Romeoville Microwave and Radio Integration

1.0 DESCRIPTION

This is a revised statement of work to complete the Dispatch move and radio connectivity for Village of Romeoville radio system. Digital Sky will replace The Village of Romeoville's existing RTNC phone circuits servicing the Police, Fire and EMA VHF radio systems by adding 5 new microwave radio hops (Romeoville Microwave map attached). By replacing the phone circuits audio levels will remain constant, thus enhancing reliability and audio consistency for the 3 legacy VHF analog radio systems. DS will add indoor 4.9 GHz microwave radios at the following sites; Police Dept. Radio Tower, Lewis University radio tower, EMA radio tower, 27 Montrose and Windham Park Water Pumping Station (Radio Integration Interconnect Map attached). Each 4.9 GHz hop will provide a minimum of Two T1 channels as well as 24 Mbps aggregate Ethernet capacity. All new microwave hops with be equipped with DC powered battery back-up capable of running without AC power for 24hrs. DS will be utilizing Adtran Total Access 850 multiplexers to replace phone circuits.

Microwave will meet a minimum of a 15 Db fade margin. Calculated RF Link Fade Margin will include connectors and transmission line losses.

The proposed microwave antennas and radomes will be capable of maintaining reliable operations during sustained storm force winds of up to 90mph. Minimum operational service parameters of each microwave link will be at a minimum as follows:

- Unfaded Bit Error Rate(BER) Not less than 10^{-9}
- Maximum Faded BER: Not less than 10^{-6}

Digital Sky shall file for any necessary FCC licensing and finalize the path studies.

1.1 OVERVIEW

The new Microwave Radio System will allow the Romeoville VHF radio system assets to eliminate the costly and less reliable phone circuits.

2.0 IMPLEMENTATION

The implementation plan consists of a phased approach to include work prior to actual system installation tasks. All implementation work shall be planned and staged to minimize any outages and expedite the project. This includes system path surveys and backhaul communication using microwave/multiplex installation. During cutover the current system shall remain operational.

DS is planning on installing new 19 inch aluminum communication racks and/ or outdoor cabinets where necessary.

Unless otherwise modified herein, materials, design and construction procedures shall be in accordance with, Motorola R56 Installation Standards, The National Electrical Code, ANSI/NFPA-70 and all federal, state and local building codes.

DS shall dispose and remove from site, all debris and refuse as result of performing work.

Upon successful implementation a copy of As-Built documentation shall be provided for the entire network. This shall include all categorized information for each individual site. Additionally, an electronic version shall be provided.

A Project Manager (PM) will be assigned by Romeoville who will interface with Digital Sky's PM Wayne Grochowski for the microwave portion of the Radio System Upgrade project from the beginning of the project through acceptance. Additionally, Apex Tower Company will be subcontracted by DS for the tower work. Digital Sky's team of technicians will ensure the successful configuration and assessment of the project. Digital Sky's Radio Service Shop located at 16400 104th Ave. Orland Park, IL 60467 is made up of a combination of offices, service shop, and staging area.

DS will program, install and align the 4.9 GHz radios to ensure maximum RSL (Receive Sensitivity Level) and performance. The paths will then be tested to minimum fade margin requirements. We will then install and configure all new Adtran multiplexers at the sites. All hops will then be tested using a T-Berd 950 T1 analyzer to verify error free performance. Once all hops have been successfully tested DS will prewired all 4 wire audio circuits from each site back to their respective voters. This will ensure a smooth and swift cutover from the phone circuits. The fire receivers will then be properly aligned with the existing Motorola voter to ensure proper audio levels.
Once Romeoville's phone circuits have been replaced DS will then connect them to the existing Motorola comparators. A Radio interconnect diagram is attached.

3.0 GENERAL

3.1 Finalize Microwave Path Studies

3.1.1 INSTALL BACKHAUL COMMUNICATIONS TO THE APPROPRIATE SITES.

3.1.1.1 Program all 4.9GHz indoor radios to FCC license

3.1.1.2 Install radios in cabinets and /or equipment racks
3.1.1.3 Install all microwave dishes, antenna lines and lightning arrestors
3.1.1.4 Sweep line & connect antenna line to radio
3.1.1.5 Connect to DC power including battery backup
3.1.1.6 Align microwave paths for optimum RSL

3.2 REQUIREMENTS

The following requirements will be made:

1. DS verified that all tower sites will accept microwave antennas at prescribed heights for line of sight.
2. DS to verify that all current radio equipment is functioning properly. Any required repair and/or replacement will be charged to the Village unless damaged by contractor.
3. DS has verified this reconfiguration process will not require tower modifications.
4. Village will provide access to equipment locations to contractor as extended workdays may be required to complete tasks and minimize conflicts with the villages operations.
5. Site access will be granted in a timely manner

4.0 TESTING AND ACCEPTANCE

DS shall comply with all technical industry standard requirements for testing and acceptance. The following sections list the tests that will be performed. The Site Acceptance Test (SAT) will test all equipment at a particular site, to include the performance of the link itself. The Network Acceptance Test (NAT) will commence once all sites/links have been tested. The tests will evaluate the end to end performance of the entire Radio System i.e. Microwave Radios, Multiplexers, and all other components.

4.1. PATH ALIGNMENT

Digital Sky will provide all material, equipment, and personnel required to perform Antenna installation and path alignments. APEX Tower Company (ATC) tower crews will perform microwave dish alignments for all microwave paths. Digital Sky will ensure all microwave dishes are aligned for maximum RSL levels.

4.1.2 INSTALLATION INSPECTION

The inspection of the completed Microwave Radio Link System equipment installation shall be performed to confirm compliance with standards set forth in final contract. Romeoville's personnel or representative will inspect and approve the site installations.

4.1.3 SWEEP RF CABLING

DS will provide Antenna sweep data of all transmission and microwave dishes for every tower site once the antenna systems have been completed. A Praxym or Site master will be used to verify the manufacturer's specifications. All measured return losses shall be documented and provided to Romeoville for microwave performance baseline data.

4.1.4 POWER PLANT TESTS

Digital Sky will measure the following:

1) Record individual battery and power plant total output voltages
2) Set float and equalize voltages on charger to 52 volts DC
3) Digital Sky will set and verify charging systems in accordance with manufacturer's specifications.

4.1.5 DC POWER SUPPLY VOLTAGE CHECKS

Digital Sky will verify all DC power supply voltages.

4.1.6 MICROWAVE RADIO TRANSMITTER CHECKS

Digital sky will measure and record all Microwave radio transmit power levels in decibels (db). Digital Sky will measure and record transmit frequencies, verify operation of GUI and compare measured values to manufacturer specifications.

4.1.7 MICROWAVE RADIO RECEIVER CHECKS

Digital Sky will measure and record Rx levels.

4.1.8 FADE TEST

Digital Sky will simulate a path fade by reducing power from the microwave radio into the antenna feed line and verifying the fade results with a T1 (T-Berd) BER test set. Digital Sky will measure and record RSL levels during the fade margin tests and document BER thresholds of 10^{-6}and10^{-3}.

Digital Sky will provide and record results of the path tests for the Village to review.

4.1.10 SYNCHRONIZATION

Digital Sky will verify operation of synchronization network in normal modes.

4.1.11 SUCCESSFUL TESTING; CORRECTIVE OR REMEDIAL MEASURES

Digital Sky is responsible for causing the equipment to be installed under this Statement of Work to successfully meet all of the testing and acceptance standards set forth in Section 4 of this Statement of Work. In the event that the equipment, once installed, shall fail to meet one or more of the testing and acceptance standards set forth in Section 4 of this Statement of Work, Digital Sky shall be responsible at its cost and expense to perform all corrective and remedial measures that may be necessary to cause the equipment installed under this

Statement of Work to thereafter successfully meet all of the testing and acceptance standards set forth in Section 4 of this Statement of Work.

5.0 PATH STUDIES

Path Studies will be provided separately.

6.0 VHF Radio

6.1 Windam Pump

6.1.1 DS to provide and install outdoor cabinet.
6.1.2 Relocate PD, FD, EMA receivers and multicoupler from Marquette Water Tower.
6.1.3 DS to provide and Install ADTRAN TOTAL ACCESS 850 multiplexer with 3 E&M cards along with punch blocks and cabling.
6.1.4 Install VHF equipment provided by Digital Sky including DB222 antenna, 7/8" coax, connectors, lightning protection, cable hangers and ground bus.
6.1.5 DS to provide and install DC power & battery backup.

6.2 27 Montrose

6.2.1 DS to provide and install outdoor cabinet.
6.2.2 Relocate FD, EMA receivers and multicoupler from 10 Montrose. PD from existing.
6.2.3 DS to provide and Install ADTRAN TOTAL ACCESS 850 multiplexer with 3 E&M cards along with punch blocks and cabling.
6.2.4 Install VHF equipment provided by Digital Sky including DB222 antenna, 7/8" coax, connectors, lightning protection, cable hangers and ground bus.
6.2.5 DS to provide and install DC power & battery backup.

6.3 Lewis University

6.3.1 VHF antenna, multicoupler, and PD/FD/EMA receivers already installed.
6.3.2 DS to provide and Install ADTRAN TOTAL ACCESS 850 multiplexer with 3 E&M cards along with punch blocks and cabling.
6.3.3 DS to provide and install DC power & battery backup.
6.3.4 Provide Structural Analysis report for tower.

6.4 Romeoville EMA

6.4.1 REMA Rx/Tx, Voter, VHF DB222 antenna and cabling already installed.
6.4.2 DS to provide and Install ADTRAN TOTAL ACCESS 850 multiplexer with E&M card along with punch blocks and cabling.
6.4.3 DS to provide and install DC power & battery backup.
6.4.4 Confirm that the Backup transmitter at the Police Station Tower is functioning as it does today.

6.5 Village Hall

6.5.1 Two Motorola Voters FD/PD located at Village Hall.
6.5.2 Possibly relocate voters to Police Station Tower building.

6.6 Police Station Tower

6.6.1 Two VHF antennas, multicoupler and transmit combiner already installed.
6.6.2 Three Tx/Rx repeaters FD/PD/REMA already installed.
6.6.3 DS to provide and Install ADTRAN TOTAL ACCESS 850 multiplexer with E&M card along with punch blocks and cabling.
6.4.3 DS to provide and install DC power & battery backup.
6.4.4 One pair of fiber media converters provided by DS.
6.4.5 Provide Structural Analysis report for tower.

6.7 Decommission Equipment

6.7.1 Citgo – Remove VHF antenna, feed line and site equipment. Deliver VHF antenna and equipment to Village.
6.7.2 10 Montrose - Remove VHF antenna, feed line and site equipment. Deliver VHF antenna and equipment to Village.
6.7.3 Windham Pump Remove VHF antenna, feed line and site equipment. Deliver VHF antenna and equipment to Village.-
6.7.4 Marquette WT - Remove VHF antenna, feed line and site equipment. Deliver VHF antenna and equipment to Village.

7.0 PARTS LIST

WYNDAM EQUIPMENT LIST	
MICROWAVE EQUIPMENT	
DESCRIPTION	**QTY**
4.9 GHz IDU terminal, 27 Mbps + 2xT1/E1 expandable to 55 Mbps + 4xT1/E1 4T1	1
2' 4.9GHz hyperbolic microwave dish ,HP2-4.7NS	1
Antenna mounts	1
1/2' Superflex Jumpers 3' ANC-FA4-PNMNF-3-USA 369968	1
1/2' Superflex Jumpers 8' F4A-PNMNF-8-USA 309156	1
N-Type Female/ Male LDF4.5-50 connectors	2
5/8" Foam coax transmission line LDF4.5-50	160ft
10 pack- snap in butterfly 5/8" line hangers	5
20 - 1/4" beam clamps	2
5/8" Cable ground kit	3

4.9 GHz lightning arrestor	1
POWER PLANT EQUIPMENT	
DESCRIPTION	**QTY**
Duracomm 48Vdc power supply-RM-1248	1
Penn Deca Deep Cycle Batteries, EB-DC24, 12Vdc	4
dc 30 amp breaker	1
1-Rack Mount Outlet Power Strip	1
Fuse blocks DuraComm DB-5	1
Other accessories - Wire & connectors, Screws, tie wraps, rack anchors, boots, etc.	lot
RECEIVER EQUIPMENT	
DESRIPTION	**QTY**
DB 222 VHF Antenna 3-6db gain	1
Antenna mounts	1
HJ5-50 7/8" Coax Cable	80'
7/8" Coax Connectors	2
7/8" Ground Kits	3
7/8' Line Hangers	50
Ground Buss Bar	1
VHF Polyphaser lightning protector	1
MULTIPLEX EQUIPMENT	
DESCRIPTION	**QTY**
Adtran Total Access 850	1
30' 50pin Telco cables	1
6' 50pin Telco cables	1
66B Punchblocks	1
Relocate PD/FD/EMA receivers and multicoupler from Marquette Water Tower	3/1

27 Montrose Equipment List	
MICROWAVE EQUIPMENT	
DESCRIPTION	

4.9 GHz IDU terminal, 27 Mbps + 2xT1/E1 expandable to 55 Mbps + 4xT1/E1 4T1	2
2' 4.9GHz hyperbolic microwave dish ,HP2-4.7NS	2
Antenna mounts	2
1/2' Superflex Jumpers 3' ANC-FA4-PNMNF-3-USA 369968	2
1/2' Superflex Jumpers 8' F4A-PNMNF-8-USA 309156	2
N-Type Female/ Male LDF4.5-50 connectors	4
5/8" Foam coax transmission line LDF4.5-50	300ft
10 pack- snap in butterfly 5/8" line hangers	8
20 - 1/4" beam clamps	4
5/8" Cable ground kit	6
4.9 GHz lightning arrestor	2
POWER PLANT	
DESCRIPTION	
Duracomm 48Vdc power supply-RM-1248	1
Penn Deca Deep Cycle Batteries, EB-DC24, 12Vdc	4
dc 30 amp breaker	1
1-Rack Mount Outlet Power Strip	1
Fuse blocks DuraComm DB-5	1
Other accessories - Wire & connectors, Screws, tie wraps, rack anchors, boots, etc.	lot
RECEIVER EQUIPMENT	
DESRIPTION	
DB 222 VHF Antenna 3-6db gain	1
Antenna mounts	1
HJ5-50 7/8" Coax Cable	180'
7/8" Coax Connectors	2
7/8" Ground Kits	3
7/8' Line Hangers	50
Ground Buss Bar	1
VHF Polyphaser lightning protector	1
MULTIPLEX/RADIO EQUIPMENT	
DESCRIPTION	**QTY**
Adtran Total Access 850	1

30' 50pin Telco cables	1
6' 50pin Telco cables	1
66B Punchblocks	1
Relocate FD, EMA receivers and multicoupler from Citgo. PD from existing.	lot

Lewis Equipment List	
MICROWAVE EQUIPMENT	
DESCRIPTION	**QTY**
4.9 GHz IDU terminal, 27 Mbps + 2xT1/E1 expandable to 55 Mbps + 4xT1/E1 4T1	1
2' 4.9GHz hyperbolic microwave dish ,HP2-4.7NS	1
Antenna mounts	1
1/2' Superflex Jumpers 3' ANC-FA4-PNMNF-X-USA	1
N-Type Female/ Male LDF4.5-50 connectors	2
5/8" Foam coax transmission line LDF4.5-50	160ft
10 pack- snap in butterfly 5/8" line hangers	4
20 - 1/4" beam clamps	3
5/8" Cable ground kit	3
4.9 GHz lightning arrestor	1
POWER PLANT	
DESRCIPTION	**QTY**
Duracomm 48Vdc power supply-RM-1248	1
Penn Deca Deep Cycle Batteries, EB-DC24, 12Vdc	4
dc 30 amp breaker	1
1-Rack Mount Outlet Power Strip	1
Fuse blocks DuraComm DB-5	1
Other accessories - Wire & connectors, Screws, tie wraps, rack anchors, boots, etc.	lot
MULTIPLEX/RADIO EQUIPMENT	
DESCRIPTION	**QTY**
Adtran Total Access 850	1
30' 50pin Telco cables	1
6' 50pin Telco cables	1

66B Punchblocks	1
FD/PD/EMS receiver & multicoupler (existing)	3

REMA Equipment List	
MICROWAVE EQUIPMENT	
DESCRIPTION	**QTY**
4.9 GHz IDU terminal, 27 Mbps + 2xT1/E1 expandable to 55 Mbps + 4xT1/E1 4T1	1
2' 4.9GHz hyperbolic microwave dish ,HP2-4.7NS	1
Antenna mounts	1
1/2' Superflex Jumpers 3' ANC-FA4-PNMNF-3-USA 369968	1
N-Type Female/ Male LDF4.5-50 connectors	2
5/8" Foam coax transmission line LDF4.5-50	200ft
10 pack- snap in butterfly 5/8" line hangers	5
20 - 1/4" beam clamps	3
5/8" Cable ground kit	3
POWER PLANT	
DESCRIPTION	**QTY**
4.9 GHz lightning arrestor	1
Duracomm 48Vdc power supply-RM-1248	1
Penn Deca Deep Cycle Batteries, EB-DC24, 12Vdc	4
dc 30 amp breaker	1
1-Rack Mount Outlet Power Strip	1
Fuse blocks DuraComm DB-5	1
Other accessories - Wire & connectors, Screws, tie wraps, rack anchors, boots, etc.	lot
MULTIPLEX/RADIO EQUIPMENT	
DESCRIPTION	**QTY**
Adtran Total Access 850	1
30' 50pin Telco cables	1
6' 50pin Telco cables	1
66B Punchblocks	1
REMA TX/RX (existing)	1

Police Station Equipment List	
MICROWAVE EQUIPMENT	
DESCRIPTION	**QTY**
4.9 GHz IDU terminal, 27 Mbps + 2xT1/E1 expandable to 55 Mbps + 4xT1/E1 4T1	3
2' 4.9GHz hyperbolic microwave dish ,HP2-4.7NS	3
Antenna mounts	3
1/2' Superflex Jumpers ANC-FA4-PNMNF-X-USA	3
N-Type Female/ Male LDF4.5-50 connectors	7
5/8" Foam coax transmission line LDF4.5-50	500ft
10 pack- snap in butterfly 5/8" line hangers	12
20 - 1/4" beam clamps	7
5/8" Cable ground kit	9
4.9 GHz lightning arrestor	3
POWER PLANT	
DESCRIPTION	**QTY**
Duracomm 48Vdc power supply-RM-1248	1
Penn Deca Deep Cycle Batteries, EB-DC24, 12Vdc	4
dc 30 amp breaker	1
1-Rack Mount 12 Outlet 20A by Triplite	1
Fuse blocks DuraComm DB-5	2
Other accessories - Wire & connectors, Screws, tie wraps, rack anchors, boots, etc.	lot
MULTIPLEX/RADIO EQUIPMENT	
DESCRIPTION	**QTY**
Adtran Total Access 850	6
30' 50pin Telco cables	7
6' 50pin Telco cables	7
66B Punchblocks	7
Transition Netowrks T1 Fiber Media Converter	2
FD/PD/EMS receiver (existing) Relocate to Tower	3

8.0 COST

The original SOW cost was $243,000 with the revised statement of work cost being $165,230 of which $121,500 was already paid. The original SOW had 7 hops of microwave. The revised SOW was reduced to 5 hops. Below is a cost summary.

ITEM	QTY	DESCRIPTION		Total
1	lot	Dispatch move – radio connectivity. Payment #1	Paid	$121,500.00
1	Lot	Complete radio connectivity for PD/FD/REMA and 5 paths microwave equipment. Decommission equipment.	Remaining	$43,730.00
			Total	$165,230.00