HF Radio Network As A System

David Rudawitz [PMP], NVIS Communications, LLC
March 2020

NVIS Communications

Individual organizations that are using HF radios for contingency operations and interoperability with other organizations often have a few HF radios with which they participate in these nets. Larger geographically dispersed organizations or coalitions of organizations may establish networks of HF radio stations to provide inter-organization contingency communications. This white paper explores the concept that a resilient contingency HF network is a **system** and should be managed as such. Taking a **systems approach** to the design, acquisition, deployment, operation, management, and maintenance of an HF network supports the leveraging of HF and advanced features available to Long Range Digital Radio (LRDR) HF networks. LRDR is built on HF radio with advanced features providing an **infrastructure independent** voice and data solution that can work when all other modes of communication have failed, are compromised or are unavailable. We will look at the features that should be included in a systems approach HF network, some examples and financing and management approaches that benefit HF network owners and participants.

"Traditional" HF Networks

Historically, when independent organizations work together (coalition) to build an HF network, each independent organization will obtain, deploy, maintain, and test their equipment. When working together as a network of independent organizations, it can be very challenging to ensure reliable network operations and very difficult to leverage the desired advanced features found in LRDR.

Long Range Digital Radio (LRDR) represents the evolution of HF long distance communications from analog based to digital for voice, messaging, and data communications. LRDR is a long distance communications medium utilizing the HF spectrum to provide a voice quality and data transmission experience similar to cellular and P25 communications, while also providing the capability for encryption, IP, and low bandwidth Ethernet connectivity as well as all standard HF capabilities. Networks using LRDR radios leverage these advanced features to provide an outstanding user experience, high reliability, and advanced capabilities not found in radio networks using conventional HF radios. These advanced features allow critical infrastructure and governmental entities to build a highly reliable, user-friendly contingency radio system to support emergency actions, C3, and restoration operations.

LRDR Advanced Features

In addition to ALE, there are several advanced features available in LRDR networks. These features may include:

- Digital voice which will cut through interference providing call quality approaching that of a cell phone.
- Data operations supporting file transfers, email-like messaging, SMS text messaging, SCADA, and general data transfer.
- Bidirectional internal and internet email.
- Bidirectional telephone interconnect to make and receive calls with the public switched telephone network including cell and satellite phones.
- Bidirectional automatic interconnection with land mobile radios.
- Encryption for message privacy.

Why a Systems Approach

In a simple voice-only HF network, operations rely on all stations being on the same channel at the same time to communicate and must ensure common channel programming and coordinated time/channel net schedules. In this case, there is little more needed to ensure interoperability. However, if the desired HF network is to leverage features making it a LRDR network, things quickly become much more complicated.

First of all, LRDR systems will want to use Automatic Link Establishment (ALE) to support ad hoc inter-station calls outside of scheduled nets. For reliable operation, the ALE features of the network need to be designed for the network and maintained across all of the participating radios.

Another key issue is network management and maintenance for coalition network composed of participants from different organizations. If each individual participating organization must have their own trained maintenance technician and network/ radio manager, it can be very difficult and expensive for each organization to staff these positions. Having a centralized system management and maintenance capability across the entire HF network achieves significant economies of scale as well as enhancing the reliability of the overall network because this approach can take advantage of network-wide testing and management tools not available to individual participating organizations with independent operations.

With centralized system management and maintenance, an LRDR system can be managed and tested from a single location and many, if not all, of these functions, can be automated. Updates to individual radio programming and features can generally be accomplished from with the centralized management model as well. The program could even include technology refresh options to keep the hardware up-to-date as the technology improves over time.

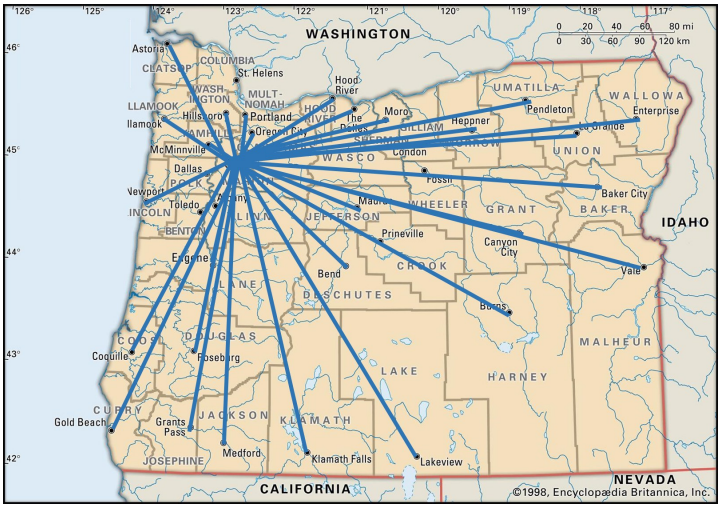
The centralized management services can also plan, facilitate, monitor, and otherwise oversee system-wide and partial system exercises and drills. This helps to maintain the readiness of the overall system and its individual components for immediate use when needed in an emergency or disaster.

Financing the HF Network System

Organizations that implement very small HF radio systems, such as one with just a couple of radios, typically, just purchase the radios and then must install those radios and manage their equipment or outsource those efforts to a contractor. When organizations are part of a larger HF network (their own or a coalition), particularly a network system that uses ALE and other advanced features of LRDR, there are some alternative acquisition and management options available.

One approach is to define an owner/user partnership, which could be that the HF network system is owned by one member organization and the users pay for use; a consortium of the members; a third party purpose-organized governmental entity; or a commercial contractor. The owner entity would: acquire the hardware, conduct all the individual site and system design efforts, install and test all equipment and antennas, provide training, provide recurring and as-needed maintenance and repair, provide day-to-day system operational oversight, and conduct periodic system tests and exercises. The individual organizations would pay this owner-entity a “lease” fee for each site/radio which can be monthly, quarterly or annually applied.

The single owner approach greatly reduces the participating individual organization’s costs as they do not have to capitalize their part of the system up front. The consortium approach requires all to capitalize their share but, with the others, ensures that the HF network system will continue to operate as a system and be ready for contingency use at all times. It is similar to what has been done in many areas of the country for the implementation or upgrading of land mobile radio systems, particularly trunked systems which require a large amount of infrastructure (at great cost) along with the subscriber units. For these systems, participants lease their subscriber units (mobile, base and handheld radios) which includes the cost of the subscriber units, capital infrastructure system, and operation and maintenance. It is also very similar to how organizations obtain and pay for cell phones and satellite telephones and service.

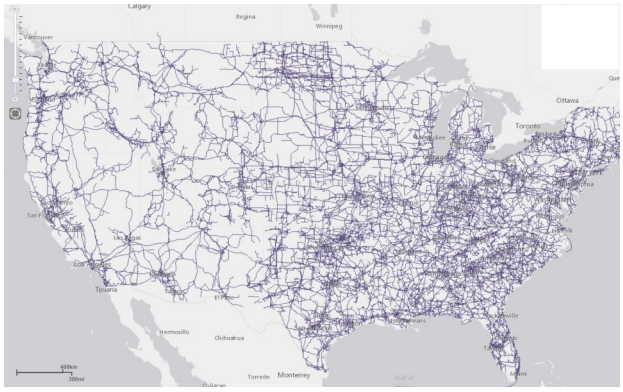


Some Implementation Sceneries

Intergovernmental System

An intergovernmental system example is a state-wide coalition system with stations in each county and the large cities in the state. This system would be used for situational awareness, mutual aid coordination, requests for assistance, and dissemination of public information for subsequent local distribution to the public.

In this example, the state would be the overall system owner and would be responsible for acquiring the equipment, arranging for the system design, installation, testing, and then ongoing system management, testing and exercises. Individual participating counties/cities could be assessed an annual fee for the system or it could be funded at the state level for all. The state could, in turn, outsource the system to a contractor and arrange a leasing structure with an annual charge for the services to be provided along with the hardware.



With this type of system, the state can ensure that their state-wide contingency HF system will always interoperate including the advanced LRDR features and be ready for immediate use in the event of a crisis or triggering event.

Utility System—Electrical Power

In the electrical power industry, specifically what is called the bulk electric system (BES), North America is divided into a number of regions each with a reliability coordinator (RC) that coordinates the generation and flow of electric energy within its geographical region and between regions as needed. To accomplish this, the RC must have reliable communication with the region's power generators, transmission, and distribution operators. This communications capability is especially critical when there are power outages and during disasters in order to keep the power running in undamaged areas and manage the restoration efforts.

An RC and its supported utilities, would benefit from an LRDR system that provides voice and limited data services during contingency events when normal communications are impacted or not available. In this example, the RC could be the overall system owner and acquiring the equipment, arrange for the system design, installation, and testing and then be responsible for the ongoing system management, testing, and exercises. The individual participating transmission and distribution utilities could be assessed an annual fee for participation in the system.

Similar to the state system example, the RC could, in turn, outsource the system to a contractor and arrange a leasing structure with an annual charge for services to be provided along with the hardware. This approach greatly lowers the cost of participation to the individual utilities and allows them to factor these costs into their rate structures while not having to set capital funding aside to participate in the system.

In Summary

Effective reliable resilient HF networks are really systems that should be conceived, designed, implemented, managed, and maintained as a system and not a collection of independent radio stations trying to communicate with each other. Taking a systems approach to the design, deployment, operation, and management of an HF network allows for the leveraging of HF and advanced features available in Long Range Digital Radio (LRDR) HF networks. Taking the systems approach truly creates a network that is much greater as a whole compared to the sum of its component parts.

The systems approach also provides attractive financing options that can lower the cost of participation for the constituent members of a coalition network or the total cost for a homogeneous single entity system. For a coalition network, the individual organizational participants do not need to have their own support technicians and system management staff. The overall system operator provides those services (with their staff or with a contractor) at a lower cost to all.

About NVIS Communications, LLC

NVIS Communications is a systems integrator and the exclusive partner/distributor for Codan HF equipment in the US, Mexico and the Caribbean. NVIS works with critical infrastructure, i.e. electricity, gas, oil, water, tele-communications and cable TV broadcasting, as well as Public Safety at the federal, state, and local levels to help them design and implement resilient communica-tions systems built on an HF-ALE core. NVIS also works closely with the Department of Homeland Security's SHARES program to further critical infrastructure entity access to nationwide HF radio backup, interoperability, and situational awareness.

Contact Information
David Rudawitz
drudawitz@nviscom.com +1-703-729-1068 x217
NVIS Communications LLC
CODAN Consulting Division
19955 Highland Vista Drive, Suite 145
Ashburn, VA 20147
www.nviscom.com

NVIS Communications

CODAN