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MediaTek LinkIt™ Assist 2502 Developer's Guide

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1. Introduction

1.1. What is MediaTek LinkIt?

MediaTek LinkIt™ is a collection of development platforms designed for the prototyping of Wearables and Internet of Things (IoT) devices. Each development platforms provide a collection of tools, hardware and related resources to enable developers to address one of the three Wearables and Internet of Things (IoT) device sectors, as shown in Figure 1.


	One Application Use (OAU)	Simple Application Use (SAU)	Rich Application Use (RAU)
Examples	Fitness Tracker Health Tracker Simple Bluetooth device Smart bulbs Smart appliances	Smart Wristband Smart Watch Child/Elderly Safety watch/ wristband/tracker	High-end Smart Watch Smart Glasses
Hardware (optional)	MCU (<100 MHz) Wi-Fi or Bluetooth Sensor LED Display	MCU (100~300 MHz) Bluetooth Sensors LED or TFT Display GSM/GPRS GPS Wi-Fi	AP (> 1GHz with multi-core) Bluetooth Sensors TFT Display or See-Through Display GSM/GPRS GPS Wi-Fi
OS		Mostly use RTOS as Kernel	Mostly use branded Linux as Kernel
Price Point	Lowest	Middle	Highest
Battery life	Long (>7 days)	Medium 5-7 days	Short (2-3 days)
Characteristics	Limited computing power, focusing on 1 task (such as sports, health, find device, switching, setting) Mostly non-display or with very simple LED display	May have multiple functions and can update apps Also need outdoor/indoor positioning	Multiple apps and functions Sophisticated UI with more powerful graphics and multimedia features
			
Focus segment for MediaTek LinkIt Connect 7681 development platform and the MT7681 chipset		Focus segment for MediaTek LinkIt Assist 2502 and LinkIt ONE development platforms and MT2502 chipset	

Figure 1 Wearables and IoT product segments

Each development platform turn offers one or more chipset and API variants designed to meet specific development and device requirements. To enable the creation devices prototypes, each developer platform includes:

- One or more HDKs consisting of a development board and one of more chipset modules to enable the prototyping of devices.
- An SDK to enable the creation of firmware or software for devices.
- One or more hardware reference designs that can be used as the basis for board layouts of final products.
- Comprehensive documentation, such as API references, developer guides, chipset descriptions and pin-out diagrams.
- Support forums.

1.2. MediaTek LinkIt Assist 2502 development platform

The MediaTek LinkIt Assist 2502 development platform is designed to enable the prototyping of Simple Application Use (SAU) Wearables and IoT devices. These devices include smartwatches, toddler and senior trackers, smart wrist bands and healthcare wearable devices.

As shown in Figure 2 this development platform consists of a SOC, API, hardware development kit (HDK), software development kit (SDK) and is supported by comprehensive documentation.

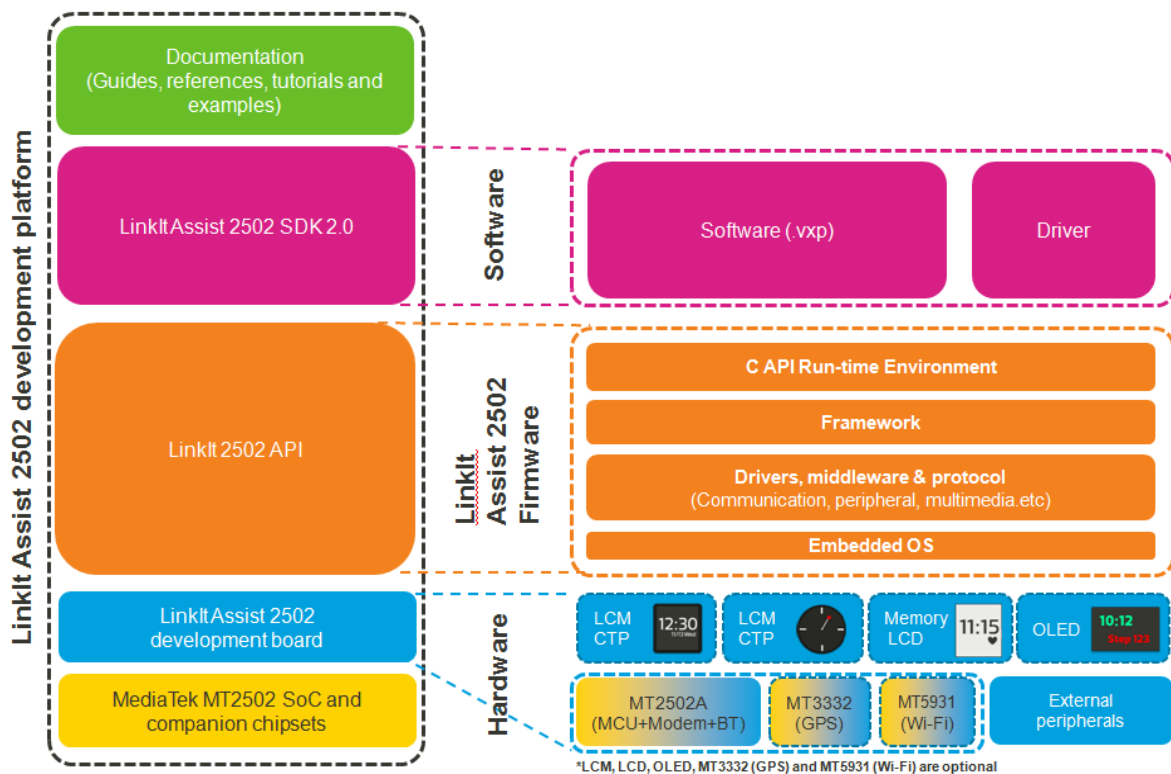


Figure 2 The components of the MediaTek LinkIt Assist 2502 development platform

1.2.1. System-on-Chip

The LinkIt development platform is built around the world's smallest commercial System-on-chip (SOC) for Wearables, MediaTek MT2502 (Aster).

This SOC also works with MediaTek’s energy efficient Wi-Fi (MediaTek MT5931) and GNSS (MediaTek MT3332) companion chipsets.

1.2.2. LinkIt Assist 2502 Hardware Development Kit (HDK)

The LinkIt Assist 2502 HDK consists of:

- LinkIt Assist 2502 development board from Seeed. The board provides access to the hardware LCD engine of MediaTek MT2502 SOC, making it suitable for prototyping wearable devices.
- LinkIt Assist 2502 modules by AcSiP that includes:
 - LinkIt Assist 2502 module (AcSiP module model number AI2502S05)
 - LinkIt Assist 2502 GNSS module (AcSiP module model number CW03S)
 - LinkIt Assist 2502 Wi-Fi module (AcSiP module model number CW01S)

1.2.2.1. LinkIt Assist 2502 development board

The LinkIt Assist 2502 development board incorporates the three LinkIt Assist 2502 modules, as shown in Figure 3, and display, pins and buttons, as shown in Figure 4.

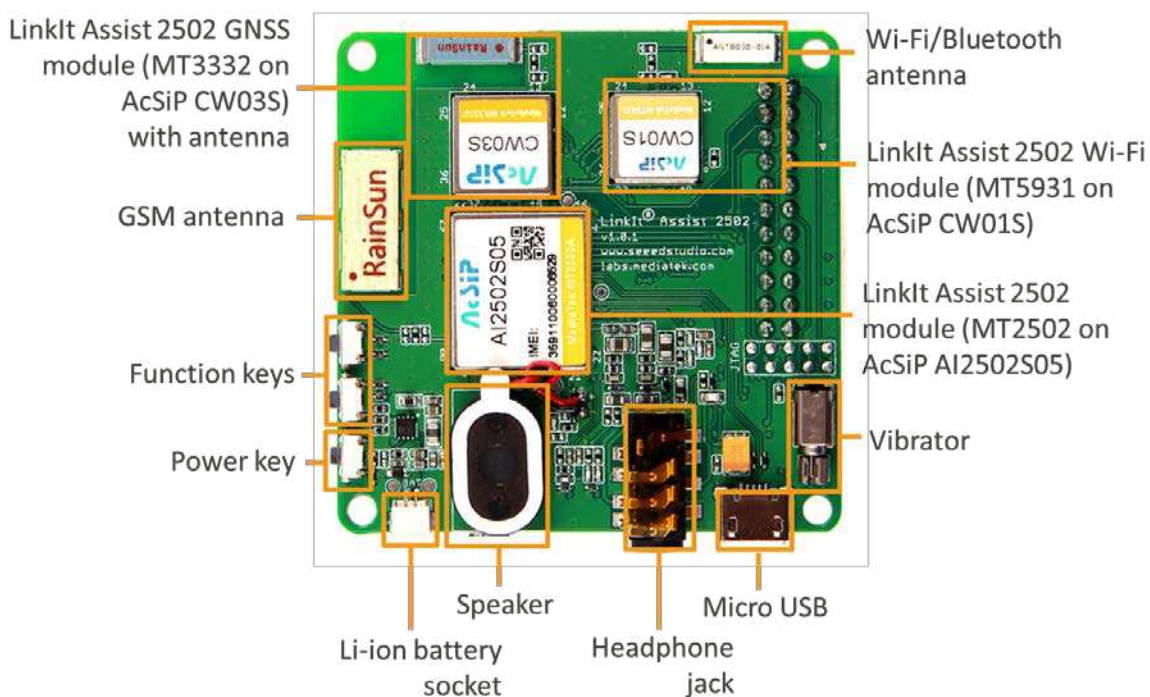


Figure 3 LinkIt Assist 2502 development board (back view)

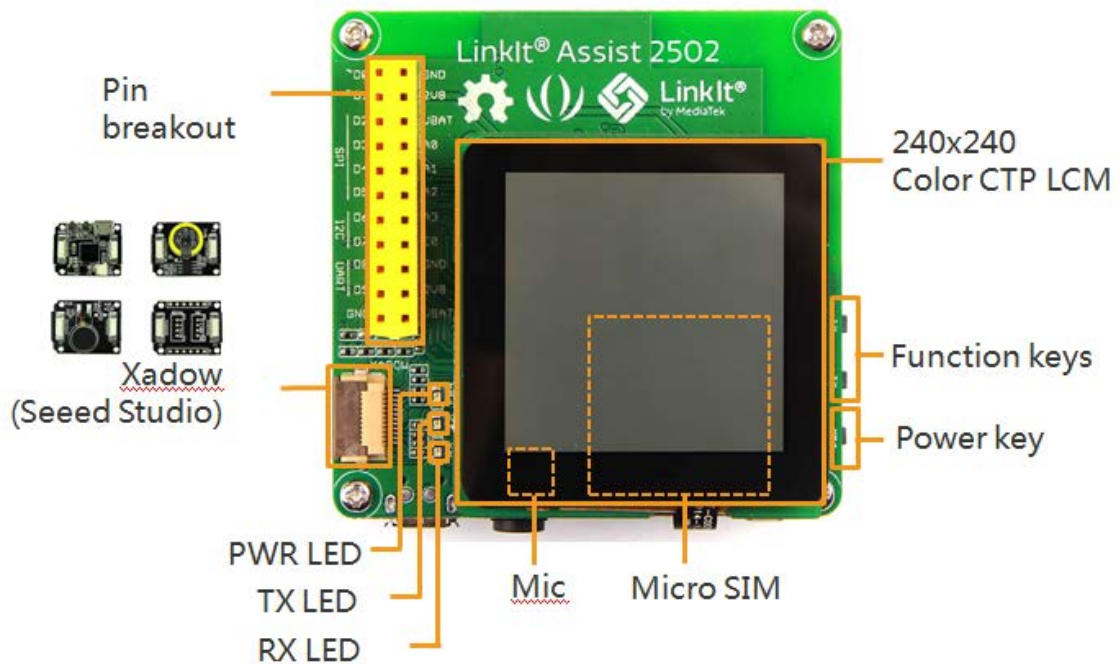


Figure 4 LinkIt Assist Development Board (front view)

Each MediaTek Assist 2502 module include a MediaTek SOC and related RF components to provide an easy-to-use hardware interface. The schematic, layout and BOM for each module are available for you to use in designing your own MT2502 product using modules. Hardware development cycle can be shortened by reference to this reference design based on modules, and make shorter time-to-market possible.

This platform provides a full-range of communication, positioning and multimedia features. This make it suitable for design and development an wide array of wearable devices such as watches, wristbands, trackers, and other mobile IoT devices. Communication protocols GSM, GPRS, Bluetooth 2.1 and 4.0 and Wi-Fi are supported. GNSS positioning feature include supports for GPS, GLONASS and BeiDou systems.

It is also easy to attach the peripheral devices that might be needed to prototype the final product through interfaces that include GPIO, analog, PWM, I2C, SPI, UART and Xadow. The available pins are illustrated in Figure 5.

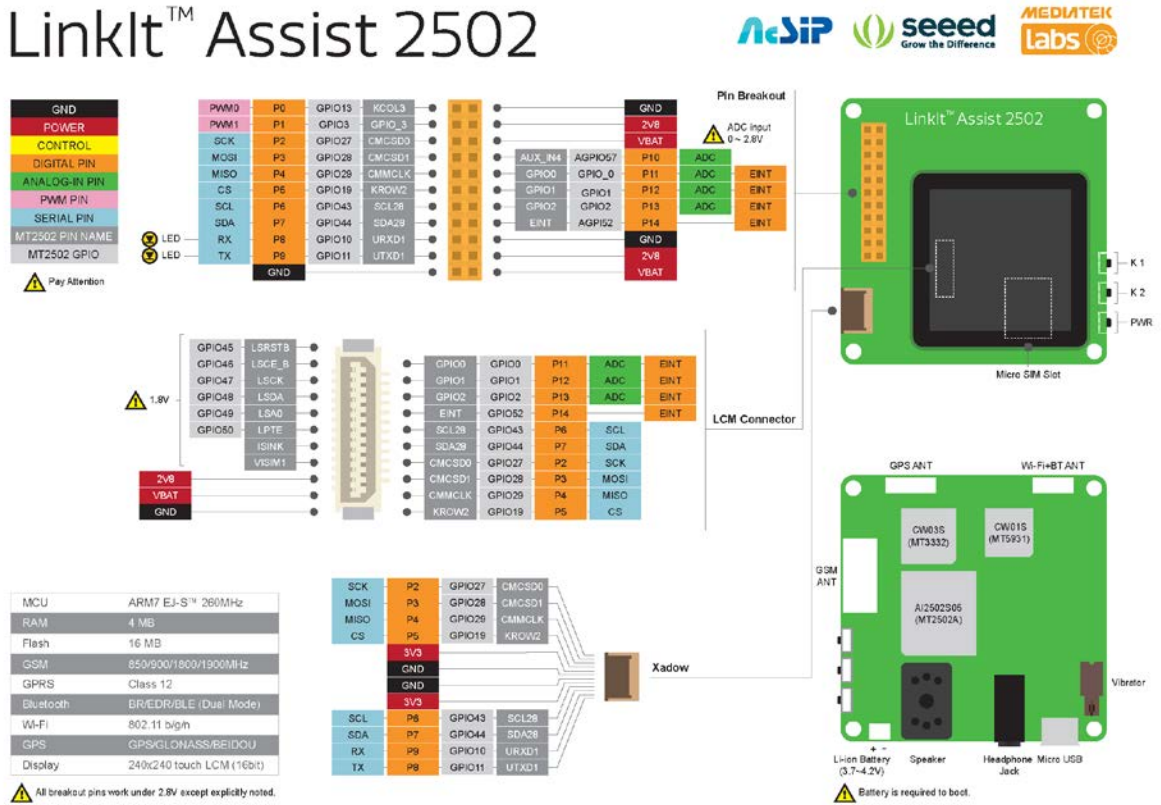


Figure 5 Pin-out diagram of the LinkIt Assist 2502 development board

The full specification of the LinkIt Assist 2502 development board is provided in Table 1.

Table 1 Specification of the LinkIt Assist 2502 development board

Category	Feature	Spec
Microcontroller Module	Module Name	AcSiP AI2502S05
	Chipset	MT2502A (Aster)
	Core	ARM7 EJ-S™
	Clock Speed	260MHz
Wi-Fi Module	Module Name	AcSiP CW01S
	Chipset	MT5931
GPS Module	Module Name	AcSiP CW03S
	Chipset	MT3332
PCB Size	Dimensions	2.1 x 2.1 inches
Memory	Flash	16MB
	RAM	4MB
Power	Battery Jack	3.7~4.2V Li-ion battery
	Charger	Micro USB
Digital IO Pins	Pin Count	14
	Voltage	2.8V
Analog Input Pins	Pin Count	4
	Voltage	0~2.8V ⁽¹⁾
PWM Output Pins	Pin Count	2
	Voltage	2.8V
External Interrupts	Pin Count	2
	Voltage	2.8V
I2C (master only)	Set Count	1 (SDA, SCL)
	Speed	100Kbps, 400Kbps, 3.4Mbps
SPI (master only)	Set Count	1 (MOSI, MISO, SCK)
	Speed	104Kbps~26Mbps
UART	Set Count	1 (RX, TX)
UART on USB ⁽²⁾	Set Count	1
Xadow (Seeed Studio)	Set Count	1
	Voltage	Signal 2.8V, Power 3.3V
Communications	GSM	850/900/1800/1900 MHz
	GPRS	Class 12
	Bluetooth	2.1 SPP and 4.0 GATT (Dual Mode)
	Wi-Fi	802.11 b/g/n
Positioning	GNSS	GPS/GLONASS/BeiDou
Display Module	LCD	Truer 240x240 transfective
	Driving IC	ST7789S

(1) Warning: Exceeding the maximum allowed voltage damages the pin.

(2) This UART on USB is used by the Monitor tool included in the SDK to display application logs and system logs.

1.2.2.2. Related HDKs

The LinkIt ONE development board is also based on the MediaTek MT2502 SOC. It's possible to use this board to run MediaTek LinkIt Assist 2502 applications, with some limitations.

A comparison of the development boards is provided in Table 2.



	LinkIt ONE	LinkIt Assist 2502
		
Purpose	Proof of concept	Prototyping
LinkIt SDK 1.0 (for Arduino) support	Yes	No
LinkIt Assist 2502 SDK support	Yes	Yes
Board Pin-out Design	Arduino-style Pin Layout	Proprietary Design
Size	84 x 53mm	53 x 53mm
Pin voltage	3.3V	2.8V
Extra Peripheral Interface	Grove (Seeed Studio)	Xadow (Seeed Studio)
Build-in Key	0	2
SD Card	Yes	No
SIM	SIM	Micro SIM
Power Source	Micro USB (5V) Battery (optional)	Micro USB (5V) Battery (required)
Audio	Headphone (inc. mic)	Headphone, speaker, mic
Vibrator	No	Yes
Antenna	External	Build-in ceramic antenna

Table 2 Comparison of the LinkIt ONE and Assist 2502 development boards

For more information on the LinkIt ONE development board, please see the [MediaTek LinkIt™ ONE Developer's Guide](#).



To be compliant with Arduino, the design of the LinkIt ONE development board includes special circuits, for example to shift pin voltage from 2.8V to 3.3V, which would add unnecessary cost if incorporated into a final product. Those circuits are therefore not included in the LinkIt Assist 2502 development board.

1.2.3. LinkIt Assist 2502 API

The LinkIt Assist 2502 API provides a collection of C-based modules that enable programmatic access to the features of the platform's SOC, companion chipsets, displays and connected peripherals. Further details on the API is provided in 5, "API Guide".

As shown in Figure 2 the LinkIt Assist 2502 API is used to create a LinkIt Assist 2502 application in the LinkIt Assist 2502 SDK. Coding is undertaken using the C programming language based API functions, as well as third party libraries and device drivers. The application is compiled into a LinkIt Assist 2502 executable file (VXP file) and executes in the runtime environment provided by the firmware of the LinkIt Assist 2502 development board. Dynamic loading is supported to run applications from flash storage.

It's possible to develop LinkIt Assist 2502 software in C++ as the toolchain supports compilation in both C and C++ files. If you want to code in C++, rename the application source code file from *.c to *.cpp after generating your project. However, note that the LinkIt Assist 2502 API provides C functions rather than C++ functions and some C++ libraries may rely on runtime functions that are not supported by the LinkIt Assist 2502 development platform.

LinkIt Assist 2502 applications are executed in a multi-threaded environment. In this environment, there are system-managed threads such as driver threads that are responsible for managing integrated hardware such as the GSM modem and Bluetooth protocol stack. A LinkIt Assist 2502 application runs on a specific thread called *main thread*. LinkIt Assist 2502 applications can also create new threads. However, most LinkIt Assist 2502 SDK 2.0 API functions can only be invoked from the main thread. Functions that are called on created threads are explained in detail in the API reference documentation.

Due to the nature of multi-thread, multi-tasking environment, LinkIt Assist 2502 applications adopt an event-based programming model. More information about this programming model is provided in 5.5.5, "Threads".

1.2.3.1. API Summary

Table 3 shows a summary of the modules available in the LinkIt 2502 API.

Table 3 Summary of LinkIt 2502 API modules

Functions	Features
Core	
Memory	Provides functions for memory allocation, deallocation and alike.
Timer	Provides three timers: precise timer, non-precise timer and HISR timer.
Thread	Provides functions for threads, signals and mutex related activities.
Character Set Conversion	Character conversion functions among the character sets of ASCII, USC-2, UTF-8 and UTF-16BE.
File System	A file system that provides file and folder related operations.
Date & Time	Sets and retrieves system time, or gets the microsecond counts since the system was powered on.
Log	Outputs log items with severity to the Monitor tool provided by the SDK.
Resource	Accesses resources in VXP file, e.g. strings, image and audio data.
Firmware	API to query firmware information and trigger the firmware update process.
Power Management	Enables shut down and reboot of the system, also provides battery and charging information.

Functions	Features
User interaction	
Keypad	Registers keypad event handlers, if the HDK provides keypad hardware.
Touch	Registers touch event handlers, if supported by HDK and firmware.
Interfaces and network	
Driver Common Layer	Provides functions to control and access (read and write) to the hardware devices, including ADC, GPIO, I2C, SPI, UART, EINT, PMU and PWM.
Network Protocol	Provides TCP, UDP, SSL, HTTPS and HTTP support.
Telephony and mobile data	
SIM	Functions to access the information from the SIM card in the device.
Telephony	Functions to control voice calls.
SMS	Functions to send, read, delete and cancel SMS messages.
Cellular Info	Functions to obtain current or neighboring cell information.
GPRS	Configures the GPRS connection.
Wi-Fi	
WLAN	Configures WLAN (Wireless LAN).
Location	
GPS	GPS and Extended Prediction Orbit (EPO) functionality
Bluetooth	
Bluetooth	Functions for applications to configure, monitor and search for Bluetooth 2.1 connections. The Bluetooth SPP API supports client and server functionality for one-to-one connections.
Notification Service	Functions to receive notifications from iOS and Android devices.
Bluetooth Low Energy	Provides Bluetooth 4.0 Generic Attribute Profile (GATT) support.
Graphics	
Graphics	Performs pixel operations Draws points, lines, rectangles and ellipses Decodes and paints images Outputs text using vector font Performs LCD operations on supported hardware
Audio	
Audio	Play and record audio files

1.2.3.2. Related APIs

In addition to the core API, the LinkIt Assist 2502 development platform can also make use of:

- LinkIt Assist 2502 Smartphone Notification API, which provides for the receipt of notifications through a Bluetooth connection, including notifications from the Apple Notification Center Service (ANCS). For more information see [LinkIt Assist 2502 Smartphone Notifications Developer's Guide](#).

- LinkIt Smart Connection libraries for Android and iOS, which provide for broadcasting wireless AP setting from a smartphone or tablet to a LinkIt 2502 development board or device. For more information see [LinkIt Smart Connection Developer's Guide](#).

1.2.4. LinkIt Assist 2502 Software Development Kit (SDK)

The MediaTek LinkIt Assist 2502 SDK 2.0 enables the creation of application (software) for the development platform. A details guide to using the SDK is provided in 2, "Getting started".

1.2.4.1. Feature summary

The SDK consists of the following:

- **Firmware Updater** that uploads matching version of the firmware to the development boards. The SDK provides firmware in binary format.
- A plug-in for the Eclipse IDE (with CDT) that provides:
 - **Eclipse Project Launcher Wizard** that creates a project skeleton for you to start programming your LinkIt Assist 2502 applications.
 - **Eclipse Tool Bar** that defines the proper application settings and compile options for the compiler to build the VXP executable for your LinkIt Assist 2502 applications.
 - **Resource Editor** that enables you to embed images and strings into the VXP executable that can be retrieved by the Resource module of the SDK.
- **Uploader** that uploads the VXP executable to your connected development board through the USB port.

1.2.4.2. Development process overview

You start creating a LinkIt 2502 applications using the Eclipse Project Launcher Wizard to create a project skeleton or open an example project. The application is codes with the Eclipse CDT tools and the compiled and linked from options on the Eclipse Tool Bar.

The generated executable (VXP) is uploaded to the internal storage of the development board with the Uploader tool. Next, the firmware on the development board reboots, and the uploaded application executes to enable access to the features of the underlying frameworks and built-in drivers.

1.2.5. Documentation and code examples

There are five references available to assist with the development of software for LinkIt Assist 2502 prototypes:

- This developer's guide, the latest copy of which is available [here](#) on the MediaTek Labs website.
- [LinkIt Smart Connection Developer's Guide](#): This document provides information on how to use Smart Connection to provision the Wi-Fi connection on a LinkIt development board and connect to a wireless AP. It includes details on how to use the Android and iOS libraries to build a smartphone app that is used to define an AP and send details to a development board.
- [LinkIt Assist 2502 Smartphone Notifications Developer's Guide](#): This document provides details of the API that can be used to receive smartphone notification on a LinkIt Assist 2502 device.

- [LinkIt Assist 2502 development board pin-out diagram](#): This diagram provides details of the pin breakout on the development board.
- [LinkIt Assist 2502 API reference](#): Details of the various modules, their functions and parameters, available for coding software for the development platform.
- Example code supplied as part of the SDK and accessible through the Eclipse Project Wizard.

In addition there are a number of resources available to assist with the creation of final device hardware boards:

- [LinkIt Assist 2502 Hardware Reference Design](#): This file includes:
 - LinkIt Assist 2502 development board schematic and layout
 - LinkIt Assist 2502 development board pin-out diagram
 - LinkIt Assist 2502 pin mux table
 - LinkIt Assist 2502 module data sheets (AcSiP)
 - Chipset datasheets

Please note: PCB layout and board schematics have been created using [Eagle](#). They can be viewed using the [freeware Eagle Light Edition](#).

- [MT2502 \(Aster\) chipset technical brief](#)
- [MT3332 \(GNSS\) chipset technical brief](#)
- [MT5931 \(Wi-Fi\) chipset technical brief](#)
- [LinkIt Assist 2502 module data sheet](#) (AcSiP AI2502S05)
- [LinkIt Assist 2502 GNSS module data sheet](#) (AcSiP CW03S)
- [LinkIt Assist 2502 Wi-Fi module data sheet](#) (AcSiP CW01S)

Additional documentation may become available from time to time and can be found on the development platforms [documentation page](#) on the MediaTek Labs website.

1.3. Related development platforms

The MediaTek LinkIt ONE development platform is also based on the MediaTek MT2502 chipset. However, LinkIt ONE development platform provides for use of a set of APIs similar to those provided on the Arduino development boards, implements through a porting layer between the Arduino API and the Runtime environment. Software development is enabled by an SDK that offers a plug-in to the Arduino software.

There is also a fundamental between the software architecture of LinkIt ONE application and those for LinkIt Assist 2502. LinkIt ONE programs consists of `setup()` and `loop()` functions and it's common for the system to be in an endless polling state in the `loop()` function. This programming style is very straightforward, but has the disadvantage that it keeps the system in a busy state for much of the time, which leads to increased power consumption. The LinkIt Assist 2502 programming style however, uses event-based programming that uses power more efficiently. Please see 4.3, "Event-driven Programming Model" for details on the event-based programming model

The LinkIt ONE development board offers features compatible with the LinkIt ONE API. Software created for the LinkIt Assist 2502 development board can be run on the LinkIt ONE development board, however some features may not work due to differences in the hardware capabilities.

For information on the LinkIt ONE development platform, please see the [MediaTek LinkIt™ ONE Developer's Guide](#).

1.4. Joining the MediaTek Labs Ecosystem

Wearables and Internet of Things are the next wave in the consumer gadget revolution. MediaTek Labs is a key player in this field, combining the best of two worlds — the existing MediaTek ecosystem of phone manufacturers, electronic device manufacturers and telecom operators combined with an open, vibrant maker and developer community.

No matter whether you're a maker, device manufacturer, student, DIY hobbyist, or programmer, you will find a development platform from MediaTek to match your requirements to create something innovative. Then you'll be able to take advantage of the [MediaTek Labs Partner Connect program](#) to take your idea to market.

You can join the MediaTek Labs ecosystem by registering on labs.mediatek.com.

2. Getting started

This chapter provides a guide to getting started with the LinkIt Assist 2502 development platform and covers the following items:

- The supported environment for development.
- Installing the [Eclipse IDE for C/C++ Developers](#).
- Installing and configuring the LinkIt Assist 2502 SDK 2.0.
- Building your first project and running it on the development board.
- Exploring example code to accomplish specific tasks.
- Using other tools in the SDK.

2.1. Environment

To make use of the MediaTek LinkIt 2502 SDK and development board please ensure you have a PC with the following:

- Operating system: Microsoft Windows XP, Vista, 7 or 8.
- Eclipse IDE: Indigo (3.7) with CDT 8.0.2.

2.2. Installing Eclipse IDE for C/C++ Developers

The LinkIt Assist 2502 SDK 2.0 includes a plug-in for Eclipse IDE and is compatible with Eclipse IDE Indigo or higher versions. Please download and install Eclipse IDE from the official [Eclipse website](#) making sure it has the C/C++ development (CDT) plug-in. The IDE installation may require an appropriate JAVA SE version to be installed on your PC.

The LinkIt Assist 2502 Eclipse plug-in needs to be installed in the same folder as the Eclipse IDE, where `eclipse.exe` is located.

2.3. Installing LinkIt Assist 2502 SDK 2.0

To install LinkIt Assist 2502 SDK 2.0 you need to do the following:

- 1) Download the [LinkIt Assist 2502 SDK 2.0](#)
- 2) Extract the content of the LinkIt Assist 2502 SDK 2.0 zip file. There are tools in addition to the Eclipse plug-in included in the SDK so consider extracting the content to a permanent location. If you extract the content to a temporary location the installer will give you the option to move it to a permanent location.
- 3) Make sure that the Eclipse IDE is not running.

4) Double click the LinkIt Assist 2502 SDK 2.0 InstallPlugins as shown in Figure 6.

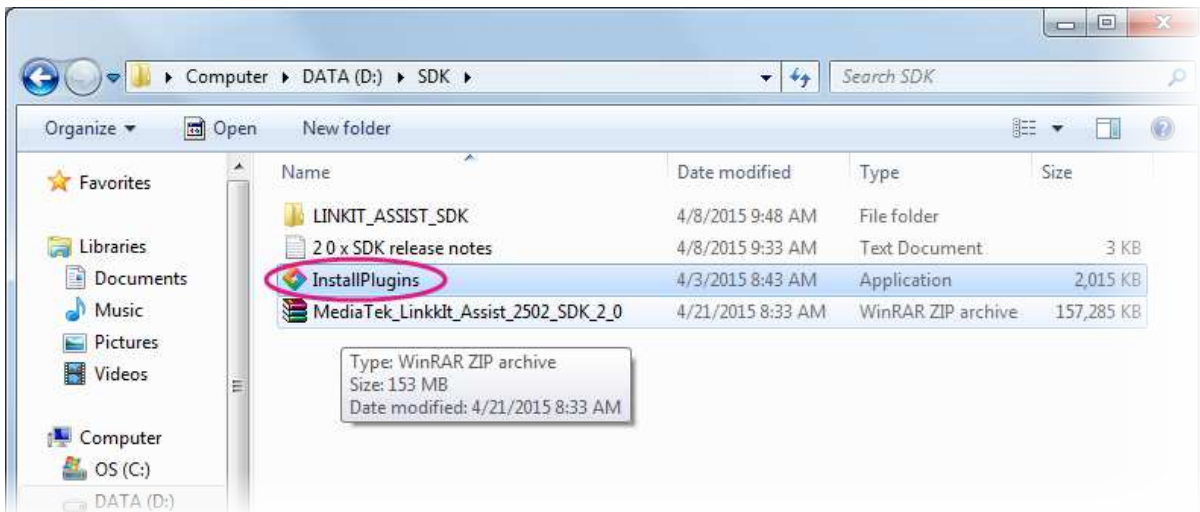


Figure 6 The LinkIt Assist 2502 SDK 2.0 installation application

5) In the Welcome page, Figure 7, click **Next**.

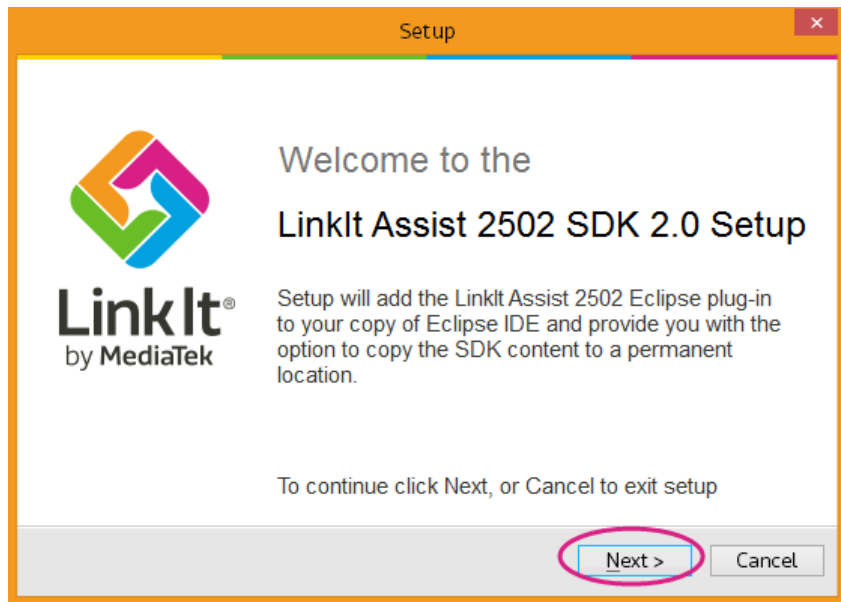


Figure 7 The welcome page of the SDK setup wizard.

- 6) In **Select Eclipse IDE Location**, click **Browse** and locate the folder in which you installed Eclipse IDE (the designated folder mentioned in 2.2, "Installing Eclipse IDE for C/C++ Developers") as shown in Figure 8.

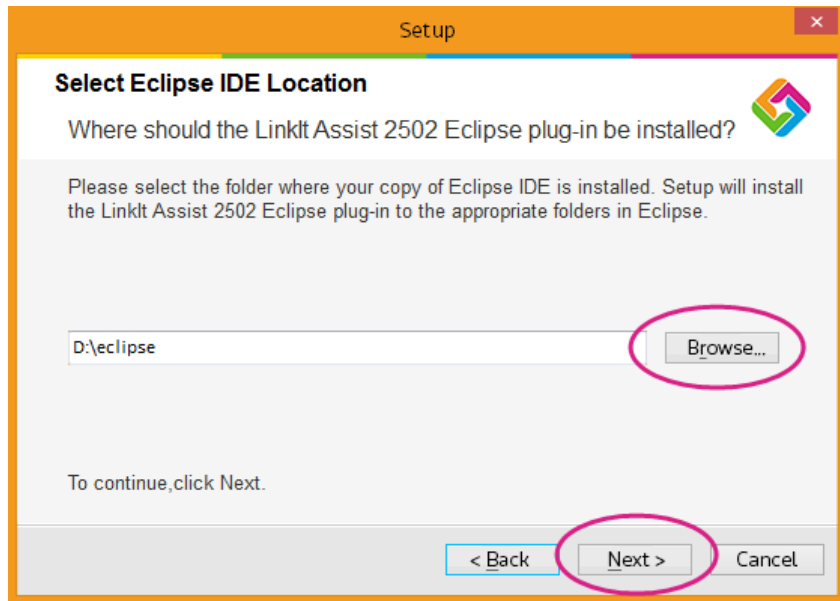


Figure 8 Selecting the folder in which Eclipse IDE is installed

Click **Next**.

- 7) In **Move SDK to permanent location** check **Move LinkIt SDK 2.0 package to new folder** if you extracted the SDK to a temporary location. Click **Browse** to locate a permanent location in which to store the SDK as shown in Figure 9.

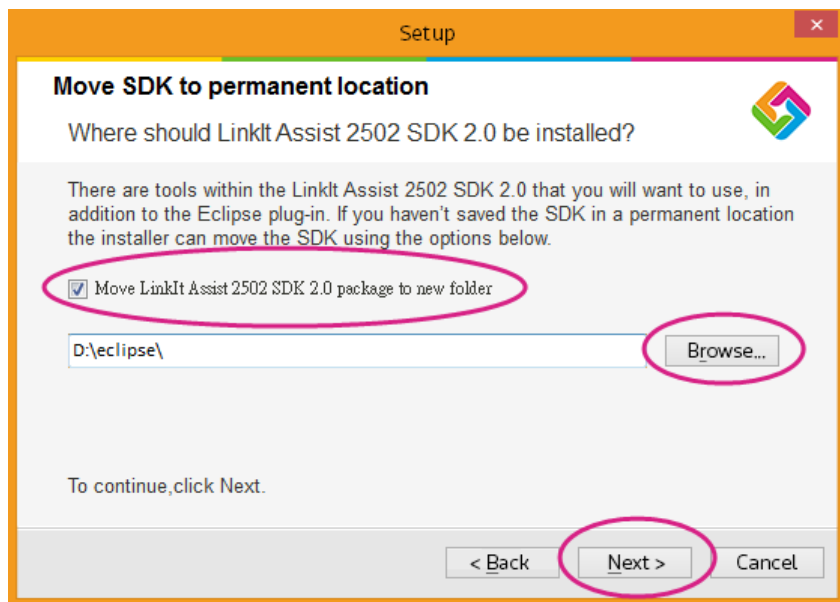


Figure 9 Option to move SDK to a permanent location

Click **Next**.

- 8) In **Ready to Install**, Figure 10, review the selected file locations and if they are OK click **Install**.

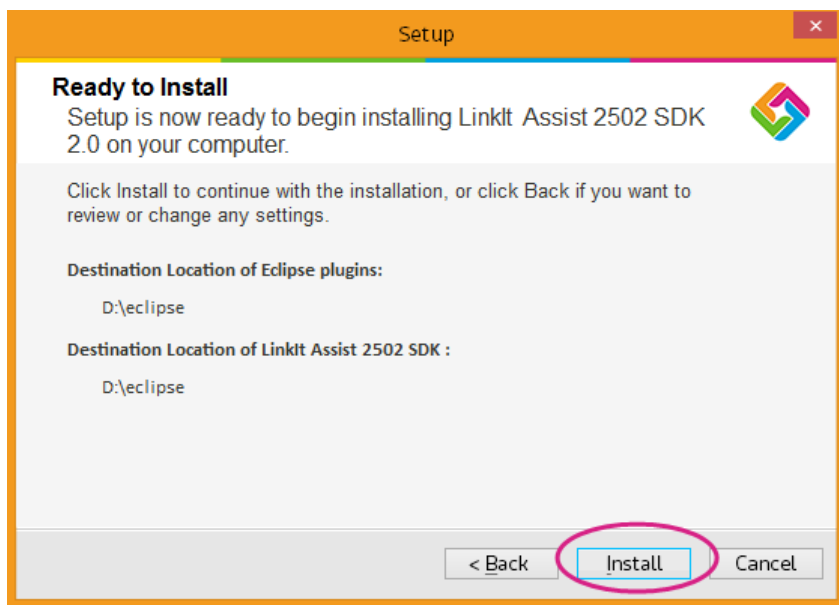


Figure 10 The Ready to Install page of the setup wizard

- 9) Once the plug-in is installed and, if the option was taken, the SDK is moved the **Completing the LinkIt Assist 2502 SDK 2.0 Setup** page, Figure 11, displays. Ensure that **Install the MediaTek USB Driver** is checked, then click **Finish**.

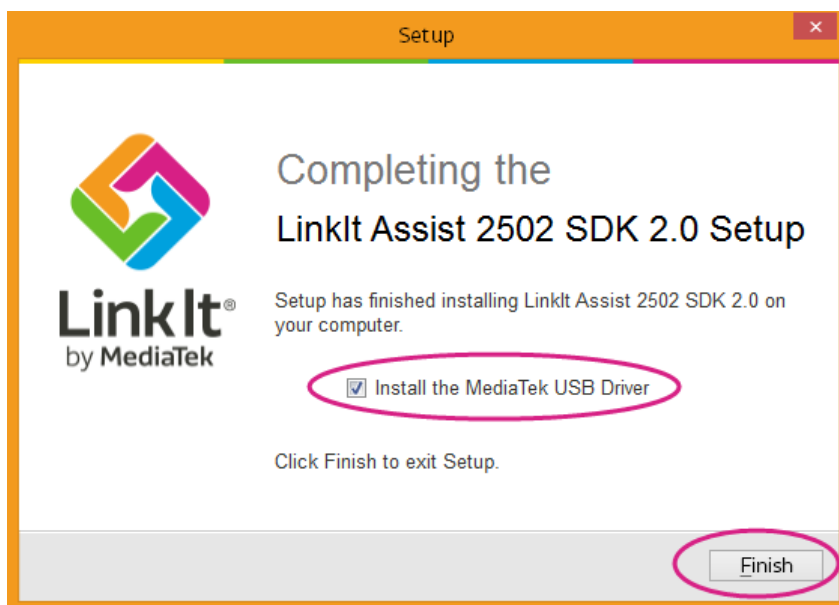


Figure 11 Final page of the SDK installer

- 10) The MediaTek USB driver is now installed and the setup completed.



The MediaTek USB Driver shouldn't need to be installed again should you upgrade the SDK in the future.

2.4. Updating the Firmware

It's essential to make sure that the firmware of the development board corresponds to the SDK you just installed, before you start programming applications in the Eclipse IDE. To do this you use the 'Firmware Updater' to update firmware after installing new versions of SDK. To get started, please make sure the following is ready:

- 1) If you've:
 - a) A LinkIt Assist 2502 development board, you are good to go.
 - b) A LinkIt ONE development board, check that it's switched into mass storage mode, (if you're using USB as the power source, make sure the USB switch is selected as well) as shown in Figure 12.



Figure 12 LinkIt ONE in mass storage mode

- 2) Disconnect your LinkIt development board from your PC.
- 3) Launch LinkIt Firmware Updater .exe, which is located in the SDK folder under {SDK_path}\tools\FirmwareUpdater\
- 4) In the **LinkIt Firmware Updater** window, in **Platform** select your development board. Then click the **green update** button, as shown in Figure 13.

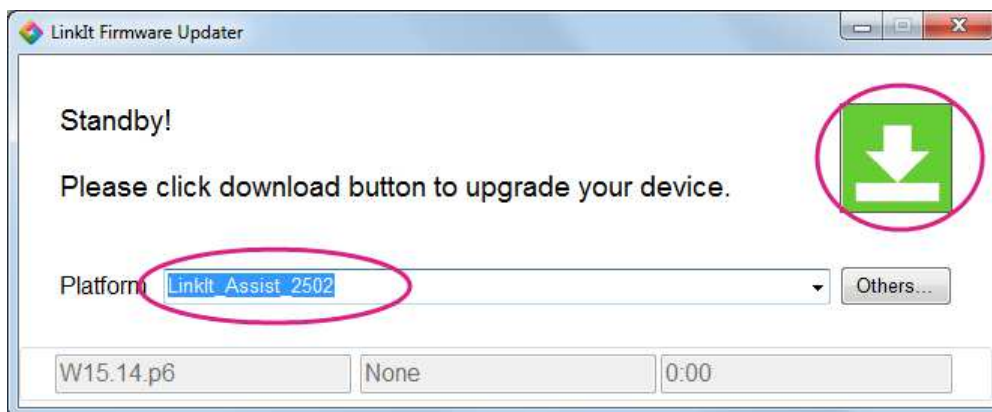


Figure 13 LinkIt Firmware Updater launch screen

- 5) The firmware is now downloaded to the development board, as shown Figure 14. Do not disconnect the development board from your PC during this process.

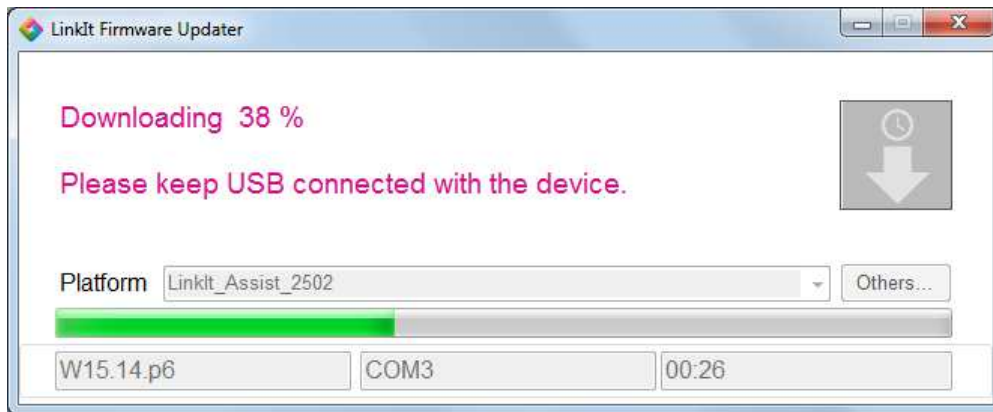


Figure 14 The firmware being uploaded to your device

- 6) When the firmware update is complete this will be confirmed in the **Download Complete** page, as shown in Figure 15.

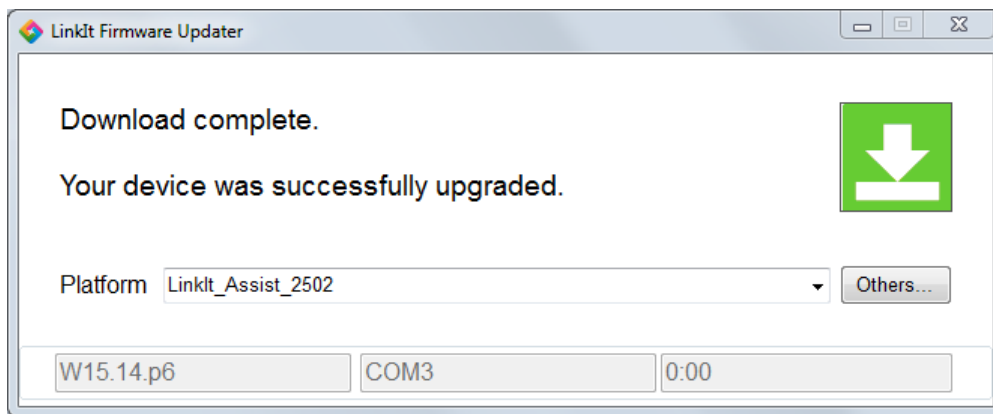


Figure 15 Firmware Updater Download Complete screen

- 7) Disconnect your LinkIt Assist 2502 development board (if you were updating a LinkIt ONE, switch it back to UART mode) and re-connect it to your PC.

With the latest SDK firmware installed, you're ready to proceed to create your first application in Eclipse IDE.

2.5. Creating Your First Project

Software development and project creation on either LinkIt ONE or LinkIt Assist 2502 development boards requires the same steps, but the results are different.

- 1) The first step is to create a new LinkIt Assist 2502 application. In the Eclipse IDE **File** menu, point to **New** and click **Other**, as shown in Figure 16, or use the CTRL+N keyboard shortcut.

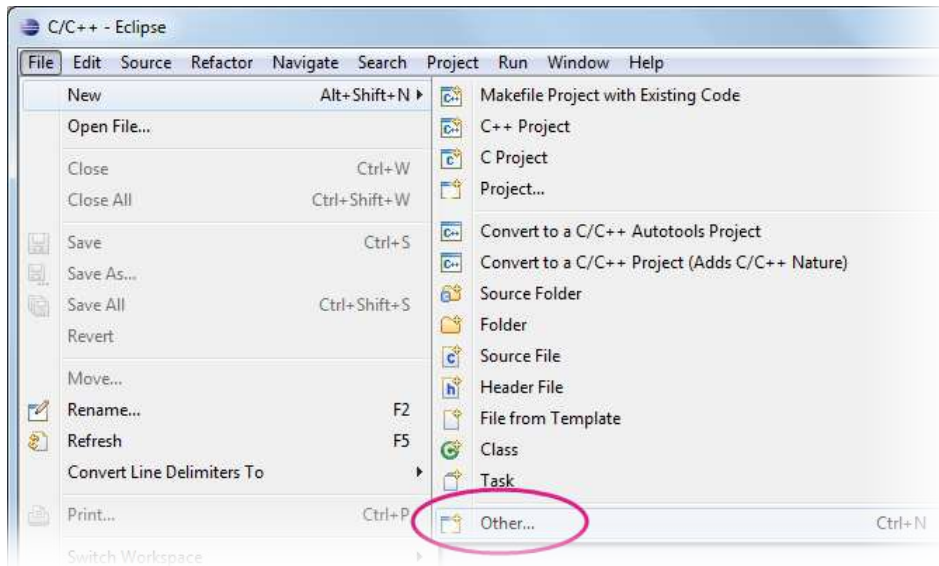


Figure 16 Creating new LinkIt Assist 2502 application

- 2) The **New** window displays. Expand the **LinkIt 2.0** folder, select **Application (*.vxp)** and click **Next** as shown in Figure 17.

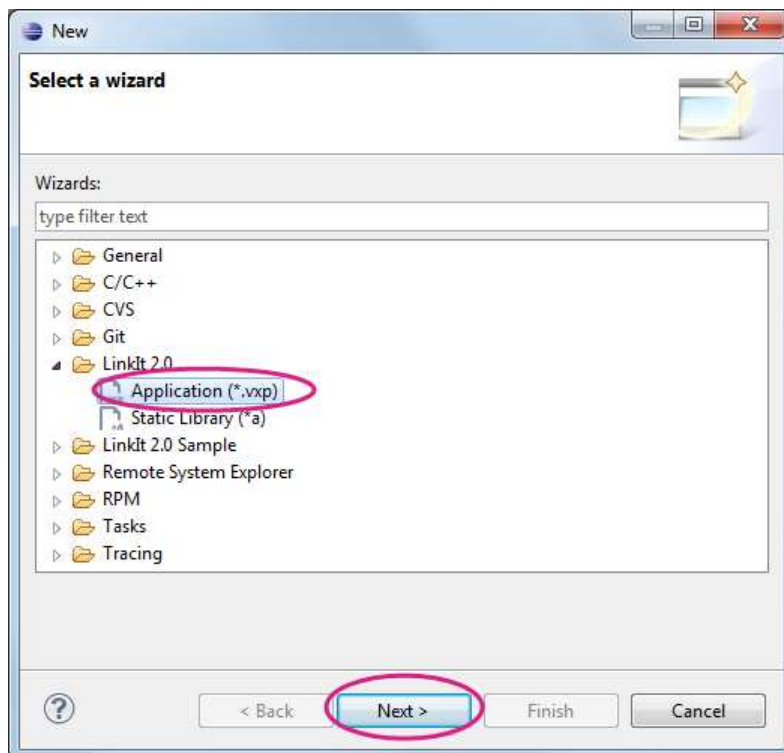


Figure 17 Selecting the LinkIt 2.0 application