Getting Connected with Point-to-Point Microwave Links The Pros and Cons of Licensed vs. Unlicensed Radios links in the U.S.

In today's world there is a need for both licensed and unlicensed point-to-point microwave radio links for providing high-speed, high transmission capacity; for example, connecting a campus community, establishing a last mile access to a remote population, or for providing backhaul connectivity between mobile or fixed broadband wireless access network base stations. Licensed radio links are those that utilize predetermined radio frequency bands (channels) licensed by the national regulatory body, such as the Federal Communication Commission (FCC) for exclusive use by one operator for each specific radio link in a given geographic locale. Unlicensed radio links utilize spectrum, known as licensed-free frequency bands, which can be used by multiple parties within the same geographic region. These bands are unregulated and available for use by any device or wireless application, including door openers, cordless phones, and wireless LANs.
The type of radio link chosen depends on several factors, but essentially comes down to a choice between the time and convenience required to establish the link versus security and quality of the transmission. Signal interference is unquestionably the chief concern in both instances. Proper design and deployment of the link are critical to avoid potential signal interference. The difference in the deployment process between license-exempt and licensed radios establishes the relative possibility for interference upon installation and defines some of the downstream risks of degraded link performance or decreased availability over time.

Unlicensed Radio Links

Certain frequency bands are designated as ISM (Industrial Scientific & Medical), but are available for a range of consumer RF devices. In these bands the regulatory authority affords no protection, and usually defines a standard which limits the RF field strength and emission characteristics of any or all RF emissions from any device which transmits RF energy.
The most common unlicensed radio band is 2.4GHz, where most consumer wireless devices operate. This band is heavily used throughout the U.S. and is, as a result, the most congested. More recently the new 5.8GHz band is becoming available for use, as a new band is less cluttered and liable to interference. However, part of this band is allocated to UNII (Unlicensed National Information Infrastructure) applications, such as Wireless LANS, including the new IEEE 802.11a standard. Further unlicensed spectrum is also available, but relatively unused, at 24 and 60GHz ranges.
Proper deployment of unlicensed radio links depends on the detection and avoidance of existing interference sources at the site. The more crowded the location, the more difficult it is. While unlicensed radios are designed to minimize

interference, they are all ultimately susceptible to a strong interference source in the adjacent area. To avoid existing interference sources prior to installation, the installer is normally recommended to perform a radio scan around the site's potential antenna location, typically over a 24-hour period to ensure detection of any consistent or intermittent interference sources. To reduce interference, a strong Received Signal Level (RSL) needs to be achieved by minimizing antenna beam widths for maximum directivity and gain. This is crucial in metropolitan areas where frequency congestion is expected. Once completed, the data is used to finalize antenna size, antenna polarization and channel selection. The link can then be installed and go immediately on-air. Operators establishing new links do not have to notify other users on the same band.

If after a link is operational, unacceptable interference becomes a problem, the operator's options are limited. If the interference is due to spectrum overcrowding, the interference can be reduced or eliminated by changing channels and/or increasing antenna size, hence directivity and gain. Otherwise, the elimination of the interference source requires resolution of the interference between the two private parties, link operator and the interference source link operator. In some cases it may be very difficult to determine the source of interference and thus improve the quality of the link. This lack of guaranteed "carrier grade" performance is the main drawback of using unlicensed spectrum to transport information that is important in nature or where strict end-user quality of service (QoS) guarantees are in place.

Licensed Radios

For licensed radio links, several dedicated "common carrier" bands are available, where an operator can apply for a frequency channel for a specific link. Which band to use depends on the capacity and distance as well as the overall availability performance target for the link. Band choices include 6 and 11GHz for longer distance applications, while higher frequency bands of 18 and 23GHz are available for shorter path lengths. For these bands, the deployment process is more structured and regulated.

In the U.S., the operator or installer first uses the FCC database to identify available open-frequency channels for the link. Actual channel selection is made based on "worst-case interference" technical calculations. After a frequency band is selected, a Prior Coordination Notification (PCN) must be completed with the FCC. The FCC then sends this notice to all operators in the same geographical area identifying the proposed new link. This gives the operators the option to object within 15 to 30 days if they believe potential conflict exists, i.e. interference with their existing radio link. Although rare, objections are generally resolved without any need to select an alternative channel.

Once cleared, the channel is assigned for the exclusive use of the operator for that specific link, eliminating the possibility of interference on that link from other operators. The operator is then able to design the link to meet specific availability targets, with the confidence that the coordination guaranteed by the FCC licensing process will ensure that the link will remain interference-free for the period for which the License is in force. In the unlikely event interference does occur, the FCC will assist in the immediate resolution.

The costs for the FCC license is $320 for a 10-year license, regardless of radio capacity. Automatic 10-year renewal is also $320. In many cases, the supplier of the licensed radio system can provide a complete service, including the planning and license application process.

Distance and Capacity Considerations

Path length, capacity (data rate) and frequency also influence the type of radio utilized, licensed vs. unlicensed. Both types require a direct radio line-of-site (LOS) between the end points of the link. For short paths, a visible check will do. For long paths, checks using a suitable path calculation program is recommended prior to the actual path survey. The achievable distance between radio sites is capacity and frequency sensitive.
While radio data rate or capacity involves complicated bandwidth and modulation considerations, essentially the higher the capacity, the lower the gain of a radio link. In turn, lower gain requires links with shorter path distances.
License-exempt radios can be used for short or long paths. Under ideal conditions, links up to 45 miles can be achieved, decreasing as the higher the capacity and frequency band deployed. In metropolitan areas, these distances can be considerably shortened to reduce the possibility of interference.
Licensed radio links utilize the 6, 10 and 11GHz bands for medium to long paths. These are minimally affected by rain. Using radio diversity receive systems, where information is selected from signals received from two spatially-separated antennas, path distances of 60 miles and more can be possible. Location is usually not an issue, except to confirm availability of a dedicated frequency channel.
Shorter to medium paths are assigned to 18 or 23GHz Common Carrier Bands. Securing interference-free link operation within a metropolitan area is straightforward, as path distances tend to be short with wider frequency availability at 18 and 23 GHz.

Equipment Availability Considerations

Capacity requirements will also drive the choice between licensed and unlicensed radio solutions. While there are many unlicensed solutions up to and including 4xDS1 (mostly in the 2.4GHz band), there are few choices available for higher capacities up to DS3 and OC-3.
For this amount of data it is more likely that an operator will want the security and high-grade availability that a licensed solution provides. In addition, licensed systems provide the option of hot standby equipment redundancy, a feature that is not universally supported for unlicensed radio solutions. Operators will also have a greater choice of solutions available in the market for high capacity (DS3 and above), enabling greater competition and leveraging of market forces.

The Choice

An operator considering deployment of a point-to-point wireless link must take into consideration a number of factors in choosing between an unlicensed and a licensed solution. The final choice will have strong implications for the downstream risks, and are essentially a balance between convenience and piece of mind.
Unlicensed radios offer an extremely convenient solution, enabling off-the-shelf equipment to be used with the ability to immediately turn up a link. However, there is a trade-off in link availability and transmission reliability, which may be acceptable if the application is not mission critical and data loss for short periods is tolerable during interference. If the data to be carried is mission critical to the operator and isolation from interference is not possible, then licensed radios should be used. In many cases operators choose to take advantage of the speed of deployment provided by unlicensed radios, but then to migrate the link over to a licensed system at a later date, providing a long-term high-quality link, thereby leveraging the benefits of both solutions. Ideally, an operator would want to find such a solution from a single source. Stratex Networks, a supplier of licensed and unlicensed radio solutions from a single T1 up to 2xOC-3, has a complete portfolio of solutions to provide unlicensed starter links with upgrade to licensed in a complete package with all required planning, deployment and licensing services.

Source URL (retrieved on *12/19/2013 - 1:05am*):
http://www.wirelessdesignmag.com/product-releases/2003/12/getting-connected-point-point-microwave-links-pros-and-cons-licensed-vs-unlicensed-radios-links-us