

Microwave Networks Implementation Overview

Microwave Networks provides the following services to support the implementation of microwave network:

- Program Management
- Project Engineering
- Kick off Meeting
- Path Survey Engineering and Technical Report
- Customer Design Review Meeting
- FCC Frequency Coordination and Licensing
- Factory System Staging/Integration
- Factory System Acceptance Testing (included expenses for 4 Customer Customer people to attend)
- Installation & Optimization of Radio and DC Power Equipment Quoted
- Installation & Optimization of Antenna, Transmission Line and Pressurization Equipment Quoted
- Field Acceptance Testing
- Complete Cutover of all circuits
- Documentation
- Proteus MX Training at Customer Location (Up to 10 Students)
- Extended Factory Warranty
- 24/7 Telephone technical support
- Local Maintenance Services
- Annual Preventive Maintenance

Below are the details of these services:

Upon Award Notification and final contract signatures and purchase orders, Microwave Networks will contact the Customer's PM to schedule a Kick-Off Meeting.

Microwave Networks will develop, in concert with the Customer Representative, a complete implementation plan utilizing Microsoft Project as the basis of communications and implementation agreement.

1. Kick-Off Meeting:

On the date scheduled the following will be reviewed with the Customer:

- Microwave Licensing Required Documents for Submission
- Agreement of Site Access Procedures and Requirements
- Determine Requirement that the Customer Requires from Microwave Networks.
- Agreement of Meeting Schedule

- Agreement on Communications Requirements
- Proposed Field Path Survey Date
- Proposed Delivery Dates after Order Release Date – Coordinated with the customer
- Review Contractor's Schedule
- Proposed Microwave Test Plan
- Agreement on the Service Warranty Plan – Beneficial Use Agreement
- Agreement on Final Documentation Required
- Agreement on Change-Order Procedure
- Proposed Training Plan
- Agreement on Milestone Billing and Payment

2. Program Management

Microwave Networks will provide Program Management services to proactively manage the flow of the project, keep customer up to date, and follow and track all aspects of the project, including documentation, scheduling, manufacturing, shipping and meetings. The Microwave Networks Program Manager will be responsible for all correspondence regarding the project and will be the primary point of contact throughout the project. See *ExhibitB3-Services-ProjMgt* for more details on Project Management Services.

3. Path Survey Engineering and Technical Report

The initial step in the design of a microwave radio link or the planning of a microwave relocation project is the path survey. The purpose of the path survey is to accurately identify and locate all critical points and potential obstructions between the two sites and to determine the antenna centerlines that are required to meet the established path clearance criteria. Microwave Networks has an in-house staff of transmission engineers and survey crews to conduct path surveys.

Prior to beginning the physical path survey, computer analysis is conducted for the proposed path. Preliminary site coordinates are entered and preliminary path profiles are generated from USGS 1/3 arc second Digital Elevation Models (DEMs). This data is then used to calculate preliminary antenna centerlines and critical elevation points which require investigation and confirmation during the actual survey.

During the physical survey, the path is traversed and the horizontal and vertical positions of the proposed radio sites, critical elevation points, and potential obstructions are accurately identified using a differential global positioning system (DGPS) and a laser range finder. This information is digitally recorded in path analysis software.

To prepare the path survey report, the surveyed coordinates are scaled and plotted on USGS 7.5 minute (1:24,000) quadrangle maps. A line is drawn connecting the radio sites and all critical points or potential obstructions are indicated as determined by the survey. Based upon the as-surveyed path profile, antenna centerlines are selected to satisfy two sets of clearance criteria: F1 @ K=4/3 and 0.3F1 @ K=2/3. An analysis is also performed to determine if potential path reflections might interfere with path performance. Path reliability for a two-way link will be at least 99.999%, unless otherwise requested by the customer.

All of the relevant information gathered during the survey, the path profiles, and the proposed antenna centerlines are compiled into a path survey report. The entire report includes each path for which a survey was conducted and will be delivered within 1 to 2 weeks after the completion of the survey.

In parallel with, or shortly after the path survey, Microwave Networks will conduct site surveys. The purpose of the site survey is to perform a visual inspection of the site and collect information that will be used to finalize the detailed site design and to accurately assess the scope and plan for installation. Within one week of the completion of the survey, Microwave Networks will deliver the site survey report which details the findings and recommendations.

4. FCC Frequency Coordination and Licensing

Microwave Networks will perform frequency coordination to find a frequency or block of frequencies that will operate without interfering with other microwave users in the area. This is an iterative process that requires computerized simulation of potential interference and an engineering analysis to eliminate interference cases and ultimately determine a usable set of frequencies.

The process begins with a tentative frequency selection consistent with existing frequency plans. Calculations are performed to determine the expected interference from and into the proposed system. These calculations include, as a minimum, co-channel and adjacent channel interference as well as interference caused by inter-modulation products. The result is a list of potential interference cases that require further analysis and resolution.

If terrain blockage is a factor, then terrain profile studies are made and the interference levels are recalculated to account for the reduction caused by blockage. If interference cases remain, the engineer then evaluates system upgrade alternatives, starting with the simplest and least costly. This process continues until a workable system is found or until it is determined that no workable alternative exists in the proposed location and frequency band. In the latter case, alternate bands or locations will be recommended.

Prior Coordination Notice (PCN) is required by the FCC prior to obtaining a license to operate on specific frequencies. Microwave Networks will circulate, to other proposed and licensed common carriers, the required PCN indicating the frequency assignment and operating characteristics of the customer's system. We will receive and respond to any objections to the proposed frequency and act as the customer's technical liaison until all cases are resolved. Upon completion of the prior coordination, Microwave Networks will supply the supplemental showing which is required under FCC rules.

When requested and contracted to prepare FCC forms, Microwave Networks will complete the engineering sections of the Private Fixed Microwave Application Form 402. In addition, we will provide the exhibits of the functional system diagram which are required by FCC rules. This is the extent of the involvement by Microwave Networks in the completion of this form (Form 402). The end-user will be responsible to complete other sections of the form which relate to shared use of facilities, environmental impact, and other non-engineering aspects of the application.

5. Project Engineering

Given the results of the path survey, the site survey, and the frequency coordination, Microwave Networks, will perform the project engineering to develop a detailed equipment list which specifies, on a site-by-site basis, all of the individual items required to implement the new microwave radio system.

In addition to generating the detailed equipment list, the project engineering function also includes the preparation of all of the project specific documentation including rack elevation drawings and wire run lists. The Project Engineer will ensure proper interfacing of the new system to those portions of the existing system that will remain in-use by the new system.

6. Customer Design Review

A Customer Design Review (CDR) will be held at the customer's location at the customer's requested time before the start of manufacturing or staging. The CDR can occur before or after the site surveys, depending on the project. Towers and site locations should be firm at the time of the CDR, so an agreed upon microwave design can be approved.

7. Manufacturing

The Microwave Networks Program Manager will monitor all of the radio equipment through the manufacturing process from the material planning phase to the final test. By having real-time access to the status of the manufacturing process, the Program Manager can ensure the successful delivery of the equipment on-site with the start of the installation. Also, whenever situations occur on the project which require a modification to the manufacturing process the Program Manager can initiate the necessary changes quickly and establish the appropriate feedback channels to confirm that the changes are implemented.

8. Factory Staging and Factory Acceptance Testing

In the factory Systems Integration Facility, Microwave Networks can perform a complete factory integration and test of an entire system or sub-system. As part of the factory integration process, all of the equipment is configured exactly as it will be when installed. All radios are connected back-to-back with fixed attenuation while various radio and system-level tests are performed.

Upon completion of the factory system integration, Microwave Networks will conduct a functional test of the entire system, called the Factory Acceptance Test (FAT) at the Microwave Networks' factory, prior to shipment.



We invite Customer personnel to attend the Staging and FAT at the Microwave Networks facility in Stafford, TX and witness the final factory testing. This will enable them to see the entire microwave network in one place and be assured that the system is working properly before installation.

9. Equipment Delivery

All racked radio equipment, except for power systems and batteries will be delivered to the local secure facility in racks, exactly as configured at the Microwave Networks factory. Power systems, batteries, antennas and waveguide and other mounting accessories will also be delivered to the local warehouse. Equipment will then be transferred directly to each site prior to installation of each site.

10. Installation of antenna systems, radio rack, DC Power System, Batteries

All antenna installation work is sub-contracted by Microwave Networks to one of our certified installation service providers who work under the direction of the Microwave Networks Program Manager. By acting as prime contractor for both the antenna installation and the other installation activities for the site, the Microwave Networks Program Manager coordinates all activities related to the antenna installation including the delivery of the equipment to the site and the assistance of the tower crew in the path alignment process.

As part of a turnkey installation, Microwave Networks will install the necessary lengths of waveguide to connect the radio to the antenna. Microwave Networks will adhere to established industry standards such as EIA Standard RS-222, Motorola R56, and manufacturers' recommendations when installing waveguide on towers.

Upon the completion of the installation of an antenna system, Microwave Networks conducts a sweep test on each section of waveguide. The purpose of the sweep test is to verify that the installed system conforms to VSWR specifications across the operating band.

Microwave Networks will also install and test the pressurization equipment. The pressurization equipment will be installed at a location designated in the site plan. Every effort is made to avoid installing the pressurization equipment in or very near the equipment rack. This will minimize any adverse effects that might be caused by vibration. Upon completion of the installation, Microwave Networks performs a pressure integrity test of the system.

At the heart of the installation of any microwave communication system is the radio itself. As manufacturer of the radio, Microwave Networks and their factory certified installation subcontractors are uniquely qualified to install and test the radio system. All of our installations are performed by our certified subcontractors whose activities are directed and monitored by the Microwave Networks Program Manager.

The general scope of the installation includes uncrating, inspection, inventory, setting and securing in place, connection of DC power, connection to transmission system, and path alignment. When channel banks or multiplexing equipment is involved, the installation of these items is also included in the scope of the radio installation. While these general activities provide an overview of the scope of installation, the detailed installation plan will vary from site to site.

11. Acceptance Test Plan

Microwave Networks can conduct a wide range of on-site testing to meet the customer's requirements. However, we typically use a routinely used set of standardized acceptance test procedures. These tests are a subset of the tests performed during the manufacturing process and the factory system test. In addition to reconfirming the results of the tests performed in the factory, all of our on-site test plans include a measurement of received signal level (RSL) to ensure that the path is installed and aligned properly as well as an extended duration (typically 24 hr.) bit-error-rate (BER) test to verify that the hop is functioning properly. Additional testing, to meet the customer's specific requirements can be included upon request.

12. Integration and Cutover

Microwave Networks will develop a cutover plan to minimize the downtime of the public safety radio system. The team and the Customer will finalize a mutually agreed upon cutover plan based upon discussions held during the CDR. All will be on site during cutover to ensure the least amount of downtime possible. All user group(s) affected by the cutover will be notified.

13. Documentation

The following documentation will be provided:

- Detailed Implementation schedule
- Cutover Plan
- FCC licenses and coordination documentation
- Path Profiles and Path Link Analysis
- Formal Path and Site Survey Report
- One complete set of Microwave Networks Operation and Maintenance manuals with drawings for each rack.
- One complete set of vendor provided Operation and Maintenance literature with drawings for each location.
- Project completion notice upon completion of the activities detailed in the Scope of Work. The project completion notice may apply to the project on a per hop or per system basis, as mutually agreed upon by Microwave Networks and the Customer.
- Complete System functional diagram

A complete documentation package of equipment as installed and accepted (As Builts), to the customer three (3) weeks after system acceptance, including wiring lists, calibration procedures, maintenance charts and tables.