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**Datasheet for the decision  
of 29 September 2009**

**Case Number:** T 1654/06 - 3.5.02

**Application Number:** 03709072.7

**Publication Number:** 1483754

**IPC:** G08C 25/02

**Language of the proceedings:** EN

**Title of invention:**

Transport block set transmission using hybrid automatic repeat request

**Applicant:**

INTERDIGITAL TECHNOLOGY CORPORATION

**Headword:**

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**Relevant legal provisions:**

EPC Art. 56

**Relevant legal provisions (EPC 1973):**

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**Keyword:**

"Inventive step - no"

**Decisions cited:**

-

**Catchword:**

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Case Number: T 1654/06 - 3.5.02

**D E C I S I O N**  
of the Technical Board of Appeal 3.5.02  
of 29 September 2009

**Appellant:** INTERDIGITAL TECHNOLOGY CORPORATION  
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**Decision under appeal:** Decision of the Examining Division of the  
European Patent Office posted 13 June 2006  
refusing European application No. 03709072.7  
pursuant to Article 97(1) EPC 1973.

**Composition of the Board:**

**Chairman:** M. Ruggiu  
**Members:** M. Rognoni  
E. Lachacinski

## Summary of Facts and Submissions

I. The applicant (appellant) appealed against the decision of the examining division refusing European application No. 03 709 072.7.

II. In the decision under appeal, the examining division held, *inter alia*, that the subject-matter of claim 8 was known from the following prior art document:

D1: S. Eriksson *et al*: "Comparison of Link Quality Control Strategies for Packet Data Services in EDGE", 1999 IEEE, pages 938 to 942,

and that the subject-matter of claims 1 and 14 was rendered obvious by D1. Hence, the application was refused on grounds of lack of novelty (Article 54 EPC) and lack of inventive step (Article 56 EPC).

III. With the statement of grounds of appeal dated 13 October 2006, the appellant filed a new set of claims 1 to 13.

IV. In a communication dated 8 May 2009 accompanying the summons to oral proceedings, the Board referred to D1 and introduced the following document into the proceedings:

D5: WO-A1-00/05911.

Moreover, the Board expressed doubts over the inventive step of the subject-matter of the newly filed claim 1.

- V. On 28 September 2009, the appellant filed an unconditional withdrawal of his request for oral proceedings.
- VI. On 29 September 2009, oral proceedings were held in the absence of the appellant.
- VII. The appellant requested in writing that the decision under appeal be set aside and that a patent be granted on the basis of the claims 1 to 13 filed with the letter dated 13 October 2006.
- VIII. Claim 1 of the appellant's request reads as follows:

"A method for transmitting data of a transmission time interval (TTI) in a wireless communication system using adaptive modulation and coding (AMC) and having a physical layer hybrid automatic repeat request mechanism, the method **characterised by:**

providing, at the transmitter side (44), data in a plurality of transport block sets (TBS) for transfer over an air interface (36) in a transmission time interval (TTI);

transmitting (50), from the transmitter side (44), the transport block sets with a first specified modulation and coding scheme;

receiving, at the receiver side (46), each transport block set and determining on each received transport block set whether each of the received transport block sets meet a specified quality;

when the specified quality is not met, transmitting, from the receiver side (46), a repeat request;

changing the specified modulation and coding scheme to a second specified modulation and coding scheme where not all of the plurality of transport block sets can be transmitted in the time transmission interval at the second specified modulation and coding scheme;

in response to the repeat request, retransmitting (54), from the transmitter side (44), the transport block sets not meeting the specified quality using the second specified modulation and coding scheme;

receiving the retransmitted transport block set at the receiver side (46); and

combining (54), at the receiver side (46), the retransmitted transport block set with a corresponding previously received transport block set.

Claims 2 to 6 are dependent on claim 1.

Claim 7 reads as follows:

"A user equipment for receiving data over an air interface (36) in a transmission time interval (TTI), the transmission time interval data transmitted using adaptive modulation and coding (AMC), the user equipment using a physical layer hybrid automatic repeat request mechanism for the received transmission time interval data, the user equipment **characterised by:**

means for receiving (46) the transmission time interval (TTI) data, the transmission time interval data having a plurality of transport block sets (TBS) transmitted using a first specified modulation and coding scheme;

means for determining on each received transport block set whether data of each of the transport block sets (TBS) meet a specified quality;

means for when the specified quality is not met, for transmitting (40) a repeat request for the received transport block sets not meeting the specified quality;

means for receiving (46) at least one retransmitted transport block set (TBS) not meeting the specified quality, the at least one retransmitted transport block set (TBS) transmitted using a second specified modulation and coding scheme where not all of the plurality of transport block sets can be transmitted in the time transmission interval (TTI) at the second specified modulation and coding scheme; and

means for combining (42) the at least one retransmitted transport block set (TBS) with a corresponding previously received transport block set (TBS).

Claims 8 to 13 are effectively dependent on claim 7.

IX. The appellant's written submissions relevant to the present decision can be summarised as follows:

Document D1 was considered to represent the closest prior art, since it related, like the present invention, to adaptive modulation and coding used in transmitting data blocks and also disclosed the switching of modulation and coding schemes.

However, D1 taught that resegmenting the data blocks prior to transmission would be needed if incremental redundancy (IR) was performed on data blocks retransmitted with a different modulation and coding

scheme (MCS). In particular, it was stressed in D1 (page 940, left column, second paragraph) that the ability to change MCS on retransmission was most important if IR combining was not used. In fact, in IR operation, resegmenting of the data block complicated or inhibited the IR combining and should thus only be done when absolutely necessary. Accordingly, the teachings of D1 exhorted the skilled person not to combine retransmitted data blocks.

The problem solved by the present invention was to optimise the data throughput when a change of MCS was required. There was no teaching in D1 for solving this problem, apart from resegmenting the data blocks prior to retransmission or avoiding incremental redundancy.

A person skilled in the art, starting from D1 and facing the problem of optimising the data throughput when a change of modulation and coding scheme MCS was required, would not try to provide at the transmitter side data in a plurality of transport block sets (TBS) for transfer over an air interface in a transmission time interval TTI. Furthermore, when a TBS was not received with the specified quality, the skilled person would not change the specified MCS to a second MCS which did not allow the transmission of the plurality of transport block sets TBS within the given time interval TTI, since this was contrary to the teachings of D1, which only disclosed retransmission and resegmenting of individual segments, but not retransmission of a whole TBS. It followed from this that the major advantage of the present invention over the prior art was the elimination of the need for resegmentation.

As described in the specification of the present application (paragraph [0011]), a person skilled in the art might consider the possibility of transmitting a TBS using a more robust modulation and coding scheme, when a TBS transported using a first modulation and coding scheme was not successfully received even after several attempts to combine the retransmitted TBS. However, the data of a TBS would not fit into the more robust modulation and coding scheme and therefore the person skilled in the art would, as disclosed in D1, deal with this problem by segmenting the TBS and send separate segments. Although incremental redundancy could be performed on the individual segments, these individual segments could not be combined with the prior transmission of the whole TBS. The result would be a lower data throughput.

In other words, the key element of the present invention was the manner in which a transport block set (TBS) was handled in a time transmission interval (TTI). As per definition, a TTI was the inter-arrival time of a TBS and was equal to the periodicity at which a TBS was transferred by the physical layer on the radio interface, it was always a multiple of the minimum interleaving period. The medium access control (MAC) delivered one TBS to the physical layer every TTI. Hence, a TTI was defined in terms of a single TBS. The present invention redefined this relationship and thus improved on the prior art.

Additionally, as disclosed in claim 1, only transport block sets not meeting the specified quality were



resent, thereby further optimising the data throughput when a change of MCS was required.

Summing up, the present invention attempted to attack the problem before it started. The TBS was redefined so that multiple TBS's were associated with one TTI. Accordingly, when the multiple TBS's were received, only the TBS's that were not successfully received were retransmitted and combined with the previously transmitted TBS's.

## **Reasons for the Decision**

1. The appeal is admissible.
  
- 2.1 Claim 1 according to the appellant's request is based on the subject-matter of claims 1 and 3 considered by the examining division. It relates to a *"method for transmitting data of a transmission time interval (TTI) in a wireless communication system"*, which comprises the following steps:
  - (a) using adaptive modulation and coding (AMC),
  
  - (b) having a physical layer hybrid automatic repeat request mechanism,
  
  - (c) providing, at the transmitter side, data in a plurality of transport block sets TBS for transfer over an air interface in a transmission time interval TTI;

- (d) transmitting, from the transmitter side, the transport block sets with a first specified modulation and coding scheme;
- (e) receiving, at the receiver side, each transport block set and determining on each received transport block set whether each of the received transport block sets meets a specified quality;
- (f) when the specified quality is not met, transmitting, from the receiver side, a repeat request;
- (g) changing the specified modulation and coding scheme to a second specified modulation and coding scheme where not all of the plurality of transport block sets can be transmitted in the time transmission interval at the second specified modulation and coding scheme;
- (h) in response to the repeat request, retransmitting, from the transmitter side, the transport block sets not meeting the specified quality using the second specified modulation and coding scheme;
- (i) receiving the retransmitted transport block set at the receiver side; and
- (j) combining, at the receiver side, the retransmitted transport block set with a corresponding previously received transport block set.

2.2 According to the appellant, "a key element to the invention is the manner that a transport block set (TBS) is handled in a Time Transmission Interval (TTI)" (statement of grounds of appeal, page 4, second paragraph).

Thus, "when the multiple TBSs are received" within a Time Transmission Interval "only the TBSs that were not successfully received are retransmitted and these retransmitted TBSs *can be combined with prior transmitted TBSs*" (see *ibid.* page 4, paragraph 4). This is possible because a TBS does not have to undergo any segmenting prior to retransmission (*ibid.* page 4, paragraph 1).

3.1 D1 relates to a method for transmitting data and is in particular concerned with "*Link Quality Control*" (LQC) for the packet radio service "EGPRS".

In section II, LQC is described conceptually and methods known as "*link adaptation*" LA and "*incremental redundancy*" IR are compared.

3.2 On page 938 (section II, "*A. Link Quality Control Methods*"), D1 refers to a pure link adaptation scheme (LA) which uses a set of type I hybrid automatic repeat request (HARQ) schemes with different modulations and coding rates (MCS). A "*type I hybrid ARQ uses a forward error correcting (FEC) code to correct errors in blockwise encoded data, and additionally an ARQ mechanism to retransmit remaining erroneous blocks, detected by a frame check sequence (FCS)*" (emphasis added). The channel quality is estimated continuously

and the MCS maximizing the link bit rate at the moment is chosen.

In a pure incremental redundancy (IR) scheme, a fixed type II hybrid automatic repeat request (HARQ) scheme is used. According to this scheme, a block of data with some low rate FEC code is encoded. Only a "subblock" of this codeword is transmitted with an initial low code rate  $R_1$ . *"For erroneously decoded blocks, detected by an FCS, transmission of additional redundancy subblocks from the same codeword is requested, received and combined with the first subblock, yielding a lower code rate  $R_{1+2}$ "* (see D1, paragraph bridging pages 938 and 939, emphasis added).

This procedure is repeated until decoding succeeds, giving a stepwise increment of the amount of redundancy, or, equivalently, a decrement of the code rate.

Obviously, an IR scheme requires memory for the temporary storage of the soft values of the received erroneous blocks until enough additional redundancy has arrived for successful decoding (see D1, page 939, left-hand side, third paragraph).

The LQC method proposed in D1 for EGPRS allows pure *link adaptation (LA)* but also *incremental redundancy (IR)* with different initial rates (D1, page 939, section B., first paragraph). In particular, it involves eight different MCS's, each of which can be used in both LA and IR modes.

As further explained in D1 (page 939, section B.) an encoded data block is divided into 2 or 3 subblocks by puncturing with puncturing patterns  $P_1$  to  $P_3$ . On retransmission, one additional subblock is transmitted. Since each subblock is by itself a decodable codeword, the receiver can either discard (cf. type I hybrid ARQ), or keep (cf. type II hybrid ARQ) old subblocks when requesting retransmission (page 939, left-hand column, penultimate paragraph).

As to the choice of the appropriate modulation and coding scheme MCS, the network controls the choice of MCS based on the channel quality of the receiver. *"If IR combining is used in the receiver, this choice can be more aggressive, i.e., less robust schemes can be used for a given channel quality"* (D1, page 939, "ii) Adaptation", first paragraph).

D1 (page 939, right-hand column, last paragraph to page 940, left-hand column, first paragraph) states that in *"GPRS, a retransmission of a block must use the same coding scheme as the initial transmission, since the data block sizes are incompatible. In EGPRS, MCS changes are enabled on retransmission by partitioning the MCS:s into families (cf. Table 1). The data block sizes for one family are multiples [of] each other. E.g., MCS-8 and MCS-6, belonging to family A, have the same data block size. In MCS-8, two subblocks, each obtained by encoding and puncturing a data block to rate one, fit into one radio block. In MCS-6 only one subblock, obtained by encoding and puncturing the same data block to rate 0.49, fits. When using the third member of family A, MCS-3, for a retransmission of a data block initially sent with MCS-6 or MCS-8, the data*

*block is resegmented into two. .... The same holds for family B."*

As stressed by the appellant, it is observed in D1 (page 940, left-hand column, second paragraph) that the *"ability to change MCS:s on retransmissions is most important if IR is not used. In fact, in IR operation, resegmentation of a datablock complicates or inhibits the IR combining and should thus only be done when absolutely necessary."*

However, in the following paragraph on page 940 (left-hand column, paragraph iii)), D1 teaches that there are two reasons for having more than one subblock per radio block for MCS-8. *"One is that it enables MCS switches without resegmentation, as described above. More important though is that it also improves the throughput for that MCS."*

It is then concluded in D1 (see page 942, " V. Conclusions") that the *"superior performance of an incremental redundancy (IR) scheme as compared to an [sic] pure link adaptation (LA) scheme is at the cost of large memory needs. With rapidly decreasing memory costs, this drawback is considered to be less important in a near future". ....With limited amounts of memory, performance can be increased by choosing modulation and coding schemes (MCS:s) more aggressively and utilizing IR combining."*

- 3.3 In summary, D1 discloses a flexible LQC (Link Quality Control) solution for EGPRS which enables, *inter alia*, IR with different initial rates and dynamic adaptation between all modes. When requesting retransmission, the

receiver can either discard or keep old subblocks, thereby switching between combining (type II hybrid ARQ) and non-combining (type I hybrid ARQ) modes. The proposed solution foresees changes of modulation and coding schemes (MCS's) when a block of data is retransmitted. MCS switches can be carried out without resegmentation of a data block prior to retransmission, if the "more aggressive", that is less robust, coding scheme has more than one subblock per radio block.

3.4 For a person skilled in the art, the overall teaching of D1 boils down to a method for transmitting data in a wireless communication system which comprises the following steps worded in the language of claim 1 of the present application:

- using adaptive modulation and coding (*i.e.* different MCS);
- having a physical layer hybrid automatic repeat request mechanism (HARQ);
- providing, at the transmitter side, data in a plurality of (*i.e.* two) subblocks for transfer over an air interface in a transmission time interval (*i.e.* in a *radio block*);
- transmitting, from the transmitter side, the *subblocks* with a first specified modulation and coding scheme (for instance MCS-8);
- receiving, at the receiver side, each subblock and determining on each received subblock whether each of the received subblocks meets a specified

quality (cf. D1, page 939, left-hand column, penultimate paragraph, last sentence);

- when the specified quality is not met, transmitting, from the receiver side, a repeat request;
- changing the specified modulation and coding scheme (*i.e.* MCS-8) to a second specified modulation and coding scheme (for instance MCS-6) where not all of the plurality of subblocks can be transmitted in the time transmission interval (*radio block*) at the second specified modulation and coding scheme;
- in response to the repeat request, retransmitting, from the transmitter side, the subblocks not meeting the specified quality using the second specified modulation and coding scheme (MCS-6);
- receiving the retransmitted subblock at the receiver side; and
- combining, at the receiver side, the retransmitted subblock with a corresponding previously received subblock (IR according to type II ARQ).

The only features which seem to distinguish the method of claim 1 from the prior art relate to the "*transmission time interval*" and the "*transport block set*".

4.1 According to the examining division, the "*plurality of transport block sets*" and the "*transmission time*



*interval*" can be construed as data (sub) blocks and the radio block, respectively, that is as terms which are used in D1.

4.2 In a Universal Mobile Telecommunications System (UMTS), however, "*Time Transmit Interval*" (TTI) and "*TBS*" appear to have a particular meaning. According to the UMTS standard, data delivered by a source are segmented into fixed portions to fit in the radio packets size and sent to the Media Access Control (MAC) layer over logical channels. The MAC performs scheduling and format selection. After the MAC processing, the resulting Protocol Data Units (PDUs), called *Transmission Blocks* (TBs) are sent over dedicated channels (DCHs) to the physical layer. In other words, the MAC arranges all the TBs of the same *Transport Channel* in one packet and forwards it in a TTI to the physical layer. The TTI can also be defined as the inter-arrival time of a set of *Transmission Blocks* (TBS). Thus, it seems that in UMTS only one TBS is normally transmitted in a *Transmission Time Interval* (TTI).

5.1 Though the present application is not limited to a particular transmission standard and does not offer a clear definition of TTI and TBS, it could be assumed, to the appellant's advantage, that the use of the terms TBS and TTI implied a method of data transmission relating to a UMTS network. In this case, the question to be considered is whether it would be obvious to a person skilled in the art, wishing to improve a method of transmission of data blocks, as known from the UMTS standard, to apply the teaching of D1 which involves providing, at the transmitter side, data in a plurality

of transport block sets TBS for transmission within a transmission time interval TTI.

5.2 D1 (page 938, left-hand column, "I. Introduction", second paragraph) points out that the "*EDGE concept*" of using high-level modulation to offer enhanced data rates "*for existing cellular systems in existing spectrum is currently being standardized for both GSM and TDMA/136 (D-AMPS). EDGE is thus a common evolution towards providing third generation services in two major cellular standards of today.*" Thus, the teaching of D1 is presented as a possible improvement of existing transmission standards.

5.3 Furthermore, the principles of segmenting, prior to transmission, data into packets of a size that allows at least one packet to be transmitted at the lowest rate within a given time interval appear to be generally known in the field of data transmission.

5.4 For instance, according to D5 (page 5, lines 3 to 7, Figure 2B), the physical channel between the remote station and the base station is typically divided into time frames. The information unit transmitted during a time frame can be seen as transmission block and one or several data packets can be transmitted within a transmission block.

According to a known transmission standard (D5, page 6, lines 11 to 18), a packet typically comprises a header part, an information part and an error detection code part. The header part includes information used for requesting retransmission of corrupted packets

according to the Automatic Retransmission Request scheme (ARQ).

As pointed out in D5 (page 8, lines 21 to 24), for efficient transmission, a higher layer Protocol Data Unit (PDU) is segmented into smaller size Radio Link Control (RLC) blocks or packets. This allows retransmissions to be performed at the RLC block level according to the chosen ARQ protocol. If a PDU frame is segmented into RLC block sizes corresponding to the lowest transmission rate, an integral number of these comparatively smaller block units are transmitted during a block period (D5, page 9, lines 6 to 8).

- 6.1 In the light of the general knowledge common in the field of data transmission, it would have been obvious to a skilled person, wishing to improve a method of transmitting a transport block set TBS within a transmission time interval TTI, as for instance known from the UMTS standard, to apply the teaching of D1 and thus arrive at a method falling within the terms of claim 1 of the appellant's request.
- 6.2 Hence, the subject-matter of claim 1 does not involve an inventive step within the meaning of Article 56 EPC.
7. As the subject-matter of claim 1 is not patentable, there is no need to consider the other claims of the appellant's request.
8. In the result, the Board finds that the appellant's only request is not allowable and that, consequently, the application has to be refused.

**Order**

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

The appeal is dismissed.

The Registrar:

The Chairman:

U. Bultmann

M. Ruggiu