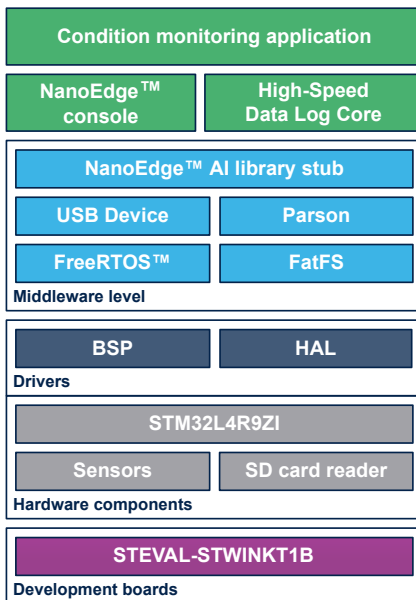


## Artificial Intelligence (AI) condition monitoring function pack for STM32Cube



### Features

- Complete firmware to program an STM32L4+ sensor node for condition monitoring and predictive maintenance applications on the [STEVAL-STWINKT1B](#) SensorTile wireless industrial node
- Stub for replacement with a Cartesiam Machine Learning library generated free of charge on STEVAL-STWINKT1B using the NanoEdge™ AI Studio for the condition monitoring application
- Configuration and acquisition of STMicroelectronics [IIS3DWB](#) 3-axis digital vibration sensor, or [ISM330DHCX](#) 6-axis digital accelerometer and gyroscope iNEMO inertial measurement unit (IMU) with machine learning core
- High-speed data logging on a microSD™ card
- Embedded file system utilities
- Configurable autonomous mode controlled by user button and JSON configuration files
- Interactive command-line interface (CLI) for
  - Node and sensor configuration
  - Data logging
  - Learn and detect phase management of the NanoEdge™ AI library
- Easy portability across STM32 microcontrollers by means of the STM32Cube ecosystem
- Free and user-friendly license terms

Product status link

[FP-AI-NANOEDG1](#)



## 1 Description

Condition monitoring is a major component of the predictive maintenance systems, allowing production performance improvement, maintenance cost reduction and a drastic decrease of the downtime due to routine maintenance.

The FP-AI-NANOEDG1 function pack helps to jump-start the implementation and development of condition monitoring applications designed with the NanoEdge™ AI Studio solution from Cartesian (a member of the ST Partner program).

NanoEdge™ AI Studio simplifies the creation of autonomous Machine Learning libraries with the possibility of running not just inference but also training on the edge. It facilitates the integration of predictive maintenance capabilities as well as the security and detection with sensor patterns self-learning and self-understanding, exempting users from advanced skills in mathematics, Machine Learning, data science, or creation and training of Neural Network.

FP-AI-NANOEDG1 covers the entire design of the Machine Learning cycle from the data set acquisition to the integration of NanoEdge™ AI Studio generated libraries on a physical node.

It runs data collection, learning session and the inference in real time on an STM32L4R9ZI ultra-low-power microcontroller (Arm® Cortex®-M4 at 120 MHz with 2 Mbytes of Flash memory and 640 Kbytes of SRAM), taking physical sensor data as input. The SensorTile wireless industrial node (STEVAL-STWINKT1B) embeds industrial-grade sensors, including 6-axis IMU, 3-axis accelerometer and vibrometer to catch any movement precisely, a very high-frequency digital and analog microphone as well as ultrasound spectra enabling fine variation monitoring and also high-precision temperature, pressure and humidity sensor for challenging industrial environment.

The NanoEdge™ AI library generation itself is out of the scope of this function pack and must be generated using NanoEdge™ AI Studio.

FP-AI-NANOEDG1 implements a wired interactive CLI to configure the node, record the data, and manage the learn and detect phases. For simple operation in the field, a standalone battery-operated mode allows basic controls through the user button, without using the console.

## 2 General information

### 2.1 Ordering information

Learning and detection require the generation of the NanoEdge™ AI library using NanoEdge™ AI Studio. It is available free of charge for STM32L4+ on [STEVAL-STWINKT1B](#) under trial version. STEVAL-STWINKT1B is a specific derivative of the STEVAL-STWINKT1 board. Refer to [www.st.com](http://www.st.com) or the STMicroelectronics distributors in case of doubt.

FP-AI-NANOEDG1 is available to download from the [www.st.com](http://www.st.com) website as described in Table 1.

**Table 1. FP-AI-NANOEDG1 ordering information**

Order code	Target board <sup>(1)</sup>	Target STM32	Detailed information
FP-AI-NANOEDG1	STEVAL-STWINKT1B	STM32L4R9ZI	<ul style="list-style-type: none"> <li>Getting started (<a href="#">wiki</a>)</li> <li>User manual (<a href="#">wiki</a>)</li> </ul>

1. For the support of the [STM32L562QE](#)-based [STM32L562E-DK](#) Discovery kit, refer to the getting started ([wiki](#)) and corresponding user manual ([UM2721](#)).

### 2.2 What is STM32Cube?

STM32Cube is an STMicroelectronics original initiative to significantly improve designer's productivity by reducing development effort, time, and cost. STM32Cube covers the whole STM32 portfolio.

STM32Cube includes:

- A set of user-friendly software development tools to cover project development from conception to realization, among which are:
  - [STM32CubeMX](#), a graphical software configuration tool that allows the automatic generation of C initialization code using graphical wizards
  - [STM32CubeIDE](#), an all-in-one development tool with peripheral configuration, code generation, code compilation, and debug features
  - [STM32CubeProgrammer \(STM32CubeProg\)](#), a programming tool available in graphical and command-line versions
  - [STM32CubeMonitor \(STM32CubeMonitor, STM32CubeMonPwr, STM32CubeMonRF, STM32CubeMonUCPD\)](#) powerful monitoring tools to fine-tune the behavior and performance of STM32 applications in real-time
- [STM32Cube MCU and MPU Packages](#), comprehensive embedded-software platforms specific to each microcontroller and microprocessor series (such as [STM32CubeL4](#) for the STM32L4+ Series), which include:
  - [STM32Cube hardware abstraction layer \(HAL\)](#), ensuring maximized portability across the STM32 portfolio
  - [STM32Cube low-layer APIs](#), ensuring the best performance and footprints with a high degree of user control over hardware
  - A consistent set of middleware components such as FAT file system, RTOS, USB Host and Device, TCP/IP, Touch library, and Graphics
  - All embedded software utilities with full sets of peripheral and applicative examples
- [STM32Cube Expansion Packages](#), which contain embedded software components that complement the functionalities of the STM32Cube MCU and MPU Packages with:
  - Middleware extensions and applicative layers
  - Examples running on some specific STMicroelectronics development boards

### 3 License

FP-AI-NANOEDG1 is delivered under the *Mix Ultimate Liberty+OSS+3rd-party V1* software license agreement (SLA0048).

The software components provided in this package come with different license schemes as shown in Table 2.

**Table 2. Software component license agreements**

Software component	Copyright	License
Arm® Cortex®-M CMSIS	Arm Limited	Apache License 2.0
FreeRTOS™	Amazon.com, Inc. or its affiliates	MIT
STM32L4xx_HAL_Driver	STMicroelectronics	BSD-3-Clause
Board support package (BSP)	STMicroelectronics	BSD-3-Clause
STM32L4xx CMSIS	Arm Limited - STMicroelectronics	Apache License 2.0
FatFS	ChaN	BSD-3-Clause
Parson	Krzysztof Gabis	MIT
Applications	STMicroelectronics	Proprietary
Python™ scripts	STMicroelectronics	BSD-3-Clause
Dataset	STMicroelectronics	Proprietary
NanoEdge Console application	STMicroelectronics	Proprietary
High Speed Data Log Core application	STMicroelectronics	Proprietary

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



## Revision history

**Table 3. Document revision history**

Date	Version	Changes
30-Jun-2020	1	Initial release.
3-Aug-2020	2	Updated <i>Features</i> and <i>Description</i> .
17-Dec-2020	3	Document entirely updated for the support of the STWIN SensorTile wireless industrial node ( <a href="#">STEVAL-STWINKT1B</a> ).

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