FASTLINKS

POINT TO POINT WIRELESS PRIMER

INTRODUCTION

With wireless communications becoming more prevalent worldwide, people are now looking more seriously at establishing their own wireless LANs. A few of the reasons why one would choose to implement a wireless LAN (WLAN) are as follows:

1. They want a high bandwidth fiber optic connection but can't get it because it is either cost prohibitive and/or because there are right of way issues.

2. They can easily cost justify the purchase of a wireless link because it typically shows a rapid pay back vs. lower bandwidth leased lines.

3. They want independence from the utilities (Telco, CATV, etc.).

4. They rather make a capital purchase vs. paying recurring charges for something can't own.

5. They want to establish an alternative medium backup to their ground based cable connection(s).

6. They need to make a connection to a site not currently connected by cable "last mile connectivity".

7. Can't afford to wait on their local cable provide to establish a connection.

8. Like the idea of a recoverable asset, such as a wireless system.

9. Want a transportable system that be relocated as needed.

Designing a PTP Wireless System

In order to design any single or multi-link wireless PTP LAN, a number of factors must be considered. The purpose of this section is to outline and discuss most of the factors that will impact the design and implementation of a wireless link.

- # of Sites: self-explanatory

- Path Distance (as measured on a map): The path distance will have an impact on the type and reliability of the wireless communications that can be used to provide connectivity.

FASTLINKS

- Line of Sight: Can you see one site from the other? High capacity wireless transmission is dependent on a path clear of obstructions; therefore line of sight between locations must be determined in order to design an appropriate wireless communications system.

  Line of sight for any proposed wireless path is best evaluated during an on-site survey. If line of sight cannot be confirmed between any two sites, then we will need to evaluate options for establishing line of sight via either the construction of a tower(s) or the establishment of a repeater site(s). Repeater sites must be used when line of sight is obstructed between any sites one wishes to establish connectivity between and where the installation of towers is not feasible. One can also choose to use a repeater sight even when line of sight can be confirmed, if the path availability calculations indicate an unacceptable amount of link outage due to weather.

  Low capacity wireless systems are available when there's no line of sight, but they require added engineering and testing before deployment.

- Types of Communications & Bandwidth Required: With so many types of wireless systems available, most customers' needs can be met. That said, one needs to answer the following questions. What are the requirements for LAN, voice and/or video communications? What types of channels are needed? How much bandwidth is needed for each channel? What communication formats need to be supported?

- Path Reliability: Path reliability is a calculation (in percent) of annual weather related outage for a particular wireless link. The variables involved in calculating path reliability for a radio link are the path distance, the product specifications (i.e. transmitter power output and receiver threshold), antenna size/specifications, and geographic rain rate region. Path reliability calculations should be made during the system configuration design phase in order to configure a wireless link capable of providing maximum path reliability of up to 99.999%.

- Critical Nature of Communications: As with any type of LAN connection, redundancy for critical connections should be considered. Wireless links can be configured to provide redundancy via alternative mediums (e.g. a low speed leased line), hot-standby links, or alternate paths (for multi-site LANs).

- Potential for Interference: When it comes to RF systems, one needs to identify existing licensed and unlicensed radio communications in the area in order to evaluate the potential for interference. When designing a system that will occupy one of the licensed frequency bands, all licensed communication links in that band for that particular area will show up when one accesses the FCC's data base. This is not the case for communications in the unlicensed bands, and therefore a visual analysis will need to be conducted as well as possibly a spectrum analysis. Poor and/or reduced performance may result as a result of interference if there is a great deal of equipment already installed in a particular area, in a particular frequency band.

- Future Growth Options: Future growth of a wireless LAN, voice and/or video communications network can be facilitated at a minimal cost by implementing all or some of the following:

  Mounts/Towers: Wireless mounts/towers capable of supporting more than one device (radio and/or FSO transceiver) can be installed at each site. Once installed, a customer can mount additional devices and said devices directed to any site the Customer may wish to establish communications with.

  Cables/Conduit Routes: Since most wireless devices are mounted on rooftops and cabling is required to these devices, it may make sense to run extra cabling to support additional devices. In addition, in cases where new conduit needs to be run, a large diameter may be advisable vs. a conduit that can only support a single run of cabling.

  Dual Polarized Antennas: Between sites where only one type of microwave communications is installed, dual polarized antennas can be used which can accommodate a second set of microwave radios (e.g. video, LAN, T-carrier, etc.) between the same two sites. A second set of microwave radios can be installed by simply attaching said radios (via flexible waveguide) to the back of the antennas.

  Bandwidth Expandable Wireless Devices: Many wireless provide the user with the option to increase bandwidth via the purchase of a software key.

  Network Interface: At sites that serve as a HUB to the connection of remote sites, network interface hardware should be installed that can accommodate the further growth of the communications network.

  LAN Topology: Individual link configurations are determined strictly on the basis of path distance, whereas network configurations are usually determined on the basis of such factors as cost, the location and number of sites, and the critical nature of the communications. Multi-site WLAN topologies include: daisy chain, star, loop, and combination.

  Existing Network: In order to design a communications network that best complements the existing network, one needs to have a clear understanding of existing network (hardware, cable, etc.).

FASTLINKS

Design & Installation Overview

A typical complete turn-key implementation would include the below listed items and accompanying descriptions:

- Preliminary path analysis
- Path reliability calculations & equipment recommendation
- On-site survey
- System design documentation w/ detailed cost proposal & on-going support options
- Detailed installation, network integration and acceptance test procedures
- Installation, test & cutover

Path Analysis: FastLinks reviews topographic maps and aerial photography to determine the likelihood of line of sight between locations. Potential obstructions are identified and path profile plots constructed to determine the antenna centerline heights that would be needed assuming the aforementioned obstructions do not pose a problem.

Path Reliability Calculations & Equipment Recommendations: Path reliability calculations will be made to estimate the annual outage time due to rain attenuation one can expect for a particular system (radios, antennas, & transmission lines) over a specified distance. As a result, we will identify and recommend equipment that can provide optimized path reliability.

Visual/On-Site Survey: The only way to guarantee an obstruction free path is to conduct a visual survey. This is typically done by physically visiting the rooftops all of all sites in order to determine the optimal transmission routes and mediums to best meet all prospective customer's networking requirements. Personnel will visit all sites as well as any other available structures suitable of supporting wireless transmitters & antennas. A site survey will typically include, but is not limited to, the following tasks:

1. Obtain GPS coordinates, ground and building elevation, existing structure elevation for use in path profile analysis.
2. Inventory, photograph, analyze and document existing structures, antenna mounting structures or rooftops that may be utilized or areas that are available for mounting antennas and their types.
3. Photograph the sites for installation reference.
4. Photograph the paths from both direction showing the line of sight.
5. Locate, identify, photograph and document suitable grounding points for lightning protection with grounding cable length and recommended grounding method.
6. Locate, identify and photograph cable paths and entry penetration into bulkhead (e.g. outdoor shelter, indoor equipment room).
7. Determinate optimal, secure and aesthetically acceptable mounting location and mounting methods and materials.
8. Analyze and determine interface to existing networks, and, where required, additional requirements for network electronics necessary to implement the link.

9. Analyze equipment shelter or equipment room with details regarding exact location of proposed equipment, rack(s), if any, power, cable entry ports, environmental details of shelter (e.g. air condition, temperature, etc.), power, and telecom connections.
10. Observe and document path line of sight noting potential existing obstacles (e.g. buildings, hills, new constructions, vehicles, roadways, trees, etc.), earth bulge, and possible surface or rooftop reflections.
11. Obtain or estimate elevations of LOS obstacles and trees. Attention will be given to the species of trees and their predicted growth rates, vehicles that may pass the line of sight path and other potential obstacles that might affect the link performance.
12. Note any terrain points or environmental factors that should be taken into account for the path analysis.
13. Perform path analysis to determine antenna height requirements.
14. Develop material requirements to meet site-specific requirements.
15. Gather information necessary to apply for FCC licenses (if needed)

Documentation and Deliverables: Upon the conclusion of the on-site survey, the following documentation is typically provided electronically:

- Survey and Design Report: This report includes, but is not limited to, findings of feasibility, findings of path profile, obstructions, mounting requirements, options and details, building entry/egress locations, network interface, availability analysis, path analysis and additional test findings. Photographs and all other data collected during the course of the site survey will be incorporated into this report.
- Implementation Proposal: A complete proposal for the solution implementation including all materials, installation labor and ongoing support options.

Typical Method of Analysis: In trying to determine adequate line of sight between locations for wireless communications, a number of methods can be employed. Typically, prior to visiting the sites, a topographic map analysis is completed to determine the likelihood of line of sight, and where potential obstructions may be. Once this has been done, a site visit is scheduled. Initially, one canvasses the area to identify landmarks, tree heights, existing towers that could considered as a repeater site, etc, which is than compared to the topographic path profiles. Next one checks for line of sight from the roof tops of the customer's sites. Finally, if these efforts prove to be unsuccessful, one can try floating large balloons above the site(s), using a strobe light at night or lifting oneself up in a crane in high enough to clear any obstructions.

Detailed Installation & Integration Approach: Installation of a wireless link is relatively standard and generally involves only minor differences from one installation to the other. The following brief summary describes a typical wireless link installation.

1. Wireless component locations & mount design: Optimal antenna (or transmitter) location is considered and agreed upon with facilities managers at each site. Depending on facilities manager's preferences and type of building structure and/or restrictions, a mount design is determined. Once the mounts have been fabricated, they are installed on each roof or support structure in compliance with building codes and facilities manager's preferences.

2. Conduit runs between outdoor antenna site: Once the mounts are installed, a conduit route is established and the cables are run from the indoor rack mounted equipment to the outdoor wireless device. A determination is made as to what type of cable is necessary to conform to building and fire codes as well as to what type of conduit should be used (e.g., PVC plastic or metal pipe). Installed cables are then terminated and sealed.

3. System burn-in, test and integration: Prior to shipping and installing any wireless component and associated interface hardware, it should be assembled and tested as a system, burned-in for 72-hours, and tested again to confirm stability of all electronics.

4. Install Indoor Rack Mounted Radio Hardware: Once the wireless components arrive on site the indoor units are rack mounted and connected to the cabling which goes to the outdoor devices.

5. Mount the Antennas/Transceivers: The antennas/transceivers are then installed to their pipe mounts and connected to the cabling. At this stage, the wireless units at each site are simply visually aimed at each other.

6. Align the Path: Once the wireless units are mounted, plugged into the cabling and rough aligned, they are powered on and the receive signal levels are checked and compared to the target level for the specific path. The devices are then adjusted both horizontally and vertically until the maximum signal is obtained.

7. Weatherproof cables and outdoor connectors: All cable connections and/or roof top penetrations are sealed.

8. Integrate the wireless link to the customers LAN, video & voice communications hardware: Once the link has been aligned and tested end to end, the customer is informed as to any necessary configuration setting s and the link is connected to the customer's LAN equipment

9. Final Test and Acceptance: After the installation has been completed, the installers should prove functionality to the satisfaction of the customer based on agreed upon test procedures.

FASTLINKS

Ongoing Support

There are a wide range of options from which to choose regarding the ongoing support of a PTP wireless link. Here is a description of some of the most popular.

Support documentation: Following any wireless installation, the customer is provided with product manuals (on CD) and bench mark levels for the system as installed and tested.

On-site training: The customer is typically offered the option of receiving basic training on the operation, maintenance and support of the installed system. This typically takes no more than 1 hour, however varies based on the end users level of interest in becoming self sufficient.

Factory training: The customer is offered factory training/certification. This type of training must be scheduled and involves a cost.

Telephone support: Both business hour and 24x7x365 telephone support are typically available.

Extended warranties: Most manufacturers offer extended warranties on their product for periods up to 5 years. The customer is given the option of purchasing a multi-year warranty at a discount or can purchase on a year to year basis with no discount.

Next business day advance replacement: As is the case with extended warranties, most manufacturers offer next business day, advance replacement on their product for periods up to 5 years. The customer is given the option of purchasing a multi-year contract at a discount or can purchase on a year to year basis with no discount.

Spare components: Having spare components available is the only way a customer can be guaranteed same day resolution if a hardware failure occurs. These are typically offered at a discount upon request.

On-site support: The customer is given a wide range of on-site support options for servicing its wireless equipment. From comprehensive contracts that define guaranteed response times to time and material calls and everything in between are typically available to meet the end users needs.

Preventative maintenance checks: Customers are given the option of having a preventative maintenance done. This is typically done annually, during which the integrity of the installation is checked as well as new bench make levels gathered and compared to the ones taken at the time of the initial installation.