IMPLEMENTING YOUR

P25 SYSTEM
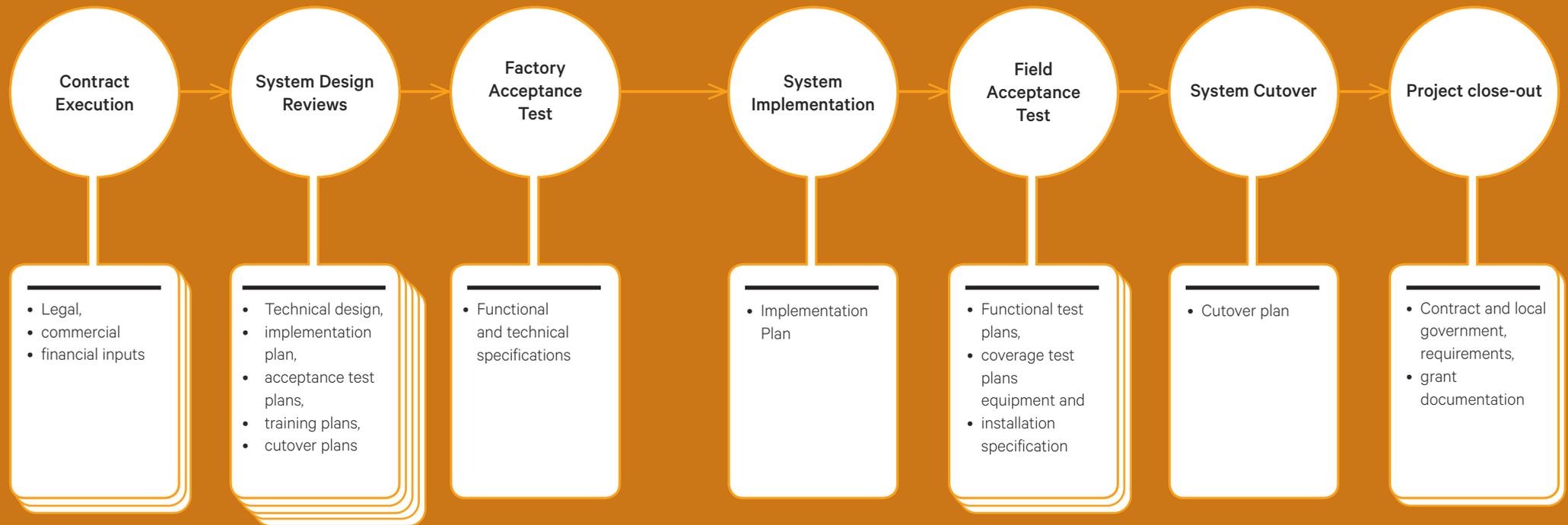
tait
communications

IMPLEMENTING YOUR P25 SYSTEM

- How do I approach change management?

- What should the System Design Review involve?

- Should I specify burn-in testing?

- What should the coverage tests involve?

This Best Practices Guide for implementing P25 systems discusses some common issues when getting a new network up and running. It addresses the often-confusing sea of documentation required, and how to make sure your people are trained and ready to accept the challenge the new communications bring.

Who should read these guides?

If you are a Public Safety official who is responsible for, or involved in, procuring a new communication system, this guide (and the others in the series) is written for you. You may be new to the position, or focused on other disciplines, such as IT. Or you may be new to P25. We assume that you have an understanding of Land Mobile Radio, but not necessarily in-depth knowledge.

We also assume that your interest is pragmatic; you want to make sure you procure and/or manage your radio system to meet the needs of your first responders and public service providers in a fiscally-responsible way. Becoming an expert on all related topics is not your objective.

We hope these guides will benefit you and your wider Public Safety Communications community by presenting you with a range of P25 topics so you can more effectively engage in the process.

The decision to adopt the digital open standards-based P25 platform offers Public Safety agencies many benefits, but it also raises a lot of questions. There are many common questions - and there a lot of agencies who have already tackled them, who are happy to share their experiences.

Tait is sponsoring an on-going project, to discuss these topics and put forward some answers.

Over a series of intensive round-table sessions, our participants discussed their own experiences and challenges, generously sharing their frustrations and triumphs. Together with Tait expert advice, these guides include their many valuable insights, based on their hands-on experience working through typical P25 project challenges.

Learn more and subscribe to future guides at www.p25bestpractice.com

CONTENTS

IMPLEMENTATION - OVERVIEW

Contract Execution

- Legal,
- commercial
- financial inputs

System Design Reviews

- Technical design,
- implementation plan,
- acceptance test plans,
- training plans,
- cutover plans

Factory Acceptance Test

- Functional and technical specifications

System Implementation

- Implementation Plan

Field Acceptance Test

- Functional test plans,
- coverage test plans equipment and
- installation specification

System Cutover

- Cutover plan

Project close-out

- Contract and local government, requirements,
- grant documentation

CONTRACT EXECUTION

This guide assumes that your contract has been carefully examined and fully executed by all parties involved, including your consultants and vendors. If applicable, the performance bonds have been posted. The down payment has been made. Your internal implementation team has been defined, and their roles and responsibilities clearly assigned and communicated. You will have identified your primary points of contact, internal Project Manager and subject matter experts.

Your selected vendor has assembled their project team and provided you with the date for your System Design Review.

Kick off meeting

As soon as possible after the execution of the contract, it is good practice to hold a kick-off meeting with your vendor. This is the time for both sides to:

- ☑ introduce all the key participants,
- ☑ set up high level expectations,
- ☑ reaffirm the project objectives for everyone involved,
- ☑ establish lines of communication,
- ☑ prepare for the system design review.
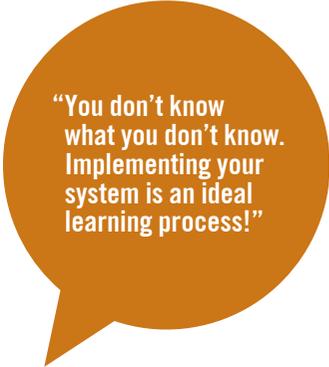
"You don't know what you don't know. Implementing your system is an ideal learning process!"

SYSTEM DESIGN REVIEW

A post-contract system design review (SDR) is necessary because it is seldom, if ever, possible to finalize all details of the design and related project documents in the contract, let alone in the proposal documents.

You need to invest significant time and preparation for the System Design Review (also known as Customer Design Review or Final Design Review). Typically held at your location, the purpose of this meeting (or, in cases of complex projects, series of meetings) is to lock in the design/project plan and enable the vendor internal procurement efforts – production of equipment, purchasing third party devices, signing up subcontractors.

The System Design Review can deliver more than its name implies. For instance, it is a good opportunity to revisit and finalize a number of additional important documents. While every project is an iterative process, there should be very few questions unanswered about project implementation after the SDR is finished.

The following technical documentation is a high level view – you should expect and demand more detailed information from your vendor.

Technical design documentation

- [x] System architecture
- [x] Detailed site drawings (RF, dispatch and backhaul equipment configuration, antenna system design, power system design, wiring, grounding, alarms, site improvements or new site details)
- [x] Detailed list of purchased items including sufficiently described software features and associated licenses

Implementation plan

- [x] Detailed statement of work identifying resources and assigning responsibilities to the vendor or to the buyer
- [x] Timeline - typically a detailed Gantt chart with dependencies, resources and critical path identified

Regulatory review – all applicable licenses and permits

- [x] FCC
- [x] FAA
- [x] NTIA
- [x] Environmental
- [x] Health and Safety
- [x] Other

Acceptance test plans

- [x] Factory Acceptance Test Plan (may be more than one, if an elaborate microwave network is being procured with the radio system)
- [x] Functional Field Test Plan (to verify system functionality after it has been installed)
- [x] Coverage Acceptance Test Plan/s (may vary by technology, geography, coverage requirements)
- [x] Burn-in test definitions (if applicable)

Training plans

- [x] User training
- [x] Technical training
- [x] Administrative training

CUTOVER PLANS

The SDR requires a formal sign-off process. Your signature on the summary document will, in most cases, override any earlier agreements (for example, specifications included in contract, quantities of equipment, software features).

Be aware of the consequences of any changes – they may impact the schedule, add or reduce costs or alter system functionality and performance.

The vendor will build and test your system as agreed in the System Design Review. If there is a discrepancy between what was agreed in the SDR and the initial contract, you may end up paying the bill (or save some funds).

"Acceptance testing should be preceded by appropriate classroom training."

FACTORY ACCEPTANCE TESTS

Factory Acceptance Tests are conducted to:

- test the system in a lab environment before it gets shipped and installed at your site,
- allow you to become familiar with your new system,
- clarify any differences between your expectations and reality.

Factory Acceptance Tests are particularly valuable if you are undergoing a major technology change, such as moving from analog conventional system to digital trunked system. In these cases, you would be well advised to have someone already expertly familiar with the new technology on your team participating in the test.

For the tests, the vendor will have assembled the system in a configuration either identical to, or if impractical (for example because of the number of sites or consoles), similar to the actual.

Tests performed during FAT include:

- ☑ visual inspection,
- ☑ verification of electrical parameters of the relevant equipment (eg. base station output power or sensitivity),

☑ functional tests (eg. group or emergency calls across multiple sites),

☑ system resiliency (eg. automatic switchover),

☑ other aspects of the system as previously agreed.

Where system design includes major microwave network, there may be a separate FAT for the microwave subsystem at a different location. It is not practical to set up actual RF microwave links in factory settings. The connection between sites is typically simulated via hard-wired connections (most commonly Ethernet).

On large networks with multiples of identical sites or large number of dispatch consoles, some sites and consoles may be excluded from testing for pragmatic reasons. Make sure that the reduced test configuration still allows realistic system testing.

Where the technology change and/or the size of the system is limited, you may be able to save some time and money by foregoing the FAT and rely on your vendor to perform the necessary testing before shipment, without your participation.

"Beware of vendors leveraging user training to sell you additional features."

SYSTEM IMPLEMENTATION

Typically, your role in implementation is limited to

- monitoring the progress,
- facilitating access to the sites where work needs to be done,
- preparing for the next steps via, detailed migration planning, subscriber fleet planning and training.

It is not necessary to monitor all installation and commissioning activities. However, many system buyers delegate some of their own technical resources to participate, as they provide an excellent opportunity for hands-on training. If you wish to do so, ask for the necessary provision in advance, preferably in the RFP.

Formal progress monitoring is typically accomplished via regular communications from the vendor, usually structured meetings or conferences with formal progress reports. Agree the format, contents and frequency of progress reports in advance.

PREPARING YOUR ORGANIZATION FOR CHANGE

Your basic migration plan should be agreed and finalized at the time of System Design Review. While the vendor is installing the system it is up to you to prepare your organization – radio users, dispatchers, system administrators – for the upcoming change. This will include training and communications making sure all involved parties understand their roles, the scope of the changes and are ready to start using the new system.

Training your users

In most cases it is not feasible to have the vendor train each user on the new system. Most buyers adopt the "train the trainer" approach under which the vendor will train a limited group of radio users or technicians and provide them with the instruction that can then be carried all the way through the organization.

Be realistic about the amount of training needed. If you are swapping a proprietary digital technology for P25 and your sites stay in their previous locations, the amount of needed training is probably limited. Where you move frequency bands, sites and technologies from analog conventional to digital trunked you need to allow significantly more time to prepare your users for the change - even if the change amounts to overall significant improvement.

Training your technical personnel

A similar approach needs to be taken in deciding the scope of training for technical personnel. Even if your technicians are not going to be maintaining and repairing the system or user equipment, they need to have thorough understanding of the system and its elements so that they can monitor its performance, report issues to the vendor, engage in potential discussions about improvements and extensions as well as explain any issues to others in your organization.

Training your system administrators

Finally, training for system administrators needs to be extensive as they will be setting up your fleet architecture, changing system features, setting alarms, enabling and disabling users, monitoring traffic and performance. This cannot be done with confidence without thorough understanding of the deployed technology.

"System management, engineering and technicians need to train before and after implementation."

Subscriber fleet planning

Creating the necessary number of groups and assigning their numbers is not particularly challenging for P25 networks once the basics are well understood. It can, however get complicated if you are planning mutual agreements with your neighbors. You should avoid using the same group and individual IDs as your neighbors to allow easy identification of groups and units across multiple networks.

FIELD ACCEPTANCE TESTS

Once the vendor has fully installed and optimized your system, they will perform three types of tests:

- ☑ Functional tests
- ☑ Coverage tests
- ☑ Burn-in test (sometimes skipped)

Functional tests

These tests are expanded versions of the previously-conducted Factory Acceptance Tests. They should include thorough examination and measurement of installation quality, especially the antenna systems, lightning protection, power systems and power supply in accordance with industry standards. Any tests that were only simulated during factory testing (if conducted with limited set-up) should now be performed live across the whole network, in their entirety.

It is especially important to verify system's resilience. Automatic or manual switchovers (power, backhaul, and controllers) need to be forced into failure mode and tested for reliable switching.

Coverage tests

The crucial parts of the field acceptance testing are the coverage test procedures. Make sure these are performed in full accordance with the agreed test plans, and the results meticulously recorded.

All coverage tests should be conducted with participation of your representatives. It is essential that you have high level of expertise available to you, which, in most cases, will mean that you need an experienced consultant to oversee this process.

Coverage tests are typically a combination of automatic, computerized signal measurements and voice quality tests. Measurements include signal strength (RSSI), Bit Error Ratio (BER) and Message Error Rate (MER) that can be automated and archived. Because voice quality testing is highly subjective, we recommend that the test participants' ears are "calibrated" by the entire group listening to audio samples just before the testing commences – each vendor can provide the samples in advance. To minimize subjectivity, test crews, whether in field or stationary, should consist of at least three people, so that a reasonable level of consensus can be achieved.

There is no consensus as to which type of coverage test is best. Signal strength and Bit-Error-Rate tests are run automatically and thus cheaper than voice quality (DAQ) tests which require significant amount of manual labor and time. However, DAQ test is seen by many as the ultimate proof of system's performance. Others cite a strong correlation between DAQ and BER measurements and so are comfortable foregoing the DAQ testing.

Signal strength testing is not sufficient by itself for two reasons – the automated test cannot differentiate

between the valid signal and interference and, in case of simulcast systems, cannot recognize areas with high level of Time Delay Interference.

Burn-in tests

If performed formally, burn–in tests should last 30-60 days and can start as soon as the vendor finishes system optimization. To conduct the tests, a limited number of trained users will start using the system and formally report any problems.

It is important to agree on a number of issues up front.

- What kinds of failures, if any, reset the test?
- What are the expected response times?
- What formal reporting of the undertaken actions and results is required when problems are reported?

It is very important to agree up front who can use the system during this time, and how it can be used. System usage during your burn-in tests must not trigger the "beneficial use" definition and start the warranty period prematurely.

All issues discovered during the burn-in test need to be carefully tracked until they are fully resolved.

SYSTEM CUTOVER

Details of system cutover will depend on your migration plan. Most commonly, the process of retiring the old system and bringing the new one on line is gradual, with the two systems, or at least their parts, coexisting for a while to enable an orderly and controlled transfer of the user fleets. There are four important considerations for this type of scenario:

1. Capacity

When migrating from one trunked system to another on a channel-by-channel basis, the combined capacity of the two systems will be less than that of either one individually. This happens for two reasons; instead of one, two of your channels will serve as control channels, and due to the nature of compounding traffic handling capacity in trunked systems, the average capacity per channel will be reduced.

This temporary capacity reduction may be of no consequence on systems with enough channels. On busy systems the combined reduction may be unacceptable and prompt you to opt for the rare instantaneous cutover mentioned below.

2. Interoperability

It is important to plan ahead for interoperability between the two coexisting systems. Potential functional capabilities are limited only by budget and common sense. It is possible to design and implement elaborate and expensive solutions providing high level of interoperability, allowing seamless roaming, transparency of advanced signaling, etc. How important, or how much are these worth during the transition time? Is it easier and more economical to opt for the simplest solutions (for example, console patching on demand) while driving towards minimizing the transition time? The answers will vary for different Public Safety organizations based on their particular circumstances.

3. Equipment space

In the past, operating two networks simultaneously would probably have caused space issues at some or all of your sites and equipment rooms. However, the smaller equipment footprints of the new technologies mean you can usually support the old and new systems operating simultaneously, without duplicating their space requirement.

"Don't change talkgroups and naming conventions from the old system to the new one if you can avoid it."

4. Instantaneous cutover

In some rare cases the cutover may be instantaneous when the old system is taken off the air at the same time when the new system is brought on line. This risky scenario should be designed so that it can be easily and orderly reversed if needed. This type of cutover is typically executed at the time of least radio traffic – such as during early hours of Monday morning.

"DO NOT BE AFRAID OF THE MIGRATION. RUN TWO SYSTEMS IN PARALLEL AND MIGRATE CHANNEL BY CHANNEL, GROUP BY GROUP, SITE BY SITE AS DICTATED BY OPERATIONAL NEEDS."

PROJECT CLOSE-OUT

Project close out has several different aspects. Not all of them will necessarily apply to your situation.

Project documentation

Make sure you have complete project documentation in one convenient and secure location – everything from the proposal, contract with its attachments, SDR documentation, all applicable permits and licenses, results of all of the tests, training records, as-built drawings and post implementation procedures including any warranty and post-warranty agreements.

Grants and funding requirements

Did you use any grants to build your new system? Verify that you have met all of their requirements and submitted all of the documentation.

Maintenance handover

Maintenance and repair services are likely to be provided by different people than the ones who installed and optimized the system. Make sure that a formal handover takes place and that the maintenance party has a solid understanding of the system and of its contractual obligations.

Support for users

Do not stop communicating with, and supporting your users, especially if your technology change was significant. Continue to offer additional internal user training sessions for as long as needed.

When is the project closed? It is never finished until the next one is rolled out because technology keeps rolling faster and faster.

"IF POSSIBLE, HAVE THE SYSTEM MAINTENANCE CREW (INTERNAL AND/OR EXTERNAL) INVOLVED IN THE SYSTEM IMPLEMENTATION. AS A MINIMUM, ENSURE SOME OVERLAP."

INSIGHTS

"Opt for comfort level over schedule level."

"It is very difficult to gather the necessary close-out information at the end of a project. Maintain documentation throughout the process."

"All external devices should be integrated at FAT as well (dispatch consoles, logging recorders)."

"Illegal carriers, old coax and old antennas can shut you down. Clean up the old stuff."

"Before sign off, perform a rigorous drive test yourself to check areas you know have coverage issues or dead spots. You may get vendor resistance. Too bad!"

"It is important not to tell users and subscribers too much – train them on a need to know basis only, not all the possible functions of P25."

"Start slow. Flash is bad, gradual is good."

"Make sure user training is internal. The vendors will teach your users theoretical capabilities of the radios, internal training will teach them how to use the new tools."

"Use "Train the trainer" for dispatch and subscribers. Continuity is important so consider this when choosing your trainers."

"Two options: start with the critical groups of users and work down, or start with the least critical and work up. There are benefits both ways."

All quote bubbles are direct insights from the industry participants at the Tait P25 round table discussions. To find out who the participants were, visit **www.p25bestpractice.com**

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