The MisterHouse/APRS Tracking System (MHATS)

Linking the World of Home Automation with Amateur Radio

by Brian Klier, N0QVC

Introduction

Early in the morning, I was driving back in my truck from a great fishing trip on Lake Kabetogama, in Northern Minnesota. I was progressing south down the Interstate on the way home, and I realized it was going to be quite a scorcher that day! Before long, it was 95 degrees, hot and humid. One of those days you feel lucky to have air conditioning in your vehicle! Unfortunately, when you usually come home from a trip with the house closed up, you are greeted by a blast of very sticky, hot air. This is where the remote control abilities of my Home Automation system come in handy. I typed out a message to my house on my laptop to "turn the air conditioning on" using my "MisterHouse/APRS Tracking System". I smiled as I received the confirmation message "X-10 Message Received" on the display screen. Sure is nice to come home to a cool house after a long drive!

So what makes this possible? The software I wrote, called the MisterHouse/APRS Tracking System, or MHATS, is a module that bridges the gap between the Home Automation world and the Amateur Radio world. Specifically, MHATS works as a "plug-in" to a home automation package called MisterHouse, written by Bruce Winter in Rochester, MN. MisterHouse provides the software interface between your X-10 devices, Caller ID, Digital/Analog I/O ports, and your computer.

MHATS, on one side, plugs into the Home Automation system. So then how do we get the long-range wireless capabilities of MHATS? This is where one of the hottest advancements in the Amateur Radio digital field comes in. It's called the Automatic Packet Reporting System, or APRS. This protocol, created by Bob Bruninga, an amateur radio operator from Maryland, was created primarily for tracking cars, hot-air balloons, or anything else equipped with a global-positioning system (GPS). With an Amateur Radio license, the GPS, a two-way radio, and a special wireless "MODEM" called a terminal node controller (TNC), anyone can jump on the APRS bandwagon.

Both MisterHouse and APRS are very nice systems. But I thought, "Wouldn't it be nice to be able to link these applications together, so that one could control a house remotely, or know where one's vehicle is by having it announced over the P.A. system in the house, or use the weather information sent over APRS to know if it's cold enough outside to turn on your electric blanket in your bedroom?" This is what the current and future development of the MisterHouse/APRS Tracking System intends to do. Best of all, both MisterHouse and MHATS are free software.

What you will need

- **An Amateur Radio License from the FCC**

- **A Pentium-Class Computer at home installed with the MisterHouse Home Automation System**

- **A laptop/palmtop computer with a flavor of APRS installed**

- **X-10 ActiveHome Starter Kit (Computer Interface, Transceiver Module, and Lamp Module) -** *$49.99*

- **A pair of TNCs, similar to wireless MODEMs, for your home and vehicle -** *$200+*

- **A pair of Amateur Radio Transceivers (two-way radios) -** *$200+*

- **A Global Positioning System (GPS) for the vehicle (Optional) -** *$200-$250*

- **Miscellaneous Cables**

    (2) Serial Cables - *$10*
    Other connectors and cables, as needed (dependent on TNC and Transceiver manufacturers)

As there is equipment to assemble, documentation to read, and software to configure, please plan two or three weekends to complete the project.

What you Need to Do

1 The first thing you will need to do in order to use Amateur Radio frequencies for wireless communication is to get an Amateur Radio license. To get an entry-level license, called the "Technician" license, you will need to pass an examination on basic electronics theory, antenna design, and operating procedure. You no longer are required to learn Morse code. Your local Radio Shack may carry books to help you study for the exam. Also, look in the **Helpful Links** box to find Amateur Radio Clubs and upcoming exams near you.

2 You may already have a vast X-10 home automation system in your household. If you don't, getting into the world of home automation is very simple, and doesn't cost too much. X-10 has been a standard for controlling lights and appliances from remote locations for 20 years. X-10 sends data to turn devices on and off, dim and brighten lights, all through your existing house AC wiring. Need to control another light or appliance? Just buy a $15 module and plug it in. No need to run strands of wiring all over your house.

To let a computer inside your house take control of your devices, you will need a CM-11a or Firecracker Computer Control Interface, from X-10 Powerhouse. The CM-11a transmits and receives X-10 signals, and plugs into a power receptacle and your computer's serial port. The Firecracker is a transmit-only device, and gets its power directly from your computer's serial port. You can get these devices, as well as motion detectors, lamp and appliance modules, and dry contact closures from your local X-10 dealer, or http://www.x10.com. I personally recommend the X-10 Activehome kit (CK-11a) for $49.99, which includes the required computer interface, as well as a transceiver/appliance and lamp module to get you started.

3 Your computer at home needs to be installed with a piece of software that can tell your X-10 computer interface what light or appliance in your home to turn on or off. The MisterHouse/APRS Tracking System handshakes with the MisterHouse home automation system. Both of these are free software, and are available at http://www.misterhouse.net. When you download MisterHouse, MHATS, in a file called "tracking.pl" will be in the "code\public" directory. MisterHouse is an open-source home automation package, capable of many high-end features found in expensive systems. MisterHouse can use voice recognition packages to turn X-10 devices on and off simply by speaking in a microphone. You can also control your house through a web browser anywhere on the Internet!

4 Next, you'll need a "client" program installed on your mobile computer, to talk with your home automation system at home. With APRS gaining popularity worldwide in the Amateur Radio world, you can use almost any platform inside your vehicle to communicate back to your home. Versions are available for 10-year-old laptops running DOS, the newest laptops running Windows, or tiny handheld computers such as the Palm V (see figure 1 and 2). Most of these versions are shareware and are not time limited, so you can use the messaging capability of them to talk back to your house. You can download APRS for your portable computer at http://www.tapr.org.

5 Now, the equipment that actually allows data transmission at a physical layer between your needs to be purchased and installed. Terminal Node Controllers, or TNCs, are wireless MODEMs for the Amateur Radio world (see figure 3). Your computer sends data to the TNC, and the TNC will convert it to tones that you can hear, and sends them out over the two-way radio. It enables two computers to transfer information using the radios instead of wires.

Almost any pair of 1200 baud TNCs will work for APRS. One of the most popular is the Kantronics KPC-3+. This TNC has two serial ports, so you can attach both your portable computer and your GPS up to it at the same time. You can also take the portable computer in and out of the vehicle without reconfiguring the system. Kantronics has more information about this TNC at http://www.kantronics.com/kpc3+.htm. Another popular TNC manufacturer is PacComm (http://www.paccomm.com/handi.html). Many ham radio operators are starting to use Kenwood transceivers, which have a built-in TNC, for use with APRS. Go to http://www.kenwood.net/ama_page.cfm for more information.

After you purchase your TNCs, attach them to both your home and portable computers with a standard serial cable.

6 In able for your home and vehicle to "hear" each other, you will need two-meter radios (see figure 3). Generally speaking, the more watts the radio is capable of outputting, the greater your range (and price). If there is a local APRS digipeater in your area, you can get away with radios as little as 1 to 5 watts. These "digipeaters" are like cellular radio towers, expanding the coverage of home and mobile stations much farther than what is normally possible. Almost every state has several of these, and coverage areas are growing all the time (see figure 4). The nationwide radio frequency for APRS is 144.390 MHz.
You will also need an antenna for each radio. After you study for your amateur radio examination, you will have the knowledge to pick a radio and antenna best suited for your situation. Your local amateur radio club will also undoubtedly be able to offer advice on radios and antennas that work the best.

Some manufacturers of transceivers:

- **Yaesu** (http://www.yaesu.com/amateur/mobile.html and http://www.yaesu.com/amateur/handheld.html)

- **Icom America** (http://www.icomamerica.com/amateur/2mhand/index.html and http://www.icomamerica.com/amateur/2mmobile/index.html)

- **Alinco** (http://www.alinco.com/usa.html)

Many ham radio operators are starting to use Kenwood transceivers, which also have a built-in TNC, for use with APRS. Go to http://www.kenwood.net/ama_page.cfm for more information.

After you acquire your transceivers, you'll need to fabricate a cable between each TNC and Transceiver. This is necessary so the TNC can "key", or start the radio transmitting. Also, this is the physical media that transfers the modulated/demodulated data between TNC and radio. All TNCs and Transceivers have included diagrams on how to assemble such cables for "Packet Radio" use.

7 If you want to be able to track where your vehicle is from the Internet and from your house, you will need a GPS that is capable of sending data to a computer device. Most GPS's will do this. Make sure to look for the statement "NMEA-0183" compatible. If the GPS you purchase does not include a serial data/power cable, make sure to buy one of these so you can attach your GPS to your TNC to send your current position.

What can I do with MHATS?

Wireless controllers you purchase today can only control devices in your house, at most, several hundred feet away. The MisterHouse/APRS Tracking System software lets you do this from several miles away, even 50 to 75 miles away! The quality of the radio and antennas you purchase, as well as the maturity of the APRS network in your area determine the range of the system.

The interconnectivity of the software with home automation and amateur radio offer several more features than just controlling X-10 devices inside your home. MHATS can also decode information sent out by GPS receivers. Using this feature, decoded information is used to provide audible notifications of where your vehicle is located. By using a list of landmarks that you can customize, it can tell you that your car is a half of mile east of the grocery store, or just pulling in your driveway!

In addition to knowing where your vehicle is, many stations on APRS report up-to-the-minute weather information such as temperature, wind direction and speed, and hourly/daily rainfall totals. This information can be accessed through the home automation system if an occupant of the house is curious, or it can be also used as an information source to control X-10 home automation products. For example, knowing it's below freezing outside so you can turn on your bed heater. If .. Then statements can be created within MisterHouse to do anything you can dream of using weather information.

MHATS provides an interface between other APRS tracking software such as WinAPRS and javAPRS that can take information and plot it on a constantly updated map display. JavAPRS uses Java and can run right in Internet Explorer or Netscape! See figure 5.

In the future, MHATS will be able to turn lights or appliances on or off if your GPS-equipped vehicle comes near your house.

Since several amateur radio operators are developing the APRS protocol, and several others are creating add-ons similar to MHATS, you can expect to see many additions in the future. It is possible to send one-line E-Mails from your vehicle, as well as send comments to people

over ICQ. Sign up for the official APRS Special Interest Group at http://www.tapr.org for more information on how to access these services.

There is documentation included with MisterHouse on how to configure MHATS. For more specific information on how to install and configure MHATS, you can point your browser to http://kliernetwork.net/aprs.

Keep in Mind

If you live in a colder climate, keep in mind that cold weather is harsh on portable computers. With this system, it is not necessary to have a brand-new laptop, so go to refurbished computer stores or "hamfests" to find inexpensive 486 or newer computers.

Amateur Radio is a shared system. Others will be able to monitor you sending commands to your home. There are safeguards in place to protect your house from being controlled by somebody other than you, but keep in mind that any information transmitted can be viewed by other APRS users on frequency.

APRS is made possible by the personal contributions of many Amateur Radio operators worldwide. Please respect the bandwidth on the APRS channel and always be sure to use the service appropriately. Join a local club and promote APRS and digital communications.

If you place your transceiver, TNC, and GPS in a concealed location in the vehicle and leave them on when you're out of the vehicle, you can always keep an eye on where it is. Other than your system at home, if there is a nearby Internet Gateway on your local APRS frequency, sites such as http://www.findu.com can track your vehicle from the Internet. Can you imagine tracking your vehicle and explaining to the Police what corners it's turning at? Keep that in mind.

Figures (to add during article as desired)

The graphic and photo captions are included below. The graphics and photos themselves are separate from this document. They are at a rather high resolution, so you shouldn't have a problem cropping and resizing them to fit white space. Let me know if you require different versions of any of these.
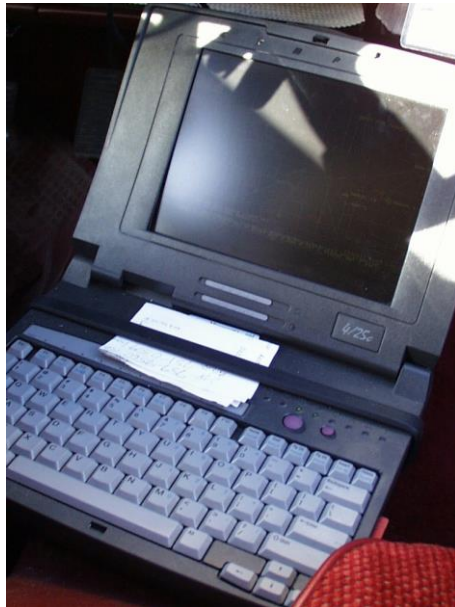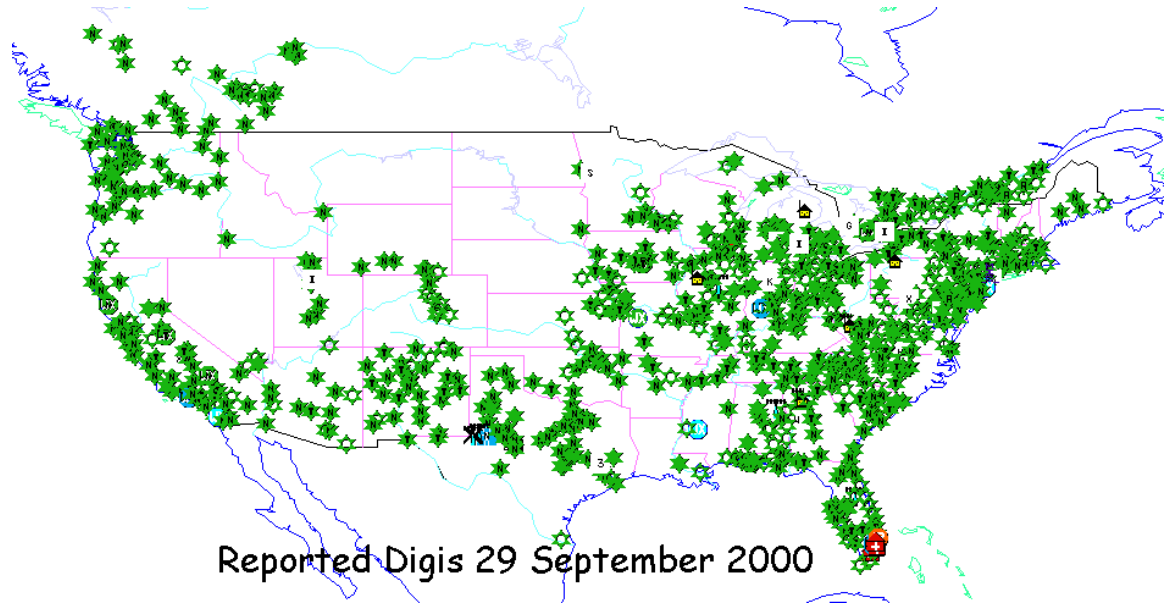
A laptop computer, used to show the vehicle's present location, and to send X-10 commands back to the house (figure 1)
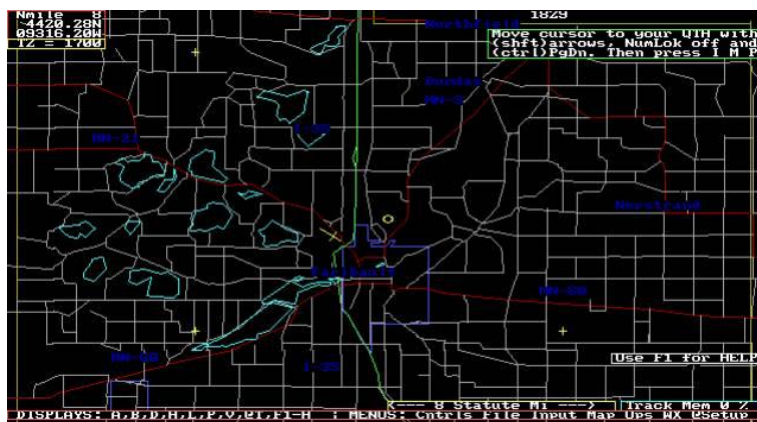
Screen snapshot from the DOS version of APRS, running in the truck (figure 2)

A Two-Way Radio and TNC (figure 3)

APRS Coverage Map from http://www.dididahdahdidit.com. Each star signifies an APRS digipeater (figure 4)

The MisterHouse interface running MHATS (figure 5)

Helpful Links

- For installation and configuration help, or to find out more technical details about this system, go to http://kliernetwork.net/aprs

- For more pictures and specific equipment I use to make this system possible, point your browser to http://kliernetwork.net/aprs/mine

- You can search for an Amateur Radio Club near you to help you pass the exam. http://www.arrl.org/field/club/clubsearch.phtml

- When you think you're all ready to get your license, find a Volunteer Examiner (VE) near you to take the test. http://www.arrl.org/arrlvec/examsearch.phtml

- View what's going on in the APRS world right now, from any Java-Enabled web browser. http://www.aprs.net

Helpful Links box to add in article as desired.

More about the Author (Print if desired)

Brian Klier is a 22-year old Network Administrator/Computer Technician for Faribault Public Schools, a K-12 school district in Southern Minnesota. Brian is studying for his Cisco Networking certification, and in his spare time enjoys snowmobiling, enhancing his home automation system and home theater, as well as helping others with technical problems. Brian can be contacted through E-Mail at brian@kliernetwork.net, and more information about him is available at http://kliernetwork.net.