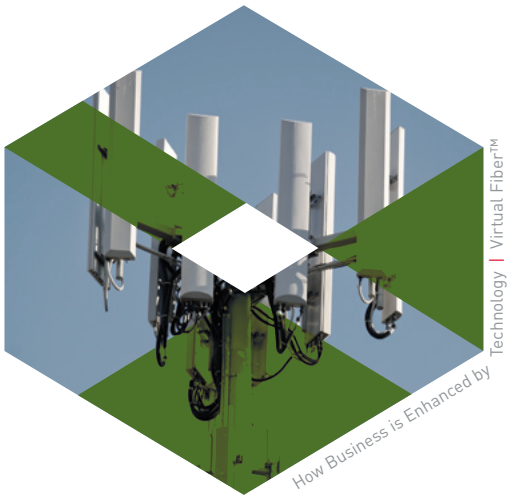
RADIO SIGNAL INTERFERENCE MITIGATION

RELIABLE WIRELESS COMMUNICATIONS ANYWHERE



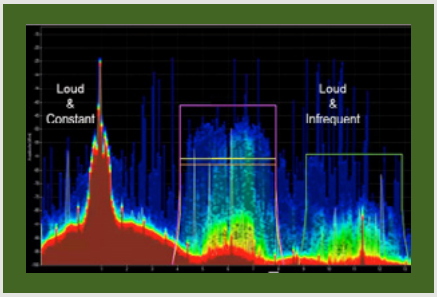
Interference is everywhere. The use of wireless communications has grown 100 fold in the past 10 years, but the number of available unlicensed frequencies has not matched that growth. This means that anyone using unlicensed spectrum will need to share the spectrum with others in their area. Redline's Virtual Fiber™ wireless system was designed to function reliably despite high levels of interference, giving you stable performance and absolute reliability.

Indoor vs. outdoor. Most unlicensed wireless networks are deployed indoors and at short range. As a result, most wireless technologies (Wi-Fi, Bluetooth, etc.) are designed and optimized to work in indoor conditions. When wireless is used indoors, the surrounding walls filter out much of the radio signal from outside, minimizing the effect of interference. For this reason, the chipsets, upon which these systems are based, are not designed to operate around high levels of interference. To communicate they listen for silence on the wireless medium and then transmit in short bursts. The protocol used to achieve this is called carrier sense multiple access (CSMA).

Indoors this system usually works quite well. However, an outdoor wireless network is very different. Each remote radio is located very far from the others, so the amount of interference at one end of the wireless network may be very different from that at the opposite end. After waiting for radio silence at one end, a remote can transmit into an area that may be filled with interference. What's worse, the levels of interference outdoor are much higher since there are no walls to filter the signal from other networks. Designing a wireless protocol for outdoor use requires development of completely different techniques from that used in CSMA. Redline's Virtual Fiber™ wireless system was designed with a number of unique, and patented, protocols which enable it to operate reliably outdoors in the presence of interference.

VIRTUAL FIBER™ INTERFERENCE MITIGATION: COMMUNICATING IN THE PRESENCE OF INTERFERENCE

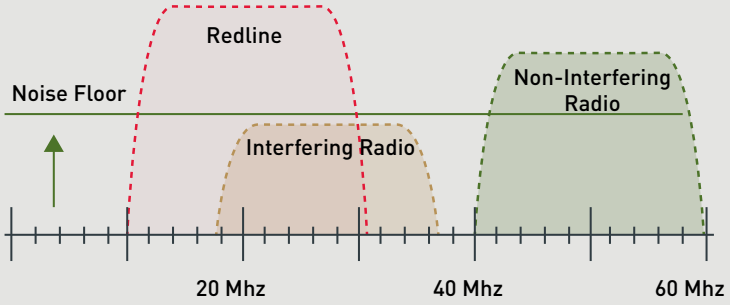
Interference Avoidance



- **Synchronized map for transmission:** Redline's Virtual Fiber™ does not use CSMA and never waits for a silent radio channel. Radios transmit based on a synchronized map created by the base station.
- **Tight channel band filters:** Our linear high power transmitters keep the power high at all radio speeds. The result is a loud and constant radio signal which takes priority over other systems using CSMA.
- **High power transmitters at all modulations:** On the receiver side, quality radio filters limit received signal to the specific channel of operation.
- **Narrow-beam and switched antennas:** Our selection of narrow-beam antennas and our patented switched antenna array are so effective at isolating interference, that they have created a trend that others are attempting to follow.

Interference Correction

When radios do interfere in our specific channel of communication, Virtual Fiber™ has a number of techniques that can correct for this interference.



- **Automatic noise floor adjustment:** Each radio automatically increases its noise floor, to ignore received signals below a certain power level. This means that any radio noise outside of the exact band of communication will cause no interference whatsoever.
- **Space-time block coding (STBC):** STBC is used to transmit dual redundant blocks of each packet in different space and time, so that damaged packets can be reconstructed from the redundant blocks.
- **Hybrid ARQ:** In the case of a complete loss of a packet, Redline's hybrid ARQ (HARQ) protocol retransmits the packet in an extremely robust method which can momentarily quadruple the receive sensitivity.
- **Large packet data caching:** Since retransmission of large packets (i.e. video I-Frames) is time consuming, our radios temporarily store (cache) any large packets within internal radio memory so that retransmissions are quick.

THE REDLINE DIFFERENCE

No other wireless system has as many protocols in order to mitigate interference – because no other system was designed to operate in these conditions and specifically for mission critical outdoor wireless. While other wireless systems offer limited solutions based on avoiding interference, Virtual Fiber™ is the only system that can avoid and correct for interference. Redline's investment in interference mitigation technologies provides your organization with stable, reliable communications to keep your business connected.

Redline Virtual Fiber™

- Software-defined radio – purpose built for outdoor wireless communication.
- Only wireless system specifically designed to avoid and correct for interference.
- The world's most deployed wireless system in difficult metropolitan areas.

Other outdoor wireless systems

- Built around a Wi-Fi chipset which was designed for indoor use at short range.
- Outdoor focus is for short-range campus networks.
- Not designed to operate in areas with high levels of interference.

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