Current transmission methods

In order to set the goals for the new modem, we first look at the common modulation types that are regularly seen in the digital band segment of QO-100:

RTTY:

RTTY is one of the oldest and best-known transmission methods for text. Instead of the usual ASCII code, a 5-bit Baudot code is transmitted by frequency shift keying. A logical “0” corresponds to the frequency 2125 Hz and a “1” to a frequency of 2295 Hz. At the usual bit rate of 45.45 bps, one bit takes 22 ms. During this time, almost 50 oscillations of the signal are transmitted, so the symbol rate is approx. 0.02 S/s. RTTY is extremely inefficient by today's standards, but easy to decode by the simplest means. PSK31 offers a significant improvement, but this shortwave mode is practically never heard on QO-100.

SSTV:

Classic SSTV is used for analogue image transmission. Brightness and colour values are assigned to different AF frequencies and transmitted together with a synchronisation signal. This method originally dates from the 1950s and is a real old-timer, but is still widely used on QO-100 and even the ISS. There are a number of similar coding schemes, on QO-100 you can usually hear “Scottie” or “Martin”. The image resolution varies, on average it is about 350 × 240 pixels. Depending on the method, the transmission time is e.g. 110 seconds. Analogue transmission is difficult to convert into digital speeds. An estimation with “Martin-1” would result in a corresponding bit rate of approx. 6800 bps. Unfortunately, analogue SSTV is very error-prone, since every slightest fluctuation in the received signal has an immediate effect on the picture content.

KGSTV:

This program, developed by JJØOBZ, is used for digital image transmission and is frequently found on QO-100. Pictures with a resolution of 320 x 240 pixels are transferred in blocks of 16 ×16 pixels. There are two methods to choose from: MSK at 1200 bps and 4FSK at 2400 bps. If the receiver was unable to decode individual blocks, it requests these again by transmitting an error list until the picture is complete. Due to the low level of interference on QO-100, however, the pictures are often complete on the first pass.

FreeDV:

The motivation for developing this mode of operation for digital voice transmission was that the digital voice systems (like D-Star and DMR) uses a proprietary codec (AMBE). This CODEC has to be bought as hardware as the software version is practically unaffordable for radio amateurs. Therefore, the free and open source Codec-2 was developed, on which FreeDV is based. On QO-100, work is

mostly done in FreeDV-2020. This system was revised for QO-100. It uses an OFDM system with a bit rate of max. 2400 bps (2400A mode) if all OFDM carriers can be used for transmission. Of course, the good signal-to-noise ratio of QO-100 must be exploited to keep the error rate low.

All these systems were primarily developed for communication on short wave, only FreeDV got some adaptations to QO-100. Accordingly, they are of course designed for the high noise level on short wave and a significant part of the valuable bandwidth has to be used for error correction.

The target of the new high-speed modem is to supplement those currently common operating modes.