

largely disappears and permits signals to travel to much more distant locations via ionospheric reflections. However, fading of the signal can be severe at night.

As well as on the medium wave bands, amplitude modulation (AM) is also used on the shortwave and long wave bands. Shortwave is used largely for national broadcasters, international propaganda, or religious broadcasting organizations. Shortwave transmissions can have international or inter-continental range depending on atmospheric conditions.<sup>[21]</sup> Long-wave AM broadcasting occurs in Europe, Asia, and Africa. The ground wave propagation at these frequencies is little affected by daily changes in the ionosphere, so broadcasters need not reduce power at night to avoid interference with other transmitters

### **2.1.2 FREQUENCY MODULATION**

FM refers to frequency modulation, and occurs on VHF airwaves in the frequency range of 88 to 108 MHz almost everywhere.

Edwin Howard Armstrong invented wide-band FM radio in the early 1930s to overcome the problem of radio-frequency interference (RFI), which plagued AM radio reception. At the same time, greater fidelity was made possible by spacing stations further apart in the radio frequency spectrum. Instead of 10KHz apart, as on the AM band in the US, FM channels are 200 kHz (0.2 MHz) apart. In other countries, greater spacing is sometimes mandatory, such as in New Zealand, which uses 700 kHz spacing (previously 800 kHz). The improved fidelity made available was far in advance of the audio equipment of the 1940s, but wide interchange spacing was chosen to take advantage of the noise-suppressing feature of wideband FM.

Bandwidth of 200 kHz is not needed to accommodate an audio signal — 20 kHz to 30 kHz is all that is necessary for a narrowband FM signal. The 200 KHz bandwidth allowed room for  $\pm 75$  kHz signal deviation from the assigned frequency, plus guard bands to reduce or eliminate adjacent channel interference. The larger bandwidth allows for broadcasting a 15 KHz bandwidth audio signal plus a 38 kHz stereo "subcarrier"—a piggyback signal that rides on the main signal. Additional unused capacity is used by some broadcasters to transmit utility functions such as background music for public areas, GPS auxiliary signals, or financial market data.