APRS and the Android Smartphone
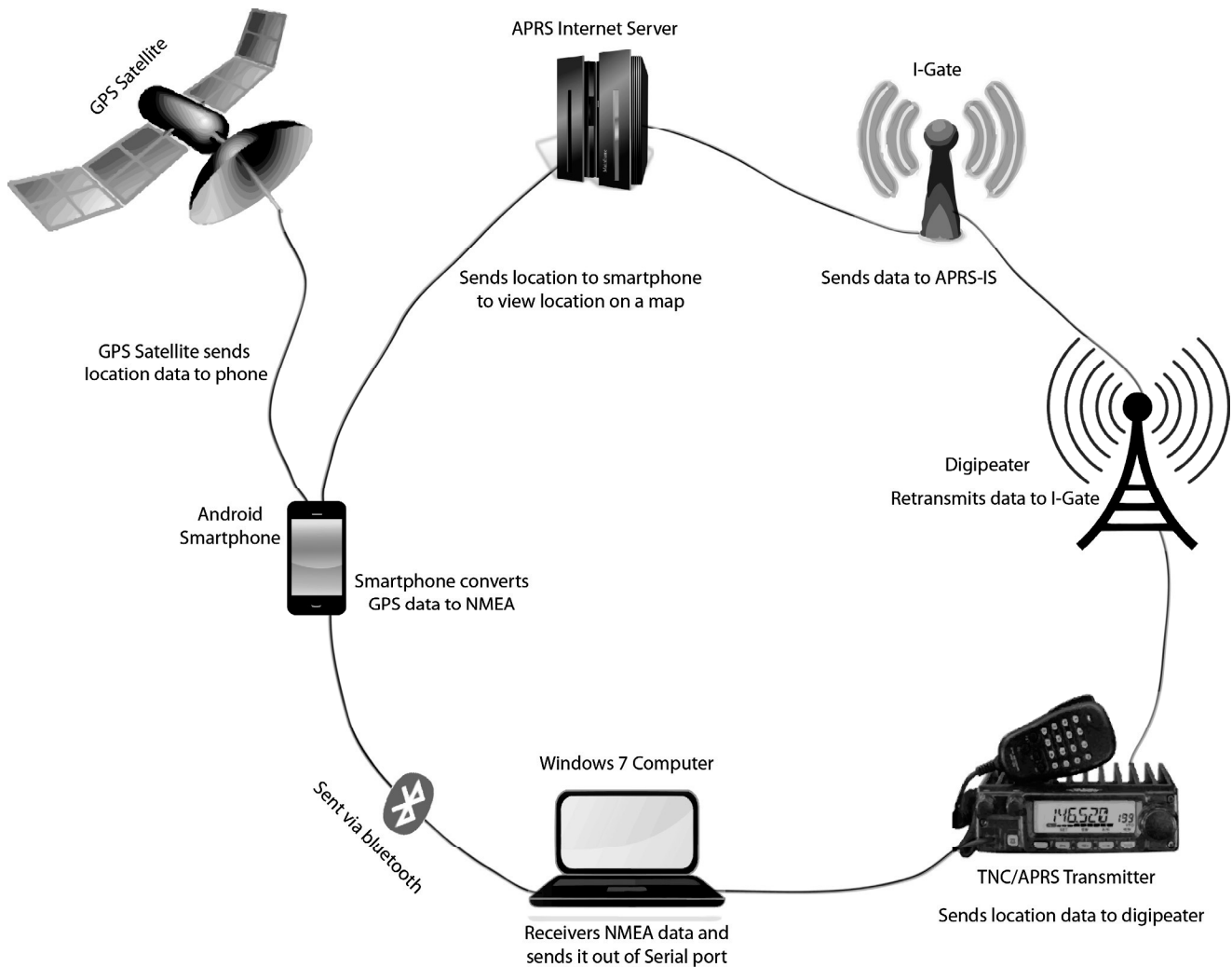
Sagar Gupta, KC2VSG
11 Cinnamon Court, Holmdel, NJ 07733
sagar.r.gupta94@gmail.com

Abstract

This paper discusses a means of using the android smartphone as a Global Positioning System (GPS) receiver unit to provide serial location data to an APRS beacon transmitter. Using an application I developed, an android smartphone with a GPS receiver sends its location to a laptop computer via Bluetooth. Through a program written for the laptop the position data is sent to a serial port in NEMA-0183 format. This serial data can then be sent to a TNC/radio to transmit an APRS beacon with location information. After appropriate digipeating, the beacon information reaches an I-gate station and appears on the APRS Internet System. Although an APRS App is available for android smartphones, which puts the location information directly on the Internet, that application is not useful when there is no cellphone coverage, Wi-Fi access, or one does not want to pay for the android data plan.

Introduction

Most Android phones are equipped with GPS receivers, but that only provides one-way communication and informs you of your location. Knowing exactly where you are is not always useful, but informing others of your location can be. An android APRS App is currently available to amateurs that use the APRS Internet Server to inform others of your location. But what if you were in a location without cellular service or Internet access? I have now created another method to put your location on the Internet using APRS using an android application to be described. The android phone will receive the user's location from its built in GPS receiver and then output the location via Bluetooth in an NMEA (National Marine Electronics Association) format to a laptop computer. The computer takes the data received and sends it out through a serial port to an APRS TNC/transmitter, which will send the location by radio to the APRS Internet Gateway known as an I-Gate. The I-Gate will then upload the location information into an APRS Intern Server. Once your location is in the server database users can track their location or the location of others on a map built in to the APRS application. The following diagram illustrates the process.

GPS Satellite

APRS Internet Server

I-Gate

Sends location to smartphone
to view location on a map

Sends data to APRS-IS

GPS Satellite sends
location data to phone

Digipeater
Retransmits data to I-Gate

Android
Smartphone

Smartphone converts
GPS data to NMEA

Windows 7 Computer

Sent via bluetooth

TNC/APRS Transmitter

Sends location data to digipeater

Receivers NMEA data and
sends it out of Serial port

APRS

APRS has been around since 1984 when Bob Bruninga (WB4APR) developed it; in fact the acronym APRS was derived from the last few characters of his call sign. Bruninga still maintains the APRS website and APRS is still an excellent service available to amateur radio operators. The technology of APRS is still excellent and it provides many useful services for the amateur radio community.

The Automatic Packet Reporting System is a digital communication protocol designed for the purpose of sending real time location data of any object or person into the APRS-Internet System (APRS-IS) using the local RF-network. The location data sent to the APRS-IS will be stored in a server and can be retrieved by a variety of APRS software that is accessible to everybody. The software will take the location data from the server and display it on a map, providing a simple user interface. Additional significant features provided by the APRS software includes signal bearing discovery, search and rescue, data collection from weather stations and the use of alerts and objects. All these amazing features

have its roots in packet communications, a method of broadcasting packets data via radio signals between two amateur radio operators, but APRS is a little different.

APRS varies from original packet communications because data is no longer sent just between two points but instead becomes public to every one. APRS works off of packet repeaters known as digipeaters, which collect and retransmit data to other digipeaters in similar fashion that repeaters retransmit radio waves. Each time it goes through a digipeater it leaves some information behind for others to access and retransmit. Through this method the data can travel great distances and eventually they will reach an I-Gate where everyone on the Internet has access to the data that has been traveling around the digipeaters. Because the data being sent is often repeated multiple times the information is generally never lost, in fact there are excess copies of the same information that the I-Gate has to delete before putting the data in the database. APRS is a strong and secure network for informing others of your location; it is a shame that more people do not use this magnificent technology.

The Android Platform

Android phones are extremely popular today and are the most popular type of smartphones available. Google has developed an extensive platform using java that is easy to use and free to develop on. This has lead to the creation of an immense application market with over 250,000 apps. The operating system (OS) is used in nearly every type of product. In products such as TVs, netbooks, tablets, phones, printers and even washing machines and driers are starting to incorporate the android OS. It is an ever expanding OS and it possibilities are limitless. While it may seem like fairly new technology, it has taken a while to develop.

The Android OS initiated development in 2003 when Rich Miner, Chris White, Andy Ruben, and Nick Sears in Palo Alto, California founded the company, Android Incorporated. The group created a strong foundation for the mobile platform using Linux as a base and after two years, they caught the eye of Google Inc. In 2005 Google acquired Android Inc. and started expanding on the work that the founders had started. With Google's vast amount of resources and technology geniuses they were able to complete the first version of the OS in just 3 years. On October 22, 2008 HTC, a large company that produces mobile phones, released the first android phone, the HTC Dream, and from there onward the android platform has taken off and matured into an incredible operating system.

Combining the APRS and Android Phones

At the moment APRS transmitters can send location information based on the location data received from a GPS receiver unit or manual input, but I take out the need for the GPS unit and replace it with a more common item: the android smartphone. The way my android application currently functions is by getting the user's location from a GPS receiver built into the android phone, converting the location data into an NMEA format and outputting the data over Bluetooth to a server code written on a Windows 7 laptop computer. A server code written in java on my PC accepts the Bluetooth connection and then sends the NMEA data received from the android phone to a C# program which sends the data to a serial

port on the computer. If the computer does not have a serial port (as most newer computers do not), a USB to serial adapter cable may be used. The APRS TNC/transmitter is connected to the serial port directly or via a 9-pin to a small stereo plug converter cable. Once the location is inputted to the APRS transmitter it will then beacon its location to an I-Gate, and once the location is available at the I-Gate the APRS app will get the location from the server and display it on a map built into the app. There is a lot of movement of data from one format to another right now, but I am working on simplifying the process by writing the server code entirely in C#.

The In the android code two main classes, the LocaitonListener class and LocationManager, are used in receiving the location data using the GPS receiver built in the phone. Once the location data is received an NmeaListener class object converts the location into an NMEA format. By using the BluetoothSocket class the NMEA data is sent over Bluetooth to a computer running Windows 7 with Bluetooth capabilities. On the computer is a server code written in java that uses and InputStream class object to read the NMEA data and an OutputStream class object to send the data to a C# server. The C# server also uses InputStreams and OutputStreams to read the NMEA data and send out of a serial port into the TNC/APRS transmitter. Once the location is in the transmitter, it can be sent out to an APRS-IS and the location data is accessible to everyone. Here is a small chart showing the basics of how the software works.

Currently in the android app store there is an APRS app, which uploads the user's current location to the APRS-IS via the cellular data network Wi-Fi connection. The app is good but it does not make use of a radio transmitter. What I have done is transform an android smartphone into a GPS receiver and use it to send location to a beaconing APRS TNC/transceiver that will then upload the user's location to an I-Gate using RF bands. It is a simple deviation from the app but it fulfills a few new purposes. For one if someone is currently in a location without access to Wi-Fi or does not have cell phone service, this app along with a laptop and APRS TNC/transmitter can be used to inform others of their location for safety purposes. For example if one were to go on an expedition somewhere deep in the Appalachian Mountains where there would be no service, one could use the android app to inform others of his location in case of an emergency. Another plus to this app is that it is free of cost. One does not need any data plan to use this service, just a functioning android phone, a laptop and an APRS TNC/transmitter.

Future Possibilities

This app is still under development and has many possibilities for additional features. One additional capability that could be added is the use of software TNCs instead of hardware ones. Software TNCs are becoming more common and making this app compatible could reduce the amount of hardware necessary drastically. Instead of having a physical TNC or an APRS transmitter, a sound card inputted in the headphone jack and the microphone jack of a computer will suffice. This would make the app less hardware dependent and that would mean fewer things needed to make this app work.

Another way to decrease the amount of supplies to make this app functioning could be by removing the laptop from this process. Currently the laptop is needed because as of now there is no way to output data from an Android phone other than Bluetooth, and currently APRS TNCs cannot accept data over Bluetooth so a laptop had to be used as a middle man to get the data from the android phone to the APRS TNC/transmitter. According to Internet rumors, Google will release a new version of its android OS in November of this year and with that update will come the ability to send data over the micro-USB to USB cable that comes with all android phones. Hopefully, once that happens the laptop could be taken out of the process and the android phone can send data directly to the APRS transmitter with a few cables, but until then there is no way I found to get data to an APRS transmitter without the use of a computer.

A third feature this application could boast is to send location data to an APRS-IS using Wi-Fi or a cellular network just like how the other APRS app currently works. By adding this feature to the app it would reduce the need of having two apps for a similar function. Also this app could have the ability to switch between a Wi-Fi mode and TNC/APRS transmitter based on the availability of theses services. For example, if one was in an area without Wi-Fi or access to a cellular network the app could automatically switch to the TNC/APRS transmitter mode and once the phone had cellular service it could switch back to Wi-Fi mode. Overall this application has not reached its full potential yet and can still become even more phenomenal.

Conclusion

Android phones have been designed to include several devices into one compact product, including phones, cameras, camcorders, browsers and much more. Now I have added one more function to android phones as a GPS transmitter. The android phone can replace a large, bulky GPS receiver unit and be used to out put the same NMEA data. Using that data the user's location can be sent to an I-Gate using an APRS TNC/transmitter, and the data can be received on the same standard APRS. The application has a lot of potential for future improvement as well by removing the amount of additional hardware and software needed to operate this application. This application makes it easier to let others be aware of your location in places without service, providing a good safety measure in areas where being safe can become a challenge.

Biography

My name is Sagar Gupta, a senior at Communications High School (CHS) in Wall, NJ. Communications High School is a school specialized to excel in graphic design, photography, computer technology and any other medium of communicating with the world. It is at CHS my interest in computer science thrived and I was able to acquire the basics need to program this application. In addition to my interest in the computer sciences I am also a licensed extra class amateur radio operator as of 2009. My interest in software lead to an interest in hardware, and while I prefer the computer sciences, the hardware knowledge I gain from amateur radio makes it clearer to me what I am doing while I code. Both software and hardware matter a lot to me, and amateur radio is the perfect outlet for me to apply both my interests.

References

http://luugiathuy.com/2011/02/android-java-bluetooth/

http://developer.android.com/resources/samples/BluetoothChat/index.html