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NASCIO Recognition Awards Entry
Communications Infrastructure category

South Dakota's Statewide Radio System

Executive summary

The State of South Dakota has constructed a statewide radio communication system that allows radio users from all federal, state and local levels of government in South Dakota — any place, any time and with existing radio systems — to communicate in the interest of Homeland Security, and public safety in general. This state-of-the-art system allows radio services to follow radios anywhere in South Dakota.

Characteristics, unique to the South Dakota system, are the following:

o The first statewide trunked communication system to utilize digital VHF.
o Service access to the network is free of charge.
o Radios have been issued at no charge to 95% of all public safety radio users in the state.
o A bioterrorism response plan with critical care health facilities, ambulance services, state health personnel, and veterinarians all equipped with radios on the new system.

The communities in South Dakota benefit with a VHF digital, trunked network by getting improved federal-state-local communications, improved emergency response, standardized communications, modern communications facilities and data communications.

No other state in the nation has such a ubiquitous radio communications system — with all public safety officials able to talk to one another. Only in South Dakota!

Description

A statewide digital trunked radio network, to serve the public safety community and its Homeland Security needs within its borders, has been constructed by the State of South Dakota. The 35 site communications system was officially opened to all government entities within the state on October 23, 2002, and is currently serving 8,500 radios issued to state and local government radio users. The system has also been opened to federal government radio users. Federal agencies including the Departments of Agriculture, Interior, and Justice have been upgrading department radios to be compatible with the state system.

South Dakota's statewide radio system provides the unique quality of being the first statewide trunked communication system to utilize digital VHF. Not only is the service access to the network free of charge, but radios have also been issued at no charge to 95% of all public safety radio users in the state. The radio system supports 100% of the local police, sheriffs, fire departments, ambulance services, and transit bus operators in the state. All state government public safety personnel are on the system.

After a lengthy evaluation process, a Motorola VHF (150 Mhz) digital trunked system was chosen as the best fit for South Dakota based upon the following criteria:

- o Compatible with 73% of existing local government agency mobiles in the state and all federal users.
- o Direct compatibility with federal government users on VHF.
- o No usage fees for local agency use.
- o Many radio dealers in state.
- o Uses existing state and federal facilities (towers, buildings, etc.).
- o Least one time and ongoing cost structure.

The state's radio system solution allowed existing analog VHF users to communicate day one — at a minimum through the statewide mutual aid channel. All radios can utilize any VHF system — whether new, existing, analog or digital. Ultimately, using one frequency ensures radio communications anywhere in South Dakota. Additionally, VHF allowed the easiest, least costly path of local agency migration into the digital world.

Digital radios convert spoken voice into a stream of data bits (0s and 1s), which is sent over the air on a radio wave. Analog radios convert spoken voice into a modified frequency format which is sent over radio waves.

Digital radios outperformed analog radios by offering superior voice quality, signal range and security. Since the digital radio actually is a computer, the radio can "digitally" fill in missing or garbled transmissions, thereby extending the radio's range of clear signals. Digital audio provided a more constant level of quality audio. Also, the system allowed state and local radio users to transmit data in addition to their normal voice

communications, thus enabling information to flow to the state's public safety officials in the field.

Never again will South Dakota experience:

- o When a tornado destroyed the town of Spencer, SD., responders to the emergency arrived with radios in three different frequency bands, and none were compatible with the other. An emergency purchase was made of a portable communications system with radios being handed out, but only after a two day delay.
- o Past forest fire response, which required information to flow to the state's public safety officials in the Black Hills involving state, local, and federal entities has often used archaic short-term solutions. "Human repeaters" or personnel who would carry radio equipment to a strategic point to allow communications, and dispatchers relaying traffic between dissimilar systems was often used to provide interagency communications in the field.
- o Interaction between state and local law-enforcement units has often required each unit to radio to their respective dispatch centers and relay traffic to the other. State and local units meeting on the road often had no direct means of communicating car to car.

Significance to State of South Dakota

Interoperability, among public safety users, is the key improvement South Dakota's Statewide Radio System provides to government operations in South Dakota. Previous to this radio network, communications among the various agencies that responded to emergencies consisted of a fractured mix of different spectrum usage and system types.

The implementation of this radio system and distribution of radios ensures such emergencies in the future will have common communications at the outset.

A trunked system was chosen because many users can share a limited number of radio channels by utilizing the first available channel for each conversation. By not having dedicated channels, a trunked radio system allows the radio to "hop" from channel to channel to find an open path, thus more efficiently using the channels at a site. This trunked technology allowed:

- o More efficient use of radio channels (supports up to 100 radio users per channel), thereby lowering system costs;

- o Communications with anyone, anywhere in the state — from mobile users to portable users to dispatchers;

- o "Broadcast" messages to be transmitted to the field from any location in the state. An example of this capability is the bioterrorism response plan, where news of an

outbreak at any location in the state can be relayed to healthcare workers statewide instantly;

o Complete autonomy for each talk group (a predefined group of radio users who can privately communicate with each other). Radio service can be made to follow the radio anywhere in the state;

o Enhanced system management to ensure high availability, reliability and serviceability; and

o Bridging from analog to digital technology. New radios can access old systems while old radios can access the new system through Mutual Aid Channels.

Benefits to the Public Safety Communications Community

Benefits to the Public Safety Community are as follows:
o Improved interoperability among local, state, and federal radio users.
o Statewide communications, agencies not limited to local systems.
o A standard established for future communications equipment purchases.
o No system support costs for local and federal agencies.

The communities in South Dakota benefit with a VHF digital, trunked network by getting improved federal-state-local communications, improved emergency response, standardized communications, modern communications facilities and data communications.

In a trunked radio system, there are no dedicated channels for any one user. The channels at all sites are available for use by all users and are linked together by a control computer located in Pierre. As the microphone push-to-talk (PTT) button is depressed, an open channel is selected and a communications path is set up between those users in the talk group. This eliminates the need to wait for an open channel (as is the case on a dedicated repeater) and allows for a much more efficient use of the frequency.

With all radio sites (at various towers) across the state linked together through the central controller in Pierre, radio users have access to the system anywhere in the state. Radio users can communicate across the state simply by speaking into the microphone, just like the public telephone system.

The state has engineered its radio sites to have a minimum of four trunked channels. One is used for control purposes (to run the system), leaving three channels for handling radio calls. A trunked channel can support between 75-100 radio users.

(Keep in mind the average radio conversation is between 5-10 seconds. With three radio channels available at 180 seconds per minute, the likelihood of conversations bumping into each other are slim, even if a large number of users are under way.) If traffic on the radio system exceeds capacity, then the state will add channels at the problem sites.

In addition to the trunked channels, there is an overlay of "mutual aid" channels. These conventional VHF channels are placed at 21 sites statewide. These channels allow

anyone with an older conventional VHF radio to communicate with those on the new system. These channels are conventional repeaters and will operate only in the coverage area of those repeaters — not across the state. All state radios are equipped with these frequencies. State Radio dispatch monitors these channels around the clock.

A data channel, in addition to the channels mentioned above, is also placed at each site. This is a dedicated data channel that will allow the use of mobile data terminals (MDTs) by law-enforcement or other public safety agencies. The data speed will be at 9,600 bits per second.

For those still operating on the low-band government channel (39.10), the channel will be supported at most of the present sites until no longer used by local agencies.

Return on Investment

Traffic through the network controller for the month of March, 2003 exceeded 1.1 million calls. This included traffic from the 500+ local agencies currently utilizing the system. As the system becomes the default communication medium for all agencies in the state the following efficiencies will result;

o The agencies supported by the system will no longer have recurring support costs associated with maintenance of local systems. The $900,000 equipment maintenance budget to support the 2,400 state radio users will also support the infrastructure for 6,000 additional local users, and additional federal users.

o Combination of services. Law-enforcement, dispatch services, fire and emergency medical response, and disaster response can all be coordinated from a single system, thus allowing combination of services from different entities.

The radio system and network is supported by the State of South Dakota via the Bureau of Information and Telecommunications' (BIT) State Radio group. The State will maintain the towers, repeater equipment, central controller and transport equipment. Local users are responsible for maintenance and repair of the mobiles and portables in use by those agencies and any related control equipment (console/dispatch) used.

This system will continue to expand with more towers being built in the eastern side of the state. These towers will further improve portable coverage. Also, the integration of Federal agencies will continue. Agreements are being developed with the BIA, BLM (Custer, Ft. Pierre National Grasslands), FBI, FF&WL (Sand Lake National Refuge), ND National Grasslands, NPS (Black Hills Parks and Mt. Rushmore fire crews), US Marshals, and WAPA (DOE)

Cost breaks and efficiencies were recognized by centralizing the networked radio system. The 66 counties in South Dakota would have recognized costs to their local government budgets in the area of $32,000,000 for a **NON** networked repeater system for

each of the counties. This does not include additional systems required for local coverage in towns and cities throughout the state.

By the state utilizing strategically placed existing towers, a network of 35 towers provides 90%+ geographic coverage to the entire state for a networked system that is accessible to all public safety users in the state. This results in a $10,000,000 savings in infrastructure costs, plus the additional savings realized by local governments no longer needing to maintain local systems.

The following chart reflects the costs associated with independent system construction by local governments, versus the costs incurred by the state for the radios provided for state and local subscribers, and the network construction costs.

Description	Locals Independent	Total	State Network	Total
Site tower & RF Equipment	66 @ $300,000 No networking	$19,800,000	35 + Statewide Networking	$9,586,072(Contract with change orders)
Mobile Radios	3900 @ $1835	$7,156,500	4583 State & Local	$11,816,620
Portable Radios	2200 @ $2162	$4,756,400	2880 State & Local	$6,504,225
		$31,712,900*		**$27,906,917**

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* The associated costs for each county (66) to install a new site of digital repeaters equivalent to the capacity supplied by the central system would be $19,800,000. The cost to equip the users within the counties would then add another $11,912,900, bringing the total cost to the local communities to $31,712,900.