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D E C I S I O N
of 8 March 2006

Case Number: T 0563/03 - 3.4.01

Application Number: 99914888.5

Publication Number: 1058952

IPC: H01Q 3/26

Language of the proceedings: EN

Title of invention:

System and method for directing an adaptive antenna array

Applicant:

GENERAL ELECTRIC COMPANY

Opponent:

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Headword:

-

Relevant legal provisions:

EPC Art. 52(1), 54, 56

Keyword:

"Inventive step - no (after amendment)"

Decisions cited:

G 0002/98

Catchword:

-



Case Number: T 0563/03 - 3.4.01

D E C I S I O N
of the Technical Board of Appeal 3.4.01
of 8 March 2006

Appellant: GENERAL ELECTRIC COMPANY
1 River Road
Schenectady, NY 12345 (US)

Representative: Goode, Ian Roy
London Patent Operation
General Electric International, Inc.
15 John Adam Street
London WC2N 6LU (GB)

Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 5 November 2002
refusing European application No. 99914888.5
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: B. Schachenmann
Members: R. Bekkering
G. Assi

Summary of Facts and Submissions

- I. European patent application 99 914 888.5 (publication Nos. WO-A-99 45609 and EP-A-1 058 952) was refused pursuant to Article 97(1) EPC by a decision of the examining division dispatched on 5 November 2002, on the grounds of lack of clarity (Article 84 EPC) and lack of inventive step (Article 56 EPC).
- II. The applicant (appellant) lodged an appeal against the decision on 3 January 2003 and paid the appeal fee on the same day. The statement setting out the grounds of appeal was received on 12 March 2003.
- III. Reference was made *inter alia* to the following document:
- D2: WO-A-98 16077
- IV. Oral proceedings, requested as an auxiliary measure by the appellant, were held on 8 March 2006.
- V. The appellant requested that the decision under appeal be set aside and a patent be granted on the basis of the following documents:
- Claims: 1 to 5 filed in the oral proceedings on 8 March 2006;
- Description: pages 1 to 9 as published;
- Drawings: Sheets 1/3 to 3/3 as published.

VI. Independent claims 1 and 5 according to the appellant's request read as follows:

"1. A system (300) for directing a receiving lobe of an adaptive antenna array (50) toward an aircraft (350) in flight comprising:

an aircraft position vector calculator (315) for receiving aircraft position information including range and bearing data for the aircraft (350) from an aircraft tracking service, and for calculating, based upon said aircraft position information, an aircraft position vector g ;

an antenna weight vector generator (320) adapted to receive said aircraft position vector g from said aircraft position vector calculator and to generate, based upon said aircraft position vector g , an antenna element weight vector w ; and

an adaptive antenna array (50) comprising a plurality of antenna elements adaptive to received [sic] said antenna element weight vector w and to adjust the respective weights of said elements in accordance with said weight vector w such that a receiving lobe of said adaptive antenna array is directed toward said aircraft in flight, wherein said adaptive antenna array operates in the the [sic] 2400-2483.5 MHz or the 5725-5850 MHz band."

"5. A method for directing a receiving lobe of an antenna array (50) operating in the 2400-2483.5 MHz or the 5725-5850 MHz band toward an aircraft in flight comprising the steps of:

providing an aircraft tracking service and obtaining aircraft position information including range and bearing data for the aircraft (350) therefrom;

*calculating a position vector g based upon said position information, said aircraft position vector g representing the direction of an aircraft (350) from said adaptive antenna array (50);
calculating a weight vector w based upon said position vector g ; and
providing said weight vector w to the elements of said adaptive antenna array (50) such a [sic] receiving lobe of said adaptive antenna array is directed toward said aircraft (350)."*

Reasons for the Decision

1. The appeal complies with the requirements of Articles 106 to 108 and Rule 64 EPC and is, therefore, admissible.

2. *Amendments*

Independent claim 1 is based on original claim 1, the additional feature which relates to the aircraft position information including range and bearing data for the aircraft being taken from the description (see page 4, lines 15 to 18 of the published application), and the additional feature which relates to the adaptive antenna array operating in the 2400-2483.5 MHz or the 5725-5850 MHz band being derivable from originally filed claim 4 and the description (see page 8, second paragraph of the published application).

Similarly, independent claim 5 is based on original claim 8 with the above additional features taken from the original description.

The board is thus satisfied that the amendments to these claims comply with the requirements of Article 123(2) EPC.

3. *Novelty, inventive step*

3.1 The present application claims priority from the following three US priority documents:

- 60/076 610 filed 3 March 1998
- 60/076 666 filed 3 March 1998
- 09/227 371 filed 8 January 1999

The subject-matter of the claims on file, in particular the position vector calculator as defined in claim 1, is not disclosed in the two earlier priority documents 60/076 610 and 60/076 666 filed 3 March 1998, but is only disclosed in the later priority document 09/227 371 filed 8 January 1999. In particular, priority document 60/076 610 filed 3 March 1998 relates to a method and apparatus for plane-to-plane data relay and is not concerned with adaptive antenna arrays. Priority document 60/076 666 filed 3 March 1998, on the other hand, discloses a system for directing a receiving lobe of an adaptive antenna array toward an aircraft in flight. The main lobe of the antenna array is steered in the direction of the airplane, which is stated to be known at the ground at any time instant (see page 8, third paragraph). As the airplane moves, its position vector g changes and the optimal array weights are recomputed to track these changes (see

page 9, second paragraph). The document is silent as to how the position vector g is obtained. In particular, there is no disclosure of an aircraft position vector calculator for receiving aircraft position information including range and bearing data for the aircraft from an aircraft tracking service, and for calculating, based upon said aircraft position information, an aircraft position vector g as per claim 1. As such, the aircraft position vector could be obtained in a number of ways. For example, instead of being calculated within the system it could be provided by a remote, external service or it could for example be derived from a phase comparison of a signal received from the aircraft between the antenna elements of the array or in any other suitable way. Accordingly, the subject-matter of claim 1 cannot be derived directly and unambiguously from this priority document as required (see G 2/98, headnote (OJ 2001, 413)).

Finally, priority document 09/227 371 filed 8 January 1999 is substantially identical to the present application as originally filed. Accordingly, in the board's opinion, only the latter priority date of 8 January 1999 is validly claimed in the application in suit.

In view of the above, document D2, having a publication date of 16 April 1998, has been published before the only validly claimed priority date of 8 January 1999 of the application in suit and is, therefore, prior art pursuant to Article 54(2) EPC.

The appellant was informed on these issues by a communication dated 20 December 2005.

3.2 Document D2, considered to provide the closest prior art, discloses a communication system with a plurality of users communicating via a wireless link, in particular a cellular mobile telephone system (see page 12, line 17 to page 13, line 12; figure 9). The system comprises fixed base stations having a directional antenna array and roving mobile units including a GPS receiver or other hardware to determine the position of each mobile unit. The base stations may comprise a 10-element directional antenna array capable of forming antenna patterns with a beamwidth of 36 degrees and beamformer hardware. The beamformer hardware takes as input the current latitude and longitude of each mobile unit, compares it with the known location of the base station to determine the angle of arrival of each mobile unit's signal, and generates a set of complex antenna weights to apply to each antenna output for each mobile unit such that the combined signal represents a beam pattern steered in the direction of the desired mobile unit for both the transmit and receive signals. The complex antenna weights are calculated to simply steer the antenna beam. Implementing a GPS receiver in the phone is one possibility for providing accurate geo-location information to the base station. Alternatively, at least three base stations can be employed to triangulate the mobile location using a variety of algorithms (see page 23, lines 15 to 18). Furthermore, although the preferred embodiments are described in the context of a cellular communication system, according to document D2 the principles can be applied to any communication system. For example, geo-location data and associated beamforming can be embodied in any radio

frequency communication system such as satellite communication systems (see page 23, line 27 to page 24, line 3).

Accordingly, document D2 discloses, using the terminology of claim 1 in suit, a system for directing a receiving lobe of an adaptive antenna array toward a mobile unit comprising:

a mobile unit position vector calculator for receiving position information for the mobile unit and for calculating, based upon said position information, a mobile unit position vector;

an antenna weight vector generator adapted to receive said position vector and to generate, based thereon, an antenna element weight vector; and

an adaptive antenna array comprising a plurality of antenna elements adaptive to receive said antenna element weight vector and to adjust the respective weights of said elements in accordance with said weight vector such that a receiving lobe of said adaptive antenna array is directed toward said mobile unit.

In particular, it is noted that the calculation of the angle of arrival of each mobile unit's signal of document D2 is equivalent to the calculation of the mobile unit position vector, which according to the application in suit comprises elevation angle and bearing (see page 5, line 6 to page 6, line 6 and figure 2 of the application as published). Furthermore, the generation of a set of complex antenna weights of document D2 corresponds to the generation of the antenna weight vector, which comprises n complex elements (n being the number of elements in the antenna array), that is, n magnitude and phase pairs, wherein

each pair corresponds to an individual element of the array (see page 3, line 23 to page 4, line 3 of the application as published).

3.3 Accordingly, the subject-matter of claim 1 in suit differs from the system known from document D2 in that

- the mobile unit is an aircraft in flight,
- the position vector calculator is for receiving aircraft position information including range and bearing data for the aircraft from an aircraft tracking service, and
- the adaptive antenna array operates in the 2400-2483.5 MHz or the 5725-5850 MHz band.

The subject-matter of claim 1 in suit is, thus, novel having regard to document D2 (Article 54(1) and (2) EPC).

3.4 In view of the above differences, the objective problem to be solved underlying the application in suit with respect to the prior art provided by document D2 may be seen as to extend the teaching of document D2 to communications with further types of mobile units.

A general hint at other fields of application than the handheld and car mounted mobile units specifically addressed in document D2 is already given in this document (see point 3.2, *supra*). The identification of the above problem per se, therefore, does not involve an inventive step.

Furthermore, the desirability of providing improved communications, less prone to co-channel interference, specifically with aircrafts, which according to the application in suit may encompass all airborne crafts ranging from airplanes to helicopters, gliders, drones and balloons, in the board's view would have been obvious for a skilled person working in the field of communication technology. Moreover, configuring the position vector calculator for receiving aircraft position information including range and bearing data for the aircraft from an aircraft tracking service, the service being a GPS system onboard the aircraft, a ground-based positioning system or some other existing commercial tracking service making aircraft position data available, constitutes an obvious solution for obtaining the required geo-location data of the aircraft. Finally, the skilled person would have to select an appropriate radiofrequency for the communication. The use of the 2400-2483.5 MHz and 5725-5850 MHz band of the license free ISM band, in the board's opinion would constitute an obvious choice for the skilled person.

- 3.5 The appellant argued that the system known from document D2 was not suitable for tracking aircrafts in flight, the requirements of power, weather penetration, speed and beam width being entirely different. In particular, document D2 failed to suggest the use of range data of an aircraft in flight allowing to adjust among other things the transmission power and beam width as a function of the distance between the antenna and the aircraft.

It is, however, noted that claim 1 is not limited to particularly fast or remote aircrafts, but rather covers any airborne craft. Furthermore, in the board's opinion at any rate greater travelling speed and distance of the mobile unit would merely be a matter of scaling without, however, affecting the fundamental principles of directing the antenna lobe based on position data taught by document D2.

Concerning the use of range data, it is noted that claim 1, and in fact the entire application in suit, is silent about any adaptation of power or beam width depending on range data. As such, the range data, with the bearing data, merely provide the geo-location data required in the system taught by document D2. It is, furthermore, noted that a consideration of the distance between the base station antenna and the mobile unit, as well as the mobile unit's speed, for an adjustment of the transmission power and antenna beam width, at any rate would already be suggested by document D2 (see page 14, lines 13 to 17).

- 3.6 For the reasons above, the subject-matter of claim 1 according to the main request lacks an inventive step (Article 56 EPC).

- 3.7 The argumentation above applies, *mutatis mutandis*, to the subject-matter of independent claim 5 directed to a corresponding method of directing a receiving lobe of an antenna array toward an aircraft in flight. The subject-matter of claim 5, thus, also lacks an inventive step (Article 56 EPC).

4. The appellant's request is, therefore, not allowable.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

R. Schumacher

B. Schachenmann