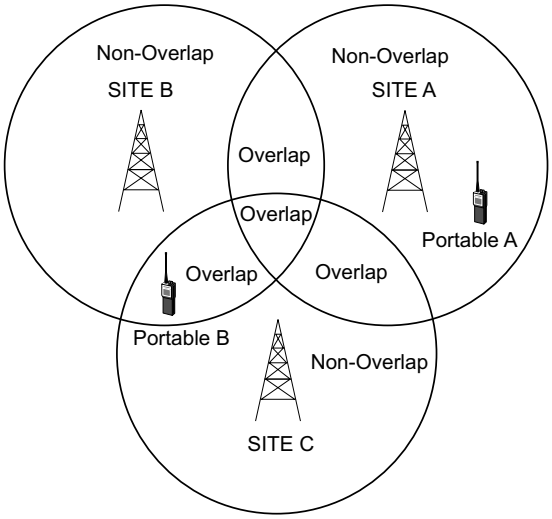
What is Simulcast?

This information is given to provide you with a basic understanding of simulcast, how it operates, and how Daniels Electronics equipment can be used in a simulcast radio or paging system.

Simulcast is a simultaneous broadcast of audio (analog audio, digital audio or data) by a number of transmitters on a single radio frequency. These simultaneous broadcasts from multiple transmitters can have overlapping areas. Simulcast can be used for both voice radio systems and paging systems. The figure below shows a voice simulcast system with three transmitters (Site A, B and C) on the same RF frequency.



In Non-Overlap areas, Portable A receives the signal from only one transmitter, which is the preferable condition. Portable B receives a signal from both Site B and Site C. This area is known as an Overlap (or non-capture) area and is the critical area in a simulcast system.

Why use Simulcast?

The primary reason for implementing a voice or paging simulcast system is for wide area coverage with minimal frequencies. Another advantage for a voice simulcast system is its operational simplicity for all radio system users (dispatchers and field personnel) since all radio traffic is on a single RF frequency. Simulcast can also be used to multiply the amount of available channels since different frequency pairs do not have to be used at each repeater site.

Simulcast is used when all other alternative radio system designs have been determined as being ineffective to provide the appropriate communications system solution. Simulcast requires a more complex system design, additional RF engineering, increased maintenance and a slight degradation in audio quality in overlap areas. In addition, simulcast requires more costly hardware than a conventional radio or paging system and some systems also run the risk of having the audio blanked out in small areas by destructive interference such as multipath (a typical RF problem).

Minimizing Distortion in Overlap areas

Overlap areas are areas in which two or more RF levels are within 10 to 15 dB of each other. Portable / mobile receivers cannot lock onto the strongest signal when RF levels are this close together and all RF signals will be received.

The Overlap areas are the critical areas where the interference between the RF signals needs to be controlled. When uncontrolled, the overlapping RF signals combine to produce an audible beat frequency in the receiver or even unintelligible audio. Differences in the audio phase and amplitude from the RF signals cause distortion in the received signal. A high degree of RF frequency stability, audio amplitude equalization and audio phase delay will minimize the distortion in these overlap areas.

RF Frequency Stability

Synchronizing the frequencies to ensure that the frequency at all sites is extremely close together can reduce the beat note in the received signal below the audible level. Daniels Electronics transmitter modules can be connected to an external high stability reference using the Daniels Paging Modulator card. The Paging Modulator uses an on-board 10 MHz OCXO frequency reference source with a standard stability of 0.03 ppm. For simulcast applications requiring a higher stability, the Paging Modulator may be configured to use an external high stability reference source (typically a GPS receiver or rubidium oscillator) with a standard stability greater than or equal to 0.002 ppm. This external reference disciplines the on-board phase-locked loop OCXO oscillator.

Audio Phase Delay and Amplitude Equalizing

Equalizing the audio phase delay so that audio from all sources arrives at the center of the overlap area at the same time, and equalizing the audio amplitude for variations between different transmission paths will reduce the distortion of these signals received in the overlap area. Daniels Electronics is designed for interfacing to 3rd party simulcast delay and equalization equipment. Connection to the Daniels transmitter module is achieved via an external audio connection.

CTCSS in simulcast systems

For voice simulcast systems, CTCSS tones (although below 300 Hz) must still meet the amplitude and phase requirements of regular audio. A synchronized CTCSS tone locked to GPS is typically generated at each site. Alternatively, a master CTCSS oscillator and distribution system must be used for supplying all subtones to the transmitters and equalizing all amplitudes and phases of the subtones.