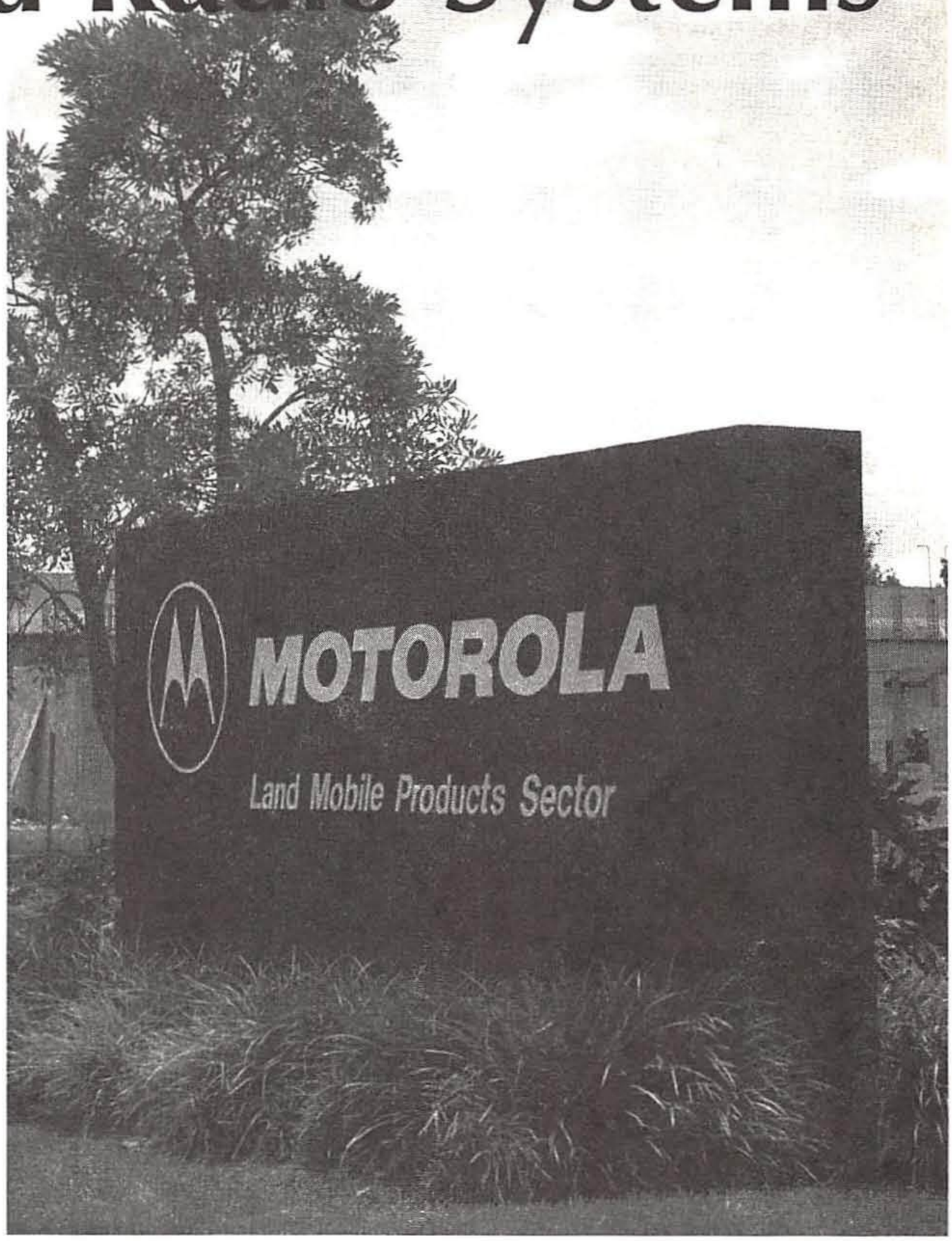
# Challenges in Identifying Trunked Radio Systems

By David T. Stark




Much information and advice has been written about figuring out subfleet or talkgroup identifications on Motorola-type trunked radio systems. There has not been much guidance offered lately about finding the actual *frequencies* on which those systems operate.

It is not possible to track or identify users of a trunked system unless the listener has *all* of the system's frequencies available. Finding trunked frequencies is not as simple as locating an agency's single- or multiple-channel conventional radio system.

SMR (Specialized Mobile Radio) is the FCC's designation for most trunked systems. Some workers in the radio business pronounce SMR as "smur." This designation should also be recognizable in other countries.

There are several methods available to the erstwhile SMR researcher. Some are tried-and-true methods that have served us well when dealing with conventional (non-trunked) radio networks. Others have become available only recently. We will discuss them generally in order of increasing effectiveness with respect to finding trunked frequencies.

## Method #1: Ask Someone

Just about anyone can simply ask someone what frequencies are in use by a particular service or agency. This requires no special tools or access. Asking may yield an exact listing and all sorts of details, or nothing at all.

End users of most radio systems, especially technically complicated networks, generally know next to nothing about the equipment they have. They can give all sorts of bizarre answers to the question, "What frequency are you using?" Users who have been exposed to system sales representatives can give very silly answers indeed. The following are some examples of what you might hear from an end user, along with a more accurate translation.

*"We're on Channel 1."*

User has no idea what sort of radio is being used.

*"Our radios can't be monitored."*

User has been talking to a sales rep. It is still very rare for a two-way radio system to be truly unmonitorable. Digital systems are currently scanner-proof, but that situation is likely to change. Also, people are sometimes told that a system is "digital" when it is only computer-controlled or has some digital features, such as mobile data terminals or alphanumeric paging. The voice traffic can still be analog in some cases.

*"It's not a radio, it's a telephone."*

Thank you, CTIA (Cellular Telecommunications Industry Association). If it doesn't have wires, it's a radio. Trust me.

*"It's illegal to monitor our radios."*

Unless the radio is actually a mobile or portable telephone, this is probably untrue. There are other services that are illegal to

monitor, but since we are mainly concerned with finding trunked frequencies here, that point is not relevant to our discussion.

There is a common misconception that it is illegal to monitor digital radio systems. The truth is, under United States law, it is only illegal to monitor digital cellular, cordless, and PCS (personal communications service) phones. Anything else digital is legal unless it is encrypted or scrambled (18 USC 2510 (16) and 2511 (2)). In Canada, though, one must have a special permit to possess a digital scanner receiver (RSS-135).

*"Our frequencies are proprietary."*

This response may come from a radio technician or sales person. Radio systems have to be licensed, and if the FCC or Industry Canada is the licensing body, the frequencies and callsigns are a matter of public record. However, arguing the point with the tech or sales rep will probably get you nowhere. You might as well move on to Method #2 or #3.

## Method #2: Search and Scan

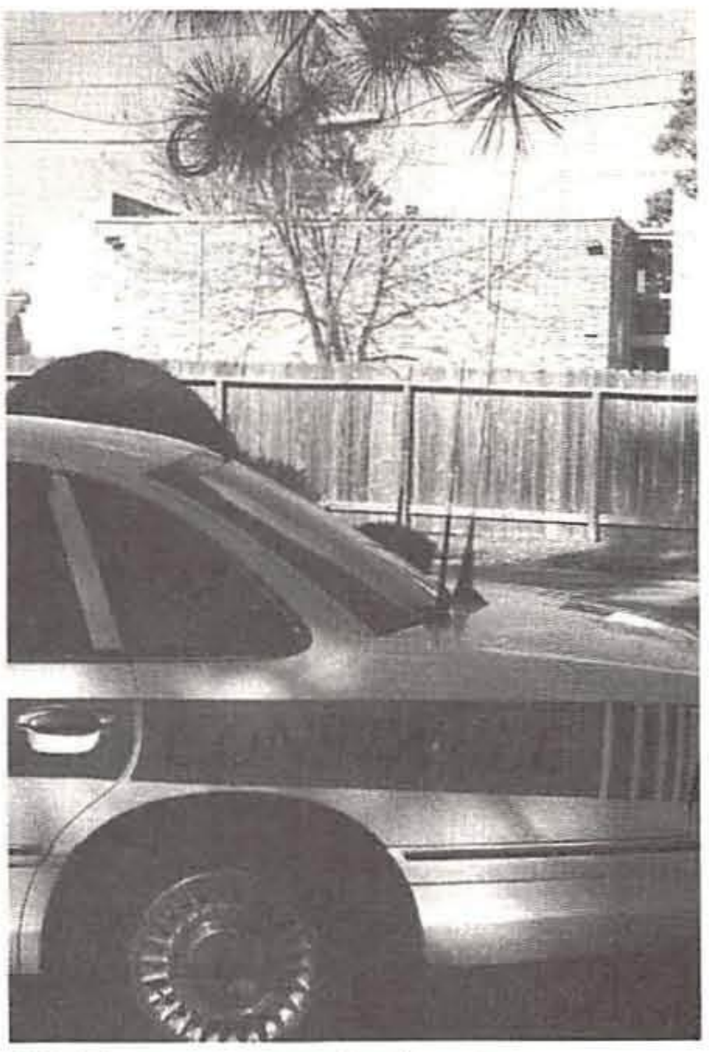
Another time honored research tactic is to use the **Search** feature of your scanner. In time, you will accumulate a list of active frequencies in your listening area. The catch is, there may be multiple trunked systems in use around you.

Your next task will be to extensively monitor those frequencies and try to associate frequencies that are part of the same system. This is done by following particular users from channel to channel and requires a good ear for voices and a fast finger on the **Scan** button.

## Method #3: Look it Up

The next step up is to check the FCC database (or that of the radio licensing body in your country). Many published scanner frequency guides are based on license data. This includes the booklet that is distributed with the Uniden® line of TrunkTracker™ scanners. Unfortunately, license information is just raw data to the scanner user. The fact that someone has been issued a license does not definitely indicate that the actual transmitter is on the air yet.

***Fifty state patrol cars are getting new radios. Chances are they'll be trunked. (Photo by Mark Swarbrick)***



***Multi-agency trunked systems present a challenge for the monitor. (Photo by Haskell Moore)***

A county or large city might have licenses on many more frequencies than can possibly be included in a single SMR. Motorola systems can have no more than 30 repeater frequencies. The mobile frequencies (repeater inputs) may also be listed, but you don't need those in your receiver to follow trunked communications. In the 800 MHz band, input frequencies are exactly 45 MHz lower in frequency than the repeater output. If you encounter a list that contains frequency pairs that are 45 MHz apart, you should always disregard the lower set.

What if you find a list of more than 30 repeater outputs licensed to the same entity? There is a way to include several separate systems into a sort of meta-SMR. This is called SmartZone™. Users on this system may "roam" or migrate among a group of networked SMRs, each different system having its own control channel and System ID. Tracking a system like this may require the use of an actual brand-name trunking radio with the correct system information programmed in by the radio shop.

Once you have a list of licensed frequencies, you can go back to manually tracking users in conventional mode, or advance to one of the newer methods.

## Method #4: Use a Trunk Tracking Scanner

A scanner that is capable of tracking SMR traffic is a very effective way of finding and verifying trunked frequencies. The available models have operating modes that can show you which programmed frequencies are being used at any given time. This allows you to determine whether or not licensed channels are actually in use, but will not reveal any new or missing frequencies. Your best indication of missing channels is the occasional loss of communication while tracking a group that is sent to a frequency not programmed into your scanner. The scanner can't tell you where they went, so all you know is that a frequency is missing.

The current generation of trunk tracking scanners are only able to track Motorola SMRs that operate on the 800 MHz band. Only the Optoelectronics' OptoCom "black box" is currently capable of tracking 400 MHz trunking (common in the U.S. military and in Canada) and 900 MHz trunking (used mainly by businesses).

A trunk tracking scanner will follow the individual SMRs that are part of a SmartZone network, but such radios are not yet capable of automatically monitoring traffic across the entire network. The user of a trunk tracking scanner may not always be able to tell that a SmartZone system is in use.

## Method #5: Computer-Assisted Scanning

The most effective trunking research tool is a computer that is connected to a scanner and running suitable software. This is where a program like **Trunker** comes in. Trunker grew out of the independent research of a few experimenters who began posting protocols and source code in Usenet newsgroups. The development "team" eventually came up with a shareware platform over which programs can be run that can analyze and track Motorola and GE/Ericsson trunking systems and decode mobile data terminals using the Motorola MDC-4800 protocol.

Trunker is the only method that automatically informs the scannist of the System ID being used. It can also track Motorola trunking on other bands beside 800 MHz.

While this suite of programs is probably the most effective and inexpensive way to have tracking capabilities on all of the systems it covers, it is limited by the fact that it uses the computer's serial port (the same type of port used by a modem) to process the data


*Trunked activity log using Trunker*

coming from the scanner. Serial communications under the current flavors of Windows do not have enough system priority to allow real-time decoding of a datastream. So these programs must be run after the computer is booted up in DOS mode. This eliminates multitasking while trunk-tracking.

Another obstacle for some hobbyists is the need for a hardware interface to the scanner. Such an interface can be built from plans that can be found in many places on the Internet, including within the Trunker documentation. The scannist must also locate and tap into the discriminator output of the scanner for baseband audio. Using a speaker or recording jack does not work because by the time the signal reaches the audio amplifier, the part that carries the digital information has been filtered out.

If you wish to use the program to actually monitor trunked communications, you need a supported second scanner and the hardware control interface, too.

With these caveats in mind, it is well worth the effort to acquire and install a computer interface to your scanner. The Trunker program can even indicate the presence of a SmartZone network of trunked systems. The following is a relatively simple example of the strengths and weaknesses of the aforementioned research methods.

## An Example

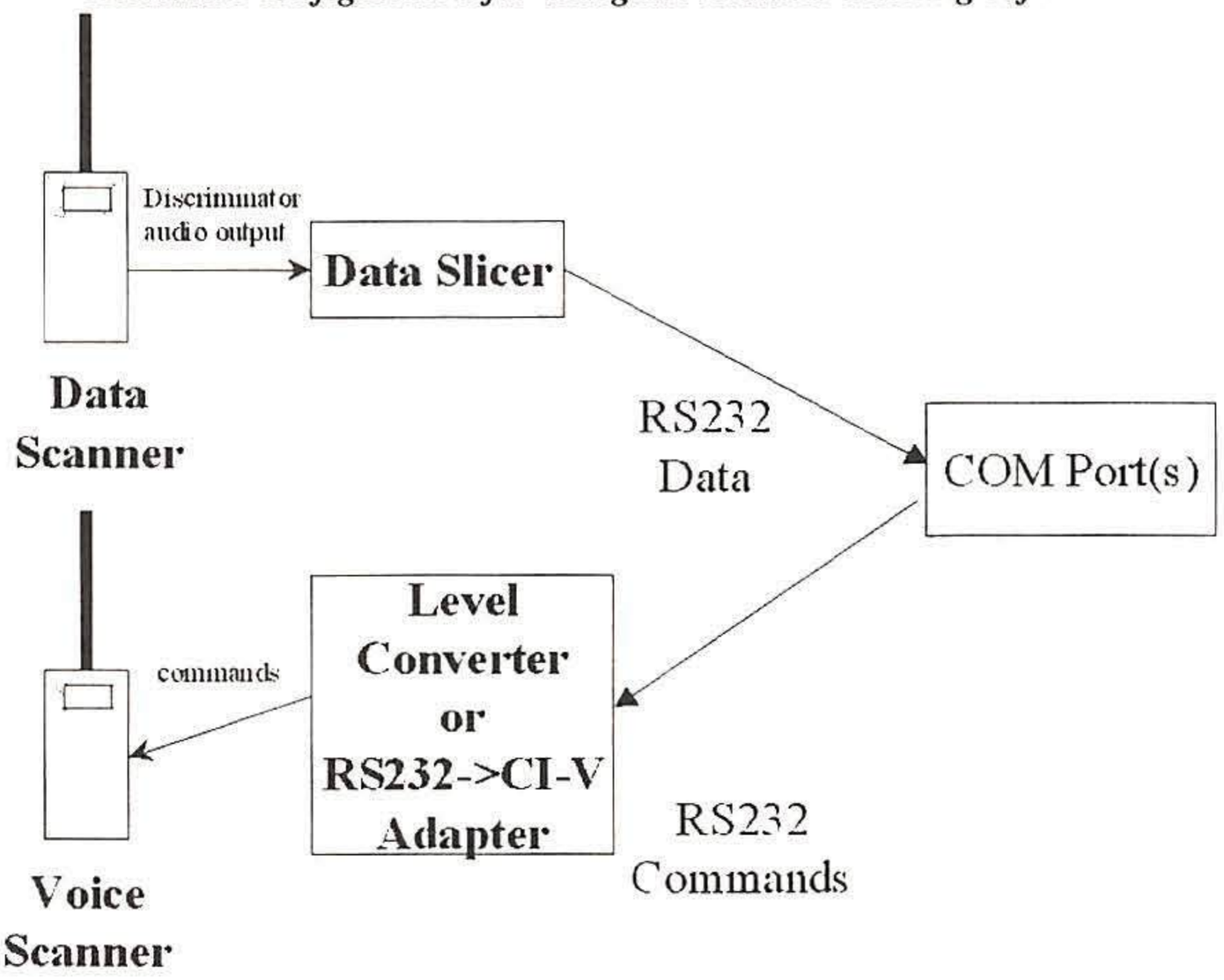
Here in Rochester, New York, there is a 12-channel single-site Motorola Type I SMR that used to be operated by Flower City Communications. Like all other Motorola systems in the country, it now belongs to NexTel® — (a whole feature topic in itself if someone wants to write it). The SysID is 1812 and the frequency list, based on Trunker's output and the FCC database, is this:

| | | | |
|---|---|---|---|
| c v | 852.7875 | WNCE-581 | Motorola, Inc. |
| v | 853.2375 | WNCE-581 | Motorola, Inc. |
| v | 863.9375 | WNMD-357 | ESMR, Inc. |
| v | 864.0375 | WNCE-581 | Motorola, Inc. |
| v | 864.3875 | WNMD-357 | ESMR, Inc. |
| dv | 864.4875 | WNCE-581 | Motorola, Inc. |
| v | 864.8375 | WNMD-357 | ESMR, Inc. |
| v | 864.9375 | WNCE-581 | Motorola, Inc. |
| v | 865.2875 | WNMD-357 | ESMR, Inc. |
| dv | 865.3875 | WNCE-581 | Motorola, Inc. |
| v | 865.7375 | WNMD-357 | ESMR, Inc. |
| dv | 865.8375 | WNCE-581 | Motorola, Inc. |

For those unfamiliar with Trunker, the small letters before the frequencies indicate channel usage observed by the program over time. A "c" indicates that a Morse callsign identification is sent on this channel. In the case of the system illustrated here, the callsign that is broadcast is WNCE-581, matching the license information for Motorola, Inc. When listening in conventional mode, the scannist will never hear the other callsign.

The "d" shows a channel that has carried digital information, normally the system con-

*Hardware configuration for using the Trunker tracking software.*




trol channel. As you can see, control rotates among three of the system's frequencies. You might also notice that only the Motorola-licensed frequencies have been control channels. If the scannist were to program a trunk tracking scanner with just the ESMR, Inc., frequencies and assume they were a separate system, the scanner would never track anything because none of these frequencies ever carry the control signal.

Finally, the letter "v" indicates that this channel has carried voice traffic. In this particular SMR, all 12 channels can be voice channels. That is not always the case, and it is impossible to associate a control signal with the correct network while scanning or searching in conventional mode without a decoder.

It takes a little time to generate a complete list. The system has to be busy enough to fully "load up" without announcing any more frequencies before you can be sure that you have them all. Some licensed frequencies may not be announced by the controller. They may be intended for future expansion. If that is the case, Trunker will automatically add them to the list when the controller announces that they are in use.

To recap, Trunker has generated a complete list of all of the channels that are included in this trunked system. The FCC database shows what would appear to be two separate systems because they are licensed to different entities. Conventional searching and scanning is not likely to reveal that all of these frequencies are associated with each other.

A trunk tracking scanner cannot tell you what frequencies are missing when it is unable to follow a user to a channel that is not programmed. It can tell you when you have frequencies programmed that are not part of the system, but only if you carefully watch the display indicators for a period of time.

## The Next Step

Any listings for trunked radio system frequencies that have not been validated by direct monitoring, preferably with a trunk tracking scanner (at least) or a computerized analysis program like Trunker, should be treated as suspect. It is very easy to inadvertently list invalid frequencies or to omit channels that are part of a large system.

Once the scannist has collected *all* of the correct frequencies included in the Motorola SMR to be monitored, he or she is ready to begin the process of differentiating between Type I, Type IIi, Type II, and Hybrid systems. This requires extensive monitoring and tracking and possibly a little hexadecimal math. The process is beyond the scope of this article. Trunker will spot a Type II system automatically, but you still have to do the bulk of the work to figure out the correct fleetmap settings for the other types.

## Where to Find More Information

At the present time there are few, if any, printed books that cover trunk tracking in any detail. Most of the research is being conducted and documented via the Internet. Each of the five research methods described in this article can be facilitated if you have access to the Internet.

• You can ask for help via the *rec.radio.scanner* Usenet newsgroup. Most of the basic trunking questions have already been asked and answered at least once, so I recommend going to DejaNews (**www.dejanews.com**) and searching the database of Usenet postings for trunking related articles.

• Another good way to converse with other trunking enthusiasts is via the TRUNKCOM mailing list. You can join TRUNKCOM by sending an e-mail message to *majordomo@qth.net* with the words "subscribe trunkcom" (no quotation marks) in the text.

• Naturally, there are several excellent websites that contain trunking information. Frequencies for many SMRs around the country, including non-Motorola systems, have been collected by many scannists and submitted to Warren Whitby's "Trunked Radio System User List" (**members.aol.com/wwhitby2/trs.html**).

General information about trunking and trunking-capable scanners is available from:
Trunktracker.com (**www.trunktracker.com**)
Motorola (**www.mot.com/LMPS/RNSG/trunking/alt.htm**)
Lindsay Blanton's website (**web2.airmail.net/lblant1/trunked.htm**)

• You can download the latest version of Trunker from:

**web2.airmail.net/lblant1/dfw/digital.htm**

and read detailed documentation at:

**www.geocities.com/CapeCanaveral/Lab/1060/beta.htm**.

• I also invite you to visit my own website. The NF2G Scannist Pages contain frequencies, codes, unit numbers, CTCSS/DCS information, trunking details, laws and regulations pertaining to Upstate New York, Western Vermont, and southern Ontario Province. It is also the home of NYSING – New York Statewide Incident Notification Group. The address is **www.nf2g.com**.

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*David Stark, NF2G, NYSING-01, got his first tunable receiver in 1972 and his ham radio license in 1981, and has about 20 years' experience in various aspects of public safety. He has nearly completed a Bachelor of Science in Criminal Justice and Sociology.*