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The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to help emergency responders improve their procurement decisions.

Located within the Science and Technology Directorate (S&T), the National Urban Security Technology Laboratory (NUSTL) manages the SAVER Program and conducts objective operational assessments of commercial equipment and systems relevant to the emergency responder community.

The SAVER Program gathers and reports information about equipment that falls within the categories listed in the DHS Authorized Equipment List (AEL).

SAVER publications focus on answering two main questions: "What equipment is available?" and "How does it perform?"

SAVER knowledge products are created for the nation's first responders and made available to help them make operational and procurement decisions.

For more information on this and other technologies, contact NUSTL by e-mail at NUSTL@hq.dhs.gov or visit the SAVER website: www.dhs.gov/science-and-technology/SAVER.

PORTABLE RADIO REPEATERS

A radio repeater is a device that receives a radio signal and re-transmits an amplified, but otherwise identical, signal. Repeaters are used to extend the range of radio systems where coverage gaps are present. Coverage gaps can be caused by signal obstructions, topology, or distance. Repeaters can also be implemented to mitigate coverage gaps in indoor and subterranean environments. Radio repeaters are commonly deployed in three forms: human-portable, cell-on-wheels (COW) and cell-on-light truck (COLT) systems. Each type has specific applications and limitations; users should choose which is best suited to the environment where a repeater is needed.
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Overview

Radio communication coverage can be limited for a variety of reasons, including excessive distance in a remote rural area or line of sight (LOS) obstructions in indoor or subterranean environments.

Employing radio repeaters can eliminate these coverage gaps.

A basic radio repeater contains a receiver, duplexer, controller, transmitter, and antenna. The receiver amplifies radio signals from the antenna and filters out noise. The duplexer isolates the receiver from the transmitter to reduce signal interference. The controller uses software to communicate with the transmitter and receiver. The transmitter converts the received audio signal's frequency and amplifies the signal before sending it to the antenna. The antenna initially receives the source signal and later transmits the processed signal. (Repeaters that lack a duplexer require separate antennas for the receiver and transmitter.) All of these components work together to complete the repeater's function. Important uses for first responders include enhancing two-way radio communication in areas with unreliable coverage and supplementing limited or damaged communications infrastructure during an emergency.

When selecting what type of repeater to use, emergency responders should consider its frequency and operating mode (analog or digital transmission) to ensure it is compatible with the radio equipment used by their agency. Transmitting power should also be considered: in general, power levels required to mitigate outdoor coverage gaps are higher than those required to mitigate indoor gaps. Higher levels of power, however, may result in the repeater retransmitting a noisier signal.

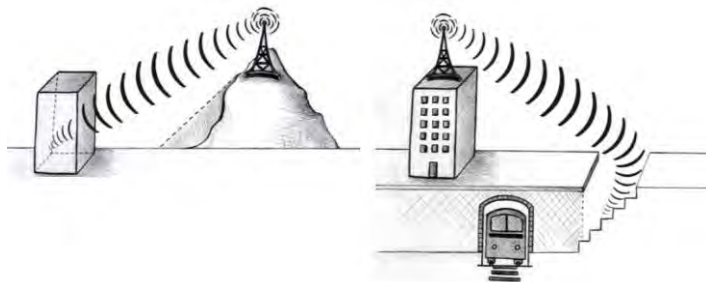


Figure 1. Indoor and Subterranean Coverage Gaps

Image courtesy of DHS SAVER

Radio Repeater Variants and Uses

Human-Portable Radio Repeaters

Human-portable radio repeaters are designed to provide a communication solution to areas where vehicle access is not possible. A typical human-portable radio repeater weighs less than 50 pounds and is contained within a single case. They can be powered externally via an AC supply or by battery, an alternative which limits their service time. Systems that require external power may limit placement options of these repeaters or may require supplemental equipment, such as a generator or battery, to maintain portability. Antenna connections for human-portable repeaters are often limited by range as well as power, making system location and position very important to achieving peak performance.



Figure 2. Human-Portable Radio Repeater
Image courtesy of Motorola

Cell-on-Wheels

COW systems are trailer-mounted communication systems that provide easily transportable radio repeater solutions. These systems can be configured for both satellite and radio communication capabilities and may also include onboard power generation. COWs are limited by potential external power requirements as well as by vehicle access to the desired area of operation. COWs can be used to support public events (e.g., concerts) and natural disaster response when cell networks are overloaded and/or where network infrastructure has been damaged.



Figure 3. Cell-on-Wheels
Image courtesy of General Dynamics Mission Systems

These systems can also be used in rural areas to supplement a limited radio network. Because COWs are towed by another vehicle, this type of system is appropriate for agencies who only occasionally deploy repeaters for outdoor operations. COWs can serve as makeshift cellular infrastructure and often provide greater transmission power levels than human-portable repeaters.

Cell-on-Light Truck

COLT systems are complete cellular systems that are integrated into a vehicle and allow for both radio and satellite communication. COLT systems generally include a power generator separate from the vehicle's engine to provide power to the communication system. The generators allow for system operation without external power as long as requirements such as fuel availability are met. These systems are highly customizable for specific scenarios and are intended for use by multiple operators. COLTs are limited to areas with vehicle access.



Figure 4. Cell-on-Light Truck
Image courtesy of FEMA

Similar to COW systems, COLT systems can be used to provide network coverage when regular infrastructure is insufficient or damaged. Due to its integration into a vehicle, a COLT system may be more appropriate than a COW system for agencies that regularly or frequently deploy outdoor repeaters. Like COWs, COLTs often provide greater transmission power than human-portable repeaters.

References

- 1) "Portable Communication Repeaters Technology Guide." DHS S&T SAVER Program. 2007. [Limited Distribution].
- 2) "Portable Cellular Systems Application Note." DHS S&T SAVER Program. 2014. [\[Online URL\]](#).