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D E C I S I O N
of 3 May 2000

Case Number: T 0917/98 - 3.5.1

Application Number: 88901461.9

Publication Number: 0300061

IPC: H04L 12/56

Language of the proceedings: EN

Title of invention:
Self-routing switching system

Applicant:
FUJITSU LIMITED

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 52(1), 56

Keyword:
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-



Case Number: T 0917/98 - 3.5.1

D E C I S I O N
of the Technical Board of Appeal 3.5.1
of 3 May 2000

Appellant: FUJITSU LIMITED
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 29 April 1998
refusing European patent application
No. 88 901 461.9 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: P. K. J. van den Berg

Members: A. S. Clelland

V. Di Cerbo

Summary of Facts and Submissions

I. This is an appeal against the decision of the Examining Division of 29 April 1998 to refuse application No. 88 901 461.9 on the ground that the subject-matter of claim 1 of the then main and first auxiliary requests lacked an inventive step. The present appeal is in fact the third in connection with this application, the first being PCT protest case No. W 33/88 in which it was decided that additional search fees, ordered by the EPO acting as the competent ISA, should be reimbursed; the second decision was T 478/94 in which the Board set aside a decision by the Examining Division to refuse the application for lack of inventive step on the ground that the Examining Division's conclusion was not adequately supported.

II. The decision by the Examining Division dated 29 April 1998 followed a communication under Rule 51(4) EPC in which the Examining Division proposed grant on the basis of a second auxiliary request and gave reasons why the main and a first auxiliary request were not allowable. In response, the appellant indicated disapproval of the text proposed for grant and requested an appealable decision. The Examining Division accordingly refused the application.

The refusal was based on the following documents, also contained in their previous decision:

D1: IEEE Journal on Selected Areas in Communications, vol. SAC-4, No. 8, November 1986, IEEE, (New York, US), J. S. Turner: "Design of an Integrated Services Packet Network", pages 1373-1380.

D4: IEEE Global Telecommunications Conference, Atlanta Georgia, US, November 26-29, 1984, pages 105-113.

D5: The 5th International Conference on Distributed Computing Systems, Denver Colorado, US, May 13-17, 1985, pages 210-217.

III. The appellant (applicant) lodged an appeal against this latest decision and together with the statement of grounds submitted a revised claim 1 of both a main and an auxiliary request. The appellant requested that the Examining Division's decision be set aside and a patent granted on the basis of either the main or the auxiliary request. Oral proceedings were requested.

IV. The oral proceedings were held on 3 May 2000. In the course of the oral proceedings the appellant withdrew both requests and filed a new claim 1 of a single request. It was requested that the decision under appeal be set aside and a patent granted on the basis of the new claim 1 and claims 2 to 18 of the Rule 51(4) EPC communication. Grant is accordingly requested on the basis of the following documents:

Claims: claim 1 as filed on 3 May 2000;
claims 2 to 18 of the main request filed on 6 November 1996.

Description: pages 7, 8, 10 to 13, 16 to 29, 31, 32, 34, 35, 37, 38, 40 to 42, 44 to 46, 48 as originally filed;
pages 1, 2, 2a, 2b, 2c, 2d, 3 to 6, 9, 14, 15, 30, 33, 36, 39, 43, 47 as filed on 20 December 1995.

Drawings: Sheets 1 to 37 as originally filed.

V. claim 1 reads as follows:

"A self-routing switching system for an asynchronous transfer mode switch (SWITCH0, SWITCH1; Fig. 8B) for asynchronously switching cells, each including a transmission information (T.INF) and an identification information (I.INF; VCN_0), between a plurality of incoming lines (# 1... # N) and a plurality of outgoing lines (# 1... # N), said cells having been generated by dividing a transmission data of a call into a plurality of transmission information and identification information, comprising:

- a) multipath self-routing speech path means (20) for creating a plurality of paths between said plurality of incoming lines and said plurality of outgoing lines from each one incoming line to each one outgoing line;

- b) route setting means (10, 11-1, 11-2, 12, 15) for receiving cells from said plurality of incoming lines, storing in a table (16), respectively provided for each incoming line, sets of a control information (RH1, RH2, RH3) for identifying a path for each cell of a call from an incoming line to an outgoing line and a new identification information (VCN_1) indicating an outgoing link of said switch, each set being designated in the table (16) by an identification information (VCN_0) of a received cell indicating an incoming link into said switch, and for reading, in a transfer phase, said control information (RH1, RH2, RH3) and said new identification information (VCN_1) from

said table (16) in accordance with the identification information (VCN_0) of the received cell and for adding said control information (RH1, RH2, RH3) and said new identification information (VCN_1) to said each cell, wherein to all cells of a call having the same identification information the same control information and the same new identification information (VCN_1) is added, such that all cells of a call are transferred through the same path selected by a call processor (12);

- c) said call processor (12) including means (11-1) for receiving, in a call setting phase performed once a call begins, notification from a calling party (X) of transmission of a call and of a destination party (Y) for said transmission information (T.INF) and for selecting one path of said plurality of paths for all cells of said call from said incoming line to said outgoing line among said plurality of paths by determining said control information and for determining the same identification information (VCN) for all cells of said call to be transmitted and for setting in said table (16) said sets of incoming link identification informations (VCN_0) and new outgoing link identification informations (VCN_1) plus the control information (RH1, RH2, RH3); and
- d) said multipath self-routing speech path means (20H, Fig. 8A; 30, Fig. 3) being comprised of a plurality of self-routing switch modules, said self-routing switch modules including: an input stage self-routing switch connectable to said plurality of incoming lines (# 1... # N), a middle stage self-routing switch connected to said input

stage self-routing switch, and an output stage self-routing switch connected to said middle stage self-routing switch so as to form a multiple link connection between said plurality of incoming lines (# 1... # N) and said plurality of outgoing lines (# 1... # N)."

Reasons for the Decision

1. *Background to the invention*
 - 1.1 ATM or asynchronous transfer mode was originally envisaged as a broad band version of ISDN to enable high-speed data communications of all types to be carried across a single, integrated, network. In ATM the data is carried in small, fixed sized cells of 53 bytes which unlike the standard packet system all transit between nodes following the same path, referred to in the art as a virtual channel. The ATM system is accordingly connection-oriented and depends on high-speed switches at the nodes in order to transfer data efficiently.
 - 1.2 At the priority dates of the present application the ATM art was in its infancy; the earliest CCITT recommendations on ATM date from 1988, after the priority dates of the application. Although the text of the description has very little to say about ATM it is clear to the Board that what is described is a preliminary ATM system and in particular an ATM switch.
 - 1.3 The application is concerned with a form of an ATM switch fabric known as a multistage switch employing serial stage-by-stage switching. The simplest such

switch fabric is the so-called "Banyan" matrix in which each switching element of each stage is a simple binary switch; the cell header contains the information for each stage of the switch, the first bit applying to the first stage, the second bit to the second stage, and so forth. Thus, if the first bit is a binary "1", the cell will be outputted at the "1" output of the switching element to which it is inputted. In a Banyan network there is one path from any input to any output and the entire switching matrix is made up of identical switching elements. A switch can be enlarged by extending the number of stages and the number of switching elements in each stage. Because the control information for the path through the network is contained in the cell being switched such a switching fabric is referred to as *self-routing*.

- 1.4 A disadvantage of a simple Banyan network is that different inputs may require access to the same switching element; since there is only one path between each input and output, signals cannot be re-routed and blocking occurs. The result is accordingly congestion.

- 1.5 This congestion problem can be overcome by a somewhat more complicated switching matrix referred to as a multiple-path multistage interconnection network. In such a matrix, which is necessarily of considerably greater complexity than a Banyan matrix, the route from input to output can be changed dynamically in order to cope with congestion and blocking. This however gives rise to a new problem, that of cell sequence integrity: cells which take a roundabout path through the matrix may arrive at the output after later cells which took a more direct path. The result is accordingly that the cells are out of sequence and buffering is needed to

recover the cell sequence, slowing down the switch.

1.6 Although not clearly stated in the description, it became clear in the course of the oral proceedings that the application is concerned with ensuring cell sequence integrity in a multiple-path multistage interconnection network.

2. *Inventive step*

2.1 The only issue in the present appeal is that of inventive step. The application was refused on the ground that claim 1 of the then main and first auxiliary requests was considered to lack an inventive step in view of the disclosure of D1 having regard to the multipath multistage interconnection networks known from D4 or D5.

2.2 It was common ground at the oral proceedings that the single most relevant document is D1. D1 does not explicitly refer to ATM and starts by describing the disadvantages of the ISDN system as then proposed. It is said that the ISDN system is not truly integrated and lacks bandwidth for future expansion. The document then goes on to map out a path towards a broad-band packet system which avoids the disadvantages of ISDN. The Board observes that D1 points the skilled person in a specific direction but contains little in the way of concrete details as to how the envisaged goal of broad-band data communication is to be achieved.

2.3 Be that as it may, D1 is a broad-band ISDN system, as noted above a name which embraces what became known as ATM. D1 proposes two services, one of which is a connection-oriented packet-switching system. In the

discussion of "*point-to-point channels*" at page 1376, left-hand column, D1 describes what appears to be a call setting phase at the commencement of a call and distinguishes between on the one hand connection-oriented "*point-to-point channels*" and on the other hand datagrams, i.e. the well-known packet switching system without any pre-established connections. Page 1377, "Packet Switch Design", refers to a protocol for data transfer packets in which the path each packet takes through the network is determined by successive bits of its destination address. The summary of D1 at page 1379 refers to the service as "predominantly connection-oriented". At page 1375, right-hand column, lines 26 to 37 and page 1376, right-hand column, lines 31 to 34, there is discussion of the sensitivity of certain applications, in particular voice, to packet jitter and delay, an application which would benefit from a connection-oriented service in which all cells of a call are sent along the same path. D1 also refers to a network level protocol for connection-oriented services in which each packet contains control information including a logical channel number characterising the connection, see Figure 3 at page 1377, right-hand column.

- 2.4 The Board accordingly concludes that D1 relates to an ATM switch as set forth in the introductory wording of claim 1.
- 2.5 In the course of the oral proceedings it became clear that the subject-matter of claim 1 differs from the disclosure of D1 primarily in features (a) and (b) of the claim.
- 2.6 D1 discloses what appears to be a standard banyan

network, see Figures 4 and 7, and indeed refers at page 1378, right-hand column, to the problem of congestion which occurs in such switches. The solution is said to be the use of a distribution network preceding the switch itself, this network dynamically distributing packets to give even loading at the switch output. The Board takes the view that the skilled person, reading D1 and noting the problem of congestion in the switch, would consider the effect of a distribution network on cell sequence integrity and would seek an alternative solution to the congestion problem. A multiple-path switch as exemplified by D4 or D5 provides such a solution. D4 discusses at page 110, left-hand column multiple-path networks which have the ability to perform dynamic re-routing to avoid busy or faulty switching elements. D5 describes the property of known switching matrices of having a unique path from an input to an output as being "an obvious threat to reliability and also causes low throughput", see page 210, left-hand column. The solution to this problem is seen as the provision of multiple-path networks, re-routing being done either statically or dynamically. The paper itself is concerned with dynamic re-routing. Thus, both D4 and D5 point the skilled person to a solution to, *inter alia*, the congestion problem, by making use of multipath switches. Accordingly, the Board considers that the skilled person, faced with the problem of congestion in the D1 proposal, would see D4 or D5 as identifying a solution. The provision of a multipath switch in the D1 arrangement in accordance with feature (a) of claim 1 is therefore in the Board's view an obvious modification.

2.7 However, it does not appear to the Board that feature

(b) of claim 1 follows from this. Turning first to D4, this is a review article covering a wide range of applications from telephone switching to parallel computers; there is no discussion of the specific requirements and problems of broad-band communications. Although D4 mentions circuit switching, its primary focus is packet switching in telephone networks and computers; there is no mention of cell sequence integrity. Reference is made to ISDN, see page 105, both columns and page 110, left-hand column. In a low bandwidth system such as ISDN, cell sequence integrity is of lesser importance; the provision of dynamic re-routing in the specific switching control scheme discussed at page 110, left-hand column, indeed suggests that cell sequence integrity was not considered an important matter. The Board accordingly concludes that the skilled person, applying the teaching of D4 to the D1 switch arrangement, would not arrive at a switching system in which all cells of a call are necessarily transferred through the same path. Nor does it appear that the provision of this further feature would be obvious since at the claimed priority dates the skilled person was not aware of the ATM specification and the need for cell sequence integrity.

2.8 Turning now to D5, this paper is explicitly concerned with multipath networks for high-bandwidth communication in which dynamic re-routing is used to improve reliability and enhance throughput. Although in the paragraph bridging the columns of page 210 reference is made to static re-routing, the discussion of this technique makes clear that it has the disadvantage that an alternate path is only selected after a separate fault diagnosis routine is run and that its throughput is the same as that of unique path

networks, i.e. it does not solve the congestion problem. Dynamic re-routing as used in D5 will however give rise to the disadvantage that cell sequence integrity cannot be guaranteed. The document nowhere addresses this problem and the Board concludes that the system it discloses does not ensure that all cells of a call are transferred through the same path as required by feature (b). The skilled person, incorporating the multipath network of D5 in the arrangement of D1 would therefore not arrive at the claimed switching system.

- 2.9 The Board accordingly concludes that the subject-matter of claim 1 involves an inventive step having regard to the disclosure of D1 when read in the light of the disclosure of D4 or D5.

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 grant a patent in accordance with the appellant's request.

The Registrar:

The Chairman:

M. Kiehl

P. K. J. van den Berg