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Datasheet for the decision of 29 November 2022

Case Number: T 3183/19 - 3.5.03

Application Number: 15746734.1

Publication Number: 3089389

IPC: H04J99/00, H04B7/04, H04B7/022

Language of the proceedings: EN

Title of invention:
Base station device, wireless communication system, and communication method

Applicant:
Nippon Telegraph and Telephone Corporation

Headword:
LLR combination/NTT

Relevant legal provisions:
EPC Art. 56
RPBA 2020 Art. 13(2)

Keyword:

Inventive step - main and 1st auxiliary request (no): obvious modification
Admittance of requests filed after summons - 2nd and 3rd auxiliary requests: no exceptional circumstances justified with cogent reasons + "fresh case"

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Case Number: T 3183/19 - 3.5.03

D E C I S I O N
of Technical Board of Appeal 3.5.03
of 29 November 2022

Appellant: (Applicant)	Nippon Telegraph and Telephone Corporation 5-1, Otemachi 1-chome, Chiyoda-ku, Tokyo 100-8116 (JP)
Representative:	Brevalex 95, rue d'Amsterdam 75378 Paris Cedex 8 (FR)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 18 June 2019 refusing European patent application No. 15746734.1 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chair	K. Bengi-Akyürek
Members:	J. Eraso Helguera
	F. Bostedt

Summary of Facts and Submissions

I. The appeal was lodged against the decision of the examining division to refuse the present European patent application for lack of inventive step (Article 56 EPC) with respect to the claims of a sole set of claims (main request).

II. During the examination proceedings, the examining division referred to the following prior-art document:

D1: Keying Wu and Xiayong Guo: "Uplink Multi-BS MIMO with Limited Backhaul Bandwidth", IEEE WCNC 2011.

III. Oral proceedings before the board were held on 29 November 2022.

The appellant requested that the appealed decision be set aside and that a patent be granted on the basis of any of four requests: the **main request** subject to the appealed decision, a **first auxiliary request** filed with the statement of grounds of appeal and a **second and a third auxiliary request** filed in response to the board's communication under Article 15(1) RPBA 2020.

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

IV. Claim 1 of the **main request** reads as follows:

"A base station apparatus comprising:
a plurality of remote unit apparatuses (20) each comprising at least one antenna (21); and
a central unit apparatus (10) connected to each of the remote unit apparatuses via a transmission path,

wherein the antenna provided in each of the remote unit apparatuses receives a transmission signal wirelessly transmitted from at least one wireless terminal (30) each comprising at least one antenna (31), and

each of the remote unit apparatuses comprises:

a radio frequency (RF) receiving unit (22) that receives the transmission signal wirelessly transmitted from the wireless terminal via the antenna provided in each of the remote unit apparatuses and outputs a reception signal (r_1, r_2);

a channel estimation unit (24) that estimates channel information (h_{e11}, h_{e12}, h_{e21}, h_{e22}) between the antenna of the wireless terminal and the antenna of each of the remote unit apparatuses, using the reception signal;

a likelihood calculation unit (29, 28) that calculates likelihood (M_{1e}, M_{2e}, R_{11}, R_{12}, R_{21}, R_{22}) of each transmission signal included in the reception signal, for each antenna provided in each of the remote unit apparatuses, using the channel information estimated by the channel estimation unit; and

an inter-unit transmission unit (23) that transmits likelihood information calculated by the likelihood calculation unit to the central unit apparatus, and

the central unit apparatus comprises:

an inter-unit receiving unit (11) that receives each likelihood information transmitted from the inter-unit transmission unit; and

a likelihood combination detection unit (17, 18) that combines the likelihood information received by the inter-unit receiving unit and outputs a signal (c_1, c_2, R_1, R_2) corresponding to each transmission signal transmitted from the wireless terminal, using combined likelihood information;

a decoding unit (14) that performs a decoding process on the signal output from the likelihood combination detection unit and outputs a bit sequence; and

a media access control (MAC) function unit (15) that performs a MAC process on the bit sequence output from the decoding unit,

the RF receiving unit, the channel estimation unit, the likelihood calculation unit, and the inter-unit transmission unit are provided in only each of the remote unit apparatuses,

the inter-unit receiving unit, the likelihood combination detection unit, the decoding unit, and the MAC function unit are provided in only the central unit apparatus,

the likelihood calculation unit calculates a reception replica using the channel information, for each transmission signal vector candidate determined in accordance with a modulation scheme of the transmission signal, and calculates a squared Euclidean distance (M_{1e}, M_{2e}) between the reception replica for each transmission signal vector candidate and the reception signal, as likelihood of the reception signal, and

the likelihood combination detection unit combines squared Euclidean distances received by the inter-unit receiving unit for each transmission signal vector candidate, and selects a transmission signal vector candidate that corresponds to minimum combined likelihood, to thereby output a code word (c_1, c_2) corresponding to each transmission signal transmitted from the wireless terminal."

Claim 1 of the **first auxiliary request** is the same as claim 1 of the main request, except for the addition of "single" before "base station" at the first line of the

claim.

Claim 1 of the **second auxiliary request** is the same as claim 1 of the main request, except for the addition of "with regard to each of the at least one antenna of each of the at least one wireless terminal," after "of each transmission signal" in the paragraph relating to the "likelihood calculation unit (29, 28)".

Claim 1 of the **third auxiliary request** is the same as claim 1 of the second auxiliary request, except for the addition of "likelihood of each antenna of the at least one wireless terminal ($R_1=R_{11}+R_{21}$, $R_2=R_{12}+R_{22}$) by using" after "that combines" in the paragraph relating to the "likelihood combination detection unit (17, 18)" and the addition of "wherein a number of the squared Euclidean distance is based on a total number of antennas of all of the at least one wireless terminal," after "the reception signal," in the penultimate paragraph of the claim.

Reasons for the Decision

1. MAIN REQUEST

1.1 Claim 1 - inventive step (Article 56 EPC)

1.1.1 Using the wording of claim 1, **D1** discloses (board's outline):

(a) A base station (BS) apparatus (page 1444, left-hand column, second paragraph: "cluster-based uplink multi-BS MIMO system") comprising:
(b) a plurality of remote unit apparatuses (page 1444, left-hand column, second paragraph: "... each

cluster contains M cooperative BSs ...") each comprising at least one antenna (page 1444, left-hand column, second paragraph: "... each BS with N_R receive antennas ...");

(c) a central unit apparatus ("central processing unit") connected to each of the remote unit apparatuses via a transmission path (page 1444, right-hand column, last paragraph),

(d) wherein the antenna provided in each of the remote unit apparatuses receives a transmission signal wirelessly transmitted from at least one wireless terminal each comprising at least one antenna (page 1444, left-hand column, second paragraph: "... The received signal is represented as ... where $\boldsymbol{y}_m(f,t)$ is the N_Rx1 signal vector received at the mth BS ..., $\boldsymbol{x}_n(f,t)$ the N_Tx1 signal vector transmitted from the nth terminal"), and

each of the remote unit apparatuses comprises:

(e) a radio frequency receiving unit that receives the transmission signal wirelessly transmitted from the wireless terminal via the antenna provided in each of the remote unit apparatuses and outputs a reception signal (page 1444, left-hand column, second paragraph: "... Orthogonal frequency division multiplexing (OFDM) is always assumed ...");

(f) a channel estimation unit that estimates channel information between the antenna of the wireless terminal and the antenna of each of the remote unit apparatuses, using the reception signal (page 1444, right-hand column, first paragraph: "... Each BS is also able to estimate the channel matrix between any terminal within the cluster and itself ...");

(g) a likelihood calculation unit that calculates likelihood of each transmission signal included in the reception signal, for each antenna provided in

each of the remote unit apparatuses, using the channel information estimated by the channel estimation unit (page 1444, right-hand column, last paragraph: "... each BS generates log-likelihood ratios (LLRs) for all information bits in local decoding ...");

(h) an inter-unit transmission unit that transmits likelihood information calculated by the likelihood calculation unit to the central unit apparatus (page 1444, right-hand column, last paragraph: "... and forwards the LLRs to a central processing unit ..."),

the central unit apparatus comprises:

(i) an inter-unit receiving unit that receives each likelihood information transmitted from the inter-unit transmission unit (page 1444, right-hand column, last paragraph: "... and forwards the LLRs to a central processing unit ...");

(j) a likelihood combination detection unit that combines the likelihood information received by the inter-unit receiving unit and outputs a signal corresponding to each transmission signal transmitted from the wireless terminal, using combined likelihood information (page 1444, right-hand column, last paragraph: "... a central processing unit, which combines the LLRs from different BSs and performs signal estimation ...");

(k) a decoding unit that performs a decoding process on the signal output from the likelihood combination detection unit and outputs a bit sequence (page 1445, left-hand column, first paragraph: "... The central processing unit then generates hard decisions based on the soft combination results ...");

(l) a media access control (MAC) function unit that performs a MAC process on the bit sequence output

from the decoding unit (*this unit must be necessarily present for further processing of the decoded bit sequence*),

(m) the RF receiving unit, the channel estimation unit, the likelihood calculation unit, and the inter-unit transmission unit are provided in ~~only~~ each of the remote unit apparatuses,

(n) the inter-unit receiving unit, the likelihood combination detection unit, the decoding unit, and the MAC function unit are provided in ~~only~~ the central unit apparatus,

(o) the likelihood calculation unit calculates a reception replica using the channel information, for each transmission signal vector candidate determined in accordance with a modulation scheme of the transmission signal, and calculates a squared Euclidean distance between the reception replica for each transmission signal vector candidate and the reception signal, as likelihood of the reception signal (page 1445, left-hand column, first paragraph: "... The generation of $\boldsymbol{L}_n^{(m)}$ is a standard operation and can be implemented using various existing techniques (both optimal and sub-optimal) ..."),

(p) the likelihood combination detection unit combines squared Euclidean distances received by the inter-unit receiving unit for each transmission signal vector candidate, and selects a transmission signal vector candidate that corresponds to minimum combined likelihood, to thereby output a code word corresponding to each transmission signal transmitted from the wireless terminal (page 1445, left-hand column, first paragraph: " ... The soft combination is carried out as [equation (3)] ... the LLR of $c_{n,i}$ after combination. The central

processing unit then generates hard decisions based on the soft combination results ...").

1.1.2 Hence, the subject-matter of claim 1 differs from D1 in features **(m)** and **(n)**, namely in that:

- the RF receiving unit, the channel estimation unit, the likelihood calculation unit, and the inter-unit transmission unit are provided in only each of the remote unit apparatuses, and

- the inter-unit receiving unit, the likelihood combination detection unit, the decoding unit, and the MAC function unit are provided in only the central unit apparatus.

1.1.3 The technical effect associated with the distinguishing features is that the resulting BS apparatus has fewer units. In other words, neither the "remote unit apparatuses" nor the "central unit apparatus" comprises all the units required to receive and decode transmission signals wirelessly transmitted from at least one wireless terminal.

The objective problem to be solved by the present invention may therefore be framed as "how to simplify the BS structure of D1".

1.1.4 The solution proposed in claim 1 does not involve an inventive step (Article 56 EPC) for the following reasons:

Document D1 concerns uplink collaborative MIMO processing among multiple BSs and introduces "three typical coordinated detection algorithms": joint detection (JD), distributed interference cancellation

(DIC) and soft combining (SC) (see page 1444, right-hand column). D1 further proposes a three-stage information exchange technique based on SC. Instead of exchanging LLRs for *all* information bits, as *existing* SC techniques do, the proposed technique first locates the bits that have different local decoding results in multiple cooperative BSs, and then exchanges LLRs for these bits only (see page 1448, right-hand column). Fig. 4 of D1 compares the performance of the above-mentioned three detection algorithms: JD, DIC and the *proposed* SC technique. For reference, the performance of single-BS processing, i.e. without any coordination among BSs, is also included. Table 1 shows a "backhaul overhead comparison" among DIC, JD, the *proposed* SC technique and the *existing* SC technique. Each of the four coordinated-detection algorithms disclosed in D1 proposes a different degree of centralisation, ranging from JD, where the BSs merely report a quantised version of the signals received to a central processing unit, to DIC, where no central processing unit is used. For each of the algorithms using a central processing unit, the skilled person would have readily recognised that there is no need to replicate in each BS the units required at the central processing unit.

In particular, for those systems using SC, there would be no need for an "inter-unit receiving unit", a "likelihood combination detection unit", a "decoding unit" and a "MAC function unit" at each BS, because these functions are carried out centrally. Correspondingly, for a separate central processing unit, as mentioned in D1, there would be no need to include the units already present at each BS: an "RF receiving unit", a "channel estimation unit", a "likelihood calculation unit" and an "inter-unit

transmission unit". Thus, the skilled person starting from D1 and aiming to simplify the BS structure of the systems disclosed therein would have avoided the futile duplication of units, arriving thereby at the claimed subject-matter without the involvement of any inventive skills.

1.1.5 The appellant submitted that document D1 represented the existing technique as "single-BS system/single-BS processing" and the proposed techniques relating to the coordinated-detection algorithms (i.e., JD, DIC and SC) as "multi-BS system/multi-BS processing" (e.g., page 1444, right-hand column, first paragraph; page 1447, right-hand column, first paragraph, and Fig. 4). Thus, D1 assumed a plurality of BSs where the transmission path for the SC/LLR combination (i.e. the transmission path among the central processing unit and the cooperative BSs) was directed to a so-called "mobile backhaul", referring also to the term "backhaul" mentioned throughout D1. In such a transmission path of D1, a situation in which the transmission capacity (required bandwidth) is large did not arise. Moreover, D1 performed the SC/LLR combination. Therefore, the above problem unique to the "mobile *fronthaul*" did not exist in D1 directed to the "mobile *backhaul*". Accordingly, one having ordinary skill in the art would not have faced the above technical problems, and would not have been motivated to seek a solution to them. Furthermore, since D1 was directed to the "mobile backhaul", it did not provide any solution to those problems unique to the "mobile fronthaul" and could not solve them.

1.1.6 This is not convincing. According to the SC technique described in the paragraph bridging pages 1444 and 1445 of **D1**, each BS "forwards the LLRs to a central

processing unit", which ultimately generates the "hard decision", just as the remote-unit apparatuses of claim 1 send their likelihood information to the respective central-unit apparatus, which generates the "hard decision" (see also the embodiments relating to Figs. 9 and 10 of the present application, where the likelihood information constitute specifically log-likelihood ratios, LLRs). In the configuration implied by claim 1, neither the (single) BS nor the remote-unit apparatuses can be assimilated to a state-of-the-art BS and state-of-the-art remote units according to Fig. 6 of the application. Rather, it is apparent that the claimed remote-unit apparatuses feature additional elements, such as a "channel estimation unit 24" and a "likelihood calculation unit 29, 28", which typically are part of a state-of-the-art BS. Hence, the board considers that the link between remote-unit apparatuses and the central-unit apparatus in claim 1 cannot correspond to a commonly known state-of-the-art "mobile fronthaul", and the claimed (single) BS is merely the conglomerate of the claimed elements.

The appellant's arguments seem to focus on the subjective technical problem defined in the application itself. However, it is immaterial whether D1 is directed to technical problems in the "mobile backhaul" or in the "mobile fronthaul". Rather, the question is whether, starting out from D1, the skilled person would have indeed found any motivation to modify its teaching in order to solve the objective technical problem associated with the distinguishing features.

1.1.7 The appellant further submitted that D1 disclosed proposals/explanations which denied "soft combining (SC)".

Compared to the disclosure under the heading "Soft Combining" starting at page 1444, right-hand column, last paragraph, the three-stage information exchange technique described on page 1445 of D1 disclosed the underlying proposal as follows (emphasis added):

> "A problem of this approach is that the BSs need to find out the positions of the bits that need LLR combination first. To solve this problem, we propose a three-stage information exchange technique.
>
> Stage-1: After the calculation of LLRs $\{L_n^{(m)}, n=1\sim N\}$ in local decoding, each cooperative BS-m generates hard decisions for $\{c_n\}$ and reports the hard decisions to the central processing unit.
>
> Stage-2: The central processing unit finds the bits that need LLR combination by comparing the hard decisions from different BSs, and signals the position information to all BSs.
>
> Stage-3: All BSs report the LLRs of the bits that need LLR combination to the central processing unit."

According to the appellant, this proposal clearly denied or contradicted the disclosure entitled "Soft Combining" on page 1444. D1 proposed a largely different operation of "each cooperative BS-m generates hard decisions ... reports the hard decisions to the central processing unit" compared to "each BS generates log-likelihood ratios (LLRs) ... and forwards the LLRs to a central processing unit". Therefore, D1 as a whole argued negative or different operations compared to the claim limitations. It was clear that a person skilled in the art who had referred to D1 could not conceive of

the constitution of claim 1 (and other claims) starting from D1 because D1 clearly denied "soft combining". For example, "a decoding unit (14) that performs a decoding process on the signal output from the likelihood combination detection unit and outputs a bit sequence" of claim 1 was clearly redundant and meaningless for the central processing unit of D1.

1.1.8 These arguments are not persuasive either.

Firstly, in the "three-stage information exchange technique" proposed in D1, there is still an LLR combination step performed at the central processing unit, albeit for a very small part of all information bits. This is made apparent by "Stage-3", which clearly states that "[a]ll BSs report the LLRs of the bits that need LLR combination to the central processing unit" and by "Stage-2" as indicated at page 1445, right column of D1, according to which "BS-2 finds the bits that need LLR combination and sends the LLRs of these bits to BS-1". It follows that the central processing unit used in the proposed SC technique also comprises "a decoding unit that performs a decoding process on the signal output from the likelihood combination detection unit and outputs a bit sequence". In this respect, the units performing "local decoding" in "Stage-1" of the proposed SC technique cannot be equated with the claimed "decoding unit", because the local decoding process is not performed on the signal output from a "likelihood *combination* detection unit".

Secondly, the skilled person would have readily realised that the reduction of redundant units applies not only to the *proposed* SC technique, but also to the *existing* SC technique.

1.2 In conclusion, the main request is not allowable under Article 56 EPC.

2. FIRST AUXILIARY REQUEST

Claim 1 of the **first auxiliary request** comprises the same limiting features as claim 1 of the main request and the following additional limitation (board's outline and highlighting):

(q) the BS is a single BS.

2.1 Claim 1 - inventive step (Article 56 EPC)

2.1.1 The appellant submitted that the claims of the first auxiliary request related to a similar subject-matter, in which the BS was explicitly a single BS, and that the comments made in the statement setting out the grounds of appeal concerned the main request and the first auxiliary request.

2.1.2 The same reasoning as that set out in point 1.1 above applies *mutatis mutandis*, and the subject-matter of claim 1 of the first auxiliary request likewise does not involve an inventive step starting out from D1.

2.2 Hence, the first auxiliary request is not allowable under Article 56 EPC either.

3. SECOND AND THIRD AUXILIARY REQUESTS

Claim 1 of the **second and third auxiliary requests** comprises the same limiting features as claim 1 of the main request and the following additional limitation (board's outline and highlighting):

(r) the likelihood calculation unit calculates likelihood of each transmission signal with regard to each of the at least one antenna of each of the at least one wireless terminal (**second and third auxiliary requests**),

(s) the likelihood combination detection unit combines likelihood of each antenna of the at least one wireless terminal by using the likelihood information (**third auxiliary request**),

(t) a number of the squared Euclidean distance is based on a total number of antennas of all of the at least one wireless terminal (**third auxiliary request**).

3.1 Admittance into the appeal proceedings (Article 13(2) RPBA 2020)

3.1.1 The claims of the **second and third auxiliary requests** were filed after notification of the summons to oral proceedings before the board.

3.1.2 Hence, the admittance of the second and third auxiliary requests is governed by Article 13(2) RPBA 2020, according to which any amendment to a party's appeal case is, in principle, not taken into account, unless there are exceptional circumstances, which have been justified with cogent reasons by the party concerned.

3.1.3 The appellant has not given reasons for the existence of "exceptional circumstances" with respect to the amendment. In addition, features (r), (s) and (t) were not present in any of the independent claims underlying the impugned decision. As a consequence, the second and third auxiliary requests create *de facto* "fresh cases". This is also corroborated by the fact that the appellant itself indicated in its replies to the

board's preliminary opinion that the above amendments implied the further distinguishing feature that "an LLR is calculated in units of antennas" and that therefore the new objective problem now was "to calculate a further accurate likelihood for resolving interference issues and avoiding reduction of a transmission rate" (see e.g. appellant's letters of 14 September 2022 and 15 November 2022, points 3.3 and 3.2, respectively). However, this problem is unrelated to the objective problem formulated in point 1.1.3 above. As a consequence, the examination of these new auxiliary requests would require a complete examination of the claimed subject-matter from the ground up, and possibly a re-assessment of the prior art, which would also be detrimental to procedural economy.

3.2 Accordingly, neither the second nor the third auxiliary request were admitted into the appeal proceedings (Article 13(2) RPBA 2020).

4. Since there is no allowable claim request on file, the appeal must be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chair:

B. Brückner K. Bengi-Akyürek

Decision electronically authenticated