

Genuine P25 Interoperability for Public Safety Agencies

Tips to maximize your investment
and avoid pitfalls



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To keep your personnel and your communities safe now and in the future, public safety agencies must work together to overcome technology barriers. While interoperability is the ultimate goal, there is often confusion about exactly what interoperability means and just how genuine claims relating to it are.

Interoperability refers to a variety of scenarios including:

- Multiple vendors' radios working together
- Multiple agencies working together, for example Police, Fire and EMS at an incident scene
- Neighboring statewide networks working together.

While failure to interoperate in any of these scenarios can have drastic consequences, this paper addresses multi-vendor interoperability and its implications for Public Safety agencies.

The intended audience is Public Safety agencies that are considering purchasing P25 equipment who want to better understand the interoperability issues associated with their selection of equipment. A brief history of Project 25 (P25) gives special attention to clarifying the P25 standards, the options permitted under the standards, and the differences between the Phase 1 and Phase 2 rollouts. The paper looks at the P25 Compliance Assessment Program (CAP) and its benefits for purchasers. Finally, it discusses the various pitfalls that affect a P25 radio's ability to work on different P25 networks.

Genuinely-open P25 standard technology, when implemented well, can make sound economic sense by providing Public Safety agencies with increased vendor competition, access to funding grants, and a better solution that fits your budget. In an industry where there is no margin for misunderstanding, this paper provides readers with an inside perspective on the challenges of P25 interoperability and advice for operators to achieve and optimize genuine P25 interoperability.

WHY PUBLIC SAFETY INTEROPERABILITY IS CRITICAL AND NEEDS TO BE UNDERSTOOD

Interoperability is a powerful tool for Public Safety agencies and one that you must get right. Your personnel and your communities rely on the ability of agencies to communicate and coordinate with each other at large events and in times of need. Interoperability achieved can result in success – conversely, its absence can turn difficult events into disasters.

Of the many vendors who claim to offer ‘P25 compliant’ radios, the question must be asked – to what extent are they truly compliant? The reality is that not all P25 radios work on all P25 networks as the standards allow room for interpretation. This is a major concern for Public Safety agencies finding themselves constrained by proprietary functionality and with varying levels of interoperability between agencies, counties and neighboring statewide networks. To give Public Safety purchasers confidence that their P25 equipment conforms to performance standards for interoperability and conformance, the P25 Compliance Assessment Program (CAP) was established in 2009. While this is a start to ensuring interoperability between vendors, it is not enough to rely on this program in isolation.

Factors that affect interoperability between vendors include the interpretation and implementation of the P25 standards, radio configurability, and certification processes for vendors onto Regional and Statewide networks.

Public Safety agencies now have access to more information than ever before, giving them the confidence to establish solid future-proofed communication plans. Through the open architecture of P25 technology, you will benefit from greater choice, price competition, more funding options, and the ability to purchase a solution to fit the needs of your agency.

A BRIEF HISTORY OF PROJECT 25 (P25) FOR PUBLIC SAFETY

Project 25 began in 1989 when public safety representatives, government bodies, and manufacturers, under the aegis of the Association of Public Safety Communications Officials (APCO) began a collaboration to develop a suite of standards for digital public safety communications services. The standardization process was to be managed by the Telecommunications Industry Association (TIA). When the first suite of P25 standards appeared in 1995, they represented a benchmark for interoperable communications, designed by public safety users for public safety users. These standards have continued to evolve as the ambitious program has been fleshed out and new requirements have been added. Throughout, the overarching goals for P25 have been to ensure interoperability between vendors, agencies and networks; to encourage competition between vendors and improve the cost-effectiveness for public safety buyers; and to offer easier migration paths from analog to digital. These goals have been set to ensure that agencies can and will work together when they need to.

UNDERSTANDING THE P25 STANDARDS

There is a great deal of misunderstanding among Public Safety agencies as to exactly what the P25 standards and rollouts are and the benefits they provide.

There are three levels of P25 standards:

- **Mandatory:** features that, to be P25 compliant, radios must meet the stated functionality as specified by the Telecommunications Industry Association (TIA).
- **Standard options:** features which, if offered by a manufacturer, must be built to the P25 standard.
- **Manufacturer’s extensions:** features that are manufacturer-specific, normally proprietary, and are not required to be P25 compliant.

Public Safety agencies may be unaware of the various levels of P25 standards, only to find themselves trapped by vendor-specific proprietary functionality that limits interoperating with equipment from other manufacturers. The expectation that all ‘P25 compliant’ networks and radios will work together is clouded by the fact that the P25 standards do not exclude proprietary features that may prevent interoperability between radios and network equipment from different vendors.

UNDERSTANDING THE P25 PHASES

There are currently two rollouts of the P25 standards; Phase 1 which is complete and Phase 2 which is waiting to be published. The table below shows the key features and benefits of each phase:

	Phase 1	Phase 2
Benefits	Digital operation via the P25 Common Air Interface (P25 CAI)	Greater spectral efficiency with narrowbanding to 6.25 kHz
	Narrowbanding conformance to 12.5 kHz	Backwards compatibility with Phase 1 SUs only (i.e.: analog operation is a manufacturer’s extension)
	Backwards compatibility with analog subscriber units (SU)	
	Improved audio quality	
	Greater funding options through P25 requirements	
	Inter RF Subsystem Interface (ISSI) to interface with neighboring networks to allow SU roaming	

The Public Safety market is only now beginning to understand Phase 1 but there is already a push from vendors promoting Phase 2-capable equipment in relation to the FCC narrowbanding compliance mandate. However, it is not widely recognized that Phase 1 already meets the narrowbanding requirements of most operators simply by achieving 12.5 kHz operation. 12.5 kHz spectral efficiency may be all that an agency requires.

FCC Narrowbanding Calendar for Radio Users				
Frequency	Channels	Achieved through	Deadline	Notes
VHF	12.5 kHz	Phase 1	1st January 2013	Radio networks must operate in 12.5 kHz or narrower channels.
UHF	12.5 kHz	Phase 1	1st January 2013	Radio networks must operate in 12.5 kHz or narrower channels.
700 MHz	12.5 kHz	Phase 1	1st January 2015	Voice networks operating before this date can continue to operate in 12.5 kHz channels until 12th December 2016. All new networks must operate in 6.25 kHz channels or demonstrate equivalent spectrum efficiency.
	6.25 kHz	Phase 2	1st January 2017	These networks must operate in 6.25 kHz channels or demonstrate equivalent spectrum efficiency.

While Phase 2 standards are sufficiently advanced for manufacturers to develop Phase 2 products, only P25 Trunking operation has been defined so far. For trunked network operators, the main benefit of Phase 2 is improved capacity through greater spectral efficiency: that is, being able to receive two communications paths from one channel on the same frequency, where currently you can have only one.

If your agency operates a P25 Phase 1 Conventional network, you need to be cautious about upgrading to Phase 2, since the standards for Phase 2 Conventional operation is still undefined. These are expected within the next few years.

Phase 2 enables more users and more conversations on your existing frequencies, so it has great potential benefit for agencies whose current network is heavily loaded. Agencies with sufficient channels for the number of current and future users will see less benefits of implementing Phase 2 as you may pay a premium for more functionality than you actually need. In this scenario it would be more economical to add extra channels to your existing network.

As many agencies are feeling driven to buy P25 Phase 2 now to narrowband their communications solutions, it is important to understand your two options:

1. Purchase Phase 2-capable equipment now and hope that it complies with the interoperability standards when they are finalized, or
2. Purchase P25 Phase 1 equipment to achieve narrowbanding compliance now, and upgrade to Phase 2 when the interoperability is defined, only if you need greater spectral efficiency when your budget allows.

If you need to purchase now, your main consideration should be, “If I buy new radios now, then I will need to upgrade to operate on Phase 2 at a later date without incurring replacement costs for Phase 2.” To avoid purchasing new hardware, you should consider only those radios that offer either hardware or software upgradability so you’ll only have to pay for the upgrade cost to obtain Phase 2 features. If an upgrade is not supported, you should negotiate a commitment with your vendors. This will give you assurance that you have the right equipment for your long term needs. A commercial upgrade policy for your P25 Phase 1 radios to Phase 2, such as Tait offers, allows you to plan now for a staged migration to fit with your timing and budget.

When planning your migration, it is important to consider the network in its entirety, including coverage, antennas, backhaul (linking between sites), and not to consider it in parts. Consultation with Network Design experts can design and deliver a comprehensive migration plan.

Public Safety agencies are already seeing equipment marketed as ‘Phase 2-ready’, but it is not clear when the upgrades will be available. There is presently no P25 Compliance Assessment Program (CAP) testing for the Phase 2; consequently no manufacturer has undergone Phase 2 CAP testing and interoperability cannot, therefore, be guaranteed.

P25 CAP FOR GREATER CHOICE AND USER CONFIDENCE

Now more than ever, Public Safety agencies have the information to enable them to purchase with greater confidence and a clearer understanding of their choices. The P25 Compliance Assessment Program (CAP) is a government initiative to define “P25 compliant” by creating a framework of standardized conformance tests for manufacturers’ equipment. The aim of this program is to create some testing standards that, as a purchaser of radios, give you confidence that the radios you’re buying meet the basic requirement of the P25 standards.

P25 CAP testing provides public safety agencies with objective evidence that their equipment meets P25 standards for interoperability and conformance. The CAP suite of tests currently encompasses P25 Phase 1 and will include testing for Phase 2 to demonstrate interoperability between vendors’ equipment. P25 CAP tested equipment

also gives agencies confidence to make new vendor selections and the best choices for their budget - which may include multi-vendor procurement.

The outputs of P25 CAP testing include Supplier's Declaration of Compliance (SDoCs) and Summary Test Reports (STRs) which vendors publish to the Responder Knowledge Base (RKB) website: www.rkb.us, and gives vendors the ability to state that version x of Tait's radios work on version y of Motorola's infrastructure equipment for example.

- **SDoCs** tell you that a particular radio meets CAP requirements,
- **STRs** show the actual test results from the CAP laboratory and are typically of one radio's performance on another vendor's network. They show which tests were passed or failed.

Publication of these documents on the RKB website is proof of interoperability based on the CAP tests. This is often a requirement for some funding grants which mandate P25 CAP-tested equipment, providing an incentive for vendors to participate in P25 CAP testing to achieve interoperability with other vendors. Agencies looking to purchase can ask vendors for these documents to make informed purchasing and funding decisions.

It is important to note that a failure in a P25 CAP test can still result in compliance as it might be a failure on an 'optional' item. Test failures should be seen as positive outcomes since they demonstrate that the testing is working and they encourage vendors to collaborate to ensure that errors are caught and exposed in a controlled environment, allowing them to be fixed prior to deployment in the real world. A 'failure' identifies an area of functionality that is likely to be corrected by any given vendor.

P25 CAP testing does have some limitations:

1. It guarantees a minimal level of interoperability. The CAP, just as the P25 standards themselves, is growing and evolving as new requirements are added.
2. Proprietary extensions are not covered in the testing - only mandatory standards and some standard options are included. There is a risk of problems being found at deployment, however most vendors are experienced enough to resolve these issues as they arise.
3. P25 CAP performance can't give you coverage and performance guarantees as coverage and performance depends on many aspects including the specifications of the radio itself.

Nevertheless, the P25 CAP represents a detailed, well-supported and vendor-neutral yardstick of interoperability that has been embraced by manufacturers who have willingly invested time and effort to test each others' equipment.

The following table shows the Department of Homeland Security (DHS) P25 CAP approved laboratories and which vendors Tait has CAP tested with:

Official P25 CAP Recognized Laboratories*	
P25 vendors with a recognized laboratory	<ul style="list-style-type: none"> ■ Tait Electronics Ltd Teltest Laboratories ■ EF Johnson Technologies ■ Harris Corporation ■ Motorola (ASTRO System Integration & Test Laboratory; GP25 HEC-PI TEC Schaumburg; P25 Performance CAI Subscriber Compliance Laboratory)
Other recognized laboratories	<ul style="list-style-type: none"> ■ Compliance Testing LLC dba Flom Test Lab ■ TIMCO Engineering, Inc.
Vendors we have tested our SUs with*	Vendors who have tested on our infrastructure*
<ul style="list-style-type: none"> ■ Tait Radio Communications / EADS ■ EF Johnson ■ Harris Corporation ■ Motorola Inc ■ PowerTrunk Inc ■ Raytheon JPS 	<ul style="list-style-type: none"> ■ Tait Radio Communications ■ EF Johnson Technologies ■ Harris Corporation ■ Icom America Inc. ■ Kenwood USA Corporation ■ Motorola Inc. ■ RELM Wireless Corporation ■ Simoco (ComGroup Australia Pty Ltd) ■ Thales Communications Inc.

*See www.rkb.us for the latest information.

THE PITFALLS AFFECTING INTEROPERABILITY BETWEEN P25 RADIOS AND NETWORKS

It is a reasonable expectation when purchasing P25 equipment, that all P25 radios should work on P25 networks if they have passed the necessary CAP tests. However individual radio idiosyncrasies, confusion about the P25 standards and programming and configuration are just some factors that affect the level of interoperability.

Different interpretation and implementation of the standards: P25 definition is still work-in-progress by the TIA, which leaves room for uncertainty in features such as data communications or AVL/location services. The standards themselves have variations on standardized functions based on a network-to-network scenario. Some P25-defined functions, such as Failsoft operation, require as yet undefined supporting features to make them work. If each vendor implements the supporting features differently, the standard Failsoft functionality becomes non-standard since it depends upon proprietary design of the supporting function.

Radio configurability and usability: Radio operation is often configured at the user or vendor level and if it doesn't match the network configuration problems can arise. Vendors should be able to offer strong support staff to resolve these issues. Usability is vendor specific, it is not related to the P25 standards and is one of the major obstacles to having multiple vendors on a statewide network as the network certification tests are based on existing radio functionality and not on the P25 standards themselves. It is recommended that you create some usability standards if you are looking to get multiple vendors on your network and it is a good practice that not every feature of the radio is defined as you may end up reducing the ability for other radios to come onto your network. You need to make sure that the testing criteria matches your users' needs, and that this criteria won't become a limitation later if you want the option to have multiple vendors working on your network.

Basing requirements on proprietary features: Multi-vendor procurement enables greater options to find a solution that best fits your needs and budget, and a highly prescribed testing criterion for your agency can limit your options. The core feature sets are defined through the mandatory standards. The standard options and manufacturer's extensions however are largely defined by individual vendors or when programming, therefore no 'uniform' operation necessarily exists. Vendors may choose not to implement a particular standard option and 'standard' P25 radios may well have 'non-standard' features on them, so it is important that purchasers understand these features early in the buying cycle to avoid being locked in to a particular vendor.

Performance restricted by non-standard functionality: You cannot guarantee your radios will be interoperable if they use non-standard functionality. Make sure you are aware of this when you make your decisions. This can become a road-block to multiple vendors supplying radios for your network. It is important that you make wise decisions when accepting non-standard functionality as you can end up limiting your choice of radio paying more as a result. For example, you may purchase some very affordable encryption only to later discover that it is a proprietary encryption. This encryption package will now restrict you from purchasing any other type of radio unless it also has the license for that proprietary encryption. These licenses also have their caveats: vendors may be charged a royalty fee per radio making it impossible to compete against it, or the license may not be for the full function of the feature. Don't get trapped into proprietary features that will restrict your future options.

Varying certification rules per Regional/Statewide network: Each network owner specifies different rules for radios to operate on their network, which can result in a lack of interoperability if proprietary functionality is specified as a prerequisite to get on the network. Benefits of being on a statewide network include greater coverage, vendor choice and improved interoperability with your neighboring agencies.

A GREATER UNDERSTANDING OF P25 CAN ENSURE AN INTEROPERABLE FUTURE

A challenge all Public Safety agencies face is that of genuine interoperability with other agencies and it could be when you need it the most that you find out you don't have it. The open standard architecture of P25 aims to define this for network operators however in reality the standards allow for variation and as a result, genuine interoperability may be compromised. Those tasked with purchasing equipment for their agency face the daunting task of selecting the best solution for their needs now and into the future. There are actions you can take which addresses these and will help protect your personnel and your communities.

While some vendors are promoting Phase 2 as driven by the FCC mandate, it is important to understand that Phase 1 can meet your immediate, and potentially only, narrowbanding needs. The only 6.25 kHz mandate is in the 700 MHz band. If you are purchasing now, ask vendors for proof that the equipment meets P25 performance standards for interoperability and conformance. P25 CAP is one way network operators can confidently purchase from a new vendor. In addition you can ask to see which vendors' radios have been tested on their proposed network and which, if any, features are proprietary. Vendors concerned with interoperability will actively participate in the P25 CAP.

Claiming interoperability does not guarantee interoperability. Vendor interpretation and misunderstanding of standards, usability and differing certification processes all lead to a confusing and frustrating lack of interoperability when you are led to believe that P25 equals interoperability. To make certain you are designing an interoperable future, ensure you understand the P25 standards and phases, and what requirements you have from a user and network perspective. Match testing criteria for network certification to agency needs and use the resources available, such as CAP, to research your options thoroughly before committing to one vendor. Thorough research can present options offering greater value for your budget and will ensure your communications go where, and to whom they are needed.

GLOSSARY

Term	Explanation
APCO	Association of Public Safety Communications Officials
CAP	Compliance Assessment Program: The P25 CAP is a partnership of the Department of Homeland Security (DHS), the National Institute of Standards and Technology (NIST), the P25 radio industry, and the emergency response community. The P25 CAP establishes an independent compliance assessment process to ensure communications equipment interoperates, conforms to P25 standards, and meets performance requirements.
DHS	Department of Homeland Security: “is a cabinet department of the United States federal government...with the primary responsibilities of protecting the territory of the U.S. from terrorist attacks and responding to natural disasters.” ¹
EMS	Emergency medical service (in the USA)
FCC	Federal Communications Commission: “an independent agency of the United States government...The FCC works towards six goals in the areas of broadband, competition, the spectrum, the media, public safety and homeland security, and modernizing the FCC.” ²
ISSI	Inter RF Subsystem Interface: “a non-proprietary interface that enables RF subsystems (RFSSs) built by different manufacturers to be connected together into wide area networks.” ³
P25	Project 25 refers to a suite of standards for digital public safety communications services
RKB	Responder Knowledge Base: An online source of information for emergency responders
SDoCs	Supplier’s Declaration of Compliance: an output of the P25 CAP testing, this document tells you that a specified radio with specified firmware meets CAP requirements
STRs	Summary Test Report: an output of the P25 CAP testing, this document shows the actual test results from the CAP laboratory and are typically of a specified radio’s performance on another vendor’s specified network
TIA	Telecommunications Industry Association (TIA): a global trade association headquartered in the United States

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Tait Radio Communications is a global leader in designing and delivering radio solutions which are the right fit for a variety of industries including; public safety agencies, government services, utilities and urban transport providers.

MORE INFORMATION

For more information on P25 interoperability, please contact your nearest Tait dealer.

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