Narrowband and Interoperability Planner

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Falcon Direct

Sometime between now and December 31, 2012, all 2-way radio users will be required to reduce the bandwidth of their radios from 25 to 12.5 kHz, a process called *Narrow banding*. At the same time, public safety users are reviewing interoperability coordination with other users.

This unfunded mandate by the FCC can be a golden opportunity to update your communications system to provide capabilities undreamed of just a short time ago through the miracle of advanced technology.

The information contained in this Planner deals with the steps involved in modifying and upgrading an existing 2-way repeater system for compliance with applicable FCC rules while simultaneously addressing interoperability alternatives.

This planner primarily deals with a technology known as IDAS (ICOM Digital Advanced System) although similar planning guides are available for other systems including Analog, DMR (Digital Mobile Radio), P25 (Project 25) and RoIP (Radio over Internet Protocol). If you require additional information, please call us at 205.854.2611 or email sales@falcondirect.com. We hope you find this information useful.

DMR, IDAS, P25, RoIP

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INTRODUCTION

to Narrow Band Planning

You've heard the news. Every VHF and UHF 2-way radio currently in operation must be converted from 25 kHz operation (this is a designation for channel spacing) to Narrow Band (NB) operation before the end of 2012.

There are some individuals that may be telling you that you must purchase a specific type of digital radio to comply with this unfunded mandate which is absolutely untrue! One example of misinformation at its worst is available at http://falconinfo.blogspot.com/2010/03/doofus-of-day-awards.html. These statements were made by those who should know better, and this is just a sampling of what you may expect as manufacturers and dealers gather around for a feeding frenzy to sell new narrow band compliant 2-way radios.

Some of the representations being made are simply errors in interpretation or prior statements that have been outdated by changing polices of the Department of Homeland Security (DHS) in relation to grants, or in the case of the Federal Communications Commission, issues relating to regulatory operational compliance issues. Other information is flat out wrong either through lack of knowledge on the part of the presenter or a hidden agenda to promote a particular brand or technology.

You can expect to be subjected to a lot of "spin" as evidenced by the reference link above. You can also expect some subtle revisions in the area of interpretation. The fact is that information is evolving and for that reason, we maintain a special site at http://falconinfo.blogspot.com where you can go for more information on narrow banding, digital system types, FCC issues, and grants. Just type in the name of desired topic, such as FCC, in the Search box at the upper right hand side of the site for a listing of all available information.

With a good solid knowledge on background and facts, you can make a more informed decision on how to best plan for your individual needs. If someone tells you there is only one solution, be very wary. There is ALWAYS more than one solution. Admittedly, you may not be an expert in regulatory issues, technology, or grants; but there is much information and a few trustworthy individuals who can make the task of communications planning a little easier.

This information has been prepared specifically for those involved in public safety whether that involves fire and rescue, law enforcement, transportation or utilities. In times of emergency, all must work together whether at the state, county, municipal, or rural volunteer level. Our objective is to help you develop a communications plan that can serve your needs over the next decade, capable of being implemented on a phased approach as resources allow.

The information contained in this Planner assumes that you are a public safety licensee using an existing VHF or UHF repeater. The examples given in this Planner assume the use of NXDN technology. The planning process is very similar for P25, DMR, and TETRA. We'll discuss this in more detail later. Let's get started!

The Switch to Narrow Band

Falcon Direct has published much information on planning for an efficient and affordable migration from the current regulatory and technical standards of 2010 to those that will impact many VHF and UHF 2-way radio users as early as 2011 and ALL users by the end of 2012.

For most users, the general thought is that the main concern is simply switching from an operating bandwidth of 25 kHz to 12.5 kHz, and ultimately to 6.25 kHz. The switch to 12.5 kHz is mandated for 2013 and switching to 6.25 kHz originally proposed by the Federal Communications Commission (FCC) for 2018 although no date certain has been established for the VHF and UHF bands at this time.

It should be kept in mind that reducing bandwidth has the benefit of providing more useable channels within a fixed operating range while recognizing that such a reduction results in reduced audio, and secondarily, lessened operating range. Accordingly, while the FCC does not require the use of digital technology for 2-way radio communications, the fact remains that digital has some significant operating advantages over analog. For this reason, the trend is toward digital as it has already been established in cellular and TV broadcast communications (with AM and FM broadcast radio close behind). The U.S. Government has already switched to digital 2-way with the established standard based on APCO-25 (P25) technology. See www.info4u.us/Top-5-Reasons.pdf for more information on why many users are switching to digital without waiting for regulatory mandates.

All agencies of the U.S. Government are required to purchase only P25 equipment. This standard is also applicable to the purchase of 2-way radio equipment funded by 2009 Assistance to Firefighters grants as approved by the Department of Homeland Security (DHS) state operating plans. Having said that we should point out that it is not our role to provide legal interpretations or to act as a watchdog for compliance issues. For those that are interested in such things, we invite you to visit several of our resource sites as follows:

For more information about APCO-25 (P25), please visit:
http://www.info4u.us/APCO25

For information relating to AFG communications funding, please visit:
http://falconinfo.blogspot.com/2010/02/important-message-concerning-fire.html

In addition to P25, there are seven other digital operating standards available, or soon to be available, in the USA. They are as follows:

DMR (Digital Mobile Radio). Originally, a European standard, is most commonly known in the USA as MotoTRBO. A new offering, known as Hytera is also available in the USA. More information is available at www.info4u.us/DMR.pdf.

ISDN radios are a low powered technology available primarily for portable radios used for on-site use. The primary supplier is Motorola with a product known as the DTR Series (DTR550 and DTR650). More information available at www.falcondirect.com/DTR.

NXDN (known as dPMR in Europe) is a technology jointly developed by ICOM and Kenwood. This is the only technology available today in the USA designed for single channel 6.25 kHz operation. More information is available on the ICOM offering at www.icomfuture.com.

PNDS (Public Network Data Systems). One of the changes evolving is the elimination of a difference between voice communications and data communications. Traditionally, voice communications has been thought of as being analog while GPS and messaging was considered to be digital. Today, they can ALL be digital and in some cases, the use of the Internet plus GPS and messaging can completely eliminate the need for voice communications.

Currently, there are three operating models for personal communications. These include PMD (Private Mobile Dispatch), (CNS) Carrier Network Systems, and SCS (Shared Cost Systems). Traditionally, public safety users have favored PMD systems since there are no monthly charges. To some degree this has changed with the utilization of data air cards used with mobile computing systems as well as wide area push-to-talk communications services such as Nextel and SouthernLINC. The shared cost concept, originally developed in Illinois and Florida allows government entities (generally at the State level) to partner with a manufacturer to build complex wide area systems and pass the cost on to the users. See www.info4u.us/InterOpPlan.pdf for more information.

One of the more interesting applications of PNDS technology is offered through a device known as a CoPilot which works in conjunction with a public data network (normally Verizon), the Internet, and a systems management company (US Fleet Tracking in this example). The user is provided with a single device that provides driving instructions and predicts arrival time. Dispatchers know the location of all vehicles in the field and can dispatch calls via a keyboard and receive status messages from field units with no voice communications required. The true operating cost from small fleet users can often be LESS than operating a conventional 2-way radio system coupled with increased efficiency. Additional information is available at www.info4u.us/CoPilot.pdf.

RoIP (Radio over Internet Protocol) is based on the idea that every 2-way radio will ultimately have an IP (Internet Protocol) address. This will allow computers and radios to function as a single operating system. Additional information on the ICOM version of RoIP is available at http://icomfuture.com/RoIP.aspx.

SDR (Software Defined Radio) is a fundamental change from a hardware device limited to operating specifically for a designated frequency range. SDR represents the initial step in the development of personal communications from a device to an integrated operating system involving the combining of communications and computers. For some interesting applications of SDR, please visit www.info4u.us/EXTender.pdf.

TETRA is an international standard, very popular in Asia and Europe. This technology, recently, introduced in the USA, by HYT America is favored by many utility users although generally unknown by Public Safety (who favor P25), Railroads (who favor NXDN) or the general business community that has not yet established a standard. For additional information on TETRA, subscribe to our Blog at http://falconinfo.blogspot.com or sign up for our eNewsletter at www.falcondirect.com/SignUp.

Which technology is best for you? Only you can make that decision, but we encourage you to make your decision based on facts, not an unbalanced sales presentation whether presented by us or someone else. Any supplier proposing a single solution for all users is not on your side!

For example, many users will elect to stay with analog technology. Is this wrong? We don't think so if you choose the right analog equipment. Sometimes, the right decision may simply be to purchase inexpensive analog equipment with the thought in mind to convert to digital when a common operating standard evolves. There are some excellent choices available in analog systems. For additional information, check out our web site at www.the-end-of-confusion.us.

Summing it all up

At this point, most existing 2-way radio users will conclude that the immediate objective is to select the digital technology best suited to their long term objectives (generally DMR, NXDN, or P25). Once this decision has been made, the next step would be to file for an FCC license to allow operation in compliance with proposed FCC narrow band standards as well as the selected digital technology. The next step would most likely be the selection of a new base or repeater station capable of meeting your long term objectives on a phased approach.

Planning For the Future

Now that we have this narrow banding thing behind us, we can direct our attention to developing a plan that fits your individual needs. In 2009 we prepared a basic migration plan that covers the essentials (See www.info4u.us/PathwayPS.pdf) but we understand that many of our users want to go beyond the basics to more advanced capabilities. For the sake of keeping things as simple as possible, let's assume that you have chosen NXDN as your preferred technology, or more specifically, IDAS (ICOM Digital Advanced System) beginning with a fundamental objective of purchasing a replacement for an existing repeater.

The basic intention is to replace an existing analog repeater with one capable of meeting mandatory and planned technical standards, improving portable communications, keeping cost as low as possible, and planning a path to trunking and computer integration as needs change.

For comparison purposes, let's assume that you have a typical "repeater" consisting of a couple of mobile radios, a power supply, duplexer, high gain antenna system, and a high power amplifier. Without getting too technical, let us share with you the writings of Stan Wright of Eureka, Indiana who describes the process of what he did to build a repeater for his fire department. See www.eurekaboy.com/electronics/repeaterbuild.htm. Many users have current repeaters very similar to this.

The problems many of these users share in common are as follows:

1) Repeater or repeater radios cannot be narrow banded. Even those that can be narrow banded often do not have the ability to compress the transmission to reduce noise (a process called compandering) or lack the receiver sensitivity to work effectively with portable radios.

2) Many existing repeater stations were designed for mobile, not portable use, which means that they use the highest possible power (typically 100 watts) coupled with duplexers designed for maximum filtering (Filtering is the function of a duplexer which protects the radio receiver from spurious RF emitted by the transmitter). The problem is that this "maximum filtering" can often reduce the sensitivity of the receiver, resulting in poor talk-back range from portables.

3) Antennas were generally selected for maximum gain with no consideration given to local topography. A high gain antenna, such as the DB-224 located on a tower much higher than average terrain may actually not perform as well as a lower gain inexpensive antenna with better down tilt.

4) Unfortunately, antenna cables and connections rarely were understood as being a critical part of performance. As long as the price was right and the cable connected the antenna to the radio, the system was complete. The problem is that the people who placed the connectors to the cable were often unskilled in what appeared to be a minimal task. The selection of cable generally did not address the advantages of copper over aluminum, foam dielectric efficiency, weather securing outside connectors, or securing the cable to the tower to avoid wind damage. Other considerations, such as dB loss were rarely considered.

The overall conclusion is that there could be a problem, not only with the repeater radio(s), but also the duplexer, the antenna, and the cable/connectors. We understand that it doesn't make sense to throw out everything (unless you have an unlimited budget). For this reason, we suggest that you begin with the replacement of your existing repeater radio(s) as a logical first step toward *narrow banding* and proceed from there.

Narrow Band Implementation

For now, we will assume that your duplexer, antenna, and cable system are OK and that you have AC power available capable of operating a 50 watt radio. We understand that you may presently be using 100 watts. We also understand that a high power transmitter often creates more problems than it solves. That is why, in Europe, transmitters are typically limited to 20 watts and often as low as 5 watts. Many are surprised to find how well these systems work. For now, we will just say that it is a combination of high spec radios (reduced transmitter spurious radiation coupled with very sensitive, well protected receivers).

We propose to provide a new repeater station by ICOM which has adjustable power levels for low (7-10 watts), intermediate (10-25 watts) and high power (25-50 watts). If we are replacing a system currently using a 100 watt amplifier coupled with a pair of mobile radios or an older analog repeater such as the Motorola GM300, we will set the power of the new ICOM repeater to the level required to be used with your existing 100 watt amplifier.

We prefer to eliminate your 100 watt repeater (if you have one) and use the ICOM repeater set to 50 watts, but the ultimate decision is with you. The price of the ICOM UR5000 repeater is $995 excluding power supply, duplexer, antenna, and cable system. Operating at 50 watts with a self contained repeater provides improved talk-back range from portables and near equal talk-out range to a 100 watt amplifier since connector cable losses to the amplifier are eliminated. Further, spurious radiation from the amplifier is also eliminated. The result is better performance with less power.

URFR5000 50 Watt Repeater Front View

URFR5000 50 Watt Repeater Rear View

As you will note from the pictures above, the URFR5000 is small, simple and efficient. It comes programmed to your repeater frequency for both analog 25 or 12.5 kHz operation as well as 6.25 kHz NXDN digital operation (i.e. your old analog radios can talk to your new digital radios as well as allowing your new digital radios to communicate PRIVATELY as desired at the individual, group, or fleet level).

The URFR5000 measures just 2.7" high, 7" deep and 6.7" wide and this includes a cooling fan! There is nothing to adjust. Just connect the duplexer Receive input to the Type N connector shown on the left of the rear view above and the duplexer Transmit input to the Type N connector shown at the right of the rear view above. A DC power cord is supplied (next to Transmit input connector) for use with your existing power supply.

Up to 32 work groups can be handled by the standard URFR5000 on a single channel. As we said before, **this incredible repeater replacement station is just $995!**

Incredibly, this station is compatible with the later addition of trunking, RoIP (Radio over IP) connection to computers, receiver voting systems for extended portable radio talk back capability and automatic vehicle location systems (AVL). We invite you to review special informational material on LTR trunking, the most popular system in the USA at www.info4u.us/LTR.pdf. We will go into more detail on AVL, voting systems and RoIP shortly. On the next page we'll look at a more advanced "repeater"

The URFR5000 is a truly unique product in that it is by far the lowest priced 50 watt repeater available anywhere but totally in a class by itself in terms of functionality with up to 32 talk groups, analog AND digital NXDN capability, 25, 12.5, and 6.25 kHz channel spacing. The small size makes it ideal of a backup repeater and we even use it as a vehicular repeater (See www.info4u.us/I-Box.pdf). As good as it is, we believe the CY5000/6000 Series repeater is even better!

At first appearance, the CY5000 VHF repeater looks like a URFR5000 mounted on a fancy panel. The fact is that it is a WHOLE lot more than that. A look inside tells the story a little better.

Inside this desktop or rack mountable cabinet is a URFR5000 plus an AC power supply, a built in duplexer and another gadget called a *preselector*. You will recall an earlier reference to the fact that most repeaters now in service were built to communicate with mobiles, not portables. Logic dictates that a 5 watt portable can't have the same talkback range as the talk out power of a base station UNLESS you figure out some way to sharpen up the incoming signal from the portable. For additional information on the function of a preselector, please see http://en.wikipedia.org/wiki/Preselector.

Looking at the CY5000 from the top, we can see the URFR5000 at the center left and the power supply to the far left. At this point, this is little more than a basic UR-FR5000 repeater with a power supply and housing. Now, we add a few things, beginning with an internal duplexer. This duplexer is especially designed to be installed inside the CY5000 housing. It goes in the space at the right side of the UR-FR5000. It can handle a full 50 watts of power with minimal loss and good isolation to keep spurious power from the transmitter from desensitizing the receiver. We are suggesting that you include this duplexer even though you may already have a duplexer (more about this later).

The next thing we add is the preselector. It goes right alongside the duplexer, connected by an internal wiring assembly. Now we have a completely self contained repeater system specifically designed to enhance the use of both mobile AND portable radios. **The price for this complete system is just $2,995 complete!** In the long run, your investment will be justified!

Perhaps an additional comment on duplexers might be in order. The function of a duplexer is to allow a radio transmitter and receiver to operate simultaneously rather than pushing to talk and releasing to listen as you do on mobile, portable, or half duplex fixed station radio. In essence, the duplexer is a filter with one side filtering the transmitter and the other, the receiver.

Selection of a duplexer is based on insertion loss (too much filtering reduces range), size, and obviously cost. Frequency separation is another consideration. Normal frequency separation for UHF is 5 MHz between the transmit and receive frequencies. VHF has no set separations but whenever possible, it is desirable to get a spread of 3.5 MHz or more. More separation is good. Less separation often requires a more expensive duplexer.

We are pretty particular about our choice of duplexers, antennas, and related accessories. In general, we prefer products manufactured by Sinclair Technologies. Additional information is available at www.falcondirect.com/daniels/sinclair.

It should be mentioned that we do not recommend the DB224 antenna or anything like it since it uses an exposed dipole construction (i.e. the radiating elements and connected by cables that are subject to weather damage (moisture, corrosion, etc.) as well as increased inter modulation potential. We prefer antenna designs with enclosed radiating elements such as the Sinclair SC229 which is described in the aforementioned web link. The SC229 features an extremely low PIM (Passive Inter Modulation) capability which can have a significant impact on performance. More info on PIM is available at: www.sinctech.com/white_%20papers/Intermod%282%29.pdf.

When your budget does not allow the purchase of the SC229 (It's a little pricey at $1,095), we offer an excellent alternative with the **ZTenna priced at just $295**. This is a great product – UPS shippable, low PIM, solid construction, and superior performance. More information at www.info4u.us/SuperTennas.pdf.

The biggest single reason for failure of base and repeater stations is power (or more correctly, lack thereof). We recommend AC line protection for sags, spikes, and surges as well as lightning protect on the antenna transmission line. Backup emergency power generators are nice to have but expensive and unreliable. A simple battery backup system with an effective alarm notification system is highly recommended. Our exclusive AC-Reporter is especially useful for this purpose. The complete package is **just $653**! Additional information is available at www.info4u.us/SiteProtect.pdf.

The biggest single reason for deteriorating performance for a 2-way radio system is an improper selection of the antenna transmission line system and/or incorrect installation of connectors on the transmission line.

If your transmission line has been in use for five years or more, we recommend replacement. Further, we recommend that the connectors be installed by the manufacturer or distributor. If you are installing the system yourself, be SURE and use a good sealant as recommended by the manufacturer on all outside fittings with weather proof tape wrapped around these connectors.

The transmission line should always be secured to the antenna support structure with the shortest possible length of cable run horizontally (if required). Use the cable ties offered by the manufacturer. Duct tape is good for a lot of things, but not generally recommended for securing transmission lines. Do the job right the first time. It can save you a lot of money later on!

There are three commonly used transmission lines – RG213 for short runs, LMR-400 for lengths of up to 150 feet, and, if budget permits – The better quality cables which use a solid core copper center conductor, foam dielectric, and an insulated copper outer shield. There are a number of manufacturers. Our preference is known as Heliax.

Heliax was developed in the USA by the Andrew Corporation and it is the standard for the world in communications transmission line. We recommend 1/2" Heliax for lengths of up to 150 feet at a cost of **$2.50 per foot plus $75 for the required connectors**. For runs between 151 and 250 feet, we recommend 5/8" Heliax at a cost of $4.00 per foot plus $100 for connectors. For lengths of 250 feet to no more than 350 feet, we recommend 7/8" cable at $5.50 per foot plus $125 for connectors. For lengths over 350 feet, call us at 1.800.489.2611 for a quote.

We got off topic just a bit to address the importance of duplexers, pre-selectors, antennas, and cable systems. The fact is that they are a vital part of any base/repeater system and your planning should include these items. Now, let's return to our original topic of narrow band communications.

Competitive Comments

An earlier review of the different types of narrow band compliant systems was briefly discussed. To refresh your memory, we are of the opinion that NXDN, and in particular, IDAS by ICOM is the best of all systems in terms of investment return, operating features, and compliance with 6.25 kHz technical standards. MotoTRBO and P25 are also very popular in the USA and we thought it was important for you to review these other technologies before moving on to options available for basic base/repeater stations.

If you are planning to spend federal grant dollars, and in particular, grants involving 2009 Assistance to Firefighters (AFG) funding, you should know that P25 is the only technology approved UNLESS you have WRITTEN permission to switch to an alternate technology. We offer some of the best choices in the world for P25 equipment, and in fact can supply mobiles and portables for under $1,000 each as well as repeaters typically costing 50% less than competitive offerings. Additional information on our P25 offerings is available at www.info4u.us/Ready4P25.pdf. Our earlier comments on duplexers, transmission lines etc. would apply to P25 as well as DMR (Hytera and MotoTRBO) systems.

Operationally, NXDN and P25 have similar characteristics with the major exceptions being that P25 is considerably more expensive than NXDN and at this time, NXDN is the only technology offering single channel 6.25 operating capability. Just remember, NXDN is NOT approved for 2009 AFG funding without written approval. For additional information, you may want to review a recent Blog comment on this subject written in response to published comments by a NXDN supplier (not ICOM). See http://falconinfo.blogspot.com/2010/02/we-couldnt-help-but-notice.html for additional information.

In general, MotoTRBO (or DMR if you prefer) and NXDN have similar operating characteristics. In some cases, MotoTRBO mobile and portable equipment may be offered at slightly lower cost than NXDN (known as dPMR in Europe and the Middle East). Single site repeaters are comparably priced with NXDN, but if you are considering expanding your system to voting receiver, trunking, or RoIP capability; there is a HUGE price advantage in selecting NXDN, and in particular the IDAS system by ICOM.

We have installed some of the largest MotoTRBO systems in the USA, but we do not feel that this technology is well suited for public safety requirements. MotoTRBO is especially well suited for the hospitality, manufacturing, and transportation industries, but the inability to provide single channel 6.25 kHz capability, lack of 2-tone paging, and the inability to provide mixed mode operation through a repeater limits this technology for public safety. Additional comments are available at www.info4u.us/FDMA-TDMA-Comparisons.pdf.

The main point we would like to make at this time is that we offer all three technologies. MotoTRBO, NXDN and P25 all have their place and represent a significant advancement in improved performance, more efficient use of channel spectrum and the potential of merging RF communications to the power of the computer. Clearly, the merging of communications and computers is a long established concept (NEC started in 1990) that is coming into reality NOW! We will be discussing this in more detail shortly.

The cost for empowering the converged technologies of communications and computers, at least in our opinion, is NXDN, and in particular IDAS by ICOM. However, if you would like more specific information on MotoTRBO or P25, just give us a call at 205.854.2611 or email sales@falcondirect.com. We'll be glad to assist in any way possible.

Now it's time to move on to our next topic – the selection of subscriber equipment (mobiles and portables for those of us who are not up to date on some of these new terms like legacy, interoperability, and infrastructure). Here we go…..

System Subscriber Equipment

You essentially have three choices in the selection of NXDN compatible mobile, desktop, and portable radios. You can purchase analog only equipment at significantly lower cost than digital (although we question the long term benefit of such a decision). Suffice it to say that you can purchase such equipment starting at well under $300. Your second option is to purchase analog equipment that can be upgraded to digital for under $500 or you can purchase full NXDN compatible equipment for under $700.

If you would like additional information on our personal choices for analog only economy radios, please visit www.info4u.us/BestChoiceRadios.pdf. We also have some good choices in other radios including a compact waterproof pager/radio for LESS than the cost of a good monitor pager, and a radio that can be upgraded from analog to NXDN digital on a special comparison guide at www.info4u.us/NB-Portables.pdf. In particular, take note of the F3161, priced at $495, which can be upgraded from analog to NXDN digital.

There are currently no digital voice pagers, but since the IDAS system can be operated in both the analog and digital modes, a conventional voice pager such as the new WatchDog pager by US Alert can be used with page encoding capability available on all our ICOM mobile and portable radios. Additional info is available at www.info4u.us/WatchDog.pdf.

Now let's take a look at our IDAS analog/Digital subscriber radios. For fixed station use, an AC power supply and desk microphone is available as well as a full line of inside and outdoor antenna systems. The prices shown below are typical selling prices. Government and quantity purchase users may be eligible for better pricing. Call us at 205.854.2611 or email sales@falcondirect.com for more information.

IDAS Mobile/Base Radios

The F5061D VHF and F6061D UHF radios provide outstanding value in mobile communications with up to 50 watts of power, 512 channels and a large LCD alphanumeric screen. They can operate at 25, 12.5, or 6.25 kHz channel spacing in either analog or, digital modes with mixed mode capability and a totally new feature called voting scan. It's kind of like a free trunking system which uses the S-meter level of repeater stations and automatically selects the strongest station or the first station to exceed the preset S-Meter level. We'll discuss this more on the following page. Enhanced MDC-1200 is standard on the F5061D and F6061D series radios at no additional cost as is CTCSS, DPL, 5-Tone, and 2-Tone paging encode/decode in the analog mode. Additional information is available at www.info4u.us/F5061.pdf. **Both the F5061D and F6061D are priced at $695**. An optional rear mount kit, AC power supply or desk microphone adds $129 each for fixed station use. See www.info4u.us/xyztennas.pdf for information on optional antennas.

IDAS Portable Radios

The F3161D VHF and F4161D UHF radios provide outstanding value in portable communications with 5 watts of power in both VHF and UHF, plus the ability to trunk in either or both LTR and digital modes (The F5061/6061 mobiles also have this feature. They can operate at 25, 12.5, or 6.25 kHz channel spacing in either analog or, digital modes with mixed mode capability and voting scan. Both radios include CTCSS, DPL, 2-tone paging encode/decode and single button switching from wideband to narrowband. More information is available at www.info4u.us/F3161.pdf. Two models are available – **the standard model is $695** and the full keypad model is $745 Both models include a high capacity Lithium-Ion battery and rapid desk charger. An optional speaker microphone or spare battery adds $69 each. A five year warranty extension is available for $57 per unit additional.

Advanced Systems

Other than obtaining an FCC license modification for narrow band digital operation (we are assuming that you are already licensed by the FCC), your system would be completely upgraded to the latest technology by following the guidelines on the preceding pages. If you are not familiar with the process of upgrading your FCC license please go to http://www.info4u.us/Narrowband_FAQs.pdf. You NEED to do this BEFORE January 1, 2013. Remember – If you haven't converted to narrow band and changed your license to reflect that conversion, you can no longer operate your system even though you have a license authorizing 25 kHz beyond December 31, 2012.

Now, let's move on to some of the more advanced features of the ICOM Very Narrow Band (VNB) 6.25 kHz system. At this point, we will no longer refer to this as a NXDN system (which includes all participating vendors of 6.25 kHz operating systems). The subscriber equipment of ICOM, Kenwood, and Ritron all can operate on a common operating platform using open architecture. However, each manufacturer may use differing technologies for Automatic Vehicle Location (AVL), Computer to Radio Integration (Commonly known as RoIP), Receiver Voting Systems for extended talk-back communications, and Trunking (Multi-site-control). We will address each of these functions in order of importance for the majority of those we serve, beginning with AVL.

Automatic Vehicle Location (AVL). This is one of the most misunderstood technologies as to what it is expected to do and what it really does. We'll do our best to separate fact from fiction by giving a few examples.

Those familiar with the MotoTRBO system by Motorola know that GPS is available as an internal feature on some mobile and portable radio models. It could be assumed that this means the subscriber (mobile and portable) radios are capable of reporting their position using dual slot (i.e. two 6.25 kHz "slots" – one for voice and the other for data) operating on a 12.5 kHz narrow band channel). That is partially correct, but necessarily what you might first understand.

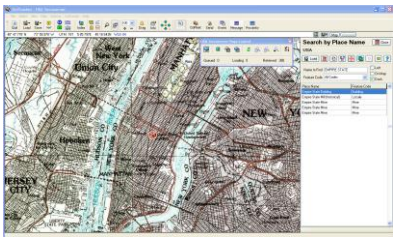
First, there is the matter of cost. The portables require a special dual function antenna (one part of the antenna is used for communicating voice and/or data and the other part is dedicated to the reception of GPS satellites which are required for determining the user location). The cost of the portable antenna is about the same as any other portable antenna, but the mobile antenna can cost $100 or more. Or, in more simple terms – about four times the cost of a standard mobile antenna. The real increase in cost is the installation of back office equipment at the dispatch center. You will need a dedicated computer with monitor, Internet access, a system management software program, a licensing fee for each "seat" or connected radio, and a significant amount of time and expense associated with setup and training.

ICOM provides the GPS receiver as an external, rather than an internal feature. The general thought is that by separating the 2-way radio from the GPS; the cost of troubleshooting, maintenance, and antenna cost could be reduced. Readily available GPS replacement mobile antennas are inexpensive and easy to replace. Rather than being restrained to the use of a limited range mobile antenna, the user has the option of using a high efficiency mobile antenna, such as our XTenna. For more information, see http://www.info4u.us/xyztennas.pdf.

The majority of those we serve are involved in public safety, transportation, or utility activities. As a result, the location of a vehicle equipped with a mobile radio will generally suffice for field reporting purposes. However, personal location capability is available through the use of optional speaker/microphones equipped with internal GPS receivers and antennas. Accordingly, we will confine our current discussion to mobile AVL technology although a GPS microphone is available for the F3161/4161 series portables. Additional information is available on request.

The Quick Silver GPS module plugs directly into the F5061 and F6061 series radio to allow IDAS radios to send the current position information to dispatch (A similar option is available for the F121 and 221 series analog radios. Simultaneous status message and GPS data can also be sent. When connected to a PC installed with a mapping software application, the dispatcher can know the real-time activity of all vehicles in the fleet. **QS/GPS - $180**.

The first supplier, to our knowledge, of AVL equipment for IDAS radios is Boyce Industries of Queensland, Australia (www.boyceindustries.com.au). This system is based on the use of the Quick Silver GPS module or an AVL microphone such as the ICOM HM-170GP. Additional information on the Quick Silver GPS module is available at www.info4u.us/qsgps.pdf.



Our personal choice for GPS software used on ICOM radios is Spectrum Digital Imaging Ltd. of Vancouver Canada. Spectrum Digital offers an efficient and affordable GPS tracking and messaging system known as the OziTracker which is available through Falcon Direct. A User Manual that thoroughly describes the operation of this system is available at www.info4u.us/OziTracker-Manual.pdf. The entire system is software downloadable and easily set up.

In general, the OziTracker is extremely affordable in comparison to some of the other competitors – just $1,900 for system software and licensing covering up to fifteen radios (mobile or portable). If additional radios require software, add $100 per radio, or less for large fleet operations. Call us at 205.854.2611 or email sales@falcondirect.com for specific requirements.

An extremely efficient and affordable vehicle tracking system known as SimpleTrack is available for use with ICOM F121/221 Standard and S Series analog radios priced at **$357 each plus $180** for the UT-321IA plug in GPS board. A special base station unit priced at just **$1,140** is used with this system (the model F1721 03B EMDC).

The F1721 03 EMDC dispatch station radio connects directly to any Windows based PC, either desktop or laptop to display all vehicle activity on the monitor (desktop PC and monitor not supplied except as an option on request).

The dispatch radio includes a palm type microphone and power supply. An antenna is not supplied but inexpensive antennas are available as an option.

A SimpleTrack system brochure is available at www.info4u.us/SimpleTrack.pdf. It should be noted that both the F3161/4161 series radios with the Quick Silver GPS option and the SimpleTrack plug-in board for the F121/221 series radio used with the F1721 03 EMDC base stations operate in essentially the same way. BOTH systems require the OziTracker software system. The difference is that SimpleTrack operates on analog radio channels whereas the F3161/4161 series radios operate in the IDAS digital model. More information on the F121221 series mobile is available at www.info4u.us/F121.pdf.

As a final comment, we should mention that the software system can be set for automatic polling at intervals 6 to 20 seconds. Do yourself a favor. Do NOT use automatic polling. Set your system up for location ID when the mobile transmits, or when specifically polled by the dispatch operator. Your AVL system will work a LOT better by following this routine. We hope you have found this information to be useful! Call us if you have additional questions.

Trunking Radio Systems utilize three or more frequencies, placed in a resource pool, then making the first unused frequency available for a mobile or portable radio user needing to communicate with dispatch or other users. A basic trunking radio system involves a single repeater site with three or more repeaters managed by a *system controller*. This controller provides automatic dynamic channel assignments as required for mobile and portable radio users.

In each portable or mobile radio is an optional circuit most commonly referred to as a *logic board*. The logic board provides information to the system controller that allows the controller to determine who talks, when they talk, and to whom they talk. A more detailed explanation of an analog system known as LTR (Logic Trunked Radio) is available at www.info4u.us/LTR.pdf.

The purpose of trunking is to increase the probability of communicating when necessary along with privacy and selectivity. Instead of the police department having a channel, the fire department having a channel, and public works having a channel; trunking pools all of these channels as a deployable on demand resource. With a conventional single channel system, the channel is unavailable for more than one conversation to take place at the same time. With a trunked system, the original conversation on the first channel can be made in private by the police department. If a second conversation needs to be established for the police department, the resource controller connects the second pair of communicators on a channel "borrowed from the fire or public works.

The more channels you have in the pool, the more your chances improve for talking when required rather than waiting in line. The net effect is that each channel is capable of more use thereby increasing the probability of quick connection. The phone company uses this same principal. A hundred "private" numbers are commonly served by only ten phone lines! It's all based on a theory called Erlanger curves. It's been around for over a hundred years and is used in a variety of applications including medicine.

Now that we know what trunking is, and what it does, let's look at how it's used.

Single site – 3 or more repeaters located at a single site. The system can be analog (LTR) or digital (IDAS, MotoTRBO, or P25) as desired. These systems are most commonly used in casinos, hospitals, and small metropolitan areas.

Multiple site – Utilizes one or more repeaters at multiple sites to provide wide area coverage with the requirement for mobile or portable users to switch channels. Connection between the sites is required which can be by phone line, radio links, microwave, fiber optic cable, or the Internet. These systems can be designed to provide county wide or regional communications networks.

Multiple site Wide area – Consists of 2 or more multiple site systems connected to each other to provide regional, national, or even international coverage (Think Nextel). These systems use very complex (and expensive) switching terminals to control up to hundreds of stations. The analog systems normally use a technology known as *Passport*. Today, Internet Protocol (IP) is the more likely choice for digital radio systems.

Regardless of which system you use, or plan to use, the right choice for the first and last repeater station is the same – the ICOM FR5000 for VHF or the FR6000 for UHF operation.

You may recall that we have provided pricing on the UR-FR5000/6000 series as well as the CY5000/6000 series earlier in this presentation. So the question is *What's the difference in this IDAS station and the others*? Glad you asked – Now let us tell you the answer on the next page.

The major difference in the FR5000/6000 and other IDAS repeaters is the purpose. This repeater is built for trunking – either voting mode or dynamic assignment (more about this shortly). The radio transceiver portion is the same as the other repeaters with the notable difference that it has a display and controls to tell you what channel is being used along with the ability to change channels (up to 32) if desired.

Another big difference is the open space available for options on the FR5000/6000 series repeaters. We normally use this space to insert a dedicated power supply for each repeater.

You will recall that a minimum of three repeaters is recommended for trunking (5 to 10 is more common. Rather than using a common power supply for all repeaters, the system reliability can be enhanced by using individual power supplies for each repeater. We DO recommend a common antenna system. We will discuss this in more detail as follows:

For a single repeater, we use a single antenna and a duplexer for connection to the radio. In a trunked system, we do things a little differently. We use TWO antennas (one for transmitting and one for receiving). We do NOT use a duplexer. On the transmitter side, we use a *Combiner* which allows multiple repeater transmitters to be connected to a single antenna. On the receiver side, we use a *Multicoupler* to allow connection of multiple receivers to a single antenna.

A single FR5000 VHF repeater with internal AC power supply is **$2,454 each or a total of $7,362 for three units**. To this, we add the cost of a 30" high, 19" rack which allows us to mount three or more repeaters, one on top of the other as shown at the left. The cost of the rack is **$195**. We also have room for the aforementioned combiner and Multicoupler which will be discussed next. However, before moving on to the external repeater components, may we suggest a quick review of the IDAS repeater system which is explained at www.info4u.us/FR5000.pdf. As you will note, this brochure provides some alternative configurations, but with the same ultimate goal as the one defined herein – to help you make a smooth and efficient transition from analog to digital communications. Now, let's talk about those Combiner and Multicoupler things.

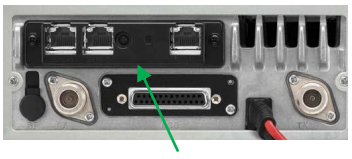
The picture at the left is an internal view of a device known as a *Combiner.* The function of a combiner is to allow multiple transmitters to feed into a single antenna. If you have more than one VHF or UHF station, a combiner can be a wise investment since you can eliminate the cost of additional antennas and transmission lines while simultaneously improving performance in many cases. In general, a combiner is most efficient when connected to four transmitters or less. The actual cost will vary depending on the frequencies to be used but for budgetary purposes, you can assume a **cost of $4,500** for a good quality three channel system combiner such as the Sinclair TC2214.

A *Multicoupler* is a device that allows multiple receivers to be fed into a single antenna. In addition to saving the expense of running multiple transmission lines and the cost of the antennas, performance is enhanced by reducing interactive effects between the antennas. The talk-back range of mobiles and portable radios can actually be improved since the Multicoupler contains an amplification stage that is not applicable in a duplexer or even in a direct antenna connection. A four channel Multicoupler such as the Sinclair **RM201 is $1,800.**

Let's recap now. We've taken care of our FCC licensing, purchased a three channel trunked radio system with 19" rack, combiner and Multicoupler with an equipment cost of $13,857 (maybe even a little less for government agencies and quantity purchase buyers). What else do we need? Other than an antenna support structure, two antennas, and associated transmission lines (See Page 8), nothing else is necessary except a little planning and a few optional items.

You may remember an earlier mention that our mobile and portable radios would operate on LTR on IDAS digital trunking systems. LTR is a three decade old trunking format designed for analog radios. The ICOM F5061/6061 mobiles and F3161/4161 portables both have LTR trunking as a standard feature. The digital models quoted on Page 9 have both LTR and IDAS digital trunking capability. This means they are compatible with older LTR systems, but for new systems, the preferred operating system would be IDAS trunking.

Our reason for pointing this out to you is that a trunking system needs a logic controller, both in the mobile or portable AND in each repeater. Historically, trunking controllers have been separate devices from the repeater made by third party suppliers such as Trident, Zetron, etc. Now, it is a simple plug in board that goes into the back of the FR5000/6000 station.



Rear view of FR5000 station with UCFR5000 module installed.

The UCFR5000 trunking controller board shown above simply plugs into the back of the radio to perform the functions of a network. Initially introduced at $1,500 to be competitive to LTR controllers, the price of the IDAS digital trunking board is no more than an analog LTR controller **just $1,500**! The initial version of this controller provides two separate functions. The first is a trunking controller which we are now discussing. This incredible device can also provide remote repeater management via the Internet. We'll be talking more about this shortly. For now, it is important to remember that the addition of one of these devices to each of your repeaters at a common single site becomes the brains to manage dynamic channel assignment.

At this point, we have budgetary numbers to apply to the planning and implementation to upgrade from an existing public safety analog repeater to digital. Here are summary prices.

System Description	Single Channel Repeater IDAS Upgrade - Price	High Spec IDAS Repeater System - Price	Three channel Trunked IDAS System - Price
Repeater	URFR5000 Repeater - $995	CY5000 Repeater - $2,995	FR5000 (2) - $7,362
Preselector	Not included	Included	Not used
19" Rack	Not required	Not required	$195
Duplexer	Use original	Included	Not used
Antenna	Use original	SC229 - $1,095	SC229 (2) - $2,190
Transmission Line	Use original	150' Heliax - $450	300' Heliax - $900
Combiner	Not applicable	Not applicable	TC2214 - $4,500
Multicoupler	Not applicable	Not applicable	RM201 - $1,800
Trunking controller	Not applicable	Not applicable	UCFR5000(3) $4,500
Site Protection	$653	$653	$1,620
FCC License	Not included – Assume $265	Not included – Assume $265	Not included – Assume $795
Installation*	Not included*	Not included*	Not included*
TOTAL PRICE	**$1,260**	**$4,458**	**$21,862****

*You can normally assume average installation cost at about 10% of equipment cost on existing antenna structures.

**Note: A three channel system with a single $1,100 redundant power supply, three URFR5000 repeater modules, a 19" rack, antennas, cable & transmission line systems, combiner and Multicoupler could reduce the equipment cost to as little as $18,170, even less with the alternate $295 station antennas. Both trunking system configurations are about the same cost as a SINGLE non-trunking P25 repeater, and considerably less than either MotoTRBO or NEXEDGE™ systems.

Vehicle tracking, either LTR or IDAS, is optionally available by adding a $1,140 base station and antenna as required. PC and Internet connection (not included) also required. A GPS microphone adds $349 to the cost of a standard F121/221 series analog mobile radio for LTR trunking, or to the $695 cost of an IDAS digital mobile or portable radio.

FCC Licensing

Upgrading existing 25 kHz analog radio systems to Narrow Band 12.5 or 6.25 kHz Very Narrow Band digital operation requires filing with the Federal Communications Commission (FCC). You can operate NB or VNB analog radios on a standard 25 kHz radio system with no modification of your existing FCC license until December 31, 2012.

After December 12, 2012, you must have your license modified to show that you are operating on 12.5 or 6.25 kHz and you must cease all operations on 25 kHz – No exceptions! On the previous page, we assumed the upgrade of a single channel repeater as well as three repeaters at a single location operating from a single license, modified from 25 kHz to narrow band. The modification can cover either 12.5 kHz or 6.25 kHz Very Narrow Band operating in either analog or digital modes.

In simple terms, you can operate analog NB radios on an existing license. You can NOT operate digital radios on an existing license whether it is 25 kHz, NB, or VNB unless you modify the emission designators (more about that in a moment). This applies whether your radio uses P25 (All brands and models, Phase 1 or Phase 2), NXDN (ICOM, Kenwood or Ritron), or DMR (Hytera and MotoTRBO). To make this topic a little easier to understand, we have prepared the following four questions and answers, beginning with the basic question of what does it cost to modify my existing license for narrow band?

By the way, if you've never heard of a Hytera, please visit http://falconinfo.blogspot.com, our Blog site, and type in the word Hytera in the search box at the top upper right hand side of the page. If you would like more information about the FCC rules and regulations, use the same search box and just type in the words FCC. Now let's proceed to the four most commonly asked questions and answers relating to narrow banding existing repeater radio systems.

Question:
What will it cost the typical 2-way radio licensee for converting VHF or UHF systems currently licensed for 25 kHz operation to 12.5 kHz to narrow band, either analog, digital, or both?

Answer:
There are three answers to this question depending on whether you are classed as a business/institutional user ($400), public safety/governmental tax exempt ($265), or public safety non-tax exempt such as volunteer fire and rescue squads for example ($325) per license, per call sign.

Question:
What would be the cost for adding a second repeater for a customer with an existing VHF or UHF 25 kHz repeater. Cost to include upgrading existing license to narrow band along with the new repeater and associated mobiles.

Answer:
Generally, this question would normally be asked by a public safety user. The narrow banding of an existing repeater would be included at no extra charge when adding the new repeater. The cost will depend on whether the user is tax exempt or non-exempt. Add $60 to the costs listed below for non-exempt (private ambulance services, volunteer fire departments or rescue squads).

There are four public safety coordinators, each with frequencies in their assigned pools or frequency banks. All have different fee schedules. AASHTO charges $460.00 per frequency pair per location, APCO $420.00 per pair per location, IMSA $400.00 per pair per location, and FCCA $380.00 per pair per location. Normally we choose to file first with FCCA since the fees are less.

When an application has been submitted to the designated public safety frequency coordinator (normally FCCA) the frequency pool for that coordinator is reviewed for NEW frequencies. If, after exhausting the common public safety pool and their own specific frequency coordinator allotment pool, it is found that no frequencies are available, it becomes necessary to search for a frequency from another public safety coordinator with their concurrence. If this is required, a $100.00 inter-service sharing fee will be assessed per frequency per location (i.e. Up to $200 for a new repeater frequency pair).

We won't know about this latter inter-service sharing until the designated coordinator has received the application and arrived at recommendations. Contingent upon the entity status in public safety e.g. governmental vs. private e.g. corporation, association the $60.00 application also may be due. Additionally, our $265.00 application preparation fee is also required.

Summing this all up, we can say that the estimated cost for narrow banding an existing VHF or UHF radio system, plus adding a second repeater would cost $380 (assuming FCCA as the coordinator plus $265 for application preparation. This would equate to a total cost of $645 for a tax exempt public safety user IF inter-service sharing is not required. If inter-service sharing is required, add $200 (and we won't know that until after your application has been submitted). As mentioned previously, business/institutional or non-tax exempt users would be subject to an additional FCC license fee. The good news is that FCC license authorizations are good for ten years. The bottom line is that the total estimated cost for a tax exempt public safety user is $645 subject to the possibility of an additional cost of up to $200.

Question:
What is the cost for adding a third frequency at a fixed location to be used as pocket repeater (i.e. receive the primary station output frequency and retransmit on a third frequency (simplex). Station antenna will not exceed the height of an existing structure by more than 20'. Existing repeater, or repeaters as applicable, control stations and mobiles to be upgraded to narrow band.

Answer:
As noted above Public Safety coordinators all charge differently. The coordination fees would be AASHTO $230.00, APCO $210.00, IMSA $200.00, or FCCA $190.00 per frequency per location. Inter-service sharing fee of $100 may be due here too as noted above. Application processing fee is $260.00 and FCC $60.00 if applicable for business/institutional or non-tax exempt public safety users. The bottom line is that the total estimated cost for a tax exempt public safety user is $450 subject to the possibility of an additional cost of $100.

Question:
What is the cost for adding a VHF repeater pair and one tactical frequency, narrow band with 4 control stations (under 20') and 100 mobiles.

Answer:
The cost for the repeater would be the same as the example above (Generally assumed to be $645 For the additional tactical channel that would be $190.00 assuming FCCA as the selected coordinator. Here also, inter-service fees may be applicable. We will not know until after the application has gone to a specific frequency coordinator, they've worked the application and arrived at recommendations. This could result in a secondary cost of up to $300 ($100 per frequency). The application processing fee is $520.00 (2 x $260) and possibly a $60.00 FCC application fee for business/institutional or non-tax exempt public safety users.

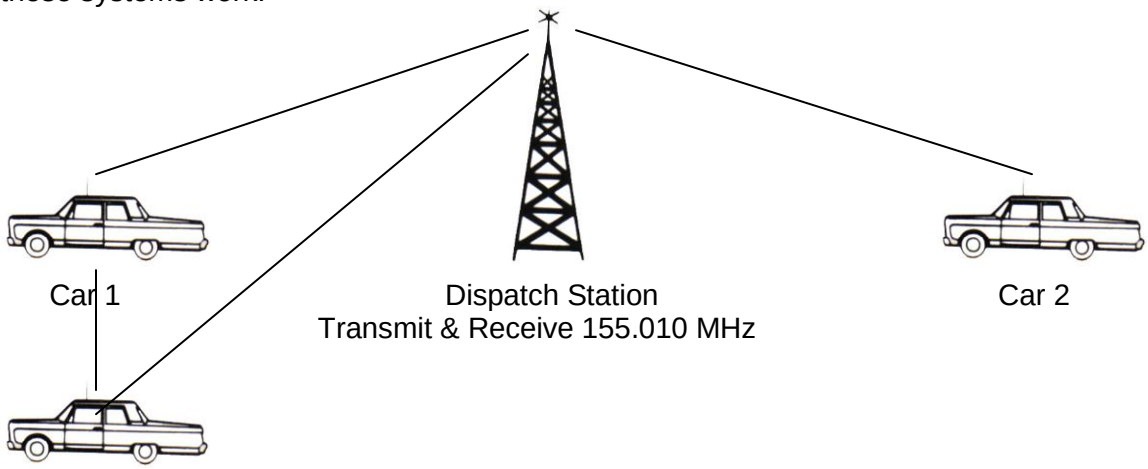
We hope this information has been useful. If you have additional questions or would like for us to handle your license modification, just give us a call at 205.854.2611. Now, let's move on to a review of other radio systems, starting with Multi-Site operation.

Multi-Site Systems

The definition of multi-site as it applies to 2-way radio communications can have a variety of meanings but primarily, it means that you have a primary station (either conventional base station, or repeater) that functions as a part of a network to extend coverage. Later in this planner, we will discuss extending 2-way communications to computers, but for now, we will confine our review to radios only.

HISTORICAL OVERVIEW

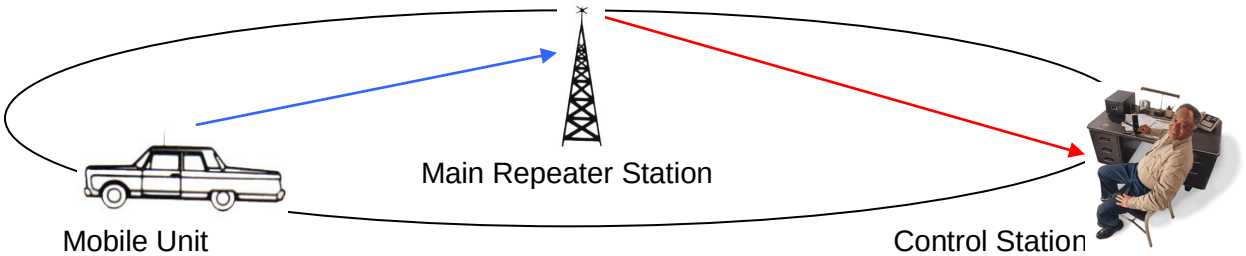
In general, all radio systems started in a simplex mobile operational mode. In simple terms, there was a base station with the ability of providing municipal or county wide coverage as applicable. The majority of these systems are either VHF or UHF with a few 800 MHz systems operated in larger metropolitan areas. The diagram below more graphically represents how these systems work.



System Diagram – Base-Mobile Simplex system

Assuming a distance of 20 miles between the station and each car, this system provides adequate coverage to and from all mobiles. In addition, Cars 1 & 3 which are within 5 miles of each other can also communicate, but car 2 which is almost 40 miles away from cars 1 and 2 cannot communicate with either car.

The initial improvement was to convert the dispatch station to repeater operation. Several benefits resulted. First, the main station could be moved to an area of higher elevation such as a mountain top tower or water tank to provide greater range. It was no longer called a *dispatch station*. Now it was called a *repeater station* and the associated dispatch station was called a *control station*. Instead of using a single frequency, a repeater uses two frequencies – one for transmitting and the other for receiving. The repeater transmits F1 and receives F2. The control station and mobile use these same frequencies in reverse order as is shown in the diagram below.

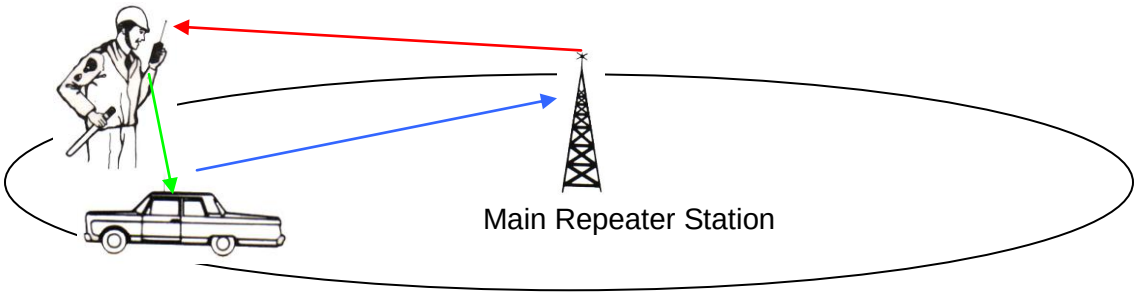


Frequency 1 – Transmitted by Main Repeater station. Received by mobile and control station

Frequency 2 - Main Repeater station receive frequency. Can be heard directly from mobile, or from control station. Control station can talk to the mobile through the repeater. Mobile/portable communication range is also extended through the repeater.

System design has not changed appreciably over the past seventy five years. Most systems are either simplex systems, as we saw in our first example, or repeater systems as we saw in our last example. The problem is that portable (handheld) radios were introduced in the seventies are replacing mobiles as we move toward personal communications. That's great, but a five watt handheld will never talk as well as a 50 watt mobile – repeater or no repeater!

This brings us to one of the issues that must be addressed in system planning – to make handhelds perform to meet the users needs. There are several ways to address this requirement. One of the more common is to use a mobile repeater that allows the mobile to pick up the transmissions from the handheld and *repeat* the call through the mobile. The diagram below shows how this works.



Frequency 1 – Transmitted by Main Repeater station. Received by mobile and handheld

Frequency 2 - Main Repeater station receive frequency. Can be heard directly from mobile, but not from handheld due to talk-back range limitations of handheld.

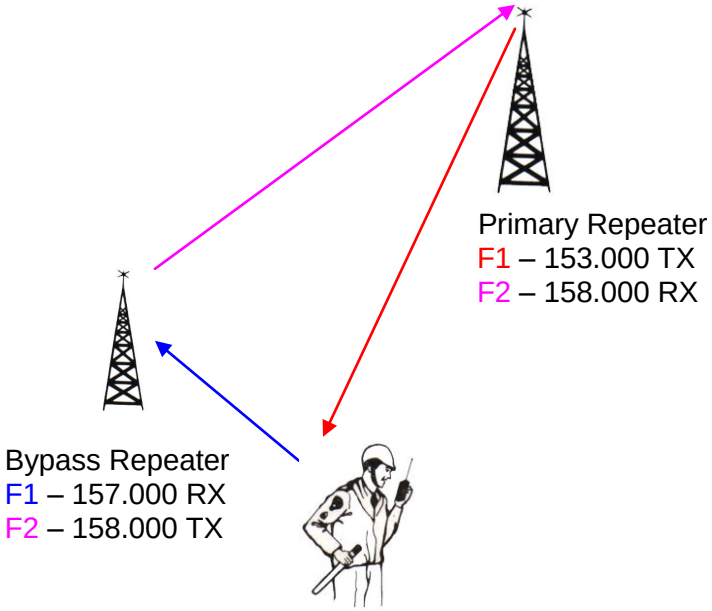
Frequency 3 – Cross-link transmit frequency from handheld. Received by mobile and retransmitted on the mobile transmit frequency to Main Repeater Station.

THE BETTER SOLUTION

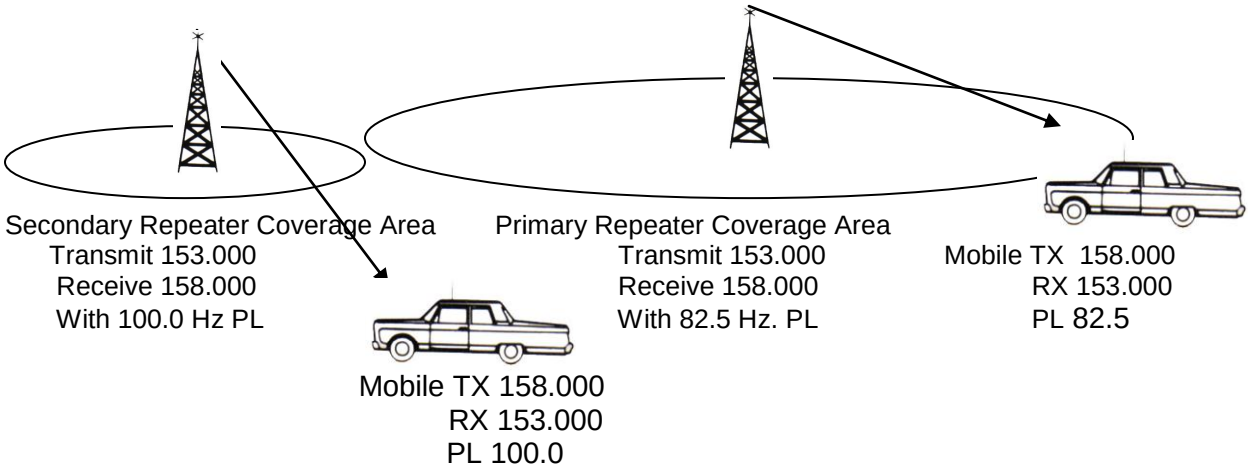
The repeater was a great improvement. Mobile repeaters can sometimes be used by smaller departments where only a few vehicles are involved. However, the better solution generally is to add a repeater. There are several ways to do this.

If the handheld radios can hear, but can't get back, a common solution is to use a *bypass repeater*. This involves using a second repeater that is within range of both the handheld radio and the main repeater.

The diagram on the following page shows the use of the two existing frequencies already used by the primary repeater and the third frequency used by the *bypass repeater* may better explain how this system extends coverage.



The second method of providing additional coverage applies when the handheld radio is NOT within range of the primary repeater. This involves adding a *zone repeater*. As you will note from the diagram below, the secondary coverage area is outside the range of the primary repeater.



As you will note from the diagram above, a mobile can access either repeater since both repeaters operate on the same frequency. The only difference is the access tone (82.5 Hz Private Line Code for Primary Repeater, or 100.0 Hz for the secondary repeater). Zone repeaters are very popular in counties where more than one repeater is required to provide adequate coverage.

The example above has been the most popular way to improve coverage for the past 50 years and is still one of the most cost effective and efficient means to extend coverage for VHF and UHF conventional radio systems. This is known as a basic multi-site repeater system. We will discuss other types of multi-site systems shortly, but before we do; we would like to introduce you to another technique used to extend talk-back coverage from mobiles and/or portable radios in marginal communications areas.

The IAS Voting Receiver System operates much like the aforementioned vehicular repeater as we will explain on the following page.

Voting Receiver Systems

Receiver voting systems allow multiple receivers at remote locations to detect the strongest received signal which is then connected to a centralized transmitting station which can either be a conventional base station or a repeater station as desired. These systems have been around since the 60's and most work on essentially the same principal as shown in the diagram below

The voter (technically known as a "Comparator") will determine the "best" received signal from one or more remote receivers (Three are shown in the diagram below). These remote receivers are connected to the voter by phone lines, microwave, fiber optic, or secondary radio frequencies. Each receiver transmits a unique ID, generally known as a pilot tone that is detected by the voter.

The strongest signal received by the voter comparator is selected (also known as "steering") to allow the best communications from the calling radio.

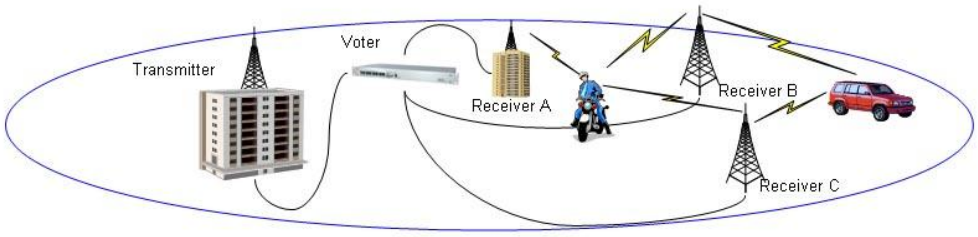
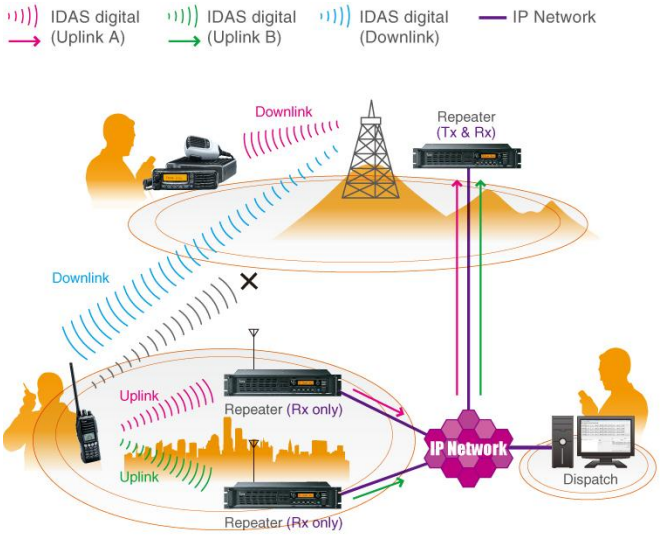


Diagram courtesy of Daniels Electronics

A description of a working system is described at www.3rd-st.com/voting.htm. Suffice it say for now than all analog voting systems require a voter (comparator) and connection via fiber or phone lines or radio/microwave. These are known as "hard" connections. A digital system such as the IDAS system by ICOM does NOT require a "hard" connection. The diagram below will better explain the operation of a digital voting system.



The IDAS digital system uses the Internet for connectivity. As long as you have Internet connections at your primary repeater location and at the secondary receiver sites, you can set up your system by simply adding a UCFR5000 IP module at **$1,500** each to your choice of IDAS digital repeater stations. (See Page 16).

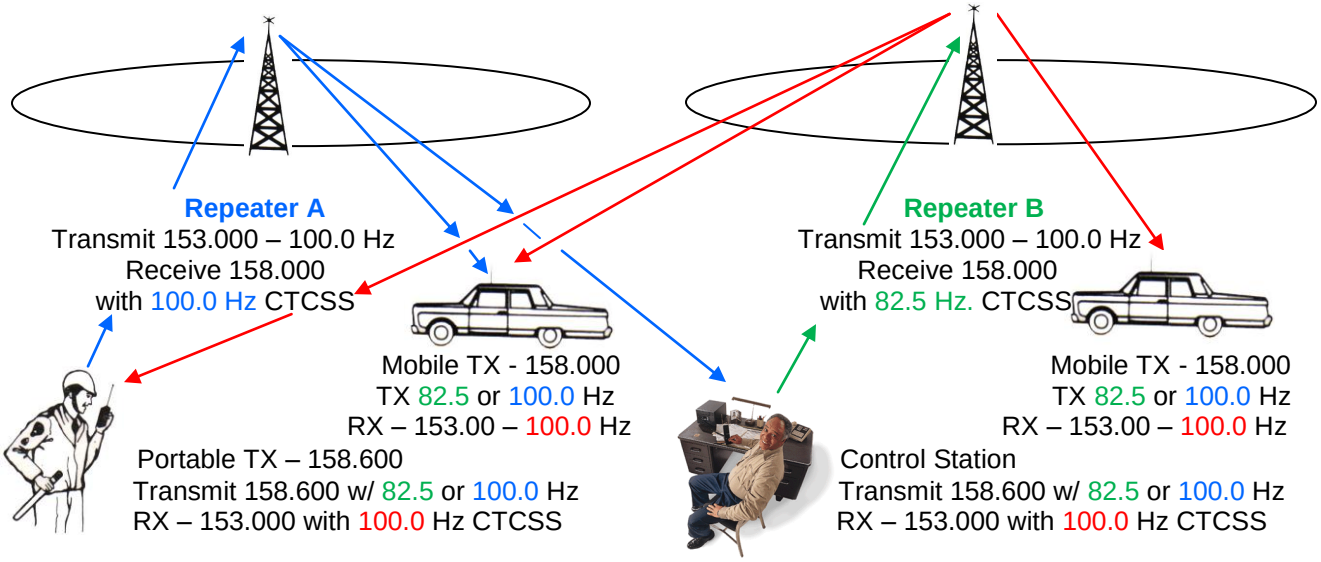
We offer a special remote receiver especially designed for use with the IDAS digital voting system priced at **$2,695** plus antenna system as desired (See Page 9). We call it the *ExRx*. Essentially, it is a URFR5000 transceiver with an AC power supply, and a UCFR5000 IP module. The diagram above shows how it all works. For many users requiring extended coverage, a receiver voting system may be all that is required. For others, we offer a variety of multi-site repeater systems which will be discussed on the next page.

Multiple Repeater Systems

Multiple repeater systems differ from multi-site receiver systems in that each site functions as a complete repeater station capable of working independently as we will see in the diagram below, or linked together with other repeaters and/or dispatch facilities.

Historically, a second repeater is added to provide coverage as the operating area for mobiles expands or there is a need for improved coverage to portables. Most 2-way radio systems operated in the USA today began with a statewide network of high powered radios (typically 300 watts or more) to cover multi-county areas. In public safety, and to a lesser extent transportation and utilities, the need developed to provide operating capabilities in a single county. The Sheriffs were among the first to establish base stations, and later repeaters, to provide communications for their own use as well as municipalities within their county.

As portables became more popular, the need developed for multiple repeaters to provide coverage in different areas of the county. With VHF systems, two repeaters generally provided the necessary coverage. In the case of UHF, that number typically increased to three or even four repeaters, and for 800 MHz, the number is closer to ten! Regardless on the number of stations, the initial systems were all based on what we call the Zone Select operating system. The diagram below should help explain the functions of a dual station zone select system. Let's assume two repeaters – one in the western part of the county (Repeater A) and one on the eastern part of the county (Repeater B).



The diagram above shows a typical two site repeater system. Both repeaters operate on the same frequency – 153.000 Transmit and 158.660 Receive. Both have a CTCSS tone (alternately known as PL or Private Line) of 100.0 Hz on the transmit frequency. This tone is essentially used to lock out unwanted co-channel and/or distant signals on the receivers of control stations, mobiles, or portables operated on this system.

The only difference between the two stations, other than physical location is that a <u>different</u> CTCSS tone is also assigned to each repeater. As you will note on the diagram above, Repeater A requires a CTCSS access code of 82.5 Hz. Repeater B requires a CTCSS access code of 100.0 Hz.

Before proceeding further, we should note that CTCSS codes are applicable to analog radios communications systems. The codes used for IDAS radios operating in the digital mode are known as RAN (Radio Access Numbers). Essentially, CTCSS and RAN codes provide the same functions – privacy and selectivity as applicable.

The diagram on the preceding page presumes a separation of around 25 miles between a current repeater (Repeater A) and a second repeater (Repeater B). The process of selecting the desired repeater is as simple as changing a channel. If a user is within the coverage area of Repeater A, he or she would select Channel 1. If they wish to talk through Repeater B, they would select Channel 2.

Since both repeaters have the same output frequency, the mobile or portable user will always hear calls from dispatch regardless of the channel selected. In a typical situation, users on the west side of the county, or city, or building complex as applicable, would normally stay on the Repeater A channel. Users on the east side would use the Repeater B channel. If a user travels outside their primary repeater coverage area, they just switch to the alternate channel.

At the dispatch center, a similar selection process is used. The dispatcher selects the desired repeater to communicate with mobile or portable radios in the desired coverage area. This can be done either by changing channels on the radio or selecting the desired repeater using the selector button on a dispatch console.

As noted earlier, IDAS repeaters can handle both analog and digital transmissions so there is no need to select analog or digital. This is called mixed mode operation which is standard in NXDN and P25 operating systems. The early version MotoTRBO repeaters do not have this capability although they can be upgraded (at additional cost) when this capability is desired. In essence, an IDAS mobile, calling in to dispatch in the digital mode will be heard by the dispatcher with no switching required. When the dispatcher answers, the response will be in the same format as the received call (i.e. digital calls are automatically answered in digital. Analog calls are answered in analog).

The latest version IDAS mobile and portable radios have an enhancement known as Voting mode scanning. The voting mode scanning detects the signal strength level of repeater stations and automatically selects the strongest station, This is very useful for roaming between 2 or more repeater sites as it virtually eliminated the need for changing channels by mobile or portable radio users. The closest repeater is automatically selected!

You will recall the system shown on the diagram uses the same frequencies. Only the CTCSS (for analog operation) or RAN code (for digital operation) is different. In some cases, it may be desirable to use different operating frequencies for each repeater. This allows simultaneous events to be conducted on both repeaters. For the mobile or portable user, there is no change in operating protocol. However, at the dispatch center, it becomes necessary to monitor BOTH channels at the same time – a very difficult process for a single dispatcher. When different repeater frequencies are used, it is normally assumed that two or more dispatchers will be available – one for the west repeater and one for the east.

The cost of adding a second repeater is shown at the left. This includes the cost of upgrading an existing 25 kHz license to narrow band 12.5 and very narrow band 6.25 kHz for both analog and digital operation.

High Spec IDAS Repeater

CY5000 Repeater	$2,995
SC229 Antenna	1,095
Antenna side mount kit	250
150' Cable kit	450
Site Protection Kit	653
FCC License Fee	1,095
Installation Estimate	500
Total	**$7,038**

The price at the right includes a preselector, duplexer, high performance antenna, high grade transmission line and an estimated installation cost (actual cost depends on type of antenna structure used). This price quote assumes an existing antenna structure with antenna mounted on the side of the tower or not exceeding building height by more than 20 feet. The FCC license fee assumes a duplication of an existing repeater frequency pair, or a new frequency pair as desired, plus a tactical channel for on-scene or vehicular repeater use. And, we'll talk about vehicle repeaters on the next page.

VEHICULAR REPEATERS

Communications is a *personal* thing. Most of us don't use mobile cell phones. We use *personal* cell phones that go where we go. Private 2-way radio systems are a little different. We don't have towers every few miles or so. We may be trying to cover an entire county with a single tower.

This means that mobile radios work better than portables since they have more power, better antennas, and more effective grounding through the vehicle body. The net result is that mobiles have far greater talk back range than portables even though portables receive almost as well as mobiles. The problem is TALKING BACK!

The traditional solution is to issue two radios – one for the vehicle and one for the person assigned to that vehicle. That can get expensive! Not only is it efficient, if often becomes necessary for the user to return to the vehicle to talk back. We think there is a better way! That way is called the *I-Box System*!

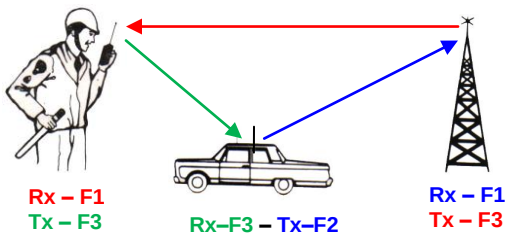
The system consists of a RF Transponder (RFT) or *mobile repeater* used with an associated personal 2-way radio (not supplied) that functions much like a long distance (half mile or more) wireless microphone that receives calls directly from the dispatch station and retransmits through the RFT back to dispatch. With *I-Box*, your personal radio talks back like a mobile!

If you wish, you can connect your mobile laptop PC to the *I-Box* unit to select up to 32 internally programmed frequencies that can be controlled by your personal radio. If you don't have a mobile laptop PC, you might want to consider the purchase of a low cost Netbook computer. The Dell Inspiron Mini 10-v is an excellent choice for under $300! Additional information is available at:

http://configure.us.dell.com/dellstore/config.aspx?oc=dncwfa2&cs=19&dgvcode=ss&c=US&l=EN&m_1=RBRU10H&dgc=SS&cid=39716&lid=1003790

I-Box uses an analog portable while the RFT can operate in both analog and IDAS (NXDN) digital modes or the system can be used with P25 systems when operated in the analog mode. Think of it! For less than the cost of a P25 mobile or handheld, you can have BOTH a mobile and a handheld with the communications power of the mobile! There is nothing else quite like *I- Box*, and remember – in the analog mode, it is compatible with both DMR and P25 radio systems and both analog and digital NXDN systems!

The heart of the *I-Box* system is the same basic transceiver used as the fundamental building block for our base station repeater systems (See Page 7). The only difference is that the repeater is placed in a vehicle and operated directly from the vehicle 12 volt battery. We use a standard rubber duck type antenna for receiving calls for an associated portable and a choice of mobile type antennas for transmitting back to the associated base/repeater station. The diagram below shows how it all works. Pricing is shown below. Don't forget – You will need a separate frequency for control use from the portable (See Page 18) and you will need to reprogram associated portables with the control frequency (Assume $35 per radio).



I-Box System Pricing

I-Box 12 volt vehicular repeater	-	$995
Receive antenna w/Type N connector	-	20
Transmit antenna, roof mount	-	40
Transmit antenna, magnet mount	-	60
FCC license, if required	-	450
On-site installation	–	Call 205.854.2611

Cross-Band Repeaters

So far, we have discussed all kinds of repeaters – wide area repeaters, local area repeaters, multiple site repeaters and even vehicular repeaters. The fact is that virtually any 2-way radio system can benefit through the use of a repeater. Repeaters extend range between mobiles and portables for field operations as well as coverage between portables and office dispatch stations in churches, hospitals, hotels, manufacturing plants, recreational facilities, schools, and warehouses. A little later on, we will discuss how to link all these repeaters, but before we do, we would like to tell you about yet another repeater. It's called a Cross-Band Repeater.

We should point out that when we reference a cross-band repeater, we are referring to the linking or bridging of a VHF radio and a UHF radio. It is also possible to bridge a VHF or UHF radio to 700 or 800 MHz conventional or trunked radio systems. The most common application is to allow law enforcement agencies using VHF radio systems to talk to fire departments, many of whom use UHF (in particular in Alabama). The product most often used for this purpose is called an X-Band 50. See specifications at www.info4u.us/XBand50.pdf.

The X-Band 50 (XB50) is essentially a VHF radio and a UHF radio using a common AC and DC power supply with a bridging network that interconnects the two radios. As a fixed station, the XB50 can be connected to external antennas (See Page 9 for outdoor antennas and cable kits or, for indoor or mobile installations, see www.info4u.us/xyztennas.pdf. These units provide essentially the same function, whether set up at a fixed location or install in a vehicle. They allow VHF radio users to talk to UHF users, easily and affordably.

For dispatch applications, the XB50 provides dual base stations with both stations operating in the VHF mode, the UHF mode, or one on VHF and one on UHF. A low cost desk microphone is available to allow control of either station as desired. The entire two channel combination is housed in an attractive desktop configuration measuring only 19" x 5" x 15.5" and weighing less than twenty pounds!

Although primarily designed for analog operation, special configurations of the XB50 are available for use with aircraft radios, IDAS and P25 digital radios. Call us for pricing at 205.854.2611 or email sales@falcondirect.com. For now, let's review the pricing on the most popular models of the XB50.

X-Band 50 System Pricing

IAS X-Band 50 12VDC/110VAC VHF/UHF repeater excluding antennas,	-	$1,995
IAS X-Band 50/V Same as above except with two VHF radios	-	1,995
IAS X-Band 50/U Same as above except with two UHF radios	-	1,995
IAS X-Band 50/AV Same as above except with Airband VHF radios	-	2,495
IAS X-Band 50/AU Same as above except with Airband UHF radios	-	2,495
Vehicle antenna system – Two antennas with roof mount and cable kit	-	80
Vehicle antenna system – Two antennas with Magnet mount and cable kit	-	120
DC accessory cable for temporary mobile installation	-	25
Desk microphones (2) for fixed station use	-	250
FCC Licensing, assuming public safety, if required (per frequency) See Page 18	-	450
On-site installation.	Call 205.854.2611 for a quote	

We now completed the basics on narrow banding, analog, and IDAS digital system planning for mobiles, portables, and single or dual site repeaters. After a short review we will move on to using the power of VoIP (Voice over Internet Protocol). Welcome to the future!

A Short Review

This may be a good time for review of narrowband planning since we have made some basic assumptions that may or may not apply to your individual situation. First, we assumed you were an existing 2-way radio user with an existing repeater or plans to use a repeater. On that assumption, we continued with the thought that you were using analog radios with standard 25 kHz bandwidth and you wanted to look at a simple and affordable migration plan – first to comply with FCC mandates for converting to 12.5 kHz Narrow Band, maybe even 6.25 kHz Very Narrow Band with a goal of continuing to use existing analog radios as long as possible.

We assumed that you would be looking at the four most popular alternatives for narrow band compliance with a brief overview of each as follows:

Analog – 12.5 kHz, complies with all current FCC mandates. Analog does not offer the benefits normally associated with digital which includes high level security, extended battery life for portables, efficient GPS and texting capability (although some analog systems DO have limited GPS and text message capabilities that may meet the needs of many users). Analog systems currently have a significant price advantage over digital systems and may be all that many users will ever need. This is the best alternative for voice paging applications. For additional information, please visit www.the-end-of-confusion.us.

DMR – A relatively new term to many users. Best known in the USA as MotoTRBO, DMR (Digital Mobile Radio) until March of 2010 was offered only by a single manufacturer (Motorola). DMR products are now available from Hytera (HYT) that address some of the shortcomings of the original MotoTRBO offerings. The original MotoTRBO repeaters could operate only in the analog or digital modes which limited an orderly migration process. Further, the MotoTRBO radios do not have 2-tone paging capability, a major requirement for volunteer fire departments and others using selective signaling. The new Hytera radio will offer both mixed mode and 2-tone paging. This is great news for those who have already installed MotoTRBO systems.

NXDN – An international open standard offered in the USA by ICOM, Kenwood, and Ritron. For commercial and non-federally funded purchases, this is, in our opinion, the best of the operating standards with the ability to operate on both analog and digital modes as well as single channel 6.25 kHz channel spacing. Prices are comparable to DMR even though mobile and portable radios have 2-tone paging capability and the standard repeaters can function in both analog and digital modes simultaneously. We believe this is the operating standard best suited for the integration of communications and computers. More information is at www.icomfuture.com.

APCO-25 - Also known as P25 is the US standard for public safety communications. P25 tends to be a little more expensive than either DMR or NXDN, but it is the only technology that meets the guidelines for Department of Homeland Security funding. Prices are coming down as more government agencies embrace this technology. If you are a government agency and anticipate using federal grant money to pay for your narrowband and digital upgrade, P25 is your logical choice. More information is available at www.info4u.us/Ready4P25.pdf as well as a special report at www.info4u.us/SAFECOM-2010.pdf.

A comment on grant funding may be in order at this time. Grants come at a price. For one thing you lose control (see note on P25 above). Additionally, you can get used to operating on funds that are not a part of what you earn from local revenues. You can lose your edge when you become too dependant on others. One day you might find that you are no longer capable of sustaining your needs independently. That can be a very unpleasant fact when reality sets in. We have many examples, such as the infamous LEAA (Law Enforcement Administrative Assistance) program of the 70's, the scientific experiments of Pavlov's dog, and even the parable of the frog in the warm/boiling water.

The point is that grant money may not always be around. Evidence strongly supports the idea that it could run out very soon. The United States is paying over one million dollars PER DAY in INTEREST on the money we owe China. And those multi-trillion dollar debts we are spending are beyond comprehension. Think of it this way – one trillion thousand dollar bills, one stacked on top of the other would rise to a height of almost 68 MILES! Looking at things in a more practical way, divide one trillion by the TOTAL population of the USA to see how much debt is owed by every man, woman, and child in the USA!

It could be safely said that federal grant money WILL dry up and it can be expected to happen very soon! With that thought in mind, you may find that your local area needs might be better served by investing in the communications system that best suits YOUR needs.

It is fairly easy to merge different types of technology using readily available interoperable devices, several of which are discussed in the Planner. Physical solutions such as our X-Band 50 provide affordable alternatives for bridging analog VHF and UHF radios as well as the aircraft bands and EVEN NXDN and P25 digital radios.

In the next few pages, we will review powerful new technologies based on Internet Protocol which will made computers function like radios, and radios function like data terminals.

You may have noticed that we have given little mention to using public cellular networks or even 700/800 MHz. There is a reason for this. 700 and 800 MHz systems do not provide the coverage of either VHF or UHF, and such systems are basically useless for in-building use. This has been documented many times and regardless of opinions or studies; the fact is that it doesn't work unless building owners are forced to install expensive in building repeaters. As far as cost is concerned, a conservative estimate is that building 700 MHz infrastructure is AT LEAST five times more than a comparable VHF or UHF system and the mobiles or portables in today's dollars are three times more than DMR or NXDN radio and approximately TEN times more than FCC narrowband compliant analog radios.

As far as using cellular networks for first responders is concerned, that is simply not a valid option. Case in point – we all remember when the Interstate bridge collapsed in Minneapolis several years ago. What virtually no one knows is that the Department of Homeland Security (DHS) was within minutes of shutting down ALL cellular networks (including Nextel) on the premise that the damage had been caused by terrorists. If DHS had flipped the switch, the rescue efforts would have been severely impaired as many of the agencies in that area relied heavily on cellular networks such as our own SouthernLINC system serving Alabama, Georgia, Mississippi, and parts of Florida. In the event of terrorist activity, cellular networks WILL BE SHUT DOWN! Clearly, the utilization of a public network is no solution for public safety!

Having said that, we believe that a true long term plan should be based on you local area needs, beginning with what you MUST do, which at this time, involves modifying your FCC license to meet both current and future needs. The time to do this is NOW!

Before modifying your license, you will need to select the best long term technology that meets your overall requirements in terms of operating requirements and financial resources. After making your technology choice (Analog, DMR, NXDN, or P25), begin reviewing the available offerings from multiple vendors (with Falcon Direct, being one of them, we hope). Look at the features and practical applications of optional capabilities offered. Review the alternatives available for making a transitional migration to narrow band, and perhaps digital as well. An evolving plan can save you a LOT of money.

Pick a vendor you can trust – one with competence, experience, and an understanding of your needs. We hope that vendor will be us! And NOW we are ready to move on to the new and wonderful things you can do by combining the power of the Internet with the radio system of tomorrow – here today!

Integrated Communications

There was a time when radios were radios and computers were computers. Now, that separation of technologies is going away. Large manufacturers such as NEC, and more recently Harris and Raytheon have begun to integrate voice, data, and video. Smaller companies like Critical RF have done some truly useful and cost effective communications solutions in the integration of voice, data, and video. As a Critical RF marketing partner and applications integrator, we coined our own term for this new technology. We call it Vodaeo!

We will come back for a review of Critical RF products and how they contribute to our overall system planning shortly, but for new, we thought it would be of interest to review what ICOM is doing in the integration of voice, data, and video. Earlier reference has been made to multiple repeaters being used at a common site (Trunking), extended receivers to enhance portable transmission range (Voting), and selectable multiple sites (Multi-Site). We did not address multiple sites with automatic selection (Passport) or simultaneous activation (Simulcasting) since these latter two technologies are generally outside the realm of private system budgets.

The integration of voice and data provides a new dimension to our system planning. Specifically, we are now able to efficiently and affordably link multiple stations through the use of IDAS technology from ICOM. To some extent, we can accomplish the same objectives with the Eclipse Series P25 stations (See http://falconinfo.blogspot.com/2010/05/new-eclipse-p25-repeater.html) as well as the Extender (See http://www.info4u.us/extenderinfo.pdf) from Critical RF which provides wide area multiple site control of analog stations. For now, we will confine our discussion to IDAS capable radios.

To review, an IDAS radio is capable of operating in either an analog mode at 25 or 12.5 kHz as well as the NXDN digital mode at 6.25 KHz. Several products have been introduced by ICOM to support the use of base stations, mobiles, portables, and repeaters IN THE DIGITAL MODE. The following information relates to the use of these products for providing wide area communications using multiple base stations or repeaters to accomplish specific objectives relating either to campus use, wide area use, or both applications within the same system.

Within the past several weeks we have received requests that can be addressed by Vodaeo. We thought this might be worthy of sharing with you.

Military Communications

From a military user requiring extended communications for non-combat operation (i.e., the cost burden of P25 technology is not necessary for this application). Essentially, the user requires two (maybe three) repeaters covering, and generally overlapping areas of operation commonly used by personnel that may travel throughout all three areas. Two of the areas are outside and the third is inside a building complex. The user wants seamless operation with no channel switching required and has ruled out simulcasting due to high initial cost and high maintenance.

Hospital Communications

From a hospital user requiring extended communications within a large multi-building campus, a similar but different scenario was presented. The current system uses multiple analog repeater stations at a common site. Coverage is poor in parking areas and in some parts of buildings within the campus.

The needs of most users (Emergency Room, Surgical Units, Family Services, etc.) can be satisfied with the current system, either through the use of existing repeaters, or on a direct communications basis.

On a recent emergency drill, the communications system failed to meet the requirements of an emergency situation requiring coordination of the combined personnel resources of the hospital. Administrative, IT, Maintenance, and Security officials had long recognized the need for radio communications coverage within different zones that could be coordinated as a single operating system. The disaster drill clearly demonstrated the need for improved communications. Equally apparent was the fact that adding a band aid to the existing system was not a solution.

Government Communications

From the communications director for a Caribbean island nation, we learned of the need for island-wide communications ranging from high elevation mountain tops and sea level communities removed by distances that did not allow single site transmitter locations. The bad news is that the user did not want to complicate either dispatcher or field user routines (i.e. manual channel selection was not an option).

International Communications

From a Middle Eastern communications user requiring nationwide communications, we learned much about the capabilities of IDAS voice and data networking in areas where direct RF linking was required between a network of stations where no broadband access was available.

IDAS Roaming

The solution to ALL of the aforementioned requirements can be summed up in one word – ROAMING! As it related to communications, roaming means to provide a radio user operating either a mobile or portable radio with the ability to communicate on two or more repeater stations with no physical channel switching required. This is called dynamic channel assignment. It is very similar to *trunking* (See information starting on Page 23 for more information), but more flexible, and less expensive.

We'll provide an example to show how this works. Let's say that you have offices in Birmingham and Montgomery, Alabama or two buildings on the same campus, or two areas within a single building or any other two locations that may be classed as a different area of operations. In our example, let's say that most of the time, I work in Birmingham, AL and communicate to my office through a mountain top repeater station. This repeater provides me with the ability to talk from a mobile radio within an approximate 40 mile area to my office in Birmingham.

When I get to Jemison, Alabama (about half way to Montgomery), I come into range of a second repeater that provides coverage within a 40 mile radius of Montgomery. Once I get within range of Jemison, my radio (assumed to be an ICOM F5061 mobile for this example) automatically switches to the Montgomery repeater. While in the Montgomery area, I would communicate with my office in Montgomery. To better explain how all this works, please refer to www.info4u.us/IDAS_Roaming.pdf.

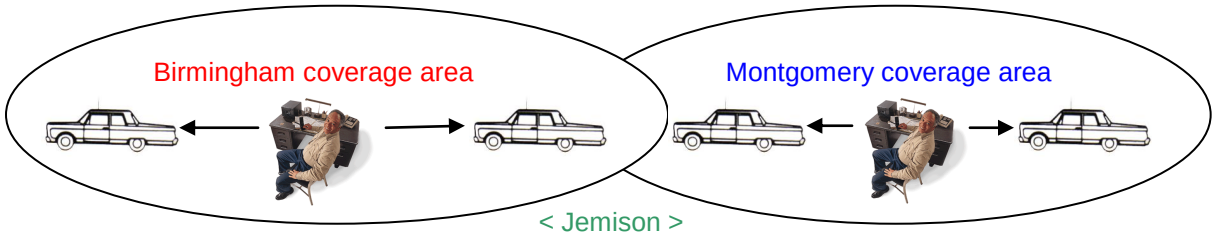
On the following page, we will provide some budgetary pricing, actually used to address the needs of our friends in the Caribbean island nation discussed above. This system will consist of two IDAS FR5000 repeaters with high performance duplexers for maximum range. No additional electronic equipment is required for voting mode scan.

Condensed Equipment Pricing for Dual Repeater System with Voting Mode Scan

System Description	IDAS Repeater at Site #1 VHF Government Price	IDAS Repeater at Site #2 VHF Government Price	IDAS Mobile Radio VHF Government Price
			
VHF 50W Repeater	FR5000 01 Repeater - $1,381	FR5000 01 Repeater - $1,381	F5061 - $526
Internal AC P/S	ICT 22012-30N - $244	ICT 22012-30N - $244	Ignition sense - $20
19" Rack, 28" H	HMDRRTT1928 - $155	HMDRRTT1928 - $155	Antenna - $27
Duplexer, Hi-Spec	IAS DVNC 1533L - $1,163	IAS DVNC 1533L - $1,163	Not used
System cables	MIS-350-IAS - $60	MIS-350-IAS - $60	Not used
Programming IAS	Programming - $50	Programming - $50	Programming $27
Service/Buildup	Assembly/Test - $80	Assembly/Test - $80	Not applicable
Programming kit	$152 with manual	Included with 1st unit	Not applicable
Crating and packing	CRT-350-IAS - $75	CRT-350-IAS - $75	Included
Reship fee in USA	$100 Estimated	$100 Estimated	$25
Site Protection**	$653	$653	5 yr warranty $57
FCC License	Not included	Not Included	Not Included
Antenna system	Not included	Not included	Not applicable
Installation	Not included	Not included	Not included
TOTAL PRICE	**$4,038**	**$3,886**	**$682**

Note: Above prices assume GSA pricing and domestic shipment within the USA. Shipping outside the USA will vary depending on carrier/method selected. ** See www.info4u.us/SiteProtect.pdf.

As you will note in the diagram below, a mobile operating in the Birmingham coverage area can talk to the Birmingham dispatcher and mobiles in the Birmingham area, but NOT Montgomery units. However, the driver CAN talk to Montgomery units while in Montgomery, but NOT Birmingham.



Where things get a little complicated is when we want to link these stations so that a dispatcher in either city can talk to mobiles in either city. If there is major overlap between the repeaters, we have to be sure that the stations don't interfere with each other. As you will note from the diagram above, there is some overlap in the Jemison area. This could be a problem if both stations used the same repeater frequencies and were operating at the same time. There are three basic methods to address this problem:

1) Simulcast with high stability oscillators and a link between the station which can be conventional VHF or UHF, microwave, or leased wired circuits. Such systems are very expensive and prone to high maintenance cost. For most users, this is not a good solution.

2) Set the stations up on different repeater frequencies to avoid interference overlap and link them with fiber optics or WI-FI for short distances (not applicable in the above example) or more traditionally - VHF, UHF, or Microwave. This is called Drop Linking, the solution applicable for our international communications user referenced on the previous page. See www.info4u.us/drs.pdf for a system diagram.

3) Where broadband connectivity is available, the Internet can be used for connecting stations in distant cities, for campus applications or combinations thereof.

Basic Broadband Connected System

A broadband connected system allows radio users in Montgomery to talk to users in Birmingham and a dispatcher using radio to talk to users in either city. The basic equipment will be essentially the same as shown on the previous page plus the aforementioned broadband connection.

The chart below defines the cost of such a two site broadband connected system (Cost of broadband service not included).

System Description	IDAS Repeater at Site #1 VHF Government Price	IDAS Repeater at Site #2 VHF Government Price
		
VHF 50W Repeater	FR5000 01 Repeater - $1,381	FR5000 01 Repeater - $1,381
Internal AC P/S	ICT 22012-30N - $244	ICT 22012-30N - $244
Network Controller	UC-FR5000 01 - $500	UC-FR5000 01 - $500
IP Repeater Link Card	CF-FR-5000 02 - $65	CF-FR-5000 02 - $65
Gigabit 4 port Router	RVS4000 - $225	RVS4000 - $225
System cables	MIS-350-IAS - $60	MIS-350-IAS - $60
Data Bus Cable	DTA-350-IAS - $18	DTA-350-IAS - $18
19" Rack, 28" H	HMDRRTT1928 - $155	HMDRRTT1928 - $155
Duplexer, Hi-Spec	IAS DVNC 1533L - $1,163	IAS DVNC 1533L - $1,163
Programming IAS	Programming - $50	Programming - $50
Service/Buildup	Assembly/Test - $80	Assembly/Test - $80
Programming kit	$152 with manual	Included with 1st unit
Container and Packing	CRT-350-IAS - $75	CRT-350-IAS - $75
Shipping – USA	Included to Falcon Direct	Included to Falcon Direct
Reship fee in USA	Estimated - $100	Estimated - $100
Site Protection**	$653	$653
FCC License	Not included	Not Included
Antenna system	Not included	Not included
Installation	Not included	Not included
TOTAL PRICE	**$4,921**	**$4,769**

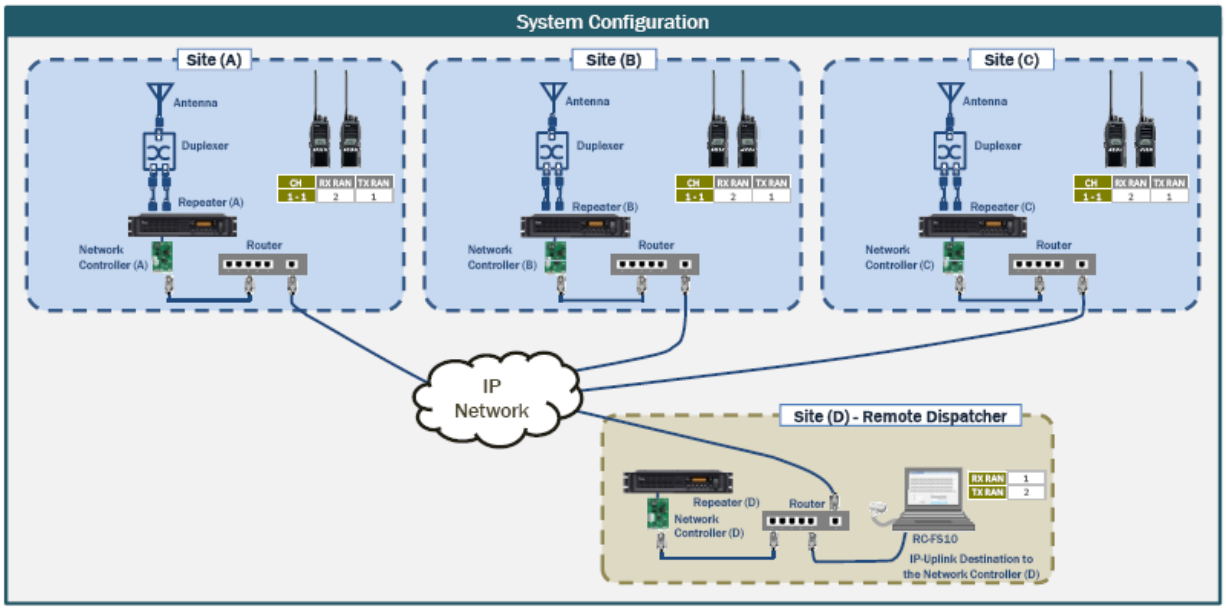
Note: Above prices assume GSA pricing and domestic shipment within the USA. Shipping outside the USA will vary depending on carrier/method selected. ** See www.info4u.us/SiteProtect.pdf.

The added dimension of a little additional hardware, broadband service, and the Internet brings our system all together. Now, any station connected through the Internet (or "the cloud" if you prefer) is an extension of every other station. Now, any mobile, or portable, or fixed station can talk to any other station connected through the cloud. Now we can build systems to meet exacting demands rather than leaving system planning to chance. That's what IDAS with IP is all about! Now, we are ready to add the capability of integrating computers with our network!

Remember our hospital user? He wanted multiple sites for use on a large hospital campus as well as other hospitals within the same region but not within the local campus operating area. In this situation, we want more than two sites and we will be using portables in lieu of mobiles, but the operating principles for a mobile system and a portable system are essentially the same.

You will recall that this user had specific operating groups, such as the Operating Room (OR) which has activities that NORMALLY do not involve administration, other hospitals in the region, maintenance, and security. Family services and Transportation work closely with the OR as does the Emergency Room (ER), but in a real emergency, EVERYONE gets involved as a part of a coordinated effort. That's when the functionality of IDAS demonstrates the real benefits of coordinated computer and communications.

As you may recall, IDAS is capable of mixed mode analog and digital operation. This allows function specific activities to use repeaters dedicated to their specific activities along with current analog radios. New radios utilizing IDAS technology can work in association with these same repeaters as a part of a local area network AND the enhanced wide area communications capability of Internet connected stations. The diagram below explains this more graphically.



As you will note, this system uses THREE repeaters, all linked together through the Internet. They can all use the same frequency pair (if properly separated), or different frequency pairs at each location. When IDAS radios are used in the digital mode, any radio on any system can talk to any other IDAS digital radio on any one of the three systems. The radios can be mobile, portable, or fixed, as long as they are operated in the digital mode. In the analog mode, they are restricted to operation on their “home” repeater unless they manually switch to an alternate repeater channel when required.

The whole idea is about keeping things simple for the user. In an emergency situation, the system must be as simple and as foolproof as possible.

We have added something new at the bottom of the diagram below. It’s called a Split Dispatch System. You can learn more about this system at www.info4u.us/sds.pdf. For now, the main thing to remember is that we can now include COMPUTERS as part of our wireless communications network.

The technology that connects computers and 2-way radios is called RoIP (Radio over IP). The ICOM RC-FS10, priced at $1,496, consists of software for a Windows or VISTA PC, and a CT-24 digital voice converter (shown at the left of the keyboard). The converter allows you to plug in the microphone of your choice or to use the $99 optional CT-23 desk microphone pictured. Up to eight repeaters can be controlled with the RC-FS10. See www.info4u.us/roip for more information on this major advancement in communications.