CS7000: A REVOLUTIONARY MULTIPROTOCOL RADIO

Reason For Developing the CS7000

Way back when I first started with Ham Radio, there were articles on how to design your own radios, kits for building them, and complete radios like those available now. At that time the Hams were able to design state of the art radios. Unfortunately, for most of us, those days are long gone as the technology involved in designing radios has become so advanced that, for the most part, only those Hams who are graduates of MIT or CalTech can design their own.

My goal in the design of the CS7000 was to create a radio that can be modified by the Radio Amateur Community with capabilities that go beyond what is commercially available. Because the manufacturing techniques in designing a good quality radio are so complex, I decided to design a state of the art piece of hardware, with an extensible software capability that will allow Hams to completely customize features of the radio.

Summary of the CS7000 Capability

The new CS7000 will enable you to:

1. Add industry standard protocols such as D-STAR, DMR, Fusion, NXDN, P25 and Analog
2. Develop new protocols specifically for your application
3. Send digital data such as Slow Scan TV, GPS, and Data Files.
4. Send voice and data from your radio directly to the Internet allowing the radio to act as a Hot Spot for D-STAR or DMR without any additional hardware or computers.
5. Send voice and data from your radio directly to the internet allowing the radio to bypass the Hot Spot and communicate directly with the world wide networks.
6. Remote your radio from any place in the world using your PC and the SIP protocol.
7. Add APPS whose functions are limited only by your imagination
8. And most important of all, if you do not like the firmware architect because it does not meet your needs, you will be able to completely redo it.

Hardware Architecture

The CS7000 is like a CS700 on steroids. The CS700 consists of a conventional double conversion superhetrodyne radio with a special chip to process the DMR format. The DVSI vocoder is done in firmware with the encode and decode functions taking up a significant amount of resources of the high speed microprocessor.

The CS7000 has three microprocessors to extend the performance of the overall product and allow the system to do in firmware multiple protocols whose limitation is only defined by the amount of memory available and the imagination of the user. There is also the capability to extend the product beyond the basic protocols so it can do things Hams could only dream about.

The primary microprocessor is a STM32F405VGT6. This is an ARM Cortex M4 32 bit high speed microprocessor. It has 1 Megabyte of internal flash memory, 196 Kilobytes of internal ram, and executes anywhere from byte instructions to floating point and DSP instructions. It has a clock speed of up to 168 MHz and executes 210 Dhrystone Mips.

The second microprocessor is a DVSI 3000R. This microprocessor uses a TMS320F2811 core and is dedicated to executing the AMBE and AMBE +2 Vocoder formats and other algorithms. Communication between the Primary microprocessor and the AMBE 3000R is by means of a serial port.

The third microprocessor is integrated into the optional WiFi adapter. This part contains the hardware to allow the system to communicate over the internet or other private IP connections with a minimal amount of overhead. Communication between the primary microprocessor and the WiFi adapter is by means of a serial port.

To increase the capability of the CS7000 we incorporated an 8 Megabyte serial flash memory. This allows the memory to hold an extensive amount of voice prompts, programming files, and firmware. To allow multiple protocols that extend beyond the 1 Megabyte of internal flash memory, the external flash memory can be used to overlay portions of the extended protocols.

There is no reason to believe this hardware architecture will not support the following protocols:

D-STAR
DMR
NXDN
FUSION
P25
dPMR
ANALOG

Because this radio is designed for Hams rather than Commercial use, we do not have to be 100% compatible with the entire protocol defined by various organizations. This will make it much easier for Hams to work with various protocols and not have to implement non-essential features such as trunking.

Software Architecture

What makes this product revolutionary is the ability to let Hams extend the radio's capability. Hams will have the following control over the radio:

1. They will have the source code of the entire radio so it can be modified to achieve any objective. The kernel of the radio will be well documented and we expect that Hams will evolve the kernel

to make it increasingly more powerful. For the programmers out there, when I use the word Kernel, think of Linux or Microsoft's Net Framework.

2. On top of the kernel, various protocols can be added.
3. On top of the protocols, apps can be added.

The Kernel

The Kernel consists of the basic routines to operate the radio. Examples of those routines include:

Keyboard Programming Interface
Read and write to Flash Memory
Keypad Scanning
Analog Tone Decode
Analog Tone Encode
Initializing and changing the frequency of the PLL
Reading and writing to the D/A and A/D Converter
GFSK Modem
4FSK Modem
LCD Display Routines
Interrupt Handlers
PWM Generation
DTMF Encoding
DTMF Generation

There are many reasons why you would want to change the Kernel. One of them would be to make the product more efficient. As an example, let's assume the Reading and Writing to Flash Memory takes 1000 bytes of programming memory. Some talented Ham might figure a way to reduce the memory size to 500 bytes. That is 500 bytes that could be used for something else.

Another reason would be to extend its capability. To do NXDN, DMR, and some other formats require a Four level FSK Encoder and Decoder. That might be a nice routine to add to the basic kernel. Even if it is not part of the basic kernel, Connect Systems will make available various routines to enable CS7000 owners to construct various protocols.

The Protocols

Connect Systems will provide certain protocols such as D-STAR and we are going to enable the talented hams develop other protocols for the product. There are over three million Radio Amateurs and some of them have developed some amazing products. This platform will enable those talented individuals to add other protocols.

The Apps

For people who are familiar with the smart phones, you know that you can add apps to your basic phone. We have the same capability within the CS7000. The number of apps that can be written is only limited by your imagination. Some of the possible apps:

* Determining the closest repeater with an optional GPS microphone
* Using the CS7000 as a DSTAR hot spot with an optional WiFi module
* Using the CS7000 to talk directly into the world wide network bypassing any DSTAR Hot Spot
* Record a Net Meeting while you are away from your base station
* Record any traffic directed specifically to you
* Press a button to generate your Call Sign using either voice or code
* Decoding Morse Code

Free Apps or Paid for Apps

The people who write the Apps have a choice of either giving away the Apps or charging for them. To help with piracy for the paid for Apps, each radio has a unique ID number and that ID number can be tied to the program.

Applications For Commercial Customers

You might have a unique application for a commercial customer you would like to exploit. Because all our radios are commercial grade and cover commercial frequencies, you will have the opportunity to sell to those customers. We will sell you as many radios as you want to buy at the great Ham pricing and then you can then add your unique application to the product and sell it to that customer.

Analog verses Digital Formats

If you are one of those Hams who thinks that this radio is only for those working on digital formats you are wrong! There are many applications for the Analog Radios that can be done. Some examples:

1. Recording Net Meetings
2. Operating your radio remotely from any place in the world
3. Decoding Morse Code
4. Automatically sending your call sign using Voice or Morse Code
5. Act as a service monitor to align your receiver and transmitter

Pricing and Availability

The CS7000 will have an introductory price of $199 for the basic radio and $249 with the Integral WiFi Module. We are taking orders now with shipping on a first come first ordered basis. Expected shipment will start about November of 2014. There is no need for any deposit or credit card to place an order.

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