

## Remote Control of the ECE Smart Kart

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### Background

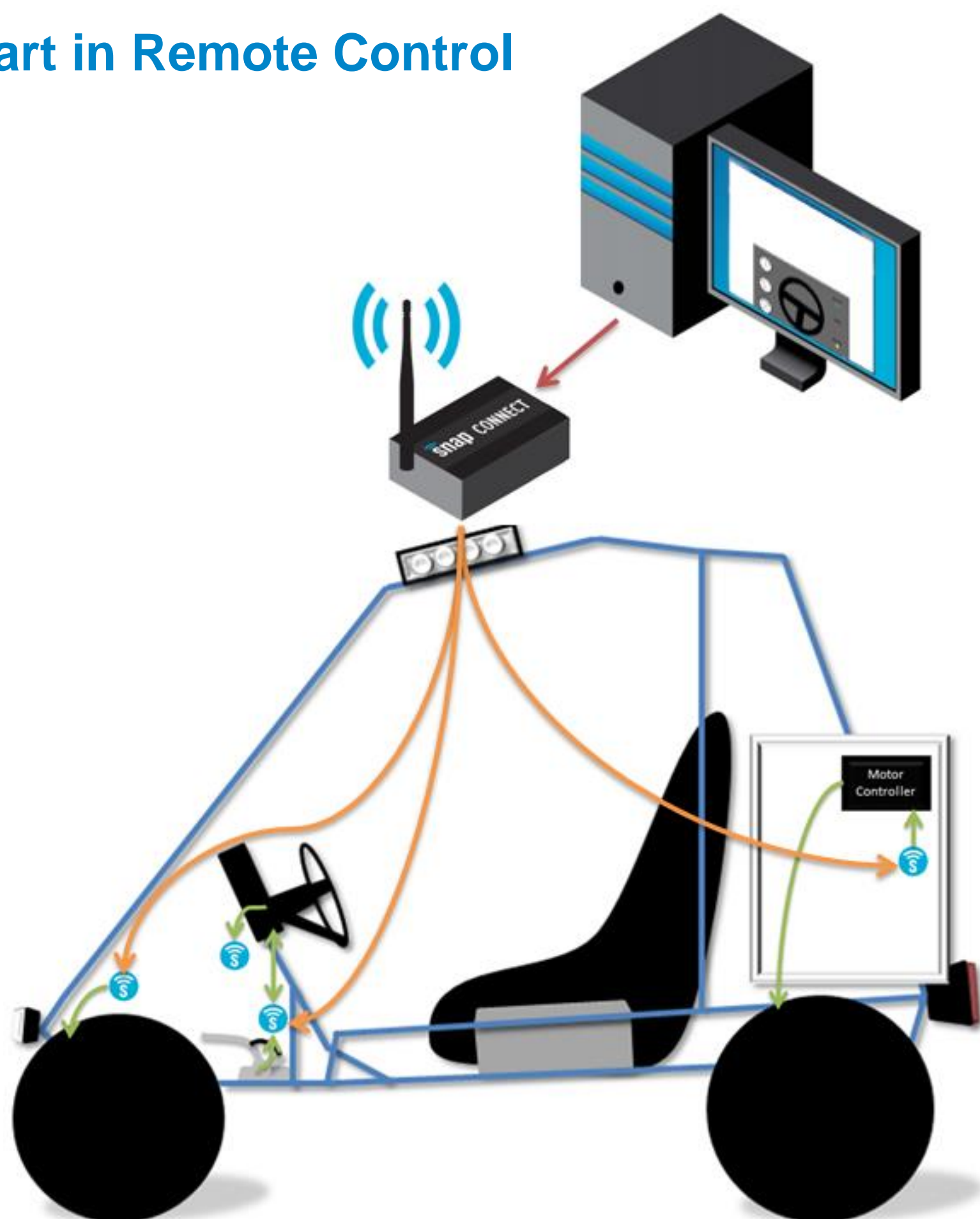
#### Smart Kart Purpose & Operations

The Smart Kart is an outreach and recruitment tool used by the UAH Department of Electrical & Computer Engineering. Over the years, various features have been added by senior design teams and RCEU students. Lights, a sound system, motion detection, and voice control are primarily handled by a Raspberry Pi. The driving-related functions of the kart—acceleration, braking, dashboard, steering wheel, pedals, and turning—are handled by a radio-connected network of microcontrollers made by Synapse and called SNAP Protoboards. The radio network is referred to as the SNAP network, and anything connected to it is a SNAP node. All SNAP nodes run scripts written in a modified version of Python.

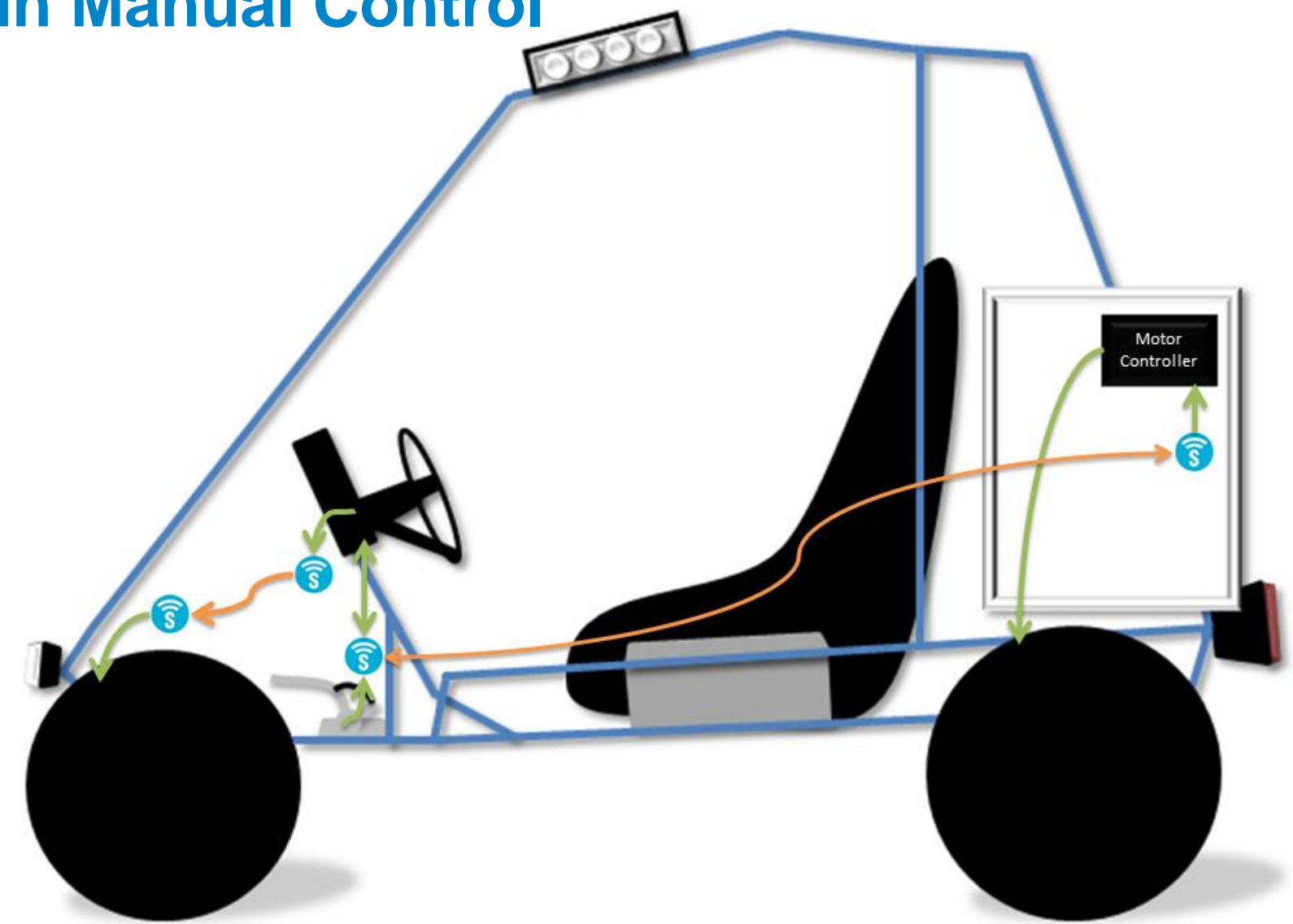
#### Past Remote Control System

In 2014, another RCEU student constructed a system to remotely control the kart from a desktop computer. Synapse provides a Python package, called SNAP Connect, to be used by programs running on PCs and embedded systems that are connected to a SNAP network. A program with this library included and a user interface ran on the desktop computer, and used a USB dongle called a SNAPstick as a “bridge node” to communicate with the kart’s SNAP network.

#### Kart in Remote Control



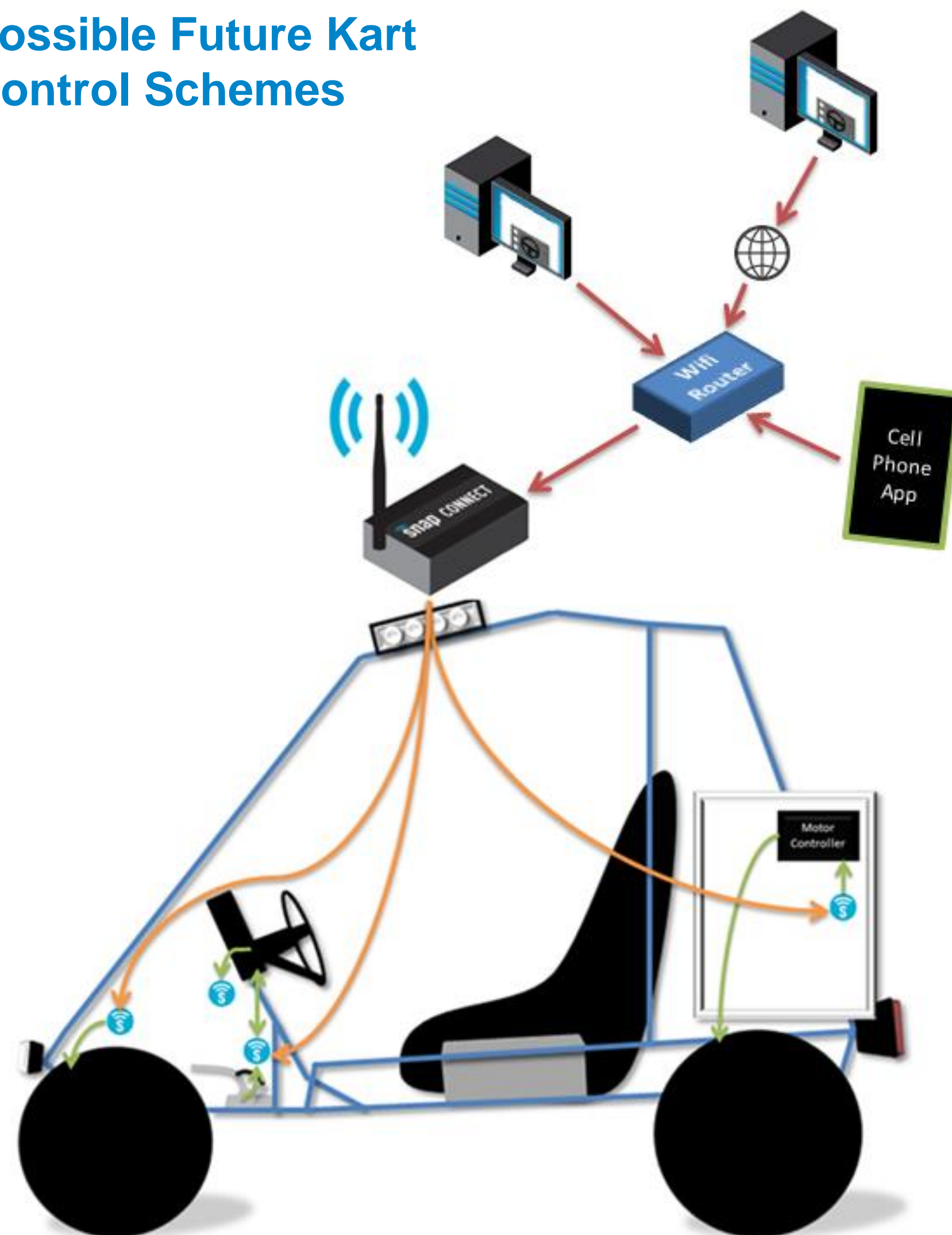
#### Kart in Manual Control



### New System & How It Works

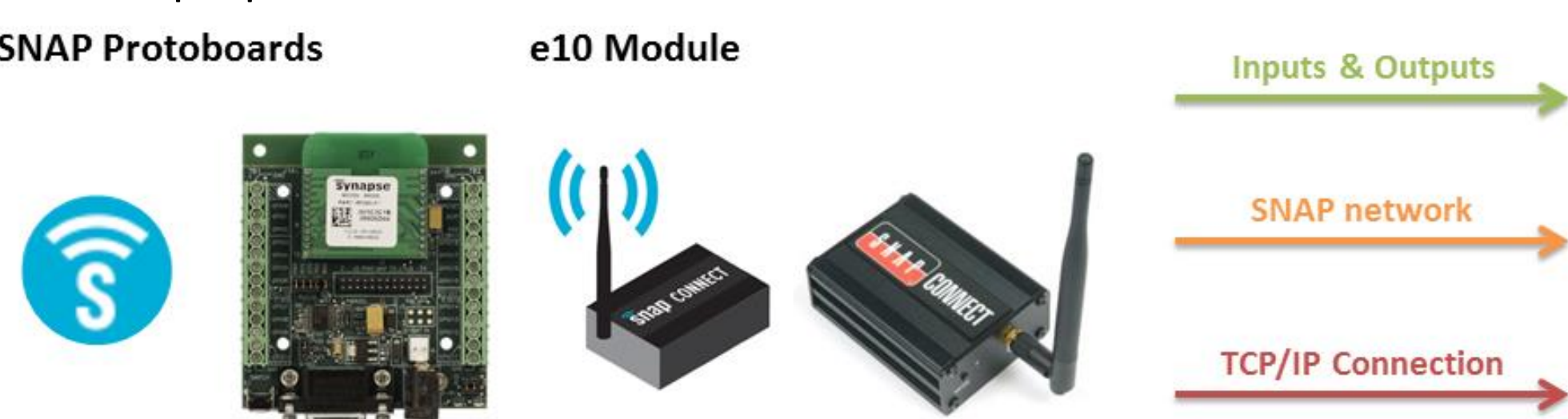
A desktop PC, running a Python program with a user interface, sends text-based commands in a specific custom format over Transmission Control Protocol/Internet Protocol (TCP/IP), the protocol used by the internet and local computer networks, to a SNAP Network Interface Device called the e10. The e10 internally includes both a computer running a Linux shell with SNAPConnect and a SNAP bridge node, so it can communicate with both regular computer networks and SNAP networks. A Python program running on the e10 interprets the TCP/IP commands and, if remote control is enabled, issues Remote Procedure Calls (RPCs), which are a special feature of SNAP software whereby any function on any node to be called on that node by a different node. This allows the e10 program to directly call the functions that control steering, driving, braking, and reversing on the relevant nodes.

#### Possible Future Kart Control Schemes



### Improvements Made & Future Ideas

The original kart remote control program was not expandable. A computer could only control the kart if it had the SNAPstick plugged in and it was running a program with SNAP Connect built in. The new system, with the SNAPConnect functions offloaded to the e10 and the simple, text-based TCP/IP communications, is flexible, allowing for easy modification on many levels. The user interface running on the PC could be easily modified or even replaced without reprogramming the communications system, if a future project wanted to add a camera to the kart and livestream video to the program. If the e10 were plugged into a router on the College of Engineering network, any computer in the network could run the user interface program and control the kart; and if the e10 were plugged into a wifi router and attached to the kart, smartphones could connect to it wirelessly and future groups could easily write an app to send the proper text commands.



### Acknowledgements & Credits

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Many of the images in the diagrams came from the Synapse website and various SNAP user’s manuals.