

The present invention concerns a method for the rapid synchronisation of vocoders coupled to each other by means of ciphering and deciphering devices.

In ciphering devices which use vocoders, speech transmission between vocoders takes place digitally. The speech signals are first sampled, then coded by the vocoder before being applied to the associated ciphering device. On reception, the speech signal samples ciphered by the ciphering device of the transmitter are deciphered before being applied to the receiving vocoder. Such a device is described in the review IEEE GLOBAL TELECOMMUNICATIONS CONFERENCE, Communications Broadening Technology Horizons, Conference Record, vol. 2, Houston, TX, 1-4 December 1986, pages 813-817, IEEE Communications Society etc., New York, US; A. TAHA et al.: "Speech encryption in linear predictive coding (LPC) system."

In order to ensure proper operation of the assemblies thus made, it is necessary to ensure at the same time synchronisation of the ciphering devices and the transmitting and receiving vocoders. In known embodiments, a first stage of synchronisation of the cipher function makes it possible to initialise correctly the receiving ciphering means, and a second stage allows synchronisation of the vocoder function, the latter being performed only when the former is finished.

As these two stages are carried out sequentially, without the second one being in any way whatsoever dependent on the first one, synchronisation of the assembly of vocoder and ciphering means takes time.

In the radio transmission mode, on HF channels for example, within the frequency range of 1 to 30 MHz, the mean time for obtaining synchronisation is of the order of a few seconds. As the use of vocoders generally takes place in half duplex operation between two speakers, or in conference mode between several speakers, the synchronisation times obtained are prohibitive and represent a real nuisance to users.

The object of the invention is to reduce the above drawbacks.

For this purpose, the invention relates to a method for the rapid synchronisation of vocoders coupled to each other by means of ciphering and deciphering devices of the type in which the link between vocoders is initialised by the ciphering device of the calling vocoder by means of a code sequence comprising at least one synchronising sequence followed by a transmission of deciphering information and in which the digital speech data transmitted are organised in each vocoder into digital frames comprising a given number of bits, characterised in that it consists of synchronising the data frames transmitted by the vocoders at the end of the synchronising sequence of the ciphering and deciphering devices, transmitting the deciphering data for a time equal to an integral multiple of the duration of a digital frame of speech data transmitted, and synchronising the vocoder called at the end of transmission of the deciphering data.

Other characteristics and advantages of the invention will be apparent below with the aid of the description given with reference to the attached drawings which show:

- figure 1 a transmission system comprising vocoders coupled to ciphering and deciphering devices carrying out the method according to the invention;
- figures 2a and 2b a known embodiment of a vocoder;
- figure 3 the format of a vocoder frame transmitted by a vocoder of the type shown in figures 2a and 2b;
- figure 4 the format of the decryption data transmitted by the ciphering devices;
- figure 5 an example showing the relative position of the code sequence in relation to the speed of the vocoder frames which makes it possible to obtain synchronisation of the vocoder frames with those of the ciphering and deciphering devices.

The transmission system which is shown in figure 1 is composed of two stations 1 and 2 communicating with each

other in half duplex operation on a transmission channel 3. Each station comprises, shown with the same references, a vocoder 4 which is coupled to a modulator-demodulator 5 via a ciphering-deciphering device 6. The whole assembly is controlled by a management unit 7 composed of a microprocessor or any equivalent device which ensures management and sequencing of the data transmitted by each of the stations, working out by the vocoder 4 of the speech data as well as transformation thereof by the ciphering device 6. A telephone handset 8 allows application of users' speech to the vocoder 4 as well as reception thereof.

The diagram of a vocoder is shown in figures 2a and 2b. The transmitting section which is shown in figure 2a comprises a spectrum analyser 9 which receives at one input 10 of the vocoder the signals obtained from the handset 8. The analyser 9 is coupled to a coder 11 via a digital filter 12, an energy calculating unit 13 and a decision unit 14 respectively. The spectrum analyser 9 performs about every 20 ms a spectral analysis of the speech signal, determining the parameters necessary for the filter 12 in order to model the vocal tract as best possible. The decision unit 14 determines the voiced or unvoiced character (pitch) of the vocal signal, and the calculating unit 13 calculates the energy of the signal in a time-division window of which the length is determined by a given number p of samples supplied by the spectrum analyser 9. The combination of these results is applied to the input of the coder 11 from which come digital sequences of binary signals S_a , S_b and S_c . The latter are applied to the input of a multiplexer 15 which forms, under the control of the management unit 7 of figure 1, a digital frame composed of these three signals.

A voice synthesis signal is obtained on reception in the manner shown in figure 2b. The vocoder section which is shown in figure 2b comprises a demultiplexer 16 of the digital frame formed by the sequences of binary signals S_a , S_b , S_c , a decoder 17 of each of the sequences of demulti-

plexed binary signals, a unit 18 for reconstituting the voiced or unvoiced character of the speech signal (pitch), a multiplier circuit 19 and a synthesising filter 20 coupled to an electroacoustic reception unit or loudspeaker 21.

As an example, according to a known embodiment which is described for example in the THOMSON-CSF review, volume 18, no. 1 of March 1986 and published by Gauthier Villars, the architecture of the vocoder shown in figures 2a and 2b makes it possible to obtain, in time-division windows of 22.5 ms, digital frames of 54 bits, of which 7 bits represent the indication of voicing or pitch, 5 bits represent the energy, 41 bits represent the spectrum and 1 bit forms the synchronising bit. The corresponding digital frame is shown in figure 3.

Synchronisation of the code function is conventionally performed by the management of a digital frame of the type shown in figure 4. In this figure the frame is broken down into three sequences, an operating sequence SR, a pseudo-random sequence SPN also called a PN sequence, where PN is the abbreviation for the Anglo-Saxon term "pseudo noise", and a sequence comprising decryption data. The operating sequence is conventionally formed by an alternating sequence of 1 and 0 bits, and it makes it possible to recognise on reception the bit synchronisation of the digital frames transmitted on the transmission channel 3. The PN sequence is conventionally obtained by a shift register of N stages comprising an input and an output, coupled to each other via one or more modulo 2 adders receiving operand data by one or more intermediate taps of the shift register. This type of circuit generates a periodic pseudo-random sequence of length $2^N - 1$ bits. The reverse operation which takes place on reception is also carried out by means of a generator of pseudo-random sequences identical with the one used for transmission and synchronous with the latter. It is recognition of the PN sequence by the receiver which makes it possible to recognise synchronisation of the digital frames transmitted on the transmission channel.

The end of the PN sequence generally marks the start of the useful data necessary for synchronisation of the ciphering unit of the receiver. These data which are transmitted between the ciphering device 6 and the management unit 7 comprise in a known manner a key number "C", marker bits "M" (time marker, for example), and a coded control word "MCC", which allow the receiving section to verify, after deciphering, the validity of the received synchronisation of the ciphering and deciphering device.

In order to avoid having to carry out two stages of synchronisation, a first stage for synchronising the ciphering and deciphering function and a second stage for synchronising the vocoder function which is performed only when the first stage is over, the method according to the invention makes it possible to label the digital frames transmitted by the vocoder with the synchronisation acquired by the ciphering and deciphering device so as to eliminate the second stage of synchronising the vocoder function. This object is achieved according to the invention by constructing a frame system for the digital data of code synchronisation coherent with the length of the elementary vocoder frame as shown in figure 5. In figure 5 the length of the zone reserved for decryption data is determined so as to be a multiple of the length of an elementary vocoder frame. Under these conditions the calling vocoder can be initialised as soon as transmission of the PN sequence is over, and the receiving vocoder can be initialised as soon as reception of the last bit of the decryption sequence is over.

These different actions are performed by suitable programming of the management unit 7. This consists of causing the management unit 7 to transmit a signal for actuation of the vocoder 4 as soon as the PN sequence carried out by the ciphering and deciphering device 6 is over, and causing the receiving vocoder 4 to be started by the receiving management unit 7, as soon as the deciphering device 6 detects the end of the decryption data.



Claims

1. Method for the rapid synchronisation of vocoders (4) coupled to each other by means of ciphering and deciphering devices (6) of the type in which the link between vocoders (4) is initialised by the ciphering device of the calling vocoder by means of a code sequence comprising at least one synchronising sequence (SR, PN) followed by a transmission of deciphering information and in which the digital speech data transmitted are organised in each vocoder into digital frames comprising a given number of bits, characterised in that it consists of synchronising the data frames transmitted by the vocoders (4) at the end of the synchronising sequence (PN) of the ciphering and deciphering devices (6), transmitting the deciphering data for a time equal to an integral multiple of the duration of a digital frame of speech data transmitted, and synchronising the vocoder called at the end of transmission of the deciphering data.
2. Method according to claim 1, characterised in that the transmissions between vocoders (4) take place in half duplex operation by successive digital frames as soon as the vocoder called has acquired synchronisation with the calling vocoder.
3. Method according to claims 1 and 2, characterised in that the synchronising sequence of the ciphering devices is formed by a sequence (PN) of pseudorandom bits of fixed duration of the "pseudo-noise" type.
4. Method according to any of claims 1 to 3, characterised in that the synchronising sequence is preceded by an operating sequence (SR).
5. Method according to any of claims 1 to 4, characterised in that the deciphering data include a key number, marker



bits and a coded check word.

6. Method according to any of claims 1 to 5, characterised in that each digital speech data frame comprises a first bit zone representing the voiced or unvoiced character of the speech signal, a second bit zone representing the energy of the speech signal, and a third bit zone representing spectrum samples, the combination of these three zones being followed by a synchronising bit, the duration of the digital speech data frame being defined by the total duration of the bits which make up the three zones to which is added the duration of the synchronising bit.