ```

```
If you have problems with the licenses please execute 'lmstat'

and show its output to the administrator.
Current session status:
  License type:         floating license
  Checkout date/time:   Thu Oct 18 12:44:21 2018
  Last auth date/time:  Mon Nov 26 12:02:51 2018
  Expiration status:    expires in 35 days
ENV_PREFIX is an environment variable that points to the root of the
build/release directory. The ENVIRONMENT file is located in the
$ENV_PREFIX directory.
Setup complete!
```

As result, the license file will be stored at `$ENV_PREFIX/.licensefile`.

Installing LCS

The Lynx Certifiable Stack (LCS) is a TCP/IP protocol stack that has the features necessary for use in safety critical avionics and other applications. Please refer to the Lynx Certifiable Stack User's Guide for further information.

```
$ cd $ENV_PREFIX/lcs
$ make install
```

This will install LCS, remove the BSD network stack and update the configuration files for every supported BSP found in $(ENV_PREFIX).

To uninstall the LCS, issue the following command:

```
$ cd $ENV_PREFIX/lcs
$ make clobber
```

Starting Luminosity

The LynxOS-178 Cross-Development Kit (CDK) includes Luminosity IDE. It is installed in `C:\Lynx\LynxOS-178-2.2.5\Luminosity\6.0.0\eclipse` on the Windows host and `/opt/Lynx/LynxOS-178-2.2.5/Luminosity/6.0.0/eclipse` directory on the Linux host. To start Luminosity IDE, use the following steps:

- On the Windows host, click the Luminosity 6.0.0 icon on the desktop
- On the Linux host, enter the following commands from the bash prompt:

```
$ cd /opt/Lynx/LynxOS-178-2.2.5/Luminosity/6.0.0/eclipse
$ ./luminosity
```

When the Luminosity IDE is started, it displays the **`Workspace Launcher`** dialog box

which contains a path for the workspace. The workspace is a directory where all projects are stored and all global project-specific settings are saved. If the Luminosity IDE is started for the first time, the dialog box will contain the default workspace directory path.

On the Windows Host, if a workspace is new, an additional dialog box will appear entitled **`Enter Path to Cygwin`**. Enter there the path to a folder where cygwin1.dll is located, e.g., `C:\Lynx\Cygwin-1.7.33\bin`.

To start development, click the **`Workbench`** icon on the Luminosity **`Welcome`** page.

Configure and Build the LynxOS-178 BSP KDI

A KDI is a Kernel Downloadable Image containing the LynxOS-178 Kernel and its associated root file system. The contents of the KDI are described in a spec file which is used by the `mkimage` utility to create the KDI. Refer to the `mkimage` and `mkimage.spec` man pages for detailed information.

This section describes a basic LynxOS-178 BSP default configuration that enables users to build a default KDI. Refer to a corresponding LynxOS-178 *Board Support Guide* for more information about configuring and booting a KDI on a specific target.

The LynxOS-178 comes with a sample spec file `$ENV_PREFIX/sys/bsp.<bsp_name>/lynxos-178.spec.in` in the build tree which is pre-processed to create the `lynxos-178.spec` file. To create a sample KDI, perform the following steps:

```
$ cd $ENV_PREFIX/sys/bsp.<bsp_name>
$ make kdi
```

where *<bsp_name>* is the BSP name as `zcu102` as example

This will create the file `lynxos-178.kdi`. The user should then copy this KDI to the TFTP server.

Users can rebuild drivers and devices in the `$ENV_PREFIX/sys/drivers` directory by going into the individual directories to `make clobber` and `make install`.

```
$ cd $ENV_PREFIX/sys/drivers
$ cd <individual_directories>
$ make clobber
$ make install
```

To build the Kernel image

```
$ cd $ENV_PREFIX/sys/bsp.<bsp_name>
$ make clean all kdi
```

This will create the bootable image file `$ENV_PREFIX/sys/bsp.<bsp_name>/lynxos-178.kdi` that can be loaded onto the target.

Besides the $ENV_PREFIX/sys/drivers directory, users are not recommended to "make clobber" in most of the other directories under $ENV_PREFIX or $ENV_PREFIX/sys or $ENV_PREFIX/sys/bsp.<bsp_name>

Load the KDI on the target platform

Once the target is preconfigured as described in the LynxOS-178 Board Supported Guide, the user can copy the LynxOS-178 KDI to the TFTP boot server directory. Assuming the "lynxos-178.kdi" KDI is to be loaded on the target platform and the network between the TFTP host and target has no issues, perform the following :

```
$ cp $ENV_PREFIX/sys/bsp.<bsp_name>/lynxos-178.kdi /var/lib/tftpboot
```

Assuming the target is powered on, and configured for autoboot as described in the LynxOS-178 Board Support Guide, the KDI will load and boot automatically.

You are now ready to begin developing!

CHAPTER 2 LynxOS-178 Source Code Installation

The user has the option to install the following LynxOS-178 sources (if purchased):

- LynxOS-178 Operating System Source (OSS)
- LynxOS-178 Board Supported Package Source Kit (PK)
- LynxOS-178 LCS source
- LynxOS-178 GNU Toolchain Source
- LynxOS-178 Test Suite Source
- LynxOS-178 OpenGroup Test Source

For any LynxOS-178 source installation, it is recommended that users install the LynxOS-178 Development Kit first; then source installation can happen if the users plan to build the product from source.

Insert the provided DVD media into your development host.

- The installation will start automatically
- Or users manually execute the installer from the top level of the install media:

  On Linux: `Linux/Disk1/InstData/VM/install.bin`

  On Windows: `Windows/Disk1/InstData/VM/install.exe`

This will install the LynxOS-178 Source at `/opt/Lynx/LynxOS-178-2.2.5` on the Linux and "`C:\Lynx\LynxOS-178-2.2.5`" on the Windows into both Development and Production modes.

LynxOS-178 Board Supported Package Source Kit (PK)

Porting Kit Source users have the option to build the following directories by "`make clobber`" and "`make install`" after setting up the cross environment.

```
$ENV_PREFIX/sys/csp.<csp_name>
$ENV_PREFIX/sys/bsp.<bsp_name>
```

Example:

```
$ cd $ENV_PREFIX/sys/csp.armv7
$ make clobber install
$ cd $ENV_PREFIX/sys/bsp.zcu102
$ make clobber install
```

LynxOS-178 OSS source

Customers that purchase the Operating System Sources have the option to build the directories by "`make clobber`" and "`make install`" by changing into individual directories or on the top level of $ENV_PREFIX after setting up the cross environment.

```
$ cd $ENV_PREFIX/<individual_directory>
$ make clobber install
Or
$ cd $ENV_PREFIX
$ make clobber install
```

Example:

```
$ cd $ENV_PREFIX/sys/drm
$ make clobber install
```

LynxOS-178 LCS source

LynxOS-178 Certifiable Stack Source customers have the option to build the LCS the directories by "`make all`" and "`make install`" by changing directory to $ENV_PREFIX/lcs after setting up the cross environment.

```
$ cd $ENV_PREFIX/lcs
$ make all install
```

CHAPTER 3 Uninstall LynxOS-178 Product

Users have the option to remove the LynxOS-178 installation by logging in as an admin or root user. This option might remove the **entire** contents of the LynxOS-178 installation including files the user created after installation.

Please exercise this script with caution as it cannot be "undone".

On the Linux host, perform the following:

```
$ /opt/Lynx/LynxOS-178-2.2.5/.IA_LynxOS-
178_2.2.5_arm/UninstallData/Uninstall
```

On the Windows host, user will remove the LynxOS-178 by following the Windows Uninstall or change a program. Other users home directory might not remove since Windows will not allow to remove other users' directories even if removal is performed under admin account.