



Planning Advisory Notice

Why You Can't Rush a Communications Tower Site Build

Introduction

This article is targeted to engineering managers of utilities that are planning to build a single microwave path or a wide area microwave network build-out. It is written with a focus on network essential sites. This article is also useful for those that have not been involved in a microwave network build in the last few years. A lot has changed.

Due to the changes in federal regulations, it can take over two years to build a licensed microwave network. You may ask, "Why does it take so long?" The answer to that question is two-fold: site planning/design and regulatory policy and procedure. (1) In order to properly design communications sites and paths, several factors must be considered and carefully designed. (2) Then, the required environmental studies, cultural reviews, permitting applications, and notifications must be filed with the FAA and the FCC. These studies and permitting applications are all tracked and linked by the FAA and the FCC specifically to prevent users from circumventing the system. The burden to the owner (utility company) due to regulatory requirements has increased dramatically since 2012.

Pre-Design Planning

Needs Assessment: The needs assessment is a detailed list of the requirements for the Channel Plan. The needs and wants are weighed on their own merits and assigned a priority level.

Network: When designing a communications network, consider facilitating the ability for future upgrades in bandwidth and services. The frequency band, bandwidth, and specific channels on many radios are now programmable, which makes updating the network easier (e.g. a software upgrade versus a fork-lift upgrade). However, higher throughputs require larger antennas for the same path length, due to the reduced radio frequency (RF) budget.

Towers: A word of caution, don't go cheap on the tower or it may need to be replaced early. Sufficient space should be designed between the proposed microwave

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antennas and the top for future microwave antennas for a future path upgrade, as there will be a short period of time the new and existing paths will be up simultaneously. The tower must be designed to ANSI/TIA 222-G (the current revision). The FAA does not require a particular type of light source such as incandescent, strobe or LED.

However LED is the

only type that can flash at the rate required to be Avian (migratory bird) Compliant. The LED is also the one that requires the least amount of power and can last the longest. However, it is the most expensive but the least expensive to maintain. The obstruction lighting system is recommended to be LED and Avian Compliant. Painting is an option for daytime marking, but due to its high maintenance (intervals and cost); it is recommended to use white light for day time marking. Red light is normally used at night.

Shelter: New technology requirements are normally the limiting factor in determining shelter replacement. Therefore, when designing the shelter, allow for at least double the amount of equipment and feed lines of the initial installation requirements. The possibility of tenants and related security also needs to be considered. For the shelter, the useful life is normally about 20+ years. Again, the shelter is not the place to cut corners, because it protects the very heart of the system. The walls and roof should consist of four-inch thick reinforced concrete. There should be redundant HVAC units and the batteries should be sized for at least three days with future load and up to seven days in remote or mountainous areas.

Generator: A standby generator is critical for repeater sites and is recommended for substation sites. In hurricane prone areas, two weeks of fuel is recommended. Radio sites should be designed to stay up even when transmission lines are down.

Budget: Both the capital expenses (CapEx) (equipment and construction/installation) and operational expenses

(OpEx) need to be considered. Do not forget spare equipment and parts.

It makes sense to plan for a major build-out versus one path at a time. There are economies of scale that can be realized such as standardization, volume discounts, fewer mobilize-demobilize cycles, fewer contracts, the same teams, etc. There may be compatibility issues if the system is built piece-meal.

Preliminary Design

Proposed Routes/Network Architecture: For IP-based radios, it is recommended that the communications network be designed as ring architecture or multiple-ring (for path diversity) and limit spurs to a single path. For the backbone, long paths or severe conditions, it is suggested to use space diversity (i.e. a main antenna and a diversity antenna) to improve path reliability.

Land Options, Acquisitions and Leasing: Trying to acquire land can be challenging, as there are several parameters to consider for a proposed site (e.g. the site must be at a high elevation for the area, must be between the minimum and maximum distances from the other sites, must be near critical sites to be served, must have access for construction equipment and maintenance crews, should be some distance away from neighbors, etc.). When acquiring a site, it is highly recommended to go with "Option to Buy," as sites sometimes do not pan out. However, at sites where a physical presence is required (e.g. next to a substation), a long-term, inexpensive lease may be obtained.

Lead time for this process is unpredictable, as sellers can be difficult to locate or reluctant to sell although condemnation can be used; it too, is a lengthy and expensive process that should be used only as the last resort and option. Furthermore, even if the owner (utility) owns the piece of property, obtaining a building permit is not guaranteed. Local jurisdictions sometimes have a moratorium on





building new towers or limit the height of towers in their area or unrealistic local codes or requirements.

Boundary and Topographical Survey:

For a new site, often a repeater, part of the preparation of a contract to purchase an option to buy on a piece of property, the surveyor will stake out and map the boundary and

elevations the aforementioned property. From the drawings provided from the surveyor, the owner and engineer propose a layout plan and develop a grading plan. The grading plan will show the locations and elevation of the proposed tower foundations. The exact

locations and elevation of the foundation, heretofore, called the top of concrete (TOC) (post construction) will be based on the 1A survey (pre-construction) (tower center) described in the final design stage. The final path analysis and tower maps will be based on the TOC elevation. Updates to the FAA Determination and the FCC Antenna Structure Registration (ASR) are described near the end of this document.

Notice Criteria Tool: This FAA tool will help determine whether the proposed site is near an airport (building near an airport will limit the height of the tower and/or change the required tower lighting). This tool is for preliminary planning purposes only. The FAA will make the final determination for any proposed site. This tool determines if the FAA requires an aeronautical study.

FCC AM Broadcast Query: In August 2013, the commission released new requirements for searching for AM broadcast stations. Initially, it was only certain types of radio services which were required to do this. However, the commission released regulations under

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Part 1 which means it applies to all parts of the CFR 47 and all systems. All radio systems must check to see if they are in the proximity to an AM broadcast station. If so, the owner of the station must be notified, appropriate engineering studies generated and approval from the station owner must be obtained, along with the correct AM detuning equipment installed. This can take significant time and resources and must be factored into the timelines for tower construction.

Preliminary Path Profiles and Coverage Plots: Preliminary path analysis will determine the approximate required tower height and antenna elevations and size.

Preliminary Tower Maps: A tower map is a spreadsheet which shows every antenna and attachment on the tower. For each proposed and future antenna, the following parameters are specified on a tower map: elevation, azimuth, install assignment, tilt, diameter, make and model, receive location (far end), and transmit frequency. For each proposed feed line, the following parameters are specified on a tower map: cable ladder assignment, entry port assignment, top-of-rack assignment, diameter(s), and length, cable and loss description. This spreadsheet is provided to the tower manufacturer, (for the point and distributed loads) to create the tower design documents.

Site and Path Survey Field Trip: The engineer and the owner perform this on-site survey to determine the best location for the proposed tower on the acquired plot of land. The tower's center-line location is determined based on actual field conditions and is staked with a rebar pin. The soil boring locations (i.e. the locations where soil samples will be taken for the Geotech Report to determine foundation designs) are also located and marked. The data will serve for the tower foundations and the shelter foundation. Furthermore, the power source and power cable routing, as well as the configuration of support equipment, are determined at this time.

During the path survey trip, obstacles along the path are identified. These obstacles can potentially interfere with the proposed communications paths and possibly affect the antennas' elevations and/or the tower's height. The obstacles' heights are measured, their GPS coordinates are recorded, and they may be photographed (if they can be safely accessed). When the obstacles are not accessible, on-line aerial photos often supply useful information about vegetation or structures.

The Final Design

Everything discussed above is the preliminary work for a proposed communications site. Now, it is time to lock-in the site.

1A Survey: Obtaining a 1A survey for a proposed site is critical because almost every required FAA and FCC form will reference it (e.g. FCC Cultural Resources Mapping and Tribal Review (Form 620), NEPA studies, Environmental Assessment, FAA Determination Application, FCC Antenna Structure Registration (ASR) Application, etc.). The preferred reference coordinates should be (+/- 1.0 foot horizontally) and base elevation should be (+/- 0.5 foot vertically) of the tower's center-line rebar pin as determined by a licensed surveyor. The accuracy of a 1A survey is actually defined as +/- 20 feet horizontally and +/- 3 feet vertical. However, the +/- 20 feet horizontally and +/- 3 feet vertical is outside the FAA tolerance, but acceptable.

It is highly recommended that existing sites also receive a 1A survey. Some existing ASR locations have been found to be hundreds of feet from the actual tower center. The ASR is updated based on survey technology improvement. This brings the existing ASR location record within FAA and FCC acceptable tolerances.

Final Path Analyses and Coverage Plots: Creating final path analyses based on the 1A survey, the tower location, and the results from the path survey trip, will determine the final required tower height and antenna elevations.

FAA & FCC Permits and Licenses

The FAA Determination (Form 7460-1): This is the FAA's "permit" application. The FAA Determination provides the approval and requirements from the FAA for the proposed site. The estimated grant time after application is 45 days (this can vary by region and time of the year). There may be a required 30-day Public Notice in addition to the 45 day processing. Allow 75

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days in the project schedule. There is no fee for this process. A PDF copy 1A survey letter for the tower center is uploaded at this time, as well as the selection of Avian compliant lighting must be indicated at this time. Since the specific transmit and receive frequencies for each microwave path on the tower have not been determined yet, we enter the frequency band limits (such 5925 – 6425 MHz) and the known/calculated EIRP in dBm to the form.

FCC Form 620 (new towers) and Form 621 (collocations) (Cultural Resources and Tribal Review), NEPA Studies/Environmental Assessment: Forms 620 and 621 addresses the Cultural Resources (State Historic Preservation Office (SHPO)) and the Tribal Review (Tribal Historic Preservation Office (THPO)) as required by the FCC.

Prior to construction, surveys must be completed for both environmental and cultural review. The environmental review must be performed by a qualified environmental agency or firm. The team sent to survey the site must have appropriate credentials and those must be submitted to the FCC with the environmental assessment.

Provided the EA (Environmental Assessment) has been approved, then the TCNS (Tower Construction Notification System) should be filed. This is technically FCC Form 620. The TCNS form notifies all the tribes who have expressed interest in the area. Once the TCNS process has been started, the tribes will either notify you of interest in consulting, or you will need to follow up and see if they are interested. Each tribe has different requirements for cultural review. Some only want the basic requirements, while others want archeologists at the site performing a shovel dig every five feet. Others require ethno-graphic reports. It's imperative prior to any survey being done that the team performing the survey has every tribe's unique requirements in hand prior to visiting the site. If the archeologist doesn't have this for the first trip, then there is a very good possibility that a second trip to the site will be required to obtain additional information prior to obtaining consent from all tribes. Approval from the tribes can take as little as 90 days to literally years. It is dependent on getting them the information they require. There are time frames, but often the clock doesn't start until you have provided them all the information they request. They determine if you have provided sufficient information. That having been said, the TCNS process can be quick or drag on for many, many months. Once approval from all the tribes has been obtained then the formal packet e-106 contain-



ing all the information from environmental and cultural review can be submitted to the SHPO (all consent from the tribes must be included). Once submitted, the SHPO has 30 days to sign off or reply with reason why they are unable to and what you can do to rectify the situation.

Steps in the review process include background research, site survey, photographs of historic structures within a designated study area and submission of a survey report to State Historic Preservation Office (SHPO). An internet database is provided by the FCC to record the data gathered during the study. Tribes have their own methodology for consultation and may require information beyond that provided to the SHPO.

The National Environmental Policy Act (NEPA) requires federal agencies to integrate environmental values into their decision making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions. To meet NEPA requirements, federal agencies prepare a detailed statement known as an Environmental Impact Statement (EIS).

These processes could easily take up to a year to complete because several studies need to be performed, reports need to be written, and approvals need to be received before you can proceed.

FCC Antenna Structure Registration (ASR) (FCC Form 854): This is the FCC's equivalent of the FAA Determination but with additional requirements. They require the FAA's Aeronautical Study Number (ASN), the grant

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date for the Determination, and approval of all the environmental and cultural studies. These are: Cultural Resources Study (research and report 90 days); Tribal Review (research, report and approval 90 days); Environmental Assessment (research and report 90 days).

These must be produced in sequence.

Next, the Local and National Notices must be posted for 45 days and run concurrently. (Local Notice must be submitted in a newspaper and run for at least one day. Local Notice must run at least one day before the National Notice can start. The National Notice runs for a period of 30 days. After the 30 day period, if there are no objections from either the Local or National Notice, then the application “disappears” for 10 days within the commission’s system. During this time, the FCC makes a final determination on the ASR. At the end of the 10-day determination period the applicant can log in and certify the application and obtain the ASR. The FCC’s database is linked to the FAA’s, so there is no getting around the proper sequence. There is no fee for the ASR. The same ASR Number will be required for each radio service on the tower. The site construction normally starts after the ASR has been granted.

When applying for the ASR, the EA should be available to be attached at this time, if requested by the FCC or required due to the tower’s height. Please note that there are severe penalties if you check the box stating that environmental and cultural due diligence has been performed but is not available. This is a certification statement entered into federal records, so checking the box when you haven’t performed the due diligence could be considered fraud.

Frequency Coordination: Frequency coordination takes place after the ASR application has been approved. A Microwave Path Datasheet, which shows the user data, the ASR number, the requested frequency sub-bands, and the polarity for each path, is submitted to a Frequency Coordinator. The coordinator provides a proposed set of frequencies and polarities to the owner, and then performs a Prior Coordination Notice to microwave operators in the area. After the 30-day Prior Coordination Notice is complete, the coordinator submits a “supplemental showing” to the owner (this document is a letter that states the aforementioned microwave operators have no objections to the proposed microwave paths). Since the coordinator is an agent for the FCC, there are associated fees for this service (the fee amount will depend on the number of sites and paths). The process of coordination, proofing, correcting and prior coordination normally takes about 45 days. For microwave, the standard is 30 days, but can be expedited to 15 days for an additional fee.

The Microwave Path Datasheet and the Prior Coordination Notice are uploaded with the FCC Microwave License Application (Form 601) in PDF format as attachments.

FCC License Application (Form 601): Form 601 is submitted after the frequency coordination is complete. The licenses are normally granted 30 to 90 days after applications are received with proper form of payment. FCC fees and coordination fees are determined based on what radio service is being applied for or if it is a modification to an existing call sign.

Additional processing time to grant determinations, ASRs and licenses may be required if there are events such as a government shut-down, a major weather disruption (e.g. a major hurricane), or if the departments are backlogged.

Typically, the tower has reached its maximum height during this stage.

FCC (ASR - NT) Notice of Reaching Maximum Height (FCC Form 854): This notice is required within 24 hours after reaching maximum height. To be conservative, the safe maximum height will be defined as top of structural steel (TOS).

FAA Notice of Reaching Maximum Height (FAA Form 7460-2 Part 2): This form is required within five days of reaching maximum height, if the tower is above 199 feet.

If the top-of-concrete of the tower foundation (post construction) is more than one foot different from 1A survey (preconstruction), the FAA will require a new study, which will generate a new ASN, and then the ASR will need to be modified. Modification of the ASR would not change the ASR number.

FCC License Constructed Notice (Form 601): The owner has 12 months from when the license is granted for the Constructed Notice to be submitted. The owner can apply for time extensions by asking the coordinator to hold the coordinated frequencies, but each time extension will require additional fees.

As you can see, designing and building a critical proposed communications utility network is much more involved than one might initially guess. Therefore, it is wise to plan ahead and establish enough budget and time in the project to properly plan, design and acquire sites for the proposed communications network. ■