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**D E C I S I O N**  
**of 7 December 2004**

**Case Number:** T 0054/02 - 3.5.3

**Application Number:** 86903722.6

**Publication Number:** 0261127

**IPC:** H04B 1/56

**Language of the proceedings:** EN

**Title of invention:**

TDM communication system for efficient spectrum utilization

**Patentee:**

MOTOROLA, INC.

**Opponents:**

Nokia Cellular Systems Oy  
Telefonaktiebolaget L M Ericsson  
Alcatel SEL Aktiengesellschaft

**Headword:**

TDM communication system/MOTOROLA

**Relevant legal provisions:**

EPC Art. 56, 114(2)

**Keyword:**

"Inventive step (yes)"  
"Late filed document - admitted (yes)"

**Decisions cited:**

T 0606/93

**Catchword:**

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Case Number: T 0054/02 - 3.5.3

**D E C I S I O N**  
of the Technical Board of Appeal 3.5.3  
of 7 December 2004

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**Decision under appeal:** Interlocutory decision of the opposition  
division of the European Patent Office posted  
5 November 2001 concerning maintenance of  
European patent No. 0261127 in amended form.

**Composition of the Board:**

**Chairman:** R. T. Menapace  
**Members:** F. van der Voort  
A. J. Madenach

## Summary of Facts and Submissions

- I. This appeal is against the interlocutory decision of the opposition division finding European patent No. 0 261 127 in amended form to meet the requirements of the EPC. The opposition division's decision was taken after Board of Appeal 3.5.1 (case number T 606/93) had set aside a previous decision of the opposition division to revoke the patent and had remitted the case to the first instance for further prosecution on the basis of a first auxiliary request which included a single claim. In its decision, the board held that the first auxiliary request did not give rise to objections under Article 123(2) and (3) EPC and that the claim was clear (Article 84 EPC).
- II. Opponent III lodged an appeal against the interlocutory decision of the opposition division and requested that it be set aside and the patent be revoked in its entirety on the ground that the claimed subject-matter lacked an inventive step. In support of the arguments, the appellant filed a further prior art document (D5, see point III) with the statement of grounds of appeal. The appellant argued that the claimed subject-matter did not involve an inventive step having regard to either a combination of D1, a statement in the patent (col. 4, line 54 to col. 5, line 5) and D4, or a combination of D1 and D5, or a combination of D5 and the common general knowledge.
- III. The prior art documents relevant to the present appeal proceedings are the following:

- D1: K. Kinoshita et al, "Digital Mobile Telephone System Using TD/FDMA Scheme", IEEE Transactions on Vehicular Technology, Vol. VT-31, No. 4, November 1982, pages 153 to 157;
- D2: EP 0 115 618 A;
- D4: CCITT Red Book, Vol. VII - Fascicle VII.1, "Telegraph Transmission", Recommendation R.101, "Code and speed dependent TDM system for anisochronous telegraph and data transmission using bit interleaving", Geneva, 1985, pages 95 to 109; and
- D5: EP 0 169 713 A.

- IV. The respondent (proprietor) filed a reply to the statement of grounds of appeal, requesting that D5 not be admitted and that the appeal be dismissed. He submitted arguments in support of his contention that the appellant's objections were incorrect.
- V. Oral proceedings were held in the absence of opponents I and II, who although parties to the appeal proceedings as of right pursuant to Article 107 EPC, had indicated in advance that they would not attend. In the course of the oral proceedings, the respondent filed an amended claim 1 and requested, as the sole request, that the patent be maintained on the basis of this claim and the description and drawings as underlying the interlocutory decision. The appellant maintained the request that the decision under appeal be set aside and the patent be revoked in its entirety.

At the end of the oral proceedings, the chairman announced the board's decision.

VI. Amended claim 1 as filed during the oral proceedings reads as follows:

"A method for efficiently utilizing the spectrum of radio frequency communication channels (200) used to communicate vo-coded voice signals in a time division multiplex communication system (100) which apportions narrow-band radio frequency communication channels (200) into at least two time slots for communicating vo-coded voice signals to achieve a full duplex communication effect, each channel having a predetermined maximum data rate, C, the method comprising the steps of:

(a1) in a first vo-coding means (406) of a first remote unit (400), analyzing at a first selected coding rate, V, voice signals of a communication from a first user for providing vo-coded signals at a selected one, V, coding data rate available to communicate such voice signals in said communication system and including means for preambuling at least a synchronization signal to said vo-coded signal;

(b) the system establishing a time division multiplex protocol defining N time slots of equal lengths, where N is a positive integer less than or equal to C/V;

(c1) in the said first remote unit (400), buffering (408) said vo-coded signals to provide buffered signals;

(d1) the said first remote unit (400) transmitting (414) said buffered signals at a transmission rate of at least twice the first selected coding rate of step (a1), in at least one of said N time slots;

(e1) receiving vo-coded signals in a receiving means (422) of the said first remote unit (400) during at least one of said N time slots at the data rate of step (d1) to provide received signals, including the step of synchronizing said receiving means to said received signals (424);

(f1) buffering (426) said received signals in the said first remote unit (400), to provide buffered received signals; and

(g1) synthesizing recovered voice signals from said buffered received signals in a synthesizing means (432) in the said first remote unit (400) at the data rate of step (a1);

(a2) in a second vo-coding means of a second remote unit (400), analyzing at a second selected coding rate,  $V'$ , voice signals of a communication from a second user for providing further vo-coded signals at a selected rate,  $V'$ , different from said first selected coding rate,  $V$ , available to communicate such voice signals in said communication system and including means for preambuling at least a synchronization signal to said vo-coded signal;

(c2) in the said second remote unit (400), buffering (408) said further vo-coded signals to provide further buffered signals;

(d2) the said second remote unit (400) transmitting (414) said further buffered signals in at least one of the said N time slots, at a transmission rate which is the same as the transmission rate in step (d1);

(e2) receiving further vo-coded signals in a receiving means (422) of the said second remote unit (400) during at least one of said N time slots at the transmission rate of step (d2) to provide further received signals including the step of synchronizing said receiving means to said received signals;

(f2) buffering (426) said further received signals in the said second remote unit (400), to provide further buffered received signals; and

(g2) synthesizing recovered voice signals from said further buffered received signals in a synthesizing means (432) in the said second remote unit (400) at the second selected rate,  $V'$ , of step (a2);

(h) the system apportioning time among users according to the fraction of the channel required at various voice encoding rates."

## **Reasons for the Decision**

### 1. *Admissibility of document D5*

1.1 D5 was filed by the appellant for the first time with the statement of grounds of appeal. At the oral proceedings the respondent particularly argued that,



although there had been sufficient time to study D5, D5 was not more relevant than D2, which was already on file. That D5, unlike D2, explicitly disclosed buffer stores was not a decisive consideration. Further, in contrast to the present invention, D5 did not disclose a full duplex system, since a full channel in each direction of transmission was not provided. The respondent concluded that D5 should not be admitted to these appeal proceedings.

- 1.2 The board notes however that D5, contrary to D2, is not limited to a communication system including a single radio frequency channel for only two users using the same voice coding rate (in D2 equal to 9.6 - or 4.8 - kBd for both users; see page 2, lines 14 to 17, and page 5, line 16). It rather relates to a system for use in a cellular radio telephone network providing duplex communications for a plurality of user links, in which for a duplex communication between two stations two distinct links at different frequencies may be provided. Further, the period of time during which each station transmits is proportional to a coding rate used in the user's encoder, which is capable of operating at different coding rates (see D5, page 1, lines 5 to 8, page 7, lines 2 to 7, page 9, lines 11 to 16, page 10, lines 9 to 18, and page 14, lines 8 to 14). These features render D5 more relevant to the present case than D2; since D5 was filed at the commencement of these appeal proceedings and *prima facie* its relevance was such as to raise the question of whether the patent should be revoked or its scope limited, the board exercised its discretion under Article 114(2) EPC at the oral proceedings to admit D5 to the proceedings.

2. *Amendments*

2.1 Claim 1 differs from claim 1 of the first auxiliary request as filed in the course of the first appeal proceedings (see above, point I) in that at the end of features (e1) and (e2) "signal" has been replaced by "signals" and in that at feature (b) "of equal lengths" has been inserted after "time slots", thereby limiting the scope of the claim. The first amendment is merely an obvious language correction, whereas the second amendment is based on Fig. 2 and the corresponding passage on page 7, lines 25 to 33 of the application as published. More specifically, Fig. 2 illustrates a preferred organization of an RF communication channel 200 which is subdivided into 8 time sub-slots of equal lengths; the time slots are assigned by the primary station such that the mobile controller of a remote unit knows **how many** of the sub-slots (1-8) are to be combined for the particular communication slot assigned to the remote unit in question (page 16, lines 11 to 13, page 10, lines 14 to 15, and Fig. 8b of the application as published). In the first board of appeal decision (see above, point I), which is binding upon the present board with respect to all issues decided therein, it was held that the claim otherwise complied with the requirements of Article 123 EPC.

2.2 The Board is therefore satisfied that the patent as amended does not contain subject-matter which extends beyond the content of the application as filed (Article 123(2) EPC) and that the scope of protection has not been extended during the opposition and appeal procedures (Article 123(3) EPC).

3. *Inventive step*

3.1 D1 relates to a time division multiplex communication system and method, providing an efficient utilization of the spectrum of radio frequency communication channels for communicating digitally-coded voice signals (see D1, page 153, the abstract and section I, 1st para.). The system establishes a time division multiplex protocol defining a time division multiple access (TDMA) frame format including N time slots of equal lengths in both the inbound-to-base link and outbound-to-mobile link (see Fig. 5), commonly referred to in the art as uplink and downlink, respectively. For a voice coding bit rate of 32 kbit/s in each of the mobile or remote units and an uplink supporting a transmission bit rate of 160 kbit/s, one frame has four time slots (N = 4) for four users, each user being assigned a time slot for the transmission of a burst signal (page 154, left col. last para., and page 156, left col., point E). Similarly, the downlink has a frame format defining four time slots per frame, in which each slot is assigned to a respective remote unit for receiving voice coded signals during the assigned slot (page 154, left col., lines 19 to 28; Figs 2 and 5).

3.2 The subject-matter of claim 1 particularly differs from the method disclosed in D1 in specifying that, at a second remote unit, a coding data rate is used which **differs from** the coding data rate used at a first remote unit and in that the system apportions time among users according to the fraction of the channel required at **various** voice encoding rates.

- 3.3 The technical effect achieved by these distinguishing features may be seen as an increased efficiency of spectrum utilization in that the required data transmission rate capacity of the radio frequency communication channels and, hence, the bandwidth of the channels, may be determined by the lower of the two coding rates and may thereby be kept to a minimum; users using a higher coding rate can nevertheless be supported by the system by allocating more time to these users such that they may receive and transmit the voice coded signals during several time slots.
- 3.4 The problem underlying the claimed subject-matter may therefore be seen in improving the spectrum utilization of the radio communication system of D1 (see also col. 1, lines 5 to 10, and col. 2, lines 14 to 17, of the patent in suit).
- 3.5 A person skilled in the art, starting from D1 and faced with this technical problem, would consider D5, since it also relates to a TDM communication system and explicitly mentions the problem of keeping the channel bandwidth to a minimum without any significant loss of quality of reproduction (page 1, last para., to page 2, 1st para., and page 4, 2nd para.). More specifically, D5 discloses a duplex communications system in which two stations may represent the terminals of two subscribers to a cellular radio network and may communicate via a mobile switching centre (page 6, line 13, to page 7, line 2). In a preferred embodiment, the two stations communicate via a single time-division multiplexed (TDM) channel where each station transmits alternately for a brief period giving the effect of full duplex communication (page 7, lines 2 to 7). In

order to reduce the required bandwidth, the voice input at each station is converted into a digital output using a voice encoder 12 which is adapted to operate at three distinct bit rates, in that a low stand-by bit rate (e.g., 250 b/s) is used when there is no input voice signal, an intermediate bit rate (16 kb/s) when both parties speak simultaneously and a high bit rate (31.75 kb/s) when only one party speaks. The transmission rate over the TDM channel is always at a constant rate (32 kb/s), but the period of time during which each station transmits is proportional to the selected bit rate of the encoder, *i.e.* with a duty cycle of either 0.25:31.75, 50:50 or 31.75:0.25 (page 3, lines 17 to 20, and page 5, lines 13 to 16, page 10, 2nd para., to page 11, 1st para.).

Hence, by dynamically varying the transmission time available to one party, at the expense of that of the other party and as a function of whether or not each party is speaking, and by correspondingly adapting the coding rates, the system of D5 permits the effect of full duplex, whereas it is sufficient for the communication channel to have an information capacity approximately equal to that of a simplex communication channel.

- 3.6 In order to apply the teaching of D5 to the system disclosed in D1, it would firstly be necessary for the skilled person to provide the remote units with encoders capable of operating at different coding data rates and secondly to modify the system's TDM protocol such that the lengths of the two time slots assigned to two users communicating with each other, e.g. channels 1 and 2 in Fig. 5, are dynamically varied. If only one

user speaks, the listening user would have to be allocated only a fraction of the time slot and would have his voice encoding rate correspondingly reduced, with the remaining part of the time slot being made available to the speaking user. This would result in two transmission time slots of different length, at least as long as only one user is speaking.

However, according to the present claim 1, time is apportioned in terms of one or more time slots of **equal length** rather than fractions of individual slots. More specifically, according to features (e1) and (e2), both users are receiving **during at least one** of the N time slots of equal length as defined by the TDM protocol of the system (feature (b)). In combination with feature (h) the method thus requires that the receiving means of the user using the higher coding rate, e.g. V', is receiving during more than one time slot and, similarly, since the vo-coding means of that user's remote unit uses the same coding rate V', the transmission of voice signals by the same user requires more than one of the N time slots.

Since neither D1 nor D5 suggests the allocation of multiples of time slots to a single user, it follows that the combination of D1 and D5 does not render the subject-matter of claim 1 obvious to the skilled person.

- 3.7 At the oral proceedings the appellant argued that both in the claimed method and in the system of D5, time was apportioned in accordance with multiples of a basic sub-slot. More specifically, in D5, a station which used a coding rate of 250 kb/s, 16 kb/s or 31.75 kb/s

would require the allocation to this station of 1, 64 or 127 of these sub-slots, respectively.

However, the board notes that D5 describes the operation of the transmitters merely in terms of different duty cycles (page 10, 2nd last line, to page 11, line 2) without any reference to sub-slots. The duty cycles 0.25:31.75, 50:50 and 31.75:0.25 respectively correspond to transmissions during 0.25/32, 16/32 and 31.75/32 of the available time (see D5, page 11, 4th and 2nd last lines). These ratios are indeed mathematically equal to 1/128, 64/128 and 127/128, but this does not imply that the system uses a TDM protocol defining 128 sub-slots.

- 3.8 The appellant further argued that, if D5 were taken as the starting point, the subject-matter of claim 1 merely differed from the method disclosed in D5 in that it explicitly defined features relating to the synchronization of the system components and in that the voice signals were analyzed and recovered voice signals were synthesized at the same coding rate in each unit. The features relating to the synchronization were part of the common general knowledge. In D5 (page 8, lines 1 to 8), the transmitted control data would obviously include synchronization data as well. Further, the selection of the same coding rate for analyzing and synthesizing was well within the ordinary competence of a skilled person, since this was a matter of the chosen system architecture and was not related to the problem of efficiently using the frequency spectrum. In any case, whether or not certain features of the system were known from the prior art was not decisive for the question of inventive step, since the

claim was directed to a method. The claimed subject-matter therefore lacked an inventive step in view of D5 and the common general knowledge.

The board does not find these arguments convincing, since, even if some or all of the above-mentioned features were considered not to contribute to an inventive step, the combination of D5 and the common general knowledge would still fail to teach the skilled person to allocate multiples of time slots to a single user (see point 3.6 above).

- 3.9 The appellant further argued that the claimed subject-matter did not involve an inventive step in view of a combination of D1, D4 and a passage in the patent at col. 4, line 54 to col. 5, line 5. From this passage, it was said to follow that at the filing date it was obvious to a person skilled in the art to combine different voice coding rates in one and the same mobile radio communication system. This feature was also known from D4, which would be considered by the skilled person, despite of the fact that D4 did not relate to the transmission of voice signals, since according to the patent in suit the transmission of data other than voice signals was not excluded (col. 8, lines 26 to 30). In any case, the type of signal, e.g. data or voice, was not relevant to the technical problem to be solved when starting from D1.

The board does not accept these arguments. Even if it were assumed that the passage referred to by the appellant represents the state of the art, it merely suggests that a combination of more efficient coding, i.e. the same quality but at a lower coding rate, and a



more efficient data transmission, *i.e.* higher than 16 kbps, allows for the transmission of more voice signals in the same 25 kHz channel. This provides no hint at the use of different coding rates in a single system.

D4 relates to telegraph transmission and defines a standard for a system for anisochronous telegraph and data transmission. The main application is for telex traffic. The system must be capable of accepting for transmission all types of telex signals and permits the efficient mixing of various combinations of anisochronous speeds, codes and signalling in the same transmission system (see page 95, points (e) to (g)). The document does not mention the problem of improving the spectrum utilization of a radio communication system and does not concern the communication of voice signals. The board therefore sees no reason why a person skilled in the art, when starting from D1 and faced with the above-mentioned problem, would consider D4. The appellant's objections under Article 56 EPC to claim 1 based on D1 and D4 are thus not convincing either.

- 3.10 The board concludes that the method according to claim 1 involves an inventive step over the cited prior art.

**Order**

**For these reasons it is decided that:**

1. The decision under appeal is set aside.
  
2. The case is remitted to the first instance with the order to maintain the patent with claim 1 as submitted during the oral proceedings on 7 December 2004, description and drawings as underlying the decision under appeal.

The Registrar:

The Chairman:

D. Magliano

R. T. Menapace