

A Layman's Guide to

Public Safety Interoperable Radio

**All you need to
know about narrow
band and digital
2-way radio**

- ❖ What you need to do
- ❖ When you need to do it
- ❖ Why you need to do it
- ❖ How to meet DHS requirements
- ❖ How to meet FCC requirements
- ❖ How to meet Grant requirements
- ❖ How to get the best performance
- ❖ How to get the best price
- ❖ How to get the best service
- ❖ How to get the best value



FALCONDIRECT
We keep you connected!

36 – 20th Avenue NW – Birmingham, AL 35215
Phone: 205.854.2611 – Email: Help4U@falcondirect.com
On the web at www.falcondirect.com
<http://falconinfo.blogspot.com>



FALCONDIRECT
We Keep You Connected

www.FalconDirect.com

The ABC's.....

of communications planning, when looking at technology, generally boils down to four essential choices for 2-way radio users:

- A** – Analog communications and plan to stay that way
- B** – Beholden to federal government grants and compliance
- C** – Corporate long term plan for migration from analog to digital
- D** – Digital or analog local area only (church, clinic, plant, or warehouse)

Virtually all government agencies fall into the “B” category since the Department of Homeland Security (DHS) controls the funds, they also write the rules. The Rules say the technology to be used will be P25 digital – period! If grant funding is not a consideration, analog “A” communications or less expensive “C” or “D” digital systems can offer significant cost savings, but not if you expect to use federal funding!

There are other agencies that have a hand in determining your communications. The Federal Communications Commission (FCC) says you must convert to narrow band operation by the end of 2012. You also should be aware that some loss of performance can be expected when you switch to narrow band. Digital systems compensate for this loss and in some cases actually enhance performance which means you should be planning an upgrade to both narrow band AND digital operations.

The material contained in this Planner deals with solutions for public safety users wanting to meet regulatory requirements while simultaneously satisfying federal grant funding guidelines and providing the necessary communications capability to meet both daily and emergency communications requirements. To meet these objectives, we will focus on P25 technology. If you have an interest in other technology for commercial or non-mission critical use, just email us at Help4U@falcondirect.com or give us a call at 205.854.2611. By the way, there are some significant benefits associated with digital radio technology. See www.info4u.us/Top-5-Reasons.pdf for some surprising facts!

We hope this information will be useful in moving to the next step of personally reviewing your needs, preparing a quotation to address those needs and working with you to make it happen. We look forward to working with you.

The Falcon Team
At your Service

Layman's Guide to P25.doc



from **Falcon Direct**

Let's get down to the basics.....

In the simplest terms, a 2-way radio system should provide the necessary capability to communicate efficiently with your personnel when needed. You will note, that we said nothing about data, interoperability, networking or anything other than your local area requirements.

Unfortunately, things are not as simple as we wish. The demands placed on public safety agencies require coordinated activities between EMS, Fire, Law, School, and Transportation agencies. The days of fire and police acting independently are over! Federal agencies, acting in the background (actually in the foreground) are developing long term plans that mandate coordinated planning.

For example, there are not enough radio frequencies to go around. The solution is to split existing frequencies in half (or quarter as applicable) so that we have two to four frequencies where we had only one previously. This is called narrow banding. You are required to convert to narrow band by the end of 2012. This is an FCC requirement, but there is a second non-mandated (at least currently) update that allows 2-way radio users to increase channel efficiency. It's called trunking.

We will not go into the specifics of trunking except to say that by combining the frequencies originally individually used by separate agencies can have the effect of doubling efficiency. Trunking also eliminates the need for users to manually switch channels, thereby simplifying and improving operational reliability. Technically, it's called *dynamic channel assignment*. A more detailed explanation of an analog system known as LTR (Logic Trunked Radio) is available at www.info4u.us/LTR.pdf. For now, we recommend the following:

- 1) Any radio purchased today, whether base/repeater, mobile, or portable, should be narrow band capable with either digital upgrade capability (from analog to P25 digital for public safety users) or better yet, all radios should have P25 digital capability initially since it is less expensive to include digital capability now than to add it later.
- 2) Any radio purchased today should have the ability to be upgraded to trunking capability in the future. If this feature is available, and doesn't add significantly to the cost, it would be a good idea to include this capability, even if you don't plan to use this function initially.
- 3) Fire and Rescue users should be sure that any radio purchased is capable of mixed mode operation (i.e. capable of automatically communicating in both analog and P25 digital operation without changing channels) and that 2-tone paging is operational in the analog mode. This is particularly important to users who are migrating from analog to digital and will continue to use 2-tone analog pagers.



from **Falcon Direct**

- 4) There are two types of digital to analog audio processors. These are known as *Vocoders*. Most P25 radios use Improved Multi-Band Excitation (IMBE) Vocoders which is adequate for the majority of public safety users. A later generation Vocoder, known as AMBE+2 (Advanced Multi-Band Excitation), is available in some top tier radios such as the ICOM F9000 and the EF Johnson ES series radios. All Vocoders use technology developed by DVSI (Digital Voice Systems Incorporated) with the exception of Motorola which is the **ONLY** radio brand reported as having a *noise problem*. In general, it can be said that an AMBE+2 Vocoder can be expected to provide better audio in a high noise level environment than an IMBE Vocoder. If AMBE+ technology is available with no significant increase in cost over IMBE, we would recommend it as the preferred choice, especially for fire service users operating on scene in the digital mode. We should point out that most fire service users operate in the ANALOG mode while using radios on the fire scene. In the analog mode, both AMBE+ and IMBE radios operate the same. In short, if you can get AMBE+ at the same cost as IMBE, take it. See www.dvsinc.com/papers/toll.htm for more information.

We have prepared comparisons of four of the most popular P25 Base/Repeater stations, mobiles and portables which are included on the following pages. You will note that we have provided both Manufacturer's Suggested Retail Pricing (MSRP) as well as discounted pricing assuming the Alabama State Contract (T300) which is an approved alternative to competitive bidding.

The discounted prices are generally comparable to those on federal, regional, and other state contracts. In some cases, a competitive bid may produce lower prices but in small quantities, a state, regional, or federal contract will often provide better prices than competitive bidding. If you need help in the selection of various procurement options available, we are available for assistance. One word of extreme importance is worthy of note.

If you have a received federal fire grant funding through FEMA for the 2009 or 2010 programs, you will need at least two vendor responses, whether you choose to use competitive bidding or to purchase from a state, regional, or federal contract. You should also remember that you can NOT exclude a prospective vendor for reasons of geographic proximity and you can NOT include supplemental service costs beyond the manufacturer's standard warranty. FEMA also will not pay for antenna structures (towers) or housing for communications base/repeater stations. They WILL pay for grant writer fees including closeout fees, required FCC licenses, and installation.

Some of the terms used on the aforementioned comparison forms may be new to you. For that reason, we have prepared the following glossary of the terms used, in alphabetical order on the following page.

You will note that we have listed four of the approved vendors on the Alabama State Contract. Obviously, there are others, but these are the ones with significant experience in P25 technology and are approved for the Common Air Interface standard. See http://en.wikipedia.org/wiki/Project_25 for additional information.



from **Falcon Direct**

Glossary of Terms Used

Antennas and systems

Antennas are included with portable radios. They are NOT included with base/repeater stations or mobile radios. Antenna prices for mobile radios are listed as options for mobiles as well as AC power supplies and desk microphones which allow mobile radios to be used for fixed station operation (when connected to external station antennas which are available as an option). The cost of a repeater station antenna system will depend on location, structure height, mounting hardware required, grounding, cable type use and antenna gain. Call us at 205.854.2611 for a quote.

Battery capacity, chemistry, and operating life

Portable batteries are available in Alkaline AA battery packs as well as Nickel-Cadmium (Ni-Cd), Nickel-Metal Hydride (Ni-MH), Lithium-Ion (Li-Ion) and Lithium-Polymer rechargeable battery packs. Alkaline battery packs are ideal for extended use or as a backup when rechargeable batteries are not available. In general, Lithium-Ion batteries are lightweight, offer high storage capacity, are virtually memory free, and relatively inexpensive. Most of the portable radios we offer use Li-Ion batteries which are rated in milliamp hours (mAh). You can typically assume about 30 minutes of use time per 100 mAh (i.e. An 1800 mAh battery would be expected to have an operating life of around 9 hours under normal use conditions. It's not a bad idea to have a spare battery since storage life on a Lithium-Ion battery is up to 10 years. The alternative is to have a AA battery pack available for emergencies.

Brand/Model selection

Later in this material we will provide a detailed overview of each of the major providers of P25 equipment. For now, we can summarize our comments as they apply to the equipment offered by each manufacturer. BK Radio is the supplier of choice by many federal agencies including the US Forest Service. The product is rock solid and reliable. ICOM is the supplier of choice if you want the most features at the lowest cost. Midland is the vendor of choice by some of the nation's largest users (States of Florida and California for example). Motorola is a little more costly than the others, and doesn't offer many of the features desired by fire and rescue users in their more affordable offerings. The top tier models are generally beyond the practical reach of any but the largest governmental agencies and the military. We have not listed the products available for these big system users mainly for reasons of cost. We should point out that there are some excellent choices available for those that want to spend over five thousand dollars per radio from EF Johnson, Harris, Motorola, Tait, and Thales.

Cabinets and racks

Base/Repeater stations offered can be table top mounted, but tradition favors mounting on 19" open racks or indoor locking door cabinets, typically with a height of around 30". These optional cost items allow mounting of duplexers, fans, and external power supplies. These items are shown as options on the price matrix which follows in the next few pages.



from **Falcon Direct**

Conventional, Non-Trunking Operation

Conventional, as it applies to 2-way radios means single channel unit to unit communications with a common base/repeater station used in conjunction with associated mobiles, pagers, and portables. A conventional system can be analog, digital, or both. Repeater stations can be operated as a conventional system or as a part of a trunked system with the addition of *controllers*. As a rule, voice pagers are always analog and are primarily designed for VHF or UHF conventional operation. In our price schedules for mobiles and portables, you will note that we offer both conventional and trunking models. In some cases, conventional mobiles can be upgraded to trunking (specifically ICOM and Midland conventional radios have this capability). Conventional radios are typically less expensive than those with trunking capability. If in doubt, always choose a radio that either has either conventional operation with trunking upgrade capability or choose a radio with trunking included as a standard feature. We do not recommend purchasing any radio that cannot be operated or upgraded on a trunking system.

Display, control, and Unit ID

Portable radios are available in non-display, display models with front and/or side panel control buttons (called Display Models) and display/control button models with a ten button numeric dial keypad (called Keypad Models). For simple dispatch operations, a non-display model may be all that is required but a display model can provide more information for the user as well as additional functionality (scan select, page sending, repeater talk-around etc.). The keypad models allow control of other devices as well as sending SMS (Short Message Service) text messages. Display Models can also display the ID of other users, time, battery condition, and other useful visual indicators. We will be discussing Unit ID in more detail in the User ID section shortly.

Duplexers

A duplexer is a filter. It has one function – to allow a transmitter and receiver to operate simultaneously through a single antenna without the transmitter bleeding over into the receiver with the least possible loss of signal. Accordingly, duplexers have to be tuned to a specific pair of repeater frequencies. If these frequencies are separated by 3.5 MHz or more, the duplexer can be produced at very reasonable cost (Under \$400). However, to keep losses at a minimum, a larger more expensive duplexer is recommended (generally under \$2,000). If the frequencies are close spaced (under 1 MHz), the duplexer will be very large and more expensive (up to \$4,000). Good frequency separation is the key to reasonable cost and high performance (especially for talk-in range from portables). A duplexer doesn't care whether the signal is analog or digital, wide or narrow band. If you have a good duplexer being used with an older repeater, the chances are good that it can also be used with a new narrow band analog or digital repeater.



from **Falcon Direct**

Equipment Programming – Factory, user, PC and Keypad

Channelizing or *programming* is NOT included in the price of the equipment on State, Regional, or Federal contracts. The process involves not only inserting the data but testing the radio before shipment. There is a charge for this service. As a user, you have the choice of taking the radio without programming, or having the seller program the radio for you using the information you supply. You can be charged for corrections in programming required as a result of incorrect data supplied to the seller. You also have the choice of purchasing a PC programming kit, or on some models, you can program the radio from the front keypad (BK and Midland currently). This is a nice feature – not so much for initial programming, but for making tactical changes in the field.

Ethernet/Internet Connectivity

The newest generation of base/repeater stations can be connected to a PC network (Ethernet) or even to the Internet to allow diagnosis of problems before dispatching a technician to a remote site or reprogramming as required. This is a NICE feature. Base/Repeater radios with this capability are listed on our pricing guide.

Fan module

Base/repeater stations such as the Eclipse by ICOM and the Midland models do not require cooling fans. However, we recommend the use of cooling fans if the equipment will be installed in an outside building without cooling. Better yet, we recommend the purchase of a low cost 110 VAC window air conditioner (actually a heat exchanger) that can cool in the summer and warm in the winter. The cost is comparable to a fan option!

FCC Licensing

Existing FCC licenses must be modified for location(s), power output, number of users authorized, as well as changing from analog to narrow band digital operation. The charges are the same for either existing or new users. The cost will vary depending on number of locations, coordination requirements, and other factors beyond our control. The estimated cost for FCC is subject to change depending on your local situation. Approval time for coordination can vary from just a few weeks to as long as a year. The typical processing time is 45 days. The processing and coordination cost for public safety tax exempt agencies is \$950, or \$1,040 if we handle construction completion notification to the FCC. A tactical or vehicle repeater control channel adds \$190. All applicants must provide a federal ID number. Volunteer fire and rescue agencies are required to submit a letter of authorization from the fire marshal or county commission naming the department to provide fire and/or rescue services within the assigned area covered by the department. An additional FCC fee of \$260 is applicable for non-tax exempt users (i.e. private ambulance services, etc.).



from **Falcon Direct**

Ignition sense Cable Option

Modern mobile radios have a fail-safe feature incorporated to protect them from electrical damage caused by jump starts. In essence if power fails, the radio does NOT automatically come back on when power is restored. This protects the radio until a STABLE 12 volt power source is available (not the case with hot charges or jump starting). However, you can purchase an ignition sense cable option for mobiles that overrides this feature. This eliminates the need to turn the radio on each time you enter the vehicle.

Installation

Some users have self installation capabilities – most don't! Smaller public safety agencies often have amateur radio operators that can handle simple mobile or base/repeater installations, but they rarely have the equipment necessary for testing. We recently sold a base antenna and cable kit to a volunteer fire department. They did a wonderful job with only one problem. They forced a look alike connector on the cable to the antenna. The result was not one, but two trips to correct the problem. In the long run, you will generally save money by having your equipment professionally installed. Installation is NOT included in the cost of the equipment.

Intrinsically safe operation

If you use a 2-way radio in a flammable atmosphere, there is a risk of explosion – not a good thing! The technical term for a radio that is safe to use is *Intrinsically Safe*. In simple terms, it means the radio and the associated battery won't create a spark that could ignite dust or gases. Such radios are insured by Factory Mutual (when applicable) as your assurance that they are safe to use in incendiary atmospheres. Some models have this capability as a standard feature. Others offer it at extra cost. On most radios, in particular, the lower priced models – it is simply unavailable.

Mixed Mode Operation

Mixed mode operation means that the radio, whether base/repeater, mobile, or portable is capable of communicating in either the analog digital mode without operator switching. For example, a portable radio receiving an analog page call should be capable of answering back in either an analog or digital format as defined in programming with no operator switching required. A portable or mobile radio receiving a call through the base/repeater should be capable of answering back in the same format as the format used by the originating radio.

P25 Experience

Any vendor proposing to bid P25 equipment should have experience in the unique capabilities of P25 technology. P25 is considerably more complex than analog. Most manufacturers require training before a representative is certified to sell P25 products.



from **Falcon Direct**

Power

The recommended power for base/repeater station is 100/110 watts. Office control stations and mobiles are typically rated at 50 watts. Portables are generally rated at a maximum of 5 watts although the BK and ICOM 9511 models are rated at 6 watts.

Service and TimeShare

A manufacturer's warranty does NOT take the place on an efficient maintenance program. You basically have a choice of maintaining spares and using the manufacturer's warranty (not a bad idea) or combining the warranty with time and material or contract service provided by a local dealer. Our TimeShare Program offers an even more efficient and affordable alternative. Additional information is available at www.info4u.us/ts.pdf.

Shipping

Shipping costs are generally included in State, Regional, or Federal contracts where the equipment is shipped directly to the user. Additional shipping charges will be incurred when the equipment must be programmed, integrated as a part of a system, or installed at a remote location.

Size and weight (Equipment)

Size and weight of base/repeaters and mobiles are generally comparable regardless of brand or model. The exception is the additional components and cabling associated with high power (100/110 watt) mobiles as well as higher installation costs. The size and weight of a portable radio can be a major factor in the selection process. P25 portables can range in weight from under 8 ounces (Midland) to over a pound (BK) with others generally in between. Physical size ranges from pager size (Midland), standard analog radio size (BK) to public safety professional (ICOM F9000 Series) size.

Site Protection

Site protection equipment is available as an option for insulating base/repeater radios from damage caused by lightning as well as sags, spikes, and surges on the AC line. An inexpensive option provides notification by 2-way radio in the event of AC power failure or unauthorized entry to a remote site.

Spares

Spare units are always recommended, in particular for base/repeater stations. It doesn't hurt to have a spare mobile and portable as well.

Specifications

Complete specifications on P25 products are available at www.info4u.us/P25Specs.pdf.



from **Falcon Direct**

Submersion capability

Portable 2-way radios are rated for their ability to withstand the effects of dust and moisture. The Intrusion Protection (IP) standards used for rating 2-way radios are available at http://en.wikipedia.org/wiki/IP_Code. As you will note, a rating of IP57 provides good dust protection as well as immersion capability at depths of up to 1 meter (3 feet approximately) for up to 30 minutes. The absolute *best* rating would be IP 68.

Trunked Radios

See Convention Non-Trunking operation.

Upgradable Capability

There are some analog radios that can be upgraded from analog to P25 digital (the ICOM F70 and the Motorola PR1500 for example). Most of the radios we offer (with the exception of the Motorola PM1500 mobile and PR1500 portable) are upgradable to trunking operation. The Eclipse Base/Repeater station can be ordered initially for analog narrow band operation and later upgraded to full P25 capability – NICE feature! Most P25 radios (with the exception of the aforementioned Motorola models) can be upgraded to a military security level known as FIPS (Federal Information Processing Standards) AES (Advanced Encryption System) as well as OTAR (Over The Air Rekeying). These features are generally used by most public safety users although a radio offering upgrade capability has potentially more future value than one without.

User ID

Being able to identify a calling radio by name through the use of a visual display on the receiving radio has some significant benefits both from the viewpoint of administration and security. All P25 radios offered have this capability in the P25 digital operating mode with the exception of the aforementioned Motorola PM and PR1500 models as well as the non-display ICOM 9011 model. Some radios have user ID functionality in the analog mode as well. This is called MDC1200 or EMDC for the newer ICOM models (EMDC provides additional capabilities such as GPS, advanced text messaging etc.) This feature is available (Analog ID) only on our ICOM radios.

Warranty

The longer the warranty, the less it will cost to maintain your radios! The manufacturer with the longest published standard warranty is Midland (5 years on the base/repeater and 3 years on mobiles and portables). See also Service and TimeShare.



from **Falcon Direct**

A word about our selected manufacturers

BK (Bendix King) Division of Relm Wireless

BK Radio, originally a merger between Bendix Radio, a commercial 2-way radio manufacturer dating back to the 1940's and King Radio, a premier manufacturer of top tier aviation radios became known as Bendix-King after the merger. The company was acquired by Relm Wireless and operated as a separate division with the primary focus of serving military and federal government agencies. BK Radio has long been a favorite of the US Forest Service as well as the Department of the Interior and the US Military around the world. Relm Wireless is the successor to Regency Electronics, the company that developed the first transistor radio and a pioneer developer of scanners and affordably priced 2-way radios. Originally headquartered in Indianapolis, IN; the company's corporate offices are in Melbourne, FL with engineering and research offices in Kansas City, MO. BK Radio products are made in the USA!

ICOM America (Subsidiary of ICOM Japan)

ICOM America, a subsidiary of ICOM Japan is a world leader in communications, not only in land mobile 2-way radio used by governmental, industrial, and public safety users, but a leading supplier of amateur communications equipment and developer of the world standard D-Star system. ICOM is also a leading supplier of aviation communications equipment and a founding member of the NXDN forum along with Kenwood and other leading manufacturers committed to advancing digital communications technology.

Midland LMR (A part of Midland International)

Midland International is best known for consumer products such as their weather alert radios and GMRS personal communications. Many people don't know of their long and successful history in service to public safety agencies around the world. Midland counts among their many users, virtually every federal agency as well as state government including two of the largest users in the USA – California and Florida. Midland is a long term partner with Toshiba of Japan which builds the phenomenally successful P25 base/repeater station. The new portable and mobile radios are produced in Turkey by a company funded by the Turkish government to build the finest products available for the Turkish military. The company spared no expense in building one of the most modern production facilities in the world, staffed by the best of the best with MIT engineers and Harvard trained administrators. Company headquarters are in Kansas City, MO.

Motorola, Inc.

Located in Schaumburg, IL, the company has moved most manufacturing operations outside the USA. A very interesting commentary on Motorola is available at <http://www.thecuttingedgenews.com/index.php?article=11989>.

Alabama State contract pricing on some of our more popular P25 radios follow on the next pages. For more detailed information, please see www.info4u.us/P25Comparisons.pdf.

Alabama State Contract Quick Pricing Guide

P25 Portables



Models
Price w/ programming
Power (VHF)/Channels
Weight/warranty
Brochure available at:

ICOM
Non-Trunking



F70DT/F80DT
\$1,227
5 watts/256
15.6 Oz./2 years
www.info4u.us/F70.pdf

Midland
Non-Trunking



STP Series
\$1,877
5 watts/999
7.5 Oz./3 years
www.info4u.us/STP.pdf

ReIm/BK
Non-Trunking



KNG-P150
\$2,228
6 watts/512
16.0 Oz./2 years
www.info4u.us/KP150.pdf

P25 Mobiles



Models
Price w/ programming
Power /Warranty
Brochure available at:

ICOM
Non-Trunking



F1721DT/F2721DT
\$1,192
50/45 watts/2years
www.info4u.us/F1721.pdf

Midland
Non-Trunking



STM Series
\$2,141
50 watts/3 years
www.info4u.us/STM.pdf

ReIm/BK
Non-Trunking



KNG-M150
\$1,602
50 watts/2 years
www.info4u.us/KM150.pdf

P25 Repeaters



Models
Price w/programming
Optional duplexer
Programming
Programming kit
F.O.B.
Power (VHF)
Warranty
Brochure available at:

ICOM



Eclipse 2
\$12,622
1,495
400
395
Anywhere in USA
Up to 100 watts
2 years
www.info4u.us/Eclipse2.pdf

Midland



P25 Base Tech III
\$9,089
2,074
Included
254
Anywhere in USA
Up to 110 watts
5 years
www.info4u.us/BT3.pdf

ReIm/BK



DRV-100
\$16,119
1,495
600
86
User Location
Up to 100 watts
2 years
www.info4u.us/V_Series.pdf



from **Falcon Direct**

Additional References

Assistance to Firefighters Program

For additional information on the Assistance for Firefighters (AFG) program, please see:

Spending of 2009/2010 grant awards –

<http://falconinfo.blogspot.com/2010/05/comment-on-2009-fema-communications.html>

What to do if you are approved or turned down –

<http://falconinfo.blogspot.com/2010/05/assistance-to-firefighters-grant.html>

For other information on the AFG program, go to <http://falconinfo.blogspot.com>

Type in the words AFG in the search block at the top right side of the page

Information on Narrow Banding

For some interesting comments on narrow banding –

<http://falconinfo.blogspot.com/2010/03/looking-for-facts-on-narrow-banding.html>

Additional information on P25 Interoperability Standards

For those who have questions concerning Interoperability requirements –

<http://falconinfo.blogspot.com/2010/03/now-weve-heard-it-all.html>

Kenwood NexEdge for Public Safety?

Is NexEdge an approved alternative for P25?

<http://falconinfo.blogspot.com/2010/02/we-couldnt-help-but-notice.html>

MotoTRBO for Public Safety?

Comments on the use of MotoTRBO for mission critical public safety requirements –

<http://falconinfo.blogspot.com/2009/05/mototrbo-for-public-safety.html>

A comment on Service

The definition of good service means different things to different people –

<http://falconinfo.blogspot.com/2010/06/word-about-service.html>