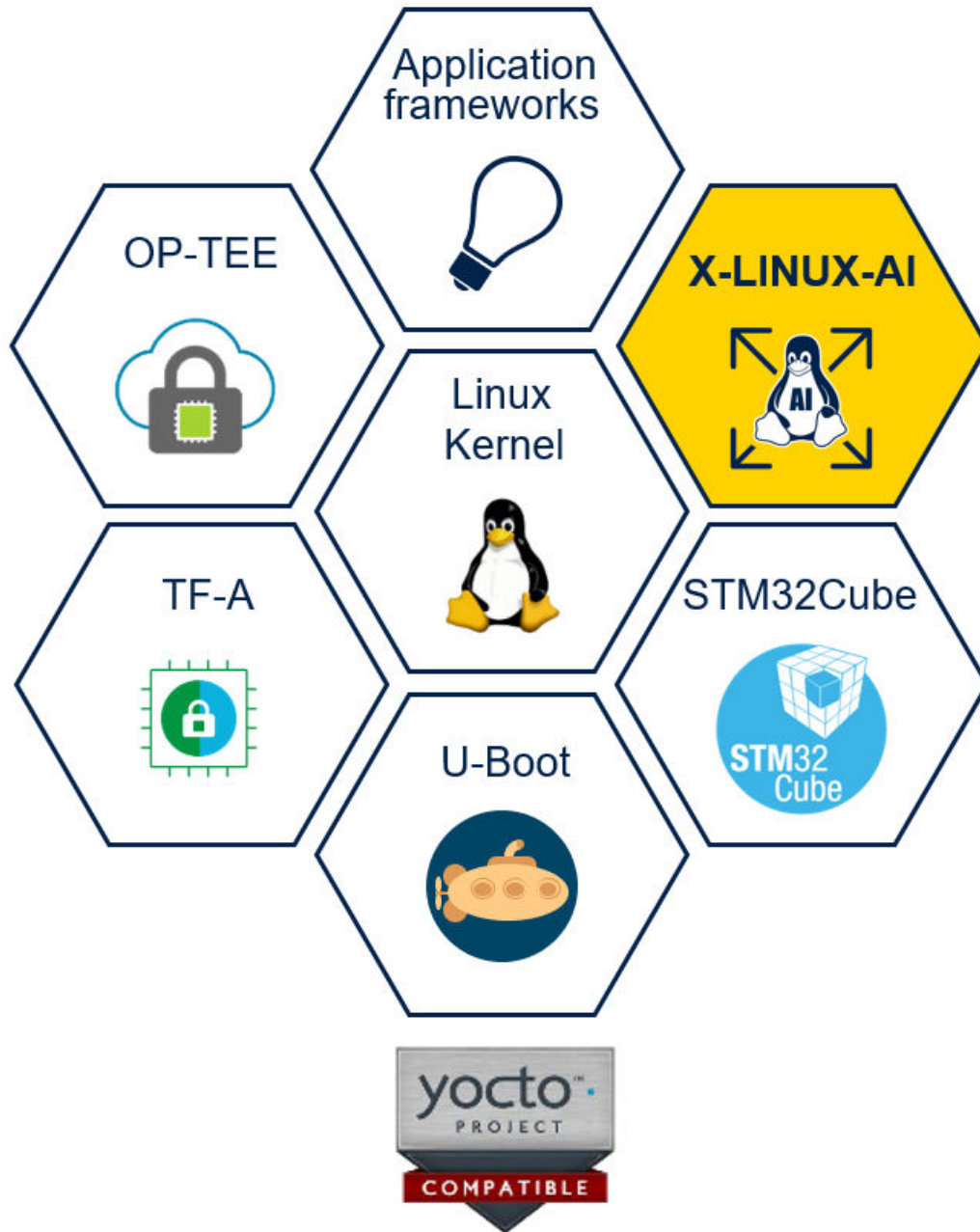


AI Expansion Package for STM32 MPU OpenSTLinux



Product status link

[X-LINUX-AI](#)

## Features

- XNNPACK support for TensorFlow™ Lite and ONNX Runtime, with about 20% to 30% performance gain for quantized networks on a 32-bit system
- TensorFlow™ Lite 2.11.0 with XNNPACK delegate activated
- ONNX Runtime 1.14.0 with XNNPACK execution engine activated
- OpenCV 4.7.x
- Python™ 3.10.x (enabling Pillow module)
- Coral Edge TPU™ accelerator native support
  - libedgetpu 2.0.0 (Grouper) aligned with TensorFlow™ Lite 2.11.0
  - libcoral 2.0.0 (Grouper) aligned with TensorFlow™ Lite 2.11.0
  - PyCoral 2.0.0 (Grouper) aligned with TensorFlow™ Lite 2.11.0
- The X-LINUX-AI OpenSTLinux Expansion Package v5.0.0 is compatible with the Yocto Project® build system MickleDore. It is validated over the OpenSTLinux Distribution v5.0 on [STM32MP157F-DK2](#) with a USB image sensor, on [STM32MP157F-EV1](#) with its built-in camera module, and on [STM32MP135F-DK](#) with its built-in camera module
- Support for the OpenSTLinux AI package repository allowing the installation of a prebuilt package using `apt-*` utilities
- Application samples
  - C++ / Python™ image classification example using TensorFlow™ Lite based on the MobileNet v1 quantized model
  - C++ / Python™ object detection example using TensorFlow™ Lite based on the COCO SSD MobileNet v1 quantized model
  - C++ / Python™ image classification example using Coral Edge TPU™ based on the MobileNet v1 quantized model and compiled for the Edge TPU™
  - C++ / Python™ object detection example using Coral Edge TPU™ based on the COCO SSD MobileNet v1 quantized model and compiled for the Edge TPU™
  - C++ face recognition application using proprietary model capable of recognizing the face of a known (enrolled) user. Contact the local STMicroelectronics support for more information about this application or send a request to [edge.ai@st.com](mailto:edge.ai@st.com)
  - Python™ image classification example using ONNX Runtime based on the MobileNet v1 quantized model
  - C++ object detection example using ONNX Runtime based on the COCO SSD MobileNet v1 quantized model
  - Python™ object detection example using ONNX Runtime based on the COCO SSD MobileNet v1 quantized model
- Application support for the 720p, 480p, and 272p display configurations
- X-LINUX-AI SDK add-on extending the OpenSTLinux SDK with AI functionality to develop and build an AI application easily. The X-LINUX-AI SDK add-on supports all the above frameworks. It is available from the [X-LINUX-AI](#) product page

## Description

X-LINUX-AI is an STM32 MPU OpenSTLinux Expansion Package that targets artificial intelligence for STM32MP1 series microprocessors. It contains Linux® AI frameworks, as well as application examples to get started with some basic use cases such as computer vision (CV).

The examples provided in X-LINUX-AI use TensorFlow™ Lite models for image classification based on MobileNet v1, and for object detection based on the COCO SSD MobileNet v1 model. The face recognition application provided in X-LINUX-AI as a prebuilt binary is based on models retrained by STMicroelectronics. Contact the local STMicroelectronics support for more information about this application.

These examples use either the TensorFlow™ Lite inference engine supporting Python™ scripting and C/C++ applications, or the Google Edge TPU™ accelerator supporting Python™ scripting and C/C++ applications, or also the ONNX Runtime supporting Python™ scripting and C/C++ applications.

X-LINUX-AI runs on the STM32MP1 series. It is demonstrated on the [STM32MP157F-DK2](#) with a USB image sensor, on the [STM32MP157F-EV1](#) with its built-in camera module, and on the [STM32MP135F-DK](#) with its built-in camera module.

## 1 General information

The X-LINUX-AI Expansion Package runs on STM32 microprocessors based on Arm® Cortex® processors.

*Note:* Arm is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere.



### 1.1 Ordering information

X-LINUX-AI is available for free download from the [www.st.com](http://www.st.com) website. The face recognition application is available on demand only via direct request to [edge.ai@st.com](mailto:edge.ai@st.com).

### 1.2 Versioning

Since its release v5.0.0, the major versioning of the X-LINUX-AI OpenSTLinux Expansion Package is aligned on the major versioning of the OpenSTLinux Distribution. This prevents painful backward compatibility attempts and makes dependencies straightforward.

The generic versioning X-LINUX-AI vx.y.z is built as follows:

- **x**: major version matching the OpenSTLinux Distribution major version. Each new major version is incompatible with previous OpenSTLinux Distribution versions.
- **y**: minor version, which is changed when new functionalities are added to the X-LINUX-AI OpenSTLinux Expansion Package in a backward compatible manner.
- **z**: patch version to introduce bug fixes. A patch version is implemented in a backward compatible manner.

### 1.3 License

X-LINUX-AI is delivered under the *Mix Ultimate Liberty+OSS+3rd-party V1* software license agreement (SLA0048).

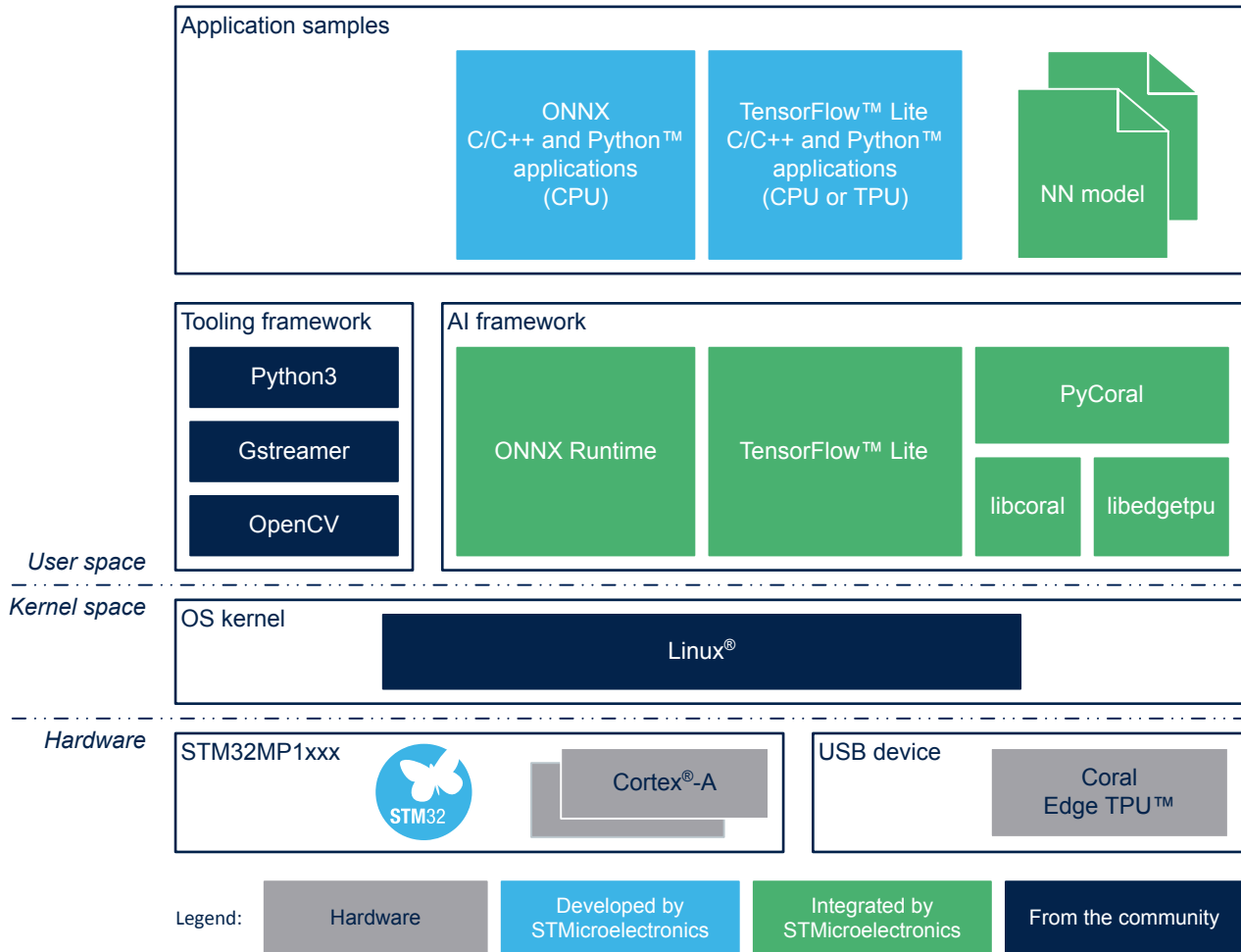
#### Software component license agreements

The software components provided in this package come with different license schemes. Refer to [wiki.st.com/stm32mpu/wiki/X-LINUX-AI\\_licenses](http://wiki.st.com/stm32mpu/wiki/X-LINUX-AI_licenses) for details.

## 2 Software architecture

The top-level architecture of the X-LINUX-AI OpenSTLinux Expansion Package is shown in Figure 1.

**Figure 1. X-LINUX-AI architecture**



DT165762V2

## Revision history

**Table 1. Document revision history**

Date	Revision	Changes
1-Jul-2020	1	Initial release.
8-Feb-2021	2	Added the prebuilt face recognition application, and updated NN tools and OpenSTLinux versions in <i>Features</i> and <i>Description</i> . Updated <i>Ordering information</i> .
2-Jul-2021	3	Added display configuration support and updated component versions in <i>Features</i> for X-LINUX-AI v2.1.1.
29-Jun-2022	4	Updated for X-LINUX-AI v2.2.0 with the X-LINUX-AI SDK add-on delivery, the focus on STMicroelectronics boards, and the discontinued supports for the Arm NN inference engine and Avenger96 board: <ul style="list-style-type: none"> <li>Updated <i>Features</i> and <i>Description</i></li> <li>Updated <i>X-LINUX-AI architecture</i></li> </ul>
21-Dec-2022	5	Updated for X-LINUX-AI v3.0.0 with the support for ONNX Runtime, and for the demonstration boards: <ul style="list-style-type: none"> <li>Updated <i>Features</i> and <i>Description</i></li> <li>Updated the cover picture and <i>X-LINUX-AI architecture</i></li> </ul>
7-Jul-2023	6	Updated for X-LINUX-AI v5.0.0 with XNNPACK support, performance improvement, new object detection applications, and new demonstration board: <ul style="list-style-type: none"> <li>Updated <a href="#">Features</a> and <a href="#">Description</a></li> <li>Updated <i>X-LINUX-AI architecture</i></li> <li>Added <a href="#">Versioning</a></li> </ul>

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