VIDEO TRANSMISSION IN AN URBAN ENVIRONMENT

MAXIMAL RATIO COMBINING AND OTHER TECHNIQUES

Human living is increasingly moving to an urban-centric society with nearly 50 Mega-Cities spread across the globe. In these fast-moving, information-driven societies we place a high value on communicating in vision – whether that be a demand to see every possible angle at a premium sporting event or communicating on-the-ground situations in disaster scenarios. The question arises – How to get good, reliable video communication within these busy urban environments?

THE NEED FOR A PRIVATE, HIGH BANDWIDTH NETWORK

We are surrounded by wireless data networks – WiFi, 4G, 5G cellular but in highly populated environments, when the video network needs to have guaranteed quality of service a private data network is often the answer. Whether the need is for a temporary or permanent network, time and money limitations will dictate that the infrastructure delivers maximum performance with minimum deployment costs.

THE CHALLENGE OF URBAN NETWORKS

Urban environments are a challenge for RF transmissions. Radio signals reflect off the built-up infrastructure combining to give constantly varying areas of strong and weak signal quality. Multi-path reflections and the signal fading that they create introduces quality of service uncertainty and reduces the useable system range.

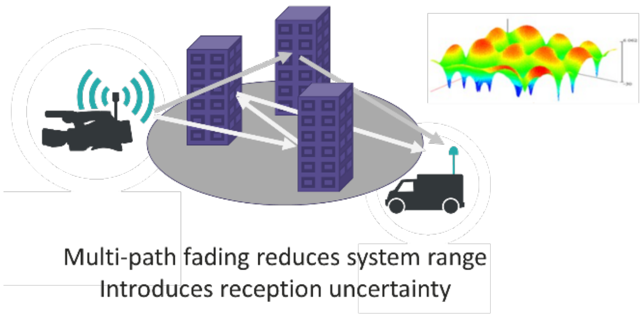

Figure 1 Multi-path reflections create signal fading effects

The very nature of multi-path fading is that moving the antenna position just a small amount will affect the received signal quality.

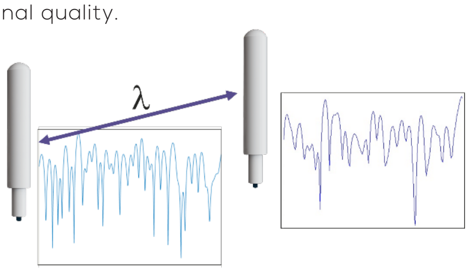

Figure 2 Antenna positioning effects fading

DIVERSITY RECEPTION: TWO BAD SIGNALS = ONE GOOD SIGNAL

Knowing that repositioning the receive antenna can lead to a different signal quality it is possible to combine the feeds from multiple antennas to create one good signal. But how best to achieve this?

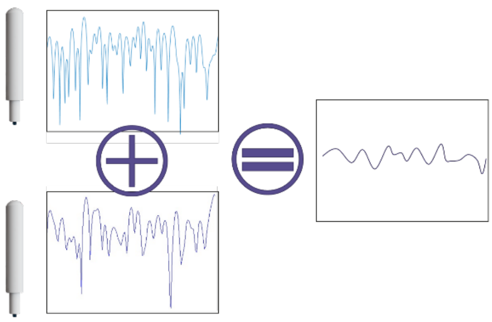

Figure 3 How best to combine antenna feeds?

SELECTING THE BEST DIVERSITY SOLUTION

Many antenna diversity reception techniques exist - delivering differing performance levels and requiring differing levels of computational complexity.

EQUAL GAIN COMBINING

This technique sums the signals from multiple antennas. Because this diversity technique is simply a sum of the antenna feeds, the resulting signal will always be heavily dominated by the worst quality path.

SWITCHED COMBINING

By dynamically switching the best quality antenna feed through to the demodulator, the degrading effect of antennas in a reception null can be removed by the signal recovery algorithms. However, there is no signal re-enforcement benefit from multiple high performing antenna locations.

MAXIMAL-RATIO COMBINING (MRC)

By weighting and then combining multiple antenna feeds according to their respective SNRs, the very best performing signal quality can be created. The best feeds re-enforce each other and the influence of the worst feeds minimized.

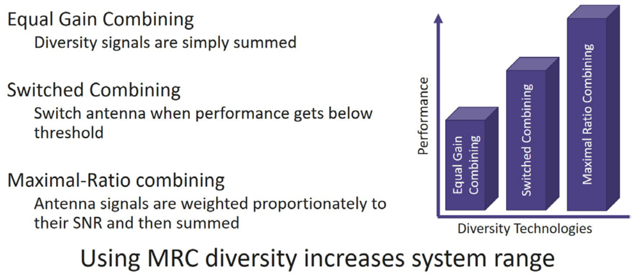

Figure 4 Different types of diversity and performance

The performance of an MRC diversity system can be enhanced by including more antennas into the diversity pool - enabling greater signal re-enforcement from antennas in good reception locations. There is however a law of diminishing returns to the number of antennas that can be added to an MRC redundancy implementation.

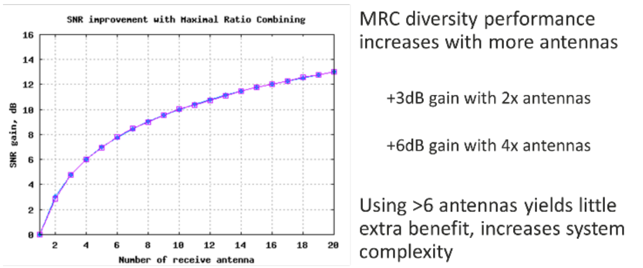

Figure 5 More antennas = better signal quality/range

MAXIMAL-RATIO COMBINING (MRC)

The RF and diversity performance of a video transmission is not solely dependent upon the DSP processing of the RF signal. Care must be taken on selecting the right choice of antennas and sighting of those antennas.

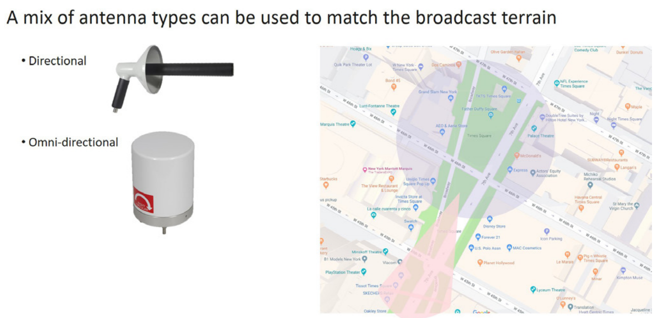

Figure 6 Selecting the correct antenna to create a robust widescale network

A mixture of omni-directional, directional and highly directional antennas may be needed to get best coverage.

CREATING WIDE-SCALE NETWORKS

The reality in implementing any form of RF communication is that network range will always be limited by the transmitter power and distance from the receive location. However, simple antenna diversity can be enhanced to create wide scale networks.

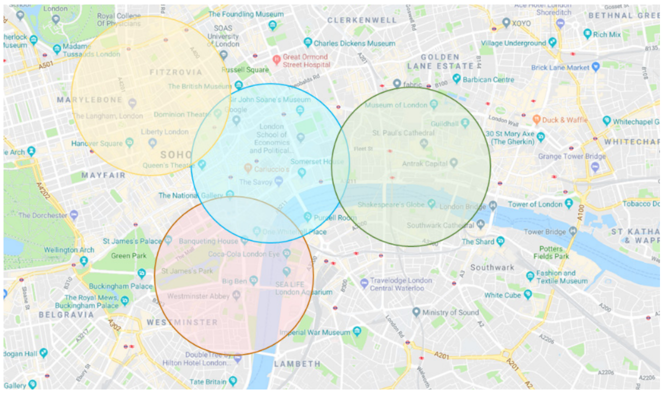

Figure 7 Implementing a wide-scale network with multiple receive locations

Multiple antenna locations – each employing their own MRC diversity can be constructed. The local signal at each receive node is demodulated and then combined with the digital data streams from other geographically distributed receive locations using packet switching techniques. This technology allows a video transmission device to roam anywhere within range of any of the reception nodes.

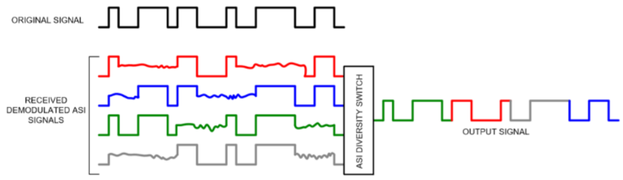

Figure 8 Packet switching diversity to create wide area networks

4 and 6-channel MRC diversity and packet switching is available across the Vislink and IMT range.

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