ACHIEVING LOW LATENCY

November, 2003

LAT-WP-110703

Introduction

Latency is one of the most important factors affecting performance of a fixed wireless access or backhaul product. A high data rate is by itself not adequate when determining performance of devices. For example, some satellite data services offer high data rates, but are negatively affected by very poor latency. Similarly, many terrestrial wireless products suffer from latencies exceeding 20 msec. This can result in poor voice quality, and poor quality for video transmissions.

Redline AN-50 Latency

Redline's AN-50 product is designed to operate with very low latency, typically lower than 3 msec for a round-trip. Round-trip latency describes the time delay for a packet of information to travel one direction across a link, plus the receipt of the acknowledgement traveling in the opposite direction.

Time-dependent applications such as voice and video, and carrying T1/E1 circuits are extremely sensitive to latency. When a system is capable of offering very low latency, it is possible to create multi-hop backhaul links, that is, to put several radio links back-to-back acting as repeaters. In real life deployments we have seen up to 7 back-to-back pairs operating with total latency of approximately 13 msec.

Achieving Low Latency

Redline's product, and many other wireless product use a technique known as Time Division Duplex (TDD) in which transmitting and receiving are both accomplished over the same frequency. TDD has become popular because of its high spectral efficiency and excellent performance especially when used with asymmetrical real-life traffic demands. The only alternative technique (Frequency Division Duplexing - FDD) uses separate frequency bands for transmitting and receiving. Typically, TDD systems have higher latency than FDD systems. A TDD system has higher latency because a station has always to wait for a transmit opportunity (i.e. for its turn); with FDD, both sides can theoretically transmit data immediately.

An ideal product would be able to take advantage of the benefits of the TDD technique AND also achieve low latency. Redline achieves this through several innovations:

1. The time it takes to get a transmit opportunity in TDD depends on the burst size. In the AN-50 the burst size is dynamically adjusted so that it is optimized for the actual network loading (burst size is increased only if higher throughput is needed, otherwise it is kept to a minimum).

2. Another factor in latency is the time needed to acquire synchronization and channel equalization (called also preamble time) at the beginning of each RF burst. This is needed because the RF transmission is fragmented in bursts. The OFDM modulation used in the

AN-50 requires only 4 symbols to reach excellent synchronization and equalization, while at the same time using only very short OFDM symbols (4μs each).

3. An important factor affecting system latency is the ARQ (Automatic Repeat Request) technique. This is a technique in which missed packet transmissions are handled at the link between two radios, without resorting to the much less efficient TCP/IP protocol to recover from lost packets. Even after resending the data, most systems must wait again for the peer to send acknowledgements (ACK/NACK) and this could repeat several times until the packet is successfully passed. The AN-50 uses a patented ARQ scheme in which the first retransmission has a very high probability of passing, and therefore the sender does not need to wait for ACK/NACK acknowledgement. Furthermore, unlike most other systems, AN-50 gives higher priority to ARQ information and retransmissions in order to minimize the delay.

4. Probably the most important factor determining system latency is the system implementation. Most devices use software wireless MACs (Media Access Controllers) which introduce severe latency, or at the very least unpredictable peaks in the latency. The AN-50 uses a hardware wireless MAC assisted by a host processor. In the AN-50, once the packet is received on the Ethernet port it is immediately scheduled for transmission over wireless, regardless on how busy the host processor is. The difference is similar to the performance difference of a PC working as a router and a modern layer 3 switch.

Conclusion

Consistent low latency enables high performance applications such as:

- High performance backhaul
- Multi-hop backhauls
- Carrying T1 and E1 traffic over IP links
- Support for voice/video /data across the wireless link

The AN-50 and the AN-30 from Redline both provide the benefits of low latency and TDD in a single product.

About Redline Communications Inc.

Founded in 1999, Redline Communications, a privately held Canadian company, is an innovative provider of second-generation broadband fixed wireless systems for service providers and enterprise markets. Redline has introduced an unprecedented product portfolio incorporating several novel technologies to deliver exceptionally high-speed data rates, under complete Non Line Of Sight (NLOS) and challenging multipath deployment conditions, and at significant ranges – all at competitive prices to quickly maximize operator return on investment. Redline's inaugural product, the AN-50, has already received a number of Industry accolades, including the prestigious SuperQuest award honored at Supercomm in Atlanta for 'Most Promising Transport Technology'.

Redline Communications Inc.
302 Town Centre Blvd.,
Markham ON Canada. L3R 0E8
905.479.8344