Secrets of Success: Lessons from WRTC2006—Part One

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WRTC2006 featured an exciting race between the top-scoring teams. A detailed study of their logs highlights many excellent operating tactics (and some occasional clinkers). Every contest has its great stories and moments of frustrations. The teams analyzed here share a few of those with us as well. Let's see what we can learn, and what can be applied to other contesting situations back home.

Antennas and Locations

The WRTC hosts provided the following hardware at each operating site:

- Antennas on a 15 meter tall tower:
  - 20 meters, 15 meter sand 10 meters: rotatable Acom LS86 8-element log periodic on a 6.5 meter boom.
  - 40 meters: Two-element Yagi on a 6.7 meters boom, on the same rotator.
  - 40 meters and 80 meters: trap inverted V.
- Feedlines and a manual coax switch for the three antennas.
- Acom 1010 amplifier.

This was the first WRTC at which competitors enjoyed a Yagi on 40 meters and transmitter power above 100 W. The Brazilian organizing committee felt that, at the bottom of the sunspot cycle from the southern hemisphere, reasonable signals required more power and better antennas than those used in past

Annex I — Rate meter deception and equivalent QSOs.

"Should I stop what I'm doing now and do something else?" A good contester asks herself this question continuously. The winning contester changes operating tactics whenever the new tactic will improve the score faster than the old tactic. But how does one evaluate two different tactics?

Many contesters watch their logging software's rate meter: that display of raw QSOs worked recently, expressed as QSOs per hour. If the rate meter goes up, they feel things are going well. When the rate meter heads down, eventually they make a change in tactics: change bands, change mode (for multi-mode contests), switch between running and S&P, change antennas or antenna system configurations or change running frequencies.

Rate meters come in several flavors — last 10 minutes, last hour, last 10 QSOs, and last 100 QSOs are common versions. For brevity I will only state (but not prove here) that, in many contest situations, measuring the last 10- or 100-QSOs to calculate rate often deceives the operator. Such measurements can tell the operator that his performance is falling off, when in fact it is improving — or vice versa.

Measuring the last 10 minutes or last hour to determine rate helps avoid one class of false indications. But even a last-10-minute measurement of raw QSO rate can mislead. Here is an example, taken from the VE3EJ and VE7ZO log.

During the ten minutes 2200–2209 UTC, the team worked 11 QSOs on 20 meters SSB. Then, switching to 40 meters CW, in the next ten minutes they worked 12 contacts. Should they stay on 40 meters CW? The rate meter at 2210 UTC read "66 QSO/hr" and now, at 2220 UTC, it reads "72 QSO/hr". Some contesters would look at that information and conclude that one should continue with the current tactic.

Hold on, though! Those contacts on 20 meters SSB were almost all 5-point DX. If we had a "QSO points per hour" rate meter, back on 20 meters SSB at 2210 UTC it would have read "348 QSO points/hr"… and now at 2220 UTC on 40 meters CW it reads "114 QSO points/hr." Guess that switch to 40 meters was a big mistake! Sure, VE3EJ and VE7ZO worked an additional QSO in the last 10 minutes, but all their QSOs are of low-point value. And that simple last-10-minute QSO-per-hour rate meter: throw it away!

But wait! There's more to the story. Back on 20 meters SSB, VE3EJ and VE7ZO worked one new multiplier. Here on 40 meters CW, they just worked nine new multipliers. So now which operating tactic was best? Help!

What we need is a performance parameter that takes into account the number of contacts, their point value, and the value of new multipliers. Ideally, it should resemble a rate meter, since contesters are familiar with that general concept.

In this article's analysis, I use "equivalent QSOs per hour." An "equivalent QSO," or e-QSO, expresses performance in terms of how many average QSOs would be required to achieve a particular improvement in score.

Let's go back and look at VE3EJ and VE7ZO's score at three recent times:

Time	*QSOs*	*QSO points*	*Multipliers*	*Score*
2200z	1393	6455	124	800,420
2210z	1405	6513	125	814,125
2220z	1416	6532	134	875,288

During the first ten minute period, the score increased 13,705 points. At 2200UTC, an average QSO was worth (800,420/1393) = 574.6 points to the then-current score. If, over the next ten minutes, the team just worked QSOs of average QSO point value and no multipliers, it would require (13,705 / 574.6) = 23.9 average contacts to reach that score shown at 2210 UTC. We can state that those 12 specific logged contacts (worth 58 points and one new multiplier) are exactly equivalent to 23.9 QSOs of average value. I'll call them "equivalent QSOs." Since these occurred over a ten minute period, multiply 23.9 by six to convert to an hourly equivalent-QSO rate of 143.1 for the 20 meters SSB run. Applying the same calculations to the next 10 minute period, we find the score increase of 61,043 (resulting from 11 contacts worth 19 QSO points and 9 new multipliers) equates to 105.6 e-QSOs. The hourly e-QSO rate on 40 meters CW just hit 633.3!

Looks like those new multipliers were really worth something. We better tell John and Jim to stick with their current tactics.

A few minutes later, 40 meters dries up and they go back to 20 meters, on CW this time. At 2230 UTC the 380.4 e-QSO/hour rate isn't as good as all those multipliers back on 40, but it's much better than the earlier rate on SSB. Being smart guys with a good feel for this stuff, they continue to hop around quickly during this slower part of the contest, changing tactics when the e-QSO rate drops off for more than a few minutes.

One cautionary note: the very first venture on a new band, with its high proportion of new multipliers, will drive e-QSO/hr numbers to very high levels. That often is the correct tactic (e.g., start populating the log with multipliers from 160m), but sometimes that's just a distraction. Abandoning a good afternoon run on 15 meters just to grab the first ordinary stations that show up with weak signals on a virgin 40 meter band could be counter-productive in the long run.

WRTCs. Events demonstrated the wisdom of the committee's judgment. Even with the additional power and gain the highest scores reached just over 2300 contacts, compared to 2700+ achieved in Finland during 2002.

On Friday morning, July 7, each team's captain randomly picked a sealed envelope out of a pile. The envelope's contents included the site identification. Table 1 summarizes the characteristics of each site for the teams analyzed here. Five of the 46 WRTC teams, and two of the top 11 teams, found themselves in towns in the interior of the state of Santa Catarina; the remaining teams were relatively close to the Atlantic coast.

Dean Straw, N6BV, has begun examining the influence of local terrain on antenna patterns for some of the WRTC locations. While writing this article, not enough information was available to draw conclusions about sites versus performance.

Contest Rules and Station Hardware

Operating rules and scoring for the teams generally followed those of the IARU contest. Important variations included:

- No self-identification: teams could not identify their operators, nationality, or use anything other than English language and common international abbreviations.
- A WRTC team, while constrained to one signal on the air at a time, could work on different bands immediately. The 10 minute rule for a normal IARU multi-single entry did not apply to WRTC competitors.
- Super check partial databases forbidden. The computers could only cite calls logged or copied during the contest, although operators could refer to printed lists of calls. A few teams brought a list of HQ multipliers expected to be participating in the contest.
- The operators could use two radios for listening, but only one radio and its current operator could make transmissions. This last point greatly influenced the interconnection of competitor-provided radios and computers. A common solution included:

Equivalent QSO per hour is superior to ordinary rate meters for tracking tactical performance trends during the contest. Think of a long contest as a series of short, 10-minute contests – 144 of them for a 24-hour contest like IARU or RDXC. Select an operating tactic that represents the very best thing you can do for your score in the next ten minutes. As you work through those next minutes, use the e-QSO/hr figure to decide if your current operating tactic is, in fact, superior that what you were doing ten minutes ago. If not, make a change.

Annex II — Uniques

Within a few hours of the end of the contest, the WRTC Log Checking Committee received over 1300 logs, arriving from around the world. The committee included this material, along with logs from WRTC competitors in Brazil, in its master database.

Initial trial discrepancy reports for the 46 WRTC teams revealed unusually high numbers of "unique" QSOs in four logs. A unique QSO is one with a station that appears in very few of the other >1300 logs; it is not literally unique (i.e., occurring just once) and the appropriate threshold for labeling a QSO as unique may vary from one contest to another. Table 3 includes the unique percentage for all eight WRTC teams analyzed here; the other teams' percentages are included in their UBN reports, posted on the WRTC 2006 Web site.

Three of the four teams whose logs contained a disproportionate number of uniques had their logs analyzed in this article. (SP7GIQ and SP2FAX were the fourth team affected.) For two, the team of DL6FBL and DL2CC and the team of 9A8A and 9A5K, the unique call signs came almost entirely from their respective home country. (The percent of non-home country unique calls fit into the very low levels typical of other WRTC logs.) The first unique German calls appeared in the German log at 1443 UTC, in the middle of a 15 meter CW run; the team had made 27 SSB contacts (none with German stations) before this time. For 9A8A and 9A5K, the first Croatian uniques appeared at 1509 UTC during a 15 meter SSB run.

The YT6A and YT6T log contained over 200 unique contacts with calls from many countries, nearly all of them in Europe. The first appeared just 54 minutes after the start of the contest, before any SSB contacts occurred. Only nine unique calls from YT appear in the log, and these occur very late in the contest after a 1024 UTC spot on the Balkan DX Yahoo forum identified the operators.

Referees had recorded operations at DL6FBL and DL2CC, and YT6A and at YT6T. In the time available, the judges, team referee G3XTT and I listened to parts of the YT6A and YT6T recording. We confirmed that contacts with the call signs had occurred; however, it appeared to us that a very small number of stations, probably more than one, fed the unique contacts to the team.

So how did this many stations come to work just one of these four teams, sometimes on several bands and modes, but none of the other 1300 and stations participating in the IARU contest?

No evidence exists than any of the affected teams communicated their identity to outsiders (a violation of the WRTC rules). Nor does any evidence exist that the affected teams colluded in an effort to "dope" their log with phantom calls and contacts not available to other contesters. Experienced contesters know adjudication uncovers unusual patterns such as uniques, so an effort to dope the log will come to the attention of the judges.

In the opinion of the judges, the phantom QSOs more likely represented an attempt to sabotage either specific teams or a randomly selected team. Such behavior by amateur operators outside of WRTC is reprehensible, violates the radio regulations, and deserves thorough investigation. Time available at WRTC did not allow completion of such an investigation.

A large quantity of contacts made available to one WRTC team, but not to any others, violates the spirit of WRTC. (WRTC attempts to provide an equal playing field for all teams.) The judges turned to the problem of how to deal appropriately with the situation within the context of WRTC.

The committee decided to set a relatively small threshold of log appearances for the purpose of categorizing a contact's callsign as unique, and to delete from all 46 WRTC logs, without penalty, all unique QSOs.

This approach resulted in the deletion of, at one extreme, just three contacts from a WRTC log containing over 1900 contacts to, at the other extreme, the deletion of 240 contacts from the YT6A and YT6T log of over 2300. Most WRTC logs lost about 15 contacts.

No doubt a few contacts so treated were valid contacts; others represented busted calls where insufficient evidence prevented labeling them as busted. The deletion of a very few valid contacts that fell into the same pot as the uniques did not alter the relative positions of any teams whose logs carried typical unique percentages.

Within the top three claimed WRTC scores, YT6A and YT6T moved from third to eleventh. Part of their change in position resulted from logging errors affecting multipliers, and a higher error rate in busted call signs and exchanges.

The material in this Annex largely comes from the report of the WRTC Judging Committee to the organizers. The WRTC 2006 Web site contains the full, original report.

Table 1

Rough description of locations for the teams analyzed here. www.WRTC2006.com/site/mapa/maps.html contains maps identifying the numbered sites.

Operator/Referee Observations:

Team	*Site*	*Locale*	*Foreground to Europe*	*Foreground to North America*
VE3EJ and VE7ZO	#5, north interior	rural, elevated	slopes down, rolling	rolling
N6MJ and N2NL	#32, south Florianopolis	1 km west of sea	sloped down	flat with a few hills.
K1DG and N2NT	#23, central coast	NE side of hill	steep down, sea 5km away	land
UT4UZ and UT5UGR	#33, central coast	suburban near sea	flat to hills >10km away	flat to low hills 10km away
IK2QEI and IK2JUB	#4, Florianopolis	shrimp farm near sea	very flat land	very flat land
DL6FBL and DL2CC	#3, north coast	100m to shore	along coast, not over water	flat land
9A8A and 9A5K	#47, south coast	lighthouse on peninsula	ocean	small hill, lagoon, then hilly.
YT6A and YT6T	#17, central interior	elevated; observatory	slopes down	slopes down

• Radio A: a transceiver with enough power to drive the Acom amplifier.

• Radio B: a second transceiver, used only as a receiver. Band-pass filters protected this receiver from the out-of-band transmitted signals of Radio A and its amplifier.

• Two laptops, networked with an Ethernet or wireless LAN, for logging and spotting stations.

Some teams also had coax stub filters on their amplifier outputs and others wished they had! N6MJ and N2NL accidentally toasted the input 20 meter band-pass filter inside their Radio B transceiver (a Yaesu FT-1000) and had to bypass it via the RX input jack. UT4UZ and UT5UG also fried the Radio B front end in the middle of the contest.

While the above description typified most setups, some teams had interesting variations. At least one team had no Radio B, the second operator using instead a second independent receiver built into Radio A (e.g., a Yaesu FT-9000).

At the other end of the scale, YT6A and YT6T used technology designed by Sinisa Hristov, YT1NT. Radio B was a modified Drake R4C; external hardware determined the Drake's receive frequency and sent serial-port commands to force Radio A's second VFO to track the Drake. At Radio A, a special footswitch allowed the transmitting operator to immediately switch to the second VFO's frequency to work a contact spotted by the second op, without having to remove a hand from the keyboard. High-power filters on the amplifier output further reduced harmonic and IMD products that could disturb the second receiver. The computer-controlled filter system included an antenna multicoupler that permitted Radio B to receive with the log periodic while Radio A was transmitting on that same antenna (700 W on a different band). The Radio B position also included a bank of crystal filters on 40 meters to help the operator listen while Radio A transmitted on 40 meters.

Advanced technological solutions are fun to try. In examining the hardware of the top finishers, one sees that technology may assist but does not determine the winners.

Team	*Run*	*Interleave*	*S&P*
VE3EJ and VE7ZO	91.9%	0.4%	7.7%
N6MJ and N2NL	89.7%	2.1%	8.2%
K1DG and N2NL	81.2%	3.7%	**15.1%**
UT4UZ and UT5UGR	88.9%	1.6%	9.55
IK2QEI and IK2JUB	84.4%	1.5%	14.1%
DL6FBL and DL2CC	89.3%	2.2%	8.5%
9A8A and 9A5K	90.8%	0.6%	8.6%
YT6A and YT6T	86.2%	**8.1%**	5.7%

Figure 1—Operating technique used to make error-free QSOs.

Overall Results

A graph on **www.ncjweb.com** plots the minute-by-minute scores of eight teams relative to the second-place finishers, N6MJ and N2NL. Unlike past WRTCs, the leading team during the contest changed rarely. N6MJ and N2NL retained first place for almost 16 hours. Then VE3EJ and VE7ZO, having begun a long march back from fifth place, reached first at 0428 UTC and kept building their lead until sunrise at 1005 UTC, with more than enough margin to hang on for a commanding finish.

N6MJ and N2NL finished second, with 95 percent of the Canadian score. No one else challenged these consistently excellent two teams. The third place team, K1DG and N2NT, finished much further back at 86 percent of the winning score. They held third for the last 12 hours of the contest.

At least six other teams held second or third place at some point in the contest. With less than one hour to go in the contest, less than 2 percent separated the scores of the six remaining teams analyzed in this article. Their order of finish would not be determined until the last 13 minutes of the contest! The Ukrainian team of UT4UZ and UT5UGR crept up to grab fourth, while the remainder finished tightly bunched at 80 percent of the first place score. ***Lesson***: *Never give up! Only a few minutes of operating may change your final position in the contest.*

Let's bring our minds back to the morning of July 7, 2006, the Friday before the start of the contest in Brazil, and see what we can learn from these excellent teams. The random drawing of locations has just finished, and teams chat urgently with their assigned referee and host families…

Friday

By lunchtime, many teams set off for their assigned locations around the state of Santa Catarina. Some will require more than three hours to reach their new weekend homes. Unfortunately, some teams reduce their contest performance before the contest begins.

Several referees will report that, once on site, their team immediately focused on assembling their equipment in the operating room. These teams fail to prioritize their work or consider the relative consequences of potential problems. At least one team gets its equipment working properly only after sunset. They then discover some problem with an antenna developed during the weeks following initial installation and test. Repairs in darkness aren't feasible, and a handful of teams begin the contest handicapped by unresolved problems. Others didn't verify the rotator direction indicator, or check for interactions between the trapped inverted V antenna and the 40 meter beam. ***Lesson***: *At an unfamiliar location with lim-*

ited remaining daylight hours, check and repair the antennas first! One can install and, if necessary, fix radios and computers after sunset.

UT4UZ and UT5UGR have another problem: the airlines will not deliver one bag of materials for their station until Monday after the contest! The Radio B operator will not be able to listen on Radio A's antenna while operator A is receiving.

Fortunately, the top teams examined in this article resolve all issues promptly and get some uneasy sleep before the 9 AM local start time on Saturday morning.

The Start: 1200-1500 UTC

Every contester who begins a serious contest effort at an unfamiliar location suffers through some nervous initial moments. Will propagation plans correspond with reality? Will the equipment work reliably? And, most of all, will this location and these antennas project a loud signal around the globe?

Imagine the terror felt by IK2QEI and IK2JUB when three minutes elapse before anyone answers their CQ! Stefan says, "When you start a contest like WRTC, you always need a pileup from the first minute, not after 3 'day-long' minutes! After that we did 130 QSOs in an hour — exciting and thrilling."

DL6FBL and DL2CC grab first place five minutes into the contest, but can hang on only for twenty minutes before K1DG and N2NT take over. Doug and Andy's reign at the top, equally short-lived, ends at 1248 UTC. Now in first, N6MJ and N2NL, together with the Canadians, build a lead over the others, as shown in the 1500 UTC standings of Table 2.

The table shows DL6FBL and DL2CC with fewer raw QSOs than K1DG and N2NT and one less multiplier, but a higher score because of their richer percentage of five point DX QSOs. "Equivalent QSOs", which take into consideration the point value of a contact and the value of new multipliers (see Annex I), quantify the ground that each team must cover to catch up to the one above it in the table. The middle of the pack, tightly bunched, trails N6MJ and N2NL by over 100 equivalent QSOs, a gap destined to grow.

By the way, the charts, tables, and statistics cited throughout this article take into account contacts removed by the WRTC Log Checking and Judging Committee as duplicates, broken calls, bro-

Table 2

Standings at 1500 UTC, and QSOs and multipliers worked from the start of the contest. Band totals on the right show raw contacts / multipliers. In each column bold highlights the largest entry for these teams. Note: UT4UZ and UT5UGR also logged one contact with the Brazil HQ station on 40 meters at 1407 UTC. See Annex I for an explanation of the equivalent QSO (e-qso) measurement used in the center column.

At 1500 UTC Team	*Points*	*QSOs*	*Mults*	*e-QSOs behind next team*	*20m*	*15m*	*10m*
N6MJ and N2NL	**97,536**	358	**64**	—	15/15	303/29	40/20
VE3EJ and VE7ZO	90,944	**400**	49	-29.0	—	**375**/33	25/16
DL6FBL and DL2CC	70,928	265	62	-77.8	21/16	213/23	31/23
K1DG and N2NT	68,733	290	63	-6.0	5/5	216/33	69/25
UT4UZ and UT5UGR	68,332	360	44	-2.1	25/8	309/23	25/12
9A8A and 9A5K	67,222	382	38	-6.3	**61**/11	321/27	—
IK2QEI and IK2JUB	60,120	312	45	-36.9	—	296/35	16/10
YT6A and YT6T	32,594	199	43	-168.1	37/**17**	85/9	**77**/17

Table 3

Performance statistics. The Log Checking Committee penalizes busted calls and not-in-log contacts by a point value equal to that claimed for the mislogged QSO. "Unrecognized multipliers" are those the operators overlook because the station's zone or HQ code was busted. The affected team will not work these multipliers again later in the contest, nor those marked here as lost because of broken call, unique call or not-in-log. "Time lost" represents hours and minutes used at the end of the contest to replace mislogged contacts and disallowed uniques.

Team	Raw Q's with dupes	Dupes QSO	Dupes %	Claimed QSOs	Unique calls QSOs	Unique calls %	Q's after dupes & uniques	Busted calls QSOs	Busted calls %	Exchange errors QSOs	Exchange errors %	Not in log QSOs	Not in log %	bust, xchng NIL	Final QSOs
VE3EJ+VE7ZO	2491	53	2.1%	2438	13	0.5%	2425	32	1.3%	15	0.6%	7	0.3%	2.2%	2371
N6MJ+N2NL	2303	44	1.9%	2259	10	0.4%	2249	33	1.5%	7	0.3%	6	0.3%	2.0%	2202
K1DG+N2NT	2255	52	2.3%	2203	12	0.5%	2191	21	1.0%	33	1.5%	11	0.5%	3.0%	2126
UT4UZ+UT5UGR	2438	51	2.1%	2387	14	0.6%	2373	28	1.2%	15	0.6%	25	1.1%	2.9%	2305
IK2QEI+IK2JUB	2135	44	2.1%	2091	17	0.8%	2074	23	1.1%	7	0.3%	16	0.8%	2.2%	2028
DL6FBL+DL2CC	2011	26	1.3%	1985	76	3.8%	1909	19	1.0%	6	0.3%	9	0.5%	1.8%	1875
9A8A+9A5K	2165	10	0.5%	2155	67	3.1%	2088	39	1.9%	23	1.1%	7	0.3%	3.3%	2019
YT6A+YT6T	2411	41	1.7%	2370	240	10.1%	2130	40	1.9%	47	2.2%	13	0.6%	4.7%	2030

Team	Mults claimed	Mults final	Mults Lost or unrecognized	Claimed place	Claimed score	Points lost	Score reduce	Time lost	Final score	Final place	Pass OK	Points / QSO
VE3EJ+VE7ZO	231	230	-1	#1	2,572,878	-128,438	-5.0%	0:43	2,444,440	#1	2	4.48
N6MJ+N2NL	244	241	-3	#2	2,460,984	-139,913	-5.7%	0:40	2,321,071	#2	7	4.37
K1DG+N2NT	237	230	-8 [a]	#4	2,277,333	-174,673	-7.7%	0:54	2,102,660	#3	5 [a]	4.30
UT4UZ+UT5UGR	209	206	-4	#5	2,203,344	-158,588	-7.2%	0:46	2,044,756	#4	—	4.31
IK2QEI+IK2JUB	236	233	-5	#8	2,117,934	-112,037	-5.3%	0:46	2,005,897	#5	5	4.25
DL6FBL+DL2CC	240	240	None!	#7	2,143,920	-165,600	-7.7%	1:01	1,978,320	#6	8	4.40
9A8A+9A5K	226	223	-4	#6	2,187,906	-222,607	-10.2%	1:10	1,965,299	#7	—	4.49
YT6A+YT6T	230	224	-10	#3	2,410,286	-457,230	-19.0%	4:32	1,953,056	#8	3	4.29

[a] K1DG+N2NT passed two HQ stations for an attempted five extra multipliers, but busted the exchange on these plus the original contacts that were the source of the pass. These errors significantly reduced the total of successful passes.

ken exchanges, not-in-logs or uniques (see Annex II), as well as associated penalties. Thus, when VE3EJ and VE7ZO log YO4SS at 1314 UTC on 21032 kHz, the graphs show the team score going backwards because of the five point penalty for a busted call sign.

I have made one adjustment to the statistics released by the Log Checking Committee: I reversed the treatment of /M and /MM call signs which were penalized at WRTC as broken calls. At that time, the Log Checking Committee knew this treatment was wrong and due to a software error, but (after review) determined that it did not affect any results. In the worst case for the logs examined here, the misclassification of /M and /MM calls affected three QSOs.

Logging Errors

Table 3 summarizes performance statistics for these teams with all adjustments. The top six teams demonstrate high accuracy compared to the contesting population as a whole. Busted call, miscopied exchanges, and not-in-log errors do not alter the relative finishing positions of the top three teams.

Unlike the past two WRTCs, passing of stations and multipliers between modes and bands plays a tiny role in strategy. Here I define a pass as an error-free contact with the same station, on a different band or mode, within five minutes of the previous contact with that station. Table 3 shows the two USA teams, N6MJ and N2NL, and K1DG and N2NT, pass more stations than other teams: 8 and 7. Multipliers count just once per band (not band-mode) this time and propagation limits the number of bands open at any one time; therefore, not many passes are needed or feasible.

At 1739 UTC, K1DG and N2NT pass P40HQ from 15 meters to 10 meters and then 20 meters for extra multipliers. Each time they log the exchange as "ARRC" rather than the correct "AARC." Not only do they lose credit for the contacts, they lose the multipliers. Ouch! ***Lesson:*** *When passing a multiplier, check log entries even more carefully than normal.*

Tactics on 10 Meters

9A8A and 9A5K work no one on 10 meters during these hours, for some reason not apparent in the log.

Some referees report tactical errors on 10 meters by other teams. Those teams' Radio B operators would listen to another WRTC competitor calling CQ on 10 meters and react as follows:

- If the competitor's CQs go unanswered, the Radio B operator assumes 10 meters is closed and moves to a different band.
- If stations that the Radio B operator could not copy answer the competitor's CQs, the Radio B operator concludes that his site was inferior to the competitor's site.
- The team's Radio A operator would switch to 10 meters, make a few short CQs, and upon hearing no answers, would switch to another band.

The first two tactics fail to recognize the potentially short-lived and spotty nature of 10 meters openings at this point of the sunspot cycle. A competitor may hear no replies to his CQ during the 15–30 seconds when you are listening — but that does not mean your own CQ will go unanswered. Marginal propagation means short-lived variations in the ionosphere will at times enhance signals to a certain area, and a few minutes later defocus signals or shift the focus to another area. Similarly, you may not hear stations answering a competitor's CQs, but if you were to transmit your own CQ, stations from a slightly different area would answer you. ***Lesson:*** *You must call CQ to determine if a marginal band is open for you.*

Under marginal or rapidly changing conditions, the band may open or close temporarily, and re-open multiple times. A couple of minutes of unanswered CQs indicate the band isn't suitable for running at the moment — but the situation may change dramatically in ten or fifteen minutes. Some teams failed to check 10 meters regularly, and missed many hours of available propagation. ***Lesson:*** *If a marginal band appears closed now, check again in 10–15 minutes.*

The third tactic fails to recognize the dynamic nature of a marginal opening. Some WRTC teams send extremely short and fast CQ messages; e.g., "Test P_5_" at 30 wpm or more. This transmission takes two seconds, and the operator then listens for about three seconds for an answer. Five or six attempts occupied only 30 seconds, during which the station was transmitting for just 10 seconds. If the band opens fleetingly to a few areas within a distant continent at any given instant, what are the chances that someone out there in one of those currently open spots will happen to tune by the correct frequency at the correct time to catch that CQ? ***Lesson****: Call CQ with transmissions long enough to be noticed by almost every station tuning up the band, typically longer than the time spent listening for a reply.*

Short, fast transmissions serve little purpose when no pileup exists. Slower CW speeds or longer transmissions increase the ratio of transmitting time versus receiving time, allowing more opportunities for a S&P operator to find you. Since no pileup is waiting, little harm occurs in taking a few extra seconds to send at a more relaxed and inviting pace. ***Lesson****: When replies dry up, try slowing down or sending longer CQ messages.*

When trying a new band, or new part of the band, don't rush to abandon the frequency. The pace of replies in any run varies widely from minute to minute. WRTC logs show the usual distribution of delays between the end of one contact and the start of the next. A 120 QSO/hour rate averages two contacts per minute, but over the course of an hour some minutes will have no contacts and others will have four or five. If an operator leaves a 120 rate on one band, he needs to call unanswered CQs for more than a minute on his new band. Only then can he fairly conclude that a 120 rate isn't achievable on the new band; i.e., he did not transmit those CQs during one of those short-lived dips in reply rates. With the adrenalin rush of fast rates, even 90 seconds of unanswered CQs often feels like forever! ***Lesson****: Allow unanswered CQs for at least 2–3 times the interval between contacts at the hoped-for rate, before abandoning a frequency as too unresponsive.*

Be aware that in slow periods this guideline may cause you to call CQ for five minutes without response; only then can you firmly conclude that a band won't support a 20- or 30-contact-per-hour rate.

Not only does this guideline assist in evaluating the productivity of a new band or frequency, it also allows time to for others to spot you on the DX spotting networks.

Meanwhile, Back in the Contest…

YT6A and YT6T start quite slowly. Uniques, discussed in Annex II, account for the loss of 28 contacts, beginning around 1410 UTC. But uniques and errors do not entirely account for their lag. The unusual technology at YT6A and YT6T provides an interesting twist to their operating techniques:

Figure 1 shows the percent of valid QSOs made by running, by interleaving spotted QSOs from another frequency in the middle of a run, and from traditional S&P. This analysis defines running contacts as those made on the same frequency, with interruptions of no more than two QSOs. Interleaved QSOs are those logged in mid-run. All other contacts (made on a variety of frequencies) go into the S&P category. The table lists teams according to their finish.

Because their station hardware simplifies the task of interleaving spotted QSOs, YT6A and YT6T salt their runs with far more contacts from other bands than their competitors do.

K1DG and N2NT also show somewhat greater interleaving, but spend a lot of time in traditional S&P. In contrast, the top-place team almost never interleaves — and the second place team falls somewhere between.

Based on the current unhappy position of YT6A and YT6T, one might conclude that interleaving represents a losing tactic. That would be incorrect. During the first two hours of the contest, this team makes 46 percent of its contacts by S&P. Only recently has the team started running and interleaving contacts more seriously, and it pays off handsomely overnight.

Just before 1500 UTC, a man in the town of Armação heads out to his car with a bag of tools. He turns on the ignition of his ancient Fiat and begins to tune up the engine. Next door, N6MJ and N2NL stare at their receivers: a S9+20 dB noise covers the European signals on 10 meters! Their host, Mr Hart, an electrician who is not an Amateur Radio operator, runs out of the house to speak with his neighbor. N6MJ and N2NL retreat to run louder signals on 15 meters, and a few minutes later the noise vanishes. Mr Hart's neighbor will tune up his elderly Fiat tomorrow after the contest. And Mr Hart will return to furtively checking the Internet hourly scoreboard of WRTC team standings, secretly rooting for his guests.

1500-2000 UTC

You will recall VE3EJ and VE7ZO running about 29 equivalent-contacts behind N6MJ and N2NL back at lunchtime (1500 UTC). By 1540 UTC, the Canadians chip the gap down to a single QSO, and thereafter follow a game of musical chairs between bands and leaders:

1557 UTC: N6MJ and N2NL (running on 15 meters CW) continue to widen their lead. Just at this moment, VE3EJ and VE7ZO (jogging on 15 meters SSB) work TMØHQ for the Ref multiplier. While typing the exchance REF into *CTWIN*, the program crashes, locking up the computer. The machine requires a complete cold-start of *Windows* and *CTWIN*: seven minutes of eternity until logging the next QSO. Other teams, including K1DG and N2NT, discover this *CTWIN* bug on multiple occasions, triggering both cold starts and hot language. The bug gives 9A8A and 9A5K (sprinting on 10 meters CW) a few extra minutes to overtake the Canadians for second place.

1617 UTC: The Croatian team (still on 10 meters CW) returns second place back to VE3EJ and VE7ZO (now on 15 meters CW). N6MJ and N2NL (now on 10 meters CW) continue to widen their lead.

1633 UTC: K1DG and N2NT (having left 10 meters CW for 15 meters SSB an hour ago, and then moved to 15 meters CW at the top of the hour) grab second place from the Canadians (still on 15 meters CW). The Croatians (now running 10 meters CW) fall to third. N6MJ and N2NL (now on 10 meters CW after a five minute attempt to run 10 meters SSB) continue to widen their lead.

1650 UTC: K1DG and N2NT (still on 15 meters CW) reach their closest point to first: 29 QSOs behind N6MJ and N2NL (just giving up on 10 meters SSB and heading down to 15 meters CW). The Canadians (just giving up 15 meters CW for an attack on 15 meters SSB) have slipped to fourth behind the Croatians (still slogging away on 10 meters CW), but recover third in the next few minutes.

1703 UTC: DL6FBL and DL2CC (hanging out on 15 meters SSB for the last two hours) overtake the Croatians (still on 10 meters CW) for fourth. N6MJ and N2NL (now running 15 meters CW) continue to widen their lead.

1706 UTC: K1ZZ, OH2MM, G3SXW, and PY7CC visit K1DG and N2NT. Something about where they stand in the room alters the distribution of RF, causing an ac power strip to catch fire! Quickly extinguishing the fire, the team discovers that the relay enabling radios A and B to listen simultaneously to the same antenna no longer functions. Radio A can transmit but can not hear any signals. Thirteen minutes later the team bypasses the relay and gets back on the air; but Radio B now must listen on a different antenna than that used by Radio A. ***Lesson****: Unforeseen gremlins can undo complex equipment configurations at temporary stations. Make fallback and recovery plans in advance.*

1716 UTC: VE3EJ and VE7ZO who (just moved to 10 meters SSB for a short-lived attempted run) regain second place from the temporarily off-air K1DG and N2NT. One minute later the Germans also pass K1DG and N2NT. N6MJ and N2NL (still running 15 meters CW) continue to widen their lead.

1725 UTC: Three-way tie for third! The Canadians hold second (now running on 15 meters CW). N6MJ and N2NL (still running 15 meters CW) continue to widen their lead.

1745 UTC: The Germans (finally leaving 15 meters CW for a 10 meters CW run) take second from the Canadians (back running 15 meters CW). The Croatians (running 15 meters CW a bit higher in the band than the Canadians) squeak by K1DG and N2NT (who have just finished a 15 meters SSB run and

Table 4

Team performance on 10 meters, in order of departure from that band. Columns on right summarize contacts made during the range of times for teams' final 10 meter QSO.

			QSOs/mults worked 1805-1922 UTC			
Team	*Total 10m QSO/mult*	*First-last QSO on 10m*	*20m*	*15m*	*10m*	*Total*
UT4UZ and UT5UGR	182 /25	1425 – 1805UTC	—	**235/10**	—	**235**/10
K1DG and N2NT	178/33	**1242** – 1812UTC	8/8	150/4	14/0	172/12
IK2QEI and IK2JUB	177/32	1342 – 1821UTC	9/9	123/5	35/2	167/16
VE3EJ and VE7ZO	89/28	1332 – 1853UTC	—	116/2	53/**4**	169/6
YT6A and YT6T	**246**/31	1350 – 1858UTC	5/4	54/9	**75/4**	134/17
N6MJ and N2NL	135/30	1318 – 1915UTC	7/7	153/3	4/1	164/11
DL6FBL and DL2CC	139/36	1339 – 1921UTC	**26/18**	88/3	7/2	121/**23**
9A8A and 9A5K	169/26	1514 – **1922UTC**	—	117/7	8/3	125/10

Table 5

Standings at 2000 UTC, and QSOs and multipliers worked between 1500 and 2000 UTC. In each column, bold highlights the largest entry.

At 2000UTC					**QSO/mult worked during 1500–2000UTC**				
Team	*Points*	*QSOs*	*Mults*	*e-QSOs behind next team*	*20m*	*15m*	*10m*	*total*	*e-QSO/hr*
N6MJ and N2NL	**590,250**	1058	125	—	108/**28**	497/23	95/10	700/61	176.6
K1DG and N2NT	492,804	954	117	-188.6	47/25	508/21	110/8	665/54	164.2
DL6FBL and DL2CC	485,902	859	**127**	-12.2	**119**/23	367/29	108/13	594/**65**	146.7
VE3EJ and VE7ZO	451,794	1059	93	-79.9	10/10	**585**/22	64/12	659/44	169.2
UT4UZ and UT5UGR	429,781	**1081**	89	-55.4	36/8	528/24	158/13	**722**/45	**181.8**
9A8A and 9A5K	425,568	1002	93	-9.9	1/1	479/26	**177/29**	657/56	168.7
IK2QEI and IK2JUB	406,014	937	98	-45.1	10/10	454/21	161/22	625/53	159.7
YT6A and YT6T	343,134	803	99	-147.2	21/12	414/**30**	169/14	604/56	145.3

are running 10 meters CW). N6MJ and N2NL (now also running 10 meters CW) continue to widen their lead.

Got that? Phew!

Musical chairs continue at a slower pace thereafter, with VE3EJ and VE7ZO eventually falling briefly into fifth place at 1948 UTC. The musical chairs episode carries an underlying, important theme. No, the theme is not "N6MJ and N2NL continue to widen their lead." WRTC runs are short-lived, and when a top-scoring team sees the rate begin to fade, they quickly change mode or band. Not only does this constant movement help the team pump up the rate meter, but also it helps the team catch any brief openings and associated multipliers on 10 meters.

In general, only SO2R, multi-op 2-transmitter or multi-transmitter teams can afford to park on a running frequency for hours on end (and even top competitors in these categories interleave QSOs from S&P). ***Lesson:*** *When the rate begins to fade, take immediate action.*

Afterward, YT6A and YT6T will report they wasted time during this period trying to interleave 10 meter multipliers while running on 15 meters. Like every other team, transmissions on a second band must bypass the manual-tune Acom amp. So for example, here this means transmissions on 10 meters used about 60 W, too low to crack these early pileups rapidly.

In late afternoon, 10 meters starts closing. The teams analyzed here give up on the band at very different times, as shown in Table 4. Examining the 10 meter subtotals for 1805-1922 UTC reveals three teams made additional runs on 10 meters after others had given the band up for dead. DL6FBL and DL2CC, despite the second-lowest contact total on this band for the day (left column), logged the most multipliers.

UT4UZ and UT5UGR, with the second-highest contact total, log the fewest multipliers on the band. Although this team will finish the contest with an average amount of contacts interleaved by the second operator into the middle of a run, and works a lot of S&P, something about their operating technique gives them a disproportionately low multiplier total. This might result from their tendency to run one band for long periods, perhaps missing brief appearances by multipliers on other bands. Here we see this team first to quit 10 meters at 1805 UTC, only to spend the next 105 minutes solely on 15 meters.

At 2000 UTC, sunset darkens the eastern horizon. The Ukrainians have booked more contact but fewer multipliers than the other seven teams; see Table 5. K1DG and N2NT barely hold second place over DL6FBL and DL2CC with their excellent multiplier total. VE3EJ and VE7ZO milked 15 meters heavily and are in the middle of a string of 13 consecutive HQ multiplier QSOs on 20 meters that, in the next three minutes, will vault them temporarily into second place. But N6MJ and N2NL, with the second-highest multiplier and QSO totals of the afternoon, strike the right balance and stand far above everyone else. The arrival of the edge of night, however, marks the last time that I will write, "N6MJ and N2NL continue to widen their lead."

To be continued...

NCJ