according to (17) using only a single complex multiplication. As mentioned earlier, the value in \( y_k[N] \) is the desired spectral coefficient \( X[k] \).

The Goertzel algorithm can hence be considered as an IIR filtering process, while only a single output sample is of interest. The algorithm is presented step by step in Fig. 3.

2.2 Comparison of Goertzel Algorithm and FFT

2.2.1 Properties

The Goertzel algorithm in fact performs the computation of a single DFT coefficient. Compared to the DFT, it has several advantages, because of which it is used.

- First of all, the Goertzel algorithm is advantageous in situations when only values of a few spectral components are required (as in the DTMF example in Sec. 1.1), not the whole spectrum. In such a case the algorithm can be significantly faster.
- The efficiency of using the FFT algorithm for the computation of DFT components is strongly determined by the signal length \( N \). The most effective case is when \( N \) is a power of two. On the contrary, \( N \) can be arbitrary in the case of the Goertzel algorithm, and the computational complexity does not vary.
- The computation can be initiated at an arbitrary moment, even at the very time of the arrival of the very first input sample; it is not necessary to wait for the whole data block as in the case of the FFT. Thus, the Goertzel algorithm can be less demanding from the viewpoint of the memory capacity and it can perform at a very low latency. Also, the Goertzel algorithm does not need any reordering of input or output data in the bit-reverse order [1].