My project is to create a modular ECU (engine control unit) /BCU (body control unit) to improve affordability for entry level competitors in motorsport, while being scalable for more advanced motorsport teams. This would be used for performance tuning applications. The device would support having multiple inputs and outputs of both analogue and digital, and could be connected to relays or sensors depending on need, to remove manufacturer limitations. This would allow for vehicle customisation such as, anti-lag, throttle blipping, launch control, drive-by-wire, and wireless steering-wheel controls, while still being modular so the end user would only need to purchase the functions that they require.

I believe there is demand for a product that can act as an ECU and BCU module that can be used in motorsport and tuning applications. There are several companies, for example; Motec, Haltec, Link, AEM & several others that already make engine management systems. There are also several companies such as Cartek and Summit Racing that make BCU’s and Wireless Steering wheel control systems but (with the exception of Motec) there are no ‘out of the box’ single supplier options that are affordable at a grass roots level. Motec currently make an all-in-one bus system for their ECU’s, but it is not affordable for most grass roots teams, with the Motec *M142 GPR Pro with Logging* unit retailing at $6841 USD without a screen or any additional features like shift controllers and sensors packages.

My product would integrate features of a normal ECU and a normal Car BCU into several smaller units. It is important that it has the ability to perform all the standard motorsport requirements as this would be the target market. Phase 1 would only support petrol & E85, with a max of 8 cylinders running direct injection.

It would need to support:

* Anti-lag
* Auto throttle blip (for full throttle shifting)
* Drive by wire
* Flex-fuel support
* Knock detection
* Launch control
* Paddle shift support
* Speed limiting
* Traction control
* Variable cam control
* Wasted spark and sequential ignition

Some of these would be in the base unit, whilst others like drive-by-wire would be an optional extra that makes use of the in-car network. Additionally, it would require and second module for the digital and analog inputs and outputs to drive relays and BCU features.

I foresee the unit consisting of multiple small units that can be networked together to create a whole system, so that an end user could buy the components that they need, rather than the current all or nothing approach taken by many ECU manufacturers. This would also allow for the manufacturer to add and remove featured based on demand without re-engineering the entire product, helping with life cycle and compatibility issues.

The product would be able to be installed with off the shelf standard ethernet cables running at 1Gbps, but would come with the recommendation to use ruggedized cables in environmentally exposed areas. By using established communication cabling and not relying on proprietary ones, this allows for more modularity and for easy urgent repairs when parts fail. It would also mean the initial purchase of this system would be a lot cheaper as a customer could purchase the ECU and then add the features they want in a customizable system. My BCU module would control everything from headlights, indicators, wipers, electronic differentials and any non-engine system on the car. This includes the provision for solid state engine and fuel kill switches, and fire management systems, all from the wireless steering wheel controls. This would eliminate cabling issues and wire failure due to constant movement of the steering wheel. This is a common point of failure in current technology and my product will eliminate this problem. This would most likely be handled over Bluetooth or 802.11bgn. Current rally cars already utilize Wi-Fi to assist with tracking, so building a system that could integrate the Wi-Fi would also require less duplication and save weight. The system would run a primary output device such as an android or apple tablet connected via USB or Wi-Fi. This would allow the user to both view and change settings easily without the need to get out a dedicated pc just to tune the car. This could also be expanded to include a second output for the navigator that could show the current GPS location and other navigator specific information for use in rallying. This would further improve cost viability because rather than using specialised custom made LCD screens, the end user could use a tablet and just download the app. Then the devices could be mounted in the vehicle using RAM mounts (which are already FIA approved) meaning less custom engineering.

The project would require the creation of two applications. The first application would be the GUI (graphic user interface) for the end user. This would be in the form of an android/apple app so that it could work on a tablet. This would allow for customizable views to monitor engine data and display dash information.

The second application would be installed on the ECU hardware and would respond to the various inputs and outputs to control the engine as a modern ECU functions. This would also include networking systems so that it can link with the additional modules

Lastly there would be a number of different units that can all connect by ethernet cables:

* Main ECU and Engine Module
* Body Control Module
* Paddle-shift Module
* Drive-by-wire actuator and potentiometer Modules
* Boost Control Module

I would require someone with extensive programing knowledge in C++ to both make the application and write the software for the individual units.

There are already many networking options available on the market that the end user could self-source.

The main hardware would need to be made using a microprocessor board with an expansion board that could handle the required inputs and outputs, averaging 40 of each. This would need to be sourced or made and would be one of the most significant expenses for the project, as reliability of the MCU will be very important.

My project will create a product that is scalable, reliable and available to more of the market than ever before. Customers would be able to start with an initial small investment and as they develop their cars, purchase ‘off the shelf’ additional modules and install them with little technical support. This would garner market share and make it a lot easier for people to enter a sport that is increasingly becoming too expensive to compete in and increase the participation at the grass-roots level.