BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

Internal distribution code:
(A) [ ] Publication in OJ
(B) [ ] To Chairmen and Members
(C) [X] To Chairmen
(D) [ ] No distribution

D E C I S I O N
of 4 February 2004

Case Number: T 0697/99 - 3.5.3

Application Number: 91311029.2

Publication Number: 0488739

IPC: G01S 5/14

Language of the proceedings: EN

Title of invention:
Multi-channel digital receiver for global positioning system

Patentee:
NovAtel Inc.

Opponent:
THALES SYSTÈMES AÉROPORTÉS S.A.

Headword:
GPS/NOVATEL

Relevant legal provisions:
EPC Art. 123(2), 56

Keyword:
"Amendments - added subject-matter - main request (yes)"
"Inventive step - first auxiliary request (yes)"

Decisions cited:
-

Catchword:
-

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0697/99 - 3.5.3

D E C I S I O N
of the Technical Board of Appeal 3.5.3
of 4 February 2004

Appellant: (Proprietor of the patent)
NovAtel Inc.
1010, 64th Avenue N.E.
Calgary,
Alberta T2E 7V8 (CA)

Representative:
Rupprecht, Kay, Dipl.-Ing.
Meissner, Bolte & Partner,
Widenmayerstrasse 48
D-80538 München (DE)

Respondent: (Opponent)
THALES SYSTÈMES AÉROPORTÉS S.A.
2 Avenue Gay Lussac
F-78990 Elancourt (FR)

Representative:
Plaçais, Jean-Yves
Cabinet Netter,
36, avenue Hoche
F-75008 Paris (FR)

Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 6 May 1999 revoking European patent No. 0488739 pursuant to Article 102(1) EPC.

Composition of the Board:

Chairman: A. S. Clelland
Members: F. A. N. van der Voort
R. Moufang

Summary of Facts and Submissions

I. This appeal is against the decision of the Opposition Division to revoke European patent No. 0 488 739.

II. The opposition was filed against the patent as a whole and on the grounds as set out in Article 100(a)-(c) EPC. Following oral proceedings, the Opposition Division held that the sole request of the proprietor, namely maintenance of the patent in amended form on the basis of a set of claims as filed during the oral proceedings, could not be allowed since, although claim 1 was novel and inventive, independent claim 10 was *prima facie* ambiguous and unclear.

In the course of the opposition proceedings the opponent referred *inter alia* to the following prior art documents:

DO1: US 4 785 463 A;

DO2: *"Analysis and Optimization of Correlative Code-Tracking Loops in Spread-Spectrum Systems"*, A. Polydoros, C.L. Weber, IEEE Transactions on Communications, Vol. COM-33, No. 1, January 1985, pages 30 to 43; and

DO4: US 4 203 070 A.

III. The proprietor lodged an appeal against the decision. A statement of the grounds of appeal was subsequently filed together with a set of claims of a main request.

IV. The respondent (opponent) filed a reply to the statement of the grounds of appeal, in response to which the appellant (proprietor) filed revised claims.

V. The parties were summoned by the Board to oral proceedings. In a communication accompanying the summons, the Board gave a preliminary opinion on the case.

VI. In preparation of the oral proceedings, the appellant filed revised claims of a main request and several auxiliary requests, each including two independent claims. The respondent filed further comments as well.

VII. Oral proceedings were held on 4 February 2004. In the course of the oral proceedings, the appellant proposed amendments to independent claims 1 and 10 of the main request and filed several auxiliary requests. The respondent explicitly stated that he did not object to the admission of the sets of claims as filed during the oral proceedings. At the end of the oral proceedings the Chairman announced the Board's decision.

The parties' requests

VIII. The appellant requested that the patent be maintained on the basis of a main request or, failing that, of a first auxiliary request, both as formulated at the oral proceedings before the Board. Further auxiliary requests were presented by the appellant in the course of the appeal proceedings, but these requests were not considered by the Board in view of the decisions taken in respect of the main and first auxiliary requests as set out below.

The main request includes claim 1 as filed during the oral proceedings, claim 10 as filed with letter of 23 December 2003, and claims 2 to 9 and 11 to 15 as granted. The first auxiliary request includes claim 1 of the main request, claim 10 as filed during the oral proceedings, and claims 2 to 9 and 11 to 15 as granted.

Claim 1 of the main and first auxiliary requests reads as follows:

"A receiver (10) for decoding a composite signal (Cs) consisting of a plurality of pseudo-random noise (PRN) encoded signals, the receiver comprising:
means (132) for generating a local clock signal (Fs);
a channel circuit (22) for decoding one of the PRN encoded signals, wherein the channel circuit further comprises:
1. means (230) for providing a local PRN code signal; and
2. a pair of correlators (240a, 240b), characterized in that
the receiver further comprising a sampling circuit (143), connected to receive the composite signal and the local clock signal, and to provide digital in-phase (I) and quadrature (Q) samples of the composite signal; and
each correlator is connected to receive the I and Q samples and the local PRN code, to provide a decoded signal,
the correlators (240a, 240b) have dynamically selectable delays for a given PRN code and a dynamically selectable relative delay spacing,

wherein the delay spacing is dynamically selectable to less than one chip."

Claim 10 of the main request reads as follows:

"a. A receiver for demodulating and decoding a composite radio-frequency ranging signal, consisting of a plurality of transmitted signals, one of which is modulated with a predetermined pseudo-random code, the receiver including:

b. means (132) for generating a local clock signal (Fs);

c. a channel circuit (22), for decoding said PRN encoded signal, wherein the channel circuit further comprises:

c1. a code generator (230) for generating the pseudo-random code;

c2. a pair of correlators (240a, 240b) for synchronising with the received version of the code the output of the code generator (230), characterised in that

d. the receiver further comprising a sampling circuit (143), connected to receive the composite signal and the local clock signal, and to provide digital in-phase (I) and quadrature (Q) samples of the composite signal; and

e. each correlator is connected to receive the I and Q samples and the local PRN code, to provide a decoded signal, and in that

f. the pair of correlators (240a, 240b) operate in an acquisition mode to synchronise the code generator (230) to within one code chip and operating in a subsequent tracking mode to track the received version of the code,

g. the pair of correlators (240a, 240b),

i. when operating in the tracking mode making correlation measurements that correspond to a correlator delay spacing that is substantially narrower than one code chip; and

h. ii. when operating in the acquisition mode making correlation measurements that correspond to code delays that are substantially wider than the narrow correlator spacing used in the tracking mode."

Claim 10 of the first auxiliary request differs in substance from claim 10 of the main request in that the pair of correlators of features (g) and (h) is additionally defined as:

"iii. being selectably configurable as early and late correlators in the acquisition mode, and configurable as punctual and early minus late correlators in the tracking mode."

IX. The respondent requested that the appeal be dismissed.

Reasons for the Decision

Main request

1. *Article 123 EPC*

1.1 In the Board's view, independent claim 10 of the main request does not comply with the requirements of Article 123(2) EPC for the following reasons:

1.2 Claim 10 defines the pair of correlators in terms of their operation in a tracking mode and an acquisition mode. Throughout the application as originally filed these two operation modes are consistently linked to the corresponding configuration modes of the pair of correlators, namely the (early, late) mode and the (early, early-late) mode, respectively. For example, the application as published states at page 3, lines 25 to 29, that:

"The correlators may also be switched between a first, or acquisition mode, and a second, or tracking mode. In the acquisition mode, the correlators are set to give an early and late correlation power indication. Once the proper carrier and phase are obtained, one of the correlators is configured as punctual for optimal carrier tracking, and the other correlator as early minus late with a narrow time delay to provide optimum code tracking.".

Similar statements can be found at page 7, lines 6 to 11, and at page 8, line 50, to page 9, line 13. Reference is also made to page 9, line 55, to page 10, line 8; page 10, lines 17 to 19, and claim 3.

1.3 At the oral proceedings, the appellant argued that the person skilled in the art would immediately recognize that at least the second mode of the correlators 240a, 240b as shown in Figure 4, in which correlator 240a is configured as a punctual correlator and correlator 240b as an early-late correlator, merely represents a specific embodiment of the tracking mode. On the basis of his common general knowledge, the skilled person would realize that in order to obtain the early-late correlator output signal, instead of subtracting the early and late PRN code signals followed by the correlation with the received code using a single correlator, two separate correlators could be used for correlating the early and late signals with the received code signal separately, followed by a subtraction of the outputs of these correlators. The appellant argued that for this reason a reference to the tracking mode in claim 10 without specifying the configuration of the correlators would be allowable.

1.4 The Board is not able to follow this argument. The summary of the invention at page 3, lines 15 to 29, of the application as published prescribes the (early, early-late) configuration of the pair of correlators for the second or tracking mode. The broadest originally-filed claim relating to this mode, namely claim 3, does the same. From this, the skilled reader would recognise that the (early, early-late) configuration is not merely a specific embodiment of the invention. For the same reason, the general reference at page 10, lines 25 to 28, to possible other variations and modifications of the specific embodiment described cannot be considered as providing a basis for

a general reference to the tracking mode without specifying the corresponding correlator configuration. In any case, the alternative embodiment referred to by the appellant, in which the second correlator 240b is replaced by two correlators, would actually require the provision of a further, third correlator for the tracking mode. A basis for such a modification cannot be found in the application as filed. Although the alternative embodiment could be considered an obvious equivalent of the embodiment disclosed, it is not directly and unambiguously derivable from the application as filed, even when account is taken of matter which is implicit to a person skilled in the art.

1.5 The Board therefore concludes that in the originally filed application the operation of the receiver in an acquisition or a tracking mode is always linked to a specific configuration of the correlators. Since claim 10 does not reflect this, it follows that the application has been amended in such a way that it contains subject-matter which extends beyond the content of the application as filed (Article 123(2) EPC).

1.6 The main request is therefore not allowable.

First auxiliary request

2. *Articles 84 and 123 EPC*

2.1 At the oral proceedings, the respondent argued that claim 1 contravened Article 123(2) EPC in that the added expression *"dynamically selectable relative delay spacing"* is used without specifying whether it

concerned the tracking mode only, the acquisition mode only or both modes.
The Board notes however that the passage at page 3, lines 5 to 10, of the application as published, refers to the dynamically adjustable code delay spacing in general terms.

2.2 In the letter of 28 January 2004, the respondent argued that feature (ii) of independent claim 10 was not originally disclosed, since the expression *"code delays"* was ambiguous in connection with the acquisition mode.
The Board notes however that in the application as published, the expression *"code delays"* is explicitly used in connection with the acquisition mode at page 10, line 2. In the acquisition mode, as explained at page 9, line 55 to page 10, line 2 of the published application, all possible code phase delays are successively tried (*"swept"*) in an attempt to obtain code lock with the received version of the code. As defined by feature (iii) of claim 10, the two correlators are configured as *"early"* and *"late"* correlators in the acquisition mode. The *"code delays"* in connection with the acquisition mode are therefore the delays applied to the locally generated PRN-code signals supplied to the inputs of the early and late correlators. In the example of a relative delay of ½ chip (see the published application at page 9, lines 3 to 4 and 56) correlation measurements are successively made by the correlators with code delays of 0 and ½ chip, 1 and 1½ chips, 2 and 2½ chips, etc., corresponding to a succession of code delays separated by ½ chip, which is substantially wider than the delay spacing as used in the tracking mode (namely 1/20 chip;

see page 7, lines 31 and 40, and page 9, lines 9 to 12, of the published application).

Accordingly, the Board considers that the use of the expression *"code delays"* in claim 10 in connection with the acquisition mode is unambiguous and that the subject-matter of feature (ii) is disclosed in the application as originally filed.

2.3 At the oral proceedings and in his written submissions, the respondent also questioned the clarity of the expressions *"dynamically selectable delays"* and *"delay spacing"* as used in the claims in connection with the correlators.

The Board interprets the feature *"the correlators have dynamically selectable delays"* as used both in present claim 1 and claim 1 as granted as meaning that the receiver is provided with selection means for changeably selecting the amounts of delay applied to the local PRN code signals at the respective inputs of the two correlators. The expression *"delay spacing"* as used for example at page 3, line 18 of the patent specification is understood by the Board as the difference between the correlator delays and, more specifically, in connection with the tracking mode as the difference in delay between the two locally generated PRN-code signals at the inputs of the correlators, configured as a *"punctual"* and an *"early minus late"* correlator, respectively (see also Figures 4 and 5 and page 10, lines 1 to 4 of the patent specification). The Board therefore considers these expressions used in the claims to be clear.

2.4 The respondent also argued that the amended wording of feature (ii) of claim 10 contravened Article 123(3) EPC. The Board considers however that the revised wording of feature (ii) in combination with the addition of feature (iii) limits the protection conferred in that the claim now specifies how the received code is stepped through in the acquisition mode, namely by setting the appropriate code delays for the early and late correlators.

2.5 At the oral proceedings and in his written submissions the respondent also objected to the wording *"selectable to"* in claim 1 for the reasons that it was inadmissible to qualify the delay as being dynamically selectable to any value when the receiver switches from the acquisition mode to the tracking mode and that, according to the description, the time difference between the correlators was ½ chip in the acquisition mode and therefore not selectable to less than one chip. The Board notes however that claim 1 does not specifically relate to the selection of the delay on switching from the acquisition mode to the tracking mode or during the tracking mode, but is formulated in more general terms.

2.6 The Board therefore concludes that the objections raised by the respondent do not give rise to objection under Articles 84 and 123 EPC.

3. *Sufficiency of disclosure*

In his letter of 28 January 2004, the respondent raised an objection of insufficient disclosure due to the use of ambiguous terms. However, no specific arguments were

presented and the Board sees no reason to deviate from the opinion of the Opposition Division that the patent discloses the invention in a manner sufficiently clear and complete for it to be carried out by the skilled person.

4. *Novelty*

At the oral proceedings the respondent argued that the subject-matter of claim 1 was not new in view of DO2. However, at the oral proceedings it was common ground between the parties that the analysis of the prior art in respect of amended claim 1 as given by the Opposition Division in their decision was correct. According to that decision at least the last feature of the claim, namely *"wherein the delay spacing is dynamically selectable to less than one chip"*, is not known from DO2. The Board agrees and, since present claim 1 also includes this feature, the subject-matter of claim 1 is new with respect to the disclosure of DO2.

5. *Inventive step - claim 1*

5.1 The respondent submitted that the subject-matter of claim 1 lacked an inventive step in view of DO2. He argued that from the passage at page 30, left column, section I, lines 5 to 8 (*"The overall synchronization (sync) process is typically achieved in two steps: an initial coarse code phase alignment (acquisition), followed by a continuous fine alignment (tracking)."*), it followed that during acquisition the code delays are wider apart than the correlator spacing used in the tracking mode. Further, he argued that the sentence at

page 41, left column, last full paragraph, namely *"In applications with significant dynamics, it might be desirable to adjust the total loop-gain K_L as d varies in order to keep the closed-loop bandwidth B_L constant."* clearly suggested to vary δ and thereby render the relative delay spacing dynamically selectable. Figure 5 of DO2 was also said to suggest this.

5.2 The Board cannot follow these arguments for the following reasons. The fact that a coarse code phase alignment is achieved during acquisition and a fine alignment during the subsequent tracking does not imply or suggest different code delays, since with the same delays in both modes the tracking would also be more accurate than the acquisition and result in a finer alignment of the local and received codes due to the feedback action of the tracking loop. Further, the Board notes that DO2 concerns a theoretical performance analysis of code tracking loops. On reading the whole paragraph which includes the sentence referred to by the respondent, it follows that the wording *"as d varies"* concerns the variation of δ in the optimization process of minimizing the linear variance σ_ε^2. This optimization process is part of the theoretical analysis of the performance of the system for different values of δ as illustrated by Figures 5, 7 and 8. There is no suggestion to actually render δ a selectable parameter in the receiver of the PN synchronization system of Figure 1. On the contrary, the Board considers that from page 34, left column, section IV, lines 6 to 16, it follows that a **fixed** value $2\delta T_c$ (T_c denoting 1 chip time) is used for the correlator spacing for the tracking mode. This also follows from

the sentence bridging pages 40 and 41 of DO2: *"Furthermore, d is lower-bounded in practice by loop-acquisition and hardware considerations, such as the highest clock rate that can be employed to implement the fractional-chip (dT_c) code shifts."*, which is understood by the Board as giving a lower limit for δ in the tracking mode in view of the requirements for δ in the acquisition mode. If different values for δ for each of the modes were envisaged or suggested, there would be no reason to give a lower limit for δ during tracking in dependence on loop-acquisition requirements.

5.3 The respondent also argued that the subject-matter of claim 1 lacks an inventive step in view of a combination of the teachings of DO2 and DO1 or a combination of DO2 and DO4, since, in fact, DO1 and DO4 each describe the hardware necessary to implement the system disclosed in DO2.

5.4 The Board disagrees; if a person skilled in the art, starting from DO2, were to consider DO1 or DO4, assuming for the sake of argument that there were a reason for doing so, and were to apply the teaching of DO1 or DO4 to the system according to DO2, he would not arrive at the subject-matter of claim 1 for the following reasons:
In the GPS-receiver according to DO1, a **fixed** relative delay of one chip is used for the tracking mode (column 7, line 67, to column 8, line 9, and column 8, lines 21 to 27) and a **fixed** spacing of about half a chip is used for the acquisition mode (column 19, lines 2 to 7). For each mode different circuitry is used, each defining a fixed delay spacing for the

corresponding mode. There is thus no suggestion to vary the delay spacing or render it dynamically selectable. DO4 (see, in particular, the title and column 3, lines 61 to 63) relates to a PRN code detection and tracking system for navigation applications. The system includes means for dynamically controlling and varying the non-linear receiver characteristics so that a relatively large extended "capture" detection range can be utilized during an initial acquisition operation and relatively narrower detection ranges during the tracking operation (see the abstract and column 2, lines 51 to 68). The detection range is dynamically varied (cf. Figures 2 and 3) by applying a feedback signal to a time shift comparator 15 (see Figure 4), the feedback signal consisting of a number M of summed delayed and advanced signal components of the signal from local code generator 19 (column 6, lines 25 to 40). Each of these signal components is delayed by a **fixed** value being a multiple of "Δ" (column 6, lines 25 to 62, and Figure 6; "Δ" in Figures 4 and 5). The number of summed signal components is determined by selecting the bit lengths of registers 30 and 31 (Fig.6A) for controlling the advance/delay element 20 (Figure 4 and column 6, lines 63 to 68). In another embodiment, the signal components are individually supplied to a plurality of correlators 52 (Figure 8), each being provided with a respective signal component having a **fixed** delay, the outputs of the correlators being weighted by weights K_i (column 8, line 56, to column 9, line 6). It follows that DO4 does not suggest to render the individual delays variable or dynamically selectable.

5.5 The respondent further argued that if, alternatively, DO1 were considered to represent the closest prior art, a person skilled in the art, when faced with the problem of increasing the tracking accuracy, would consider DO2 and select a smaller delay spacing for the tracking mode.

According to the Board, if a person skilled in the art were to do so and were to apply a smaller delay spacing for the tracking mode to the receiver of DO1, this would not result in making the delays and the delay spacing dynamically selectable since separate circuitry is used in DO1 for tracking and acquisition; for the acquisition mode, correlators consisting of multipliers 332, 334 and low-pass filters 322, 324 are used to correlate the received code with the *"prompt"* (or punctual) code provided by the local C/A code generator 330 (see Figure 3), whereas for the tracking mode, a *"late-early"* signal (defining the relative delay spacing in the tracking mode) is correlated with the received code by means of correlators consisting of multipliers 336, 338 and low-pass filters 326, 328.

5.6 The Board therefore concludes that the receiver according to claim 1 involves an inventive step over the cited prior art.

6. *Inventive step - claim 10*

6.1 With respect to claim 10, the respondent argued that the subject-matter thereof lacked an inventive step in view of a combination of DO1 and DO2.

The Board notes however that in order to arrive at the subject-matter of claim 10 starting from DO1, it would

inter alia be necessary to reconfigure the channel processor 320 of the receiver of DO1, including the multipliers 332, 334, 336, 338, filters 322, 324, 326, 328 and C/A code generator 330 (see Figure 3) such that a pair of correlators acts as early and late correlators in the acquisition mode and the same pair acts as punctual and early-late correlators in the tracking mode. DO1 does not suggest such reconfiguration. Moreover, since no hint at such reconfiguration of the channel processor can be found in DO2, applying the teaching of DO2 to the receiver of DO1 would not result in a receiver as claimed in claim 10. For the same reasons, starting from DO2, the application of the specific configuration of the correlators as disclosed in DO1 (Figure 3) as referred to above to the system as shown in DO2, Figures 1 and 4, would not result in the two configurations of the same pair of correlators as claimed in claim 10.

6.2 The Board therefore concludes that the receiver according to claim 10 involves an inventive step over the cited prior art.

7. The opposition ground referred to in the notice of opposition according to which the subject-matter of the patent is excluded from patentability pursuant to Article 52(2) EPC was not substantiated during either the opposition or the appeal proceedings and therefore need not to be further considered by the Board.

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 as amended in the following version:

   - claims according to the first auxiliary request (see point VIII);

   - description and drawings as granted.

The Registrar: The Chairman:

D. Magliano A. S. Clelland