Contest Automation 2020

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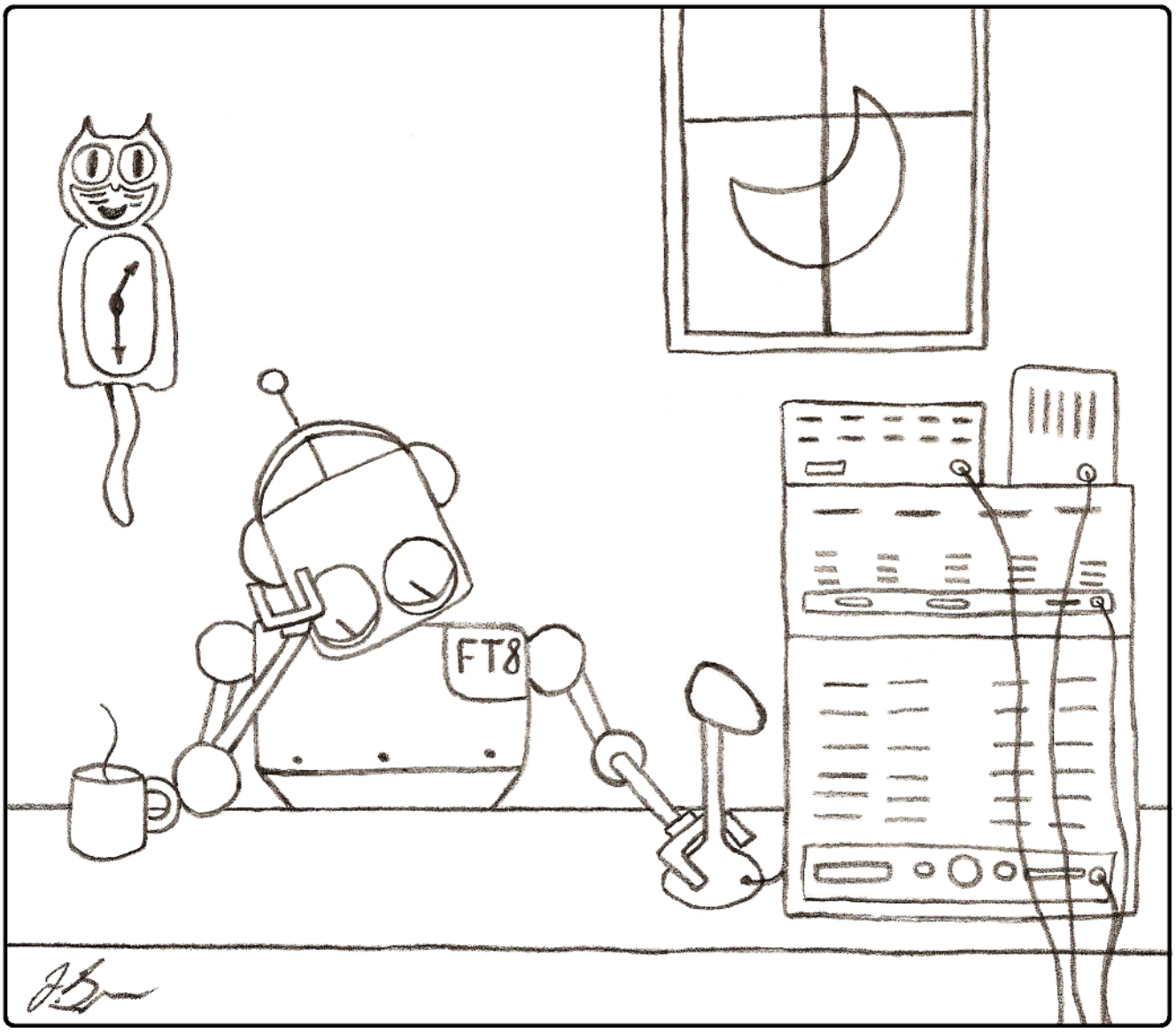

Abstract

Hams have applied technologies throughout the years to automate routine tasks and make their contesting more efficient. This reduces operator fatigue and allows the operator to extend their focus beyond the immediate. Over the last several years, rule changes and new operating modes have dramatically altered the VHF contesting landscape.

As we grapple with these changes, we discover every silver lining has its cloud. These clouds are no longer on the horizon, they are here. This is an exploration of some of the challenges those participating in VHF contests are facing today. These challenges include how workload

has shifted, how some automation that has served us so well in the past is becoming less important, and what new automation could do to addresses the challenges we face today.

Background and History

Contest Automation refers to those technologies applied to contesting. Technologies that ease the contester's workload, make operation more efficient, and reduce fatigue. Some types of station automation can also be considered contest automation such as radio and rotator interfacing to logging software.

Early automation involved electromechanical means such as paper tape or mechanical disks that when moved through or rotated in a machine would key CW. Recorded magnetic tape loops were used for voice. By the mid-70s electronic memory keyers were available.

With the rise of microcomputers, hams started to use computers for logging and dupe checking. Dupe sheets, and the desirability of having someone "dupe check", are largely historical artifacts today.

In the 90s we saw the rise of spotting networks and APRS which can be used to track rovers.

Today's logging software often includes built-in CW keying, voice keying, rig interface, rotator control and spotting network interface. These are amazing pieces of software that when running a frequency the operator need do little more than enter in the callsign and exchange information while pressing a few buttons. On CW the computer can send the other stations call, exchange information and start calling CQ with just those key presses. If operating phone only need to speak to say the other person's callsign and perhaps give the exchange.

This level of automation has served us well for a long time, but the world does not remain static. Change has come to the VHF contesting landscape that has disrupted the status quo. In many ways we don't know where this will lead. What is clear is that the "old" ways have to change. As we search for the "new" way, it is becoming evident that the automation of the past may not be well suited for the future.

The winds of change

As often happens, change starts out slow and the effects aren't felt until it starts to snowball. Thus was the case when the ARRL changed the VHF contest assistance rules four years ago to allow all classes of operators to self-spot and set up skeds in real time.

Initially this rule change just added another tool to the existing cornucopia. Operating patterns didn't change much. It reduced importance of pre-planning skeds and gave opportunities to reach out to operators for those extra contacts. It had little impact on the bread and butter

operation of calling CQ and sweeping the antennas to find contacts. It was fairly universally welcomed.

Eventually operators started focusing more attention towards venues such as ON4KST and setting up skeds for more distant contacts. The logic was solid, you've already worked most of the local stations already and calling CQ just wasn't very productive. Getting on OK4KST not only offered the promise of more contacts, but new multipliers by selecting specific stations to try and work rather than leave it to chance. Even though one can have a voice keyer going in the background calling CQ, and probably should while arranging a sked, it is hard to keep ones focus divided. Along with diminished CQ activity, stations started to listen less for CQs creating a positive feedback cycle.

As a rover, the effects of the assistance rules were first noticed in the 2017 spring sprints where the same assistance rules were adopted. Being a single band event where stations aren't off running bands with someone, the CQ patterns are usually simple. As a rover hitting a new grid, it had been fairly easy to find the stations that were still active. Now, what was observed was that after the first 30 minutes or so of the sprint, most of the stations appeared to have disappeared off the air. There were some still calling CQ while they worked ON4KST setting up skeds, but many got fixated on setting up skeds and just didn't CQ.

In the larger contests, stations would still actively call CQ for much longer, perhaps the first several hours. But unless there was a big band opening where calling CQ would yield immediate rewards, the same shift in focus would occur.

The rise of the machines

Back before the turn of the century, a challenge was made that asserted that no kind of filtering or computer decode of EME signals would be possible. At the time this was referring to the characteristics of CW signals as reflected back to earth off the moon. Now, roughly 20 years later, we have seen that ship sail. JT65 modes make EME more accessible to smaller stations than had historically been the case.

It was evident then that JT65 could resolve signals better than humans could decode CW, and JT65 saw some adoption on HF and weak signal VHF terrestrial use. Yet the one minute sequence interval resulted in contact times on the order of 5 minutes or longer. That long period pretty much relegated the JT65 modes to digital mode enthusiasts, specialty cases like EME, or when one really needed to resort to it for that weak signal contact.

Still human interaction was needed for the JT65 modes. It didn't advance the sequence automatically. A skilled operator could also stack multiple receive sequences of a signal that could not be decoded in any single sequence to eventually get a decode.

Meteor scatter is quite a different mode. Not truly a “weak signal” mode, meteor scatter can be thought of as being similar to e-skip where signals could be fairly strong, but with openings of a fraction of a second to several seconds. Meteor scatter using phone is an exhausting and time consuming process. Fast CW was more effective but again was a tedious sort of operation and time consuming.

Machines are patient and very good at sending data fast as well as decoding fast data. Faster data also means shorter openings are needed. Shorter openings occur more frequently thus it takes less time to complete a contact. FSK441 did this very well and it is no surprise that digital is the standard method to operate meteor scatter today. FSK441 didn’t cut humans out of the equation. Humans were needed to look at the data received, identify good data from the garbage and to advance the sequence.

The paradigm shift started to occur with MSK144. MSK144 brought some automation to the process. It could now identify good data from garbage, and present clean decodes to the user. Not just that, but user no longer needed to advance the sequence. With clean decodes and a simple predictable exchange, an option to auto sequence was included. Now it was possible for MSK144 to completely follow up on a user’s action to call or answer a CQ and finish the contact.

Up to this point basic SSB and CW operation wasn’t threatened. Yes MSK144 was a good addition to the available tools and yes JT65 could do better than CW if one was willing to tolerate the long sequences. That all changed when FT8 burst onto the scene.

FT8 brought to us the same simplicity of operation like MSK144, shorter sequences so contacts were much quicker, and CW like performance. When it first appeared there was much skepticism as to its ability to work as well as CW. In part this was fed by FT8 ops who expressed “amazing” FT8 contact feats that were considered easily achievable on SSB much less CW. None the less, FT8 gave the op who didn’t know CW the ability to operate with far weaker signals than needed for SSB.

As of this writing, there is little question about FT8 equaling, and likely exceeding, the performance of CW. It may not be good enough for the run rates one can get on phone or CW during a big e-skip opening, but the time for one contact using FT8 is still quite reasonable and one is likely to spend much longer than a typical FT8 contact trying to a difficult SSB or CW contact.

One can argue about the practical usability of these modes which are useful for making contacts rather than having a QSO. From the weak signal contester’s perspective, a contact is a contact and these digital modes are just as good.

We humans aren’t completely out of the picture. We are still part of the loop even on the most automated of the digital modes. There are still those cases where our hardware isn’t stable

enough or propagation/scatter characteristics introduce variables such as Doppler that digital modes may not tolerate well.

Nevertheless, it can be a bit humbling as we see machines able to make contacts in weak signal conditions better than we can. Humans still have the edge as far as achieving higher run rates. Unless there is a big 6m opening however, VHF contesting is not to be very dependent on high run rates. Even so, as of this writing there are some less frequently used digital modes with 5 second sequences and rumors of a 5 second sequence FT8 mode which will trade speed for needing a bit stronger signal. So this edge in run rate may not be long lived.

Where we are now

As described above the assistance rule changes started the snowball rolling. As activity adapted to the rule changes that de-emphasized CQing, a cycle of self-reinforcement added some momentum to that snowball. The first highly automated digital mode MSK144 added its weight to the snowball helping it pick up speed. Then FT8 with its further refinements in automation exploded on the scene like an 800 pound gorilla, picked up the snowball and threw it down the hill.

Those of us that were relying on stations calling CQ, and were already concerned about the decline in this activity due to the rule change, saw this accelerate at an unbelievable pace once FT8 caught on. Thus we became motivated to find ways to integrate FT8 into our operation.

Unlike the assistance rule changes and MSK144, both of which have made operation easier and increased contact opportunities for fixed stations, FT8 has been more of a mixed bag. FT8 gives better reach and is bringing new operators on, but as people focus on FT8 it can be difficult to get stations to QSY to other bands if one doesn't have means to request the other station to change other than trying to do so over FT8 itself.

Some discussion about FT8

The changes brought into in the VHF contesting landscape by FT8 are so central to this discussion that we need to discuss some of the effects FT8 has had in order to find ways to adapt to this change.

FT8 has been proven effective. Early on questions were raised about its performance relative to CW but that is now settled. Dave K1RZ did a great deal of testing of this nature with very distant stations on 2m and found that when the CW was so weak that he couldn't tell dits from dahs, he was still able to make a contact on FT8. Dave found this to be the same on 1.25m and 70cm

FT8 has attracted new operators especially to 6m. Many of these new operators are ones who were introduced to FT8 on HF and with the prevalence of HF+6m rigs moved up to 6m. Those of us who have run FT8 in contests have worked stations on FT8 who are local, and would have been easily workable on SSB, but those operators appear to have never gotten on prior to FT8.

FT8, unlike the JT65 modes, is relatively fast and uses automation to make operation simple and nearly automatic. Operation is predictable and one won't run into two FT8 ops rag chewing so the timid don't have to worry about interrupting a QSO in progress to make a contact.

With a designated "FT8 frequency" and FT8's ability to support many stations within a single 2.8 kHz passband, one doesn't have to scan frequencies to find stations. They just show up in the decodes.

As stated above, every silver lining has its cloud and FT8 is no exception. One of the most confounding issues is how does one get the station just worked on FT8 to QSY to other bands? As FT8 has gained in popularity, and drawn in stations to the mode, it can be exasperating to work someone on FT8 that one normally works on multiple bands, but not be able to get them to QSY. Thus only the single contact on FT8 is made. Attempts have been made to try and use a free message text to signal a CQ, but this doesn't always work.

An example of this effect was experienced by K2EZ/R during the September 2018 VHF contest. While roving through Ohio down into Kentucky, passing through 5 or 6 grids in easy reach of N8ZM, K2EZ/R and N8ZM only connected for a couple 6m FT8 contacts. Only two contacts in lieu of a potential 20 to 24 contacts had there been some way to coordinate QSYs.

Another issue with FT8 is product of one of its virtues. While it is nice that everyone is concentrated on one frequency, despite FT8's ability to dredge signals out of the noise, it has finite limits. Having everyone within a 2.8 kHz passband may be no issue most of the time, but it has to result a higher noise level when it is busy. That will degrade the chances of working the weakest signals. In some instances a single very strong local signal alone is enough to impair ability to copy the weakest signals. While K1RZ proved to himself FT8 can make a contact that couldn't be made on CW, these FT8 contacts were not under contest conditions. In a contest, when the frequency is busier, the chance of success might be different. This may not be an issue for stations in less populated area, but it could pose an issue for some.

Another downside to FT8 is a product of the short sequence times. Short enough to keep operators from falling asleep, but not really long enough to turn one's attention elsewhere. This can promote a bit of a tunnel vision.

Today's contest environment

As the year 2020 approaches, the tools and methods available to the VHF contester are a hodgepodge of the well-established and the new.

Five years ago a serious VHF contester may have had a CW/voice keyer, logging software, rig integration, other station automation, and perhaps be keeping an eye on the propagation maps. More sophisticated operators might have been tracking rovers on APRS, have a list of operators they usually work, and perhaps even a list of skeds they had pre-arranged. A few operated digital modes, but these were more the exception than the rule and mostly used at the times when other modes were slow.

Today one has most all of that plus keeps a phone handy for voice calls and text messages. They will also frequently keep windows open on ON4KST chat, Ping Jockey if doing meteor scatter, and might use other or tools to contact each other. Spotting networks are now available to all operators so will have a window watching for spots. Digital modes, specifically FT8 followed by MSK144, are so common that one is likely to have one or more instances of WSJT-X running for good measure.

Between the growth of the digital modes, and the ability to coordinate skeds, operators are more able to keep themselves occupied seeking contacts with others. MSK144 opened up the nighttime hours for many as this was when the rocks were better. Operators that used to go to bed at night as local activity tapered off, now found they can remain productive through most of the night.

For the rover, these changes have been a mixed blessing. Phone calls and TXT messages can be handy to alert stations when one is in a new grid. On the other hand stations aren't CQing as often which results in less random contacts and one relies much more on those phone calls and TXT messages. Digital modes are possible but these are more challenging in the mobile environment particularly if one is operating solo and needs to drive. Chat pages are similarly difficult and there is no guarantee that the remote location some rovers visit will have cell phone coverage to make a phone call much less data network access. Even when those are available the challenge becomes getting the operators attention in a timely fashion and all those efforts cut into operating time.

Some of today's challenges

We have more ways than ever to contact each other, yet the multitude of methods can divide ones attention and become a distraction. As a result, sometimes they get tuned out, turned off, audio muted, etc. When that happens one can try to reach that operator all they want, but will not be successful until the operator remembers to check.

Phone calls and TXT messaging can work great if the other person answers or looks at their phone. Sometimes phones don't get answered because one is busy. Sometimes operators don't hear the phone because they are wearing headphones. Complicating matters is that junk phone calls have become so problematical that the some operators just won't answer because the person

calling isn't in their contact list. Thus even if one has a list of operators phone numbers, calling operators when one isn't on their contact list can be fruitless.

Other methods are pretty archaic if one thinks about it. ON4KST requires one to type /CQ the other station's callsign followed by the message if one wants to direct a message to an individual. Even after doing that, there are no guarantees the other person will see the message before it scrolls from the screen.

Speaking of archaic, what we are communicating is fairly basic. Mode, frequency, direction we are beaming, and if a digital mode what sequence we are on. Why spend all the time typing that? Why can't we do this with a few mouse clicks?

We also face issues of information overload. If one starts getting messaged by multiple people at once to set up skeds, how does one keep track of it? How does one answer if one is currently busy? Even if one manages to keep track of it, by the time one gets back to them they are off working someone else.

In the case of a rover, the rover has to spend a bunch of time to get people to come. Invariably stations are busy and the rover has to wait, then at the worst possible time, after the rover is busy hopping bands with a station, they all are suddenly ready. Then when the rover is ready again the others are busy.

We ask the question, why can't we have something that can accept requests for us, maintain the list, answer for us when we are busy, and allow for priority requests like from a rover or new multiplier? We also have to ask ourselves how productively we spend our time. Is sitting in front of WSJT-X waiting on MSK144 or FT8 to complete a contact efficient use of time? What could we be doing at the same time? What if we could link our digital mode operation to sked requests?

The elephant in the room

Before we get into the details on how we can add automation to address the sorts of issues we have discussed thus far, we need to acknowledge the elephant in the room.

There have been many criticisms of FT8. These range from claims about it not being real ham radio to it being like watching paint dry. Jokes have been made about "my machine working yours" and some general claims that there is no skill involved. Even suggestions that one can simply sit back and let ones computer operate the contest. Despite the criticisms and jokes, many love the mode, the performance is good, and as long as it is communicating via radio, it is still radio and valid for a contact.

We do need to acknowledge however a bit of truth in the criticisms. The reality is that with the very controlled exchange, and the level of automation already built into FT8, it is very easy to

create a FT8 robot. A few minutes of internet searches and one can quickly find out how to do it using off the shelf third party software. Rather than pretend that this isn't done, and that a single mouse click by a human makes it all good, maybe it is time to accept the inevitable.

The argument for FT8 robots

As of this writing, the auto sequencing in WSJT-X can completely finish a contact after the user clicks on the decode of someone's CQ. Similarly, a single click will start WSJT-X calling CQ and it can automatically answer the first station that responds and complete the contact. This isn't perfect, but it works quite well. WSJT-X can also log the contact and/or send the contact information to other logging software such as N1MM.

The single click prevents one from having WSJT-X run on its own, but as mentioned previously, it is fairly easy to defeat it as a protection. Furthermore it would not be difficult for someone to make a version that is fully robotic given that WSJT-X is open source.

The question we have to ask ourselves is if an operator's time baby-sitting WSJT-X by clicking when needed a productive use of their time? Are the decisions so sophisticated? What else might the operator be doing if they aren't tethered to keeping it going?

It is easy enough to address the cases when auto sequencing hangs up or a contact does not complete. Such could be built into WSJT-X or handled by external scripts.

From a FCC part 97 standpoint, there is no question that automatic control would be allowed with a control operator present. As of this writing, the ARRL VHF contest rules do not speak to it. Therefore a robot appears to be legal and valid to use in the contests at the moment as long as the operator is present to monitor its operation.

By acknowledging robots, their existence can be recognized in the rules. Robots could be allowed to be used freely. Robots could be limited to some contest entry categories. Or robots could be prohibited outright. In the RTTY roundup, the ARRL stated with regard to FT8 entrants "Unattended operation is not permitted. Utilizing QSO/macro automations is not permitted". That would bar it completely. Just how robots should fit within the contest is outside the scope of this paper. We note however that the line between robots, and user initiated contacts, is likely to get quite blurry.

Contest Manager 2020

It is finally time to start discussing what sort of contest automation we might want to start creating. For purposes of discussion we will generically call our contesting tool Contest Manager 2020 or simply Contest Manager. This could be one piece of software or a collection

of software packages that work with each other. It might involve hardware, but most hardware would fall on the station automation side of the fence.

It may be a bit early to think ahead to 2020, but it seems reasonable that any development started now won't be ready till 2020 for general use at the earliest. Besides next year is bound to be the best year ever for development since we could look back on the past with 20/20 hindsight and look towards the future with 20/20 vision.

Contest Manager 2020 – Configuration

For starters Contest Manager would be configured with one's station information. Basic information such as callsign, 6 digit grid, bands available, modes available, power per band, antenna gain per band, etc. We would also enter real time status information such as operating, away, unavailable. In cases when away or unavailable, a time could be entered for when we are returning. Real time status could also include station problems such as bands that may have been failed or temporarily offline for some reason. It might even make sense to include the specific frequencies we are generally operating on, perhaps even our radio's actual frequency in real time.

We would also have it connect to our logging software, WSJT-X, and station automation. These hooks will let Contest Manager see who we have worked, monitor stations on digital modes and perform control functions. The more it can control the more Contest Manager could potentially do for us.

Contest Manager 2020 – Communications

With all the means we now have available to us to communicate, the last thing we would need is another way to communicate. Part of the problem however is just how many different ways we can reach each other to setup a sked. The other problems are the relative archaic nature of some methods and managing all these sources.

Imagine for starters that when we open up Contest Manager it immediately lets us see what other operators are using Contest Manager. Not just that they are online, but let us look at their station information and look at their real time status. We would also have capability to message other stations directly if needed.

Contest Manager could also act as a client for ON4KST, Ping Jockey, TXT messaging, etc. It would provide a direct window into the respective messaging system, but would also monitor them for messages directed at us. Messages to us would be gathered into one alert area so they don't scroll off the screen before we see them. It will not only collect all this information, but allow us to respond privately without having to manually type a command prefix and their call

like "/CQ K2EZ ….". Just click on the message we received, type in a reply, and Contest Manager sends the response back through the means received. For that matter, we can have some user configurable messages we can send privately or publically at a mouse click. Once we have responded or acted on a message we received, it can be cleared from the alert area.

To continue with the theme of concentrating information, it could also make sense to have Contest Manager obtain spots from the spotting networks and allow spots to be made. Do all the stuff we are used to with spotting, but perhaps a bit more as we will discuss later. With self-spotting allowed, user configurable messages could be sent with a click to self-spot.

Another piece of information Contest Manager can accumulate is tracking information for rovers from APRS. With this information Contest Manager can generate alerts when rovers enter new grids where we have a reasonable chance of working them.

Contest Manager 2020 – A rules based system

Central to the functioning of Contest Manager would be a rules based system. This can be thought of as a rudimentary Artificial Intelligence that enables Contest Manager to take some actions on the behalf of the operator. The rules that govern these actions would be fully configurable.

Rules are triggered by an event and define an action or actions to be taken. An event might be a new spot received, timer expired, time of day, station copied on FT8, station answering our CQ or message received on ON4KST. An action might be to log a contact, generate a special alert to the operator, or answer a message automatically that another operator sent us on one of the chat pages.

Simple "canned" rules would be parameters on forms or within menus built into Contest Manager that govern responses to common events. More advanced rules would be handled with a scripting language such as Python.

The rules create a powerful system that can be unique for every operator and station. They can be adjusted for different times of the contest and as priorities shift.

Contest Manager 2020 – Sked Management

We have spoken about having Contest Manager act as a client for ON4KST, Ping Jockey and other messaging systems as well as being able to message other operators via Contest Manager. We have also spoken about how messages directly addressed to the operator could be gathered into alert area for attention and avoid them getting lost. In many instances these messages are a crude way of setting up a sked.

Since we already discussed having the the ability to view other stations who are running Contest Manager, and their station information, it would be a fairly simple matter for our rules based system to identify likely sked candidates. They could then be displayed in a list of prospects. The rules system could prioritize the list using any number of factors. For example, distance, mode, antenna gains, power, and past successes/failures attempting contacts with the station.

We could take this a step further, and from the list of candidates, allow a sked to be requested with a couple mouse clicks. The requested sked will show in our pending requests list and show up on the other stations sked request list. Sked requests received from other stations would show up on our sked request list. Once there they could be manually accepted, accepted with changes (such as mode), or declined. Alternatively the rules system could be set to auto accept/decline some requests while seeking operator input to accept or decline other requests.

Part of the request/approval would be agreement on bands to try and frequencies so these are all reflected in the finally accepted sked. The rules system would be capable of proposing specific frequencies on a band based upon the operators known preferences and negotiating a final frequency. Once a sked is accepted by both, it moves over to both stations sked queue list.

Once on the sked queue list, the sked will stay on it till the request is attempted. The rules system sets the priority order with the operator having the final say. The rules system could use a number of criteria for priority. New multipliers may be given a higher priority, but could have priority lowered if they are a low probability of success. Mode can also affect priority such as meteor scatter skeds being given higher priority during prime meteor hours while given a lower priority during times when there are fewer rocks. Antenna heading might also be used to adjust priority to minimize time rotating antennas.

This sort of request system doesn't suffer from the problems we experience in venues such as ON4KST or TXT messaging when the person we seek to contact is off running the bands with someone else. Now the request will either be accepted or declined based on the rules, or it will be awaiting approval when the operator completes running the bands or otherwise has a moment to address the request.

The other common problem is stations trying to make a sked being out of sync with each other. One station is off running the bands while the other is waiting. Then by the time they get finished, the other is now busy with a different station. With a sked request accepted, Contest Manager can coordinate with the other station's Contest Manager, bumping priorities until both are ready to operate. When each operator starts to work the sked, the other operator gets an affirmative confirmation. This way each operator knows that the other operator is also trying.

The sked queue system eliminates the problems where one operator is waiting for another to finish with someone else, but that other operator has already finished and forgotten to come back to the waiting operator. With the sked queue system, when the one operator completes, the next one in the queue will be waiting.

The auto prioritizing system can help out rovers as well in instances where the rover has internet connectivity. The problem discussed before was time getting requests sent, the other stations being busy, and time waiting on the other stations to become available. Now the rover can easily request a number of skeds quickly with mouse clicks. If other operators have rovers as a priority, when the requests go out the rover will appear high in the sked queue and be attended as soon as possible. The rover can have confidence that they will not be forgotten.

Spots, if they meet certain priority requirements, could trigger a pseudo sked that goes into the sked queue. A pseudo sked essentially creates a slot for the operator to go check the frequency of the spot and try and work the station. Similarly if APRS is feeding into Contest Manager, rovers entering new grids could also trigger pseudo skeds. Both these methods can aid stations in finding rovers when rovers don't have internet connectivity.

To comply with the rules, the final exchange of information is the exchange of confirmations that they are initiating a sked. The sked request would have an accepted attempt time period and after that period operators could continue trying, but it would be understood that after that period the other operator may no longer be trying. Successful or not, the sked will be cleared from the list without any information as to success/failure sent back to the other station.

Contest Manager 2020 – Contact automation

When we speak of contact automation, we aren't speaking of robots but we do start blurring the lines. As discussed earlier, FT8 and MSK144 are two examples of digital modes that use automation to complete contacts once initiated by the user. These are not the only ones that exist and we can expect this automation trend to continue.

With that level of automation, and with Contact Manager interfaced to WSJT-X, there is no reason why Contest Manager couldn't automatically initiate a digital mode contact. Once initiated Contest Manager would monitor its progress and log the finished contact or abort if it fails. Contest Manager would then move on to the next one in the queue.

Since some skeds can be handled automatically, while others require manual operation, we would want to have two separate sked queues. One queue for skeds requiring manual operation, and one for automatically processed digital mode skeds. It is conceivable that an operator may only have digital modes available on some bands. The sked making process could then split an approved sked into two where the sked for some bands would go in the automated queue and the sked for the other bands would go in the manual queue.

We talked earlier about the difficulty getting stations worked on FT8 to go to other bands. One of the things Contest Manager can do for us is QSY the radio to the band and frequency agreed upon when the sked was setup. Thus band changes become automatically handled. Some operators might have separate WSJT-X instances running for different bands and separate radios.

In those instances Contest Manager will select the appropriate instance of WSJT-X and radio control for setting the frequency.

One of the other issues discussed with FT8 is the possibility of the FT8 frequency being so busy that the noise floor is elevated or there being a very strong station making it hard to copy the weakest stations. With Contest Manager running through a set of skeds, there is no reason why contacts must be made on the "FT8 Frequency". As easily as it changes bands, it could go off to a quiet frequency where there aren't any other signals in the passband to work one station before returning back to the standard FT8 frequency.

Some operators may object to the invasion of FT8 out of its corralled frequency. Other objections may come from FT8 advocates who feel that dividing FT8 among other frequencies dilutes the power of FT8. That power is FT8's ability to multi-decode and handle many stations on the one the frequency and thereby not having to tune around to find stations. In actuality, a temporary QSY to a quieter frequency is neither an invasion, nor does it split FT8 stations to multiple frequencies. It is no different than jumping to a quiet frequency to do a CW contact. Once the contact is over the stations will return. In most instances there is no need to QSY off the standard frequency.

MSK144 benefits more by being on different frequencies than with FT8. This is because MSK144 uses more bandwidth and requires stronger signals. So this capability of going to other frequencies will be more important for MSK144 contacts.

Before we move on, we should note that these automatically processed skeds would not fall into the category of a robot. They have been initiated using manual intervention just like someone operating WSJT-X directly trying to tail-end a QSO in process. That manual intervention is just one step removed by being initiated in Contest Manager and perhaps initiated at a time removed from when the actual contact is worked.

Contact automation as described here allows the operator to focus on more productive tasks and manual tasks rather than waiting for the next digital mode sequence to finish. It is about removing the operator from needing to be tied to the WSJT-X console to do mouse clicks at the appropriate times.

Some preliminary work has been done that reveals it would not be that difficult to get WSJT-X or some derivative to accept the direction to initiate a contact at the command of another application such as Contest Manager. Some operators use multiple computers and WSJT-X has functionality built in that allows it to interface to N1MM for logging that uses UDP packets. UDP packets can be transported over a network. Contest Manager could use a similar interface to communicate with some sort of WSJT-X derivative on multiple computers.

Contest Manager 2020 – A better robot

Using our rules based system, and the interfacing to WSJT-X for contact automation, Contest Manager could also act as an enhanced robot. This changes the robot from a simple CQ machine answering the first caller, to an assistant operator of sorts by following rules set forth by the operator. Such a robotic mode could be filler when there aren't other functions scheduled and it doesn't need to be limited to one digital mode.

A simple rule might make the decision to answer a specific caller rather than just the first based on one or more criteria. This criteria could be their distance, decode strength, being a new multiplier, being DX etc.

An operator can setup more complex rules. They can have it periodically switch sequences or simply monitor and listen to both sequences answering stations that are new. Rules could be made to automatically scan antennas while calling CQ or just listen for stations. A rule could be set up to automatically turn the antenna towards a new station that is copied, depending on distance, signal strength and how far the station's grid is off the present beam heading before attempting to contact that station.

Rules could look at stations it hears directly as well as stations being worked by others it doesn't copy directly. If one of those other stations it doesn't hear directly represents a new station or multiplier, the robot could then rotate the antenna and listen to see if the other station can be copied directly. If direct copy is possible then it can call that other station. Quite a bit of intelligence can be incorporated into the rules.

The rules applied to the robot can be taken a step further and an operator can create different rule sets to be used at different times in the contest. One set may work well for the start of the contest, but later a different set of strategies pays off. Yet a different set of rules may be appropriate for times when meteor scatter picks up.

While we call it a robot, it is acting in response to the rules set by the operator. Rather than the operator sitting at the console directly working stations, the operator becomes more of a manager working at a higher level. As with contact automation it frees up the operator to do more productive tasks. Unlike contact automation, this is more definitively a robot although a more intelligent robot and one guided at a much higher level. In a way the robot becomes an avatar of the operator's will.

This robotic operation doesn't need to be strictly on FT8 and could be extended to MSK144 and other similar modes. Some experimentation has already been done with WSJT-X in this area that shows these types of improvements discussed are not particularly difficult. While much of this could get built into WSJT-X, a more flexible system would have WSJT-X focus on what it does well and build the hooks into WSJT-X to allow external applications to perform higher level functions.

As discussed previously, robotic operation would be legal as long as a control operator is present and overseeing the operation. As of this writing the VHF contest rules would not prohibit robots.

Contest Manager 2020 – Multitasking

Despite claims by some to be excellent multitaskers, humans generally are not good at multitasking. Humans tend to focus on one task before moving on to the next. If one arranges the tasks smartly, fills wait times in longer tasks with shorter ones, and most of all not forgetting all one is trying to do, one would be considered a good multitasker.

One of the challenges we face in the contest environment is a multitude of different tasks. With the explosion of digital modes, specifically FT8, more attention than ever is focused into digital operating. Some operators use multitasking to great effect and can still be found CQing on SSB or CW late in the contests as they periodically shift through different modes. It is not surprising that these ops tend to be consistently among the leaders in the results.

Contest Manager can aid multitasking. It could be configured through the rules system to cycle through modes with frequency changes made automatically. It could be setup to call CQ for a few sequences on FT8, then move to MSK144 and do the same, go to SSB and trigger the voice keyer, change to CW and call CQ there before cycling back to FT8. It could even change bands and cycle through the modes again on the other band. Operators would have to keep an ear for SSB and CW responses while Contest Manager could handle the digital mode responses itself.

The ARRL VHF contest rules hand us one other big opportunity for multitasking. As of this writing, the rules do not prohibit operating on more than one band at a time. Single operators are the most restricted and the rule for single ops reads “Only one transmitted signal per band is permitted at any given time; alternating CQs on two or more frequencies using the same band and mode is prohibited”. The emphasis on “per band” is the ARRL’s and clearly allows one signal on each band even if they are at the same time. The rule also prohibits alternating CQs on multiple frequencies on the same band and mode, but since the cycling through modes as we discussed earlier is changing modes when we change frequency, that does not run afoul of that restriction.

With this contest rule there is significant advantage in having multiple radios. At least having dedicated radios for the key calling bands could pay off. Even without Contest Manager one could have FT8 running on 2m and on 6m while one manually runs the upper bands with another station. There is nothing lost by initiating FT8 CQs on 2m and 6m before starting the manual work. Even if one doesn’t have the attention to spare while working the upper bands, if someone answers one of the digital mode CQs, WSJT-X will complete the contact on its own.

Contest Manager significantly enhances multiple band operation. In the preceding scenario, rather than just calling CQ on 6m and 2m, Contest Manager could continue to work through the automated sked queue while the operator manually runs the upper bands. If the automated sked queue is empty it could still operate in the more intelligent robot mode. It wouldn’t be able to rotate the antennas if they were locked to the same tower as the ones being used for manual

operation, but that is why we would use beam heading as a prioritizing factor in the sked queue. Skeds that require a significantly different beam heading would get deprioritized unless signal strengths are expected to be strong enough not to make a difference.

Multitasking can be further enhanced if one has an SDR based radio. With a Flex radio one instance of WSJT-X can be on FT8, another instance on MSK144. While they can't all transmit at once, whenever none are transmitting Contest Manager could monitor both FT8 and MSK144 while the operator monitors the SSB/CW. In this way, if one sets up Contest Manager to cycle through the modes as described earlier, it would still be able to keep track of any new stations that come on digital modes between pauses in CQs on SSB and CW. If one has this capability on more than one band, then the sequencing could be staggered so that the CQs on SSB and CW alternate between bands so the operator only has to listen to one band at a time.

Conclusion

The rule changes and digital modes have resulted in some significant shifts in operating patterns. FT8 in particular has disrupted operating patterns. In many ways we are trying to figure it all out. Many are scrambling to add digital modes because that is where everyone seems to be even if they are less than enthusiastic about it.

It is not the purpose to pass judgement on digital modes, but accept them for what they are as well as the changes that are inevitable as a result of these modes. They work too well and are too popular to ignore. Even if this is a bit humbling that machines are getting better than us humans at copying signals, it is a reality that needs to be acknowledged.

In our exploration we have sought to identify some of the problem areas that are cropping up as a result of the disruption. We have also looked at how the digital modes are being operated and sought to find a way to redress some operational shortcomings. We have tried to find ways to get the operator doing higher level functions rather than being reduced to waiting for the next digital mode sequence to complete.

We see great potential with added automation especially with regard to the digital modes. If such systems actually get developed, it should help operators work the easy stations quicker and focus on the more challenging contacts. A shorter sequence FT8 mode would allow digital contacts with stronger stations to be cleared even faster.

It is uncertain if making digital mode contacts more efficient will make digital even more popular. For contest purposes, where a contact is a contact, there is no doubt it will find popularity. On the other hand if digital mode operation is so streamlined might this leave time for operators to spend more time back on legacy modes?

We also note that Contest Manager would be of limited use unless it is adopted in significant numbers. While some features of Contest Manager would be useable in only the more advanced stations, there are two relatively straightforward use cases that would aid its adoption.

The first is its ability to show every other station in the contest using Contest Manager. At this level skeds could be easily requested, prioritized and kept in the sked queue even if all are manual. This would include pseudo skeds that get inserted from the spotting networks or APRS input from rovers.

The second use case would be as an assistant for digital modes. With that interface, it becomes relatively simple to make the automated sked queue a reality even if ones Contest Manager setup doesn't have ability to control the antenna or QSY frequencies. It would also allow for the enhanced robotic operation.

The subject of robotic operation is one that appears to be inevitable and needs to be acknowledged. The question raised here is if the very limited user interaction to initiate a contact on these digital modes makes sense and if it is substantially different than the machine running automatically using guidance given by the operator. The prospect of robots is controversial and it is likely that at some point the rules will have to acknowledge them in one way or another.

We note that there is opportunity for abuses with robotic operation. Some will find the temptation to leave a robot running unattended while one is away or sleeps just too great. Ignoring this does not make the issue go away. It would be possible to have Contest Manager halt automated sked queue processing and any other robotic operation if the operator stops interacting with Contest Manager for some period of time. This would create a limitation similar to what exists in WSJT-X.

Contest Manager 2020 has been a theoretical exercise. Not all concepts are original as any good idea has been shamelessly borrowed. Some testing has been done with WSJT-X to evaluate the difficulties of some of the ideas expressed, but that is as far as it has gone. Others are welcome to borrow any idea expressed should those more capable wish to turn any of this into reality including using the name Contest Manager.