Collocation RF interference analysis and Mitigation

A typical collocation site such as a cell tower can host various cellular, WiMax, Microwave and Public Safety radios with antennas which results in a lot of different transmit and receive frequencies in a close proximity. These large number of frequencies if not coordinated together will create undesired interference in transmit and receive radios.

RF interference can be categorized into in-band interference and out-of-band interference. In-band interference occurs when spurious signals originated within the receiver or transmitter bandwidth and cause signal distortion and bit errors. Co-channel interference (a form of in-band interference) is the crosstalk from two different transmitters using the same frequency in an area with over crowded radio spectrum. Out-of-band interference occurs when spurious signals originated from another transmitter enter the bandwidth of a transmitter or receiver and cause signal distortion and bit errors. Transmitter harmonics, ACI (adjacent channel interference) and intermodulation interferences are all examples of out-of-band interferences. Intermodulation, transmitter harmonics are integer multiples of the transmitter frequency and spurious emissions, both produced by non-linearity of the transmitting system. ACI is interference caused by extraneous power from a signal in an adjacent channel. ACI may be caused by inadequate filtering or improper tuning of the reference channel or interfering channel.

Receiver desense is caused by a strong off-frequency signal that pass through a receiver filter and overloading the receiver - usually in the front end. Such a strong signal will increase the noise floor of the receiver. In such a condition the receiver can hardly respond to any weak signals – i.e. desensitized.

The mixing of transmitter frequencies at a cellular or other wireless site produces intermodulation interference. System non-linearities in amplifiers, antennas, and structural components cause transmitter frequencies to interfere with receivers at the co-location site. Of these mechanisms, there are two that are most significant. Transmitter intermodulation results when signals enter a transmitter final amplifier and mix. The resulting intermod frequencies are then reradiated by the transmitter antenna. Receiver intermodulation results when signals enter and mix in a receiver front end, and the resulting intermod products are detected at the receiver's demodulator.

To mitigate RF intermodulation (IM) interference, intermodulation studies are performed to calculate potential IM products and analysis of intermod calculations and the diagnosis of site and equipment conditions that could lead to the generation of intermodulation interference. Intermod studies increase the potential of wireless sites being able to support additional tenants without interference, thereby improving a site's marketability and value.