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Datasheet for the decision of 20 November 2007

Case Number: T 1285/06 - 3.5.03

Application Number: 99102790.5

Publication Number: 0944191

IPC: H04B 10/18

Language of the proceedings: EN

Title of invention:
Method for optical fiber communication, and device and system for use in carrying out the method

Applicant:
FUJITSU LIMITED

Opponent:
-

Headword:
Optical fiber communication/FUJITSU

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step - no"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 1285/06 - 3.5.03

D E C I S I O N
of the Technical Board of Appeal 3.5.03
of 20 November 2007

Appellant: FUJITSU LIMITED
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Decision under appeal: **Decision of the examining division of the European Patent Office posted 17 March 2006 refusing European application No. 99102790.5 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: A. S. Clelland
Members: F. van der Voort
M.-B. Tardo-Dino

Summary of Facts and Submissions

I. This appeal is against the decision of the examining division refusing European patent application No. 99102790.5 (publication number EP 0 944 191 A) on the ground that the subject-matter of the independent claims of both a main and an auxiliary request lacked an inventive step (Articles 52(1) and 56 EPC).

II. The following documents, which are referred to in the impugned decision and/or the European search report for the present application, are relevant to the present decision:

D1: GB 2 308 675 A; and

D5: WO 96/23372 A.

III. With the statement of grounds of appeal the appellant filed fair copies of the independent claims of the main and auxiliary requests and submitted arguments in support. Oral proceedings were conditionally requested.

IV. The appellant was summoned to oral proceedings. In a communication accompanying the summons, the board raised, without prejudice to its final decision, objections under Articles 84 and 123(2) EPC, as well as under Article 52(1) in combination with Article 56 EPC.

V. In preparation for the oral proceedings, the appellant filed amended independent claims of both the main and the auxiliary request and presented arguments in support.

VI. Oral proceedings were held on 20 November 2007 in the course of which the appellant filed amended independent claims, i.e. claims 1, 7 and 16, of the main request and amended independent claims, i.e. claims 1 and 7, of the auxiliary request. The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of claims 1, 7 and 16 of the main request as filed during the oral proceedings and claims 2 to 6 and 8 to 15 as filed with the letter dated 5 April 2004 or, alternatively, on the basis of claims 1 and 7 of the auxiliary request as filed during the oral proceedings and claims 2 to 6 and 8 to 15 as filed with the letter dated 5 April 2004. In the course of the oral proceedings, whilst discussing the auxiliary request, the board drew the appellant's attention to D5 (see point II above).

At the end of the oral proceedings, after deliberation, the board's decision was announced.

VII. Claim 7 of the main request reads as follows:

"A system for compensating chromatic dispersion and non-linearity in fiber optical communications, comprising:

a first terminal device (2) and a second terminal device (4); and

an optical fiber transmission line (6) connecting said first and second terminal devices (2, 4);

wherein

said first terminal device (2) comprising:

control means (10) for setting a first positive chirp parameter ($\alpha > 0$) and a second negative chirp parameter ($\alpha < 0$), and an optical transmitter (8) for outputting to said transmission line (6) a first optical signal having a red-shift chirping according to said first positive chirp parameter received from said control means (10), and a second optical signal having a blue-shift chirping according to a second negative chirp parameter ($\alpha < 0$) received from said control means (10); and

said second terminal device (4) comprising

an optical receiver (12) for receiving said first and second optical signals from said optical fiber transmission line (6) and converting said first and second optical signals into first and second electrical signals, respectively;

a monitor unit (14) receiving *[sic]* said first and second electrical signals, for separately detecting a bit error of said first and second electrical signals, and for outputting a first bit error signal (EC1) and a second bit error signal (EC2) respectively,;

receiving means (18) for comparing said first bit error signal (EC1) and said second bit error signal (EC2) with each other and for determining that bit error signal which is lower in comparison to the other bit error signal; and

fixing means (Step 110) for automatically fixing that one of said first chirp parameter and said second chirp parameter which is associated with said lower one of said first bit error signal (EC1) and said second bit error signal (EC2), and for outputting a corresponding control signal (CS) to said control unit (10) for setting said first positive chirp parameter ($\alpha > 0$) or said second negative chirp parameter ($\alpha < 0$) for being used until restart of said system."

Claim 7 of the auxiliary request reads as follows:

"A system for compensating chromatic dispersion and non-linearity in fiber optical communications, comprising:

a first terminal device (2) and a second terminal (4); and

an optical fiber transmission line (6) connecting said first and second terminal devices (2, 4);

wherein:

said first terminal device (2) comprising

an optical transmitter (8) for outputting a first optical signal having a chirping of first positive chirp parameter ($\alpha > 0$) and a second optical signal having a chirping of negative second chirp parameter ($\alpha < 0$);

a dispersion compensating fiber (126) for compensating chromatic dispersion of said first and second optical signal *[sic]* when output to said optical fiber transmission line (6);

an optical amplifier (124) for amplifying the compensated first and second optical signals and outputting said amplified first and second optical signals to said optical fiber transmission line (6);a receiver (18); and

a control unit (10) for controlling a chirp parameter according to a control signal (CS) generated by said receiver (18); and

said second terminal device (4) comprising

an optical receiver (12) for receiving said first and second optical signal from said optical fiber transmission line (6), and for converting said first and second optical signal into first and second electrical signals, respectively;

a monitor unit (14) for receiving said first and second electrical signals and for separately detecting a bit error of said first and second electrical signal *[sic]*, respectively, so as to output supervisory information on said bit error; and

an electrical transmitter (16) for transmitting said supervisory information to said receiver (18) of said first terminal device

wherein said first terminal device (2) further comprises

fixing means (Step 110) for automatically fixing that one of said first chirp parameter and said second chirp parameter which is associated with said lower one of said first bit error signal (EC1) and said second bit error signal (EC2), and for outputting a corresponding control signal (CS) to said control unit (10) for setting said first positive chirp parameter ($\alpha > 0$) or said second negative chirp parameter ($\alpha < 0$) for being used until restart of said system."

In view of the board's decision with respect to claim 7 of the main and auxiliary requests, independent claim 1 of each of these requests and independent claim 16 of the main request are not reproduced here.

Reasons for the Decision

1. *Inventive step - claim 7 of the main request*

1.1 D1 is considered to represent the closest prior art available to the board, since it relates to a method of driving an optical transmitter of an optical communications system, in which by pre-chirping the optical pulses to be transmitted, wavelength dispersion, i.e. chromatic dispersion, in the optical fibre is compensated for, see D1, page 16, line 14 to page 17, line 13. Since the dispersion may also be due to non-linear effects in the optical system, e.g. the so-called self-phase modulation arising from the Kerr effect, see paragraph [0004] of the present application as published, it is implicit that the method of D1 is also suitable for compensating non-linearity.

1.2 More specifically, D1 discloses, using the language of claim 7 of the main request, a system for compensating chromatic dispersion and non-linearity in fiber optical communications, in which a first terminal device 66, see Fig. 12, is connected to a second terminal device 70 by means of an optical fiber transmission line 72, see also the description, page 26, line 17, to page 28, line 10.

The first terminal device 66 includes a control means, i.e. chirp parameter setting circuit 78, for setting a chirp parameter α, and an optical transmitter 64. The optical transmitter 64 has the basic configuration as shown in Fig. 1, in which the control means 10 and the bias circuit 6 correspond to the control means 78 shown in Fig. 12 and in which the transmitter is preferably a modulator integrated laser diode MI-LD 12, see Fig. 10 and page 26, last line, to page 27, line 2. The control means 10 may be implemented such that a switching can be performed between two chirp parameters, i.e. a positive chirp parameter (+1) and a negative chirp parameter (-1), see page 25, line 19 to page 26, line 16, Fig. 8 (operating points A and B) and claim 8. The MI-LD 12 then outputs an optical signal having either a red-shift chirp or a blue-shift chirp according to which of the two chirp parameters is received from the control means

10. Further, since there are only two operating states for the MI-LD 12 as determined by the chirp parameters, the computation of the drive parameters at CPU 40 (Fig. 10) is simplified, see page 26, lines 4 to 8.

The second terminal device 70 (Fig. 12) includes an optical receiver 68 for receiving the optical signals from the optical fiber transmission line 72 and for converting the signals into electrical signals, and a monitor unit 73 for receiving the electrical signals, for detecting a bit error rate of the electrical signals and for sending corresponding bit error signals to the first terminal device 66. The control means 10 receives the monitored bit error signal at port 62 (see page 20, lines 5 to 10, and Fig. 10) and sets the chirp parameter for the transmitter on the basis of the bit error signal (see page 27, line 10 to page 28, line 2 and Fig. 12). More specifically, when the optical fiber transmission line 72 is a single mode fiber having a zero dispersion wavelength within a l,3 μm band, the control means 10 sets a negative chirp parameter for an optical signal lying within the 1,55 μm band, i.e. within an anomalous dispersion region of the optical fiber transmission line, which results in a blue shift of the optical pulses to be transmitted, see page 16, line 14, to page 17, line 18, and page 28, lines 3 to 10. Similarly, if the fiber transmission line is to be operated in the normal dispersion region, i.e. below the 1,3 μm band, a positive chirp parameter is set, which results in a red shift of the optical pulses to be transmitted in order to compensate for the blue shift caused by the normal dispersion of the fiber.

1.3 D1 does not disclose making a comparison between the bit error signals corresponding to the positive and negative chirp parameters, nor that the chirp parameter is then automatically set to the one which gives rise to the lowest bit error rate. Further, the board notes that D1 does not provide details of how and how often the monitored bit error rate affects the selection of the chirp parameter, except that the selection is based on the monitored data, see page 27, lines 16 to 21.

1.4 The board notes however that D1 does describe that the chirp parameter of the transmitter is preferably chosen so as to be suited to the system it is used in, which in the case of an optical communications system means that it is preferably chosen such that the transmission distance is maximized, see D1, page 4, line 9 to page 5, line 2.

In the board's view, it is well-known that the bit error rate is a measure of the performance of a communications system and, more specifically, that the lower the bit error rate is, the longer the maximum transmission distance can be. The skilled person would be aware that when applying the optical transmitter of D1 to an optical communications system including an optical fiber of unknown properties, in particular unknown as to the zero dispersion wavelength of the fiber, it could not be foretold whether a normal or an anomalous dispersion of the optical pulses would result at the given wavelength. It would therefore have been obvious to successively try the two possible chirp parameters by switching between these two parameters, as described in D1, and to subsequently select that chirp parameter which corresponds to the lowest monitored bit error rate, thereby achieving the longest possible transmission distance. This would imply a means for comparing the respective bit error rates and for selecting that chirp parameter which corresponds to the lowest bit error rate. Whether or not the parameter selection is fixed for only a short period of time or a longer period, e.g. until a restart of the system, is merely a matter of the degree of control accuracy desired. If easy computation is more important, e.g. in order to reduce costs, fixing the chirp parameter, i.e. carrying out the bit error monitoring only once for the two parameter values, would have been an obvious choice.

1.5 The appellant argued that in D1 the chirp parameter was continuously adjusted dependent on the monitored data, whereas in the present system an unexpected advantage was achieved in that, as illustrated in Fig. 6, merely by successively setting the chirp parameter to the positive and negative values and keeping that parameter which gave the best performance, the operation was simplified and the hardware costs were accordingly reduced. Hence, a prejudice was overcome in that the inventors had realized that a continuous adjustment of the chirp parameter as described in D1 was actually not necessary and could be simplified, even in the case of high transmission bit rates.

The board notes however that in the application as originally filed there is no mention of overcoming any prejudice. It is also noted that claim 7 does not specify any particular transmission bit rate. Nor did the appellant provide any evidence in support of the alleged unexpected advantage, e.g. evidence showing that a single measurement was adequate and that this was contrary to what a person skilled in the art would have expected. In the absence of such evidence, in the board's view, the alleged simplification and reduction in costs can be expected to result in lower performance, since no account can be taken of any subsequent changes in the system over time, e.g. due to temperature or aging effects. Weighing up the trade-off between system costs and system accuracy is however considered to be part of the ordinary skills of a person skilled in the art.

1.6 The appellant further argued that the object of D1 was to optimize the transmission through the fiber, which implied that monitoring of the bit error rate and a corresponding adjustment of the chirp parameter were necessarily repeated multiple times, each time for both the positive and negative parameters. Reference was made to D1, page 28, lines 11 to 16. It would therefore not have been obvious to simplify the monitoring process as described in D1 by carrying it out only once as claimed.

The board notes however that the object of D1 is to provide a method and device for driving an optical modulator capable of arbitrarily setting a chirp parameter in a system, see page 4, line 20 to page 5, line 2. The passage at page 28, third paragraph, which the appellant referred to, relates to an optimization of the transmission ("the optimum characteristic can be obtained"), which appears to be optional and which takes into account variations in time of the system. In the simplified embodiment in which the control means is for switching between two chirp parameters only, see point 1.2 above, an optimum value of the chirp parameter is not necessarily obtained. D1 does not therefore exclude a once only monitoring. A similar conclusion is drawn in the present application as published, see paragraph [0108].

1.7 The appellant's arguments are accordingly not convincing.

1.8 The board therefore concludes that the subject-matter of claim 7 of the main request lacks an inventive step having regard to the disclosure of D1 and taking into account the common general knowledge of the person skilled in the art (Articles 52(1) and 56 EPC). The main request is therefore not allowable.

2. *Inventive step - claim 7 of the auxiliary request*

2.1 Claim 7 of the auxiliary request differs from claim 7 of the main request essentially in that the first terminal device additionally includes a dispersion compensating fiber for compensating chromatic dispersion and an optical amplifier for amplifying the compensated optical signals.

2.2 It is however common general knowledge in the field of optical communications systems that a dispersion compensating fiber and an optical amplifier can be used to improve the system's performance, see, e.g., the acknowledgement of the prior art in D5, page 1, lines 4 to 30. This view was not contested by the appellant.

Hence, the application of these well-known techniques to the optical communications system of D1 in order to improve the system's performance does not contribute to an inventive step. The board also notes that no unexpected effect is obtained by the inclusion of the dispersion compensating fiber and the optical amplifier; nor did the appellant argue this.

2.3 For these reasons and the reasons set out at point 1 above in relation to claim 7 of the main request, the subject-matter of claim 7 of the auxiliary request does not involve an inventive step (Articles 52(1) and 56 EPC). The auxiliary request is therefore not allowable.

3. In view of the foregoing, it has not proved necessary to consider independent claim 1 of the main and auxiliary requests, independent claim 16 of the main request, or indeed any of the further objections set out in the communication accompanying the summons to oral proceedings.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

D. Magliano A. S. Clelland