

Aspects of VSB Extension/Enhancement Bits

In developing the enhancement to the 8-VSB modulation system currently in progress within ATSC, it has been recognized that other enhancements and extensions of 8-VSB may be desirable in the future. Since receivers may not be able to determine which enhancements or extensions are in use at a particular time just through interpretation of the received stream, it is important to provide a mechanism for directly signaling their inclusion in the stream. It also is important that such a mechanism be in place before any receivers are manufactured using any enhancements or extensions so that the earliest of those receivers can appropriately recognize and perhaps ignore later extensions and enhancements for which they are not equipped. The currently proposed revision of A/53C with Amendment 1 and Corrigendum 1 serves these purposes.

A VSB Extension, as the term implies, is a method to enhance the functionalities of the ATSC 8-VSB modulation system. The E-8VSB scheme (Approved A/53C Annex D) is an example of such an extension. The VSB Extension Signaling mechanism would make E-8VSB and other future 8-VSB enhancements possible without creating backward compatibility issues.

The VSB Extension Signaling bits are conveyed as one bit per symbol in the RESERVED portion of the 2-VSB Data Field Sync (DFS), which is Data Segment #1 of a 313 Data segments field. To maintain backward compatibility with the Approved Annex D with EVSB, the VSB Extension Signaling bits would be transmitted just before the last 12-Trellis-Coding pre-code bits.

There are eight VSB Extension Signaling bits that signal which VSB Extension or Enhancement (E/E) is being transmitted. There are two additional bits for future extensions. Thus, there are a total of ten (10) VSB Extension Signaling bits. The two additional bits, in combination with the 8-bits, facilitate different usage of the remaining 82-symbol (104 -12 -10) RESERVED space.

Each enhancement is assigned one of the eight bits. It is expected that a TV station might switch to another (or no) enhancement once every few years. Thus, a particular VSB E/E for any TV station can be treated as a parameter for that TV station. A receiver can identify and store the information associated with that TV station.

A TV receiver must (robustly) know which E/E is being transmitted before it can decode the enhanced stream. There are a limited number of bits available in the DFS for the combination of Extension Signaling bits plus encoded E/E parameter bits. Since there are other means (e.g. averaging) to achieve robustness for the VSB Extension Signaling bits, these (8+2) bits signaling the type of VSB Extension need not be encoded. Since the DFS uses 2-VSB modulation, the bits it carries are already more robust than 8-VSB data. To further improve their robustness, they should be appropriately averaged over many fields. The VSB Extension Signaling bits are phase-reversed from field to field. This means of achieving robustness through averaging was chosen because A) it is not necessary to immediately know which type of enhancement is being transmitted, and B) this conserves the limited available Reserved symbols space. It is not necessary to know immediately the type of E/E because, as mentioned above, a TV station, once it selects a particular VSB E/E, is not likely to switch the selected E/E for years. So, this information – the type of VSB Extension being used can be determined in a receiver automatically as a part of set up and then stored. Averaging does not provide protection from multipaths. That shortcoming can be alleviated if the averaging of the VSB Extension Signaling bits is performed from the equalizer output because the equalizer removes multipath interference. Thus, improved SNR through averaging should provide the robustness needed for the VSB

Extension Signaling bits. The receiver design should also, as a part of set-up, make it possible for a consumer to manually enter the type of EVSB used by a DTV station.

It is possible that a future proposed VSB Extension will be compatible with an existing E/E such that both Extensions should be signaled. For this purpose, it is necessary and simpler to use one bit to indicate each Extension or Enhancement. Thus, the number of bits reserved to signal E/E is the initial number of expected E/Es. More E/Es or other functions can be formulated using the two extension bits, which are specifically reserved for such options in combination with the other eight bits.