

TRANSCIEVER INTERFERENCE: MESSAGING FOR THE MULTI-DEVICE BACKCOUNTRY ERA

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ABSTRACT: It has long been established that avalanche transceivers are susceptible to electromagnetic interference from nearby electrical and electronic devices. The historical approach was to ignore this issue or direct users to switch off their devices. More recently the so-called 20/50 rule (20 cm when transmitting, 50 cm when searching) has guided placement of transceivers in relation to electronics carried on one's person.

Over the past decade there has been a rapid increase in the number of electronic devices being marketed to and used by backcountry travelers. These include smartphones, satellite messengers, fan-powered avalanche airbag packs, VHF radios, on-person video cameras, drones, smartwatches, wireless earphones, speakers, heated clothing, and more. While some devices such as heated gloves do warrant special consideration, directing users to switch all their devices off wastes time, ignores entrenched user behaviour patterns, and doesn't account for the operational benefits of these devices.

A significant challenge in addressing user education around interference has been the sparse and uncoordinated communications between avalanche educators and transceiver manufacturers. This has led to inconsistent public messaging in public outreach and educational settings.

In the fall of 2022, a group representing the interests of both recreational and professional backcountry users in North America came together with avalanche transceiver and avalanche airbag manufacturers to consider how to improve awareness and messaging associated with this issue. The group committed to finding collaborative solutions that would result in better and more consistent information reaching end users in both public and professional realms.

This paper describes the framework the group built to address contemporary issues with transceiver interference and the working groups that emerged to focus on specific aspects of the issue. The paper focuses on one of the key deliverables: basic recreational-level messaging. It describes how the group was able to reaffirm the core 20/50 rule, while limiting exceptions only to common devices known to affect outcomes. For the first time, manufacturers and educators collaborated to develop practical advice related to interference and snowmobiles. Finally, the paper explains how specific language and precise graphics were used to create clear, straightforward, and accurate advice.

KEYWORDS: Avalanche Transceiver, Interference, EMI, Public Communication

1. INTRODUCTION

It has long been known that avalanche transceivers are susceptible to electromagnetic interference from nearby electrical and electronic devices. Until the advent of digital transceivers in the late 1990s, the problem could largely be ignored. Not only were there fewer sources of interference in the backcountry, but also analogue transceivers placed the task of analyzing signal strength and quality on the human brain, which is good at rejecting spurious signals.

Once digital transceivers became more common in the 2000s, users started noticing that devices such as cell phones (Shokoples, 2008) and pacemakers (Darwin, 2005) had the potential to interfere with their normal operation. However, there was not widespread awareness of the issue. Transceiver manuals of this era varied greatly in their advice, with some suggesting 30 cm separation from electronics in search mode, some suggesting 1.5 m, some advising users to switch devices off, and some not addressing the issue at all (BeaconReviews.com, 2023).

Barkhausen, 2012 tested a number of devices commonly used in the backcountry and suggested maintaining a minimum separation of 40 cm from a transceiver in search mode. In a similar study, Genswein

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et al., 2013 recommended a minimum separation of 50 cm in search mode and 20 cm in transmit mode.

The latter of these recommendations became the de-facto guideline for mitigating transceiver interference. The so-called 20/50 rule has since become incorporated into user manuals by every transceiver manufacturer as well as instructional materials for avalanche courses.

The 20/50 rule has proved to be a robust basic guideline. However, following a Canadian avalanche fatality in 2021 where the transceiver search may have been affected by interference, and acting on concerns that the number of electronic devices users were taking into the backcountry was ballooning, North American agencies started to question whether the guidelines should be revisited and/or given greater prominence.

In response, a workshop was organized by a group representing the interests of both recreational and professional backcountry users in North America.

2. SALT LAKE CITY WORKSHOP

In September 2022, delegates from North American public and professional avalanche safety agencies joined avalanche equipment manufacturers and avalanche educators in Salt Lake City for a three-day workshop. Many of the equipment manufacturers traveled from Europe to attend the workshop.

Delegates reviewed the state of knowledge and were asked to identify devices known to cause interference, as well as knowledge gaps where uncertainty existed. Delegates were also asked to determine how users might need to consider transceiver interference issues at the following timepoints: during knowledge attainment (e.g., when purchasing gear or learning about avalanche rescue); during pre-trip planning (e.g., when selecting gear for a trip); during group safety checks (e.g., when leaving the trailhead); and during rescue response (e.g., when conducting a transceiver search).

The workshop focused on exploring the complex issues around transceiver interference and building a framework for finding collaborative solutions. Delegates adopted the idea that solutions should be rooted in optimizing overall outcomes for avalanche safety rather than aiming solely at eliminating interference issues.

2.1 State of knowledge

Delegates reviewed the state of knowledge and identified three areas where evidence suggested that devices commonly found in the backcountry could interfere with transceivers in search mode at distances greater than 50 cm. These were digital radios, snowmobiles, and some first-generation electrically powered avalanche airbags.

While the avalanche airbag issue was concerning to delegates, not least because it is a type of device that should not be separated from the user or switched off during a rescue, an effective solution to the problem was already available. The issue had been traced to power regulators used in control circuits in some first-generation inflation systems. Manufacturers have made firmware updates available to mitigate the problem.

The broader point this issue raised was the importance of ensuring new avalanche safety devices do not introduce interference. Equally important is ensuring firmware updates allow manufacturers to improve performance in light of new information. Manufacturers at the workshop committed to ensuring all future avalanche safety equipment, including avalanche airbags, do not introduce interference at levels that will impact the normal operation of transceivers during a signal search. The European standard for avalanche airbags, EN 16716:2016, is currently being revised (Berker and Fritz, 2023). Avalanche safety agencies committed to promoting a culture of performing updates and early-season equipment checks to help ensure user's equipment is well-maintained and uses the latest available firmware.

The issue of digital radios is specific to those that use time domain multiple access (TDMA) signal separation technology. Forrer et al., 2018 discovered that some TDMA radio models interfere with avalanche transceivers in search mode at distances up to 1 m.

Delegates identified a significant lack of knowledge regarding the influence of snowmobiles on transceiver interference. At the workshop, Edgerly (2022, personal communication) reported having experienced interference with transceivers and mountain snowmobiles at distances of between 1 and 3 m. Subsequently, Edgerly, 2023, has performed additional testing and found snowmobiles to interfere at distances up to 5 m.

2.2 Subcommittees

While many preliminary ideas were generated during the workshop, the task of creating tangible solutions, such as developing basic messaging aimed at recreational users or resources for educators, was deferred to subcommittees that were expected to meet at intervals after the workshop.

Three subcommittees were created, one to address public outreach, one to address technical issues for manufacturers, and one to address avalanche education issues.

3. BASIC PUBLIC MESSAGING

The main tasks for the public outreach subcommittee were to agree on appropriate guidelines for basic public messaging and create resources to disseminate this information. The resources included social

media campaign graphics aimed at encouraging users to check and update their avalanche safety gear, and a two-page basic public messaging communication (Figure 1 and Figure 2) designed to give guidelines on how to avoid interference issues.

Building on ideas that had been brought forward at the Salt Lake City workshop, the subcommittee's philosophy in designing the basic public messaging was to communicate only the most critical information and do it in a way that was easily understandable. It was important to minimize the chance of adding confusion to the already daunting task of performing companion rescue.

The title was chosen for simplicity, *Transceiver Interference*, and given the catchy tagline, *Keep Your Distance*, a well-known vernacular expression implying you should stay far enough away from something to be safe.

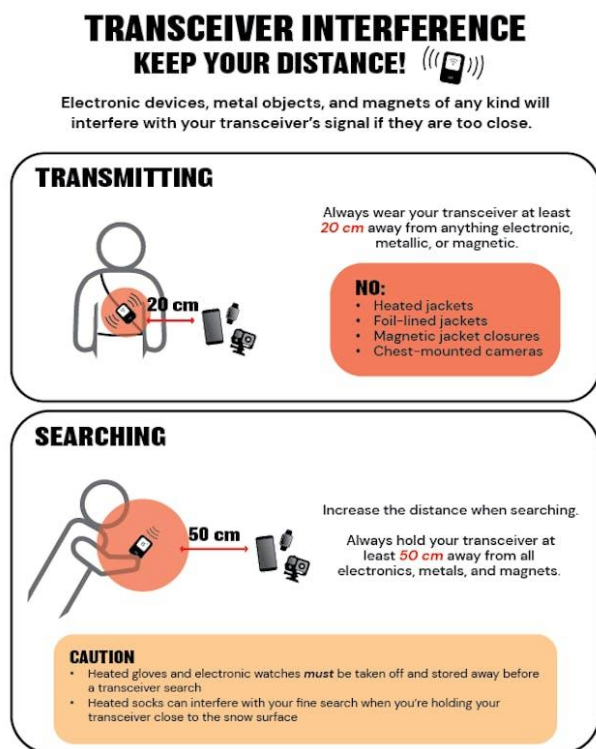


Figure 1: Page 1 of the basic public messaging communication. The authors thought it important for the graphics to be simple, non-gendered, and brand neutral. This image and the one in Figure 2 are available for download at: <https://avalanche.ca/transceiver-interference-messaging>.

A description of the problem follows, which was deliberately kept as concise as possible: *Electronic Devices, metal objects, and magnets of any kind will interfere with your transceiver's signal if they are too close*. The use of the indicative mood for the verb *will* was deliberate to avoid introducing uncertainty or hesitancy into the messaging, which would have reduced its impact.

3.1 *Transmitting and searching*

The technical foundation of the messaging is the 20/50 rule, and the main body of the first page was organized into two sections: the first addressing issues when transmitting (20 cm separation), and the second addressing issues when searching (50 cm separation). Items that needed to be highlighted were listed in boxes and included four devices the group considered incompatible when transmitting (heated jackets, foil-lined jackets, magnetic jacket closures, and chest-mounted cameras), and three devices that warranted special consideration when searching (heated gloves, electronic watches, and heated socks).

It is important to note the advice only explicitly instructs users to switch specific devices off when searching (heated gloves and electronic watches). The group rejected advising users to switch all devices off because of the additional burden of time this takes, particularly given how many devices modern backcountry users carry.

Page 2 contains two sections that deal with specific scenarios: searching when snowmobiles are present; and calling for help. It also includes a section on helpful measurements designed to give users easy references for the distances used in the guidelines.

3.2 *Snowmobiles*

After much deliberation, reviewing the available evidence from testing, and consulting members of the snowmobile guiding community, the group considered that 3 m was the optimum separation distance between a snowmobile and a transceiver in search mode. There is evidence that a running snowmobile can interfere at a greater distance than 3 m (Edgerly, 2023), but a rider who is 3 m from their machine will invariably have switched it off because of the use of tethered kill-switches. There is also evidence that machines that are switched off may interfere at distances less than 3 m. However, some modern machines include electronics and powered circuits that remain activated for some time after the engine has been switched off.

Including two distances (one for snowmobiles with engine on and one with engine off) or listing machines that remain active even when the engine has been switched off is cumbersome and had we taken that approach would have resulted in poor communication. The nuance of instructing users approaching an ongoing rescue scene to stop further back than 3 m is best dealt with during hands-on training once basic rescue skills have been mastered. 3 m has a secondary advantage of being approximately the same length as an average mountain snowmobile, convenient for helping users easily visualize this distance.

3.3 Calling for help

The best contemporary advice the subcommittee received from the equipment manufacturers was that cell phones, sat phones, satellite messenger devices and analogue VHF radios are unlikely to interfere with avalanche transceivers, even when in use, provided a minimum distance of 50 cm is adhered to. This is a significant departure from advice by Genswein et al., 2013, who advised staying 25 m away when making an emergency call, advice that had previously been embedded in Canadian public safety advice (Klassen, 2021). It also differs from that of Meister and Dammert, 2014, who advised users to keep their phones off during a search. In our advice, only digital VHF radios require an additional separation of at least 1 m when being used.

Reducing the separation distance and/or eliminating the step of turning off phones and other communication equipment decreases the complexity of the rescue process and increases rescue speed. It also allows users to continue to gain the benefits some of these devices provide. For example, a group can continue to organize themselves using radios during a rescue, or a witness that captured a video on a cell phone can review the footage to determine a last-seen point.



Figure 2: Page two of the basic public messaging communication.

Despite a small increase in the risk of interference by not advising users to switch communications equip-

ment off, the authors believe that overall rescue outcomes are likely to improve with this approach due to the time saved in eliminating a rescue step and because of the additional benefits of being able to use cell phones and other communication equipment during a rescue. It also aligns with modern behaviour that resists switching cell phones off.

4. GUIDELINES FOR ADVANCED USERS

One important tenet that was agreed on during the Salt Lake City workshop is that advice for different levels of users should be compatible but does not need to be identical.

Because the subject of interference and transceivers is complicated and edge cases exist, more experienced users, including professionals, may deem it beneficial to inform themselves of additional information and/or adhere to a different set of guidelines.

For example, organized rescuers may be required to conduct a search precisely because it is a complicated or deep burial scenario where only weak signals exist. Or an advanced solo rescuer covering a wide debris field may wish to maximize the search strip width to improve the chance of locating a victim quickly. In these cases, eliminating any potential for interference would likely be the best strategy.

While it may be appropriate to instruct advanced users in more nuanced strategies, the same strategies may overwhelm the novice who is still working towards mastering the basics of companion rescue.

5. SUMMARY

The Salt Lake City workshop was highly successful in bringing together public and professional avalanche agencies, educators, and equipment manufacturers to find collaborative solutions to issues around transceiver interference. Moving forward, the hope is that these groups will stay aligned. As technology improves and new evidence comes to light the advice may change; it will be best if everyone changes with a unified voice. The model of greater communication between manufacturers, educators and public safety organizations is well suited to addressing future challenges.

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