Hierarchical Modulation Explained

DVB-T Hierarchical Modulation

DVB-T is a flexible system allowing terrestrial broadcasters to choose from a variety of options to suit their various service environments. This allows the choice between fixed roof-top antenna, portable and even mobile reception of DVB-T services. Broadly speaking the trade-off in one of service bit-rate versus signal robustness. But that is not all. The DVB-T specification and indeed all the current chipsets allow "Hierarchical Modulation".

What is Hierarchical Modulation?

In hierarchical modulation, two separate datastreams are modulated onto a single DVB-T stream. One stream, called the "High Priority" (HP) stream is embedded within a "Low Priority" (LP) stream. Receivers with "good" reception conditions can receive both streams, while those with poorer reception conditions may only receive the "High Priority" stream. Broadcasters can target two different types of DVB-T receiver with two completely different services. Typically, the LP stream is of higher bitrate, but lower robustness than the HP one. For example, a broadcaster could choose to deliver HDTV in the LP stream.

How does it work?

DVB-T is a multi-carrier system using about 2000 or about 8000 carriers, each of which carries QPSK, 16QAM or 64QAM. QAM (Quadrature Amplitude Modulation) is one of the means at our disposal to increase the amount of information per modulation symbol. Taking the example of 64QAM, the hierarchical system maps the data onto 64QAM in such a way that there is effectively a QPSK stream buried within the 64QAM stream. Further, the spacing between constellation states can be adjusted to protect the QPSK (HP) stream, at the expense of the 64QAM (LP) stream.

In layman's terms, good quality reception allows receivers to resolve the entire 64QAM constellation. In areas with poorer quality reception, or in the case of mobile or portable reception, receivers may only be able to resolve the lighter coloured portions of the constellation, which correspond to QPSK.

Considering bits and bytes, in a 64QAM constellation you can code 6 bits per 64QAM symbol. In hierarchical modulation, the 2 most significant bits (MSB) would be used for the robust mobile service, while the remaining 6 bits would contain, for example, a HDTV service. The first two MSBs corre-

DVB-T Hierarchical 64QAM constellation with an embedded QPSK stream

"High Priority" stream bits

"Low Priority" stream bits
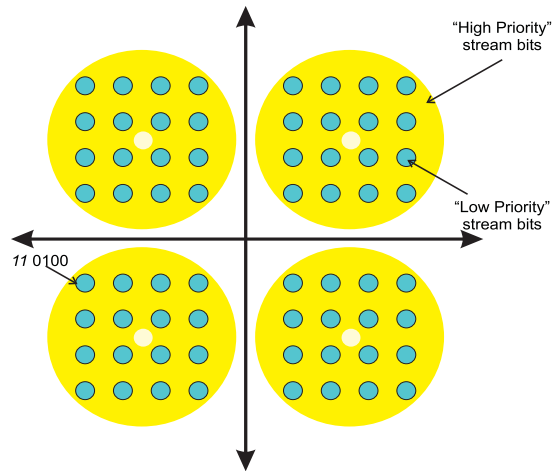
11 0100

spond to a QPSK service embedded in the 64QAM one.

11 0100 (bits "**11**" are used to code the High Priority (HP) service)

Example of system parameters

A set of parameters, which might be appropriate for use in a North American 6MHz channel for HD/SD simulcast, is as follows:

Modulation:

QPSK in regular 64QAM 6MHz DVB-T

Guard interval:1/32

Code rates:

HD (low priority) service: ¾

SD (high priority) service: ½

Video resolution:

HD:720P

SD:480I

Bit rate:

HD layer - 13.6Mbit/s,

SD layer - 4.5Mbit/s

Gaussian noise performance:

HD layer - 19.6dB