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Datasheet for the decision
of 23 January 2024

Case Number: T 1996/22 - 3.5.03

Application Number: 14704496.0

Publication Number: 2954737

IPC: H04W52/52, H03F1/02

Language of the proceedings: EN

Title of invention:
Power tracker for multiple transmit signals sent simultaneously

Patent Proprietor:
Qualcomm Incorporated

Opponents:
Apple Inc. ("opponent 1")
Intel Corporation ("opponent 2" until 12 February 2021)

Headword:
Power-tracking signal/QUALCOMM

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step - (no): no credible technical effect other than providing an alternative calculation scheme

Decisions cited:
G 1/19

Case Number: **T 1996/22 - 3.5.03**

D E C I S I O N
of Technical Board of Appeal 3.5.03
of 23 January 2024

Respondent: (Patent Proprietor)	Qualcomm Incorporated 5775 Morehouse Drive San Diego, CA 92121-1714 (US)
Representative:	Grosch, Marcus Quinn Emanuel Urquhart & Sullivan, LLP Mollstrasse 42 68165 Mannheim (DE)
Appellant: (Opponent 1)	Apple Inc. One Apple Park Way Cupertino, CA 95014 (US)
Representative:	Samson & Partner Patentanwälte mbB Widenmayerstraße 6 80538 München (DE)

Decision under appeal: Interlocutory decision of the Opposition Division of the European Patent Office posted on 13 June 2022 concerning maintenance of the European Patent No. 2954737 in amended form.

Composition of the Board:

Chair	K. Bengi-Akyürek
Members:	J. Eraso Helguera
	R. Romandini

Summary of Facts and Submissions

I.   The proprietor and opponent 1 filed respective appeals
        against the decision of the opposition division
        maintaining the patent in amended form in accordance
        with "auxiliary request 2b" filed during the opposition
        proceedings.

II.   The decision under appeal cited, *inter alia*, the
        following prior-art document:

        D3:   EP 2 442 440 A1.

III.   Oral proceedings before the board were held on
        23 January 2024. During these oral proceedings, the
        proprietor withdrew its appeal. The final requests of
        the parties were as follows:

        Opponent 1 (appellant) requested that the decision
        under appeal be set aside and that the patent be
        revoked.

        The proprietor (respondent) requested that the
        opponent's appeal be dismissed, i.e. that the patent be
        maintained on the basis of **auxiliary request 2b.**

IV.   Claim 1 of **auxiliary request 2b** reads as follows:

        "An apparatus (500, 502) of a wireless
        device (110), the apparatus (500, 502) comprising:
            a power tracker (582) configured to determine a
        single power tracking signal based on a plurality
        of inphase, I, and quadrature, Q, components of all
        of a plurality of transmit signals being sent
        simultaneously,

on a plurality of carriers at different
frequencies,

wherein the power tracking signal has a
bandwidth that is smaller than the overall
bandwidth of the pluralities of carriers;

wherein the power tracker (582) is further
configured to

determine an overall power of the plurality
of transmit signals based on the I and Q
components of the plurality of transmit signals
at baseband,

wherein the overall power is the sum of the
powers of each of the transmit signals in the
form of

$$I_1^2(t)+Q_1^2(t)+...+I_k^2(t)+Q_k^2(t),$$

wherein $I_k^2(t)+Q_k^2(t)$ denotes the power of
the k-th transmit signal in sample period t, and

determine the power tracking signal based on
the overall power of the plurality of transmit
signals;

a power supply generator (586) configured to
generate a single power supply voltage based on the
single power tracking signal; and

a power amplifier, PA, (560) configured to
receive the single power supply voltage and a
single modulated radio frequency, RF, signal
comprising all of the plurality of transmit
signals, and configured to amplify the single
modulated RF signal based on the single power
supply voltage to produce a single output RF
signal."

Reasons for the Decision

1. AUXILIARY REQUEST 2b

1.1 *Claim 1 - inventive step (Article 56 EPC)*

1.1.1 Using the wording of claim 1 of auxiliary request 2b, document **D3** discloses:

1 An apparatus of a wireless device ([0034]: "... base stations ... mobile terminals ..."), the apparatus comprising:

1.1 a power tracker (Figs. 3 and 4: blocks 104, 106, 108) configured to determine a single power tracking signal (Figs. 3 and 4: "control signal CTRL") based on a plurality of inphase, I, and quadrature, Q, components (Figs. 3 and 4: "abs(x) 104, 106" implies I and Q components) of all of a plurality of transmit signals (Figs. 3 and 4: "signals S1, S2") being sent simultaneously,

1.1.1 on a plurality of carriers at different frequencies (Fig. 3: "LO+IF1", "LO-IF2"; Fig. 4: "LO1, LO2"),

1.1.2 the power tracking signal has a bandwidth that is smaller than the overall bandwidth of the pluralities of carriers (Figs. 3 and 4, [0059], [0070] and [0071]);
~~the power tracker is further configured to~~

1.1.3 ~~determine an overall power of the plurality of transmit signals based on the I and Q components of the plurality of transmit signals at baseband,~~

1.1.4 ~~the overall power is the sum of the powers of each of the transmit signals in the form of $I_1^2(t)+Q_1^2(t)+\ldots+I_k^2(t)+Q_k^2(t)$, wherein $I_k^2(t)$~~

~~$+Q_k{}^2(t)$ denotes the power of the k-th transmit~~
~~signal in sample period t,~~

1.1.5 ~~determine the power tracking signal based on the~~
~~overall power of the plurality of transmit~~
~~signals;~~

1.2   a power supply generator (Figs. 3 and 4: power
amplifier supply voltage module PA') configured
to generate a single power supply voltage
(Figs. 3 and 4: "supply voltage V_{sup}") based on
the single power tracking signal;

1.3   a power amplifier, PA (Figs. 3 and 4: "power
amplifier PA"), configured to receive the single
power supply voltage and a single modulated radio
frequency, RF, signal (Fig. 3: "RF signal S_{RF}",
Fig. 4: "RF signal S'_{RF}") comprising all of the
plurality of transmit signals, and configured to
amplify the single modulated RF signal based on
the single power supply voltage to produce a
single output RF signal.

1.1.2   Thus, the subject-matter of claim 1 differs from the
apparatus of D3 in **features 1.1.3 to 1.1.5.**

Contrary to the conclusions set out in Reasons 63 of
the decision under appeal, the board agrees with the
proprietor that "overall power" cannot be equated with
"overall voltage". "Overall power", however broad, is
still "power", and certainly not the power of an
individual signal. There is a notorious difference
between "power" and "voltage" or "amplitude". Even if
the computation of the "absolute value" of signals S1
and S2 depicted in Figures 3 and 4 of D3 typically
involved the intermediate calculation of their
individual powers, document D3 does not disclose the
calculation of an "overall power", let alone the use of
the specific formula of feature 1.1.4.

1.1.3   Opponent 1 submitted that D3 used for the power
         tracking an "envelope signal". Such signal was
         typically an oscillating signal which outlines its
         amplitude, i.e. extremes, in a smoothed way. The
         smoothing property of the envelope signal could be
         achieved for instance with a low-pass filter (cf.
         paragraph [0050] of the opposed patent). The common
         approach applied in the opposed patent and in the
         system of D3 to smooth the envelope was to tap the
         baseband signal, i.e. before the signal was
         upconverted. When the signal was composed of many
         independent individual signals, as was the case here,
         the individual signal had to be considered in the
         computation of the envelope signal. Document D3
         (Fig. 3) and Equation (2) of the opposed patent used
         the arithmetical mean or "L1-norm" of the amplitudes of
         the complex baseband signals, whereas Equation (1) of
         the opposed patent used the quadratic mean or "L2-norm"
         of the amplitudes of the complex baseband signals.

1.1.4   According to the proprietor, opponent 1's obviousness
         arguments ignored the technical effect of determining
         the "overall power" of the transmit signals according
         to feature 1.1.4 as a basis for the calculation of the
         "power tracking signal". This calculation - as applied
         for instance in Equation (1) of the opposed patent -
         led to a reduced bandwidth when compared with the power
         tracking signal calculated using Equation (2) of the
         opposed patent or the approach of Figure 3 of D3. The
         different methods for the determination of the "power
         tracking signal" described in the opposed patent were
         not just interchangeable. It was apparent to the
         skilled person that the use of the overall power led to
         a *significant* reduction of the bandwidth of the power
         tracking signal. Using the overall power instead of the
         individual voltages of the transmit signals as a basis

struck a balance between efficiency and noise at the
power tracker. On the basis of Equation (1), the
approximation of the envelope of the output RF signal
was less accurate, which meant that the power tracker
was "lazier" and that there was a further "smoothing"
effect which went hand in hand with a reduced bandwidth
of the "power tracking signal". Document D3 did not
suggest in any way to use the overall power of the
transmit signals according to feature 1.1.4 as a basis
for determining the power tracking signal. Rather, D3
taught to preferably use the embodiment according to
Figure 2, in which the power tracking signal
(uncontestedly) did not have a reduced bandwidth with
the technical benefit of being basically identical with
the envelope signal. Only exceptionally, namely in case
of large frequency spacings between the input signals,
D3 suggested to determine the "power tracking signal"
at baseband level leading to a reduction of the
bandwidth. This corresponded to the embodiment of
Figure 3 of D3. Only for this specific purpose, D3
disclosed summing the absolute values (voltages) of the
individual signals in order to determine the power
tracking signal. Based on this, there was simply no
motivation at all for the skilled person to look for
other ways to determine the power tracking signal,
which would even lead to a further reduction of the
bandwidth, i.e. an even less accurate approximation of
the envelope of the RF output signal. Thus, the skilled
person would not have modified the embodiment covered
by Figure 3 of D3 in a way to arrive at the teaching of
claim 1 according to auxiliary request 2b. The
opposition division endorsed this line of argumentation
in Reasons 75 of the decision under appeal. Finally,
according to paragraph [0051] of the opposed patent,
the "digital power tracking signal" might be computed
in different manners dependent on the number of

transmit signals being sent simultaneously or other
factors. For instance, Equation (1) would be more
appropriate for a higher number of transmit signals, as
the power tracker would then become busier.

1.1.5   The board considers that the technical effect indicated
         by the proprietor and by the opposition division -
         inasmuch as it is founded on the assertions in
         paragraph [0049] of the opposed patent - cannot be
         credibly associated with features 1.1.3, 1.1.4 and
         1.1.5. More specifically, paragraph [0049] of the
         opposed patent states the following:

             "... [t]he digital power tracking signal computed
             in equation (1) or (2) has a bandwidth that
             approximates the bandwidth of the widest transmit
             signal (instead of the overall bandwidth of all
             transmit signals being sent simultaneously). Having
             the bandwidth of the power tracking signal being
             smaller than a modulation bandwidth may allow for a
             more efficient power tracking circuitry and may
             also result in less noise being injected into
             PA 560 via the power supply."

         It follows that paragraph [0049] of the opposed patent
         provides no conclusive information about how the
         bandwidth of the power tracking signal resulting from
         Equation (1) ("the digital power tracking signal is
         then obtained by taking the square root of the overall
         power") compares with the one resulting from
         Equation (2) ("the voltages of all transmit signals are
         then summed to obtain the digital power tracking
         signal"). At any rate, this paragraph suggests that
         both "power tracking signals" should have a similar
         bandwidth, i.e. that of the transmit signal having the

broadest bandwidth. And the advantages identified therein ostensibly concern both Equations (1) and (2).

1.1.6   As regards any "further smoothing" beyond the bandwidth being approximated to the bandwidth of the widest transmit signal, the board agrees with opponent 1 that this would have to be achieved by means of a subsequent low-pass filter, as indicated in paragraph [0050] of the opposed patent. However, such a filter is not present in claim 1. Nor does the opposed patent give any indications as to whether or not the "power tracking signal" computed according to Equation (1) would indeed enable narrower filtering than the signal computed according to Equation (2).

1.1.7   In summary, the board does not dispute that - applied to the same plurality of transmit signals - the apparatus of D3 and the claimed one would generate different "power tracking signals". The question at stake is whether or not these differences would actually translate into a tangible and noticeable technical effect or improvement, such as the bandwidth reduction asserted by the proprietor. The board is not convinced that this is the case. In the absence of a credible technical effect associated with features 1.1.3, 1.1.4 and 1.1.5 of claim 1, the use in D3 of a "sum of powers" instead of the disclosed "sum of absolute values" cannot be considered to contribute to the presence of an inventive step (see e.g. G 1/19, Reasons 49 and 124).

1.1.8   Finally, both in the opposed patent (see e.g. paragraph [0055]) and in Figure 3 of D3, the "power tracking signal" is intended to follow the envelope of the output RF signal. Even if the board were to assume - *arguendo* - that the calculation of the "overall

power" according to features 1.1.3, 1.1.4 and 1.1.5 did
indeed lead to a reduced bandwidth of the power
tracking signal and to the technical effects ascribed
thereto by the proprietor, i.e. "lazier" power tracker
and better balance between efficiency and noise, the
advantages - as well as the drawbacks - derived from
the mathematical properties of the known envelope-
tracking algorithms - including "absolute value" and
"squaring" - would have been apparent. Starting from
document D3, a person skilled in the art would have
chosen one tracking algorithm or the other, according
to the practical circumstances, without the need of any
inventive step.

1.2   It follows that auxiliary request 2b is not allowable
       under Article 56 EPC.

2.   Since there is no allowable claim request on file, the
       patent must be revoked.

Order

For these reasons it is decided that:

1.   The decision under appeal is set aside.

2.   The patent is revoked.

The Registrar: The Chair:

B. Brückner   K. Bengi-Akyürek

Decision electronically authenticated