

## Simplex Net Operation Training

ERC Training

12/10/2014 and 12/17/2014

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### BACKGROUND

We all know that repeaters are very powerful and are useful for amateur radio communication. One of their primary purposes is to extend the range of handheld and mobile transceivers. Many sites also include enhanced features such as auto-patch or weather station access. Some hams may be led to conclude that communicating on the VHF and UHF bands is useless without a repeater.

Both 2 meters and 70 centimeters normally exhibit line-of-sight propagation. This means that the signal travel to the optical horizon (and perhaps a little farther). Increased Height Above Average Terrain (HAAT) increases the distance to the horizon and the propagation distance.

Consider two operators with mobile radios transmitting over relatively flat terrain. They can typically communicate about 15 to 20 miles. If one of the stations is elevated, like on a hill or tall building, the range can be much greater. This is why repeaters are located on the tops of mountains or tall buildings. However, simplex operators don't always have the luxury of being on a mountain top or hillside.

The definition of simplex operation "...is direct station-to-station radio communication without the use of an intermediate relay station, such as a repeater." (<http://www.k0nr.com/rwite/fmvhf.html>) Successful simplex communication, whether it's in the HF bands or the VHF band, is very dependent on your antenna system and, to some lesser degree, your power output.

### OUR LOCAL SITUATION

Some of our regions cover huge areas of land and a wide assortment of terrains. The Rexburg Region, for example, stretches about 75 miles between its two most distant points and covers about 2,000 square miles. I know that the Rigby Region has similar challenges. The distance from Ririe to Terreton is over 50 miles. In fact, all of the regions have challenges of one form or another. These vast distances make operating a simplex net very demanding.

The most common feedback we receive from operators is "I can't hear Net Control!" Tonight, I'd like to provide some guidelines for both running a simplex net and participating in a simplex net. Next week, we will continue this training by reviewing and demonstrating some of these techniques.

### OVERVIEW OF SIMPLEX NET OPERATION

Let's begin by answering a few questions:

#### What is a simplex net?

A simplex net is a net conducted without the use of a repeater. All operators communicate with Net Control simplex, meaning they transmit and receive on the same frequency. There are no offsets for input and output frequencies. All transmissions are done on the same frequency. The majority of HF nets are simplex nets.

#### Why do we use simplex nets?

There are at least four major VHF or UHF repeaters within the boundaries of the Rexburg Region. Many hams have asked me, "With all of the available repeaters, why don't we use one of them for our 8:30 net?" The answer is this: In a major disaster or emergency situation, the repeaters may be damaged or unavailable for ERC use. If we can learn to communicate simplex, without the use of repeaters, we will be better prepared to communicate in any circumstance, even the most adverse conditions.

The purpose of our regional nets is to "... train radio operators, test equipment, improve operating skills ..., and

prepare for emergency operation.” What better way to test the capabilities of our equipment, improve our skills, and prepare for emergency operation than by practicing simplex communication.

## BASIC SIMPLEX OPERATION

Let's talk about a few basic elements of simplex operation.

### Power

FCC regulations state that we should transmit with the minimum power required for RELIABLE communication. The operative word here is “RELIABLE”, not minimum. When you are talking with your next door neighbor or utilizing the repeater, a couple hundred milliwatts may suffice. But when operating simplex on a regional or storehouse net, you'll need to increase your output power. That may mean transmitting with the maximum power that your system will produce. There are trade-offs here. In an emergency situation, we want to do everything we can to conserve power, but we must also be heard.

### Squelch

You may have a tendency to close your squelch to block out static and any extraneous noise. When operating in a simplex net, you should open your squelch all the way to increase your chances of hearing weak stations.

### Weak Stations

Speaking of weak stations, it may take twice as much time and power to relay a message from a weak handheld transmission: once for the HT to make the initial transmission and again for another station to relay the message to net control. Please don't misunderstand the meaning of this point. We are not discriminating against handheld users. We want you to participate in the nets, even if you must be relayed to net control. We also want you to understand that in a true emergency, different equipment may make your transmission more effective.

We encourage all operators to save your pennies and acquire a mobile radio. Mobile 2 meter radios can be purchased new for about \$140. Used ones can be found for much less. A mobile radio can produce 10 times the output power of a handheld. At the very least, invest in an antenna system with higher gain than the stock rubber duck that ships from the factory. Also, brick amplifiers for handhelds, such as the Mirage B34 (bravo-34), are available for about \$100. But at that price, you'd be better off just buying a mobile radio.

### Antenna

Your antenna is perhaps the most critical component of your system. Many operators use the stock "rubber duck" antenna that comes with a handheld transceiver. This antenna is essentially a quarter-wave which is shrunk down to about one-fourth of its usual length. It generally does not do much to amplify your signal. Some hams refer to them affectionately as “attenuators” or “leaky dummy loads”. The short length and lack of ground plane make its performance quite poor. There is a school of thought that says adding a tiger tail can improve the performance by providing the missing ground plane, but their effectiveness has received mixed reviews. In the end, only the high sensitivity of FM repeaters make handheld radios with rubber duck antennas effective for more than about 10-15 miles over level terrain.

For hiking, public service events, emergency communication and other activities where radio range is important, a longer antenna is very helpful. Antennas are available commercially or easily assembled. One was gifted to me last year made of a 19 inch length of piano wire soldered to an SMA connector. Beam antennas generally exhibit more gain than a vertical whip. J-poles are generally better than mag-mounts.

The height of your antenna may just well be the second most critical. Some studies indicate that raising your antenna from 10 feet to 20 feet (twice the height) can make the same difference in transmission quality as increasing your output power from 5 watts to 20 watts (four times). Raising your antenna from 10 feet to 40 feet (four times) can equate to nearly 10 times the power, all else being equal.

***[The following paragraph is for explanation only and should not be read on the air unless a related question or comment is raised.]***

*When a good antenna is attached to an HT, the receiver often exhibits problems due to the much stronger signals*

*present. Strong signals (typically paging transmitters) will come blasting through the receiver and interfere with the desired signal. Radio amateurs usually refer to this as "intermod", short for "intermodulation". In reality, intermodulation has a specific technical definition that describes only some of these noise and interference problems. Independent of the name, the end result is that the HT receiver is overloaded by these strong signals. One solution to the problem is to use an external filter to block out signals outside the ham band. This type of filter will also block police, fire, weather and other non-ham signals, too.*

## DEMONSTRATION

In an effort to illustrate the difference in signal quality, I've invited Paul Jeppson KG7DWT in Sugar City to transmit using a few different configurations. We are going to do this across the repeater, so it may be a little difficult for you to discern a lot of variance between the different configurations. Keep in mind that any subtle difference you do notice will be greatly magnified when communicating simplex: a little crackle or static will equate to a large amount, etc.

Paul will first transmit using a handheld with its stock rubber duck antenna. KG7DWT, begin your first transmission now.

*[KG7DWT will key up, identify, and transmit a brief sentence or two.]*

Thank you, Paul. The repeater system is very sensitive to weak signals and does a great job picking them up. Did you hear the slight amount of static and crackling? Although he is readable through the repeater, it would not take much distance or many obstacles to eliminate a simplex signal.

Paul will now transmit using the same handheld, but connected to a homebrew roll-up slim-jim antenna. This antenna is made from 300 ohm twin-lead attached to about 5 feet of coax. This antenna is easy to construct, light-weight, and extremely portable. Listen and see if you can tell the difference from his previous transmission. KG7DWT, begin your second transmission.

*[KG7DWT will key up, identify, and transmit a brief sentence or two.]*

Thank you, Paul. You may have noticed a little static, but for the most part, the signal was clearer. A simple antenna can really improve your signal. Now listen to Paul transmit using his mobile radio attached to mag-mount antenna. KG7DWT, Paul begin your final transmission.

*[KG7DWT will key up, identify, and transmit a brief sentence or two. This is his final transmission, so he should state his call sign at the end, too.]*

Now he is just booming into the repeater, full quieting. Even on simplex, most operators in the Rexburg Region would have little or no problem hearing Paul.

The bottom line is this: acquire a good antenna system, get it up in the air, and increase your power.

{ID}

The following are suggestions for more effective simplex communication. (Every region is different and may require adaptation.)

### 1. Hearing NCS

Net Managers and Regional Coordinators should select Net Control stations wisely. As we've taught in other seminars, the Net Control Station should have a commanding signal, able to be heard by as many stations as possible. This reduces the amount of relays and improves the effectiveness of communication.

### 2. Alternate (temporary) NCS

You may also select temporary ad-hoc net control stations to accept check-ins in areas of the region that cannot hear net control. For example, I live in a valley on the east side of Rexburg. The sub-division is called aptly named Hidden Valley! As net control, I can communicate fairly well with operators to the north and west of my home, but hearing operators in the Rexburg South Stake is a challenge.

In order compensate, I might turn the net control function temporarily over to Keland KM7G who lives in the South Stake. He'll ask for check-ins from the South Stake, jotting down on paper their reports. At the same time, I'll record in the log the reports I can hear. When he has received all the check-ins, he'll call back to me. He might report that he received five check-ins. If I heard five check-ins, then we're done. If I only heard three, I'll tell him which ones I heard and he can fill in the two that I missed.

If there are announcements or business on the net, these alternate net control stations should be given an opportunity to repeat this traffic to operators that cannot hear net control.

### 3. Relaying

Relaying traffic to net control is a skill that should be learned, practiced and mastered by all operators. In order to get messages over distances of 50 to 75 miles, it is a given fact that we will have to do some relaying.

When I am calling the net, I know that there are some distant areas that I cannot hear. So, if I call a stake and hear no stations, I'll then call for any relays from that stake. Listen to this example:

KM7G: Operators in the South Stake, please call now.

KG7GZO: KG7GZO

KM7G: Nothing heard. Are there any relays from the South Stake?

K5CTR: Relay, K5CTR

KM7G: Go ahead, Relay.

K5CTR: This is K5CTR, relay for Net Control. KG7GZO, please give me your report.

KG7GZO: This is KG7GZO from the South Stake, 5 watts emergency power, no traffic.

K5CTR: Thank you Eric. Net Control K5CTR.

KM7G: K5CTR

K5CTR: KG7GZO from the South Stake checked in with 5 watts of emergency power and no traffic. K5CTR

KM7G: Thank you, Ron.

### 4. Cross-band repeat

Some dual-channel mobile radios allow a feature called cross-band repeat. You tune one channel to your regional simplex frequency and the other channel to another frequency and enable cross-band repeat. When someone transmits on the regional frequency, the cross-band radio automatically and simultaneously retransmits on the other channel—and vice versa. A cross-band radio strategically placed within the region can dramatically extend the range of net control. The one disadvantage of this system, is that you are dependent upon another hop in the system. Someone has to deploy that radio and/or have such a radio. In an emergency situation where resources (both operators and radios) are scarce, dedicating equipment to cross-band repeat functions may not be feasible. Nevertheless, it can be an effective method of reaching the outer borders of your region.

### 5. Simplex Repeaters

Simplex repeaters offer another technical solution. Simplex repeaters operate on a store-and-forward principle. When you transmit, the simplex repeater will record your transmission. When you un-key, the simplex repeater will retransmit on the same frequency what it recorded. Using a simplex repeater takes practice and discipline because everyone on frequency must wait for the repeater to re-transmit every transmission. In an emergency situation, this takes up valuable air-time which may not be conducive to priority or emergency traffic. Personally, I would not employ such a device in our nets, but there may be circumstances where it is feasible and desirable.

### 6. Augment with technology

The Rexburg region has employed an app called GroupMe. Although its adoption by Rexburg Region operators is minimal, the use of GroupMe during a net allows operators that might not be able to hear net control to know where we are in the roster. It also lets us know what operators are monitoring the net and reminds us that we need to prompt for relays. Although this technology may not be available in every emergency situation, it does provide a mechanism to receive valuable feedback while we're learning the limitations of our equipment.

This concludes tonight's training. Are there any questions or comments? If so, please come now with your call sign?

12/17/2014

Review last week's training

- . Acquire a good antenna system, get it up in the air, and increase your power.
- . Net Control should have a commanding position and signal.
- . Utilize ad hoc, temporary net control stations
- . Relay weak stations
- . Utilize cross-band repeat
- . Consider a simplex repeaters

As a reminder, these are only suggestions and your mileage may vary. We encourage operators to experiment within your regions and learn what works best in varying conditions, circumstances, and locations.

Practice what we learned last week.

Demonstrate the difference between a handheld and a mobile.

- . Invite an operator to check in from the same location with an HT and then a mobile.

Relaying

- . Simulate a net
- . Ask a few stations to check in
- . Move to the next stake; and handle a relay

Alternate NCS

- . Take a couple of check-ins from one stake
- . Invite an operator in the second stake to take check-ins from the second stake.
- . Operator reports back to NCS, phonetically <<call sign and power>>

Resources

<http://www.chem.hawaii.edu/uham/simplex.html>

<http://www.pcacs.org/radio-operations/repeater-failure-simplex-operations/>

<http://www.tcoe.trinity.k12.ca.us/~tcarc/simpop.doc>

<http://www.k0nr.com/rwite/fmvhf.html>

<http://www.sarinfo.bc.ca/Library/Communications/SimplexOps.com>