Genuine Signal Reports with Copyability and Strength

Signal reporting is pretty much of a ritual in Amateur Radio. Even a short, friendly QSO usually includes a signal report early in the exchange. A large number of contests – but not all of them by any means – include so-call "signal reports" as part of a required exchange. Radio amateurs are experimenters. We might be trying out a new mode, a new antenna, a new transceiver, and we often play around with different power levels. Genuine signal reports are much easier with the new CS or Copyability and Strength system than with the familiar RST. RST is purely descriptive. RST includes no quantitative information except for ranked categories.

Signal Readability in RST

The **R** part of RST consists of five numbers denoting different degrees of readability. All of the distinctions are useful. There are significant differences among those five levels. On the low end, the difference between "unreadable" and "barely readable, occasional words distinguishable" is helpful. At the top end, the distinction in RST **R** levels 4 and 5 conveys a minor difference between "readable with practically no difficulty" and "perfectly readable." Nevertheless, most of us get uncomfortable if we receive an **R** report of 4 rather than 5. We shouldn't. That is, we shouldn't worry if we know that the other operator really understands RST and is actually telling us that our signals are "readable with practically no difficulty." If so, we don't need to adjust the beam. We don't need to increase the output power. We don't need to speak closer to the microphone or enunciate more clearly or use wider word spacing in Morse. The other operator is experiencing "practically no difficulty" in understanding us. We tend to hand out RST R-5 reports far more often than we should. "Perfectly readable" signals are common enough, but signals which are "readable with practically no difficulty" occur much more frequently. If we receive an R report of 3, however, we need to take note. Our transmissions are "readable with considerable difficulty." There is a huge gulf between level 3, "readable with considerable difficulty" and level 4, "readable with practically no difficulty."

The five levels of readability in RST are not enough to give us an accurate picture of the readability of our signals. At least one more level between 3 and 4 would be helpful. Suppose we were to change R part of RST to read:

1 – Unreadable
2 – Barely readable, occasional words distinguishable
3 – Readable with considerable difficulty
4 – Readable with some difficulty

5 – Readable with practically no difficulty
6 – Perfectly readable

In that six-level form, the Readability part of RST would do the job better.

Signal Strength in Official RST

1 – Faint signals, barely perceptible
2 – Very weak signals
3 – Weak signals
4 – Fair signals
5 – Fairly good signals
6 – Good signals
7 – Moderately strong signals
8 – Strong signals
9 – Extremely strong signals

The nine levels of the RST Signal Strength scale is a pretty good list. Some people may quibble about the language of 4, 5 and 6, but the progression is clear and it does give lots of scope for useful **S** reports. RST has three levels in the "strong signal" category: moderately strong, strong and extremely strong. Let's think about that "extremely strong signals" level, 9 on the RST signal strength scale. In order to grasp the meaning of "extremely" take a look at the ITU Radio Bands classification system:

International Telecommunications Union (ITU) Radio Bands

3 Hz to 30 Hz = **Extremely** Low Frequency
30 Hz to 300 Hz = Super Low Frequency
300 Hz to 3 kHz = Ultra Low Frequency
3 kHz to 30 kHz = Very Low Frequency
30 kHz to 300 kHz = Low Frequency
300 kHz to 3 MHz = Middle Frequency
3 MHz to 30 MHz = High Frequency

30 MHz to 300 MHz = **V**ery **H**igh **F**requency
300 MHz to 3 GHz = **U**ltra **H**igh **F**requency
3 GHz to 30 GHz = **S**uper **H**igh **F**requency
30 GHz to 300 GHz = **Extremely** **H**igh **F**requency

Middle Frequency (MF) is in the middle of a set of bands graded on a geometric scale by orders of magnitude. Low Frequency (LF) is just below the middle, and High Frequency (HF) is just above the middle. The bands above and below those three categories are designated by four different levels of superlatives: Very, Ultra, Super and Extremely. Those descriptors are the same going down and going up. Extremely Low Frequency and Extremely High Frequency are just that: extreme. They are outliers. They are beyond ordinary experience. Likewise, "extremely strong signals" are outliers. They are beyond our ordinary experience.

Many operators equate 9 on the RST **S** scale with the approximate equivalent of S-9 on the S-meter. Look at S-meter(s) on your transceiver(s). Where is S-9? Is it as high as half-way up the S-meter scale, which is also geometric? Maybe it's below half-scale. Different S-meters are set differently, but a generally-agreed standard promulgated by the International Amateur Radio Union Region 1 [1] is to calibrate an S-meter so that a 50 µV signal reads S-9. That's certainly not "extremely strong." The official language of RST says that a strength report of 9 for RST is truly extreme. Based on the standard wording of RST, an S-9 report in RST should generally be reserved for that next-block kilowatt station whose beam is pointed toward our antenna. If our S-meter reads only S-9, our RST signal strength report should be 5, or maybe 6 on a good day, never more than that, according to official RST.

The actual language of the signal strength portion of RST is blissfully ignored by many operators, even when they are trying to give "honest" reports. For DXing and contesting? That's a whole different can of worms. Stereotyped signal reports serve no useful communications purpose whatsoever.

Signal Strength Scale in Unofficial RST

The official RST signal strength scale is complicated and tough to remember. When RST was invented, there was no such thing as an S-meter in amateur stations. When S-meters arrived, they were game-changers:

[1] The IARU Region 1 covers countries in Africa, Europe, the Middle East and Northern Asia.

Genuine Signal Reports with Copyability and Strength

Collins KWM-2

The Collins KWM-2 analog S-meter is simple and elegant. S-9 is exactly mid-scale, and the maximum signal shown is a whopping 60 decibels over S-9. Most modern transceivers are equipped with analog or digital S meters. Some go as high as 60 dB over S-9. Others top out a bit lower than 60 dB over S-9. Here's what those values in decibels over S-9 actually mean:

10 dB over S-9 is 10 times more powerful than an already-respectable S-9 signal.

20 dB over S-9 is 100 times more powerful.

30 dB over S-9 is 1000 times more powerful.

40 dB over S-9 is 10 000 times more powerful.

50 dB over S-9 is 100 000 times more powerful.

60 dB over S-9 is 1 000 000 times more powerful.

S-meters are most helpful, since with an automatic AGC (audio gain control) or ALC (audio level control) commonly used on Amateur Radio rigs, very loud signals and moderately-loud signals sound about the same. Most S-meters are actually governed by the AGC or ALC control voltages. Since the lower part of the S-meter measures S-units 1 through 9, many operators began to ignore the official verbiage of the RST strength scale and substituted those S-units, like this:

Genuine Signal Reports with Copyability and Strength

Genuine Signal Reports with Copyability and Strength

Unofficial RST Strength Scale

1 – S-meter S-1
2 – S-meter S-2
3 – S-meter S-3
4 – S-meter S-4
5 – S-meter S-5
6 – S-meter S-6
7 – S-meter S-7
8 – S-meter S-8
9 – S-meter S-9
9 plus – more than S-meter S-9

Although never sanctioned by any Amateur Radio organization, this unofficial strength scale actually rules the bands now when operators are actually trying to send real signal reports. It's fine as far as it goes, but since it doesn't actually take into account the number of decibels over S-9 which real S-meters measure, the unofficial scale isn't accurate.

Tone in RST

1 – Sixty-cycle ac or less, very rough and broad
2 – Very rough ac, very harsh and broad
3 – Rough ac tone, rectified but not filtered
4 – Rough note, some trace of filtering
5 – Filtered rectified ac but strongly ripple-modulated
6 – Filtered tone, definite trace of ripple modulation
7 – Near pure tone, trace of ripple modulation
8 – Near perfect tone, slight trace of modulation
9 – Perfect tone, no trace of ripple or modulation of any kind

The tone part of RST is a whole different story. Look at the nine-level description. Talk about a solution looking for a problem! Tone in RST is all about power supply problems. Back in the day of the transition from spark to CW, amateurs often had to build their own power supplies from scratch. AC products in transmitted signals were a significant problem then. When was the last time you heard a signal with a "rough note, some trace of filtering" or some such

description? A sign of how little attention is actually paid to the tone part of RST is the fact that T-1 is still defined as **<Sixty-cycle ac or less, very rough and broad>**. The terminology hasn't even been updated to read 60 hertz! It doesn't refer specifically to signals originating from the many places where commercial power is transmitted at 50 hertz.

Signals with AC products are not completely unknown today, but they certainly are not common enough to merit a nine-level scale in every CW or other digital signal report. That fact was implicitly recognized when by the time that phone modes became common in Amateur Radio, the T part of RST was dropped for those modes. Other quality problems for phone modes, overmodulation for amplitude-modulated signals and overdeviation for frequency-modulated signals, were not addressed by the RS(T) system. Most of our three-character RST reports end properly with a 9-level tone report.

Optional Suffixes in RST

The suffixes which are listed for RST do address the problem of quality of signals. Chirpy signals and key clicks are still heard from some CW stations. The C and K suffixes telegraph those problems for CW, but the RST suffixes don't treat quality problems in digital and phone modes. The optional X suffix is a fine compliment. Its absence implies the same thing: There are no quality problems to report.

Genuine Signal Reporting

If we want to receive accurate reports for our radio signals, we need answers to three questions:

1) How much of our transmission can the other operator copy?
2) How strong is our transmission?
3) Does our transmission have any quality problems?

CS or Copyability and Strength with optional suffixes answers those three questions.

Genuine Signal Reports with Copyability and Strength

Copyability and Strength or CS

C or Copyability Scale

N = no recoverable signal*
0 = discernible but not copyable*
1 = 10 % copy
2 = 20 % copy
3 = 30 % copy
4 = 40 % copy
5 = 50 % copy
6 = 60 % copy
7 = 70 % copy
8 = 80 % copy
9 = 90 % copy
G = Good 100 % copy, but short of perfect
P = Perfect armchair 100 % copy or full-quieting on FM

S or Signal Strength Scale

0 = no S-meter reading
1 = S-1
2 = S-2
3 = S-3
4 = S-4
5 = S-5
6 = S-6
7 = S-7
8 = S-8
9 = S-9
A = 10 dB over S-9
B = 20 dB over S-9
C = 30 dB over S-9
D = 40 dB over S-9
E = 50 dB over S-9
F = 60 dB or more over S-9

Optional Quality Suffixes

C = Chirp or tail on make and/or break
K = key clicKs or other Keying transients
O = Overmodulation or Overdeviation in phone or digital modes
R = AC Ripple or buzz in transmission
X = characteristic steadiness of crystal (Xtal) control or eXcellent quality

* For Copyability reports of N or 0, no Signal Strength report is needed.

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Genuine Signal Reports with Copyability and Strength

The CS system does a much better job than RS(T) of telling the real story about our signals in a very brief format, normally consisting of two characters:

> **On phone: "Your CS is papa seven." That's a perfectly-copyable S-7 signal. Excellent quality is implied with no suffix. The suffix X could optionally be added, just as in the case of RS(T).**
> **On CW: "CS GA" for good 100 % copy at 10 dB over S-9, or "CS 74K" for 70 % copyability at S-4 signal strength with key clicks.**
> **On PSK-31: "CS G3O" for good 100 % copy at S-3, but overdeviated.**

Signal Copyability in CS

Way back in 1925, when RST was in its infancy, the American **QST** magazine reported a percentage "readability" proposal:

> **E. G. Watts of 4FM makes a very good suggestion regarding an addition to the present R system of stating audibilities. The present "R9" signal only indicates a very loud signal---it may be audible all over the shack but if there is any great amount of QRN or streetcar QRM or induction the *readability* may be way down. Why not add to the signal strength "R" signal to indicate percent readability, thusly: 9 is 100%, 8-80%, 7-70%, 6-60%, and so on.[2]**

E. G. Watts' proposal didn't catch on then. Maybe that was because designating 100 % with a 9 and then skipping to 80 % with an 8 is awkward. CS borrows E. G. Watts' idea, but fixes that glitch.

At the lower end, CS makes a distinction between "no recoverable signal" (N) and "discernible but not copyable" (0). The numerical digits from 1 through 9 designate 10 % through 90 % copyability. That's straightforward and very easy to remember. In practice, operators often distinguish between a signal which is just 100 % copyable and one which is not only 100 % copyable, but at an "armchair" or "full-quieting" level. CS calls the first "G" for **Good**. Copyability of "G" in CS is the equivalent of R-4 in RST. The second is "P" for **Perfect**, the exact equivalent of R-5 in RST. The five levels of readability in RST, as we've seen, are a bit sparse for very useful characterization, and since in RST that parameter consists of non-quantitative verbiage, it's hard to remember the details.

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[2] **QST** October 1925, p. 36

Genuine Signal Reports with Copyability and Strength

C in CS Compared to R in RST

C-N = no recoverable signal ≡ R-1 – Unreadable
C-Ø = discernible but not copyable ≡ R-2 – Barely readable, occasional words distinguishable
C-1 to C-9 = 10% to 90% copy ≈ R-3 – Readable with considerable difficulty
C-G = Good 100% copy, but short of perfect ≡ R-4 – Readable with practically no difficulty
C-P = Perfect armchair 100% copy or full-quieting on FM ≡ R-5 – Perfectly readable

Note: ≡ means <is comparable to>; ≈ means <is approximately equal to>.

Signal Strength in CS

To report signal strength, CS uses S-meter readings. We all know about S-meter variations. We're radio amateurs with practical communications equipment. Most of us don't have fine-tolerance lab equipment in our stations. Although a 50 μV signal with a 50 Ω input impedance is an emerging standard for S-9 on HF S-meters, not all S-meters are calibrated that way. There is wide variation in receiver sensitivity, and of course our antennas vary considerably. Nevertheless, this is no longer the early 20th century when S-meters didn't exist. Most of us now operate transceivers equipped with S-meters. Using them is the reasonable way for most hams to report signal strength.

Unlike with RST, we can properly use the numbers 1 through 9 to designate S-1 through S-9 signal strength in CS. For signals stronger than S-9, we can report so many decibels above S-9 using the letters A through F. At the very top of the scale, a signal which is at least 60 decibels over S-9 is indicated by the letter F, actually the number fifteen in hexadecimal notation. Remember that the 60-decibel level is 1 000 000 times more powerful than S-9. We will be reporting a signal-strength at that magnitude very rarely, indeed. To send the maximum CS report of PF routinely is laughably absurd.

Optional Quality Suffixes in CS

CS borrows three optional suffixes directly from RST: C, K and X. The quality-reporting system in RST has one

major flaw: there is no way within RST to report overmodulation or overdeviation in non-CW modes. CS remedies that by employing a single letter **O** to alert an operator about those problems. Similarly, the **tone** parameter in RST has been eliminated in CS, since it is mostly irrelevant. For those rare cases when AC power supply products appear in the signals, the optional **R** suffix can be used to flag the issue, but not to characterize it with the nine levels of the tone report in RST.

CS in Operation

CS is far simpler than RST. Unless optional suffixes are added, CS requires only two characters to make a complete report, yet it can apply to any common Amateur Radio mode. For signals with no quality problems, we only have to think about two items: **percentage copyability** and **S-meter reading**.

When should CS be used? CS, or any signal reporting system including RST, should be used only for routine contacts. Signal reporting, even if done accurately, doesn't enhance fast-paced operations like contests and DX pileups. Contest sponsors should re-evaluate exchanges which require signal reports. What purpose do they serve when they are almost always given in stereotyped forms? How about substituting other things like operator name or Maidenhead grid or year first licensed or whatever? In some cases, the signal-report contest requirement can simply be dropped. It will not be missed and the QSO rates will increase. The same holds for DXpedition operations. Bogus signal reports perform no useful service. Two-character Maidenhead Grids would be much more appropriate as DXpedition exchanges.

The following is an abbreviated summary of the CS Copyability Strength system which is suitable for mounting at the station position:

Genuine Signal Reports with Copyability and Strength

CS Compact Summary

C or Copyability Scale

N = no recoverable signal*

Ø = discernible but not copyable*

1-9 = 10% to 90% copy

G = Good 100% copy, but short of perfect

P = Perfect armchair 100% copy or full-quieting on FM

S or Signal Strength Scale

Ø = no S-meter reading

1-9 = S-1 to S-9

A = 10 dB over S-9

B = 20 dB over S-9

C = 30 dB over S-9

D = 40 dB over S-9

E = 50 dB over S-9

F = 60 dB or more over S-9

Optional Quality Suffixes

C = Chirp or tail on make and/or break

K = key clicKs or other Keying transients

O = Overmodulation or Overdeviation in phone or digital modes

R = AC Ripple or buzz in transmission

X = characteristic steadiness of crystal (Xtal) control or eXcellent quality

***** For Copyability reports of N or 0, no Signal Strength report is needed.