Appendix VII

OPTIONAL PAGING SCHEMES

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1 GENERAL

For the access procedure, several paging schemes may be used. There is one mandatory paging scheme which has to be supported by all Bluetooth devices. This scheme has been described in Baseband Specification Section 10.6 on page 99 In addition to the mandatory scheme, a Bluetooth unit may support one or more optional paging schemes. The method used for page scan is indicated in the FHS payload, see Baseband Specification Section 4.4.1.4 on page 56. Three additional optional paging schemes are possible; only optional paging scheme ***I*** has been defined yet.

2 OPTIONAL PAGING SCHEME I

In this section the first optional paging scheme is described which may be used according to the rules specified in Baseband Specification Section 10 on page 95 and LMP Specification Section 3.23 on page 223. The paging code for optional scheme ***I*** is 1 (0 is used for the mandatory scheme), see also Baseband Specification Section 4.4.1.4 on page 56

The main difference between the first optional paging scheme and the mandatory scheme is the construction of the page train sent by the pager. In addition to transmission in the even master slots, the master is transmitting in the odd master slots as well. This allows the slave unit to reduce the scan window.

2.1 PAGE

The same 32 frequencies that are used for transmitting ID-packets in the mandatory paging scheme are used in the optional paging scheme ***I*** (for the construction of page trains, see Baseband Specification Section 11.3.2 on page 135. The 32 frequencies are also split into an **A-train** and **B train**. In contrast to the mandatory scheme, the same 32 frequencies that are used for transmitting are also used for reception trials, to catch the response from the addressed device.

The construction of the page train in optional page scheme ***I*** differs from the page train in the mandatory scheme in two ways:

- the page train consists of 10 slots, or 6.25 ms
- the first 8 slots of the train are used to transmit the ID packets, the 9th slot is used to send a marker packet, and the 10th slot is used for the return of a slave response

The marker packets precede the return slot, indicating the position where the slave can respond, and with which frequency. For the marker codes M_ID, bit-inverted page access codes are used. If a marker code is received at T_m with frequency f_k, a return is expected at nominally T_m+625µs at frequency f_k.

Note: The bit-inverted code M_ID to be used as marker code is beneficial for the implementation of the correlators, because the sign of the correlation peak can be used to identify the mark code during page scanning. Still, the transmitting party is uniquely identified, since inverted ID packets are not identical to the ID packets for the device with bit-wise inverted LAP.

The frequency ordering in the train and the frequencies used for the marker and receive slots change after every train. After 8 trains, all of which have a different appearance, the entire procedure is repeated. It is, therefore, more appropriate to talk about subtrains, each with length 6.25ms. Eight subtrains form a supertrain, which is repeated. An example of a supertrain with the eight subtrains is

illustrated in Figure 2.1. The supertrain length is 50ms. In this example, the **A-train** is assumed with an estimated frequency of f_8; as a consequence, the frequencies selected for the train range from f_0 to f_{15}. The marker codes M_ID are indicated as **M**; the receive (half) slots are indicated as **R**.

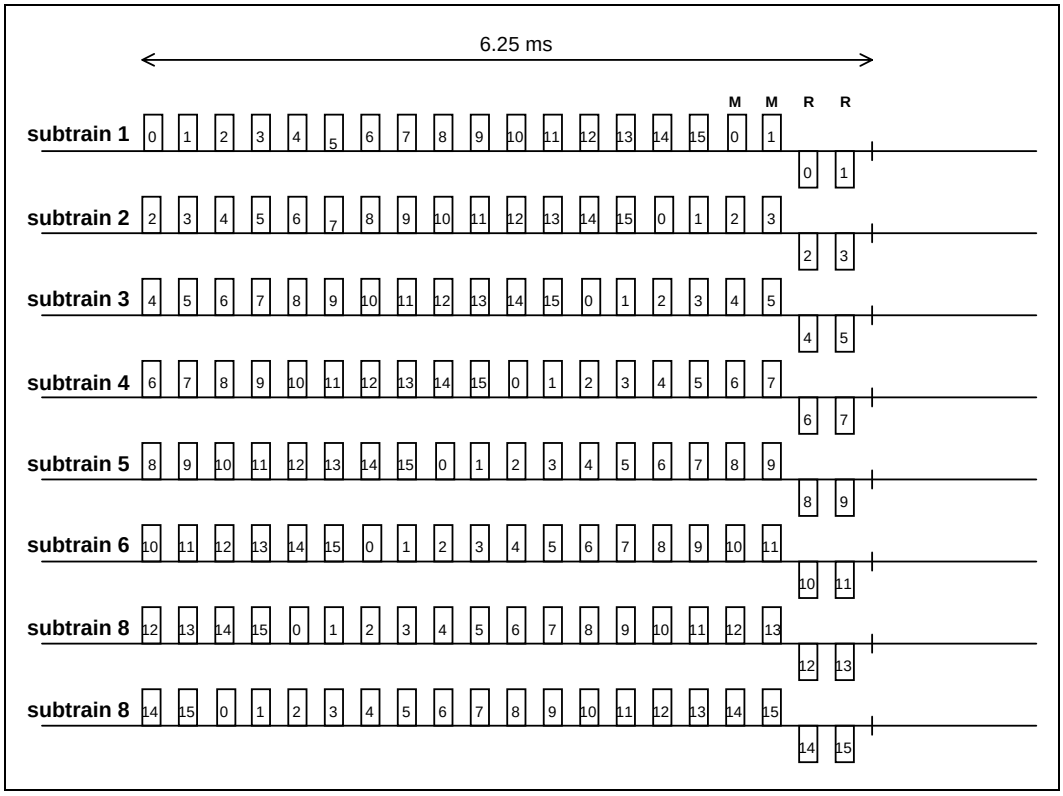

Figure 2.1: Example of train configuration for optional page scheme I.

Corresponding to the paging modes R0, R1 and R2 of the mandatory scheme, the optional scheme supports the same three modes as described for the mandatory scheme in Baseband Specification Section 10.6.2 on page 99

Since the subtrain length is now 10 slots, the 1.28s interval does not cover a multiple of (sub)trains any longer. Therefore, in contrast to the mandatory scheme, the exchange from **A-train** to **B-train** and vice versa is not based on the 1.28s interval, but instead on a multiple number of supertrains. For the R1 and R2 modes, the repetition of a supertrain N_{sup} is indicated in Table 2.1 below.

mode	No SCO link	One SCO link (HV3)	Two SCO links (HV3)
R1	N_{sup}=26	N_{sup}=52	N_{sup}=77
R2	N_{sup}=52	N_{sup}=103	N_{sup}=154

*Table 2.1: Relation between repetition duration of **A**- and **B**-trains and paging modes R1 and R2 when SCO links are present*

In accordance with the phase input to the hop selection scheme *Xp* in (EQ 4) on page 135 in the Baseband Specification (Section 11.3.2), the phase input *Xp_opt* in the optional mode is determined by:

$$Xp\_opt=[k_{offset\_opt} + \mathrm{ST}(cnt)] \bmod 32 \qquad \text{(EQ A1)}$$

where k_{offset_opt} is determined by the A/B selection and the clock estimation of the recipient:

$$k_{offset\_opt} = \begin{cases} \mathrm{CLKE}_{16\text{-}12} + 24 & \text{A-train} \\ \mathrm{CLKE}_{16\text{-}12} + 8 & \text{B-train} \end{cases} \qquad \text{(EQ A2)}$$

and ST is a function determining the structure of the sub- and supertrain:

$$\mathrm{ST}(cnt) = (cnt \bmod 160 - 2*\mathrm{INT}[((cnt \bmod 160) + 18)/20]) \bmod 16 \qquad \text{(EQ A3)}$$

k_{offset_opt} is determined once at the beginning of the repetition period. The CLKE value as is found at the beginning of the repetition interval is taken (the repetition interval being the interval in which the same supertrain is repeated all the time). As long as no train change takes place, k_{offset_opt} is not updated. *cnt* is a counter which is reset to zero at the beginning of the repetition interval and is incremented at the half-slot rate (3200 cycles/s)

The first two ID-packets of a train are transmitted in an even numbered slot.

2.2 PAGE SCAN

The basic page scanning is identical to the mandatory scheme except that a scan duration of 9.5 · 0.625 = 5.9375 ms is sufficient at the slave side.

If a device wants to scan concurrently for the mandatory and optional mode (e.g. after an inquiry response was sent), the device shall try to identify whether the paging party uses the optional scheme after an ID packet was caught. This can be done by train tracing; i.e. the device can determine whether transmission takes place in consecutive slots (optional paging scheme ***I***) or in every over slot (mandatory paging scheme), and/or whether mark codes are sent.

2.3 PAGE RESPONSE PROCEDURES

The page response procedures at the master and slave sides are almost identical to the procedures described in the mandatory mode (see Baseband Specification Section 10.6.4 on page 104). There are two differences:

- The page response routine starts after the transmission and reception of the marker code M_ID
- The ID packet sent by recipient is identical to the frequency in which the marker code was received

For the page response timing, see Figure 2.2 and Figure 2.3.

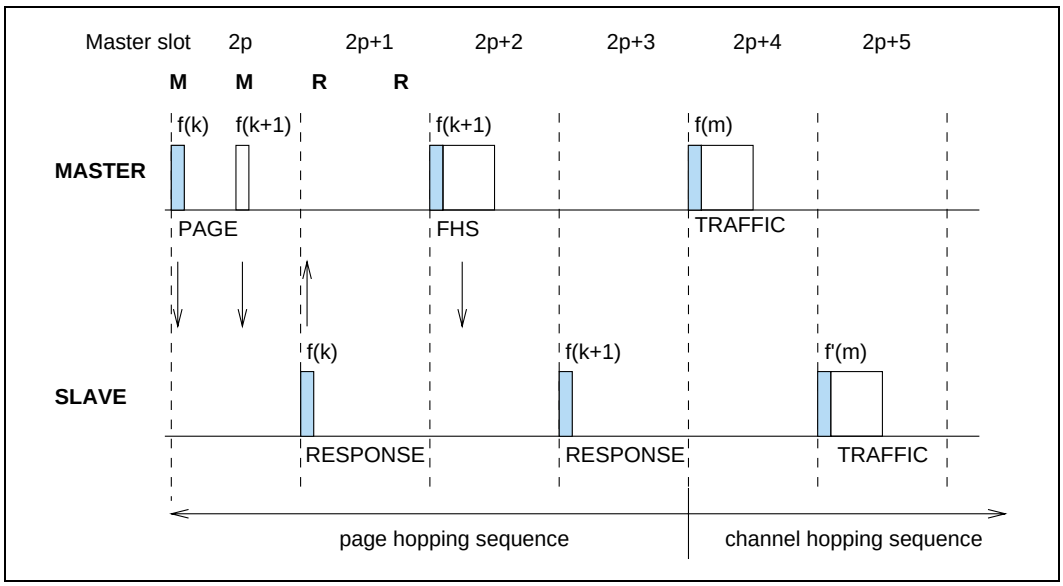

Figure 2.2: Messaging when marker code is received in first half slot of even master slot

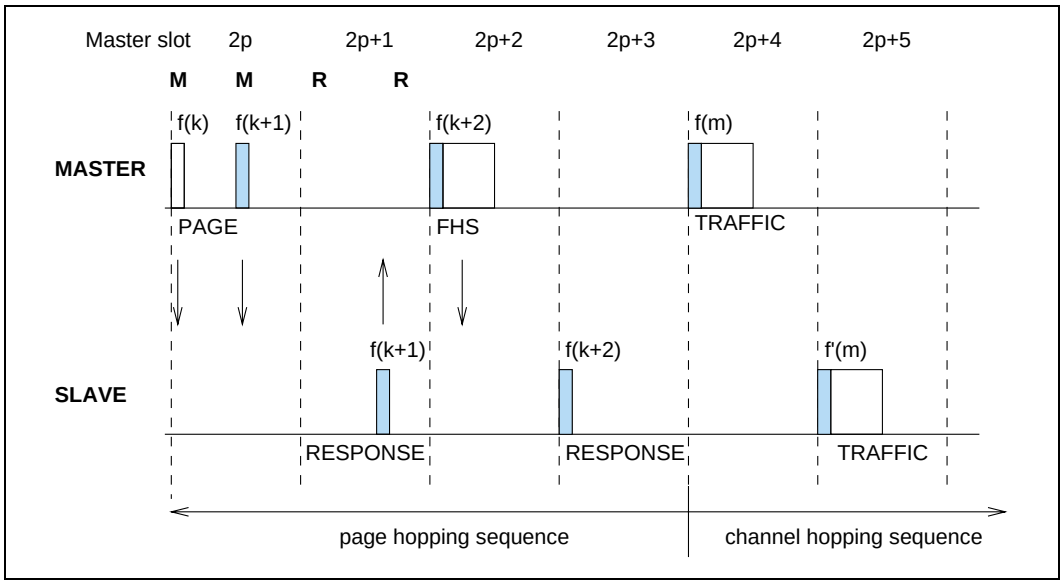

Figure 2.3: Messaging when marker code is received in second half slot of even master slot

2.4 TRAIN TRACING

This section outlines how a slave may search for the mark code although the current partitioning into A- and B-trains at the master side is not known. Train tracing means that the slave tries to receive as many page access codes from the train as possible, to catch a mark code as soon as possible. When searching for the mark codes, or trying to distinguish between the mandatory paging mode and the optional paging mode, a unit shall set up a hopping pattern for train tracing after the reception of the first access code. The hopping pattern

shall ensure that the transmission and reception is performed with a 50% probability on the same frequency regardless of the actual frequency set (16 frequencies) used for paging.