Re: Docket 16-142

I am concerned that adoption of the ATSC 3.0 standard for digital TV broadcasting using COFDM not stifle more recent development in the art.

The ATSC 3.0 standard prescribes double-sideband (DSB) modulation of radio-frequency (RF) carrier by the COFDM signal. I have previously pointed out that the demodulation of a DSB-COFDM signal using conventional synchrodyning techniques provides 2.5 dB poorer signal-to-noise ratio for reception over an additive-white-Gaussian-noise (AWGN) channel than can be achieved by demodulating the two sidebands separately and combining soft bit results of independent de-mapping procedures. In fairness, receiver designs are somewhat simpler in their construction.

Using independent-sideband (ISB) modulation of RF carrier by the COFDM signal, rather than DSB modulation, can support further improvements in reception.

In an ISB-COFDM signal similar coded-data is transmitted twice in each COFDM symbol interval. The coded-data is mapped both to OFDM subcarriers located in the lower sideband of the ISB-COFDM modulation signal and to OFDM subcarriers located in its upper sideband. Preferably, the ordering of OFDM subcarriers modulated by given coded-data is the same in both the lower and upper sidebands of the COFDM modulation signal. This separates the subcarrier frequencies of each pair of OFDM subcarriers conveying the same-coded data by half the channel bandwidth. This helps overcome reception difficulties posed by narrow-band interfering signals and/or drop-outs in energy.

This arrangement also allows the use of symmetric cancellation coding (SCC) in which OFDM subcarriers conveying the same-coded data are antipodally modulated. SCC is primarily used for implementing intercarrier interference (ICI) cancellation, to obviate the need for guard intervals and cyclic prefixes which reduce useful data throughput.

However, rather SCC incidentally affords PAPR reduction. Owing to the use of Doherty type power amplification, PAPR reduction has become of less concern to broadcasters with regard to wastage of power in RF amplification because of need to back-off average power to avoid excessive clipping of

peak power. Reduction of PAPR remains a benefit to COFDM receivers, however. Clipping of peaks in RF amplifiers is less problematic. It is easier to maintain linearity in analog-to-digital conversion and demapping procedures.

ISB-COFDM permits an alternative dual-mapping procedure that provides shaping gain that further improves signal-to-noise ratio for reception over an additive-white-Gaussian-noise (AWGN) channel. Bits of the labels in the map of QAM symbol constellations in each sideband that are more likely to experience error correspond to bits of the labels in the map of QAM symbol constellations in the other sideband less likely to experience error.

The better signal-to-noise ratio for reception over an AWGN channel better accommodates QAM symbols each having more lattice points, thus to increase digital-data throughput for prescribed channel bandwidth. On the other hand, if the number of lattice points in QAM symbols are kept the same, larger coverage area can be expected for given transmitter power.

PAPR of this procedure to secure shaping gain can be reduced if the dual-mapping employs superposition coded modulation (SCM) mapping, rather than standard Gray mapping. In SCM the four quadrants of square QAM symbol constellations are each Gray mapped independently from the others and from the pair of bits in the map label specifying that quadrant. SCM has been found to facilitate iterative linear minimum-mean-square-error (LMMSE) detection particularly well.

A fundamental consideration is what standards are DTV receivers to be held to in the USA, so that consumers can purchase receivers that they can reasonably expect not to have to replace in only a few years. ATSC has concerned itself with introducing DSB-COFDM more along the lines of established European practice than with seeking to improve DTV system performance further.

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