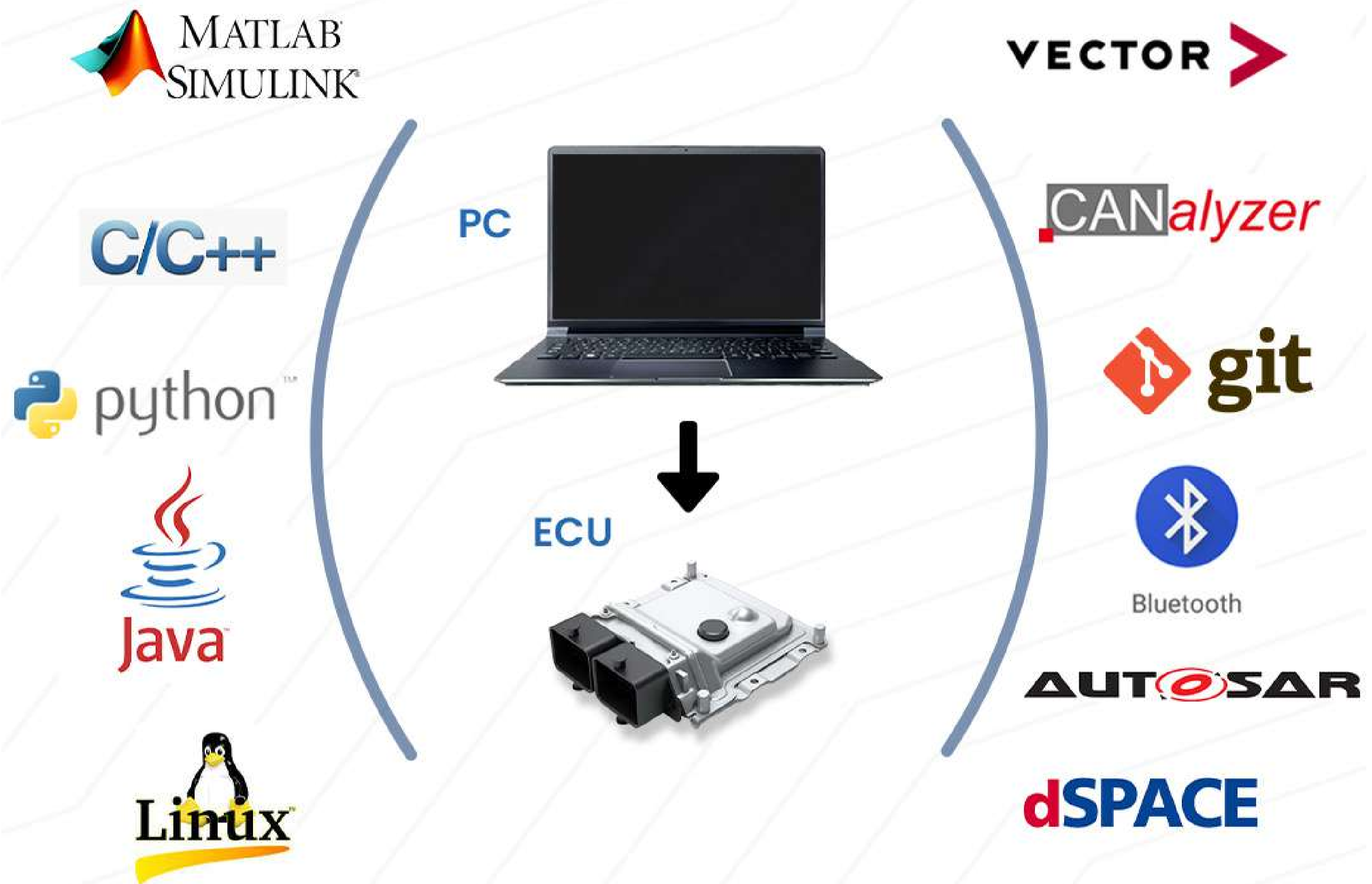


Embedded Software Development Tools



Embedded software is the vital component that is the “brains” in all of the devices used in our civilization, from microwave ovens, cars, tractors to airplanes. Embedded software is the program that runs on the embedded controller hardware, referred to as ECU (electronic control unit) or ECM (electronic control module), which is a printed circuit board (PCB) in one package that includes a microcontroller, IO interface, and often power amplifier circuits. The exact content and shape of the ECU vary depending on the application market, i.e. ECUs used in vehicle applications are different than the ECUs used on microwave ovens or medical equipment.

The smarter the functionalities of the device, the more sophisticated the embedded software needs to be. As systems become more and more complex, so do the complexity of embedded software. For instance, the embedded software on a microwave oven is much simpler than the embedded software on a self-driving car.

Equally important aspect of embedded software development is its testing and validation; how do we make sure it is reliable. Extensive simulation testing technologies are utilized in testing and validation, such as model in the loop (MIL), software in the loop (SIL), hardware in the loop (HIL) testing. Depending on what is at stake (lives or inconvenience), the extent to which embedded software is tested and validated varies in different applications.

Embedded Software versus Non-Embedded Software

Embedded software is a type of computer software that is “embedded” in a device that we use. The differences between “embedded software” and general purpose “software” are as follows:

- Embedded software deals with real world IO in real-time. A few seconds or even milliseconds of delay can have serious consequences, including loss of life, in some embedded control applications. Whereas such delays in general software may simply result in inconvenience to the user.
- Embedded software is the “brain” of a device. The smarter the “brain” is, the smarter the device is.
- Embedded software reliability is paramount importance because lives may be riding on it, hence must be tested extensively using exhaustive testing techniques using MIL/SIL/HIL technologies. Non-embedded software generally does not have this strict requirement on reliability.
- As the markets demand more and more sophisticated devices, with more reliability and lower cost, the embedded software development task necessarily becomes more sophisticated, must be reliable, and development cost must be low.
- Security is a fundamental concern for embedded software and embedded computers, since virtually everything will shortly have IIoT connectivity, opening a box for many opportunities as well as security vulnerabilities.