edgement packet (ACK) and (when the RTS/CTS transmission mode is used) an RTS and CTS packet.

[0064] Further hereinbelow a detailed implementation for scheduling IEEE 802.11 packets in an active SCO connection is given. A 'slot-stealing' scheme is explained and a calculation of data throughput that can be achieved given.

[0065] The IEEE 802.11 packets may need to be as short as a single slot when such a slot-stealing scheme is implemented, and this implies that the interoperability device **106** has to implement a packet fragmentation and re-assembly scheme, so that it can divide IEEE 802.11 packets in chunks that can be accommodated in the number of Bluetooth slots that are available. The IEEE 802.11's own fragmentation mechanisms cannot be used, since these mechanisms assume that all fragments are sent consecutively. In the detailed implementation described hereinbelow, a suitable fragmentation scheme is discussed.

[0066] In the following, an example is given for introducing the IEEE 802.11 functionality into a Bluetooth radio system, to enable both radio systems to function together in the same device. The following example is not limiting of the present invention, and the person skilled in the art will recognise that other possibilities exist for the implementation of such an architecture. However, as the Bluetooth specification is dominant the following is a preferred implementation.

[0067] The standard Bluetooth radio system uses Frequency Shift Keying (FSK) modulation, sending one bit of information per symbol time of 1 μs. Thus the raw bit-rate is 1 Mbit/s. A packet consists of a preamble, containing a channel access code and a payload. The payload, in turn, is divided into a header (containing packet type, destination address and some other information fields) and a user payload field.

[0068] On the synchronous connection orientated (SCO) links, voice packets are used. The voice packets are typically of the high-quality voice (HV) types HV1, HV2 or HV3. All of these packet types have a 30-byte payload. The most robust packet, HV1, uses rate 1/3 Forward Error Correction (FEC). Packet type HV2 uses rate 2/3 FEC, and type HV3 does not use FEC at all. The number of user bytes is 10,20 and 30 bytes respectively for HV1, HV2 and HV3. The packet layout of an Hv-i (where i=1,2,3) packet is shown in **FIG. 3**. The total duration of a HV-i voice packet is 330 μs. Referring to **FIG. 3**, it can be seen that the Hv-i packet **300** comprises a 72 bit preamble **302**, an 18 bit header **304**, and a 240 bit (or 30 byte) payload **306**.

[0069] In addition to the HV-i type packets, there also exists for Bluetooth a data and voice (DV) type packet. The DV type packet offers the same performance as HV3 (i.e. with no FEC), and carries a variable amount of data as well as voice in the same packet. However, a DV packet carries only 10 user bytes, i.e. a third of HV3's user bytes. The duration of the DV packet is 238 to 356 μs, depending on the amount of data carried.

[0070] Bluetooth packets are sent in time slots, which each have a duration of 625 μs. However packets must be less then 625 μs to allow the radio system sufficient time to hop to another frequency between time slots. Examples of channel operation for HV1, HV2 and HV3 connection are shown in **FIG. 4**, and described further hereinbelow.

[0071] FIGS. **4**(*a*) to **4**(*c*) illustrate timing diagrams for a single Bluetooth voice connection, based on HV1 (**FIG. 4**(*a*)), HV2 (**FIG. 4**(*b*)), or HV3 (**FIG. 4**(*c*)) packets. The shaded packets are in the forward direction (from Bluetooth master device to Bluetooth slave device), and the clear packets are in the reverse direction (from Bluetooth slave device to Bluetooth master device). Eight time slots TS**1** to TS**8** are shown. As can be seen forward packets are sent in odd-numbered time-slots and reverse packets are sent in even-numbered time-slots. The frequency hops, in accordance with the Bluetooth standard, on every time slot, such that the frequencies f_1, to f_8 are hopped-to in times slots TS**1** to TS**8** respectively.

[0072] All voice connection rates are specified to be 64 kbit/s. To achieve this rate a HV1 packet must be sent every other slot, since in every HV1 packet (1/3)×30×8=80 bits of user data are sent. (1/3) is the FEC used in HV1, and 30×8 is the number of bits in a 30 byte payload. One packet is sent every 2×0.625 ms time-slots, which is equal to 1.25 milliseconds, 0.625 ms being the length of each slot. The user bit rate is thus 80/1.25 bits/ms=64 kbit/s. Since a voice link is full duplex, the other remaining alternate empty slots are required for the reverse link. This allocation of forward and reverse packets to time-slots is shown in **FIG. 4**(*a*).

[0073] HV2 packets carry twice the number of user bits as HV1 packets and hence only one forward and one reverse packet is required for every four slots, as shown in **FIG. 4**(*b*).

[0074] HV3 packets carry twice the number of user bits as HV1 packets and hence only one forward and one reverse packet is required for every six slots, as shown in **FIG. 4**(*c*). Thus even if there were two HV3 links active, there would still be required only four time-slots in every six time-slots, leaving two time-slots in every six free.

[0075] As a DV packet, similar to a HV1 packet, carries only 10 user bytes, a DV packet must similarly be transmitted every other slot to achieve a rate of 64 kbit/s.

[0076] Hence in combination with a single HV1 or DV voice link, no IEEE 802.11 data traffic can be transmitted or received without reducing the voice quality of the transmission.

[0077] With a single HV2 link, or HV3 links, two slots are available for IEEE 802.11 traffic. With a single HV3 link, 4 slots are available for IEEE 802.11 traffic.

[0078] Working within these parameters set by the Bluetooth transmission system, it is necessary to determine what IEEE 802.11 user bit rate is possible, given the available time slots. As discussed further hereinbelow, this depends to a certain extent on the overhead of the IEEE802.11 packet.

[0079] IEEE 802.11 packets have either a short or a long preamble, of 96 or 192 μs respectively. The IEEE 802.11 packet payload is transmitted at a rate of one byte in every symbol time with a duration of 8/11-th μs. This gives a bit rate of 11 Mbit/s. The payload contains a 24 byte header and a 32 bit (4 byte) CRC field, which takes 28×(8/11)=20.3 μs to send in total. A SIFS (Short Inter-frame Space) time of 10 μs after correct reception of a packet, the recipient transmits an acknowledgement packet, which consists of a header of 96 or 192 μs. The payload contains MAC protocol control