[0075] **FIG. 2B** is a block diagram representing an illustrative implementation of the front end **220** of the receiver **200** shown in **FIG. 2A**. The front end **220** receives an analog waveform signal **210** from the transmission medium, e.g. a wire. The incoming signal may be conditioned to improve the amplitude and/or signal to noise ratio in a signal conditioning mechanism **222**. An Analog-to-Digital (A/D) converter **224** generates a digital sampled packet **230** corresponding to the received analog waveform **210**.

[0076] **FIG. 2C** is a block diagram representing an illustrative implementation of the decoder **240** of the receiver **200** shown in **FIG. 2A**. As a waveform **170**, as realized in the transmitter, may be distorted while propagated over the transmission medium, the distorted waveform **210** may be processed for compensation of the effect of the transmission and/or the transmission medium, e.g. noise, attenuation and phase shifts, on the waveform by a compensator mechanism **246** yielding compensated received packets **248**. In an alternative embodiment compensation for the distortion introduced by the transmission medium can also be incorporated in the base functions; in such a case the collection of base functions may vary, possibly per block. Illustratively, compensation for cross talk induced during transmission may be included in processing in both the transmitter **100** and the receiver **200**. A calibration mechanism **242** may be used to determine the parameters that govern the compensation by comparing the received waveform **210** with a known sent waveform. A demodulator **250** demodulates the (digitally encoded) packets **248** with a carrier frequency for each channel used in the transmission, resulting in sampled blocks **252**. In a matching mechanism **254** the sampled blocks **252** are matched with a set of TFB functions in order to determine a weighing factor for each of the functions in the set. Illustratively, this results in bit i being set to 0 if that weighing factor is −1, or to 1 if the weighing factor is +1, in the case of the weighing factors given in the example above. The weighing factors are by no means limited to the example and can be chosen freely to suit the application or system needs. Illustratively, an i^{th} function maps onto an i^{th} bit in the sequence generated for a single block **252**. The resulting N weighing factors are mapped onto a group **260** of N bits in such a way that the input block **124** is reconstructed with the probability P. Illustratively, the matching is done by computing an approximation of the inner products of the received packets **248** with the TFB functions used to decode the data. The matching process provides information on noise generated in the transmission and/or transmission medium, which is then estimated by a noise estimation mechanism **256** and sent back **258** to the transmitter for adaptation of the encoding, if required. In the transmitter **100** this information can, for example, be directed to the input **129** of the error correction mechanism for optimizing the error correction algorithm, and/or to the input **131** of the weighing mechanism to be used in optimizing the weights applied to the TFB functions, given the effects of the transmission medium. The information can also be used to modify the set of TFB functions used within the transmitter. It is also possible to use information that has not been estimated by the estimation mechanism **256**, e.g. from a separate measurement, for optimization.

[0077] **FIG. 2D** is a block diagram representing an illustrative implementation of the bit stream generator **270** of the receiver **200** shown in **FIG. 2A**. The M data bits in the groups **260** extracted in the matching mechanism **254** are processed with an error correction algorithm, in an error correction mechanism **272**, matching an algorithm used for encoding, so that the original bit sequence results. Group **274** of M decoded bits is placed in a buffer **276** and, after being concatenated, the resulting bit stream **280** is made available for external equipment, such as a computer, by an interface mechanism **278**.

[0078] In the embodiment depicted by **FIGS. 2A, 2B, 2**C and **2**D the incoming waveforms **210** are digitized after signal conditioning and before compensation. The invention is by no means limited to this embodiment. Alternative embodiments, wherein the incoming waveform **210** is converted to digital data at a different point within the system all fall within the scope of the invention. Examples are digitally applying signal conditioning or compensating for e.g. attenuation in an analog fashion. Further, the invention could be embodied electronically, in firmware, in software, in hardware or in various combinations thereof.

[0079] The hardware embodiments of **FIGS. 1A and 2A** may be employed to create multiple channels using frequency division multiplexing (FDM) where each of the channels consists of a stream of packets. Each of these packets, in turn, is constructed from weighted sums of a set of TFB functions.

[0080] **FIG. 3B** is an example of a non-TFB function, in the frequency domain. The function of **FIG. 3B** is nicely confined to a rectangular slice in the frequency domain of 1 Hz wide, but its Fourier transform, the Sinc function, spills into plus and minus infinity in the time domain **(FIG. 3A)**. Similarly, a function that is confined to a rectangular slice in the time domain spills into plus and minus infinity in the frequency domain.

[0081] In order to reduce the dramatic spillover of the Sinc function shown in **FIG. 3A**, the steep rise and fall in amplitude of the rectangular slice **(FIG. 3B)** can be changed to a more gradual rise and fall in amplitude by using e.g. a raised-cosine function. However, even the more gradual raised-cosine functions result in substantial spilling over. The best solution to this spillover problem is to use TFB functions, an example of which is shown in **FIGS. 4A and 4B**.

[0082] **FIG. 4A** is an example of a TFB function in the time domain, and **FIG. 4B** the corresponding TFB function in the frequency domain.

[0083] For comparison, **FIGS. 5A and 5B** show enlargements of the time domain graphs of the TFB function, and the Sinc function, respectively. Note that the vertical plot range is reduced with respect to **FIGS. 3A and 4A** in order to show the decay of local maxima.

1. A system for transmitting digital data, comprising:

a digital receiving mechanism to receive an incoming stream of digital information on at least one incoming digital lines, the digital information being in a binary format;

a weighing mechanism to generate respective weighing factors using the digital information;

a signal generation mechanism equipped to generate a plurality of smooth Time-and-Frequency-Bounded functions;