COMMUNICATION PLANNING 101

Virtually every communications user in the USA is confronted with the issue of how to meet the operational, technical, regulatory, and interoperability requirements coupled with a growing trend toward portable, rather than mobile communications. Most of those we serve are doing their planning at the county level to include the needs of law enforcement, fire protection, emergency medical services, and transportation.

Most current users have a problem with spotty or no coverage for portable radios in many areas of the county, the high cost of equipment replacement and maintenance, and the increasing dependency (and cost) of using cellular push-to-talk service as a supplement to your existing 2-way radio system.

There is the issue of interoperability with local area agencies that may operate on different frequency bands or incompatible technology and there is the need to bring your existing communications system into compliance with changing FCC standards. Last, but certainly not least, is the need to fund the increased demand for reliable communications. Let's review some of these issues progressively and see where it takes us.

The objective of this planner is to provide an overview of where we have been, where we are, where we can go, and how we get there. We begin by reviewing coverage issues. We will address the requirements of a typical rural Alabama county with needs and concerns similar to other throughout the USA.

COVERAGE

Fifty years ago, Alabama law enforcement communications was based on a VHF network starting at the state level (Department of Public Safety). This system used a series of high powered stations serving large area districts. The purpose of this system was to provide coverage to high powered mobile radios (portables were virtually non-existent at that time). This system is still in use today.

County Sheriff's Departments then added a VHF base station to serve the mobile communications needs in their county. This allowed county dispatchers to communicate with officers throughout the county in most cases. Repeaters were rare back in those days. Then came the cities with VHF local area radio systems.

To provide coordination (now called interoperability); a common frequency was established for the smaller towns to allow them to talk to each other. This same frequency (155.01 MHz) could be used for interoperable communications between the Sheriff's Department and DPS when required. Back in those days, Sheriff's and municipalities could not talk on the DPS system (still can't) to avoid network congestion. Still later, the hospitals joined in with a VHF communications network to allow coordination for emergency medical services. The system was called H.E.A.R. It is still in operation today. An interesting historical review of the H.E.A.R. system is available at www.info4u.us/HEAR_Program.pdf.

Still later, ambulances and fire departments joined in the operation of VHF equipment for compatibility with the H.E.A.R. system.

About this same time, many counties discovered the use of repeater stations to improve mobile-to-mobile coverage as well as filling in weak signal areas. The point of all of this is two facts:

1) VHF is the predominant system being used in the State of Alabama and in the US.

2) The current systems were not designed for portable use although the trend is toward portable, rather than mobile communications.

We understand that the larger metro areas (Birmingham, Huntsville, Montgomery, and Mobile as well as most large cities in the USA) have largely migrated to 800 MHz. This was done primarily as a perceived lack of available frequencies in the VHF band. The technology is proprietary, expensive, and by today's standards – inefficient. Admittedly, these systems provide better channel efficiency, privacy, data capability, and portable coverage but they are far too expensive to purchase and maintain in any but the largest metro areas.

To make matters more confusing (and expensive), these systems have been found to be economically and technically inefficient for meeting emergency system requirements. As a result virtually every large metropolitan area in the USA is now considering a replacement of these systems. There are several types of competing technology included the highly touted 700 MHz nationwide band, Wi-Fi, MESH networking (kind of like a super Wi-Fi), TETRA (primarily a European standard), and the list goes on.

That's the bad news. The good news is that there is a technology that can address the needs of a rural county at reasonable cost. We'll discuss it further shortly. For now, we will just say that if you need better coverage and for planning purposes, any changes should be based on a VHF operating system that is compatible with existing equipment.

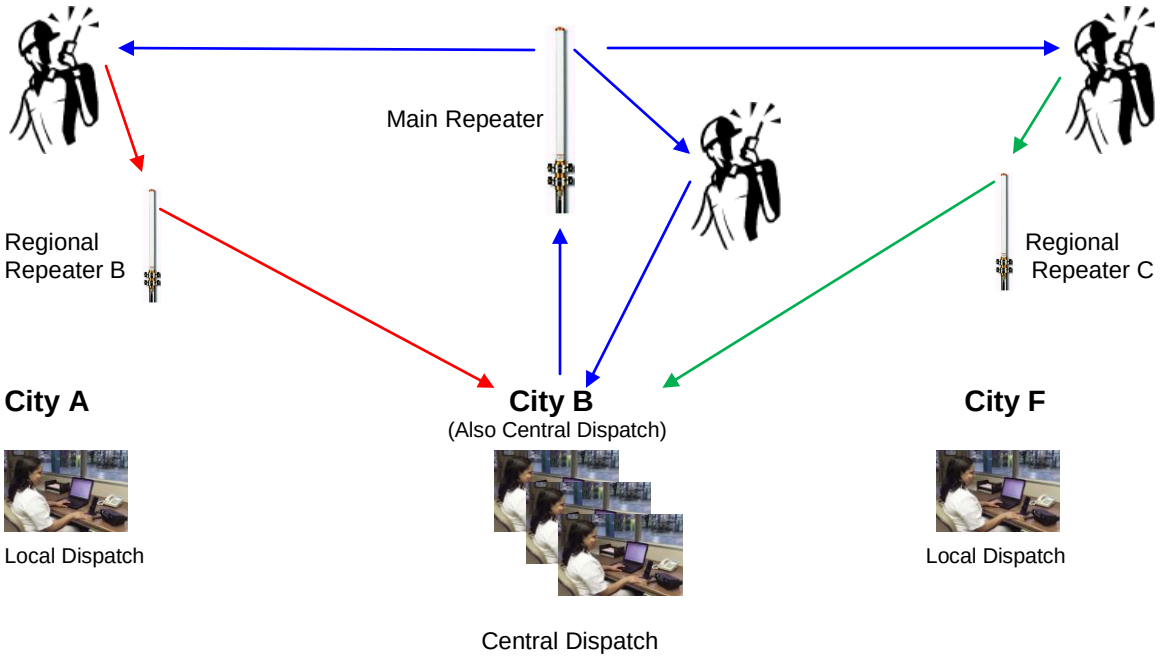
In the past, our primary concern was to provide reliable voice communications. That is STILL the primary requirement. The additional functions of data and GPS are separate issues that may or may not be a part of the primary voice communications system. For now, our objective is to develop the best system possible at reasonable cost for county/city communications. Here's an example of how we might meet our objective.

SYSTEM PLANNING

In the typical Alabama County, a single centrally located repeater on a site with good elevation and tower height will provide RECEPTION coverage to portables throughout the county. There are a few exceptions, but for our planning purposes, let's assume that such a site exists.

Keep in mind that we are not addressing the need for portables to talk back – only that they be able to receive a dispatch message. We understand that the ability to communicate between radios is also a tangible benefit. That is what we assume the use of repeater stations for wide area communications. However, we further understand that such communications is generally localized within a municipal region or in some cases within a few miles.

We understand the concept of trunking (dynamic channel assignment of a pooled group of frequencies). We envision this as being a future upgrade by basically incompatible with current vintage P25 equipment. For now, we will assume multiple frequencies being available within each of three of four operating zones plus a master dispatch frequency capable of covering an entire county. The diagram on the following page may explain our planning a little better.



HOW IT WORKS

The proposed system would use three pairs of VHF 12.5 kHz digital frequencies. One pair each for the centrally located wide area dispatch repeater, the regional A repeater, and the regional B repeater. The frequency pairs are represented as shown below. In additional to the frequency pairs, we would assume the use of 6 tactical frequencies for local area direct use. These would also be programmed into the scan list of each radio.

Central Dispatch Repeater – Represented by a blue line.
Transmits on 155.565 and Receives 159.910. All radios dispatched by central dispatch receive 155.565 as well as their local regional repeater (2 frequency scan with talkback on selected channel). All channels are now 25 kHz wide. This would be reduced to 12.5 kHz concurrent to the switch to digital operation.

Regional A Repeater – Represented by a green line.
Transmits on 154.845 and Receives 158.970. All radios dispatched by central dispatch receive 155.565 as well as their local regional repeater (2 frequency scan with talkback on selected channel).

Regional F Repeater – Represented by a red line.
Transmits on 154.040 and Receives 155.850 All radios dispatched by central dispatch receive 155.565 as well as their local regional repeater (2 frequency scan with talkback on selected channel).

Tactical Frequencies – Not represented on the diagram above. For local area direct use (surveillance, pursuit, etc.) Six new VHF simplex frequencies will be applied for with the FCC for tactical use.

As you can see from the diagram above, all dispatching is done on 155.565. Depending on the location of the officer, they would answer back through the central repeater (159.910 receive), the Region A repeater (158.970 receive) or the Region F repeater (155.850 Receive). At the dispatch center all three repeaters could be received with three different events being managed at the same time.

The system can handle both voice and text messages on the same channel which has the potential of doubling system capacity.

The beauty of P25 technology is that departments desiring to use a different operating platform such as MotoTRBO can do so, yet still have the ability of utilize the P25 system in an analog operating mode. Users with neither analog or digital VHF capability can participate through the use of a low cost micro-bridge such as the NCS-C250 (See www.info4u.us/ncs250).

Any VHF user could have access to this system. This would allow simple and affordable interoperable communications between Law Enforcement, EMA, EMS, Fire, and Transportation users in times of emergency

CURRENT EQUIPMENT COST

Of all the alternatives available, continuing to operate as you are now is most likely the most expensive choice you can make. Why is this? Mainly, it is the result of an increasing dependency upon public communications services such as SouthernLINC or Nextel services to make up for the inadequacies of your current radio system. Not only are these services expensive, they have proven to be totally unreliable in times of emergency.

We are not privileged to the details of your operating budget, but we can make some general assumptions and you can correct our figures as applicable. In a typical budget for a rural Sheriff's Department, we would assume 2-way radio replacement cost at $2,500 per year with maintenance being a similar amount for a total of $5,000. Adding the cost of cellular push-to-talk service would add another $10,000 for a total of $15,000 per year (I am assuming 20 people equipped with SouthernLINC or comparable communicators for the purpose of this estimate.

CHANGING TECHNOLOGY

The Federal Communications Commission originally had a requirement that all manufacturers had to offer 6.25 kHz channel spacing by January 1, 2011. This was later rescinded for reasons that will not be discussed at this time. This is a significant technological advance from the current 25 kHz standard and even goes beyond the mandatory user requirement for 12.5 kHz operation by 2013.

Currently, there are only two manufacturers offering 6.25 kHz equipment in the U.S. and neither meets federal agency P25 digital guidelines. Only one technology has the ability to function at 25 or 12.5 kHz in an analog or digital mode and only one has a defined migration plan to federal agency approved 6.25 kHz standards. That technology is P25!

Motorola offers a trunked version of P25 that has no compatibility with other P25 radios. Some will recall that the original intent of the P25 operating platform was, and is, to develop a system network that would provide open access to any manufacturer desiring to produce equipment in accord with this standard. Equally important, P25 was developed by a group of people representing users, engineers, manufacturers, and associations to develop low cost digital communications systems. To choose a technology that does not meet these objectives seems to be contrary to the original intent.

There are some good systems available that for now are less expensive than P25. The 6.25 kHz FDMA technology developed by ICOM and Kenwood is a good example. MotoTRBO is another. Both are digital systems but like P25, there is no established standard for trunking, satellite receivers, or trunking.

LTR trunking is a great analog technology that has been around for years. If is efficient and affordable, but does not address the new digital standards required for narrow band (12.5 KHz required by 2013) or ultra narrow band (6.25 kHz originally required by 2018).

Only two cellular companies are offering iDEN push-to-talk technology. The largest (Sprint/Nextel) is moving to more advanced technology. That leaves only SouthernLINC using this technology in the U.S. As production numbers go down for the manufacturer, support will diminish and prices will go UP!

After reviewing all of the available technologies, we are convinced that the way to go is P25! If you would like to know more about P25, how and what it was developed, and why we believe it is the best choice for those desiring to migrate to digital technology, we invite you to visit www.info4u.us/APCO25.

In some cases, the requirement is simply to improve coverage, in particular for portable radio operation. There are ways to do this without going to a digital system. Some of the alternatives, such as LTR Passport are quite sophisticated. Some, such as the TR-50 require no system infrastructure cost at all. The following will provide a general overview of what you can expect to pay for some of the more popular alternatives.

NEW EQUIPMENT COST

There are several ways to improve coverage. Some are practical, some are not. One of the least expensive "fixes" to poor portable communications coverage is the use of a mobile repeater such as the HYT TR-50.

In essence, the TR-50 is installed in each vehicle for the purpose of picking up calls from portable radios and repeating them through the mobile. If dispatch can be heard on a portable and a mobile can talk back from a specified location, the TR-50 is a simple and affordable solution at approximately $1,000 per vehicle. Additional information is available at www.info4u.us/tr50cpr.pdf. The benefit to this system is that no additional infrastructure is required to support extended portable coverage.

The second alternative is to install a new high powered analog watt base station near the center of the county with one or more secondary repeaters as shown in our previous system diagram. Without getting into system design, we can say that the cost of such a system, excluding antenna support structures could be estimated at approximately $25,000 as compared to $60,000 for a P25 digital/analog system. Reprogramming of existing equipment would be included in this estimate. The advantage to this system is that you could continue using existing analog equipment.

One of the more pricey alternatives is known as LTR Passport Trunking. In essence, you throw all of your frequencies (police, fire, etc.) under the control of a big switch. This is similar to EDACS and SmartNet except it is analog. It is relatively expensive, is not P25 compatible, and not a good long term investment in our opinion. A typical three site system, excluding antenna support towers would be estimated at $75,000 to $100,000. The advantage of this system is that it would allow county wide direct coverage between portables with no channel switching required. The system is simple to operate, relatively inexpensive to maintain and the portables are very affordable (A good quality LTR portable would typically cost under $500). The downside is that LTR is an analog technology and obsolete the day it is purchased.

Another alternative is known as simulcasting. In essence, this involves linking a network of stations together that all transmit at the same time. It's great in theory, but rarely works. It takes a lot of money, a lot of patience, and the willingness to virtually underwrite the operating cost of a service organization. A typical three site repeater system can easily cost a quarter million dollars and the cost of maintenance can work out to about the cost of adding another employee. Currently, the price of a portable will average between $1,500 and $3,500 – not a real good choice for rural law enforcement use!

One of the better concepts is the use of multiple extended receivers connected to one or more repeater stations. The premise is that the remote receivers can pick up the transmissions from handheld radios that may be able to hear the station but do not have sufficient power to talk back. Actually, this concept is economically practical, fairly simple to set up, and requires very little maintenance. The problem is that it is not compatible with digital technology and to invest is analog technology at this time is not recommended.

The better alternative, in our opinion, would be to construct a multi-site transmitting system using P25 digital technology, the only digital system that provides backwards compatibility with existing analog radios. In the U.S. there are several different types of digital systems. These include P25 at the forefront as well as FDMA 6.25, MotoTRBO, and in some areas, a European system known as TETRA. P25 and TETRA are *open standard* technologies, meaning that you have access to multiple vendors which generally results in lower prices. EDACS, SmartNet, SmartZone, and MotoTRBO are closed architecture with no competitive offerings. With the occasional exception of MotoTRBO, we generally do not recommend any of these close architecture systems.

If you are currently using 2-way radio, you are probably thinking about how to adapt to changing technology and regulatory standards. You're not alone. We've prepared a special report that provides direct side-by-side comparisons of FDMA 6.25 systems versus MotoTRBO and P25. We have attempted to be as objective as possible since we recognize that different users have different needs. If you are thinking about digital 2-way, we invite you to view this special report at www.info4u.us/Thinking.pdf.

P25 mobiles and portables are a little more expensive than analog radios. On the other hand, they do a lot more. They talk further, are virtually immune to interference from analog radio, provide more secure communications with high level security and offer compatibility with text messaging and vehicle location devices. Additionally, P25 radios draw far less current than analog radios which results in longer operating cycles, extended battery life and reduced cost. On average, you can assume a cost of approximately $1,200 for either a P25 digital portable or mobile radio. System infrastructure cost for a typical three site system is estimated at $60,000 if you take advantage of the savings available on the Midland Alabama State contract. Additional information on the new Midland P25 products is available at www.midlandradios.us.

Now, the question is *how do you pay for all this new technology?*

GETTING MORE AND PAYING LESS!

An earlier reference was made to the cost of building a new digital repeater station network at an estimated cost of $60,000. Where do you find money to pay for this system? The fact is you may be already spending it by paying rental for cell phones, and trying to maintain a radio network that is past its prime. By our calculations, the typical rural Sheriff's Department is spending approximately $15,000 per year and you can expect this cost to increase over time.

Instead of spending $60,000 for new infrastructure, why not spend $14,400 annually for five years which will cover the cost of purchasing, installing, and maintaining a brand new system that will provide portable radio coverage throughout the county. That breaks down to just $1,200 per month. Now, let's assume that you open up your system to municipal law enforcement users throughout the county. If each department pays just $200 per month (assuming four users), that would leave the county share aa $400 per month. This is virtually less than maintaining the cost of what you have and an outstanding value to participating municipal agencies.

So what about mobiles and portables?

For many years, public safety users have been on a treadmill of buying, maintaining, and replacing equipment and all the while putting up with delays in getting service, downtime awaiting repairs, and technological obsoleteness.

With the typical flat rate repair now averaging over two hundred dollars and on-site service being charged at one hundred twenty five dollars an hour or more, we have reached a point where the old ways just don't work anymore!

Let's look at another alternative. How about just paying $30 per month per mobile or portable radio? You don't have to worry about maintenance. It's included! You don't have to worry about downtime. You get a replacement the very next day! You don't have to worry about obsoleteness. You get a new radio every five years! Or maybe you don't need a new radio after five years. The radio is yours to use as you desire. You can resume with a new lease at any time. Now that's flexibility AND affordability!

$30 per month works out to $360 per year. My guess is that if you figure up the cost of maintaining and replacing your current radios, you will find that you are actually paying more for what you have and getting less! We haven't even addressed the cost of moving radios from one vehicle to another. With a good portable system, you may not need a mobile radio. After all, you don't have a mobile cell phone do you?

So why do you have mobiles? The answer is because your present system will not support portable only operation and besides, you've ALWAYS had mobiles. It's the right thing to do to pay for a portable and a mobile – or is it? We don't think so!

We haven't gotten into the details. That can come later. For now, the point is that you can have first class communications, most likely for LESS than you are now paying. That is a subject worthy of further discussion. If you agree, let's move to the next step of identifying your needs as well as other agencies in your county.

We are ready when you are!

Burch H. Falkner, At your service!

Communication 101

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