



Dispatch Solutions Using Voice over IP

A Catalyst Communications Technologies White Paper

April 2002

Introduction

Land Mobile Radio is no stranger to the introduction of new technologies invented for other applications – witness the migration from analog to digital transmission technologies during the 1990's. Today, a technology invented from the Internet – the Internet Protocol – promises to dramatically alter the way LMR systems are built and to bring the cost benefits of packet technology to these systems.

The Internet today brings low cost access and widespread information to its users because it is ubiquitous – but it wasn't always that way. In the early days of the Internet, a handful of specialized applications – primarily file sharing among research universities – drove the early use of the Internet. It is so also with Land Mobile Radio – large IP based installations of LMR networks are only recently being proposed, and ubiquitous use of IP on mobile radio networks is years away. But one application in particular is driving the use of IP in mobile radio, and that application is Voice over IP based Dispatch.

Dispatch lends itself well to early adoption of IP technology. Dispatch applications can reap the advantages of IP without wholesale changes to the existing LMR structure. Most often, IP Dispatch augments, rather than replaces, existing Dispatch operations. Dispatch is all about communicating across networks, and so is Voice over IP.

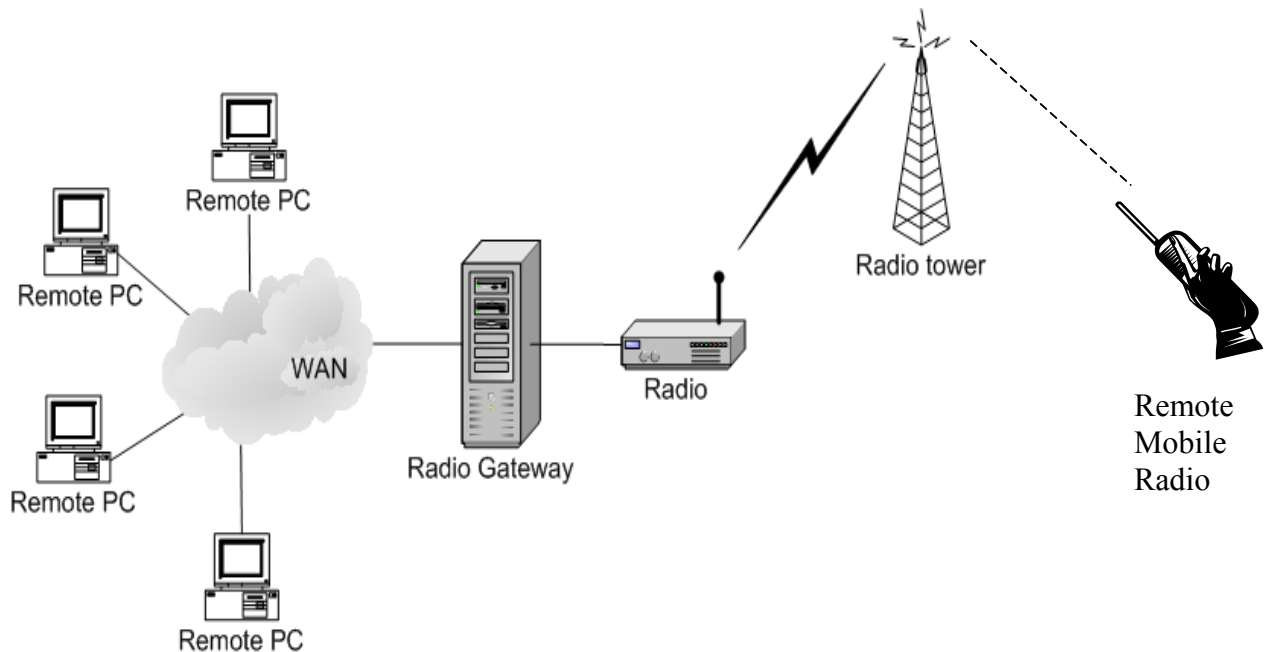
This paper provides an overview of Voice over IP as it applies to Dispatch operations. It highlights companies and applications that demonstrate technology leadership in an increasingly competitive environment. And it describes how VoIP is implemented from a network and technical perspective.

Architecture

The first step to understanding how Dispatch solutions can be improved by using Voice over IP technology is to understand the network architecture of how these systems are built. The underlying concept of Dispatch Voice over IP is that Dispatch communications

can be located anywhere with this technology and utilize the IP backbone network to connect to radios that transmit over the air to portable and mobile radios. Catalyst Communications Technologies provides a simple user interface on a personal computer that communicates using Voice over IP to Gateways that interface to radios. There are other products in the market that adopt the same basic architecture, which is the translation of voice and control signals from some console device into packets to be sent over an IP network and reassembled into audible voice and control to be presented to a radio for transmission over the air. The diagram below presents the basic concept, using the Catalyst scheme as a model.

Managed backbone networks



In this diagram, Remote personal computers with headsets, speakers, microphones, and VoIP Dispatch software translate the voice and Push To Talk (PTT) control into packets that are sent over the IP backbone network – the Wide Area Network. The Radio Gateway translates these packets back into voice and control signals and interfaces to the radio, which send the voice out over the air. Of course, many PCs can interface to the network, and the Wide Area Network gives each of them access to many Radio Gateways - and many Radios - dispersed geographically.

There is an additional concept that is important to understanding the Dispatch application use of Voice over IP technology, and that concept is that *Voice over Internet Protocol IS NOT Voice over the Internet*. It is critical to understand that, although this application uses an Internet derived technology to accomplish its mission, the transmission occurs over private, managed, backbone networks. These include networks that serve a community, such as in the case of public safety applications, and enterprise networks that

support utility operations and government agencies – but these are not the Internet. Today, the Internet has delay, insufficient security, and unreliability, which together make this network a poor choice for critical Dispatch communications. All of the early adopters of Voice over IP Dispatch solutions described in this paper operate their Dispatch operations over their own private, secure, managed networks. (For more information on this topic, see the Catalyst White Paper *Security Considerations on Voice over IP Networks* at our website www.catcomtec.com/whatsnew.)

Technology

Understanding the technology of Radio/Voice over IP is very straightforward. The key concepts to understand are Voice transmission and signaling. To understand the transmission of voice, one needs only to understand the basics of digital voice, which has been with us since the early 1960's.

Voice is an analog signal, represented electrically as a sine wave. Digital interpolation samples this sine wave at tiny increments – 8,000 times a second for telephony – and represents the position of the sine wave as an 8-bit code. This 8-bit code represented 8,000 times a second is where 64,000 bits per second comes from, a universal standard for representing voice in digital form. New voice compression techniques can reduce the bandwidth requirements of transmitting voice, and Catalyst and other manufacturers use these techniques effectively.

Once this information is digitally represented, it is easy to comprehend that it can be placed in a “packet” – an envelope really, with an address that can be read and forwarded to its correct destination. The Internet Protocol is a set of rules for interpreting the addresses on these envelopes and correctly forwarding them to their precise destination.

The tricky part of mobile radio over IP is the concept of signaling. In telephony, signaling information includes the number you dial, ringing tones, busy tones and other status information. In mobile radio, the signals we need to send include Push-To-Talk (PTT), release PTT, change channel, send emergency indication, turn on/off scan, and a number of other activities unique to land mobile radio. This is why Voice over IP solutions designed for telephony are ill equipped to manage the requirements of Radio over IP operations. Fortunately, there are companies, including Catalyst, dedicated to meeting the needs of mobile radio applications that can take advantage of IP technologies.

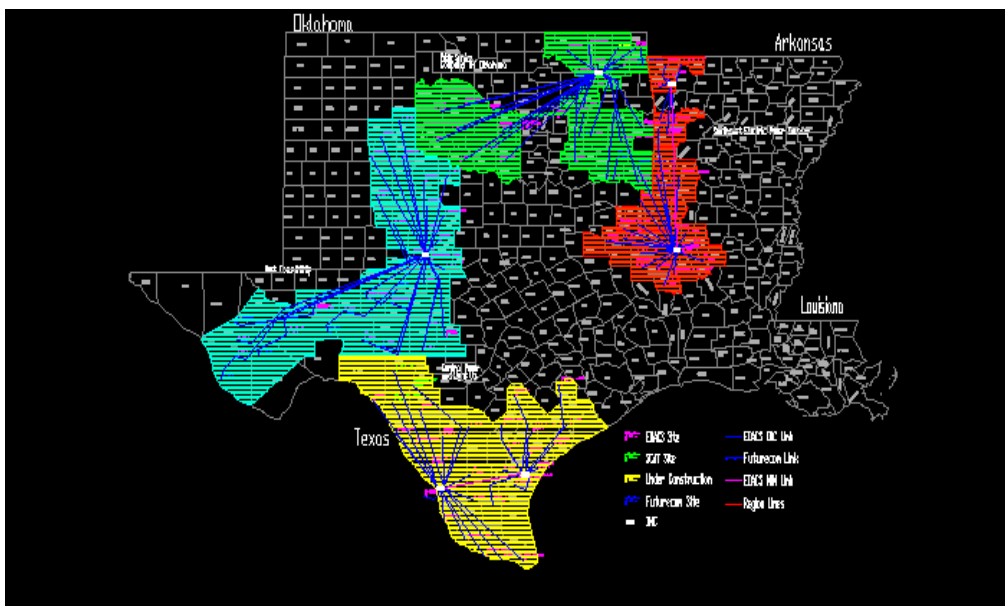
Applications

Interestingly, while not universal, the application uses for Dispatch Voice over IP segregate by industry. In the public safety segment, Voice over IP is used primarily to backup the primary dispatch operation. New concerns for terrorism or sabotage, coupled with longstanding fears of natural disasters wiping out a dispatch center, are fueling a re-look at Dispatch. Many public safety departments that review their terrorism/disaster recovery operations have concluded that (1) often two way mobile radio is the only

effective communication that exists during these events, and (2) they cannot afford to be without their Dispatch operation, which plays a key role in coordinating and directing response and recovery activities.

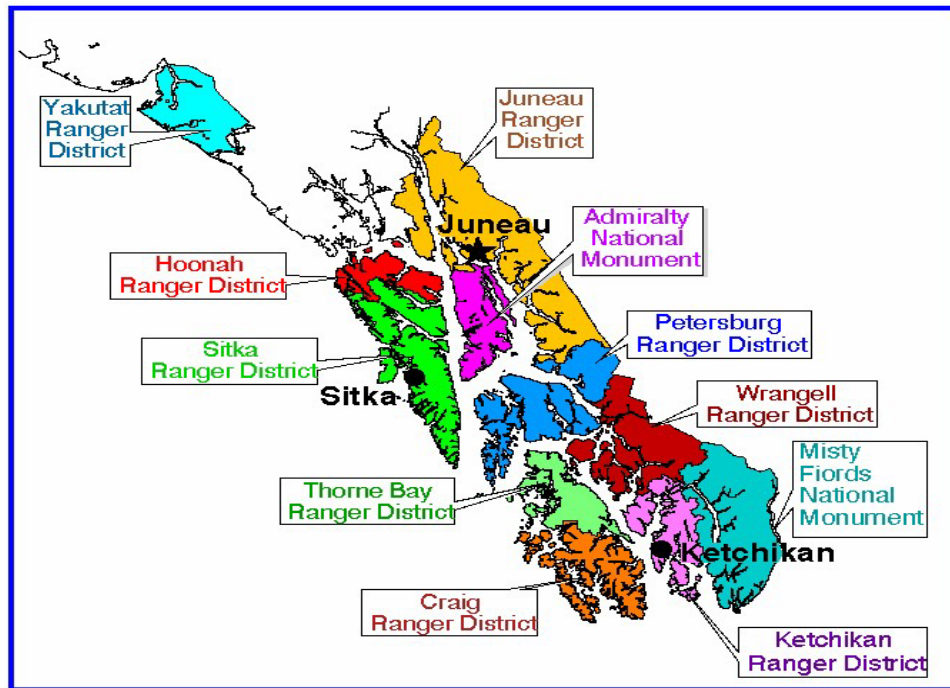
Duplicating an existing Dispatch operation is not cost practical, however. Consoles alone cost up to \$50,000 each; and the expense of connecting them to the radio network, the creation of secondary facilities, and the ongoing maintenance of a system everyone hopes will never be used is prohibitive. In contrast, the VoIP Dispatch system provided by Catalyst utilizes *existing* personal computers and the *existing* agency or community data network to provide a cost effective backup Dispatch operation. Dispatch can be performed from any computer equipped with our software on the network, and new computers can be brought online for Dispatch in a matter of minutes, offering significant flexibility during times of disaster.

Utility and government mobile radio operations are more prone to using Voice over IP for primary Dispatch operation. These organizations are interested in consolidating Dispatch operations into a single operation without consolidating people physically. For example, American Electric Power had dispatch operations over four geographic areas, but the Dispatch personnel in one area could not communicate with field personnel in other areas. Using Dispatch Voice over IP, Dispatchers located anywhere on the network now can communicate to any field personnel over a four state region.



Similarly, in the Tongass National Forest in southeast Alaska, Voice over IP is allowing Dispatchers in the southern region of Saint Petersburg or Sitka to communicate with field personnel fighting fires outside Yakutat in the north, over 400 miles away. Forest Service office personnel use the existing Forest backbone network to connect their personal

computer VoIP Dispatch application to field radio users for fire control, law enforcement, public safety, flight tracking, and other mobile radio applications.



Benefits

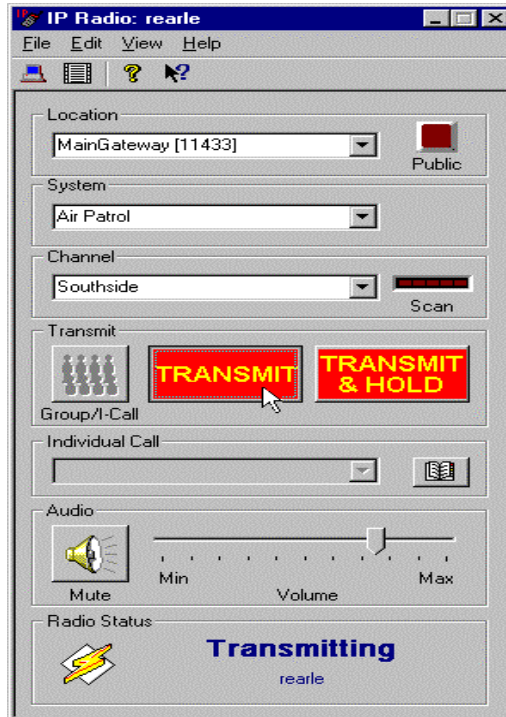
From reading this White Paper, you should now have an overall understanding of how Voice over IP can be used to provide and enhance Dispatch operation in land mobile radio networks. The next question to answer is... Why would you do this? We've already touched on one of the major benefits of VoIP technology, and that is cost. Establishing a backup system that takes advantage of existing personal computers and existing network infrastructures is much less expensive than duplicating an existing Dispatch Center to be used solely for backup. And, using an existing network infrastructure to provide connectivity between Dispatch operations and radios, towers, and base stations is much less expensive than leasing Telco circuits or constructing microwave links to make these connections.

Diversify your assets to reduce risk. Use different types of equipment, different types of connections. Therefore a failure mode, like Y2K that takes down the primary system is less likely to also take down the backup.

Another major benefit of using VoIP for Dispatch is that communications between office and field personnel can be expanded and enhanced. Using the model described in this paper, office workers can be added to the network for a few hundred dollars, and these workers can be geographically dispersed anywhere on the network.

There are a number of other benefits derived from implementing VoIP for Dispatch. In addition to the low cost of adding Dispatch locations, these locations can be added

quickly, in a matter of minutes. Dispatch Application Software can be downloaded onto the personal computer over the network and communications can begin almost immediately. Software can also be loaded onto laptop computers and connectivity with field personnel can occur over dial-up links into the network. Dispatch Voice over IP can interface with virtually every radio manufactured today, assuring universal applicability and even creating a single user interface for multiple radio types. Below is a sample of the Catalyst User Interface, a simple GUI that allows Push To Talk to a selected radio, and a simple way (through drop-down menus) to choose among radios and channels on the radios.



We invite you to learn more about how Voice over IP can improve your Dispatch operations and how a system design might be constructed for your particular application. Call Catalyst – the leader in IP based Dispatch solutions - or visit our web site for more information at www.catcomtec.com.

For more information about Catalyst Communications Technologies and our products, please visit www.catcomtec.com or call us at 434.582.6146.

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