PALM BEACH COUNTY
BOARD OF COUNTY COMMISSIONERS
AGENDA ITEM SUMMARY

Meeting Date: April 15, 2014	[] Consent	[X] Regular
	[ ] Ordinance	[ ] Public Hearing

Department: Facilities Development & Operations

I. EXECUTIVE BRIEF

Motion and Title: Staff recommends motion to approve: a capital renewal/replacement project to migrate from the existing countywide public safety trunked radio system to a full digital system which is compliant with APCO Project 25 (P25) standards.

Summary: In January 2014, Staff distributed the P25 Migration Path Recommendation Report (Report) which identified procurement options, critical issues in choosing a migration approach, and recommendations on timing. The Report contained three general conclusions which were that the County: 1) conduct a competitive selection for the vendor responsible for the design and implementation, 2) consider the complex interoperability, fiscal and transitional impacts on its users prior to choosing a specific approach to replacing the existing system, and 3) begin the infrastructure replacement no later than 2016 in order to complete same by 2018. The Report did emphasize that there could be operational/functionality requirements and/or decisions by interoperability partners which could cause an earlier Project commencement. Since the distribution of the Report, Sheriff Ric Bradshaw has asked that County begin the migration as soon as possible in order to gain encryption functionality which currently only exists for a limited number of users. The next major activity in the project will be the selection of a design professional/consultant pursuant to the Competitive Consultants Negotiation Act (CCNA) who will be responsible for preparing the technical specifications (including recommending a specific approach to the migration), soliciting input from direct connect cities and other interoperability partners prior to finalizing the technical specifications, and summarizing any comments from interoperability partners which are not addressed by the final specifications. Staff also intends on seeking input from potential vendors on the draft RFP prior to the RFP being solicited. The recommended award of the consultant contract will likely occur in September 2014. The goal is to have drafts of the technical specification out for review and comment in January – March of 2015. This project will be funded from the 800 MHz System Renewal/Replacement Fund which is made up of annual renewal/replacement contributions by PBSO, Fire Rescue, county departments and all cities who have direct connect agreements on the existing County system as well as PBSO generated $12.50 funding. No new appropriations are anticipated. **(FDO Admin)** Countywide **(JM)**

Background & Policy Issues: In November 2012 Staff recommended, and the Board approved proceeding with the replacement of the master site equipment of the existing countywide radio system, which has since been completed. The basis for that recommendation was that the existing equipment was no longer in production nor supported (end of life) and the need to maintain mission critical reliability. In August and twice in November of 2012 Staff committed that it would evaluate full system replacements prior to any future major replacement expenditures whether due to end of life issues, the needs for additional functionality beyond the existing system's capability, or the desire to achieve to full P25 compliance. The Report fulfills that commitment by beginning a comprehensive analysis of the fiscal, operational and functional impact of migration approaches. Staff's recommendation to solicit municipal and vendor input on the RFP prior to finalizing and soliciting the County's procurement recognizes the County's sensitivity to the complex and potentially significant operational and fiscal implications of the County's actions on its partners.

Attachments:

1. P25 Migration Path Recommendation Report
2. Memo from Sheriff Ric Bradshaw dated January 27, 2014

Recommended By:	_Ashley Wolf_	_3/27/14_
	Department Director	Date
Approved By:	_[signature]_	_4/7/14_
	County Administrator	Date

II. FISCAL IMPACT ANALYSIS

A.   **Five Year Summary of Fiscal Impact:**

Fiscal Years	2014	2015	2016	2017	2018
Capital Expenditures	_____	_____	_____	_____	_____
Operating Costs	_____	_____	_____	_____	_____
External Revenues	_____				
In-Kind Match (County	_____	_____	_____	_____	_____
NET FISCAL IMPACT	✱_____	_____	_____	_____	_____
# ADDITIONAL FTE POSITIONS (Cumulative)	_____	_____	_____	_____	_____

Is Item Included in Current Budget: Yes _____   No _____

Budget Account No: Fund _____   Dept _____   Unit _____   Object _____
Program _____

B.   **Recommended Sources of Funds/Summary of Fiscal Impact:**

There is no fiscal impact to this item. All expenses associated with the P25 Migration will be funded from the 800 MHz System Renewal/Replacement Fund which is made up of annual renewal/replacement contributions by PBSO, FR, county departments, cities who have direct connect agreements on the existing County system as well as PBSO generated $12.50 funding. No new appropriations are anticipated.

C.   **Departmental Fiscal Review:** _____ 3·28·2014

III. REVIEW COMMENTS

A.   **OFMB Fiscal and/or Contract Development Comments:**
  ✱ Fiscal impact is indeterminable at this time & will be presented at a future date

OFMB   3/31   Contract Development and Control   4/1/14

B.   Legal Sufficiency: _____ 4/3/14
Assistant County Attorney

C.   **Other Department Review:**

_____
Department Director

Palm Beach County, FL

Master Site Equipment Replacement/Renewal Project

Deliverable #3

P25 Migration Path Recommendation Report
Revision 1

January 16, 2014

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File: Migration Path Recommendation Report - Task 5 - Deliverable 3 - 20140106.docx

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Revision History:

Revision 1: Correction to Table 5 - Interoperability Matrix: Boca Raton & West Palm Beach P25 Migration (Hypothetical) and narrative below, Page 24

1. EXECUTIVE SUMMARY

Palm Beach County Capital Improvement Division retained Johnson, Levinson, Ragan and Davila, Inc. (JLRD) and RCC Consultants, Inc. (RCC) for consulting services related to the peer design review, post implementation audit and 3-5 years of system performance evaluation of the County's existing Motorola SmartZone 3.0 voice radio system. RCC is not affiliated with, nor do we have any financial interest in, any communications equipment manufacturer, distributor, or supplier. We do not receive or accept remuneration of any type from any manufacturer, distributor, or supplier for recommending any of their products. Our unbiased independent position provides our clients a capable partner in meeting their project requirements without the potential for conflicts of interest.

The Palm Beach County radio system has been operating on new Master Site Equipment (MSE) since 8/8/2013. The MSE replaced the central core of the system that had reach end-of-life status end-of-support status. However, the County must plan for the 12/31/2018 end-of-life issues associated with other critical components of the RF infrastructure and dispatch consoles. Some of the risks associated with operating equipment that has reached its end-of-life are; 1) lack of spare part availability, 2) lack of manufacturer 3) trained support for the end of life equipment, and 4) a greater portion of the responsibility of maintaining the system is shifted onto the local support team (vendors and in-house staff) who will no longer have technical support available from the manufacturer. Palm Beach County would often have to rely upon third party vendors to repair broken items and/or purchase replacement parts.

The choice for the County to replace or address the end-of-life issues of the RF infrastructure and the dispatch equipment is a matter of risk-tolerance. As equipment ages it becomes more prone to damage or breakage. Though the system can continue to work after it has reach end-of-life, it may take longer to repair and restore the system should it break down as it will be harder and harder to find parts for it and harder to find technicians that are familiar with the old technology. The County's radio system is critical to the safety of the users and to their ability to perform their duties. As such, this should set the threshold for replacing a system sooner rather than later and RCC recommends that the County not rely upon a radio system that has reached end-of-life.

The most viable plan moving forward is for the County to migrate to a P25 system. A P25 system will alleviate the end-of-life issues with the current RF infrastructure and dispatch console systems, provide greater interoperability, allow for new sites and additional channels, and provide new features, functionality and reliability improvements that are not available with the current system.

The County has two primary options for migrating to P25; a complete system replacement and a phased migration.

	Complete System Replacement	Phased Migration
Impact on User Agencies	Requires all user agencies to purchase P25 radios prior to cutover to new system.	Provides time to user agencies to budget and procure P25 radios and allows agencies ready to begin operation on P25 to do so now.
Integration with Legacy System	Only simple audio patching is required to facilitate a smooth transition	If vendor of new system is not Motorola, full-featured interconnections (e.g., ISSI) and workarounds may be required and County would have to manage two independent systems. Motorola is able to fully integrate the legacy system into a new P25 system.
Facility Requirements	May require new shelters, antennas, transmission lines, tower structural modifications and/or tower replacements	Will not likely require any significant facility improvements or replacements
Maintenance Costs	County will pay for maintenance on only one system at a time.	County will pay for maintenance on two systems. If vendor of new system is not Motorola, County may have to pay more due to needing additional hardware (MSE, ISSI, etc.) required to connect old and new systems.

The County has the option of competitively procuring a new P25 system with either migration scenario, however, it can be argued that Motorola will have a competitive advantage since the County already owns a Motorola MSE that is capable of supporting P25 RF infrastructures and consoles. Though the cost of the MSE is not trivial, it is a relatively small percentage of a complete system replacement – approximately 11% of a projected total system cost. Prior to purchasing the new MSE in late 2012, the County

acknowledged this and committed to not using the purchase of the new MSE as the basis for not proceeding with a competitive selection.

The impact of the Motorola P25 MSE is further reduced if the County chooses to implement additional redundancy options such as a redundant master site and redundant simulcast prime sites as recommended by RCC. The requirement to replace the large number of dispatch consoles that are used by PBSO (due to the need for uniformity or/and compatibility) will have the same effect of reducing the impact of the new MSE. Depending upon when the County migrates to P25, the value of the MSE will be even less as it may require additional hardware and/or software upgrades to be compatible with the system that Motorola proposes, thereby further leveling the playing field and mitigating the advantage of having an existing MSE incorporated into their proposal.

Any vendor can potentially provide for a complete replacement system, however, a phased migration to a system other than Motorola, may cause issues for the new vendor as they must rely upon Motorola, with possible mediation by the County, to overcome compatibility issues with the County's current Motorola RF infrastructure and dispatch consoles. In addition, a phased migration may require that certain upgrades to the current system to meet integration requirements and must be purchased from Motorola. Regardless of migration methodology, other vendors will be required to integrate Motorola subscribers for agencies that already own a quantity of Motorola P25 subscribers.

When the County begins its migration to P25, other cities and counties in the area with their own end-of-life systems could participate in the process with the County. Due to the operational importance of maintaining interoperability with West Palm Beach and/or Boca Raton (each for different reasons), in the event that either choose a non-Motorola P25 system (and therefore non-Motorola P25 subscribers), the County must begin its migration to a P25 solution concurrent with these cities' decision. In addition, regardless of the vendors the cities select, County agencies that have a need to operate on those systems (day-to-day, mutual aid response, etc.) must migrate to P25 subscribers.

The choice of a vendor for P25 system by these cities is not the only driving factor. If the County and these other agencies migrate to P25 in a joint manner where a single vendor is selected, all parties could realize cost reductions due to economies of scale as well as greater interoperability between agencies as everyone would operate on a single, seamless system. Such a "system of systems" would eliminate the need for expensive P25 interconnect servers to tie together systems from different vendors and also allow certain features, such as Priority Level Access and Queuing, Private Call, Radio Inhibit/Uninhibit, Dynamic Regrouping, GPS, Text Messaging, etc. to work across all systems; something that cannot currently be done using P25 interconnect servers.

By performing the MSE replacement/renewal project, the County has time to decide the

proper course of action and the need to upgrade the current system to P25 should be driven by the needs of the users. The County should begin the process of migrating to P25 by 2016 and complete the migration by the end of 2018, which is the end-of-life date for many of the most critical components of the system. If the County or another agency has a need for features, functionality, expansion, etc. that can only be supported by a new P25 system sooner than 2018, or if another partner were to make a decision that has the effect of reducing overall interoperability amongst all public safety agencies countywide, the County should consider beginning the migration to P25 at that time.

2.   END-OF-LIFE ISSUES

With the Master Site Equipment (MSE) Renewal/Replacement project, the County addressed the end-of-life issues with the central core of the radio system (SmartZone and prime site controllers, both of which were past end-of-life and repair efforts by Motorola were on a best-effort basis.).   End-of-life refers to a date at which the manufacturer of a particular product no longer provides support for that product that they stop selling many years in advance. This is not to be confused with the life expectancy of a product as a product could continue to operate for many years after the manufacture stops offering support.   The risk of operating equipment that is end-of-life is related primarily to maintenance contracts and spare parts availability. Items that are end-of-life do not have official support from the manufacturer and support is provided on a "best effort" basis.   The manufacturer is no longer training support staff on the end-of-life equipment and software updates and bug fixes are no longer being developed.   A greater portion of the responsibility of maintaining the system is shifted onto the local support team who will no longer have technical support available from the manufacturer. Parts also become more and more sparse, spares are no longer being manufactured and broken parts are only being repaired by the manufacturer if commercially feasible for the manufacturer to do so.   The owner of end-of-life equipment must often rely upon third party vendors to repair broken items and/or purchase replacement parts.

As of 8/8/2013, the system is operating on a new Motorola 7.13 ASTRO25 MSE with redundant MTC3600 prime site controllers. Though Motorola has not set an end-of-life date for the 7.13 MSE, Motorola has set the end-of-life date for the MTC3600 prime site controllers to be 12/31/2018. The County must plan for the 12/31/2018 end-of-life date of the MTC3600 prime site controllers as well as many of the other components of the RF infrastructure and dispatch consoles that have similar end-of-life dates.   The subscriber radio portion does not face end-of-life issues; however, it faces issues with age, wear-and-tear, and compatibility.

2.1   RF Infrastructure

2.1.1   Current End-of-Life Equipment

After addressing end-of-life issues associated with the MSE and prime site controllers, the following portions of the RF infrastructure remain end-of-life at this time:

Component
Remote Site Controllers
System Clocks
Tower Top Amplifier Systems

2.1.1.1   6909-Based Remote Site Controllers

The remote site controllers are responsible for controlling the repeaters at the RF sites based upon instructions received from the prime site controllers. Each of the County's ten RF sites has a single 6809-based remote site controller. If a RF site's remote site controller fails, that site is removed from the simulcast system and effectively turned-off until the controller is repaired. The loss of a single site in the County's radio system will result in a degradation of RF coverage in the area surrounding the site, but because the County's system is simulcasted and voted with overlapping coverage from each site, the remaining operational sites will provide some level of coverage in the affected area. RF coverage to mobile radios and portable radios operating outdoors may be relatively unaffected whereas in-building coverage to portable radios will likely be affected.

As the County has replaced the two 6809-based prime site controllers, some parts from these controllers may be used as spares for the 6809-based remote site controllers. Furthermore, though the 6809-based remote site controllers are end-of-life, Motorola will replace a failed 6809-based remote site controller with a currently supported MTC-3600 remote site controller through 12/31/2018. However, the replacement with a MTC-3600 remote site controller requires planning, engineering, installation and configuration tasks that will take substantially longer than repairing the 6809-based remote site controller.

2.1.1.2   System Clocks

The system clocks are highly critical to the operation of the simulcast transmissions of the County radio system and a loss of a clock at a site could result in significant interference in the system if the site is allowed to continue to operate without receiving proper timing. The clocks ensure that all sites transmit their signals at the exact same time such that interference is minimized. One broken clock can result in a site drifting out-of-sync with the other sites resulting in interference. Though the system clocks are end-of-life, a comparable replacement is available to restore operation of the site should one fail. In fact, the new MSE included a system clock for computer network timing and can be readily adapted with additional distribution equipment to provide timing to the simulcast equipment.

2.1.1.3   Tower Top Amplifiers

Tower top amplifiers (TTA) are installed on the base station receive antennas to increase the received signal levels at the top of the tower to overcome the loss associated with the transmission lines that connect the antennas to the receivers. TTAs help balance the talk-out and talk-back radio coverage disparity due to the difference in transmitter power levels (base transmitters output 100 Watts of power while portable radios transmit only 3 Watts of power). The failure of a TTA will result in loss of the receivers at a particular site. Because the system is voted (picks the best signal received from all the sites), the loss of a single site will have similar effects on coverage

as the loss of a remote site controller, except the loss will only be present on talk-in coverage only (user to base).

2.1.2   Equipment End-of-Life Projections

Motorola has announced end-of-life for the following portions of the RF infrastructure:

Component	Date
MTC 3600 Prime Site Controllers	12/31/2018
DigiTAC Comparator	12/31/2018
ASTRO-TAC Comparator	12/31/2018
QUANTAR Repeater	12/31/2020
SmartX Site Converter	12/31/2023

2.1.2.1   MTC 3600 Prime Site Controllers

The MTC3600 prime site controllers are responsible for performing the audio processing and channel resource management of the simulcast system. The system utilizes two prime site controllers configured in a redundant configuration. If the prime site controllers fail, the system enters into Failsoft[1] mode where the dispatch consoles would be disconnected from the system. In this scenario, dispatchers would have to resort to backup means of communications, such as using portable radios or RF control stations. The end-of-life date for the MTC3600 prime site controller is 12/31/2018, however, between 12/31/2018 and 12/31/2020 repairs will be at a flat rate and off-contract. The MTC3600 is the end of the product line for the legacy system and no replacement for the MTC3600 is available.

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[1] Failsoft is the term commonly used to describe a graceful degradation of a trunked radio system. When a trunked radio system loses its centralized control capabilities, the system and subscriber radios enter into Failsoft mode; a pre-defined backup plan for conventional (non-trunked) operation. The County's Failsoft plan has two level of Failsoft; in the first level of Failsoft, the system continues to simulcast and the 28 channels are divided among the agencies that use the system. In the event that the ability to simulcast is lost, the second level of Failsoft further divides the channels among the individual sites.

2.1.2.2 SmartX Site Converter

The SmartX Site Converter is the device that is currently being used to interface the existing RF infrastructure to the new MSE. The loss of the SmartX Site Converter would result in the County's system entering into Site Trunking[2] mode. As such, having one or more spare SmartX Site Converter is important. The County has two spare SmartX Site Converters as part of the Master Site (one of which is preconfigured as a spare County unit and the other one dedicated to the tri-cities of Boca Raton, Boynton Beach, and Delray Beach).

2.1.2.3 DigiTAC and ASTRO-TAC Comparators

The DigiTAC and ASTRO-TAC comparators are associated with the receiver voting system and are the equipment that selects the best signal received from the users at all the sites for retransmission out to the other users. The DigiTAC is used with analog channels while the ASTRO-TAC is used with digital channels. There are 21 DigiTAC comparators and 7 ASTRO-TAC comparators in the County system (a total of 28 comparators, one for each of the 28 RF channels). The loss of a single DigiTAC or ASTRO-TAC will result in the channel associated with that unit to be removed from service. It is not uncommon for a system to have a DigiTAC or an ASTRO-TAC off-line at some point as these modules do require maintenance (e.g., adjusting levels from the sites so that the best signal is selected). The loss or outage of one channel is not significant (less than 4% of the capacity of the system), but a major outage that affects a large number of these devices (such as a lightning strike) could result in queuing on the system where users could potentially receive a busy signal. If such an outage were to occur and the system maintainer did not have adequate spare parts, then the system would operate at reduced capacity until new parts are located, purchased and installed.

As with the MTC3600 prime site controllers, the end-of-life date for the ASTRO-TAC and DigiTAC comparators is 12/31/2018, however, between 12/31/2018 and 12/31/2020 repairs will be at a flat rate and off-contract.

2.1.2.4 QUANTAR Repeaters

The QUANTAR repeaters[3] are the RF infrastructure radios that are used to communicate with the users in the field. In the County system, each of the ten sites has 28 QUANTAR repeaters for a total of 280 repeaters. The loss of a single QUANTAR at one of the sites results in that channel being removed from service from all sites. This is to ensure equal radio coverage for all channels, which is important in a trunked radio

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[2] Site trunking mode is a state of the radio system where users cannot talk between the simulcast system and the three city systems (Boca Raton, Boynton Beach and Delray Beach) or with dispatchers. Users on the same system can talk with each other, just not across systems or with dispatchers.

[3] Repeaters are radios that combine a transmitter and a receiver into a single unit.

system where all users share all channels. Like with the DigiTAC and ASTRO-TAC, the loss of a channel is not significant, however, as with the DigiTAC and ASTRO-TAC, a major outage that affects a large number of QUANTARs at a site (such as a lightning strike) could result in queuing on the system. Again, if such an event would occur and the maintainer did not have adequate spare parts, then the system would operate at reduced capacity until new parts are located, purchased and installed.

2.1.3 RF Infrastructure End of Life Summary

Component	End of Life Date	Impact	Repairability Until 12/31/2018	Repairability After 12/31/2018
6809 Remote Site Controllers	Past EOL	Medium - Single Site Impact	Medium (May require replacement with MTC3600)	Very Low
Prime System Clock	Past EOL	High	High (Readily available replacement)	High (Readily available replacement)
Remote System Clock	Past EOL	Low – Single Site Impact	High (Readily available replacement)	High (Readily available replacement)
Tower Top Amplifiers	Past EOL	Low - Single Site Impact	High (Readily available replacement)	High (Readily available replacement)
MTC3600 Prime Site Controller	12/31/2018	High	Supported	Low
SmartX	12/31/2023	High	Supported	Low
DigiTAC Comparator	12/31/2018	Low	Supported	Low
ASTRO-TAC Comparator	12/31/2018	Low	Supported	Low
QUANTAR Repeater	12/31/2020	Low	Supported	Supported until 2020

2.2   Dispatch Consoles

2.2.1   Current End-of-Life Equipment

Currently, there are no components of the dispatch console system that have reached end-of-life.

2.2.2   Equipment End-of-Life Projections

Motorola has announced end-of-life for the following portions of the dispatch consoles system:

Component	Date
Gold Elite Dispatch Console	12/31/2018
Ambassador Electronics Bank	12/31/2018
Central Electronics Bank	12/31/2018

2.2.2.1   Gold Elite Dispatch Console

The Gold Elite dispatch console is the combination of a Console Interface Electronics (CIE) unit, a commercially-available computer workstation, and various accessories and software that the dispatchers use to communicate with units in the field. The Gold Elite dispatch console, specifically the CIE and the software, has an end-of-life of 12/31/18 at which time technical support and software updates will no longer be available. Failed consoles can potentially be replaced with new MCC7500 consoles, but compatibility issues between the two console platforms needs to be considered (see Section 3.3.1).

For public safety agencies, the ability to communicate with a dispatcher is of utmost importance and particularly so during an emergency incident; so much so that it is standard for a public safety radio to have an "emergency" button just so the user in trouble can have priority communications with the dispatcher.   Should a dispatch console fail (hard drive crash, virus, software conflict, "Blue Screen of Death", etc.) and an alternate spare dispatch console is not available; the dispatcher would be forced to revert to a desktop radio or a portable radio to communicate with the users. This could lead to issues with receiving emergency requests and also prevents the dispatcher from overriding other users as only the dispatch console has the ability to do so.

2.2.2.2   Ambassador Electronics Bank and Central Electronics Bank

The Ambassador Electronics Bank (AEB) and the Central Electronics Bank (CEB) together perform the routing of audio between the dispatch console and the MSE. The AEB and the CEB are critical to the operation of the dispatch consoles in that should

either piece of equipment fail, a portion or all of the dispatch consoles would be off-line. There are 20 CEBs and one AEB in the system today. Should one of the CEBs fail, a portion (approximately 4-5 consoles) would go off-line. Many of the CEBs are located in the same room and next to each other so should an incident occur, such as a lightning strike, there is a chance that multiple CEBs would be damaged. Should the AEB fail, all consoles would go offline. Both the AEB and the CEB have end-of-life dates of 12/31/18 just like the Gold Elite dispatch console. Because the AEB and the CEB support the dispatch consoles, they are just as critical to the system as the dispatch console.

2.2.3 Dispatch Console End of Life Summary

Component	End of Life Date	Impact	Repairability Until 12/31/2018	Repairability After 12/31/2018
Gold Elite Console – CIE/Software	12/31/2018	Low - Single Position	Supported	Low
Gold Elite Console – Computer Workstation	Not Announced	Low - Single Position	Supported	High (Commercially available product)
Ambassador Electronics Bank	12/31/2018	High – All Consoles	Supported	Low
Central Electronics Bank	12/31/2018	High – Multiple Positions	Supported	Low

2.3 Review of End-of-Life Issues

The choice for the County to replace or address the end-of-life issues of the RF infrastructure and the dispatch equipment is a matter of risk-tolerance. As equipment ages it becomes more prone to damage or breakage. Though the system can continue to work after it has reach end-of-life, it may take longer to repair and restore the system should it break down as it will be harder and harder to find parts for it and harder to find technicians that are familiar with the old technology. The County's radio system is critical to the safety of the users and to their ability to perform their duties. As such, this should set the threshold for replacing a system sooner rather than later and RCC recommends that the County not rely upon a radio system that has reached end-of-life.

Ensuring replacement prior to the high impact, low repairability equipment reaching its end-of-life is the most important physical consideration in setting forth the migration plan and outside date. How early an agency begins to implement that plan should be determined after considering the operational (including interoperability) and procurement considerations.

3.   MIGRATING TO P25

3.1   General

Today, the County realistically has only one option and that is to begin to plan to migrate to a P25 system so that the migration can be completed no later than 2018, thereby addressing all remaining end-of-life issues (see Appendix B for further description of P25).

The operational and procurement considerations which need to be balanced are; 1) increasing interoperability while not losing interoperability with legacy systems, 2) increasing redundancy and back-up disaster capabilities, and 3) being able to grow system, procure equipment required for renewal/replacement, and deploy new functionality in the time before migration completion without unduly impacting the competitiveness of a new system procurement.   Weighing and balancing these considerations will be a complex and difficult task for Palm Beach County due to the number of the independent governmental entities that currently enjoy interoperability but each having its own governing board, objectives, and funding opportunities and constraints.   This section attempts to set forth the various factors that need to be considered when determining if, and when the migration plan should commence.

3.2   Greater Interoperability

Most public safety agencies in the South Florida area operate on 800 MHz radio systems and all new subscribers being replaced by those agencies are P25 capable due to the limited availability of new non-P25 800 MHz subscribers capable of operating on their current systems.   Those agencies that do not have SmartZone-compatible subscribers are currently not able to directly interoperate with the County on the radio system's "common" talkgroups.[4]   In this case, the County and these agencies must either patch talkgroups from each system together via a console or fall back to the greatest common denominator, specifically, the 800 MHz mutual aid channels (8CALL90, 8TAC91 through 8TAC94, and MA-FLA)[5].

The "common" talkgroups are a set of 16 predefined interoperability talkgroups programmed into all subscribers authorized to operate on the County radio system.

[5] 8CALL90 and 8TAC91 through 8TAC94 are national interoperability channels and are commonly programmed in all 800 MHz public safety radios throughout the nation. MA-FLA is a Florida-specific 800 MHz interoperability channel and is commonly programmed in all 800 MHz public safety radios throughout Florida.

As shown below, compatibility with the current system is solely dependent upon whether or not a user has a SmartZone-Compatible subscriber.

	SmartZone-Compatible Subscriber		Non-SmartZone-Compatible Subscriber	
	(non-P25)	(P25)	(non-P25)	(P25)
Current County System	Compatible	Compatible	Incompatible	Incompatible

Table 1 - Current County System Subscriber Compatibility

Should agencies that operate on the County system need to interoperate with agencies on, for example the MPSCC OpenSky system, the agencies could patch their talkgroups together via a console on either system if the location of the incident is within the range of radio coverage of both systems. In the case of a County agency responding to an MPSCC city, this is not an issue as the County system provides coverage within all MPSCC cities. However, the MPSCC's system does not currently provide county-wide coverage and when interoperability is required outside of the MPSCC's system's coverage area, then only the conventional analog mutual aid channels are available.

Agencies that utilize SmartZone-compatible subscribers, such as Broward County Sheriff's Office (BSO) and Martin County Sheriff's Office and Fire Rescue currently do not have compatibility issues and agreements are in place with Palm Beach County that permits each agencies' radios to operate on each of the other county's systems. This level of interoperability is highly desired and much more effective than using console patches or mutual aid resources.

The potential for greater interoperability would occur if some level of P25 RF infrastructure is deployed in Palm Beach County in addition to the current system. With P25 RF infrastructure, the subscribers no longer need to support Motorola's proprietary SmartZone protocol. Therefore, any agency with 800 MHz P25 capable radios could operate on a Palm Beach County P25 system, with the proper agreements in place, and utilize P25 common interoperability channels rather than the mutual aid channels.

	SmartZone-Compatible Subscriber		Non-SmartZone-Compatible Subscriber	
	(non-P25)	(P25)	(non-P25)	(P25)
Current County System	Compatible	Compatible	Incompatible	Incompatible
Current County System + P25 System	Compatible	Compatible	Incompatible	Compatible

Table 2 - Current County System vs. P25 System Subscriber Compatibility

Finally, the P25 standard defines the Inter RF Subsystem Interface (ISSI) as a means to interconnect standalone P25 systems together to provide a level of integration between the systems. One of the primary benefits of ISSI is that talkgroups on each system can be digitally patched together and support emergency calls and encrypted voice. Though the current RF infrastructure is not P25, the master site is P25-capable and can be upgraded to support an ISSI interface to other radio systems. This would allow radios from agencies such as BSO to operate on the County system and communicate directly back to their own dispatchers. Likewise, PBSO and PBFR could operate on Broward County's system and communicate back to their own dispatchers.

3.3   System Expansion

The County's current Motorola SmartZone platform is limited in its ability to support expansion. This is due in part with the platform having reached end-of-life, but is also due to lack of available hardware or ability to expand existing hardware to support expansion. The County has replaced the radio system's Master Site Equipment with a new Motorola 7.13 platform that is capable of supporting a P25 RF infrastructure that will allow for some system expansion capabilities.

Feature	Requires P25 RF Infrastructure
Additional Motorola Consoles	No
Additional P25 CSSI Consoles	No
Additional RF Sites	Yes
Additional RF Channels	Yes

3.3.1   Additional Motorola Consoles

With the new master site, additional consoles can be added to the system. Prior to the new master site, the County was unable to add any dispatch consoles to the system. However, dispatch consoles are proprietary to a vendor and the County and its partners' consoles all have an end of life date. Hence, the recommendation that all consoles be replaced with consoles by the same manufacturer of the selected P25 system.

MCC7500 consoles, as well as the existing Gold Elite consoles, can only be used on a Motorola system so the County and its partners are investing in proprietary equipment. In the period between now and P25 migration, new console purchases should be limited to only those required for a failed unit or an expansion.

Compatibility with the existing Gold Elite consoles must be considered as the MCC7500 and Gold Elite consoles cannot coexist in the same area of a dispatch center due to cross-mute issues. Because of the cross-mute issue, any new MCC7500 console should be installed in areas where there are no cross-mute issues and the existing Gold Elite console used in the other Gold Elite dispatch center to not force the purchase of proprietary equipment prior to an RFP. PBSO is currently procuring new Motorola MCC7500 consoles to expand the number of dispatch positions at Gun Club. PBSO has mitigated the cross-mute issue by installing the new MCC7500 consoles at the Belle Glade facility and relocating the Belle Glade Gold Elite consoles to Gun Club.

3.3.2 Additional P25 CSSI Consoles

The P25 standard defines an open interface, the Console Subsystem Interface (CSSI), between dispatch consoles and P25 systems. CSSI is built upon ISSI, but includes additional console specific functionality. Generally, P25 system manufacturers support the CSSI standard, however, most of these manufacturer's own consoles are not CSSI compliant. For example, Motorola's P25 system can support CSSI-compliant consoles, but Motorola's MCC7500 are not CSSI compliant and utilize a proprietary interface.

The current system can be upgraded to support CSSI-compliant consoles; however, the same cross-mute issue exists as with the MCC7500 consoles. In addition, interfacing the consoles to the radio system requires the involvement of two vendors (console vendor and Motorola) for operational and maintenance aspects. This eliminates the ability of having a single point of responsibility with respect to dispatch consoles.

3.3.3 Additional RF Channels / Talk-Paths

The current system was constructed with the maximum number of supported channels (28) and there is no indication that there is any capacity issue with the current system. However, if additional capacity is ultimately needed, new P25 RF infrastructure is required as new analog RF infrastructure compatible with the County's current system is no longer available from Motorola.

3.3.4 Additional RF Sites

For additional RF sites, new P25 RF infrastructure is required as new analog RF sites compatible with the County's current system are no longer available from Motorola. It has been reported to RCC that the West Acreage area has a need for expanded coverage and a tower in Loxahatchee is being considered. By migrating to P25, the County can construct a new RF site that is incorporated into the county-wide trunked system.

3.4 P25 Features

The current system is limited in its ability to support new features. As Motorola is no longer developing new features for legacy SmartZone RF infrastructure, new P25 RF infrastructure is required.

Feature	Requires P25 RF Infrastructure	P25 Standard or Proprietary
Encryption and Over-the-Air-Rekeying (OTAR)	Yes	P25 Standard
Over-the-Air-Programming (OTAP)	Yes	Proprietary
Geosynchronous Positioning System (GPS)	Yes	P25 Standard or Proprietary
Text Messaging	Yes	P25 Standard

3.4.1 Encryption and Over-the-Air-Rekeying (OTAR)

The P25 standard supports both AES (Advanced Encryption Standard) and DES (Data Encryption Standard) forms of standards-based encryption. The P25 standard recommends the use of AES over DES and the Department of Homeland Security's National Emergency Communications Plan includes an initiative to standardized the use of AES for all Federal, State, local and tribal emergency responders. AES encryption is required when federal grant funds are used.

The P25 standard also supports OTAR, which wirelessly updates the encryption key in the subscriber radios; eliminating the need to physically touch the radio.

The current system supports encryption on seven channels and the equipment required to add additional encrypted channels is no longer available. Furthermore, the current system cannot support OTAR. For additional encrypted channels or the ability to utilize OTAR, a migration to P25 is necessary.

3.4.2 Over-the-Air-Programming (OTAP)

Similar to OTAR, Over-the-Air-Programming (OTAP) allows for the wireless updating of the subscriber radio's programming without the need to physically touch the radios. This feature can reduce the manpower and logistics associated with reprogramming of radios and can eliminate pulling personnel away from the jobs just to bring in a radio for reprogramming. However, OTAP is not part of the P25 standard and each vendor that provides OTAP functionality does so in a proprietary fashion for their P25 implementation. The current system does not support OTAP.

Some of the radios being purchased today by the PBSO are being equipped with features and functionality that cannot be used by the current system, such as over-the-air programming (OTAP), encryption and over-the-air encryption rekeying (OTAR). These features are being purchased in anticipation of the deployment of P25 within the County but may not be usable or fully compatible if the system is not a Motorola system.

3.4.3 Geosynchronous Positioning System (GPS)

GPS location of portable and mobile subscriber radios is not available on the County's current system and requires new P25 RF infrastructure. The P25 includes a standard for GPS operation, however, some vendors are also selling proprietary implementations that provide improved refresh rate and prioritization control not available in the P25 standard.

3.4.4 Text Messaging

The P25 standard supports the transmission and reception of short text messages. The current system cannot support text messaging.

3.5 System Redundancy Improvements

The current system also has limited redundancy. Should the current master site fail, the County will lose all console dispatch capabilities and all simulcast capabilities. The system will revert to site-distributed Failsoft in which a limited number of channels per site will be active in conventional mode (non-trunked) and some sites will be limited to only a single channel. Due to the age and technology of the current system, improvements in system redundancy cannot be made. To improve the resiliency of the County's radio communications, a new radio system is required.

Redundancy in a new system can be implemented in many areas and are highly recommended considering the high level of risk in the County. With a new system, it is recommended that the County implement both a redundant master site and a redundant simulcast prime site.

One of the critical functions of a master site is to interconnect various sites together. From the master site's perspective, the County's simulcast system is a single site, the Boca Raton, Boynton Beach, and Delray Beach systems are each a site, and the dispatch consoles are a site. A redundant master site would allow for continued operation of wide-area communications as well as dispatch console operation should the primary master site fail. The master site also supports other critical functions such as system management and alarms, radio authentication and interoperability gateways.

As the County's main radio communications is based upon a county-wide simulcast system, the loss of the simulcast prime site forces the system into site-distributed Failsoft mode with very limited communications capability. With the system in site-distributed Failsoft, dispatch operation on the county-wide system is also lost. A redundant simulcast prime site would allow for continued operation of simulcast communications as well as dispatch operation should the primary simulcast prime site fail.

4. RADIO SYSTEM PARTNER CONSIDERATIONS

4.1 Boca Raton, Boynton Beach and Delray Beach

The County's radio system supports the radio systems of Boca Raton, Boynton Beach, and Delray Beach. These systems rely upon the County's master site to provide management functionality and console operations. If the County were to procure a complete replacement of the simulcast system and decommission the current system in its entirety, then Boca Raton, Boynton Beach and Delray Beach would no longer have a master site and the cities' systems would enter into a failure mode called Site Trunking.[6] To mitigate this, the cities would have to participate in the procurement of the system, procure their own system independently of the County, or negotiate an arrangement with the County where the current master site is not decommissioned and is continued to be maintained.

However, if the vendor of the new system was Motorola, the current master site would be incorporated into the new system and the cities' systems could continue to function normally until their systems reached end-of-life. If the County chose to perform a phased migration or P25 overlay, the cities' systems could also continue to function normally as the existing master site would continue to be used.

Boca Raton is currently in the planning phase of migrating to P25 and is currently planning on transition to P25 at the same time as transitioning to a new dispatch center in early 2015. RCC is not aware of any radio system planning activity by Boynton Beach or Delray Beach.

The cities and the County currently share a very high-level of interoperability by the nature of effectively operating from a single system. Should Boca Raton, or any other city, decide to procure a system independent of the County, it may result in a lower degree of interoperability and/or additional operational complexities.

4.2 West Palm Beach

The City of West Palm Beach is currently a member of the MPSCC, however West Palm Beach has not accepted or migrated to the MPSCC's OpenSky system. In 2012, West Palm Beach City Commission directed City staff to negotiate with Harris Corporation to implement a P25 solution for the City in lieu of OpenSky. To RCC's knowledge, West Palm Beach has not reached an agreement with Harris.

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[6] In Site Trunking, connection between the RF infrastructure and the master site is lost. The RF infrastructure continues to operate, but the remote site controllers perform all call processing. Because the consoles are connected to the master site, the loss of the master site results in the loss of console functionality.

In the event the City does not enter into an agreement with Harris, the City has the option of joining the County in migrating to P25 when the County decides to move forward. West Palm Beach's system could be integrated into the new P25 system, much like the tri-cities' systems.

4.3   Nearby Counties Considerations

Nearby counties, such as Indian River County, Martin County and Broward County, are all in various stages of planning to migrate to P25. Any or all of these counties could potentially participate with Palm Beach County in migrating to P25. Some of the counties could opt to rely upon Palm Beach County's master site while other counties could integrate their own master site with Palm Beach County into a single networked system. Should such arrangement occur, ISSI connections between the systems would not be necessary as they would be integrated into a single system. Orange County and the City of Orlando are integrating their two Motorola systems into a single "multi-zone" system to, among other reasons, eliminate the need for ISSI connectivity.

4.4   Summary

Presently, the County, Cities of West Palm Beach, Boca Raton, Boynton Beach and Delray Beach all utilize Motorola 800 MHz SmartZone/SmartNet systems and subscribers and therefore can program each other's systems into their subscribers. The following interoperability matrix shows the compatibility between systems and subscriber radios:

	Countywide Motorola SmartZone				West Palm Beach Motorola SmartNet
	County Motorola System	Delray Beach Motorola System	Boynton Beach Motorola System	Boca Raton Motorola System	
County Subscribers	-	Compatible	Compatible	Compatible	Compatible
Delray Beach Subscribers	Compatible	-	Compatible	Compatible	Compatible
Boynton Beach Subscribers	Compatible	Compatible	-	Compatible	Compatible
Boca Raton Subscribers	Compatible	Compatible	Compatible	-	Compatible
West Palm Beach Subscribers	Compatible	Compatible	Compatible	Compatible	-

Table 3 - Interoperability Matrix: Current Environment

If one or more of the systems, but not all systems, migrate to P25, a loss of interoperability will occur for subscribers that are not P25 compatible. This is shown in the following interoperability matrix where, hypothetically, Boca Raton migrates to a Motorola P25 system.

| | Subscriber Type | Countywide Motorola SmartZone | | | Boca Raton Motorola P25 System | West Palm Beach Motorola SmartNet |
		County Motorola System	Delray Beach Motorola System	Boynton Beach Motorola System		
County Subscribers	Motorola P25	-	Compatible	Compatible	Compatible	Compatible
	Motorola Non-P25	-	Compatible	Compatible	Incompatible	Compatible
Delray Beach Subscribers	Motorola P25	Compatible	-	Compatible	Compatible	Compatible
	Motorola Non-P25	Compatible	-	Compatible	Incompatible	Compatible
Boynton Beach Subscribers	Motorola P25	Compatible	Compatible	-	Compatible	Compatible
	Motorola Non-P25	Compatible	Compatible	-	Incompatible	Compatible
Boca Raton Subscribers	Motorola P25	Compatible	Compatible	Compatible	-	Compatible
West Palm Beach Subscribers	Motorola P25	Compatible	Compatible	Compatible	Compatible	-
	Motorola Non-P25	Compatible	Compatible	Compatible	Incompatible	-

Table 4 - Interoperability Matrix: Boca Raton P25 Migration (Hypothetical)

To resolve this incompatibility, all subscriber radios that have a need to operate on the Boca Raton system (day-to-day or mutual aid) would need to be P25 and SmartZone/SmartNet compatible (i.e., either Motorola or EF Johnson).

For full-feature support and single point of responsibility, agencies typically purchase subscriber radios from the same vendor of their radio system (Motorola subscribers for Motorola systems, Harris subscribers for Harris systems, Tait subscribers for Tait systems, etc.) If the County or one of the cities replace their systems and purchase P25 subscribers that are not SmartZone/SmartNet compatible (e.g., Harris, Tait) then there will be a further loss of interoperability. An example is shown in the following interoperability matrix where Boca Raton migrates to a Motorola P25 system and West Palm Beach reaches an agreement with Harris for a new P25 system and Harris P25 subscriber radios:

	Subscriber Type	County Motorola SmartZone			Boca Raton Motorola P25 System	West Palm Beach Harris P25 System
		County Motorola System	Delray Beach Motorola System	Boynton Beach Motorola System		
County Subscribers	Motorola P25	-	Compatible	Compatible	Compatible	Compatible
	Motorola Non-P25	-	Compatible	Compatible	Incompatible	Incompatible
Delray Beach Subscribers	Motorola P25	Compatible	-	Compatible	Compatible	Compatible
	Motorola Non-P25	Compatible	-	Compatible	Incompatible	Incompatible
Boynton Beach Subscribers	Motorola P25	Compatible	Compatible	-	Compatible	Compatible
	Motorola Non-P25	Compatible	Compatible	-	Incompatible	Incompatible
Boca Raton Subscribers	Motorola P25	Compatible	Compatible	Compatible	-	Compatible
West Palm Beach Subscribers	Harris P25	Incompatible	Incompatible	Incompatible	Compatible	-

Table 5 - Interoperability Matrix: Boca Raton & West Palm Beach P25 Migration (Hypothetical)

As seen above, only the P25-capable subscribers of the County, Boca Raton, Boynton Beach and Delray Beach would be interoperable with the new West Palm Beach system; however, the West Palm Beach P25 subscribers, manufactured by Harris, would not be interoperable on any system other than their own and the Boca Raton P25 system.

To resolve this interoperability issue, all systems need to migrate to P25 at the same time. This is shown in the following interoperability matrix:

	Subscriber Type	County P25	Boca Raton P25	Boynton Beach P25	Delray Beach P25	West Palm Beach P25
County Subscribers	P25	Compatible	Compatible	Compatible	Compatible	Compatible
Boca Raton Subscribers	P25	Compatible	Compatible	Compatible	Compatible	Compatible
Boynton Beach Subscribers	P25	Compatible	Compatible	Compatible	Compatible	Compatible
Delray Beach Subscribers	P25	Compatible	Compatible	Compatible	Compatible	Compatible
West Palm Beach Subscribers	P25	Compatible	Compatible	Compatible	Compatible	Compatible

Table 6 - Interoperability Matrix: P25 Migration of All Systems

As shown, the decision of any one agency to migrate to P25 impacts the interoperability environment. To maintain interoperability, the County must begin its migration to a P25 solution concurrent with these cities' decision, regardless of the vendor of the P25 system. If one of the cities selects a Motorola P25 system (with Motorola P25 subscribers), then the pressure is associated only with ensuring that everyone that has a need to operate on that system has a P25 capable subscriber radio. The same would be true for Martin and Broward County if they migrate to P25 and utilize radios that are not compatible with the County's SmartZone system. Such a situation would result in a significant step backwards with interoperability unless the County also migrated to P25 at the same time.

The choice of a vendor for P25 system by these cities is not the only driving factor. If the County and these other agencies migrate to P25 in a joint manner where a single vendor is selected, all parties could realize cost reductions due to economies of scale as well as greater interoperability between agencies as everyone would operate on a single, seamless system. Such a "system of systems" would eliminate the need for expensive P25 interconnect servers to tie together systems from different vendors and also allow certain features, such as Priority Level Access and Queuing, Private Call, Radio Inhibit/Uninhibit, Dynamic Regrouping, GPS, Text Messaging, etc. to work across all systems; something that cannot currently be done using P25 interconnect servers.

5.   P25 IMPLEMENTATION METHODOLOGIES

The County has two primary options for migrating to P25; a complete system replacement and a phased migration.

In a complete system replacement, a new system is constructed that utilizes the full RF resources of the current system (i.e., 28 channels). On a specified date, the current radio system is turned off, the new system is turned on, and the users switch to operating on the new system[7].

In a phased migration, a new system is constructed that utilizes only a portion of the current system (e.g., 12 channels on new system, 16 channels on current system). On a specified date, a portion of the current system is turned off, the new system is turned on, and the users with P25 capable radios switch to operating on the new system while the users without P25 capable radios remain on the current system. As time progresses, additional RF channels and users are migrated to the P25 system as users replace their radios with ones that are P25 capable. Eventually, all resources and users are migrated to the P25 system and the old system is decommissioned. A variant to the phased migration is to utilize an overlay approach where a new, but limited capacity, P25 system is constructed in parallel with the existing system using all new RF channels (700 MHz or 800 MHz). Users with P25 capable radios can utilize the P25 overlay either on a regular basis or on an as-needed basis. Overtime, channels can be migrated from the legacy system to the P25 system in the same manner as a traditional phased migration approach.

5.1   Complete System Replacement

A complete system replacement requires that all agencies have subscribers capable of P25 trunking prior to the cutover. As shown below, once the cutover to the new P25 system only P25 subscribers will operate on the system.

	SmartZone-Compatible Subscriber		Non-SmartZone-Compatible Subscriber	
	(non-P25)	(P25)	(non-P25)	(P25)
Prior to Replacement	Compatible	Compatible	Incompatible	Incompatible
After Replacement	Incompatible	Compatible	Incompatible	Compatible

Table 7 - Complete System Replacement Subscriber Compatibility

[7] A cutover to a completely new system can be performed in a controlled fashion where a portion of the new system is turned on and the same portion of the current system is turned off (e.g., 14 channels turned-off on the current system and 14 channels turned-on on the new system). This allows for a more controlled cutover, however, the cutover plan is predicated on basis that the system be in this transitional state only a very short period of time (e.g., less than one day).

During the transition to the new system, it is advisable to establish some level of interconnection between the old system and the new system to provide a smoother migration. As an example, during the transition, users could operate on a limited number of talkgroups that are patched between the old and new system. The patches are intended to be temporary and used for only a very short period of time during the transitional period (i.e., less than one hour). The transition begins with half the channels of the old system being turned off and the corresponding channels on the new system being turned on. Dispatchers start operating on the new consoles and users migrate from the old system to the new system. Once all users have migrated, the remaining channels on the old system are turned off and all channels on the new system are turned on.

One of the most significant disadvantages to a complete system replacement is that it requires that the County's facilities be able to support two complete systems. At some of the County sites, new equipment shelters and emergency power systems (generators and UPS) will be required. In addition, new antennas and transmission line may be required to be installed on the towers. This may necessitate either performing structural improvements to the towers or even require tower replacement depending upon the current condition of the tower.

One advantage to a complete system replacement is that since the old system is turned off when the new system is turned on, the County will only have one system in which to fund maintenance. As the new system includes at least a one-year warranty, the County will have no maintenance cost for the warranty period.

5.2   Phased Migration

The phased migration approach allows the County to implement P25 RF infrastructure for those agencies desiring to move forward with P25 while still provide radio communications for those agencies without P25 capable subscribers or prefer to remain analog (P25 is a digital-only technology). This affords time to agencies without P25 capable subscribers to budget and procure new P25 capable subscribers in accordance with their financial capabilities while allowing the County to implement some level of P25 service in the meantime.

While performing a phased migration to P25, the County would gradually migrate agencies to the new system as they replace or re-flash their subscriber radios with P25. When all users from a particular group have P25 compatible subscribers, the entire group can migrate to the new system and utilize the new features associated with a P25 protocol. Though it would be possible to have a portion of an agency on the current system and portion on the new system for an extended period of time, this has the disadvantage of utilizing a channel from both the systems if a common talkgroup is used. This is an inefficient use of channel resources and it is preferred that entire agencies are moved over at a time, along with the dispatch console position that supports that

agency.   In the event of a major incident where users on the legacy system as well as users on the new system are operating on these talkgroups, channel availability can become an issue if a large percentage of the talkgroups are active. For this reason, it is desirable to migrate users to P25 expeditiously so that trunking efficiency is restored.

As shown below, during a phased migration both SmartZone-compatible subscribers (P25 or not) and P25 non-SmartZone-compatible subscribers will be compatible with the County system. During this transitional period, interoperability will be at its highest since after the phased migration is complete only P25 subscribers will be compatible with the County system.

	SmartZone-Compatible Subscriber		Non-SmartZone-Compatible Subscriber	
	(non-P25)	(P25)	(non-P25)	(P25)
Before Phased Migration	Compatible	Compatible	Incompatible	Incompatible
During Phased Migration	Compatible	Compatible	Incompatible	Compatible

Table 8 - Phased Migration Subscriber Compatibility

One of the most significant advantages to a phased system migration is that it does not require that towers and buildings be able to support two complete systems. Initially, the County sites will only have to support the additional equipment associated with the new RF channels and site controller/networking hardware required for the first group of P25 channels. Once the first group of P25 channels is in operation, the equipment racks supporting the decommissioned channels on the old system can be removed thereby freeing up space for additional P25 channels. The current towers and buildings should be able to support the addition of a limited number of P25 channels and new antennas and transmission lines would not be needed on the towers.

One of the disadvantages to a phased migration is that the County must maintain maintenance on the old system. If the vendor of the new system is Motorola, then less infrastructure will be required and therefore the maintenance cost should be less. For example, if Motorola was the vendor of the new system, then the current MSE would be used for the new system and the County would not have to pay maintenance on an additional MSE, as would be the case for another vendor's P25 system. In addition, if another vendor provided the P25 system, the County would have to pay for maintenance on the additional infrastructure required to interconnect the old system with the new system (ISSI servers, RF control stations, etc.)

The most significant disadvantage to a phased migration occurs if the vendor of the new system is not the vendor of the old system and special interconnections are required to tie the systems together. If Motorola is the vendor of the new system being implemented during a phased migration, then the current system and the new system can be

integrated as one system and there will be no loss of features or functionality between the systems and the County, in effect, has only one system to manage. See the diagram below.
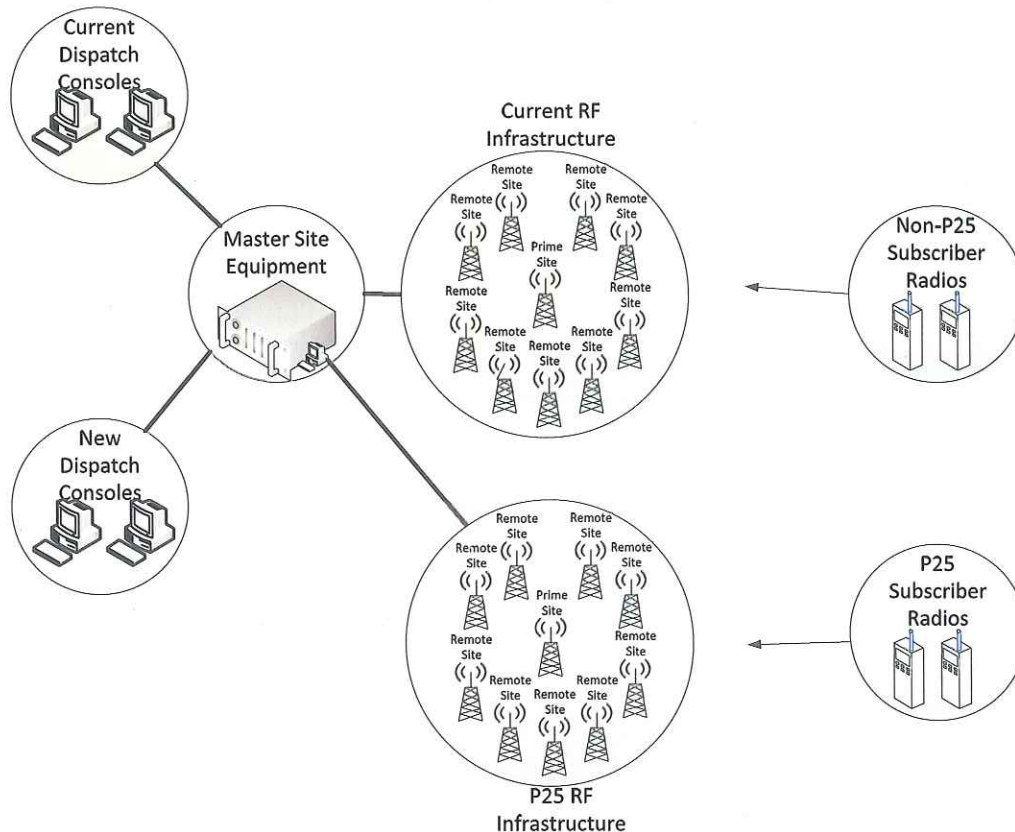

Figure 1 - Motorola-Specific P25 Migration

When vendors of two systems are different, the connection between the systems is generally performed at a talkgroup level. Such connection can be through an ISSI interface, conventional wireline patching, over-the-air RF control station patches or through some other means devised by the vendor of the new system. The disadvantage of this is that there needs to be a specific resource (ISSI talkgroup license, cable pair, RF control station, etc.) for each talkgroup to be "patched".

Connecting the systems together via an ISSI[8] interface provides the greatest level of integration between systems manufactured by different vendors. In the case of the

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[8] ISSI is still maturing and vendors are beginning to incorporate more of the P25 standard features in their implementations of ISSI. However, compatibility of these new features has not been proven in the field. As an example, at this time, Motorola has only one deployment of its latest generation ISSI system and it is with another Motorola system, not a system from another vendor.

County's system, the current system would require new hardware and software upgrades to implement the ISSI feature (this was not included in the Master Site Equipment Renewal/Replacement project as it was not needed). Some of the features and functionality that are supported by the ISSI standard require workarounds in order to work with the legacy radio system since the legacy radio system is not P25. For example, the transmission of a user's alias requires a Motorola-provided work-around (i.e., use of a MCC7500 console on the legacy system to translate the aliases between the legacy RF infrastructure and the P25 ISSI connection). However, this workaround has not been proven to work between a Motorola and non-Motorola system. Other ISSI features such as busy queuing and radio authentication across the ISSI link may work without a workaround, may require a workaround, or will just not work depending upon the features and functionality of the other vendor's ISSI implementation. Connecting two systems together through an ISSI interface could result in the loss of some features and functionality **between** the systems.

With an ISSI connection, subscribers and consoles on either system can communicate with each other. However, there is a limit on the number of simultaneous talkgroups that can be supported by the ISSI interface. The cost associated with an ISSI connection from the current system depends specifically upon the number of talkgroups that need to be supported by the connection. See diagram below.
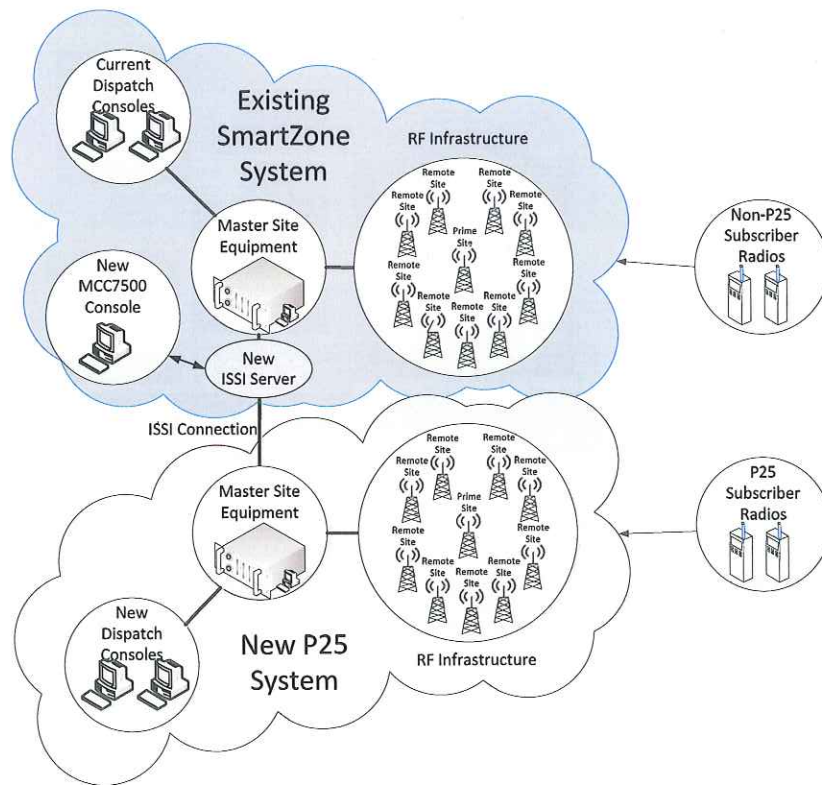

Figure 2 - P25 Migration to a Non-Motorola System Using ISSI Interface

The systems can also be connected through wireline connections or RF control stations. In order to implement wireline interconnects to the current system, additional conventional gateways need to be installed on the current system to access the talkgroups at a wireline level. RF control stations can also be used to connect the two systems together, however, each talkgroup to be patched between the systems requires a dedicated RF control station, and features such as emergency call, end-to-end encryption and PTT-ID are generally not supported via RF control station interconnections.
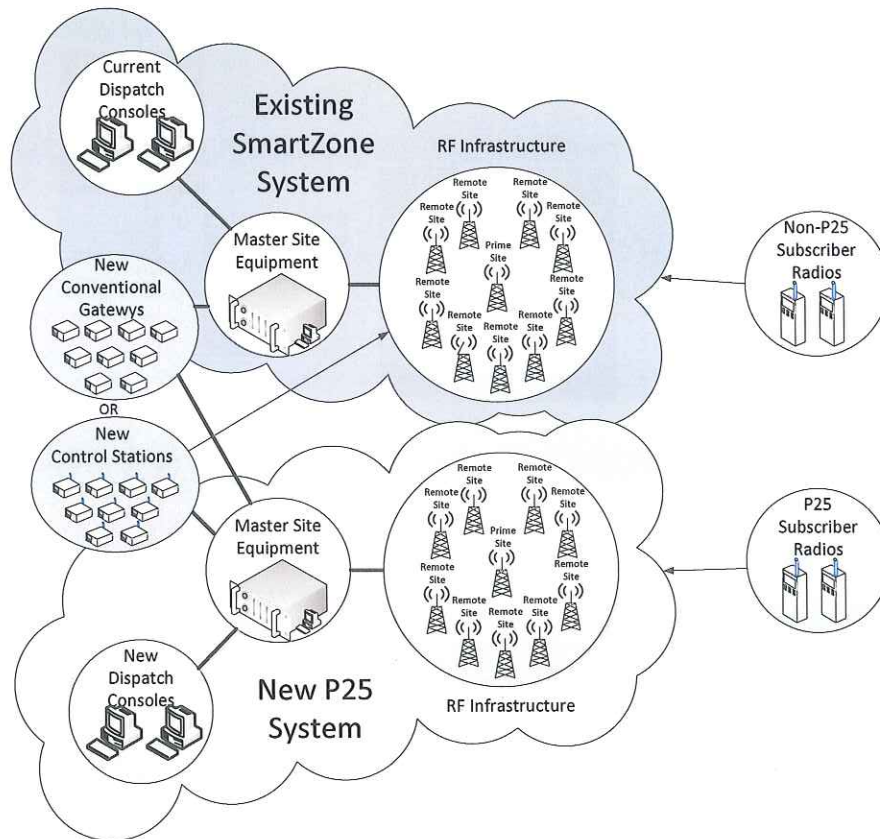

Figure 3 - Wireline/RF Control Station System Interconnection

RCC understands that PBSO and PBFR would consider operating across two systems with loss of critical features such as PTT-ID, aliases, emergency calls, etc. as unacceptable. Before a P25 migration using ISSI or other form of patching is implemented, the loss of critical features needs to be addressed. This may be overcome by migrating all users of these agencies onto the new P25 system at the same time, or through technical advancements in such patching that currently do not exist.

A variant to the phased migration is to initially implement a P25 overlay in which a limited quantity of additional channels is constructed specifically for P25 to support a group of users that desire P25 operation. The P25 overlay may be implemented for use by a

particular agency or groups of agencies (e.g., PBSO), particular units within an agency (e.g., SWAT) or solely for interoperability purposes. The number of RF channels implemented is based upon the loading of the system and the availability of new RF channels.

The P25 overlay approach, however, has the same multiple-system interconnect issues as a phased migration. If the vendor of the P25 overlay is Motorola, the P25 overlay and the current system can be integrated as a single system with no loss of features or functionality between the two systems. If the vendor is not Motorola, then an ISSI, wireline or RF control station interconnection is required and some features and functionality between the two systems may be lost.

One benefit of a P25 overlay where new radio channels are implemented is that there is no impact to the current system. As shown below, as long as the County maintains the current system, compatibility with non-P25 Motorola subscribers is maintained.

	SmartZone-Compatible Subscriber		Non-SmartZone-Compatible Subscriber	
	(non-P25)	(P25)	(non-P25)	(P25)
Current System	Compatible	Compatible	Incompatible	Incompatible
P25 Overlay	Incompatible	Compatible	Incompatible	Compatible
Combined Current System & P25 Overlay	Compatible	Compatible	Incompatible	Compatible

Table 9 - P25 Overlay Subscriber Compatibility

5.3 Summary

The County has two primary options for migration to P25, either through a complete system replacement or a phased migration. The advantages and disadvantages of the two options are shown below.

	Complete System Replacement	Phased Migration
Impact on User Agencies	Requires all user agencies to have P25 radios prior to cutover to new system.	Provides time to user agencies to budget and procure P25 radios and allows agencies ready to begin operation on P25 to do so now.
Integration with Legacy	Only simple audio patching is required to facilitate a	If vendor of new system is not Motorola, full-featured

System	smooth transition	interconnections (e.g., ISSI) and workarounds may be required and County would have to manage two independent systems. Motorola is able to fully integrate the legacy system into a new P25 system.
Facility Requirements	May require new shelters, antennas, transmission lines, tower structural modifications and/or tower replacements	Will not likely require any significant facility improvements or replacements
Maintenance Costs	County will pay for maintenance on only one system at a time.	County will pay for maintenance on two systems after the first year. If vendor of new system is not Motorola, County may have to pay more due to needing additional hardware (MSE, ISSI, etc.) required to connect old and new systems.

6.   PROCUREMENT OPTIONS

The County has the option of competitively procuring a new P25 system with any migration scenario. However, it can be argued that Motorola will have a competitive advantage because the County already owns a Motorola MSE that is capable of supporting P25 RF infrastructures and consoles. Though the cost of an MSE is not trivial, it is a relatively small percentage of a complete system replacement – approximately 11% of a projected total system cost. That percentage is reduced if the County chooses to implement additional redundancy options such as a redundant master site and redundant simulcast prime sites as recommended by RCC. If the County waits until 2016 before proceeding with a P25 system, the value of the MSE will be reduced as it will be approximately 3 years old at that point and certain hardware and/or software upgrades may be required to incorporate it into the new system. It is certain that Motorola will be operating a new release of software (Motorola introduces a new software release every other year) and it is possible that some hardware components of the MSE will need to be replaced to support the new software release. The need for hardware/software upgrades of the current MSE would inherently further level the playing field.

Even though the County has the option of competitively procuring a new P25 system, certain compatibility issues with the current system and subscribers can be eliminated only by implementing a Motorola P25 system.

Issue	Motorola System	Other Vendor System
Over the Air Programming (OTAP)	All existing P25-capable Motorola subscribers can be reprogrammed using OTAP	Either the existing P25-capable Motorola subscribers are replaced with new Vendor's radios to support Vendor's OTAP implementation or the County procures, via sole-source, a standalone Motorola OTAP system to support existing Motorola radios.
Failsoft	No compatibility issues with existing Motorola subscribers.	Other vendor's Failsoft may not be fully compatible with existing Motorola subscribers as a P25 standard for Failsoft is not clearly defined. Some vendors systems, such as Tait's, revert to conventional operation, similar to Motorola, when trunking fails. However, Tait's solution and Motorola's solution are not guaranteed to be compatible with each other. Other vendors, such as Harris, continue to trunk until a certain threshold of

Issue	Motorola System	Other Vendor System
		available channels is reached (no limitation on the number of control channels). When this threshold is reached, the Harris system reverts to a single-site "bypass" mode where that site is active. This "bypass" mode may require users to manually switch to the bypass system depending upon the manufacturer, compatibility and programming of the radios. Full compatibility can only be guaranteed if all subscriber radios are manufactured by the same provider as the RF infrastructure.
P25 Standard Feature Compatibility (OTAR, GPS, data calls, etc.)	No compatibility issues with existing Motorola subscribers.	Though P25 is an industry standard, it is not guaranteed that vendors will fully implement all features the same way. Compatibility issues could still occur when using subscribers from one manufacturer and RF infrastructure from another manufacturer. This will require that the County mediate between the two parties to resolve all compatibility issues.
P25 Infrastructure Transitioning	The transition to a new Motorola P25 does not require an ISSI interface or special patching because a new P25 system would be integrated as a single site on the current MSE, much like the current analog system is.	During a complete system replacement, temporary patching of a limited number of talkgroups between the old system and the new system would be required (and the user agencies would have to operate on a limited number of talkgroups or the 800 MHz Mutual Aid conventional mutual aid channels during the transition). During a phased migration, ISSI interconnections or other long-term patching is required for, at a minimum, the County's common interoperability talkgroups. Depending upon the solution offered by the new vendor and acceptable to the County, this may necessitate Motorola sole-source improvements to the current radio

Issue	Motorola System	Other Vendor System
		system. Additional complexity is introduced in either scenario (more so with a phased migration) and may require mediation by the County in disputes between Motorola and the new vendor when issues must be resolved.
Long Term Support for Current System	Should the County choose to maintain some level of analog trunking for users that desire not to operate exclusively in the digital mode of P25, the integration of the County's current system could continue and spares can be provided by the portion of the system that is decommissioned.[9] The level of integration between the current system and a new Motorola system is relatively simple and does not require additional components that do not exist today.	ISSI interconnections and other long-term patching is required to be maintained for a longer period of time.
Subscriber Familiarity	Current users of Motorola radios will find new Motorola radios similar (operation and layout of new and old Motorola radios share common traits)	If subscribers from a new manufacturer are introduced to current Motorola radio users, more training will be necessary and users must familiarize themselves with different ways of operating radios. For instance, the functionality of buttons and switching between banks of channels/talkgroups differs between manufacturers. For current users of Motorola radios, the learning curve would be steeper with a new manufacturer's radio than with a new Motorola radio.

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[9] RCC strongly recommends against relying solely upon an end-of-life system for mission critical voice communications. All public safety and other mission critical agencies that continue to operate on the old system (for analog trunking operation) should utilize P25 compatible radios that can readily switch to the P25 system in the event of an outage of the old system or have other backup plans readily available and practiced.

Issue	Motorola System	Other Vendor System
Dispatch Console Familiarity	Current users of Motorola Gold Elite consoles will find new MCC7500 consoles very similar (Motorola can very closely mimic the layout and functionality of a Gold Elite console with a MCC7500 console if desired).	Other vendors can attempt to mimic the layout and functionality of the Motorola Gold Elite consoles in use on the system today, but will necessarily have some differences and will lead to a learning curve that would not be present with MCC7500 consoles.
Radio System Familiarity	Current County radio system managers and technicians are familiar with the Motorola technology, its operations and its modes of redundancy. A new Motorola P25 system would utilize the same MSE as the current system and there would be no difference in the operation of the system.	Other vendors' radio systems will be different than Motorola's system and new technology, operations and modes of redundancy will have to be learned by the County's current radio system managers and technicians.
Established Relationships with Vendor	The County has established relationships with Motorola and its local support staff	New relationships must be established with a new vendor as the current local support staff only supports Motorola systems.

Because the existing system and many of the P25 capable subscriber radios are manufactured by Motorola, only Motorola can provide the County with a single point of responsibility for migration to P25. This is not to say that no other vendor can potentially provide for a replacement system, rather it is to say that other vendors must rely upon Motorola, with possible mediation of the County, to overcome compatibility issues with the County's current RF infrastructure, dispatch consoles and P25-capable Motorola subscribers and to provide certain upgrades, if needed, to the current system to meet integration requirements.

Furthermore, in a complete system replacement by a vendor other than Motorola, the cities of Boca Raton, Boynton Beach and Delray Beach will be significantly impacted. Though Boca Raton is in the planning process of migrating to P25, RCC is not aware of any plans for Boynton Beach or Delray Beach to migrate. If the County's current system is decommissioned, the cities' systems will enter into permanent site-trunking with no console dispatch capabilities and no administrative capabilities. The cities must either make alternative communications plans or participate in a County procurement should the County decide to competitively procure a new P25 system. At a minimum, any procurement by the County should include the option for the cities to participate.

Appendix A

Glossary

Item/Acronym	Definition
APCO	Association of Public-Safety Communications Officials
BDA	Bi-Directional Amplifier
bps	Bits per seconds
CEB	Central Electronics Bank. An intercommunications network that allows for integration of dispatch positions and the communications equipment they control.
CSC	Central Site Controller. A central controller is typically a computer that processes inbound and outbound data traffic, assigns repeaters for voice channel access, and generally monitors and maintains order in the system.
Console Patching	Ability to connect channels via dispatch consoles
Failsoft	A "graceful degradation" mode of a trunked radio system. May result in loss of trunking and reversion to conventional operation.
FCC	Federal Communication Commission
FNE	Fixed Network Equipment
GoS	Grade of Service
GPS	Global Positioning System
Inter-agency	Located or occurring between two or more agencies
Interoperable	Ability of a system to use the parts or equipment of another system
ISSI	Inter-RF Subsystem Interface. P25 non-proprietary interface that enables P25 compliant systems to be connected together into wide area networks.
kHz	Abbreviation for kilohertz. 5 kHz = 5,000 Hz
Master Site	Site that contains the core network equipment and provides call processing equipment and serves as a hub for the connection of multiple communication subsystems. The master site consists of a complex network of servers, computer workstations, LAN switches, routers, databases, software applications, etc.
Mbps	Megabits per seconds
MGEG	Motorola Gold Elite Gateway
MHz	Abbreviation for megahertz. 5 MHz = 5,000,000 Hz or 5,000 kHz.
MOU	Memorandum of Understanding

Item/Acronym	Definition
Mutual Aid	Personnel, equipment, or services provided to another jurisdiction
NPSPAC	National Public Safety Planning Advisory Committee
P25	Project P25
PSAP	Public Safety Answering Point
Remote Site	A site that consists of repeaters and a site controller, which are linked to a Master Site
ReSC	Remote 6809 Site Controller. The remote site board that receives data link instructions from the central controller
RF	Radio Frequency
Simulcast	A wide-area trunked system configuration that uses multiple transmitter and receiver sites to extend coverage of the system. All the corresponding channel numbers at all the sites uses the same frequency
Site Trunking	A failure mode where the remote site controller loses connectivity to the master site. The disconnected system continues trunking, however, dipsatch consoles are inoperable.
SmartX	Site interface that enables the two dissimilar Motorola's technologies to communicate as if they were a single system.
Subscriber	End user radio equipment, such as a portable or mobile radio
Talkgroup	Term ususally used with trunked radio systems. A talkgroup is a predefined list of radios/users assigned a unique ID which allows them to communicate with each other over the trunked radio system.

Appendix B

System Description and Technology Review

SYSTEM DESCRIPTION

The County's radio system is a trunked, simulcast and voted radio system. A trunked system is a system in which a group of radio channels are combined together and shared among all the users. In a trunked system, no particular user (or group of users such as SWAT, Patrol, etc.) is assigned a particular channel; rather, they are assigned the next available channel when requested. By comparison, in a conventional radio system, a specific RF channel is dedicated to a certain group of users or a certain function (e.g., Sheriff Dispatch, SWAT, etc.) As there are a limited number of RF channels available, agencies with a large number of users need to be very efficient in the use of RF channels. In a trunked system, only users actively talking are using an RF channel and channel assignments are made "on-the-fly" and in less than one half a second[10]. This allows for highly-efficient usage of the channel resources and as more channels are added to the system, the number of users that can be supported by the system begins to grow exponentially. A good analogy is the telephone lines to an E-9-1-1 public safety answering point (PSAP) where there are a limited number of telephone lines available for the public use. Even though there are millions of people that could potentially call 9-1-1, relatively few actual telephone lines are needed to minimize the risk of a caller receiving a busy signal. The same is true with the County's radio system where users, for the most part, never receive a busy signal. Most radio systems that support a large number of users are trunked radio systems.

Simulcast and voted systems are methods of reusing the limited number of channels to improve radio coverage. The County's current system has 10 transmit/receive sites located primarily in the eastern portion of the County where there is a higher density of population and buildings. The County's system has 28 radio channels with one of those channels designated as a control channel; leaving 27 radio channels available for carrying voice messages. In a simulcast system, each of these channels is broadcasted out to the users from each of the tower sites simultaneously. Because the timing of when the signals are broadcasted in a simulcast configuration is tightly controlled through the use of highly accurate GPS clocks, the signals do not generally interfere with each other. In a voted system, each tower site also listens to every transmission sent back by the users and the best signal is picked out from all the sites. In deploying a simulcast and voted system, all channels can also be configured to provide improved capacity. If a simulcast and voted system was not used, the 28 channels would have to be divided among the 10 sites providing, at best, three channels per site. In such a

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[10] This requirement for a channel assignment in less than one half a second is a requirement of the APCO-16 standard. The County's current radio system is APCO-16 compliant.

system design[11], the system could potentially reach a busy state after only two simultaneous conversations. The likelihood of the County's trunked system reaching busy on a normal day is well less than 1%[12], whereas if the County system was not a simulcast system, reaching busy on a normal day is all but guaranteed.

The County system also includes three other much smaller systems owned by the cities of Boca Raton, Boynton Beach and Delray Beach. These systems share the same "core" as the County's simulcast system and are deeply integrated with the County system. Any decision made by the County with regards to the County system will have an impact of the systems owned by the three cities.

When looking at the County radio system from an equipment perspective, it can best be viewed as being comprised of four basic parts (see Figure 1):

- Master Site Equipment (MSE) – The electronics (switches & servers) that perform the routing of voice communications, assigns radio channels to users, provides management of system, etc. The MSE is the "core" of the radio system.
- Radio Frequency (RF) Infrastructure – The equipment that transmits and receives signals to/from the users. Because the County's system is a simulcast (multiple tower sites transmitting the same signal) and voted (multiple tower sites receiving the same signal) system, the RF infrastructure also includes a centralized set of equipment for timing and synchronization of the signals. The County has 10 tower sites with transmitters and receivers. The site with the centralized RF equipment is referred to as the prime site. All the other sites are commonly referred to as remote sites. In the County's case, the prime site is co-located with the MSE (it is common to have a prime site co-located with the MSE).
- Dispatch Consoles – The equipment the dispatchers use to communicate with the users. Most of the dispatch consoles in the County's system are computers with specialized additional audio processing modules. The computers are interfaced to multiple Console Electronics Banks (CEB) and an Ambassador Electronics Banks (AEB) that perform routing of voice communications between the MSE and the consoles.

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[11] Some radio system architectures provide for multiple conversations to be carried over a single radio channel. A P25 Phase II system can support two conversations per RF channel whereas a P25 Phase I system only supports one conversation. In a Harris OpenSky system, up to four conversations can be supported in a single RF channel but requires high signal levels for comparable coverage, cannot be simulcasted or voted and is a proprietary technology only available from Harris..

[12] A 1% chance of a user receiving a busy signal (also known as a 1% Grade of Service) is a public safety industry standard and is the system design recommendation of the Public Safety Wireless advisory Committee (PSWAC) Report, *Spectrum Requirements Subcommittee (SRSC) Final Report, Appendix D, Public Safety Wireless Communications User Traffic Profiles and Grade-of-Service Recommendations (September 1996) at 76 (676).*

- Subscriber Radios – The hand-held radio (i.e., portable radios) and vehicular radios (i.e., mobile radios) with which the users communicate.
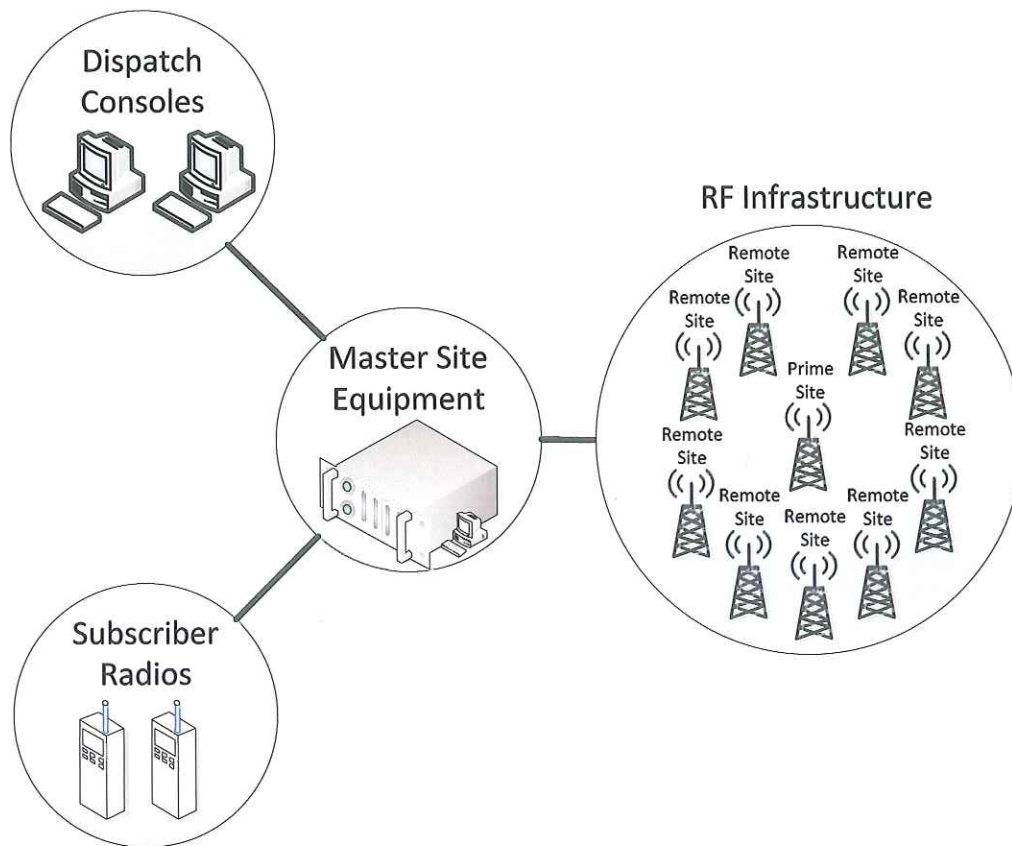

Figure 4 - Radio System Components

Technology Review

The desire of the County to migrate to a P25 compliant system when the current radio system is replaced is based upon the fact that P25 is a national standard for over-the-air digital communications such that subscriber radios from multiple vendors can communicate together as long as the radio system and subscriber radios are P25 compatible. Prior to the standard, each manufacturer utilized a proprietary over-the-air protocol for trunked radio systems such that only that manufacturer's radios would work on the system. The County's current system is an example of a proprietary system where only Motorola radios[13] are compatible. By establishing a standard, a P25 system

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[13] Motorola licensed the SMARTNET/SmartZone protocol to EF Johnson to manufacturer radios that will work on a Motorola proprietary system. The County and some municipalities use a small amount of EF Johnson radios on the system.

manufactured by one vendor will work with P25 radios manufactured by any other vendor. A P25 Compliance Acceptance Program has been established such that manufacturers can test their system and subscriber radio compatibility with other vendors.

The P25 standard allows for greater interoperability as any user with a P25-capable radio can communicate on any P25 radio system assuming they have the correct programming and authorization. This would allow an agency that uses a Harris P25 radio system on a daily basis to be able to roam onto a Motorola P25 system when needed, and vice versa. The P25 standard also allows for agencies to have options in procuring new radios as they are no longer required to purchase a specific manufacturer's radio as long as the features specified in the P25 standard are adequate for the user. However, the P25 standard does not address all features that may be part of a trunked radio system. For example, over-the-air-reprogramming (OTAP) of subscriber radios is not part of the standard and each vendor has their own proprietary methodology. As such, a radio from Vendor A operating on a system from Vendor B would not be able to be reprogrammed via OTP. The P25 standard addresses core functionality and leaves supplemental features largely to the discretion of the vendors.

Technology is always moving forward and with the recent passage of the American Jobs Act, a nationwide public safety broadband data system called FirstNet is legislated for construction. This system is based upon LTE[14] technology that is being deployed by commercial wireless carriers, such as Verizon, AT&T and Sprint, to accommodate the growth in demand for high-speed data. These carriers are not using LTE to support voice communications as the standard for such is not complete. However, even if a standard that supports cellular type voice communications exists, it would not be suitable for public safety agencies as their mission-critical communications relies upon features (e.g., talk-around, group calls, push-to-talk, emergency buttons, encryption, etc.) that is not present in cellular systems. To utilize LTE for mission-critical voice communications, these features would have to be added to the standard and for some of the requirements, they are not even on the standards roadmap.

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[14] LTE is an abbreviation for Long Term Evolution.

RECEIVED

FEB - 4 2014

DIRECTOR'S OFFICE

January 27, 2014

Audrey Wolf
Director of Facilities Development and Operations
2633 Vista Parkway
West Palm Beach, FL 33411

Subject: P-25 Radio Upgrade Project

Dear Audrey,

I am under the impression that the proposed P-25 radio upgrade is on hold. I am requesting that the project start as soon as possible due to the fact one of the components of the system, the encryption function is of great importance to the Sheriff's Office. The reason is that we are the lead Agency in charge of all Homeland Security for South Florida and as such, we are constantly involved in complex investigations that can be compromised if the criminal element intercepts our radio communication. Additionally, our Organized Crime Bureau conducts highly sensitive investigations that can also be compromised if the criminal element hears or monitors our communications. Please consider starting the project as soon as possible so we can operate more effectively.

Sincerely,

Ric L. Bradshaw
Sheriff

RLB:am